ABB Drives

TYRAK® L

Convertor type YGMP and YHMP
Manual YT 280 - 303 E
Art. no. 4890 066 - 342

Description convertor

Description drive system

Description function modules

Installation

Commissioning

Operation

Maintenance

Fault tracing

~~Program diagram~~

7742 013 - 22

TYRAK L

Thyristor convertor with microcomputer for d.c. drive systems, 10 - 2000 kW

Description convertor

YT 280-302 E, Edition 3

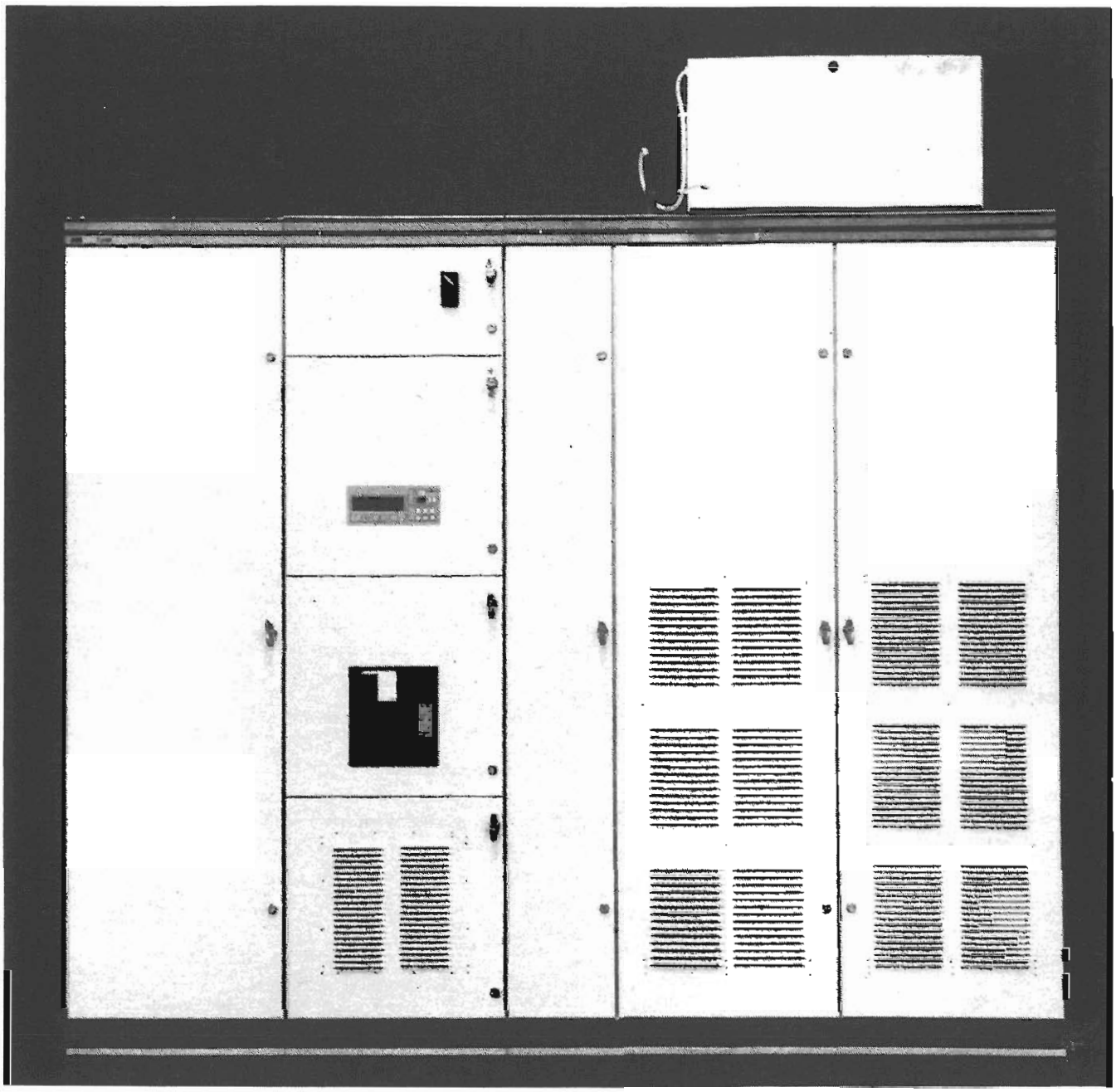


ABB Drives

ASEA BROWN BOVERI

Contents Page

GENERAL

The ABB Tyrak L thyristor convertor series is designed for demanding industrial operation and satisfies the requirements of the international standard, IEC 146.

The convertors are built up of standardized function units such as power distribution (–W1), auxiliary power supply (–AL1), armature convertor (–U1), field convertor (–U2) and control equipment (–AK1).

Convertors with accessories can be delivered without enclosure or installed in ABB type VMH switchgear cubicles. The cubicle enclosures have a degree of protection rating IP 22, in accordance with IEC 144. If the ventilation openings are provided with mesh coverings the degree of protection becomes IP 31.

The modular design together with the microcomputer-based control system simplifies maintenance and service and reduces the need for spare parts to a minimum.

Considerable emphasis has been placed on personnel safety and operational reliability in the design of the convertor. An extensive diagnostic program simplifies fault-tracing and ensures a high degree of reliability.

Each convertor is subject to a series of rigorous tests before delivery.

Explanation of the circuit diagram

This description refers to the delivery circuit diagram or guiding drawings. Sheet numbers are specified for each function. If the circuits are available in several variants, the same sheet number appears several times in the guiding drawing but with an index e.g. 80.1, 80.2 etc.

The functional item designations (–) are the same for the convertors in the complete power range. The circuit diagram supplied with each delivery also indicates where the units are located in the equipment concerned by means of location-oriented item designations (+).

In the circuit diagram, the convertor control program is divided into sub-functions designated function modules. Each such module is presented as a dot-dash rectangle with an identity (type designation) in the upper left corner. Parameters which can be controlled externally via the operator's panel are shown within an oval frame. The correct program function is first located and then the correct parameter name within this function. Values set are also presented on the display.

The standard data format is 2 byte "fraction" (F2). This is not normally indicated in the circuit diagram. If a different data format is used, the format concerned is indicated. All signals named in circuit diagrams with format F2 which are not within parentheses, ( ), are accessible from the display for status check.

The symbols used are explained in the section **"Diagram symbols"**, page 12.

Configuration

The Tyrak L convertors are of similar design within the complete power range.

Circuit diagram sheet 3 shows how drive equipment is divided into functional parts. The function limits are, expressed simply, speed or torque references in and driving torque out.

The functional parts of the convertor and their configuration are described in the following chapters.

The operator's panel, description and operation are presented in **"Operator's panel management"** (YT 280-304 E). The control program is described broadly in different **"System descriptions"** and in detail in **"Descriptions of function modules"**.

A.C. VOLTAGE DISTRIBUTION (-W1)

Circuit diagram, sheet 80

Convertors with rated currents up to 800 A are connected to the supply mains via a load break switch and main fuses. In convertors with greater capacities, this unit and the main contactor are replaced with an air circuit breaker. The auxiliary supply circuits are connected directly to the mains voltage except with 660 V when the voltage is transformed down to 500 V.

Load break switch and fuses

Convertors with current ratings up to 800 A

The a.c. voltage distribution consists of load break switch, main fuses and auxiliary supply fuses. (6A). The load break switch is provided with position indication which shows the location of the contactors, irrespective of the orientation of the operating handle. The load break switch can be locked with a padlock (not included in the delivery).

Convertors with ratings up to 530 A are provided with high speed semiconductor fuses in the phases whereas convertors rated at 650 and 800 A have normal phase fuses of type gL in accordance with VDE 0636. The control and operating circuits can be tested without voltage applied to the main circuit by removing the main fuses.

Convertors with current ratings 950 A or greater

The a.c. voltage distribution consists of a load break switch and fuses for auxiliary voltage circuits.

Connection of external field exciter

A three phase fuse group is provided for connection of an external field exciter. The connection is made directly at the fuse socket.

The following are the fuses used for different convertors:

40 - 530 A:	25 A
650 - 1400 A:	63 A
1600 - 3000 A:	125 A

Other auxiliary supply voltages and operating signals are connected to auxiliary supply transformers and the terminal block unit.

PHASE INDUCTORS (-L1)

Circuit diagrams sheet 80 (40 - 530 A) and sheet 90 (650 - 3000 A)

Convertors with current ratings up to 530 A have phase inductors with both single and double convertor configurations. The inductors protect the thyristor blocks against excessive voltage transients.

Convertors with current ratings 650 - 1400 A are provided with phase inductors only with double convertor configuration. They then protect the thyristors in the non-conducting bridge against voltage transients in the reverse direction.

In double convertors with current ratings over 1600 A, branch inductors are used to ensure adequate cooling.

Unenclosed convertors are not provided with inductors and external inductors must be therefore be connected. These should have inductances of approximately 6 µH for mains voltages up to 500 V and approximately 10 µH for voltages over 500 V. These values are the same for convertors of all current ratings.

If the length of the supply cable to another convertor is at least approximately 25 or 45 meters respectively, no separate phase inductors are required. The inductance of the cable itself is then greater than 6 or 10 µH respectively.

AUXILIARY SUPPLY (–AL1)

Circuit diagram, sheet 82

The auxiliary supply transformers (–AL1.51 and -AL1.56) can be connected directly to voltages up to 575 V. Mains voltage 660 V is transformed down to 500 V via an auto-transformer. The convertor has four different voltages, designated Q1, Q2, M1L and M2L for auxiliary supply.

24 V supply voltages

Q1 and Q2 are 24 V d.c. voltages used to supply the control equipment. Q1 is used only internally in the control equipment and supplies the computer board and one half of the I/O board which can be connected to the computer board. The outer half of the I/O board and terminal block board and other external circuits are supplied with Q2.

The risk of external interference affecting the function of the computer is minimized with separate supply voltages. Each convertor computer can also be directly earthed even in plants with a common reference system.

Both of the voltages are obtained from the same transformer. This is provided with a screen between primary and secondary windings and a screen between the two secondary windings. The transformer also contains a winding to give a low a.c. voltage, approximately 7 V, between phases and neutral. This voltage is used for synchronization of trigger pulses and for mains voltage monitoring.

The circuits are fused with glass tube fuses, Q1 with 6.3 A and Q2 with 4 A fuses.

The computer supply is backed up with a capacitor to maintain the function with brief voltage interruptions.

Approximately 0.5 A (Q2), (depending on the equipment, more with few I/O boards, less with full equipment, specially of digital output boards) is available for external circuits.

110 V and 220 V supply voltages

M1L is a 110 V a.c. voltage 50/60 Hz, used as operating voltage for contactors, air circuit breakers, digital input boards etc.

M2L is a 220 V a.c. voltage used for fans in convertors with ratings 180 - 530 A. M2L can also be used as operating voltage to digital input boards, provided that the adaptation resistors on the boards are dimensioned to permit this.

M1L and M2L are generated in a common transformer with their neutral leads connected. M1L is protected with a 4 A glass tube fuse and M2L with a 2 A fuse. M1L and M2L are dimensioned for a load of a maximum of 20 digital inputs.

Grounding

Q1 (computer supply) is grounded directly in the chassis via the screws fixing the circuit boards. The neutrals of the other supply voltages are connected and grounded via a terminal block. If several convertors are to be connected, the grounding of all of the convertors but one must be disconnected.

A.C. VOLTAGE BREAKER (–Q1)

Circuit diagram sheet 88

A switching device is required to disconnect the convertor from the mains at switch-off, or when tripped. This is located on the a.c. voltage side of the thyristor unit to ensure that this also is disconnected from the mains. During normal operations, the contactor/breaker is always operated in a currentless condition as the control equipment electronics first controls the current to zero before the off command is issued. As an extra safety measure, the off-command operates the contactor/breaker directly via a timer.

Main contactor

Convertors with current ratings up to 800 A are provided with an EH type contactor. The contactor is operated with 110 V a.c. In convertors with ratings up to 120 A, the operation is direct and in convertors with higher ratings, via an auxiliary contactor. In the latter case, the coil voltage of the main contactor is equal to the mains voltage except with 660 volt mains when it is 500 V.

Air circuit breaker

In convertors with current ratings ≥ 950 A, the main contactor is replaced with an air circuit breaker operated by an auxiliary contactor. A motor tensions the switch-off spring after each operation. The breaker is provided with an instantaneous over-current tripping device. The mechanism of the breaker can be tested with the main circuit dead by pulling out the breaker to the TEST-position.

ARMATURE EXCITATION (-U1)

Circuit diagram, sheet 90

Thyristor unit

The thyristor bridge is built up as a three phase, completely controlled 6-pulse coupling. It is available in two versions, as a single convertor (YGMP) or as a double convertor (YHMP). In the double convertor version, the thyristors are directly anti-parallel coupled with common fusing and RC-circuits.

Thyristor blocks with two thyristors in each are used in convertors with current ratings up to 530 A. Phase fuses, RC circuits and phase inductors are used as protection for these blocks.

Convertors with larger current ratings are provided with "puck" thyristors. These are protected with the help of semiconductor fuses in the branches. For single convertors, the RC circuits are sufficient protection against voltage transients but with double convertor couplings, phase or branch inductors are used. See also "**Phase inductors (-L1)**", page 4.

Trigger pulse transmission

The trigger pulses are, in principle, transmitted in the same way, irrespective of the capacity of the convertor but the mechanical construction differs.

The trigger pulses are conducted via a ribbon cable from the convertor control board YPQ 101 to a pulse transformer unit. After galvanic insulation in a pulse transformer unit, the gate pulses are conducted to the different thyristors. The appearance of the trigger pulses can be measured via test terminals on the pulse transformer unit. The test terminals are located on the primary side of the transformer i.e. separate from the main voltage.

In double convertors, the trigger pulses are coupled to the forward and reverse bridges with the help of electronic contacts on the pulse transformer unit. The bridge conducting is indicated by the activation of LEDs, green for forward and yellow for reverse, but can also be measured at test terminals.

Current measurement

The d.c. current is measured on the a.c. voltage side of the thyristor unit with the help of the current transformers. The output signal is rectified in a diode bridge and is adapted with resistors so that the output voltage is 1.00 V with rated current.

Fan unit

Circuit diagram, sheet 88

The thyristor bridge in convertors of all ratings except 40 A are cooled with fans.
Convertors with 70 and 120 A ratings are provided with an axial fan powered with the operating voltage 110 V a.c.

In 180 - 530 A convertors, components are cooled with a 220 V a.c. three phase radial fan. The fan is supplied with single phase 220 V power, M2L, with the help of an external start capacitor. If the convertor is connected to an anticlockwise phase sequence, the connections to the fan must be changed to obtain the correct direction of rotation.

Convertors with higher current ratings are equipped with three phase fans for the same connection voltage as the supply mains (with 660 V, the voltage is transformed down to 500 V in 650 - 1400 A convertors). All fans are protected by integrated thermo-contactors in the motor winding.

VOLTAGE MEASUREMENT (-PU1)

Circuit diagram, sheet 90

A d.c./d.c. convertor delivers an output voltage proportional to the armature voltage. The output voltage is separated from the main circuit by high impedance.

The unit is used primarily together with a controlled field exciter for field weakening with constant e.m.f. The output signal can also be connected to an analog input channel and constitutes the actual value for the speed if the machine flux is kept constant. It can also be used in the same way to indicate the output voltage from the thyristor bridge.

FIELD EXCITATION (-U2)

Circuit diagram, sheet 87

For effective control performance, a d.c. motor requires separate excitation of the field winding. The Tyrak L convertor program contains a number of field excitation alternatives for different requirements.

Diode field exciter

The diode field exciter consists basically of a transformer and a two-pulse two way diode bridge. The field voltage is nominally 220 V but can be varied in steps of 5 % within 70 - 105 % of the nominal value, using the transformer taps. The current varies with the mains voltage and is also dependent on the resistance (temperature) of the field winding. This means that the current can become up to 150 % of the rated field current with a cold field winding and 10 % overvoltage in the mains supply. As the temperature of the field winding increases, the field current decreases. The field exciter is dimensioned to withstand this overcurrent during the warming-up process.

The diode field exciter can be connected to mains voltage 380 - 500 V and to 575 V and 660 V via an autotransformer. Minimum field current is monitored with a reed relay with a coil through which the field current is conducted. The function values are fixed in relation to the rated field exciter current.

Rated current (A)	On-value (A)	Off-value (A)
1.0	0.13 - 0.19	>0.08
2.5	0.32 - 0.47	>0.2
6.0	0.65 - 0.95	>0.4
10.0	1.3 - 1.9	>0.8

Controlled field exciter

The field current is kept constant with a controlled field exciter in accordance with a reference, independent of the resistance of the field winding and independent of variations in the mains voltage. The controlled field exciter consists of main circuits, trigger pulse circuits, contactor and fuses.

The field exciter is controlled with program functions in the control equipment -AK1. See **"Descriptions of function modules"**.

A.c. voltage connection and contactor

With mains voltage up to 500 V, the field exciter is connected directly to the mains via fuses and a main contactor. Higher voltages are connected via an auto transformer with ratio 575/460 or 660/500 V.

The contactor is operated with 110 V a.c. (M1L) and is controlled form the sequential control circuits of the drive equipment.

Main circuits

The main circuits consist of a phase inductor for limitation of the rate of change of the current during commutation, a semiconductor bridge and a varistor for limitation of the voltage transients from the field winding.

Single field exciters have a bridge with "mixed coupling" (two diodes, two thyristors). The current can only pass in one direction and the voltage cannot change sign. This bridge can also be used in field weakening systems with moderate acceleration requirements (>2 s for zero-max speed).

When shorter acceleration times with negative forcing voltages are required double field exciters are used. The principal use of double field exciters is in systems with field reversal and opti-torque. The double field exciter has two antiparallel fully-controlled bridges which can give positive and negative output voltage and current in both directions.

Trigger pulse circuits

The pulse transformers are assembled on one circuit board together with current measurement circuits and RC-circuits. The trigger pulses are generated in the control equipment and are transmitted to the field exciter via ribbon cable.

MOTOR SWITCH UNIT (-AQ1)

Circuit diagram, sheet 85

The unit (which is also designated control unit, external fans) is used for supply and operation of external motors such as cooling fans and heat exchangers. Convertors with ratings 40 - 530 A can supply two external motors whereas those with greater capacity can supply three. If two 40 - 120 A convertors are installed in the same cubicle, each can supply one external motor. Each group consists of fuses, contactor and overload relay. The contactor is operated with 110 V a.c. (M1L).

The unit is available in a normal version and an advanced version. In the normal version, all of the motors are activated simultaneously. The convertor is tripped immediately a fault is detected.

The advanced control unit permits thermostat control of the second and third motors. The convertor is tripped immediately a fault is detected in a motor. The tripping of motors two or three can be delayed from 0 to 327 seconds. "Tripping follows" can be indicated instantaneously in the event of a fault.

The maximum current ratings of the external motors are limited to the values in the table below.

Enclosed convertor (A)	Max motor current (A)
40	1.6
70	2.5
120	6.0
180 - 530	9.0
650 - 3000	18.0

The limitation in 40 - 120 A convertors permits selectivity between the motor fuses and the high-speed semiconductor fuses in the main circuit.

Unenclosed convertor (A)	Max motor current (A)
40 - 530	9.0
650 - 3000	18.0

CONTROL EQUIPMENT (-AK1)

Circuit diagram, sheets 18 - 78

The Tyrak L convertors are completely digitally controlled. Both control procedures and sequential functions are implemented digitally, from reference to control pulse.

The control equipment consists of both hardware and software which can be supplemented with optional accessory functions for separate each individual application.

The accessories can be in the form of communication units such as analog and digital I O boards, serial communication boards or similar or in the form of software.

Physical configuration

The control unit consists of circuit boards mounted on a base plate, installed on the inside of the cubicle door of enclosed convertors.

The basic version contains the following circuit boards:

- Computer unit YPP 105
- Convertor control YPQ 101
- Memory unit YPR 103 or YPR 104

If a controlled field exciter is included, the following is also necessary:

- Field control YPQ 102

External signals are connected via a terminal block unit. The terminal block unit consists of circuit boards mounted in an aluminium section. Terminal blocks for connection of external cables (max 2.5 mm^2 conductive area) are mounted on the circuit boards. The boards on the terminal block unit are connected with the control unit via ribbon cables.

In this basic version, the terminal block unit is equipped with a board (YPQ 104) which accommodates six digital input and two digital output channels. If further digital channels or analog input·output signals are required, the terminal block unit is supplemented with the required number of accessory boards. See "**Communication units**", page 10.

Communication units

Communication with the convertor control equipment is possible via the operator's panel, via I/O units for discrete signals or with the help of serial communication, from other computer equipment.

Operator's panel

Circuit diagram, sheet 16

The button set on the operator's panel has a fixed programmed section, ON, OFF and RESET with associated indication and a free, programmable section with 6 functional push-buttons and LEDs for indications. In the normal version, this section is programmed for the functions Remote/Local (Rem Loc), Automatic/Manual (Auto Man) and Reference + Reference– (Ref– Ref–), these texts appearing on the push-button. If required, the functions can be changed and the button text amended accordingly. Digital signals can be connected optionally to any button or LED on the operator's panel by means of a "signal switch box" which is programmed via the operator's panel.

The operator's panel and its functions are described in more detail in **"Operator's panel management"**, YT 280-304 E.

I/O units for discrete signals

Discrete signals are connected to terminal block boards, digital or analog and are connected in the software with the corresponding signal in the control program.

The basic version contains a connection unit for six digital input and two digital output signals (YPQ 104A-D), circuit diagram, sheet 29. If further inputs or outputs are required, extra I/O units can be ordered.

Note! An extra I/O unit is always required for connection of the actual speed value, either an analog input unit for analog tachometer or a connection unit for digital speed measurement (pulse generator), YPH 105.

The following I/O units are available:

- Connection unit for pulse generator (YPH 105 + terminal block board YPH 104). Circuit diagram sheet 39. The unit contains circuits for supply of pulse generator, 12 or 24 V and inputs for two separate measurement channels to detect forward/reverse rotation. Inputs for 0-pulse and synch pulse are also provided. The maximum pulse frequency is 50 kHz.
- Digital input unit for up to eight digital input signals. Circuit diagram sheet 30. The function unit consists of two circuit boards, one on the control unit (YPI 103) and one on the terminal block unit YPI 105A-D). The boards are connected by a ribbon cable.
- Digital output unit (YPO 103 + terminal block board YPO 104A) for up to eight digital output signals. Circuit diagram sheet 32. The outputs have galvanically free relay contactors and can be loaded with 5 A, 250 V a.c. or 30 W, 250 V d.c. The activation of an output is indicated by the illumination of a LED on the terminal block board.
- Analog input unit (YPG 110 + YPG 106) for up to four analog input signals. Circuit diagram sheet 36. The input signal can be 0 - 1 V, 0 - 10 V, ±10 V, 0 - 20 mA or 4 - 20 mA. The resolution is 11 bits + sign which corresponds to 0.05 %.
- Analog output unit (YPM 102 + YPM 105) for up to four analog output signals. Circuit diagram, sheet 38). The resolution is 8 bits which corresponds to 0.4 % bit with 0 - 10 V and 0.8 % with ±10 V.
- Signal convertor EGA is a unit for conversion of an analog output signal to a 0 - 20 mA current signal. Circuit diagram sheet 37.
- Signal convertor DSTY 101 is a unit for galvanic separation of an input or output signal and optional conversion of current-voltage or voltage-current signal. The input signal can be 0 - ±10 V, 0 - ±20 mA or 4 - +20 mA. The output signal can be selected between the same limits. Circuit diagram, sheets 35 and 37.

All of the I/O units with associated program functions are described in more detail in section **"Descriptions of function modules"**.

High speed serial bus

Circuit diagram, sheets 19-24

The serial communication unit, YPK 107 (unit 41) with modem board YPC 104 is a unit for high speed serial communication with an ABB Master (unit 41.1) and between convertors in Master/Follower operations (unit 41.2).

The unit is mounted on the rear of the control unit base plate. The modem board, YPC 104 is mounted above the circuit board YPK 107.

The unit is provided with a communication circuit of DUSCC (Dual Universal Serial Communication Control type), a double port memory, a 16 bits processor which reads and writes in this memory and a DMA (Direct Memory Access) circuit. The Communication is half-duplex in accordance with the specification for the Master Field Bus (modified SDCC protocol) . The transmission code used is NRZI.

The ABB Master communication equipment can address up to sixteen convertors in a multidrop configuration. The convertors are connected together with coaxial cable connected to the modem boards YPC 104. The cycle time is 1 ms per drive connected and the transmission speed is 2 Mbit/s.

The unit hardware is also prepared for communication with other master computers with other protocols.

The communication unit has two channels. The other channel can be utilized for master/follower communication by ordering a further modem board. Up to eight followers can be connected to one master and the cycle time is 1 ms per follower connected.

The transmission of signals is described in more detail in **"Descriptions of function modules"**.

Drive supervision and diagnostics

Tyrak L convertors have an extensive system for status check, operational supervision and fault diagnosis. These functions, together, give a high degree of availability, protect the drive equipment and the object driven and facilitate fault tracing, upkeep and operation.

Indication

Up to four optional signals can be presented simultaneously on the operator's panel in the form of bar graphs. The scale factor can be selected individually for each signal and the indication is in the form of a percentage or process-units (e.g. Amperes or Volts).

Protection and supervision

The control equipment monitors the operation and reports abnormal conditions.

- Protective functions such as earth fault, overload, supervision of speed feedback etc.
- Check of circuit board function. Faulty boards are indicated with name and board type.
- Switch-on and switch-off sequences are supervised and evaluated.

  If a command is not acknowledged within a certain time, an error message is presented on the operator's panel display.

The error message is presented in plain language with first-fault indication and consequential fault with time of occurrence in relation to the first fault.

The error text can be presented in Swedish, German, English or French.

Error statistics

Each fault is allocated a consecutive number 1 - 99. Information about the fault is stored in a RWM with voltage backup and it is therefore possible, at any time, to return to investigate the circumstances of a particular fault. The complete fault list can also be printed via a separate printer.

Logging

This function permits the recording of measured values from up to six optional signals at individually optional measurement intervals. The log function stores 186 values per signal and the value stored is the mean value during the measurement interval. The signals can be shown graphically on the operator's panel. The function can be used to show trends in certain signals or provide a basis for the analysis of faults which have resulted in tripping of the drive. Signals logged can be used in commissioning, for example when trimming a speed controller.

Supervision of supply voltages

Circuit diagram, sheet 29, upper part

The electronics supply is divided into an external (QL) and an internal (Q1) circuit. The unregulated voltage supply (24 V d.c.) is received via a diode bridge from the secondary windings of the three phase auxiliary voltage transformer (sheet 82 in the circuit diagram). See section "**24 V supply voltages**". The external supply is connected to connection unit YPQ 103 (A-D) item designation A1. This board then provides the voltages +30 VE, +24 VE, +15 VE and -15 VE. The latter two are stabilized. These voltages are supervised by a flip-flop and when all are correct, a green LED (with the label EPOWOK) illuminates. The signal from the flip-flop is conducted further via an opto-coupler to the computer board YPP 105 where a collective fault signal for the auxiliary voltage is generated, ASUV (Auxiliary Supply Under Voltage).

The voltages +24 VC, +15 VC, +5 VC and -15 VC are generated from Q1 on YPP 105 in the same way. These are also supervised with a flip-flop the output from which affects ASUV. When ASUV = "1", the convertor trips via TRIP1. The internal supply is also indicated with the following LEDs:

+24 V OK	(green)	= illuminates when the 24 V received is correct.
FAULT ±15 V	(red)	= illuminates with faults in ±15 V voltage.
FAULT +5 V	(red)	= illuminates with faults in +5 V voltage.

The signal EN30VE (Enable 30 V External) is generated by the computer after initialization and then releases, via opto-coupler and contact, +30 VE to the different terminal block board. This prevents activation of the relays to digital outputs before the signals have been properly arranged in connection with the connection of the supply. The contact also opens with computer malfunction.

Status indication on computer board YPP 105

Circuit diagram, sheet 29, upper right hand

The LEDs on YPP 105 for status indication have the following significances:

IOBUS	(yellow)	= I/O Bus connected.
MAST	(yellow)	= This circuit board is the "master" (double computer version only).
SOK	(green)	= System OK. Time interrupt handling functional.
STALL	(red)	= The programs are not completely executed.
BERR	(red)	= Computer bus fault.
HALT	(red)	= Computer has ceased execution.
POK	(green)	= Program OK. Not used in Tyrak L.
FAULT	(red)	= Not used in Tyrak L.
SOUT	(yellow)	= Data transmission to operator's panel on the door.
SIN	(yellow)	= Data transmission from operator's panel on the door.

CONTROL PROGRAMS

Tyrak L convertors are delivered with an individually adapted control program.

The program is divided into function modules. Basic functions such as current control and protection are always included whereas other, drive-specific functions are ordered with the help of the "**Technical appendix to the order**". Before delivery, all of the function modules are linked together to form a complete control program which is read into the convertor memory.

Special function can be developed in PRIDE, (Programmable Industrial Drive Electronics), a programming language developed by ABB Drives for motor drive application.

The software is stored in a semiconductor memory. All memory packages are mounted on a special circuit board, the memory unit. The memory board is located above the computer board and is connected with a board-to-board contact. This means that any of the other circuit boards can be replaced without affecting control programs or parameter values set. The program functions are stored in memories of EPROM type and parameter values in EEPROM. Both of these retain their information in the event of a loss of voltage. Parameter values can be changed during operations.

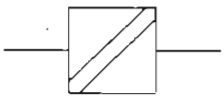
Error signals and log values are stored in a RWM with voltage backup to retain its contents for a week following a loss of power.

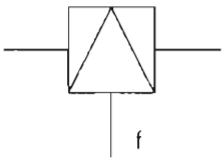
Function modules

The function modules are described in detail in separate documents. See "**Descriptions of function modules**".

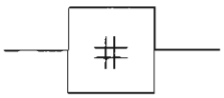
DIAGRAM SYMBOLS (from 2000 808-21, sheet 1)

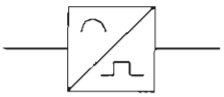
General symbols

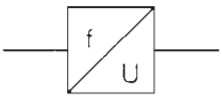

Galvanic isolation



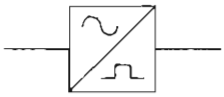
Modulator

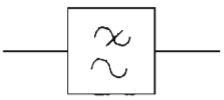

General symbol in digital systems

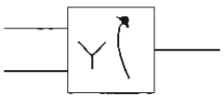

Convertor from an analog signal to pulses



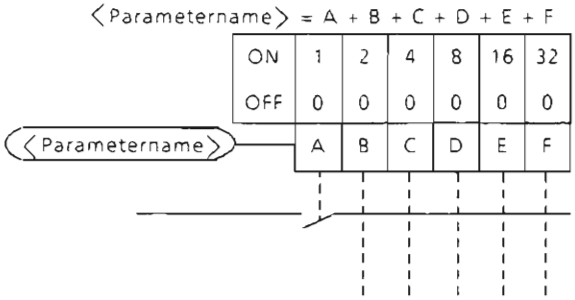
Convertor from frequency to voltage


Convertor from a sine wave signal to a square pulse


Low-pass filter

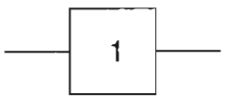


Clockwise phase sequence makes output = "1"

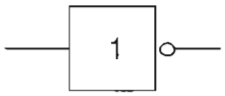


To unpack a compressed integer value to two or more boolean parameters. Above is shown a symbol with six sections (= six boolean parameters), there for example section A is controlling a signal switch.

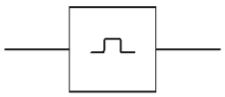
Logical elements

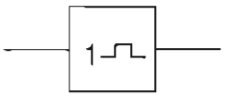


Buffer

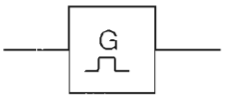


Logic inversion

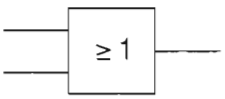

Monostable element
Possible to re-trigger



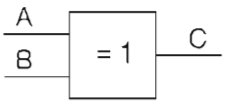
Monostable element
Not possible to re-trigger



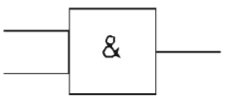
Pulse generator



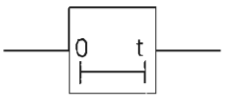
OR-gate



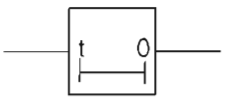
Exclusive-OR. C = "1", when only one of the inputs is "1".



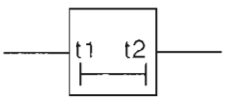
AND-gate



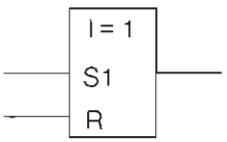
Time delay element
Time delay when changing to "0"-position.



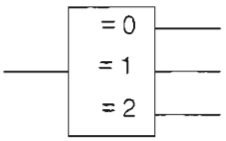
Time delay element
Time delay when changing to "1"-position.



Time delay element
Time delay t1 when changing to "1"-position and t2 when changing to "0"-position.



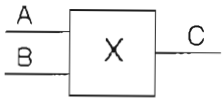
SR flip-flop with SET-signal dominating. At supply connection (Init) the output goes to "1".



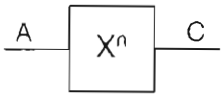
When input has any of values 0, 1 or 2, corresponding output is "1".

DIAGRAM SYMBOLS (from 2000 808-21, sheet 1)

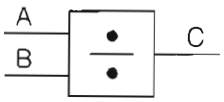
Arithmetical elements



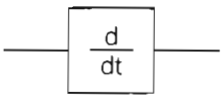
Multiplier
$A \cdot B = C$



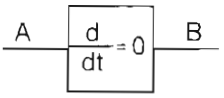
$B = A^n$ with $n = 2, 3, \ldots$



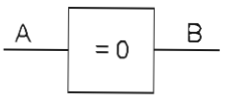
Division
$\frac{A}{B} = C$



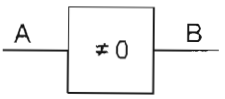
Derivating function.



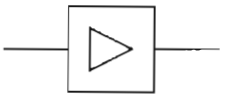
$B = "1"$ when $\frac{dA}{dt} = 0$



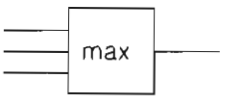
$B = "1"$ when $A = 0$



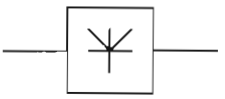
$B = "1"$ when A is not zero



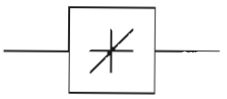
Amplifier



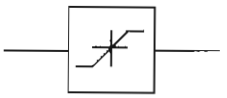
Max. value generator



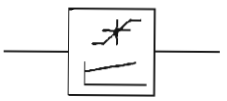
Absolute value generator



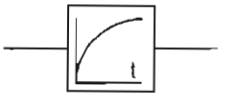
Linear amplifier



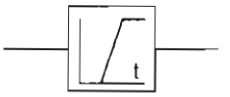
Linear amplifier with positive and negative limitation



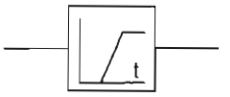
PI-controller
Linear type with limitation



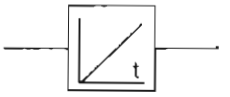
Element with time constant



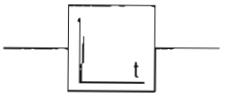
Function generator with limitation.



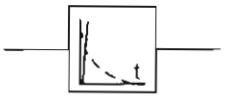
Ramp function



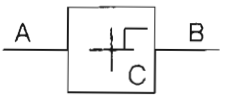
Integrating element



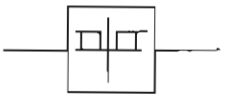
Derivating element



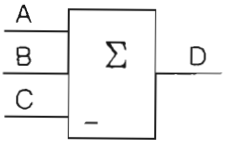
Derivating element with time constant



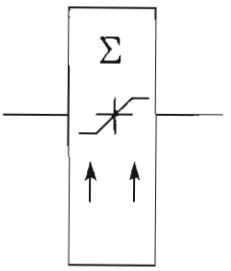
Level detector which makes $B = "1"$ when $A > C$.



Symmetrical level detector with hysteresis



Summation element
$D = A + B - D$



Summation element with limitations

DIAGRAM SYMBOLS (from 2000 808-21, sheet 2)

Signal symbols

NREFG — Output signal NREFG with data size F2 (2 byte "fraction") Available for operator's panel

N12.F2 NFEEDBPT — Output signal NFEEDBPT with data size 12.F2 (2 byte "integer" and 2 byte "fraction") Not available for operator's panel

(POSSMAX) — Output signal with data size F2 (2 byte "fraction") Not available for operator's panel.

DO33.1 — TRIPPED ← Signal switch-box.

In this example the digital output board in pos. 33 channel 1 is connected to the software signal TRIPPED.

AOTEST — Parameter
Setting value can be changed from operator's panel.

~~NREF1S~~ — Parameter
Setting value can only be changed from a data terminal.

NREF1S — Parameter
Setting value can only be changed from a data terminal.

Remaining symbols

Closing contact

Breaking contact

Closing function

Breaking fuction

Change-over function

Control switch withautomatic return

Control switch without automatic return

Relay with closing contact which is time delayed at opening.

Jumper contact

Terminal

Soldering pin

Disconnectable terminal with test points on both sides of the isolator

DIAGRAM SYMBOLS (from 2000 808-21, sheet 2)

Remaining symbols (cont.)

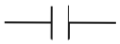

Test point, made as a cage device. Also used as a general symbol.

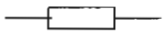

Test point, made as a pin device

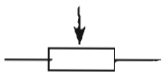

Earth (Ground)


Conductor with screen

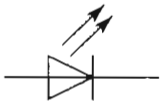

Twisted conductor.


Capacitor


Resistor

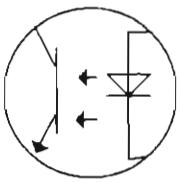

Potentiometer

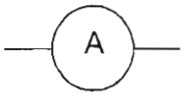

Semi-conductor diode


Light emitting diode (LED)

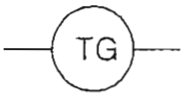

Voltage regulator diode


Signal lamp.
General symbol


Opto-switch



Indicating instrument, shown as A-meter



Tachometer generator

ASEA BROWN BOVERI

ABB Drives AB
Power Electronics Division
S-721 75 Västerås Sweden
Telephone: Int + 46 21 34 00 00
Telecopier: Int + 46 21 18 36 39
Telex: 40843 ABBDRI S

Information YT 280-302 E
Reg. no. 4890 066-332
901212, Edition 3

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ABB Drives AB Dept. DFA

7630 022 - 1

START / STOP logic

Tyrak L
System description general drives
880607

Introduction

Characteristic of the program function modules for the control equipment, general drive systems (see guiding drawing, 4893 1004-AKK), is that each program module contains a complete function; hence the designation program function module. This means that each module contains the necessary logic and control circuits to perform a specific control function.

The basic idea behind the function concept is that it should be possible to compose a total control system of existing modules and the necessary mutual interlockings and similar are to be included in these.

The logic for a simple system with one reference unit only, the increase/decrease unit (NINDE1) is described below but the interlockings in relation to other reference units will be discussed.

Sequence modes - divided and undivided start sequences

In the sequential control for general drive systems, reference units (such as the increase/decrease unit NINDE1), sequential control unit drive system (SEQST), mechanical brake control unit [BRMEC (option)] and sequential control unit convertor (SEQCON) interact. See Fig. 1.

There are four sequential modes in SEQCON, controlled by the parameter SEQMODE.

SEQMODE				Activities in the start sequence
"0"	"1"	"2"	"3"	
START	ON	ON	ON	Fans on
START	START	ON	ON	Field on
START	START	START	ON	Main contactor on
START	START	START	START	Release
STOP (OFF)	STOP (OFF)	STOP (OFF)	STOP (OFF)	Blocking
STOP (OFF)	STOP (OFF)	STOP (OFF)	OFF	Main contactor off
STOP (OFF)	STOP (OFF)	OFF	OFF	Field off
STOP (OFF)	OFF	OFF	OFF	Fans off

Table 1. Activities in the start sequence executed when START/STOP and ON/OFF are commanded.

The convertor is prepared for running if the signal RDYRUN = "1" in the function module SEQCON.

In SEQMODE = "0", a so-called undivided start sequence, RDYRUN = "1" as soon as the auxiliary voltage of the convertor is switched on, no fault has been detected (TRIPPED = "0") and the switch-off relay is active (OFF1 = "0"). In SEQMODE = "1", "2", "3", which means divided start sequences, it is also required that the command ON has been given.

A divided start sequence is intended for use in systems in which certain basic functions have an excessively long start-up time in relation to more important process requirements or where forced cooling of the convertor and d.c. machine is required while the armature circuit remains without voltage.

The principles of ON and OFF

· **ON**
The ON-signal (ON2) is used only in divided start sequences. (See section "Sequence modes").

The condition for acknowledgement of an on-command (RDYRUN = "1") is
- No external off-command.
  The signals OFF1 and OFF2 must be "0".

- No interlocking.
  The signal INLKRES (Interlocking resetting) must be "0". INLKRES is "1" when there is a start command to the convertor. But for this condition, the equipment would start when switched on. This could be dangerous for the operating personnel. (The delay of 5 s of INLKRES is only of interest with an undivided start sequence).

· **OFF**
The off signal (OFF1/2) can be used at any time. Off always means immediate retardation (RDYREF = "0") reference disconnection [RDYRUN, (RDY2RUN), RDYREF and RDY2REF become "0"] and switch-off of fans, field and main contactor i.e. running down.

With an undivided start sequence and continuous external start signal, an off-pulse is sufficient. The signal INLKRES prevents switch-on of fans etc when RDYRUN and START1 become "1" again.

The START and STOP principle

In Tyrak L drives, it is possible to have an undivided start sequence in a double convertor. If, in that case, the stop button is pressed, regenerative braking to zero-speed and subsequent retardation and switch off of fans, field and main contactor are obtained.

· **START**
Start conditions:
A start command is given via the increase/decrease unit NINDE1. If it is permitted to start the equipment via NINDE1, the signal START2C becomes = "1".

The following conditions must be satisfied.
- No external stop command.
  The input signals NIDSTOP (Stop local), STOP, STOPFAST and EMSTOP (Emergency stop) must be "0". External stop-pushbutton is normally closed (for example STOP_N, EMSTOP_N), but these signals can be inverted by the software in the digital input modules.

- Drive system prepared to run.
  Signal RDY2RUN = "1" means that the drive system is prepared for running. A precondition for this is that the convertor is prepared for running (RDYRUN = "1" in function module SEQCON). RDYRUN either passes through the function module SEQST unaffected or a zero speed condition is added. If parameter N0INLKS = "1" in SEQST, RDY2RUN remains = "0" with a rotating machine (NGTN0 = "1") and retarded convertor (RDYREF = "0").

  In master/follower combinations, the function module SEQST is replaced by SEQMF and there is further processing of RDYRUN. This is described in more detail in separate documentation of general master/follower systems.

- No interlockings from other function modules
  TENSION and RUN are two selectable interlocking signals to avoid the risk of impermissible parallel running through several function modules. If these are selected and "1", START2C cannot become "1". (The output signal NINDEON from NINDE1 corresponds to TENSION and RUN).

- Release command
  When START2C = "1", START1 becomes "1". If a mechanical brake is included (function module BRMEC) parameter BRMECS is = "1" in function module SEQCON. Depending on whether it is a pulling load or not, the brake release time etc., a number of conditions are generated in function module BRMEC before the signal STARTBR = "1". (See description of function module BRMEC")

  The start command (START1 or STARTBR) to function module SEQCON is acknowledged by the output signal RDYREF becoming "1".

- Reference connection
  RDYREF = "1" permits release of the current controller IACTRL to receive a current reference, IAREF1.

  RDYREF = "1" passes through function module SEQST and only changes name to RDY2REF (In coordinated drive systems, conditions must be generated for RDY2REF to become "1").

  RDY2REF = "1" releases the speed controller NCTRL and connects the speed reference NREF6 in function module NINDE1.

  The speed can now be controlled with the increase/decrease pushbuttons REF + and REF– on the operator's panel.

- STOP
  Stop is obtained when any of the signals NIDSTOP (stop local), STOP, STOPFAST or EMSTOP (emergency stop) becomes "1".

- Reference disconnection
  Directly after a stop command is issued, the signal START2C becomes "0" and the speed reference is disconnected i.e. NREF6 becomes 0 (zero).

  a) Stop without braking
     If the zero speed condition in the function module SEQST is not selected (parameter N0STOPS = "0") START1 becomes = "0" when START2C = "0".

  b) Stop with braking
     1) If the zero speed condition in function module SEQST is selected (parameter N0STOPS = "1") START1 remains "1" until signal NGTN0 = "0" (still-standing motor). If the equipment is a double covnertor, the d.c. machine will be braked to standstill, regeneratively. The signal START1 then becomes = "1" and the mechanical brake (if provided) can be applied.

     2) If function module BRMEC is included, both regenerative and mechanical braking is possible with an emergency stop. The braking is regenerative to a speed determined by parameter BMNFALL. When the speed actual value NACT is less than BMNFALL, the mechanical brake is applied.

     3) If function module BRDYN is included, dynamic braking is possible (resistor braking) with an emergency stop, see description of "**Function module BRDYN**".

- Retardation
  When START1 becomes "0", it is dependent on whether mechanical brake is included (parameter BRMECS = "1") or not (parameter BRMECS = "0"). The control principle of STARTBR with pulling load etc is described in a separate description of function module BRMEC. When START1 or STARTBR = "0", RDYREF becomes "0". The convertor is retarded.
  RDYREF = "0" gives retardation of the current controller IACTRL.
  RDYREF = "0" also gives retardation of the speed controller NCTRL and in function module NINDE1, the output signal NINDEON becomes = "0".

The stop sequence is now completed and earlier interlocked reference units (such as REFGEN or REFAD) can now be operated if required.

Interlocking of deblocking

- INLKRES/A/B/C
  The signal INLKRES is "1" as long as there is a start command to the convertor. When INLKRES = "1", two possibilities are prevented (See function module SEQCON).

  1) With a divided start sequence, the convertor cannot be switched on.

  2) If the convertor has tripped (TRIPPED = "1") the convertor cannot be reset with the signal RESET.

If it were possible to switch on or to reset the convertor, it would start automatically when RDY(2)RUN becomes "1". This would be dangerous for the operating personnel.

With an undivided start sequence, it is necessary to delay INLKRES for 5 s for START1 or STARTBR to have effect before the INLKRES interlocking.

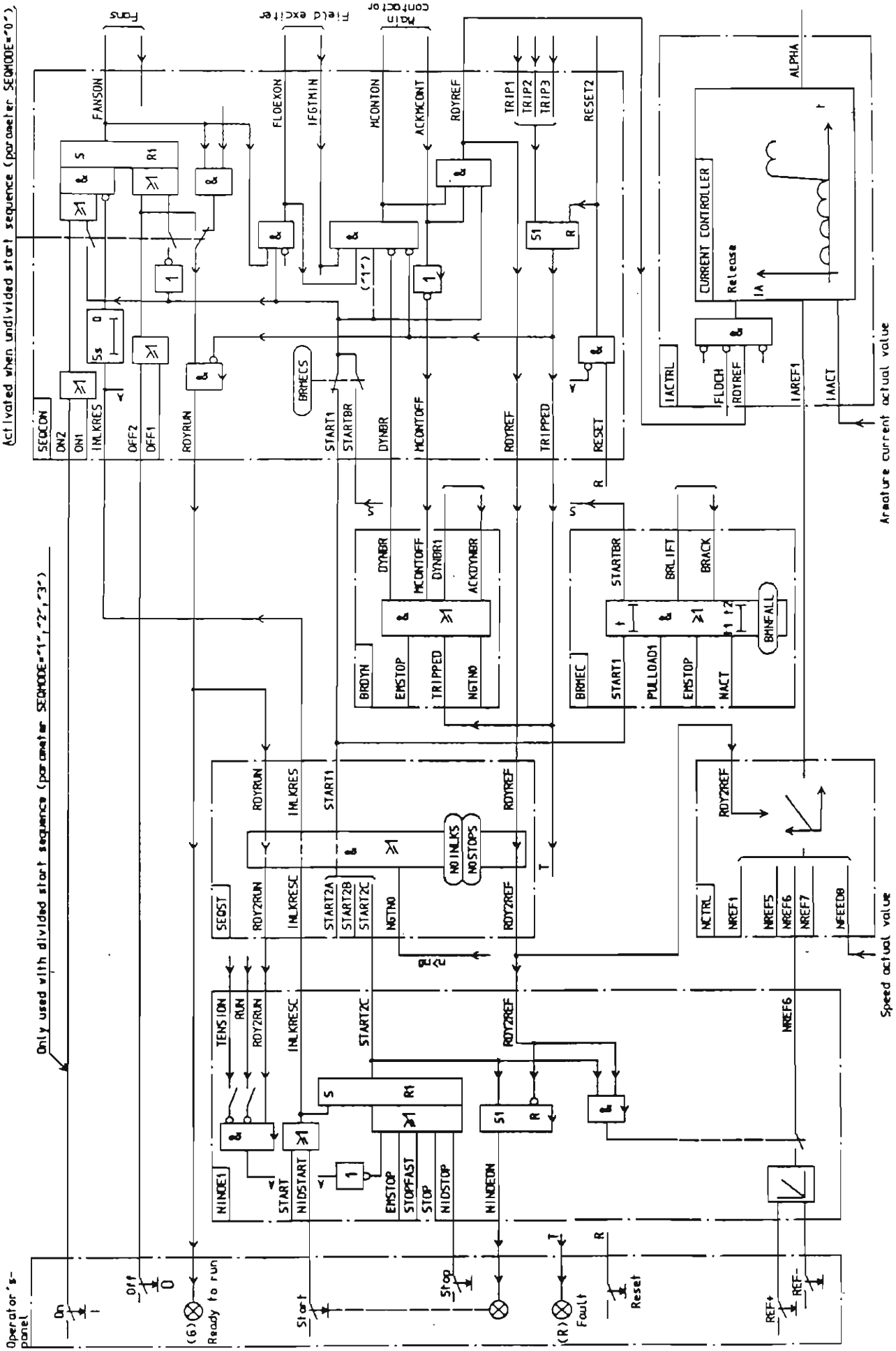


Fig 1. START/STOP logic
(2000 808-10/10).

PRIDE
Description of function module

AIN342X
Analog input

Applies to all board locations but exemplified here with board position number 34

Reference

This document is related to current software diagram for functional modules of TYRAK L/MIDI.

Item designations of functional blocks referred to in this documents as well as delivered preset values and selection rules of parameters can in most cases be found in current software diagram.

Function description

The function unit of which this module is a part is used to connect external analog signals to the convertor control equipment. Up to four signals can be connected to each input unit.

The function unit consists of function module AIN342X and two circuit boards connected with ribbon cable, one on the control unit (YPG 110) and one on the terminal block unit (YPG 106).

The input signals can be ±1 V, ±10 V, 0 - 20 mA or 4 - 20 mA.

The voltage level is selected with the straps S1-S4 on YPG 110 which give an input resistance of 100 kohm for 1 V and 1 Mohm for 10 V. The resolution is 11 bits plus sign (0.05 %) for both 1 V and 10 V. The input resistors have a tolerance of ±0.1 %. The total temperature drift of the input unit is ≤0.005 % / °C.

At current input, the 10 V range is normally used and a current shunt of 500 ohm is connected with the jumpers S1-S4: 1-2 on YPG 106. If compensation to zero of the 4 mA signal level is required already in the input unit, parameter AI34MODE can be set affecting every channel individually.

The time constant 10 or 25 ms can be selected individually for each channel.

The input signal is isolated from the control equipment by means of a differential amplifier ("Common Mode" tolerance 100 V) and converted to digital form in an A/D convertor.

The unit also contains a voltage divider for an analog tachometer signal with buffer amplifier for external instrument (max. 5 mA), current generator (5 mA) for supply to Pt 100 elements and a reference voltage source ±10 V (max. load 5 mA). The board function is monitored and malfunction is indicated by the LED, "FAULT" on YPG 110 and faultsignal HWF10.34.

Function module AIN342X

The parameter AAI34 is set to "1" if the unit is to be connected. If parameter AAI34 is set to "0" the unit is disconnected and the LED "FAULT" lights continuously.
The input signals are conducted further through this function module to the corresponding signals in the control program. The input channels (parameters AI34.1 to AI34.4) are connected to the control signal with the help of a signal switch-box which is described in **"Operator's panel management"**.

Channels 2 and 3 can be multiplied with a scale factor set with the parameters AI34.2MU and AI34.3MU respectively.

Parameter descriptions

AAI34 ("0", "1")		Attach Analog In 34. AAI34 = "0", function module AIN341X not used and cards YPG 106 and YPG 110 can be omitted. AAI34 = "1", function module AIN341X connected.
AI34MODE (0-32767)		Analog In 34MODE. Selection of working range for channels 1-4.
AI34.(2-3)MU (–16.000 - +16.000)		Analog In 34.(2-3) MUltiplier. Scaling of channel (2-3).

Signal list

The sample levels (T1-T4 and INIT) are defined in the function description of module TSYSXXX.

HWF10.34 ("0", "1")	INIT	HardWare Fault 10.34. Hardware fault on board YPG 110, board position 34. Fault text "ANALOG INPUT YPG 110"

Signal switch-box

AI34.(1-4)	T2	Analog In 34.(1-4). Selection of signal to channel (1-4).

PRIDE
Description of function module

DIN112X
Basic digital input

Reference

This document is related to current software diagram for functional modules of TYRAK L/MIDI.

Item designations of functional blocks referred to in this documents as well as delivered preset values and selection rules of parameters can in most cases be found in current software diagram.

Function description

Introduction

The function unit of which this module forms a part is used to connect up to six digital input signals to the convertor control equipment.

Function

The function unit consists of the following:

- Part of connection board YPQ 10 on the terminal block unit.
- Part of the control board YPQ 101 on the control unit.
- Function module DIN112X.

See the circuit diagram. The connection board is normally delivered as YPQ 104 which has a signal level 110 V (d.c. or a.c.) but versions for 24 V, 48 V or 220 V are also available. The 24 V and 48 V versions accept only d.c. voltage, but the 110 V and 220 V versions also accept 50/60 Hz a.c. voltage. The input resistors (R1 - R6) can be changed to permit individual adaptation of the voltage level for each input channel. The resistors are mounted, easily accessible on solder posts. An active input is indicated by the illumination of a LED on the connection board, with one separate LED for each channel.

The neutral of the optocouplers is accessible at terminal block B50.11.X1.3,4. The neutral is grounded at the supply transformer 56. See sheet 82 in the circuit diagram. Supply voltage for external contact is available at terminal block B50.11.X1.1,2. The voltage level can be selected with solder straps W1-W3:

- W1 closed gives 24 V d.c.
- W2 closed gives 110 V a.c. 50/60 Hz.
- W3 closed gives 220 V a.c. 50/60 Hz.

The six input channels on board YPQ 104 are connected to the control board YPQ 101 via ribbon cable. The inputs are galvanically isolated from the control equipment by means of optocouplers on control board YPQ 101.

The six input channels from the circuit boards are connected to the corresponding number of inputs in the function module DIN112X. The parameter DI11INV is used to change sign individually for each channel

A so-called signal switch-box (parameters DI11.1 to DI11.6) is used to connect an input channel to the required signal in the control program. The signal switch-box is programmed via the operator's panel and is described in more detail in "**Operator's panel management**".

Relay -AK1.K1 (see circuit diagram) is a switch-off relay which is activated during normal operations. When an external switch-off is commanded, the relay drops out, its contact 13-14 E opens instantaneously and channel 2 on YPQ 104/YPQ 101 becomes "0" and module DIN112X gives an output signal OFFREM = "1", if DI11INN is set so channel 2 is inverted. This means that an instantaneous off-command is obtained via the software. For extra safety, the delayed (0.5 s) contact -AK1.K1.57-58 will open and give a hardware switch-off.

Relay - AK1.K2 is an emergency stop relay which is active during normal operations. In the event of an external emergency stop command, the relay drops out, its contact 13 - 14 opens instantaneously and channel 1 on YPQ 104/YPQ 101 goes to "0" and the module DIN112X gives the output signal EMSTOPA = "1" if DI11INV is set so channel 1 is inverted. After a delay (preset to a time somewhat longer than the time taken to brake the motor to standstill) the relay contact 57 - 58 opens to give an instantaneous off command via the relay AK1.K1 in accordance with the description above.
Function module DIN112X consists of six digital inputs. Inputs DI11.(1-5) are executed on sample level T4 (slow execution, usually between 90 - 200 ms, depending on the application). Input DI11.6 is executed on sample level T2 (fast execution usually between 6 - 12 ms).

Parameter description

DI11INV (0-32767)	Digital In 11 INVerse. Selection of inversion on/off for each individual channel 1-6.

Signal list

The sample levels (T1-T4 and INIT) are defined in the function description of module TSYSXXX.

HWF03 ("0", "1")	INIT	HardWare Fault 03. Hardware fault on the board YPQ 101, board position 11.

Signal switch-box

DI11.(1-5) **DI11.6**	T4 T2	Digital In 11.(1-6). Selection of signal to channel 1-6. DI11.(1-6) is set to the signal concerned.

PRIDE
Description of function module

DIN322X
Digital input

Applies to all board locations but exemplified here with board position number 32

Reference

This document is related to current software diagram for functional modules of TYRAK L/MIDI.

Item designations of functional blocks referred to in this documents as well as delivered preset values and selection rules of parameters can in most cases be found in current software diagram.

Function description

The function unit of which this module is a part is used to connect external digital signals to the convertor control equipment. Up to eight signals can be connected to each input unit. The function unit consists of function module DIN322X and two circuit boards connected with ribbon cable, one on the control unit (YPI 103) and one on the terminal block unit (YPI 105).

Terminal block board YPI 105 is available in a number of variants, depending on the voltage level of the input signals. The normal version is YPI 105C, for 110 V signal level, but versions for 24 V, 48 V or 220 V are also available. For 24 and 48 V, d.c. voltage must be used but with 110 and 220 V, the inputs also withstand 50/60 Hz a.c. voltage. By changing the relevant input resistor on the board, it is also possible to adapt the voltage level individually for each input channel. The resistors are easily accessible, mounted on solder posts.

An active input is indicated by the illumination of a LED on the terminal block board YPI 105. The signal is galvanically isolated from the control equipment via optocouplers, the function of which is continuously monitored by the computer.

The board function is monitored and malfunction is indicated by the LED on YPI103 and fault signal HWF08.32.

Function module DIN322X

Parameter ADI32 is set to "1" if the unit is to be connected.

The eight input channels from the circuit boards are connected to eight inputs in the function module DIN322X. It is possible to select individual change of the sign of the input signal for each channel with the help of a selector, parameter DI32INV.

A so-called signal switch-box is used to connect an input channel to the required signal in the control program. This is a menu which is shown on the operator's panel where a certain input channel (parameter DI32.1 to DI32.8) can be connected to a particular signal name. This function is described in more detail in "**Operator's panel management**".

The execution time for all inputs in function module DIN322X is T4 (90 - 200 ms, depending on the application).

Parameter descriptions

ADI32 ("0", "1")	Attach Digital In 32 ADI32 = "0", function module DIN322X is not used. ADI32 = "1", function module DIN322X is connected.
DI32INV (0-32767)	Digital In 32 INVerse. Selection of inversion on/off for channel 1-8.

Signal list

The sample levels (T1-T4 and INIT) are defined in the function description of module TSYSXXX.

HWF08.32 ("0", "1")	INIT	HardWare Fault 08.32. Hardware fault on board YPI 103, board position 32.

Signal switch-box

DI32.(1-8)	T4	Digital In 32.(1-8). Selection of signal to channel (1-8). DI32.(1-8) is set to the signal concerned.

DOUT111X
Basic digital output

Reference

This document is related to current software diagram for functional modules of TYRAK L/MIDI.

It designations of functional blocks referred to in this documents as well as delivered preset values and selection rules of parameters can in most cases be found in current software diagram.

Function description

Introduction

The function unit of which this module forms a part permits the transmission of two digital signals from the convertor control equipment.

Function

Function module DOUT111X is one part of this function unit which consists of the following:

- Part of connection board YPQ 104 on the terminal block unit.
- Part of control board YPQ 101 on the control unit.
- Function module DOUT111X.

See circuit diagram. The connection board YPQ 104C is normally delivered, but in all versions A, B, C or D, the outputs are galvanically free relay contacts which can be loaded with 5A, 250 V a.c. or 30 W, 250 V d.c. An active output is indicated by illumination of a LED on the connection board.

The two output channels on board YPQ 104 are connected to the control board YPQ 101 by ribbon cable. The relay coils are galvanically isolated from the control equipment by means of opto-couplers on YPQ 101.

The two output channels from the circuit boards are connected to two outputs in function module DOUT111X. Reversal of the sign of the output signal can be selected individually for each channel with the help of the parameter DO111INV.

A so-called signal switch-box (parameters DO11.1 and DO11.2) is used to connect a signal in the control program to an output channel. The signal switch-box is programmed via the operator's panel and is described in more detail in **"Operator's panel management"**.

The execution time for both outputs in function module DOUT111X is T3 (25 - 50 ms depending on the application).

Parameter descriptions

DO111INV (0-32767)		Digital Out 11.1 INVerse. Selection of inversion on/off for output.

Signal list

The sample levels (T1-T4) are defined in the function description of module TSYSXXX.

Signal switch-box

DO11.1		Digital Out 11.1.
	T3	Selection of signal to output channel 1. DO11.1 is set to the signal concerned.
DO11.2		Digital Out 11.2.
	T3	Selection of signal to output channel 2. DO11.2 is set to the signal concerned.

PRIDE
Description of function module

DOUT332X
Digital output

Applies to all board locations but exemplified here with board position number 33.

Reference

This document is related to current software diagram for functional modules of TYRAK L/MIDI.

Item designations of functional blocks referred to in this documents as well as delivered preset values and selection rules of parameters can in most cases be found in current software diagram.

Function description

The function unit of which this module is a part is used to transmit digital signals from the convertor control equipment. Up to eight signals can be connected to each output unit. The function unit consists of function module DOUT332X and two circuit boards connected with ribbon cable, one on the control unit (YPO 103) and one on the terminal block unit (YPO 104).

The outputs are electrically free relay contacts.
Continuous current max 5A.
Breaking current AC max 5A at 250 V cos $\phi \geq 0{,}4$.
Breaking current DC max 0,2 at 220 V, L/R $\leq$ 40 ms.
Breaking current DC max 0,3 at 110 V, L/R $\leq$ 40 ms.
Breaking current DC max 1,2 at 48 V, L/R $\leq$ 40 ms.
Breaking current DC max 1,2 at 24 V, L/R $\leq$ 40 ms.

An active output is indicated by the illumination of a LED (1-8) on the terminal block board. The board function is monitored and malfunction is indicated by the LED "FAULT" on YPO103, and faultsignal HWF09.33.

Function module DOUT331X.

Parameter ADO33 is set to "1" if the unit is to be connected. If parameter ADO33 is set to "0" the unit is disconnected and LED "FAULT" lights continuously.

A particular output signal from the control program (DO33.1 to DO33.8) is connected to the output channel signal with the help of a signal switch-box. This is programmed via the operator's panel and is described in greater detail in **"Operator's panel management"**.

Parameter descriptions

ADO33 ("0", "1")		Attach Digital Out 33. ADO33 = "0", function module DOUT332X is not used, and cards YPO103 and YPO104 can be omitted. ADO33 = "1", function module DOUT332X is connected.
DO33INV (0-32767)		Digital Out 33INVerse. Selection of inversion on/off for channels 1-8.

Signal list

The sample levels (T1-T4 and INIT) are defined in the function description of module TSYSXXX.

HWF09.33 ("0", "1")	INIT	HardWare Fault 09.33. Hardware fault on board YPO 103, board position 33.

Signal switch-box

DO33.(1-8)	T4	Digital Out 33.(1-8). Selection of signal to channel (1-8).

PRIDE
Description of function module

DSP2316X
Digital speed and position measurement

Reference

This document is related to current software diagram for functional modules of TYRAK L/MIDI.

Item designations of functional blocks referred to in this documents as well as delivered preset values and selection rules of parameters can in most cases be found in current software diagram.

Function description

Introduction

The module is used to calculate the speed actual value and to count pulses from incoming pulse transmitter signals. The signals are to be received in the form of 2 pulse trains displaced 90 ° in relation to each other.

Function module DSP2316X

The parameter ADIGSP31 is set to "1", if the unit is to be connected.
The module DSP2316X consists of two circuit boards, one on the control unit (YPH 105) and one on the terminal block unit (YPH 104). The boards are connected by ribbon cable. The connection unit YPH 104 contains 12 V- and 24 V-circuits for supply of the pulse transmitter and inputs for two separate measurement channels (for direction detection).

It also contains inputs for strobe pulse (0-pulse) and synch. pulse. The measurement channels can be set for 12 or 24 V voltage levels or for a 13 mA current signal. The maximum permitted frequency is 50 kHz.

The pulse train CHA_N (channel A) and CHB_N (channel B) from the input board are transmitted to function module DSP2316X where they are processed and converted to signals for speed actual value (NFEEDBPT) and position actual value (POSACT).

- **Speed measurement**
  Input board YPH 105 contains two counters; a pulse counter which counts pulse flanks from the pulse transmitter and a time counter which counts clock pulses from the processor board (YPP 105). The speed actual value NFEEPBPT is calculated in the following way:

$$NFEEDBPT(new) = \frac{PC(new) - PC(old)}{TC(new) - TC(old)} \times CONST$$

where: PC = contents of the register for pulse flanks
TC = contents of the register for clock pulses.

$$CONST = \frac{60 \times 65536 \times 10^7}{NBRPPR \times NBREDGES \times NMAX}$$

Maximum measureable speed is the lowest value of following three equations:

$$n_{max1} = \frac{50000 \times 60}{NBRPPR} \text{ rpm}$$

$$n_{max2} = 1.5 \times N100 \text{ rpm}$$

$$n_{max3} = \frac{60 \times 30719 \times 1000}{(NBRPPR \times NBREDGES \times T)} \text{ rpm}$$

$$n_{max4} = \frac{60 \times 4095 \times 1000}{(NBRPPR \times NBREDGES \times T)} \text{ rpm}$$

Note: n_{max4} is to be considered when hardware synchronization is used. where T = T2 + 1 ms.

If the parameters are set so too high speed can be reached, or if:
NBRPPR x NBREDGES > 65535
NBRPPR x NBREDGES x N100 > 24994200
NBRPPR x NBREDGES x N100 < 6120
the signal NFEEDBPT is set to it's maximum value. This calculation is including the setting of the over speed monitor (signal MOTOSPL).
The speed derivative must be lower than:

$$\frac{60 \times 2047 \times 1000000}{(NBRPPR \times NBREDGES \times T^2)} \text{ rpm/s.}$$

Minimum speed which can be measured is determined from the following equation:

$$n_{min} = \max \left\{ \begin{array}{c} \dfrac{60}{T2 \times NBRPPR \times NBREDGES} \\ \dfrac{NMAX}{32767} \end{array} \right\} \text{ rpm}$$

e.g. NMAX = 1000 rpm, NBRPPR = 1024, NBREDGES = 4, T2 = 15 ms gives:

$$n_{min} = \max \left\{ \begin{array}{c} 0.0010 \\ 0.031 \end{array} \right\} = 0.031 \text{ rpm}$$

Because of the data format used, the speed cannot be measured via signal NFEEDBPT on the display or analog output. The speed can instead be measured via the unfiltered signal NACTUN.

- **Position measurement**

With position measurement, a new position actual value is calculated with each sampling as follows:

POSACT(new) = POSACT(old) + {PCPOS(new) - PCPOS(old)}

where: PCPOS(new) = The number of pulse flanks read from the pulse counter with this sampling.
PCPOS(old) = The number of pulse flanks read from the pulse count with the immediately preceding sampling.

The synchronization is performed either program-controlled (PGMSYNC) from a superior control system or hardware-controlled in according with conditions determined by the parameter SYNCCOND. The program-controlled synchronization is relatively slow (delays in PC-program, in communication and in the superior program), whereas hardware controlled synchronization is considerably faster (direct input). The current regulation has however higher priority. With synchronization, POSACT(old) is set = PRECOUNT (see signal list). PCPOS (old) = PC with synchronization.

To use hardware synchronization, a jumper must be applied to position S4:2-3 on the computer board YPP105.

Hardware controlled synchronization can be interlocked with the signal INHESYNC from superior control. The synchronization is performed otherwise in accordance with conditions determined by parameter SYNCCOND.

The signal SYNCRDY is set to "1"when the synchronization is complete and can be reset with the signal RESYNCRY = "1".

As mentioned before the maximum puls frequency is 50 kHz. If the setting of parameter NBRPPR, N100 and MOTOSPL (in module SPMON3X) exceeds maximum puls frequency 50 kHz, the output signal NFEEDBPT will be set at maximum level, tripping the convertor for "overspeed".

Parameter description

ADIGSP31
("0","1")

Attach **DIG**ital **SP**eed 31.
ADIGSP31 = "0", function module DSP2316X is not used.
ADIGSP31 = "1", function module DSP2316X is connected.

NFEEDBTC
(0 - 32767)

N(rotation speed) **FEED** Back Time Constant.
Filter time constant for speed actual value NFEEDBPT. Permissible values are

$$0 \text{ and } \frac{T2}{8} \text{ to } 128 \times T2.$$

NBREDGES
(0-32767)

NumBReR of **EDGES**.
Number of edges on the two pulse trains that are used to create one count pulse on the YPM105.

NBRPPR
(0 - 32767)

NumBeR of **P**ulses **P**er **R**evolution.
The number of pulses per revolution from the pulse transmitter.

NMAX
(0 - 32767 rpm)

N(rotation speed) **MAX**.
Maximum operational speed i.e. the speed which is to correspond to 100 %. See description for Max and Min settings.

SYNCCOND
(0 - 32767)

SYNChronization **CON**Dition.
Condition for hardware synchronization (STROBE or SYNC) of the pulse counter in accordance with the table.
PGMSYNC has however higher priority.
Only values in the table is permitted.

Ext. signal		Wait for STROBE pulse (CHZ)	Direction		SYNCCOND
Pos edge	Neg edge		Forward	Backw	
x					1
	x				2
x		x			3
	x	x			4
		x			5
x			x		6
	x		x		7
x		x	x		8
	x	x	x		9
		x	x		10
x				x	11
	x			x	12
x		x		x	13
	x	x		x	14
		x		x	15

Signal list

The sample levels (T1 - T4 and BG) are defined in the function description of module TSYSXXX.

Input signals

CHA_N		**CH**annel **A_N**. Channel A from pulse transmitter. Hardware signal.
CHB_N		**CH**annel **B_N**. Channel B from pulse transmitter. Hardware signal.
INHESYNC ("0", "1")	T3	**INH**ibit **E**xternal **SYNC**hronization. Blocking of external synch. signal.
MOTOSPL (0.00 - 128.00)	BG	**MOT**or **O**ver**SP**eed **L**evel. Tripping level for high speed (16 bits, I1.F1).
PGMSYNC ("0", "1")	T2	**P**ro**G**ra**M** **SYNC**hronization. Program-controlled synchronization of the increment added to the pulse counter.
PRECOUNT $[-2^{31} - +(2^{31}-1)]$	T2	**PRE**set value pulse **COUNT**er.
PTSIGNSW ("0", "1")	T2	**P**ulse **T**ransmitter **SIGN** **SW**itch. PTSIGNSW = "1" gives sign change of position actual value.
RESYNCRY ("0", "1")	T3	**RE**set of **SYNC**hronization **R**ea**dY**. Resetting of output signal SYNCRDY.
STROBE ("0", "1")		**STROBE** Pulse. Strobe pulse (one per rev.) from pulse transmitter. Hardware signal.

Output signals

HWF07.31		**H**ard **W**are **F**ault **07.31**. Hardware fault 07: "Digital speed measurement unit YPH 105" at board position 31. No sample time is defined.
NACTUN (−100.00 - + 100.00 %)	T2	**N**(rotation speed) **ACT**ual **U**nfiltered. Speed actual valve, always unfiltered.
NBREDGES (0 - 32767)	BG	**N**um**B**e**R** of **EDGES**. See parameter NBREDGES.
NBRPPR (0 - 32767)	BG	**N**um**B**e**R** of **P**ulses **P**er **R**evolution. See parameter NBRPPR.
NFEEDBPT (−32767.9999 - +32767.9999)	T2	**N**(rotation speed) **FEED** **B**ack **P**ulse **T**ransmitter. Speed actual value (32 bits; format I2. F2). Used as feedback in speed regulation. Can measure values to 150 % of N100.
NMAX (0 - 32767 rpm)	BG	**N**(rotation speed) **NMAX**. See parameter NMAX.
POSACT $[-2^{31} - +(2^{31}-1)]$	T2	**POS**ition **ACT**ual value. Position actual value, expressed in number of pulses. (32 bits, format I4).
SYNCRDY ("0", "1")	T2	**SYN**Chronization **R**ea**DY**. Synchronization of pulse counter completed.

PRIDE
Description of function module

ECURM3X
Earth current monitor

Reference

This document is related to current software diagram for functional modules of TYRAK L/MIDI.

Item designations of functional blocks referred to in this documents as well as delivered preset values and selection rules of parameters can in most cases be found in current software diagram.

Function description

Introduction

As the detection of earth faults is based on the measurement of the total current at the connection point of the convertor to the mains, only earth faults which give rise to a current will be detected, i.e. either in a network with a low impedance earthed neutral or with a second earth fault.
A first earth fault in a high impedance earthed network can only be detected with a voltage-measuring earth fault monitor.

The current-measuring monitor is particularly suitable in large installations with many convertors connected to a common supply mains. At a second ground fault, the drive system in which the fault has occurred is indicated. The error signal is given when the earth current becomes excessive.

Function.

Earth faults are detected by measurement of the current from one or three current transformers. The total sum of the currents from the three phases is transmitted via board YPQ 103 or YPQ108 to board YPQ 101 where the response signal is rectified in block **A1**. The analog output signal from **A1** is monitored by the level flip-flop **A2** which gives an output signal "1" from YPQ 101 if the level becomes too high.

The parameter EARTHCUR in the function module ECURM3X determines the level at which the status of flip-flop **A2** changes. If **A2** signals "1", the flip-flop **L1** is set after a time delay = EARTHTIM in the timer **T1**.

The signal for earth fault (EARTHFLT) is processed in function module TRIP1 where it is determined if a warning is to be given or if the convertor is to be tripped.

Parameter descriptions

EARTHCUR (4 - 12 A)	**EARTH CUR**rent. Level of earth fault current which gives a warning signal or tripping of the convertor.
EARTHTIM (0 - 32767 ms)	**EARTH** fault **TIM**e delay. Time delay for tripping of the convertor at earth fault.

Signal list

The sample levels (T1 - T4) are defined in the function description of module TSYSXXX.

Input signal

RESET2 ("0", "1")	T2	**RESET 2**. RESET2 = "1" resets the error signal EARTHFLT from "1" to "0" if the earth fault not remains.

Output signal

EARTHFLT ("0", "1")	T2	**EARTH FauLT**.

PRIDE
Description of function module

FLTLOG7X
Fault logger

Reference

This document is related to current software diagram for functional modules of TYRAK L/MIDI.

Item designations of functional blocks referred to in this documents as well as delivered preset values and selection rules of parameters can in most cases be found in current software diagram.

Function description

The fault logger starts if any of the fault signals in the fault signal list is set to "TRUE". First fault and additional fault, which occures within 95 ms, are indicated in the fault logger. Additional fault signals are blocked until a reset order is to be executed on the fault logger.

For some signals there is a possibility to select warning or trip function. The signals are:
ARMHLW
ARMOLF
ARMRPLF
CFANOLF
EFLTF
EXFANOLF
EXFLTD1X
EXFLTD2X
EXFLTD3X
HWF06AF
HWF06BF
LNK31FX
LNK32F
LNK37F
LNK36FX
MOTHT1W
MOTHT2W
THYHTW
TQFLTF

The selection, if a signal shall be used as a warning or a trip signal, is done in other modules.

Signals which are classified as warnings will reset the fault logger automatically if TRIPPED = "0".

All fault signals, classified as error signals, will not reset the fault logger because TRIPPED = "1". Reset must be done by setting the reset order (FRESET = "1"). The signal L__TRIGG is set at the time the first fault is to be detected. This signal trig the signal logger. (The signal logger is also started by the fault signals).

If the parameter FCLEAR is set to "1" all error messages are erased.

The fault logger counter can handle maximum 99 errors. Then it starts at 01 again.

All signals are updated on T2 sample level.

IACTRL7X
Armature current control

Reference

This document is related to current software diagram for functional modules of TYRAK L/MIDI.

Item designations of functional blocks referred to in this documents as well as delivered preset values and selection rules of parameters can in most cases be found in current software diagram.

Function description

Introduction

The function module includes armature current control, from current reference to gate pulses and supervision of the supply voltage and armature current.
Signals written with lower case letters in the circuit diagram are internal. External signals are written with capital letters.

Armature current control

The current controller is completely digital and uses a predictive control algorithm.

The predictive control algorithm is based on a mathematical model which, based on the current situation predicts the future appearance of the armature current. A delay angle can be calculated with the help of this prediction, the actual value and the reference. This results in superior control performance during both continuous and discontinuous current.

The first current pulse after a reference change is already in principle the value required. This leads in turn to superior speed control with exceptional dynamic properties which can counter-balance mechanical deficiencies in the system such as shaft torsion or back-lash. The module includes an option to preset a slower and more stable control function via the parameter IAGAIN.

The current controller can be tuned with the parameters specified in the rectangle CURRENT CONTROLLER (A1). The parameters CONSTCON and CONSTRL gives a motor model. CONSTCON is in proportion to inductive plus resistive voltage drop. CONSTRL is in proportion to the ratio between resistive and inductive voltage drop. Detailed instructions for trimming are provided in the manual, chapter **"Commissioning"**.

The current controller contains functions for blocking gate pulses and polarity reversal and can be used for both single and double convertors. The decision is made by the parameter IADOUBLE.

Before polarity reversal in a double convertor is done, zero current must be detected in the conducting thyristor bridge before the pulses in this may be blocked. The level detector A8 monitors the actual value of the current. The output signal from A8 goes via the jumper X10:3-4 to the controller A1. If a double convertor is used as a field exciter, A8 cannot be used for current indication. X10:1-2 is then connected instead and a reverse or off-state voltage testing device is connected via the signal BLKVOLT.

When the new thyristor bridge is deblocked after a polarity-reversal, the controller normally starts with a delay ange = BETALIM. This gives an unnecessarily long zero current interval. To avoid this, voltage adaptation can be performed via the signal EMFACT or NACT. The e.m.f. actually measured. EMFACT, is used in field-weakening systems while the signal NACT is used in system with field current fixed.

The controller now calculates a delay angle which corresponds to the current e.m.f. voltage. If the current thereby obtained is too great for the process, the angle calculated can be increased with a value given by the parameter ALPHAADJ.

With this method, the reversing time for a double convertor is approximately 5 ms.

When the field current is constant and there is no real measurement of the e.m.f. voltage, the signal EMFVOLT can still be used for voltage indication on, for example, the display.

The armature voltage can be limited with the help of parameters ALPHALIM and BETALIM (A2). ALPHALIM limits the armature voltage in the rectifier range and BETALIM in the inverter range.

It is also possible to introduce a variable limitation controlled by the armature current. BELIMMAX is selected so that current corresponding to the highest current limitation level can be commutated. BETALIM can now have a lower value to permit control down to a low armature current even with high EMF voltage. Variable BETA limitation is only needed with a weak mains when the limitation has a relatively high value.

Current reference smoothing

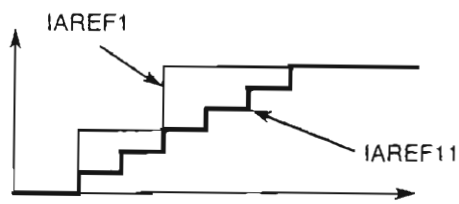
The signal IAREF11 is a smoothed IAREF1 signal.
The signal IAREF1 is generated at level T2 in other modules. A9 is calculating the increment to the ramp A10 as:

$$\frac{(\mathrm{IAREF1} - \mathrm{IAREF11})}{\mathrm{Integer}\left[\frac{T2}{I1} + 1\right]}$$

where **T2** is the sample time T2 (see TSYSxxxx module) and I1 is

$$\frac{1}{(\mathrm{FREQNOM} \times 6)}$$

This is done on level T2. The ramp is working on level I1 and therefore the signal IAREF11 will look like the figure below.



Normally the smoothed reference IAREF11 should be used.
In the drives with speed control rise time less than 5 x T2 it can be necessary to use IAREF1.

Current derivative delimiter

Both excessive positive and excessive negative rates of change are limited. The limitation is performed by element A5. The maximum positive or negative rate of change is given by the parameter IADERMAX.

Scaling of armature current actual value (IAACT)

The parameter IASCALE scales the current feedback in relation to the motor. For example, if the nominal convertor current is 400 A and that of the motor is 200 A, IASCALE is set to 2.000. IASCALE can be set 0.000 - 7.999 and is multiplied by the incoming current actual value ICONVACT, where +100 % corresponds to the convertor current rating in the forward direction. IASCALE = 1.000 gives IAACT = ICONVACT.

Undervoltage protection

The voltage level of the synchronization voltage L11, L12 and L31 is monitored via the level detector A4.
The detection level is adjustable between 0 and 130 % of the nominal voltage, with parameter MINVOLT.
If detection of low voltage level stays longer than number of I1-samples, set by parameter MSLVD, the convertor will control down and block the trigger pulses at discontinuous current.
If detection of low voltage level remain longer than time set by parameter MSUVD, the fault signal MSUVD is set to "1" and at discontinuous current the signal MSFLT is also set to "1".

Protection against incorrect phase sequence

The phase sequence of the synchronization voltage is monitored in the circuit A6. On delivery, parameter PHSEQCW is "1". This means that the sequence is to be clockwise. If this is not the case, the convertor does not start. It is then possible either to change the phase sequence of the incoming supply or change parameter PHSEQCW to "0".

The equipment can then be run with the anticlockwise phase sequence but in convertors with ratings 180 A and greater, the phase sequence to the fans must be changed to get correct rotation direction.

With incorrect phase sequence, the fault signal PHSEQFLT is given and the trigger pulses are blocked after zero current indication. If frequency is outside the interval specified, the signal FREQFLT will indicate.

Synchronization software filter

The attenuation of frequency changes in the synchronization signal is delimited by the parameter IASYNCKP.

The attenuation is $2^{IASYNCKP}$.
IASYNCKP = 0 gives no filtering.
IASYNCKP = 2 gives the attenuation 4.

Frequency supervision

The supply voltage frequency is compared in A3 with a value, set with parameter FREQNOM. The frequency may vary within an interval which can be set with parameter FREQDEV.

Instantaneous overcurrent protection

The actual value of the armature current, IAACTABS, affects a level detector A7 which trips the convertor instantaneously with overcurrent. The tripping level can be set with the parameter OVERCUR. The signal ARMOCNBR points out the faulty thyristor branch in the case of overcurrent and its function corresponds with that of ARMNCNBR (see Fault in thyristor branch).
During normal shop conditions the signal ARMOCNBR = 0.

Ripple supervision

The function will indicate, via the signal ARMRPLF, if ripple in the armature current exceeds the permitted level. The permitted level is set by parameter ARMRPPL. The indication could be delayed by parameter ARMRPLD. It is important to have in mind that the function will only handle ripple introduced by the current controller. Ripple in the current reference will not be detected.

Fault in thyristor branch

The protection points out which thyristor has failed in the event of a failure. The parameter ARMNCL sets the level at which the protection is activated. In the event of tripping, the signal ARMNC goes high and ARMNCNBR shows with a number 1 - 12 which thyristor branch is faulty as follows.
1 - 6 indicates a faulty thyristor 1 - 6 in the forward bridge.
7 - 12 indicates a faulty thyristor 1 - 6 in the reverse bridge.
During normal shop conditions, the signal ARMNCNBR = 0.
The detection could be delayed by parameter ARMNCD.

Parameter descriptions

ACTADAP (0 - 200 %)	**ACT**ual **ADAP**tation. Setting of corresponding e.m.f./speed actual value for voltage adaptation.
ALPHAADJ (0 - 180 °)	**ALPHA ADJ**ustment. ALPHAADJ is added to the delay angle which is calculated for voltage adaptation.
ALPHALIM (0 - 180 °)	**ALPHA LIM**itation. Alfa-limitation of control angle.
ARMNCD (0 - 32767 s)	**ARM**ature **N**o **C**urrent **D**elay. Delay of no current, indication.
ARMNCL (0 - 200 %)	**ARM**ature **N**o **C**urrent **L**evel. Level for detection of zero current in a thyristor branch.
ARMRPLD (0 - 32767 s)	**ARM**ature **RiPpLe D**elay. Delay of armature ripple, indication.
ARMRPLL (0 - 200 %)	**ARM**ature **RiPpLe L**evel. Lowest deviation level for detection of ripple in armature current.
BELIMMAX (10 - 180°)	**BE**ta **LIM**itation **MAX**imum. Specifies, at variable beta-limit, the maximum beta-limitation of control angle.
BELIMVAR ("0", "1")	**BE**ta **LIM**itation **VAR**iable. BELIMVAR = "0" gives fixed beta-limitation of the control angle. BELIMVAR = "1" gives variable limitation.
BETALIM (20 - 180°)	**BETA LIM**itation. Specifies beta-limitation of the control angle. If variable limitation is used, BETALIM is the least value of the beta-limitation of the control angle.
CONSTCON (0 - 3267)	**CONST**ant **CON**tinuous mode. Trim constant for continuous armature current.
CONSTRL (0 - 3267)	**CONST**ant **RL**. Trim constant for continuous armature current.
EMFACTS ("0", "1")	**EMF ACT**ual **S**elect. EMFACTS = "0" gives voltage adaptation via the speed NACT. EMFACTS = "1" gives voltage adaptation directly via EMFACT.
EMFADAP (0 - 32767 V)	**EMF ADAP**tation. Setting of e.m.f. actual value for voltage adaptation.
FREQDEV (0 - 11 Hz)	**FREQ**uency **DEV**iation. Maximum permitted deviation from nominal mains frequency before the fault signal FREQFLT appears.
FREQNOM (50 - 32767 Hz)	**FREQ**uency **NOM**inal. Nominal mains frequency.
IABRKHI (0 - 200 %)	**I** (current) **A**rmature **BR**eaK**H**igh. Upper breakpoint in the function for variable beta-limit.
IABRKLO (0 - 200 %)	**I** (current) **A**rmature **BR**eaK**L**ow. Lower breakpoint in the function for variable beta-limit.
IACALVAL (0.0 - 100.0 %)	**I** (current) **A**rmature **CAL**ibration **VAL**ue. Scale factor for normalizing of the convertor's current response. Set during the delivery test.
IADERMAX (0.1 - 40.0 %/ms)	**IA DER**ivative **MAX**imum. Limitation of range of change of the armature current reference IAREF1.

IADOUBLE ("0", "1")	I (current) Armature **DOUBLE** convertor. IADOUBLE = "0", means single convertor type. IADOUBLE = "1", means double convertor type.
IAGAIN (0.3 - 1.0)	I (current) Armature **GAIN**. IAGAIN = 1.0 gives maximum rate of speed for controlling. Lower value will give a slower but more stable control function.
IARHFOHS ("0, "1")	I (current) Armature Reference First Order Hold Select.
IASCALE (0.000 - 7.999)	I(current) Armature **SCALE** factor. Scale factor for calibrating to the rated motor current
IASTEP1 (0 - 200 %)	I (current) Armature **STEP1**. Amplitude of stepping.
IASYNCKP (0 - 4)	I (current) Armature **SYN**Chronization **K** (constant) Proportional. Proportional constant for the synchronization software filter.
MINVOLT (0 - 130 %)	**MIN**imum **VOLT**age. Lowest permitted mains voltage. Values detected under this value are indicated with the fault signal MSUV.
MSLVD (0 - 4)	Mains Supply Low Voltage Supply. Number of I1-samples delay of mains supply low voltage indication.
MSUVD (0 - 100 ms)	Mains Supply Under Voltage Delay. Delay of MSUV detection.
OVERCUR (0 - 400 %)	**OVERCUR**rent level. Highest permitted value of momentary overcurrent. Values detected over this value are indicated with the fault signal ARMOC.
PHSEQCW ("0", "1")	**PH**ase **SEQ**ence **C**lock**W**ise. PHSEQCW = "0" indicates an anticlockwise phase sequence. PHSEQCW = "1" indicates a clockwise phase sequence.
UNOM (0 - 32767 V)	U (voltage) **NOM**inal. Nominal mains voltage phase-to-phase.

Signal list

The sample levels (T1 - T4) are defined in the function description of module TSYSXXX.
Sample level I1 is generated by the current control board YPQ 101 and is synchronous with the main supply frequency.

Input signals

BLOCK ("0", "1")	I1	**BLOC**King. Blocking signal.
EMFACT (−200.0 - +200.0 %)	I1	**EMF**-voltage **ACT**ual. E.m.f. actual value as a percentage.
FANSON ("0", "1")	I1	**FANS ON**. On-command for fans.
IAREF1 (−200.0 - +200.0 %)	I1	I (current) Armature **REF**erence 1. Armature current reference 1.
NACT (−100.00 - +100.00 %)	I1	N (rot. speed) **ACT**ual. Speed actual value.
RDYREF ("0", "1")	I1	**ReaDY** for **REF**erence. Convertor prepared for reference.
RESET2 ("0", "1")	T4	**RESET 2**. Resetting signal 2.

Output signals

ALPHA (0 - 180 °)	T3	**ALPHA**. Control angle, LP-filtered value.
ARMNC ("0", "1")	T3	**ARM**ature **N**o **C**urrent. Armature current is missing in one thyristor branche.
ARMNCNBR (0 - 12)	T3	**ARM**ature **N**o **C**urrent **NumBeR**. Points out a thyristor branch which has failed. 1 - 6: a thyristor 1 - 6 in the forward bridge. 7 - 12: a thyristor 1 - 6 in the reverse bridge. ARMNCNBR = 0 if no fault has occurred.
ARMOC ("0", "1")	I1	**ARM**ature **O**ver**C**urrent. Indicates momentary overcurrent, armature.
ARMOCNBR (0 - 12)	I1	**ARM**ature **O**ver **C**urrent **NumBeR**. Points out a thyristor branch in which there is overcurrent. 1 - 6: a thyristor 1 - 6 in the forward bridge. 7 - 12: a thyristor 1 - 6 in the reverse bridge. ARMOCNBR = 0 if there is no overcurrent in a thyristor branch.
ARMRPL ("0", "1")	T3	**ARM**ature **RiPpLe**. Indicates large ripple in armature current.
EMFVOLT (−1000 - +1000 V)	T3	**EMF VOLT**age. Actual value of e.m.f. in volts.
FREQFLT ("0", "1")	I1	**FREQ**uency **FauLT**. Indicates mains frequency deviation.
FREQNOM (50, 32767)	INIT	**FREQ**uency **NOM**inal. Nominal mains frequency.

IAACT (−200.0 - +200.0 %)	I1	**I** (current) **A**rmature **ACT**ual. Actual value of armature current.
IAACTABS (−200.0 - +200.0 %)	I1	**I** (current) **A**rmature **ACT**ual **ABS**olute value. Absolute value of armature current actual value.
IADERLIM ("0", "1")	I1	**IA DER**ivation **LIM**itation. Rate of change of the armature current reference has reached the maximum permissible value.
IAREFSUM (−200.0 - +200.0 %)	T2	**I** (current) **A**rmature **REF**erence **SUM**ation. The summation current reference.
ICONVACT (−200.0 - +200.0 %)	I1	**I**(current) **CONV**ertor **ACT**ual. Current actual value with the calibrated value +100.0 % corresponding to the rated convertor current (I_{dMN1}) in the forward direction.
MSFLT ("0", "1")	I1	**M**ains **S**upply **FaLT**.
MSUV ("0", "1")	I1	**M**ains **S**upply **U**nder **V**oltage. Indicates undervoltage in mains voltage when the convertor is switched on. Reset via RESET2.
MSLV ("0", "1")	I1	**M**ains **S**upply **L**ow **V**oltage. Indicates low voltage in the mains supply, then the convertor is on.
MSLV1 ("0", "1")	I1	**M**ains **S**upply **L**ow **V**oltage **1**. Indicates low voltage in the mains supply.
PHSEQCW1 ("0", "1")	I1	**PH**ase **SEQ**uence **C**lock**W**ise **1**. Indicates clockwise phase sequence.
PHSEQFLT ("0", "1")	I1	**PH**ase **SEQ**uence **FaLT**.

PRIDE
Description of function module

MOTOLM1X
Motor overload monitor

Reference

This document is related to current software diagram for functional modules of TYRAK L/MIDI.

Item designations of functional blocks referred to in this documents as well as delivered preset values and selection rules of parameters can in most cases be found in current software diagram.

Function description

Introduction

The function module MOTOLM1X supervises the thermal loading of the drive system via the armature current actual value. The module is provided with a time-integrating overload protection which, in the event of overload, trips the convertor. The module also provides a time-delayed alarm signal at a preset armature current level.

Function

The absolute value IAACTABS of the armature current is monitored by this module. The parameter IATEST is normally zero (0) and the level flip-flop **A2** monitors the value IAACTABS. If IAACTABS reaches the level ARMHLL, **A2** signals "1", activating the timer **T1**. After the preset time ARMHLD, the function module gives the signal ARMHL = "1". This signal is intended to provide an alarm at an early stage with incipient overheating. The switch-off of the signal ARMHL is also delayed the time ARMHLD in the timer **T2**.

Normalizing to the rated current value is performed in element **A3**. If, in the preceding module IACTRL the signal IAACTABS is normalized to the rated current of the complete drive system (normally the same as the rated motor current), parameter ARMOLL is to be at 100 %. Otherwise ARMOLL is to have a value corresponding to the required tripping level as a percentage of IAACTABS.

The temperature rise is assumed to be a function of I^2 and the output signal from **A3** is squared in **A4**.

The squared current response is integrated up by element **A5** with a time constant = MOTORTC. If the output signal of the integrator reaches the level MOTCURMA, level flip-flop **A6** reacts and transmits "1". Flip-flop **L1** is thereby set to "1" and the function module signals ARMOL = "1" i.e. armature overload.

If the armature current falls below the level ARMOLL before the integrator **A5** has reached level MOTCURMA, the integrator will integrate downward with:

Alt. 1) the time constant MOTORTC, if the parameter SRECTIME = "0".
In this case, the cooling time of the motor has been set to MOTORTC.

Alt. 2) the time constant 300 s if the parameter SRECTIME = "1" which means that the motor cooling time has been specified as 300 s.

The tripping time is shown on page 3 as a function of IAACTABS.

That the motor is already "warm" is simulated when supply voltage is switched on (IAACTABS = ARMOLL before switch-on). This is to ensure that element **A5** is not reset to "cold" motor if the supply voltage is disconnected.

A high armature current can be simulated with the parameter IATEST. The summator **A1** adds IATEST to the actual current response IAACTABS.

The setting of parameter ARMHLL is analogous with that of ARMOLL (see above). ARMHLLis normally selected as 90 % of ARMOLL .

The parameter MOTCURMA is the overload capacity of the motor and is set as a percentage of the motor current rating.

The parameter MOTORTC is the thermal time constant of the motor i.e. approximately the shortest time taken by the armature or stator to reach a steady-state temperature.

The signal ARMOL = "1" is reset to "0" by setting the signal RESET2 to "1".

Parameter descriptions

ARMHLD (0 - 32767 s)	**ARM**ature **H**igh **L**evel time **D**elay. Time delay for signal, high armature current.
ARMHLL (0 - 200 %)	**ARM**ature **H**igh **L**oad **L**evel. Level for signal, high armature current.
ARMOLL (0 - 200 %)	**ARM**ature **O**ver**L**oad **L**evel. Setting level for overload.
IATEST (0 - 200 %)	**I** (current) **A**rmature **TEST**ing. Simulation level for armature current.
MOTCURMA (100 - 400 %)	**MOT**or **CUR**rent **MA**ximum. Overload capacity for the motor.
MOTORTC (1 - 32767 s)	**MOTOR** **T**ime **C**onstant. The thermal time constant for the motor.
SRECTIME ("0", "1")	**S**et **REC**overy **TIME**. Motor cooling time. With SRECTIME = "0" a cooling time = MOTORTC has been assumed. With SRECTIME = "1" a cooling time = 300 s has been assumed.

Signal list

The sample levels (T1 - T4) are defined in the function description of module TSYSXXX.

Input signals

IAACTABS (-200.0 - +200.0 %)	T4	**I** (current) **A**rmature **ACT**ual **ABS**olute value.
RESET2 ("0", "1")	T4	**RESET** signal **2**. Reset of fault monitor.

Output signals

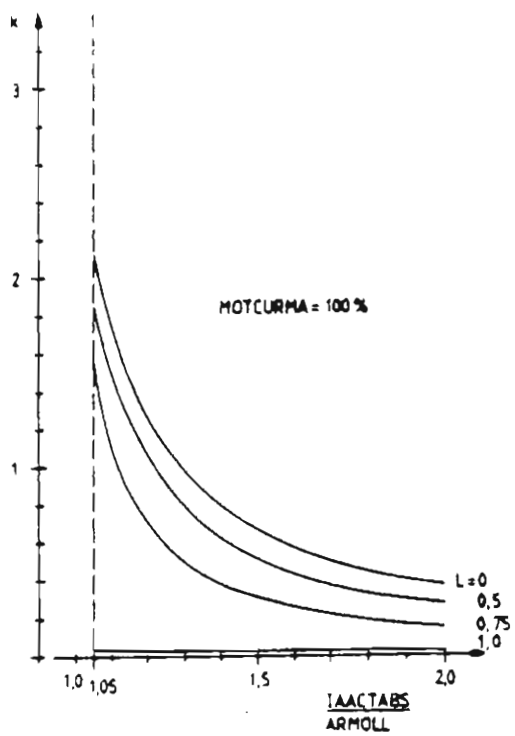
ARMHL ("0", "1")	T4	**ARM**ature current **H**igh **L**evel.
ARMOL ("0", "1")	T4	**ARM**ature **O**ver**L**oad.

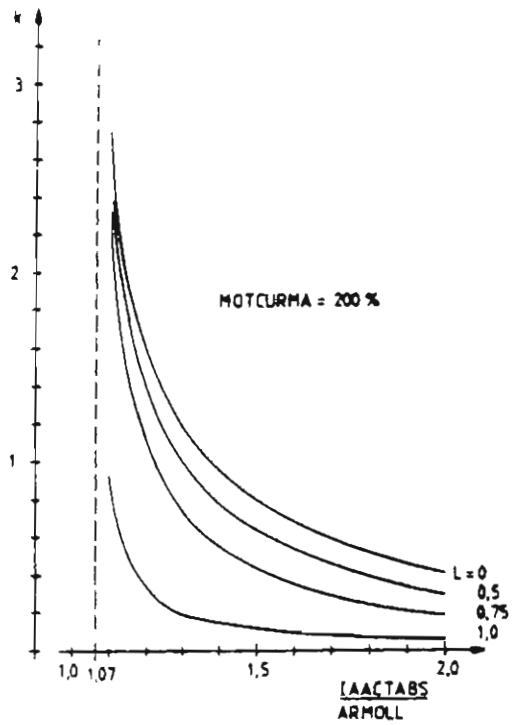
Tripping time as a function of IAACTABS

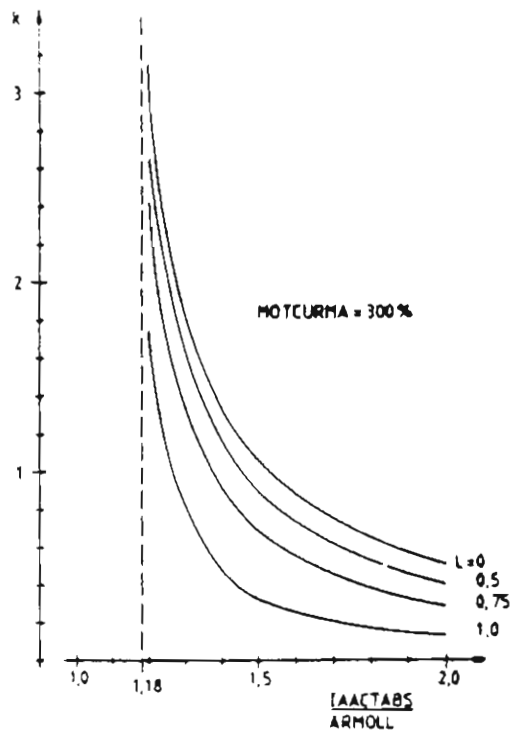
t = K x MOTORTC Tripping time (s)

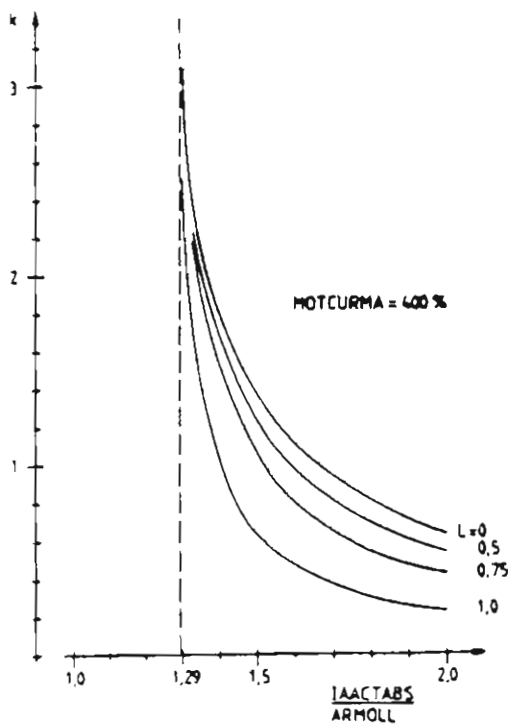
L = Ibas / ARMOLL Load factor before overload

K: Constant read in fig. (1 - 4)
MOTORTC: Thermal time constant of the motor
Ibas: Stationary armature current before overload
ARMOLL: Setting level before overload









PRIDE
Description of function module

NFBADJ0X
Speed feedback adjustment

Reference

This document is related to current software diagram for functional modules of TYRAK L/MIDI.

Item designations of functional blocks referred to in this documents as well as delivered preset values and selection rules of parameters can in most cases be found in current software diagram.

Function description

In function module NFBADJ0X it's possible to select one of three different signals as speed feedback signal.

NFEEDBPT	Speed feedback from puls transmitter.
NFEEDBTG	Speed feedback from tacho generator.
EMFACT	Using the EMF of the armature in the motor as feedback.

The selection is done with parameter NFEEDBS.
Parameter value 0 selects NFEEDBPT as feedback.
Parameter value 1 selects NFEEDBTG as feedback.
Parameter value 2 selects EMFACT as feedback.

Parameter NFBADJ is used to make the final adjustment of the maximum speed of the DC motor when signal NFEEDBTG or EMFACT are used as feedback.

Sign inverse of output signal NFEEDB is used in some winder applications. Order for sign inverse is given when signal PTSIGNSW is set "1".

The format I2, F2 of the output signal NFEEDB is required to transmit speed feedback values more then ten times the nominal speed. The signal is transmitted to speed controller and overspeed monitor.

Output signal NACT and NACTMV are signals limited to 100 %. The filter time of NACTMV is set by parameter NACTMVTC.

Parameter descriptions

NFBADJ (1.050 - 4.000)	N(rotation speed) Feed Back ADJustment. Level adjustment of analog speed actual value.
NACTMVTC (0 - 32767 ms)	N(rotation speed) ACTual Mean Value Time Constant. Time constant for the mean value of speed.
NFEEDBS (0 - 32767)	N(rotation speed) FEEDBack Select. Choice of different speed feed back values. NFEEDBS = 0 pulse transmitter. NFEEDBS = 1 tachometer generator. NFEEDBS = 2 EMF.

Signal List

The sample levels (T1 - T4) are defined in the function description of module TSYSXXX.

Input signals

EMFACT (−200.00 - +200.00 %)	T2	ElectroMotive Force ACTual. The EMF from the machine.
NFEEDBPT (−32767.9999 - +32767.9999)	T2	N(rotation speed) FEEDBack Pulse Transmitter. Speed actual value (I2.F2) from pulse transmitter.
NFEEDBTG (−100.00 - +100.00 %)	T2	N(rotation speed) FEEDBack Tacho Generator. Speed actual value from tachometer generator.
PTSIGNSW ("0","1")	T2	Pulse Transmitter SIGN SWitch. Sign of speed feed back.

Output signals

NACT (−100.00 - +100.00 %)	T2	N(rotation speed) ACTual. Speed actual value.
NACTMV (−100.00 - +100.00 %)	T2	N(rotation speed) ACTual Mean Value. Mean value of speed actual value.
NFBEMF ("0","1")	T2	N(rotation speed) FeedBack EMF. Indicates if EMFACT is used as speed feed back signal or not.
NFEEDB (−32767.9999 - +32767.9999)	T2	N(rotation speed) FEEDBack. Speed actual value (I2.F2).

Reference

This document is related to current software diagram for functional modules of TYRAK L/MIDI.

Item designations of functional blocks referred to in this documents as well as delivered preset values and selection rules of parameters can in most cases be found in current software diagram.

Function description

Introduction

The speed reference can be controlled with the function module NINDE1 with the help of push buttons via digital input signals. The reference can be set from three operator's stations and the rate of change can be selected between 0.03 and 3276.7 %/s.

The reference can be preset and, at start, a smooth acceleration of the reference is obtained with the help of a built-in ramp.

Automatic following is standard to permit bumpless transition from an external reference to the increase/decrease reference. A soft transfer from increase/decrease reference back to external reference is obtained with the help of a built-in ramp.

Increase/decrease unit (A1)

The increase/decrease unit (A1) can work in four different modes:
1. Reset. Reset instantaneously.
2. Return. Return via "Return slope".
3. Follow.
   Follow means that the output A1-OUT follows the input signal A1-Followref. At transition from the Follow mode to the increase/decrease mode, A1-OUT remains at the latest Follow ref value.
4. (+ /–) Increase/decrease .

The output A1-OUT can be limited with the parameters NIDNMAX and NIDNMIN.

Reset

If the A1 input Reset is "1", the A1 output "OUT" (NREF6A) goes instantaneously to the value which is the greater of zero or the negative limit (parameter NIDNMIN). The or-gate L10 can be affected via contacts controlled by the parameter NIDMODE.

- NIDMODE section A is on. As soon as RDY2REF = "0" or NIDREFON = "0" unit A1 is reset to zero or its negative limit.

- NIDMODE section B is on. As soon as the L1 flip-flop goes to "0" the unit A1 is reset to zero or its negative limit.

Return

If the A1 input Return is "1"and the A1 input Reset is "0", the A1 output "OUT" returns to the value which is the greater of zero or the negative limit (parameter NIDNMIN value) with the rate of change "Return slope". "Return slope" is set with the parameter NIDRET.

When parameter NIDMODE section C is on, Return is controlled by the output of the L1 flip-flop. A smooth retardation is then obtained with a stop command. Note that the parameter NREFST2C must be "0".

Follow

If Follow is "1" and the A1 inputs Reset and Return are both "0", the A1 output OUT follows the A1 input Follow ref. A precondition is however that NIDNMIN ≤ Follow ref ≤ NIDNMAX. Follow ref is connected instantaneously to A1-OUT.

Follow is controlled by the signals LOCAL2, REMOTE/ AUTO and LOCAL1/MANU and also by the output of the L1 flip-flop and by the parameter NIDMODE (sections D, E and F). The and-gate L13 is "1" if the two or-gates L11 and L12 are "1".
- NIDMODE section D is on. When the L1 flip-flop output is "0", Follow = "1".

- NIDMODE section E is on. If it is assumed that section D of NIDMODE is off, the signal LOCAL2 must be "0" and the signal REMOTE must be "1" (or AUTO = "1" if the paramter AUTOMANS = "1").

- NIDMODE section F is on. If it is assumed that section D of NIDMODE is off, the signal LOCAL2 must be "0" and the signal LOCAL1 must be "1" (or MANU = "1" if the parameter AUTOMANS = "1").

The Follow reference, Follow ref, is determined by the input signals NREFFOL, NREF5 and NACT and by the parameters FNREF5S and FREFNACT.

If FREFNACT = "1", the actual value of the speed, NACT, is followed.

If FREFNACT ="0", NREFFOL is followed (see **"Function module NRSUM2"**) and if FNREF5S = "1", NREF5 is also followed (see **"Function module NRAMP2"**).

Increase/decrease (+/–)

If none of the inputs Reset, Return or Follow are "1", the output A1-OUT can be affected by the increase/decrease input (+/–). The (+/–)-input can be affected by the input signals INCRREM - DECRREM, INCRLOC1 - DECRLOC1 or INCRLOC2 - DECRLOC2. The output signals INCRIND and DECRIND can be used as acknowledgements of the increase/decrease command.

There are different rates of change, two for increase and two for decrease. NIDINCRS or NIDDECRS is first connected during the time t1 determined by the parameter NIDTSLOW after which NIDINCRF or NIDDECRF is connected. NIDINCRS and NIDDECRS can be used for fine setting and if they are set at 0%/s, the rate of change becomes 0.03 %/s.

Reference connection

The reference is connected to the output signal NREF6 when the and-condition L8 is satisfied:

- And-gate L6 = "1", see section **"Start logic and interlockings"**.

- Or-gate L7 = "1". The parameter NREFST2C is normally = "1". The basic idea is that it is "0" only when "Return" is required. This means that either the L1 flip-flop output is "1" or Follow = "1". This makes it possible to give a run (start) command via, for example, reference adaptation unit REFAD and to use the follow function to be able to use the ramp R1 for soft-start without it being necessary to give a start-command to the L1 flip-flop. The L1 flip-flop is then used only with LOCAL2-mode during commissioning and service.

- REMOTE/AUTO and/or LOCAL1/MANU must be "0", if any of the parameters NIDDISC1 and/or NIDDISC2 is "1".

- EMSTOP and STOPFAST must be "0".

Ramp start (Soft start)

NINDE1 contains an internal ramp **R1** which is used for a ramp start/soft start. The and-gate **L6** = "0" before start as RDY2REF and possibly NIDREFON is "0". This means that the or-gate **L20** is "1" and the ramp **R1** is in the Follow mode.

The follow reference is given by the summator **A3** in which the difference between **A1**-OUT (NREF6A) and NACT is calculated. While the ramp **R1** is in the follow mode, the output signal from the summator **A4** is:

NREF6B = NREF&A + R1-out = NREF6A + (NACT - NREF6A) = NACT, when the and-gate **L6** becomes "1" after a start, the or-gate **L20** becomes "0" and the signal R1-out goes towards zero, i.e. NREF6B = NREF6A + R1-out ⇒ NREF6A.
The ramp time for 100 - 0 % is determined by parameter NIDRTIME.

Smooth transition from manual to auto (local to remote)

It is assumed that AUTOMANS = "1", but the following argumentation is general. AUTO can be replaced with REMOTE and MANU with LOCAL1.

As described in **"Function module REMLOC"** there can be three operator's stations where LOCAL2 normally means the operator's panel on the convertor.

The AUTO and MANU signals are created for example in the function modules REFAD or PRCTRL.

Example
The Auto-reference is connected via NREFFOL and the manual reference is controlled via external push-buttons connected to INCRLOC1/DECRLOC1. The parameter NIDMODE is set so **L12** can be true through its middle input and LOCAL2 = "0".

When AUTO = "1", A1-OUT = Followref.
When MANU becomes "1" (AUTO = "0"), **A1**-OUT remains at its preceding value but can now be changed with INCRLOC1 and DECRLOC1. On return to AUTO = "1", a pulse is generated in the pulse circuit **L22**. Ramp **R1** goes briefly over to follow, at which the difference between the old manual actual value NACT and **A1**-OUT = Follow ref is entered into the ramp **R1** and transmitted on **R1**-OUT.

NREF6B = NREF6A + **R1**-out = NREF6A + (NACT - NREF6A) = NACT. When the short pulse of **L22** goes to "0", the signal R1-out goes towards zero i.e.
NREF6B = NREF6A + **R1**-out ⇒ NREF6A

In the same way that the pulse circuit **L22** gives a smooth transition to auto,

- gives the pulse circuit **L21** a smooth transition from "Return" to "Follow".

- gives the pulse circuit **L23** a smooth transition to manual. The pulse circuit **L23** can be used for example when the manual reference is given with an external potentiometer via function module REFAD. A smooth transition is then obtained in both directions between auto and manual.

Auto/manual, convertor operator's panel

If the manual reference is given with external pushbuttons connected to INCRLOC1/DECRLOC1 and increase/decrease pushbuttons are to be connected in the convertor (LOCAL2), LOCAL2 can be "1" at the same time that MANU = "1". The and-gate L31 prevents INCRLOC1/DECRLOC1 becoming parallel with INCRLOC2/DECRLOC2.

Start logic and interlockings

When a start-order is required from NINDE1, the parameter NIDST2CS is set = "1". As soon as the or-gate **L2** becomes "1", INLKRESC becomes "1", and if the or-gate **L3** is "0", START2C also goes to "1".

- INLKRESC is an interlocking signal which prevents resetting of the convertor after tripping if a start signal is active. INLKRESC also prevents switch-on of the convertor with a divided start sequence if a start command is active.

- START2C goes via the sequence control unit for drive system SEQST (or SEQMF with master/follower) and the brake control unit BRMEC, if relevant, to the sequence control unit convertor SEQCON.

The output signals INLKRESC, START2C and NINDEON are affected by:

- Start signals, REST2C, START, NIDSTART and INC/DEC signals.

- Stop signals, EMSTOP, STOPFAST, STOP and NIDSTOP.

- Interlock signals, TENSION, RUN and RDY2RUN.

The flip-flop **L1** can be set to "1" with the help of the or-gate **L2** if the input signals to the or-gate **L3** are "0". The or-gate **L3** is "0" if there is neither stop signal to the or-gate **L4** nor interlockings via the and-gate **L5**.

The output signal from the and-gate **L5** is "1" if:

- RDY2RUN = "1", which presupposes that the drive system is ready to run.

- the parameter NIDINLKR = "0", or NIDINLKR = "1" and RUN = "0".

- the parameter NIDINLKT = "0", or NIDINLKT = "1" and TENSION = "0".(RUN and TENSION are signals received from other reference units. They correspond to the output signal NINDEON from NINDE1.)

The or-gate **L2** is "1" if:

- REST2C = "1". This signal is intended for use in an advanced restart system.

- START = "1" and the parameter NIDSTS = "1" (see **"Function module REMLOC"** for details of the signal START).

- NIDSTART = "1" and the input signal LOCAL2 = "1" or the parameter NIDLOC2S = "1". NIDLOC2S is normally "0"but can be set to "1" in programs which do not include function module REMLOC and the use of the input signals NIDSTART, INCRLOC2 and DECRLOC2 is required.

- One of the increase/decrease input signals becomes "1" and the parameter NIDIDSTS = "1". NIDIDSTS is normally "0" but if the saving of a start signal is required, can be set to "1".

NINDEON becomes "1" as soon as the flip-flop **L1** becomes "1". When **L1** goes to "0", NINDEON remains at "1" as long as the and-gate **L6** remains at "1". The and-gate **L6** = "1" when RDY2REF and NIDREFON are "1".

Parameter descriptions

AUTOMANS ("0", "1")	**AUTO**matic **MAN**ual Select. Selection of the input signals AUTO (automatic) and MANU (manual).
FNREF5S ("0", "1")	**F**ollow **NREF5** Select. Selection of following of the speed reference NREF5.
FREFNACT ("0", "1")	**F**ollow **REF**erence **N** (speed) **ACT**ual select. Selection of following of the speed actual value
NID...	**N** (rotation speed) **I**ncrease/**D**ecrease.
NIDDECRF (0.0 - 3276.7 %/s)	**NID DEC**Rease **F**ast. Magnitude of fast decrease of the output signal.
NIDDECRS (0.0 - 3276.7 %/s)	**NID DEC**Rease **S**low. Magnitude of slow decrease of the output signal.
NIDDISC(1, 2) ("0", "1")	**NID DIS**Connect **(1, 2)**. Disconnect speed reference NREF6.
NIDIDSTS ("0", "1")	**NID** Increase/Decrease **ST**art Select. Selection of start command with the increase/decrease signals.
NIDINCRF (0.0 - 32767.7 %/s)	**NID INC**Rease **F**ast. Magnitude of fast increase of the output signal.
NIDINCRS (0.0 - 32767.7 %/s)	**NID INC**Rease **S**low. Magnitude of slow increase of the output signal.
NIDINLKR ("0", "1")	**NID IN**ter**L**oc**K** **R**un. The signal RUN interlocks a start command from NINDE1.
NIDINLKT ("0", "1")	**NID IN**ter**L**oc**K** **T**ension. The signal TENSION interlocks a start command from NINDE1.
NIDLOC2S ("0", "1")	**NID LOC**al **2** Select. Selection of operator's station"local 2".
NIDMODE (0-32767)	**NIDMODE**. Design parameter to select function of NINDE1.
NIDNMAX (-100 - +100 %	**NID N** (rotation speed) **MAX**imum. Maximum speed. NIDNMAX must be greater than NIDNMIN.
NIDNMIN (-100 - +100 %	**NID N** (rotation speed) **MIN**imum. Minimum speed. NIDNMIN must be less than NIDNMAX.
NIDREFS ("0", "1")	**NID REF**erence on Select. Selected to utilize the input signal NIDREFON.
NIDRET (0.0 - 3276.7 %/s)	**NID RET**urn. Return speed.
NIDRTIME (0 - 32767 s)	**NID** Ramp **TIME**. Ramp time for smooth start etc. Permissible range is 0 - 1000 s.
NIDST2CS ("0", "1")	**NID ST**art **2C** Select. Selected to give a start command (START2C) from NINDE1.
NIDSTS ("0", "1")	**NID ST**art Select. Selected to utilize the input signal START.
NIDTSLOW (0.0 - 32.7 s)	**NID** Time **SLOW**. The time during which the parameters NIDDECRS and NIDINCRS are connected.
NREFST2C ("0", "1")	**N** (rotation speed) **REF**erence **ST**art **2C**. Permits the signal "START2C" to affect the connection of NREF6.

Signal list

The sample levels (T1 - T4) are defined in the function description of module TSYSXXX.

Input signals

AUTO ("0", "1")	T4	**AUTO**matic. Automatic command.
DECRLOC(1, 2) ("0", "1")	T4	**DEC**Rease **LOC**al **(1, 2)**. Decrease command from operator's station "local (1, 2)".
DECRREM ("0", "1")	T4	**DEC**Rease **REM**ote. Decrease command from operator's station "remote".
EMSTOP ("0", "1")	T4	**EM**ergency **STOP**. Emergency stop command.
INCRLOC(1, 2) ("0", "1")	T4	**INC**Rease **LOC**al **(1, 2)**. Increase command from operator's station "local (1, 2)".
INCRREM ("0", "1")	T4	**INC**Rease **REM**ote. Increase command from operator's station "remote".
LOCAL(1, 2) ("0", "1")	T4	**LOCAL (1, 2)**. Operator's station "local (1, 2)" is selected.
MANU ("0", "1")	T4	**MANU**al. Manual operation command.
NACT (-100.00 - +100.00 %)	T3	**N** (rotation speed) **ACT**ual. Speed actual value.
NREF5 (-100.00 - +100.00 %)	T3	**N** (rotation speed) **REF**erence 5. Speed reference 5.

NREFFOL (–100.00 - +100.00 %)	T3	**N** (rotation speed) **REF**erence **FOL**low. Speed reference for following.
NID ...		**N** (rotation speed) **I**ncrease/**D**ecrase. Speed increase/decrease.
NIDREFON ("0", "1")	T4	**NID REF**erence **ON**. Can connect and disconnect the speed reference NREF6.
NIDSTART ("0", "1")	T4	**NIDSTART**. Start command from operator's station "local 2".
NIDSTOP ("0", "1")	T4	**NIDSTOP**. Stop-command which only affects the **L1** flip-flop (start flip-flop) in NINDE11X.
RDY2REF ("0", "1")	T4	**R**ea**DY 2** for **REF**erence. The drive system is prepared for reference.
RDY2RUN ("0", "1")	T4	**R**ea**DY 2** for **RUN**. The drive system is prepared to run.
REMOTE ("0", "1")	T4	**REMOTE**. The operator's station "remote" is selected.
REST2C ("0", "1")	T4	**REST**art **2C**. Restart command (in advanced restart system).
RUN ("0", "1")	T4	**RUN**. Acknowledgement / interlocking signal (if input signals NINDEON and TENSION) which indicates that REFGEN is connected.
START ("0", "1")	T4	**START**. Start command.
STOP ("0", "1")	T4	**STOP**. Stop command.
STOPFAST ("0", "1")	T4	**STOPFAST**. Fast stop command.
TENSION ("0", "1")	T4	**TENSION**. Acknowledgement signal designated TENSION is received from, for example, the tension controller.

Output signals

DECRIND ("0", "1")	T4	**DEC**Rease **IND**ication. Indication of a decrease command.
INCRIND ("0", "1")	T4	**INC**Rease **IND**ication. Indication of an increase command.
INLKRESC ("0", "1")	T4	**IN**terLoc**K** **RES**et **C**. Interlocking signal which prevents resetting (RESET) of a tripped convertor.
NINDEON ("0", "1")	T4	**N** (rotation speed) **IN**crease **DE**crease **ON**. Acknowledgement signal/interlocking signal (cf. RUN and TENSION) which indicates that function module NINDE11X is connected.
NREF6 (–100.00 - +100.00 %)	T3	**N** (rotation speed) **REF**erence **6**.
NREF6A (–100.00 - +100.00 %)	T3	**N** (rotation speed) **REF**erence **6A**. Speed reference **6A** always shows the value set at the output of the increase/decrease output.
NREF6B (–100.00 - +100.00 %)	T3	**N** (rotation speed) **REF**erence **6B**. The speed reference **6B** always shows the value at the output of the increase/decrease unit plus the value at the output of the internal ramp.
START2C ("0", "1")	T4	**START 2C**. Start command from function module NINDE11X.

PRIDE
Description of function module

OPCH31X
Defines pushbuttons and LED for operator's panel
Selection of INTERNAL, EXTERNAL operator's panel

Reference

This document is related to current software diagram for functional modules of TYRAK L/MIDI.

Item designations of functional blocks referred to in this documents as well as delivered preset values and selection rules of parameters can in most cases be found in current software diagram.

Function description

This compulsory function module is to produce the pictures for logger and indication to the display on the operator's panel. It also defines the pushbuttons and the LED indication at the operator's panel.

The selection of INTERNAL and/or EXTERNAL operator's panel is also to be done in this module, by the parameters OPCTRINT and OPCTREXT.

The authority for both INTERNAL and/or EXTERNAL operator's panel is to be set with the parameters AUTHINT and AUTHEXT. The number of authority degree of a panel is not possible to set lower than 3 if there is no other active panel, i. e. with authority degree 3. Otherwise the parameters are possible to change by a terminal.

The three different degrees of authorities are as follows:

Authority	Range of possibilities
1.	Measurements. Logger analysis. Registration screen: Min/max value change. Language change. Viewing angle change. Start/stop of logger. Fault messages. Scale factor change in the indication screen. Signal change in the indication screen.
2.	Authorities according to 1. Auto log usage. Logger channel: Signal, posttrig or time scale.
3.	Authorities according to 1 and 2. Step disturbance. Parameter setting. Change connections.

Parameter descriptions

AUTHEXT (1-3)	**AUTH**ority **EXT**ernal operator's panel. (See function description).
AUTHINT (1-3)	**AUTH**ority **INT**ernal operator's panel. (See function description).
OPCTREXT ("0","1")	Operator's **P**anel **C**on**TR**ol **EXT**ernal. To select EXTERNAL operator's panel the parameter is set to "1".
OPCTRINT ("0","1")	Operator's **P**anel **C**on**TR**ol **INT**ernal. To select INTERNAL operator's panel the parameter is set to "1".

Signal list

The sample levels (T1-T4 and BG) are defined in the function description of module TSYSXXX.
Sample level I1 is a hardware interrupt syncronous with the supply frequency.

Input signals

FREQNOM (50-32767 Hz)	INIT	**FREQ**uency **NOM**inal. Nominal mains frequency.
LOC2IND ("0","1")	T4	**LOC**al **2** **IND**ication. Indication that operator's station "local 2" is selected.
L_TRIGG ("0","1")	I1	Logger_**TRIGG**. When the logger is triggerd, the signal is set = "1".
NINDEON ("0","1")	T4	**N** (rotation speed) **IN**crease **DE**creas **ON**. Acknowledgement signal/interlocking signal which inbdicates that function module NINDEX is connected.
NREF (−200.0 - +200.0 %)	I1	**N**(rotation speed) **REF**erens. Speed reference value.
RDYRUN ("0","1")	T4	**ReaDY** for **RUN**. The drive system is prepared to run.
REM2IND ("0","1")	T4	**REM**ote **2** **IND**ication. Indication that operator's station "local 2" is not selected.
STOPIND ("0","1")	T4	**STOP** **IND**ication. Indication that a stop has been commanded.
TRIPPED ("0","1")	T4	**TRIPPED** convertor fault. LED is switched on.
TRIPWARN ("0","1")	T4	**WARN**ing of error inb the convertor. Fault LED is flashing.

Output signals

DECRLOCK2 ("0","1")	T4	DECRement LOCal 2. Decrease reference from "local".
INCRLOCK2 ("0","1")	T4	INCRease LOCal 2.. Increase reference from "local".
LNK35 ("0","1")	T4	LiNK 35. Link fault. Data from operator's panel missing.
LNK55 ("0","1")	T4	LiNK 55. Link fault. Disturbance in communication to operator's panel.
LOCLOC ("0","1")	T4	LOCal LOCal.. Select of operator's station "local" from operator's station "local".
NIDSTART ("0","1")	T4	NIDSTART. Start command from operator's station "local 2".
OFF2 ("0","1")	T4	OFF order 2. Off command from operator's station "local".
ON2 ("0","1")	T4	ON order 2. On command from operator's station "local".
RDYLOG ("0","1")	T4	ReaDY LOGger. The signal is set = "1" when the logger is ready.
REMLOC ("0","1")	T4	REMote LOCal. Select of operator's station "remote" from operator's station "local".
RESET1 ("0","1")	T4	RESET 1. Reset of tripping from "local".
S_AMP (+100 - −100 %)	BG	Step test_AMPlitude.
S_FUNO (1 - 6)	BG	Step test_FUnction module NO. The number of the step test module.
S_TIME (0.0 - 99.9 s)	BG	Step test_TIME. The lenght of the step disturbance.
S_TRIGG ("0","1")	BG	Step test_TRIGG flag. Step test triggered when signal is high.
STOPLOC2 ("0","1")	T4	STOP LOCal 2. Stop command from operator's station "local".

Signal switch-box

DIOP.(1 - 8)	Digital In OPerator's panel (1 - 8). Selection of signal to pushbuttons, on operator's panel.
DOOP.(1 - 7)	Digital Out OPerator's panel (1 - 7). Selection of signal to LED indication, on operator's panel.

PRIDE
Description of function module

REMLOC2X
Remote local selection

Reference

This document is related to current software diagram for functional modules of TYRAK L/MIDI.

Item designations of functional blocks referred to in this documents as well as delivered preset values and selection rules of parameters can in most cases be found in current software diagram.

Function description

Introduction
One of a maximum of three operator's stations can be selected with the function module REMLOC. If required, exchange of operator's station can be prevented during running.

There are also circuits for processing of
- automatic/manual signals
- on/off signals
- start/stop signals

Example nr	Operator's station			Value of the parameter REMLOCMS
	"Remote"	"Local"	"Convertor"	
1	Control room	Control desk	Switchgear room	"3"
2	Control desk	Jog box	–	"2"
3	Control room	–	Switchgear room	"1"
4	Control box	–	–	"3", "2", "1"
5	–	–	Operator's panel in convertor	"0"

Figure 1. Examples of the interpretation of the operator's station designations "Remote", "Local" and "Convertor".

Operator's stations

the terminology selected is, (see also Fig. 1):
- REMOTE
- local 1: locally at the machine (LOCAL1)
- local 2: local operator's panel in the convertor (LOCAL2)

The output signals REMOTE, LOCAL1 and LOCAL2 can be affected with the input signals REMREM, LOCREM, LOCLOC and REMLOC.

The effects of the input signals on the output signals can be controlled in four different ways with the parameter REMLOCMS. There are also four parameters (REMLOCSW, RLINLK1S, RLINLK2S and SERVLOC2) which can modify input/output signal relation. These four parameters are normally "0", but are set to "1" in accordance with the following:

REMLOCSW. Used when the signal REMREM is a fixed signal. REMREM = "1" means remote and REMREM = "0" means local. REMLOCSW is then set = "1".

RLINLK1S. RLINLK1S is set = "1" when exchange of operator's station during running is to be prevented (RDY2REF = "1"). The AND-gates **L3**, **L4**, **L5** and **L6** interlock the input signals when RDY2REF = "1".

RLINLK2S. RLINLK2S is set = "1" when the signals REMLOC and LOCLOC are to be prevented from affecting the flip-flop **L1**. RLINLK2S is intended for use when REMLOCMS is "1" or "2".

SERVLOC2. When, for example, during servicing, it is to be ensured that REMOTE = "0", LOCAL1 = "0" and LOCAL2 = "1", SERVLOC2 is set = "1". SERVLOC2 is mainly intended for use when REMLOCMS is "2".

REMLOCMS

A number of different alternatives are available with one, two or three different operator's stations, see Fig. 2.

Note the possibility of interactive interlocking of operator's station exchange if RLINLK2S = "1". If flip-flop **L2** is set to "1", the signal REMREM is always prevented from setting flip-flop **L1** to "1". When RLINLK2S = "1" and flip-flop **L1** is set to "1", the signal LOCLOC is prevented from resetting flip-flop **L1** to "0" and from setting flip-flop **L2** to "1".

- REMLOCMS = "0".
  One operator's station, the convertor.
  REMOTE = "0" and LOCAL1 = LOCAL2 = "1".

Number of operator's stations	Value of parameter REMLOCMS	Internal signal designation in circuit diagram	Signal combinations. Operator's station selected			Comments
			"Remote"	"Local"	"Convertor"	
3 Remote Local Convertor	"3"	REMOTE LOCAL1 LOCAL2	"1" "0" "0"	"0" "1" "0"	"0" "0" "1"	Remote and local can be equivalent operator's stations. The convertor is a subordinate operator's station.
2 Remote Local	"2"	REMOTE LOCAL1	"1" "0"	"0" "1"	– –	LOCAL2 = "0". (The convertor can be connected during service with the help of a parameter.)
2 Remote Convertor	"1"	REMOTE LOCAL2 = LOCAL1 1)	"1" "0"	– –	"0" 1	Remote and convertor can be equivalent operator's stations.
1 Remote	"3", "2", "1"	REMOTE	"1"	–	–	No input signals for selection of operator's station are connected.
1 Convertor	"0"	LOCAL2 = LOCAL1 1)	–	–	"1"	No input signals for selection of operator's station are connected.

1) LOCAL2 = LOCAL1 means that these signals are both "0" or both "1".

Figure 2. Possible operator's station combinations. If an operator's station is not selected (= "0" or "–"), its controls are disconnected. Note

- REMLOCMS = "1".
  Two operator's stations, remote or convertor. The following signal combinations are available:

  REMOTE = "1", LOCAL1 = "0", LOCAL2 = "0".
  REMOTE = "0", LOCAL1 = "1", LOCAL2 = "1".

- REMLOCMS = "2".
  Two operator's stations, remote or local at the machine. The following signal combinations are available:

  REMOTE = "1", LOCAL1 = "0", LOCAL2 = "0".
  REMOTE = "0", LOCAL1 = "1", LOCAL2 = "0".

- REMLOCMS = "3".
  Three operator's stations, remote, local or convertor. REMREM and possibly LOCREM and LOCLOC and REMLOC must be connected. The following output signal combinations are available:

  REMOTE = "1", LOCAL1 = "0", LOCAL2 = "0".
  REMOTE = "0", LOCAL1 = "1", LOCAL2 = "0".
  REMOTE = "0", LOCAL1 = "0", LOCAL2 = "1".

An operator's station can be selected from two places with the help of REMREM and LOCREM or LOCLOC and REMLOC.

When REMLOCMS = "3", the selection must be made from two places:

REMREM and LOCREM control REMOTE and LOCAL1 via flip-flop **L1**. LOCLOC and REMLOC control LOCAL2 via flip-flop **L2**. LOCAL2 can only be set to "1" if REMOTE = "0".

If REMLOCMS = "1" or "2", it is sufficient that the selection is performed from **one** operator's station. When the selection is performed from two operator's stations, it is suitable to set RLINLK2S = "1".

When REMLOCMS = "1", "2" or "3", REMOTE always becomes "1" when voltage is applied to the convertor and remains in this state until one of the input signals affects flip-flop **L1**.

There are also two signals LOC2IND and REM2IND which in the basic version are used for LED indication in the convertor. LOC2IND = "1" means convertor selected and REM2IND = "1" means convertor not selected.

Automatic/manual control

The output signals AUTORL and MANURL can be affected by the input signals AUTOREM, MANUREM, AUTOLOC1 and MANULOC1. The signals AUTORL and MANURL are conducted further for example to the process controller PRCTRL or the reference adaptation unit REFAD, and these interact with the increase/decrease unit NINDE1. When designing an installation, consideration should be given to whether it is remote/local control or automatic/manual control which is meant. See Fig. 3. Automatic/manual control can be switched during running, as can be done with remote/local control if RLINLK1S = "0".

AUMASWS. Used when the signal AUTOREM is a fixed signal.
AUTOREM = "1" means automatic control
AUTOREM = "0" means manual control, and then parameter AUMASWS is set to "1".

Example nr	"Auto"	"Manual"
1	4 - 20 mA input signal	Potentiometer
2	Process controller	Push buttons Increase/Decrease
3	0 - 20 mA input signal	Push buttons Increase/Decrease

Figure 3. Examples of interpretation of the signal designations "Auto" and "Manual". In examples 1 and 3, the signal designations could be "Remote" and "Local" as well.

On/off commands

When a divided start sequence is required, for example first switch-on of fans and field and then start of the system by connecting main contactor and reference (see **"Function module SEQCON"**) on/off-signals are required in addition to start/stop-signals.

The output signals ON1 and OFF1 can be affected with the input signals ONREMINL, ONREM, OFFINLK and OFFREM. These signals are only used with a divided start sequence except OFFREM which is always used in combination with the hardware relay -AK1.K1.1, 2 (electrical emergency switch-off, see **"Function module DIN11"**).

ONREMINL = "1" interlocks ONREM (on/remote). It is possible, however, in the mode "local 2" to switch on the convertor from the operator's panel via the signal ON2 to the function module SEQCON.

OFFINLK = "1" switches off the convertor, irrespective of which operator's station is selected.

ONOFFSWS. Used when the signal ONREM is a fixed signal. ONREM = "1" mean on and ONREM = "0" means off. ONOFFSWS is then set = "1".

Start/stop commands

In Tyrak L, the start signal is used when an undivided start sequence is required i.e. fans, field, main contactor and reference are to be connected with one signal. If, with a double convertor, braking to zero speed is required, the stop signal is to be used. In the case of a single convertor and insufficient digital input signals, the stop push button can be connected in series with the signal OFFREM, see section **"On/off commands"**.

The output signals START and STOP can be affected by the input signals STARTINL, STARTREM, STOPREM, STOPINLK, STARTLOC, STOPLOC1 and STOPLOC2.

STARTINL = "1" interlocks STARTREM (start/remote). If the parameter STAINLKS = "1", STARTLOC (start/local 1) is also interlocked. If there are one or two operator's stations, (REMLOCMS = "1" or "0") and a start interlocking is required which interlocks the convertor START button (which in the basic version is connected to the signal NIDSTART in the increase/decrease module NINDE1), the push button can instead be connected to the signal STARTLOC.

STOPINLK = "1" gives a stop (STOP = "1") in the remote mode. If parameter STOINLKS = "1", STOPINLK also gives a stop in the local mode.

If the stop push button of the convertor (input signal STOPLOC2) is not always to be active and program function modules are available which can give a start command parallel with the increase/decrease unit NINDE1, the push button can be connected to the input signal NIDSTOP in NINDE1. The stop push button is then active only when the start command is given via NINDE1.

Parameter descriptions

AUMASWS ("0", "1")
AUto **MA**nual **SW**itch Select.
Selection of automatic/manual selector.

ONOFFSWS ("0", "1")
ON OFF SWitch Select.
Selection of on/off selector.

REMLOCMS ("0", "1", "2", ≥"3")
REMote **LOC**al **M**ode Select.
Selection of suitable operator's station combination.

REMLOCSW ("0", "1")
REMote **LOC**al **SW**itch (select).
Selection of remote/local selector.

RLINLK1S ("0", "1")
Remote **L**ocal **IN**ter**L**oc**K** 1 Select.
Selection of interlocking which prevents operator's station exchange during running.

RLINLK2S ("0", "1")
Remote **L**ocal **IN**ter**L**oc**K** 2 Select.
Selection of interlocking nr 2 which prevents operator's station exchange.

SERVLOC2 ("0", "1")
SERVice **LOC**al 2
Selection of operator's station "local 2", for example, during service.

STAINLKS ("0", "1")
STArt **IN**ter**L**oc**K** Select.
Selection of start interlocking is also to prevent start from operator's station "local 1".

STASTSWS ("0", "1")
STArt **ST**op **SW**itch Select.
Selection of start/stop selector.

STOINLKS ("0", "1")
STOp **IN**ter**L**oc**K** Select.
Selection of stop interlocking to be active also for operator's stations "local 1" and "local 2".

Signal list

The sample levels (T1-T4) are defined in the function description for module TSYSXXX.

Input signals

AUTOLOC1 ("0", "1") T4
AUTO LOCal 1.
Automatic command from operator's station "local 1".

AUTOREM ("0", "1") T4
AUTO REMote.
Automatic command from operator's station "remote".

LOCLOC ("0", "1") T4
LOCal **LOC**al.
Selection of operator's station "local" from operator's station "local".

LOCREM ("0", "1") T4
LOCal **REM**ote.
Selection of operator's station "local" from operator's station "remote".

MANULOC1 ("0", "1") T4
MANUal - **LOC**al 1.
Manual operation command from operator's station "local 1".

MANUREM ("0", "1") T4
MANUal **REM**ote.
Manual operation command from operator's station "remote".

OFFINLK ("0", "1") T4
OFF INter**L**oc**K**.
Interlocking which gives switch-off.

OFFREM ("0", "1") T4
OFF REMote.
Off-command from operator's station "remote".

ONREM ("0", "1") T4
ON REMote.
On-command from operator's station "remote".

ONREMINL ("0", "1") T4
ON REMote **IN**ter**L**ock.
[illegible]

RDY2REF ("0", "1") T4
Rea**DY** 2 for **REF**erence.
The drive system is prepared for reference.

REMLOC ("0", "1") T4
REMote **LOC**al.
Selection of operator's station "remote" from operator's station "local".

REMREM ("0", "1") T4
REMote **REM**ote.
Selection of operator's station "remote" from operator's station "remote".

STARTINL ("0", "1") T4
START INter**L**ock.
Interlocking which prevents start command (from operator's station "remote" and, optionally, also "local 1").

STARTLOC ("0", "1") T4
START LOCal.
Start command from operator's station "local 1".

STARTREM ("0", "1") T4
START REMote.
Start command from operator's station "remote".

STOPINLK ("0", "1") T4
STOP INter**L**oc**K**.
Interlocking which gives stop (in the "remote" mode and optionally also the "local" mode).

STOPLOC1 ("0", "1") T4
STOP LOCal 1.
Stop command from operator's station "local 1".

STOPLOC2 ("0", "1") T4
STOP LOCal 2.
Stop command from operator's station "local 2".

STOPREM ("0", "1") T4
STOP REMote.
Stop command from operator's station "remote".

Output signals

AUTORL ("0", "1") T4
AUTO Remote Local.
Automatic-command from the operator's stations "remote" or "local 1".

LOC2IND ("0", "1") T4
LOCal 2 **IND**ication.
Indication that operator's station "local 2" is selected.

LOCAL1 ("0", "1") T4
LOCAL 1.
Command for operator's station "local 1".

LOCAL2 ("0", "1") T4
LOCAL 2.
Command for operator's station "local 2".

MANURL ("0", "1") T4
MANUal Remote Local.
Manual operation command from the operator's stations "remote" and "local 1".

OFF1 ("0", "1") T4
OFF 1.
Off-command from operator's station "remote".

ON1 ("0", "1") T4
ON 1.
On-command from operator's station "remote".

REM2IND ("0", "1") T4
REMote 2 **IND**ication.
Indication that operator's station "local 2" is not selected.

REMOTE ("0", "1") T4
REMOTE.
Command for operator's station "remote".

START ("0", "1") T4
START.
Start command from operator's stations "remote" or "local 1".

STOP ("0", "1") T4
STOP.
Stop command from operator's stations "remote", "local 1" and "local 2".

PRIDE
Description of function module

SEQCON7X
Start sequence convertor equipment

Reference

This document is related to current software diagram for functional modules of TYRAK L/MIDI.

Item designations of functional blocks referred to in this documents as well as delivered preset values and selection rules of parameters can in most cases be found in current software diagram.

Function description

Introduction

The convertor start-stop procedure is controlled from the function module SEQCON7X.

Digital input and output signals from and to the hardware are galvanically separated by means of opto-couplers on the circuit board YPQ 101, which in turn is connected to the connection board YPQ 103. See the circuit diagram.

Definitions

ON means preparatory connection such as switch-on of fans and field exciter. The ON command is given by the signals ON1, ON2, REON or EMON. The signals can be of the pulse type (brief) as **L4** goes to self-holding. The preparatory connection is cancelled by OFF: the signals EMOFF, OFF1 or OFF2.

START means final connection such as switch-on of main contactor and release (acceleration) of the controllers. This is commanded when the signal START1 or STARTBR becomes "1". Final connection is cancelled with STOP i.e. when START1 or STARTBR becomes "0".

Parameter setting

The function depends on how the associated logical and arithmetical parameters are set. See under **"Parameter descriptions"** below.

The most important parameter is SEQMODE, which determines the interaction between the ON and the START command.

Certain parameter settings involve selection of protective procedures in the event of malfunction - See **"Parameter descriptions"**.

Start sequences

A survey of the effects of the parameter SEQMODE on the operation of fan, field, mains contactor and release command is given in the parameter descriptions.

SEQMODE = "0"
The circuit diagram shows that when SEQMODE is set = "0", three contacts will return to predetermined status.

With SEQMODE = "0", a complete start sequence will be initiated when input signal START1 or STARTBR (which, depends on the parameter BRMECS) becomes "1". The start sequence is described below. Note that the on-commands are given in the following chronological order:

R1 - on command fans
R2 - on command field
R3 - on command main contactor
R4 - release command RDYREF = "1".

START1 (STARTBR) = "1" is monitored by the OR-gate **L1** which gives the output signal "1". The AND-gate **L2** gives "1" if input signal INLKRES is "0". If this occurs, the OR-gate **L3** signals "1", this setting flip-flop **L4** (provided its reset input is not "1"). This function module then gives the output signal FANSON, which means on-command convertor fan(s) (signal C FAN ON) and also on-command external fans (signal E FAN ON), if provided. If there are no external fans, the terminal blocks 2 and 6 on board YPQ 103 are jumpered.

When both signals ACKCFAN and ACKEFAN (acknowledgement fans on) are "1", the AND-gate **L5** gives the output signal "1". This output signal and signal FANSON are monitored by the AND-gate **L6** which gives "1", the OR-gate **L7** then signalling "1" i.e. the function module gives an on-command for the field, signal FLDEXCON = "1".
When either of the input signals IFGTMIN and IFGTMIN1 (acknowledgement of field ON) becomes 1, the OR-gate **L8** gives the output signal "1" which is monitored by the AND gate **L9**. This signals "1" and the output signal MCONTON becomes = "1" which is the on-command for the mains contactor. (Timer **T2** is only activated at switch-off.)

The acknowledgement signal for the mains contactor in the on-position gives an input signal ACKMCONT = "1", the AND-gate **L10** then giving the output signal RDYREF = "1"which is the release signal to the controllers. This completes the start sequence.

Note that as soon as SEQMODE is set to "0", the output signal RDYRUN (convertor ready to run) = "1" because of the signal chain **L11** - **L12** - **L13**, if all input signals EMOFF, OFF1 and OFF2 are "0".

SEQMODE = "1"
When SEQMODE is set = "1", two contacts close, see circuit diagram.

In this case the start-command START1 (or STARTBR) must be preceded by an on-command ON1, ON2, REON or EMON. Such an on-command will give the command R1 (see above) and also the command RDYRUN = "1", whereas a succeeding start command START1 (STARTBR) gives commands R2 + R3 + R4.

The start sequence is as follows:
If input signal ON1 or ON2 becomes "1", **L1** signals "1" and then a signal chain follows, analogous with that when SEQMODE = "0", until **L5** signals that the fans are on by giving the signal "1". The signal RDYRUN = "1" is also obtained then, via **L14** - **L13**, as **L14** receives "1" at both inputs. The remaining on-commands are blocked however as **L6** has one input "0" as the signal START1 (STARTBR) is "0".

The command REON or EMON = "1" has the same effect as ON1/ON2 via the OR-gate **L26**.

Only when signal START1 (STARTBR) becomes "1", is the **L6** signal "1" and then the function module SEQCON7X gives the commands R2 + R3 + R4 in the same way as when SEQMODE = "0".

SEQMODE = "2"
When SEQMODE is set = "2", two contacts close (see diagram), not those which close with SEQMODE = "0" or "1".

This start sequence follows the same procedure as with SEQMODE = "1" but in this case the following commands are given:

- Command R1 + R2 and RDYRUN = "1" with ON1, ON2, REON or EMON = "1".
- Command R3 + R4 with START1 (STARTBR) = "1".

The start sequence is in accordance with the following.
With the on-command, the AND-gate **L9** (instead of **L6**) blocks the signal chain as **L9** awaits a start command START1 (STARTBR). When the acknowledgement of command R2 (i.e. field is on) reaches the AND-gate **L14**, the module gives the signal RDYRUN = "1" via **L14** - **L13**.

When the module detects the start command START1 (STARTBR) = "1", **L9** gives the output signal "1" after which the commands R3 + R4 follow.

SEQMODE = "3"
When SEQMODE is set = "3", contact **S1** closes. See the circuit diagram.

In this case the start sequence is as follows:
- Commands R1 + R2 + R3 and RDYRUN = "1", with ON1, ON2, REON or EMON = "1".
- Command R4 with START1 (STARTBR) = "1".

The start sequence is as follows.
With the on-command, the **L10** gate blocks the signal chain as **L10** awaits the start command START1 (STARTBR). The signal RDYRUN = "1" is also obtained via **L14** - **L13** when the acknowledgement of command R3 (i.e mains contactor is on) reaches **L14**.

When the module detects the start command START1 (STARTBR) = "1", **L10** gives the output signal "1" i.e. command R4 is given.

OFF-command

With an OFF-command i.e. one of the signals EMOFF, OFF1 or OFF2 becomes "1", the following occurs:

- Commands R1, (R2), R3, R4 are cancelled via **L11** - **L25** - **L16**.
- RDYRUN is set = "0" via **L12** - **L13** (if SEQMODE = "0"), or via **L14** - **L13**.

The field exciter (command R2) can be connected in the OFF-position to give, via a low field current, a slight degree of heating of the motor to prevent condensation. This is commanded with the signal FLDHEAT and is executed in **L19** provided that the convertor has not tripped as a result of a field exciter malfunction (flip-flop **L18** set to 1).

STOP command

With a STOP command i.e. if STARTBR/START1 returns from "1" to "0", while one of the ON-commands ON1, ON2, REON or EMON is "1", the following occurs:

- If SEQMODE = "0", the commands R1 + R2 + R3 + R4 are cancelled.
- If SEQMODE = "1", the commands R2 + R3 + R4 are cancelled.
- If SEQMODE = "2", the commands R3 + R4 are cancelled.
- If SEQMODE = "3", the command R4 is cancelled.

Fault signal processing

Three different procedure levels, TRIP1, TRIP2 and TRIP3 have been defined for the different protective functions of the drive system. In principle, as much of the drive system as possible should remain in operation after a fault has been indicated.

- TRIP1
  This is the extreme procedure, tripping of the complete convertor. The signal TRIP1 is a collective signal for the protections which give this reaction. The group also normally includes the conditions "Overload convertor fan" CFANOL and "Overload external fan" EXFANOL and "Acknowledgement fans absent" i.e. the signals CFANNA and EXFANNA. When a fault signal is issued, the flip-flops **L21** and **L24** go to self-holding until reset via the signal RESET2.

- TRIP2
  On this level of procedure, all of the convertor functions except the fans are tripped. Except for collective signal TRIP2 it is used if the acknowledgement field exciter is absent, the signals FLDNA and FLDLC. With a fault signal, the flip-flops **L18** and **L24** go to self-holding until resetting is performed via the signal RESET2.

- TRIP3
  This is the minimum procedure and means that only the main contactor is switched off and the control circuits are phased back. Given by the collective signal TRIP3 plus the main contactors own supervision signals MCONTNA and MCONTF. When a fault occur, the flip-flop **L24** is set to "1" until reset via the signal RESET2.

Supervision of objects controlled

The module SEQCON7X controls 4 objects: Fans, field exciter, main contactor and gives a release signal to control circuits. For these, there are 4 different supervision units for: convertor fan (**T3**) external fans (**T4**), field exciter (**T6**) and mains contactor (**T7**). As these function, in principle, in the same way, only one of these is described: supervision of field-exciter **T6**.

When the field exciter on-command FLDEXCON becomes "1", a timer in **T6** is activated. If the field current is not acknowledged within 5 s, "1" is given on the signal FLDNA. The convertor is then tripped on the TRIP2 level and the fault message "NO ACKN FIELD CURRENT" is presented on the display. If the switch-on is successful but the acknowledgement is lost during running, **T6** gives "1" on the signal FLDLC. The convertor trips in the same way but the display presents the message "LOW FIELD CURRENT".

Mains voltage supervision

The mains voltage is monitored in module IACTRL with respect to: level (all 3 phases), phase sequence and frequency. With any fault, the signal MSFLT becomes "1". The convertor can now be controlled to a normal switch-off or a tripping via TRIP1. Parameters are set as described below:

Module Parameter	TRIP1 MSFLTS	SEQCON5X MSFLTOFF
Switch-off	"0"	"1"
Tripping	"1"	"0"

Fast retarding of the controllers and thereby of the armature current is obtained in both cases, by MSFLT giving RDYREF = "0" directly via **L10**.

Resetting after tripping

When the drive has tripped, the fault signal is kept set to "1" by SR-flip-flops in the protective module concerned. In SEQCON7X, information is held by the flip-flops **L18**, **L21** and **L24**. All of these flip-flops are reset with the signal RESET2. This is normally given from the operator's panel via RESET1. If parameter OFFRESET = "1" a resetting is also obtained on pressing the OFF button. The signal FRESET gives a fault message on the display and increments the fault number counter by "1". Resetting of protections is interlocked via the signal INLKRES. This signal is generated by superimposed start commands in other modules and prevents unintentional start of the convertor.

Interlocking of ON-command

ON-command ("1" from **L3**) is interlocked (in the same way as resetting of fault signals) by the signal INLKRES via **T1** and **L2**. This means that ON-command e.g. via ON1 is not executed if a START-command is active at a reference unit. With an undivided start sequence (SEQMODE = "0") the reference unit generates the signal START1 = "1" and INLKRES = "1" simultaneously. The timer **T1** then prevents INLKRES blocking a start of the drive system.

Parameter descriptions

BRMECS
("0", "1")
BReak MECanical Select.
BRMECS = "1" if the drive includes a mechanical brake.

EXFANTD
(0.0 - 32.7 s)
EXternal FAN Time Delay.
Time-delay of fault signal/tripping with overload external fan.

IFACKBLK
("0", "1")
I Field ACKnowledgement BLocKing.
Acknowledgement of field current.
IFACKBLK = "0" is the normal status.
IFACKBLK = "1" is used with the (first) commissioning to simulate field current with a standing still armature and open field circuit.

MSFLTOFF
("0", "1")
Mains Supply FauLT gives OFF.
MSFLTOFF = "0" means that no OFF-command is given with mains fault (MSFLT = "1") and is used if there is separate voltage backup of auxiliary supply circuits.

OFFRESET
("0", "1")
OFF RESET.
Selection of the manner of acknowledging a fault signal.
OFFRESET = "0" is standard.
OFFRESET = "1" means that a fault signal is acknowledged, from the convertor cubicle front button RESET and also when the command OFF is given.

SCLOC2S
("0", "1")
Sequence Control LOCal 2 Select.
SCLOC2S = "0" is selected if input signal LOCAL2 is to control the connection and disconnection of the input signal ON2.

SEQMODE
(0-32767)
SEQuence MODE.
Selection of start sequence.
The parameter is used to determine if a divided start-sequence (SEQMODE = "1", "2", "3") or an undivided start sequence (SEQMODE = "0") is to be used. With an undivided start-sequence, only the start and stop push-buttons are used. With a divided start-sequence, the ON and OFF buttons are also used. See the table below. Note that the OFF button always gives instantaneous disconnection.

TFLDON
(0-32 s)
Time FieLD exciter ON.
ON-delay of the contactor in double field exciter. At loss of AC-power the field current starts to free wheel through the "FWD" or "REV" bridge. If the AC-loss is long enough the "FWD" or "REV" information is lost. When the AC-power returns the convertor is restarted. Closing of the field exciter contactor before the field current becomes zero, is prevented by setting the parameter TDLDON longer than the free wheeling time.

Start-seq-uence	Parameter SEQMODE	Cooling fan	Field exciter	Mains contac-tor	Pre-pared for refe-rence
un-divided	0	START 1	START 1	START 1	START 1
divided	1	ON	START 1	START 1	START 1
divided	2	ON	ON	START 1	START 1
divided	3	ON	ON	ON	START 1

Signal list

The sample levels (T1 - T4) are defined in the function description of module TSYSXXX.

Input signals

ACKCFAN
("0", "1") T4
ACKnowledgement Convertor FAN.
Acknowledgement of "convertor fan On".

ACKEFAN
("0", "1") T4
ACKnowledgement External FAN.
Acknowledgement of "external fan On".

ACKMCONT
("0", "1") T4
ACKnowledgement Mains CONTactor.
Acknowledgement of "mains contactor On".

DYNBR
("0", "1") T3
DYNamic BRake.
Order for the mains contactor switch-off with dynamic braking.

EMOFF
("0", "1") T4
EMergency OFF.
Off-command with emergency stop.

EMON
("0", "1") T4
EMergency ON.
On-command with emergency stop.

EXFANOLW
("0", "1") T4
EXternal FAN OverLoad Warning.

FLDHEAT
("0", "1") T3
FieLD HEATing.
On-command for heating of field winding.

IFGTMIN
("0", "1") T4
I Field Greater Than MINimum.
Field current greater than minimum value with digitally controlled field exciter.

IFGTMIN1
("0", "1") T4
I Field Greater Than MINimum 1.
Field current greater than minimum value with a diode field exciter.

INLKRES
("0", "1") T4
INterLocK RESet.
Interlocking signal which prevents resettting (RESET).

LOCAL2
("0", "1") T4
LOCAL 2.
Operator's station "local 2" is selected.

MSFLT
("0", "1") T4
Mains Supply FauLT.

OFF1 ("0", "1")	T4	**OFF 1.** Off-command 1.
OFF2 ("0", "1")	T4	**OFF 2.** Off-command 2.
ON1 ("0", "1")	T4	**ON 1.** On-command 1.
ON2 ("0", "1")	T4	**ON 2.** On-command 2.
REON ("0", "1")	T4	**REstart ON.** On-command from automatic restart system.
RERESET ("0", "1")	T4	**REstart RESET.** Resetting simultaneous with restart.
RESET ("0", "1")	T4	**RESET.** Resetting.
RESET1 ("0", "1")	T4	**RESET 1.** Resetting (from convertor operator's panel).
START1 ("0", "1")	T4	**START 1.** Start-command.
STARTBR ("0", "1")	T4	**START BRake.** Start-command via function module Mechanical braking.
TRIP(1-3) ("0", "1")	T4	**TRIPping (1-3).** Tripping signal (1-3).

Output signals

CFANNA ("0", "1")	T4	Convertor **FAN** No Acknowledgement.
CFANOL ("0", "1")	T4	Convertor **FAN** OverLoad.
EXFANNA ("0", "1")	T4	**EX**ternal **FAN** No Acknowledgement.
EXFANOL ("0", "1")	T4	**EX**ternal **FAN** OverLoad.
FANSON ("0", "1")	T4	**FANS ON.** On-command for fans.
FLDEXCON ("0", "1")	T3	**FieLD EXCiter ON.** On-command for the field exciter.
FLDLC ("0", "1")	T4	**FieLD** Low Current.
FLDNA ("0", "1")	T4	**FieLD** No Acknowledgement. Acknowledgement of the field exciter.
FRESET ("0", "1")	T4	**Fault RESET.** Resetting of fault signal texts.
MCONTOFF ("0", "1")	T4	Mains **CONT**actor **OFF**.
MCONTF ("0", "1")	T4	Mains **CONT**actor **F**ault.
MCONTNA ("0", "1")	T4	Mains **CONT**actor No Acknowledgement. Acknowledgement from mains contactor absent.
MCONTON ("0", "1")	T4	Mains **CONT**actor **ON.** On-command for mains contactor.
RDYREF ("0", "1")	T3	**ReaDY** for **REF**erence. Convertor prepared for reference.
RDYRUN ("0", "1")	T4	**ReaDY** for **RUN.** Convertor prepared for running.
RESET2 ("0", "1")	T4	**RESET 2.** Resetting of protective circuits.
TRIPPED ("0", "1")	T4	**TRIPPED.** Convertor tripped.

PRIDE
Description of function module

SPMON3X
Speed monitor

Reference

This document is related to current software diagram for functional modules of TYRAK L/MIDI.

Item designations of functional blocks referred to in this documents as well as delivered preset values and selection rules of parameters can in most cases be found in current software diagram.

Function description

Introduction

The function module SPMON3X is used to supervise the motor speed. This supervision includes the following:

- To give a tripping signal with loss of the speed actual value.
- To give a tripping signal at over speed.
- to give a warning signal at an adjustable level less than the tripping speed.

Function

If the delay angle ALPHA is under a certain level (= ALPHANSP), it can be presumed that the speed NFEEDB is above a particular level (= MOTNSPL). The AND-gate **L1** checks that this is the case with the help of the level detectors **A1** and **A2**. If this is not the case, **L1** gives an output signal "1" which, after the time delay NSPTIME in the element **T1**, sets the flip-flop **L2**, and thereby the tripping signal NSPFBACK = "1" is given i.e. "speed actual value absent".

During normal operation, the output signal NGTN0 = "1". When the speed is less than the level NGTN0L, **A3** gives "0" out and after the time N0TIME in the element **T2**, the output signal NGTN0 = "0" is obtained (this means approximately zero speed) from this function module.

A particular speed can be supervised via MOTSP1L. When the speed exceeds this level, the level detector **A4** gives a logical "1" and the output signal MOTSP1 = "1" is given.

At a speed above MOTHSPL, the alarm signal MOTHSP = "1" is given via level detector **A5**.

If the speed increases further, the function module SPMON1X gives the tripping signal MOTOSP = "1" via level detector **A6** and flip-flop **L3**.

The flip-flops **L2** and **L3** are reset to "0" if a resetting pulse (i.e. "1") is given with the signal RESET2.

Parameter descriptions

ALPHANSP (0 - 180°)	**ALPHA No SPeed.** Level of the delay angle at which the motor must rotate.
MOTHSPL (0 - 100 %)	**MOTor High SPeed Level.** Level for signal high speed.
MOTNSPL (0 - 100 %)	**MOTor No SPeed Level.** Level for signal speed actual value absent.
MOTOSPL (0 - 200 %)	**MOTor OverSPeed Level.** Tripping level for high speed.
MOTSP1L (0 - 100 %)	**MOTor SPeed 1 Level.** Speed level which sets signal MOTSP1 = "1".
N0TIME (0 - 32767 ms)	**N0 TIME.** Time delay for signal zero speed.
NGTN0L (0.0 - 100.0 %)	**N** (rotation speed) **Greater Than N0** (zero speed) Level. Level for signal zero speed.
NSPTIME (0 - 32767 ms)	**No SPeed TIME.** Time delay for tripping of convertor with loss of the speed actual value.

Signal list

The sample levels (T1 - T4) are defined in the function description of module TSYSXXX.

Input signals

ALPHA (0 - 180 °)	T4	**ALPHA.** Delay angle.
NFEEDB (−32767.9999 - +32767.9999)	T4	**N** (rotation speed) **FEEDBack.** Actual speed value (I2.F2).
RESET2 ("0", "1")	T4	**RESET 2.** Resetting signal.

Output signals

MOTHSP ("0", "1")	T4	**MOTor High SPeed.** Alarm signal for high speed.
MOTOSP ("0", "1")	T4	**MOTor Over SPeed.** Tripping of convertor because of high speed.
MOTSP1 ("0", "1")	T4	**MOTor SPeed 1.** MOTSP1 = "1" for speeds above MOTSP1L.
NGTN0 ("0", "1")	T4	**N** (rotation speed) **Greater Than N0** (zero speed). NGTN0 = "0" means zero speed.
NSPFBACK ("0", "1")	T4	**No SPeed FeedBACK.** Tripping of convertor with loss of speed actual value.

STEPG3X
Step generator

Reference

This document is related to current software diagram for functional modules of TYRAK L/MIDI.

Item designations of functional blocks referred to in this documents as well as delivered preset values and selection rules of parameters can in most cases be found in current software diagram.

Function description

This compulsory function module produces the REGISTR picture in the operator's panel, where different step responses can be studied. With this module can step reference be given to:

Armature current control (Torque control)
Field current control
EMF control
Speed control
Process control
Position control

Parameter description

TQSTRATE (0 - 16384 ms)	TorQue STep RAmp TimE. Time for 0 - −100 % TQSTEP.

Signal descriptions

The sample levels (T1 - T4) are defined in the function description of module TSYSXXX.

Input signals

S_amp (−32767 - +32767)	T2	Step amplitude.
S_funo (−32767 - +32767)	T2	Step function number.
S_time (−32767 - +32767)	T2	Step time.
S_trigg ("0", "1")	T2	Step trigger.

Output signals

EMFSTEP (−200 - +200 %)	T2	EMF STEP. Simulated step in the e.m.f. reference.
IFSTEP (−200 - +200 %)	T2	IF STEP. Step in the field current reference.
NSTEP (−100 - +100 %)	T2	N(rotation speed) STEP. Step in the speed reference.
POSSTEPF (−100- +100 %)	T2	POSitionSTEP Fraction. Step in the position reference fraction part. The integer part has to be set by parameter POSTEPI in module POSREF.
PSTEP (−100- +100 %)	T2	Process STEP. Step in the process reference.
TQSTEP (−200 - +200 %)	T2	TorQue STEP. Ramp step in the torque reference. The step is a negative ramp with ramptime TQSTRATE.

TEND1X
End of Load Program

Reference

This document is related to current software diagram for functional modules of TYRAK L/MIDI.

Item designations of functional blocks referred to in this documents as well as delivered preset values and selection rules of parameters can in most cases be found in current software diagram.

Function description

This compulsory function module defines the end of the load program. It must be included as the last function module in the system map.

Parameter description

There are no parameters defined in the module.

Signal list

There are no signals used or defined in the module.

Reference

This document is related to current software diagram for functional modules of TYRAK L/MIDI.

Item designations of functional blocks referred to in this documents as well as delivered preset values and selection rules of parameters can in most cases be found in current software diagram.

Function description

Introduction

Module TEST4X enables the performance of the following operations from the operator's panel:

- Test of analog and digital outputs.
- Calibration of connected instruments.
- Indication of logical signals as "analog" signals (0% and 50%).
- Triggering of the internal logger by means of a logical signal.
- Triggering of the internal logger by means of an analog signal.
- Triggering of the internal logger by means of the derivative of an analog signal.
- Measurement of the present processor load.

Practical instructions for the operator's panel are provided in "**Operator's Panel Management**".

Function

- TEST OF OUTPUTS AND CALIBRATION OF INSTRUMENTS.
The various outputs can be tested from the operator's panel. Analog outputs are tested by connecting successively, in the menu CONNECT, the outputs to the signal AOTEST1 in function module TEST4X. The function can be checked by setting different values on the parameter AOTEST, in module TEST4X and at the same time measure the voltage at an output with a voltage meter. Instruments connected can be calibrated in the same way.

Digital outputs are tested in a similar way. The outputs are connected successively, in the menu CONNECT, to the signal DOTEST1 in the function module TEST4X. The function can be checked by setting the parameter DOTEST to "0" or "1" alternately, in module TEST, and observing the LEDs for the outputs connected on the connection board or, by in some other way, observing the status of the output.

- INDICATE LOGICAL SIGNALS AS "ANALOG".
It is possible, from the operator's panel, to convert 2 digital signals to "analog" where "0" corresponds to 0 % (0V) and "1" to 50 % (5 V). This permits a fast (T2) registration of digital signals at an analog output. The digital signals which are to be registered are connected, in the menu CONNECT by means of DO71.1 and DO71.2 respectively. The output signals DTEST1 and DTEST2 are connected to analog outputs.

- TRIGGERING OF INTERNAL LOGGER.
Triggering of the internal logger can be controlled from the operator's panel to the following signals:

- DTRIG. The digital signal which is to trigger the logger is connected, in the menu CONNECT, via DO71.3. When the value of the signal connected is changed from "0" to "1", or from "1" to "0", the logger is triggered and the error text "DIGITAL TRIGG is obtained on the display.
- ATRIG. The analog signal which is to trigger the logger is connected via AO72.1. The signal level (absolute value) at which the triggering is to occur is set by means of the parameter ATRIGL in the module TEST4X. When the absolute value of the signal connected reaches the level set on ATRIGL, the logger is triggered and the error text "ANALOG TRIGG" is obtained on the display.
- DERTRIG. The analog signal, of which the derivative is to trigger the logger, is connected in the menu CONNECT via AO72.2. The level (absolute value) of the derivative, at which the logger is to be triggered, is set by means of the parameter DERTRIGL in the module TEST4X. When the derivative of the connected signal (absolute value) reaches the level set on DERTRIGL, the logger will be triggered and the error text "HIGH DERIVATIVE TRIGG" is obtained on the display. The derivative of the connected signal is extracted as the output signal DERTEST and can be used for other purposes.

- MEASUREMENT OF PRESENT PROCESSOR LOAD
The current processor load, in per cent, can be read as a signal named CCPULOAD in module TEST4X by means of the operator's panel.

Parameter descriptions

AOTEST (–100.0 - +100.0 %)	Analog Output TEST. Setting of the value of output signal, AOTEST1.
ATRIGL (0.00 - +100.00 %)	Analog TRIG signal Level. Triggering level on the analog signal which is connected via AO72.1.
DERTRIGL (0.00 - +100.00 %)	DERivative TRIG Level. Triggering level on the derivative of signal which is connected via AO72.2. Derivative is the difference between the present and the previous value on sample time T2. The scaling is made for signals with max values ± 100 %. I.e. that for a signal with max values ± 200 % and a wanted trigglevel of 10,00%, the parameter has to be set at 5,00%.
DOTEST ("0","1")	Digital Output TEST. Setting of the value on output signal DOTEST1.

Signal list

The sample times (T1-T4 and BG) are defined in the description of module TSYSXXX.

Output signals

AOTEST1 (–100.0 - +100.0 %)	BG	Analog Output TEST1. Analog output signal for test purposes.
ATRIG ("0","1")	T2	Analog TRIG. Triggering of internal logger from analog signal.
CCPULOAD (0 - 100 %)	BG	Calculated CPU LOAD. Calculated processor load.
DERTEST (–100.0 - +100.0 %)	T2	DERivative TEST. Derivative for test purpose. Derivative is the difference between the present and the previous value on sample time T2. The scaling is made for signals with max values ± 100 %. I.e. that for a signal with max values ± 200 % the readings of DERTEST has to be multiplied with 2.
DERTRIG ("0","1")	T2	DERivative TRIG. Triggering of internal logger from derivative.
DOTEST1 ("0","1")	BG	Digital Output TEST1. Digital output signal for test purposes.
DTEST1 (0.00 - 50.00 %)	T2	Digital signal TEST1. Analog presentation of digital signal 1 for test purposes.
DTEST2 (0.00 - 50.00 %)	T2	Digital signal TEST2. Analog presentation of digital signal 2 for test purposes.
DTRIG ("0","1")	T2	Digital TRIG. Triggering of internal logger from digital signal.

Signal exchange

AO72.1	Analog Output 72.1. Selection of analog signal for triggering of internal logger.
AO72.2	Analog Output 72.2. Selection of analog signal, the derivative of which is to trigger the internal logger.
DO71.(1-2)	Digital Output 71.(1-2). Selection of digital signal which is to be presented in analog form as signal DTEST (1-2).
DO71.3	Digital Output 71.3. Selection of digital signal for triggering of internal logger.

Reference

This document is related to current software diagram for functional modules of TYRAK L/MIDI.

Item designations of functional blocks referred to in this documents as well as delivered preset values and selection rules of parameters can in most cases be found in current software diagram.

Function description

Introduction

The primary purpose of function module TRIP17X is to assemble signals for hardware and link fault and to transmit trip and fault signals to other modules.

Function

In the following cases, the fault signal HWF = "1" and the trip signal TRIP1 = "1" are given via the or-gates **L1** and **L2** :

- If any of the input signals HWF01, HWF02, HWF03 or HWF04 becomes "1".
- If input signal HWF05 becomes "1",when parameter HWF05S has been selected to "1". Fault signal HWF05F is also set = "1".
- via the or-gate L3 if either of HWF07.31 or HWF07.61 becomes "1". Output signal HWF07 = "1" is also obtained.
- via the or-gate **L4**, **L5**, **L6** or **L7** if any of the input signals HWF (08-11). (31-36) or HWF (08-11). (61-64) becomes "1". The corresponding output signal HWF08, HWF09, HWF10 or HWF11 is also set = "1".
- If input signal HWF12 becomes "1"when parameter HWF12S has been selected as "1". The output signal HWF12F is also set to "1".

When the following faults occures the module gives only the trip signal TRIP1 = "1" via or-gate **L2** :

- If input signal MSFLT becomes "1", when parameter MSFLTS has been selected to "1".
- If input signal ASUV, EARTHFLT or TRIPMP becomes "1".

Link fault, general

When local or emergency stop mode is selected, the input signal LOC_EMM = "1" i.e. the two associated contacts shown in the diagram are open. When local mode is selected, the input signal LOCM also is = "1" i.e two associated contacts as shown in the diagram are closed.

Link fault with local mode

In local mode, the input signals LNK32 and LNK37 are not detected. The module gives, however the trip signal TRIP1 = "1" via the or-gate **L2**, with the following link fault:

- Via **L8**, if the input signal LNK35 becomes "1". The output signal LNK35F is also set to = "1".

- Via **T1** and **L9**, if input signal LNK55 becomes "1". The timer **T1** gives a time delay = LNK40D. The output signals LNK40 and LNK40F are also set to "1".

Parameter descriptions

CFANOLS ("0", "1")	Convertor Fan Over Load Switch. Selection of protective action when overload of convertor fan.
CVLNKFS ("0", "1")	ConVertor LiNK Fault Switch. CVLNKFS = "0" is standard. CVLNKFS = "1" gives signal and tripping of the convertor if signal LNK32 becomes "1".
EFLTS ("0","1")	Earth FauLT Switch. Selection of protective action when earth fault.
EXFANOLS ("0","1")	EXternal FAN Over Load Switch. Selection of protective action when overload of external fan.
LNK40D (0 - 32767 ms)	LiNK 40 Delay. Time delay for signal LNK55.
LNK40S ("0", "1")	LiNK 40 Select. LNK40S = "0" is standard. LNK40S = "1" gives a signal and tripping (time-delayed) of the convertor if signal LNK55 becomes "1".
MSFLTS ("0", "1")	Mains Supply FauLT Select. MSFLTS = "1" gives tripping of the convertor if signal MSFLT becomes "1".

Signal list

The sample levels (T1-T4) are defined in the function description of module TSYSXXX.

Input signals

ASUV ("0","1")	T4	Auxiliary Supply Under Voltage.
CFANOL ("0","1")	T4	Convertor FAN OverLoad.
COORDRF ("0","1")	T4	COORDinated Run Follower. Coordinated run and follower selected.
COORDRM ("0","1")	T4	COORDinated Run Master. Coordinated run and master selected.
EARTHFLT ("0","1")	T4	EARTH FauLT.
EXFANOL ("0","1")	T4	EXternal FAN Over Load.
HWF...		HardWare Fault.
HWF(01-04) ("0","1")	T4	HardWare Fault (01-04). Hardware fault 01: Computer unit YPP 105. Hardware fault 02: Memory unit YPR 103. Hardware fault 03: Control unit armature YPQ 101. Hardware fault 04: Control unit field YPQ 102.

HWF06B
("0","1") T4
Hard Ware Fault 06B.
Hardware fault YPK 107.

HWF07.31
("0","1") T4
HardWare Fault 07.31.
Hardware fault - board YPH 103, digital speed measurement, board position 31.

HWF07.61
("0","1") T4
HardWare Fault 07.61.
Hardware fault - board YPH 103, digital speed measurement, board position 61.

HWF(08-11).(31-36)
("0","1") T4
HardWare Fault (08-11).(31-36).
Hardware fault 08, 09, 10 eller 11 at one of the board positions 31 - 36.
Hardware fault 08: Digital input unit YPI 103.
Hardware fault 09: Digital output unit YPO 103.
Hardware fault 10: Analog input unit YPG 110.
Hardware fault 11: Analog output unit YPM 102.

HWF(08-11).(61-64)
("0","1") T4
HardWare Fault (08-11).(61-64).
Hardware fault 08, 09, 10 or 11 at one of the board positions 61 - 64.

LNK32
("0","1") T4
LNK 32.
Link fault. Transmission master/follower is missing.

LNK35
("0","1") T4
LNK 35.
Link fault. Data from operator's panel is missing.

LNK37
("0","1") T4
LNK 37.
Link fault. Transmission between master and follower subject to disturbance.

LNK55
("0","1") T4
LNK 55.
Link fault.

LOC_EMM
("0","1") T4
LOCal_EMergency Mode.
Local or emergency stop mode.

LOCM
("0","1") T4
LOCal Mode.

MFCOMMON
("0","1") T4
Master and Follower in COMMON drive.
Master/Follower communication is active.

MSFLT
("0","1") T4
Mains Supply FauLT.

TRIPMP
("0","1") T4
TRIPping Multi Protocol.

Output signals

CFANOLF
("0","1") T4
Convertor FAN Over Load Fault indication.
Fault message when convertor fan is overloaded.

EFLTF
("0","1") T4
Earth FauLT Fault indication.
Fault message when earth fault occures.

EXFANOLF
("0","1") T4
EXternal FAN Over Load Fault indicating.
Fault message when external fan is overloaded.

HWF
("0","1") T4
HardWare Fault.

HWF06BF
("0","1") T4
Hard Ware Fault 06B Fault indication.

HWF(07-11)
("0","1") T4
HardWare Fault (07-11).
Hardware fault (07 - 11). See under the heading "Input signals".

LNK(32F, 35F, 37F)
("0","1") T4
LiNK(32F, 35F, 37F).
Link fault. See signals LNK32, 35, 37 under the heading "Input signals".

LNK(40, 40F)
("0","1") T4
LiNK (40, 40F).
Link fault. Transmission between operator's panel and main computer subject to interference.

TRIP1
("0","1") T4
TRIPPing 1.
Tripping signal 1.

TRIP1W
("0","1") T4
TRIPing 1 Warning.
Collective signal for TRIP1 warnings.

Reference

This document is related to current software diagram for functional modules of TYRAK L/MIDI.

Item designations of functional blocks referred to in this documents as well as delivered preset values and selection rules of parameters can in most cases be found in current software diagram.

Function description

Introduction

The purpose of the function module, TRIP25X, is to assemble certain fault signals and to transmit a tripping signal or a fault message only, and in some cases, a fault signal also, to another module.

Function

The trip signal TRIP2 = "1" is given via or-gate **L1** in the following cases:

- If any of the input signals ARMNEMF, ARMOV, EXFLT, FLDOC, SIGNFLT, THYOT or BLOCK becomes "1".
- If the input signal ARMOL becomes "1", when parameter ARMOLS has been selected as "1". The fault message ARMOLF is also set to "1".
- If input signal MOTOT becomes "1" when parameter MOTOTS has been selected as "1".

A fault message is only given in the following cases:

- If input signal ARMOL becomes "1" when parameter ARMOLS = "0".
- If input signal ARMHL, MOTHT1, MOTHT2 or THYHT becomes "1". The corresponding fault message ARMHLF, MOTHT1F, MOTHT2F resp. THYHTF is set to "1".

Fault messages in the form of short pulses permit continued new registrations in the error list of the operator's panel.

If a fault message is set continuously at "1", registration of new fault messages is blocked. (Used when tripping of the convertor has been selected as the result of a fault signal).

Parameter descriptions

ARMOLS ("0", "1")
ARMature OverLoad Select.
ARMOLS = "1" gives a signal and tripping of the convertor if signal ARMOL becomes "1".
ARMOLS = "0" only gives a fault message if signal ARMOL becomes "1".

MOTOTS ("0", "1")
MOTor Over Temperature Select.
MOTOTS = "1" gives tripping of the convertor if signal MOTOT = "1". MOTOTS = "0" gives fault message, only via function module MOTEMP1X, if MOTOT becomes "1".

Signal list

The sample levels (T1 - T4) are defined in the function description of module TSYSXXX.

Input signals

ARMHL ("0", "1")	T4	**ARMature current High Level.** High rotor current.
ARMNEMF ("0", "1")	T3	**ARMature No EMF-voltage.** EMF voltage missing.
ARMOL ("0", "1")	T3	**ARMature OverLoad.**
ARMOV ("0", "1")	T3	**ARMature OverVoltage.**
BLOCK ("0", "1")	T3	**BLOCKing.** Blocking signal.
EXFLT ("0", "1")	T3	**EXternal FauLT.**
EXFLTDI ("0", "1")	T3	**EXternal FauLT Digital In.**
EXFLTW ("0", "1")	T4	**EXternal FauLT Warning.** Warning signal for external fault.
FLDOC ("0", "1")	T3	**FieLD OverCurrent.**
MOTHT1 ("0", "1")	T4	**MOTor High Temperature 1.** Alarm caused by high temperature at measureing point 1.
MOTHT2 ("0", "1")	T4	**MOTor High Temperature 2.** Alarm caused by high temperature at measureing point 2.
MOTOT ("0", "1")	T3	**MOTor OverTemperature.**
SIGNFLT ("0", "1")	T3	**SIGN FauLT.**
THYHT ("0", "1")	T4	**THYristor High Temperature.** Alarm caused by high temperature in thyristor bridge.
THYOT ("0", "1")	T3	**THYristor OverTemperature.** Tripping of convertor caused by over temperature in thyristor bridge

Output signals

ARMHLW ("0", "1")	T4	**ARM**ature current **H**igh **L**evel **W**arning. Fault message (warning) for high armature current. Short pulse.
ARMOLF ("0", "1")	T4	**ARM**ature **O**ver**L**oad **F**ault.
MOTHT1W ("0", "1")	T4	**MOT**or **H**igh **T**emperature **1** **W**arning. Fault message (warning) for high temperature at measureing point 1. Short pulse.
MOTHT2W ("0", "1")	T4	**MOT**or **H**igh **T**emperature **2** **W**arning. Fault message (warning) for high temperature at measureing point 2. Short pulse.
THYHTW ("0", "1")	T4	**THY**ristor **H**igh **T**emperature **W**arning. Fault message (warning) for high temperature in thyristor bridge. Short pulse.
TRIP2 ("0", "1")	T3	**TRIP**ping **2**. Tripping signal 2.
TRIP2W ("0", "1")	T4	**TRIP**ping **2** **W**arning. Collective warning signal for TRIP2 faults.

Reference

This document is related to current software diagram for functional modules of TYRAK L/MIDI.

Item designations of functional blocks referred to in this documents as well as delivered preset values and selection rules of parameters can in most cases be found in current software diagram.

Function description

Introduction

The function module TRIP36X assembles certain error signals and transmit a trip signal and warning signals to other modules.

Function

The trip signal TRIP3 = "1" is transferred via or-gate L1 if any of the following input signals becomes "1":

BRAKEFLT, MOTOSP, NSFBACK1 or NSFBACK2, STALL, TQFLT1, ARMOC or ARMNC.

The warning signal TRIPWARN = "1" is detected via an or-gate if ARMRPFL, FREQFLT, TQFLT, TRIP1W or TRIP2W is set "1".

Parameter description

There are no parameters defined in the module.

Signal list

The sample levels (T1 - T4) are defined in the function description of module TSYSXXX.

Input signals

ARMNC "0", "1"	T4	**ARM**ature **N**o **C**urrent.
ARMOC ("0", "1")	T4	**ARM**ature **O**ver**C**urrent. Instantaneous overcurrent in armature.
ARMRPLF ("0", "1")	T4	**ARM**ature **RiPpLe F**ault. Excessive ripple in armature current.
BRAKEFLT ("0", "1")	T4	**BRAKE F**au**LT**. Mechanical brake out of control.
FREQFLT ("0", "1")	T4	**FREQ**uency **F**au**LT**.
MOTOSP ("0", "1")	T4	**MOT**or **O**ver**SP**eed.
NSFBACK1 ("0", "1")	T4	**N**o **S**peed **F**eed **BACK 1**. Speed actual value is missing.
NSFBACK2 ("0", "1")	T4	**N**o **S**peed **F**eed **BACK 2**. Speed actual value is missing.
STALL ("0", "1")	T4	**STALL**ing.
TQFLT ("0", "1")	T4	**T**or**Q**ue **F**ault.
TQFLT1 ("0", "1")	T4	**T**or**Q**ue **F**au**LT 1**.
TRIP1W ("0", "1")	T4	**TRIP1W**arning. Warning signal from the TRIP1 module.
TRIP2W ("0", "1")	T4	**TRIP2W**arning. Warning signal from the TRIP2 module.

Output signal

TRIP3 ("0", "1")	T4	**TRIP**ping 3. Trip signal 3.
TRIPWARN ("0", "1")	T4	**TRIPWARN**ing.

PRIDE
Description of function module

TSYL120X
Begin of Load Program

Reference

This document is related to current software diagram for functional modules of TYRAK L/MIDI.

Item designations of functional blocks referred to in this documents as well as delivered preset values and selection rules of parameters can in most cases be found in current software diagram.

Function description

This compulsory function module for TYRAK L, set the start of the load program and defines the sample levels T1, T2, T3 and T4 in milliseconds.

TSYL120X defines the sample level to:

T1 = 12 ms
T2 = 12 ms
T3 = 36 ms
T4 = 108 ms

The INIT level are only executed once after the power supply has been switched on.

The BG level is executed when the processor is idle, all other processor activities has priority over BG.

TSYL120X also defines the stall alarm time to 216 ms.

The module also check the computer board supply voltage.

Parameter description

There are no parameters defined in the module.

Signal list

Input signals

There are no input signals defined in the module.

Output signal

ASUV		Auxiliary Supply Under Voltage.
("0","1")	T4	

Reference

This document is related to current software diagram for functional modules of TYRAK L/MIDI.

Item designations of functional blocks referred to in this documents as well as delivered preset values and selection rules of parameters can in most cases be found in current software diagram.

Function description

This compulsory function module define the background text in the pictures of the operator's panel .

Parameter description

There are no parameters defined in the module.

Signal list

There are no signals used or defined in the module.

TYRAK L

Thyristor convertor with microcomputer for d.c. drive systems, 10 - 2000 kW

Installation

YT 280-308 E, edition 2

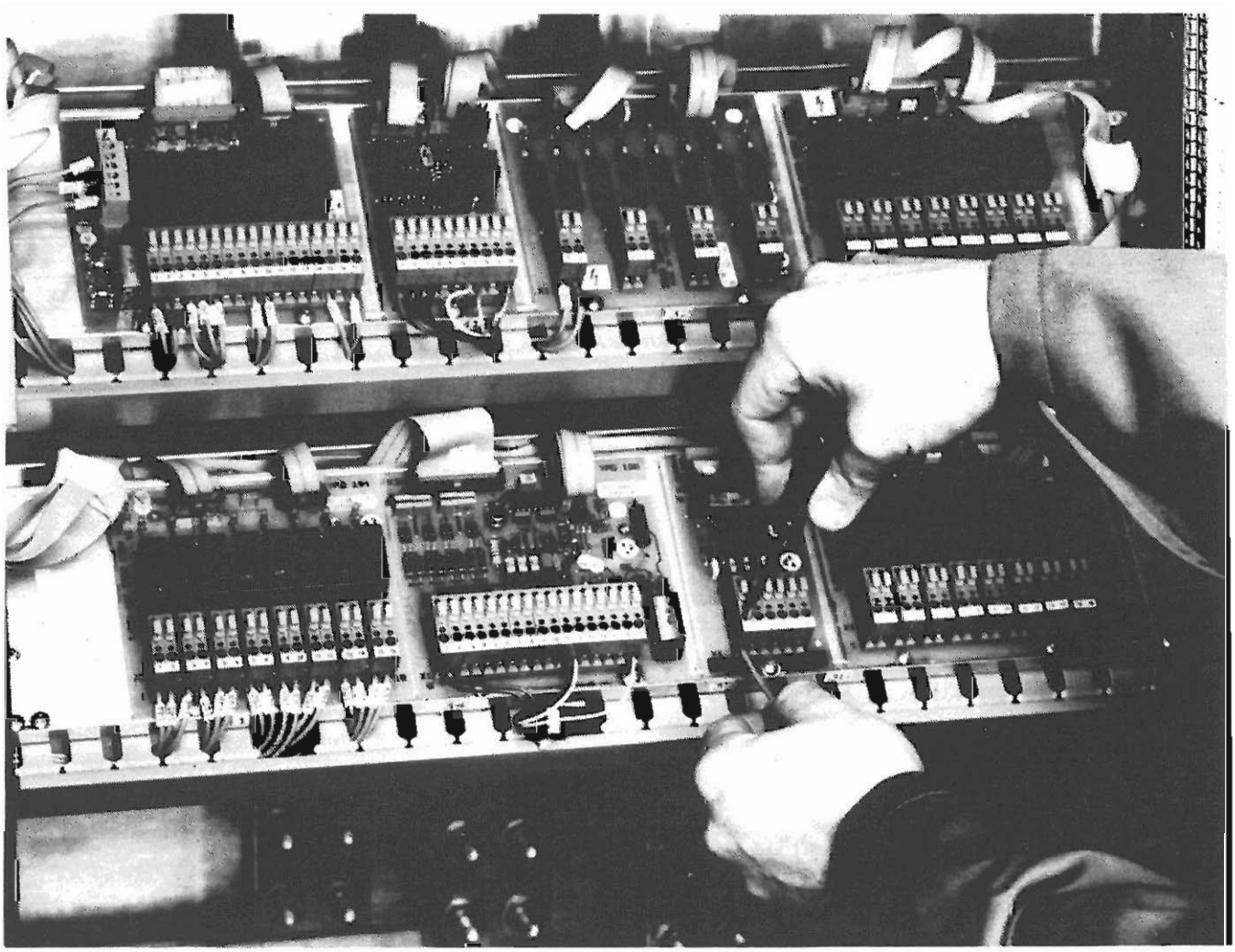


ABB Drives

ASEA BROWN BOVERI

Contents

GENERAL

These instructions apply to single and double convertors of YGMP/YHMP types with current ratings 40 - 3000 A. Note that enclosed dimension drawings could be changed.

TRANSPORT AND STORAGE

The convertors are delivered in packaging suited to the mode of transport. The equipment is to be checked against the transport documents on delivery. Any shortage or damage is to be reported immediately to ABB Drives to avoid delay in installation and commissioning.

If the equipment is not to be installed on delivery, it must be stored in its transport packaging in dry and dust-free premises. The ambient temperature during storage is to be above –25 °C and below +60 °C (max. daily mean temperature +45 °C).

Convertors are delivered in a standing position, fixed to pallets.

If necessary, TYRAK L, 40 - 530 A convertors can be transported in a horizontal position.

Convertor cubicles can be transported by crane using lifting eyes or lifting beams fixed at the top of the cubicle, see fig. 1. When the cubicles are placed in right position, the lifting beams are to be removed.

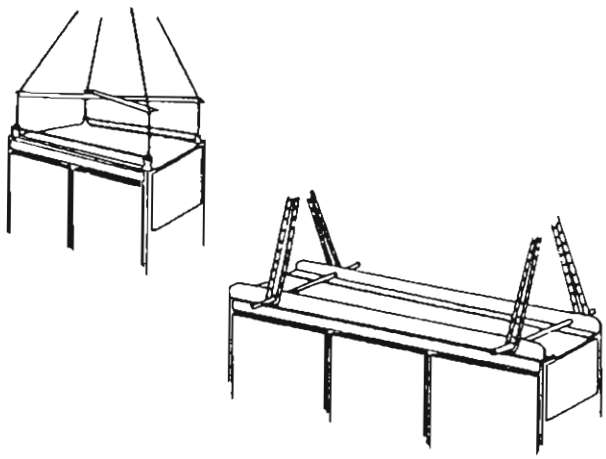


Fig. 1 Lifting instructions

POSITIONING

The convertor is intended for installation indoors in a normal industrial environment with ambient temperatures –5 °C - +40 °C (+50 °C with reduced loading). The air is to be free from dust and aggressive gases.

Convertors provided with air filters can be located in a dusty environment. The filter, which is washable, is to be inspected at regular intervals and cleaned if necessary. (See service instructions).

The least distances from the top of the cubicle to the ceiling and between its rear side and adjacent wall are shown in the dimension drawings. Between cubicle side and wall the least distance is 40 mm.

The design of the cubicle presupposes installation on a flat and well levelled floor (+3 mm). This applies particularly to several cubicles in a row.

Compensation for unevenness in the floor can be provided by adjusting bolts at the corners of the cubicle. See fig. 2.

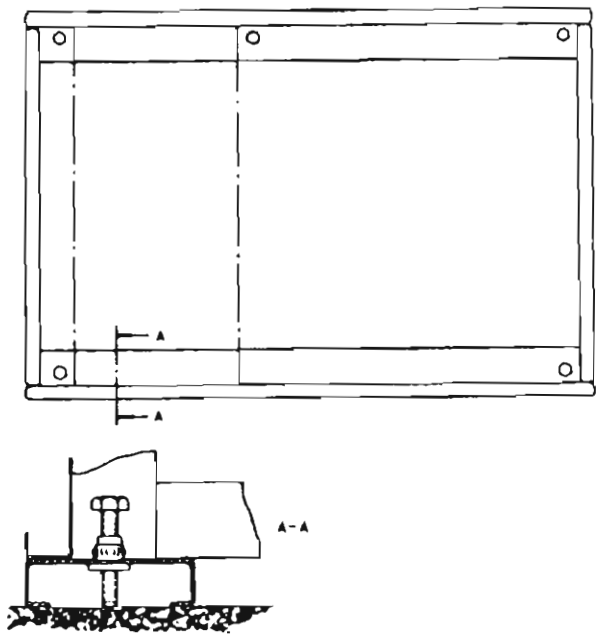


Fig. 2 Adjustment bolts

Cubicles which are to be bolted to each other are to be levelled first. The cubicles, free standing or bolted to each other are not to stand on the adjustment bolts for a long time. Therefore chocks are to be inserted between the bottom beam and the floor to carry the load.

Cubicles are to be bolted to each other before they are fixed to the floor. The connecting bolts are to be tightened to a maximum of 20 Nm. See fig. 3.

In the under frame there are holes for M6-bolt joint at the top, at the foot and in the middle of the vertical girder used for chaining of cubicles to each other. The spacing sleeves from the lifting beams can be used in this matter.

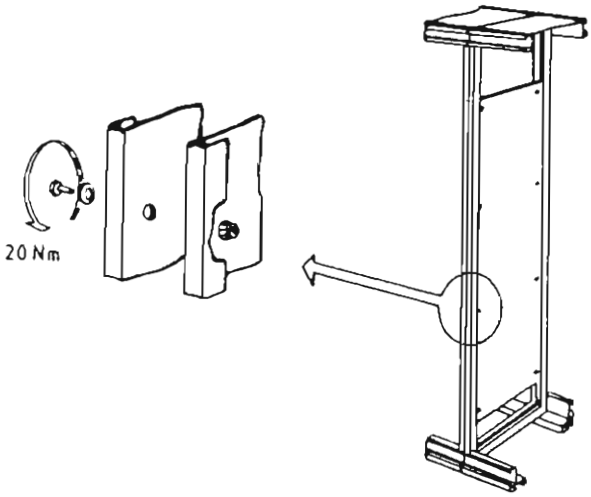


Fig. 3 Cubicle assembly with bolt joint

The dimension drawings include a pattern for locating passages for cables and air intakes and specify the cooling air requirement and the weight of the equipment.

To ensure adequate ventilation of the cubicle, there is to be no external pressure drop. Cooling air passages must remain free at all times.

CONNECTIONS

Main circuits

Connection voltage U_{vN} (V)	Rated direct current I_{dmN1} (A)	Short circuiting current I_{kmax} (kA)
≤ 500	≤ 3000	50
575, 660	650 - 1600	35
575, 660	≥ 2500	45

Table 1 Max. permissible short circuiting currents.

The dimensioning of cables depends on current, voltage and fuse capacity. The catalogue and apparatus list provide the necessary information.

40 - 800 A convertors are provided with load break switch and main fuses at the mains connection.

In convertors with 40 - 530 A ratings, the incoming mains voltage can be connected to horizontal busbars at the top of the cubicle or, by cable, to terminals at the bottom of the cubicle.

In convertors with ratings 650 - 3000A the mains voltage can be connected to horizontal busbars at the top of the cubicle or by cable to a cable cubicle. Which of these alternatives is selected depends on the choice of accessories. See the dimension drawings.

The d.c. terminals are intended for cable connections and are located as shown in the dimension drawings.

Cables for supply to convertors of all ratings normally enter cubicles from below. Cubicles for convertors with ratings 40 - 530 A can be provided with roof panels (accessories) prepared for the passage of cables from above (not d.c. cables).

For 650 - 3000 A convertors with cable cubicle, the power cables enter the cubicles from below.

Jointing of horizontal busbars

The busbars are jointed from the front of the cubicle.

Any protective cover plates in front of the busbars are to be removed to permit access to the joint locations.

The bolts fixing the ends of the bars in adjacent cubicles are to be loosened. In the right hand cubicle, the bolts are to be bolted out so far that the splicing bar can be inserted between the bar and the nut washer.

The splicing bar is inserted to engage the right hand bar bolts and all bolts are then tightened to 40 Nm with a torque wrench. See fig. 4.

Replace the cover plates

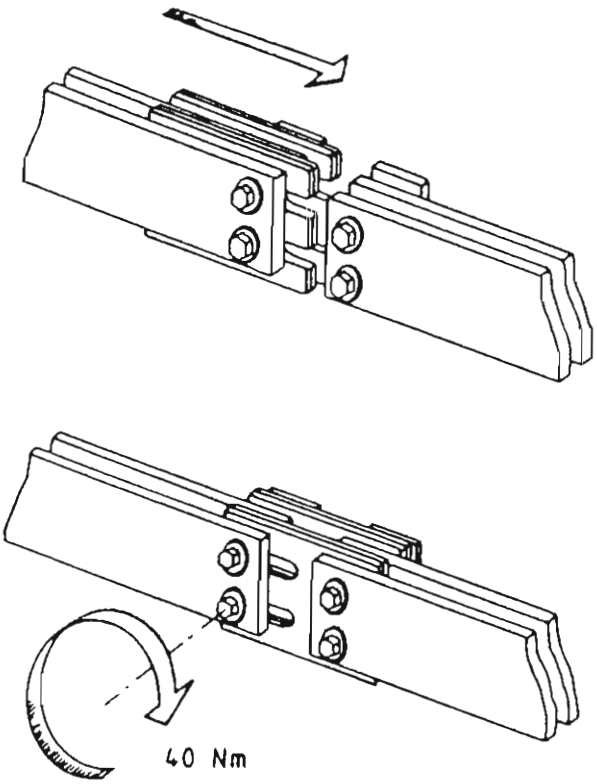


Fig. 4 Jointing of busbars

Jointing of grounding bars

The bars are jointed from the front of the cubicle.

The bolts fixing the terminal clamps on the grounding bars in two adjacent cubicles are to be loosened. The bolts in the right hand cubicle are to be bolted out so far that the splicing bar can be inserted under the clamp.

The splicing bar is inserted under both clamps and the bolts are tightened to 9 Nm with a torque wrench. See fig. 5.

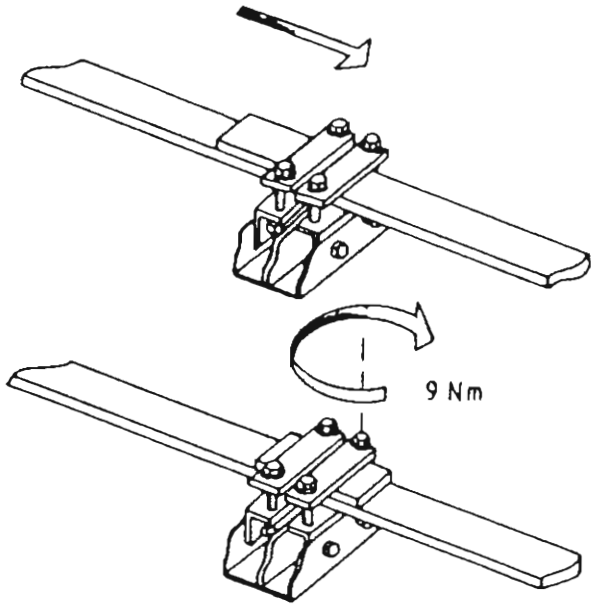


Fig. 5. Jointing of grounding bars

Serial communication for ABB Master

If serial communication for ABB Master is included in the installation, the convertors and the MP 200 are to be connected with coaxial cable A in accordance with fig. 6. If, in addition serial communication for master/follower is included, coaxial cable B is added.

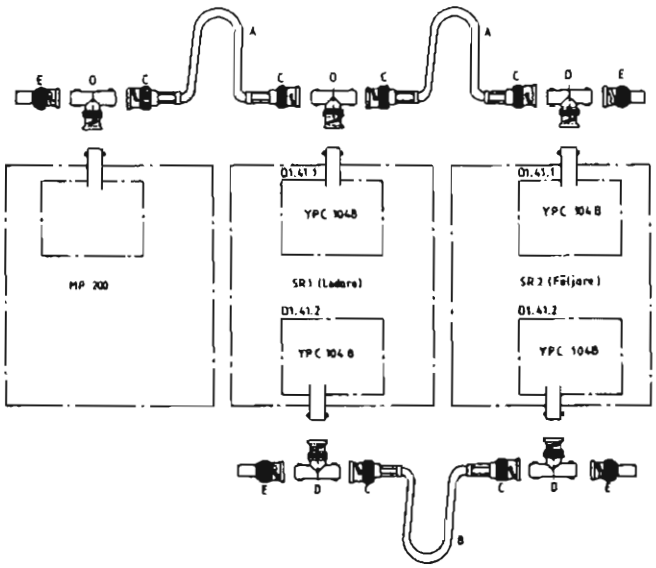


Fig. 6 Coaxial cables for serial communication. Example with one master and one follower.

The connector D and termination E are normally included in the delivery from ABB Drives but not the cables A/B nor connector C. The types of cable and connectors are given in table 2. See Instruction 2096 075-2 for the mounting of connector C on the coaxial cable.

Object	Type	Ordering number
Cable A/B	RG59B/U 75 ohm	1689 0016-1
Connector C	-	5217 423-8
Connector D	T-piece	5217 423-13
Termination E	75 ohm	5217 423-14

Table 2. Connection material for modem YPC 104B.

Other circuits

The supply cable to the field winding of the motor is connected to terminal block B51 (terminal block type UK10 with max connectible area 6 mm^2). See field exciter and terminal block B51 on page 87 of the circuit diagram.

The cables to external fan motors are also connected to terminal block B51, (terminal block type UK5, max. area 4 mm^2). See the fan contactors and terminal block B51 on page 85 of the circuit diagram.

The location of terminal block B51 is shown in the dimension drawings.

CABLE ROUTING

The convertor contains both high power apparatus and electronics which means that the circuits can be divided into two groups, those generating interference and those sensitive to interference. The former are the main circuits and the latter the electronic control circuits.

To minimize the risk of interference effects, conductors sensitive to interference should be routed separately at least 100 - 300 mm apart, from those generating interference. Signal cables (up to 110 V d.c., a.c.) which are connected to optocouplers on the control equipment should not have a length greater than 300 m.

Electronics signals connected to the neutral of the electronic system (references, actual values and certain digital signals) are to be conducted in screened cables. The screen (SC in the circuit diagram) is to be grounded at special terminal blocks in terminal block row B50, in order to avoid the development of inductive currents.
The cables are to be installed in accordance with the relevant rules and regulations.

Coaxial cables for serial communication

Coaxial cables to the convertors in accordance with fig. 6 are to be connected to the control equipment on the door of the cubicle. The coaxial cables are then drawn out to the door immediately above the control equipment (not between door and control equipment).

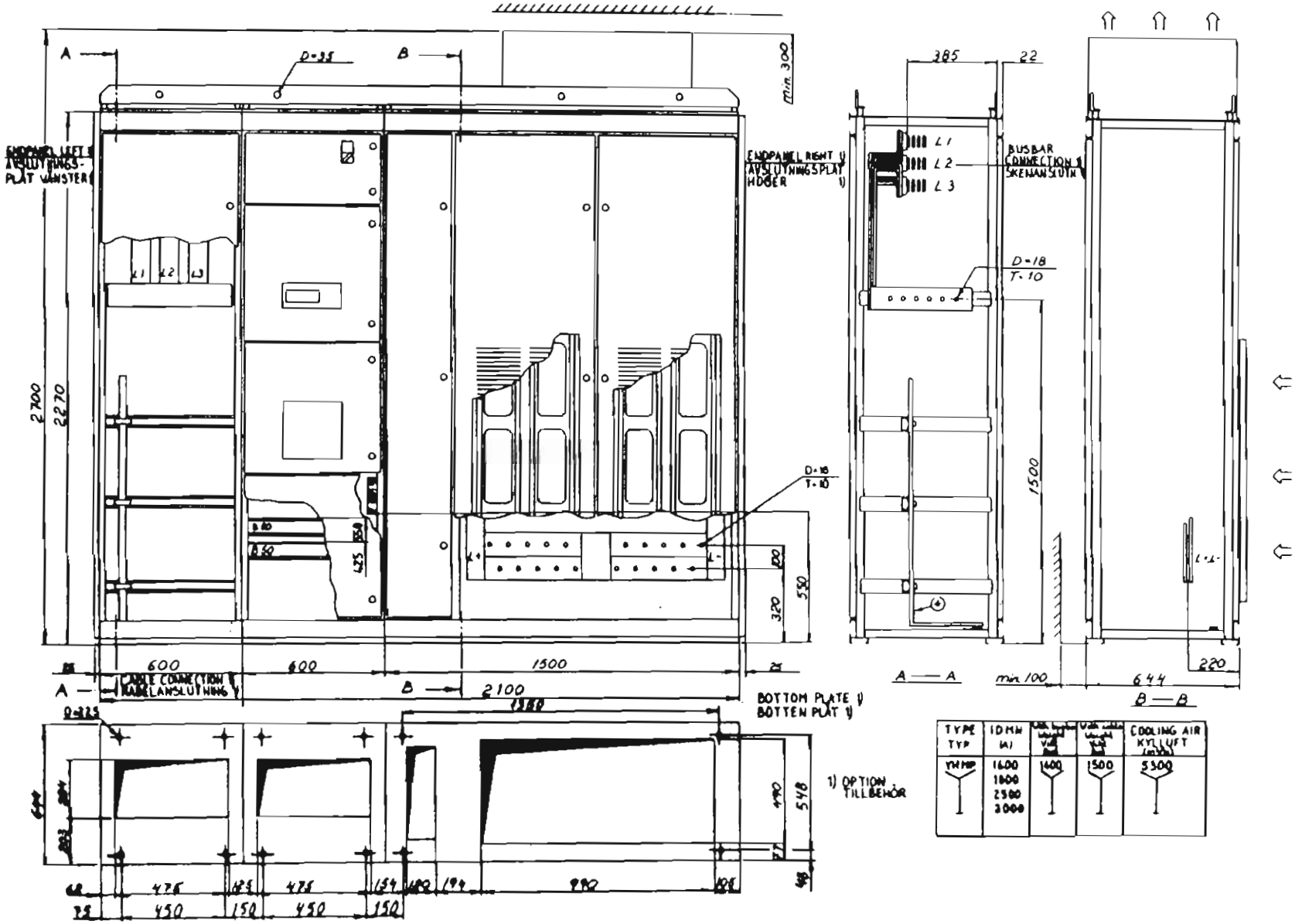
GROUNDING

All units in the convertor are connected electrically to the cubicle frame via their fixings.

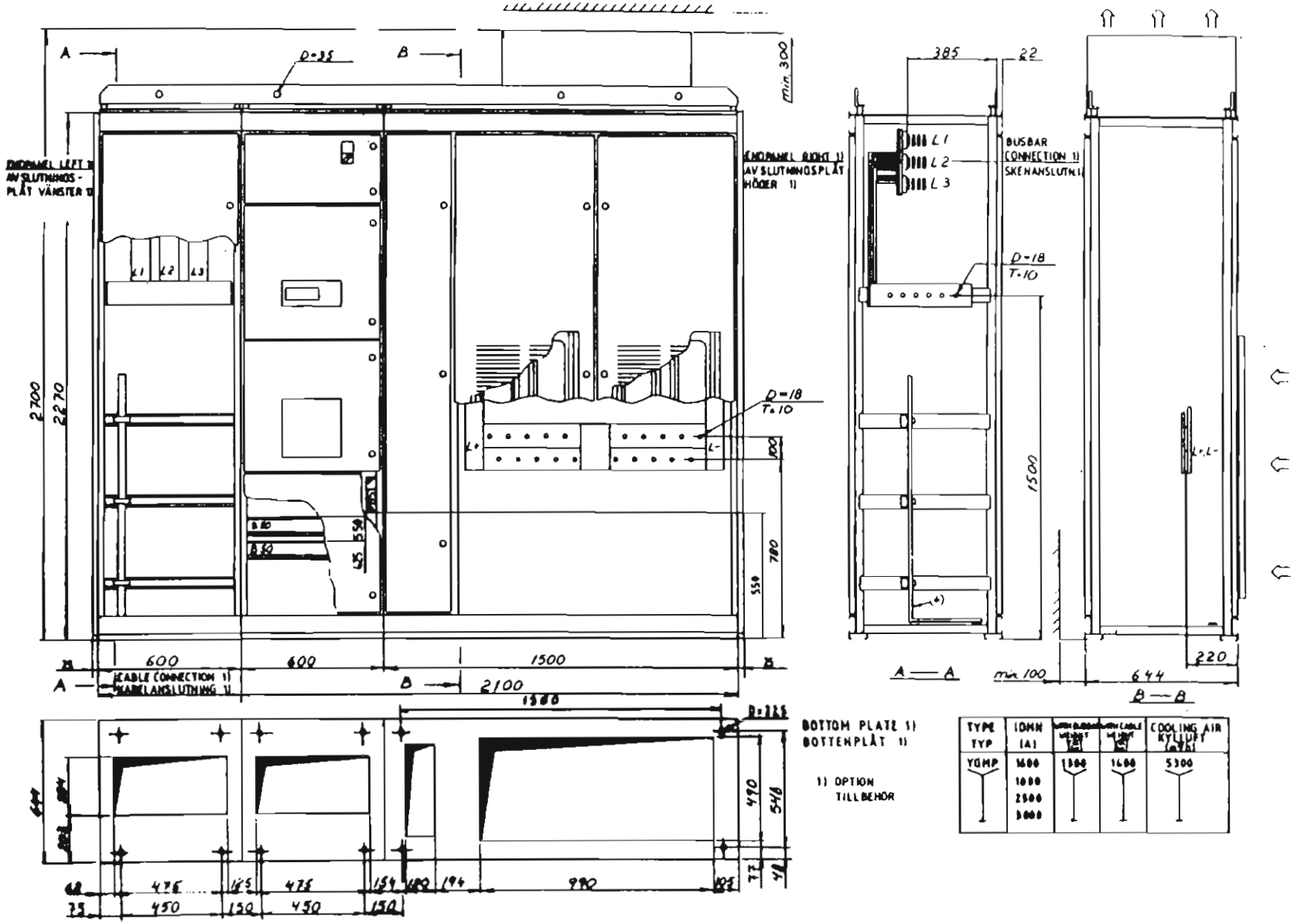
The cubicle frame is provided with a grounding clamp to which a ground line or bar to a reliable ground is to be connected. The ground line is dimensioned in accordance with the relevant regulations.

The neutral (MN) for the operating voltages M1L and M2L is connected to the external zero (OVE) of the electronic system on terminal block board YPQ 104, B50.11. See sheet 29 of the circuit diagram. Both neutrals are directly grounded via terminal block X1.11 on the supply transformer 56. See sheet 82 of the circuit diagram.

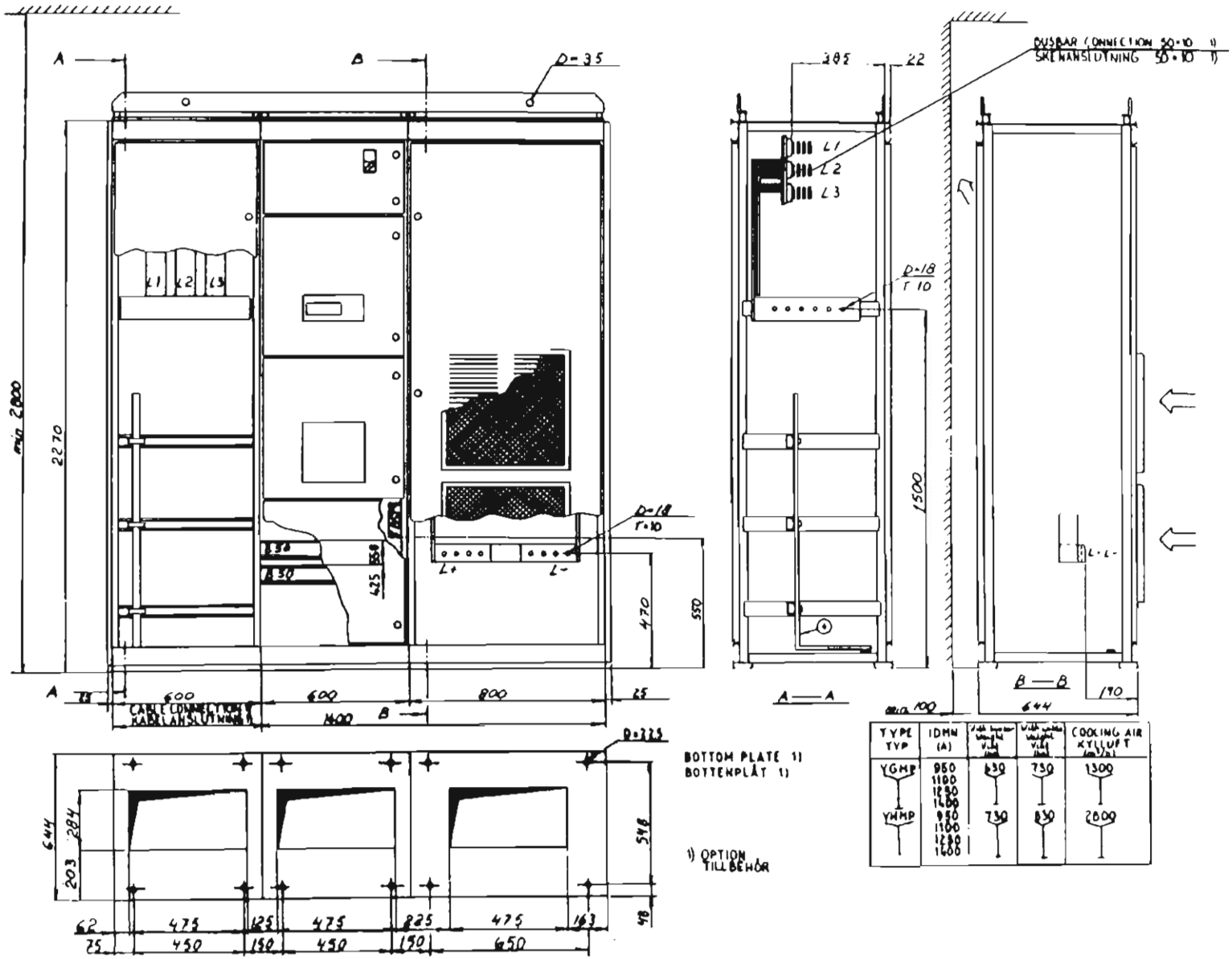
Note!
In drive equipment with combined control of several convertors, the zero system is to be grounded at one point only. This is obtained by opening terminal block 56.X1.11 in all of the connected convertors except one.



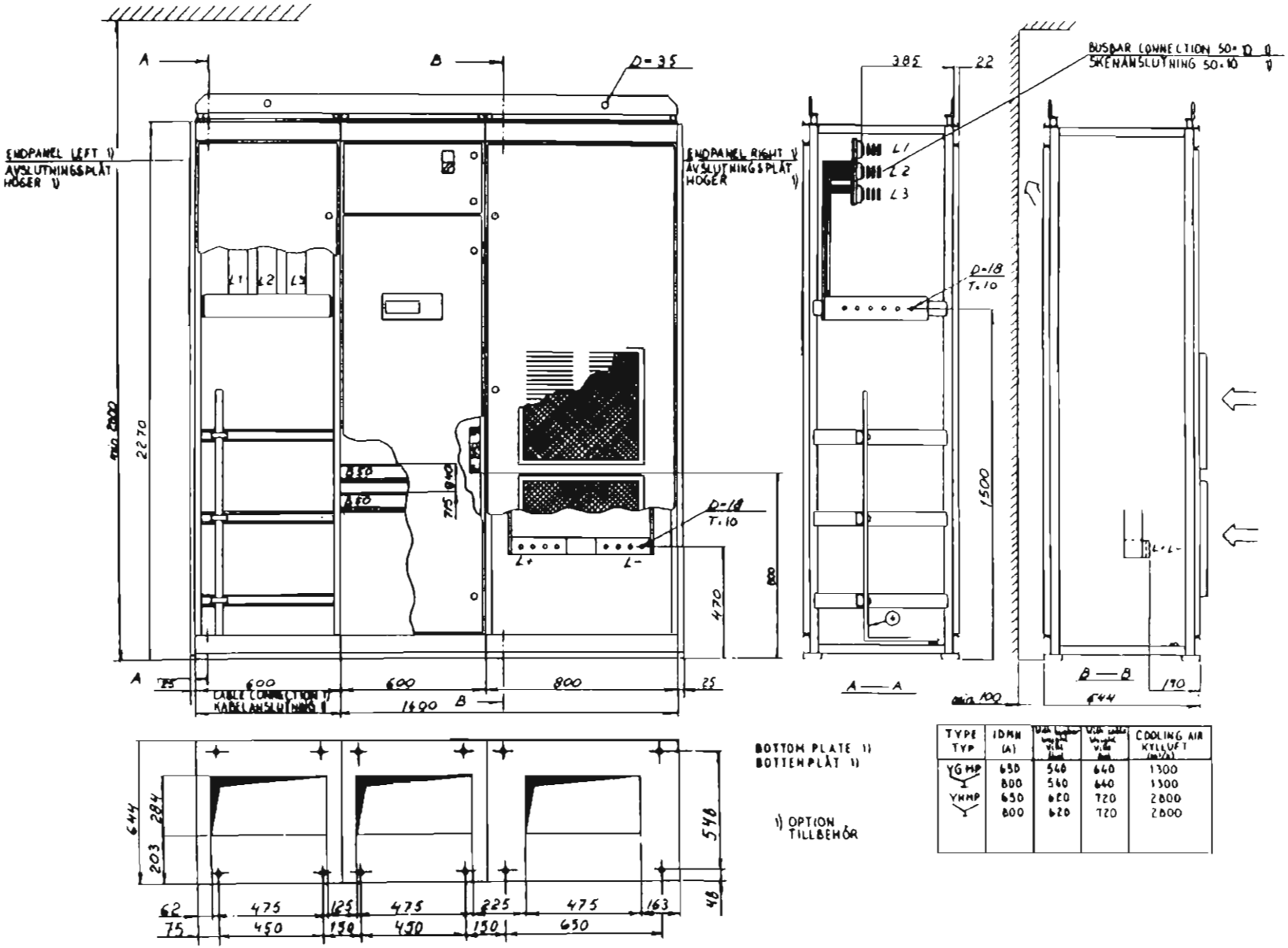
TYPE TYP	IDMW (W)	[illegible]	[illegible]	COOLING AIR KYLLUFT (m³/h)
YWMP	1600 1800 2500 3000	1400	1500	5300



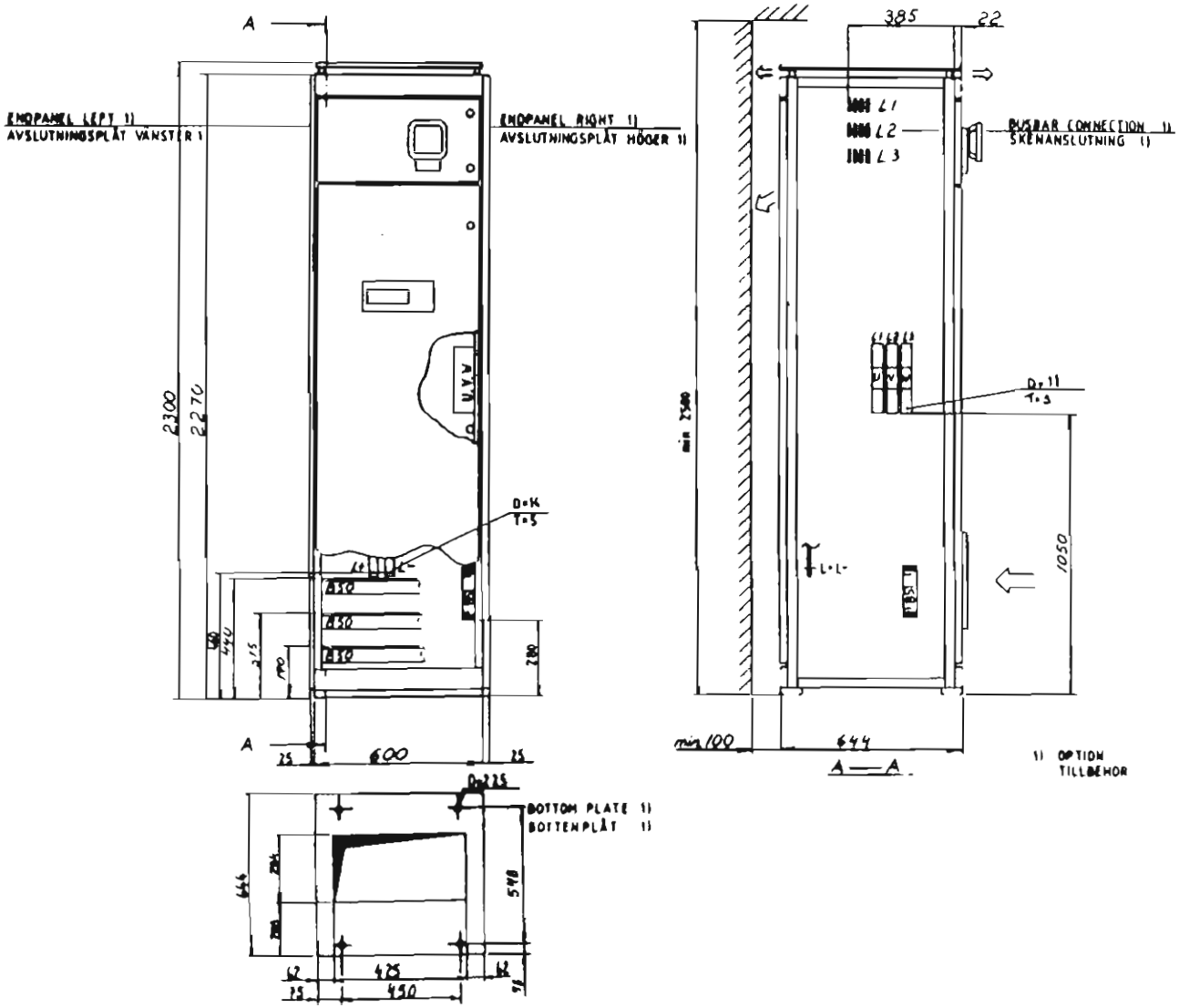
TYPE TYP	IDMN (A)			COOLING AIR KYLLUFT
YGMP	1600	1300	1600	5300
	1000			
	2500			
	3000			



TYPE TYP	IDMN (A)	Width without cabinet W1 (mm)	Width with cabinet W2 (mm)	COOLING AIR KYLLUFT (m³/h)
YGMP	950 1100 1250 1400	630	730	1300
YMMP	950 1100 1250 1600	730	830	2000

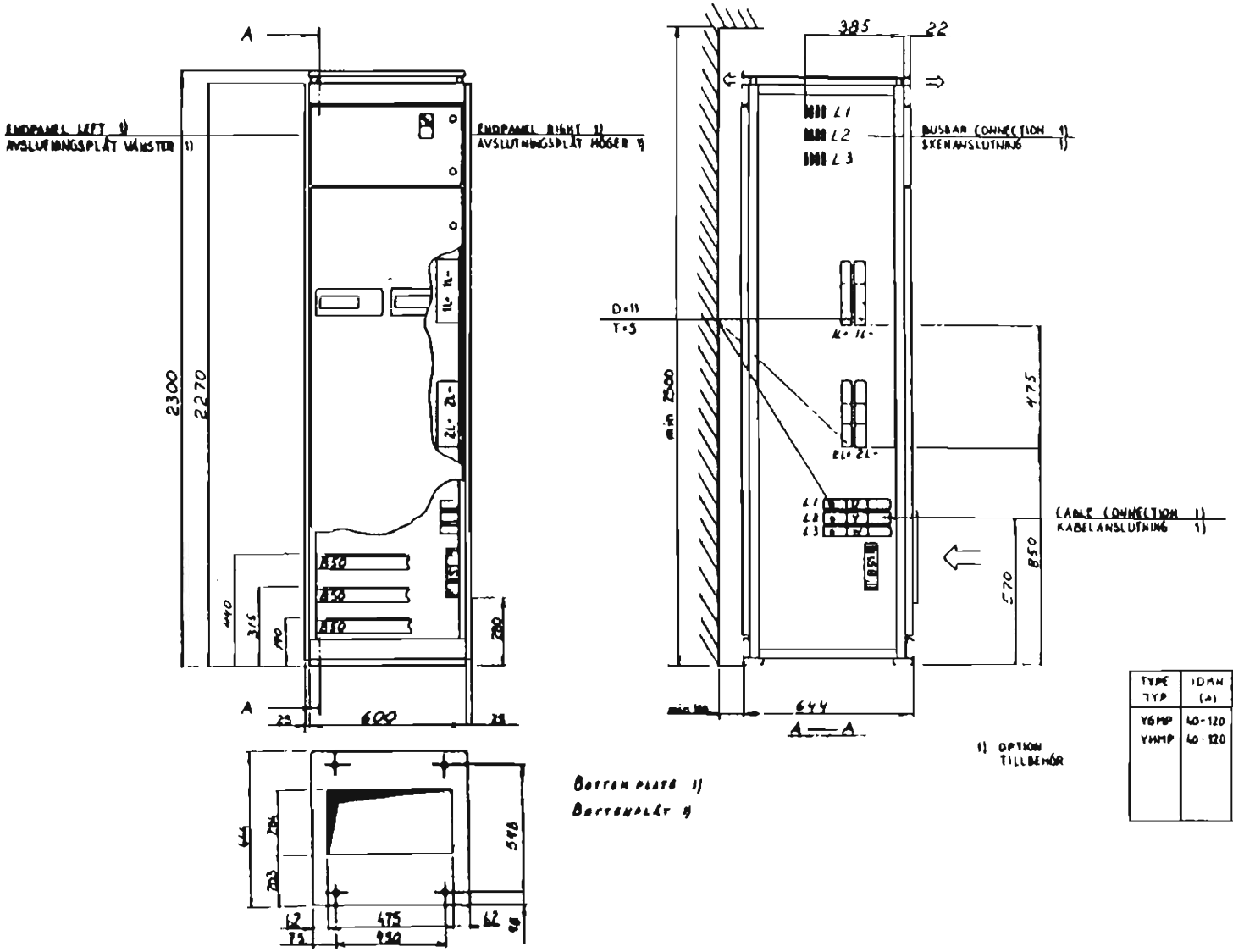


TYPE TYP	IDMN (A)	[illegible]	[illegible]	COOLING AIR KYLLUFT (m³/s)
YGMP	630	540	640	1300
	800	540	640	1300
YHMP	630	620	720	2800
	800	620	720	2800



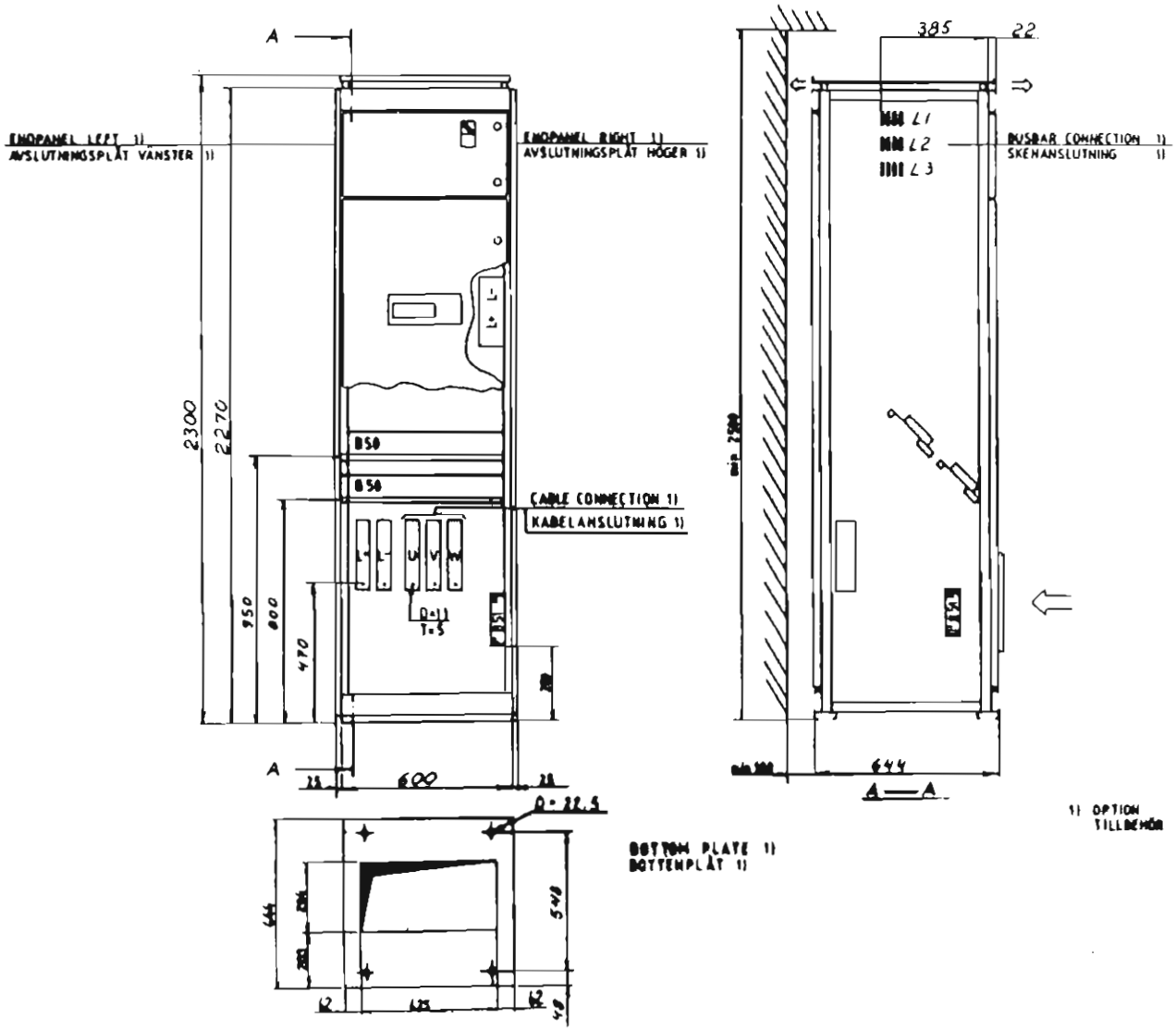
1) OPTION
TILLBEHÖR

TYPE TYP	IDMN (A)	WEIGHT VIKT (kg)	COOLING AIR KYLLUFT (m³/h)
YGMP	180 - 400	260	400
YGMP	530	260	500
YHMP	180 - 400	265	400
YHMP	530	265	500



1) OPTION
TILLBEHÖR

TYPE TYP	IDMN (A)	WEIGHT VIKT (kg)	COOLING AIR KYLLUFT (m³/h)
Y6MP	60-120	300	200
YMMP	60-120	300	200



1) OPTION
TILLBEHÖR

TYPE TYP	IDMN (A)	WEIGHT VIKT (kg)	COOLING AIR KYLLUFT (m³/h)
YDMP	40-120	230	100
YHMP	40-120	230	100

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Information YT 280-308 E
Reg. nr. 4890 066-392
891011, edition 2

To be ordered from
ABB Drives AB/Dept. DFA.

TYRAK L / MIDI

Thyristor convertor with microcomputer for d.c. drive systems

Commissioning

YT 280-331 E, Edition 2

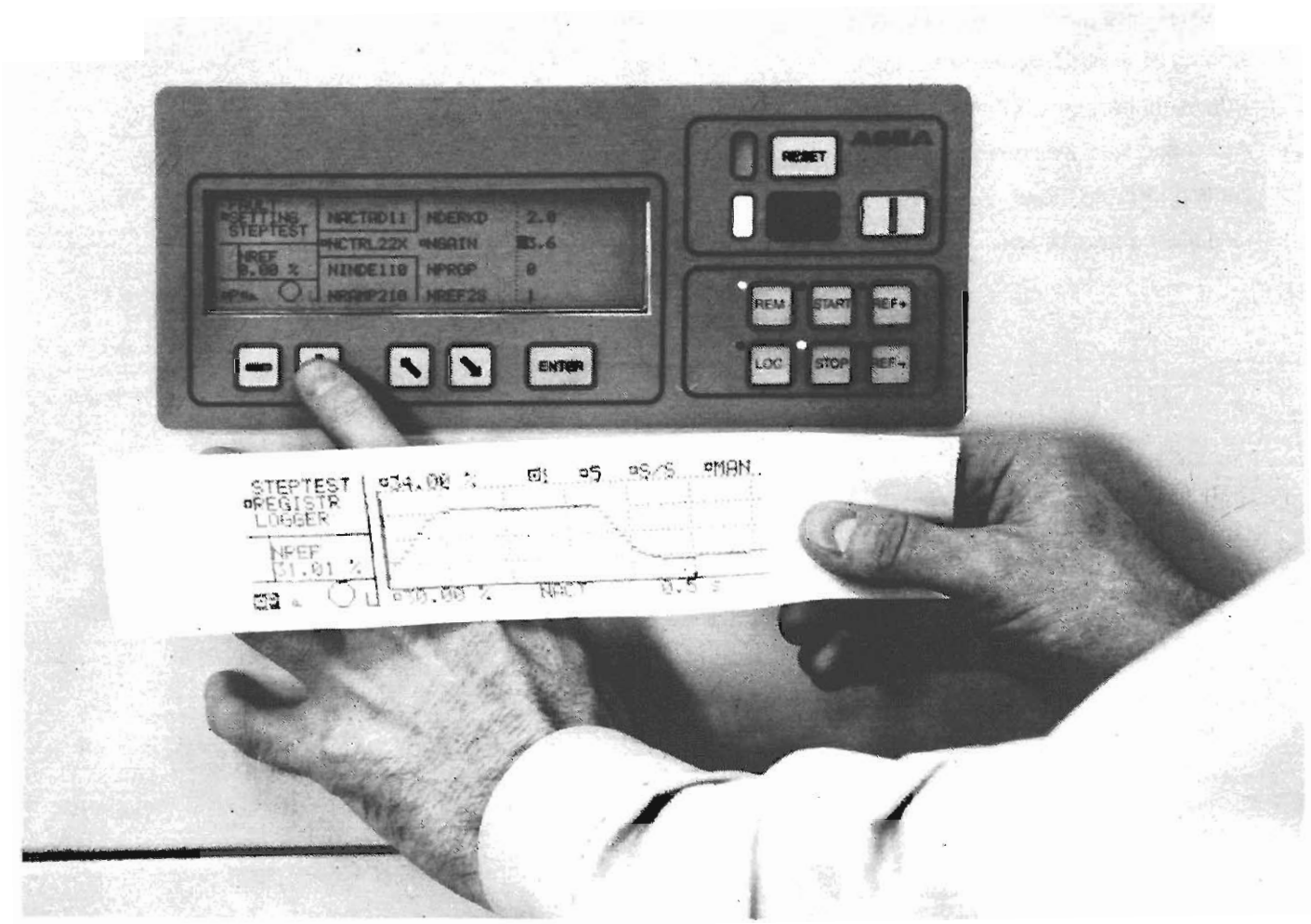

ABB Drives

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Contents Page

INTRODUCTION

This commissioning instruction is adapted to the latest release of software library REL3_X, VAX, REL04_XX, PCASE and GENERAL01_XX, PCASE.

This Information describes the commissioning of the convertor, speed control and all protective and monitoring functions.

If the convertor is provided with a superior reference system and controllers, the supplementary commissioning instructions at system level must be studied.

This document presumes that the convertor is enclosed but the procedures are, in principle, the same for the enclosed convertor as for the convertor module and the instructions apply to this also.

It is also assumed that the equipment includes an operator's panel (OP-panel).

The commissioning technician must have read the description of the OP-panel, chapter **"Operator's Panel Management"** of operator's panel or have learned otherwise how to use the OP-panel.

The figures in brackets in the section headings are the numbers of relevant sheets of the circuit diagram.

The ON and OFF buttons on the OP-panel referred to in this document are marked I and O respectively. The start and stop buttons are normally the buttons on the OP-panel marked START and STOP.

When the convertor is tripped, (red lamp illuminates on the OP- panel) the convertor must be reset by pressing the RESET button on the OP-panel.

A twinkling red lamp on OP-panel indicate warning in the convertor. The convertor will during warnings still be phased advanced, i. e. signal RDYREF will still be high.

The speed reference can be increased and decreased by pressing the REF + and REF– buttons respectively on the OP-panel.

On delivery of the equipment, the digital input and output boards are connected to dummy signals unless the order for the convertor requires otherwise.

Connections required for the drive are intended to be made in accordance with the chapter **"Input and Output boards"**. This connecting of signals can naturally be performed successively during the commissioning and is documented by entering signal name and sheet reference in the circuit diagram.

To avoid problems when commissioning, the 1 F capacitor mounted on the memory board YPR 104 is to be short-circuited between pins X21:1 and :2 adjacent to the capacitor.

This action is absolutely necessary when the PROM on the memory board has been replaced.

Because of the high internal resistance in the capacitor, the short-circuiting of the capacitor must be maintained for at least one minute.

When switching on the supply to the convertor the text on the display will be "TYRAK" for approximately 30 seconds. When "TYRAK" text is replaced with the INDIC-picture it will be possible to control the convertor from OP-panel.

The parameters and connections in the convertor are set up during the test in workshop in correspondence with the circuit diagram for the convertor.

Parameters crossed over and signals with brackets in circuit diagram can not be set from OP-panel. It is however possible to set these parameters from an external terminal, type MICROSCRIBE, MA 214, 215, Toshiba etc.

The parameter values set on delivery are not to be changed unless specified in the commissioning instructions or otherwise.

The commissioning is documented by printing the different parameter settings on a printer and fixing these in the circuit diagram, or in a sep. list, at the appropriate places.

Connections made with the signal switch box during the commissioning are written into circuit diagram or printed out and fixed in the documentation.

The step response from the adjustment of the current controller and the speed controller are also printed out to document the commissioning.

If no printer is available, the new parameter settings are to be noted on the circuit diagram by hand.

Function modules consist normally of an abbreviated description of the function etc of the module.

Example:

IACTRL7X: I(current) **A**rmature **C**on**TR**o**L**.

IACTRL is the reference to the current controller.

7; indicates the version number and can be 0 - 9 (considerable variations).

X; indicates the revision number and varies 0 - 9 (lesser program changes).

The revision number does not appear on the circuit diagram. The OP-panel can be used to determine the revision number of the function module. The required function module can be paged forward in the menu MEASURE thus providing the revision number.

EQUIPMENT REQUIRED FOR BOTH SIMPLE AND ADVANCED DRIVES

1 pcs. Multimeter 0 - 1000 V d.c. and a.c., Ri ≥10 kohm/V d.c. such as an AVO meter or an UNIGOR meter. It should be possible to measure field current up to 20 A d.c. if diode field exciter or controlled field exciter are included in the equipment.

4 pcs. Instrument leads with 4 mm banana contacts and reduction sockets (catalogue number SK 175 2160) for 2 mm terminal contacts.

1 pcs. Printer, for printing out the parameters, ABLE 24 including cable.
Catalogue number YT 290 000- A.
Accessories:
Colour tape, catalogue number 5697 799-3.
Paper roll, catalogue number 5697 799-4.

1 pcs. Potentiometer, 10 kohm, ≥0.5 W, linear for setting of references and simulation of signals such as ABB article number 5248 2051-10.

1 pcs. Oscilloscope (memory oscilloscope will make it easier) which can be line-triggered, to be used for trimming of rotor current control.

1 pcs. Recorder, 2 channels, high-impedance input.

1 pcs. Hand tachometer with pulse generator feedback.

1 pcs. Microscribe/Toshiba/MA 214, 215 etc. A terminal is needed if parameters, connection of signals, which are not available through OPC, need to be changed.

The following documents are also needed:

- Circuit diagram (soft and hardware)
- Apparatus list
- Description of convertor
- Operator's panel management which informe:
  - How to operate the convertor in local mode
  - Indication of signals
  - Measure of signals
  - Setting of parameters
  - Step function for trimming
  - Connect signals to I/O
  - Logger
  - How to print

  Remark! When you should print out all the OPC-available parameters, you press the + button instead of ENTER.

SAFETY MEASURES

Protection of personnel

The following rules are to be observed to reduce the risk of accident to personnel:

A. Never work alone when commissioning Tyrak equipment.

B. Ensure that all concerned know how the voltage to the installation is switched off.

C. Inform persons near the machine that it may start without warning. Screen the machine if possible.

D. If the machine rotor is provided with mechanical locking, ensure that the locking does not become a danger to the surroundings. See also "**Equipment, point D**"

E. Work in the convertor should be performed as far as possible with the voltage disconnected from the section concerned. The auxiliary supply should also be disconnected.

Equipment

The following instructions should be obeyed to avoid damage to d.c. machine, convertor or control equipment:

A. Do not stop convertor operations with the main circuit breaker. Press the OFF-button first.

B. Set protections at a low level when beginning the commissioning. For example, when adjusting the armature current control, the tripping level of the overspeed protection should be set very low.

C. If the d.c. machine is located so that it cannot be seen or heard by the person performing the commissioning, it should be kept under observation by another person who can give a warning, or disconnect the voltage, if the motor should begin to race.

D. When adjusting the armature current control and compensation of the armature voltage-drop with EMF-control, the armature current is conducted through the d.c. machine at stand-still. The field-exciter is disconnected on these occasions but the field-winding of the motor must then be short-circuited or connected to the field exciter (risk of high induced voltages).

Static friction is then generally sufficient to hold the machine stationary, specially in the case of larger machines. If a small machine begins to give trouble by racing, the rotor can be locked mechanically. It is then important that the means of locking is so strong that it does not break up under load and endanger the surroundings.

E. Current is not to be conducted through a stationary rotor for more than 20 s. at a time. The current should not exceed the rated current and the rotor should be rotated between each loading to avoid stressing the same segment in the commutator each time.

F. If the cooling equipment of the motor has not been installed when the field exciter is commissioned, there is a risk of overheating of the field winding. On such cases, the field current is only to be applied for 2 minutes at the time.

COMMISSIONING PROCEDURES

General

Irrespective of the drive type it should be possible to commission the field exciter, control equipment, convertor and speed control in the same manner.

It should not be necessary for the master control and reference generation to be commissioned previously except that the master control should be operational if a mechanical or dynamic brake is provided.

Recommended sequence of operations:

1. **Perform certain checks and settings without voltage in the main circuit.**
2. **Check of the ON/OFF circuits and the fan supervision.**
3. **Start the field exciter and trim.**
4. **Start the speed control provisionally.**
5. **Trim the rotor current control.**
6. **Set the rotor current limitation.**
7. **Trim the EMF control.**
8. **Trim the speed control, voltage adaption and rate of change of the rotor current.**
9. **Set the other protective and supervision functions with which the convertor is equipped.**
10. **Check the input and output boards.**

CHECKS AND SETTINGS BEFORE VOLTAGE IS APPLIED TO THE MAIN CIRCUIT

Check of earthing, auxiliary supply circuits (29) or (82)

When several convertors have a common reference system, the neutral of the auxiliary supply is to be earthed at one point only.

Check also the jumpers on the boards in the convertor according to circuit diagram.

Check of d.c. machine

Check that no transport damage has occurred. When commissioning the convertor, it must be considered that the DC-motor concerned is probably being started on site for the first time. The motor maintenance and commissioning instruction are to be observed, where relevant, both before and during the commissioning.

If the object driven cannot rotate in the reverse direction or can only be run slowly at start without risking damage, the coupling between the d.c. machine and object driven is to be open with the separate sections fixed to the shafts of machine and object. Check this with the manufacturer or user of the equipment.

The armature circuit, field circuit and tachometer/pulse transmitter are to be connected. Check particularly that the field windings are connected for the correct voltage. Any series winding is to be active.

Check the contact between the brushes and the commutator.

Setting of thermal protection (85) (Tyrak L)

The thermal relays 4, 5 and 6 in "Control unit, external fans" are to be set for the rated current of the different motors. Either automatic or manual resetting of these relays after tripping is also to be selected. On delivery, automatic resetting (A) is selected.

Check of supply voltage

Check by measurement with a voltmeter that the mains voltage corresponds to the rated voltage for the convertor, UV_N ± 10 %.

Remove the main fuses and then switch on the main circuit breaker. The text "TYRAK" then appears on the display.

Note! Do not control the convertor from the OP-panel before "TYRAK" disappears from the display and is replaced by INDIC menu.

Check of emergency switch-off and emergency stop relay (29) (Tyrak L)

As standard, the convertor is provided with a mechanical emergency switch-off relay (- AK1.K1.1, 2), which, when it drops out, deactivates the equipment. Check that the relay is active (i.e. voltage is available at terminal block X1:6 on terminal block board YPQ 104) and check which external push buttons deactivate the relay. The input signal has to be inverted in the software and is connected to a software signal which gives OFF-commands e.g. the signal OFFREM with general drive system applications.

The convertor can be provided with an optional mechanical emergency stop relay (- AK1.K2.1, 2) which, on dropping out, activates a stop command (and, if required, braking to stop) and then deactivates the equipment via relay - AK1.K1.1, 2. Check that the relay is activated (i.e. voltage is available at terminal block X1:5 on YPQ 104) and check which external push-buttons deactivate the relay. The input signal has to be inverted in the software and is connected to a software signal which activates an emergency stop command e.g. the signal EMSTOPA in general drive system applications.

Check of phase sequence (73)

The convertor electronics including the trigger pulse system is designed to function with both positive phase sequence i.e. L_1, L_2, L_3 and negative phase sequence L_1, L_3, L_2.

Note! On delivery, the convertor electronics and cooling fans are connected for positive phase sequence.

Measure with the OP-panel signal PHSEQCW1 in the function module IACTRLXX.
If this signal is "1", the phase sequence is positive L_1, L_2, L_3, and therefore correct. If however the signal is "0", the convertor supply negative phase sequence L_1, L_3, L_2.

The following 2 alternatives are then available:

Alternative 1
Disconnect the voltage and shift two of the incoming phases. Switch on the main circuit breaker and check that the signal PHSEQCW1 is "1", for positive phase sequence L_1, L_2 and L_3.

Alternative 2
The parameter PHSEQCW (IACTRLXX) is set to "0" via the OP-panel. Negative phase sequence is now selected which means that the phase sequence to the cooling fans in the converters with 3-phase-supplied cooling fans must be reconnected. The phase sequence of external fans must also be reconnected. Switch off the main circuit breaker, perform the re-connection and switch on the main circuit breaker.

Connections of signals with a signal switch-box (CONNECT)

On delivery, certain connections are performed as standard unless otherwise agreed upon. The convertor can normally be controlled from the OP-panel i.e. local control. In general drive systems, a channel on DIN11 (29) is also connected to OFFREM. Channel 2 is normally coupled to this signal and the channel is sign-reversed when the parameter DI11.2IN, DI11.1NV (Function Library GENERAL01_XX) is set. OFFREM gives electrical disconnection.

When a program is made, the function modules selected are linked together. During the linking, signals with the same name will be connected.

Inputs to function modules not connected are placed in two modules, CONNECT1 and CONNECT2.

Two modules could be needed because the number of signals could be too many to be handled by one module.

In module CONNECT1 signals in the alphabet from A to M are placed.

In module CONNECT2 signals in the alphabet from N to Z are placed.

How to use the CONNECT-function, see "Operator's panel management".

INPUT AND OUTPUT BOARDS

Analog input board (36)

Analog input is normally used for the following:

External references, actual value feedback from rotor voltage measurement, actual value feedback from temperature transducers with Pt100-elements and actual value feedback from tachometer generators.

A speed indicating instrument, ±10 V, for external display of the speed, can also be connected to the board.

Both current and voltage references can be connected to the analog input board. Current references 0 - 20 mA and 4 - 20 mA. In these cases, strap 1 - 2 at the input is to be inserted to permit the passage of current through the 500 ohm resistor at the input. With voltage references, 3 - 4 can be strapped instead.

With voltage reference with differential input, neither strap 1 - 2 nor 3 - 4 is to be inserted.

The reference level is selected with parameter AI34.(1 - 4)MO in module AIN341X.
The reference can be selected for 0 - 20 mA (0 - 10 V), 4 - 20 mA or –10 V to +10 V.
The setting of the parameter is shown in the table below and the circuit diagram, sheet 36.

Reference inputs	AI34.(1 - 4)MO
0 - 20 mA (0 - 10 V)	0
–10 - +10 V	1
4 - 20 mA	2

Function Library GENERAL01_XX
The reference level is selected with parameter AI34MODE in module AIN341X.
The reference can be selected for 0 - 20 mA (0 - 10 V), 4 - 20 mA or –10 V to +10 V.
The setting of the parameter is shown in the circuit diagram, sheet 36.

When the analog input board is used for armature voltage measurement, neither straps 1 - 2 nor 3 - 4 for the channel concerned is to be used. YPG 105 or YPG 110 is to be strapped for 10 V.

When the analog input board is to be used for feedback of temperature values from a Pt100-transducer, neither strap 1 - 2 nor 3 - 4 for the channel concerned is to be connected on terminal block board YPG 106. On I/O board YPG 105 or YPG 110, the channel concerned is to be strapped for 1 V.

Channels 2 and 3 have a multiplication element. The signal can be multiplied or sign changed with parameter AI34.2MU or AI34.3MU. On delivery the parameters are set to 1.000.

On delivery, the 4 channels on the analog input board are zero balanced. If however it should be necessary during commissioning, channel 1 is zero-balanced with R58, channel 2 with R57, channel 3 with R60 and channel 4 with R59.

Analog output board (38)

The I/O-board for analog output can either be YPM 102 or YMP 106.
YPM 102 has 8 Bits resolution and four channels.
YPM 106 has 12 Bits resolution and two channels.

Check that the strapping of the board is in agreement with that shown in the circuit diagram and that this is in agreement with the instrument connected to the connection unit, board YPM 105.

The strapping can be performed for either 0 - +10 V or –10 V - +10 V. Parameter AO35.1MO or AO35.2MO on function module AOUT35 must be set at the same time, depending on whether unipolar mode (0 - +10 V) or bipolar mode (–10 V - +10 V) is required. The parameter is to be set to "0" with unipolar mode and to "1" when the channel is to be bipolar. (This is also shown in circuit diagram, sheet 38).

Function Library GENERAL01_XX
The strapping can be performed for either 0 - +10 V or –10 V - +10 V. Parameter AO35 on function module AOUT35 must be set at the same time, depending on whether unipolar mode (0 - +10 V) or bipolar mode (–10 V - +10 V) is required. The parameter is shown in circuit diagram, sheet 38.

The function is to be checked further on during the commissioning in a suitable manner.

Digital input board (30, 31)

All control signals connected to the board are operated individually. At the same time, the LED on terminal board YPI 105 will illuminate.

The signal to which the channel is connected can be measured on OP-panel in one of the CONNECT-modules.

If required the signs of all the channels can be reversed, channel 1 and 2 from OP-panel.

To sign inverse channel 3 - 8 a terminal has to be used.

Digital output board (32, 33)

All control signals connected to the board are operated individually. At the same time, the LED on terminal board YPO 104 will illuminate.

The signal to which the signal is connected can be measured on OP-panel in the module from which it is connected.

To sign inverse the channels a terminal has to be used.

Connection and disconnection of digital speed feedback board and of analog and digital input and output boards

On delivery, the convertor hardware includes input and output boards as described in the technical appendix. In these cases, the parameter (e.g. parameter AAO35, page 38) which connects the boards via the software, is set to "1".

If during commissioning or fault tracing the convertor is to be supplemented with one of the above named boards, such as an analog output board, the following procedure is to be followed.

1. Open the load disconnector.

2. Fasten with screws the terminal block board YPM 105 to the B50 terminal block. Connect auxiliary supply from board A1 (A11) YPQ 103, contact X32, to contact X32 on terminal block board YPM 105 with a 10-conductor ribbon cable.

3. In the normal case, fix I/O board YPM 102 in position 35 on the computer board YPP 105 (the location is shown on the circuit diagram) and connect a 10-conductor ribbon cable between the terminal block board YPM 105, contact X31 and I/O board YPM 102, contact X31.

4. Close the load disconnector and set, in menu SET on the OP- panel, parameter AAO35 to "1". The coupling in the software is performed during the initialization of the program. Open the load disconnector briefly for this. The analog output board can be used when the load disconnector is closed again.

If the digital output board is to be removed for some reason, the following procedure is to be followed.

1. Set in function module DOUT 33 on the OP-panel, parameter ADO 33 to "0" and open the load disconnector.

2. Close the load disconnector and check that the red LED on YPO 103 illuminates.

3. Open the load disconnector and remove the board.

Connection board YPQ 108

Analog input channels (27)

Analog input is normally used for the following:

External references, actual value feedback from rotor voltage measurement, actual value feedback from temperature transducers with Pt100-elements and actual value feedback from tachometer generators.

A speed indicating instrument, ± 10 V, for external display of the speed, can also be connected to the board.

Both current and voltage references can be connected to the analog inputs . Current references 0 - 20 mA and 4 - 20 mA can be used. In these cases, strap 1 - 2 at the input is to be inserted to permit the passage of current through the 500 ohm resistor at the input. With voltage references, 3 - 4 can be strapped instead.

With voltage reference with differential input, neither strap 1 - 2 nor 3 - 4 is to be inserted.

The reference level is selected with parameter AI37.MO in module AIN371X. The reference can be selected for 0 - 20 mA (0 - 10 V), 4 - 20 mA or –10 V to + 10 V.

The setting of the parameter is shown in the table below and the circuit diagram, sheet 36.

Reference inputs	AI37.MO
–10 - + 10 V	1
4 - 20 mA	0

Function Library GENERAL01_XX
The reference level is selected with parameter AI37MODE in module AIN371X. The reference can be selected for 0 - 20 mA (0 - 10 V), 4 - 20 mA or –10 V to + 10 V.

The setting of the parameter is shown in the circuit diagram, sheet 27.

When an analog input is used for armature voltage measurement, neither straps 1 - 2 nor 3 - 4 for the channel concerned is to be used. The input is to be strapped for 10 V.

When an analog input is used for feedback of temperature values from a Pt100-transducer, neither strap 1 - 2 nor 3 - 4 for the channel concerned is to be connected. The channel concerned is to be strapped for 1 V.

Channels 2 and 3 have a multiplication element. The signal can be multiplied or sign changed with parameter AI37.2MU or AI37.3MU. On delivery the parameters are set to 1.00.

Analog output channels (28)

Start the convertor and check in a suitable manner that the instrument follows the signals connected to the different channels.

Digital input channels (26)

All control signals connected to the board are operated individually. The signal to which the channel is connected can be measured on OP-panel in one of the CONNECT1-module. If required the signs of all the channels can be reversed, channel 1 and 2 from OP-panel.

To sign inverse channel 3 - 8 a terminal has to be used.

Digital output channel (26)

All control signals connected to the board are operated individually. The signal to which the signal is connected can be measured on OP-panel in the module from which it is connected.

To sign inverse the channels a terminal has to be used.

Connection and disconnection of expansion I/O boards

If during commissioning or fault tracing the convertor is to be supplemented with one or more expansion I/O boards, such as an analogue output board, the following procedure is to be followed.

1. Open the load disconnect switch.

2. Fasten with screws the terminal block board YPM 105 to the B50 terminal block. Connect auxiliary supply from board YPQ 108, contact X32, to contact X32 on terminal block board YPM 105 with a 10-conductor ribbon cable.

3. In the normal case, fix I/O board YPM 102 in position 35 on the computer board YPP 105 (the location is shown on the circuit diagram) and connect a 10-conductor ribbon cable between the terminal block board YPM 105, contact X31 and I/O board YPM 102, contact X31.

4. Close the load disconnector and set, in menu SET on the OP- panel, parameter AAO35 to "1". The coupling in the software is performed during the initialization of the program. Open the load disconnector briefly for this. The analogue output board can be used when the load disconnector is closed again.

If an expansion I/O board, such as a digital output board is to be removed for some reason, the following procedure is to be followed.

1. Set in function module DOUT 33 on the OP-panel, parameter ADO 33 to "0" and open the load disconnector.

2. Close the load disconnector and check that the red LED on YPO 103 illuminates.

3. Open the load disconnector and remove the board.

If you make a mistake of setting a parameter for an I/O-board, for example AI, which is not physically included, you will use the terminal (Microscribe etc.) in following way:

- **OP AAI34 "1" → "0" ENTER**
- **= "0" ENTER**
- **Make a new init, supply voltage off-on.**

Setting of delay angle limitation in the current controller IACTRLXX (73)

On delivery, parameter ALPHALIM is set to 10° and parameter BETALIM to 30°.

Selection of start sequence (67)

The start sequence of the convertor can be either separated or not. When the sequence is separated, the preparatory connection of the drive is performed with the ON-signal, the convertor being then prepared for reference with a START1-signal.

In a start sequence, not separated, the convertor is prepared for reference directly with a START1-signal.

The start sequence in the function module SEQCONXX is described in the table below and in the description of Tyrak L.

Start-sequence	Parameter SEQ-MODE	Cooling fan	Field excitation	Main contactor	Prepared for reference
Not separated	0	START1	START1	START1	START1
Separated	1	ON	START1	START1	START1
Separated	2	ON	ON	START1	START1
Separated	3	ON	ON	ON	START1

The commissioning instructions require, to begin with, a separated start sequence. On delivery, the convertor is normally connected for a separated start-sequence with operation from the OP-panel. The software connections of the convertor OP-panel is shown in the circuit diagram, page 16, module OPCHXXX, or by the OP-panel under the menu CONNECT. If the OP-panel of the convertor is connected as shown below, a separated start sequence is obtained.

DIOP.3 connected to NIDSTART (START).
DIOP.4 connected to STOPLOC2 (STOP).
DIOP.7 connected to OFF2 (OFF).
DIOP.8 connected to ON2 (ON).

If this is not the case, the ON2 and OFF2 signals can be temporarily connected to DIOP.7 and DIOP.8 respectively as above. DIOP.3 and DIOP.4 need not be reconnected in this case.

After this, the convertor can be operated in accordance with the following:

On-button (I-button); preparatory connection of drive (ON).

Off-button (O-button); disconnection of the equipment.

Check of ON/OFF circuits and fan supervision (67)

In the function module SEQCONXX the parameter SEQMODE is set to 1 via the OP-panel.

Local control operation is selected by pressing the LOC button on the OP-panel, the corresponding LED illuminating.

Press the ON button on the OP-panel, check that the convertor fan(s) start and that the air flow direction is upwards or backwards.

In 40 A convertors, there is no convertor fan and it is then possible to check that the contactors in "Control Unit external fans" pick up or that LED O1, I1 and I2 on unit A1 (board YPQ 103) illuminates.

Leave the convertor "on". Test the fan supervision for the external fans by moving the test button in the direction of the arrow on one of the thermal relay in "Control Unit external fans". The convertor is now to trip. Check the fault indication.

The selector switch on the thermal relay can be set in either manual (M) or automatic (A) resetting.

When the thermal relay is set at manual resetting (M), the O/R button on the relay must be pressed to reset this.

After these checks, switch the main circuit breaker off and return the main fuses.

Check of external fans (85)

Switch on the main circuit breaker and press the ON button in the OP-panel and check that the external fans rotate in the correct direction.

If the motor is provided with protection for lost air flow, the following test has to be made:

Prevent the air flow to the motor.

The convertor shall trip or give warning.

Switch off the convertor and then the main circuit breaker.

COMMISSIONING OF FIELD EXCITER

Note the following, when an ammeter is connected in the field circuit. Do not switch on/off in the field circuit (with the ammeter measurement range selector). Do not open the circuit with current flow in the field windings.

Diode field exciter (87)

Connect an ammeter in the field current circuit and switch on the main circuit breaker. Interlock the switch-on of the main contactor by setting the parameter SEQMODE to 2 (function module SEQCONXX) and check that signal START1 cannot go high "1". (I.e. do not press the START-button on the front panel). See page 67 in the circuit diagram.

Press the ON button on the OP-panel and check that the field current and field voltage are in agreement with their calculated values. The current is not to exceed the rated field exciter current when the d.c. machine is **warm**.

If the field current needs to be adjusted, certain adjustment can be performed on the supply transformer of the field exciter. If this is insufficient, an external serial resistor must be introduced.

Check that tripping is obtained for low field current by **temporarily** unscrewing one of the field exciter fuses and check the fault indication.

Analogue field exciter, YGBF 20

The analogue field exciter YGBF 20 is commissioned according to instruction YT 220-145 E.

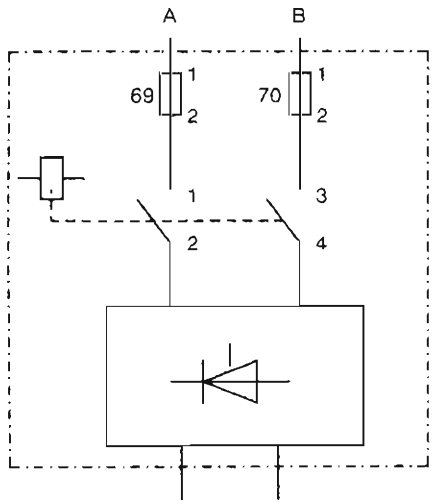
Controlled field exciter (75, 78, 87)

The module IF1CTRXX is common for both single and double field exciters.
The module is attached (software) in the workshop with the parameter AFETYPE.
The module can be disconnected the same way as I/O boards.

The main circuit of the field exciter is normally connected to phases L2 and L3. If the field exciters in several convertors is to be distributed between the phases to give a symmetric loading, the parameter PHASE is to be set in accordance with the following.

			PHASESEQ	
			POS	NEG
L1	L2	L3	PHASE	
69 [2]	70 [3]		1	4
	69	70	2	5
70		69	3	6

2) Connect to fuse 69 (..87)
3) Connect to fuse 70 (..87)



Adjusting the field current control IF1CTR2X (75, 77, 78)

Check the d.c. voltage rating of the field exciter. If this exceeds the maximum permissible field voltage of the d.c. machine, (rated d.c. voltage + permitted degree of forcing), the maximum field exciter voltage is to be reduced by increasing FLDALIM.

Ensure that the signal START1 can not go high "1". LOCAL MODE is required with operations from the OP-panel and SEQMODE = 2.
See **"Selection of start sequence"**, page 9.

Set the following parameters with the OP-panel.

Function module	Parameter	Setting
IF1CTRXX	AFETYPE	0 = No YPQ 102 1 = Single half bridge 2 = Single full bridge ≥3 = Double full bridge
	IFSCALE	I exciter/I field (Rated current field exciter/Rated current field winding).
	FLDCONI FLDCONP FLDCONR FLDCONL	0.0 0.0 0.0 0.0
IAREFHXX (Double field exciter)	IALIMNS IALIMPS	0 % 0 %
IFREFG1X (Fixed field current)	IFNOM	100 %
ECTRL11X (EMF control)	IFNOM	100 %
EMFSP1X (Speed controlled field weakening)	IFNOM	100 %
SEQCONXX	IFACKBLK SEQMODE	"1" 2

Explanation of adjusting of field current control single and double

The parameters FLDCONI, FLDCONL, FLDCONP and FLDCONR are to be set when adjusting the field current control.

The I-part is set with parameter FLDCONI. Parameter FLDCONL provides compensation for inductive voltage drop in connection with stepping. The P-part is set with the parameter FLDCONP. The delay angle for the trigger pulses with stationary current is given with parameter FLDCONR.

IFACT and FLDALPHA are to be logged. A suitable time setting on the logger is 0.5 to 2 seconds. Set the event line in the REGISTR display at the extreme left for registration, 186 points after the event. The resolution on the channels must also be reset as the stepping is only 3 %. It is recommended that the step should occupy half of the available height on the display.

The signals IFACT and FLDALPHA could also be connected, through CONNECT1, to AO for registration on a recorder.

Press the ON button on the OP-panel.

Increase successively the parameter FLDCONR until the signal IFACT is in agreement with IFNOM (in the beginning step of five is useful). The current will decrease successively because the field resistance increases with increasing winding temperature.

Adjust FLDCONR after some minutes to the correct level.

Check with a voltmeter that the field voltage is that intended and that the control margin is sufficient. The resistance in the field winding and thereby the necessary field voltage can increase with 40 % when the winding becomes warm.

If the current rating of the field winding is not known, 70 % of the rated voltage at room temperature can be set.

Adjustment of IF1CTRXX with low dynamic demands. (IFREFG1X)

When the dynamic of field controller is of no importance, that is when the field current is fixed and no field weakening is required it is enough just to follow the instruction when adjusting parameter FLDCONR. The rest of the parameters are to be set permanently as follows:

FLDCONI	10
FLDCONL	0
FLDCONP	15

Make step in the field current reference IFSTEP using the OP-panel steptest function. The steps have to be small enough so that signal FLDALPHA does not reach the limits FLDALIM or FLDBLIM. Suitable steps are 0.5 - 1 % and step length 0.5 seconds.
The field current shall go between the two levels without overshoot, rise time less than 0.2 s.

Adjustments of IF1CTRXX with high dynamic demands. (ECTRL11X and EMFSP1X)

Note! Start values for parameter FLDCONI, FLDCONP and FLDCONL according to table.

Make step in the field current reference IFSTEP using the OP-panel STEPTEST function. The steps have to be small enough so that signal FLDALPHA does not reach the limits FLDALIM or FLDBLIM. Suitable steps are 0.5 - 1 % and step length 0.5 seconds.

Adjust FLDCONP while making steps in IFSTEP. FLDCONP is adjusted in steps 1, 2, 5, 10, 15 etc. IFACT is to go between the two levels without overshoot or undershoot. The rise time in current has to be less than 100 ms.

This value has to be checked for stability margins. therefore increase FLDCONP to 1.3 times previous value. Repeat the step and check that no continuous oscillation occurs.

If no oscillation occurs:
Set FLDCONP to previous value.

If oscillation occurs:
Stop oscillations by setting FLDCONP to 0.0.
Set FLDCONP to the value that gave no overshoot.
Increase FLDCONP with 1 at a time.
Make steps and check at which level continuous oscillation occurs.
Decrease FLDCONP to 0.77 times this value.

FLDCONL is adjusted in steps 0.1, 0.2, 0.5, 1.0, 1.5 etc. Check the result between each adjustment by performing IFSTEP. IFACT is to go between the two levels without overshoot or undershoot as quick as possible.

Finally FLDCONI is adjusted. FLDCONI is adjusted in steps 1, 2, 5, 10, 15 etc. Check the result between each adjustment by performing IFSTEP. IFACT is to go between the two levels without overshoot or undershoot as quick as possible.

As the conclusion of the adjustment the REGISTR-display of IFACT and FLDALPHA is printed as documentation of the setting.

Reduce IFNOM to the lowest field current occurring (maximum field weakened). Perform step testing and check the step response. The step time is longer than with rated current because of greater inductance.

As the conclusion of the adjustment the REGISTR-display of IFACT is printed as documentation of the setting.

Double field exciter (77, 78)

Check that the field current can be reversed by pressing REF+ or REF– button on OP-panel.
(The sign of signal IAREF3 will change the direction of field current).

At field reversal the overshoot in field current control has also to be checked.

Logger signal IFACT. Logger channel set at 180 points and time 2 seconds.
To trigger the logger module TESTXX is used.
Connect signal FLDCH to DO71.3 in CONNECT menu.

Reverse the field current by pressing the REF+ or REF– button on OP-panel.
When the signal FLDCH goes high the logger will be triggered and the text DIGITAL TRIGG will display.
Check the REGISTR display of signal IFACT.
Signal IFACT must not make an overshoot of more than 5 %.

Note! If the registration need to be repeated the RESET knob on OP-panel must be pressed.

If the overshoot is higher than 5 % the field current controller need to be re-adjusted.

Check of IFCALVAL

The parameter IFCALVAL is used to adjust the current feedback. The parameter is adjusted in the test room against a defined load.

This means that the parameter is normally not to be changed. If however board YPQ 102 is to be replaced the parameter IFCALVAL must be adjusted.

Default value of parameter IFCALVAL in function module IF1CTRXX is for 50 Hz set at 170 and for 60 Hz set at 204.

The setting can be adjusted on site in accordance with one of following ways:

a) Connect an d.c.-ammeter in the field circuit. **Warning! Be careful, high inductance load.** Check that the measured value is in agreement with IEXCACT. If not, adjust with IFCALVAL.

b) Switch off the convertor. Set parameter FLDOCL to 150 % and IFTRIM to "1". This connects a voltage (1.235 V ± 1%) instead of the ordinary current feedback. Check that IEXCACT shows 123.5 %. If not adjust with IFCALVAL. Set parameter IFTRIM to "0" and FLDOCL to its original value.

c) Measure the voltage on board YXU 172 or YXU 173. Between X31:13A and 13B, 1 V corresponds to 100 % of the field exciter current rating. Check that the measured value is in agreement with IEXCACT. If not, adjust with IFCALVAL. This alternative needs detailed information about YXU 172, YXU 173 and YPQ 102.

Setting of overcurrent protection (78)

The overcurrent protection parameter FLDOCL is set 15 % above the rated field current. Increase IFNOM progressively and check that the convertor trips at the correct level. Return IFNOM to its original level.

Note! There is no separate thermal protection for the field circuit. The overcurrent level must therefore not be set higher than is permitted by the field winding, connection cables and field exciter.

Setting of minimum current protection (78)

Set IFACKBLK to "0" (SEQCONXX). Start the convertor. Set the minimum current protection IFGTMINL to 70 % (approx.) of the field current at max. speed. Reduce IFNOM progressively and check that the convertor trips at the level expected. Reset IFNOM to its original level.

Setting of reduced field current (75)

If parameter IFREDSEL (IFREFG1X, ECTRL11X or EMFSP1X) is set to "1" the signal IFREF will go to the value of parameter IFRED, 10 seconds after RDYREF goes low.

Setting of field heating current (75)

If parameter FLDHEATS (IFREFG1X, ECTRL11X or EMFSP1X) is set to "1" the signal IFREF will go to the value of parameter IFHEAT when signal FANSON goes low.

PROVISIONAL COMMISSIONING OF SPEED CONTROL AND CHECK OF OVERSPEED PROTECTION

The speed control should be commissioned provisionally at this stage to ensure that the connection to the tachometer or pulse transmitter functions. The overspeed protection or measure the speed feedback for checking that the d.c. machine does not race during the commissioning.

Set the parameters with the OP-panel in accordance with the table below and than switch off the convertor main current breaker. Function module IAREFHXX is only provided with advanced speed controllers NCTRL2XX and NCTRL3XX.

Function module	Parameter	Value set
IAREFHXX	IALIMPS	20 %
IAREFHXX	IALIMNS	– 20 %
IACTRLXX	OVERCUR	30 %
IACTRLXX	IASCALE	Rated current armature convertor/Rated current DC-motor
	IADOUBLE	1 Double convertor 0 Single convertor
NFBADJ0X	NFBADJ	4.000
NFBADJ0X	NFEEDBS	0 (PT-feedback) 1 (TG-feedback) 2 (Armature voltage control)
NCTRL1XX	IALIMP	20 %
NCTRL1XX	IALIMN	– 20 %
NCTRLXXX	NPROP	"1"
NCTRLXXX	NGAIN	1.0
SPMONXX	ALPHANSP	75 DEG
SPMONXX	MOTOSPL	30 %

Calculation and strapping of I/O board YPG 106/YPQ 108 with tacho feedback (36/27)

Calculate the tachometer voltage with maximum speed using the equation:

$U_{max} = k \times n_{max}$

where k = 0.1 for type BD 2510
0.2 for type TDP 1306
0.06 for type REO 444
0.025 for type TGRB 1-5 A

Strap the input board YPG 106/YPQ 108 in accordance with the table on page 36/22 of the circuit diagram.

Select the voltage range immediately above that calculated.

With the help of the OP-panel, connect signal NFEEDBTG to channel 4 on the analog input.

On delivery, the analog input board is connected for the bipolar mode (± 10 V). The channel for speed feedback is always to be connected for the bipolar mode. For switch-over to the unipolar mode or 4 - 20 mA reference, see section **"Analog input board"** or the circuit diagram for the analog input board.

If the REF + and REF– push buttons are connected on the OP-panel, all external reference inputs on the analog input board YPG 106/YPQ 108 can be disconnected. This is done most simply at the disconnectable terminal block on the terminal block board.

If the OP-panel does not have REF + and REF– marked buttons a reference potentiometer is connected to a suitable speed reference input on the terminal block board YPG 106/YPQ 108. Supply voltages ± 10 V are available on the board.

In this case, NREF7, for example is connected to a suitable channel on the analog input board with signal switch CONNECT. When the OP-panel REF + and REF– buttons are mentioned in the text, the external ref-potentiometer can be used instead.

Connect a voltmeter to the analog input board YPG 106 between terminal blocks X1:15 and 16 with the plus on 16 or to the I/O board YPQ 108 between terminal blocks X5:7 and 8 with the plus on 8.

Adaptation of board YPQ 108 with digital speed feedback (39)

The strapping of YPQ 108 is dependent on the pulse transmitter selected.

The table for the location of the straps is given on sheet 39 of the circuit diagram.

Adaptation of board YPH 104 and YPH 105 with digital speed feedback (39)

On delivery, parameter ADIGSP31 in function module DSP231XX is set to "1", when the convertor is ordered for digital speed feedback. This means that the board is activated.

The strapping of terminal block board YPH 104 is dependent on the pulse transmitter selected.

Leine & Linde (18 - 30 V), QGFA 110, 120:	supply +24 V	S1:13-14
AVTRON:	Supply +12 V	S1:15-16

Terminal block board YPH 104 is also to be strapped in accordance with the feedback from the pulse transmitter. The table for the location of the straps is given on sheet 39 of the circuit diagram.

Leine & Linde (18 - 30 V):	24 V	S1:3-4, 7-8, 11-12
QGFA 110, 120:	13 mA	S1:1-2, 5-6, 9-10
AVTRON:	12 V	S1:1-2, 5-6, 9-10

The maximum pulse frequency from the pulse transmitter is strapped on I/O board YPH 105 and is calculated in accordance with the following:

$$\text{Max pulsfrequency} = \frac{N_{max}}{60} \times P$$

Where: N_{max} 1) = Max. speed at which the d.c. motor will be run.
P = Number of pulses/revolution from pulse transmitter.

1) The maximum speed allowed is the minimum of following conditions:

$$n_{max1} = \frac{50000 \times 60}{NBRPPR} \text{ rpm}$$

$$n_{max2} = 1.5 \times NMAX \text{ rpm}$$

$$n_{max3} = \frac{60 \times 30719 \times 1000}{(NBRPPR \times NBREDGES \times T)} \text{ rpm}$$

$$n_{max4} = \frac{60 \times 4095 \times 1000}{(NBRPPR \times NBREDGES \times T)} \text{ rpm}$$

where T = T2 + 1 ms.

Note: n_{max4} is to be considered when hardware synchronization is used.

The pulse number for the transmitter is indicated on the rating plate. The maximum pulse frequency is strapped in accordance with the table on sheet 39 in the circuit diagram.

Switch on the convertor load disconnector and set the following parameters in function modules DSP2314X.

- When both channels A and B from the pulse generator are connected to the terminal block board YPH 104, parameter NBREDGES is set to 4. (Channel A X1:1, Channel B X1:3).
- Parameter NBRPPR is set at the number of pulses which the pulse transmitter gives per revolution.
- The parameter NMAX is set at the maximum speed of the drive.
- The parameter NFEEDBTC, filter time constant, is normally set at 10 ms.

  Note! If the setting of parameter NMAX, NBRPPR and MOTOSPL (in module SPMON2X) exceeds maximum puls frequency 50 kHz the convertor will trip for "OVERSPEED".

Check of rotation direction (27, 36, 39, 67)

Applies for both tachometer generator and pulse transmitter.

Switch on the convertor main circuit breaker. If the convertor has been temporarily reconnected in accordance with the instructions under the heading **"Selection of start sequence"**, the original connections should now be reinstated in accordance with the circuit diagram.

With an unseparated start sequence, the signal (normally NIDSTART) which gives switch-on of the convertor is to be normally connected to the OP-panel ON (I) button. In single convertors, OFF2 can be connected to the Off (O) button on the OP-panel. In double convertors, when regenerative braking down to zero speed is required, signal STOPLOC2, for example, must be coupled to the O button.

To obtain instantaneous switch-off without braking in the latter case, the emergency switch-off relay -AK1.K1.1, 2 must be deactivated. With an unseparated start sequence parameter SEQMODE (SEQCONXX) is set to "0". With separated start sequence the parameter is set either to 1, 2 or 3 depending on the drive properties required.

If the d.c. machine is out of sight or out of earshot, an assistant should be placed to observe any tendency of the machine to race and then to give warning.

Start the convertor but be prepared to press the OFF button if the machine should begin to race. If the d.c. machine begins to race, the connections of the tachometer (pulse generator) or field winding are reversed.

Analog tachometer
With racing in the correct direction of rotation, the speed feedback has incorrect polarity. Change the tachometer connections.

If the machine races in the incorrect direction, the field current polarity is incorrect. Change the connections to the d.c. motor field winding.

If the d.c. machine is continuously controllable with the OP-panel REF + button but rotates in the incorrect direction, the connections to both tachometer and field winding must be exchanged.

Pulse transmitter
When racing is in the correct direction, shift channels A and B from pulse generator. (X1:1 and X1:3 on the terminal block board YPH 104, X6:1 and X1:3 on the I/O board YPQ 108)

When racing is in the incorrect direction, the field current polarity is incorrect. Exchange the connections to the d.c. motor field winding.

If the d.c. machine is continuously controllable with the OP-panel REF + button but rotates in the incorrect direction, change the connection to the field winding and change channels A and B from the pulse transmitter.

Overspeed protection (63)

Analog tachometer and pulse transmitter
Overspeed protection is standard equipment. Check that this can trip the convertor by slowly increasing the speed reference. The convertor is to trip for overspeed. Check the fault indication.

If the d.c. machine is serial-wound, check that the serial winding is active. Measure the voltages over S1 - S2 and F1 - F2. S1 and F1 are to have the same polarity.

Adjusting of nominal speed with tachometer generator feedback (40, 64)

- Set parameter MOTOSPL (SPMONXX) to 110 %.
- Set parameter NPROP in function module NCTRLXXX to "0" which means that any speed error is integrated out in the speed controller.
- Start the convertor with the OP-panel and with the REF + button, increase NREF to 50 % (with speed controlled field weakening, set NREF to the base speed).
- Check with the voltmeter connected to the tachometer generator, that the maximum speed is not exceeded.
- Now adjust parameter NFBADJ in function module NFBADJ0X until 50 % of maximum speed is obtained (with speed-controlled field weakening, NREF is set to the corresponding base speed). A reduction of the parameter gives a higher speed. Do not lower the parameter by more than 5 % at a time and never to a value lower than 1.050.
- Increase NREF to 100 % and check that the motor now rotates with maximum speed. (This does not apply with speed controlled field weakening).

Single convertor
Lower the reference to 0 and switch off the convertor.

Double convertor
Check with NREF set to –100 % (or base speed) that the motor rotates in the opposite direction with maximum speed (basic speed). Reduce the reference to 0 and switch off the convertor.

Checking of nominal speed with pulse transmitter feedback

- Set parameter MOTOSPL (SPMONXX) to 110 %.
- Set the parameter NPROP to "0" in the function module NCTRLXXX. This means that any speed fault is integrated out in the speed controller.
- Start the convertor and control NREF to 50 % with the REF + button (with speed controlled field weakening, NREF is set to the base speed).
- Check with a hand tachometer that the d.c. motor rotates at 50 % of its maximum speed (with speed controlled field weakening, the base speed is obtained.
- Increase the reference to 100 % and repeat the check with the hand tachometer which should now indicate maximum speed. (This does not apply with speed controlled field weakening).

If the measured speed is not corresponding with the setting.
Check the rating of pulse transmitter.
The pulse transmitter or the YPH boards are faulty.

Single convertor
Lower the reference to 0 and switch off the convertor.

Double convertor
With NREF set to –100 % (or base speed) check that the motor rotates in the opposite direction at maximum speed (base speed). Lower the reference to 0 and switch off the convertor.

Voltage adaptation (73)

General

Voltage adaption is used with double convertors to adapt the delay angle, i.e. the output voltage of the convertor, to the present EMF in connection with reversal of current direction in the armature. The parameter is set at 180 degrees on delivery this giving phase retardation to the β-limit. With pole reversal, the firing pulses are controlled from the β-limit until the EMF induced in the motor is obtained.

ALPHAADJ must therefore be adjusted to optimize the voltage adaption. The lowest value of ALPHAADJ which can be set is 0 degree which gives the shortest reversal time of armature current.
A normal setting is 0 - 10 degrees.

The adaption can be performed in two ways:

- With a fixed field current, the speed actual value, NACT, is used.
- In drives with speed-controlled or EMF-controlled fieldweakening, the EMF actual value is used. The setting of voltage adaption is not always needed. Still it is best to make the settings anyway.

Adjusting of the EMF actual value with EMF control (when EMFMEM1X is included) (72)

- Connect a voltmeter via fuses to the convertor L + and L– bars.
- Control the speed up until the convertor give the EMF voltage for which the drive is dimensioned.
- Measure the signal ARMVOLT (module CONNECT1 in menu MEASURE) with the OP-panel. The signal ARMVOLT and the voltage L +, L– measured with the voltmeter are to be in agreement. Any adjustment is performed with the parameter AI34.3MU/AI37.3MU.
- Set parameter ARMRVOLT (EMFMEM1X) to 0 V. Measure the signal EMFACT with the OP-panel. This signal is to show 100 % when the convertor gives the maximum EMF voltage of the drive. If not, adjust with parameter EMFADJ.

Setting of voltage adaptation and adjusting of the signal EMFVOLT for drives without field weakening. (73)

Set the parameters in function module IACTRLXX in accordance with the following:

- Set EMFACTS to "0".
- Set UNOM to nominal mains voltage, U_{vN}.
- Increase the speed until 75 % of the nominal speed is obtained.
- Measure signal NACT (NFBADJ0X) value with the OP-panel and then set the parameter ACTADAP to this value.
- Measure the output voltage from the convertor. Set the parameter EMFADAP to the voltage measured.
- Parameter ALPHAADJ is to be set as 0 degree.

Setting of voltage adaptation and adjusting of the signal EMFVOLT for drives with EMF control (73)

Set the parameter in the function module IACTRLXX in accordance with the following:

- Set EMFACTS at "1".
- Set UNOM at nominal mains voltage, U_{vN}.
- Increase the speed until 75 % of nominal EMF is obtained.
- Measure signal EMFACT (EMFMEM1X) value with the OP-panel. Then set the parameter ACTADAP to this value.
- Measure the output value from the convertor. Set the parameter EMFADAP to the voltage measured.
- Parameter ALPHAADJ is to be set at 0 degree.

Voltage adaptation in drives with Speed Controlled Field Weakening (73)

Voltage adaption can not be used in drives with speed controlled field weakening.
Slow current reversal must be accepted and parameter ALPHAADJ in current controller must then remain at 180 degrees.

Note! When voltage measuring and module EMFMEM is included, the setting is done in accordance with above.

ADJUSTING OF ARMATURE CURRENT CONTROL

General

In the current control IACTRLXX, a parameter IACALVAL is used to adjust the level of the current feedback. This parameter (IACALVAL) is adjusted in workshop against a well-defined load.

This means that the parameter is normally not to be changed. If however board YPQ 101 is to be replaced, the parameter IACALVAL must be adjusted.

IACALVAL default value: 78.0 % for 50/60 Hz

The setting can be adjusted on site in accordance with the following.

Connect a digital voltmeter over the current feedback resistor on the pulse transformer unit, (detailed information about the pulse transformer board is needed) page 90, (between X31.A13 and B13) and set the following parameters:

- NPROP (NCTRLXXX) to "1".
- IFACKBLK (SEQCONXX) to "1".
- IFGTMINL (IF1CTRXX) to 0 %.
- MOTOSPL (SPMONXX)/(MONIT2X) to 30 %.
- NDEVL (MONIT2X) to 100 %.
- STALLIAL (MONIT2X) to 100 %.
- Remove the fuses to the field exciter.
- Adjust the armature current until 0.50 V (0.5 x I_{dmN}) can be measured with the external voltmeter.
- Measure the signal ICONVACT in the function module IACTRLXX on the OP-panel. ICONVACT is to show 50 %. If not, adjust with the parameter IACALVAL after the current has been reduced to zero.

When these is agreement with half rated current (0.5 V over the current feedback resistor) adjust the armature current until the voltmeter shows 1.0 V, if the motor allows, when the signal ICONVACT is measured. ICONVACT is now to show 100 %. Lower the armature current to 0 and switch off the convertor. If this setting is performed in connection with replacement of convertor control board YPQ 101, the parameters changed for setting are returned to the original value.

Connection and presetting (64, 73)

With manual setting, the armature current control is adjusted with the d.c. machine stationary and with the field winding disconnected in accordance with the following:

Connect a voltmeter to the speed actual value output or measure the NACT on the OPC, to check that the machine remains stationary.

The current feedback is measured by connecting an oscilloscope and/or recorder to terminal block board YPQ 104, terminal block X1:15 and 17 with 0 V on terminal block 17, or YPQ 108 terminal X7:3 and 4 with 0 V on terminal 4.

Disconnect the field exciter by unscrewing the field exciter fuses (on the a.c. side). It is important that the field winding is still connected to the field exciter to limit high induced voltages.

Warning!

The inductance in the armature winding is higher when the field current in the DC motor is zero.

This fact can, if the current controller is optimal adjusted, give unstable current, when later on the field current is reconnected.

If so, it is most likely that this will be seen when the armature current is high and the motor speed is low.

Set the following parameters with the OP-panel.

Function module	Parameter	
IACTRLXX	IADOUBLE	"0" single convertor. "1" double convertor.
	IASCALE	Rated current armature convertor/rated current d.c. motor.
	OVERCUR	Set to 230 % which corresponds to the rated current of the d.c. motor multiplied by 2.3.
IAREFHXX with advanced speed controller	IALIMPS IALIMPN	Set to ±100 % which corresponds to the rated current of the d.c. motor.
	IALIMMAX	Set to a value that corresponds to the maximum load current.
IF1CTRXX	IFGTMINL	Set to 0 %. With this setting signal FLDCH will go low and it will be possible to make the necessary adjustments of current controller.
NCTRL1XX (No IAREFHXX)	IALIMP	Using rev. bridge set 0 %. Using forw. bridge set to a value corresponding to the max load current.
	IALIMN	Using forw. bridge set 0 %. Using rev. bridge set to a value corresponding to the max load current.
NCTRLXXX	NPROP	Set to "1" for P-connection.
	NGAIN	Set to 1.0.
SEQCONXX	IFACKBLK	Set to 1 which acknowledges the field current.
SPMONXX	MOTOSPL	Set to 30 %.

Explanation of adjusting armature current control

The following three parameters are to be adjusted in the current controller:
CONSTCON, CONSTRL and IAGAIN. .

The parameters CONSTCON and CONSTRL give a model of the DC-motor where the parameter CONSTCON corresponds to the inductive and resistive armature voltage drop. Parameter CONSTRL corresponds to relation between inductive and resistive armature voltage drop.

Normal settings of parameter CONSTCON is 20 - 300. Parameter CONSTRL is normally set to 0.05 - 0.30. IAGAIN is a parameter giving the gain in the whole range of current, both discontinuous and continuous current.

Function of step generator

When adjusting the armature current control, a step in the armature current is introduced by setting the magnitude of parameter IASTEP1.

Preparing test

Start the convertor and increase the current with the REF + button of the OP-panel out to the rated current and lower the current again.

If the rotor of the DC machine rotates, the rotor must be locked in a suitable manner. Remember that current is applied for periods no longer than 20 seconds with intermediate cooling periods and that the rotor should be turned between each loading with current.

The sequence of setting the current controller:

1. **Optimal setting of CONSTCON and CONSTRL in continuous current mode, with IAGAIN = 1.0.**
   Start with following default value CONSTCON = 20 and CONSTRL = 0.13

2. **Verification of the result in discontinuous current mode.**

3. **Change IAGAIN to 0.5 - 0.8 and reduce CONSTCON with 30 %.**

1. Optimal setting in continuous current mode

Control the armature current to continuous mode. Current pulsations can occur in the area between discontinuous current and continuous current which means that under certain circumstances it is necessary to go up relatively high in the range of continuous current to obtain stability.

Set a suitable step, approximately 7 - 18 % with parameter IASTEP1.A suitable sweep speed on the oscilloscope is 5 -10 ms/division.

If the oscilloscope picture does not remain still, adjust the calibration button on the oscilloscope so that the picture on the screen remains stationary and that the front of the step appears.

Adjust with parameter CONSTCON the first current pulse according to fig. 1. In all alternatives shown in fig. 1, parameter CONSTCON is adjusted correctly.

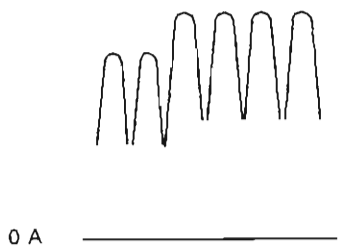


Fig. 1a

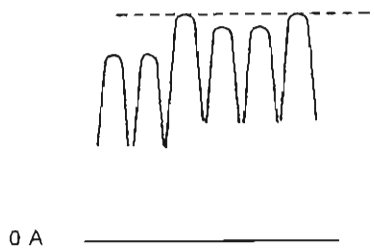


Fig. 1b

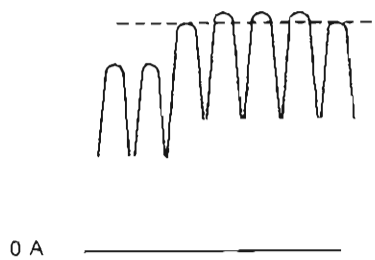


Fig. 1c

The fault shown in figure 1b or 1c is corrected with parameter CONSTRL.
In fig. 1b the parameter CONSTRL is set too low.
In fig. 1c the parameter CONSTRL is set too high.
After adjusting parameter CONSTRL the result shall be in accordance with fig. 1a.

2. Verification of the result in discontinuous current mode

The current is then reduced to discontinuous mode. When the step is to be done within discontinuous mode the step often has to be reduced to approximately 5 %. The result shall be in accordance with fig. 2.

If the step response in the discontinuous current mode does not correspond to fig. 2, the adjustments made in continuous mode are not correct.
The current controller need to be re-adjusted.
Start from point 1 again.

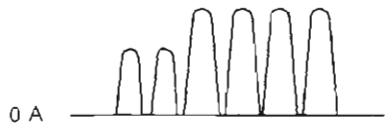


Fig. 2

3. Setting the gain in current controller

When setting of parameter CONSTCON and CONSTRL is done the gain in the current controller is set with parameter IAGAIN.

The parameter IAGAIN is default set to 1.0 which also is the maximum setting of the parameter.
When the parameter is reduced the gain will be lower, also giving more stable control.

To achieve stable current control, with the field supply connected, the parameter IAGAIN is to be set to 0.5 - 0.8 and parameter CONSTCON reduced with 30 %.

The armature current is finally increased, from the discontinuous current mode up to rated current and back again. No abnormally large current pulsations may occur at any time during this test.
Return the parameter IASTEP1 to 0 % and repeat the last test.

As documentation of the setting a step in the armature current can be made in menu STEPTEST.
The signal giving a step in the armature current is TQSTEP.

Note! A negative TQSTEP gives a positive step in the armature current.

The step is normally performed within continuous current. The registration is to be taken out on a printer and kept in the documentation of the commissioning.

Note! When function module EMFMEM1X is included, the compensation for the resistive armature voltage drop of the motor is adjusted in connection with the setting of armature current control.

Adjusting of armature voltage drop in the function module EMFMEMXX (72)

- Measure the signal ARMVOLT (CONNECT1) with the OP-panel. Start the convertor and increase the armature current to the rated motor current.
- Read the ARMVOLT signal. Lower the armature current to 0. The ARMVOLT value read is entered in the parameter ARMVOLT.
- Now measure the signal EMFACT with the OP-panel. Increase the armature current to the motor rated current. The signal EMFACT is to show 0 % over the complete range.
- Lower the rotor current to zero and switch off the convertor.

SETTING OF ARMATURE CURRENT LIMITATION

Single convertor with standard speed controller (64)

The armature current limitation is set with the parameter IALIMP in function module NCTRL1XX. A possible setting range is 0 - 200 % of the rated convertor current.

Note! Parameter IALIMN is set to 0 %.

Single convertor with advanced speed controller (66)

The limitation of the armature current is set with parameter IALIMPS in function module IAREFHXX. A possible setting range is 0 - 200 % of the rated current of the convertor. Parameter IALIMNS is set to 0 %.

Note! When field reversal is included parameter IALIMPS is set for positive torque direction and parameter IALIMNS for negative torque direction.

Double convertor with standard speed controller (64)

The limitations of the armature current in the FORWARD and REVERSE directions are set with parameters IALIMP and IALIMN in the function module NCTRL1XX.

A possible setting range is 0 - 200 % of the rated current of the convertor.

Note! Parameter IALIMN is to be set at a negative value such as –80 %.

Double convertor with advanced speed controller (66)

The current limits are set as described above for the standard controller with parameter IALIMPS for FORWARD and IALIMNS for the REVERSE direction in the function module IAREFHXX.

Note! Parameter IALIMNS is to be set to a negative value e.g. –80 %.

Setting of armature current rate of change (73)

The setting of armature current rate of change is performed in module IACTRLXX with parameter IADERMAX.

On delivery of the equipment, the parameter is set at 10.0 % which give a rate of change of current one hundred times the rated convertor current per second. When a higher rate of change is required, the parameter is increased but not normally higher than to 20 %/ms which gives a rate of change 200 times the rated convertor current per second.

Note! When older motors, not fully laminated are used, the parameter value 10 %/ms can be too high. If so, sparkings on the commutator might occur causing damages on the commutator of the motor.

The commutator must always be checked during normal use of the drive after completed commissioning.

ADJUSTING OF SPEED CONTROL

Preparations (63, 67)

The parameter MOTOSPL is set in the function module SPMONXX to 110 %.
Reset the parameter IFGTMINL (IF1CTRXX) to 70 % (approx.) of the field current at max. speed.

The parameter IFACKBLK in function module SEQCONXX is set to "0". Insert the field fuses.

Disconnect any locking of the rotor of the d.c. machine. If the driven object has not previously been coupled to the rotor shaft, it can be connected now. Check the lubrication.

Note! The drive object should be run with no load when the speed control is adjusted.

Adjusting of standard speed controller NCTRL1XX or advanced speed controller NCTRL3XX (64)

Two ways of adjusting speed controllers with PI-gain and derivating feedback of the speed feedback are described below.

The first is the conventional method of adjusting a speed control function i.e. by first adjusting the P-part of the controller, then the I-part and finally the derivating feedback of the speed feedback. A second method is applied to high speed controllers and controllers in which fast compensation is required for loading variations. In this case, the P-part of the controller is adjusted first, then the derivating feedback of the speed feedback and finally the I-part of the controller. This method of adjusting the controller is also the fastest as no subsequent adjustment is normally necessary.

The P-part of the controller is set with the parameter NGAIN, the controller time constant with the parameter NTC1 and the magnitude of the derivating feedback with parameter NDERKD.

Start the convertor and increase the speed with the Ref + button to approximately 30 % of the nominal speed. Then step the speed reference with NSTEP in the OP-panel function STEPTEST. Suitable steps are approximately 2 % and the duration of each step 1 second.

Note! IAACT and NACT are normally preset on two of the logger channels on delivery. A suitable time setting on the log for the two signals is 0.5 - 2 seconds. Set the event line in the REGISTR display at the extreme left (186 points after the event).

The resolution in the channels must also be set as the testing step is only 2 %. It is appropriate if the step occupies half of the available height of the display.

Adjusting of normal drives

In function module NCTRL1XX or NCTRL3XX, set parameter NPROP to "1". Increase NGAIN in steps of 0.5. Check the result after each adjustment by performing steps. A rise time between 100 and 200 ms can be accepted for normal drives.

Set parameter NPROP to "0". Continue the adjustment by reducing parameter NTC1. After each adjustment, check the result. The normal setting range for NTC1 is 100 - 300 ms.

Overshoots can be trimmed off with parameter NDERKD. The normal setting range is 0.5 - 4.0.

When the adjustment is completed, the REGISTR-display of NACT is printed as documentation of the settings.

Adjusting of fast drives

In the function module NCTRL1XX or NCTRL3XX, set parameter NPROP to "1". Increase NGAIN in steps of 0.5. Check the result after each adjustment. Adjust until a second overshoot is obtained. Then reduce NGAIN until the second overshoot is barely perceptible.

Continue the adjustment by eliminating the overshoot with parameter NDERKD. After adjusting with NDERKD, the step response from 50 % to 100 % of the step height is to have an evenly rounded curve.

Then set parameter NPROP to "0". Reduce the controller time constant with parameter NTC1 until a noticeable change in step response is obtained.

When the adjustment is concluded, the REGISTR-display of NACT is printed as documentation of the setting.

Adjusting of advanced speed controller NCTRL2XX (64)

The advanced controller NCTRL2XX can be adjusted as follows:

- Fixed coupling with PI-controller.
- Fixed coupling with PIPI or PDPI controller.
- Coupling with long shafts or play.

Adjusting of systems with fixed coupling (short shafts) and PI- control with derivative speed feedback

NCTRL2XX
Set parameters NTC2 and NTC3 equal and ≥ 100 ms. Adjust the controller in the same way as a standard speed controller NCTRL12X.

Adjusting of system with fixed coupling and PIPI/PDPI control

For systems which require a greater gain, the advanced speed controller provides the possibility of increasing the gain within certain frequency ranges more than is possible with an ordinary PI- control. The adjustment is simplified if the system resonance frequency is known. The controller can then be adjusted with a lower gain in the range around the resonance frequency and higher gain in other ranges.

The amplifier can be adjusted either as a PIPI controller fig. 4 or as a PDPI-controller fig. 5.

The selection of either PIPI or PDPI depends on the total system. The PIPI controller is normally more stable than PDPI but the latter is the faster controller.

The PIPI/PDPI controller is adjusted as follows:

1. Set the speed controller parameter NPROP to "1" to P-couple the controller.
2. Start the convertor. Increase the speed to approximately 30 % of nominal with the REF + button. Then make steps in the speed reference. This can be done with STEPTEST on the OP-panel. A suitable step is approximately 2 % and the length of the step can be approximately 2 seconds. IAACT and NACT are to be logged. A suitable time setting on the logger for the two signals is 0.5 - 2 seconds.

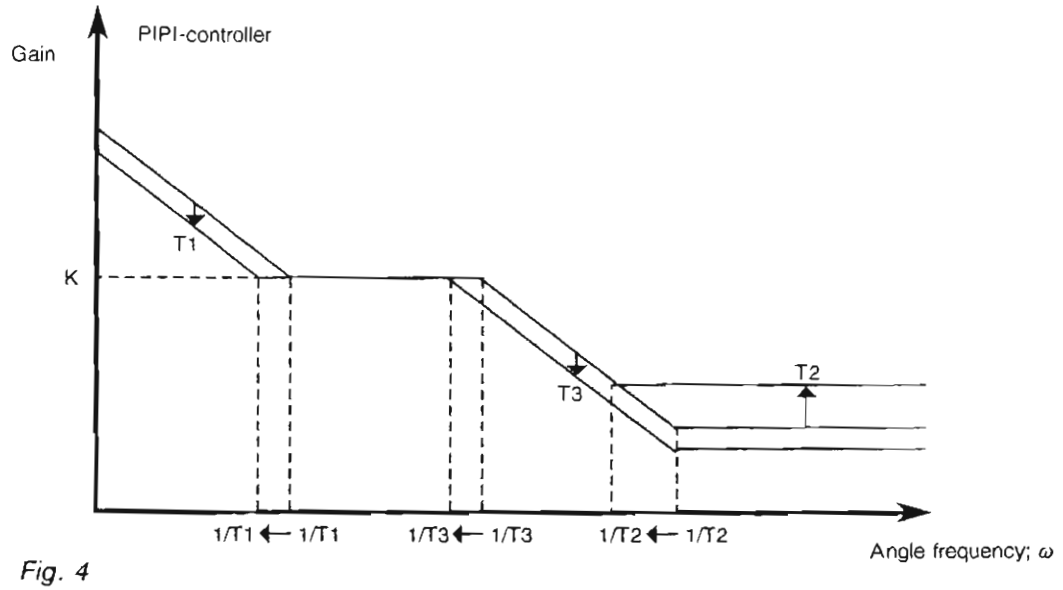


Fig. 4

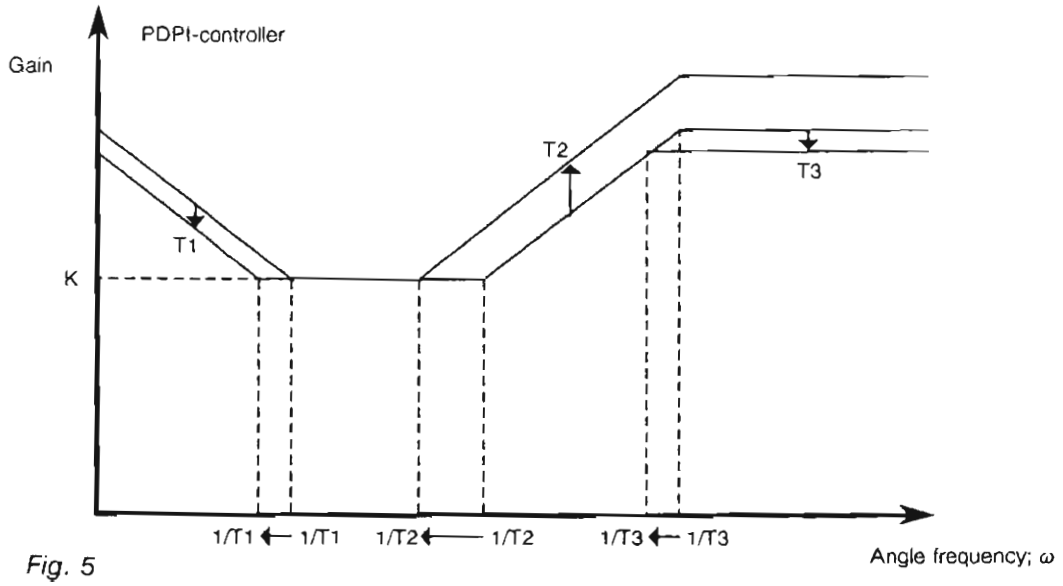


Fig. 5

Note! IAACT and NACT are normally preset on two of the logger channels when the equipment is delivered.

A PIPI-controller is obtained when
NTC1 > NTC3 > NTC2.

The setting is done as follows:

Parameter NTC2 and NTC3 shall at start be set at 100 ms. Increase NGAIN in steps of 0.5 until signal NACT starts to oscillate.

Measure the time t between two peaks.

The resonance frequency (Hz) is calculated as follows:

$$f_{osc} = \frac{1}{t} \qquad t = \text{time in seconds}$$

NGAIN is then reduced until an overshoot of approximately 10 % is obtained.

Set parameter NPROP to "0".

Adjust NTC1 as for an ordinary PI-controller.

NTC2 (ms) is calculated as follows:

$$NTC2 = \frac{1}{2 \times f_{osc}} \times 1000 \text{ (ms)}$$

Set NTC2 to the value calculated, but not lower than 12 ms.

Set NTC3 to a value 2 to 3 times the value of NTC2.

Adjust now the controller with parameter NGAIN and NTC3. If NTC3 is increased it is normally also possible to increase NGAIN and vise versa.

The regulator is adjusted until the control is as quick as possible. The oscillations in current initiated by the resonance must also be kept at an acceptable level.

A PDPI-controller is obtained when
NTC1 > NTC2 > NTC3.

The setting is done as follows:

Parameter NTC2 and NTC3 shall at start be set at 100 ms.

Adjust NGAIN and NTC1 as for an ordinary PI-controller.

Measure the rise time of the speed feedback.

Set NTC2 to 0.5 times the rise time as start value.

Set NTC3 to 0.5 times NTC2 as start value.

This setting will make it possible to increase NGAIN and decrease NTC2 and NTC3.

As a result of the adjustment the rise time is to be shorter than a PI-controller.

At the end of the adjustment, the REGISTR-display of NACT is printed out as documentation of the setting.

Couplings with long shafts or backlash

The adjusting is largely performed in accordance with the description for fixed coupling and PIPI/PDPI control except that NGAIN normally becomes lower and NTC1 must be set to a higher value (500 - 1000 ms). Rise times up to 1000 ms and overshoots up to 40 % are not unusual.

At the conclusion of the adjustment, the REGISTR-display of NACT is printed as documentation of the settings.

AUTOMATIC FIELD WEAKENING

EMF-control (ECTRL1XX) (75)

Setting of function generator flux/field current

On delivery, the parameters IFCONST1, 2 and 3 in function module ECTRL1XX are set to give a straight flux curve for ABB motors of LAP (DMP), LAR (DMG), LAB (DMB) and LAN (DMA) types in accordance with the following.

IFCONST1 29.0 %
IFCONST2 53.5 %
IFCONST3 79.5 %

If the excitation curve is **not known**, the function generator is set as described below.

Measure the signal EMFACT (EMFMEMXX) or connect an external voltmeter via fuses to the convertor L+ and L– bars.

Switch on the convertor and set a speed so that EMFACT becomes less than 100 %. Note this start value on EMFACT.

Set successively the different FILIMN and FILIMP and adjust IFCONST 1 - 3 in accordance with the following table.

PHILIMN, PHILIMP %	Corr. to FIREF1 %	Adjust IFCONST	so that EMFACT becomes
0	100		start value × 1.0
– 8	90	3	× 0.9
– 26	70	2	× 0.7
– 66	40	1	× 0.4

Return FILIMP to 0.0 % and FILIMN to –100 %

Adjustment of EMF-control

Set parameter EMFPROP to "0".
Set parameter EMFTC to 1000 ms.
Set the speed so that signal EMFACT increases to 85 %.
Reduce parameter EMFREF to 80 %.
Check that EMFACT decreases to 80 %.
When increasing the speed slowly so that maximum speed is obtained, signal EMFACT shall remain at 80 %.
Decrease the speed to zero.
Increase the speed to the level where the signal IFREF starts to decrease.

Increase the speed reference 5 % above this level.

Make steps in the Emf reference with signal EMFSTEP in the STEPTEST menu on OP-panel. Suitable step is 4 % and the step length is 2 seconds.

EMFACT and IFACT are to be logged. A suitable time setting on the logger is 1 second. The event line 186 points after the event. As the step is only 4 % the resolution of the channel must be changed. The step shall occupy half the height available on the display.

Adjust the gain of the controller by increasing parameter EMFGAIN.

Check the result between each adjustment by performing EMFSTEP.

EMFACT is to go between the two levels without overshoot.

Adjust the time constant of the controller by decreasing the parameter EMFTC.

Check the result between each adjustment by performing EMFSTEP.

Decrease EMFTC until a small overshoot in signal EMFACT can be visible.

When parameter EMFGAIN is adjusted a small overshoot is accepted.

This setting is normally sufficient for the EMF controller. If however a quicker controller is required the setting can be done as follows:

The parameter EMFTC is reduced so that the overshoot is increased.

Remove the overshoot with parameter EMFDERKD and EMFDERTC. Parameter EMFDERKD is changed in steps of 0.1 at the same time as parameter EMFDERTC is reduced.

Decrease the speed to zero.

The result of the adjustment is checked by increasing the speed reference after the fastest ramp the drive will be exposed to.The ramp for this test is possible to set in module NINDE1XX with parameter NIDINCRF which is scaled in %/sec.

To trigger the logger module TEST3X is used.

Connect signal EMFACT to AO72.1 in CONNECT menu.

Set the parameter ATRIGL to 39.90 % (Parameter ATRIG is scaled for signals with 100 % as max. value. EMFACT has 200 % as max. value.

Increase the speed by pressing the REF + button on OP-panel.When the value of signal EMFACT is 79.8 % the logger will be triggered and the text ANALOG TRIGGER will appear.

Check the REGISTR display of signal EMFACT.

Signal EMFACT must not make an overshoot of more than 5 %.

Note! If the registration need to be repeated the RESET knob on OP-panel must be pressed.

If the overshoot is higher than 5 % the EMF controller need to be readjusted.

If not, change the parameter EMFREF to 100 % and parameter ATRIGL (TESTXX) to 49.95 % and repeat the test with the fastest ramp the convertor can be exposed to.

Signal EMFACT must not make an overshoot of more than 5 %.

After setting of EMF-controller a new test of the dynamics of speed controller has to be done.

In speed controller the parameter FIADAPTS is set to "1". This will connect signal FIOFI to speed controller.

The test of the speed controller is done in the same way as described earlier but with the difference that a step is given when the motor speed is 90 % of maximum speed.

The step response of signal NACT shall be the same as after previous adjustment of speed controller due to signal FIOFI. Signal FIOFI will increase the gain in speed controller to compensate lower field current.

If the speed control will be unstable the following two alternatives are possible.

1. Reduce the parameter ADAPTLIM to half the value of the quota between maximum speed and the base value of speed.

2. Reduce the NGAIN in speed controller.

Repeat the NSTEP as mentioned above.

If the speed control still is unstable the parameters have to be reduced even more until the speed control is stable.

Speed-controlled field weakening EMFSP1X (75)

This type of field weakening gives less accurate control than conventional EMF control. Consideration must be given to this in selecting the maximum EMF level to avoid the d.c. motor exceeding the maximum permitted armature voltage.

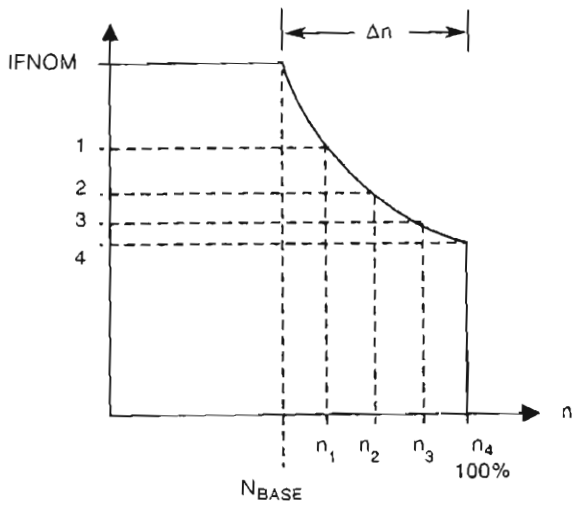
Connect a voltmeter via fuses to the convertor L + and L– bars.

Switch on the convertor and increase the speed so that the rotor voltage increases to 98 % of the maximum EMF voltage. Read the speed reference value NREF (%).

This speed actual value is now entered in the parameter NBASE.
Then reduce the speed to zero.

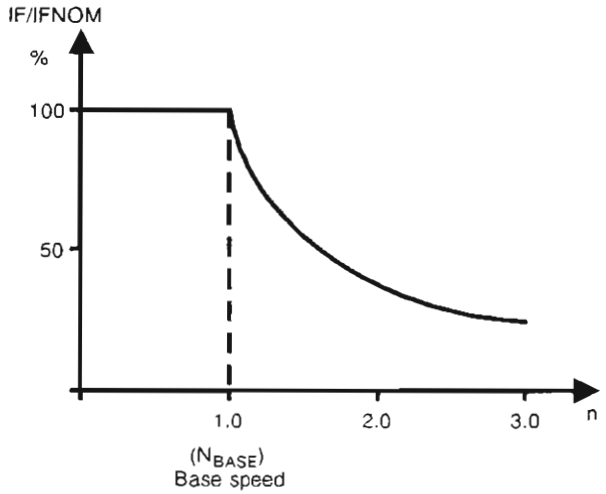
The values for n_1, n_2 and n_3 are now calculated in accordance with the following:

$n_1 = n_{base} + 0{,}1 \times \Delta n$
$n_2 = n_{base} + 0.3 \times \Delta n$
$n_3 = n_{base} + 0{,}6 \times \Delta n$
$n_4 = 100\ \%$



Put nbase, n_1 - n_4 in the diagram below and read the constants IFCONST 1 - 4

Field weakening curve for motor types LAP/DMP, LAR/DMG, LAB/DMB, LAN/DMA



Set the parameters. Values obtained in IFCONST 1 - 4, obtained from field weakening curve and parameter NBASE.

It is important that the speed increases continuously and never decreases during the following trimming.

If the increase is excessive, at any stage, a restart must be made from the beginning.

Increase the speed slowly past NBASE. The EMF voltage will then begin to increase somewhat and subsequently to decrease.

Increase the speed slowly to n_1.
Adjust IFCONST1 so that 98 % of max. EMF is reached.

Increase the speed slowly to n_2.
Adjust IFCONST2 so that 98 % of max. EMF is reached.

Increase the speed slowly to n_3.
Adjust IFCONST 3 so that 98 % of max. EMF is reached.

Increase the speed slowly to n_4.
Adjust IFCONST4 so that 98 % of max. EMF is reached.

If the EMF voltage increases too much between the break points, a restart must be made with a lower voltage e.g. 95 % with NBASE.

Run then slowly through the complete speed range with both increase with decrease of the speed and check the EMF level. The variations should be kept within 5 - 10 %.

The EMF-voltage always becomes higher with speed increase than with speed decrease because of the hysteresis of the d.c. machine excitation circuit. If the drive requires fast acceleration during normal operations, the EMF voltage should be studied with a recorder during acceleration with the fastest available ramp. If the overshoot is too great at transition to the field-weakened area, the EMF-level must be lowered.

After setting of the speed-controlled field weakening system a new test of the dynamics of speed controller has to be done.

In speed controller the parameter FIADAPTS is set to "1". This will connect signal FIOFI to speed controller.

The test is done in the same way as described earlier with the difference that a step of 2 % is given when the motor speed is 90 % of maximum speed.

The step response of signal NACT shall be the same as after previous adjustment of speed controller due to signal FIOFI. Signal FIOFI will increase the gain in speed controller to compensate lower field current.

If the speed control is unstable the NGAIN in speed controller can be reduced until stability in speed control is achieved.

SETTING OF PROTECTIONS

General

It is possible to select warnings instead of trip for some of the protections on the convertor.

When a warning has occurred the red lamp on OP-panel will start to twinkle. A fault message is also given to the FAULT logger and it will be kept in the FAULT logger as the last message.

Note! The convertor will still be phased advanced.

The parameters in all modules are default set to give trip when a fault occurs in the convertor.

Note! Module EXFLTXX is an exception. The parameters EXFLTD1S, EXFLTD2S and EXFLTD3S in this module are default set to "0" which will give warning instead of trip.

Function Library GENERAL01_XX
Note! Module EXFLTXX is an exception. The parameter in this module which will give warning instead of trip.

Check and setting of overspeed protection (63)

- Start the convertor and increase the speed to 100 %. In function module SPMONXX, set the parameter MOTOSPL to 99 %. The convertor will trip for overspeed.

- Normal setting of parameter SPMON is 110 % allowing the speed to be 10 % higher then nominal speed.

  Note! With puls transmitter feedback. If the setting of parameter MOTOSPL is set too high, allowing a puls frequency higher then 50 kHz, the convertor will trip for "OVERSPEED".

- Set the parameter ALPHANSP to 75°, this activating the protection for loss of tachometer signal. The protection should not trip the convertor when the motor accelerates at its maximum rate from zero speed with the rated load.

If the convertor trips for lost TG-feedback the parameter ALPHANSP has to be reduced 5° at the time but not lower than 30°.

Check of overvoltage protection (72)

The module EMFMEM1X is included in EMF controller or when the convertor is to be armature voltage-controlled.

- Reduce the parameter ARMOVL to 90 %.

- Start the convertor and increase the speed. Check that the convertor trips with 90 % of the nominal voltage.

- Return the parameter ARMOVL to 110 %.

Setting of undervoltage protection (74)

The level of the undervoltage is set by the parameter MINVOLT, setting area 0 - 130 %.

The default value is set to 80 %. After that you have indicate the undervoltage with the hardware, there are two parameters MSLVD and MSUVD that you can delay the block of the current controller and the pulses (MSLVD) and the TRIP (MSUVD).

MSLVD, main supply low voltage delay, with default value = 0.
The setting area is 0 - 10 and the scale is
for 50 Hz:
1 x 3.3 ms, 2 x 3.3 ms, ...10 x 3.3 ms.
for 60 Hz:
1 x 2.8 ms, 2 x 2.8 ms, ...10 x 2.8 ms.

MSUVD, main supply undervoltage delay, with default value = 0.
The setting area is 0 - 100 ms.

Remark! If you have problem with net-disurbance, that creat undangerous situations but trip the convertor, a good setting is to delay the trip with MSUVD and set MSLVD = 0.

Setting of protection Emf-, pulse transmitter signal- and tacho feedback failure. EMFMEM1X (72)

When Emf-measurement is not included or Emf-measurement is included for voltage regulation, protection SPMONXX or MONITXX will then be used for speed feedback failure, parameter FBACK1S will then be set = 0.

Parameter NOACKLEV, no acknowledge level, has the default value = 20 %.
The setting area = 0 - 100%.

Setting of overload protection (63)

(Not to be set during running)

Output signal ARMHL will give warning when the level for parameter ARMHLL is reached.

Output signal ARMOL is default set to give trip, however it is possible with parameter ARMOLS in module TRIP2XX to select warning instead of trip even for this signal.

The setting is performed in function module MOTOLM0X.

The parameter ARMOLL is set for that part of the equipment which has the lowest current rating i.e. motor or convertor.The following applies if the rated current of the motor is less than that of the convertor:

$$\frac{\text{Motor current rating (A)}}{\text{Convertor current rating (A)}} \times 100 = \text{Setting of parameter ARMOLL.}$$

Remark: When IASCALE is used for IAACTABS = motor current, the ARMOLL could be set at 100 %

If the rated current of the motor is greater than that of the convertor, ARMOLL is to be set at 100 %.

The settings of parameters MOTCURMA and MOTORTC depend on the type of motor used as given in the following table.

This table is valid for good ventilated motors with cooling form IC06, 17, etc. Correct value on MOTORTC and MOTCURMA for motors with other cooling forms, please be in touch with ABB Drives Motor Division.

Motor type and shaft height	MOTORTC Sec	MOTCURMA %
LAP/DMP 112	240	180
132	240	180
160	240	180
180	240	180
LAR/DMG 180	240	180
200	240	180
225	260	180
250	310	180
LAB 350	240	160
400	310	160
450	300	160
LAN 560	390	200
710	360	200
DMA 280	480	200
315	480	200
355	540	200
400	540	200
450	600	200
500	600	200

Note! After setting of module MOTOLM0X the supply to the convertor is switched off and then on again to activate the change.

Setting of overcurrent protection and other protections in IACTRLXX (73, 74)

The overcurrent protection is to be set at 230 % of the rated motor current. The protection is set in function module IACTRLXX with parameter OVERCUR. The setting range is 0 - 400 % of the convertor current rating.

The rest of the protection circuits in current controller have default values corresponding to normal setting values and normally they do not need to be readjusted during commissioning.

However if the current limit is lower than 100 %, parameter IADIFFL need to be reduced to a value 10 % lower then the setting of current limit.

The protection for armature current ripple can be chosen as trip or warning in TRIP36X module on page 69.

Supervision of motor temperature with Pt100-transducer (62)

The function module MOTEMP1X is used normally to supervise the winding temperature of a d.c. motor but it can also be used for monitoring bearing temperatures and in certain cases, air temperature.

On delivery of motors equipped with Pt100-transducers, the documentation provided (XO-drawing) shows the temperature at which a temperature warning is to be given and at which temperature the protection is to trip the convertor. See also the maintenance / commissioning instructions for the motor concerned. The analog input board which gives 5 mA supply to the Pt100-transducer is strapped in accordance with the information in section **"Analog input boards"**.

The warning for high temperature is set with parameter MOTHTL1 and 2 whereas the tripping level is set with parameters MOTOL1 and 2.

It is however possible to disconnect the tripping function. This is done with parameter MOTOTS on page 69.

Supervision of thyristor temperature (72)

The function module TYTEMPXX monitors the temperature of the thyristor crystal via the Pt100-transducer which is mounted on the thyristor heat sink. The analog input board which gives 5 mA supply to the Pt100-transducer is strapped in accordance with the information in section "**Analog input boards**".

From the module it is possible to send a warning when the thyristor temperature is too high. The signal giving the warning is THYHT and the level is set with parameter THYHTL.
If the level for parameter THYOTL is exceeded the convertor will trip.

The parameters in the function module TYTEMPXX is set in accordance with the current rating of the convertor as in the table below.

Convertor current rating I_{dmN1} (A)	Parameter COMHSINK	Parameter TEMP.J-H Grad (°C)	Parameter THYTC (ms)
40	1	22	1000
70	1	40	1000
120	1	22	1000
180	1	21	2000
270	1	32	2000
350	1	46	2000
400	1	30	2000
530	1	43	2000
650	0	28	2000
800	0	27	2000
950	0	25	3000
1100	0	25	3000
1250	0	33	3000
1400	0	30	3000
1600	0	43	3000
1800	0	40	3000
2500	0	29	3000
3000	0	27	3000

Selecting trip or warning for OVERLOAD THYRISTOR FAN, OVERLOAD EXTERNAL FAN and EARTH FAULT (67, 68)

The choice of trip or warning is made in TRIP1XX module, page 68.
The default setting of parameter CFANOLS, EXFANOLS and EFLTS will give trip.
To select warning the parameter concerned has to be set to "0".

Setting of external fault protection (41)

In the module it is possible to select delay time for trip or warning signal.
It is also possible to choose if the external fault shall give trip or warning.
Note! The default parameter setting will give warning.

Setting of stall monitor (61)

The stall monitor normally does not been to be adjusted during commissioning.
The parameter for the armature current is default set to 50 %. The speed level is 2 % and the time delay is 3 seconds.

Setting of torque monitor (61)

In module TQMONXX it is possible to select warning instead of trip. This is normally done by setting the parameter TQFLTS1 to "0".
For more information about function and parameters in the module, read Module Description.

CONCLUDING PROCEDURES

Check, in function module IACTRLXX that parameter IASTEP1 is at 0 %.

Check, in function module SEQCONXX that parameter IFACKBLK is at 0.

Reset the fault logger by **temporarily** setting parameter FCLEAR in function module FLTLOGXX to "1" and then back to "0".

Log six signals which can be of interest to those who are to perform fault tracing.

Start the logger. Note that the L which flashes in the square at the lower left of the display is to disappear.

Set switch S10 in position PS at the top on the computer board YPP 105. A cross is now to become visible in the circle on the display (prevent resetting of parameter).

Print the parameter settings in all modules and fix these in place on the circuit diagram.

The connections made with the signal switch-box are to be printed and fixed in place on the circuit diagram.

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Contents Page

Operator's panel management

Introduction

There is a continuous demand for improved communication between man and machines. ABB has developed an operator's panel to satisfy this requirement with respect to motor drive systems.

The operator's panel permits simple and accurate measurement of variable signals, setting of parameters, the performance of step tests in drive systems etc.

The different displays which can be presented on the operator's panel have been designed to enable the operator to learn quickly the functions used most frequently. To obtain basic knowledge it is sufficient to read Section **"General characteristics of the operator's panel"**. The next step is to continue with practical training with the equipment.

This document can then be used as a reference to provide more detailed information when required.

General characteristics of the operator's panel

Display design

The total display is divided into four fields.
The format of Field 1 remains constant. The three display designations at the top of Field 1 can be varied as described below.

The contents of fields 2 - 4 vary and depend upon which display designation is in the middle position of the three currently presented in Field 1.

To change the display , the display designations are moved upwards or downwards as described under "Display Exchange" below.

Cursor movement

The operator's panel can be used to change the value of a system parameter, command a printout, change a scale value etc. The factor common to these operations is that a cursor is moved to specific positions on the display. The positions to which the cursor can be moved are marked with squares. For examples, see fig. 2.

The buttons ↘ or ↖ are pressed to move the cursor to the position required.

Figs 3 and 4 show examples of the path of the cursor when ↘ or ↖ are pressed under different conditions.

When the ↘ or ↖ button is depressed continuously, the cursor moves automatically between the different

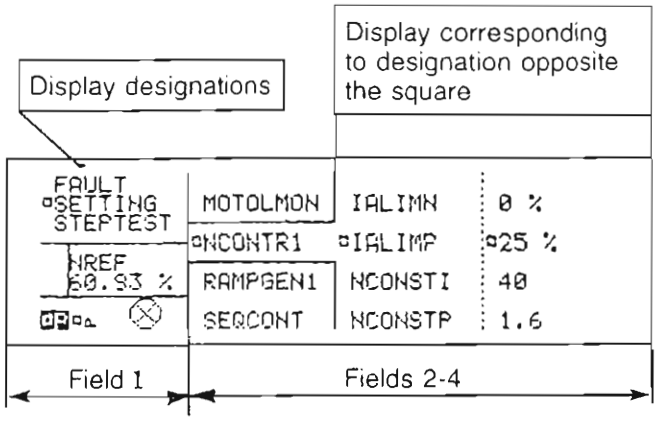


Figure 1. Arrangement of operator's panel display.

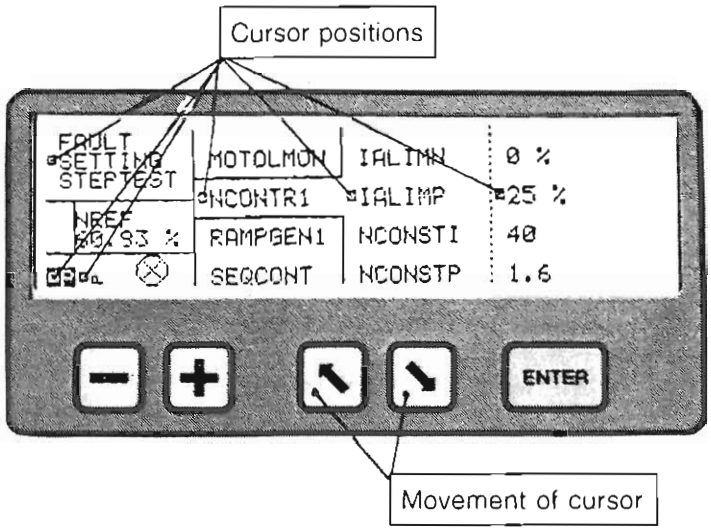


Figure 2.

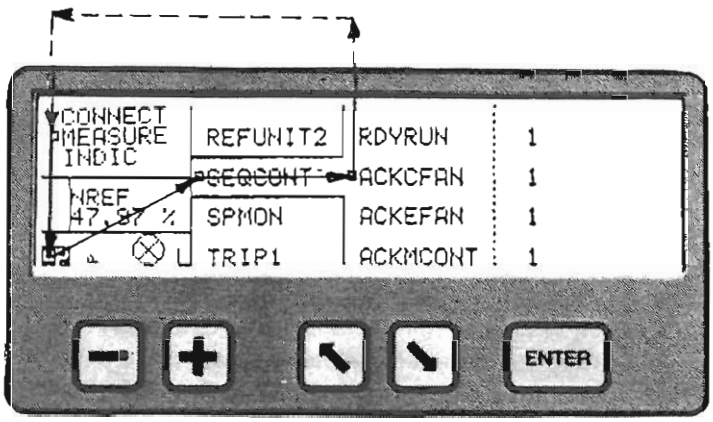


Figure 3. Display MEASURE.
Example of cursor movement on pressing ↘ . The cursor moves in the opposite direction when ↖ is pressed.

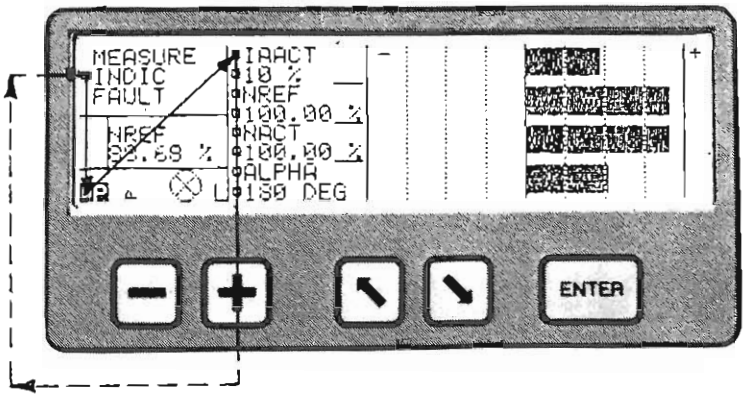


Figure 4. Display INDIC (ATION). Example of cursor movement on pressing ↘ . When ↖ is pressed, the cursor moves in the opposite direction.

Display exchange

Different displays can be obtained on the operator's panel by placing the cursor as shown in fig. 5 and then pressing + or – .

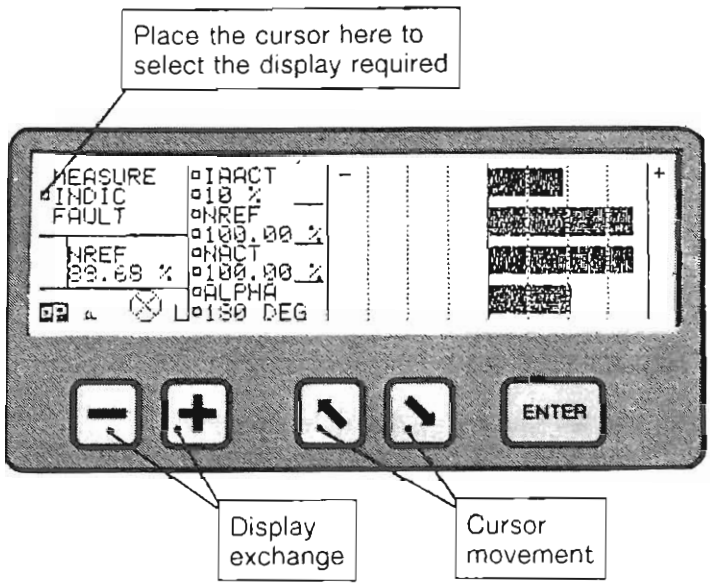
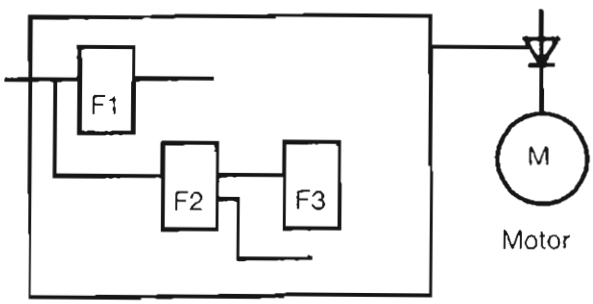


Figure 5. Display selection.

Functions, signals and parameters

The control and regulation system of a motor drive system is an assembly of a large number of function modules. See fig. 6.

These function modules contain parameters and signals and a typical function module is illustrated in fig. 7. The signals and parameters with identities given on the circuit diagram can be measured and set respectively via the operator's panel.



F1 - F3: Function modules.

Figure 6. Control and regulation system for motor drives.

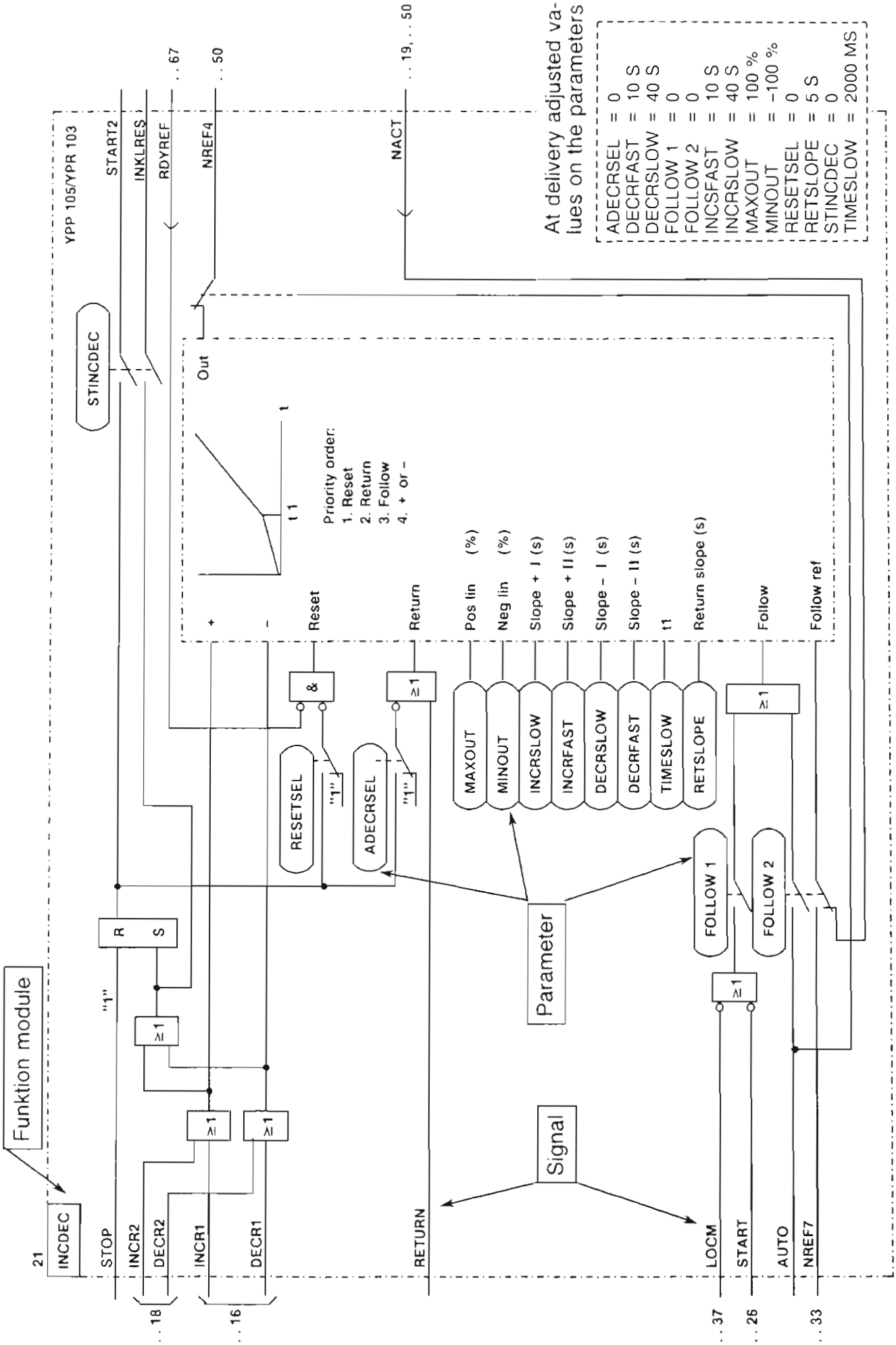


Figure 7. Example of a function module.

The figures 8 and 9 show the displays for measurement (MEASURE) and parameter setting (SETTING) respectively.

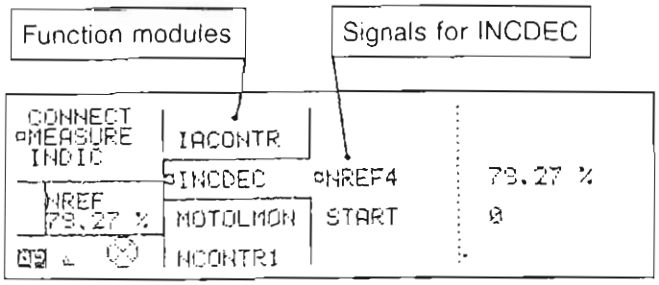


Figure 8. Measurement.

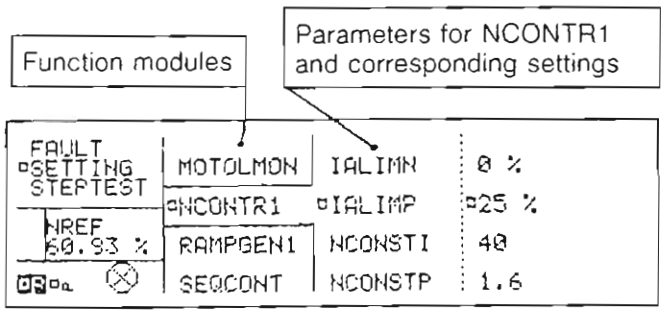


Figure 9. Parameter setting.

Table arrangement

The + or – buttons are pressed to change between different displays on the operator's panel or to switch between function modules during parameter setting for example. See "**Display exchange**" above. The texts can be considered to be on a rotating drum which rotates forwards one step when + is pressed and backwards one step when – is pressed. See fig. 10. This model applies for all of the displays available.

The tables for function modules, signals and parameters are arranged in alphabetical order.

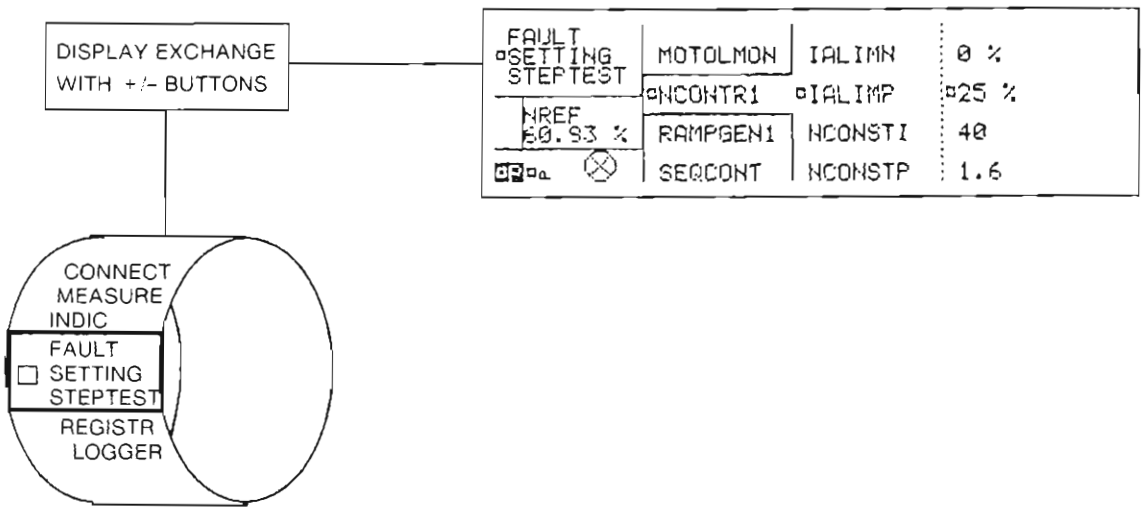


Figure 10. Model to illustrate text presentation (in this case, display designations at top of Field 1).

Printout

Printouts of the operator's panel display are available in three different sizes with different degrees of resolution. When a printout is required, place the cursor in the position shown in fig. 11. Then press **ENTER**, + or – . The printout size is dependent on whether + or – is pressed, as shown in figs 12 - 14. The printer is connected at contact X31 on the operator panel circuit board on the inside of the door.

The printer can be connected or disconnected during operations.

It is not possible to print the GENERAL screen.

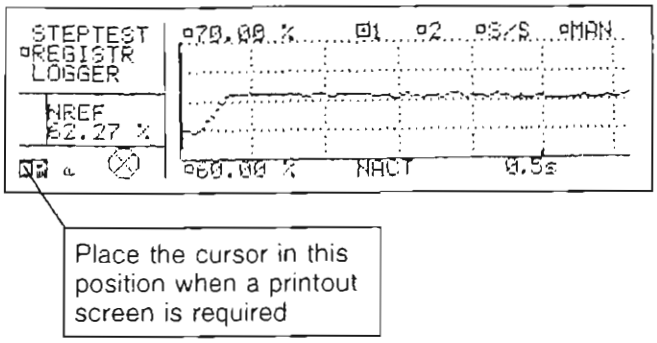


Figure 11. Printout.

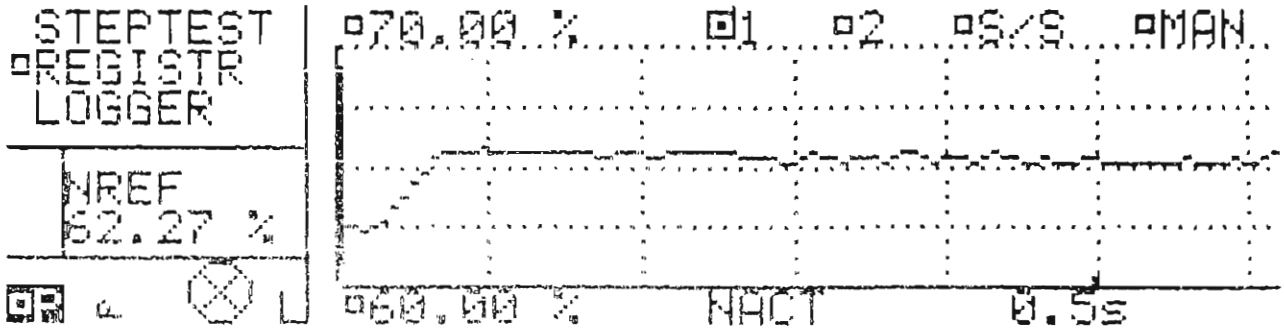


*Figure 12. Appearance of printout when **ENTER** is pressed.*

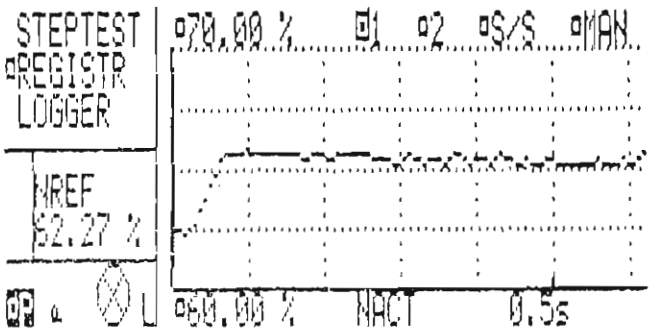


Figure 13. Appearance of printout when + is pressed.

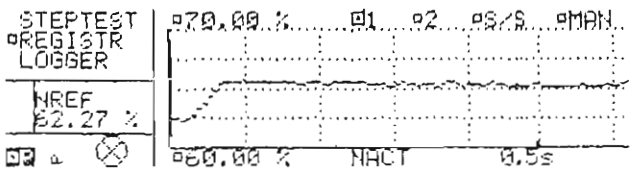
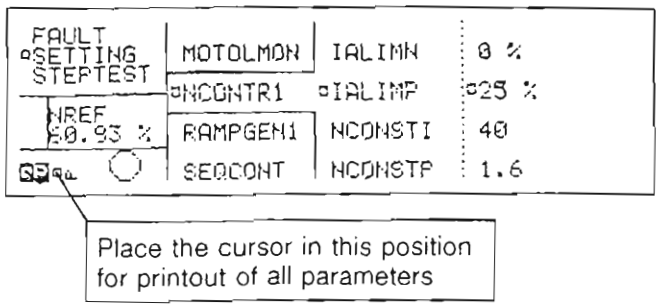


Figure 14. Appearance of printout when – is pressed.

The number of signals and parameters within a function module as well as fault signals can exceed the number which it is possible to show at one time on the operator's panel. If a printout of all signals or parameters within a function module or a printout of all fault signals is required, the cursor is first placed as shown in fig. 15. Then press **ENTER**.

The printer can be stopped by pressing the **–** **button**.

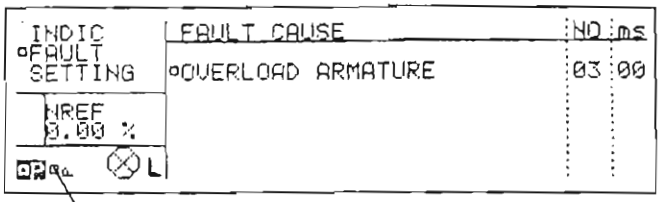



```
NCONTR1
=======
IADERMAX = 100
IALIMN   = 0 %
IALIMP   = 25 %
NCONSTI  = 40
NCONSTP  = 1.6
NDERCONS = 6.9
NFILTTC  = 121 MS
```

Appearance of printout

Figure 15. Printout of all parameters within a function module.

If instead **+** is pressed in the SETTING screen all parameters in all function modules will be printed.




```
FAULTS   TYRAK
===============

OVERLOAD ARMATURE
GROUP : 03    TIME : 00

HIGH ARMATURE CURR DIFF
GROUP : 02    TIME : 00

OVERCURR ARMATURE
GROUP : 02    TIME : 00

UNDERVOLTAGE MAINS SUPPL
GROUP : 01    TIME : 00

NO EARLIER FAULTS STORED
```

Appearance of printout

Figure 16. Printout of all error signals within a function module.

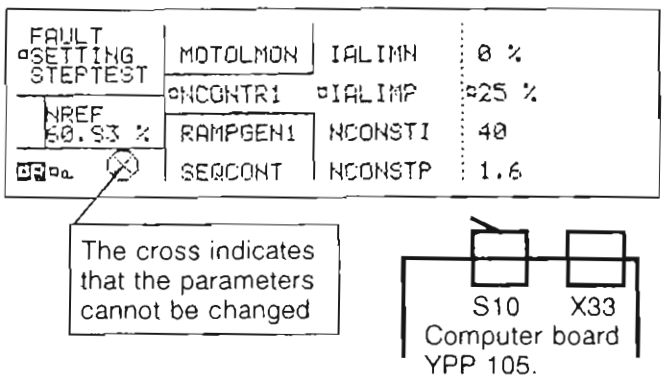


Figure 17. Latch function active. Parameters cannot be changed.

Latch function

A latch function has been introduced to prevent unintentional change of parameters. If the parameters are blocked, a cross appears in the ring as shown in fig. 17. This cross disappears when parameter values can be changed. See fig. 18. The latch is located on the computer board YPP 105 and its status, active or inactive, can be changed by operating switch S10 at the top of the computer board.

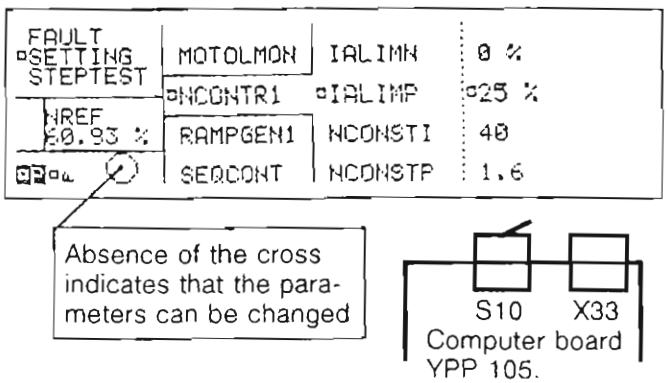


Figure 18. Latch function inactive. Parameters can be changed.

Pushbuttons for convertor operation

To activate the convertor press button **I**. To deactivate the convertor, press button **O**. When the convertor is active, a green field illuminates. This extinguishes when the convertor is deactivated. See Fig. 19.

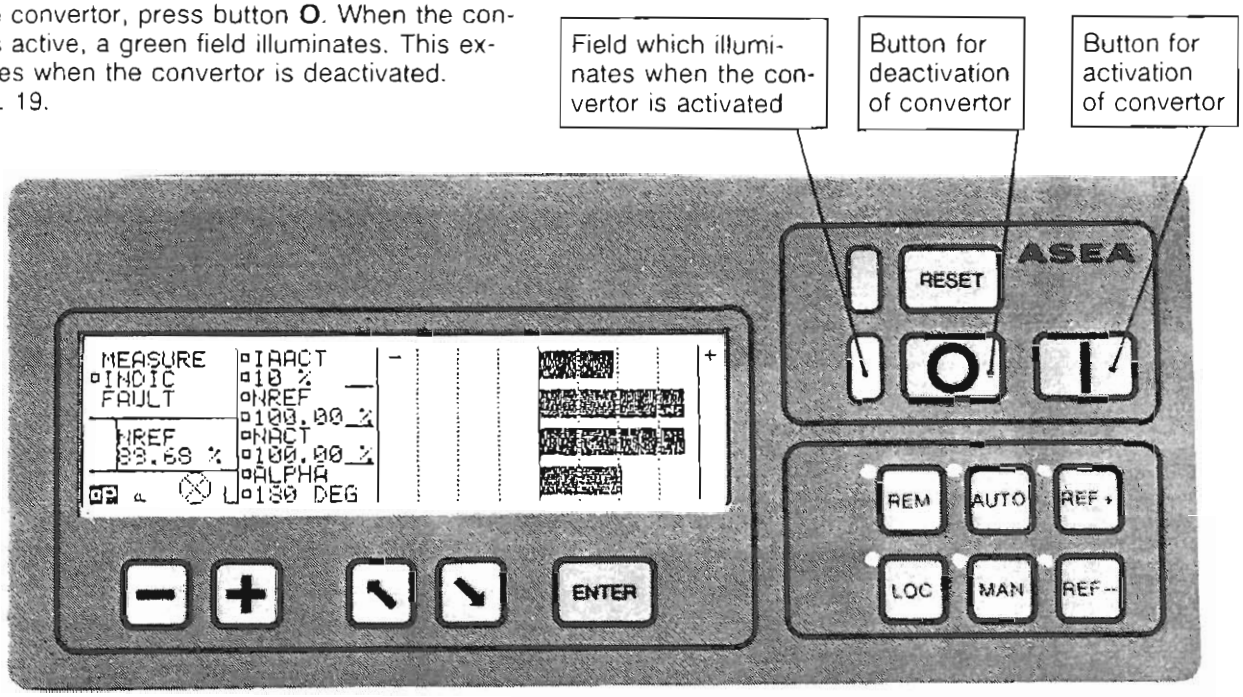


Figure 19. Activation and deactivation of convertor.

If a protection trips because of some malfunction, a red field illuminates and the drive system is deactivated. The malfunction must be corrected and the **RESET** button pressed, extinguishing the red field, before the system can be restarted. See Fig. 20.

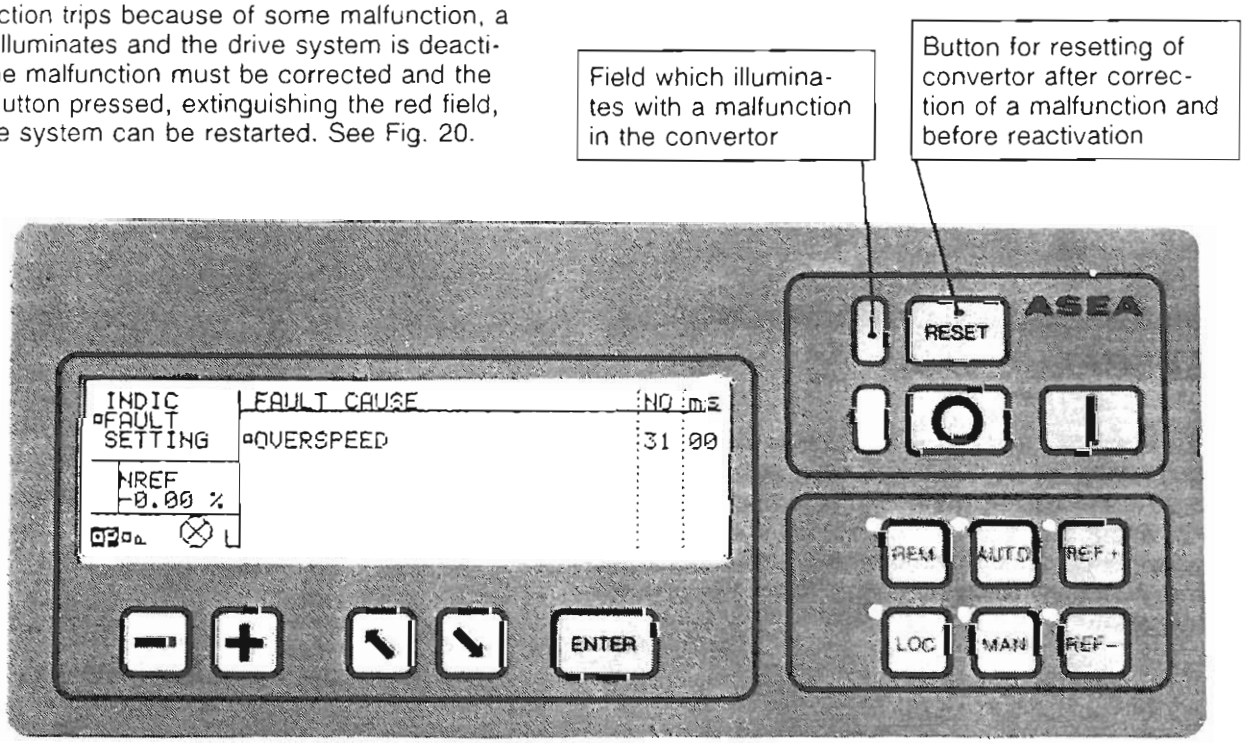
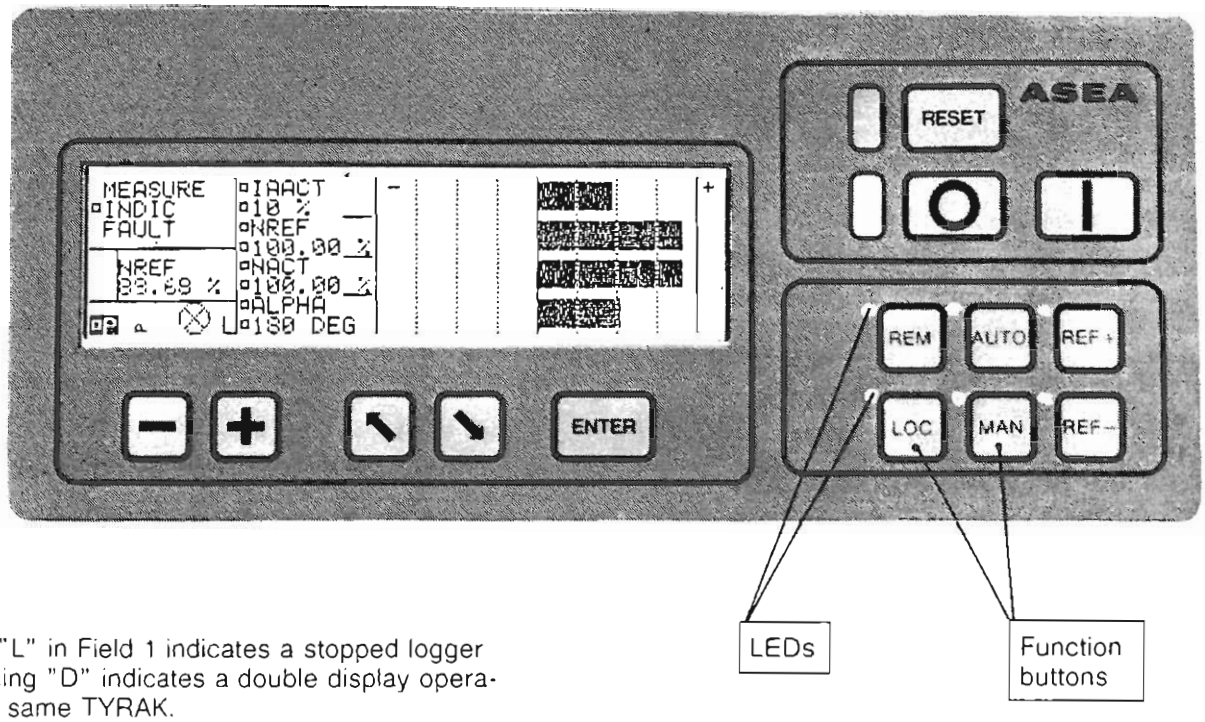


Figure 20. Resetting of convertor before reactivation .

Six buttons for commanding functions are located at the lower right hand corner of the panel. See Fig. 21. The function of each push button is inscribed on each button. The functions of the buttons can vary in different installations and the text can be changed accordingly. Each button contains a light emitting diode which may be used as a feedback from the application process.



A flashing "L" in Field 1 indicates a stopped logger and a flashing "D" indicates a double display operation on the same TYRAK.

Figure 21. Function buttons.

General display, designation GENERAL

The operator's panel text is available in 4 different languages, Swedish, English, German and French. To change the language, the cursor is placed as shown in fig. 22 and the + button is pressed until the required language is opposite the cursor. If **ENTER** is pressed also all fault texts will be changed into the selected language.

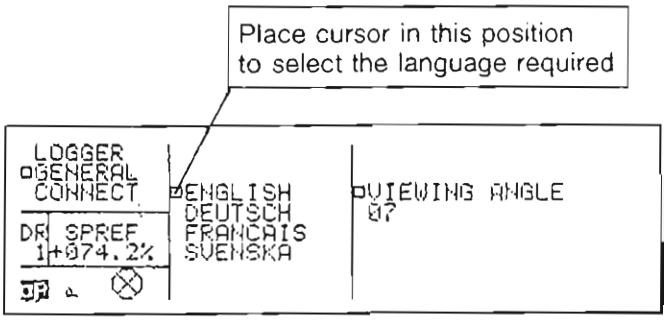


Figure 22. Display General. Selection of language.

Function module names, parameter names and signal names do not change when the panel language is changed.
See figs. 23 and 24.

Figure 23. General.

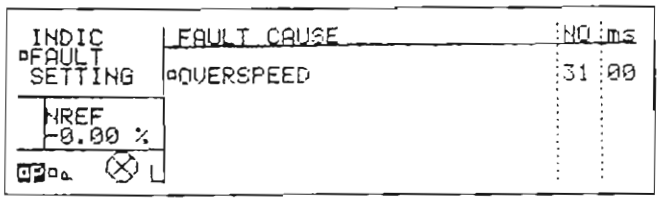


Figure 24. Fault Indication.

The operator's panel was only clearly legible when viewed from within a limited angle. This angle is adjustable to permit the best viewing conditions for both tall and short operators. To adjust the viewing angle, the cursor is first placed as shown in fig. 25 and then the + or – button is pressed. The angle can be varied through a scale range 0 - 15. Press **ENTER** for permanent storage of the viewing angle selected.

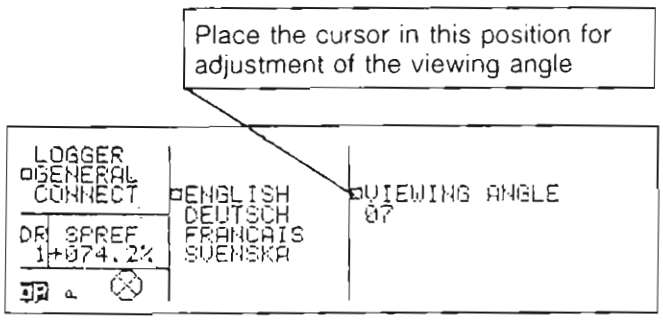


Figure 25. General.
Adjustment of viewing angle.

Indication display, designation INDIC

Four **arithmetical** signals can be measured and presented simultaneously when the INDIC display is selected. The magnitudes of the signal values are indicated by horizontal staples.

If a signal is to be exchanged, the cursor is to be placed before the signal to be replaced. Press + or – until the required signal is presented and then press **ENTER**. The result of pressing + or – is explained above under **"Table arrangement"**.

When setting a scale factor, place the cursor in front of the number which is to be changed. Then press + or – to increase or decrease the scale factor.
See fig. 27.

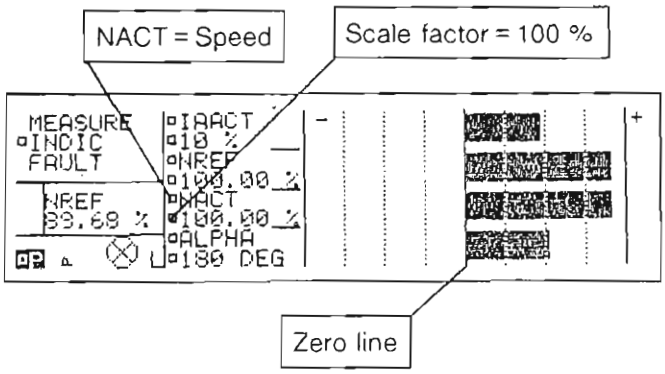


Figure 26. Appearance of Indication display.

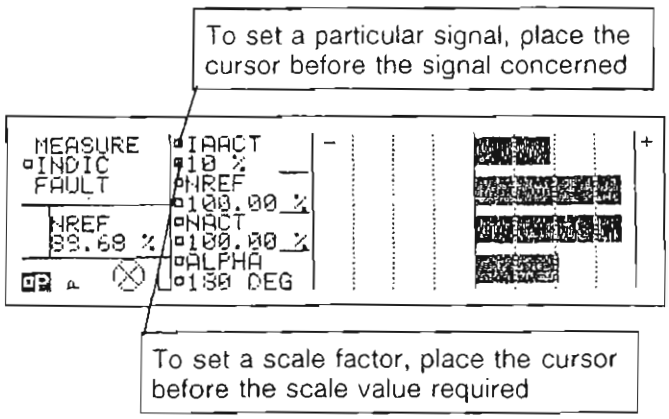


Figure 27. Display INDIC.

Fault indication display, designation FAULT

The Fault Indication display is of great assistance when tracing faults. The display FAULT is shown automatically when a fault is detected and if a series of faults occurs, these are presented in order of occurrence. The first fault is given the time 0 and the subsequent faults are time tagged in relation to this. See fig. 28. Only the faults in the sequence which occur within 255 ms are indicated. Each fault is given a number. Only the first fault within a group get the group number. The rest just gets " + ".

After the fault has been corrected, the faulty status is concluded by the operator processing the **RESET** button.

To obtain a survey of all of the faults which have occurred after the commissioning of the convertor, the cursor is placed as shown in fig. 29 and the + or – button is pressed. Fault texts are not normally displayed until a fault is detected. This means that the latest error message is "above" the uppermost line on the operator's panel. The most recent fault can then be presented by pressing the – button.

The fault memory accommodates 200 faults. The group numbering is restarted at 99. If it should become fully occupied, the oldest error is written over and the group numbering restarts at 01.

The contents of the fault memory can be erased after commissioning by briefly setting the parameter FCLEAR to 1 in the function module $FLTLOG_{XX}$.

When malfunction has been detected its cause must be corrected first. After this, the **RESET** button must be pressed before the drive system can be reactivated.

Measurement display, designation MEASURE

For measurement of signal values in the control system, the display MEASURE is paged forward. Four signal values can be presented at a time on this display. The appearance of the measurement display is shown in fig. 30.

When a signal within a certain function module is to be measured the cursor is first placed in Field 2 to scroll the function module required. See fig. 31.

When the cursor is placed in Field 2, press the + or – button until the function module required is presented opposite the cursor. The modules are available in alphabetical order. A table of the signals included in the module is now presented in Field 3.

When the function module required is set, the cursor is placed in Field 3 to permit "rotating" forward the signal required. See fig. 32. Press then the + or – button until the signal required appears on the opera-

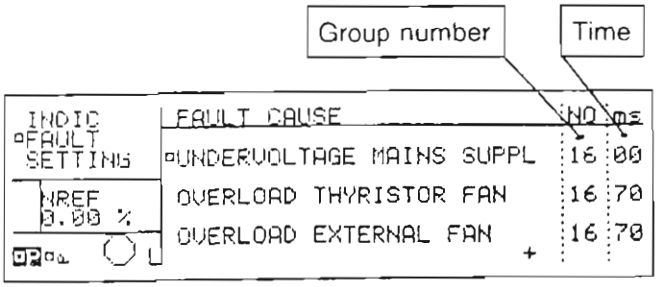


Figure 28. Fault Indication.

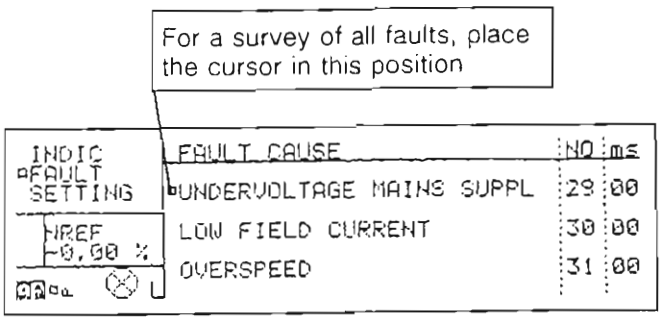


Figure 29. Fault statistics.

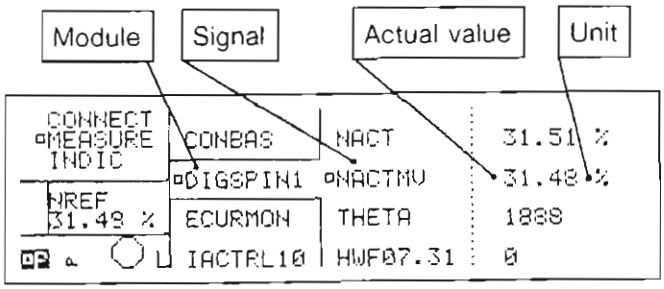


Figure 30. Measurement of signals.

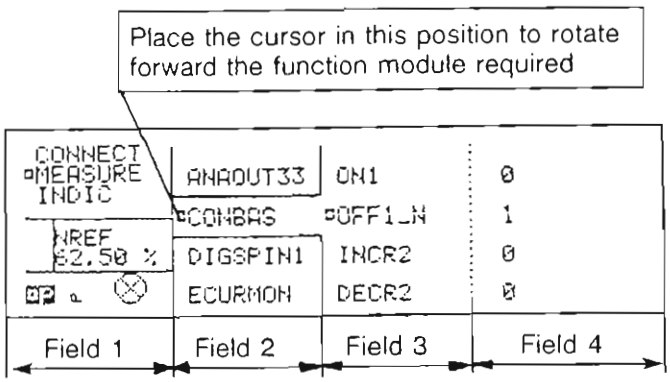


Figure 31. Measurement of signals.
Setting of required function module.

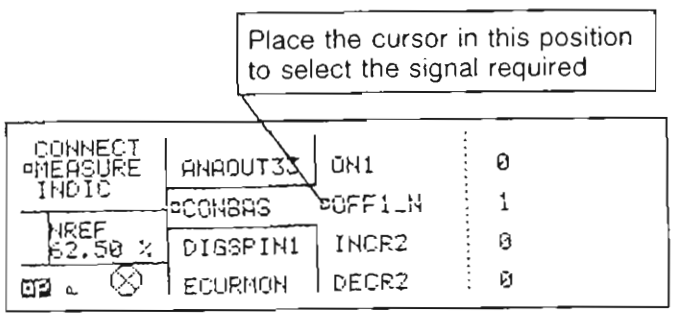


Figure 32. Measurement of signals.
Selection of a signal

Display for setting of parameters, designation SETTING

The function of a control system is determined by a large number of parameters which can be increased or decreased via the operator's panel.

To determine the current value of a parameter or to give a parameter a new value, the function module containing the parameter is selected first. The cursor is located as shown in fig. 33. Press then the + or – buttons until the name of the required module appears by the cursor. The modules are stored in alphabetical order. A table of the parameters included in the function selected now appears to the right of the function table.

When the required function module has been selected, the cursor is moved to the position shown in fig. 34. Press then the + or – button until the parameter required appears on the screen. The parameters are also stored in alphabetical order.

When a parameter value is to be changed, the parameter concerned is placed opposite the cursor in Field 3. see fig. 35.

The latch must first be inactivated. See section **"Latch function"**. When double display operation is used also the authority parameters in module OPCH$_{XX}$ must have appropriate settings.

When the name of the parameter concerned is placed as shown in fig. 35, the cursor is moved to Field 4. Press the + or – buttons until the parameter value required is shown. When the value set is that required, the button **ENTER** is pressed. The new parameter value is now transmitted to the convertor computer where it is stored in an EEPROM and is used directly in the control system.

N.B: The previous parameter value is stored in the display computer so that it can be recalled quickly if any control probem should develop with the new value. The previous value is obtained if ENTER is depressed a second time.

Registration display, designation REGISTR

The behavior of an arithmetic or logic signal can be registered with the display REGISTR. When a step test is performed on an optional signal the response to the step becomes available for study.

The logger can be stopped in three different ways:

1. The convertor has been tripped by a fault signal.
2. A step test has been commanded.
3. The logger is stopped manually.

A flashing "L" on the display indicates that the logger has stopped. If the convertor has tripped, the logger must be restarted manually by pressing **ENTER** in po-

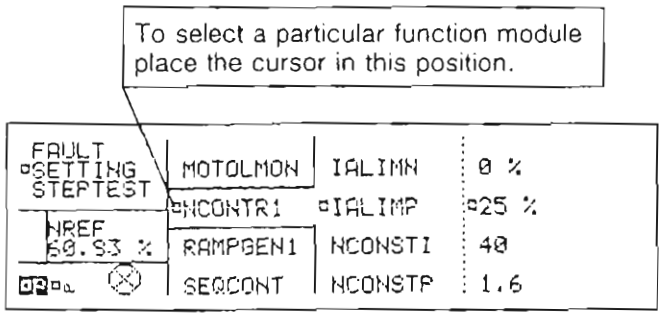


Figure 33. Parameter display. Selection of function module.

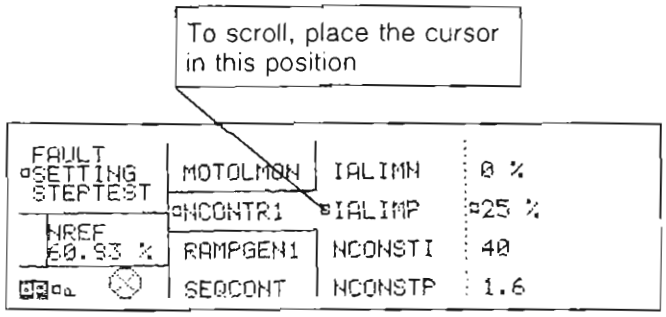


Figure 34. Parameter display. Parameter check.

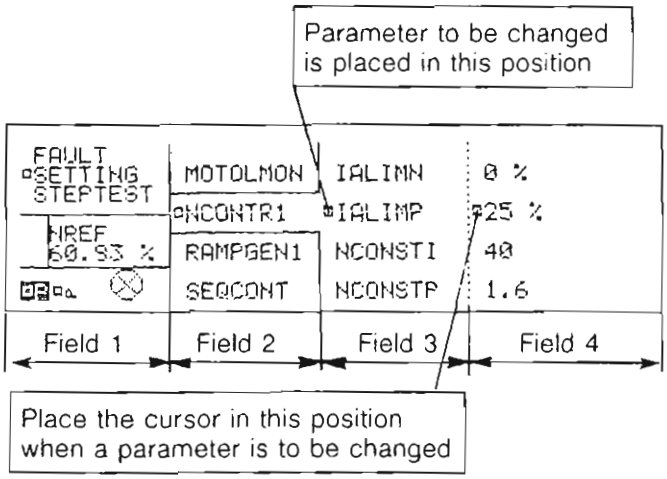


Figure 35. Parameter display. Setting of parameter.

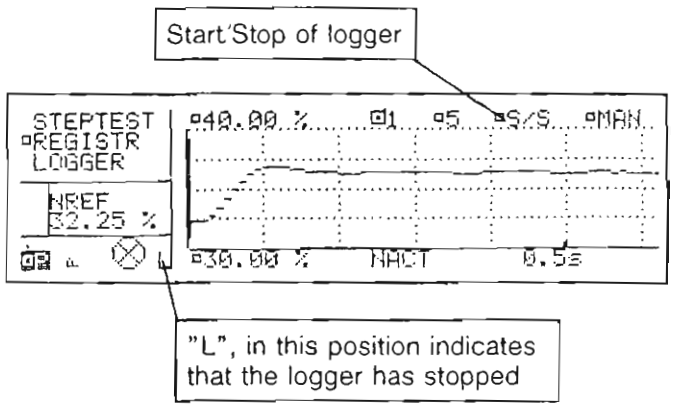


Figure 36. REGISTR. Start of logger.

When the upper limit of the amplitude scale is to be changed, the cursor is first placed in the upper position as shown in fig. 37. Press + or – until the required value is presented and then **ENTER**. The procedure is similar for changing the lower limit.

If the upper limit is selected slightly above the lower, a "part- enlargement" of a control level of particular interest can be obtained.

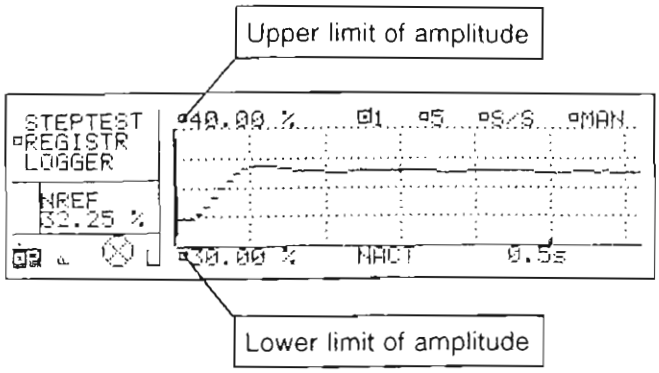


Figure 37. Registration.
Setting of amplitude.

To select a channel on the registration display, the cursor is placed as shown in fig. 38. The signal which is active in the channel is specified in the display LOGGER. When the cursor is placed in the required position, press + or – until the channel required is presented. Then press **ENTER**.

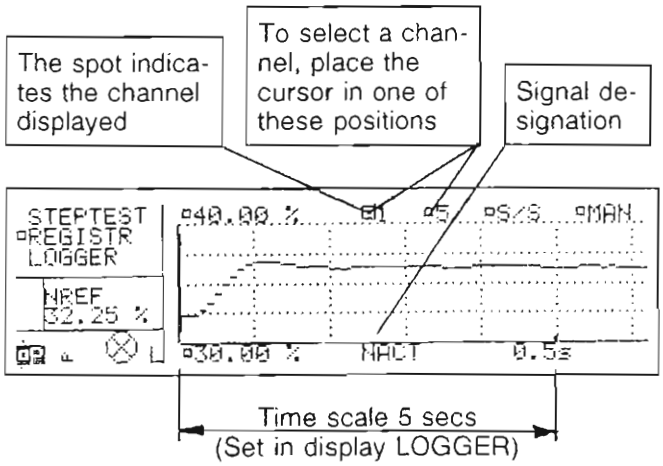


Figure 38. Registration.
Selection of channel.

Two logger channels can be stored simultaneously in the display computer. The number of the channel required is specified in position A or position B as in fig. 39. If **ENTER** is then pressed the signal in the channel selected is presented. The logger must be inactive if the channel is to be changed i.e. a flashing "L" must be visible.

If the signal currently displayed is to be compared with another signal, the cursor is placed in position A or position B. See fig. 39.

Then press ENTER to obtain a presentation of the other signal. The original signal is recovered by pressing **ENTER** again. A rapid exchange is obtained if **ENTER** is held in its depressed position.

Example: Assume that the signal on channel 1 is displayed and that the cursor is at position A as in fig. 40. If **ENTER** is pressed, the signal on channel 5 is presented and the cursor moves to position B as in fig. 41. If **ENTER** is pressed again, the display shown in fig. 40 returns.

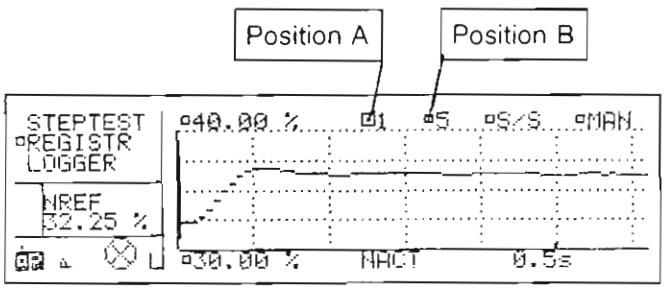


Figure 39. Registration.

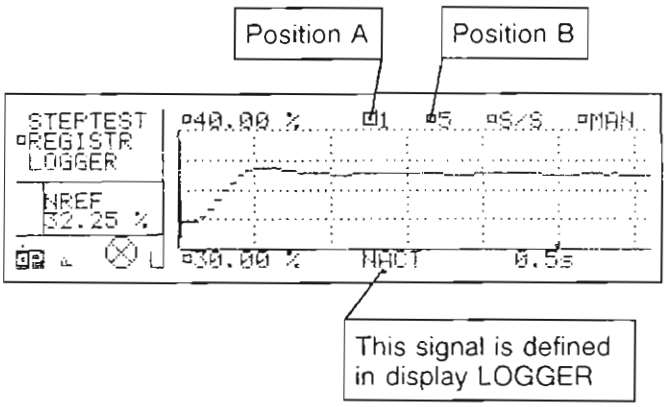


Figure 40.

Step testing is defined in the section "**Display for setting of step testing, designation STEPTEST**". Step testing can however be commanded in the display REGISTR, either manually in single steps or automatically in a series of steps.

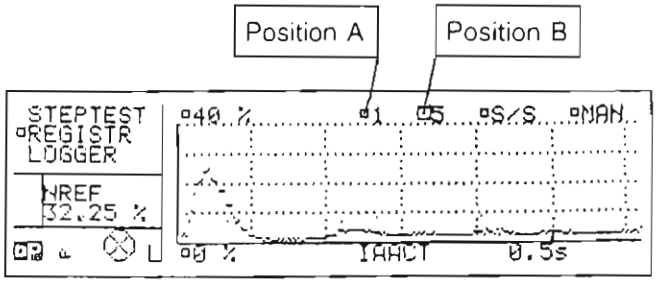


Figure 41.

When a manual step test is to be performed, the cursor is placed in the position shown in fig. 42. Press + or – until MANual is presented. **ENTER** is pressed to activate the stepping in the value. This triggers the logger which means that the logger registers the signal and continues recording until its memory is filled. The signal curve is then presented on the REGISTR display.

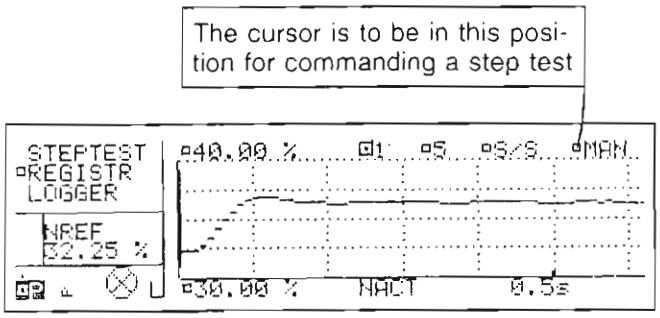


Figure 42. Registration.
Manual step testing.

If a step test is to be repeated automatically, the cursor is first placed in the position shown in fig. 43 and the + or – button is pressed until the text REP is presented. Automatic repetition of the step test is started when **ENTER** is depressed.

The step test is stopped by pressing **ENTER** once again. The cursor will then move out to the text REGISTR in Field 1 as in fig. 43.

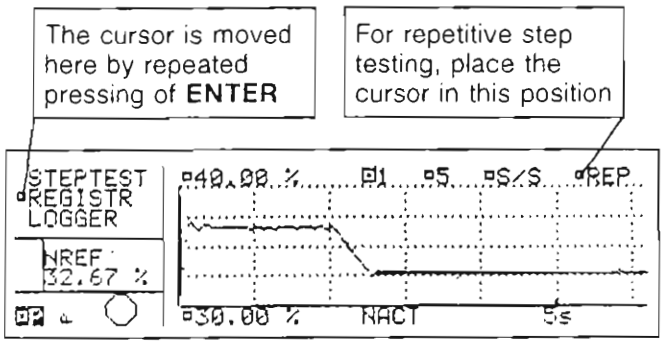
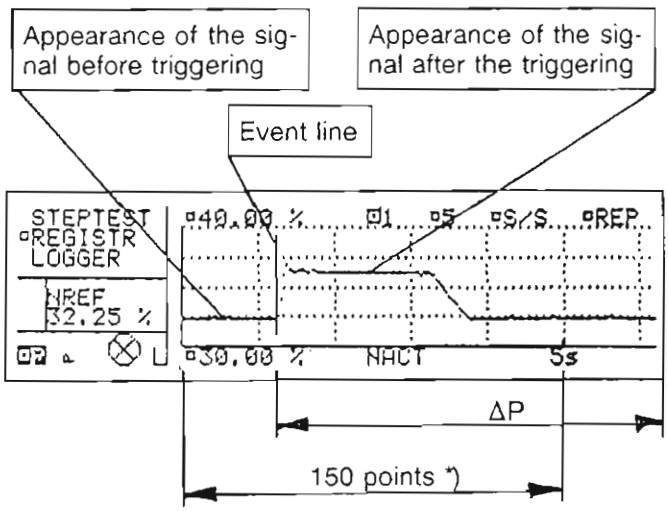


Figure 43. Registration.
Repetition of step testing.

The amplitude of the step, its duration and the signal to which it is applied are set on the STEPTEST display. The time between each test step is dependent on where the event line is placed and the time scale factor in the registration display. It is however always greater than ten seconds. See fig. 44.

The different durations of the square wave steps are described in more detail in fig. 45.



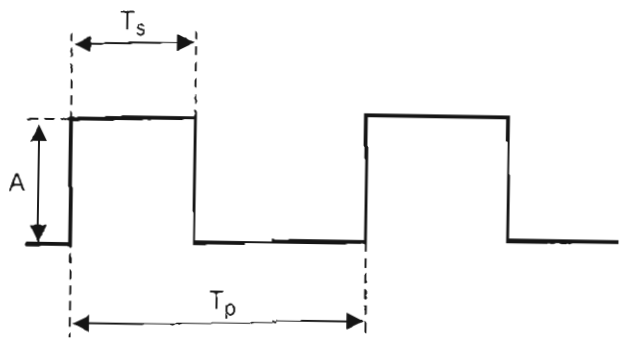
*) For Tyrak: 150 points in a 50 Hz-system
180 points in a 60 Hz-system

ΔP: Number of points after the event line.
Defined in display LOGGER.

Figure 44.

The amplitude + 100 % means a maximum positive step.

This is equal to the maximum of any other signal even if maximum of a tested signal is defined e.g. as 400 %.



A: Amplitude of the test step. Defined in display STEPTEST

T_s: Duration of the test step. Defined in display STEPTEST

T_p: The time between each step

$$(T_p)_{max} = \Delta P \times \frac{\text{Scale factor for time in registration display}}{150} + 1 \text{ (sek)}$$

ΔP: Number of points after the event line. Defined in display LOGGER.

Figure 45. Step test with automatic repetition.

If the variations in a signal are to be studied continuously, the cursor is placed as shown in fig. 46. Press + or – until the text AUTO is presented. Then press **ENTER**, the display then showing how the signal varies in time. Note that the time scale for the channel must then be set to ≥ 500 seconds.

To stop the automatic updating, place the cursor in front of AUTO and press **ENTER**. The cursor is then automatically transferred to the display designation REGISTR.

A documentation of the variation of an interesting signal may be required. The cursor should be placed at S/S (Start/Stop) and the button **ENTER** pressed. Make a printout, return the cursor to S/S and then press **ENTER** again.

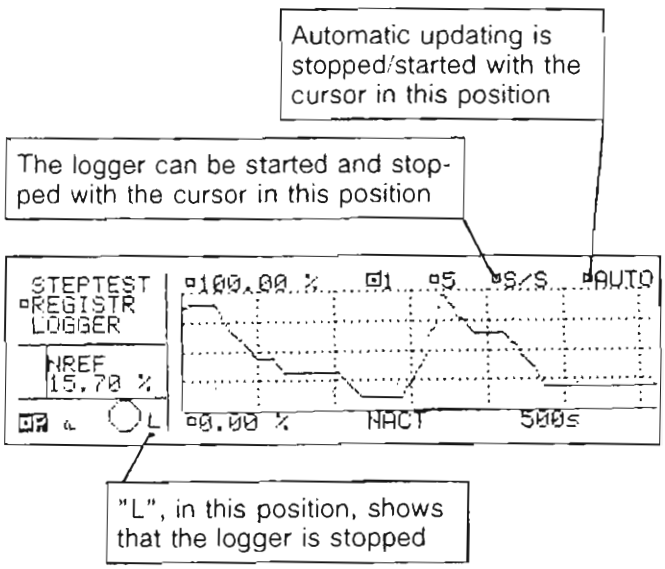
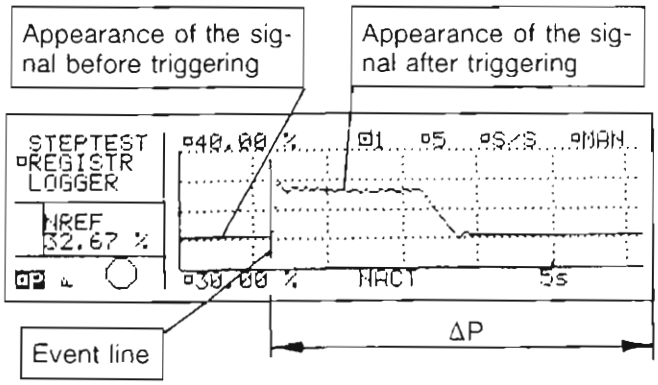


Figure 46. Registration. Automatic updating.

When performing step tests, the signal after the triggering point is that most interesting. The event line is then set at the extreme left (ΔP 157 or 186). In the case of a fault, the events leading up to the failure are of more interest. The event lines are therefore to be set at the extreme right during normal operations (ΔP approx. 30).

If the logger is not started before the steptest is done, the display will show old values before the event line.



ΔP: Number of points set in the LOGGER display.

Figure 47. Registration.
Significance of the event line.

The position of the event line is set in the LOGGER display. The number of points is specified there. See fig. 48. For a more detailed description of the logger, see below.

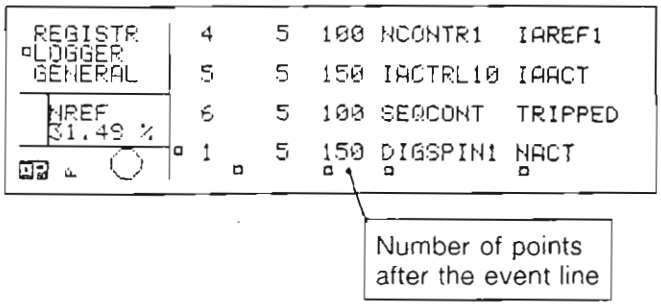


Figure 48. Logger.
Setting of event line.

Logger display, designation LOGGER

The logger is a memory in which 186 values from each of 6 channels can be stored. When a new value is stored in a channel, the oldest value from the channel disappears. The contents of the logger can be read in graphic form on the REGISTR display, each point corresponding to a mean value of measured values.

The signals in the different channels are specified in the LOGGER display. The time scale and the number of measured values after the event line are also given there. See fig. 49.

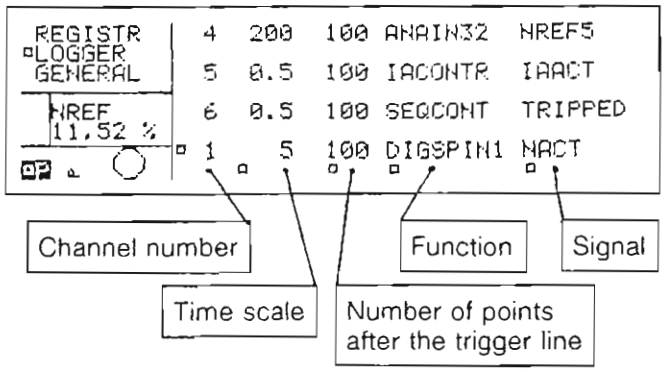


Figure 49. Logger.

A function for table scrolling is used to determine the signals in all of the channels in the logger. The cursor is first placed in the position shown in fig. 50 and then + or – is pressed.

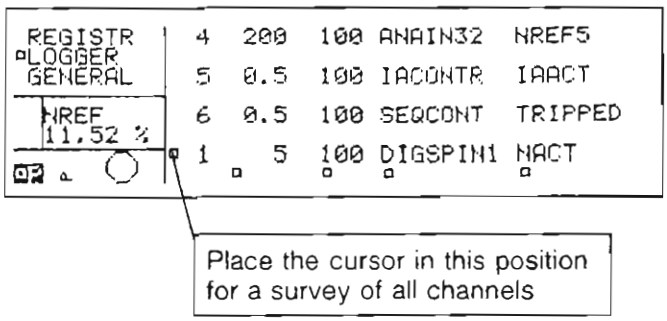


Figure 50. Logger.
Channel survey.

If new data is to be defined in the logger, the channel to be changed is first placed on the bottom line as shown in fig. 51.

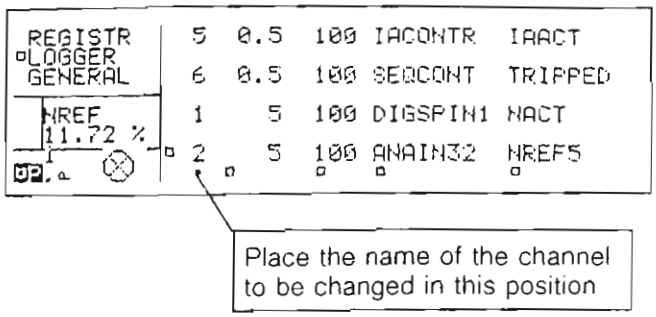


Figure 51. Logger.

To change the time scale, the cursor is placed in the position shown in fig. 52. Press + or – until the time scale required is shown. The time from the start to the time markings on the REGISTR display is given in seconds.

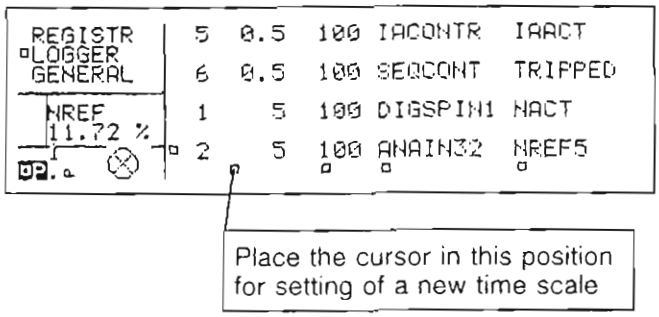


Figure 52. Logger.
Setting of time scale.

To change the number of measured values after the event line, the cursor is placed in the position shown in fig. 53. Press + or – until the number of measured values after the event line is that required.

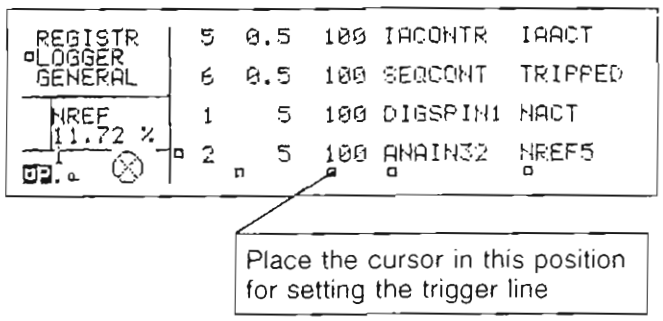


Figure 53. Logger.
Setting of event line.

The function module concerned must be defined before the new signal can be found. This is done by first placing the cursor as shown in fig. 54 and then pressing the + or – button until the identity of the required function module is shown. The first signal within this function module is then shown at the right.

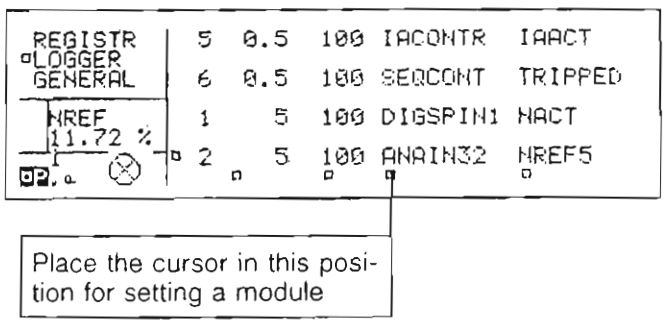


Figure 54. Logger.
Setting of function.

When the function module required is set, the cursor is placed as shown in fig. 55 and + or – pressed until the signal required is presented within the function module.

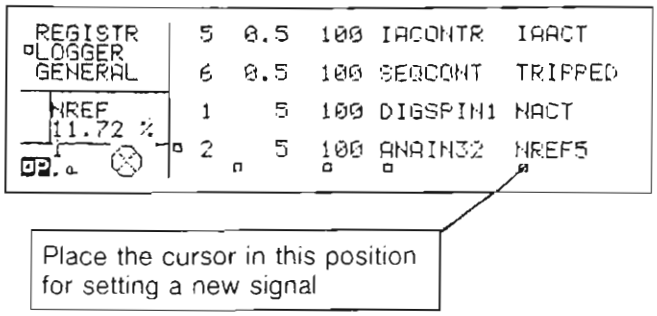


Figure 55. Logger.
Setting of a new signal.

When the new setting is that required, the cursor is placed as shown in fig. 57 and the **ENTER** button pressed. The new setting will now be stored.

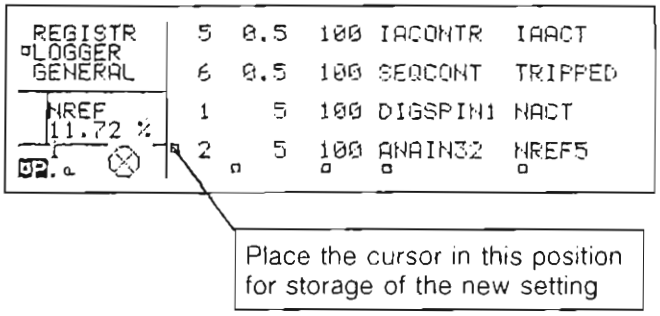


Figure 56. Logger.
Storage of a new setting.

If a step test is performed (manually or automatically) or if a fault is detected, the logger is stopped and an "L" on the operator's panel begins flashing, irrespective of the display set. See fig. 57.

If any fault develops in the drive system, the logger is tripped and all signal values are frozen. It is therefore important to restart the logger before the drive system is restarted after malfunction or a step test. This is done by placing the cursor in position S/S (Registration display) and then pressing **ENTER**. See fig. 57.

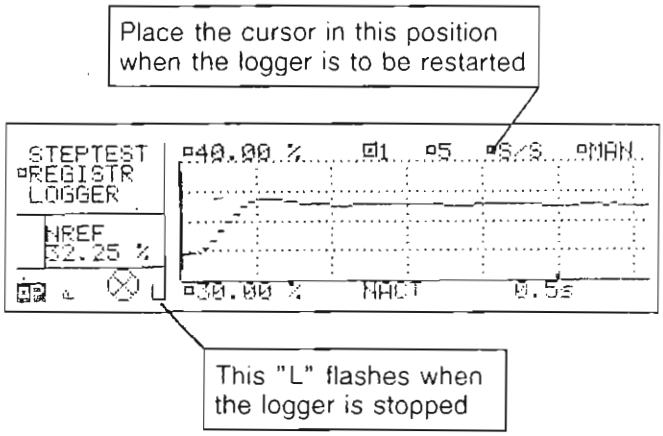


Figure 57. Registration display.

Display for setting step testing, designation STEPTEST

STEPTEST, REGISTR and LOGGER are three interdependent displays. When a step test is performed, the registration display changes forward automatically when the logger memory is fully occupied. The functions of the registration and logger are described under **"Registration display, designation REGISTR"** and **"Logger display, designation LOGGER"**.

When a step test is to be performed on a function, the cursor is to be placed in Field 2. Press + or – until the required function is presented beside the cursor. See fig. 58.

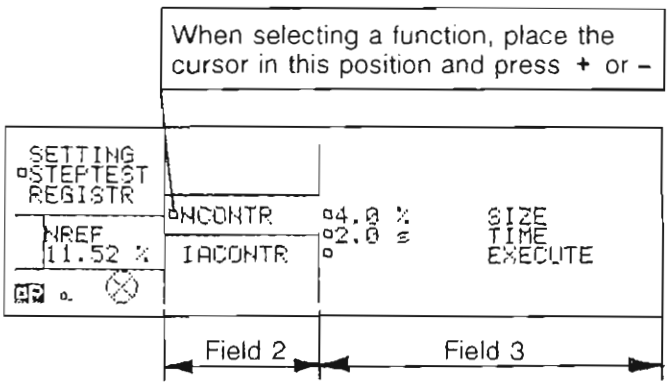


Figure 58. Step testing.
Selection of function.

When the required function is set in Field 2, place the cursor in front of the text SIZE in Field 3 and then press + or – until the amplitude required is displayed. When the required amplitude is reached, press **ENTER**.

To set the duration of the step in the value, place the cursor in front of the text TIME. Press + or – until the required time is presented on the operator's panel and then press **ENTER**.

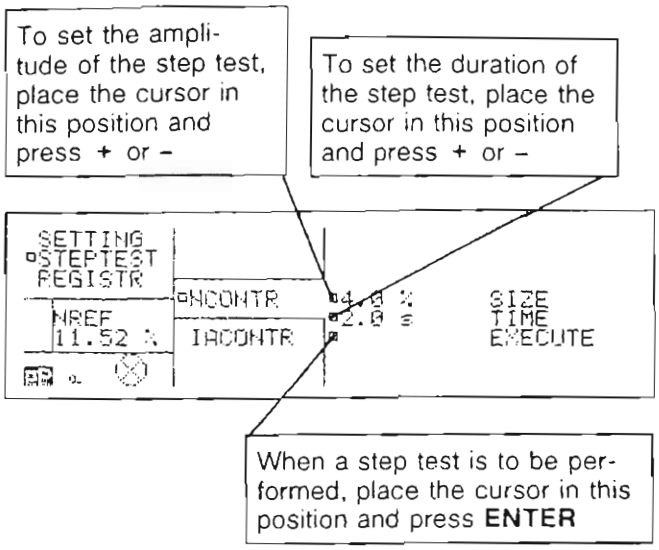


Figure 59. Step testing. Setting of amplitude.

When the required function, amplitude and duration of the test step have been set, place the cursor in front of the text EXECUTE and press **ENTER**.

The REGISTR display will then be presented as soon as the logger memory is full. The measurement time is set in the LOGGER display. See fig. 60.

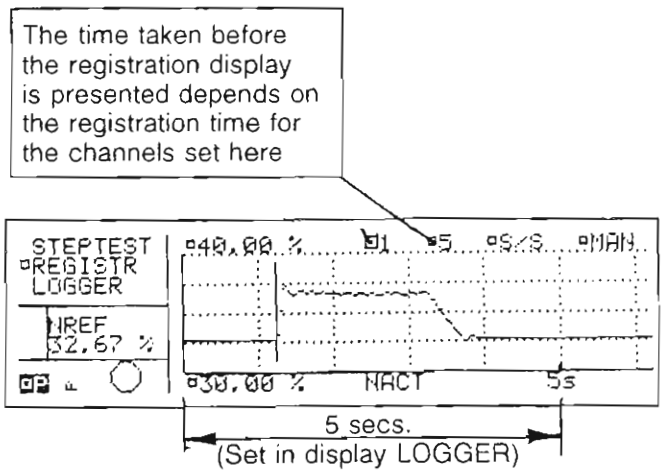


Figure 60. Registration.

Display for connection of external signals, designation CONNECT.

With the display CONNECT, it is possible to reconnect the signals on the different I/O units connected to the computer board. It is also possible to redefine push buttons and LEDs on the operator's panel.

The CONNECT display appears as shown in fig. 61. The significance of, for example, DOOP.3 is given in the section **"Abbreviations"**.

When signals are to be reconnected, the channel concerned is first placed on the bottom line by placing the cursor in position 1 and then pressing + or – until the channel required is presented, see fig. 61. The required function module is given in position 2 and the signal required is given in position 3. When the new setting is performed, the cursor is returned to position 1 and **ENTER** is pressed.

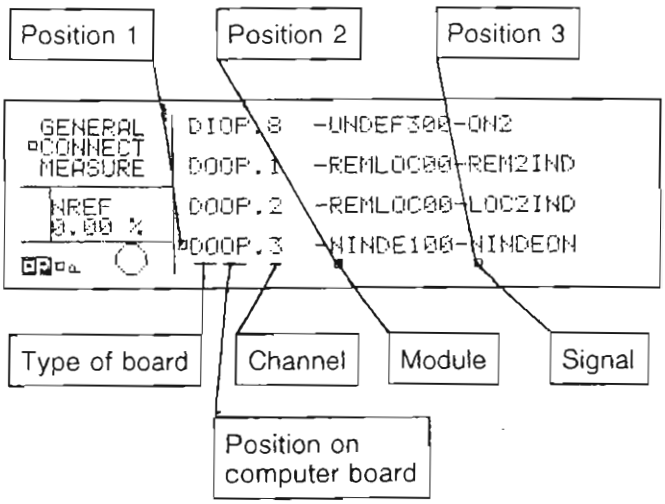


Figure 61. Appearance of the display.

Safety

Certain blocking functions are provided for protection against incorrect handling. In addition, when signals are exchanged in position 3, only arithmetical signals are selected for analogue units and logical signals for digital units. See fig. 62.

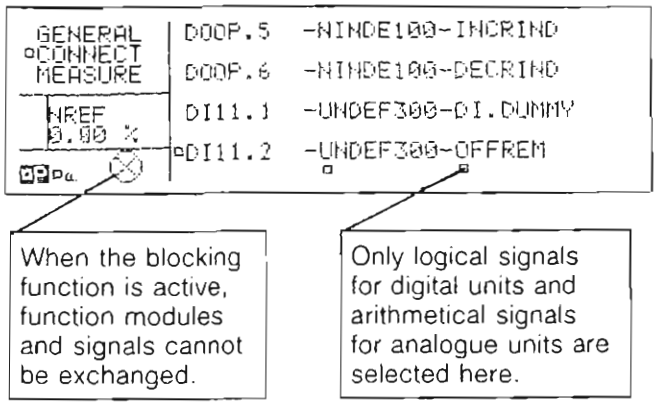


Figure 62. Safety functions.

The situations against which no protection is provided are shortcircuiting and the connection of an output to an inport or vice versa. See fig. 63.

N.B. The operator must be observant here and register the connections made.

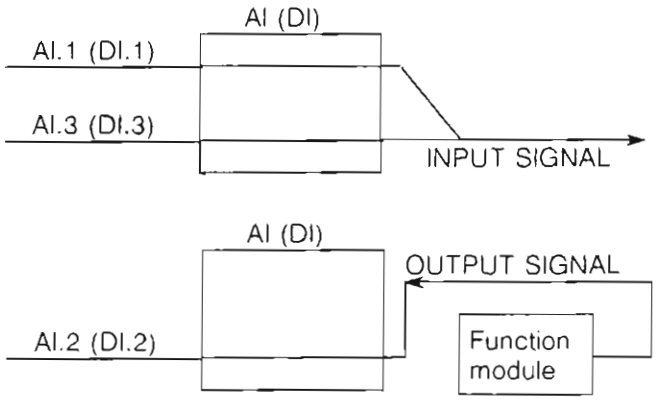


Figure 63. Situations against which no protection is provided.

Abbreviations

AI = Analogue IN-put.
AO = Analogue OUT-put.
DI = Digital IN-put.
DO = Digital OUT-put.

The numbering of the positions on the computer board and the operator's panel are numbered as shown in figs 64 and 65.

AI33.4 corresponds to ANALOGUE IN, placed in position 33 and the signal concerned is connected to channel 4.

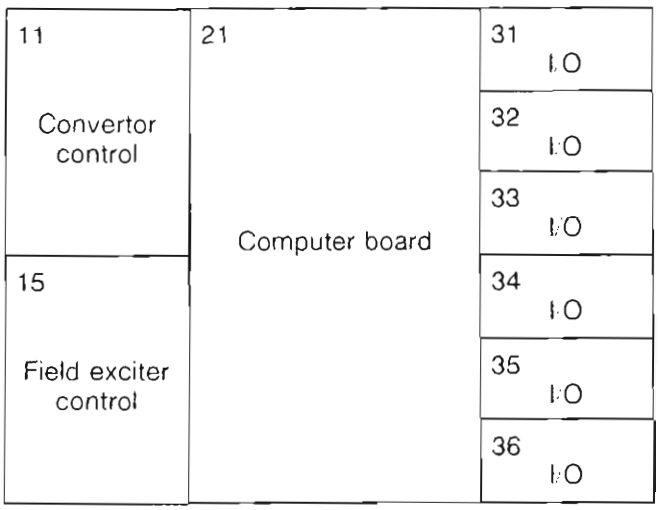


Figure 64. Board numbering for computer unit.

DOOP.3 corresponds to LED number 3 (Digital OUT) on the operator's panel.

DIOP.5 corresponds to push button number 5 on the operator's panel.

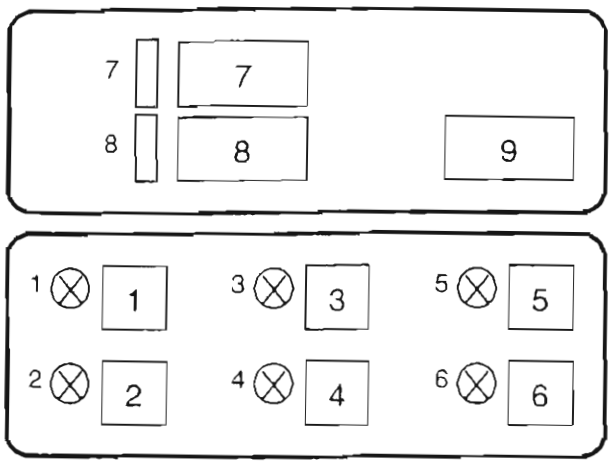


Figure 65. Numbering of push buttons and LEDs on the operator's panel.

ABB Drives AB
Power Electronics Division
S-721 75 Västerås Sweden
Telephone: Int + 46 21 34 00 00
Telecopier: Int + 46 21 18 36 39
Telex: 40 843 ABBDRI S

Operator's panel management
Reg. no. 4890 066 - 352
9101/1000
To be ordered from
ABB Drives AB/Dept. DFA.

TYRAK L

Thyristor convertor with microcomputer for d.c. drive systems, 10 - 2000 kW

Maintenance

YT 280-324 E

ABB Drives

ASEA BROWN BOVERI

List of contents

GENERAL

TYRAK L convertors with ratings ≤ 800 A contain no components subject to wear in the usual sense of the word.

TYRAK L with ratings ≥ 950 A contain an ALH type air circuit breaker which requires certain maintenance if operated frequently.

The maintenance of these convertors is therefore mainly of a preventive nature. In addition to the specific check points listed below, general maintenance is necessary to ensure trouble-free operation.

This type of maintenance is common to all electrical equipment and can therefore be included in the general service routine of the installation.

CHECK POINTS

The convertor should be inspected at regular intervals, determined by the nature of its operation and its working environment (vibration, dust, humidity etc.).

The following points should then be checked:

- Fouling
- Connections
- Fixings
- In convertors ≥ 950 A:
  The counter on the power breaker which registers the number of operations performed.

Danger to personnel!
The a.c. supply to the convertor is to be disconnected before maintenance work is begun on the convertor.

FOULING

Cubicles must be cleaned from all accumulated fouling. Dust and scraps of material are easiest removed with a vacuum cleaner. Compressed air can be used in extreme cases but the air supply must be free from condensate.

Stubborn fouling can be removed with isopropyl alcohol solvent followed by blowing with clean compressed air. If badly soiled, the display can be cleaned with a cloth dampened with a mild solution of detergent.

If the convertor contains an air filter or screened ventilation opening, this should be checked at regular intervals and cleaned as necessary or replaced. The filter should be removed from its holder and cleaned at such a distance from the convertor that the dust etc. does not reenter the cubicle.

A lightly soiled filter can be cleaned carefully with compressed air but any considerable fouling may require washing in a mild detergent solution.

The convertor should be inspected for signs of physical damage, overheated components etc. after cleaning.

CONNECTIONS

Main circuits

Test with a torque wrench all connections of heavy cables and bars to the load breaker unit, the thyristor unit and the contactor unit. Check bar joints, particularly connections to aluminium parts and connections to thyristors thyristor modules and high speed fuses. The following torque values should be set on the wrench:

For thyristor modules 40 - 530 A

	Mechanical fixings	Electrical fixings
M5	4 Nm	4 Nm
M6	5.5 Nm	5.5 Nm
M8		15 Nm

Other bar joints

M4	1.4 Nm
M5	2.9 Nm
M6	9 Nm
M8	20 Nm
M10	40 Nm
M12	72 Nm

For thread-cutting screws in sheet metal (T = 2 mm), use 6 Nm.

Other circuits

Check with a screwdriver other screw connections (contactors, transformers, circuit boards, terminal blocks etc.). Check that the terminals on the circuit boards make effective contact with the conductive pattern.

Fixing

Ensure that all units in the cubicle are fixed securely and that there are no loose screws or nuts.

Check the fixing and connections of the circuit boards of the control equipment.

Cables are to be routed and supported to avoid chafing against sharp edges.

AIR CIRCUIT BREAKER, TYPE ALH

Convertors with current ratings ≥950 A contain air circuit breakers of type ALH. They are normally operated with the convertor inactive, i.e. the breaker is only subject to mechanical wear.

An ALH breaker remains normally serviceable after up to 2500 operations without maintenance and after up to 25 000 operations if maintained in accordance with instructions. If, however, short-circuiting should occur, contacts and arc screens should be checked as soon as possible.

The maximum frequency of operation is shown by the following table:

Breaker type	ALH 1250	ALH 1600	ALH 2500
Included in convertor	950-1400A	1600, 1800A	2500, 3000A
Cycles per hour	30	20	20

If the maximum frequency of operation is exceeded at any time the motorized actuator should be replaced as soon as possible.

For maintenance of the breaker, see the following documents:
Maintenance instruction 5809 059-1 E
with appendix 5809 066-1 E

REPLACEMENT OF PARTS

Fuses

When replacing fuses, ensure that the new fuses are of the correct type and rating. Check against the apparatus list of the convertor concerned.

Fan, convertors 70, 120 A

- Disconnect the two flat tab connectors and the earth connection to the fan.
- Disconnect the connections to the thermal protection by unscrewing the upper cables in the terminal blocks X10.3 and 4. Clip the cable strap.
- Unscrew the screw at the right and swing the fixing bar out.
- Remove the fan.
- Install the new fan, following the above procedure in the reverse direction.

Fan, convertors 180 - 530 A

- Disconnect the cables to terminal block X10:
  X10.3-blue
  X10.4-black
  X10.5-brown
  X10.6-white
  X10.7-white
  and the earth connection
- Remove the three fixing screws at the corners of the fan unit. The unit can then be drawn straight out. After insertion of the new fan, check that the seal is effective.

Fan, convertors 650 - 1400 A

Single convertors have one fan, 61, whereas double convertors have two fans, 61 and 62.

- Disconnect the flat tab connections for the fan cable/cables in terminal block 63.X1 and the earth connection. Note the different conductor markings to avoid confusion when these are replaced.
- Remove the small hatch in the roof panel.
- Then remove the hatch under, on the thyristor unit.
- The fan/fans can now be lifted straight up. A free space 500 mm high must be available above a cubicle with one fan and a free space at least 950 mm high must be available above a cubicle with two fans. Note, however, if only 500 mm can be provided, that this is sufficient if the fans are separated when removed half-way from the cubicle.

Fan, convertors 1600 - 3000 A

- Disconnect the cable at the Cannon contact at the roof of the cubicle.
- Disconnect the earth cable between the fan housing and the cubicle.
- The fan housing can now be unscrewed and lifted out.

Thyristor, convertors 40 - 120 A

Each thyristor module contains 2 thyristors.

- Unscrew the pulse transformer board
- Disconnect all cables to the module which is to be replaced. Note the markings of all conductors to avoid confusion when these are replaced.
- Unscrew the thyristor module itself.
- Check against the apparatus list that the new module is of the correct type before screwing it in place.
- See below for installation of thyristors

Thyristor, convertors 180 - 530 A

Each thyristor module contains two thyristors.

- Remove the protective cover from the thyristor unit.
- Disconnect the flat tabs to the trigger pulse cables on the thyristor module concerned. Note the cable numbers, to avoid confusion when replacing these. Gate and cathode have flat tabs of different sizes so that these cannot be replaced incorrectly.
- Slacken, approximately 5 turns, all screws to the copper bars L+ and L– which connect the modules.
- Remove all screws to the module which is to be replaced.
- The module can now be removed towards the left.
- Check against the apparatus list that the new module is of the correct type before it is screwed in place.
- See below for installation of thyristors.

Thyristors, convertors 650 - 1400 A

- Remove the high speed fuse.
- Disconnect the trigger pulse cables on the pulse transformer board.
- Disconnect the cables to the capacitor (RC circuit).
- Slacken the 4 screws which hold the heat sink against the d.c. bar.
- The complete package, including heat sink and resistor, can now be drawn out.
- Unscrew the thyristor.
- Check against the apparatus list that the new thyristor is of the correct type before it is screwed in place. Ensure that it is installed with the correct orientation.
- See below for installation of thyristors.

Thyristor, convertors 1600 - 3000 A

- Remove the connection to the RC-circuit and the primary connection to the pulse transformer board.
- Unscrew the connection bars to the thyristor to be changed.
- Remove the complete thyristor "package".
- Unscrew the thyristor.
- Check against the apparatus list that the new thyristor is of the correct type before it is screwed in place. Ensure that the thyristor is oriented correctly.
- See below for installation of thyristors.

Installation of thyristors

The following procedures must be followed when installing thyristors and thyristor modules on heat sinks.

- If the contact surfaces of the heat sink and/or the thyristor are uneven, oxidized or soiled:
  Polish the contact surface very lightly (2 strokes) with abrasive cloth (gauge 600). Clean the contact surfaces with denatured alcohol and a lint-free cloth. Apply a very thin layer of silicon grease to the contact surface using a lint-free cloth.

- Module thyristors:
  Place the module in position and tighter the screws with the following torque:

	Mechanical fixings	Electrical connections
M5	4 Nm	4 Nm
M6	5.5 Nm	5.5 Nm
M8		15 Nm

- "Puck" thyristors:
  Locate the guide pin in the corresponding hole in the heat sink/thyristor. Adjust the heat sink/thyristor with the guide pin. Check that the thyristor is oriented correctly (a conduction symbol is located on the component).

  The thyristor/heat sink unit is held together by a mounting clamp. Tighten the mounting clamp screws alternatively by hand so that the leaf spring is parallel with the contact surfaces of the thyristor/heat sink. Continue tightening the screws with a socket wrench, a half turn at a time on each side, (still alternately). The mounting clamp has several snap positions each marked with different clamping forces. Tighten the screws until the spring indicating the correct force snaps over the leaf spring.

Thyristor	Convertor rating	Clamping force
YST 6	650 - 800 A	8 kN
YST 14	1250 - 1800 A	16 kN
YST 35	2500 - 3000 A	40 kN

See also the installation instructions supplied with the thyristor.

Circuit boards

The main voltage must be disconnected when replacing circuit boards.

When handling circuit boards containing IC circuits, it is important to avoid damage to these, caused by discharge of static electricity. Circuit boards are always to be stored in envelopes of conductive plastic. The person handling a circuit board should always first discharge himself to the cubicle frame, using an earthed wrist band.

Remove connections at screw terminal blocks and/or ribbon cable contacts for external connections by drawing these straight out from the board. Loosen the board carefully from the plastic holders screw connections.

Note! To ensure effective connection, the contact should not be pulled off more than 10 times before replacement.

Check jumpers, solder posts for resistors etc. to ensure agreement between the new and old boards.

It is important that all fixing screws are returned in the correct way as some of these are used for earth connections between board and cubicle.

Some boards require special handling:

Pulse transformer unit, convertors 40 - 530 A

- Disconnect ribbon cable X31 and the connector for current measurement X1.
- Remove the locking screws in the two guide bars and extract the complete unit.
- Remove the contacts for the trigger pulse cables.
- Replace the board, following the above procedure in reverse.

Circuit board for operator's panel

- Open the hatch for the control unit E12.
- Remove the ribbon cable E18.1.X33 and the ribbon cable to the key pad E18.1.X32.
- Remove the 4 nuts holding the unit E18.
- Draw the unit straight out and replace the faulty board.
- Follow the above procedures in the reverse direction. Ensure that the display seal is located correctly.

PROM-packages

Unnecessary handling of loose memory packages is to be avoided. When exchanging control programs, it is preferable to replace the complete memory board.

If, however, replacement of any individual PROM-package is necessary, the following rules are to be observed:

- The convertor is always to be disconnected from the mains supply when packages are to be changed.
- The packages are to be handled carefully and protected against static electricity. It is recommended that packages be stored in the packing in which they were received from ABB Drives.
- Before a package is inserted into, or removed from a board, the operator is to be connected to the cubicle frame via a conductive wristband to obtain the same potential as the equipment.
- Always check that it is the correct package which is removed and that the replacement is correct and that it is inserted in the correct position. **With uncertainty, contact ABB Drives.**
- When the convertor is to be returned to service after replacement of a PROM- package, the 1 F capacitor mounted on the memory board YPR 103/104 must first be short-circuited at pins X21.1 and 2 adjacent to the capacitor. Because of the high internal resistance in the capacitor, the short-circuiting must continue for at least 1 minute.

Key pad for operator's panel

- First open the hatch to control unit E12
- Disconnect the ribbon cable E18.1.X32 to the key pad.
- Remove the text strip for the push buttons.
- Lever up one corner of the key pad with, for example, a knife, and remove the complete key pad.
- Clean the plate carefully with denatured alcohol and allow to dry before installing the new button set.
- Remove the paper protection on the new button set and insert the ribbon cable in the opening in the door. **Note!** The adhesive fastens immediately.
- Use the display as a guide and press from the middle toward the edges.
- Return the text strip and connect the ribbon cable.

Note! A button set installed incorrectly cannot be removed without being damaged and must therefore be scrapped.

ASEA BROWN BOVERI

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To be ordered from
ABB Drives AB/Dept. DFA.

TYRAK L / MIDI

Thyristor convertor with microcomputer for d.c. drive systems,

Fault tracing

YT 280-332 E

ABB Drives

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Contents Page

INTRODUCTION

It may be necessary to check the complete drive system when tracing faults. See section **GENERAL FAULTS**.

Malfunctions detected by the built-in protective and monitoring functions are indicated on the operator's panel. These malfunctions and their causes are described in section **FAULT INDICATING TEXTS**.

Many of the circuit boards are provided with LEDs for indication purposes. The significances of these are given in section **LED INDICATIONS ON BOARDS**.

Malfunctions not indicated on the operator's panel are tabulated in section **OTHER FAULT SYMPTOMS**.

In certain cases, faults are in the software application or are intermittent. The operator's panel is used for tracing such faults as described in section **FAULT TRACING WITH THE HELP OF THE OPERATOR'S PANEL**.

PERSONNEL SAFETY

When tracing faults it may be necessary to work with the supply voltage switched on. The Tyrak L convertors provide the highest possible degree of personnel safety by the galvanic isolation of the control equipment from the main circuit. There are no dangerous voltages on PC board located on the control panel.

Note! Pulse transformer and snubber circuit boards located on the thyristor bridge carry line voltage in certain areas. Great care must be observed when testing on these boards.

GENERAL FAULTS

Check the following in the event of the occurrence of any faults not indicated on the operator's panel:

- That all fuses are intact. A blown fuse is always to be interpreted as a secondary fault. Check therefore the fuse circuits protected by the fuse concerned.

  High-speed fuses are to be checked by observing the red indication plug on the fuse. It is possible, in some cases, that the fuse ruptures without indication.

  If a high-speed thyristor has ruptured, the thyristors in the main circuit are to be checked. An ohmmeter is used to check that the thyristor is not short-circuited. Always remove some connection so that other circuits do not shunt the measurement.

- That the electronic supplies are correct by checking the following LEDs:

  +24 V OK on YPP 105 is to illuminate.
  POWOK on YPQ 103 is to illuminate. (Not for Tyrak Midi)
  FAULT ±15 V on YPP 105 is to remain inactive.
  FAULT +5 V on YPP 105 is to remain inactive.

- That other auxiliary supply is correct. Measure with a voltmeter at the supply transformer 56.

  Tyrak L
  X1.5 – X1.8 is to be 110 V a.c.
  X1.5 – X1.10 is to be 220 V a.c.

  Tyrak Midi
  X1.7 – X1.8 is to be 110 V a.c.
  X1.8 – X1.9 is to be 110 V a.c.
  X1.7 – X1.9 is to be 220 V a.c.

- That the wiring between convertor and its control system is correctly installed and intact

- That the wiring between the convertor and the d.c. machine is correctly installed and intact

- That there are no defects in any conductors.

- That cable screens and grounding are installed correctly and are intact.

- That signals to be received by the convertor are received at the correct time and on the correct level.

- That the d.c. machine is serviceable with respect to installation, commutation and brush wear.

FAULT INDICATING TEXTS

The fault texts are listed alphabetically

Fault text	Signal name	Significance / Corrective measures
ANALOG INPUT YPG 110	HWF10	Board YPG 110 is faulty. Replace the board, check that the new board is jumpered correctly.
ANALOG OUTPUT YPM 102	HWF11	Board YPM 102 is faulty. Replace the board, check that the new board is jumpered correctly.
ANALOG TRIGG	ATRIG	Fault signal generated by module TEST2. Permits stopping of the logger when the magnitude of any arithmetic signal exceeds its adjustable level.
ARM CONTROL YPQ 101	HWF03	Board YPQ 101 faulty. Replace the board, check that the new board is correctly jumpered.
ARMATURE CURR HIGH LEVEL	ARMHLW	Warning for high loading of d.c. motor. If the load is not reduced, the convertor will, after a time, trip for overload.
COMPUTER UNIT YPP 105	HWF01	Board YPP 105 is faulty. Replace the board, check that the new board is jumpered correctly.
CV-COMM UNIT YPK 107	HWF06BF	Hardware fault in serial communication Master/Follower. Check LEDs on YPK 107 and YPC 104 in accordance with section **LED INDICATIONS ON BOARDS**, in all convertors connected via the Master/Follower bus. Also check groundings and the connections of the coaxial cable. If the fault persists, replace the board which indicates a fault.
DIG INPUT YPI 103	HWF08	Board YPI 103 is faulty. Replace the board, check that the new board is jumpered correctly.
DIG OUTPUT YPO 103	HWF09	Board YPO 103 is faulty. Replace the board, check that the new board is jumpered correctly.
DIG SPEED MEAS YPH 105	HWF07	Board YPH 105 (YPH 103) is faulty. Replace the board, check that the new board is jumpered correctly.
DIGITAL TRIGG	DTRIG	Fault signal generated by module TEST2. Permits stopping of the logger when any logical signal becomes "1".
DRIVE STALLED	STALL	Overload on d.c. machine. Field current too low. No speed feedback. Incorrectly set parameters in module STALLM.
EARTH FAULT	EFLTF (EARTHFLT)	Ground fault in one of the power or auxiliary supplies. Incorrectly set parameters in module ECURM.
EXTERNAL FAULT A1, A2, A3	EXFLTA(1-3)F	An external arithmetical signal has exceeded the set tripping level.
EXTERNAL FAULT D1, D2, D3	EXFLTD(1-3)F	An external logical signal has indicated malfunction.
EXTERNAL LOGSTOP	LOGSTOP	External fault signal which command stop of the logger.
EXTERNAL WARNING A1, A2, A3	EXWA(1-3)F	An external arithmetical signal has exceeded the set warning level.
EXTERNAL WARNING D1, D2, D3	EXWD(1-3)F	An external logic signal has indicated a warning status.

FAULT INDICATING TEXTS (cont.)

Fault text	Signal name	Significance / Corrective measures
FAULT MAIN CONTACTOR	MCONTF	Faulty main contactor Acknowledgement not received, break in conductor. Connection unit YPQ 103/YPQ 108 faulty. Convertor control board YPQ 101 faulty. Supply voltage M1L absent.
FIELD CONTROL YPQ 102	HWF04	Board YPQ 102 faulty. Replace the board, check that the new board is correctly jumpered.
FREQUENCY FAULT	FREQFLT	Warning signal. Irregular mains frequency. Incorrectly set parameters in module IACTRL.
HIGH ARM CURRENT RIPPLE	ARMRPLF	Warning signal. Oscillations in loading. Current controller incorrectly trimmed. Speed controller incorrectly trimmed. Parameter IASTEP not reset to zero. Incorrectly set ripple protection.
HIGH ARMATURE LOAD	ARMHLW	Warning for high loading of d.c. motor. If the load is not reduced, the convertor will, after a time, trip for overload.
HIGH DERIVATIVE TRIGG	DERTRIG	Fault signal generated by module TEST2. Permits stopping of the logger when the rate of change (derivative) of any arithmetic signal exceeds an adjustable level.
LOW FIELD CURRENT	FLDLC	Break in field circuit, fuse rupture. Faulty contactor. Break in conductor or poor contact. Faulty connection unit YPQ 103/YPQ 108. Faulty convertor control board YPQ 101. Parameters set incorrectly in module IFCTR or IF1CTR. Difference between field current and low field current protection is too small. Supply voltage M1L absent.
MECH BRAKE UNCONTROLLABL	BRAKEFLT	Brake fault. Break in conductor or poor contact. Parameters set incorrectly in module BRMEC.
MEMORY UNIT YPR 104	HWF02	Memory board YPR 104 faulty. Replace the board, check that the new board is correctly jumpered.
MOTOR TEMP OVER LEVEL1 (or LEVEL2)	MOTHT1W MOTHT2W	The temperature at measurement points 1 (or 2) is above the warning level. Check the loading and cooling of the d.c. motor.
MP-COMM UNIT YPK 107	HWF06AF	Communication board YPQ 107 faulty. Replace the board, check that the new board is jumpered correctly.
NO ACKN EXTERNAL FAN	EXFANNA	External fan faulty. Break in conductor or poor contact. Connection unit YPQ 103/YPQ 108 faulty. Convertor control board YPQ 101 faulty. Supply voltage M1 absent. Thermal overload protection tripped (fuse rupture).
LOW VOLTAGE MAINS SUPP	MSLV	Indication of low mains supply.

FAULT INDICATING TEXTS (cont.)

Fault text	Signal name	Significance / Corrective measures
NO ACKN FIELD CURRENT	FLDNA	Break in the field circuit, fuse rupture. Faulty contactor. Break in conductor or poor contact. Faulty connection unit YPQ 103/YPQ 108. Faulty convertor control board YPQ 101. Field current less than low field current level. Supply voltage M1L absent.
NO ACKN MAIN CONTACTOR	MCONTNA	Faulty contactor/main breaker. Break in conductor or poor contact. Faulty connection unit YPQ 103/YPQ 108. Faulty convertor control board YPQ 101. Supply voltage M1L absent.
NO ACKN THYRISTOR FAN	CFANNA	Fan contactor faulty. Break in conductor or poor contact. Connection unit YPQ 103/YPQ 108 faulty. Convertor control board YPQ 101 faulty. Supply voltage M1L absent. Thermal overload protection tripped (fuse rupture).
NO ARMATURE CURRENT	ARMNC	Check with the signal ARMNCNBR in which thyristor branch the fault has developed (before reset). Fuse rupture. Faulty thyristor. Trigger pulse error. Incorrectly set zero current protection.
NO DATA FR CONVERTOR	LNK32F	Communication Master/Follower has stopped (Time out). Check LEDs on YPK 107 and YPC 104 in accordance with section **LED INDICATIONS ON BOARDS** in all convertors connected via the Master/Follower bus. The noise level on the bus is too high. Check the grounding of YPK 107 and YPC 104. Check the routing and connection of the coaxial cable.
NO DATA FR OVERRIDING	LNK31F (LNK31)	Communication with central control (Master Piece) has stopped (Time out). Check the LEDs on YPK 107 and YPC 104 in accordance with section **LED INDICATIONS ON BOARDS**. Check also the corresponding indications in the Master Piece. The noise level on the bus is too high. Check the grounding of YPK 107 and YPC 104. Check the routing and connection of the coaxial cable.
NO DATA OP PANEL	LNK35F	Communication with the operator's panel has ceased. Press any of the buttons on the operator's panel. Check the transmission and the reception of signals with the LEDs SOUT and SIN on YPP 105. Replace YPP 109 (YPP 106) first and, if necessary, YPP 105.
NO EMF-FEEDBACK	ARMNEMF	Break or poor contact in the measurement circuit. Incorrectly set parameters in the module of EMFMEM.
NO SPEED FEEDBACK	NSPFBACK	Break in cable from pulse generator/tachometer. Faulty pulse generator tachometer. Incorrectly jumpered digital speed measurement board YPH 103 (YPH 105) or connection board YPH 104 or analog input board YPG 110 or connection board YPG 106. Incorrectly set parameters in module EMFMEM or SPMON.

FAULT INDICATING TEXTS (cont.)

Fault text	Signal name	Significance / Corrective measures
OVERCURR ARMATURE	ARMOC	Check with the signal ARMOCNBR, in which thyristor branch the current was excessive (before reset). Armature current feedback control set incorrectly. Short-circuiting between cables or in armature winding. Commutator sparking. Thyristor fault, trigger pulse fault. Mains failure in connection with inversion. Parameter IASTEP not reset to zero. Overcurrent protection set incorrectly.
OVERCURRENT FIELD	FLDOC	Field current feedback control set incorrectly. Short-circuiting between cables or in field winding. Overcurrent protection set incorrectly. Current measurement faulty.
OVERLOAD ARMATURE	ARMOLF	Overload in d.c. machine. Parameters in module MOTOLM set incorrectly.
OVERLOAD EXTERNAL FAN	EXFANOLF	Thermal overload protection tripped, fuse rupture in supply voltage. Fan motor faulty. Break in conductor or poor contact. Connection unit YPQ 103/YPQ 108 faulty. Convertor control board YPQ 101 faulty. Supply voltage M1L absent.
OVERLOAD THYRISTOR FAN	CFANOLF	Thermal overload protection tripped, fuse rupture in supply voltage. Fan motor fault. Break in conductor or poor contact. Connection unit YPQ 103/YPQ 108 faulty. Convertor control board YPQ 101 faulty. Supply voltage M1L absent.
OVERSPEED	MOTOSP	Incorrectly trimmed speed feedback control. Parameter MOTOSPL set incorrectly. Parameters in module for digital speed measurement set incorrectly or connection board for analog input board, YPG 106, jumpered incorrectly or parameter NACTADJ set incorrectly.
OVERTEMP MOTOR	MOTOT	Thyristor bridge overloaded. Cooling air absent or insufficient. Air filter clogged. Pt100 element faulty. Parameters in module MOTEMP set incorrectly.
OVERTEMP THYRISTOR	THYOT	Thyristor bridge overloaded. Cooling air absent or insufficient. Air filter clogged. Pt100 element faulty. Parameters in module TYTEMP set incorrectly.
OVERVOLTAGE ARMATURE	ARMOV	Excessive acceleration at speeds over basic speed. Max. EMF too high. Field weakening inactive. Parameters in module EMFMEM set incorrectly. Parameters in module EMFCTR or ECTRL set incorrectly.
SERIAL MODEM1 YPK 103	HWF 12F	Board YPK 103 faulty. Replace the board, check that the new board is correctly jumpered.
SIGN FAULT	SIGNFLT	Field reversal function not available.

FAULT INDICATING TEXTS (cont.)

Fault text	Signal name	Significance / Corrective measures
THYRISTOR TEMP HIGH LEV	THYHTW	Warning for high thyristor temperature. Thyristor bridge overloaded. Cooling fan inactive. Air filter clogged. If the temperature remains high or increases, the convertor will trip soon for overtemperature.
TORQUE FAULT	TQFLTF (TQFLT1)	Overload on d.c. machine. Stalling Speed feedback absent. Parameters set incorrectly in module TQMON.
TRANSM FAULT CONVERT	LNK37F	Communication Master/Follower subject to interference. Check the grounding of YPK 107 and YPC 104. Check the routing and connection of the coaxial cable. The setting of the parameter LNK37D is too low.
TRANSM FAULT OP PANEL	LNK40F	Communication with operator's panel subject to interference. Check the grounding of YPP 109 (YPP 106) and YPP 105 and the ribbon cable connecting these.
TRANSM FAULT OVERRID	LNK36F (LNK36)	Communication with the central control equipment (Master Piece) is subject to interference. Check the grounding of YPK 107 and YPC 104. Check the routing and connection of the coaxial cable. The setting of the parameter LNK36D is too low.
TRIP FROM OVERRIDING	TRIPMP	Tripping commanded from central control system (Master Piece).
UNDERVOLTAGE AUX SUPPLY	ASUV	Voltage Q1 or Q2 absent (+ 24 V d.c.). Break in conductor or poor contact. Fuse rupture. Transformer fault.
UNDERVOLTAGE MAINS SUPPL	MSUV	Low mains voltage. Fuse rupture. Break in conductor or poor contact. Parameter MINVOLT installed incorrectly. Transformer fault.
WRONG PHASE SEQUENCE	PHSEQFLT	Mains voltage connected with incorrect phase sequence. If possible, change the phases. It is also possible, with the parameter PHSEQCW set to zero, to run the convertor with reversed phase sequence. Note however that the supply to 3-phase fans must be connected for a positive phase sequence.

LED INDICATIONS ON BOARDS

Significances of indicating LEDs

Computer unit YPP 105

+24 V OK	(green)	=	Illuminates when the incoming 24 V is correct.
FAULT ±15 V	(red)	=	Illuminates when the ±15 V voltage is incorrect.
FAULT +5 V	(red)	=	Illuminates when the +5 V voltage is incorrect.
IOBUS	(yellow)	=	I/O bus connected.
MAST	(yellow)	=	This circuit board is the "master" (in two-computer versions).
SOK	(green)	=	System OK. Time interrupt handling functions.
STALL	(red)	=	Insufficient time for execution of the program.
BERR	(red)	=	Computer bus fault.
HALT	(red)	=	Computer has stopped executing.
POK	(green)	=	Program OK. Not used in Tyrak L.
FAULT	(red)	=	Not used in Tyrak L.
SOUT	(yellow)	=	Data transmission to the operator's panel on the door.
SIN	(yellow)	=	Data transmission from the operator's panel on the door.

Connection unit convertor YPQ 103/YPQ 108

POW OK	(green)	=	Illuminates when the external electronics supply is correct.
I1 - I4 O1 - O4	(yellow)	=	Indicates active signal status for internal convertor signals.

Convertor control board YPQ 101

FAULT	(red)	=	Hardware fault.

Field control YPQ 102

FAULT	(red)	=	Hardware fault. Board parameter AIF1CTR is set to zero.

Digital speed measurement YPH 105 (YPH 103)

FAULT	(red)	=	Hardware fault. Board parameter ADIGSP31 is set to zero.

Digital input YPI 103

FAULT	(red)	=	Hardware fault. Board parameter ADI32 is set to zero.

Digital output board YPO 105

FAULT	(red)	=	Hardware fault, board parameter ADO33 is set to zero.

Digital output YPO 103

FAULT	(red)	=	Hardware fault, board parameter ADO33 is set to zero.

Analog input YPG 110

FAULT	(red)	=	Hardware fault, board parameter AAI34 is set to zero.

Analog output YPM 102

FAULT	(red)	=	Hardware fault, board parameter AAO35 is set to zero.

Serial modem RS YPK 103

FAULT	(red)	=	Hardware fault.

Terminal block board for serial modem RS YPK 106

TA	(yellow)	=	Transmission on channel A
RA	(yellow)	=	Reception on channel A
TB	(yellow)	=	Transmission on channel B
RB	(yellow)	=	Reception on channel B

MP-communication YPK 107

CHA	(yellow)	=	Channel A communicates
CHB	(yellow)	=	Channel B communicates
OK	(green)	=	Program initialization completed
FLT	(red)	=	Hardware fault
BERR	(red)	=	Computer bus fault

FSK modem YPC 104

RX = V1	(yellow)	=	Reception
TX = V2	(yellow)	=	Transmission
PW = V3	(green)	=	Illuminates when 5 V supply is correct

Terminal block board for digital inputs and outputs

Yellow LED per channel illuminates with an active signal (= 1).

OTHER FAULT SYMPTOMS

Fault symptoms	Cause of fault / Corrective measures
Convertor does not start.	Check, using the operator's panel display measurement, if **the convertor is fully released** i.e. RDYREF = "1". If it is: Check that there is a reference in to the convertor and that it is in operation through the reference circuits and are measurable in the speed controller (NREF). Check that there is a reference in to the current controller (IAREF1). If the convertor is inhibited i.e. RDYREF = "0": **Check if a start order is active**, i.e. START1/STARTBR = "1". If there is no start command, follow the signal backwards through the modules. **Check if the convertor is prepared for operations**, i.e. RDYRUN = "1". If the convertor is not prepared for operation, check that an ON-command is active i.e. ON1 or ON2 is "1". Check that there no OFF-command is active. Check also that the disconnection relay K1 is active. If the disconnection relay K1 is not active, check that the relay receives supply voltage.
Overcurrent at switch-on.	One of the parameters in the current controller is too high. See otherwise fault cause **"Overcurrent armature"**.
The d.c. machine does not reach full speed.	Incorrect reference voltage. Incorrectly jumpered speed measurement board YPH 105 (YPH 103) or incorrectly set parameters in the speed measurement module. Incorrectly jumpered analog connection board YPG 106 or parameter NACTADJ set incorrectly. Field weakening set incorrectly.
The operator's panel loses communication with the convertor computer. The display flickers or is black. LEDs for Sout and Sin on YPP 105 do not illuminate.	Switch off the supply voltage and short-circuit the capacitor which backs up the RWMs. The capacitor is located on the memory board. Contact pins X21.1 and 2 are short-circuited for at least 1 minute. The display control board YPP 109 (YPP 106) can be faulty. Check the ribbon cable between YPP 109 (YPP 106) and YPP 105. With repeated problems, contact ABB Drives Service department.
The program cannot be executed. The HALT and BERR LEDs on YPP 105 illuminates.	**If this follows a PROM exchange** Switch off the supply voltage and short-circuit the capacitor which backs up the RWMs. The capacitor is located on the memory board. Contact pins X21.1 and 2 are short-circuited for at least 1 minute. **If this follows a board exchange** In this case, a number of FAULT lamps on the circuit board can illuminate. Check that the new board is jumpered correctly. Check that the new circuit board is located at the correct place. Check that the board-to-board contacts function correctly. **If this occurs during operations** Check that groundings and screens are installed and function correctly. Check that the board-to- board contacts function correctly.

FAULT TRACING WITH THE HELP OF THE OPERATOR'S PANEL

For a more detailed study see document "OPERATOR'S PANEL MANAGEMENT".

Remaining faults in control functions

When tracing faults in the software, the operator's panel and display is used in the measurement mode.

Signals are available for measurement under the module from which they are transmitted.

Unconnected input signals are listed in the modules CONNECT1 or CONNECT2 (previously UNDEF).

For visual checking, LEDs which illuminate when an input or output is active are provided on the connection boards for logical output and input signals.

For testing of hardware outputs, it is possible, under module TEST, to connect AOTEST or DOTEST with the signal exchange.

It is possible to connect an external printer via ANALOG OUTPUT. Optional signals are connected in the software with the help of the signal exchange. Adjustment with "offset" and multiplication is possible for 2 of the four channels.

In certain programs released after 1.1.89 it will be possible, with the signal exchange, to connect logical signals also under module TEST2 to ANALOG OUTPUT.

Intermittent faults

The operator's panel display for logging and registration is used. The logger can register up to six different signals, logical or arithmetical. Suitable signals are set. The time scale is selected so that good resolution is obtained.

The event line is set so that the signals can be studied a suitable time before and after tripping. The logger is started. The program then reads these signals at the rate of 186 measured values per time scale. With tripping, the measured values are frozen and the value of each channel set can be studied under the display for registration. The logger can also be stopped manually by pressing ENTER in cursor position s/s on the registration display.

If required, a printer can be connected and the displays printed.

In certain programs released after 1.1.1989 it will be possible to set a trigger level to stop the logger.

Module TEST2 provides the possibility of connecting an optional signal, logical or arithmetical. When the signal exceeds the trigger level, the logger is stopped and the stored logger values are frozen. Derivative (rate of change)-dependent triggering of stop of the logger can also provided.

Registration during long periods

The operator's panel displays for registration and logger are used. The logger is set at logical or arithmetical signal. The time scale is set at ≥500 s.

In the registration display, the text for "AUTO" is paged forward in the upper right hand corner. The signal will be updated with 186 measured values during the time scale set. This updating is continuous and can be observed in the registration display. The stop is obtained with the cursor position s/s.

If required, a printer can be connected and the display picture printed.

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