

ASTAT[®]
Manual

Version AST10_054

Crane motion controller

25-2000 A, 380-690 V



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News in 10_054 and 10_055

10_054

Hardware

- 1) New thyristor module DASD 145, 600 V - 500 A
- 2) Improved speed control with incremental encoder at very low speed with new firmware PU_APP1.2 in DAPU 100 board (from May 2007)
- 3) Start of replacement of semiconductor fuses from higher voltage to 690 V with higher current rating in DASD 146, 147, 156, 157 based on the technical development.
- 4) Control sequence for output relays and safety brake lifter contactor for DARA 200 supervision system.

Software functions

- 5) Display of DAPC 100 shows "54" when there is no Fault. "54" indicates 10_05, revision 4.
- 6) A large number of parameters fixed to constants for quicker parameterisation.
- 7) Acceleration control of travel motions as alternative to speed control developed and included.
- 8) Torque control with DARA 1001 is removed as acceleration control is better. SW release 10_053 shall be asked for when ordering spare part board DAPC 100.
- 9) Positioning "Soft limit switch" is removed as positioning on incremental encoder no more is recommended due to the development of absolute encoders. SW release 10_053 shall be asked for when ordering spare part board DAPC 100.
- 10) Firing angle can be modified in regenerative mode. Extremely loaded motors with high CosFi that else can operate in two-phase mode with heavy mechanical vibrations.
- 11) Correction of execution time to prevent a 10 ms long brake opening when trying to lift a load with load above the mechanical overload level.
- 12) Supervision time of MF-link and Remote I/O-link set to 500 ms time.
- 13) Fast stop function included; an active or passive signal can force the motion controller to stop also in healthy mode with master switch in driving position.
- 14) Speed dependent gain improved by separate break points for stand still (0% reference) in addition to existing 10%, 25%, 50% and 100% speed reference.
- 15) A step reference can be optimised for light motions (travel or hoist) by setting 08.01 to 5. With value 5 overshooting is prevented as the integral part of the speed regulator is set to zero each time the ramp output value coincides with the step reference. By setting 08.01 to 6 the integral part is not reset, which minimises load droop for hoists and is more suitable for fine positioning of heavy travel motions.
- 16) Standard value for switch to super synchronous speed changed from 85% to 95% speed.
- 17) Better function to enter in open control with light load. Full motor voltage is no longer required.
- 18) Contactor K3 will always close in super synchronous mode, if installed.
- 19) Function "Adoption to low line voltage with longer ramp times" is fixed, and cannot be deselected.
- 20) DO 6 can be used off-delayed to control, as example, lubrication pumps or rail cleaning blowers.
- 21) DI 15 can be used to switch between parameter sets 1 and 2 in installations without any remote I/O.

10_055

Software functions

- 22) Display of DAPC 100 shows "55" when there is no Fault. "55" indicates 10_05, revision 5.
- 23) Bypass functions as rescue operation with one of two (large) motors, and for E-room/cubicle loss reduction
- 24) Faults for operation are as before reset by crane on command. Fault indication codes are reset by activation of DI 2, and not automatically cleared as before.

Historical release information:

From 10_053 to 10_053C

10_053

Hardware

- 25) Increased voltage range to 1000 V rated rotor voltage for EH rotor contactors.

Software functions

- 26) Display of DAPC 100 shows "53" when there is no Fault. "53 indicates 10_05, revision 3.
- 27) User does not have to contact ABB to modify a hidden parameter from its standard value to use Master-Follower. If that was not done, the Followers brake was directly released when Masters Direction signals (A or B) was removed.
- 28) Correction of logic for dynamic Master-Follower partner selection. Master-Follower partner is now fully selectable by macro-change.
- 29) Correction of very occasional trips in 60 Hz networks due to collision between current regulator execution and communication links.
- 30) Rotor contactors do not open during acceleration in case reverse thyristor bridge is commended by speed regulator.
- 31) Rotor contactors K2 and K3 do not close during acceleration if the stator current is larger than parameter 12.10 for hoists and 12.11 for Travel motions. The system is less sensitive for line voltage dips and low class power system design. The standard values should only be modified for macros used for temporary overload.
- 32) Standard values of parameter for rotor contactor closing time modified:
12.29 from 80 ms to 60 ms
- 33) Standard values of parameters related to thyristor bridge reversal have been modified; these are not modified by most users:
11.44 from 30 ms to 20 ms
11.46 from 200 ms to 50 ms
- 34) Standard value of parameter 08.18 changed from 0 to 1. Standard is 1 meaning active function for line voltage adopted ramp times.

Tool program

- 35) For Monitor and View recording, the gridlines can be turned on and off.
- 36) For Monitor and View recording, two lines for each of six signals can be displayed.
- 37) For View recording, a vertical time-line can be moved in the chart, and the signal values at this time are presented.
- 38) Possible to add comments to record files, *.asg.

10_053A, ex works from 2006-08-01

Software functions

- 39) The additional brake setting based on speed reference has been corrected. The normal brake setting has worked and works without any remark.
- 40) The associated timer function for brake setting based on speed reference, parameter 06.08, has incorrectly been implemented as an ON-delay of reference coming to zero instead as an OFF-delay. Well working installations should not be modified.
- 41) A Follower in a MF-configuration is changed to use the uncorrected Masters speed reference for brake setting instead of the Followers lively speed reference. The action is more predictable. Well working installations should not be modified.
- 42) The slow down and stop limit switches in Master-Follower are corrected according to the existing specification to a true OR-action between the Masters and Followers limit switches.

10_053B, ex works from 2006-09-03

Software functions

- 43) For Master-Follower such states in Follower that cause fault codes in Follower, but not requires the Master to stop are not causing Master-Follower links faults any more.
- 44) Master-Follower link supervision corrected. Permitted down time was always zero (un-delayed trip), whatever parameter value was set. After correction the trip is delayed with value in milliseconds of parameter 30.01.
- 45) Automatic resynchronization of Electrical Shaft after reactivation of the mode (in practice at first CRANE ON after changing from single drive to Master-Follower) restored after having been removed by mistake in Release 10_03A.

- 46) Erroneous fault suppression removed: Overspeed from Encoder / Tachometer did not react if 110 V DC had tripped of any reason.
- 47) Electrical braking a certain time after releasing the brake contactor is changed for Travel motion. The set time with parameter 06.03 was forced to zero in program for Travel motion, but not for hoist motion. Function remains unchanged for Hoist motions. After modification Hoist and Travel Motions have same function with active regulator a time set by 06.03 after releasing the brake contactor.
- 48) A new option included for parameter 06.14. The original options 0 and 1 are same as before. By adding 10 to the values 0 or 1, becoming 10 or 11, the integral part of the speed regulator will active as long as the speed regulator is active, released.
Original values 0 and 1 removes the integral part of the speed regulator at speeds around stand still, in order to not let the speed regulated motor work against the mechanical brake.
- 49) We recommend for new installations to set 06.14 to 10 or 11. We recommend for Hoist motions to set 08.30 to 6% and 08.31 to about 3 times.

10_053C, ex works from 2007-01-10

Software functions

- 50) The revision is only concerning Travel motions. Sometimes speed will be lagging during acceleration. The revised function makes the speed reference restart from the (slower) actual value ramping back to stand still. The integrated value of the speed (= the travelled distance) will be smaller after returning the master switch to neutral position.

Historical release information:

From AST10_04C to 10_052

Hardware

- 1) New Overvoltage Protection unit for 690 V AC, 50 Hz, DASG 222, 690 V AC, 60 Hz, DASG 223.
- 2) New thyristor 690 V modules for installation in +40 degree C with rated data:
 - DASD 151 (25 A motor rated current)
 - DASD 152 (50 A motor rated current)
 - DASD 153 (100 A motor rated current)
 - DASD 154 (200 A motor rated current)
 - DASD 155 (330 A motor rated current)
 - DASD 156 (630 A motor rated current)
 - DASD 157 (1000 A motor rated current)
- 3) New thyristor 400-600 V modules in the higher current range. These modules will fully replace previous types of modules:
 - DASD 146 (600 V- 630 A motor rated current at +55 degree C. Replaces DASD 106, 116 and 126)
 - DASD 147 (600 V- 630 A motor rated current at +55 degree C. Replaces DASD 107, 108, 117 and 127))
- 4) New recommendation as rule of thumb for equivalent resistance value of rotor resistance cable. Changed from 2% of unity resistance value to 0,5% of unity resistance value.
- 5) New hoist supervision system, DARA 2000. Read in Chapter 13.

Software functions

- 6) Display of DAPC 100 shows "52" when there is no Fault. "52 indicates 10_05, revision 2.
- 7) Hysteresis 50% for AI overload.
- 8) Cabin I/O AI2 can be used for connection to AI Load cell.
- 9) Supervision of signal < 4 mA for load cell. Gives Warning overload, not stop. Fault code is 49.
- 10) Limit switch type = 3. Same function as Type = 1, but blocks limit switch fault for impossible combinations.
- 11) New packed signals, 2 bytes = 16 Booleans for Fault signals, physical DI and DO, for faster communication with MMC-systems.
- 12) New current values for the 690 V DASD accepted for parameter 05.01 IN_ASTAT.
- 13) New values accepted for parameter 03.01 MAINS_VO. Values 660 V and 690 V.
- 14) Correction in fault handling where Fault signals L2_MISS and L3_MISS were swapped.
- 15) Correction of function for detection of wrong phase sequence at start up. Previous function could miss to detect wrong phase sequence.
- 16) Three-contactor operation for Travel is possible. No parameters involved.
- 17) New defaults for speed of closing contactors:
 - Contactors K2 from 33% to 42% speed
 - Contactors K3 from 70% to 75% speed
- 18) New conditions for contactor operation of K2 and K3. Speed is different (faster) for keeping the contactor closed in steady state speed mode than in acceleration mode. Two new parameters, defined as the difference between speed change switch point and steady state switch point. Defaults are properly selected for typical 2- and 3-contactor operation with 30% acc. torque.
- 19) Possible to operate at low speed hoisting without any contactor closed. Parameter 12.19 SW_K1 added.
- 20) New sequence for contactor opening ensures that the rotor contactor opening is with zero current. Stator current is forced to zero parameter 11.44 IS_ZER_T before the DO to the rotor contactor is opened, and is kept to zero parameter 11.39 CON_OP_T after opening the DO.
- 21) Reduced torque when changing torque direction. Torque (current) is reapplied as a ramp.
- 22) New parameter 22.05, SHOWBRAKE, can change function of DO 8 Cabin I/O from ASTAT status to Brake lifted status. High output = brake lifted.
- 23) State based speed ramp variables are coming from the correct source in Follower-mode.
- 24) New numerical parameter 06.14 with name CONT_ACT enables use of DC-brake and brake contactor as acknowledgement signal instead of limit switch. Default of CONT_ACT is 0. Value 1 will override the brake open ack., and keep forced brake voltage until the time of DC-brake is elapsed.
- 25) The "automatic" rotor contactor mode is changed.

A new parameter 08.18 = 1 will mean executing the speed-based and adjusting the acceleration and deceleration ramps in case we get a low line voltage. The set values are valid at nominal line voltage. At only 80% of nominal line voltage the acceleration is 3,00 times longer, and the deceleration is 1,67 times longer.
- 26) Supervision of rotors also with tachometer / encoder feedback is possible. Rotors can be activated with parameters 0521 .. 0524. At each controller release the system will select the next active rotor for start up and continuous supervision. In case of failure of the rotor frequency supervision system, the motion will continue, and only gives fault signal.
- 27) Supervision that Zero position signal of master switch goes to 0 (False) after moving the switch out of neutral. Fault code is 45.
- 28) Influence of DI-signals for direction when AutoDir mode is used is removed.

- 29) Selection of one of two physical ports for M/F-communication supports redundant system design. Parameter 01.02 is used for this choice.
- 30) Selection between two ways to change Macro. The selection is made with DI3 and DI4 of process I/O board DATX 110. A new parameter 01.03 is inserted.
- Value = 0: Change takes place during CRANE OFF (as until AST10_04)
- Value = 1: Change takes place during standstill with Master switch in neutral position
- Value = 2: Change takes place during CRANE OFF and standstill with Master switch in neutral position
- Value = 3: Change takes place during standstill with Master switch in neutral position, and DI 7 of Cabin I/O is high. DI 7 used in this way has higher priority than Step 4 function and Load display tare function.
- 31) Brake test function: The start can be delayed until the controller, while keeping the brakes closed, has injected a current same as the set current limit without rotating the motor.
- 32) New function for smooth speed approach to stand-still after hoisting, removes tendency to roll back.
- 33) New Reference tracking system. The system is developed to early detect any electrical fault that will lead to a dangerous situation, but can be stopped with only high speed brakes. The system is most used in large hoist mechanisms. Emergency braking will come directly or independently based on set-up.
- 34) Simplified fan control: On directly at motion start, off one minute after motion stop.
- 35) A new argument for parameter 13.01 offers to always run the fan in rescue mode. If this argument is used in normal modes, the fan life is only approximately one third.
- 36) A number of previous visible or hidden parameters are made as fixed functions in AST10_05, and are no longer parameters:
- 04.14 MAXTO_E
 - 04.15 MAXTO_M
 - 06.05 TOR_PROV (a new brake test function is included in 10_05)
 - 06.07 ZERO_OFF
 - 06.17 ZER_RFPC
 - 06.25 VLINETC
 - 06.26 VSTTC
 - 09.05 LO_DROOP
 - 09.30 K_TQKICK
 - 10.10 OSPFRHIS
 - 11.37 K_ISKICK
 - 12.01 RES_1_pc
 - 12.02 RES_2_pc
 - 12.03 RES_3_pc
 - 12.04 RES_4_pc
 - 12.05 RES_5_pc
 - 12.06 RES_HYpc
 - 12.09 ANTICLAP
 - 12.28 NACT_FIL
 - 12.30 RCHA_MAN (a new line voltage adoption function is included in 10_05)
 - 22.01 HIS_VOPC
 - 24.10 FON_DEL (cooling fan control simplified)
- 37) New external reset DI for operation with electrical shaft.
- 38) The newest ten faults can be shown on the display.
- Pressing Reset (DI 2 of DATX 110) longer than 2 seconds starts a sequence in the two digit display: Newest Fault, "- -", second newest fault, "- -", 10th newest fault, ... (normally displayed) Version code. Each fault is displayed during 4 sec. " - - " during 1 second, so there is good time to make notes on paper. The function will be included in 10_05, revision 5, Display code 55.

Tool program

- 39) The monitor function can record as long as there is space on the hard disk of the computer.
- 40) Faster speed for updates of six monitor signals

From AST10_03A to AST10_04C:

Hardware

- 1) Change of Overvoltage Protection units from DASG 1xx to DASG 2xx series. New units include 32 J varistors between phases, while the phase sequence supervision is moved to each ASTAT.
- 2) New thyristor modules DASD 126 (630 A motor rated current) and DASD 127 (1000 A motor rated current) for installation in +55 degree C with rated data.

Software functions

Changes in revisions 10_04A, 10_04B and 10_04C listed from item 32) below are not covered by the Manual AST10_04, but are found on Internet ,www.abb.com/cranes

- 3) Display of DAPC 100 shows "40" when there is no Fault. "40" indicates AST10_04, revision 0.
- 4) Possible to adjust general control dynamics with a parameter. Unity setting 1,00 for a perfect system with encoder, a normal value can be 1,15; a bad mechanical system with rotor feedback can be 1,30.
- 5) Current regulator includes function for peak torque elimination after reversal of field direction.
- 6) Speed reference generation changed from 20 ms to 10 ms periodicity to get smoother control at short ramp times. Example: From 0% to 100% speed in 1 second is made with steps of 1%, before it was 2%.
- 7) Improved speed control by state dependent adoption of P- and I-parameters in addition to the previous only speed based adoption. State dependent treatment of speed controller's integral part.
- 8) Possible to hold speed reference at zero at start before the brake has opened. With time, or time interrupted by limit switch "open". Prevents competition between motor and brake as well as current peaks.
- 9) Possible to adjust notchback impact returning from full speed lowering with Rotor Feedback.
- 10) Stopping a travel with Delayed brake function now includes braking with reduced current limit, default ~ 30 % motor torque, to damp our remaining sway of motion before it stops with mechanical brake.
- 11) A time based rescue sequence takes over thyristor cooling fan control in case the thermistor sensors are damaged, and an attention alarm is given. The motion is not stopped.
- 12) Possibility to use a new rescue or start-up setting for limit switch control, parameter 05.04 can be temporary set to 0, to override the four limit switches and the fault that comes from impossible limit switch combination.
- 13) Function changed to tripping, not only attention, for Limit switch fault, Wrong phase sequence and Unbalance for parallel thyristor bridges.
- 14) Supervision of Unbalance for parallel thyristor Bridge #2 is only active when Bridge #1 is powered.
- 15) Faults are only reset when master switch is in its neutral position.
- 16) Changed default values of several parameters based on experience. New functions have commonly feasible default values.
- 17) Several parameters have been fixed as constants in program based on experience.
- 18) Rotor contactor K1 is allowed to open for fast electrical braking in hoisting also in speed mode.
- 19) The so called Ladle tilting function, see section 4.12, is changed to forced opening of K1, K2 and K3 after four seconds steady state speed during step 1 hoisting.
- 20) Improved overlapping of slow making rotor contactors while motoring. Example: at acceleration K1 will be closed for additionally a defined time after K2 was ordered to close.
- 21) All rotor contactors are opened during change of thyristor bridge.
- 22) Correction of Master-Follower function, Torque mode.
- 23) New type of follower, Current Follower, for very large drives (4000 A) or 12-pulse operation.
- 24) Removal of not desired false overspeed trip in some situations in High speed down mode (Load functions).
- 25) Speed deviation differentiated into two functions:
 - 1 Tachometer, Encoder respectively Rotor measurement failure: Very fast supervision that there is any feedback at all.
 - 2 Speed deviation: The actual speed from Tachometer (Encoder or Rotor) does not follow the speed reference accurate enough.
- 26) New Fault codes for Tachometer, Encoder and Rotor Frequency Measurement failures, faster fault tracing.
- 27) New run type for I/O units and Factory test; Master switch to Cabin I/O#2, Inputs and Outputs of Cabin I/Os #1 and #3 are each others mirrors. For common use of fiber cable from control desk to electrical room. New Fault code for DATX 120:3 not found.
- 28) Function "Torque proving" (Previous Manual section 4.6.1.5) is removed from ASTAT, due to slowing down start procedure and low requirement in market for installation of shared motion control.
- 29) Factory test mode, previously announced, is now included.
- 30) Functions in ASTAT now published in diagram form; static schemes as well as in browser format for dynamic following of signal paths.
- 31) New design form for Cabin I/O makes crane design faster.
- 32) Program versions: The display shows 41 for program version AST10_04A. The display shows 42 for program version AST10_04B. The display shows 43 for program version AST10_04C.
- 33) Presented current, Signal 11.53 ISACT. The signal value is modified to % of the motors rated current (AST10_04A). The value before was 1,732 times higher.

- 34) Current limit, Parameter 11.01 LIM_INpc: Systems upgraded from software AST10_04 first release or earlier, must have its value for 11.01 modified before upgrading to 10_04A or later:
 $11.01 (10_04A) = 11.01 (10_04) * 11.10 / 1,732 (AST10_04A)$
- 35) Digital signals: The signals 05.66 DO_1 and 05.73 DO_8 always present their correct values in CMT program (AST10_04A).
- 36) Cabin I/O signals:
 The LED for Over temperature Cable relay will not lit up at control voltage power up as before (AST10_04A).
 The LED (flash) for Warning Mechanical overload will not be active with default parameter values as before (AST10_04A).
- 37) Master-Follower: The position of slow down and stop limit switches of the Follower are included in the M-F communication. Motion stops (or slows down) based on OR-condition of the Masters and Followers switches. The evaluation of not valid combination of limit switches remains unchanged; Follower reports error if the Follower's limit switches are invalid, and Master reports error if its limit switches are invalid. Both Master and Follower limit switch error stops the motion (AST10_04A).
- 38) Scaling of rotor speed feedback. The scaling with parameters 07.03 and 07.04 has a higher resolution (AST10_04A).
- 39) Fewer operations of rotor contactors in no load state (AST10_04B).
- 40) Softer transition from full speed / direct on-line control mode. Softer return to speed control state without any visible delay (AST10_04B). The controller is back in controlled state maximally 100 ms after notching back from full speed.
- 41) Update of Rotor frequency minimal current function (AST10_04C)
- 42) Update of Rotor frequency hoist lowering notch batch function (AST10_04C)
- 43) Fewer operations of rotor contactors in deceleration state and hoist lowering state (AST10_04C)
- 44) Noise level signals from AI to step reference: In AST10_04 we introduced a new value for parameter 08.01 (RAMP_TYP) = 5. Value 5 sets analogue speed ref. to exactly 0. But it was still AI contribution added after ramp unit from AI number 6 of DATX 110. IN AST10_05 08.01 = 5 will in addition force speed ref. contribution after ramp to 0 (AST10_04C)

Tool program

- 45) Improved revision handling of parameter files created by different CMT-releases. This CMT release makes it possible to handle all ASTAT delivered to this date by the same CMT.
- 46) Function for copy visible and hidden Parameters Set x to Set y, incl. teach-in values of position and weight.
- 47) Logging by means of PC of coming and going Fault signals 21.xx as well as any selected signal.
- 48) Export of Monitor files to EXCEL-format for off-line study
- 49) CMT- program tested for Windows XP.
- 50) The CMT by default connects your on-line adjustments to the active macro (CMT10_04A).
- 51) If a parameter value is entered outside the Minimal and Maximal limits the colour of its cell of the edit spread sheet will be red (CMT10_04B).
- 52) A Parameter Check Report function creates two sequential previews of two check reports based on the current ASTAT parameters file (CMT10_04B). An example of a report is displayed below.

ASTAT Tool - Modified Parameter Values
 Project filename: New Project
 Timestamp: 2004-05-11 14:49:04

Group	ID	Name	Set 1	Set 2	Set 3	Set 4	Unit	Norm	Min	Max
1		Identify								
2		I/O station definition								
3		Supply information								
4		Motor information								
5		ASTAT configuration								
6		Brake information								
*	8.1	ZER_SPpc	3.0 *				%	2.0	0.0	10.0
*	6.3	BRA_EL_T	200 *				MSEC	100	0	1 000
7		Speed feed-back								
8		Speed reference								
9		Speed regulator								
10		Speed supervision								
11		Current/Torque regulator								
12		Rotor resistor								
13		Selectable DO								
14		Load functions								
15		Slack Ramp Function								
16		Soft Limit switch Function								
17		Rotor system								
20		Master follower functions								
22		Options for Fault handling								

- 53) Parameter Print: Use Print Parameters to create a hard copy report of the project.
- 54) A four part reports can be selected with Project information sheet and Parameter values being pre-selected.
- 55) The last two reports are identical to the reports created by the Parameter Check Report function described in the previous section.
- 56) Parameters out of range report creates a report consisting of parameter values that fall out of the range defined by the min and max properties of parameters. Modified parameter values report creates a report that lists all parameters with values that differ from the default (norm) parameter value (CMT10_04B).

From AST10_03 to AST10_03A:

AST10_03A is a revision of release AST10_03 that gives the user some more options for crane control. The modifications are:

- 1) A rich variety of functions based on **load measurement**, not only the previously announced overload protection function, are ready. These functions are:
 - Load cell linearisation
 - Load model: Torque based load estimation
 - Mass inertia compensation
 - Rope length estimation
 - Working with unity form of load signal
 - Overload logic for own hoist of ASTAT
 - High speed down: Cycle Time Reducer
 - Slack rope functions up and down
 - Slack rope detection hoisting
 - Slack rope detection lowering
 - Protection functions for twin load cell systems
 - Overload protection
 - Prevention of unequal load
 - Operator functions
- 2) Master-Follower: Two control signals **A** and **B** give different options for various control modes for the Follower in Master-Follower communication.
Master (parameter 20.01 = 1) is always speed controlled.
Follower mode (parameter 20.01 = 2) is controlled within the same parameter set in following way:

A	B	Follower mode control
0	0	Speed control by electrical shaft, only mode until Release AST10_03.
0	1	Speed control by own reference, for tilting, skew control etc
1	0	Speed control with torque compensation, used in four rope grab cranes and control of load sharing motion control. Requires DARA 1001.
1	1	Speed control by speed compensation; aim is same speed rather than same position
- 3) Even faster notch back reaction. Input filtration time (50 ms) is the dominant part.
- 4) Uncontrolled stop of crane, ex: Emergency stop, can lock the crane until Electrical engineer arrives
- 5) Compensation for offset if the speed control is made only proportional.
- 6) Integral part of speed regulator is reset at setting the brake that allows higher integral gain for high performance tuning.
- 7) Presentation of speed estimation on analog outputs for rotor frequency control even in open control state by using slip of motor and actual load.
- 8) Hiding secondary faults for Fault "DATX 110 not found" for faster trouble-shooting.
- 9) Nominal voltage of DASD thyristor module program is changed from 500 V+10% -30% to 530 V+10% -30%.
- 10) New control module, DARA 1010, with no need for tachometer / encoder but no explicit vector shaft torque control. Replaces DARA 1001 in most applications.
- 11) New Cabin I/O module, DAPM 101 for only stepped master switch and no second operator station. Will replace DAPM 100 in many applications.
- 12) A new generation of DAPC 100 will be delivered from spring 2003. It is back compatible. It has better voltage measurement above 400 V, a new serial link and improved current measurement for parallel bridges. The tower capacitors are replaced by lower components making it less sensitive for handling.

Tool program

- 13) New files Parameters.ini and Signals.ini needed for the new functions. Found in www.abb.com/cranes ASTAT Updates and Downloads. Using old files will not make the new functions visible. Loading setting files "file-name.ast" of generation AST10_03 into a system of revision AST10_03A will make no change of the function unless using new Parameters.ini and Signals.ini activates the new functions.
- 14) Better readability of text for Signals

From AST10_02 to AST10_03:

- 1) Technical information and downloads are available on www.abb.com/cranes
- 2) About 10 new default for parameter values.
- 3) New sorting of parameters for Design, basic Start up and Special functions.
- 4) To enter super-synchronous lowering is based only on speed reference and not on estimated speed when rotor frequency based speed feedback is used.
- 5) A faster control response then exit from super-synchronous lowering to regulated speed range with rotor frequency based speed feedback by injection of predicted plugging current.
- 6) A faster return then exit from super-synchronous lowering to regulated speed range. The faster return is not dependent on setting of retardation time or type of speed feedback. A driver will have a virtually direct response then notching back
- 7) A faster return then changing from full speed reference with typically reached 90% final speed for travel motions and hoists up. The faster return is not dependent on setting of retardation time or type of speed feedback. A driver will have a virtually direct response then notching back.
- 8) The function of previous releases with higher gain for a certain time after controller release has been removed, as the general speed control is capable of giving good properties also in this situation.
- 9) N+1 run (DRI_TYPE = 4) has been removed as this situation is covered by the four parameter sets.
- 10) Possibility to connect a Low pass-filter to the speed feedback. With time set with parameter. The standard setting is to not use this filter, but it can improve the control for mechanically unstable cranes.
- 11) For manually operated cranes a Travel motion can have a virtual plug braking if pulling the master switch to the opposite direction than the actual motion. This function will shorten the deceleration ramp time.
- 12) The I- and P-gains can be functions of Speed reference range when needed to have very fast control as for sway control or automated cranes in general. There are 4 + 4 = 8 new speed regulator parameters for this.
- 13) The rotor contactors will not close if the line current is too low. The control will be performed with averagely lower current and better controllability of the motor
- 14) The ASTAT controller can be forced to operate with rotor contactor K1 closed in hoisting direction to better adopt to older existing rotor resistors
- 15) The rotor contactors K2 and K3 will not close in lowering operation except for super-synchronous lowering.
- 16) A detection of wrong connection of direction signals and polarity of speed reference. Gives Fault code 50.
- 17) Electrical shaft: The phenomena that the Follower stops earlier than Master (only noted in some applications with slow retardation ramp) is removed.
- 18) Electrical shaft: The Follower will never move in the opposite direction to the master switch, it will stay at zero speed until the Master has equalised the position error.
- 19) Speed feedback with rotor frequency can be selected from any of the maximally four motors, not only from motor number 1. This is important for shared motion and redundant drive installations.
- 20) Annunciation with LED no. 8 in "Cabin I/O" changed to: Flashing green: The control system is working and is powered but with detected fault. Steady green: Powered, no Fault. No light: Control system is out.
- 21) Status display of Control System Module visible with the cover mounted through a window in the cover (from September 2002).

Tool program

- 22) Print out of Parameters will include "Normal Values". It is indicated by a star "*" then any of the four values are different from Normal
- 23) Parameter printout with All parameters or only Design/Start up/Special
- 24) The logical signals in the Monitor Tool have thinner lines than in previous version.
- 25) Setting of offset of value signals in the Monitor Tool can be done.
- 26) Predefinition of sets with six signals with colours and scaling in the Monitor Tool
- 27) Default settings for comm.-port and speed
- 28) Tool program able to communicate over TCP/IP (not in freeware version)

From AST10_01 to AST10_02:

- 1) Technical information and downloads are available on www.astat.nu
- 2) New compact Thyristor Modules in the 500 V range: DASD 001 (25 A), DASD 002 (50 A) and DASD 003 (100 A)
- 3) Star-point resistors for rotor resistor earth fault detection are available from stock
- 4) The voltage range for the DASG 118, 119 and 121 Overvoltage protection modules is rearranged
- 5) PC Tool has different parameter views for different situations; Start up, Design and Advanced trouble shooting
- 6) PC Tool shows version of ASTAT program, Control board and Software of Rotor frequency / Torque measurement.
- 7) PC Tool can import setting files from AST10_01 (filename.ast) and convert to AST10_02 setting files.
- 8) PC Tool has step function for easy start up regulator tuning
- 9) PC Tool has signal monitor function. Six different curves can be shown at the same time.
- 10) PC Tool can record and later present recorded curves.
- 11) New communication modules for PC Tool connection in multi-drop
- 12) A number of default values of parameters are adjusted by experience
- 13) Super-synchronous braking can be used also for direction B, directions A+B as well as already existing direction B (Example: tilting of ladles)
- 14) Faster reaction when notching back from full speed motoring (like a travel motion) while still keeping the motion at fastest possible speed
- 15) Faster reaction when notching back from full speed lowering in super synchronous state
- 16) Speed supervision is deactivated in torque control mode
- 17) Speed regulator can have higher gain without giving inrush magnetising current at voltage reversal. Load drop for hoists is reduced without torque transients.
- 18) There are fewer operations of rotor contactors with maintained optimisation of stator current
- 19) It is easier to reduce load sway in manually operated cranes by quick response at first touch of master switch
- 20) Function of Fault relay (DO 7) is changed from most frequent faults to all faults
- 21) New safety function of DO 8 then the drive type is **not** shared motion:
DO 8 will always open at overspeed. Control voltage must be switched off to restart.
DO 8 can open (parameter yes/no) when any of the brakes still is open 500 ms after the order to open the brakes is removed (typically welded contactor). Control voltage must be switched off to restart.
DO 8 of each ASTAT can be included in the emergency stop logic of the crane.
- 22) Four parameter sets can be used for the same motion
- 23) Rotor frequency speed feedback is supported by open control speed feedback when full speed is ordered, left / right and up / down.
- 24) Electrical shaft function is improved
- 25) Prepared for more than 600 V AC line voltage by using a synchronisation voltage step down transformer

1. ASTAT system basics

ASTAT® is a highly developed, well-proven system for speed controlled heavy-duty motors in cranes and other heavy industrial machinery. Designed for even the toughest environments ASTAT brings reliable, cost effective crane control into the computer age.

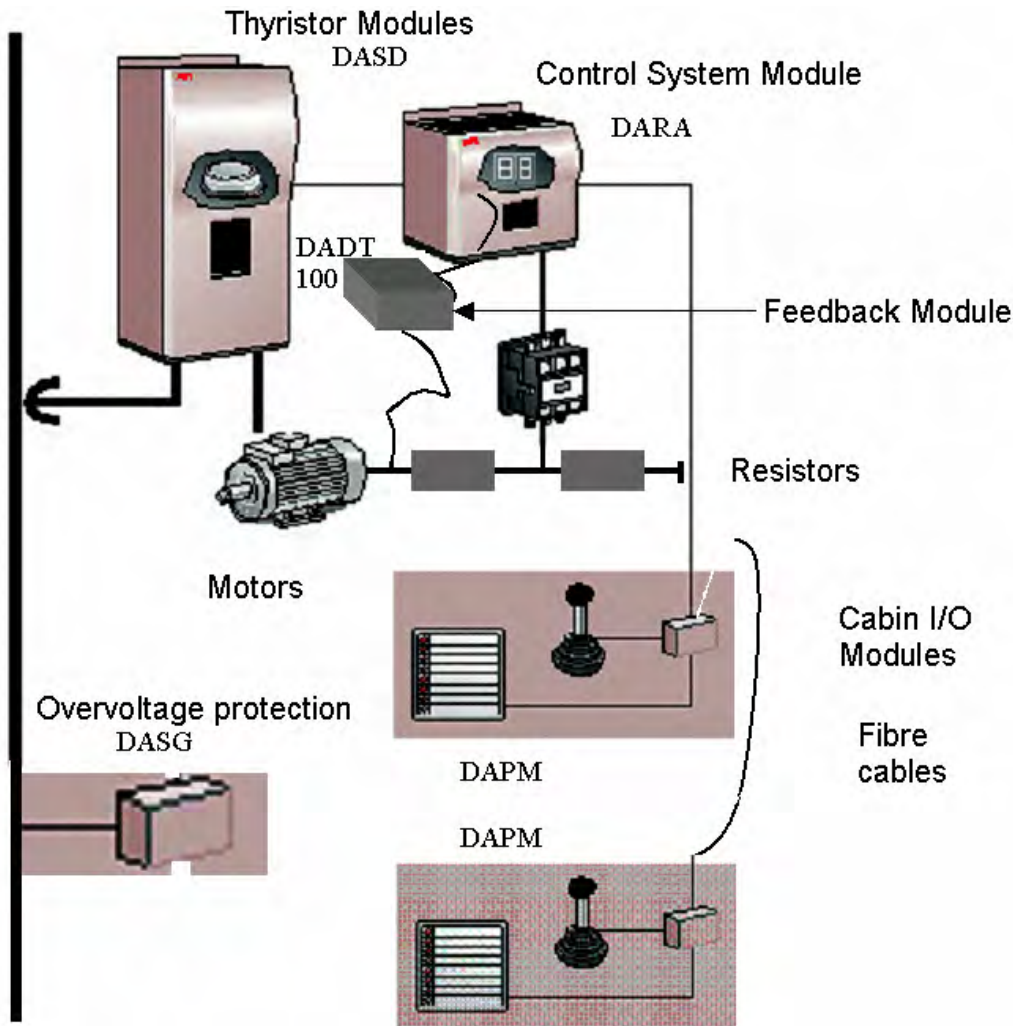
Using leading edge computer technology, ASTAT now combines advanced control features with comprehensive information and data distribution to enhance performance at all levels.

ASTAT is made especially for high utilisation, designed with higher-grade components and larger margins than normal industrial drives.

The motor is the torque-producing device of an **ASTAT Motion Control system**. The electrical power is fed to the motor from the power bus through the **DASD Thyristor Module**. The DARA Control System Module controls the voltage of the DASD Thyristor modules.

The DARA Control System Module controls the voltage and its phase sequence as well as selecting the best speed-torque characteristic for the motor based on desired and real speed. A tachometer, a pulse encoder or a **DADT 100 Feedback Module** measures the real speed. The desired speed comes from a **DAPM Cabin I/O Module**. For optimisation of torque-speed characteristic an external rotor resistor and sometimes a contactor are used. The ASTAT system is primary designed for loads that most of the time moves at full speed. In this normal state the speed control is replaced by full motor voltage.

There are several options to the ASTAT Crane Motion Control program, below is shown a **DASG line Over-voltage protection Module**.



The Control System Module offers a lot of functions related to the control of the motion. The functions are introductory described below in the sub-section **Motion control for heavy industrial machinery** and more detailed in the rest of this Manual.

The fundamentals of the torque control are found in the sub-section, **Motor torque control**.

Operation limits

Voltage:	Control and Thyristor Modules: Nominal -30% .. Nominal +10%.
Frequency:	Nominal -10 Hz .. Nominal +10 Hz
Temperature:	-25 degree C cont. w/o heating +70 degree C cont. for Control System Modules + 85 degree C cont. for Thyristor Modules with reduced data above 40 / 55 degree C
Isolation	EN 60664, Pollution degree 4 250 V AC for Control System Modules 630 V AC for Thyristor Modules

Key data

Control System Module

Control System Module DARA 1001*

- 2 Voltages 115 or 230 V AC 50 / 60 Hz. 1 phase.
- 2 Thyristor bridges each max. 1100 A
- 1¹ RS232 interface for programming/supervision PC and computer control
- 1 Opto interface for Master-Follower connection
- 1 Opto interface for Overriding Control connection
- 1 RS 232 for connection of fault display or others (only on control boards of Generation 2 and later)
- 17 Digital in, 110 V DC (supplied internally)
- 8 Digital out
- 4 Motor PTC inputs
- 4 Analogue in,
- 2 Analogue out
- 2 RS 232 for intelligent transducers
- 1 Pulse transmitter
- 4 Rotor connections for speed feedback/ rotor monitoring
- 2 Remote I/O can be connected

Key data

Thyristor Module

- 3 Voltage ranges; maximally 530 V, maximally 600 V or maximally 690 V
- 2 Frequencies; 50 / 60 Hz
- 10 Currents: 25 A ... 1000 A

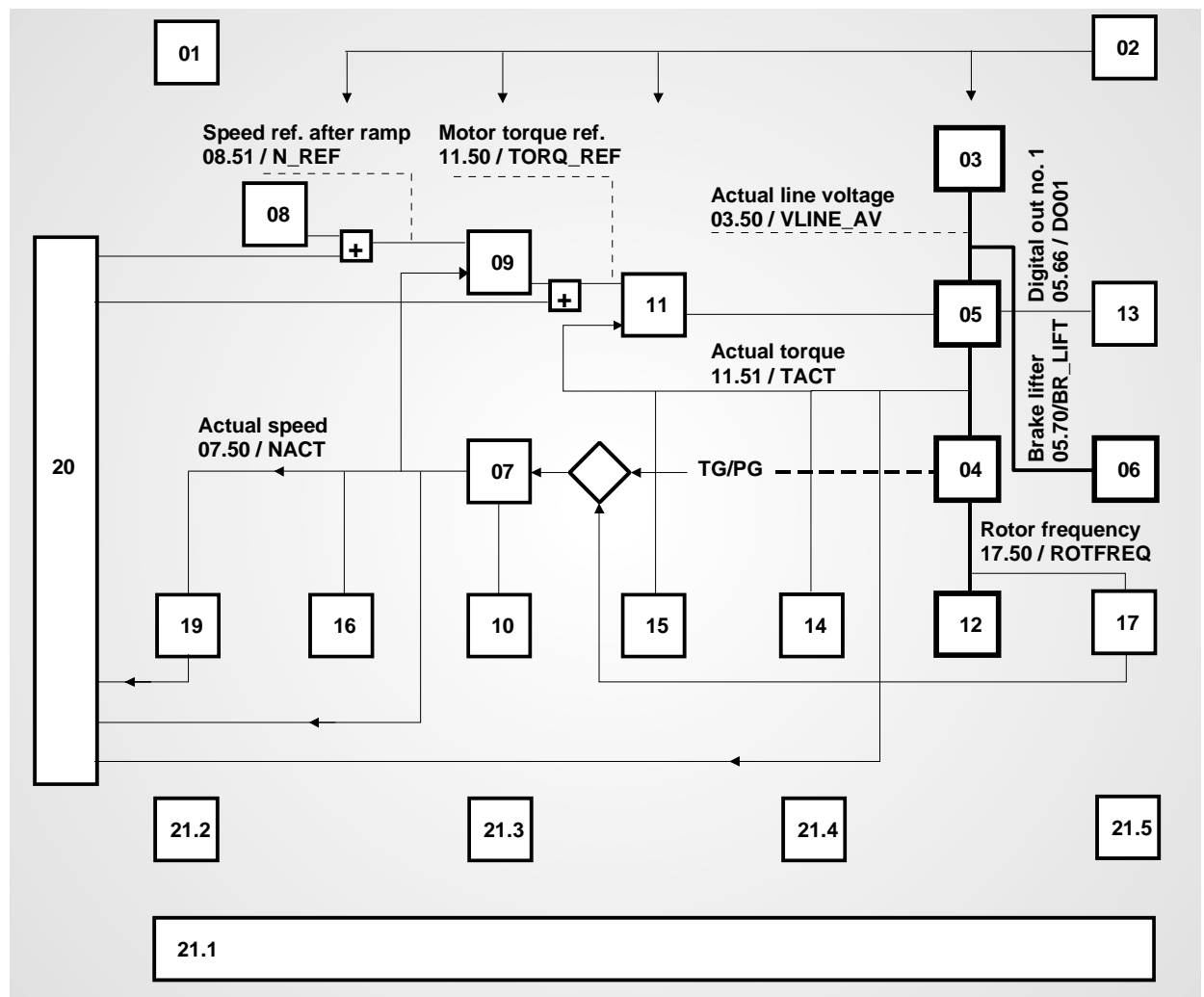
* DARA 1000 has no Rotor connections, DARA 1010 has same outside connections as DARA 1001

¹ Board DAPC 100 generation 2 has 2 (two) RS 232 interfaces.

1.1. Motion control of heavy machinery

Main relations between the Groups of functions:

Group	Name	Group	Name	Group	Name
01	Identity	09	Speed regulator	17	Rotor system
02	I/O units and Factory test	10	Speed supervision	19	Pulse encoder
03	Supply information	11	Current regulator	20	Master-Follower
04	Motor information	12	Rotor resistor	21.1	Motion control logic
05	ASTAT configuration	13	Selectable DO	21.2	Shared motion
06	Brake information	14	Load functions	21.3	Two operator stations
07	Speed feedback	15	Slack Rope function	21.4	Four parameter sets
08	Speed reference	16	Limit switch function	21.5	Fault handling system



Inside each group mostly only a few parameters have to be modified for each installation while the others can be left as the Normal value suggested or from the company standard of the user. In most cases the majority of parameters can be left as they are.

It is not only possible to set parameters. A large number of signals are available for daily supervision and maintenance support as well as for qualified troubleshooting and motion control optimisation. Signals can either be internal inside a group of functions or between different groups.

1.2. Motor torque control

1.2.1. Voltage and slip control

How it all works

ASTAT uses, like a car, two variables for the control: Stator control, corresponding to the accelerator of the car, and the Rotor control, corresponding to the gearbox. To continue this parallel, like a good driver, she will use the brake only in emergency situations and as a parking brake.

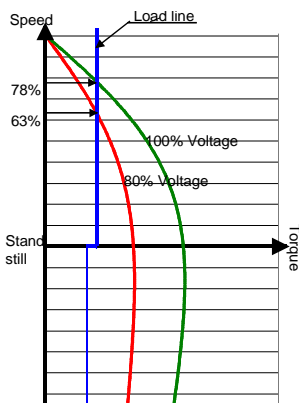
Like in the modern car, the control system includes functions like a cruise control, *the speed regulator*, and automatic gearbox, *the optimisation of rotor characteristic*. Further more, with ASTAT the *speed regulator* can be disconnected, and the driver can control the motion directly as with the accelerator of her car.

Stator control by electronic voltage control puts more or less torque into the motor...

The aim is to keep a desired speed. Controlling the motors torque does this.

A reduced stator voltage will reduce the peak torque by approximately the square of the voltage reduction.

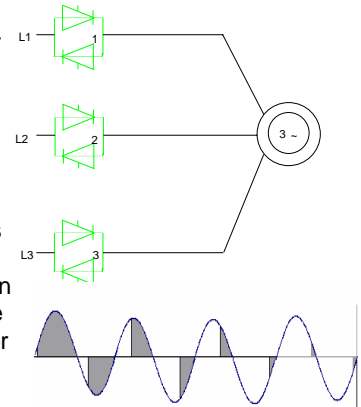
Here a voltage reduction from 100% to 80 % will reduce the speed from 78% to 63%.



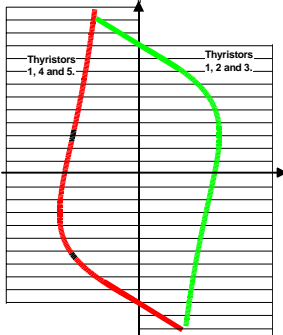
By the use of a pair thyristors in each phase, the voltage can be reduced steplessly from full line voltage to zero.

= +

The microprocessor orders the phase control thyristors to switch to on-state by adjusting the phase position of the trigger pulses, hence applying more or less stator voltage.



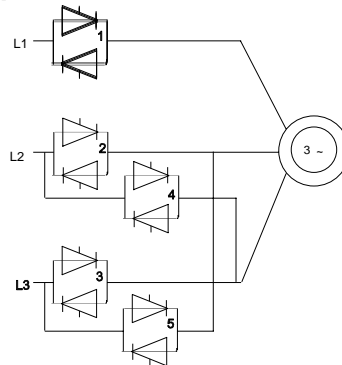
... and changes the direction of the torque



No contactors are needed for reversal.

Forward torque direction is achieved by the thyristor-pairs 1,2 and 3, while the other direction follows by 1,4 and 5.

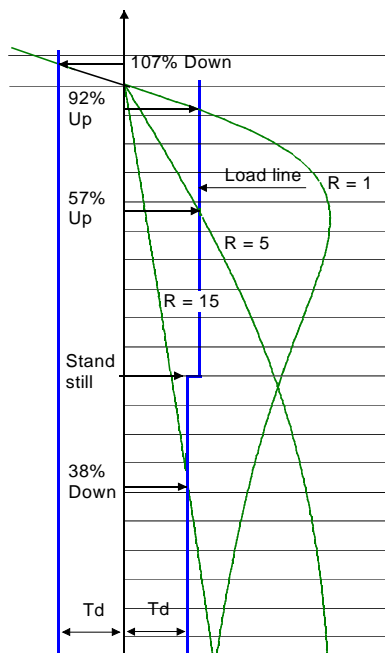
Change of torque direction takes less than 20 ms.



Rotor control by optimising the resistance gives the motor the right characteristics

The slip-ring motor torque is controllable at any speed by varying the external rotor resistance. Here the different speeds 92% and 57% up as well as 38% down are obtained with only variation of the resistance. This property has been used for many years for crane motors.

When lowering with a slightly higher speed than the motors synchronous, in this example 107% of the synchronous, the motor will regenerate the energy back to the line in the most robust manner. When the lowering speed is approaching the synchronous, the rotor resistor is minimised and the direction of torque changes electronically to act like a motor down. In the figure, this is shown by drawing the lowering load line, T_d , for both plug braking and for regenerative lowering.



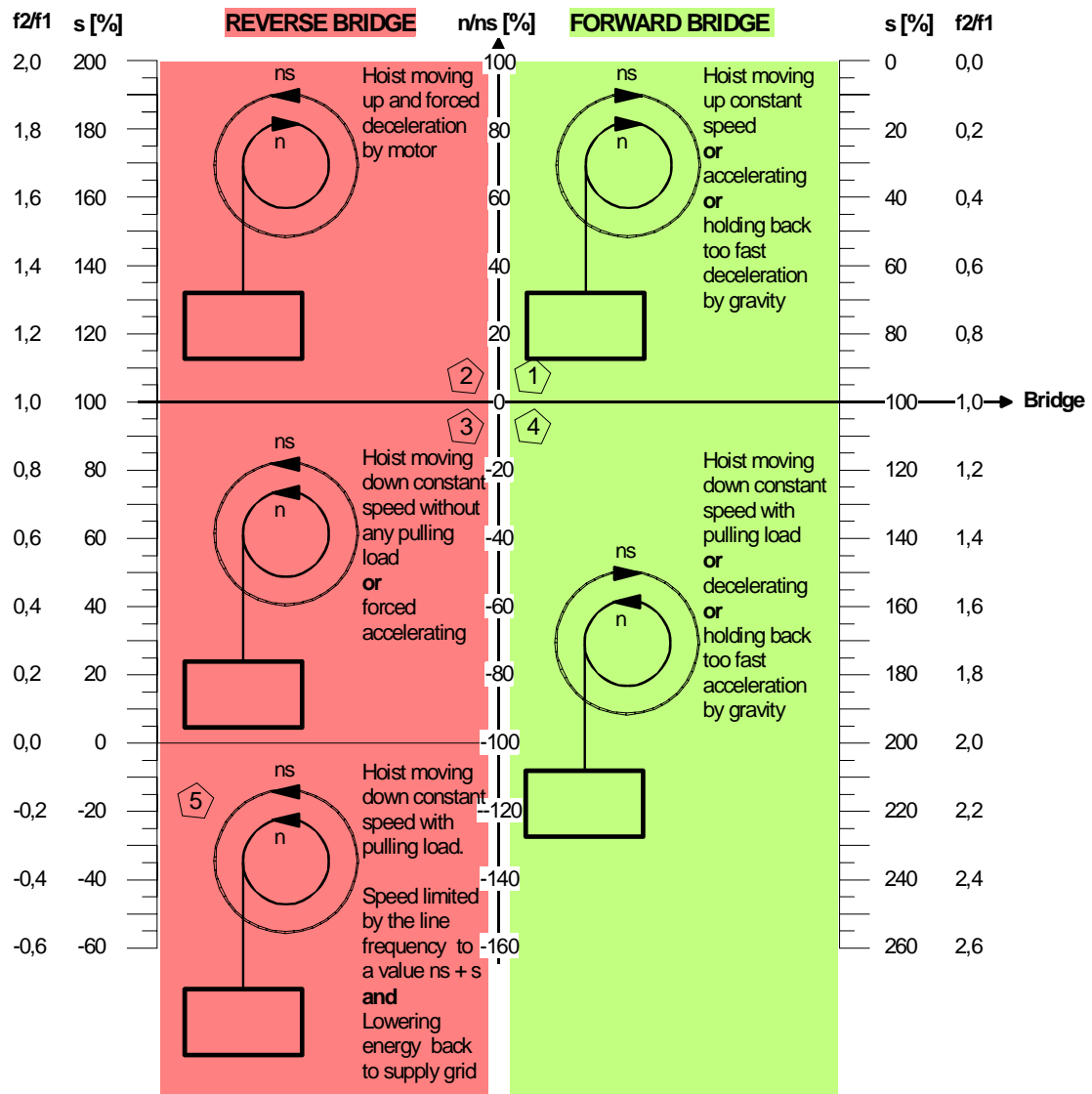
For earlier generations of ASTAT controllers a compromise between the motors torque at lowest expected line voltage and lowest peak current at normal voltage was necessary.

This ASTAT generation has no need for manual adjustment, and considers with high frequency which is the best motor characteristic at this voltage Target: Not more current than necessary.

The number of rotor characteristics is selected according to the duty. ASTAT supports 1 - 5 characteristics.

1.2.2. Application for hoist motion

Hoist motion ASTAT Control



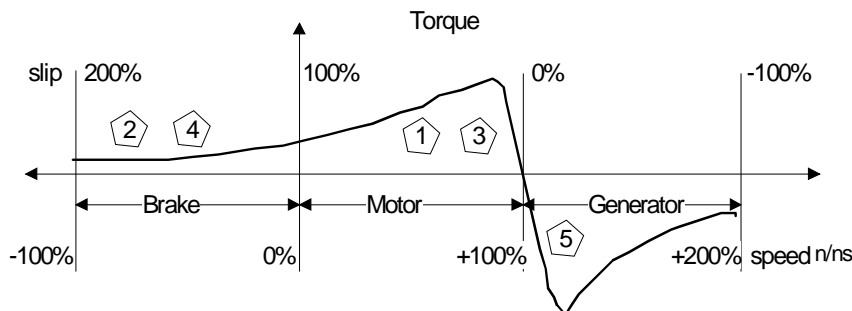
f_2/f_1The fundamental rotor frequency expressed as a multiple of the line frequency.

Value 1,0 means 50 or 60 Hz. A negative value means the direction of rotor voltage is opposite to the stator voltage.

s [%].....slip, difference in percent between the actual speed of the motor and the synchronous speed.

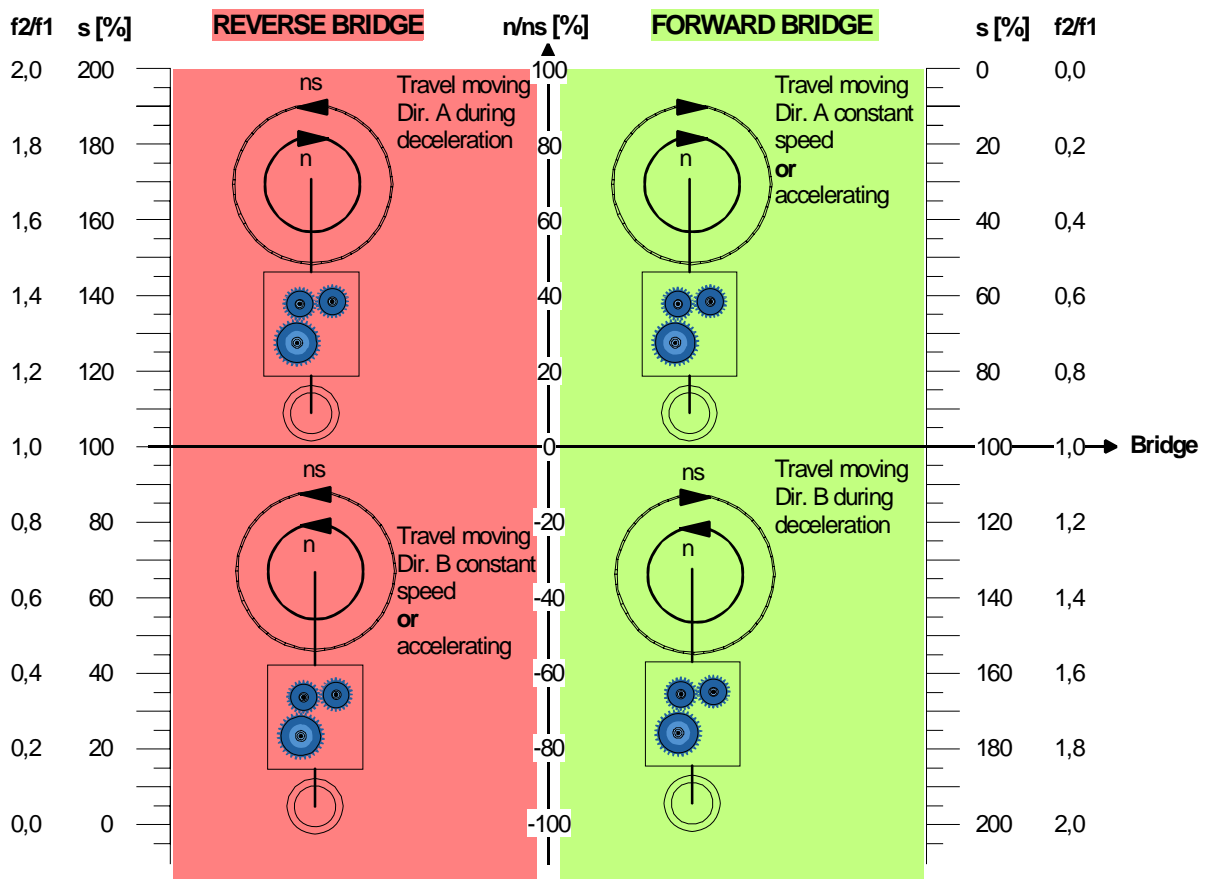
n/ns [%].... n = Speed in percent of the motor rated speed. n = the synchronous speed of the machine.

iReference mark for Torque-speed diagram



1.2.3. Application for travel motion

Travel motion ASTAT Control



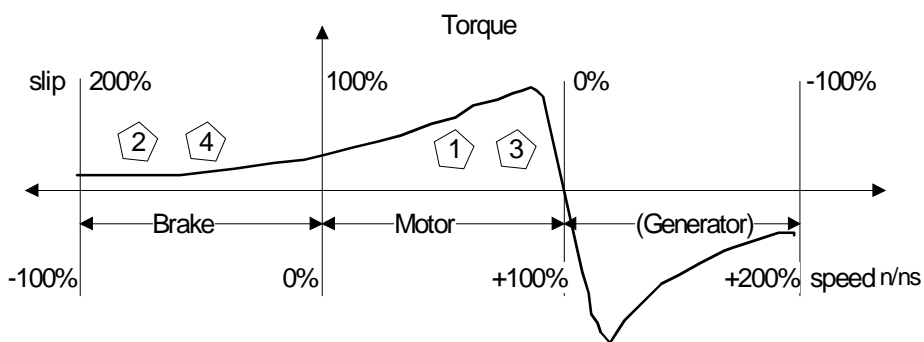
f_2/f_1The fundamental rotor frequency expressed as a multiple of the line frequency.

Value 1,0 means 50 or 60 Hz. A negative value means the direction of rotor voltage is opposite to the stator voltage.

s [%].....slip, difference in percent between the actual speed of the motor and the synchronous speed.

n/ns [%].... n = Speed in percent of the motor rated speed. n = the synchronous speed of the machine.

\diamondReference mark for Torque-speed diagram



1.3. Control system

1.3.1. Stand alone Motion Control

The control board is built up around a micro controller unit, DAPC 100.

It has following main data:

- Data bus size 16 bit
- Address bus size 18 bit
- Clock frequency 16,384 MHz
- Interrupt levels 7
- Watch supervision 2 levels
- Time out supervision 50 μ s
- Interval clock Programmable
- On board EPROM 512 Kbytes
- On board RAM 64 Kbytes
- MCU Internal RAM 2 Kbytes
- Debug interface (BDM) 1
- Thyristor bridges interface 2
- Power Supply Monitor

The system interface units, i. e. Process I/O, and Cabin I/O, are designed by using a common I/O communication controller board and a unit specific termination board.

The DSP-equipped Rotor observer board DATX 130 gets speed and condition status from the motor's or motors' slip rings.

The DSP-equipped Torque observer board DATX 132 evaluates the shaft torque of the motor(s).

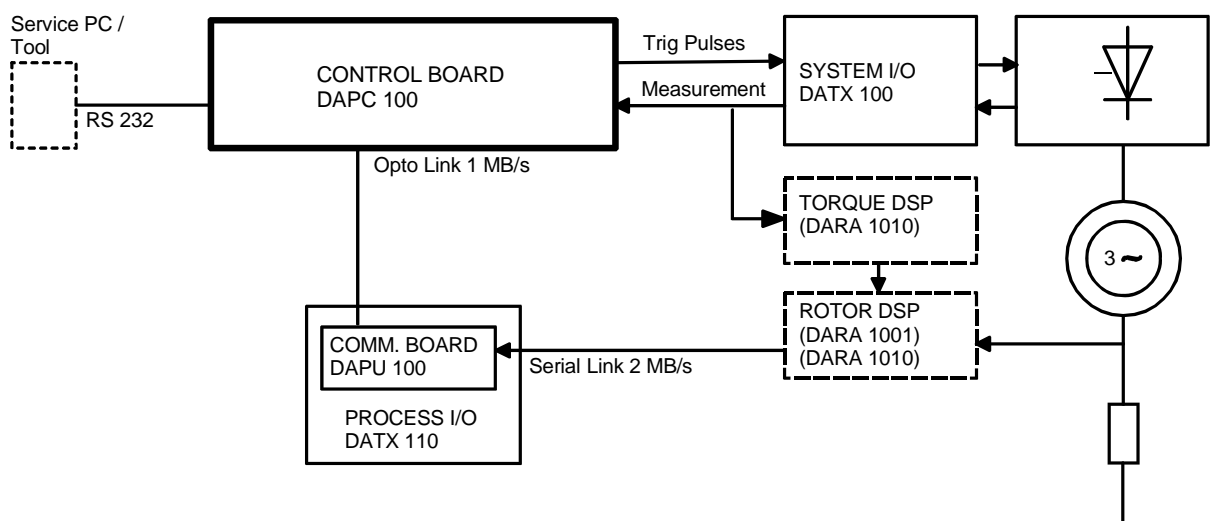
The boards mentioned above contain the latest generation of electronics, and have as a consequence short creepage distances between different potentials. The boards are for this reason specially adapted to the dusty conditions in the heavy industry by coating. It is allowed that the dust is conductive, like in metal industry.

All information channels between units, both inside modules and for longer distances, are based on fiber. With HCS technology, no practical limitation in distances exists on board a crane; see the Cabling instruction in Chapter 2.

The System I/O board is mounted inside the ventilated thyristor module. The board is designed with reasonable distances between potentials and its surface is coated to withstand the dust ingress. This board couples the control system to the power circuit by means of pulse transformers.

All parts of ASTAT are selected, designed or loaded in such a way that the installation temperature is permitted to reach more than +70 °C continuously.

ASTAT is a modular system that includes all options from the single drive without tachometer or pulse-encoder to a complete system for automating the crane.



Above: Stand alone ASTAT system

Comments: The not-dotted frame components in the figure above (except the PC and the RS 232-cable) are parts of Control System Module DARA 1000 and one Thyristor Module DASD. A tachometer or pulse-encoder is required for speed control. The Control System Modules DARA 1001 and DARA 1010 do not need tachometer or pulse-encoder.

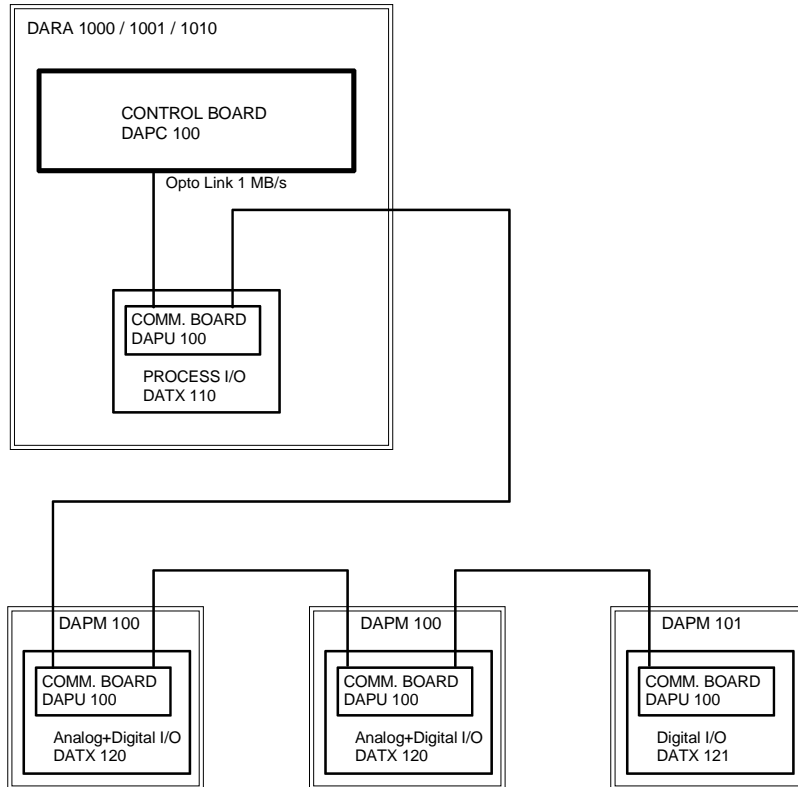
1.3.2. Extended I/O

The I/O can be extended if the motion consists of four motors and it is needed to have all detailed information available. Four motors can still be used without any Cabin I/O, but in that case it is needed to wire signals like "Brake closed" and "Over current trip" in serial; it is not possible to point out which motor that has caused the trip.

Extended I/O is also used for fiber communication to a control desk, for switching between different operator stations and for signal concentration.

Extended I/O is also needed for some advanced functions.

How a different number of Remote I/O, "Cabin I/O", can be installed is described in **Section 4.2**.

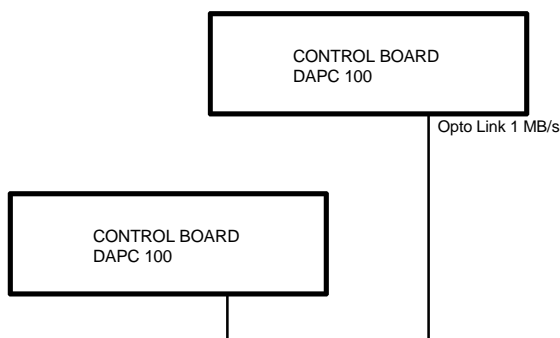


Above: ASTAT system with maximally extended I/O

1.3.3. Master-Follower Motion Control

For time-critical information exchange between two ASTAT a Master-Follower Link can be used. This information is optimised for real time control, and is not open outside the ASTAT system. Most common implementation is an Electrical shaft, but also Speed, Torque and Position control loops can be closed over the Master-Follower link.

Master-Follower is described in **Section 4.20** of this Manual.



Above: ASTAT system with Master-Follower connection

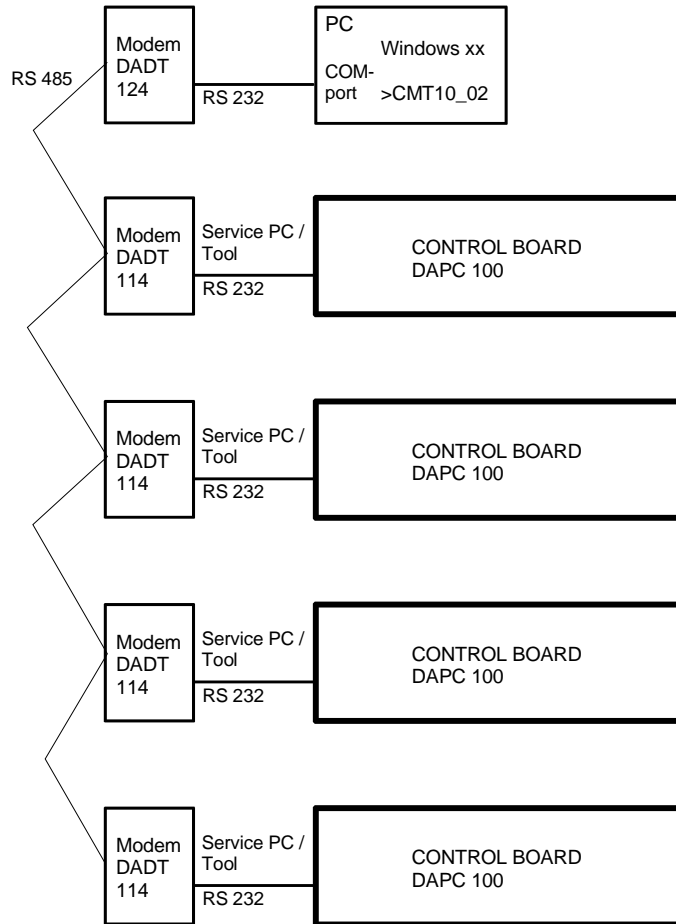
1.3.4. On crane RS485 Multi-drop System

The basic RS232 Service PC / Tool connection can only be 3 meters long. It is only possible to reach one ASTAT from the PC (if you do not have multiple COM-ports). Both these disadvantages can be overruled by using the RS485 Multi-drop System.

The system supports up to 254 number of ASTAT in one Multi-drop system.

With deliveries from ABB Crane Systems including start-up, this system is always temporarily installed as it makes the start up-work quicker and results in better tuning.

RS485 Multi-drop System is described in **Section 3** of this Manual.



Above: ASTAT system with RS485 Multi-drop System

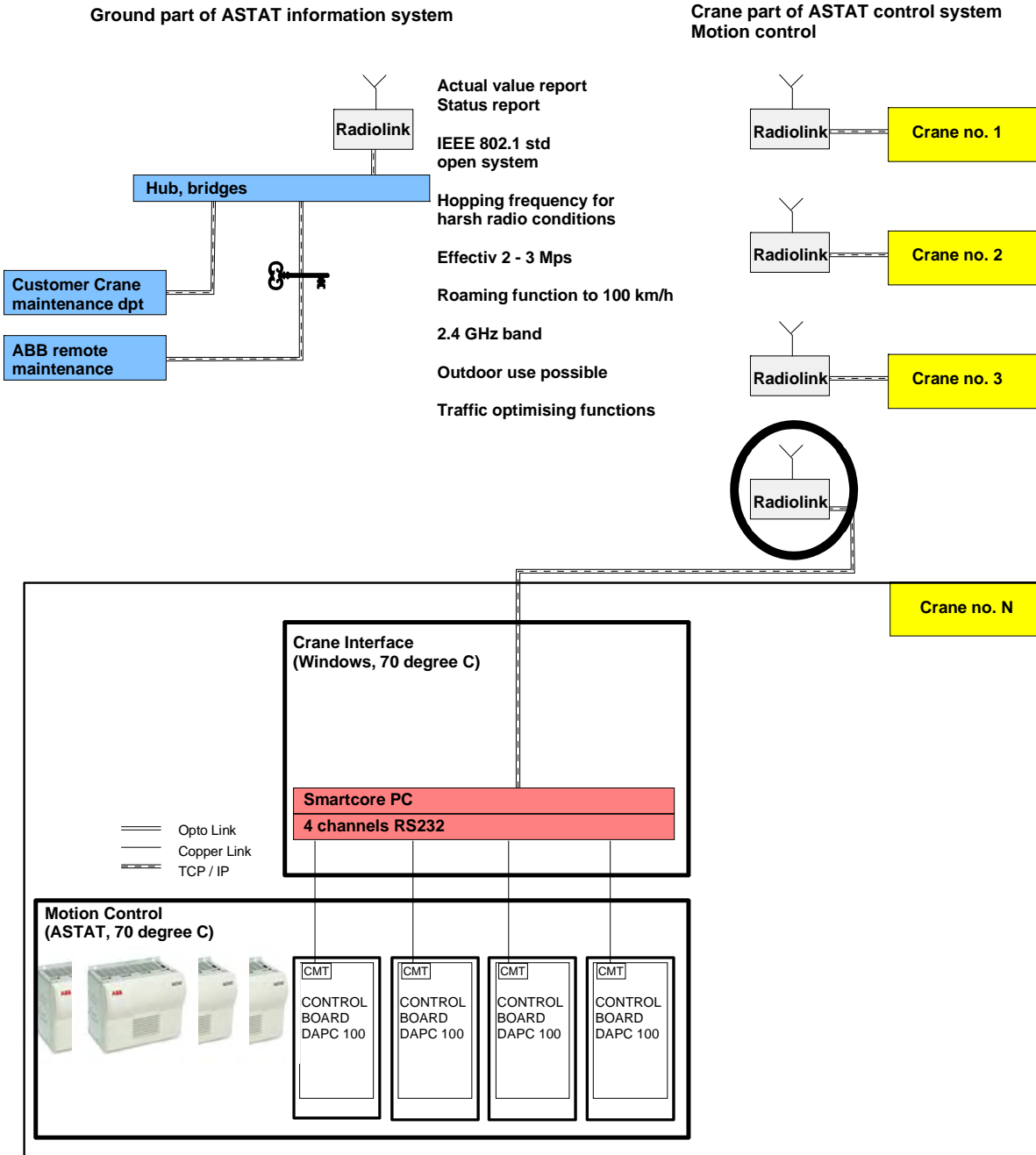
1.3.5. Factory Information System

It is of the outmost importance for a process industry, for example a steel-making mill, to have direct access from office to its cranes. The condition can be monitored, the cause of failures is known before a repair man is sent to the crane, and the basic information for the plants maintenance system is already on the ground. Backup of settings as well as different settings of motion control can be made from the ground.

As this system is not intended for real time control, it runs in a standard Windows environment.

The equipment on the crane is all made to continuously withstand 70 degree C in a dusty environment.

The software package installed in the ground computer / computers has the same functionality as described in **Section 3** of this Manual.

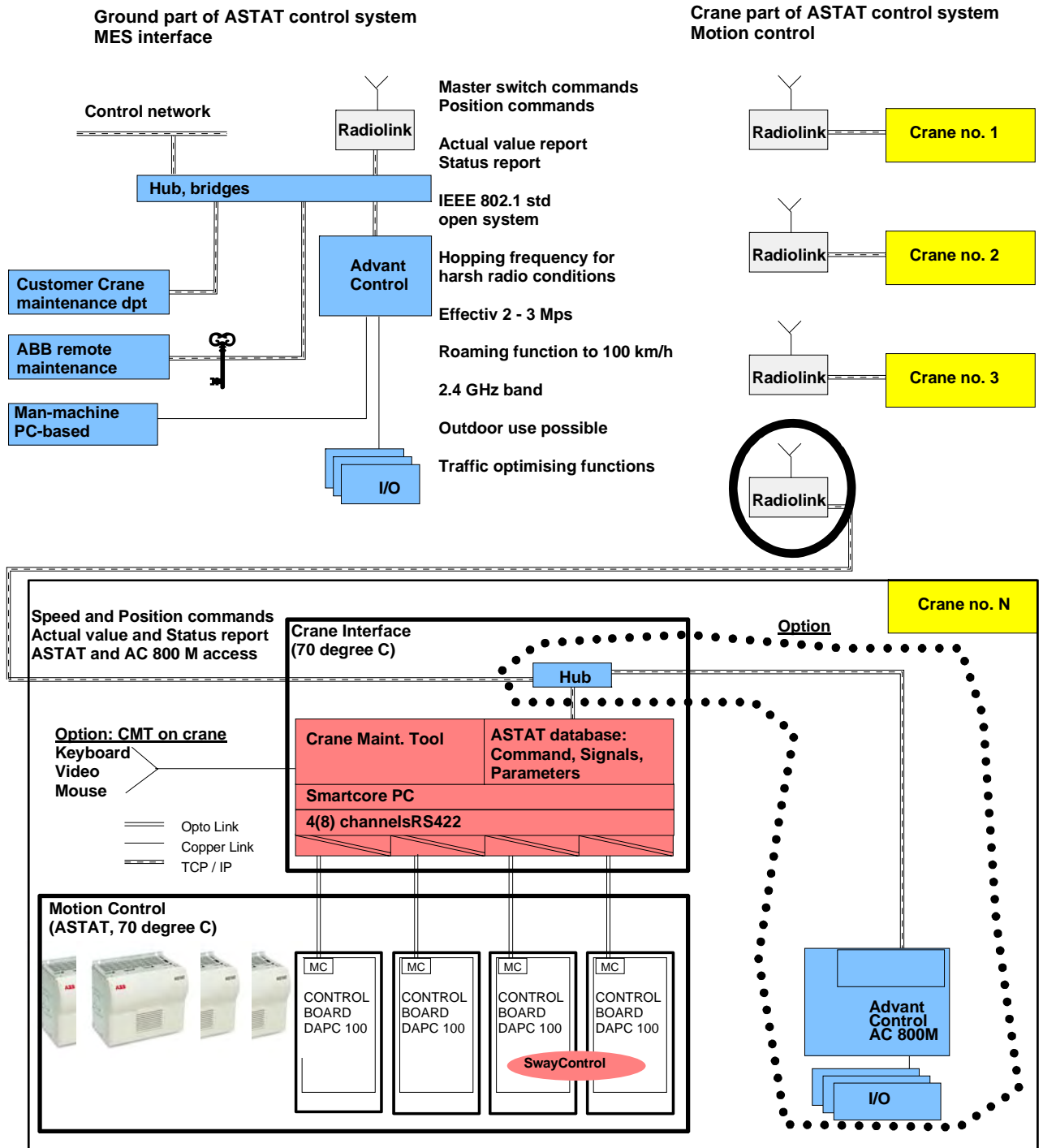


For information about the Factory information system contact ABB Crane Systems (see address / mail on the backside of this manual).

1.3.6. Factory Automation System

There are some particulars for ASTAT crane automation compared to other automation:

- ASTAT already contains I/O and functions for motion control; no PLC is needed.
- The environment is mostly too severe for ordinary industrial equipment with heat and dust
- A crane does not have any own autonomous role in factory automation. It is a part of a larger logistic system with its most process connections on the ground.
- For most cranes controlled with ASTAT the information transfer should be fast and absolutely reliable based on wire-less transfer in factory halls with a lot of metal and large electrical interference.



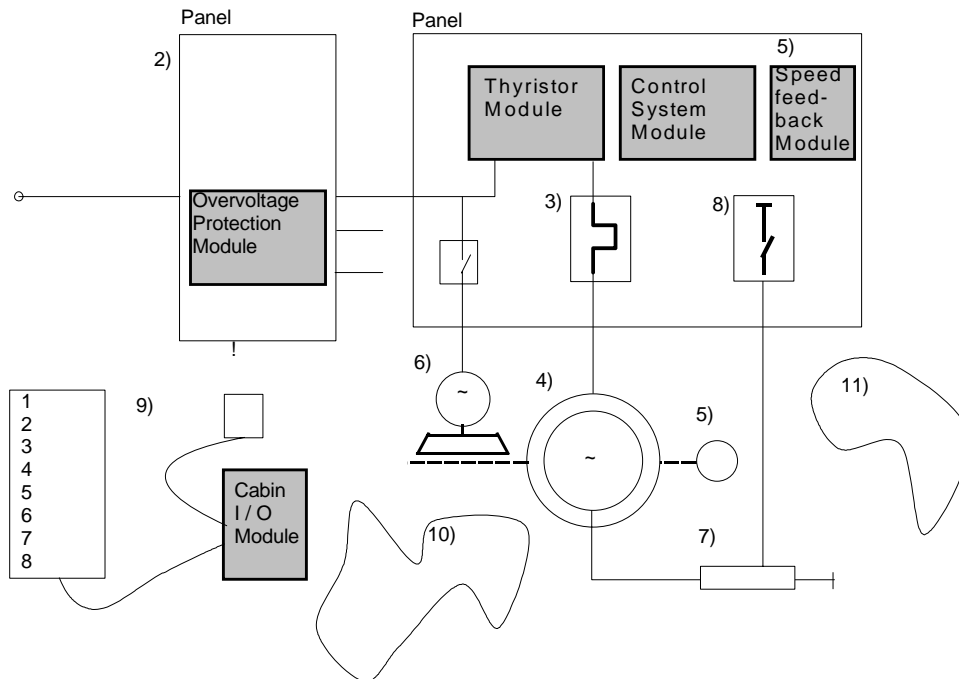
For information about co-ordinated motion control in various automation systems contact ABB Crane Systems (see address / mail on the backside of this manual).

2. ASTAT system design

A motion control system with ASTAT contains certain main components. In this Section the main components are reviewed, and the most common selection criteria are presented.

A system consists of:

- | | | |
|---------------------|---|----------------------|
| 1) ASTAT components | 2) Power and Control voltage distribution | 3) Motor cable relay |
| 4) Motor | 5) Speed feedback device (alternatives) | 6) Brake |
| 7) Resistor | 8) Rotor contactor | 9) Driver's console |
| 10) Cables | 11) Limit switches, Overspeed monitor, Overload monitor | |



For more detailed information, contact ABB.

2.1. ASTAT components

The ASTAT Motion Controller consists of:

No. of units	Description	Type designation	Circuit diagram item
1	Control System Module	DARA 100*	-A1
1 or 2	Thyristor Modules	DASD 1** or 00*	-A2 (and -A3)
0 to 4	Rotor adoption Module	DADT 100	-A4.1 to -A4.4
0, 1, 2 or 3	Cabin I/O Module	DAPM 100, 101	-A5 (and -A6)
0 or 1	Overvoltage Protection	DASG 2**	-Z1

Technical data:

See next page

Control System Modules Max. +70 °C. IP 20. 100 VA.	H, mm	W, mm	D, mm	Weight, kg	Pf, no load W	Pf, full load W	Ref. temp °C	Reduce per °C
3ASC25H231 DARA 1000 For tachometer / Pulse encoder. No AO	422	473	315	15	11	28	70 °C	-
3ASC25H231+AO DARA 1000+AO For tachometer /Pulse encoder. 2 AO	422	473	315	15	11	28	70 °C	-
3ASC25H233 DARA 1010 Rotor frequency feedback. No AO	422	473	315	15,5	12	29	70 °C	-
3ASC25H233+AO DARA 1010+AO Rotor frequency feedback. 2 AO	422	473	315	15,5	12	29	70 °C	-
3ASC25H232 DARA 1001 For use without rotary feedback and/or torque control	422	473	315	15,5	12	29	70 °C	-
3ASC25H248 DARA 2000 Hoist Safety System with Safety Relay Module DARU 100. No AO	422	473	315	17	25		70 °C	
3ASC25H248+AO DARA 2000+AO Hoist Safety System with Safety Relay Module DARU 100. 2 AO	422	473	315	17	25		70 °C	
Thyristor Modules Max. +85 °C. IP 20.	H, mm	W, mm	D, mm	Weight, kg	Pf, no load W	ΔV V	Ref. temp °C	Reduce per °C
We recommend to use DASG Overvoltage protection Modules 415, 530 and 600 V Thyristor Modules								
3ASC25H241 530 V - 25 A DASD 001	422	+87 ⁺	315	16	10	0,80	55	1,2 %
3ASC25H242 530 V - 50 A DASD 002	422	+87	315	17	13	0,85	55	1,2 %
3ASC25H243 530 V - 100 A DASD 003	422	+87	315	18	16	0,95	55	1,2 %
3ASC25H281 600 V - 25 A DASD 101	422	473	315	20	10	0,80	55	1,2 %
3ASC25H282 600 V - 50 A DASD 102	422	473	315	21	30	0,85	55	1,2 %
3ASC25H283 600 V - 100 A DASD 103	1174	473	372	21	30	0,95	55	1,2 %
3ASC25H284 600 V - 200 A DASD 104	422	473	315	32	40	0,95	55	1,2 %
3ASC25H285 600 V - 355 A DASD 105	422	473	315	32	40	1,00	40	1,2 %
3ASC25H258 600 V - 500 A DASD 145.	1172	243	358	60	200	0,95	55	1,2 %
3ASC25H270 600 V - 630 A DASD 146	1174	473	372	102	200	1,40*	55	1,2 %
3ASC25H280 600 V - 1000 A DASD 147	1174	473	372	107	200	1,45*	55	1,2 %
DASG 222, 223 Overvoltage protection Modules MUST be used for 690 V Thyristor Modules								
3ASC25H251 690 V - 25 A DASD 151	422	473	315	30	40	0,85	55	1,2 %
3ASC25H252 690 V - 50 A DASD 152	422	473	315	30	40	0,90	55	1,2 %
3ASC25H253 690 V - 100 A DASD 153	422	473	315	32	40	0,95	55	1,2 %
3ASC25H254 690 V - 200 A DASD 154	422	473	315	32	40	1,00	55	1,2 %
3ASC25H255 690 V - 330 A DASD 155	422	473	315	32	40	1,05	40	1,2 %
3ASC25H256 690 V - 630 A DASD 156	1174	473	372	103	200	1,50*	40	1,2 %
3ASC25H257 690 V - 1000 A DASD 157	1174	473	372	108	200	1,50*	40	1,2 %

* Thyristor modules DASD 001, 002 and 003 shall be mounted together with DARA 1000 / 1001 before installation in panel. The width of DARA 1000 / 1001 / 1010 increases with 87 mm to the left then a DASD 001, 002 or 003 is fitted.

Overvoltage protection and voltage monitor Max +70 °C	H, mm	W, mm	D, mm	Weight, kg	Pf, no load W	Pf, full load W	Ref. temp °C
3ASC25H272 , 380-400 V AC, DASG 218	300	180	240	2,5	15	15	70 °C
3ASC25H273 , 415 V AC, DASG 219	300	180	240	2,5	15	15	70 °C
3ASC25H274 , 440-480 V AC, DASG 220	300	180	240	2,5	15	15	70 °C
3ASC25H275 , 500-600 V AC, DASG 221	300	180	240	2,7	20	20	70 °C
3ASC25H276 , 690 V-50 Hz, DASG 222	347	244	280	12	50	50	70 °C
3ASC25H277 , 690 V-60 Hz, DASG 223	347	244	280	12	50	50	70 °C

The Thyristor Modules are tested together with a DASG Overvoltage Protection Module:

415 V AC Modules with DASG 218 or DASG 219, 530 V AC Modules with DASG 220 or DASG 221

600 V AC Modules with DASG 221

690 V AC Modules with DASG 222 or DASG 223

Cabin I/O Modules IP20.	H, mm	W, mm	D, mm	Weight, kg	Power: V - A	Power loss, no load W	Power loss, full load W
3ASC25H221 DAPM 100 Cabin I/O Module, Analog+Digital Plastic case. Max. +55 °C.	180	120	70	1	24 V DC - 1 A	3	4 (inputs high)
3ASC25H249 DAPM 101 Cabin I/O Module, Digital Plastic case. Max. +55 °C.	180	120	70	1	24 V DC - 1 A	2	3 (inputs high)
3ASC25H221+HD DAPM 100+HD Cabin I/O Module, Analog+Digital Metal case. Max. +70 °C.	180	120	70	1	24 V DC - 1 A	3	4 (inputs high)
3ASC25H249+HD DAPM 101+HD Cabin I/O Module, Digital Metal case. Max. +70 °C.	180	120	70	1	24 V DC - 1 A	2	3 (inputs high)

3ASC291321E1 Optimised HCS-cable with latches (L = 0,7 m) as spare part for internal connection inside DARA Control Modules, or between two DAPM Cabin I/O-Modules.

3ASC291322E1 Optimised HCS-cable with latches (L = 2 m) for connection from one DARA Control Module to one DAPM Cabin I/O-Module.

3ASC291323E1 Optimised HCS-cable with one latch (L = 2 m) for connection from one DARA Control Module or from one DAPM Cabin I/O-Module to one Duplex Opto splice unit DATX 140.

3ASC291361Hmmm Replace *mmm* in your order code with Length in dm (maximally 10 meter = 100 dm). Ready made duplex Hard Clad Silica Fiber cable with V-type connectors. Very flexible type. Outside dimension 3 x 5 mm. Not suitable for festoon systems. Zip cord type (two fibers). Additional mechanical wear protection. For indoors use, mainly inside or between electrical control panels.

The cable is terminated with V-pins in both ends with no additional mechanical latches. Suitable for connection between DATX 140 in both ends.

For direct connection to circuit boards of DAPM or DARA-modules, we recommend to order the Duplex Latch **3ASC267401E1**.

3ASC291361J20 HCS cable (L=2 m)

3ASC291361J50 HCS cable (L=5 m)

3ASC291361J100 HCS cable (L=10 m)

3ASC291312Emmm Replace *mmm* in your order code with Length in dm (maximally 150 meter = 1500 dm).

Ready made duplex Hard Clad Silica Fiber cable with V-type connectors. Outside dimension D= 10 mm. Not suitable for festoon systems. Zip cord type (two fibers). Additional mechanical wear protection. For indoors use, mainly between electrical control panels.

The cable is terminated with V-pins in both ends with no additional mechanical latches. Suitable for connection between DATX 140 in both ends.

For direct connection to circuit boards of DAPM or DARA-modules, we recommend to order the Duplex Latch **3ASC267401E1**.

3ASC291312E100 HCS cable (L=10 m)

3ASC291312E200 HCS cable (L=20 m)

3ASC291312E400 HCS cable (L=40 m)

3ASC291312E600 HCS cable (L=60 m)

3ASC25H266 Duplex Opto splice unit DATX 140

For connection of two Ready-made duplex Hard Clad Silica Fiber cable with V-type connectors. Snap on 35 mm rail.

<p>3ASC267401E1 Latch device For safe connection of one end of Ready-made duplex Hard Clad Silica Fiber cable with V-type connectors. Not needed for connection to DATX 140.</p>
<p>3ASC291368Mmmm Replace <i>mmm</i> in your order code with Length in meter (maximally 150 meter). Ready made Hard Clad Silica Fiber cable with V-type connectors. Optimised for indoors and outdoors fixed cabling systems. Contains 3 x 2 fibers HCS. Break out type. Diameter: 15 mm. Colour: Black. Oil: Very good resistance. Radiation: For outdoor use. Temperature: -50 °C ... +80 °C.</p>
<p>3ASC262901Mmmm. Replace <i>mmm</i> in your order code with Length in meter (maximally 150 meter). Ready made Hybrid Copper and Hard Clad Silica Fiber cable with V-type connectors. Optimised for festoon systems. Contains 7 x 2,5 mm² Cu and 3 x 2 fibers HCS. Outer sheath: Oil- and low temperature resistant PVC. Diameter: 20mm Colour: Black. Voltage rating: 300 /500 V. Oil: Very good resistance. Radiation: For outdoor use. Temperature: -30 °C ... +70 °C. Bending radius: min. 15 * d.</p>

Speed feedback, Rotor monitoring IP20. Rated +70 °C. Max +70 °C	H, mm	W, mm	D, mm	Weight, kg	Power: V - A	Power loss, no load W	Power loss, full load W
3ASC25H211 DADT 100 Feedback Module	130	110	50	0,5	Internal supply	1	1
3ASC531201A550 50 kΩ, 50 W Star-point resistor, with wires	115,5	210	90	2	Only at resistor earth fault	0	0
3ASC566101M102 IG 0006 Limit switch, maker ifm Germany Plastic, PBTP, Non-flush, 8 mm	L = 98 totally	Cable: 2 m, 2x0,5mm ²	M18x1	-	ASTAT supply 110 V DC, Max. 100 Hz	0	0

Service / Tool PC accessories IP20. Rated +70 °C. Max +70 °C	H, mm	W, mm	D, mm	Weight, kg	Main data V - A	Power loss, no load W	Power loss full load W
3ASC262741H1 Tool cable RS 232, L = 3 m	3000 [#]	-	-	0,1	-	-	-
3ASC25H268 DADT 114 232 / 485 Modem set ASTAT	119 ^{##} 3000 [#]	22,5	99	0,2	24 V DC - 0,85 A	2	2
3ASC25H269 DADT 124 232 / 485 Modem set PC	119 ^{##} 3000 [#]	28	99	0,2	24 V DC - 0,85 A	2	2

Not listed here but available from ABB: Rotor resistors, Motors, Ready-made panels, Spare parts, Control and communication systems

2.1.1. Component selection

2.1.1.1. Control System Module DARA 1000 1001, 1010

Electrical designation in drawing: -A1

Protection: IP 41

Calculated loss contribution: 20 W

Temperature range: Max +70 °C.

Select 1 DARA per motion.

DARA 1010 shall be selected for:

Rotor frequency feedback for Travel motions

One or more feedback modules DADT 100 in stead of tachometer or pulse-encoder.

DARA 1000 can be selected for other requirements

Length of cable

Additionally 100 mm for cable connector

2.1.1.2. Thyristor Modules DASD 00* and 1**

Electrical designation in drawing: -A2, -A3 if two units are used

Protection: IP 20. DASD 001 .. 003 are IP 20 after installation.

The nominal current capacity is valid for any duty factor ED[%] for the motor (15, 25, 40, 60 or 100%).

Calculated loss contribution: $P_{\text{loss}} = P_0 + 1,25 * ED [\%] * 3 * I_1 * \Delta_V [W]$, where 1,25 is a start current factor, I_1 is the normal (mechanical) load current, P_0 and Δ_V are from above.

Temperature range: Nominal values are given at +40 or +55 °C. Reduce the allowed current with 1,2 % / K above +40 or +55 °C. Max +85 °C. Highest altitude without down rating is 1000 m a s l. In other cases, please contact ABB.

Normally select 1 per motion, but 2 units can be paralleled without any current reduction.

The Thyristor modules should not be used for motors with rated current lower than 40% of the ASTAT rated current if not approved by ABB. The Thyristor modules can be used for more than the rated current after approval from ABB.

2.1.1.3. Rotor Adoption Module DADT 100

Electrical designation in drawing: -A4

Protection: IP 41

Calculated loss contribution: 1 W

Temperature range: Max +70 °C.

One to four units Rotor adoption module DADT 100 are selected.

Select 1 DADT 100 per motion unless the motion has its feed back from a tachometer / pulse encoder, and no motor supervision is desired. For monitoring of all motors of the motion, select 1 DADT 100 per motor.

2 or 4 DADT 100 is also chosen for rescue service with 1 of 2 or 2 of 4 motors in a motion, and the speed feedback must be selected from different motors in the configurations.

The star-point of each rotor resistor should be grounded for earth fault supervision purpose. Use the Star-point resistor 50 kΩ, 50 W 3ASC531201A550 fitted with wires, or select according to section **2.8.1**.

2.1.1.4. Cabin I/O Module DAPM 100, 101

DAPM 100: Analog and Digital signal interface.

DAPM 101: Only Digital signal interface.

Electrical designation in drawing: -A5 or -A6

Protection: IP 20

Calculated loss contribution: 3 W

Temperature range: Max +70 °C.

Select one per operation station for every motion. Maximally two units (one for DAPM 101), one for the on-board operation station of the crane and a second one for the relay unit of a radio remotely controlled crane.

For functions based on load cell signal, DAPM 100 must be selected.

2.1.1.5. Overvoltage protection DASG 2**

Electrical designation in drawing per crane: -Z1

Protection: IP 20

Temperature range: Max +70 °C.

Prevent spikes and checks supply for voltage level and phase sequence.

It is recommended to use one Overvoltage Protection Module per unique cable system to each main contactor. Most cranes have one cable way from one current collector to one main contactor, and thus one DASG 2** protection.

A large crane with more than one main contactor will have more than one DASG 2** unless the main contactors are mounted in the same panel supplied with one common cable system from the common point.

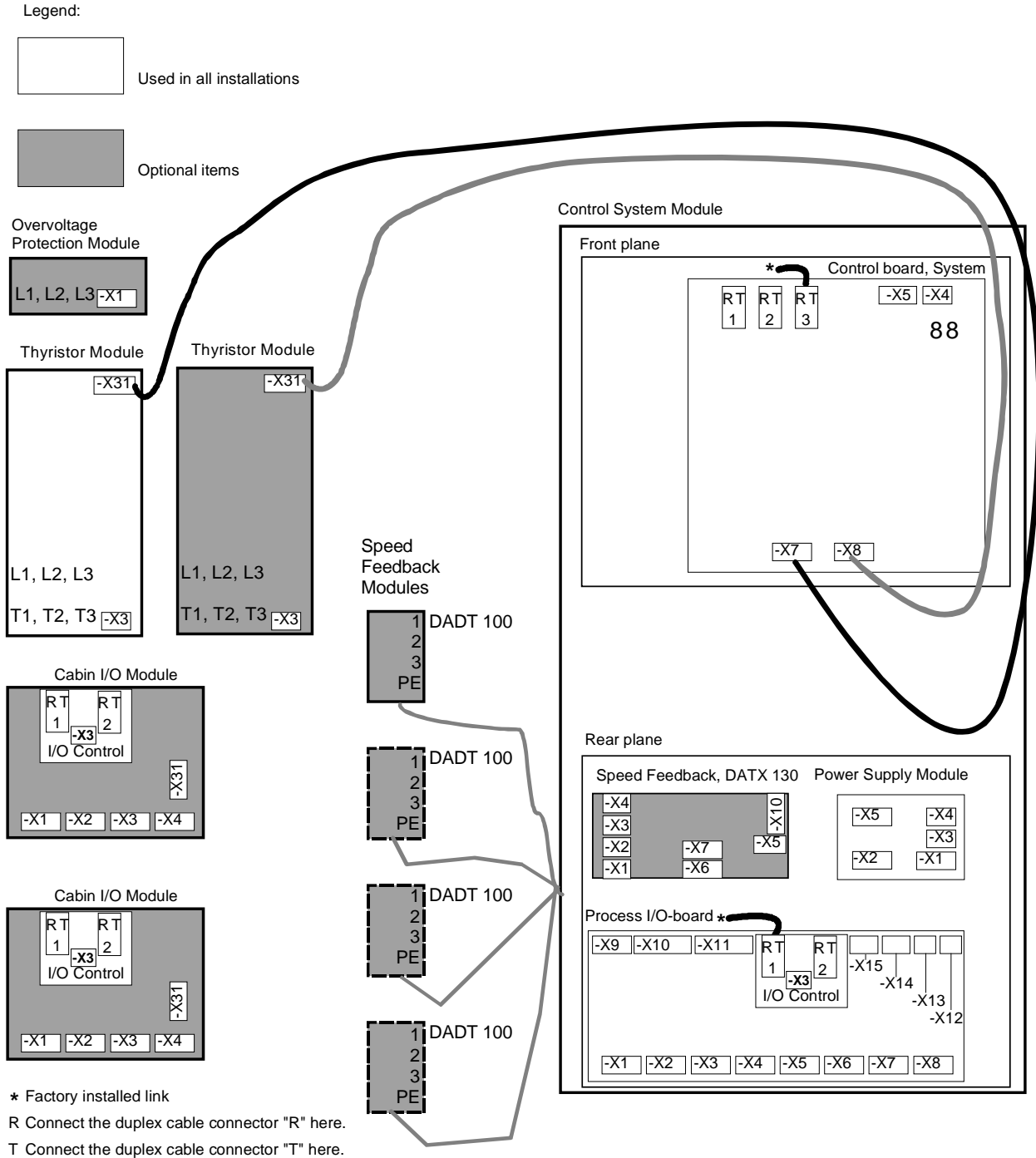
690 V ASTAT controllers **must** have DASG 2**, as there is no separate Overvoltage protection in each Thyristor module.

The function is described in SECTION POWER AND CONTROL VOLTAGE.

2.1.1.6. Vacant

2.2. Detailed connection list

In the figure below all terminal groups for the Crane Motion Controller are shown. Prepare the study of this section by selecting and printing out the suitable forms in Section 11, Installation Diagram Forms.



 **Hint: Use the EXCEL "Interface_generator_xx.xls" of the Tool software to easily get the actual signal list for a particular application. xx is a number 01 - 99.**

The function of some of the terminals is given by the configuration parameters:

Default values are Boldface

02.01	RUN_TYPE	Value 5 will use DI and AI of the Process I/O. Value 0 will use DI and AI of the Cabin I/O.							
05.01	IN_ASTAT	Rated current of the Thyristor module. In case of Parallel bridge combination, Ie is the sum of the two units together. Unit: A. 25 A. DI no. 17 on board DATX 110 is determined by this information.							
05.03	DRI_TYPE	Parameter to set for whether the input configuration shall be 11 for "Hoist without Shared Motion", 12 for "Hoist with Shared Motion", 21 for "Travel without Shared Motion", or 22 for "Travel with Shared Motion".							
05.04	L_SW_TYP	Type of limit switch for motion. 1 : Based on four switches. 2 : Soft based on Pulse transmitter.							
05.27	STA2_PA2	With STA2_PA2 = 0 , DI no.3 on process I/O board DATX 110 will select between operator station number two out of number one and number two. With STA2_PA2 = 1 , DI no.3 on process I/O board DATX 110 will extend the selectable parameter sets to four, but disable the selection possibility between two operator stations. STA2_PA2 = 1 is not possible for Shared motion. STA2_PA2 = 1 is not possible for duty with master switch connected direct to DARA, i. e. RUN_TYPE=5 .							
05.29	SELECT_A	0	0	0	0	1	1	1	1
05.30	SELECT_B	0	0	1	1	0	0	1	1
14.30	TWIN_OVL	0	1	0	1	0	1	0	1
DATX 110	AO no. 1	Speed ref.	Speed ref.	Speed ref.	Speed ref.	Current	Current	Current	Current
	AO no. 2	Torque ref.	Torque ref.	Act. speed	Load, units	Torque ref.	Torque ref.	Act. speed	Load, units
13.01	SEL_DO_1	Function of DO no. 1. The DO relay is closed for 0 : Extended lowering contactor. 1 : Cable reel used. 2 : Pull in a contactor for the thyristor fan. 3 : Fan runs all the time							
20.01	MF_TYPE	Definition of the role of the ASTAT in a Master-Follower connection. Used for definition of DI no. 17 on board DATX 110 is determined by this information. 0 : No Master-Follower connection 1 : Master in Master-Follower connection 2 : Follower in Master-Follower connection							



Hint: Use the EXCEL "Interface_generator_xx.xls" of the Tool software to easily get the actual signal list for a particular application. xx is a number 01 - 99.

Below: Input form for Interface_generator_04.xls. See full description in Section **Software for Design, Start up and Fault tracing:**

Item	Name	Selection rule	Value	Comment
Motion identity: CR 888 Hoist 1				
02.01	RUN_TYPE	Value 0 will use Cabin I/O. Value 5 will use DI and AI of the Process I/O board.	0	
05.01	IN_ASTAT	Rated current of the Thyristor module. In case of Parallel bridge combination, Ie is the sum of the two units together. Unit: A. DI no. 3 on board DATX 110 is determined by this information.	100	
05.03	DRI_TYPE	Setting: 11 for "Hoist without Shared Motion", 12 for "Hoist with Shared Motion", 21 for "Travel without Shared Motion", 22 for "Travel with Shared Motion", 23 for "Single motion SwayControl", 24 for "Travel of Four motion SwayControl system with owned hoist" or 25 for "Travel of Four motion SwayControl system with the other travel motions owned hoist"	11	
05.04	L_Sw_TYP	Type of limit switch for movements. 1: Classic based on four switches. 2: Soft based on Pulse transmitter.	1	
05.27	STA2_PA2	STA2_PA2 = 0: DI #3 on process I/O board DATX 110 will select between operators stations number one and two. STA2_PA2 = 1: DI #3 on process I/O board DATX 110 will extend the selectable parameter sets to four, but disable the selection between two operators stations. STA2_PA2 = 1 is not possible for Shared motion. STA2_PA2 = 1 is not possible for duty with Local I/O, i.e. RUN_TYPE=5.	1	
05.29	SELECT_A	Control AO no. 1 of process I/O board DATX 110. Value = 0: 0 V = 0% actual line current +10 V = 400% actual line current Value = 1: -10 V = -200% speed reference +10 V = +200% speed reference	0	
05.30	SELECT_B	Control AO no. 2 of process I/O board DATX 110. Value = 0: -10 V = -400% torque reference +10 V = +400% torque Control AO no. 2 of process I/O board DATX 110. Value = 0: -10 V = -400% torque reference +10 V = +400% torque reference Value = 1: Parameter 14.30 TWIN_OVL = 0 -10 V = -200% actual speed +10 V = +200% actual speed Parameter 14.30 TWIN_OVL = 1 Load in Weight Units	1	
13.01	SEL_DO_1	Function of DO no. 1. The DO relay is closed for 0: Extended lowering contactor. 1: Cable reel used. 2: Pull in a contactor for the thyristor fan, if installed (the heat sink is warmer than +50 °C)	2	
14.30	TWIN_OVL	Enable parameter for function with summation and/or comparison of weight signals from two load cell or two hoists. The sum level is set with parameter 14.24. Requires that the two ASTAT are connected together by DATX 110 AO 2 - AI 6.	1	
20.01	MF_TYPE	Definition of the role of the ASTAT in a Master-Follower connection: 0: No Master-Follower connection: 1: Master in Master-Follower connection 2: Slave in Master-Follower connection 4: This travel motion a consumer of rope length and weight class information of a hoist	0	

Fill in!

2.2.1. Thyristor Module connection

Units without any fan

3ASC25H241 530 V - 25 A DASD 001
3ASC25H281 600 V - 25 A DASD 101
3ASC25H251 690 V - 25 A DASD 151

- Line connection, 530 and 600 VAC-modules : L1, L2, L3. Terminal max. 35 mm².
Line connection, DASD 151 : L1, L2, L3. Bus bar 20 * 6 with 1 hole D = 11 mm
- Motor connection, 530 and 600 VAC-modules: T1, T2, T3. Terminal max. 35 mm².
Motor connection, DASD 151 : T1, T2, T3. Bus bar 20 * 6 with 1 hole D = 11 mm
- Control cable: -X31 (System cable)

Units with one fan, module sizes

3ASC25H242 530 V - 50 A DASD 002
3ASC25H282 600 V - 50 A DASD 102
3ASC25H283 600 V - 100 A DASD 103

- Line connection: L1, L2, L3. Terminal max. 35 mm².
- Motor connection: T1, T2, T3. Terminal max. 35 mm².
- Control cable: -X31 (System cable)
- Fan connection: -X3:1-2. Terminals max. 2,5 mm². In DASD 002 the fan is fitted with wires which shall be connected to DARA 1000 / 1001 / 1010 Power Supply Module Supply -X2:3 (+) and :4 (0).

Units with one fan, narrow type with thyristor modules

3ASC25H248 600 V - 500 A DASD 145

- Line connection: L1, L2, L3. Bus bar 30 * 6 hole D = 11 mm
- Motor connection: T1, T2, T3. Bus bar 30 * 6 with 2 hole D = 11 mm
- Control cable: -X31 (System cable)
- Fan connection: -X3:1-2. Terminals max. 2,5 mm²

Units with one fan, puck thyristor sizes

3ASC25H270 600 V - 630 A DASD 146
3ASC25H280 600 V - 1000 A DASD 147
3ASC25H256 690 V - 630 A DASD 156
3ASC25H257 690 V - 1000 A DASD 157

- Line connection: L1, L2, L3. Bus bar 60 * 10 with 2 holes D = 11 mm (630, 1000 A)
- Motor connection: T1, T2, T3. Bus bar 60 * 10 with 2 holes D = 11 mm (630, 1000 A)
- Control cable: -X31 (System cable)
- Fan connection: -X3:1-2. Terminals max. 2,5 mm²

Units with two fans

3ASC25H243 530 V - 100 A DASD 003
3ASC25H284 600 V - 200 A DASD 104
3ASC25H285 600 V - 355 A DASD 105
3ASC25H252 690 V - 50 A DASD 152
3ASC25H253 690 V - 100 A DASD 153
3ASC25H254 690 V - 200 A DASD 154
3ASC25H255 690 V - 330 A DASD 155

- Line connection, DASD 003 : L1, L2, L3. Terminal max. 35 mm².
Line connection, other modules with two fans: L1, L2, L3. Bus bar 20 * 6 with 1 hole D = 11 mm.
Bus bar 60 * 10 with 2 holes D = 11 mm (630, 1000, 1100 A)
- Motor connection, DASD 003: T1, T2, T3. Terminal max. 35 mm².
Motor connection, other modules with two fans: T1, T2, T3. Bus bar 20 * 6 with 1 hole D = 11 mm.
Bus bar 60 * 10 with 2 holes D = 11 mm (630, 1000, 1100 A)
- Control cable: -X31 (System cable)
- Fan connection: -X3:1-2. and -X3:3-4. Terminals max. 2,5 mm². In DASD 003 the fans are fitted with wires which shall be connected to DARA 1000 / 1001 / 1010 Power Supply Module Supply -X2:3 (+) and :4 (0).

2.2.2. Control System Module connection

Control System Module DARA 1000, DARA 1001 and DARA 1010
The modules have fixed as well as configuration dependent connections.

- **Power Supply Module**
 - **Supply 115 / 230 V AC:** L1 on -X1:1 and :(3).
L2/N on -X1:2 and :(4)
For connection with 115 V AC:
Strap Power supply module
-X1:5 to 7 as well as -X1:6 to 8

For connection with 230 V AC:
Strap Power supply module
-X1:6 to 7
 - **Fan connections for DASD 145, 146, 147, 156, 157:**
Connect the fan to 220 V AC without wiring inside the Control System Module DARA.
We recommend via a contactor controlled by DO no. 1.
 - **Fan connections for DASD 102, 103, 104, 105, 152, 153, 154, 155:**
Fan no.1 to -X3:1 and :2
Fan no.2 to -X3:3 and :4 (DASD 104, 105, 152, 153, 154, 155)
We recommend via a contactor controlled by DO no. 1.
 - **Fan connections for DASD 00x:**
Fan no.1 to -X2:3 (red) and :4 (blue)
Fan no.2 to -X2:3 (red) and :4 (blue) (two leads in same terminal)
We recommend via contactor controlled by DO no. 1.
 - **110 V DC Detection Voltage**
Directly grounded system (Normal) Power supply module -X2:9 to Ground.
Floating grounded system (Special installations) Power supply module -X2:10 to Ground.
- **Control board system, DAPC 100**
Information channels:
 - -X5: PC-connection via multi-drop RS 485 (DADT 114 and DADT 124) or point-to-point RS 232 Tool connection.
 - Opto links:
Channel 1, Opto pair connection to TCP / IP controller (Vertical communication), or to other ASTAT in dynamic Horizontal communication mode. **MC**
Channel 2, Opto pair connection to other ASTAT (Horizontal communication). **M/F**
Channel 3, Internal fiber connection to Process I/O, DAPU 100. **I/O**
 - 24 V DC connection: -X4 (Internally connected)

Thyristor Module Control cable: -X7 (System cable).
Routed via DATX 130 for DARA 1001 and 1010 modules.

Thyristor Module Control cable: -X8 (System cable); only used for parallel Thyristor modules.

- **Process I/O-board**

- 24 V DC: + on -X12:3, - on -X12:4
- **Control board I/O, DAPU 100 (mounted on Process I/O-board)**
 Channel 1, Internal fiber connection to Control board System, DAPC 100
 Channel 2, Communication to Speed feedback Module / Cabin, fiber connection.

- **Digital Out**

Configuration dependent:

Configuration → Terminal -X10:↓	13.01 SEL_DO_1=0	13.01 SEL_DO_1=1	13.01 SEL_DO_1=2 / 3
1-2	Rotor contactor K0	Cable reel	Thyristor fan(s)
3-4	Rotor contactor K1		
5-6	Rotor contactor K2		
7-8	Rotor contactor K3		
Terminal -X11:↓			
1-2	Brake-lifter contactor		
3-4	Delayed brake-lifter; for DC-brake hold current		
5-6	Any Fault / Fault that will activate a fault DO in the cabin		
Configuration → Terminal -X11:↓	05.03 DRI_TYPE=12, 22	05.03 DRI_TYPE = 11, 21	
7-8	Shared motion selected	No dangerous fault	

- **Digital In**

Fixed: All odd terminals -X1, -X2, -X3 and -X4 are internally connected to detection voltage M1+ (110 V DC).
 Example: -X1:1.

Configuration dependent interface with master switch connected direct to DARA; RUN_TYPE = 5:

Configuration → DI No.	Terminal -X1:↓	02.01 RUN_TYPE=5 05.03 DRI_TYPE=11	02.01 RUN_TYPE=5 05.03 DRI_TYPE=21
1	2	ON	
2	4	Fault reset	
3	6	Master switch in zero position	
4	8	Master switch full speed	
DI No.	Terminal -X2:↓		
5	2	Prelim Dir. A	
6	4	Prelim Dir. B.	
7	6	Stop Dir. A	
8	8	Stop Dir. B	
DI No.	Terminal -X3:↓		
9	2	Cable relay	
10	4	Brake open	
11	6	Master switch Direction A	
12	8	Master switch Direction B	
DI No.	Terminal -X4:↓		
13	2	Mech. Overload	Cable relay
14	4	Master switch Step 2	
15	6	Mech. Overspeed	.....
16	8	Master switch Step 3	
DI No.	Terminal -X9:↓		
17	6	Unsymmetry parallel bridges	

Combinations with Cabin I/O: See next page.



Hint: Use the EXCEL "Interface_generator_xx.xls" of the Tool software to easily get the actual signal list for a particular application. xx is a number 01 - 99.

Configuration dependent for Cabin I/O control with one or two DAPM:

All combinations for hoist motions:

Configura- tion →	02.01 RUN_TYPE≠5 05.03 DRI_TYPE=11 05.04 L_SW_TYP=1 05.27 STA2_PA2=0	02.01 RUN_TYPE≠5 05.03 DRI_TYPE=11 05.04 L_SW_TYP=2 05.27 STA2_PA2=0	02.01 RUN_TYPE≠5 05.03 DRI_TYPE=11 05.04 L_SW_TYP=1 05.27 STA2_PA2=1	02.01 RUN_TYPE≠5 05.03 DRI_TYPE=11 05.04 L_SW_TYP=2 05.27 STA2_PA2=1	02.01 RUN_TYPE≠5 05.03 DRI_TYPE=12 05.04 L_SW_TYP=1	02.01 RUN_TYPE≠5 05.03 DRI_TYPE=12 05.04 L_SW_TYP=2	
DI No.	Terminal -X1:↓						
1	2	ON					
2	4	Fault reset					
3	6	Station 2 select	Parameter set 1&2 or 3&4 select			Station 2 select	
4	8	Parameter set 2 select	Parameter set 1&3 or 2&4 select			Parameter set 2 select	
DI No.	Terminal -X2:↓						
5	2	Prelim Dir. A	Synch Limit switch	Prelim Dir. A	Synch Limit switch	Prelim Dir. A Main	Synch Limit switch Main.
6	4	Prelim Dir. B.	.....	Prelim Dir. B.	.....	Prelim Dir. B Main	Synch Limit switch Aux.
7	6	Stop Dir. A	.....	Stop Dir. A	.....	Stop Dir. A Main	.....
8	8	Stop Dir. B	.....	Stop Dir. B	.....	Stop Dir. B Main	.....
DI No.	Terminal -X3:↓						
9	2	Cable relay	Cable relay	Cable relay	Cable relay	Cable relay Main	Cable relay Main
10	4	Brake open	Brake open	Brake open	Brake open	Brake open Main	Brake open Main
11	6	Cable relay	Cable relay	Cable relay	Cable relay	Cable relay Aux.	Cable relay Aux.
12	8	Brake open	Brake open	Brake open	Brake open	Brake open Aux.	Brake open Aux.
DI No.	Terminal -X4:↓						
13	2	Mech. Overload	Mech. Overload	Mech. Overload	Mech. Overload	Stop Dir. A Aux.	.....
14	4	Brake open	Brake open	Brake open	Brake open	Stop Dir. B Aux.	.....
15	6	Mech. Overspeed	Mech. Overspeed	Mech. Overspeed	Mech. Overspeed	Mech. Overspeed Main	Mech. Overspeed Main .
16	8	05.20 USE_DI16≠2: Brake open	05.20 USE_DI16≠2: Brake open	05.20 USE_DI16≠2: Brake open	05.20 USE_DI16≠2: Brake open	Mech. Overspeed Aux.	Mech. Overspeed Aux.
		05.20 USE_DI16=2: Synchronisation of electric shaft	05.20 USE_DI16=2: Synchronisation of electric shaft	05.20 USE_DI16=2: Synchronisation of electric shaft	05.20 USE_DI16=2: Synchronisation of electric shaft		
Configura- tion →	05.01 IN_ASTAT≠660, IN_ASTAT≠710, IN_ASTAT≠1200, IN_ASTAT≠1260, IN_ASTAT≠1700, IN_ASTAT≠2000, IN_ASTAT≠2200 05.03 DRI_TYPE=11, 21						
DI No.	Terminal -X9:↓						
		20.01 MF_TYPE = 1	20.01 MF_TYPE = 2				
17	6	A Ctrl-signal for Master-Follower	B Ctrl-signal for Master-Follower			Unsymmetry parallel bridges	

Combinations for travel motions: See next page.

Configuration dependent for Cabin I/O control with one or two DAPM:

All combinations for travel motions:

Configuration →		02.01 RUN_TYPE≠5	02.01 RUN_TYPE≠5	02.01 RUN_TYPE≠5
DI No.	Terminal -X1:↓	05.03 DRI_TYPE=21	05.03 DRI_TYPE=21	05.03 DRI_TYPE=22
		05.27 STA2_PA2=0	05.27 STA2_PA2=1	
1	2	ON		
2	4	Fault reset		
3	6	Station 2 select	Parameter set 1&2 or 3&4 select	Station 2 select
4	8	Parameter set 2 select	Parameter set 1&3 or 2&4 select	Parameter set 2 select
DI No.	Terminal -X2:↓			
5	2	Prelim Dir. A	Prelim Dir. A	Prelim Dir A Travel 1
6	4	Prelim Dir. B.	Prelim Dir. B.	Prelim Dir B Travel 1
7	6	Stop Dir. A	Stop Dir. A	Stop Dir A Travel 1
8	8	Stop Dir. B	Stop Dir. B	Stop Dir B Travel 1
DI No.	Terminal -X3:↓			
9	2	Cable relay	Cable relay	Cable relay Travel 1
10	4	Brake open	Brake open	Brake open Travel 1
11	6	Cable relay	Cable relay	Cable relay Travel 2
12	8	Brake open	Brake open	Brake open Travel 2
DI No.	Terminal -X4:↓			
13	2	Cable relay	Cable relay	Stop Dir. A Travel 2
14	4	Brake open	Brake open	Stop Dir. B Travel 2
15	6	Cable relay	Cable relay	Prelim Dir. A Travel 2
16	8	05.20 USE_DI16≠2: Brake open	05.20 USE_DI16≠2: Brake open	Prelim Dir. B Travel 2
		05.20 USE_DI16=2: Synchronisation of electric shaft	05.20 USE_DI16=2: Synchronisation of electric shaft	

Configuration →		
DI No.	Terminal -X9:↓	
17	6	Unsymmetry parallel bridges

Combinations for hoist motions: See previous page.



Hint: Use the EXCEL "Interface_generator_xx.xls" of the Tool software to easily get the actual signal list for a particular application. xx is a number 01 - 99.

- Analogue In**

Fixed: Reference Voltage + 10 V: -X7:5

Reference Voltage - 10 V: -X7:6

Reference Voltage Analogue Ground: -X7:7

Configuration dependent for Cabin I/O control with one or two DAPM; RUN_TYPE = 0:

Configuration →		02.01 RUN_TYPE≠5 05.03 DRI_TYPE=11	02.01 RUN_TYPE≠5 05.03 DRI_TYPE=12	02.01 RUN_TYPE≠5 05.03 DRI_TYPE=21	02.01 RUN_TYPE≠5 05.03 DRI_TYPE=22
PTC 1	1-2	Motor no.1 PTC	Main Hoist PTC	Motor no.1 PTC	Travel 1 PTC
PTC 2	3-4	Motor no.2 PTC	Aux. Hoist PTC	Motor no.2 PTC	Travel 2 PTC
PTC 3	5-6	Motor no.3 PTC	Motor no.3 PTC	Motor no.3 PTC	Motor no.3 PTC
PTC 4	7-8	Motor no.4 PTC	Motor no.4 PTC	Motor no.4 PTC	Motor no.4 PTC
Configuration →		14.30 TWIN_OVL= 0		14.30 TWIN_OVL= 1	
AI No.	Terminal -X5:↓				
5	1-2	Load cell signal		Load cell signal	
6	3-4	Additional speed reference, no ramp influence		Load of twin hoist in units	
7	5-6	Additional torque reference, no ramp influence		Additional torque reference, no ramp influence	
8	7-8	Tacho feedback.		Tacho feedback.	

Configuration dependent interface with master switch connected direct to DARA; RUN_TYPE = 5:

Configuration →		02.01 RUN_TYPE=5 05.03 DRI_TYPE=11	02.01 RUN_TYPE=5 05.03 DRI_TYPE=21
PTC 1	1-2	Motor no.1 PTC	Motor no.1 PTC
PTC 2	3-4	Motor no.2 PTC	Motor no.2 PTC
PTC 3	5-6	Motor no.3 PTC	Motor no.3 PTC
PTC 4	7-8	Motor no.4 PTC	Motor no.4 PTC
AI No.	Terminal -X6:↓		
5	1-2	AI Reference -10 +10 V	
6	3-4	Additional speed reference, no ramp influence	
7	5-6	Additional torque reference, no ramp influence	
8	7-8	Tacho feedback.	



Hint: Use the EXCEL "Interface_generator_xx.xls" of the Tool software to easily get the actual signal list for a particular application. xx is a number 01 - 99.

- Analogue Out**

Standard connection at the delivery.

Fixed: Stator current: -X7:1; Common -X7:2

Torque reference: -X7:3; Common -X7:4

Configuration dependent:

Configuration →	AO No.	Terminal -X7:↓	05.29 SELECT_A = 0 05.30 SELECT_B = 0 14.30 TWIN_OVL = 0	05.29 SELECT_A = 0 05.30 SELECT_B = 1 14.30 TWIN_OVL = 0	05.29 SELECT_A = 1 05.30 SELECT_B = 0 14.30 TWIN_OVL = 0	05.29 SELECT_A = 1 05.30 SELECT_B = 1 14.30 TWIN_OVL = 0
1		1-2	Line current, (-400% ... 0 ... +400%	Line current, (-400% ... 0 ... +400%	Speed ref., -200% ... 0 ... +200%	Speed ref., -200% ... 0 ... +200%
2		3-4	Torque ref., -400% ... 0 ... +400%	Speed actual, -200% ... 0 ... +200%	Torque ref., -400% ... 0 ... +400%	Speed actual, -200% ... 0 ... +200%

Configuration →	AO No.	Terminal -X7:↓	05.29 SELECT_A = 0 05.30 SELECT_B = 0 14.30 TWIN_OVL = 1	05.29 SELECT_A = 0 05.30 SELECT_B = 1 14.30 TWIN_OVL = 1	05.29 SELECT_A = 1 05.30 SELECT_B = 0 14.30 TWIN_OVL = 1	05.29 SELECT_A = 1 05.30 SELECT_B = 1 14.30 TWIN_OVL = 1
1		1-2	Line current, (-400% ... 0 ... +400%	Line current, (-400% ... 0 ... +400%	Speed ref., -200% ... 0 ... +200%	Speed ref., -200% ... 0 ... +200%
2		3-4	Torque ref., -400% ... 0 ... +400%	Load of own hoist in units	Torque ref., -400% ... 0 ... +400%	Load of own hoist in units

- Pulse encoder interface**

-X8:1 Channel A

-X8:2 Channel A

-X8:3 Channel B

-X8:4 Channel B

-X8:5 Channel Z

-X8:6 Channel Z

-X8:7 Supply 24 V DC: +

-X8:8 Supply 24 V DC Ground

The Pulse Encoder inputs are differential. If a single ended output encoder is used, connect terminals -X8:2 and -X8:4 to -X8:8 (Ground)

Interface RS 232 for smart transducers

(Only for applications with approval from ABB)

Port #1: -X14:1, :2 and :3

Port #2: -X15:1, :2 and :3



Hint: Use the EXCEL "Interface_generator_xx.xls" of the Tool software to easily get the actual signal list for a particular application. xx is a number 01 - 99.

2.2.3. Cabin I/O Module connection

3ASC25H221 Cabin I/O Module DAPM 100, **3ASC25H239** Cabin I/O Module DAPM 101

The modules have fixed as well as configuration dependent connections. Plastic case. Max. +55 °C. Metal case, extension code +HD, max. +70 °C.

- **Supply 24 V DC:**
+ on -X1:1 and :3
Ground on -X1:2 and :4
- **Information channel 1**, Fiber connection.
- **Information channel 2**, Fiber connection. Only for DAPM 100.
- **Digital Out** (LED-display): -X21 (System cable).
- **Digital In** (from Master switch)
Fixed: +24 V DC: -X3:5 and -X4:5 (to Master switch)
Configuration dependent:

Configuration → Terminals:↓	05.03 DRI_TYPE=11 05.04 L_SW_TYP=1	05.03 DRI_TYPE=11 05.04 L_SW_TYP=2	05.03 DRI_TYPE=12 05.04 L_SW_TYP=1	05.03 DRI_TYPE=12 05.04 L_SW_TYP=2
-X3:1	Master switch in zero position			
-X3:2	Dir. A (≅Up)			
-X3:3	Dir. B (≅Down)			
-X3:4	Bypass speed limit of low load	HH/LL limit switch overrun	.....	HH/LL limit switch overrun
-X4:1	Step 2			
-X4:2	Step 3			
-X4:3	01.03 MACROMOD#3 14.25 NOM_LOAD=0: Step 4 (only for 5-0-5 not connected for 4-0-4 step Master switch)		Second Motion Selected	Second Motion Selected
	01.03 MACROMOD#3 14.25 NOM_LOAD>0 Tare of load shown on display, as the load functions are used			
	01.03 MACROMOD=3: Additional condition to change macro.			
-X4:4	Step Full speed			

Configuration → Terminals:↓	05.03 DRI_TYPE=21	05.03 DRI_TYPE=22
-X3:1	Master switch in zero position	
-X3:2	Dir. A	
-X3:3	Dir. B	
-X3:4	Step for free brake	Step for free brake
-X4:1	Step 2	
-X4:2	Step 3	
-X4:3	01.03 MACROMOD#3: Step 4 (only for 5-0-5 not connected for 4-0-4 step Master switch)	
	01.03 MACROMOD=3: Additional condition to change macro.	
-X4:4	Step full speed	



Hint: Use the EXCEL "Interface_generator_xx.xls" of the Tool software to easily get the actual signal list for a particular application. xx is a number 01 - 99.

- **Analogue In** (from Master switch)

Fixed: Reference Voltage + 10 V: -X6:1 (to Master switch)

Reference Voltage - 10 V: -X6:2 (to Master switch)

Reference Voltage Analogue Ground: -X6:3 and :4 (to Master switch)

Configuration dependent:

Configuration → Terminal -X5:↓	05.03 DRI_TYPE=11	05.03 DRI_TYPE=12	05.03 DRI_TYPE=21	05.03 DRI_TYPE=22
1	AI Reference -10 +10 V			
2	Common to -X2:1			
3	Load cell signal	AI Reference -10 +10 V	Load cell signal	AI Reference -10 +10 V
4	Common to -X2:3			

- **Analogue Out**

Fixed:

Configuration → Terminal -X2:↓	
1	Load in % of the hoists nominal capacity, (-200% ...)0 ... +200%
2	Common to -X2:1
3	Speed, -200% --- 0 --- +200%
4	Common to -X2:3



Hint: Use the EXCEL "Interface_generator_xx.xls" of the Tool software to easily get the actual signal list for a particular application. xx is a number 01 - 99.

2.2.4. Speed feedback Module connection

3ASC25H211 Feedback Module DADT 100

-X1 terminal to rotor of motor.

-X1: 1, 2, 3:

Maximal **rated** rotor voltage: 600 V AC 50 / 60 Hz

-X1: 11, 12, 13:

Maximal **rated** rotor voltage: 300 V AC 50 / 60 Hz

The unit must be properly connected to ground.

-X2:1, 2, 3 with fitted cable to Control System Module DARA 1001 and 1010.

2.2.5. Overvoltage protection Module

3ASC25H272, 3ASC25H273, 3ASC25H274 and 3ASC25H275 Overvoltage protection DASG 218, DASG 219, DASG 220 and DASG 221

- Line connection: L1, L2, L3.
- Status Supply phases OK: -X1: 11 to :12 closed
- Fused terminals for connection of Voltmeter: -X1: 1(L1), :2(L2) and :3(L3)

3ASC25H276, 3ASC25H277 Overvoltage protection DASG 222 and DASG 223

- Line connection upstream contactor: L1, L2, L3.
- Line connection downstream contactor: L11, L21, L31.
- Status Supply phases OK: -X1: 23 to :24 closed
- Fused terminals 25 A for connection of Voltmeter upstream contactor: -X1: 1(L1), :2(L2) and :3(L3)
- Fused terminals 2 A for connection of Voltmeter downstream contactor: -X1: 4(L1), :5(L2) and :6(L3)

2.3. Crane power and control voltage

One potential system design for the electrical equipment of a crane fed by a bus system is shown below. **This suggestion must always be adapted to the supply type, power, regulations and other circumstances.**

The names of some devices are underlined. These terms are the same as are used in EN 60204-32. The reader should consult EN 60204-32 for proper selection of these devices.

Switches:

- S00 Crane-supply-switch. For disconnecting (isolating) the collector wires or collector bars .. to which the hoisting machine(s) is (are) connected from the incoming supply for repair and maintenance works (e.g. on the collector wires to the hoisting machine(s)); and where required for emergency stop and/or emergency switching off.
- S0 Isolator. This item is only recommended if more than one crane is supplied from the same bus.
- Q1 Crane disconnecter. Generally a hoisting machine shall be equipped with a single crane-disconnector to enable the electrical equipment to be isolated for maintenance and repair purposes, and to prevent unexpected start-up during mechanical work on the hoisting machine. For ASTAT controlled cranes, whose with medium voltage supply and transformers on the crane can have a solution with crane disconnecter on the LV-side(s).
We recommend using HRC-fuses in favour of circuit breakers as far as possible due to the current limiting capability (Personal safety), longer life and the high availability of HRC-fuses.
- S1 Switch for Motion and auxiliary drives.
- S10 Back-up Switch / isolator for -S1, if needed.
- S2 Switch for control voltage.
- S20 Back-up Switch / isolator for -S2, if needed.
- S3 Special circuits switch, such as lighting and heating.
- S30 Back-up Switch / isolator for -S3, if needed.
- S100 Emergency push-button; or a series of emergency tripping devices, like an independent mechanical top limit switch for hot metal cranes or other cranes there such a device should be used. Two sets closed contacts when not emergency off.
- S101 Crane OFF push-button / key switch. Closed when not off.
- S102 Crane ON push-button. Open when not pressed.
- S103 Fault RESET push-button. Open when not pressed.

Contactors, relays:

- K1 Crane-switch, a contactor, which can be chosen as the true thermal sum of the thermal current of the motions, and an ultimate emergency breaking capacity for the all motions running at the same time, and the largest motion stalling. The normal starting and stopping of slip-ring motors is made by semiconductor control, not by this contactor.
Practically the sum of all motors 100% c d f value currents and contactor duty AC1 is appropriate. Compensate a higher adjacent temperature than +40 °C to reduce the AC1 value of the preliminary chosen contactor with 1,25% per degree C above 40 °C.
 - K101 Relay with a number of NO contacts: One / each ASTAT + One for -K1.
If -K101 is omitted, and -K1 cuts the power to the ASTAT without an OFF by -K101, ASTAT will interpret the situation as a line voltage drop.
 - K102 Relay with a number of NO contacts: One / each ASTAT. For fault reset without making Crane on.
- D1D08, D2D08, D3D08 ..
Digital Output no. 8 of the different ASTAT can be used for emergency trip if the brakes continue to indicate open even after order to close, if the motion is stopped by emergency stop rather than soft electrical braking or if there is a detection of overspeed.
This function is not available for Shared motion drives.

Overvoltage protection:

- Z1 Overvoltage Protection:
 - 380 - 400 V AC, DASG 218,
 - 415 V AC, DASG 219
 - 440 - 480 V AC, DASG 220
 - 500 - 600 V AC, DASG 221.
 - Function 1: Capacitive surge arrestor
 - Function 2: Monitor of phase fall out.
 - Function 3: Varistors between phases

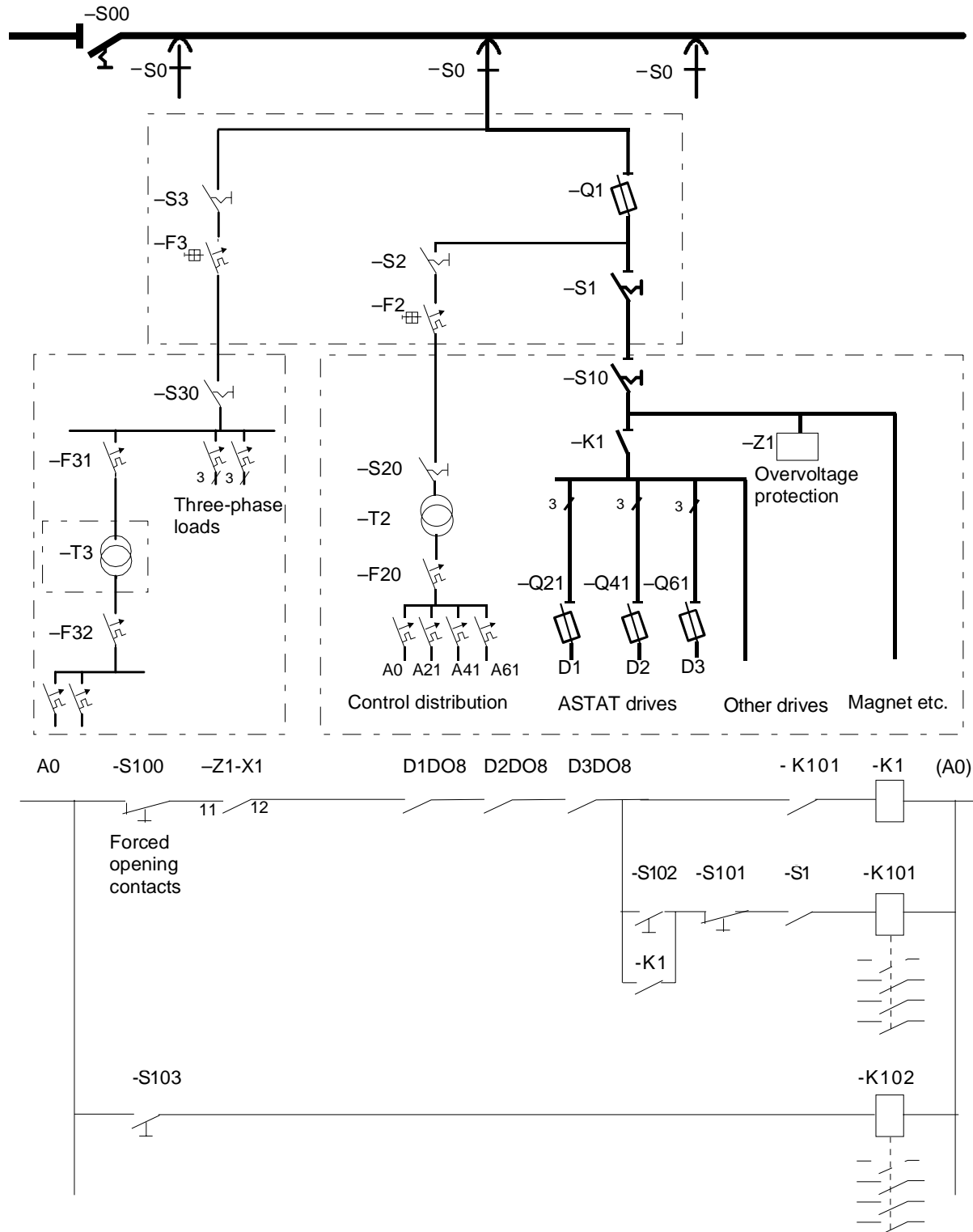
Transformers:

- T2 Transformers for Auxiliary and control voltage.
- T3 Transformer for Special circuits.

See advice for transformer design below.

Fuses and breakers:

- F2 Primary protection (Verify the short circuit capacity!) for cable and Control Voltage transformer -T2.
- F20 Secondary protection (thermal overload) of Control Voltage transformer -T2.
- F3 Current limiting circuit breaker to enable an adequate cable section from crane disconnection box to E-room and serve as back up for MCB -F31.
- F31 Primary protection (short circuit) of transformer -T3.
- F32 Secondary protection (thermal overload) of transformer -T3.
- Q21.. Supply to ASTAT thyristor modules can be done with three fuses in a fuse switch. Size and characteristic for each ASTAT is given below. If semiconductor fuses are used; a thermal relay for the cable is mandatory. This relay can be installed downstream the ASTAT controller. Supply to 630 A, 1000 A and 1100 A ASTAT thyristor modules with integrated semiconductor fuses can be done with circuit breakers with built in thermal and magnetic releases.



2.3.1. Main fuses and breakers

ASTAT Thyristor module current	Fuses ²
25 A	3 * 50 A gL-gG, 500 V or 690 V. Any size.
50 A	3 * 80 A gL-gG, 500 V or 690 V. Any size.
100 A	3 * 200 A aR, 500 V or 690 V. Size DIN 1.
200 A	3 * 350 A aR, 500 V or 690 V. Size DIN 2.
355 A, ≤ 600 V	3 * 550 A aR, 500 V or 690 V. Size DIN 3.
330 A, 690 V	3 * 550 A aR, 690 V. Size DIN 3.
500 A	3 * 710 A aR, 500 V or 690 V. Size DIN 3.
630 A, ≤ 600 V	3 * 800 A gL-gG, 690 V. Size DIN 3. 3 * 800 A aM, 690 V. Size DIN 3. Circuit breaker is allowed.
600 A, 630 A, 690 V	3 * 800 A aM / gL-gG, 690 V. Size DIN 3. Circuit breaker is allowed.
1000 A, ≤ 600 V	3 * 1250 A aM / gL-gG, 500 V. Size DIN 4/4a. 3 * 2// 800 A aM / gL-gG, 500 V. Size DIN 4. 3 * 2// 630 A aM / gL-gG, 500 V. Size DIN 3. Circuit breaker is allowed.
850 A, 690 V	3 * 1250 A aM / gL-gG, 690 V. Size DIN 4. 3 * 1000 A aM / gL-gG, 690 V. Size DIN 4a. 3 * 2// 630 A aM / gL-gG, 690 V. Size DIN 3. Circuit breaker is allowed.

For 600 A, 630 A, 850 A, 1000 A and 1100 A sizes, the Semiconductor fuses are part of ASTAT.

In some installations all fuses are substituted by circuit breakers due to the minimal risk for short circuit in an ASTAT. It should not be forgotten that ASTAT produces harmonics during low speed operation, and that the selected circuit breaker must permit these harmonics of 5th, 7th, 11th, 13th.... order without tripping. If there is any uncertainty about the function of the circuit breaker, install fuses.

² Fuses with lower rated current are recommended to reduce short circuit power if the characteristic match the working current.

2.3.2. Control and auxiliary transformers

2.3.2.1. Control transformer -T2

2.3.2.1.1. Size

The control transformer, T2, is used for ASTAT control power, coils, radio remote controllers and other electronic equipment. The commonly used sizes are 2 kVA -10 kVA (110 V) or 20 kVA (220 V). Transformers smaller than 2 kVA are not recommended as the short circuit voltage might be too low with risk for non-satisfactory tripping conditions for MCBs and voltage drop for coils.

In the range 2 - 20 kVA a normal short circuit voltage is 4%.

The size in kVA is mainly given by the **Pull-in power** of the largest contactors that are energized at the same time. Normally it is one of following factors that will decide the size of the transformer:

- Main contactor(s) of the crane
- Contactor of main hoist; if two motors are used for main hoist this should be considered
- Four contactors of a large four-corner crane travel motion

The holding power for contactors is small compared with Pull-in. Also the thermal power of ASTAT control power, radio remote controllers and other electronic equipment is very small compared with Pull-in of contactors. Chose a transformer so the voltage drop is maximally 5% in the most critical situation.

ASTAT works in the way that no rotor contactors are pulled if the main contactor is not already pulled, and if two rotor contactors for the same motor should be closed, there is a short time separation between the operations of the different contactor coils.

If the transformer size tends to grow larger than 10 / 20 kVA, DC-coils for the largest contactors will help to reduce the size due to their lower Pull-in power in kVA.

Practically, the discussion above leads mostly to a selection of a 2 kVA transformer for cranes with a main contactor of maximally 300 A.

2.3.2.1.2. To consider

Electrical networks of today are not clean. Of this reason we recommend to select the Control transformer - T2, with EMC-shield between the primary and secondary windings. This shield shall be adequately grounded.

A primary varistor protection is always recommended.

For installations in mills with ≥ 500 V AC systems with electrical steel melting of any form or frequency converters of significant size we recommend an output filter on the transformer.

Do never look for a contactor with low pull in power to get a smaller transformer. Normally a contactor with high pull in power has good operation times.

2.3.2.2. Special circuits transformer -T3

2.3.2.2.1. Classification of Special circuits

The transformer for Special circuits, T3, is used for ASTAT control power, coils, radio remote controllers and other electronic equipment.

Most times it is made as a single-phase transformer, but for larger cranes or if a three phase system with neutral is needed, it can be made as a Dy0-transformer.

EN60204-32: "Circuits that shall not be disconnected during repair and maintenance work are regarded as special circuits...."

NOTE - Special circuits may be the following:

- circuits for socket-outlets and lighting circuits;
- circuits for lifts, repair tools and repair cranes installed in hoisting machines;
- circuits for air conditioning and ventilation
- circuits for electrical equipment fulfilling safety measures, e g anti-collision device, aviation lighting;
- circuits for fire alarm systems

It can be seen from the list, that "Special circuits" can contain important electronic equipment.

2.3.2.2.2. To consider

Electrical networks of today are not clean. Of this reason we recommend to select the Transformer -T3, with EMC-shield between the primary and secondary windings. This shield shall be adequately grounded.

A primary varistor protection is always recommended.

For installations in mills with ≥ 500 V AC systems with electrical steel melting of any form or frequency converters of significant size we recommend an output filter for the MCBs for the most sensitive on the transformer.

2.4. Motor cable thermal relay

The motor cable relay(s) shall thermally protect the cables from the Power distribution through the ASTAT to the Rotor resistor. For short circuit protection of the same cables, either the fuses/breaker -Q21 along with the integrated semiconductor fuses of ASTAT or the fuses of -Q41 described above are in most cases sufficient also for branching cables to more than one motor; if not the motor cable thermal relays must have an additional magnetic trip function.

The thermal relays for a single motor motion are installed before or after the ASTAT, while for a motion with more than one motor always after the ASTAT. A thermal protection before ASTAT can be a function of a circuit breaker.

Criterion 1 and 2 below must always be fulfilled, while Criterion 3 only is valid for motors without embedded PTC-sensors.

Criterion 1

The rated stator current of a motor is $I1N$ [A]. The rated rotor current of the same is $I2N$ [A].

The used stator cable has in this installation a current carrying capability of $IC1$ [A]. The used rotor cable has in this installation a current carrying capability of $IC2$ [A].

The setting of the cable relay shall not be higher than the lowest value of $IC1$ [A] and $(\frac{I1N}{I2N} * IC2)$ [A]. If the value is too low to operate the motion without trip, the cable section or type must be improved.

Criterion 2

Check the setting of the relay against the starting / stopping current. The setting of the relay should typically allow 2,5 - 3 times the rated current $I1N$ [A] of the motor for a time at 5 - 10 seconds at warm state.

If the relay setting gives a tripping risk at normal conditions, the setting must be higher and eventually the stator and rotor cable's section or type must be improved.

Criterion 3

When the motor has no embedded PTC, the cable relay is better than no thermal protection at all.

Get the $S3 - 100\% = S1$ rated stator current of a motor, $I1N_{100\%}$ [A].

Recalculate the $I1N_{100\%}$ capability to the actual service ambient temperature, Θ [°C], $I1N_{100\%_{\Theta}}$ [A].

The setting of the cable relay shall not be higher than $I1N_{100\%_{\Theta}}$ [A]. If the relay setting gives a tripping risk at normal conditions, the setting must be higher and the stator and rotor cable's section or type might have to be improved.

2.5. Motor

Cast iron frame, or machines made of welded steel designed particularly for crane duty are recommended. Embedded PTC-elements³ for thermal protection shall be used. Use (normal) motors acc. IEC 60034-1 to fulfil IEC 60204-32, Safety of Machinery, Electrical equipment of machines, Requirement for hoisting machines.

Slip-ring motors for cranes are tabulated by the manufactures for different duty classes and c. d. f. Of this reason the motor selection for ASTAT is simple.

Travel motors are mostly not critical at all with respect for moment of inertia, while opposite is valid for hoist motors. A motor with too high moment of inertia requires an expensive cabling and power supply to achieve an acceptable rate of acceleration.

Larger motors are best designed for high temperature, rather than using catalogue motor with base +40 degree and reduction factors.

ASTAT duty corresponds to the duty class S3.

³ According to EN 60664 the thermistor requires doubled or reinforced isolation to live parts of the motor.

Duty class S5 requirement leads to a motor with lower CosFi and higher inertia. The losses are higher, and the equipment in form of transformer, current supply, ASTAT, resistor and cables and also air conditioning, must be unnecessarily larger. For new installations S5 should never be used. For modernisations where duty class S5 motors are installed, the motor power can be recalculated to S3 (approximately) and the equipment designed based on that situation.

To design a motion control system following data is necessary:

Rated power, Rated speed, Pullout torque, Stator voltage and frequency, Stator current and Rotor current. If unknown the Pullout torque can be estimated to 250% of the nominal.

With ASTAT, there is no need to use special insulation systems or electrically isolated bearings.

Contact ABB Crane Systems for an optimal motor selection.

2.6. Speed feedback device

ASTAT always work with speed feedback, although it can be configured for Acceleration control. In this case the speed is needed to set the brake, and to model the torque actual value.

The speed feedback device can be static or rotary:

2.6.1. The motors own slip-rings

The slip-ring motor itself is used for feedback, together with the **DARA 1001 or DARA 1010**. The rotor voltage is connected to the Feedback Module DADT 100, and the frequency of the rotor is measured, which together with the other internal variables is used to obtain the motors slip, and subsequently also the speed. This method is statically accurate for very low |speed|. For high |speed| it is supported by suitable open control functions which do not require any measured feedback.

If speed control is required outside the region $-85\% < n < +85\%$ the static feedback method should not be used.

2.6.2. Rotary with Analogue tachometer

If there is no other requirement desired, this is the most economical and least sensitive to mechanical and installation problems among the rotary types. Use $U_{TG} = 60 \text{ V} / 1000 \text{ rpm}$ when possible, as this is the most stocked.

If $U_{TG} * N_{MAX} > 100 \text{ V}$, there N_{MAX} is the fastest speed which you still wish to measure, typically for over-speed monitoring, connect an external resistor in serial with the tachometer.

For $U_{TG} * N_{MAX} \leq 200 \text{ V}$ connect $300 \text{ k}\Omega / 1 \text{ W}$.

For $U_{TG} * N_{MAX} \leq 300 \text{ V}$ connect $600 \text{ k}\Omega / 1 \text{ W}$.

2.6.3. Rotary with pulse-encoder

Can be used when also the number of pulses is of interest for monitoring or position measurement. The encoder is supplied by ASTAT with 24 V DC (dual channel type, no zero track or inverse channels needed). Consider Analogue tachometer as an alternative as the installation of an analog tachometer both electrical and mechanical is less critical.

Monitoring combinations of the above are possible, and are set up with Parameters of Group 7, SPEED FEEDBACK.

2.7. Brake

The brake should never be additionally controlled by any PLC, "brake control device" or similar. It is important that the DO of the ASTAT directly controls the brake, as the brake control is an integrated part of the real time motion control with 3 ms resolution.

ASTAT can handle both thruster ("Eldro") brakes by one DO relay-contact, and a solenoid DC-brake by using two DO relay-contacts to first connect the coil and then to connect an economy resistor, or to change the solenoid connection from "halves in parallel" to "halves in serial" after a set time.

A modern well-maintained brake of most types will open in 150 ms, and be closed in the same time after removal of electrical power. Although ASTAT contains support functions for slow action brake, it is our recommendation to always keep the mechanical brake in good shape, as it gives the crane its final safety.

To assure that the brake is immediately closed in case of removal of power to the ASTAT (EN 60204-32: 15.7), an integrated three-phase branching power supply for the brake is included. The short circuit current is limited to about 0 - 3 kA (5 kA for 1000 A thyristor module) at these terminals, allowing an economical choice of MCB and contactor for the brake. Of this reason for example the MCB S263 of ABB can be used where the voltage permits. This supply additionally saves cables.

At emergency stop the main contactor -K1 of the crane and the service brake contactor of the motion will be opened independently by each other, given that the recommendations in this Manual are followed.

The main contactor -K1 can be tripped by any of the different ASTAT without manual action if the brakes continue to indicate open even after order to close, or if there is a detection of overspeed. **This function is only available from software version AST10_02. It is not available for Shared motion drives.**

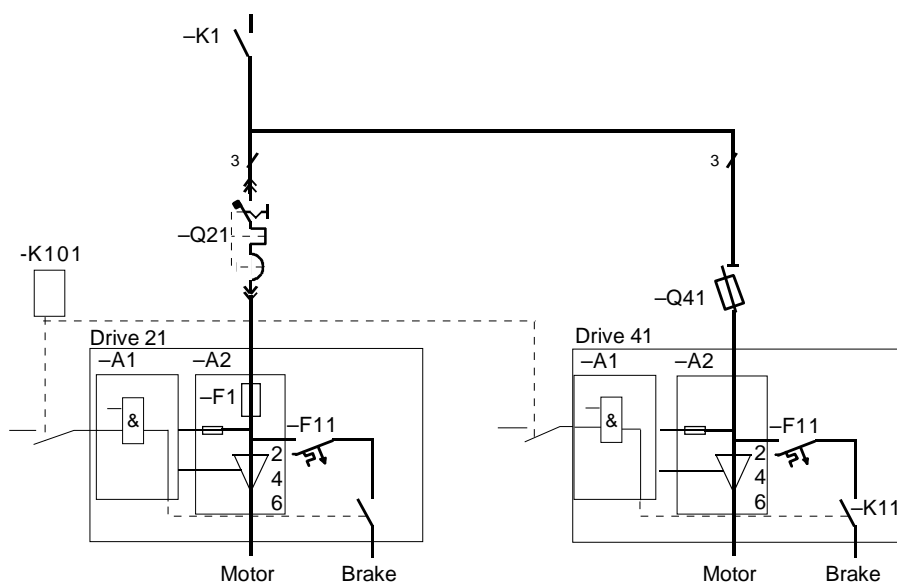
In the examples below, 2, 4 and 6 are the branched brake output from ASTAT, -K11 is the Brake-lifter contactor, while -K12 is the Delayed brake-lifter; for DC-brake hold current.

Motion 21 is a drive with integrated fuses, -F1 etc., in the thyristor module (size 630 A or 1000 A), while drive 41 is smaller with external fuses, -Q41. For both drives the brake will be set by ASTAT, as the Control system module -A1 measures the voltage after the main fuses (externally or internally mounted).

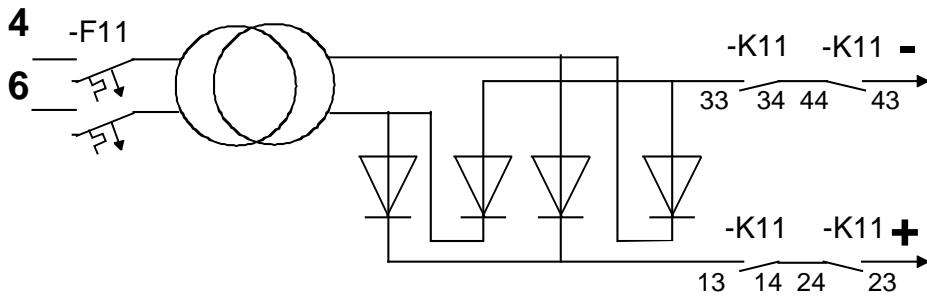
In case of that the main contactor -K1 is welded at emergency stop, the service contactors -K11 will act without delay as the stop relay -K101 also is tripped in case of emergency stop.

A brake open limit switch of robust type or none at all is recommended.

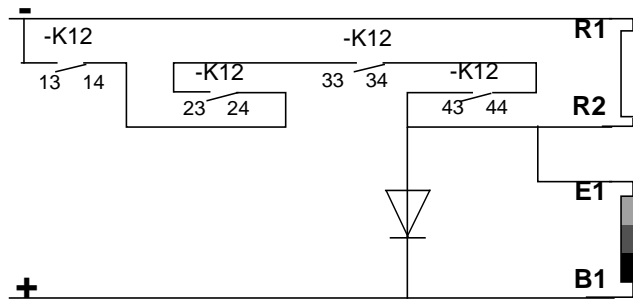
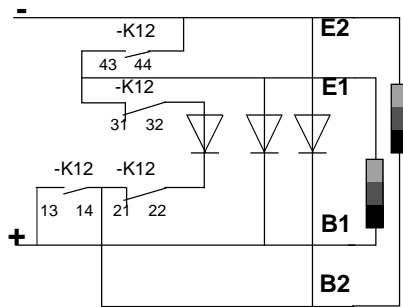
AC thruster brake connection



DC brake connection:



For both foreseen types of DC-brakes, a DC-supply source must be arranged. It is possible to select Diodes that withstand short-circuit current based on the selected transformer and MCB.

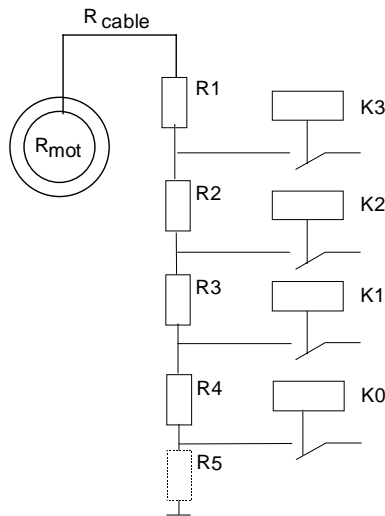


Left: Change of the solenoid connection from "halves in parallel" to "halves in serial" after a set time.

Right: connect an economy resistor.

2.8. Rotor resistor

For most motions the resistor based on the guidelines in this section can be chosen. For optimisation of installations with larger number of cranes or for larger motors ABB can assist.



The meaning of the left figure is:

$$\Sigma R1 = f(R_{mot} + R_{cable} + R1)$$

$$\Sigma R2 = f(R_{mot} + R_{cable} + R1 + R2)$$

$$\Sigma R3 = f(R_{mot} + R_{cable} + R1 + R2 + R3)$$

$$\Sigma R4 = f(R_{mot} + R_{cable} + R1 + R2 + R3 + R4)$$

$$\Sigma R5 = f(R_{mot} + R_{cable} + R1 + R2 + R3 + R4 + R5)$$

where:

R2 etc. is the Ohmic value of the resistor element R2 installed

$\Sigma R2$ etc. is the percentage value of made by:
 $(R_{mot} + R_{cable} + R1 + R2) / \text{Unity resistance}$.

The Unity resistance is the resistance that will hold the motor at zero speed with nominal load and nominal voltage.

R_{mot} is the rated slip part of the motors unity resistance

R_{cable} is the resistance of the cable from motor to resistor

For different types of movements the below suggested resistor values will give trouble-free performance in most situations:

The values in the table are expressed percent of the motors unity resistance, R100' (see below). Movement	$\Sigma R1$	$\Sigma R2$	$\Sigma R3$	$\Sigma R4$	$\Sigma R5$	Reference figure no.
Hoists, small motor or with large torque margins	None	12	40	60 to 65	None	1
Hoist	8	18	38	60 to 65	None	2
Hoist, without super-synchronous braking and lowering heavy load	8	18	38	60 to 65	100	3
Indoors travel. Top speed normally is about 90% of synchronous. Minimises cabling. No contactors. Can be placed on trolley or near each corner motor. Recommended. If top speed is critical: select one size larger motor and change gear ratio.	None	None	30	None	None	4
Travel	None	12	40	None	None	5
Balanced luff / jib	None	None	30	None	None	4
Luff / jib in general	None	12	40	None	None	5
Slewing	None	12	40	None	None	5

The star point of the resistor must be available for control with DARA 1001 and DARA 1010.



Hint: Use the EXCEL "Resistance_checker_xx.xls" of the Tool software to easy get the optimal resistance values for a particular motion. xx is a number 01 - 99.

Reference figures:

The reference figures explain how the parameters of Group 12 are related to the main circuit diagram, and which digital output relay of the DARA 1000, 1001 or 1010 that is connected to a certain rotor contactor.

Figure no. 1

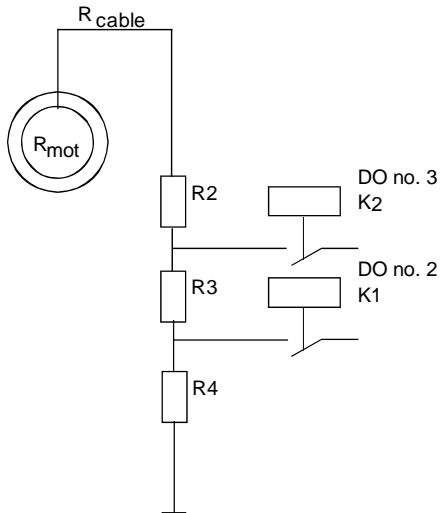


Figure no. 4

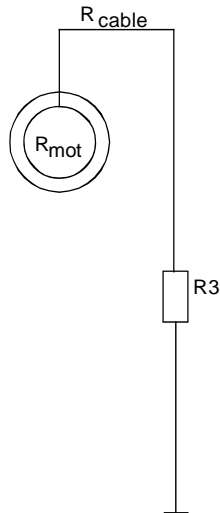


Figure no. 2

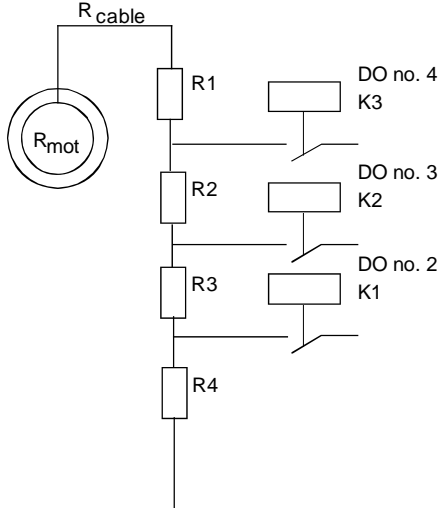


Figure no. 5

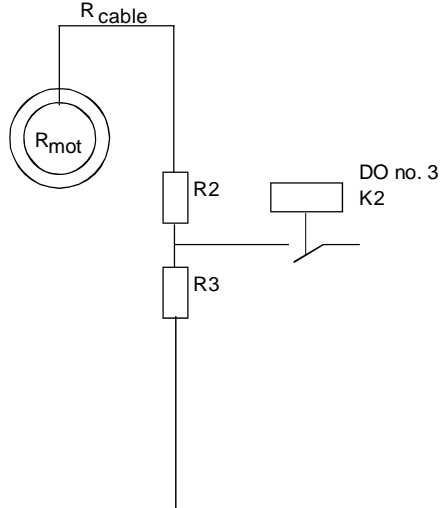
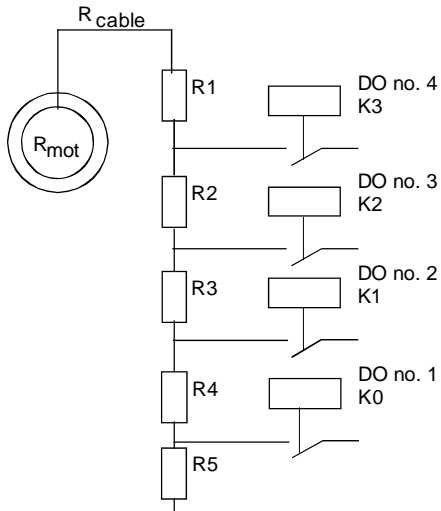


Figure no. 3



For all steps, except the lowest ΣR_i -resistor value, the resistor current value could be reduced due to low intermittence factor, but this is not recommended as this depends on the driver's performance.

Calculation step by step and an Example:

Step 1 $R_{100'} = \frac{1000 * P_n}{3 * I_2^2 * (1 - \frac{s_n}{100})} [\Omega],$

P_n : Rated motor power [kW]
 s_n : Rated motor slip [%]
 I_2 : Rated motor rotor current [A]

Step 2 $R_{mot} = s_n * R_{100'} [\Omega]$
 Normal magnitude of $s_n \approx 1$ to 4 %. The value is lower for larger motors.

$R_{cable} = R_{Cu_{Rotorcable}} [\Omega]$
 Normal magnitude $R_{cable} \approx 0,5 \% * R_{100}'$

Step 3 A For lowest ΣR_i -resistor value larger than 0:

$R_i = \frac{\Sigma R_i * R_{100}'}{100} - R_{mot} - R_{cable} [\Omega]$

Step 3 B For other than lowest ΣR_i -resistor value larger than 0,
 if it exists:

$R_j = \frac{\Sigma R_j * R_{100}'}{100} - R_{j-1} [\Omega]$

Step 4⁴ The power rating of the resistor, expressed as dimensioning current for continuous duty:

110% for of I_2 .

Step 5 For hoists: Use steel grid resistors with $\pm 10\%$ **total** resistance deviation from the nominal.

For travels and slewing:
 Use steel grid resistors with $\pm 10\%$ **total** resistance deviation from the nominal or -10% +30% total resistance deviation from the nominal.

Example:

One motor with is used as Hoist
 P_n : Rated motor power 24,6 kW
 s_n : Rated motor slip 2,0 %
 I_2 : Rated motor rotor current 64 A

$R_{100'} = \frac{1000 * 24,6}{3 * 64^2 * (1 - \frac{2}{100})} [\Omega], = 2,05 \Omega$

$R_{mot} = 2 \% * 2,05 [\Omega]$

$R_{cable} = 0,5 \% * 2,05 [\Omega]$ (after checking Length, Section, Temperature or based on experience)

For lowest ΣR_i -resistor value larger than 0:
 This value is ΣR_1 with the value 8 in the table.
 $R_1 = ((\Sigma R_1 - R_{mot} - R_{cable})/100) * R_{100}' [\Omega] =$
 $R_1 = ((8 - 2 - 0,5)/100) * 2,05 [\Omega] = 0,113 \Omega$

Next value larger than 0 is ΣR_2 with the value 18.
 $R_2 = ((\Sigma R_2 - \Sigma R_1)/100) * R_{100}' [\Omega] =$
 $R_2 = ((18 - 8)/100) * 2,05 [\Omega] = 0,205 \Omega.$

Next value larger than 0 is ΣR_3 with the value 38.
 $R_3 = ((\Sigma R_3 - \Sigma R_2)/100) * R_{100}' [\Omega] =$
 $R_3 = ((38 - 18)/100) * 2,05 [\Omega] = 0,410 \Omega.$

Next value larger than 0 is ΣR_4 with the value 65.
 $R_4 = ((\Sigma R_4 - \Sigma R_3)/100) * R_{100}' [\Omega] =$
 $R_4 = ((65 - 38)/100) * 2,05 [\Omega] = 0,554 \Omega.$

R_1, R_2, R_3 and R_4 are for 110% of 64 A continuously = 70 A.

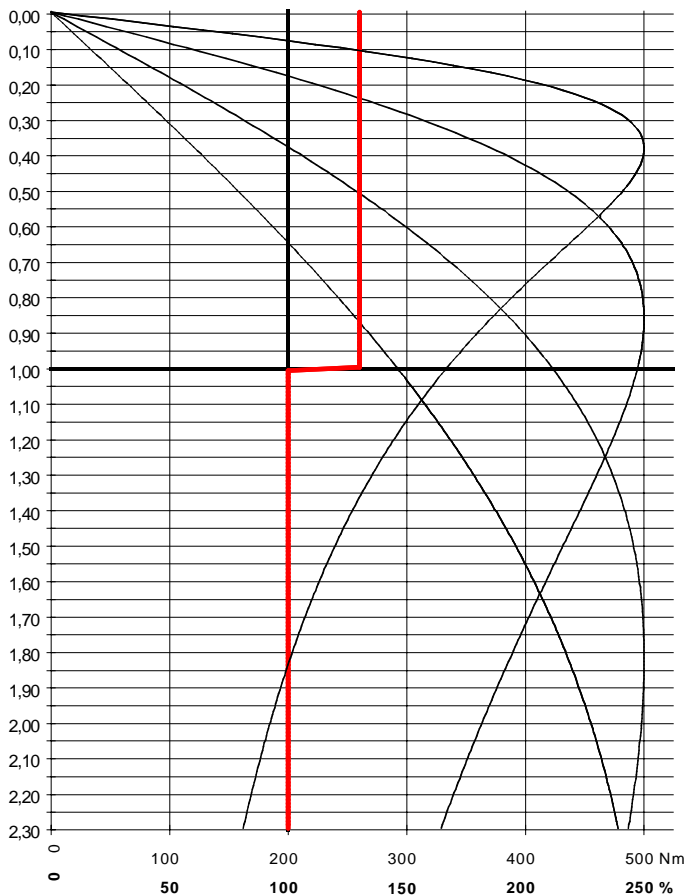
The resistors are ordered with max. $\pm 10\%$ **total** resistance deviation from the nominal. The lowest and highest ambient temperature are specified in the order of the resistor.



Hint: Use the EXCEL "Resistance_checker_xx.xls" of the Tool software to easy get the optimal resistance values for a particular motion. xx is a number 01 - 99.

⁴ Recommendation changed for AST10_03A

For the hoist motor used in the above example, the resistors steps give the following characteristics at nominal line voltage and unlimited current. For understanding is also added the hoisting torque requirement including the acceleration torque (assumed to 130 % of the nominal torque) and the braking torque (assumed to 100 % of the nominal torque). The used motor has a rated torque of 200 Nm, with a pullout torque of 250 % of the nominal; which is a normal value.



If the torque limits (see section FUNCTIONS) are set to 130% and 100% and the actual line voltage is 100% of the nominal, the ASTAT will from start with K1 closed in direction up, close K2 at about slip 0,50, corresponding to 50% of the synchronous speed, and close K3 at about slip 0,25, corresponding to 75% of the synchronous speed. At a lower line voltage the closing would be earlier.

Starting in the lowering direction, the contactor K1 and the other contactors are open.

If super-synchronous regeneration is selected (normally it is for a hoist), at approximately 50% speed (reached from standstill) ASTAT internally gives an additional speed reference ordering the motor to drive down with about 150% speed. In this situation the K3 will close and minimise the rotor resistance and motor's speed will be locked going down by the line supply frequency at a speed only slightly higher than the synchronous.

If regenerative mode of some reason is not selected, the motor will plug with the total resistance $R_1+R_2+R_3+R_4$ connected.

As seen in the chart, there is basically a very large margin between the constant speed torque, 200 Nm and the torque producing capacity (at least 460 Nm) at 100% line voltage. This margin is used as spare for reduced voltage, alternatively ASTAT drives can be used prior to other drives there short time high torque are required. The constant speed motor load should normally not exceed the nominal torque of the motor as it in this case

In the **REFERENCE SECTION** different examples of Speed-torque diagrams are included. For detailed studies, an Excel-file is included on the ASTAT Tools CD.

2.8.1. Star point resistor

For control with DARA 1001 and DARA 1010 the star point ("the neutral") of the resistor must be connected to solid ground through a resistor R_Y . The motors rated Rotor Voltage is U_2 [V]

Data for R_Y : Resistance: $R_Y = 50$ to 150 kOhm.

Working voltage: $U_{WVR} = 2 * U_2$

Power: $\frac{(2 * U_2)^2}{R_Y}$

Example: A motor with a rated rotor voltage of 340 V is speed control by rotor voltage feedback.

Select and install a resistor between the resistors star point and solid ground with following data:

Resistance: $R_Y = 100$ kOhm. Resistors working voltage: 750 V AC. Power: 10 W (the high power was selected to get a mechanically robust device; from heat up point of view 5 W was enough).

Recommendation: Use the resistor 3ASC531201A550, which is listed in the order table. This resistor includes wire tails and mounting holes for screw and it is easy to mount in the field.

2.9. Rotor contactor

The rotor contactors should never be additionally controlled by any PLC or similar. It is important that the DOs of the ASTAT directly control the rotor contactors, as the rotor control is an integrated part of the real time motion control with 3 ms resolution.

Selection and application recommendations:

- 1) Connect the contactors in Star, not in Δ . The Recommendation tables are based on Star connection.
- 2) All contactors are thermally considered as final short circuit rotor contactors. This compensates for the additional heat up of the contacts from short time low magnetisation and harmonics due to the primary thyristor control.
- 3) The closing operation of the contactors is made with rotor current.
Typical value: 1,0 - 1,5 times rated rotor current.
- 4) The opening operation of the contactors is made with zero rotor current.
- 5) Installation temperature is 55 degree C. Reduce the values below for 70 degree C.
- 6) The installations are many times made in panels in steel work cranes with conductive dust. All components in open panels must correspond to EN 60664, Pollution degree 4. We recommend keeping the contactors clean by installing these in a closed cubicle / box of reasonable size to avoid heat-up by their own losses, or to use robust contactors.
- 7) For good control properties a contactor with short opening time is **needed**, and short closing time is **desired**. Consider that the inrush coil current sizes the control transformer.
- 8) The lifetime of the contacts (electrical endurance) is calculated to be the same as the calculated lifetime of the contactors mechanical system (mechanical endurance).
- 9) For Δ -connected current capacity values, multiply the figures in the tables by 1,5 or 1,73, depending on the manufacturers recommendations. But, Δ -connection increases voltage stress (shorter life), the panel-wiring job is larger and the quality control measures of wire selection and tightening torque are stricter.
- 10) It is recommended to connect the contactor coil directly to the DO relay of the process I/O-board only for AC-coil-contactors with a pull-in current of 2 A or less. For larger AC-contactors and all DC-contactors a pilot relay shall be used.
Using ABB contactors, A75 is the largest size with 110 V AC coil and EH 145 (old range) / A 110 (new range) the largest size with 230 V AC coils still not needing a pilot relay.
- 11) The times below are for AC-coil-contactors. The times might differ slightly from catalogues values to match the real time control system of ASTAT.
- 12) The listed contactors from ABB and Schneider are made with conventional coils, while the contactors from Siemens are made with electronic magnet system.

2.9.1. Recommendation of ABB contactors

Duty	A 9	A 12	A 16	A 26	A 30	A 40	A 50	A 63	A 75	A 95	A 110	A 145	A 185	A 210	A 260	A 300	EH 370	EH 550	EH 700	EH 800	
$\leq 40\%$	22	27	35	52	56	61	78	100	120	150	170	276	300	373	410	468	617	812	975	1105	
60%	19	25	30	45	49	55	71	91	106	130	150	243	260	325	373	422	526	715	910	975	
Opening time, ms	20																				
Closing time, ms	40															60					
Operations Millions	10										5										
Pull in ⁵ power, VA	80		140			210			450		600		1550			2900		4000			
Max 3-phase rotor rated voltage when starting and with reverse current braking																					
Ur	(550) 600						(690) 730						(690) 1000								

Values in brackets are values for Δ -connection

⁵ at 60 Hz

2.9.2. Recommendation of Schneider contactors

Duty	LC1D09.7	LC1D12.7	LC1D18.7	LC1D40.7	LC1D50.7	LC1D65.7	LC1D80.7	LC1D95.7	LC1F115 + coil LX9FF...	LC1F150 + coil LX9FF...	LC1F185 + coil LX9FG...	LC1F225 + coil LX9FG...	LC1F265 + coil LX9FH...	LC1F330 + coil LX9FH...	LC1F400 + coil LX9FJ...	LC1F630 + coil LX9FL...	LC1F800.7
≤ 40 %	28	36	58	63	80	103	123	153	173	283	307	383	420	480	633	833	1133
60 %	26	31	51	57	73	93	109	133	153	250	267	333	383	433	540	733	1000
Opening time, ms	20	20	20	20	20	20	20	20	20	20	20	20	30	30	50	50	180
Closing time, ms	20	20	20	40	40	40	40	40	40	40	40	40	60	60	60	60	80
Operations Millions	15	15	15	6	6	6	4	4	10	10	10	10	10	10	10	5	5
Pull in ⁶ power, VA	70	70	70	245	245	245	245	245	660	660	970	970	660	660	500	830	1700

	Max 3-phase rotor rated voltage when starting and with reverse current braking	
Ur	(550) 690	(690) 1000

Values in brackets are values for Δ-connection

2.9.3. Recommendation of Siemens contactors

Duty	3RT1023	3RT1024	3RT1025	3RT1026	3RT1034	3RT1035	3RT1036	3RT1044	3RT1045	3RT1046	3RT1054	3RT1055	3RT1056	3RT1064	3RT1065	3RT1066	3RT1075	3RT1076
≤ 40 %	23	23	23	39	50	61	55	100	111	111	154	176	203	274	329	329	439	604
60 %	23	23	23	35	44	55	50	89	99	99	137	156	181	247	294	294	393	540
Opening time, ms	20	20	20	20	30	30	30	40	40	40	100	100	100	100	100	100	80	80
Closing time, ms	20	20	20	20	20	20	20	20	40	40	60	80	80	80	80	80	100	100
Operations Millions	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Pull in ⁶ power, VA	69	69	69	69	120	166	166	232	300	300	300	300	300	590	590	590	830	830

	Max 3-phase rotor rated voltage when starting and with reverse current braking	
Ur	690	750

⁶ at 60 Hz

2.10. Driver's console

It is common to mount the Travel motions Master switches in the left console, and the Hoist(s) Master switches in the right console. For long- and cross travels, as well as for main and auxiliary hoists, universal (Cross type) Master switches could be used. The Master switches must be procured separately.

If a "normal" manually operated master switch is used, step references are generally better than analog references. The reasons for this are listed in **Section 4.8, Speed reference**.

Cabin I/O has DI of 24 V DC type, and a Master switch with gold-plated contacts or static contacts should be used.

ASTAT can be equipped with two different operator stations. Most common is one for cable-less control, and one back up station on the crane. The selection is made with one DI of the Control System module. Additionally the actuating relay or switch provided for this DI should show an indication to show which station that has the command.

For each separate motion one ASTAT Cabin I/O module is installed in the console. This unit requires a 24 V DC supply. For different Master switches the signals below can be used:

Master switch	Analogue type	Stepped type
Hoist and Travel	In Zero position	In Zero position
Hoist	Direction A (≡Up)	Direction A (≡Up)
Hoist	Direction B (≡Down)	Direction B (≡Down)
Travel	Direction A	Direction A
Travel	Direction B	Direction B
Hoist and Travel	AI: Reference	
Hoist and Travel		Step 2
Hoist and Travel		Step 3
Hoist and Travel		100% Reference
Hoist and Travel		Step 3 Between Step 3 and 100% Reference. Step 4 is normally not used.
Hoist and Travel	Macro selection	Macro selection
Travels	Free brake	Free brake
Hoist	Tare of load	Tare of load
Hoist	By-pass slack rope speed limit	By-pass slack rope speed limit

In case of a potentiometer type Master switch is used (not recommended), the ± 10 V reference voltage is available from the Cabin I/O module.

Close to each Master switch the Cabin indication unit, size about 80 *120 (H *W) shall be mounted. This unit and one 1 m long connection cable are parts of the Cabin I/O module. The indication unit is described in the section **OPERATOR INFORMATION SYSTEM**.

Except for the Master switches some devices are closely related to the ASTAT motion controllers:

- S100 Emergency push-button or a series of emergency tripping devices.
- S101 Crane OFF push-button / key switch. Closed when not off.
- S102 Crane ON push-button. Open when not pressed.
- S103 Fault RESET push-button. Open when not pressed.

These devices are described in the section **POWER AND CONTROL VOLTAGE DISTRIBUTION**.

2.11. Cables

2.11.1. Power

2.11.1.1. Short circuit check

Check the short circuit back up fuse or breaker for the preliminary selected cable. Special attention should be given to the cables from the current collector to the Main circuit breaker (-Q1 in the single line diagram in Section **POWER AND CONTROL VOLTAGE**); the short circuit current is limited by the ground circuit breaker.

For rotor cables the motor can be seen as a transformer.

2.11.1.2. Thermal check

Check the thermal relays setting vs. the preliminary selected cable. Use cable data, motors cdf, ambient temperature and installation type as in data.

For rotor cables the motor can be seen as a transformer.

2.11.1.3. Voltage drop check

Check for voltage drop. Use transformer data, crane supply system data, impact from other consumers and the motors peak current as in data. For low voltage supply system normally the resistive voltage drop is most significant.

The voltage drop in a stator cable can limit the torque and even stall the motor during acceleration.

The voltage drop in a rotor cable can be used as a part of the external resistor. The voltage drop of a rotor cable properly selected for short circuit and thermal stress, is equivalent to 0,5 to 1% resistor value for a festooned rotor cable and 0% resistor value then the resistor is close to the motor.

For calculation of voltage drop following rule of thumb can be used for peak current:

3 rotor contactors: Peak current = 200% of rated motor current.

2 rotor contactors: Peak current = 250% of rated motor current.

1 or 0 rotor contactors: Peak current = 250 - 300% of rated motor current.

After checking the voltage drop, it might be needed to revise the preliminary cable selection. In most cases the voltage drop checks decides the cable section.

2.11.1.4. Advice

To connect Thyristor modules with a rated current of 100 A or less, both single and three core cables could be used with preference, while for larger thyristor modules single core cables make the installation faster. For other cables, like the festoon system, 3- or 4-core cables can be used where it is convenient.

For steel mill installation, it is mostly best to select cables designed for high temperature, rather than using building installation cables and apply reduction factors.

Shielded power cables are not recommended in the festoon system, as the cost is higher and the lifetime of this type of cable is less than for the same cable in unshielded execution. Ref.: EN 61800-3.

Make the power cable from rotor resistor to the rotor contactor(s) as short as possible and use symmetrical three-core cable when possible to keep the inductance for the rotor contactors low.

The cable from the rotor / rotor resistor to the Feedback Module DADT 100 should have short circuit protection in the rotor / rotor resistor end.

For more advice for cabling on cranes with festoon systems, see the chapter **Installation**.

2.11.2. Control

2.11.2.1. Opto fiber

Duplex silicon fiber is used between the electrical room to the operator station, and if applicable from the operator first station to the second station.

Note that ready-made cables with connectors are listed in the Order page of this Manual. If these cables are used, the installation is trouble-free.

The cables listed in the Order page can be joined with 3ASC25H266 Duplex opto splice unit DATX 140. DATX 140 occupies 20 mm width on the mounting rail. Connect the "T" fiber of one cable with the "R" fiber of the other cable only by pressing it into the splice bushing until it clicks. Do the same with the other two fibers in the other bushing.

The sum of length of joined cables shall not exceed 150 m. Number of joints shall not exceed four.

For hot metal applications an outer protection hose should be used. The manufacturer ALMI, Postfach 130227, 4330 Mülheim-Ruhr 13 (Saarn), Germany, phone +49 208 486186, fax +49 208 482528 can supply suitable hoses. Ask for the HY program (asbestos-free). Several cables can be inside the same hose. Diameters from 12 mm are available.

For distances over 150 m and "fiber slip-rings" for slewing cranes: Contact ABB.

The fiber has the advantage over conventional cable that it reduces the size of the cable ducts and junction boxes, as well as reducing the risk of destroying the electronic equipment when welding is done on the crane.

2.11.2.2. Shielded cables

Shielded cables with pair twisted cores shall be used for:

- Tachometer / Pulse transmitter
- PTC-sensors
- Other analogue signals if used
- RS 485 multi-drop for Tool communication

The pairs do not need an inner shield

For festoon systems in mill environment we recommend to use flat form polychloroprene compound screened cable, "Neoprene", M (StD) HÖU-JZ 12 x 1,5 mm² or round cable (N)SHTÖU-J 6 X (2 X 1,5) C with type of sheath.

For cable chains we recommend to listen to the recommendations from the manufacturer of the cable chain. We do not recommend using cable with less section than 1 mm² of practical reasons.

2.11.2.3. Conventional wires

For control and detection voltage 110 V DC and 115 V AC or 230 V AC are used. This mix of voltage is used for ASTAT since it is not necessary to separate these wires in the installation. Example: It is allowed to use **one** cable for 230 V AC supply to an Anti-collision sensor and the detection voltage to its contact function.

110 V DC should not have a cable length exceeding 150 m for 1 mm² section. Contact ABB for approval for longer distances.

2.11.3. Service / Tool PC

A twisted pair cable 2 x 2 x 1 mm² with common shield.

The terminals accept cable a range of section between 0,14 mm².. 1,5 mm² (AWG 28.. AWG 16).

2.12. Limit switches

For the selection of these types of safety oriented devices applicable norms and standard shall always be checked. The ASTAT accepts nearly any choice of electromechanical contacts (110 V DC).

Static inductive type limit switches can be used. Requirements:

- NO-type
- Two wire cable moulded into switch
- IP 67 protection preferred
- Range at least 40 - 150 V DC
- Continuous current: at least 15 mA
- Switching frequency: 8 Hz for DC.
For use as Overspeed monitor: only 100 Hz types are approved for use.
- Installation temperature: To check
- Approved types:

ifm electronic gmbh, Postfach 10 18 33, 45018 Essen (Teichstrasse 4, 45127 Essen), Germany,
phone +49 201 2 24 20, fax +49 201 2 42 22 00.

Tested versions: IG0005(Plastic tread M18x1 / 5 mm / flush mount / 100 Hz),
IG0006(Plastic tread M18x1 / 8 mm / non-flush mount / 100 Hz),
IG0011(Metal tread M18x1 / 5 mm / flush mount / 100 Hz),
IG0012(Metal tread M18x1 / 8 mm / non-flush mount /100 Hz),
II0005(Plastic tread M30x1,5 / 10 mm / flush mount / 30 Hz),
II0006(Plastic tread M30x1,5 / 15 mm / non-flush mount / 30 Hz),
II0011(Metal tread M30x1,5 / 10 mm / flush mount / 30 Hz),
II0012(Metal tread M30x1,5 / 15 mm / non-flush mount / 30 Hz),
ID0014(Rectangular Plastic / 50 mm / non-flush mount / 8 Hz),

Tested versions with shorter distances for rigidly supported mounting:

IN0073(Rectangular Plastic / 2 mm / flush mount / 50 Hz),
IN0081(Rectangular Plastic / 4 mm / non-flush mount / 50 Hz),

2.12.1. Motion limits

2.12.1.1. Master Follower motions

Following remark for release AST10_04 and earlier is not valid for AST10_04A and later:

The stop limit switch for the master drive shall under normal conditions be the one stopping the motion. The Followers stop limit switch only serves as back up. When an over travel limit switch is used for a Master Follower motion, the normal stop limit switch of the Follower can be set to "Not used" in the follow mode parameter set. In the single drive mode it shall be set to "Used".

2.12.2. Overspeed monitor

For hoists. ASTAT contains functions for evaluation of overspeed and applying the mechanical brake. Check with applicable regulations if a back up in the form of another back up switch, which is wired directly in the emergency trip circuit of the crane, is needed.

One possibility for overspeed monitoring is to detect a High frequency on DI number 15.

An inductive limit switch with DC-frequency 100 Hz from the list above can be used. Mounting can be on the low speed side of the gearbox, or directly sensing the key of the motor shaft.

Consider following rules for mounting on the shaft:

- Synchronous speed is maximally 1200 rpm
- Keys part of the perimeter is minimally 8% for 1200 rpm (4% for 600-rpm motor)
- Radius for mounted key is minimally 3 mm larger than any other part of the shaft circumference.
- Mounting distance between limit switch and key is tentatively 1,5 mm less than the sensing distance of the sensor.
- The function shall be verified by moving the limit switch 1,0 mm closer as well as 1,0 mm apart from the final mounting position.

The above-described key arrangement is according to DIN 6885, sheet 1, form A for a motor shaft with diameter 38 mm, corresponding to shaft height 132.

2.12.3. Load sensor

ASTAT has a DI for connection of a NC free contact for overload.

ASTAT with Cabin I/O can have the load transducer (mA- or V-signal) connected to an AI in either Process I/O or Cabin I/O, and the load cell functions described in Section 4 are available.

3. Software for Design, Start up and Fault tracing

To set up a new installation and to keep an existing installation up to date, special Software and a connection cable from your PC to the ASTAT is needed.

To set up an installation, only parameters have to be set - there is no programming in the word's right meaning to do.

3.1. Configuration and installation

3.1.1. Installation

Installation consists of two parts. The hardware installation and configuration, and the software installation and configuration.

3.1.1.1. Hardware

Prior to starting the ASTAT Tool software, check the settings of the DAPC 100 circuit board(s) of the ASTAT Control System Module(s).

3.1.1.1.1. Point-to-Point set-up

A Point-to-Point configuration consists of a single physical serial connection between the ASTAT Hardware and the PC using the RS-232 protocol.

To enable Point-to-Point configuration set jumpers according to:

All S2 jumpers removed

All S3 jumpers installed

3.1.1.1.2. Multi-Drop set-up

In a multi-drop configuration several ASTAT Hardware units can be connected to a single PC using the RS-485 protocol. Multi-drop requires an RS-485 ↔ RS-232 conversion box connected between the ASTAT Hardware chain and the PC. Thus the PC only needs to be equipped with a standard serial communication port (RS-232).

To enable multi-drop configuration set jumpers according to:

All S2 jumpers installed in all ASTAT

All S3 jumpers removed in all ASTAT

3.1.1.1.3. Communication speed

The communication speed is determined by the **S4** jumper according to:

Position 1-2 = 9600 bps

Position 3-4 = 19200 bps

Position 5-6 = 38400 bps

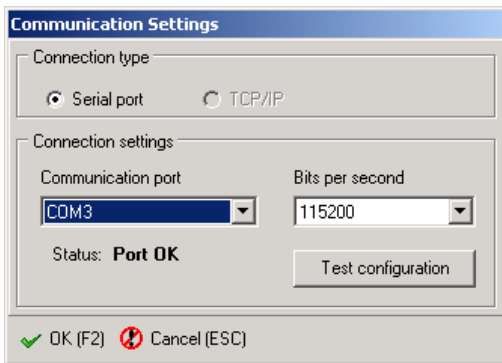
Position 7-8 = 115200 bps (Rightmost jumper)

A speed of 115200 should normally be used. In case of excessive errors or a complete communication failure check the cables, install a higher quality communication port or try a lower communication speed.

3.1.1.1.4. Connection

Use Tool cable 3ASC262741H1 to connect between the PC and the ASTAT hardware.

3.1.1.2. Software



Once you have configured the hardware and connected it to the PC, start the ASTAT Tool application. Ideally, you would have connected the hardware to the first serial port off your PC (COM1) and used 115200 bps as the communication speed. If another configuration is used then press ALT+C to open the Communication Settings dialog and modify the communication settings according to the jumper settings on the DAPC 100 board.

3.1.1.2.1. Connecting using USB

Some modern PC systems do not include a RS232 port as standard equipment but instead include one or more USB ports.

To connect to ASTAT hardware using an USB port you need an USB to Serial Converter. This is a small (and cheap) piece of hardware that connects directly into a free USB port or to an USB hub and registers a serial port in the OS (Operating System).

After the OS has detected the converter it registers a serial port; this port can then be selected in the Communication Port list in the Communication Settings dialog. ASTAT Tool.

Note: Because ASTAT Tool enumerates serial ports at start up you will have to restart the application if you have connected an USB to Serial Converter while the ASTAT Tool was running.

The TCP/IP connection requires additional hardware and is available in crane systems after agreement with ABB.

3.1.2. Installation troubleshooting

ASTAT Tool software must be installed on a Win32 compliant system.

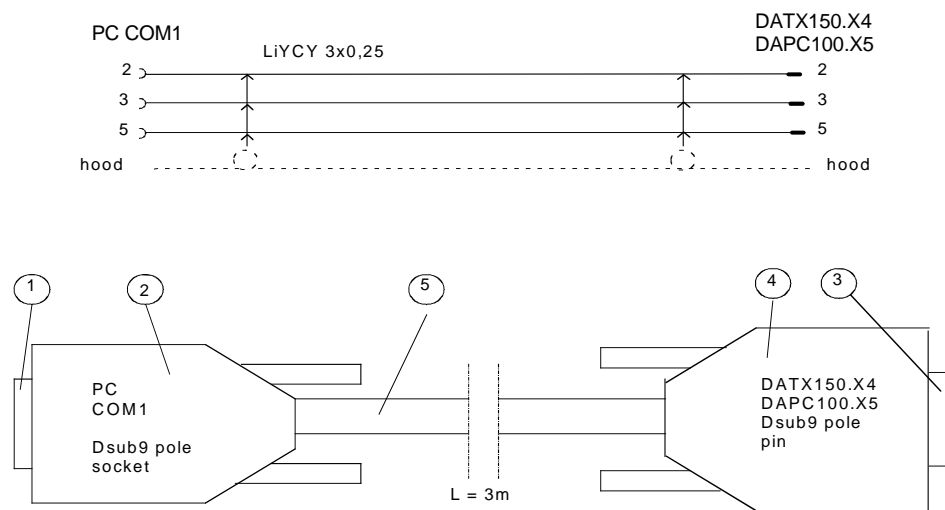
This includes Microsoft Windows 95, Windows 98, Windows NT, Windows 2000 and Windows XP operating systems.

Tool has been tested in a variety of different Windows environments and care has been taken to provide maximum compatibility and stability.

If you are experiencing problems with your installation; you might have some components within your systems that haven't been tested together with the software in which case you should contact our support team. Have your system description ready for quicker troubleshooting.

If you are experiencing problems DURING the installation process, the most probable reason would be damaged installation media (scratched CD-ROM, broken downloads etc.) in which case the media should be replaced. The installed does not allow files with bad CRCs to be installed.

The cable to order for connection to your personal computer can if needed be manufactured by the user herself as the sketch below:



3.1.2.1. Required files and replacement of ASTAT board

3.1.2.1.1. Software recovery

For proper function, ASTAT Tool application uses the following files:

ASTAT.EXE (main executable)

PARAMETERS4.INI (parameters definition file)

SIGNALS4.INI (signals definition file)

MIDAS.DLL (used for rapport generation. If missing or corrupted printing will not work)

You do NOT need to use the installer to run Tool. This provides for quick recovery in situations where you don't have the distribution media, e.g. a computer crashes at the site and the OS has to be reinstalled. As long as the main executable is not lost, the software will run.

Further, ASTAT Tool will create and use files with following extensions:

AST – Project file (parameter settings)

ATT – Project template file (same structure as AST)

ASG – Monitor graph recording

LOG or **TXT** – Basic text file output of the logger

DEFMONx.INI – Default settings for monitor tool

3.1.2.1.2. DAPC 100 replacement

In case replacing a DAPC 100 board you will need:

A PC with the ASTAT Tool application installed and a parameter file (*.ast) for the motion concerned.

Tool cable 3ASC262741H1 RS 232

24 V DC power supply 10 A if switched type, 2 A if linear type (inrush current sets the size)

Terminal block Phoenix 1777280, FRONT-MSTB2,5/2-ST-5,08, 2 poles, plug-in part (if you don't have, use the one of the board you are to replace - do not mix polarities!)

A new DAPC 100 board.

Recovery procedure:

Place the board with the display on top.

DAPC 100 Generation No. 1: Remove all S2 jumpers and install all S3 jumpers

Place Jumper S4 in position 7-8 (115200 bps communication rate)

Connect 24 V DC to X4 terminal. Polarity Left: - Right: +

Watch the display of DAPC 100 light up (do not mind what it shows)

Connect the Tool cable 3ASC262741H1 between COM1 of your PC and the DAPC 100 board (On top of the board). The cable can only be inserted correctly as it is keyed.

Start ASTAT Tool application on the PC and configure the application to use COM1 and 115200 bps communication speed.

Load the parameter file (*.ast).

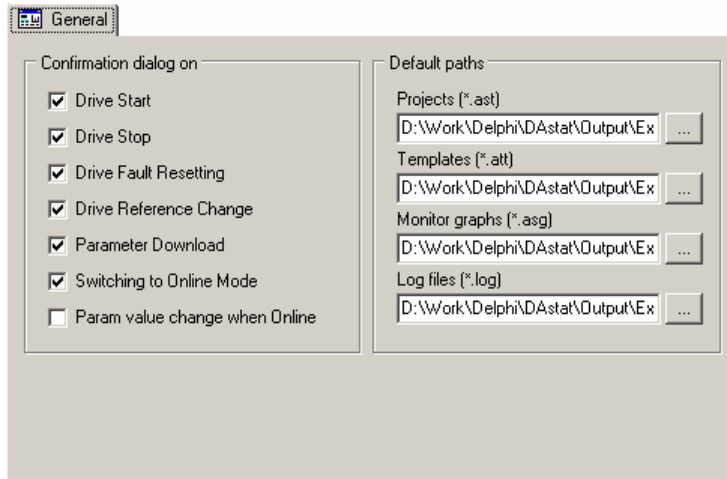
If the new DAPC 100 board has a newer Software than the original ast-file was created for, the Tool will add default values for all additional functions in the new DAPC 100 software. Watch the motion properties after installation.

Switch to ONLINE mode and synchronise the parameters using SEND TO ASTAT method.

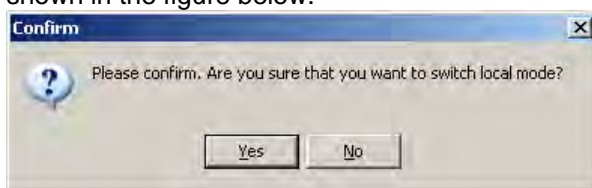
3.1.3. Software configuration

The configuration of the software is handled via the **Preferences** function in the **Options** submenu (shortcut key **F9**). The Preferences dialog features a set of categories presented by tabs. Below is a description of the preferences contained within each tab.

3.1.3.1. General



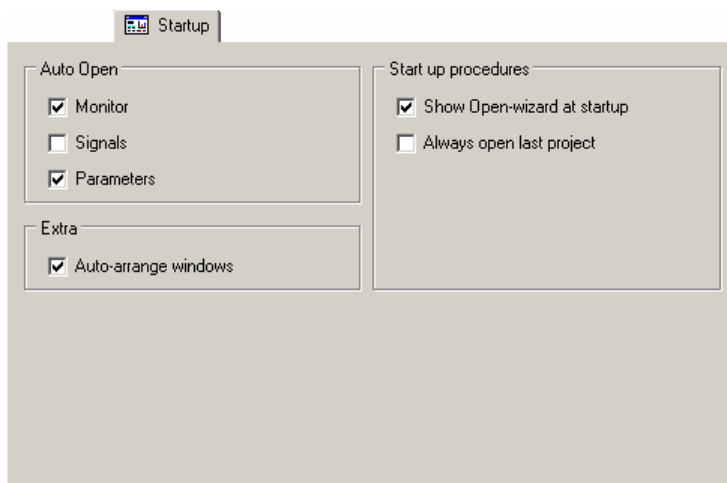
A group of checkboxes, listed in the “**Confirmation dialog on**” group box, toggles whether or not the user is required to confirm selected actions. If checked, triggering the selection actions, opens a dialog as shown in the figure below.



Toggling confirmations off is only recommended for experienced users as accidental mouse clicking may produce unwanted results.

The ‘**Paths**’ group box allows you to define the default directories for ASTAT projects (*.ast), templates (*.at), monitor graphs (*.sag) and log files (*.log). The program will automatically jump to these directories upon functions such as “Open” and “Save as...”.

3.1.3.2. Start-up



This tab handles the behaviour of the Tool during the start-up sequence.

The ‘**Auto-open**’ group box allows users to define which (if any) of the available tools should be automatically opened at start-up.

If ‘**Auto-arrange Windows**’ is enabled ASTAT Tool performs a vertical tiling of Tool windows on start up and when a new Tool window has been created.

The “**Start up procedures**” group box has two toggles:

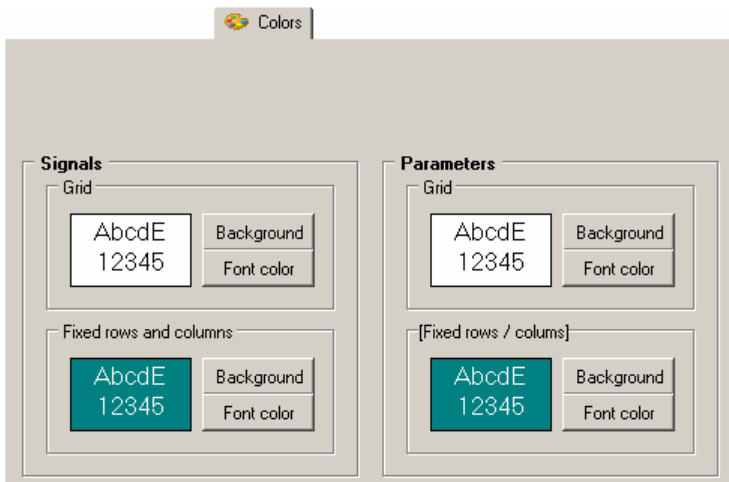
Show Open-Wizard at start-up

The Open-Wizard is a simple popup dialog during the start-up which allows users to perform a few common tasks directly at the start-up.

Always open last project

When this is enabled the Tool will automatically open (if found) the last project that the user has been working on. Checking this preference overrides the Open-Wizard.

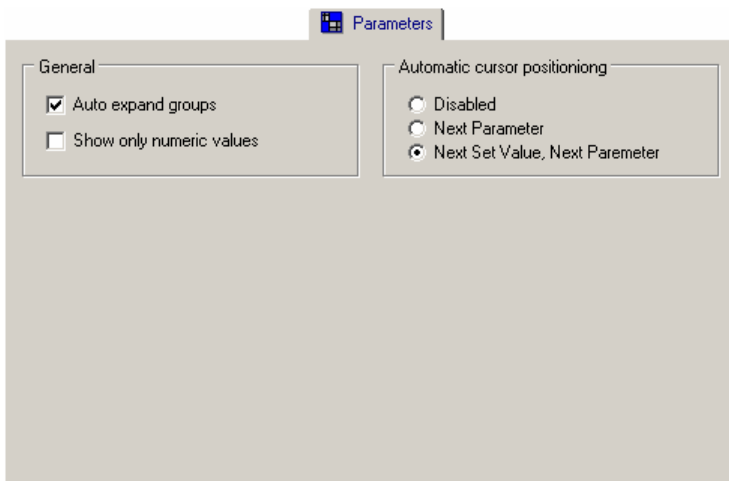
3.1.3.3. Colours



The “**Colours**” tab allows the users to customise the colours used by the Tool.

Users can customize the colours of the grids in the **Parameters Tool** and the **Signals Tool**.

3.1.3.4. Parameters



The topmost group box features preferences specific to the Parameters Tool and its behaviour.

The following toggles are available:

Auto-expand parameter groups

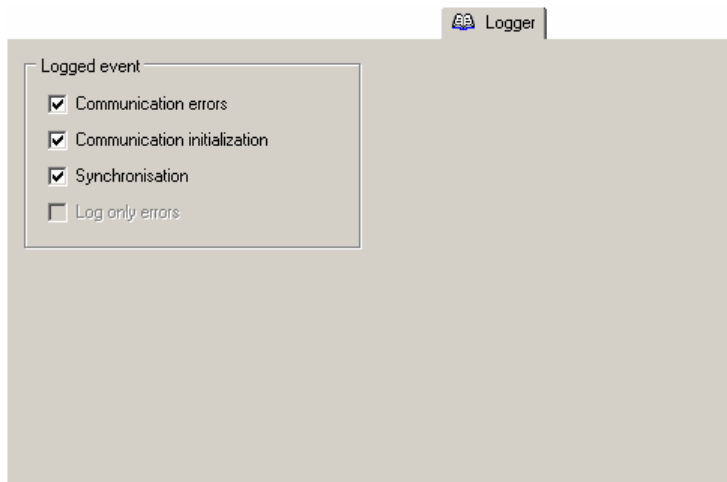
When set, opening the Parameters Tool will automatically expand (open) all parameter groups.

Use numeric-values ONLY (no type-sensitive editors)

When set, the values of the parameters will be represented with numbers only. When reset, the Tool will differentiate between different types of parameters (such as multiple-choice parameters and integer parameters) and use text instead of numbers where applicable.

The down most radio-buttons control the behaviour of the parameter editor after a value has been entered. The editor will stay in the same field, jump down to next parameter or jump right to the next stop and then jump down to the first set in the next parameter.

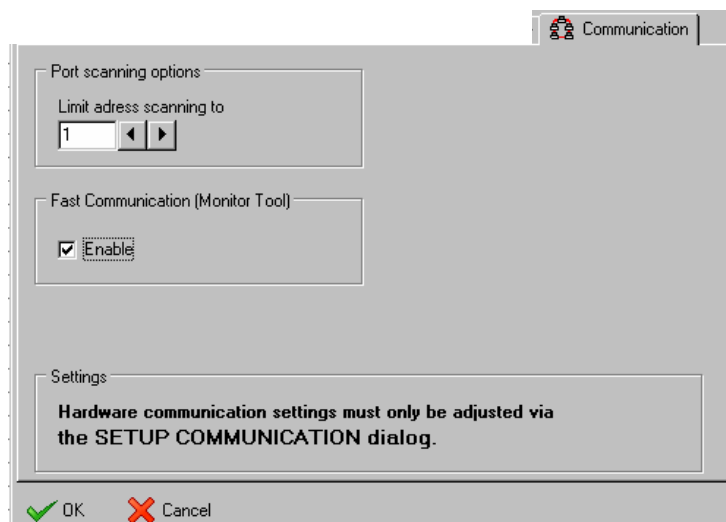
3.1.3.5. Logger



Controls which events are added to the System Log.

If **Synchronisation** is not checked, the **Log only errors** check box becomes available; If **Log only errors** is checked the System Log will only include synchronisation error events.

3.1.3.6. Communication



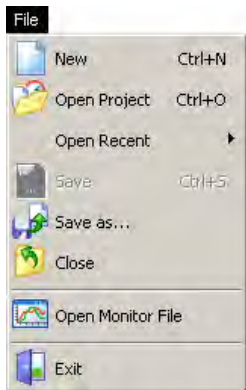
The Port scanning option limits the ASTAT address scanning range when a port is queried. The higher the value the longer the time a port scan will take.

The Fast Communication (Monitor Tool) Check box enables to use the fast communication in the Monitor Tool. Fast Communication improves the resolution of the registration, and works well for most PCs. For PCs with less processor capacity the Fast Communication can not be used.

If this Check box is left unchecked, the Tool will as default not use the Fast Communication.

3.2. Menu Commands

3.2.1. File

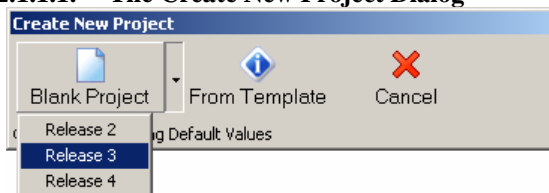


The File submenu contains commands used for file handling and printing. These functions follow the look and behaviour of standard Windows conventions.

3.2.1.1. New

Start working on a new project. Clicking this menu option opens the Create New Project dialog.

3.2.1.1.1. The Create New Project Dialog



When creating a new project you can either start with a blank project or a template.

The Blank Project button has a drop down menu that allows you to select the release version. If you do not manually select a version, ASTAT Tool will default to the latest release version as defined in the configuration files.

3.2.1.2. Open Project

Opens a dialog where you select an existing Project.

3.2.1.3. Open Recent

This is a submenu that lists recently opened project files. Projects that are currently opened by the ASTAT Tool are not listed here until they have been closed.

3.2.1.4. Save

Saves the project you are currently working with.

For new Projects, this command is not available until the Project has been saved using the **Save as...** command.

3.2.1.5. Save as...

Saves the project to a (new) file.

3.2.1.6. Close

Closes the project.

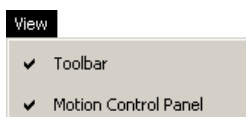
3.2.1.7. Open Monitor File

Opens a dialog where you select an existing Monitor Graph.

3.2.1.8. Exit

Exits the application.

3.2.2. View



The View submenu consists of check items that allow certain parts of the graphical user interface to be toggled visible or hidden. Hiding panels will produce more window space for functions such as the parameter editor.

3.2.2.1. Toolbar

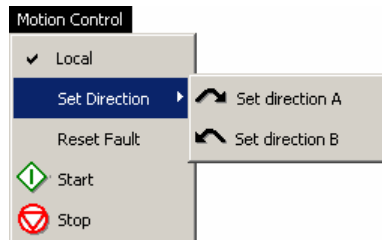


The Toolbar contains shortcuts to the most common functions such as creating new projects, saving project, opening Tools, configuring communication and tiling Tool Windows.

3.2.2.2. Motion Control Panel

The Motion Control Panel references the functions that apply to the current motion. This panel is the graphical mirror of the functions represented in the Motion submenu. Due to the nature of functions contained within this panel, it is mainly usable during the On-line procedures at the site and can therefore be hidden during the design-phase.

3.2.3. Motion Control



The Motion Control submenu contains functions that control the current motion. All operate on the hardware and require a physical connection to the ASTAT hardware. The functions in the 'Motion Control' submenu are mirrored in the 'Motion Control Panel' as icons.

3.2.3.1. Local

Switch to local control mode. To control motion the Tool must request local mode from the ASTAT system.

3.2.3.2. Set Direction

Set direction of the motion. As ASTAT is a multi-purpose controller, the directions are simply named 'A' and 'B' whereas users might be used with 'Forward' and 'Reverse', 'Up' and 'Down', 'Left' and 'Right'.

3.2.3.3. Reset fault

In case of a fault that stops the system the ASTAT users may reset the fault and allow the system to continue.

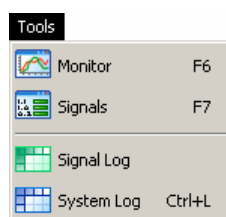
3.2.3.4. Start

Starts the motion. LOCAL mode required.

3.2.3.5. Stop

Stops the motion. As opposed to **Start** the system does NOT have to be in the LOCAL mode.

3.2.4. Tools



The Tools submenu contains the tools available to the user. Some of the tools are online-tools; i.e. a live connection to the ASTAT is required. A child window represents each tool. See below for further information on the tools.

3.2.4.1. Monitor

The Monitor tool allows the user to monitor signals over a period of time. For the Monitor tool to function a live connection to the ASTAT is required; users can however view and analyse previously recorded sessions. See chapter

- 3.3.2. **Monitor** Tool in the **Tools** section of the manual for more information.
- 3.2.4.2. **Signals**

A numeric table representing current signal values in the ASTAT system. The Signals-tool will not function unless a connection to the ASTAT has been established.

See chapter 3.3.3. **Signals** Tool in the **Tools** section of the manual for more information.

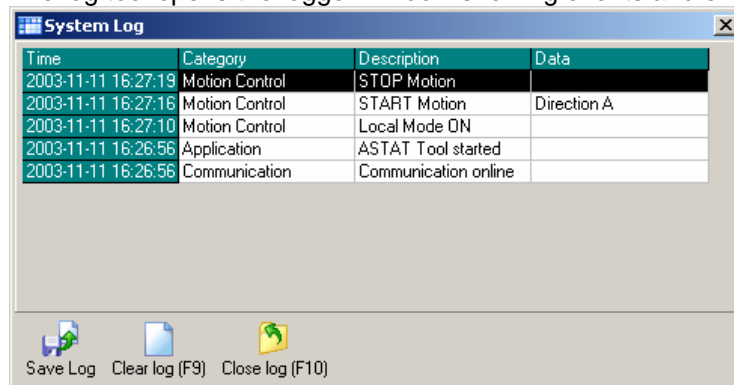
3.2.4.3. Signal Log

Use the Signal Log Tool for short and long term logging of signal values.

See chapter 3.3.4. **Signal Log Tool** in the **Tools** section of the manual for more information.

3.2.4.4. System Log

The log tool opens the logger-window showing events and errors such as communication problems.



Events in the log tool show category (for example communication), type of error and additional data. The information in the additional data field is dependent upon the nature of the error. For communication errors it contains information about which specific command caused the error.

The log can be exported to a standard text file using the **“Save to file”** button.

User may clear the log file by clicking the **‘Close Log’** button or pressing F10.

3.2.4.5. Application Tool

The application tools are worksheets in Microsoft EXCEL. It is needed that the user has Microsoft EXCEL in her computer.

3.2.4.5.1. Resistor checker

The resistor checker helps the user to calculate the resistor values, and to study the result of voltage fluctuations and current limits.

The input sheet, see below, returns the nominal torque of the motor and the Ohm values of the resistor steps in the same sheet.

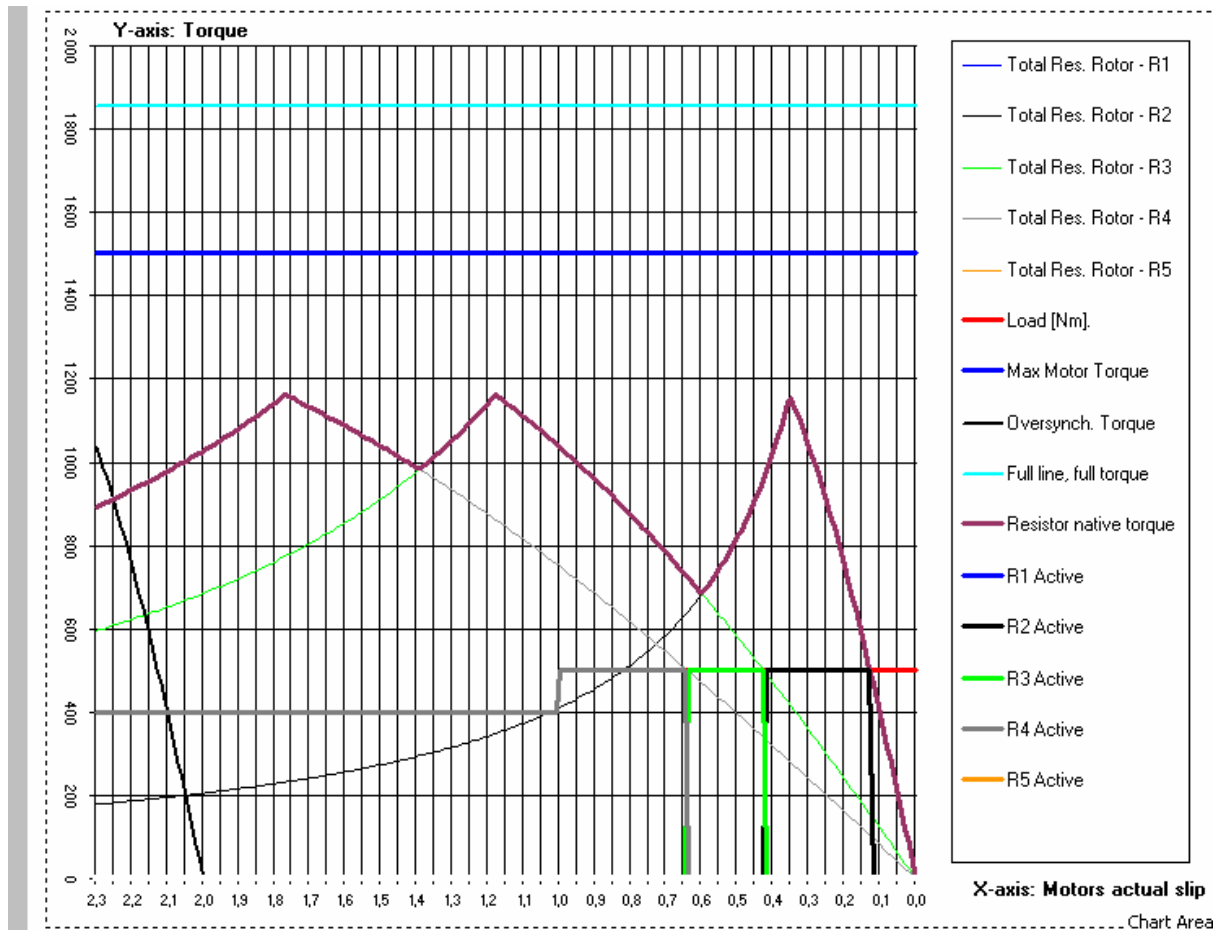
The torque speed diagram is another tab of the worksheet. It is based on the data of the input sheet. The torque speed diagram is shown in the next page. By varying the input data, advanced simulations can be done to get good engineering solutions for the motion control.

	A	B	C	D	E
1	Hoist/Travel ?	H	H=Hoist,T=Travel	Places for notes below:	
2	Tbrake [Nm]	400	Required braking torque		
3	Tmotor [Nm]	500	Required motoring torque including acceleration.		
5	Line frequency [Hz]	50	50 or 60 allowed		
6	U min [%]	90	Min Line Voltage in %		
7	Pn [kW]	60	Motor power in kW		
8	Nn [rpm]	988	Motors nominal speed in r. p. m. Range: 450 - 1800.		
11	Irot [A]	195	Motors rotor current related to Motor power above		
12	Tmax/Tn [-]	3,2	Motors pull out torque. Use full catalogue value		
13	Ilim / In [1]	2,7	Current Limits		
14	Tn[Nm]	580	Motors nominal torque		
16	sn [%]	1,2	Motors nominal slip		
24	Slip 0 [%]	1,2	Internal resistance of motor		
25	Cable [%]	2	Cable resistance as percent of the motors unity resistance. Normal value 1 to 3.	R4 allowed for low speed Hoisting (Y/N) ?	Y
26	Resistance of rotor and cable	3,2	The % of Rtot that is given the the rotor itself and the cable.	Resistance increase in %?	0
27	Enter resistance value Rtot in %: Rtot=R1+3,2%	N	Please enter "N" if not present,otherwise R1 in %, must be at least 3,2% , but less than Slip R2	R1 [Ohm]	0,000
28	Enter resistance value in %: Rtot=R2+3,2%	12	Please enter "N" if not present,otherwise R2 in %, must be more than than Slip R1	+ Rext [Ohm]	0,047
29	Enter resistance value Rtot in %: Rtot=R3+12%	40	Please enter "N" if not present,otherwise R3 in %, must be more than than Slip R2.	+ R3 [Ohm]	0,149
30	Enter resistance value Rtot in %: Rtot=R4+40%	60	Please enter "N" if not present,otherwise R4 in %, must be more than than Slip R3	+ R4 [Ohm]	0,106
31	Enter resistance value Rtot in %: Rtot=R5+60%	N	Please enter "N" if not present,otherwise R5 in %, must be more than than Slip R4	+ R5 [Ohm]	0,000
264	Please type in data inside the red frames				

Explanations of input fields:

Cell B1 Enter Capital H for a hoist design or T for a travel motion design

- Cell B2 Needed torque for braking. Assume that the mechanical efficiency is helping to brake.
- Cell B3 Needed torque for motoring. Include both the static part and the acceleration part. For hoists the static part is the dominant.
- Cell B5 Line frequency, 50 or 60 Hz.
- Cell B6 The least line voltage to consider as a percentage of the nominal.
- Cell B7 Motor power in kW
- Cell B8 Rated speed of the motor in rpm
- Cell B11 The rotor current of the motor related to the power in cell B7.
- Cell B12 Pull out torque of the motor. If the catalogue is not available the value 2,5 can be used.
- Cell B13 The set limit of the line current as a multiple of the rated current of the motor.
- Cell B25 For a short cable motor-resistor this value can be almost 0, for a long cable normally not more than 3.
- Cell E25 For hoists. During long time operation at low speed, typically during ladle tilting, the power factor can be improved by connecting resistance step R4 (and R5 in some cases) also in hoisting mode.
- Cell E26 Add a positive value to study the impact of warm resistor, and negative to see what happens then the resistor is cold.
- Cell B27 Total value from the internal resistance of the rotor to R1. Enter "N" if not installed. Almost never used for travels.
- Cell B28 Total value from the internal resistance of the rotor to R2. Enter "N" if not installed.
- Cell B29 If you have only one resistor step, use this cell.
- Cell B30 Total value from the internal resistance of the rotor to R4. Enter "N" if not installed. Never used for travels.
- Cell B31 Total value from the internal resistance of the rotor to R5. Enter "N" if not installed. Almost never used.



It is seen that the resistor step R1 is not installed.

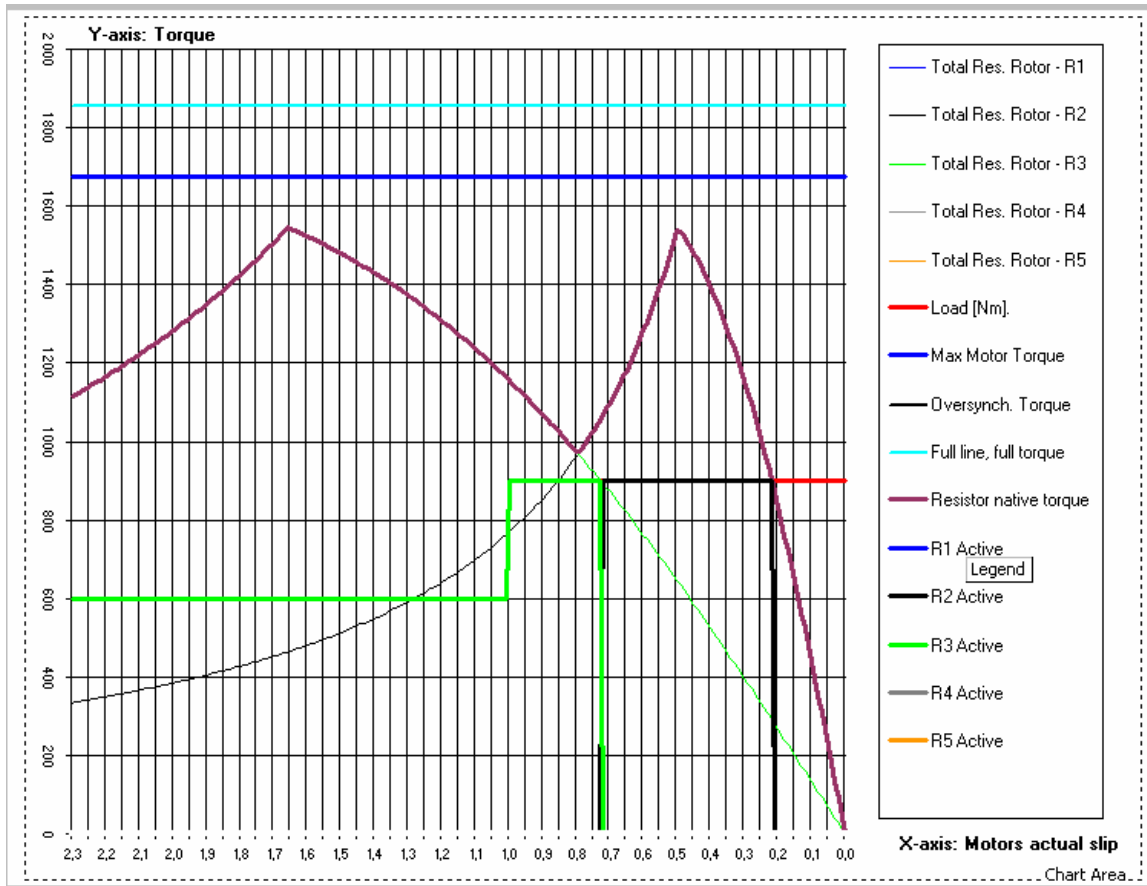
Step R4 is allowed for low speed operation at hoisting.

The simulation is made for 90% line voltage. In this case ASTAT minimises the line current by switching R4→R3 at slip=0,64, same as speed is 36 % and by switching R3→R2 at slip=0,42, same as speed is 58%.

At slip=0,12, same as speed is 88%, the acceleration will be reduced as the motor can not produce the required motoring torque.

	A	B	C	D	E
1	Hoist/Travel ?	T	H=Hoist,T=Travel	Places for notes below:	
2	T _{brake} [Nm]	600	Required braking torque		900
3	T _{motor} [Nm]	900	Required motoring torque including acceleration.		
5	Line frequency [Hz]	50	50 or 60 allowed		
6	U _{min} [%]	95	Min Line Voltage in %		
7	P _n [kW]	60	Motor power in kW		
8	N _n [rpm]	988	Motors nominal speed in r. p. m. Range: 450 - 1800.		
11	I _{rot} [A]	195	Motors rotor current related to Motor power above		
12	T _{max} /T _n [-]	3,2	Motors pull out torque. Use full catalogue value		
13	I _{lim} / I _n [1]	3,5	Current Limits		
14	T _n [Nm]	580	Motors nominal torque		
15	s _n [%]	1,2	Motors nominal slip		
24	Slip 0 [%]	1,2	Internal resistance of motor		
25	Cable [%]	2	Cable resistance as percent of the motors unity resistance. Normal value 1 to 3.	R4 allowed for low speed Hoisting (Y/N) ?	Y
26	Resistance of rotor and cable	3,2	The % of R _{tot} that is given the the rotor itself and the cable.	Resistance increase in %?	0
27	Enter resistance value R _{tot} in %: R _{tot} =R1+3,2%	N	Please enter "N" if not present,otherwise R1 in %, must be at least 3,2% , but less than Slip R2	R1 [Ohm]	0,000
28	Enter resistance value in %: R _{tot} =R2+3,2%	12	Please enter "N" if not present,otherwise R2 in %, must be more than than Slip R1	+ Rext [Ohm]	0,047
29	Enter resistance value R _{tot} in %: R _{tot} =R3+12%	40	Please enter "N" if not present,otherwise R3 in %, must be more than than Slip R2.	+ R3 [Ohm]	0,149
30	Enter resistance value R _{tot} in %: R _{tot} =R4+40%	N	Please enter "N" if not present,otherwise R4 in %, must be more than than Slip R3	+ R4 [Ohm]	0,000
31	Enter resistance value R _{tot} in %: R _{tot} =R5+N%	N	Please enter "N" if not present,otherwise R5 in %, must be more than than Slip R4	+ R5 [Ohm]	0,000
264	Please type in data inside the red frames				

The inputs and output forms on this page are already described above, but give a better understanding for a travel motion.



3.2.4.5.2. Interface generator

The interface generator helps the user to conveniently get the I/O lists for the Control System Module and Cabin I/O Modules only by entering the values of the parameters that are determining these lists.

It is only to type the five parameter values, and after that print out the lists.

Input form:

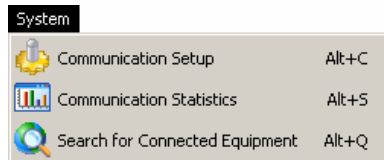
Motion identity:		CR 888 Hoist 1		
Item	Name	Selection rule	Value	Comment from ABB
02.01	RUN_TYPE	Value 0 will use Cabin I/O. Value 5 will use DI and AI of the Process I/O board.	0	
05.01	IN_ASTAT	Rated current of the Thyristor module. In case of Parallel bridge combination, Ie is the sum of the two units together. Unit: A. DI no. 3 on board DATX 110 is determined by this information.	100	
05.03	DRI_TYPE	Setting: 11 for "Hoist without Shared Motion", 12 for "Hoist with Shared Motion", 21 for "Travel without Shared Motion", 22 for "Travel with Shared Motion", 23 for "Single motion SwayControl", 24 for "Travel of Four motion SwayControl system with owned hoist" or 25 for "Travel of Four motion SwayControl system with the other travel motions owned hoist"	11	
05.04	L_SW_TYP	Type of limit switch for movements. 1: Classic based on four switches. 2: Soft based on Pulse transmitter.	1	
05.27	STA2_PA2	STA2_PA2 = 0: DI #3 on process I/O board DATX 110 will select between operators stations number one and two. STA2_PA2 = 1: DI #3 on process I/O board DATX 110 will extend the selectable parameter sets to four, but disable the selection between two operators stations. STA2_PA2 = 1 is not possible for Shared motion. STA2_PA2 = 1 is not possible for duty with Local I/O, i.e. RUN_TYPE=5.	1	
05.29	SELECT_A	Control AO no. 1 of process I/O board DATX 110. Value = 0: 0 V = 0% actual line current +10 V = 400% actual line current Value = 1: -10 V = -200% speed reference +10 V = +200% speed reference	0	
05.30	SELECT_B	Control AO no. 2 of process I/O board DATX 110. Value = 0: -10 V = -400% torque reference +10 V = +400% torque reference Control AO no. 2 of process I/O board DATX 110. Value = 0: -10 V = -400% torque reference +10 V = +400% torque reference Value = 1: Parameter 14.30 TWIN_OVL = 0 -10 V = -200% actual speed +10 V = +200% actual speed Parameter 14.30 TWIN_OVL = 1 Load in Weight Units	1	
13.01	SEL_DO_1	Function of DO no. 1. The DO relay is closed for 0: Extended lowering contactor. 1: Cable reel used. 2: Pull in a contactor for the thyristor fan; if installed (the heat sink is warmer than +50 °C).	2	
14.30	TWIN_OVL	Enable parameter for function with summation and/or comparison of weight signals from two load cell or two hoists. The sum level is set with parameter 14.24. Requires that the two ASTAT are connected together by DATX 110 AO 2 - AI 6.	1	
20.01	MF_TYPE	Definition of the role of the ASTAT in a Master-Follower connection. 0: No Master-Follower connection. 1: Master in Master-Follower connection. 2: Slave in Master-Follower connection. 4: This travel motion a consumer of rope length and weight class information of a hoist	0	

Result of print out , see next page:

Result of print out

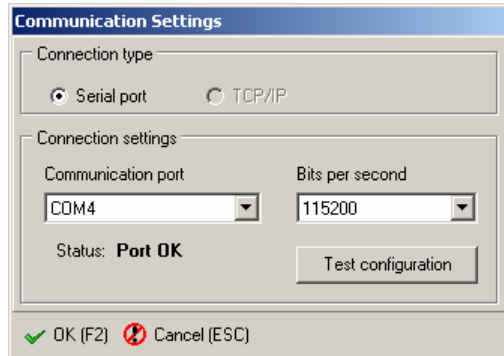
Panel	Board	Process I/O DATX 110	
		<u>Digital In</u>	
	X11-2	DN	DI #1
	X13-4	Fault reset	DI #2
	X15-6	Parameter set 1&2 or 3&4 select	DI #3
	X17-8	Parameter set 1&3 or 2&4 select	DI #4
	X21-2	Prelim Dir. A	DI #5
	X23-4	Prelim Dir. B.	DI #6
	X25-6	Stop Dir. A	DI #7
	X27-8	Stop Dir. B	DI #8
	X31-2	Cable relay	DI #9
	X33-4	Brake open	DI #10
	X35-6	Cable relay	DI #11
	X37-8	Brake open	DI #12
	X41-2	Mech. Overload	DI #13
	X43-4	Brake open	DI #14
	X45-6	Mech. Overspeed	DI #15
	X47-8	Brake open	DI #16
	X9-5-6	Two thyristor bridges: Not symmetrical current	DI #17
		<u>Analog In</u>	
	X51-2	Motor #1 PTC	AI #1
	X53-4	Motor #2 PTC	AI #2
	X55-6	Motor #3 PTC	AI #3
	X57-8	Motor #4 PTC	AI #4
	X61-2	Loadcell signal	AI #5
	X63-4	Additional speed reference, no ramp influence	AI #6
	X65-6	Additional torque reference, no ramp influence	AI #7
	X67-8	Tacho feedback.	AI #8
		<u>Pulse encoder</u>	
	X81-8	A, B, Z + inverted	PI
		<u>Digital Out</u>	
	X101-2	Thyristor fan(s)	DO #1
	X103-4	Rotor contactor K1	DO #2
	X105-6	Rotor contactor K2	DO #3
	X107-8	Rotor contactor K3	DO #4
	X111-2	Brake-lifter contactor	DO #5
	X113-4	Delayed brake-lifter; for DC-brake hold current	DO #6
	X115-6	Fault DO	DO #7
	X117-8	No dangerous fault	DO #8
		<u>Analog Out</u>	
	X71-2	Stator current 0 V = 0 %; +10 V = +400 %	AO #1
	X73-4	Torque reference -10 V = -400%; +10 V = +400 %	AO #2
Panel	Board	Cabin I/O DATX 120:1	
		<u>Digital In</u>	
	X3:1	Master switch in zero pos	DI #1
	X2:2	Direction A	DI #2
	X3:3	Direction B	DI #3
	X3:4	Bypass Low load hoist speed limitation	DI #4
	X4:1	Step 2	DI #5
	X4:2	Step 3	DI #6
	X4:3	Tare of hook presented load in hook	DI #7
	X4:4	Step 100%	DI #8
		<u>Analog In</u>	
	X51-2	AI Reference	AI #1
	X53-4	.....	AI #2
		<u>Digital Out</u>	
	X21	Over-temperature in motor by PTC-element (Stop: Steady Red, in case of Warning Flashing)	DO #1
	X21	Brake-lifter not acknowledging in time (Red)	DO #2
	X21	Overload in motor cable by thermal overload relay (Red)	DO #3
	X21	Rotor / Speed measurement / Speed supervision (Red)	DO #4
	X21	Mechanical overload (Stop: Steady Red, in case of calculated Warning Flashing Red)	DO #5
	X21	Mechanical overspeed (Red)	DO #6
	X21	Overload thyristor stack, bridge 1 or 2 in case of parallel bridges (Red)	DO #7
	X21	ASTAT OK (Steady Green); Fault detected by ASTAT (Flashing Green), check error code on	DO #8
		<u>Analog Out</u>	
	X21-2	Total or Net load in hook +10 V = 32767 Weight Units	AO #1
	X23-4	Speed, -10 V = -200%; +10 V = +200 %	AO #2

3.2.5. System



The System submenu contains functions that regard the physical connection between the computer and the ASTAT system.

3.2.5.1. Communication Setup



Use this dialog box to set up the communication port and transfer speed. The communication port is the physical connection to the ASTAT hardware. The speed must be the same as configured in the ASTAT hardware.

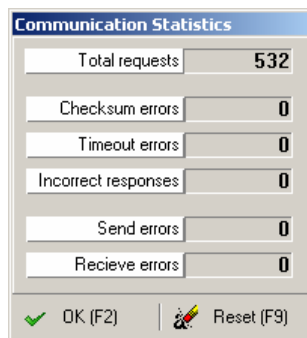
Note on speed: For ASTAT parameter configuration dumping, the speed is not critical as relatively small amounts of data are transferred. However, for monitoring purposes, especially when monitoring multiple signals, try setting the speed as high as possible because lower speeds introduce more delay and less timing accuracy.

The 'Test configuration' button forces Tool to retest the currently selected configuration.

Upon exit by pressing the 'OK' button the Tool will re-identify the network and search the selected port for connected hardware and configured motion(s).

Note: As of Release 4, Tool automatically saves the selected communication settings to its configuration file upon exit.

3.2.5.2. Communication Statistics



Open a dialog that shows information about the condition of the hardware connection and the communication protocol between ASTAT Tool and ASTAT Hardware.

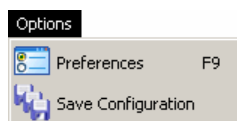
Values can be reset by pressing the Reset button

3.2.5.3. Search for Connected Equipment

If a connection with the ASTAT Hardware has been broken for some reason (for instance a cable has been disconnected), ASTAT Tool will automatically go Offline – and any open Tool Window will be notified and act accordingly. Use this function to re-establish connection.

ASTAT Tool automatically performs the search on start-up.

3.2.6. Options



Preferences

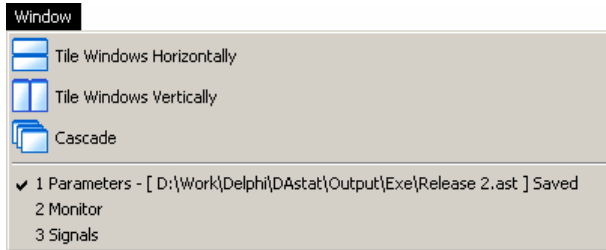
This opens the **Preferences dialog** which is described in detail in the chapter **0 3.1.3. Software configuration.**

As opposed to the System submenu, which concentrates on the hardware, the Preferences regard the software configuration. This is where you adjust how the look and the behaviour of the ASTAT Tool.

Save Configuration

Saves the current configuration.

3.2.7. Window



The Window submenu simplifies the window handling by arranging the currently open windows in certain manners.

A list of child windows is available below the separator line. The list is particularly useful in situations where a lot of windows are open at the same time.

3.2.7.1. Tile Windows Horizontally

Fits all opened Tool Windows horizontally. Tool Windows that are minimized will not be affected.

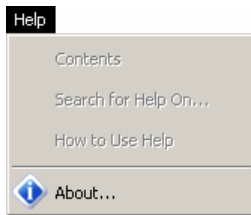
3.2.7.2. Tile Windows Vertically

Fits all opened Tool Windows vertically. Tool Windows that are minimized will not be affected.

3.2.7.3. Cascade

Cascades all opened Tool Windows. Tool Windows that are minimized will not be affected.

3.2.8. Help



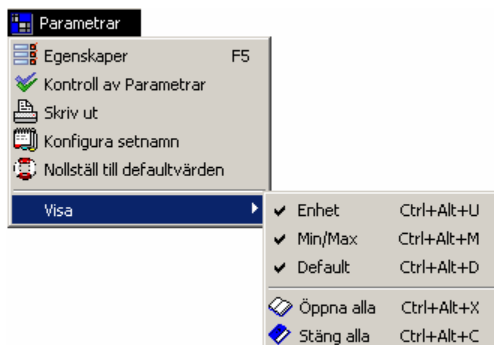
Current release has no online help included.

3.2.8.1. About



Shows an “**About**” dialog-box containing basic information about the ASTAT Tool application.

3.2.9. Parameters



The Parameters submenu is shown only when the active (selected) child window is a Parameters window. Likewise, the Signals submenu is only shown when the Signals Tool is active.

Menu options are mirrored in the ‘Parameters’ windows in form of icons:

3.2.9.1. Properties

Opens a dialog (see figure) with user definable motion properties. These include the motion name, type, and the name of the designer and the revision number of the current project.

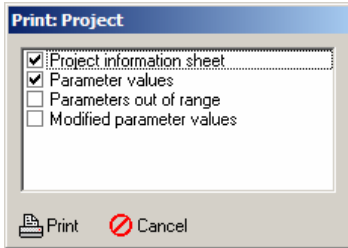
3.2.9.2. Parameter Check Report

The Parameter Check Report function creates two sequential previews of two check reports based on the current ASTAT parameters file. An example report is displayed below.

Group ID	Name	Set 1	Set 2	Set 3	Set 4	Unit	Norm	Min	Max
1	Identity								
2	I/O station definition								
!	2:10 FACT_RUN	2 !				NOUN	0	0	1
3	Supply information								
4	Motor information								
5	ASTAT configuration								
6	Brake information								
7	Speed feed-back								
8	Speed referenc e								
9	Speed regulator								
10	Speed supervision								
11	Current/Torque regulator								

While preview the report, you may choose to send the report to printer by pressing the button placed in the top row of control buttons.

3.2.9.3. Print Parameters



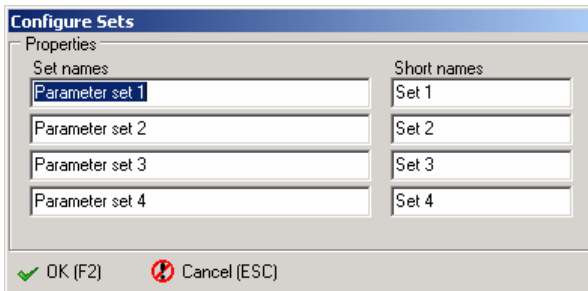
Use 'Print Parameters' to create a hard copy report of the project.

Four part reports can be selected with "Project information sheet" and "Parameter values" being pre-selected.

The last two reports are identical to the reports created by the "Parameter Check Report" function described in the previous section.

"Parameters out of range" report creates a report consisting of parameter values that fall out of the range defined by the min and max properties of parameters. "Modified parameter values" report creates a report that lists all parameters with values that differ from the default (norm) parameter value.

3.2.9.4. Configure Sets



The set 'configuration' is a dialog allowing the user to give custom names to any of the four sets. Each set has two name properties: 'Set name' and 'Short name'. Set name is a fully descriptive name of the set shown where the length of the set name is not a problem. Short names are used in situations where the length of the description would exceed the length allowed by the graphical design of the form.

Reset to default

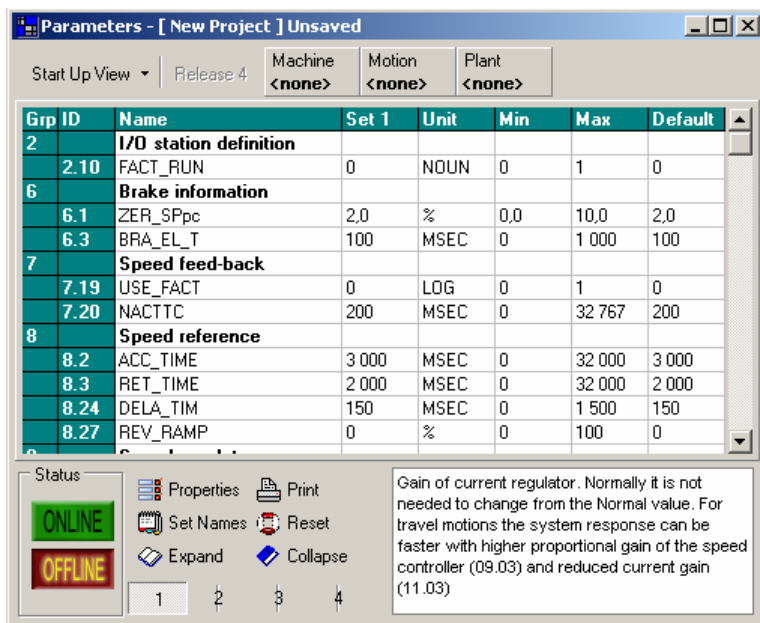
This will reset all parameters to their default values as defined in the 'parameters.ini' file. Use only at design phase.

3.2.9.5. View

The 'View' submenu controls the visual properties of the selected 'Parameters' windows. These properties include whereas unit names, default values etc are shown or hidden.

3.3. Tools

3.3.1. Parameters Tool



The main part of the Parameters window is the parameter-table. Edit the table to configure the parameters of the ASTAT project.

Each configuration has four parameter sets. By toggling the SET-buttons shown into the control panel of the Parameters window, user can choose which sets of parameters are shown on the screen. Users can also toggle whether or not the parameter units and minimum/maximum values are shown.

Each parameter belongs to a Parameter Group. Each group is represented by a number and a name. Parameter Groups are opened and closed by double-clicking the group name or selecting a Parameter Group with the cursor pressing <SPACE>.

For parameters the Tool includes different **Parameters Views**. All the parameters are listed in the Manual together with information regarding the View they belong to.

Start Up View

A restricted number of parameters that by experience are the most important for Start Up.

Design View:

Shows parameters belonging to the Start Up class and belonging to the Design class.

Special View:

Shows parameters belonging to the Start Up class, belonging to the Design class and belonging to the Special class.

Views are selected by the drop down button in the upper left corner of the Parameters Tool window.

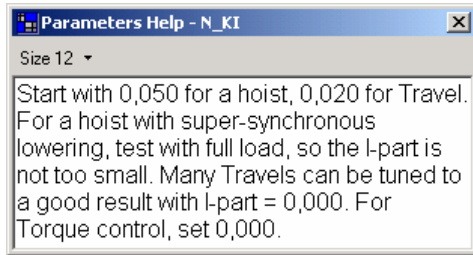
Next to the **Parameters Views** button is the **Release Version** button. The caption of the button shows the Release Version of the current **project**. If this does not equal the latest version a drop down menu can be selected allowing conversion to a **higher** release version. When converting, ASTAT Tool scans the project to remove parameters not used in the new release version and add new parameters. Added parameters are set to their default values.

Notice that while you can convert the project from Release X to Release X + n, the opposite is prohibited by ASTAT Tool. This limitation is implemented because of the way the parameter lists are evolved in the ASTAT Hardware.

When a group is open, it will show the parameters belonging to the group. A group and parameter number and an 8-character long identifier represent each parameter. Most of the parameters have a short description, which is shown in a description text box placed in the lower tool bar of the parameter window.

Some of the parameters also have a short Help text attached. Pressing F1 shows the help. This opens the Parameter Help window as shown below.

3.3.1.1. Parameters Help



The parameters help windows show available (if any) help regarding the currently selected parameter.

Four different font sizes can be selected. This is included to allow adjustments to different screen sizes and environmental conditions.

3.3.1.2. Editing Parameters



Most parameters are edited using the standard numerical edit box (see figure). User may enter floating-point values; ASTAT Tool converts these to 16-bit values according to the definition of the particular parameter. Due to the limited resolution (16 bit, signed) entering a value such as 11.57 may result in 11.6.

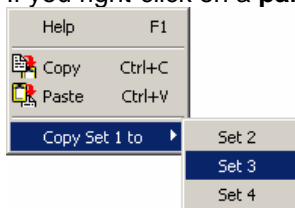


Some parameters are defined as 'multiple-choice' settings. Editing such a parameter will present another kind of edit box (see figure). This type of content-sensitive editing can be turned off via the Preferences menu function (F9).

Changing the value of the parameter 1.1 (DR_ADD) will also update the address of the current communication channel.

3.3.1.3. Copying Parameter Sets

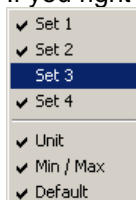
If you right-click on a **parameter value** in the parameters grid the context menu pictured below appears.



The "Copy Set" function to copies the complete parameter set to another set. This will affect all parameters, not only the visible ones.

3.3.1.4. Grid Header Context Menu

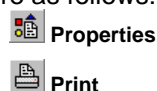
If you right click on the **column header** in the parameters grid the context menu pictured below appears.








This context menu allows you to toggle which columns should be visible.

3.3.1.5. Parameters - control panel

The icons are as follows:



-  **Configure Set Names**
-  **Reset to Default Values**
-  **Icons 1 to 4 determine which Sets are visible**
-  **Expand All Groups**
-  **Collapse All Groups**

3.3.1.6. Parameters - Online / Offline

The differences between being ONLINE and OFFLINE are as follows:

When editing in OFFLINE mode, the values of the parameters are only altered in the ASTAT Tool. No data is sent to or received from the ASTAT Hardware.

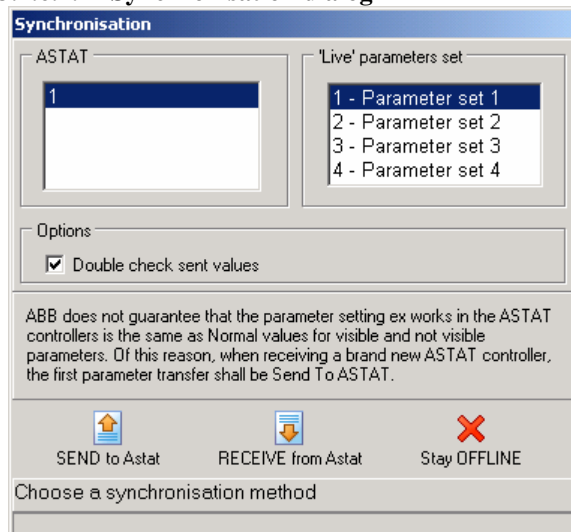
When editing in ONLINE mode, the values of the parameters are altered in BOTH ASTAT Tool and the connected ASTAT Hardware.

In ONLINE mode, only one (currently selected) parameter group can be edited.

ONLINE mode requires a connection to ASTAT Hardware.

Notice that, unlike the Signals Tool, parameters that are **not visible** because of the **Parameters View** selection or a closed group **are processed** when entering ONLINE mode and copying sets. When switching to ONLINE mode, a process called 'Synchronisation' is applied. Synchronisation makes sure that the values in the ASTAT Tool and the ASTAT Hardware are identical. As there are different ways of synchronising, the user is presented with the Synchronisation dialog (see figure below).

3.3.1.6.1. Synchronisation dialog



The 'Live Parameter Set' box lists four parameter sets. The group currently active in the ASTAT Hardware will be pre-selected. User may change the current group by clicking in the list box.

ASTAT Tool will then temporarily take over the control of the group selection that is otherwise controlled by the hardware. The control will be returned to ASTAT Hardware when going OFFLINE.

'Live Parameter Set' is the only set of parameters that can be edited while being in the ONLINE mode. This set is distinguished from other sets by a different colour.

The Synchronisation dialog offers two distinct methods of synchronisation:

Send to ASTAT

Local parameter values are sent to the ASTAT Hardware. Use this when you want to apply the parameter configuration of the current project to the connected Hardware. **NOTE!** Make sure that the ASTAT is not running any motions when using 'Send To ASTAT'.

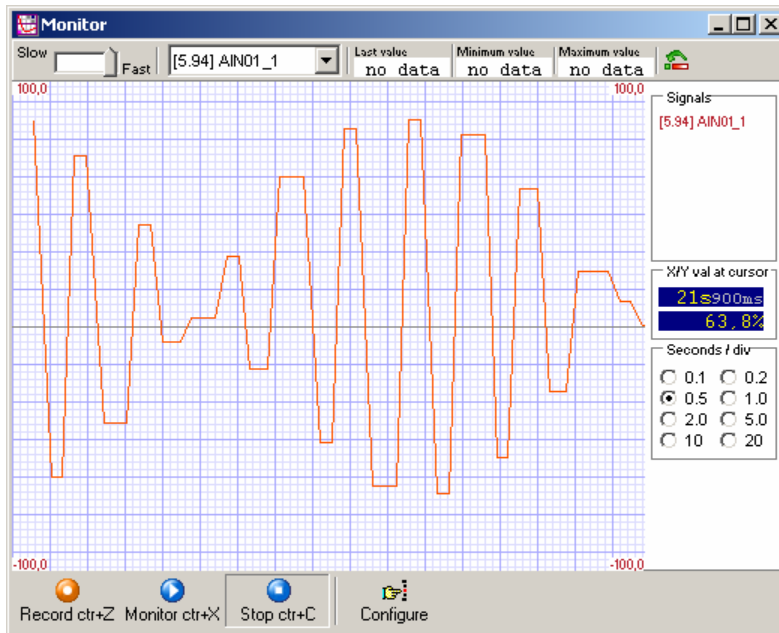
Receive from ASTAT

Parameter values will be received from the ASTAT Hardware and stored in the parameter configuration of the current project.

The changes made in the ONLINE mode (i.e. after the synchronisation has been performed) are NOT stored into the Flash memory of the ASTAT Hardware unless the user chooses to do so when going OFFLINE).

Warning: ABB does not guarantee that the parameter setting ex works in the ASTAT controllers is the same as Normal values for visible and not visible parameters. Of this reason, when receiving a brand new ASTAT controller, the first parameter transfer shall be Send To ASTAT.

3.3.2. Monitor Tool



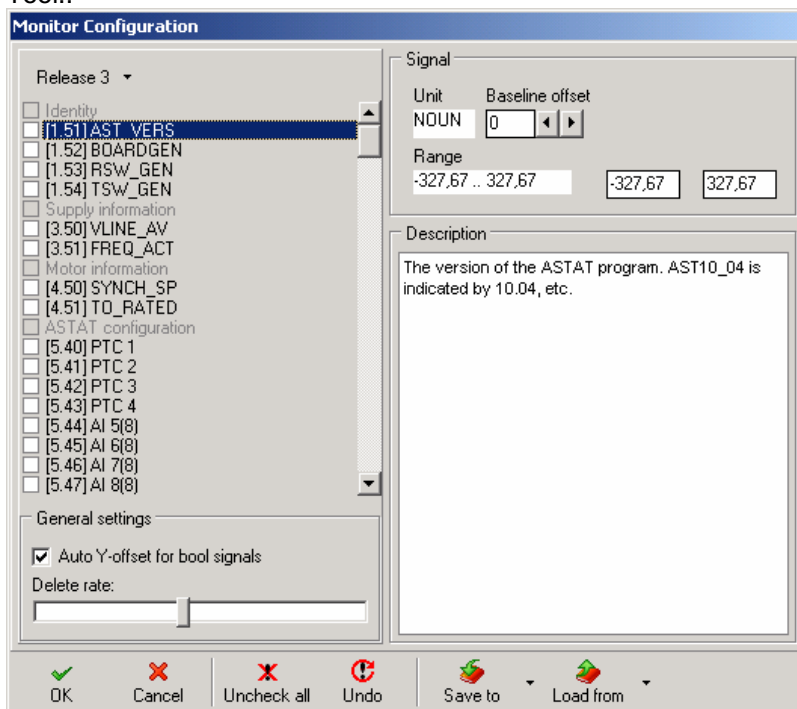
The Monitor Tool is used to present selected ASTAT signals in a visual manner.

Up to six separate signals can be monitored at the same time. Each signal is Y-scaled (value) according to its definition in the signal-definition file (signals4.ini).

3.3.2.1. Monitor Configuration dialog

Before using the Monitor Tool you will need to select the signals you wish to monitor. This is done with the Monitor Configuration dialog.

The Monitor Configuration dialog is accessed through a button in the lower control panel of the Monitor Tool.



Check the signals that you want to monitor in the signal-panel to the left.

When first checked, the signal is assigned a semi-random (white will never be assigned for instance) colour. If you want to choose a different colour press the “Color” button, which becomes visible once a signal has been checked.

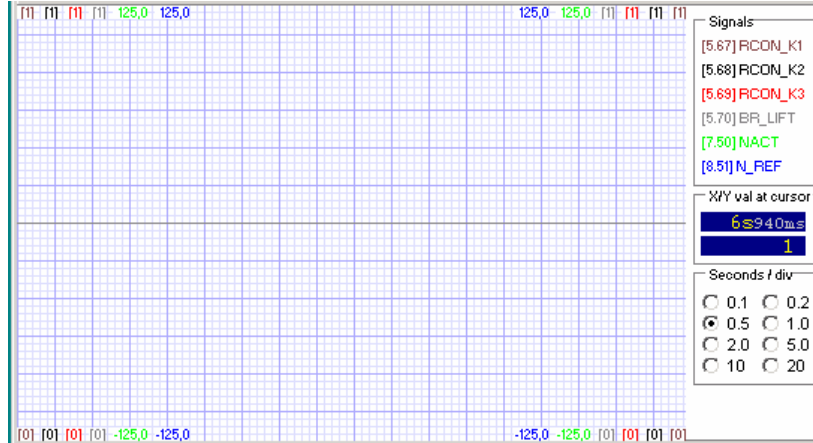
The **Delete rate** slide bar controls the width of the horizontal gap when the monitoring wraps in X-axis. When checked, the ‘Auto Y-offset for bool signals’ toggle will automatically place boolean-type signals in separate horizontal planes for better visibility. The Y-offset can also be manually changed by altering the **Baseline offset** value. Each step equals one blue square.

ASTAT Tool will not allow for more than six signals to be selected. The limitation to six signals is due to the optimisation in the communication protocol that allows for faster and less CPU intensive transfer of signal-values. *Note: here the "CPU" refers to the central processing unit of the ASTAT Hardware, not the PC running ASTAT Tool software.*

Up to three monitor configurations can be saved and recalled using **Save to** and **Load from** buttons.

At delivery two Sets are predefined. The choice of signals is based on experience from crane start-up procedures:

Set One:



Set Two:



Set Three:

is not predefined

Note: Each Set is stored in a separate file named DEFMONx.INI and placed in the same directory as the ASTAT.EXE files. The files can be easily replaced and are small enough to be sent over slow modem connections – for instance when you would like to get back a recording of a particular setup

3.3.2.2. Upper control panel

Functions in the upper control panel allow user to change the 'sample-rate' i.e. time interval between requests to the ASTAT hardware. Further, user can view last value, minimum and maximum values of the selected signals and reset these values.

3.3.2.3. Lower control panel and right side control panel


The three leftmost buttons of the lower control panel are used for recording, monitoring and stopping. Recording can be started by either immediately pressing the record button or by pressing the recording button after the monitoring has been started.

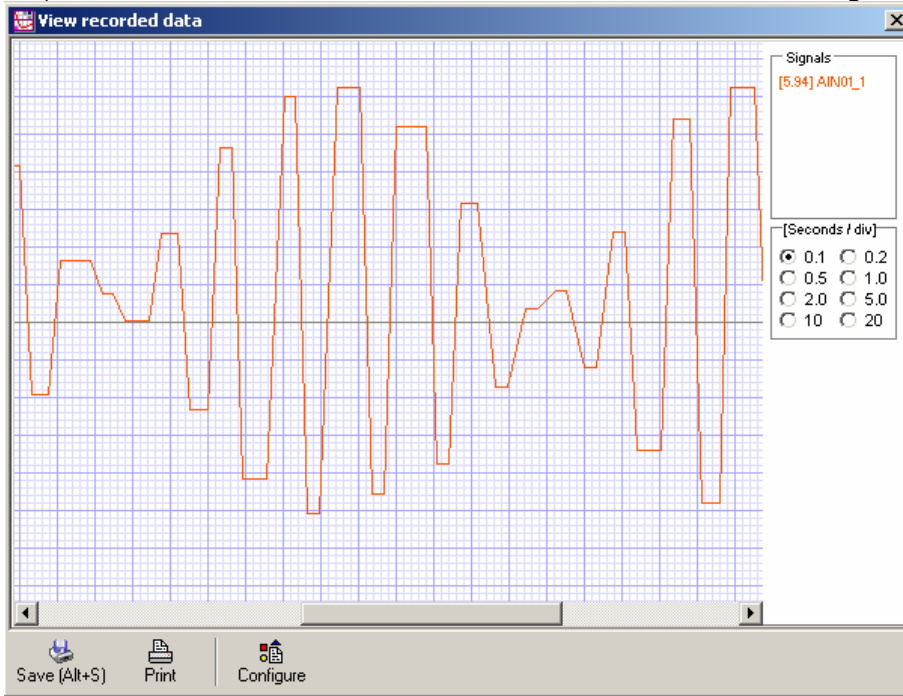
The right side control panel allows the user to control the X-axis scaling of the graph. This is the time scale ratio in respect to the blue square net drawn in the background of the graph. A seconds/div value of 1.0 means that each square (dark blue lines) represents one second of time. Use higher values for long term monitoring and lower values for precise short term monitoring.

The 'X/Y value at cursor' box shows the time delta relative to the left edge of the graph window and the value of the selected signal at the cursor position.

In the corners of the graph, maximum and minimum values of each signal is shown in the signal's respective colour.

Note that resizing the monitor window will restart the graph. Choose an appropriate window size before starting any important monitoring!

When the  (RECORD) button is pressed, a new window (the monitor viewer window, see below) is created. This window shows the recorded data after the recording has been stopped.



Although this window has a very similar layout to the Monitor window there are a few differences. As this is a view of already recorded data, the **Record** and **Monitor** buttons are missing. Instead, there are two new buttons –**Save** and **Print**. Further, the graph data is shown as a continuous strip that can be scrolled using the scroll-bar situated below the graph.

3.3.3. Signals Tool

Grp ID	Name	Value	Unit
8.55	DIR_B	0	LOG
9	Speed regulator		
9.50	SPEEDERR	0,0	%
11	Current/Torque regulator		
11.50	TORQ_REF	0,0	%
11.51	TACT	0,0	%
11.52	IS_REF	21,1	%
11.53	ISACT	4,9	%
11.55	ALPHA	140,0	DEG
11.57	VMOT_AV	0	V
11.61	FREQFLT	0	LOG
11.62	PHSEQFLT	0	LOG
11.63	SYNC_OK	0	LOG
11.72	BR_ACT	0	LOG
11.73	BR_FWD	0	LOG

Status: ONLINE

Expand Collapse

Slow Fast

Online

Synchronisation with line voltage, 1- synchron. OK, 0-synch. failed.

The Signals Tool is used to monitor current values of the signals in ASTAT Hardware. The values are presented with a numerical value and the signal unit.

Each signal belongs to a Signal Group. Each group is represented by a number and a name.

Signal Groups are opened and closed by double-clicking the group name or selecting a Signal Group with the cursor pressing <SPACE>.

For signals the Tool now includes different Views. All the signals are listed in the Manual together with information regarding the View that they belong to.

Start Up View:

A restricted number of signals that by experience are the most important for Start Up.

I/O View:

Maps the boards DATX 100, DATX 110 and active Cabin I/O DATX 120. Also shows the Start Up class signals.

Fault View:

Shows all Fault Signals but no other signals

Normal View:

Shows most used signals including the classes Start Up, I/O and Faults

Special View:

Like Normal view, but shows all listed signals in the system

Views are selected by the drop down button in the upper left corner of the Signals Tool window.

Next to the **Signal Views** button is the **Release Version** button. If there was a connection to ASTAT Hardware when Signal Tool was opened this defaults to the Release Version retrieved from the ASTAT Hardware. If no connection was available, **Release Version** defaults to the latest version defined in the configuration files – you can manually change the **Release Version** at any time.

3.3.3.1. Signal Group 21

Signals belonging to Group 21 (Fault Handling System) are logical values and are colour coded according to following:

Values of 0 (no error) are coloured **green** while values of 1 (error) are coloured **red**.

3.3.3.2. Signals - Online / Offline

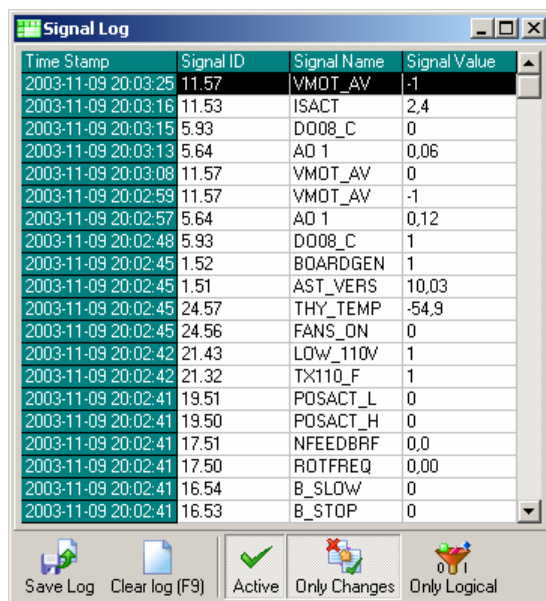
The Signals tool can be either Online or Offline. Being Online means that the ASTAT Tool is continuously updating the signal values with actual values from the hardware.

The values of signals in closed groups are not retrieved; Closing groups that do not contain signals of interest will speed up the refresh rate when in the Signal Tool is in ONLINE mode.

3.3.3.3. Signals – Control panel

The control panel of the signals tool contains a slide bar that controls the speed of value updates. Further there are icons for expanding and collapsing signal groups, description of the currently selected signal and status text.

3.3.4. Signal Log Tool



Time Stamp	Signal ID	Signal Name	Signal Value
2003-11-09 20:03:25	11.57	VMOT_AV	-1
2003-11-09 20:03:16	11.53	ISACT	2,4
2003-11-09 20:03:15	5.93	DO08_C	0
2003-11-09 20:03:13	5.64	AD 1	0,06
2003-11-09 20:03:08	11.57	VMOT_AV	0
2003-11-09 20:02:59	11.57	VMOT_AV	-1
2003-11-09 20:02:57	5.64	AD 1	0,12
2003-11-09 20:02:48	5.93	DO08_C	1
2003-11-09 20:02:45	1.52	BOARDGEN	1
2003-11-09 20:02:45	1.51	AST_VERS	10,03
2003-11-09 20:02:45	24.57	THY_TEMP	-54,9
2003-11-09 20:02:45	24.56	FANS_ON	0
2003-11-09 20:02:42	21.43	LOW_110V	1
2003-11-09 20:02:42	21.32	TX110_F	1
2003-11-09 20:02:41	19.51	POSACT_L	0
2003-11-09 20:02:41	19.50	POSACT_H	0
2003-11-09 20:02:41	17.51	NFEEDBRF	0,0
2003-11-09 20:02:41	17.50	ROTFREQ	0,00
2003-11-09 20:02:41	16.54	B_SLOW	0
2003-11-09 20:02:41	16.53	B_STOP	0

Save Log Clear log (F9) Active Only Changes Only Logical

The Signal Log Tool is a simple yet effective multi purpose logger of signals.

It works in conjunction with the Signal Tool and the Monitor Tool in the sense that it can log signal values that are retrieved by the Signal Tool and the Monitor Tool.

3.3.4.1. Using the Signal Log Tool

To log signals, you need to make sure that the signals are retrieved from the ASTAT Hardware. The System Log Tool will not request signals by itself; instead it relies on signals requested by other Tools. The main benefit of the approach is maintained communication speed.



When created Signals Log Tool is in **Inactive** mode.



When in **Active** mode, any signal that is retrieved from ASTAT Hardware will be sent to the Signal Log Tool as well as the Tool that “ordered” the Signal. Once the Signal Log Tool starts receiving data in **Active** mode it begins adding log events.

3.3.4.1.1. Filtering events

To increase usefulness of the logger output, you can filter the stream by toggling these buttons:



When **Only Changes** option is active, the logger caches the received signals and only adds an event to the log when a change has been detected. Note: The initial signal value for a particular signal is considered a “change” and an event is added. Further, if no value for a particular signal has been received for more than 60 seconds, the next value received is considered a “change” and an event is added to the log.



When **Only Logical** option is active, the logger will only add an when a received signal is a logical signal (true or false).

Inherently, when both filter are active, the logger will add an event only when a state change in a logical signal has been detected.

3.3.4.2. Saving the logger output to a text file

Pressing the **Save Log** button opens a dialog allowing user to select an output file. The saved file is a tab separated text file. You can open this file in a regular text editor or import it into a worksheet application like Microsoft Excel.

3.3.4.3. Example: Using Signal Log Tool to log faults

In this setup example, the Signal Log Tool is used as a fault logger:

Open the **Signals Tool** and select the **Fault View**

Open the **Signals Log Tool**

Toggle the mode to **Active** by pressing the button in the Toolbar of the Signals Log Tool.

To start logging, set the Signals Tool to ONLINE mode. The Signals Tool will start retrieving signals (in this example, limiting the signals to fault signals) and the Signal Log Tool will log the received data. The result might look like the figure below.

The screenshot shows the Signals Log Tool interface. On the left, the 'Signals' window displays a table of fault signals for 'Fault handling system 21'. The table has columns for Grp ID, Name, Value, and Unit. The 'Value' column shows 0 for most signals and 1 for TX122_F and LOW_110V. The 'Unit' column shows LOG for all signals. Below the table, there are controls for Status (Online), Expand/Collapse, and a speed slider.

On the right, the 'Signal Log' window displays a table of logged events. The table has columns for Time Stamp, Signal ID, Signal Name, and Signal Value. The 'Signal Name' column lists various fault signals like TQPR_FLT, PTC4TRIP, PTC3TRIP, etc. The 'Signal Value' column shows 0 or 1.

At the bottom of the Signal Log window, there are buttons for Save Log, Clear log (F9), Active, Only Changes, and Only Logical.

If the **Only Changes** option is active **and** the received signals belong to group 21 (fault handling) the filtering rules are modified to include following: If the **initial** value received for a particular signal in group 21 is FALSE (i.e. 0 = no fault), an event will **not** be added. *Initial value of TRUE, as well as the consequent state changes are logged.*

3.3.5. Motion Control Panel



The Motion Control Panel (MCP) contains the same functions as the Motion submenu, presented through a graphical user interface.

Additionally, the MCP shows status of the communication channel to ASTAT hardware.

The MCP is divided into four areas. These are (from left to right):

ASTAT Address

Motion Control Buttons

Speed/Torque Reference setting

Active Connection Status

The ASTAT Address field states the ID of the ASTAT Hardware that the MCP is operating on. Depending on the state of the connection, the number is light green (LOCAL mode ON) or dark green (LOCAL mode OFF). If no ASTAT has been found, the caption (in red colour) is 'N/A'.

To signal whereas a connection is established MCP draws a picture of ASTAT hardware in the rightmost corner of the panel. If there is no connection with the hardware the picture is greyed.



Active Connection



No Connection

If there is an active connection available, ASTAT Tool will retrieve the Release version of the Software running the ASTAT hardware. For instance, in the screenshot in the beginning of this chapter the hardware that the ASTAT Tool was connected to had Release 3 software running. This information is used by rest the system as a default (for instance the Signals Tools will automatically select signals available in Release 3 if this is what has been detected in hardware).

If no connection was detected the system defaults to the latest release version registered in the configuration files.

Note: In "Active Connection", the term "Active" is used to imply that the status of the connection has been confirmed; if no user traffic is detected, the communication protocol generates ping-pong style messaging.

3.4. Templates

3.4.1. Templates defined

Templates are ASTAT tool configuration files with the file-extension *.ATT (as opposed to *.AST). The difference is in the way the Tool handles the file upon opening or saving. When the user opens a template it is treated as a NEW file without a name, thus user must use the 'Save As' function when saving a template. The default extension when saving an opened template file is AST.

Or in other words, templates are used to create new ASTAT configuration files from a set of parameter values and motion properties defined by the opened template.

3.4.2. Working with templates

Templates are particularly useful in two scenarios:

Predefined configurations for certain types of hardware (motor etc.)

Using a machine or plant template to create configuration files

In the first scenario the user starts with a template that contains parameters that are suitable for the type of hardware that is being used.

The second scenario targets the situation when the user first defines parameters such as the 'Machine name', 'Plant name' etc. These parameters are generally same for each motion within the system of motions (cranes).

3.5. Keyboard shortcuts

To make usage easier in environments where the mouse or other pointing device is impractical, most of the functions have keyboard shortcuts. These are as follows:

Keyboard shortcut	Function
F1	Opens the parameters help file
F5	Motion properties
F6	Monitor tool
F7	Signals tool
F8	Parameters tool
F9	Program preferences
Control + N	Create a new file / open a template
Control + O	Open a file
Control + P	Printing functions
Control + Q	Close current file
Control + S	Save current file
Control + Z	Start Recording (in Monitor/ Recording Window)
Control + X	Start Monitoring (in Monitor/ Recording Window)
Control + C	Stop Monitor / Recording (in Monitor/ Recording Window)
Alt + C	Communication Setup
Alt + Q	Search for Connected Equipment

4. Functions

ASTAT has different functions available for the motion control. The functions are categorised in different groups, where the functions are fixed and ready to use or selectable by parameters.

Inside each group mostly only a few parameters have to be modified for each installation while the others can be kept as the Normal Values, or from the company standard of the user. In most cases the majority of parameters can be left as they are.

It is not only possible to set parameters. A large number of signals are available for daily supervision and maintenance support as well as for qualified troubleshooting and motion control optimisation. Signals can either be internal inside a group of functions or carry information between different groups.

Following Groups of functions are available:

Group no.	Group name	No. of changeable Parameters			No. of Signals	Main circuit information
		Office (Design)	Crane (Start up)	Special		
	Place of setting the parameter: (Project working phase):					
01	Identity	1	0	2	3	-
02	I/O units and Factory test	1	0	1	0	-
03	Supply information	3	0	0	2	Yes
04	Motor information	7	0	0	2	Yes
05	ASTAT configuration	29	0	1	56	Yes
06	Brake information	4	2	4	5	Yes
07	Speed feedback	3	2	2	3	-
08	Speed reference	7	6	12	6	-
09	Speed regulator	4	9	10	1	-
10	Speed supervision	4	1	10	0	-
11	Current regulator	2	2	7	10	-
12	Rotor resistor	9	0	11	0	Yes
13	Selectable DO	2	0	0	0	-
14	Load functions	12	0	4	2	-
15	Slack Rope function	1	0	0	0	-
16	Limit switch function	0	0	0	4	-
17	Rotor system	0	1	1	2	-
19	Pulse encoder	0	0	2	0	-
20	Master-Follower	1	0	3	1	
21.1	Motion control logic	0	0	0	0	-
21.2	Shared motion	0	0	0	0	-
21.3	Two operator stations	0	0	0	0	-
21.4	Different parameter sets	0	0	0	0	-
21.5	Fault handling system	0	0	0	61	-
22	Options for Fault handling	3	0	0	0	-
25	By-pass control	1	0	10	2	
Total number of parameters and signals		94	23	80	160	

Parameters

The parameters shall be set in the by the application Designer (**D** in the column SET), by the start up engineer at the Start-up (**S** in the column SET) and some are set only for advanced tuning and some particular functions (**X** in the column SET).

D: At design: 94 parameters
S: At start-up: 23 parameters
X: Special: 80 parameters for advanced tuning and particular functions

10_05 has fewer parameters than earlier releases as a large number of hidden parameters are replaced by constants.

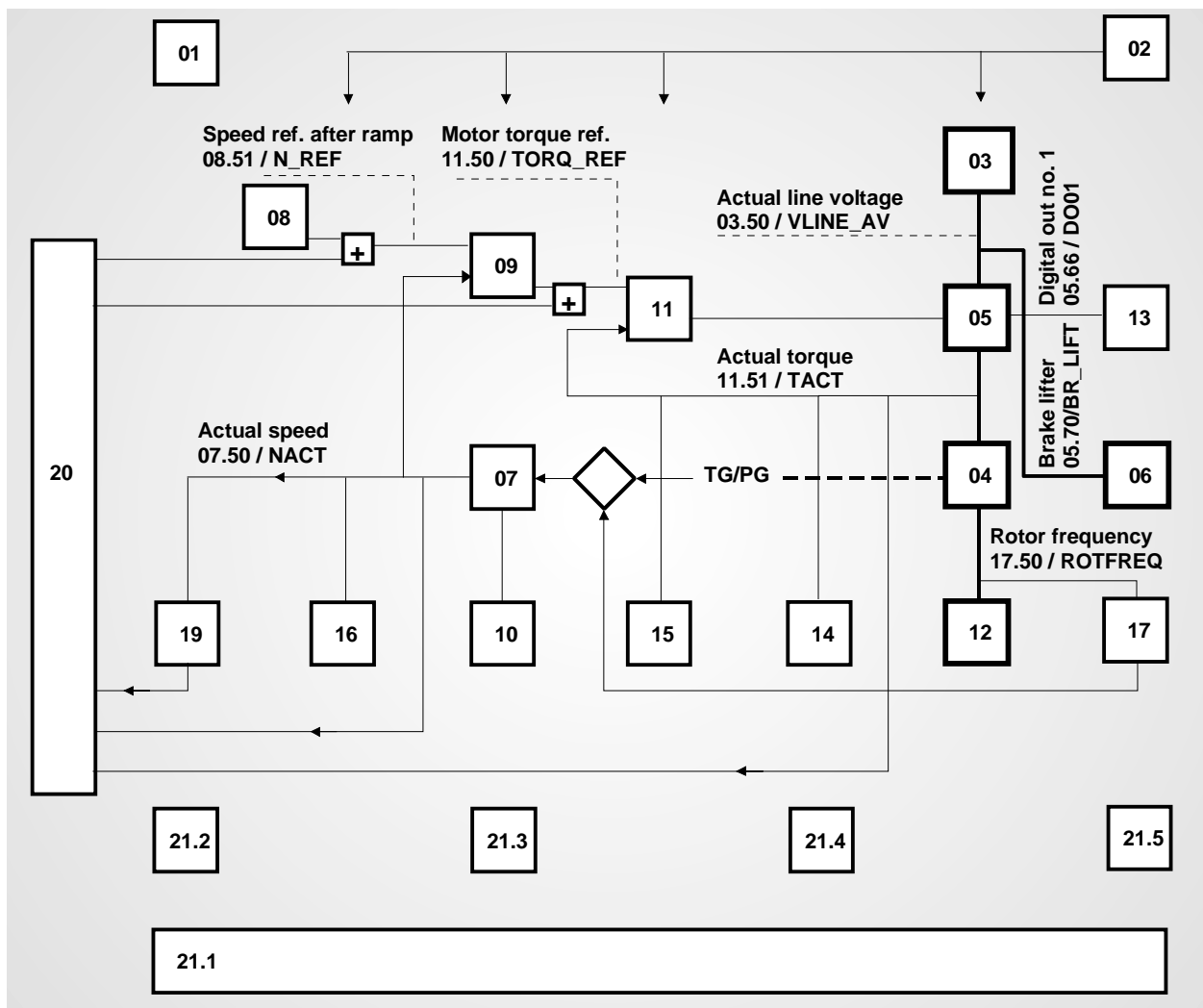
Signals

Also Signals can be selected in different Views.

- Start-up View gives you the most important signals
- I/O View gives a mirror of the physical inputs and outputs (+ all from Start-up View)
- Normal View gives you the most important signals including Fault signals
- Special View gives you all signals.

Main relations between the Groups of functions:

Group	Name	Group	Name	Group	Name
01	Identity	09	Speed regulator	17	Rotor system
02	I/O units and Factory test	10	Speed supervision	19	Pulse encoder
03	Supply information	11	Current regulator	20	Master-Follower
04	Motor information	12	Rotor resistor	21.1	Motion control logic
05	ASTAT configuration	13	Selectable DO	21.2	Shared motion
06	Brake information	14	Load functions	21.3	Two operator stations
07	Speed feedback	15	Slack Rope function	21.4	Different parameter set
08	Speed reference	16	Limit switch function	21.5	Fault handling system



4.1. Group 1: Identity

4.1.1. Description

4.1.1.1. Identity

The motion identity must be unique among the motions that are managed from one tool as well as among the nodes of a Master-Follower network.

As delivered from the factory a new ASTAT / a spare part board has the Motion identity 1, i. e. parameter **01.01** is 1.

For a crane the different motions can have the same identities as the recommended functional designations:

ASTAT for motion:	Parameter 01.01
Hoist no. 1 / Grab crane Hold drive	2
Redundant or second ASTAT for Hoist no. 1 / Grab crane Close drive	8 ⁷
Hoist no. 2 / Jib	3
Redundant or second ASTAT for Hoist no. 2	8
Trolley no. 1 / Slew drive	4
Redundant or second ASTAT for Trolley no. 1	8
Trolley no. 2	5
Redundant or second ASTAT for Trolley no. 2	8
Crane Bridge travel / Gantry	6
Redundant or second ASTAT for crane Bridge travel	8
Hoist no. 3	7
Redundant or second ASTAT for Hoist no. 3	8
Identity of a spare board on stock	1

4.1.1.2. Reallocation of Master-Follower partner

From 10_05 release it is possible for different Macros to use different partners in a M-F relation. The function is developed for installations with very high requirements of availability.

4.1.1.3. Condition for change of macro

Selection between different ways for changing Macro. The selection is made with DI3 and DI4 of process I/O board DATX 110. A new parameter 01.03 is inserted.

Value = 0: Change takes place during CRANE OFF (as until AST10_04)

Value = 1: Change takes place during standstill with Master switch in neutral position

Value = 2: Change takes place during CRANE OFF as well as standstill with Master switch in neutral position.

Value = 3: Change takes place during standstill with Master switch in neutral position, and DI 7 of Cabin I/O is high. DI 7 used in this way has higher priority than Step 4 function and Load display tare function.

⁷ If Address no. 8 is not covering the needs, the address range can be extended to 255.

4.1.2. Parameters

Description	MIN	MAX	NORM	SET	IDENTITY	English text
Motion identity.	1	255	1	D	0101	DR_ADD
0=The standard MF-port is used for MF-communication. 1=The MC-port is used for MF-communication. This function is used for redundant systems.	0	1	0	X	0102	MFCMPORT
0=Change takes place during CRANE OFF (as until AST10_04) 1=Change takes place during standstill with Master switch in neutral position 2=Change takes place during CRANE OFF and standstill with Master switch in neutral position 3=Change takes place during standstill with Master switch in neutral position, and DI 7 of Cabin I/O is high. DI 7 used in this way has higher priority than Step 4 function and Load display tare function.	0	3	0	X	0103	MACROMOD

4.1.3. Signals

Description	Unit	IDENTITY	English text
The version of the ASTAT program. 10_05 is indicated by 10.05, etc. Older versions than AST10_02 will give 00.00	-	0151	AST_VERS
The generation of control board DAPC 100. 10_05 can be run on at least generation 1 and 2 of DAPC 100.	-	0152	BOARDGEN
The version of software of Rotor measurement unit DATX 130. Version 1 is labelled R1 ; version 2 is labelled R2 etc. The signal gives a value 0, 2, 3..... Value 15 is given when no DATX 130 is used (i. e. for DARA 1000) and for earlier versions than R2. Value 2 is given for version R2; value 3 is given for version R3 etc. Version of ASTAT program 10_05 (see signal 01.51 above) requires software version R2 of DATX 130.	-	0153	RSW_GEN

4.2. Group 2: I/O units and Factory test

4.2.1. Description

4.2.1.1. Cabin I/O

The motion control system can be used with or without remote/extended I/O, "Cabin I/O". Some functions requires Cabin I/O:

Shared motion, Soft limit switch, Direct connection of load cell, Switching between two operator stations, Switching between two / four parameter sets, Full information about four motors.

If the motion includes four motors, without Cabin I/O ASTAT will only see two motors from the detailed information point of view - still four motors can be used with a few contacts in serial connection.

Parameter **02.01 = 5** means that the master switch is connected DARA 100x board DATX 110.

Parameter **02.01 = 0** for installation with one or two Cabin I/O for master switch connection.

Parameter **02.01 = 1** for the master switch connected to Cabin I/O #2, and Cabin I/Os #1 and #3 used for mirror wise signal transfer from cabin to E-room using the same fiber cable. DO and AO of Cabin I/O #1 are copies of DI and AI of Cabin I/O #3 and vice verse.

4.2.1.2. Mechanical No-load test

The mechanical drive train can be tested with no load. This function overruns following eleven faults:

- 1) Fault 65 Speed Deviation
- 2) Fault 66 Pulse transmitter fault
- 3) Fault 71 Torque fault
- 4) Fault 72 Overload DI
- 5) Fault 73 Overload AI
- 6) Fault 75 Overspeed DI
- 7) Fault 76 Overspeed, Calculated
- 8) Fault 78 Slack rope down stop
- 9) Fault 79 Slack rope down slow-down
- 10) Fault 80 Limit switch fault
- 11) Fault 89 Tachometer fault

All other faults are actively supervised. The electrical supply and internal wiring except what is related to the eleven exceptions should be in good order.

This function cannot be used for Shared motion drives.

Full master-switch in any direction corresponds to full voltage on the motor(s). First step corresponds to a small voltage; intermediate positions to intermediate values correspond to intermediate voltages. One cannot say that the master-switch position is proportional to the speed of the motion.

The direction of rotation of the rotation will follow the direction signals "A" and "B" of the master-switch. Leaving the crane factory, all motors of each motion should have the correct direction of rotation.

Digital outputs will be set in following pattern:

DO 1 ... (Thyristor fan)	0
DO 2 ... (Rotor contactor K1)	1
DO 3 .. (Rotor contactor K2)	0
DO 4 ... (Rotor contactor K3)	0
DO 5 ... (Brake lifter contactor)	Closing when the master-switch is moved out of neutral position
DO 6 ... (Forced Brake contactor)	Follows normal program
DO 7 ... (Fault)	1
DO 8 ... (Dangerous fault interlocking)....	1

This function helps the crane builder to pre-commission the crane, motion by motion.

The mechanical No-load test function is made on by setting parameter **02.10** to 1. It is made off and back to normal control by setting parameter **02.10** to 0.

! It is important that parameter **02.10** has the value 0 when the crane is delivered from the crane factory.

! Hoist motions must only be handled with small load using the mechanical No-load test function.

4.2.1.3. System check run

This run type checks the condition of contactors and rotor resistors. It needs support functions by a PLC.

4.2.1.4. Load functions

All information about the load functions is moved to subsection **14.4, Load functions.**

4.2.2. Parameters

Description	MIN	MAX	NORM	SET	IDENTITY	English text
Set 0 for installation with one or two Cabin I/O for master switch connection. Set 1 for one Cabin I/O for master switch and two for mirror wise signal transfer. Set 5 for installations without Cabin I/O. The setting is overridden by By-pass mode 1 or 2 (parameter 25.01)	0	5	5	D	0201	RUN_TYPE
Run crane factory test program. No interlocking, works in soft starter mode. Must be set to 0 at delivery from the crane factory. This is a subject of safety.	0	1	0	S	0210	FACT_RUN

4.3. Group 3: Supply information

4.3.1. Description

This group of information shall be included in the design phase.

The parameters are self-explanatory.

4.3.2. Parameters

Description	MIN	MAX	NORM	SET	IDENTITY	English text
Line and motor nominal voltage. Unit: V. Use any voltage up to 600, or one the two voltages 660 or 690, nothing else. Examples: 530 V is OK. 630 V is not OK. 690 V is OK	380	690	400	D	0301	MAINS_VO
Can be set to either 50 or 60. Unit: Hz.	50	50 / 60	50	D	0302	FREQUENC
The smallest voltage that is accepted before the motion is stopped.	70	100	80	D	0303	MIN_Vopc

4.3.3. Signals

Description	Unit	IDENTITY	English text
Actual line voltage	V	0350	VLINE_AV
Actual line frequency	Hz	0351	FREQ_ACT

4.4. Group 4: Motor information

4.4.1. Description

This group of information shall be included in the design phase.

Parameter **04.08** permits the use of special higher voltage than 690 V Thyristor Modules by using a step down Motor voltage measurement transformer. The rest of parameters are self-explanatory.

4.4.2. Parameters

Description	MIN	MAX	NORM	SET	IDENTITY	English text
Numbers of connected motors.	1	16	1	D	0401	NO_MOTOR
Rated kW of each motor.	1	2000	1	D	0402	kW_MOTOR
Rated current of each motor. Unit: A. If the motor rating plate is other than S3-40% or S3-60% at IEC +40 degree C, recalculate the rating plate current to S3-60%. Rated current for rating Duty S2-60 minutes fits without recalculation.	1	2200	1	D	0403	IN_MOTOR
The motor's or motors' rated speed in min^{-1} .	340	3600	980	D	0404	NN_MOTOR
Number of poles.	2	16	6	D	0405	NO_POLES
Pull out Torque of the motor in per cent of the rated torque.	150	400	250	D	0406	MAX_TOpc
Rated rotor voltage of the motor(s). The voltage is only used for supervision of resistors and the rotor and is of this reason only interesting for DARA 1001, 1010	50	600	350	D	0407	U_ROTOR

4.4.3. Signals

Description	Unit	IDENTITY	English text
Synchronous motor speed	RPM (min^{-1})	0450	SYNCH_SP
Rated motor torque	Nm	0451	TO_RATED

4.5. Group 5: ASTAT configuration

4.5.1. Description

This group of information shall be included in the design phase, and shall be known before the wiring scheme is made. The parameters will determine the function of Process interface DATX 110 and Cabin interface DATX 120(121).

4.5.1.1. Rated current

It is only allowed to use current values from the catalogue list: 25, 50, 100, 200, 355, 500, 600, 630, 850, 1000, and 1100. And 660 / 710 for low height high capacity version with parallel 330/355 Amp thyristor modules. And 1200/1260 for two parallel 600/630 A thyristor modules. And 2000 for two parallel 1000 A thyristor modules. And 2200 for two parallel 1100 A thyristor modules.

For parallel thyristor modules jumper S1 of board DAPC 100 must be in position 3-4. For single thyristor module in position 1-2.

4.5.1.2. Type of control system

From release 10_054 it is not needed to give this information.

4.5.1.3. Shared motion

The shared motion function allows the ASTAT to act as one hoist motion and one travel motion or as two hoists or two travels:

Connect a switch to DI no. 7 of the Cabin I/O DAPM 100, 101.

With the switch **open** following situation will be:

- Parameter set 1 or 2 is selected.
- Board DATX 110, DI no. 4 will finally decide with of these two sets, 1 or 2, that is used.
- Open DATX 110 DO no. 8, "Shared motion selected".
- Command which DI and AI, which should be read.
- NB! The DI is only receptive for changes when the Master switch is in zero position.

With the switch **closed** following situation will be:

- Parameter set 3 or 4 is selected.
- Board DATX 110, DI no. 4 will finally decide with of these two sets, 3 or 4 that is used.
- Close DATX 110 DO no. 8, "Shared motion selected".
- Command which DI and AI, which should be read.
- NB! The DI is only receptive for changes when the Master switch is in zero position.

Outside the system must be done (based on the DO):

- Operate contactors for the main circuit
- Brake lifter contactors must be selected as a wired "AND" of the DO Brake-lifter contactor and the DO Shared motion selected.
- Operate change over relays for the speed feedback

Comments:

- Rotor contactors can operate for both the selected and not selected motors.
- For the auxiliary hoist in Shared motion, there are no Pre limit switches included, only Stop limit switches.
- For the creation of the application software it is considered the not addressed DIs could be in any state.
- Motion no. 1 uses parameter set no. 1 as first (=normal) parameter set and no. 2 as second parameter set. Digital input no. 4 on the process I/O board DATX 110 will switch over to the second parameter set for this motion that is parameter set number 2.

- Motion no. 2 uses parameter set no. 3 as first (=normal) parameter set and no. 4 as second parameter set. Digital input no. 4 on the process I/O board DATX 110 will switch over to the second parameter set for this motion that is parameter set number 4.

Parameter setting of parameter **05.03**:

- Parameter sets number 1 and number 2 must be the same. Either 12 or 22.
- Parameter sets number 3 and number 4 must be the same. Either 12 or 22.

4.5.1.4. Type of Limit switch

During normal service the limit switch H slows down the motion in direction A (\equiv Up/right), and limit switch HH stops it. In direction B (\equiv Down/left) L slows down, and LL stops.

4.5.1.4.1. Four switches

Considers traditional limit switches HH, H, L and LL. There are settings of parameter **05.04** to either totally bypassing the limit switches or to keep using them, but suppressing the evaluation of impossible combinations of the four switches.

4.5.1.5. Shall an input be used or not?

ASTAT contains a foreseen maximum number of input signals, and has of this reason for most motions more input signals when required.

Parameters **05.05 - 05.08** (USE_PTC1 etc...) shall be set to 0 if there is no PTC connected.

Parameters **05.09 - 05.20** (USE_DI05 etc...) shall be set to 0 if there is no signal connected.

Parameters **05.21 - 05.24** (USE_ROT1 etc...) shall be set to 0 if there is no live DADT 100 connected to board DATX 130 plug -X1 etc inside DARA 1001 or DARA 1010.

4.5.1.6. Rotor feedback information

Only applicable for DARA 1001 and DARA 1010.

Set parameters **05.21 - 05.24** to 1 if a motor's rotor is connected to it, and it is desired to monitor the rotor.

In case the speed feedback is made with tachometer or pulse encoder, a rotor is supervised in case the corresponding parameter is set to 1. Each time the motion is started, the "next" rotor is selected for supervision.

Example: **05.21** = 1, **05.22** = 0, **05.23** = 1, **05.24** = 0. At first start rotor of motor 1 is supervised, at second start rotor of motor 3 is supervised, at third start rotor of motor 1 is supervised In case the pointed out rotor fails, the motion continues.

In case the feedback is the rotor frequency, parameters **05.21 - 05.24** only the same rotor as used for the speed feedback can be used for supervision. The other must be off. In case the pointed out rotor fails, the motion stops.

Example: **05.25** = 2. **05.21** must be 0, **05.22** can be 0 or 1, **05.23** must be 0, **05.24** must be 0.

Set parameter **05.25** to define which of the motors that is active as speed feedback for Rotor feedback. 1 for first input to DATX 130, 2 for second, 3 for third and 4 for fourth input to DATX 130. Value has no importance if other speed feedback is used.

4.5.1.7. Thermistor action

PTC inputs PTC3 and PTC4 can be used for trip (normal setting) or warning while PTC1 and PTC2 are only for trip.

With parameter **05.26** = 0, a high resistance value for PTC3 or PTC4 only gives a flashing indication. With parameter **05.26** = 1, a high resistance value for PTC3 or PTC4 gives a trip (same result as for PTC1 or PTC2).

4.5.1.8. Different parameter sets

It is only allowed to change parameter sets under the conditions given by parameter **01.03**, MACROMODE. Basically there is a selection between two parameter sets with DI no.4 of the process I/O, but it can be extended to four parameter sets with a parameter **05.27** (STA2_PA2).

05.27 = 0 No restriction			
DI no.3 = 0	DI no.3 = 1	DI no.4 = 0	DI no.4 = 1
Operator station no. 1 active	Operator station no. 2 active	Parameter set no. 1 used	Parameter set no. 2 used

05.27 = 1 05.27 = 1 is not possible for Shared motion. 05.27 = 1 is not possible for duty with master switch connected direct to DARA, i. e. 02.01 = 5 .			
DI no.3 = 0	DI no.3 = 0	DI no.3 = 1	DI no.3 = 1
DI no.4 = 0	DI no.4 = 1	DI no.4 = 0	DI no.4 = 1
Parameter set no. 1 used	Parameter set no. 2 used	Parameter set no. 3 used	Parameter set no. 4 used

Process I/O digital input no.3 can be used in two ways:

- 1) To select between operator stations
- 2) To make the selection between parameter sets 1 or 2 (Low sets family) or parameter sets 3 or 4 (High sets family)-selection within the family is done by Process I/O digital input no.4.

With **05.27 = 0**, a high value (=110 V) on DI no.3 on process I/O board DATX 110 will use DI no.3 to select between operator station number two out of number one and number two.

With **05.27 = 1**, a low value (=0 V) on DI no.3 on process I/O board DATX 110 will use parameter sets 1 and 2. The selection between Sets 1 and 2 is made with DI no.4.

With **05.27 = 1**, a high value (=110 V) on DI no.3 on process I/O board DATX 110 will use parameter sets 3 and 4. The selection between Sets 3 and 4 is made with DI no.4.

4.5.1.9. Prevention of motion at Crane On

Sometimes a hydraulic pump for emergency brakes is started at the same time as the crane motions are powered. It can take a few seconds to build up the pressure and lift the brake shoes. During that period the motors must not be used. It is possible to prevent motion during that time.

Parameter **05.33** is used. The normal setting 650 ms covers all configurations with only ASTAT itself concerned.

4.5.1.10. Fast stop

It can be useful to stop a motion in a controlled way by electrical braking independent of the position of the master switch. Example: In an operation with two hoists one hoist stops of any reason. Of safety reasons the other "healthy" hoists should stop at the same time, and the driver can after that deselect the faulty hoist and restart with only the "healthy".

The activation signal to stop is given to DI 17, same as used for parallel bridge supervision. Of this reason the Fast stop function is not available for parallel bridges

Parameter **05.36** is used to set up Fast stop function.

4.5.2. Parameters

Description	MIN	MAX	NORM	SET	IDENTITY	English text
Rated current of the Thyristor module. In case of Parallel bridge combination, I _e is the sum of the two units together. Unit: A.	25	2200	25	D	0501	IN_ASTAT
Parameter to set whether the configuration shall be 11 for "Hoist without Shared Motion", 12 for "Hoist with Shared Motion", 21 for "Travel without Shared Motion", or 22 for "Travel with Shared Motion".	11, 12, 21, 22	11, 12, 21, 22	11	D	0503	DRI_TYPE

Description	MIN	MAX	NORM	SET	IDENTITY	English text
Type of limit switch for movements. 1: Classic based on four switches. 0: Override limit switches, block fault detection (only for rescue purpose) 3: Classic based on four switches, block fault detection	0	3	1	D	0504	L_SW_TYP
1 if a PTC is connected, else 0.	0	1	0	D	0505	USE_PTC1
1 if a PTC is connected, else 0.	0	1	0	D	0506	USE_PTC2
1 if a PTC is connected, else 0.	0	1	0	D	0507	USE_PTC3
1 if a PTC is connected, else 0.	0	1	0	D	0508	USE_PTC4
DATX 110 DI 5. Set to 1 if used, else to 0. Pre limit switch A	0	1	1	D	0509	USE_DI05
DATX 110 DI 6. Set to 1 if used, else to 0. Pre limit switch B	0	1	1	D	0510	USE_DI06
DATX 110 DI 7. Set to 1 if used, else to 0. Stop limit switch A	0	1	1	D	0511	USE_DI07
DATX 110 DI 8. Set to 1 if used, else to 0. Stop limit switch B	0	1	1	D	0512	USE_DI08
DATX 110 DI 9. Set to 1 if used, else to 0. Hoist + remote I/O: T- or TM-relay 1 Hoist without remote I/O: T- or TM-relay Travel + remote I/O: T- or TM-relay 1 Travel without remote I/O: T- or TM-relay 1	0	1	1	D	0513	USE_DI09
DATX 110 DI 10. Set to 1 if used, else to 0. Hoist + remote I/O: Brake lifter 1 Hoist without remote I/O: Brake lifter Travel + remote I/O: Brake lifter 1 Travel without remote I/O: Brake lifter	0	1	1	D	0514	USE_DI10
DATX 110 DI 11. Set to 1 if used, else to 0. Hoist + remote I/O: T- or TM-relay 2 Hoist without remote I/O: Master switch direction A Travel + remote I/O: T- or TM-relay 2 Travel without remote I/O: Master switch dir. A	0	1	1	D	0515	USE_DI11
DATX 110 DI 12. Set to 1 if used, else to 0. Hoist + remote I/O: Brake lifter 2 Hoist without remote I/O: Master switch direction B Travel + remote I/O: Brake lifter 2 Travel without remote I/O: Master switch dir. B	0	1	1	D	0516	USE_DI12
DATX 110 DI 13. Set to 1 if used, else to 0. Hoist + remote I/O: Overload contact Hoist without remote I/O: Overload, contact Travel + remote I/O: T- or TM-relay 3 Travel without remote I/O: T- or TM-relay 2	0	1	1	D	0517	USE_DI13
DATX 110 DI 14. Set to 1 if used, else to 0. Hoist + remote I/O: Brake lifter 3 Hoist without remote I/O: Master switch, step 2 Travel + remote I/O: Brake lifter 3 Travel without remote I/O: Master switch, step 2.	0	1	1	D	0518	USE_DI14
DATX 110 DI 15. Set to 1 if used, else to 0. <u>Set to 2 if used to change between parameter set 1 and 2 in installations without remote I/O.</u> Hoist + remote I/O: Overspeed switch Hoist without remote I/O: Overspeed switch Travel + remote I/O: T- or TM-relay 4 Travel without remote I/O: -	0	2	1	D	0519	USE_DI15
DATX 110 DI 16. Set to 1 if used, 0 if not used. <u>Set to 2 if used as external synchronisation of electrical shaft of Follower in a M-F combination.</u> Hoist + remote I/O: Brake lifter 4 Hoist without remote I/O: Master switch, step 3 Travel + remote I/O: Brake lifter 4 Travel without remote I/O: Master switch, step 3	0	2	1	D	0520	USE_DI16

Description	MIN	MAX	NORM	SET	IDENTITY	English text
Set parameter to 1 if a motor's rotor is connected to DATX 130-X1, and it is desired to monitor the rotor.	0	1	0	D	0521	USE_ROT1
Set parameter to 1 if a motor's rotor is connected to DATX 130-X2, and it is desired to monitor the rotor.	0	1	0	D	0522	USE_ROT2
Set parameter to 1 if a motor's rotor is connected to DATX 130-X3, and it is desired to monitor the rotor.	0	1	0	D	0523	USE_ROT3
Set parameter to 1 if a motor's rotor is connected to DATX 130-X4, and it is desired to monitor the rotor.	0	1	0	D	0524	USE_ROT4
Selection of which motor 1-4 that is used for speed feedback. 1 for first input to DATX 130, 2 for second, 3 for third and 4 for fourth input to DATX 130. Value has no importance if other type of speed feedback is used.	0	4	1	D	0525	ROTOR_FB
With PTC_ACTN = 1, a high resistance value for PTC3 or PTC4 gives a trip. PTC1 or PTC2 always give a trip. With PTC_ACTN = 0, a high resistance value for PTC3 or PTC4 only gives a flashing indication.	0	1	1	D	0526	PTC_ACTN
With STA2_PA2 = 0, DI 3 on process I/O board DATX 110 selects between two operator's stations. DI 4 selects between two macros for each station. With STA2_PA2 = 1, DI 3 and DI 4 are used to select one of four macros. STA2_PA2 = 1 is not possible for Shared motion. STA2_PA2 = 1 is not possible for duty with master switch connected direct to DARA I/O; RUN_TYPE=5.	0	1	0	D	0527	STA2_PA2
Control AO no. 1 of process I/O board DATX 110. Value = 0: 0 V = 0% actual line current +10 V = 400% actual line current Value = 1: -10 V = -200% speed reference +10 V = +200% speed reference	0	1	0	D	0529	SELECT_A
Control AO no. 2 of process I/O board DATX 110. Value = 0: -10 V = -400% torque reference +10 V = +400% torque reference Value = 1: Parameter 14.30.TWIN_OVL = 0 -10 V = -200% actual speed +10 V = +200% actual speed Parameter 14.30.TWIN_OVL = 1 Load in Weight Units	0	1	0	D	0530	SELECT_B
Time in ms after Crane ON motion is blocked. Do not reduce below 650 ms without consulting ABB. A larger value than 650 ms is needed than (for example) the pressure of a hydraulic system must be build up before starting the motor.	250	5000	650	X	0533	ON_DEL1

Description	MIN	MAX	NORM	SET	IDENTITY	English text
Controlled fast stop by using DI17. The setting of this parameter defines how a signal to DI 17 should be interpreted: 0: Function not active 1: High signal to DI17 stops. 2: Low signal to DI17 stops.	0	3	0	D	0536	FASTSTOP

4.5.3. Signals

Description	Unit	IDENTITY	English text
DATX 110. PTC No. 1; 1: Temp. OK. Also 1 with parameter 0505 is set to 0.	Bool	0540	EFF_PTC1
DATX 110. PTC No. 2; 1: Temp. OK. Also 1 with parameter 0506 is set to 0.	Bool	0541	EFF_PTC2
DATX 110. PTC No. 3; 1: Temp. OK. Also 1 with parameter 0507 is set to 0.	Bool	0542	EFF_PTC3
DATX 110. PTC No. 4; 1: Temp. OK. Also 1 with parameter 0508 is set to 0.	Bool	0543	EFF_PTC4
DATX 110 AI 05. Load cell (for system with Cabin I/O) / speed reference (for system with master switch connected direct to DARA I/O).	V	0544	AIN05_1
DATX 110 AI 06. Direct additional speed reference without any ramp.	V	0545	SPREF_NR
DATX 110 AI 07. Direct additional torque reference without any ramp	V	0546	TQREF_NR
DATX 110 AI 08. Speed feedback from tachogenerator. Range 10 V: Value 32767 = 10 V Range 50 V: Value 32767 = 58,7 V Range 100 V: Value 32767 = 107,3 V DATX 110 -X6:7-8 AI 8(8)	Value	0547	NFEEDBTG
DATX 110 DI 01	Bool	0548	ON
DATX 110 DI 02	Bool	0549	LO_RESET
DATX 110 DI 03	Bool	0550	DIN03_1
DATX 110 DI 04	Bool	0551	DIN04_1
DATX 110 DI 05. Also 1 with parameter 0509 is set to 0.	Bool	0552	EFF_DI05
DATX 110 DI 06. Also 1 with parameter 0510 is set to 0.	Bool	0553	EFF_DI06
DATX 110 DI 07. Also 1 with parameter 0511 is set to 0.	Bool	0554	EFF_DI07
DATX 110 DI 08. Also 1 with parameter 0512 is set to 0.	Bool	0555	EFF_DI08
DATX 110 DI 09. Also 1 with parameter 0513 is set to 0.	Bool	0556	EFF_DI09
DATX 110 DI 10. Also 1 with parameter 0514 is set to 0.	Bool	0557	EFF_DI10
DATX 110 DI 11. Also 1 with parameter 0515 is set to 0.	Bool	0558	EFF_DI11
DATX 110 DI 12. Also 1 with parameter 0516 is set to 0.	Bool	0559	EFF_DI12
DATX 110 DI 13. Also 1 with parameter 0517 is set to 0.	Bool	0560	EFF_DI13
DATX 110 DI 14. Also 1 with parameter 0518 is set to 0.	Bool	0561	EFF_D14
DATX 110 DI 15. Also 1 with parameter 0519 is set to 0.	Bool	0562	EFF_DI15
DATX 110 DI 16. Also 1 with parameter 0520 is set to 0.	Bool	0563	EFF_DI16
Process I/O analog output No. 01. Line current in % of the connected motor(s) rated current. 10 V = 400% if parameter 05.29 = 0 Speed reference in %. 10 V = 200% if parameter 05.29 = 1	V	0564	AO01_1

Description	Unit	IDENTITY	English text
Process I/O analog output No. 02. Torque reference in % of the motor(s) rated torque. +10 V = +400% if parameter 05.30 = 0 Actual speed in %. 10 V = 200% if parameter 05.30 = 1 If parameter 14.30 = 1, this AO is taken over by the Load functions, and the output value in Volt has another interpretation.	V	0565	AO02_1
Process I/O digital output No. 01. Rotor contactor K0 / Cable reel contactor / Thyristor fan.	Bool	0566	DO01_1
Process I/O digital output No. 02. Rotor contactor K1	Bool	0567	RCON_K1
Process I/O digital output No. 03. Rotor contactor K2	Bool	0568	RCON_K2
Process I/O digital output No. 04. Rotor contactor K3	Bool	0569	RCON_K3
Process I/O digital output No. 05. Brake lift	Bool	0570	BR_LIFT
Process I/O digital output No. 06. Delayed brake lift	Bool	0571	DBR_LIFT
Process I/O digital output No. 07. Any of fault with code has occurred	Bool	0572	FAULT
Process I/O digital output No. 08. Shared motion selected	Bool	0573	SH_MOT
Cabin I/O analog input No. 01. Analog continuous reference from Master switch. (100% ref.=synch. speed). For motion No. 1 of shared motion.	%	0574	AIN01_AC
Cabin I/O analog input No. 02. Load cell signal, selected by parameter as alternative to DATX 11o, AI 05. Analog continuous reference from Master switch. (100%ref.=synch. speed). For motion No. 2 of shared motion.	%	0575	AIN02_AC
Active Cabin I/O digital input No. 01	Bool	0576	DIN01_AC
Active Cabin I/O digital input No. 02	Bool	0577	DIN02_AC
Active Cabin I/O digital input No. 03	Bool	0578	DIN03_AC
Active Cabin I/O digital input No. 04	Bool	0579	DIN04_AC
Active Cabin I/O digital input No. 05	Bool	0580	DIN05_AC
Active Cabin I/O digital input No. 06	Bool	0581	DIN06_AC
Active Cabin I/O digital input No. 07	Bool	0582	DIN07_AC
Active Cabin I/O digital input No. 08	Bool	0583	DIN08_AC
Cabin I/O analog output No. 01. Load torque in % of motors rated torque. -/+10 V = -400%...0...+400% of rated torque.	%	0584	AO01_C
Cabin I/O analog output No. 02. Actual speed. -/+10 V = -200%...0...+200% of synchronous speed.	%	0585	AO02_C
Cabin I/O digital output No. 01	Bool	0586	DO01_C
Cabin I/O digital output No. 02	Bool	0587	DO02_C
Cabin I/O digital output No. 03	Bool	0588	DO03_C
Cabin I/O digital output No. 04	Bool	0589	DO04_C
Cabin I/O digital output No. 05	Bool	0590	DO05_C
Cabin I/O digital output No. 06	Bool	0591	DO06_C
Cabin I/O digital output No. 07	Bool	0592	DO07_C
Cabin I/O digital output No. 08	Bool	0593	DO08_C
Conditions to rotate thyristor-cooling fans are fulfilled. Note Group!	Bool	2456	FANS_ON
Temperature in degree C of thyristor cooler (only for Thyristor modules with fans). Note Group!	Value	2457	THY_TEMP

4.6. Group 6: Brake control

4.6.1. Description

This group of information shall be included in the design phase. Some parameters need final tuning at Start up.

4.6.1.1. Speed for applying brake

Applying the mechanical brake at the normal 2% speed before the motion stops electrically will in nearly all cases give a good compromise between minimal brake wear and a smooth handling. Set the speed level with parameter **06.01**.

Of safety reasons the brake is also applied a time after the direction signals A or B are 0 (zero), and the speed reference has come to zero. This time is given by parameter **06.08**.

4.6.1.2. Brake supervision

Brake open

When the brake is ordered to open it must acknowledge open in the time give by parameter **06.02**. Else it will generate a fault and stop the motion.

Brake closing

See section **4.6.1.9 Extended brake supervision**. Considered as a dangerous fault.

4.6.1.3. Handling of slow brakes

Compensation for slow closing for hoists

During the action time of the mechanical brake ASTAT will electrically hold the load regulated at zero speed. The normal is setting $0,1^{10_03A}$ seconds by parameter **06.03** which can in most cases remain unchanged.

Until release 10_053A: Parameter **06.03** does not have any meaning for travel motions.

From release 10_053B: Parameter **06.03** can be used also for travel motions.

Compensation for slow opening for hoist and travel

See sections **4.6.1.10** and **4.8.1.20 Slow opening brake compensation**

4.6.1.4. DC-brake

At the same time as DO 5 (Brake-lifter) closes, also DO 6 (DC-brake forcing) closes. A time after that, set by parameter **06.04**, DO 6 for delayed brake-lifter will open. DO 6 will also open if the acknowledgement signal(s) for brake(s) open is (are) required, and it's (their) acknowledgement DI is (are) high.

If not using the DC-brake function, DO 6 can be used to control an off-delayed auxiliary device like a rail fan or a grease pump. Study parameter **13.06**. This off-delay time is set with parameter **06.04**.

A parameter **06.14** is included from release10_05. Value 1 supports DC-brake without limit switch, but where the contactor is used as acknowledgement signal. The time set by 06.04 will always elapse, although the brake acknowledgement signal comes. Value 0 is used for a real brake open limit switch and if no limit switch at all is used.

Active speed control around zero-speed

In release 10_040 a function was included that disables the integral part of the speed regulator at very low speed. In some situations this is not suitable.

From release 10_053B (November 2006) it is possible to activate the integral part of the speed regulator also at very low speed. The activation is made by setting parameter **06.14** to 10 instead of 0, or 11 instead of 1. **Most used value for new design will be 10.**

4.6.1.5. Torque proving

^{10_03A} The normal value was 500 ms in earlier releases than AST10_03A. A normal acting brake and a too high value of parameter **06.03** can lead to brake wear.

The function is removed from AST10_04 release

Testing of brake capacity before start:

See section **4.8.1.19 Delayed start for brake testing**

4.6.1.6. Delayed travel motion brake setting

The release of the brake is delayed a time, parameter **06.06**, after the brake should have applied based on speed condition. During this period, the motion is slightly electrically braked, to damp out any remaining pendulum from the motion. The level of braking is set by parameter **11.28**. Normal value 100% current limit gives about 30% braking torque.

The delayed brake function is used only for travel movements. If parameter is set to another value than 0 for a hoist, it will be ignored by ASTAT and the brake will not be delayed.

The delayed brake function can also be used together with the DC-brake function.

Typical delay time: between 0,1 – 10 seconds, normal 1,0 seconds.

This parameter does not have any meaning for hoist motions.

4.6.1.7. Increased action of electrical braking

This function is removed in 10_05, as it is not needed.

4.6.1.8. Free travel motion brake

A Master switch with an additional notch close to the Zero-position of the Master switch is used.

The brake is not applied in this position (DO Brake-lifter), but the firing pulses are removed completely.

The free brake function is only for travel movements. There is no parameter; just connect the Master switch.

4.6.1.9. Extended brake supervision

Traditional brake supervision checks that the brake's limit switch detects an open brake within a set time after ordering open brake. As a complement ASTAT is able to detect if the electrical brake contactor or the brake itself is jammed in lifted brake position. This supervision is turned on with parameter **06.09**.

If any used brake no. 1 - 4 is still announcing open 500 ms after the ASTAT controller ordered brake closing a fault state is declared. This is a dangerous fault, and the final action that the control system can take is to cut out the main contactor to the crane. In case the source of the problem was a stuck electrical contactor, the emergency situation can be solved.

If the above state is declared DO no. 8 of DATX 110 will open. It cannot be closed or the ASTAT will not be ready for new service until the 230 (115) V AC control voltage has been off and on again.

See also Sections **2.3 Crane power and control voltage** and **4.22, Options for Fault handling**

This function is not available for share motion drives.

4.6.1.10. Slow opening brake compensation

See also Section **4.8.1.20, Speed reference**.

It is possible to hold the speed reference at zero at start before the brake has opened. With time, or time interrupted by limit switch "open". This function prevents competition between the motor and the brake as well as it reduces current/torque peaks.

A slow brake will cause wear of its own, bad regulation and high current/torque peaks.

The reference is zero until the brake is assumed to have started its opening. The function is determined by parameter **08.21**: 0 = No action of function, 1 = Keeps zero reference until time **08.24** is elapsed or 3 = Keeps zero reference until brake indicates OPEN, however never longer than time **08.24**

An optimal setting is found during Start Up by studying Speed reference, Speed feedback and Actual current at the same time with the monitor Tool.

The Compensation for slow brake opening shall be considered and adjusted prior to increasing the monitor time for tachometer / encoder failure, parameter **10.15**.

4.6.2. Parameters

Description	MIN	MAX	NORM	SET	IDENTITY	English text
Speed at which the mechanical brakes is applied. As a percentage of the synchronous speed 0 ..10%. Normal 2%.	0	10	2	S	0601	ZER_SPpc
Time in which the brake must reach open position; otherwise there is a fault. 0,1 ... 10 seconds. Normal is 1 second = 1000 ms. Set time in ms.	100	10 000	1 000	D	0602	BRA_AC_T
Time, during which the motor will be held with electrical torque after order to close brake. 0,1 .. 1,0 seconds. Normal is 0,1 seconds = 100 ms. Set time in ms. This time is ignored by travels.	0	1 000	100	S	0603	BRA_EL_T
For parameter 13.06 = 0: Time after which the brake shall be reduced to holding DC-voltage. 0,5 .. 5,0 s. Normal is 1,5 second=1500 ms. For parameter 13.06 = 1: Time after stopping the motion an aux device will continue to run. Set time in ms.	500	5 000	1 500	D	0604	BRA_DC_T
Time at stop for which the closing of the brake is delayed. During this time the motion is softly electrically braked to damp out sway in load. Braking current is set with 11.28 , 100% gives about 30% nominal motor torque as braking torque. Set time in ms. This time is ignored by hoists.	0	10 000	0	X	0606	BRA_DELA
Time lag for safety setting of brake based on the speed reference independent of the actual speed measurement. Time in ms.	0	32000	1000	X	0608	BR_REF_T
Set 1 to activate the early warning brake closing supervision (Cannot be used for shared motion system)	0	11	0	D	0609	EARLY_WG
First digit: 1=Use Integral gain around zero-speed. 0 or omitted=Do not use Integral gain around zero-speed. Last digit: 1=Forcing will continue the full set time 0=Forcing of DC-brake is until Brake open signal comes or the set time elapses, whichever comes first. Values 11 and 1 support DC-brake without limit switch, but there the contactor is used as acknowledgement signal	0	1	10	D	0614	CONT_ACT
1: As a back-up for faults in speed measurement system, the brake is applied when the speed reference is zero, delayed with the time 06.08 . 0: Brake application is not based on speed reference.	0	1	1	X	0615	USE_NREF
1: Like for all other speed controlled drive systems, the brake is applied when the direction signals are removed, and the speed measurement indicates zero speed. 0: Brake application is not based on measured speed. To be used only in special cases.	0	1	1	X	0616	USE_NACT

4.6.3. Signals

Description	Unit	IDENTITY	English text
Latching of signal 06.55 . Zero speed and master switch in neutral position are not needed.	Bool	0654	DBLCK
Logical conditions, like no faults, zero speed detected and master switch in neutral position, to start to control the motion are present.	Bool	0655	DBLCK_C
We have three accepted phases connected.	Bool	0656	LINE_OK
Voltage on motor and brake lifted as we intend to run.	Bool	0657	RELEASE
OK to start to run in direction A; no stop limit switch hit, direction signal exists and there is no mechanical overload in this direction.	Bool	0658	RUN_A
OK to start to run in direction B; no stop limit switch hit, direction signal exists and (there is no mechanical overload in this direction).	Bool	0659	RUN_B

4.7. Group 7: Speed feedback

4.7.1. Description

This group of information shall be included in the design phase.

4.7.1.1. Type of speed feedback

A speed feedback is always required. The speed feedback can be accompanied by an independent supervision system of another type.

Normal settings of parameter **07.01** are 13, 23 or 33. Values 10, 20 and 30 are frequently used during Start up to disable the monitoring that the actual value follows the speed reference.

The Rotor voltage frequency feedback is an accurate method for speed control of crane motions, and shall not be compared with other simpler methods such as traditional frequency relays used for contactor switching or estimation based on an assumed slip of the motor and the actual stator current.

4.7.1.2. Pulse transmitter

The pulse transmitter can be mounted free from the motor on an independent gearbox. Of this reason the additional parameters **07.03** and **07.04** can be set to other integer values than 1.

Internal adjustments of the pulse transmitter: See Group 19.

4.7.1.3. Analogue tachometer

By hardware jumpering one of following ranges shall be selected:

- 1) -10 V ... 0 ...+10 V Range adjustment factor = 1,000
- 2) -50 V ... 0 ...+50 V Range adjustment factor = 0,856
- 3) -100 V ... 0 ...+100 V and -200 V ... 0 ...+200 V⁸ Range adjustment factor = 0,931

Parameter **07.05** (TAC_ADpc) shall be set in the following way shown with an example:

A 6-pole hoist motor is installed in a 60 Hz network. It is equipped with an analogue tachometer with 60 V / 1000 rpm.

It follows that the synchronous speed of the motor is 1200 rpm. Allow 20 % extra for margin to trig the overspeed switch function (as it is a hoist) as well as to keep the speed feedback out of possible saturation. Count with $1,20 * 1200 * \frac{60}{1000} = 86,4$ V. Select the 100 V range with the jumpers.

For the synchronous speed of the motor the tachometer voltage is: $1200 * \frac{60}{1000} = 72$ V

Set parameter **07.05** (TAC_ADPC) = $0,931 * 100\% * \frac{72}{100} (\%) = 67\%$

Also a tachometer can be scaled beyond the action of parameter **07.05**. Of this reason parameters **07.03** and **07.04** are active also for tachometer from release AST10_04. If the normal values 1 are kept there is no influence of this additional scaling ($x * 1 : 1 = x$).

4.7.1.4. Rotor voltage frequency feedback

Also rotor feedback can be scaled. Of this reason parameters **07.03** and **07.04** are active also for rotor feedback from release AST10_04. If the normal values 1 are kept there is no influence of this additional scaling ($x * 1 : 1 = x$).

4.7.1.5. Filtering of speed feedback

Testing during start up, some motions can be better controlled by filtering the feedback signal with a Low Pass filter. It is not possible to predict in advance which motions and which settings that can improve. The filter time can be helpful for both rotor frequency feedback and rotary transducer feedback.

⁸ If $200 \text{ V} > |U_{TG} * N_{MAX}| > 100 \text{ V}$, there N_{MAX} is the fastest speed for which you still wish to know the speed and U_{TG} is the tachometer voltage, **connect an external resistor 300 kΩ in serial with the tachometer** and secure that the highest voltage at the terminals of DATX 110 is max. 100 V

In several installations Long Travel motions have got better control properties by using a filter time in the range of 100 - 200 ms.

4.7.2. Parameters

Description	MIN	MAX	NORM	SET	IDENTITY	English text
<p>10: Rotor 13: Rotor check reference 14: Acceleration control, brake applied by rotor frequency feedback.</p> <p>20: Analogue tachometer 23: Feedback Analogue tachometer and compared with the speed reference 24: Acceleration control brake applied by Analogue tachometer.</p> <p>30: Pulse encoder 33: Feedback Pulse transmitter, and compared with the speed reference 34: Acceleration control, brake applied by pulse encoder.</p> <p>Values 10, 20 and 30 are used for start-up, the crane shall be handed over with value 13, 14, 23, 24, 33 or 34.</p> <p>If value = 10 or 13, it could be needed to set parameter 17.27, MAGN_DEL larger than 0.</p>	10	34	13	D	0701	SPEED_FB
<p>Pulses per revolution of motor shaft turn is equal $M * N / P$. This parameter is M.</p> <p>Internal adjustments of the pulse transmitter: See Group 19.</p>	1	16384	1024	D	0702	NO_PULSE
<p>Pulse per revolution of motor shaft turn is equal $M * N / P$. This is N. Normal 1.</p>	1	100	1	X	0703	N_X_PULS
<p>Pulse per revolution of motor shaft turn is equal $M * N / P$. This is P. Normal 1.</p>	1	100	1	X	0704	P_X_PULS
<p>Insert jumpers for range 10V, 50V or 100V. For pulling through loads allow 20% margin for the tacho.</p> <p>The range can be extended to 200 V by an external serial resistor = 300 kiloOhm.</p> <p>Range adjustment factors: 10 V = 1,000. 50 V = 0,856. 100 V = 0,931.</p> <p>Example: Tacho-voltage at synchronous speed = 60 V. Select range 100 V. Parameter 07.05 is set to value: $0,931 \times (60 \text{ V} / 100 \text{ V}) \times 100\% = 55,9\%$.</p>	1	100	100	D	0705	TAC_ADpc
<p>A switch to connect the filter time of 07.20 also for the closed loop control, typically in case non-performing mechanical drives system.</p>	0	1	0	S	0719	USE_FACT
<p>Filter time for speed feedback for presentation. Also connected in the closed control loop if parameter 07.19 is set to 1.</p>	0	1000	200	S	0720	NACTTC

4.7.3. Signals

Description	Unit	IDENTITY	English text
Actual motor speed in % of synchronous speed. Measured value before filtering.	%	0750	NACT
Actual motor speed in % of synchronous speed, filtered value.	%	0751	NACTMV
<p>The deviation between Actual speed and Reference speed in % of the synchronous speed.</p> <p>This signal is only used for speed supervision, not for speed control. If desired to use for tuning, use 09.52 in stead.</p>	%	0752	SPMEASER

4.8. Group 8: Speed reference

4.8.1. Description

This group of information shall be included in the design phase.

A Master switch with following signals shall be used:

- Potentiometer or steps 2 - 0 - 2, 3 - 0 - 3, 4 - 0 - 4 or 5 - 0 - 5. 4 - 0 - 4 is most common.
- Zero position signal
- and B-directions signals. For a hoist A-direction \equiv up and B-direction \equiv down.

The speed reference system is based on that the motion can be operated from either of two operator stations, if installed. Parameters related to the **first** or only station are designated an English text **C1xxxxxx**, while the English designations for the **second** station are **C2xxxxxx**.

Change from Station 1 to Station 2 or vice versa is only allowed when the crane is OFF.

Notes for use of analogue reference

Using direct driver joystick potentiometer control introduces some disadvantages that must be considered.

- A) Analogue reference does not prevent critical speeds resulting in shaking of the structure and resonance in active mechanical parts.
- B) With step control an important supervision of tacho/encoder based on smallest speed can be done
- C) With step control a more robust hardware can be used, no potentiometer or uncertain quality PLC is needed.
- D) For a Travel motion, the torque requirement can be 20 times during speed change than in steady state driving. If the speed is changed for every small movement of the joystick, the wear of the crane will be larger.
- E) For a Hoist motion with short ramp times the ratio defined in previous bullet D) with empty hook is the same as for a travel motion, and 2,5 times when the crane is loaded to its nominal capacity. The cranes are sometimes empty, and most of the time they are loaded with less than the nominal load. Assume that the weighted average is 6 times. If we can reduce the time the speed is changed, the life of the mechanisms and the structure will be much longer.
- F) Sitting in a moving crane or using a radio remote control, it is not possible at all to maintain a fixed speed with potentiometer control.
- G) The driver will probably not get a very good crane to position with potentiometer command. With step joystick the driver will get a feeling to touch the stick for a small time, and he/she gets a tool to repeatedly position the crane within 5 mm (typical example). With analogue joystick you have to consider joystick angle, joystick movement speed and time, which is not so comfortable for crane drivers. It might not be so critical for Hoists as for Travels, but the general problem is the same.
- H) We have used analogue joysticks for some applications (ship cranes, container cranes). To overcome the problems above, we have used different ways to filter the drivers hand movements in a PLC before it is send to the ramp unit of the drive. These methods do not overcome (A), (B) and (C) above, and will introduce delays and a new way to drive cranes, so problems (E), (F) and (G) will be worse.
- I) The mind set must be that the ramp and speed control make the smoothness of the control, not depending on if there is nervous driver or not!
- J) Sometimes still experience from step joystick for clapper control is mixed with the very smooth control of our modern controllers.

4.8.1.1. Shaping of analogue reference

The input can be shaped by parameter **08.01** (RAMP_TYP). The options are linear or square root interpretation with or without a minimum allowed reference, **08.08** (C1REFMIN) or **08.14** (C2REFMIN). These value-formers between master-switch position and reference are illustrated below with Crewmen = 20 (%). The self-explaining RAMP_TYP value 5 is not shown.

Default setting is **08.01** = 5 which means that the contribution from the analog input for speed reference is forced to zero (DATX 110 AI 5, or Cabin I/O module AI 1 or AI 2 for Shared motion as well as the "Additional Reference" DATX 110 AI 6) and the reference comes only digitally via step references or from computer.

When using step reference, set **08.01** = 5.

References given as steps will not be affected by the value former set by parameter **08.01**. If any other character than a proportional is desired, this is easily obtained by setting different percentages for the steps.

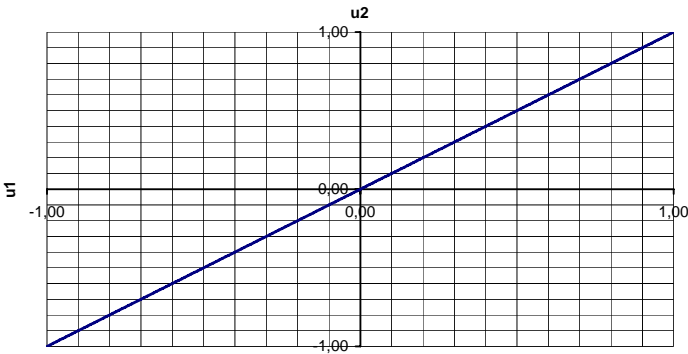
Set parameters **08.04** (and **08.10**) to 0 then analogue reference is given, else the direction signal from the master switch will add Step 1 percentage to the analogue reference.

Common information for all illustrations on this page:

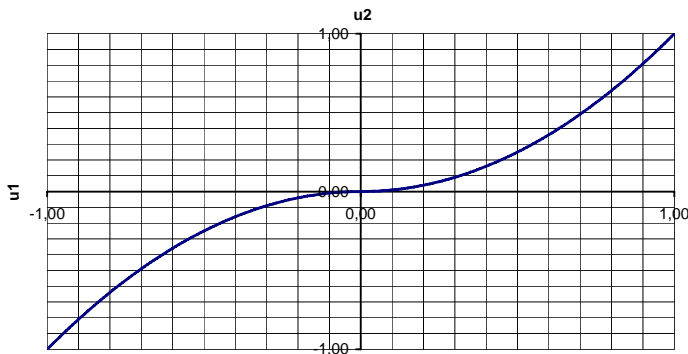
u1: Position of the master switch.

u2: Value to the ramp unit.

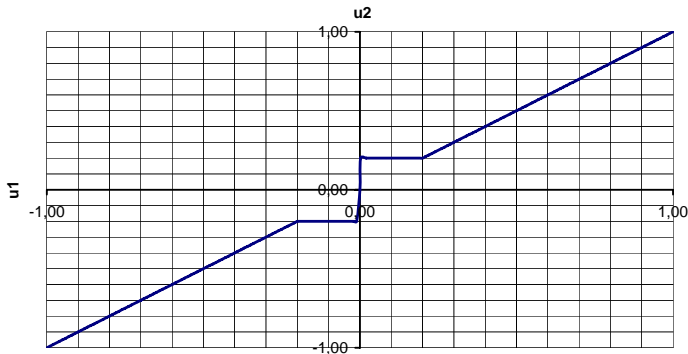
08.01 RAMP_TYP = 1



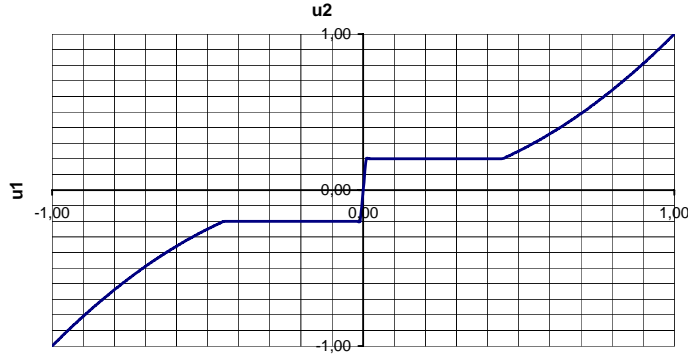
08.01 RAMP_TYP=2



08.01 RAMP_TYP=3



08.01 RAMP_TYP=4



4.8.1.2. Acceleration ramp

The time is defined from stand still to 100% synchronous speed. For most applications except for lowering hoists, the motor will not reach the 100% speed (the synchronous speed). ASTAT will follow the set ramp as far as the available torque from the motor permits, and faster than the set out full line voltage on the motor terminals.

4.8.1.3. Deceleration ramp

The time is defined from 100% synchronous speed to stand still.

For most applications except for lowering hoists, the motor will not have 100% speed (the synchronous speed) when the deceleration starts. ASTAT will in that situation quickly⁹ reduce the start value of the ramp from 100% to the real speed the motor could reach in real life, and after that follow the set ramp.

This means that the real ramp time from full speed to stop almost always will be shorter than the set ramp time.

As soon as the ramp has come down to the actual value of the speed, the system will follow the ramp.

Limiting the torque to the mechanical drive train at notch-back from full speed has higher priority than to keep a straight line of the actual speed.

4.8.1.4. Step references

Step and analogue references would be added if both should be used at the same time.

For each operator station, in most cases there is only one, step contacts of a Master switch can be connected as mentioned 2 - 0 - 2, 3 - 0 - 3, 4 - 0 - 4 or 5 - 0 - 5. The maximal reference step always corresponds to full reference. For the other steps the percentage can be set with parameters.

Only the highest step number is read as reference. Example: Assume that **08.04** is set to 10%, and **08.05** is set to 25%. If both DIs of the Cabin I/O are active the input value to the ramp generator is 25%, **not** 35%.

From 10_54 a new value=6 for parameter **08.01** is supported. A step reference can be optimised for light motions (travel or hoist) by setting **08.01** to 5. With value 5 over-shooting is prevented as the integral part of the speed regulator is set to zero each time the ramp output value coincides with the step reference. By setting **08.01** to 6 the integral part is not reset, which minimises load droop for hoists and is more suitable for fine positioning of heavy travel motions.

4.8.1.5. ...

4.8.1.6. ...

4.8.1.7. ...

4.8.1.8. ...

4.8.1.9. Analogue inputs without direction or zero signal

Before using **08.09** (1AUT_DIR) or **08.15** (2AUT_DIR) = 1, check the safety aspects for the installation. Positive reference input gives direction A (=up) and negative reference gives direction B (=down).

4.8.1.10. ...

4.8.1.11. ...

4.8.1.12. ...

4.8.1.13. ...

4.8.1.14. ...

4.8.1.15. ...

4.8.1.16. Final limit speed

Reaching the Pre limit switch in any of the directions, the motor will ramp down to the speed set by parameter **08.16**.

⁹ Not visible for a human being

4.8.1.17. Reduced top speed

By limiting the top speed below the normal "as fast as possible", the speed controller can be kept active through the whole speed range. Parameter **08.17** (NREF_RED) is used to reduce the top speed from 100%. Avoid setting values between 90% and 100%. For 100% the motor simply is given full line voltage as soon as ASTAT can not more deliver the needed torque for acceleration when the speed approaches the synchronous. Do **not** modify parameter **08.22** as an alternative.

Take the value 99% as an example. ASTAT will never reach 99% of the synchronous speed with a normal load and a normal resistance. The speed controller will however be kept active, and the integral part of it will be saturated. It will take an unacceptable time between the notchback and until the speed decreases.

Take the value 85% as an example. ASTAT will without any problem work with the speed controller in the active range, and there will be no saturation. But, the motor voltage will not be fully sinusoidal.

4.8.1.18. Weak electrical supply adoption

In 10_05 a new function is included to manage weak line supply. The function will slow down the ramp times in case the network is weak.

The incoming voltage to the ASTAT is sensed every half period, every 10 ms, with an input connected directly to the processor, not via bus-connected I/O. Based on this information the acceleration and deceleration ramps are adjusted. Compared with current limit control it means that the ramp time is always defined, that integral action of the speed regulator will not compensate for a "historical" speed error and the speed deviation supervision can be finer set.

Release 10_05 to 10_055 the: Parameter **08.18** controls this function. Value 0 means it is off, 1 it is on.

Release 10_054 and later: The function is always active.

Multiplication factors with 08.18 = 1 for ramp times in case of low line voltage:

Line voltage	Acceleration	Deceleration
75%	3,00	1,50
80%	3,00	1,50
85%	2,75	1,45
80%	2,20	1,35
92%	1,60	1,20
95%	1,20	1,05
100%	1,00	1,00
105%	1,00	1,00

4.8.1.19. Delayed start for brake testing

The start can be delayed for testing of brakes. The testing can be made with approx. 160% of the rated motor torque with all rotor contactors open with value **08.19** = 1, or with 220% of the rated motor torque by K1 closed with **08.19** = 2. The normal value is **08.19** = 0 that does not cause any reference delay for brake testing.

Brake testing has higher priority than Slow opening brake compensation. If **08.19** has another value than 0, whichever setting of **08.21** is overridden the Slow opening brake compensation is not effective.

The referenced is delayed during the time set by **08.24**. During this time the brakes are not lifted. The controller tries to reach a current same as set current limit, parameter **11.01**, which in most cases is not possible or needed. The target direction is B, meaning lowering for hoists.

If the value of the maximal measured speed is larger than set by parameter **10.12** we have a fault, code 90.

If the value of the maximal measured speed is less than set by parameter **10.12** during this time, the brake testing is passed, and the controller turns to a state for normal running.

4.8.1.20. Slow opening brake compensation

See also Section **4.6.1.10, Brake control**.

It is possible to hold the speed reference at zero at start before the brake has opened. By time, or by time interrupted by limit switch "open". This function prevents competition between the motor and the brake as well as it reduces current/torque peaks.

A slow brake will cause wear of its own, bad regulation and high current/torque peaks.

The reference is zero until the brake is assumed to have started its opening. The function is determined by parameter **08.21**: 0 = No action of function, 1 = Keeps zero reference until time **08.24** is elapsed or 3 = Keeps zero reference until brake indicates OPEN, however never longer than time **08.24**.

An optimal setting is found during Start Up by studying Speed reference, Speed feedback and Actual current at the same time as with the monitor Tool.

The Compensation for slow brake opening shall be considered and adjusted prior to increasing the monitor time for tachometer / encoder failure, parameter **10.15**.

4.8.1.21. Master-switch kick

The Master-switch kick function in AST10_02 has been removed as it is not needed due to the improved regular speed control. Parameters **08.25** and **08.26** have no influence and **08.27** has another meaning since AST10_03.

4.8.1.22. Increased plugging action

Used in manual operation: If the driver pulls the master-switch to the opposite side than the actual motion, the retardation ramp time is reduced by the percent value given with parameter **08.27**. This function is estimated function by experienced crane drivers.

4.8.1.23. Supervision of master switch

Any impossible combination of direction signals and zero position signal will give a fault, and stop the motion. Typically welded interface relays or bad grounding of neutral is monitored. This function is included from 10_05.

4.8.1.24. Stopping a hoist without visible load setting

When stopping a hoist motion after lifting, but not after lowering, it is detected when the speed reference falls below the level set with **0830**. In this situation the ramp time is made a multiple longer than it is set as with parameter **0803**. As the time for this passage between the change in ramp slope and the setting of the brake is short, the increased stopping distance is possible to neglect.

The rate of which the deceleration ramp slope is increased at zero-speed approach is defined with parameter **0831**.

Undershooting and stresses in the brake disc/drum are reduced by this function.

4.8.2. Parameters

Description	MIN	MAX	NORM	SET	IDENTITY	English text
The analogue reference input as well as the input from the PC-based Tool (but not from step control) is shaped by a function generator prior to the ramp generator. Selection between 1: $u_2 = u_1$, 2: $u_2 = \text{SIGN}(u_1) * u_1^2$, 3: $u_2 = \text{SIGN}(u_1) * \text{MAX}(|u_1|; \text{REFMIN})$, 4: $u_2 = \text{SIGN}(u_1) * \text{MAX}(u_1^2; \text{REFMIN})$ or 5: $u_2 = 0$ (zero). Use for step control with light load. Over-shooting is prevented as the integral part of the speed regulator is set to zero each time the ramp output value coincides with the step reference. 6: $u_2 = 0$ (zero). Use for step control with heavy load. The integral part is not reset, which minimises load droop for hoists and is more suitable for fine positioning of heavy travel motions.	1	6	5	D	0801	RAMP_TYP

Description	MIN	MAX	NORM	SET	IDENTITY	English text
Set time in ms. Typical value for a Hoist: 1400 - 3000 ms Typical value for a Travel: 2500 - 7000 ms 0 will give acceleration on Torque limit. The ramp times shall be calculated at design, but are kept as start-up parameters.	0	32 000	3 000	S	0802	ACC_TIME
Set time in ms. Typical value for a Hoist: 1200 - 2500 ms Typical value for a Travel: 2000 - 6000 ms 0 will give acceleration on Torque limit. The ramp times shall be calculated at design, but are kept as start-up parameters.	0	32 000	2 000	S	0803	RET_TIME
% reference of step 1 of the master switch for first operation station, in most cases the only operation station. Set to 0,0% when analogue reference is given, else the step 1 percentage will be added to the analogue reference. As soon as Direction A or Direction B signals are active, the reference starts to ramp to this target value.	0	100	10	D	0804	C1_ST1pc
% reference of step 2 for first operation station, in most cases the only operation station	0	100	25	D	0805	C1_ST2pc
% reference of step 3 for first operation station, in most cases the only operation station	0	100	50	D	0806	C1_ST3pc
% reference of step 4 for first operation station, in most cases the only operation station. Step 4 is only used for the rare installations with five speed steps. N B! There is another input for FULL SPEED, set by 08.22 . This is almost always 100%.	0	100	50	X	0807	C1_ST4pc
Minimum allowed reference for first operation station.	0	100	0	X	0808	C1REFMIN
Analogue reference inputs will not need the direction signals A and B or the Zero Position signals to become effective.	0	1	0	X	0809	AUT1_DIR
% reference of step 1 for second station. Set to 0 when analogue reference is given, else the step 1 percentage will be added to the analogue reference	0	100	10	X	0810	C2_ST1pc
% reference of step 2 for second operation station.	0	100	25	X	0811	C2_ST2pc
% reference of step 3 for second operation station.	0	100	50	X	0812	C2_ST3pc
% reference of step 4 for second operation station. Step 4 is only used for the rare installations with five speed steps. N B! There is another input for FULL SPEED, set by 08.22 . This is almost always 100%.	0	100	50	X	0813	C2_ST4pc
Minimum allowed reference for second operation station.	0	100	0	X	0814	C2REFMIN
(for second operation station), analogue reference inputs will not need the direction signals A and B or the Zero Position signals to become effective.	0	1	0	X	0815	AUT2_DIR

Description	MIN	MAX	NORM	SET	IDENTITY	English text
The slow speed from PRELIM switch to final limit switch. As a percentage of the synchronous speed. Set between value of parameter 06.01 ZER_SPpc and 50%. Normal 10%	0	50	10	D	0816	END_SPpc
If by any reason the full position of the master switch should give another value than full speed, this parameter should be used. Example: Setting 75 will limit the max. speed to 75% of the synchronous for both step and potentiometer master switch. If the step master switch has the steps 12%, 30% and 60% beside full position, the speeds will be 9%, 22,5%, 45% and 75% for the four notches given a setting 75% of this parameter. Should in most cases be set to the normal value 100.	0	100	100	X	0817	NREF_RED
Delayed start for testing of brakes. The testing can be made with approx. 160% of the rated motor torque with value 08.19 = 1, or with 220% of the rated motor torque with 08.19 = 2. The normal value is 08.19 = 0, which does not cause any reference delay for brake testing. The referenced is delayed during the time set by 08.24 . During this time the brakes are not lifted. The controller tries to reach a current same as set current limit. The target direction is B, meaning lowering for hoists. If the value of the maximal measured speed is larger than set by parameter 10.12 we have a fault, code 90 If the value less than set by parameter 10.12 during this time, the testing is passed, and the controller turns to a state for normal running.	0	2	0	D	0819	BRK_TEST
Percent movement of analogue master switch around zero then it is considered to not have been intentionally moved.	0	200	2,0	X	0820	DEADZONE
Reference can be zero until the brake is assumed to has started its opening. 0 = No action of function 1 = Keeps zero reference until time 08.24 is elapsed 3 = Keeps zero reference until brake indicates OPEN, however never longer than time 08.24	0	3	0	D	0821	REF_DELA
Speed reference for fastest notch of controller. Use normal setting 100% , which will result in as fast as possible.	0	200	100	X	0822	STP100pc
Time, corresponding to opening time of the brake, then the speed reference is kept at zero. See parameter 0821 .	0	1500	150	S	0824	DELA_TIM

Description	MIN	MAX	NORM	SET	IDENTITY	English text
Used in manual operation of travel motions: If the driver pulls the lever to the opposite side than the actual motion, the retardation ramp time is reduced by the percent value given with parameter 08.27	0	100	0	S	0827	REV_RAMP
When stopping a hoist motion after lifting, but not after lowering, it is detected when the speed reference falls below the level set with 0830 . In this situation the ramp time is made a multiple longer than it is set as with parameter 0803 .	0%	25%	6%	S	0830	N_APPRCH
The rate of which the deceleration ramp slope is increased at zero-speed approach.	1,00	10,00	3,00	S	0831	RATE_APR

4.8.3. Signals

Description	Unit	IDENTITY	English text
Speed reference from the selected step control master switch, before the ramp function.	%	0850	PRERAREF
Speed reference from whichever origin as Master Switch, Computer or Master-Follower, after the ramp function.	%	0851	N_REF
Continuous speed reference measured after the reference value former set by parameter RAMP_TYP, 08.01 .	%	0852	CONT_REF
Operation station no. 2 selected	Bool	0853	STAT2_S
(mainly) master switch in direction A	Bool	0854	DIR_A
(mainly) master switch in direction B	Bool	0855	DIR_B

4.9. Group 9: Speed regulator

4.9.1. Description

This group of information shall partly be included in the design phase; example: parameters related to super-synchronous braking (**09.08** and **09.09**).

Parameters related to the PID-regulator can be estimated by the designer and tuned by the start up engineer.

In release 10_040 a function was included that disables the integral part of the speed regulator at very low speed. In some situations this is not suitable.

From release 10_053B (November 2006) it is possible to activate the integral part of the speed regulator also at very low speed. The activation is made by setting parameter **06.14** to 10 instead of 0, or 11 instead of 1. **Most used value for new design will be 10.**

Alternatively to Speed control Acceleration control (Group 18) can be used for travel motions. Acceleration control is available from release 10_054.

4.9.1.1. PID-regulator

The PI control is maintained inside the speed range there the controlled slip ring motor can produce as much torque that the desired torque can be delivered. For Hoists going up and Travel motions this limit is assumed to be not less than 85% of the synchronous speed.

For Hoists going down normally Super-synchronous lowering is used to reduce heat up and regenerate the lowering energy to the power grid. The switch over speed for this is normally 95%.

The Normal values are used for a first start up.

4.9.1.2. Improved regulator

- The P- and I-parts of the speed regulator are adjusted separately, which by experience has been found better for Start-up tuning and motion performance.
- The I-memory of the speed regulator is reset to zero when any speed reference ramp has reached the requested value. The classical problem with under-/overshooting due to the principle of reversible phase control is now eliminated. It is possible to include I-part of the gain for most motions, also Travel motions.
- The transition from Open Control state or Super-synchronous mode back to the speed-regulated mode is made invisible for the driver, and with low peak current impact, which saves the electrical and mechanical equipment. Further improvements to better control backlash in the drive system is made in 10_05.

4.9.1.3. ...

4.9.1.4. Open control

For Travels in both directions and Hoists in hoisting direction the speed control loop is disconnected, and the motor is fed with sinusoidal voltage.

When leaving Open Control the controller moves from a non-linear mode with full line voltage on the motor to a speed controlled mode. The motor voltage is forced to a very low value at this stage, and is after that softly reapplied until the motor voltage corresponds to what is needed to maintain the ordered speed. Parameters **11.45** and **11.46** are used for this purpose. In this way the controller will give a very soft action even in the case the drive system contains backlash.

The conditions to enter this state are:

- The speed reference is larger than parameter **09.27**. Normally the standard value 85% shall not be changed.
- ASTAT is already applying full voltage to the motor.

The open control state is ended when:

- A slow-down or stop limit switch is hit
- When the driver notches back so the speed reference is slower than the speed feedback
- In case rotor frequency feedback is used the state is ended as soon as the speed reference is slower than parameter **09.27**.

4.9.1.5. Super synchronous regenerative lowering

When the |speed| is faster than set by parameter **09.09**, the motor will accelerate to slightly more than the synchronous speed, and reverse the active energy to the mains taking the magnetising power from the mains. This regenerative mode is possible only for motions with a load that pulls with a higher speed than the synchronous, like hoists.

At first Start Up of the system, provoke the worst conditions with largest load and tap the apply transformer for low voltage. In that situation, at notching back from Super synchronous lowering, check that the gain parameters **09.02** and **09.03** are large enough to pick up the load from falling through.

For hoists setting parameter **09.08** to 1 activates the regenerative lowering.

4.9.1.6. Notch back optimisation from super-synchronous lowering

4.9.1.6.1. Softening of transition

From AST10_05 the super-synchronous "motoring" in lowering direction is ended already when the full speed notch of the master switch disappears. The advantage is that the speed error will not have time to increase and give a larger current pulse/torque pulse in the motor when the speed reference else must ramp back to (standard value) 85%, which typically results in a speed error of $105\% - 85\% = 20\%$ when the regulator once more becomes active. With the new function the speed error is typically $105\% - 100\% = 5\%$, which gives a lower current impact.

4.9.1.6.2. Additional for rotor frequency controlled hoists

From AST10_03A a function is included that makes the notch back after super synchronous lowering for hoists with rotor frequency control at least as fast as for those with tachometer or encoder control.

During super synchronous lowering the lowering current is memorised. At notching back the rotor contactors are opened, and during the time set with **09.34** a current **09.33** times the memorised current is injected in braking direction. After this time, it is back to normal speed control

From AST10_04C, it is possible to modify the performance of the function; most modifications are made to reduce the fast notch back and allow a small load droop!

4.9.1.7. Speed dependent gain

For most applications better servo drive properties can be obtained by varying the gain vs. the speed reference. Typically the proportional gain can be increased for the low speed range.

Between the fixed breakpoints 10, 25, 50% and full speed there is interpolation of the values.

From release 10_054 a new breakpoint 0% speed is available for P- and I-gain.

The experience-based default values will serve well in nearly all applications.

4.9.1.8. State dependent gain

For most applications better servo drive properties can be obtained by varying the gain vs. the speed reference change state.

For motion control with regular requirements, that is nearly all industrial cranes, leave the default values of **09.35** (Integral) and **09.40** (Proportional part) unchanged. The defaults give 50% reduction of the I- and 25% reduction of the P-gain during steady state motion compared to the gains during speed change state.

4.9.1.9. Acceleration control

Acceleration control is the recommended control for driver controlled travel motions. Read more about Acceleration control in group 18.

4.9.1.10. ...

4.9.1.11. Load droop compensation

The function is only used for hoists. If the intention is to go in direction A (up), a torque pulse is injected with forced forward bridge.

The load droop function should only be used when the performance of the normal speed regulator is unacceptable; before activating the fuzzy load droop function tries to increase the gain of the speed regulator.

It is recommended to **not** use the load droop function from AST10_03 and on as the regular control performance is good enough to prevent load droop.

The load droop compensation is removed by release 10_05.

4.9.2. Parameters

Description	MIN	MAX	NORM	SET	IDENTITY	English text
A derivate (DN/dt) the of Speed reference is calculated, and can give a feed forward contribution to the input of the speed regulator. Higher entered parameter value gives more action. Very rarely modified from 0.	0,000	10,000	0,000	X	0901	DER1_N
Integration part of speed regulator. Higher value gives more integration. Adjustment for hoists is mostly to a higher value. Note the option to have higher gain during non-stationary speed, parameter 09.35 . Start with 0,050 for a hoist, 0,020 for Travel. For a hoist with super-synchronous lowering, test with full load, so the I-part is not too small. For travels the value can mostly be 0,000. Bad or complicated mechanical drive gear requires a lower value for travel motions.	0,000	4,000	0,020	S	0902	N_KI
Proportional part of speed regulator. Higher entered parameter value gives higher gain. Adjustment is mostly to a higher value. Note the option to have higher P-gain during non-stationary speed, parameter 09.40 .	0,200	64,000	2,000	S	0903	N_KP
Switching to super-synchronous braking is made in lowering mode. 0: is not effective. 1: is effective only in direction B (lowering for hoists). 2: is effective only in direction A. 3: is effective in both directions.	0	3	0	D	0908	SUP_SYNC
Value in percent of the motors synchronous speed for switching to super-synchronous braking.	50%	100%	95%	D	0909	SUP_SPpc
Increased action of the Speed controller Integral part at 10% speed. The value entered is relative to 09.02 . It can be dangerous to use this parameter to reduce the Integral gain at low speed.	-100	400	0	X	0912	KI_ADD10
Increased action of the Speed controller Integral part at 25% speed reference The value entered is relative to 09.02 .	-100	400	0	X	0913	KI_ADD25
Increased action of the Speed controller Integral part at 50% speed reference. The value entered is relative to 09.02 .	-100	400	0	X	0914	KI_ADD50
Increased action of the Speed controller Integral part at full speed reference. The value entered is relative to 09.02 .	-100	400	0	X	0915	KI_ADD99
Increased action of the Speed controller Proportional part at 10% speed. The value entered is relative to 09.03 .	-100	400	50	S	0916	KP_ADD10

Description	MIN	MAX	NORM	SET	IDENTITY	English text
Increased action of the Speed controller Proportional part at 25% speed reference. The value entered is relative to 09.03 .	-100	400	25	S	0917	KP_ADD25
Increased action of the Speed controller Proportional part at 50% speed reference. The value entered is relative to 09.03 .	-100	400	10	S	0918	KP_ADD50
Increased action of the Speed controller Proportional part at full speed reference. The value entered is relative to 09.03 .	-100	400	-30	S	0919	KP_ADD99
Above this reference the optimisation function for full speed can be active, and in principle the motor is DOL. Do not set larger than 85% for rotor feedback. If set to at least 101%, the speed control is always active. Set to 200% for Electrical shaft and similar applications.	0	200	85	X	0927	NREF_LEV
Normal value = 1 0=turn off the optimisation function for full speed. Do not turn-off without consulting ABB.	0	1	1	X	0928	OPEN_C
High reference to ramp generator will be to a value of (100%+ 09.31) when weight is less than 14.04 AND direction of motion is down AND speed reference is down AND value of speed reference larger than 50% AND super-synchronous lowering is not active during a lowering. See Load functions	0	70	55	D	0931	ADD_PLUG
The reference to the ramp generator will be limited to a value of (100%-09.32) when Weight less than 14.25 unless FREE_HOK is true. The Speed limitation is made before the ramp function AND only in positive direction reference AND FREE_HOK = 0 See Load functions	0	100	65	D	0932	REDSLACK
This parameter is active only when speed feedback is made with rotor voltage frequency. For a time, defined as 09.34 ms, after exit from super-synchronous lowering, the current will be forced to 09.33 % of the historical current that was measured for the super-synchronous lowering phase.	0	400	280	X	0933	REV_CUFA
This time starts when Super Synchronous lowering ends. If there is rotor freq. feedback, during this time 09.34 the speed control is replaced by plug braking with parameter 09.33 x the lowering current in Super Synchronous mode.	0	500	250	X	0934	CURRTIME

Description	MIN	MAX	NORM	SET	IDENTITY	English text
For most motions the behaviour of the drive is better if the Integral gain is higher during speed changing than in steady state. By setting this parameter larger than 0 the Integral gain will be reduced during steady speed compared to during change. Leave as default = 50% for regular applications.	0	100	50	S	0935	KI_RD_SS
For most motions the behaviour of the drive is better if the Proportional gain is higher during speed changing than in steady state. By setting this parameter larger than 0 the gain will be reduced during steady speed compared to during change. Leave as default = 25% for regular applications..	0	100	25	S	0940	KP_RD_SS
Increased action of the Speed controller Integral part at 0% speed. The value entered is relative to 09.02 . It can be dangerous to use this parameter to reduce the Integral gain at low speed.	-100	400	0	X	0942	KI_ADD10
Increased action of the Speed controller Proportional part at 0% speed. The value entered is relative to 09.03 .	-100	400	100	S	0946	KP_ADD10

4.9.3. Signals

Description	Unit	IDENTITY	English text
Speed error = In-signal to speed regulator	%	0950	SPEEDERR

4.10. Group 10: Speed supervision

4.10.1. Description

This group of information shall be included in the design phase. Most parameters are self-explanatory.

4.10.1.1. Tachometer and Encoder supervision

It is monitored that a Step 1 speed reference gives any response from the speed feedback device in a short time. **If the motion is not able to start within a few 100 ms due to a slow opening brake, the function for handling slow opening brake should be adjusted before the supervision time for the tachometer supervision is set longer.**

Parameters that are active: **10.12**, **10.13** and **10.15**

Remark: Rotor frequency feedback is supervised electronically.

4.10.1.2. Speed deviation supervision

It is monitored that the deviation as defined by parameter **07.01** is not larger than allowed in active speed control range. Parameters that are active: **10.11**, **10.13** and **10.19**.

4.10.1.3. Overspeed supervision

ASTAT cannot be reset in the usual way after an overspeed trip. If there is an overspeed trip DO no. 8 of DATX 110 will open. It cannot be closed or the ASTAT will not be ready for new service until the 230 (115) V AC control voltage has been off and on again. See also Sections **2.3 Crane power and control voltage** and **4.22, Options for Fault handling**. This function is not available for share motion drives.

The speed can be compared for an absolute high value, see parameters **10.01** and **10.02**.

With setting **10.01** = 3 the trip level can be temporary changed to only 40% of the synchronous speed by making DI no. 15 active. This is particularly for testing the safety system at a lower speed than 125% of the synchronous.

4.10.1.4. Reference tracking system for early overspeed detection

The function is tracking the actual speed from the speed reference. It can only be used for hoists with tachometer or pulse encoder.

In case it finds an abnormal state, it sets a fault flag, gives code 91, and can not be reset by OFF like Over-speed faults. It opens DATX110 DO8 (emergency stop) depending of the selection of parameter **10.30** USE_OVSP. The function is developed to make an early stop with the working brakes of the high speed side in case there is an electrical fault, and avoid to stress the emergency brakes and rest of the drive system as far as possible.

The function can as well be used for hoists without any emergency brakes, and in that case it can emergency trip the whole crane

Parameters that are active: **10.30**, **10.31**, **10.32**, **10.33**, **10.34** and **10.35**. This system is new from 10_05.

4.10.1.5. Thyristor bridge supervision

For travel motions ASTAT allows only the other thyristor bridge than the motoring bridge for the ordered direction during the set retardation time (parameter **08.03**) and a margin given by parameter **10.22**. **10.22** can normally be left as 100%. If the time is elapsed the motion is stopped with Torque Fault.

For a hoist the monitor is connected only in the hoisting direction ("Direction A"); if the conduction time of the motoring down bridge ("Bridge Reverse") is longer than the set retardation time (parameter **08.03**) and a margin given by parameter **10.22** the motion is stopped with Torque Fault.

In the special case that the motion is a jib or similar that requires plug braking during longer time setting parameter **10.22** to 1 will turn off the Thyristor bridge supervision.

4.10.2. Parameters

Description	MIN	MAX	NORM	SET	IDENTITY	English text
Overspeed supervision of hoists. 1 .. 3. 1: DI requires high input. 2: Pulse frequency higher than allowed on DI. 3: Speed measurement based; trips at the value of parameter 10.14 % ^{CTR} of the synchronous speed.	1	3	1	D	1001	OSP_TYPE
Overspeed pulse frequency on DI. 1 .. 75 ^{CTR} . Normal 1. Unit: Hz.	1	75	1	D	1002	OSP_FREQ
Allowed error in speed as percent of the reference. If the speed reference is low, a speed error of parameter 10.13 percent is allowed. Trip is delayed by time 10.19 . Fault code is 65. Using rotor frequency feed-back, in Open control (full speed hoisting or travelling) and in Super-synchronous braking (full speed lowering) this supervision is not active	0	100	30	X	1011	SMERRTOL
The level that defines that there is some life at all in the tachometer. The minimum of this level is determined by discrimination of noise as an active tachometer input.	0	200	0,5	X	1012	FEEDBLEV
At this level, set slightly less than Step 1, a feedback is requested from tachometer or encoder. Any feedback is defined by a speed feedback value larger than 10.12 , typically 0,5% of full speed. Trip is delayed by time 10.15 . Fault codes are 89 or 66. The Fault indications 89 and 66 have higher priority than Fault 65. Rotor feedback is checked in another way, and gives Fault code 37.	0	200	8	X	1013	REFLEV
If parameter 10.01 = 3, the motion will trip at absolute measured speed level. This level is set with 10.14 . It will adjust itself to a higher value in case of the High Speed Down - function is used. Do not adjust 10.14 of this reason.	0	200	125	X	1014	OVSPLEV
Time that no feedback at all is accepted. If this trip comes at start the most common reason is a slow lifting brake. Use the function to delay the reference until the brake has lifted, see Section 4.8 Speed reference , before that parameter 10.15 is set longer. Brakes will degenerate by age and be slower in action, so the delayed reference shall have some margin when starting up a new crane.	0	1500	500	X	1015	FEEDB_T
Time that a speed deviation of 10.11 % of speed reference is accepted. Can be carefully increased if Speed deviation Fault is generated although the drive system is without any error	0	2500	1000	S	1019	SP_DEV_T

CTR If the Cycle Time Reducer function is used, see section **Load Functions**, ASTAT will itself adopt the overspeed limits to the increased speed. The application engineer shall **not** compensate for that situation by increasing limits in Group 10.

Description	MIN	MAX	NORM	SET	IDENTITY	English text
Margin as % of the set retardation time added to the set retardation time, in which the motion is allowed to reverse-current ("plug") brake.	0	200	100	X	1021	RTIME_SC
Set 1 to turn off the Thyristor bridge supervision for motions that needs long time reverse-current braking. The supervision is not active lowering with a hoist (no need to set to 1!)	0	1	0	D	1022	JIB_TRAV
The system is developed to early detect any electrical fault that will lead to dangerous situations, but can be stopped with only the high speed brakes. The system is most used in large hoist mechanisms. ASTAT can not be reset without control voltage off, like an overspeed trip. 0: Reference tracking system off 1: Reference tracking system on. Emergency stop of the crane will come directly, as DO 8 opens. 2: Reference tracking system on. Emergency braking will not occur, as DO 8 remains closed. Use for installations with emergency brakes.	0	2	0	D	1030	USE_OSPT
For a hoist, except in the conditions given by 10.32 and 10.33 it is not allowed that the actual speed measurement gives a value 10.31 or more less than the reference with tendency to fall down.	10%	50%	20%	X	1031	TRK_DIFF
For a hoist, except in the condition given by 10.33 it is not allowed that the actual speed measurement in Open control mode gives a value 10.32 or less with tendency falling down.	0%	60%	25%	X	1032	TRK_OCTL
For a hoist it is not allowed that the actual speed measurement in Bridge changing state gives a value 10.33 or less than the reference with tendency falling down.	10%	80%	40%	X	1033	TRK_BRCH
For a hoist it is considered that the Open control or bridge changing mode is preventing optimal control for the time 10.34 after the Open Control was finished, or the new bridge started.	250 ms	1000 ms	600 ms	X	1034	TRK_TIME
Although there are conditions to set the fault signal OSPTRACK (21.91), there is a delay time 10.35 before the fault is issued.	50 ms	500 ms	200 ms	X	1035	TRKDELAY

4.11. Group 11: Current regulator

4.11.1. Description

4.11.1.1. ...

4.11.1.2. Current limit

This parameter is used to limit the torque for the scalar control DARA 1000 and 1010. The parameter is overriding the torque set point for DARA 1001. The most used range is 200 .. 400 %. For two-contactor hoists and travels the value 250% can be used, and for three-contactor hoists the value 200% can be used without deeper investigations.

Parameter **11.01** must be changed to a lower value when upgrading systems from software AST10_04 or earlier. The value for 11.01 for 10_04A and newer must be reduced acc. to following formula:

$$\text{Value 11.01 (10_04A or later)} = \text{Value 11.01 (10_04)} * \text{Value 11.10} / 1,732$$

The normal current limit is overrun by the Delayed travel motion braking and the soft impact control for back-lash impact reduction when leaving Open Control. See parameters **11.28**, **11.45** and **11.46**

4.11.1.3. Current gain

This parameter **11.03** is determining the gain of the current controller. Normally it is not needed to change from the Normal value. For travel motions the system response can be faster with higher proportional gain of the speed controller (**09.03**) and reduced current gain (**11.03**)

A lower value than 10,000 will result in a softer action, a higher value in an aggressive action.

4.11.1.4. System dynamics

This parameter **11.10** rescales the motion control system to handle different dynamic properties. The dynamics are limited both by the mechanism itself and the type of feedback. By experience has follow setting been found very successful:

- Good mechanics + tachometer allows 1,00
- Average mechanics + tachometer or good mechanics + rotor feedback allows 1,15
- Average/bad mechanics + rotor feedback or Bad mechanics + tachometer allows 1,30

4.11.1.5. Peak torque limitation

Parameters **11.45** and **11.46**, introduced in 10_52 offer, increased functions to handle systems with limited mechanic properties. The normal value settings are in most cases suitable without being modified.

In case a motion without any contactor is used, mostly a travel, at least one use-contactor parameter **12.25**, **12.26** or **12.27** must be set to 1, although no contactor is used.

4.11.1.6. Delayed travel motion brake

The release of the brake is delayed a time, parameter **06.06**, after the brake should have applied based on speed condition. During this period, the motion is slightly electrically braked, to damp out any remaining pendulum from the motion. The level of braking is set by parameter **11.28**. Normal value 100% current limit gives about 30% braking torque.

The delayed brake function is used only for travel movements. If the parameter is set to another value than 0 for a hoist, it will be ignored by ASTAT and the brake will not be delayed.

The delayed brake function can also be used together with the DC-brake function.

Typical delay time: between 0,1 – 10 seconds, normal 1,0 seconds.

This parameter does not have any meaning for hoist motions.

4.11.2. Parameters

Description	MIN	MAX	NORM	SET	IDENTITY	English text
Current limit in % of rated current of the motor or the motors together. For Speed control this parameter is used to limit the electrical impact by high current, not for speed control. For Acceleration control the value can be smaller	100	400	250	S	1101	LIM_INpc
Gain of current regulator. The current regulator is working with only integral gain. The value can be modified after careful testing. Travel motions can be better with reduced value of this parameter and higher speed regulator gain.	0,100	32,000	10,000	X	1103	US_KI1
Earliest starting time in electrical degrees of firing pulses in motor mode. The value 20 degree corresponds to that the firing pulses are allowed to start so early in the electrical period, that the motor gets full line voltage.	20	180	20	X	1106	ALPHAMIN
Controls the systems dynamics. Typical setting in some situations: Good mechanics+tachometer allows 1,00 Average mechanics+tachometer or good mechanics+rotor feedback allows 1,15 Average/bad mechanics+rotor feedback or Bad mechanics+tachometer allows 1,30	0,300	2,560	1,150	S	1110	ISCALVAL
Earliest starting time in electrical degrees of firing pulses in regenerative mode. This parameter shall only be increased for heavy loaded motors with high CosFi that else can operate in two-phase mode with heavy mechanical vibrations.	20	180	20	X	1112	ALPHAGEN
Current limit for elimination of sway of travel motions by electrical braking with this current during the time defined by parameter 06.06.	100	400	100	D	1128	RED_INpc
If a slow breaking rotor contactor is used, ASTAT can still perform the opening of it with zero current. The control performance will however to badly influenced by a slow opening contactor.	0	100	20	D	1139	CON_OP_T

Description	MIN	MAX	NORM	SET	IDENTITY	English text
Expected time in ms to reach current zero after giving zero current reference. Used for implementation of solid state contactor opening.	0	200	20	X	1144	IS_ZER_T
Current limit in % of rated current of the motor to start with after reactivating the speed regulator after ending Open Control, Super-synchronous lowering or after contactor opening.	0	400	0	X	1145	LIM_INOC
Time for linear increase of the current limit from LIM_INOC (11.45) to LIM_INpc (11.01).	0	1000	50	X	1146	LIMIRATE
Time for bridge change, the time none of the forward or the back thyristor bridge is active. Whatever value entered, there is a hard coded minimal value of 12 milliseconds.	0	50	12	X	1147	BR_CH_TM
The thyristor bridge is changed from forward to back or back to forward in case the reference to the current regulator changes sign. In an ASTAT there is no 1:1 relation between the output from speed regulator (= torque reference) and the current reference. To avoid to frequent change of thyristor bridge, there must be a hysteresis prior to bridge change. This parameter sets the level in % motor rated current on how far on the bridge change requesting side the reference must go before the change request is accepted.	0	400	10	X	1148	BR_CH_LV

4.11.3. Signals

Description	Unit	IDENTITY	English text
Current reference in % rated current of the connected motors.	%	1152	IS_REF
Actual stator current in % of motor rated current of the connected motors. (Analog output No. 1)	%	1153	ISACT
Thyristor phase (firing) angle	Degree	1155	ALPHA
Actual motor voltage measured on ASTAT motor connection terminals	V	1157	VMOT_AV
Frequency measurement fault. 1: Fault	Bool	1161	FREQFLT
Phase sequence fault; 1: Fault	Bool	1162	PHSEQFLT
Synchronisation with line voltage; 1: synch. OK, 0: failed.	Bool	1163	SYNC_OK
One of the thyristor bridges is active. 1: active, 0: not active	Bool	1172	BR_ACT
Active thyristor bridge for motoring in direction A. 1: active, 0: not active	Bool	1173	BR_FWD
Active thyristor bridge for motoring in direction B. 1: active, 0: not active	Bool	1174	BR_REV

4.12. Group 12: Rotor resistor

4.12.1. Description

For different types of movements the below suggested resistor values will give trouble-free performance:

$\Sigma R1 = f(R_{mot} + R_{cable} + R1)$. Could, as example be 8% of $R100$.

$\Sigma R2 = f(R_{mot} + R_{cable} + R1 + R2)$. Could, as example be 18% of $R100$.

$\Sigma R3 = f(R_{mot} + R_{cable} + R1 + R2 + R3)$. Could, as example be 38% of $R100$.

$\Sigma R4 = f(R_{mot} + R_{cable} + R1 + R2 + R3 + R4)$. Could, as example be 65% of $R100$.

$\Sigma R5 = f(R_{mot} + R_{cable} + R1 + R2 + R3 + R4 + R5)$. Could, as example be 100% of $R100$.

$R100$ is the resistance with which the motor will produce nominal torque at stand still. See the section **ASTAT**

SYSTEM DESIGN for more information how the calculation is made.

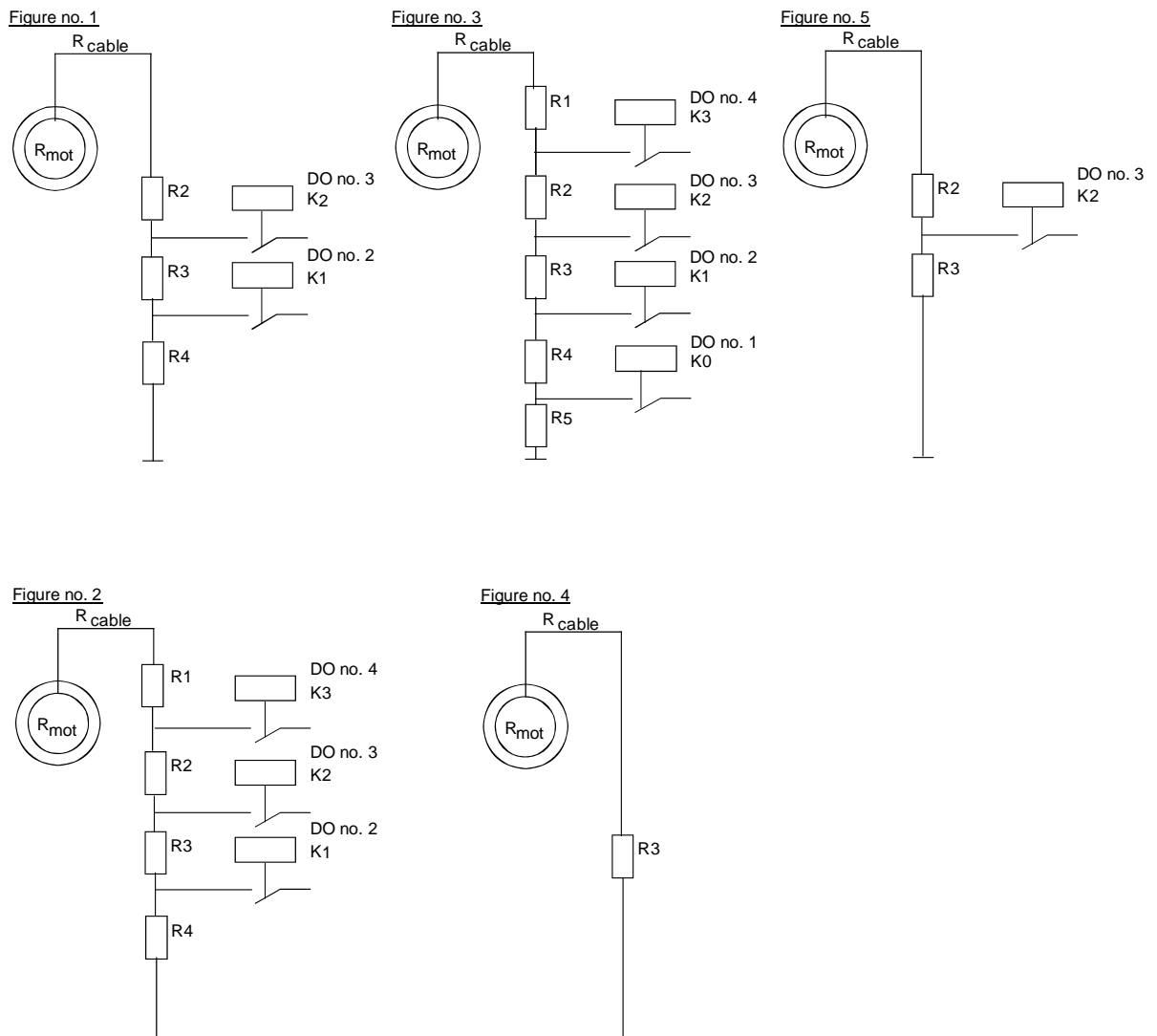
R_{mot} varies from 0% in a large "copper-rich" hoist motor for high ambient temperature to 6-7% for a small travel motor.

R_{cable} is normally around 0,5%, occasionally more than 1%.

The values of **the resistance steps R1..R5** shall be entered as their normally expected warm values. The cold values can be 10% less, the highest designed for resistance values can be 10% higher.

Reference figures:

The reference figures explains how the parameters of Group 12 are related to the main circuit diagram, and which digital output relay that shall be connected to a certain rotor contactor.



The values in the table are expressed percent of the motors unity resistance, R100' (see Section ASTAT SYSTEM DESIGN, Rotor Resistor).	ΣR1	ΣR2	ΣR3	ΣR4	ΣR5	Reference fig. no.
Hoists, small motor or with large torque margins	0	12	40	60 to 65	0	1
Hoist	8	18	38 to 40	60 to 65	0	2
Hoist, without super-synchronous braking and lowering heavy load	8	18	38 to 40	60 to 65	100	3
Indoors travel. Top speed normally is about 90% of synchronous. Minimises cabling. No contactors. Can be placed on trolley or near each corner motor. Recommended. If top speed is critical: select one size larger motor and change gear ratio.	0	0	30	0	0	4
Travel	0	12	40	0	0	5
Balanced luff / jib	0	0	30	0	0	4
Luff / jib in general	0	12	40	0	0	5
Slewing	0	12	40	0	0	5

 **Hint: Use the EXCEL "Resistance_checker_xx.xls" of the Tool software to easily get the optimal resistance values for a particular motion. xx is a number 01 - 99.**

From Release 10_05 there is only one fixed function for operating the contactors.

From Release 10_05 the rotor contactors are opened without any current using the primary side thyristors as solid state switches. Parameter **11.44** is assigned to this function. See section **Current regulator** above.

The normal values fit to a 0, 1, 2, 3 or 4 contactor system with preferably stepped master switch, with step levels as per free choice.

For both Travel and Hoist motions the contactors can be disabled with parameters **12.24** to **12.27**. If the corresponding contactor **is not installed, its parameter shall be set to 0**. If the corresponding contactor **is installed, its parameter shall be set to 1**.

During acceleration the contactors K2 and K3 are interlocked from closing if the line current is too high.

Contactor operation for Travel motion.

The operation is symmetrical in directions A and B

Contactor	Pull in speed	Open speed	Open control = Full speed motoring	Acceleration control
K1	Faster than (12.19) . Overridden by Brake testing, see section Delayed start for brake testing , parameter 08.19	Braking <u>or</u> slower than (12.19 - fixed Hysteresis) . Overridden by Brake testing, see section Delayed start for brake testing , parameter 08.19	-	Same as speed control
K2	Faster than (12.20) , and master switch order larger than (12.20) + (12.17) . Line current must be less than (12.11)	Braking, except during acceleration, <u>or</u> slower than (12.20) - (12.22) , or master switch order smaller than (12.20) + (12.17) - (12.22)	Closing momentary if not already closed	Same as speed control
K3	Faster than (12.21) , and master switch order larger than (12.21) + (12.18) . Line current must be less than (12.11)	Braking, except during acceleration, <u>or</u> slower than (12.21) - (12.23) , or master switch order smaller than (12.21) + (12.18) - (12.23) . Always open at speed decrease, independent of the actual speed.	Closing confirmed a time after K2 (12.29) to avoid control voltage inrush current	Same as speed control
K0	-	-	-	

Contactors operation for Hoist motion.

For Hoist motions the contactors can be manipulated with parameter **12.08**.

The operation is not symmetrical in directions A (hoisting) and B lowering)

Contactor	Pull in speed	Open speed	Open control = Full speed motoring	Super-synchronous state = Full speed regeneration
K1, Hoisting direction	Faster than (12.19). Overridden by Brake testing, see section Delayed start for brake testing , parameter 08.19	Braking <u>or</u> slower than (12.19). Overridden by Brake testing, see section Delayed start for brake testing , parameter 08.19	-	-
K2, Hoisting direction	Faster than (12.20), and master switch order larger than (12.20) + (12.17). Line current must be less than (12.10)	Braking, except during acceleration, <u>or</u> slower than (12.20) - (12.22), or master switch order smaller than (12.20) + (12.17) - (12.22)	Closing momentary if not already closed	-
K3, Hoisting direction	Faster than (12.21), and master switch order larger than (12.21) + (12.18) Line current must be less than (12.10)	Braking, except during acceleration, <u>or</u> slower than (12.21) - (12.23), or master switch order smaller than (12.21) + (12.18) - (12.23). Always open at speed decrease, independent of the actual speed.	Closing confirmed a time after K2 (12.29) to avoid control voltage inrush current	-
K0, Hoisting direction	Closed	-	-	-
K1, Lowering direction	-. Overridden by Brake testing, see section Delayed start for brake testing , parameter 08.19	Open. Overridden by Brake testing, see section Delayed start for brake testing , parameter 08.19	-	-
K2, Lowering direction	-	-	-	(12.27) = 1: Closing delayed with (12.29) to avoid control voltage inrush current. (12.27) = 0: Closing momentary.
K3, Lowering direction	-	-	-	(12.27) = 1: Closing momentary. (12.27) = 0: Not closing
K0, Lowering direction	Opening for high speed lowering with light load (not together with Super-synchronous state)	-	-	-

4.12.1.1. Using contactors with slow magnet system

The normal values are suitable for all ABB contactors A 9 .. A300 and EH 370 .. EH 800 with AC- as well as DC-magnet systems. If other contactors with longer times are used, parameters **11.39** and **12.29** can be adjusted to avoid short torque weakness (12.29) and premature aging due to opening the contactor with current flow (11.39).

The experience is that the performance is negatively affected by using contactors of 30 to 50 ms opening time or more. If slower contactors are used, it might be needed to reduce their life-length to get acceptable control.

4.12.2. Parameters

Description	MIN	MAX	NORM	SET	IDENTITY	English text
System with K3: Most used value is 8%. When K3 is not installed enter 12.27 = 0, and 12.01 = 0%.	0%	200%	8%	D	1201	RES_1_pc
System with K2: When also K3 is installed, the most used value is 18%. System without K3: Most used value is 12%. When K2 is not installed enter 12.26 = 0, and 12.02 = 0%.	0%	200%	18%	D	1202	RES_2_pc
System with one or more rotor contactors: Most used value is 40%. System without any rotor contactor: Most used value is 30%. 12.03 must not be 0%!	0%	200%	40%	D	1203	RES_3_pc
System with K1: Most used value is 65%. When K1 is not installed enter 12.25 = 0, and 12.04 = 0%.	0%	200%	65%	D	1204	RES_4_pc
System with K0: Most used value is 100%. When K0 is not installed enter 12.24 = 0, and 12.05 = 0%.	0%	200%	0%	X	1205	RES_5_pc
12.08 = 1: Resistor step 4 is used in the hoisting at Step 1 after four seconds of no speed change. Typically used for tilting of ladles in the hot metal industry. Only used for cranes with step master switch, not for analog reference.	0	1	0	D	1208	HI_RES_A
Hoist: A higher line current than parameter 12.10 will block K2 and K3 to close while accelerating. Prevents motor running on current limit. For protection of motor and resistor when the rotor resistance does not match switching speed. Overridden at By-pass control in rescue mode with one motor, parameter 25.01 = 2.	0%	400%	135%	X	1210	CL_H_LEV
Travel motion: A higher line current than parameter 12.11 will block K2 and K3 to close while accelerating. Prevents motor running on current limit. For protection of motor and resistor when the rotor resistance does not match switching speed.	0%	400%	200%	X	1211	CL_T_LEV
K2 is switching at the value set with 12.20, but the reference value before the ramp unit must the value of 12.17 higher than 12.20. With normal value settings K2 will only pull in with the master switch in full speed position.	0%	35%	15%	X	1217	SSTDIFK2
K3 is switching at the value set with 12.21, but the reference value before the ramp unit must the value of 12.18 higher than 12.20. With normal value settings K3 will only pull in with the master switch in full speed position.	0%	15%	5%	X	1218	SSTDIFK3

Description	MIN	MAX	NORM	SET	IDENTITY	English text
If there is enough torque, the full resistor can be used for low speed hoisting. The switch point of K1 is set with parameter 12.19	0%	30%	0%	X	1219	SW_K1
K2 is switching at the value set with 12.20, but the reference value before the ramp unit must be the value of 12.17 higher than 12.20. With normal value settings K2 will only pull in with the master switch in full speed position.	20%	90%	42%	X	1220	SW_K2
K3 is switching at the value set with 12.21, but the reference value before the ramp unit must be the value of 12.18 higher than 12.21. With normal value settings K3 will only pull in with the master switch in full speed position.	50%	95%	75%	X	1221	SW_K3
Hysteresis for contactor K2. Pulls in at speed set by parameters 12.20 and 12.17, drops at a slower speed. The difference is defined by 12.22.	0%	10%	4%	X	1222	HIST_K2
Hysteresis for contactor K3. Pulls in at speed set by parameters 12.21 and 12.18, drops at a slower speed. The difference is defined by 12.23.	0%	10%	4%	X	1223	HIST_K3
Set to 1 if the rotor contactor K0 is installed, else to 0.	0	1	0	X	1224	USE_K0
Set to 1 if the rotor contactor K1 is installed, else to 0.	0	1	1	D	1225	USE_K1
Set to 1 if the rotor contactor K2 is installed, else to 0.	0	1	1	D	1226	USE_K2
Set to 1 if the rotor contactor K3 is installed, else to 0.	0	1	1	D	1227	USE_K3
If a slow breaking rotor contactor is used, ASTAT can still perform the opening of it with zero current. The control performance will however to badly influenced by a slow opening contactor.	0	100	20	D	1139	CON_OP_T
If a slow making rotor contactor is used, ASTAT will delay the making of "redundant" contactors for Open control and Super-synchronous lowering in order to reduce to inrush current and voltage dip of the control voltage system.	0	32767	60	D	1229	CON_CL_T

4.13. Group 13: Selectable DO

4.13.1. Description

4.13.1.1. DO 1

Digital Out no. 1 of the process I/O board DATX 110 is programmable. With parameter **13.01** = 0 the Rotor Resistor Control can manage DO no. 1 for contactor K0.

To prolong the life-time of a friction coupling type cable reel for hoists, its motor can be disconnected except when it shall roll in at hoisting when the brake is lifted, and the speed reference is up. With the parameter set to **1**, DO no. 1 will have this function.

When none of the above functions are needed, the DO no. 1 can be used to prolong the life of the fans of the thyristor module. As soon as the motion starts, the fan/fans start and will continue 1 minute after the motion has stopped. With the parameter set to **2**, DO no. 1 will have this function. The actual temperature of the heat sink is shown as signal **05.94**.

Set to **3**, it is used in hoist systems with one oversized motor that shall lift and lower the full load for a limited time in case of a single motor failure. Value 3 is used in the macro that describes the rescue mode. The thyristor cooling fan will always run in rescue mode. For that short time typically the life of the fan is only one third, but the starting temperature for the thyristors will be lower.

4.13.1.2. DO 6

From 10_054 the Digital Out no. 6 of the process I/O board DATX 110 is programmable.

With parameter **13.06** = 0, DO 6 is used for control of DC-brake.

With parameter **13.06** = 1, DO 6 is used to control an off-delayed auxiliary device like rail fan or grease pump. The time is set with **06.04**.

4.13.2. Parameters

Description	MIN	MAX	NORM	SET	IDENTITY	English text
0: Extended lowering contactor. 1: Cable reel used. 2: Thyristor fan(s) can be temperature controlled. 3: The thyristor fans run all the time. Used for hoist systems with one of two motors oversized in rescue mode.	0	2	2	D	1301	SEL_DO_1
0: Forcing voltage for DC-brake, see section 6. 1: Control of an off-delayed auxiliary device.	0	1	0	D	1306	SEL_DO_6

4.14. Group 14: Load functions

4.14.1. Functions

4.14.1.1. Introduction

If information about Loads weight is available, the performance of the crane can be improved. An analog input 0-20 mA, 4-20 mA or 0-10 V from a load cell is connected to AI 5 (of 8) of I/O-board DATX 110, or to AI 2 (of 8) of the Cabin I/O. The resolution of the input is 11 bits (+sign). Example: A load range of 50 ton has a resolution of 25 kg.

A 4-20 mA signal can be supervised. An alarm is given, but the motion is not stopped.

The calibration of the load cell signal to weight is made by setting the value of two different test weights as parameters, and memorize their corresponding analog input signal values; formally as parameters. This allows for all of 0-20 mA, 4-20 mA or 0-10 V. The resolution improves if one test weight is very small (empty hook), and the other very large (nominal load or overload limit). Other weight values are simply calculated as $y = kx + l$.

The actual value, y in the previous sentence, is transformed to % by a parameter that determines the nominal load of the crane. The internal data format is 32-bit format, to keep the final resolution as 16-bit.

Most levels of functions are set by parameters.

The functions are not available for shared motion drives.

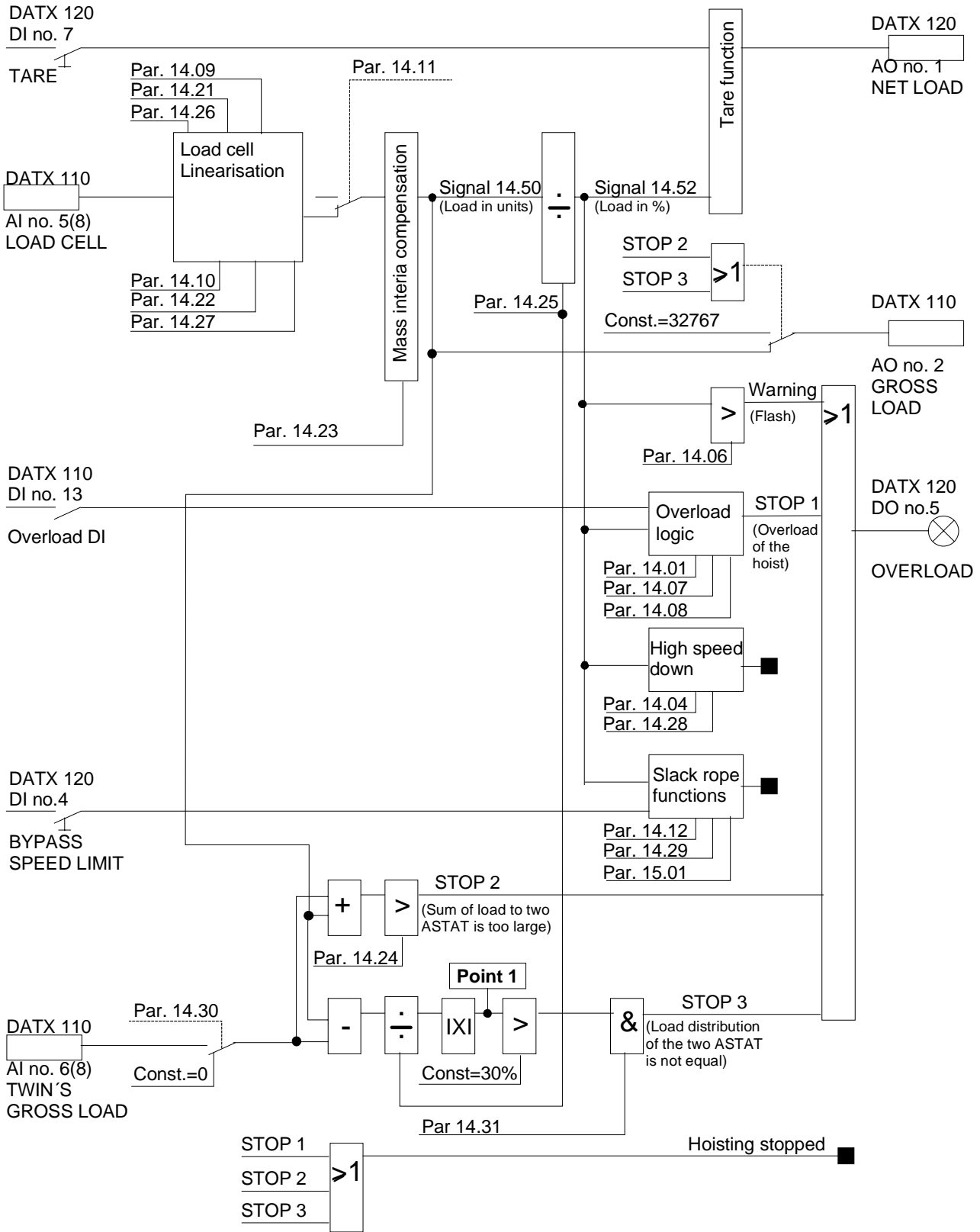
A remote I/O, "Cabin I/O DAPM 100" is needed for the load related functions.

4.14.1.1.1. Block diagram

In next page is found a block diagram describing the relationship between the different load cell functions.

Black quadratic ends of lines represent further interaction with rest of the AST software.

Parameters, Par. **14.01** etc., are described in the text for each functions and in addition listed in a separate section.



4.14.1.2. Load cell linearisation

There is no need to adjust the sensor or transducer part of the load cell. Any linear load cell that gives a milliamp or Volt signal within the whole measuring range can be used. The quality of the measurement is mainly set by the quality of the load cell. ASTAT resolution is limited to the 11 bit + sign AI and the internal 16-bit format of the Weight. Internal mathematics in ASTAT is made with 32-bit word length.

Set the jumpers of AI no. 5 (8) for mA or V signal from load cell.

Decide a division 1 Weight Unit = ? kg. Be as close as possible to 32 767 for the highest occurring load but do not pass it in any case.

You need two calibration points, one with a low known weight and the other with a high (as high as practically possible) weight.

First calibration point; Low weight

Set **14.09** The load between 0 - 32 767 Weight units.

Trig **14.26** Change triggering parameter from 0 to 1 to store the signal level for load value of parameter 14.09.

Second calibration point; High weight

Set **14.10** The load between 0 - 32 767 Weight units.

Trig **14.27** Change triggering parameter from 0 to 1 to store the signal level for load value of parameter 14.10.

After the described procedure any signal from the load cell will give a weight value as signal **14.50**

4.14.1.3. Load model: Torque based load estimation

This method is in most cases accurate enough for estimation if hook is empty or having (example) a tong or having (example) tong + coil. Torque in direction up during constant speed operation is multiplied by a factor giving the hook load instead of connecting a load cell. This function is still not implemented in AST10_04.

As long as the motion is idle or load is lowered or the speed is accelerating or decelerating, the load value is memorized.

A logical switch parameter is used to select Torque based load estimation instead of load cell.

The function requires Control System Module DARA 1001.

4.14.1.4. Mass inertia compensation

The load cell senses the heavy mass as well as the inertia mass of the load. All overload settings, weighing indications etc. are related to the heavy mass.

As ASTAT is a real time system with the needed information such as real acceleration easy available internally, the inertia mass is subtracted from the load cell measurement.

The hoists nominal speed in meter / minute is given as a parameter, maximally 327,67 m/minute.

At steady state speed the load cell only senses the heavy mass affected by the gravity force **g**, in the software universally set to $9,81 \frac{\text{m}}{\text{s}^2}$.

At acceleration **the** heavy mass contribution of the load cell is only: $\text{MIC} = \frac{\text{g}}{\text{g}+\text{a}}$

The acceleration is determined by using the nominal speed of the hoist and the actual slope given by parameters **08.02** (ACC_TIME), **08.03** (RET_TIME) and influence of the reduction factor described in the High speed down function below in this text.

Cases that are considered:

Case	Movement	Change in speed	Ramp to use	MIC	Remark
1	Up, positive	Going faster	ACC_TIME	<1	
2	Up, positive	Going slower	RET_TIME	>1	
3	Down, negative	Going slower	RET_TIME	<1	The reduction formula for High speed down function is considered.
4	Down, negative	Going faster	ACC_TIME	>1	

Example: For a hoist with nominal speed 6 m/m and acceleration (and retardation) time of 2 s the influence of the inertia mass is 1% of the total mass at change in speed.

4.14.1.5. Vacant

4.14.1.5.1. Vacant

4.14.1.6. Working with unity form of load signal

For some functions it is better to work with unity values (%) rather than absolute values (Weight Units). The load signal after the Mass inertia compensation is normalised by the nominal load of the hoist in Weight Units. Output is the load in %.

- The load in % is used as input to some functions:
- Presentation of load on display; 0 - 200% net load after tare
- Overload logic for own hoist of ASTAT; Warning and Stop
- High speed down function; higher speed down at low load
- Slack rope functions; prevent rope jerk at hoisting as well at makes stopping at landing

Other functions use the absolute load signal in Weight units:

- Twin load cell system: Total overload
- Twin load cell system: Prevention of unequal load.

4.14.1.7. Overload logic for own hoist of ASTAT

If load is > Warning limit in % of nominal capacity a LED in the display of DAPM 100 will flash.

If load is > Stop limit in % of nominal capacity a LED in the display of DAPM 100 will lit steady. A fault code is generated. Motion up stops. Motion down is possible. Fault is automatically reset as soon master switch is in zero position.

The direction of the over load function can be reversed from active in direction A to active in direction B (only for special applications).

4.14.1.8. High speed down: Cycle Time Reducer

Many process cranes are hoisting heavy weight and lowering low weight. Examples: Converter and casting cranes in the steel industry. Lowering of an empty tong handling slabs or similar. Cycle time can be won by lowering the empty hook (ladle, tong, magnet) faster than synchronous speed.

The function is only useful for pulling through loads. If the function is used for example then reeving ropes and there is no pull through load the only result is that the speed will be maximized to close to the synchronous speed.

This function requires either tachometer or pulse encoder speed feedback. The active measurement range shall be not less than $1,25 * (100\% + \text{ADD_PLUG})$. ADD_PLUG is set by parameter **09.31**.

If the load < parameter **14.10** (ADDPLGPC) in % of nominal capacity the speed reference in down direction is increased by a value ADD_PLUG for normal reference value is faster than 50% lowering. ADD_PLUG is set by parameter **09.31**. It means that low speed manipulations will be as without this function. ADD_PLUG is maximised to 70%. Example: The lowering speed with empty hook (ladle) with a 6-pole motor in a 50 Hz country is limited to 1700 rpm.

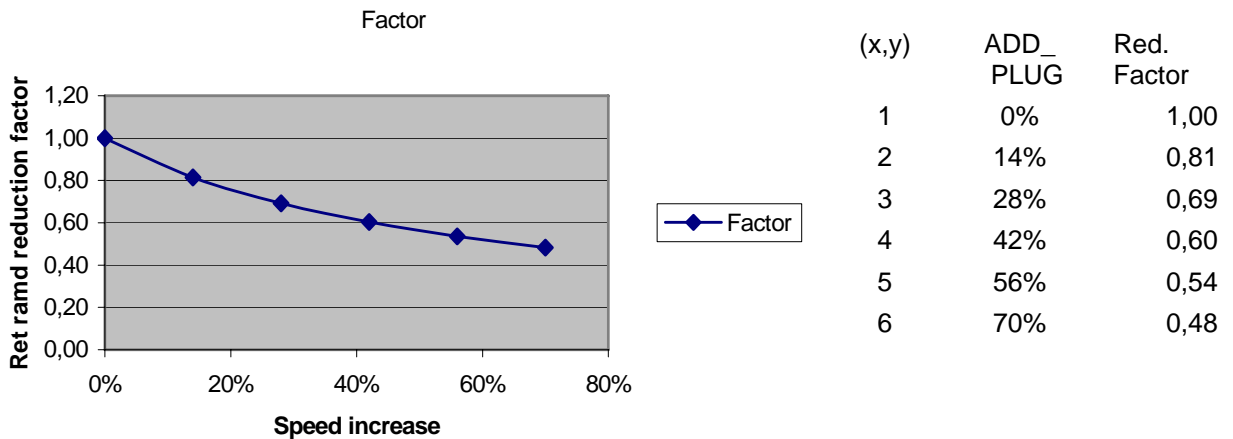
When notching back from the fast lowering speed range, the retardation will be fast with the same stop distance will be the same as without Cycle Time Reducer (CTR). The reason for this is uniformity and safety in performance.

During the deceleration from 100 % + parameter 09.31 "ADD_PLUG" to 50% speed the normal deceleration ramp time will be reduced. During the continuation of the stopping from 50% speed to standstill, the deceleration rate will be same as without CTR. The stopping distance for the driver when notching full speed down to zero speed will be the same as without CTR.

The fast retardation will many times be the limiting factor for the increased lowering speed.

Setting a parameter to 1 must enable the function.

4.14.1.8.1. Function for reduction of retardation time



Formula: Reduction factor = $((100\% + \text{ADD_PLUG}) / (50\% + \text{ADD_PLUG})) * (3 / (6 + 4 * \text{ADD_PLUG}))$

4.14.1.8.2. Advice

It is extremely important that the motor, resistor and contactor configuration matches the plugging current of the motor and the reversal voltage of the rotor. Guidelines:

Motor: Rotor voltage should as low as possible. Check with the supplier for service with high speed and increased rotor voltage. An 8-pole motor can be worth to check as an alternative.

Contactor: Subject to same voltage as motor.

Resistor: Designed with 100 - 110% percent of rated motor current for all steps.

Recommended maximal lowering speed vs. lowering load portion of nominal load:

Resistor: Load portion	Totally 65% of the motors unity resis- tance	Totally 100% of the motors unity resis- tance	Comment
1 / 2	Not allowed	(Max. 120% speed)	Use super synchronous regenerative lowering in this situation!
1 / 3	Max. 130% speed	Max. 170% speed	
1 / 4	Max. 160% speed	Max. 170% speed	
1 / 5	Max. 170% speed	No need to use this high resistance.	

4.14.1.9. Slack rope functions up and down

4.14.1.9.1. Slack rope detection hoisting

If the load < parameter 14.12 "REDSLKPC" in % of nominal capacity, the speed in up direction is limited to a value (100% - REDSLACK). REDSLACK is parameter 09.32

The driver can have a switch to bypass the speed limitation of the Hook-In Protection as well as the Slack Rope Function when she is working with empty hook. This switch is connected to DI 4 (of 8) of Cabin I/O.

Setting a parameter to 1 must enable the function.

4.14.1.9.2. Slack rope detection lowering

If the load in lowering direction is detected to be less than the load < parameter 14.12 "REDSLKPC" in % of nominal capacity, the movement can be set to stop or slow down to the same level as for slow down limit switch.

This level is the same as for Slack Rope detection hoisting.

The function determined by a parameter.

4.14.1.10. Protection functions for twin load cell systems

These functions will only work in direction A (up) for hoists. There is one enable parameter and limit parameter to set for overload protection and in addition one enable parameter for the Prevention of unequal load.

This function will replace presentation of speed on AO no. 2 of DATX 110 with the load in Weight Units.

4.14.1.10.1. Overload protection

This function is either used when the cranes capacity is less than the individual capacities of main and auxiliary hoist, or simply to add two load cells for one hoist mechanism.

When the function is enabled both ASTAT controlled hoist motions will stop when the total load is too high. The other ASTAT will stop as the first ASTAT will set a load of 32 767 Weight units to read for the second ASTAT, and this will also cause STOP 2 in this ASTAT as the limit set for total overload is exceeded.

4.14.1.10.2. Prevention of unequal load

This function is developed particularly for the steel industry using cranes equipped with beams with two hooks to lift ladles with steel. The beam is suspended in each end, and each suspension is fit with a load cell that measures a fixed portion of the load. The drive system is realised with two ASTAT, two (or four pair-wise coupled) motors and a planetary gearbox.

Each load cell is connected to each one ASTAT.

The ASTAT controllers are tied together by two short cross-links DATX 110: AO2 - AI6.

An example clearly describes the settings to do and the function.

Typical weights for this kind of crane:

Beam itself: 25 ton

Ladle itself: 60 ton

Liquid steel: 220 ton

Totally suspended: 305 ton, total load 280 ton

As the crane also some times a year is used for special heavier loads, we decided to set 1 Weight unit = 125 kg (32 767 Weight units = 410 ton)

At linearisation of the load cell the load was set to 0 with empty beam. With 250,0 ton hanging equally distributed in the beam the load was set to 10 000 Weight Unit per ASTAT.

The nominal load of each ASTAT (same as each suspension) is set to 11 200 Weight units.

The individual overload stop limit is set to 110% for each ASTAT (same for each suspension).

The total overload is set to 290 ton or 23 200 Weight units.

To lift extremely heavy load, another setting is selected by using another Macro (parameter set).

Objectives:

- 1) Equal load is correct
- 2) It is allowed to lift the empty beam with all loads in one end.
- 3) It is not allowed to lift the empty ladle with only one end of the beam.
- 4) It is not allowed to lift the full ladle with only one end of the beam.

Studying the block diagram and the test point Point 1 in the same we see for the different objectives:

- 1) Value of Point 1 = 0
- 2) Value of Point 1 = 18 %
- 3) Value of Point 1 = 43 % as load distribution is 12,5 t in one end and (12,5 t + 60 t) in the other end.
- 4) Value of Point 1 = 200 % as load distribution is 12,5 t in one end and (12,5 t + 60 +220 t) in the other end.
- 5) For cases 3) and 4) the motion up will be stopped as STOP 3 as the limit of Point 1 is 30 %. Also the other ASTAT will stop as the first ASTAT will set out a load of 32 767 Weight units to read for the second ASTAT, and this will cause STOP 2 as the limit set for total overload is exceeded.

4.14.1.11. Operator functions

The load is presented on AO no. 1 of Cabin I/O. -200% .. 0% .. +200% load = -10 V .. 0 .. +10 V. Prior to presenting a tare value can be subtracted, so for example, the weight of a slab can be presented. DI 7 (of 8) of Cabin I/O is used to tare.

The LED no. 5 (of 8) of the Cabin I/O flashes for warning level, and lit steady for stop level of overload.

The driver can have a switch to bypass the speed limitation of the different Slack Rope Functions when she is working with empty hook. This switch is connected to DI 4 (of 8) of Cabin I/O.

4.14.2. Related parameters and signals

4.14.2.1. Parameters

Parameters are located in group 14, 15 and group 09 for the speed limits for increased lowering speed and slack rope detection.

4.14.2.2. Load cell linearisation

First calibration point; Low weight

- | | |
|-------|--|
| 14.09 | The load between 0 - 32 767 Weight units. |
| 14.26 | Change triggering parameter from 0 to 1 to store the signal level for load value of parameter 14.09. |

Second calibration point; High weight

- | | |
|-------|--|
| 14.10 | The load between 0 - 32 767 Weight units. |
| 14.27 | Change triggering parameter from 0 to 1 to store the signal level for load value of parameter 14.10. |

4.14.2.3. ...

4.14.2.4. Mass inertia compensation

- | | |
|-------|---|
| 14.23 | Nominal speed of the hoist at 100% motor speed. Between 0 - 32,767 meter per minute. Name: HOIST_SP |
|-------|---|

4.14.2.5. Vacant

4.14.2.6. Working with unity form of load signal

- | | |
|-------|---|
| 14.25 | The nominal load of the hoist between 0 - 32 767 Weight units. Name: NOM_LOAD |
|-------|---|

4.14.2.7. Overload Protection logic for own hoist of ASTAT

- | | |
|-------|---|
| 14.01 | Type of overload protection. 0:not used, 1:DI in Direction A, 2:DI in Direction B, 31:AI in Direction A, 32:AI in Direction B. Name: MEC_OV_L |
| 14.06 | Warning limit in % of 14.25 (Flashing LED). Name: OV_WA_PC |
| 14.07 | Stop limit in % of 14.25% (Fix LED and stop like DI). Name: OV_ST_PC |

4.14.2.8. High speed down: Cycle Time Reducer

09.31	The high reference to the ramp generator will be changed to a value of (100% + 09.31) when Weight is less than 14.04 and direction of motion is down and speed reference is down and value of speed reference larger than 50% and super-synchronous lowering is not active at lowering. In this situation the super-synchronous lowering is blocked. The trip levels of the speed based overspeed detection and the frequency based are enlarged. Application engineers shall set these parameters as the Cycle Time Reducer function did not exist. The speed based overspeed detection is forced active by the program during fast lowering, and value of parameter 09.31 is added to the trip level. The frequency based overspeed detection is increased with the same percentage as the desired speed increase. 09.31 is restricted in program to 0%..+70%. Name: ADD_PLUG
14.28	Enable parameter for function Cycle Time Reducer. Name: PERM_PLG
14.04	Maximum Load for increased lowering speed in % of 14.25% (Speed will not be faster than synchronous if Weight larger than 14.04). Name: ADDPLGPC

4.14.2.9. Slack rope functions

4.14.2.9.1. Slack rope detection hoisting

09.32	The reference to the ramp generator will be limited to a value of (100% - parameter 09.32), when Weight is less than parameter 14.25 unless a speed limit bypass push-button is pressed. The Speed limitation is made before the ramp function and only in positive direction reference ("up"). Parameter 09.32 is restricted in program to 0%..+99%. Name: REDSLACK
14.29	Enable parameter for Slack Rope Protection Hoisting. Name: PERM_RED
14.12	Needed load to not limit the speed as % of parameter 14.25 (Speed will be limited if Weight is less than parameter 14.12). Name: REDSLKPC

4.14.2.9.2. Slack rope detection lowering

15.01	Detection of a slack rope will have influence on the lowering: 0 = not used, 1 = Stopping the lowering, 2 = Reducing lowering speed to END_SPpc.
-------	--

4.14.2.10. Protection functions for twin load systems

4.14.2.10.1. Overload protection

14.24	The sum load in weight units that will stop two simultaneously operated hoists. Same kg per weight units must be used for both hoists. Hoists connected together by DATX 110 AO 2 - AI 6. Both hoists will stop at overload. Between 0 - 32 767 Weight units. Name: TWINSTOP
14.29	Enable parameter for twin hoist overload protection. Name: TWIN_OVL

4.14.2.10.2. Prevention of unequal load

14.30	Enable parameter for function comparison of weight signals from two load cell or two hoists. If the difference in load cell measurement is larger than 30% of one load cells nominal load, the motions up are stopped. Name: TWIN_DIF
-------	---

4.14.2.11. Signal(s)

14.50	The load of the hoist between 0 - 32 767 Weight units.
14.52	Load in hook in percent of nominal load. 0 - 200%.
21.72, 21.73, 21.74.	Different overload logical values.

4.14.3. I/O-list for load functions

Terminal	Control board DAPC 100, <u>Opto links</u>	
M/F	Master Follower	OPTO
MC	Motion control	OPTO
I/O	I/O communication	OPTO

Terminal	Control board DAPU 100, <u>Opto links</u> (Process I/O DATX 110)	
Ch 1	I/O communication	OPTO
Ch 2	DAPM communication	OPTO

Terminal	Cabin I/O DAPM 100 DATX 120	
	<u>Opto link</u>	
Ch. 1	DARA communication	OPTO
	<u>Digital In</u>	
X3:1	Master switch in zero pos	DI #1
X2:2	Direction A	DI #2
X3:3	Direction B	DI #3
X3:4	Bypass of slack rope speed limit	DI #4
X4:1	Step 2	DI #5
X4:2	Step 3	DI #6
X4:3	Tare of weight indicator	DI #7
X4:4	Step 100%	DI #8
	<u>Digital Out</u>	
X21	Over-temperature motor (Stop: Steady Red, Warning: Flash Red)	DO #1
X21	Brake-lifter not acknowledging in time (Red)	DO #2
X21	Overload in motor cable by thermal overload relay (Red)	DO #3
X21	Rotor / Speed measurement / Speed supervision (Red)	DO #4
X21	Over load: Stop=Steady red, Warning = Flash red)	DO #5
X21	Motor overspeed (Red)	DO #6
X21	Overload thyristor stack (Red)	DO #7
X21	ASTAT OK (Steady Green); Fault detected by ASTAT (Flash Green)	DO #8
	<u>Analog In</u>	
X5:1-2	AI Reference	AI #1
X5:3-4	Alternative 2 Load cell signal	AI #2
	<u>Analog Out</u>	
X2:1-2	(Net) hook load, +10 V = +200 %	AO #1
X2:3-4	Speed, -10 V = -200%	AO #2

Terminal	Process I/O DARA 1000 DATX 110	
X1:1-2	ON	DI #1
X1:3-4	Fault reset	DI #2
X1:5-6	Parameter set 1&2 or 3&4 select	DI #3
X1:7-8	Parameter set 1&3 or 2&4 select	DI #4
X2:1-2	Prelim Dir. A	DI #5
X2:3-4	Prelim Dir. B.	DI #6
X2:5-6	Stop Dir. A	DI #7
X2:7-8	Stop Dir. B	DI #8
X3:1-2	Cable relay	DI #9
X3:3-4	Brake open	DI #10
X3:5-6	Cable relay	DI #11
X3:7-8	Brake open	DI #12
X4:1-2	Mech. over load	DI #13
X4:3-4	Brake open	DI #14
X4:5-6	Mech. overspeed	DI #15
X4:7-8	Brake open	DI #16
X9:5-6	If two thyristor bridges: Not symmetrical current. One bridge: Control signal for Master-Follower control.	DI #17
	<u>Analog In</u>	
X5:1-2	Motor #1 PTC	AI #1
X5:3-4	Motor #2 PTC	AI #2
X5:5-6	Motor #3 PTC	AI #3
X5:7-8	Motor #4 PTC	AI #4
X6:1-2	Alternative 1 Load cell signal	AI #5
X6:3-4	Gross load of Twin hoist	AI #6
X6:5-6	Additional torque reference	AI #7
X6:7-8	Tacho feedback	AI #8
	<u>Pulse encoder</u>	
X8:1-8	A, B, Z + inv.	PI
	<u>Digital Out</u>	
X10:1-2	Thyristor fan(s)	DO #1
X10:3-4	Rotor contactor K1	DO #2
X10:5-6	Rotor contactor K2	DO #3
X10:7-8	Rotor contactor K3	DO #4
X11:1-2	Brake-lifter contactor	DO #5
X11:3-4	Delayed brake-lifter; for DC-brake	DO #6
X11:5-6	Fault DO	DO #7
X11:7-8	No dangerous fault	DO #8
	<u>Analog Out</u>	
X7:1-2	Stator current +10 V = +400 %	AO #1
X7:3-4	Gross load of own hoist	AO #2

4.14.4. Jumpers in board DATX 110

4.14.4.1. Analog in no. 5 (8)

Load cell signal 0-20 mA or 4-20 mA

- S5:1-2 Current source for sensor.
- :3-4 **x** Shunt resistor (500 ohm) for current input signals
- :5-6 **x** Ground connection of negative input
- :7-8 **(x)** Rest position for spare jumper.

Load cell signal 0-10 V

- S5:1-2 Current source for sensor.
- :3-4 Shunt resistor (500 ohm) for current input signals
- :5-6 **x** Ground connection of negative input
- :7-8 **(x)** Rest position for spare jumper.

4.14.4.2. Analog in no. 6 (8)

Load signal 0-10 V

- S6:1-2 Current source for sensor.
- :3-4 Shunt resistor (500 ohm) for current input signals
- :5-6 **x** Ground connection of negative input
- :7-8 **(x)** Rest position for spare jumper.

4.14.4.3. Analog out no. 2 (2)

Load cell signal 0-10 V

No jumpers to set

Jumpers marked with " x " shall be installed. Jumpers marked with " (x) " do not matter.

4.14.5. Jumpers in Cabin I/O DAPM 200

4.14.5.1. Analog in no. 2 (2)

Load cell signal 0-20 mA or 4-20 mA

- :5-6 **x** Shunt resistor (500 ohm) for current input signals AI 2
- :7-8 **x** Ground connection of negative input. AI 2

Load cell signal 0-10 V

- :5-6 Shunt resistor (500 ohm) for current input signals AI 2
- :7-8 **x** Ground connection of negative input. AI 2

4.14.6. Detailed description of parameters

Description	MIN	MAX	NORM	SET	IDENTITY	English text
Speed regulator					09	
High reference to ramp generator will be to a value of (100%+ 09.31) when weight is less than 14.04 & direction of motion is down & speed reference is down & value of speed reference larger than 50% & super-synchronous lowering is not active during a lowering. & is used in the meaning: Logical AND for all expressions.	0	70	55	D	0931	ADD_PLUG
The reference to the ramp generator will be limited to a value of (100%-09.32) when Weight less than 14.25 unless FREE_HOK is true. The Speed limitation is made before the ramp function and only in positive direction reference ("up").	0	100	65	D	0932	REDSLACK

Description	MIN	MAX	NORM	SET	IDENTITY	English text
Load functions					14	
0: not used, 1: DI in Direction A, 2: DI in Direction B, 31: AI (0-10 V) in Dir. A to AI 5 DARA 131: AI (4-20 mA) in Dir. A to AI 5 DARA 41: AI (0-10 V) in Dir. A to AI 2 Cabin 141: AI (4-20 mA) in Dir. A to AI 2 Cabin	0	141	1	D	1401	MEC_OV_L
Load for increased lowering speed in % of 14.25% (Speed will not be faster than synchronous if Weight larger than 14.04)	0	70	0	D	1404	ADDPLG_pc
Warning level in % of: the hoists nominally given load.	0	150	80	D	1406	OV_WA_PC
Stop level in % of: the hoists nominally given load.	50	150	110	D	1407	OV_ST_PC
The load between 0 and 32767 Weight units related to AI signal=x1v V or x1c mA. Parameter to enter 0 .. 32767. Same unit must be used for parameters 14.09, 14.10, 14.24, 14.25. 20 mA or 10 V from load cell must not generate more than 32767 units in ASTAT. Example: A 200 t hoist with 1/16 of the load by a load cell which gives 10 V=20 t. Say that 10 V=16 x 20=320 t weight= 320000 kg. As 320000>32767 we let 1 WEIGHT UNIT be 10 kg. If the load cell had given 10 V=25 t we had chosen 1 WEIGHT UNIT be 100 kg.	0	32767	0	X	1409	LC_Y1VAL
The load between 0 and 32767 Weight units related to AI signal=x2v V or x2c mA. Parameter to enter 0 .. 32767. Same unit must be used for parameters 14.09, 14.10, 14.24, 14.25. 20 mA or 10 V from load cell must not generate more than 32767 units in ASTAT. Example: A 200 t hoist with 1/16 of the load by a load cell which gives 10 V=20 t. Say that 10 V=16 x 20=320 t weight= 320000 kg. As 320000>32767 we let 1 WEIGHT UNIT be 10 kg. If the load cell had given 10 V=25 t we had chosen 1 WEIGHT UNIT be 100 kg.	0	32767	0	X	1410	LC_Y2VAL
The reference to the ramp generator will be limited to a value of (100%-09.32) when Weight less than 14.25 unless the bypass pushbutton is pressed. The Speed limitation is made before the ramp function and only in positive direction reference (up). To decrease stresses on ropes and mechanism when hoisting with slack ropes.	0	100	0	D	1412	REDSLKpc
The nominal speed of the hoist. The given speed in meter per minutes shall be valid for motor speed = synchronous speed. Used for calculation of mass inertia contribution.	0	32767	32767	D	1423	HOIST_SP

Description	MIN	MAX	NORM	SET	IDENTITY	English text
The sum load in weight units that will stop two simultaneously operated hoists. Same kg per weight units must be used for both hoists. Hoists connected together by DATX 110 AO 2 - AI 6. Both hoists will stop at overload. Example: Crane with 200 t hoist + 60 t hoist. Totally allowed 220 t. Use 1 WEIGHT UNIT = 20 kg. Set parameter 14.24 to 11000.	0	32767	32767	D	1424	TWINSTOP
The nominal load of the hoist between 0 and 32767 Weight units. Parameter to enter 0 .. 32767. Same unit must be used for parameters 14.09, 14.10, 14.24, 14.25. 20 mA or 10 V from load cell must not generate more than 32767 units in ASTAT. Example: A 200 t hoist with 1/16 of the load by a load cell which gives 10 V=20 t. Say that 10 V=16 x 20=320 t weight= 320000 kg. As 320000>32767 we let 1 WEIGHT UNIT be 10 kg. If the load cell had given 10 V=25 t we had chosen 1 WEIGHT UNIT be 100 kg.	0	32767	32767	D	1425	NOM_LOAD
Change triggering parameter from 0 to 1 to store the signal level 14.21 for load value of parameter 14.09.	0	1	0	X	1426	SETX1VAL
Change triggering parameter from 0 to 1 to store the signal level 14.22 for load value of parameter 14.10.	0	1	0	X	1427	SETX2VAL
Enable parameter for function Cycle Time Reducer.	0	1	0	D	1428	PERM_PLG
Enable parameter for Slack Rope Protection Hoisting.	0	1	0	D	1429	PERM_RED
Enable parameter for function with summation and/or comparison of weight signals from two load cell or two hoists. The sum level is set with parameter 14.24. Requires that the two ASTAT are connected together by DATX 110 AO 2 - AI 6.	0	1	0	D	1430	TWIN_OVL
Enable parameter for function comparison of weight signals from two load cell or two hoists. If the difference in load cell measurement is larger than 30% of one load cells nominal load, the motion up is stopped and overload LED for both hoists are lit up. Requires in addition that 14.30 is set to 1. Requires that both ASTAT are connected together by DATX 110 AO 2 - AI 6.	0	1	0	D	1431	TWIN_DIF
Slack rope function lowering					15	
Detection of a slack rope will have influence on the lowering . 0:not used, 1:Stopping the lowering, 2:Reducing lowering speed to END_SPpc.	0	32767	32767	D	1501	SLACK_RP

4.14.7. Signals

Description	Unit	IDENTITY	English text
Load in hook	Units	1450	HOOKLOAD
Load in % of rated load	%	1452	TLOAD_PC

4.15. Group 15: Slack Rope Function

4.15.1. Description

All information about the load functions is moved to previous subsection **4.14, Load functions**.

4.16. Group 16: Limit switch Function

Parameter **05.04** (L_SW_TYP), decides which kind of limit switch arrangement to use:

0, 1 and 3: Based on four switches. 1 is normal setting, 0 bypasses switches (for testing), and 3 accepts impossible combinations without stopping the motion for faulty state.

4.16.1. Based on four switches

The motion is enclosed inside four limit switches:

STOP B.....**PRELIM B**.....Working position.....**PRELIM A**.....**STOP A**

Moving right, from the working position, the motion first hits **PRELIM A**. It will continue with a reduced speed, but not stop. The reduced speed is given by parameter **08.16** (END_SPpc). Continuing further right, it will hit **STOP A**, and the reference will be zero and the motion will stop.

The same will occur moving left, but with **STOP A** replaced by **STOP B** and **PRELIM A** replaced by **PRELIM B**.

The USE_DI-parameters are used to bypass these limit switches in case they are not installed.

It is only needed that a limit switch is temporary hit as PRELIM and STOP are latched, and must be reset by master switch in zero position, or moved to the opposite direction.

4.16.2. Not used

4.16.3. Supervision

A number of physically impossible situations are checked, and any of them will give an alarm for limit switch fault.

Case no.	STOP B hit by motion	PRELIM B hit by motion	PRELIM A hit by motion	STOP A hit by motion	Additional condition for Fault detection	State
1	Hit	Hit	Hit	Hit		Fault
2	Hit	Hit	Hit	Free		Fault
3	Hit	Hit	Free	Hit		Fault
4	Hit	Free	Hit	Hit		Fault
5	Free	Hit	Hit	Hit		Fault
6	Hit	Free	Hit	Free		Fault
7	Free	Hit	Free	Hit		Fault
8	Free	Hit	Hit	Free		Fault
9	Hit	Free	Free	Hit		Fault
10	Free	Free	Free	Hit	Prelimit switch A is installed	Fault
11	Hit	Free	Free	Free	Prelimit switch B is installed	Fault
12	Free	Free	Free	Free		Normal
13	Free	Free	Hit	Free		Normal
14	Free	Free	Hit	Hit		Normal
15	Free	Hit	Free	Free		Normal
16	Hit	Hit	Free	Free		Normal

"Free" indicates that the corresponding DI has voltage, or that the same USE_DI-parameter is set to 0.

For software before AST10_04: Case no. 10 and 11 were not considered as faults. The motion was not stopped for Fault.

For software including AST10_04 and later: All cases 1 - 11 are considered as faults. The motion is stopped.

4.16.4. Parameters

There are no parameters.

4.16.5. Signals

Description	Unit	IDENTITY	English text
Stop ordered in direction A. Value = 1: No restriction	Bool	1651	A_STOP
Slow down ordered in direction A. Value = 1: No restriction	Bool	1652	A_SLOW
Stop ordered in direction B. Value = 1: No restriction	Bool	1653	B_STOP
Slow down ordered in direction B. Value = 1: No restriction	Bool	1654	B_SLOW

4.17. Group 17: Rotor system

4.17.1. Description

The rotor monitor system gives indication codes for different types of faults. These codes are described in the REFERENCE SECTIONS.

4.17.2. Parameters

Description	MIN	MAX	NORM	SET	IDENTITY	English text
<p>Limit for accepted Unsymmetry between phases in rotor circuit in measurement point. 100 = Accept full asymmetry. 0 = no asymmetry at all accepted (no practical purpose). If the speed control is based on rotor frequency, a detected fault will stop the motion. The supervision can also be used for TG/encoder feedback, and that situation there is only an information provided, no stopping.</p> <p>In case the parameters 05.21 .. 05.24 are 0, 17.20 has no meaning.</p>	60	100	80	S	1720	ROTSENSE
<p>For some (small) motors it is needed to let the motor build up the rotor voltage before it is acceptable for rotor frequency feedback. The need of a time longer than 0 is noted by a false interpretation of low speed as zero speed, and the motion can make a single jerk before it is stable control mode. 0 ... 1 second. Normal 0 s = 0 ms. Set time in ms. If this parameter is needed to modify, it is mostly for motors below 10 kW and with 460 V voltage or more. A value around 500 ms can be tested.</p>	0	1000	0	X	1727	MAGN_DEL

4.17.3. Signals

Description	Unit	IDENTITY	English text
Actual rotor frequency	Hz	1750	ROTFREQ
Speed feedback from rotor frequency estimation	%	1751	NFEEDBRF

4.18. Acceleration control

4.18.1. Description

Acceleration control can be used for travel motions. Acceleration control is selected by setting parameter 07.01 to 14, 24 or 34. Different to speed control (Group 9) the driver only uses one regulator, the inner current control loop, in acceleration control mode.

Acceleration control is preferably used for driver controlled travel motions, while speed control is used for hoist motions.

Most crane drivers prefer acceleration control for their travel motions.

- Speed control = Speed regulator + Current regulator
- Acceleration control = Driver + Current regulator.

Steps 1, 2, 3 and 4 or an analogue reference give acceleration depending on the %-value of the parameters. The %-value is not % of rated current, but a larger %-value gives a higher acceleration. The classic 10-25-50-100% serve as first start up value. These values go straight through the speed regulator, and are not affected by speed regulator gain parameters. Acceleration control has fixed ramp times, 250 milliseconds up to 100% and 0 (directly) down.

When a limit switch is hit the motion will bumplessly transfer into speed control. It follows to selected retardation ramp (parameter 08.03) to the level of slow down speed (08.16) or stop. Of this reason, the start up of an acceleration controlled motion must start with a, at least acceptable, speed control tuning with parameter 07.01 as 10, 20 or 30. Parameter 08.02 has no importance.

When the master switch is returned to its neutral position, i. e. the direction signals A and B disappear, the motion will coast to roll by itself for a limited time; time set with parameter 10.15. After this time has elapsed, the speed control will take over and bring the motion controlled to stand still in the same way as for limit switch stop. The time should be assessed from installation to installation, but must always be so short that the "Hold to run" principle of the Machinery Directive is not in danger. Using rotor frequency feedback the coast time is limited to practically 500 ms as the speed detection is blocked in coasting mode.

The brake is applied based on measured speed, level as decided by parameter 06.01.

As acceleration control has no defined speed feedback, there is no supervision of encoder/tachometer in this control mode.

One can use a four step master switch, 4-3-2-1-0-1-2-3-4 or 3-2-1-coast-0-coast-1-2-3, or a five step master switch, 4-3-2-1-coast-0-coast-1-2-3-4. For a five step version DAPM 200 / 201 is needed. The coast-position requires that an encoder or tachometer is installed to detect the actual speed also in time without any rotor voltage.

Acceleration control with tachometer or pulse encoder can be realised with no (most common), one or two rotor contactors. If one contactor is used, it corresponds to K2 in below single line diagram, and if two are used these correspond to K2 and K3 in the single line diagram. With rotor frequency feedback a contactor K3 is needed. K3 can be installed there most convenient in either end of the resistance unit. See the single line in top of next page.

With acceleration control the current limit can be set lower than with speed control, which gives an indication of its friendliness to the mechanical drive gear. Parameter 11.01 most common settings are between 100% and 175% with acceleration control.

4.18.2. Parameters

Uses parameters from other groups.

4.18.3. Signals

Uses signals from other groups.

4.19. Group 19: Pulse encoder settings

4.19.1. Description

Adjustments of the pulse encoder that is used for speed control or as electrical shaft positioning.

4.19.2. Parameters

Description	MIN	MAX	NORM	SET	IDENTITY	English text
How to evaluate the pulses from the encoder 1=use only positive flanks 4=use positive and negative flanks, best resolution. Only values 1 and 4 are allowed.	1	4	1	X	1901	EDMODE
Software filter time in milliseconds for incremental encoder.	0	32767	10	X	1902	NFLTTC

4.19.3. Signals

There are no signals.

4.20. Group 20: Master-Follower

In Master-Follower systems it should be observed that:

- Super-synchronous mode is not a controllable speed mode, i. e. set parameter **09.08** (SUP_SYNC) to 0
- Master-Follower control cannot be used for shared motion, drive types 12 or 22.
- Cabin I/O must be used.
- The speed shall be kept in the controllable range, i. e. set parameter **08.17** (NREF_RED) to a value below which the motor voltage is full line voltage; NREF_RED can typically be 80 .. 85%.

Limit switches

Description for Release 10_01 to 10_04

The stop limit switch of the master drive shall under normal conditions be the one stopping the motion. Approaching the end from the middle of the range, the Master's stop limit switches shall be the first to hit. The Followers stop limit switch serves only as back up. When an over travel limit switch is used for a Master Follower motion, the normal stop limit switch of the Follower can be set to "Not used" in the follow mode parameter set. In the single drive mode it shall be set to "Used".

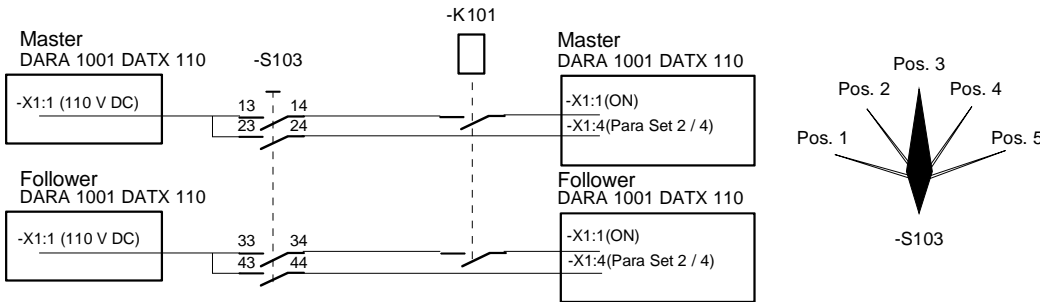
Description for Release 10_04A and newer

The position of slow down and stop limit switches of the Follower are included in the M-F communication. Motion stops (or slows down) based on OR-condition of the Masters and Followers switches. The evaluation of invalid combination of limit switches remains unchanged; Follower reports error if the Follower's limit switches are invalid, and Master reports error if its limit switches are invalid. Both Master and Follower limit switch error stops the motion (AST10_04A).

4.20.1. Release AST10_01 to AST10_03

- The position difference is set to zero (0) with parameter set no. 1 is changed to parameter set no. 2 as well as with parameter set no. 3 is changed to parameter set no. 4. Both these cases are executed by changing DI no. 4 from 0→1.
The change of parameter set will only take place if the ON-command to ASTAT is removed. The ON-command must be removed for 100 ms. ON is DI no. 1

The implementation of the electrical shaft function application of Master-Follower with possibility to move the Master and the Follower as separate motions requires a five position switch, see -S103 in the below example:



The relay -K101 is included in all installations, see Section 2.3 Crane power and control voltage, and it gives order "ON" to ASTAT as soon as the main voltage is applied.

Master Parameter set no. 1: Parameter 20.01 = 0

Master Parameter set no. 2: Parameter 20.01 = 1

Follower Parameter set no. 1: Parameter 20.01 = 0

Follower Parameter set no. 2: Parameter 20.01 = 2

Description of -S103

Function	
Pos. 1	Master only
Pos. 2	No motion
Pos. 3	Electrical shaft function
Pos. 4	No motion
Pos. 5	Follower only

Closed contacts	
Pos. 1	13-14
Pos. 2	-
Pos. 3	13-14, 23-24 33-34, 43-44
Pos. 4	-
Pos. 5	33-34

4.20.2. Implementation from Release AST10_03A

The functionality in the previous releases still remains unchanged. A control board DAPC 100 with software AST10_03A can fully replace an older board, using same parameters.

The new features are controlled with two control signals **A** and **B** that give different options for various Sub-modes control for the Follower in Master-Follower communication.

Master (parameter 20.01 = 1) is always speed controlled.

Follower mode (parameter 20.01 = 2) is controlled within the same parameter set in following way:

Sub	A	B	Follower mode control
MF1	0	0	Speed control by electrical shaft, only mode until Release AST10_03.
MF2	0	1	Speed control by own reference, for tilting, skew control etc
MF3	1	0	Speed control with torque compensation, used in four rope grab cranes and control of load sharing motion control. Requires DARA 1001.
MF4	1	1	Speed control by speed compensation; aim is same speed rather than same position

- New features are not available for motions with parallel thyristor bridges, sizes from 1260 A and above.

- The position difference for electrical shaft control is set to zero (0) in three ways:
 - (1) as in earlier releases with parameter set no. 1 is changed to parameter set no. 2 as well as with parameter set no. 3 is changed to parameter set no. 4. Both these cases are executed by changing DI no. 1 from 0 to 1.
 - (2) when the combination of Control signals **A** NOR **B** changes to Boolean True. Example: Running in Sub mode MF2 until the operator or other external conditions decides to switch to electrical shaft (Sub MF1) is done without stopping by simply changing control signal **B** from 1 to 0. Control **A** is all the time 0.
 - (3) From 10_05: with parameter 05.20, USE_DI16 is set to 2 for a Follower that has Cabin I/O, the function Brake #4 acknowledged for DI 16 is changed external reset of the Electrical shaft.

The sub mode MF3 is especially suitable for load sharing in four ropes grab systems. It can also be used for load sharing for Travel motions, although not needed for most EOT cranes.

The sub mode MF4 is useful in some applications. It can as example make two motions with analogue tachometers to move with the (for the eye) same speeds.

4.20.2.1. Control signals A and B

The signals **A** and **B** are controlled in following way:

Control signal **A**:

Closed contact of terminal Master ASTAT DATX 110: -X9:5-6. -X9:5 is +110 V DC.

Control signal **B**:

Closed contact of terminal Follower ASTAT DATX 110: -X9:5-6. -X9:5 is +110 V DC.

4.20.3. Current follower

ASTAT can as a single controller work with two parallel bridges, with a total capacity of maximally 2200 A. In some installations this capacity is not enough. Of that reason a follower mode that doubles the capacity is developed. Set up: Master has **20.01** = 1, Current Follower has **20.01** = 3.

Connection:

Each Motion controller of maximally 2200 A is conventionally connected to motor and network. Nothing prevents that a 12-pulse connection is used, although there are normally no big advantages with 12-pulse.

Supervision of parallel bridges, there can be two parallel bridges of the totally four bridges used in the full system, must have both open contacts connected in parallel to the DI no. 17 of the Masters DATX 110. As usual, these contacts should be open for a healthy system.

All control signals should be connected to the Masters DATX 110 and Cabin I/O. The system allows that the Followers DATX 110 is removed, but it is mostly kept for separate Motion control.

Optical M/F fiber cable installed.

Settings:

Parameter **11.39** should be changed from 20 to 30 ms (and more if slow opening rotor contactors are used; add always 10 ms to the actual opening time).

4.20.4. Parameters

Description	MIN	MAX	NORM	SET	IDENTITY	English text
<p>Definition of the role of the ASTAT in a Master-Follower connection.</p> <p>0: No Master-Follower connection</p> <p>1: Master in Master-Follower connection</p> <p>2: Follower in Master-Follower connection</p> <p>3: Voltage controller. Same current as the Master. No Process I/O active.</p> <p>12: Follower in Master-Follower connection. Same as 2, except that the followers master switch gives direction, zero pos. and reference commands inside sub mode MF 2</p>	0	12	0	D	2001	MF_TYPE
<p>The part, in percent, of the position difference between the two motions of the Master-Follower that the Follower will compensate as:</p> <p>Follower Speed Reference = Master Speed reference * (1+((MF_SCAL /100)*Difference¹⁰))</p>	0	100	100	X	2002	MF_SCAL
<p>Part in %¹¹ of one of the two identical motors rated torque that shall be the difference in torque in torque follower mode.</p> <p>For positive sign the Follower is weaker</p>	-100	100	0	X	2003	TQ_RATIO
<p>The correction signal can be applied more softly by using a ramp function from actual to requested value. In most cases this ramp is not used, and by setting MF_RAMP to 0, there is no influence of the ramp.</p> <p>A value less than values of parameters 08.02 and 08.03 can give better performance when switching between sub modes MF1 - MF4</p>	0	32000	0	X	2005	MF_RAMP

4.20.5. Signals

Description	Unit	IDENTITY	English text
The correction speed reference given to the Follower when in Follower mode.	%	2050	N_CORR

¹⁰ With Difference it shall be understood:

Sub mode MF1, Electrical shaft:

Sub mode MF2, Individual speed reference:

Sub mode MF3, Torque control:

Sub mode MF4, Uniform speed:

Position difference

Follower is not controlled by any difference, so this parameter is not active

Desired difference in torque

Speed difference

¹¹ Only meaning for Sub mode MF3, Torque control

4.21. Fixed functions

A number of build in functions will always be performed in the same way.

4.21.1. Motion control logic

The motion control logic control the Stop, Start and Slow-down of the motion.

The logic interfaces other internal control functions and external signals from driver or limit switches.

Operator:

- OFF
- Zero position
- A-direction
- B-direction

Limit switches:

- Stop Limit A
- Pre Limit A
- Pre Limit B
- Stop Limit B

or the SOFT LIMIT SWITCH FUNCTION.

Interfacing functions:

- I/O UNITS AND FACTORY TEST
- BRAKE INFORMATION
- SPEED REFERENCE
- SELECTABLE DO
- SLACK ROPE FUNCTION
- SOFT LIMIT SWITCH FUNCTION
- FAULT HANDLING SYSTEM

Start up delays:

- Power up control voltage 115 or 230 V AC:
Delay to service: 6 seconds
- Power up main voltage using Digital in no. 1 (ON) for contactor position information:
Delay to service: 0,6 seconds

4.21.2. Shared motion

The shared motion is only allowed to change when both motions have Zero Position signal.

Actuation of a DI will:

- Change the set of parameters to the second set of two.
- Hold a DO "Shared motion selected" on the process I/O board to True.
- Command which DI and AI that should be read.

Outside the system must be done (based on the DO):

- Operate contactors for the main circuit
- Brake lifter contactors must be selected as a wired "AND" of the DO Brake-lifter contactor and the DO Shared motion selected.
- Operate change over relays for the speed feedback

Comments:

- Rotor contactors can operate for both the selected and not selected motors.
- For the auxiliary hoist in Shared motion, there are no Pre limit switches included, only Stop limit switches.
- For the creation of the application software it should be considered the not addressed DIs should be allowed to be in any state.
The DI is only receptive for changes when the Master switch is in zero position.
- Motion no. 1 uses parameter set no. 1 as first (=normal) parameter set and no. 2 as second parameter set. Digital input no. 4 on the process I/O board DATX 110 will switch over to the second parameter set for this motion, which is parameter set number 2.

- Motion no. 2 uses parameter set no. 3 as first (=normal) parameter set and no. 4 as second parameter set. Digital input no. 4 on the process I/O board DATX 110 will switch over to the second parameter set for this motion, which is parameter set number 4.

4.21.3. Two operator stations

Typically the two operator station function is used for a crane that is controlled by a radio remote unit and a local console on board the crane.

Actuation of a Process DI will:

- Make the ASTAT taking command from either of the two stations.
- The indications (DO and AO) will remain for both stations at the same time.

The change of operator station is only allowed to change when the system is OFF.

4.21.4. Different parameter sets

It is only allowed to change parameter sets under the conditions given by parameter **01.03**, MACROMODE. Basically there is a selection between two parameter sets with DI no.4 of the process I/O, but it can be extended to four parameter sets with a parameter **05.27** (STA2_PA2).

05.27 = 0 No restriction			
DI no.3 = 0	DI no.3 = 1	DI no.4 = 0	DI no.4 = 1
Operator station no. 1 active	Operator station no. 2 active	Parameter set no. 1 used	Parameter set no. 2 used

05.27 = 1 05.27 = 1 is not possible for Shared motion. 05.27 = 1 is not possible for duty with master switch connected direct to DARA, i. e. 02.01 = 5 .			
DI no.3 = 0	DI no.3 = 0	DI no.3 = 1	DI no.3 = 1
DI no.4 = 0	DI no.4 = 1	DI no.4 = 0	DI no.4 = 1
Parameter set no. 1 used	Parameter set no. 2 used	Parameter set no. 3 used	Parameter set no. 4 used

Process I/O digital input no.3 can be used in two ways:

- 3) To select between operator stations
- 4) To make the selection between parameter sets 1 or 2 (Low sets family) or parameter sets 3 or 4 (High sets family)-selection within the family is done by Process I/O digital input no.4.

With **05.27 = 0**, a high value (=110 V) on DI no.3 on process I/O board DATX 110 will use DI no.3 to select between operator station number two out of number one and number two.

With **05.27 = 1**, a low value (=0 V) on DI no.3 on process I/O board DATX 110 will use parameter sets 1 and 2. The selection between Sets 1 and 2 is made with DI no.4.

With **05.27 = 1**, a high value (=110 V) on DI no.3 on process I/O board DATX 110 will use parameter sets 3 and 4. The selection between Sets 3 and 4 is made with DI no.4.

NB! Do not mix this function with Shared motion, although related. The second parameter set function is typically used for redundant motions, there, as an example; the acceleration ramps are lower when only half of the motors are used.

4.21.5. Fault handling system

The complete list of Fault codes displayed on DARA Control System Module is found in the **REFERENCE SECTION** of this Manual. The Fault indications of the DAPM 100, 101 Cabin I/O-Module are presented below.

Description	Signal	Action
Parameter 05.22, PTC_ACTN=1 and any PTC-element has high resistance (AI).	LED 1	Motion stopped
Parameter 05.22, PTC_ACTN=0 and PTC-element PTC 3 or PTC 4 has high resistance (AI).	LED 1F	None
Brake fault	LED 2	Motion stopped
Thermal relay tripped	LED 3	Motion stopped
Rotor unbalance (in case of Rotor Voltage measurement)	LED 4	Motion stopped
<p><u>Speed measurement failure:</u> If an Analogue tachometer is used for speed measurement, it is crosschecked with a Rotor frequency measurement against breakdown = zero signal. If a Digital pulse encoder is used, there is a state OK coming from the embedded programs for the pulse encoder. The use of the different speed measurements and the monitors is: Rotor frequency feedback: For Travels and Slewing motions. Internal monitors are enough. Analogue tachometer without supervision (same as ASTAT 9 in some conditions): Special travels, Hoists in manned cranes with overspeed switches. Analogue tachometer with Rotor frequency feedback Monitor: Special travels, Hoists in unmanned / manned cranes with overspeed switches. Digital tachometer: For Special travels, Hoists in unmanned / manned cranes with overspeed switches. Internal monitors are enough. Digital tachometer with Rotor frequency feedback Monitor: Special travels, Hoists in unmanned / manned cranes with overspeed switches. Digital tachometer with Analogue tachometer Monitor: For installation sites, example nuclear plants, there two independent systems are evaluated against each other through the whole speed range. For Special travels, Hoists in unmanned / manned cranes with overspeed switches. For motions with pure speed control all free speed measurement methods can be compared vs. the given reference.</p> <p><u>Stall: like the hook is locked:</u> Only valid for hoists. The overload monitor function will act.</p> <p><u>The motor can not develop torque:</u> The actual torque value (TACT) is compared with the reference (TREF).</p> <p>TDIFF = ITACT - TREFI. If TDIFF is larger than 20% of the rated motor torque during an uninterrupted time of 100 ms, there is a fault condition like O/C motor in rotor or stator or thyristor fault.</p>	LED 4	Motion stopped
Mechanical Over-load (DI or load cell). Stop	LED 5	Motion stopped, Direction A (or B) blocked.
Mechanical Over-load (DI or load cell). Warning	LED 5F	None
Motor Over-speed	LED 6	Motion stopped
Over-temperature in thyristors	LED 7	Motion stopped
Controller is ready for service	LED 8	None
Any fault detected the controller	LED 8F	None
Controller is not powered / CPU-fault	LED 8 out	

4.21.6. Operator information system

The Cabin I/O module contains a 80 * 120 mm (W * H) LED-indication to mount visible in the driver's console:

- ⊗ 1 Over-temperature in motor by PTC-element (Stop: Steady Red, in case of Warning Flashing Red)
- ⊗ 2 Brake-lifter not acknowledging in time (Red)
- ⊗ 3 Overload in motor cable by thermal overload relay (Red)
- ⊗ 4 Rotor / Speed measurement / Speed supervision (Red)
- ⊗ 5 Mechanical overload (Stop: Steady Red, in case of calculated Warning Flashing Red)
- ⊗ 6 Motor overspeed (Red)
- ⊗ 7 Overload thyristor stack, bridge 1 or 2 in case of parallel bridges (Red)

Parameter 22.05 = 0 (only action before 10_05)	Parameter 22.05 = 1 (from 10_05)
⊗ 8 ASTAT OK (Steady Green) A fault is detected by the controller (Flashing Green) Controller is not powered / CPU-fault if the LED is out.	⊗ 8 Brake lifted (Steady Green)

On terminals are available two -10 V --- 0 --- +10 V Analogue Outputs for indication:

AO 1 Total Motor load in % of rated torque, -400% --- 0 --- +400%

AO 2 Speed, -200% --- 0 --- +200%

There are a few options for presentation and action of Faults.

4.21.7. Action of DATX 110 DO no. 7

Parameter **22.04** let us decide if DO no. 7 of DATX 110 shall close for all occurring faults, or only for the faults of the Cabin I/O LED-display.

In mostly all installations All occurring faults shall result in DO 7 relay closing.

The function is available from AST10_02.

4.21.8. Action of DATX 110 DO no. 8

All uncontrolled stops of a crane should by subject to investigation. Typical reasons for uncontrolled stops are Over speeding a hoist, Hitting upper safety limit switch or an Emergency stop push-button is pressed during run. In all cases the reason should be reported and the reason should if possible be prevented from being repeated. Example of measures: The working limit switch and the safety limit switch should be separated in distance, Instructions should be given how to use the emergency stops.

Frequent electrically uncontrolled stops will increase the wear of the crane considerably.

An uncontrolled stop is defined by loosing the crane contactors on-state annunciation signal while the brake is lifted by the ASTAT control system. This supervision is turned on with parameter **22.03**.

If the above state is declared DO no. 8 of DATX 110 will open. It cannot be closed or the ASTAT will not be ready for new service until the 230 (115) V AC control voltage has been off and on again.

See also Sections **2.3 Crane power and control voltage**.

This function is not available for share motion drives.

This function is available from AST10_03A.

Description	MIN	MAX	NORM	SET	IDENTITY	English text
0= Accept that uncontrolled stops can be reset with normal Crane On push button. 1= Require that electrical maintenance shall reset the uncontrolled stop by switching control power off on.	0	1	0	D	2203	PT_FLT_S
0= DATX 110 DO 7 closes for all faults. 1= Only faults presented on the Cabin I/O LED-display.	0	1	0	D	2204	ALLFAULT
0= Cabin I/O DO 8 shows status of ASTAT. 1= Cabin I/O DO 8 shows if the brakes are lifted.	0	1	0	D	2205	SHOWBRAKE

4.22. Thyristor cooling fan control

The Thyristor modules DASD are equipped with cooling fans. Before 10_05 the fans were controlled by the fitted NTC-sensors.

From 10_05 the simple control rule is: Fans can be controlled by DO no. 1 of DATX 110. It closes at motion start, and opens delayed one minute after motion stop.

For special applications it is possible to let the fans run all the time, parameter **13.01**.

4.23. Reserved

4.24. Reserved

4.25. Group 25: By-pass functions

4.25.1. Description

A By-pass function is introduced in release 10_055. It is normally not used; however it can be set up in two different modes, Mode 1 and Mode 2. The by-pass functions require an additional Remote I/O (Cabin I/O).

The first Cabin I/O after the Control System Module DARA has below I/O-list:

DO 1: Closes By-pass contactor KA (up, travel in direction A)

DO 2: Closes By-pass contactor KB (lower super-synchronous, travel in direction B)

DO 3: Opens mech. brake 1, which might be needed to stop the heavy load after lowering

DO 4: Opens mech. brake 2, which might be needed to stop the heavy load after lowering

The second Cabin I/O after the Control System Module DARA is connected to the master switch, and is optional. However, practically it must be used for By-pass mode 2, heavy by-pass, as this mode is used as one of more macros, and macro selection requires a Cabin I/O for the master switch.

By-pass mode 1 is used to reduce the losses inside an electrical room or a free cubicle.

When the thyristor bridge by control conditions already is on totally conducting state giving full line voltage to the motor, the bridge can be shorted with one of two contactors KA or KB.

The primary intention is to use this function rather than installing an active cooling system for a stand alone cubicle. Two contactors will drastically reduce the future maintenance compared to an active air-conditioning unit.

As KA and KB are operated without current, they can be selected thermally. It is no reason to consider the emergency braking capability for KA and KB.

It is only needed to modify parameter 25.01.

By-pass mode 2 is used for large process cranes without any differential gearbox. The philosophy is that one of two hoist motors should be capable to handle one complete load cycle with hoist full and lower, or lower full.

Each motor has two brakes; the complete hoisting machinery has four brakes.

By-pass mode 2 requires that the hoisting machinery is equipped with one weighing system or load cell that is delivering the actual load information as 4-20 mA (or Voltage 10 V) to ASTAT.

The rotor resistor must be designed for continuous service with only one motor in the last resistor step, the other steps should be done according to the ASTAT standard recommendations with 1,10 ... 1,15 times rated rotor current of the motors. The parameter **25.11** is set to 20 seconds considering a common modern stainless steel grid resistor with natural cooling is used. This kind of resistor has a time constant of about 200 seconds.

As long as the load is low, the hoisting machine will run in conventional speed control mode.

With higher load the thyristors are only used to remove the stresses from contactors KA and KB; else will the operation be like conventional contactor control.

Stopping after lowering is supported by one or two mechanical brakes, whatever is needed due to the actual load.

As a start condition for by-pass mode 2 it is required that the temperature of the thyristor stack is low. After the process is started a certain time slot is allocated to finish the operation, else it is required to restart from cool thyristor condition.

4.25.2. Parameters

Description	MIN	MAX	NORM	SET	IDENT	English text
0=No By-pass function	0	2	0	D	2501	MODE_B_P
1=Loss optimisation, By-pass in full voltage state. For Hoist and Travel						
2=Exceptional heavy load By-pass control for Hoist						
Load in % of the hoists nominal at which rescue By-pass becomes active.	5%	100%	55%	X	2502	LOAD_BP
Highest allowed thyristor stack temperature to start the motor in rescue by-pass mode.	30	45	40	X	2503	TEMP_BP

Description	MIN	MAX	NORM	SET	IDENT	English text
Time slot after heating the thyristor stack above temperature acc. to parameter 25.03 that operation is allowed unless the thyristor stack is cooled down below the same temperature again.	0	900	900	X	2504	TIME_BP
Current limit % of rated current of the motor in rescue by-pass mode	100%	400%	330%	X	2505	ILIM_BP
Load in % of the hoists nominal at which rescue By-pass is supported with one brake to stop.	5%	100%	55%	X	2506	LEV_1_BR
Load in % of the hoists nominal at which rescue By-pass is supported with two brakes to stop.	5%	100%	80%	X	2507	LEV_2_BR
Pull in speed for rotor contactor K1 in rescue by-pass mode	-50%	30%	-10%	X	2508	K1LEV_BP
Pull in speed for rotor contactor K2 in rescue by-pass mode	20%	90%	30%	X	2509	K2LEV_BP
Pull in speed for rotor contactor K3 in rescue by-pass mode	50%	95%	65%	X	2510	K3LEV_BP
Time with high load during that service with rotor contactor K3 is allowed. The value shall be selected so the theoretical time is about 3 times longer.	0	60	20	X	2511	TIM_K3BP

4.25.3. Signals

Description	Unit	IDENT	English text
Remaining time for operation in heavy by-pass mode without needed to restart with cool thyristor stack.	Seconds	2551	BP_TY_TI
Remaining time for operation in heavy by-pass mode without closing final rotor contactor K3.	Seconds	2552	BP_K3_TI

5. EMC considerations

5.1. Regulations

ASTAT fulfils the requirements of the directive 89/336/EEC.

5.2. Emission from ASTAT

The EMC-requirement is fulfilled with respect to radiated and conducted emission with the basic IP20 ASTAT, i. e. no cubicle is necessary inside the crane girder. No filters have been used for testing.

To simulate realistic conditions for start-up and service work, the radio frequency testing (emission and immunity) were made with removed covers.

Power cables are unshielded rubber cables. 1-phase control supply is through unshielded cable. DO- and DI-signals are through unshielded cables. AO, AI-signals and pulse encoder cables are through shielded cables.

5.2.1. Conducted emission

(1a) Emission conducted 1-phase Full with Q-peak

(1b) Emission conducted 3-phase Full with Q-peak

According to EN 61800-3(1996) + A11 (2000) the ASTAT controller fulfil the emission requirement in Second Environment¹² (limit of EN 55011 Class A, Group 2)

The test was performed in accordance with:

Standard	EN 55011
Frequency range:	0.15 MHz - 30 MHz
Bandwidth:	10 kHz
Step size:	6 kHz
Measure time:	5.0 s at quasi-peak and final average measurement else 0.02 s

5.2.2. Radiated emission

(2a) Emission radiated Full with Q-peak

(2b) Emission radiated Full, night pass

(2c) Emission radiated Pre-testing, scanning

According to CISPR 11 (1997), EN 55011 (1998) + A1 (1999) + A2 (2002) the ASTAT controller fulfil the emission requirement)

The test was performed in accordance with:

Standard	EN 55011
Frequency range:	30 MHz - 1000 MHz
Bandwidth:	120 kHz
Step size:	80 kHz
Measure time:	5.0 s during quasi-peak measurement else 0.01 s

¹² Second Environment: Industrial network

5.3. Immunity of ASTAT

The testing covers all critical phenomena.

Standard: Generic Standard, Industrial Equipment

The EMC-requirement is fulfilled with respect to radiated and conducted emission with the basic IP20 ASTAT, i. e. no cubicle is necessary inside the crane girder. No filters have been used for testing.

To simulate realistic conditions for start-up and service work, the radio frequency testing (emission and immunity) were made with removed covers.

Power cables are unshielded rubber cables. 1-phase control supply is through unshielded cable. DO- and DI-signals are through unshielded cables. AO, AI-signals and pulse encoder cables are through shielded cables.

5.3.1. Radio Frequency immunity

- (4a) Three-phase supply
- (4b) Control voltage
- (4c) PE
- (4d) DI, open
- (4e) DI, closed
- (4f) DO
- (4g) AI
- (4h) AO
- (4i) Pulse encoder

The test was performed in accordance with:

Standard:	IEC / EN 61000-4-6
Test level:	15 V
Frequency:	0.15 MHz - 80 MHz
Modulation:	80% AM sine at 1 kHz
Step size:	$0.01 \times f_p$
Dwell time:	2 s

5.3.2. Electrostatic discharge immunity

- (5) ESD The ASTAT Controller was fired this electrical discharge (mixed air discharge and contact discharge, to 13 different points. This test was performed with the covers installed.

The test was performed in accordance with:

Standard:	IEC / EN 61000-4-2
Test voltages:	
-contact discharge:	$\pm 2, 4$ kV
-indirect discharge:	$\pm 2, 4$ kV
-air discharge:	$\pm 2, 4, 8$ kV
Repetition rate:	1/s
Number of tests:	>10 pulses per polarity and test point.

5.3.3. Electrical fast Transient / Burst immunity

- (6a) EFT / burst Main voltage 3-phase, ± 2 kV, Common mode as well as Line to Ground
- (6b) EFT / burst Control voltage 1-phase, ± 2 kV, Common mode as well as Line to Ground
- (6c) EFT / burst Thru capacitive clamp of the cables covering AI, DI, DO, AO, Encoder, ± 1 kV

The test was performed in accordance with:

Standard:	IEC / EN 61000-4-4
Duration of test:	>1 min/ polarity
Burst duration:	15 ms
Repetition rate:	5 kHz at test levels up to 2 kV

5.3.4. Single pulse/Surge immunity

- (7a) Three-phase supply. Line-Line 1 kV. Line-PE 2 kV. Applied for 0 degree, 90 degree and for 270 degree phase position relative zero-crossing of the main voltage between two of the three phases (there are three such combinations in a three phase system)
- (7b) Control voltage. Line-Line 1 kV. Line-PE 2 kV.
- (7d) DI, open. Line-Line 1 kV. Line-PE 1 kV.
- (7e) DI, closed. Not tested as Open DI is worst case
- (7f) DO. Not tested, as DO is not assumed to be cabled outside the installation panel of the ASTAT
- (7g) AI. Potential difference 1 kV.
- (7h) AO. Potential difference 1 kV.
- (7i) Pulse encoder. Potential difference 1 kV.

The test was performed in accordance with:

Standard:	IEC / EN 61000-4-5
Repetition rate:	3/min ¹⁾
Phase angle:	0, 90 and 270 degrees
Coupling method:	capacitive coupling
Number of tests:	five pulses per polarity and test point.

¹⁾ Standard requirement is to perform the surge immunity test with a repetition rate of minimum 1 pulse per minute. In agreement with the client the repetition rate was increased to 3 pulses per minute.

5.3.5. Voltage dips and short interruptions

- (8a) 30 % Voltage drop - 10 ms
- (8b) 60 % Voltage drop - 100 ms
- (8c) 60 % Voltage drop - 1000 ms
- (8d) 95 % Voltage drop - >5000 ms

Situation	Result for ASTAT in test	Requirement
30 % Voltage drop - 10 ms	A = Max speed drop 5%	B = To continue without stop, however is a temporary speed drop allowed
60 % Voltage drop - 100 ms	A = Max speed drop 5%	C = Allowed to stop, but shall be operational after operator reset and or restart.
60 % Voltage drop - 1000 ms	C = Allowed to stop, but shall be operational after operator reset and or restart.	C = Allowed to stop, but shall be operational after operator reset and or restart.
95 % Voltage drop - >5000 ms	C = Allowed to stop, but shall be operational after operator reset and or restart.	C = Allowed to stop, but shall be operational after operator reset and or restart.

The test was performed in accordance with:

Standard:	IEC / EN 61000-4-11
Test level:	30% reduction for 10 ms 60% reduction for 100 ms 60% reduction for 1 s >95% reduction for 5 s
Number of tests:	3 dips/interruptions with interval of 10 s minimum

5.4. Practical considerations

5.4.1. To prevent malfunction of ASTAT

Make the installation according to the section **Installation**.

6. Installation

Install the ASTAT in accordance to the instructions of this manual:

Section **REFERENCE SECTION**
Subsection **TECHNICAL INFORMATION**
Subsection **OPERATION LIMITS**

6.1. Panel design

6.1.1. Rules

The panels should have a stable steel mounting-plane. This plane serves both as mechanical frame and as grounding plane. We recommend using a plane with non-isolating surface like a zinc-plated steel sheet.

If a painted steel sheet is used, all main components shall be grounded to the steel sheet with a short cable. Section: determined by the main fuses but always at least 25 mm² (AWG 4).

The steel sheet plane shall be grounded with a short cable. Section: determined by the main fuses but always at least 25 mm² (AWG 4).

For internal wiring inside the panel, follow the same rules as for external wiring in section **ASTAT SYSTEM DESIGN, Cables**.

For safety local rules shall be followed.

6.1.2. Useful advice

ASTAT has optimised hardware for crane motion control. Most needed function/apparatus are included in the ASTAT motion controller itself.

Examples:

- EMC tests are made with modules in open rack, i. e. there is no need to consider particular EMC-cubicles, EMC-glands or other expensive and less practical devices.
- Control wires can be fixed to prevent loosening by vibration. This is especially important with stranded "AWG" wire.
- Detection voltage distribution terminals included.
- Detection voltage 110 V DC can be routed together with 115 / 230 V AC.
- Detection voltage supply included.
- Opto link communication to cabin.
- PTC-relays included.
- Short-circuit proof 24 V DC available for Pulse transmitters / Speed feedback Module
- 24 V and 110 V DC protected by MCB.
- DO outputs are dimensioned for direct connections of most power contactors. The terminals for the DOs are made for 230 V.

In this section some examples of panel design are shown. If the panels are made as the examples show, thermal properties are good and connections are oriented in the best way. External connections will be easy at the site.

Panels can be made as cubicles or open racks.

6.2. Thyristor module DASD 001, 002, 003

The DASD 00x and the DARA 100x modules shall be pre-assembled prior to mounting into a panel.

- The left side of the DARA 100x shall be unscrewed and removed. You will get 4 screws to left over.
- Remove the "lip" marked with "3" in Section **Routing of cables to DARA 1000/1001/1010**
- Join the DARA 00x and DASD 00x with care and use the four screws left over. Two screws at the top side, two screws at the bottom side. For normal crane-installations, do not insert the two screws along the left rear side of the unit. These two screws are only for extremely vibrations, and if these screws are installed one has to take out the combined DASD 00x and DARA assembly.
- Join the DASD 00x and the DARA 100x modules with final joining screw+nut, see picture:
Use screw M5 + nut.



- Firing pulse cable
DARA 1000: Connect the firing pulse cable to the board DAPC 100 (X7). Study the fixing of the factory installed cable inside DARA 1000, remove this cable and connect and fix the cable from DARA 00x in the same way, using the cable ties of the package.
DARA 1001 and DARA 1010: Connect the to the board DATX 132 or DATX 133 (X7).
- Fan connection
DASD 002: Connect the fan to DARA power supply module DASA 110, -X2: 3 and :4. Red to :3 and blue to :4.
DASD 003: Connect the fans to DARA power supply module DASA 110, -X2: 3 and :4. Two leads shall be put in the same terminal. Red to :3 and blue to :4.

Before connecting the fans: Check if the application design includes temperature control. In that case the red fan wire is connected via DO no. 1 of the DARA 10xx.

6.3. Panel lay-out

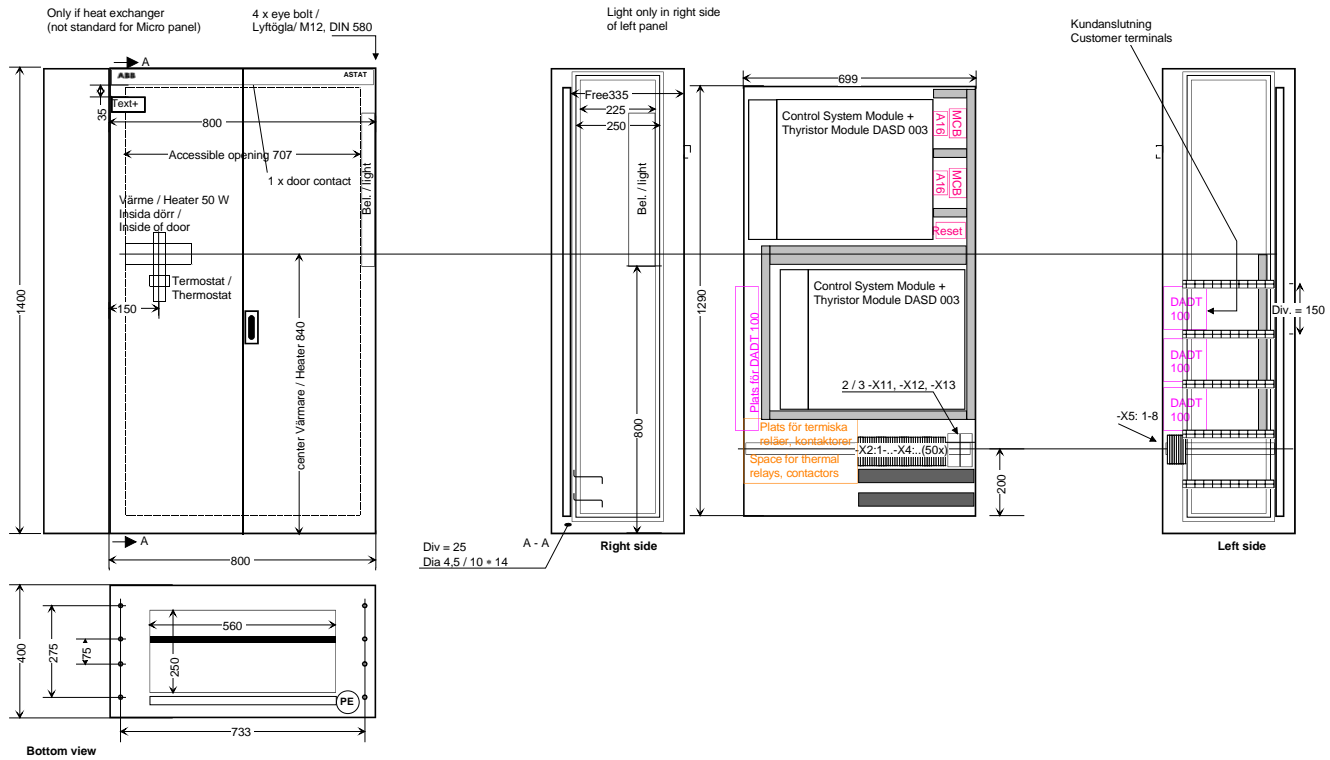
See our suggestions in following pages:

With an "E-room" is assumed a modern full height compartment. The panel height is 1800 mm, and is it convenient for cabling if there is approximately 300 mm additional free space on top of the panels. A false floor for cabling below the panels is also assumed. ASTAT panels can be installed in open panels in E-rooms as the EMC-emission is acceptable for EC-Directive and EN-norms in that execution. No additional protection barrier for dust / dirt is needed as ASTAT is made for pollution degree 4.

Motion controllers mounted in freestanding cubicles are mostly used for modernisation and smaller cranes. In both cases it is essential that the dimensions are small. We suggest to use cubicles with WxHxD = 800x1400x400 mm, and that the cubicle has **double doors**. For panels with width = 1200 mm we recommend **triple doors**. All connection should be to through the bottom of the cubicle.

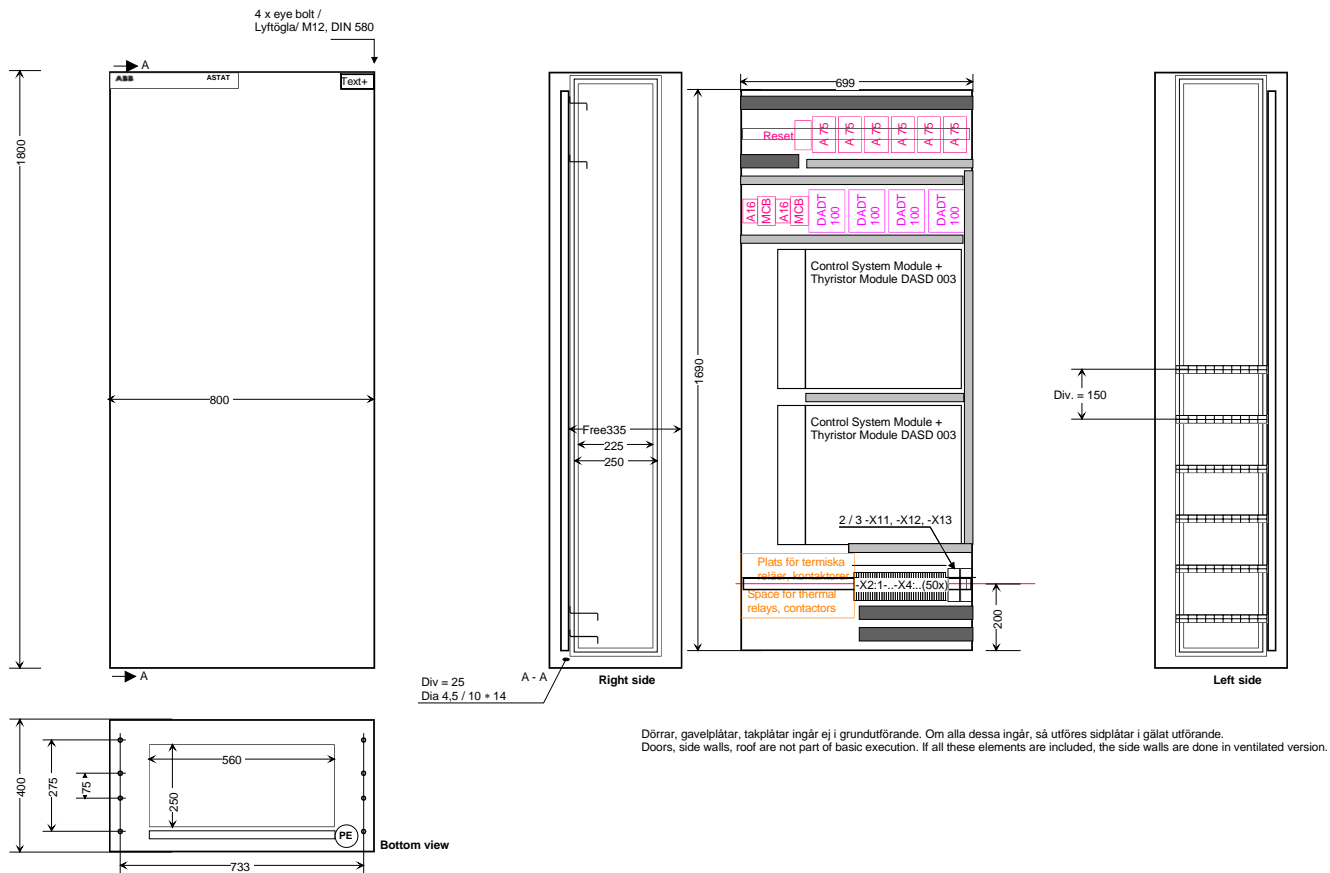
Contact ABB Crane Systems for more layout suggestions for switch or junction boxes, power distribution etc.

6.3.1. Cubicles with DASD 00x modules



Rotor connections to bottom. WxHxD of cubicle = 800x1400x400 mm. Space for two DARA10xx + DASD 00x.

6.3.2. E-room panels with DASD 00x modules

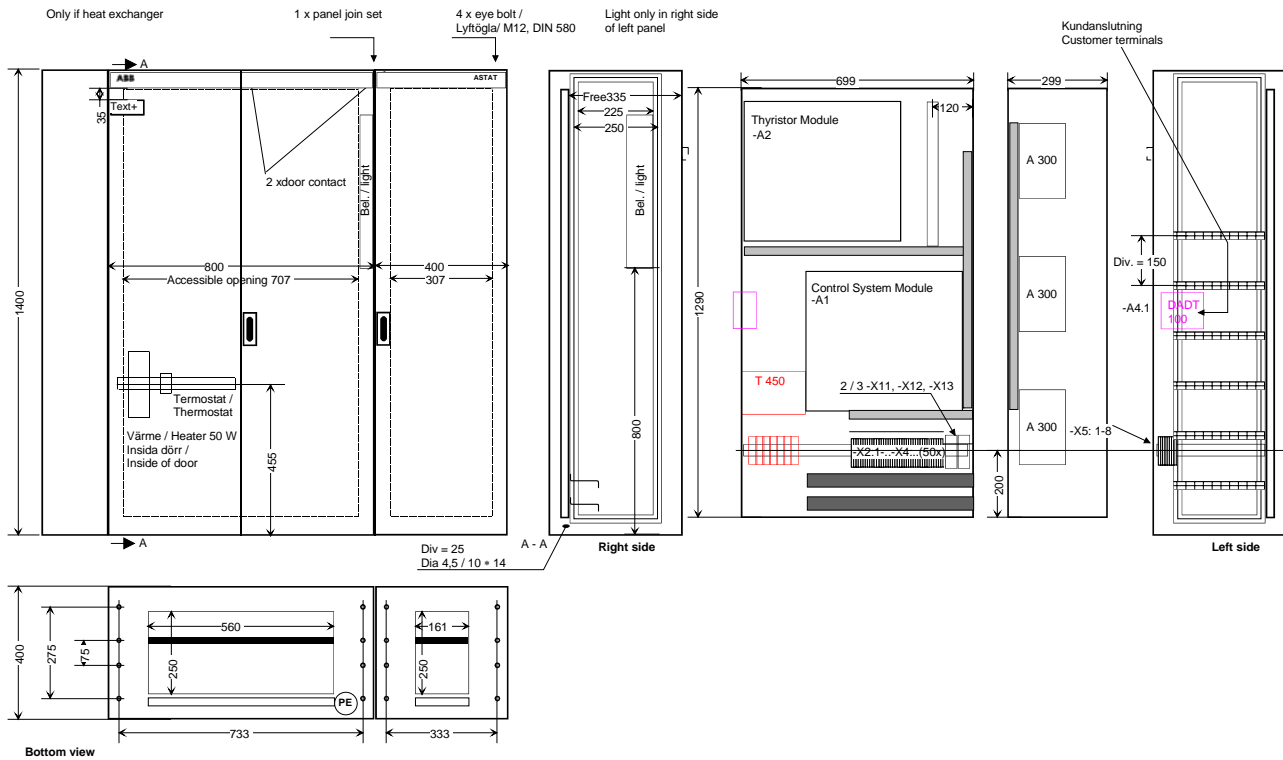


Dörrar, gavelplåtar, takplåtar ingår ej i grundutförande. Om alla dessa ingår, så utföres sidplåtar i gälalt utförande. Doors, side walls, roof are not part of basic execution. If all these elements are included, the side walls are done in ventilated version.

Rotor connections to top. WxHxD of panel = 800x1800x400 mm. Space for two DARA10xx + DASD 00x.

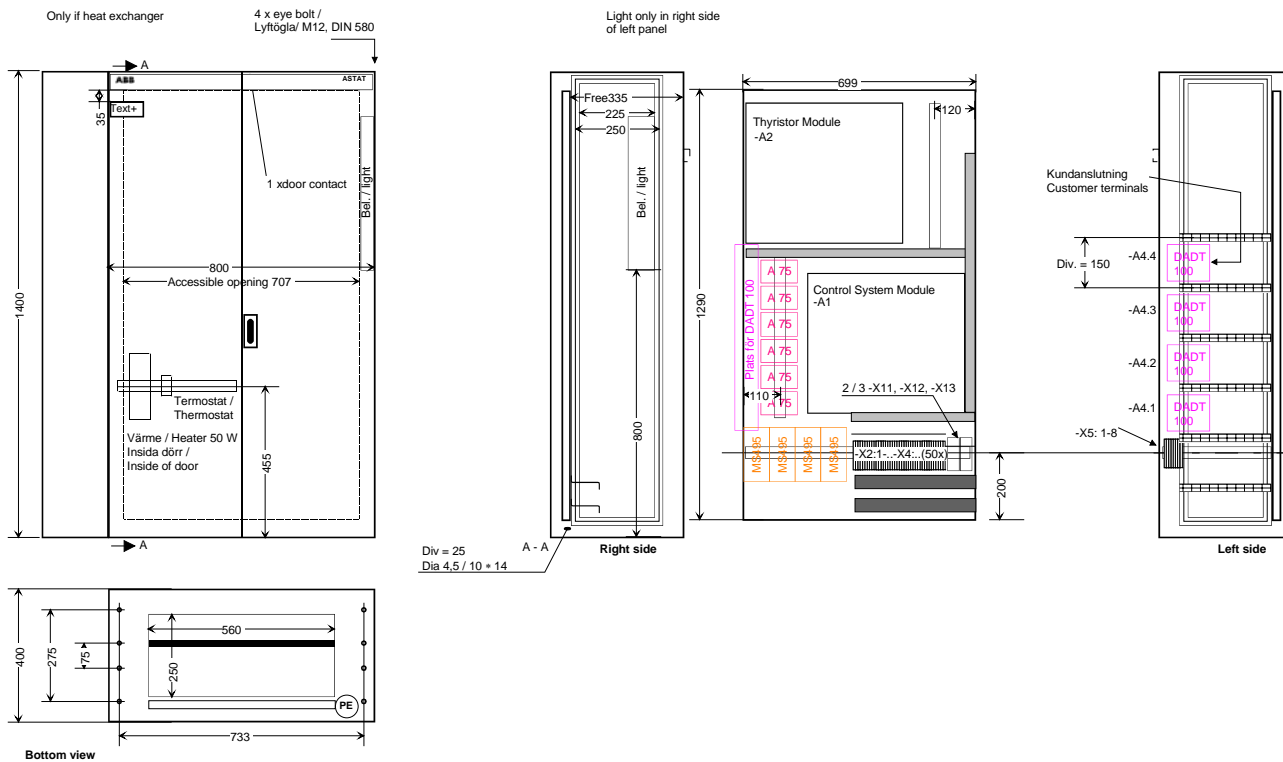
6.3.3. Cubicles with DASD 104-105 modules

6.3.3.1. Example width = 1200 mm



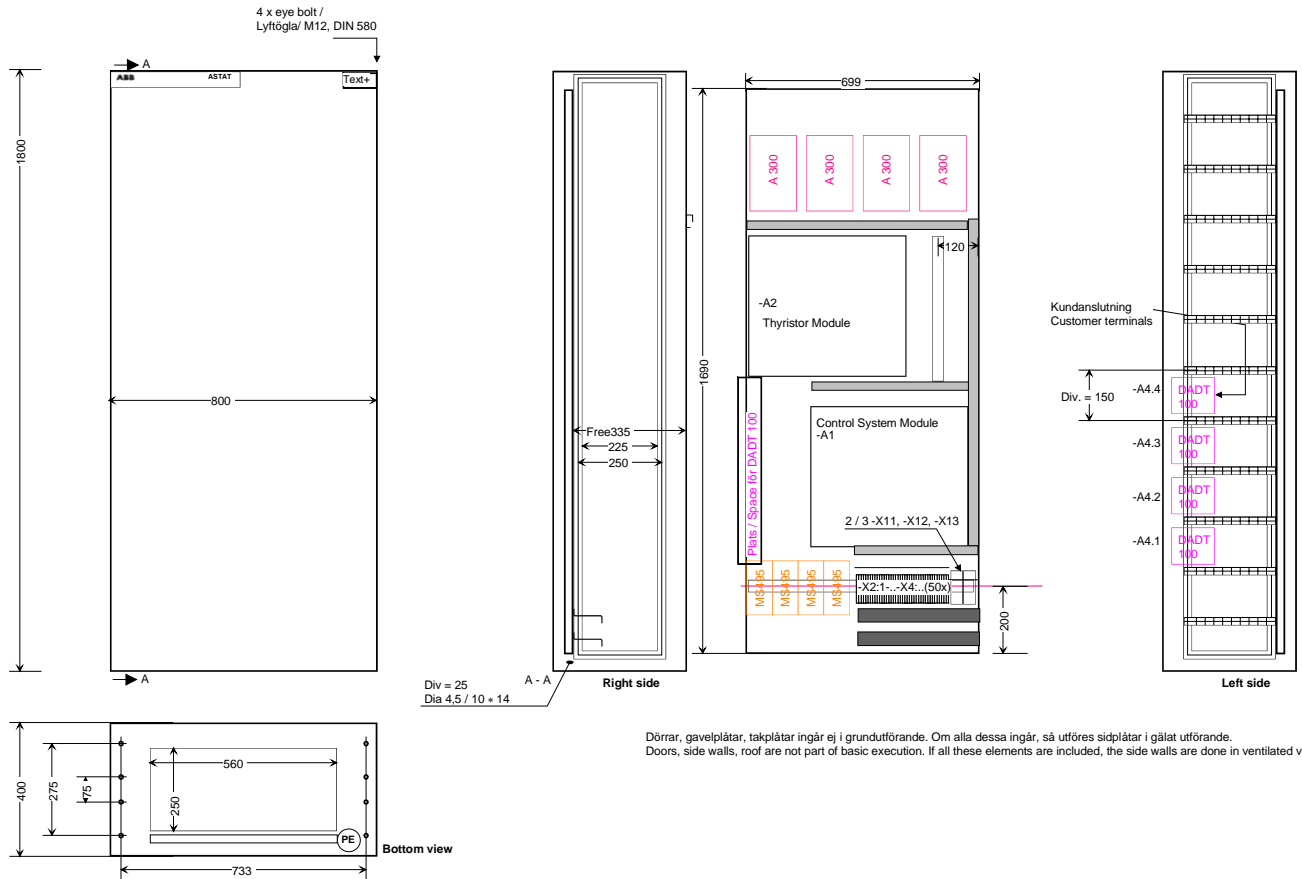
Rotor connections to bottom. WxHxD of cubicle = 1200x1400x400 mm. A separate compartment for the large rotor connectors. Space for one DARA10xx + DASD 105.

6.3.3.2. Example width = 800 mm



Rotor connections to bottom. WxHxD of cubicle = 800x1400x400 mm. Space for one DARA10xx + DASD 105

6.3.4. E-room panels with DASD 104-105

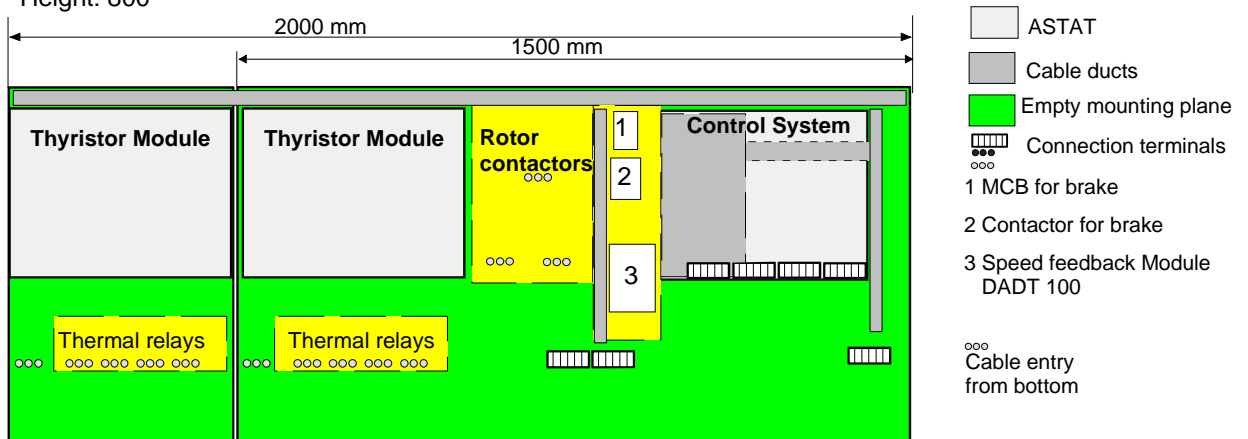


Rotor connections to top. WxHxD of panel = 800x1800x400 mm. Space for one DARA10xx + DASD 105.

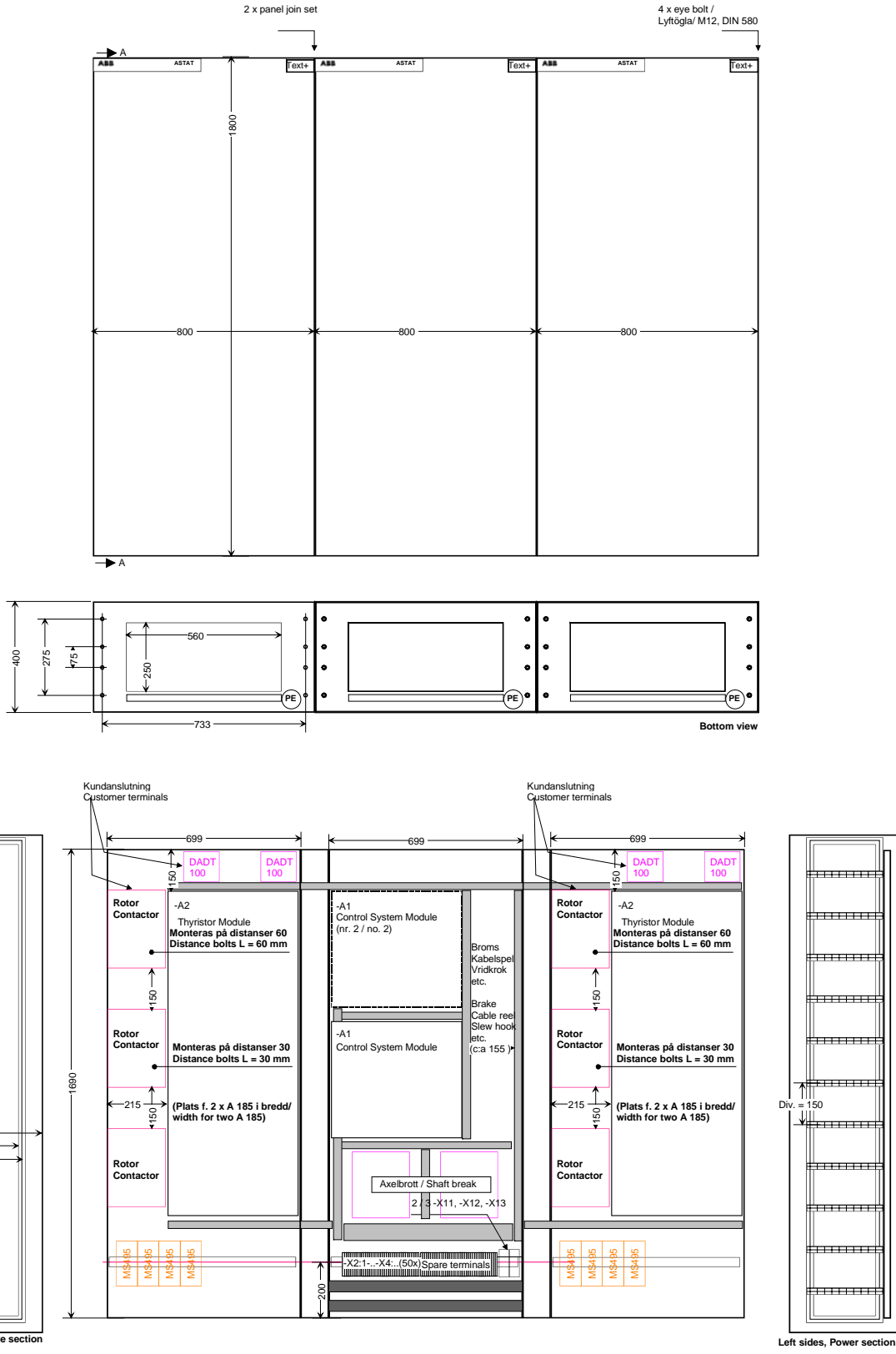
6.3.5. Cubicle with limited height

Cubicles can be assembled with a low height. For 355 A and less 1500 mm wide cubicles can be enough. Parallel 355 A modules, 710 A requires at least 2000 mm width.

Width: 1500 or 2000
Height: 800



6.3.6. Large E-room panels



Dörrar, gavelplåtar, takplåtar ingår ej i grundutförande. Om alla dessa ingår, så utföres sidplåtar i gälalt utförande.
Doors, side walls, roof are not part of basic execution. If all these elements are included, the side walls are done in ventilated version.

Rotor connections to top.

WxHxD of panel = (800 + 800)x1800x400 mm. Space for two DARA10xx + one DASD 127.

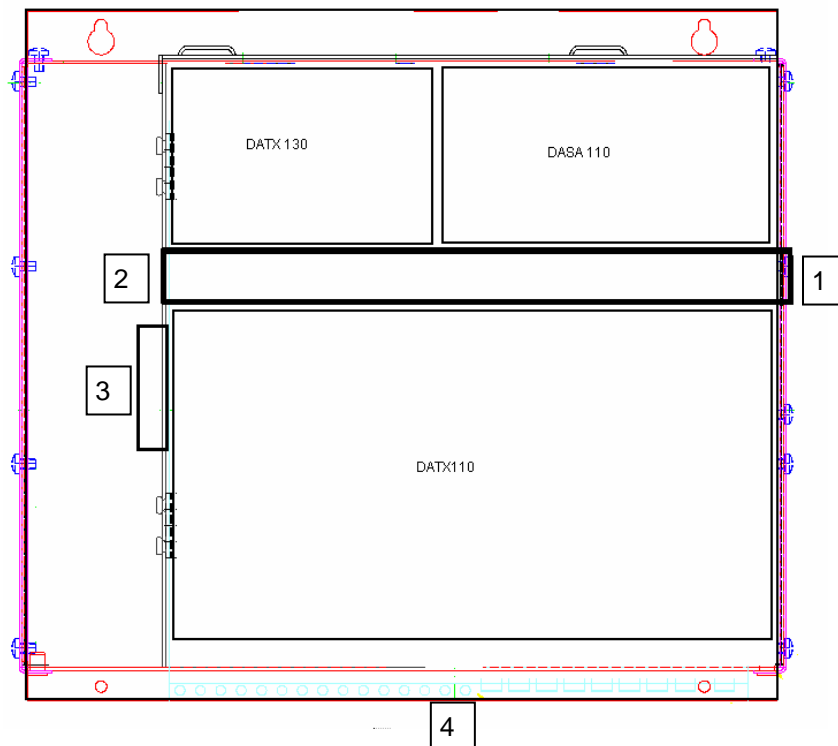
For parallel bridges, add 800 on left or right side to get 1260 / 2000 / 2200 A, or two independent drives of each 630 / 1000 / 1100 A.

Observe that the number of Rotor contactors and number of Thermal relays shown in the layout are not occurring in the same installation.

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6.3.7. Routing of cables to DARA

The EMC tests for ASTAT are carried out with the different types of connections to DARA arranged in the below way. The picture shows the DARA with the hinged mounting sheet opened totally.



References numbers for the boxes in the above figure:

- 1) **Pulse cable to Thyristor Module DASD, 115 / 230 V AC supply, Fan supply, Opto fiber to Cabin I/O, RS 485 communication to computer.**
Inside fitted the wire duct.
Wires out on right side.

Then DASD 00x thyristor modules are used, the Cable from DADT 100 and Digital Out cables shall used exit 1, while the Pulse cable is using exit 2.

- 2) **Cable from DADT 100 (not for DASD 00x).**
Inside fitted the wire duct.
Wires out on left side into vertical duct.
Can be routed up or down inside the vertical duct.
- 3) **Digital Out (not for DASD 00x).**
Wires out on left side into vertical duct.
Use cable ties in punched holes to fix the wires on lip.
Can be routed up or down inside the vertical duct.
- 4) **Digital In, PTC, Analogue In, Analogue Out, Pulse Encoder.**
Wires down.
Use cable ties in punched holes in DARA.
Use the fitted clamps for screened cables.

6.3.8. Power cables, terminals

General advice for Power cables is given in **Section 2.11**. Regarding the installation, we strongly recommend that terminals for power cables are used only if needed (like in junction boxes). The quality of the installation is improved by connecting the power cables directly to the main circuit apparatus in panels rather than by additional terminals.

Each additional power terminal will increase cost.

Each additional power terminal will increase future inspection work.

Acc. to EN60204-32 terminals are not needed for power cables.

6.3.9. Finish IP 20 protection of ASTAT

To achieve the IP 20 protection of Thyristor modules DASD 1.., following measures must be taken:

For sizes 200 A, 355 A, 630 A, 1000 A and 1100 A install a flameproof isolator protection cover over the main circuit cables or bars after they are installed. Lexan™ can be used. The cover shall be fit with ventilation holes $D = 10 \text{ mm}$ so at least 3 dm^2 and $1/3$ of the cover surface is free for air ventilation.

Size 500 A fulfils IP 20 without any additional measures.

6.4. Cabin Indication unit

For the mounting of the unit four holes circular holes $D=3,5 \text{ mm}$ and one $D=30 \dots 60 \text{ mm}$ are drilled or punched according to the dimension drawing.

If the delivered English text is not usable it can be replaced. Turn the unit upside down and loosen the circuit board for the unit by removing the inserted screws. Leave the transparent sheet in place.

Remove the English factory delivered text foil, and replace it by your own choice.

Put the circuit back, fasten the screws again. Turn the unit so the text can be read.

Remove the two screw covers (snap action).

Fasten the unit with four M3 screws. Restore the two screw covers.

Connect the 10-pole ribbon cable from the backside.

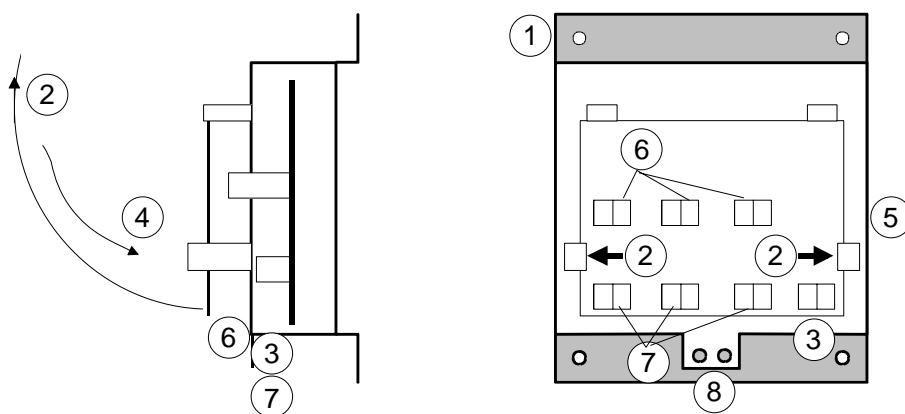
6.5. Speed Feedback Module DADT 100

Panel preparation in assembly workshop

- (1) Install with at least two M4 screws using two of four holes diagonally.
- (2) Open the protection cover by pressing the plastic latches out and swing it up.
- (3) Install the PE-connector.
- (4) Close by swinging down.
- (5) Install the cable to DARA 1001 / 1010

Site installation

- (2) Open the protection cover by pressing the plastic latches out and swing it up.
- (6), (7) Install the three cores of the cable for high rotor voltage, **max. rated 600 V**, (7) or low rotor voltage, **max. rated 300 V**, (6).
- (4) Close by swinging down.
- (8) Inserting a cable tie at (8) can support the cores of the cable.



6.5.1. Star point resistor

For control with rotor frequency feedback the star point ("the neutral") of the Rotor resistor must be connected to solid ground through a resistor R_Y . The motors rated Rotor Voltage is U_2 [V]

Data for R_Y : Resistance: $R_Y = 50$ to 150 kOhm.

Working voltage: $U_{WVR} = 2 * U_2$

Power: $\frac{(2 * U_2)^2}{R_Y}$

Example: A motor with a rated rotor voltage of 340 V is speed control by rotor voltage feedback. Select and install a resistor between the resistors star point and solid ground with following data: Resistance: $R_Y = 100$ kOhm. Resistors working voltage: 750 V AC. Power: 10 W (the high power was selected to get a mechanically robust device; from heat up point of view 5 W was enough).

Recommendation: Use the resistor 3ASC531201A550, which is listed in the order table. This resistor includes wire tails and mounting holes for screw and it easy to mount in the field.

6.6. Vacant

6.7. Tool modem sets DADT 114, 124

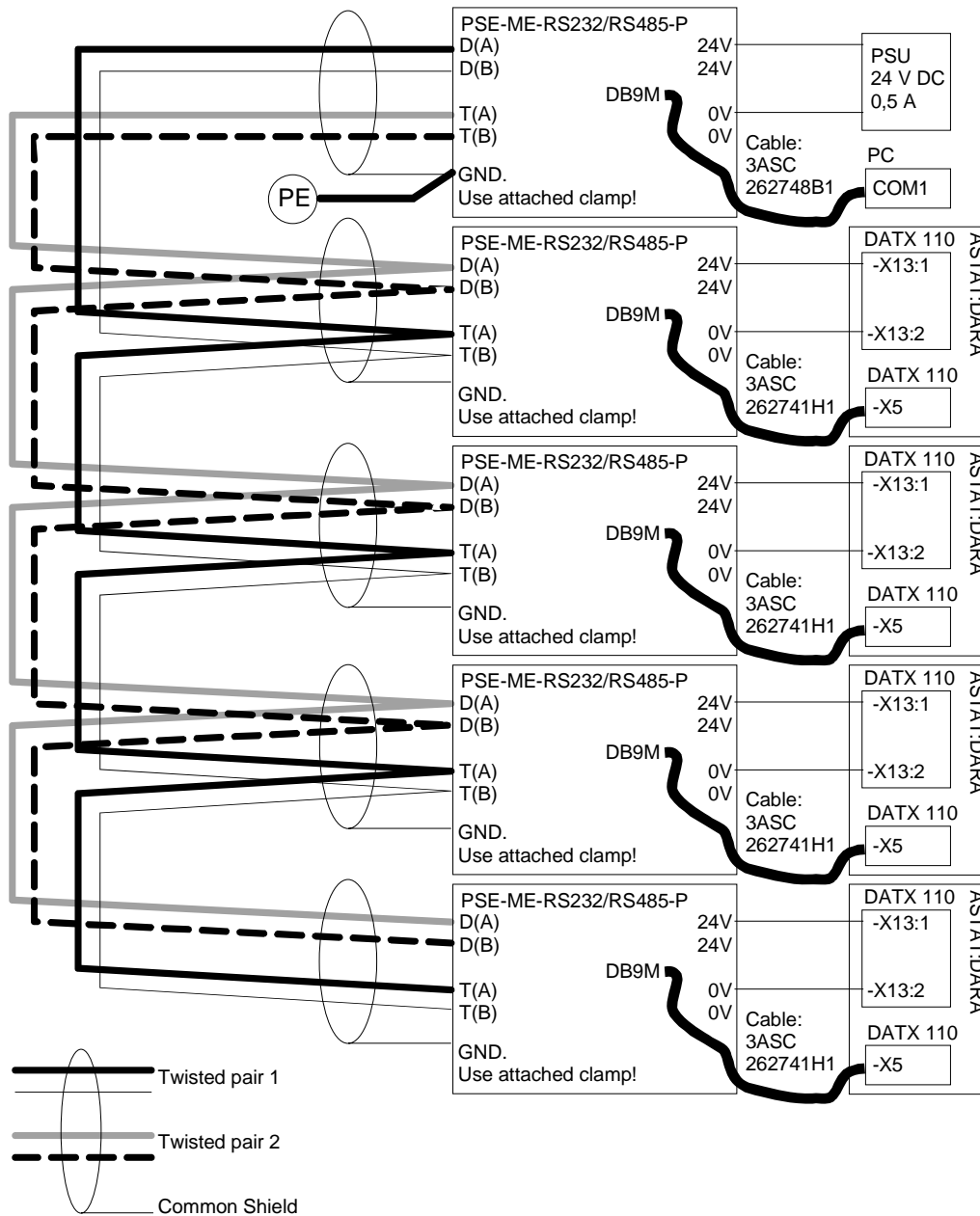
All devices are made for mounting on a 35 mm mounting rail. The mounting rail shall be connected to ground potential.

The cables that are connected to the signal converters shall be stripped using a stripping tool preset to 7,0 mm.

6.7.1. Cable for modems

Pair wise twisted 2 x 2 x max. 0,5 mm² with common shield. Do not use any inner individual shield for each pair. The cable LiCY (TP) 2 x 2 x 0,5 can be used.

Connection: See below:



Cable: LiYCY (TP) 2 x 2 x 0,5 mm²

Jumper setting: See **Reference Section**.

The common shield of the data line cables shall be connected with the shield clamp at each signal converter.

Prior to energising the signal converters, check that the polarity of the 24 V is correctly connected.

6.8. Screened signal cables, general

Shielded cables, as far as possible with pair twisted cores, shall be used for:

- RS 485 multi-drop for Tool communication
- Tachometer / Pulse transmitter
- PTC-sensors
- Other analogue signals if used, example load cell transducer

The routing and grounding of RS 485 multi-drop is described in previous page. For other connections with screened signal cables we have following rules to consider:

- 1) Maximally 20 mm wire visible outside the end of the screen
- 2) Screen shall be grounded directly by a spring pressure clamp, or with a tail less than 20 mm long. If grounding is made through capacitor, the length of the capacitor legs shall be as short as possible.
- 3) Only in one point the grounding of each screen network shall be made direct to ground.
- 4) In all other grounding points the grounding shall be made by a 0,022 microF / 250 V AC (1000 V DC) capacitor. Properties: Application: Y-type filter capacitor meaning it is made to be installed between live and ground; Design: Metalised paper (self healing); Capacitance: 0,022 microF; Voltage:250 V AC (1000 V DC). **Example: Evox Rifa, PME 271 0,022 microF.**
- 5) The direct grounding of the screen is made in the control system module DARA 1000 / 1001 / 1010. It is not allowed to install any terminal strip in the cubicle / panel. The cable with screen shall be directly connected to the DARA 1000 / 1001 / 1010 and its fit spring pressure clamp. Example: Pulse encoder for hoist on trolley. Example: PTC for crane travel motor.
- 6) For screened cables from DARA to a transducer without passing any junction box, leave the screened cable screen isolated^{remark} in the transducer end. This cable must be fixed directly to the steel structure of the crane or conduits should be used, not for example laid on a cable ladder. Example: PTC for crane travel motor.
- 7) For cables routed by junction boxes it is many times needed to use screened cables suitable for mill duty in the festoon part. It is shown on next page how junction boxes shall be designed.
- 8) For screened cables from trolley junction box to a transducer, leave the cable screen isolated^{remark} in the transducer end. This cable must be fixed directly to the steel structure of the crane or conduits should be used, not for example laid on a cable ladder.
- 9) Keep the unscreened ends of the screened cables apart from other control and power voltages.
- 10) Keep signals from same transducer close to each other in cables, if possible as twisted pairs.

For cranes use flat cable systems, or if desired round cable festoon systems. With cranes it is not possible to use a large number of 2-, 4- or 8-core shielded cables in these installations for the festoon system. In stead other considerations must be made.

A sketch over cable arrangement for cable with common screen in junction boxes is shown on next page. Observe that nothing prevents to use the same box for power, control and signals if the arrangements are properly done.

The power cable terminals are placed in the lower part to minimise cable length, cost and voltage drop.

If of any reason a frequency controlled drive system is used for any motion on the crane, its cable system must be installed separately from the rest of the installation.

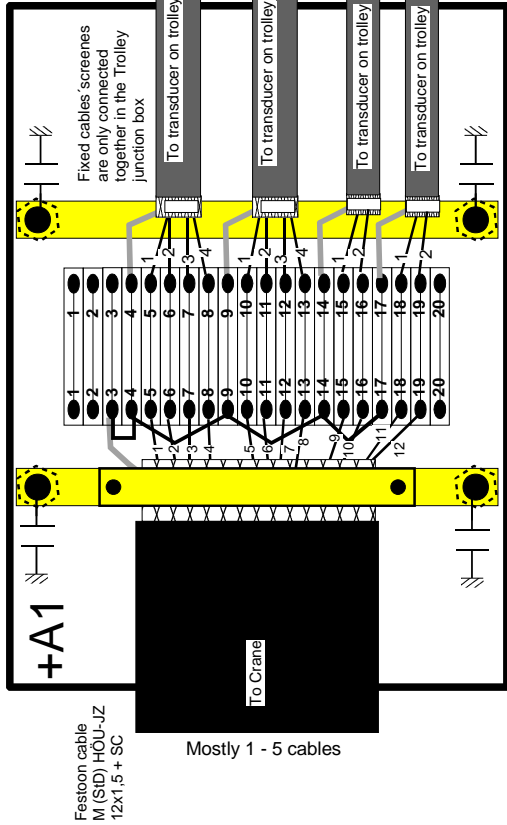
^{remark} The method is a compromise between the best capacitor-grounding and practical considerations for crane installation

Phoenix Spring pressure clamp system

- 2 x Isolator spacer M6 x 20, male + female
- 2 x Nut, M6
- 6 x Screw + flat + spring washer M6
- 4 x Cable lug, soldering or crimp to M6
- 130 mm Cu-bar 10 x 3, NLS-CU 3/10
- 85 mm Cu-bar 10 x 3, used as clamp
- 2 x Capacitor

Phoenix Terminals

- 1 x 130 mm NS35:7,5
- 20 x Rivets
- 20 x UK 3 N
- 1 x EBL 2-5, 2 pole bridge
- 9 x Screw + flat + spring washer M6
- 6 x Cable lug, soldering or crimp to M6
- 1 x D-UK 4/10
- 2 x 20 x ZB 15 (1-20) terminal markers



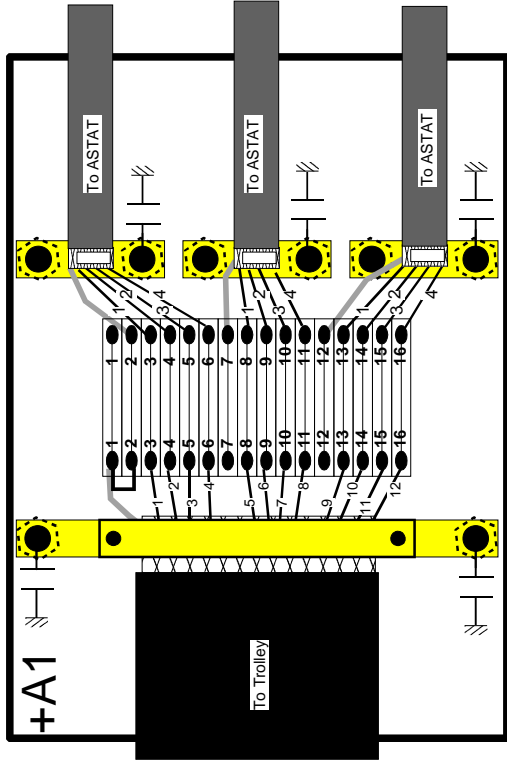
All screens isolated at transducer

Phoenix Spring pressure clamp system

- 2 x Isolator spacer M6 x 20, male + female
- 2 x Nut, M6
- 6 x Screw + flat + spring washer M6
- 4 x Cable lug, soldering or crimp to M6
- 130 mm Cu-bar 10 x 3, NLS-CU 3/10
- 85 mm Cu-bar 10 x 3, used as clamp
- 2 x Capacitor

Phoenix Terminals

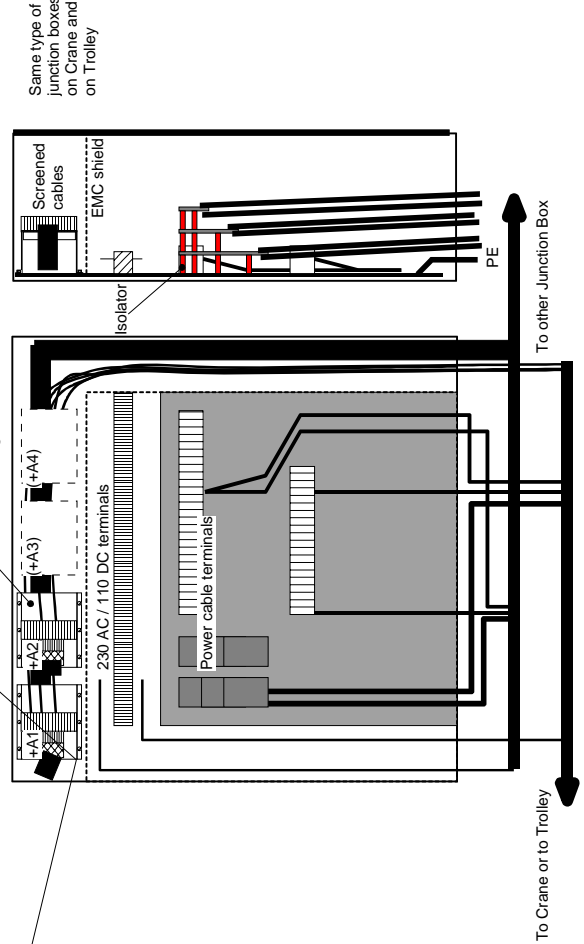
- 1 x 130 mm NS35:7,5
- 2 x Rivets
- 16 x UK 3 N
- 1 x EBL 2-5, 2 pole bridge
- 9 x Screw + flat + spring washer M6
- 1 x D-UK 4/10
- 2 x 16 x ZB 15 (1-16) terminal markers



All screens directly grounded by clamps in ASTAT DARA module

Trolley Junction Box Screen Cable Terminal group

Crane Junction Box Screen Cable Terminal group



Arrange cable supports for all cables. The screen clamps must not be used for supporting the cables.

7. Start up

This start up procedure is written as a verification of a thought through parameterisation design at the office desk in the previous stage.

If somebody likes to make the design by trail and error at start up there is nothing that prevents it, but remember in this case to start with a consistent set of parameters. This way of working is however less effective than to arrive to the crane with the design parameters ready from office.

ABB does not guarantee that the parameter setting ex works in the ASTAT controllers is the same as Normal values for visible and not visible parameters. Of this reason, when receiving a brand new ASTAT controller, the first parameter transfer shall be **Send To ASTAT.**

7.1. Safety precautions

7.1.1. Personal safety

CAUTION!

- ! Follow all applicable rules regarding personal safety.
- ! All people concerned must know how to disconnect mains and auxiliary voltage.
- ! Do not perform any kind of work on the controller if there is any risk of touching live parts.
- ! Do not perform any start up work alone.
- ! Inform people working near the driven machine that it may start without prior warning.

7.1.2. Equipment

The following precautions should be taken to avoid damage to the machine, rotor resistors and drivers equipment:

- Check the equipment for damage during transport or installation.
- Check that all cables and plug-in components are fixed properly in terminals and at other connection points.

7.2. Tools

An ASTAT unit can normally be commissioned without sophisticated equipment:

- Digital Multimeter, ranges: Voltage: 0-1000 V DC and AC, Resistance 0,1 Ohm resolution or better
- Set of screwdrivers. Including Torx.
- Set of spanners of metric type.
- Pair of side cutters
- Pairs of tongs to move jumpers
- Laptop PC with (normal) COM 1 port, or Laptop with USB port and USB/Serial converter
- PC-Tool for ASTAT Crane Motion Controller. Including cable.
- For cranes with closed electrical room it is strongly recommended to use Tool modem sets DADT 114, 124 to install the PC in a place with good vision of the crane movements.

7.3. Check list before power up

Make the following checks vs. the parameter list of the motion and the circuit diagram:

- That the ASTAT controller is connected to the correct mains and auxiliary voltages.
- That the fuses for the mains and auxiliary supply are present, and have right type and rating.
- That the cables, controller and motor are provided with appropriate external thermal overload protection.
- That the brake is properly installed and connected.
- That the rotor resistor is connected. Check by measurement the value of the rotor resistor if needed. Check the sequence of contactors K3 (DO4) - K2 (DO3) - K1 (DO2). K3, if installed, is closest to the motor.
- That the Rotor feedback Module, pulse-encoder or tachometer is connected properly when used.
- That the emergency-off switch functions correctly.

7.4. Start up step by step

7.4.1. Initial steps

Isolate the ASTAT from Mains and Auxiliary voltage by removing fuses or lock any circuit breaker with padlock. In case of a Shared motion drive, isolate also the second motion between ASTAT and motor.

Check wiring vs. circuit diagram. Check the tightening of power cables to ASTAT, resistor and motor. Isolate all DI and PTC-inputs with the yellow separators of DATX 110.

Check jumpers vs. circuit diagram.

Check the address switches of the remote I/O modules.

7.4.1.1. Control of digital inputs

Pull out all connected DI voltage separators of DATX 110.

Isolate (=Trip) the MCB for 24 V DC in the Control System Module.

Switch on the Auxiliary voltage, 115 (110) or 230 (220) V AC.

Switch on the MCB for 110 V DC in the Control System Module. LED 110 V OK on DATX 110 shall lit up.

For a floating system check that the MCB 110 V DC does not trip when connecting 110 V DC to ground. The LED Earth fault on DATX 110 shall lit up.

In case there are parallel bridges, check the function of the asymmetry protection by the LED Unsymmetry on DATX 110.

Check all other DIs 1 -16 by one by one closing the separators of detection voltage distribution terminal separators and all used digital input signals of DATX 110. Include the circuits inside and outside the panel in the checking.

End the test by checking that the digital inputs are in such a combination that the motion can start:

Type	With Cabin I/O	Without Cabin I/O
DI 1	ON: 1	ON: 1
DI 2	Fault reset: 0	Fault reset: 0
DI 3	Station 2 select: 0	Master switch in zero position: 1
DI 4	Parameter set 2 select: 0	Step 100%: 0
DI 5	All other for which the USE_Dlxx-parameter ¹³ is 1: 1	Prelim Dir. A: 1
DI 6		Prelim Dir. B: 1
DI 7		Stop Dir. A: 1
DI 8		Stop Dir. B: 1
DI 9		Cable relay: 1
DI 10		Brake open: 1
DI 10		Dir. A: 0
DI 12		Dir. B: 0
DI 13		Mech. Overload / Cable relay: 1
DI 14		Step 2: 0
DI 15		Mech. Overspeed / : 1
DI 16		Step 3: 0

7.4.1.2. Control of PTCs in motors

Check that the LED(s) on DATX 110 for which the USE_PTCx-parameter¹⁴ is 1 are lit up.

7.4.1.3. Control of fans

Check that the fan(s) are rotating. If time control is used, set parameter **13.01** to 3 to test the fan.

7.4.2. Power up the control system

Connect the fiber cable(s) between Control System Module and Cabin I/O Module(s), DAPM 100, 101.

Connect the PC with Tool program.

Switch on 24 V DC MCB in the Control System Module.

Start the ASTAT Tool program in on-line mode. Check that it is possible to study different variables of the ASTAT. Signal 01.51, gives the program version, as example 01.04.

Make the start up using the same operator station (or local) and the same parameter set at the time.

For Shared Motion drives, first make one motion ready.

For Master-Follower applications, first do one motion ready and copy all applicable parameters to the other.

¹³ Parameters 05.09 ... 05.20

¹⁴ Parameters 05.05 ... 05.08

7.4.2.1. Verification / modification of the parameters

Select **Design View** for parameters, and check:

Group 01: Identity

Check only

Group 02: I/O units and Factory test

0: master switch connected to Cabin I/O

1: master switch connected to Cabin I/O #2 and signals mirror wise transferred Cabin I/O #1 - #3

5: master switch connected to DARA

Group 03: Supply information

Check only

Group 04: Motor information

Check only

Group 05: ASTAT information

If the design is made with parameter **05.04, L_SW_TYP = 2**, change for the first stage of the start up to value L_SW_TYP = 0..

Type of limit switch for movements. 05.04, L_SW_TYP

0: Limit switches not active

1: Classic based on four switches.

2: Soft based on Pulse transmitter.

Rest of parameters: Check only.

Group 06: Brake information

Check that the designer has selected the right type of brake. The default values will always serve as a first getting started set if given the right type of brake is selected. Note down your changes if any.

Group 07: Speed feedback

Check that the designer has selected the right type. The speed feedback must be proven in a later stage with main power up.

Group 08: Speed reference

Check the parameter values.

Use the PC Tool to check that the reference value and the direction signals are properly interpreted by the ASTAT when moving the Master switch or whichever way the reference is given.

Group 09: Speed regulator

Check only at this stage. The default values will always serve as a first get started set if there would be any doubt regarding the designed values. If you make changes, note down your already tested values to avoid tuning with same values repeatedly.

Group 10: Speed supervision

Check only.

Group 11: Current regulator

Check only.

Group 12: Rotor resistor

Check only.

Group 13: Selectable DO

Check only.

Group 14: Load functions

Type of limit switch for movements. 14.01, MEC_OV_L

0: not used,

1: DI in Direction A,

2: DI in Direction B (Used for luffing cranes),

31 / 131 / 41 / 141: AI in Direction A. Check also rest of parameters in the Group

32: AI in Direction B (Used for luffing cranes). Check also rest of parameters in the Group

Group 15: Slack rope function

Check only.

Group 16: Limit switch function

Check only if the intention is to use the soft limit switch function.

Group 20: Master Follower

Check only.

End the test by pulling out the yellow separator of the DI no.1, ON, is 0 (the LED is out) and will remain 0 also then the main voltage is switched on.

7.4.3. Power up the main system

CAUTION!

! During this stage the motor can run at full speed without prior warning.

The motion shall be as lightly loaded as possible.

Switch on the Main voltage.

Check the phase sequence and voltage level with the ASTAT Tool program or with the display of the DAPC 100 board. Wrong sequence or a missing phase will result in Fault.

Make the ASTAT ON (DI no.1). The display of DAPC 100 shows an error code if there is any Fault.

For software before AST10_04: If no Fault, it will show the CPU-load of the control system in percent for Pulse Encoder / Tachometer speed feedback or the Rotor frequency in Hertz for Rotor frequency feedback. In case there is an error code, remove the source and make a Fault Reset (DI No. 2) or OFF + Fault Reset (DI No. 1).

For software including AST10_04 and later. If no Fault, it shows program version and revision letter, "40" for AST10_04 without revision. "41" is reserved for "A" first revision of AST10_04 etc.

At this stage it shall be possible to drive the motion. Move it gently in both directions to check that it is following the commands. The crane shall not be loaded. Direction A must be upwards for a hoist.

- 1) If the motion runs away in the correct direction: Check connection of the Rotor feedback Module or polarity of pulse-encoder / tachometer.
- 2) If the motion runs away in the wrong direction: Check (change) the main circuit connection sequences from ASTAT to motor.
- 3) If the motion can be controlled, but moves in the wrong direction: Check the phase / polarity of pulse-encoder / tachometer. Check (change) the main circuit connections sequence from ASTAT to motor. Check the direction commands A and B as well as polarity of analog signal from master switch.
- 4) If the motion does not move at all, there can be various explanations:
 - Function of the brake
 - Any DI has been changed

Give full reference. Check for both directions that the speed is approximately the rated of the motor, and that there is full main voltage out to the motor from the ASTAT.

At this stage the motion is basically controlled. Follow the procedure below to verify all included functions.

7.4.3.1. Brake function

Check the function of the brake as set up in parameter group 06.

Check the Fault handling system with respect to Brake supervision.

Check the lifting of the brake. Adjust Slow opening brake compensation (Group 8) and Tacho / Encoder supervision (Group 10).

7.4.3.2. Limit switches

Move the machinery to a position that is between Pre limit switches A and B.

If the design is made with parameter 05.04, L_SW_TYP = 2, read first the description in section Functions

If the design is made with parameter 05.04, L_SW_TYP = 1, move machinery in direction A to first be limited in speed with Pre limit Dir. A and finally stopped with Stop Dir. A.

Move back in direction B until the machinery first be limited in speed with Pre limit Dir. B and finally stopped with Stop Dir. B.

Move back to the in between zone there you started.

Test impossible combinations of limit switches to provoke Limit switch Fault.

7.4.3.3. Overspeed supervision

7.4.3.3.1. Absolute value trip

This is only applicable for Hoist motions or similar motions with a pulling load.

Check the Fault handling system with respect to Speed supervision.

Testing of speed deviation should be done after regulator tuning. Parameter 07.01 can be temporary set to 10, 20 or 30 and parameter 10.30 set to 0.

Pre testing

For setting **10.01, OSP_TYPE = 1** move the machinery and simulate first an overspeed by opening the digital input.

For setting **10.01, OSP_TYPE = 2** change temporary parameter **10.02** to half its value, and then move the machinery to simulate an overspeed. Restore 10.02.

For setting **10.01, OSP_TYPE = 3** no pre testing is needed.

Full testing

Discuss with the customer if full testing is required, as the ASTAT will stop the motion by other means before reaching overspeed, so full testing of the Speed supervision requires manipulation of the safety system.

7.4.3.3.2. Reference tracking trip

The Reference tracking system introduced in 10_05 will detect overspeed earlier than a fixed setting centrifugal switch or similar, and can stop the system with either working brakes or emergency brakes in coordination with the working brakes in case the reason is an electrical failure to avoid the heavy stress from the emergency brakes.

Identity	English text	Description
1030	USE_OSPT	The system is developed to early detect any electrical fault that will lead to dangerous situations, but can be stopped with only the high speed brakes. The system is most used in large hoist mechanisms. ASTAT can not be reset without control voltage off, like an overspeed trip. 0: Reference tracking system off 1: Reference tracking system on. Emergency stop of the crane will come directly, as DO 8 opens. 2: Reference tracking system on. Emergency braking will not occur, as DO 8 remains closed. Use for installations with emergency brakes.
1031	TRK_DIFF	For a hoist, except in the conditions given by 10.32 and 10.33 it is not allowed that the actual speed measurement gives a value 10.31 or more less than the reference with tendency to fall down.
1032	TRK_OCTL	For a hoist, except in the condition given by 10.33 it is not allowed that the actual speed measurement in Open control mode gives a value 10.32 or less with tendency falling down.
1033	TRK_BRCH	For a hoist it is not allowed that the actual speed measurement in Bridge changing state gives a value 10.33 or more less than the reference with tendency falling down.
1034	TRK_TIME	For a hoist it is considered that the Open control or bridge changing mode is preventing optimal control for the time 10.34 after the Open Control was finished, or the new bridge started.
1035	TRKDELAY	Although there are conditions to set the fault signal OSPTRACK (21.91), there is a delay time 10.35 before the fault is issued.

7.4.3.4. Selectable DO

Check the function of the device as set up in parameter group 13.

7.4.4. Tuning of parameters

Unless the motion properties need tuning by using the special functions, it can be completely adjusted by the parameters that are listed below, i. e. the Start Up view of parameters.

The Monitor Tool of the CMT is very important for Tuning. A recommended multipurpose setting of Signals can be:

1)	07.51	{Actual speed, filtered}	NACTMV	-125% .. +125%	(Green)
2)	08.51	{Speed reference}	N_REF	-125% .. +125%	(Blue)
3)	11.53	{Actual current}	IS_ACT	0% .. 400%	(Red)
4)	05.67	{Rotor cont. K1}	RCON_K1	Boolean	(Brown)
5)	05.68	{Rotor cont. K2}	RCON_K2	Boolean	(Black)
6)	05.70	{Brake lifter}	BR_LIFT	Boolean	(Grey)

Note that you can save and recall this setting! You can keep three different settings in your computer.

In which order to change:

Always at the final installation site, parameter 02.10 must be 0

Identity	English text	Description
0210	FACT_RUN	Run crane factory test program. No interlocking, works in soft starter mode. Must be set to 0 at delivery from the crane factory. This is a subject of safety.

Ramp times for acceleration and deceleration are sometimes changed. Times can be shorter with ASTAT than most other controllers: **08.02** and **08.03**

Identity	English text	Description
0802	ACC_TIME	Set time in ms. Typical value for a Hoist: 1250 - 2500 ms Typical value for a Travel: 2500 - 6000 ms 0 will give acceleration on Torque limit. This parameter has no influence for Acceleration control travel motions.
0803	RET_TIME	Set time in ms. Typical value for a Hoist: 1000 - 2000 ms Typical value for a Travel: 2000 - 5000 ms 0 will give acceleration on Torque limit.

Dynamics of the crane

Study the crane and set a suitable value for its dynamic properties.

This parameter 11.10 rescales the motion control system to handle different dynamic properties. The dynamics are limited both by the mechanism itself and the type of feedback. By experience has follow setting been found very successful:

- Good mechanics + tachometer. Set **11.10** = 1,00
- Average mechanics + tachometer or good mechanics + rotor feedback. Set **11.10** = 1,15
- Average/bad mechanics + rotor feedback or Bad mechanics + tachometer. Set **11.10** = 1,30

Identity	English text	Description
1110	ISCALVAL	Controls the systems dynamics. Typical setting in some situations: Good mechanics+tachometer allows 1,00. <i>Values < 1,00 are sometimes used.</i> Average mechanics+tachometer or good mechanics+rotor feedback allows 1,15 Average/bad mechanics+rotor feedback or Bad mechanics+tachometer allows 1,30

All other settings important for the dynamics are found in **Drive optimisation** below.

Speed regulator: Use the monitor function of the ASTAT Tool. Study signals 7.51 and 8.51:

Be prepared to increase 10.15 to a higher value during the tuning of the speed control.

Integration part of speed regulator. 09.02, N_KI. Final testing for motions with Super synchronous lowering shall be with full load.

First start with Normal values for 09.35, .40. 16, .17. 18 and 19.

Tune 09.02 and 09.03 to get acceptable values. For higher ambition, make iterations with 09.35↔09.02 and 09.40↔09.03 to differentiate as much as possible for speed change and steady state and highest possible gain in both situations.

At the end, see if there can be any improvements by changing one by one 09.16 .. 09.19.

If needed, in most situations with cranes with high dynamics there can be almost total overlap of reference and actual value.

Identity	English text	Description
0935	KI_RD_SS	For most motions the behaviour of the drive is better if the Integral gain is higher during speed changing than in steady state. By setting this parameter larger than 0 the Integral gain will be reduced during steady speed compared to during change. Leave as default = 50% for regular applications.
0940	KP_RD_SS	For most motions the behaviour of the drive is better if the Proportional gain is higher during speed changing than in steady state. By setting this parameter larger than 0 the gain will be reduced during steady speed compared to during change. Leave as default = 25% for regular applications.
0902	N_KI	Integration part of speed regulator. Higher value gives more integration. Adjustment for hoists is mostly to a higher value. Note the option to have higher gain during non-stationary speed, parameter 09.35 . Start with 0,050 for a hoist, 0,020 for Travel. For a hoist with super-synchronous lowering, test with full load, so the I-part is not too small. Many Travels can be tuned to a good result with I-part = 0,000. For travels the value can mostly be 0,000. Bad or complicated mechanical drive gear requires a lower value for travel motions. With 09.26 = 1 the Integral part can be set higher, servo properties are improved, without getting any over-/undershooting. For Torque control, set 0,000.
0903	N_KP	Proportional part of speed regulator. Higher entered parameter value gives higher gain. Adjustment is mostly to a higher value. Note the option to have higher P-gain during non-stationary speed, parameter 09.40 . Always set 1,000 for Torque Control.
0946	KP_ADD00	Increased action of the Speed controller Proportional part at 0% speed. The value entered is relative to 09.03 .
0916	KP_ADD10	Increased action of the Speed controller Proportional part at 10% speed. The value entered is relative to 09.03 .
0917	KP_ADD25	Increased action of the Speed controller Proportional part at 25% speed reference. The value entered is relative to 09.03 .
0918	KP_ADD50	Increased action of the Speed controller Proportional part at 50% speed reference. The value entered is relative to 09.03 .
0919	KP_ADD99	Increased action of the Speed controller Proportional part at full speed reference. The value entered is relative to 09.03 .

A motor with rotor **frequency control makes jerk at start**

The motor needs more magnetisation time before it gives any rotor feedback.

Increase 17.27 first to 1000 to look for improvement, and after that reduce as much as possible.

Identity	English text	Description
1727	MAGN_DEL	For some (small) motors it is needed to let the motor build up the rotor voltage before it is acceptable for rotor frequency feedback. The need of a time longer than 0 is noted by a false interpretation of low speed as zero speed, and the motion can make a single jerk before it gets stable control mode. 0 ... 1 second. Normal 0 s = 0 ms. Set time in ms. If needed, a value around 500 ms can be tested.

Slow lifting brake Use the monitor function of the ASTAT Tool. Study signals 7.51, 8.51, 11.53 and 05.70:

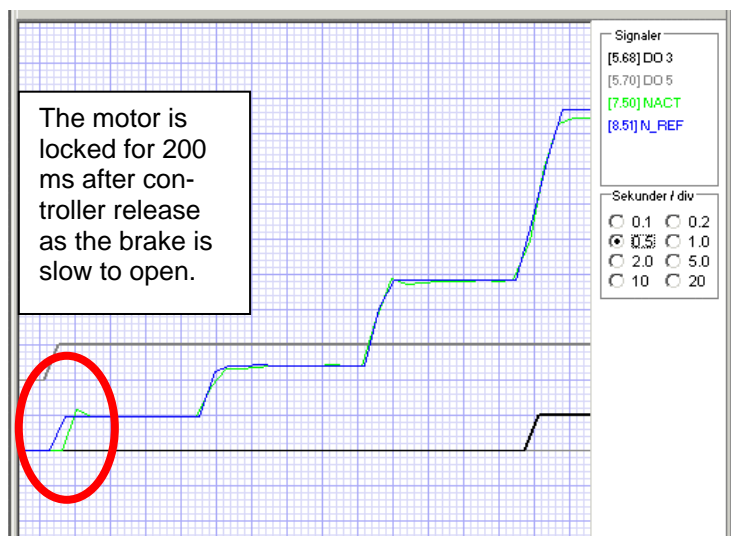
It is possible to hold the speed reference at zero at start before the brake has opened. With time, or time interrupted by limit switch "open". This function prevents competition between the motor and the brake as well as it reduces current/torque peaks.

A slow brake will cause wear of its own, bad regulation and high current/torque peaks.

An optimal setting is found during Start Up by studying Speed reference, Speed feedback and Actual current at the same time with the monitor Tool.

The Compensation for slow brake opening shall be considered and adjusted prior to increasing the monitor time for tachometer / encoder failure, parameter **10.15**. If no influence is noted, check if the designer has forgotten to activate the function with parameter **08.21**.

Identity	English text	Description
0824	DELA_TIM	Time corresponding to opening time of the brake, when the speed reference is kept at zero. See parameter 0821.



Speed supervision Use the monitor function of the ASTAT Tool. Study signals 7.51, and 8.51:

First restore **10.15** to the normal value 500 ms and see it is never tripping.

After that, see with load in the mechanism that no Fault 65 is coming when **10.19** is set to the normal value 1000 ms. If it trips in any situation, first reconsider the time.

Identity	English text	Description
1015	FEEDB_T	Time that no feedback at all is accepted.
1019	SP_DEV_T	Time that a speed deviation of 10.11 % of speed reference is accepted. Can be carefully increased if Speed deviation Fault is generated although the drive system is without any error

Mechanical brake Use the monitor function of the ASTAT Tool. Study signals 7.51, 8.51 and 05.70 :

The normal values of these parameters are such as they can be left without any modification for a mechanically good crane with well-tuned speed regulation.

Identity	English text	Description
0601	ZER_SPPC	Speed at which the mechanical brakes is applied. As a percentage of the synchronous speed 0 ..10%. Normal 2%.
0603	BRA_EL_T	Time, corresponding to at least normal closing time for the brake, during which the motor will be held with electrical torque after order to close brake. 0,1 .. 1,0 seconds. Normal is 0,1 seconds = 100 ms. Set time in ms. This time is ignored by travels.

What to do for a slow acting mechanical brake? Increase 06.01. Even 06.03 can need an increase. **Report the slow brake to the responsible person in charge as it might be a safety risk. Even if the load is well controlled in ASTAT duty, it can be a safety risk in case of emergency stop.**

Trying to get the best out of a travel motion with acceleration control:

IDENT	Text	Description
0701		Start with 10, 20 or 30 and tune the speed control, especially for retardation and low speed travel after hitting slow down limit switch. Switch to 14, 24 or 34 to continue with the acceleration control tuning.
0803		Retardation time (from full speed) that the travel motion will use when the master switch is moved to the neutral position, or when a limit switch is hit.
1015		The time as coasting with master switch in neutral is allowed without violating "Hold to run".
1101		Set as large as possible without getting mechanical stresses in the crane or parts of it when the master switch is moved from one extreme to the other.
0804		Subjectively perceived good acceleration for Step 1.
0805		Subjectively perceived good acceleration for Step 2.
0806		Subjectively perceived good acceleration for Step 3.

Trying to get the best out of a travel motion with speed control:

The control properties can in some situations be better if a low pass filter is inserted in the speed feedback. It might help for some travel motions. We can just recommend connecting the filter by setting 07.19 to 1, and studying the properties. If the control is good without this filter, there is no meaning to test it.

Test if the driver's comfort is better with the increased reverse current braking action connected. Watch out for Faults 65 and 71 if the motion is unable to follow the resulting reduced deceleration ramp.

Identity	English text	Description
0719	USE_FACT	A switch to connect the filter time of 07.20 also for the closed loop control, typically in case of non-performing mechanical drives system.
0720	NACTTC	Filter time for speed feedback for presentation. Also connected in the closed control loop if parameter 07.19 is set to 1.
0827	REV_RAMP	Used in manual operation of travel motions: If the driver pulls the lever to the opposite side than the actual motion, the retardation ramp time is reduced by the percentage value given by parameter 08.27

Trying to get the best out of a hoist motion:

When stopping a hoist after hoisting, there is a risk for load setting when stopping. When stopping after lowering, there is no such risk. The solution is a slower ramp for the final part from Step 1 to stop. Parameters **0830** and **0831** take action. Normally the default values, "slower than 6% speed reference" and 2three times longer ramp" can stand without any modification.

Identity	English text	Description
0830	N_APPRCH	When stopping a hoist motion after lifting, but not after lowering, it is detected when the speed reference falls below the level set with 0830 . In this situation the ramp time is made a multiple longer than it is set as with parameter 0803 . As the time for this passage between the change in ramp slope and the setting of the brake is short, the increased stopping distance is possible to neglect. Undershooting and stresses in the brake disc/drum are reduced by this function.
0831	RATE_APR	The rate of which the deceleration ramp slope is increased at zero-speed approach.

Drive optimisation:

Drive optimisation is normally only done for larger drives. Motors with shaft height from 400 mm and larger together with the mechanical drive train should be treated with respect, and the experienced site engineer has to find out the best settings for smooth electrical and mechanical performance. The mentioned could also be valid for smaller motors.

Modify the current gain **11.03**, normal value = 10,000, by making it double, half etc. to find a better operation point. If it is found that it is stable for lower gain, but not for higher, lower the gain as much as possible without getting a slower response on speed change. In this situation you should once more try to increase the speed regulator gain; note that this might be an iterative process.

Identity	English text	Description
1103	US_K11	Gain of current regulator. The current regulator is working with only integral gain. The value can be modified after careful testing. Travel motions can be better with reduced value of this parameter and higher speed regulator gain.

Check the scaling of the current feedback if not already done.

Identity	English text	Description
1110	ISCALVAL	Controls the systems dynamics. Typical setting in some situations: Good mechanics+tachometer allows 1,00. <i>Values < 1,00 are sometimes used.</i> Average mechanics+tachometer or good mechanics+rotor feedback allows 1,15 Average/bad mechanics+rotor feedback or Bad mechanics+tachometer allows 1,30

7.4.5. Special functions to set at start up

Opening the Special Parameter View Special all parameters of Design, Start Up and Special Views become visible.

A special selection of the Special functions parameters that must be set during start up, i. e. not possible to fix during design phase is presented below (this selection is not possible to get from the PC Tool).

Most times the Special functions parameters are not touched at all during the start up.

7.4.5.1. Brake manipulation

Identity	English text	Description
0606	BRA_DELA	Time for which the setting of the brake is delayed. The motion is electrically soft braked to eliminate sway. Set time in ms. This time is ignored by hoists.
1128	RED_INPC	Current limit for elimination of sway of travel motions by electrical braking with this current during the time defined by parameter 06.06. Normal value 100% current limit gives about 30% braking torque around zero-s speed.
0608	BR_REF_T	Time lag for the safety setting of brake based on the speed reference independent of the actual speed measurement. Set time in ms.

7.4.5.2. Speed control functions

Identity	English text	Description
0901	DER1_N	Derivation part of speed regulator. Higher entered parameter value gives more feed forward based on derivation of speed reference. Normally never changed from 0.
0909	SUP_SPPC	Value in percent of the motors synchronous speed for switching to super-synchronous braking. Normally not changed.
0933	REV_CUFA	During super synchronous lowering the lowering current is memorised. At notching back the rotor contactors are opened, and during the time set with 09.34 a current 09.33 times the memorised current is injected in braking direction. After this time, it is back to normal speed control In AST10_04, it is possible to modify the performance of the function; most modifications are made to reduce the fast notch back and allow a <u>small</u> load droop! This parameter is active only when speed feedback is made with rotor voltage frequency. For a time, defined as 09.34 ms, after exit from super-synchronous lowering, the current will be forced to 09.33 % of the historical current that was measured for the super-synchronous lowering phase.
0934	CURRTIME	This time starts when Super Synchronous lowering ends. If there is rotor freq. feedback, during this time 09.34 the speed control is replaced by plug braking with parameter 09.33 x the lowering current in Super Synchronous mode.

7.4.5.3. ...

7.4.5.4. Rotor resistor control

Normally the rotor resistor parameters are not touched at start up. If any of them must be adjusted, it can be a sign of that the design is made more critical than needed.

Identity	English text	Description
1208	HI_RES_A	12.08 = 1: Resistor step 4 is used in the hoisting at Step 1 after four seconds of no speed change. Typically used for tilting of ladles in the hot metal industry. Only used for cranes with step master switch, not for analog reference.
1217	SSTDIFK2	K2 is switching at the value set with 12.20, but the reference value before the ramp unit must have the value of 12.17 higher than 12.20. With normal value settings K2 will only pull in with the master switch in full speed position.
1218	SSTDIFK3	K3 is switching at the value set with 12.21, but the reference value before the ramp unit must have the value of 12.18 higher than 12.20. With normal value settings K3 will only pull in with the master switch in full speed position.
1219	SW_K1	If there is enough torque, the full resistor can be used for low speed hoisting. The switch point of K1 is set with parameter 12.19
1220	SW_K2	K2 is switching at the value set with 12.20, but the reference value before the ramp unit must have the value of 12.17 higher than 12.20. With normal value settings K2 will only pull in with the master switch in full speed position.
1221	SW_K3	K3 is switching at the value set with 12.21, but the reference value before the ramp unit must have the value of 12.18 higher than 12.21. With normal value settings K3 will only pull in with the master switch in full speed position.
1222	HIST_K2	Hysteresis for contactor K2. Pulls in at speed set by parameters 12.20 and 12.17, drops at a slower speed. The difference is defined by 12.22.
1223	HIST_K3	Hysteresis for contactor K3. Pulls in at speed set by parameters 12.21 and 12.18, drops at a slower speed. The difference is defined by 12.23.
1224	USE_K0	If 0, Rotor contactor K0 will never pull-in
1225	USE_K1	If 0, Rotor contactor K1 will never pull-in
1226	USE_K2	If 0, Rotor contactor K2 will never pull-in
1227	USE_K3	If 0, Rotor contactor K3 will never pull-in
1139	CON_OP_T	If a slow breaking rotor contactor is used, ASTAT can perform the breaking with no current. The consideration of a slow contactor will give a longer time to change torque direction.
1229	CON_CL_T	If a slow making rotor contactor is used, ASTAT will delay the making of "redundant" contactors for Open control and Super-synchronous lowering in order to reduce to inrush current and voltage dip of the control voltage system.
1144	IS_ZER_T	Expected time in ms to reach current zero after giving zero current reference. Used for implementation of solid state contactor opening.

7.4.5.5. Load functions

The procedure is:

Before going to the crane find out settings for parameters of Group 14, 15 and 09.31, 09.32. Get acceptance for the settings from the crane's responsible engineer.

At the crane, check wiring, make sure that test weight are available.

Set parameters in the order they are listed in section **4.14.2** of this Manual, not 14.01, 14.02, 14.03 etc. Save the parameters to safe back up.

Test all functions.

7.4.5.6. ...

7.4.5.7. Master-Follower control

Identity	English text	Description
2001	MF_TYPE	Definition of the role of the ASTAT in a Master-Follower connection. 0: No Master-Follower connection 1: Master in Master-Follower connection 2: Follower in Master-Follower connection
2002	MF_SCAL	The part, in percent, of the position difference between the two motions of the Master-Follower that the Follower will compensate as: Follower Speed Reference = Master Speed reference * (1+((MF_SCAL /100)*Difference¹⁵))
2003	TQ_RATIO	Part in % ¹⁶ of one of the two identical motors rated torque that shall be the difference in torque in torque follower mode. With positive sign the Follower is weaker
2005	MF_RAMP	The correction signal can be applied more softly by using a ramp function from actual to requested value. In most cases this ramp is not used, and by setting MF_RAMP to 0, there is no influence of the ramp. A value less than values of parameters 08.02 and 08.03 can give better performance when switching between sub modes MF1 - MF4

¹⁵ With Difference it shall be understood:

Sub mode MF1, Electrical shaft:

Position difference

Sub mode MF2, Individual speed reference:

Follower is not controlled by any difference, so this parameter is not active

Sub mode MF3, Torque control:

Desired difference in torque

Sub mode MF4, Uniform speed:

Speed difference

¹⁶ Only meaning for Sub mode MF3, Torque control

7.4.6. Functions to prove

A few functions can be proved after tuning is ready. In most installations these functions are not used.

7.4.6.1. Slack rope function

Moved to Load functions.

7.4.6.2. Check of second speed feedback device

If the speed feedback is made by redundant system (i. e. parameter **07.01, SPEED_FB**, has the value 21, 31 or 32) check the function of the back up device:

- Set the back up device as the normal feedback by temporarily changing SPEED_FB.
- After restoring SPEED_FB, disconnect the normal feedback device when operating the machine, to see that it stops.
- Check the Fault handling system with respect to Second feedback device.

Type of feedback. 07.01, SPEED_FB

10/13: Rotor voltage frequency.

20/23: Analogue tachometer.

21: Feedback Analogue tachometer and compared with the Rotor voltage.

30: Pulse transmitter.

31: Feedback Pulse transmitter and compared with the Rotor voltage.

32: Feedback Pulse transmitter and compared with an analogue tachometer.

7.4.6.3. Check of second operator station

Check the switch over function and the operation from the second operator station.

7.4.6.4. Check of different parameter set

Check the switch over function and specially the functions of parameters that have been given a different value in the second parameter set.

7.4.6.5. Check of fault handling system

Check the installed functions of the Fault handling system. Check that the Cabin I/O display is lit up correctly.

7.4.6.6. Shared motion

Keep the second motions main circuit isolated.

Check the switch over logic.

Make a complete start up sequence for the second drive in shared motion as already done with the first drive.

7.5. Final procedures

Save the AST-file in your PC.

Save a N-REF, N-ACT diagram as ASG-file for light load and full load.

Check that the drive equipment can be run in the intended way.

Tighten all terminal and bus bar connections.

Check that all components are fixed properly.

Restore the covers.

Run all motion once more from all operator stations.

8. Maintenance of ASTAT

8.1. Personal safety

CAUTION!

- ! Follow all applicable rules regarding personal safety.
- ! All people concerned must know how to disconnect mains and auxiliary voltage.
- ! Do not perform any kind of work on the controller if there is any risk of touching live parts.
- ! Control System Modules DARA ... are connected to maximally 250 V AC. Disconnect at its source voltage prior to perform any maintenance work of the DARA module.
- ! Thyristor Modules DASD are connected to maximally 600 V AC. Disconnect all three phases at its source voltage prior to perform any maintenance work of the DASD module. The fans of the DASD modules are supplied from the DARA module. Also disconnect the fan supply voltage at its source prior to any maintenance work of the DASD module.

8.2. General

The controller contains no parts subject to mechanical wear except some pilot relays and, for some current ratings, one or two fans. In addition to the checkpoints below the controller requires only general upkeep to ensure reliable operation. This type of maintenance is common to all industrial electrical equipment and can therefore be included in general maintenance routines.

The controller should be inspected at regular intervals, determined by the nature of the operation and environmental factors (vibrations, humidity, dust etc.).

8.3. Cleaning

Use a vacuum cleaner.

Be careful to avoid mechanical damage of circuit board components.

An inspection should be made after this cleaning to detect mechanical damage, overheated components etc.

8.4. Plug-in components

Check that the connectors of the circuit boards and power pack are firmly in place.

8.5. Terminal connections

Tighten the main terminals L1 ... T3 and PE-connection.

Tighten the main fuses of DASD 106, 107, 108, 126, 127, 116 and 117.

8.6. Screwed joints

Check that the different units in the controller are screwed firmly in place and that there are no loose screws or nuts.

Check that no cables or leads wear against sharp edges.

8.7. Cooling air fan

Check that the fan(s) rotates freely and that there is no abnormal sound.

Check that the electrical connections are firmly in place.

9. Fault tracing

9.1. Basics

9.1.1. Personal safety

CAUTION!

- ! Follow all applicable rules regarding personal safety.
- ! All people concerned must know how to disconnect mains and auxiliary voltage.
- ! Do not perform any kind of work on the controller if there is any risk of touching live parts.
- ! Control System Modules DARA are connected to maximally 250 V AC.
- ! Thyristor Modules DASD are connected to maximally 690 V AC. The fans of the DASD modules are supplied from the DARA module.

9.1.2. Introduction

The controller has a simple and functional design with few components and component units. All components and units are of high quality, and will of that reason be subjected to fewer faults than normal industrial electronic equipment.

The basis for the Fault tracing are the LEDs of the Cabin I/O unit DAPM 100, 101, which explicitly shows the most frequent faults and give reference to when it is needed to check the ASTAT controller in the electrical room. If there is no Cabin I/O unit DAPM 100, 101 installed, it is needed to check the two-digit display of the DARA 100x Control System Module to view any Fault code.

Except the power units with thyristors the components are the same throughout the range.

9.1.3. Component fault

First, it is more frequent that a fault has external sources than internally in the ASTAT controller.

The components are listed below in order of estimated fault frequency internally:

- Mechanical components
- Connectors and cables
- Circuit boards
- Power pack
- Fans
- Fuses
- Thyristors

The above can serve as a first guide for those tracing faults in the controller.

9.1.4. Working with voltage

When tracing faults, it may be necessary to work with the voltage switched on.

Follow all applicable rules regarding personal safety.

9.1.5. Equipment and tools

Beside the circuit diagram set and the parameter list for the ASTAT following equipment and tools are recommended.

<ul style="list-style-type: none"> • Digital Multimeter, ranges: Voltage: 0-1000 V DC and AC, Resistance 0,1 Ohm resolution or better • Set of screwdrivers. Including Torx. • Set of spanners of metric type. • Pair of side cutters • Pairs of tongs to move jumpers • Cable tie spanner • Draw out tool for Phoenix circuit board separators
--

In case it is needed to replace the board DAPC 100, the same installed program version and the parameter set that is stored in the DAPC 100 to replace must be entered in the new board:

<ul style="list-style-type: none"> • Laptop PC with (normal) COM 1 port, or USB-port with USB/Serial-converter • PC-Tool for ASTAT Crane Motion Controller and cable.

In case it is needed to replace thyristors in Thyristor modules with puck thyristors the gate leads are soldered to the thyristors. The reason for this is a pay-off between risk for the leads to come out in case of heavy vibrations and the risk for a thyristor failure of other reasons.

<ul style="list-style-type: none"> • Soldering iron • Soldering tin for installation of new thyristor.
--

Follow the instructions of the Tool to make this procedure.

9.2. Standard fault tracing scheme

Following the scheme below can identify most malfunctions in the equipment. The scheme should be followed step by step in the following order:

Error code	Note the LED annunciation and if needed the Error Code of DAPC 100. ASTAT will automatically try to reset all faults and restart the motion at main voltage power up, so to find error codes there are the following ways: 1) The display of the DARA is viewed before restart. 2) The PC Tool is used. 3) The error remains at power on.
Symptoms	Note the driver's observations in connection with the malfunction.
Electric power [^]	Check the electrical power supply to the controller (mains and auxiliary) and the cable connections between the ASTAT controller, the motor and the resistor. Check main fuses (DASD 106, 107, 108, 126, 127,116, 117) and measuring fuses (all DASD).
Internal voltages	Check 24 V DC and 110 V DC. Look for instructions below.
External control [^]	Do the external interlocking to prevent a release of the controller Attempt a manual start of the controller. Execute a manual release and reference generation.
Limit switches [^]	Are the end, slow-down position and brake limit switches in order
Speed reference [^]	Is the speed reference available. Is the external master control equipment serviceable
Speed feedback [^]	Is the speed feedback available and stable ?
Rotor circuit [^]	Status of the slip rings and brushes. Status of the rotor resistors
Excessive heat / dangerous dust	Inspect the controller for overheated components and for excessive dust.

[^] Check for loose connections!

Faulty thyristor	Is a thyristor short-circuited in the reverse or off-state directions Check by measuring the resistance; $< 100 \Omega \cong$ short circuit. Look for instructions below.
Settings on circuit boards	Check the settings of the circuit boards in relation to the updated circuit diagrams.

9.2.1. Process indication codes

The following codes are used to indicate errors detected internally or externally by the Control System Module.

For software including AST10_04 and later: If no Fault, it shows program version and revision letter, "40" for AST10_04 without revision.

In case there is an error, the display will toggle "F1" and the error code. Example: PHASE SEQUENCE WRONG will display F1-01-F1-01-F1-01.....

Generally: Load related signals would disappear when the master switch is returned to the neutral position. All other indications will remain until pushbutton "RESET" is pressed or Crane is turned ON. For most faults RESET will be disabled until crane is turned OFF. All non-persistent fault will disappear at the same time when pressing.

From release 10_054 the code will stay until reset is activated, although the motion is ready to run after a motion OFF -> ON sequence.

All start of motion, Fault or not fault, must be initialised by "ZERO POS-signal"

no.	Name	Action	How to Reset?
01	PHASE SEQUENCE WRONG or FREQUENCY OUT OF RANGE	Motion stopped	OFF
02	PHASE L1 MISSING	Motion stopped	OFF
03	PHASE L2 MISSING	Motion stopped	OFF
04	PHASE L3 MISSING	Motion stopped	OFF
05	LINE VOLTAGE L1 < Set level	Motion stopped	OFF
06	LINE VOLTAGE L2 < Set level	Motion stopped	OFF
07	LINE VOLTAGE L3 < Set level	Motion stopped	OFF
31	DAPC 100 ERROR	Motion stopped	OFF
32	DATX 110 NOT FOUND	Motion stopped	OFF
33	DATX 120:1 NOT FOUND	Motion stopped	OFF
34	DATX 120:2 NOT FOUND	Motion stopped	OFF
35	DATX 120:3 NOT FOUND	Motion stopped	OFF
36	MASTER-FOLLOWER ERROR	Motion stopped	OFF
37	DATX 130 NOT FOUND	Motion stopped	OFF
43	110 V DC TOO LOW	Motion stopped	OFF
44	110 V DC EARTH FAULT	None	OFF OR RESET
45	Not possible combination of direction and zero position signals from master switch	Motion stopped	OFF
46	UNBALANCE; PARALLEL BRIDGES	Motion stopped	OFF
47	ERROR IN THYRISTOR TEMPERATURE MEASUREMENT	None	OFF OR RESET
48	CRANE UNCONTROLLED STOPPED	Motion stopped (by itself)	CONTROL VOLT. OFF
49	4 - 20 mA load cell signal broken	None	OFF OR RESET
50	Mismatch of reference polarity and direction signals of joystick	None	OFF
51	Manual operation: JOYSTICK NOT IN NEUTRAL SWITCHING WHEN SHARED MOTION WAS SELECTED / Computer operation: REMOTE OPERATION ABNORMALLY ENDED. MASTER SWITCH OUT OF ZERO or COMMUNICATION BREAK DOWN	Joystick must back to neutral before the new motion is active / Motion stopped	OFF
52	PTC TRIP no.1	Motion stopped	OFF
53	PTC TRIP no.2	Motion stopped	OFF
54	PTC TRIP no.3	Motion stopped / None	OFF or RESET if the PTC is for Warning
55	PTC TRIP no.4	Motion stopped / None	OFF or RESET if the PTC is for Warning
57	BRAKE NO ACK. no.1	Motion stopped	OFF
58	BRAKE NO ACK. no.2	Motion stopped	OFF
59	BRAKE NO ACK. no.3	Motion stopped	OFF
60	BRAKE NO ACK. no.4	Motion stopped	OFF
61	CABLE RELAY no.1	Motion stopped	OFF
62	CABLE RELAY no.2	Motion stopped	OFF

no.	Name	Action	How to Reset?
63	CABLE RELAY no.3	Motion stopped	OFF
64	CABLE RELAY no.4	Motion stopped	OFF
65	SPEED DEVIATION	Motion stopped	OFF
66	PULSE TRANSMITTER FAULT	Motion stopped	OFF
67	ROTOR FREQ. MEAS FAULT no.1	Motion stopped	OFF
68	ROTOR FREQ. MEAS FAULT no.2	Motion stopped	OFF
69	ROTOR FREQ. MEAS FAULT no.3	Motion stopped	OFF
70	ROTOR FREQ. MEAS FAULT no.4	Motion stopped	OFF
71	TORQUE FAULT	Motion stopped	OFF
72	OVERLOAD, DI	Motion stopped, Direction A (or B) blocked.	Master switch
73	OVERLOAD, AI	Motion stopped, Direction A (or B) blocked.	Master switch
75	OVERSPEED, DI	Motion stopped	CONTROL VOLT. OFF
76	OVERSPEED, CALCULATED	Motion stopped	CONTROL VOLT. OFF
77	OVERTEMP. THYRISTORS	Motion stopped	OFF
78	SLACK ROPE; SLOW DOWN	Stop as PRE LIMIT switch	Master switch
79	SLACK ROPE; STOP	Stop as STOP LIMIT switch	Master switch
80	NOT POSSIBLE LIMIT SWITCH VALUES	Motion stopped	OFF
81	EARTH FAULT ROTOR no.1	Motion stopped	OFF
82	EARTH FAULT ROTOR no.2	Motion stopped	OFF
83	EARTH FAULT ROTOR no.3	Motion stopped	OFF
84	EARTH FAULT ROTOR no.4	Motion stopped	OFF
85	UNSYMMETRICAL ROTOR no.1	Motion stopped	OFF
86	UNSYMMETRICAL ROTOR no.2	Motion stopped	OFF
87	UNSYMMETRICAL ROTOR no.3	Motion stopped	OFF
88	UNSYMMETRICAL ROTOR no.4	Motion stopped	OFF
89	TACHOMETER FAULT	Motion stopped	OFF
90	The brakes could withstand the applied test torque at start	Motion stopped	OFF
91	Hoist speed not able to follow the reference-based tracking. Overspeed risk.	Motion stopped	CONTROL VOLT. OFF

9.3. 24 V DC voltage

Check the MCB -F1 of DASA 110.

If tripped, disconnect the consumers of 24 V DC acc. to the ASTAT circuit diagram at end of this manual, and try to restore the MCB. Measure 24 V DC between (DASA 110)-X2:2 (plus) and :4 (minus). The value must be between 17 V and 33 V.

If this is impossible to restore, the fault might be internal in DASA 110.

Connect the consumers one by one, until the consumer that causes the trip is found, and causes a trip again.

If no consumer causes a new trip, check all consumers for internal faults.

The board DAPC 100 has LED 5 V OK (green).

The board DAPU 100 has LED 5 V OK (green).

The board DATX 110 has LED 5 V OK (green).

The board DATX 130 has a green LED for 15 V OK.

The board DATX 120 has LED 5 V OK (green); this board has mostly a different 24 V DC supply.

24 V DC is directly grounded, and can always be measured to ground.

9.4. 110 V DC voltage

Check the MCB -F2 of DASA 110. Check the LED 110 V OK (green) on DATX 110. In case there is a floating system for 110 V, check the LED Earth fault (red) on DATX 110.

If the MCB is tripped or there is an earth fault, disconnect the consumers of 110 V DC acc. to the ASTAT circuit diagram at end of this manual by opening the yellow separators on DATX 110, and try to restore the MCB. Measure 110 V DC between (DASA 110)-X2:6 (plus) and :7 (minus). The value must be between 55 V and 140 V.

If this is impossible to restore, the fault might be internal in DASA 110.

Connect the consumers one by one, until the consumer that causes the trip is found, and causes a trip again.

110 V DC is directly grounded or floating.

9.5. Circuit boards

If circuit boards must be replaced, the actual settings from the replaced board must be implemented on the replacement boards. When possible, the setting / jumpering is done on the connector rather than on the boards, and in that case no setting / jumpering is needed.

Handle all circuit boards with care mechanically and with respect to static electricity discharge.

Boards with variable software:

DAPC 100¹⁷

Boards with setting / jumpering:

DATX 110

DATX 120

DAPC 100¹⁸

DATD 100¹⁹

Boards without setting / jumpering:

DAPU 100

DATX 100

DATX 130 + DATX 132

Boards with plug in PROM (8 pin DIL):

DATX 130 + DATX 132

Boards that are part of Modules: DADT 100 and DASA 110.

¹⁷ The Tool program, the file with extension AST for the motion, a PC and either a RS 232-cable or a RS 485 network must be

available to replace DAPC 100.

¹⁸ In most cases there will be no changes from the delivered state.

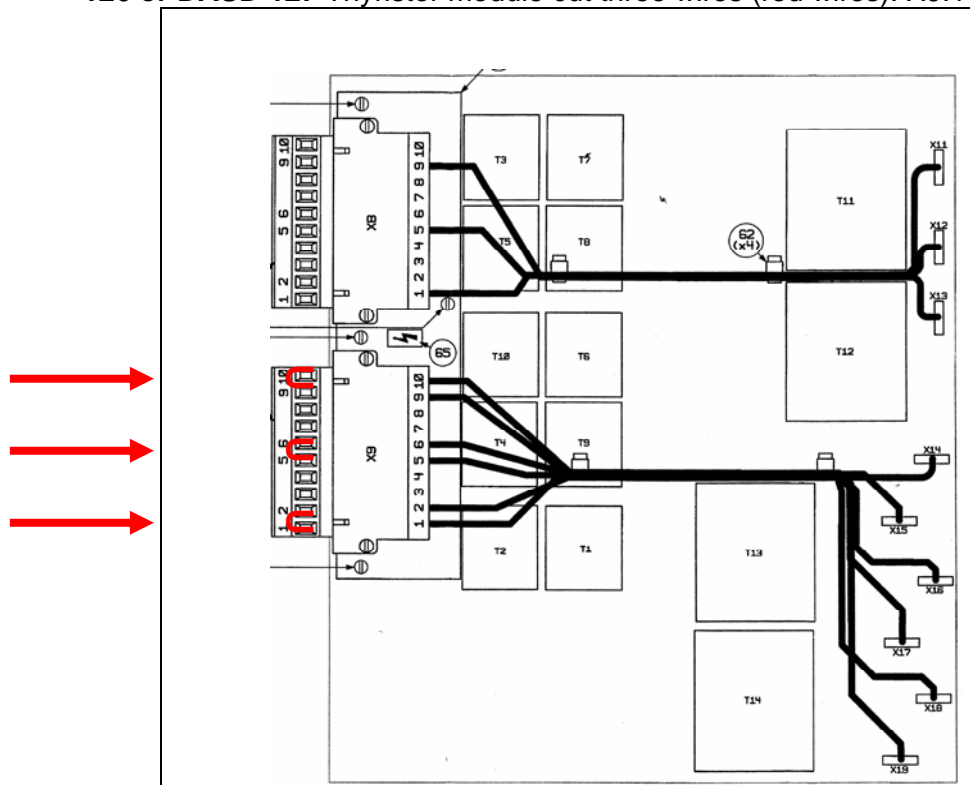
¹⁹ In most cases there will be no changes from the delivered state.

To replace the board DATX 100 do as follows:

- Cut the cable ties holding the heat sink temperature sensors cable.
- Remove the rail that holds the gate cables in place.
- Pull out all plug-in connectors.
- If the board is installed in DASD 106, 107, 126 or 127 study and follow the notes below.
- Loosen, only a few turns, the two screws that hold the board base plate in place.
- Tilt the board base plate with the board to the right and pull it out.
- Replace the board on the board base plate. There are no jumpers on the board; all settings are made in factory on the connectors.
- Restore the board base plate in the opposite order as it was removed.

Special notes for DATX 100 manufactured after week 38 (September), 2005

Before this board is to be installed as replacement in a **DASD 106, DASD 107, DASD 126 or DASD 127** Thyristor module cut three wires (red wires): X9:1-2, X9:5-6, X9:9-10



If this board is installed as replacement in any DASD Thyristor module manufactured before September 2005, it is needed to take out the key guides from positions 3 and 4 of the five contacts -X1, -X2, -X3, -X4 and -X5, before installing the board.

Use the tip of a sharp knife.

9.6. Fans

9.6.1. Modules with two fans

A fan fault can cause an Over temperature in thyristor stack.

For DASD modules with two fans change both fans at one time. Use only the fans listed in the Spare Part list.

Do not cut any leads when replacing a fan, pull out the contacts from the old fan and insert into the new.

Be aware of the air direction, which is directed up.

The fan in DASD 102, 103, 112 and 113 (50 and 100 A) is simply loosened with screws from below and dismantled by gravity.

The fans in DASD 104, 105, 114 and 115 (200 and 355 A) are simply loosened with screws from below and dismantled by gravity.

The fans in older DASD 106, 107, 108, 126 and 127 thyristor modules with puck thyristors (630, 1000 and 1100 A) are screwed to a sheet, which is pulled out after loosening of its fastening screws. Prior to pull out this sheet, loosen the tinned thin copper conductors above the semiconductor fuses.

9.6.2. Modules with one fan

9.6.2.1. DASD 146, 147, 156 and 157

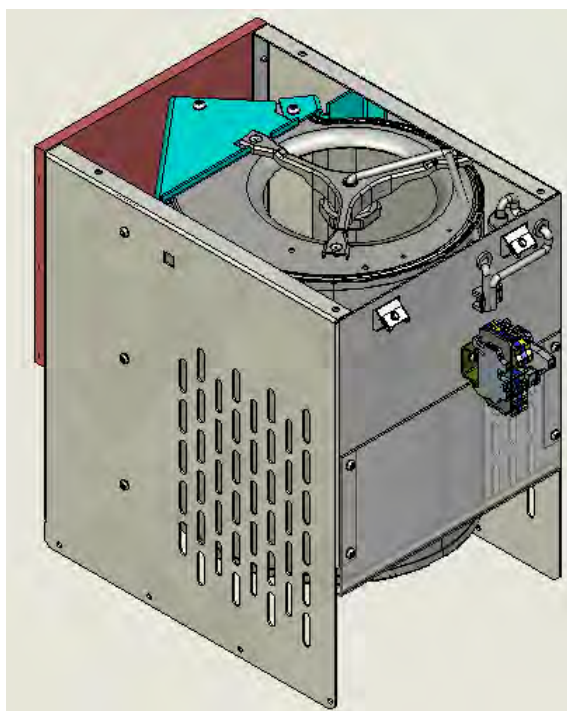
Newer DASD modules with puck thyristors, DASD 146, 147, 156 and 157 has one 230 V AC radial fan with dual side inlet. It has a discrete capacitor.

To replace the fan do as follows:

- 1) Disconnect the main supply and the fan supply to the DASD module, and prevent unexpected reconnection.
- 2) Remove the cover from the DASD module.
- 3) Remove totally 12 pcs. of M8 screws with spring and plain washers so the interconnection bars from fuse-holders to Al-cooling element extension flags are disconnected, although still physically fixed.
- 4) Disconnect the inside Grey-Blue-Green Yellow terminal plug to the fan unit.
- 5) Remove the M6 screws that hold the horizontal metal stabiliser. Remove the stabiliser, together with the interconnection bars from fuse-holders to Al-cooling element extension flags.
- 6) Take out the air supply unit by pulling the fan straight out.
- 7) Trouble shoot the unit. Replace fan or capacitor. When replacing the fan, replace always the capacitor at the same time.
- 8) Test the air supply unit.
- 9) Reinstall the air supply unit by doing the above listed measures in the opposite order.

9.6.2.2. DASD 145

The same fan and capacitor as for DASD 147 and 157 are used. The same spare parts can be used, see Section **Spare Parts List**. It is however relative time consuming to replace the fan, and of that reason a larger assembly, DAFU 145 (code 3ASC25H229) is available as spare. See picture below and spare parts list.



DAFU 145

9.7. Thyristor fault

9.7.1. Fast check

Try to run the motion at low speed in both directions. It might be possible, but with bad control properties. At the same time measure the **DC**-current of the three line phases one by one by means of a tong-type A-meter in DC-mode. In case of thyristor failure there is a significant DC-current in some of the phases.

9.7.2. Investigation after fast checking

Disconnect the main supply, for example by removing the line fuses, and disconnect the motor.

For thyristor faultfinding remove the six voltage measurement fuses and disconnect the gate connectors in the circuit board end. To avoid confusing results, it is also recommended to temporarily disconnect the RC circuit DASG 110 or DASG 111.

Start the trouble shooting with Multimeter in resistance range. This is mostly adequate as the most common thyristor faults result in short circuit or diode action of the devices.

If you cannot find any faulty thyristor but still suspect thyristor fault make the faultfinding with a thyristor tester. Use following voltages for testing depending of the rated voltage of the ASTAT Thyristor Module:

Rated voltage 415 V: Use 1200 V test voltage

Rated voltage 600 V: Use 1600 V test voltage

Rated voltage 690 V: Use 2200 V test voltage

All treatment of thyristors shall be with absolutely cleanliness. If more grease must be added after replacement follow the instructions for the grease used.

Use following tightening torque then restoring screwed / bolted connections without tell tale washers or spring indicators inside the thyristor bridges. The torque are valid both for electrical connections as well mounting of fuses (630 - 1100 A) and thyristor modules (25 - 355 A)²⁰:

Size	Torque [Nm]	Torque [lbf.ft]
M5	6	4,5
M6	6	4,5
M8,	11	8
M8 in new range DASD 145, 146, 147, 156 and 157	20	15
M10	40	30
M12, Fuse	50	38
M12, Except fuse	80	60

²⁰ These torque are only used for repair of ASTAT Thyristor modules, and are not universally valid for the mentioned thread sizes.

9.7.2.1. Size 25 - 100 A and 500 A

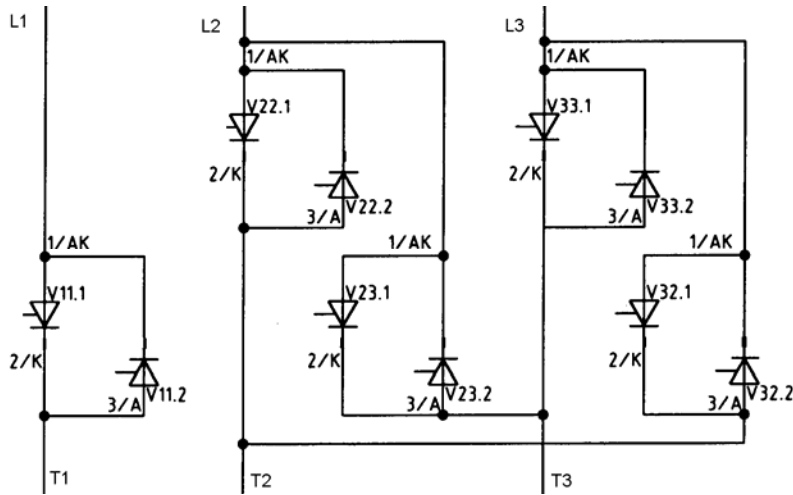


Diagram:

Measurement 1

Measure the resistances between: L1–T1, T1–L1. All values must be $\geq 100 \Omega$.

If there is a fault, the problem is in the lower device.

Normally, this is the only thyristor fault in the DASD ... Module.

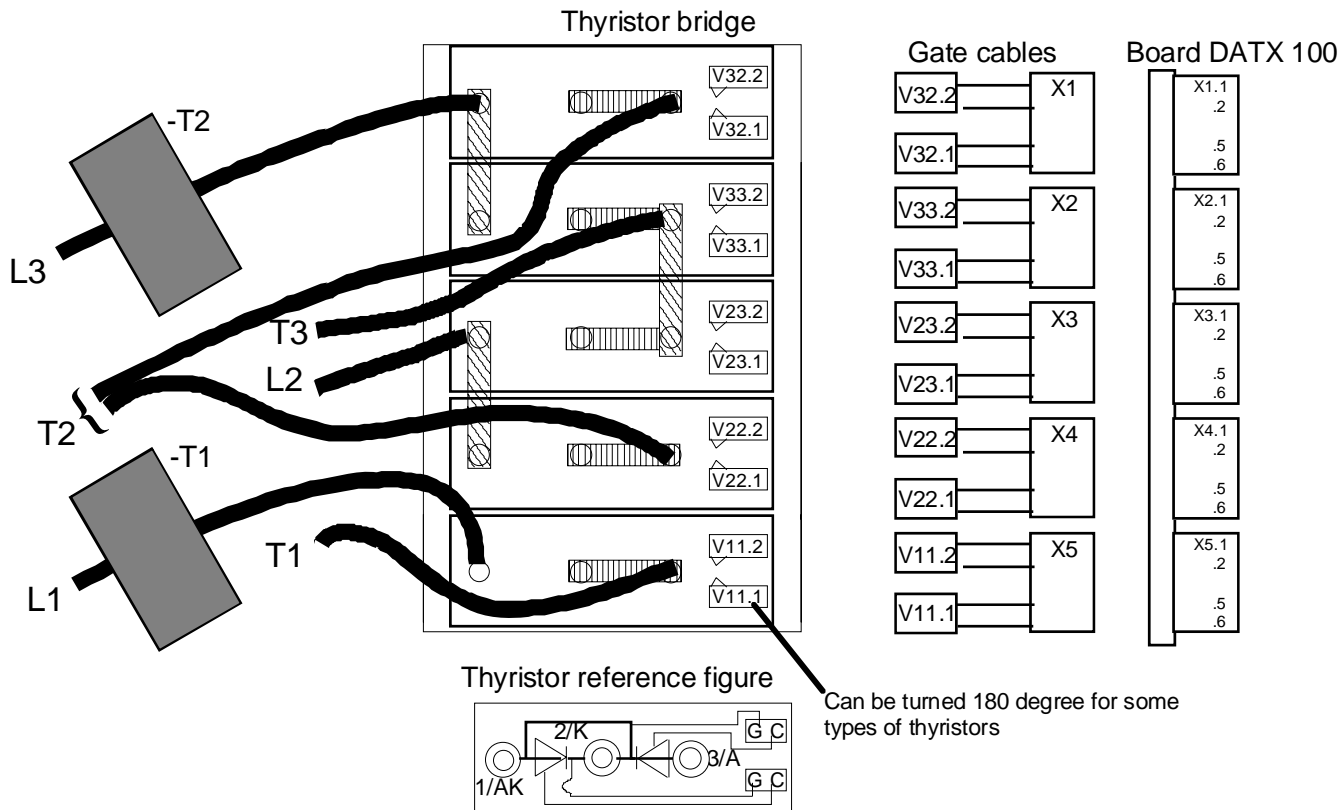
Measurement 2

Loosen the vertical connections and the three copper plates but restore the bolts and washers.

For each of the four upper devices, measure the resistance between: 1/AK and 2/K (which is linked with 3/A)
All values must be $\geq 100 \Omega$.

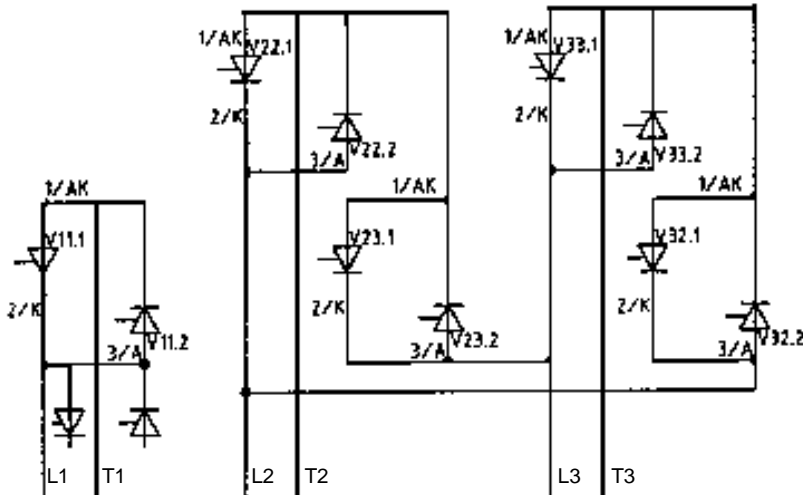
Replace the faulty thyristor.

When loosening bolts and washers we recommend restoring them in the original thread holes at once, as they otherwise can be mixed, and the connections will be erroneous or the devices can be destroyed.



9.7.2.2. Size 200 - 355 A

Diagram:



Measurement 1

Measure the resistances between: L1-T1, T1-L1. All values must be $\geq 100 \Omega$.

If there is a fault, the problem is in one of the two left devices.

Remove the left connection with straight lugs. Check which of the two possible thyristors that is faulty. Replace that thyristor.

Under normal conditions, this is the only thyristor fault in the DASD ... Module.

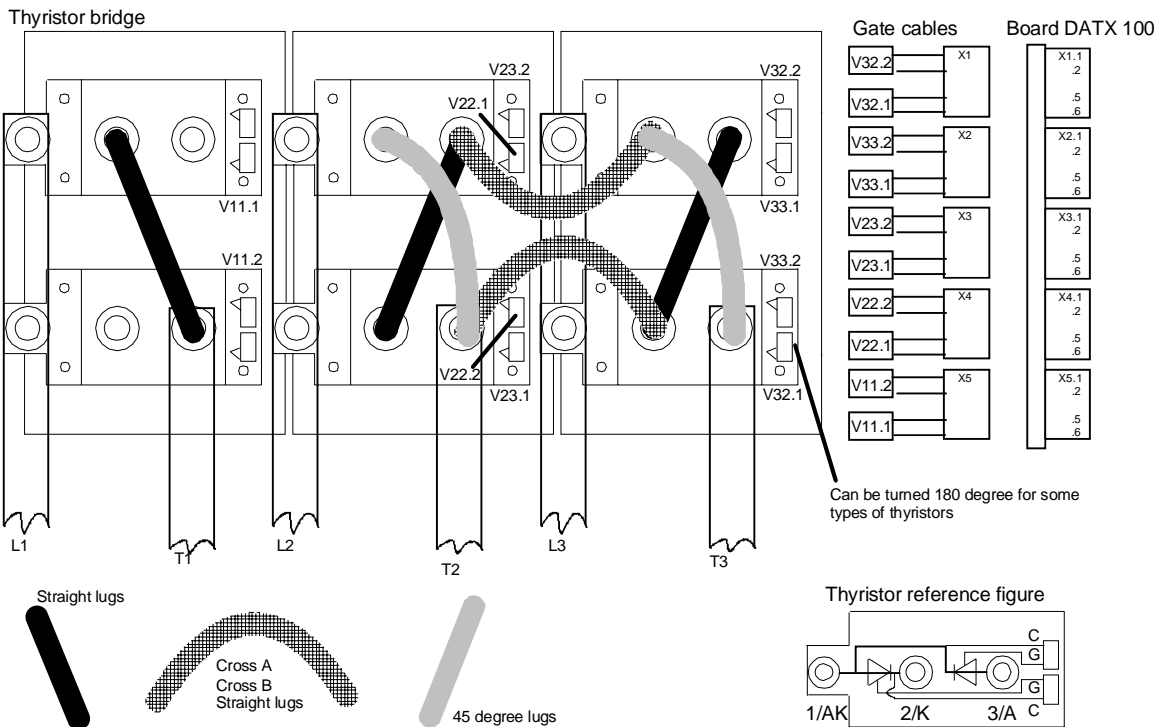
Measurement 2

Loosen the Crosses A and B, but restore the bolts and washers.

Measure the resistances between: L2-T2, T2-L2, L3-T3, T3-L3. All values must be $\geq 100 \Omega$.

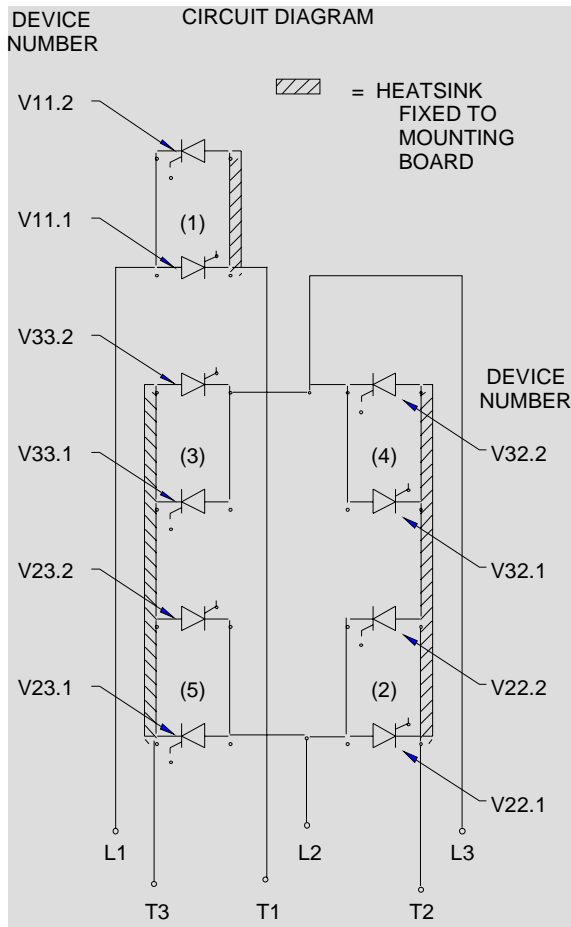
Check by successive disconnection of the flexible connectors in which of the thyristors the fault is present. Replace that thyristor.

When loosening bolts and washers we recommend restoring them in the original thread holes at once, since they otherwise can be mixed, and the connections will be erroneous and the devices may be destroyed.



9.7.2.3. Size 630 - 1100 A

Phased out types DASD 106, 107, 108, 116, 117



1) Measure the resistances between: L1-T1, T1-L1. All values must be $\geq 100 \Omega$.

1.1) If the result is acceptable, continue with step 2).

1.2) If the result of the resistance measurement is not acceptable the front cooler of the devices V11.2 and V11.1 shall be dismantled and these devices checked. Check, and replace if needed. The right mounting torque for the devices is obtained with the tell tale washers installed.

2) Measure the resistances between: L3-T3, T3-L3, L3-T2, T2-L3. All values must be $\geq 100 \Omega$.

2.1) If the result is acceptable, continue with step 3).

2.2) If the result of the resistance measurement is not acceptable remove the Cross-B. Measure the resistances between: L3-T2, T2-L3. All values must be $\geq 100 \Omega$.

2.2.1) If the result of the resistance measurement is not acceptable, the front cooler of the devices V32.2 and V32.1 shall be dismantled and these devices checked. Check, and replace if needed. Restore Cross B. The right mounting torque for the devices is obtained with the tell tale washers installed.

2.2.2) If the result of the resistance measurement is acceptable do not yet restore Cross B. Measure the resistance between: L3'-T3, T3-L3', there L3' is the left front cooler to which Cross-B is mounted. All values must be $\geq 100 \Omega$.

2.2.2.1) If the result of the resistance measurement is not acceptable, the front cooler of the devices V33.2 and V33.1 shall be dismantled and these devices checked. Check, and replace if needed. Restore Cross B. The right mounting torque for the devices is obtained with the tell tale washers installed.

2.2.2.2) If the result of the resistance measurement is acceptable, Restore Cross B, go back to step 2), as the result is not fully understandable.

3) Measure the resistances between: L2-T3, T3-L2, L2-T2, T2-L2. All values must be $\geq 100 \Omega$.

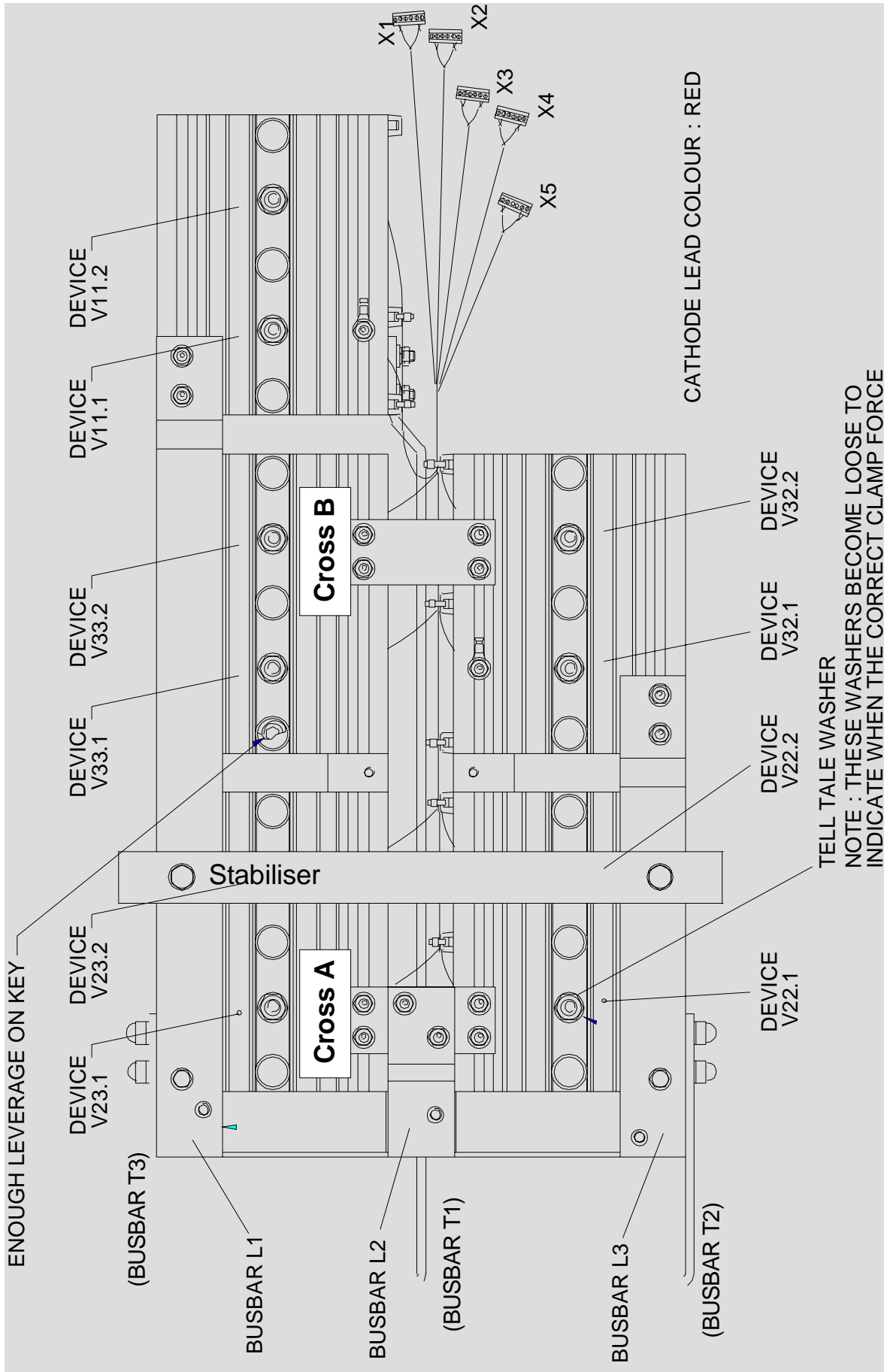
3.1) If the result of the resistance measurement is not acceptable remove the Cross A. Measure the resistance between: L2''-T2, T2-L2'', there L2'' is the right front cooler to which Cross A is mounted. All values must be $\geq 100 \Omega$.

3.1.1) If the result of the resistance measurement is not acceptable, the front cooler of the devices V22.2 and V22.1 shall be dismantled together with the Stabiliser and these devices checked. Check, and replace if needed. Restore Cross A and the Stabiliser. The right mounting torque for the devices is obtained with the tell tale washers installed.

3.1.2) If the result of the resistance measurement is acceptable do not yet restore Cross A nor the Stabiliser. Measure the resistances between: L2'-T3, T3-L2', there L2' is the left front cooler to which Cross A is mounted. All values must be $\geq 100 \Omega$.

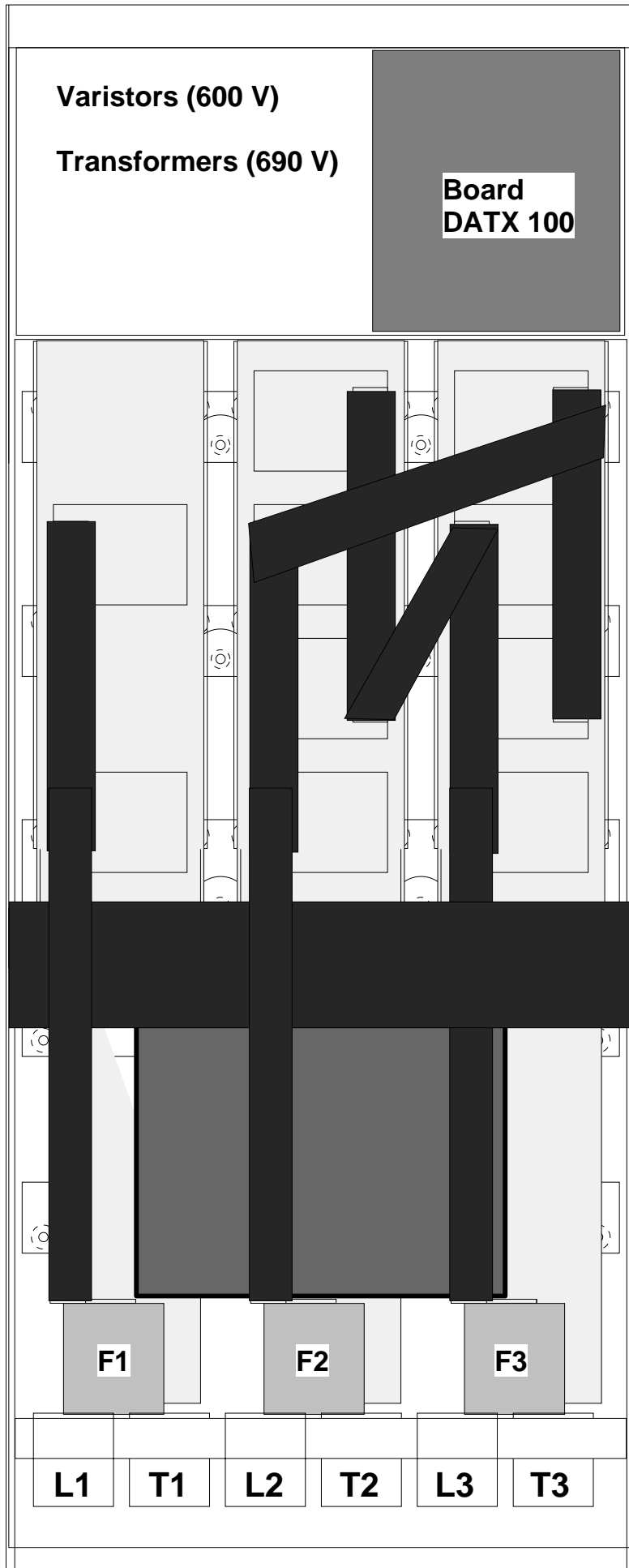
3.1.2.1) If the result of the resistance measurement is not acceptable the front cooler of the devices V23.2 and V23.1 shall be dismantled and these devices checked. Check, and replace if needed. Restore Cross A and the Stabiliser. The right mounting torque for the devices is obtained with the tell tale washers installed.

3.1.2.2) If the result of the resistance measurement is acceptable, Restore Cross A and the Stabiliser, go back to step 3), as the result is not fully understandable.



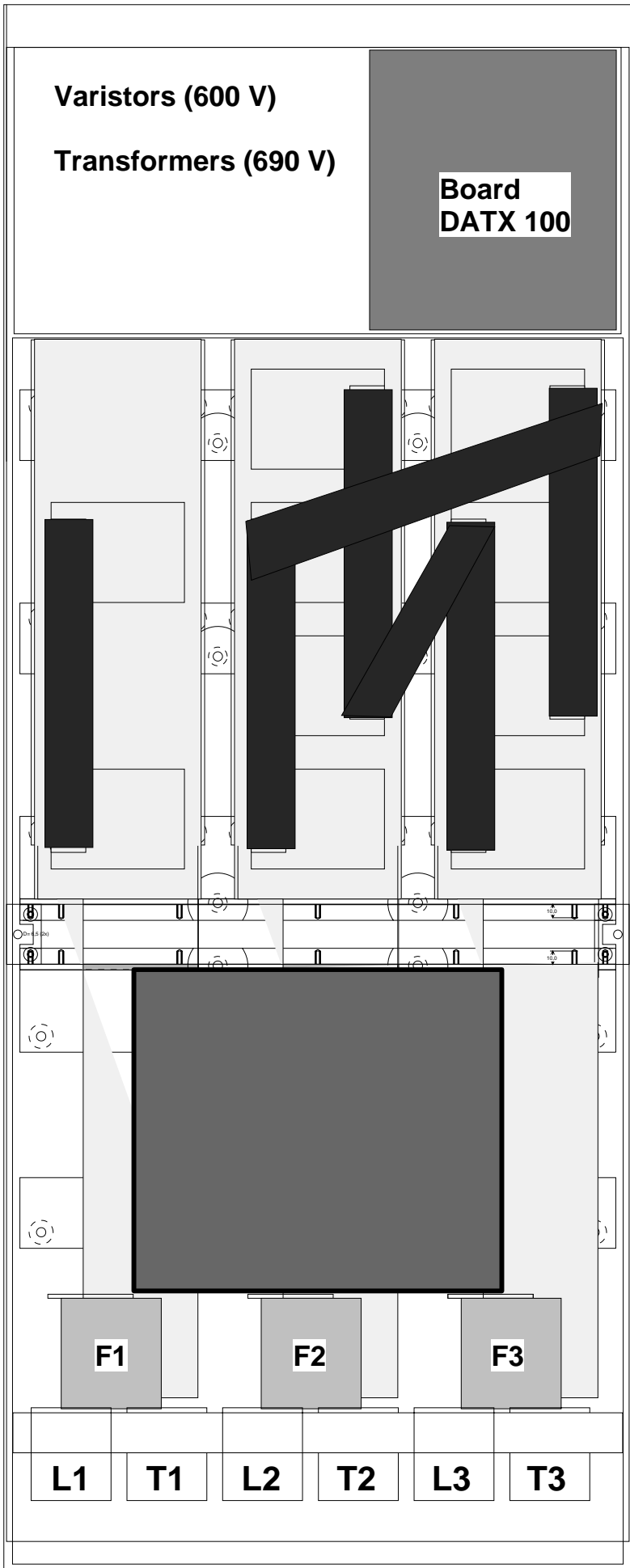
New types DASD 146, 147, 156, 157

See following pages



Instructions for how to replace fuses, varistors and circuit board.

- 1) Disconnect the main supply and the fan supply to the DASD module, and prevent unexpected reconnection.
- 2) Remove the cover from the DASD module.
- 3) Fuses, varistors and circuit board can be replaced.

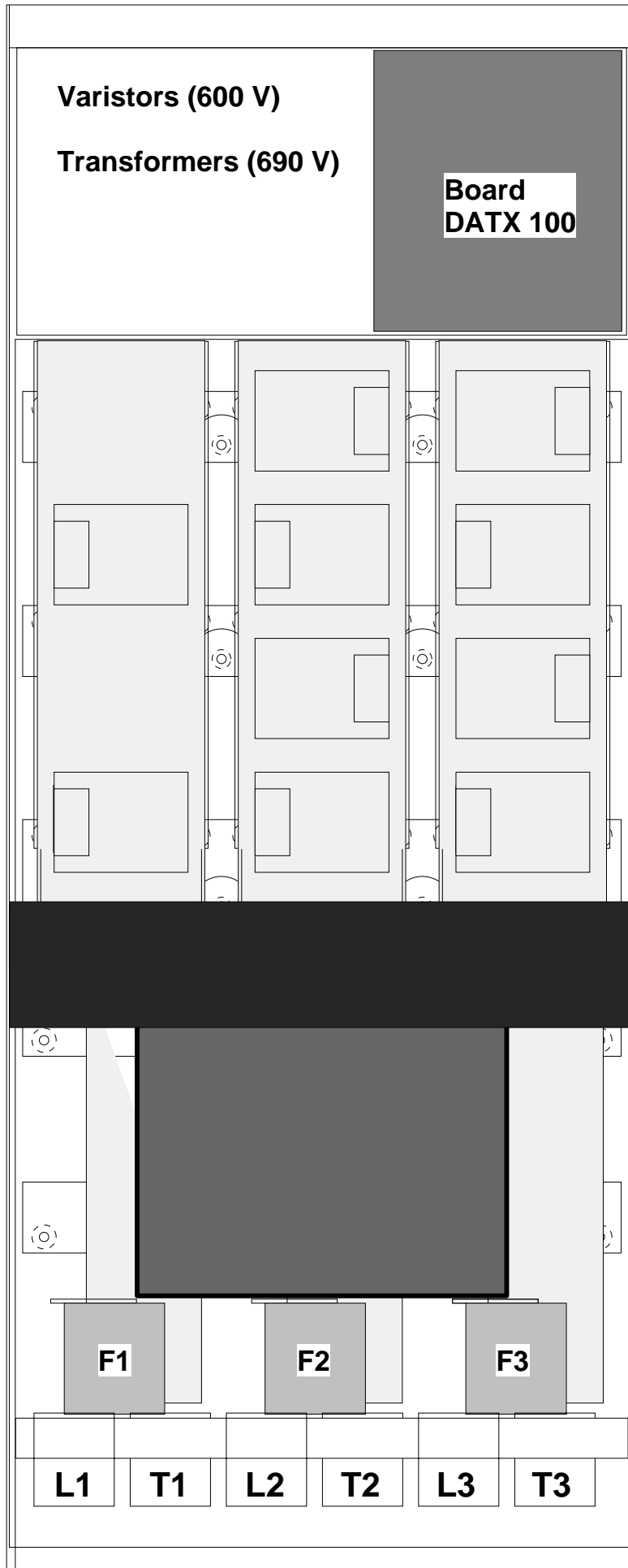


Instructions for how to replace the fan

- 1) Disconnect the main supply and the fan supply to the DASD module, and prevent unexpected reconnection.
- 2) Remove the cover from the DASD module.
- 3) Remove totally 6 pcs. of M8 and 3 pcs. of M12 screws with spring and plain washers so the interconnection bars from fuse-holders to AI-cooling element extension flags are disconnected, although still physically fixed.
- 4) Disconnect the inside Grey-Blue-Green&Yellow terminal plug to the fan unit.
- 5) Remove totally 6 pcs. of M6 screws that hold the horizontal metal stabiliser. Remove the stabiliser, together with the interconnection bars from fuse-holders to AI-cooling element extension flags.

The sketch shows this situation

- 6) Take out the air supply unit by pulling the fan straight out.
- 7) Trouble shoot the unit. Replace fan or capacitor. When replacing the fan, replace always the capacitor at the same time.
- 8) Test the air supply unit.
- 9) Reinstall the air supply unit by doing the above listed measures in the opposite order.



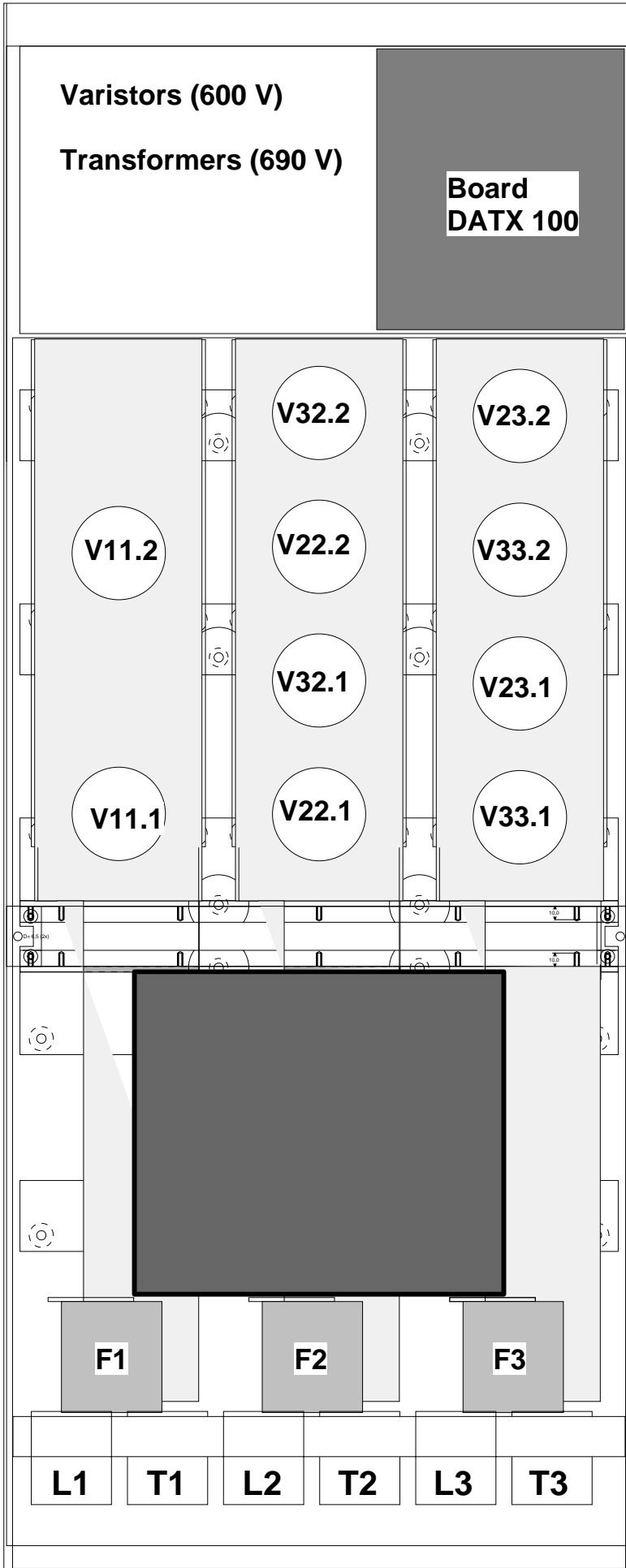
Instructions for how to check thyristors

- 1) Disconnect the main supply and the fan supply to the DASD module, and prevent unexpected reconnection.
- 2) Remove the cover from the DASD module.
- 3) Remove bus bars to main fuses, and interconnection bus bars in the stack.
- 4) All potentials of the thyristors are available without loosening any pressure clamp

The sketch shows this situation

Circuit diagram, see Reference section

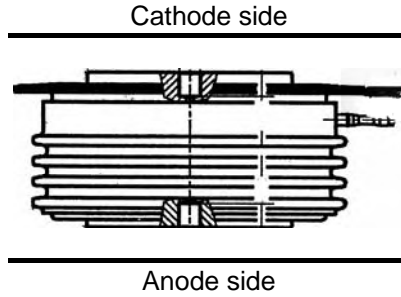
- 5) Check the thyristors acc. to the circuit diagram.
- 5) Restore



Mounting position of each thyristor device.

Devices with index .1:
Mounted with the Cathode side to the fixed 125 mm wide cooler.

Devices with index .2:
Mounted with the Anode side to the fixed 125 mm wide cooler.



Circuit diagram, see Reference section

Check the thyristors acc. to the circuit diagram.

Following clamping forces shall be used:

DASD 146 and DASD 156: 12 kN. Turn until position 3 (of 4) of the position indicator is reached.

DASD 147 and DASD 157: 22 kN. Turn until the position indicator is reached.

10. Spare parts list

Modules and items that are no longer delivered in new equipment but available as spare parts only are marked with Grey shading: **Old part**

Category	Type	Description	Identity	Used where
Circuit boards	DAPC 100	Control board	3ASC25H203	DARA 1000, 1000+AO, 1001, 1010, 1010+AO
	DAPU 100	I/O Control board	3ASC25H204	DARA 1000, 1001, DAPM 100, DAPM 101 (Som reservdel)
	DATX 100	Pulse transformer board	3ASC25H208	DASD 0xx, 1xx
	DATX 110	I/O board, No AO, Control Module	3ASC25H209	DARA 1000, 1001, 1010
	DATX 110+AO+PU	I/O board, with I/O Control board 2 AO, Control Module	3ASC25H209+AO+PU	DARA 1000, 1001, 1010
	DATX 111	I/O board No AO, Supervision system	3ASC25H224	DARA 2000
	DATX 111+AO	I/O board 2 AO, Supervision system	3ASC25H224+AO	DARA 2000
	DATX 120	I/O board Remote I/O DI+DO+AI+AO	3ASC25H210	DAPM 100
	DATX 121	I/O board Remote DI+DO+AI	3ASC25H218	DAPM 101
	DATX 130	Rotor feedback board	3ASC25H214	DARA 1001, 1010
	DATX 132	Torque observer board	3ASC25H216	DARA 1001
	DATX 133	Pulse repeater board	3ASC25H219	DARA 1010
Thyristors ²¹	Thyristor Module		3ASC485811H11	DASD 001 ... 103 (5x)
	Thyristor Module		3ASC485812H11	DASD 104 and 105 (6x)
	Thyristor Module		3ASC485813H11	DASD 151..155 (5x)/(6x)
	Thyristor Module		3ASC485814F1	DASD 145 (5x)
	Thyristor		3ASC485506E19	DASD 146 (10x)
	Thyristor		3ASC485506E23	DASD 156 (10x)
	Thyristor		3ASC485514E19	DASD 147 (10x)
	Thyristor		3ASC485514E23	DASD 157 (10x)
	Thyristor		3ASC485506E17	DASD 106 (10x).
	Thyristor		3ASC485506E13	DASD 126 (10x).
	Thyristor		3ASC485514E17	DASD 107 (10x).
	Thyristor		3ASC485514E13	DASD 108, 127 (10x).
Fans	Ziehl ebm W2S 142-BB 05-01	Compact fan 115 VAC, 330 m ³ /h, 172 mm	3ASC648020H1	DASD 102, 103 (1x) DASD 104 .. 107 (2x)
Replaced with 3ASC648030A1	Ziehl ebm Papst 8314 HLR	Compact fan 24 VDC, 60 m ³ /h, 80 mm	3ASC648030A1	DASD 002 (1x), DASD 003 (2x)
	Ziehl ebm Papst 8124 K	Compact fan 24 VDC, 60 m ³ /h, 80 mm	3ASC648040A1	DASD 002 (1x), DASD 003 (2x)
	Ziehl ebm D4E133-ASTAT	Radial fan 220-230 VAC, 760 m ³ /h	3ASC648050E1	DASD 146, DASD 156 (1x)
	Ziehl ebm D4E160-ASTAT	Radial fan 220-230 VAC, 1310 m ³ /h	3ASC648051E1	DASD 147, DASD 157 (1x)
	DAFU 145	Fan unit for DASD 145 including D4E160-ASTAT	3ASC25H229	DASD 145 (1x)

²¹ The thyristors listed here are always suitable as spare. The installed thyristors are not always the same. Always change both devices that are fixed with a common cooler in DASD 10x and DASD 12x!

Category	Type	Description	Identity	Used where	
Fuses	SIBA / Gould	2 A FF, 6 * 32 mm, 600 700V	3ASC567201H12 3ASC567201H23	DASD 001 .. 105 (6x) (3x) DASD 145, 146, 147 (3x) DASD 151 .. 157 (3x) DASG 222, DASG 223 (3x)	
	SIBA	10 A , 6 * 32 mm, 600V	FAR7009463 302-8800	DASD 106, 107, 126, 127 , 001, 002, 003, 101, 102, 103, 104, 105, 145, 146, 147 (3x)	
	BUSSMAN	10 A F, 10,3 * 38 mm, 600 V	3BSC770010R301	DASG 218, DASG 219, DASG 220, DASG 221, DASG 118, DASG 119, DASG 121 (3x)	
	HRC-fuse	25 A, 10,3 * 38 mm, 690 V	RS314-4838	DASD 222, DASG 223 (3x)	
	From 2007 To 2007	Fast fuse link	690 V AC, 900 A	G3MÜF02/900A/690V	DASD 146 (3x)
	From 2007 To 2007	BUSSMAN 3BKN/80 170M6546	80 mm 1000 V AC, 800 A	3ASC567501H10	DASD 106, 126, 146, 156 (3x)
	From 2007 To 2007	Fast fuse link	690 V AC, 1250 A	G3MÜF02/1250A/690V	DASD 147 (3x)
	BUSSMAN 3BKN/80 170M6549	80 mm 1000 V AC, 1100 A	3ASC567501H16	DASD 107, 108, 127, 147, 157 (3x)	
Cables	-	Firing Pulse cable, 2 m	3ASC262721H20	All ASTAT with DASD 1xx	
	-	Firing Pulse cable 3 m	3ASC262721H30	ASTAT with Double Bridges	
	-	Firing Pulse cable 0,7 m	3ASC262721H7	DARA 1001, 1010, DASD 0xx	
Overvoltage protection	Crouzet FW 3 x 400 V	Phase failure and sequence monitor	3ASC742401J12	DASG 118	
	Crouzet FW 3 x 480 V	Phase failure and sequence monitor	3ASC742401J15	DASG 119	
	Crouzet FW 3 x 575 V	Phase failure and sequence monitor	3ASC742401J16	DASG 221, DASG 121	
	BC9-30-10, 240 V	DC-contactor	FPL 141 3001 R3103	DASG 118, DASG 119, DASG 121, DASG 218, DASG 219, DASG 220, DASG 221	
	A9-30-10, 380 - 400 V AC	AC-contactor	1SBL141001R8510	DASG 218 (2x)	
	A9-30-10, 415 V AC	AC-contactor	1SBL141001R8610	DASG 219 (2x)	
	A9-30-10, - 440 V / 50 Hz - 500 V / 60 Hz	AC-contactor	1SBL141001R5310	DASG 220 (2x)	
	Semikron: SKD 31/16	Diode bridge	3ASC485821H1	DASG 218, DASG 219, DASG 220, DASG 118, DASG 119	
	Semikron: SKKD 81/20	Diode module	3ASC485822H1	DASG 221 (3x), DASG 121 (3x)	
	PaM 63-8,0	Capacitor, 8 µF, 630 VAC	4984 229-9	DASG 218 (1x), DASG 219 (1x), DASG 220 (xx), DASG 118 (1x), DASG 119 (2x)	
	PaM 85-4,0	Capacitor, 8 µF, 850 VAC	4984 220-9	DASG 221 (2x) DASG 121 (3x)	
	DASG 110	RC module, 530V	3ASC25H297	DASD 101, 102, 103, 104, 105	
	DASG 111	RC module, 600V	3ASC25H295	DASD 106, 107, 126, 127	
	Power supply	DASA 110	Power supply module	3ASC25H271	DARA 1000, 1001, 1010
Indication	DATD 100	Termination board, Cabin I/O	3ASC25H207	DAPM 100, 101	
Hoist Safety	DATD 111	Safety Relay board	3ASC25H213B	DARA 2000	

11. Installation diagram forms

The circuit diagram forms are developed to serve as a tool for the electrical designer. The forms are available in printed form in this manual and as dxf-files on the ASTAT Tools CD.

11.1. Thyristor Modules

Select one of the forms of Section Thyristor Modules:

25 A Thyristor Module, DASD 001 and DASD 101: {see page 226}.

dxf-file: 200-2.1.dxf

50, 100 A Thyristor Module, DASD 102 and DASD 103 (Large type): {see page 227}.

dxf-file: 200-2.2.dxf

50 A Thyristor Module, DASD 002 (Compact type): {see page 228}.

dxf-file: 200-2.2A.dxf

100 A Thyristor Module, DASD 003 (Compact type): {see page 229}.

dxf-file: 200-2.2B.dxf

200, 355 A Thyristor Module: {see page 230}.

dxf-file: 200-2.3.dxf

Parallel 200, 355 A Thyristor Modules: {see page 231}.

dxf-file: 200-2.4.dxf

630, 1000, and 1100 A Thyristor Module: {see page 232}.

dxf-file: 200-2.5.dxf

Parallel 630, 1000, 1100 A Thyristor Modules: {see page 233}.

dxf-file: 200-2.6.dxf

11.2. Control System

Select one of the Control Systems DARA 1000 DARA 1001, DARA 1010 and the common I/O forms.

11.2.1. Control System

11.2.1.1. DARA 1000

Basic Control System Module: {see page 234}. dxf-file: 200-1.1#.dxf

11.2.1.2. DARA 1001, 1010

Extended Control System Module: {see page 235}. dxf-file: 200-1.2#.dxf

11.2.2. I/O of DARA 1000, 1001 or 1010

For both DARA 1000 and DARA 1001 (6 sheets) {see page 236 to 241}

dxf-files: 200-3.dxf, 200-4.dxf, 200-5.dxf, 200-6.dxf, 200-7.dxf, and 200-8.dxf

11.2.3. Rotor measurement

For DARA 1001, 1010 (1 sheets) {see page 242}. dxf-file: 200-9.dxf

11.3. Cabin I/O

Select one of the Cabin I/O alternatives, if remote one, two or three I/O will be installed. For two I/O use two forms, for three I/O use three forms.

The form is valid for DAPM 100 as well as DAPM 101.

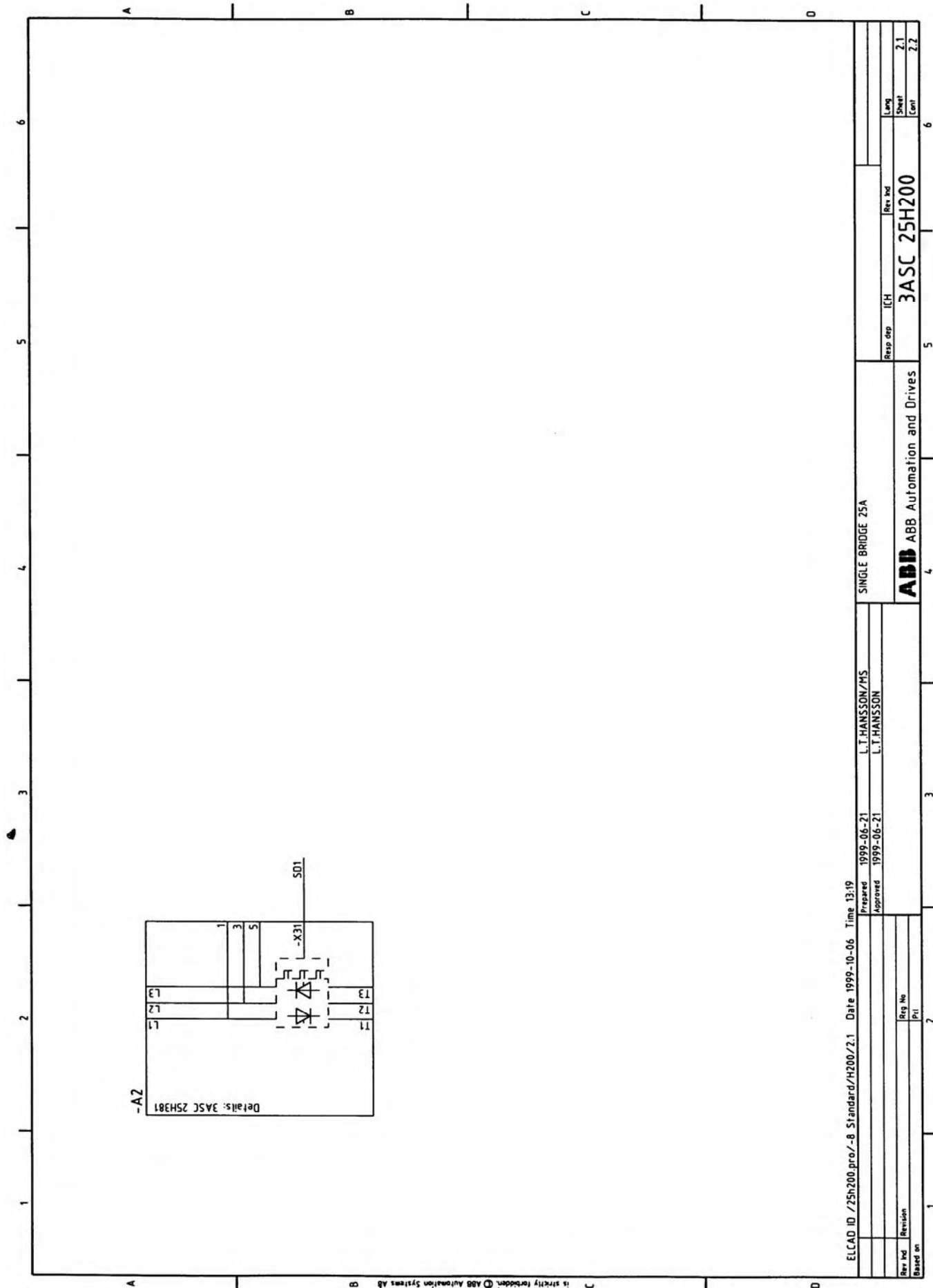
Form: {see page 243}. dxf-file: 200-10A.dxf

11.4. Overvoltage protection

Form: {see page 244}. dxf-file: 200-12.dxf

11.5. Multi-drop communication

Form: {see page 245}. dxf-file: 200-13#.dxf



ELCAD ID / 25H200.pro/-8 Standard/H200/2.1 Date 1999-10-06 Time 13:19

Prepared 1999-06-21 L.T.HANSSON/MS
 Approved 1999-06-21 L.T.HANSSON

SINGLE BRIDGE 25A

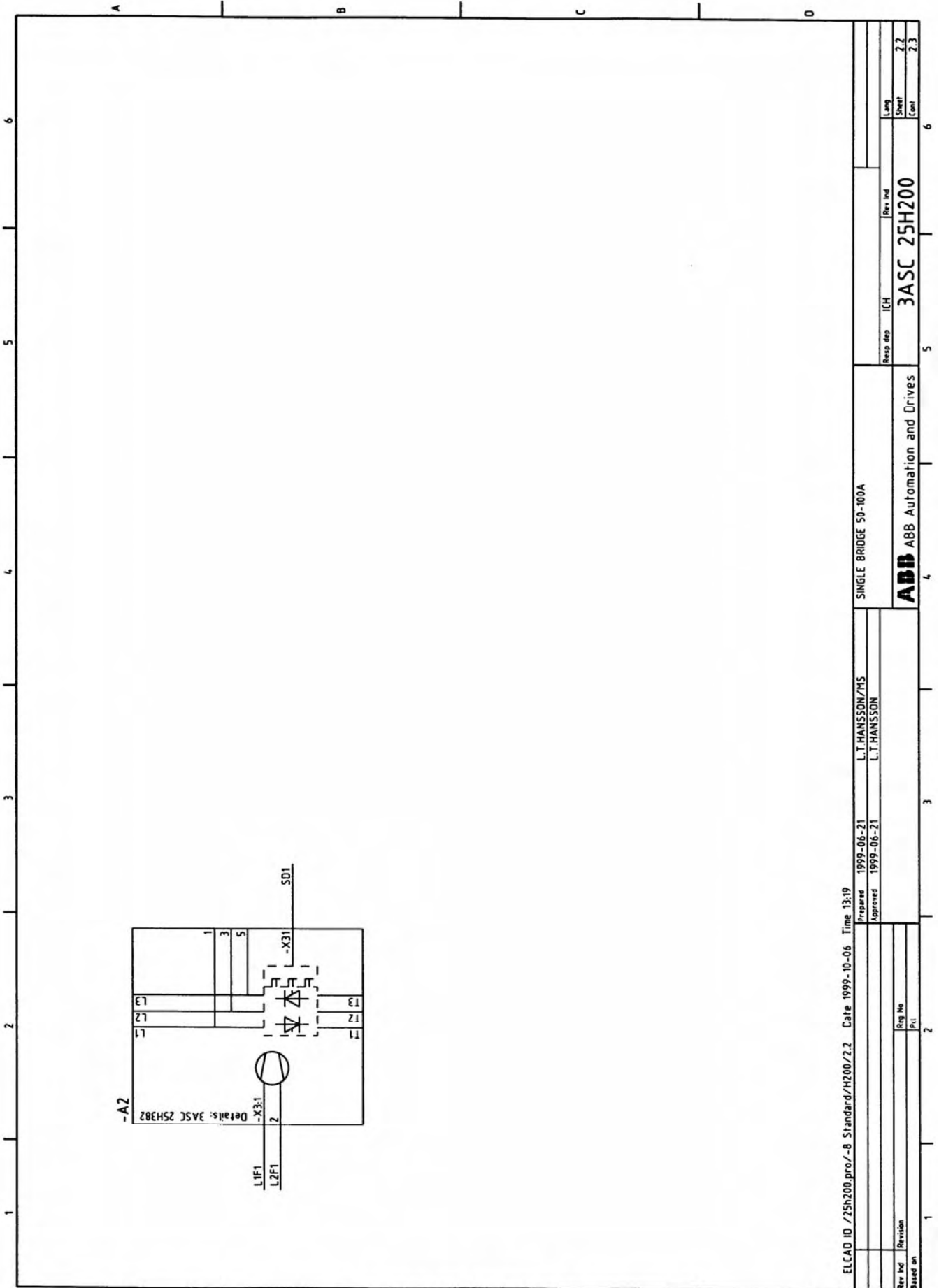
Rev. Ind	Revision	1
Req. No	Prj	2

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Resp. Dep. ICH
 Resp. Ind 3ASC 25H200

Long	6
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Cont	2.2

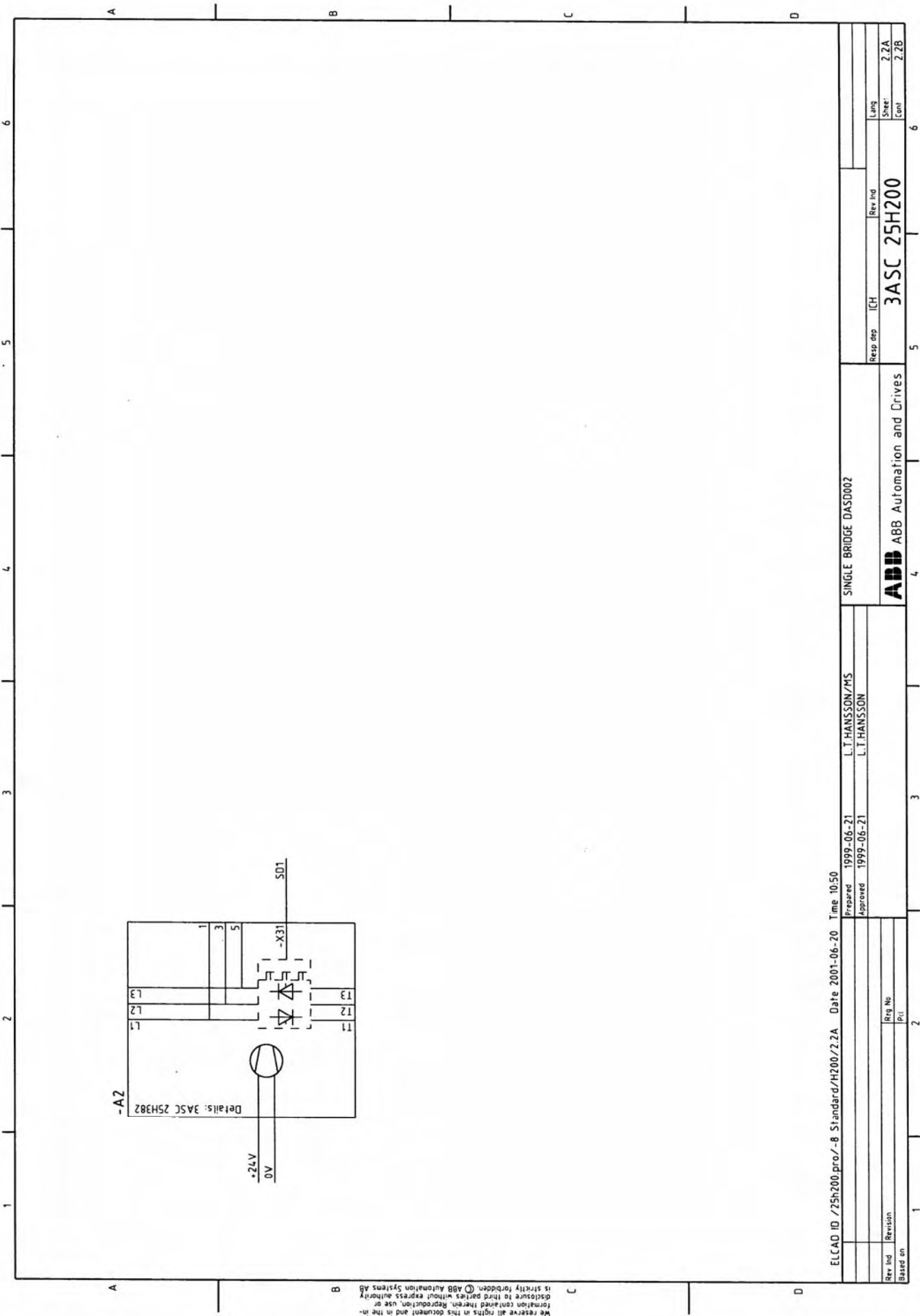
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		Approved 1999-06-21	L.T.HANSSON
Rev Ind	Revision	Reg No	
Based on		Pri	

SINGLE BRIDGE 50-100A		Resp dep	ICH	Rev Ind		Long
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						2.2
						2.3

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-A2
Details: 3ASC 25H382

ELCAD ID / 25h200.pro/-8 Standard/H200/2.2A Date 2001-06-20 Time 10:50

Prepared 1999-06-21 L.T.HANSSON/MS
Approved 1999-06-21 L.T.HANSSON

SINGLE BRIDGE DASD002

ABB ABB Automation and Drives

Resp dep ICH
Rev Ind
3ASC 25H200

Lang
Sheet 2.2A
Cont 2.2B

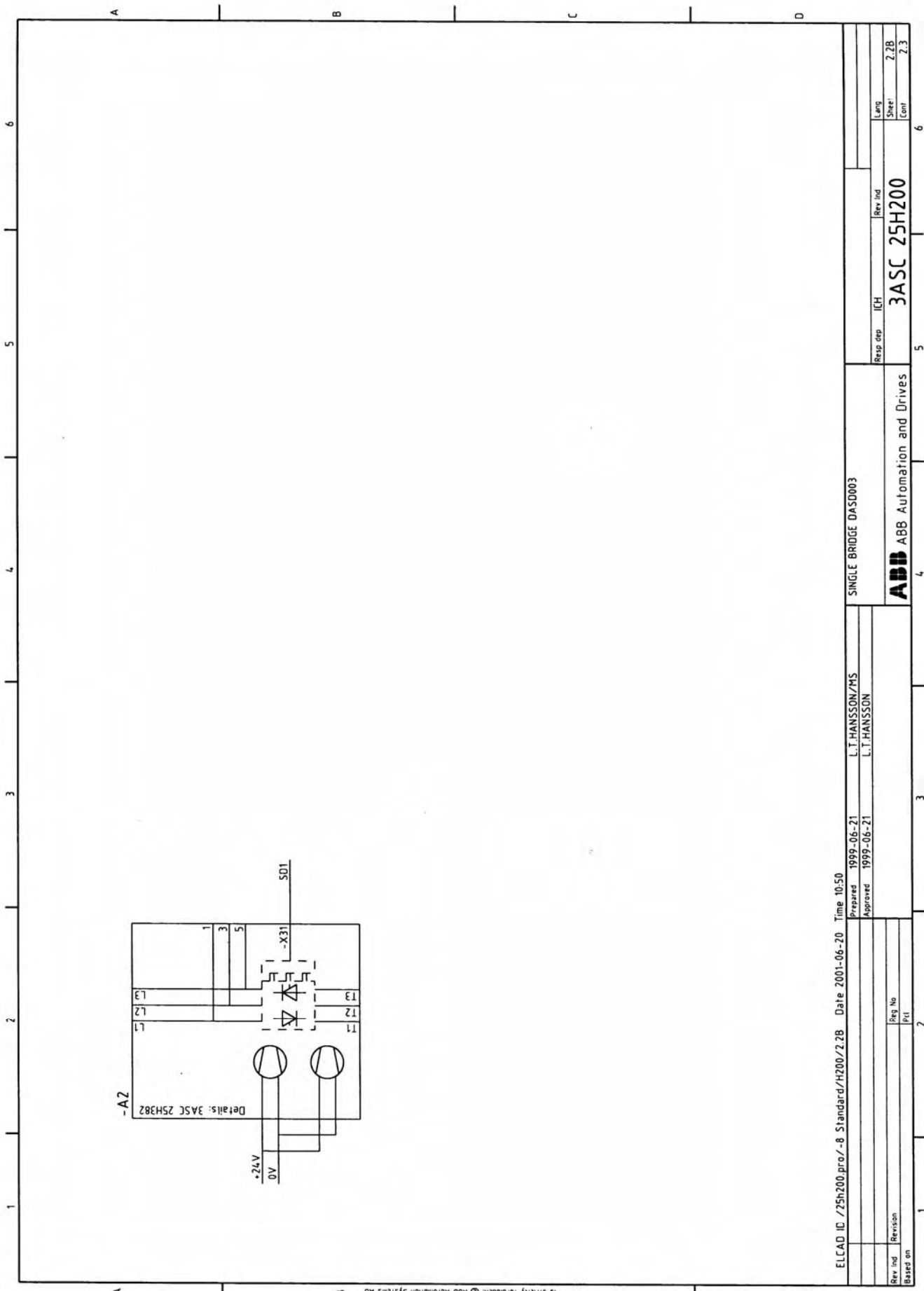
Rev Ind	Revision	Rtg No
Based on		PL

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1 2 3 4 5 6

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A B C D



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Prepared 1999-06-21 L.T.HANSSON/MS
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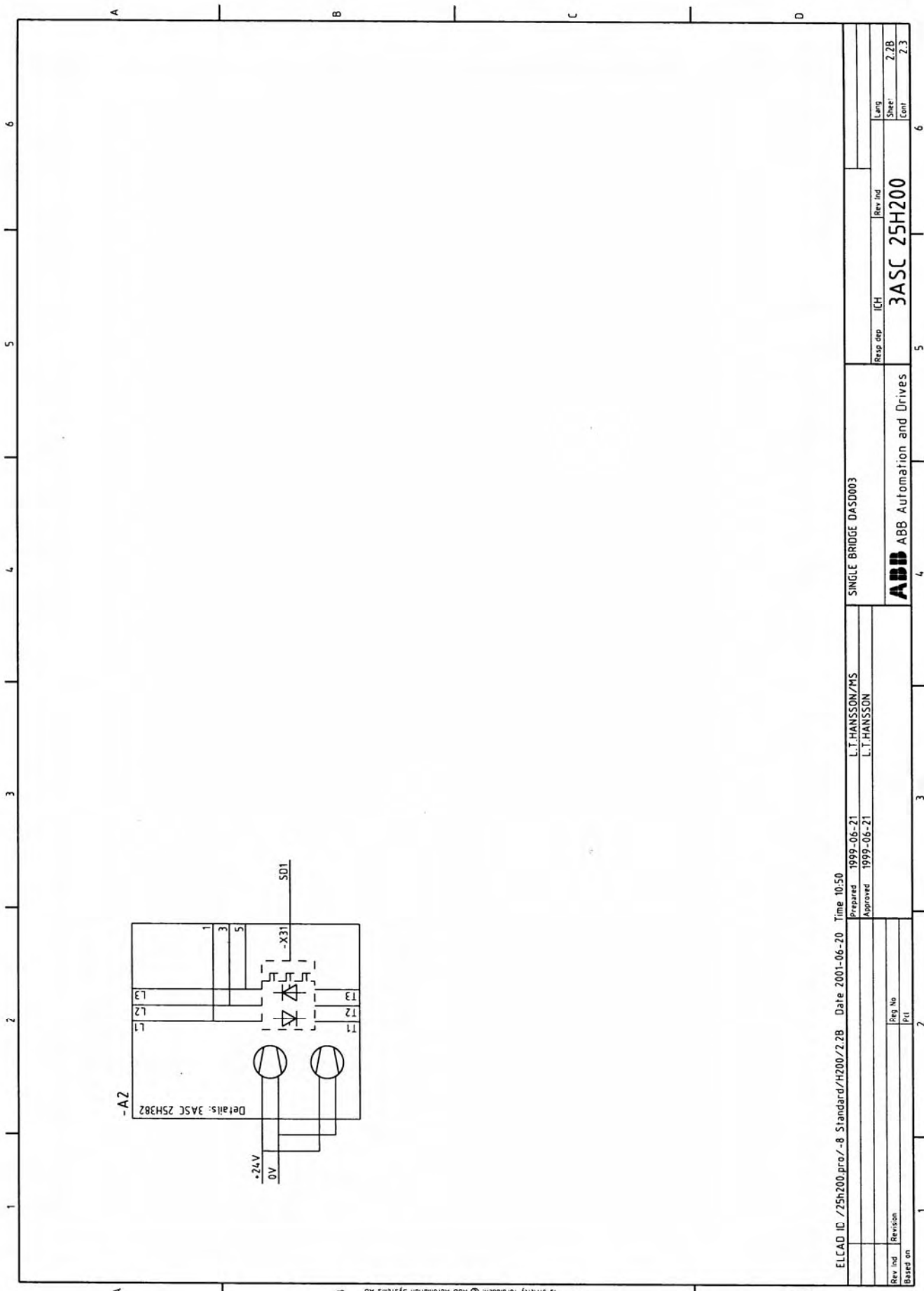
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Rev. Ind	Revision	Req. No	Prj

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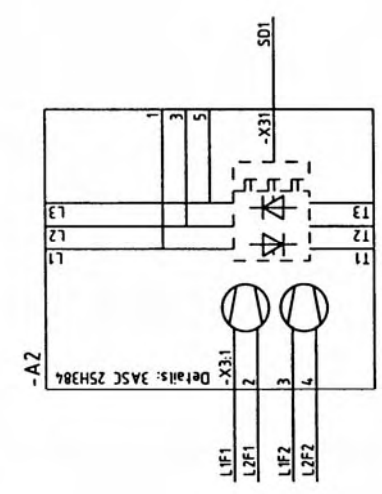


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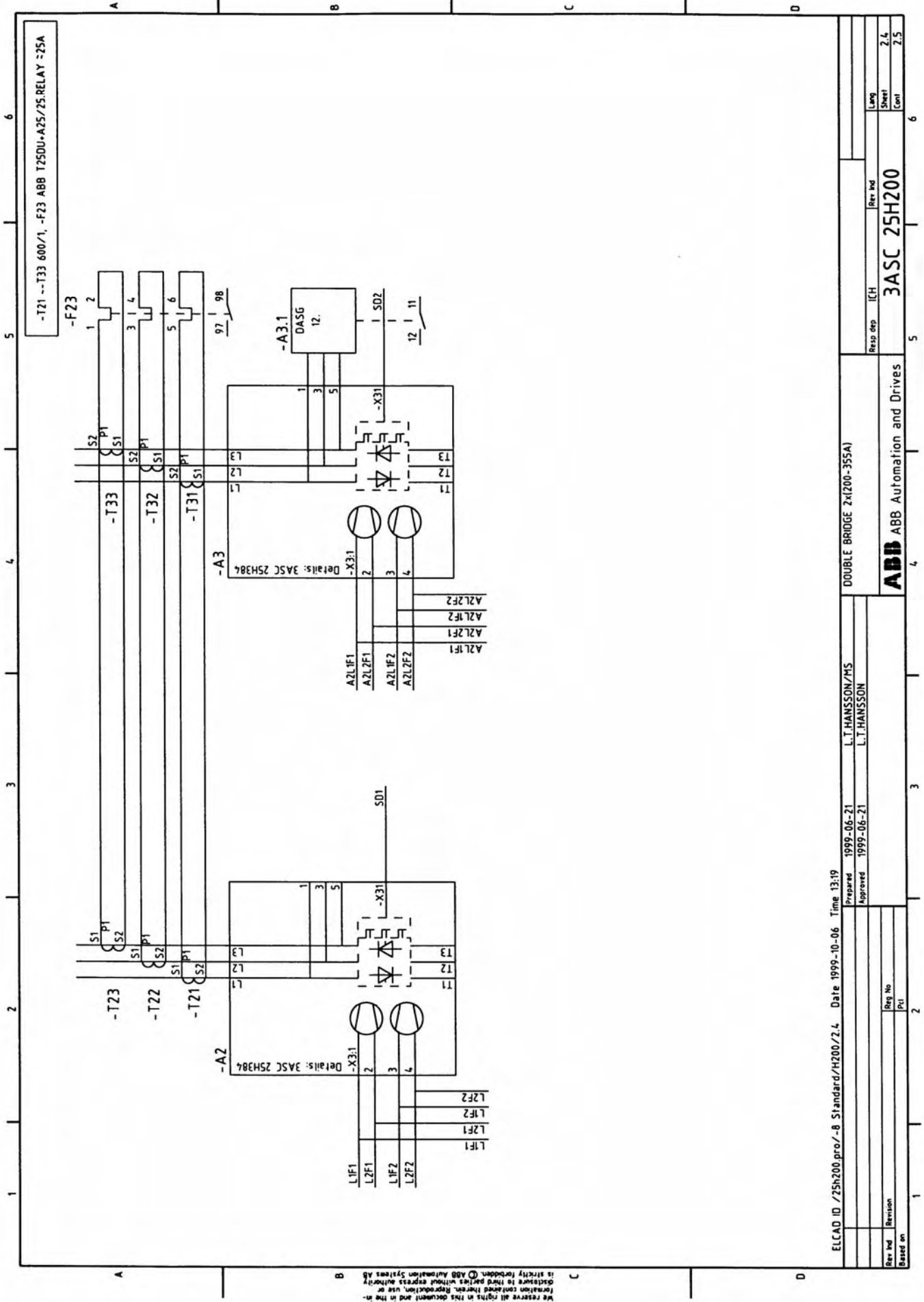
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1 2 3 4 5 6



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Prepared	1999-06-21	L.T.HANSSON/MS	
Approved	1999-06-21	L.T.HANSSON	
Rev Ind	Revision	Resp dep	ICH
Based on	Reg No Pct	3ASC 25H200	
		ABB ABB Automation and Drives	
		Rev Ind	2.3
		Sheet	2.3
		Conn	2.3



-T21 --T33 600/1, -F23 ABB T25DU-A25/25-RELAY ≈25A
-F23

ELCAD ID /25h200.pro/-8 Standard/H200/2.4 Date 1999-10-06 Time 13:19

Prepared 1999-06-21
Approved 1999-06-21

L.T.HANSSON/MS
L.T.HANSSON

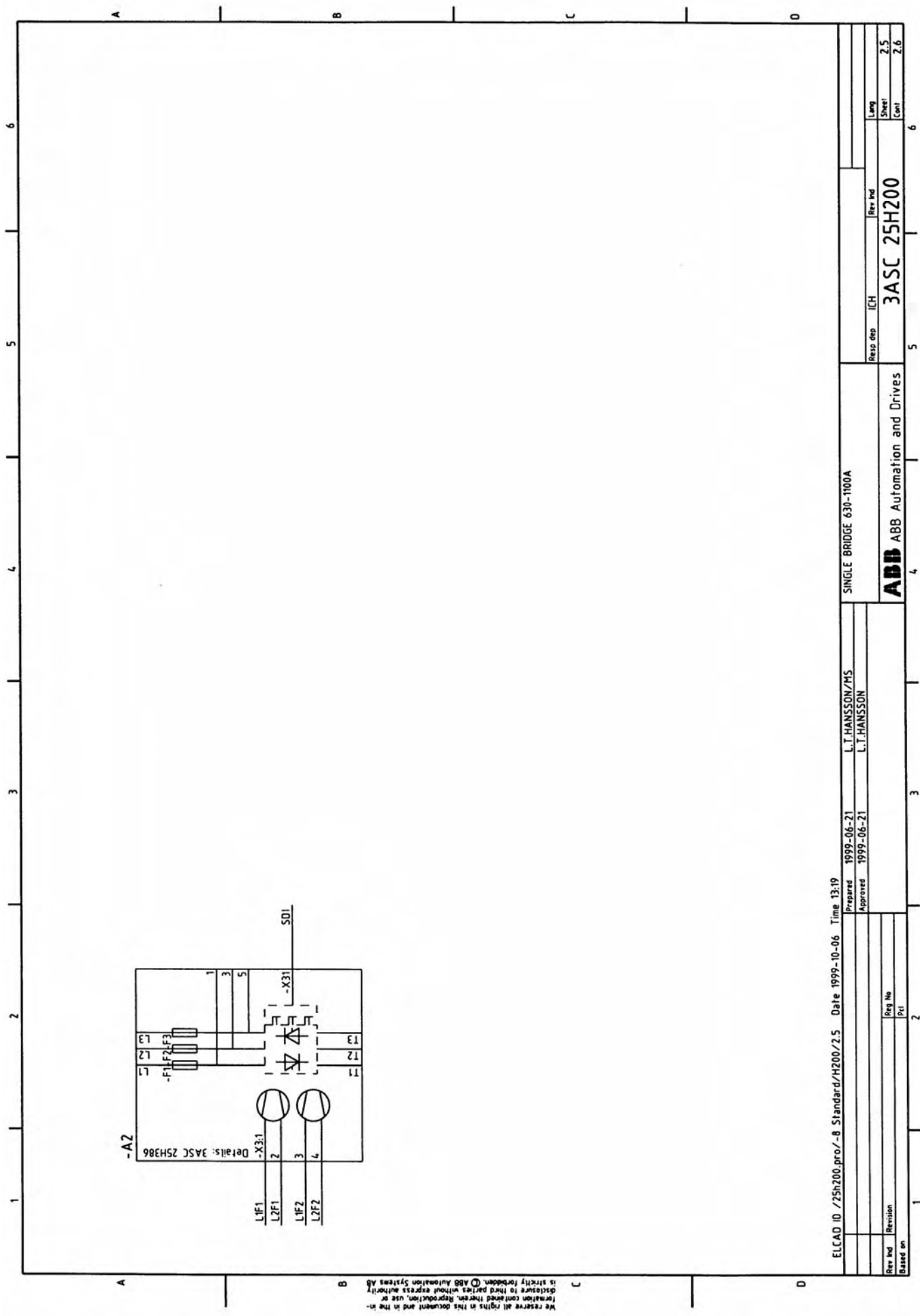
DOUBLE BRIDGE 2x(200-355A)

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SINGLE BRIDGE 630-1100A

Rev Ind	Revision	Reg No	Prj
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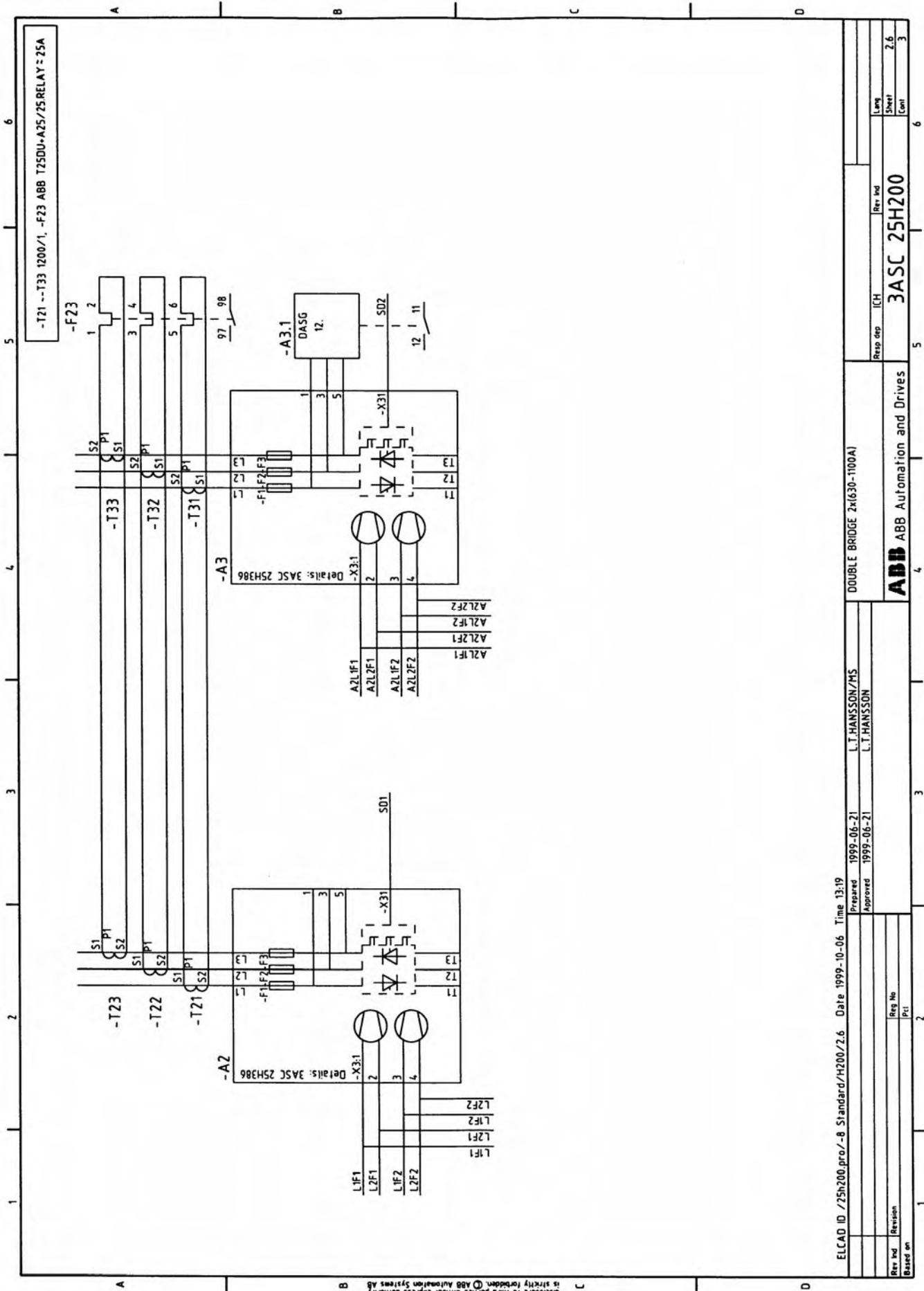
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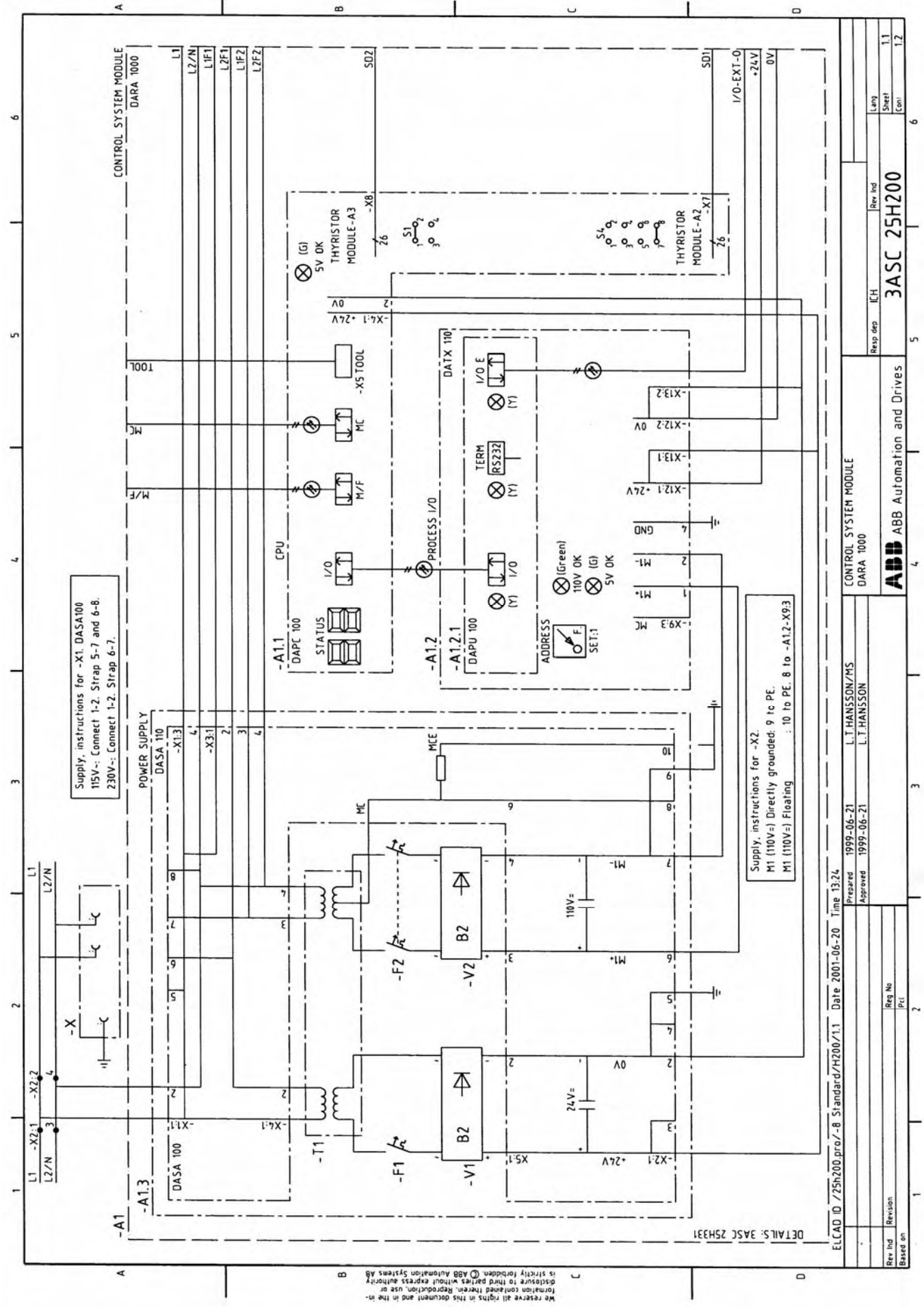
Resp dep IEH
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Long Sheet	6
2.5	
2.6	

A B C D

1 2 3 4 5 6





Supply, instructions for -X1, DASA100
115V-; Connect 1-2, Strap 5-7 and 6-8.
230V-; Connect 1-2, Strap 6-7.

Supply, instructions for -X2.
M1 (110V-) Directly grounded; 9 to PE.
M1 (110V-) Floating : 10 to PE, 8 to -A1.2-X9.3

ELCAD ID / 25h200.pro/-8 Standard/H200/1.1 Date 2001-06-20 Time 13:24

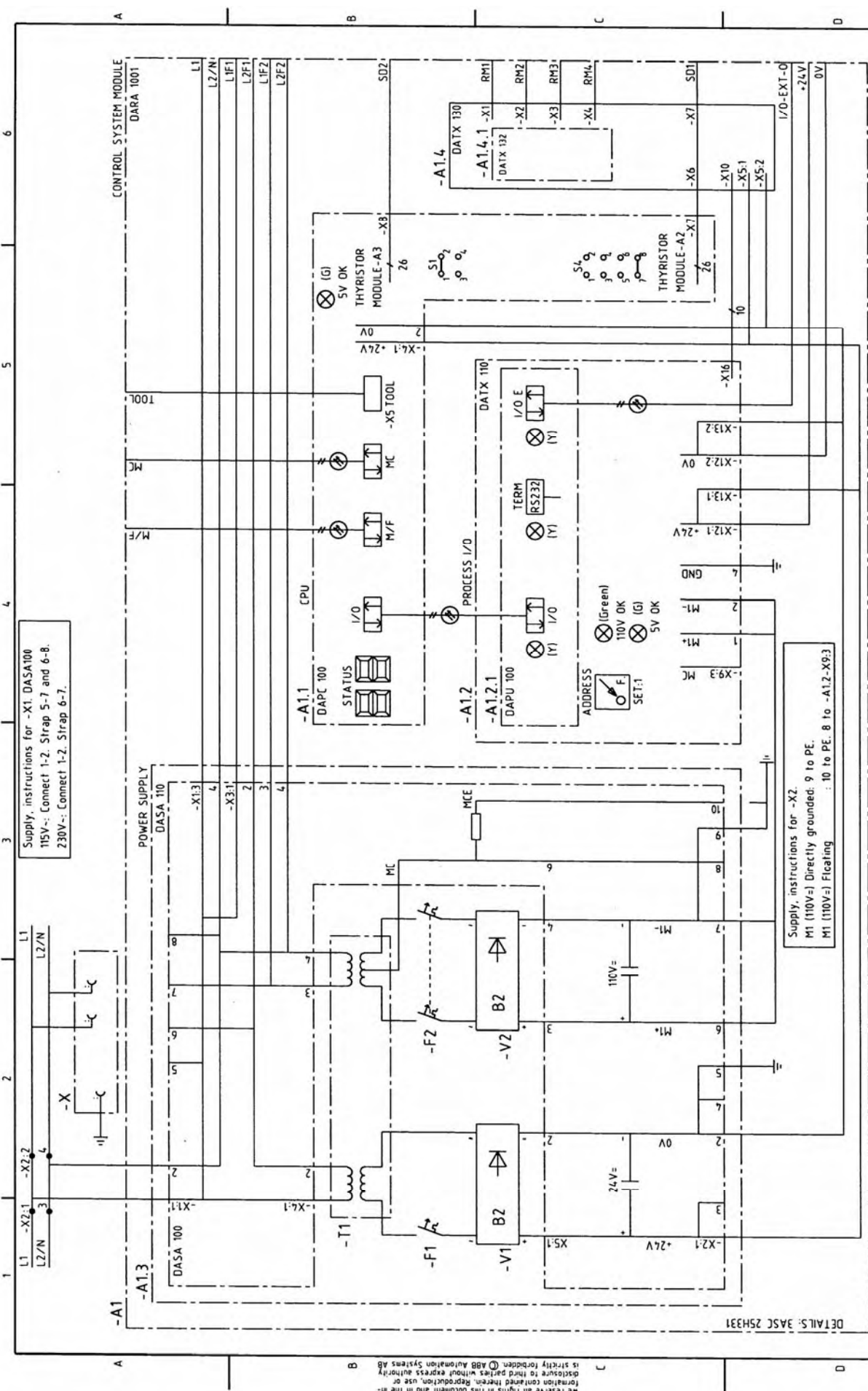
Prepared 1999-06-21 L.T.HANSSON/MS
Approved 1999-06-21 L.T.HANSSON

CONTROL SYSTEM MODULE
DARA 1000

ABB Automation and Drives

3ASC 25H200

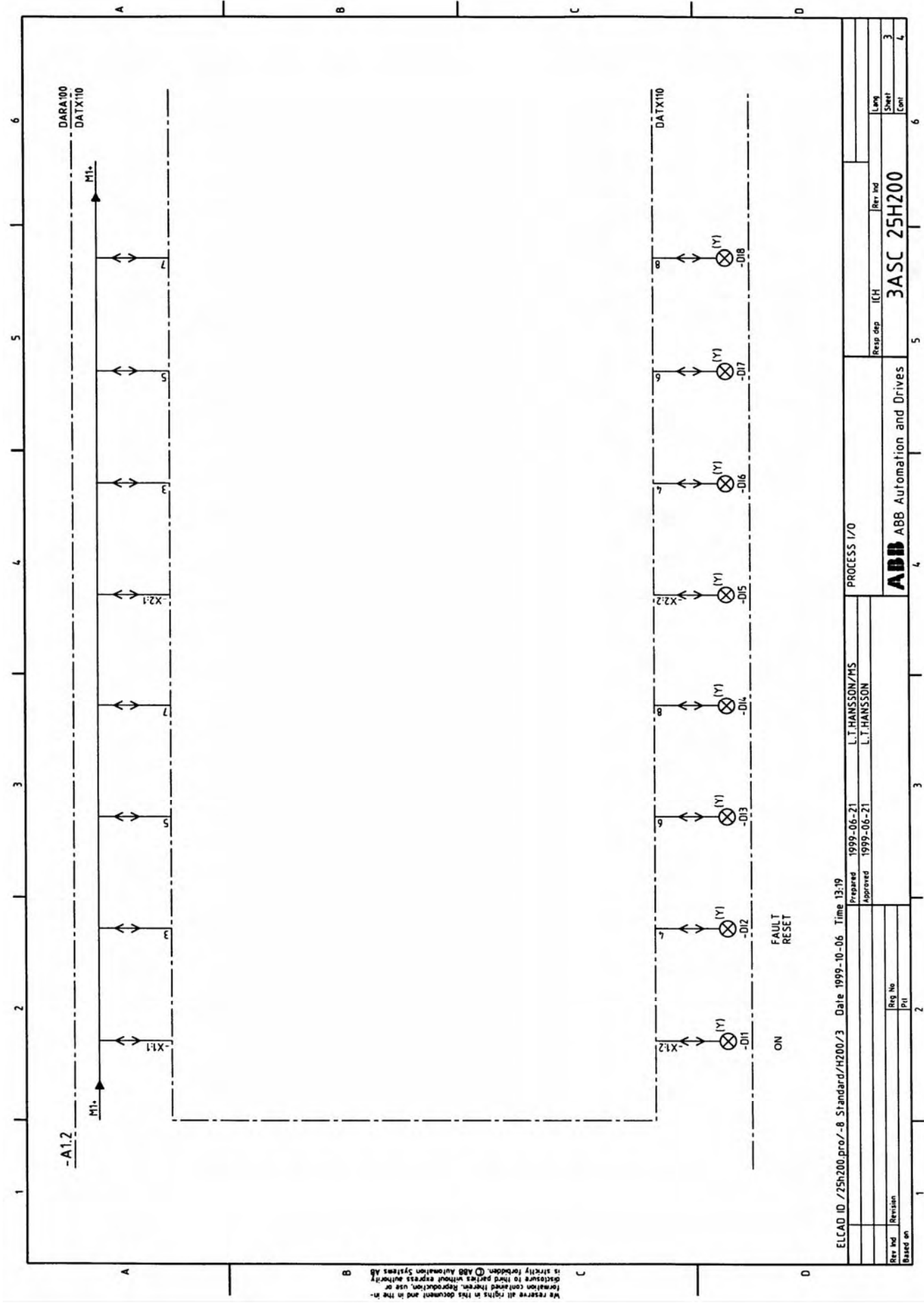
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			1.2	



Supply, instructions for -X1, DASA100
115V-; Connect 1-2, Strap 5-7 and 6-8.
230V-; Connect 1-2, Strap 6-7.

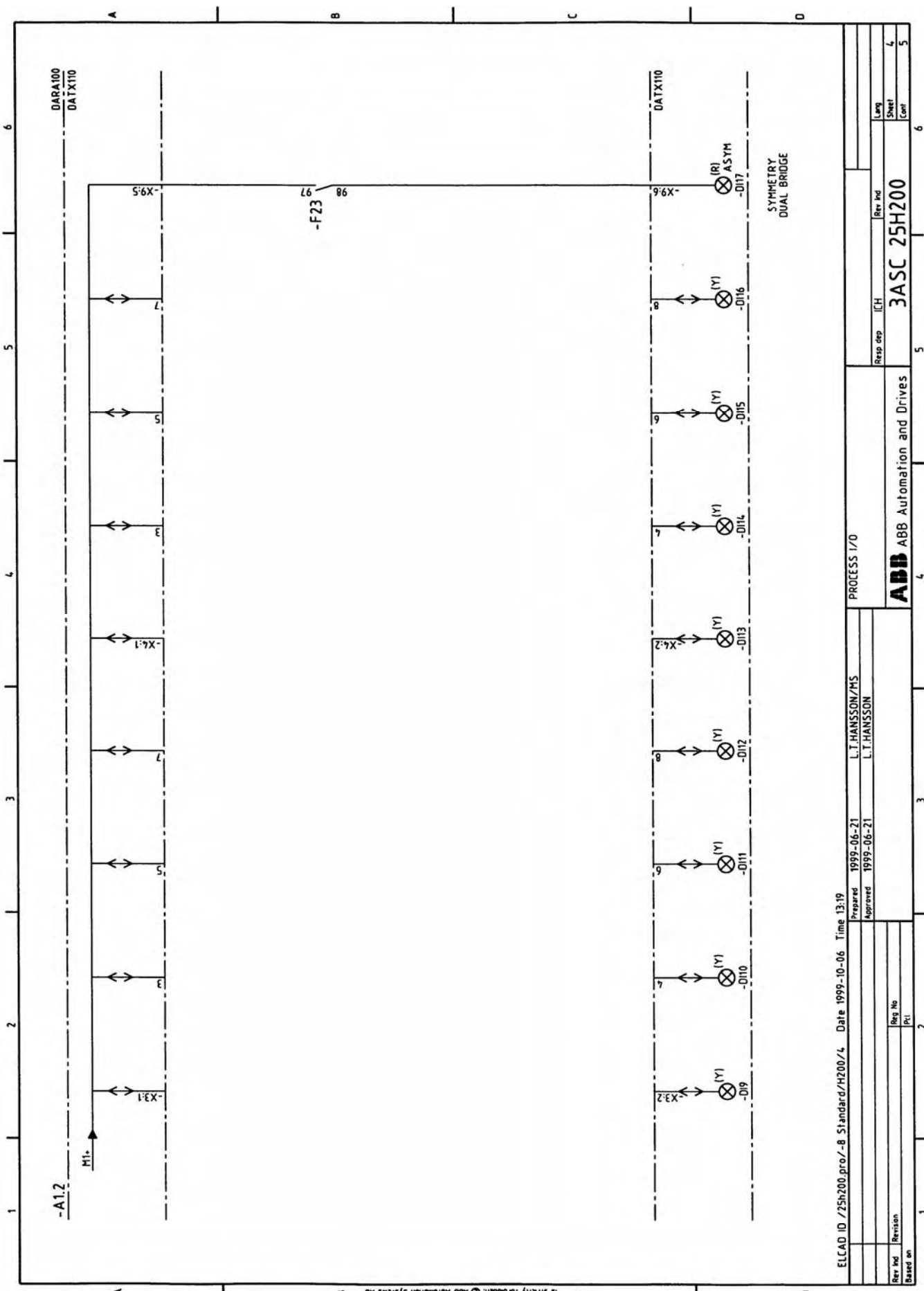
Supply, instructions for -X2.
M1 (110V-) Directly grounded: 9 to PE.
M1 (110V-) Floating : 10 to PE. 8 to -A1.2-X9.3

ELCAD ID : 25h200 pro/-8 Standard/H200/12 Date 2001-06-20 Time 13:52		Prepared 1999-06-21 L.T.HANSSON/MS	
Rev Ind Revision		Approved 1999-06-21 L.T.HANSSON	
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CONTROL SYSTEM MODULE DARA 1001		Resp dep ICH	
ABB Automation and Drives		Rev. Ind	
3ASC 25H200		Lang	
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ELCAD ID / 25h200 pro/-6 Standard/H200/3		Date	1999-10-06	Time	13:19
Prepared		1999-06-21	L.T.HANSSON/MS		
Approved		1999-06-21	L.T.HANSSON		
PROCESS I/O					
Resp dep	IC(H)	Rev	101		
3ASC 25H200				Lang	6
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Based on				Cont	4

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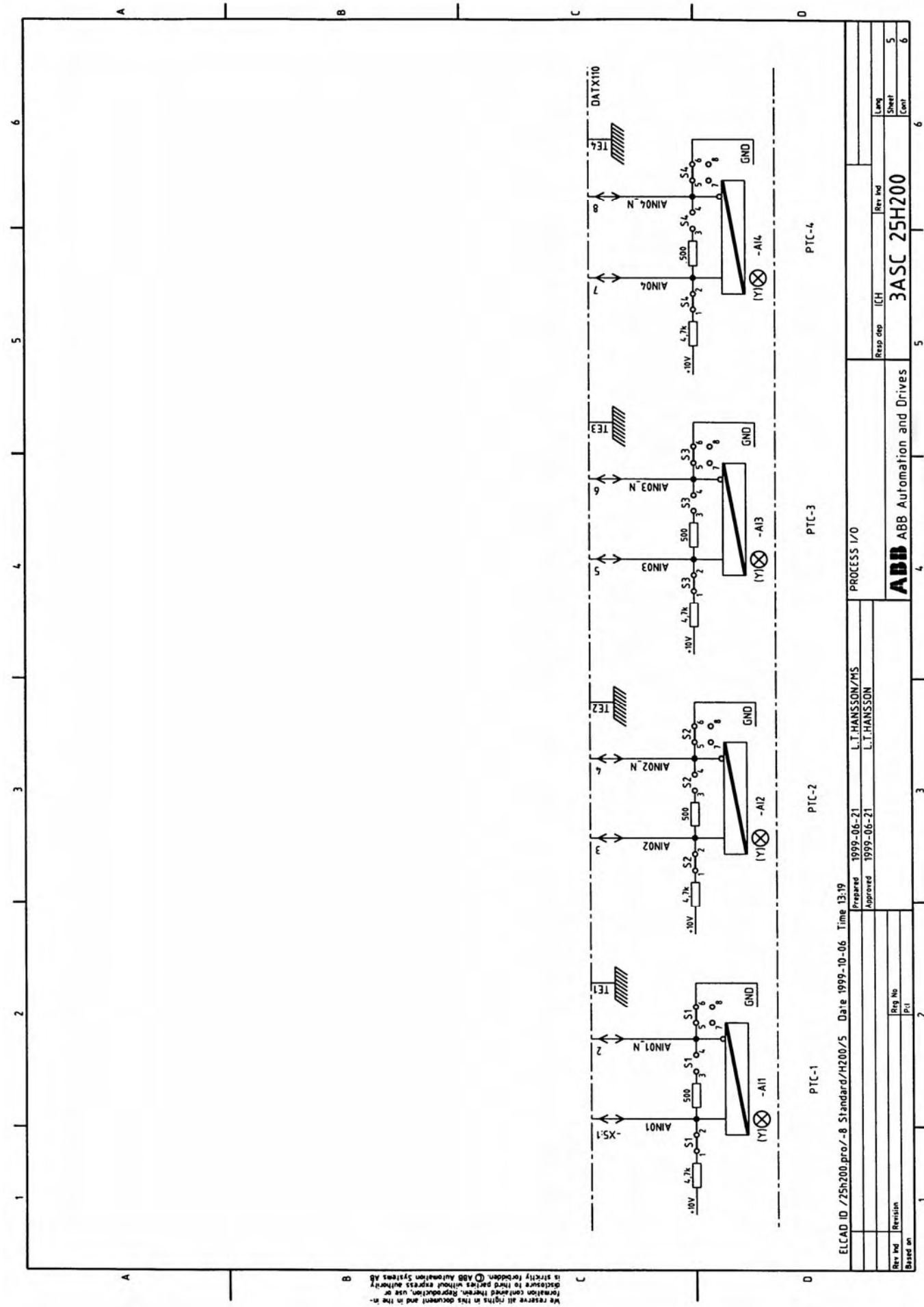
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PROCESS I/O

Resp dep ICH
ABB ABB Automation and Drives

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3ASC 25H200

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Sheet	4
Cont	5



ELCAD ID / 25H200.pro/-8 Standard/H200/S Date 1999-10-06 Time 13:19

Prepared 1999-06-21 L.T.HANSSON/MS
 Approved 1999-06-21 L.T.HANSSON

PROCESS I/O

Base Id	Revision	Rep No	2
Based on		Pri	

ABB ABB Automation and Drives

3ASC 25H200

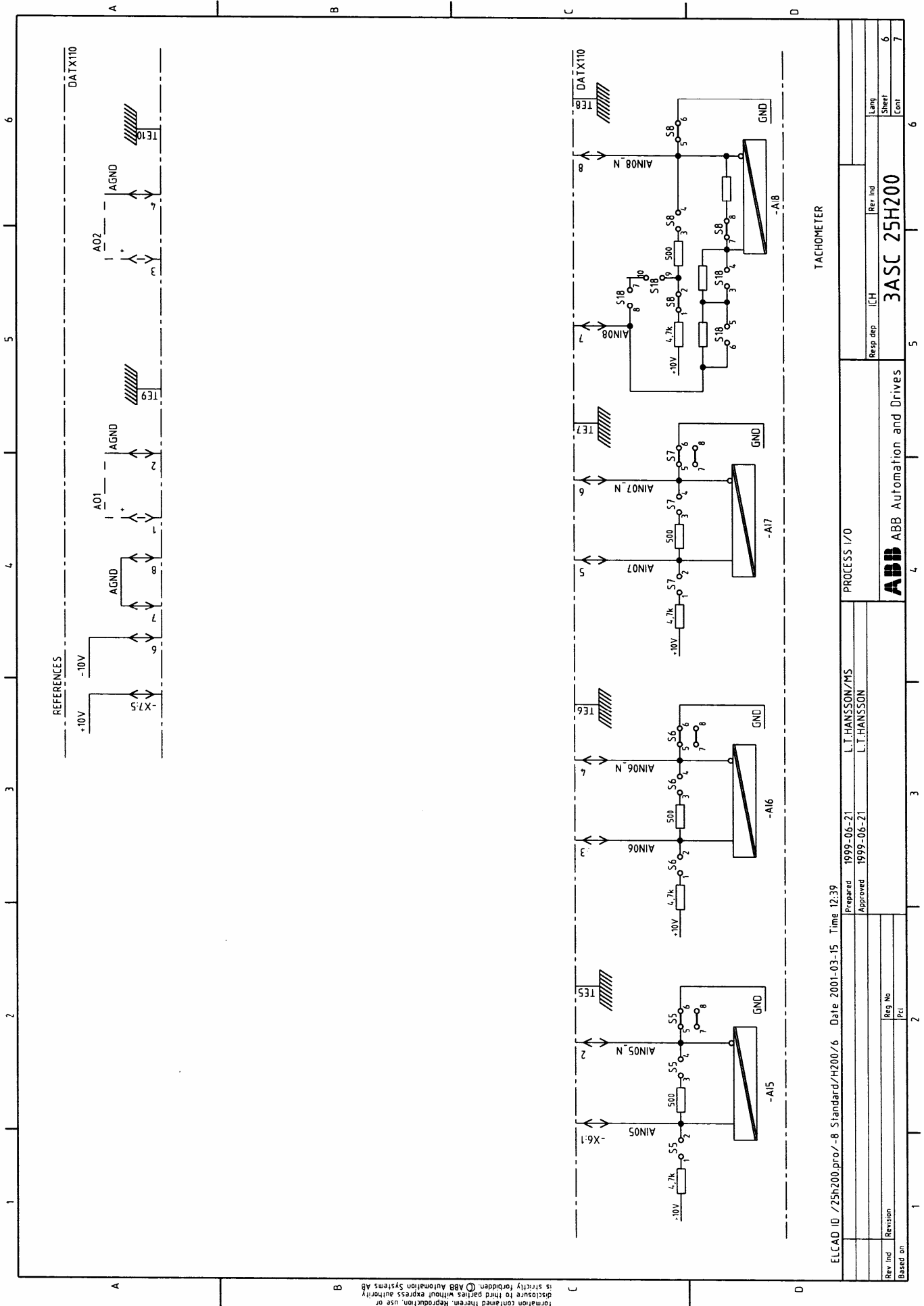
Resp dep	ICH	Rev Ind	5
Lang	Sheet	Sheet	6
Cont			6

PTC-4

PTC-3

PTC-2

PTC-1



ELCAD 10 / 25h200.pro/-8 Standard/H200/6 Date 2001-03-15 Time 12:39

Prepared	1999-06-21	L. I. HANSSON/MS
Approved	1999-06-21	L. I. HANSSON

PROCESS I/O

Resp dep [CH] Rev Ind

TACHOMETER

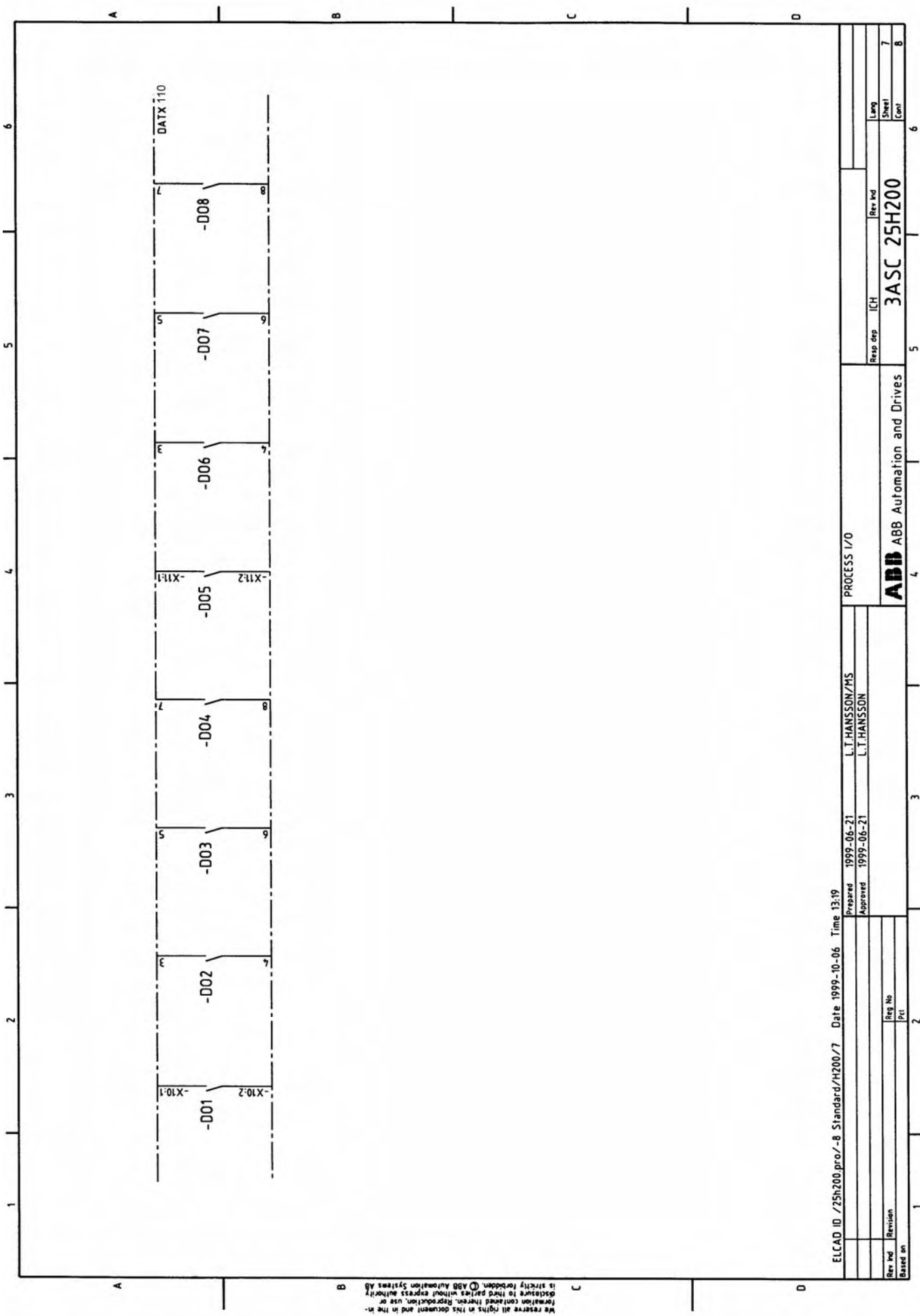
3ASC 25H200

ABB ABB Automation and Drives

Rev Ind	Revision	Reg No	Prct
6			
7			

Lang Sheet Cont

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ELCAD ID /25h200.pro/-8 Standard/H200/7 Date 1999-10-06 Time 13:19

Prepared 1999-06-21
Approved 1999-06-21

L.I. HANSSON/MS
L.I. HANSSON

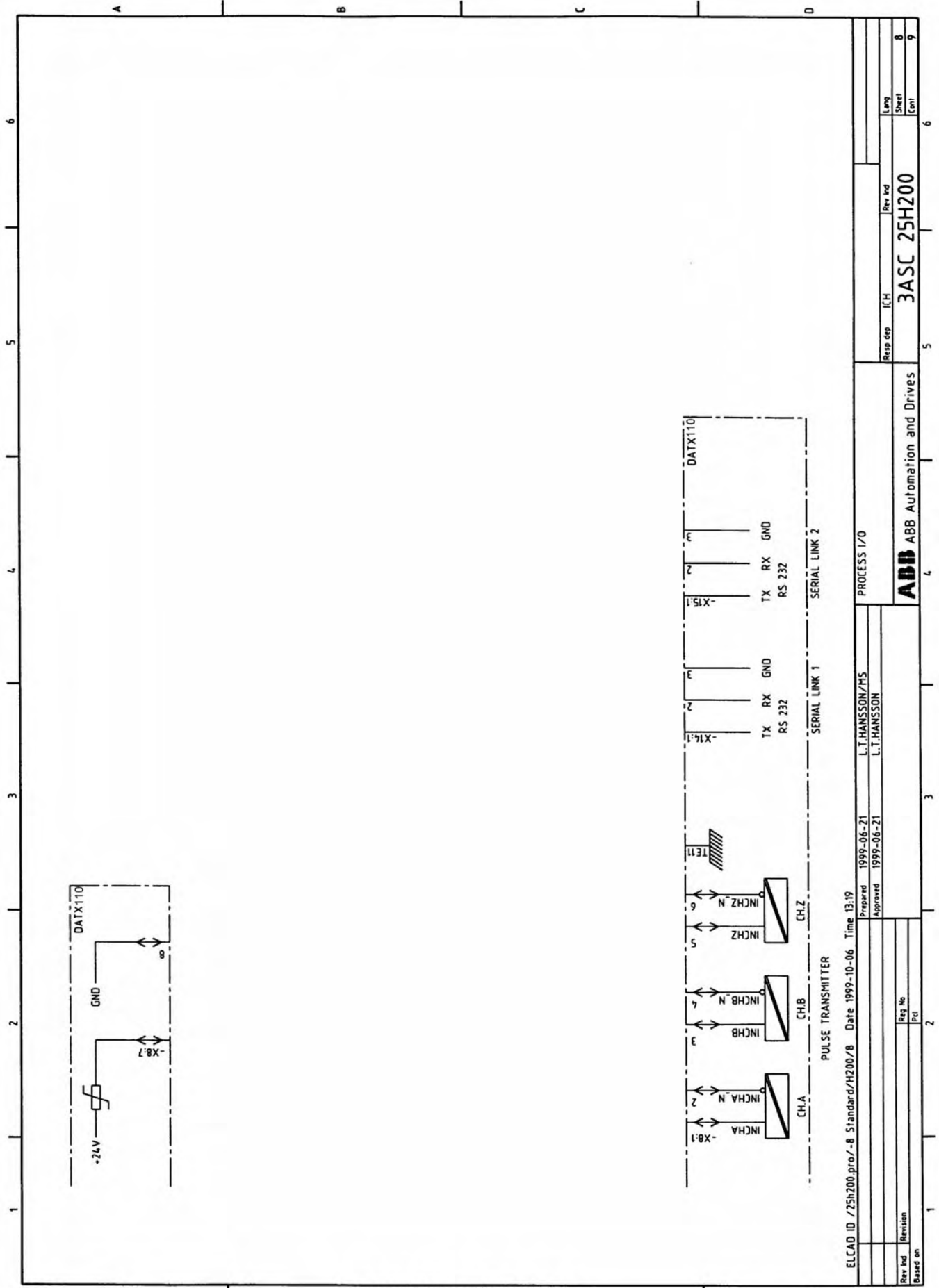
PROCESS I/O

Rev Ind	Revision	Reg No	Pri
Based on			

ABB ABB Automation and Drives

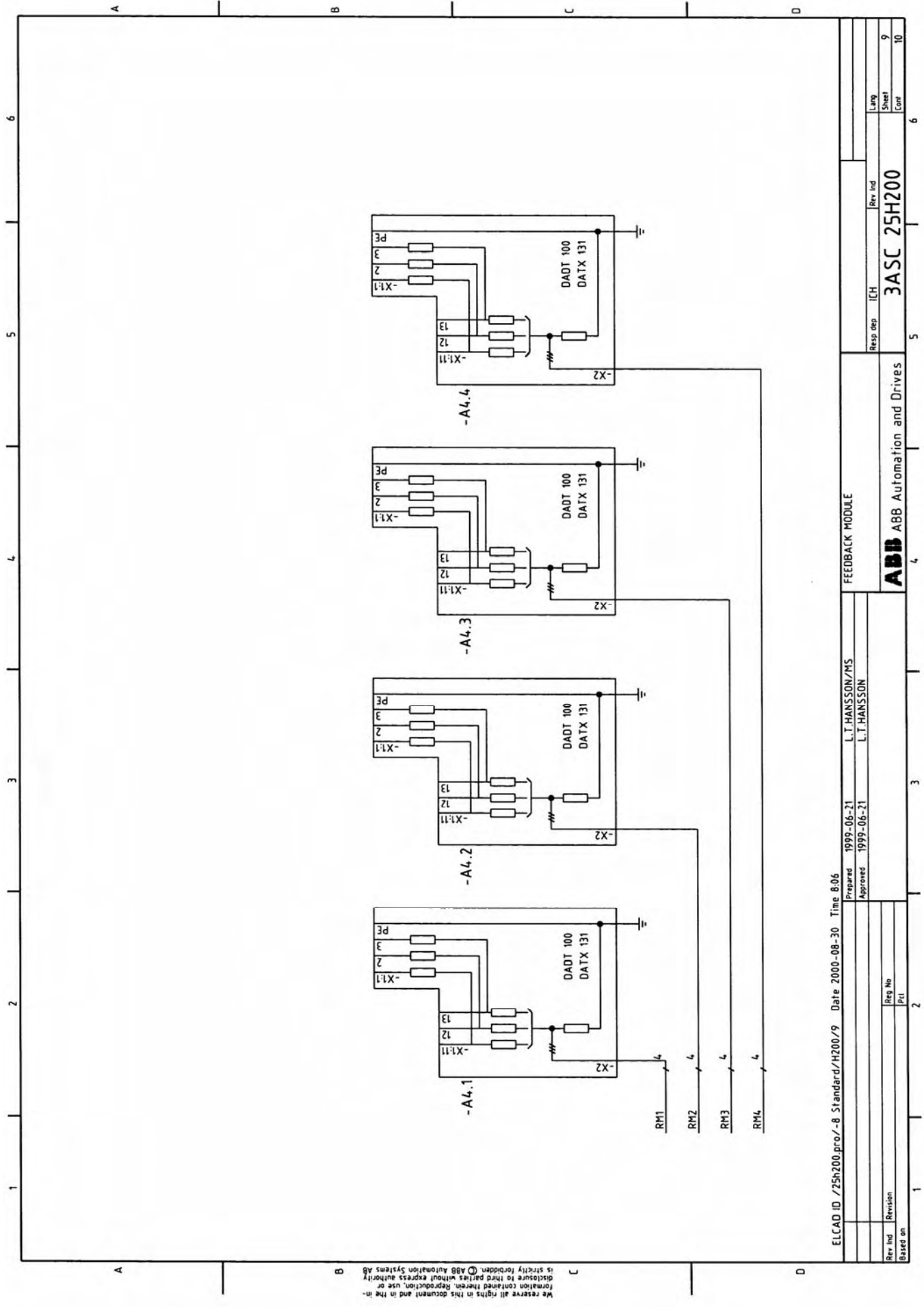
Resp dep ICH
3ASC 25H200

Long	6
Sheet	7
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ELCAD ID / 25h200 pro/-8 Standard/H200/8 Date 1999-10-06 Time 13:19		Prepared 1999-06-21 L.T.HANSSON/MS		PROCESS I/O	
Approved 1999-06-21 L.T.HANSSON				Resp dep ICH	
Rev Ind		Revision		Rev Ind	
Based on		Reg No		3ASC 25H200	
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2		2		6	
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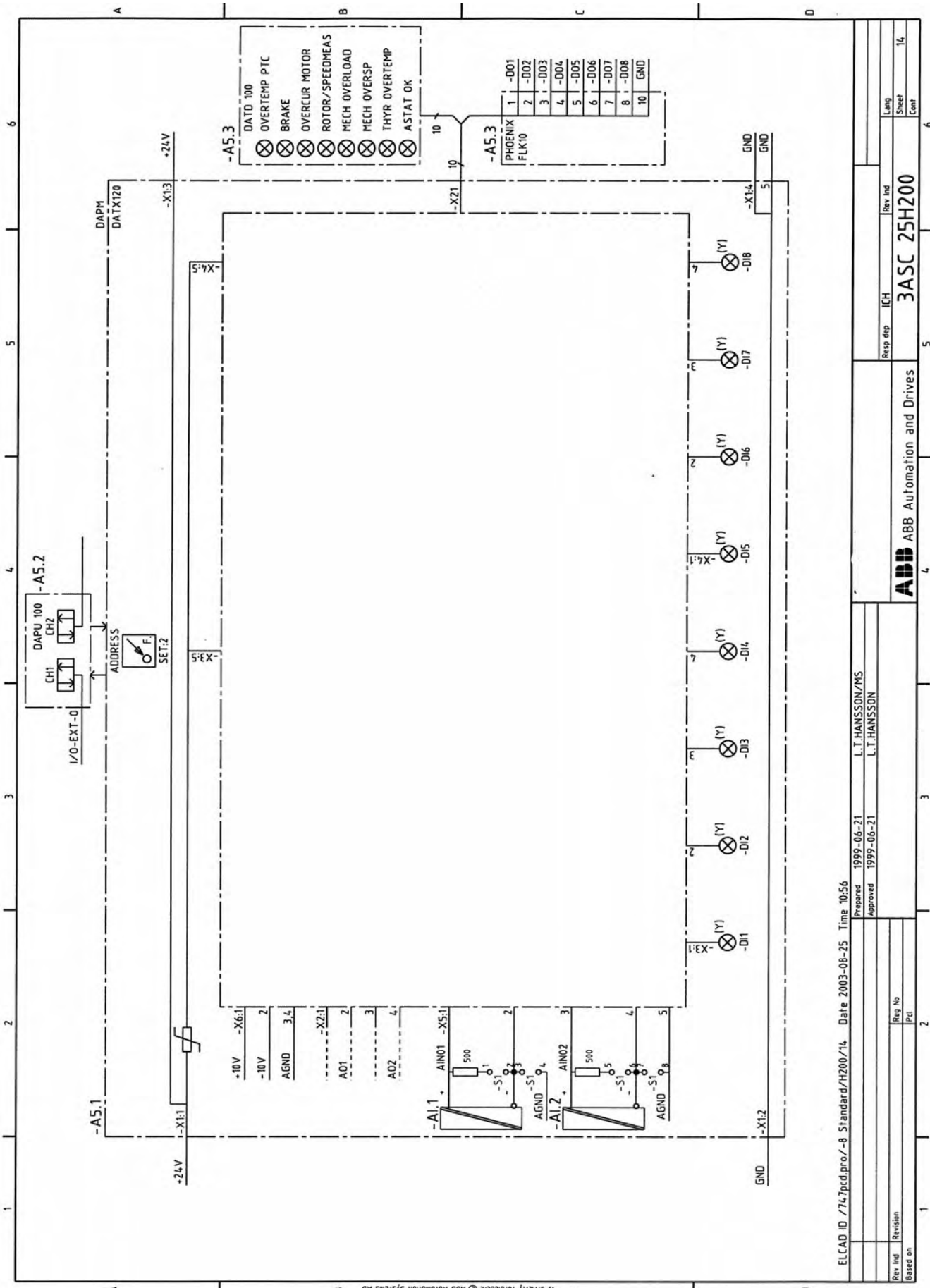
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ELCAD ID /25h200.pro/-8 Standard/H200/9 Date 2000-08-30 Time 8:06

Prepared 1999-06-21 L.T.HANSSON/MS
Approved 1999-06-21 L.T.HANSSON

FEEDBACK MODULE

Rev Ind	Rev No	Rev Ind	Rev No
Based on	Pct	Lang	Sheet
			9
		Resp dep	Con
			10
		3ASC 25H200	
ABB ABB Automation and Drives			



ELCAD ID /747pccd.pro/-B Standard/H200/14 Date 2003-08-25 Time 10:56

Prepared 1999-06-21 L.T.HANSSON/MS
Approved 1999-06-21 L.T.HANSSON

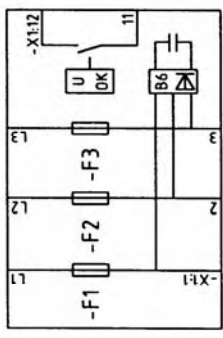
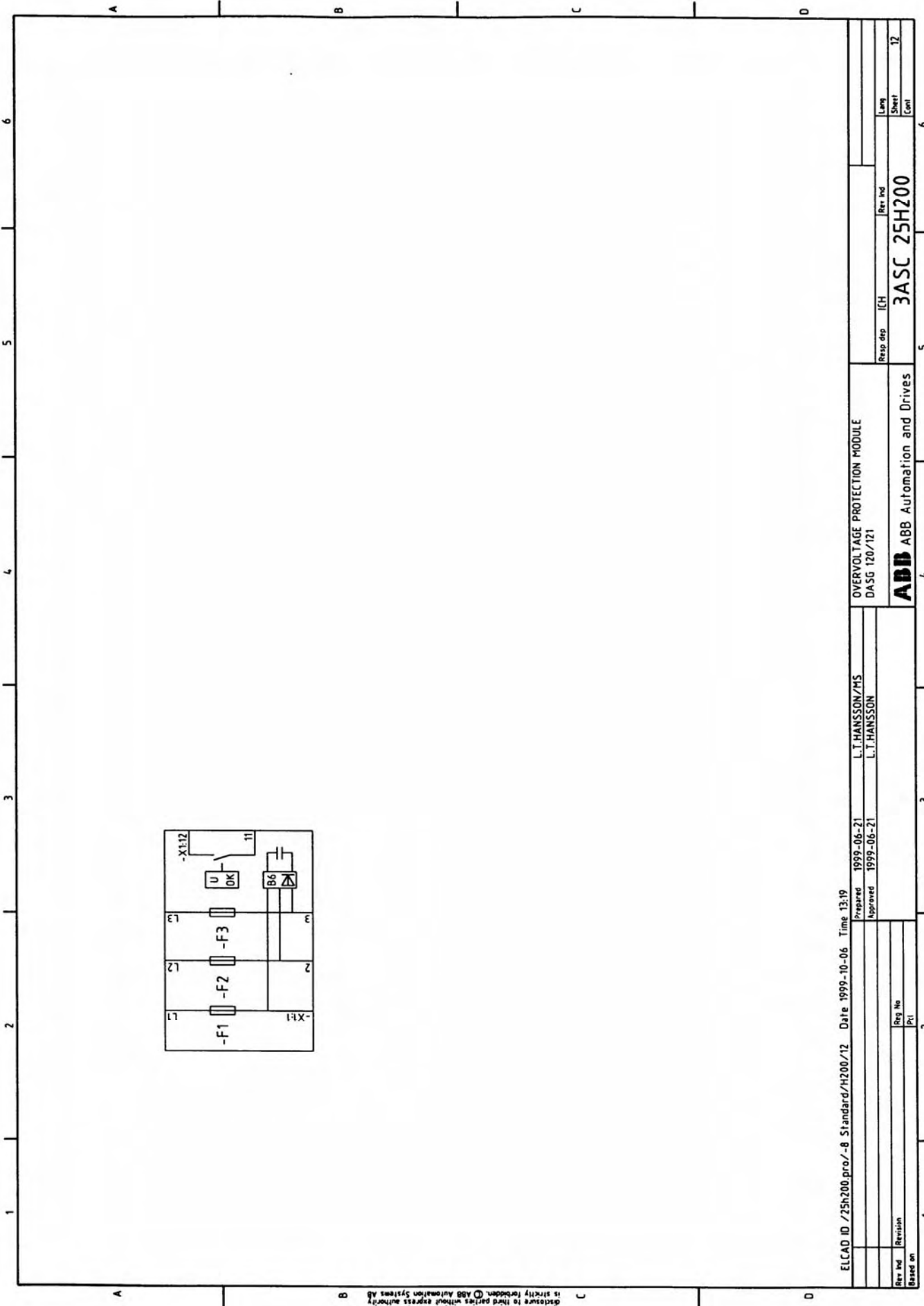
Rev Ind	Revision	Reg No	Per
Based on			

ABB Automation and Drives

3ASC 25H200

Lang	14
Sheet	
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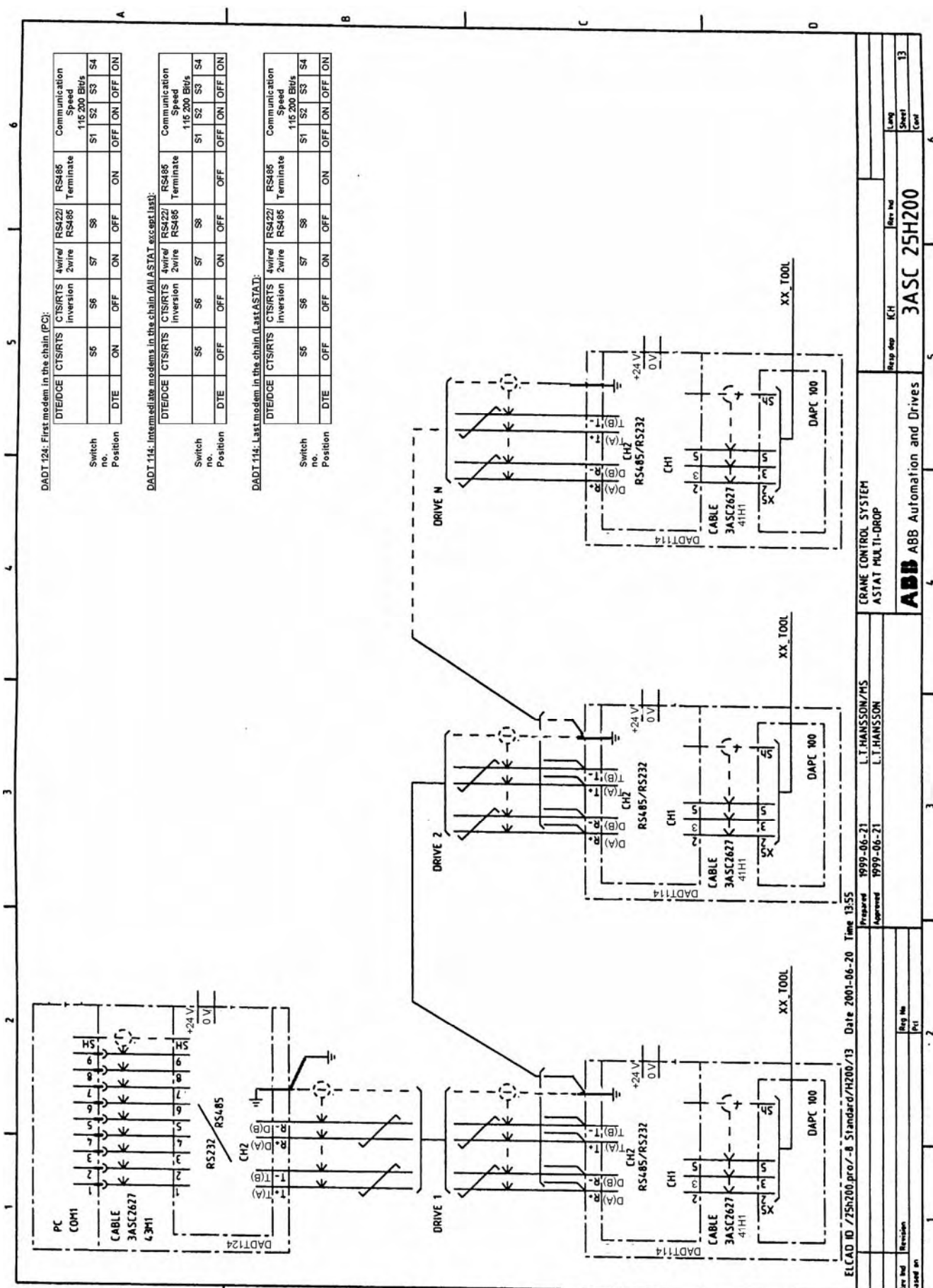
ELCAD ID /Z5h200.pro/-8 Standard/H200/12 Date 1999-10-06 Time 13:19

Prepared 1999-06-21 L.T.HANSSON/MS
 Approved 1999-06-21 L.T.HANSSON

OVERVOLTAGE PROTECTION MODULE
 DASG 120/121

Rev. No.	1	2	3	4	5	6
Revision						
Based on						
Resp. dep.	ICH			Res. Ind		
Part No.	3ASC 25H200					
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Cont.						

ABB ABB Automation and Drives



DADT.124: First modem in the chain (PC):

DTE/DOE	CTS/RTS	CTS/RTS Inversion	4wire/RS485	2wire/RS485 Terminate	RS422/RS485	RS485 Terminate	Communication Speed 115 200 Buds
S5	S6	S7	S8	S1	S2	S3	S4
ON	OFF	OFF	ON	OFF	ON	ON	OFF
DTE	ON	OFF	ON	OFF	ON	ON	OFF
Position	ON	OFF	ON	OFF	ON	ON	OFF

DADT.114: Intermediate modems in the chain (All ASTAT except Last):

DTE/DOE	CTS/RTS	CTS/RTS Inversion	4wire/RS485	2wire/RS485 Terminate	RS422/RS485	RS485 Terminate	Communication Speed 115 200 Buds
S5	S6	S7	S8	S1	S2	S3	S4
OFF	OFF	OFF	ON	OFF	OFF	OFF	ON
DTE	OFF	OFF	ON	OFF	OFF	OFF	ON
Position	OFF	OFF	ON	OFF	OFF	OFF	ON

DADT.114: Last modem in the chain (Last ASTAT):

DTE/DOE	CTS/RTS	CTS/RTS Inversion	4wire/RS485	2wire/RS485 Terminate	RS422/RS485	RS485 Terminate	Communication Speed 115 200 Buds
S5	S6	S7	S8	S1	S2	S3	S4
OFF	OFF	OFF	ON	OFF	ON	ON	OFF
DTE	OFF	OFF	ON	OFF	ON	ON	OFF
Position	OFF	OFF	ON	OFF	ON	ON	OFF

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ELCAD ID /75h200.pro-8 Standard/H200/13 Date 2001-06-20 Time 13:55
 Prepared 1999-06-21 L.T.HANSSON/MS
 Approved 1999-06-21 L.T.HANSSON

CRANE CONTROL SYSTEM
 ASTAT MULTI-DROP

3ASC 25H200

ABB Automation and Drives

Rev No: 13
 Sheet: 13
 Cont: 6

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<p> <small> Rev Ind Revision </small> </p>	<p> <small> Reg No PCL </small> </p>	<p> <small> Prepared 1999-06-21 L.T.HANSSON/MS Approved 1999-06-21 L.T.HANSSON </small> </p>	
<p> <small> ELCAD ID /25h200 pro./- 8 Standard/HZ00/12 Date 1999-08-02 Time 15:38 </small> </p>		<p> <small> ABB ABB Automation and Drives </small> </p>	
<p> <small> Resp dep ICH </small> </p>		<p> <small> Rev Ind </small> </p>	
<p> <small> 3ASC 25H200 </small> </p>		<p> <small> Long Sheet Cont </small> </p>	

12. Reference section

12.1. Technical information

12.1.1. LEDs

	LED name	Colour	Function
12.1.1.1. Board DAPC 100			
	5V OK	Green	
	I/O	Yellow	Process I/O Communication
	MC	Yellow	Horizontal link I
	M/F	Yellow	Horizontal link II
	STATUS	Two 7-segment indicators	
	TOOL	Yellow	Tool/ Terminal connector
12.1.1.2. Board DAPU 100			
	I/O	Yellow	Process I/O Communication
	I/O E	Yellow	Process I/O Communication Extended
	RUN OK	Green	
	TERM	Yellow	Terminal connector
12.1.1.3. Board DATX 110			
	110V OK	Green	
	ASYM	Red	Asymmetry between two bridges
	EARTH FAULT	Red	Earth fault on 110V
	AI 1- AI 4	Yellow	Analogue Input software controlled level
	DI 1- DI 16	Yellow	Digital Input active
	DO 1- DO 8	Yellow	Digital output active
12.1.1.4. Board DATX 130			
	V1 (top)	Motor 4 (top)	Green: Speed feedback OK. Yellow: Supervision OK Red: Fault
	V2	Motor 3	Green: Speed feedback OK. Yellow: Supervision OK Red: Fault
	V3	Motor 2	Green: Speed feedback OK. Yellow: Supervision OK Red: Fault
	V4	Motor 1	Green: Speed feedback OK. Yellow: Supervision OK Red: Fault
	V24	Green	5V OK
12.1.1.5. Board DATD 100			
	OVER TEMP PTC	Red	
	BRAKE	Red	
	OVERCURRENT MOTOR	Red	
	ROTOR / SPEED MEAS	Red	
	MECH OVERLOAD	Red	
	MECH OVERSPEED	Red	
	THYR OVERTEMP	Red	
	ASTAT OK	Green	

12.1.2. Address switches

12.1.2.1. Board DATX 110

Always: **Position 1**

12.1.2.2. Board DATX 120 (121) / DAPM 100 (101)

Operator station No. 1: **Position 2**

Operator station No. 2: **Position 3, only for DATX 120**

12.1.2.3. Tool modem set DADT 114 and 124

Maker of modem: Phoenix Contact 2744416 with DAPC 100 Generation 1 and Generation 2

DADT114, Modem for ASTAT(s)

Last modem in the chain (Last ASTAT)

	DTE/DCE	CTS/RTS	CTS/RTS inversion	4 wire/ 2 wire	RS422/ RS485	RS485 Terminate	Communication Speed 115 200 Bit/s			
Switch		S5	S6	S7	S8		S1	S2	S3	S4
Setting	DCE	OFF	OFF	ON	OFF	ON	OFF	ON	OFF	ON

Intermediate modems in the chain (All ASTAT except last)

	DTE/DCE	CTS/RTS	CTS/RTS inversion	4 wire/ 2 wire	RS422/ RS485	RS485 Terminate	Communication Speed 115 200 Bit/s			
Switch		S5	S6	S7	S8		S1	S2	S3	S4
Setting	DCE	OFF	OFF	ON	OFF	OFF	OFF	ON	OFF	ON

DADT124, Modem for PC

First modem in the chain (PC)

	DTE/DCE	CTS/RTS	CTS/RTS inversion	4 wire/ 2 wire	RS422/ RS485	RS485 Terminate	Communication Speed 115 200 Bit/s			
Switch		S5	S6	S7	S8		S1	S2	S3	S4
Setting	DCE	ON ²²	OFF	ON	OFF	ON	OFF	ON	OFF	ON

²² Corrected in this version: Was "OFF" in Manual version 10_053 and earlier.
Page 248 Manual 3BSE 017 422 R0008EN for ASTAT version 10_054

12.1.3. Process indication codes

The following codes are used to indicate errors detected internally or externally by the Control System Module.

For software before AST10_04: If no Fault, it will show the CPU-load of the control system in percent for Pulse Encoder / Tachometer speed feedback or the Rotor frequency in Hertz for Rotor frequency feedback. Values larger than 99 Hz are presented as EE.

For software including AST10_04 and later: If no Fault, it shows program version and revision letter, "40" for AST10_04 without revision.

In case there is an error, the display will toggle "F1" and the error code. Example: PHASE SEQUENCE WRONG will display F1-01-F1-01-F1-01.....

Generally: Load related signals would disappear when the master switch is returned to the neutral position. All other indications will remain until pushbutton "RESET" is pressed or Crane is turned ON. For most faults RESET will be disabled until crane is turned OFF. All non-persistent fault will disappear at the same time when pressing.

From release 10_054 the code will stay until reset is activated, although the motion is ready to run after a motion OFF -> ON sequence.

All start of motion, Fault or not fault, must be initialised by "ZERO POS-signal"

no.	Name	Action	How to Reset?	Blocked in Factory test mode?
01	PHASE SEQUENCE WRONG or FREQUENCY OUT OF RANGE	Motion stopped	OFF	
02	PHASE L1 MISSING	Motion stopped	OFF	
03	PHASE L2 MISSING	Motion stopped	OFF	
04	PHASE L3 MISSING	Motion stopped	OFF	
05	LINE VOLTAGE L1 < Set level	Motion stopped	OFF	
06	LINE VOLTAGE L2 < Set level	Motion stopped	OFF	
07	LINE VOLTAGE L3 < Set level	Motion stopped	OFF	
31	DAPC 100 ERROR	Motion stopped	OFF	
32	DATX 110 NOT FOUND	Motion stopped	OFF	
33	DATX 120:1 NOT FOUND	Motion stopped	OFF	
34	DATX 120:2 NOT FOUND	Motion stopped	OFF	
35	DATX 120:3 NOT FOUND	Motion stopped	OFF	
36	MASTER-FOLLOWER ERROR	Motion stopped	OFF	
37	DATX 130 NOT FOUND	Motion stopped	OFF	
43	110 V DC TOO LOW	Motion stopped	OFF	
44	110 V DC EARTH FAULT	None	OFF OR RESET	
45	Not possible combination of direction and zero position signals from master switch	Motion stopped	OFF	
46	UNBALANCE; PARALLEL BRIDGES	Motion stopped	OFF	
47	ERROR IN THYRISTOR TEMPERATURE MEASUREMENT	None	OFF OR RESET	
48	CRANE UNCONTROLLED STOPPED	Motion stopped (by itself)	CONTROL VOLT. OFF	
49	4 - 20 mA load cell signal broken	None	OFF OR RESET	
50	Mismatch of reference polarity and direction signals of joystick	None	OFF	
51	Manual operation: JOYSTICK NOT IN NEUTRAL SWITCHING WHEN SHARED MOTION WAS SELECTED / Computer operation: REMOTE OPERATION ABNORMALLY ENDED. MASTER SWITCH OUT OF ZERO or COMMUNICATION BREAK DOWN	Joystick must back to neutral before the new motion is active / Motion stopped	OFF	
52	PTC TRIP no.1	Motion stopped	OFF	
53	PTC TRIP no.2	Motion stopped	OFF	
54	PTC TRIP no.3	Motion stopped / None	OFF or RESET if the PTC is for Warning	
55	PTC TRIP no.4	Motion stopped / None	OFF or RESET if the PTC is for Warning	
57	BRAKE NO ACK. no.1	Motion stopped	OFF	
58	BRAKE NO ACK. no.2	Motion stopped	OFF	
59	BRAKE NO ACK. no.3	Motion stopped	OFF	
60	BRAKE NO ACK. no.4	Motion stopped	OFF	

no.	Name	Action	How to Reset?	Blocked in Factory test mode?
61	CABLE RELAY no.1	Motion stopped	OFF	
62	CABLE RELAY no.2	Motion stopped	OFF	
63	CABLE RELAY no.3	Motion stopped	OFF	
64	CABLE RELAY no.4	Motion stopped	OFF	
65	SPEED DEVIATION	Motion stopped	OFF	Blocked
66	PULSE TRANSMITTER FAULT	Motion stopped	OFF	Blocked
67	ROTOR FREQ. MEAS FAULT no.1	Motion stopped	OFF	
68	ROTOR FREQ. MEAS FAULT no.2	Motion stopped	OFF	
69	ROTOR FREQ. MEAS FAULT no.3	Motion stopped	OFF	
70	ROTOR FREQ. MEAS FAULT no.4	Motion stopped	OFF	
71	TORQUE FAULT	Motion stopped	OFF	Blocked
72	OVERLOAD, DI	Motion stopped, Direction A (or B) blocked.	Master switch	Blocked
73	OVERLOAD, AI	Motion stopped, Direction A (or B) blocked.	Master switch	Blocked
75	OVERSPEED, DI	Motion stopped	CONTROL VOLT. OFF	Blocked
76	OVERSPEED, CALCULATED	Motion stopped	CONTROL VOLT. OFF	Blocked
77	OVERTEMP. THYRISTORS	Motion stopped	OFF	
78	SLACK ROPE; SLOW DOWN	Stop as PRE LIMIT switch	Master switch	Blocked
79	SLACK ROPE; STOP	Stop as STOP LIMIT switch	Master switch	Blocked
80	NOT POSSIBLE LIMIT SWITCH VALUES	Motion stopped	OFF	Blocked
81	EARTH FAULT ROTOR no.1	Motion stopped	OFF	
82	EARTH FAULT ROTOR no.2	Motion stopped	OFF	
83	EARTH FAULT ROTOR no.3	Motion stopped	OFF	
84	EARTH FAULT ROTOR no.4	Motion stopped	OFF	
85	UNSYMMETRICAL ROTOR no.1	Motion stopped	OFF	
86	UNSYMMETRICAL ROTOR no.2	Motion stopped	OFF	
87	UNSYMMETRICAL ROTOR no.3	Motion stopped	OFF	
88	UNSYMMETRICAL ROTOR no.4	Motion stopped	OFF	
89	TACHOMETER FAULT	Motion stopped	OFF	Blocked
90	The brakes could withstand the applied test torque at start	Motion stopped	OFF	
91	Hoist speed not able to follow the reference-based tracking. Overspeed risk.	Motion stopped	CONTROL VOLT. OFF	

12.1.4. Jumpers

Jumper (x=Delivery) Function name setting

12.1.4.1. Board DAPC 100

12.1.4.1.1. Generation 1

Generation 1 boards have four pairs of opto couplers in the left part of the upper edge

S1:1-2	x	Single bridge	
:3-4		Double bridge	
S2:1-2		TXD_UP to Terminal	(RS232)
:3-4		RXD_UP to Terminal	(RS232)
:5-6		TXDA2 to Tool	(RS485)
:7-8		RXDA2 to Tool	(RS485)
S3:1-2	x	TXD_UP to Tool	(RS232)
:3-4	x	RXD_UP to Tool	(RS232)
:5-6	x	TXDA2 to Terminal	(RS485)
:7-8	x	RXDA2 to Terminal	(RS485)
S4:1-2	x	Baud rate	9,6k
:3-4		Baud rate	19,2k
:5-6		Baud rate	38,4k
:7-8		Baud rate	115 k (Try this setting first)

12.1.4.1.2. Generation 2

Generation 2 boards have three pairs of opto couplers in the left part of the upper edge

S1:1-2	x	Single bridge	
:3-4		Double bridge	
S4:1-2		Baud rate	9,6 k
:3-4		Baud rate	19,2 k
:5-6		Baud rate	38,4 k
:7-8	x	Baud rate	115,2 k

Jumper (x=Delivery) Function name setting

12.1.4.2. Board DATX 120

BOARD ADDRESS x = 2

S1:1-2		Shunt resistor (500 ohm) for current input signals AI 1	
:3-4	x	Ground connection of negative input AI 1	
:5-6		Shunt resistor (500 ohm) for current input signals AI 2	
:7-8	x	Ground connection of negative input. AI 2	

1.1.3.5 Board DATD 100

S2:1-2	x	LED pos1, red	
:3-4	x	LED pos2, red	
:5-6	x	LED pos3, red	
:7-8	x	LED pos4, red	
:9-10	x	LED pos5, red	
:11-12	x	LED pos6, red	
:13-14	x	LED pos7, red	
S1:1-2	x	LED pos8, green	

12.1.5. Test terminals

12.1.5.1. Board DAPC 100

T1	Current feedback
T2	0V

Jumper (x=Delivery) Function name setting

12.1.5.2. Board DATX 110

BOARD ADDRESS x = 1

- S1-4:1-2 **x** Analogue Input 1-4. Current source for PTC
- :3-4 Shunt resistor (500 ohm) for current input signals
- :5-6 **x** Ground connection of negative input.
- :7-8 Rest position for spare jumper.

- S5-7:1-2 Analogue Input 5-7. Current source
- :3-4 Shunt resistor (500 ohm) for current input signals
- :5-6 **x** Ground connection of negative input
- :7-8 **x** Rest position for spare jumper.

Setting of S8 and S18 groups for AI 8, Tachometer feedback

Attenuation	Max input	Jumper group S8				Jumper group S18				
		1-2	3-4	5-6	7-8	1-2	3-4	5-6	7-8	9-10
1:1	10 V			H		H	H	H		
1:5	50 V			H	H	H	H			
1:10	100 V			H	H	H				

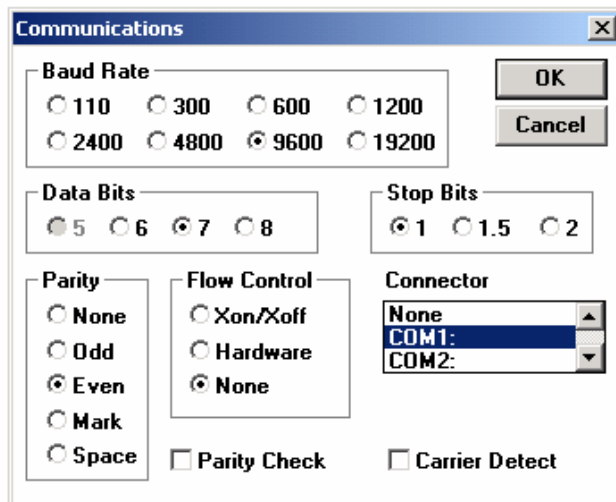
H = the jumper is inserted

- S10:3-4 Pulse encoder. Setting of maximum speed channel A **5 kHz**
- :1-2 **x** Pulse encoder. Setting of maximum speed channel A **20 kHz**
- :1-3 Pulse encoder. Setting of maximum speed channel A **50 kHz**
- S11:3-4 Pulse encoder. Setting of maximum speed channel B **5 kHz**
- :1-2 **x** Pulse encoder. Setting of maximum speed channel B **20 kHz**
- :1-3 Pulse encoder. Setting of maximum speed channel B **50 kHz**
- S12:3-4 Pulse encoder. Setting of maximum speed channel Z **5 kHz**
- :1-2 **x** Pulse encoder. Setting of maximum speed channel Z **20 kHz**
- :1-3 Pulse encoder. Setting of maximum speed channel Z **50 kHz**

12.1.6. Data for in- and out-puts

12.1.6.1. Board DAPC 100

Terminal RS 232 setting:



12.1.6.2. Board DATX 110

DI: 110 V DC. Galvanically separated. Internally supplied voltage.
Logical false: < 15 V. Logical True: > 25 V

DO: 250 V AC Relay. Suitable for connection of relay and contactor coils. Max. pull in current 2 A.

AI No. 1 - 4: with programmable LEDs.

AI No. 1 - 7: ± 10 V or 0 - 20 mA, selectable with jumper. Galvanically separated.
Resolution 11 bits + 1 bit sign.

AI 8: ± 10 V, ± 50 V, ± 100 V, or 0 - 20 mA, selectable with jumper. Galvanically separated.
Resolution 11 bits + 1 bit sign.

AO: ± 10 V. Galvanically separated. Resolution 11 bits + 1 bit sign.

Pulse encoder:

A, B and Zero channels. 24 V supply internally supplied (short circuit protected).
DATX 110 generation PR:A can be loaded with 200 mA,
DATX 110 generation PR:B or newer with 500 mA

12.1.6.3. Board DATX 120

DI: 24 V DC. Galvanically separated. Logical false: < 5 V. Logical True: > 10 V

DO: Dedicated for LED indication board.

AI: ± 10 V or 0 - 20 mA, selectable with jumper. Galvanically separated.
Resolution 11 bits + 1 bit sign.

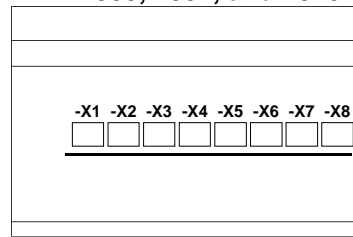
AO: ± 10 V. Galvanically separated. Resolution 11 bits + 1 bit sign.

24 V supply internally supplied (short circuit protected). Terminals -X3:5 / -X4:5. Only for the DIs of the board.

12.1.7. Dimensions

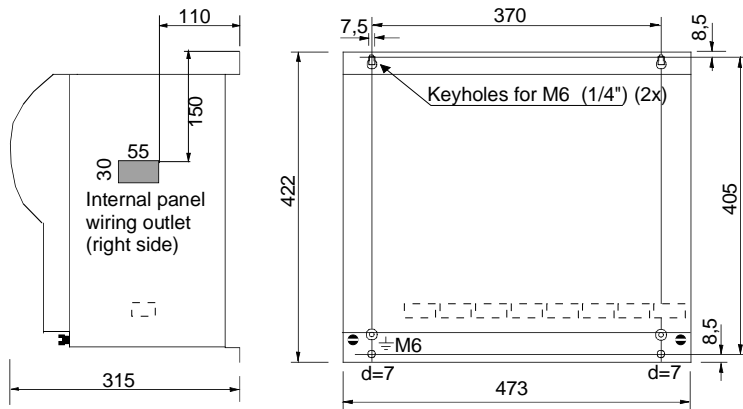
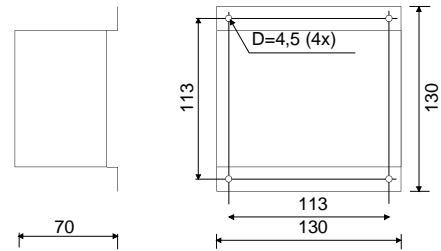
All dimension drawings are made with the European projection method, showing the top in the lower part of each sketch and the right side in the left part of each sketch.

Control System modules DARA 1000, 1001, and 1010



Free space bottom: Given by cables

DADT 100, Feedback Module.

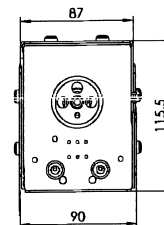
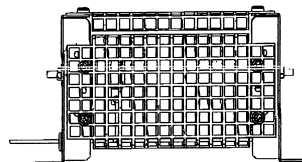


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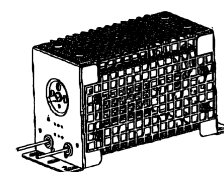
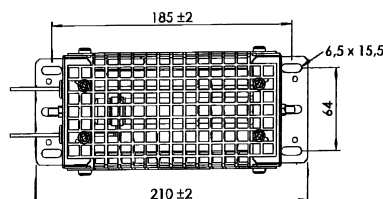


Grounding resistor for Star-point of rotor resistor

Identity: 3ASC531201A550
Data: 50 W 50 000 Ohm

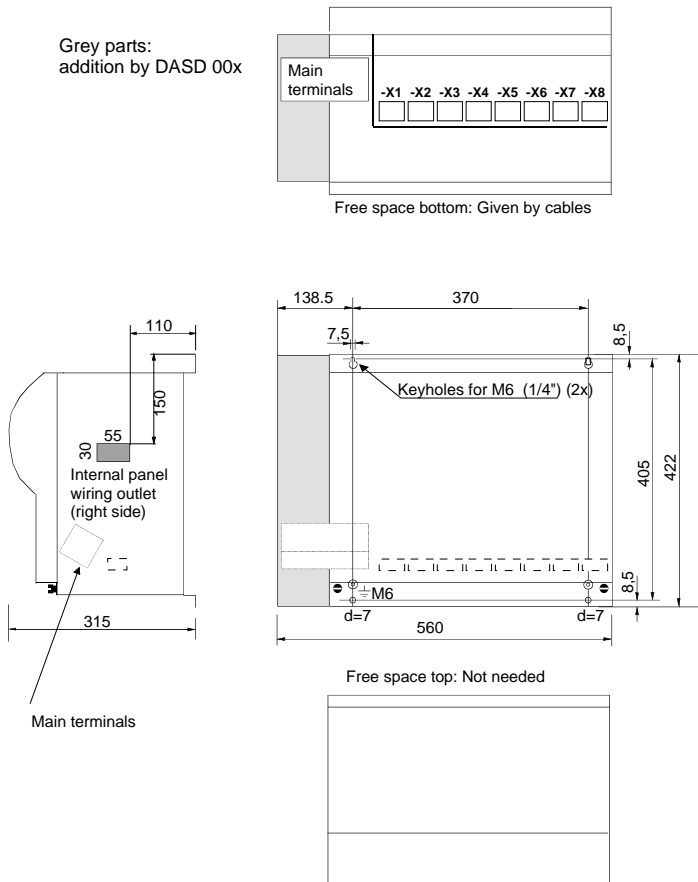


Both ends: Black cable, L = 1,5 m



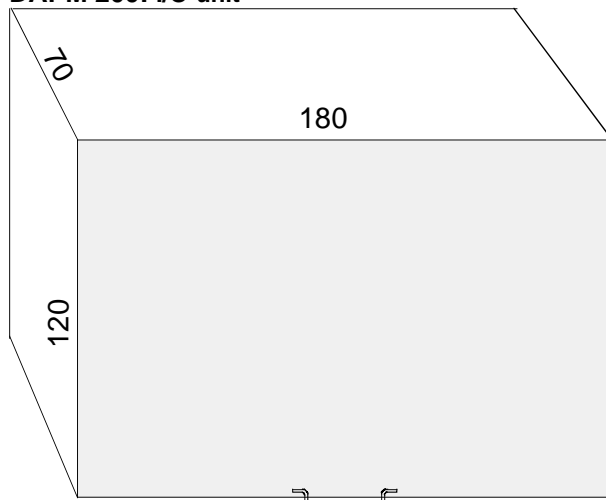
DARA1000, 1001 with Thyristor Module DASD 001, 002 or 003

The given dimensions are after assembly of the Modules.

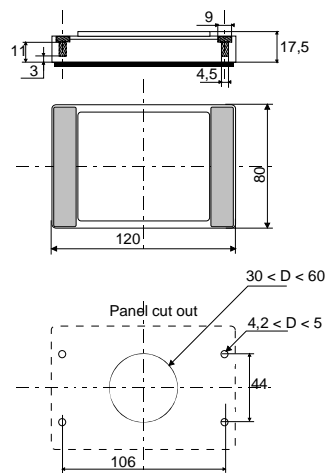


Remote I/O / Cabin I/O DAPM 100 = DAPM 200 + DAPM 300

DAPM 200: I/O-unit

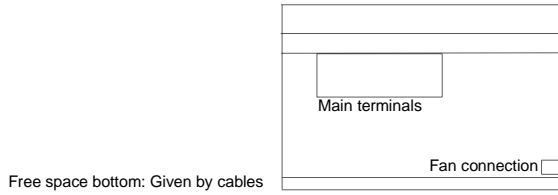


DAPM 300: Indication part

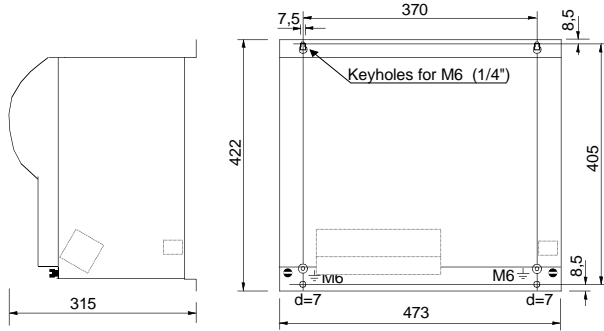


The 35 mm mounting rail is not included in the dimensions. Free space between connection parts:
 Vertical rail: 70 mm
 Horizontal rail: 35 mm
 Rail mounted in bottom: 35 mm

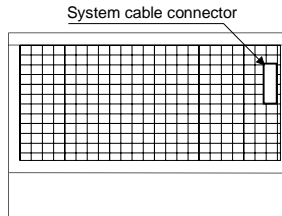
DASD 101, 102, 103, 111, 112, 113



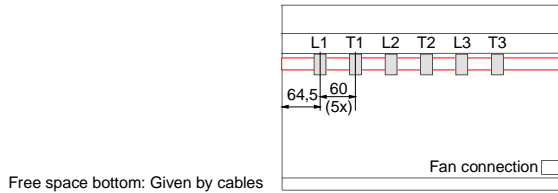
Free space bottom: Given by cables



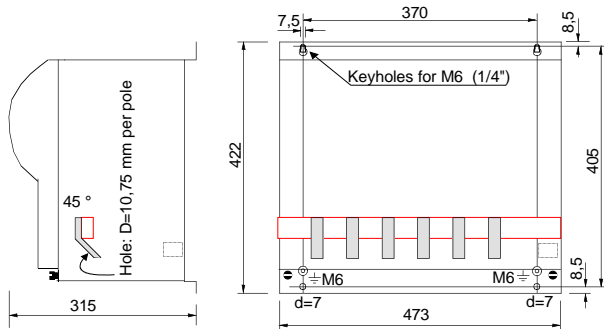
Free space top: 75 mm



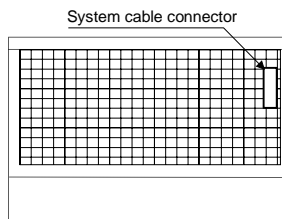
DASD 104, 105, 114, 115, 151, 152, 153, 154, 155



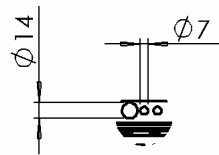
Free space bottom: Given by cables



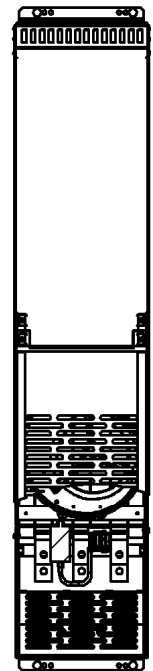
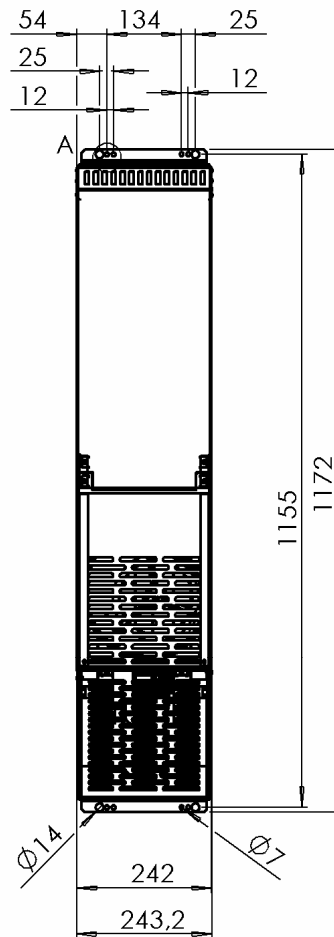
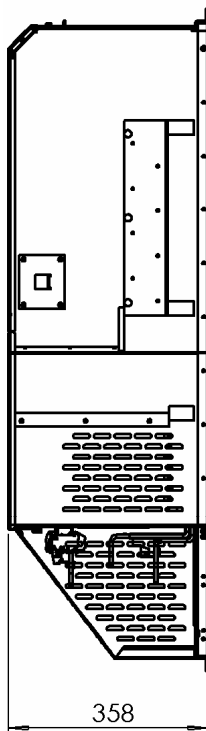
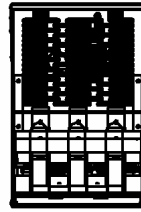
Free space top: 75 mm



DASD 145



DETAIL A
SCALE 1 : 5



Connections:

Incoming: Bars 30 x 6. Hole D = 11 with aux. M4

Motor side: Bars 30 x 6. Hole D= 11

Fan connection, down: Single phase 230 V.

System cable connection: top.

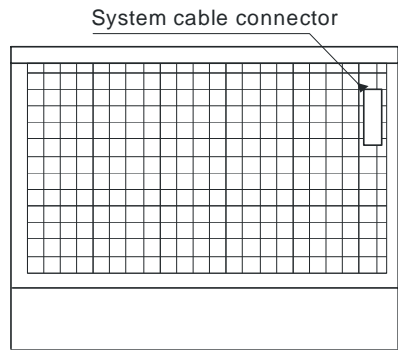
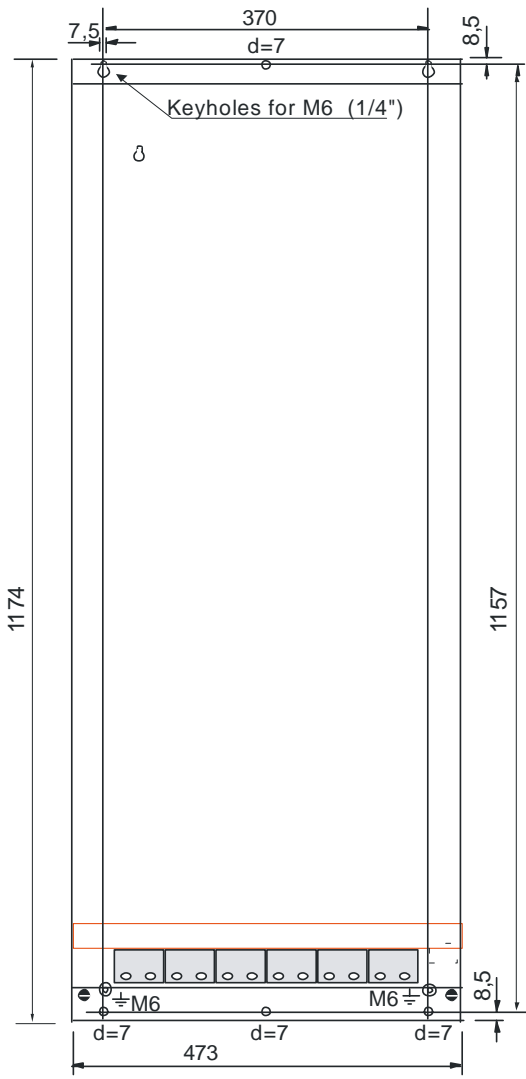
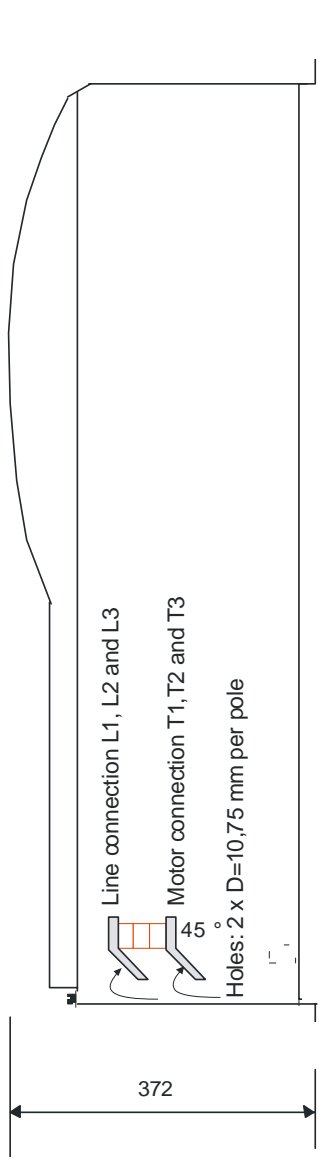
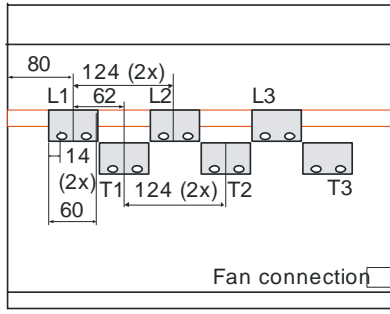
Fulfil IP20 with connection box cover mounted.

Free space on top:

75 mm

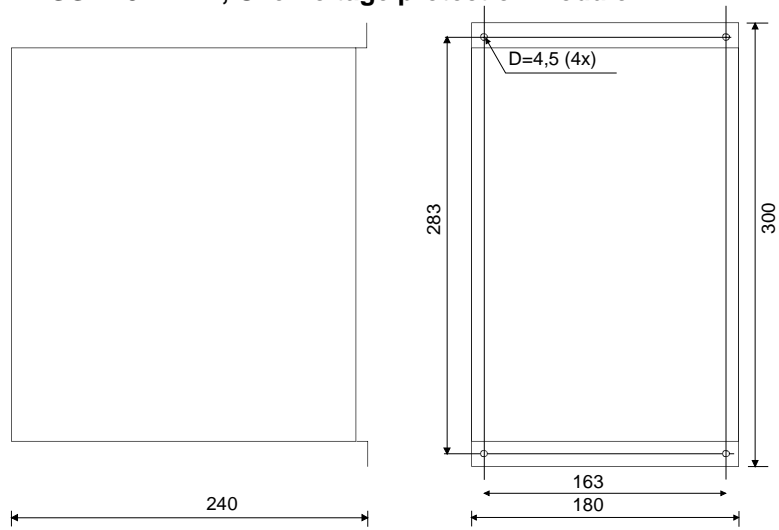
DASD 146, 147, 156, 157

Free space bottom: Given by cables

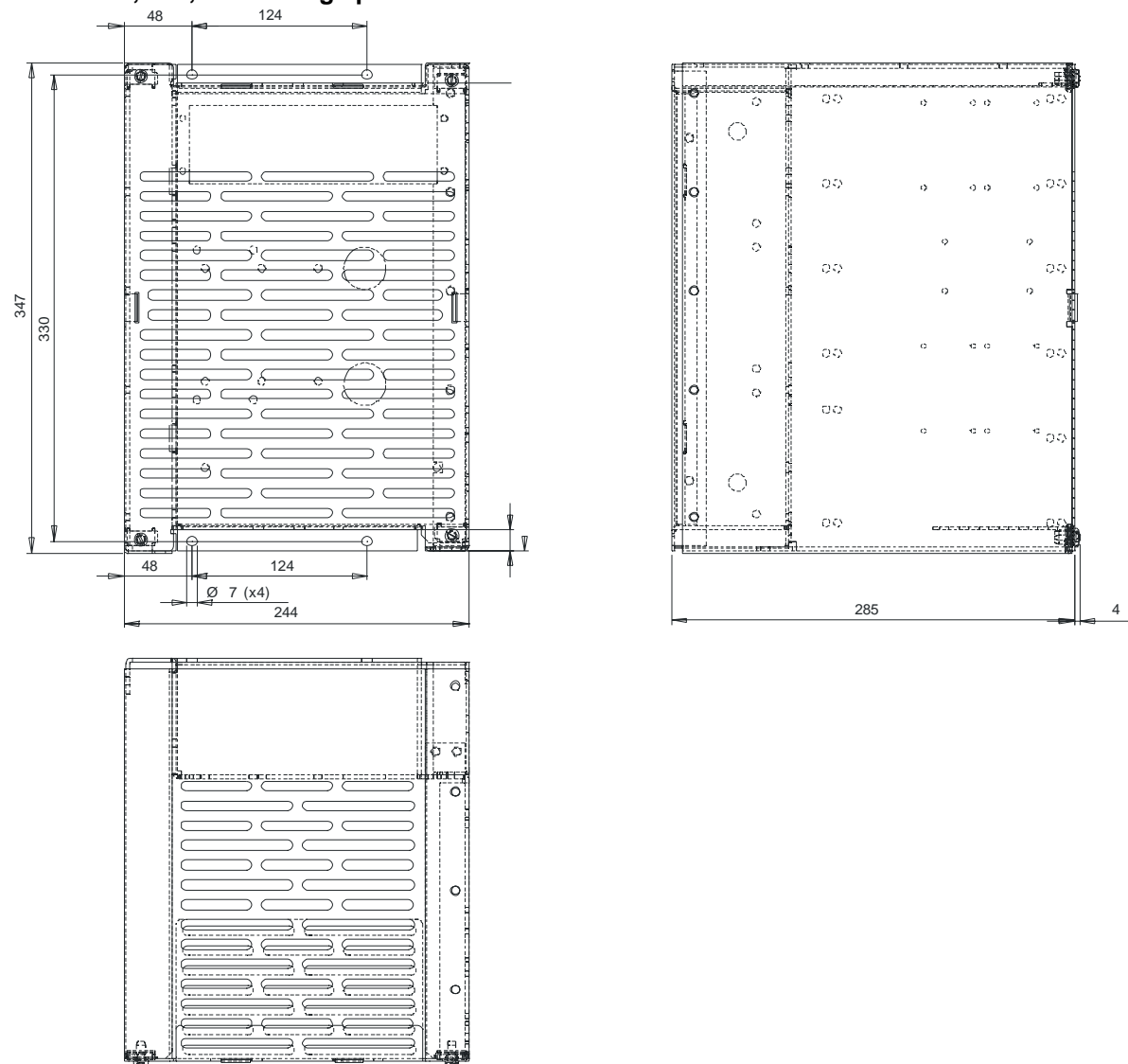


Free space top: 75 mm

DASG 218 ... 221, Overvoltage protection Module.

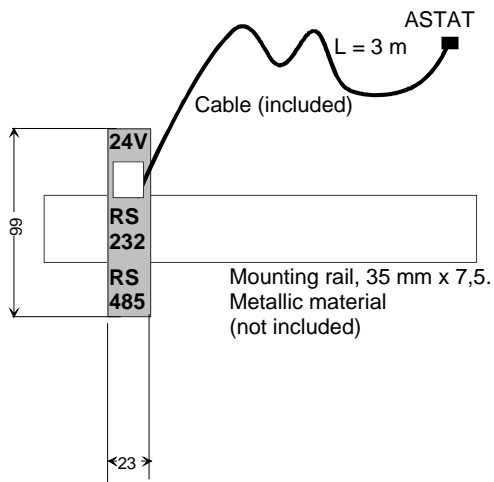
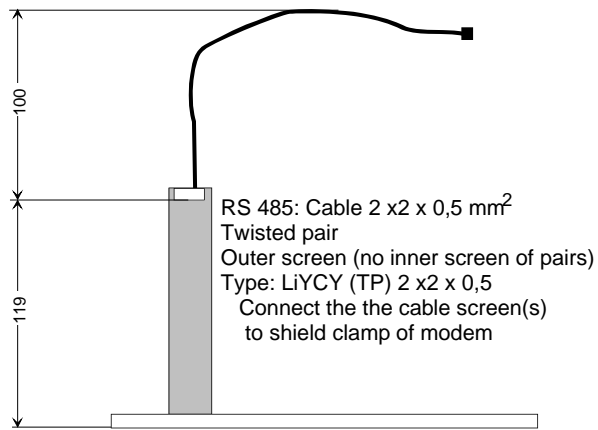


DASG 222, 223, Overvoltage protection Module.

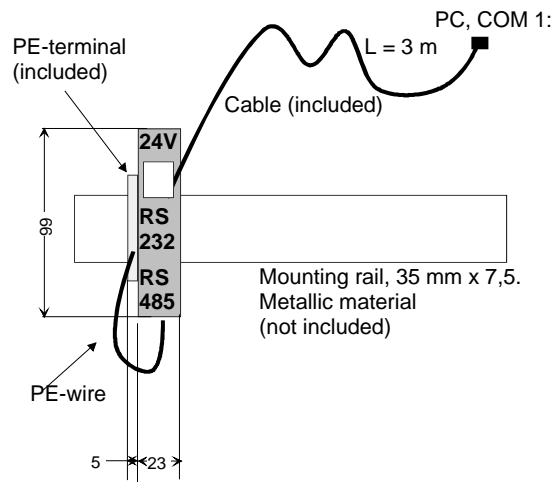
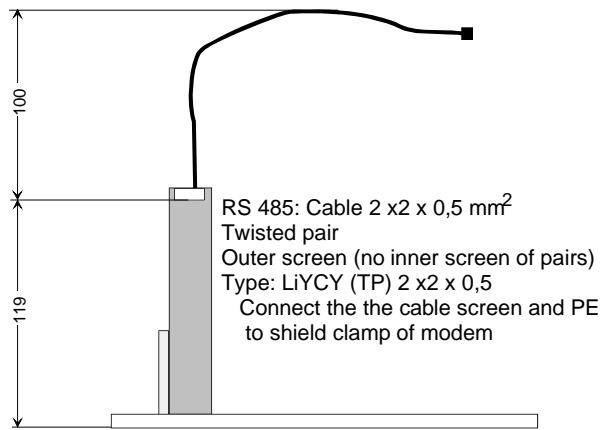


Tool modem sets

DADT 114



DADT 124



12.2. Operations limits and tests

12.2.1. Temperature

Operation and storage: -25 degree C to +70 degree C.

For operation below -25 degree C we recommend additional cubicle heating.

Long time operation above +70 degree C is not recommended.

The thyristor modules, DASD *v* can be installed to max. +85 degree C.

Observe that the rated current is valid at +40 degree C or at +55 degree C acc. to the Technical and order data.

12.2.2. Isolation

12.2.2.1. Creepage distances

The creepage distances required are valid for the microenvironment. Where of practical reason it has been less effective to fulfil the requirements only by matching distances with the tracking properties of the isolators, instead the microenvironment has been improved by means of moulding or coating.

DASD Thyristor modules: Acc. to EN 60664

DASD 001, 002, 003 and DASD 101, 102, 103

Pollution degree 2: 2500 V AC

Pollution degree 3: 1000 V AC

Pollution degree 4: 630 V AC

Highest applied voltage: 600 V AC

DASD 146, 147, 156, 157

Pollution degree 2: 5000 V AC

Pollution degree 3: 2000 V AC

Pollution degree 4: 1250 V AC

Highest applied voltage: 690 V AC

DASD 151, 152, 153, 104, 154, 105, 155

Pollution degree 2: 4000 V AC

Pollution degree 3: 1600 V AC

Pollution degree 4: 1000 V AC

Highest applied voltage: 690 V AC

DARA Control System modules: Acc. to EN 60664

Pollution degree 2: 1 000 V AC

Pollution degree 3: 400 V AC

Pollution degree 4: 250 V AC

Highest applied voltage: 230 V AC

12.2.2.2. Routine test voltage

DASD Thyristor modules:

Main circuits together to earth: 3 000 V RMS, 50 Hz, 1 minute.

Between main circuits: Limited by installed thyristor devices.

DARA Control System modules:

Supply 115 / 230 V AC to ground: 1 500 V RMS, 50 Hz, 1 minute.

12.2.3. Rated current definition

The rated current, I_e , is determined by the load-cycle:

6 seconds with $2,5 * I_e$

30 seconds with $1 * I_e$

24 seconds with $0 * I_e$

This cycle is repeated infinitely

Additionally, ASTAT will carry at least the rated current I_e continuously.

ASTAT is primary intended for use as a starter with dominant standstill or full line voltage in forward or back direction, although capable for accurate speed control through the whole speed range.

12.2.4. Supply tolerances

12.2.4.1. Operational voltage (main voltage) U_e

Functional range:

Level: $0,70 * U_e.. 1,1 * U_e$.

Note that total interruption in power will stop the motion controlled by ASTAT.

Frequency: Setting 50 Hz: 40 Hz .. 60 Hz

Setting 60 Hz: 50 Hz .. 70 Hz

12.2.4.2. Control voltage U_s

Functional range:

Level: $0,70 * U_s.. 1,1 * U_s$

Note that total interruption in power will stop the motion controlled by ASTAT.

Frequency: Setting 50 Hz: 40 Hz .. 60 Hz

Setting 60 Hz: 50 Hz .. 70 Hz

12.2.5. EMC

See the section **EMC**

12.3. Circuit diagrams

12.3.1. Thyristor Modules DASD

Diagram 3ASC 25H381: DASD 001, 101 {see page 264 }

Diagram 3ASC 25H382: DASD 002, 003, 102, 103 {see page 265 }

Diagram 3ASC 25H384: DASD 104, 105 {see page 266 }

Diagram 3ASC 25H358: DASD 145 {see page 267 }

Diagram 3ASC 25H378: DASD 146, 147 {see page 268 }

Diagram 3ASC 25H351: DASD 151 {see page 269 }

Diagram 3ASC 25H352: DASD 152, 153, 154, 155 {see page 270 }

Diagram 3ASC 25H356: DASD 156, 157 {see page 271 }

12.3.2. Overvoltage Protection Modules DASG

Diagram 3ASC 25H372: DASG 218 {see page 272}

Diagram 3ASC 25H373: DASG 219 {see page 273 }

Diagram 3ASC 25H374: DASG 220 {see page 274 }

Diagram 3ASC 25H375: DASG 221 {see page 275 }

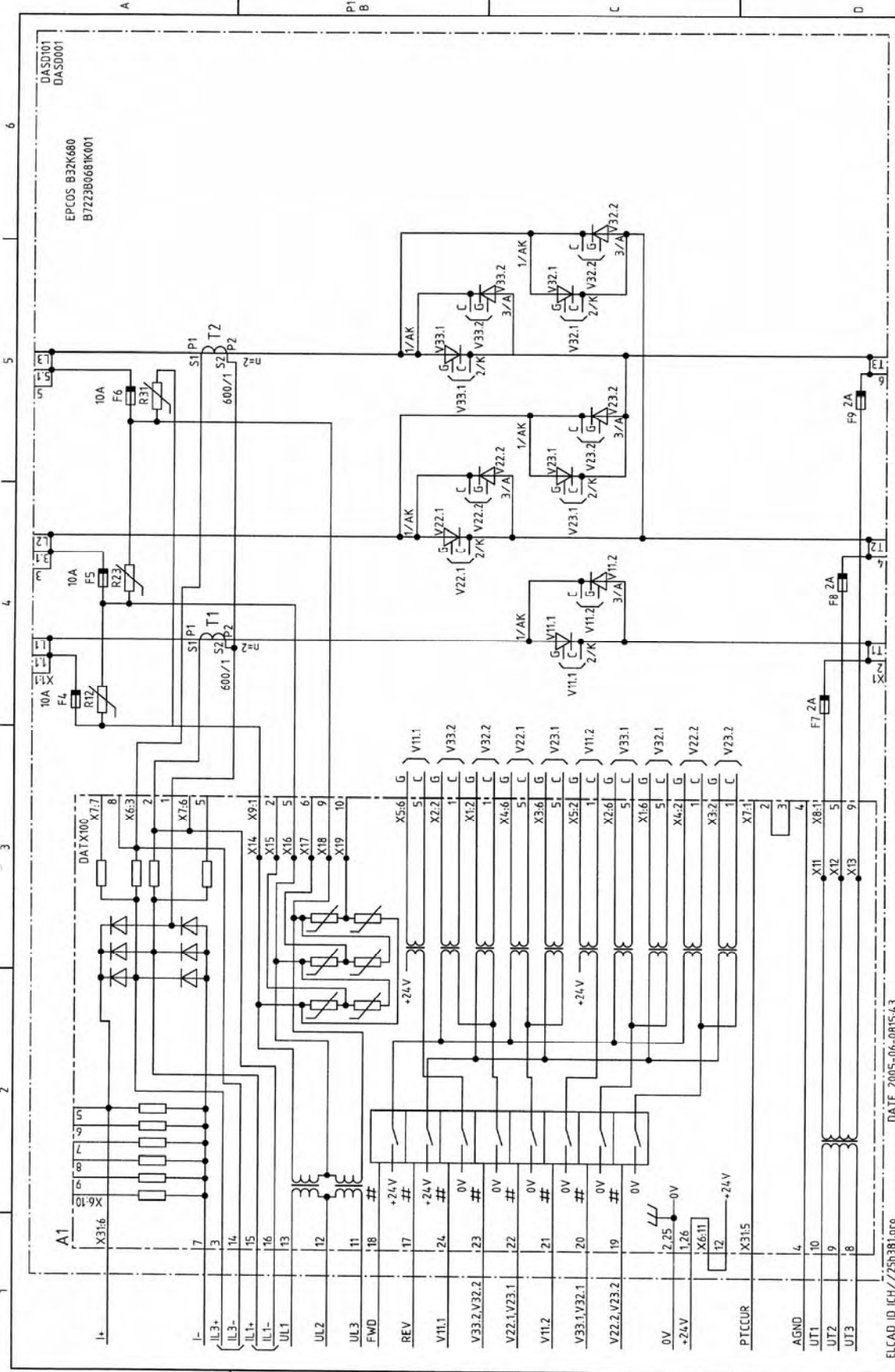
Diagram 3ASC 25H376: DASG 222, 223 {see page 276 }

12.3.3. Control System Modules DARA

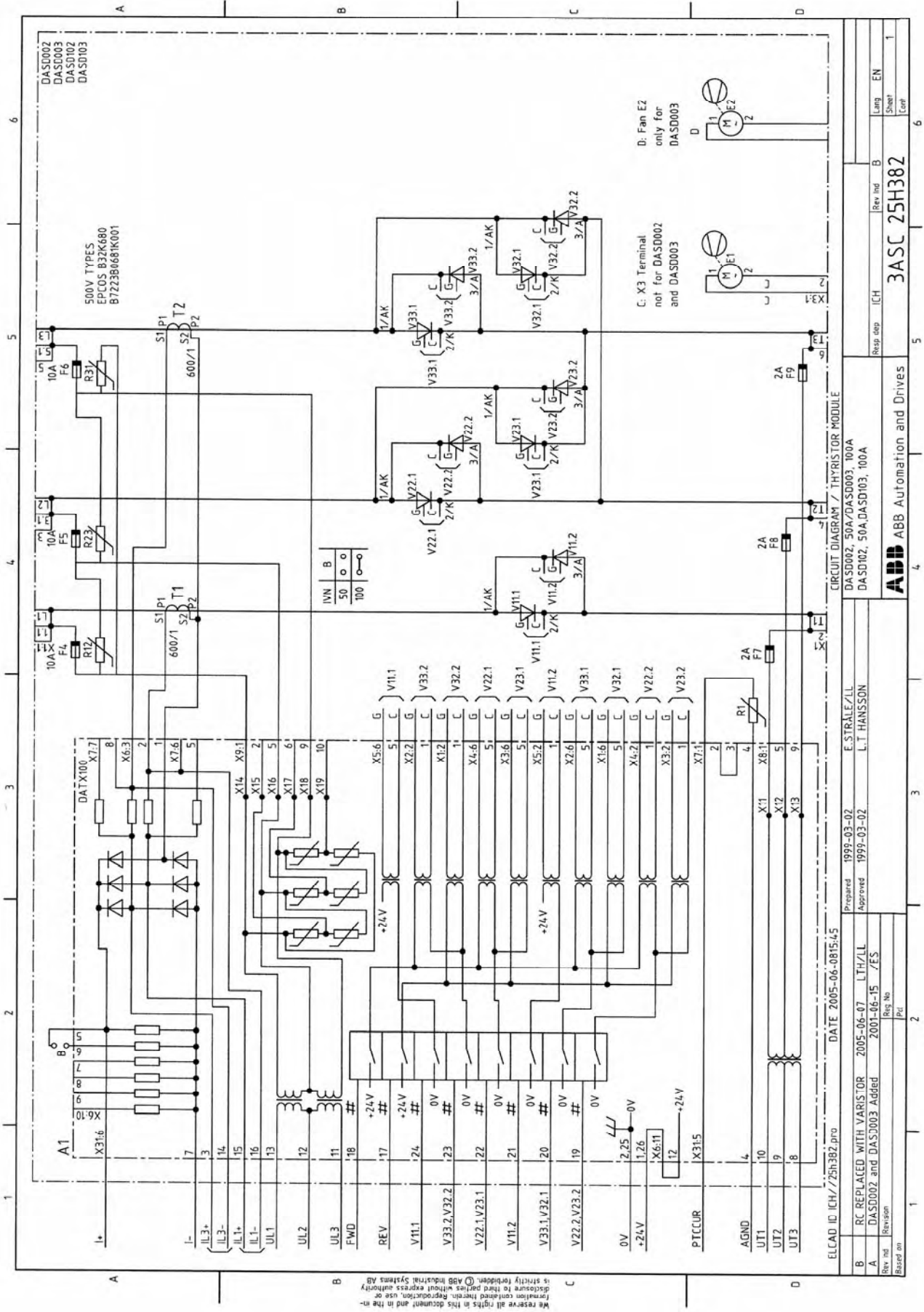
Diagram 3ASC 25H331: DARA 1000, 1001 1010 (9 sheets) {see page 277 to 285}

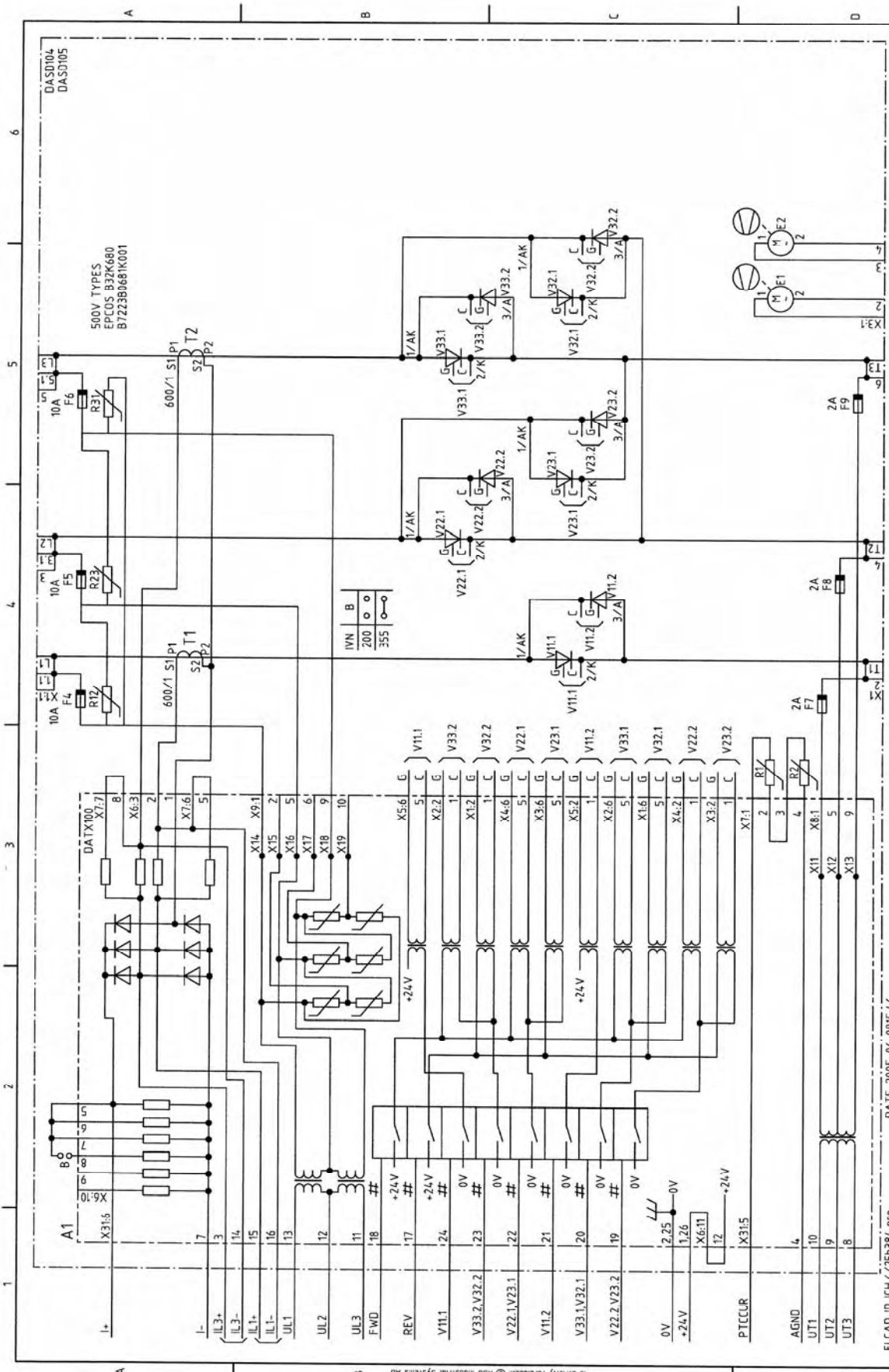
12.3.4. Cabin I/O Modules DAPM

Diagram 3ASC 25H321: DAPM 100, 101 (2 sheets) {see page 286 to 287} For DAPM 101, delete analog parts.



ELCAD ID: ICH//25H381.pro		DATE: 2005-06-08 15:43	
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C	DASD001 Added	Approved	1999-03-02
B	A1X7.1 was connected to X7.4	E. STRALE/L.L. L.T. HANSSON	
A		Rev No	Reg No
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Based on		3ASE 25H381	
		Resp desig	ICH
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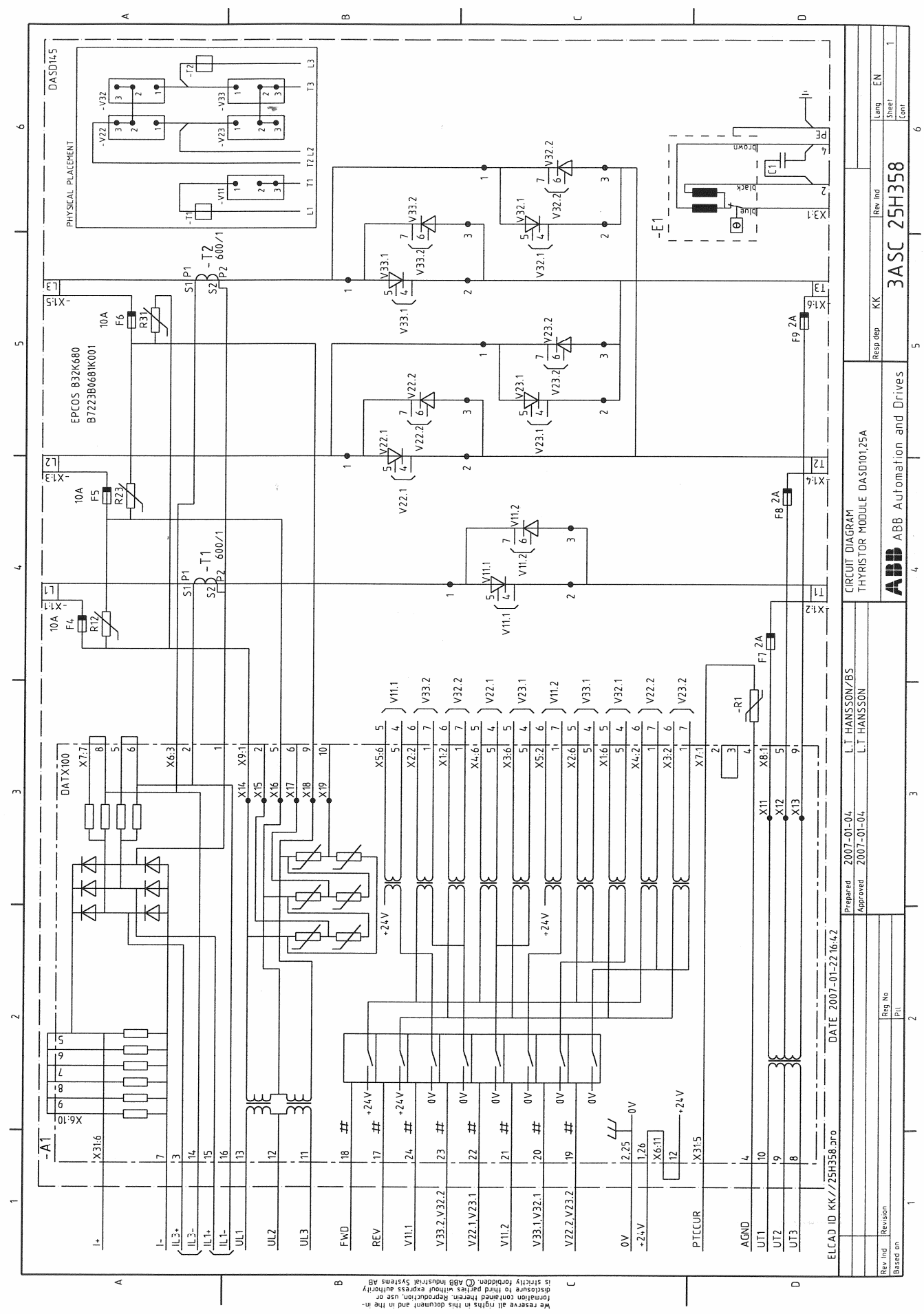




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Prepared: 1999-03-02		E-STRALE/LL	
Approved: 1999-03-02		L.T. HANSSON	
Rev. Ind. / Revision		Resp. dep. / ICH	
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Sheet / 1		Sheet / 1	

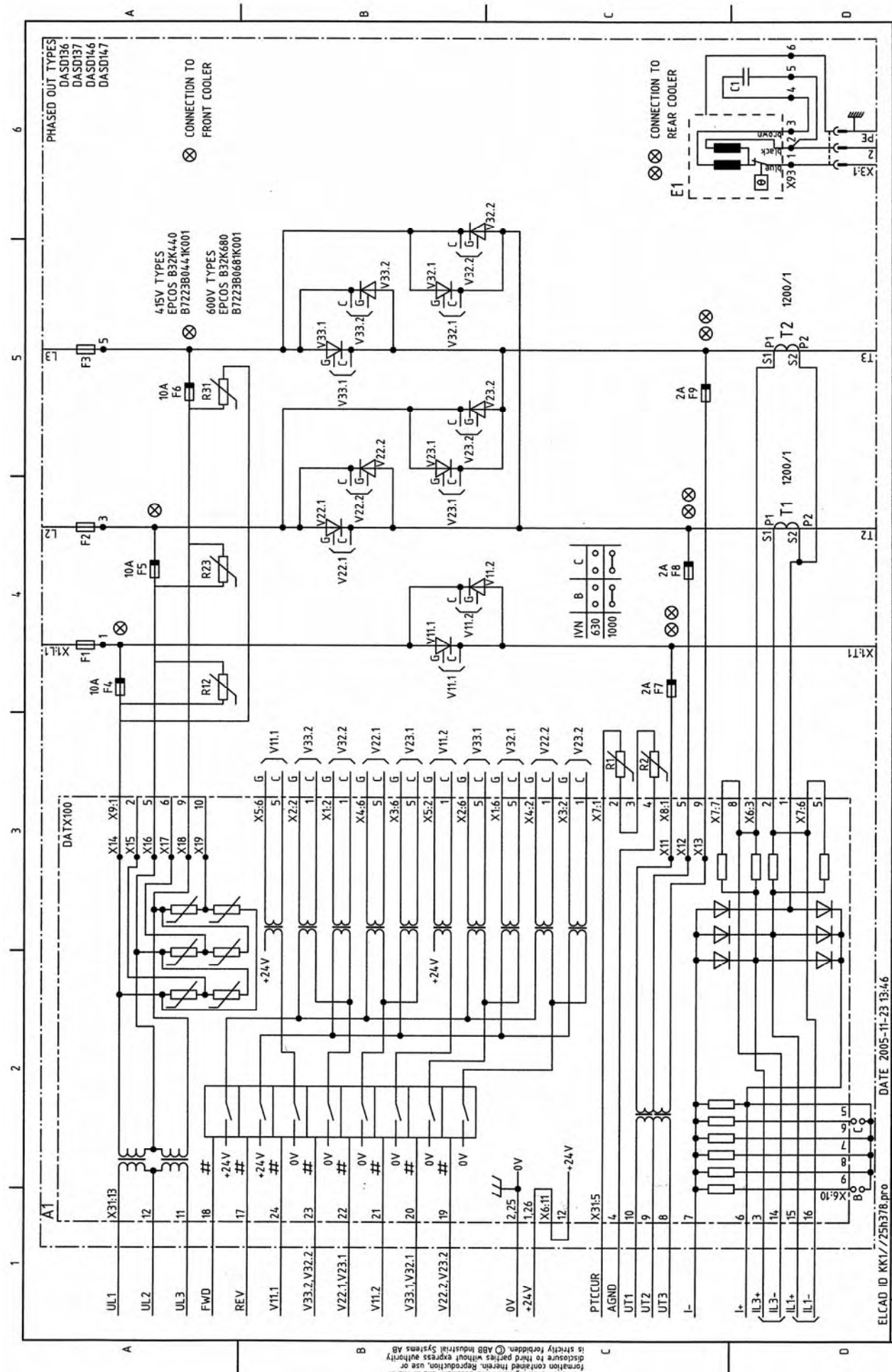
CIRCUIT DIAGRAM / THYRISTOR MODULE
 DASD104, 200A / DASD105, 355A

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EUCAD ID: KK//25H358_jrto		DATE: 2007-01-22 16:42	
Rev. No.	Revision	Prepared	2007-01-04
Based on		Approved	2007-01-04
		L.T. HANSSON/BS L.T. HANSSON	
		CIRCUIT DIAGRAM THYRISTOR MODULE DASD101,25A	
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Lang	EN	Sheet	1
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ELCAD ID KKI/25H378.pro

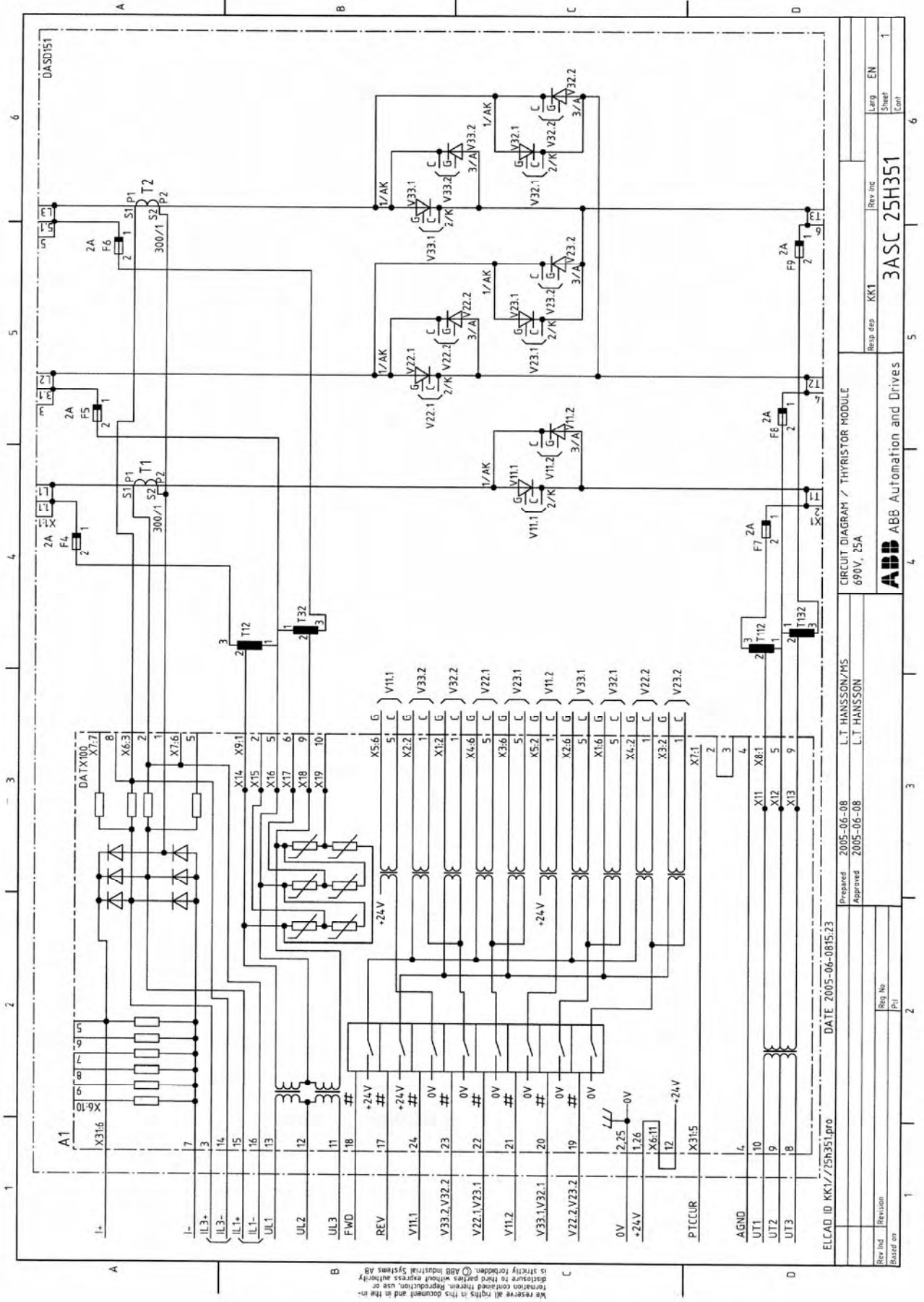
Prepared 2005-05-08 E.STRÅLE/LL
 Approved 2005-05-08 L.T. HANSSON

CIRCUIT DIAGRAM / THYRISTOR MODULE
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 DASD137, 415V, 1000A, DASD147, 600V, 1000A

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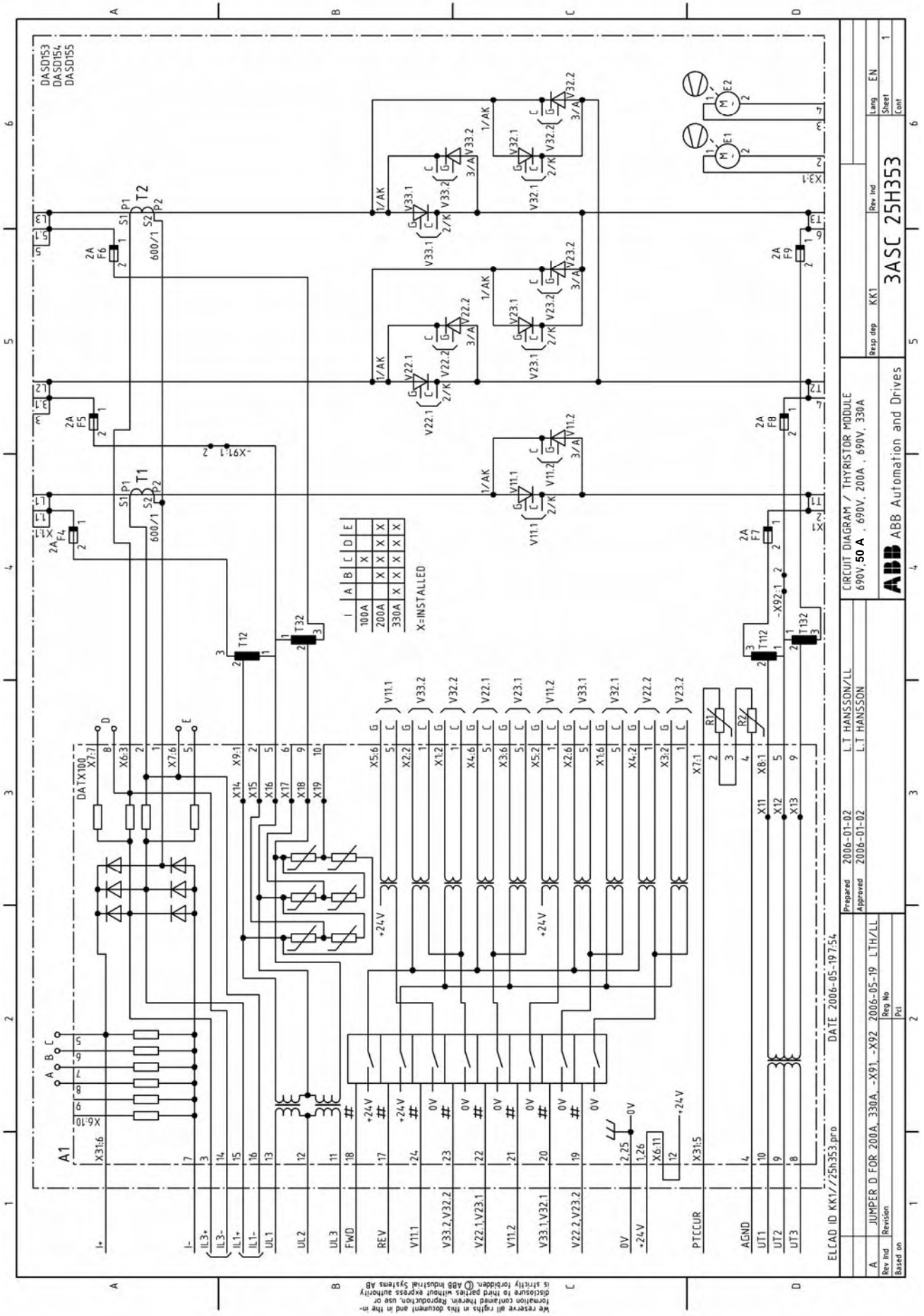
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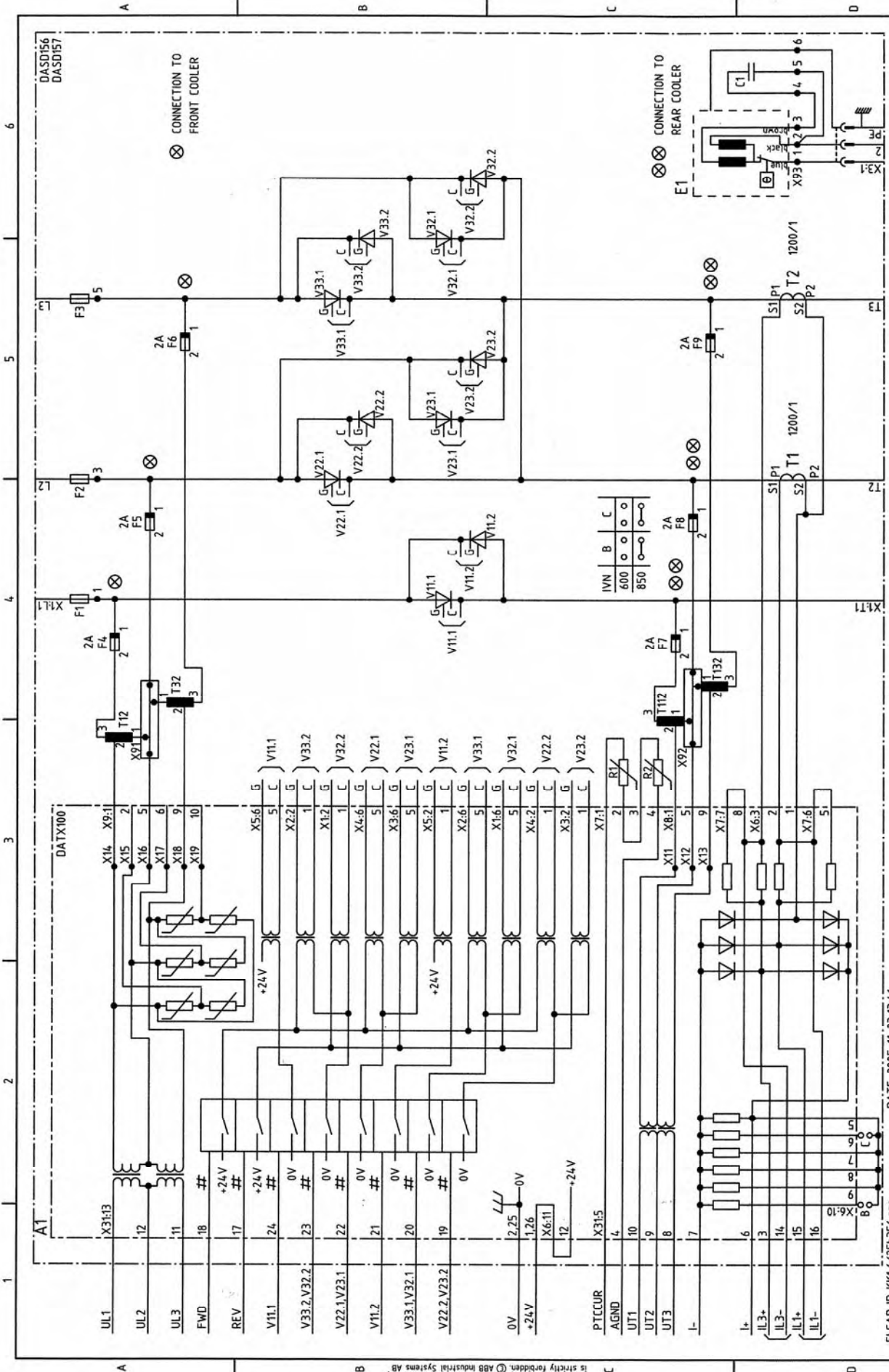
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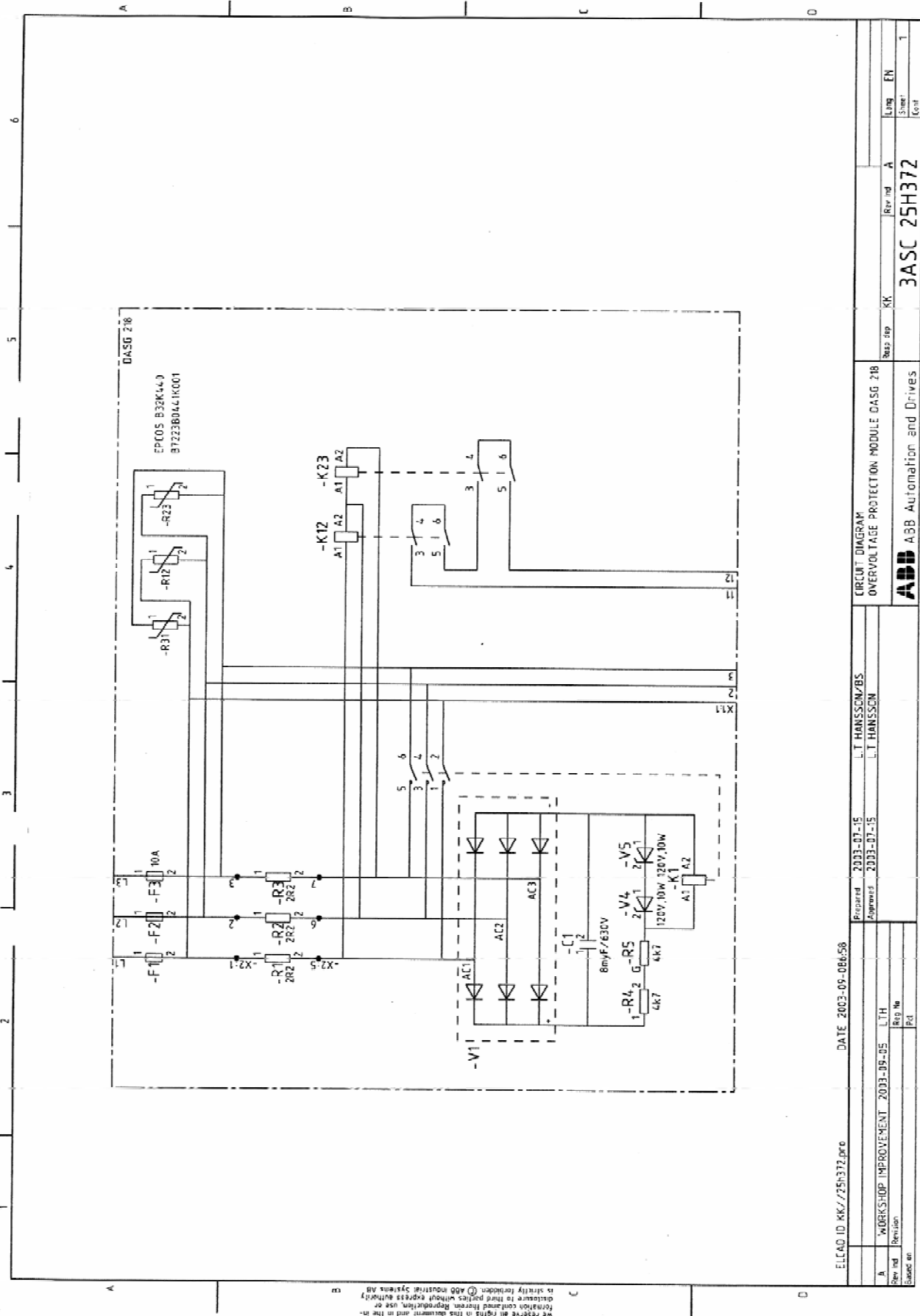
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Prepared	2005-06-08	L.T. HANSSON/MS		
Approved	2005-06-08	L.T. HANSSON		
Rev. No.		Reg. No.		
Revision		Prj.		
Based on				
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690V, 25A				
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ELCAD ID	KK1//25H356.pro	DATE	2005-11-23 13:41
Prepared	2005-06-08	L.T. HANSSON/L.L.	
Approved	2005-06-08	L.T. HANSSON	
Rev Ind	Revision	Reg No	
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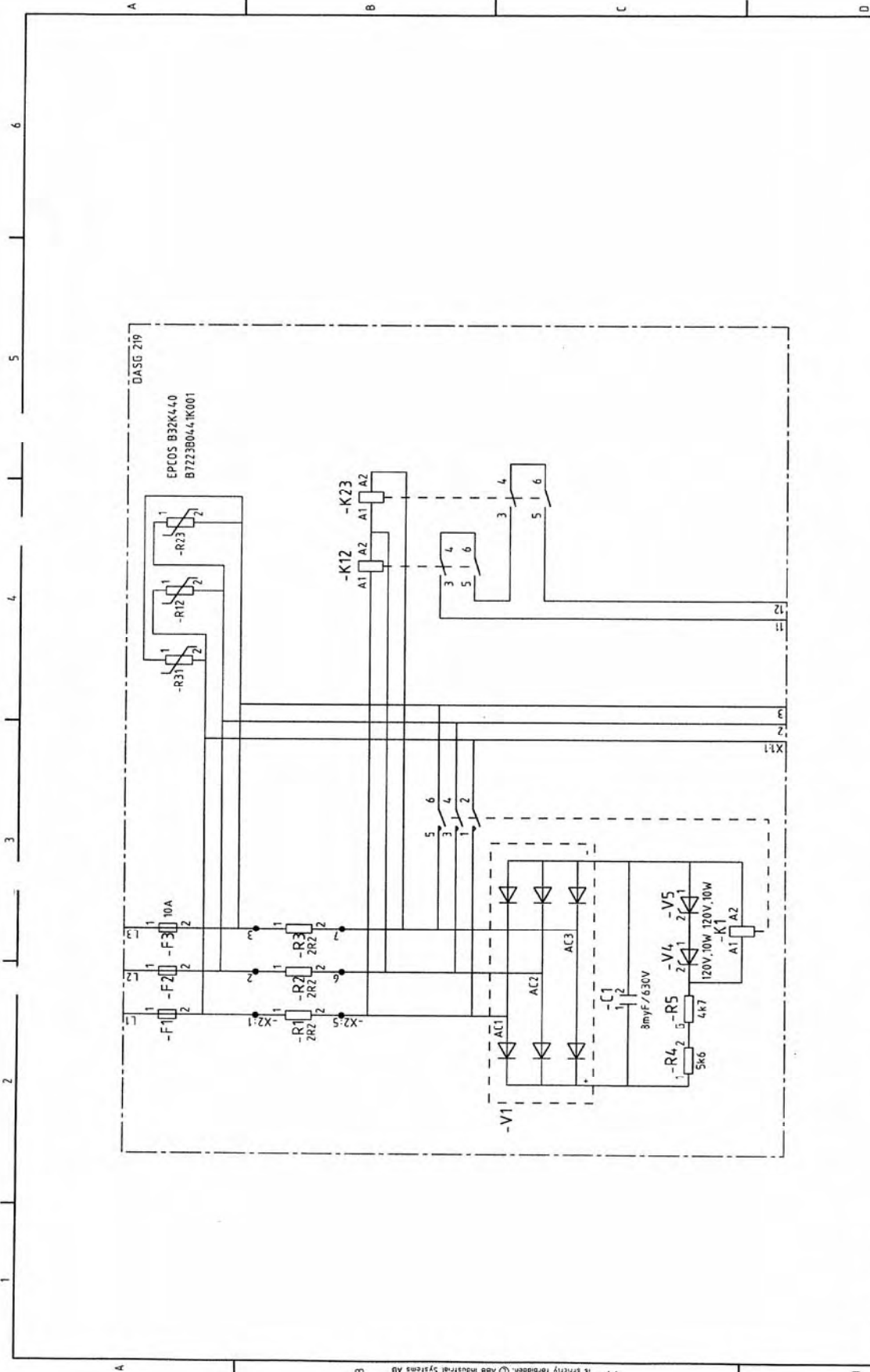
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Prepared	2003-07-15	L.T. HANSSON/BS	
Approved	2003-07-15	L.T. HANSSON	
Rev. no.	A	WORKSHOP IMPROVEMENT	2003-05-05
Rev. No.			
Part			

CIRCUIT DIAGRAM
OVERVOLTAGE PROTECTION MODULE DASG 218
ABB Automation and Drives

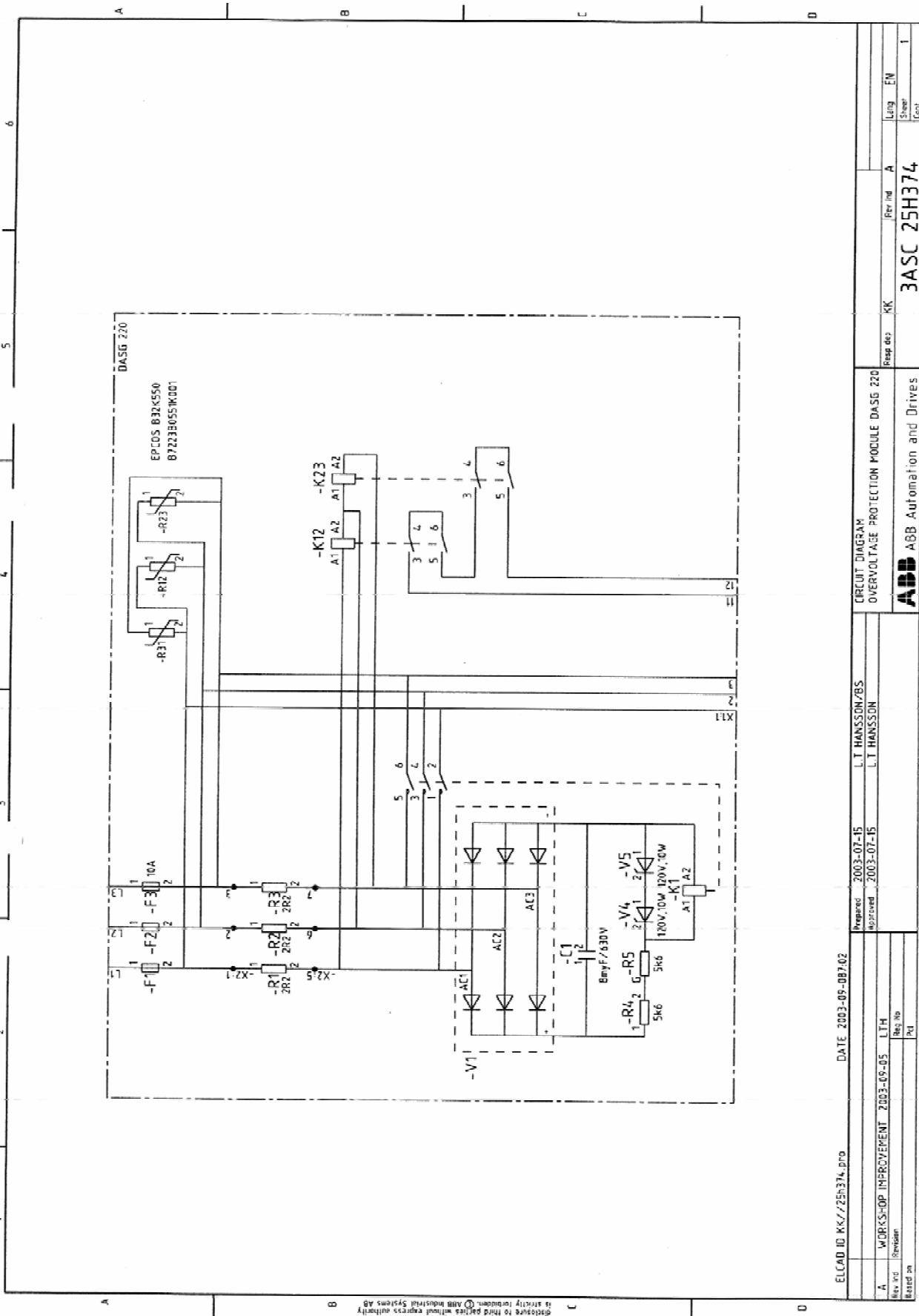
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Rev. no. A
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ELCAD ID KK//25h373.pro		DATE 2003-09-08T.00	
Prepared	2003-07-15	L.I. HANSSON/BS	
Approved	2003-07-15	L.I. HANSSON	
Rev. Ind	Revision	Res. No	Pri
A	WORKSHOP IMPROVEMENT 2003-09-05	LTH	
Res. dep.	KK	Res. Ind	A
ABB Automation and Drives		3ASC 25H373	
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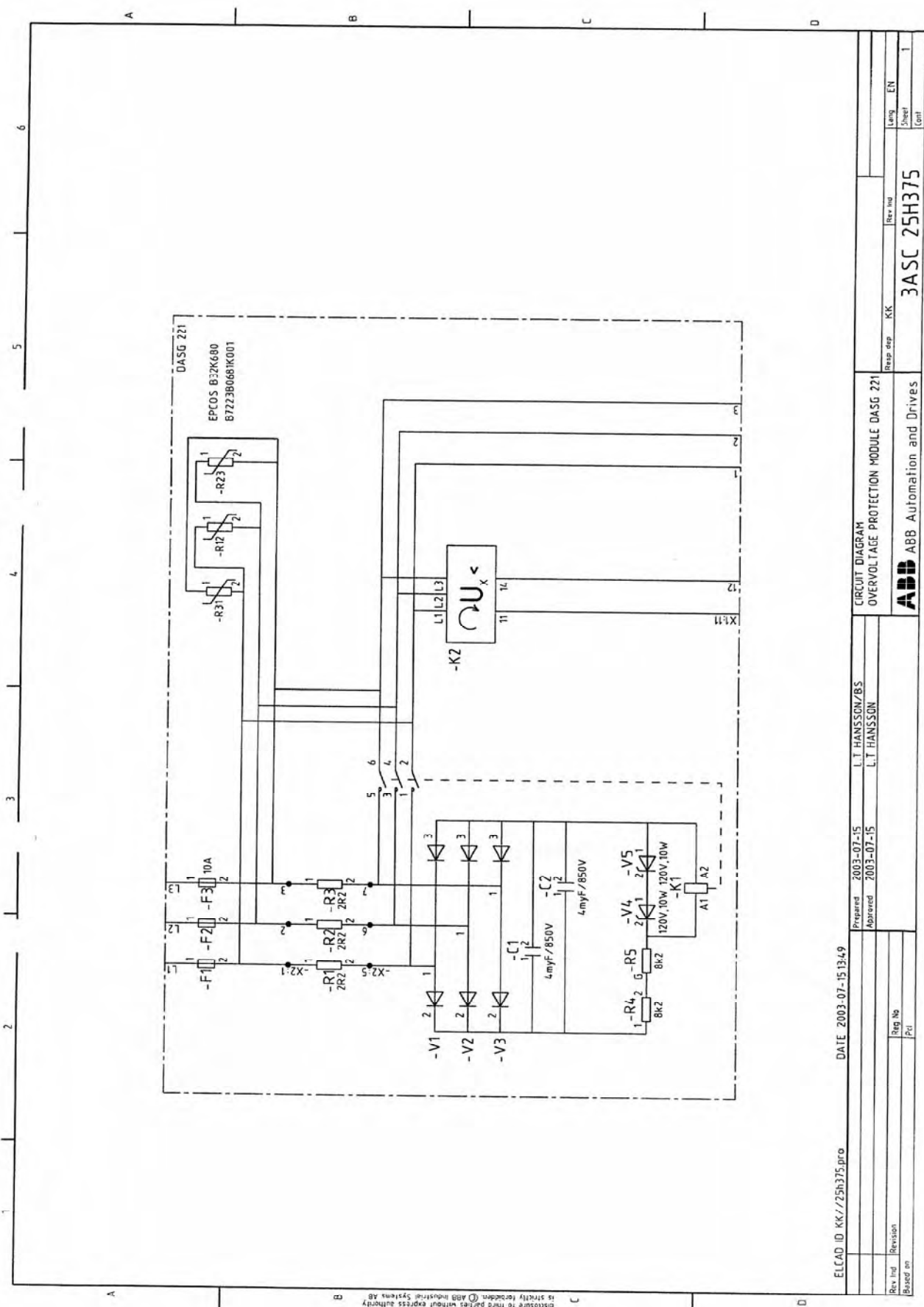
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Prepared	2003-07-15	L.T. HANSSON/BS	
Approved	2003-07-15	L.T. HANSSON	
Rev. no	05	Rev. no	05
Revision	LTH	Rev. no	05
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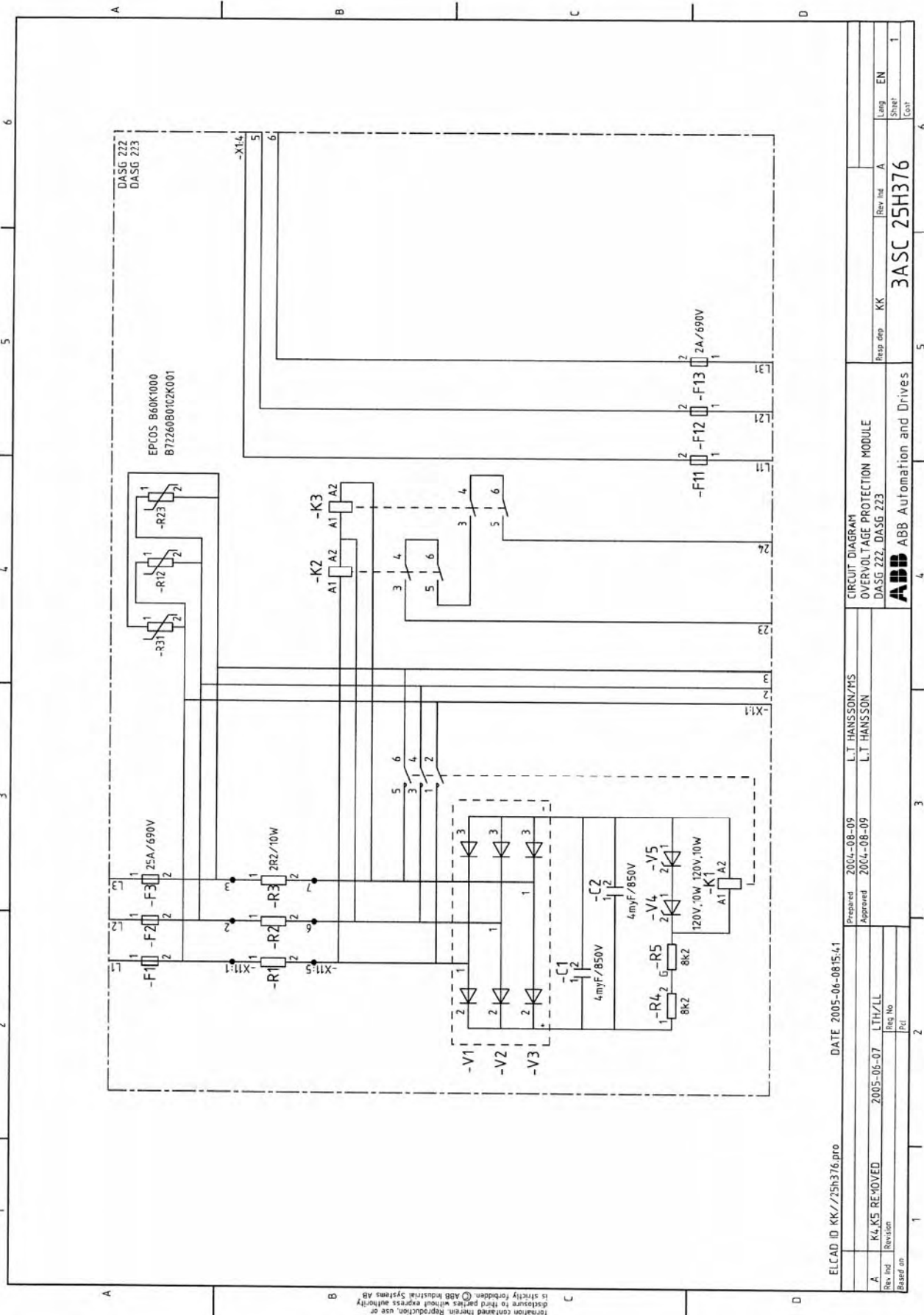
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OVERVOLTAGE PROTECTION MODULE DASG 220
Responsible: KK
ABB Automation and Drives

3ASC 25H374

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Prepared	2003-07-15	L.T. HANSSON/B.S.	
Approved	2003-07-15	L.T. HANSSON	
Rev. Ind.	Revision	Reg. No.	Pci
Based on			
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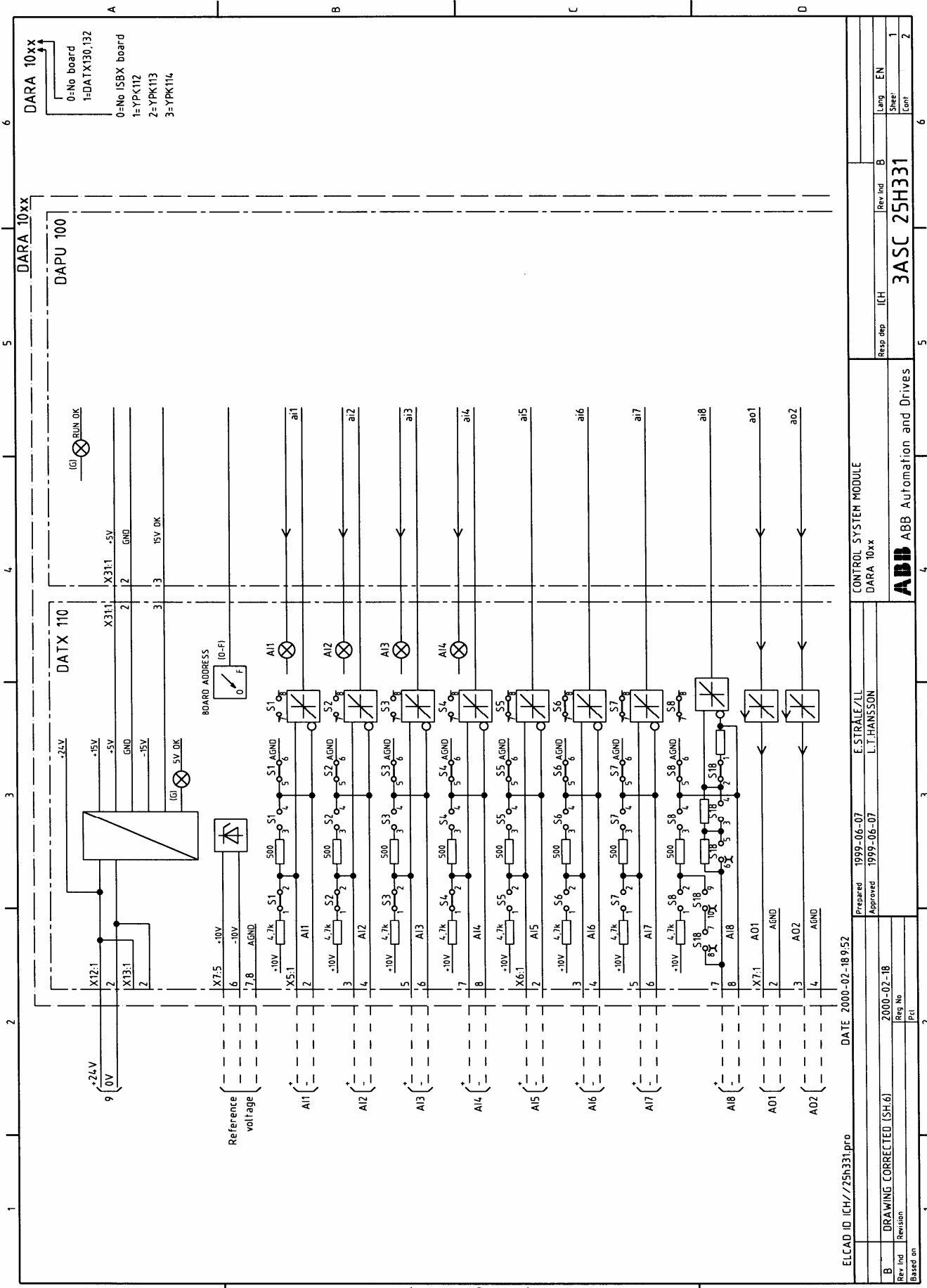
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Prepared 2004-08-09 L.T. HANSSON/MMS
 Approved 2004-08-09 L.T. HANSSON

Rev. Ind	Revision	Reg. No	Part
A	K4_K5 REMOVED	2005-06-07	LTH/LL

CIRCUIT DIAGRAM
 OVERVOLTAGE PROTECTION MODULE
 DASG 222, DASG 223

Resp dep	KK	Rev ind	A	Lang	EN
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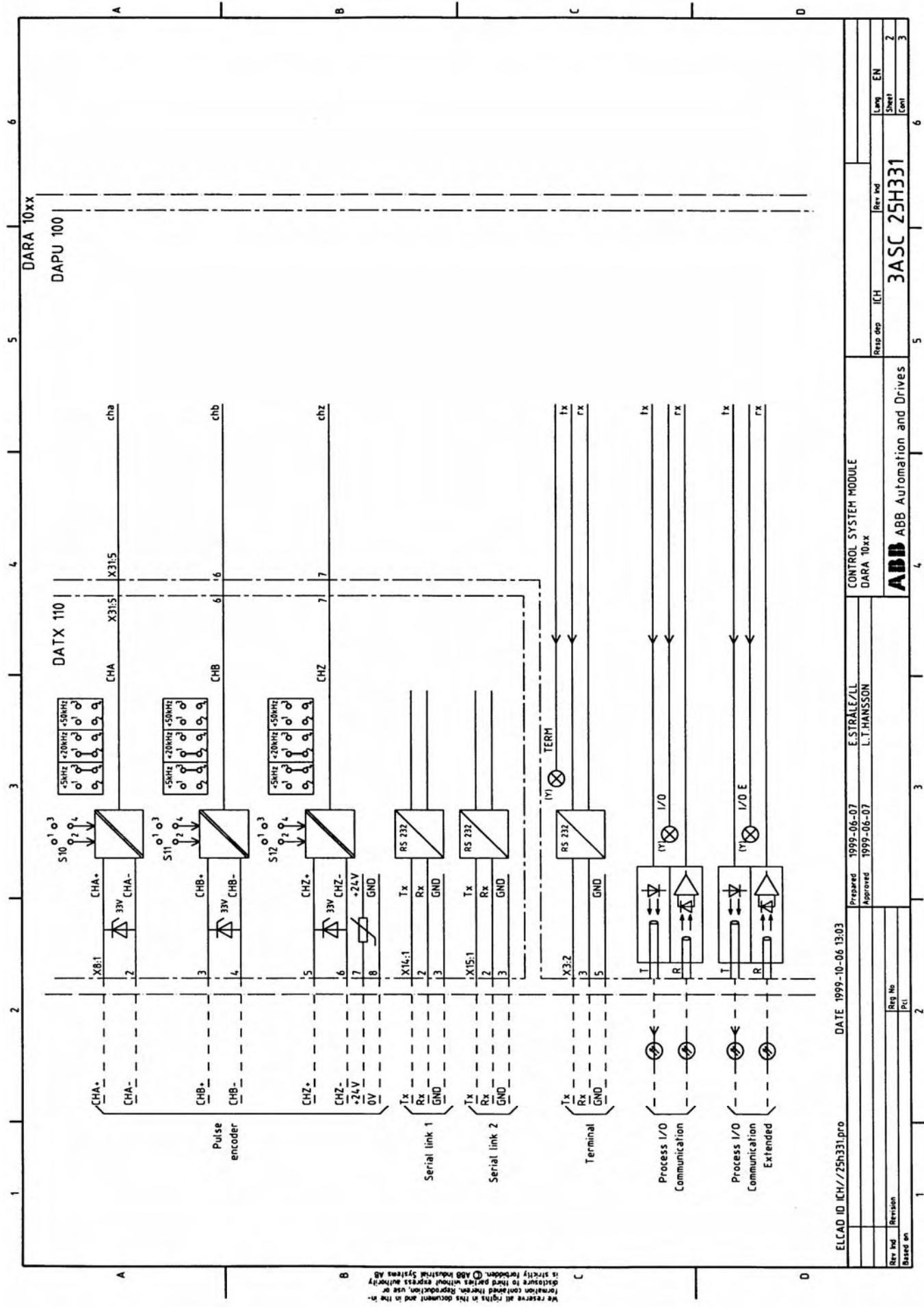


ELCAD ID: CH//25h331.pro DATE: 2000-02-18 9:52

Prepared	1999-06-07	E.STRÅLE/LIL
Approved	1999-06-07	L.I.HANSSON
CONTROL SYSTEM MODULE		
DARA 10xx		
ABB ABB Automation and Drives		
Rep. step	(CH)	Rev. Ind. B
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 2000-02-18
 Reg. No. Pct.



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Rev. Ind		Revision		Approved 1999-06-07 L.T. HANSSON		DARA 10xx	
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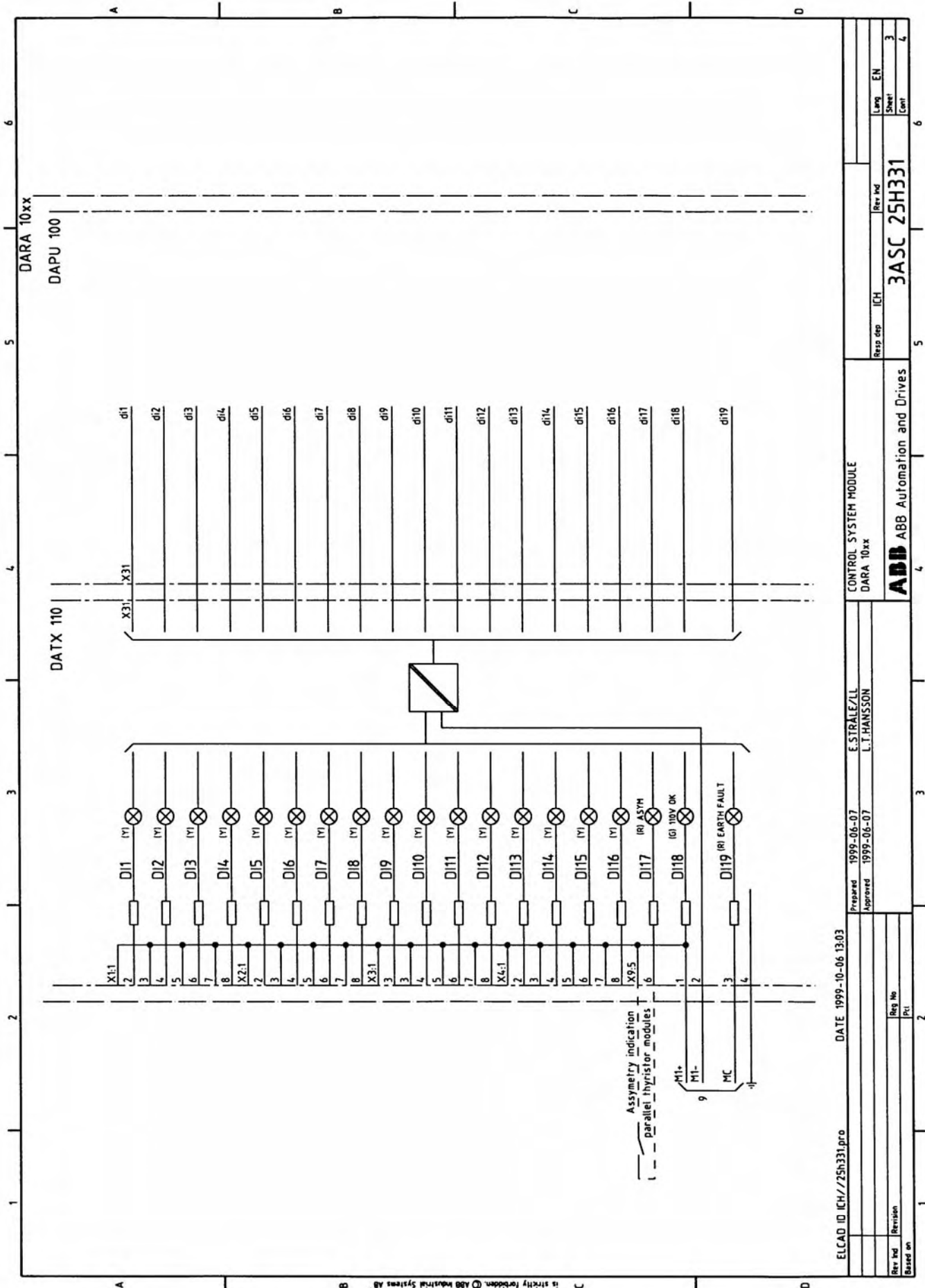


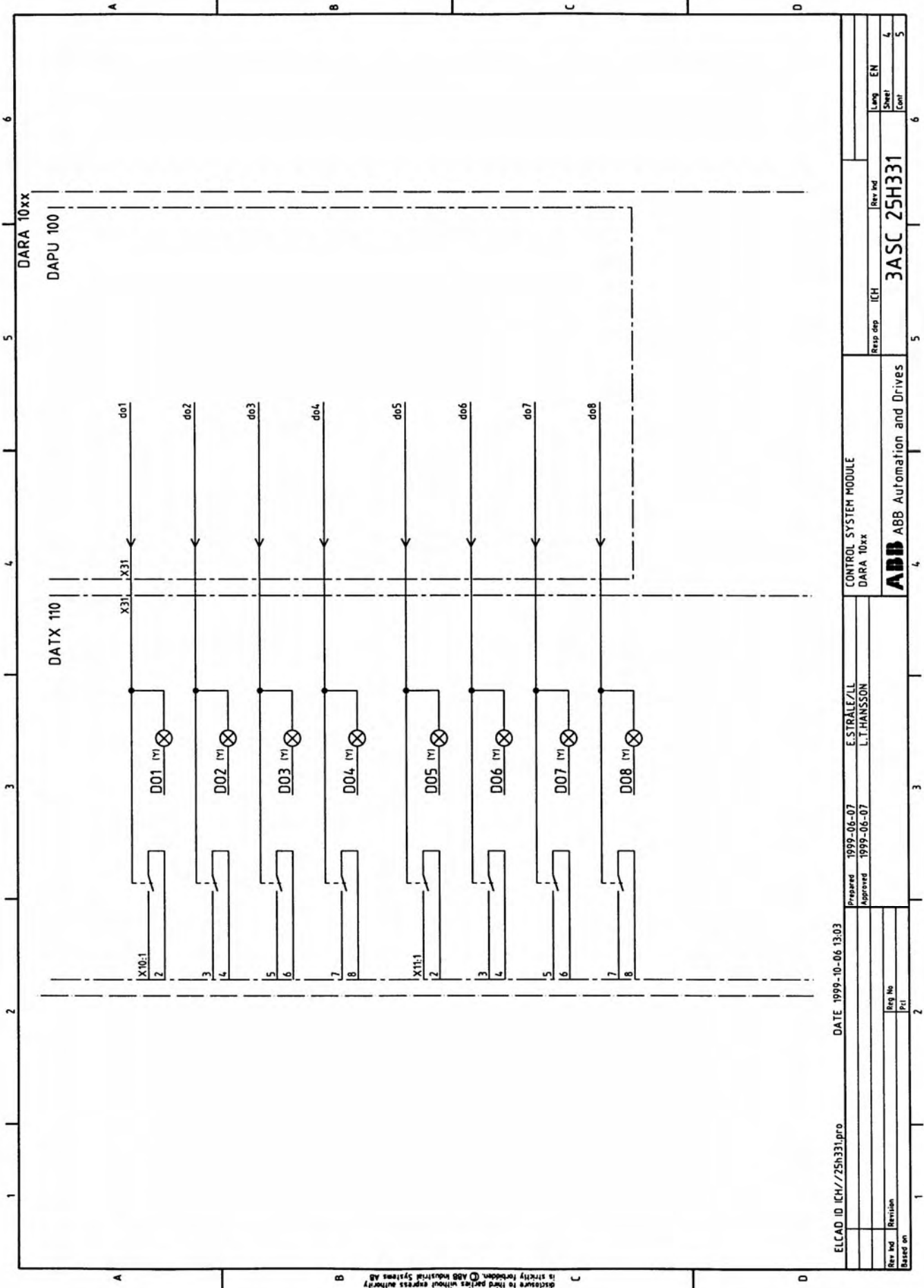
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Prepared	1999-06-07	E.STRÅLEZLL	
Approved	1999-06-07	L.T.HANSSON	
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DATE 1999-10-06 13:03

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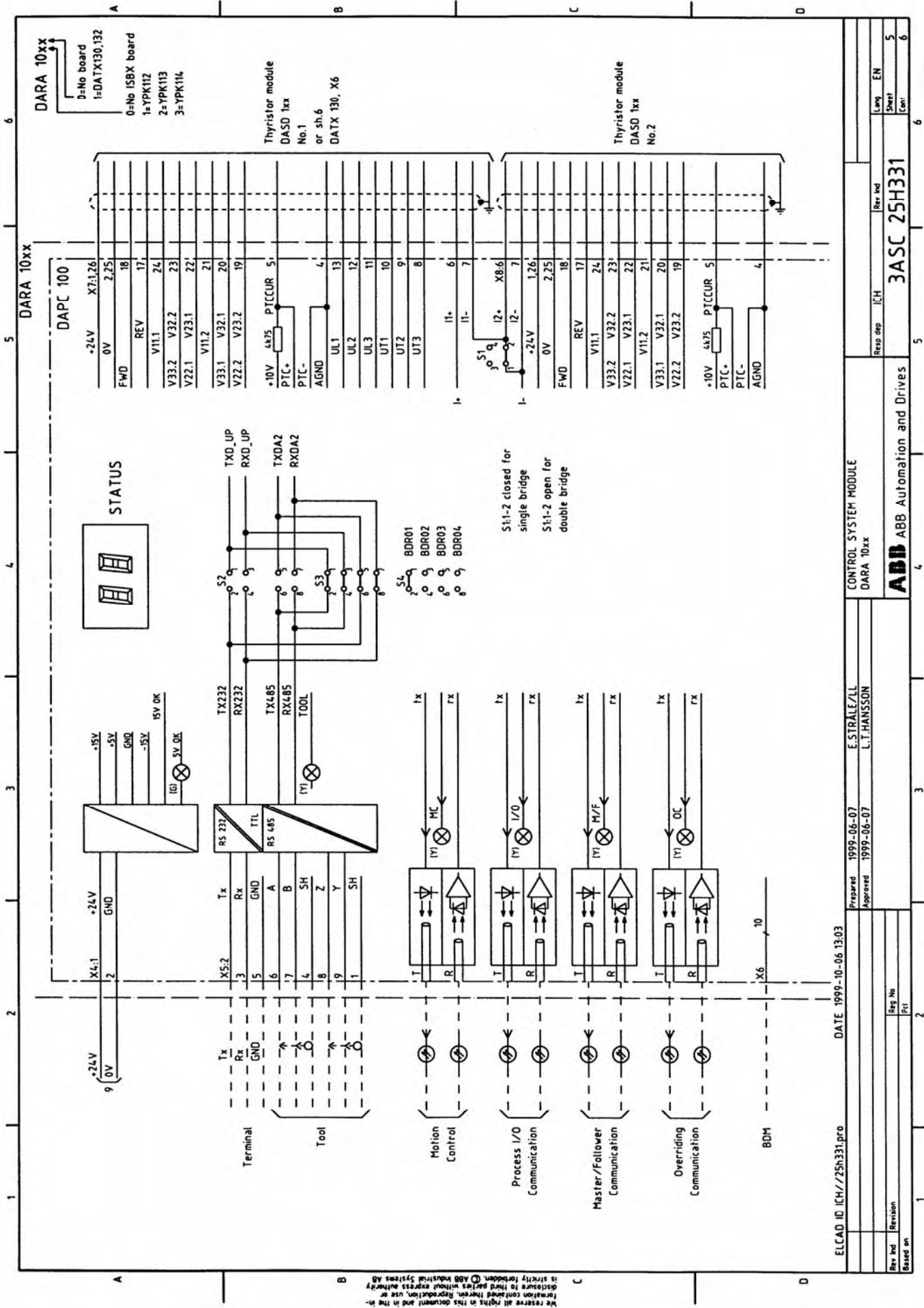
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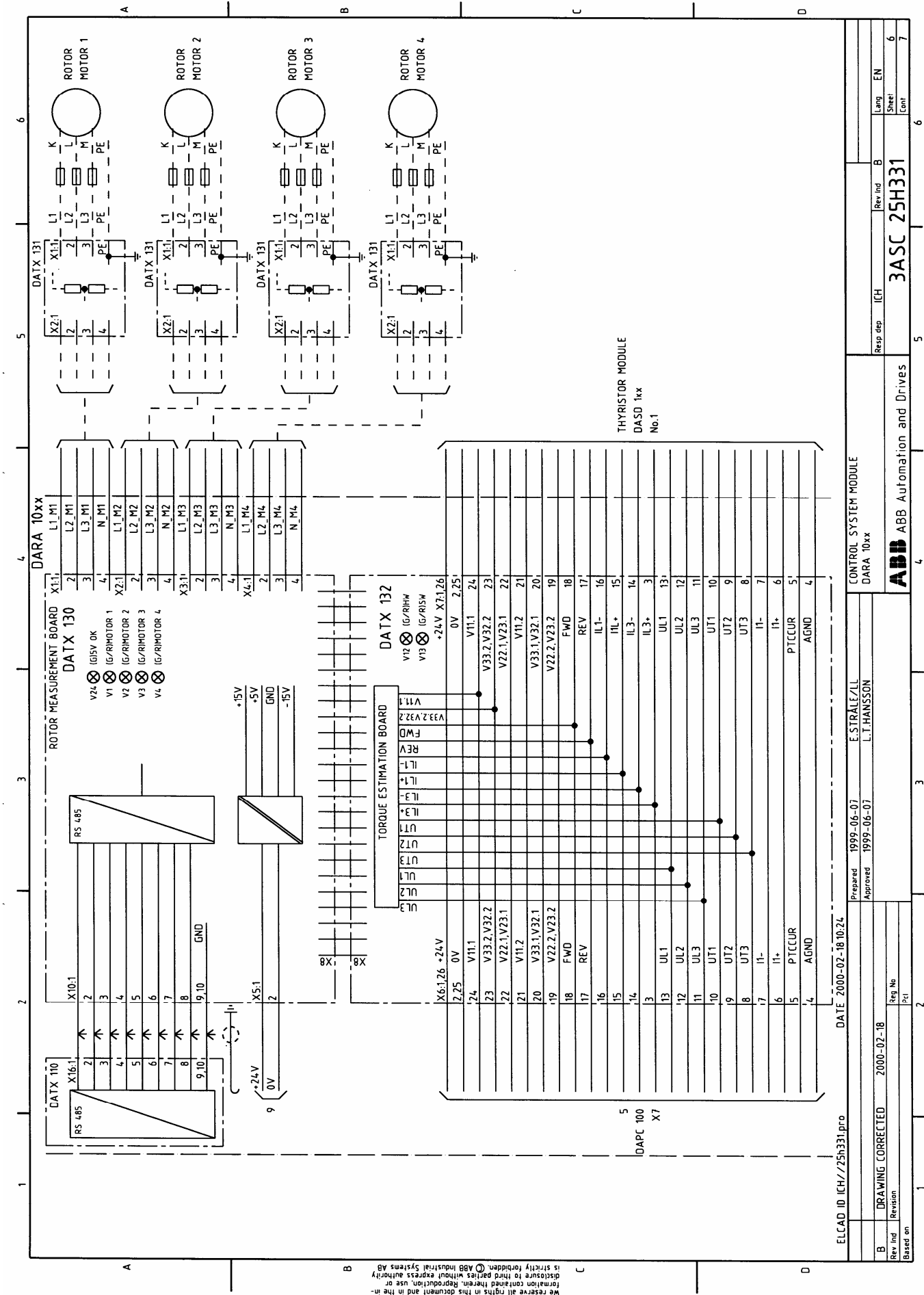
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Prepared 1999-06-07	E. STRALE/LIL
Approved 1999-06-07	L.T. HANSSON
Rev Ind	Revision
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Rev Ind	Rev Ind
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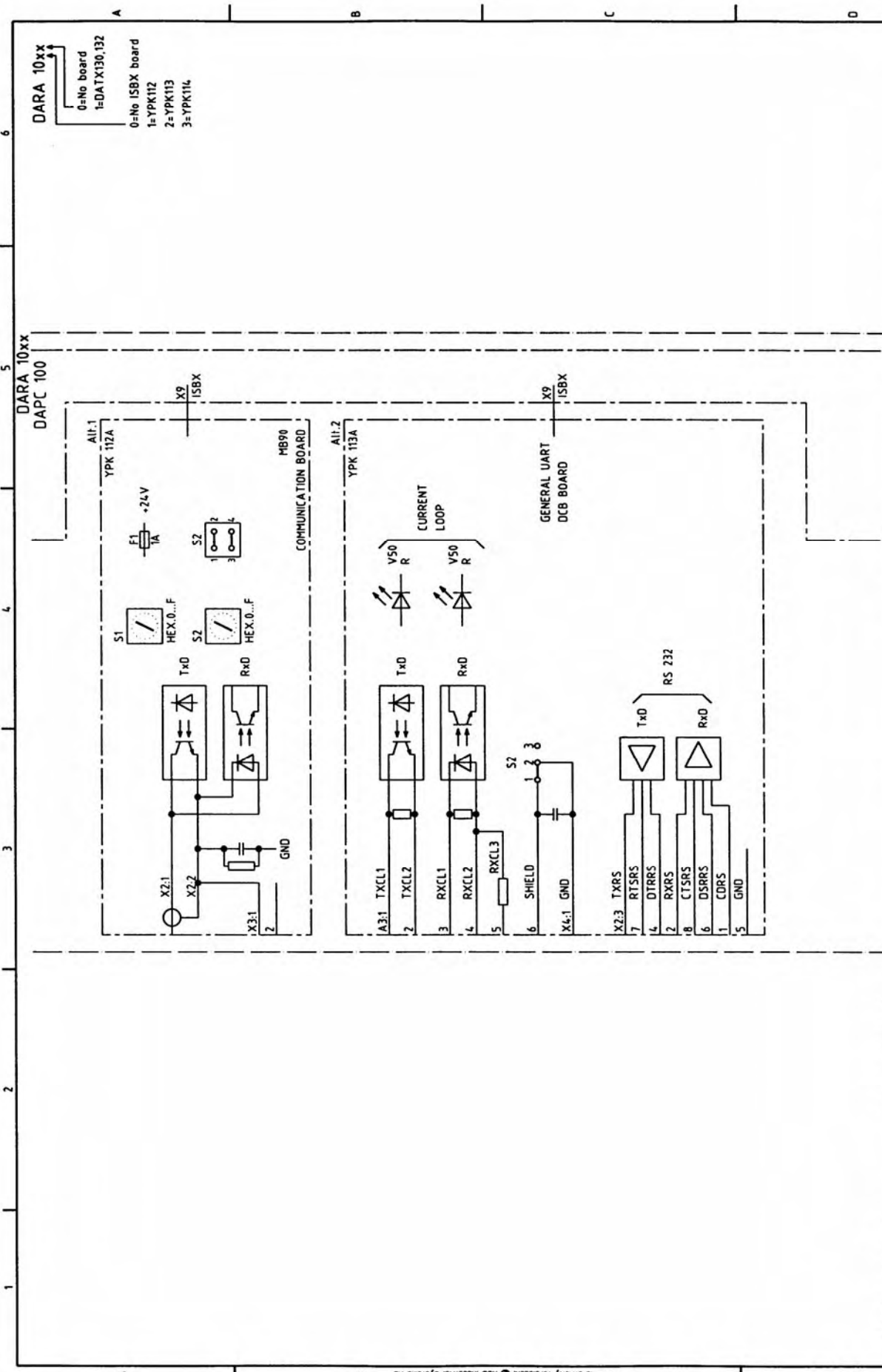
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Prepared	1999-06-07	E. STRALE/LL
Approved	1999-06-07	L.T. HANSSON
Revision	2000-02-18	
Based on		

CONTROL SYSTEM MODULE		
DARA 10xx		
Resp. dep.	ICH	3ASE 25H331
Rev. Ind.	B	
Lang	EN	
Sheet	6	
Cont.	7	

ABB Automation and Drives		
ABB		

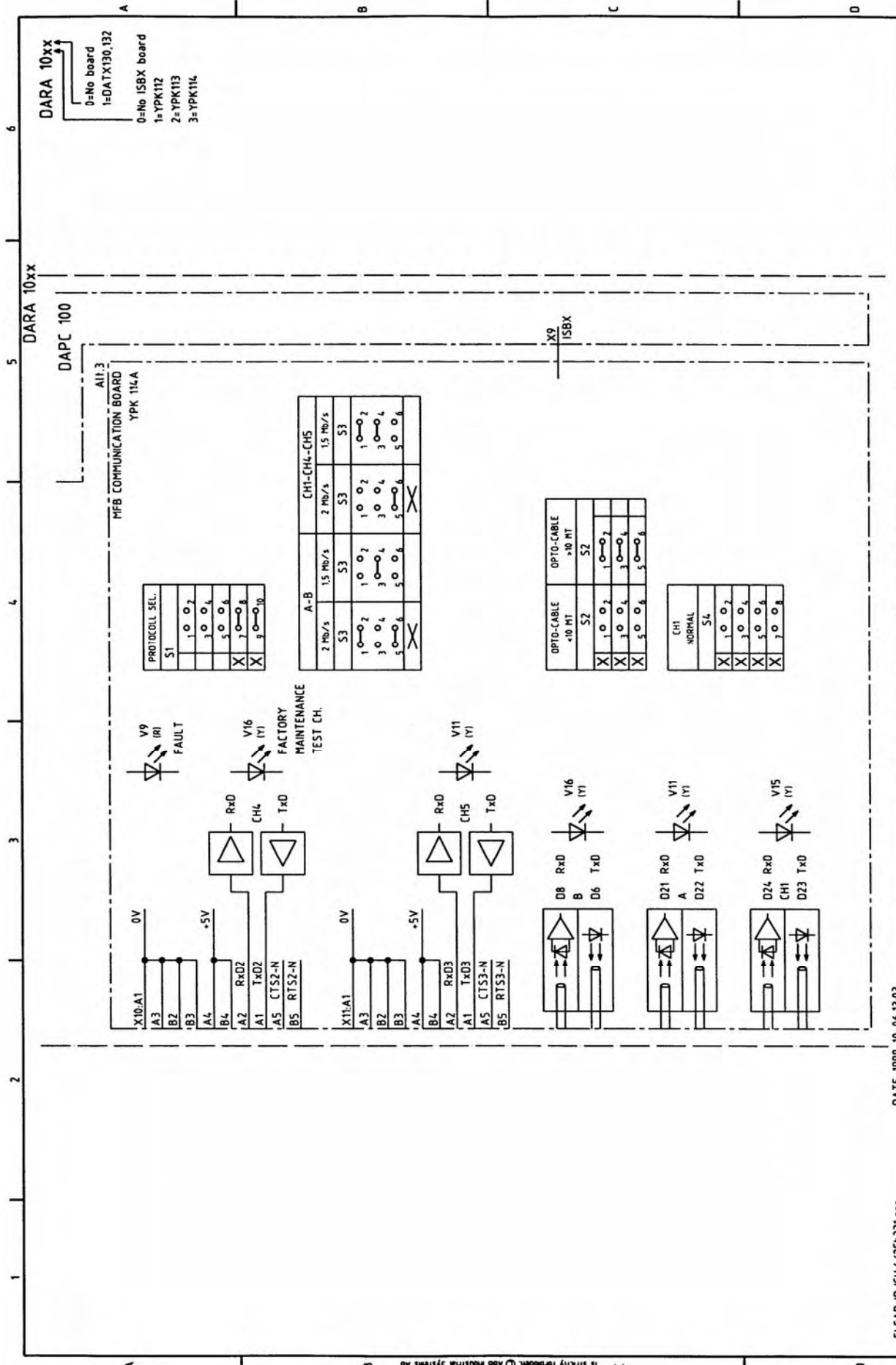
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DARA 10xx
 0=No board
 1=DATX130,132
 0=No ISBX board
 1=YPK112
 2=YPK113
 3=YPK114

ELCAD ID ICH//25h331.pro		DATE 1999-10-06 13:03		CONTROL SYSTEM MODULE		DARA 10xx		Resp dep ICH		Rev ind		Lang EN	
Prepared 1999-06-07		Approved 1999-06-07		E. STRALE/LL		L.T. HANSSON		3ASC 25H331		7		8	
Revision		Reg No		Based on		Sheet		Cont		7		8	
ABB Automation and Drives												3ASC 25H331	

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DARA 10xx

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ELCAD ID ICH//25H331.pro DATE 1999-10-06 13:03

Prepared 1999-06-07 E.STRÅLE/LL
Approved 1999-06-07 L.T.HANSSON

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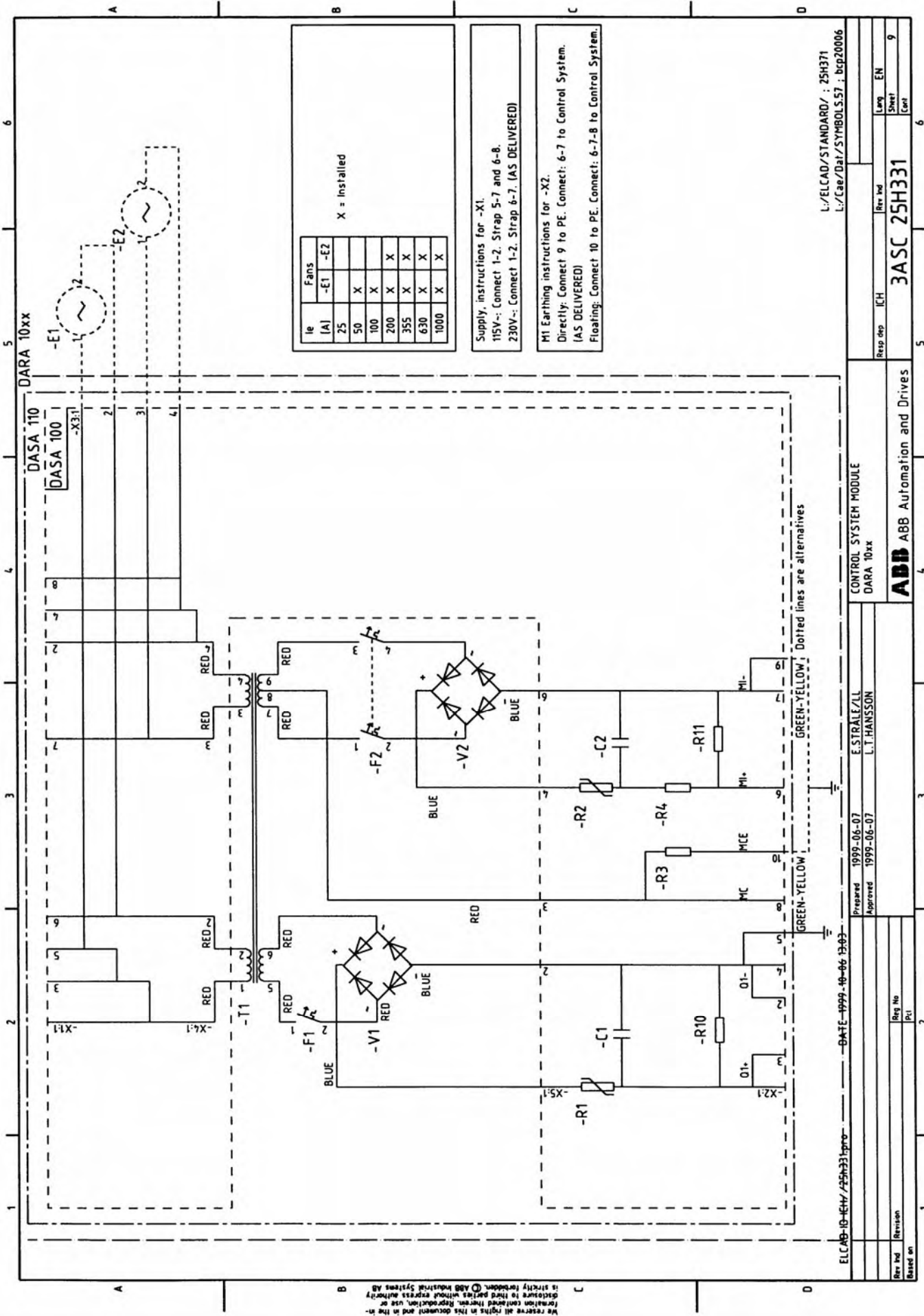
Lang EN

Sheet 8

Cont 9

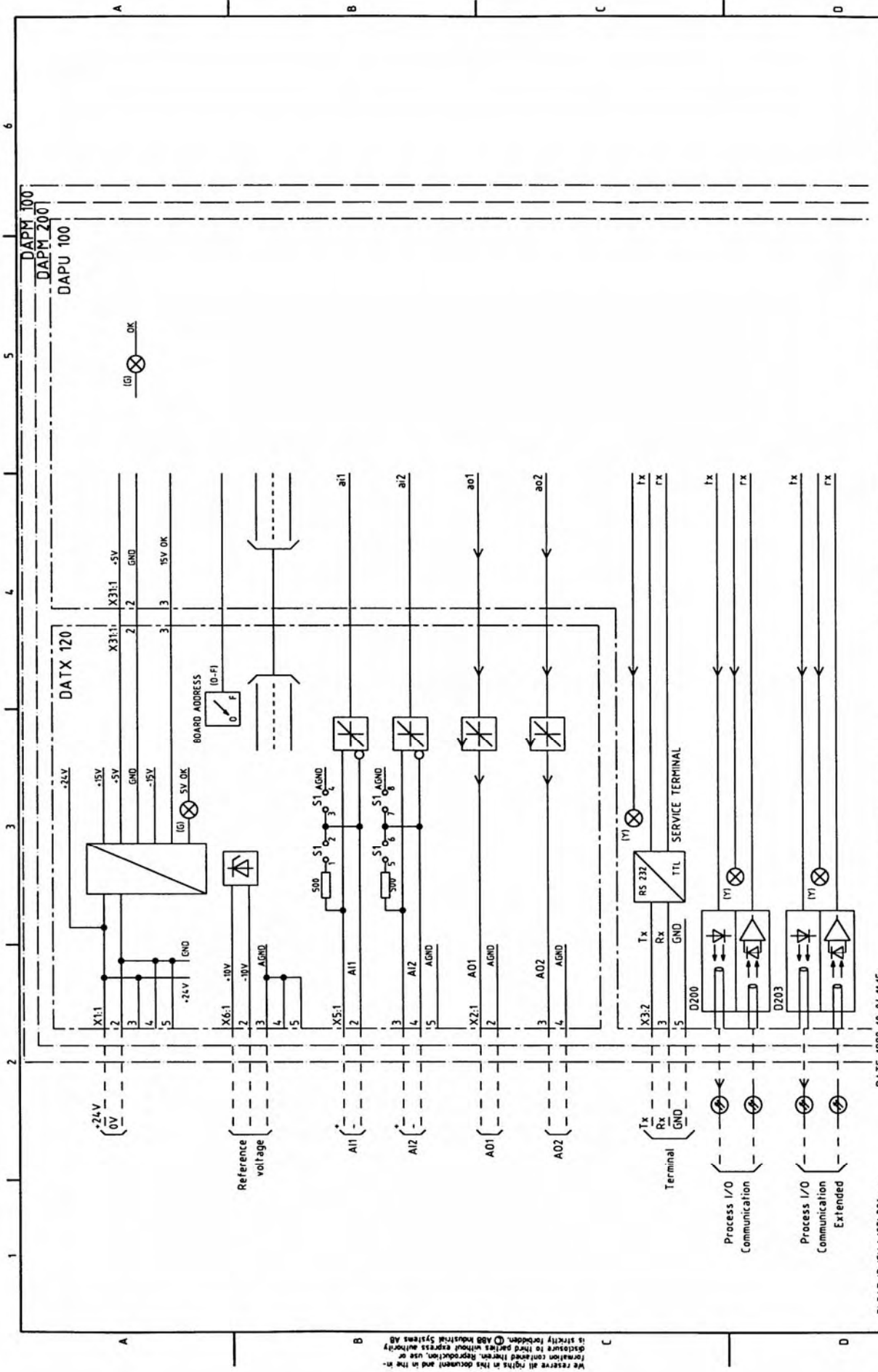
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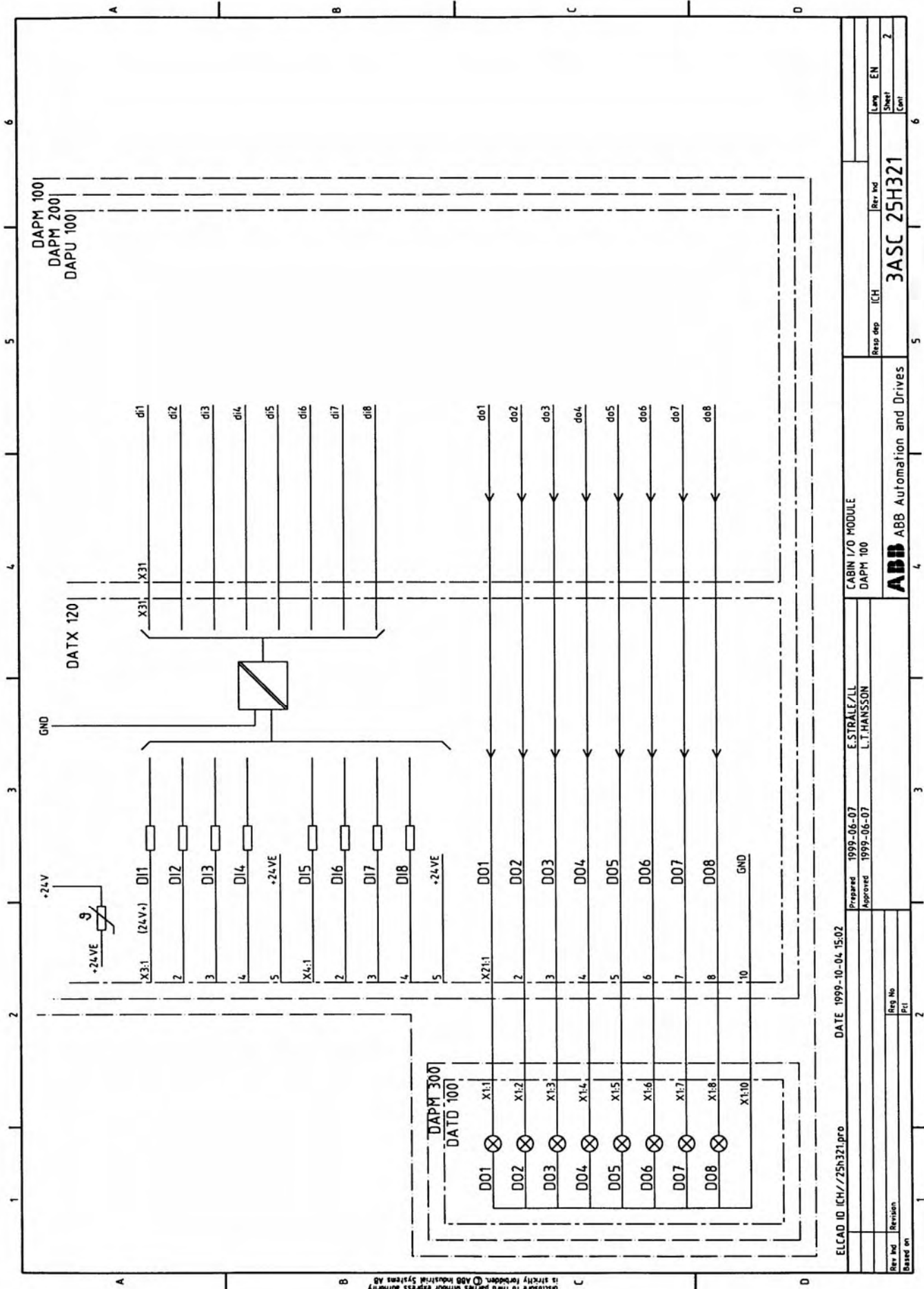
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Prepared 1999-06-07 Approved 1999-06-07		E STRA L E / L L L. J. HANSSON	
CONTROL SYSTEM MODULE DARA 10xx			
Rep. no.	IC#	Rev. no.	Lang. Sheet / Cont.
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Based on			3ASC 25H331
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ELCAD ID: ICH/75H321.pro		DATE: 1999-10-04 11:15		Prepared: 1999-06-07 Approved: 1999-06-07		E. STRALE/IL L.T. HANSSON		CABIN I/O MODULE DAPM 100		Resp dep: ICH		Rev ind: 3ASC 25H321		Lang: EN	
Rev ind	Revision	Reg No	Rev							1		2		1	
Based on:		2								5		6		6	

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12.4. Function diagrams

Group	Name	Pages
01	Identity	289
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04	Motor information	292 to 293
05	ASTAT configuration	294 to 296
06	Brake information	297
07	Speed feedback	298
08	Speed reference	299 to 301
09	Speed regulator	302
10	Speed supervision	303 to 304
11	Current regulator	305
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17	Rotor system	312
18	Torque measurement	313
19	Positioning system	314
20	Master-Follower	315
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Hint: Use the Browser version of the Function diagrams for training and study. The browser version will navigate you through the software by clicking on parameters, signals and references. The browser version available in two versions, optimised for Large or Small screen. The names are **AST10_04EN Desktop.htm and **AST10_04EN Laptop.htm** respectively.**

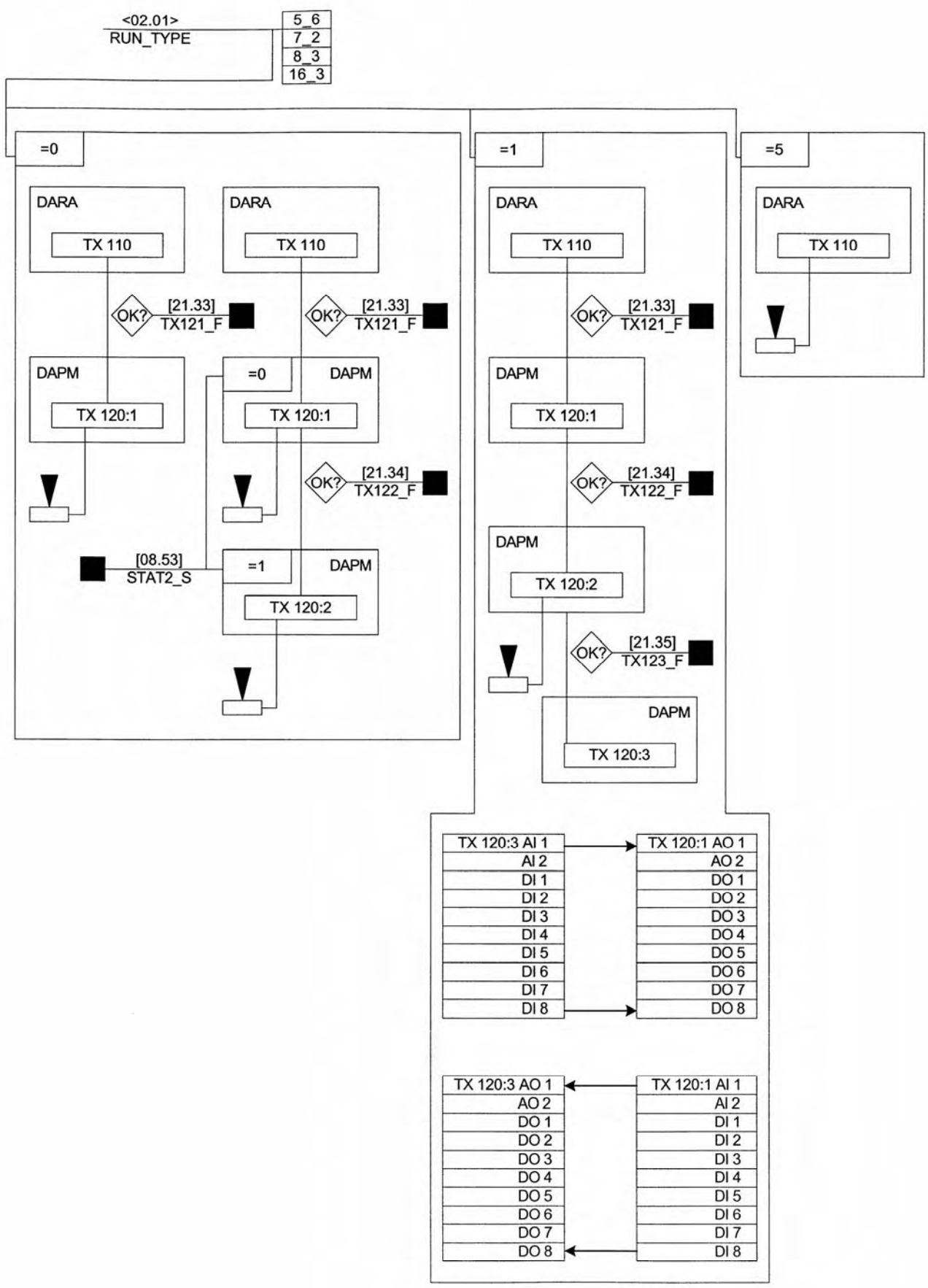
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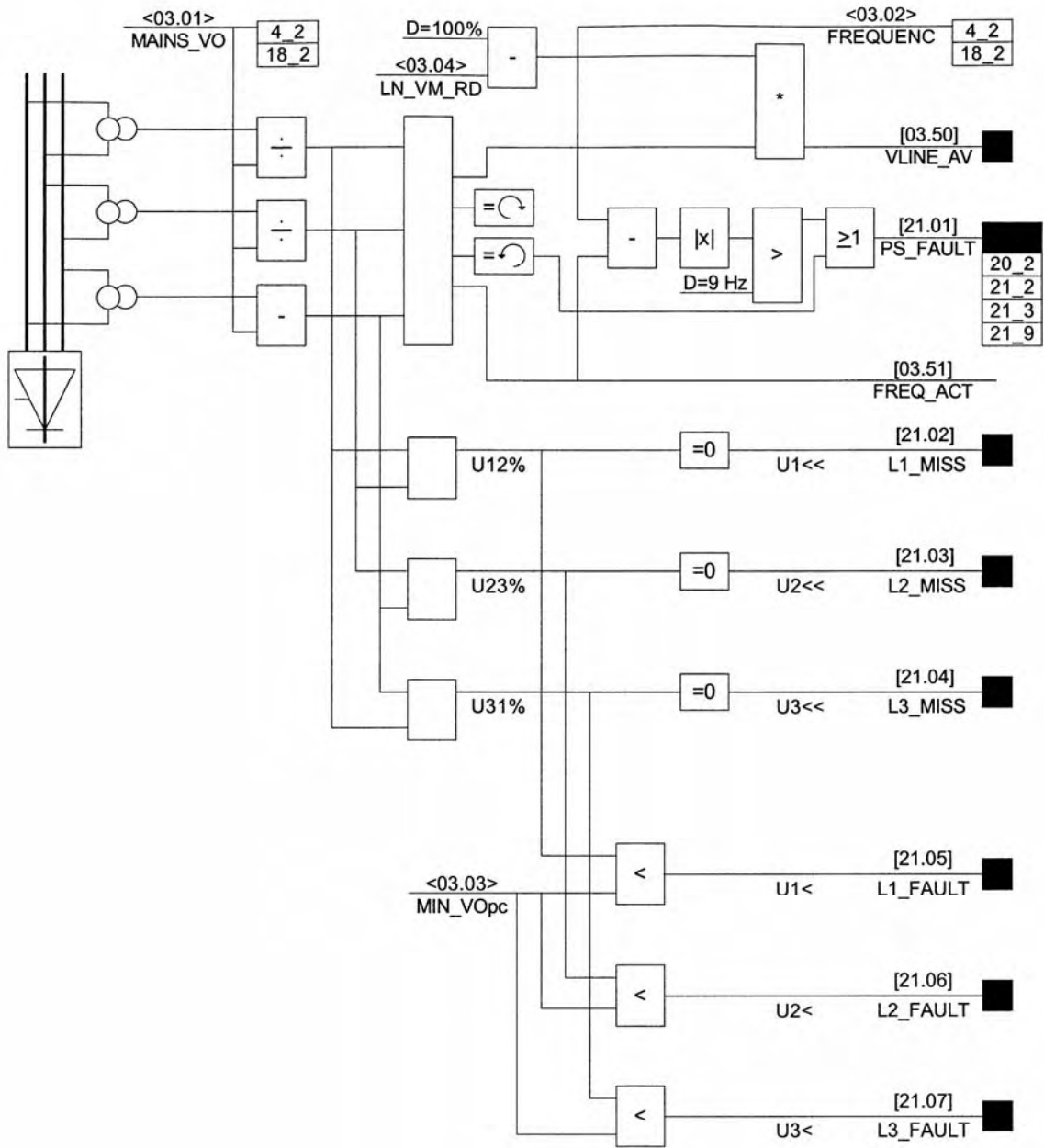
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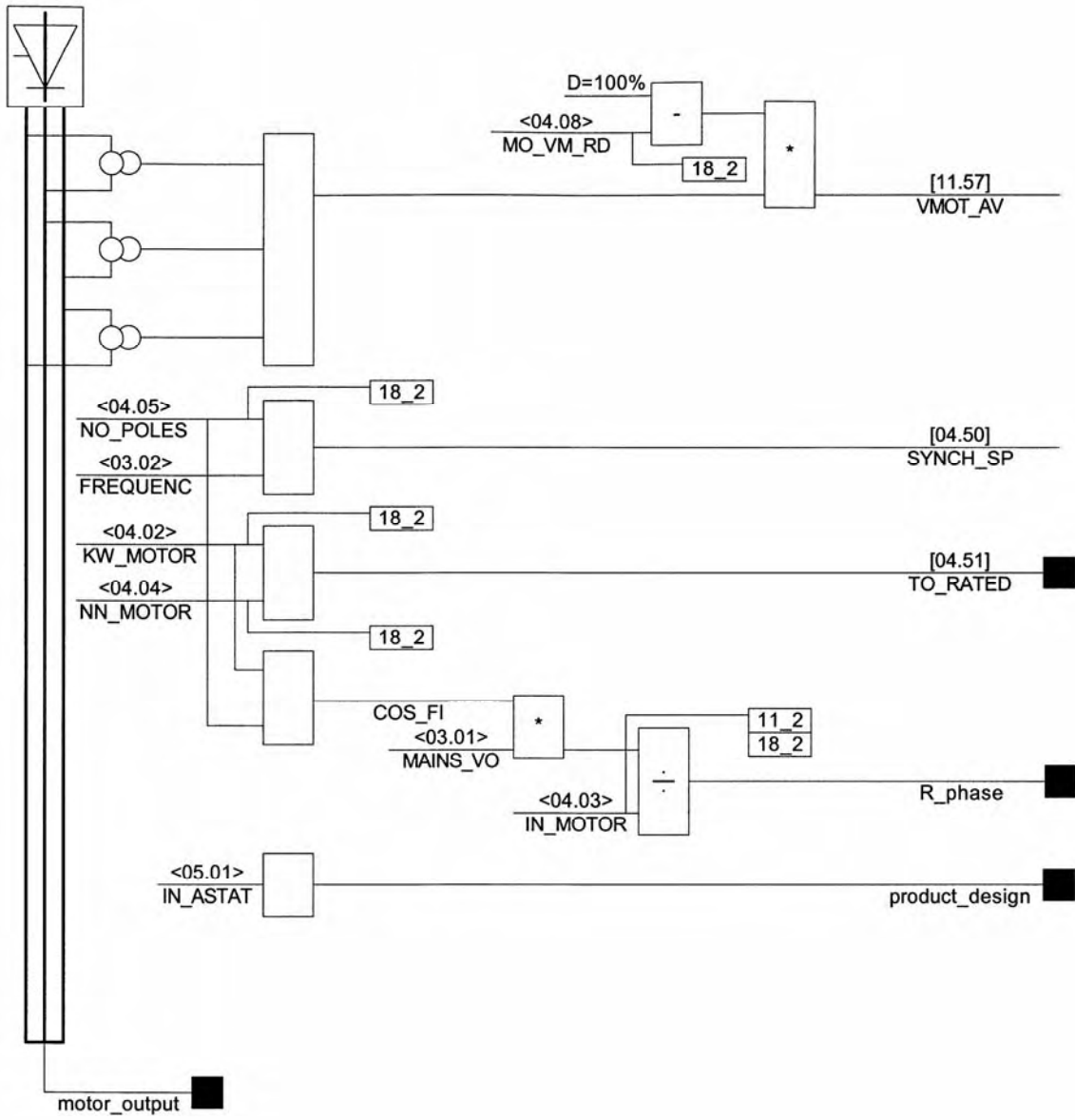


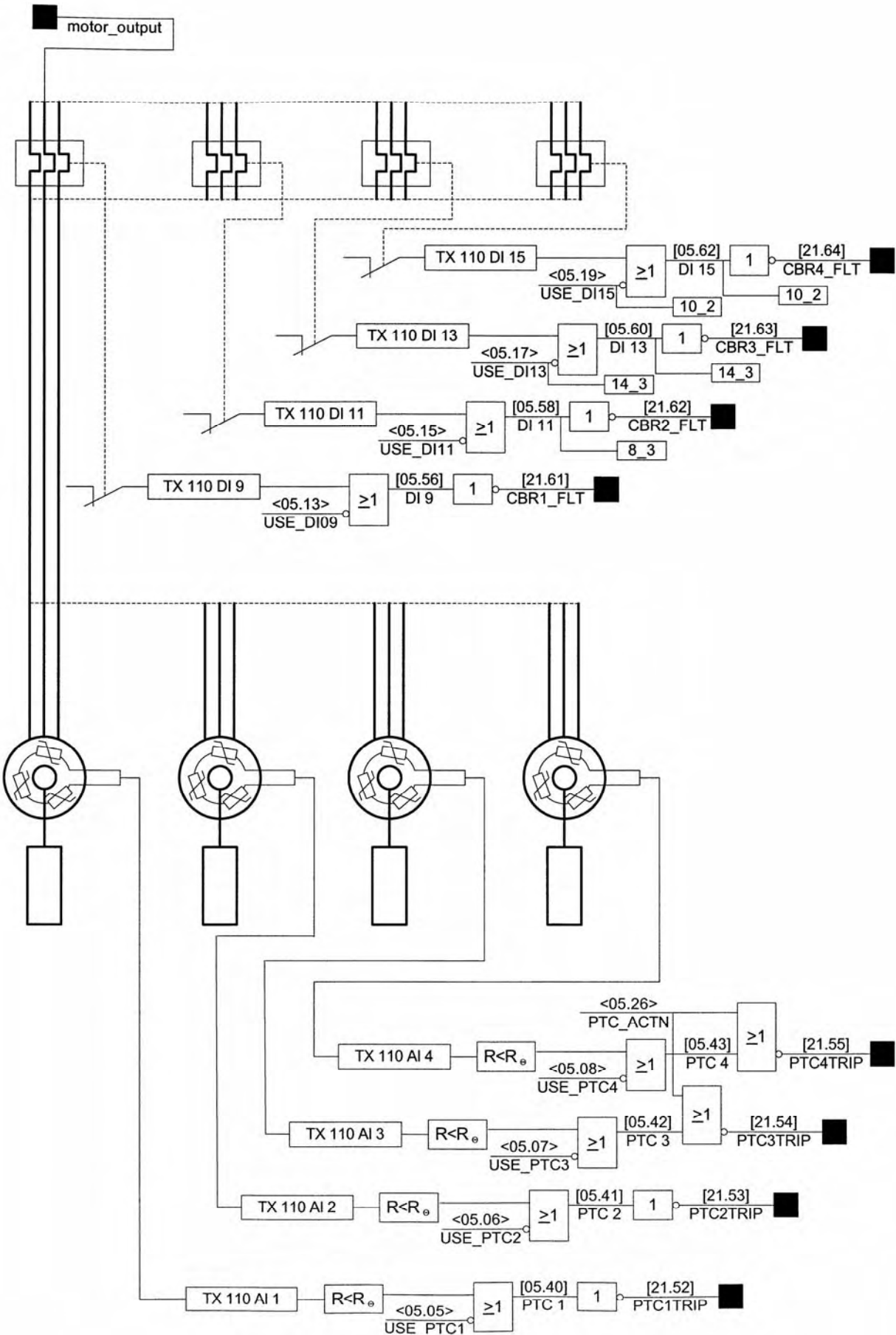
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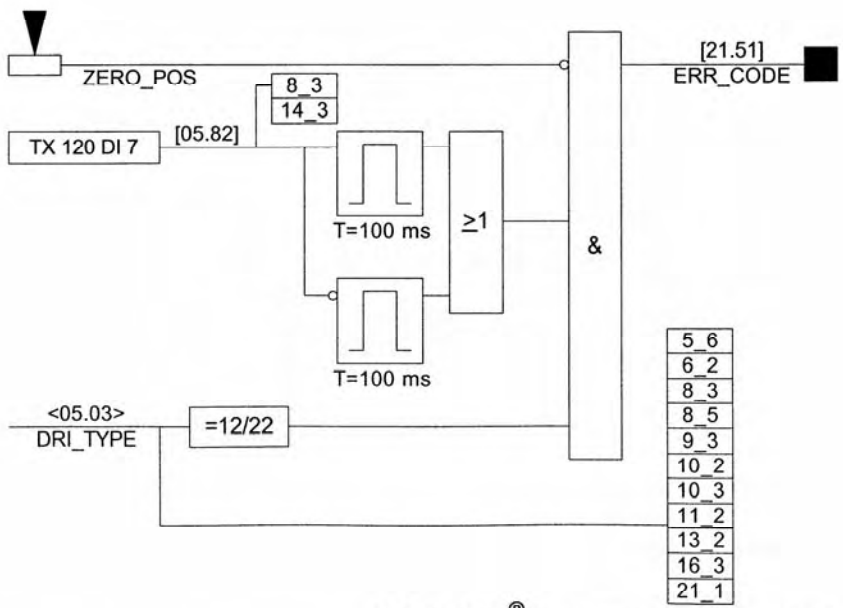
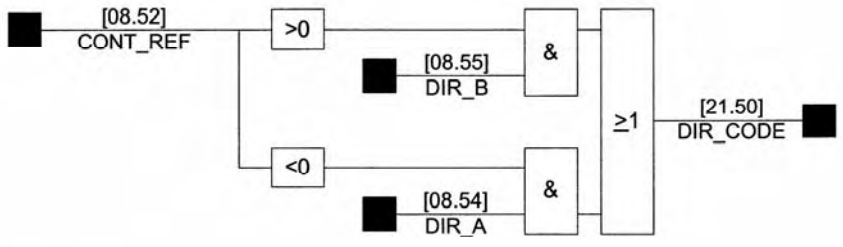
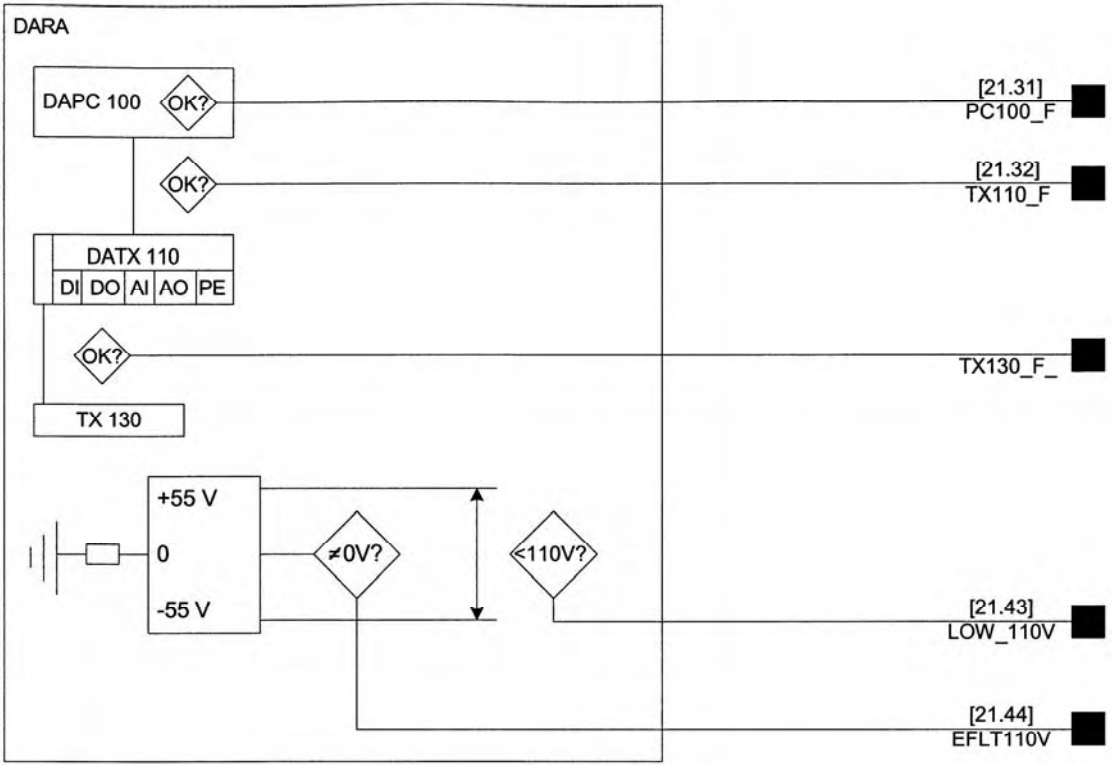
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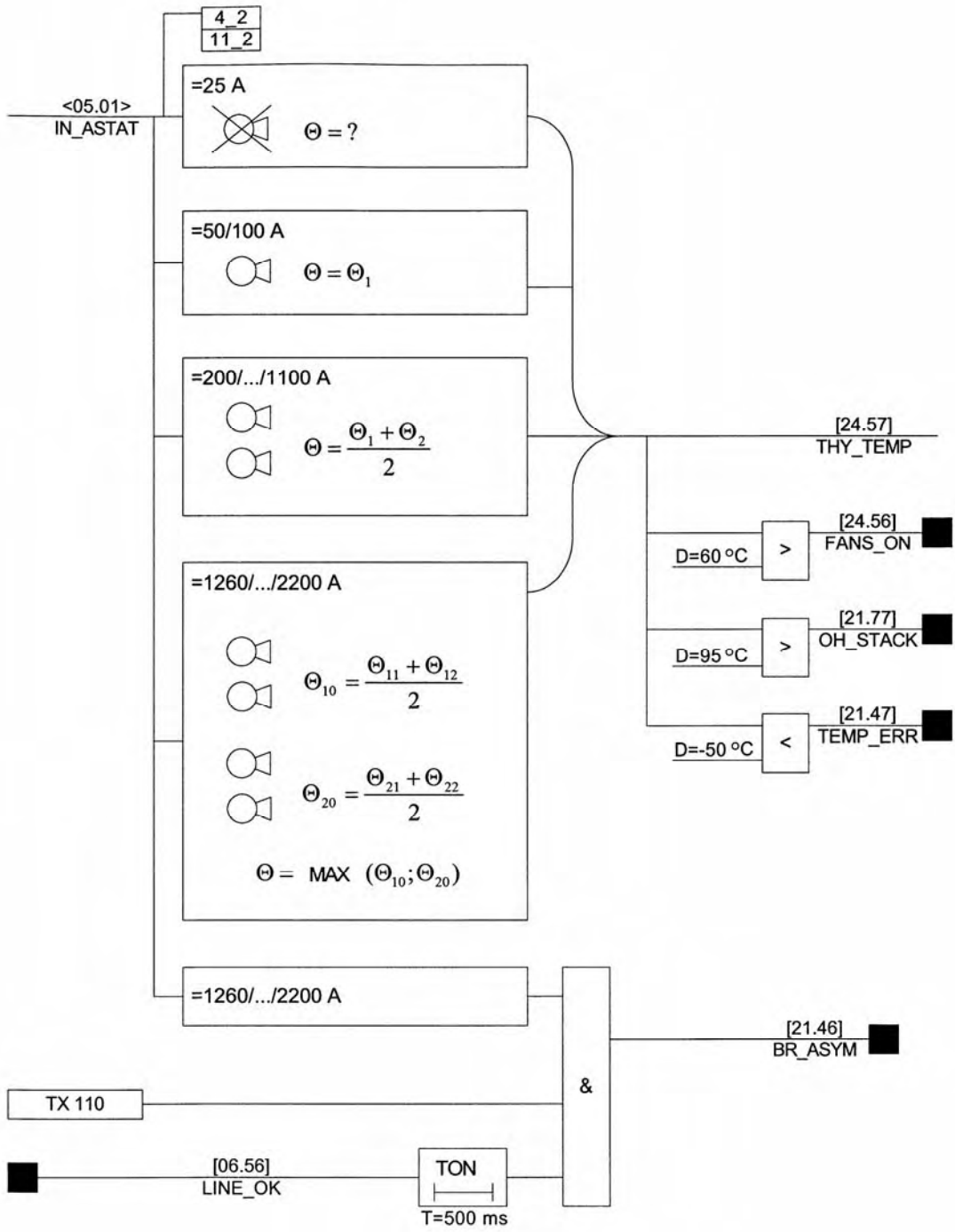


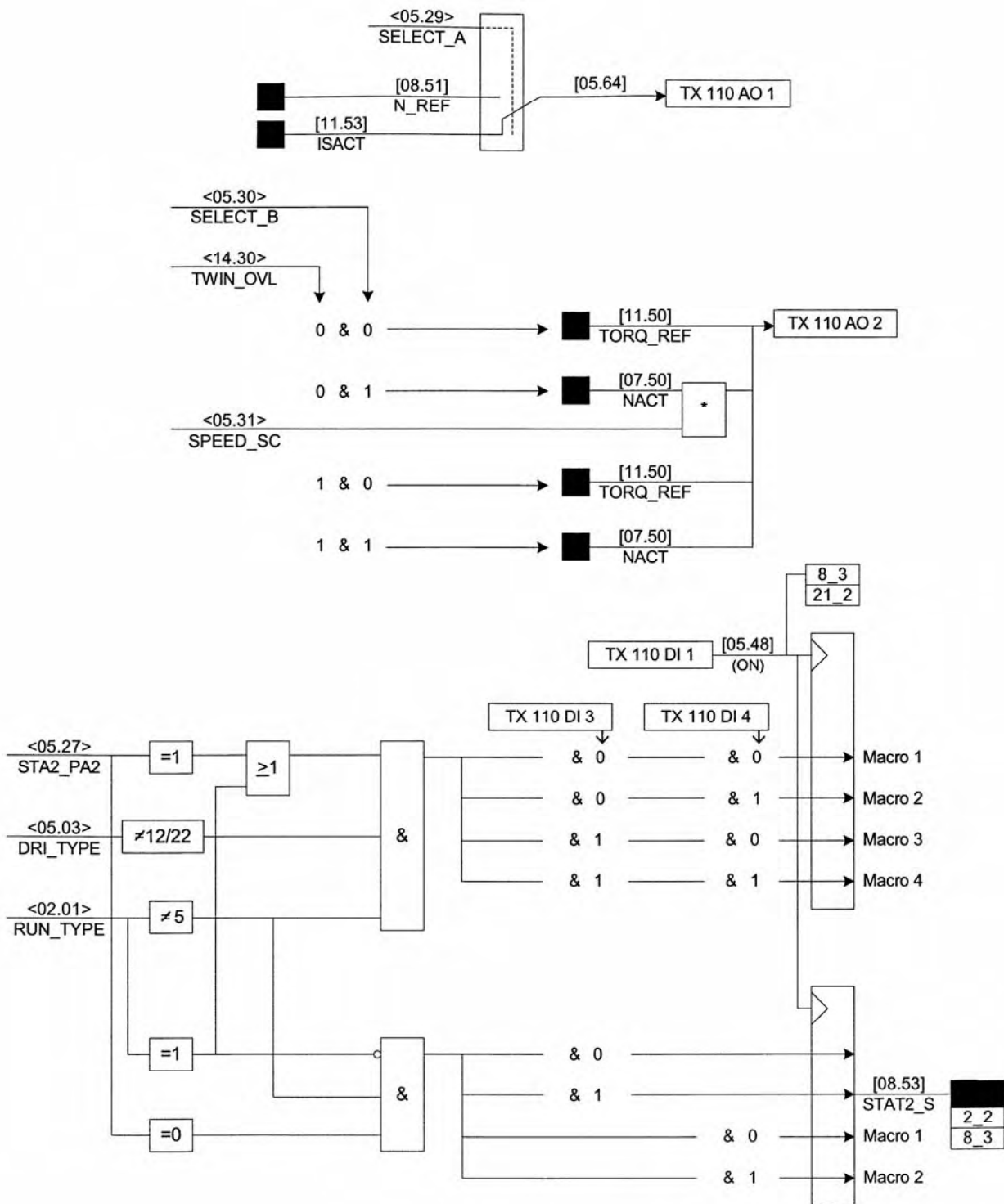


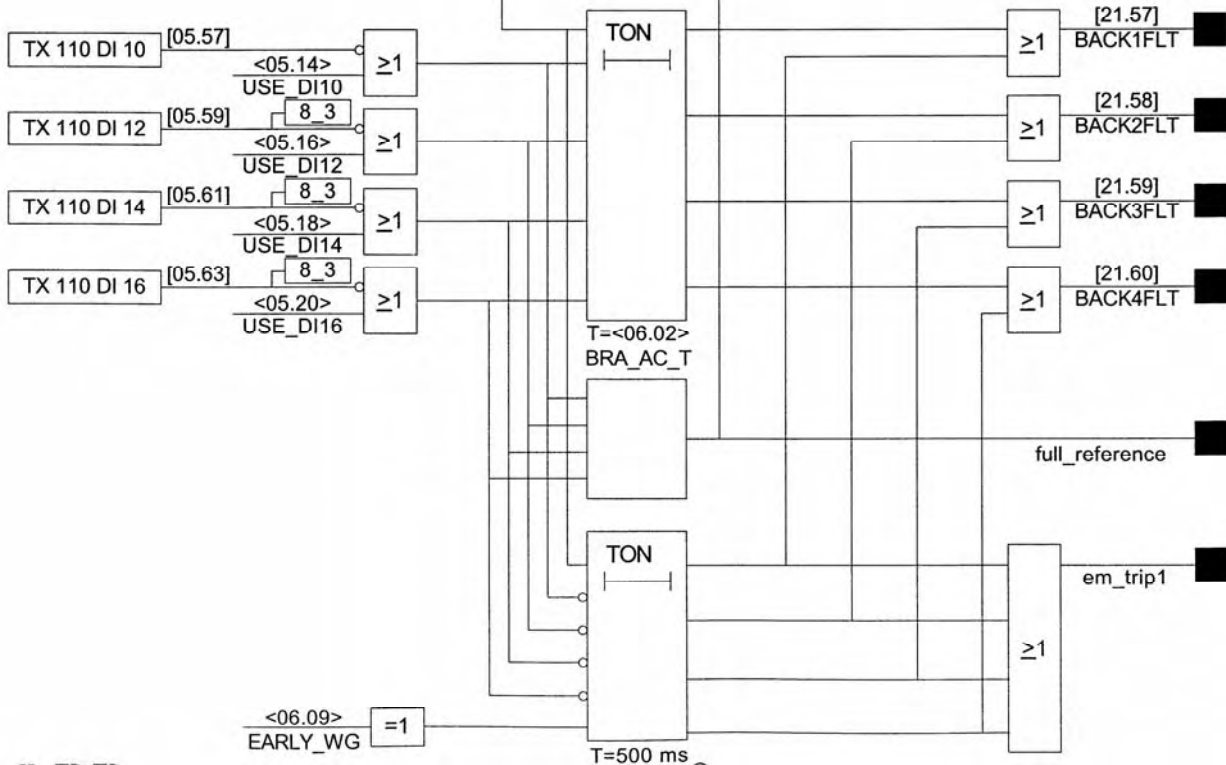
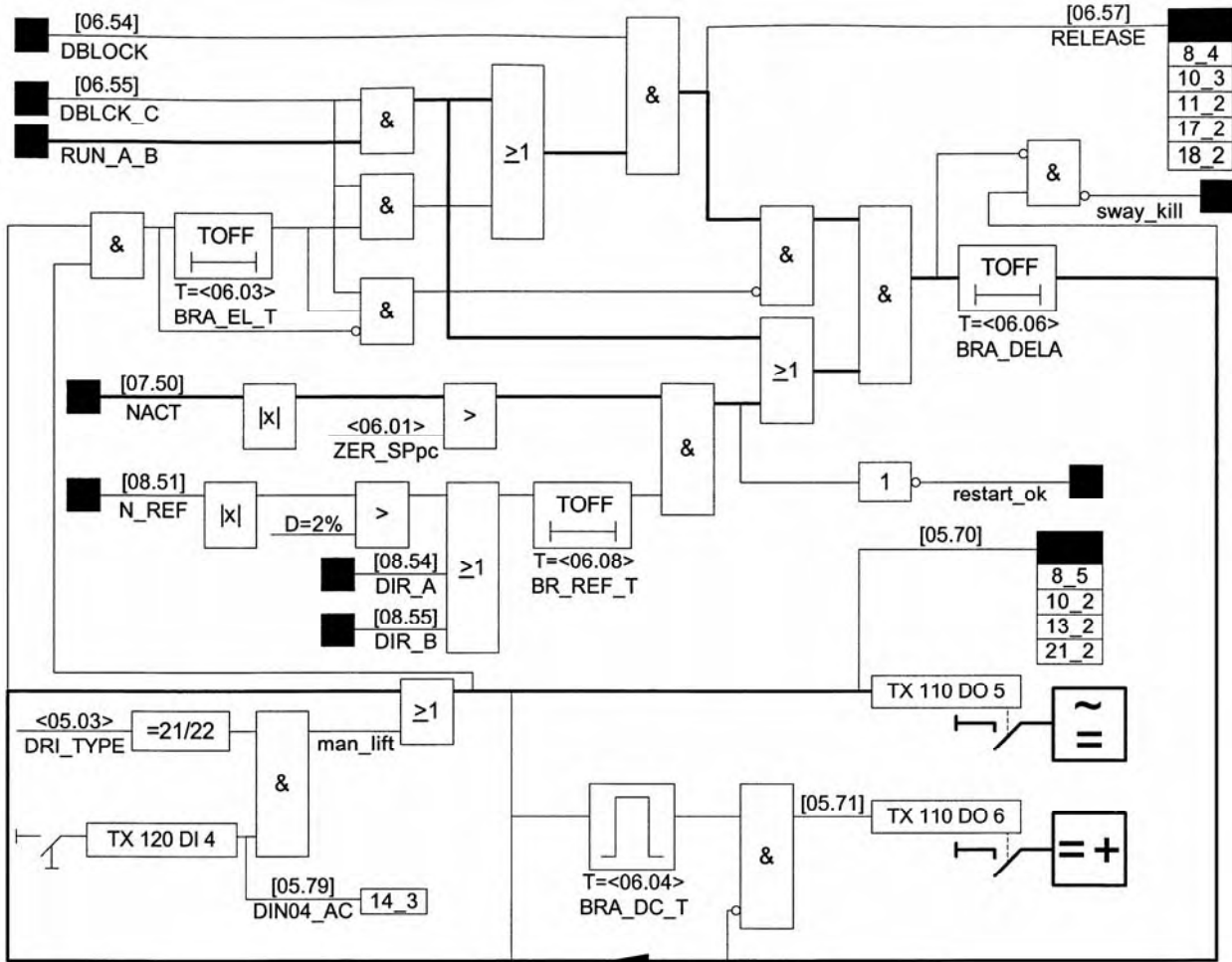


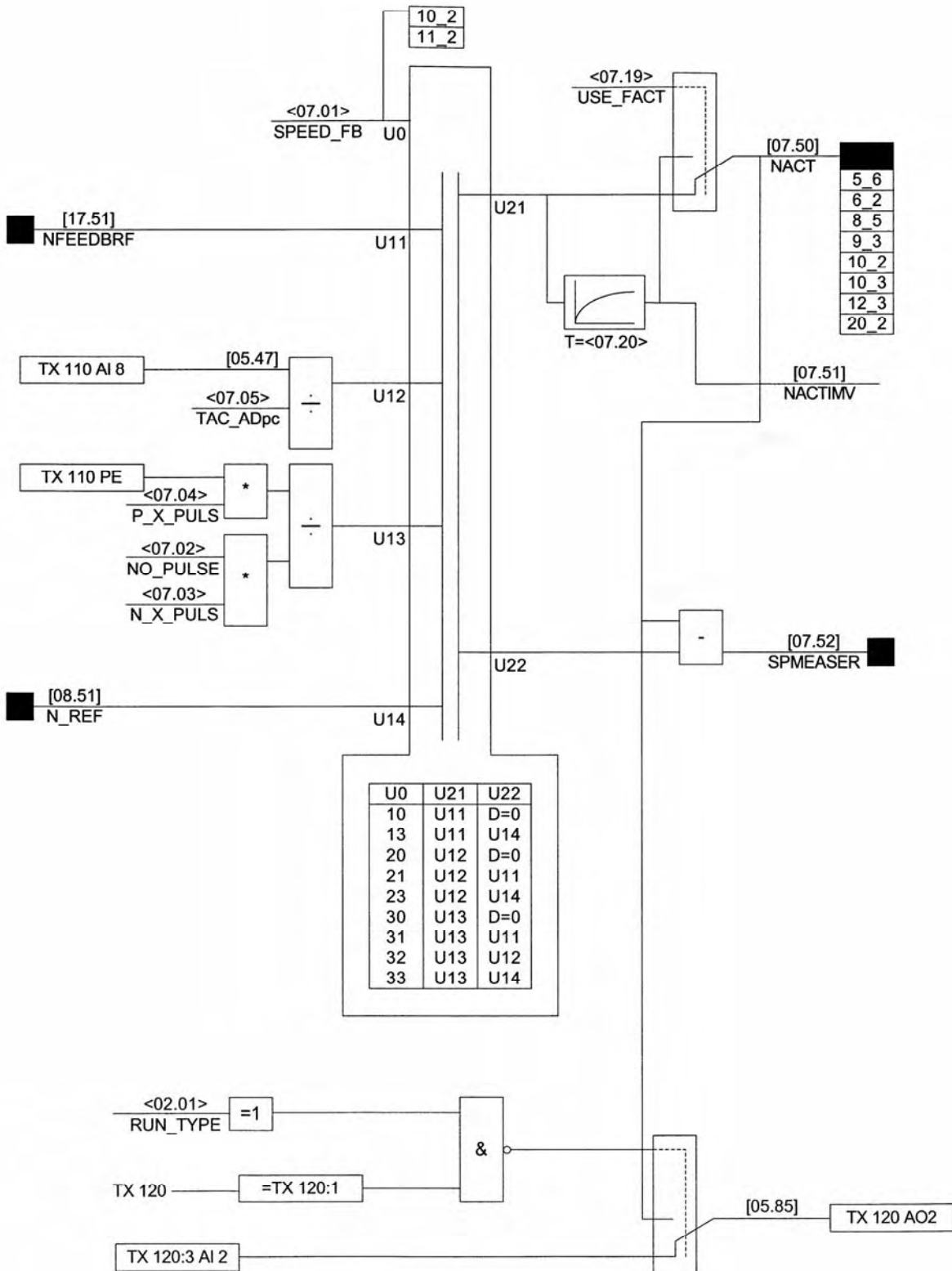


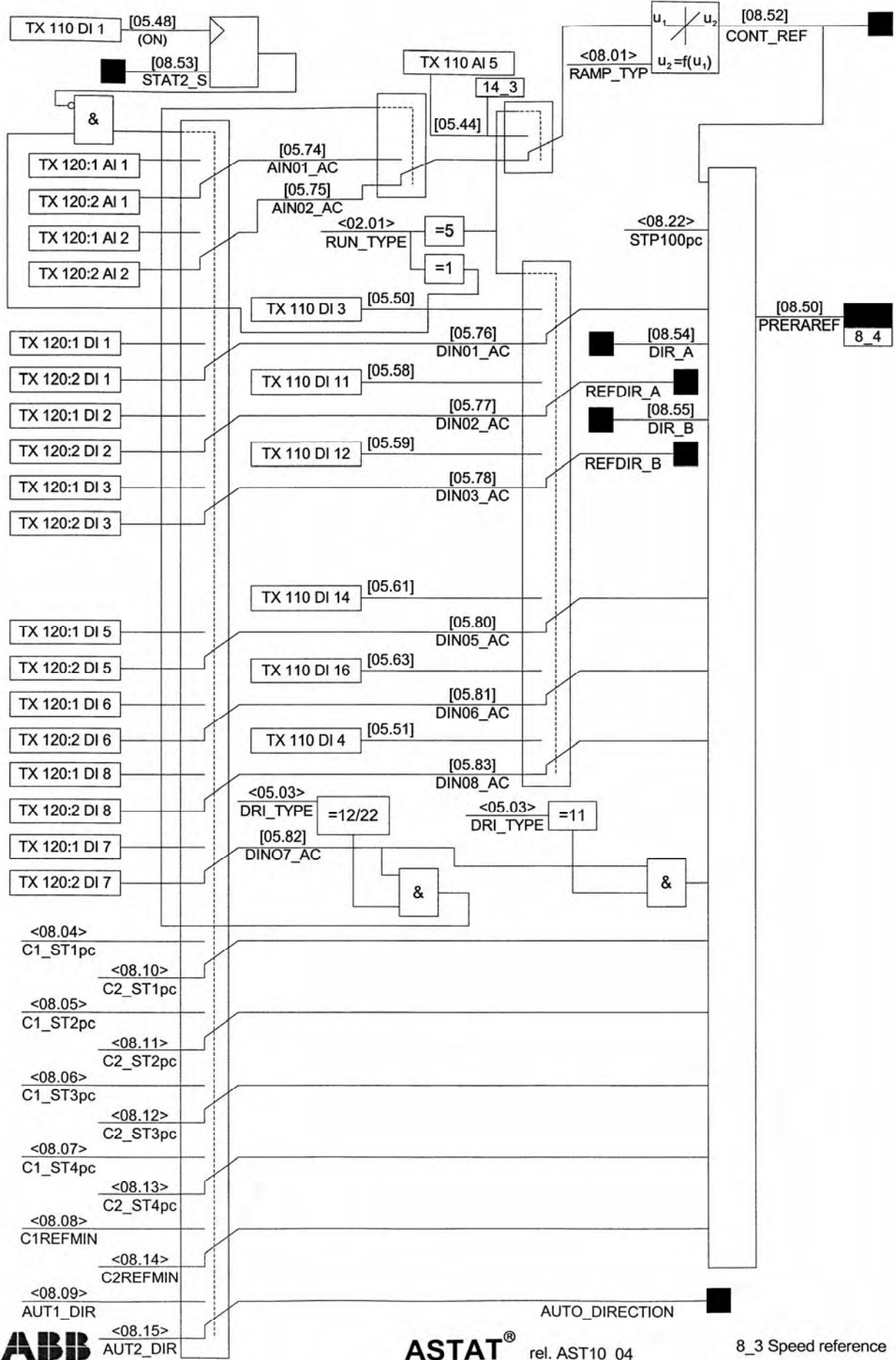






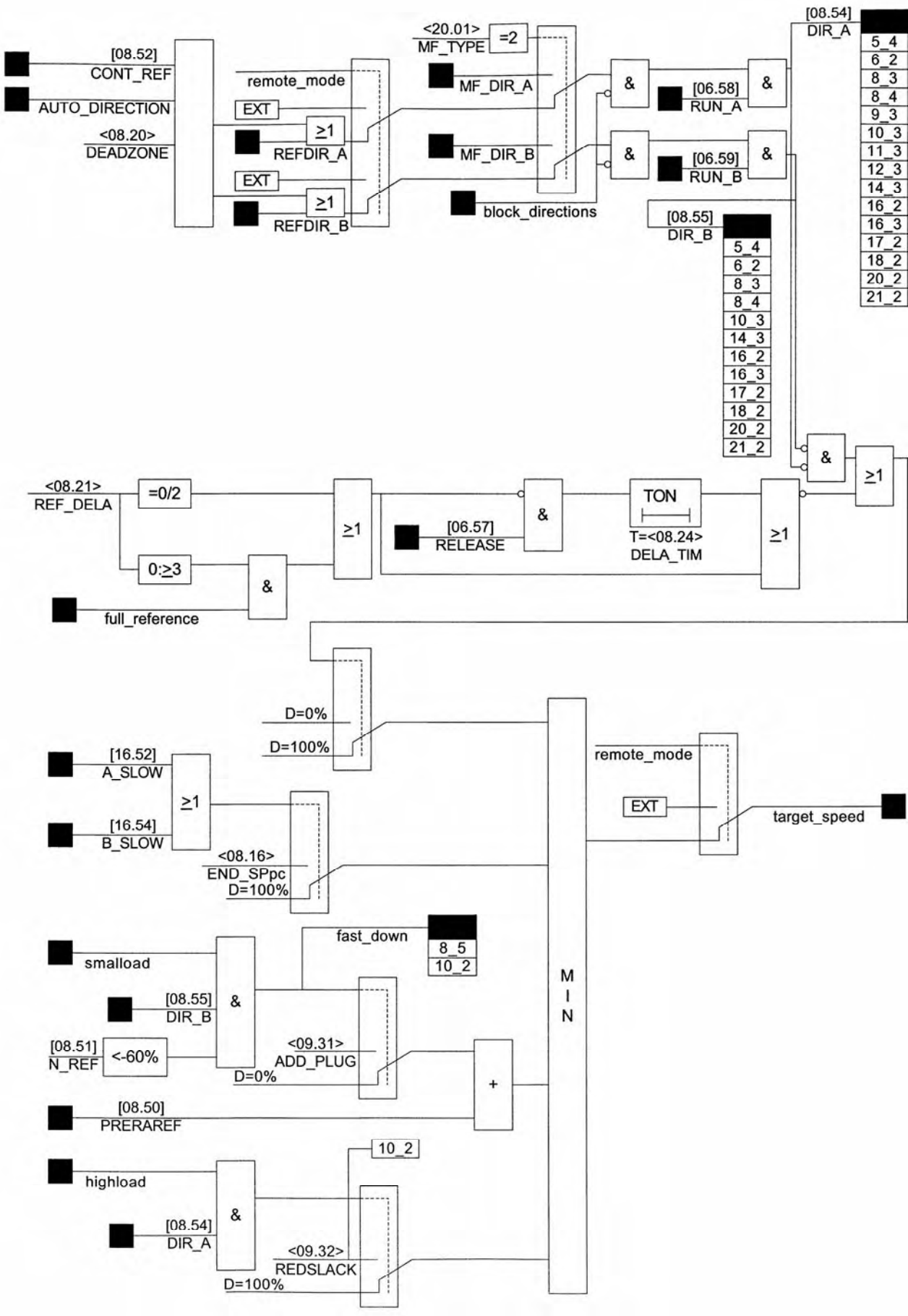


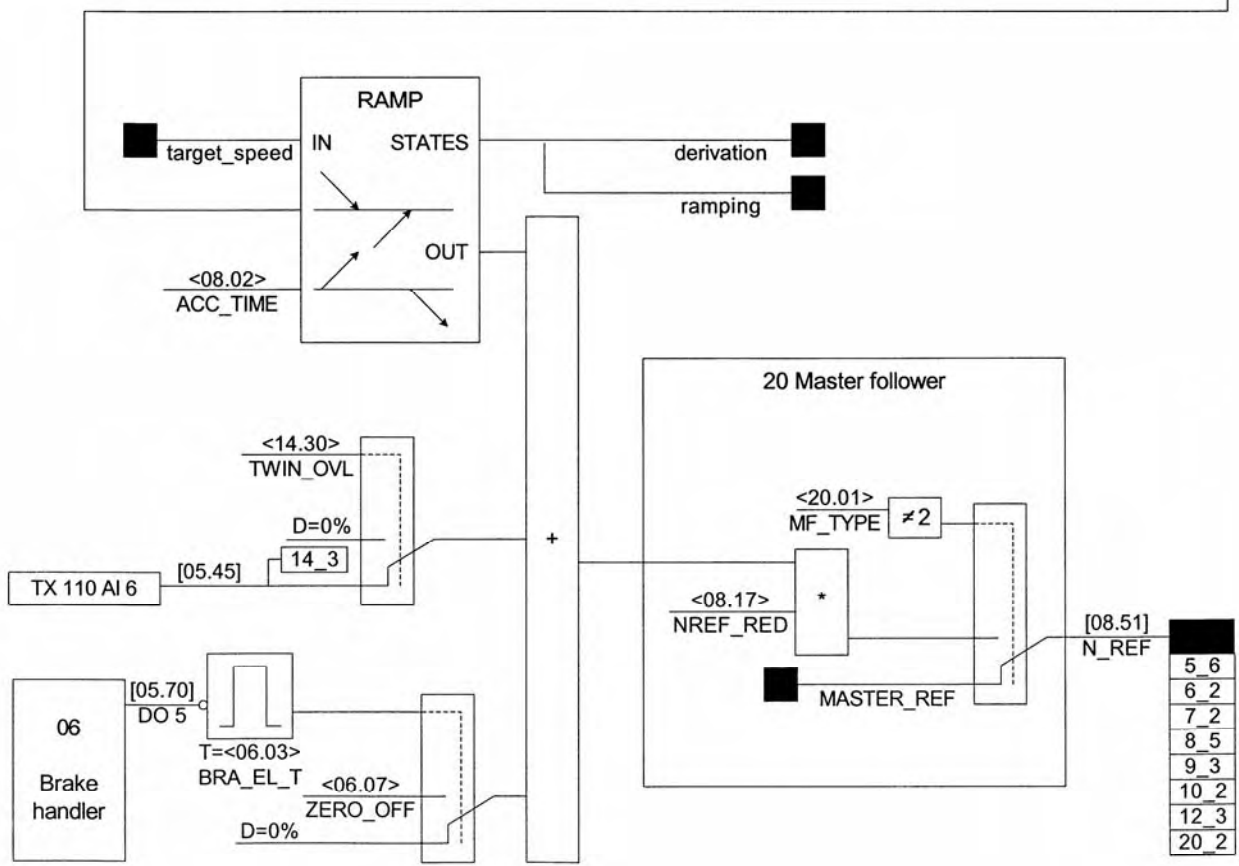
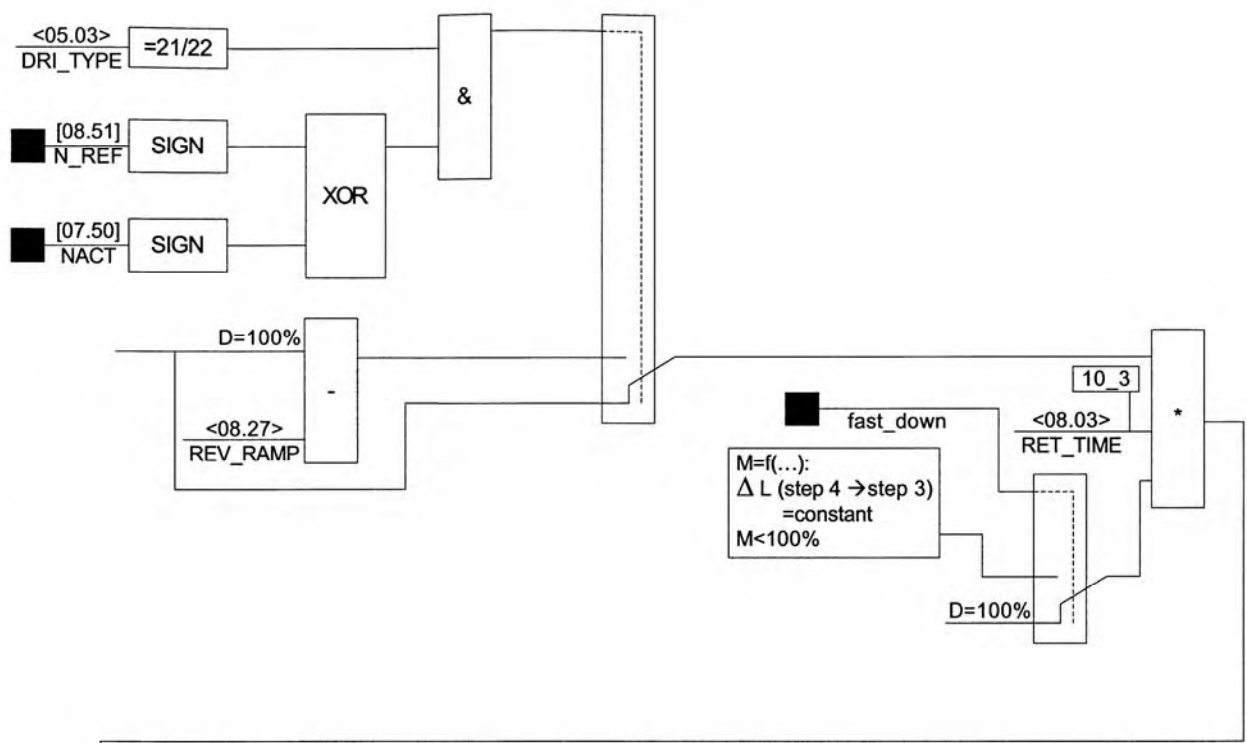


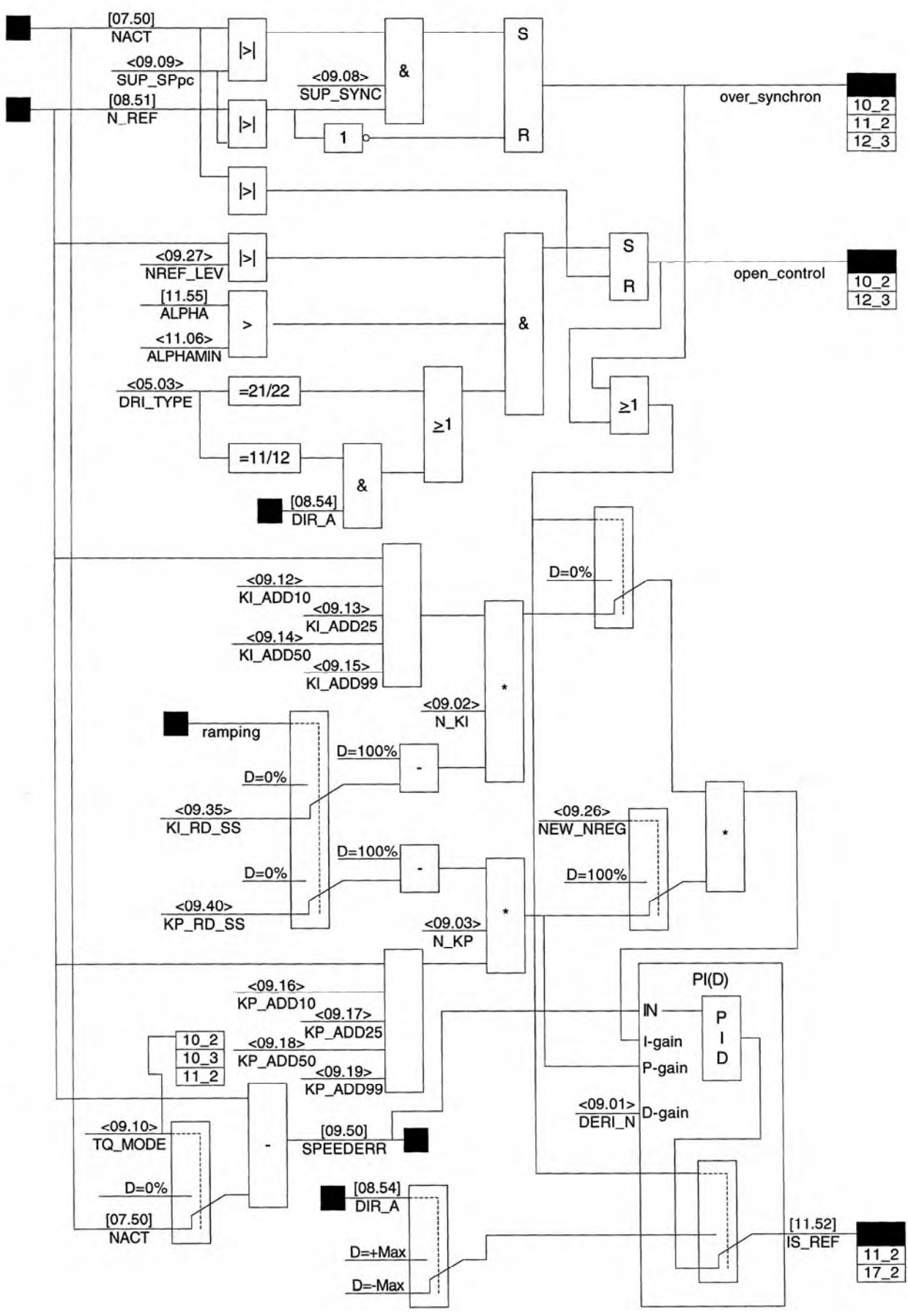


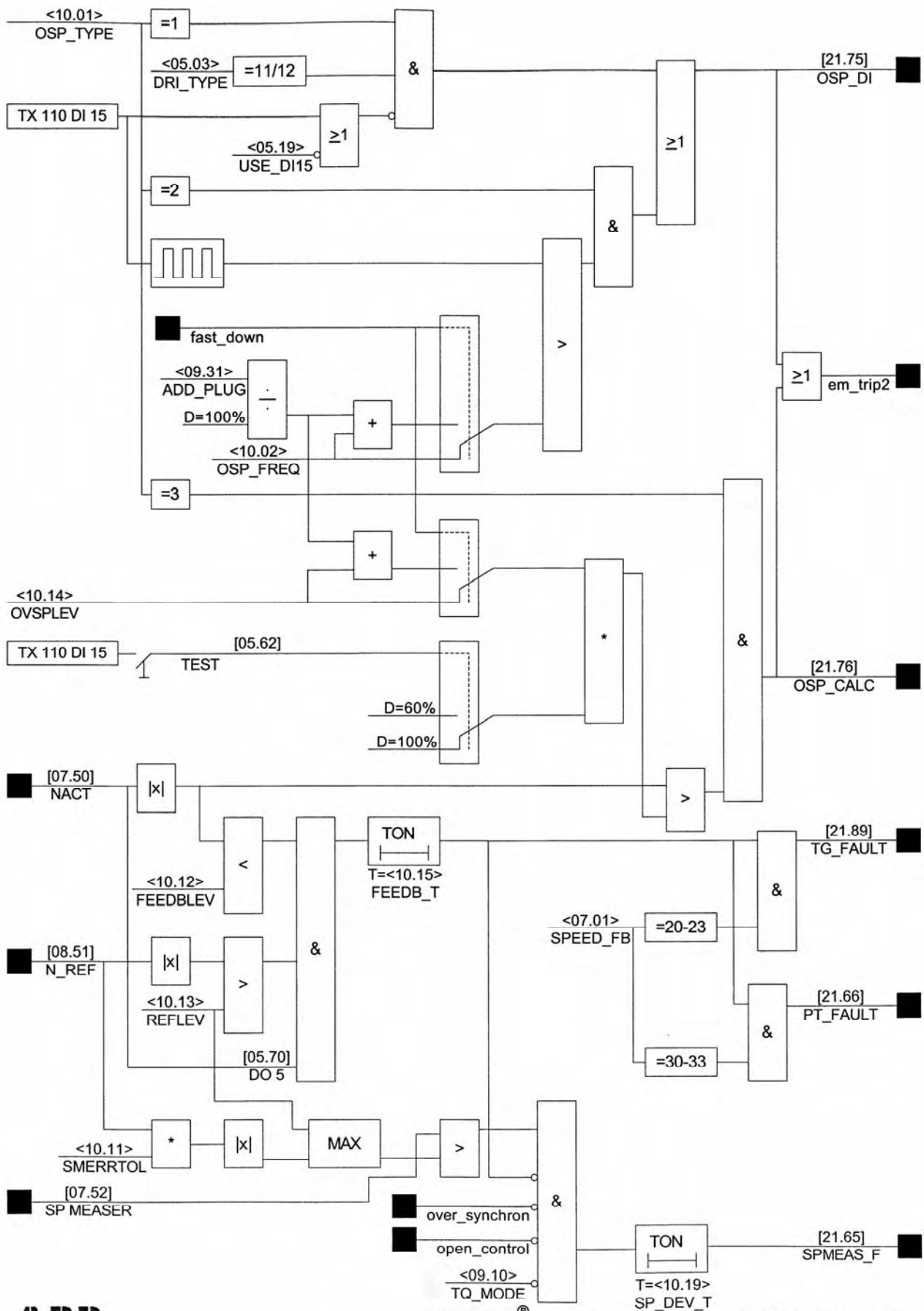
ASTAT[®] rel. AST10_04

8_3 Speed reference





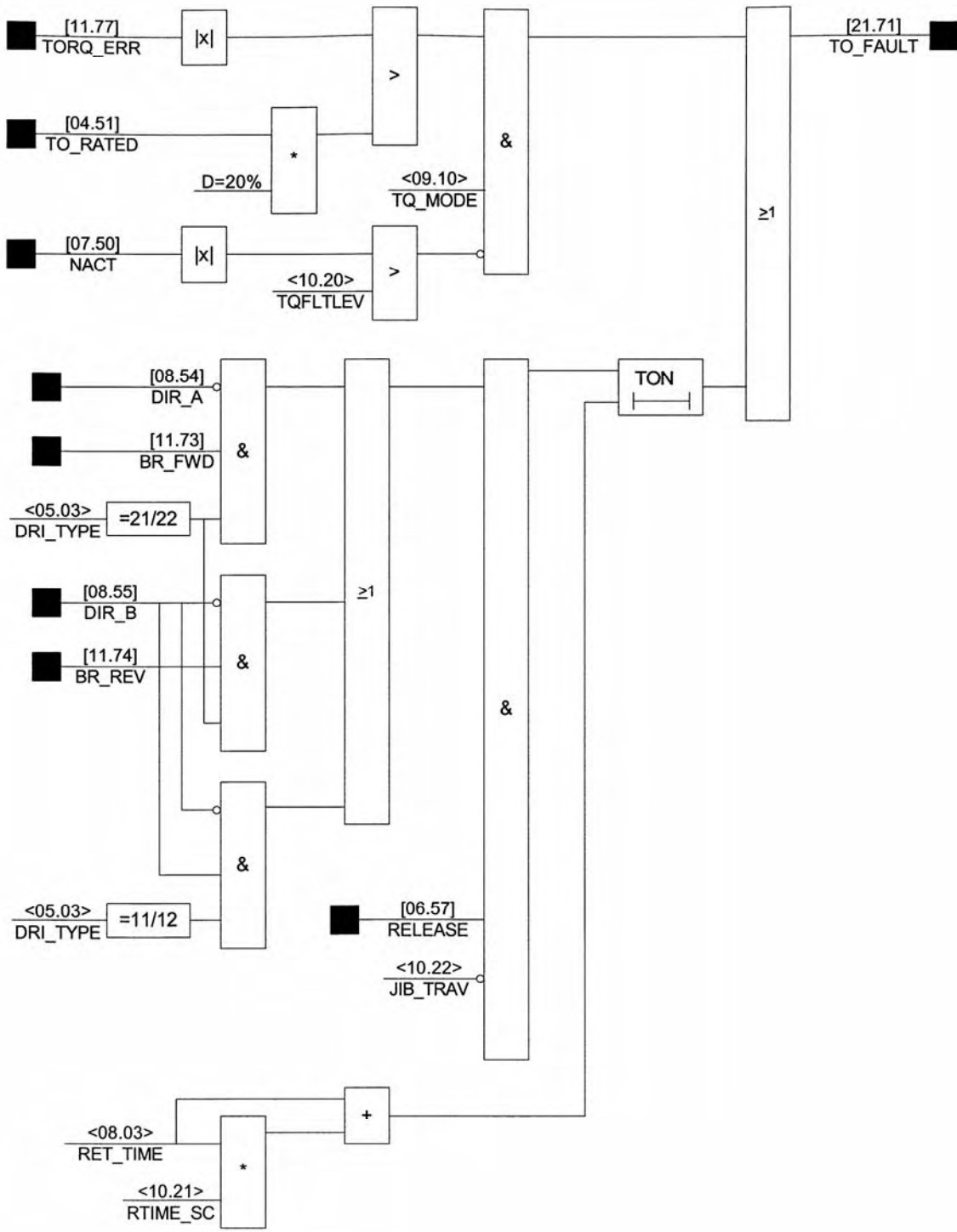


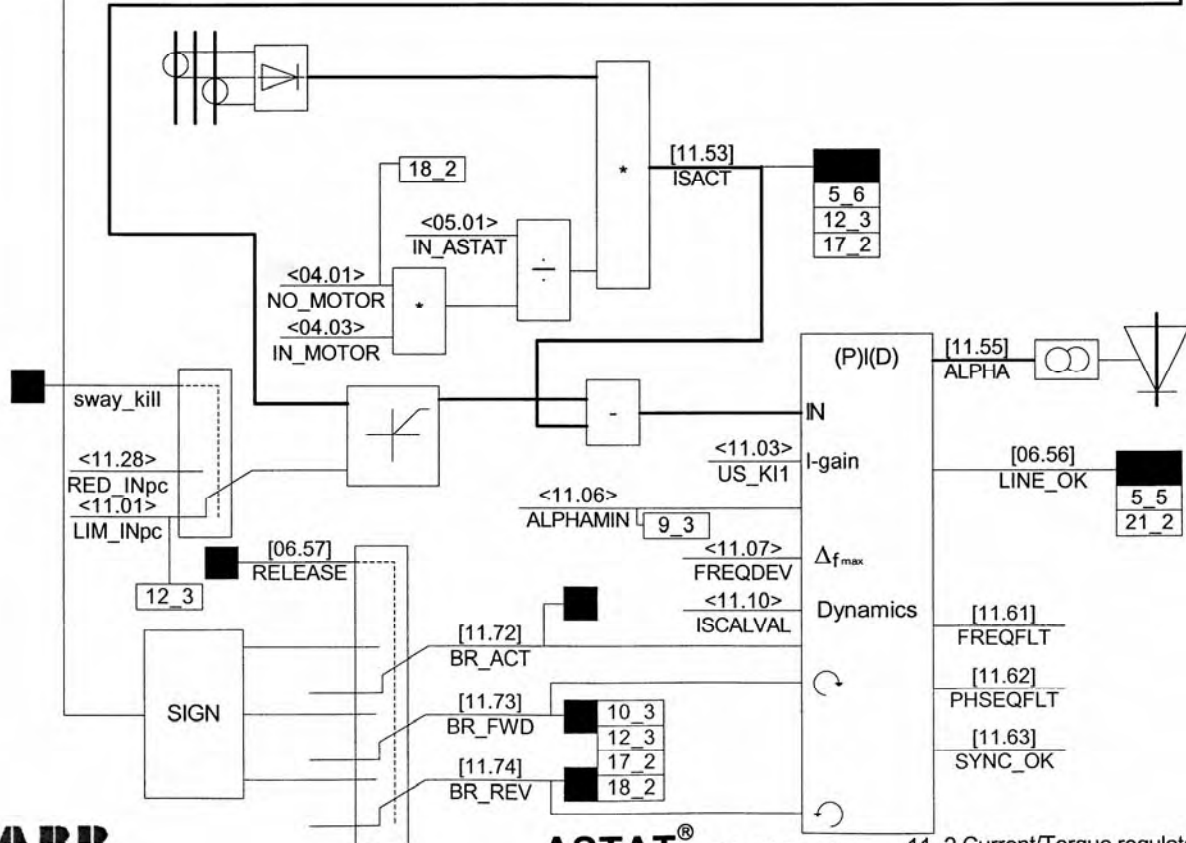
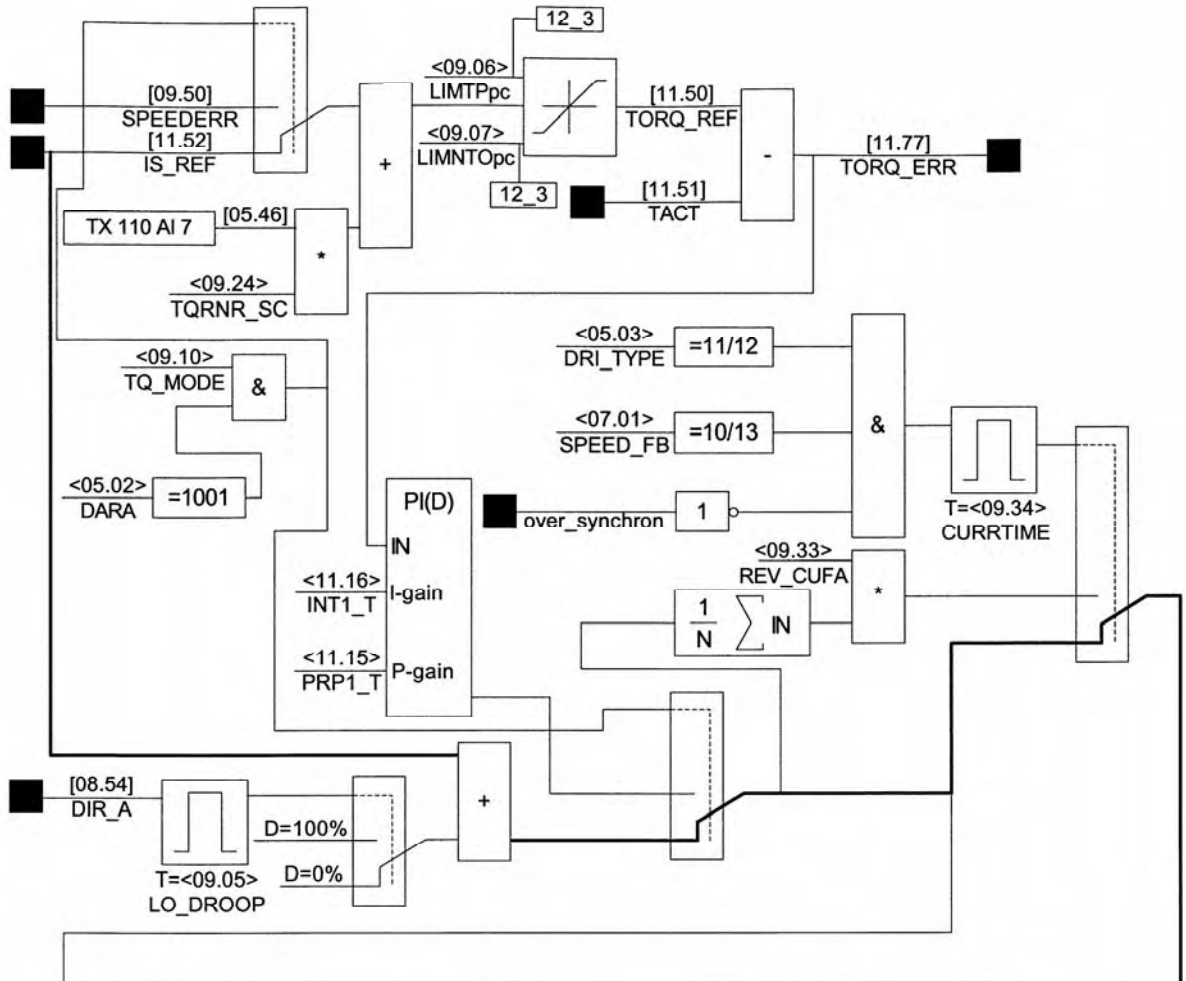


ASTAT[®]

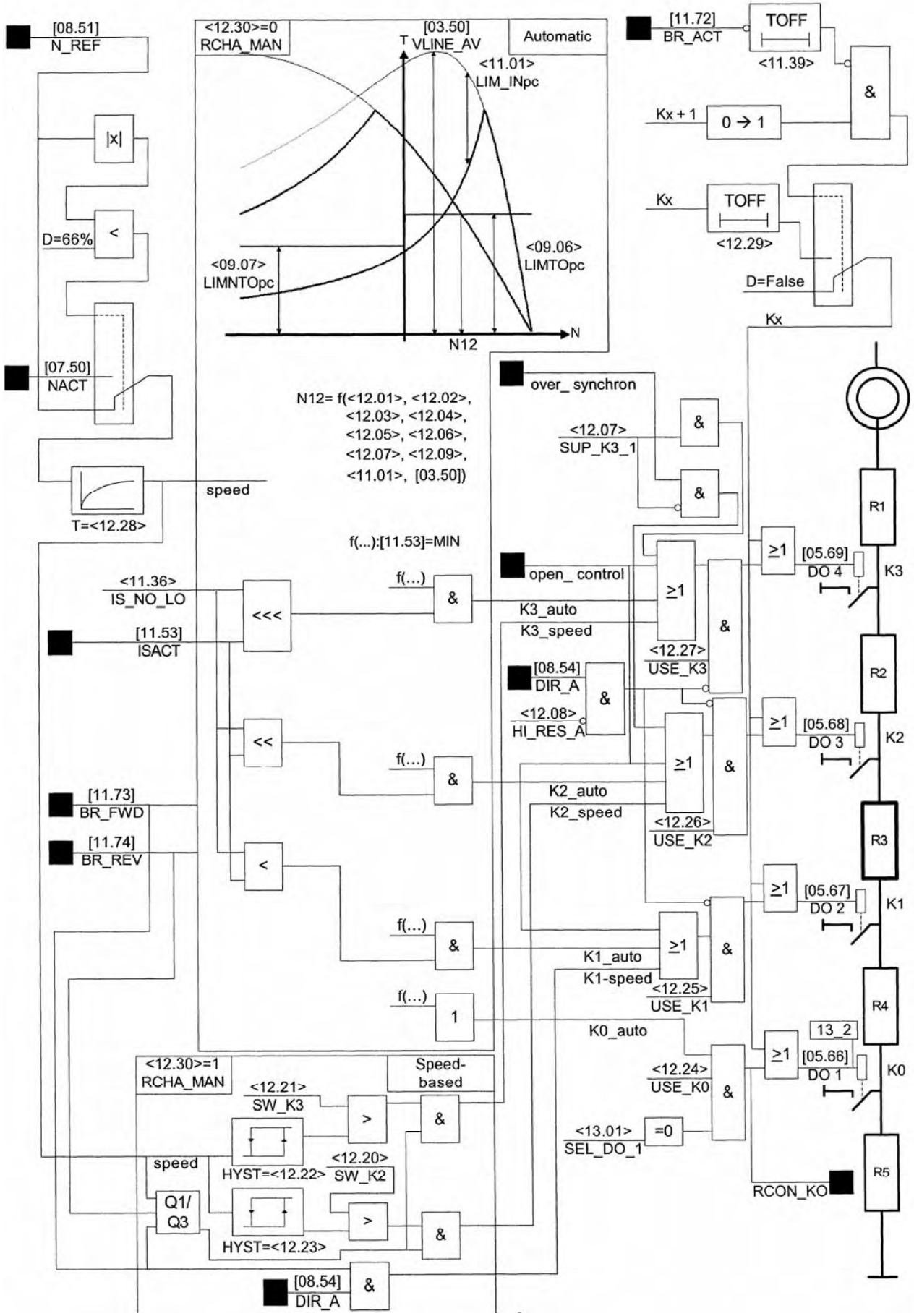
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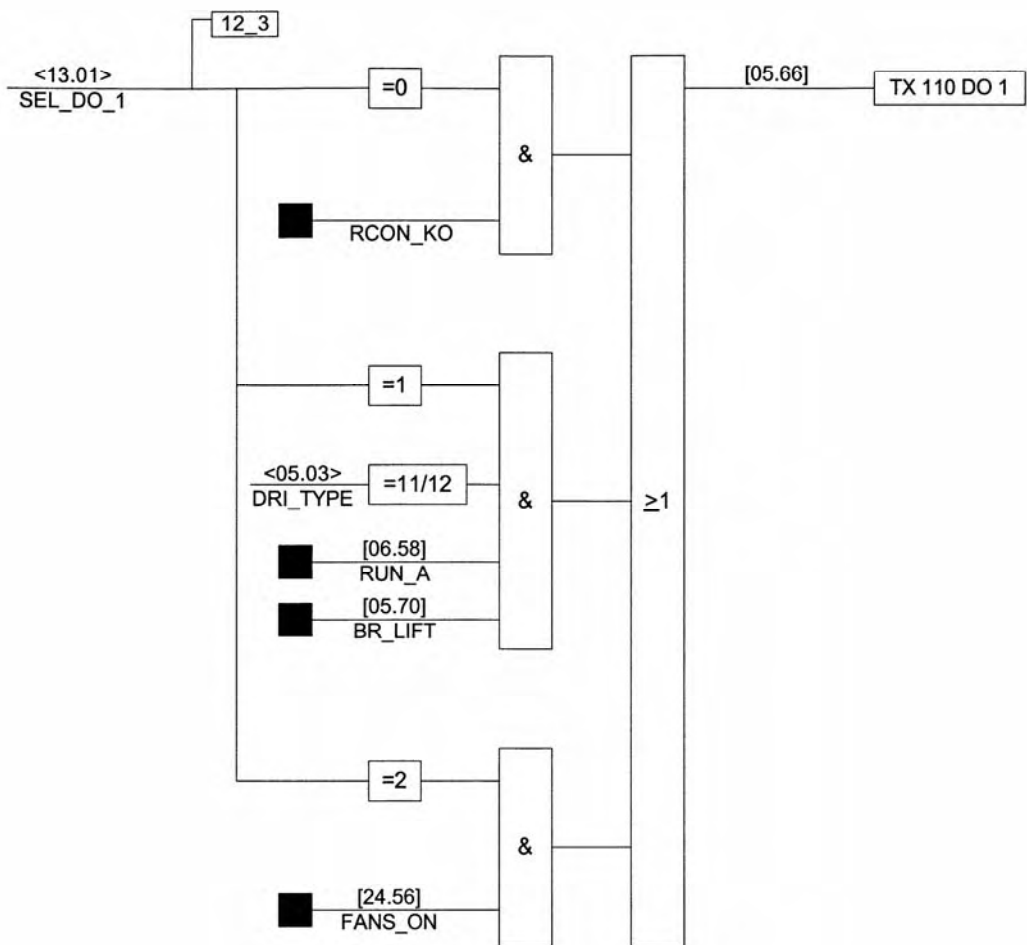
10_2 Speed supervision



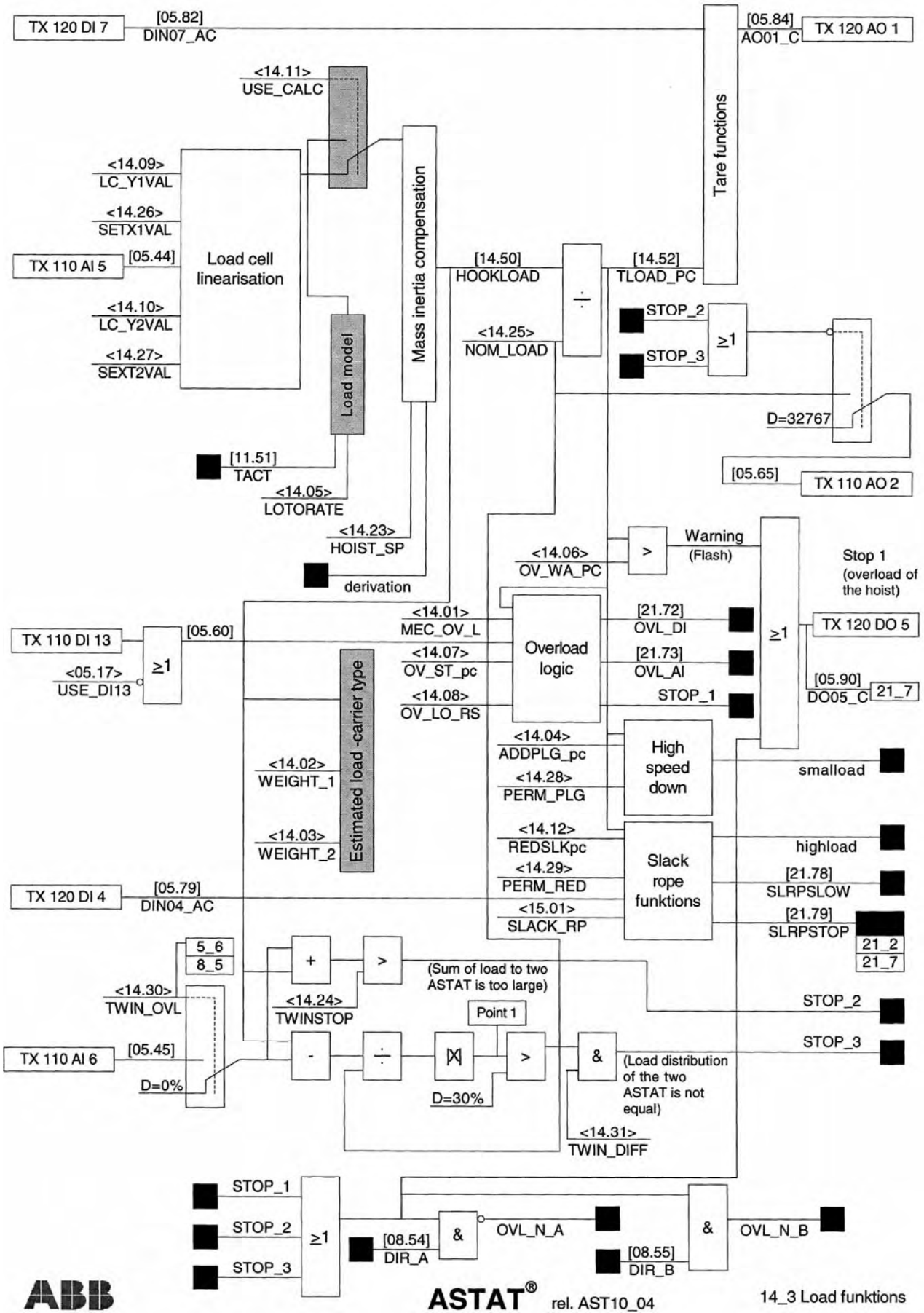


ASTAT® rel. AST10_04 11_2 Current/Torque regulator



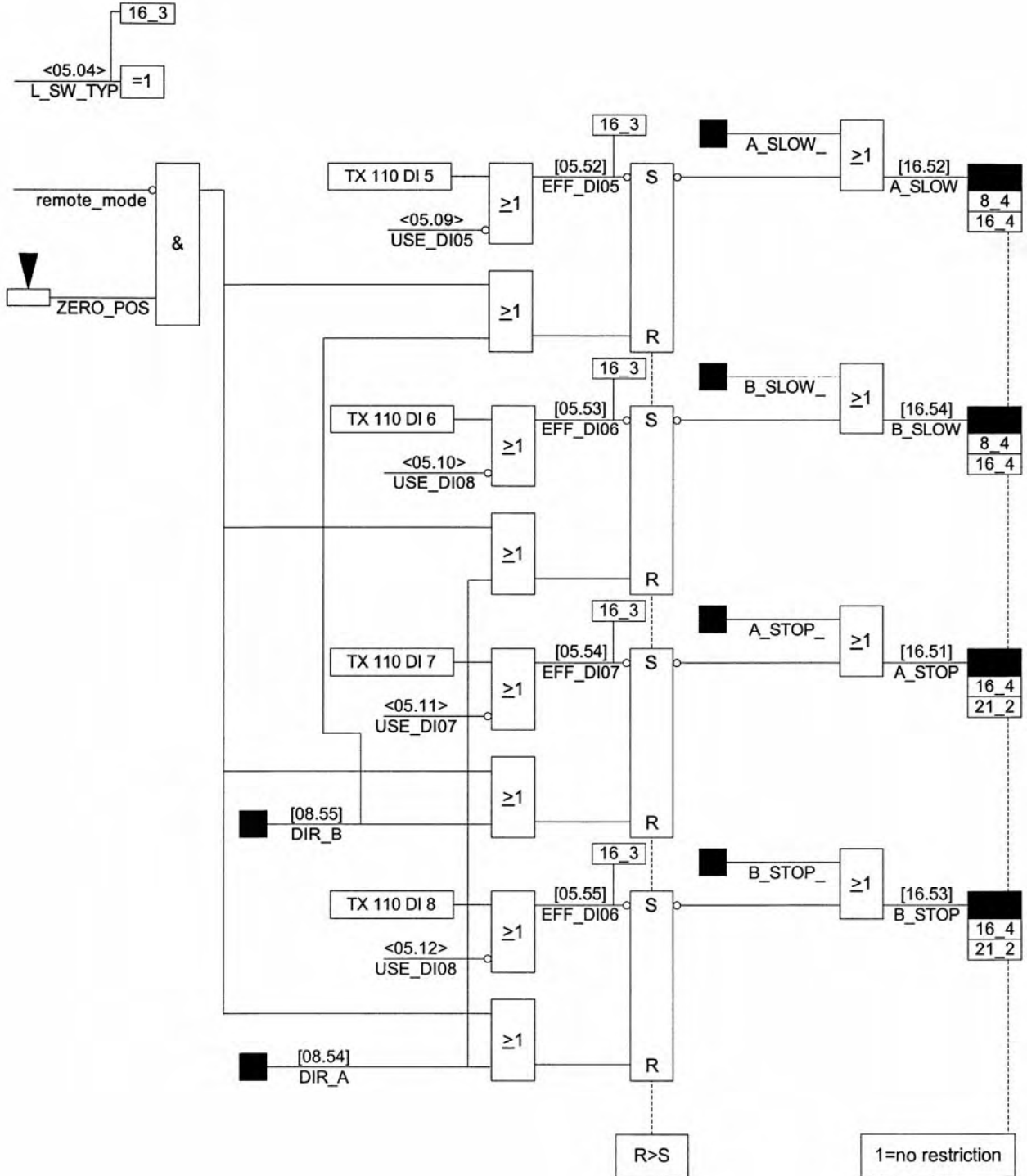


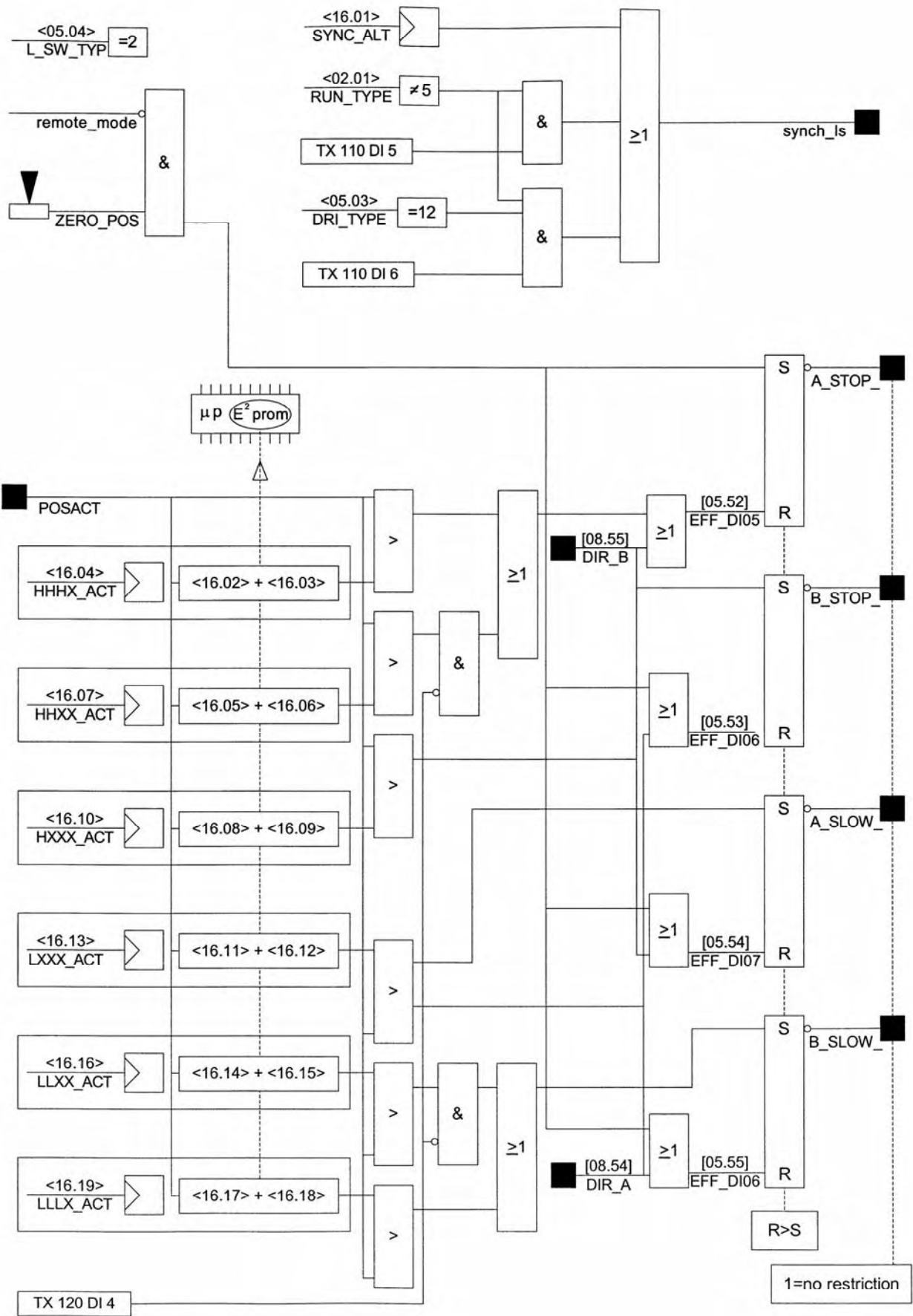
14, 15 Load functions, Slack Rope function

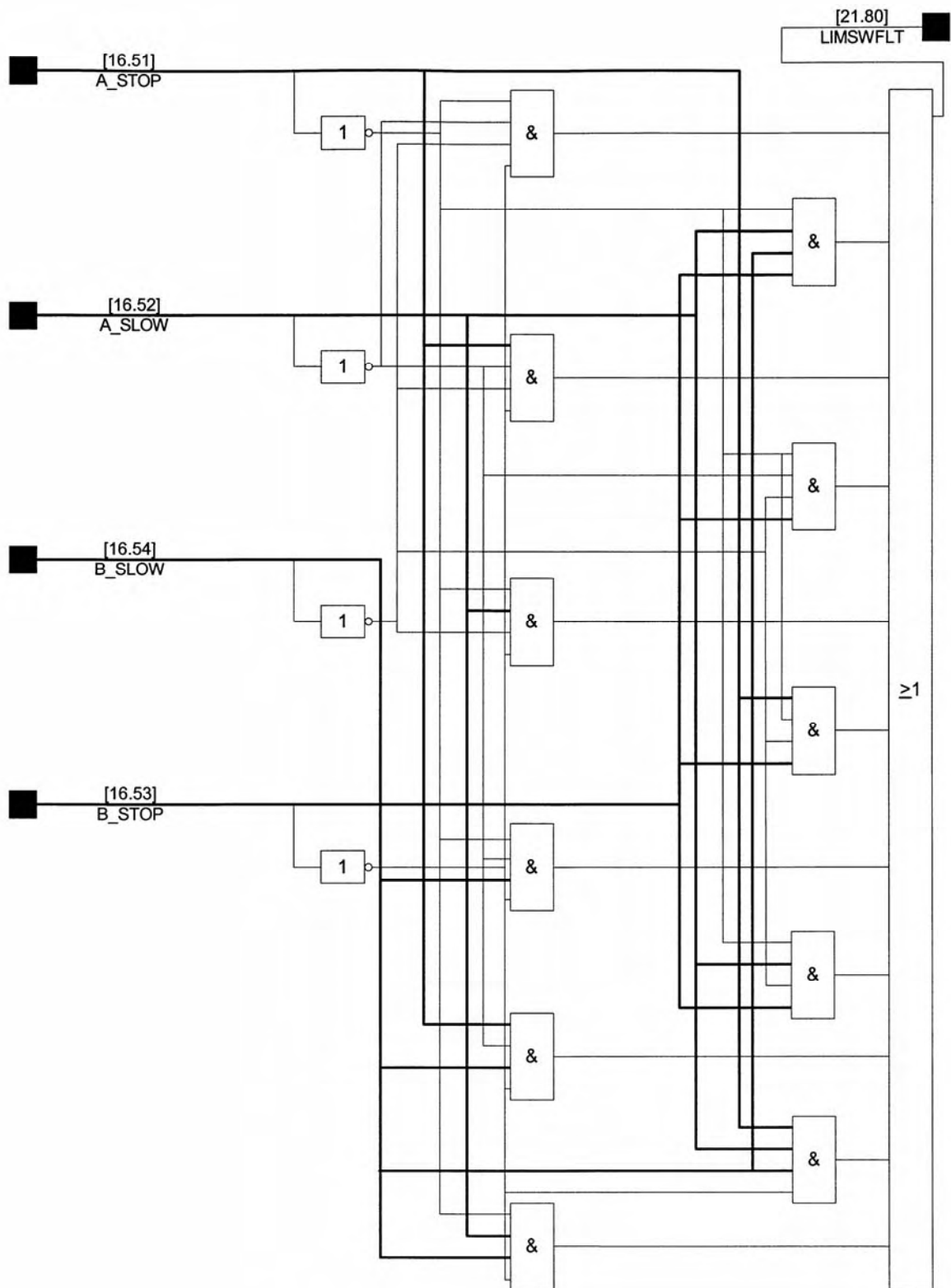


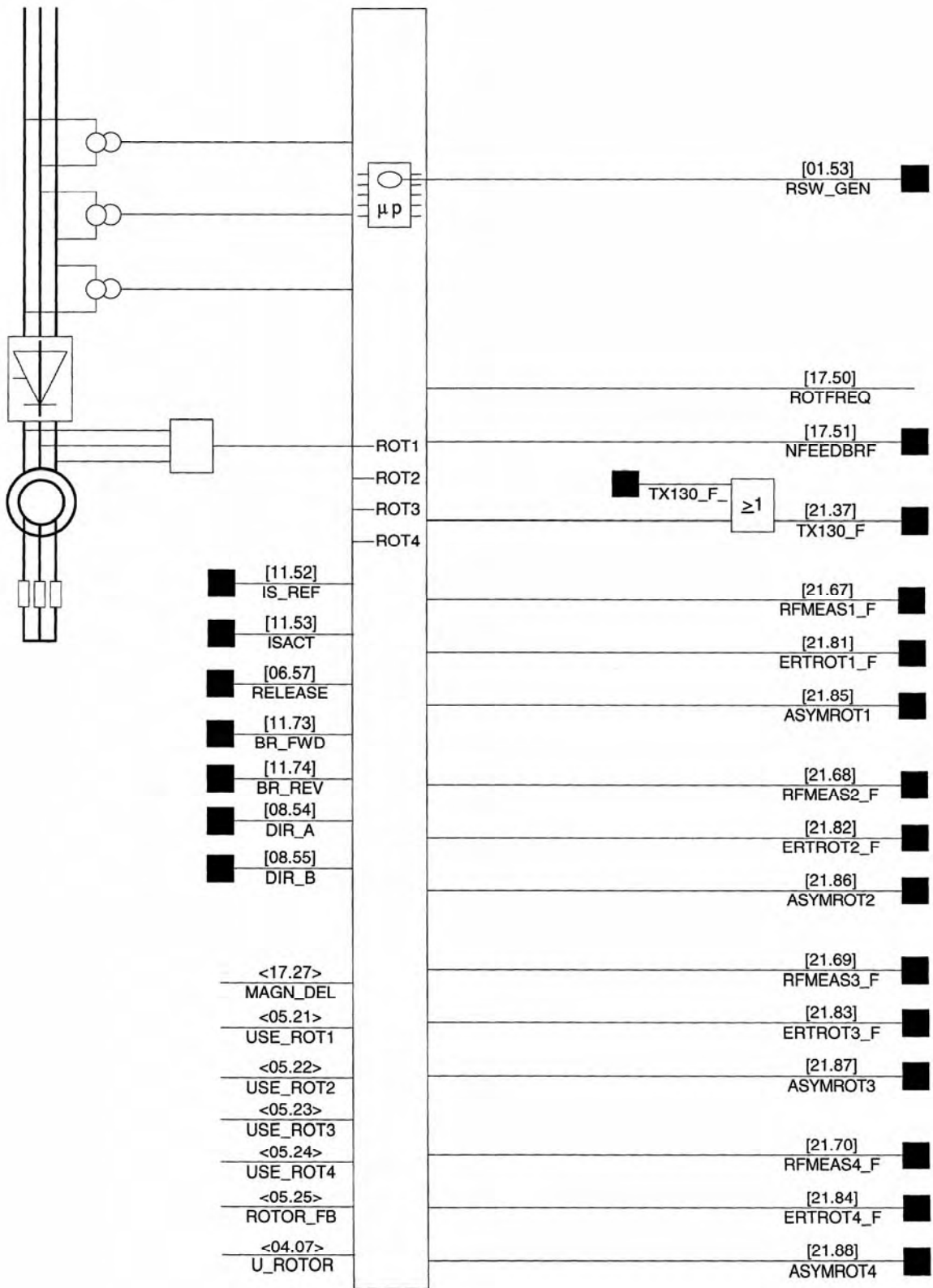
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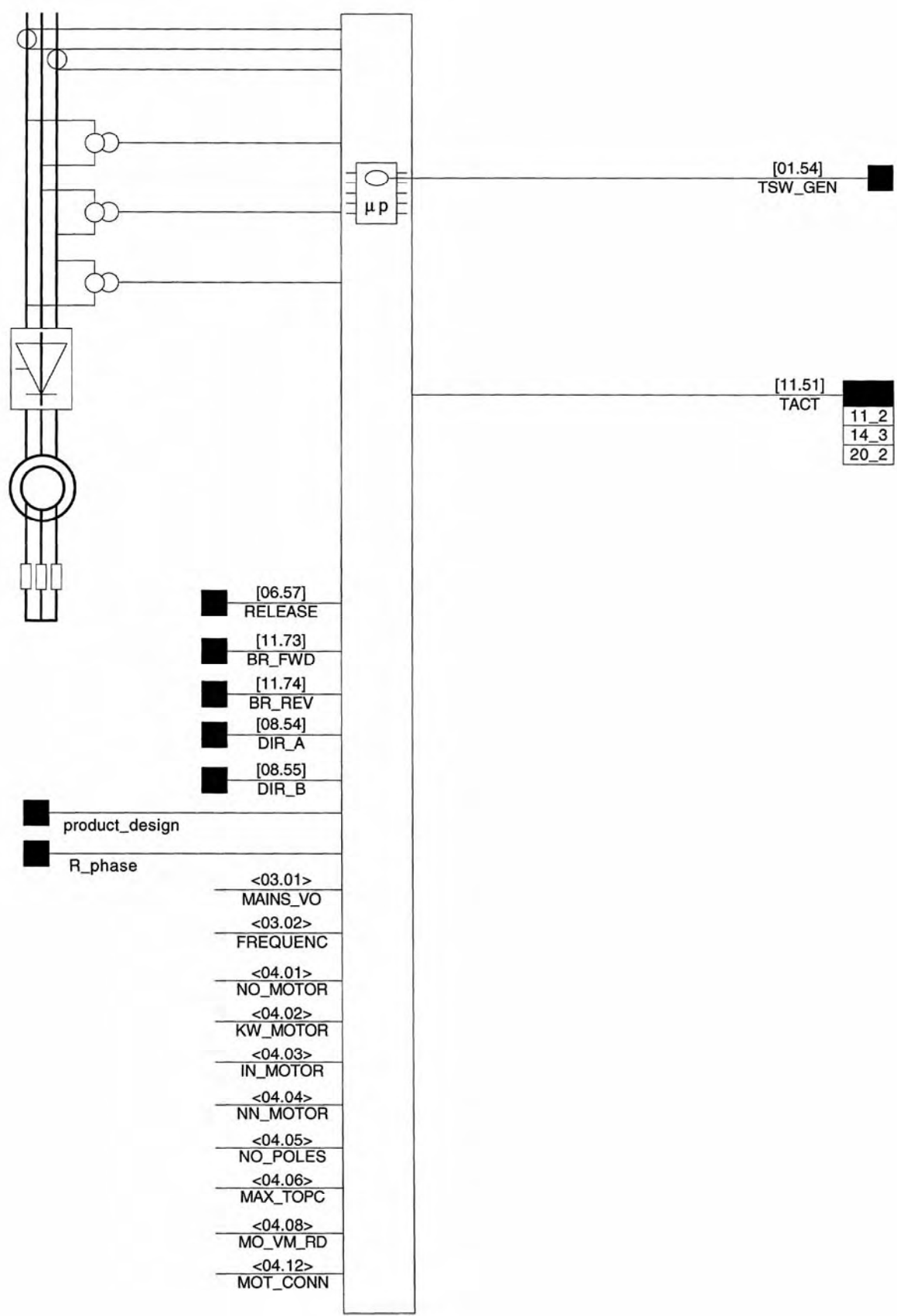
14_3 Load funktions

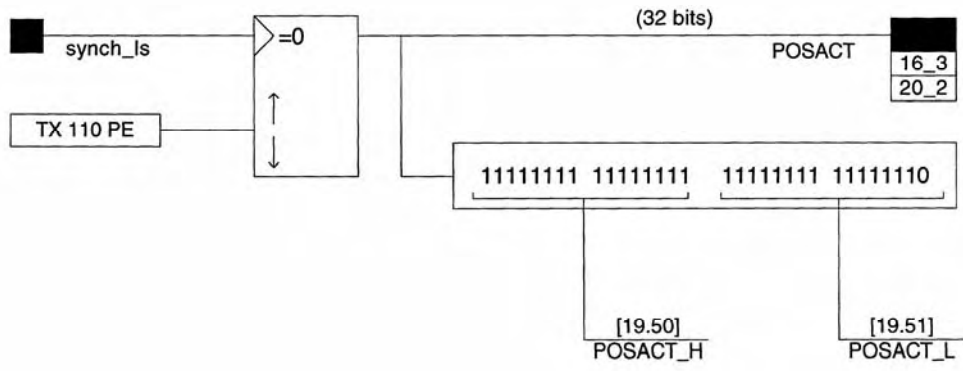


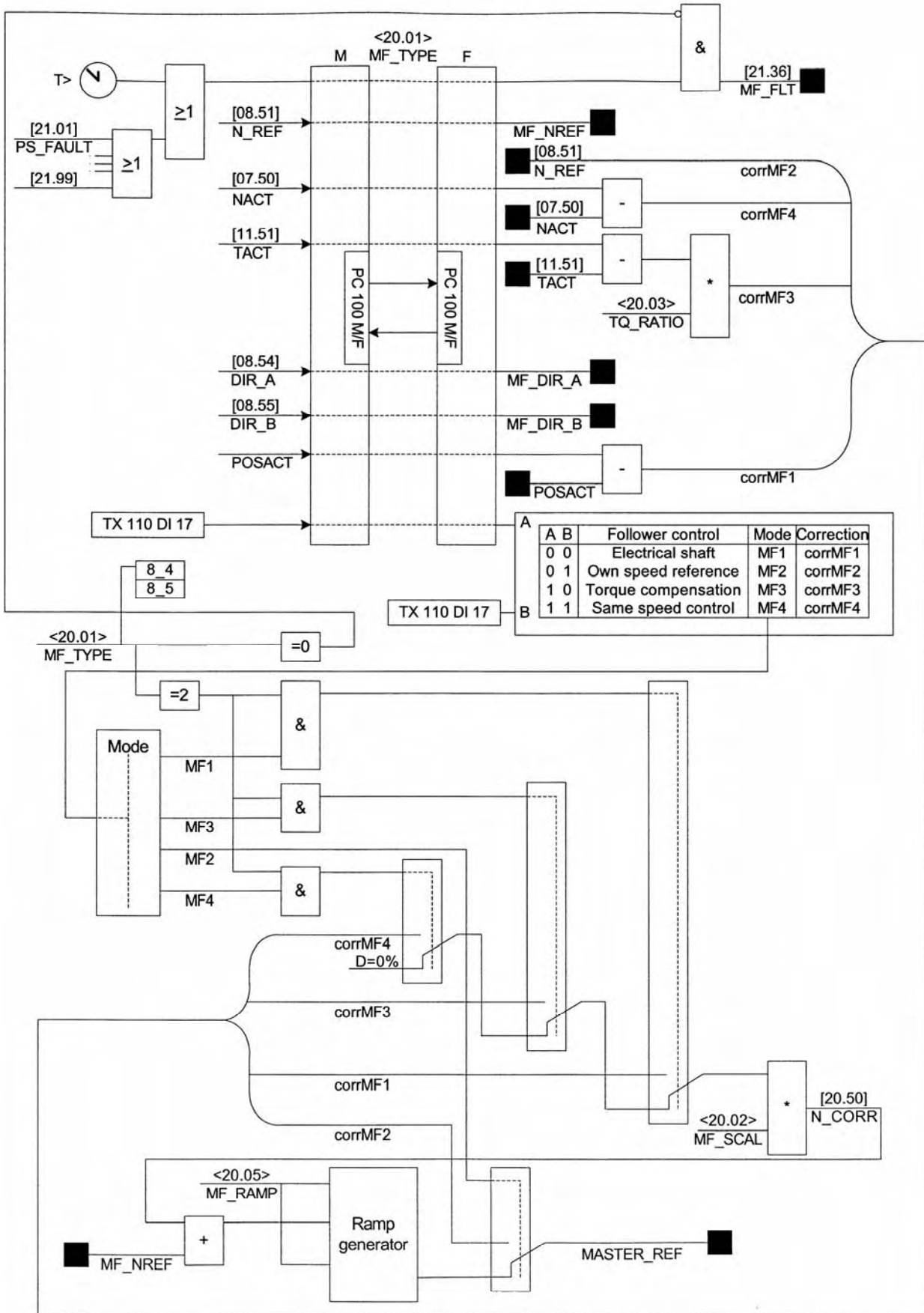




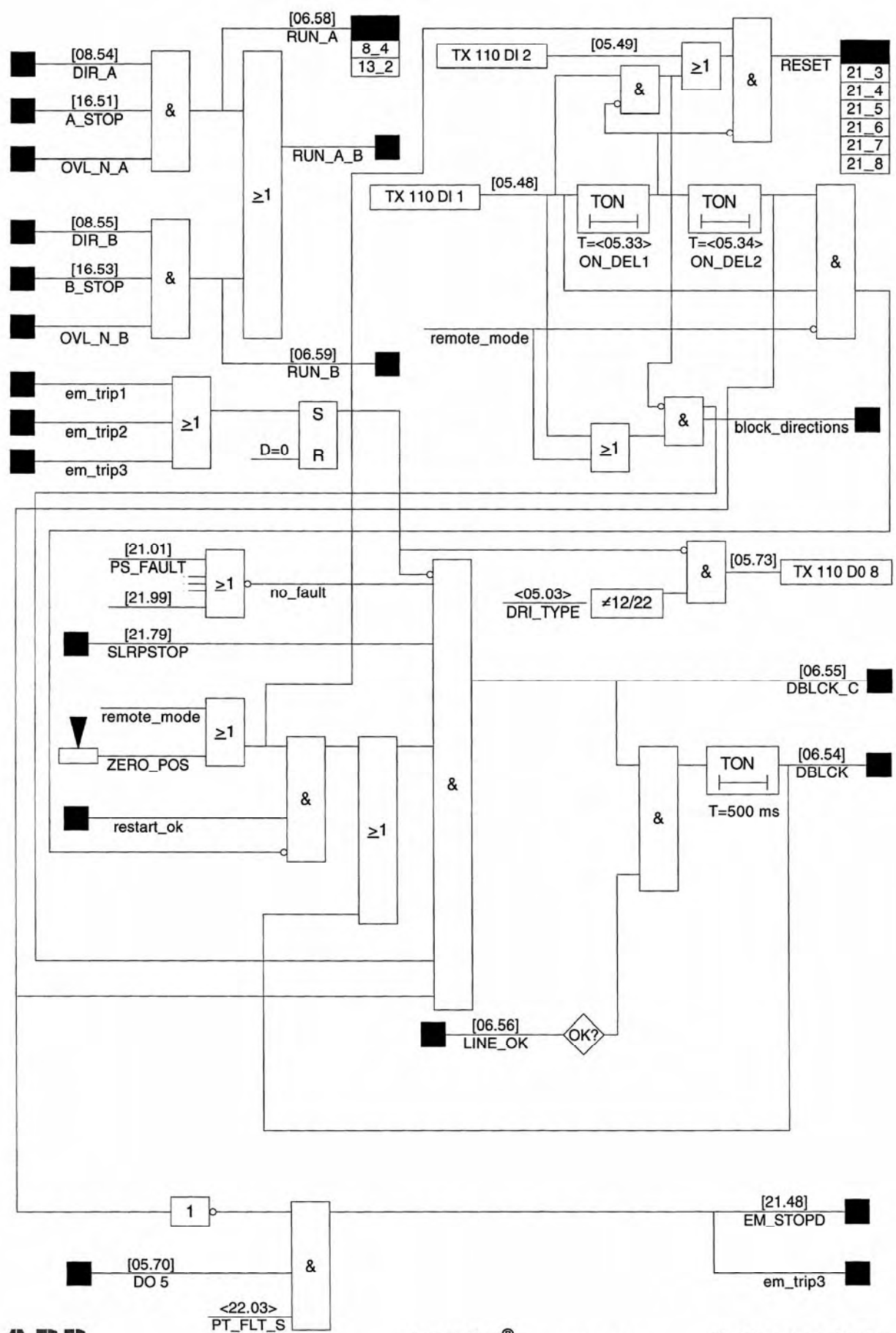


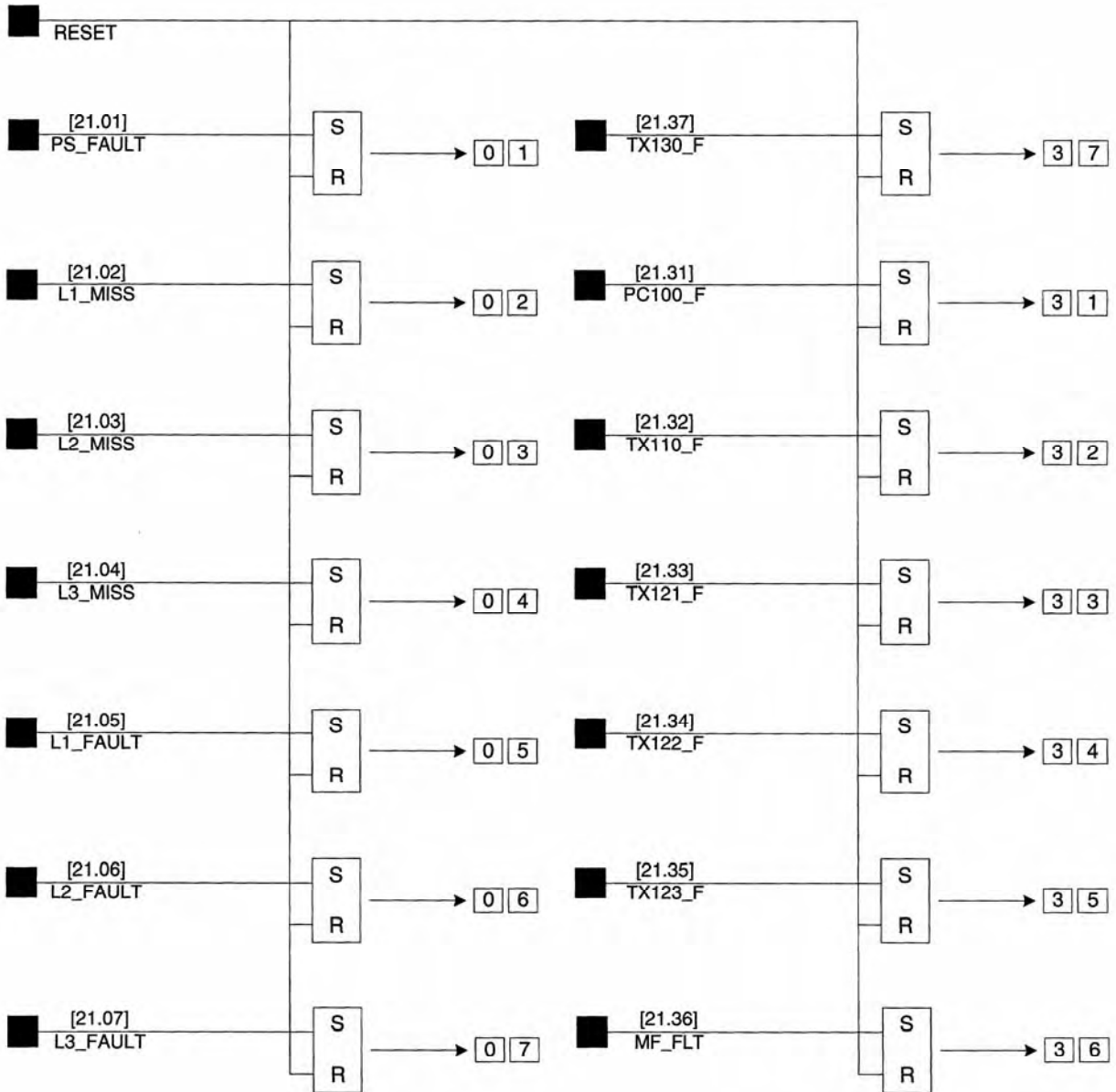


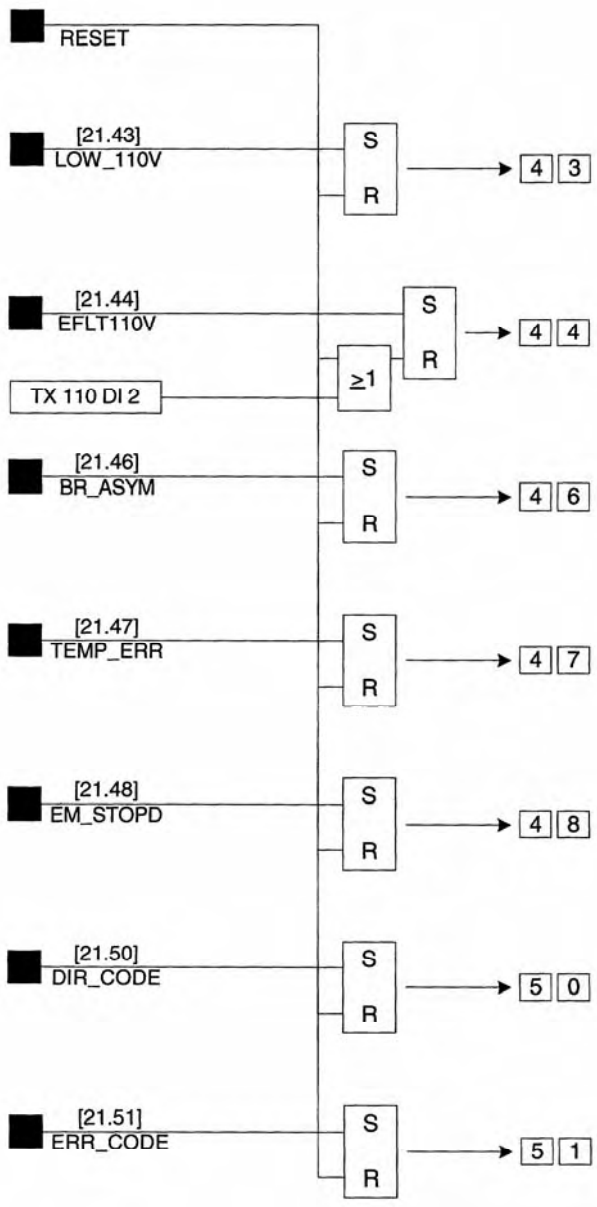


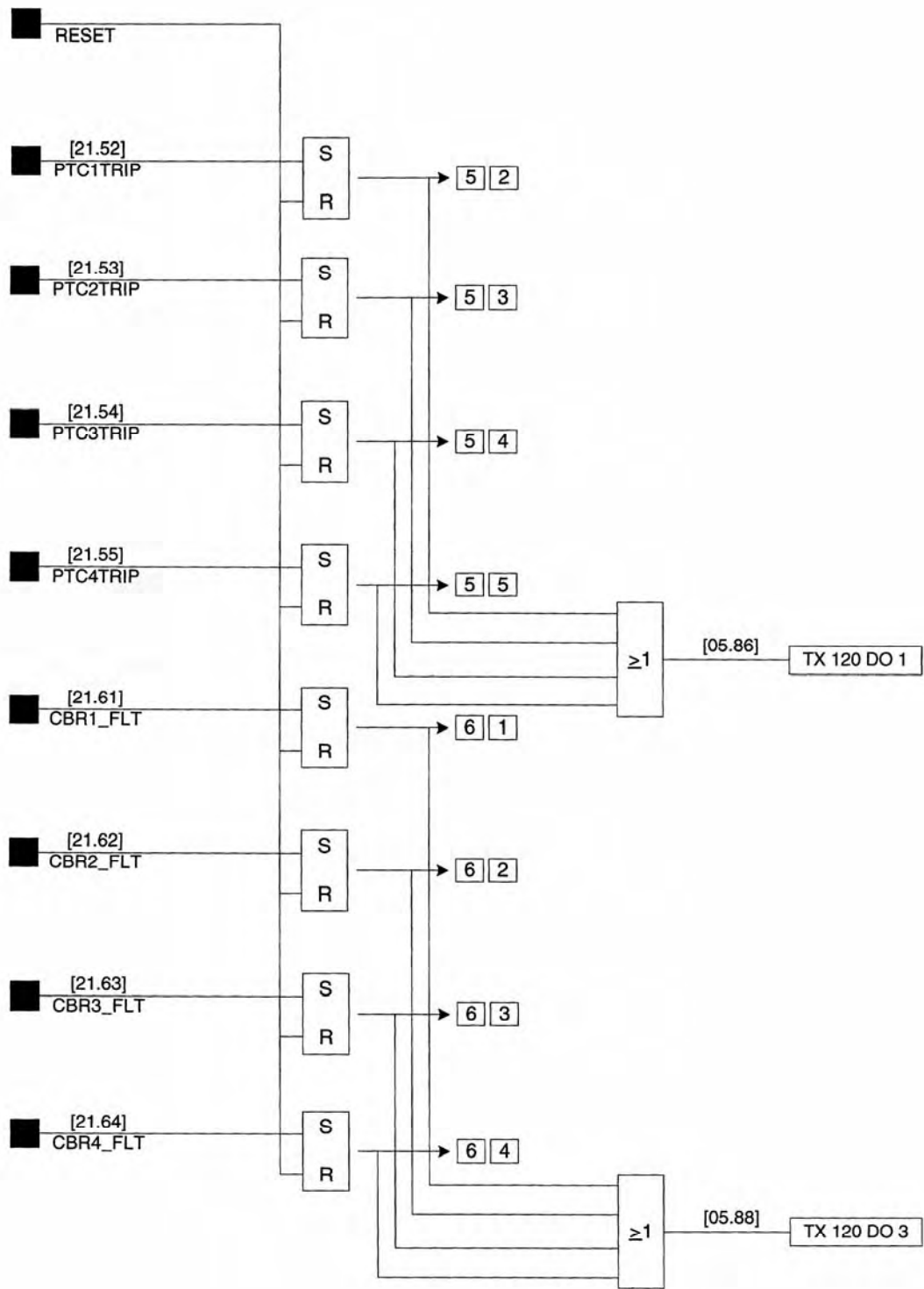


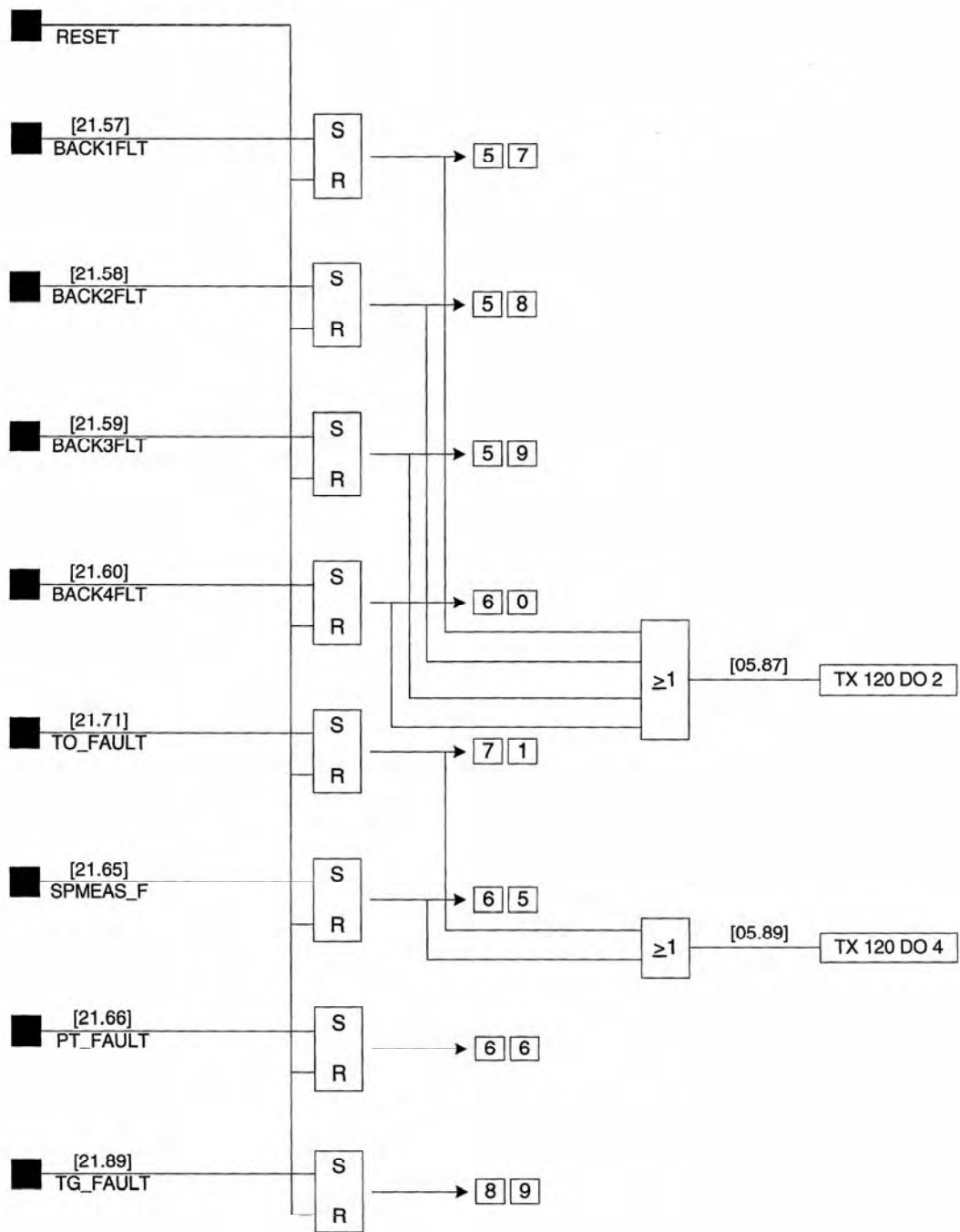
21.1 Motion control logic

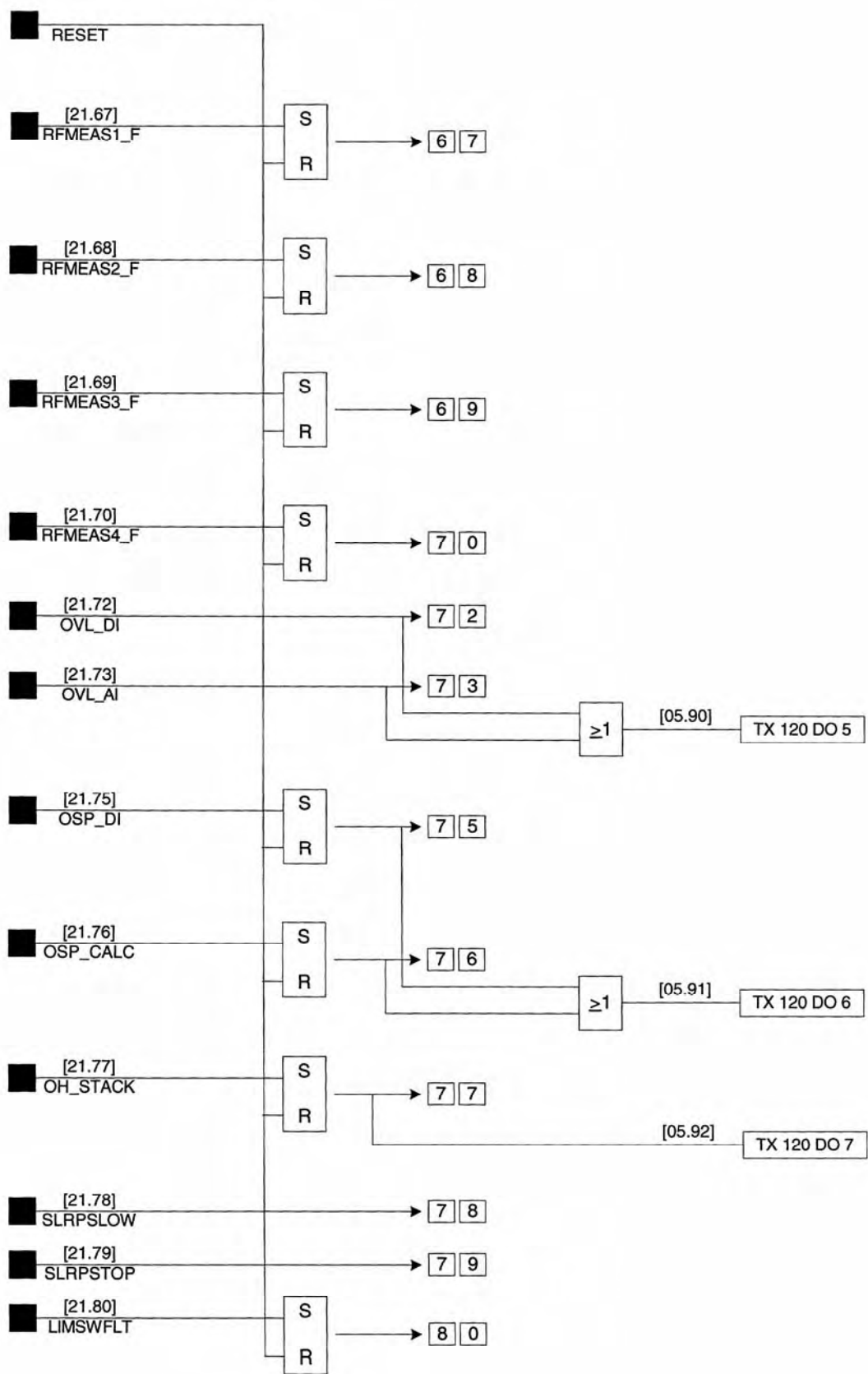


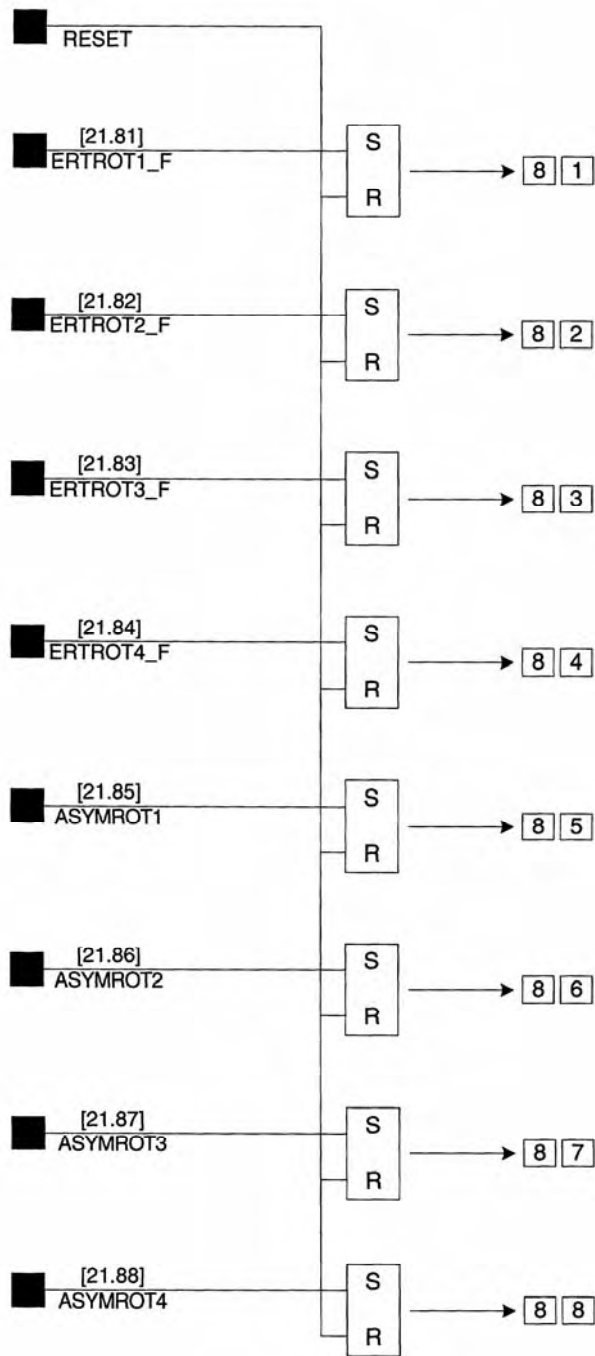


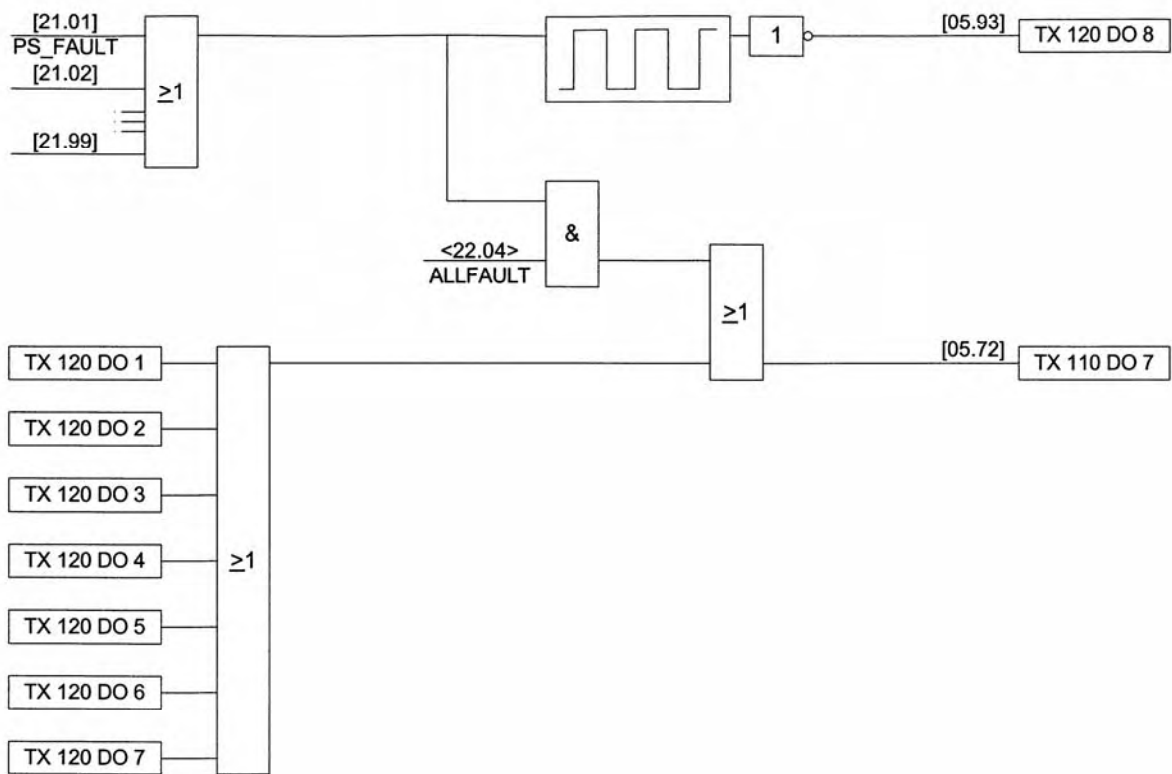












12.5. Torque speed diagrams

The diagrams shown in this chapter serve as an illustration to different designs for the rotor circuit. All diagrams are based on the same motor, a motor with a nominal torque of 200 Nm and a pullout torque of 500 Nm. The torque requirements for acceleration and deceleration are typical for crane motions.

For hoist motions the regeneration in the lowering direction is made by allowing the load to rotate the machine over-synchronously. The slip of the motor in this state is typically -0,05 to -0,30. This part of the machines torque curve (dotted) is of space and clearness reasons drawn close to the same machines torque curve for plug braking with slip +2,05 to +2,30.

Each diagram shows:

- Acceleration torque in the motoring direction for speeds from zero to full. This torque is $1,3 * \text{the nominal}$ for hoists, and $1,75 * \text{the nominal}$ for travels.
- Braking torque in the opposite direction for speeds from zero to the highest occurring negative speed. This torque is the same as the nominal for hoists, and $1,4 * \text{the nominal}$ for travels.
- The motor nominal torque for 100% voltage.
- The motor pullout torque for 100% voltage.
- The different torque curves available for the different resistor steps. ASTAT will select a certain curve at a certain slip given the momentary line voltage; in this way the resulting envelope of the torque curves is shown as a thick curve. The torque curves are plotted only for the highest needed current for the actual voltage.

In the **motoring direction** the motor must overcome the friction and the real efficiency.

In the **opposite direction** the friction and the real efficiency help the motor to decelerate.

For hoist motions it is assumed that the nominal torque is needed to lift the nominal weight in the hook when the final speed is calculated (this is conservative).

For travel motions it is assumed that 20% of the nominal torque is needed to move on in steady state speed when the final speed is calculated.

12.5.1. Hoist with 3 contactors

The resistances available are 8% -18% - 38% - 65% of the motor unity resistance.

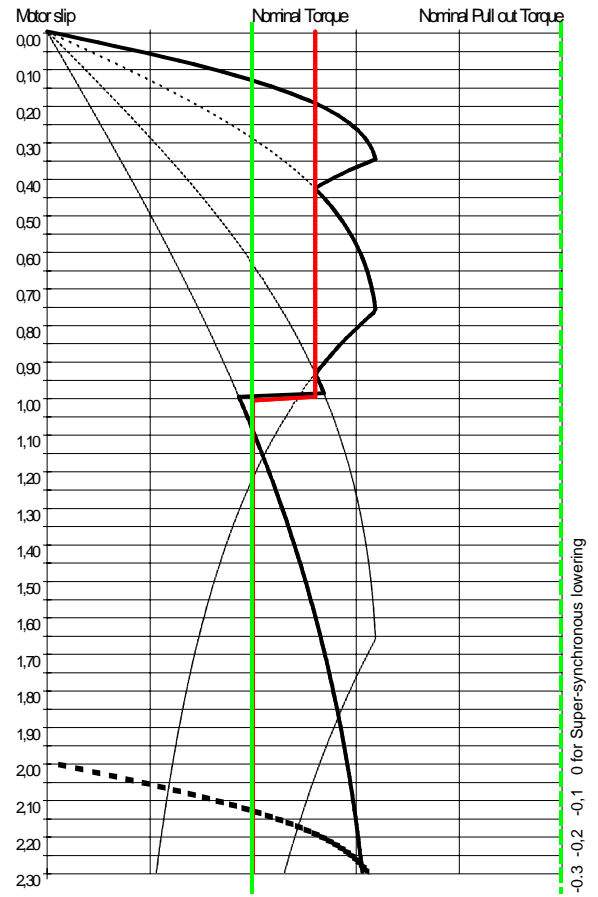
12.5.1.1. Line voltage 100%



Comments:
The highest current will be 1,9 * the nominal of the motor. The final hoisting speed will be 92% of the synchronous.

The hoist with 3 contactors is the most economical choice for large motors (economy from the benefit of higher speed vs. a more complex resistor with additional contactor) and also when the risk for low voltage and frequent operation at not full speed is high.

12.5.1.2. Line voltage 80%



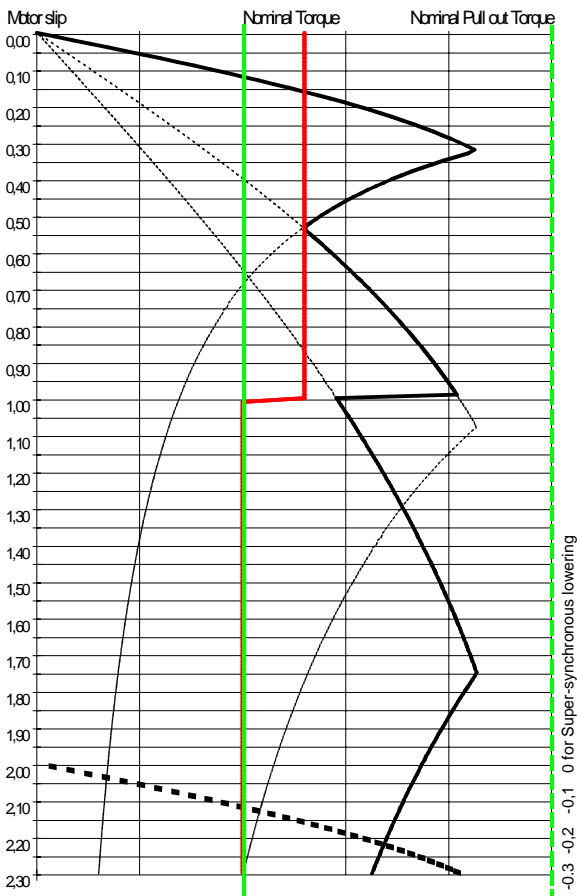
Comments:
The highest current will be 3,3 * the nominal of the motor. The final hoisting speed will be 87% of the synchronous.

It can be seen that the motion under the defined conditions is not capable of lowering the nominal load at creep speed. In practice this situation does not occur, as all factors are not the worst at the same time. If requested the solution would however be to reduce the total resistor to 60%. This is however not recommended.

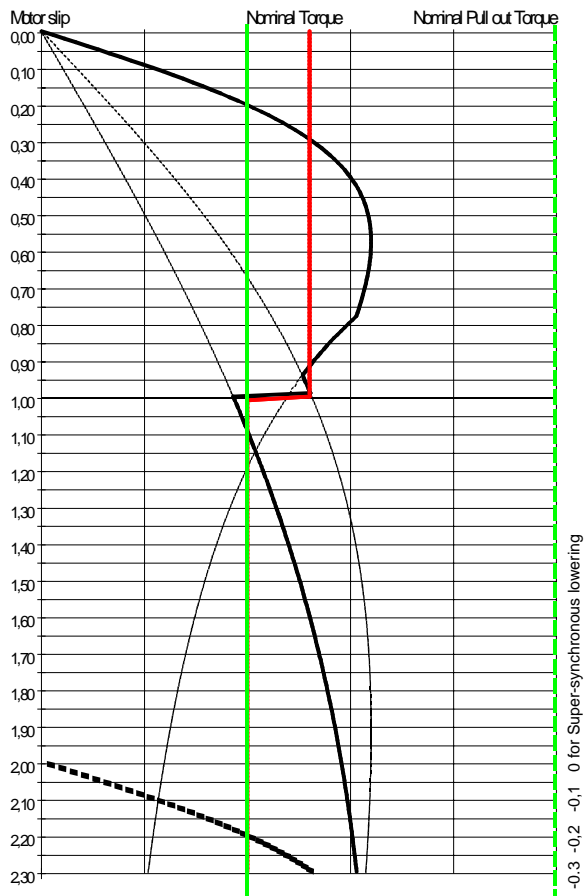
12.5.2. Hoist with 2 contactors

The resistances available are 12% -40% - 65% of the motor unity resistance.

12.5.2.1. Line voltage 100%



12.5.2.2. Line voltage 80%



Comments:

The highest current will be $2,4 \times$ the nominal of the motor. The final hoisting speed will be 88% of the synchronous.

The hoist with 2 contactors is the most economical choice for small and medium sized motors then the nominal torque of the motor is higher than required mechanically.

Comments:

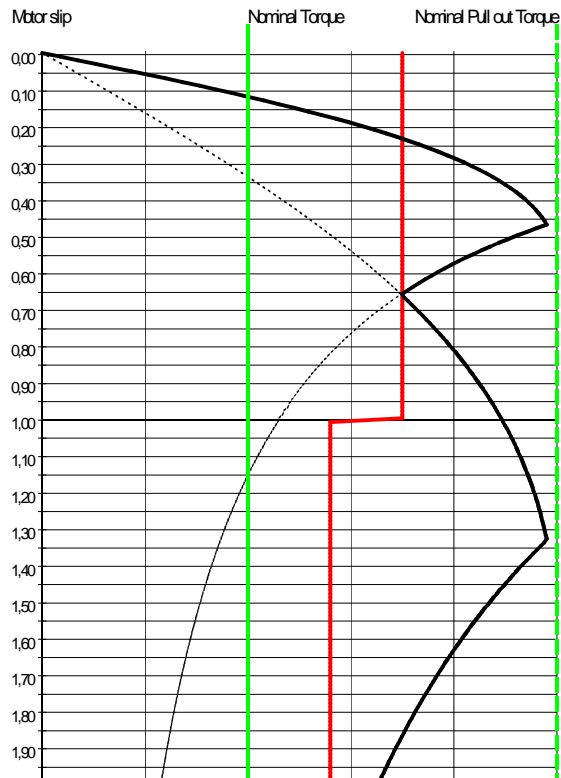
The highest current will be $3,8 \times$ the nominal of the motor. The final hoisting speed will be 80% of the synchronous.

It can be seen that the motion under the defined conditions is not capable of lowering the nominal load at creep speed. In practice this situation does not occur, as all factors are not the worst at the same time. If requested the solution would however be to reduce the total resistor to 60%. This is however not recommended.

12.5.3. Travel with 1 contactor

The resistances available are 12% - 40% of the motor unity resistance.

12.5.3.1. Line voltage 100%

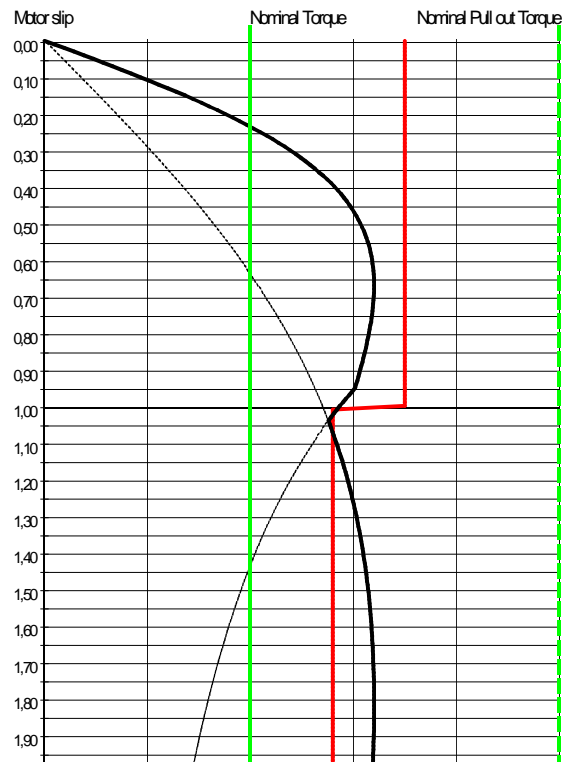


Comments:

The highest current will be 3 * the nominal of the motor. The final speed will be 98% of the synchronous.

For travel motions a higher current can be accepted as the motor sizes are less than for hoists (normally). Hence the voltage drop impact can be accepted also for 3 to 4 * the nominal current of the motor.

12.5.3.2. Line voltage 80%



Comments:

The highest current will be 4 * the nominal of the motor. The final speed will be 95% of the synchronous.

The acceleration time will be longer at reduced voltage. The deceleration required is still available.

12.5.4. Travel with 0 contactors

The resistance available is 30% of the motor unity resistance.

12.5.4.1. Line voltage 100%



12.5.4.2. Line voltage 80%



Comments:

The highest current will be 3 * the nominal of the motor. The final speed will be 85% of the synchronous.

Travel without any contactor is economical as the resistor is smaller and less complex and one cable from the resistor to the E-room can be omitted.

The disadvantage is the longer acceleration time compared with the 1-contactor solution.

A good compromise is to use travel without any contactor together with a one size larger motor (discuss the gear ratio).

In case of temperature derating of the motors the larger motor size comes "free of charge" seen from the contactor and resistor point of view.

Comments:

The highest current will be 4 * the nominal of the motor. The final speed will be 85% of the synchronous.

The acceleration time will be longer at reduced voltage. The deceleration required is still available.

13. Hoist supervision system

13.1. Summary

In short this system is a modern and affordable digital system for hoist supervision.

The system can be placed on the trolley.

Inside the protection barrier in form of a cubicle the boards are coated, and isolation distances are according to EN 60664, Pollution degree 4. Components for +85 degree C are generally used.

Mounted on the trolley, there are short connections to encoders and no need for digital signals in the festoon system.

External connections: 110 or 230 V AC, four incremental encoders, optionally two absolute encoders (Profibus)+ a few DO / DI / AO

Configurable by PC.

The same incremental pulse encoders can be used in all places there these are used. The same absolute encoders can be used in all places these are used. The adoption to the drive system is done with parameters.

The system is based on an ASTAT Control System Module DARA 1000 with one modified I/O board for connection of four incremental pulse encoders, one Profibus master and a few DI and DO for control signals. Optionally analogue signals can be connected for monitoring with relay output from the control box.

The system permits 25 kHz incremental encoders.

The position counter capacity is 32 bits.

The system is parameterised with a Software that runs under Windows, and a simple serial cable that can be connected to COM1: or a USB-port. The software is included in the basic system. The PC is normally not connected for service.

Key data

DARA 2000, Supervision System

H x W x D = 422 mm x 473 mm x 315 mm (with cover)

M = 15 kg

DARU 100, Supervision Relay System

H x W x D = 240 mm x 94 mm x 100 mm

M = 1 kg

13.2. Interface

Inputs:

Supply voltage 110 / 230 V AC, 50/60 Hz

M1 Incremental encoder Motor 1, A + B
M2 Incremental encoder Motor 2, A + B
D1 Incremental encoder Drum 1, A + B
D2 Incremental encoder Drum 2, A + B
P1²³ Absolute position Drum 1
P2 Absolute position Drum 2

DI1 Reset fault for operation
DI2 Reset fault indications
DI3 NC auxiliary contact of the contactor for the solenoid valves of emergency brake.
DI4 Aux. contact of emergency top limit switch. Closed for normal operation.
DI5 Interposing 1 NO + 1 NC relay controlled by DO 4. The NO contact of this relay is connected to DI 5. The NC controls the contactor for the solenoid valves of the emergency brake.
DI6 Selection of parameter values 05.31...05.50 for overspeed levels, else 05.01...05.20. When DI6 is activated (=connected to 110 V DC) the shaft break detection is disabled, and rescue lowering with active overspeed monitoring only can be made after a shaft break incident.
DI7 Start pushbutton is pressed
DI8 0→1: Predefined reference position is set.

AI PTC 1 - 4 (Option)

AI Voltage 1 - 4 (Option)

Outputs

DO1 Any Fault
DO2 Soft level stop M1
DO3 Soft level stop M2
DO4 Fast trip of the contactor for the solenoid valves of emergency brake
DO5 Slow down limit A
DO6 Slow down limit B
DO7 Stop limit A
DO8 Stop limit B

DO5 - DO8 are set by teach in, like position values and weight values in ASTAT. In case the board DAPC 100 must be replaced, the values are stored like parameters and can be restored from the company server.

AO Height 4-20 mA from P1 / P2

AO Speed 4-20 mA 1-4, AI 1-4

²³ Hübner AMG11

13.3. Supervisions

13.3.1. Differential gearbox system and one motor with two drums

- 1) Difference between Counted Pulses (M1 + M2) and D1. Soft stop level, Trip level
- 2) Difference between Counted Pulses D1 and D2. Soft stop level, Trip level
- 3) Speed value from any of the four encoders greater than desired. Soft stop level, Trip level
- 4) Compare difference between absolute encoder P1 and P2. Soft stop level, Trip level.
- 5) Any of four PTC, Soft stop level
- 6) Any of four signals 0 - 10 V, Soft stop level
- 7) Control of relay outputs for Stop and Slow down in both directions.

13.3.2. Two independent hoist system

- 1) Difference between Counted Pulses M1 and D1. Soft stop level, Trip level
- 2) Difference between Counted Pulses M2 and D2. Soft stop level, Trip level
- 3) Speed value from any of the four encoders greater than desired. Soft stop level, Trip level
- 4) -
- 5) Any of four PTC, Soft stop level
- 6) Any of four signals 0 - 10 V, Soft stop level
- 7) -

13.4. I/O

13.4.1. Lower end I/O of DATX 111

Digital Inputs 110 V DC

X10:1	D11	Reset Faults for operation
X10:2	D12	Reset Fault indications
X10:3	D13	NC aux. contact of the contactor for the solenoid valves of emergency brake
X10:4	D14	Aux. contact of emergency top limit switch. Closed for normal operation. : Position check point reached.
X10:5	D15	Interposing 1 NO + 1 NC relay controlled by DO 4. The NO contact of this relay is connected to DI 5. The NC controls the contactor for the solenoid valves of the emergency brake.
X10:6	D16	Selection of parameter values 05.31...05.50 for overspeed levels, else 05.01...05.20. When DI6 is activated (=connected to 110 V DC) the shaft break detection is disabled, and rescue lowering with active overspeed monitoring only can be made after a shaft break incident.
X10:7	D17	Start pushbutton is pressed
X10:8	D18	Set position to reference position.
X10:9		+110 V DC, Distribution
X10:10		+110 V DC, Supply from DARU 100, PTC-protected

Incremental encoder Motor 1

X11:1	M1 track A+
X11:2	M1 track A-
X11:3	M1 track B+
X11:3	M1 track B-
X11:5	+24 V (max 24 V) supplied through PTC
X11:6	0 V

Incremental encoder Motor 2 (or Tandem set 2)

X12:1	M2 track A+
X12:2	M2 track A-
X12:3	M2 track B+
X12:4	M2 track B-
X12:5	+24 V (max 24 V) supplied through PTC
X12:6	0 V

Incremental encoder Drum 1

X13:1	D1 track A+
X13:2	D1 track A-
X13:3	D1 track B+
X13:4	D1 track B-
X13:5	+24 V (max 24 V) supplied through PTC
X13:6	0 V

Incremental encoder Drum 2

X14:1	D2 track A+
X14:2	D2 track A-
X14:3	D2 track B+
X14:4	D2 track B-
X14:5	+24 V (max 24 V) supplied through PTC
X14:6	0 V

Thermistors

X31:1	PTC1 +
X31:2	PTC1 -
X31:3	PTC2 +
X31:4	PTC2 -
X31:5	PTC3 +
X31:6	PTC3 -
X31:7	PTC4 +
X31:8	PTC4 -

Analog inputs

X32:1	AI1 +
X32:2	AI1 -
X32:3	AI2 +
X32:4	AI2 -
X32:5	AI3 +
X32:6	AI3 -
X32:7	AI4 +
X32:8	AI4 -

Analog outputs

X33:1	AO1 +
X33:2	AO1 -
X33:3	AO2 +
X33:4	AO2 -

13.4.2. Topside I/O of DATX 111

Commands 110 V DC

X1:1	+110 V DC (M1+), From PSU
X1:2	0 V (M1-), From PSU
X1:3	+110 V DC (M1+), To DARU 100
X1:4	0 V (M1-), To DARU 100
X1:5	M1 Mp (for Earth fault supervision)
X1:6	True ground (for Earth fault supervision)

Digital Outputs

X2:1	DO1 Any Fault, contact side 1
X2:2	DO1 Any Fault, contact side 2
X2:3	DO2 Soft level stop M1, contact side 1
X2:4	DO2 Soft level stop M1, contact side 2
X2:5	DO3 Soft level stop M2, contact side 1
X2:6	DO3 Soft level stop M2, contact side 2
X2:7	DO4 Leading Safety Stop (shaft break or drum over-speed) side 1. NO
X2:8	DO4 Leading Safety Stop (shaft break or drum over-speed) side 2. NO

Digital Outputs

X3:1	DO5 Slow down limit A, contact side 1
X3:2	DO5 Slow down limit A, contact side 2
X3:3	DO6 Slow down limit B, contact side 1
X3:4	DO6 Slow down limit B, contact side 2
X3:5	DO7 Stop limit A, contact side 1
X3:6	DO7 Stop limit A, contact side 2
X3:7	DO8 Stop limit B, contact side 1
X3:8	DO8 Stop limit B, contact side 2

Watchdog

X6:1	+ 24 V DC (through PTC)
X6:2	0 V DC
X6:3	Watchdog signal with selectable frequency

Connections 24 V level to DARU 100

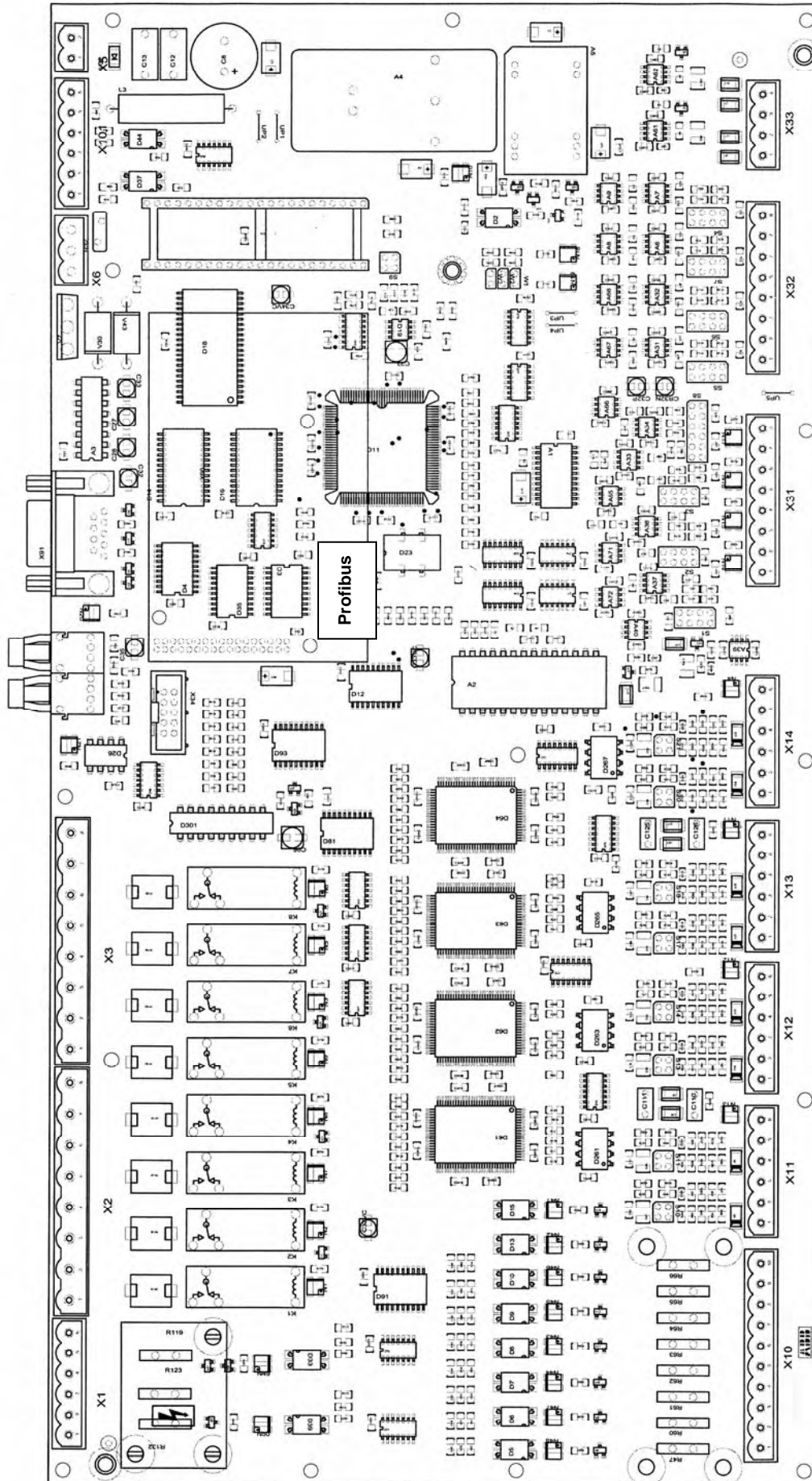
X101:1	+ 24 V DC
X101:2	0 V DC
X101:3	Regulated +24 V DC, system 1
X101:4	Regulated +24 V DC, system 2
X101:5	Control signal #1 for safety trip
X101:6	Control signal #2 for safety trip

24 V supply

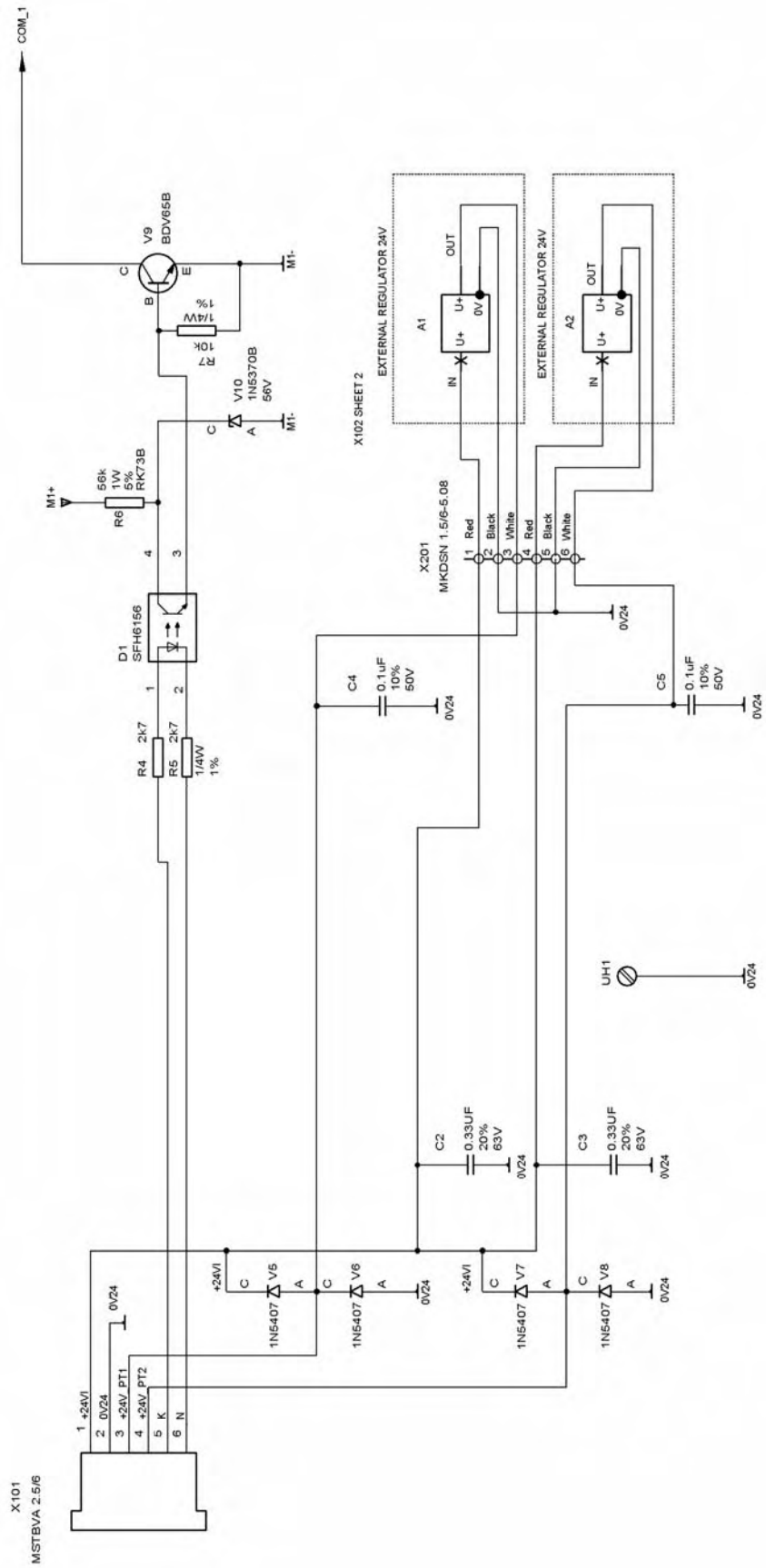
X5:1	+ 24 V DC
X5:2	0 V DC

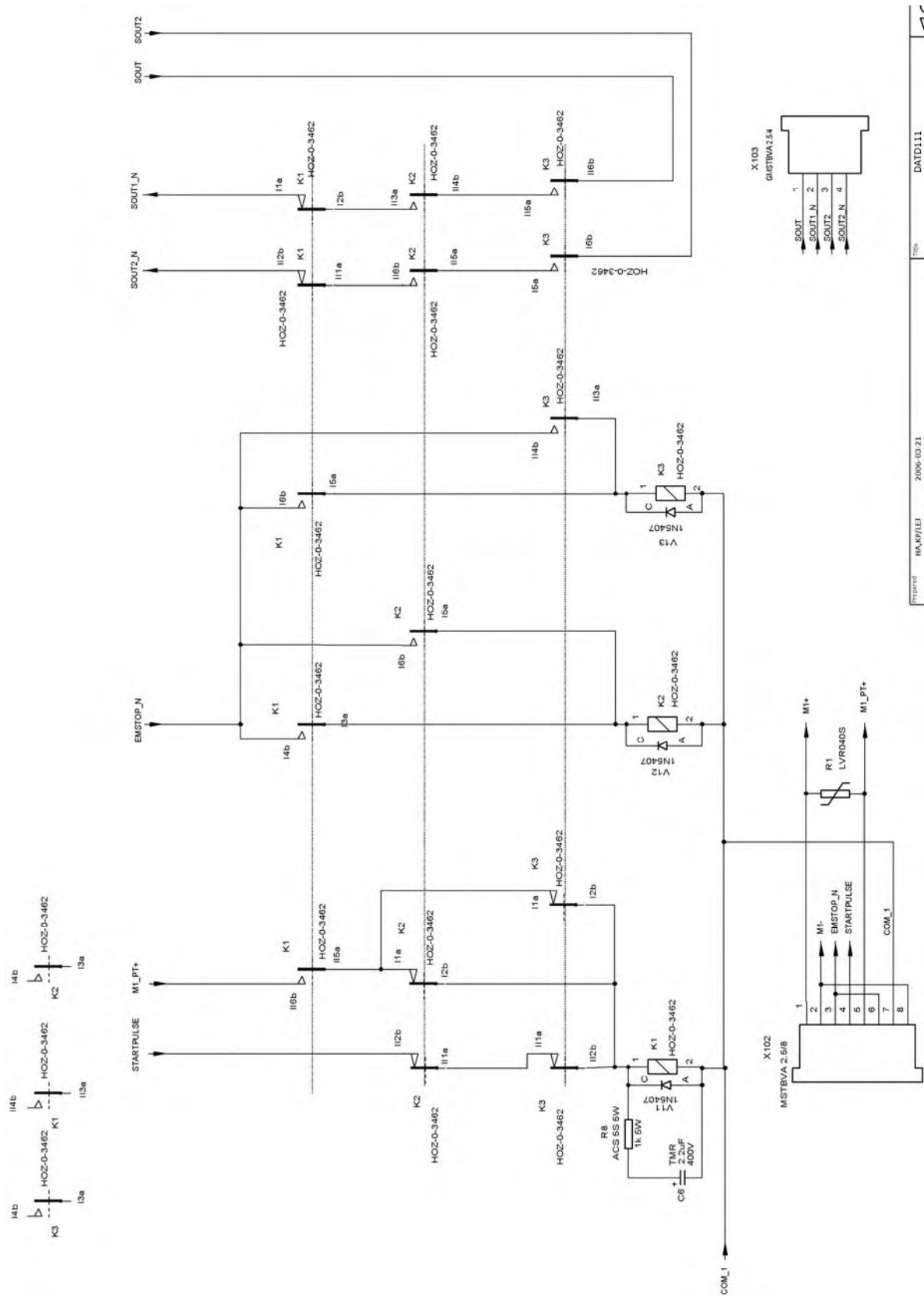
13.4.3. Profibus DATX 111

Place: Middle of board (for Absolute encoders).



13.4.4. Relay unit DARU 100





13.4.5. I/O of DARU 100

Lower end I/O

24 V DC level to DATX 111

X101:1	+ 24 V DC
X101:2	0 V DC
X101:3	Regulated +24 V DC, system 1
X101:4	Regulated +24 V DC, system 2
X101:5	Control signal #1 for safety trip
X101:6	Control signal #2 for safety trip

Topside I/O

Commands etc. 110 V DC

X102:1	+110 V DC, external supply via DATX 111
X102:2	0 V (110 V DC) external supply, via DATX 111
X102:3	Emergency stop chain, +110 V to run
X102:4	Start pulse, +110 V DC
X102:5	+110 V DC, PTC-protected for distribution
X102:6	Emergency stop chain, +110 V to run (same as terminal 3)
X102:7	A bridge 7-8 will turn DATD 111 and DARU 100 into a basic safety relay.
X102:8	0 V (M1-)

Connect Stop and trip circuit between X102:3 and :5. Closed to run.
Connect Start pulse and start interlock conditions between X102:4 and :6

Safety Outputs

X103:1	Safe Out channel 1, contact side 1
X103:2	Safe Out channel 1, contact side 2
X103:3	Safe Out channel 2 contact side 1
X103:4	Safe Out channel 2 contact side 2

13.5. Connections DARA 2000(DATX111) - DARU 100

24 V DC level	DARA 2000 (DATX 111)	DARU 100 (DATD 111)
+ 24 V DC	-X101: 1	-X101: 1
0 V DC	2	2
Regulated +24 V DC, system 1 to DATX 111	3	3
Regulated +24 V DC, system 2 to DATX 111	4	4
Control signal 1 for safety trip	5	5
Control signal 2 for safety trip	6	6
110 V DC level	DARA 2000 (DATX 111)	DARU 100 (DATD 111)
+ 110 V DC	-X1: 3	-X102: 1
0 V DC	4	2

13.6. Function blocks, Parameter list, Signal list

The descriptive level of functions, signals and parameters is considered as source code and is not public.

The function blocks and all accessible signals and parameters are listed below.

13.6.1. System definitions

13.6.1.1. Functions

This is the definition of how the drive system to be supervised is build up.

The most complex system type is the differential gearbox with two motors and two drums. The system allows for different gear ratio from the two motors to the drums.

The other systems definitions are derived from the differential gearbox system.

If a System with two independent hoists is defined, parameter **01.60** = 4, the system with Motor 2 and Drum 2 is only used for monitoring of shaft break and over-speed, not for emulation of stop and slow down limit switches.

13.6.1.2. Parameters

01.60	SYS_TYPE	Value = 1 Differential gearbox, M1 AND M2 AND D1 AND D2 Value = 2 M1 AND D1. If Height encoder is used, it will be P1 Value = 3 M2 AND D2. If Height encoder is used, it will be P2 Value = 4 M1 AND D1 & M2 AND D2 ²⁴ Value = 5 M1 AND D1 AND D2 Value = 6 M2 AND D1 AND D2 Value = 7 Run-in mode, all protections disabled. Safety out will open, must be bridged with wires.
01.61	USE_PENC	Value = 0 No absolute encoder used Value = 1 One absolute used Value = 2 P1 or P2 used Value = 11 Active encoder inverted Value = 21 P1 inverted and P2 not inverted Value = 22 P1 not inverted and P2 inverted Value = 23 P1 inverted and P2 inverted
01.62	SPARE_01	(Spare parameter)
01.63	SC_01IN	To rotate D1 (and D2 in case of differential gearbox or M1+D1+D2 in case of that configuration) 1,0000 turn, we need to rotate M1 MMM,dddd turns. "," is a decimal sign. In case of a differential gearbox M2 stands still braked. Parameter 01.63 stands for MMM, with a value 0-999.

²⁴ For M2+D2 an encoder P2 cannot be used.

01.64	SC_01FR	<p>To rotate D1 (and D2 in case of differential gearbox or M1 AND D1 AND D2 in case of that configuration) 1,0000 turn, we need to rotate M1 MMM,dddd turns. "," is a decimal sign. In case of a differential gearbox M2 stands still braked.</p> <p>Parameter 01.64 stands for dddd, with a value 0000-9999.</p> <p>The entered value must be a four digit number. Examples: 6218, 5000, 0123</p>
01.65	SC_02IN	<p>To rotate D2 (and D1 in case of differential gearbox or M2 AND D1 AND D2 in case of that configuration) 1,0000 turn, we need to rotate M2 NNN,eeee turns. "," is a decimal sign. In case of a differential gearbox M1 stands still braked.</p> <p>Parameter 01.65 stands for NNN, with a value 0-999.</p>
01.66	SC_02FR	<p>To rotate D2 (and D1 in case of differential gearbox or M2 AND D1 AND D2 in case of that configuration) 1,0000 turn, we need to rotate M2 NNN,eeee turns. "," is a decimal sign. In case of a differential gearbox M1 stands still braked.</p> <p>Parameter 01.66 stands for eeee, with a value 0000-9999.</p> <p>The entered value must be a four digit number. Examples: 6218, 5000, 0123</p>

13.6.2. Encoders

13.6.2.1. Functions

Number of pulses per turn for encoders.

Normalization of absolute encoders to the hoist(s) concerned.

The active absolute encoder is selected as follows:

Value = 0 No absolute encoder used

Value = 1 One absolute used

Value = 2 P1 AND P2 used

The value of the active absolute encoder is signal 02.62.

The encoder of Drum 1 has address 1. If used, the encoder of Drum 2 has address 2. The end of loop encoder shall have end termination selected.

The system has two height levels for calibration, **Reference position** and **Check position**.

The **Reference position** is defined height (parameter), for example 5000 mm hook height, to which the hook (beam etc.) can be moved to after a rope replacement, or need to synchronize the system of any other reason, and a push-button connected to DI 8 is pressed.

The **Check position** is a NC contact of the upper emergency limit switch of the hoist, connected to DI 4. If voltage is disappearing on DI 4, the system will understand it is in the check position, and compare the Check position (parameter) with the actual measurement. In case of deviation the system will give a warning only, as the dangerous situation is managed by direct wiring of another NC contact of the emergency limit switch in the emergency stop chain.

If a System with two independent hoists is defined, parameter **01.60** = 4, the system with Motor 2 and Drum 2 is only used for monitoring of shaft break and over-speed, not for emulation of stop and slow down limit switches.

13.6.2.2. Parameters

02.01	M1_PL_TR	M1 - Pulses per turn of motor encoder
02.02	M1_ED_MO	How the pulses from the incremental encoder for Motor 1 shall be interpreted: A+ B+ (value: 1) or A+ A- B+ B- (value: 4)
02.03	M1_SYNSP	M1 - the motors synchronous speed
02.04	M1_FILTl	M1 - Filter time constant in ms
02.05	M2_PL_TR	M2 - Pulses per turn of motor encoder
02.06	M2_ED_MO	How the pulses from the incremental encoder for Motor 2 shall be interpreted: A+ B+ (value: 1) or A+ A- B+ B- (value: 4)
02.07	M2_SYNSP	M2 - The motors synchronous speed
02.08	M2_FILTl	M2 - Filter time constant in ms
02.09	D1_PL_TR	D1 - Pulses per turn of drum encoder

02.10	D1_ED_MO	How the pulses from the incremental encoder for Drum 1 shall be interpreted: A+ B+ (value: 1) or A+ A- B+ B- (value: 4)
02.11	D1_SYNSP	D1 - The drums synchronous speed
02.12	D1_FILT1	D1 - Filter time constant in ms
02.13	D2_PL_TR	D2 - Pulses per turn of drum encoder
02.14	D2_ED_MO	How the pulses from the incremental encoder for Drum 2 shall be interpreted: A+ B+ (value: 1) or A+ A- B+ B- (value: 4)
02.15	D2_SYNSP	D2 - the drums synchronous speed
02.16	D2_FILT1	D2 - Filter time constant in ms
02.17	P1_PL_TR	Pulse count per one revolution of the absolute encoder on drum 1.
02.18	P1_FACT1	Position change of the hook for one turn of Drum 1. Given in mm with one decimal.
02.19		
02.20	P1SY1_MM	Lift height P1 in mm stand at calibration mark , +/- 65354 mm = +/-65,354 m. The resolution is 0,002 meter (2 mm)
02.21	P1SY2_M	Accepted deviation in mm between actual position based on measurement with P1 when hitting check mark .
02.22	P1SY2_MM	Lift height P1 in mm stand at check mark , +/- 65354 mm = +/-65,354 m. The resolution is 0,002 meter (2 mm)
02.23	P1_TRIGG	Set Parameter 0→1. The current position will be memorised as calibration position of P1. Same function if DI 8 goes 0→1. Set Parameter 0→2. The current position will be memorised as check position of P1. Same function as when DI 4 goes 1 → 0.
02.24	P2_PL_TR	Pulse count per one revolution of the absolute encoder on drum 2.
02.25	P2_FACT1	Position change of the hook for one turn of Drum 2. Given in mm with one decimal.
02.26		
02.27	P2SY1_MM	Lift height P2 in mm stand at calibration mark , +/- 65354 mm = +/-65,354 m. The resolution is 0,002 meter (2 mm)
02.28	P2SY2_M	Accepted deviation in mm between actual position based on measurement with P2 when hitting check mark .
02.29	P2SY2_MM	Lift height P2 in mm stand at check mark , +/- 65354 mm = +/-65,354 m. The resolution is 0,002 meter (2 mm)

02.30	P2_TRIGG	<p>Set Parameter 0→1. The current position will be memorised as calibration position of P2. Same function if DI 8 goes 0→1.</p> <p>Set Parameter 0→2. The current position will be memorised as check position of P2. Same function as when DI 4 goes 1→0.</p>
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13.6.2.3. Signals

02.51	M1_SPPER	Speed of M1 in % of synchronous +/- 200,0%
02.52	M1_SPRPM	Speed of M1 rpm +/- 3267 RPM
02.53	M2_SPPER	Speed of M2 in % of synchronous +/- 200,0%
02.54	M2_SPRPM	Speed of M2 rpm +/- 3267 RPM
02.55	D1_SPPER	Speed of D1 in % of synchronous +/- 200,0%
02.56	D1_SPRPM	Speed of D1 rpm +/- 60,00 RPM
02.57	D2_SPPER	Speed of D2 in % of synchronous +/- 200,0%
02.58	D2_SPRPM	Speed of D2 rpm +/- 60,00 RPM
02.59	P1_HGTMM	Height of P1 in m +/- 65,354 m.
02.60	P2_HGTMM	Height of P2 in m +/- 65,354 m.
02.61	P12_HDIF	Difference in height for P1 and P2, +/-65,354 m..
02.62	ENC_HGTA	Height value of the active absolute encoder in m, +/- 65,354 m.

13.6.3. Difference of in- and outgoing pulses to the gearbox

13.6.3.1. Functions

The function checks that the turns of the motors into the gearbox are the same as the outgoing turns, considering the gear ratio. The counters are set to 0 at action by DI1. The counter size is 32 bits.

A deviation outside Trip level will unconditionally open the safety output relays.

A Soft level deviation will open DO2, DO3 as set up.

The trip level parameters are echoed as signals to make recordings with the CMT-program.

{01.60} means value of parameter 01.60

[01.63≡01.64] means an internal data format to handle the gear ratio values entered as integers and decimals.

When DI6 is activated (=connected to 110 V DC) the supervision of in- and outgoing pulses to the gearbox is disabled.

Signals 03.51, 03.52 and 03.53 are set to zero when DI 1 goes 0→ 1.

When pulses are evaluated from all four slopes (Channel A ↗, Channel A ↘, Channel B ↗ and Channel B ↘) the counted number of pulses will be four times higher than the number of pulses of the incremental encoder. {03.51}, {03.52}, {03.53} and {04.51} will be four times larger than i the Formulas below. To get an understandable system, let all incremental encoders be parameterised uniformly; set all of {02.02}, {02.06}, {02.10} and {02.14} to either 1 or 4. For value 4 pulses are counted on all four slopes, for value 1 for each of the rating plate pulse number of the encoder.

Example for 01.60 = 2, One motor with one drum.

Gear ratio = 63,56

Pulses per turn motor side: 1024

Pulses per turn drum side: 2048

Disconnect pulse encoder on motor, so its contribution to the difference is zero:

Desired trip level: 1 degree of drum angle.

$$\text{Set value: } \frac{1}{360} * 2048 * \frac{1024}{2048} = 3$$

Disconnect pulse encoder on drum, so its contribution to the difference is zero:

Desired trip level: 0,25 turns (90 degree) of motor.

$$\text{Set value: } \frac{90}{360} * 1024 * \frac{1}{63,56} = 4$$

Formulas

For 01.60 = 1

$$\{03.51\} = \frac{1}{\{01.63 \equiv 01.64\}} * \int M1 + \frac{1}{\{01.65 \equiv 01.66\}} * \int M2 - \left(\frac{\{02.01\}}{\{02.09\}} * \int D1 + \frac{\{02.05\}}{\{02.13\}} * \int D2 \right)$$

For 01.60 = 2

$$\{03.52\} = \frac{1}{\{01.63 \equiv 01.64\}} * \int M1 - \frac{\{02.01\}}{\{02.09\}} * \int D1$$

For 01.60 = 3

$$\{03.53\} = \frac{1}{\{01.65 \equiv 01.66\}} * \int M2 - \frac{\{02.05\}}{\{02.13\}} * \int D2$$

For 01.60 = 4

$$\{03.52\} = \frac{1}{\{01.63 \wedge 01.64\}} * \int M1 - \frac{\{02.01\}}{\{02.09\}} * \int D1 \quad \text{och}$$

$$\{03.53\} = \frac{1}{\{01.65 \wedge 01.66\}} * \int M2 - \frac{\{02.05\}}{\{02.13\}} * \int D2$$

For 01.60 = 5

$$\{03.52\} = \frac{1}{\{01.63 \wedge 01.64\}} * \int M1 - \frac{1}{2} * \left(\frac{\{02.01\}}{\{02.09\}} * \int D1 + \frac{\{02.01\}}{\{02.13\}} * \int D2 \right)$$

For 01.60 = 6

$$\{03.53\} = \frac{1}{\{01.65 \wedge 01.66\}} * \int M2 - \frac{1}{2} * \left(\frac{\{02.05\}}{\{02.09\}} * \int D1 + \frac{\{02.05\}}{\{02.13\}} * \int D2 \right)$$

13.6.3.2. Parameters

03.01	TR_L_P31	Trip level +side for signal 03.51
03.02	TR_L_N31	Trip level -side for signal 03.51
03.03	TR_L_P32	Trip level +side for signal 03.52
03.04	TR_L_N32	Trip level -side for signal 03.52
03.05	TR_L_P33	Trip level +side for signal 03.53
03.06	TR_L_N33	Trip level -side for signal 03.53
03.11	SS_L_P31	Soft stop level +side for signal 03.51
03.12	SS_L_N31	Soft stop level -side for signal 03.51
03.13	SS_AC_31	Action of Soft stop 03.51: Value = 1: Opens DO2 and DO3 Value = 2: Opens DO2 Value = 3: Opens DO3
03.14	SS_L_P32	Soft stop level +side for signal 03.52
03.15	SS_L_N32	Soft stop level -side for signal 03.52
03.16	SS_AC_32	Action of Soft stop 03.52: Value = 1: Opens DO2 and DO3 Value = 2: Opens DO2 Value = 3: Opens DO3
03.17	SS_L_P33	Soft stop level +side for signal 03.53
03.18	SS_L_N33	Soft stop level -side for signal 03.53
03.19	SS_AC_33	Action of Soft stop 03.53: Value = 1: Opens DO2 and DO3 Value = 2: Opens DO2 Value = 3: Opens DO3

13.6.3.3. Signals

03.51	DIFF_IO1	Difference of in- and outgoing pulses to the gear-box normalized to the motor encoders for 01.60 = 1, differential gearbox.
03.52	DIFF_IO2	Difference of in- and outgoing pulses to the gear-box normalized to the motor encoder for 01.60 = 2, 4 or 5 motor M1 as sole prime mover.
03.53	DIFF_IO3	Difference of in- and outgoing pulses to the gear-box normalized to the motor encoder for 01.60 = 3, 4 or 6 motor M2 as sole prime mover.
03.61	TR_S_P31	Trip level +side for signal 03.51, echo
03.62	TR_S_N31	Trip level -side for signal 03.51, echo
03.63	TR_S_P32	Trip level +side for signal 03.52, echo
03.64	TR_S_N32	Trip level -side for signal 03.52, echo
03.65	TR_S_P33	Trip level +side for signal 03.53, echo
03.66	TR_S_N33	Trip level -side for signal 03.53, echo
03.71	TR_S_O31	Trip level 03.51 out of range. Latched in Trip module
03.72	TR_S_O32	Trip level 03.52 out of range. Latched in Trip module
03.73	TR_S_O33	Trip level 03.53 out of range. Latched in Trip module
03.81	ST_S_P31	Soft stop level +side for signal 03.51, echo
03.82	ST_S_N31	Soft stop level -side for signal 03.51, echo
03.83	ST_S_P32	Soft stop level +side for signal 03.52, echo
03.84	ST_S_N32	Soft stop level -side for signal 03.52, echo
03.85	ST_S_P33	Soft stop level +side for signal 03.53, echo
03.86	ST_S_N33	Soft stop level -side for signal 03.53, echo
03.91	ST_SI_O1	Soft stop level 03.51 out of range. Latched in Trip module
03.92	ST_SI_O2	Soft stop level 03.52 out of range. Latched in Trip module
03.93	ST_SI_O3	Soft stop level 03.53 out of range. Latched in Trip module

13.6.4. Difference in pulses between the drums

13.6.4.1. Functions

Checks that the turns of both drums are the same. It considers different number of pulses, but not any gear ratio. The counters are set to 0 at action by DI1. The counter size is 32 bits. A deviation outside Trip level will unconditionally open the safety output relays.

A Soft level deviation will open DO2, DO3 as set up.

The trip level parameters are echoed as signals to make recordings with the CMT-program.

{01.60} means value of parameter 01.60

[01.63;01.64] means an internal data format to handle the gear ratio values entered as integers and decimals.

For 01.60 = 1, 4, 5, 6

$$\{04.51\} = \int D1 - (\int D2 * \frac{\{02.09\}}{\{02.13\}}); \text{ normalized to the D1 encoder. The signal 04.51 will}$$

have a value restricted to +/-32767.

Signal 04.51 is set to zero when DI 1 goes 0→1.

When pulses are evaluated from all four slopes (Channel A↗, Channel A↘, Channel B↗ and Channel B↘) the counted number of pulses will be four times higher than the number of pulses of the incremental encoder. {03.51}, {03.52}, {03.53} and {04.51} will be four times larger than in the Formula above. To get an understandable system, let all incremental encoders be parameterised uniformly; set all of {02.02}, {02.06}, {02.10} and {02.14} to either 1 or 4. For value 4 pulses are counted on all four slopes, for value 1 for each of the rating plate pulse number of the encoder.

When DI6 is activated (=connected to 110 V DC) the supervision of Difference in pulses between the drums is disabled.

13.6.4.2. Parameters

04.01	TR_L_P41	Trip level +side for signal 04.51
04.02	TR_L_N41	Trip level -side for signal 04.51
04.11	SS_L_P41	Soft stop level +side for signal 04.51
04.12	SS_L_N41	Soft stop level -side for signal 04.51
04.13	SS_AC_41	Action of Soft stop 04.51: Value = 1: Opens DO2 and DO3 Value = 2: Opens DO2 Value = 3: Opens DO3

13.6.4.3. Signals

04.51	DIFF_D41	Difference in pulses from the two drums normalized to drum D1
04.61	TR_S_P42	Trip level +side for signal 04.51, echo
04.62	TR_S_N42	Trip level -side for signal 04.51, echo
04.71	TR_S_O41	Trip level 04.51 out of range. Latched in Trip module
04.81	ST_S_P43	Soft stop level +side for signal 04.51, echo
04.82	ST_S_N43	Soft stop level -side for signal 04.51, echo

13.6.5. Overspeed from any of the maximally four pulse encoders

13.6.5.1. Functions

The speed normalised absolute value of the four incremental encoders M1, M2, D1 and D2 are compared with set levels.

The trip is detected in following way, taking M1 as an example:

The speed is available as {02.51}, % of the synchronous speed.

If the value of {02.51} is larger than {05.01} for {05.02} ms, a fault signal {05.51} is generated. It is latched in Trip module. The safety output relays will open unconditionally.

If the value of {02.51} is larger than {05.09} for {05.10} ms, a fault signal {05.55} is generated. It is latched in Trip module. A Soft level deviation will open DO2, DO3 as set up.

{01.60} means value of parameter 01.60.

Detection of Trip level overspeed drums is made in board DATX 111 microcomputer, not including DAPC 100, to get start of opening of safety relays in not more than 5 ms.

By changing DI 6 from 0 to 1, the overspeed levels, delays and actions are taken from parameters 05.31....05.50 instead of 05.01...05.20. DI6 is intended to use for rescue lowering with automatic overspeed supervision in a situation there a shaft break has occurred, and the mismatch supervision between drums or between in- and outgoing pulses to the gearbox by definition cannot be used.

13.6.5.2. Parameters

DI6=1	DI6=0		
05.21	05.01	TR_L_P51	Trip level for high speed of Motor 1, signal 02.51, in % of the synchronous speed of the motor.
	05.02	TR_L_T51	Delay time for trip level for signal 02.51
05.22	05.03	TR_L_P53	Trip level for high speed of Motor 2, signal 02.53, in % of the synchronous speed of the motor.
	05.04	TR_L_T53	Delay time for trip level for signal 02.53
05.23	05.05	TR_L_P55	Trip level for high speed of Drum 1, signal 02.55. The trip level is in % of all motors running with synchronous speed. For parameter 01.60 set to 1 (Differential gearbox) 100% drum speed corresponds to a summation of both motors running at their synchronous speed, for other settings of parameter 01.60 it corresponds to the synchronous speed of Motor 1.
	05.06	TR_L_T55	Delay time for trip level for signal 02.55
05.24	05.07	TR_L_P57	Trip level for high speed of Drum 2, signal 02.57. The trip level is in % of all motors running with synchronous speed. For parameter 01.60 set to 1 (Differential gearbox) 100% drum speed corresponds to a summation of both motors running at their synchronous speed, for other settings of parameter 01.60 it corresponds to the synchronous speed of Motor 2.
	05.08	TR_L_T57	Delay time for trip level for signal 02.57
05.25	05.09	SS_L_P51	Soft stop level for signal 02.51
	05.10	SS_L_T51	Delay time for Soft stop level for signal 02.51
	05.11	SS_AC_51	Action of Soft stop 02.51: Value = 1: Opens DO2 and DO3 Value = 2: Opens DO2 Value = 3: Opens DO3

05.26	05.12	SS_L_P53	Soft stop level for signal 02.53
	05.13	SS_L_T53	Delay time for Soft stop level for signal 02.53
	05.14	SS_AC_53	Action of Soft stop 02.53: Value = 1: Opens DO2 and DO3 Value = 2: Opens DO2 Value = 3: Opens DO3
05.27	05.15	SS_L_P55	Soft stop level for signal 02.55
	05.16	SS_L_T55	Delay time for Soft stop level for signal 02.55
	05.17	SS_AC_55	Action of Soft stop 02.55: Value = 1: Opens DO2 and DO3 Value = 2: Opens DO2 Value = 3: Opens DO3
05.28	05.18	SS_L_P57	Soft stop level for signal 02.57
	05.19	SS_L_T57	Delay time for Soft stop level for signal 02.57
	05.20	SS_AC_57	Action of Soft stop 02.57: Value = 1: Opens DO2 and DO3 Value = 2: Opens DO2 Value = 3: Opens DO3

13.6.5.3. Signals

05.51	OSPM1_01	Trip level overspeed 02.51, encoder Motor 1. Latched in Trip module
05.52	OSPM2_01	Trip level overspeed 02.53, encoder Motor 2. Latched in Trip module
05.53	OSPD1_01	Trip level overspeed 02.55, encoder Drum 1. Latched in Trip module
05.54	OSPD2_01	Trip level overspeed 02.57, encoder Drum 2. Latched in Trip module
05.55	OSPM1_02	Soft stop level overspeed 02.51, encoder M1. Latched in Trip module
05.56	OSPM2_02	Soft stop level overspeed 02.53, encoder M2. Latched in Trip module
05.57	OSPD1_02	Soft stop level overspeed 02.55, encoder D1. Latched in Trip module
05.58	OSPD2_02	Soft stop level overspeed 02.57, encoder D2. Latched in Trip module

13.6.6. Compare difference between absolute encoder P1 and P2.

13.6.6.1. Functions

This supervision is only made for {01.60} = 1, 5 or 6, and for {01.61} = 2.

The trip is detected in following way:

The height in mm of P1 is available as {02.59}. The height in mm of P2 is available as {02.60}.

The difference of 02.59 - 02.60 is calculated as signal 02.61.

If the value of {02.61} is larger than {06.01}, a fault signal {06.51} is generated. It is latched in Trip module. The safety output relays will open unconditionally.

If the value of {02.61} is larger than {06.02}, a fault signal {06.52} is generated. It is latched in Trip module. A Soft level deviation will open DO2, DO3 as set up.

{01.60} means value of parameter 01.60.

13.6.6.2. Parameters

06.01	TR_L_P61	Trip level for signal 02.61
06.02	TR_L_N61	Soft stop level for signal 02.61
06.03	TR_AC_61	Action of Soft stop 02.61: Value = 1: Opens DO2 and DO3 Value = 2: Opens DO2 Value = 3: Opens DO3

13.6.6.3. Signals

06.51	ABSDEV01	Trip level 02.61. Latched in Trip module
06.52	ABSDEV02	Soft stop level 02.61. Latched in Trip module

13.6.7. Any of four PTC, Soft stop.

13.6.7.1. Functions

This supervision is made according to module 07 parameter set up.

13.6.7.2. Parameters

07.01	PTC1_ACT	Action of PTC 1: Value = 0: No action, "not used" Value = 1: Opens DO2 and DO3 Value = 2: Opens DO2 Value = 3: Opens DO3
07.02	PTC1_TRL	The value 40% corresponds to the resistance value for trip when thermistors acc. to DIN are used.
07.03	PTC1_HIS	A value larger than 0 will require a lower temperature for restart than the trip temperature.
07.04	PTC2_ACT	Action of PTC 2: Value = 0: No action, "not used" Value = 1: Opens DO2 and DO3 Value = 2: Opens DO2 Value = 3: Opens DO3
07.05	PTC2_TRL	The value 40% corresponds to the resistance value for trip when thermistors acc. to DIN are used.
07.06	PTC2_HIS	A value larger than 0 will require a lower temperature for restart than the trip temperature.
07.07	PTC3_ACT	Action of PTC 3: Value = 0: No action, "not used" Value = 1: Opens DO2 and DO3 Value = 2: Opens DO2 Value = 3: Opens DO3
07.08	PTC3_TRL	The value 40% corresponds to the resistance value for trip when thermistors acc. to DIN are used.
07.09	PTC3_HIS	A value larger than 0 will require a lower temperature for restart than the trip temperature.
07.10	PTC4_ACT	Action of PTC 4: Value = 0: No action, "not used" Value = 1: Opens DO2 and DO3 Value = 2: Opens DO2 Value = 3: Opens DO3
07.11	PTC4_TRL	The value 40% corresponds to the resistance value for trip when thermistors acc. to DIN are used.
07.12	PTC4_HIS	A value larger than 0 will require a lower temperature for restart than the trip temperature.

13.6.7.3. Signals

07.51	PTC1_SST	Soft stop PTC 1. This signal is not latched. The resulting fault state is however latched, and requires a reset-action.
07.52	PTC2_SST	Soft stop PTC 2. This signal is not latched. The resulting fault state is however latched, and requires a reset-action.
07.53	PTC3_SST	Soft stop PTC 3. This signal is not latched. The resulting fault state is however latched, and requires a reset-action.
07.54	PTC4_SST	Soft stop PTC 4. This signal is not latched. The resulting fault state is however latched, and requires a reset-action.

13.6.8. Any of four signals 0 - 10 V, Soft stop.

13.6.8.1. Functions

The analogue inputs senses -10,000 V to +10,000 V. -10,000 V=-100% and +10,000 V=+100%.

The supervision is made according to module 08 parameter set up as described here below. Assume AI is set up as follows:

{08.01} = 2

{08.02} = 20%

{08.03} = 10%

Example 1

It will trip and open DO2 when input voltage has grown from 0 to +2,00 V at AI 1.

It will remain in trip position until the voltage is below +1,00 V.

Example 2

It will trip and open DO2 when input voltage has grown from 0 to -2,00 V at AI 1.

It will remain in trip position until the voltage is approaching 0 V at -1,00 V.

13.6.8.2. Parameters

08.01	AIN1_ACT	Action of AI 1: Value = 0: No action, "not used" Value = 1: Opens DO2 and DO3 Value = 2: Opens DO2 Value = 3: Opens DO3
08.02	AIN1_TRL	The AI is bipolar, -10,000 V to +10,000 V. The signal is first processed to its absolute-value in the system. The level for trip is than the absolute value of the in signal in % is larger than parameter 08.02.
08.03	AIN1_HIS	This signal is entered as 0 % to +100,00 %. A larger value than 0 requires that the analog signal to the AI is reduced to a less value than the trip level before the fault state is possible to reset.
08.04	AIN2_ACT	Action of AI 2: Value = 0: No action, "not used" Value = 1: Opens DO2 and DO3 Value = 2: Opens DO2 Value = 3: Opens DO3
08.05	AIN2_TRL	The AI is bipolar, -10,000 V to +10,000 V. The signal is first processed to its absolute-value in the system. The level for trip is than the absolute value of the in signal in % is larger than parameter 08.05.
08.06	AIN2_HIS	This signal is entered as 0 % to +100,00 %. A larger value than 0 requires that the analog signal to the AI is reduced to a less value than the trip level before the fault state is possible to reset.
08.07	AIN3_ACT	Action of AI 3: Value = 0: No action, "not used" Value = 1: Opens DO2 and DO3 Value = 2: Opens DO2 Value = 3: Opens DO3

08.08	AIN3_TRL	The AI is bipolar, -10,000 V to +10,000 V. The signal is first processed to its absolute-value in the system. The level for trip is than the absolute value of the in signal in % is larger than parameter 08.08.
08.09	AIN3_HIS	This signal is entered as 0 % to +100,00 %. A larger value than 0 requires that the analog signal to the AI is reduced to a less value than the trip level before the fault state is possible to reset.
08.10	AIN4_ACT	Action of AI 4: Value = 0: No action, "not used" Value = 1: Opens DO2 and DO3 Value = 2: Opens DO2 Value = 3: Opens DO3
08.11	AIN4_TRL	The AI is bipolar, -10,000 V to +10,000 V. The signal is first processed to its absolute-value in the system. The level for trip is than the absolute value of the in signal in % is larger than parameter 08.11.
08.12	AIN4_HIS	This signal is entered as 0 % to +100,00 %. A larger value than 0 requires that the analog signal to the AI is reduced to a less value than the trip level before the fault state is possible to reset.

13.6.8.3. Signals

08.51	AIN1_SST	Soft stop AI 1. This signal is not latched. The resulting fault state is however latched, and requires a reset-action.
08.52	AIN2_SST	Soft stop AI 2. This signal is not latched. The resulting fault state is however latched, and requires a reset-action.
08.53	AIN3_SST	Soft stop AI 3. This signal is not latched. The resulting fault state is however latched, and requires a reset-action.
08.54	AIN4_SST	Soft stop AI 4. This signal is not latched. The resulting fault state is however latched, and requires a reset-action.

13.6.9. System internal monitor module

13.6.9.1. Functions

The system can perform supervision of undesired contact between the detection voltage 110 V DC and earth. It is required that the 110 V DC-system is coupled as floating, and the terminals -X1:7 and :8 are connected as described in the terminal list.

The system has a watchdog, which checks that the system processor(s) are not stalled. The watchdog must be an independent watchdog relay, which can be wired into the emergency stop circuit. The period time for the square wave output from the supervision system can be set as parameter. Terminal -X6 is used for the watchdog.

Before start of the system a control sequence could, and normally should, be run. The sequence will be executed by setting parameter 09.03 to 1. It will not be executed if it is set to 0. The sequence is:

- 1) Driver presses Start. If all start conditions else are fulfilled, the Start command comes to DI 7 of DATX 111 board as well as to -X104:4 (Start pulse) of DARU 100, simply by parallel wire connection. The Start button must be hold in during the complete test execution, less than 100 ms.
- 2) The Start button 0→1 transition resets a flag for release. No release of relay unit DARU 100 is possible.
- 3) Blocked release flag AND a NC auxiliary contact of the contactor for the solenoid valves of emergency brake makes DO 4 close. The said NC contact is connected to DI 3.
- 4) DO 4 pulls a relay. This relay has one NC and one NO contact. The relay must be classified for concurrent operation of both contacts.
- 5) NC of the said relay will open the contactor for the solenoid valves of emergency brake. The contactor is however already deenergised in this situation. If the contactor had been welded, the test had already failed in step 3.
- 6) NO of the said relay is connected to DI 5. When DI 5 goes 0→1 the release flag mentioned in step 2 is deblocked, given that the driver stills presses the Start button. DO 4 reopens
- 7) If the test passes, DARU 100 will be operational, if it fails Fault code 75 is given.

The Hardware is supervised, and this kind of fault will result in Safety stop (SO1) and when the system still is partly controllable by early direct un-delayed stop with emergency brakes (DO4). Report the Fault codes 71, 72 or 75 to ABB before restarting the supervision system.

13.6.9.2. Parameters

09.01	A_EARTH F	Action of Earth fault 110 V DC: Value = 1. No control action. Value = 2. Soft stop = Opens DO2 and DO3 Value = 3. Opens Safety Out
09.02	PERD TIME	Period time in ms for the watchdog square wave 0/+24 V
09.03	STARTCHK	Control operation sequence of relays and contactors before releasing SO for operation. Value = 0. No control sequence. Value = 1. Run control sequence of relays and contactors prior to release the Safety Output for operation.

13.6.9.3. Signals

09.51	EARTHFR	Code 61: Fault DO closing only. Code 62: Earth Fault resulting in DO2 + DO3 opened. Code 63: Earth Fault resulting in SO opened.
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13.6.10. Evaluation of four slowdown and stop limit switches.

13.6.10.1. Functions

The value of the active absolute encoder is signal 02.62. The setting is made as teach in.

No automatic synchronization is done. All resynchronization is made by manual intervention.

The evaluation is made according to module 10 parameter set up.

13.6.10.2. Parameters

10.01	POS_HH_L	Position of HH level, +/- 65354 mm
10.02	SET_HH_L	Set HH-level (0→1).
10.03	POS_H_L	Position of H level, +/- 65354 mm
10.04	SET_H_L	Set H-level (0→1).
10.05	POS_L_L	Position of L level, +/- 65354 mm
10.06	SET_L_L	Set L-level (0→1).
10.07	POS_LL_L	Position of LL level, +/- 65354 mm
10.08	SET_LL_L	Set LL-level (0→1).

13.6.10.3. Signals

10.51	P10_C01	Position is above LL, L, H and HH. <u>OPEN</u> DO5 Slow down limit A <u>CLOSE</u> DO6 Slow down limit B <u>OPEN</u> DO7 Stop limit A <u>CLOSE</u> DO8 Stop limit B
10.52	P10_C02	Position is above LL, L, and H. Below HH. <u>OPEN</u> DO5 Slow down limit A <u>CLOSE</u> DO6 Slow down limit B <u>CLOSE</u> DO7 Stop limit A <u>CLOSE</u> DO8 Stop limit B
10.53	P10_C03	Position is above LL and L. Below H and HH. <u>CLOSE</u> DO5 Slow down limit A <u>CLOSE</u> DO6 Slow down limit B <u>CLOSE</u> DO7 Stop limit A <u>CLOSE</u> DO8 Stop limit B
10.54	P10_C04	Position is above LL. Below L, H and HH. <u>CLOSE</u> DO5 Slow down limit A <u>OPEN</u> DO6 Slow down limit B <u>CLOSE</u> DO7 Stop limit A <u>CLOSE</u> DO8 Stop limit B
10.55	P10_C05	Position is below LL, L, H and HH. <u>CLOSE</u> DO5 Slow down limit A <u>OPEN</u> DO6 Slow down limit B <u>CLOSE</u> DO7 Stop limit A <u>OPEN</u> DO8 Stop limit B

13.6.11. Analog out control.

13.6.11.1. Functions

AO 1 is connect to signal 02.62 (Height). -65354 mm = - 10V. +65354 mm = +10 V.

Connection of AO 2 depends on parameter 11.01

AO 2:

{11.01}	Connect signal to AO 2
0	02.51
1	08.51
3	02.53
4	08.53
5	02.55
6	08.55
7	02.57
8	08.57

13.6.11.2. Parameters

11.01	AO2_SSET	Selection of signal set for AO 2. See table above.
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13.6.12. Trip module

13.6.12.1. Fault items

Controls soft stop and safety stop outputs.

Safety stop is made with redundant (serial) transistors and supervision that one of these is not short-circuited.

X denotes that the output will open.

For {01.60} = 7 no Faults are generated, but SO is forced open.

Any Fault will close DO 1.

The identity of the Fault Signal is Module no. "." Code, 12.01 for the first Fault signal.

X: DO-relay opens

Code	Signal	Parameter	Value	DO 2	DO 3	SO	Description
01	03.71					X	Shaft break, differential gear
02	03.72					X	Shaft break, gear system 1
03	03.73					X	Shaft break, gear system 2
04	03.91	03.13	1	X	X		Early stage Shaft break, diff. gear
05			2	X			Early stage Shaft break, diff. gear
06			3		X		Early stage Shaft break, diff. gear
07	03.92	03.16	1	X	X		Early stage Shaft break, system 1
08			2	X			Early stage Shaft break, system 1
09			3		X		Early stage Shaft break, system 1
10	03.93	03.19	1	X	X		Early stage Shaft break, system 2
11			2	X			Early stage Shaft break, system 2
12			3		X		Early stage Shaft break, system 2
13	04.71					X	Break between drums
14	04.91	04.13	1	X	X		Early stage break between drums
15			2	X			Early stage break between drums
16			3		X		Early stage break between drums
17	05.51					X	Direct trip Overspeed motor 1
18	05.52					X	Direct trip Overspeed motor 2
19	05.53					X	Direct trip Overspeed drum 1
20	05.54					X	Direct trip Overspeed drum 2
21	05.55	05.11	1	X	X		Early stage Overspeed motor 1
22			2	X			Early stage Overspeed motor 1
23			3		X		Early stage Overspeed motor 1
24	05.56	05.14	1	X	X		Early stage Overspeed motor 2
25			2	X			Early stage Overspeed motor 2
26			3		X		Early stage Overspeed motor 2
27	05.57	05.17	1	X	X		Early stage Overspeed drum 1
28			2	X			Early stage Overspeed drum 1
29			3		X		Early stage Overspeed drum 1
30	05.58	05.20	1	X	X		Early stage Overspeed drum 2
31			2	X			Early stage Overspeed drum 2
32			3		X		Early stage Overspeed drum 2
33	06.51					X	Trip absolute encoder mismatch
34	06.52	06.03	1	X	X		Early stage abs. encoder mismatch
35			2	X			Early stage abs. encoder mismatch
36			3		X		Early stage abs. encoder mismatch
37	07.51	07.01	1	X	X		Overtemp. thermistor (PT100) 1
38			2	X			Overtemp. thermistor (PT100) 1
39			3		X		Overtemp. thermistor (PT100) 1

X: DO-relay opens

Code	Signal	Parameter	Value	DO 2	DO 3	SO	Description
40	07.52	07.04	1	X	X		Overtemp. thermistor (PT100) 2
41			2	X			Overtemp. thermistor (PT100) 2
42			3		X		Overtemp. thermistor (PT100) 2
43	07.53	07.07	1	X	X		Overtemp. thermistor (PT100) 3
44			2	X			Overtemp. thermistor (PT100) 3
45			3		X		Overtemp. thermistor (PT100) 3
46	07.54	07.10	1	X	X		Overtemp. thermistor (PT100) 4
47			2	X			Overtemp. thermistor (PT100) 4
48			3		X		Overtemp. thermistor (PT100) 4
49	08.52	08.05	1	X	X		Out of range AI (PT100) 5
50			2	X			Out of range AI (PT100) 5
51			3		X		Out of range AI (PT100) 5
52	08.54	08.10	1	X	X		Out of range AI (PT100) 6
53			2	X			Out of range AI (PT100) 6
54			3		X		Out of range AI (PT100) 6
55	08.56	08.15	1	X	X		Out of range AI (PT100) 7
56			2	X			Out of range AI (PT100) 7
57			3		X		Out of range AI (PT100) 7
58	08.58	08.20	1	X	X		Out of range AI (PT100) 8
59			2	X			Out of range AI (PT100) 8
60			3		X		Out of range AI (PT100) 8
61	09.51= 61	09.01	1				Earth fault 110 V DC
62	09.51= 62		2	X	X		Earth fault 110 V DC
63	09.51= 63		3			X	Earth fault 110 V DC
64							-----
65				X	X		Encoder fault motor 1
66				X	X		Encoder fault motor 2
67				X	X		Encoder fault drum 1
68				X	X		Encoder fault drum 2
69				X	X		Absolute encoder fault drum 1
70				X	X		Absolute encoder fault drum 2
71				X	X		HW supervision board DATX 111, code 71
72				X	X		HW supervision board DATX 111, code 72
73				X	X		Position measurement error based on encoder P1 hitting top limit switch
74				X	X		Position measurement error based on encoder P2 hitting top limit switch
75				X	X		Control sequence at start for relays and contactors failed.

13.6.12.2. Fault system

The latching system uses SR-flip-flops with dominant S. If the error persists, it cannot be re-set.

Every Fault has two SR set by the same condition. Using the code 56 as example, these SR can be named 56A and 56B. If any A-type SR is set, DO1 is set and DO2, DO3 and SO are affected. The B-type SR will only set a Fault signal, and not affect operation.

All A-type are reset by DI 1, alternatively by 0→1 transition of parameter 12.01

All B-type are reset by DI 2, alternatively by 0→1 transition of parameter 12.02.

It means it is possible to restore the system for operation, but maintaining the fault indications, however not power-safe.

It is possible to see which Faults that are present a moment by opening Signals Group 70 of the CMT-program. In Group 70 all Fault signals are listed from 70.01 to 70.74. Green colour for no Fault, and Red colour for Fault state.

13.6.12.3. Parameters

12.01	RSTIND_A	Reset fault memories for operation (0→1). Same as activating DI 1.
12.02	RSTIND_B	Reset fault memories for indication (0→1). Same as activating DI 2.

13.7. Power

The control systems contains a robust DC PSU, same as in ASTAT DARA 1000.

The nominally 24 V (unregulated) supplied to the interface board is regulated to +24 V by means of serial regulators, 15 W power.

Supplied voltages to encoders are protected by PTC.

The nominally 110 V (unregulated) supplied to the interface board is regulated to +125 V by means of a serial regulator, 3 W power. The externally supplied voltages are protected by PTC.

13.8. Set up (programming)

The same programming tool program and cable as for DARA 1000 is used. DARA 2000 requires however another set of Signal and Parameter files. These are delivered together with DARA 2000.

All handling of the systems follows the guidelines in Chapter 3.

13.9. Electrical components to control a safety drum brake

It must be assured that the safety brakes in all normal situations are applied so long time after the high speed side working brakes, that there are no stresses on the gearbox or other mechanical parts.

Only in case of break in the drive train or overspeed of a rope drum the safety brakes shall be applied immediately.

In case of interruption of the electrical line supply the safety brakes must not be applied immediately.

The solution is to hold the safety brake a defined time after crane disconnection by holding the solenoid valves by means of an electric capacitor with a limited energy. In case a break in the drive train or overspeed of a rope drum, the system will release the safety brakes without delay.

Contact ABB for a selection of encoders, contactors, relays, transformers, rectifiers, capacitors and other parts of a control system.

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