

TECHNICAL

DESCRIPTION

MSX-E3601

Ethernet system for the acquisition of dynamic signals



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. ADDI-DATA GmbH reserves the right to make changes to the technical data and the materials included herein.

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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!

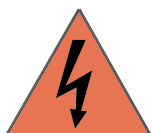
Designates hints and other useful information.



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 system as well as safety precautions
2	Brief description of the MSX-E system (functions, features, block diagram)
3	Function description (analog inputs) including pin assignment
4	Description of the function-specific pages of the MSX-E web interface
5	Description of the acquisition mode (Sequence mode)
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 system **MSX-E3601** for the acquisition, processing and transferring of ICP sensor signals 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-E3601** must not be used as safety-related part (SRP).

The Ethernet system **MSX-E3601** must not be used for safety-related functions.

The Ethernet system **MSX-E3601** must not be used in potentially explosive atmospheres.

The Ethernet system **MSX-E3601** 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 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 system **MSX-E3601** 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-E3601** 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-E3601** for the acquisition of dynamic signals has eight or two analog inputs with 24-bit resolution and a maximum sampling frequency of 128 kHz per channel. In addition, eight or two current sources for ICP/IEPE sensors are integrated in the system.

By means of an external trigger, measurement sequences on multiple systems can be started simultaneously (synchronisation). The system can be configured and the acquisition can be started over either the integrated web interface or SOAP commands. This interface also enables sensor 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. The "Status" LED provides for a quick and easy error diagnosis.

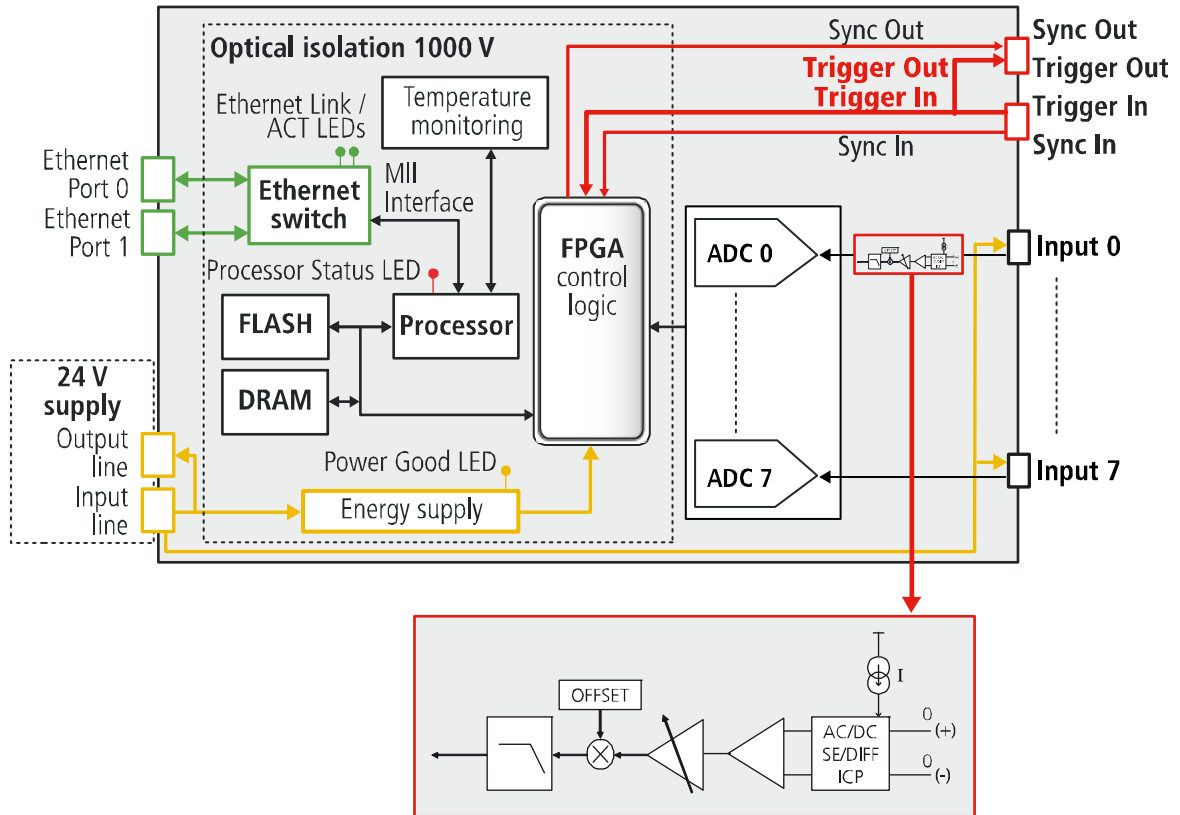
The electronics are no longer in the computer itself but in an external housing connected to the computer via Ethernet. As the Ethernet system is attached directly to the signal generator (measuring point), the measurements are no longer affected by long cables. The length of the (Ethernet) connection 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:

- 8 or 2 analog inputs, single-ended or differential, 24-bit, simultaneous acquisition
- 8 or 2 current sources for ICP/IEPE sensors
- DC or AC coupling
- Sampling frequency of up to 128 kHz
- Input ranges (SE): ± 10 V (gain: x1), ± 1 V (x10), ± 0.1 V (x100)
Input ranges (Diff): ± 5 V (gain: x1), ± 0.5 V (x10), ± 0.05 V (x100)
- Onboard calibration
- Acquisition: can be controlled by means of an external trigger (digital 24 V trigger input)
- Web interface to configure, control and monitor the acquisition or the inputs
- Data access via SOAP (TCP or UDP)
- Optical isolation
- Degree of protection: IP 65
- Cascadable; synchronisation in the μ s range
- Extended operating temperature range from -40 °C to +85 °C

2.2 Block diagram

Fig. 2-1: MSX-E3601: Block diagram



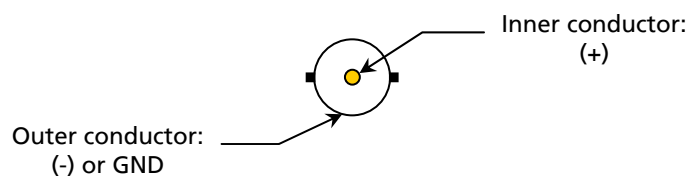
3 Function description: Analog inputs

The Ethernet system **MSX-E3601** has eight analog inputs for ICP or IEPE sensors. The system **MSX-E3601-2** is equipped with two inputs.

3.1 Pin assignment

To each insulated BNC female connector, one sensor can be connected. One analog input consists of input + and input – (differential) or input + and GND (single-ended).

Fig. 3-1: BNC female connector



3.2 Configuration

Each analog input can be configured through software, i.e. via the integrated web interface (see Chapter 5.1.1) or SOAP commands. Below, you can find a description of the single parameters.

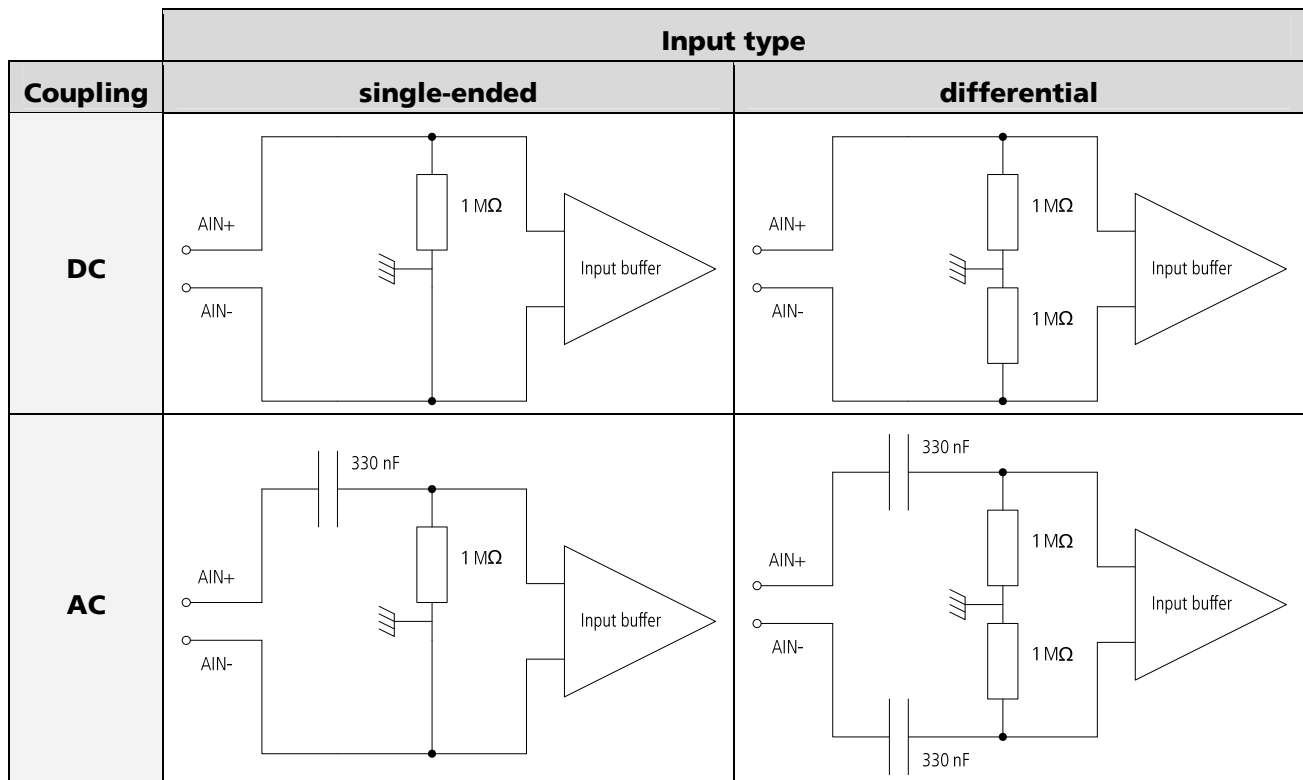
3.2.1 Coupling

In DC mode, the cut-off frequency of the low-pass filter corresponds to the Nyquist frequency and thus depends on the sampling frequency (see Chapter 6.4.4, section “Filter properties”). In AC mode, a high-pass filter with a cut-off frequency (-3 dB) of 0.48 Hz is connected in addition.

3.2.2 Signal type

As the signal type, you can define “single-ended” or “differential”.

Fig. 3-2: Input type and coupling: Input circuits



3.2.3 ICP or IEPE sensor

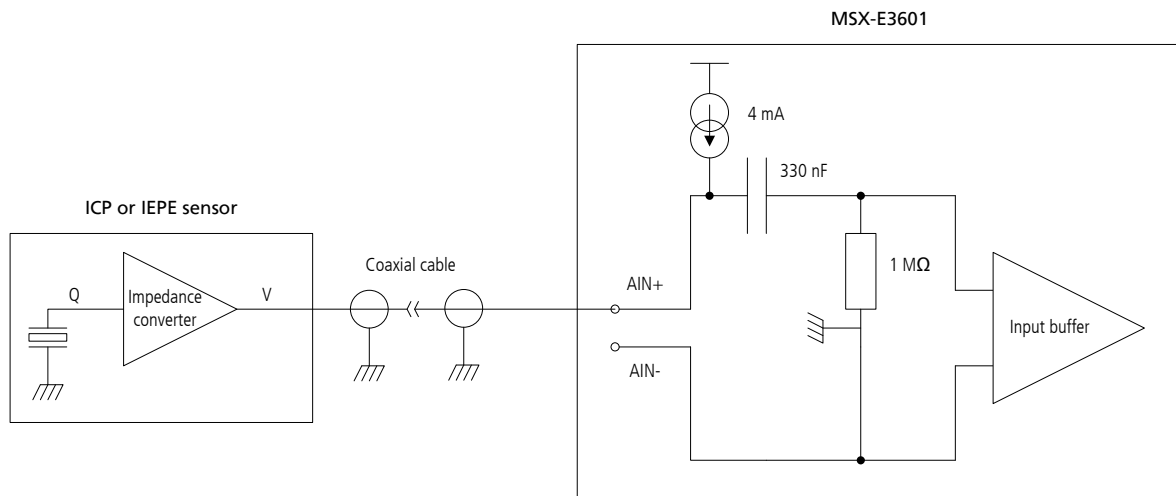
The abbreviations ICP (Integrated Circuit Piezoelectric) and IEPE (Integrated Electronics Piezo Electric) denote industry standards for piezoelectric acceleration, force and pressure sensors with a built-in impedance converter. IEPE is a non-proprietary standard.

The sensor contains a sensing element made of a piezoelectric material, which converts mechanical strain into an electrical signal. This high-impedance signal again is converted by the sensor electronics into a voltage signal with a low impedance of about 100 Ω. A low-impedance sensor signal is beneficial as it can be transmitted over long lines with little loss.

The sensor electronics are supplied with a constant current of 4 mA. This supply current and the sensor signal are transmitted together over a single coaxial cable.¹ The constant current supply is integrated in each analog input of the **MSX-E3601** and can be activated through software. When the current source is activated, the selected input is automatically set as a single-ended input in AC coupling mode.

¹ Sources: http://de.wikipedia.org/wiki/Integrated_Electronics_Piezo-Electric (03/04/2014)
http://en.wikipedia.org/wiki/Integrated_circuit_piezoelectric_sensor (03/04/2014)

Fig. 3-3: Connection example: ICP or IEPE sensor



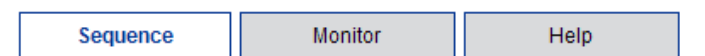
4 Web interface: Quick access to the MSX-E system

In this chapter, the system-specific parts of the **MSX-E3601** web interface 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”

4.1.1 “Sequence” tab

Fig. 4-1: Acquisition mode: Sequence



For the acquisition, the Sequence mode is available, which is described in detail in Chapter 5 of this manual.

The acquisition is started and stopped in the tool bar above (“Start” and “Stop” buttons). In addition, the configuration can be saved in a file (“Save as”) and later be reloaded (“Load configuration”). Moreover, you can display the source code as a C sample (“Source code”).

In the “Autostart” section, the current configuration can be saved as the autostart configuration. As soon as the MSX-E system is switched on the next time, it can load this configuration and execute it. In other words, the acquisition is started automatically after the system has booted up.

On this tab, also the data format is shown for all data to be acquired (see Chapter 5.1.5).

4.1.2 “Monitor” tab

When the acquisition has been started, you can enter the number of data packets to be transferred. The respective transfer time is automatically displayed in the line below. Via the button “Display as table”, all values that have been sent are listed.

4.1.3 “Help” tab

Here, you can find detailed information on the data transfer in Sequence mode.

5 Acquisition mode

This chapter exemplifies how to configure and start an acquisition via the web interface of the Ethernet system **MSX-E3601**. Moreover, you can use SOAP functions (see MSX-E CD or driver download on the ADDI-DATA website) to perform these steps.

5.1 Sequence mode

The Sequence mode enables you to acquire one or more channels per acquisition sequence. The acquisition can be started by a trigger.

- On the web interface, from the menu on the left, select the item "Acquisition", and on the right, select the "Sequence" tab.

5.1.1 "Channel configuration" (channel selection and configuration)

Fig. 5-1: Sequence mode: "Channel configuration"

Channel	Type/Description	ICP	Coupling	Signal type	Gain	Selection
All	All Analog inputs	<input checked="" type="checkbox"/>	DC	Single-ended	x1	<input checked="" type="checkbox"/>
0	Analog input 0	<input checked="" type="checkbox"/>	AC	Single-ended	x10	<input checked="" type="checkbox"/>
1	Analog input 1	<input checked="" type="checkbox"/>	DC	Differential	x1	<input checked="" type="checkbox"/>
2	Analog input 2	<input type="checkbox"/>	DC	Single-ended	x100	<input type="checkbox"/>
3	Analog input 3	<input checked="" type="checkbox"/>	AC	Differential	x1	<input checked="" type="checkbox"/>
4	Analog input 4	<input type="checkbox"/>	DC	Single-ended	x1	<input type="checkbox"/>
5	Analog input 5	<input checked="" type="checkbox"/>	DC	Differential	x100	<input checked="" type="checkbox"/>
6	Analog input 6	<input checked="" type="checkbox"/>	AC	Single-ended	x10	<input checked="" type="checkbox"/>
7	Analog input 7	<input checked="" type="checkbox"/>	AC	Single-ended	x1	<input checked="" type="checkbox"/>

In this table, you can select and configure the channels to be acquired. The channels are acquired in ascending order. Parameters include ICP, coupling, signal type and gain (see also Chapter 3.2).

5.1.2 "Sequence configuration"

Fig. 5-2: Sequence mode: "Sequence configuration"

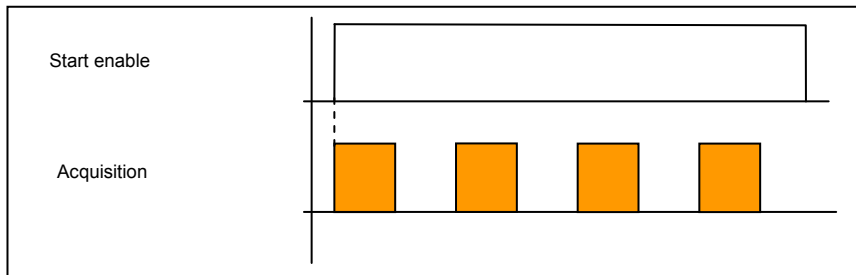
	Number of sequences	Frequency (Hz)
Description	Number of sequences to be acquired	Sampling frequency per channel
Value	<input type="text" value="0"/>	<input type="text" value="1000.00"/>

In the column "Number of sequences", you have to enter the number of sequences to be acquired (1 to 4294967295). If this value is 0, the acquisition is continuous.

Example

To acquire four sequences after the start, the field "Number of sequences" must contain the value 4.

Fig. 5-3: "Number of sequences" (example)



The sampling frequency for each channel (1 to 128 kHz) can be selected in the "Frequency" column.

5.1.3 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. 5-4: Acquisition: Trigger configuration

	Hardware trigger	Synchro trigger
Trigger source	<input checked="" type="checkbox"/>	<input type="checkbox"/>

	Hardware trigger active edge	Hardware trigger count
Description	Type of edges before the acquisition starts	Number of trigger events before the acquisition starts
Value	Falling <input type="button" value="v"/>	5 (1 - 65535)

- **Trigger source:** Available trigger sources are hardware trigger and synchro 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.

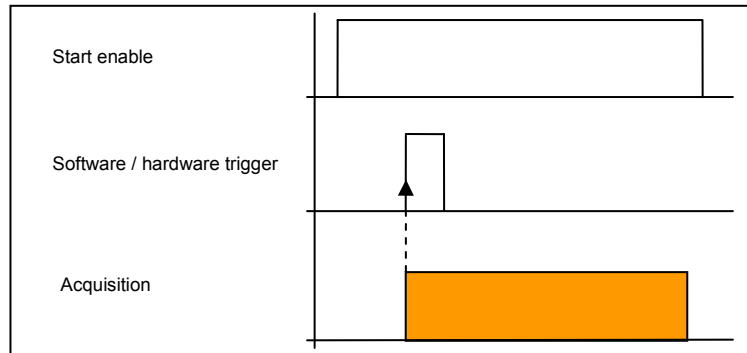
The following pages contain examples of the hardware trigger.

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

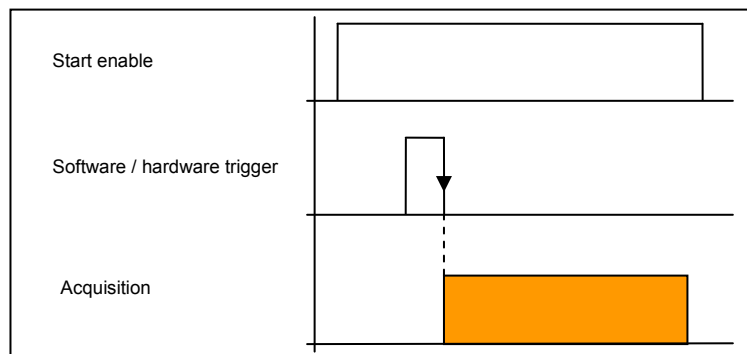
Hardware trigger

1) Examples of edges

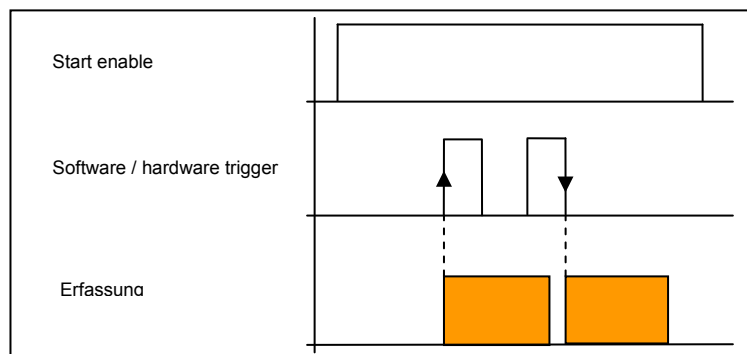
a) Rising: Rising edge



b) Falling: Falling edge



c) Both: Rising and falling edges



2) Examples of hardware triggers

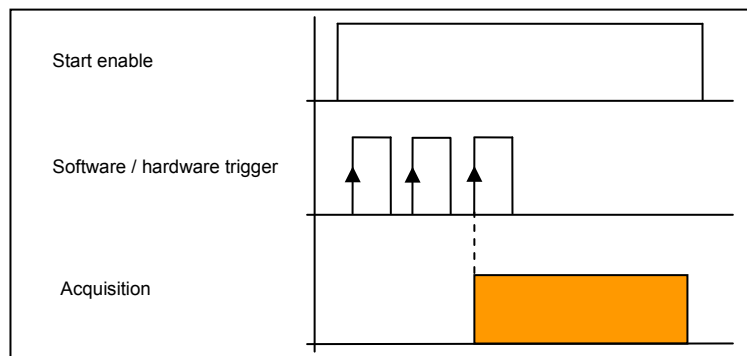
a) To start the acquisition once only after three rising edges, you can use the following configuration:

Fig. 5-5: Hardware-Trigger (a)

	Hardware trigger	Synchro trigger
Trigger source	<input checked="" type="checkbox"/>	<input type="checkbox"/>

	Hardware trigger active edge	Hardware trigger count
Description	Type of edges before the acquisition starts	Number of trigger events before the acquisition starts
Value	Rising <input type="button" value="v"/>	3 (1 - 65535)

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



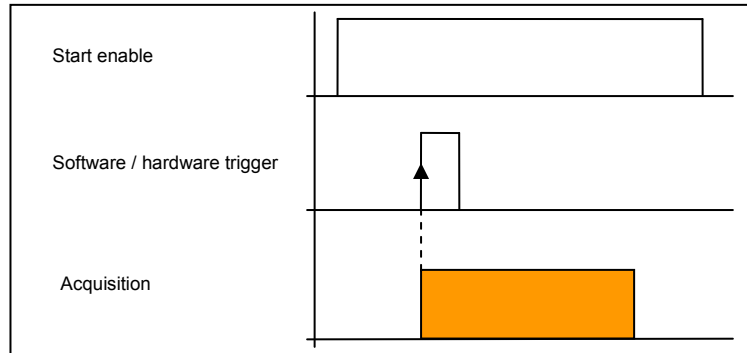
b) With "Hardware trigger active edge", "Rising" is selected again, and with "Hardware trigger count", the value 1 is entered.

Fig. 5-6: Hardware-Trigger (b)

	Hardware trigger	Synchro trigger
Trigger source	<input checked="" type="checkbox"/>	<input type="checkbox"/>

	Hardware trigger active edge	Hardware trigger count
Description	Type of edges before the acquisition starts	Number of trigger events before the acquisition starts
Value	Rising <input type="button" value="v"/>	1 (1 - 65535)

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



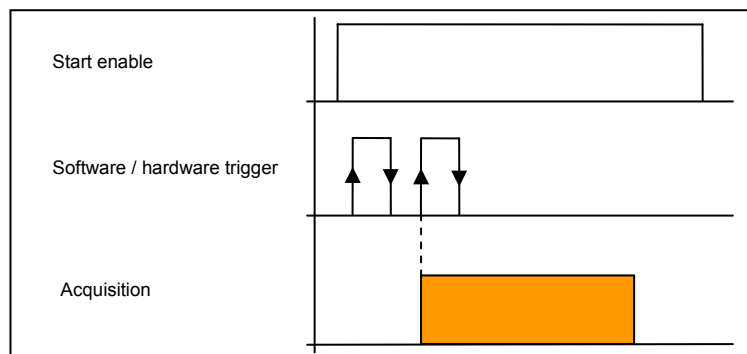
- c) With "Hardware trigger active edge", the option "Both" is selected, and with "Hardware trigger count", the value 3 is entered.

Fig. 5-7: Hardware-Trigger (c)

	Hardware trigger	Synchro trigger
Trigger source	<input checked="" type="checkbox"/>	<input type="checkbox"/>

	Hardware trigger active edge	Hardware trigger count
Description	Type of edges before the acquisition starts	Number of trigger events before the acquisition starts
Value	Both <input type="button" value="v"/>	3 (1 - 65535)

After the 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. 5-8: Hardware-Trigger (d)

	Hardware trigger	Synchro trigger
Trigger source	<input checked="" type="checkbox"/>	<input type="checkbox"/>

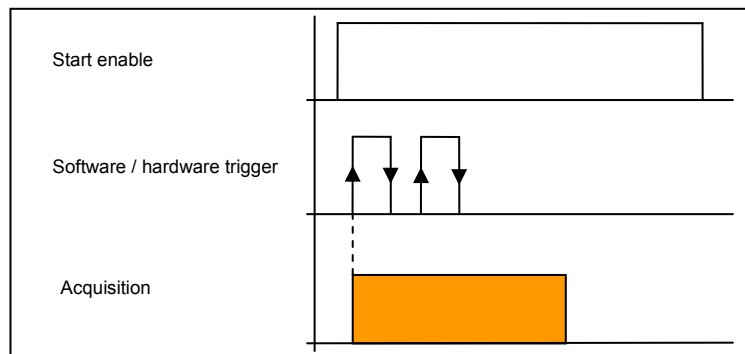
	Hardware trigger active edge	Hardware trigger count
Description	Type of edges before the acquisition starts	Number of trigger events before the acquisition starts
Value	Both <input type="button" value="v"/>	1 <input type="text" value="1"/> (1 - 65535)

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



IMPORTANT!

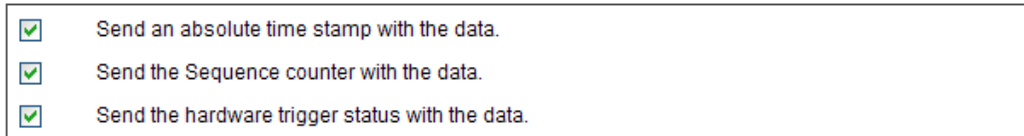
Edges that occur during an acquisition are ignored. Only those edges are considered that occur after the end of an acquisition.



5.1.4 “Data server frame configuration” (supplementary data)

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

Fig. 5-9: Data server frame configuration (Sequence mode)



- **Send an absolute time stamp with the data:** A time stamp is sent, which contains the date of the acquisition.
- **Send the Sequence counter with the data:** 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.).
- **Send the hardware trigger status with the data:** The current status of the hardware trigger is indicated, i. e. if a rising or falling edge occurred.

5.1.5 “Data server frame format” (data format)

Fig. 5-10: Acquisition: Data server frame format

Size	Name	Description
4 bytes	Time stamp (seconds)	The seconds part of the system time stamp (encoded as integer)
4 bytes	Time stamp (microseconds)	The microseconds part of the system time stamp (encoded as integer)
4 bytes	Sequence counter	Number of acquired sequences (encoded as integer)
4 bytes	Hardware trigger status	Bit 0: Status of the hardware trigger (0 or 1).
3 bytes	Analog input 0	Analog input value encoded as a floating point value (in V)
3 bytes	Analog input 1	Analog input value encoded as a floating point value (in V)
3 bytes	Analog input 3	Analog input value encoded as a floating point value (in V)
3 bytes	Analog input 5	Analog input value encoded as a floating point value (in V)
3 bytes	Analog input 6	Analog input value encoded as a floating point value (in V)
3 bytes	Analog input 7	Analog input value encoded as a floating point value (in V)

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. All measurement values and the additional data such as the time stamp form a group of values that is called a packet.



IMPORTANT!

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

The type and amount of the data sent depends on the respective configuration. The complete data format is as follows:

Table 5-1: Data format

Information	Size	Description	Format
Time stamp (s)	4 bytes	Seconds part of the acquisition time	Integer
Time stamp (µs)	4 bytes	Microseconds part of the acquisition time	Integer
Sequence counter	4 bytes	Number of the data packet	Integer
Hardware trigger status	4 bytes	Hardware trigger status at the acquisition time	Bit-coded according to Table 5-2
Analog inputs	n * 4 bytes (n = number of channels)	Acquired data of the selected analog inputs - D31-D24 = 0 - D23-D0 = Digital value of the channel: - 0 corresponds to -10 V (gain = 1) - 0x800000 corresponds to 0 V - 0xFFFFFFFF corresponds to +10 V (gain = 1)	Integer

Table 5-2: Bit-coding of the hardware trigger status

Bit	Description
0	Hardware trigger status (0 = low, 1 = high)
1	Falling edge of the hardware trigger (occurred since the last acquisition time)
2	Rising edge of the hardware trigger (occurred since the last acquisition time)
3	Acquisition has been triggered by the hardware trigger
4	Acquisition has been triggered by the synchro trigger

6 Technical data and limit values

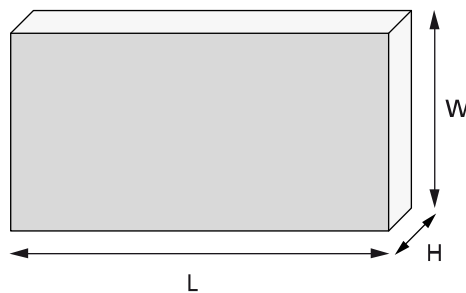
6.1 Electromagnetic compatibility (EMC)

The Ethernet system **MSX-E3601** 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.

6.2 Mechanical structure

Fig. 6-1: MSX-E3601: Dimensions



Dimensions (L x W x H):	215 x 110 x 52 mm
Weight:	860 g
	920 g (with MX-Rail)

Fig. 6-2: MSX-E3601: View from above



Fig. 6-3: MSX-E3601-2: View from above



6.3 Versions

The Ethernet system **MSX-E3601** is available in the following versions:

Table 6-1: MSX-E3601: Versions

Version	Features
MSX-E3601	8 analog inputs for ICP/IEPE sensors
MSX-E3601-2	2 analog inputs for ICP/IEPE sensors

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):	350 mA typ. (±10 %)

Safety:	
Degree of protection:	IP 65 ²
Optical isolation:	1000 V



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

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:	U _{Hmax} : 30 V U _{Hmin} : 19 V U _{Lmax} : 14 V U _{Lmin} : 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.

² 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-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:	8 (MSX-E3601) 2 (MSX-E3601-2) (1 A/D converter per channel, simultaneous acquisition)
Input type:	single-ended or differential (software-selectable)
Coupling:	DC, AC (software-selectable)
Resolution:	24-bit
Gain:	x1, x10, x100 (software-selectable)
Input ranges:	see Table 6-2
ADC type:	oversampled SAR with linear-phase FIR anti-aliasing digital filter
Sampling frequency f_s :	up to 128 kHz (software-selectable), see Table 6-3
Oversampling:	8 x f_s
Frequency accuracy:	± 50 ppm
Input stage:	
Input impedance:	1 M Ω // 300 pF typ., DC-coupled
AC cut-off frequency (-3 dB):	0.48 Hz typ.
Overvoltage protection (max. continuous current):	positive input: -14 V to +27 V, ± 100 mA negative input: ± 14 V, ± 100 mA
ESD protection:	> 30 kV (Human Body Model)
Filter properties:	
Passband:	DC up to $0.453 \times f_s$ typ.
Passband ripple:	± 0.01 dB max., DC of up to $0.453 \times f_s$
Bandwidth (-3 dB):	$0.49 \times f_s$ typ.
Stop-band:	$0.547 \times f_s$ typ.
Stop-band attenuation:	100 dB min.
Group delay:	37 / f_s (μ s) typ.
Settling time:	74 / f_s (μ s, complete settling)
Dynamic properties:	
Signal-to-noise ratio (SNR):	FSR, $f_{in} = 1$ kHz, see Table 6-4
Total harmonic distortion (THD):	FSR, $f_{in} = 1$ kHz, see Table 6-4
Dynamic range:	short-circuited inputs, see Table 6-4
Crosstalk:	between channels 0-1, 2-3, 4-5, 6-7, with gain x1, see Table 6-5

Phase mismatch:	between channels 1-2, 3-4, 5-6, 7-8, with gain x1, see Table 6-6
Amplitude accuracy:	± 0.009 dB max. at $f_{in} = 1$ kHz (sine signal), gain: x1, x10, x100
Common-mode rejection ratio (CMRR):	> 110 dB typ. at DC > 90 dB typ. at $f_{in} < 1$ kHz
Offset error:	± 90 μ V after calibration at 25 °C
Onboard DC calibration:	software-selectable
Calibration voltage:	see Table 6-7
Temperature drift:	± 8 ppm/°C typ.
Sensor supply:	
Number of channels:	8 (MSX-E3601) 2 (MSX-E3601-2) (input +)
Current source:	4 mA typ. to 24 V max.
Coupling:	AC (input +) GND (input -)

Table 6-2: Input ranges

Gain	Input ranges (V)	
	single-ended	differential
x1	± 10	± 5
x10	± 1	$\pm 0,5$
x100	$\pm 0,1$	$\pm 0,05$

Table 6-3: Selectable sampling frequencies f_s

Sampling frequencies f_s (Hz)			
128,000.00	100,000.00	80,000.00	66,666.67
64,000.00	50,000.00	40,000.00	33,333.33
32,000.00	25,000.00	20,000.00	16,666.67
16,000.00	13,333.33	12,800.00	12,500.00
10,000.00	8000.00	6,666.67	6,400.00
6,250.00	5000.00	4,000.00	3,333.33
3,200.00	3,125.00	2,500.00	2,000.00
1,666.67	1,600.00	1,562.50	1,280.00
1,000.00			

Table 6-4: Dynamic properties

Gain	SNR (dB)	THD (dB)	Dynamic range (dB)
x1	≥ 95	≥ 100	≥ 105
x10	≥ 94	≥ 100	≥ 100
x100	≥ 75	≥ 90	≥ 85

Table 6-5: Crosstalk

Input signal frequency	Crosstalk (dB)
Short-circuited input, $f_{in} = 100$ Hz	≥ 104
Short-circuited input, $f_{in} = 1$ kHz	≥ 100
50 Ω input, $f_{in} = 100$ Hz	≥ 104
50 Ω input, $f_{in} = 1$ kHz	≥ 100

Table 6-6: Phase mismatch

Input signal frequency	Phase mismatch (°)
$f_{in} < 100$ Hz	±0.001
$f_{in} < 1$ kHz	±0.01
$f_{in} < 10$ kHz	±0.1

Table 6-7: Calibration voltage

Gain	Calibration voltage (typ.)
x1	5 V
x10	900 mV
x100	90 mV

7 Appendix

7.1 Glossary

ADC

= A/D converter

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.

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.

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 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) and "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.

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.

synchronous

Two time-dependent events, time slots, or signals are synchronous if their respective significant dates correspond with each other and are divided by requested time intervals that are nominally the same.

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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