ADDI-DATA®
PARTNER FÜR PRÄZISION

Technical Description

MSX-E3011 and MSX-E3021

Ethernet analog input system

DIN EN ISO 9001:2015 certified

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Warning!

The following risks result from the improper implementation of the Ethernet system and from use 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 the wrong use of the Ethernet system.
- Pay attention to the following symbols:

NOTICE!
Designates hints and other useful information.

NOTICE!
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 system as well as safety precautions
2	Brief description of the MSX-E system (functions, features, block diagrams)
3	Function description (analog inputs) including pin assignment
4	Description of the function-specific pages of the MSX-E web interface plus information on the data format
5	Description of the acquisition modes (Auto-refresh and Sequence modes)
6	List of technical data and limit values of the MSX-E system
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-E3011** and **MSX-E3021** for the acquisition, processing and transferring of analog input signals are intended for the connection to a network, which is used as electrical equipment for measurement, control and laboratory pursuant to the standard DIN EN IEC 61010-1.

1.1.2 Usage restrictions

The Ethernet systems **MSX-E3011** and **MSX-E3021** must not be used as safety-related parts (SRP).

The Ethernet systems **MSX-E3011** and **MSX-E3021** must not be used for safety-related functions.

The Ethernet systems **MSX-E3011** and **MSX-E3021** must not be used in potentially explosive atmospheres.

The Ethernet systems **MSX-E3011** and **MSX-E3021** must not be used as electrical equipment according to the European Low Voltage Directive.

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 ES1 according to DIN EN IEC 62368-1 or PELV according to DIN EN 60204-1.

1.2.2 Degrees of protection

NOTICE!
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 black sides.
- Do not hold the Ethernet system by the connectors!

1.5 Questions and updates

If you have any questions, do not hesitate to call us or to send us an e-mail:

Phone: +49 7229 1847-0
E-mail: info@addi-data.com

Manual and software download from the Internet

The latest versions of the technical manual and the standard software for the Ethernet systems **MSX-E3011** and **MSX-E3021** can be downloaded for free at: www.addi-data.com.

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

2 Brief description

2.1 Functions and features

Each of the intelligent Ethernet systems **MSX-E3011** and **MSX-E3021** has 16 differential analog inputs with 16-bit resolution and a throughput rate of 25 kHz per channel.

In addition, the Ethernet system **MSX-E3021** has a buffered real-time clock, which keeps the system time even in case of power loss, and an extended memory of 4 GB for storing the measured values. Thus, the system is perfectly suited for long-term measurements.

By means of an external trigger, analog inputs 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 sensor data to be accessed.

Via 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.

The Ethernet systems are 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. The “Status” LED provides for a quick and easy error diagnosis.

The Ethernet system is connected to the computer via Ethernet. As the Ethernet systems are attached in direct vicinity of the sensor, the function of the latter is not 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:

- 16 analog inputs, differential, 16-bit
- **MSX-E3021:** extended memory (4 GB), buffered real-time clock
- Analog input: can be controlled by means of an external trigger (digital 24 V trigger input)
- Web interface to configure, control and monitor the analog input
- 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 (**MSX-E3021:** on request)

2.2 Block diagrams

Fig. 2-1: MSX-E3011: Block diagram

Fig. 2-2: MSX-E3021: Block diagram

3 Function description: Analog inputs

Each of the Ethernet systems **MSX-E3011** and **MSX-E3021** has 16 analog inputs for sensors, which are divided into four groups.
An A/D converter and a 4-channel multiplexer are assigned to each group of inputs. As an option, the individual groups may be composed of either voltage or current inputs. The data is acquired simultaneously in all groups.
In unipolar mode, the resolution is reduced from 16-bit to 15-bit.

3.1 Pin assignment

To each M12 female connector, one sensor can be connected. One analog input consists of input + and input -.

For the sensor supply, a 24 V voltage is available. The maximum total current for the sensor supply is 1.8 A (PTC-fused) per group of eight channels.

Table 3-1: Pin assignment: Analog inputs

Pin No.	Female connector, 5-pin, M12	Cable (black)
		Lead colour
1	+24 V	brown
2	Diff. input -	white
3	GND[1]	blue
4	Diff. input +	black
5	not connected	grey

[1] To use the inputs as single-ended inputs, pins 2 and 3 have to be connected externally with each other.
The connector shield is not connected to ground but to the housing of the MSX-E system.

3.2 Analog input circuit

Fig. 3-1: Analog input circuit (differential)

R_1 (PC-Diff option) = Optional equipment with current version PC-Diff = 250 Ω
C_{DF} = Optional equipment with DF filter

Table 3-2: Cut-off frequency calculation (differential)

Cut-off frequency $f_{-3dB} = 1 / (2 \pi * (R_1 + R_1) * [C_{DF} + (C_1 \parallel C_2)]$

C_{DF} = 0 (if not fitted)

Equipment	R_1	R_2	C	Cut-off frequency
Standard version	100 Ω	1 MΩ	$C_1 = C_2 = 10$ nF	159 kHz
DF option (filter)	10 kΩ	10 MΩ	$C_{DF} = 470$ nF	30 Hz

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

In this manual, the function-specific pages of the **MSX-E3011** or **MSX-E3021** web interface, which are located under the menu item “Acquisition” or “Monitor”, 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).

4.1 Menu item “Acquisition”

Fig. 4-1: MSX-E web interface: Acquisition

4.1.1 “Acquisition”

Fig. 4-2: Acquisition: Acquisition

For the acquisition, the Auto-refresh mode and the Sequence mode are available. A detailed description of these modes can be found in Chapter 5 of this manual.

The following actions are possible via the buttons in the “Acquisition” section:
Start or stop the acquisition, save the configuration, display the configuration saved last, display the default configuration.

NOTICE!
The configuration only takes effect if you click on the “Save configuration” button.

4.2 Menu item “Monitor”

Fig. 4-3: MSX-E web interface: Monitor

4.2.1 Displaying acquired data

Fig. 4-4: Monitor: Show data

Fig. 4-5: Monitor: Monitor configuration

The acquired data can be displayed either directly on the web interface (“Show data” section) or in a CSV file. For this, the number of data packets has to be defined.

4.2.2 “Configuration details”

Fig. 4-6: Monitor: Configuration details

Configuration details

TYPE OF ACQUISITION		
Type of acquisition	Auto refresh	
MONITOR CONFIGURATION		
Number of packets to acquire	1	
Data format	Analog Data	
CONVERSION TIME		
Conversion time	1	
Conversion Time Unit	Millisecond	
CONFIGURATION OF THE SELECTED CHANNELS		
CHANNEL	GAIN	POLARITY
0	1	Unipolar
1	1	Unipolar
AVERAGE MODE		
Average Mode	perSequence	
Average Value	1	
TRIGGER CONFIGURATION		
Trigger Source	Disabled	
ADDITIONAL INFORMATION IN DATA PACKET		
Analog Data		
Counter		

In this section, information on the current configuration as well as on data packets from the data server is listed.

4.2.3 “Structure of binary data packets” (packet format)

Fig. 4-7: “Monitor”: Data packets

Structure of binary data packets sent by the data server

FIELD	SIZE (BYTES)
Counter	4
Channel 0	4
Channel 1	4

The MSX-E system sends the data over the network to one or more clients. In order that the client can interpret the values correctly, these are formatted. The format is defined as “Binary data frame packet structure”. All measurement values and the additional data such as the time stamp form a group of values that is called a packet.

NOTICE!
The MSX-E system sends the packets in the Intel format (Little Endian).

Example

A packet consists of a counter value and eight measurement values. The MSX-E system always sends one or more of these packets. The data client has to be programmed in such a way that it can receive a packet and interpret it correctly.

Data format

In Auto-refresh mode, the following data format applies:

Table 4-1: Auto-refresh mode: Data format

tv_sec	tv_usec	Auto-refresh counter	Auto-refresh data
4 bytes	4 bytes	4 bytes	4 bytes x amount of data
Time stamp (in s) low (if data format has time stamp)	Time stamp (in µs) high (if data format has time stamp)	always available	The amount of data depends on the Auto-refresh mask.

In Sequence mode, the data format is as follows:

Table 4-2: Sequence mode: Data format

tv_sec	tv_usec	Sequence counter	Sequence data
4 bytes	4 bytes	4 bytes	4 bytes x amount of data
Time stamp (in s) low (if data format has time stamp)	Time stamp (in µs) high (if data format has time stamp)	Sequence counter (if data format has Sequence counter)	The amount of data depends on the Sequence channel list.

To both modes applies:

Data format = without conversion into an analog value

Data x	32-bit digital value

Data format = with conversion into an analog value

Data x	32-bit floating point value (analog value) in V/A

5 Acquisition modes

This chapter exemplifies how to configure and start an acquisition via the web interface of the Ethernet system **MSX-E3011** or **MSX-E3021**. Moreover, you can use Modbus or SOAP functions (see driver download on the ADDI-DATA website) to perform these steps.

For the acquisition, the Auto-refresh mode and the Sequence mode are available.

- On the web interface, select the menu item “Acquisition”.

5.1 Auto-refresh mode

In Auto-refresh mode, one or more channels can be acquired. It is possible to start the acquisition by means of a trigger.
The measurement values are cyclically updated according to the set acquisition time. An average value can be calculated directly on the MSX-E system.

5.1.1 “Acquisition” (acquisition mode selection)

Fig. 5-1: Acquisition: Acquisition

- In the “Acquisition” section, select the acquisition mode “Auto-refresh”.

5.1.2 “Channel configuration” (channel selection)

Fig. 5-2: Acquisition: Channel configuration

- In the “Channel configuration” section, select the channels you want to acquire.

NOTICE!
In case of a high sampling frequency and a fast acquisition speed, it is reasonable that the single channels of all four multiplexers should be acquired at the same time (channels 0, 4, 8, 12; channels 1, 5, 9, 13; channels 2, 6, 10, 14; channels 3, 7, 11, 15). For this, see also Chapter 5.1.4.

5.1.3 “Average setup” (average value calculation)

Fig. 5-3: Auto-refresh mode: “Average setup”

The MSX-E system is capable of calculating an average value for each channel. In the “Average value” field, you have to enter the number of acquisitions after which this value should be calculated.

Acquisition “per sequence” means that all selected channels are acquired simultaneously.
If an acquisition “per channel” is to take place, the selected channels are acquired individually.

a) Acquisition per sequence

Example: The MSX-E system acquires channels 1 to 8. “Number of acquisitions” contains the value 10. This means that ten sequences run down, with each sequence consisting of eight channels to be acquired.

Fig. 5-4: Auto-refresh mode: Acquisition per sequence

After these ten sequences have run down, the MSX-E system performs the following calculation:

Average value of channel 1
= (sequence 1, value of channel 1 + sequence 2, value of channel 1 + … + sequence 10, value of channel 1) / 10

Average value of channel 2
= (sequence 1, value of channel 2 + sequence 2, value of channel 2 + … + sequence 10, value of channel 2) / 10

…

Average value of channel 8
= (sequence 1, value of channel 8 + sequence 2, value of channel 8 + … + sequence 10, value of channel 8) / 10

The network client will not receive ten data packets, with eight values in each packet, but only one data packet containing the average values from channels 1 to 8.

b) Acquisition per channel

Example: The MSX-E system acquires channels 1 to 8. “Number of acquisitions” contains the value 10. This means that each of the eight channels is acquired ten times.

Fig. 5-5: Auto-refresh mode: Acquisition per channel

After all of the eight channels have been acquired, the MSX-E system performs the following calculation:

Average value of channel 1
= (value of channel 1 + value of channel 1 + … + value of channel 1) / 10

Average value of channel 2
= (value of channel 2 + value of channel 2 + … + value of channel 2) / 10

…

Average value of channel 8
= (value of channel 8 + value of channel 8 + … + value of channel 8) / 10

The network client will not receive eight data packets, with ten values in each packet, but only one data packet containing the average values from channels 1 to 8.

5.1.4 Exceptions with the MSX-E3011 or MSX-E3021

As already mentioned in Chapter 3, the **MSX-E3011** or **MSX-E3021** has four 4-channel multiplexers. Consequently, the selected channels are not always acquired simultaneously or individually in an acquisition per sequence or per channel.
The reason for this is that, for example, line 1 of multiplexer 1 is connected in parallel to line 1 of each of the other three multiplexers.

CH = Channel L = Line MUX = Multiplexer

The following examples illustrate the two acquisition modes with multiplexer lines connected in parallel or not.

Example 1: Acquisition per sequence

The MSX-E system acquires four channels. The corresponding multiplexer lines are connected in parallel. “Average value” contains the value 2.

CT = Settling time EOA = End of acquisition (average value is sent)

In this example, the acquisition takes place in the usual manner, i.e. as described in Chapter 5.1.3.

Example 2: Acquisition per channel

The MSX-E system acquires four channels. The corresponding multiplexer lines are connected in parallel. “Average value” contains the value 2.

CT = Settling time EOA = End of acquisition (average value is sent)

As there is no difference between examples 1 and 2 in this case, the same values as in example 1 are acquired.

Example 3: Acquisition per sequence

The MSX-E system acquires four channels. The corresponding multiplexer lines are not connected in parallel. “Average value” contains the value 2.

CT = Settling time EOA = End of acquisition (average value is sent)

Example 4: Acquisition per channel

The MSX-E system acquires four channels. The corresponding multiplexer lines are not connected in parallel. “Average value” contains the value 2.

CT = Settling time EOA = End of acquisition (average value is sent)

In this example, the acquisition takes place in the usual manner, i.e. as described in Chapter 5.1.3.

Example 5: Acquisition per sequence

The MSX-E system acquires eight channels. The corresponding multiplexer lines 1 or 2 are connected in parallel. “Average value” contains the value 2.

CT = Settling time EOA = End of acquisition (average value is sent)

Example 6: Acquisition per channel

The MSX-E system acquires eight channels. The corresponding multiplexer lines 1 or 2 are connected in parallel. “Average value” contains the value 2.

CT = Settling time EOA = End of acquisition (average value is sent)

5.2 Sequence mode

The Sequence mode enables you to acquire one or more channels. The acquisition can be started by a trigger. There is a definable delay between the individual sequences.

5.2.1 “Acquisition” (acquisition mode selection)

Fig. 5-6: Acquisition: Acquisition

- In the “Acquisition” section, select the acquisition mode “Sequence”.

5.2.2 “Channel configuration” (channel selection)

Fig. 5-7: Acquisition: Channel configuration

- In the “Channel configuration” section, select the channels you want to acquire.

You can define the order of the channels. A channel can be acquired several times per sequence.

NOTICE!
In case of a high sampling frequency and a fast acquisition speed, it is reasonable that the single channels of all four multiplexers should be acquired at the same time (channels 0, 4, 8, 12; channels 1, 5, 9, 13; channels 2, 6, 10, 14; channels 3, 7, 11, 15). For this, see also Chapter 5.1.4.

5.2.3 “Delay” (wait time)

Fig. 5-8: Acquisition: Delay

In the “Delay” section, you can define the wait time between the individual sequences. There are two modes, which are explained below.
With “Time unit”, you can select the unit of the delay (µs, ms or s). Enter the value of the delay in the field “Delay”.

a) Mode 1

The time between the starts of two subsequent sequences is defined as the delay.

Fig. 5-9: "Delay": Mode 1

Example

After the acquisition start, the delay between the starts of the individual sequences is 300 ms.

b) Mode 2

The time between the end of a sequence and the start of the subsequent sequence is defined as the delay.

Fig. 5-10: "Delay": Mode 2

Example

After the acquisition start, the delay between the end and the start of the individual sequences is 2 s.

5.2.4 “Number of sequences to acquire”

Fig. 5-11: Acquisition: Number of sequences to acquire

1) “Sequences to acquire”

In the field “Sequences to acquire”, you enter the number of sequences to be acquired.
If this value is 0, the acquisition is continuous. If it is a value between 1 and 4294967295, the number of sequences is predefined.

Example

To acquire four sequences, the field “Sequences to acquire” must contain the value 4. As a result, after the acquisition start, four sequences are acquired.

2) "Sequences before sending"

In the field "Sequences before sending", you define the maximum number of sequences that have to be acquired before the measurement values are sent to the target system. If the MSX-E system does not have sufficient memory to store the required number of sequences, the measurement values are sent earlier, that is, before the maximum number of sequences to be acquired is reached. This helps to reduce the network traffic load and the CPU resources of the MSX-E systems.

Example

After the acquisition start, the acquisition begins. If two sequences are acquired, the measurement values are sent to the client.

5.2.5 Acquisition time calculation

The duration of the acquisition is calculated automatically. As already mentioned in Chapter 3, the **MSX-E3011** or **MSX-E3021** has four 4-channel multiplexers. Consequently, the selected channels are not always acquired simultaneously in an acquisition in Sequence mode.

NOTICE!
The calculation of the acquisition time depends on the way the channels are acquired: simultaneously or individually.

Example 1

The MSX-E system acquires 16 channels (CH0 to CH15) in this order:
CH0, CH1, CH2, CH3, CH4, CH5, CH6, CH7, CH8, CH9, CH10, CH11, CH12, CH13, CH14, CH15.

Line 4 of multiplexer 0 is connected in parallel to line 1 of multiplexer 1, line 4 of multiplexer 1 in parallel to line 1 of multiplexer 2 and line 4 of multiplexer 2 in parallel to line 1 of multiplexer 3.

CH = Channel CT = Settling time
L = Line EOA = End of acquisition
MUX = Multiplexer

The two channels of the channel pairs CH3 and CH4, CH7 and CH8 as well as CH11 and CH12 are acquired simultaneously (CH3 and CH4 acquisition time = settling time * 1). The other channels are acquired individually (CH0 to CH2 acquisition time = settling time * 3, CH5 and CH6 acquisition time = settling time * 2). This results in the following calculation: CH0 to CH15 acquisition time = settling time * 13

Example 2

The MSX-E system acquires 16 channels (CH0 to CH15) in this order:
CH0, CH4, CH8, CH12, CH1, CH5, CH9, CH13, CH2, CH6, CH10, CH14, CH3, CH7, CH11, CH15.

The corresponding multiplexer lines 1 to 4 of multiplexers 0 to 3 are connected in parallel, i.e. line 1 of multiplexer 0 is connected in parallel to each line 1 of the other three multiplexers, line 2 in parallel to each line 2, etc.

CH = Channel
L = Line
MUX = Multiplexer
CT = Settling time
EOA = End of acquisition

CH0, CH4, CH8 and CH12 are acquired simultaneously (acquisition time = settling time * 1). With the other three groups with four channels each, the channels are also acquired simultaneously per group. This results in the following calculation: CH0 to CH15 acquisition time = settling time * 4

5.3 Common functions

The following functions are available both in Auto-refresh mode and in Sequence mode.

5.3.1 “Channel configuration” (gain and polarity)

Fig. 5-12: Channel configuration: Gain or polarity

1) Gain

The gain enables the measurement to be adapted to the input voltage range or input current range to achieve greater precision. Two gain types are available. The size of each measurement range depends on the gain and the polarity:

Gain 1 unipolar:	0 V to +10 V	or	0 mA to 20 mA
bipolar:	-10 V to +10 V	or	-20 mA to +20 mA
Gain 2 unipolar:	0 V to +5 V	or	0 mA to 20 mA
bipolar:	-5 V to +5 V	or	-20 mA to +20 mA

Example

Gain 1 in unipolar 15-bit:

(10 / 32768) = 1 bit (corresponds to approx. 0.000305 V)

Gain 2 in unipolar 15-bit:

(5 / 32768) = 1 bit (corresponds to approx. 0.0001525 V)

NOTICE!
For current measurements, gain 2 should be used.

2) Polarity

For each channel that is selected, you can define the polarity.
“Unipolar” means that the MSX-E system measures only the values in the positive range from 0 V or 0 A. With “Bipolar”, also the values in the negative range are measured. The size of each relevant measurement area depends on the selected gain.

5.3.2 “Conversion time” (settling time)

Fig. 5-13: Acquisition: Conversion time

In the “Conversion time” section, the settling time is set, i.e. the time required to switch from one channel to another.
As the unit of the settling time, microseconds, milliseconds or seconds can be defined. The range in which this time can lie is based on the unit that is selected:

Microseconds: 10 to 65535
Milliseconds: 1 to 65535
Seconds: 1 to 65535

If only one channel is selected, this parameter is insignificant.

5.3.3 Trigger configuration

The acquisition can be started by an external signal.
The synchro trigger configuration has to be set both on the master's and slave's web interface.

Fig. 5-14: Acquisition: Trigger configuration

- **Trigger source:** Available trigger types are hardware trigger and synchro trigger.
- **Trigger mode:** If the trigger mode "one-shot" is selected, only one acquisition starts after a trigger. If the option "sequence" is activated, a defined number of acquisitions starts (see field "Number of sequences per trigger").
- **Hardware trigger active edge:** Here, the type of edge is defined in case of which the MSX-E system identifies a trigger.
- **Hardware trigger count:** This field defines the number of edges after which an acquisition is started.
- **Number of sequences per trigger:** In the trigger mode "sequence" (see field "Trigger mode"), the number of sequences that are acquired after a trigger is defined. This value must be between 1 and 65535.

The following pages contain examples of the hardware trigger.
For further information on the hardware or synchro trigger, please refer to the general manual of the MSX-E systems (see PDF link).

1) Examples of edges

a) Rising: Rising edge

b) Falling: Falling edge

c) Both: Rising and falling edges

2) Examples of hardware triggers with “one-shot”

a) To start the acquisition once only after three rising edges, you can use the following parameters:

Fig. 5-15: Hardware trigger with “one-shot” (a)

After the acquisition start, the MSX-E system waits for three rising hardware edges. Once the three edges have been identified, the acquisition starts.

b) With “Hardware trigger active edge”, “rising” is selected again, and with “Hardware trigger count”, the value 1 is entered.

Fig. 5-16: Hardware trigger with “one-shot” (b)

The trigger starts only one acquisition, which begins with the first hardware edge after the acquisition start.

c) With “Hardware trigger active edge”, “both” is selected, and with “Hardware trigger count”, the value 3 is entered.

Fig. 5-17: Hardware trigger with “one-shot” (c)

After the acquisition start, the MSX-E system waits for three rising and falling hardware edges. Once the three edges have been identified, the acquisition starts.

d) With “Hardware trigger active edge”, the option “both” is selected again, and with “Hardware trigger count”, the value 1 is entered.

Fig. 5-18: Hardware trigger with “one-shot” (d)

If several edges occur after the acquisition start, the acquisition is started (triggered) with the first edge. The subsequent edges are ignored.

3) Examples of hardware triggers with “sequence”

a) To start each acquisition after one rising edge, you can use the following parameters:

Fig. 5-19: Hardware trigger with “sequence” (a)

b) With “Hardware trigger active edge”, “both” is selected, and with “Hardware trigger count”, the value 3 is entered.

Fig. 5-20: Hardware trigger with “sequence” (b)

After the acquisition start, the acquisition is started after three rising and falling edges. After the end of this sequence, the next sequence is started after three rising and falling edges, and so on.

NOTICE!
Edges that occur during an acquisition are ignored. Only those edges are considered that occur after the end of an acquisition (see the previous and following examples).

c) The settings correspond to example 3 b), with the exception of “Number of sequences per trigger”, where the value 2 is entered.

Fig. 5-21: Hardware trigger with “sequence” (c)

After each trigger, two sequences are acquired.

5.3.4 “Information in data packet” (additional data)

Fig. 5-22: Acquisition: Information in data packet

By default, only the acquisition values are sent to the client. However, it can also receive additional information if you activate the following options.

- **Data in analog format:** With this option, the MSX-E system can convert the raw values immediately to the correct unit. This unit depends on the system type. With an **MSX-E3011** and an **MSX-E3021**, the unit is volts (V) or amperes (A). As the conversion affects the MSX-E CPU to a certain extent, this can result in slower sending speed.
- **Send time stamp with data:** A time stamp is sent that contains the date of the acquisition.
- **Send Sequence counter:** The value of the Sequence counter is sent. In Sequence mode, all sequences are acquired. Thus, the succession of these counter values is complete (1, 2, 3, etc.).

NOTICE!
The value of the Auto-refresh counter is displayed automatically under the menu item “Monitor”. In Auto-refresh mode, not all sequences are acquired so that the succession of the counter values is incomplete (e.g. 1, 3, 7).

6 Technical data and limit values

6.1 Electromagnetic compatibility (EMC)

The Ethernet systems **MSX-E3011** and **MSX-E3021** comply with the European EMC directive. The tests were carried out by a certified EMC laboratory in accordance with the standard DIN EN IEC 61326-1. 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-E3011 and MSX-E3021: Dimensions

Dimensions (L x W x H):	215 x 110 x 50 mm
Weight:	850 g 920 g (with MX-Rail)

Fig. 6-2: MSX-E3011 and MSX-E3021: View from above

NOTICE!
The connection lines must be installed in such a way that they are protected against mechanical loads.

6.3 Version

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:	**MSX-E3011:** -40 °C to +85 °C **MSX-E3021:** -25 °C to +85 °C
Storage temperature:	**MSX-E3011:** -40 °C to +85 °C **MSX-E3021:** -25 °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.)
Voltage supply:	
Nominal voltage:	24 VDC
Supply voltage:	18-30 V
Current consumption (at 24 V):	180 mA typ. (± 10 %)
Safety:	
Degree of protection:	IP 65[2]
Optical isolation:	1000 V
Reverse polarity protection:	1 A max.

NOTICE!
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)

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

6.4.2 Trigger input

24 V trigger input

Number of inputs:	1
Filter/Protective circuit:	low-pass/TVS 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/TVS 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.

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-B}:	≤ -1.5 V (low) ≥ 1.5 V (high)
Receiver level (slave) V_{A-B}:	≤ -200 mV (low) ≥ 200 mV (high)

6.4.4 Analog inputs

Number of inputs:	16 (differential)
Architecture:	4 groups of 4 channels each (4-channel simultaneous converter with one 4-channel multiplexer per converter)
Resolution:	16-bit (bipolar) 15-bit (unipolar)

Precision:	± 1.221 mV typ. (± 4 LSB) ± 2.442 mV max.
Relative precision (INL):	± 3 LSB max. (ADC)
Max. total current (sensor supply):	1.8 A per group (channels 0-7 and 8-15)
Optical isolation:	1000 V
Input range:	± 5 V, ± 10 V (software-programmable)
Throughput rate:	25 kHz per channel or 100 kHz max. (if only 1 channel in each group is used)
Gain:	x1, x2 (software-programmable)
Common mode rejection:	80 dB min., DC up to 60 Hz (differential amplifier)
Input impedance (PGA):	10^9 Ω // 10nF relating to GND
Bandwidth (-3 dB):	160 kHz (limited by low-pass filter) 16 Hz (equipment option with differential filter)
Overvoltage protection:	± 40 V
Trigger:	a) software-programmable b) digital input c) synchro
Offset error:	± 1 LSB (± 305 µV)
Gain error:	± 2.5 LSB
Temperature drift:	2.3 (µV/V/°C) * V_{in} + 22.5 (µV/°C) typ. V_{in}: input voltage in V (-10 V ≤ V_{in} ≤ +10 V) in the temperature range from -40 °C to +85 °C: 4.5 ppm/°C FSR
MSX-E3011-16-PC-Diff (option)	
Shunt resistance:	250 Ω (0.01 % TC 25 ppm)
Calibration:	gain x2 (± 5 V input range)

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.

EMC
= Electromagnetic Compatibility

According to the European EMC Directive, electromagnetic compatibility is “the ability of equipment to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to other equipment in that environment.”

FSR
= Full Scale Range

FSR is the usable measurement range.

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.

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 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.

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.

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.

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.

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