

Operating Manual for

ARTIQ 235

Short version 2.1

The complete and most actual version of this manual is available online at <http://www.KMB.cz/>

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1 General Description

The ARTIQ 235 is specially designed for monitoring of energy and the related power quality in all types of power systems and grids. This high-end instrument with multiple communication options is suitable for a wide spectrum of automation tasks in modern buildings, distributed power generation, remote supervision of the infrastructure and also remote load management. With a proper firmware module it can be used to collect also data from simpler slave units and provide them up. Absence of local panel controls (LED panel option without screen and keyboard) limits possibilities for hostile user interaction. Inputs and outputs can be programmed for a wide range of functions and conditions for advanced control applications. In this second generation the analyser offers advanced metering and data processing functions for quick overview and detailed scope capabilities.

1.1 Version 2.1 improvements and advanced functions

- sampling rate of 28 kHz, up to 128 harmonics measured with high accuracy
- slow transients - measurement and recording of voltage and current sampled peak values, 10 and 20 ms RMS values.
- voltage and current trends - conditional records based on 10 ms value evaluation
- precise four quadrant active and reactive energy measurement with optional 10 ms evaluation period - to record fluctuations and fast changes of power flow direction
- histograms for basic set of quantities - voltages, currents, active and reactive power - for really quick overview of long measurement intervals
- optional push-data function in modbus master - to feed the remote server automatically
- additional and optional modbus master archive to record slave unit data in main unit memory
- improved reliability of the remote data acquisition and firmware updates within GPRS and LTE networks with various 3-rd party routers and RTUs
- Linux (ARM, x866) library for custom control software development
- Extended set of conditions and control actions in the IO programming section
- special current input for precise residual current monitoring
- main archive now supports optional intervals as short as 40 ms (two period) to record more details in the main archive

The ARTIQ 235 is available in several configurations according to the customer requirements¹. See the ordering scheme on figure 1.

¹Complete and most up to date list of optional and other accessories are available on request from the device vendor.

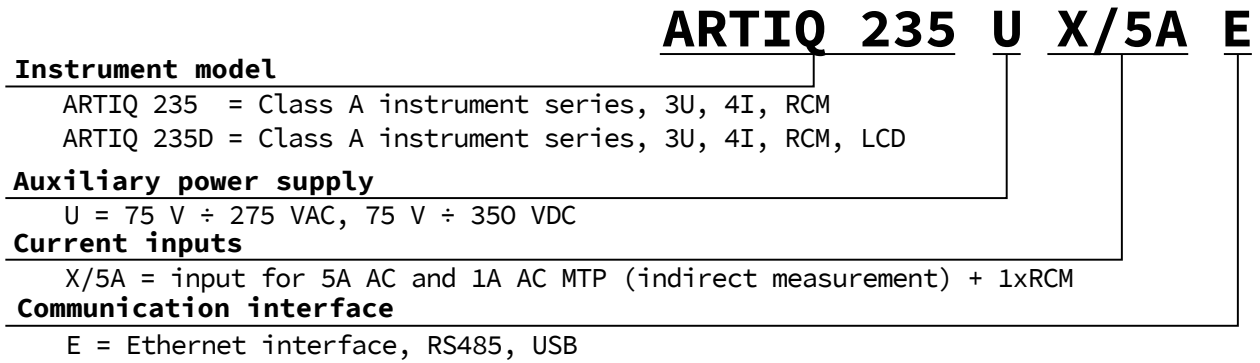


Figure 1: Schematics of the ARTIQ 235 ordering options and variants. It includes special codes for proper current and voltage rating options.

2 Operating the Meter

2.1 Safety requirements when using ARTIQ 235

Warning !: When working with the instrument it is necessary to perform all necessary measures for the protection of persons and property against injury and electric shock.



- The device must be operated by a person with all required qualifications for such work and this person must know in detail the operation principles of the equipment listed in this description!
- When the device is being connected to the parts which are under dangerous voltage it is necessary to comply with all the necessary measures to protect users and equipment against injury with electrical shock.
- Person, performing the installation or maintenance of the instrument must be equipped with and must use personal protective clothing and tools.
- If the analyzer is used in a manner not specified by the manufacturer, the protection provided by the analyzer may be impaired.
- If the analyzer or its accessories appear to be impaired or not functioning properly, do not use it and send it in for repair.

2.2 Installation of the instrument

Natural air circulation should be provided inside the distribution board cabinet, and in the instrument's neighborhood. Especially underneath the instrument, no other instrumentation that is source of heat should be installed or the temperature value measured may be influenced. A connection wire's maximum cross section area is 2.5 mm^2 in case of all screw terminals.

The ARTIQ 235 is primarily intended for DIN-rail mounting. Dimensions of the instrument are on figure 2. There are also positions marked with dash dot lines of holes for wall-mounting with three screws.

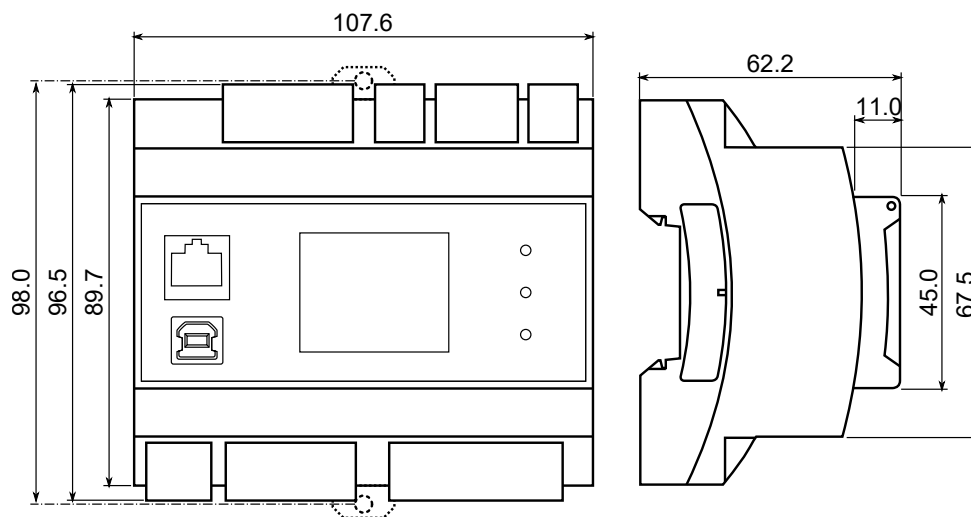


Figure 2: Dimensions of the ARTIQ 235 analyzer.

2.2.1 Supply voltage

Power supply voltage (options in ch. 3) must be connected to the terminals X1 and X2 via a circuit breaking device (power switch – see installation diagram on figure 3). It has to be located left to the instrument and reachable by the operator. The circuit breaking device must be identified as the equipment power disconnection switch. A circuit breaker of the nominal value 1 A is a convenient circuit breaking device. Its function and position has to be clearly identified (symbols ‘0’ and ‘I’ acc. to IEC EN 61010-1). Internal power supply is galvanically isolated from internal circuits.

2.2.2 Measured voltage

The measured voltages are connected to the terminals L1, L2 and L3. Neutral wire (if present in the system) should be connected to the terminal N. With delta or Aaron connections terminal N remains unused. Voltage measurement inputs are connected with internal circuits over high impedance.

It is suitable to protect the measured voltage lines for example with 1A fuses of the required rating. Measured voltages can also be connected via instrument voltage transformers. A connection cable maximum cross section area is 2.5 mm^2 for voltage terminals.

2.2.3 Measured currents

The instruments are designed for indirect current measurement via external CT only. Proper current signal polarity (S1 or S2 terminals) and CT orientation must be observed. You can check the polarity by the sign of phase active powers on the instrument display or in ENVIS application (in case of energy transfer direction is known, of course). Figure 3 illustrates a common connection of ARTIQ 235 in three- and four-wire LV network. Intended direction of power flow is from left (source) to right (load). It is highly recommended to verify the correctness of CT wiring polarity with phasor diagram in Actual Data window of the ENVIS.Daq application, on display or through the instruments web pages.

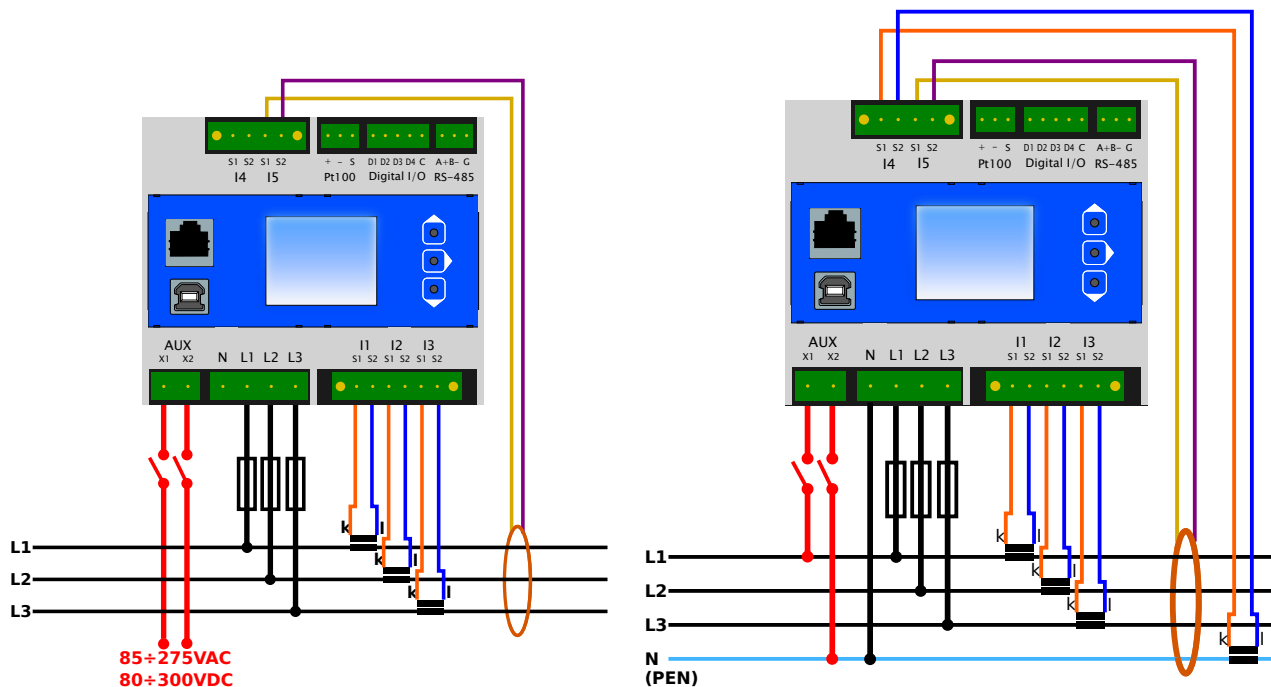


Figure 3: An example of typical installation of ARTIQ 235 instrument in a low voltage network with RCM function — left to right: with low voltage supply voltage (possible DC, AC including battery backed UPS setups); with supply from measured network.

X/5A current input option is a standard option for current measurement. The current signals from a 5A or 1A current transformers must be connected to the terminal pairs S1 and S2 of the I1, I2, I3 and optionally I4 current inputs. A connection cable maximum cross section area is 2.5 mm^2 .

RCM current sensing input option is marked as RCM1. Only a special RCM measurement CT must be used for this input. Figure 3 shows typical usage of this optional feature in LV network.

Warning !: Do not connect X/5A, X/1A or another unsupported current transformers to the RCM input!!! The instrument can be seriously damaged!



2.2.4 Communication peripherals

All peripherals stated below are galvanically isolated from the rest of the instrument and from each other.

USB 2.0 slave port with USB-A connector is located on the front panel. It is intended for easy and fast local configuration and download of archived data to the local PC. Use the supplied USB cable only. ARTIQ 235 is a USB 2.0 slave device. For correct operation it needs a driver installed in your operating system (see the ENVIS user guide for more info).

100Base-TX Fast Ethernet interface with RJ-45 connector described *ETH* is situated on a top panel of the device. It can be used as substitution for the primary RS-485 for connection of the device to LAN and for easy connection of remote control PC. Modbus-TCP, KMB proprietary protocol for ENVIS, embedded web server with data formatted in JSON, NTP time synchronization and other network functions are provided.

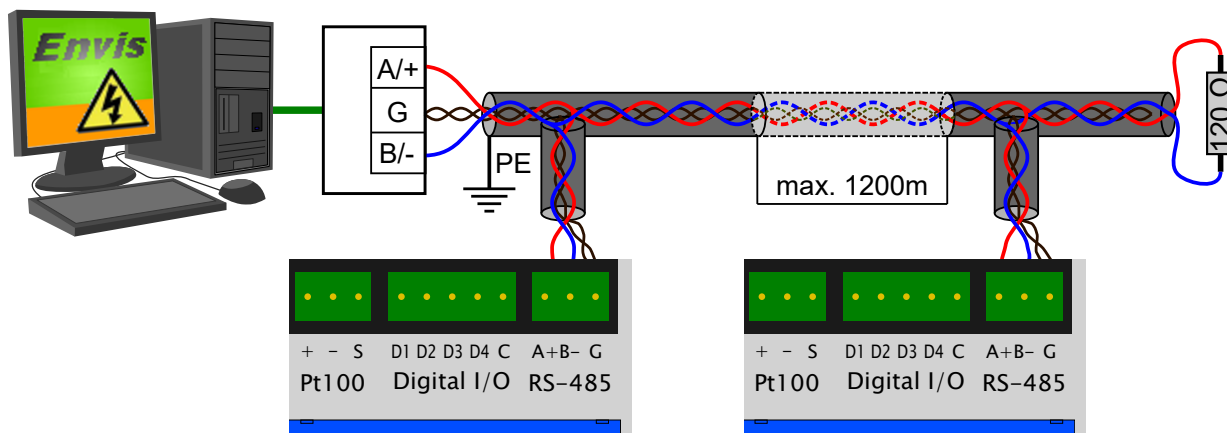


Figure 4: Typical wiring of the RS-485 communication line terminals in ARTIQ 235 .

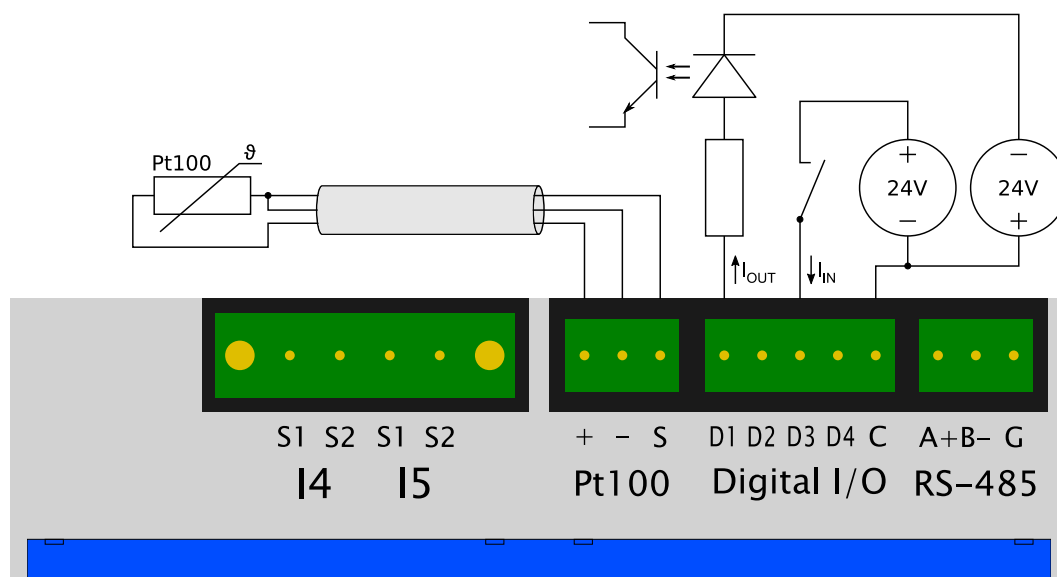


Figure 5: An example of inputs or outputs of ARTIQ 235 supplied by two independent power supplies.

RS-485 serial line provides a communication for reading of actual data, archive downloading and device configuration. Modbus RTU can be also used on this interface. Serial RS-485 line uses terminals $A+$, $B-$ with shielding at terminal G of $COM1$ block (fig. 4). The end-point of the communication line must be properly terminated with $\sim 120\Omega$ resistor.

2.2.5 Outputs and inputs

Instrument provides four universal I/O ports ($D1 \dots D4$) with a common pole on terminal C . Each of the I/O ports can be used individually as an input or an output. For a correct operation of the I/O it is necessary to use an external power supply with DC voltage 12 to 24 V. For a combination of inputs and outputs a single symmetrical power supply with common ground or two independent supplies connected in series must be used to obtain positive and negative auxiliary voltage - see fig. 5. Appropriate polarity of supply voltage for inputs resp. outputs must be kept.

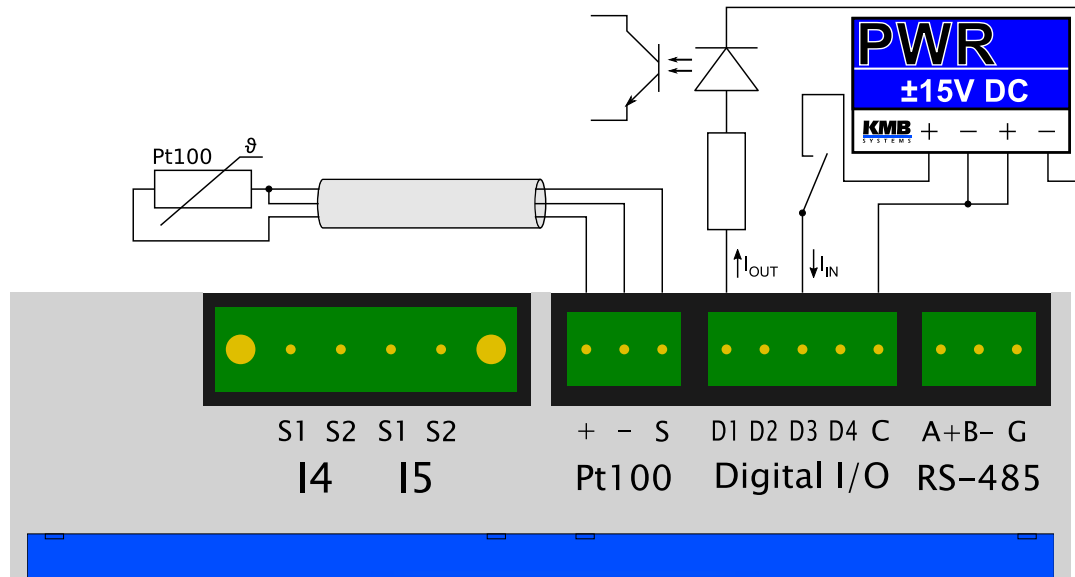


Figure 6: An example of inputs or outputs of ARTIQ 235 supplied by a special symmetrical DC power supply with common ground pole - see KMB PWR XX documentation for further information .

Warning !: Digital I/Os are unipolar. Right polarity must be kept for a proper operation of the terminal. Incorrectly connected external power supply can damage the instrument.



I/O as a digital input is connected to the selected I/O terminal (D1 .. D4) and a common terminal (C) with external power supply in the following way: the current flows from positive terminal of the supply through the external input contact to a DI terminal (D1, D2, D3 or D4) and than from the common terminal (C) back to the negative terminal of the external power supply.

I/O as a digital output is connected to the selected I/O terminal (D1 .. D4) and a common terminal (C) with external power supply in the following way: the current flows from positive terminal of the supply to the C terminal and from a DI terminal (D1, D2, D3 or D4) through the controlled load to the negative terminal of the supply. If an I/O port is used as an output (its behavior is controlled by an internal logic function) the instrument also indicates its activation with the respective input register.

2.3 Downloading data to PC

Connect the instrument to the PC and run ENVIS.Daq application. Select the appropriate communication option and connect to the instrument. In the next screen press *Refresh All*. This will load and display the actual status of each supported archive.

Device Information section contains editable description and name under which the actual record is stored. *Time Frame for Other Archives* tab allows you to limit the date ranges of all archives by the time interval of the main archive. In the *Destination* section the actual storage can be selected - either to the SQL database or to the file. The check boxes in *Archives to Download* determines which specific archive(s) you want to download.

The actual download will start by pressing the *Download All* button. progress is displayed on screen. When finished the archive can be viewed in the ENVIS application. User can open the downloaded file directly from

ENVIS.Daq.

2.4 Energy meter readings

ARTIQ 235 has an embedded three phase, four-quadrant energy meter with automatic meter reading functions and multiple programmable tariffs (Time-of-Use, TOU). The instrument registers active energy (EP, EP+, EP-) and reactive energy (EQL, EQC or EQC+, EQC-, EQL+, EQL-). According to the configuration of meter readings are shuffled to the respective tariffs. It automatically provides summaries per phase. For star connections and single phase measurements it can also register energy for each phase separately.

Meter data readings can be downloaded and analyzed in ENVIS or via the standard ModBus protocol in any other system.

3 Technical Specifications

3.1 Basic Parameters

Auxiliary Voltage	
AC aux. voltage range, f: 40 ÷ 100 Hz	75 ÷ 275 VAC
DC aux. voltage range	75 ÷ 300 VDC
power supply	10 VA / 5 W
overvoltage category	III
pollution degree	2
connection	isolated, polarity free

Other Specifications	
operational temperature	- 20 to 60°C
storage temperature	- 30 to 80°C
operational and storage humidity	< 95 % - non-condensable environment
EMC – immunity	EN 61000 – 4 - 2 (6 kV / 8 kV) EN 61000 – 4 - 3 (10 V/m from 80 MHz to 3 GHz) EN 61000 – 4 - 4 (4 kV) EN 61000 – 4 - 5 (4 kV / 2 kV) EN 61000 – 4 - 6 (10 V from 150 kHz to 80 MHz) EN 61000 – 4 – 11
EMC – emissions	EN 55011, class A EN 55022, class A (not for home use)
communication ports	RS-485 (2400 ÷ 921600 Bd), USB, Ethernet 100 Mbit
communication protocols	KMB, Ethernet to RS-485 gateway (optional module), Modbus RTU and TCP, Modbus Master (optional module), WEB server, JSON, DHCP, NTP
accuracy of RTC	+/- 0,2 second per day from 0°C to +40°C (+/- 2 ppm) +/- 0,3 second per day from -40°C to +85°C (+/- 3,5 ppm)
capacity of RTC backup battery	> 5 years (at room temperature, without supply voltage applied)
	< 2000m
protection class front panel whole instrument	IP 40 IP 20
dimensions front panel whole instrument	108 x 45 mm 108 x 90 x 61 mm
weight	max. 0.3 kg

3.2 Measured Quantities

Measured Quantities – Voltage	
Frequency	
f_{NOM} – nominal frequency	50 / 60 Hz
measuring range	40 ÷ 70 Hz
uncertainty	± 5 mHz
Voltage	
voltage input option	standard variant („230“)
U_{NOM} (U_{DIN})– rated voltage	50 ÷ 440 V _{AC}
measuring range line-to-neutral	3 ÷ 850 V _{AC}
measuring range line-to-line	5 ÷ 1470 V _{AC}
intrinsic uncertainty ($t_A=23\pm 2^\circ\text{C}$)	+/- 0.05 % of rdg ± +/- 0.01 % of rng
temperature drift	+/- 0.03 % of rdg ± +/- 0.01 % of rng / 10 °C
measurement category	300V CAT III
permanent overload	1300 V _{AC} (UL–N)
peak overload, 1 second	2210 V _{AC} (UL–N)
burden power (impedance)	< 0.1 VA ($R_i = 3.9 \text{ M}\Omega$)
Voltage Unbalance	
measuring range	0 ÷ 10 %
measuring uncertainty	± 0.15 %
THDU	
measuring range	0 ÷ 20 %
measuring uncertainty	± 0.1 %
Harmonics (up to 127th order)	
reference conditions	other harmonics up to 200 % of class 3 acc. to IEC 61000–2-4 ed.2
measuring range	10 ÷ 200 % of class 3 acc. to IEC 61000–2-4 ed.2
measuring uncertainty	the levels of class I acc. to IEC 61000–4-7 ed.2

Measured Quantities – Current, Temperature	
Current	
current input option	X/5A
I_{NOM} (I _B) – rated (basic) current	5 A _{AC}
measuring range	0.0025 ÷ 10 A _{AC}
intrinsic uncertainty (t _A =23 ±2 °C)	+/- 0.05 % of rdg ± +/- 0.01 % of rng
temperature drift	+/- 0.03 % of rdg ± +/- 0.01 % of rng / 10 °C
measurement category	150V CAT III
permanent overload	15 A _{AC}
peak overload 1 second, maximum repetition frequency > 5 minutes	70 A _{AC}
burden power (impedance)	< 1 VA (R _i < 10 mΩ)
Current Unbalance	
measuring range	0 ÷ 100 %
measuring uncertainty	± 0.15 %
Harmonics & Interharmonics (up to 50th order)	
reference conditions	other harmonics up to 1000 % of class 3 acc. to IEC 61000–2-4 ed.2
measuring range	500 % of class 3 acc. to IEC 61000–2-4 ed.2
measuring uncertainty	I _h ≤ 10 % I _{NOM} : ± 0.1 % I _{NOM}
	I _h > 10 % I _{NOM} : ± 0.5 % of rdg
THDI	
measuring range	0 ÷ 200 %
measuring uncertainty	THDI ≤ 100 %: ± 0.1 %
	THDI > 100 %: ± 0.1 % of rdg
Temperature (internal sensor, measured value affected by the instrument power dissipation)	
measuring range	- 40 ÷ 85°C
measuring uncertainty	± 3 °C

Measured Quantities – Power, Power Factor, Energy	
Active / Reactive Power, Power Factor (PF), cos φ (P_{NOM} = U_{NOM} x I_{NOM})	
reference conditions "A": ambient temperature (t _A) U, I for active power, PF, cos φ for reactive power	23 ± 2 °C U = 80 ÷ 120 % U _{NOM} , I = 1 ÷ 120 % I _{NOM} PF = 1.00 PF = 0.00
act. / react. power uncertainty	± 0.1 % of rdg ± 0.005 % P _{NOM}
PF & cos φ uncertainty	± 0.005
reference conditions "B": ambient temperature (t _A) U, I for active power, PF, cos φ for reactive power	23 ± 2 °C U = 80 ÷ 120 % U _{NOM} , I = 2 ÷ 120 % I _{NOM} PF ≥ 0.5 PF ≤ 0.87
act. / react. power uncertainty	± 0.2 % of rdg ± 0.005 % P _{NOM}
PF & cos φ uncertainty	± 0.005
temperature drift of powers	± 0.05 % of rdg ± 0.02 % P _{NOM} / 10 °C
Energy	
measuring range	corresponds to U & I measuring ranges 4 quadrant energy counters for both active and reactive energies
active energy uncertainty	class 0.2S acc. to EN 62053 – 22
reactive energy uncertainty	class 0,5S acc. to EN 62053 – 24

3.3 Inputs and Outputs

Digital Outputs & Digital Inputs: universal 2+1 DIO	
Digital Outputs	
type	Opto-MOS relay, unipolar (IOx -, IOxC +)
load rating	100 V _{DC} , 100 mA _{DC}
dynamic parameters (pulse output): - pulse duration - gap duration - maximum frequency	S0 - compatible 50 ms ≥ 50 ms 10 Hz
Digital Inputs	
type	Optically isolated, unipolar (IOx +, IOxC -)
maximum voltage	30 V _{DC}
voltage for "logical 1"	> 7 V _{DC}
voltage for "logical 0"	< 3 V _{DC}
input current	5 mA @ 12V / 13 mA @ 24V
dynamic par. (pulse counter): - pulse/gap duration - maximum frequency	≥ 0.5 / 0.5 ms 1 kHz

3.4 Power Quality and Energy Management

3.4.1 IEC 61000-4-30, 61000-4-15, 61000-4-7:

Function characteristics according to IEC 61000-4-30 ed.2				
Function	Class	Uncertainty	Measuring range	Notes
frequency	A	± 10 mHz	40 ÷ 70 Hz	
magnitude of the supply	A	± 0.1 % U _{din}	10 ÷ 200 % U _{din}	
flicker	A	± 5 % of value or $\pm 0,05$	0.2 ÷ 20	2, 4)
dips and swells	A	± 0.1 % U _{din} , ± 1 cycle	5 ÷ 200 % U _{din}	2)
interruptions	A	± 1 cycle	unlimited	2)
unbalance	A	± 0.15 %	0.5 ÷ 10 %	
voltage harmonics & interharmonics	A	the levels of class I acc. IEC 61000-4-7 ed.2	10 ÷ 200 % of class 3, 50h acc. IEC 61000-2-4 ed.2	1)
mains signalling voltage	A	the levels of class I acc. IEC 61000-4-7 ed.2	0 ÷ 20 % U _{din}	1, 3)

1) ... according to IEC 61000-4-7 ed. 2.0

2) ... with optional firmware module „PQ A“

3) ... with optional firmware module „RCS“

4) ... class F1 according to IEC 61000-4-15 ed. 2.0

3.4.2 EN 50160

Power Quality acc. to EN 50160 (with optional firmware module „PQ A“ only)	
evaluation period	weekly
Interharmonics (up to 127th order)	
reference conditions	other harmonics up to 200 % of class 3 acc. to IEC 61000–2-4 ed.2
measuring range	10 ÷ 100 % of class 3 acc. to IEC 61000–2-4 ed.2
measuring uncertainty	the levels of class I acc. to IEC 61000–4-7 ed.2
Flicker (with optional firmware module „PQ S/PQ A“ only)	
measuring range	0.2 ÷ 10
measuring uncertainty	± 5 % of rdg (class F3/F1 acc. to IEC 61000–4-15 ed. 2.0)
Voltage Dips & Swells (with optional firmware module „PQ A“ only)	
measuring uncertainty	+/- 0.1 % of rng
Voltage Interruptions (with optional firmware module „PQ A“ only)	
measuring uncertainty	+/- 0.1 % of rng
duration measuring uncertainty	± 1 cycle
Mains Signalling Voltage	
evaluation period	3s interval

3.5 IEC 61557-12: Classification of the power monitoring instrument

Instrument characteristics according to IEC 61557-12	
power quality assessment function	PQI-A
classification according to par. 4.3	
direct voltage connection	SD
voltage connection via VT	SS
temperature according to par. 4.5.2.2	K55
humidity + altitude according to par. 4.5.2.3	< 95 % - noncondensation conditions < 2000 m
active power/energy function performance class	0.2

Function characteristics according to IEC 61557-12				
Model „X/5A“, $I_{NOM} = 5 \text{ A}$, $U_{NOM} = 230 \text{ V}$				
Symbol	Function	Class	Measuring range	Notes
<i>P</i>	total effective power	0.2	0 ÷ 24 kW	
<i>Q_A, Q_V</i>	total reactive power	1	0 ÷ 24 kvar	
<i>S_A, S_V</i>	total apparent power	0.2	0 ÷ 24 kVA	
<i>E_a</i>	total active energy	0.2	0 ÷ 24 kWh	
<i>E_{rA}, E_{rV}</i>	total reactive energy	2	0 ÷ 24 kvarh	
<i>E_{apA}, E_{apV}</i>	total apparent energy	0.2	0 ÷ 24 kVAh	
<i>f</i>	frequency	0.02	40 ÷ 70 Hz	
<i>I</i>	phase current	0.1	0.05 ÷ 10 AAC	
<i>I_N</i>	neutral current measured	0.2	0.01 ÷ 10 AAC	
<i>I_{Nc}</i>	neutral current calculated	–	–	
<i>U_{LN}</i>	line-to-neutral voltage	0.1	40 ÷ 800 VAC	
<i>U_{LL}</i>	line-to-line voltage	0.1	70 ÷ 1400 VAC	
<i>P_{FA}, P_{FV}</i>	power factor	0.5	0 ÷ 1	
<i>P_{st}, P_{It}</i>	flicker	2	0.4 ÷ 10	2)
<i>U_{dip}</i>	voltage dips	0.1	10 ÷ 230 VAC	2)
<i>U_{swl}</i>	voltage swells	0.1	230 ÷ 850 VAC	2)
<i>U_{tr}</i>	transients overvoltage	–	–	
<i>U_{int}</i>	voltage interruption	0.1	0 ÷ 10 VAC	2)
<i>U_{nba}</i>	voltage unbalance (amp.)	0.2	0 ÷ 10 %	
<i>U_{nb}</i>	voltage unbalance (ph.&.)	0.2	0 ÷ 10 %	
<i>U_h</i>	voltage harmonics	1	up to 50 th order	1)
<i>THD_u</i>	voltage total harmonic distortion (rel. to fund.)	1	0 ÷ 20 %	1)
<i>THD-R_u</i>	voltage total harmonic distortion (rel. to RMS)	1	0 ÷ 20 %	1)
<i>I_h</i>	current harmonics	1	up to 50 th order	1)
<i>THD_i</i>	current total harmonic distortion (rel. to fund.)	1	0 ÷ 200 %	1)
<i>THD-R_i</i>	voltage total harmonic distortion (rel. to RMS)	1	0 ÷ 200 %	1)
<i>M_{sv}</i>	mains signalling voltage	1	0 ÷ 46 VAC	1, 3)

1) ... according to IEC 61000-4-7

2) ... with optional firmware module „PQ A“

3) ... with optional firmware module „RCS“

4 Maintenance, Service, Warranty

Maintenance: the ARTIQ 235 power analyzer does not require any maintenance during its operation. For reliable operation it is only necessary to meet the operating conditions specified and not expose the instrument to violent handling and contact with water or chemicals which could cause mechanical damage.

Service: in the case of failure or a breakdown of the product, you should contact the supplier at their address:

KMB Systems, s. r. o.
Tř. dr. M. Horákové 559
460 05 Liberec 7
Czech Republic
Tel. 485 130 314, Fax 482 739 957
E-mail: kmb@kmb.cz, Web: www.kmb.cz

The product must be in proper packaging to prevent damage during transit. A description of the problem or its symptoms must be delivered together with the product.

If a warranty repair is claimed, the warranty certificate must be sent in. In case of an out-of-warranty repair you have to enclose an order for the repair.

Warranty certificate: warranty period of 24 months from the date of purchase is provided for the instrument, however, no longer than 30 months from the day of dispatch from the manufacturer. Problems in the warranty period, provably because of faulty workmanship, design or inconvenient material, will be repaired free of charge by the manufacturer or an authorized servicing organization.

The warranty ceases even within the warranty period if the user makes unauthorized modifications or changes to the instrument, connects it to out-of-range quantities, if the instrument is damaged due to ineligible or improper handling by the user, or when it is operated in contradiction with the technical specifications presented.

Type of product:	ARTIQ 235	Serial number:
Date of dispatch:	Final quality inspection:
		Manufacturer's seal:
Date of purchase:	Supplier's seal: