

TYRAK XL
Thyristor convertor with
microcomputer for large
d. c. drive systems

User's manual

Edition 3

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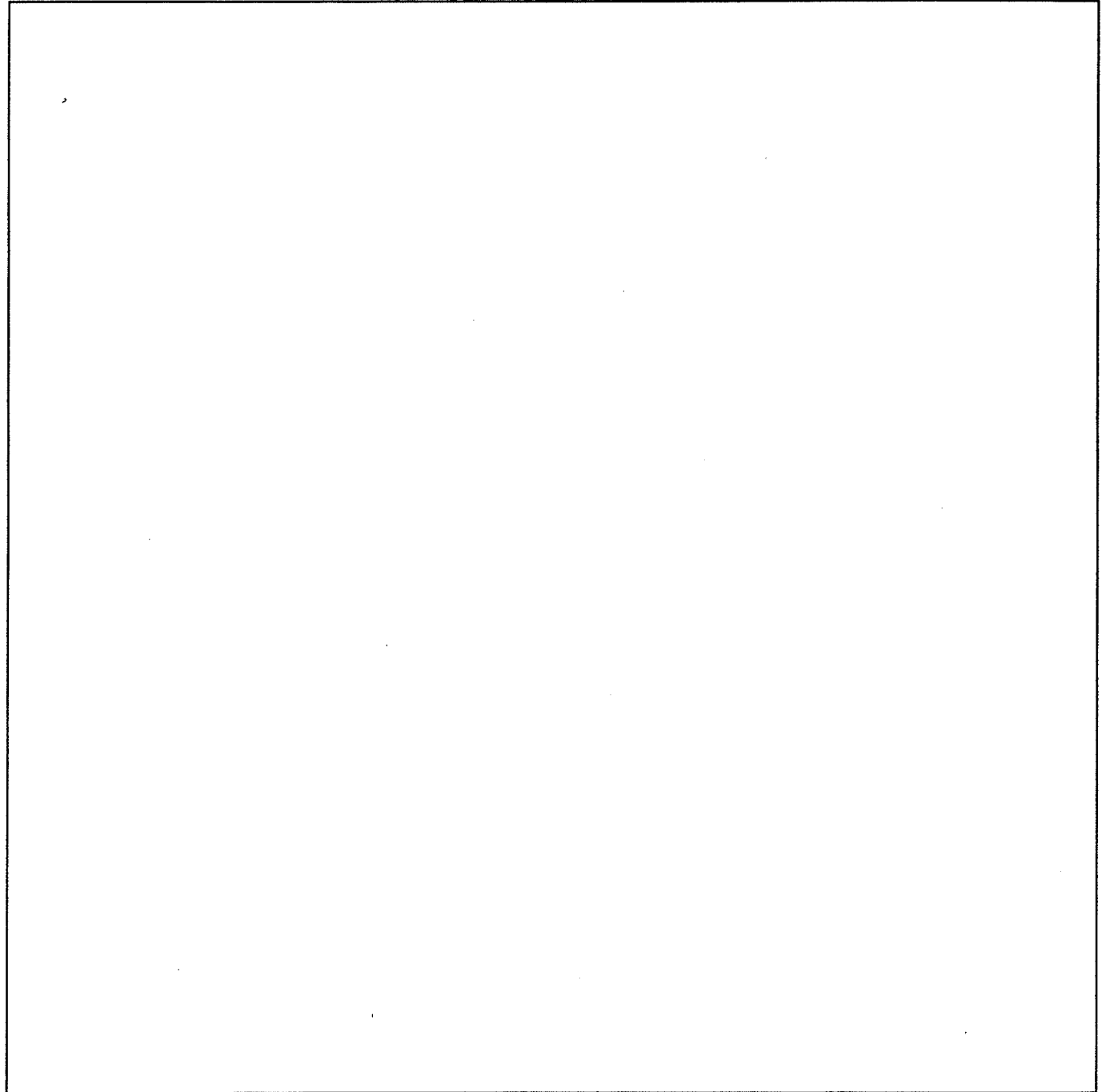


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TYRAK XL
User's Manual

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Description

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General

Tyrak XL convertors are designed in accordance with international standard IEC146, and meet the highest demands regarding performance, reliability and immunity to interference.

The control system is fully digital, from reference to trigger pulses. Both control procedures and sequential control functions are implemented digitally. Considerable emphasis has been placed on personnel safety. A powerful operators panel simplifies commissioning, handling and fault tracing of the convertor.

Configuration

The convertor equipment consists of a control cubicle, one or two thyristor cubicles depending on the main circuit configuration, and a field exciter cubicle.

The following type designations are used for the different convertor types:

- 6-pulse single convertor	YGMV
- 6-pulse double convertor	YHMV
- 12-pulse parallel convertor, single	YGMW P
- 12-pulse parallel convertor, double	YHMW P
- 12-pulse series convertor, single	YGMW S
- 12-pulse series convertor, double	YHMW S
- 2* 6-pulse tandem convertor, single	YGMW T
- 2* 6-pulse tandem convertor, double	YHMW T

Form of protection	IEC 144-IP22
	SEN 2121-S21
	DIN 400S0-P21.

BS 2817-Screen protected Drip-proof.

A.C. Power Distribution

Main circuit breakers are not included in the Tyrak XL delivery, however, one or two a.c. or d.c. breakers can be controlled from the drive control equipment.

Control cubicle

The control cubicle contains circuits for auxiliary power supply, motor starters for cooling fans and drive and convertor control units.

Power supply

The control cubicle is supplied by cable from below, connected to terminals at the bottom of the cubicle. The supply voltage can be 380 V, 415 V, 440 - 460 V or 500 V.

The circuit is protected by an incoming current limiting molded case circuit breaker (MCCB, pos H1.1) of type ABB Sace Limitor.

Control units

The control cubicle is equipped with two or three control units, depending on the main circuit configuration. One control unit contains the drive control. For main circuits with 6 pulse and 12 pulse series connection with synchronous or bridge sequence control, there is one convertor control unit. The slave convertor trigger pulses are generated on a separate trigger pulse board, YPQ203, connected directly to the convertor control board YPQ 201.

With 6 pulse tandem and 12 pulse parallel connection two convertor control units are included.

Each control unit contains three circuit boards, the processor board, YPQ201, the memory module, YPR201, and the I/O-board, YPQ202. The processor board and the I/O-board are mounted on opposite sides of a hinged panel, with the processor board facing front. The memory module is plugged in on top of the processor board.

Each control unit is equipped with a modem unit for communication with a service terminal or PC. The units are equipped with optocouplers which galvanically isolate computer side and terminal side from another.

Internal communication

The control units communicate with each other through an internal serial bus for transmitting data at high speed. An opto link is used to eliminate electrical interference. A communication board, YPK 114, is connected to the ISBX connector on each of the processor boards. From the drive control unit, data is distributed via a distribution board, YPC 111.

Drive control unit, pos B2

The drive control unit (pos. B2) contains the drive's application control program. Space is provided for up to four expansion I/O-units, which are installed as required by the software control program. Space is also provided for a serial communication unit for ABB Master (option). Further, the drive control unit is equipped with two contactors intended for operating external a. c. or d. c. breakers.

Convertor control unit, pos B20

The convertor control unit contains convertor control software. Opto couplers are used for galvanic isolation of the trigger pulses. The unit also contains a current measurement board and a connection unit for current and voltage measurement. Two analog output channels for test purposes are included.

A contactor intended for tripping of an external a. c. breaker is also included.

The convertor control unit contains a transformer, which generates a reference voltage for the thyristor trigger pulses. The transformer is supplied (3*110 V) from an adjustment transformer in the thyristor cubicle.

Convertor control unit, pos B32

With 12 pulse parallel, or tandem drive coupling there is an additional convertor control unit, designated B32. The contents of this unit is identical to that of pos B20.

Processor board YPQ201.

A powerful microcontroller of type Motorola MC68332, running at 16 MHz, is used. The operating system is monitored by diagnostic functions. The monitoring functions include a watch-dog, bus supervision, memory checking and power supply monitoring. In case of a fault, a flashing fault code appears on a two digit LED display. The fault codes are explained in the fault tracing section. During normal conditions the CPU load is monitored and displayed.

Error signals and log values are stored in a RWM (Read Write Memory) with voltage back-up. It retains its contents for 12 hours following a power loss.

Memory module, YPR201

The function of the drive equipment is determined by the control program installed. An application control program is installed in the drive control unit, the main thyristor convertors are controlled by convertor control programs, and the field exciter by a field control program. The control programs are stored in EPROM/EEPROM memory capsules on memory modules.

A selection of standard memory modules for different applications are available, each delivered with a user manual with a functional description, signal and parameter list. For detailed description of the control program, refer to the user manual.

Electronics power supply

Each control unit is equipped with its own electronics power supply transformer, pos B51.

The three-phase transformer generates two 24 V voltages, designated Q1 and Q2. The microcontroller is supplied by Q1, while external circuits are supplied with Q2.

A high degree of immunity to interference is obtained with separate supply voltages. Each convertor's computers are directly grounded even in plants with a common reference system.

The supply transformers are provided with screens between primary and secondary windings and between the two secondary windings.

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

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 terminal block B2.52.X1:9. If several convertors have a common reference system, the grounding of all of the convertors but one must be disconnected.

Auxiliary distribution unit, pos B1

The distribution of auxiliary voltages in the control cubicle is shown on pages 60-65 in the CD. The different auxiliary power breakers are placed in pos. B1 in the right part of the cubicle. The number of breakers is dependent upon the needs of the actual application, for example whether one or two thyristor cubicles are included, or whether external motor fans are to be controlled, and so on. The unit also includes a transformer (pos 20) generating the operating voltages M1L and M2L. M1L is a 110 V a.c. voltage with a frequency of 50/60 Hz, and is used as operating voltage for contactors, optional power breakers, digital input ports, and so on. M2L is 220 V alternating current, and can be used as operating voltage for digital input ports, on condition that the discharge resistors on the port is adequate.

The unit is also equipped with contactors intended for the functions "Electrical disconnect" and "Emergency stop".

Terminal units (B50, B51, B52)

The drive control unit may be equipped with expansion I/O-units. The customer connection terminals for these units are placed on terminal rail B50 at the bottom of the left compartment of the cubicle.

B51 is the coupling terminal for external connections such as operation functions and cooling fan supply.

Terminal B51 is located at the bottom of the right compartment of the control cubicle.

Terminal B52, in the right compartment, consists of a number of plug in connectors for signal interchange between the control and thyristor cubicles. The control pulses for example, are transmitted to the thyristor cubicle via this terminal.

Drive supervision and diagnostics

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

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

Thyristor cubicle

General description

The main circuit contains the thyristor bridge, cooling fan, fast acting fuses and other protective functions for the main circuit.

The power components are designed to allow connection to supply voltages from 510 to 1190 V.

Power supply

The main circuit connections at supply and machine side, as well as interconnections between thyristor cubicles, are done by cables from below.

Thyristor bridge

The thyristor bridge (G1) is built up as a three phase, fully controlled 6-pulse coupling. It is available as a single convertor or as a double convertor. In the double convertor version, the thyristors are directly anti-parallel coupled with common fusing and RC-circuits.

Trigger pulse transmission

The trigger pulses are conducted via shielded cables from the opto coupler units in the convertor control units in the control cubicle. From the opto coupler unit, the trigger pulses are conducted via a shielded cable to the pulse amplification unit (B15) in the thyristor cubicle. After galvanic isolation in pulse transformers, the gate pulses are conducted to the different thyristors. The trigger pulses can be measured via test terminals on the pulse amplifier board YXU 201A.

In single convertors, the trigger pulse amplifier is equipped with two circuit boards (YXU 201A + YXU 202A). In double convertors, there are two sets of circuit boards, one set for forward and one set for reverse direction.

Current measurement

The d.c. current is measured on the a.c. voltage side of the thyristor unit with the help of two current transformers, pos. G1.35, 36 (37). The output signal is rectified in a diode bridge (pos.B13) and is adapted with load resistors on the current measuring board YXA 118 pos. Y2.B20. (B32). 8, so that the output voltage is 3,30 V at rated current (3,0 V with parallel bridges). If two thyristor bridges are connected in parallel, the current is measured in all three phases for each bridge. This is to enable the use of the asymmetry protection unit on the current measuring board YXA 118.

Semiconductor fuses

The thyristors are protected by fast acting semiconductor fuses in the branches.

Transient protection (A13)

The transient protection consists of six capacitors which are coupled to form three groups of two serial coupled capacitors. Each such group is coupled between one phase and earth. Each group is protected by a 1500 V 6 A fuse. The fuses, 1 - 3, protect the synchronizing voltage transformer (B8.1) and the earth fault protection unit (B30). The unit A13 also contains fuses for the DC voltage measuring unit (B26.2).

Asymmetry protection

Current asymmetry protection is included in the basic equipment for all convertors in which two thyristor bridges are connected in parallel. The function of the protection is to indicate poor division of current between the parallel connected bridges, and thus hinder overloading of the thyristors. An error indication (and blocking) is obtained when one thyristor arm is loaded with a current which approaches its maximum permitted value and the parallel thyristor arm is loaded with significantly lower current. The current feedback from each thyristor bridge is compared in a current sensor unit placed on the current measuring board YXA 118 in the control cubicle.

An error indication can, for example, be obtained by reason of poor contact in one of the bus connections in the convertor, a trigger pulse error to a thyristor bridge or to a particular thyristor, a trip fast fuse for one or more thyristors or a malfunctioning thyristor.

Any fault that may occur is indicated on the operating panel at the same time as the convertor control orders phase retard and blocking.

Current unbalance detection

In convertors with double bridges, both the a. c. and d. c. current is measured. The d. c. current is measured by means of a shunt in the the d. c. output. The d. c. current feedback is compared with the a. c. current feedback in the convertor control software. If there is a difference, the protection is activated. The aim of the unbalance detection is to give a quick detection if there is a difference between the input a. c. current and the output d. c. current, for instance if a circulating current between the forward and reverse thyristors has come up.

Converter fan

The thyristor bridge is cooled with a three-phase fan. The fan is D-coupled for 380 V 50 Hz or 440 V 60 Hz supply, and Y-coupled for higher voltages.

Cooling air is taken via the floor, or through louvres on the doors. Air outlet is through the roof.

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

Terminal units (B51, B52)

Terminal units B51 and B52 are located at the bottom of the apparatus compartment of the thyristor cubicle. Terminal B51 is used for power supply for the cooling fan. Terminal B52 consists of plug-in connectors for communication between the control and thyristor cubicles.

Field exciter

The motor field circuit is supplied from a three phase digitally controlled field exciter, housed in a separate cubicle. At delivery, the field exciter is bolted on to the control cubicle as shown on dimension prints.

The field exciter consists of a main circuit breaker, thyristor bridge with current measurement, control unit, and a field discharge unit.

The field exciter communicates with the converter control system via an optical serial link.

Power supply

The field exciter is supplied by cables from below, connected to terminals at the bottom of the cubicle. The thyristor bridge is protected by a moulded case circuit breaker. The standard supply voltages are 380, 415, 440/460 and 500 V.

Main circuit

The main circuit contains phase inductors, thyristor bridge, cooling fan, fast acting fuses, field discharge unit, and auxiliary power supply for the control equipment.

The thyristor bridge is built up as a three phase, fully controlled 6-pulse coupling. It is available as a single or double bridge. Thyristor blocks with two thyristors in each are used.

Phase fuses, RC-circuits and phase inductors are used as protection for the blocks.

Trigger pulse circuits

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

Current measurement

The d. c. current is measured on the a. c. side of the thyristor unit with help of two 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 at rated current.

Converter fan

Field exciters rated up to 115 A are provided with an axial fan powered with the operating voltage 110 V a. c. (M1).

Field exciters rated 195-515 A are cooled with a radial fan, supplied with 220 V a. c. (M1 - M2).

Communication

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

I / O- system

Basic I/O-board YPQ202

External signals are connected to the basic I/O-board YPQ202 via individually disconnectable terminal blocks, accepting up to 2.5 sqmm (AWG14) wires. Following functions are included:

- Three digital output and four digital input channels with fixed functions, for external fans, oil pumps and main breaker operation. These circuits are connected to the 110 V a.c. control voltage.
- Five digital input channels, user defined function.
- One digital output channel, user defined function.
- Four analogue input channels, user defined function. The input signal can be ± 1 V, ± 10 V or 4 - 20 mA.
- Two analogue output channels, user defined functions, connected to test outputs in the door.
- One or two analogue outputs for current actual value, via buffer amplifier on current feedback signal (only on convertor control units).
- One analogue output for speed actual value (buffer amplifier on analogue tacho feedback signal).
- Pulse generator input.
The unit has three inputs, two 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.

The setting of user defined input/output channels is performed from the operator's panel or from a service terminal or PC.

Expansion I/O units (CD 26-29)

The drive control equipment is prepared for four expansion I/O-units which are installed as required by the application control program chosen.

Each expansion unit consists of two circuit boards and an interconnecting ribbon cable. One board is plugged on to the computer board on the drive control module. The other board accommodates the customer connection terminals, and is placed outside the control module (pos B50) for convenient connection of wires.

Following expansion units are available:

- Digital input unit (YPI103 + YPI104).
Eight channels, adapted for 110 V a.c./d.c. supply.
- Digital output unit (YPO105 + YPO106).
Eight channels, galvanically free relay contacts.
- Analogue input unit (YPG110 + YPG106).
Four channels and a voltage divider for analog tachometer signal, a current generator for Pt100 supply and a reference voltage source ± 10 V.
- Analogue output unit. (YPM102 + YPM105).
Four channels (two of which are connected to test outputs).

Analog output channels

Basic I/O (AO37XX) (CD 22)

Expansion I/O (AO34XX) (CD 29)

The analog output channels on the basic I/O-board give ± 10 V output. On the expansion unit the signal level can be set for either 0 - +10 V or -10 V - +10 V. using parameter AO34MODE.

Two of the output signals can be multiplied up to 256 times, using parameters AO37.XMU/AO34.XMU. The signals can also be offset by ± 100 % using parameters AO37.XOF/AO34.XOF.