TYRAK® MIDI

Drive system components for d.c. drives rated up to 860 kW.

Convertor module YGMT, YHMT and accessories.

Description YT 390 - 101 E. Edition 3.

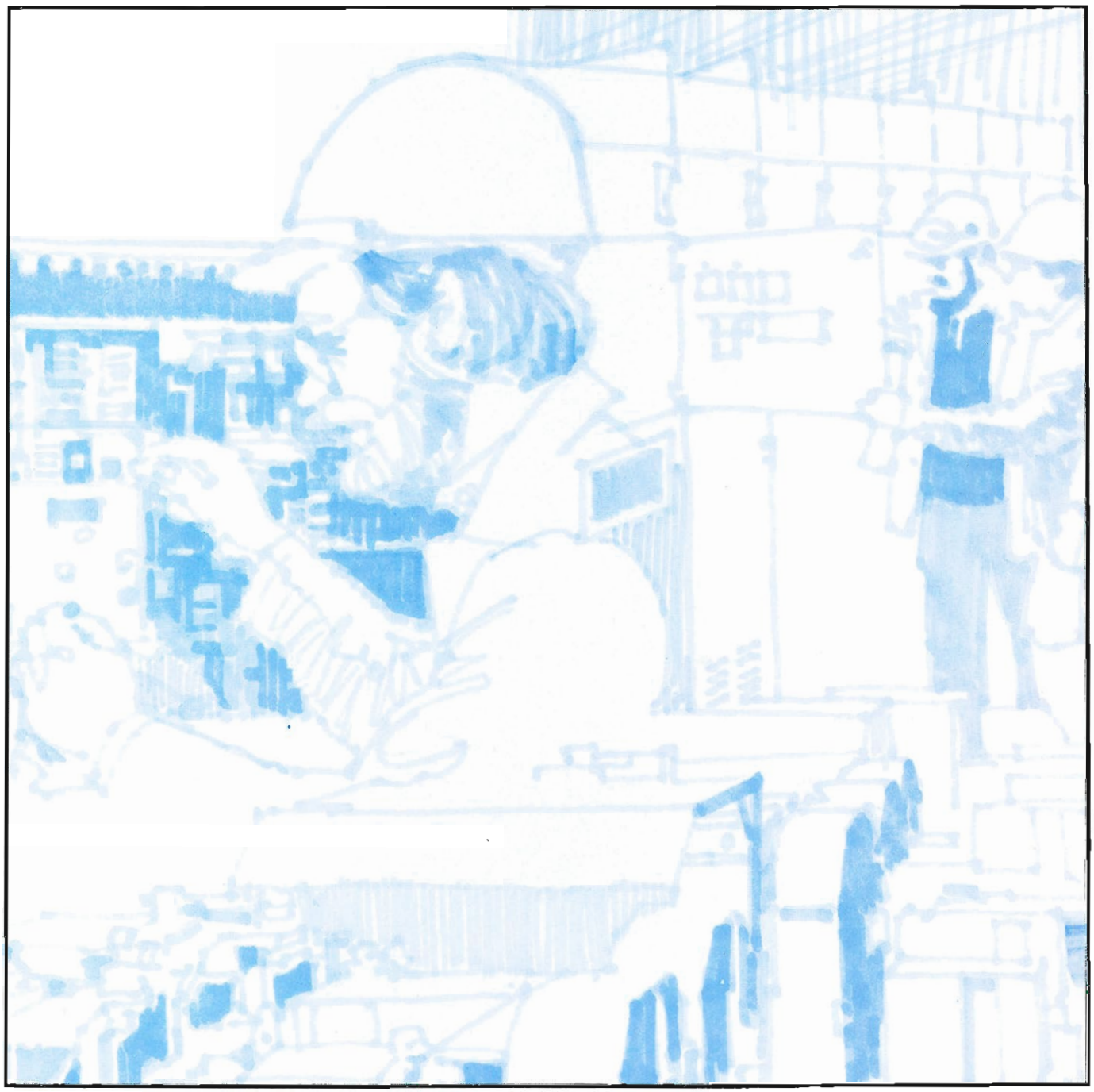

ABB Drives

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General

The Tyrak Midi digital thyristor convertors are intended to be a cost effective solution for plant engineering.

The convertors are designed for demanding industrial operation and meet the requirements of IEC 146 international standard.

The control system is fully digital, from reference to control pulses. Both control procedures and sequencing functions are implemented digitally. Considerable emphasis has been placed on personnel safety and operation reliability. An extensive diagnostic program simplifies fault tracing and ensures a high degree of availability. Application specific control functions can be programmed into the convertor control system.

The powerful operator's panel simplifies commissioning, handling and service of the convertor.

Configuration

A Tyrak Midi drive equipment is built up of a convertor module, a contactor module (optional) and other optional functions such as field supply, communication units etc.

Convertor module

The Tyrak Midi convertor YGMT, YHMT is a nonenclosed module, designed for installation in any standard 19" enclosure. Each module is a complete function tested unit, built up from standardized functional parts. The module contains the control equipment and the thyristor bridge with cooling fan as well as auxiliary power supply circuits for the electronics and fast acting SCR fuses.

Contactor module

The contactor module contains a main a.c. contactor and a control voltage transformer. Equipped with the contactor module, the Tyrak Midi convertor module is totally independent of external sources for auxiliary power supply.

Description of convertor module YGMT and YHMT

The convertor module consists of two parts, the main circuit unit and the control equipment. The control equipment is common to all convertor modules while the main circuit comes in different variants depending on the current rating.

Main circuit unit -U1

The main circuit unit contains the power circuit such as the thyristor bridge, cooling fan, fast acting SCR fuses and auxiliary power supply for the control equipment.

The power components are designed to allow connection to supply voltage up to 500 V a.c.

Thyristor bridge

The thyristor bridge is built up as a three phase, fully controlled 6-pulse coupling. It is available in two versions as a single convertor (YGMT) or as a double convertor (YHMT). 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 rating 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.

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 101A to a pulse transformer unit. After galvanic isolation 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 LED:s 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 three current transformers. The output signal is rectified in a diode bridge and is adapted with load resistors so that the output voltage is 1.00 V with rated current.

Convertor fan

The thyristor bridge in convertors of all ratings are cooled with fans. Convertors rated up to 120 A are provided with an axial fan powered with the operating voltage 110 V a.c. (M1).

Convertors rated 200 - 530 A are cooled with a radial fan, while convertors 800 - 1400 A are equipped with two axial fans for cooling. The supply is 220 V single phase M1 - M2. A start capacitor is also used.

Note! With a 60 Hz supply line the value of the start capacitor must be changed as specified in catalogue YT 39 - 1 E.

If the convertor is connected to an anti-clockwise phase sequence, the connections to the fan must be changed to obtain the correct direction of rotation.

Semiconductor fuses

The thyristors are protected by fast acting semiconductor fuses. Convertors rated up to 530 A have the SCR fuses in the incoming phases, while convertors with higher ratings have branch fuses.

Auxiliary power supply

The auxiliary supply circuits can be connected directly to 380 V, 415 V, 460 V and 500 V, 50 or 60 Hz. The convertor has two different internal voltages for auxiliary supply, designated Q1 and Q2.

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 is connected to the computer board. The other half of the I/O 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 grounded even in plants with a common reference system.

Both of the voltages are obtained from the same transformer, which 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 functions with brief voltage interruptions.

Approximately 0.5 A (Q2), depending of optional functions added, is available for external circuits.

Grounding

Q1 (computer supply) is grounded directly in the chassis via the screws fixing the circuit boards. The neutral of the other supply voltage is 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.

Control equipment -AK1

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

The control equipment consists of a basic hardware and software set-up, sufficient for many applications.

Both hardware and software can, if necessary, be supplemented with optional accessory functions, such as additional I/O boards or application specific software functions.

Physical configuration

The control unit consist of PC boards mounted on a hinged panel.

The basic set-up includes:

- CPU board YPP 105
- Convertor control board YPQ 101

The basic configuration also includes the operator's panel (OPC) with a graphical display. The OPC is furnished with a long enough connection lead to allow it to be moved from the convertor module and installed in the enclosure door.

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

The convertor module is prepared for simple installation of expansion communication units.

Software control program

The function of the drive is determined by a software control program stored in electronic memory capsules on a separate memory board, YPR 104A. The Tyrak Midi convertor is delivered without this memory board. A suitable memory board is ordered separately.

The control program is divided in two parts, the system program for processor data handling routines.and the application program for drive control functions.

The plug-in memory board is chosen with a standard or a custom made application control program as described in catalogue YT 39 - 1 E.

The memory board is mounted on top of computer board YPP 105 and is connected with a board-board connector.

The application control programs are built up from standard function modules which are described in detail in section "Description of function modules".

Examples of function modules are speed- and current controllers, ramp generator, speed increase/decrease, reference generator and convertor supervision. Also included are functions required for I/O-communication, basic I/O-unit as well as expansion units.

The program functions are stored i EPROM type memories and parameter values in EEPROM. Both of these retain their information in case of power failure. Parameter values can be changed during operation.

Error signals and log values are stored in a RWM with voltage back-up. It retains its contents for a week following a power loss.

Operator's panel

Circuit diagram, sheet 16.

The push-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 six functional push-buttons and LEDs for indications Remote/Local (Rem/Loc), Automatic/Manual (Auto/Man) and Reference + / Reference- (Ref + / Ref-). These texts appear 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 board" 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.

Drive supervision and diagnostics

Tyrak Midi 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.
- 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 faults 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.

Logger

This function permits the recording of measured values from up to six optional signals at individually optional intervals. The log function stores 186 values per signals 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

The electronics supply is divided into an external (Q2) and a 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. See section auxiliary power supply. The external supply is connected to the I/O board YPQ 108 A. This board then provides the voltages +24 VE, +15 VE and -15 VE. The latter two are stabilized.

The voltages +24 VC, +15 VC, +5 VC and -15 VC are generated from Q1 on YPP 105B in the same way. These are supervised with a flip-flop the output from which affects ASUV, Auxiliary Supply Under Voltage. 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)	= illuminated with faults in +15 V voltage.
FAULT +5 V (red)	= illuminates with faults in +5 V voltage.

Status indication on computer board YPP 105

Circuit diagram, sheet 25, 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). Not used in Tyrak Midi.
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 Midi.
FAULT (red)	= Not used in Tyrak Midi.
SOUT (yellow)	= Data transmission to operator's panel on the door.
SIN (yellow)	= Data transmission from operator's panel on the door.

I/O-unit YPQ 108

Tyrak Midi convertors are delivered with a basic I/O board, YPQ 108.

External signals, digital or analogue, are connected to terminals on the I/O board. The terminals accept up to 2.5 mm wires (AWG 14).

The basic I/O board contains following functions:

- Three digital output and four digital input channels with fixed functions for fan, field and main contactor operation. These circuits are connected to the M1 control voltage (110 V a.c.).

- Eight digital input channels, programmable function. The input resistors are designed for connection of 110 V a.c. or d.c., but other voltages may be used if the input resistors are changed accordingly.

Voltage	24 V	48 V	110 V	220 V
Resistor 5 W	2.2 kΩ	4,7 kΩ	10 kΩ	22 kΩ

- Five digital output channels, programmable function. The outputs are galvanically free relay contacts which can carry 5 A, 250 V a.c. or 30 W, 250 V a.c.

- Four analogue input channels, programmable function. 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 %.

- Two analogue output channels, programmable function. The resolution is 11 bits + sign.

- One analogue output for current actual value (buffer amplifier on current feedback signal).

- One analogue output for speed actual value (buffer amplifier on analogue tacho feedback signal).

The function programming of analogue and digital I/O channels i performed from the operator's panel, i.e. no service terminal is required.

- Pulse generator input.
  The unit contains a 24 V power supply for the pulse generator, inputs for two separate measurement channels to detect forward/reverse rotation and one 0-pulse input. One of the standard digital input channels can be programmed to give a synchronization pulse in positioning applications. The maximum pulse frequency is 50 kHz.

- Modem for standard interface RS232C.
  The port is intended for connection of a service terminal.

Description of accessories

Contactor module

The contactor module contains a main a.c. contactor and a control voltage transformer. The contactor module comes in different sizes, each dimensioned to match the different convertor modules. The transformer generates control voltage 110 V a.c. and 220 V a.c. for supply of the convertor fan. The control voltage is used to supply the main contactor and other contactors, and for digital input channels.

Contactor modules up to 120 A are designed to fit inside the convertor module, while higher rated modules comes mounted on a separate 19" back panel.

Main contactor

The main contactor is used to disconnect the d.c. machine from the supply line when the drive is turned off, or when the equipment is tripped because of a fault.

The main contactor is controlled from the convertor control equipment. Supply voltage is 110 V a.c. (M1) for convertors with current rating 40 - 120 A. Convertors with higher current ratings are equipped with an auxiliary contactor.The aux. contactor is supplied with 110 V while the main contactor has a 380 V coil.

During normal conditions the contactor is always operated in a currentless stage since the control equipment first controls the current to zero before the contactor off command is issued.

Control voltage transformer

The control voltage transformer generates two voltages designated M1 and M2. M1 and M2 are generated in a 2 × 110 V winding with the middle point as a common neutral. Both circuits are protected by 4A miniature circuit breakers.

M1 is a 110 V a.c. voltage 50/60 Hz, used as operating voltage for contactors and digital input channels. M1 is dimensioned for the main contactor, two additional contactors (field and motor blower) and 20 digital input channels. In addition to that there is 50 VA available for optional use.

The 220 V voltage M1 - M2 is used to supply the fan in convertors rated 200 - 1100 A. No external load allowed.

Field supply -U2

The TYRAK Midi drive system comprises three different types of field supply. Diode field exciter, controlled field exciter with analog control, and a digitally controlled field exciter.

Diode field exciter

The diode field exciter comes with four different current ratings, from 1 A to 10 A, and can be connected to line voltages between 380 - 500 V.

The diode field exciter consists of a transformer and a two-pulse two-way diode bridge. The field voltage is 310 V but taps on the transformer allows this voltage to be adjusted within 70 - 105 % of nominal value in 5 % steps.The current is dependent on the supply voltage and also on the field winding resistance (temperature). This means that the field current can become up to 150 % of rated value at cold field winding and 10 % line overvoltage. The field exciter is designed to manage this overcurrent until the field winding is warmed up.

Minimum field current is supervised by means of a current sensitive relay. The pick up/drop out values are fixed relative the field exciter rating according to table:

Rated current (A)	On-value (A)	Off-value (A)
1	0.13 - 0.19	>0.08
2.5	0.32 - 0.47	>0.2
6	0.78 - 1.14	>0.48
10	1.3 - 1.9	>0.8

Recommended fuse/circuit breaker rating for short circuit and overload protection of the field circuit (fuses not included in the delivery):

Field current (A)	Fuse rating (A)
1	2
2.5	4
6	10
10	16

Controlled field exciter

With a controlled field exciter, the field current is kept constant in accordance with a reference value, independent of line voltage and field winding resistance. Two different types of controlled field exciters are available for Tyrak Midi.

With a controlled field exciter, the nominal field current of the machine should not be lower than 20 % of the field exciter rated current.

Field exciter YGBF 20 with analogue control

The field exciter YGBF 20 is a single convertor which can be connected to a 380 V, 415 V, 460 V or 500 V mains supply and can deliver 5 A, 10 A or 20 A field current (determined by jumpers on the unit).

A built-in circuit allows field current reduction at standstill.

The symmetrically controlled thyristor bridge permits forced increase/decrease of the field current for example with field weakening.

Field exciter YGBF 20 is provided with an integrated d.c. convertor, max 700 V, and an EMF controller for automatic field weakening. The EMF controller keeps the machine EMF constant within the field weakening range. Circuits for IR compensation compensate for the resistive voltage drop in the armature circuit which is dependent on the armature current.

YGBF 20 has integrated circuits for minimum current/overcurrent/overvoltage protection for indication and tripping.

YGBF 20 is further described in manual
YT 220 - 145 E.

Digital field exciter

The digital field exciter consists of a power unit and a field control board with an interconnecting ribbon cable.

The power unit is available as a single or a double convertor with current rating 5 A, 10 A or 20 A. The main circuit can be connected to supply voltages up to 500 V. The field control board, YPQ 102A, is installed in the control equipment on the convertor module, while the power unit is mounted separately.

The field exciter is controlled with software program functions in the convertor control equipment.

Note: The field control software functions must be added as required. See "Description of function modules".

A.c. voltage connection and contactor

The field exciter is connected directly to the mains via fuses/circuit breaker (not included in the delivery). The field contactor is controlled from the convertor control equipment, and is operated with 110 V a.c. (M1).

Main circuit

The main circuit consist of a phase inductor for limitation of the rate of change of the current during communication, 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 be used in field weakening systems with moderate acceleration requirement (>2 s for zero- max speed).

When shorter acceleration time with negative forcing voltage is required, double field exciter must be used. The principal use of double field exciters is in systems with field reversal and opti torque. The double field exciter has two anti-parallel 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.

Recommended fuse/circuit breaker rating for short circuit protection of the field circuit (valid for both analogue and digital field exciter):

Field current (A)	Fuse rating (A)
5	6
10	10
20	20
40	50

Communication units

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

Expansion I/O units

Circuit diagram sheet 30 - 39

The Tyrak Midi convertor module is equipped with a standard I/O-unit, covering most needs, as described earlier. In some cases however, the number of I/O channels is insufficient. The control equipment is therefore designed to allow additional I/O-units to be plugged in.

Each expansion unit consists of two circuit boards and an interconnecting ribbon cable. One board is plugged on to the computer board on the convertor module. The other board accommodates the customer connection terminals, and is placed outside the convertor module.

Note: Software functions needed for analog and digital expansion units, and for the pulse generator input, are already included in the standard control programs except for "Basic drive".

Following expansion units are available:

- Digital input unit (YPI 103 + YPI 104).
  Each unit contains eight channels, adapted for 110 V a.c./d.c. supply. Other voltages may be used if the load resistor on the input is changed accordingly, see description of standard I/O-unit.

- Digital output unit (YPO 105 + YPO 106).
  Each unit contains eight channels. The outputs are galvanically isolated relay contacts which can carry 5 A, 250 V a.c. or 30 W, 250 V d.c.

- Analogue input (YPG 110 + YPG 106).
  Four channels which can be individually set for ±1 V, ±10 V, 0 - 20 mA or 4 - 20 mA. The resolution is 0.05 %. This unit also contains a voltage divider for analog tachometer signal, a current generator for Pt100 supply and a reference voltage source ±10 V.

- Analogue output unit.
  Four channels which can be individually adapted for 0 - 10 V or ±10 V. The resolution is 0.4/0.8 %.

- Input unit for pulse generator (YPH 105 + YPH 104).
  Input for max 50 kHz (e.g. 2000 pulses per rev. at 1500 rev/min) with two channels for detection of rotation direction. In addition there is one input for a synchronization pulse and one input for a zero pulse. Supply circuits for the pulse generator, 12 V, 24 V or ±13 mA.

High speed serial bus

The serial communication unit, YPK 107A (unit 41) with modem board YPC 104B 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 front of the control unit base plate. The modem board, YPC 104B is mounted on top of the circuit board YPK 107A.

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 104B. 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 computers and the cycle time is 1 ms per follower connected.The transmission of signals is described in more detail in "Descriptions of function modules".

Convertor temperature sensor (Pt 100)

Temperature monitoring allows the equipment to be utilized optimally. It also provides a check on the cooling system. The convertor temperature is monitored by a Pt 100 sensor on the heat sink and actual temperature can be read on the operator's panel.The limit values can be programmed, one warning level and one tripping level.

Earth fault monitor

The function operates on the basis of summation current measurement with a current transformer. The circuit causes tripping of the equipment in the event of double earth faults, provided that the faults develop on each side of the current transformer.

Software functions needed are included in the standard control program. The ratio of the transformer is 400/1. The setting range for fault currents is from 4 to 12 A.

Voltage transducer

The voltage transducer is used to provide a voltage feedback signal, proportional to the armature voltage. The output voltage is separated from the main circuit by high impedance, and the output signal level is appr. 1 % of the actual value. This unit is primarily intended to be used together with the digital field exciter for field weakening with constant EMF. The output voltage 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 to indicate the output voltage from the thyristor bridge.

D.c. fuses

The fuses are of a special design to protect a d.c. circuit. The fuses are primarily intended to be used together with the analog field exciter YGBF 20 for field weakening with constant EMF. They can also be used to protect a voltmeter for armature voltage.

Reactor unit

Line reactors are recommended for double convertor installations. The purpose of these is to protect the thyristor in the non-conducting bridge against excessive voltage transients in the blocking direction.

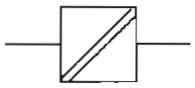
Line reactors are also recommended with single convertors rated up to 530 A, especially with supply voltages 460 - 500 V.

If the length of the supply cable to another convertor is at least 25 meters the line reactors may be left out. The inductance of the cable itself is the sufficient to protect the convertor.

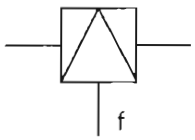
Diagram symbols

(from 2000 808 - 21, sheet 1)

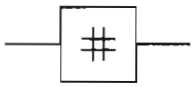
General symbols



Galvanic isolation.

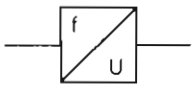


Modulator.



General symbol in digital signal systems.

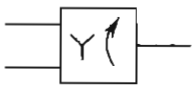
Convertor from an analog signal to pulses.



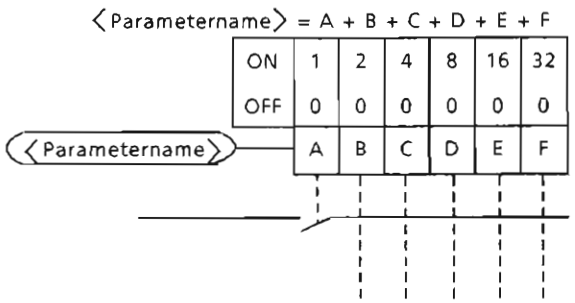
Convertor from freqvency to voltage.

Convertor from a sine wave signal to a square pulse.

Low-pass filter.

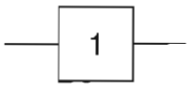


Clockwise phase sequence makes output = "1".

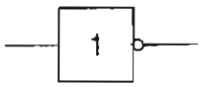


To unpack a compressed integer value to two or more boolean parameters. Above is shown a symbol with six sections (= six boolean parameters), there for example section A is controlling a signal switch.

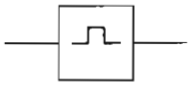
Logical elements



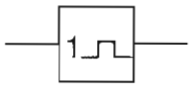
Buffer.



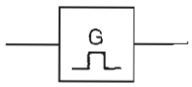
Logic inversion.



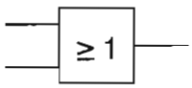
Monostable element.
Possible to re-trigger.



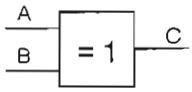
Monostable element.
Not possible to re-trigger.



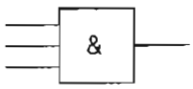
Pulse generator.



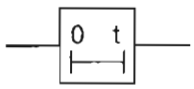
OR-gate.



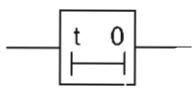
Exclusive-OR. C = "1" when only one of the inputs is "1".



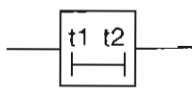
AND-gate.



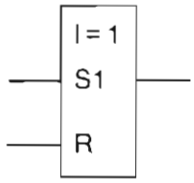
Time delay element.
Time delay when changing to "0"-position.



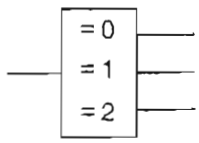
Time delay element.
Time delay when changing to "1"-position.



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".

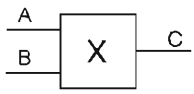


When input has any of values 0, 1 or 2, corresponding output is "1".

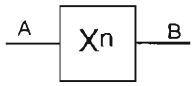
Diagram symbols

(from 2000 808 - 21, sheet 1)

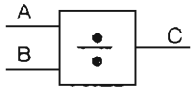
Arithmetical elements



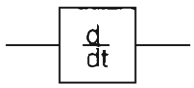
Multiplier
$A \times B = C$



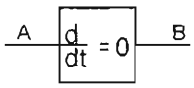
$B = A^n$ with $n = 2, 3, ...$



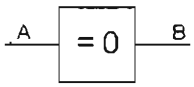
Division
$\frac{A}{B} = C$



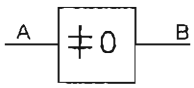
Derivating function.



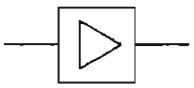
B = "1" when $\frac{dA}{dt} = 0$.



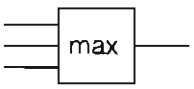
B = "1" when A = 0.



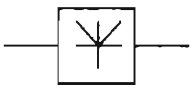
B = "1" when A is not zero.



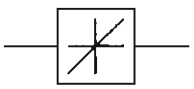
Amplifier.



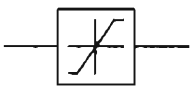
Max. value generator.



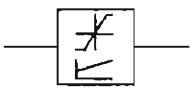
Absolute value generator.



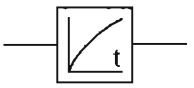
Linear amplifier.



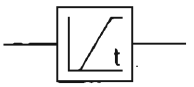
Linear amplifier with positive and negative limitation.



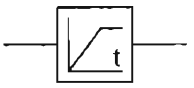
PI-controller.
Linear type with limitation.



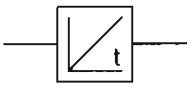
Element with time constant.



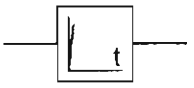
Function generator with limitation.



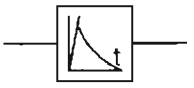
Ramp function.



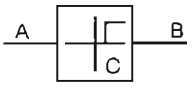
Integrating element.



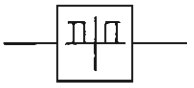
Derevating element.



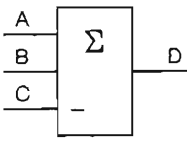
Derevating element with time constant.



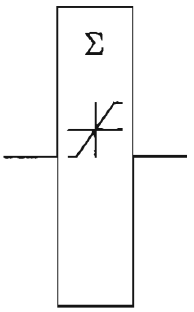
Level detector which makes
B = "1" when A > C.



Symmetrical level detector with hysteresis.



Summation element.
D = A + B-C



Summation element with limitations.

Diagram symbols

(from 2000 808 - 21, sheet 2)

Signal symbols

NREF6 — Output signal NREF6 with data size F2 (2 byte "fraction"). Available for operator's panel.

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

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

D033.1 TRIPPED ← Signal switch-box

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

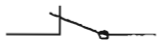
AOTEST — Parameter. Setting value can be changed from operator's panel.

NREF15 — Parameter. Setting value can only be changed from a data terminal.

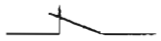
NREF1S — Parameter. Setting value can only be changed from a data terminal.

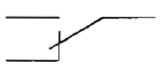
Remaining symbols

Closing contact.


Breaking contact.

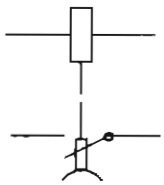
Closing function.

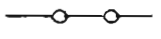

Breaking function.


Change over function.

Control switch with automatic return.

Control switch without automatic return.


Relay with closing contact which is time delayed at opening.


Jumper contact.

Terminal.

Soldering pin.

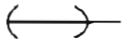

Disconnectable terminal with test points on both sides of the isolator.

Diagram symbols

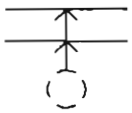
(from 2000 808 - 21, sheet 2)

Remaining symbols (cont.)

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

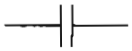
Test point, made as a pin device.

Earth (Ground).

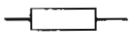


Conductor with screen.

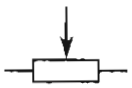
Twisted conductor.



Capacitor.

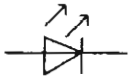


Resistor.



Potentiometer.

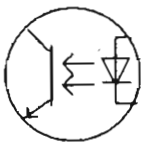
Semi-conductor diode.



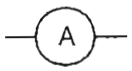
Light emetting diode (LED).

Voltage regulator diode.

Signal lamp.
General symbol.



Opto-switch.



Indicating instrument, shown as A-meter.

Tachometer generator.

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

Description YT 390 - 101 E
Reg. no. 4890 064 - 342
9104/1000
To be ordered from
ABB Drives AB/Dept. DFF.

Västerås 1991 Västra Aros

GDB1
General Drive Basic 1

This description covers the standard Pride program GDB1 belonging to the "Basic application category". Pride (PRogrammable Industrial Drives Electronics) is the computer based control system used in the Tyrak drive system.

Introduction

The basic application program GDB1 covers non-coordinated drives with limited requirements on control functions.

The drive application may include a single or a double convertor, and the motor field may be supplied from a fixed voltage diode exciter or a current controlled exciter of conventional non-computer type ("analog field exciter").

The following control functions are available:

- o Sequence control for convertor and drive
- o Armature current control
- o Speed control, standard performance type
- o Basic speed reference comprising ramp function and increase-decrease ordering of speed level
- o Field control
- o Protective and monitoring functions
- o Diagnostic system and fault indication
- o I/O communication interface

Operating station

The drive is operated from one operating station. This may be an external operator's desk or box connected to Pride interface terminals (operating station LOCAL1), or the Pride operator's panel located in the convertor cubicle (operating station LOCAL2). The selection between the two alternatives is done from the Pride operator's panel by setting parameters in the Pride software. The default delivery version is set for use of the Pride operator' panel (LOCAL2).

Pride operator's panel (= LOCAL2)

In the basic program GDB1, the following operating devices of the operator's panel are used, see Fig 1:

- o Push button marked "I" for ON order
- o Push button marked "O" for OFF order
- o Green coloured LED which illuminates when the convertor is ready for operation

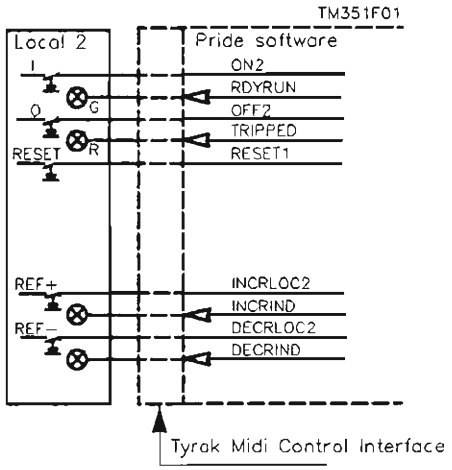


Fig 1 Operation from Pride operator's panel (TM351F01)

- o Red coloured LED which illuminates in case the convertor is tripped
- o Push button marked "RESET" for resetting the trip sequence logic when a tripping fault has been restored.
- o Two push buttons marked "REF+" and "REF-". Pushing REF+ gives increasing motor speed and REF- decreasing speed.
- o Each of the soft keys REF+ and REF- has a LED which may be used to indicate the action of the corresponding key.
- o Remaining four soft keys of the operator's panel are not used in the GDB1 program.

When the Pride operator's panel is used, increase and decrease of the speed is generated with this soft key operation only.

Separate external operating station (= LOCAL1)

By changing some parameters in the Pride software, external operating devices can be connected to appropriate software signals (variables) in Pride.

The operating station in use will then be the Local 1 station instead of Local 2.

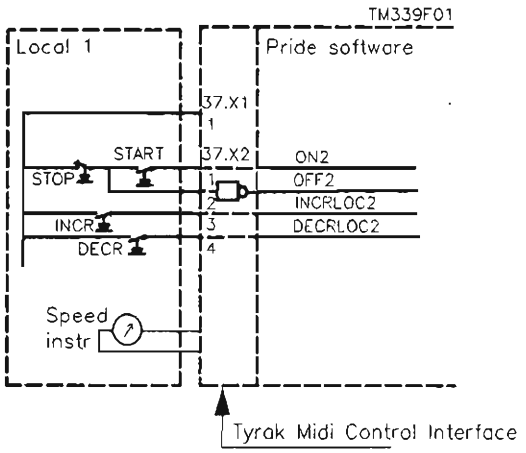


Fig 2 Start/stop and increase/decrease operation from LOCAL 1 station (TM339F01)

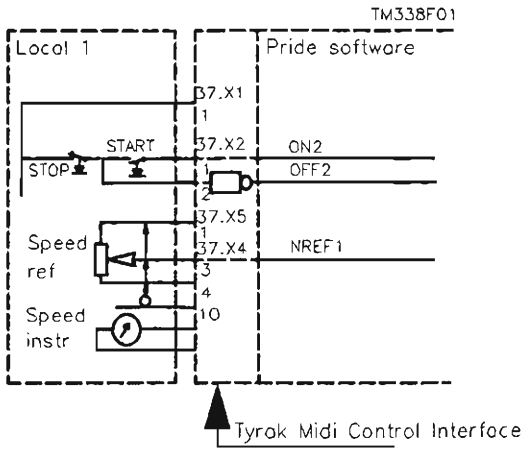


Fig 3 Start/stop and potentiometer speed setting from LOCAL 1 operating station (TM338F01)

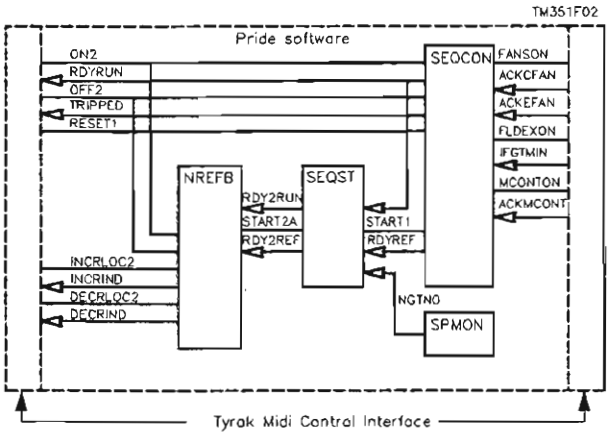


Fig 4 Sequence control software (TM351F02)

The speed setting may be with push-buttons for increase and decrease, connected via a digital input interface as in Fig 2, or with an adjustable reference voltage e.g. from a potentiometer connected via an analog input interface as in Fig 3. It is also possible to connect meters for motor speed and current.

Sequence control

The basic program GDB1 is working with a one-step start and stop sequence. When the start order reaches the "on/start" software signal ON2, the complete start sequence will be executed in one consecutive order, connecting the fans, the field exciter and the armature convertor to the supply line. Finally, the control system is released and the motor is permitted to rotate.

In case of an off or stop order, the "off/stop" sequence is executed, disconnecting the drive from the supply line. The disconnection of the armature convertor, however, is delayed so that the convertor and the control equipment are blocked first.

Armature current control

The torque control is performed by the armature current controller, receiving the torque reference from the speed controller. As the output from the speed controller has an adjustable limit setting, i.e. the current limit, the maximum torque during acceleration and retardation is limited.

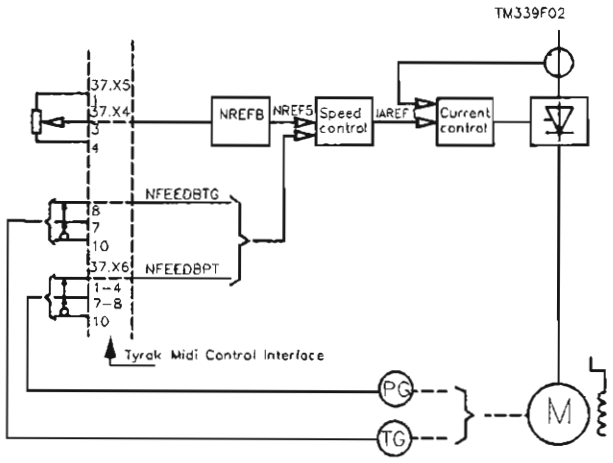


Fig 5 Speed control loops with tacho or pulse transmitter feedback (TM339F02)

Speed control

The motor speed is measured with a d.c. tacho generator or a pulse generator. Depending on which, the speed feedback will be brought to the speed controller through different input channels in the control interface, see Fig 5. In the interface, the speed feedback is conditioned and adapted to the present control conditions and converted to digital form.

The behaviour and performance characteristics of the speed control loop are adjusted by setting a number of program parameters, which normally is done on the operator's panel.

Speed reference handling

The speed can be set from the selected operating station, either the operator's panel in the convertor (LOCAL2) or an external operating station e.g. an operators desk or box in the process plant (LOCAL1).

Increase/decrease reference ordering

The speed reference software accepts increase/decrease orders e.g. from push-buttons in the external operator's desk or from the REF+/REF- keys in the operator's panel. The software signals INCRLOC2 and DECRLOC2 carries the order information onto the increase/decrease function in the module NREFB.

Reference generation

The speed may also be set with a continuously adjustable reference order e.g. With an internal reference setting parameter NREF3 inside the NREFB software or from a reference potentiometer in the external operating desk.

External references can be connected directly to the reference input of the speed controller by means of the signals NREF1, NREF2, NREF3 or NREF7.

Ramp function

Alternatively, external references can be connected via the reference module NREFB. The two signals NREF1 and NREF2 are added and the sum can either be transferred to the speed controller directly as speed reference NREF4, or via a ramp function as speed reference NREF5.

Bumpless transfer between control modes

Speed setting by the push-button operated increase/decrease order may be combined with potentiometer or parameter reference value setting. Selection between the two modes is done with orders connected to the software signals NRBAUTO and NRBMANU. The transition AUTO/MANU is bumpless.

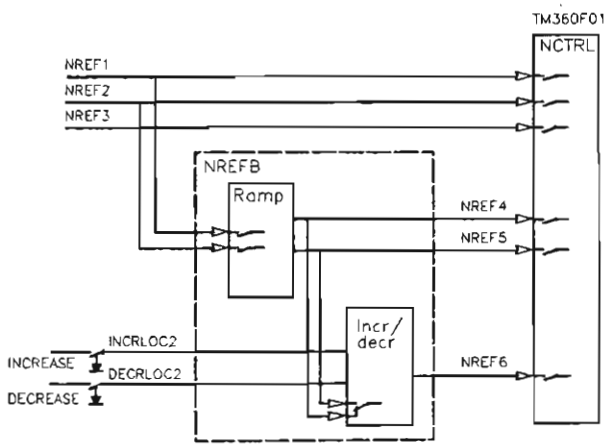


Fig 6 Speed reference signals and modules (TM360F01)

Field control

The motor field may be supplied from a fixed voltage diode exciter or a controlled exciter of conventional non-computer type (sometimes also called analogue controlled exciter).

The basic Pride software GDB1 does not include any functions for field control and it is presumed that a field current control, if any, is included in the field exciter.

Protective and monitoring system

Start sequence

The Pride sequence control monitors the connection and disconnection of the internal and external fans, the main contactor and the field exciter. These monitoring functions are found in the convertor sequence control module SEQCON.

Supply line

Pride monitors the main and auxiliary supply and detects low line voltage, frequency faults and incorrect phase sequence.

D.c. current

Pride also detects the current related faults: instantaneous overcurrent, loss of current in a thyristor branch, current pulsation and large current control deviation. Overcurrent tripping also indicates the faulty thyristor branch.

Motor speed

The motor speed monitor has one zero-speed indication, one overspeed indication for tripping and two speed level indications for optional use. The presence of the speed feedback is also monitored, the drive is tripped in case the feedback disappears.

Motor load

The motor is protected against thermal overload by monitoring the armature current. The monitor has adjustable levels for overload tripping, alarm and time delay.

Diagnostic system and fault indication

Faulty operation is reported to the fault indication and diagnostic system from where the information about failures and possible measures is made available to the operating and servicing staff.

Fault information software signals

The software contains signals (variables) carrying information about the conditions in the system. Some of these signals are used by the system itself to take appropriate action, while others are reported to the operator's panel for displaying of the information.

The list below contains some examples of software signals (variables) which are used to report important information about the condition of the system.

TRIPPED	The drive has tripped
RDYRUN	The convertor is ready to operate
RDYREF	The convertor is ready to receive current reference
RDY2RUN	The drive is ready to run
RDY2REF	The drive is ready to accept references
ARMHLW	High armature load

Fault messages

Fault information e.g. all the tripping signals are displayed on the operator's panel in legible text.

Besides indication of faults in the drive itself, the GDB1 program has software to accept and indicate one external fault on the operator's panel.

Control interface and communication

The communication between the Pride software and the external hardware involves the basic terminal and conversion board YPQ 108 and the modules for connection between the external signals channeled into Pride and the internal software signals, see Fig 7. These modules are also called the software switchbox.

Basic I/O interface

In the basic I/O interface for the basic program GDB1 the following communication channels are available:

I/O type	No. of channels	Separation	Note
Digital input	8	Opto	
Digital output	5	Opto, free relay contact	
Analog input	4 1)	High ohmic diff. ampl.	Resolution 0.05 percent
Analog output	2	High ohmic diff. ampl.	Resolution 0.05 percent
Pulse transmitter input	3	Opto	

1) Facilities for accepting tacho feedback inclusive.

The basic I/O interface also includes terminals for connection of meters for actual armature current and, in case of tacho feedback, actual speed.

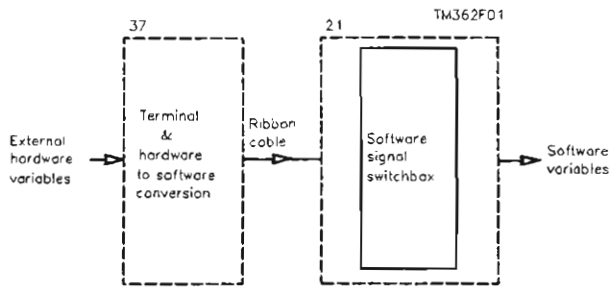


Fig 7 Communication interface (TM362F01)

Software modules

AIN37	Analog input
AOUT37	Analog output
CONNECT1	Basic connect module
DIN37	Digital input
DOUT37	Digital output
DSP131	Pulse transmitter input
FLTLOG	Fault logger
IACTRL5	Armature current controller
MOTOLM	Motor overload monitor
NCTRL1	Speed controller 1
NFBADJ	Speed feedback adjustment
NREFB	Basic speed reference handler
OPCH3	Operator's panel definition
SEQCON4	Sequence logic convertor
SEQST	Drive system sequence logic
SPMON	Speed monitor
STEPG2	Step generator
TEND	End of load program
TEST	Test facility
TRIP1	Tripping 1
TRIP2	Tripping 2
TRIP3	Tripping 3
TSYS	Begin of load program
TTEXTS	Background text

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GDE1
General Drive Extended 1

This description covers the standard Pride program GDE1 belonging to the "Extended application category". Pride (PRogrammable Industrial Drives Electronics) is the computer based control system used in the Tyrak drive system.

Introduction

The extended program GDE1 covers non-coordinated drive applications with requirements on optional control functions.

The drive application may include a single or a double convertor. The motor field may be supplied from an optional selection of field exciter types including computer controlled exciters ("digital field exciters").

The following control functions are available:

- o Selection of operating station
- o Sequence control for convertor and drive including emergency stop and dynamic and mechanical brake control
- o Armature current control
- o Speed control, standard performance type
- o Speed reference handling including ramp generator, reference generator and increase/decrease ordering.
- o Field control
- o Protective and monitoring functions
- o Diagnostic system and fault indication
- o I/O communication interface

Operating station

The drive may be operated from various operating stations. These may be:

- o a remote station like a central control room or a higher level computer system (operating station REMOTE), *or*
- o an external operator's desk or box connected to Pride interface terminals (operating station LOCAL1), *or*
- o the Pride operator's panel located in the convertor cubicle (operating station LOCAL2).

Selection of operating station

The selection between the operating stations is done with order signals connected to the Pride software. The software logic for the selection is found in the software module REMLOC. From this module, the consequences of the actual selection is distributed to the Pride modules concerned.

With parameters in the REMLOC module, the definition and combination of the various operating stations can be changed, see Fig 1.

Internal operator's panel (= LOCAL2)

In the extended program GDE1, the following operating devices of the operator's panel are available, see Fig 2:

- o Push button marked "I" for ON order. Pushing "I" brings the drive from complete disconnected condition to *ready for run*.
- o Push button marked "O" for OFF order. Pushing "O" disconnects the complete drive from the line.
- o Green coloured LED which illuminates when the convertor is ready for operation
- o Red coloured LED which illuminates in case the convertor is tripped
- o Push button marked "RESET" for resetting the Pride logic when a tripping fault has been restored.
- o Two push buttons (soft keys) marked "START" and "STOP". Pushing START gives start sequence operation from the condition *ready for run* to *ready for reference*. Pushing STOP brings the drive back to the condition *ready to run*.
- o Each of the soft keys START and STOP has a LED which may be used to indicate the action of the corresponding key.
- o Two push buttons (soft keys) marked "REM" and "LOC". After permission is given by the remote

TL254F01

Ordering signal	Parameter REMLOC:REMLOCMS			
	"3"	"2"	"1"	"0"
	Operating station			
REMOTE	Control room	Operator's desk	Control room	
LOCAL 1	Operator's desk			
LOCAL 2	Convertor panel		Convertor panel	Convertor panel

Fig 1 Examples of some possible combinations of operating stations depending on the selection of order signals and parameter settings. (TL254F01)

TM363F01

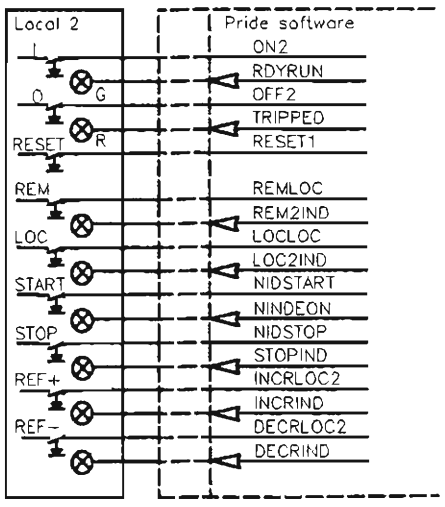

Fig 2 Operation from Pride operator's panel (TM363F01)

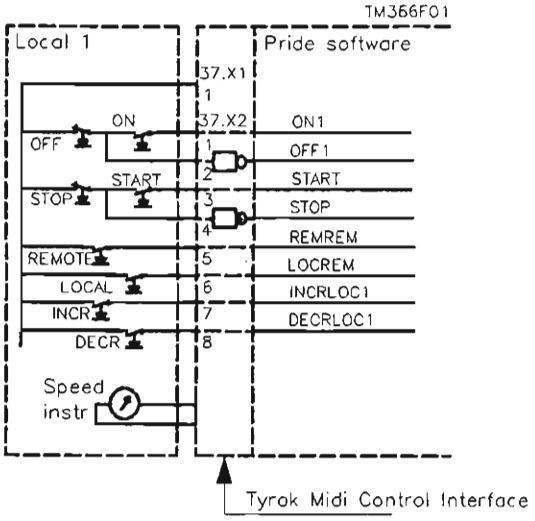

Fig 3 Start/stop and increase/decrease operation from LOCAL1 station (TM366F01)

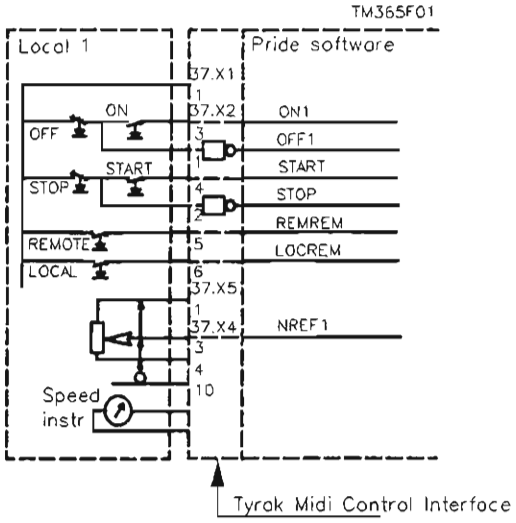

Fig 4 Start/stop and potentiometer speed setting from LOCAL1 operating station (TM365F01)

station, pushing LOC means that the local station accepts to take control. Pushing REM disconnects the local station and leaves the initiative to the remote station.

- o Each of the soft keys REM and LOC has a LED which may be used to indicate the action of the corresponding key.
- o Two push buttons (soft keys) marked "REF+" and "REF-". Pushing REF+ gives increasing motor speed and REF- decreasing speed.
- o Each of the soft keys REF+ and REF- has a LED which may be used to indicate the action of the corresponding key.

Separate external operating station (= LOCAL1)

When ordering LOCAL1 operation, external operating devices connected to appropriate software signals (variables) in Pride can be used to operate the drive.

The speed setting may be with push-buttons for increase and decrease connected via a digital input interface as in Fig 3, or with an adjustable reference voltage e.g. from a potentiometer connected via an analog input interface as in Fig 4. It is also possible to connect meters for motor speed and current.

When pushing the ON push-button, parts of the drive will be connected to the supply line, and the sequence control software will indicate *ready for run*. When pushing the START push-button, remaining parts of the drive is connected to the line, the control system will be released and the motor will follow the speed reference given.

When pushing the STOP push-button the speed reference is disconnected, the control system is blocked and parts of the drive is disconnected from the supply line. When pushing the OFF push-button, the complete drive is disconnected. Details about this split on/start and off/stop operation is presented below under Sequence control.

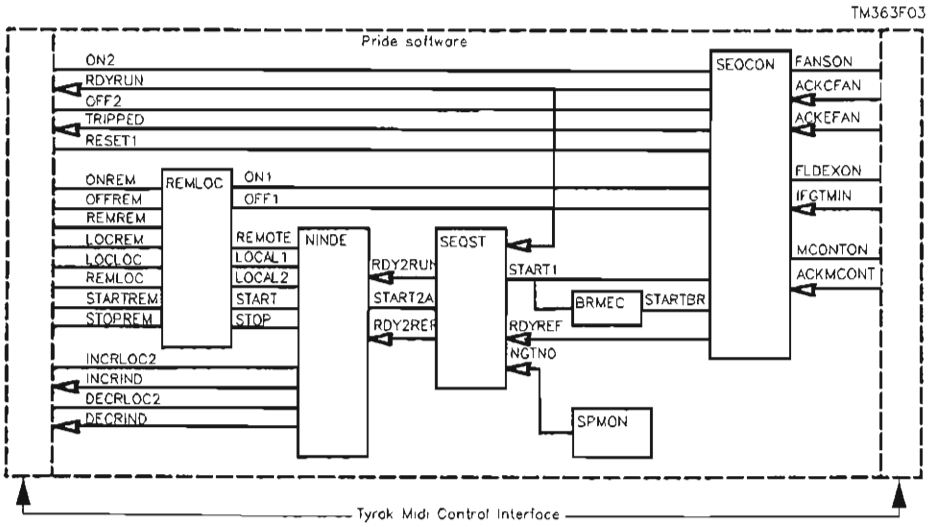

Fig 5 Sequence control software (TM363F03)

Remote operating station (=REMOTE)
When ordering REMOTE operation, operating devices located in the REMOTE station can be used to operate the drive. The remote station may be of the same kind as those described for the LOCAL1 station, see above.

Sequence control

ON/START and OFF/STOP sequences

The program allows a split start and stop sequence which means that the starting and stopping of the drive are arranged in two steps. The first step when starting is executed by the ON command, bringing the drive from disconnected condition to *ready for run*. The second step is executed by the START command, bringing the drive from the condition *ready for run* to the condition *ready for reference*. This split sequence has four modes of execution controlled by the parameter SEQMODE, see Fig 6. The on-start/off-stop sequence for the default setting of this parameter *(SEQMODE = "2")* is described below.

When the ON order reaches the software order signal ON1, the ON sequence will be executed, connecting the fans and the field exciter to the supply line. The sequence logic will then remain standby, waiting for the START order to appear.

When the START order turns up, the armature convertor is connected to the line, the control system is released and the motor is permitted to rotate with a speed corresponding to the reference signal presented to the speed controller.

A STOP order will bring the drive to standstill and disconnect the armature convertor.

In case of an OFF order, the OFF sequence is executed, disconnecting the complete drive from the supply line. The disconnection of the armature convertor, however, is delayed so that the convertor and the control equipment are blocked first.

The sequence logic operation for other settings of the SEQMODE parameter is shown in Fig 6.

Emergency stop logic

When pushing the *emergency stop push button*, the drive will normally stop on current limit. Alternatively, by setting of the appropriate parameters, the emergency stop may be on the normal ramp or a faster emergency stop ramp. It is also possible to involve mechanical braking during emergency stop by activating the brake control module.

TL114F01

START/ON sequence	SEQMODE 0	1	2	3
Ventilators			ON	
Exciter				
Main contactor	START			
Release				

STOP/OFF sequence	SEQMODE 0	1	2	3
Phase retard	STOP/OFF			
Main contactor				
Exciter			OFF	
Ventilators				

Fig 6 Start-stop sequence modes (TL114F01)

Mechanical brake logic

The mechanical brake logic coordinates the operation of the mechanical brake and the start/stop logic of the drive.

Armature current control

The torque control is performed by the armature current controller, receiving the torque reference from the speed controller. As the output from the speed controller has an adjustable limit setting, i.e. the current limit, the maximum torque during acceleration and retardation is limited.

Speed control

The motor speed can be measured with a d.c. tacho generator or a pulse generator. Depending on which, the speed feedback will be brought to the speed controller through different input channels in the control interface, see Fig 7. In the interface, the speed feedback is conditioned and adapted to the present control conditions and converted to digital form.

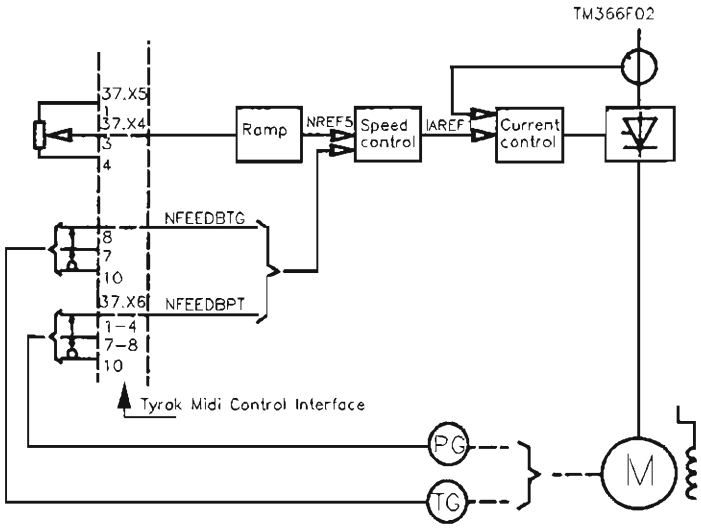

Fig 7 Speed control loops with tacho or pulse transmitter feedback (TM366F02)

The behaviour and performance characteristics of the speed control loop are adjusted by setting a number of program parameters, which normally is done on the operator's panel.

Speed reference handling

The speed is set from the selected operating station, either the operator's panel in the convertor (LOCAL2) or external operating stations e.g. an operator's desk or box in the process plant (LOCAL1) or a central control room (REMOTE).

Increase/decrease reference ordering

The speed reference software accepts increase/decrease orders e.g. from push-buttons in the external operator's desk or from the REF+/REF- keys in the operator's panel. The software signals INCRLOC2 and DECRLOC2 carries the order information onto the increase/decrease function in the module NINDE.

Reference generation

The speed may also be set with a continuously adjustable reference order e.g. with the internal reference setting parameters SP1AREFS through SP6AREFS inside the REFGEN software or from external reference potentiometers.

External references can be connected directly to the reference input of the speed controller by means of the signals NREF1 through NREF7 or via the software module REFGEN, see Fig 8.

Ramp function

The external references may also be connected via the ramp function modules NRSUM and NRAMP. The reference signals NREF1 through NREF4 are added, the sum is transferred through the ramp module NRAMP and then presented to the speed controller as speed reference NREF5.

Bumpless transfer between remote and local

When using the reference signals NREF1 through NREF5 for remote reference setting and NREF6 for local reference setting, the operating facility *follow* in the module NINDE can be used for arranging bumpless transition between remote and local reference.

Field control

The motor field may be supplied from a fixed voltage diode exciter or an adjustable field current. The adjustable exciter may be a conventional hardware components exciter or a computer controlled exciter (sometimes referred to as analog or digital field exciter respectively).

Protective and monitoring system

Start sequence

The Pride sequence control monitors the connection and disconnection of the internal and external fans, the main contactor and the field exciter. These monitoring functions are found in the convertor sequence control module SEQCON.

Earth fault (Ground fault)

The earth current monitor uses the phasor sum of the three phase line current to detect and indicate the presence of an earth fault. The earth fault current is measured with the optional earth fault transformer.

Supply line

Pride monitors the main and auxiliary supply and detects low line voltage, frequency faults and incorrect phase sequence.

D.c. current

Pride also detects the current related faults: instantaneous overcurrent, loss of current in a thyristor branch, current pulsation and large current control deviation. Overcurrent tripping also indicates the faulty thyristor branch.

Motor speed

The motor speed monitor has one zero-speed indication, one overspeed indication for tripping and two speed level indications for optional use. The presence of the speed feedback is also monitored, the drive is tripped in case the feedback disappears.

Motor load

The motor is protected against thermal overload by monitoring the armature current. The monitor has adjustable levels for overload tripping, alarm and time delay.

Stall condition

The motor is protected against stalling condition by

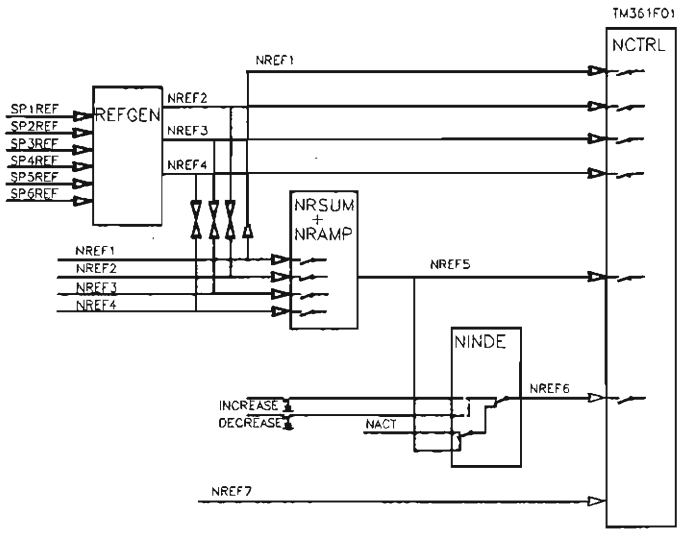

Fig 8 Speed reference signals and module (TM361F01)

permitting an adjustable stalling current during standstill for a certain adjustable stalling time interval. Stalling condition will trip the drive.

Field current

The minimum field monitor will prevent starting or trip the drive if the field current drops below the minimum field setting.

In the case of the computer controlled field exciter, the software includes overcurrent tripping.

External faults

The program includes software to accept three external fault signals to give tripping of the drive, see also Diagnostic and fault indication.

Diagnostic system and fault indication

Faulty operation is reported to the fault indication and diagnostic system from where the information about failures and possible measures is made available to the operating and servicing staff.

Fault information software signals

The software contains signals (variables) carrying information about the conditions in the system. Some of these signals are used by the system itself to take appropriate action, while others are reported to the operator's panel for displaying of the information.

The list below contains some examples of software signals which are used to report important information about the condition of the system.

TRIPPED	The drive has tripped
RDYRUN	The convertor is ready to operate
RDYREF	The convertor is ready to receive current reference
RDY2RUN	The drive is ready to run
RDY2REF	The drive is ready to accept references
ARMHLW	High armature load

Fault messages

Fault information e.g. all the tripping signals are displayed on the operator's panel in legible text.

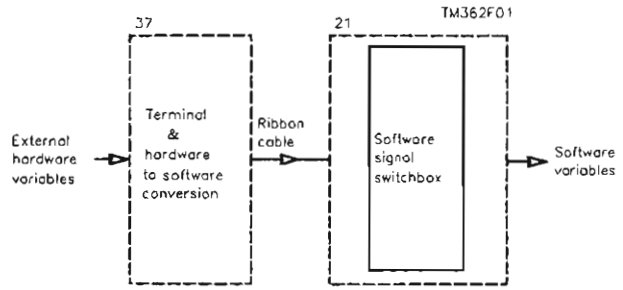

Fig 9 I/O communication interface (TM362F01)

External fault handling

Besides indication of faults in the drive itself, the program has software to accept and indicate three external faults on the operator's panel. The external fault signals are also available for tripping of the drive, see Protective and monitoring system.

Control interface and communication

I/O interface

The communication between the Pride software and the external hardware involves the basic terminal and conversion board YPQ 108 and the modules for connection between the external signals channeled into Pride and internal software signals, see Fig 9. These modules are also called the software switchbox.

Basic I/O interface

In the basic I/O interface the following communication channels are available:

I/O type	No. of channels	Separation	Note
Digital input	8	Opto	
Digital output	5	Opto, free relay contact	
Analog input	4 1)	High ohmic diff. ampl.	Resolution 0.05 percent
Analog output	2	High ohmic diff. ampl.	Resolution 0.05 percent
Pulse transmitter input	3	Opto	

1) Facilities for accepting tacho feedback inclusive.

The basic I/O interface also includes terminals for connection of meters for actual armature current and, in case of tacho feedback, actual speed.

Expansion I/O interface

The program includes software for the following expansion I/O interface:

I/O type	No. of channels	Separation	Note
Digital input	8	Opto	
Digital output	8	Opto, free relay contact	
Analog input	4 1)	High ohmic diff. ampl.	Resolution 0.05 percent
Analog output	4	High ohmic diff. ampl.	Resolution 0.4 percent

1) Facilities for accepting tacho feedback inclusive.

In case the expansion I/O interface is wanted, optional hardware must be ordered and the software must be activated.

Software modules

AIN34	Analog input
AIN37	Analog input
AOUT354	Analog output
AOUT37	Analog output
BRDYN	Dynamic brake control
BRMEC	Mechanical brake control
CONNECT1	Connect module
DIN32	Digital input
DIN37	Digital input
DOUT33	Digital output
DOUT37	Digital output
DSP131	Pulse transmitter input
ECURM	Ground fault monitor
EMSTOP	Emergency stop
EXFLT3	External fault handling
FLTLOG	Fault logger
IACTRL5	Armature current controller
IF1CTR	Field current control
IFREFG	Field current reference generator
MOTOLM	Motor overload monitor
NCTRL1	Speed controller 1
NFBADJ	Speed feedback adjustment
NINDE1	Speed increase/decrease
NRAMP2	Ramp generator
NRSUM2	Ramp reference summator
OPCH3	Operator's panel definition
REFGEN	Reference generator
REMLOC	Remote local selector
SEQCON4	Sequence logic convertor
SEQST	Drive system sequence logic
SPMON	Speed monitor
STALLM	Stall monitor
STEPG2	Step generator
TEND	End of load program
TEST	Test facility
TRIP1	Tripping 1
TRIP2	Tripping 2
TRIP3	Tripping 3
TSYS	Begin of load program
TTEXTS	Background text

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GDE2
General Drive Extended 2

This description covers the standard Pride program GDE2 belonging to the "Extended application category". Pride (PRogrammable Industrial Drives Electronics) is the computer based control system used in the Tyrak drive system.

Introduction

The extended program GDE2 covers coordinated drive applications with requirements on optional control functions.

The drive application may include a single or a double convertor. The motor field may be supplied from an optional selection of field exciter types including computer controlled exciters ("digital field exciters").

The following control functions are available:

- o Selection of operating station
- o Sequence control for convertor and drive including emergency stop and mechanical brake control
- o Armature current control
- o Speed control, standard performance type
- o Speed reference handling including ramp generator, reference generator and increase/decrease ordering.
- o Field control
- o Protective and monitoring functions
- o Diagnostic system and fault indication
- o Communication interface including I/O and bus communication

Operating station

The drive may be operated from various operating stations. These may be:

- o a remote station like a central control room or a higher level computer system (operating station REMOTE), *or*
- o an external operator's desk or box connected to the Pride interface terminals (operating station LOCAL1), *or*
- o the Pride operator's panel located in the convertor cubicle (operating station LOCAL2).

TL254F01

Ordering signal	Parameter REMLOC:REMLOCMS			
	"3"	"2"	"1"	"0"
	Operating station			
REMOTE	Control room	Operator's desk	Control room	
LOCAL 1	Operator's desk			
LOCAL 2	Convertor panel		Convertor panel	Convertor panel

Fig 1 Examples of some possible combinations of operating stations depending on the selection of order signals and parameter settings. (TL254F01)

Selection of operating station

The selection between the operating stations is done with order signals connected to the Pride software. The software logic for the selection is found in the software module REMLOC. From this module, the consequences of the actual selection is distributed to the Pride modules concerned.

With parameters in the REMLOC module, the definition and combination of the various operating stations can be changed, see Fig 1.

Internal operator's panel (= LOCAL2)

In the extended program GDE2, the following operating devices of the operator's panel are available, see Fig 2:

- o Push button marked "I" for ON order. Pushing "I" brings the drive from complete disconnected condition to *ready for run.*
- o Push button marked "O" for OFF order. Pushing "O" disconnects the complete drive from the line.
- o Green coloured LED which illuminates when the convertor is ready for operation
- o Red coloured LED which illuminates in case the convertor is tripped
- o Push button marked "RESET" for resetting the Pride logic when a tripping fault has been restored.
- o Two push buttons (soft keys) marked "START" and "STOP". Pushing START gives start sequence operation from the condition *ready for run* to *ready for reference*. Pushing STOP brings the drive back to the condition *ready to run.*
- o Each of the soft keys START and STOP has a LED which may be used to indicate the action of the corresponding key.
- o Two push buttons (soft keys) marked "REM" and "LOC". After permission is given by the remote

TM363F01

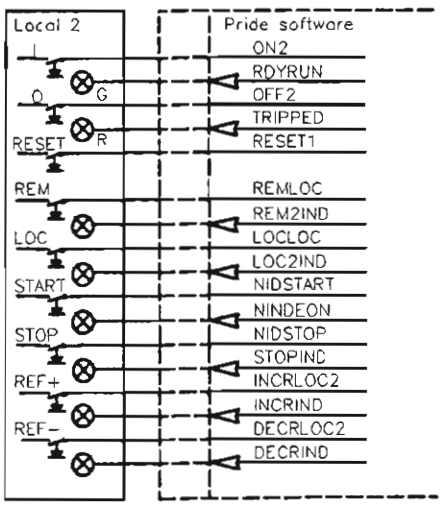

Fig 2 Operation from Pride operator's panel (TM363F01)

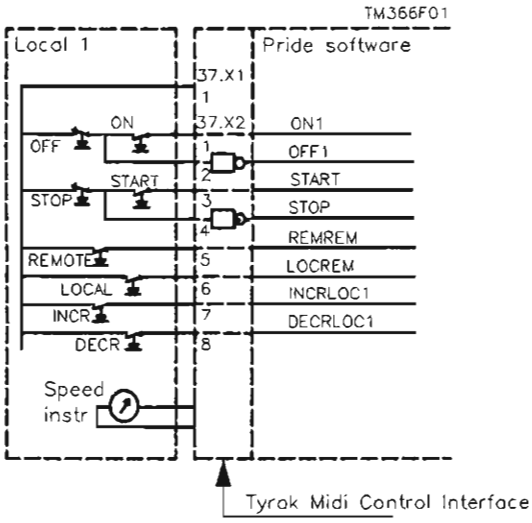

Fig 3 Start/stop and increase/decrease operation from LOCAL 1 station (TM366F01)

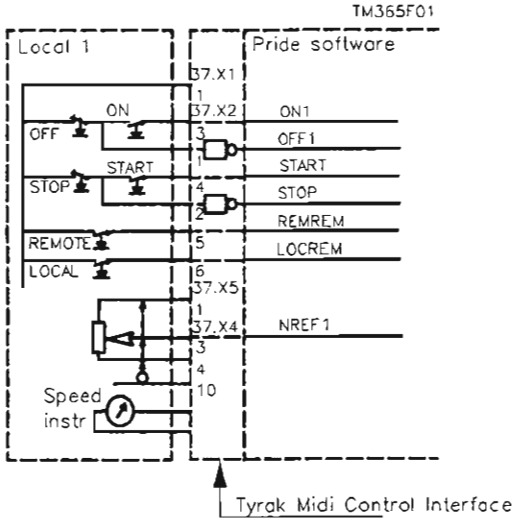

Fig 4 Start/stop and potentiometer speed setting from LOCAL 1 operating station (TM365F01)

station, pushing LOC means that the local station accepts to take control. Pushing REM disconnects the local station and leaves the initiative to the remote station.

- o Each of the soft keys REM and LOC has a LED which may be used to indicate the action of the corresponding key.
- o Two push buttons (soft keys) marked "REF+" and "REF-". Pushing REF+ gives increasing motor speed and REF- decreasing speed.
- o Each of the soft keys REF+ and REF- has a LED which may be used to indicate the action of the corresponding key.

Separate external operating station (= LOCAL1)

When ordering LOCAL1 operation, external operating devices connected to appropriate software signals (variables) in Pride can be used to operate the drive.

The speed setting may be with push-buttons for increase and decrease connected via a digital input interface as in Fig 3, or with an adjustable reference voltage e.g. from a potentiometer connected via an analog input interface as in Fig 4. It is also possible to connect meters for motor speed and current.

When pushing the ON push-button, parts of the drive will be connected to the supply line, and the sequence control software will indicate *ready for run*. When pushing the START push-button, remaining parts of the drive is connected to the line, the control system will be released and the motor will follow the speed reference given.

When pushing the STOP push-button the speed reference is disconnected, the control system is blocked and parts of the drive is disconnected from the supply line. When pushing the OFF push-button, the complete drive is disconnected. Details about this split on/start and off/stop operation is presented below under Sequence control.

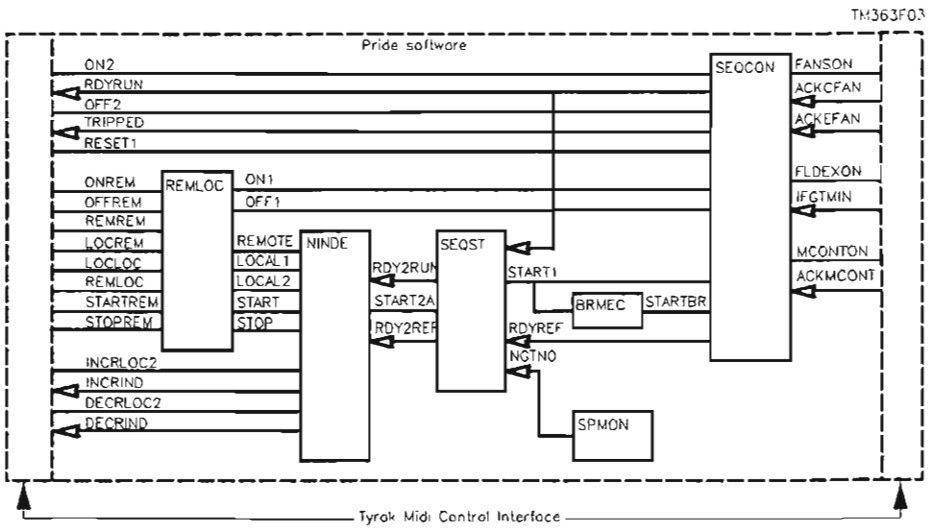

Fig 5 Sequence control software (TM363F03)

Remote operating station (=REMOTE)
When ordering REMOTE operation, operating devices located in the REMOTE station can be used to operate the drive. The remote station may be of the same kind as those described for the LOCAL1 station, see above.

Sequence control

ON/START and OFF/STOP sequences

The program allows a split start and stop sequence which means that the starting and stopping of the drive are arranged in two steps. The first step when starting is executed by the ON command, bringing the drive from disconnected condition to *ready for run*. The second step is executed by the START command, bringing the drive from the condition *ready for run* to the condition *ready for reference*. This split sequence has four modes of execution controlled by the parameter SEQMODE, see Fig 6. The on-start/off-stop sequence for the default setting of this parameter *(SEQMODE = "2")* is described below.

When the ON order reaches the software order signal ON1, the ON sequence will be executed, connecting the fans and the field exciter to the supply line. The sequence logic will then remain standby, waiting for the START order to appear.

When the START order turns up, the armature convertor is connected to the line, the control system is released and the motor is permitted to rotate with a speed corresponding to the reference signal presented to the speed controller.

A STOP order will bring the drive to standstill and disconnect the armature convertor.

In case of an OFF order, the OFF sequence is executed, disconnecting the complete drive from the supply line. The disconnection of the armature convertor, however, is delayed so that the convertor and the control equipment are blocked first.

The sequence logic operation for other settings of the SEQMODE parameter is shown in Fig 6.

Emergency stop logic

When pushing the *emergency stop push button*, the drive will normally stop on current limit. Alternatively, by setting of the appropriate parameters, the emergency stop may be on the normal ramp or a faster emergency stop ramp. It is also possible to involve mechanical braking during emergency stop by activating the brake control module.

TL114F01

START/ON sequence	SEQMODE 0	1	2	3
Ventilators			ON	
Exciter				
Main contactor	START			
Release				

STOP/OFF sequence	SEQMODE 0	1	2	3
Phase retard	STOP/OFF			
Main contactor				
Exciter			OFF	
Ventilators				

Fig 6 Start-stop sequence modes (TL114F01)

Mechanical brake logic

The mechanical brake logic coordinates the operation of the mechanical brake and the start/stop logic of the drive.

Armature current control

The torque control is performed by the armature current controller, receiving the torque reference from the speed controller. As the output from the speed controller has an adjustable limit setting, i.e. the current limit, the maximum torque during acceleration and retardation is limited.

Speed control

The motor speed can be measured with a d.c. tacho generator or a pulse generator. Depending on which, the speed feedback will be brought to the speed controller through different input channels in the control interface, see Fig 7. In the interface, the speed feedback is conditioned and adapted to the present control conditions and converted to digital form.

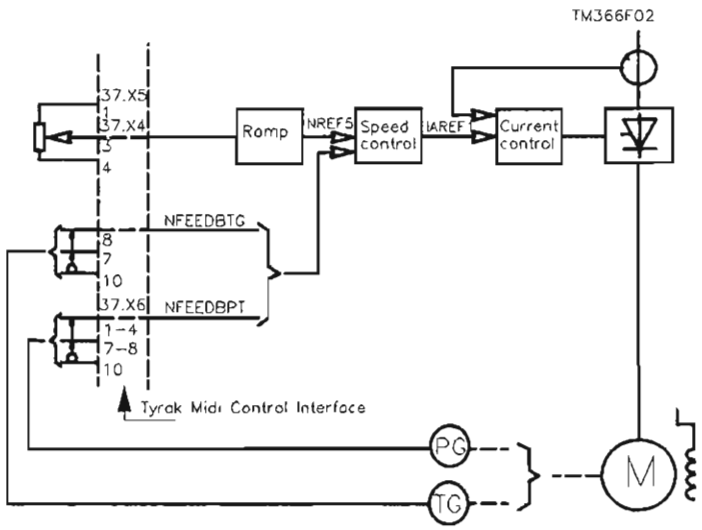

Fig 7 Speed control loops with tacho or pulse transmitter feedback (TM366F02)

The behaviour and performance characteristics of the speed control loop are adjusted by setting a number of program parameters, which normally is done on the operator's panel.

Speed reference handling

The speed is set from the selected operating station, either the operator's panel in the convertor (LOCAL2) or external operating stations e.g. an operator's desk or box in the process plant (LOCAL1) or a central control room (REMOTE).

Increase/decrease reference ordering

The speed reference software accepts increase/decrease orders e.g. from push-buttons in the external operator's desk or from the REF+/REF- keys in the operator's panel. The software signals INCRLOC2 and DECRLOC2 carries the order information onto the increase/decrease function in the module NINDE.

Reference generation

The speed may also be set with a continuously adjustable reference order e.g. with the internal reference setting parameters SP1AREFS through SP6AREFS inside the REFGEN software or from external reference potentiometers.

External references can be connected directly to the reference input of the speed controller by means of the reference signals NREF1 through NREF7 or via the software module REFGEN, see Fig 8.

Ramp function

The external references may also be connected via the ramp function modules NRSUM and NRAMP. The reference signals NREF1 through NREF4 are added, the sum is transferred through the ramp module NRAMP and then presented to the speed controller as speed reference NREF5.

Bumpless transfer between remote and local

When using the reference signals NREF1 through NREF5 for remote reference setting and NREF6 for local reference setting, the operating facility *follow* in the module NINDE can be used for arranging bumpless transition between remote and local reference.

Field control

The motor field may be supplied from a fixed voltage diode exciter or an adjustable field current. The adjustable exciter may be a conventional hardware components exciter or a computer controlled exciter (sometimes referred to as analog or digital field exciter respectively).

Protective and monitoring system

Start sequence

The Pride sequence control monitors the connection and disconnection of the internal and external fans, the main contactor and the field exciter. These monitoring functions are found in the convertor sequence control module SEQCON.

Earth fault (Ground fault)

The earth current monitor uses the phasor sum of the three phase line current to detect and indicate the presence of an earth fault. The earth fault current is measured with the optional earth fault transformer.

Supply line

Pride monitors the main and auxiliary supply and detects low line voltage, frequency faults and incorrect phase sequence.

D.c. current

Pride also detects the current related faults: instantaneous overcurrent, loss of current in a thyristor branch, current pulsation and large current control deviation. Overcurrent tripping also indicates the faulty thyristor branch.

Motor speed

The motor speed monitor has one zero-speed indication, one overspeed indication for tripping and two speed level indications for optional use. The presence of the speed feedback is also monitored, the drive is tripped in case the feedback disappears.

Motor load

The motor is protected against thermal overload by monitoring the armature current. The monitor has adjustable levels for overload tripping, alarm and time delay.

Stall condition

The motor is protected against stalling condition by

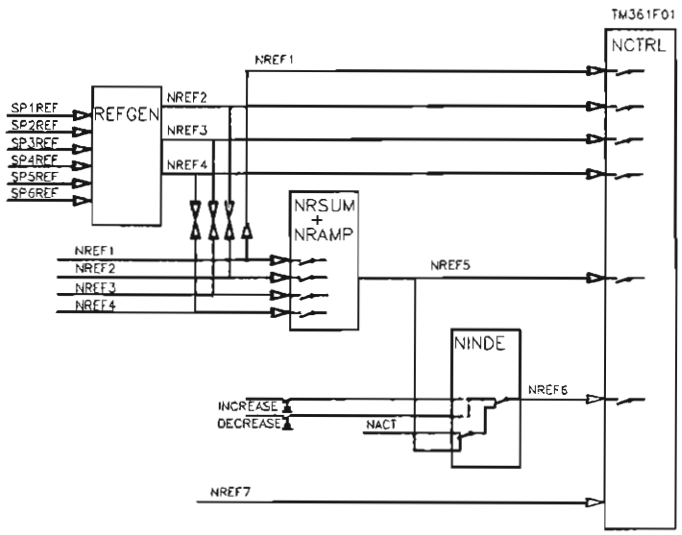

Fig 8 Speed reference signals and modules (TM361F01)

permitting an adjustable stalling current during standstill for a certain adjustable stalling time interval. Stalling condition will trip the drive.

Field current

The minimum field monitor will prevent starting or trip the drive if the field current drops below the minimum field setting.

In the case of the computer controlled field exciter, the software includes overcurrent tripping.

External faults

The program includes software to accept three external fault signals to give tripping of the drive, see also Diagnostic and fault indication.

Diagnostic system and fault indication

Faulty operation is reported to the fault indication and diagnostic system from where the information about failures and possible measures is made available to the operating and servicing staff.

Fault information software signals

The software contains signals (variables) carrying information about the conditions in the system. Some of these signals are used by the system itself to take appropriate action, while others are reported to the operator's panel for displaying of the information.

The list below contains some examples of software signals (variables) which are used to report important information about the condition of the system.

TRIPPED	The drive has tripped
RDYRUN	The convertor is ready to operate
RDYREF	The convertor is ready to receive current reference
RDY2RUN	The drive is ready to run
RDY2REF	The drive is ready to accept references
ARMHLW	High armature load

Fault messages

Fault information e.g. all the tripping signals are displayed on the operator's panel in legible text.

External fault handling

Besides indication of faults in the drive itself, the program has software to accept and indicate three external faults on the operator's panel. The external fault signals are also available for tripping of the drive, see Protective and monitoring system.

Control interface and communication

I/O interface

The communication between the Pride software and the external hardware involves the basic terminal and conversion board YPQ 108 and the modules for connection between the external signals channeled into Pride and the internal software signals, see Fig 9. These modules are also called the software switchbox.

Basic I/O interface

In the basic I/O interface the following communication channels are available:

I/O type	No. of channels	Separation	Note
Digital input	8	Opto	
Digital output	5	Opto, free relay contact	
Analog input	4 1)	High ohmic diff. ampl.	Resolution 0.05 percent
Analog output	2	High ohmic diff. ampl.	Resolution 0.05 percent
Pulse transmitter input	3	Opto	

1) Facilities for accepting tacho feedback inclusive.

The basic I/O interface also includes terminals for connection of meters for actual armature current and, in case of tacho feedback, actual speed.

Expansion I/O interface

The program includes software for the following expansion I/O interface:

I/O type	No. of channels	Separation	Note
Digital input	8	Opto	
Digital output	8	Opto, free relay contact	
Analog input	4 1)	High ohmic diff. ampl.	Resolution 0.05 percent
Analog output	4	High ohmic diff. ampl.	Resolution 0.4 percent

1) Facilities for accepting tacho feedback inclusive.

In case the expansion I/O interface is wanted, optional hardware must be ordered and the software must be activated. In case this also observe that some software signals are tied up to the bus interface and therefore are not available for the I/O communication.

Bus interface for serial communication

For communication with the Master Piece and the TCDC control systems, the GDE2 program includes a high speed serial communication interface, see Fig 10.

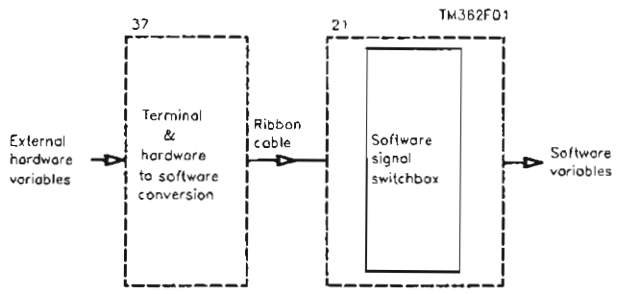

Fig 9 I/O communication interface (TM362F01)

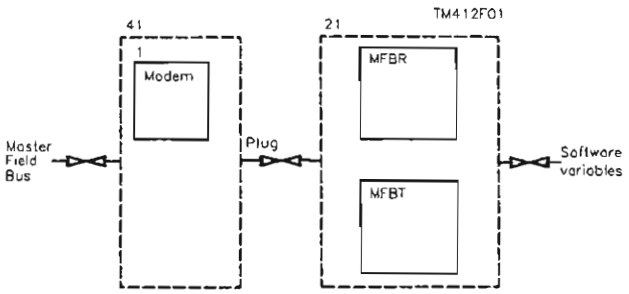

Fig 10 Bus interface for serial communication (TM412F01)

Software modules

AIN34	Analog input
AIN37	Analog input
AOUT354	Analog output
AOUT37	Analog output
BRMEC	Mechanical brake control
CONNECT1	Connect module
DIN32	Digital input
DIN37	Digital input
DOUT33	Digital output
DOUT37	Digital output
DSP131	Pulse transmitter input
ECURM	Ground fault monitor
EMSTOP	Emergency stop
EXFLT3	External fault handling
FLTLOG	Fault logger
IACTRL5	Armature current controller
IF1CTR	Field current control
IFREFG	Field current reference generator
MFBR1	Master Field Bus reception
MFBT1	Master Field Bus transmission
MOTOLM	Motor overload monitor
NCTRL1	Speed controller 1
NFBADJ	Speed feedback adjustment
NINDE1	Speed increase/decrease
NRAMP2	Ramp generator
NRSUM2	Ramp reference summator
OPCH3	Operator's panel definition
REFGEN	Reference generator
REMLOC	Remote local selector
SEQCON4	Sequence logic convertor
SEQST	Drive system sequence logic
SPMON	Speed monitor
STALLM	Stall monitor
STEPG2	Step generator
TEND	End of load program
TEST	Test facility
TRIP1	Tripping 1
TRIP2	Tripping 2
TRIP3	Tripping 3
TSYS	Begin of load program
TTEXTS	Background text

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GDA1
General Drive Advanced 1

This description covers the standard Pride program GDA1 belonging to the "Advanced application category". Pride (PRogrammable Industrial Drives Electronics) is the computer based control system used in the Tyrak drive system.

Introduction

The advanced application program GDA1 covers non-coordinated drives, e.g. a pump or a fan drive. The software includes one process control loop above the speed loop.

The drive application may include a single or a double convertor. The motor field may be supplied from an optional selection of field exciter types including computer controlled exciters ("digital field exciters").

The following control functions are available:

- o Selection of operating station
- o Sequence control for convertor and drive
- o Armature current control
- o Speed control, standard performance type
- o Speed reference handling including ramp generator, reference generator and increase/decrease ordering.
- o Process controller
- o Field control
- o Protective and monitoring functions
- o Diagnostic system and fault indication
- o I/O communication interface

Operating station

The drive may be operated from various operating stations. These may be:

- o a remote station like a central control room or a higher level computer system (operating station REMOTE), *or*
- o an external operator's desk or box connected to Pride interface terminals (operating station LOCAL1), *or*
- o the Pride operator's panel located in the convertor cubicle (operating station LOCAL2).

Selection of operating station

The selection between the operating stations is done with order signals connected to the Pride software. The software logic for the selection is found in the software module REMLOC. From this module, the consequences of the actual selection is distributed to the Pride modules concerned.

With parameters in the REMLOC module, the definition and combination of the various operating stations can be changed, see Fig 1.

Internal operator's panel (= LOCAL2)

In the advanced program GDA1, the following operating devices of the operator's panel are available, see Fig 2:

- o Push button marked "I" for ON order. Pushing "I" brings the drive from complete disconnected condition to *ready for run*.
- o Push button marked "O" for OFF order. Pushing "O" disconnects the complete drive from the line.
- o Green coloured LED which illuminates when the convertor is ready for operation
- o Red coloured LED which illuminates in case the convertor is tripped
- o Push button marked "RESET" for resetting the Pride logic when a tripping fault has been restored.
- o Two push buttons (soft keys) marked "START" and "STOP". Pushing START gives start sequence operation from the condition *ready for run* to *ready for reference*. Pushing STOP brings the drive back to the condition *ready to run*.
- o Each of the soft keys START and STOP has a LED which may be used to indicate the action of the corresponding key.
- o Two push buttons (soft keys) marked "REM" and "LOC". After permission is given by the remote

TL254F01

Ordering signal	Parameter REMLOC:REMLOCMS			
	"3"	"2"	"1"	"0"
	Operating station			
REMOTE	Control room	Operator's desk	Control room	
LOCAL 1	Operator's desk			
LOCAL 2	Convertor panel		Convertor panel	Convertor panel

Fig 1 Examples of some possible combinations of operating stations depending on the selection of order signals and parameter settings. (TL254F01)

TM363F01

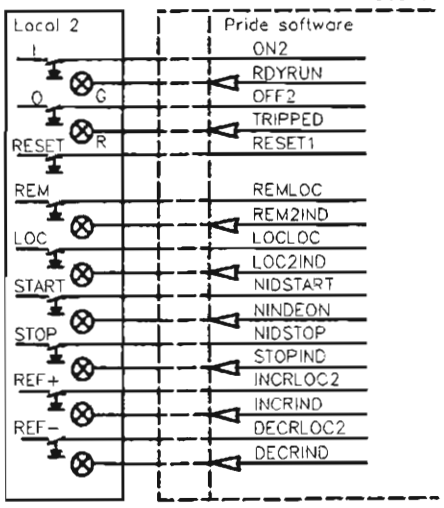

Fig 2 Operation from Pride operator's panel (TM363F01)

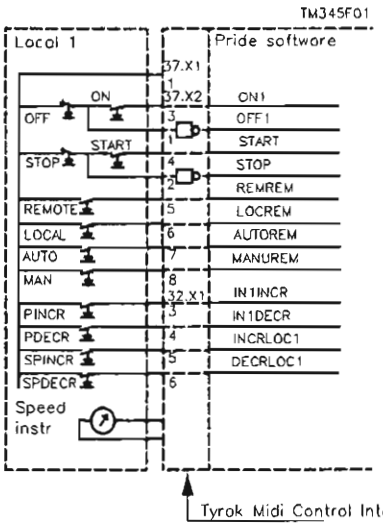

Fig 3 Start/stop and increase/decrease operation from LOCAL1 station (TM345F01)

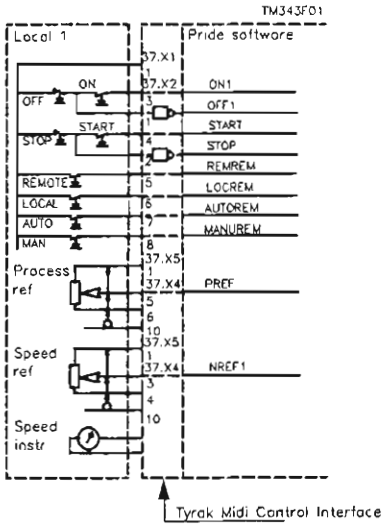

Fig 4 Start/stop and potentiometer reference setting from LOCAL1 station (TM343F01)

station, pushing LOC means that the local station accepts to take control. Pushing REM disconnects the local station and leaves the initiative to the remote station.

- o Each of the soft keys REM and LOC has a LED which may be used to indicate the action of the corresponding key.
- o Two push buttons (soft keys) marked "REF+" and "REF-". Pushing REF+ gives increasing motor speed and REF- decreasing speed.
- o Each of the soft keys REF+ and REF- has a LED which may be used to indicate the action of the corresponding key.

Separate external operating station (= LOCAL1)

When ordering LOCAL1 operation, external operating devices connected to appropriate software signals (variables) in Pride can be used to operate the drive.

In automatic operating mode, the setting of the process reference may be from an external reference voltage or from increase and decrease orders connected via a digital input interface.

In manual operating mode, the speed setting may done be with push-buttons for increase and decrease connected via a digital input interface as in Fig 3, or with an adjustable reference voltage e.g. from a potentiometer connected via an analog input interface as in Fig 4. It is also possible to connect meters for motor speed and current.

When pushing the ON push-button, parts of the drive will be connected to the supply line, and the sequence control software will indicate *ready for run*. When pushing the START push-button, remaining parts of the drive is connected to the line, the control system will be released and the motor will follow the speed reference given.

When pushing the STOP push-button the speed reference is disconnected, the control system is blocked and parts of the drive is disconnected from the supply line. When pushing the OFF push-button, the

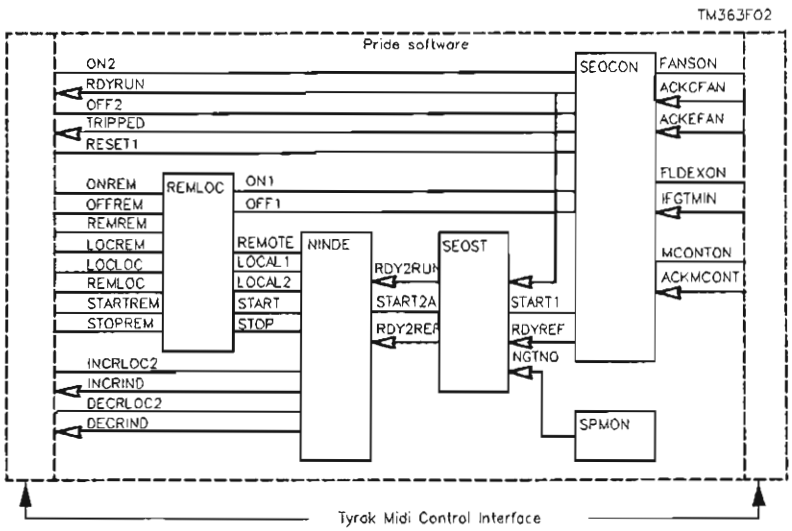

Fig 5 Sequence control software (TM363F02)

complete drive is disconnected. Details about this split on/start and off/stop operation is presented below under Sequence control.

Remote operating station (=REMOTE)
When ordering REMOTE operation, operating devices located in the REMOTE station can be used to operate the drive. The remote station may be of the same kind as those described for the LOCAL1 station, see above.

Sequence control

ON/START and OFF/STOP sequences

The program allows a split start and stop sequence which means that the starting and stopping of the drive are arranged in two steps. The first step when starting is executed by the ON command, bringing the drive from disconnected condition to *ready for run*. The second step is executed by the START command, bringing the drive from the condition *ready for run* to the condition *ready for reference*. This split sequence has four modes of execution controlled by the parameter SEQMODE, see Fig 6. The on-start/off-stop sequence for the default setting of this parameter (*SEQMODE = "2"*) is described below.

When the ON order reaches the software order signal ON1, the ON sequence will be executed, connecting the fans and the field exciter to the supply line. The sequence logic will then remain standby, waiting for the START order to appear.

When the START order turns up, the armature convertor is connected to the line, the control system is released and the motor is permitted to rotate with a speed corresponding to the reference signal presented to the speed controller.

A STOP order will bring the drive to standstill and disconnect the armature convertor.

In case of an OFF order, the OFF sequence is executed, disconnecting the complete drive from the supply line. The disconnection of the armature convertor, however, is delayed so that the convertor and the control equipment are blocked first.

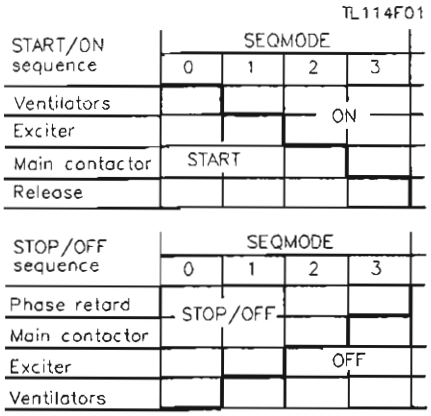

Fig 6 Start-stop sequence modes (TL114F01)

The sequence logic operation for other settings of the SEQMODE parameter is shown in Fig 6.

Armature current control

The torque control is performed by the armature current controller, receiving the torque reference from the speed controller. As the output from the speed controller has an adjustable limit setting, i.e. the current limit, the maximum torque during acceleration and retardation is limited.

Speed control

The motor speed can be measured with a d.c. tacho generator or a pulse generator. Depending on which, the speed feedback will be brought to the speed controller through different input channels in the control interface, see Fig 7. In the interface, the speed feedback is conditioned and adapted to the present control conditions and converted to digital form.

The behaviour and performance characteristics of the speed control loop are adjusted by setting a number of program parameters, which normally is done on the operator's panel.

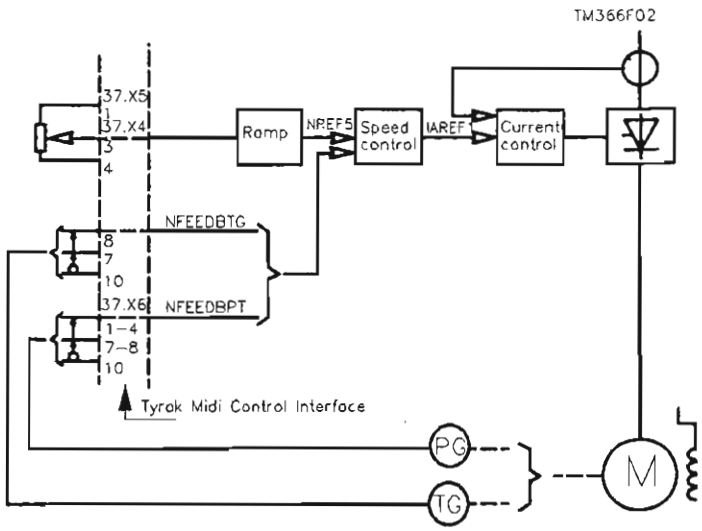

Fig 7 Speed control loops with tacho or pulse transmitter feedback (TM366F02)

Speed reference handling

In automatic control mode, the speed reference is received from the process controller.

In manual operation mode, the speed is set from the selected operating station, either the operator's panel in the convertor (LOCAL2) or external operating stations e.g. an operator's desk or box in the process plant (LOCAL1) or a central control room (REMOTE).

Increase/decrease reference ordering

The speed reference software accepts increase/decrease orders e.g. from push-buttons in the external operator's desk or from the REF+/REF- keys in the operator's panel. The software signals INCRLOC2 and DECRLOC2 carries the order information onto the increase/decrease function in the module NINDE.

Reference generation

The speed may also be set with a continuously adjustable reference order e.g. with the internal reference setting parameters SP1AREFS through SP6AREFS inside the REFGEN software or from external reference potentiometers.

External references can be connected directly to the reference input of the speed controller by means of the reference signals NREF1 through NREF7 or via the software module REFGEN, see Fig 8.

Ramp function

The external references may also be connected via the ramp function modules NRSUM and NRAMP. The reference signals NREF1 through NREF4 are added, the sum is transferred through the ramp module NRAMP and then presented to the speed controller as speed reference NREF5.

Bumpless transfer between control modes

When using the reference signals NREF1 through NREF5 for remote reference setting and NREF6 for local reference setting, the operating facility *follow* in the module NINDE can be used for arranging bumpless transition between remote and local reference.

The *follow* facility in the module NINDE is also used for bumpless transfer between automatic and manual mode.

Process control

The process controller can be used to control a process variable such as level, pressure, flow or temperature. The controller accepts a wide variety of process transmitters and has facilities to calibrate the process feedback.

The voltage from a reference potentiometer can be connected to the controller via the analog input interface.

The process reference may also be set from increase/decrease orders e.g. from push-buttons in the operator's desk. The software signals ID1INCR and ID1DECR carries the order information onto the increase/decrease function in the module INDE.

Field control

The motor field may be supplied from a fixed voltage diode exciter or an adjustable field current. The adjustable exciter may be a conventional hardware components exciter or a computer controlled exciter (sometimes referred to as analog or digital field exciter respectively).

Protective and monitoring system

Start sequence

The Pride sequence control monitors the connection and disconnection of the internal and external fans, the main contactor and the field exciter. These monitoring functions are found in the convertor sequence control module SEQCON.

Earth Fault (Ground fault)

The earth current monitor uses the phasor sum of the three phase line current to detect and indicate the presence of an earth fault. The earth fault current is measured with the optional earth fault transformer.

Supply line

Pride monitors the main and auxiliary supply and detects low line voltage, frequency faults and incorrect phase sequence.

D.c. current

Pride also detects the current related faults: instantaneous overcurrent, loss of current in a thyristor branch, current pulsation and large current control

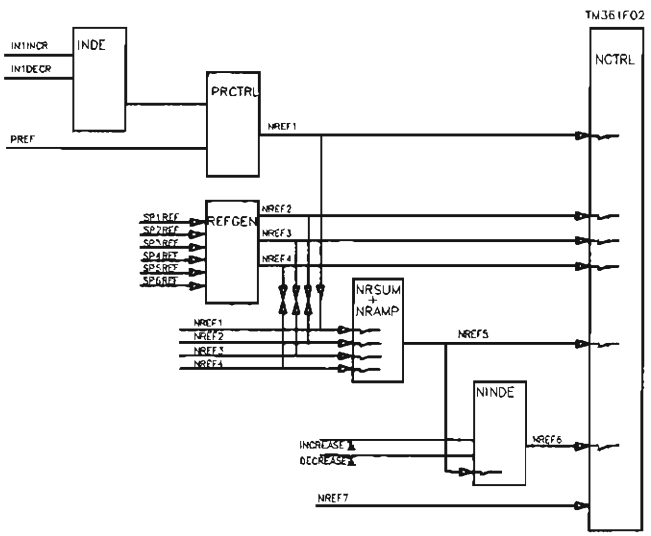

Fig 8 Speed reference signals and modules (TM361F02)

GDA2
General Drive Advanced 2

This description covers the standard Pride program GDA2 belonging to the "Advanced application category". Pride (PRogrammable Industrial Drives Electronics) is the computer based control system used in the Tyrak drive system.

Introduction

The advanced application program GDA2 covers non-coordinated drives, e.g. a pump or a fan drive. The software includes speed reference handling for one process control loop realized with an external process controller.

The drive application may include a single or a double convertor. The motor field may be supplied from an optional selection of field exciter types including computer controlled exciters ("digital field exciters").

The following control functions are available:

- o Selection of operating station
- o Sequence control for convertor and drive
- o Armature current control
- o Speed control, standard performance type
- o Speed reference handling including ramp generator, reference adaptation and increase/decrease ordering.
- o Field control
- o Protective and monitoring functions
- o Diagnostic system and fault indication
- o I/O communication interface

Operating station

The drive may be operated from various operating stations. These may be:

- o a remote station like a central control room or a higher level computer system (operating station REMOTE), *or*
- o an external operator's desk or box connected to Pride interface terminals (operating station LOCAL1), *or*
- o the Pride operator's panel located in the convertor cubicle (operating station LOCAL2).

TL254F01

Ordering signal	Parameter REMLOC:REMLOCMS			
	"3"	"2"	"1"	"0"
	Operating station			
REMOTE	Control room	Operator's desk	Control room	
LOCAL1	Operator's desk			
LOCAL2	Convertor panel		Convertor panel	Convertor panel

Fig 1 Examples of some possible combinations of operating stations depending on the selection of order signals and parameter settings. (TL254F01)

Selection of operating station

The selection between the operating stations is done with order signals connected to the Pride software. The software logic for the selection is found in the software module REMLOC. From this module, the consequences of the actual selection is distributed to the Pride modules concerned.

With parameters in the REMLOC module, the definition and combination of the various operating stations can be changed, see Fig 1.

Internal operator's panel (= LOCAL2)

In the advanced program GDA2, the following operating devices of the operator's panel are available, see Fig 2:

- o Push button marked "I" for ON order. Pushing "I" brings the drive from complete disconnected condition to *ready for run.*
- o Push button marked "O" for OFF order. Pushing "O" disconnects the complete drive from the line.
- o Green coloured LED which illuminates when the convertor is ready for operation
- o Red coloured LED which illuminates in case the convertor is tripped
- o Push button marked "RESET" for resetting the Pride logic when a tripping fault has been restored.
- o Two push buttons (soft keys) marked "START" and "STOP". Pushing START gives start sequence operation from the condition *ready for run* to *ready for reference.* Pushing STOP brings the drive back to the condition *ready to run.*
- o Each of the soft keys START and STOP has a LED which may be used to indicate the action of the corresponding key.
- o Two push buttons (soft keys) marked "REM" and "LOC". After permission is given by the remote

TM363F01

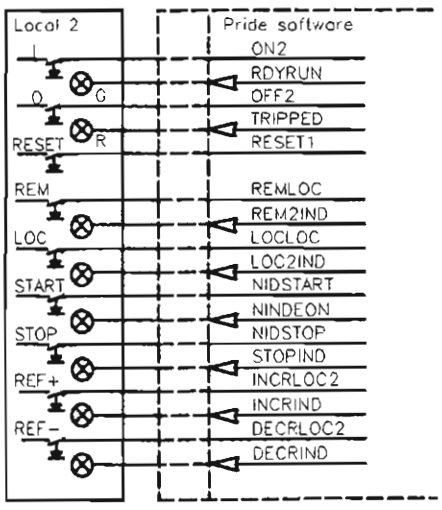

Fig 2 Operation from Pride operator's panel (TM363F01)

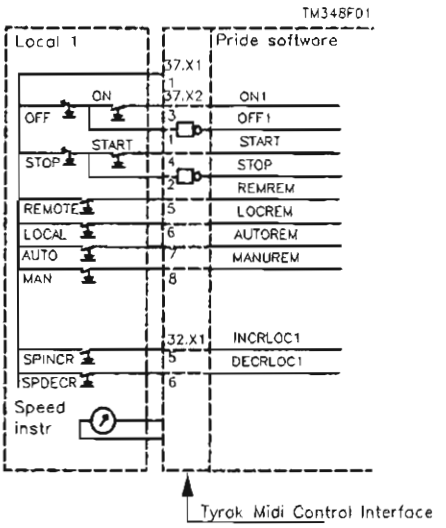

Fig 3 Start/stop and increase/decrease operation from LOCAL 1 station (TM348F01)

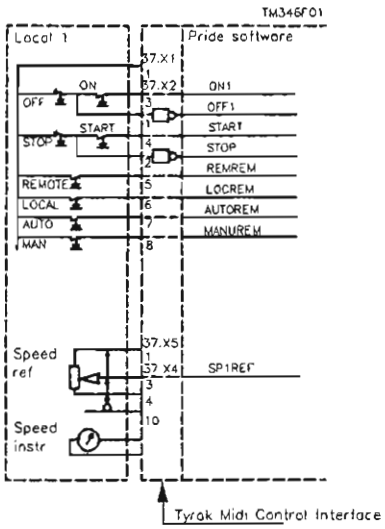

Fig 4 Start/stop and potentiometer reference setting from LOCAL 1 station (TM346F01)

station, pushing LOC means that the local station accepts to take control. Pushing REM disconnects the local station and leaves the initiative to the remote station.

- o Each of the soft keys REM and LOC has a LED which may be used to indicate the action of the corresponding key.
- o Two push buttons (soft keys) marked "REF+" and "REF-". Pushing REF + gives increasing motor speed and REF- decreasing speed.
- o Each of the soft keys REF+ and REF- has a LED which may be used to indicate the action of the corresponding key.

Separate external operating station (= LOCAL1)

When ordering LOCAL1 operation, external operating devices connected to appropriate software signals (variables) in Pride can be used to operate the drive.

In automatic operating mode, the setting of the process reference may be from an external reference voltage or from increase and decrease orders connected via a digital input interface.

In manual operating mode, the speed setting may done be with push-buttons for increase and decrease connected via a digital input interface as in Fig 3, or with an adjustable reference voltage e.g. from a potentiometer connected via an analog input interface as in Fig 4. It is also possible to connect meters for motor speed and current.

When pushing the ON push-button, parts of the drive will be connected to the supply line, and the sequence control software will indicate *ready for run*. When pushing the START push-button, remaining parts of the drive is connected to the line, the control system will be released and the motor will follow the speed reference given.

When pushing the STOP push-button the speed reference is disconnected, the control system is blocked and parts of the drive is disconnected from the supply line. When pushing the OFF push-button, the

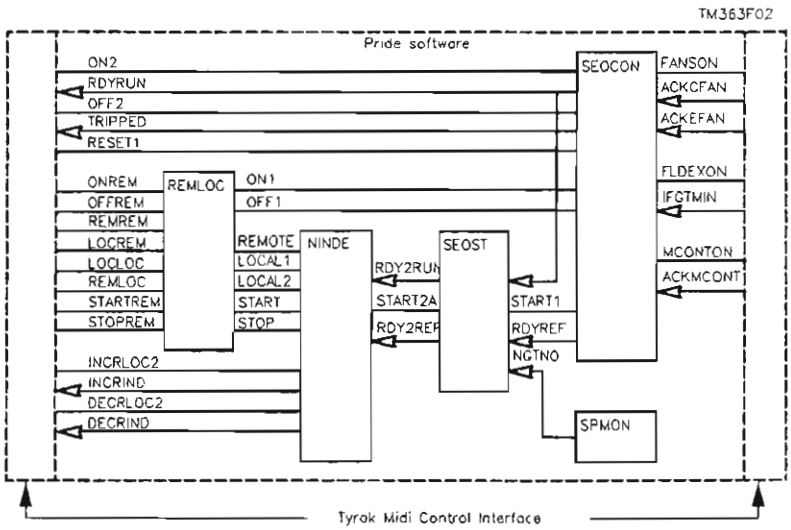

Fig 5 Sequence control software (TM363F02)

complete drive is disconnected. Details about this split on/start and off/stop operation is presented below under Sequence control.

Remote operating station (=REMOTE)

When ordering REMOTE operation, operating devices located in the REMOTE station can be used to operate the drive. The remote station may be of the same kind as those described for the LOCAL1 station, see above.

Sequence control

ON/START and OFF/STOP sequences

The program allows a split start and stop sequence which means that the starting and stopping of the drive are arranged in two steps. The first step when starting is executed by the ON command, bringing the drive from disconnected condition to *ready for run*. The second step is executed by the START command, bringing the drive from the condition *ready for run* to the condition *ready for reference*. This split sequence has four modes of execution controlled by the parameter SEQMODE, see Fig 6. The on-start/off-stop sequence for the default setting of this parameter (*SEQMODE = "2"*) is described below.

When the ON order reaches the software order signal ON1, the ON sequence will be executed, connecting the fans and the field exciter to the supply line. The sequence logic will then remain standby, waiting for the START order to appear.

When the START order turns up, the armature convertor is connected to the line, the control system is released and the motor is permitted to rotate with a speed corresponding to the reference signal presented to the speed controller.

A STOP order will bring the drive to standstill and disconnect the armature convertor.

In case of an OFF order, the OFF sequence is executed, disconnecting the complete drive from the supply line. The disconnection of the armature convertor, however, is delayed so that the convertor and the control equipment are blocked first.

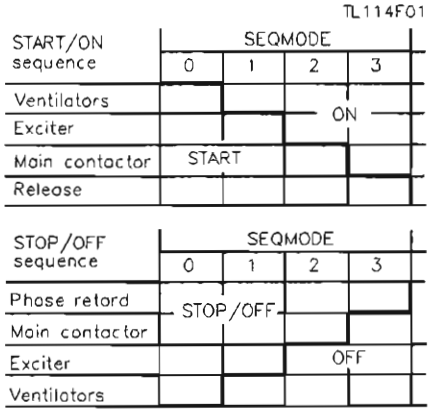

Fig 6 Start-stop sequence modes (TL114F01)

The sequence logic operation for other settings of the SEQMODE parameter is shown in Fig 6.

Armature current control

The torque control is performed by the armature current controller, receiving the torque reference from the speed controller. As the output from the speed controller has an adjustable limit setting, i.e. the current limit, the maximum torque during acceleration and retardation is limited.

Speed control

The motor speed can be measured with a d.c. tacho generator or a pulse generator. Depending on which, the speed feedback will be brought to the speed controller through different input channels in the control interface, see Fig 7. In the interface, the speed feedback is conditioned and adapted to the present control conditions and converted to digital form.

The behaviour and performance characteristics of the speed control loop are adjusted by setting a number of program parameters, which normally is done on the operator's panel.

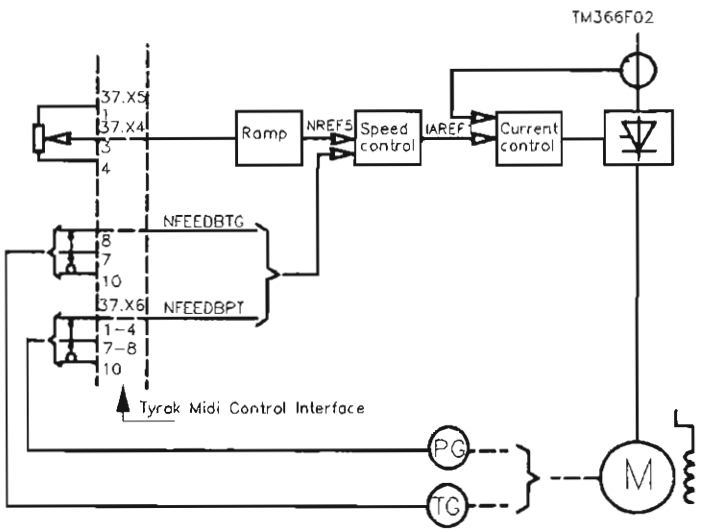

Fig 7 Speed control loops with tacho or pulse transmitter feedback (TM366F02)

Speed reference handling

In automatic control mode, the speed reference is received from the external process controller.

In manual operation mode, the speed is set from the selected operating station, either the operator's panel in the convertor (LOCAL2) or external operating stations e.g. an operator's desk or box in the process plant (LOCAL1) or a central control room (REMOTE).

Increase/decrease reference ordering

The speed reference software accepts increase/decrease orders e.g. from push-buttons in the external operator's desk or from the REF+/REF- keys in the operator's panel. The software signals INCRLOC2 and DECRLOC2 carries the order information onto the increase/decrease function in the module NINDE.

Reference adaptation

The speed may also be set with a continuously adjustable reference order e.g. with the internal reference setting parameters SP1AREFS and SP2AREFS inside the REFAD software or from external reference potentiometers.

External references can be connected directly to the reference input of the speed controller by means of the signals NREF1 through NREF7 or via the software module REFAD, see Fig 8.

Ramp function

The external references may also be connected via the ramp function modules NRSUM and NRAMP. The reference signals NREF1 through NREF4 are added, the sum is transferred through the ramp module NRAMP and then presented to the speed controller as speed reference NREF5.

Bumpless transfer between control modes

When using the reference signals NREF1 through NREF5 for remote reference setting and NREF6 for local reference setting, the operating facility *follow* in the module NINDE can be used for arranging bumpless transition between remote and local reference.

The *follow* facility in the module NINDE is also used for bumpless transfer between automatic and manual mode.

Process control

An external process controller can be used to control a process variable such as level, pressure, flow or temperature.

The output from the external process controller is connected to the Pride software via the analog input interface. The module REFAD has facilities to calibrate this process feedback.

Field control

The motor field may be supplied from a fixed voltage diode exciter or an adjustable field current. The adjustable exciter may be a conventional hardware components exciter or a computer controlled exciter (sometimes referred to as analog or digital field exciter respectively).

Protective and monitoring system

Start sequence

The Pride sequence control monitors the connection and disconnection of the internal and external fans, the main contactor and the field exciter. These monitoring functions are found in the convertor sequence control module SEQCON.

Earth Fault (Ground fault)

The earth current monitor uses the phasor sum of the three phase line current to detect and indicate the presence of an earth fault. The earth fault current is measured with the optional earth fault transformer.

Supply line

Pride monitors the main and auxiliary supply and detects low line voltage, frequency faults and incorrect phase sequence.

D.c. current

Pride also detects some current related faults: instantaneous overcurrent, loss of current in a thyristor branch, current pulsation and large current control

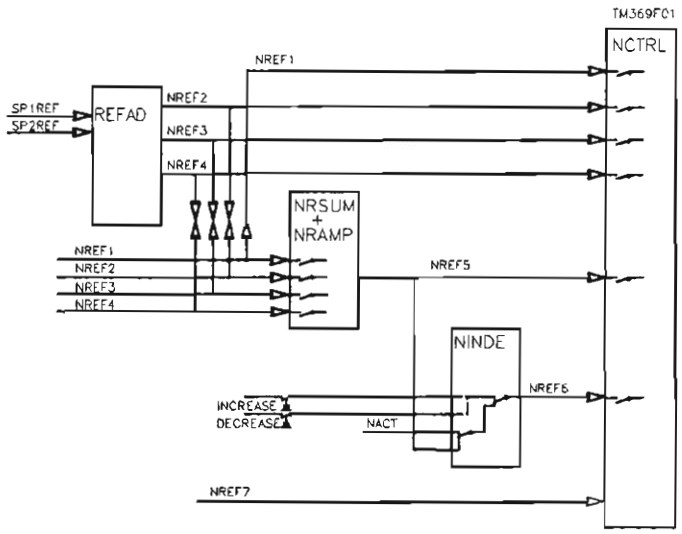

Fig 8 Speed reference signals and modules (TM369F01)

deviation. Overcurrent tripping also indicates the faulty thyristor branch.

Motor speed

The motor speed monitor has one zero-speed indication, one overspeed indication for tripping and two speed level indications for optional use. The presence of the speed feedback is also monitored, the drive is tripped in case the feedback disappears.

Motor load

The motor is protected against thermal overload by monitoring the armature current. The monitor has adjustable levels for overload tripping, alarm and time delay.

Stall condition

The motor is protected against stalling condition by permitting an adjustable stalling current during standstill for a certain adjustable stalling time interval. Stalling condition will trip the drive.

Motor temperature

The motor temperature monitor accepts up to two PT100 inputs for monitoring motor temperature. When the temperature reaches certain adjustable levels, alarm or tripping respectively is activated.

Thyristor junction temperature

The convertor temperature monitor accepts up to two PT100 inputs for monitoring thyristor temperature. When the temperature reaches certain adjustable levels, alarm or tripping respectively is activated.

Field current

The minimum field monitor will prevent starting or trip the drive if the field current drops below the minimum field setting.

In the case of the computer controlled field exciter, the software includes overcurrent tripping.

External faults

The program includes software to accept three external fault signals to give tripping of the drive, see also Diagnostic and fault indication.

Diagnostic system and fault indication

Faulty operation is reported to the fault indication and diagnostic system from where the information about failures and possible measures is made available to the operating and servicing staff.

Fault information software signals

The software contains signals (variables) carrying information about the conditions in the system. Some of these signals are used by the system itself to take appropriate action, while others are reported to the operator's panel for displaying of the information.

The list below contains some examples of software signals (variables) which are used to report important information about the condition of the system.

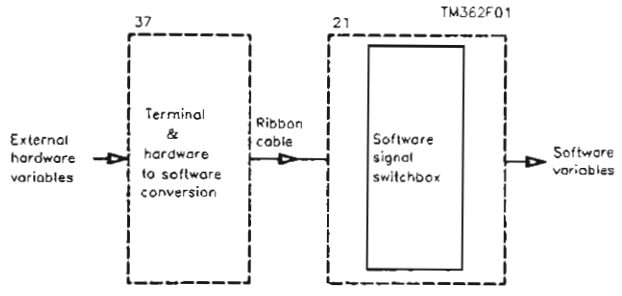

Fig 9 Communication interface (TM362F01)

TRIPPED	The drive has tripped
RDYRUN	The convertor is ready to operate
RDYREF	The convertor is ready to receive current reference
RDY2RUN	The drive is ready to run
RDY2REF	The drive is ready to accept references
ARMHLW	High armature load

Fault messages

Fault information e.g. all the tripping signals are displayed on the operator's panel in legible text.

External fault handling

Besides indication of faults in the drive itself, the program has software to accept and indicate three external faults on the operator's panel. The external fault signals are also available for tripping of the drive, see Protective and monitoring system.

Control interface and communication

I/O interface

The communication between the Pride software and the external hardware involves the basic terminal and conversion board YPQ 108 and the modules for connection between the external signals channeled into Pride and internal software signals, see Fig 9. These modules are also called the software switchbox.

Basic I/O interface

In the basic I/O interface the following communication channels are available:

I/O type	No. of channels	Separation	Note
Digital input	8	Opto	
Digital output	5	Opto, free relay contact	
Analog input	4 1)	High ohmic diff. ampl.	Resolution 0.05 percent
Analog output	2	High ohmic diff. ampl.	Resolution 0.05 percent
Pulse transmitter input	3	Opto	

1) Facilities for accepting tacho feedback inclusive.

The basic I/O interface also includes terminals for connection of meters for actual armature current and, in case of tacho feedback, actual speed.

Expansion I/O interface

The program includes software for the following expansion I/O interface:

I/O type	No. of channels	Separation	Note
Digital input	8	Opto	
Digital output	8	Opto, free relay contact	
Analog input	4 1)	High ohmic diff. ampl.	Resolution 0.05 percent
Analog output	4	High ohmic diff. ampl.	Resolution 0.4 percent

1) Facilities for accepting tacho feedback inclusive.

In case the expansion I/O interface is wanted, optional hardware must be ordered and the software must be activated.

Software modules

AIN34	Analog input
AIN37	Analog input
AOUT354	Analog output
AOUT37	Analog output
CONNECT1	Connect module
DIN32	Digital input
DIN37	Digital input
DOUT33	Digital output
DOUT37	Digital output
DSP131	Pulse transmitter input
ECURM	Ground fault monitor
EXFLT3	External fault handling
FLTLOG	Fault logger
IACTRL5	Armature current controller
IF1CTR	Field current control
IFREFG	Field current reference generator
MOTEMP	Motor temperature monitor
MOTOLM	Motor overload monitor
NCTRL1	Speed controller 1
NFBADJ	Speed feedback adjustment
NINDE1	Speed increase/decrease
NRAMP2	Ramp generator
NRSUM2	Ramp reference summator
OPCH3	Operator's panel definition
REFAD	Reference adaptation
REMLOC	Remote local selector
SEQCON4	Sequence logic convertor
SEQST	Drive system sequence logic
SPMON	Speed monitor
STALLM	Stall monitor
STEPG2	Step generator
TEND	End of load program
TEST	Test facility
TRIP1	Tripping 1
TRIP2	Tripping 2
TRIP3	Tripping 3
TSYS	Begin of load program
TTEXTS	Background text
TYTEMP	Convertor temperature monitor

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GDA3

General Drive Advanced 3

This description covers the standard Pride program GDA3 belonging to the "Advanced application category". Pride (PRogrammable Industrial Drives Electronics) is the computer based control system used in the Tyrak drive system.

Introduction

The advanced application program GDA3 covers non-coordinated drives with requirements on optional application control functions.

The drive application may include a single or a double convertor. The motor field may be supplied from an optional selection of field exciter types including computer controlled exciters ("digital field exciters").

The following control functions are available:

- o Selection of operating station
- o Sequence control for convertor and drive
- o Armature current control
- o Speed control, advanced performance type (NCTRL3)
- o Speed reference handling including ramp generator, reference adaptation and increase/decrease ordering.
- o Field control
- o Automatic field weakening
- o Protective and monitoring functions
- o Diagnostic system and fault indication
- o I/O communication interface

Operating station

The drive may be operated from various operating stations. These may be:

- o a remote station like a central control room or a higher level computer system (operating station REMOTE), *or*
- o an external operator's desk or box connected to Pride interface terminals (operating station LOCAL1), *or*
- o the Pride operator's panel located in the convertor cubicle (operating station LOCAL2).

TL254F01

Ordering signal	Parameter REMLOC:REMLOCMS			
	"3"	"2"	"1"	"0"
	Operating station			
REMOTE	Control room	Operator's desk	Control room	
LOCAL1	Operator's desk			
LOCAL2	Convertor panel		Convertor panel	Convertor panel

Fig 1 Examples of some possible combinations of operating stations depending on the selection of order signals and parameter settings. (TL254F01)

Selection of operating station

The selection between the operating stations is done with order signals connected to the Pride software. The software logic for the selection is found in the software module REMLOC. From this module, the consequences of the actual selection is distributed to the Pride modules concerned.

With parameters in the REMLOC module, the definition and combination of the various operating stations can be changed, see Fig 1.

Internal operator's panel (= LOCAL2)

In the advanced program GDA3, the following operating devices of the operator's panel are available, see Fig 2:

- o Push button marked "I" for ON order. Pushing "I" brings the drive from complete disconnected condition to *ready for run*.
- o Push button marked "O" for OFF order. Pushing "O" disconnects the complete drive from the line.
- o Green coloured LED which illuminates when the convertor is ready for operation
- o Red coloured LED which illuminates in case the convertor is tripped
- o Push button marked "RESET" for resetting the Pride logic when a tripping fault has been restored.
- o Two push buttons (soft keys) marked "START" and "STOP". Pushing START gives start sequence operation from the condition *ready for run* to *ready for reference*. Pushing STOP brings the drive back to the condition *ready to run*.
- o Each of the soft keys START and STOP has a LED which may be used to indicate the action of the

TM363F01

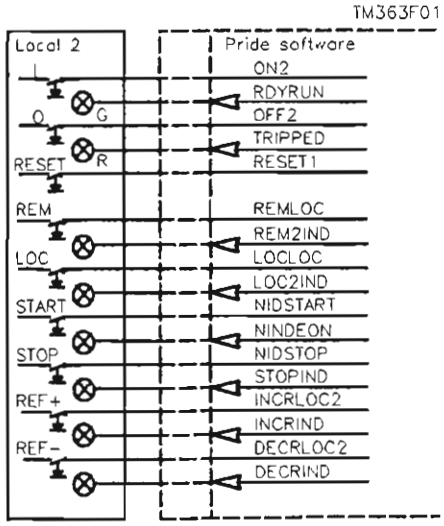

Fig 2 Operation from Pride operator's panel (TM363F01)

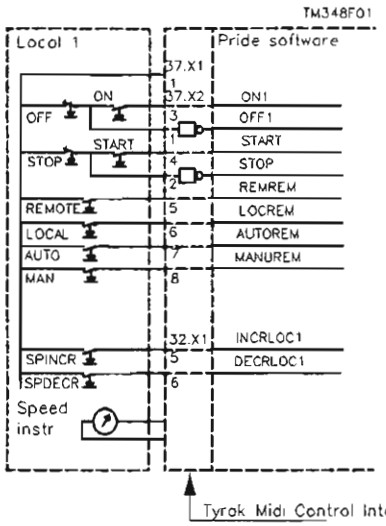

Fig 3 Start/stop and increase/decrease operation from LOCAL1 station (TM348F01)

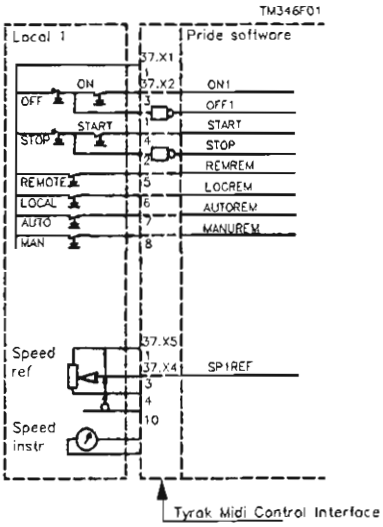

Fig 4 Start/stop and potentiometer reference setting from LOCAL1 station (TM346F01)

corresponding key

- Two push buttons (soft keys) marked "REM" and "LOC". After permission is given by the remote station, pushing LOC means that the local station accepts to take control. Pushing REM disconnects the local station and leaves the initiative to the remote station.
- Each of the soft keys REM and LOC has a LED which may be used to indicate the action of the corresponding key.
- Two push buttons (soft keys) marked "REF+" and "REF-". Pushing REF+ gives increasing motor speed and REF- decreasing speed.
- Each of the soft keys REF+ and REF- has a LED which may be used to indicate the action of the corresponding key.

Separate external operating station (= LOCAL1)

When ordering LOCAL1 operation, external operating devices connected to appropriate software signals in Pride can be used to operate the drive.

In automatic operating mode, the setting of the process reference may be from an external reference voltage or from increase and decrease orders connected via a digital input interface.

In manual operating mode, the speed setting may done be with push-buttons for increase and decrease connected via a digital input interface as in Fig 3, or with an adjustable reference voltage e.g. from a potentiometer connected via an analog input interface as in Fig 4. It is also possible to connect meters for motor speed and current.

When pushing the ON push-button, parts of the drive will be connected to the supply line, and the sequence control software will indicate *ready for run.* When pushing the START push-button, remaining parts of the drive is connected to the line, the control system will be released and the motor will follow the speed reference given.

When pushing the STOP push-button the speed reference is disconnected, the control system is blocked and parts of the drive is disconnected from the

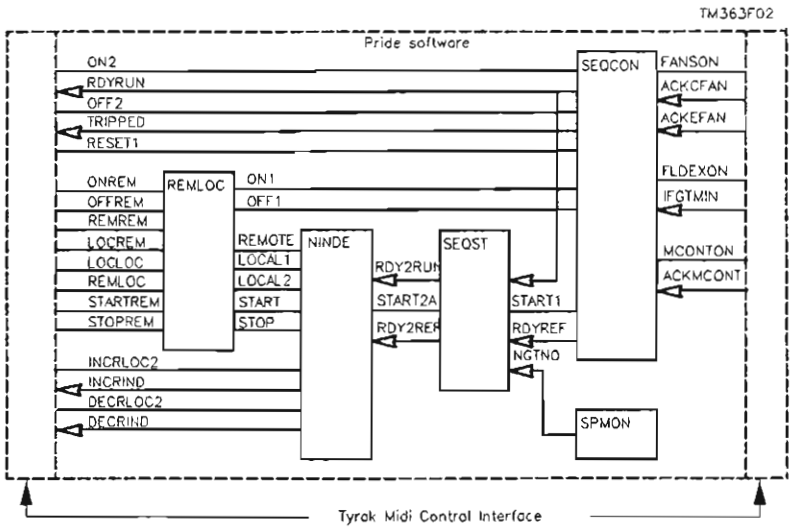

Fig 5 Sequence control software (TM363F02)

supply line. When pushing the OFF push-button, the complete drive is disconnected. Details about this split on/start and off/stop operation is presented below under sequence control.

Remote operating station (=REMOTE)
When ordering REMOTE operation, operating devices located in the REMOTE station can be used to operate the drive. The remote station may be of the same kind as those described for the LOCAL1 station, see above.

Sequence control

ON/START and OFF/STOP sequences

The program allows a split start and stop sequence which means that the starting and stopping of the drive are arranged in two steps. The first step when starting is executed by the ON command, bringing the drive from disconnected condition to *ready for run*. The second step is executed by the START command, bringing the drive from the condition *ready for run* to the condition *ready for reference*. This split sequence has four modes of execution controlled by the parameter SEQMODE, see Fig 6. The on-start/off-stop sequence for the default setting of this parameter (*SEQMODE = "2"*) is described below.

When the ON order reaches the software signal ON1, the ON sequence will be executed, connecting the fans and the field exciter to the supply line. The sequence logic will then remain standby, waiting for the START order to appear.

When the START order turns up, the armature convertor is connected to the line, the control system is released and the motor is permitted to rotate with a speed corresponding to the reference signal presented to the speed controller.

A STOP order will bring the drive to standstill and disconnect the armature convertor.

In case of an OFF order, the OFF sequence is executed, disconnecting the complete drive from the supply line. The disconnection of the armature convertor, however, is delayed so that the convertor and the control equipment are blocked first.

TL114F01

START/ON sequence	SEQMODE 0	1	2	3
Ventilators			ON	
Exciter				
Main contactor	START			
Release				

STOP/OFF sequence	SEQMODE 0	1	2	3
Phase retard	STOP/OFF			
Main contactor				
Exciter			OFF	
Ventilators				

Fig 6 Start-stop sequence modes (TL114F01)

The sequence logic operation for other settings of the SEQMODE parameter is shown in Fig 6.

Armature current control

The torque control is performed by the armature current controller, receiving the torque reference from the speed controller.

As the output from the speed controller has an adjustable limit setting, i.e. the current limit, the maximum torque during acceleration and retardation is limited.

The current limit may alternatively be set from an external source.

Speed control

The motor speed can be measured with a d.c. tacho generator or a pulse generator. Depending on which, the speed feedback will be brought to the speed controller through different input channels in the control interface, see Fig 7. In the interface, the speed feedback is conditioned and adapted to the present control conditions and converted to digital form.

The behaviour and performance characteristics of the speed control loop are adjusted by setting a number of program parameters, which normally is done on the operator's panel.

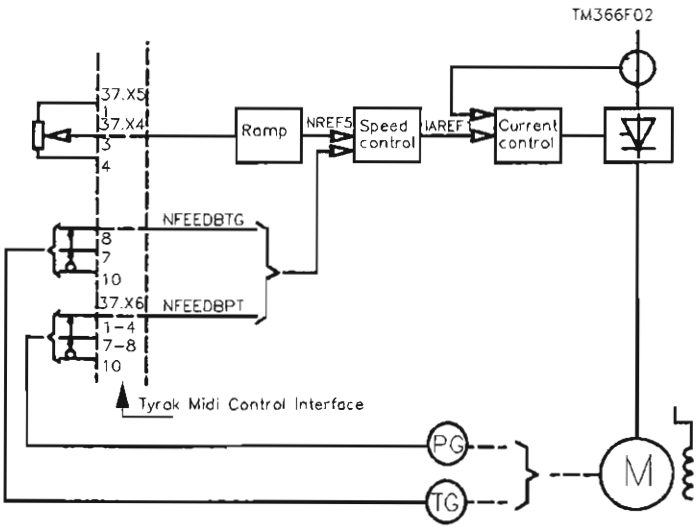

Fig 7 Speed control loops with tacho or pulse transmitter feedback (TM366F02)

Speed reference handling

In automatic control mode, the speed reference is received from the external process controller.

In manual operation mode, the speed is set from the selected operating station, either the operator's panel in the convertor (LOCAL2) or external operating stations e.g. an operator's desk or box in the process plant (LOCAL1) or a central control room (REMOTE).

Increase/decrease reference ordering

The speed reference software accepts increase/decrease orders e.g. from push-buttons in the external operator's desk or from the REF+/REF- keys in the operator's panel. The software signals INCRLOC2 and DECRLOC2 carries the order information onto the increase/decrease function in the module NINDE.

Reference adaptation

The speed may also be set with a continuously adjustable reference order e.g. with the internal reference setting parameters SP1AREFS through SP2AREFS inside the REFAD software or from external reference potentiometers.

External references can be connected directly to the reference input of the speed controller by means of the signals NREF1 through NREF7 or via the software module REFAD, see Fig 8.

Ramp function

The external references may also be connected via the ramp function modules NRSUM and NRAMP. The reference signals NREF1 through NREF4 are added, the sum is transferred through the ramp module NRAMP and then presented to the speed controller as speed reference NREF5.

Bumpless transfer between control modes

When using the reference signals NREF1 through NREF5 for remote reference setting and NREF6 for local reference setting, the operating facility *follow* in the module NINDE can be used for arranging bumpless transition between remote and local reference.

The *follow* facility in the module NINDE is also used for bumpless transfer between automatic and manual mode.

Field control

The motor field may be supplied from a fixed voltage diode exciter or an adjustable field current. The adjustable exciter may be a conventional hardware components exciter or a computer controlled exciter (sometimes referred to as analog or digital field exciter respectively).

In the case of a controlled exciter, automatic field weakening may be used above motor base speed.

Protective and monitoring system

Start sequence

The Pride sequence control monitors the connection and disconnection of the internal and external fans, the main contactor and the field exciter. These monitoring functions are found in the convertor sequence control module SEQCON.

Earth fault (Ground fault)

The earth current monitor uses the phasor sum of the three phase line current to detect and indicate the presence of an earth fault.

Supply line

Pride monitors the main and auxiliary supply and detects low line voltage, frequency faults and incorrect phase sequence.

D.c. current

Pride also detects some current related faults: instantaneous overcurrent, loss of current in a thyristor branch, current pulsation and large current control deviation. Overcurrent tripping also indicates the faulty thyristor branch.

Motor speed

The motor speed monitor has one zero-speed indication, one overspeed indication for tripping and two speed level indications for optional use. The presence of the speed feedback is also monitored, the drive is tripped in case the feedback disappears.

Motor load

The motor is protected against thermal overload by monitoring the armature current. The monitor has adjustable levels for overload tripping, alarm and time delay.

Stall condition

The motor is protected against stalling condition by

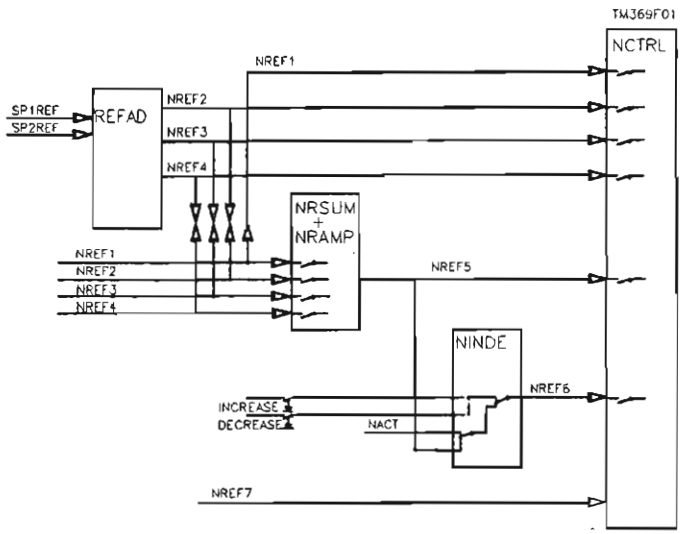

Fig 8 Reference signals and modules (TM369F01)

permitting an adjustable stalling current during standstill for a certain adjustable stalling time interval. Stalling condition will trip the drive.

Motor temperature

The motor temperature monitor accepts up to two PT100 inputs for monitoring motor temperature. When the temperature reaches certain adjustable levels, alarm or tripping respectively is activated.

Thyristor junction temperature

The convertor temperature monitor accepts up to two PT100 inputs for monitoring thyristor temperature. When the temperature reaches certain adjustable levels, alarm or tripping respectively is activated.

Field current

The minimum field monitor will prevent starting or trip the drive if the field current drops below the minimum field setting.

In the case of the computer controlled field exciter, the software includes overcurrent tripping.

External faults

The program includes software to accept three external fault signals to give tripping of the drive, see also Diagnostic and fault indication.

Diagnostic system and fault indication

Faulty operation is reported to the fault indication and diagnostic system from where the information about failures and possible measures is made available to the operating and servicing staff.

Fault information software signals

The software contains signals (variables) carrying information about the conditions in the system. Some of these signals are used by the system itself to take appropriate action, while others are reported to the operator's panel for displaying of the information.

The list below contains some examples of software signals (variables) which are used to report important information about the condition of the system.

TRIPPED	The drive has tripped
RDYRUN	The convertor is ready to operate
RDYREF	The convertor is ready to receive current reference
RDY2RUN	The drive is ready to run
RDY2REF	The drive is ready to accept references
ARMHLW	High armature load

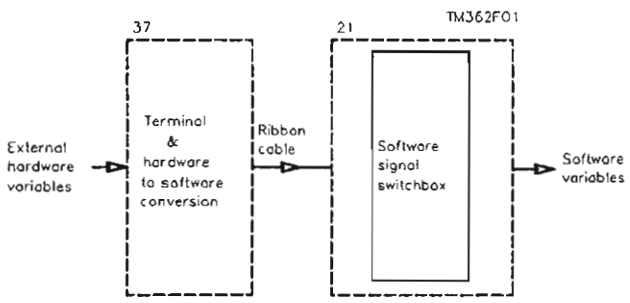

Fig 9 Communication interface (TM362F01)

Fault messages

Fault information e.g. all the tripping signals are displayed on the operator's panel in legible text.

External fault handling

Besides indication of faults in the drive itself, the program has software to accept and indicate three external faults on the operator's panel. The external fault signals are also available for tripping of the drive, see Protective and monitoring system.

Control interface and communication

The communication between the Pride software and the external hardware involves the basic terminal and conversion board YPQ 108 and the modules for connection between the external signals channeled into Pride and internal software signals, see Fig 9. These modules are also called the software switchbox.

Basic I/O interface

In the basic I/O interface the following communication channels are available:

I/O type	No. of channels	Separation	Note
Digital input	8	Opto	
Digital output	5	Opto, free relay contact	
Analog input	4 1)	High ohmic diff. ampl.	Resolution 0.05 percent
Analog output	2	High ohmic diff. ampl.	Resolution 0.05 percent
Pulse transmitter input	3	Opto	

1) Facilities for accepting tacho feedback inclusive.

The basic I/O interface also includes terminals for connection of meters for actual armature current and, in case of tacho feedback, actual speed.

Expansion I/O interface

The program includes software for the following expansion I/O interface:

I/O type	No. of channels	Separation	Note
Digital input	8	Opto	
Digital output	8	Opto, free relay contact	
Analog input	4 1)	High ohmic diff. ampl.	Resolution 0.05 percent
Analog output	4	High ohmic diff. ampl.	Resolution 0.4 percent

1) Facilities for accepting tacho feedback inclusive.

In case the expansion I/O interface is wanted, optional hardware must be ordered and the software must be activated.

Software modules

AIN34	Analog input
AIN37	Analog input
AOUT354	Analog output
AOUT37	Analog output
CONNECT1	Connect module
DIN32	Digital input
DIN37	Digital input
DOUT33	Digital output
DOUT37	Digital output
DSP131	Pulse transmitter input
ECTRL1	EMF controller
ECURM	Ground fault monitor
EMFMEM	EMF measure and monitor
EXFLT3	External fault handling
FLTLOG	Fault logger
IACTRL5	Armature current controller
IAREFH	Armature current reference handler
IF1CTR	Field current control
MOTEMP	Motor temperature monitor
MOTOLM	Motor overload monitor
NCTRL3	Speed controller 3
NFBADJ	Speed feedback adjustment
NINDE1	Speed increase/decrease
NRAMP2	Ramp generator
NRSUM2	Ramp reference summator
OPCH3	Operator's panel definition
REFAD	Reference adaptation
REMLOC	Remote local selector
SEQCON4	Sequence logic convertor
SEQST	Drive system sequence logic
SPMON	Speed monitor
STALLM	Stall monitor
STEPG2	Step generator
TEND	End of load program
TEST	Test facility
TRIP1	Tripping 1
TRIP2	Tripping 2
TRIP3	Tripping 3
TSYS	Begin of load program
TTEXTS	Background text
TYTEMP	Convertor temperature monitor

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GDA4

General Drive Advanced 4

This description covers the standard Pride program GDA4 belonging to the "Advanced application category". Pride (PRogrammable Industrial Drives Electronics) is the computer based control system used in the Tyrak drive system.

Introduction

The advanced program GDA4 covers coordinated and non-coordinated drive applications with requirements on optional control functions.

The drive application may include a single or a double convertor. The motor field may be supplied from an optional selection of field exciter types including computer controlled exciters ("digital field exciters").

The following control functions are available:

- o Selection of operating station
- o Sequence control for convertor and drive including emergency stop and mechanical brake control
- o Armature current control
- o Speed control, advanced performance type (NCTRL2)
- o Speed reference handling including ramp generator, reference generator and increase/decrease ordering.
- o Field control
- o Protective and monitoring functions
- o Diagnostic system and fault indication
- o Communication interface including I/O and bus communication

Operating station

The drive may be operated from various operating stations. These may be:

- o a remote station like a central control room or a higher level computer system (operating station REMOTE), *or*
- o an external operator's desk or box connected to Pride interface terminals (operating station LOCAL1), *or*
- o the Pride operator's panel located in the convertor cubicle (operating station LOCAL2).

TL254F01

Ordering signal	Parameter REMLOC:REMLOCMS			
	"3"	"2"	"1"	"0"
	Operating station			
REMOTE	Control room	Operator's desk	Control room	
LOCAL 1	Operator's desk			
LOCAL 2	Convertor panel		Convertor panel	Convertor panel

Fig 1 Examples of some possible combinations of operating stations depending on the selection of order signals and parameter settings. (TL254F01)

Selection of operating station

The selection between the operating stations is done with order signals connected to the Pride software. The software logic for the selection is found in the software module REMLOC. From this module, the consequences of the actual selection is distributed to the Pride modules concerned.

With parameters in the REMLOC module, the definition and combination of the various operating stations can be changed, see Fig 1.

Internal operator's panel (= LOCAL2)

In the advanced program GDA4, the following operating devices of the operator's panel are available, see Fig 2:

- o Push button marked "I" for ON order. Pushing "I" brings the drive from complete disconnected condition to *ready for run*.
- o Push button marked "O" for OFF order. Pushing "O" disconnects the complete drive from the line.
- o Green coloured LED which illuminates when the convertor is ready for operation
- o Red coloured LED which illuminates in case the convertor is tripped
- o Push button marked "RESET" for resetting the Pride logic when a tripping fault has been restored.
- o Two push buttons (soft keys) marked "START" and "STOP". Pushing START gives start sequence operation from the condition *ready for run* to *ready for reference*. Pushing STOP brings the drive back to the condition *ready to run*.
- o Each of the soft keys START and STOP has a LED which may be used to indicate the action of the corresponding key.
- o Two push buttons (soft keys) marked "REM" and "LOC". After permission is given by the remote station, pushing LOC means that the local station accepts to take control. Pushing REM disconnects the local station and leaves the initiative to the remote station.

TM363F01

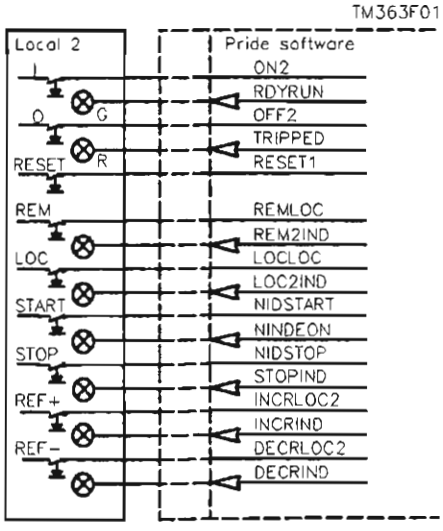

Fig 2 Operation from Pride operator's panel (TM363F01)

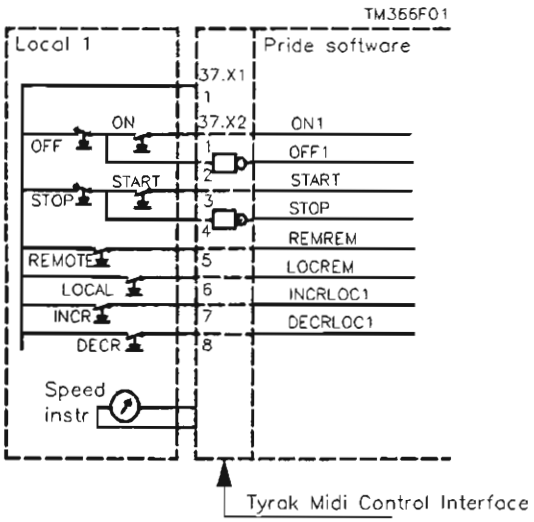

Fig 3 Start/stop and increase/decrease operation from LOCAL1 station (TM366F01)

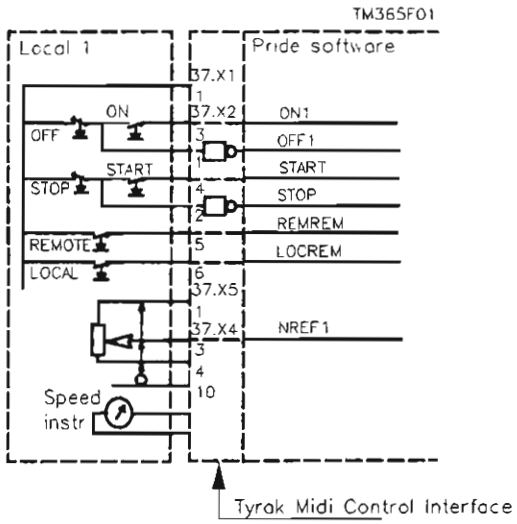

Fig 4 Start/stop and potentiometer speed setting from LOCAL1 operating station (TM365F01)

- o Each of the soft keys REM and LOC has a LED which may be used to indicate the action of the corresponding key.
- o Two push buttons (soft keys) marked "REF+" and "REF-". Pushing REF+ gives increasing motor speed and REF- decreasing speed.
- o Each of the soft keys REF+ and REF- has a LED which may be used to indicate the action of the corresponding key.

Separate external operating station (= LOCAL1)

When ordering LOCAL1 operation, external operating devices connected to appropriate software signals (variables) in Pride can be used to operate the drive.

The speed setting may be with push-buttons for increase and decrease connected via a digital input interface as in Fig 3, or with an adjustable reference voltage e.g. from a potentiometer connected via an analog input interface as in Fig 4. It is also possible to connect meters for motor speed and current.

When pushing the ON push-button, parts of the drive will be connected to the supply line, and the sequence control software will indicate *ready for run*. When pushing the START push-button, remaining parts of the drive is connected to the line, the control system will be released and the motor will follow the speed reference given.

When pushing the STOP push-button the speed reference is disconnected, the control system is blocked and parts of the drive is disconnected from the the supply line. When pushing the OFF push-button, the complete drive is disconnected. Details about this split on/start and off/stop operation is presented below under Sequence control.

Remote operating station (=REMOTE)

When ordering REMOTE operation, operating devices located in the REMOTE station can be used to operate the drive. The remote station may be of the same kind as those described for the LOCAL1 station, see above.

Sequence control

ON/START and OFF/STOP sequences

The program allows a split start and stop sequence which means that the starting and stopping of the drive are arranged in two steps. The first step when starting is executed by the ON command, bringing the drive from disconnected condition to *ready for run*. The

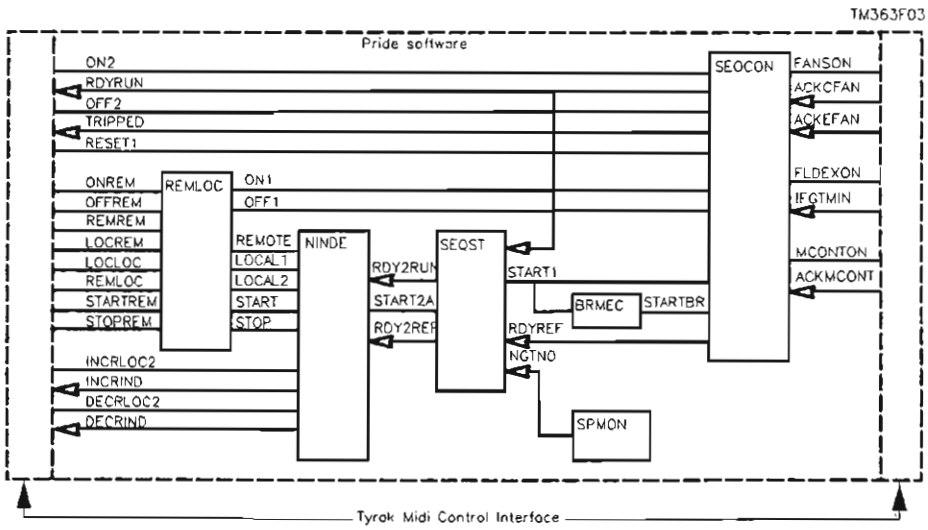

Fig 5 Sequence control software (TM363F03)

second step is executed by the START command, bringing the drive from the condition *ready for run* to the condition *ready for reference*. This split sequence has four modes of execution controlled by the parameter SEQMODE, see Fig 6. The on-start/off-stop sequence for the default setting of this parameter (*SEQMODE = "2"*) is described below.

When the ON order reaches the software signal ON1, the ON sequence will be executed, connecting the fans and the field exciter to the supply line. The sequence logic will then remain standby, waiting for the START order to appear.

When the START order turns up, the armature convertor is connected to the line, the control system is released and the motor is permitted to rotate with a speed corresponding to the reference signal presented to the speed controller.

A STOP order will bring the drive to standstill and disconnect the armature convertor.

In case of an OFF order, the OFF sequence is executed, disconnecting the complete drive from the supply line. The disconnection of the armature convertor, however, is delayed so that the convertor and the control equipment are blocked first.

The sequence logic operation for other settings of the SEQMODE parameter is shown in Fig 6.

Emergency stop logic

When pushing the *emergency stop push button*, the drive will normally stop on current limit. Alternatively, by setting of the appropriate parameters, the emergency stop may be on the normal ramp or a faster emergency stop ramp. It is also possible to involve mechanical braking during emergency stop by activating the brake control module.

Mechanical brake logic

The mechanical brake logic coordinates the operation of the mechanical brake and the start/stop logic of the drive.

Armature current control

The torque control is performed by the armature current controller, receiving the torque reference from the speed controller.

Inside the advanced speed controller modules, the current reference can be switched from speed control to torque reference mode. In torque reference mode

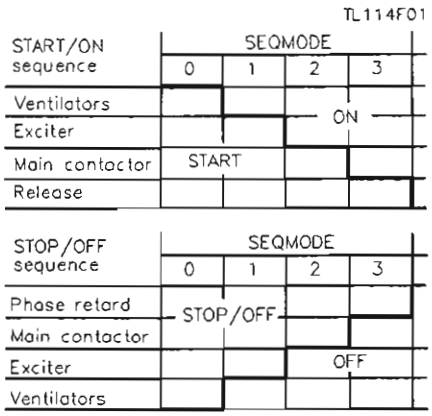

Fig 6 Start-stop sequence modes (TL114F01)

the torque reference is received from the torque reference generator.

As the output from the speed controller has an adjustable limit setting, i.e. the current limit, the maximum torque during acceleration and retardation is limited.

The current limit may alternatively be set from an external source.

Speed control

The motor speed can be measured with a d.c. tacho generator or a pulse generator. Depending on which, the speed feedback will be brought to the speed controller through different input channels in the control interface, see Fig 7. In the interface, the speed feedback is conditioned and adapted to the present control conditions and converted to digital form.

The behaviour and performance characteristics of the speed control loop are adjusted by setting a number of program parameters, which normally is done on the operator's panel.

Speed reference handling

The speed is set from the selected operating station, either the operator's panel in the convertor (LOCAL2) or external operating stations e.g. an operator's desk or box in the process plant (LOCAL1) or a central control room (REMOTE).

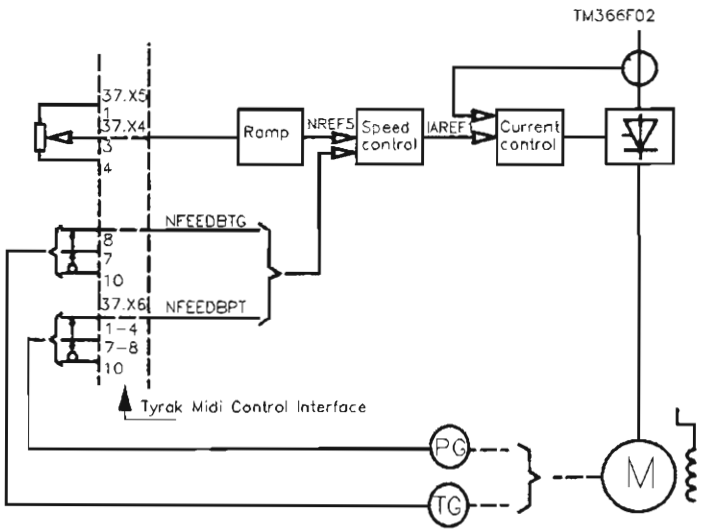

Fig 7 Speed control loops with tacho or pulse transmitter feedback (TM366F02)

Increase/decrease reference ordering
The speed reference software accepts increase/decrease orders e.g. from push-buttons in the external operator's desk or from the REF+/REF- keys in the operator's panel. The software signals INCRLOC2 and DECRLOC2 carries the order information onto the increase/decrease function in the module NINDE.

Reference generation
The speed may also be set with a continuously adjustable reference order e.g. with the internal reference setting parameters SP1AREFS through SP6AREFS inside the REFGEN software or from external reference potentiometers.
External references can be connected directly to the reference input of the speed controller by means of the signals NREF1 through NREF7 or via the software module REFGEN, see Fig 8.

Ramp function
The external references may also be connected via the ramp function modules NRSUM and NRAMP. The reference signals NREF1 through NREF4 are added, the sum is transferred through the ramp module NRAMP and then presented to the speed controller as speed reference NREF5.

Bumpless transfer between control modes
When using the reference signals NREF1 through NREF5 for remote reference setting and NREF6 for local reference setting, the operating facility *follow* in the module NINDE can be used for arranging bumpless transition between remote and local reference.
The *follow* facility in the module NINDE is also used for bumpless transfer between automatic and manual mode.

Field control

The motor field may be supplied from a fixed voltage diode exciter or an adjustable field current. The adjustable exciter may be a conventional hardware components exciter or a computer controlled exciter (sometimes referred to as analog or digital field exciter respectively).

Protective and monitoring system

Start sequence
The Pride sequence control monitors the connection and disconnection of the internal and external fans, the main contactor and the field exciter. These monitoring functions are found in the convertor sequence control module SEQCON.

Earth fault (Ground fault)
The earth current monitor uses the phasor sum of the three phase line current to detect and indicate the presence of an earth fault. The earth fault current is measured with the optional earth fault transformer.

Supply line
Pride monitors the main and auxiliary supply and detects low line voltage, frequency faults and incorrect phase sequence.

D.c. current
Pride also detects the current related faults: instantaneous overcurrent, loss of current in a thyristor branch, current pulsation and large current control deviation. Overcurrent tripping also indicates the faulty thyristor branch.

Motor speed
The motor speed monitor has one zero-speed indication, one overspeed indication for tripping and two speed level indications for optional use. The presence of the speed feedback is also monitored, the drive is tripped in case the feedback disappears.

Motor load
The motor is protected against thermal overload by monitoring the armature current. The monitor has adjustable levels for overload tripping, alarm and time delay.

Motor temperature
The motor temperature monitor accepts up to two PT100 inputs for monitoring motor temperature. When the temperature reaches certain adjustable levels, alarm or tripping respectively is activated.

Thyristor junction temperature
The convertor temperature monitor accepts up to two PT100 inputs for monitoring thyristor temperature. When the temperature reaches certain adjustable levels, alarm or tripping respectively is activated.

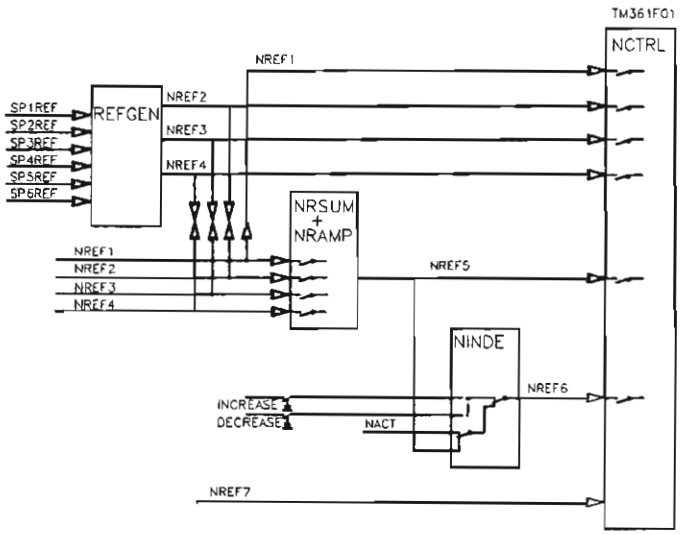

Fig 8 Speed reference signals and modules (TM361F01)

Field current

The minimum field monitor will prevent starting or trip the drive if the field current drops below the minimum field setting.

In the case of the computer controlled field exciter, the software includes overcurrent tripping.

External faults

The program includes software to accept three external fault signals to give tripping of the drive, see also Diagnostic and fault indication.

Diagnostic system and fault indication

Faulty operation is reported to the fault indication and diagnostic system from where the information about failures and possible measures is made available to the operating and servicing staff.

Fault information software signals

The software contains signals (variables) carrying information about the conditions in the system. Some of these signals are used by the system itself to take appropriate action, while others are reported to the operator's panel for displaying of the information.

The list below contains some examples of software signals (variables) which are used to report important information about the condition of the system.

TRIPPED	The drive has tripped
RDYRUN	The convertor is ready to operate
RDYREF	The convertor is ready to receive current reference
RDY2RUN	The drive is ready to run
RDY2REF	The drive is ready to accept references
ARMHLW	High armature load

Fault messages

Fault information e.g. all the tripping signals are displayed on the operator's panel in legible text.

External fault handling

Besides indication of faults in the drive itself, the program has software to accept and indicate three external faults on the operator's panel. The external fault signals are also available for tripping of the drive, see Protective and monitoring system.

Control interface and communication

I/O interface

The communication between the Pride software and the external hardware involves the basic terminal and conversion board YPQ 108 and the modules for connection between the external signals channeled into Pride and internal software signals, see Fig 9. These modules are also called the software switchbox.

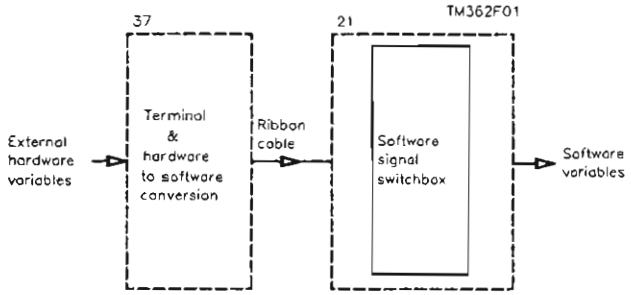

Fig 9 I/O communication interface (TM362F01)

Basic I/O interface

In the basic I/O interface the following communication channels are available:

I/O type	No. of channels	Separation	Note
Digital input	8	Opto	
Digital output	5	Opto, free relay contact	
Analog input	4 1)	High ohmic diff. ampl.	Resolution 0.05 percent
Analog output	2	High ohmic diff. ampl.	Resolution 0.05 percent
Pulse transmitter input	3	Opto	

1) Facilities for accepting tacho feedback inclusive.

The basic I/O interface also includes terminals for connection of meters for actual armature current and, in case of tacho feedback, actual speed.

Expansion I/O interface

The program includes software for the following expansion I/O interface:

I/O type	No. of channels	Separation	Note
Digital input	8	Opto	
Digital output	8	Opto, free relay contact	
Analog input	4 1)	High ohmic diff. ampl.	Resolution 0.05 percent
Analog output	4	High ohmic diff. ampl.	Resolution 0.4 percent

1) Facilities for accepting tacho feedback inclusive.

In case the expansion I/O interface is wanted, optional hardware must be ordered and the software must be activated. In case this also observe that some software signals are tied up to the bus interface and therefore are not available for the I/O communication.

Bus interface for serial communication

For communication with the MasterPiece and the TCDC control system, the GDA4 program includes a high speed serial communication interface, see Fig 10.

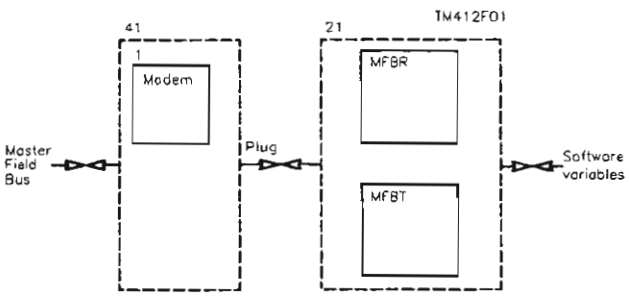

Fig 10 Bus interface for serial communication (TM412F01)

Software modules

AIN34	Analog input
AIN37	Analog input
AOUT354	Analog output
AOUT37	Analog output
CONNECT1	Connect module
BRMEC	Mechanical brake control
DIN32	Digital input
DIN37	Digital input
DOUT33	Digital output
DOUT37	Digital output
DSP131	Pulse transmitter input
ECURM	Ground fault monitor
EMSTOP	Emergency stop
EXFLT3	External fault handling
FLTLOG	Fault logger
IACTRL5	Armature current controller
IAREFH	Armature current reference handler
IF1CTR	Field current control
IFREFG	Field current reference generator
MFBR1	Master Field Bus reception
MFBT1	Master Field Bus transmission
MOTEMP	Motor temperature monitor
MOTOLM	Motor overload monitor
NCTRL2	Speed controller 2
NFBADJ	Speed feedback adjustment
NINDE1	Speed increase/decrease
NRAMP2	Ramp generator
NRSUM2	Ramp reference summator
OPCH3	Operator's panel definition
REFGEN	Reference generator
REMLOC	Remote local selector
SEQCON4	Sequence logic convertor
SEQST	Drive system sequence logic
SPMON	Speed monitor
STEPG2	Step generator
TEND	End of load program
TEST	Test facility
TQREFG	Torque reference generator
TRIP1	Tripping 1
TRIP2	Tripping 2
TRIP3	Tripping 3
TSYS	Begin of load program
TTEXTS	Background text
TYTEMP	Convertor temperature monitor

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GDA5

General Drive Advanced 5

This description covers the standard Pride program GDA5 belonging to the "Advanced application category". Pride (PRogrammable Industrial Drives Electronics) is the computer based control system used in the Tyrak drive system.

Introduction

The advanced program GDA5 covers coordinated and non-coordinated drive applications with requirements on optional application control functions.

The drive application may include a single or a double convertor. The motor field may be supplied from an optional selection of field exciter types including computer controlled exciters ("digital field exciters").

The following control functions are available:

- o Selection of operating station
- o Sequence control for convertor and drive including emergency stop and mechanical brake control
- o Armature current control
- o Speed control, advanced performance type (NCTRL3)
- o Speed reference handling including ramp generator, reference generator and increase/decrease ordering.
- o Field control
- o Protective and monitoring functions
- o Diagnostic system and fault indication
- o Communication interface including I/O and bus communication

Operating station

The drive may be operated from various operating stations. These may be:

- o a remote station like a central control room or a higher level computer system (operating station REMOTE), *or*
- o an external operator's desk or box connected to Pride interface terminals (operating station LOCAL1), *or*
- o the Pride operator's panel located in the convertor cubicle (operating station LOCAL2).

TL254F01

Ordering signal	Parameter REMLOC:REMLOCMS			
	"3"	"2"	"1"	"0"
	Operating station			
REMOTE	Control room	Operator's desk	Control room	
LOCAL1	Operator's desk			
LOCAL2	Convertor panel		Convertor panel	Convertor panel

Fig 1 Examples of some possible combinations of operating stations depending on the selection of order signals and parameter settings. (TL254F01)

Selection of operating station

The selection between the operating stations is done with order signals connected to the Pride software. The software logic for the selection is found in the software module REMLOC. From this module, the consequences of the actual selection is distributed to the Pride modules concerned.

With parameters in the REMLOC module, the definition and combination of the various operating stations can be changed, see Fig 1.

Internal operator's panel (= LOCAL2)

In the advanced program GDA5, the following operating devices of the operator's panel are available, see Fig 2:

- o Push button marked "I" for ON order. Pushing "I" brings the drive from complete disconnected condition to *ready for run*.
- o Push button marked "O" for OFF order. Pushing "O" disconnects the complete drive from the line.
- o Green coloured LED which illuminates when the convertor is ready for operation
- o Red coloured LED which illuminates in case the convertor is tripped
- o Push button marked "RESET" for resetting the Pride logic when a tripping fault has been restored.
- o Two push buttons (soft keys) marked "START" and "STOP". Pushing START gives start sequence operation from the condition *ready for run* to *ready for reference*. Pushing STOP brings the drive back to the condition *ready to run*.
- o Each of the soft keys START and STOP has a LED which may be used to indicate the action of the corresponding key.
- o Two push buttons (soft keys) marked "REM" and "LOC". After permission is given by the remote station, pushing LOC means that the local station accepts to take control. Pushing REM disconnects the local station and leaves the initiative to the remote station.

TM363F01

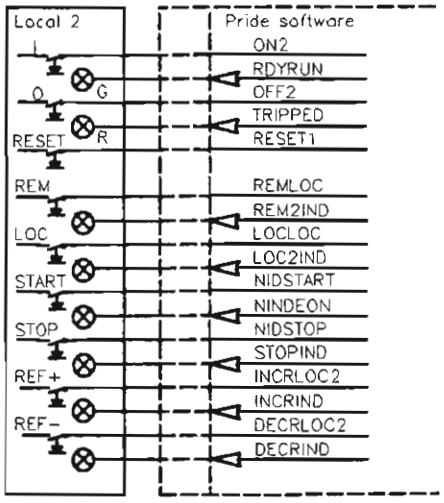

Fig 2 Operation from Pride operator's panel (TM363F01)

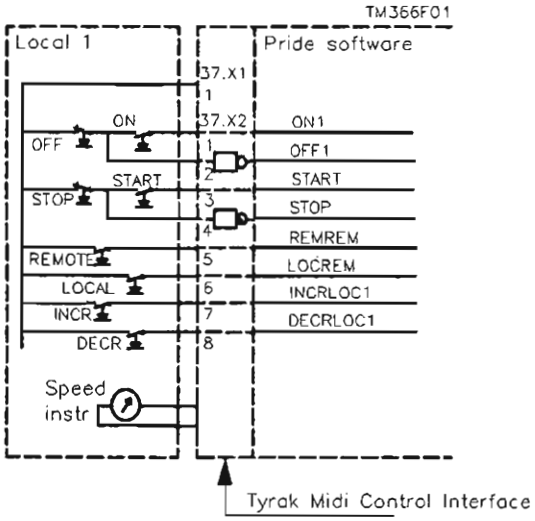

Fig 3 Start/stop and increase/decrease operation from LOCAL1 station (TM366F01)

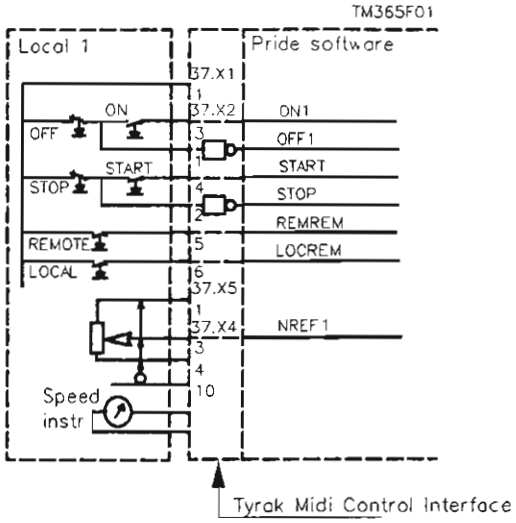

Fig 4 Start/stop and potentiometer speed setting from LOCAL1 operating station (TM365F01)

- o Each of the soft keys REM and LOC has a LED which may be used to indicate the action of the corresponding key.
- o Two push buttons (soft keys) marked "REF+" and "REF-". Pushing REF+ gives increasing motor speed and REF- decreasing speed.
- o Each of the soft keys REF+ and REF- has a LED which may be used to indicate the action of the corresponding key.

Separate external operating station (= LOCAL1)

When ordering LOCAL1 operation, external operating devices connected to appropriate software signals (variables) in Pride can be used to operate the drive.

The speed setting may be with push-buttons for increase and decrease connected via a digital input interface as in Fig 3, or with an adjustable reference voltage e.g. from a potentiometer connected via an analog input interface as in Fig 4. It is also possible to connect meters for motor speed and current.

When pushing the ON push-button, parts of the drive will be connected to the supply line, and the sequence control software will indicate *ready for run*. When pushing the START push-button, remaining parts of the drive is connected to the line, the control system will be released and the motor will follow the speed reference given.

When pushing the STOP push-button the speed reference is disconnected, the control system is blocked and parts of the drive is disconnected from the supply line. When pushing the OFF push-button, the complete drive is disconnected. Details about this split on/start and off/stop operation is presented below under sequence control.

Remote operating station (=REMOTE)

When ordering REMOTE operation, operating devices located in the REMOTE station can be used to operate the drive. The remote station may be of the same kind as those described for the LOCAL1 station, see above.

Sequence control

ON/START and OFF/STOP sequences

The program allows a split start and stop sequence which means that the starting and stopping of the drive are arranged in two steps. The first step when starting is executed by the ON command, bringing the drive from disconnected condition to *ready for run*. The

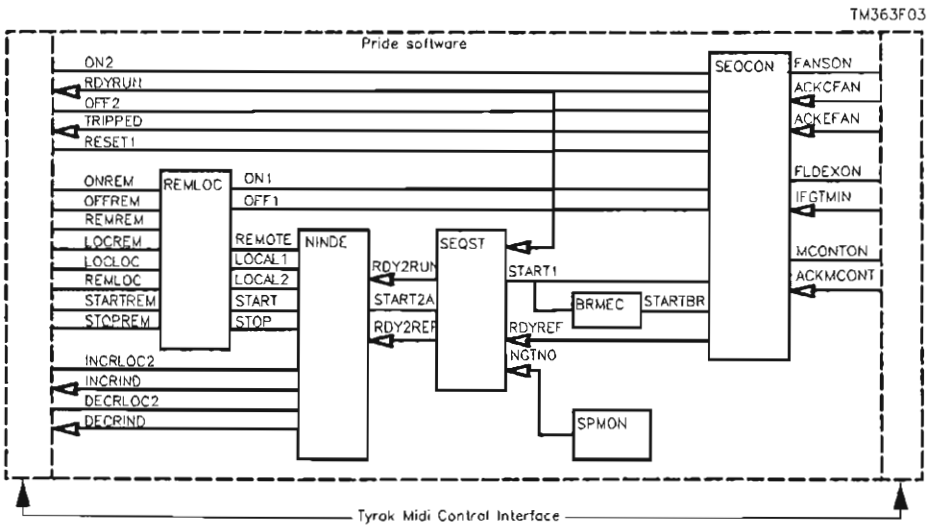

Fig 5 Sequence control software (TM363F03)

second step is executed by the START command, bringing the drive from the condition *ready for run* to the condition *ready for reference*. This split sequence has four modes of execution controlled by the parameter SEQMODE, see Fig 6. The on-start/off-stop sequence for the default setting of this parameter (*SEQMODE = "2"*) is described below.

When the ON order reaches the software signal ON1, the ON sequence will be executed, connecting the fans and the field exciter to the supply line. The sequence logic will then remain standby, waiting for the START order to appear.

When the START order turns up, the armature convertor is connected to the line, the control system is released and the motor is permitted to rotate with a speed corresponding to the reference signal presented to the speed controller.

A STOP order will bring the drive to standstill and disconnect the armature convertor.

In case of an OFF order, the OFF sequence is executed, disconnecting the complete drive from the supply line. The disconnection of the armature convertor, however, is delayed so that the convertor and the control equipment are blocked first.

The sequence logic operation for other settings of the SEQMODE parameter is shown in Fig 6.

Emergency stop logic

When pushing the *emergency stop push button*, the drive will normally stop on current limit. Alternatively, by setting of the appropriate parameters, the emergency stop may be on the normal ramp or a faster emergency stop ramp. It is also possible to involve mechanical braking during emergency stop by activating the brake control module.

Mechanical brake logic

The mechanical brake logic coordinates the operation of the mechanical brake and the start/stop logic of the drive.

Armature current control

The torque control is performed by the armature current controller, receiving the torque reference from the speed controller.

As the output from the speed controller has an adjustable limit setting, i.e. the current limit, the maximum torque during acceleration and retardation is

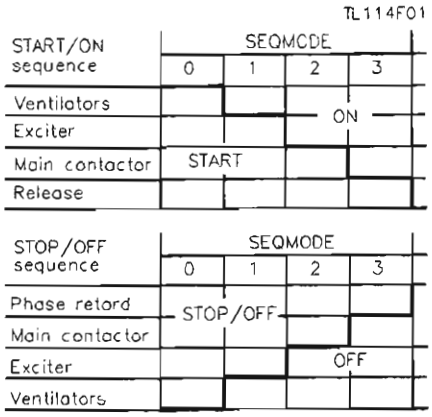

Fig 6 Start-stop sequence modes (TL114F01)

limited.

The current limit may alternatively be set from an external source.

Speed control

The motor speed can be measured with a d.c. tacho generator or a pulse generator. Depending on which, the speed feedback will be brought to the speed controller through different input channels in the control interface, see Fig 7. In the interface, the speed feedback is conditioned and adapted to the present control conditions and converted to digital form.

The behaviour and performance characteristics of the speed control loop are adjusted by setting a number of program parameters, which normally is done on the operator's panel.

Speed reference handling

The speed is set from the selected operating station, either the operator's panel in the convertor (LOCAL2) or external operating stations e.g. an operator's desk or box in the process plant (LOCAL1) or a central control room (REMOTE).

Increase/decrease reference ordering

The speed reference software accepts increase/decrease orders e.g. from push-buttons in the external operator's desk or from the REF+ /REF- keys in the

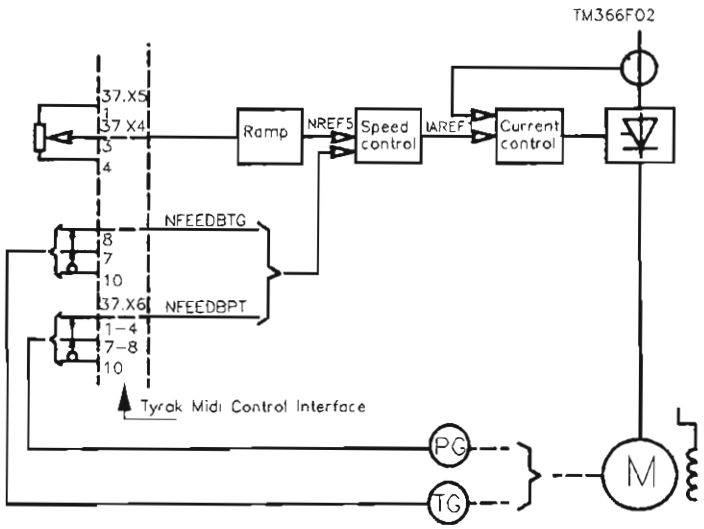

Fig 7 Speed control loops with tacho or pulse transmitter feedback (TM366F02)

operator's panel. The software signals INCRLOC2 and DECRLOC2 carries the order information onto the increase/decrease function in the module NINDE.

Reference generation

The speed may also be set with a continuously adjustable reference order e.g. with the internal reference setting parameters SP1AREFS through SP6AREFS inside the REFGEN software or from external reference potentiometers.

External references can be connected directly to the reference input of the speed controller by means of the signals NREF1 through NREF7 or via the software module REFGEN, see Fig 8.

Ramp function

The external references may also be connected via the ramp function modules NRSUM and NRAMP. The reference signals NREF1 through NREF4 are added, the sum is transferred through the ramp module NRAMP and then presented to the speed controller as speed reference NREF5.

Bumpless transfer between control modes

When using the reference signals NREF1 through NREF5 for remote reference setting and NREF6 for local reference setting, the operating facility *follow* in the module NINDE can be used for arranging bumpless transition between remote and local reference.

The *follow* facility in the module NINDE is also used for bumpless transfer between automatic and manual mode.

Field control

The motor field may be supplied from a fixed voltage diode exciter or an adjustable field current. The adjustable exciter may be a conventional hardware components exciter or a computer controlled exciter (sometimes referred to as analog or digital field exciter respectively).

In the case of a controlled exciter, automatic field weakening may be used above motor base speed.

Protective and monitoring system

Start sequence

The Pride sequence control monitors the connection and disconnection of the internal and external fans, the main contactor and the field exciter. These monitoring functions are found in the convertor sequence control module SEQCON.

Earth fault (Ground fault)

The earth current monitor uses the phasor sum of the three phase line current to detect and indicate the presence of an earth fault. The earth fault current is measured with the optional earth fault transformer.

Supply line

Pride monitors the main and auxiliary supply and detects low line voltage, frequency faults and incorrect phase sequence.

D.c. current

Pride also detects the current related faults: instantaneous overcurrent, loss of current in a thyristor branch, current pulsation and large current control deviation. Overcurrent tripping also indicates the faulty thyristor branch.

Motor speed

The motor speed monitor has one zero-speed indication, one overspeed indication for tripping and two speed level indications for optional use. The presence of the speed feedback is also monitored, the drive is tripped in case the feedback disappears.

Motor load

The motor is protected against thermal overload by monitoring the armature current. The monitor has adjustable levels for overload tripping, alarm and time delay.

Motor temperature

The motor temperature monitor accepts up to two PT100 inputs for monitoring motor temperature. When the temperature reaches certain adjustable levels, alarm or tripping respectively is activated.

Thyristor junction temperature

The convertor temperature monitor accepts up to two PT100 inputs for monitoring thyristor temperature. When the temperature reaches certain adjustable levels, alarm or tripping respectively is activated.

Field current

The minimum field monitor will prevent starting or trip the drive if the field current drops below the minimum field setting.

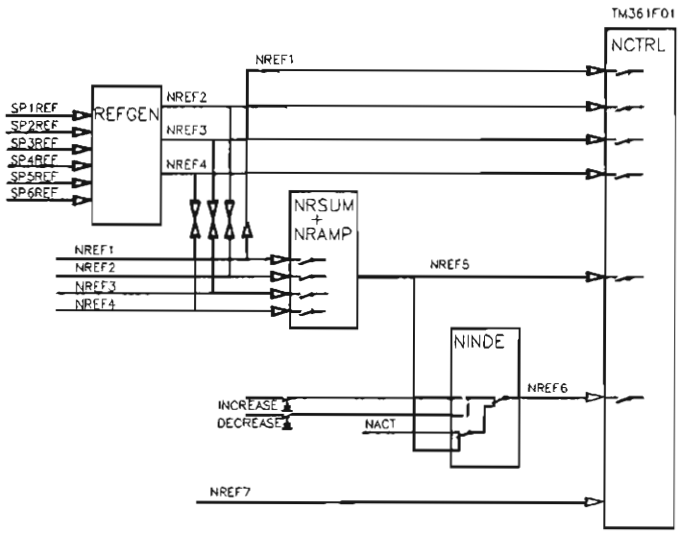

Fig 8 Speed reference signals and modules (TM361F01)

In the case of the computer controlled field exciter, the software includes overcurrent tripping.

External faults

The program includes software to accept three external fault signals to give tripping of the drive, see also Diagnostic and fault indication.

Diagnostic system and fault indication

Faulty operation is reported to the fault indication and diagnostic system from where the information about failures and possible measures is made available to the operating and servicing staff.

Fault information software signals

The software contains signals (variables) carrying information about the conditions in the system. Some of these signals are used by the system itself to take appropriate action, while others are reported to the operator's panel for displaying of the information.

The list below contains some examples of software signals which are used to report important information about the condition of the system.

TRIPPED	The drive has tripped
RDYRUN	The convertor is ready to operate
RDYREF	The convertor is ready to receive current reference
RDY2RUN	The drive is ready to run
RDY2REF	The drive is ready to accept references
ARMHLW	High armature load

Fault messages

Fault information e.g. all the tripping signals are displayed on the operator's panel in legible text.

External fault handling

Besides indication of faults in the drive itself, the program has software to accept and indicate three external faults on the operator's panel. The external fault signals are also available for tripping of the drive, see Protective and monitoring system.

Control interface and communication

I/O interface

The communication between the Pride software and the external hardware involves the basic terminal and conversion board YPQ 108 and the modules for connection between the external signals channeled into Pride and internal software signals, see Fig 9. These modules are also called the software switchbox.

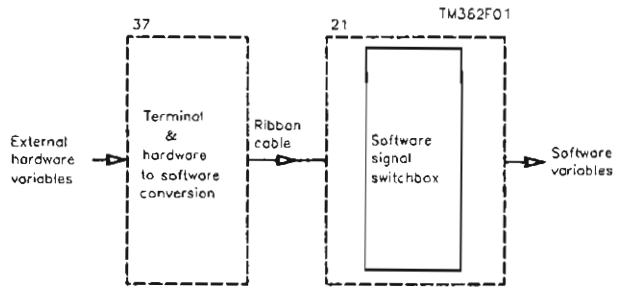

Fig 9 I/O communication interface (TM362F01)

Basic I/O interface

In the basic I/O interface the following communication channels are available:

I/O type	No. of channels	Separation	Note
Digital input	8	Opto	
Digital output	5	Opto, free relay contact	
Analog input	4 1)	High ohmic diff. ampl.	Resolution 0.05 percent
Analog output	2	High ohmic diff. ampl.	Resolution 0.05 percent
Pulse transmitter input	3	Opto	

1) Facilities for accepting tacho feedback inclusive.

The basic I/O interface also includes terminals for connection of meters for actual armature current and, in case of tacho feedback, actual speed.

Expansion I/O interface

The program includes software for the following expansion I/O interface:

I/O type	No. of channels	Separation	Note
Digital input	8	Opto	
Digital output	8	Opto, free relay contact	
Analog input	4 1)	High ohmic diff. ampl.	Resolution 0.05 percent
Analog output	4	High ohmic diff. ampl.	Resolution 0.4 percent

1) Facilities for accepting tacho feedback inclusive.

In case the expansion I/O interface is wanted, optional hardware must be ordered and the software must be activated. In case this also observe that some software signals are tied up to the bus interface and therefore are not available for the I/O communication.

Bus interface for serial communication

For communication with the Master Piece and the TCDC control system, the GDA5 program includes a high speed serial communication interface, see Fig 10.

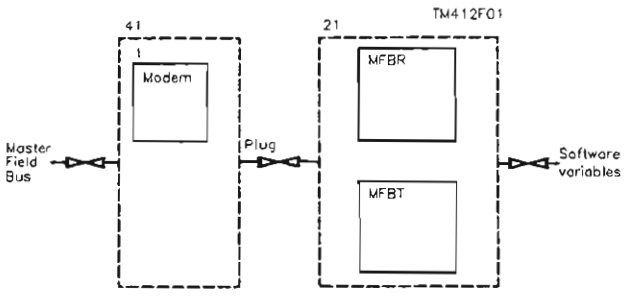

Fig 10 Bus interface for serial communication (TM412F01)

Software modules

AIN34	Analog input
AIN37	Analog input
AOUT354	Analog output
AOUT37	Analog output
BRMEC	Mechanical brake control
CONNECT1	Connect module
DIN32	Digital input
DIN37	Digital input
DOUT33	Digital output
DOUT37	Digital output
DSP131	Pulse transmitter input
ECTRL1	EMF controller
ECURM	Ground fault monitor
EMFMEM	EMF measure and monitor
EMSTOP	Emergency stop
EXFLT3	External fault handling
FLTLOG	Fault logger
IACTRL5	Armature current controller
IAREFH	Armature current reference handler
IF1CTR	Field current control
MFBR1	Master Field Bus reception
MFBT1	Master Field Bus transmission
MOTEMP	Motor temperature monitor
MOTOLM	Motor overload monitor
NCTRL3	Speed controller 3
NFBADJ	Speed feedback adjustment
NINDE1	Speed increase/decrease
NRAMP2	Ramp generator
NRSUM2	Ramp reference summator
OPCH3	Operator's panel definition
REFGEN	Reference generation
REMLOC	Remote local selector
SEQCON4	Sequence logic convertor
SEQST	Drive system sequence logic
SPMON	Speed monitor
STEPG2	Step generator
TEND	End of load program
TEST	Test facility
TRIP1	Tripping 1
TRIP2	Tripping 2
TRIP3	Tripping 3
TSYS	Begin of load program
TTEXTS	Background text
TYTEMP	Convertor temperature monitor

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GDA6

General Drive Advanced 6

This description covers the standard Pride program GDA6 belonging to the "Advanced application category". Pride (PRogrammable Industrial Drives Electronics) is the computer based control system used in the Tyrak drive system.

Introduction

The advanced program GDA6 covers coordinated and non-coordinated drive applications with requirements on optional application control functions.

The drive application may include a single or a double convertor. The motor field may be supplied from an optional selection of field exciter types including computer controlled exciters ("digital field exciters").

The following control functions are available:

- o Selection of operating station
- o Sequence control for convertor and drive including control logic for emergency stop, mechanical brakes and master drive/follower drive
- o Armature current control
- o Speed control, advanced performance type (NCTRL2)
- o Speed reference handling including ramp generator, reference generator and increase/decrease ordering.
- o Field control
- o Protective and monitoring functions
- o Diagnostic system and fault indication
- o Communication interface including I/O and bus communication

Operating station

The drive may be operated from various operating stations. These may be:

- o a remote station like a central control room or higher level computer system (operating station REMOTE), *or*
- o an external operator's desk or box connected to Pride interface terminals (operating station LOCAL1), *or*
- o the Pride operator's panel located in the convertor cubicle (operating station LOCAL2).

TL254F01

Ordering signal	Parameter REMLOC:REMLOCMS			
	"3"	"2"	"1"	"0"
	Operating station			
REMOTE	Control room	Operator's desk	Control room	
LOCAL1	Operator's desk			
LOCAL2	Convertor panel		Convertor panel	Convertor panel

Fig 1 Examples of some possible combinations of operating stations depending on the selection of order signals and parameter settings. (TL254F01)

Selection of operating station

The selection between the operating stations is done with order signals connected to the Pride software. The software logic for the selection is found in the software module REMLOC. From this module, the consequences of the actual selection is distributed to the Pride modules concerned.

With parameters in the REMLOC module, the definition and combination of the various operating stations can be changed, see Fig 1.

Internal operator's panel (= LOCAL2)

In the advanced program GDA6, the following operating devices of the operator's panel are available, see Fig 2:

- o Push button marked "I" for ON order. Pushing "I" brings the drive from complete disconnected condition to *ready for run*.
- o Push button marked "O" for OFF order. Pushing "O" disconnects the complete drive from the line.
- o Green coloured LED which illuminates when the convertor is ready for operation
- o Red coloured LED which illuminates in case the convertor is tripped
- o Push button marked "RESET" for resetting the Pride logic when a tripping fault has been restored.
- o Two push buttons (soft keys) marked "START" and "STOP". Pushing START gives start sequence operation from the condition *ready for run* to *ready for reference*. Pushing STOP brings the drive back to the condition *ready to run*.
- o Each of the soft keys START and STOP has a LED which may be used to indicate the action of the corresponding key.
- o Two push buttons (soft keys) marked "REM" and "LOC". After permission is given by the remote station, pushing LOC means that the local station accepts to take control. Pushing REM disconnects the local station and leaves the initiative to the remote station.

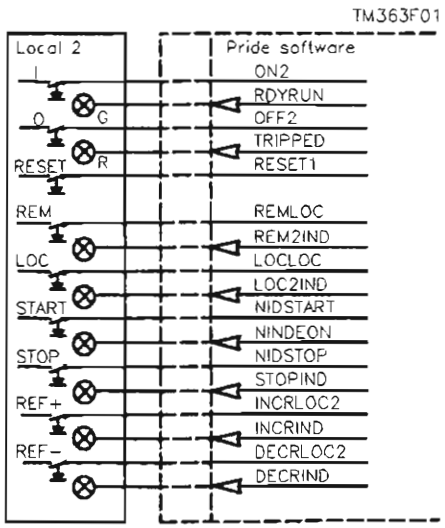

Fig 2 Operation from Pride operator's panel (TM363F01)

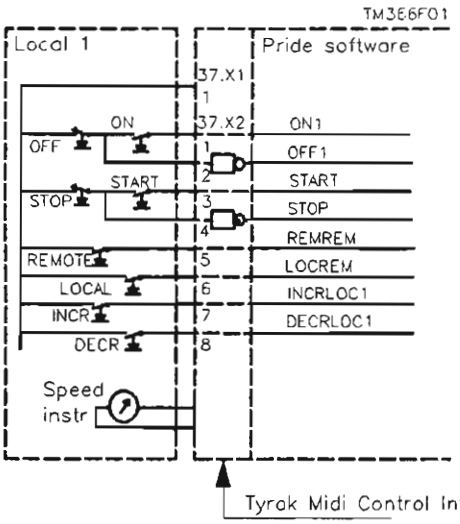

Fig 3 Start/stop and increase/decrease operation from LOCAL1 station (TM366F01)

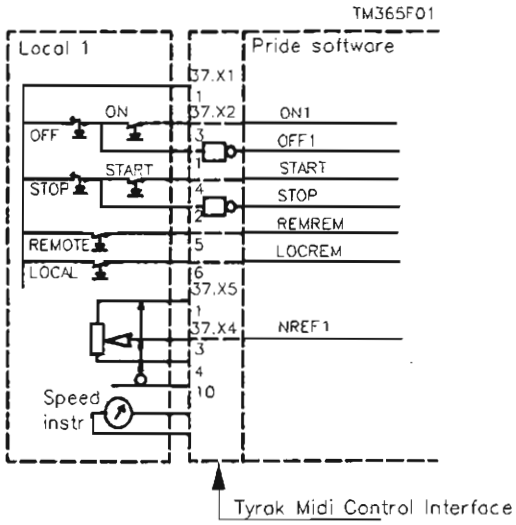

Fig 4 Start/stop and potentiometer speed setting from LOCAL1 operating station (TM365F01)

- Each of the soft keys REM and LOC has a LED which may be used to indicate the action of the corresponding key.
- Two push buttons (soft keys) marked "REF+" and "REF-". Pushing REF+ gives increasing motor speed and REF- decreasing speed.
- Each of the soft keys REF+ and REF- has a LED which may be used to indicate the action of the corresponding key.

Separate external operating station (= LOCAL1)

When ordering LOCAL1 operation, external operating devices connected to appropriate software signals (variables) in Pride can be used to operate the drive.

The speed setting may be with push-buttons for increase and decrease connected via a digital input interface as in Fig 3, or with an adjustable reference voltage e.g. from a potentiometer connected via an analog input interface as in Fig 4. It is also possible to connect meters for motor speed and current.

When pushing the ON push-button, parts of the drive will be connected to the supply line, and the sequence control software will indicate *ready for run.* When pushing the START push-button, remaining parts of the drive is connected to the line, the control system will be released and the motor will follow the speed reference in action.

When pushing the STOP push-button the speed reference is disconnected, the control system is blocked and parts of the drive is disconnected from the supply line. When pushing the OFF push-button, the complete drive is disconnected. Details about this split on/start and off/stop operation is presented below under sequence control.

Remote operating station (=REMOTE)

When ordering REMOTE operation, operating devices located in the REMOTE station can be used to operate the drive. The remote station may be of the same kind as those described for the LOCAL1 station, see above.

Sequence control

ON/START and OFF/STOP sequences

The program allows a split start and stop sequence which means that the starting and stopping of the drive are arranged in two steps. The first step when starting is executed by the ON command, bringing the drive from disconnected condition to *ready for run.* The

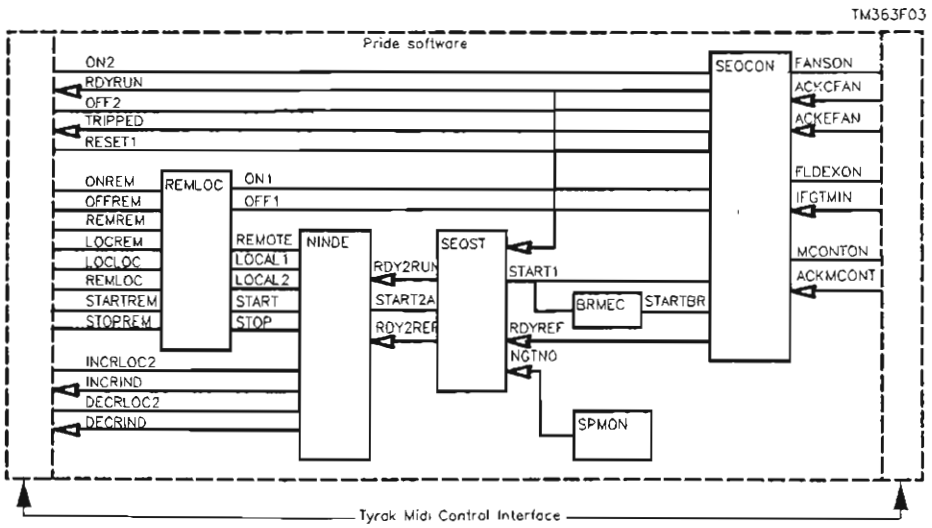

Fig 5 Sequence control software (TM363F03)

second step is executed by the START command, bringing the drive from the condition *ready for run* to the condition *ready for reference*. This split sequence has four modes of execution controlled by the parameter SEQMODE, see Fig 6. The on-start/off-stop sequence for the default setting of this parameter (*SEQMODE = "2"*) is described below.

When the ON order reaches the software signal ON1, the ON sequence will be executed, connecting the fans and the field exciter to the supply line. The sequence logic will then remain standby, waiting for the START order to appear.

When the START order turns up, the armature convertor is connected to the line, the control system is released and the motor is permitted to rotate with a speed corresponding to the reference signal presented to the speed controller.

A STOP order will bring the drive to standstill and disconnect the armature convertor.

In case of an OFF order, the OFF sequence is executed, disconnecting the complete drive from the supply line. The disconnection of the armature convertor, however, is delayed so that the convertor and the control equipment are blocked first.

The sequence logic operation for other settings of the SEQMODE parameter is shown in Fig 6.

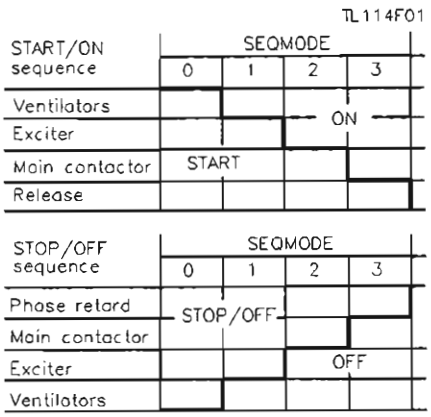

Fig 6 Start-stop sequence modes (TL114F01)

Emergency stop logic

When pushing the *emergency stop push button*, the drive will normally stop on current limit. Alternatively, by setting of the appropriate parameters, the emergency stop may be on the normal ramp or a faster emergency stop ramp. It is also possible to involve mechanical braking during emergency stop by activating the brake control module.

Mechanical brake logic

The mechanical brake logic coordinates the operation of the mechanical brake and the start/stop logic of the drive.

Armature current control

The torque control is performed by the armature current controller, receiving the torque reference from the speed controller.

Inside the advanced speed controller modules, the current reference can be switched from speed control to torque reference mode. In torque reference mode the torque reference is received from the torque reference generator.

As the output from the speed controller has an adjustable limit setting, i.e. the current limit, the maximum torque during acceleration and retardation is limited.

The current limit may alternatively be set from an external source.

Speed control

The motor speed can be measured with a d.c. tacho generator or a pulse generator. Depending on which, the speed feedback will be brought to the speed controller through different input channels in the control interface, see Fig 7. In the interface, the speed feedback is conditioned and adapted to the present control conditions and converted to digital form.

The behaviour and performance characteristics of the speed control loop are adjusted by setting a number of program parameters, which normally is done on the operator's panel.

Speed reference handling

The speed is set from the selected operating station, either the operator's panel in the convertor (LOCAL2) or external operating stations e.g. an operator's desk or box in the process plant (LOCAL1) or a central control room (REMOTE).

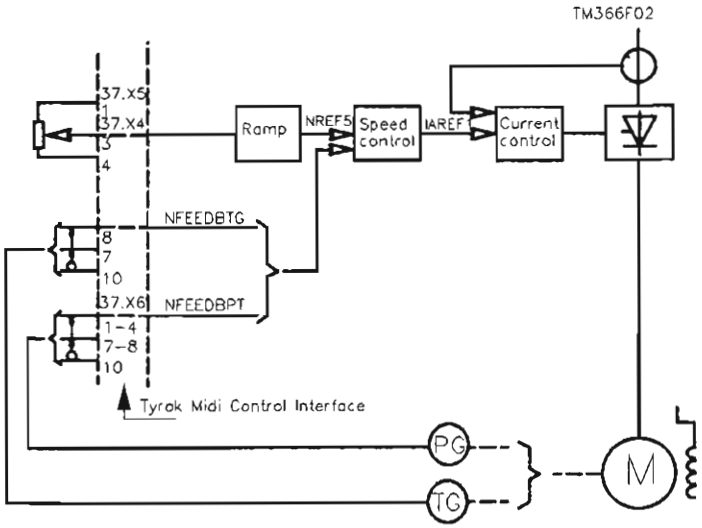

Fig 7 Speed control loops with tacho or pulse transmitter feedback (TM366F02)

Increase/decrease reference ordering

The speed reference software accepts increase/decrease orders e.g. from push-buttons in the external operator's desk or from the REF+/REF- keys in the operator's panel. The software signals INCRLOC2 and DECRLOC2 carries the order information onto the increase/decrease function in the module NINDE.

Reference generation

The speed may also be set with a continuously adjustable reference order e.g. with the internal reference setting parameters SP1AREFS through SP6AREFS inside the REFGEN software or from external reference potentiometers.

External references can be connected directly to the reference input of the speed controller by means of the signals NREF1 through NREF7 or via the software module REFGEN, see Fig 8.

Ramp function

The external references may also be connected via the ramp function modules NRSUM and NRAMP. The reference signals NREF1 through NREF4 are added, the sum is transferred through the ramp module NRAMP and then presented to the speed controller as speed reference NREF5.

Bumpless transfer between control modes

When using the reference signals NREF1 through NREF5 for remote reference setting and NREF6 for local reference setting, the operating facility *follow* in the module NINDE can be used for arranging bumpless transition between remote and local reference.

The *follow* facility in the module NINDE is also used for bumpless transfer between automatic and manual mode.

Field control

The motor field may be supplied from a fixed voltage diode exciter or an adjustable field current. The adjustable exciter may be a conventional hardware components exciter or a computer controlled exciter (sometimes referred to as analog or digital field exciter respectively).

Protective and monitoring system

Start sequence

The Pride sequence control monitors the connection and disconnection of the internal and external fans, the main contactor and the field exciter. These monitoring functions are found in the convertor sequence control module SEQCON.

Earth fault (Ground fault)

The earth current monitor uses the phasor sum of the three phase line current to detect and indicate the presence of an earth fault. The earth fault current is measured with the optional earth fault transformer.

Supply line

Pride monitors the main and auxiliary supply and detects low line voltage, frequency faults and incorrect phase sequence.

D.c. current

Pride also detects the current related faults: instantaneous overcurrent, loss of current in a thyristor branch, current pulsation and large current control deviation. Overcurrent tripping also indicates the faulty thyristor branch.

Motor speed

The motor speed monitor has one zero-speed indication, one overspeed indication for tripping and two speed level indications for optional use. The presence of the speed feedback is also monitored, the drive is tripped in case the feedback disappears.

Motor load

The motor is protected against thermal overload by monitoring the armature current. The monitor has adjustable levels for overload tripping, alarm and time delay.

Motor temperature

The motor temperature monitor accepts up to two PT100 inputs for monitoring motor temperature. When the temperature reaches certain adjustable levels, alarm or tripping respectively is activated.

Thyristor junction temperature

The convertor temperature monitor accepts up to two PT100 inputs for monitoring thyristor temperature. When the temperature reaches certain adjustable levels, alarm or tripping respectively is activated.

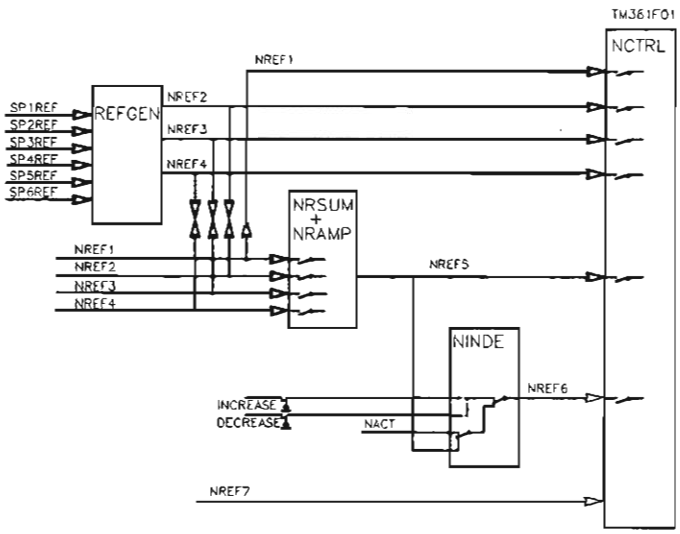

Fig 8 Speed reference signals and module (TM361F01)

Field current

The minimum field monitor will prevent starting or trip the drive if the field current drops below the minimum field setting.

In the case of the computer controlled field exciter, the software includes overcurrent tripping.

External faults

The program includes software to accept three external fault signals to give tripping of the drive, see also Diagnostic and fault indication.

Diagnostic system and fault indication

Faulty operation is reported to the fault indication and diagnostic system from where the information about failures and possible measures is made available to the operating and servicing staff.

Fault information software signals

The software contains signals (variables) carrying information about the conditions in the system. Some of these signals are used by the system itself to take appropriate action, while others are reported to the operator's panel for displaying of the information.

The list below contains some examples of software signals which are used to report important information about the condition of the system.

TRIPPED	The drive has tripped
RDYRUN	The convertor is ready to operate
RDYREF	The convertor is ready to receive current reference
RDY2RUN	The drive is ready to run
RDY2REF	The drive is ready to accept references
ARMHLW	High armature load

Fault messages

Fault information e.g. all the tripping signals are displayed on the operator's panel in legible text.

External fault handling

Besides indication of faults in the drive itself, the program has software to accept and indicate three external faults on the operator's panel. The external fault signals are also available for tripping of the drive, see Protective and monitoring system.

Control interface and communication

I/O interface

The communication between the Pride software and the external hardware involves the basic terminal and conversion board YPQ 108 and the modules for connection between the external signals channeled into Pride and Prides software signals, see Fig 9. These modules are also called the software switchbox.

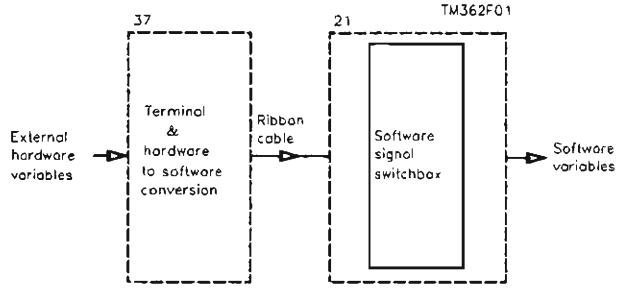

Fig 9 I/O communication interface (TM362F01)

Basic I/O interface

In the basic I/O interface the following communication channels are available:

I/O type	No. of channels	Separation	Note
Digital input	8	Opto	
Digital output	5	Opto, free relay contact	
Analog input	4 1)	High ohmic diff. ampl.	Resolution 0.05 percent
Analog output	2	High ohmic diff. ampl.	Resolution 0.05 percent
Pulse transmitter input	3	Opto	

1) Facilities for accepting tacho feedback inclusive.

The basic I/O interface also includes terminals for connection of meters for actual armature current and, in case of tacho feedback, actual speed.

Expansion I/O interface

The program includes software for the following expansion I/O interface:

I/O type	No. of channels	Separation	Note
Digital input	8	Opto	
Digital output	8	Opto, free relay contact	
Analog input	4 1)	High ohmic diff. ampl.	Resolution 0.05 percent
Analog output	4	High ohmic diff. ampl.	Resolution 0.4 percent

1) Facilities for accepting tacho feedback inclusive.

In case the expansion I/O interface is wanted, optional hardware must be ordered and the software must be activated. In case this also observe that some software signals are tied up to the bus interface and therefore are not available for the I/O communication.

Bus interface for serial communication

For communication with the MasterPiece system, the TCDC control system and between master/follower drives, the GDA6 program includes a high speed serial communication interface, see Fig 10.

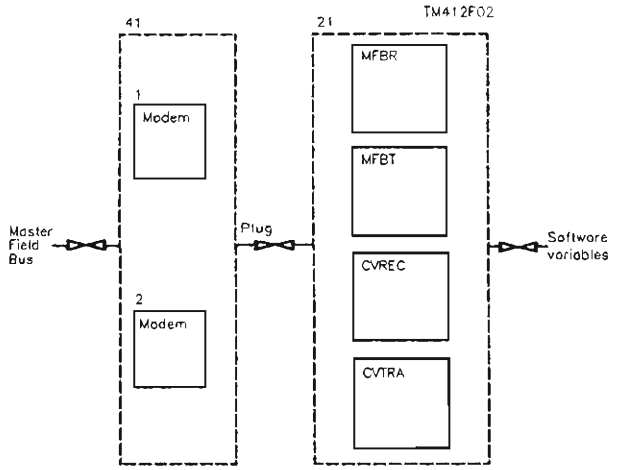

Fig 10 Bus interface for serial communication (TM412F02)

Software modules

AIN34	Analog input
AIN37	Analog input
AOUT354	Analog output
AOUT37	Analog output
BRMEC	Mechanical brake control
CONNECT1	Connect module
CVREC	Master/follower receive
CVTRA	Master/follower transmit
DIN32	Digital input
DIN37	Digital input
DOUT33	Digital output
DOUT37	Digital output
DSP131	Pulse transmitter input
ECURM	Ground fault monitor
EMSTOP	Emergency stop
EXFLT3	External fault handling
FLTLOG	Fault logger
IACTRL5	Armature current controller
IAREFH	Armature current reference handler
IF1CTR	Field current control
IFREFG	Field current reference generator
MFBR1	Master Field Bus reception
MFBT1	Master Field Bus transmission
MOTEMP	Motor temperature monitor
MOTOLM	Motor overload monitor
NCTRL2	Speed controller 2
NFBADJ	Speed feedback adjustment
NINDE1	Speed increase/decrease
NRAMP2	Ramp generator
NRSUM2	Ramp reference summator
OPCH3	Operator's panel definition
REFGEN	Reference generator
REMLOC	Remote local selector
SEQCON4	Sequence logic convertor
SEQMF	Master/follower drive sequence logic
SPMON	Speed monitor
STEPG2	Step generator
TEND	End of load program
TEST	Test facility
TQREFG	Torque reference generator
TRIP1	Tripping 1
TRIP2	Tripping 2
TRIP3	Tripping 3
TSYS	Begin of load program
TTEXTS	Background text
TYTEMP	Convertor temperature monitor

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Information 4890 068-432
December 1990
To be ordered from
ABB Drives
Dept. SEDRI/DFF

GDA7

General Drive Advanced 7

This description covers the standard Pride program GDA7 belonging to the "Advanced application category". Pride (PRogrammable Industrial Drives Electronics) is the computer based control system used in the Tyrak drive system.

Introduction

The advanced program GDA7 covers coordinated and non-coordinated drive applications with requirements on optional application control functions.

The drive application may include a single or a double convertor. The motor field may be supplied from an optional selection of field exciter types including computer controlled exciters ("digital field exciters").

The following control functions are available:

- o Selection of operating station
- o Sequence control for convertor and drive including control logic for emergency stop and master drive/follower drive
- o Armature current control
- o Speed control, advanced performance type (NCTRL3)
- o Speed reference handling including ramp generator, reference generator and increase/decrease ordering.
- o Field control
- o Protective and monitoring functions
- o Diagnostic system and fault indication
- o Communication interface including I/O and bus communication

Operating station

The drive may be operated from various operating stations. These may be:

- o a remote station like a central control room or higher level computer system (operating station REMOTE), *or*
- o an external operator's desk or box connected to Pride interface terminals (operating station LOCAL1), *or*
- o the Pride operator's panel located in the convertor cubicle (operating station LOCAL2).

TL254F01

Ordering signal	Parameter REMLOC:REMLOCMS			
	"3"	"2"	"1"	"0"
	Operating station			
REMOTE	Control room	Operator's desk	Control room	
LOCAL1	Operator's desk			
LOCAL2	Convertor panel		Convertor panel	Convertor panel

Fig 1 Examples of some possible combinations of operating stations depending on the selection of order signals and parameter settings. (TL254F01)

Selection of operating station

The selection between the operating stations is done with order signals connected to the Pride software. The software logic for the selection is found in the software module REMLOC. From this module, the consequences of the actual selection is distributed to the Pride modules concerned.

With parameters in the REMLOC module, the definition and combination of the various operating stations can be changed, see Fig 1.

Internal operator's panel (= LOCAL2)

In the advanced program GDA7, the following operating devices of the operator's panel are available, see Fig 2:

- o Push button marked "I" for ON order. Pushing "I" brings the drive from complete disconnected condition to *ready for run*.
- o Push button marked "O" for OFF order. Pushing "O" disconnects the complete drive from the line.
- o Green coloured LED which illuminates when the convertor is ready for operation
- o Red coloured LED which illuminates in case the convertor is tripped
- o Push button marked "RESET" for resetting the Pride logic when a tripping fault has been restored.
- o Two push buttons (soft keys) marked "START" and "STOP". Pushing START gives start sequence operation from the condition *ready for run* to *ready for reference*. Pushing STOP brings the drive back to the condition *ready to run*.
- o Each of the soft keys START and STOP has a LED which may be used to indicate the action of the corresponding key.
- o Two push buttons (soft keys) marked "REM" and "LOC". After permission is given by the remote station, pushing LOC means that the local station accepts to take control. Pushing REM disconnects the local station and leaves the initiative to the remote station.

TM363F01

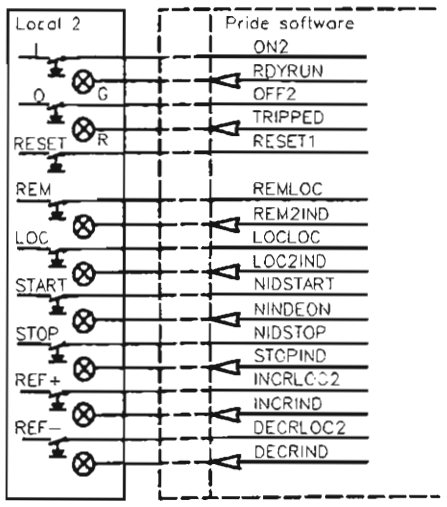

Fig 2 Operation from Pride operator's panel (TM363F01)

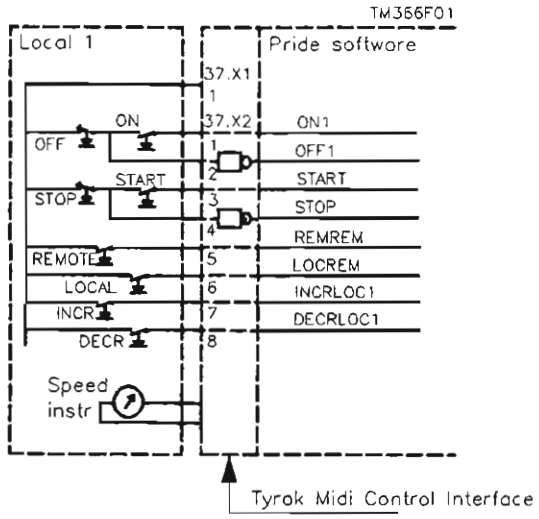

Fig 3 Start/stop and increase/decrease operation from LOCAL1 station (TM366F01)

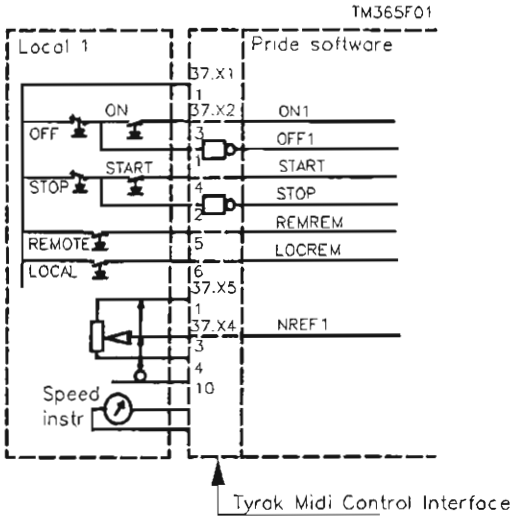

Fig 4 Start/stop and potentiometer speed setting from LOCAL1 operating station (TM365F01)

- o Each of the soft keys REM and LOC has a LED which may be used to indicate the action of the corresponding key.
- o Two push buttons (soft keys) marked "REF+" and "REF-". Pushing REF+ gives increasing motor speed and REF- decreasing speed.
- o Each of the soft keys REF+ and REF- has a LED which may be used to indicate the action of the corresponding key.

Separate external operating station (= LOCAL1)

When ordering LOCAL1 operation, external operating devices connected to appropriate software signals (variables) in Pride can be used to operate the drive.

The speed setting may be with push-buttons for increase and decrease connected via a digital input interface as in Fig 3, or with an adjustable reference voltage e.g. from a potentiometer connected via an analog input interface as in Fig 4. It is also possible to connect meters for motor speed and current.

When pushing the ON push-button, parts of the drive will be connected to the supply line, and the sequence control software will indicate *ready for run*. When pushing the START push-button, remaining parts of the drive is connected to the line, the control system will be released and the motor will follow the speed reference in action.

When pushing the STOP push-button the speed reference is disconnected, the control system is blocked and parts of the drive is disconnected from the supply line. When pushing the OFF push-button, the complete drive is disconnected. Details about this split on/start and off/stop operation is presented below under sequence control.

Remote operating station (=REMOTE)

When ordering REMOTE operation, operating devices located in the REMOTE station can be used to operate the drive. The remote station may be of the same kind as those described for the LOCAL1 station, see above.

Sequence control

ON/START and OFF/STOP sequences

The program allows a split start and stop sequence which means that the starting and stopping of the drive are arranged in two steps. The first step when starting is executed by the ON command, bringing the drive from disconnected condition to *ready for run*. The

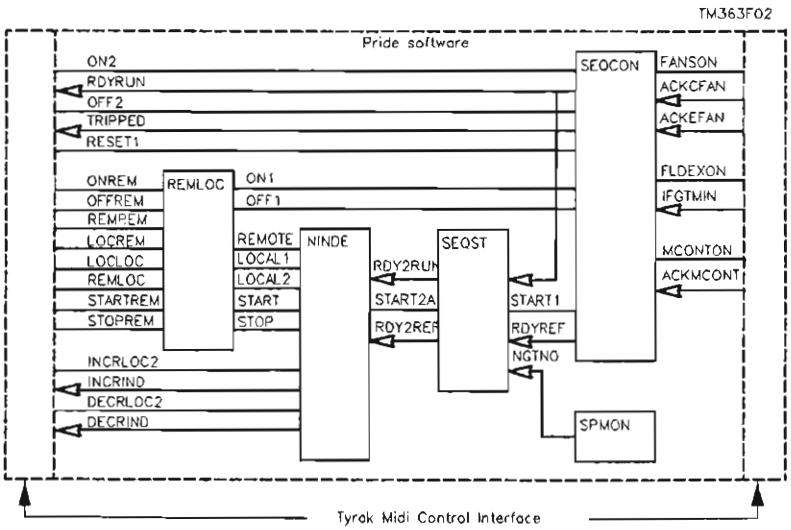

Fig 5 Sequence control software (TM363F02)

second step is executed by the START command, bringing the drive from the condition *ready for run* to the condition *ready for reference*. This split sequence has four modes of execution controlled by the parameter SEQMODE, see Fig 6. The on-start/off-stop sequence for the default setting of this parameter (*SEQMODE = "2"*) is described below.

When the ON order reaches the software signal ON1, the ON sequence will be executed, connecting the fans and the field exciter to the supply line. The sequence logic will then remain standby, waiting for the START order to appear.

When the START order turns up, the armature convertor is connected to the line, the control system is released and the motor is permitted to rotate with a speed corresponding to the reference signal presented to the speed controller.

A STOP order will bring the drive to standstill and disconnect the armature convertor.

In case of an OFF order, the OFF sequence is executed, disconnecting the complete drive from the supply line. The disconnection of the armature convertor, however, is delayed so that the convertor and the control equipment are blocked first.

The sequence logic operation for other settings of the SEQMODE parameter is shown in Fig 6.

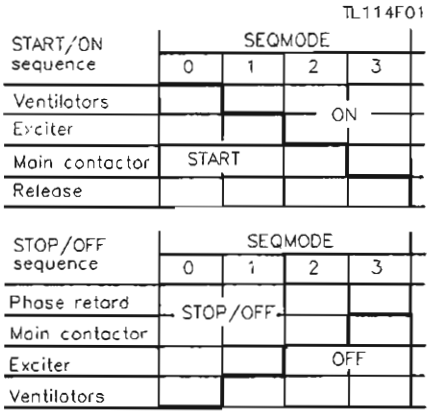

Fig 6 Start-stop sequence modes (TL114F01)

Emergency stop logic

When pushing the *emergency stop push button*, the drive will normally stop on current limit. Alternatively, by setting of the appropriate parameters, the emergency stop may be on the normal ramp or a faster emergency stop ramp. It is also possible to involve mechanical braking during emergency stop by activating the brake control module.

Armature current control

The torque control is performed by the armature current controller, receiving the torque reference from the speed controller.

Inside the advanced speed controller modules, the current reference can be switched from speed control to torque reference mode. In torque reference mode the torque reference is received from the torque reference generator.

As the output from the speed controller has an adjustable limit setting, i.e. the current limit, the maximum torque during acceleration and retardation is limited.

The current limit may alternatively be set from an external source.

Speed control

The motor speed can be measured with a d.c. tacho generator or a pulse generator. Depending on which, the speed feedback will be brought to the speed controller through different input channels in the control interface, see Fig 7. In the interface, the speed feedback is conditioned and adapted to the present control conditions and converted to digital form.

The behaviour and performance characteristics of the speed control loop are adjusted by setting a number of program parameters, which normally is done on the operator's panel.

Speed reference handling

The speed is set from the selected operating station, either the operator's panel in the convertor (LOCAL2) or external operating stations e.g. an operator's desk or box in the process plant (LOCAL1) or a central control room (REMOTE).

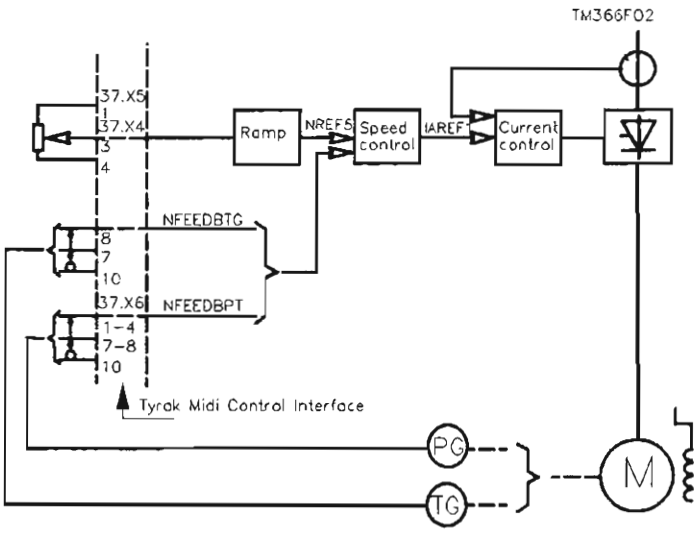

Fig 7 Speed control loops with tacho or pulse transmitter feedback (TM366F02)

Increase/decrease reference ordering
The speed reference software accepts increase/decrease orders e.g. from push-buttons in the external operator's desk or from the REF+/REF- keys in the operator's panel. The software signals INCRLOC2 and DECRLOC2 carries the order information onto the increase/decrease function in the module NINDE.

Reference generation
The speed may also be set with a continuously adjustable reference order e.g. with the internal reference setting parameters SP1AREFS through SP6AREFS inside the REFGEN software or from external reference potentiometers.
External references can be connected directly to the reference input of the speed controller by means of the signals NREF1 through NREF7 or via the software module REFGEN, see Fig 8.

Ramp function
The external references may also be connected via the ramp function modules NRSUM and NRAMP. The reference signals NREF1 through NREF4 are added, the sum is transferred through the ramp module NRAMP and then presented to the speed controller as speed reference NREF5.

Bumpless transfer between control modes
When using the reference signals NREF1 through NREF5 for remote reference setting and NREF6 for local reference setting, the operating facility *follow* in the module NINDE can be used for arranging bumpless transition between remote and local reference.
The *follow* facility in the module NINDE is also used for bumpless transfer between automatic and manual mode.

Field control

The motor field may be supplied from a fixed voltage diode exciter or an adjustable field current. The adjustable exciter may be a conventional hardware components exciter or a computer controlled exciter (sometimes referred to as analog or digital field exciter respectively).

Protective and monitoring system

Start sequence
The Pride sequence control monitors the connection and disconnection of the internal and external fans, the main contactor and the field exciter. These monitoring functions are found in the convertor sequence control module SEQCON.

Earth fault (Ground fault)
The earth current monitor uses the phasor sum of the three phase line current to detect and indicate the presence of an earth fault. The earth fault current is measured with the optional earth fault transformer.

Supply line
Pride monitors the main and auxiliary supply and detects low line voltage, frequency faults and incorrect phase sequence.

D.c. current
Pride also detects the current related faults: instantaneous overcurrent, loss of current in a thyristor branch, current pulsation and large current control deviation. Overcurrent tripping also indicates the faulty thyristor branch.

Motor speed
The motor speed monitor has one zero-speed indication, one overspeed indication for tripping and two speed level indications for optional use. The presence of the speed feedback is also monitored, the drive is tripped in case the feedback disappears.

Motor load
The motor is protected against thermal overload by monitoring the armature current. The monitor has adjustable levels for overload tripping, alarm and time delay.

Motor temperature
The motor temperature monitor accepts up to two PT100 inputs for monitoring motor temperature. When the temperature reaches certain adjustable levels, alarm or tripping respectively is activated.

Thyristor junction temperature
The convertor temperature monitor accepts up to two PT100 inputs for monitoring thyristor temperature. When the temperature reaches certain adjustable levels, alarm or tripping respectively is activated.

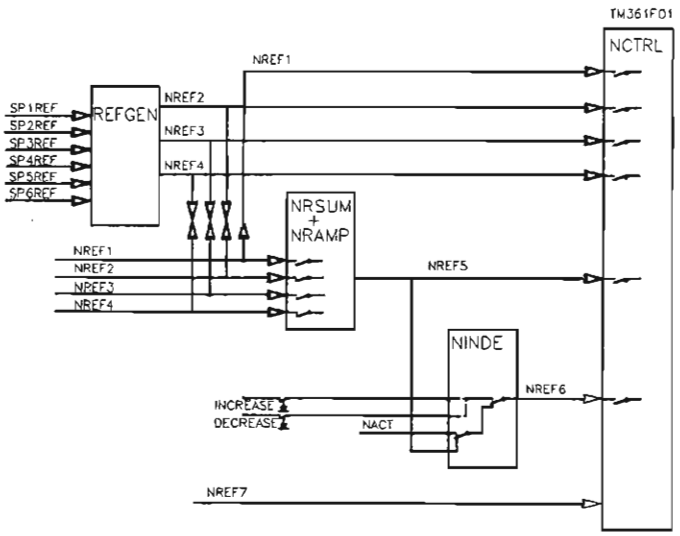

Fig 8 Speed reference signals and module (TM361F01)

Field current

The minimum field monitor will prevent starting or trip the drive if the field current drops below the minimum field setting.

In the case of the computer controlled field exciter, the software includes overcurrent tripping.

External faults

The program includes software to accept three external fault signals to give tripping of the drive, see also Diagnostic and fault indication.

Diagnostic system and fault indication

Faulty operation is reported to the fault indication and diagnostic system from where the information about failures and possible measures is made available to the operating and servicing staff.

Fault information software signals

The software contains signals (variables) carrying information about the conditions in the system. Some of these signals are used by the system itself to take appropriate action, while others are reported to the operator's panel for displaying of the information.

The list below contains some examples of software signals which are used to report important information about the condition of the system.

TRIPPED	The drive has tripped
RDYRUN	The convertor is ready to operate
RDYREF	The convertor is ready to receive current reference
RDY2RUN	The drive is ready to run
RDY2REF	The drive is ready to accept references
ARMHLW	High armature load

Fault messages

Fault information e.g. all the tripping signals are displayed on the operator's panel in legible text.

External fault handling

Besides indication of faults in the drive itself, the program has software to accept and indicate three external faults on the operator's panel. The external fault signals are also available for tripping of the drive, see Protective and monitoring system.

Control interface and communication

I/O interface

The communication between the Pride software and the external hardware involves the basic terminal and conversion board YPQ 108 and the modules for connection between the external signals channeled into Pride and Prides software signals, see Fig 9. These modules are also called the software switchbox.

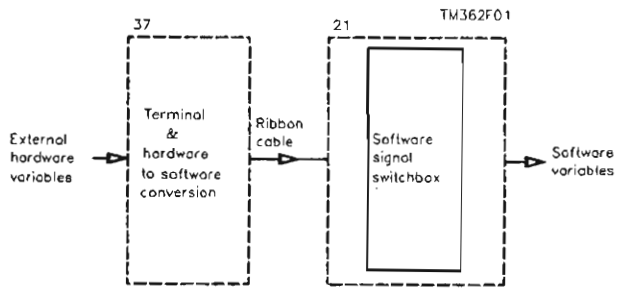

Fig 9 I/O communication interface (TM362F01)

Basic I/O interface

In the basic I/O interface the following communication channels are available:

I/O type	No. of channels	Separation	Note
Digital input	8	Opto	
Digital output	5	Opto, free relay contact	
Analog input	4 1)	High ohmic diff. ampl.	Resolution 0.05 percent
Analog output	2	High ohmic diff. ampl.	Resolution 0.05 percent
Pulse transmitter input	3	Opto	

1) Facilities for accepting tacho feedback inclusive.

The basic I/O interface also includes terminals for connection of meters for actual armature current and, in case of tacho feedback, actual speed.

Expansion I/O interface

The program includes software for the following expansion I/O interface:

I/O type	No. of channels	Separation	Note
Digital input	8	Opto	
Analog input	4 1)	High ohmic diff. ampl.	Resolution 0.05 percent

1) Facilities for accepting tacho feedback inclusive.

In case the expansion I/O interface is wanted, optional hardware must be ordered and the software must be activated. In case this also observe that some software signals are tied up to the bus interface and therefore are not available for the I/O communication.

Bus interface for serial communication

For communication between master/follower drives, the GDA7 program includes a high speed serial communication interface, see Fig 10.

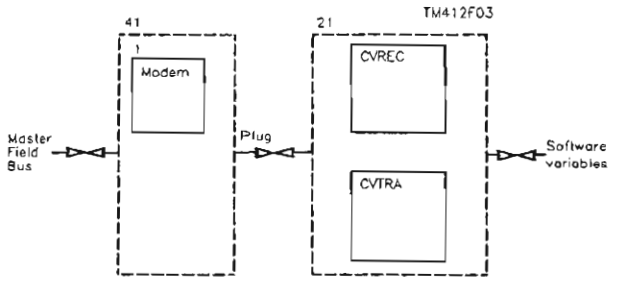

Fig 10 Bus interface for serial communication (TM412F03)

Software modules

AIN34	Analog input
AIN37	Analog input
AOUT37	Analog output
CONNECT1	Connect module
CVREC	Master/follower receive
CVTRA	Master/follower transmit
DIN32	Digital input
DIN37	Digital input
DOUT37	Digital output
DSP131	Pulse transmitter input
ECURM	Ground fault monitor
EMSTOP	Emergency stop
EXFLT3	External fault handling
FLTLOG	Fault logger
IACTRL5	Armature current controller
IAREFH	Armature current reference handler
IF1CTR	Field current control
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MOTOLM	Motor overload monitor
NCTRL3	Speed controller 3
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NINDE1	Speed increase/decrease
NRAMP2	Ramp generator
NRSUM2	Ramp reference summator
OPCH3	Operator's panel definition
REFGEN	Reference generator
REMLOC	Remote local selector
SEQCON4	Sequence logic convertor
SEQMF	Master/follower drive sequence logic
SPMON	Speed monitor
STEPG2	Step generator
TEND	End of load program
TEST	Test facility
TQREFG	Torque reference generator
TRIP1	Tripping 1
TRIP2	Tripping 2
TRIP3	Tripping 3
TSYS	Begin of load program
TTEXTS	Background text
TYTEMP	Convertor temperature monitor

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December 1990
To be ordered from
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Dept. SEDRI/DFF

Tyrak Midi - Software Module Descriptions

The descriptions for modules included in Tyrak Midi are found in the manual "Pride module library".

Software module	Document No.
AIN34	7630 022-172
AIN37	7630 022-152
AOUT354	7630 022-168
AOUT355	7630 022-169
AOUT37	7630 022-153
BRDYN	7630 022-74
BRMEC	7630 022-75
CONNECT1	7630 022-233
CVREC	7630 022-45
CVTRA	7630 022-230
DIN11	7630 022-96
DIN32	7630 022-170
DIN37	7630 022-155
DOUT11	7630 022-41
DOUT33	7630 022-214
DOUT37	7630 022-157
DSP131	7630 022-166
DSP231	7630 022-165
ECTRL1	7630 022-211
ECURM	7630 022-97
EMFMEM	7630 022-48
EMFSP	7630 022-213
EMSTOP	7630 022-55
EXFLT3	7630 022-98
FLTLOG	7630 022-229
IACTRL5	7630 022-257
IAREFH	7630 022-207
IF1CTR	7630 022-224
IFREFG	7630 022-219
IFREV	7630 022-263
INDE	7630 022-47
MFBR1	7630 022-227
MFBT1	7630 022-228
MOTEMP	7630 022-51
MOTOLM	7630 022-31
NCTRL1	7630 022-208
NCTRL2	7630 022-209
NCTRL3	7630 022-210
NFBADJ	7630 022-194
NINDE1	7630 022-36
NRAMP2	7630 022-132
NREFB	7630 022-150
NRSUM2	7630 022-225
OPCH3	7630 022-167
PRCTRL	7630 022-239
REFAD	7630 022-220
REFGEN	7630 022-63
REMLOC	7630 022-35
REST1	7630 022-54
SEQCON4	7630 022-226
SEQMF	7630 022-73
SEQST	7630 022-72
SPMON	7630 022-244
STALLM	7630 022-49
STEPG2	7630 022-234
TEND	7630 022-43
TEST	7630 022-260
TQMON	7630 022-221
TQREFG	7630 022-151
TRIP1	7630 022-171
TRIP2	7630 022-222
TRIP3	7630 022-217
TSYS06	7630 022-235
TSYS08	7630 022-236
TSYS10	7630 022-237
TSYS12	7630 022-231
TTEXTS	7630 022-238
TYTEMP	7630 022-203

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TYRAK® MIDI

Drive system components for d.c. drives rated up to 860 kW.

Installation

Instruction YT 390 - 102 E. Edition 2.

ABB Drives

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General

This instruction applies to Tyrak Midi convertor modules type YGMT, YHMT with current rating 40 - 1400 A, and to Tyrak Midi drive system accessories.

Transport and storage

The convertors are delivered in packaging suited to the mode of transport. The equipment is to be checked against the shipping documents upon arrival. Damaged or missing goods must be reported to ABB Drives immediately to avoid delay in the installation and commissioning.

If the convertor is not to be installed on delivery it must be stored in its packaging in a dry and dust-free environment. The ambient temperature during storage must be within the range -25 °C to +60 °C (24 hour average maximum +45 °C).

Physical installation

General

The equipment is intended for indoors installation in an ordinary industrial environment. Ambient temperature must be within the range 0 °C to +40 °C, and the air must be free from dust and corrosive gases.

Convertor module

The convertor module is to be installed vertically with the DC connections downwards.

The convertor module is delivered on a 19" base plate. It can be placed directly on a wall (screen protected) or installed in any standard enclosure.

When installed in a cubicle, following points should be observed:

- The convertor module must receive an adequate amount of cooling air.

  Cooling air flow:
  Convertors 40 - 120 A: 100 m^3/h.
  Convertors 200 - 350 A: 400 m^3/h.
  Convertors 530 A: 500 m^3/h.
  Convertors 800 - 1400 A: 1000 m^3/h.

- The air temperature 10 cm below the thyristor bridge must not exceed +40 °C for the convertor to be loaded in accordance with the ratings.

- Avoid installing the convertor above apparatus developing any quantity of heat.

- The air outlet must be located above the top of the convertor module.

- To avoid undesired internal air circulation, the exhaust air should have free passage out of the enclosure (air duct or similar).

Operator's panel

The operator's panel can be moved from the convertor module to the enclosure door.

The ribbon cable should be routed as close to a metal surface as possible to avoid electrical interference.

The ribbon cable supplied is 1.8 m long and must not be replaced by a longer cable, as proper function can not be guaranteed.

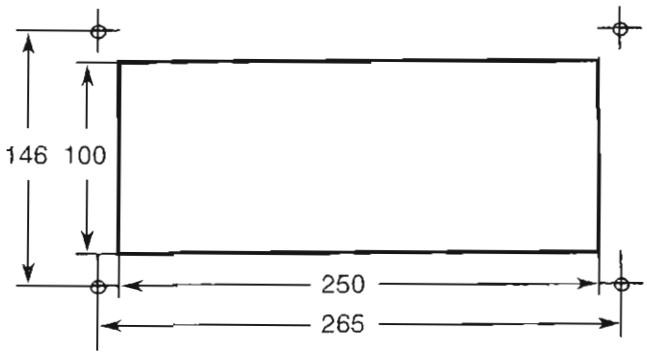


Figure 1. Drilling view for operator's panel.

Contactor module

The contactor module for convertors up to 120 A is installed inside the convertor module (all necessary mechanical and electrical fixing devices are included).

Higher rated contactor modules are delivered on 19" panels, and can be installed to suit.

Field exciters

The field exciters are delivered as units intended for back panel mounting.

The diode field exciters requires no special mounting procedure.

The controlled field exciters must be mounted vertically to allow air flow through the heat sink.

Electrical installation

Power distribution

Line disconnect switch

The drive is connected to the mains via a load switch and fuses, or a circuit breaker. Recommended fuse/ circuit breaker rating for the different convertor modules:

Convertor module (A)	Fuse/circuit breaker (A)
40/70	50/100
120	125
200	250
350	400
530	600
800	800
1100	1000 (MCCB)
1400	1200 (MCCB)

Line reactors

Line reactors are required if several double convertors are supplied from a common main supply and the cables between the convertors is short. The reactors are installed in the phases and the inductance should be at least 6.5 µH. Sufficient inductance is obtained if the length of the supply cable exceeds 25 m.

Note: The Tyrak Midi reactor unit for 530 A requires foreed cooling, either by a separate fan or by placing the unit in the convertor fan air flow.

Main contactor

A main contactor is used to disconnect the d.c. machine from the supply line when the drive is turned off, or when the equipment is tripped because of a fault.

The main contactor can be installed either on the a.c. or the d.c. side of the convertor module. It is controlled (switched on/off) via signals from the convertor control equipment.

The contactor module offered in the Tyrak Midi program is intended for installation on the a.c. side. The physical and electrical installation is described in chapter"**Installation of options**".

Connections on convertor module

A.c. supply

Three phase ac voltage is connected to the main circuit terminals U, V, W. The maximum permissible short circuit current (symmetrical value) in the mains supply is 50 kA.

Main circuit terminals are located at the bottom of modules 40 - 120 A and 800 - 1400 A. Modules rated 200 - 530 A are delivered with top a.c. connections, but can easily be changed to bottom entry.

Note: When changing from top to bottom enty, the phase designation on the terminals changes, see dimension print 4893 1006 - T.

Three phase ac voltage is connected to the auxiliary supply circuit terminal X1:1 - 3.

Note: Phase connection must be identical to the main circuit.

The auxiliary power supply circuit must be fused for short circuit protection. Recommended fuse/circuit breaker rating, 6 A. On delivery the module is wired for 380 V supply. With other supply voltages the connections on transformer, item no 51, must be moved according to table below:

Supply voltage (V)	Connect wires 101, 102, 103 to terminals:
380	51.X1:1 - 5 - 9
415	51.X1:2 - 6 - 10
460	51.X1:3 - 7 - 11
500	51.X1:4 - 8 - 12

Control voltage 110 V a.c. (single phase) is connected to terminals X1:7, 8 (neutral). This control voltage is also used to supply the convertor fan in convertors rated 40 - 120 A (fan power 30 VA).

Supply voltage 220 V a.c. for convertor fan in convertors rated 200 - 1400 A is connected to terminals X1:9, 10. Power requirement as per table below.

Convertor (A)	Power (VA)
200 - 350	170
530	250
800 - 1400	315

The fan has a built-in thermal contact connected in the operation circuit (applies to all types).

Note: When equipped with the contactor module (optional) both the 110 V and the 220 V voltages are generated internally. No external supply required.

D.c. output

The armature circuit of the machine is connected to the d.c. terminals L+, L- on the convertor module.

Convertor (A)	Max cable area (mm^2)
40 - 120	35
200 - 530	2×240
800 - 1400	6×240

Control signals

Control signals are connected to terminals on the I/O board YPQ 108 A, item 37.

Some of the terminals have a fixed function, while others can be programmed via the operator's panel. Programmable channels are indicated by an ▮ in the table below.

Terminal configuration:

37.X1:
1 110 V a.c.
2 Convertor fan on
3 Field exciter on
4 Main contactor on
5 Ack. convertor fan
6 Ack. external fan
7 IF > Min
8 Ack. main contactor
9 External fan on
10 OV - DI (110 V a.c. - neutral)

37.X2:
1▮ Digital input channel 1
2▮ - " - 2
3▮ - " - 3
4▮ - " - 4
5▮ - " - 5
6▮ - " - 6
7▮ - " - 7
8▮ - " - 8
9 +24 VE
10 0 VE (24 V - neutral)

37.X3:
1▮ Digital output channel 1
2▮ - " - 1
3▮ - " - 2
4▮ - " - 2
5▮ - " - 3
6▮ - " - 3
7▮ - " - 4
8▮ - " - 4
9▮ - " - 5
10▮ - " - 5

37.X4:
1▮ Analogue output channel 1
2▮ - " - 2
3▮ Analogue input channel 1
4▮ - " - 1
5▮ - " - 2
6▮ - " - 2
7▮ - " - 3
8▮ - " - 3
9▮ - " - 4
10▮ - " - 4

37.X5:
1 Ref. voltage +10 V
2 - " - – 10 V
3 Current source 5 mA
4 5 mA - 0
5 RPM output from TG feedback
6 0 VE
7 Common
8 Tacho generator input
9 Common
10 Ground (shield)

37.X6:
1 Pulse generator input, channel A
2 - " - - " -
3 - " - channel B
4 - " - - " -
5 - " - channel Z
6 - " - - " -
7 + 24 V supply for pulse generator
8 0 VE
9 0 VE
10 Ground (shield)

37.X7:
1 Earth fault transformer input
2 Ditto
3 Current actual value
4 0 VE
5 Not connected
6 Not connected
7 Serial comm. (current loop) transmit
8 Ditto
9 Serial comm. (current loop) receive
10 Ditto

37.X10 RS 232C

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 (reference, actual values and certain digital signals) are to be conducted in shielded cables. The shield (SC in the circuit diagram) is to be grounded at special terminal, as shown in the circuit diagram, in order to avoid the development of inductive currents.

The cables are to be dimensioned and installed in accordance with relevant rules and regulations.

Grounding

All units in the equipment are to be electrically connected to the cubicle frame, via their fixings or via a separate ground wire.

The cubicle frame should be provided with a grounding clamp to which a ground line or bar to a reliable ground is connected.

The neutral MN, terminal X1:8 on the convertor module, for the operating voltage M1 and M2 (110 V a.c.) should be directly grounded in the cubicle.

The neutral OVE for the electronic system (24 V d.c.), terminal X1:4 on the convertor module, is directly grounded in single drive applications. In coordinated drives with a common reference system the neutral is to be grounded in one point only. This is obtained by interconnecting the neutral in all the drives included, and connect one of them to the ground.

Installation of options

Options available in the Tyrak Midi program are delivered with an installation instruction.

The same instructions are enclosed hereafter:

Option	Installation instruction
Expansion I/O-unit	4893 1006 - FA
High speed serial comm.	4893 1006 - FB
Earth fault transformer	4893 1006 - FC
Termperature sensor Pt100	4893 1006 - FD
D.c. voltage transducer/d.c. fuses	4893 1006 - FE
Contactor module	4893 1006 - FF
Digital field exciter	4893 1006 - FG

Installation of expansion I/O-unit

The expansion I/O-unit is delivered as a material kit for installation into the drive. Up to six units can be added. Each kit consists of two PC-boards, board-board connectors a ribbon cable and mounting details.

An expansion I/O-unit can be added also after a drive has been taken into operation, provided that necessary software functions are included in the control program.
All standard programs include software functions for one expansion unit of each type on a predetermined location as shown in figure 1.

Type of I/O-unit	Predetermined location
Digital speed input unit	31
Digital input unit	32
Digital output unit	33
Analogue input unit	34
Analogue output unit	35
Standard modem	36

If, for some reason, another board location is required, or if two or more expansion units of one type are needed, a custom made control program must be made.

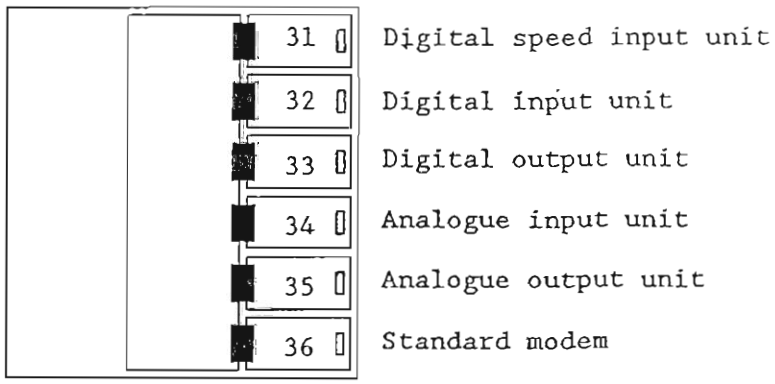


Figure 1 Location designation of I/O-boards

Installation procedures:

One of the PC-boards, the I/O-board, is installed in the convertor module. The other, terminal board, is located on a terminal unit outside the convertor module. There is a terminal board assembly kit available for convenient installation.

The recommended location of the terminal unit is below, but as close as possible to the convertor module, as shown in fig. 2. The distance between the convertor module and the terminal unit should in no case exceed 0,6 m (2 feet).

1. Open the load switch

2. Mount spacers (included in the kit) in the proper location on the control door

3. Put the board-board connectors on the I/O-board.

4. Slide the I/O-board on to the computer board and fasten it on the spacers.

5. Fix the terminal board on to the holder with screws supplied in the kit.

6. Connect the ribbon cable between connectors X31 on the I/O-board and X31 on the terminal board.

   Note: the signals are sensitive to interference. The ribbon cable must be routed close to a metal surface, separated from power and control cables, and separated from contactors and other power components.

7. Connect auxiliary supply from basic I/O-board YPQ 108 connector X32, to connector(s) X32 on the terminal board(s). Use ribbon cable supplied in the terminal board assembly kit.

8. The software function needed is connected via the operator' panel. An analogue output unit serves as example, but the procedure is the same for all types of expansion units:
   Close the disconnect switch.
   In menu SET on the display, set parameter AA035 to "1"
   The coupling of the software is performed during the initialization of the program. Open the switch briefly for this.
   When the switch is closed again, the analogue output board is ready for operation.

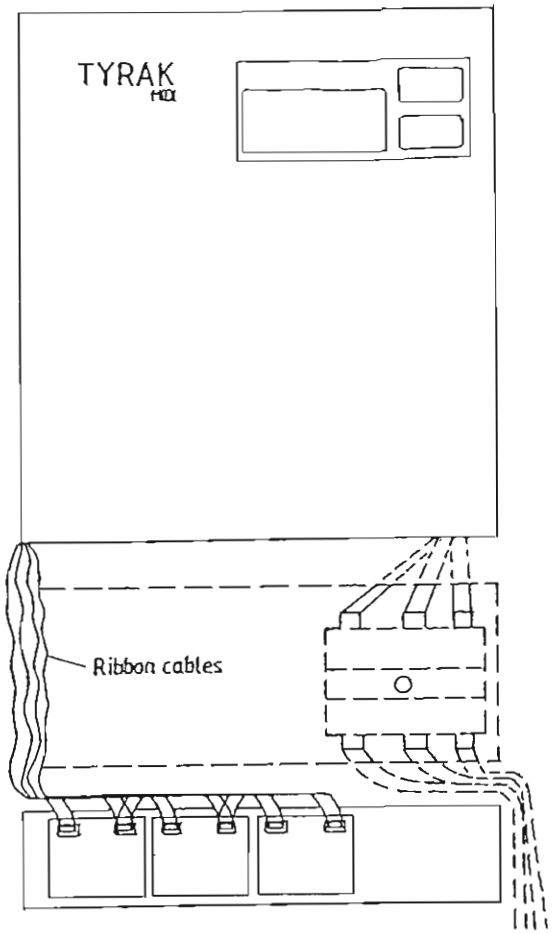


Figure 2 Convertor module and terminal unit

Removing an expansion I/O-unit

If an expansion I/O-unit, such as a digital input board, is to be removed for some reason, the following procedure should be observed:

1. Set in function module DIN32 on the Operator's panel parameter ADI32 to "0" and open the disconnect switch

2. Close the switch and check that the red LED on YPI 103 illuminates.

3. Open the switch again, and remove the board.

Installation of high speed serial communication unit

The high speed serial communication unit consists of:

- Communication board YPK107X
- Modem board YPC104X, 1 or 2 pcs
- Connection unit YPC105X, 1or 2 pcs
- Two ribbon cables
- T-piece connector, 1 or 2 pcs
- Termination 75 ohm, 1 or 2 pcs.

The communication board is mounted on the stand-offs below the operator's panel on the front of the control door (remove the plastic cover to install).
The modem board is mounted on top of YPK 107.

The communication board YPK 107 is connected to the control equipment with two ribbon cables. One, 10-pole, is used for power supply and is connected between terminals X32 on YPK107 and CPU board YPP 105. The ribbon cable already installed in terminal X32 on the CPU board, is moved to the male connector on the new ribbon cable.

The other, 40-pole, is used for signal transmission and is connected between terminals X35 on CPU board YPP 105 and communication board YPK 107.

Route the ribbon cables as shown in fig. 1.

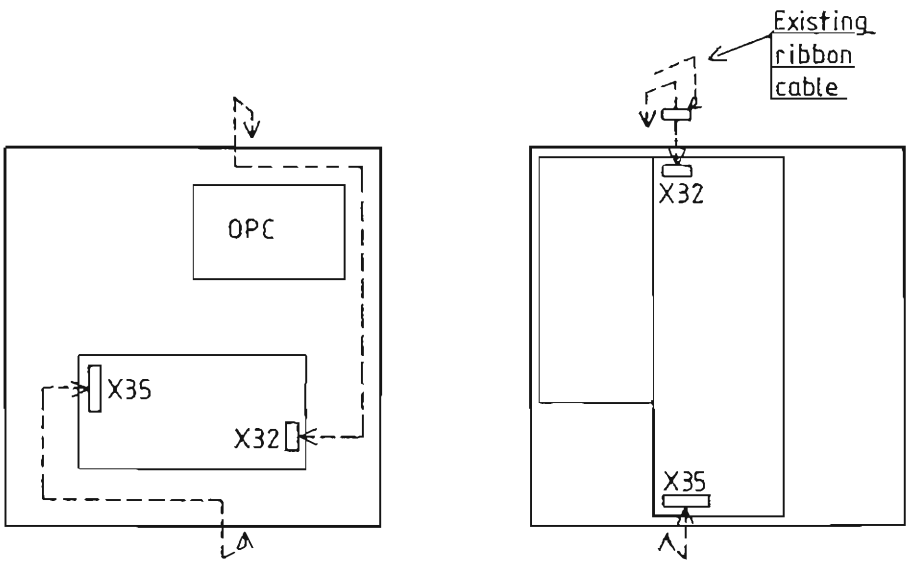


Figure 1. Routing of ribbon cables.

Prod class 811 399	Tech ref G Petersson	Erection Provisions High speed serial link	Reserved for customer			
Dec reg 4893	Drawn by H-E Johansson		Preliminary 90-05-18 10:14 4893 1006-FB	Lang en	Sheet 1	
	Resp dept DKK	Date	ABB Drives	Rev ind	Cont 2	

There is space for two modem boards on the communication board. One location, with a terminal designated X1, is used for communication with an ABB Master. The other location, terminal X2, is used for master/ follower communication between drives.

If both ABB Master and master/follower communication is required, both modem boards must be used.

A coaxial cable is run from the modem board YPC104 to the connection unit F as shown in figure 2.
The connection unit is placed in a suitable location for connection of external coaxial cables.
The board must be mounted directly to the cubicle frame with a safe ground connection (ground connection in mounting holes).

Table 1 Connection material for modem YPC 104B

Object	Type	Part 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
Connection unit F	YPC 105X	YT 204 001-HE

Cable A is for communication between the convertor and the ABB Master. Cable B is used for master/follower communication.

The connector D, the termination E and the connection unit(s) F are included in the kit, but not the cables A/B, nor connector C on the coaxial cable.

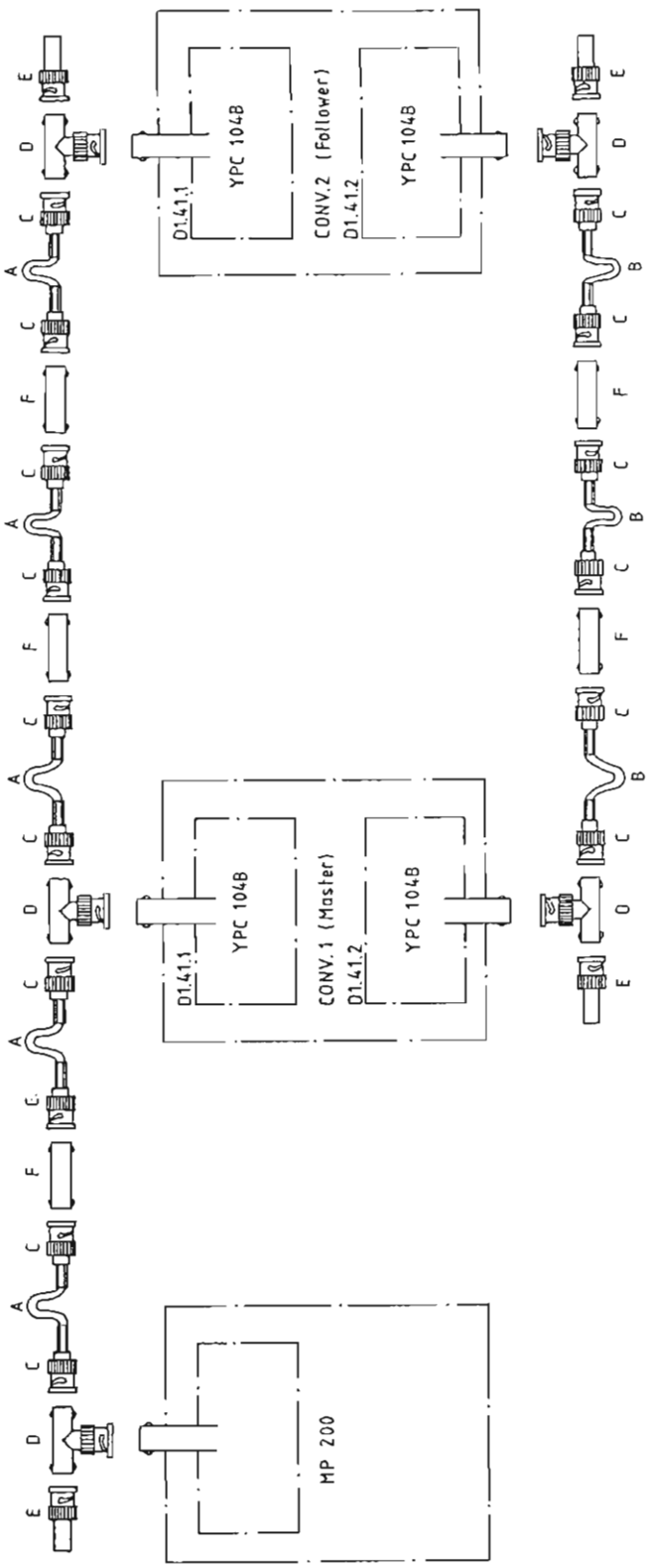


Figure 2. Connection of serial communication.
Example with one master and one follower.

Prod class	Tech ref	Erection Provisions	Reserved for customer		
811 399	G Petersson	High speed serial link			
Dec reg	Drawn by		Preliminary	Lang	Sheet
4893	H-E Johansson		90-05-18 10:14	en	3
	Resp dept / Date	ABB Drives	4893 1006-FB	Rev ind	Cont
	DKK				-

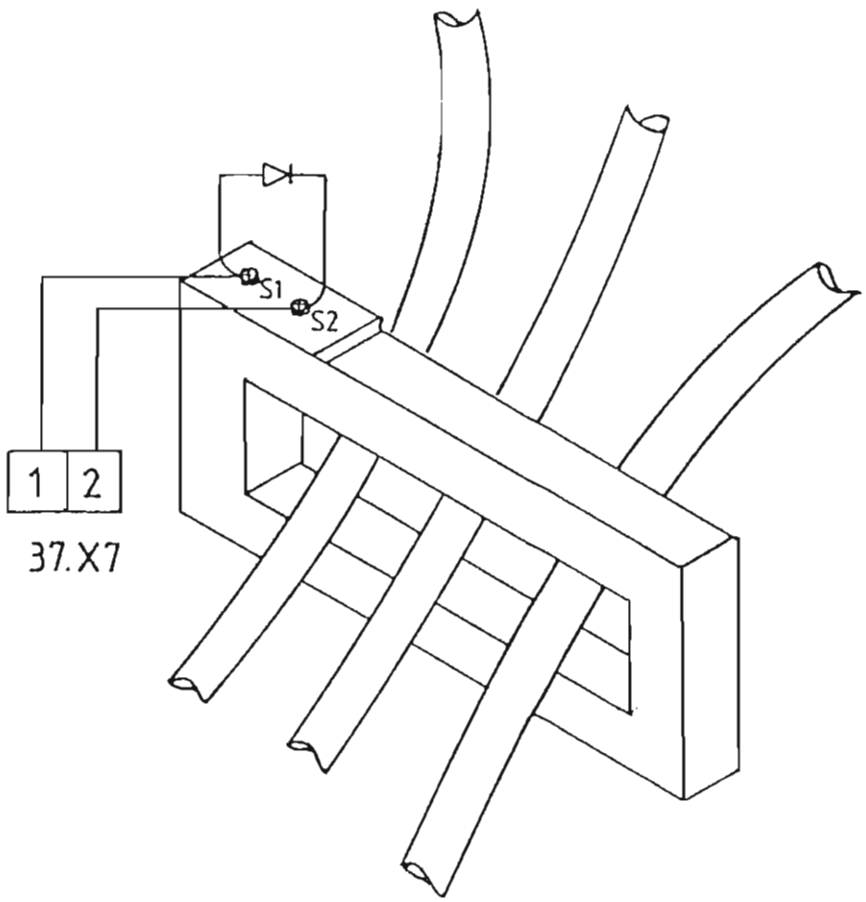
Earth fault transformer
==========

The function operates on the basis of summation current measurement with a current transformer.

The transformer is to be installed on the incoming power supply to the equipment.

All three phases are routed through the transformer. The secondary terminals on the transformer are connected to the I/O-board YPQ 108, terminals 37.X7:1 - 2.

The transient protection diode is connected across the S1 - S2 terminals on the transformer.



Prod class	Tech ref	Erection Provisions	Reserved for customer		
811 XXX		Earth fault transformer			
Dec reg	Drawn by			Lang	Sheet
	H E Johansson			E	1
	Resp dept / Date	ABB Drives	4893 1006-FC	Rev ind	Cont
	DKK / 89-04-19				-

Temperature sensor Pt 100

The Pt100 element is a resistor with impediance characteristics proportional to the temperature. The sensor is supplied with a fixed current of 5 mA and the voltage across is measured and used as the temperature signal.

The temperature sensor is mounted on the thyristor unit heat sink and provides a check on the cooling system.

The heat sinks are prepared with mounting holes for simple installation.

Convertor modules 40 - 120 A

Untighten the screws that hold the trigger pulse board on the thyristor unit.
Move the PC-board slightly down (it will not be necessary to remove any connectors) and mount the temp. sensor in the ready-made mounting holes at the top of the heat-sink.
Connect the component leads to terminals X10:1-2, located on the fan holder (cut excessive length if required).
Add wiring as shown in fig. 1.

Convertor modules 200 - 530 A

The temp. sensor is mounted in the ready-made mounting holes above the top thyristor module.
The leads are connected to terminals X10:1-2 on the back panel. Add wiring as shown in fig. 1.

Convertor modules 800 - 1400 A

In this current range single convertors require one temperature sensor while double convertors require two.

The temp. sensor in a single convertor is installed in the far left branch unit. First remove the fuse, then the cover on the branch unit (six screws). Mount the sensor in the ready-made holes in the heat sink. Twist the leads and run them through the threaded hole in the cover. Connect to terminals X10:1-2 as shown in fig. 1.

In a double convertor the second sensor is installed in the second left branch unit. The leads are connected to terminals X10:11-12 and the connections to the basic I/O unit YPQ 108 is done as shown in fig. 2.

Note: the heat sinks have supply line potential. In case another sensor than the one offered in the Tyrak Midi program is used, it must provide adequate isolation, 2,5 kV.

Connection diagram

The temperature transducer is connected to the control equipment as shown in the schematic below:

Wiring from X10 to the I/O-unit YPQ 108, terminal 37.X5:3-4, must be added (5 mA current supply). The temperature signal is connected to a vacant analog input channel on terminal 37.X4.
The channel used must be adapted for 1V signal level i.e. jumper S(1-4):5-6 and 7-8 inserted.

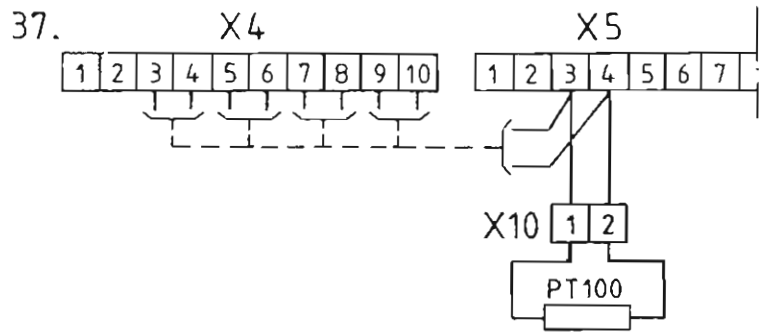


Fig. 1 YGMT/YHMT 40-530 A
YGMT 800-1400 A

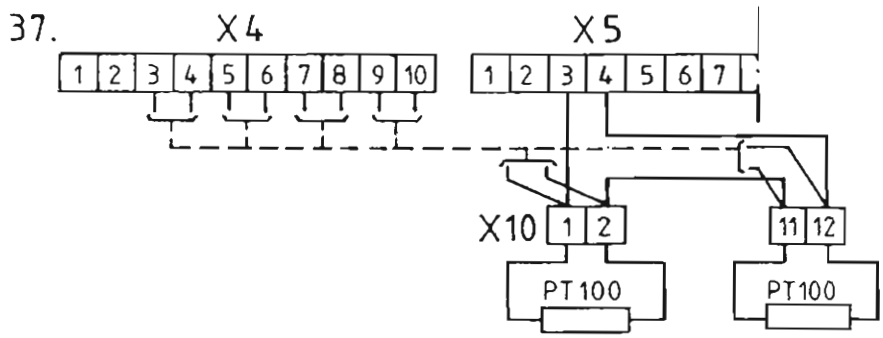


Fig. 2 YHMT 800-1400 A

Prod class	Tech ref	Erection Provisions	Reserved for customer		
811 399	G Petersson	Temperature transducer			
Dec reg	Drawn by			Lang	Sheet
4893	H-E Johansson			en	2
	Resp dept / Date	ABB Drives	4893 1006-FD	Rev ind	Cont
	DKK / 89-04-25			1	-

DC voltage transducer / DC fuses

The DC transducer/ DC fuses are connected directly to the L+, L- terminals on the convertor module and provide protection for the dc signal circuit.

The connection leads are not short circuit protected and thus they must not exceed 0,5 m of length.

DC voltage transducer

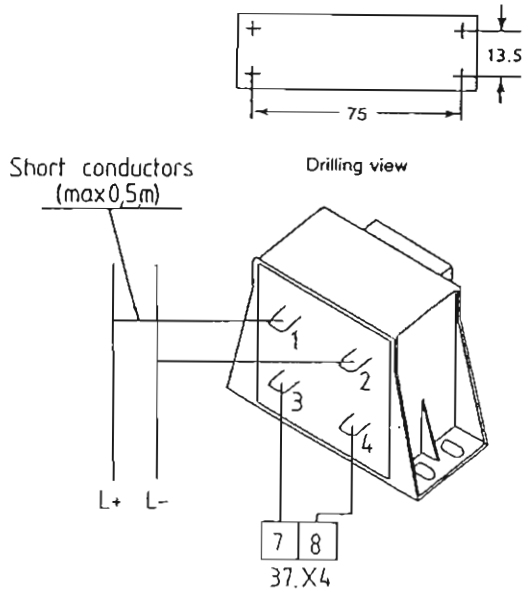
The output from the voltage transducer is isolated from the input by high impediance and is short circuit proof.

The output signal is connected to an analogue input channel on the I/O-board YPQ 108, for example terminal 37.X4:7 - 8.

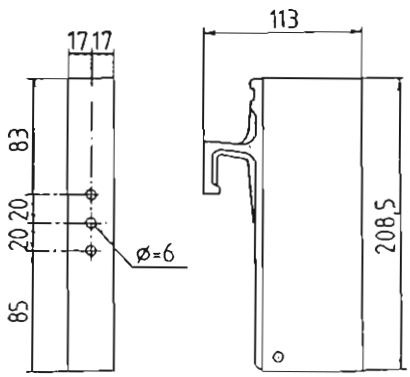
DC fuses

The fuse bases must be mounted close to the DC terminals to allow short connecting leads.

The fuses protect the dc circuit used for example for an armature voltmeter or for controlled field exciter YGBF 20.
It is recommended to route the dc cables separated from other signal cables because of the high voltage.



D.c. voltage transducer.



D.c. fuses.

Prod class 811 XXX	Tech ref		Erection Provisions DC volt. transducer/fuses	Reserved for customer	
Dec reg	Drawn by H E Johansson			Lang E	Sheet 1
	Resp dept DKK	Date 89-04-19	ABB Drives	4893 1006-FE	Rev ind Cont -

Installation of contactor module

The Tyrak Midi contactor module is delivered as a separate unit, to be installed into the drive equipment.

40 - 120 A

In this current range the contactor module is accomodated inside the convertor module. The module comes with all necessary power and control wires.

Installation procedures:

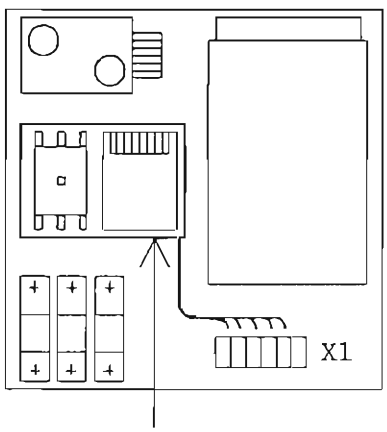
1. Disconnect existing power cables from the SCR fuse terminals in the convertor module.

2. Mount the contactor module on the four stand-offs at the bottom of the convertor module.

3. Connect the existing power cables to the upper terminals on the contactor. The power cables supplied with the contactor module are connected to the SCR fuse terminals.

4. Connect control wires per table below:

Wire no.	Connect to
301	X1:1
302	X1:2
303	X1:7
304	X1:8
305	37.X1:4
306	37.X1:8



Contactor module mounted inside the convertor module 40-120A

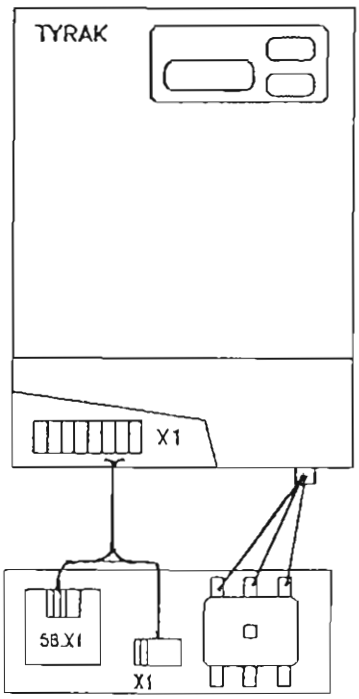
200 - 1400 A

In this current range the contactor module must be mounted in a suitable location outside the convertor module. Convertor modules 200 - 530 A are delivered with top entry AC connection terminals, but can easily be changed to bottom entry.
The contactor module can be located above or below the convertor module, as required.

1. Power cables are connected between the contactor module and the convertor module (not included in the delivery). The dimensioning of these cables must follow local standards of factory built equipment.
   Note: the phase designation of the AC terminals on convertor modules 200 - 530 A differ between top and bottom entry, see dimension print 4893 1006-T.

2. Control cables are connected according to table below:
   (Control wires are not included in the delivery)

Contactor module, terminal:	Convertor module, terminal:
56.X1:1	X1:1 (L1)
56.X1:2 (380V)-- --	X1:2 (L2)
56.X1:3 (415V)--	
56.X1:4 (460V)--	
56.X1:5 (500V)--	
56.X1:7	X1:7 (M1L)
56.X1:8	X1:8 (MN)
56.X1:9	X1:9 (M2L)
	X1:10 - X1:7 (M1L)
X1:1	37.X1:4 (MCONT ON)
X1:2	37.X1:8 (ACK MCONT)



Convertor module

Contactor module

Prod class	Tech ref	Erection Provisions Contactor module	Reserved for customer		
811 399					
Dec reg	Drawn by			Lang	Sheet
4893	H E Johansson			E	2
	Resp dept / Date	ABB Drives	4893 1006-FF	Rev ind	Cont
	DKK / 89-04-19				-

Installation of digital field exciter

The digital field exciter is delivered as a material kit for installation into the drive equipment.

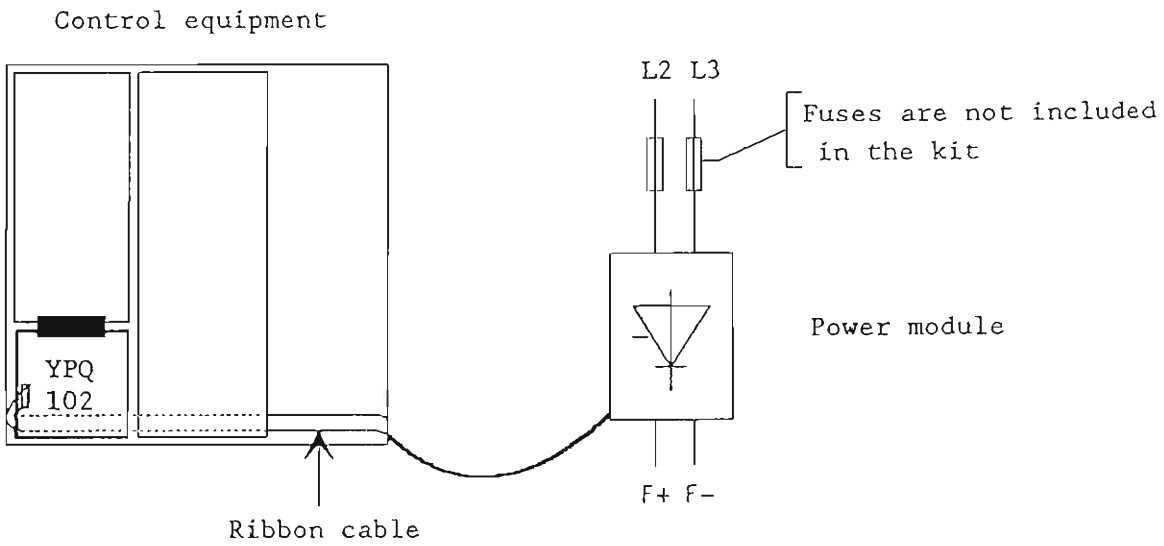
The kit consists of a control board YPQ 102, a power module, a ribbon cable and connectors.

The control board is installed in the convertor module control equipment per figure 1.
The power module is mounted in a suitable location outside the convertor module.
The control board and the power module are connected via the ribbon cable. The ribbon cable should be routed close to a metal surface to avoid electrical interference.

Connect following control cables between the convertor module and the field power module:

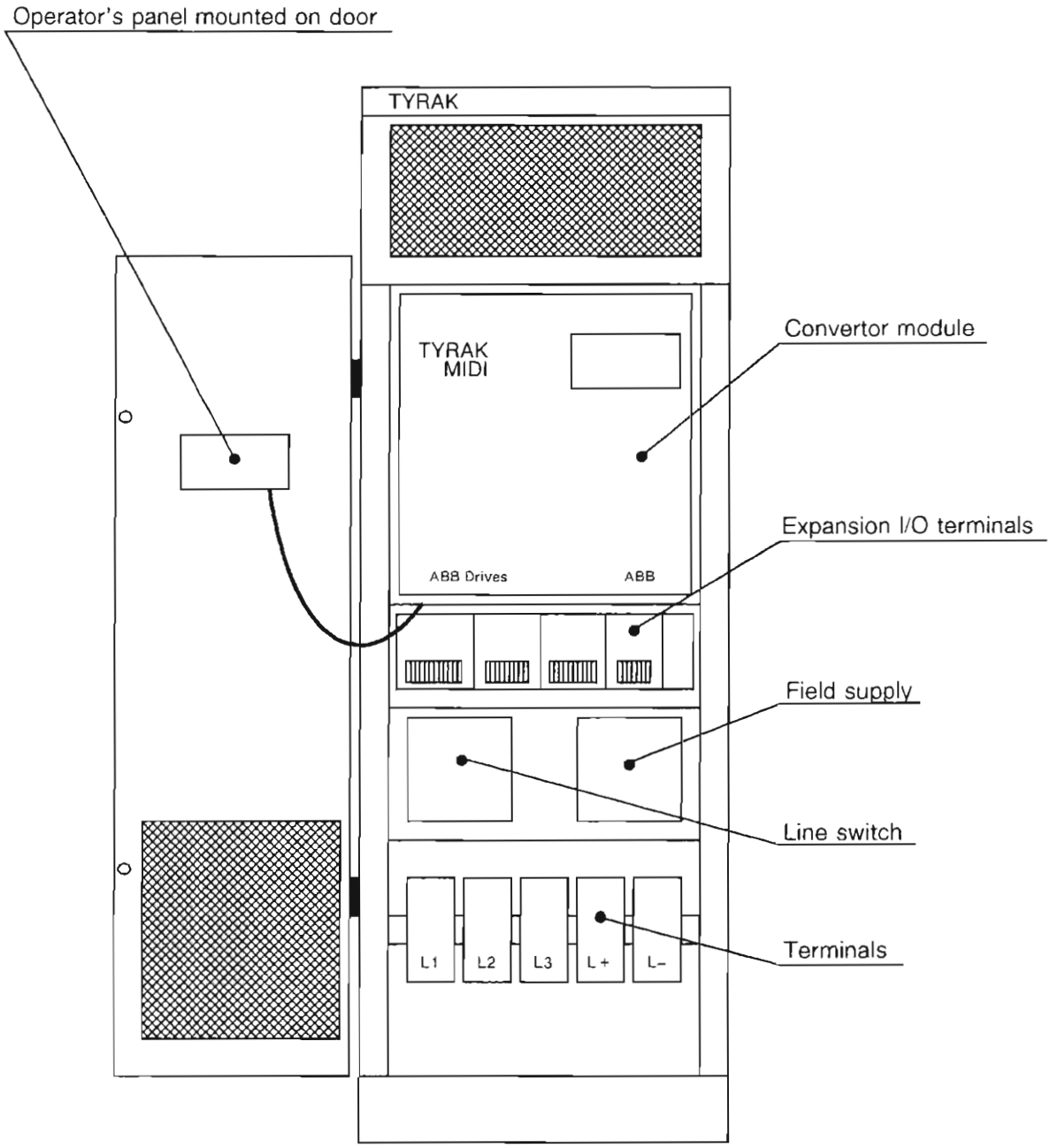
Field power module terminal:	Convertor module terminal:
72.X1:1	37.X1:3 (F. E. ON)
72.X1:2	X1:8 (MN)

The motor field circuit is connected to terminals F+/F-.



Prod class 811 399	Tech ref		Erection Provisions Digital field exciter	Reserved for customer	
Dec reg 4893	Drawn by H E Johansson			Lang E	Sheet 1
	Resp dept DKK	Date 89-04-19	ABB Drives	4893 1006-FG	Rev ind - Cont -

Example of a Tyrak Midi drive equipment built into a standard enclosure



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Commissioning

Instruction YT 390 - 103 E. Edition 2.

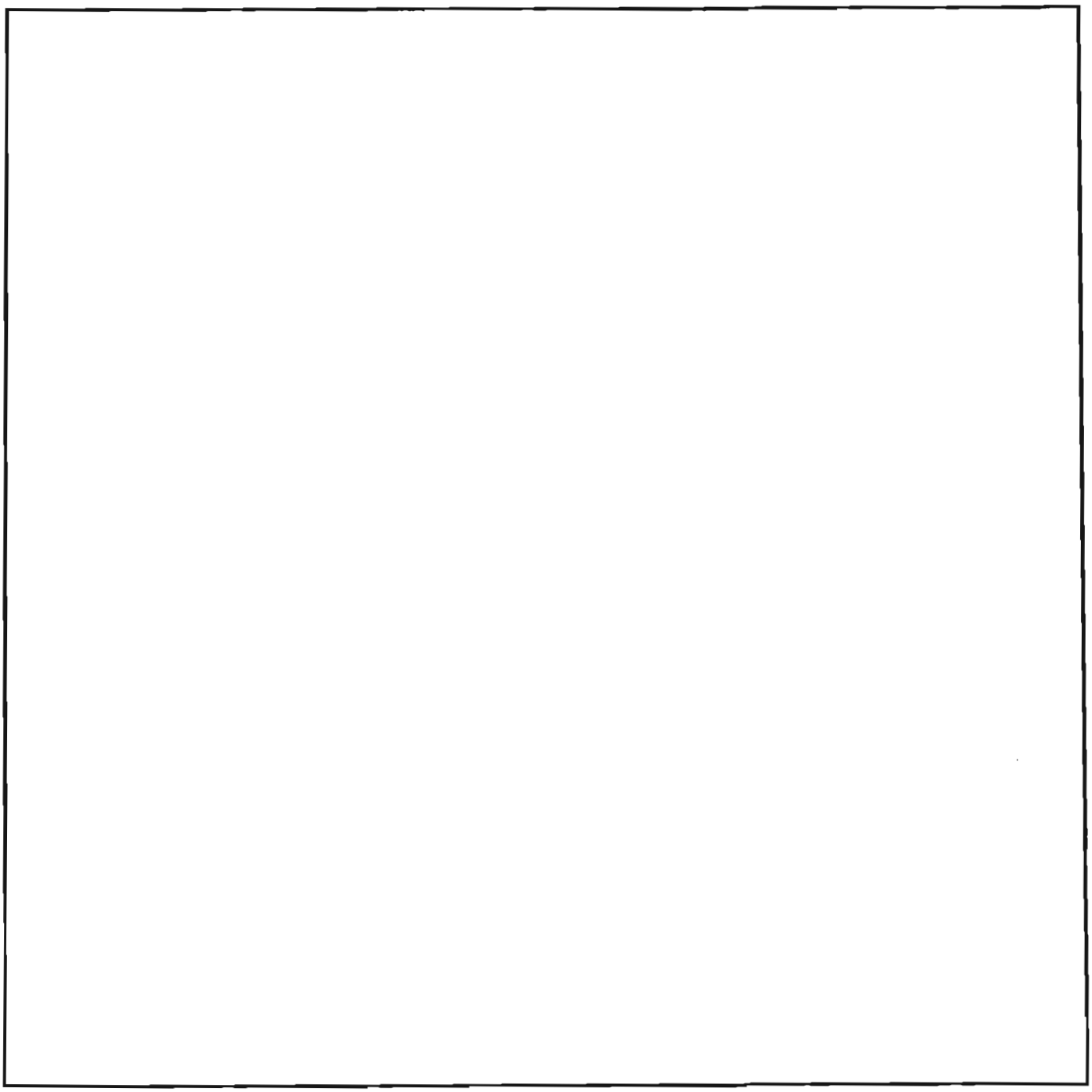

ABB Drives

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Introduction

This commissioning instruction is adapted to the latest release of PCASE software library REL3__X.

The following items have been improved in library REL3__X compared with the old library.

- Current controller. The current control in the area between discontinuous and continuous current is improved.
- A new parameter for reducing the amplification in the current controller is implemented. Two other parameters excluded.
- Supervision of communication between main computer and field exciter implemented.
- Communication between OP-panel and main computer is improved.
- Possibility to select warnings instead of trip for some faults.
- A twinkling LED on computer bord YPP 105 indicates if wrong category of memory board is chosen for the software included. Valid for locally developed PCASE programs.

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.

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 indicates warning . The convertor will during warning still be phase 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 **"Connection board YPQ 108"**. 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 in circuit diagram can not be set from OP-panel. It is however possible to set these parameters from an external terminal, type MICROSCRIBE.

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 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:

IACTRL5X: **I**(current) **A**rmature **Con**T**R**o**L**.

IACTRL is the reference to the current controller.

5; 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, 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 - 510.

1 pcs. Oscilloscope which can be line-triggered, to be used for trimming of rotor current control.

1 pcs. Hand tachometer with pulse generator feedback.

1 pcs. Microscribe. A terminal is needed if parameters which in circuit diagram are crossed over need to be changed.

The following documents are also needed:

- Circuit diagram.
- Apparatus list.
- Description of Tyrak Midi convertor.
- Description of function modules in drive system control including explanation of parameters and signal names.

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.
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, I/O-boards

Check of earthing, auxiliary supply circuits

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, page 14.

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 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.

Check of supply voltage

Check by measurement with a voltmeter that the mains voltage corresponds to the rated voltage for the convertor, ±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 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 IACTRL5X. 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".

Alternative 2
The parameter PHSEQCW (IACTRL5X) 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 converters ≥200 A must be switched. 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.

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 a module, CONNECT 1.

All arithmetical output signals in all function modules, CONNECT1 included, exept signals within brackets.

To digital output channels the following signals can be connected:

All digital output signals in all function modules, including CONNECT 1, except signals within brackets.

The signal paths to be selected and how the parameters in the function modules are to be set to obtain the function required are given in the descriptions of the function modules. See **"Description of function modules"**.

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

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.

Setting of delay angle limitation in the current controller IACTRL5X (73)

On delivery, parameter ALPHALIM is set to 10° and parameter BETALIM to 30°. These values normally need no adjustment but if this is necessary or desirable, see the module description. The parameter BETALIM is set in relation to the mains impedance in accordance with a special calculation.

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 SEQCON4X is described in the table.

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 OPCH30X, 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 OFF2 and ON2 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 SEQCON4X 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 .

After these checks, switch the main circuit breaker off and return the main fuses.

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 SEQCON4X) 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)

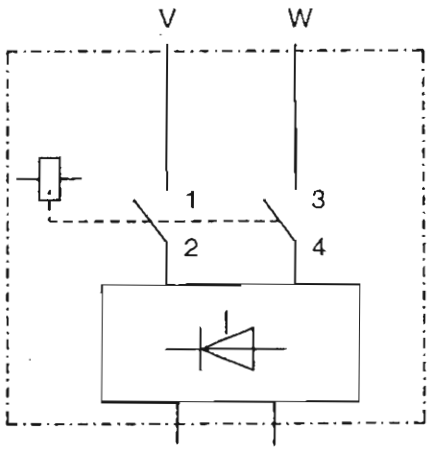
The module IF1CTR1X is common for both single and double field exciters.

The module is attached (software) in the workshop with the parameter AIF1CTR ("1").

The module can be disconnected the same way as expansion 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	
V	W		1	4
	V	W	2	5
V		W	3	6



Adjusting the field current control IF1CTR1X (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". See page 67 in the circuit diagram.

Set the following parameters with the OP-panel.

Function module	Parameter	Setting
IF1CTR1X	FLDEXCDS	"0" single "1" double
	IFSCALE	I exciter/I field (Rated current field exciter/ Rated current field winding).
	FLDCONI	0.0
	FLDCONP	0.0
	FLDCONR	0.0
	FLDCONL	0.0
IAREFH4X (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 %
SEQCON4X	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.

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 IF1CTR1X 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 %
FLDCONP15 %

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 3 % 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 IF1CTR1X with high dynamic demands. (ECTRL11X and EMFSP1X)

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 3 % 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. therefor 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 TEST3X 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 IF1CTR1X 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 ammeter in the field circuit. Check that the measured value is in agreement with IEXCACT. If not, adjust with IFCALVAL.

b) 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.

c) 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.

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" (SEQCON4X). 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 voltmeter can be used to more easily check 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 IAREFH4X is only provided with advanced speed controllers NCTRL2XX and NCTRL3XX.

Function module	Parameter	Value set
IAREFH4X	IALIMPS	20 %
IAREFH4X	IALIMNS	– 20 %
IACTRL5X	OVERCUR	30 %
IACTRL5X	IASCALE	Current convertor/ current armature (Rated current armature convertor/ rated current armature)
NFBADJ0X	NFBADJ	4.000
NFBADJ0X	NFEEDBS	0 (PT-feedback) 1 (TG-feedback) 2 (Armature voltage control)
NCTRL12X	IALIMP	20 %
NCTRL12X	IALIMN	– 20 %
NCTRLXXX	NPROP	"1"
NCTRLXXX	NGAIN	1.0
SPMON1X	ALPHANSP	75 DEG
SPMON1X	MOTOSPL	30 %

Calculation and strapping of connection board YPQ 108 with tacho feedback (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 YPQ 108 in accordance with the table on page 27 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 (AI37.4) on the analog input board.

If the REF + and REF– push buttons are connected on the OP-panel, all external reference inputs on YPQ 108 can be disconnected. This is done most simply by disconnecting terminal block X4.

If the OP-panel does not have REF + and REF– marked buttons a reference potentiometer is connected to a suitable speed reference input on 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 between terminal blocks X5:7 and 8 with the plus on 8.

Adaptation of board YPQ 108 with digital speed feedback (29)

The strapping of YPQ 108 is dependent on the pulse transmitter selected.

The table for the location of the straps is given on sheet 29 of the circuit diagram.

Leine & Linde	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 YPQ 108 and is calculated in accordance with the following:

$$\text{Max pulsfrequency} = \frac{N_{max}}{60} \times P$$

Where N_{max} = max. speed at which the d.c. motor will be run.
P = Number of pulses/revolution from pulse transmitter.

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 29 in the circuit diagram.

Switch on the convertor main circuit breaker and set the following parameters in function modules DSP1311X and DSP2312X.

- When both channels A and B from the pulse generator are connected, parameter NBREDGES is set to 4. (Channel A X6:1, channel B X6:3).In module DSP1311X the parameter NBREDGES is not shown in circuit diagram but it is however set internally to the value 4.

- 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. If very fast speed control is required, the parameter can be set at 6 ms. The parameter may not be set higher than 63 ms.

Note! If the setting of parameter NMAX, NBRPPR and MOTOSPL (in module SPMON1X) exceeds maximum puls frequency 50 kHz the the convertor will trip for "OVERSPEED".

Check of rotation direction (27, 29, 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 (SEQCON4X) 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 (X6:1 and X6:3 on 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 (SPMON1X) 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 (SPMON1X) 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 adaptation 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. 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 field-weakening, the EMF actual value is used.

Adjusting of the EMF actual value with EMF control (when EMFMEM0X 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 AI37.3MU.
- Set parameter ARMRVOLT (EMFMEM0X) 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 IACTRL5X 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.

Setting of voltage adaptation and adjusting of the signal EMFVOLT for drives with EMF control (73)

Set the parameter in the function module IACTRL5X 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 (EMFMEM0X) 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.

Adjusting of parameter ALPHAADJ with double convertors

The parameter ALPHAADJ in function module IACTRL5X must also be adjusted when fast control contact with pole reversal is required (voltage adaption).

The parameter is set at 180° 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° which gives the shortest reversal time of armature current.

Adjusting of current control

General

In the current control IACTRL5X, 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:

YPQ 101		IACALVAL		
		IACTRL1X - IACTRL4X		ACTRL5X -
Version	Bare board number	50 Hz	60 Hz	50/60 Hz
0	2668 184 - 436	35.4 %	42.5 %	35.4 %
1	2668 184 - 436/1	35.4 %	42.5 %	35.4 %
2	2668 184 - 436/2	35.4 %	42.5 %	35.4 %
3 - 4	2668 184 - 436/3	78.0 %	93.6 %	78.0 %
5	2668 184 - 436/4	78.0 %	93.6 %	78.0 %

The setting can be adjusted on site in accordance with the following.

Connect a digital voltmeter over the current feedback on the pulse transformer unit, page 90, between X31.A13 and B13 and set the following parameters:

- NPROP (NCTRLXXX) to "1".
- IFACKBLK (SEQCON4X) to "1".
- MOTOSPL (SPMON1X) to 30 %.
- 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 IAACT in the function module IACTRL5X on the OP-panel. IAACT 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 when the signal IAACT is measured. IAACT 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 to check that the machine remains stationary.

The current feedback is measured by connecting an oscilloscope to YPQ 108, terminal block X7:3 and 4 with 0 V on terminal block 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 d.c. 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	
IACTRL5X	OVERCUR	set at a value which corresponds to the rated current of the d.c. motor multiplied by 1.15 if it is lower than that of the convertor.
IAREFH4X with advanced speed controller	IALIMPS	set at a value which corresponds to the rated current of the d.c. motor (100 % corresponds to the rated current of the convertor).
IF1CTR1X	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.
NCTRL12X	IALIMP	set at a value corresponding to the rated current of the d.c. motor (100 % corresponds to the rated current of the convertor).
NCTRLXXX	NPROP	set to "1" for P-connection.
SEQCON4X	IFACKBLK	set to 1 which acknowledges the field current.
SPMON1X	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 in continuous current mode.
2. Verification of the result in discontinuous current mode.
3. Setting of gain in current controller.

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 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 figure 1.

In all alternatives shown in figure 1, parameter CONSTCON is adjusted correctly.

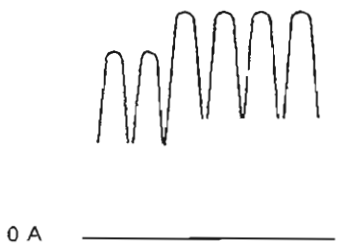


Figure 1a

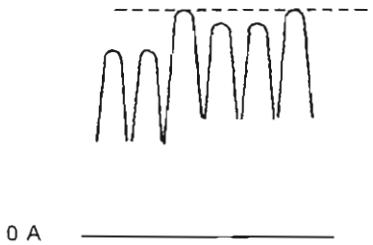


Figure 1b

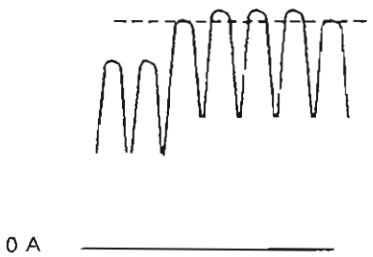


Figure 1c

The fault shown in figure 1b or 1c is corrected with parameter CONSTRL.

In figure 1b the parameter CONSTRL is set too low.
In figure 1c the parameter CONSTRL is set too high.

After adjusting parameter CONSTRL the result shall be in accordance with figure 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 figure 2.

If the step response in the discontinuous current mode does not correspond to figure 2, the adjustments made in continuous mode are not correct. The current controller need to be re-adjusted.

Start from point 1 again.

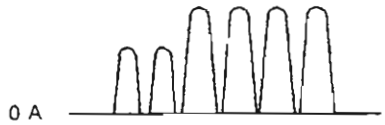


Figure 2

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 the parameter IAGAIN is to be set as low as possible, however the need of quick current control must be considered.

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 EMFMEM0X 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 EMFMEM0X (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 NCTRL12X. 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 IAREFH4X. 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 NCTRL12X. 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 IAREFH4X.

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 SPMON1X to 110 %.

Reset the parameter IFGTMINL (IF1CTR1X) to 70 % (approx.) of the field current at max. speed.

The parameter IFACKBLK in function module SEQCON4X 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 NCTRL12X or advanced speed controller NCTRL33X (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 NCTRL12X or NCTRL33X, 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 NCTRL12X or NCTRL33X, 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 NCTRL24X (64)

The advanced controller NCTRL24X 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

NCTRL24X
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 figure 4 or as a PDPI-controller figure 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.

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.

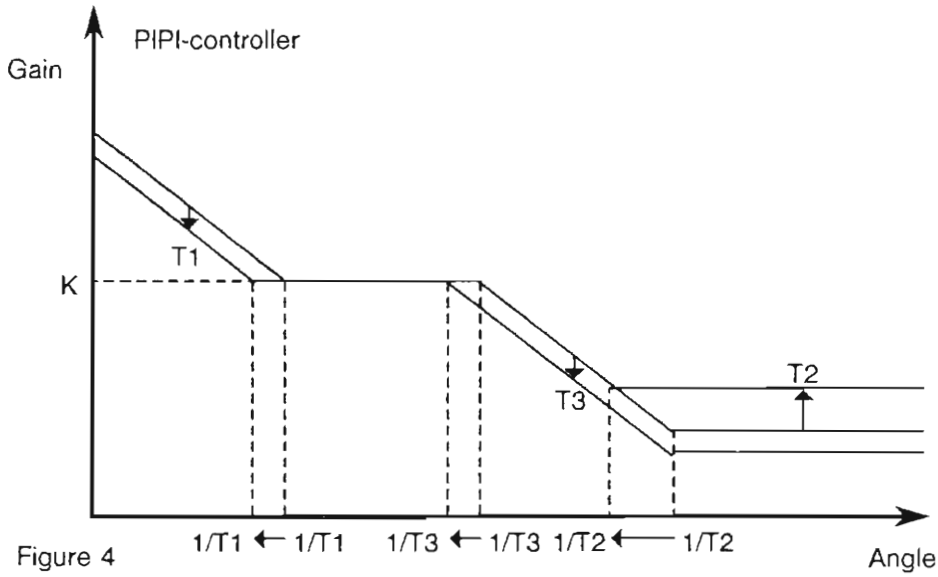


Figure 4

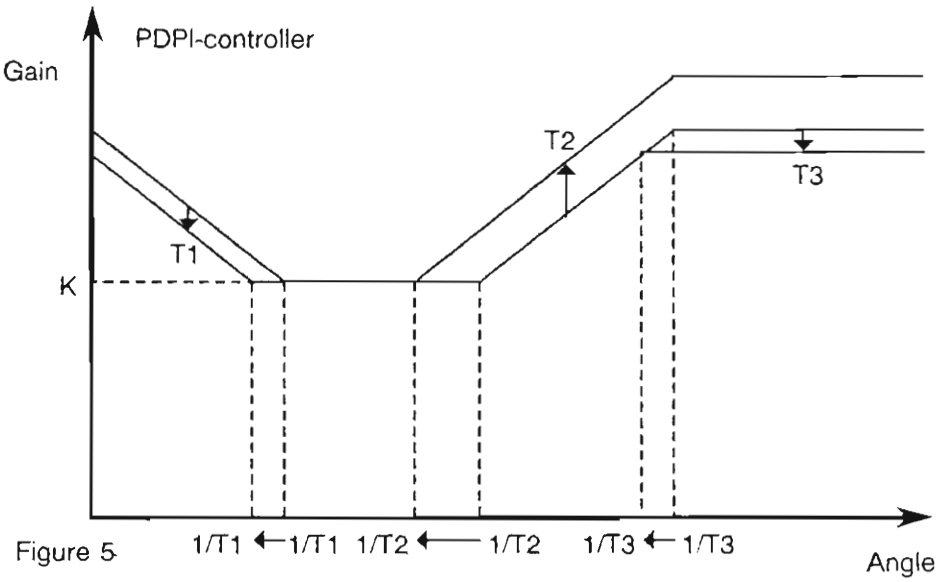


Figure 5

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.

FILIMN, FILIMP %	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 NINDE11X 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 (TEST3X) 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 FI0FI 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 FI0FI. Signal FI0FI 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.

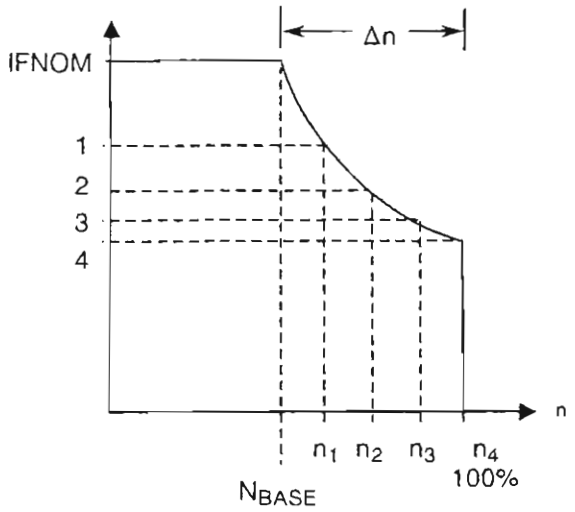
Speed-controlled field weakening EMFSP1X (75)

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.

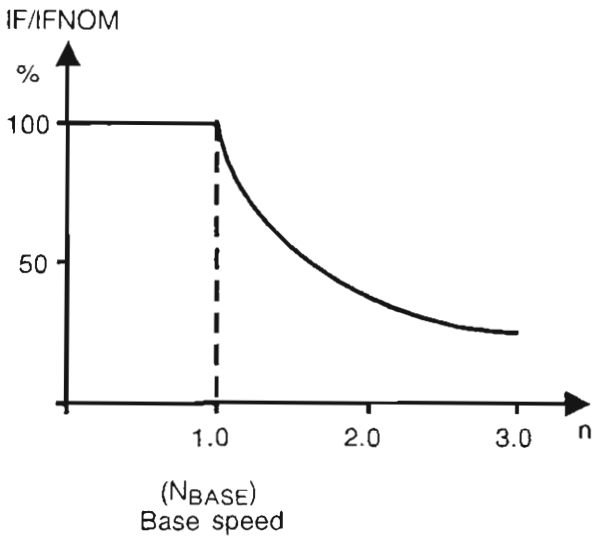
The values for n_1, n_2 and n_3 are now calculated in accordance with the following:

$n_1 = n_{base} + 0{,}1 \times \Delta n$
$n_2 = n_{base} + 0{,}3 \times \Delta n$
$n_3 = n_{base} + 0{,}6 \times \Delta n$
$n_4 = 100\ \%$



Put n_{base}, 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, LAN, DMA, DMB



Set the parameters. Values obtained in IFCONST 1 - 4, obtained from field weakening curve and parameter N_{BASE}.

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 FI0FI 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 FI0FI. Signal FI0FI 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

In the new software library 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 EXFLT3X is an exception. the parameters EXFLTD1S, EXFLTD2S and EXFLTD3S in this module are default set to "0" 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 SPMON1X, 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 EMFMEM0X 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 %.

The parameters ARMVL, ALPHAHL, ALPHALL and IAACTL in the function module normally need not be changed.

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 TRIP24X 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:

$$\frac{\text{Motor current rating (A)}}{\text{Convertor current rating (A)}} \times 100 = \text{Setting of parameter ARMOLL.}$$

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.

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 IACTRL5X (73,74)

The overcurrent protection is to be set at 230 % of the rated motor current. The protection is set in function module IACTRL5X 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 TRIP35X 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 channels"**.

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 TYTEMP1X 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 channels"**.

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 TYTEMP1X 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	40	1000
70	1	40	1000
120	1	22	1000
200	1	23	2000
350	1	46	2000
530	1	43	2000
800	0	27	2000
1100	0	25	3000
1400	0	30	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 TRIP15X 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 (40)

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 TQMON2X 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 IACTRL4X that parameter IASTEP1 is at 0 %.

Check, in function module SEQCON4X that parameter IFACKBLK is at 0.

Reset the fault logger by **temporarily** setting parameter FCLEAR in function module FLTLOG6X to "1".

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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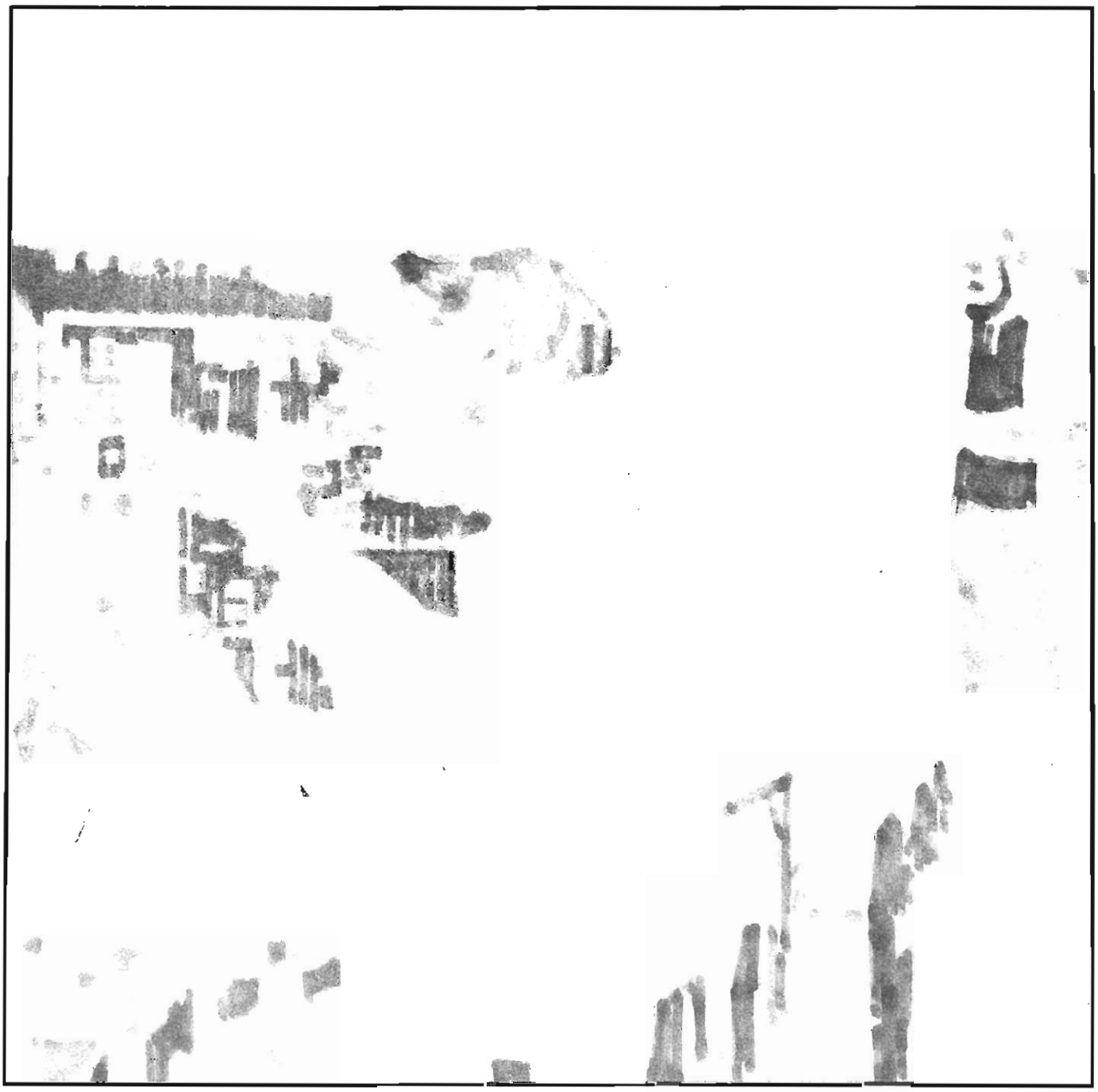

ABB Drives

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General

The convertor contains no components subject to mechanical wear. The maintenance therefore mainly consists of preventive maintenance. In addition to the following check points, the convertor requires general maintenance to avoid interruption to operations.

This type of maintenance is common to all types of electrical equipment and can therefore be considered sufficiently well established as a service routine.

Check points

The convertor should be inspected at regular intervals. The frequency of these inspections is determined by the nature of the operation and environmental factors (vibration, dust, humidity).

The following points should then be checked:

- Fouling
- Connections
- Installation

Observe the risk of electric shock! Before work is begun in the convertor, make sure that the a.c. supply is disconnected.

Fouling

Cubicles in which foreign material has accumulated must be cleaned. Dust and similar fouling can be removed with a vacuum cleaner. Compressed air can be used to remove stubborn deposits but this should be free from condensation. Fouling, difficult to remove otherwise, can be removed with isopropyl alcohol (or a similar solvent) which may be blown dry with clean air.

A visual inspection should be performed after cleaning to detect any mechanical damage or components damaged by overheating.

Connections

Main circuits

Tighten all screwed cable and bar connections. Check bar joints and connections to thyristors and the fast acting fuses on the thyristor unit.

The following torque values should be set on the wrench:

Thyristor modules 40 - 530 A

	Mechanical fixings	Electrical fixings
M5	4 Nm	4 Nm
M6	5.5 Nm	5.5 Nm
M8		15 Nm

Bus bar joints

	Mechanical fixings
M4	1.4 Nm
M5	2.9 Nm
M6	9Nm
M8	20Nm
M10	40 Nm
M12	72 Nm

For thread-cutting screws in sheet metal (T = 2 mm), use 6 Nm.

Other circuits

Check the tightness of all screwed connections with a screwdriver (contactors, transformers, circuit boards, terminals, etc.)! Check that the circuit board connectors are installed correctly.

Installation

Ensure that all units are screwed together firmly and that no screws or nuts are loose.

Check the circuit boards of the control equipment with respect to fixing and connections.

Wiring is to be fixed to avoid chafing against sharp edges.

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 40/70, 120 A

- Disconnect the two flat tab connectors and the earth connection to the fan.
- Disconnect the thermal protection, terminal blocks X10.6 and 7.
- Loosen 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 two fixing screws at the front of the fan. Pull out the fan. After insertion of the new fan, check that the seal is effective.

Fan, convertors 800 - 1400 A

Both single and double convertors have two fans designated 12.1 and 12.2.

- Disconnect the fan cable/cables in terminal block X10 and the earth connections.

  X10.3 blue
  X10.4 black
  X10.5 brown
  X10.6 white
  X10.7 white
  X10.8 white

- Remowe the fixing screws on the fan. Remove the fan.

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.

Thyristor, convertors 800 - 1400 A

- Remove the protective cover.

- Remove the fast acting fuse in the branch concerned.

- Remove trigger pulse cables to the thyristor.

- Unscrew the heat sink package using a socket wrench with extension as shown in figure 1.
  Note! Do not pull out the screw.

- Pull the heat sink package straight out.

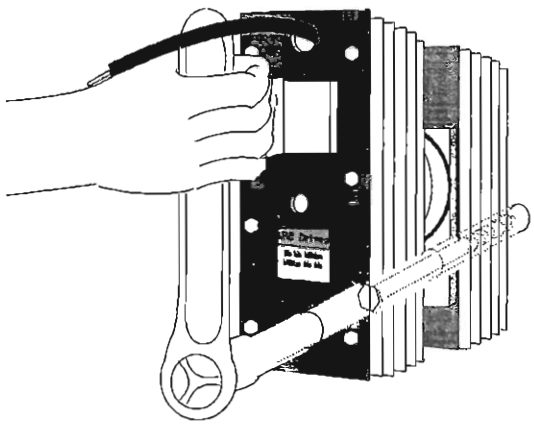

Figure 1.

Now, with the heat sink package separate, it is time to replace the thyristor.

- Remove the metal front cover.

- Loosen the thyristor mounting clamp until the heat sink halves are separated enough for the thyristor to be removed.

- Install the new thyristor as described in installation instructions below.

The mounting clamp is tightened to the correct torque as described below. (Figur 2)

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 tighten the screws with the torque values given in section "Connections", page 3.

- "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). Tighten the screws until the spring indicating the correct force is in level with the plate bracket as shown in figure 2.

Circuit boards

The main voltage must be disconnected when replacing circuit boards.

Important!
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, preferably using an earthed wrist band.

Remove connections at screw terminal blocks and/or ribbon cable contacts by drawing these straight out from the board. Loosen the board carefully from the holders/screw connections .

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.

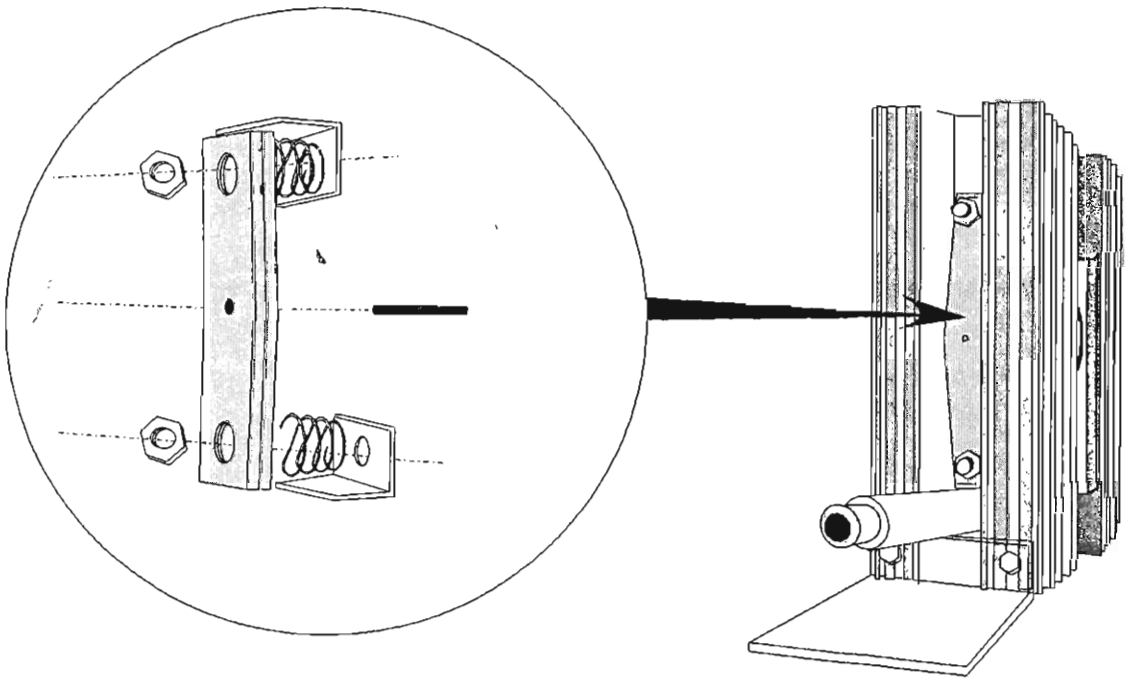

Figure 2.

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 started up 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

- Disconnect the ribbon cable 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 plate.
  Note! The adhesive sticks 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.

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Fault tracing

YT 280-332 E

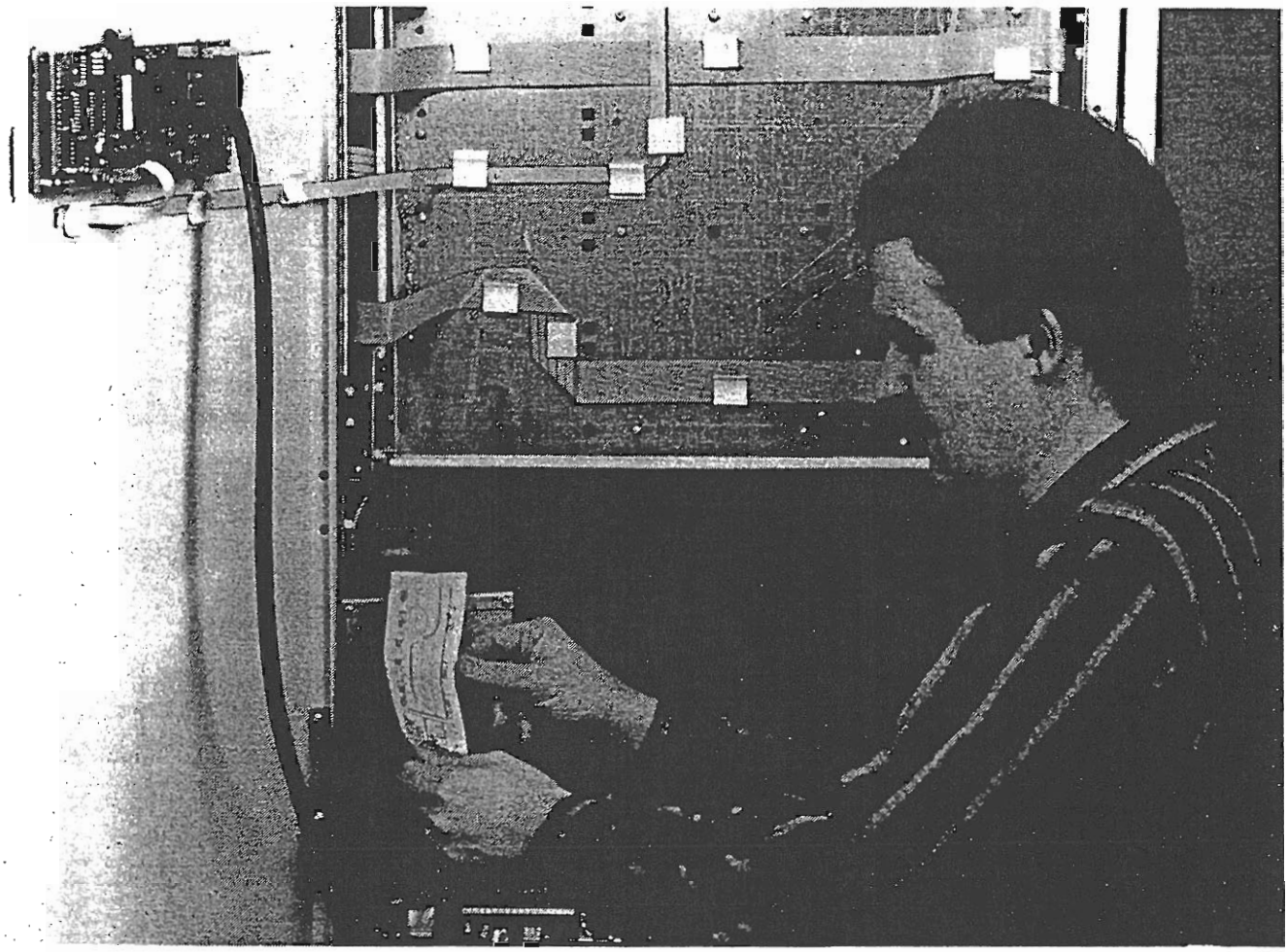

ABB Drives

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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 durin the time scale set. This updating is continuous and ca 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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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 cursor positions.

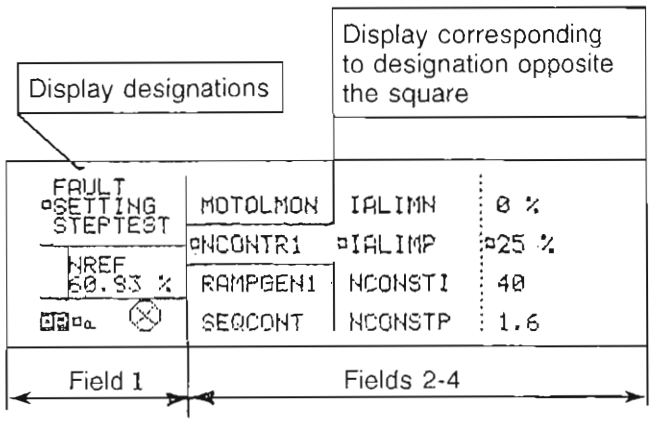


Figure 1. Arrangement of operator's panel display.

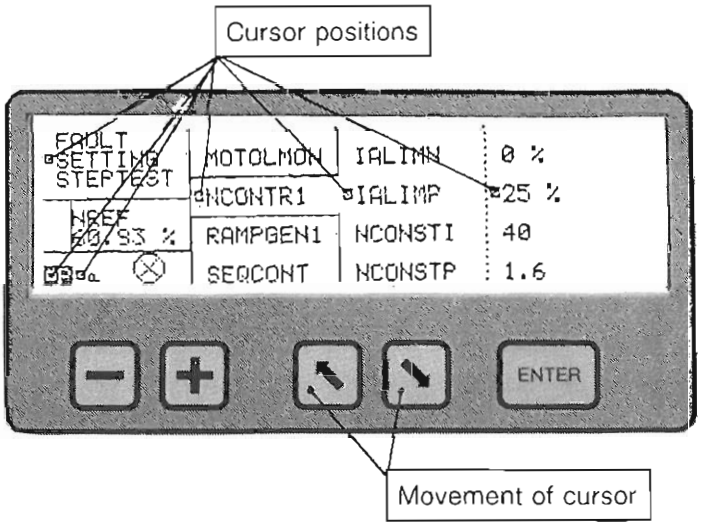


Figure 2.

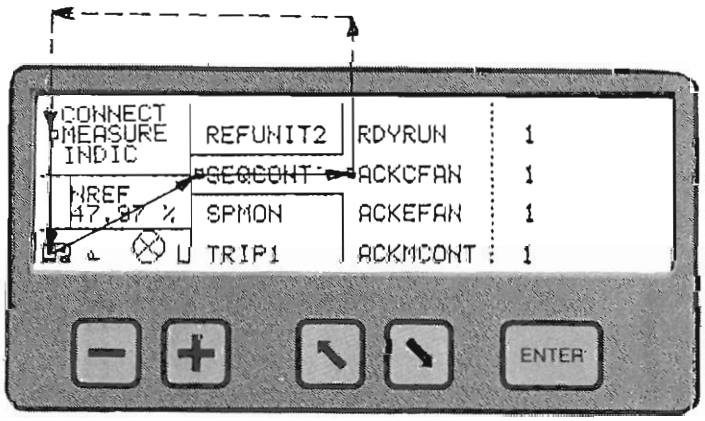


Figure 3. Display MEASURE.
Example of cursor movement on pressing ↘ . The cursor moves in the opposite direction when ↖ is pressed.

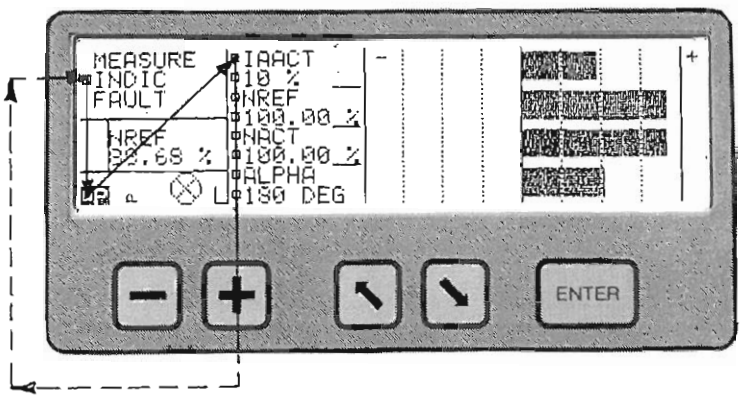


Figure 4. Display INDIC (ATION). Example of cursor movement on pressing ↘ . When ↖ is pressed, the cursor moves in the opposite direction.

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 – .

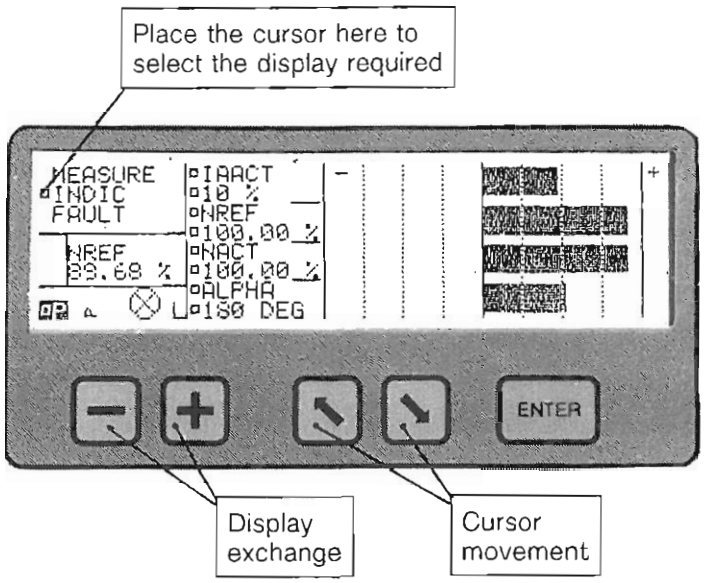
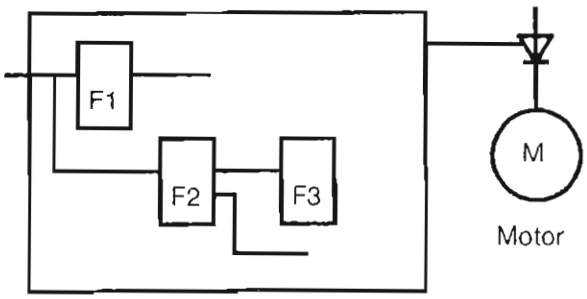


Figure 5. Display selection.

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.

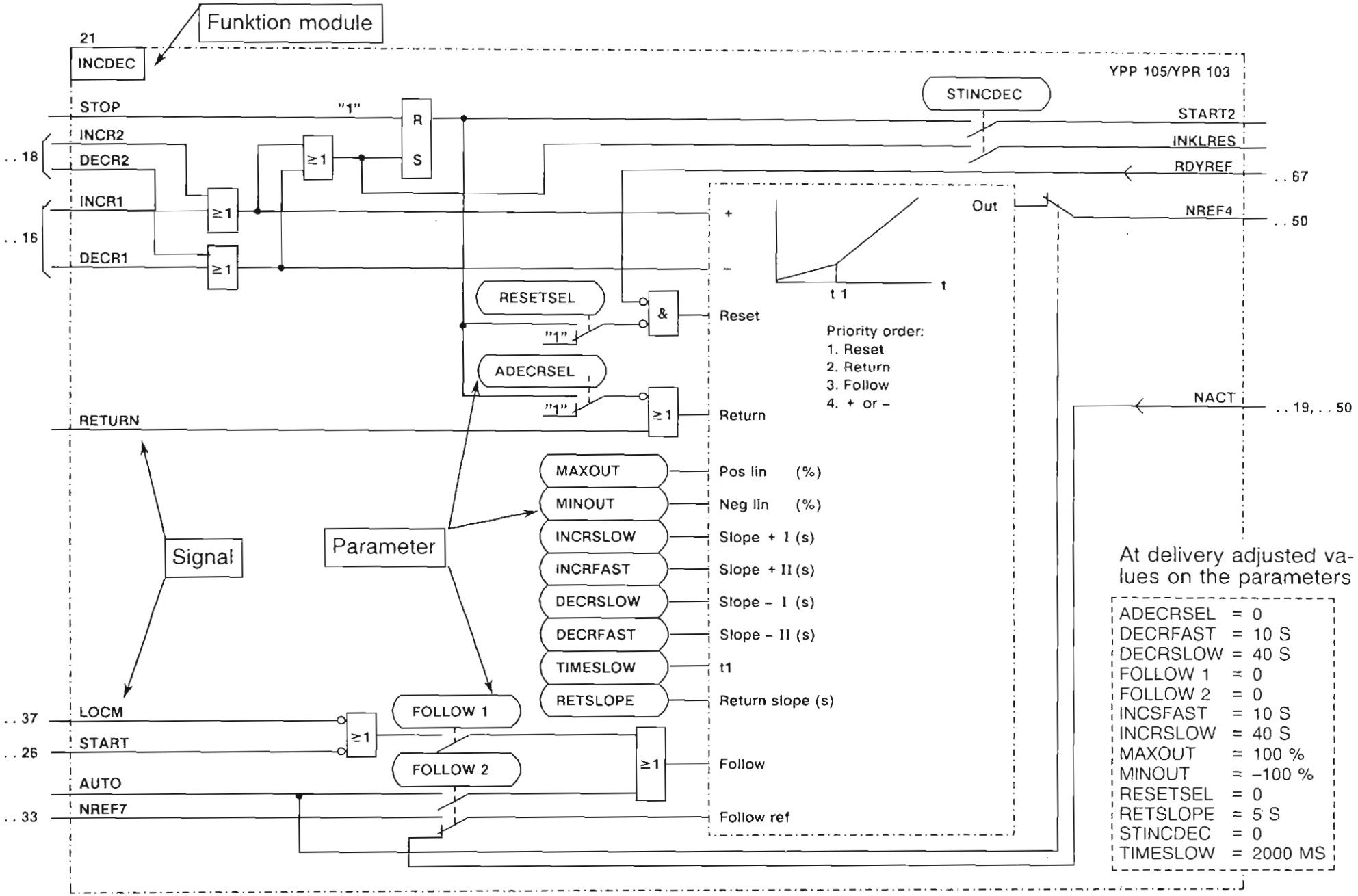


Figure 7. Example of a function module.

The figures 8 and 9 show the displays for measurement (MEASURE) and parameter setting (SETTING) respectively.

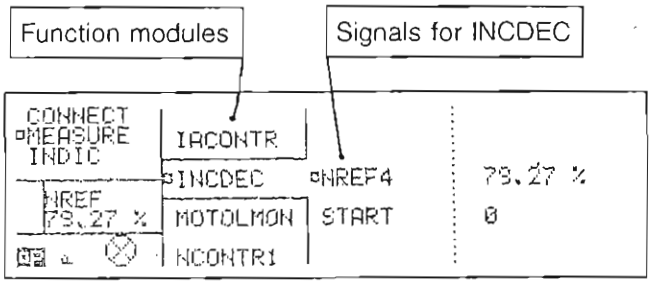


Figure 8. Measurement.

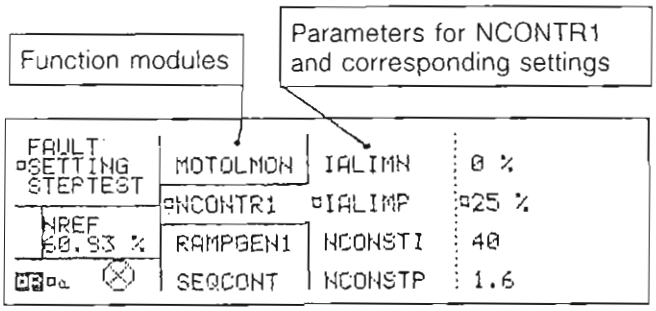


Figure 9. Parameter setting.

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.

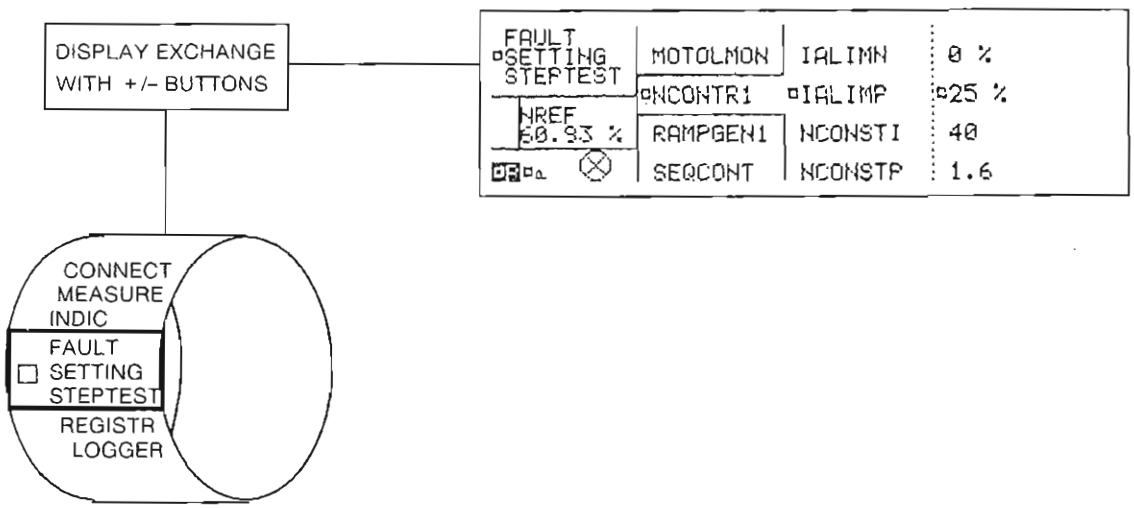


Figure 10. Model to illustrate text presentation (in this case, display designations at top of Field 1).

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.

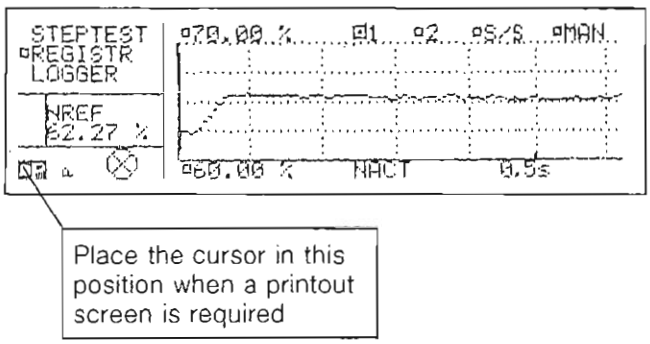


Figure 11. Printout.

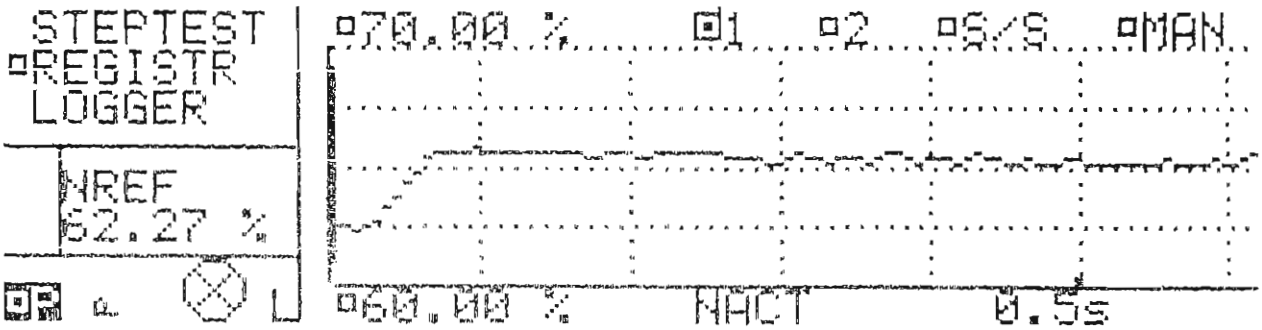


*Figure 12. Appearance of printout when **ENTER** is pressed.*

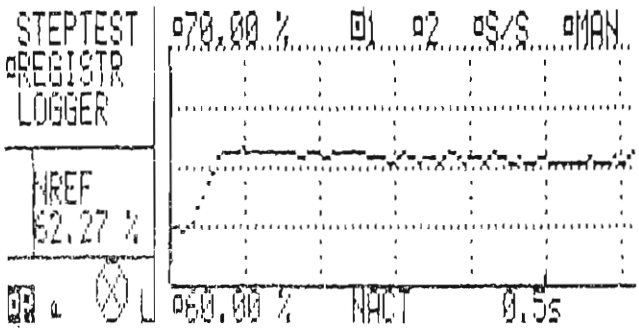


*Figure 13. Appearance of printout when **+** is pressed.*

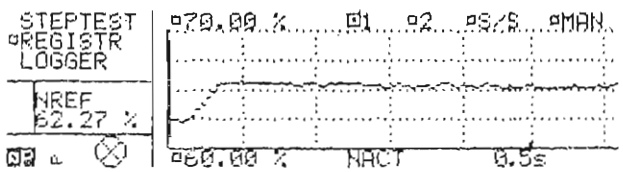
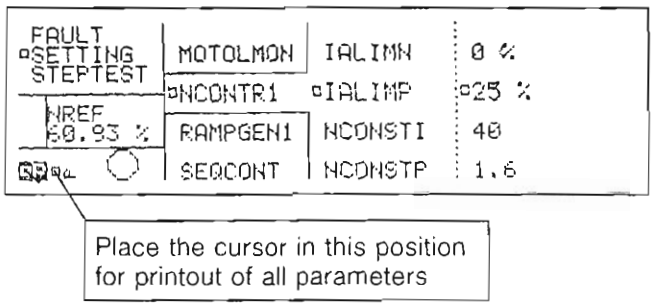


*Figure 14. Appearance of printout when **–** is pressed.*

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**.

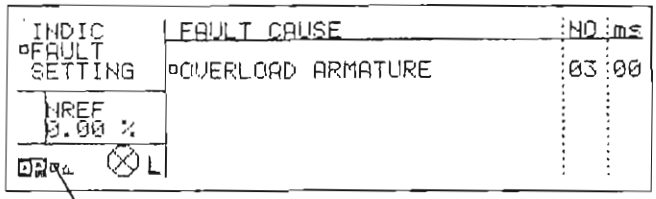



```
NCONTR1
=======
IADERMAX = 100
IALIMN   = 0 %
IALIMP   = 25 %
NCONSTI  = 40
NCONSTP  = 1.6
NDERCONS = 6.9
NFILTTC  = 121 MS
```

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.

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.

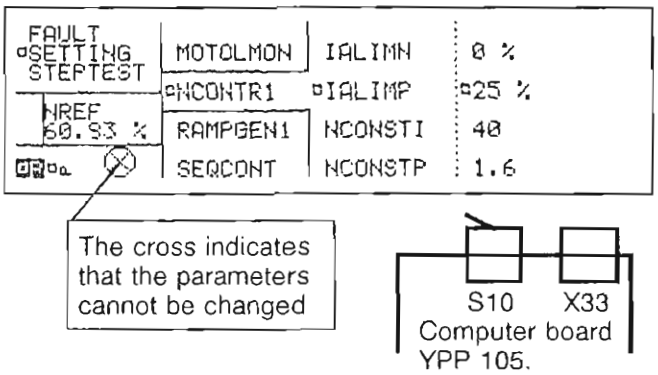


Figure 17. Latch function active. Parameters cannot be changed.

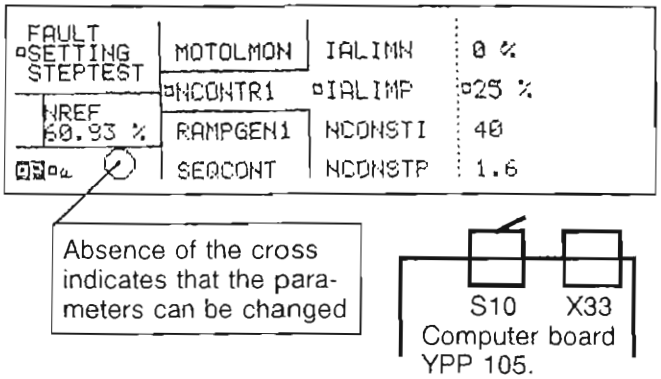


Figure 18. Latch function inactive. Parameters can be changed.

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.

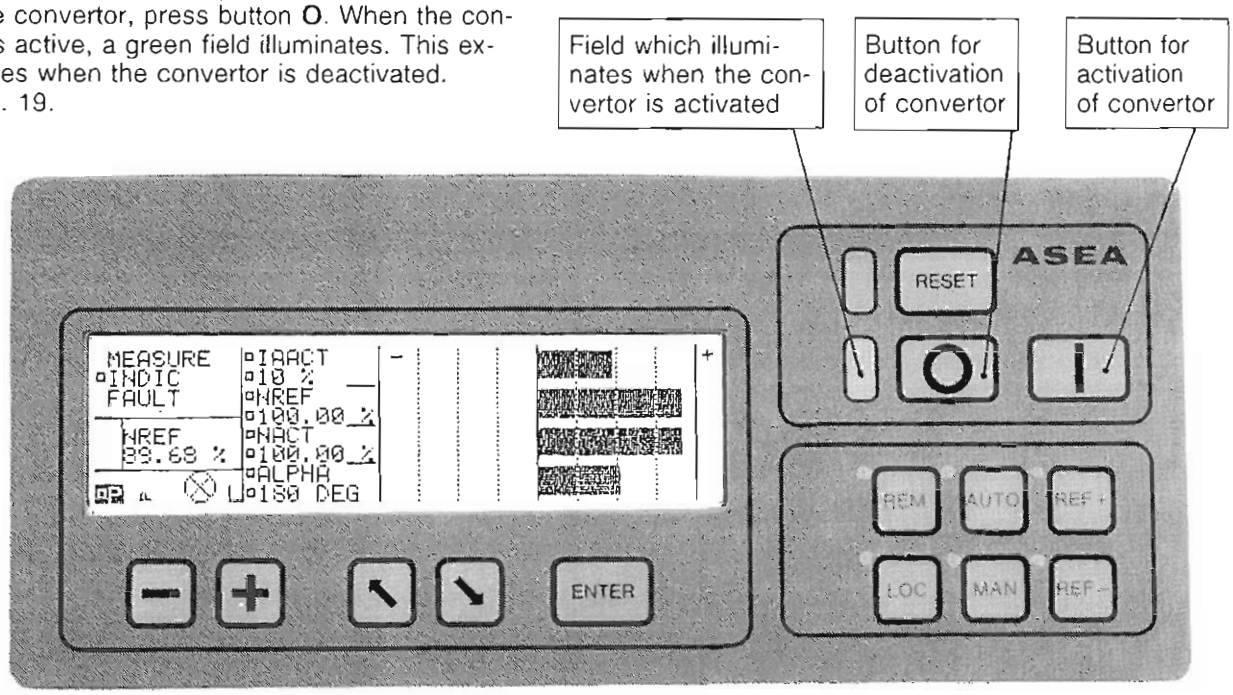


Figure 19. Activation and deactivation of convertor.

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.

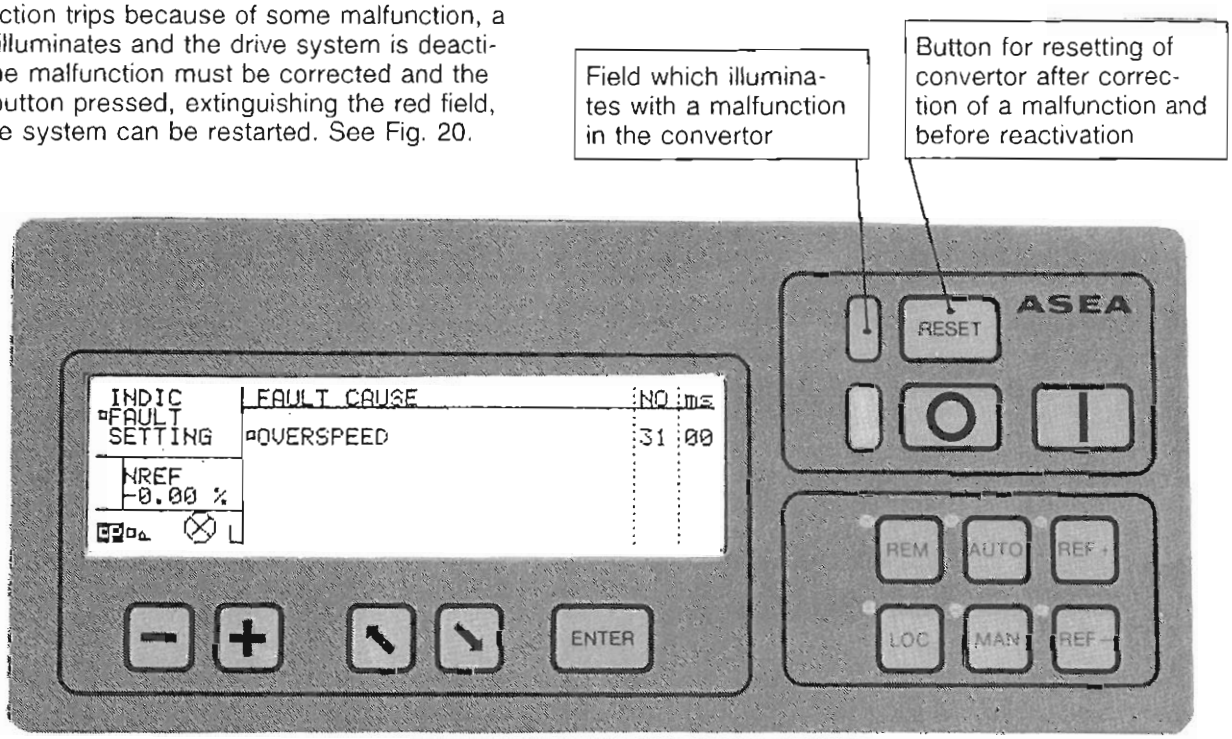
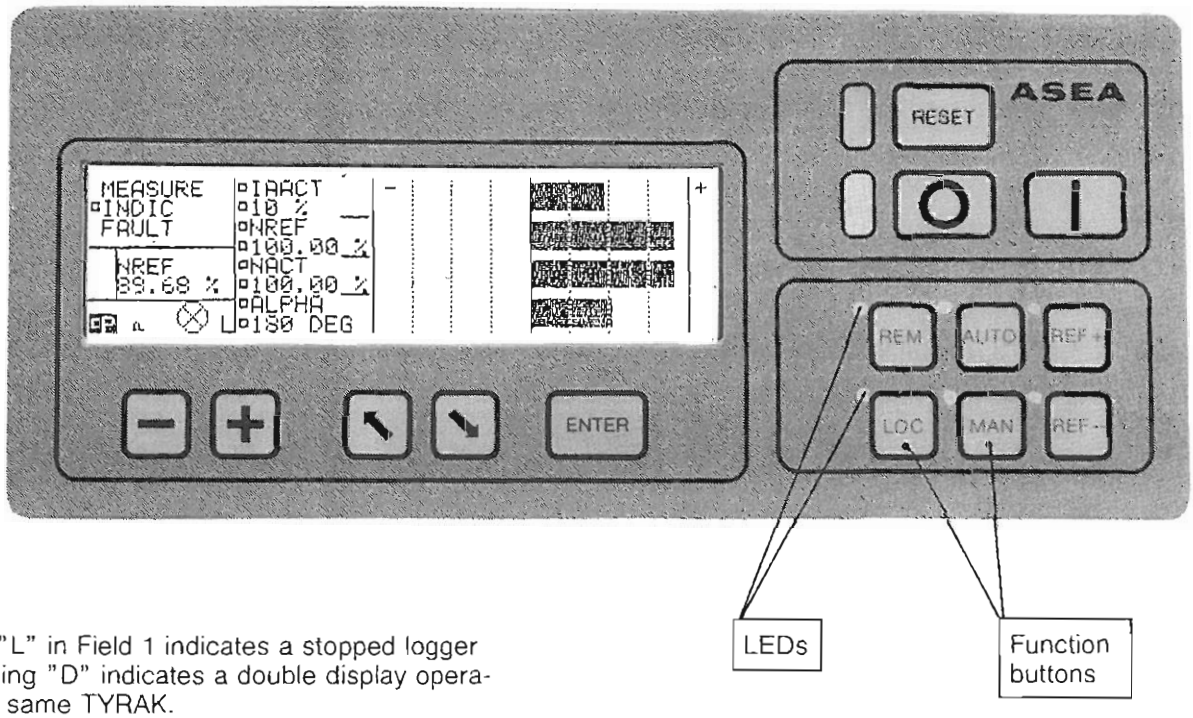


Figure 20. Resetting of convertor before reactivation .

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 ˋENERAL

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.

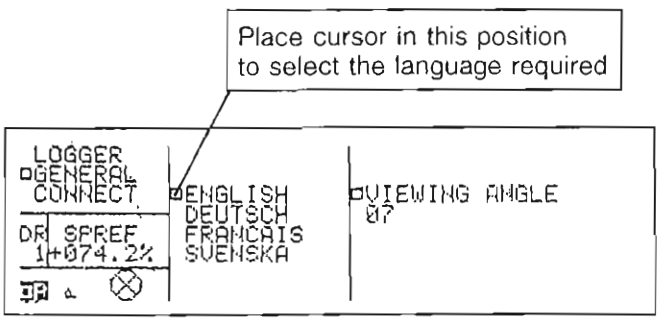


Figure 22. Display General. Selection of language.

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.

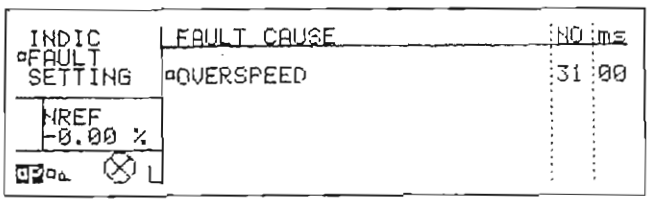


Figure 24. Fault Indication.

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.

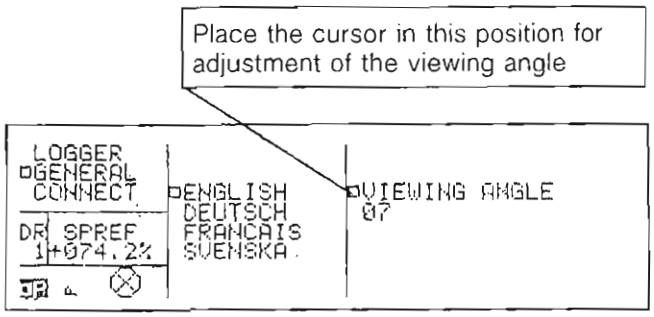


Figure 25. General.
Adjustment of viewing angle.

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.

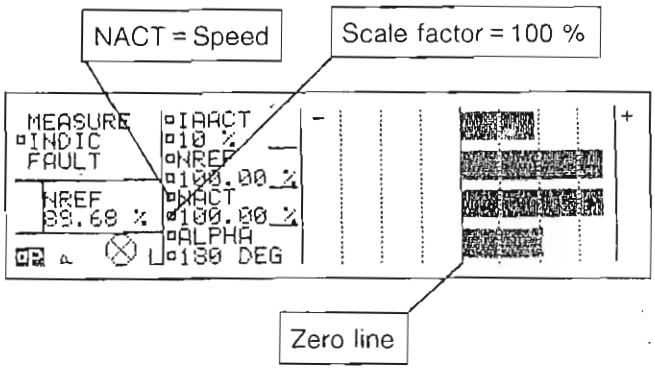


Figure 26. Appearance of Indication display.

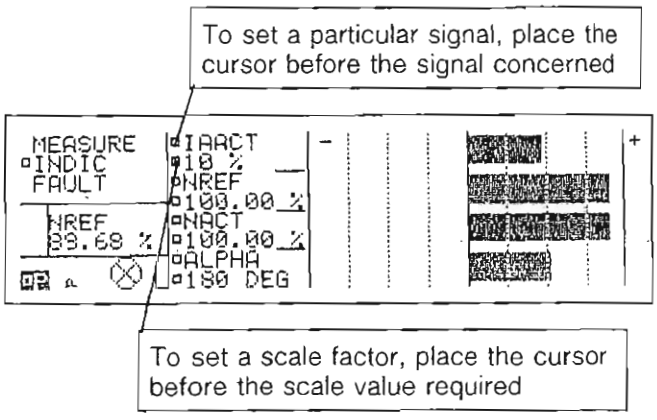


Figure 27. Display INDIC.
Setting of signal and scale factors.

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.

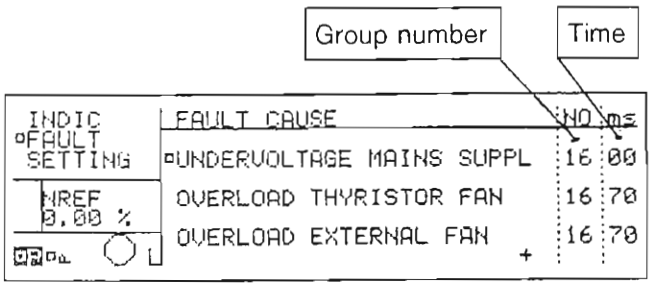


Figure 28. Fault Indication.

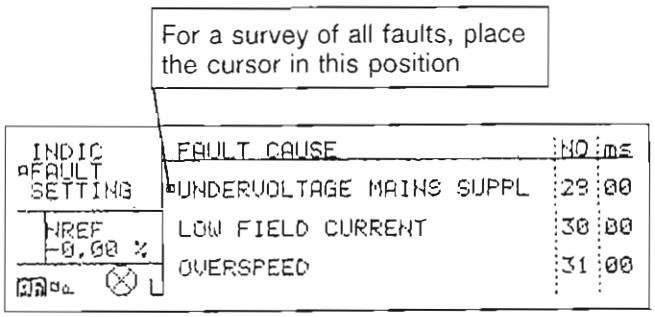


Figure 29. Fault statistics.

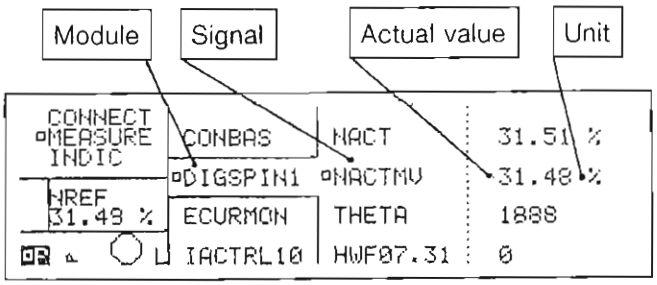


Figure 30. Measurement of signals.

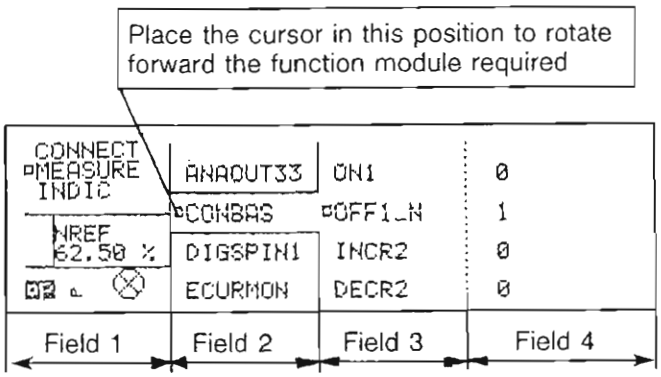


Figure 31. Measurement of signals. Setting of required function module.

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 operator's panel.

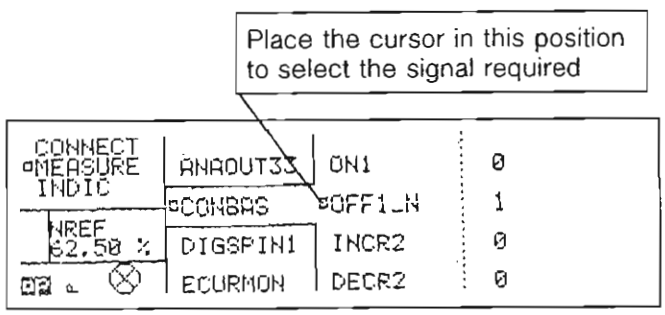


Figure 32. Measurement of signals. Selection of a signal.

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.

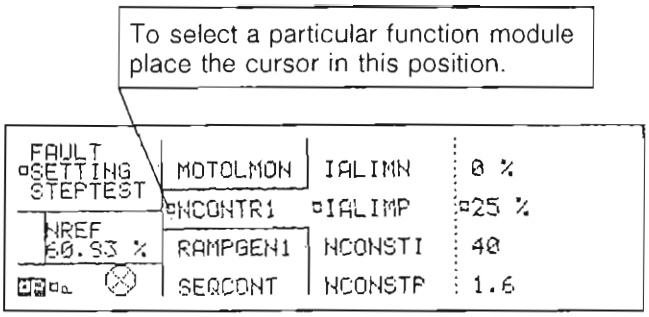


Figure 33. Parameter display. Selection of function module.

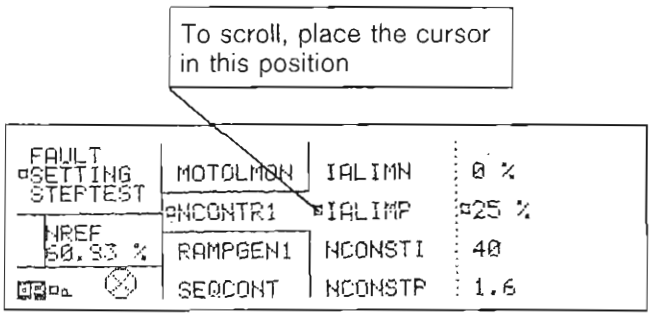


Figure 34. Parameter display. Parameter check.

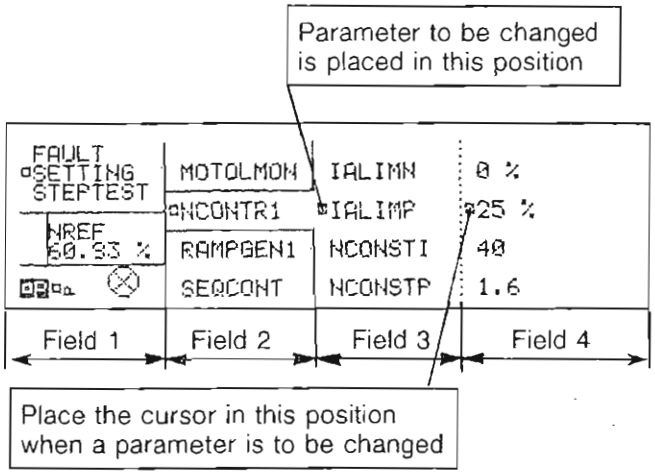


Figure 35. Parameter display. Setting of parameter.

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 position S/S.

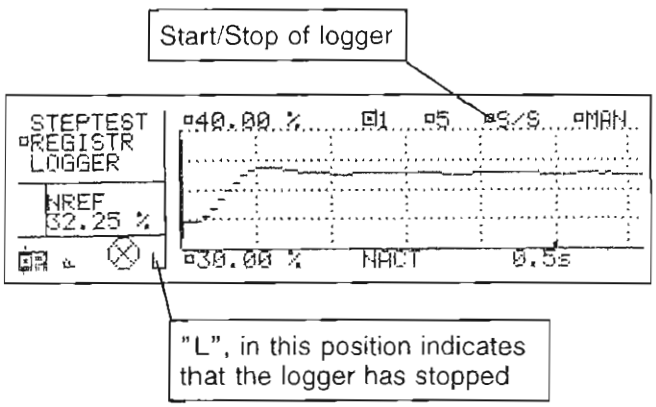


Figure 36. REGISTR. Start of logger.

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.

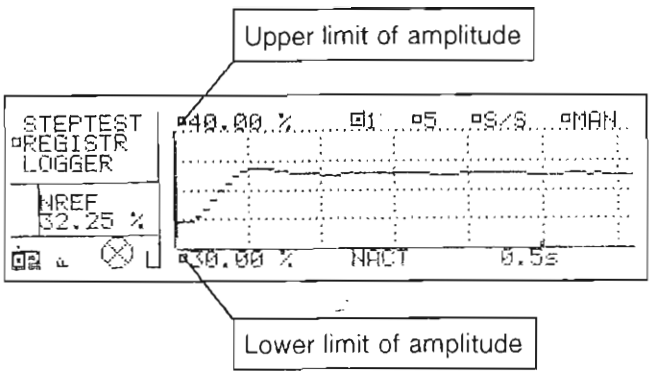


Figure 37. Registration.
Setting of amplitude.

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**.

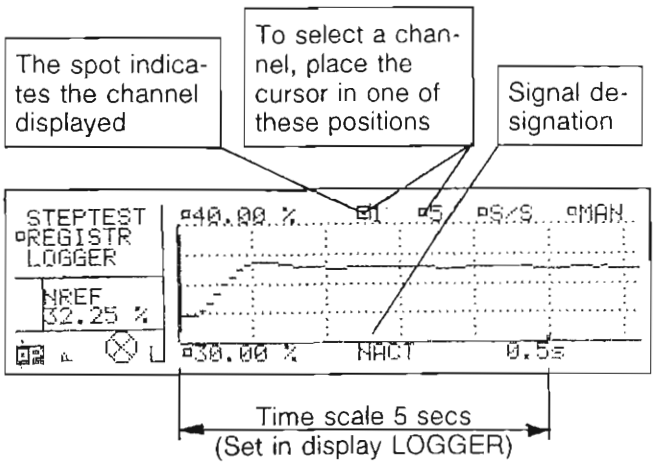


Figure 38. Registration.
Selection of channel.

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.

The signal currently displayed is to be compared with another signal, the cursor is placed in position A or position B. See fig. 39.

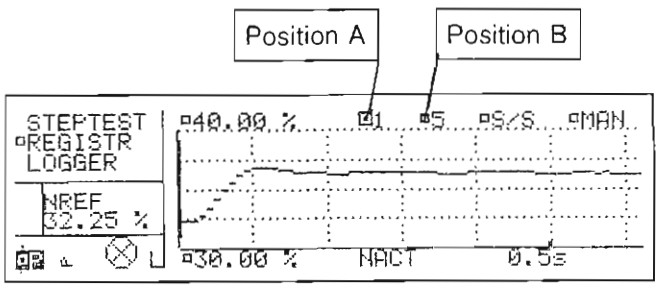


Figure 39. Registration.

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.

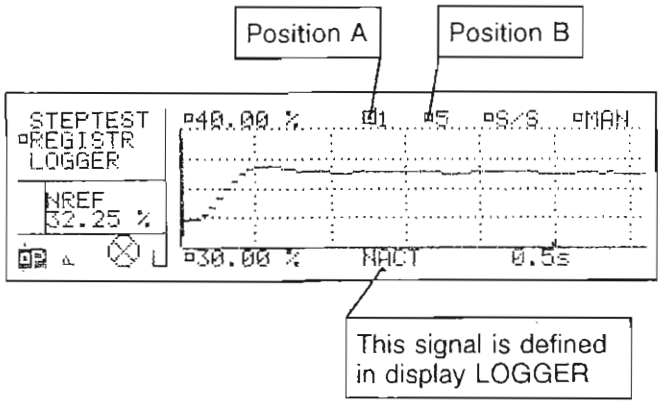


Figure 40.

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.

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.

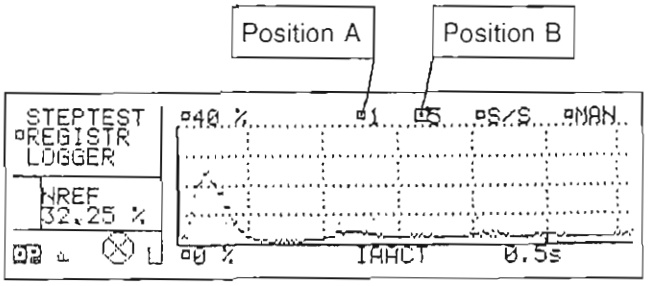


Figure 41.

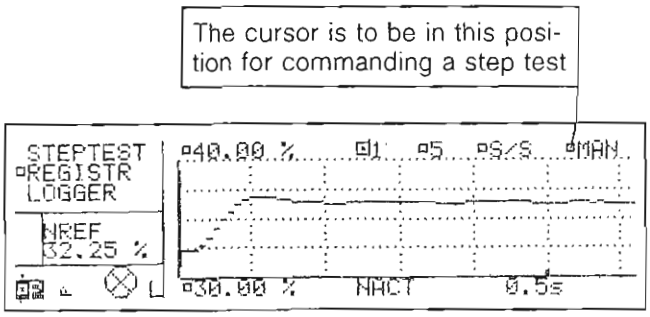


Figure 42. Registration.
Manual step testing.

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.

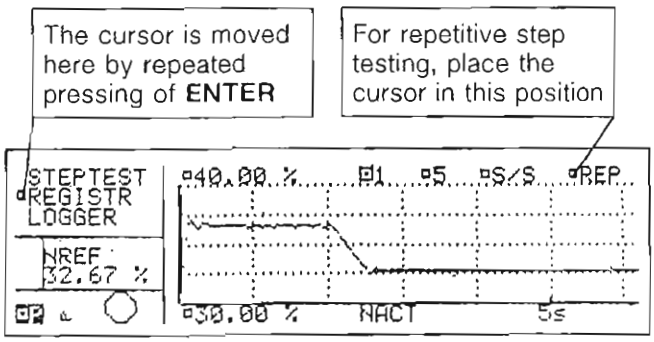
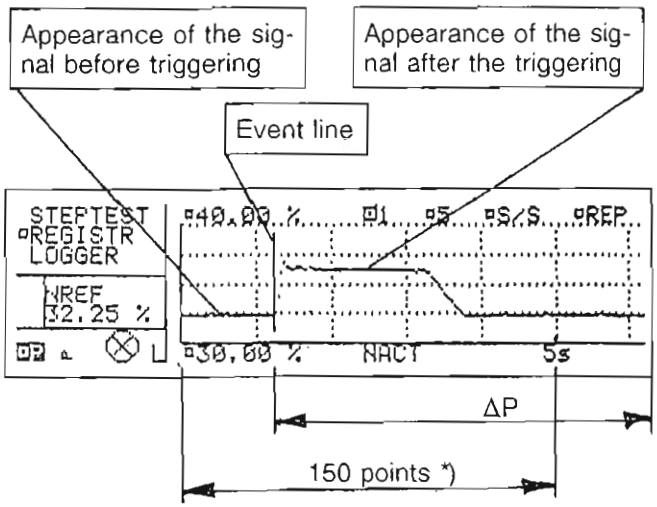


Figure 43. Registration.
Repetition of step testing.

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.



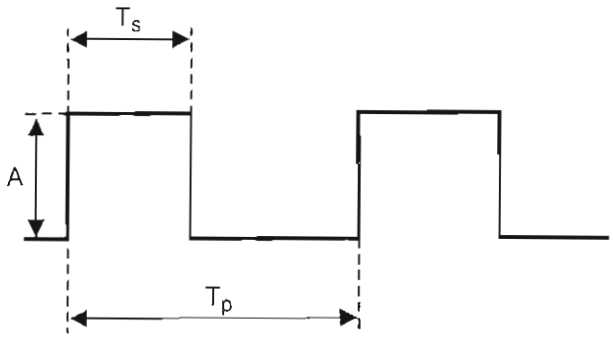
*) For Tyrak: 150 points in a 50 Hz-system
180 points in a 60 Hz-system

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.

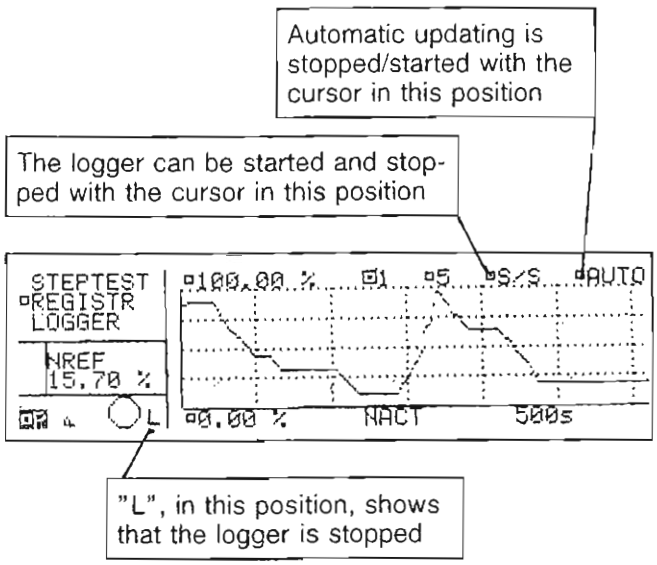
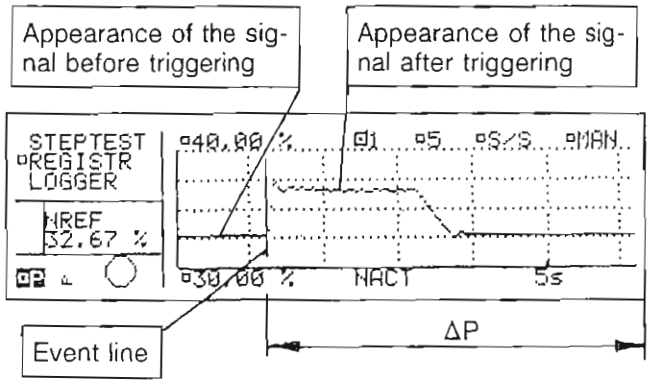


Figure 46. Registration. Automatic updating.

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.

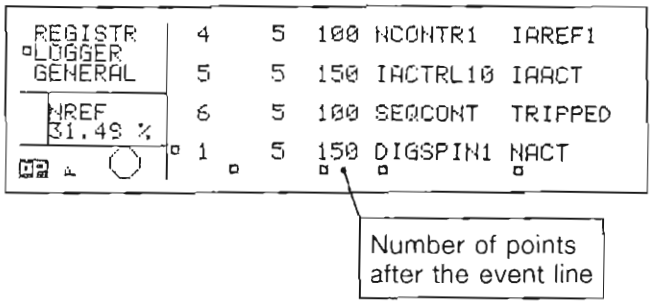


Figure 48. Logger.
Setting of event line.

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.

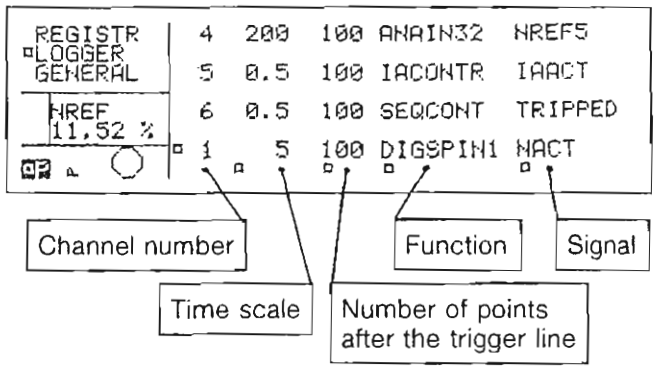


Figure 49. Logger.

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.

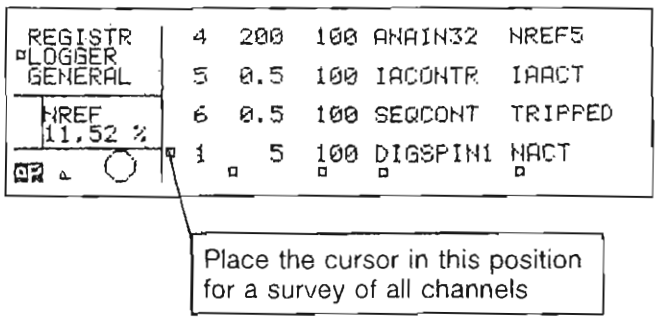


Figure 50. Logger.
Channel survey.

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.

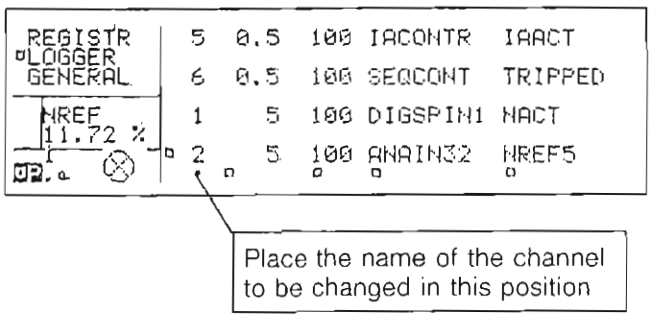


Figure 51. Logger.

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 ne markings on the REGISTR display is given in seconds.

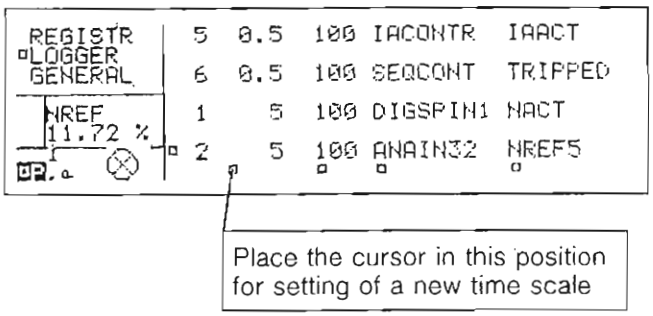


Figure 52. Logger.
Setting of time scale.

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.

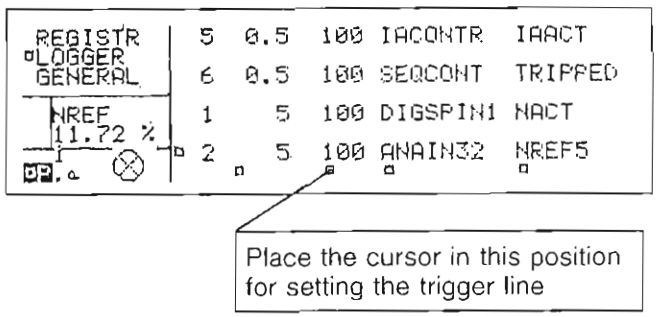


Figure 53. Logger.
Setting of event line.

The function module concerned must be defined befo- 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.

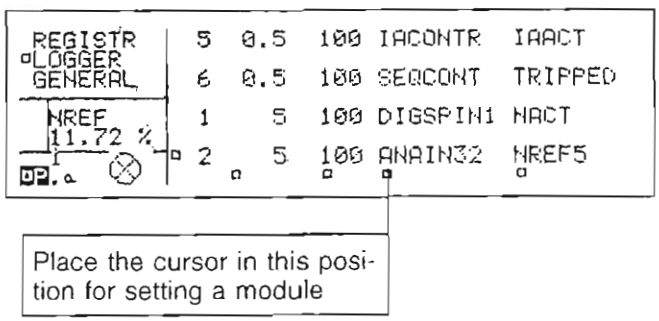


Figure 54. Logger.
Setting of function.

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.

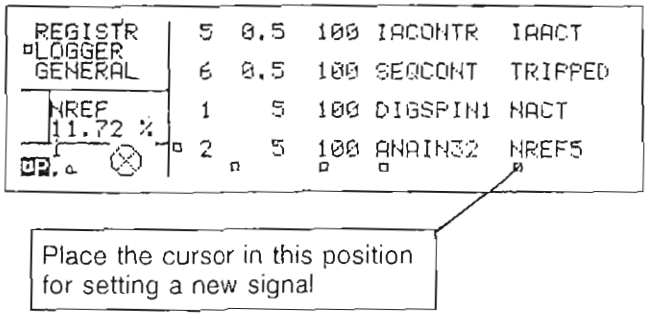


Figure 55. Logger.
Setting of a new signal.

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.

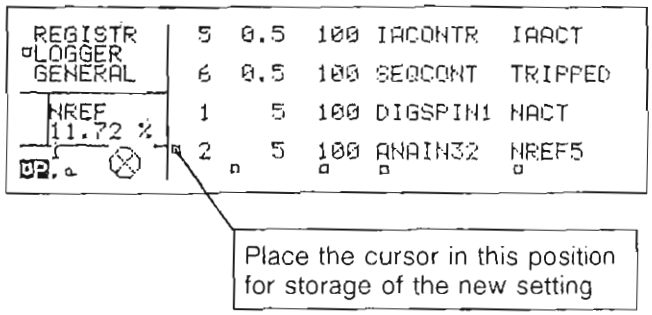


Figure 56. Logger.
Storage of a new setting.

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.

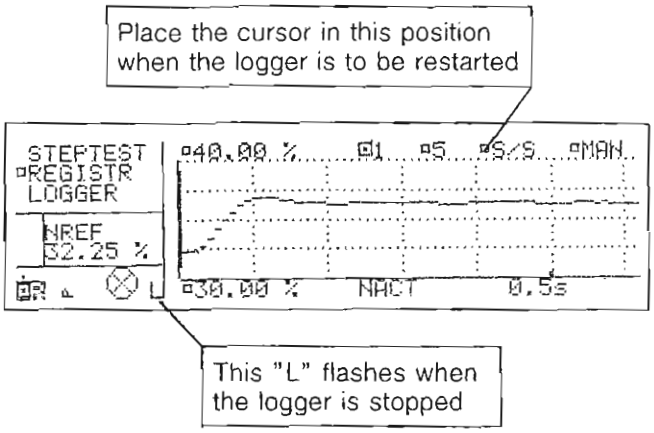


Figure 57. Registration display.

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.

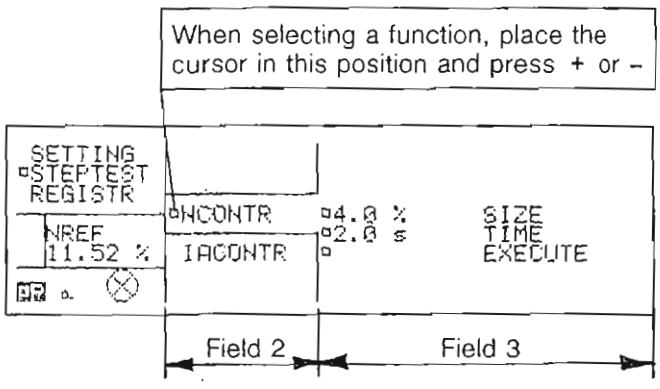


Figure 58. Step testing.
Selection of function.

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**.

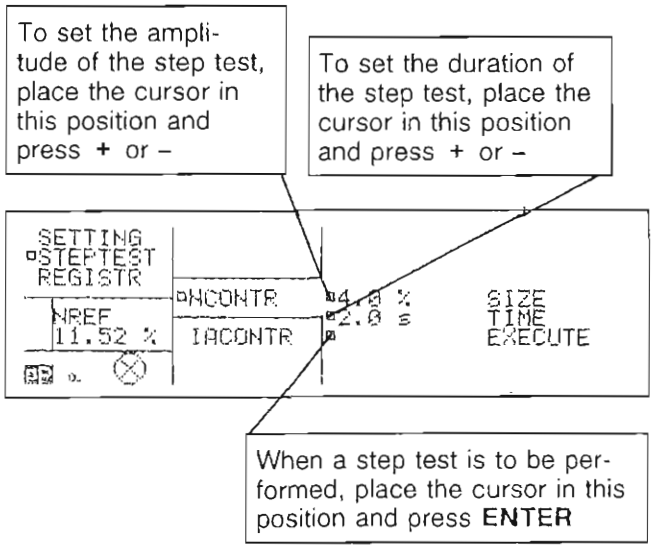


Figure 59. Step testing. Setting of amplitude.

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.

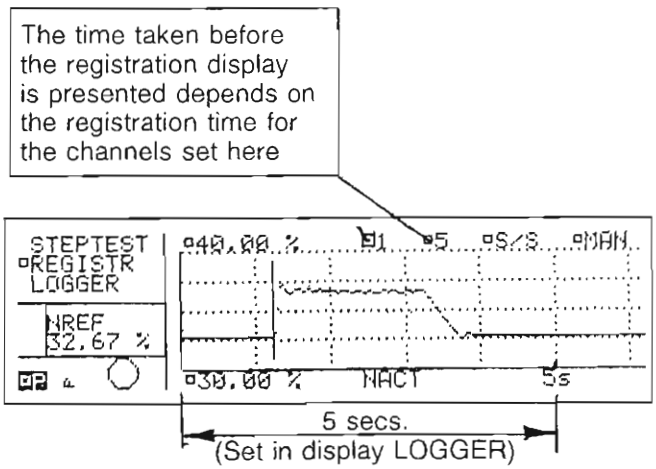


Figure 60. Registration.

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.

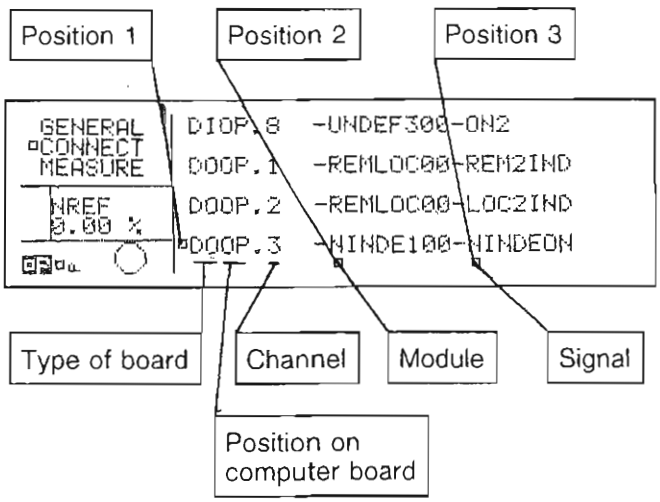


Figure 61. Appearance of the display.

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.

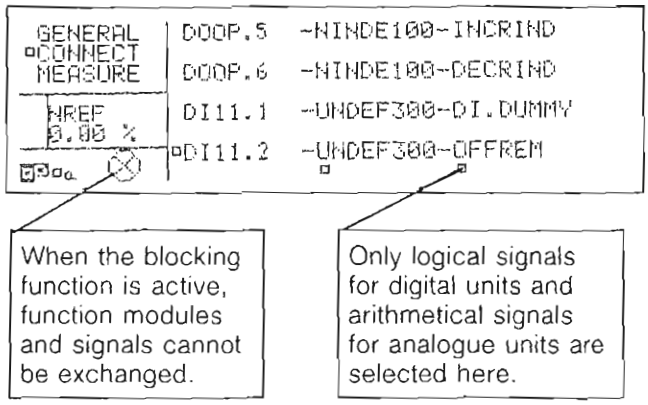


Figure 62. Safety functions.

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.

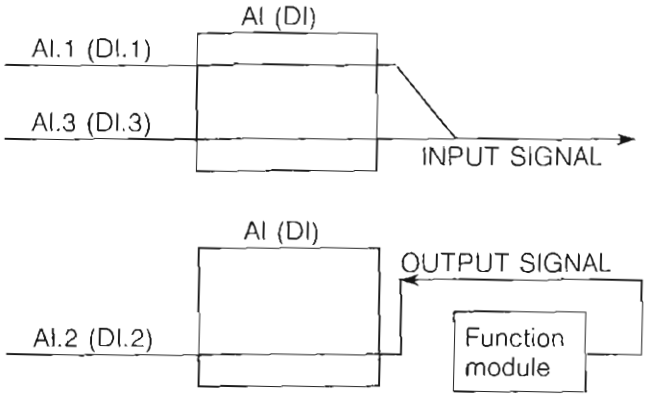


Figure 63. Situations against which no protection is provided.

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.

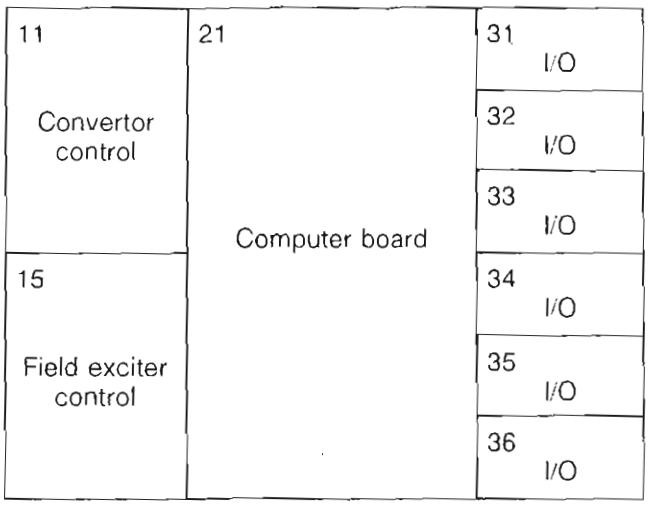


Figure 64. Board numbering for computer unit.

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.

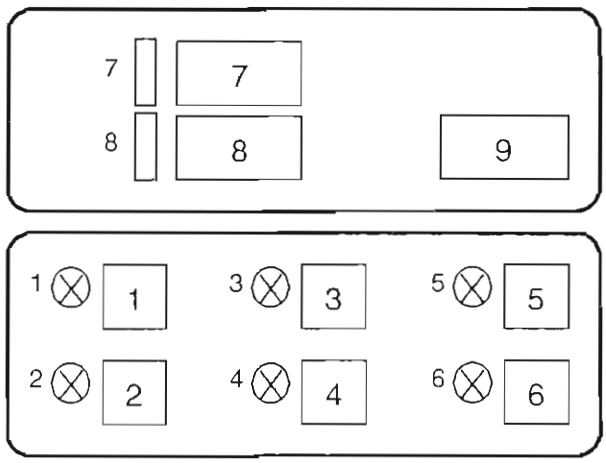


Figure 65. Numbering of push buttons and LEDs on the operator's panel.