Iskra®

User 's Manual

EN

Programmable AC Voltage Transducer MT416

Programmable AC Current Transducer MT418

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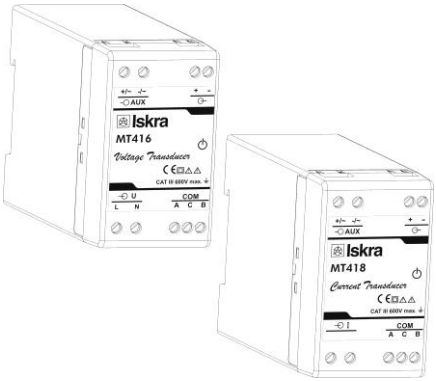
1. SECURITY ADVICE AND WARNINGS

1.1 Welcome

Please read this chapter carefully before starting work with a programmable AC measuring transducer.

This chapter deals with important information and warnings that should be considered for safe handling with a programmable AC measuring transducer.



1.2 Introduction

This booklet contains instructions for installation and use of programmable AC measuring transducers MT416/418. Installation and use of devices also includes handling with dangerous currents and voltages and shall therefore be carried out by qualified persons. The Iskra MIS Company assumes no responsibility in connection with installation and use of the product. If there is any doubt regarding installation and use of the system in which the instrument is used for measuring or supervision, please contact a person who is responsible for installation of such system.

1.3 Health and safety

The purpose of this chapter is to provide a user with information concerning safe installation and handling with the product in order to assure its correct use and continuous operation.

It is essential that everyone using the product is familiar with the contents of chapter »Security Advices and Warnings«.

If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

1.4 Safety warnings and instructions for use

Check the following before switching on the device:

- Nominal voltage,
- Proper connection and level of auxiliary supply,
- Nominal frequency,
- Voltage ratio,
- Current transformer ratio and terminals integrity,
- Protection fuse - recommended maximal external fuse size is 6 A,
- Proper connection of analogue output.

Important: A current transformer secondary should be short circuited before connecting the meter.

Waste

It is forbidden to deposit electrical and electronic equipment as municipal waste. The manufacturer or provider shall take waste electrical and electronic equipment free of charge. The complete procedure after lifetime should comply with the Directive 2002/96/EC about restriction on the use of certain hazardous substances in electrical and electronic

1.5 Warnings, information and notes regarding designation of the product

Used symbols:

	See product documentation.
	Double insulation in compliance with the **SIST EN 61010−1** standard.
	Compliance of the product with directive 2002/96/EC, as first priority, the prevention of waste electrical and electronic equipment (WEEE), and in addition, the reuse, recycling and other forms of recovery of such wastes so as to reduce the disposal of waste. It also seeks to improve the environmental performance of all operators involved in the life cycle of electrical and electronic equipment.
	Compliance of the product with European CE directives.

Contents of consignment

The consignment includes:

− Programmable AC measuring transducer MT416/418

− Quick guide.

2. BASIC DESCRIPTION AND OPERATION OF PROGRAMMABLE AC MEASURING TRANSDUCER

2.1 Introduction

MT416 and MT418 are programmable AC voltage / current transducers with minimal differences in functionality. Where there are some characteristic features that denote MT416 or MT418 symbol next to data.

Subchapter

Symbols next to the subchapters indicate accessibility of functions described. Accessibility of functions is indicated with the following symbols:

PC − Function accessible via communication (MiQen software)

User information

For unknown technical terms please refer to Glossary on the next page.

2.2 Glossary

Term	Explanation
RMS	Root Mean Square value
MODBUS	Industrial protocol for data transmission
MiQen	Software for Iskra MIS instruments
AC	Alternating voltage, current
DC	Direct voltage, current
THD	Total harmonic distortion
MD	Measurement of average values in time interval (Maximum Demand)
M_v − Sample factor	Defines a number of periods for measuring calculation on the basis of measured frequency
M_p − Average interval	Defines frequency of refreshing displayed measurements on the basis of a Sample factor
Hysteresis expressed as percentage [%]	Percentage specifies increase or decrease of a measurement from a certain limit after exceeding it.

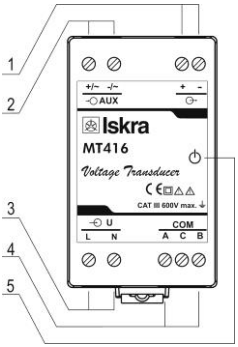
2.3 Description of the product

Programmable AC measuring transducer is intended for measuring, analyzing and monitoring single-phase voltage or current. Also frequency measurement of voltage or current signal is supported. It measures RMS values by means of fast sampling of voltage and current signals, which makes instrument suitable for acquisition of transient events. A built-in microcontroller calculates measurements (voltage, current, frequency, THD, MD) from the measured signals.

Appearance

Programmable AC Measuring transducer can differ from yours depending on the type and functionality.

1 – Analogue output
2 – Auxiliary supply
3 – Voltage/Current/Frequency input
4 – Communication port
5 – LED indicator



Communication port

Serial communication (RS485 or RS232) is connected with screw-in connector.

USB can be connected through mini USB-B type connector at the bottom of housing behind removable cap. IT IS INTENTED ONLY FOR QUICK SETUP BY MIQEN SOFTWARE PRIOR INSTALLING THE INSTRUMENT.

LED indicator

LED indicator is intended for POWER ON signalling (red symbol on the front panel).

Analogue output

Analogue output is connected through screw-in connectors. Features sophisticated 2 voltage and 4 current ranges, possible user defined non-linear characteristics.

Auxiliary supply

Auxiliary supply is connected through screw-in connectors. For safety purposes it is important that both wires are firmly connected. Auxiliary supply can be either Universal (24 VDC – 300 VDC; 40 VAC – 276 VAC) or Transformer (110, 230 VAC), which should be chosen at placing the order.

Voltage input (MT416)

Voltage input is connected to measuring circuit through measuring voltage transformer (500kΩ). Maximum value of input voltage is 600 V_{L-N}.

Current input (MT418)

Current input is connected to measuring circuit through current transformer (0.01Ω). Maximum allowed thermal value of input current is 15A (cont.).

2.4 Purpose and use of programmable AC measuring transducer

Programmable AC Voltage transducer MT416

MT416 is intended for measuring and monitoring single-phase voltage or frequency. Voltage input is electrically insulated from the system by means of voltage transformer. It measures RMS voltage value by means of fast sampling of voltage signals, which makes instruments suitable for acquisition of transient events. A built-in microcontroller calculates measurands (voltage, frequency) from the measured signals. Measurands can be then converted into load independent DC current or voltage which is proportional to the RMS measured value for the purpose of regulation of analogue and/or digital devices.

Programmable AC Current transducer MT418

MT418 is intended for measuring and monitoring single-phase current or frequency. Input current is electrically insulated from the system by means of current transformer. MT418 measures RMS current value by means of fast sampling of current signals, which makes instruments suitable for acquisition of transient events. A built-in microcontroller calculates measurands (current, frequency) from the measured signals. Measurands can be then converted into load independent DC current or voltage which is proportional to the RMS measured value for the purpose of regulation of analogue and/or digital devices.

3. CONNECTION

3.1 Introduction

This chapter deals with the instructions for programmable AC measuring transducer connection. Both the use and connection of the device includes handling with dangerous currents and voltages. Only a qualified person shall therefore perform connection. Iskra MIS does not take any responsibility regarding the use and connection. If any doubt occurs regarding connection and use in the system, which device is intended for, please contact a person who is responsible for such installations.

Before use: Check voltages, supply voltage and nominal frequency.

A circuit breaker with current rating of at least 1A shall be included in close proximity with aux. supply installation as a means of disconnection. It shall be properly marked.

Warning!

Wrong or incomplete connection of supply, measurement or other terminals can cause malfunction or damage the device.

Note

After connection, settings have to be performed via communication (connection mode, current and voltage transformers ratio …).

3.2 Mounting

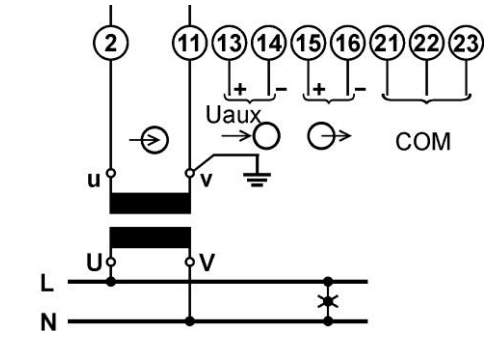
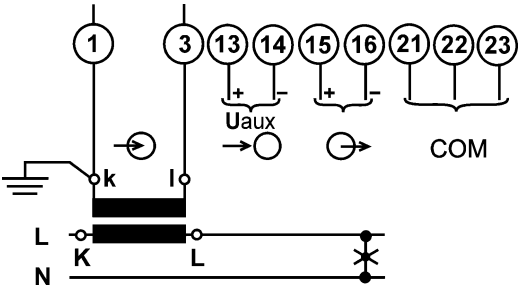
MT416/418 Programmable AC measuring transducer is designed for panel mounting. It should be mounted on a 35 mm DIN rail by means of one plastic fastener. Before installation fastener should be in open position (pulled). After device is on place, fastener is locked (pushed) to close position.

3.3 Electric connection

Voltage inputs of programmable AC measuring transducer can be connected directly to low-voltage network or via appropriate voltage measuring transformer to medium or high voltage network.

Current inputs of programmable AC measuring transducer can be connected directly to low-voltage network or via a corresponding current transformer.

Choose corresponding connection from the figures below and connect corresponding voltages and currents. Information on electrical characteristics is given in chapter *Inputs* on page 25.

System/ connection	Terminal assignment
MT416 *Voltage measurement*	
MT418 *Current measurement*	

3.4 Communication connection

MT416/418 has one galvanic separated communication port, which can be equipped with RS232 or RS485 or left open (to be specified with order).

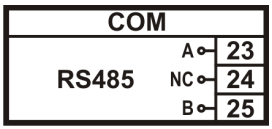
Different configurations are possible (to be specified with order):

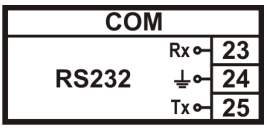
Configuration	COM
WO	USB (1)
RS232	RS232 + USB (1)
RS485	RS485 + USB (1)

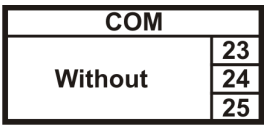
(1) AUXILARY USB PORT IS NOT GALVANIC SEPARATED FROM ANALOGUE OUTPUT, THUS IT IS INTENTED ONLY FOR QUICK SETUP BY MIQEN SOFTWARE PRIOR INSTALLING THE INSTRUMENT.

USB connector is placed on the bottom of the MT416/418, behind removable cap. After installation it is not accessible any more. When connected, MT416/418 is powered by USB port.

Connect a communication line by means of a corresponding terminal. Corresponding data are stated on the instrument label, regarding the selected communication. Connector terminals are marked on the label on the upper side of the instrument.







RS232

RS232 communication is intended for direct connection of the programmable AC measuring transducer to the personal computer. Check the sticker on top of the instrument for correct connection of terminals.

RS485

RS485 communication is intended for connection of devices to network where several instruments with RS485 communication are connected to a common communication interface. We recommend the use of Iskra MIS communication interfaces for best compatibility! Check the sticker on top of the instrument for correct connection of terminals.

USB

USB communication serves as a fast peer-to-terminal data link. The instrument is detected by host as a USB 2.0 compatible device. The USB connection is provided through a USB standard mini type B connector.

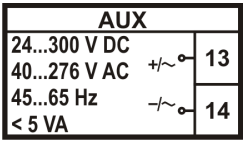
Note

When MT416/418 is connected to a PC through USB communication for the first time, a user is prompted to install a driver. The driver can be downloaded from the Iskra MIS web page www.iskra-mis.si. With this driver installed, USB is redirected to a serial port, which should be selected when using MiQen software.

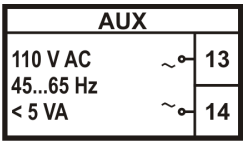
3.5 Connection of auxiliary power supply

Programmable AC measuring transducer has universal (AC/DC) auxiliary power supply. Information on electric consumption is given in chapter *Technical data* on page 22. Auxiliary supply is connected through two screw-in connectors. Universal (24 VDC – 300 VDC; 40 VAC – 276 VAC) or Transformer (110, 230 VAC), which should be chosen at placing the order.

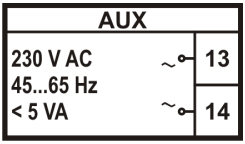
According to power supply voltage specification on the label, choose and connect the power supply voltage:



Connection of universal power supply to terminals 13 and 14



Connection of transformer 110 V power supply (terminals 13 and 14)



Connection of transformer 230 V power supply (terminals 13 and 14)

Warning!

For safety purposes it is important that both wires are firmly connected. They should be connected only to the designated terminals as shown on the label above as well as on the front foil.

Function			Connection	
Measuring input:	AC current	I ω	1/3	MT 418
	AC voltage	U ω	2/11	MT 416
Analogue output:		+ ϖ	15	
		– ϖ	16	
Auxiliary power supply:		+ / AC	13	
		– / AC	14	
Communication:	RS232/485	Rx / A	21	
		GND / C	22	
		Tx / B	23	

4. SETTINGS

4.1 Introduction

Instrument settings can be remotely modified with communication (COM1 and/or USB if available) and MiQen software when connected to a PC.

4.2 MiQen software

MiQen is a software tool for complete monitoring of measuring instruments, connected to a PC via serial or USB communication. A user-friendly interface consists of five segments: devices management, instrument settings, real-time measurements, data analysis and software upgrading.

Two editions of MiQen software are available:

- Professional edition with full functionality and supports all software functionality. CD-Key is required for the installation.
- Standard edition, freeware edition which supports all software functionality except data analysis.

Devices management

Select the instrument in a favourite's line. Use the network explorer to set and explore the devices network. Communication parameters of all devices and their addresses in network can be easily set.

Instrument settings

Multi Register Edit technology assures a simple modification of settings that are organized in a tree structure. Besides transferring settings into the instrument, storing and reading from the setting files is also available.

Real-time measurements

All supported measurements can be captured in real time in a table form. For further processing of the results of measurements, copying via a clipboard into standard Windows formats is supported.

Data analysis

Not supported with this instrument.

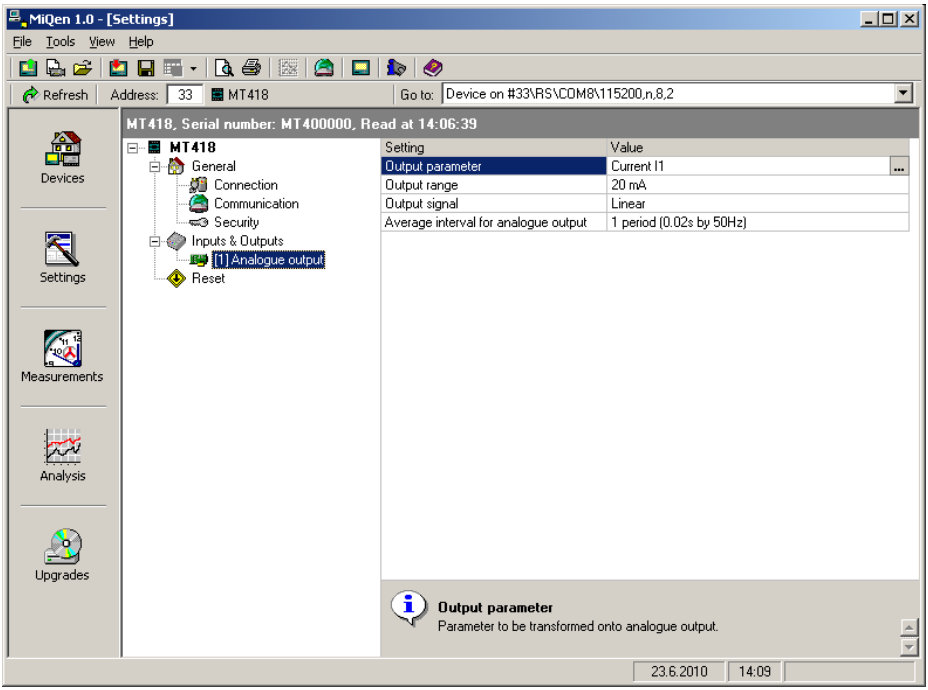
Software upgrading

Always use the latest version of software, both MiQen and software in the instrument. The program automatically informs you on available upgrades that can be transferred from the web site and used for upgrading.

Note

More information about MiQen software can be found in MiQen Help system!

MiQen user interface PC



Note

You can download freeware MiQen (standard edition) from: www.iskra-mis.si

4.3 Setting procedure

In order to modify instrument settings with MiQen, current parameters must be loaded first. Instrument settings can be acquired via a communication link (serial or USB) or can be loaded off-line from a file on a local disk. Settings are displayed in the MiQen Setting Window - the left part displays a hierarchical tree structure of settings, the right part displays parameter values of the chosen setting group.

4.4 General settings

General settings are essential for programmable AC measuring transducer. They are divided into four additional sublevels (Connection, Communication and Security).

Description and Location PC

Two parameters that are intended for easier recognition of a certain unit. They are especially used for identification of the device or location on which measurements are performed.

Average interval PC

The averaging interval defines the refresh rate of measurements on communication.

Maximum demand calculation (MD mode), (MT418) PC

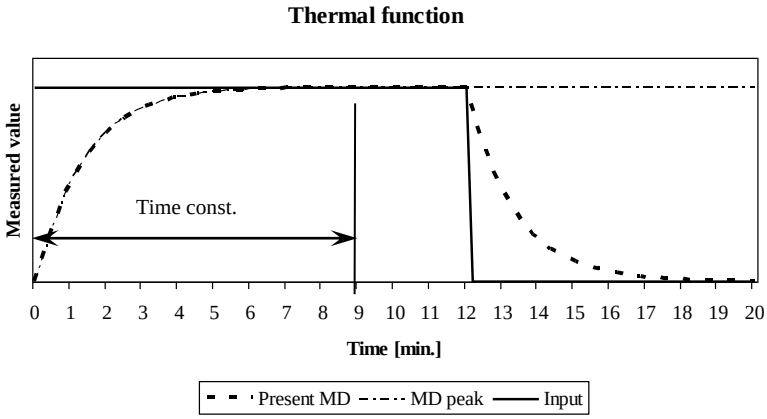
The instrument provides maximum demand values from a thermal function demand values.

A thermal function assures exponent thermal characteristic based on simulation of bimetal meters.

Maximal values and time of their occurrence are stored in device. A time constant (t. c.) can be set from 1 to 255 minutes and is 6 − time thermal time constant (t. c. = 6 * thermal time constant).

Example:

Mode: Thermal function
Time constant: 8 min
Present MD and MD peak: Reset at 0 min.



4.5 Serial communication

Communication parameters PC

They define parameters that are important for the operation in RS485 network or connections with PC via RS232 communication. Factory settings of communication are #33\115200,n,8,2 (address 1 to 247\rate 2400 to 115200 b/s, parity, data bits, stop bit).

USB communication connects directly to the CPU, thus no serial settings are needed.

(firmware at least V1.17)

4.6 Security

Settings parameters are divided into four groups regarding security level:

1 At the first level (PL1), settings of a real time clock can be changed, and energy meters and MD can be reset.

2 At the second level (PL2), the access to all data that are protected with the first level (PL1) and setting of all other parameters in the »SETTINGS« menu are available.

3 A backup password (BP) is used if passwords at levels 1 (PL1) and 2 (PL2) have been forgotten, and it is different for each device (depending on a serial number of the meter). The BP password is available in the user support department in ISKRA MIS, and is entered instead of the password PL1 or/and PL2. Do not forget to state the meter serial meter when contacting the personnel in Iskra MIS.

User information

A serial number of device is stated on the label and also accessible with MiQen software.

Password setting PC

A password consists of four letters taken from the British alphabet from A to Z. When setting a password, only the letter being set is visible while the others are covered with *.
Two passwords (PL1, PL2) and the time of automatic activation could be set.

Password modification PC

A password can be modified; however, only that password can be modified to which the access is unlocked at the moment.

Password disabling PC

A password is disabled by setting the "AAAA" password.

Note

A factory set password is "AAAA" at both access levels (L1 and L2). This password does not limit access.

Password and language

Language change is possible without password input. When language is changed from or to Russian, character transformation has to be taken in to account. Character transformation table (English or Russian alphabet) is stated below.

English	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Russian	А	Б	В	Г	Д	Е	Ж	З	И	Й	К	Л	М	Н	О	П	Р	С	Т	У	Ф	Х	Ц	Ч	Ш	Щ	

4.7 Analogue output PC

Output is fully programmable and can be set to any of 6 ranges.

Output parameter

Set the measured parameter to be transformed onto the analogue output.

Output range

Defines analogue output full-scale ranges:

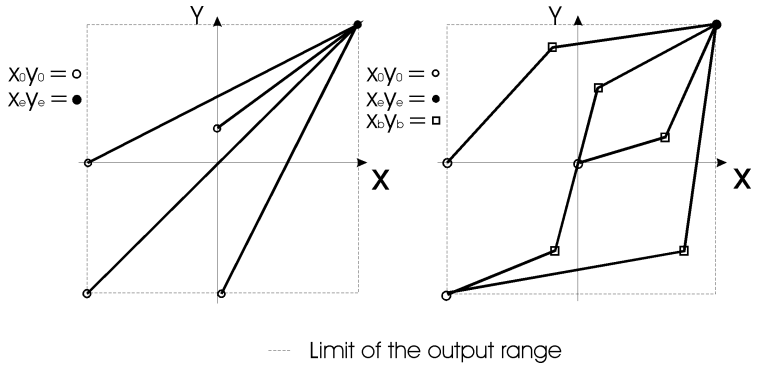
DC current output	DC voltage output
0 … 1 mA	0 … 1 V
0 … 5 mA	
0 ... 10 mA	0 … 10 V
0 ... 20 mA	

Output signal

Defines the shape and up to 5 break points of an analogue output. For intrinsic-error for analogue outputs with bent or linear zoom characteristic multiply accuracy class with correction factor (c). Correction factor c (the highest value applies):

Linear characteristic	Bent characteristic
$c = \frac{1 - \frac{y_0}{y_e}}{1 - \frac{x_0}{x_e}}$ *or* $c = 1$	$x_{b-1} \le x \le x_b$ b – number of break points (1 to 5) $c = \frac{y_b - y_{b-1}}{x_b - x_{b-1}} \cdot \frac{x_e}{y_e}$ *or* $c = 1$

Example of settings with linear and bent characteristic:



Average interval for analogue output

Defines the average interval for measurements on the analogue output. Available settings are from 1 period (0.02 sec at 50Hz) up to 256 periods (5.12 sec at 50Hz).

Reset maximal MD values (MT418), PC

Current and stored MDs are reset.

Reset the last MD period (MT418), PC

Current MD value is reset.

5. MEASUREMENTS

5.1 Introduction

In the following chapters the device's operation is explained more in detail.

5.2 Explanation of basic concepts

Sample factor − M_V

A meter measures all primary quantities with the sample frequency of 6.991 kHz. The minimum of 107 samples must be in the calculation period. Based on these limitations (65Hz·107 samples) a sample factor is calculated. A sample factor (M_V), depending on frequency of a measured signal, defines a number of periods for a measurement calculation and thus a number of harmonics considered in calculations.

Average interval − M_P

Due to readability of measurements from communication, an Average interval (M_P) is calculated with regard to the measured signal frequency. The Average interval (see chapter *Average interval* on page 15) defines refresh rate of displayed measurements based on a sampling factor.

5.3 Calculation and display of measurements

This chapter deals with capture, calculation and display of all supported quantities of measurement. Detailed description with formulas is shown in chapter *Equations* on page 34.

5.4 Present values

Voltage PC

Instrument measures real effective (rms) value of phase voltage (U), connected to the meter.

Voltage measurement is available via communication.

Current PC

Instrument measures real effective (rms) value of phase currents, connected to current input.

Current measurement is available via communication.

Frequency PC

Network frequency is calculated from time periods of measured voltage.

MD values PC, (MT418)

Measurements of MD values.

THD − Total harmonic distortion PC

THD is calculated for phase currents, phase voltages and is expressed as percent of high harmonic components relative to first harmonic.

Instrument uses measuring technique of real effective (rms) value that assures exact measurements with the presence of high harmonics up to 53rd harmonic

6. TECHNICAL DATA

6.1 Applied standards

EN 61010-1: 2001, Safety requirements for electrical equipment for measurement, control and laboratory use Part 1: General requirements

EN 60688:1992 Electrical measuring transducers for converting a.c. electrical quantities to analogue or digital signals

EN 60688:1995 / A1: 1999 Electrical measuring transducers for converting a.c. electrical quantities to analogue or digital signals

EN 60688:1995 / A2: 2001 Electrical measuring transducers for converting a.c. electrical quantities to analogue or digital signals

EN 61326-1:2006, EMC requirements for electrical equipment for measurement, control and laboratory use - Part 1: General requirements

6.2 Accuracy

Total accuracy (measurements and analogue output) according to EN 60688 is presented as percentage of range of the measurand's nominal value, except when it is stated as an absolute value.

Measured values	**Range**	**Accuracy class***	
Rms current I_1	1, 5,10 A	0.5 (0.2)**	MT418
Maximum current	12 A	0.5 (0.2)**	MT418
Rms voltage U_1	62.5, 125, 250, 500 V $_{L-N}$	0.5 (0.2)**	MT416
Maximum voltage	600 V $_{L-N}$	0.5 (0.2)**	MT416
Frequency (f) − actual	50 / 60Hz	0.02	
Nominal frequency range	16 … 400 Hz***	0.02	
THD	5 … 500 V 0.1 10A 0 … 400 %	0.5	

Note

* − All measurements are calculated with high harmonic signals.
** − Measurements on communication.
*** − 16 Hz output possible only if Nominal frequency in Miqen (Settings-General-Connection) set to 16 Hz

6.3 Inputs

Voltage input		
	Nominal values	62.5, 125, 250, 500 V_{LN}
	Rated voltage (U_N)	500 V_{LN}
	Max. allowed value	1.2 × U_N permanently, 2 × U_N 10s
	Minimal measurement	10 mV sinusoidal
	Maximal measurement	600 V_{L-N}
	Input impedance	500 kΩ
	Consumption	U^2 /500kΩ
Current input		
	Nominal values	1, 5, 10 A
	Rated current (I_N)	5 A
	Max. allowed value	15 A continuous
	(thermal)	20 × I_N (5 × 1s)
	Min. measurement	2 mA sinusoidal
	Max. measurement	12 A sinusoidal
	Consumption	I^2 × 0.01Ω
Frequency		
	Nominal frequency range	50/60, 400 Hz
	Measuring range	16 … 400 Hz*
Power supply		
Universal	Nominal voltage AC range	40 … 276 V
	Nominal frequency range	45 … 65 Hz
	Nominal voltage DC range	24 … 300 V
	Consumption	< 5VA
	Power-on transient current	< 20 A; 1 ms
Transformer	AC Rated voltage	110, 230 V
	Nominal frequency range	45 … 65 Hz
	Consumption	< 5VA

* Only for frequency measurement

6.4 Connection

Permitted conductor cross-sections

Terminals	Max. conductor cross-sections (stranded wire)
Voltage / Current inputs	0,325 … 2,5 mm^2 (22 – 14 AWG) one conductor
Aux Supply	0,325 … 2,5 mm^2 (22 – 14 AWG) one conductor
Analogue output	0,325 … 2,5 mm^2 (22 – 14 AWG) one conductor
Communication	0,325 … 2,5 mm^2 (22 – 14 AWG) one conductor

6.5 Analogue output

General		
	Linearization	Linear, Quadratic
	No. of break points	5
	Output value limits	+ 120 % of nominal output
	Response time	Input → output < 100 ms (1)
	Response time – Fast	Input → output < 50 ms (1)
	Residual ripple	< 1 % p.p.
	Residual ripple - Fast	< 2 % p.p.
DC Current output		
	Output range values	0 … 100 %
	0 … 1 mA	Range 1
	0 … 5 mA	Range 2
	0 ... 10 mA	Range 3
	0 ... 20 mA	Range 4
	Other ranges	possible by MiQen software
	Burden voltage	10 V
	External resistance	RB_{max} =10 V / I_{outN}
DC Voltage output		
	Output range values	0 … 100 %
	0 … 1 V	Range 5
	0 … 10 V	Range 6
	Other ranges	possible by MiQen software
	Burden current	20 mA
	External resistance	RB_{min}= U_{outN} / 10 mA

6.6 Communication

Type	**RS232**	**RS485**	**USB**(2)
Type of connection	Direct	Network	Direct
Max. connection length	3 m	1000 m	3m
Number of bus stations	–	≤ 32	–
Terminals	Screw terminals		mini USB-B (2)
Insulation	Protection class II, 500V_{ACRMS} 1min		/
Transfer mode	Asynchronous		
Protocol	MODBUS RTU		
Transfer rate	2.400 to 115.200 bit/s		USB 2.0

(1) Not for frequency, frequency response time:

typical	300 ms
maximum	3000 ms

(2) After installation of instrument onto DIN rail not accessible any more

6.7 Electronic features

Response time Input → communication	All calculations are averaged over an interval of between 8 to 256 periods. Preset interval is 64 periods, which is 1.28 second at 50 Hz. Average interval below 64 periods may result to unstable measurements, depended on measuring signal.	
Status LED's PWR	Red	Instrument power ON

6.8 Safety features

Protection	Protection class II
⧈	Double insulation on all connectors (analogue output, voltage / current input and RS232/485 Com port)
Pollution degree	2
Installation category	CAT III; 600 V meas. Inputs Acc. to EN 61010-1 CAT III; 300 V aux. supply Acc. to EN 61010-1
Test voltages	Universal U_{AUX}↔ output, COM: 3500 VAC_{rms} Transformer U_{AUX}↔ output, COM: 5200 VAC_{rms} U / I input↔Output, COM, Aux power supply: 5200 VAC_{rms} Output↔COM: 500 VAC_{rms}
EMC	Directive on electromagnetic compatibility 2004/108/EC Acc. to EN 61326-1

6.9 Mechanical

	ABS self-extinguish ability, in compliance with UL 94 V0
Enclosure protection	IP 20
Flammability	Acc. to UL 94 V-0
Mounting	Rail mounting 35 × 15 mm acc. to EN 50022
Dimensions	W45 × H75× D105 mm
Weight	340 g Transformer aux. power supply 170 g Universal aux. power supply

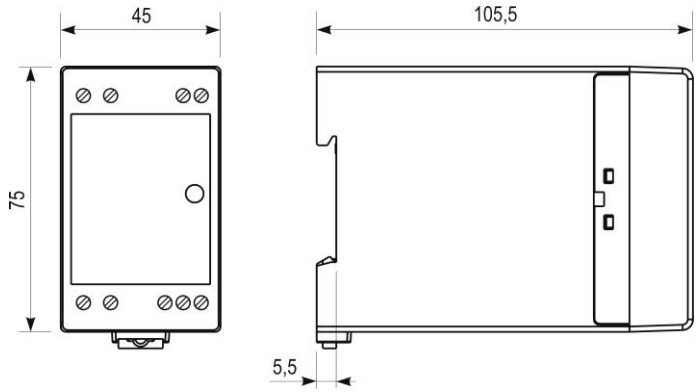
6.10 Environmental conditions

Ambient temperature	usage group II 0 … 15 … 30 … 45 °C Acc. to EN 60688
Operating temperature	- 30 to + 70 °C
Storage temperature	- 40 to + 70 °C
Temperature koefficient	+-0.1% per 10°C
Average annual humidity	≤ 93% r.h.
Altitude	≤ 2000 m

6.11 Reference conditions

Ambient temperature	0 .. 45 °C
Relative humidity	≤ 93% r.h.
Voltage input	57.7…500V
Current input	0.31…5A
Frequency	45…65Hz
Waveform	Sinus

6.12 Dimensions

Construction	Appearance
Programmable AC measuring transducers MT416/418	

7. APPENDIX A: MODBUS PROTOCOL

7.1 Modbus communication protocol

Modbus protocol is enabled via RS232 and RS485 or USB communication.

Modbus

Modbus protocol enables operation of device on Modbus networks. For device with serial communication the Modbus protocol enables point to point (for example Device to PC) communication via RS232 communication and multi drop communication via RS485 communication. Modbus protocol is a widely supported open interconnect originally designed by Modicon.

The memory reference for input and holding registers is 30000 and 40000 respectively.

VERSION1:

Register table for the actual measurements

Parameter	MODBUS			
	Register		Type	
	Start	End		
Frequency	30105	30106	T5	
U1	30107	30108	T5	MT416
I1	30126	30127	T5	MT418
THD HARMONIC DATA				
U1 THD%	30182		T16	MT416
I1 THD%	30188		T16	MT418
Internal Temperature	30181		T17	
DEMAND VALUES				
DYNAMIC DEMAND VALUES				
I1	30502	30503	T5	MT418
MAX DEMAND SINCE LAST RESET				
I1	30518	30519	T5	MT418

VERSION2:

Register table for the actual measurements

Parameter	MODBUS			
	Register		Type	
	Start	End		
Frequency	30049	30050	T5	MT416
U1	30057	30058	T5	MT418
THD HARMONIC DATA				
U1 THD%	30639		T16	MT416
I1 THD%	30645		T16	MT418
Internal Temperature	30181		T17	
DEMAND VALUES				
DYNAMIC DEMAND VALUES				
I1	30175	30176	T5	MT418
MAX DEMAND SINCE LAST RESET				
I1	30207	30208	T5	MT418

All other MODBUS registers are a subject to change. For the latest MODBUS register definitions go to ISKRA MIS's web page www.iskra-mis.si

Data types decoding

Type	Bit mask	Description
T1		**Unsigned Value (16 bit)** Example: 12345 = 3039(16)
T2		**Signed Value (16 bit)** Example: -12345 = CFC7(16)
T3		**Signed Long Value (32 bit)** Example: 123456789 = 075B CD 15(16)
T4	bits # 15…14 bits # 13…00	**Short Unsigned float (16 bit)** Decade Exponent(Unsigned 2 bit) Binary Unsigned Value (14 bit) Example: 10000*102 = A710(16)
T5	bits # 31…24 bits # 23…00	**Unsigned Measurement (32 bit)** Decade Exponent(Signed 8 bit) Binary Unsigned Value (24 bit) Example: 123456*10-3 = FD01 E240(16)
T6	bits # 31…24 bits # 23…00	**Signed Measurement (32 bit)** Decade Exponent (Signed 8 bit) Binary Signed value (24 bit) Example: - 123456*10-3 = FDFE 1DC0(16)
T7	bits # 31…24 bits # 23…16 bits # 15…00	**Power Factor (32 bit)** Sign: Import/Export (00/FF) Sign: Inductive/Capacitive (00/FF) Unsigned Value (16 bit), 4 decimal places Example: 0.9876 CAP = 00FF 2694(16)
T9	bits # 31…24 bits # 23…16 bits # 15…08 bits # 07…00	**Time (32 bit)** 1/100s 00 - 99 (BCD) Seconds 00 - 59 (BCD) Minutes 00 - 59 (BCD) Hours 00 - 24 (BCD) Example: 15:42:03.75 = 7503 4215(16)
T10	bits # 31…24 bits # 23…16 bits # 15…00	**Date (32 bit)** Day of month 01 - 31 (BCD) Month of year 01 - 12 (BCD) Year (unsigned integer) 1998..4095 Example: 10, SEP 2000 = 1009 07D0(16)
T16		**Unsigned Value (16 bit), 2 decimal places** Example: 123.45 = 3039(16)
T17		**Signed Value (16 bit), 2 decimal places** Example: -123.45 = CFC7(16)
T_Str4		**Text:** 4 characters (2 characters for 16 bit register)
T_Str6		**Text:** 6 characters (2 characters for 16 bit register)
T_Str8		**Text:** 8 characters (2 characters for 16 bit register)
T_Str16		**Text:** 16 characters (2 characters for 16 bit register)
T_Str40		**Text:** 40 characters (2 characters for 16 bit register)

8. APPENDIX B: CALCULATIONS & EQUATIONS

8.1 Calculations

Definitions of symbols

No	Symbol	Definition
1	M_v	Sample factor
2	M_P	Average interval
3	U_f	Phase voltage
4	N	Total number of samples in a period
5	n	Sample number ($0 \leq n \leq N$)
6	i_n	Current sample n
7	u_{fn}	Phase voltage sample n

8.2 Equations

Voltage

$$U_f = \sqrt{\frac{\sum_{n=1}^{N} u_n^2}{N}}$$

N − samples in one period (up to 65 Hz)
N − samples in M_v periods (above 65 Hz)
Example: 400 Hz → $M_V = 7$

Current

$$I_{RMS} = \sqrt{\frac{\sum_{n=1}^{N} i_n^2}{N}}$$

Phase current
N − 128 samples in a period (up to 65 Hz)
N − 128 samples in more periods (above 65 Hz)

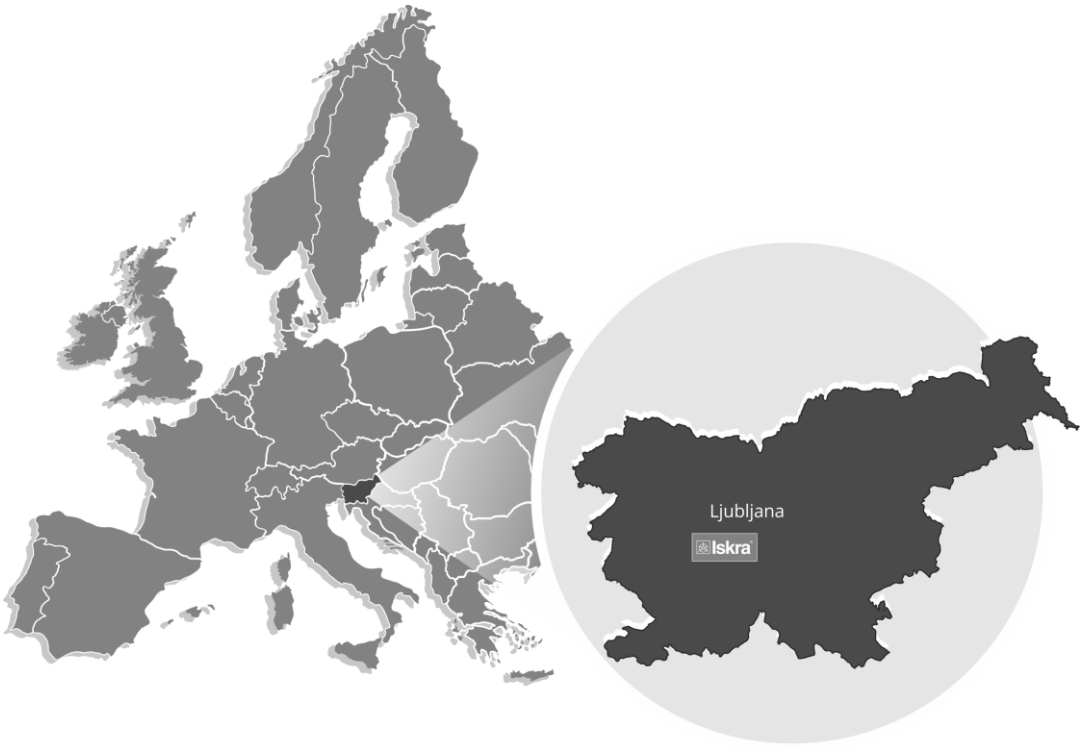
THD

$$I_f THD(\%) = \frac{\sqrt{\sum_{n=2}^{63} In^2}}{I_1} \cdot 100$$

Current THD
I_1 – value of first harmonic
n – number of harmonic

$$U_f THD(\%) = \frac{\sqrt{\sum_{n=2}^{63} Un^2}}{U_1} \cdot 100$$

Phase voltage THD
U_1 – value of first harmonic
n – number of harmonic



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