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Laboratory : *Department of primary metrology of DC and LF electrical quantities*

PROTOKOL O ZKOUŠCE TEST REPORT

6011-PT-L0019-20

Datum vystavení : 14.9.2020
Date of issue : 14th September 2020

List 1 z(e) 6 listů
Page 1 of 6

Zákazník : BMR s.r.o.
Customer : Lipovka 17
Rychnov nad Kněžnou 516 01

Měřidlo :
Measuring instrument : PQ monitor

Výrobce : BMR
Manufacturer :

Typ : PLA44
Type :

Výrobní číslo :
Serial number : 1B071401

Výsledky zkoušek byly získány za podmínek a s použitím postupů uvedených v tomto protokolu o zkoušce a vztahují se pouze k době a místu provedení zkoušky.

The results of the tests have been obtained following the procedures reported in this Report and are related only to the date, place and conditions of the test.

Datum provedení zkoušky : 3.8.2020 – 14.9.2020
Date of test : 3rd August - 14th September 2020

Protokol vystavil :
Report issued :


Ing. Michal Hedvčák



Vedoucí oddělení :
Head of the Department :


Ing. Jiří Streit

- Pověření :** Účelem tohoto protokolu o zkoušce je prověřit, zda PQ monitor splňuje požadavky normy IEC 62586-2:2017 Měření kvality elektřiny v systémech elektrického napájení – Část 2: Funkční zkoušky a požadavky na nejistotu. Tato norma specifikuje funkční zkoušky a požadavky na nejistotu pro přístroje, jejichž funkce zahrnují měření, záznam a případně monitorování parametrů kvality elektrické energie v energetických systémech a jehož měřicí metody pro třídy A a S jsou definovány v normě IEC 61000-4-30:2015 – Elektromagnetická kompatibilita (EMC) – Část 4-30: Zkušební a měřicí technika – Metody měření kvality energie. Norma IEC 62586-2:2017 platí pro přístroje kvality elektrické energie v souladu s normou IEC 62586-1:2017 – Měření kvality elektřiny v systémech elektrického napájení – Část 1: Přístroje pro měření kvality elektřiny. Přístroj byl zkoušen jen v rozsahu dále uvedených testů.
- Commission :* *Purpose of this Test Report is to find out whether PQ monitor meets requirements of standard IEC 62586-2:2017 – Power quality measurement in power supply systems – Part 2: Functional tests and uncertainty requirements. This part of standard specifies functional tests, and uncertainty requirements for instruments whose functions include measuring, recording, and possibly monitoring power quality parameters in power supply systems, and whose measuring methods for Class A and S are defined in IEC 61000-4-30:2015 – Electromagnetic compatibility (EMC) – Part 4-30: Testing and measurement techniques – Power quality measurement methods. The standard IEC 62586-2:2017 applies to power quality instruments complying with IEC 62586-1:2017 – Power quality measurement in power supply systems – Part 1: Power Quality Instruments (PQI). The device was tested only in the range of the tests listed below.*
- Specifikace zkoušeného vzorku :** PQ monitor PLA44: dle normy IEC 62586-1 se jedná o typ PQI-A-F1-H, přístroj pro pevnou instalaci v krytých prostorech, třída přesn. A - podle normy IEC 61000-4-30:2015. 3x230/400 V, 5 A, 50 Hz, napájecí napětí: 230 V / 50 Hz, pracovní teplota: -25 °C / 70 °C, verze firmware: 2.0.1, vyhodnocovací/nastavovacího software: PMS 1.3.8.3
- Specification of tested sample :* *PQ monitor PLA44: type PQI-A-F1-H according to standard IEC 62586-1, portable instrument for outdoor applications, Class A - according to standard IEC 61000-4-30:2015. 3x230/400V, 5 A, 50 Hz, supply range: 230V/50 Hz, -25 °C/+70 °C, firmware version:2.0.1 evaluation/configuration software: PMS 1.3.8.3*
- Použité etalony:** Kalibrátor střídavého elektrického výkonu, proudu a napětí FLUKE 6100A + 6101A (2 ks), v.č. 891350632, v.č. 891350638, v.č. 891350639, kalibrační list č. 6011-KL-E0052-19. Sada napěťových děličů, ČMI OI Brno, v.č. 230 V/0.6 V/1, 230 V/0.6 V/2, 230 V/0.6 V/3, kalibrační listy č. 6011-KL-E0002-19. Proudový bočník typ 10 A, v.č. CMI/10A/1/13, kalibrační list č. 6011-KL-E0011-20 Etalon času a frekvence
- Measurement standard used :* *Electrical power standard FLUKE 6100A + 6101A (2 pieces), sn. 891350632, sn. 891350638, sn. 891350639, calibration certificate no. 6011-KL-E0052-19. Set of voltage dividers, CMI OI Brno, sn. 230 V/0.6 V/1, 230 V/0.6 V/2, and 230 V/0.6 V/3, calibration certificates no. 6011-KL-E0002-19. Current shunt, type 10 A. s.n. CMI/10A/1/13, calibration certificate no. 6011-KL-E0011-20 Standard of time and frequency*

Další použité přístroje : Sada napěťových zesilovačů, MEgA, KZU 30, v.č. 2, 3 a 4.
Vzorkovací karty NI PXI 5922, v.č. EF3F4F a v.č. 00F22D5B
Univerzální D/A karta NI PXI 6733, v.č. 019299A9.
Napěťový zesilovač Fluke 5215A, v.č.3190009
Transkonduktanční zesilovač Wavetek 4600, v.č. 29630

Other devices used : *Set of voltage amplifiers, MEgA, KZU 30, sn. 2, 3, 4.*
NI PXI 5922 digitizer cards, s.n. EF3F4F and s.n. 00F22D5B
Auxiliary power source, KMB systems, PWR 3P, en. B27.
Voltage amplifier Fluke 5215A, s.n.3190009
Wavetek 4600 autocal transconductance amplifier, s.n. 29630

Výsledky zkoušek : Výsledky příslušných zkoušek jsou uvedeny v tabulkách výsledků.
Results of testing : *Appropriate test results are stated in Tables of Results.*

Poznámka 1: Nejistota generovaných veličin: Napětí / Voltage: <300 ppm
Note 1 *The uncertainty of the* Frekvence / Frequency: <100 ppm
generated quantities: Proud / Current: <300 ppm

Nejistota měření : Standardní nejistota měření byla určena v souladu s dokumentem JCGM 100:2008. Uvedené rozšířené nejistoty měření jsou součinem standardní nejistoty měření a koeficientu k , který odpovídá pravděpodobnosti pokrytí přibližně 95 %, což pro normální rozdělení odpovídá koeficientu rozšíření $k = 2$.

Measurement uncertainty : *The standard uncertainty of measurement has been determined in accordance with JCGM 100:2008. The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k corresponding to a coverage probability of approximately 95 %, which for normal distribution corresponds to a coverage factor $k = 2$.*

Vyjádření o plnění specifikace : PQ monitor PLA44 splňuje všechny zkoušené požadavky dle normy IEC 62586-2:2017.

Statement of compliance : *PQ monitor PLA44 has met all tested requirements according to standard IEC 62586-2:2017.*

Poznámka 2: Naměřené hodnoty a konkrétní výsledky testů jsou uvedeny v příloze 1 tohoto protokolu (celkem 14 listů).

Note 2: *Measured values and the specific test results are stated in Annex 1 of this Test Report (in sum 14 pages).*

Metrologická návaznost: Měření jsou metrologicky navázaná na (mezi)národní etalony.
Measurement are traceable to (inter)national standards.

Measurement traceability:

Místo měření: Český metrologický institut, Regionální inspektorát Brno, Okružní 31, Brno 638 00
Calibration place: *Czech Metrology Institute, Regional Inspectorate Brno, Okružní 31, Brno 638 00*

Český metrologický institut
Oblastní inspektorát Brno
Okružní 31
638 00 Brno

Byly testovány následující metody měření dle IEC 62586-2:2017:

The following measurement methods have been tested according to IEC 62586-2:2017:

Parametr <i>Parameter</i>	Test <i>Test</i>	Třída <i>Class</i>	Realizace <i>Implemented</i>	Výsledek <i>Result</i>	
Síťová frekvence <i>Power frequency</i>	A.1.1.1	A	Ano / Yes	√	
	A.1.2.1	A	Ano / Yes	√	
	A.1.2.2	A	Ano / Yes	√	
	A.1.2.3	A	Ano / Yes	√	
	A.1.3.1	A	Ano / Yes	√	
	A.1.3.2	A	Ano / Yes	√	
	A.1.4.1	A	Ano / Yes	√	
Velikost napájecího napětí <i>Magnitude of supply voltage</i>	A.2.1.1	A	Ano / Yes	√	
	A.2.2.1	A	Ano / Yes	√	
	A.2.2.2	A	Ano / Yes	√	
	A.2.2.3	A	Ano / Yes	√	
	A.2.3.1	A	Ano / Yes	√	
	A.2.3.2	A	Ano / Yes	√	
	Agregace / Aggregation				
	A.2.4.1	A	Ano / Yes	√	
	A.2.5.1	A	Ano / Yes	√	
	A.2.6.1	A	Ano / Yes	√	
	A.2.7.1	A	Ano / Yes	√	
Fliker <i>Flicker</i> (podle / according to IEC 61000-4-15)	Pst podle / according to Tab. 5	k = 0.4	A	Ano / Yes	√
		k = 0.8	A	Ano / Yes	√
		k = 1	A	Ano / Yes	√
		k = 5	A	Ano / Yes	√
		k = 10	A	Ano / Yes	√
Napěťové události <i>Voltage events</i>	A.4.1.2	A	Ano / Yes	√	
	A.4.1.3	A	Ano / Yes	√	
	A.4.1.4	A	Ano / Yes	√	
Měření odchylek napětí <i>Measurement of underdeviation and overdeviation parameters</i>	A.9.1.1	A	Ano / Yes	√	
	A.9.1.2	A	Ano / Yes	√	
	A.9.1.3	A	Ano / Yes	√	
	A.9.1.4	A	Ano / Yes	√	
	A.9.1.5	A	Ano / Yes	√	
	A.9.2.1	A	Ano / Yes	√	
	A.9.2.2	A	Ano / Yes	√	
	A.9.3.1	A	Ano / Yes	√	
	A.9.4.1	A	Ano / Yes	√	
Označování intervalů <i>Flagging</i>	A.10.1.1	A	Ano / Yes	√	
	A.10.1.2	A	Ano / Yes	√	

Parametr <i>Parameter</i>	Test <i>Test</i>	Třída <i>Class</i>	Realizace <i>Implemented</i>	Výsledek <i>Result</i>	
Napěťová nesymetrie <i>Supply voltage unbalance</i>	A.5.1.1	A	Ano / Yes	√	
	A.5.1.2	A	Ano / Yes	√	
	A.5.1.3	A	Ano / Yes	√	
	A.5.1.4	A	Ano / Yes	√	
Napěťové harmonické <i>Voltage harmonics</i>	A.6.1.1	A	Ano / Yes	√	
	A.6.1.2	A	Ano / Yes	√	
	A.6.1.4	A	Ano / Yes	√	
	A.6.1.5	A	Ano / Yes	√	
	A.6.1.6	A	Ano / Yes	√	
	A.6.2.1	A	Ano / Yes	√	
	A.6.2.2	A	Ano / Yes	√	
	A.6.2.3	A	Ano / Yes	√	
	A.6.2.4	A	Ano / Yes	√	
	A.6.2.5	A	Ano / Yes	√	
	A.6.3.1	A	Ano / Yes	√	
	A.6.3.2	A	Ano / Yes	√	
	Agregace / Aggregation				
	A.6.7.1	A	Ano / Yes	√	
Signály v napájecím napětí (HDO) <i>Mains signalling voltages on the supply voltage</i>	A.8.1.1	A	Ano / Yes	√	
	A.8.1.2	A	Ano / Yes	√	
	A.8.1.3	A	Ano / Yes	√	
	A.8.1.4	A	Ano / Yes	√	
	A.8.1.5	A	Ano / Yes	√	
	A.8.1.6	A	Ano / Yes	√	
	A.8.1.7	A	Ano / Yes	√	
	A.8.2.1	A	Ano / Yes	√	
	A.8.2.2	A	Ano / Yes	√	
	A.8.2.3	A	Ano / Yes	√	
	A.8.3.1	A	Ano / Yes	√	
	A.8.3.2	A	Ano / Yes	√	
	A.8.3.3	A	Ano / Yes	√	
Proudové nesymetrie <i>Current unbalance</i>	A.17.1.1	A	Ano / Yes	√	
	A.17.1.2	A	Ano / Yes	√	
	A.17.1.3	A	Ano / Yes	√	
	A.17.1.4	A	Ano / Yes	√	
	A.17.1.5	A	Ano / Yes	√	

<i>Parameter</i>	<i>Test</i>	<i>Class</i>	<i>Implemented</i>	<i>Result</i>	
Velikost proudu <i>Magnitude of current</i>	A.2.1.1	A	Ano / Yes	√	
	A.2.2.1	A	Ano / Yes	√	
	A.2.2.2	A	Ano / Yes	√	
	A.2.2.3	A	Ano / Yes	√	
	A.2.3.1	A	Ano / Yes	√	
	A.2.3.2	A	Ano / Yes	√	
	Agregace / Aggregation				
	A.2.5.1	A	Ano / Yes	√	
	A.2.6.1	A	Ano / Yes	√	
	Proudové harmonické <i>Current harmonics</i>	A.6.1.1	A	Ano / Yes	√
A.6.1.2		A	Ano / Yes	√	
A.6.1.4		A	Ano / Yes	√	
A.6.1.5		A	Ano / Yes	√	
A.6.1.6		A	Ano / Yes	√	
A.6.2.1		A	Ano / Yes	√	
A.6.2.2		A	Ano / Yes	√	
A.6.2.3		A	Ano / Yes	√	
A.6.2.4		A	Ano / Yes	√	
A.6.2.5		A	Ano / Yes	√	
A.6.3.1		A	Ano / Yes	√	
A.6.3.2		A	Ano / Yes	√	
Rychlé změny napětí <i>Rapid voltage changes</i>		A13.1.1	A	Ano / Yes	√
		A13.1.2	A	Ano / Yes	√
	A13.1.3	A	Ano / Yes	√	
	A13.2.1	A	Ano / Yes	√	
	A13.3.1	A	Ano / Yes	√	
	A13.4.1	A	Ano / Yes	√	
	A13.5.1	A	Ano / Yes	√	
	A13.5.2	A	Ano / Yes	√	

Konec protokolu o zkoušce.

End of Test report.

**Naměřené hodnoty a konkrétní výsledky testů dle
IEC 62586-2:2017**

***Measured values and the specific test results according to
IEC 62586-2:2017***

Český metrologický institut, Oblastní Inspektorát Brno (14 listů)

Czech Metrology Institute, Regional Inspectorate Brno (14 pages)

Power frequency

Test [-]	Testing points [-]	Number of samples in 2 min N [-]	Max. difference ^a [mHz]	Requirement [mHz]
A1.1.1	Loop: 42.5 Hz – 57.5 Hz triangle - duration: 5 s 57.5 Hz – 42.5 Hz triangle - duration: 5 s	12	0	20

a: The maximum absolute difference of measured values during the test.

Test [-]	Testing points [Hz]	Error ^b [mHz]	Standard criterion [mHz]
A1.2.1	42.500	1	10
A1.2.2	50.050	0	10
A1.2.3	57.500	2	10

b: The largest absolute error of the test value (testing point) during the test.

Test [-]	Testing points [Hz]	Complementary conditions [-]	Error ^b [mHz]	Standard criterion [mHz]
A1.3.1	50.050	10 % U_{din}	0	10
A1.3.2	50.050	H3: 10 % U_{din} , 180° H7: 10 % U_{din} , 180° H11: 10 % U_{din} , 180° H15: 4 % U_{din} , 180° H19: 5 % U_{din} , 180° H23: 5 % U_{din} , 180°	1	10

Test	Target of the test	Result
A1.4.1	Check that the frequency measurement is made on the reference channel.	√

Magnitude of supply voltage

Test	Requirements		
A2.1.1	$Q_{rms} > 20$	$4.5 \% < A(46)/V_1 < 5.5 \%$	$TS[U(99)]-TS[U(0)] = 20000 \pm 6 \text{ ms}^*$
	Measured values		
	16479	5.1	20000

* TS = Time Stamp

Test [-]	Testing points [-]	Testing points [V]	Error ^c [V]	Standard criterion [V]
A2.2.1	10 % U _{din}	23.000	0.003	1.150
A2.2.2	80 % U _{din}	184.000	0.047	1.150
A2.2.3	150 % U _{din}	345.000	0.065	1.150

c: The largest absolute error of the test value determined from all three phases.

Test [-]	Testing points [V]	Complementary conditions [-]	Error ^c [V]	Standard criterion [V]
A2.3.1	184.000	42.5 Hz	0.015	...
		57.5 Hz	0.063	...
A2.3.2	184.000	H3: 10 % U _{din} , 180° H7: 10 % U _{din} , 180° H11: 10 % U _{din} , 180° H15: 4 % U _{din} , 180° H19: 5 % U _{din} , 180° H23: 5 % U _{din} , 180°	0.056	1.150

c: The largest absolute error of the test value determined from all three phases.

Magnitude of supply voltage – measurement aggregation

Test	Testing points	Complementary conditions	Standard criterion
A2.4.1	80 % U _{din}	f = 49.99 Hz test duration = 11 min	Test the time tag and the sequence number of blocks for proper resynchronization to the 10-min tick.
	Testing points [V]	Difference of TS 10/12 cycle time interval no. 3000 and 2999 Measured value [ms]	Difference of TS 10/12 cycle time interval no. 3000 and 2999 Requirement [ms]
	184	200.00	200.04 ± 20
		Difference of TS 10/12 cycle time interval no. 3001 and 3000 Measured value [ms]	Difference of TS 10/12 cycle time interval no. 3001 and 3000 Requirement [ms]
	83.00	80.02 ± 20	

Test	Testing points	Complementary conditions	Standard criterion
A2.5.1	Loop: P1 - P3 - 1 min P3 - P1 - 1 min [V]	f = 50.125 Hz	Test the aggregation of 10/12 cycles data into 150/180 cycles
	10 % U _{din} - 80 % U _{din} 80 % U _{din} - 10 % U _{din}	Difference of TS 150/180 cycle time interval no. 202 and 201 Measured value [s]	Difference of TS 150/180 cycle time interval no. 202 and 201 Requirement [s]
		1.595	1.60 ± 0.03
		Error of aggregated values ^a [% U _{din}]	Requirement [% U _{din}]
		0.01	±0.10

a: The maximum difference of measured values during the test.

Test	Testing points	Complementary conditions	Standard criterion
A2.6.1	Loop: P1 - P3 - 1 min P3 - P1 - 1 min [V] 10 % U_{din} - 80 % U_{din} 80 % U_{din} - 10 % U_{din}	$f = 50$ Hz	Test the aggregation of 10/12 cycles data into 10 min interval
		Error of aggregated value [% U_{din}]	Requirement [% U_{din}]
		0.01	0.10

Test	Target of the test	Result
A2.7.1	Check that the 2-h aggregated value is provided by the equipment under test.	√

Flicker

Test	Testing points		Standard requirement Pst [-]	Error ^c [%]	Test criterion [%]
	k [-]	r [min^{-1}]			
Parameter Pst Rectangular voltage changes according to Table 5 of standard IEC 61000-4-15	0.4	1	0.4	1.7	5
		2	0.4	0.9	5
		7	0.4	1.1	5
		39	0.4	1.1	5
		110	0.4	1.3	5
		1620	0.4	2.2	5
		4000	0.4	1.2	5
		0.8	1	0.8	1.6
	2		0.8	1.6	5
	7		0.8	1.6	5
	39		0.8	1.4	5
	110		0.8	1.3	5
	1620		0.8	2.3	5
	4000		0.8	1.7	5
	1		1	1	1.3
		2	1	1.4	5
		7	1	1.3	5
		39	1	1.3	5
		110	1	1.5	5
		1620	1	2.3	5
		4000	1	3.1	5
		5	1	5	2.3
	2		5	1.8	5
	7		5	1.7	5
	39		5	1.4	5
	110		5	1.5	5
	1620		5	2.0	5
	4000		5	3.7	5
10	1		10	4.4	5
	2	10	1.5	5	
	7	10	1.3	5	
	39	10	1.5	5	
	110	10	1.4	5	
	1620	10	2.9	5	
	4000	10	4.6	5	

c: The largest error of the test value determined from all three phases.

Test A4.1.2 – Measurement of residual voltage									
Standard setting				Measured value			Error		
Residual voltage [%]	Set duration [cycle]	Set duration [ms]	Expected duration [ms]	Channel 1 [%]	Channel 2 [%]	Channel 3 [%]	Channel 1 [%]	Channel 2 [%]	Channel 3 [%]
200.00	1	20	30	200.09	200.11	200.13	0.09	0.11	0.13
	1.5	30	40	200.10	200.10	200.12	0.10	0.10	0.12
	2.5	50	60	200.07	200.08	200.08	0.07	0.08	0.08
	10	200	210	200.07	200.05	200.05	0.07	0.05	0.05
	30	600	610	200.06	200.08	200.07	0.06	0.08	0.07
	150	3000	3010	200.07	200.07	200.06	0.07	0.07	0.06
20.00	1	20	30	20.04	20.07	20.11	0.04	0.07	0.11
	1.5	30	40	20.06	20.07	20.07	0.06	0.07	0.07
	2.5	50	60	20.07	20.06	20.07	0.07	0.06	0.07
	10	200	210	20.05	20.05	20.04	0.05	0.05	0.04
	30	600	610	20.06	20.04	20.04	0.06	0.04	0.04
	150	3000	3010	20.04	20.06	20.04	0.04	0.06	0.04

Test A4.1.2 – Measurement of duration									
Standard setting				Measured value			Error		
Residual voltage [%]	Set duration [cycle]	Set duration [ms]	Expected duration [ms]	Channel 1 [ms]	Channel 2 [ms]	Channel 3 [ms]	Channel 1 [ms]	Channel 2 [ms]	Channel 3 [ms]
200.00	1	20	30	31	31	31	1	1	1
	1.5	30	40	42	42	42	2	2	2
	2.5	50	60	63	63	63	3	3	3
	10	200	210	212	212	212	2	2	2
	30	600	610	611	612	612	1	2	2
	150	3000	3010	3013	3013	3013	3	3	3
20.00	1	20	30	31	31	31	1	1	1
	1.5	30	40	41	41	41	1	1	1
	2.5	50	60	62	62	62	2	2	2
	10	200	210	212	211	212	2	1	2
	30	600	610	611	612	612	1	2	2
	150	3000	3010	3012	3012	3013	2	2	3

Test A4.1.3									
Standard setting			Measured value			Error			Recorded Event
Set duration [ms]	Expected duration [ms]	Residual voltage [%]	Channel 1 [ms]	Channel 2 [ms]	Channel 3 [ms]	Channel 1 [ms]	Channel 2 [ms]	Channel 3 [ms]	
50	40	112.2	42	42	41	0	0	0	swell
		107.8	0	0	0	0	0	0	WR
	40	22.2	0	0	0	0	0	0	WR
		17.8	41	41	41	0	0	0	dip

*WR = without record

Test A4.1.4									
Standard setting				Measured value			Error		
Residual voltage [%]	Set frequency [Hz]	Set duration [ms]	Expected duration [ms]	Channel 1 [ms]	Channel 2 [ms]	Channel 3 [ms]	Channel 1 [ms]	Channel 2 [ms]	Channel 3 [ms]
22.2	42.5	47.1	58.8	59	59	59	0.2	0.2	0.2
		705.9	717.6	718	718	718	0.4	0.4	0.4
	57.5	34.8	43.5	43	43	43	-0.5	-0.5	-0.5
		521.7	530.4	530	530	530	-0.4	-0.4	-0.4

Test A4.1.5 – A test shall be achieved according to the requirements of A4.2.1 and A4.3.1.	Test result	√
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*WR = without record

Rychlé změny napětí / Rapid voltage changes

Test	Requirements	Testing points	Result	Test Criterion
A13.1.1	To verify that no RVC event will be detected if the voltage magnitude changes too slowly	50 Hz	No RVC was detected	No RVC shall be detected
A13.1.2	To verify that no RVC event will be detected if the voltage magnitude changes less than the threshold.	50 Hz	No RVC was detected	No RVC shall be detected
A13.1.3	To verify that if a dip/swell is detected during an RVC event, including the disabled 100/120 half cycles, then the RVC event would be discarded and recorded as a dip/swell.	50 Hz	No RVC was detected	No RVC shall be detected
A13.2.1	To verify that the RVC setup values as specified in 6.13.2.3 are valid.	50 Hz	dUmax = 6,97% dUss = 6,97% Duration: 63 halfcycles	Start: 100 halfcycles ΔUmax: 7 % U _{din} ΔUss: 7 % U _{din} Duration: 63 halfcycles ± 2 halfcycles
A13.3.1	To verify that the above mentioned RVC parameters are valid.	50 Hz	dUmax = 6,97% dUss = 2.98% Duration: 49 halfcycles	Start: 100 halfcycles ΔUmax: 7% U _{din} ΔUss: 3% U _{din} Duration: 49 halfcycles ± 2 halfcycles

Supply voltage unbalance

Test	Target of the test	Testing conditions		u ₀ [%]		u ₂ [%]	
				Measured value	Criterion	Measured value	Criterion
A5.1.1	Check accuracy of unbalance measurement	L1-N: 57.73 V, 0° L2-N: 57.73 V, -120° L3-N: 57.73 V, 120°	MIN	0.00	0.00	0.00	0.00
			MAX	0.02	0.15	0.04	0.15
A5.1.2	Check accuracy of unbalance measurement	L1-N: 42.143 V, 0° L2-N: 46.184 V, -120° L3-N: 50.225 V, 120°	MIN	5.04	4.90	5.09	4.90
			MAX	5.07	5.20	5.11	5.20
A5.1.3	Check accuracy of unbalance measurement	L1-N: 87.750 V, 0° L2-N: 80.822 V, -120° L3-N: 73.894 V, 120°	MIN	4.91	4.80	4.95	4.80
			MAX	4.97	5.10	4.99	5.10
A5.1.4	Check accuracy of unbalance measurement with phase displacement with a 4 wires system	L1-N: 57.730 V, 0° L2-N: 51.957 V, -122° L3-N: 57.730 V, +118°	MIN	4.55	4.37	2.41	2.32
			MAX	4.51	4.67	2.47	2.62

Rychlé změny napětí / Rapid voltage changes

Test	Requirements	Testing points	Result	Test Criterion
A13.4.1	To verify that in a polyphase system, RVC detection depends on the combined VSS (voltage-issteady-state) logic signal.	50 Hz	dU _{max} = 7,97% dU _{ss} = 4,00% Duration: 59 half-cycle	One polyphase RVC shall be detected: Start: 100 halfcycles ΔU _{max} : 8 % U _{din} ΔU _{ss} : 4 % U _{din} Duration: 59 half cycles ± 2 halfcycles
A13.5.1	To verify that, if the second RVC event starts before the VSS (voltage-is-steadystate) logic signal changes to true, only one RVC event will be detected.	50 Hz	dU _{max} = 8,97% dU _{ss} = 5,96% Duration: 170 half-cycles	One RVC detected: Start: 100 halfcycles ΔU _{max} : 9 % U _{din} ΔU _{ss} : 6 % U _{din} Duration: 170 halfcycles ± 2 halfcycles
A13.5.2	To verify that if, the second RVC event starts after the VS (voltage-is-steady-state) logic signal changes to true, two RVC events shall be detected.	50 Hz	RVC1: dU _{max} = 6,97% dU _{ss} = 2,98% Duration: 49 half-cycles	Two RVC detected: RVC1: Start: 100 half cycles ΔU _{max} : 7 % U _{din} ΔU _{ss} : 3 % U _{din} Duration: 50 halfcycles ± 2 halfcycles
			RVC2: dU _{max} = 5,98% dU _{ss} = 3,05% Duration: 57 half-cycles	RVC2: Start: 270 halfcycles ΔU _{max} : 6 % U _{din} ΔU _{ss} : 3 % U _{din} Duration: 57 halfcycle ± 2 halfcycles

Voltage harmonics

Test	Requirements		
A6.1.1	$Q_H > 20$	$13.5 \% < B(46)/V_N < 16.5 \%$	$TS[H(99)]-TS[H(0)] = 20000 \pm 6 \text{ ms}^*$
	Measured values		
	4942	14.9	20000

* TS = Time Stamp

Test	Testing points	Standard requirement $U_{2\text{harm}} [\%]$	Error ^d [%]	Test criterion [%]
A6.1.2	5 %, 100 Hz (2 nd harmonic)	5.00	0.02	0.25
	5 %, 75 Hz (1.5 x fundamental frequency)	0.00	0.02	0.05
	4 %, 105 Hz (2 nd harmonic + 5 Hz) 6 %, 110 Hz (2 nd harmonic + 10 Hz)	4.00	0.04	0.20

Test	Target of the test	Result
A6.1.3	Verify that at least 50 harmonics are provided by the device.	√

Test	Testing points	Expected value THDu [%]	Measured value THDu ^d [%]
A6.1.4	Distortion on all harmonics simultaneously up to the 50 th order at 200 % of class 3 compatibility levels from IEC 61000-2-4.	35.12	34.39
	Distortion on 4 selected interharmonics up to the 50 th order at 200 % of class 3 compatibility levels from IEC 61000-2-4.	0.00	0.19

Test	Testing point	Result
A6.1.5	H3: 10 % U_{din} , 180° H7: 10 % U_{din} , 180° H11: 10 % U_{din} , 180° H15: 4 % U_{din} , 180° H19: 5 % U_{din} , 180° H23: 5 % U_{din} , 180° Crest factor = 2	All 50 harmonics comply accuracy according to IEC 61000-4-7, Class I.

Test	Testing points	Error ^d [%]	Standard criterion [%]
A6.1.6	10 %, 3750 Hz	0.01	0.05
	10 %, 7500 Hz	0.02	0.05
	10 %, 25050 Hz	0.02	0.05
	no aliasing detected		

d: The largest error of the test value determined from all three phases.

Test [-]	Testing points [-]	Expected value [%]	Error ^c [%]	Standard criterion [%]
A6.2.1	5 %, 100 Hz (2 nd harmonic)	5.00	0.01	0.25
A6.2.2	10 %, 150 Hz (3 rd harmonic)	10.00	0.01	0.50
A6.2.3	1 %, 2500 Hz (50 th harmonic)	1.00	0.01	0.05

c: The largest error of the test value determined from all three phases.

Test	Testing points	Result
A6.2.4	Distortion on all harmonics simultaneously up to the 50 th order at 10 % of class 3 compatibility levels from IEC 61000-2-4.	All 50 harmonics comply accuracy according to IEC 61000-4-7, Class I.
A6.2.5	Distortion on all harmonics simultaneously up to the 50 th order at 200 % of class 3 compatibility levels from IEC 61000-2-4.	All 50 harmonics comply accuracy according to IEC 61000-4-7, Class I.

Test [-]	Testing points [-]	Complementary conditions [-]	Expected value of U_{din} [%]	Error ^c [%]	Standard criterion [%]
A6.3.1	5 %, 85 Hz (2 nd harmonic) ¹	42.5 Hz	5.00	0.02	0.25
	1 %, 2875 Hz (50 th harmonic) ¹	57.5 Hz	1.00	0.03	0.05
1: All 50 harmonics comply accuracy according to IEC 61000-4-7, Class I.					
A6.3.2	10 %, 150 Hz (3 rd harmonic)	10 % U_{din}	1.00	0.01	0.05
	10 %, 150 Hz (3 rd harmonic)	200 % U_{din}	20.00	0.05	1.00
All 50 harmonics comply accuracy according to IEC 61000-4-7, Class I.					

c: The largest error of the test value determined from all three phases.

Test	Target of the test	Result
A6.7.1	Check that the 2-h aggregated value is provided by the equipment under test.	√

Mains signalling voltages on the supply voltage

Test	Target of the test	Result
A8.1.1	Verify that the user can specify the carrier frequency to monitor up to 3 kHz.	√

Test	Target of the test	Result
A8.1.2	Verify that the user can specify the detection threshold (above 0.3 % U_{din}) and length of recording period (up to 120 s).	√

Test	Testing points	Target of the test	Result
A8.1.6	0 % U_{din} , 316.67 Hz	The product <u>does not</u> indicate that the signal exceeded the detection threshold.	√
	1 % U_{din} , 316.67 Hz	The product <u>does</u> indicate that the signal exceeded the detection threshold.	√

Test [-]	Testing points [-]	Expected value [V]	Error ^c [V]	Standard criterion [V]
A8.1.4	3 % U_{din} , 315 Hz 3 % U_{din} , 320 Hz	9.758	0.202	0.345
	3 % U_{din} , 310 Hz 3 % U_{din} , 325 Hz	9.758	0.189	0.345
	3 % U_{din} , 305 Hz 3 % U_{din} , 330 Hz	0.000	0.078	---

Test [-]	Testing points [-]	Expected value HDO_{max} [V]	Error ^c [V]	Standard criterion [V]
A8.1.7	1 % U_{din} , 316.67 Hz recording period = 120 s	2.300	0.064	0.345

c: The largest error of the test value determined from all three phases.

Test [-]	Testing points [-]	Expected value [V]	Error ^c [V]	Standard criterion [V]
A8.2.1	1 % U_{din} , 316.67 Hz	2.300	0.059	0.345
	3 % U_{din} , 316.67 Hz	6.900	0.115	0.345
	9 % U_{din} , 316.67 Hz	20.700	0.456	1.035
	15 % U_{din} , 316.67 Hz	34.500	0.552	1.725

c: The largest error of the test value determined from all three phases.

Test [-]	Testing points [-]	Expected value [V]	Error ^c [V]	Standard criterion [V]
A8.2.2	1 % U_{din} , 1060 Hz	2.300	0.047	0.345
	3 % U_{din} , 1060 Hz	6.900	0.106	0.345
	9 % U_{din} , 1060 Hz	20.700	0.335	1.035
	15 % U_{din} , 1060 Hz	34.500	0.502	1.725

Test [-]	Testing points [-]	Expected value [V]	Error ^c [V]	Standard criterion [V]
A8.2.3	1 % U _{din} , 2975 Hz	2.300	0.062	0.345
	3 % U _{din} , 2975 Hz	6.900	0.112	0.345
	9 % U _{din} , 2975 Hz	20.700	0.351	1.035
	15 % U _{din} , 2975 Hz	34.500	0.712	1.725

Test [-]	Testing points [-]	Expected value [V]	Error ^c [V]	Standard criterion [V]
A8.3.1	3 % U _{din} , 2975 Hz 42.5 Hz	6.900	0.187	0.345
	3 % U _{din} , 1060 Hz 57.5 Hz	6.900	0.211	0.345

Test [-]	Testing points [-]	Expected value [V]	Error ^c [V]	Standard criterion [V]
A8.3.2	3 % U _{din} , 316.67 Hz 23 V	6.900	0.141	0.345
	3 % U _{din} , 316.67 Hz 460 V	6.900	0.223	0.345

Test [-]	Testing points [-]	Expected value [V]	Error ^c [V]	Standard criterion [V]
A8.3.3	3 % U _{din} , 316.67 Hz H3:10%U _{din} ,180° H7:10%U _{din} ,180° H11:10%U _{din} ,180° H15:4%U _{din} ,180°	6.900	0.141	0.345
	3 % U _{din} , 1060 Hz H19:5%U _{din} ,180° H23:5%U _{din} ,180°	6.900	0.201	0.345

Flagging

Test	Target of the test	Flagged	Result
A10.1.1	This test shall include atleast 1 complete 2-hinterval.	No	√
A10.1.2	Dip: 70 % of U _{din} , 1 channel, L2, duration: 100ms This test shall include at least 1 complete 2-h interval.	Yes	√

Magnitude of current

Test	Requirements		
A2.1.1	$Q_{rms} > 20$	$4.5 \% < A(46)/V_1 < 5.5 \%$	$TS[I(100)]-TS[I(0)] = 20000 \pm 6 \text{ ms}^*$
	Measured values		
	17986	4.8	20000

Test	Test. points	Testing points	Error ^c	Standard criterion ^b
[-]	[-]	[A]	[A]	[A]
A2.2.1	10 % Idin	0.500	0.001	0.050
A2.2.2	80 % Idin	4.000	0.001	0.050
A2.2.3	100 % Idin	5.000	0.001	0.050

c: The largest absolute error of the test value determined from all three phases.

b: Standard requirement: $\pm 1,0 \% \text{ Idin}$

Test	Test. points	Complementary conditions	Error ^c	Standard criterion ^b
[-]	[A]	[-]	[A]	[A]
A2.3.1	4.000	42.5 Hz	0.002	...
		57.5 Hz	0.003	...
A2.3.2	4.000	H3: 60 % Idin, 180° H5: 55 % Idin, 0° H7: 50 % Idin, 180° H9: 41 % Idin, 0°	0.002	0.050

c: The largest absolute error of the test value determined from all three phases.

b: Standard requirement: $\pm 1,0 \% \text{ Idin}$

Test	Test. points	Complementary conditions	Standard criterion	
A2.4.1	80 % Idin	f = 49.99 Hz test duration = 11 min	Test the time tag and the sequence number of blocks for proper resynchronization to the 10-min interval.	
	Testing points	Difference of TS 10/12 cycle time interval no. 3000 and 2999	Difference of TS 10/12 cycle time interval no. 3000 and 2999	
	[A]	Measured value [ms]	Requirement [ms]	
	4		200.00	200.04 ± 20
			Difference of TS 10/12 cycle time interval no. 3001 and 3000	Difference of TS 10/12 cycle time interval no. 3001 and 3000
			Measured value [ms]	Requirement [ms]
		84.00	80.02 ± 20	

Test	Test. points	Complementary conditions	Standard criterion
A2.5.1	Loop: P1 - P3 - 1 min P3 - P1 - 1 min	f = 50.125 Hz	Test the aggregation of 10/12 cycles data into 150/180 cycles
	[A]	Difference of TS 150/180 cycle time interval no. 202 and 201	Difference of TS 150/180 cycle time interval no. 202 and 201
		Measured value [s]	Requirement [s]
	10 % Idin - 80 % Idin	1.596	1.60 ± 0.03
	80 % Idin - 10 % Idin	Result	
The error of all aggregated values is less than the allowed error			

Test	Testing points	Complementary	Standard criterion
A2.6.1	Loop: P1 - P3 - 1 min P3 - P1 - 1 min	f = 50 Hz	Test the aggregation of 10/12 cycles data into 10 min interval
	[A]	Error of aggregated	Requirement
	10 % I _{din} - 80 % I _{din} 80 % I _{din} - 10 % I _{din}	[% I _{din}] 0.01	[% I _{din}] ±1.00

Test	Target of the test	Result
A2.7.1	Check that the 2-h aggregated value is provided by the equipment under test.	√

Current harmonics

Test	Requirements		
A6.1.1	Q _H > 20	13.5 % < B(46)/VN < 16.5 %	TS[H(100)]-TS[H(0)] = 20000 ± 6 ms*
	Measured values		
	3675	14.4	20000

Test	Testing points	Standard requirement I _{2harm} [%]	Error ^a [%]	Test criterion ^b [%]
A6.1.2	5 %, 100 Hz (2nd harmonic)	5.00	0.03	0.25
	5 %, 75 Hz (1.5 x fundamental freq.)	0.00	0.03	0.05
	4 %, 105 Hz (2nd harmonic + 5 Hz) 6 %, 110 Hz (2nd harmonic + 10 Hz)	4.00	0.04	0.20

a: The largest absolute deviation from the test value U_{2harm} = 5% is determined from all three phases.

b: Maximum absolute tolerance allowed

Test	Target of the test	Result
A6.1.3	Verify that at least 50 harmonics are provided by the device.	√

Test	Testing points	Expected value THDi [%]	Measured value THDi [%]
A6.1.4	Distortion on all harmonics simultaneously up to the 50 th order at 200 % of class 3 compatibility levels from IEC 61000-2-4.	35.12	34.43
	Distortion on 4 selected interharmonics up to the 50 th order at 200 % of class 3 compatibility levels from IEC 61000-2-4.	0.00	0.00

Test	Testing point	Result
A6.1.5	H3: 60 % I _{din} , 180° ; H5: 55 % I _{din} , 0° H7: 50 % I _{din} , 180° ; H9: 41 % I _{din} , 0° Crest factor = 3	All 50 harmonics comply accuracy according to IEC 61000-4-7, Class I.

Test	Testing points	Error ^c [%]	Standard criterion [%]
A6.1.6	10 %, 3750 Hz	0.01	0.15
	10 %, 7500 Hz	0.02	0.15
	10 %, 25050 Hz	0.02	0.15
	no aliasing detected		

Test	Testing points	Expected value	Error ^c	Standard criterion
[-]	[-]	[%]	[%]	[%]
A6.2.1	5 %, 100 Hz (2 nd harmonic)	5.00	0.03	0.25
A6.2.2	10 %, 150 Hz (3 rd harmonic)	10.00	0.02	0.50
A6.2.3	1 %, 2500 Hz (50 th harmonic)	1.00	0.02	0.15

c: The largest error of the test value determined from all three phases.

Test	Testing points	Result
A6.2.4	Distortion on all harmonics simultaneously up to the 50 th order at 10 % of class 3 compatibility levels from IEC 61000-2-4.	All 50 harmonics comply accuracy according to IEC 61000-4-7, Class I.
A6.2.5	Distortion on all harmonics simultaneously up to the 50 th order at 200 % of class 3 compatibility levels from IEC 61000-2-4.	All 50 harmonics comply accuracy according to IEC 61000-4-7, Class I.

Test	Testing points	Complem. conditions	Expected value of I _{din}	Error ^c	Standard criterion
[-]	[-]	[-]	[%]	[%]	[%]
A6.3.1	5 %, 85 Hz (2 nd harmonic) ¹	42.5 Hz	5.00	0.03	0.25
	1 %, 2875 Hz (50 th harmonic) ¹	57.5 Hz	1.00	0.05	0.15
	1: All 50 harmonics comply accuracy according to IEC 61000-4-7, Class I.				
A6.3.2	10 %, 150 Hz (3 rd harmonic)	10 % I _{din}	10.00	0.01	0.50
	10 %, 150 Hz (3 rd harmonic)	100 % I _{din}	10.00	0.06	0.50
	All 50 harmonics comply accuracy according to IEC 61000-4-7, Class I.				

c: The largest error of the test value determined from all three phases.

Current unbalance

Test	Target of the test	Testing conditions		i_0 [%]		i_2 [%]	
				Measured value	Criterion	Measured value	Criterion
S17.1.1	Check accuracy of unbalance measurement	L1: 100,2 % I_{din} , 0° L2: 99,9 % I_{din} , -120° L3: 99,9 % I_{din} , 120°	MIN	0.07	0.00	0.07	0.00
			MAX	0.12	0.35	0.08	0.35
S17.1.2	Check accuracy of unbalance measurement	L1: 110 % I_{din} , 0° L2: 95 % I_{din} , -120° L3: 95 % I_{din} , 120°	MIN	5.01	4.80	5.00	4.80
			MAX	5.11	5.20	5.04	5.20
S17.1.3	Check accuracy of unbalance measurement	L1: 100 % I_{din} , 0° L2: 100 % I_{din} , -150° L3: 100 % I_{din} , 90°	MIN	17.83	17.50	17.81	17.50
			MAX	17.92	18.10	17.84	18.10
S17.1.4	Check accuracy of unbalance measurement	L1: 55,0 % I_{din} , 0° L2: 47,5 % I_{din} , -120° L3: 47,5 % I_{din} , 120°	MIN	4.99	4.70	5.00	4.70
			MAX	5.04	5.30	5.03	5.30
S17.1.5	Check accuracy of unbalance measurement	L1: 105,0 % I_{din} , 0° L2: 97,5 % I_{din} , -120,5° L3: 97,5 % I_{din} , 120,5°	MIN	2.00	1.80	2.96	2.80
			MAX	2.04	2.20	3.08	3.20

Konec přílohy k protokolu o zkoušce č. 6011-PT-L0019-20.
End of annex to the test report no. 6011-PT-L0019-20.