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SPIRIT OF EXCELLENCE

TECHNICAL

DESCRIPTION

MSX-E1701

Ethernet multifunction counter system

DIN EN ISO 9001:2008 certified

Edition: 02.02-08/2012

Product information

This manual contains the technical installation and important instructions for correct commissioning and usage, as well as production information according to the current status before printing.
The content of this manual and the technical product data may be changed without prior notice.
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Warning

The following risks result from improper implementation and from use of the Ethernet system contrary to the regulations:

Personal injury

Damage to the Ethernet system, the PC and peripherals

Pollution of the environment

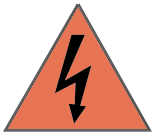
- Protect yourself, others and the environment!
- Read the safety precautions (yellow leaflet) carefully!

  If this leaflet is not enclosed with the documentation, please contact us and ask for it.
- Observe the instructions of this manual!

  Make sure that you do not forget or skip any step. We are not liable for damages resulting from a wrong use of the Ethernet system.
- Pay attention to the following symbols:

IMPORTANT!
Designates hints and other useful information.

WARNING!
Designates a possibly dangerous situation.
If the instructions are ignored, the Ethernet system, the PC and/or peripherals may be **destroyed**.



WARNING!
Designates a possibly dangerous situation.
If the instructions are ignored, the Ethernet system, the PC and/or peripherals may be **destroyed** and persons may be **endangered**.

Contents

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Chapter overview

In this manual, you will find the following information:

Chapter	Content
1	Important information on the application, the user and on handling the MSX-E system as well as safety precautions
2	Brief description of the MSX-E system (functions, features, block diagram)
3	Function description (incremental counter inputs) including pin assignment and connection example
4	Function description (digital inputs/outputs) including pin assignment and connection example
5	Function description (PWM outputs) including pin assignment
6	Description of the function-specific pages of the MSX-E web interface
7	List of technical data and limit values of the MSX-E system
8	Appendix with glossary and index
9	Contact and support address

1 Definition of application, user, handling

1.1 Definition of application

1.1.1 Intended use

The Ethernet system **MSX-E1701** for the acquisition, processing and transferring of rotary encoder signals as well as for digital input or output is intended for the connection to a network, which is used as electrical equipment for measurement, control and laboratory pursuant to the norm EN 61010-1 (IEC 61010-1).

1.1.2 Usage restrictions

The Ethernet system **MSX-E1701** must not be used as safety-related part (SRP).

The Ethernet system **MSX-E1701** must not be used for safety-related functions.

The Ethernet system **MSX-E1701** must not be used in potentially explosive atmospheres.

The Ethernet system **MSX-E1701** must not be used as electrical equipment according to the Low Voltage Directive 2006/95/EC.

1.1.3 Limits of use

All safety information and the instructions in the manuals must be followed to ensure proper intended use.

Uses of the Ethernet system beyond these specifications are considered as improper use.
The manufacturer is not liable for damages resulting from improper use.

The Ethernet system must remain in its anti-static packaging until it is installed.

Please do not delete the identification numbers of the Ethernet system or the warranty claim will be invalid.

1.2 Safety precautions

1.2.1 Current sources

All connected devices must be supplied from current sources that comply with SELV according to IEC 60950 or EN 60950; or PELV according to IEC 60204-1 or EN 60204-1.

1.2.2 Degrees of protection

IMPORTANT!
The protection according to the defined degree of protection (see Chapter 7.4) is only given if the openings are protected with adequate protection caps or connectors.

If you are not sure, please contact us:

Phone: +49 7229 1847-0

E-mail: info@addi-data.com

1.2.3 Cables

The cables must be installed safely against mechanical load.

1.2.4 Housing

The housing must not be opened. It may only be opened by persons who have been authorised by ADDI-DATA.

1.3 User

1.3.1 Qualification

Only persons trained in electronics are entitled to perform the following works:

- Installation
- Commissioning
- Use
- Maintenance.

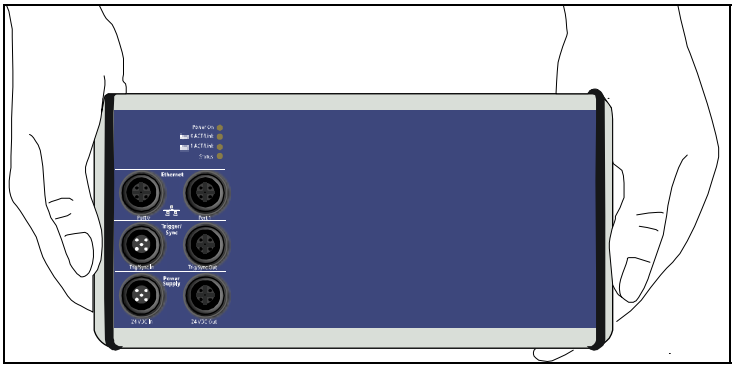
1.3.2 Country-specific regulations

Do observe the country-specific regulations regarding

- the prevention of accidents
- electrical and mechanical installations
- Electromagnetic compatibility (EMC).

1.4 Handling of the Ethernet system

Fig. 1-1: Correct handling



- Hold the Ethernet system by the bottom and the grey sides.
- Do not hold the Ethernet system by the connectors!

1.5 Questions and updates

You can send us any questions by e-mail or call us:

E-mail: info@addi-data.com

Phone: +49 7229 1847-0.

Manual and software download from the Internet

The latest versions of the technical manual and the standard software for the Ethernet system **MSX-E1701** can be downloaded for free at:

www.addi-data.com

IMPORTANT!

Before using the Ethernet system or in case of malfunction during operation, check if there is an update (manual, driver, firmware) available on our website or contact us directly.

2 Brief description

In this chapter, the functions and features of the Ethernet system **MSX-E1701** are described in brief. Furthermore, you will find a general block diagram of the MSX-E system.

2.1 Functions and features

The intelligent Ethernet system **MSX-E1701** has four incremental counter inputs or four PWM outputs as well as 16 digital inputs and outputs, which can be configured as pairs of inputs or outputs.

By means of an external trigger, the inputs and outputs on multiple systems can be updated simultaneously. The system can be configured over either the integrated web interface or SOAP commands. These interfaces also enable signal generator data to be accessed.

Over an integrated Ethernet switch, the system can be cascaded with other MSX-E systems. This also applies to the voltage supply and the trigger/synchro line, which facilitates wiring between the single systems.

The Ethernet system is mounted in a robust EMC-protected metal housing, which complies with the degree of protection IP 65. In this way, the Ethernet system is able to cope with daily stresses and strains such as current peaks, vibrations, dirt or extreme temperatures. Moreover, it can be used in the extended operating temperature range from -40 °C to +85 °C and is equipped with numerous protective circuits. Error diagnoses are quickly identified by means of the “Status” LED display.

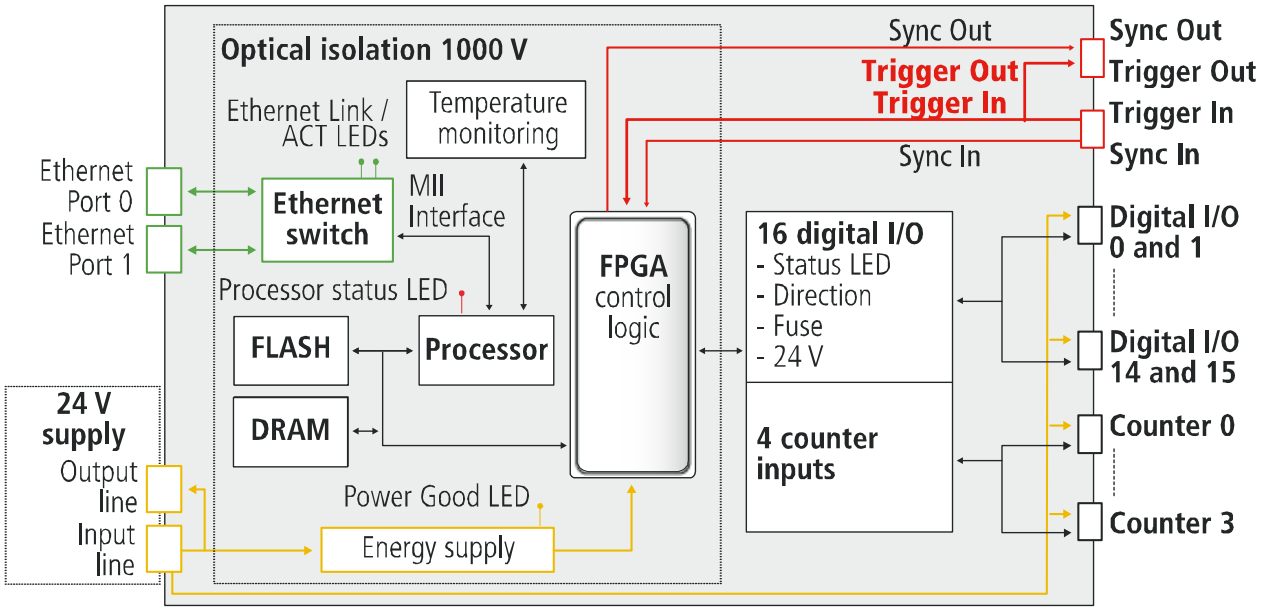
The electronics are no longer in the computer itself but in an external housing connected to the computer via Ethernet. As the Ethernet system is attached in direct vicinity of the signal generator or actuator, the function of the latter is no longer affected by long cables. The length of the (Ethernet) connection cable from the Ethernet system to the computer may be up to 150 m. The system must be supplied with external voltage (24 V).

Features:

- 4 incremental counter inputs (32-bit) or 4 PWM outputs
- 16 digital inputs/outputs, 24 V, can be configured in pairs, LEDs to display level and direction
- Watchdog for resetting the outputs to “0” (the latter are set to “0” at Power-On)
- Input/output: can be controlled by means of an external trigger (digital 24 V trigger input)
- Web interface to configure, control and monitor the digital input/output
- Data access via SOAP or Modbus (always TCP or UDP)
- Optical isolation
- Degree of protection: IP 65
- Cascadable; synchronisation in the µs range
- Extended operating temperature range from -40 °C to +85 °C

2.2 Block diagram

Fig. 2-1: MSX-E1701: Block diagram



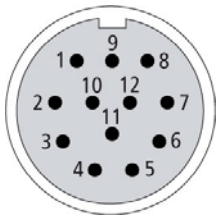
3 Function description: Incremental counter inputs

The Ethernet system **MSX-E1701** is equipped with four incremental counter inputs.

3.1 Pin assignment

To each M23 female connector, one rotary encoder can be connected.

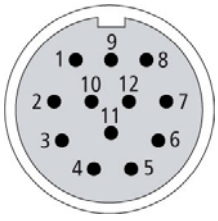
Table 3-1: Pin assignment: Incremental counter inputs

Pin No.	Female connector, 12-pin, M23	Polarity	Function
2, 12	Voltage supply 24 V or 5 V[1]	Output 5 V / 24 V (can be set via jumper), condition upon delivery: 5 V	Supply for incremental encoder
10, 11	GND	GND	
5	A+	Input RS422/TTL	Trace A Incremental signal
6	A-		
8	B+	Input RS422/TTL	Trace B Incremental signal
1	B-		
3	C+	Input RS422/TTL	Trace C Index
4	C-		
9	D+	Input RS422/TTL	Reference signal for reference point logic
7	D-		
			

WARNING!
Sensors transmitting RS422 or TTL signals must not be connected to the system **MSX-E1701-24V** (see Chapter 7.3).

[1] see Chapter 3.2

Table 3-2: Pin assignment: Incremental counter inputs (MSX-E1701-24V)

Pin No.	Female connector, 12-pin, M23	Polarity	Function
2, 12	Voltage supply 24 V or 5 V[2]	Output 5 V / 24 V (can be set via jumper), condition upon delivery: 24 V	Supply for incremental encoder
10, 11	GND	GND	
5	A+	Input 24 V	Trace A Incremental signal
6	A-	not connected	
8	B+	Input 24 V	Trace B Incremental signal
1	B-	not connected	
3	C+	Input 24 V	Trace C Index
4	C-	not connected	
9	D+	Input 24 V	Reference signal for reference point logic
7	D-	not connected	
			

[2] see Chapter 3.2

3.2 Selecting the supply voltage

At pins 2 and 12 of the M23 female connector, you can select between a supply voltage of 24 V and 5 V. This voltage is set by means of a jumper.
The jumper is inside the housing of the MSX-E system. In order to set the jumper to the desired position, the right-hand side of the housing (see Fig. 3-1) needs to be opened.

IMPORTANT!
Please note the following:

- The housing of the MSX-E system may be opened only for this purpose (see also Chapter 1.2.4)!
- Use safeguarding against electrostatic charge!
- The MSX-E system must not be connected to a voltage source during work at the housing and the jumper!
- When the housing is opened, neither solid nor liquid foreign bodies (dirt, moisture, etc.) may enter the inside of the housing!

Fig. 3-1: MSX-E1701: Right-hand side of the housing

Fig. 3-2: 24 V supply: Jumper at positions 1 and 2

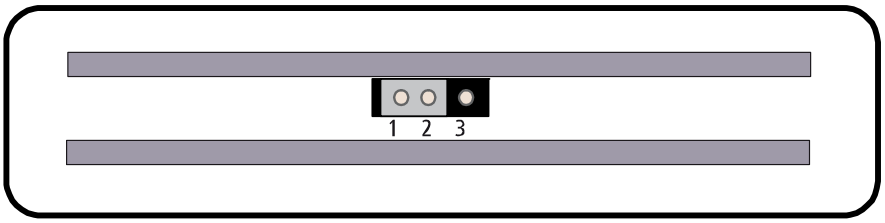
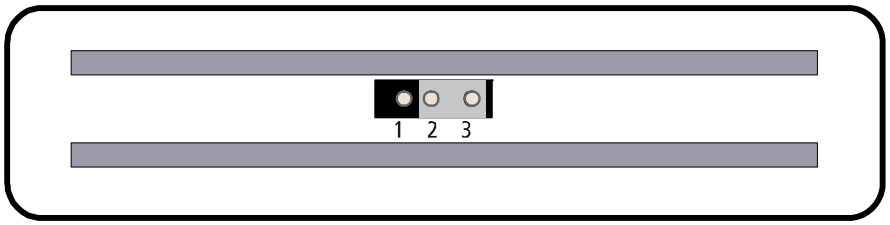
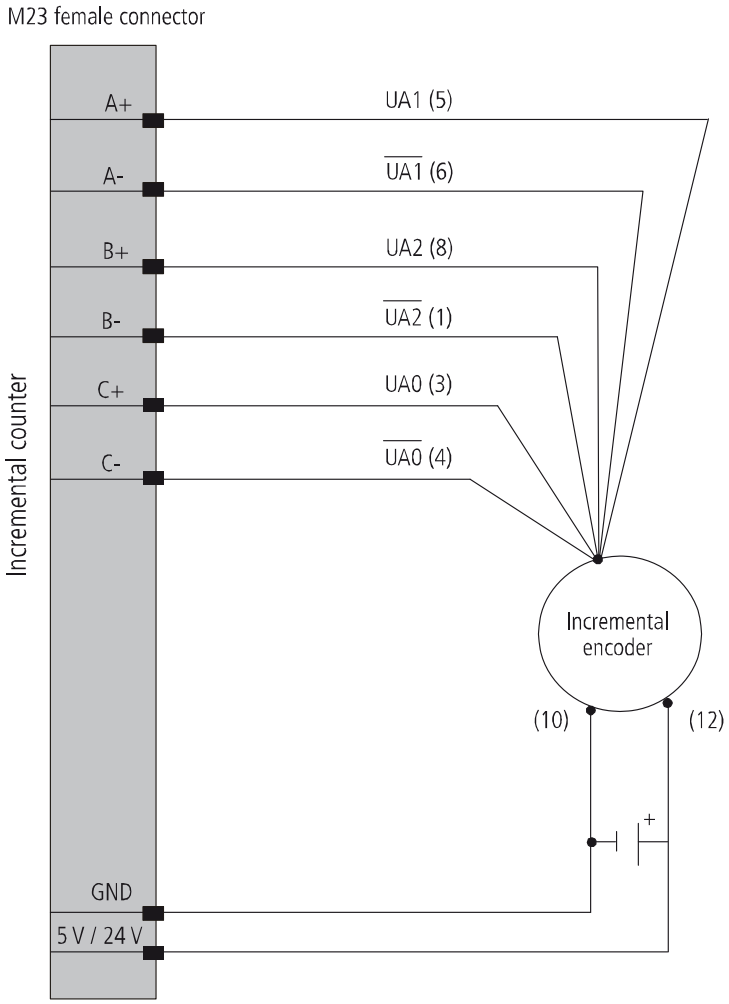


Fig. 3-3: 5 V supply: Jumper at positions 2 and 3



3.3 Connection example

Fig. 3-4: Connection example: Incremental encoder



3.4 TTL signal to RS422 input

IMPORTANT!
This option does not apply to the system **MSX-E1701-24V**.

A TTL signal may also be connected to a differential RS422 input using a reference voltage of approx. 1.4 V. The reference voltage is switched on through software and output at pin D- of the M23 female connector. On that condition, a differential signal cannot be connected to input D.

TTL signal to input D

The reference voltage is output at pin D-. The ground of the TTL signal must be connected to the ground of the female connector. The TTL signal has to be connected to pin D+.

TTL signal to input A / B / C

The reference voltage needs to be connected externally from pin D- to the desired negative input (A- / B- / C-). The ground of the TTL signal must be connected to the ground of the female connector. The TTL signal has to be connected to the requested positive input (A+ / B+ / C+).

3.5 Acquisition modes

There are four modes available for the acquisition of incremental encoder signals.

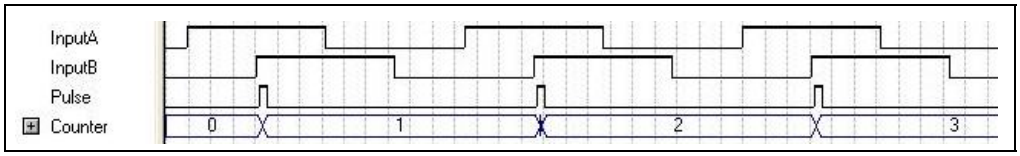
Table 3-3: Incremental counter: Acquisition modes

Mode	Feature
Single	Acquisition with a quarter of the highest possible resolution
Double	Acquisition with half of the highest possible resolution
Quadruple	Acquisition with the highest possible resolution
Direct	Acquisition without detection of the direction

a) Single mode

In single mode, if trace A of the incremental encoder signal is on “high”, the system counts with each rising edge of trace B.

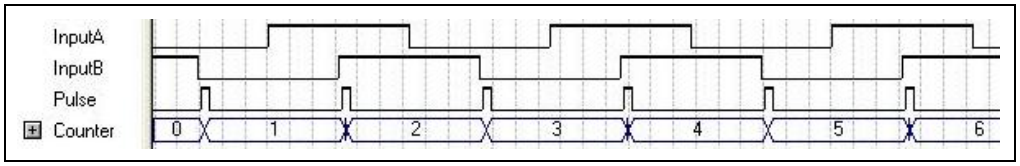
Fig. 3-5: Incremental counter: Single mode



b) Double mode

In double mode, the system counts with each rising and falling edge of trace B.

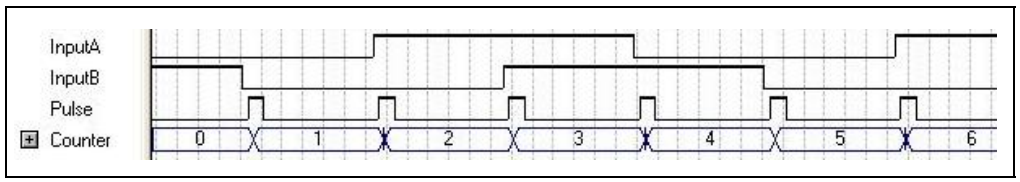
Fig. 3-6: Incremental counter: Double mode



c) Quadruple mode

In quadruple mode, the system counts with each rising and falling edge of traces A and B.

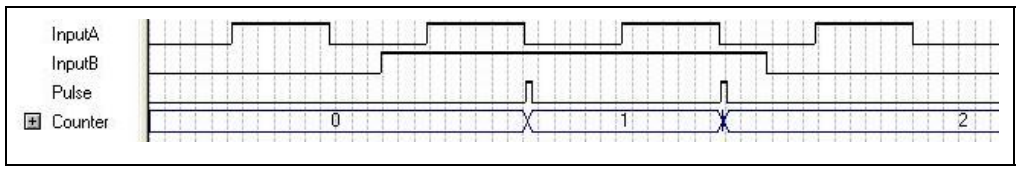
Fig. 3-7: Incremental counter: Quadruple mode



d) Direct mode

In direct mode, the system counts with each falling edge of trace A, with input B serving as a gate input. The system counts only if trace B is on “high”.
Moreover, in direct mode, the direction of counting can be programmed through software.

Fig. 3-8: Incremental counter: Direct mode

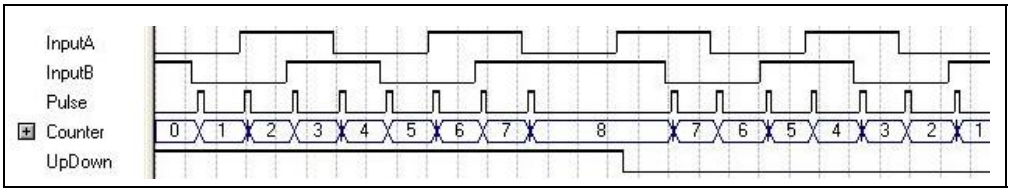


3.5.1 Options

1) Hysteresis function

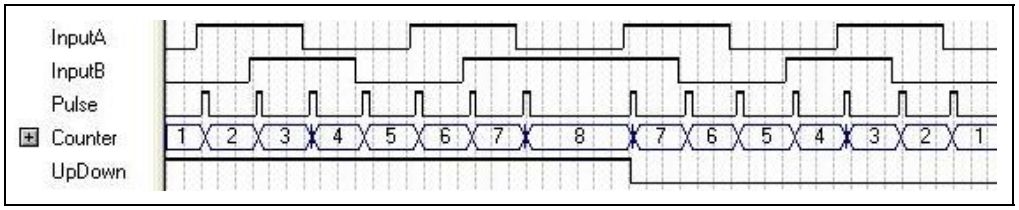
The hysteresis function can be used in single, double and quadruple mode.

Fig. 3-9: Quadruple mode: Hysteresis "on"



With hysteresis "on", the first counting pulse after a change of rotational direction is not evaluated.

Fig. 3-10: Quadruple mode: Hysteresis "off"



2) Way of counting

In direct mode, counting can be either upwards or downwards.

3.6 Frequency measurement

During frequency measurement, all pulses within a selected time frame are counted.
This interval may take 100 ns to 6.55 ms. Depending on the mode set (see Chapter 3.5), a pulse is counted at a rising or falling edge of the incremental encoder signal.
The frequency measurement is started independently of the input signal through software. The 32-bit counter is set to zero then. When the measurement is finished, the frequency of the input signal is calculated from the length of the time frame and the number of counted pulses.

3.7 Compare logic

It is possible to use the compare logic for the generation of a trigger or synchro trigger signal in order to latch the counter value.

There are two compare logic modes:

a) Simple mode

In Simple mode, a reference value can be indicated. As soon as the counter value corresponds to the reference value, a trigger or synchro trigger is released.

b) Modulo mode

In Modulo mode, a reference value is indicated as well. When the counter value corresponds to the reference value or a multiple of it, a trigger or synchro trigger is released.

3.8 Index and reference point logic

The index signal of an incremental encoder can be used either for latching or latching and deleting the counter value.
You can select if the rising edge, the falling edge or both edges of the index signal should be counted. Depending on the mode, the counter value is latched only once or endlessly after each defined edge.

Examples

a) Index logic with falling edge in continuous mode

In addition to the index logic, the reference point logic can be activated.
In this case, the defined edge of the index signal is counted only after a falling edge of the external reference signal. Further relevant edges of the index signal are not taken into account until the next falling edge of the reference signal has been counted.

b) Index logic with rising edge in continuous mode and reference point logic with falling edge

3.9 Hardware trigger

The digital 24 V trigger input of the MSX-E system can be used to latch the incremental counter value. You can select if the rising edge, the falling edge or both edges of the trigger signal generated externally should count. By means of the counter, you can define after which number of edges the incremental counter value is to be latched.

Examples:

- Selected edge: rising
  Counter value: 1
  The incremental counter value is latched after every rising edge of the trigger signal.
- Selected edge: rising
  Counter value: 3
  The incremental counter value is latched after every third rising edge of the trigger signal.
- Selected edge: rising and falling
  Counter value: 3
  The incremental counter value is latched after every third edge of the trigger signal.

In order to suppress interfering signals, a software-programmable digital filter can be used for the trigger input.
The filter time may be in the range between 250 ns and 16.38 ms. When the filter is activated, every positive or negative pulse lasting shorter than the defined filter time is suppressed.

3.10 Digital filter for the incremental counter inputs

Not only for the hardware trigger input, but also for the incremental counter inputs a programmable digital filter can be used to eliminate interfering signals.
For each of the four inputs, the filter can be set individually. The filter time may be 100 ns to 26.2 ms. When the filter is activated, every positive or negative pulse lasting shorter than the defined filter time is suppressed.

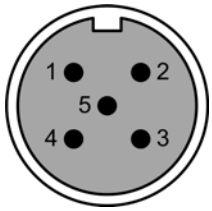
4 Function description: Digital inputs/outputs

The Ethernet system **MSX-E1701** has 16 digital inputs or outputs for sensors or actuators.

4.1 Pin assignment

To each M12 female connector, up to two sensors or actuators can be connected. In addition, a 24 V supply is available.

Table 4-1: Pin assignment: Digital inputs/outputs

Pin No.	Female connector, 5-pin, M12	Cable (black)
		Lead colour
1	24 V output	brown
2	Digital I/O (2n+1)*	white
3	GND	blue
4	Digital I/O (2n)*	black
5	not connected	grey
		

* Please note that the female connector (n) is dual-wired and that the digital I/Os are determined via (2n+1) or (2n) with 0 ≤ n ≤ 7.

Examples:

Female connector 0 (n=0) –> Pin 2: (2 x 0 + 1) –> Digital I/O 1
–> Pin 4: (2 x 0) –> Digital I/O 0

Female connector 7 (n=7) –> Pin 2: (2 x 7 + 1) –> Digital I/O 15
–> Pin 4: (2 x 7) –> Digital I/O 14

4.2 LED display

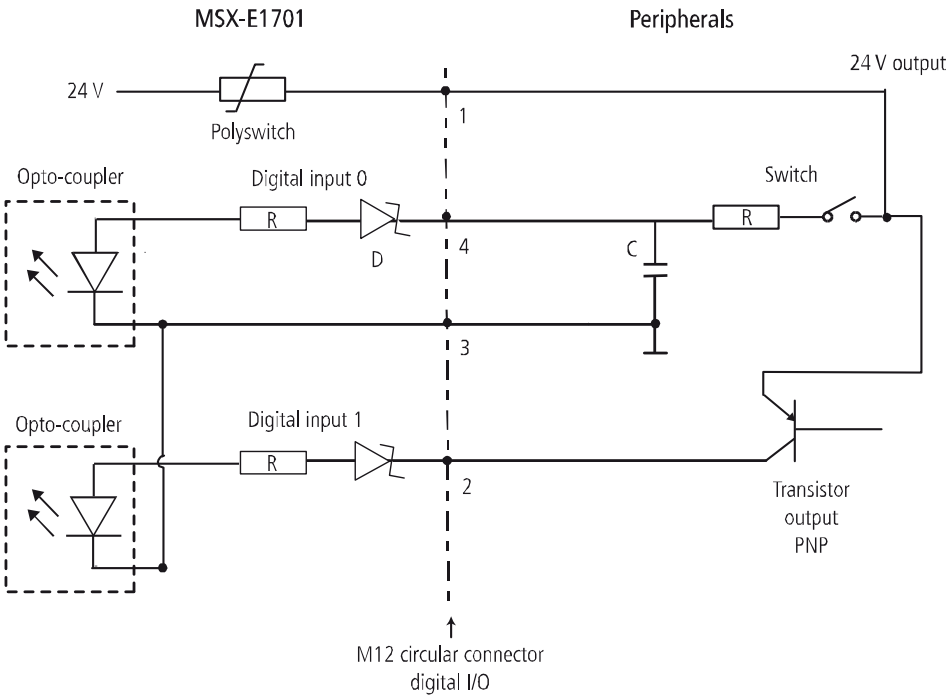
Table 4-2: LED display: Digital I/O

Direction	Status	LED	Meaning
Output	inactive	black 	- No output active - No voltage applied
Output	active	Lights red 	- Output is active - No voltage applied **Caution, risk of short-circuit!**
Input	inactive	Lights green 	- Input is ready for operation - Signals can be received
Input	active	Lights yellow 	- Input is active - Signal being received

4.3 Connection examples

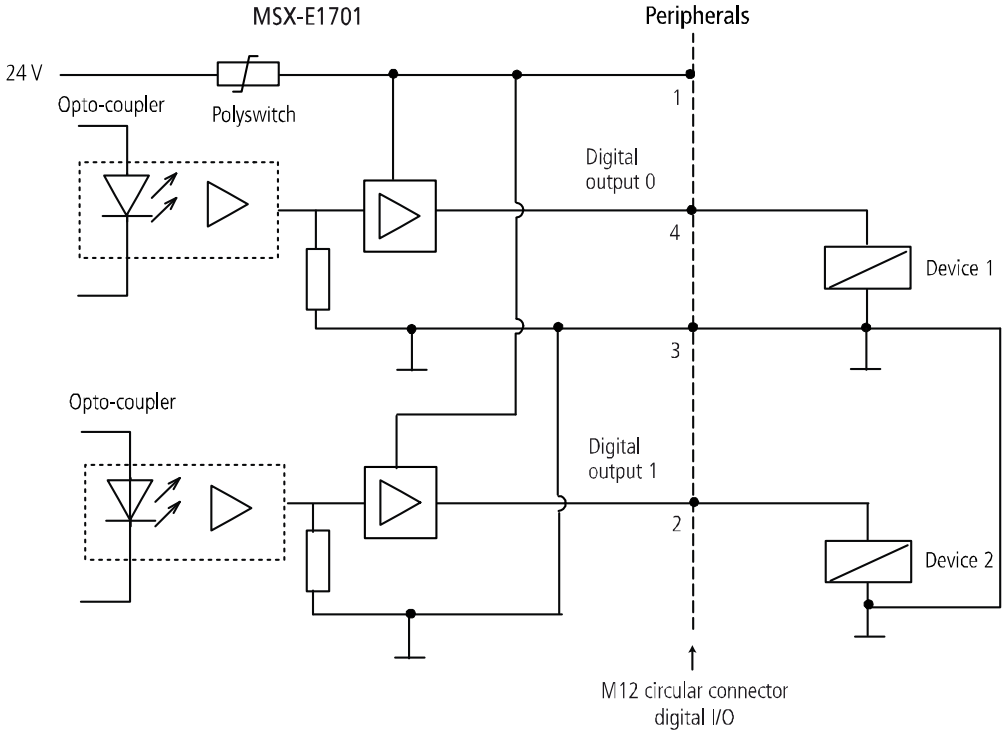
4.3.1 Digital inputs (24 V)

Fig. 4-1: Connection example: Digital inputs (24 V)



4.3.2 Digital outputs (24 V)

Fig. 4-2: Connection example: Digital outputs (24 V)



4.4 Digital outputs

By default, the digital channels of the **MSX-E1701** are configured as inputs.
In order to convert a port, i. e. a pair of channels into an output, the configuration has to be changed on the web interface of the MSX-E system (see Chapter 6.1.1) or by the SOAP function "int MSXE170x__DigitalIOInitPortConfiguration()".

IMPORTANT!
For each connector or port, only inputs or outputs can be configured.

The ports configured as outputs are high-impedance. The status of the outputs can be read back by way of control.

If a short-circuit occurs at a connected output, this output will be deactivated.
As soon as the short-circuit has been eliminated, a rearm has to be carried out to reactivate the output (see Chapter 6.1.1). This means that the output is set to the status value that was programmed before the short-circuit occurred. A new value can only be defined after the rearm event.

4.5 Watchdog

The Ethernet system **MSX-E1701** has a 16-bit watchdog, which is programmable in three time units (µs, ms, s). The watchdog is used to reset the digital outputs to 0 V after a specific time.

Operation of the watchdog

1. After the system reboot, the watchdog is in “Uninitialised” state.
   It can be initialised and activated (“Running” state) over the web interface of the MSX-E system or by a software function.
2. With the first write access to the outputs, the watchdog is started: The watchdog time is loaded and the watchdog starts counting down.
   As long as the watchdog time has not elapsed, the watchdog is triggered with every further write access to the outputs, i. e. the watchdog time is reloaded.
3. When the watchdog time has elapsed, the watchdog is put in “Overrun” state and all digital outputs are set to 0 V or 0 mA. In “Overrun” state, any write access to the outputs is ignored.
4. To re-enable write access, the watchdog first has to be put in “Stopped” state (web interface) or deactivated by a software function.
   To reactivate the watchdog, it has to be put in “Running” state again or reinitialised and reactivated by a software function.

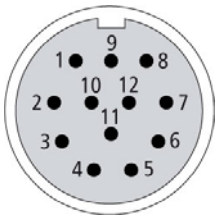
5 Function description: PWM outputs

The Ethernet system **MSX-E1701** is designed to use four PWM outputs.

5.1 Pin assignment

To each M23 female connector, one PWM actuator can be connected.

Table 5-1: Pin assignment: PWM outputs

Pin No.	Female connector, 12-pin, M23	Polarity	Function
2, 12	Voltage supply 24 V or 5 V[3]	Output 5 V / 24 V (can be set through jumper), condition upon delivery: 5 V	
10, 11	GND	GND	
5	A+	Output RS422/TTL	PWM 0 Output
6	A-		
8	B+	Output RS422/TTL	PWM 1 Output
1	B-		
3	C+	Input RS422/TTL	PWM 0 Gate/External clock
4	C-		
9	D+	Input RS422/TTL	PWM 1 Gate/External clock
7	D-		
			

[3] see Chapter 3.2

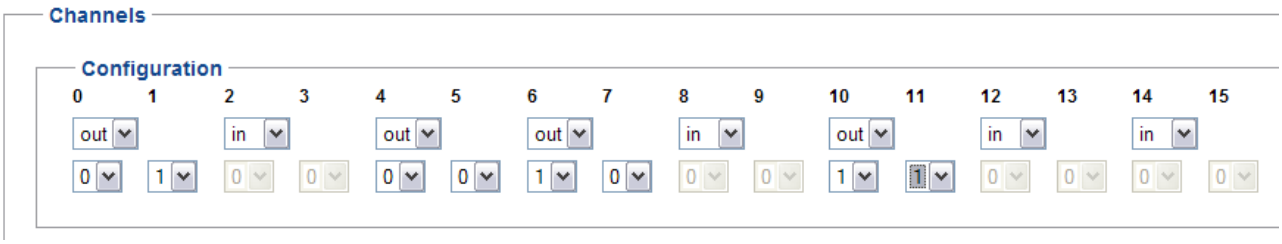
6 Web interface: Quick access to the MSX-E system

6.1 "I/O Configuration"

In this manual, the function-specific pages of the **MSX-E1701** web interface, which are located under the menu item "I/O Configuration", are described.
For further information on the MSX-E web interface, please refer to the general manual of the MSX-E systems (see PDF link).

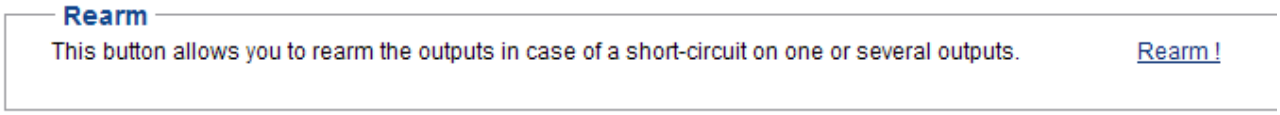
6.1.1 Menu item "Digital I/O"

Fig. 6-1: Digital I/O: Channels



On this page, you can configure the digital channels as pairs of inputs or outputs. For each output, also the status (0 or 1) has to be defined.

Fig. 6-2: Digital I/O: Rearm



After a short-circuit occurred, the required rearm (see Chapter 4.4) can be carried out via the correspondent button.

6.1.2 Menu item "I/O Watchdog"

Fig. 6-3: I/O Watchdog: Current state

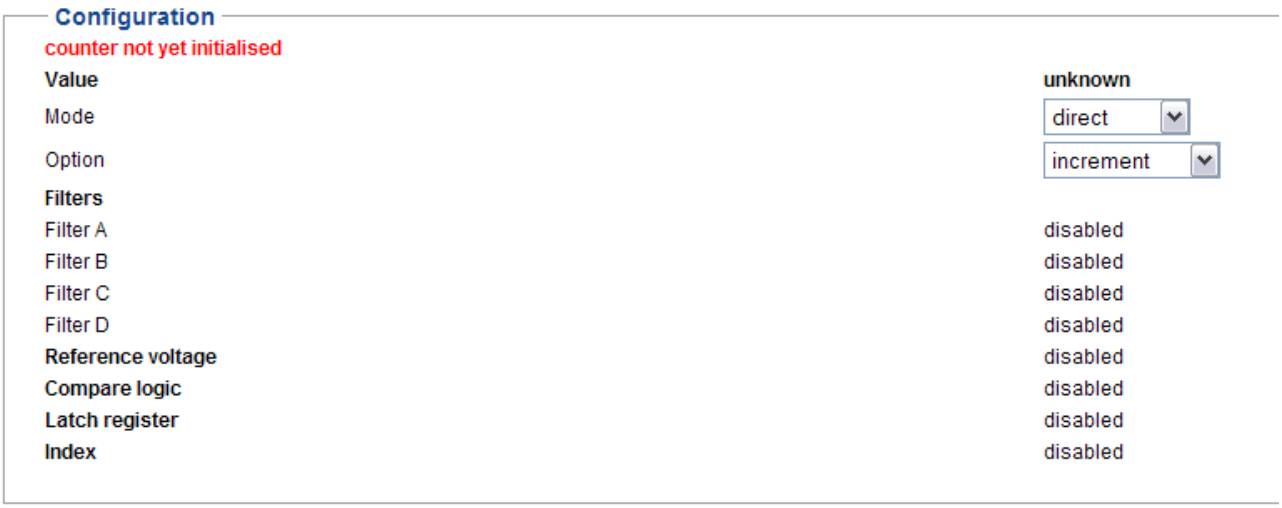
On this page, the current status of the watchdog for the digital inputs and outputs is displayed.

Fig. 6-4: I/O Watchdog: Configuration

You can configure the watchdog by defining the time unit and the watchdog time.

6.1.3 Menu item "Incremental counter"

Fig. 6-5: Incremental counter: Configuration

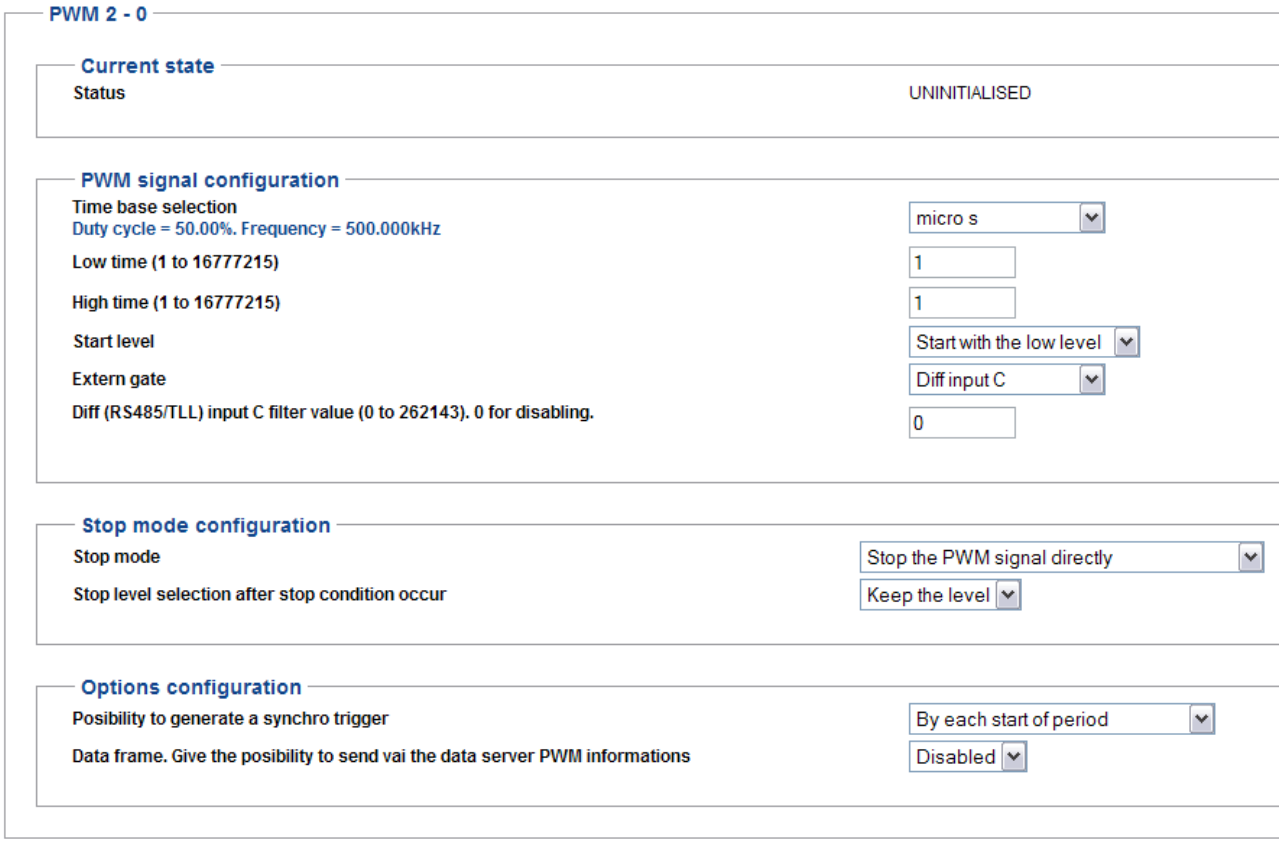


In this section, you can select the acquisition mode of the incremental encoder signal and the corresponding options. A description of these is to be found in Chapter 3.5.

Moreover, you can see in this section if the following options are activated:
digital filter of the incremental counter inputs A to D, reference voltage for TTL signal, compare logic, latch register of the synchro trigger and index logic.

6.1.4 Menu item “PWM”

Fig. 6-6: PWM: Configuration



This menu item is only available in the system version containing PWM outputs.

In the area “PWM signal configuration”, you can set the following parameters:
time base, level times, start level, external gate and filter value of input C.

The stop mode and the level state of the signal after a stop command have to be defined in the area “Stop mode configuration”.

In the area “Options configuration”, you have the possibility to select the source of the synchro trigger and to activate the data server.

6.1.5 Data format

Below, the data format of incremental counter values is described. The data server is not used for the digital I/Os and the watchdog.

Table 6-1: Incremental counter: Data format

Time stamp (µs)	Time stamp (s)	Counter No.	Event source	Data
4 Bytes	4 Bytes	4 Bytes	4 Bytes	4 Bytes
Time stamp in microseconds	Time stamp in seconds	Number of the incremental counter (0 to 3)	see Table 6-2	see Table 6-2

A data packet consists of five fields (field format: 32-bit Little Endian). The data width of all data is 32-bit.

Table 6-2: Data

Event source	Result
0: Compare logic	Counter value
1: Frequency measurement	Number of pulses within the defined interval
2: Latch value via the digital hardware trigger	Counter value
3: Latch value via the synchro trigger	Counter value
4: Latch value via the index input	Counter value

7 Technical data and limit values

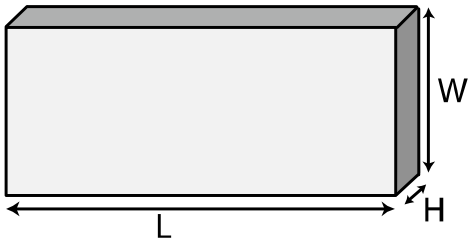
7.1 Electromagnetic compatibility (EMC)

The Ethernet system **MSX-E1701** complies with the European EMC directive. The tests were carried out by a certified EMC laboratory in accordance with the norm from the EN 61326 series (IEC 61326).
The limit values as set out by the European EMC directive for an industrial environment are complied with.

The respective EMC test report is available on request.

7.2 Mechanical structure

Fig. 7-1: MSX-E1701: Dimensions



215 mm (L) x 110 mm (W) x 54 mm (H)

Weight:	900 g 960 g (with MX-Rail)

Fig. 7-2: MSX-E1701: View from above

7.3 Versions

The Ethernet system **MSX-E1701** is available in the following versions:

Table 7-1: MSX-E1701: Versions

Version	Features
MSX-E1701	RS422 or 5 V inputs (incremental counter) or RS422 outputs (PWM)
MSX-E1701-24V	24 V inputs (incremental counter)

The specific version name can be found on the type label of your Ethernet system (see also Chapter 1.1 of the general MSX-E manual).

7.4 Limit values

Height:	2000 m over NN
Operating temperature:	-40 °C to +85 °C
Storage temperature:	-40 °C to +85 °C
Relative air humidity at indoor installation:	50 % at +40 °C 80 % at +31 °C (Ice formation from condensation must be prevented.)
Current supply:	
Nominal voltage:	24 VDC
Supply voltage:	18-30 V
Current consumption (at 24 V):	150 mA (±10 %)
Safety:	
Degree of protection:	IP 65[4]
Optical isolation:	1000 V
Reverse polarity protection:	1 A max.

IMPORTANT!
After boot-up, the MSX-E system should warm up for a minimum 15 minutes so that a constant internal temperature will be reached.

[4] The degree of protection is only provided when the relevant protection caps are used.

7.4.1 Ethernet

Number of ports:	2
Optical isolation:	1000 V
Cable length:	150 m (max. for CAT5E UTP)
Bandwidth:	10 Mbps (auto-negotiation) 100 Mbps (auto-negotiation)
Protocol:	10 Base-T according to IEEE 802.3 100 Base-TX according to IEEE 802.3
MAC address:	00:0F:6C:##:##:## (unique for each device)

7.4.2 Trigger input

24 V trigger input

Number of inputs:	1
Filter/Protective circuit:	low-pass/transorb diode
Optical isolation:	1000 V (via opto-couplers)
Nominal voltage:	24 VDC
Input voltage:	0-30 V
Input current:	11 mA typ. (at nominal voltage)
Max. input frequency:	2 MHz (at nominal voltage)
Logic input levels:	UH_{max}: 30 V UH_{min}: 19 V UL_{max}: 14 V UL_{min}: 0 V

5 V trigger input (optional)

Number of inputs:	1
Filter/Protective circuit:	low-pass/transorb diode
Optical isolation:	1000 V (via opto-couplers)
Nominal voltage:	5 VDC
Input voltage:	0-5 V
Input current:	12 mA typ. (at nominal voltage)
Max. input frequency:	1 MHz (at nominal voltage)
Signal threshold:	2.2 V typ.

7.4.3 Synchro input and output

Number of inputs:	1
Number of outputs:	1
Optical isolation:	1000 V
Output type:	RS422
Driver level (master) V_{A-B}:	≤ -1.5 V (low) ≥ 1.5 V (high)
Receiver level (slave) V_{A-B}:	≤ -200 mV (low) ≥ 200 mV (high)

7.4.4 Incremental counter inputs

Number of inputs:	4 (with A, B, C and D signals each)
Input type:	differential or TTL **(MSX-E1701)** 24 V **(MSX-E1701-24V)**
Sensor supply: Voltage: Current:	 5 V or 24 V (can be selected via jumper) 500 mA max. (for each female connector)
Differential inputs:	comply with EIA standards RS422A
Common mode range:	+12 V to -7 V
Input sensitivity:	±200 mV
Input hysteresis:	50 mV typ.
Max. input frequency:	5 MHz
Input impedance:	12 kΩ min.
"Open Circuit Fail Safe Receiver Design":	"1" = inputs open
ESD protection:	up to ±15 kV
TTL inputs:	see Chapter 3.4
24 V inputs:	version for the connection of 24 V encoders or 24 V signals
Nominal voltage:	24 VDC
Max. input frequency:	1 MHz (at nominal voltage)
Input impedance:	1 MΩ typ.
Logic input levels:	UH_{max}: 30 V UH_{min}: 19 V UL_{max}: 14 V UL_{min}: 0 V

7.4.5 PWM

Number of outputs:	4 (with A, B, C and D signals each)
Output type:	RS422
Nominal voltage:	3.3 V
Max. input frequency:	5 MHz (depending on the function)

7.4.6 Digital inputs

Number of inputs:	16 (2 per female connector / common GND according to IEC 1131-2)
Overvoltage protection:	30 V
Optical isolation:	1000 V (via opto-couplers)
Nominal voltage:	24 VDC
Input voltage:	0-30 V
Input frequency (max.):	1 MHz (at nominal voltage)
Input impedance:	> 1 MΩ
Logic input levels:	UH_{max}: 30 V UH_{min}: 19 V UL_{max}: 14 V UL_{min}: 0 V

7.4.7 Digital outputs

Number of outputs:	16 (2 per female connector)
Optical isolation:	1000 V (via opto-couplers)
Output type:	high-side (load to ground according to IEC 1131-2)
Nominal voltage:	24 V
Supply voltage:	18-30 V
Current:	1.85 A max. (for each group[5]) via PTC
Output current per output:	500 mA max.
Short-circuit current per output:	1.7 A max. shut-down logic at 24 V, R_{Load} = 10 mΩ
R_{DS} ON resistance:	280 mΩ max.
Switch-on time:	100 µs (max. R_L = 48 Ω of 80 % V_{out})
Switch-off time:	150 µs (max. R_L = 48 Ω of 10 % V_{out})
Overtemperature (shut-down):	135 °C max. (output driver)
Temperature hysteresis:	15 °C typ. (output driver)
Diagnosis:	common diagnostic bit for all 16 channels at overtemperature of one channel

7.4.8 Watchdog

Number:	1
Watchdog depth:	16-bit
Programmability:	1 µs to 65535 s
Time base:	µs, ms, s (programmable)

[5] Group 1: Digital outputs 0 to 3, 8 to 11 and the respective 24 V output
Group 2: Digital outputs 4 to 7, 12 to 15 and the respective 24 V output

8 Appendix

8.1 Glossary

Cascading
Cascading means connecting multiple similar elements together to enhance their individual effect. The individual elements must be such that the outputs of a given element are compatible with the inputs of the subsequent element in terms of values and functionality.

Counter
A counter is a circuit that counts pulses or measures pulse duration.

Data acquisition
Data acquisition means gathering information from sources such as sensors and transducers in an accurate, timely and organised manner. Modern systems convert this information to digital data which can be stored and processed by a computer.

Digital signal
A digital signal is a digital representation of a constantly changing value or other piece of information. Digital signals consist of a finite number of values. The smallest possible difference between two digital values is referred to as the resolution. Digital signals are discontinuous in terms of value and time ranges.

Driver
A driver is a series of software instructions written specifically to manage particular devices.

EMC
= Electromagnetic Compatibility

The definition of the VDE regulation 0870 states: Electromagnetic compatibility is the ability of an electrical installation to function satisfactorily within its electromagnetic environment without unduly affecting its environment and the equipment it contains.

ESD
= Electrostatic Discharge

On non-conductive surfaces, an electric charge is conducted away very slowly. If the dielectric strength is overcome, there is a fast potential equalisation between the surfaces involved. The often very sudden equalisation process is referred to as electrostatic discharge (ESD). Currents of up to 20 A may occur in this process.

Ethernet
The Ethernet is a baseband bus system originally developed in order to connect mini-computers. It is based on the CSMA/CD access method. Coaxial cables or twisted-pair cables are used as the transmission medium.
The transmission speeds are 10 Mbit/s (Ethernet), 100 Mbit/s (Fast Ethernet) and 1 Gbit/s or 10 Gbit/s (Gigabit-Ethernet). This widely used technology for computer networking in a LAN has been standardised since 1985 (IEEE 802.3 and ISO 8802-3). Ethernet technology is now common practice in the office environment. After making even very tough real-time requirements possible and adapting the device technology (bus cables, patch fields, junction boxes) to the harsh application conditions of the industrial environment, Ethernet is now also increasingly used in the field areas of automation technology.

Event
An event is an occurrence detected by the MSX-E system. Where e. g. a short-circuit is detected and an event is activated, a short-circuit warning can be sent via the event server.

Ground line
Ground lines should not be seen as potential-free return lines. Different ground points may have small potential differences. This is always true with large currents and may cause inaccuracy in high-resolution circuits.

Hysteresis
Hysteresis is the difference between the start-up and shut-down voltage. In TTL circuits, it is typically 0.8 V; in CMOS circuits, it depends on the supply voltage.

IEC
= International Electrotechnical Commission

The IEC is a UN body affiliated to the ISO (International Standards Organisation) which sets standards for electrotechnical parts and components.

Input impedance
The input impedance is the ratio of voltage to current at the input terminals when the output terminals are open.

Input level
The input level is the logarithmic ratio between two electrical values of the same type (voltage, current or power) at the signal input of any receiving unit. This unit is often configured as a logical level related to the input of the circuit. The input voltage corresponding to logic "0" is between 0 V and 15 V and the voltage corresponding to logic "1" is between 17 V and 30 V.

IP degree of protection
The IP standard defines the degree of protection of a system against dirt and water. The first figure after the "IP" (e.g. 6 in IP 65) indicates the degree of protection against solid objects penetrating the housing. The second figure indicates the degree of protection against liquids penetrating the housing.
In IP 65, the figures 6 and 5 have the following meaning: 6 = full protection against moving parts and against dirt penetration;
5 = protection against jets of water from any direction.
In IP 40, the figure 4 equates to protection against contact with small objects and protection against small foreign bodies (larger than 1 mm). The figure 0 means that there is no protection.

Level
Logic levels are defined for processing and displaying information.
In binary switches, voltages are used for digital values. Here, the two voltage ranges "H" (high) und "L" (low) represent the information.
The "H" range is closer to plus infinity; the "H" level corresponds to digital 1. "L" denotes the range closer to minus infinity; the "L" level corresponds to digital 0.

Limit value
Exceeding the limit values, even for a short time, can easily result in the destruction of the component or the (temporary) loss of functionality.

MAC address
MAC = Media Access Control

This is the hardware address of network components used to identify them uniquely within the network.

Optical isolation
Optical isolation means that there is no flow of electrical current between the circuit to be measured and the measuring system.

Protective circuit
A protective circuit is set up on the actuator side to protect the control electronics and provide adequate EMC safety. The simplest protective circuit involves connecting a resistor in parallel.

Resolution
The resolution indicates how precisely a signal or value is held within the computer.

Short-circuit
A short-circuit exists between two terminals of an electric circuit if the relevant terminal voltage is zero.

SOAP
= Simple Object Process Protocol

SOAP is a simple extensible protocol for exchanging information in distributed environments. It defines XML messages that can be exchanged between heterogeneous applications via HTTP.

SOAP is independent of operating systems and can be integrated into existing Internet structures, including Ethernet TCP/IP-based automation concepts. SOAP is based on Remote Procedure Calls and XML. This means that functions from other platforms can be called and used from any point within the network. Any results data can also be returned using XML schemas. This enables distributed computing capacity and non-redundant data storage in distributed systems.

Switch-off time
The switch-off time is the time between the control current being switched off and the output voltage falling to 10% of its original value.

TCP/IP
= Transmission Control Protocol/Internet Protocol

TCP/IP is a family of network protocols and therefore often just referred to as Internet protocol. The computers that are part of the network are identified via their IP addresses. UDP is another transport protocol that belongs to the core group of this protocol family.

Trigger
A trigger is a pulse or signal for starting or stopping a special task. Triggers are often used for controlling data acquisition.

UDP
= User Datagram Protocol

This is a minimal connection-free network protocol which is part of the transport layer within the Internet protocol family. The purpose of UDPs is to ensure that data transmitted over the Internet reach the correct application.

Watchdog
A watchdog is an electronic delay switch used to monitor key components or devices. It is activated periodically and triggers an alarm after a specified time. If the unit to be monitored is working correctly, the watchdog is reset before triggering the alarm.

8.2 Index

9 Contact and support

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