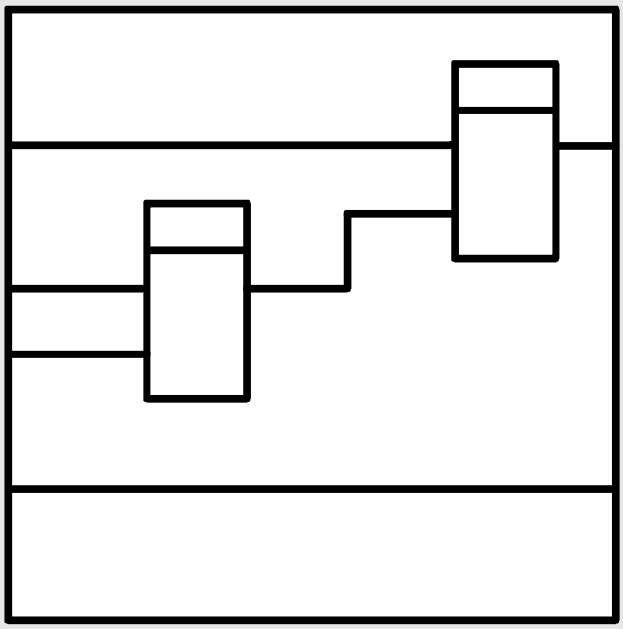
# SIMADYN D
# Digital Control System

User Manual

# I/O board EM13



Edition 05.95

DK-Nr. 233341

# 1. Description

The EM13 I/O board is used for digitizing (analog inputs with A/D or V/F/D converters) and for the output of analog voltage signals, for the input of binary incremental signals (speed), for input/output (binary I/O) and display (LED) of binary information.

The programmable address decoder calculates the board address, related to the board location.

The board features the following:

a) X6: For digitizing analog voltage signals:

* Four channels with A/D conversion,
* Two channels with V/F and subsequent F/D conversion (V/F/D conversion)

b) X6: For the output of analog voltage signals:

* Two channels with D/A conversion

c) X5: For incremental encoding:

* One channel for actual speed value and position encoding with inputs for two tracks plus the zero marking pulse;
* Subsequent digital filter and quadrupling the track frequency of the incremental shaft angle encoder
* Circuit for the correction of the pole angle with synchronized zero pulse as trigger
* One input for function monitoring

d) X7: For the input and output of binary information:

* 16 binary inputs (1 to invert the triggering zero pulse).
* 8 binary outputs
* 4 binary outputs for signal states of the X5 connector

e) H10/H20: For display:

* 16 LED's on the front panel, logical order in two bytes:
* one byte (H10) with red LED's (H11-H18, H11 is least sign. bit)
* one byte (H20) with yellow LED's (H21-H28, H21 is least sign. bit)
* independent from binary signals in d)

The 40 pin BERG connector X7 is plugged in at the front panel. The pins are arranged in three rows of ten and one row of six pins whereas

* 10 pins are designed for 8-bit information,
  external supply with P 24 external and M 24 external, and

* 6 pins are assigned to the zero marking pulse, track A signal,
  track B signal, monitor signal for connector X5, P 24 external and
  M 24 external (the other 4 pins are not connected).

The connector is thus subdivided into the following sections:

* 2 sections (bytes) for input,

* 1 section (byte) for output and

* 4 single bit outputs (1 bit information, wired and not configurable)
  for the zero marking pulse, track A, track B and X5 monitor signal.

## 1.1. New functions

The board offers some additional features starting from version 3.0. It is compatible with previous versions, if the following is adhered to:

- The nominal levels of the speed value input (connector X5) are 15 V.

- The 5 V (supply for a shaft angle encoder) is no longer available on
  pins 9 and 10 of the speed input connector X5.

- The setpoint time base is located in the 5th. counter of the 2nd.
  counter board (previously: 4th. counter of the 2nd. counter board).
  Therefore the software must be modified.

### 1.1.1. RIC: *RDY-INTERNAL-CONTROL

The new connector RIC in the board screen is designed to suppress the board reset signal *BGRES when the *RDYIN signal occurs. An active signal *RDYIN usually generates a board reset *BGRES, which causes the outputs (analog and binary: output of zero volts) to be disabled. The board requires a renewed initialization. The RIC enables the board to continue running w i t h o u t *BGRES when a processor fails in the sub-rack (*RDYIN active).

Filtering out this signal is only effective until the next *RESAD (reset signal from the power supply, always generates a *BGRES).

If the *RDYIN is to be ineffective on the board, then a "Y" must be configured at the RIC connector (i.e. the outputs remain active). The board does then not run a reset and the outputs remain enabled. The default value of "N" in the STRUC-L screen corresponds to the functionality of the previous board version.

### 1.1.2. Speed Value Inputs

The three tracks A, B and zero are detected via differential inputs with a rated voltage level of 15#V. The threshold lies by approximately half the rated level with a hysteresis of 5 to 15% of the rated level (see technical specifications). The corresponding minus terminal of each track may be grounded (ground supply terminal of the digital encoder from X5:M').

### 1.1.3. Monitor Input of the Speed Value Connector

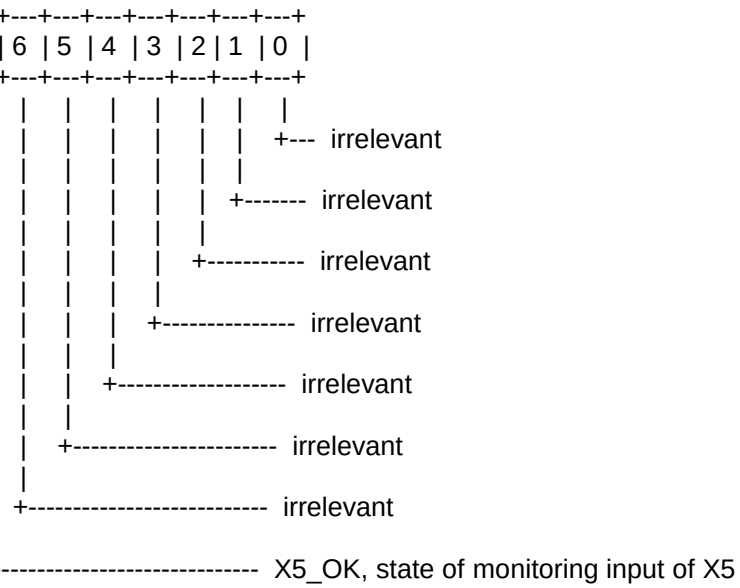
The supply of the speed plug connector with P5 is dispensed with because of the definition of the speed signal level (5 V - level deleted). The pins 9 and 10 have therefore become available for a monitoring signal with a
level of 15 V. The threshold lies by approximately half the rated level with a hysteresis of 5 to 15% of the rated level (see technical specifications).
The corresponding minus terminal of each track may be grounded (ground supply terminal of the digital encoder from X5:M').

The speed input can be monitored with this monitoring input. Connection of a monitoring signal from the digital speed encoder or checking whether the encoders plug is connected by jumpering P15' with the positive input pin 9 and jumpering M' (ground) with the negative input pin 10.

### 1.1.4. Monitor Register for the Speed Value Input

The EM13 board has an additional monitor register starting from version 3.0, which is accessed via the ZPC connector.

Currently only bit 7 (X5_OK, status of monitoring input of X5) is utilized.




This bit has the state HIGH, if the switching threshold of the monitor input on speed value connector X5 is exceeded (see technical specification). Otherwise it is LOW.

### 1.1.5. Binary outputs

Three new binary outputs have been installed on previously unconnected pins of the sub-connector X7B (pins 12, 13, 14, see also connector allocation).
These outputs permanently take the state of internal 5V signals. These are set via output drivers to a 24 V level (usual binary output SIMADYN D, no reaction on the original signal). The signals are the following:

X7, pin 11: zero marking pulse (as up to now)
X7, pin 12: track A
X7, pin 13: track B
X7, pin 14: X5 monitor signal

### 1.1.6. Analog Inputs

The previous model EM11 Z2 the analog inputs with VFD acquisition were completely dispensed with because the pole angle was measured in the second counter board. This version retained two of the four channels. The measurement values cannot, however be read by the AFC module. A new software module will be created with the probable name of AFC002.

### 1.1.7. Analog outputs

The two analog outputs of the board generate 0 V when disabled (in previous versions: - 10 V).

# 2. Board Design

* One slot (1 1/3 SPS)

* SIMADYN D local bus interface

* Programmable address decoder with board identification

* Three system timing controllers AM 9513

* One analog/digital converter AD 574, 12 bits

* One digital/analog converter AD 7549, 12 bits

* Four analog input channels with multiplexer and A/D converter

* Two analog input channels with V/F/D conversion

* Two analog output channels with D/A converters.

* One channel for the incremental shaft angle encoder comprised of the following:

* Three pulse inputs (2 tracks, 1 zero marking pulse), one monitor input (differential amplifier inputs, non-floating)

* 16 binary inputs (1 to invert the triggering zero pulse) (non-floating)

* 8 binary outputs (non-floating, 30 V/ 50 mA max.)

* 1 binary output for zero marking pulse (non-floating, 30 V/ 50 mA max.),

* 1 binary output for track A (non-floating, 30 V/ 50 mA max.),

* 1 binary output for track B (non-floating, 30 V/ 50 mA max.),

* 1 binary output for X5 monitor signal (non-floating, 30 V/ 50 mA max.),

* 16 LED's on the front panel.

# 3. Application Notes

The EM 13 board can be used in all SIMADYN D sub-racks connected to the local bus. It requires one slot in the sub-rack.

The board must be fixed to the sub-rack with screws (even during commissioning) to ensure perfect operation.

If the board is plugged onto an adapter, the front panel (or better still one of the two metallized front panel handles) must be electrically connected to chassis via a short lead.

The pulse inputs at connector X5 are linked with the incremental shaft angle encoder of the drive via a multi-core screened cable.

The appropriate block diagram is shown in the appendix, diagram 1.

Supplementary Components at the Speed Input:

Component set

* SM1.1 6 DD 1680 - 0AB1
  15 pin male connector, with casing

The analog input and output signal lines are connected via the SE7.1 interface module, which snaps onto the mounting rail. The 20 pin ribbon cable SC12 is used to inter-connect boards from connector X6 to the interface module connector X1. The cable type SC12 (twisted pair) guarantees higher transmission security.

The SE7.1 interface module provides one screw-type terminal each for signal inputs ± ,signal outputs/ground and screen for each channel.

The SE40 interface modules enable additional boards to be connected (1-to-1 connection between faston connectors and screw-type terminals).

The configuration for analog signals is shown in the appendix in diagram 2.

Supplementary components used for analog signals:

Ribbon cable

* 20 pole, twisted pair, 1.5 m SC12 6 DD 1684 - 0BC0,

* 20 pole 2.0 m SC11 6 DD 1684 - 0BB0.

Interface modules

* SE7.1 6 DD 1681 - 0AH1
  I/O block, analog, 8/10 channels

* SE40 6 DD 1681 - 0EA0
  terminal block, 20 pole, one to one

The binary signal lines are connected as follows:

Ribbon cables are used to link connector X7 of the EM13 board with the interface modules (both ends are provided with ribbon cable socket connectors).
- The corresponding block diagram is located in the appendix, as diagram 3.

The binary outputs are supplied with power (24 V) via the interface modules. The M24 ground is simultaneously reference potential for the binary inputs and is connected to the SIMADYN D ground on the board.

Comments to diagram 3:

to a) The 16 binary inputs and outputs at connector X7 of the EM13 are connected to the SE3.1 or SE23 interface module via a 40 pin ribbon cable. The interface modules incorporate the external connections for the plant (screw-type terminals).

to b) The binary inputs and outputs of the connector are split up and allocated to four different SE4.1 interface modules. The 40 pin connector is divided up into four separate cables by splitting up the attached ribbon cable (4 x 10 pin, with sub-connector identification, see diagram 3) at the ends and connecting the four cable sections to the individual interface modules. Thus it is possible e.g. to connect input or output signal lines with or without galvanic isolation.

Supplementary binary input and output components

Ribbon cable

| | | | |
|---|---|---|---|
| * 40 pin | 2.0 m | SC18 | 6DD 1684-0BJ0 |
| * 40 pin --> 4+10 pin | 2.0 m | SC13 | 6DD 1684-0BD0 |

Interface modules

* SE3.1 6DD 1681-0AD0
  16 binary inputs and 16 binary outputs, non-floating

* SE4.1 6DD 1681-0AE1
  8 binary inputs or outputs, non-floating

* SE5.3 6DD 1681-0AF3
  8 binary inputs, 220 V, floating

* SE6.1 6DD 1681-0AG1
  8 binary outputs, 220 V max., floating

* SE8 6DD 1681-0AJ0
  8 binary inputs or outputs
  (10 pin, one-to-one connection)

* SE23 6DD 1681-0CD0
  16 binary inputs and 16 binary outputs
  (40 pin, one-to-one connection)

* SE37 6DD 1681-0DH0
  8 binary outputs, 24 V, floating

* SE41.1 6DD 1681-0EB1
  8 binary inputs, 48 V, floating

* SE41.2 6DD 1681-0EB2
  8 binary inputs, 24 V, floating

# 4. Technical Specification

GENERAL

| | |
|---|---|
| INSULATION COORDINATION | acc. to VDE 0110/1.89;contamination grade 2 |
| AMBIENT TEMPERATURE | 0 to 55 deg. C, with unforced ventilation |
| STORAGE TEMPERATURE | -40 to +70 deg. C |
| PROTECTION TYPE | IP00 acc. to DIN 40050 |
| HUMIDITY CLASS | F to DIN 40040 |
| ALTITUDE RATING | S to DIN 40040 |
| MECHANICAL STRESS | Installation in stationary, equipment, sensitive to vibrations |
| PACKAGING SYSTEM | ES 902 C |
| DIMENSIONS | 233.4 x 220 mm |
| BOARD WIDTH | 1 1/3 SPS = 1 slot = 20.14 mm |
| WEIGHT | 0.6 kg |
| CURRENT CONSUMPTION | P5 1.20 A<br>P15 0.10 A + Consumption connector X5, P15'<br>N15 0.15 A + Consumption connector X5, N15'<br>P24 0.10 A + Consumption connector X7A, X7B |

BINARY INPUTS

| | |
|---|---|
| NUMBER | 16, no galvanic isolation |
| INPUT VOLTAGE | +24 V rated value |
| FOR 0 SIGNAL | -1V to +6V; or binary inputs open |
| FOR 1 SIGNAL | +13 V to +33 V |
| INPUT CURRENT | |
| - AT 1 SIGNAL | 5 mA (typical) |
| DELAY | 200 us |

BINARY OUTPUTS

| | |
|---|---|
| NUMBER | 12, no galvanic isolation |
| SUPPLY VOLTAGE | 24 V - rated value |
| - RIPPLE | 3.6 V DC |
| - PERM. RANGE | +20 to +30 V, including ripple |
| - TEMPORARY | +35 V, t < 0,5 sec. |
| OUTPUT CURRENT AT 1 SIGNAL | 50 mA rated value |
| - PERM. RANGE | O.2 mA to 60 mA |
| SHORT-CIRCUIT PROTECTION TO GROUND | Electronic, unlimited duration |
| DELAY | 15 us at full load<br>4 us at no load (measurement instrument) |
| INDUCTIVE CIRCUIT INTERRUPT. | Limited to -1V |
| TOTAL LOAD | 80 % at 55 deg. C all outputs 50 mA |
| RESIDUAL CURRENT | 20 uA at 0 signal |
| SIGNAL LEVEL | 24 VDC rated |
| - AT 0 SIGNAL | 3 V max. |
| - AT 1 SIGNAL | -2.5 V min. supply voltage |

ANALOG OUTPUTS D/A CONVERSION

| | |
|---|---|
| NUMBER | 2 |
| OUTPUT VOLTAGE (MIN | - 10 V |
| OUTPUT VOLTAGE (MAX.) | + 10 V |
| OUTPUT CURRENT (MAX.) | 10 mA |
| RESOLUTION | 11 bits + sign (corresponding to 5 mV) |
| ACCURACY (ABSOLUTE / TYPICAL) | ± 0.25 % ( = ± 25 mV) |
| SHORT-CIRCUIT PROTECTION TO GROUND | Ohmic resistance 56 Ohm |
| SHORT-CIRCUIT DURATION (MAX.) | 120 sec |
| TOTAL LOAD | All outputs simultaneously at 10 mA each |

MEASURING SYSTEMS

ANALOG INPUTS WITH A/D CONVERSION

| | |
|---|---|
| NUMBER | 4 |
| RATED INPUT VOLTAGE (MIN.) | - 10V |
| RATED INPUT VOLTAGE (MAX.) | + 10V |
| OVERLOAD INPUT VOLTAGE (MIN.) | - 14 V (absolute value) |
| OVERLOAD INPUT VOLTAGE (MAX.) | + 14 V (absolute value) |
| INPUT RESISTANCE | 20 kohms (differential amplifier input) |
| RESOLUTION | 11 bits + sign (corresponding to 5 mV) |
| ACCURACY (ABSOLUTE / TYPICAL) | ± 0.25 % ( = ± 25 mV) |

| | |
|---|---|
| ANALOG WITH V/F/D CONVERSION | |
| NUMBER | 2 |
| RATED INPUT VOLTAGE (MIN.) | - 10V |
| RATED INPUT VOLTAGE (MAX.) | + 10V |
| OVERLOAD INPUT VOLTAGE (MIN.) | - 14 V (absolute value) |
| OVERLOAD INPUT VOLTAGE (MAX.) | + 14 V (absolute value) |
| INPUT RESISTANCE | 20 kohms (differential amplifier input) |
| RESOLUTION | 14 bits + sign (corresponding to 0.6 mV) |
| ACCURACY (ABSOLUTE / TYPICAL) | ± 0.25 % ( = ± 25 mV) |
| ACTUAL SPEED VALUE ACQUISITION | |
| PULSE INPUTS TRACKS ZERO, A, B, AND MONITOR INPUT | 15 V, 1 mA rated value |
| PULSE AMPLITUDE | 8-30 V, I maximum = 3 mA |
| PULSE FREQUENCY (MAX.) | 100 KHz sin or squarewave sampling 1:1 |
| SIGNAL LEVEL | 7,5 V rated value for threshold |
| 1-SIGNAL | > 8 V |
| 0-SIGNAL | < 5 V, minimum: -30 V |
| SWITCHING HYSTERESIS | > 1 V |
| SMOOTHING TRACKS ZERO, A, B | 1 usec |
| SMOOTHING MONITOR INPUT | 200 usec |
| POWER SUPPLY | P15', M', N15', each via resistance |
| P15' | +15 V ± 10%, Imax = 250mA, Ri = 3,6Ohm |
| M' | 0 V ±0,2V, Imax = 250mA, Ri = 0,9Ohm |
| N15' | -15 V ± 10%, Imax = 250mA, Ri = 3,6Ohm |
| SHORT CIRCUIT PROTECTION (GRD) | Resistance (Ri) |
| SHORT CIRCUIT DURATION (MAX.) | 1 sec., longer: Ri becomes infinite |

NOTE : SPECIAL ATTENTION MUST BE PAID TO THE TOTAL LOADING OF THE SUB-RACK POWER SUPPLY WHEN THE SUPPLY OUTPUTS AT PLUG CONNECTOR X5 IS LOADED (CONCERNS P15', N15'). THIS IS ESPECIALLY IMPORTANT WHEN SEVERAL EM13 BOARDS ARE SUPPLIED FROM ONE SUB-RACK POWER SUPPLY. THE SIMADYN-D POWER SUPPLY CUTS OUT WHEN OVERLOADS OCCUR (I.E. ALSO FOR SHORT CIRCUITS).

The practical resolution of the measuring systems depends on the function blocks used.

| Measuring system | Function block |
|---|---|
| A/D conversion | ADC001 : analog input |
| V/F/D conversion | AFC002 : analog frequency/digital conv. *) |
| D/A conversion | DAM : analog output EM11/EM13 |
| Actual speed value acquisition | NAV : digital actual speed value acquisition |

*) currently not available

# 5. Connector Pin Assignments of the EM 13

## 5.1. Pin Assignments for Actual Speed Value, Connector X5

| Socket no. | Designation | Connector | Function |
|---|---|---|---|
| 1 | screen | | |
| 2 | Digital ground | | Voltage reference for P15' or P5' |
| 3 | NC | | Not connected |
| 4 | Zero marking pulse Z+ | X5A, B | Connection for zero marking pulse |
| 5 | Track A+ | X5A, B | Connection for track A |
| 6 | Track A- | X5A, B | Inverse signal or zero voltage reference for track A |
| 7 | P15' | | Supply voltage for encoder +15 V |
| 8 | Digital ground | | Zero voltage reference for P15' or P5' |
| 9 | Monitor | | Monitoring signal |
| 10 | Monitor | | Monitoring signal |
| 11 | Zero marking pulse Z- | X5A,B | Inverse signal or zero voltage reference point for zero marking pulse |
| 12 | Track B+ | X5A,B | Connection for track B |
| 13 | Track B- | X5A,B | Inverse signal or zero voltage reference point for track B |
| 14 | N15' | | Supply voltage for encoder -15V |
| 15 | screen | | |

## 5.2. Pin Assignments of the Analog Inputs and Outputs, Connector X6

| Pin no. | Designation | Connector | Function |
|---|---|---|---|
| 1 | Analog input 1+ | X6A | |
| 2 | Analog input 1- | | 4 analog inputs with |
| 3 | Analog input 2+ | X6B | differential amplifiers |
| 4 | Analog input 2- | | and one A/D converter |
| 5 | Analog input 3+ | X6C | (multiplexed) |
| 6 | Analog input 3- | | |
| 7 | Analog input 4+ | X6D | |
| 8 | Analog input 4- | | |
| 9 | Input (V/F) 1+ | X6E | |
| 10 | Input (V/F) 1- | | |
| 11 | Input (V/F) 2+ | X6F | 2 analog inputs with |
| 12 | Input (V/F) 2- | | differential amplifiers |
| 14 | N.C. | | V/F converters and F/D |
| 15 | N.C. | | conversion |
| 16 | N.C. | | |
| 17 | Analog output 1 | X6J | D/A conv., analog signal |
| 18 | Analog ground | | reference for output 1 |
| 19 | Analog output 2 | X6K | D/A conv., analog signal |
| 20 | Analog ground | | reference for output 2 |

The two analog outputs can only be addressed via function block DAM.

## 5.3. Pin Assignments for the Binary Inputs/Outputs, Connector X7

(40 pin faston connector)

| Pin no. | Designation | Connector | Function |
|---|---|---|---|
| 1 | Output 1 | X7 A | |
| 2 | Output 2 | X7 A | |
| 3 | Output 3 | X7 A | |
| 4 | Output 4 | X7 A | Binary outputs |
| 5 | Output 5 | X7 A | |
| 6 | Output 6 | X7 A | |
| 7 | Output 7 | X7 A | |
| 8 | Output 8 | X7 A | |
| 9 | P external | | External power supply for binary inputs and outputs |
| 10 | M external | | |
| 11 | Output 9 | X7 B | zero marking pulse |
| 12 | Output 10 | X7 B | Output for track A |
| 13 | Output 11 | X7 B | Output for track B |
| 14 | Output 12 | X7 B | Output for X5 monitoring signal |
| 15 | N.C. | | |
| 16 | N.C. | | Not connected |
| 17 | N.C. | | |
| 18 | N.C. | | |
| 19 | P external | | External power supply for binary inputs and outputs |
| 20 | M external | | |
| 21 | Input 1 | X7 C | |
| 22 | Input 2 | X7 C | |
| 23 | Input 3 | X7 C | |
| 24 | Input 4 | X7 C | |
| 25 | Input 5 | X7 C | Binary inputs |
| 26 | Input 6 | X7 C | |
| 27 | Input 7 | X7 C | |
| 28 | Input 8 | X7 C | |
| 29 | P external | | External power supply for binary inputs and outputs |
| 30 | M external | | |
| 31 | Input 9 | X7 D | |
| 32 | Input 10 | X7 D | Pin 32 inverts the triggering pulse |
| 33 | Input 11 | X7 D | Binary inputs |
| 34 | Input 12 | X7 D | |
| 35 | Input 13 | X7 D | |
| 36 | Input 14 | X7 D | |
| 37 | Input 15 | X7 D | |
| 38 | Input 16 | X7 D | |
| 39 | P external | | External power supply for binary inputs and outputs |
| 40 | M external | | |

# 6. STRUC-L Screen of the EM 13 Board

STRUC-L menu

```
      : EM13          "I/O board 1, L-bus"
ISE 1C = N             "Ignore failed message (RDYINT) (Y/N) ?"
ZPC 8K <               "Zero impulse monitor register"
X5A 4K <               "pole position"
X5B 4K <               "digital speed"
X6A 1K <               "A/D converter 1"
X6B 1K <               "A/D converter 2"
X6C 1K <               "A/D converter 3"
X6D 1K <               "A/D converter 4"
X6E 1K <               "V/F/D converter 1"
X6F 1K <               "V/F/D converter 2"
X7C 8K <               "binary inputs 1"
X7D 8K <               "binary inputs 2"
RTB 1K >               "setpoint time base"
X6J 1K >               "D/A converter 1"
X6K 1K >               "D/A converter 2"
X7A 8K >               "binary outputs 1"
H10 8K >               "LED block 1: H11-H18"
H20 8K >               "LED block 2: H21-H28"
```