

TECHNICAL

# DESCRIPTION

**MSX-E3701-DIO**

Ethernet system for length measurement



### 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.

### Warranty and liability

The user is not permitted to make changes to the product beyond the intended use, or to interfere with the product in any other way.

ADDI-DATA shall not be liable for obvious printing and phrasing errors. In addition, ADDI DATA, if legally permissible, shall not be liable for personal injury or damage to materials caused by improper installation and/or commissioning of the product by the user or improper use, for example, if the product is operated despite faulty safety and protection devices, or if notes in the operating instructions regarding transport, storage, installation, commissioning, operation, thresholds, etc. are not taken into consideration. Liability is further excluded if the operator changes the product or the source code files without authorisation and/or if the operator is guilty of not monitoring the permanent operational capability of working parts and this has led to damage.

### Copyright

This manual, which is intended for the operator and its staff only, is protected by copyright. Duplication of the information contained in the operating instructions and of any other product information, or disclosure of this information for use by third parties, is not permitted, unless this right has been granted by the product licence issued. Non-compliance with this could lead to civil and criminal proceedings.

### ADDI-DATA software product licence

Please read this licence carefully before using the standard software. The customer is only granted the right to use this software if he/she agrees with the conditions of this licence.

The software must only be used to set up the ADDI-DATA products.

Reproduction of the software is forbidden (except for back-up and for exchange of faulty data carriers). Disassembly, decompilation, decryption and reverse engineering of the software are forbidden. This licence and the software may be transferred to a third party if this party has acquired a product by purchase, has agreed to all the conditions in this licence contract and the original owner does not keep any copies of the software.

### Trademarks

- ADDI-DATA, APCI-1500, MSX-Box and MSX-E are registered trademarks of ADDI-DATA GmbH.
- Turbo Pascal, Delphi, Borland C, Borland C++ are registered trademarks of Borland Software Corporation.
- Microsoft .NET, Microsoft C, Visual C++, MS-DOS, Windows XP, Windows 7, Windows 8, Windows Server 2000, Windows Server 2003, Windows Embedded and Internet Explorer are registered trademarks of Microsoft Corporation.
- LabVIEW, LabWindows/CVI, DASyLab, DIAdem are registered trademarks of National Instruments Corporation.
- CompactPCI is a registered trademark of PCI Industrial Computer Manufacturers Group.
- VxWorks is a registered trademark of Wind River Systems, Inc.
- RTX is a registered trademark of IntervalZero.
- Mozilla Firefox is a registered trademark of Mozilla Foundation.
- SIMATIC S7 is a registered trademark of Siemens AG.



## 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**.

## Contents

<b>Warning!</b>	<b>3</b>
<b>Chapter overview</b>	<b>7</b>
<b>1 Definition of application, user, handling</b>	<b>8</b>
1.1 Definition of application	8
1.1.1 Intended use	8
1.1.2 Usage restrictions	8
1.1.3 Limits of use	8
1.2 Safety precautions	8
1.2.1 Current sources	8
1.2.2 Degrees of protection	8
1.2.3 Cables	9
1.2.4 Housing	9
1.3 User	9
1.3.1 Qualification	9
1.3.2 Country-specific regulations	9
1.4 Handling of the Ethernet system	10
1.5 Questions and updates	10
<b>2 Brief description</b>	<b>11</b>
2.1 Functions and features	11
2.2 Block diagram	12
<b>3 Displacement transducers</b>	<b>13</b>
3.1 Inductive transducers	13
3.1.1 Half-bridge transducers	13
3.1.2 LVDT transducers	14
3.2 Transducer properties	14
<b>4 Function description: Transducer inputs</b>	<b>15</b>
4.1 Pin assignment	15
4.2 Acquisition principle	16
4.3 Calibration	16
4.4 Diagnostic function	25
<b>5 Function description: Digital inputs/outputs</b>	<b>26</b>
5.1 Pin assignment	26
5.2 SOAP/Modbus API	26
5.3 Connection examples	27
<b>6 Web interface: Quick access to the MSX-E system</b>	<b>28</b>
6.1 Menu item "I/O Configuration"	28
6.1.1 "Digital I/O" tab	28
6.1.2 "Transducers" tab	29
6.2 Menu item "Transducers"	29
6.2.1 "Database" tab	29
6.2.2 "Diagnosis" tab	30
6.3 Menu item "Acquisition"	30
6.3.1 "Auto-refresh" and "Sequence" tabs	30
6.3.2 "Monitor" tab	31
6.3.3 "Help" tab	31
<b>7 Acquisition modes</b>	<b>32</b>
7.1 Auto-refresh mode	32
7.1.1 "Channel configuration" (channel selection)	32
7.1.2 "Transducer selection"	32
7.1.3 "Average" (average value calculation)	33
7.2 Sequence mode	34
7.2.1 "Channel configuration" (channel selection)	35

7.2.2	"Transducer selection" .....	35
7.2.3	"Delay" (wait time).....	35
7.2.4	"Sequence measurement" (number of sequences).....	36
7.3	Common functions.....	38
7.3.1	"Division factor" .....	38
7.3.2	"Acquisition time" .....	38
7.3.3	Trigger configuration .....	38
7.3.4	"Data server frame configuration" (supplementary data).....	46
7.3.5	"Data server frame format" (data format).....	47
<b>8</b>	<b>Technical data and limit values .....</b>	<b>49</b>
8.1	Electromagnetic compatibility (EMC) .....	49
8.2	Mechanical structure .....	49
8.3	Versions and options .....	50
8.4	Limit values.....	50
8.4.1	Ethernet.....	51
8.4.2	Trigger input .....	51
8.4.3	Synchro input and output .....	52
8.4.4	Transducer inputs.....	52
8.4.5	Sine wave generator (transducer supply) .....	53
8.4.6	Digital inputs.....	54
8.4.7	Digital outputs .....	54
<b>9</b>	<b>Appendix .....</b>	<b>55</b>
9.1	Glossary.....	55
9.2	Index .....	58
<b>10</b>	<b>Contact and support .....</b>	<b>59</b>

## Figures

Fig. 1-1:	Correct handling .....	10
Fig. 2-1:	MSX-E3701-DIO: Block diagram.....	12
Fig. 3-1:	Half-bridge transducer .....	13
Fig. 3-2:	LVDT transducer.....	14
Fig. 4-1:	MSX-E3701-DIO: Acquisition principle .....	16
Fig. 4-2:	ConfigTools: Main window .....	17
Fig. 5-1:	Pin assignment: Digital I/O (37-pin D-Sub male connector).....	26
Fig. 5-2:	Connection example: Digital inputs (24 V) .....	27
Fig. 5-3:	Connection example: Digital outputs (24 V).....	27
Fig. 6-1:	Web interface: "XT-370x-MIX" option.....	28
Fig. 6-2:	I/O configuration: Digital inputs.....	28
Fig. 6-3:	I/O configuration: Digital outputs .....	29
Fig. 6-4:	MSX-E transducer database .....	29
Fig. 6-5:	I/O Configuration: Diagnosis.....	30
Fig. 6-6:	Acquisition modes: Auto-refresh and Sequence .....	30
Fig. 7-1:	Auto-refresh mode: "Channel configuration" .....	32
Fig. 7-2:	Auto-refresh mode: "Transducer selection" .....	32
Fig. 7-3:	Auto-refresh mode: "Average" .....	33
Fig. 7-4:	Auto-refresh mode: Acquisition per sequence .....	33
Fig. 7-5:	Auto-refresh mode: Acquisition per channel .....	34
Fig. 7-6:	Sequence mode: "Channel configuration" .....	35
Fig. 7-7:	Sequence mode: "Transducer selection" .....	35
Fig. 7-8:	Sequence mode: "Delay" .....	35
Fig. 7-9:	Delay: Mode 1 (example) .....	36

Fig. 7-10: Delay: Mode 2 (example) .....	36
Fig. 7-11: Sequence mode: "Sequence measurement" .....	36
Fig. 7-12: "Number of sequences" (example) .....	37
Fig. 7-13: "Number of data frames" (example) .....	37
Fig. 7-14: Acquisition: Division factor .....	38
Fig. 7-15: Acquisition: Acquisition time .....	38
Fig. 7-16: Acquisition: Trigger configuration .....	38
Fig. 7-17: Hardware trigger with "One-Shot" (a) .....	41
Fig. 7-18: Hardware trigger with "One-Shot" (b) .....	41
Fig. 7-19: Hardware trigger with "One-Shot" (c) .....	42
Fig. 7-20: Hardware trigger with "One-Shot" (d) .....	43
Fig. 7-21: Hardware trigger with "Sequence" (a) .....	43
Fig. 7-22: Hardware trigger with "Sequence" (b) .....	44
Fig. 7-23: Hardware trigger with "Sequence" (c) .....	45
Fig. 7-24: Data server frame configuration (Auto-refresh mode) .....	46
Fig. 7-25: Data server frame configuration (Sequence mode) .....	46
Fig. 7-26: Acquisition: Data server frame format .....	47
Fig. 8-1: MSX-E3701-DIO: Dimensions .....	49
Fig. 8-2: MSX-E3701-DIO: View from above .....	49

## Tables

Table 4-1: Pin assignment: Transducer inputs .....	15
Table 7-1: Auto-refresh mode: Data format .....	47
Table 7-2: Sequence mode: Data format .....	48
Table 8-1: MSX-E3701-DIO: Versions .....	50
Table 8-2: MSX-E3701-DIO: Option .....	50
Table 8-3: Current consumption (at 24 V) .....	51

## 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	Information on inductive displacement transducers
4	Function description (transducer inputs) including pin assignment
5	Function description (digital inputs/outputs) including pin assignment and connection examples
6	Description of the function-specific pages of the MSX-E web interface
7	Description of the acquisition modes (Auto-refresh and Sequence modes)
8	List of technical data and limit values of the MSX-E system
9	Appendix with glossary and index
10	Contact and support address

# 1 Definition of application, user, handling

## 1.1 Definition of application

### 1.1.1 Intended use

The Ethernet system **MSX-E3701-DIO** for the acquisition, processing and transferring of displacement transducer signals as well as for digital input and output is intended for the connection to a network, which is used as electrical equipment for measurement, control and laboratory pursuant to the norm EN 61010-1 (IEC 61010-1).

### 1.1.2 Usage restrictions

The Ethernet system **MSX-E3701-DIO** must not be used as a safety-related part (SRP).

The Ethernet system **MSX-E3701-DIO** must not be used for safety-related functions.

The Ethernet system **MSX-E3701-DIO** must not be used in potentially explosive atmospheres.

The Ethernet system **MSX-E3701-DIO** 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



#### NOTICE!

The protection according to the defined degree of protection (see Chapter 8.4) 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](mailto: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

If you have any questions, you can send them to us by e-mail or call us:

E-mail: [info@addi-data.com](mailto: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-E3701-DIO** can be downloaded for free at: [www.addi-data.com](http://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

With the intelligent Ethernet system **MSX-E3701-DIO**, 16 HB or LVDT displacement transducers can be acquired with 24-bit resolution. In addition, the system is equipped with 32 digital I/O (24 V).

By means of an external trigger, on multiple systems, measurement sequences can be started simultaneously or the inputs and outputs can be updated simultaneously (synchronisation). The system 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.

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.

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 operating temperature range from 0 °C to +60 °C and is equipped with numerous protective circuits. The "Status" LED provides for a quick and easy error diagnosis.

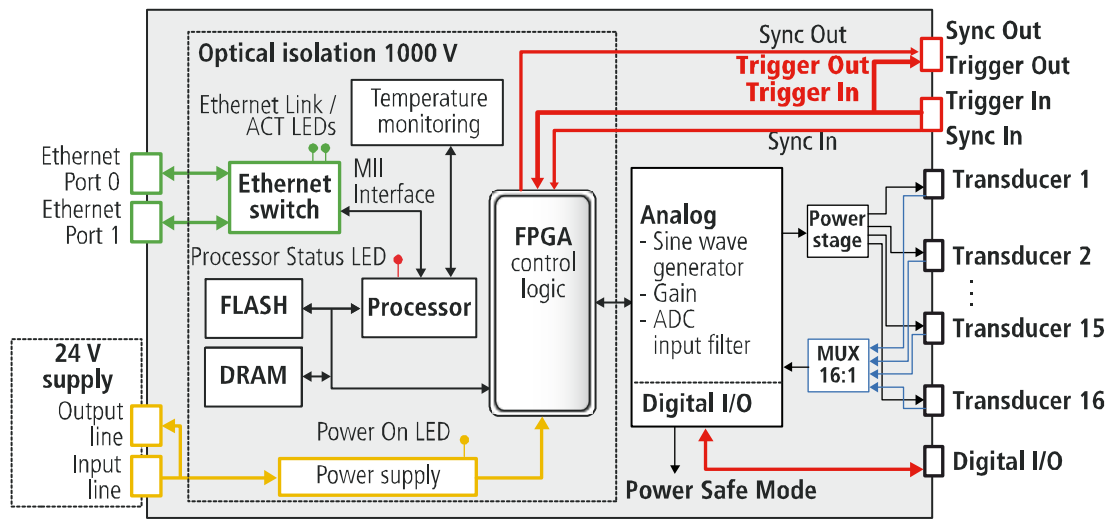
The electronics are no longer in the computer itself but in an external housing connected to the computer via Ethernet. As the Ethernet system is attached directly to the signal generator (measuring point) or in direct vicinity of the sensor or actuator, the measurements and accordingly, the function of the sensor or actuator 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:

- Acquisition of 16 inductive displacement transducers (HB, LVDT) of the same type
- **XT-370x-MIX** option: Acquisition of 16 HB or LVDT displacement transducers of different types
- 16 digital inputs and 16 digital outputs, 24 V
- Acquisition or input/output: 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 and outputs
- Data access via SOAP or Modbus (always TCP or UDP)
- Optical isolation
- Degree of protection: IP 65
- Cascadable; synchronisation in the  $\mu$ s range
- Operating temperature range from 0 °C to +60 °C

## 2.2 Block diagram

Fig. 2-1: MSX-E3701-DIO: Block diagram



### 3 Displacement transducers

In this chapter, the properties of the different displacement transducers are described in more detail. This should help you to find the right transducer for your measuring system and to identify and prevent possible measuring errors in advance.

#### 3.1 Inductive transducers

Inductive transducers are used for precise measurement of a defined distance. They are displacement/voltage sensors, whose output voltage changes linearly along with the moving magnetic core (ferrite).

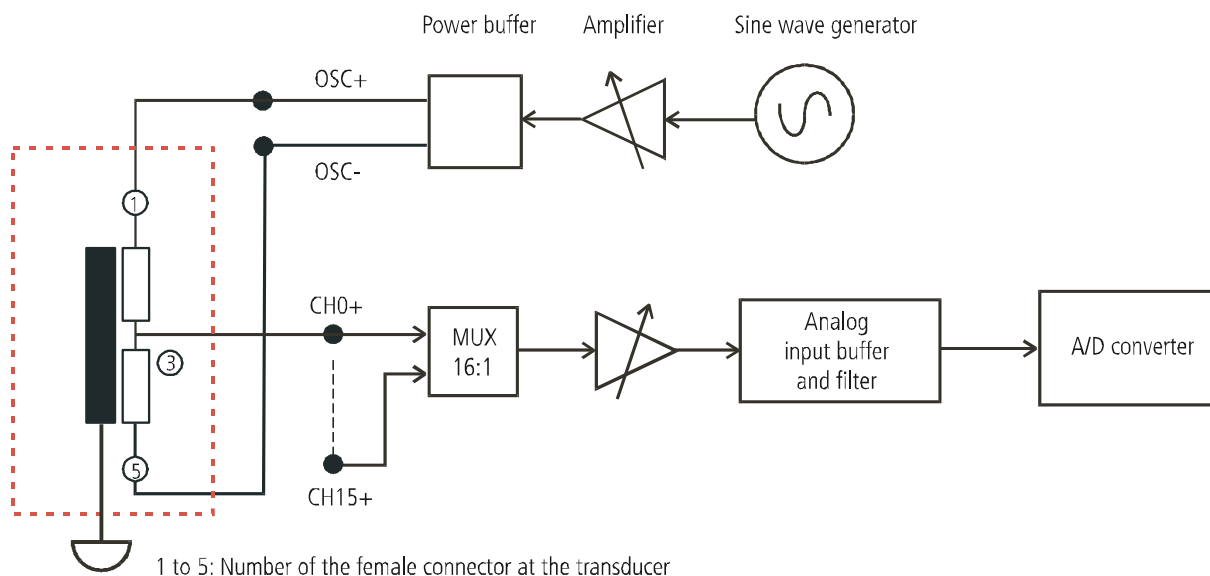
The magnetic core moves according to a straight line in a transformer, which consists of a central primary coil and two external secondary coils (cylindrical windings). The power buffer provides an AC voltage source to the primary coil. The secondary voltage changes according to the position of the magnetic core.

##### 3.1.1 Half-bridge transducers

A half-bridge transducer consists of two inductive coils (windings). These are fed directly with two sinusoidal voltage signals, i. e. a positive and a negative oscillator voltage.

A measuring bolt moves along the two coils with a ferromagnetic core. Depending on its position, this core changes the voltages in the two coils. The measuring bolt thus functions like a variable voltage distributor. The change in voltage at the coils results in the sinusoidal measurement signal to be evaluated.

**Fig. 3-1: Half-bridge transducer**

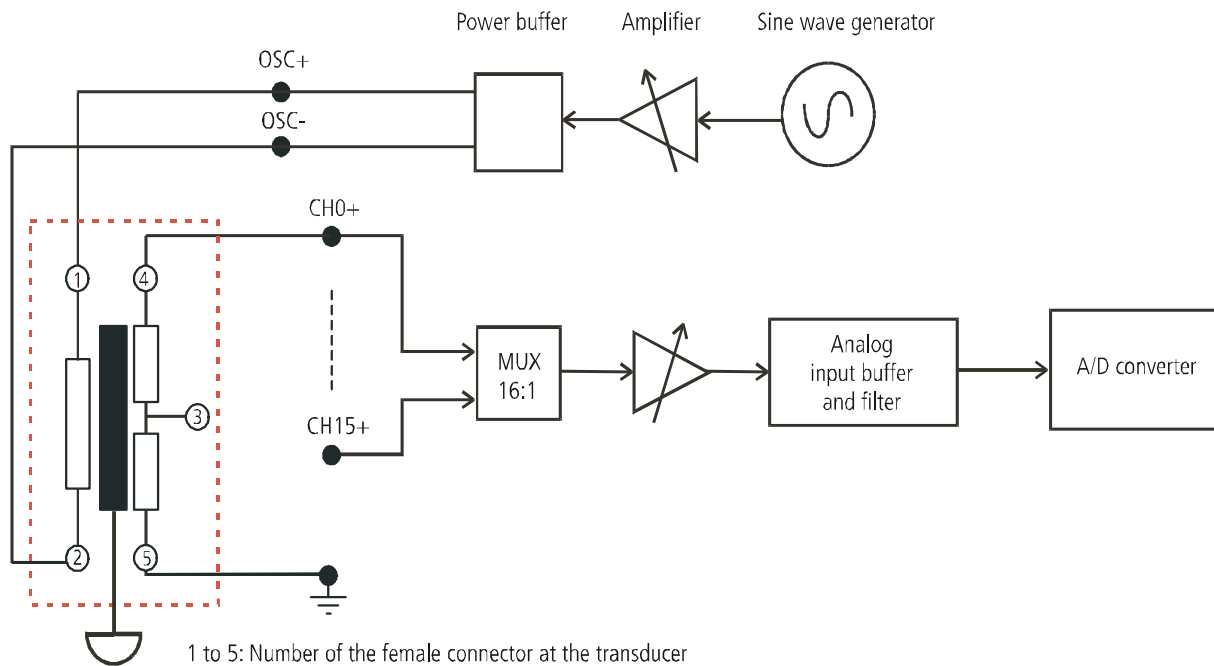


### 3.1.2 LVDT transducers

An LVDT transducer features three coils: a primary coil and two secondary coils. These coils are positioned concentrically around the mobile core and form two symmetrical transformers with respect to the electrical zero point of the transducer.

The primary coil is fed by two sinusoidal voltage signals, i. e. a positive and a negative one, whereas both secondary coils (switched in phase opposition) produce an electrical signal proportional to the measured displacement.

**Fig. 3-2: LVDT transducer**



## 3.2 Transducer properties

In the **ConfigTools** program, in the User database, the following properties of a transducer can be defined:

- Name
- Type
- Nominal frequency (Hz)
- Impedance (ohms)
- Nominal supply voltage  $V_{\text{eff}}$  ( $V_{\text{rms}}$ )
- Sensitivity (mV/V/mm)
- Measurement range (mm).

## 4 Function description: Transducer inputs

The Ethernet system **MSX-E3701-DIO** has 16 single-ended inputs for inductive displacement transducers.

### 4.1 Pin assignment

To each M18 female connector, one displacement transducer can be connected. The differential transducer supply consists of OSC+ and OSC-.



#### NOTICE!

With the Ethernet system **MSX-E3701-DIO**, only one type of transducer can be connected to one system.

**Exception:** The option **XT-370x-MIX** enables the connection of up to 16 different HB or LVDT transducer types per system. For this, the frequency and the input resistance of the transducers must be equal.

**Table 4-1: Pin assignment: Transducer inputs**

Pin No.	Half-bridge	LVDT
	Female connector, 5-pin, M18	Female connector, 5-pin, M18
1	OSC+	OSC+
2	GND	OSC-
3	Transducer signal	not connected
4	not connected	Transducer signal
5	OSC-	GND

OSC = oscillator voltage = supply voltage

## 4.2 Acquisition principle

The Ethernet system **MSX-E3701-DIO** provides all signals required for the supply of the inductive transducers.

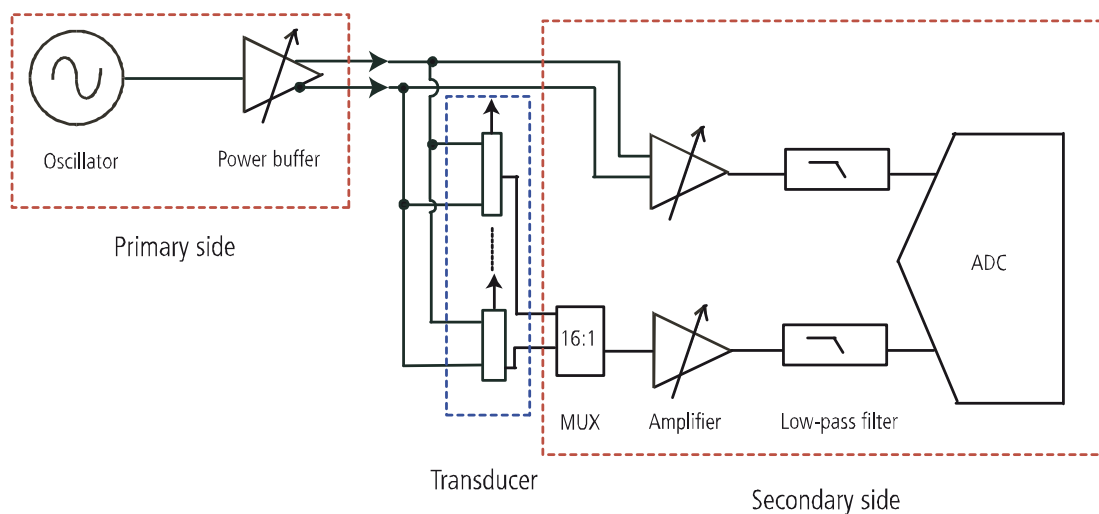
By means of a sine wave generator, the primary side of the transducer is supplied. The output frequency and the gain of the sine wave generator can be programmed through software. The transducers are supplied via a differential power buffer.

The incoming measurement signals are led over a multiplexer (16:1).

The measurement signal passes through a software-programmable amplifier. Then the signal is led over an analog low-pass filter and acquired by a 24-bit ADC.

Parallel to the measurement signal, the supply signal of the transducer is monitored via a second input at the ADC.

**Fig. 4-1: MSX-E3701-DIO: Acquisition principle**

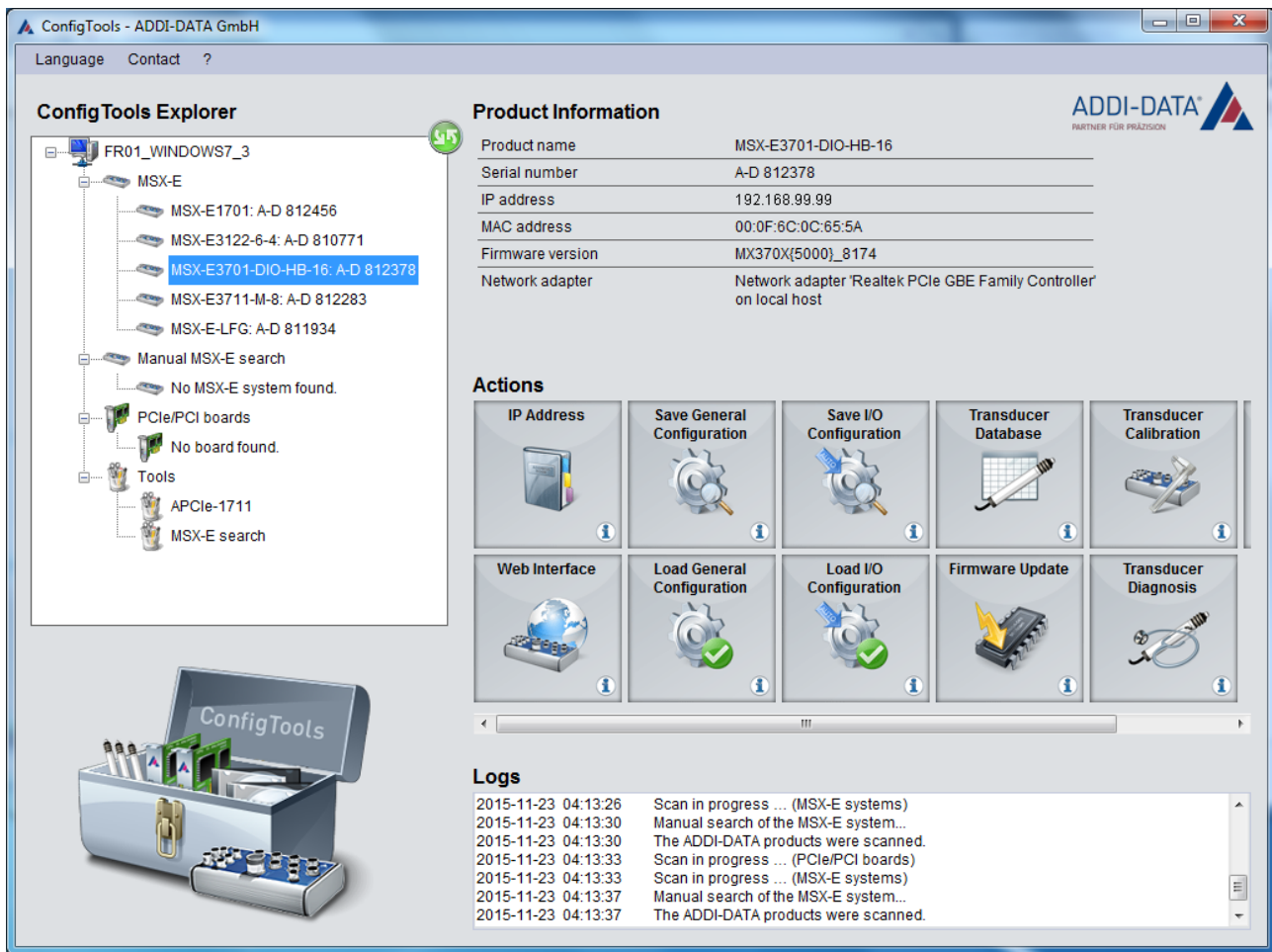


## 4.3 Calibration

The gain and the offset error of the **MSX-E3701-DIO** can be corrected by means of the software tool **ConfigTools** (see PDF link "General manual MSX-Exxx"). When the MSX-E system is booting up, the calibration values are read from the flash and uploaded to the system.



Fig. 4-2: ConfigTools: Main window



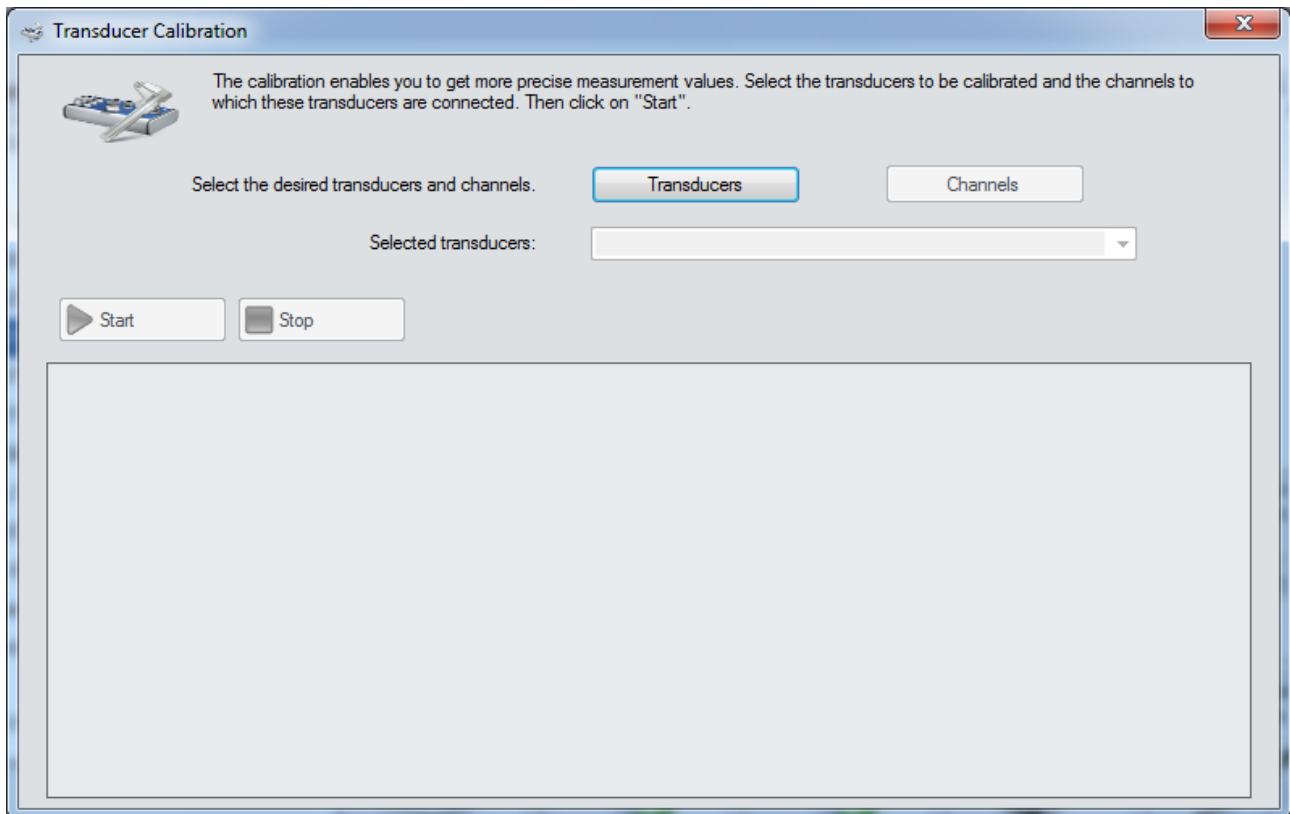
As already mentioned in Chapter 4.1, transducers of different types can be connected to the system **MSX-E3701-DIO** if you use the **XT-370x-MIX** option. The calibration of the transducers is carried out in one run then.

A sample for the calibration of an **MSX-E3701-DIO** (also with the **XT-370x-MIX** option) is included in delivery of the respective system.

On the following pages, the calibration of three Solartron LVDT transducers with different measuring ranges and sensitivity is described:

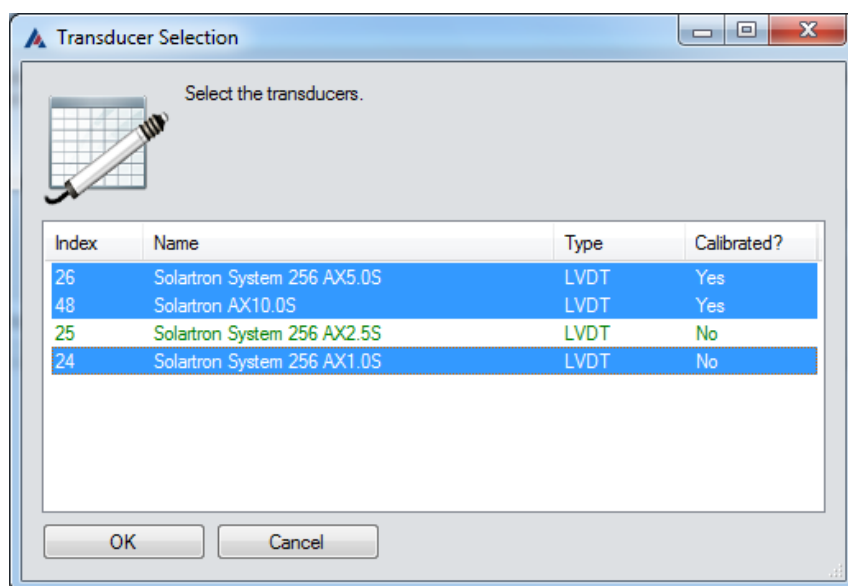
1. In the **ConfigTools** main window, click on the action button "Transducer Calibration" (see Fig. 5-2).

The following window is displayed:



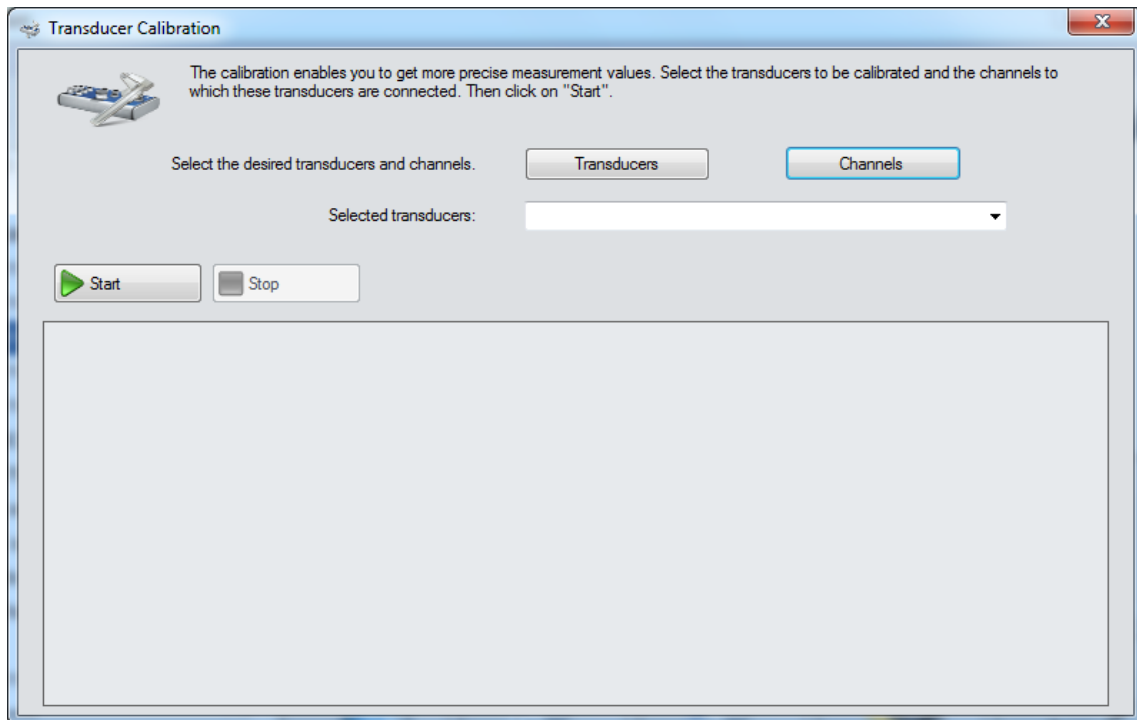
2. Click on the "Transducers" button.

In the following window, the transducer types of the MSX-E database (action button "Transducer Database") are listed.

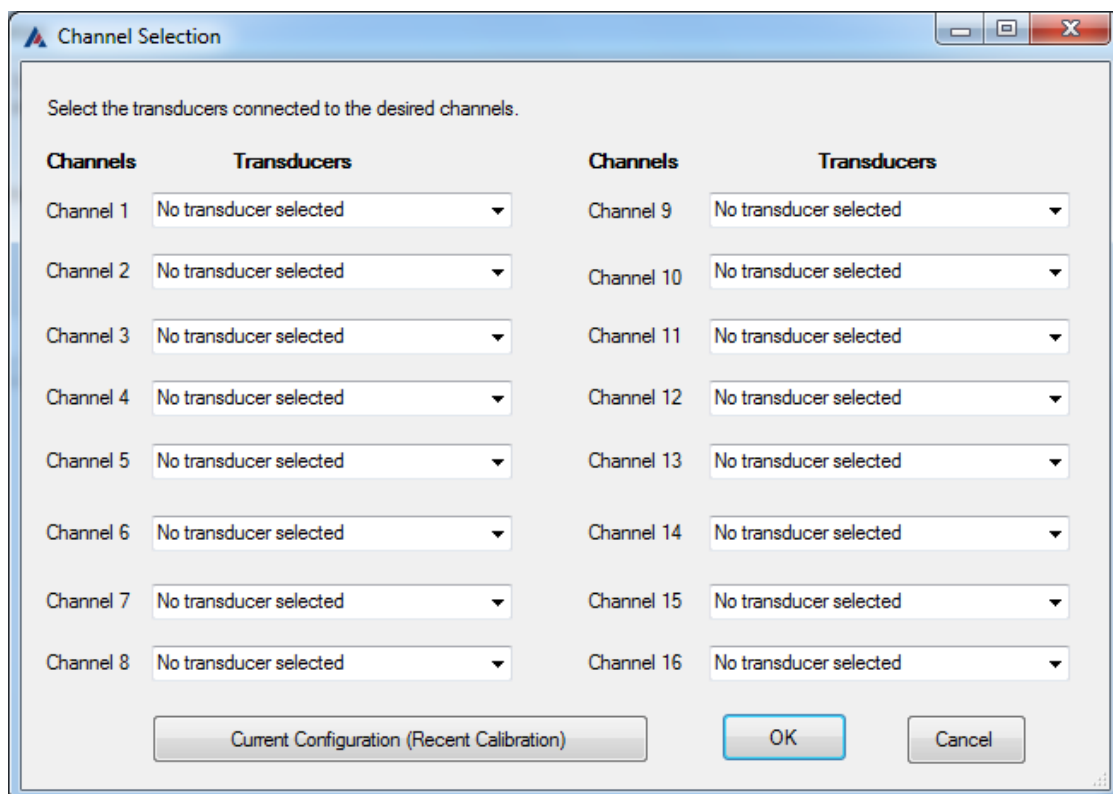


3. Select the transducers to be calibrated and click on "OK".

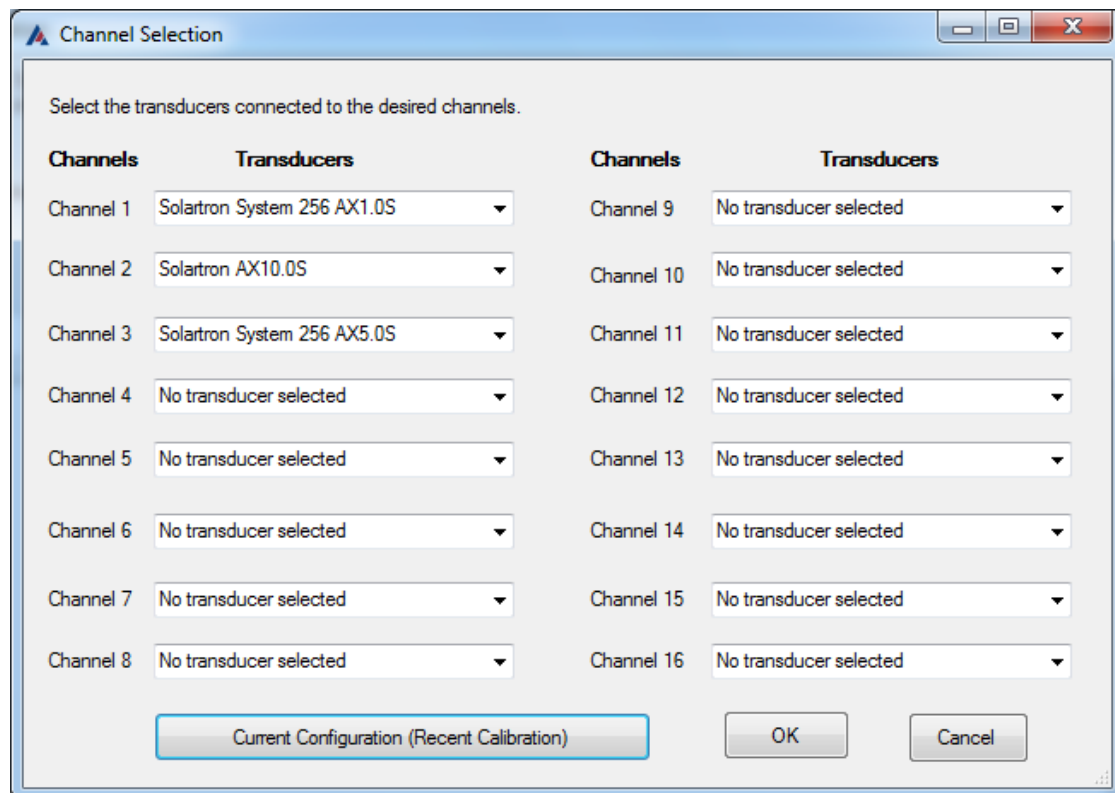
4. Click on the "Channels" button.



In the following window, via the button "Current Configuration (Recent Calibration)", the configuration used last for a calibration can be displayed.

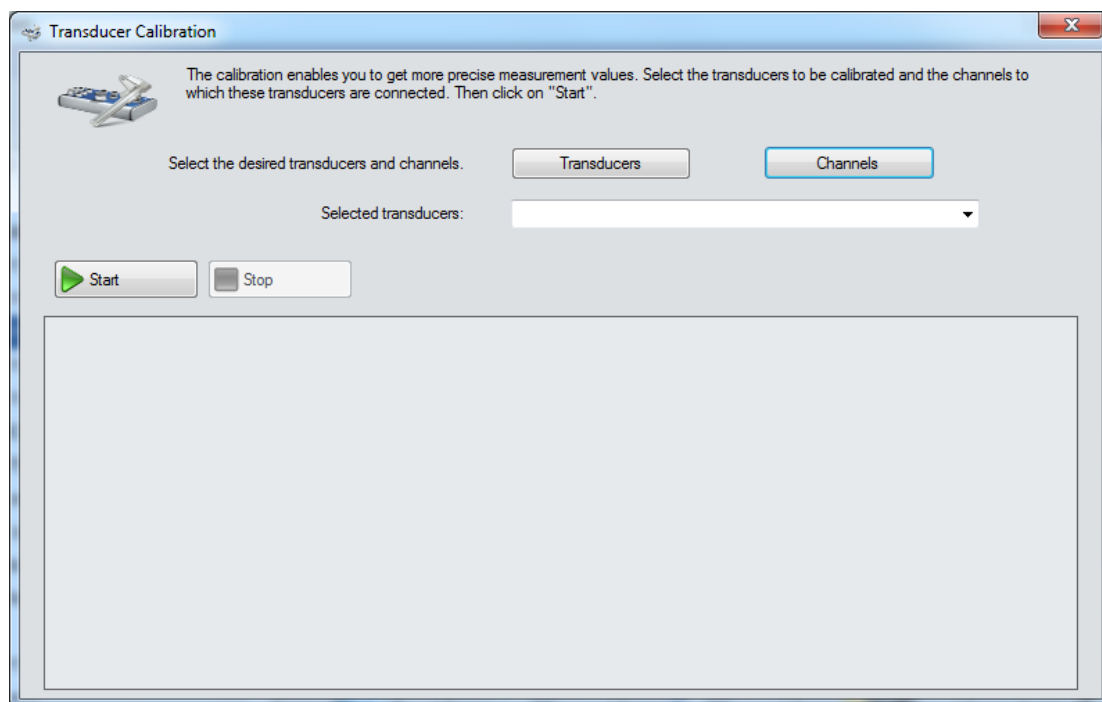


5. Assign the transducers to be calibrated to the corresponding channels and click on "OK".

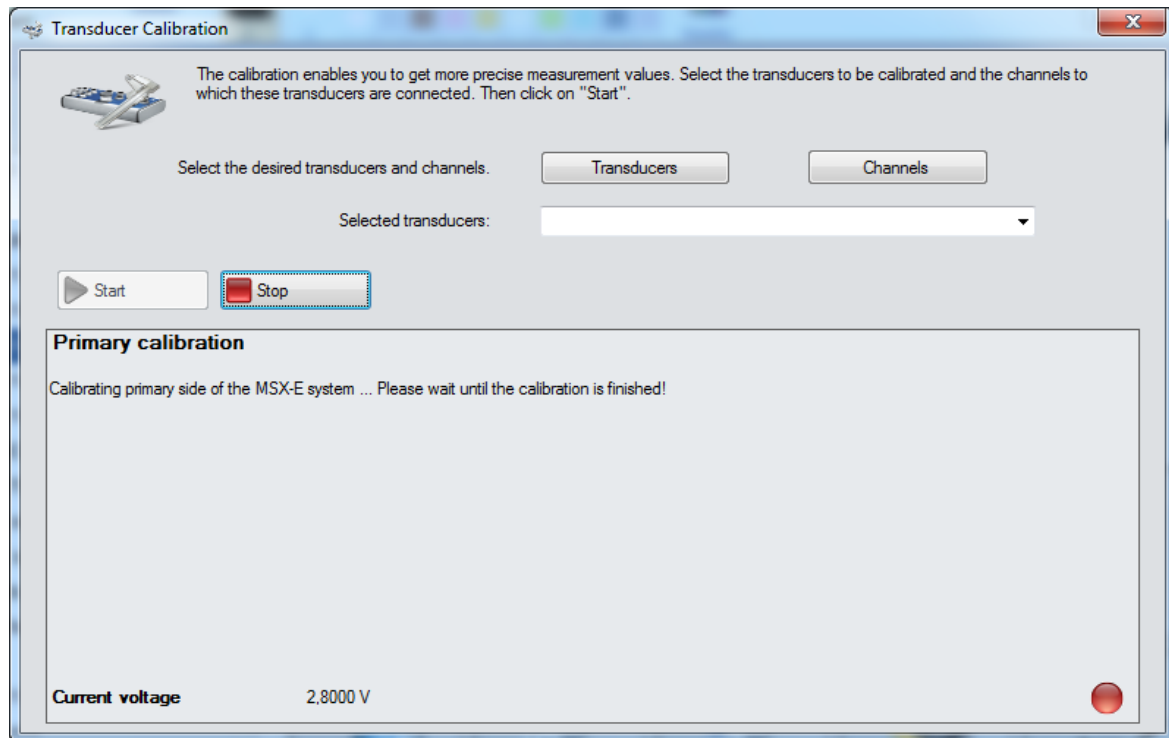


Assigning the transducers to the channels is also possible with the software function "MX370x\_SetMixTransducerList".

6. Click on "Start" to start the calibration.

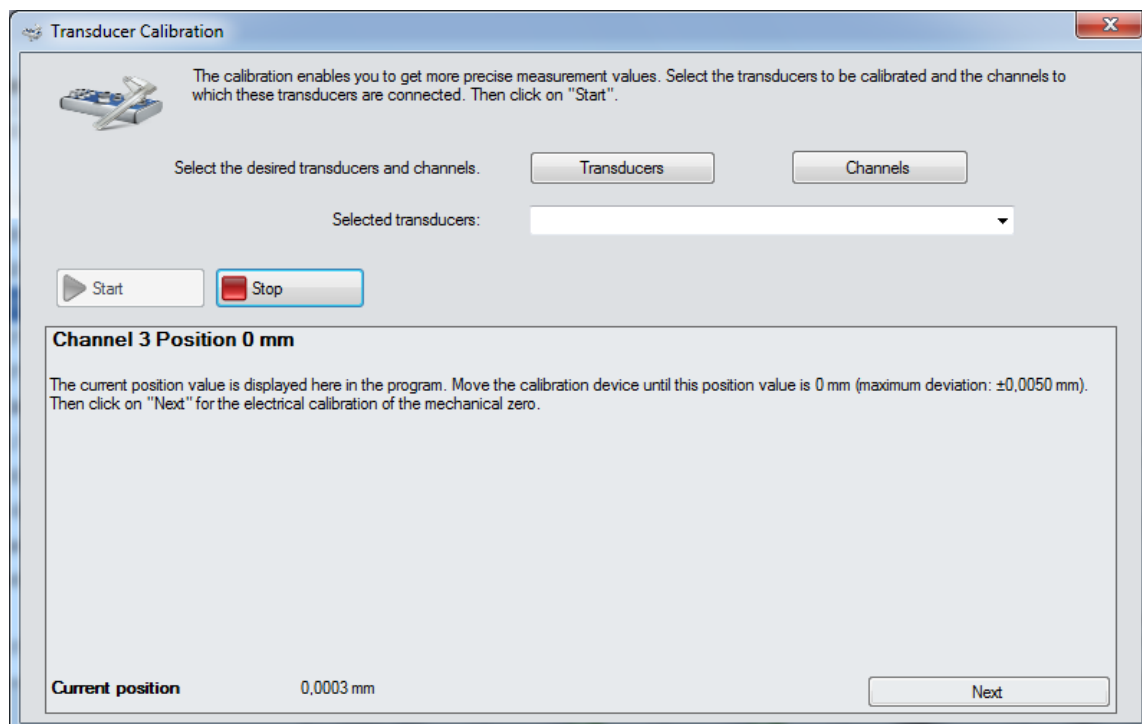


First, the primary side of the MSX-E system is calibrated.

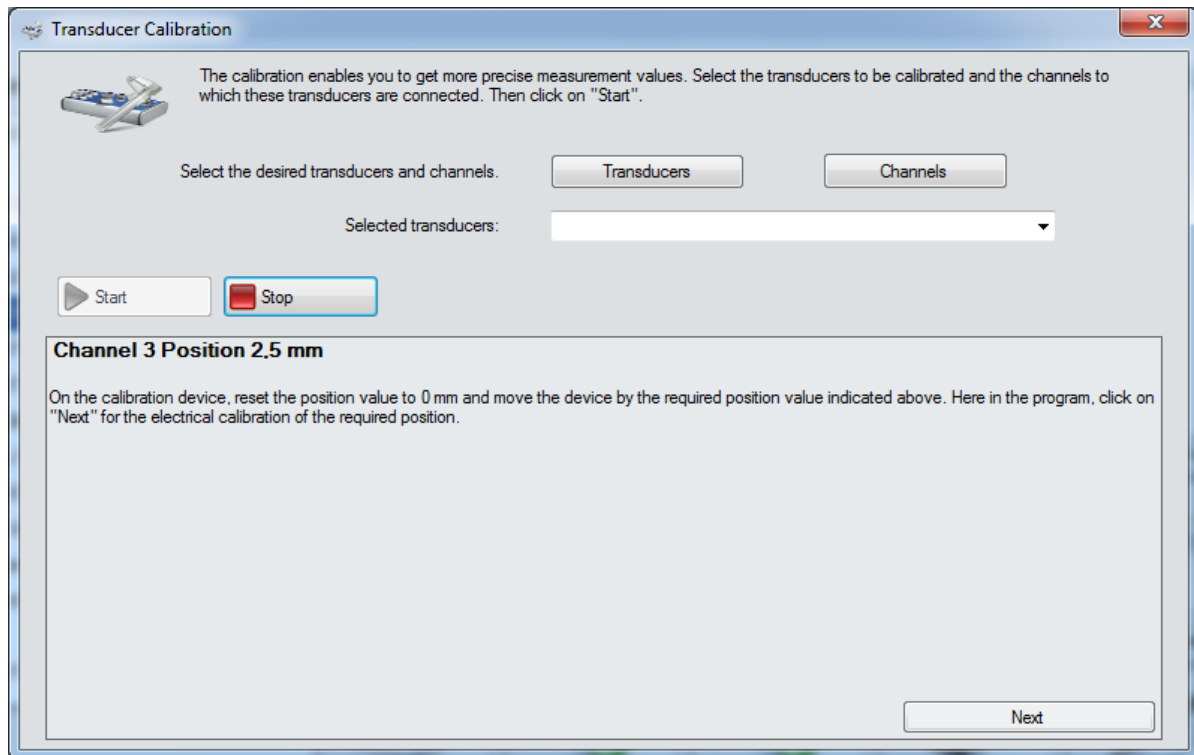


Then, the calibration of the transducers is started. The order of the transducers to be calibrated is defined automatically. In this example, channel 3 is calibrated first.

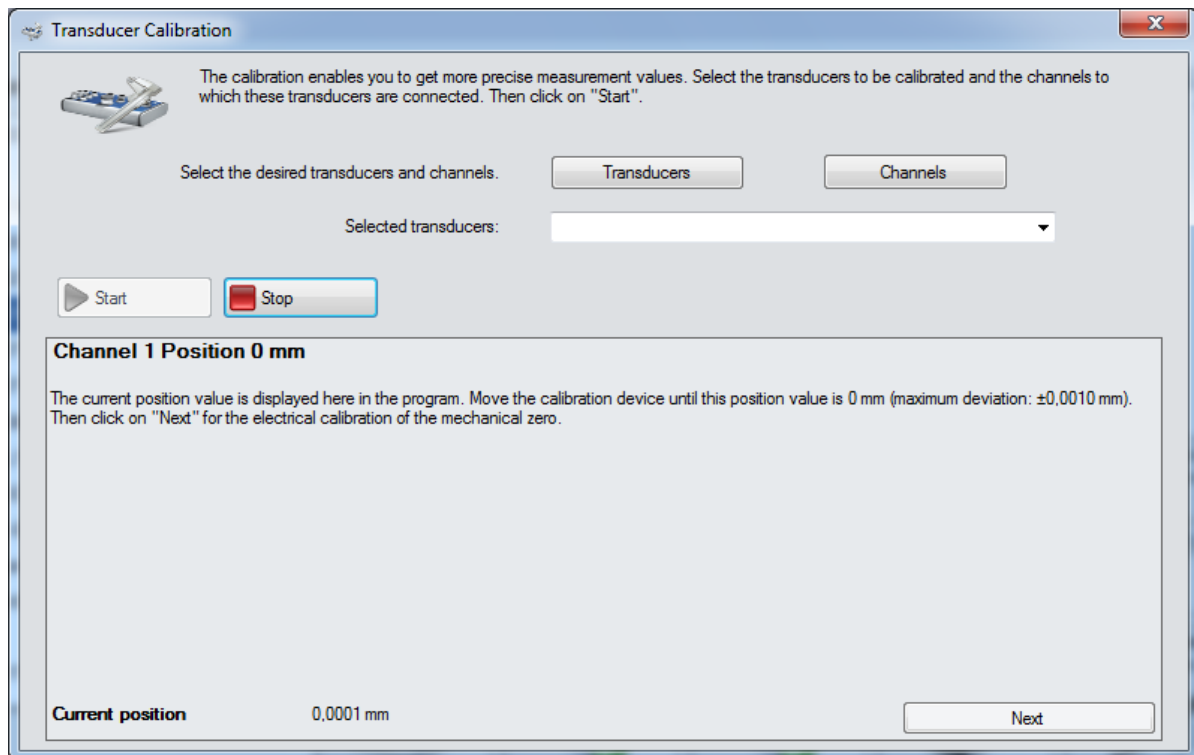
7. For the transducer connected to channel 3, set the current position to 0 mm and click on "Next".



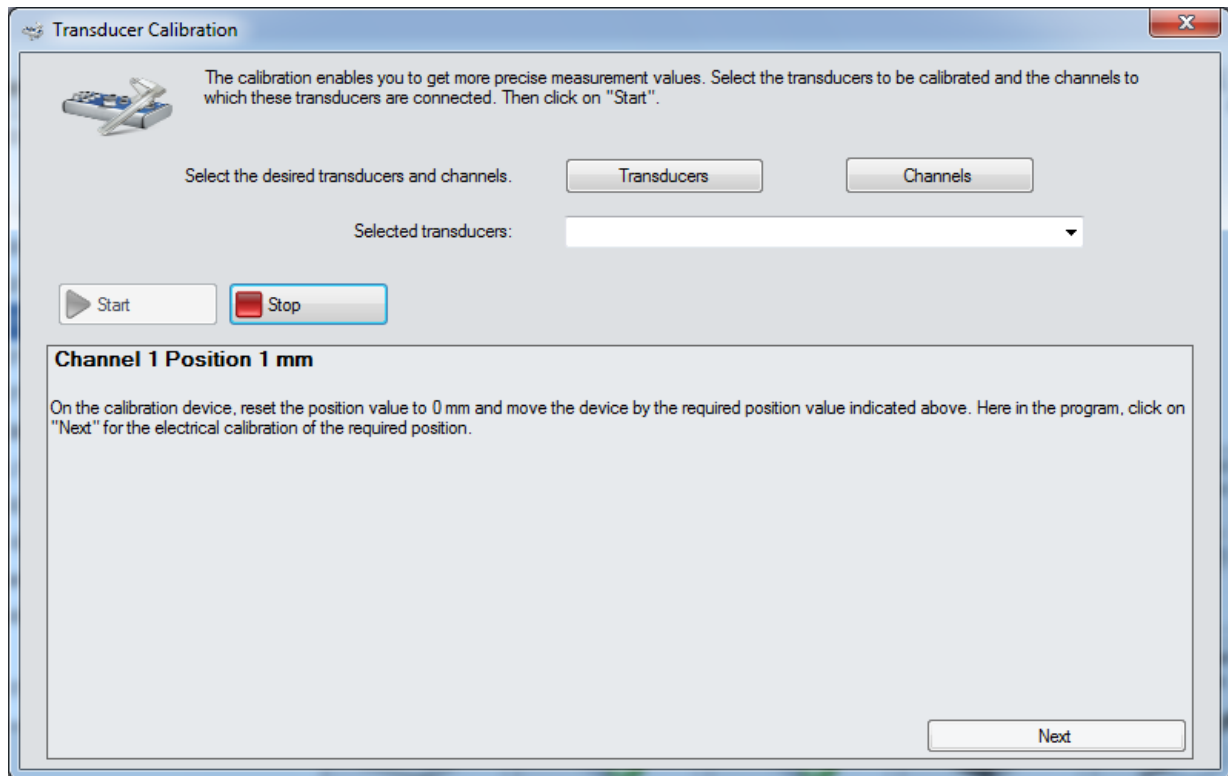
8. For the transducer connected to channel 3, set the required position to 2.5 mm and click on "Next".



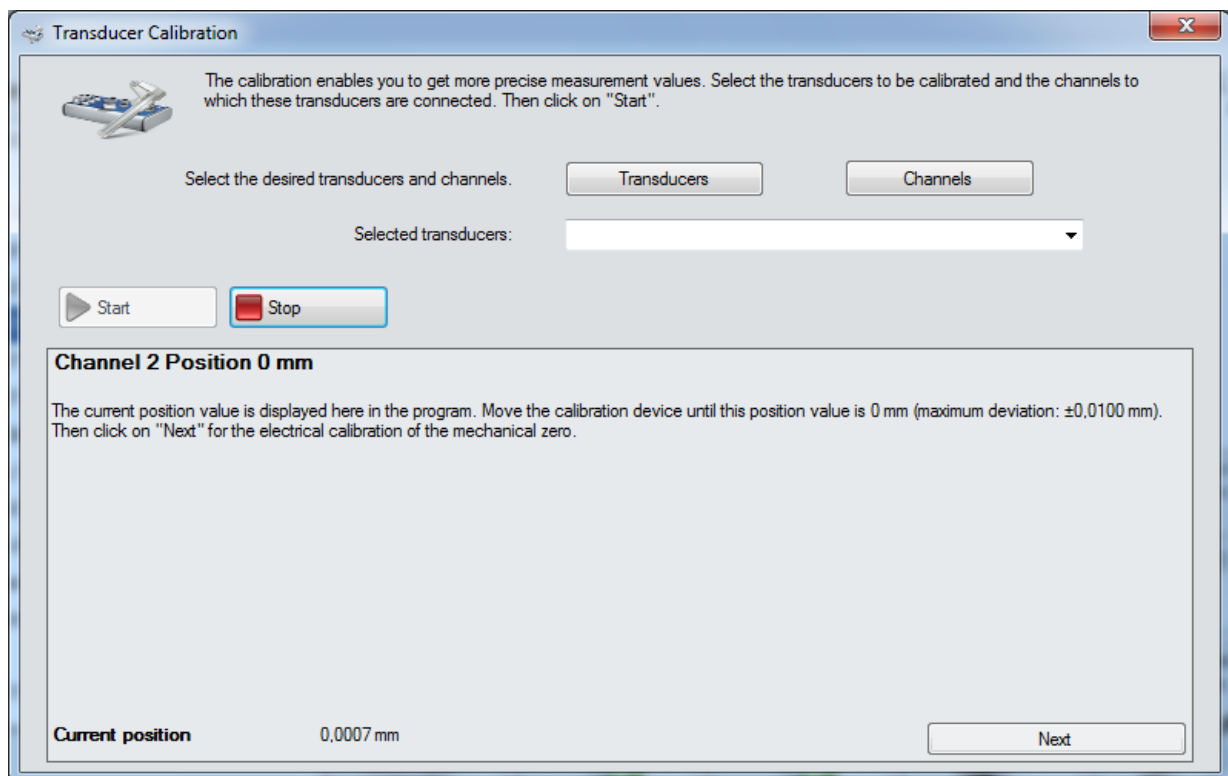
9. For the transducer connected to channel 1, set the current position to 0 mm and click on "Next".



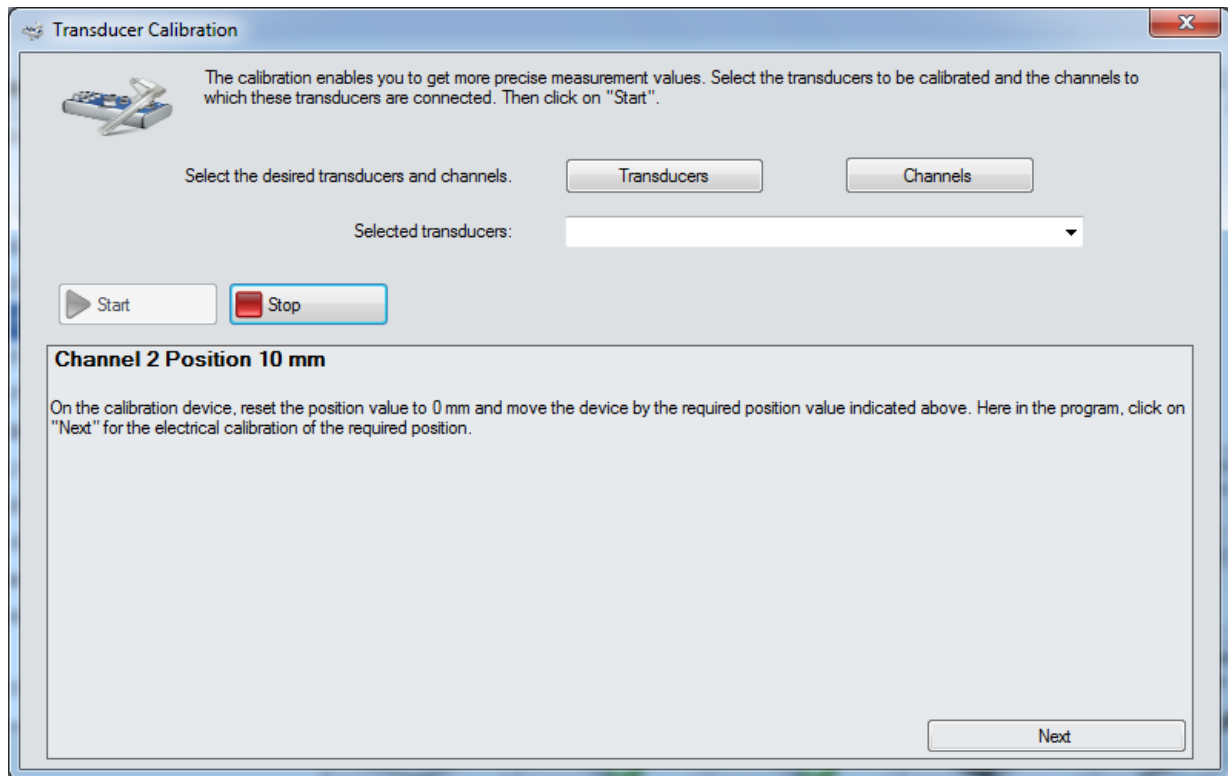
10. For the transducer connected to channel 1, set the required position to 1 mm and click on "Next".



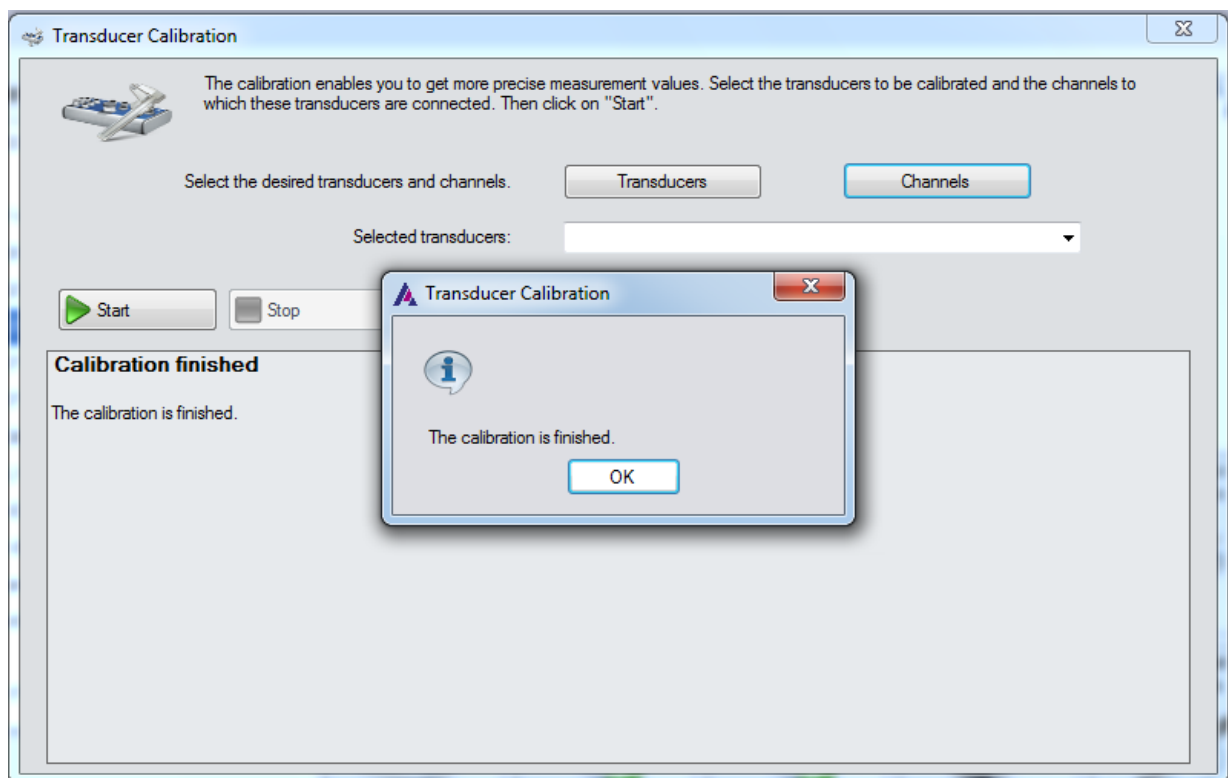
11. For the transducer connected to channel 2, set the current position to 0 mm and click on "Next".



12. For the transducer connected to channel 2, set the required position to 10 mm and click on "Next".



The calibration of the transducers connected to channels 1 to 3 is finished.





## 4.4 Diagnostic function

Each input has a diagnostic function in order to detect a short-circuit, for example.

If such an error occurs, the respective input is switched off.

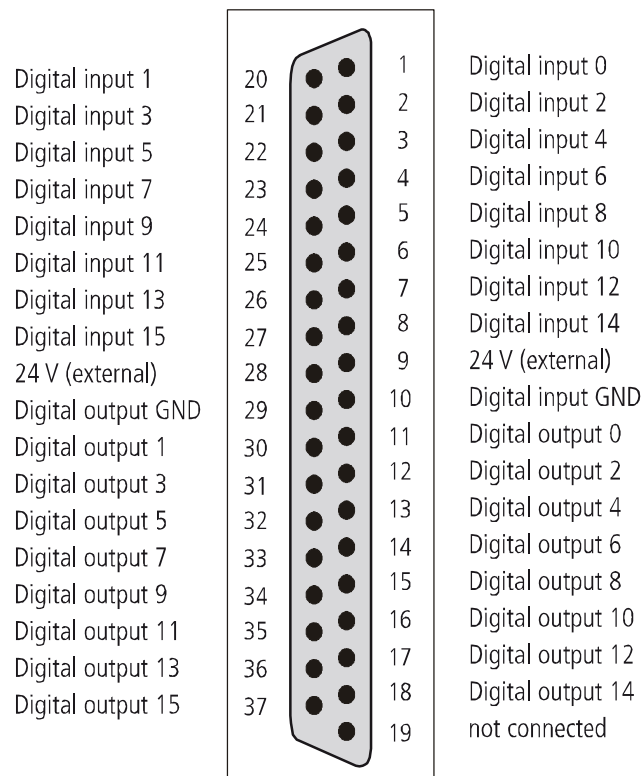
As soon as the short-circuit has been eliminated, a rearm has to be carried out to reactivate the input (see also Chapter 6.2.2). This means that the input is set to the status value that was programmed before the error occurred. A new value can only be defined after the rearm event.

## 5 Function description: Digital inputs/outputs

The Ethernet system **MSX-E3701-DIO** has 16 digital inputs and 16 digital outputs for sensors or actuators.

### 5.1 Pin assignment

**Fig. 5-1: Pin assignment: Digital I/O (37-pin D-Sub male connector)**



### 5.2 SOAP/Modbus API

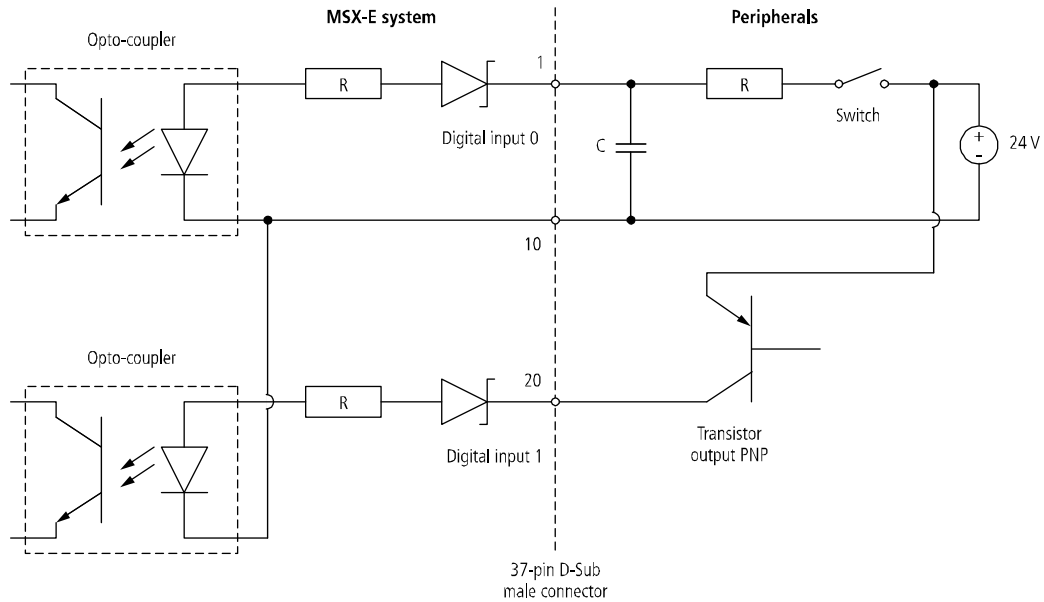
If you configure and control the digital I/O of the **MSX-E3701-DIO** via SOAP or Modbus, you have to use the software functions starting with "Ext".

Example: A digital output can be set by the function "MX370x\_\_ExtDigitalIOWriteChannel (ulChannel, ulState, ulOption1, Response)".

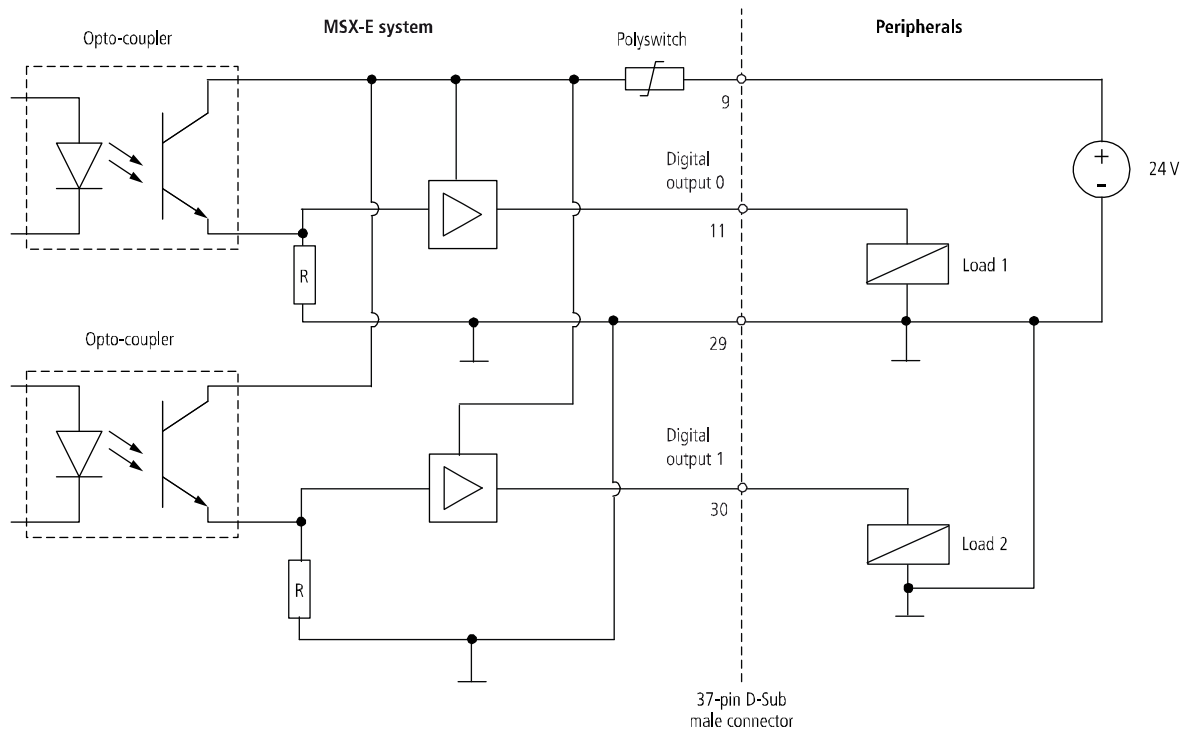
More information on the parameters and return values is to be found in the driver package, i.e. in the directory "SOAP\Documentation" or "Modbus\Documentation" and in the sample folder "ExtDigitalIO".

### 5.3 Connection examples

**Fig. 5-2: Connection example: Digital inputs (24 V)**



**Fig. 5-3: Connection example: Digital outputs (24 V)**

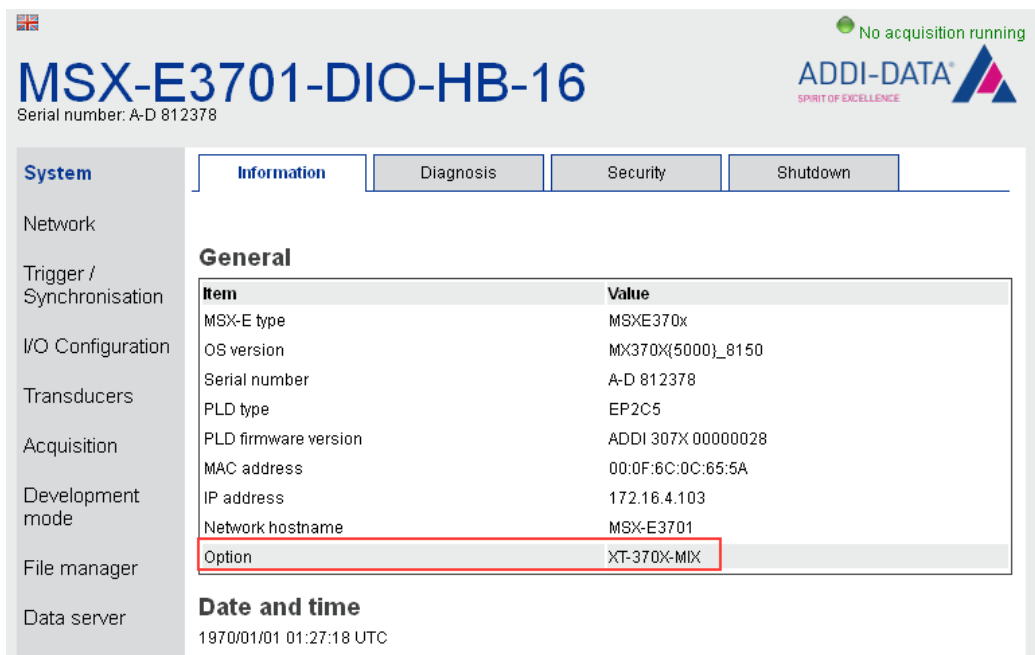


## 6 Web interface: Quick access to the MSX-E system

In this chapter, the system-specific parts of the **MSX-E3701-DIO** 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).

If you use the **XT-370x-MIX** option, this is shown on the homepage of the web interface, in the section “General”.

Fig. 6-1: Web interface: “XT-370x-MIX” option



### 6.1 Menu item “I/O Configuration”

#### 6.1.1 “Digital I/O” tab

Fig. 6-2: I/O configuration: Digital inputs

Enable digital input filter

Filter time (between 20µs and 10220µs in steps of 20µs)

Channel	State	Channel	State
0	Low	8	Low
1	Low	9	Low
2	Low	10	Low
3	Low	11	Low
4	Low	12	Low
5	Low	13	Low
6	Low	14	Low
7	Low	15	Low

For the digital inputs, a filter is available. The filter time can be set in the range from 20  $\mu$ s to 10220  $\mu$ s in steps of 20  $\mu$ s.



### NOTICE!

The configuration only takes effect if you click on the “Set and save” button.

**Fig. 6-3: I/O configuration: Digital outputs**

Short-circuit		OK	
External power supply		No power supply	

Channel	State	Channel	State
16	High	24	Low
17	Low	25	High
18	Low	26	Low
19	High	27	Low
20	Low	28	Low
21	Low	29	High
22	High	30	Low
23	Low	31	Low

For each digital output, the status (“High” or “Low”) can be defined by clicking on the corresponding button.

If a short-circuit occurs or an external 24 V voltage is not applied, this will be specified above the channel table.

### 6.1.2 “Transducers” tab

On this tab, you can find the pin assignment of the 5-pin M18 female connectors for the connection of the transducers (see also Chapter 4.1).

## 6.2 Menu item “Transducers”

### 6.2.1 “Database” tab

**Fig. 6-4: MSX-E transducer database**

Index	Name	Calibrated	Type	Nominal frequency (Hz)	Load impedance (ohms)	Vrms (V)	Sensitivity (mV/V/mm)	Range (mm)
24	Solatron System 256 AX1.0S	No	LVDT 10000	10000	10000	2.00	100.00	± 1.00
26	Solatron System 256 AX5.0S	No	LVDT 10000	10000	10000	2.00	100.00	± 5.00

In the **ConfigTools** program, transducers that are to be used for the acquisition, have to be copied into the MSX-E database. The transducer properties can be changed in the User database of this program (see also Chapter 3.2).

The table above displays the content of the MSX-E database. By clicking on the “Reload” button, the table is refreshed.

### 6.2.2 “Diagnosis” tab

**Fig. 6-5: I/O Configuration: Diagnosis**

Task	Status	Result
Test Primary side short-circuit	Done	Ok
Initialise primary side connection line	Done	Ok
Test primary side connection line	Done	Ok
Test secondary side connection line of channel 0	Done	Ok
Test secondary side connection line of channel 1	Done	No transducer connected, or open line detected.
Test secondary side connection line of channel 2	Done	No transducer connected, or open line detected.

To carry out a transducer diagnosis, you have to click on “Start”.

The list above shows if on the primary or secondary side of the transducer, a short-circuit has occurred. If no transducer is connected or if there is a line break, this is also indicated.

In case of a short-circuit, the required rearm can be carried out via the correspondent button. Please find further information on this in Chapter 4.4 of this manual.

The diagnosis should be repeated in the event of transducer changes, errors such as a short-circuit or after a certain time.

## 6.3 Menu item “Acquisition”

### 6.3.1 “Auto-refresh” and “Sequence” tabs

**Fig. 6-6: Acquisition modes: Auto-refresh and Sequence**



For the acquisition, the Auto-refresh mode and the Sequence mode are available. A detailed description of these modes can be found in Chapter 7 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”).

On these tabs, also the data format (see Chapter 7.3.5) is shown for each transducer input.

### 6.3.2 “Monitor” tab

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

### 6.3.3 “Help” tab

Here, you can find detailed information on the channel selection in Sequence mode and the data transfer in both acquisition modes.

## 7 Acquisition modes

This chapter exemplifies how to configure and start an acquisition via the web interface of the Ethernet system **MSX-E3701-DIO**. Moreover, you can use Modbus or SOAP functions (see MSX-E CD or driver download on the ADDI-DATA website) to perform these steps.

### 7.1 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. Directly on the MSX-E system, an average value can be calculated.

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

#### 7.1.1 "Channel configuration" (channel selection)

**Fig. 7-1: Auto-refresh mode: "Channel configuration"**

Channel	Transducer	Selection
Channel 0	Inductive transducer 0	<input checked="" type="checkbox"/>
Channel 1	Inductive transducer 1	<input checked="" type="checkbox"/>
Channel 2	Inductive transducer 2	<input type="checkbox"/>
Channel 3	Inductive transducer 3	<input type="checkbox"/>
Channel 4	Inductive transducer 4	<input type="checkbox"/>
Channel 5	Inductive transducer 5	<input type="checkbox"/>

- Select the channels you want to acquire.

#### 7.1.2 "Transducer selection"

**Fig. 7-2: Auto-refresh mode: "Transducer selection"**

**Transducer selection**  
 24: Solatron System 256 AX1.0S ▼

- Select the connected transducer type.



### 7.1.3 “Average” (average value calculation)

Fig. 7-3: Auto-refresh mode: “Average”

Average mode Per channel

When you have selected the average mode (per channel or per sequence), you can define the number of acquisitions after which the average value should be computed. Possible values: 2 to 255.

Number of acquisitions 5

The MSX-E system is capable of computing an average value for each channel. In the field “Number of acquisitions”, you have to enter the number of acquisitions (2 to 255) after which this value should be computed.

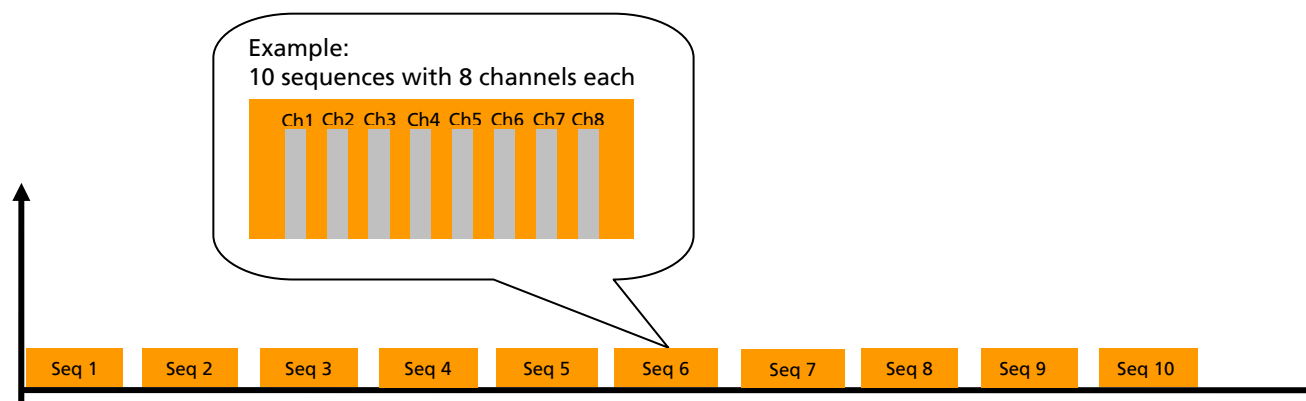
The acquisition can be carried out in two different ways (“Average mode”):

- **Per sequence:** All selected channels are acquired simultaneously.
- **Per channel:** 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. 7-4: 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

...

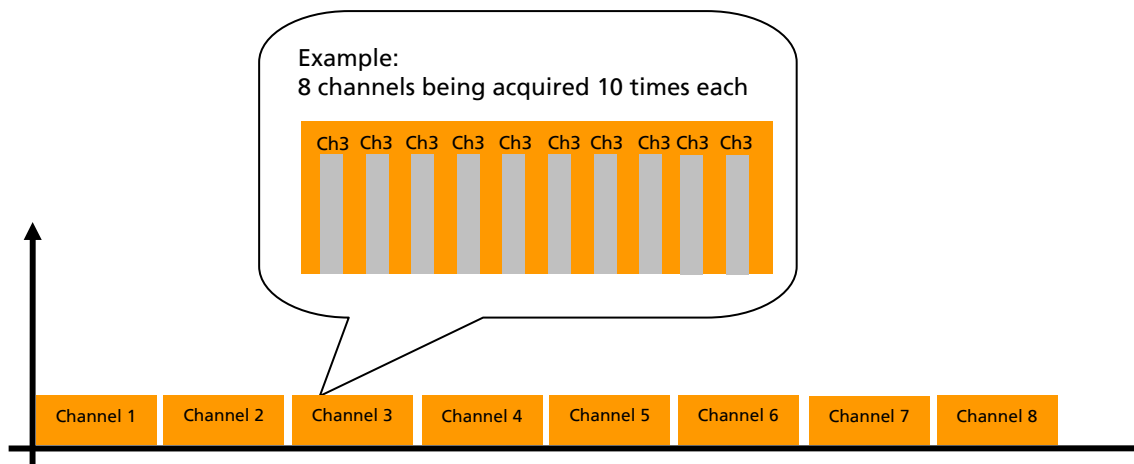
Average value of channel 8  
 = (sequence 1, value of channel 8 + sequence 2, value of channel 8 + ... + sequence 10, value of channel 8) / 10

The network client will not receive ten data packets with eight values in each packet, but only one data packet with 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. 7-5: 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  
 $= (\text{value of channel 1} + \text{value of channel 1} + \dots + \text{value of channel 1}) / 10$

Average value of channel 2  
 $= (\text{value of channel 2} + \text{value of channel 2} + \dots + \text{value of channel 2}) / 10$

...

Average value of channel 8  
 $= (\text{value of channel 8} + \text{value of channel 8} + \dots + \text{value of channel 8}) / 10$

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

## 7.2 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.

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

### 7.2.1 “Channel configuration” (channel selection)

**Fig. 7-6: Sequence mode: “Channel configuration”**

Channel	Transducer	Selection	Acquisition order
Channel 0	Inductive transducer 0	<input checked="" type="checkbox"/>	2
Channel 1	Inductive transducer 1	<input checked="" type="checkbox"/>	4
Channel 2	Inductive transducer 2	<input checked="" type="checkbox"/>	1
Channel 3	Inductive transducer 3	<input checked="" type="checkbox"/>	0
Channel 4	Inductive transducer 4	<input checked="" type="checkbox"/>	5
Channel 5	Inductive transducer 5	<input checked="" type="checkbox"/>	3

You can define the acquisition order of the channels. This is displayed in the correspondent column as soon as you have selected a channel. Each channel can be acquired only once per sequence.

- Select the channels you want to acquire.

### 7.2.2 “Transducer selection”

**Fig. 7-7: Sequence mode: “Transducer selection”**

**Transducer selection**

24: Solatron System 256 AX1.0S ▼

- Select the connected transducer type.

### 7.2.3 “Delay” (wait time)

**Fig. 7-8: Sequence mode: “Delay”**

Delay mode Mode 1 ▼

Possible values:

- If **mode 1** is selected, the delay value must be a value **between the switching time between channels and 65535** (milliseconds or seconds).
- If **mode 2** is selected, the delay value must be a value **between 0 and 65535** (milliseconds or seconds).

Delay 100 Millisecond ▼

In the “Delay” section, you can define the wait time between the individual sequences. There are two modes, which are explained below.

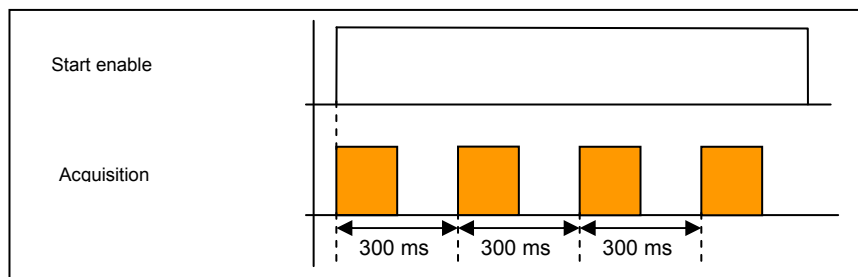
With “Delay”, you can define the value and the unit of the wait time (ms or s).

**a) Mode 1**

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

**Example**

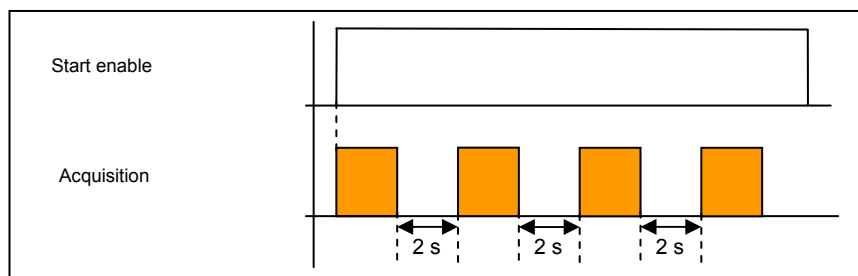
After the start of the acquisition, the delay between the start of the individual sequences is 300 ms.

**Fig. 7-9: Delay: Mode 1 (example)****b) Mode 2**

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

**Example**

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

**Fig. 7-10: Delay: Mode 2 (example)****7.2.4 “Sequence measurement” (number of sequences)****Fig. 7-11: Sequence mode: “Sequence measurement”**

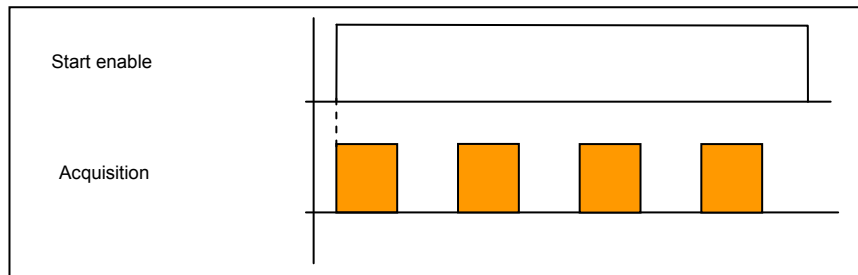
Number of sequences	<input type="text" value="0"/>
Number of data frames	<input type="text" value="1"/>

In the field “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. 7-12: “Number of sequences” (example)**



In the field “Number of data frames”, you need to define the number of sequences (1 to 4096) that have to be acquired before the measurement values are sent to the target system.

**NOTICE!**

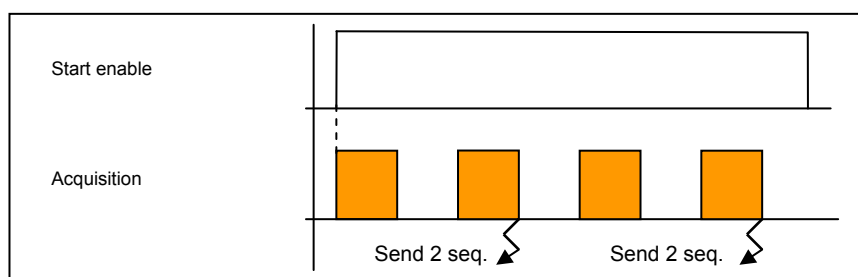
The value entered must not be higher than the value in the field “Number of sequences”. The latter must be divisible by this value.

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 start, two sequences are acquired. Then the measurement values are sent to the client.

**Fig. 7-13: “Number of data frames” (example)**



## 7.3 Common functions

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

### 7.3.1 “Division factor”

**Fig. 7-14: Acquisition: Division factor**

Division factor (must be between 5 and 255)	15
---	----

In this section, the settling time is set, i. e. the time required to switch from one channel to another. If only one channel is selected, this parameter is insignificant.

- Select the division factor (value between 5 and 255).

### 7.3.2 “Acquisition time”

**Fig. 7-15: Acquisition: Acquisition time**

Nominal frequency of the transducer (Hz)	Transducer acquisition time (µs)	Settling time (µs)	Total acquisition time (µs)
20000	50	1000	10000

The total acquisition time is automatically computed according to the selected transducer and the division factor. In Sequence Mode, the total time also depends on the selected delay mode (see Chapter 7.2.3).

### 7.3.3 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. 7-16: Acquisition: Trigger configuration**

	Trigger source	Trigger mode	Number of sequences per trigger
Description	Trigger mask (API)		Number of sequences to be acquired at each trigger event
Value	Disabled ▼	One-shot ▼	1 (1 - 65535)

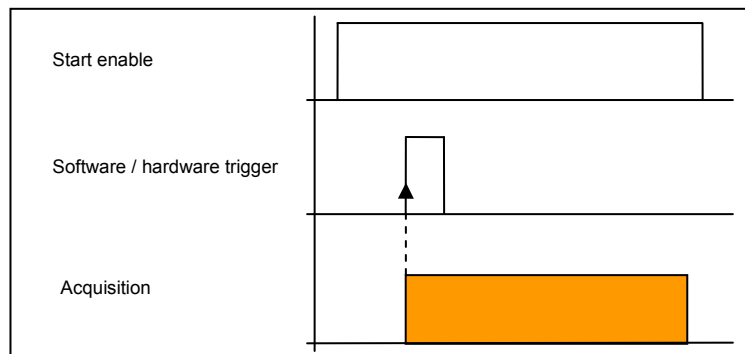
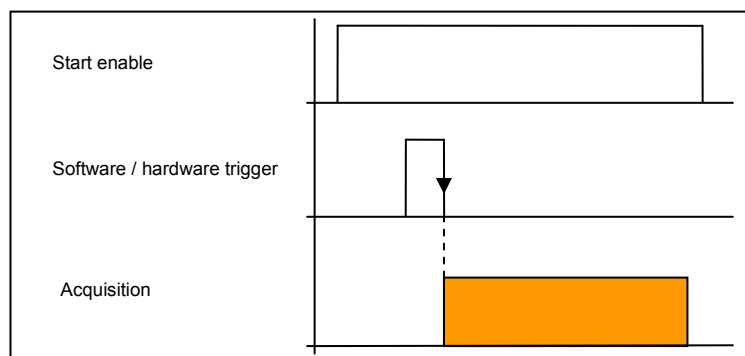
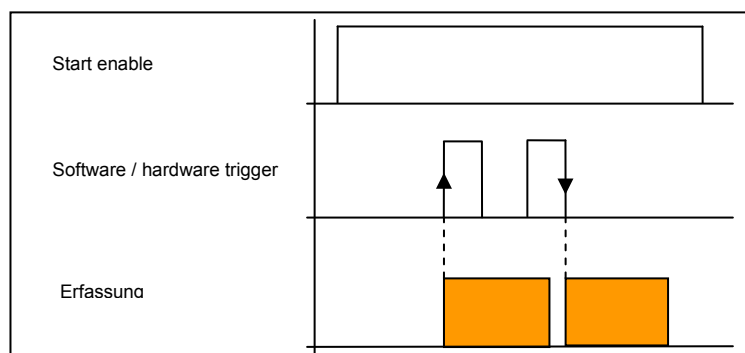
  

	Hardware trigger active edge	Hardware trigger count
Description		Number of trigger events before the acquisition starts
Value	Rising ▼	1 (1 - 65535)

- **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" (= "Multi-shot") is activated, a defined number of acquisitions starts (see field "Number of sequences per trigger").
- **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.
- **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 with “One-shot”

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

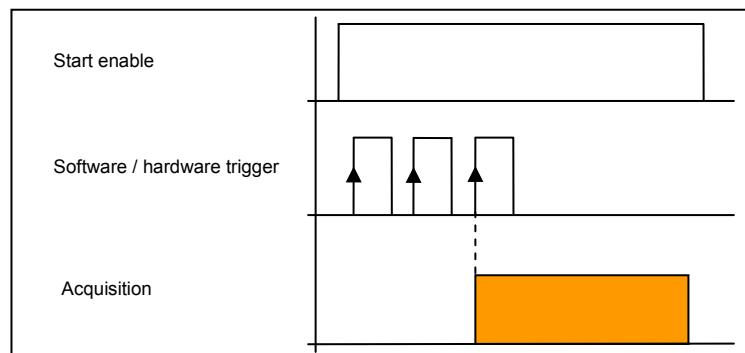
**Fig. 7-17: Hardware trigger with “One-Shot” (a)**

	Trigger source	Trigger mode	Number of sequences per trigger
Description	Trigger mask (API)		Number of sequences to be acquired at each trigger event
Value	Hardware ▼	One-shot ▼	1 (1 - 65535)

	Hardware trigger active edge	Hardware trigger count
Description		Number of trigger events before the acquisition starts
Value	Rising ▼	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.

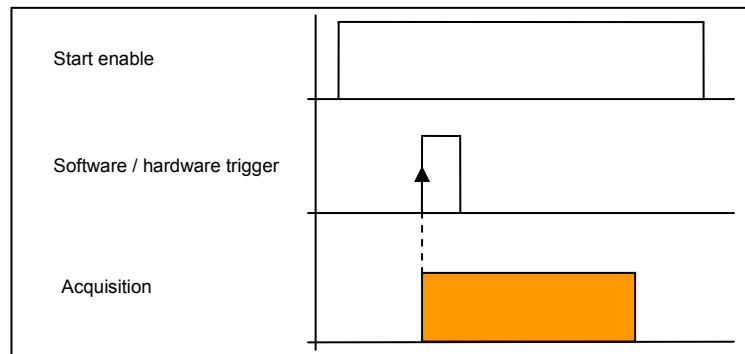
**Fig. 7-18: Hardware trigger with “One-Shot” (b)**

	Trigger source	Trigger mode	Number of sequences per trigger
Description	Trigger mask (API)		Number of sequences to be acquired at each trigger event
Value	Hardware ▼	One-shot ▼	1 (1 - 65535)

	Hardware trigger active edge	Hardware trigger count
Description		Number of trigger events before the acquisition starts
Value	Rising ▼	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.

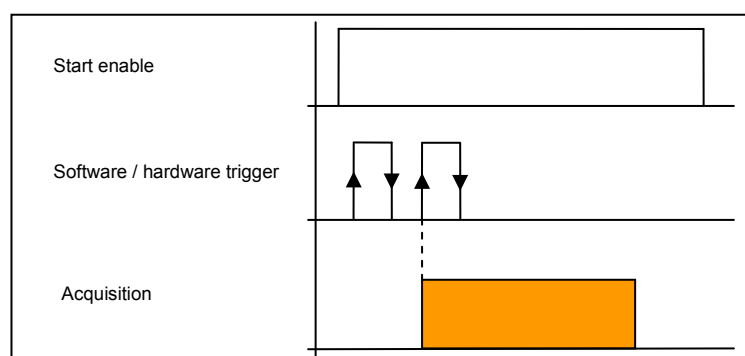
**Fig. 7-19: Hardware trigger with "One-Shot" (c)**

	Trigger source	Trigger mode	Number of sequences per trigger
Description	Trigger mask (API)		Number of sequences to be acquired at each trigger event
Value	Hardware ▼	One-shot ▼	1 (1 - 65535)

	Hardware trigger active edge	Hardware trigger count
Description		Number of trigger events before the acquisition starts
Value	Both ▼	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.

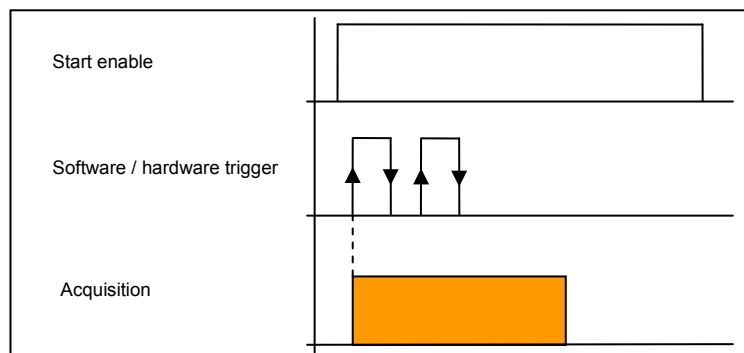
**Fig. 7-20: Hardware trigger with "One-Shot" (d)**

	Trigger source	Trigger mode	Number of sequences per trigger
Description	Trigger mask (API)		Number of sequences to be acquired at each trigger event
Value	Hardware ▾	One-shot ▾	1 (1 - 65535)

	Hardware trigger active edge	Hardware trigger count
Description		Number of trigger events before the acquisition starts
Value	Both ▾	1 (1 - 65535)

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



### 3) Examples of hardware triggers with "Sequence"

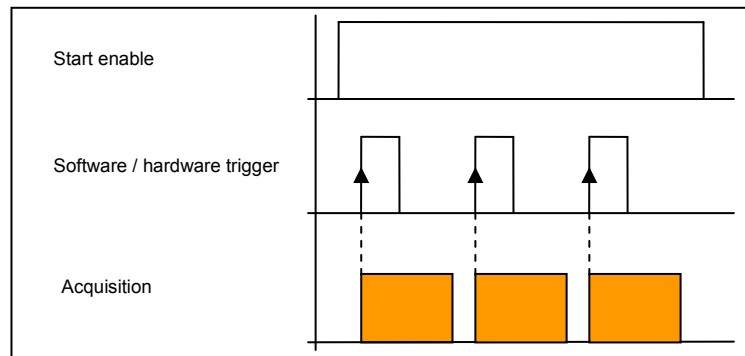
- a) To start the acquisition after each rising edge, you can use the following configuration:

**Fig. 7-21: Hardware trigger with "Sequence" (a)**

	Trigger source	Trigger mode	Number of sequences per trigger
Description	Trigger mask (API)		Number of sequences to be acquired at each trigger event
Value	Hardware ▾	Sequence ▾	1 (1 - 65535)

	Hardware trigger active edge	Hardware trigger count
Description		Number of trigger events before the acquisition starts
Value	Rising ▾	1 (1 - 65535)



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

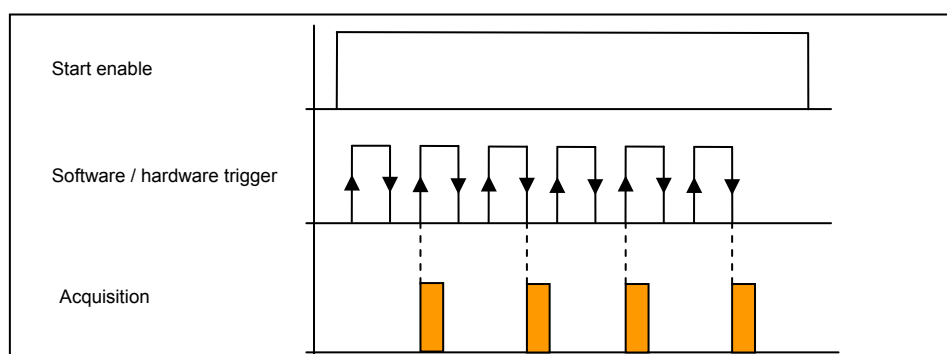
**Fig. 7-22: Hardware trigger with "Sequence" (b)**

	Trigger source	Trigger mode	Number of sequences per trigger
Description	Trigger mask (API)		Number of sequences to be acquired at each trigger event
Value	Hardware ▾	Sequence ▾	1 (1 - 65535)

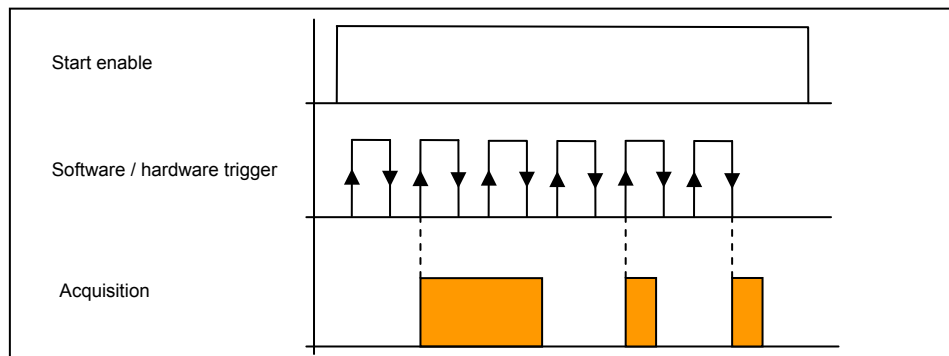
	Hardware trigger active edge	Hardware trigger count
Description		Number of trigger events before the acquisition starts
Value	Both ▾	3 (1 - 65535)

After the 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 2 b) with the exception of "Number of sequences per trigger", where the value 2 is entered.

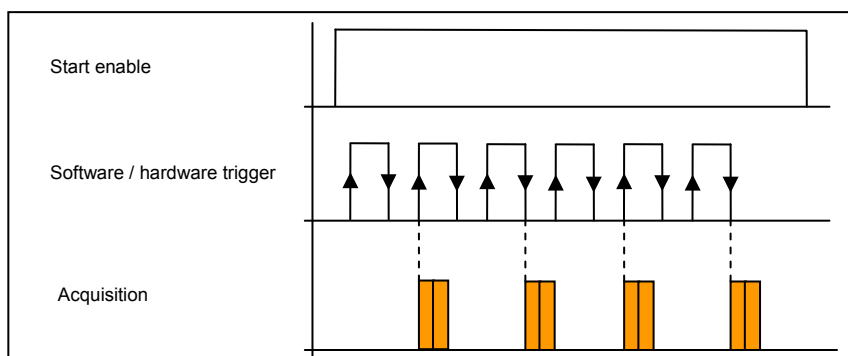
**Fig. 7-23: Hardware trigger with "Sequence" (c)**

	Trigger source	Trigger mode	Number of sequences per trigger
Description	Trigger mask (API)		Number of sequences to be acquired at each trigger event
Value	Hardware ▼	Sequence ▼	2 (1 - 65535)

	Hardware trigger active edge	Hardware trigger count
Description		Number of trigger events before the acquisition starts
Value	Both ▼	3 (1 - 65535)

After each trigger, two sequences are acquired.



### 7.3.4 “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. 7-24: Data server frame configuration (Auto-refresh mode)**

<input checked="" type="checkbox"/>	Send an absolute time stamp with the data.
<input checked="" type="checkbox"/>	Convert the raw values into analog values.
<input type="checkbox"/>	Invert the sign of the measured values.

- **Send an absolute time stamp with the data:** A time stamp is sent, which contains the date of the acquisition.
- **Convert the raw values into analog values:** 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-E3701-DIO**, the unit is millimetres (mm). As the conversion affects the MSX-E CPU to a certain extent, this can result in slower sending speed.
- **Invert the sign of the measured values:** It is possible to invert the sign of the measurement value.

**Fig. 7-25: Data server frame configuration (Sequence mode)**

<input type="checkbox"/>	Send an absolute time stamp with the data.
<input checked="" type="checkbox"/>	Send a relative time stamp with the data, which is based on the start of the acquisition.
<input checked="" type="checkbox"/>	Send the Sequence counter value with the data.
<input type="checkbox"/>	Convert the raw values into analog values.
<input checked="" type="checkbox"/>	Invert the sign of the measured values.

- **Send an absolute time stamp with the data:** A time stamp is sent, which contains the date of the acquisition.
- **Send a relative time stamp with the data:** The date of the time stamp relates to the starting point 0 of the acquisition.
- **Send the Sequence counter value with the data:** The value of the Sequence counter is sent. In Sequence mode, all sequences are acquired so that the succession of these counter values is complete (1, 2, 3, etc.).
- **Convert the raw values into analog values:** 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-E3701-DIO**, the unit is millimetres (mm). As the conversion affects the MSX-E CPU to a certain extent, this can result in slower sending speed.
- **Invert the sign of the measured values:** It is possible to invert the sign of the measurement value.

### 7.3.5 “Data server frame format” (data format)

**Fig. 7-26: Acquisition: Data server frame format**

Size	Field	Description
4 bytes	Time stamp (s)	Time stamp of the system in seconds (encoded as integer)
4 bytes	Time stamp (µs)	Time stamp of the system in microseconds (encoded as integer)
4 bytes	Sequence counter	Number of acquired sequences (encoded as integer)
4 bytes	Inductive transducer 0	Analog value, encoded as a floating point value (in mm)
4 bytes	Inductive transducer 1	Analog value, encoded as a floating point value (in mm)
4 bytes	Inductive transducer 2	Analog value, encoded as a floating point value (in mm)
4 bytes	Inductive transducer 3	Analog value, encoded as a floating point value (in mm)
4 bytes	Inductive transducer 4	Analog value, encoded as a floating point value (in mm)
4 bytes	Inductive transducer 5	Analog value, encoded as a floating point value (in mm)
4 bytes	Inductive transducer 6	Analog value, encoded as a floating point value (in mm)
4 bytes	Inductive transducer 7	Analog value, encoded as a floating point value (in mm)

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.



#### **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.

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

**Table 7-1: 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
optional (if data format has time stamp)	optional (if data format has time stamp)	always available	The amount of data depends on the setting.

In Sequence mode, the data format is as follows:

**Table 7-2: Sequence mode: Data format**

<b>tv_sec</b>	<b>tv_usec</b>	<b>Sequence counter</b>	<b>Sequence data</b>
4 bytes	4 bytes	4 bytes	4 bytes x amount of data
optional (if data format has time stamp)	optional (if data format has time stamp)	optional (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
--------	--



## 8 Technical data and limit values

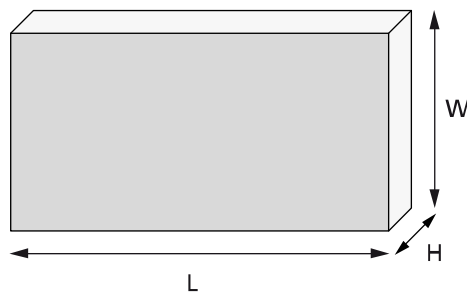
### 8.1 Electromagnetic compatibility (EMC)

The Ethernet system **MSX-E3701-DIO** 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.

### 8.2 Mechanical structure

Fig. 8-1: MSX-E3701-DIO: Dimensions



Dimensions (L x W x H):	260 x 110 x 50 mm
Weight:	965 g
	1025 g (with MX-Rail)

Fig. 8-2: MSX-E3701-DIO: View from above



**NOTICE!**

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

### 8.3 Versions and options

The Ethernet system **MSX-E3701-DIO** is available in the following versions:

**Table 8-1: MSX-E3701-DIO: Versions**

Version	Features
<b>MSX-E3701-DIO-HB-16</b>	for 16 HB displacement transducers of the same type
<b>MSX-E3701-DIO-LVDT-16</b>	for 16 LVDT displacement transducers of the same type

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).

**Table 8-2: MSX-E3701-DIO: Option**

Option	Features
<b>XT-370x-MIX</b>	for 16 HB or LVDT displacement transducers of different types

### 8.4 Limit values

Height:	2000 m over NN
Operating temperature:	0 °C to +60 °C
Storage temperature:	-25 °C to +70 °C
Relative air humidity at indoor installation:	50 % at +40 °C 80 % at +31 °C (Ice formation from condensation must be prevented.)
<b>Current supply:</b>	
Nominal voltage:	24 VDC
Supply voltage:	18-30 V
Current consumption (at 24 V):	see Table 8-3
<b>Safety:</b>	
Degree of protection:	IP 65 <sup>1</sup>
Optical isolation:	1000 V

<sup>1</sup> The degree of protection is only provided when the relevant protection caps are used.

**Table 8-3: Current consumption (at 24 V)**

<b>MSX-E3701-DIO</b>	<b>Current consumption (at 24 V)</b>
Typ. in Power Safe mode / Idle	90 mA ( $\pm 10\%$ )
Power On, typ. without load (transducers), digital I/O switched off	200 mA ( $\pm 10\%$ )
Power On, typ. without load (transducers) all digital I/Os switched on	220 mA ( $\pm 10\%$ )
Typ. with 16 Solartron AX1S transducers at $\pm 7$ V power, 5 kHz and 3 V <sub>rms</sub> digital I/O switched off (switched on: +20 mA)	320 mA ( $\pm 10\%$ )
Typ. with 8 Knäbel IET0200 transducers at $\pm 5$ V power, 50 kHz and 1 V <sub>rms</sub> digital I/O switched off (switched on: +20 mA)	330 mA ( $\pm 10\%$ )



### 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.

## 8.4.1 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)

## 8.4.2 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:	$U_{H_{max}}: 30 \text{ V}$ $U_{H_{min}}: 19 \text{ V}$ $U_{L_{max}}: 14 \text{ V}$ $U_{L_{min}}: 0 \text{ V}$

### 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.

### 8.4.3 Synchro input and output

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

### 8.4.4 Transducer inputs

Number of inputs:	16 (multiplexed)
Input type:	single-ended
Coupling:	DC
Resolution:	24-bit
Transducer accuracy:	Please contact us for more information.
Sampling frequency $f_s$ :	<div>on 1 channel:  <math>f_s = f_p</math> </div> <div>at a primary frequency <math>f_p</math> of:  5 kHz  7.69 kHz  10 kHz  12.5 kHz  20 kHz  50 kHz </div> <div>from <math>n \geq 2</math> channels:  <math>f_s = \frac{f_p}{SP \cdot n}</math> </div>
	$f_p$ = primary frequency SP = settling period ( $5 \leq SP \leq 255$ ) $f_s$ : applies to all n channels here

Example with TESA GT21	
on 1 channel: $f_s = f_p$	= 12.5 kHz
from $n \geq 2$ channels:	
on 4 channels: $f_s = \frac{12.5 \text{ kHz}}{5 \cdot 4}$	= 625 Hz
on 8 channels: $f_s = \frac{12.5 \text{ kHz}}{5 \cdot 8}$	= 312.5 Hz
on 16 channels: $f_s = \frac{12.5 \text{ kHz}}{5 \cdot 16}$	= 156.25 Hz
<b>Input level:</b>	
Input impedance (software-programmable):	2 kΩ 10 kΩ 100 kΩ 10 MΩ
Input range:	± 3.3 V max. (programmable)

#### 8.4.5 Sine wave generator (transducer supply)

Number of outputs:	2
Coupling:	AC
<b>Programmed signals:</b>	
Type:	sine (differential)
Output frequency:	5 kHz typ. 7.69 kHz typ. 10 kHz typ. 12.5 kHz typ. 20 kHz typ. 50 kHz typ.
<b>Output level:</b>	
Output range:	± 11 V max.
Output impedance:	< 0.1 Ω typ. > 30 kΩ typ. (in shutdown mode)
Short-circuit current:	0.7 A typ. (at 25 °C with thermal protection)
Switching time	1 μs typ.
Buffer Off/On:	
Bandwidth (-3 dB):	0.65 Hz high-pass filter On 50 kHz low-pass filter
Frequency response:	10 Hz to 20 kHz 0.7 dB min. 0 dB max.

Output voltage:	High Z (after Power On) 0 V (after Reset)
FIFO depth:	64 DWord (for each analog output)

#### 8.4.6 Digital inputs

Number of inputs:	16 (common GND according to IEC 1131-2)
Optical isolation:	1000 V (via opto-couplers)
Nominal voltage:	24 VDC
Input voltage:	0-30 V
Input current (at nominal voltage):	Channels 0-15: 3.9 mA typ.
Max. input frequency (at nominal voltage):	Channels 0-15: 5 kHz
Logic input levels:	U <sub>Hmax</sub> : 30 V / 6 mA typ. U <sub>Hmin</sub> : 19 V / 2 mA typ. U <sub>Lmax</sub> : 14 V / 0.7 mA typ. U <sub>Lmin</sub> : 0 V / 0 mA typ.

#### 8.4.7 Digital outputs

Number of outputs:	16
Output type:	high-side (load to ground according to IEC 1131-2), driver type: Infineon BTS4880R (8-channel type)
Optical isolation:	1000 V (via opto-couplers)
Nominal voltage:	24 VDC
Supply voltage:	11-36 V
Current:	1.5 A (per 8 channels, via PTC)
Output current per output:	150 mA max.
Short-circuit current per output:	1.1 A typ. (pulse current) shutdown logic at 24 V, R <sub>Load</sub> < 0.1 Ω
R <sub>DS</sub> ON resistance:	0.2 Ω max. at 25 °C
Switch-on time:	50 μs typ.
Switch-off time:	75 μs typ.
Overtemperature (shutdown):	135 °C
Temperature hysteresis:	10 °C
Diagnosis:	common diagnostic bit for all 16 channels at overtemperature of one channel

## 9 Appendix

### 9.1 Glossary

**ADC**

= A/D converter

**Buffer**

The buffer is used for the temporary storage of information that is only needed at a later time.

**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.

**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.

**Edge**

Edges can either be rising or falling. Logic levels are defined for processing and displaying information. In binary circuits, 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. The rising edge is the transition from the status "0" to "1"; the falling edge is the opposite transition.

**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.

**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.

**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.

**PTC**

= Positive Temperature Coefficient

The best-value resistance sensors are either specified as PTC or NTC thermistors. A PTC thermistor has a positive temperature coefficient, hence, "PTC".

**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.

**Short-circuit current**

A short-circuit current is the current between two short-circuited terminals.

**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.

**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.

## 9.2 Index

- Acquisition mode 32
  - Auto-refresh mode 32
  - Sequence mode 34
- Block diagram 12
- Brief description 11
- Connection examples
  - Digital I/O 27
- Country-specific regulations 9
- Data format 47
- Dimensions 49
- Displacement transducers 13
- EMC 49
- Functions 11
- Glossary 55
- Handling 10
- Intended use 8
- Limit values 50
- Pin assignment
  - Digital I/O 26
  - Transducer inputs 15
- Safety precautions 8
- Sequences 36
- Sine wave generator 16
- Technical data 49
- Time stamp 46
- Transducers
  - Calibration 16
  - Diagnosis 25
  - Half-bridge 13
  - LVDT 14
- Trigger
  - Configuration 38
  - Hardware-Trigger 40
- Update
  - Driver 10
  - Firmware 10
  - Manual 10
- Usage restrictions 8
- User
  - Qualification 9
- Versions 50
- Web interface
  - Acquisition 30
  - I/O Configuration 28

## 10 Contact and support

**Do you have any questions? Write or phone us:**

Address: ADDI-DATA GmbH  
Airpark Business Center  
Airport Boulevard B210  
77836 Rheinmünster  
Germany

Phone: +49 7229 1847-0

Fax: +49 7229 1847-222

E-mail: [info@addi-data.com](mailto:info@addi-data.com)

**Manual and software download from the Internet:**

[www.addi-data.com](http://www.addi-data.com)