General

Tyrak LCI 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, two thyristor cubicles, and a field exciter cubicle.

The type designation for a 12 pulse series convertor is: YRTK XXXX-YYYY, where X is the main supply voltage and Y is the rms phase current.

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 LCI delivery, however, one or two a.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 moulded case circuit breaker (MCCB, pos H1.1) of type ABB Sace Limitor.

Control units

The control cubicle is equipped with three control units. One control unit contains the drive control system, while the two additional units contain the line convertor control and the machine control system.

The control units B2 and B20 contain 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. The unit B32 contains the control boards for the machine control.

The control units B2 and B20 are equipped with modem units for communication with a service terminal or PC. The units are equipped with optocouplers which galvanically isolate computer side and terminal side from each other.

Internal communication

The control units B2 and B20 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. The unit is equipped with 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. 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 analogue output channels for test purposes are included.
A contactor intended for tripping of an external a. c. breaker is also included.
The control unit also contains a transformer, which generates a reference voltage for the thyristor trigger pulses. The transformer is supplied (3X110 V) from a synchronising transformer in the thyristor cubicle.

Machine convertor control unit, pos B32

The unit B32 contains two synchronisation transformers, one for each three phase machine output. The unit also contains control boards for the machine convertor control, as well as optocouplers for galvanic isolation of the machine convertor firing pulses. Also circuits for the machine side current measurement are located here.

Processor board YPQ201.

A powerful micro controller 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. The control program (DSRB) contains a selection of standard memory modules. The program is 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 delivers two 24 V voltages, designated Q1 and Q2. The micro controller is supplied by Q1, while external circuits are supplied by 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 on 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 hand part of the cubicle. The number of breakers is dependent upon the needs of the actual application, for example whether external motors are to be controlled. The unit also includes a transformer (pos 20) supplying 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 circuit 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 are 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 is 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 the terminal devoted 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 LCI 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 backup and it is therefore possible, at any time, to recall 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 thyristor cubicle contains the convertors main circuits.
The incoming A.C. power from the main supply is converted to D.C. power by the line convertor and fed into the D.C. link, and then converted to variable frequency A.C. power by the machine convertor. The direction of the power transmission can also be reversed in order to brake the motor.

The thyristor cubicles central part comprises two thyristor modules in 6 pulse two-way connection, one for the line convertor and one for the machine convertor.

In addition a trigger pulse amplifier unit is included and so are units for protection, supervision and measurement.

The power components are designed to allow connection to the supply voltages 1190 or 1470 V.

Connection of main circuits

The convertor is to be connected to the mains by cables. Connection can be performed from the underside of the thyristor cubicle.

The convertor's D.C.-link current connection can be arranged in the same way, that is by cables from the underside.

Thyristor module

The thyristor module (G1) is built up as two bridges in 6-pulse two-way connection. One thyristor module operates as the line convertor and the other as the machine convertor.

Each module comprises six thyristors sandwiched between seven heat sinks and thus forming a thyristor stack. The thyristors and heat sinks are held together by two tension bolts and with a straining clamp at the top to provide the holding force.
All the thyristors are equipped with transient protection in the form of an RC-circuit.

The thyristors are thermally overrated in order to allow for the fuseless design.

The thyristor module also comprises the firing pulse transformers, one for each thyristor.

Current measurement in the line convertor

The current is measured with the help of current transformers, located in two of the incoming phases of each group. A resistor is connected across the secondary to prevent voltage spikes in case of open load circuits, since the load resistors are located in the control cubicle.

The three-phase secondary currents are connected to a current sensor unit (B20.8) in the control cubicle.

After a 6 pulse rectification a current signal is obtained which is proportional to the convertor's D.C.-current. This current develops a voltage by passing through a load resistor. The voltage signal is then fed to the convertor computer, where it forms a current feedback signal for the current regulation.

Current measurement in the machine convertor

The current is measured on the machine side with the use of two current transformers, located in two of the phases of each group. A resistor is connected across each secondary for the same reason as described above for the line convertor.