Overview of IEC standards relevant for PQ measurement

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Introduction

- Measurement methods and ranges implemented in PQ meters need to be verified

- Measurement methods implemented in PQ meters as well as functional test methods are covered by relevant IEC standards

- **95 test methods + flicker**

- **it is not easy to maintain the traceability for all of them**

IEC standards for PQ

- **Basic: IEC 61000-4-30:** Power quality measurement methods
- **Edition 3, April 2015**

- **Important links to:**
  - IEC 62586 Power quality measurement in power supply systems
  - IEC 61000-4-7 EMC General guide on harmonics and interharmonics….
  - IEC 61000-2-4 EMC Compatibility levels in industrial plants for LF instalations
  - IEC 61000-4-15 EMC Flickermeter

IEC 61000-4-30

- EMC Part 4-30: Testing and measurement techniques - Power quality measurement methods

- „…**defines the methods for measurement and interpretation of results for PQ parameters** in a.c. power supply systems with a declared fundamental frequency of 50 Hz or 60 Hz…“

- „…addresses measurement methods for **in-situ measurements**…“

- „….. measurement methods are described in terms of **reliable and repeatable results** regardless of the method’s implementation…“

IEC 61000-4-30

- **PQ parameters measurement considered** in this standard:
  - Frequency
  - Magnitude of supply voltage
  - Flicker
  - Supply voltage dips and swells
  - Voltage interruptions
  - Transient voltages
  - Supply voltage unbalance
  - Voltage harmonics and interharmonics
  - Mains signalling on the supply voltage
  - Rapid voltage changes
  - Current measurement
  - Informative: Under- and overdeviations, emissions in 2 -150 kHz

IEC 61000-4-30

- **Instruments:**
  - Class A: more accurate as Class S
    wider measurement range
  - Class S: less accurate as Class A
    not so wide measurement range as Class A
    less methods implemented
  - Class B: moved to informative annex and considered for future removal

IEC 61000-4-30

- **Relevant for:**
  - Producers of PQ meters while developing of the new devices
  - Energy producers and distributors to assist with interpretation of results (to ensure secure supply)
- „Test methods for verifying compliance with this standard can be found in **IEC 62586-2**.“

(in previous edition the tests were different and were part of EMC 4-30)

IEC 62586

- Power Quality Measurement in Power Supply Systems
- Edition 1, 2013

Part 1: PQ instruments

- Product and performance requirements for PQ instrumentation in power supply systems:
  - Safety requirements
  - EMC requirements,
  - Climatic requirements
  - Mechanical requirements

Part 2: Functional tests and uncertainty requirements

- Functional tests and uncertainty requirements for PQ instrumentation in power supply systems:
  - Functional testing procedures for verifying measurment methods implemented according to IEC 61000-4-30

IEC 62586-2

- **Functional tests considered** in this standard:
  - Power frequency
  - Magnitude of supply voltage
  - Flicker
  - Supply voltage interruptions, dips and swells
  - Supply voltage unbalance
  - Voltage harmonics and interharmonics
  - Mains signalling on the supply voltage
  - Underdeviation and overdeviation
  - Flagging
  - Clock uncertainty testing
  - Variation due to external influence quantities (temperature, power supply voltage)

IEC 62586-2

- Does **not consider testing of current measurement methods**!

(Even if the methods are described in last edition of EMC 4-30)

- **95 test methods + flicker tests** (according to IEC 61000-4-15)

- More than 170 test points for Class A + flicker testing !!!

IEC 62586-2 – how to work with?

- **Test description**:

  target of the test

  test points (Table 3)

  complementary test conditions (description, Table 4, Table 6)

  test criterion (Table 8)

  (Test duration)

- **Uncertainty requirements:** Table 9 (magnitude and frequency)
- **Calculation of uncertainties:** Annex A, Annex B, link to EMC-4-30

IEC 62586-2 – example

- Magnitude of supply voltage:

6.2.2.2 Variations due to single influence quantities

Each test shall last at least 1 s.

3 test points !

N°	Target of the test	Testing points according Table 3	Complementary test conditions according to Table 4	Test criterion (if test is applicable)
A2.3.1	Measure influence of frequency on measurement uncertainty (for further calculations as required in 8).	P3 for Voltage magnitude	S1 for Frequency	---
			S3 for Frequency	---
			S4 for Frequency	---
A2.3.2	Measure influence of harmonics on measurement uncertainty (for further calculations as required in 8).	P3 for Voltage magnitude	S1 for Harmonics	TC10/12(unc) on ch1 compared to a reference voltage

IEC 62586-2 – test points in Table 3

Table 3 – Testing points for each measured parameter

Measured parameter	Class	Testing point P1 [a]	Testing point P2 [a]	Testing point P3 [a]	Testing point P4 [a]	Testing point P5 [a]
Frequency 50 Hz [b] (covers 50 Hz)	A	42,5 Hz	50,05 Hz	57,5 Hz	50 Hz	N.A.
	S	42,5 Hz	50,05 Hz	57,5 Hz	50 Hz	N.A.
Frequency 60 Hz [b] (covers 60 Hz)	A	51 Hz	59,95 Hz	69 Hz	60 Hz	N.A.
	S	51 Hz	59,95 Hz	69 Hz	60 Hz	N.A.
Voltage magnitude	A	10 % U_{din}	45 % U_{din}	80 % U_{din}	115 % U_{din}	150 % U_{din}
	S	20 % U_{din}	45 % U_{din}	70 % U_{din}	95 % U_{din}	120 % U_{din}
Swells [c]	A	Threshold swell- [d]	Threshold swell+ [d]	110 % U_{din}	120 % U_{din}	200 % U_{din}
	S	Threshold swell- [d]	Threshold swell+ [d]	110 % U_{din}	120 % U_{din}	150 % U_{din}

IEC 62586-2 – example

- Magnitude of supply voltage:

6.2.2.2 Variations due to single influence quantities

Each test shall last at least 1 s.

N°	Target of the test	Testing points according Table 3	Complementary test conditions according to Table 4	Test criterion (if test is applicable)
A2.3.1	Measure influence of frequency on measurement uncertainty (for further calculations as required in 8).	P3 for Voltage magnitude A 80 % U_{din} S 70 % U_{din}	S1 for Frequency	---
			S3 for Frequency	---
			S4 for Frequency	---
A2.3.2	Measure influence of harmonics on measurement uncertainty (for further calculations as required in 8).	P magnitude	S1 for Harmonics	TC10/12(unc) on ch1 compared to a reference voltage

IEC 62586-2 – complementary condition in Table 4

Table 4 – List of single "power system influence quantities"

Power system influence quantities	Class	Testing state S1 [a]	Testing state S2 [a]	Testing state S3 [a]	Testing state S4 [a]
Frequency: 1) for instruments covering both 50 Hz and 60 Hz frequencies	A	42,5 Hz	50 Hz	55,75 Hz	69 Hz
	S	42,5 Hz	50 Hz	55,75 Hz	69 Hz
2) for instruments covering only 50 Hz frequency	A	42,5 Hz	50 Hz	57,5 Hz	---
	S	42,5 Hz	50 Hz	57,5 Hz	---
3) for instruments covering only 60 Hz frequency	A	51 Hz	60 Hz	69 Hz	---
	S	51 Hz	60 Hz	69 Hz	---
Voltage magnitude	A	10 % U_{din}	---	200 % U_{din}	---
	S	10 % U_{din}	---	150 % U_{din}	---
Harmonics (in addition to the	A	[c d]	---	---	---

IEC 62586-2

- Links to other standards where relevant

- To specify the test points

- **Links to:**
  - IEC 61000-4-15: Flickermeter
  - IEC 61000-4-7: General guide on harmonics and interharmonics…
  - IEC 61000-2-4: Compatibility levels in industrial plants for LF instalations

IEC 61000-4-15

- **EMC Part 4-15:** Testing and measurement techniques – Flickermeter – Functional and design specification

- **Linked in EMC 4-30:**
  - Requirements on measurement methods.

- **Linked in IEC 62586-2:**
  - Tests shall be performed according to testing requirements described in EMC 4-15

IEC 61000-4-7

- **EMC Part 4-7:** Testing and measurment techniques- General guide on harmonics and interharmonics measurements and instrumentation, for power supply systems and equipment connected thereto

- **Linked in EMC 4-30:**
  - Definition of basic measurement method and uncertainty of voltage harmonics of Class A and S,
  - Calculation of THD of Class A and S,
  - Definition of basic measurement method and uncertainty of voltage interharmonics harmonics of Class A,

IEC 61000-2-4

- **EMC Part 2-4:** Environment – Compatibility levels in industrila plants for LF conducted disturbances

- **Linked in EMC 4-30:**
  - To specify measuring range of voltage harmonics and interharmonics of Class A and Class S instrument
- **Linked in IEC 62586-2:**
  - To specify testing points for harmonics and interharmonic

Conclusion

- Important PQ standards:

  IEC 61000-4-30: PQ instruments requirements

  IEC 62586-1: Product and performance requirements

  IEC 62586-2: PQ functional tests

  IEC 61000-4-15: Flicker

  IEC 61000-4-7: Guide on harmonics and interharmonics

  IEC 61000-2-4: Compatibility levels (harmonics and interharmonics)

- In bold: **to provide traceability of measurement**!

Thank you for your attention!