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TECHNICAL

DESCRIPTION

MSX-E1711 and MSX-E1721

Ethernet multifunction counter system

DIN EN ISO 9001:2008 certified

Edition: 02.04-07/2013

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.
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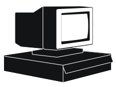
Warning

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

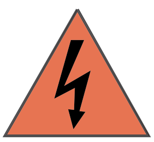
- Protect yourself, others and the environment!
- Read the safety precautions (yellow leaflet) carefully!

  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**.

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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 systems as well as safety precautions
2	Brief description of the MSX-E systems (functions, features, block diagram)
3	Function description (Sin/Cos counter) including pin assignment and connection example
4	Function description (digital inputs/outputs) including pin assignment and connection example
5	Description of the function-specific pages of the MSX-E web interface
6	List of technical data and limit values of the MSX-E systems
7	Appendix with glossary and index
8	Contact and support address

1 Definition of application, user, handling

1.1 Definition of application

1.1.1 Intended use

The Ethernet systems **MSX-E1711** and **MSX-E1721** for the acquisition, processing and transferring of signals from Sin/Cos signal generators as well as for digital input or output are 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 systems **MSX-E1711** and **MSX-E1721** must not be used as safety-related parts (SRP).

The Ethernet systems **MSX-E1711** and **MSX-E1721** must not be used for safety-related functions.

The Ethernet systems **MSX-E1711** and **MSX-E1721** must not be used in potentially explosive atmospheres.

The Ethernet systems **MSX-E1711** and **MSX-E1721** 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 manual 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

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IMPORTANT!
The protection according to the defined degree of protection (see chapter 6.4) 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.

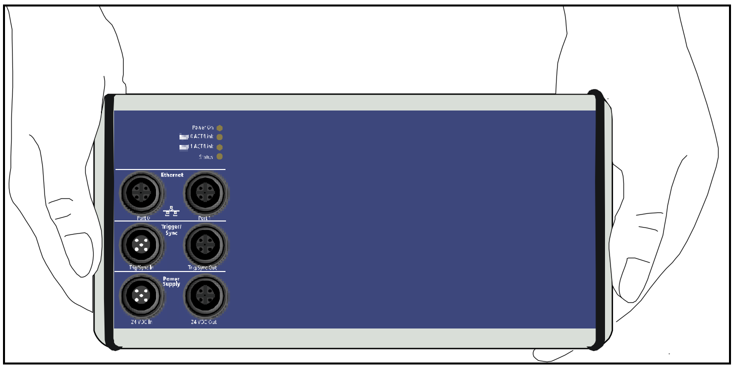
1.3.2 Country-specific regulations

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 systems **MSX-E1711** and **MSX-E1721** can be downloaded for free at:

www.addi-data.com

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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 systems **MSX-E1711** and **MSX-E1721** are described in brief. Furthermore, you will find a block diagram that applies to both MSX-E systems.

2.1 Functions and features

Each of the intelligent Ethernet systems **MSX-E1711** and **MSX-E1721** has four Sin/Cos counter inputs as well as16 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 (synchronisation). The systems can be configured and the acquisition can be started over either the integrated web interface or SOAP or Modbus commands. These interfaces also enable signal generator data to be accessed.

Over an integrated Ethernet switch, the systems 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.

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

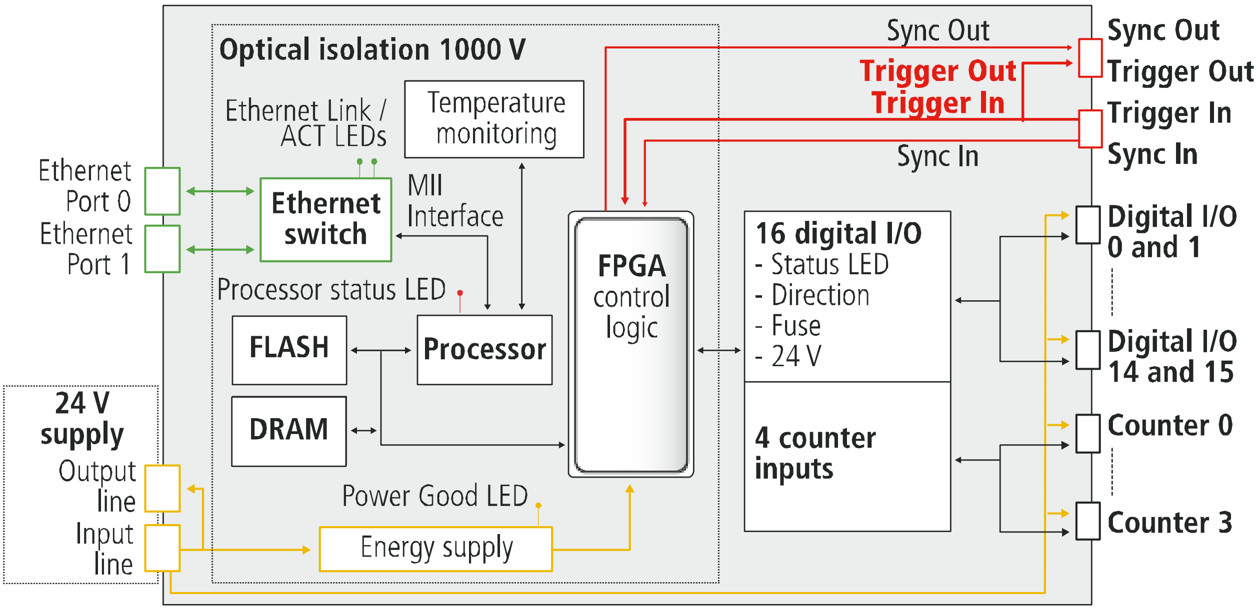
The electronics are no longer in the computer itself but in an external housing connected to the computer via Ethernet. As the Ethernet systems are attached in direct vicinity of the signal generators or actuators, the function of the latter is no longer affected by long cables. The length of the (Ethernet)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

Features:

- 4 Sin/Cos counter inputs (32-bit) for 1 V_{SS} **(MSX-E1711)** or 11 μA_{SS} **(MSX-E1721)**;
  additional functions in Full Range Mode: compare logic, index logic and hardware trigger
- 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 inputs/outputs and the Sin/Cos counter inputs
- 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-E1711 and MSX-E1721: Block diagram



3 Function description: Sin/Cos counter inputs

The Ethernet systems **MSX-E1711** and **MSX-E1721** both have 4 inputs for the acquisition of Sin/Cos signals.

The Ethernet system **MSX-E1711** is configured for the connection of 1 V_{PP} signals, whereas the Ethernet system **MSX-E1721** is capable of acquiring 11 μA_{PP} signals.
A signal period of the Sin/Cos signal is divided into a defined number of steps according to the selected resolution. The maximum input frequency of the counter input also depends on the selected resolution.

3.1 Pin assignment

To each M23 female connector, one Sin/Cos encoder can be connected.

Table 3-1: Pin assignment: Sin/Cos counter inputs (MSX-E1711)

Pin No.	Female connector, 12-pin, M23	Polarity	Function
2, 12	Voltage supply (5 V)	Output (5 V)	Supply for Sin/Cos encoder
10, 11	GND	GND	
5	A+	Input	Trace A (Sine)
6	A-		
8	B+	Input	Trace B (Cosine)
1	B-		
3	C+	Input	Trace C (Index)
4	C-		
7, 9	not connected		

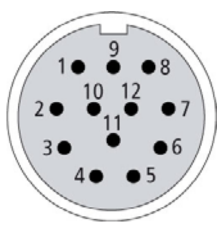
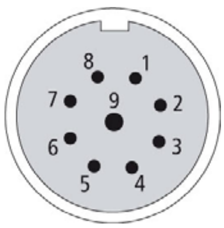


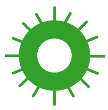
Table 3-2: Pin assignment: Sin/Cos counter inputs (MSX-E1721)

Pin No.	Female connector, 9-pin, M23	Polarity	Function
3	Voltage supply (5 V)	Output (5 V)	Supply for Sin/Cos encoder
4	GND	GND	
1	A+	Input	Trace A (Sine)
2	A-		
5	B+	Input	Trace B (Cosine)
6	B-		
7	C+	Input	Trace C (Index)
8	C-		
9	not connected		



3.2 LED display

Table 3-3: LED display: Sin/Cos counter inputs

Display	Meaning
Black 	Sin/Cos input signal is constant (Signal generator is not moved)
Lights green 	Sin/Cos input signal is constant (Signal generator is not moved)
Flashes green 	Counter is active

3.3 Circuit diagrams

Fig. 3-1: Basic input circuit: MSX-E1711

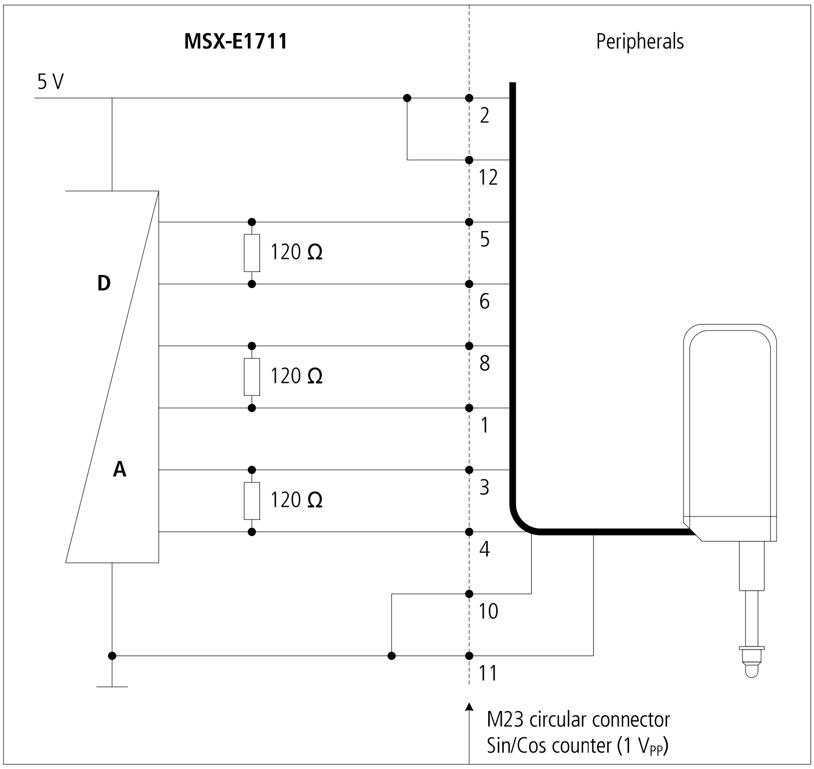
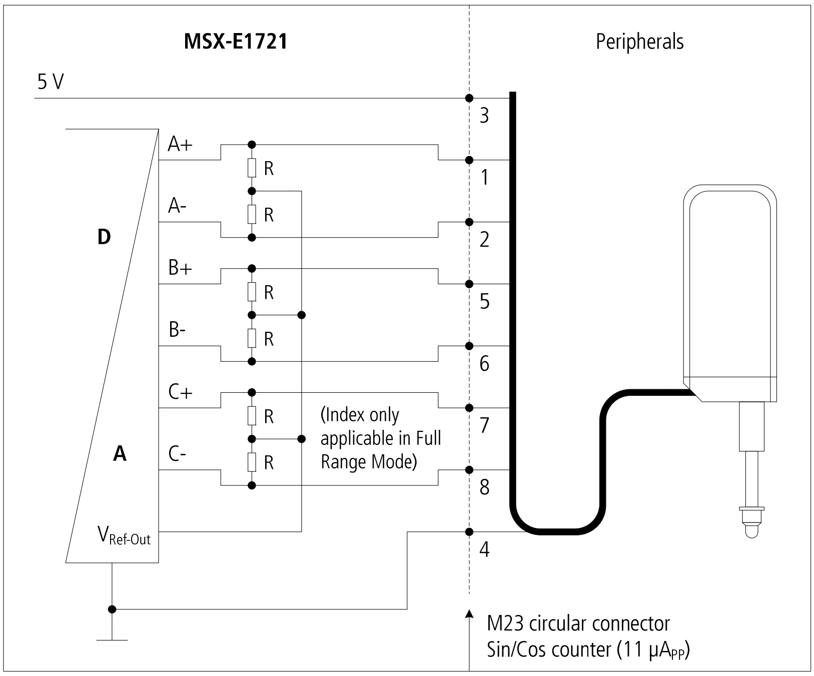


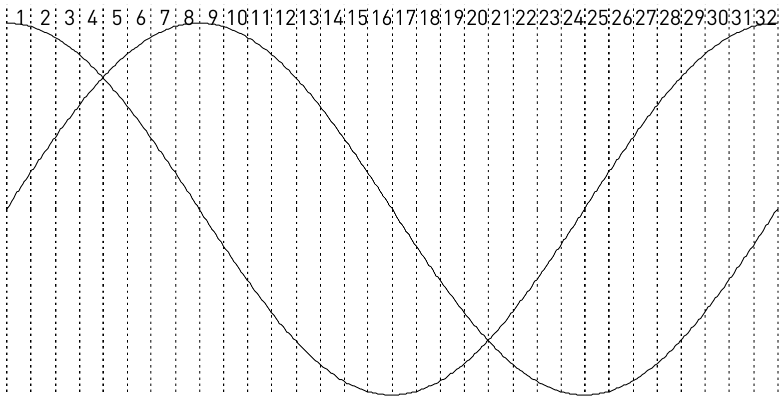
Fig. 3-2: Basic input circuit: MSX-E1721



3.4 Acquisition principle

A Sin/Cos signal generator transfers two sinusoidal signals that have a common signal period, with each signal being transferred on a differential trace. The two traces are shifted by 90° so that one trace is referred to as sine and the other one as cosine.
This signal period is indicated in the data sheet of the signal generator and is needed for the initialisation of the counter.

Fig. 3-3: Division of a signal period (resolution: 32)



If, for example, a connected Sin/Cos displacement transducer has a signal period of 2 µm, this means that with a distance of 0.4 mm an exact total of 200 sine periods and cosine periods is passed through. With the aid of the resolution, this hardware-specific distance is divided one more time into 16 to 8192 steps.
Accordingly, with a transducer that has a signal period of 10 µm and a selected resolution of 100, the increment is 0.1 µm.

3.5 Function parameters

To provide for a correct acquisition of data from the Sin/Cos signal generator, the following parameters have to be indicated with the initialisation:

- channel number
- signal period
- resolution
- output format
- mode.

The return value is the maximum input frequency which the counter input may be operated with. The higher the resolution is selected, the lower is the maximum frequency of the sine signals at the input, which can be processed.

The individual parameters are explained in the following chapters.

3.5.1 Channel number

The Ethernet systems **MSX-E1711** and **MSX-E1721** have 4 inputs each for the acquisition of Sin/Cos signals. Each input can be configured separately.
The channel numbers (0-3) are indicated on the housing of the MSX-E system, above each connector.

3.5.2 Signal period

The signal period is specified in the data sheet of the connected signal generator. If your signal generator is, for instance, a displacement transducer, the signal period is indicated in micrometres. This parameter is required in particular to calculate standardised values correctly and to output them.

3.5.3 Resolution

The resolution determines the actual increment, i.e. the smallest change in distance that can be measured. The increment is the quotient of the signal period and the selected resolution.

$$\text{Increment} = \frac{\text{Signal period}}{\text{Resolution}}$$

i **IMPORTANT!**
If the resolution is increased, the maximum input frequency, which can be processed, decreases.

In the following table, all available resolutions are listed. Some of these resolutions are only available in "Fast Mode". For more information on the modes, see chapter 3.5.5.

Table 3-4: Available resolutions

Resolution	Maximum input frequency (Hz)	Availability (Mode)
16	250,000	Full Range Mode, Fast Mode
25	26,000	Fast Mode
32	162,500	Full Range Mode, Fast Mode
40	16,300	Full Range Mode, Fast Mode
50	26,000	Fast Mode
64	81,300	Full Range Mode, Fast Mode
80	16,300	Full Range Mode, Fast Mode
100	26,000	Full Range Mode, Fast Mode

Resolution	Maximum input frequency (Hz)	Availability (Mode)
125	20,800	Fast Mode
128	40,600	Full Range Mode, Fast Mode
160	16,300	Full Range Mode, Fast Mode
200	26,000	Full Range Mode, Fast Mode
250	20,800	Fast Mode
256	20,300	Full Range Mode, Fast Mode
320	16,300	Full Range Mode, Fast Mode
400	13,000	Full Range Mode, Fast Mode
500	10,400	Full Range Mode, Fast Mode
512	10,200	Full Range Mode, Fast Mode
800	6,500	Full Range Mode, Fast Mode
1000	5,200	Full Range Mode, Fast Mode
1024	5,100	Full Range Mode, Fast Mode
1600	3,300	Full Range Mode, Fast Mode
2000	2,600	Full Range Mode, Fast Mode
2048	2,540	Full Range Mode, Fast Mode
4096	1,270	Full Range Mode, Fast Mode
8192	635	Full Range Mode, Fast Mode

3.5.4 Output format

The current sensor value can be output in two different formats. This means that, in addition to the standardised values, you can also receive the raw values.

a) Standardised output

The acquired sensor data from a displacement transducer is directly output as distance in millimetres. For this, it is essential that the correct signal period of the transducer is indicated in micrometres during the initialisation, because otherwise the measurement data will be miscalculated.

b) Raw value output

If the sensor data is further processed in your application, it might be useful to leave the data in the raw format at first in order to prevent rounding errors or the like. In the raw format, the data is output as 32-bit signed value.

You get the actual value by multiplying the raw value by the increment. With a signal period of 10 µm and a resolution of 100 (increment: 0.1 µm), the calculation result would therefore be the following distance data (see table below).

Table 3-5: Example of distance calculation from raw value (Full Range Mode)

Raw value	Decimal value	Distance (with increment of 0.1 µm)
0x80000000	-2,147,483,648	-214.75 m
⋮	⋮	⋮
0xFFFFFFFE	-2	-0.2 µm
0xFFFFFFFF	-1	-0.1 µm
0x00000000	0	0 µm
0x00000001	1	0.1 µm
0x00000002	2	0.2 µm
0x00000003	3	0.3 µm
⋮	⋮	⋮
0x7FFFFFFF	2,147,483,647	214.75 m

3.5.5 Acquisition modes

The Ethernet systems **MSX-E1711** and **MSX-E1721** support two different modes for the acquisition of data from Sin/Cos signal generators.

a) Full Range Mode

In Full Range Mode, there is always the complete 32-bit range of values available. This mode is appropriate for measurements in case of which the indicated maximum input frequency with the selected resolution is not exceeded.
In the event that this frequency is exceeded anyhow, maybe also during two read accesses, all of the following measurement results are incorrect in relation to the previously defined zero point. During the first reading of the sensor data, i.e. while or after the cut-off frequency is exceeded, the exceeding is output as return value 1 in the parameter "Frequency error".
After an error has occurred, the reference point has to be redefined so that reliable data will be output again. For this purpose, the counter at the desired sensor position has to be deleted.

b) Fast Mode

The Fast Mode has to be applied if between two read accesses to the Sin/Cos sensor data, sensor movements faster than the selected resolution allows, should also be possible.
During two read commands, the input frequency can be up to 250 kHz in this mode. But if the frequency is exceeded during the read access, a frequency error is displayed, too. In this case, this measurement value is incorrect. If the frequency limit is adhered to in the case of a further write access, the measurement value in Fast Mode will be correct again in relation to the reference point originally defined.

The Fast Mode is specially suited if, for example, a measuring point is to be approached fast, and at the same time, a measurement (while the sensor is not moving) with a highly precise increment is required.
In order to enable these temporarily higher movement speeds, there is, however, only a measurement range of 256 signal periods available. This means that where the measurement range is exceeded or undershot, the measurement value jumps one step towards the opposite maximum. Therefore, the complete measurement range in Fast Mode comprises only 12 to 21 bits depending on the selected resolution. This measurement range is symmetrical about the reference point, i.e. the mid-point of the measurement range shows a maximum variance of one signal period from the reference point.

Table 3-6: Example of a limited measurement range (resolution: 25)

Raw value	Decimal value	Distance (with increment of 0.4 µm)
0xFFFFF371	-3,215	-1,286 µm
0xFFFFF372	-3,214	-1,285.6 µm
⋮	⋮	⋮
0xFFFFFFFE	-2	-0.8 µm
0xFFFFFFFF	-1	-0.4 µm
0x00000000	0	0 µm
0x00000001	1	0.4 µm
0x00000002	2	0.8 µm
0x00000003	3	1.2 µm
⋮	⋮	⋮
0x00000C6F	3,183	1,273.2 µm
0x00000C70	3,184	1,273.6 µm

In this example, the measurement range includes 12.64 bits (6,400 different values) because 256 periods can be distinguished and a period is divided into 25 steps.
In the following table, you can find the size of the measurement range in Fast Mode according to the selected resolution.

Table 3-7: Resolution and measurement range (Fast Mode)

Resolution	Measurement range (bits)
16	12
25	12.64
32	13
40	13.32

Resolution	Measurement range (bits)
50	13.64
64	14
80	14.32
100	14.64
125	14.97
128	15
160	15.32
200	15.64
250	15.97
256	16
320	16.32
400	16.64
500	16.97
512	17
800	17.64
1000	17.97
1024	18
1600	18.64
2000	18.97
2048	19
4096	20
8192	21

3.5.6 Input frequency

To receive correct values when the Sin/Cos sensor data is acquired, it is necessary that the maximum input frequency, which depends on the resolution, is complied with. This frequency directly relates to the sine signal.
With the aid of the signal period, the maximum movement speed for transducers (v_{max}) can be calculated from the product of the signal period and the maximum input frequency (f_{max}).
If you divide the input frequency (f_{max}) by the number of periods per revolution, you obtain the maximum speed for shaft encoders (n_{max}).

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$$v_{max} = \text{Signal period} \cdot f_{max}$$

$$n_{max} = \frac{f_{max}}{\text{Periods per revolution}}$$

Table 3-8: Conversion from maximum frequency

Frequency (Hz)	Max. velocity (with signal period of 2 µm)	Max. speed (with 2048 periods per revolution)
635	0.08 m/min	18.6 rev/min
1,270	0.15 m/min	37.21 rev/min
2,540	0.3 m/min	74.41 rev/min
2,600	0.31 m/min	76,17 rev/min
3,300	0.4 m/min	96.68 rev/min
5,100	0.61 m/min	149.41 rev/min
5,200	0.62 m/min	152.34 rev/min
6,500	0.78 m/min	190.43 rev/min
10,200	1.22 m/min	298.83 rev/min
10,400	1.25 m/min	304.69 rev/min
13,000	1.56 m/min	380.86 rev/min
16,300	1.96 m/min	477.54 rev/min
20,300	2.44 m/min	594.73 rev/min
20,800	2.5 m/min	609.38 rev/min
26,000	3.12 m/min	761.72 rev/min
40,600	4.87 m/min	1189.45 rev/min
81,300	9.76 m/min	2381.84 rev/min
162,500	19.5 m/min	4760.74 rev/min

3.5.7 Error logging

When the Sin/Cos sensor data are acquired, two different types of error can occur.
The frequency error indicates that during or, in Full Range Mode also before the last read access, the specified maximum input frequency has been exceeded. In the Full Range Mode, this helps that the reference point is internally shifted so that all further measurements are incorrect, since they refer to this new point. If afterwards the maximum input frequency is complied with, no further errors will be indicated, although the measurement values are incorrect. For this reason, the return values should always be monitored and errors be dealt with accordingly.

IMPORTANT!
If an error has occurred in Full Range Mode, the reference point is permanently shifted which results in errors during the following measurement process.

Another type of error is the amplitude error. Both in Full Range Mode and in Fast Mode, it produces measurement values that are permanently incorrect in relation to the originally defined reference point.
An amplitude error can occur if, for instance, a signal generator is not or incorrectly connected or if it has a mechanical error.

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.
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

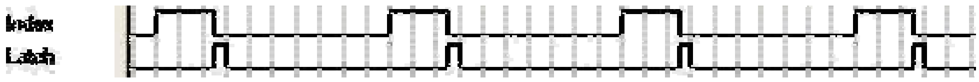
In Modulo mode, a reference value is indicated as well. When the counter value corresponds to the reference value or a multiple of it, a trigger or synchro trigger is released.

3.8 Index logic

The index signal of a Sin/Cos 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.

Example

Index logic with falling edge in continuous mode



3.9 Hardware trigger

The digital 24 V trigger input of the MSX-E system can be used to latch the Sin/Cos 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 Sin/Cos counter value is to be latched.

Examples:

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

4 Function description: Digital inputs and outputs

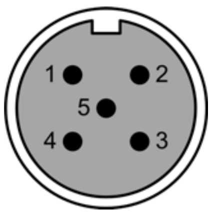
The Ethernet systems **MSX-E1711** and **MSX-E1721** have 16 digital inputs or outputs for sensors or actuators.

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 I/O

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 $0 \leq n \leq 7$.

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

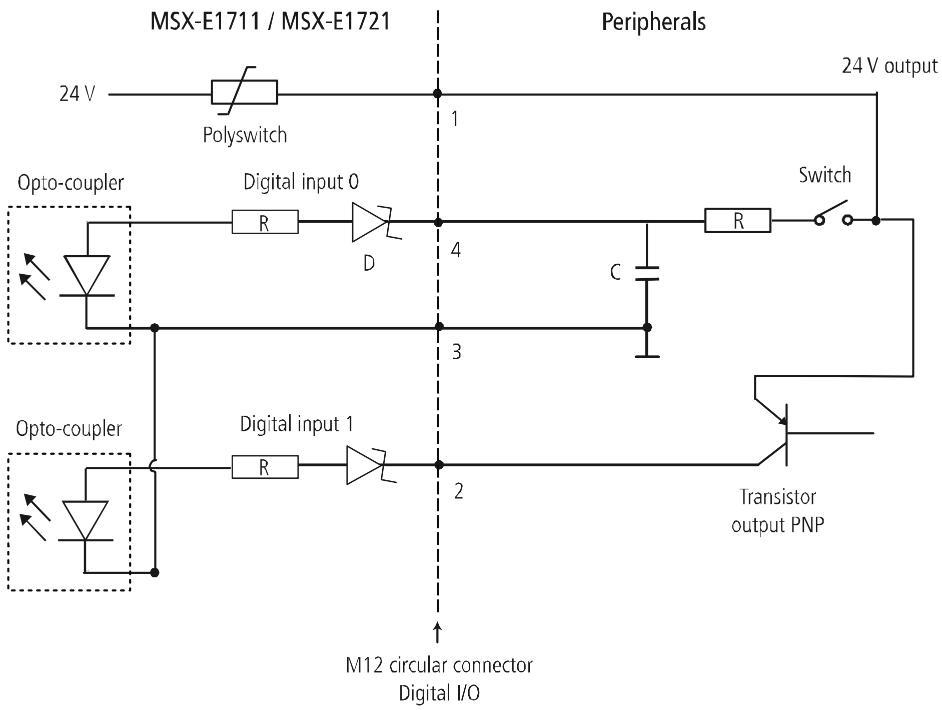
Table 4-2: LED display: Digital I/O

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

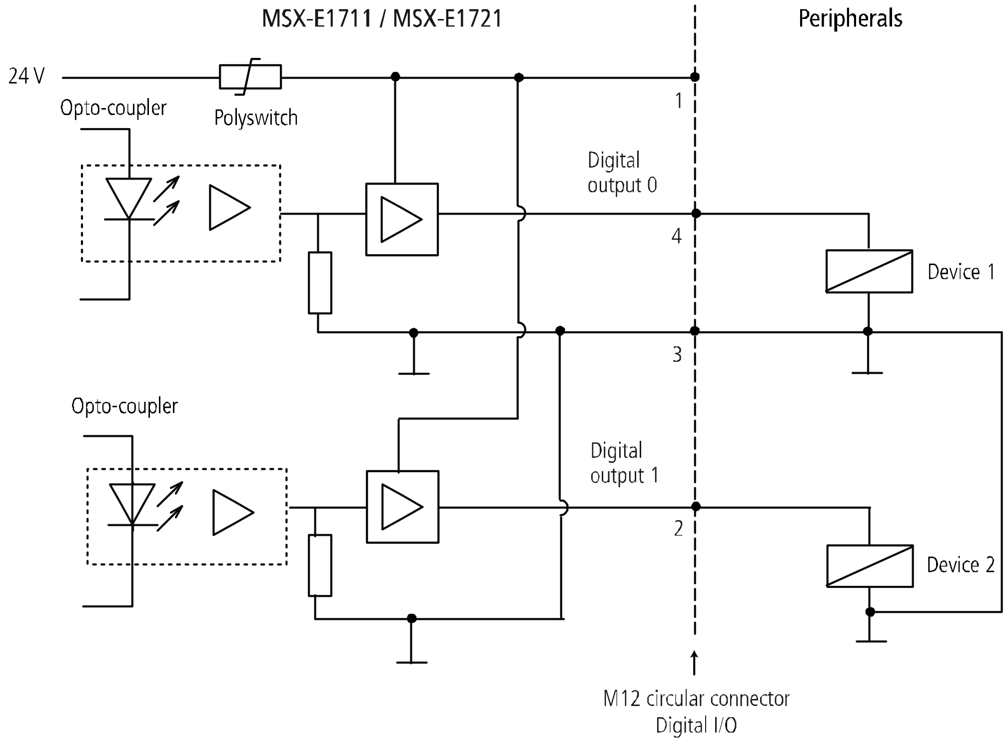
4.3.1 Digital inputs (24 V)

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-E1711** or **MSX-E1721** 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 5.1.1) or by the SOAP or Modbus function "DigitalIOInitPortConfiguration".

IMPORTANT!
For each connector or port, only inputs or outputs can be configured.
In the event of a system reboot, the configuration is only persistent if it has been changed on the web interface.

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 5.1.1). 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 systems **MSX-E1711** and **MSX-E1721** both have 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.

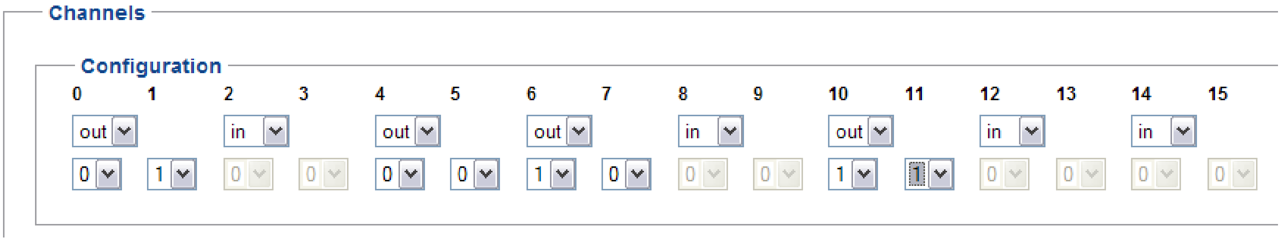
5 Web interface: Quick access to the MSX-E system

5.1 "I/O Configuration"

In this manual, the function-specific pages of the **MSX-E1711** or **MSX-E1721** 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).

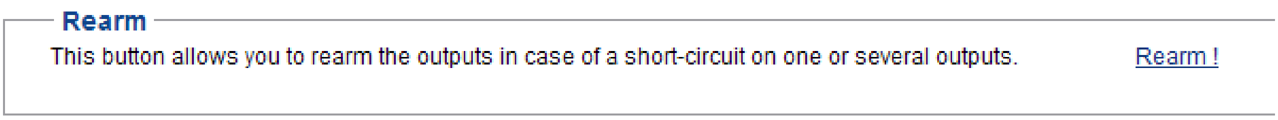
5.1.1 Menu item "Digital I/O"

Fig. 5-1: 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. 5-2: Digital I/O: Rearm



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

5.1.2 Menu item "I/O Watchdog"

Fig. 5-3: I/O Watchdog: Current state

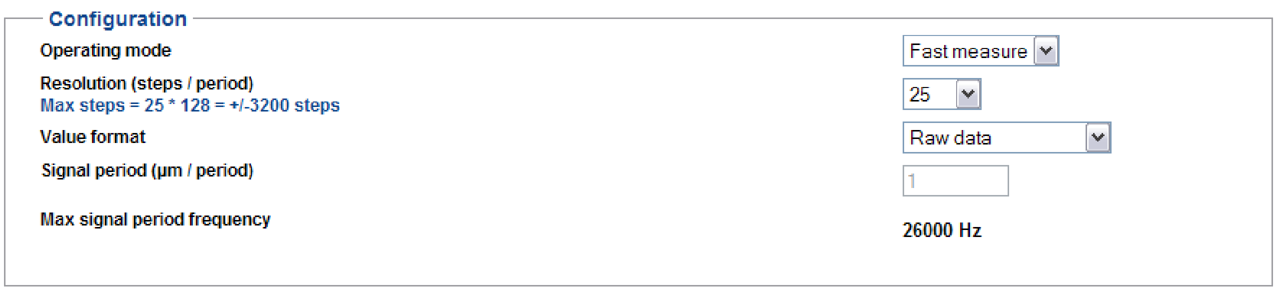
On this page, the current status of the watchdog for the digital inputs and outputs is displayed.

Fig. 5-4: I/O Watchdog: Configuration

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

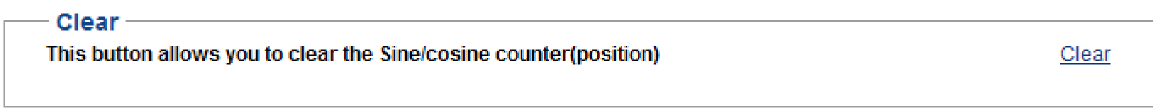
5.1.3 Menu item “Sine/cosine”

Fig. 5-5: Sine/cosine: Configuration



In this section, the acquisition mode, resolution, output format of the acquired Sin/Cos sensor data and the signal period have to be defined.
The maximum input frequency of the signal is indicated automatically.

Fig. 5-1: Sine/cosine: Clear



The Sin/Cos counter can be reset to zero using the button in the section “Clear”.

5.1.4 Data format

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

Table 5-1: Sin/Cos 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 Sin/Cos 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 5-2: Event sources

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

6 Technical data and limit values

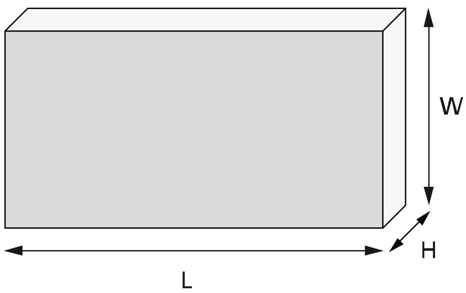
6.1 Electromagnetic compatibility (EMC)

The Ethernet systems **MSX-E1711** and **MSX-E1721** comply 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.

6.2 Mechanical structure

Fig. 6-1: MSX-E1711 and MSX-E1721: Dimensions



Dimensions (L x W x H):	215 x 110 x 54 mm
Weight:	900 g 960 g (with MX-Rail)

Fig. 6-2: MSX-E1711: View from above

Fig. 6-3: MSX-E1721: View from above

6.3 Versions

The Ethernet systems **MSX-E1711** and **MSX-E1721** are available in the following versions:

Table 6-1: MSX-E1711 and MSX-E1721: Versions

Version	Features
MSX-E1711	Sin/Cos counter inputs (1 V_{SS})
MSX-E1721	Sin/Cos counter inputs (11 μA_{SS})

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).

6.4 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):	400 mA (±10 %)

Security:	
Degree of protection:	IP 65[1]
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.

6.4.1 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)

6.4.2 Trigger input

Trigger input 24 V

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

Trigger input 5 V (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.

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

6.4.3 Synchro input and output

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

6.4.4 Sin/Cos counter inputs

	MSX-E1711	**MSX-E1721**
Number of inputs:	4 (with A, B and C signals each)	4 (with A, B and C signals each)
Input type:	Sin/Cos 1 V_{PP}	Sin/Cos 11 μA_{PP}
Input frequency:	250 kHz max. (may be lower depending on mode and resolution)	250 kHz max. (may be lower depending on mode and resolution)
Output voltage (sensor supply):	5 V	5 V
Current:	500 mA max. (for each female connector) via PTC	500 mA max. (for each female connector) via PTC
Signal size:	0.6–1.2 V_{PP} (1 V_{PP} typ.)	7–16 μA_{PP} (11 μA_{PP} typ.)
ESD:	2 kV	2 kV

6.4.5 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
Max. input frequency:	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

6.4.6 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 VDC

Supply voltage:	18-30 V
Current:	1.85 A max. (for each group[2]) 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 resistor:	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

6.4.7 Watchdog

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

[2] 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

7 Appendix

7.1 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.

7.2 Index

8 Contact and support

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