



TECHNICAL SPECIFICATION C8/08

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EMBEDDED METERS AS PART OF AN aFRR SERVICE DELIVERY POINT CONNECTED TO THE DISTRIBUTION GRID

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1. Scope

This document applies only to embedded meters (for the definition, see section 3) of accuracy classes 3.5, 6 and 10 for the measurement of alternating current electrical active energy in 50 Hz (or 60 Hz) networks and it applies to their type tests only.

Remark: The same paragraph numbering as in IEC 62053-21 and IEC 62052-21 is used.

2. Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document.

IEC 62052-11:2020, Electricity metering equipment – General requirements, tests and test conditions – Part 11: Metering equipment

IEC 62054-21:2017, Electricity metering (AC) – Tariff and load control – Part 21: Particular requirements for time switches

3. Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62052-11:2020 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia website: <http://www.electropedia.org/>
- ISO Online Browsing Platform website: <http://www.iso.org/obp>

In this document one additional term is defined:

Embedded meter: meter in which currents and voltages act on solid state (electronic) elements to produce an output proportional to the energy to be measured. The meter has no own enclosing but is part of another appliance/product and its physical protection by the enclosure of the appliance/product.

4. Standard electrical values

4.1. Voltages

The values given in IEC 62052-11:2020 apply.

4.2. Currents

4.2.1. Nominal current

The values given in IEC 62052-11:2020 apply.

4.2.2. Starting current

The requirements and acceptance criteria of IEC 62052-11:2020 apply (see Table 4-1).

Embedded meters for	Starting current I_{st}			Power factor ($\cos \varphi$)
	class 3.5	class 6	class 10	
Direct connection	$0.005 I_n$	$0.01 I_n$	$0.01 I_n$	1

Table 4-1: Starting current

4.2.3. Minimum current

The requirements and acceptance criteria of IEC 62052-11:2020 apply (see Table 4-2).

Embedded meters for	Minimum current I_{min} Class 3.5, class 6 and class 10
Direct connection	$0.05 I_n$

Table 4-2: Minimum current

4.2.4. Maximum current

The requirements and acceptance criteria of IEC 62052-11:2020 apply, that is:

The maximum current (I_{max}) for directly connected meters should be an integral multiple of the nominal current (for example four times the nominal current).

4.3. Frequencies

The values given in IEC 62052-11:2020 apply.

4.4. Power consumption

The requirements, test conditions and procedures, and acceptance criteria of IEC 62052- 11:2020 apply.

5. Construction requirements

Only the appliance/product construction requirements and standards are applicable. No further requirements are imposed.

6. Meter marking and documentation

Only the appliance/product requirements regarding marking and documentation are applicable.

Within the appliance/product documentation, the manufacturer shall indicate the accuracy class index of the embedded meter if it meets all applicable accuracy and performance requirements specified in this document.

7. Metrological performance requirements and tests

7.1. General test conditions

The test conditions of IEC 62052-11:2020 apply.

7.2. Methods of accuracy verification

The requirements, test conditions and procedures, and acceptance criteria of IEC 62052-11:2020 apply.

7.3. Measurement uncertainty

The requirements, test conditions and procedures, and acceptance criteria of IEC 62052-11:2020 apply.

7.4. Embedded Meter constant

The requirements, test conditions and procedures, and acceptance criteria of IEC 62052-11:2020 apply.

7.5. Initial start-up of the meter

The requirements, test conditions and procedures, and acceptance criteria of IEC 62052-11:2020 apply.

7.6. Test of no-load condition

The requirements, test conditions and procedures, and acceptance criteria of IEC 62052-11:2020 apply.

7.7. Starting current test

The requirements, test conditions and procedures, and acceptance criteria of IEC 62052-11:2020 apply.

7.8. Repeatability test

The requirements, test conditions and procedures, and acceptance criteria of IEC 62052-11:2020 apply.

7.9. Limits of error due to variation of the current

When the meter is operated under the reference conditions given in IEC 62052-11:2020, 7.1, the percentage errors shall not exceed the limits for the relevant accuracy class given in Table 7-1.

Value of current	Power factor (cos φ)	Acceptance percentage error limits for embedded meters of class		
		3.5	6	10
$I_{min} \leq I < 0.1 I_n$	1	±5.5	±9	±15
$0.1 I_n \leq I \leq I_{max}$	1	±3.5	±6	±10
$0.1 I_n \leq I < 0.2 I_n$	0.5 inductive	±5.5	±9	±15
	0.8 capacitive	±5.5	±9	±15
$0.2 I_n \leq I \leq I_{max}$	0.5 inductive	±3.5	±6	±10
	0.8 capacitive	±3.5	±6	±10

Table 7-1: Acceptable percentage error limits (single-phase and poly-phase embedded meters with balanced loads or single-phase loads)

7.10. Limits of error due to influence quantities

Tests and test conditions given in IEC 62052-11:2020, 7.1 apply.

Influence quantity	Specified range or value and recommended value of test current (balanced unless otherwise stated)	Power factor (cos φ)	Acceptable limits of variation in percentage error for meters of class		
			3.5	6	10
Radiated, radiofrequency, electromagnetic field immunity test – test with current	I_n	1	±5.5	±9	±15
Electrical fast transient/burst immunity test	I_n	1	±7	±12	±20
Immunity to conducted disturbances, induced by radio-frequency fields	I_n	1	±5.5	±9	±15
Test for immunity to conducted, differential mode disturbances and signaling in the frequency range 2 kHz to 150 kHz at AC power ports	I_n	1	±7	±12	±20
Damped oscillatory wave immunity test	I_n	1	±5.5	±9	±15
External static magnetic fields	I_n	1	±5.5	±9	±15
Power frequency magnetic field immunity test	I_n	1	±5.5	±9	±15
Harmonics in the current and voltage circuits – 5th harmonic test	$0.5 I_{max}$	1	±1.75	±3	±5

Influence quantity	Specified range or value and recommended value of test current (balanced unless otherwise stated)	Power factor (cos φ)	Acceptable limits of variation in percentage error for meters of class		
			3.5	6	10
Interharmonics in the current circuit – burst fired waveform test	$0.5 I_n$	1	±7	±12	±20
Odd harmonics in the current circuit	$0.5 I_n$	1	±7	±12	±20
DC and even harmonics – half-wave rectified waveform test	$I_{max} / \sqrt{2}$	1	±7	±12	±20
		0.5			
Voltage variation	$I_{min} \leq I \leq I_{max}$ (I_n)	1	±1.75	±3	±5
	I_n $0.1 I_n \leq I \leq I_{max}$	0.5	±3.5	±6	±10
Ambient temperature variation	$I_{min} \leq I \leq I_{max}$ (I_n)	1	±0.2	±0.3	±0.5
	$0.2 I_n \leq I \leq I_{max}$ (I_n)	0.5	±0.3	±0.5	±0.75
Frequency variation	$I_{min} \leq I \leq I_{max}$ (I_n)	1	±1.75	±3	±5
	$0.1 I_n \leq I \leq I_{max}$ (I_n)	0.5	±1.75	±3	±5
Auxiliary voltage variation	I_{min}	1	±0.7	±1.2	±2
Operation of auxiliary devices	I_{min}	1	±0.7	±1.2	±2
Short-time overcurrents	I_n	1	±5.5	±9	±15
Self-heating	I_{max}	1	±1.75	±3	±5
		0.5	±2.6	±4.5	±7.5
Fast load current variations	I_n	1	±5.5	±9	±15
Earth fault	I_n	1	±1.75	±3	±5
Dry heat test	I_n	1	±1.75	±3	±5
Cold test	I_n	1	±1.75	±3	±5
Damp heat cyclic test	I_n	1	±1.75	±3	±5

Table 7-2: Acceptable limits of variation in percentage error due to influence quantities

7.11. Time-keeping accuracy

The time-keeping accuracy requirements of IEC 62054-11:2017 section 7.5.2 apply.

8. Climatic requirements

Only the appliance/product climatic requirements and standards are applicable. No further requirements are imposed.

Under the varying climatic conditions (and tests), the embedded meter shall still function with the accuracy as indicated in section 7.10.

9. The effects of external influences and disturbances

9.1. General

These general test conditions apply to all tests specified in 9.3 and 9.4, unless therein specified otherwise.

9.2. Acceptance criteria

The acceptance criteria, regarding energy registration, of IEC 62052-11:2020 apply. Table 13 in IEC 62052-11:2020 gives an overview of the requirements. For tests with acceptance criteria A, Table 7-2 of this document shall be used.

9.3. Electromagnetic compatibility

Only the appliance/product electromagnetic compatibility requirements and standards are applicable.

During the different electromagnetic compatibility conditions and tests, the embedded meter shall still function with the accuracy as indicated in section 7.10.

9.4. Tests of immunity to other influence quantities

The requirements, test conditions and procedures, and acceptance criteria of IEC 62052-11:2020 apply.

10. Type test

The requirements given in IEC 62052-11:2020 apply.

11. Appendix

In this appendix the tables from section 7.9 and 7.10 of IEC 62053-21:2020, Electricity metering equipment – General requirements, tests and test conditions – Part 21: Static meters for AC active energy (classes 0,5, 1 and 2) are provided. This for comparison with the tables provided in this document in the corresponding sections.

**Table 3 – Acceptable percentage error limits
(single-phase meters and poly-phase meters with balanced loads or single-phase loads)**

Value of current		Power factor $\cos \varphi$	Acceptable percentage error limits for meters of class		
for directly connected meters	for transformer operated meters		0,5	1	2
$I_{\min} \leq I < 0,1 I_n$	$I_{\min} \leq I < 0,05 I_n$	1	$\pm 1,0$	$\pm 1,5$	$\pm 2,5$
$0,1 I_n \leq I \leq I_{\max}$	$0,05 I_n \leq I \leq I_{\max}$	1	$\pm 0,5$	$\pm 1,0$	$\pm 2,0$
$0,1 I_n \leq I < 0,2 I_n$	$0,05 I_n \leq I < 0,1 I_n$	0,5 inductive	$\pm 1,0$	$\pm 1,5$	$\pm 2,5$
		0,8 capacitive	$\pm 1,0$	$\pm 1,5$	-
$0,2 I_n \leq I \leq I_{\max}$	$0,1 I_n \leq I \leq I_{\max}$	0,5 inductive	$\pm 0,6$	$\pm 1,0$	$\pm 2,0$
		0,8 capacitive	$\pm 0,6$	$\pm 1,0$	-----
$0,2 I_n \leq I \leq I_{\max}$	$0,1 I_n \leq I \leq I_{\max}$	0,25 inductive	$\pm 1,0^a$	$\pm 3,5^a$	-----
		0,5 capacitive	$\pm 1,0^a$	$\pm 2,5^a$	-----
		0,25 capacitive	-----	-----	-----

^a When specially requested by the user.

NOTE 1 The current transformers under IEC 61869-2 have a lowest load point at $0,05 I_n$.

NOTE 2 See Annex A for an informative comparison of percentage error limits for classes 0,5, 1 and 2.

Table 4 – Acceptable limits of variation in percentage error due to influence quantities

Influence quantity	Test clause in IEC 62052-11:2020	Specified range or value and recommended value of test current (balanced unless otherwise stated)		Power factor $\cos \varphi^c$	Acceptable limits of variation in percentage error for meters of class		
		for directly connected meters	for transformer-operated meters		0,5	1	2
Radiated, radio-frequency, electromagnetic field Immunity test – test with current	9.3.5	I_n		1	2,0	2,0	3,0
Electrical fast transient/burst Immunity test	9.3.6	I_n		1	2,0	4,0	6,0
Immunity to conducted disturbances, induced by radio-frequency fields	9.3.7	I_n		1	2,0	2,0	3,0
Test for immunity to conducted, differential mode disturbances and signalling in the frequency range 2 kHz to 150 kHz at AC power ports	9.3.8	I_n		1	2,0	4,0	6,0
Damped oscillatory wave Immunity test ^d	9.3.11	---	I_n	1	2,0	2,0	3,0
External static magnetic fields	9.3.12	I_n		1	2,0	2,0	3,0
Power frequency magnetic field immunity test	9.3.13	I_n		1	1,0	2,0	3,0
Harmonics in the current and voltage circuits – 5th harmonic test	9.4.2.2	$0,5 I_{max}$		1	0,5	0,8	1,0
Interharmonics in the current circuit – burst fired waveform test	9.4.2.3	$0,5 I_n$		1	1,5	3,0	6,0
Odd harmonics in the current circuit	9.4.2.4	$0,5 I_n$		1	1,5	3,0	6,0
DC and even harmonics – half-wave rectified waveform test ^f	9.4.2.5	$\frac{I_{max}}{\sqrt{2}}$	---	1	1,5	3,0	6,0
				0,5			
Voltage variation	9.4.3	$I_{min} \leq I \leq I_{max}$ (I_n)		1	0,25	0,5	1,0
		I_n $0,1 I_n \leq I \leq I_{max}$	I_n $0,05 I_n \leq I \leq I_{max}$	0,5	0,5	1,0	1,5
Ambient temperature variation ^b	9.4.4	$I_{min} \leq I \leq I_{max}$ (I_n)		1	0,03	0,05	0,10
		$0,2 I_n \leq I \leq I_{max}$ (I_n)	$0,1 I_n \leq I \leq I_{max}$ (I_n)	0,5	0,05	0,07	0,15
Interruption of phase voltage	9.4.5	I_n		1	1,0	2,0	4,0

Influence quantity	Test clause in IEC 62052-11:2020	Specified range or value and recommended value of test current (balanced unless otherwise stated)		Power factor $\cos \varphi^c$	Acceptable limits of variation in percentage error for meters of class		
		for directly connected meters	for transformer-operated meters		0,5	1	2
Frequency variation	9.4.6	$I_{min} \leq I \leq I_{max}$ (I_n)		1	0,2	0,5	0,8
		$0,1 I_n \leq I \leq I_{max}$ (I_n)	$0,05 I_n \leq I \leq I_{max}$ (I_n)	0,5	0,2	0,7	1,0
Reversed phase sequence	9.4.7	$0,1 I_n$		1	0,1	0,5	1,0
Auxiliary voltage variation	9.4.8	I_{min}		1	0,1	0,2	0,4
Operation of auxiliary devices	9.4.9	I_{min}		1	0,1	0,2	0,4
Short-time overcurrents*	9.4.10	I_n	---	1	1,0	1,5	1,5
		---	I_n		0,2	0,5	1,0
Self-heating *	9.4.11	I_{max}		1	0,5	0,7	1,0
				0,5	0,7	1,0	1,5
Fast load current variations	9.4.12	I_n		1	1,0	2,0	3,0
Earth fault *	9.4.13	---	I_n	1	0,25	0,5	1,0
Dry heat test *	8.3.3	I_n		1	0,25	0,5	1
Cold test *	8.3.4	I_n		1	0,25	0,5	1
Damp heat cyclic test*	8.3.5	I_n		1	0,25	0,5	1

* The test shall be carried out for at least 1 h, or until the variation of error during 20 min does not exceed 0,2 %.

^b These values shall be considered as mean temperature coefficients %/K for meters of class.

^c Inductive.

^d Voltage transformer operated meters only.

* For these tests, the meter accuracy is measured before and after the test. The difference in percentage error before and after the test shall not exceed the error limits specified in this table. These error limits may be interpreted as allowable meter accuracy drift induced by the specified test conditions.

^f The purpose of this test is to check for current sensor saturation only. This test does not apply to transformer-operated meters.