EURAMET 1209 Three-phase AC power comparison at 50 Hz

1st COMPARISON REPORT

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1. Introduction

This bilateral comparison was organized between EIM, the National Institute of Metrology of Greece and PTB, Physicalish Technische Bundesanstalt of Germany with the purpose that EIM supports its calibration capability. EIM was responsible for providing the protocol document and evaluating and reporting the results.

2. Comparison details

2.1 Description of the travelling standard

The travelling standard was a precision three-phase reference electricity meter of EIM with following characteristics:

- Type: TPZ 303
- S/N: 98-728-6
- Manufacturer: ZERA
- Measurement current: I=0.005 A-20 A
- Measurement voltage: V=60 V- 480 V
- Connection type: 3-phase 3-wire and 4-wire
- Measurement mode: Active Energy, Reactive Energy

2.2 Measurement points

The measurement points are summarized in the following tables:

Active Power at 60 V

Nr.	$U_{1\text{-}3}$ *(P-N)*	I_1	I_2	I_3	φ	***f***	***Mode***
No.	in V	in A	in A	in A	in °	in Hz	
1	60	0,05	0,05	0,05	0	53	4wa
2	60	1	0	0	0	53	4wa
3	60	1	1	1	0	53	4wa
4	60	1	1	1	30	53	4wa
5	60	1	1	1	-30	53	4wa
6	60	1	1	1	60	53	4wa
7	60	1	1	1	-60	53	4wa
8	60	1	1	1	75	53	4wa
9	60	1	1	1	-75	53	4wa
10	60	5	5	5	0	53	4wa
11	60	5	5	5	30	53	4wa
12	60	5	5	5	-30	53	4wa

Active Power at 120 V

Nr.	***U_{1-3}*** *(P-N)*	***I_1***	***I_2***	***I_3***	***φ***	***f***	***Mode***
No.	in V	in A	in A	in A	in °	in Hz	
13	120	5	0	0	0	53	4wa
14	120	5	5	5	0	53	4wa
15	120	5	5	5	30	53	4wa
16	120	5	5	5	60	53	4wa
17	120	5	5	5	75	53	4wa
18	120	5	5	5	-30	53	4wa
19	120	5	5	5	-60	53	4wa
20	120	5	5	5	-75	53	4wa
21	120	0,005	0	0	0	53	4wa
22	120	0,01	0,01	0,01	0	53	4wa
23	120	0,02	0,02	0,02	0	53	4wa
24	120	0,05	0,05	0,05	0	53	4wa
25	120	0,1	0,1	0,1	0	53	4wa
26	120	0,2	0,2	0,2	0	53	4wa
27	120	0,5	0,5	0,5	0	53	4wa
28	120	1	0	0	0	53	4wa
29	120	1	1	1	0	53	4wa
30	120	2	2	2	0	53	4wa
31	120	5	5	5	0	53	4wa
32	120	10	10	10	0	53	4wa

Active Power at 240-480 V

Nr.	***U_{1-3}*** *(P-N)*	***I_1***	***I_2***	***I_3***	***φ***	***f***	***Mode***
No.	in V	in A	in A	in A	in °	in Hz	
33	240	0,05	0,05	0,05	0	53	4wa
34	240	0,05	0,05	0,05	60	53	4wa
35	240	0,05	0,05	0,05	-60	53	4wa
36	240	0,1	0,1	0,1	0	53	4wa
37	240	0,1	0,1	0,1	60	53	4wa
38	240	0,1	0,1	0,1	-60	53	4wa
39	240	0,5	0,5	0,5	0	53	4wa
40	240	0,5	0,5	0,5	60	53	4wa
41	240	0,5	0,5	0,5	-60	53	4wa
42	240	1	1	1	0	53	4wa

43	240	1	1	1	37	53	4wa
44	240	1	1	1	-37	53	4wa
45	240	1	1	1	60	53	4wa
46	240	1	1	1	-60	53	4wa
47	240	1	1	1	75	53	4wa
48	240	1	1	1	-75	53	4wa
49	240	2,5	2,5	2,5	0	53	4wa
50	240	2,5	2,5	2,5	60	53	4wa
51	240	2,5	2,5	2,5	-60	53	4wa
52	240	5	0	0	0	53	4wa
53	240	5	5	5	0	53	4wa
54	240	5	5	5	37	53	4wa
55	240	5	5	5	-37	53	4wa
56	240	5	5	5	60	53	4wa
57	240	5	5	5	-60	53	4wa
58	240	5	5	5	75	53	4wa
59	240	5	5	5	-75	53	4wa
60	240	10	10	10	0	53	4wa
61	240	10	10	10	60	53	4wa
62	240	10	10	10	-60	53	4wa
63	240	20	20	20	0	53	4wa
64	240	20	20	20	60	53	4wa
65	240	20	20	20	-60	53	4wa
66	480	20	20	20	0	53	4wa
67	480	20	20	20	60	53	4wa
68	480	20	20	20	-60	53	4wa

Reactive Power at 60-240 V

Nr.	***U_{1-3}*** *(P-N)*	***I_1***	***I_2***	***I_3***	***φ***	***f***	***Mode***
No.	in V	in A	in A	in A	in °	in Hz	
69	60	1	1	1	90	53	4wr
70	60	1	1	1	60	53	4wr
71	60	1	1	1	-60	53	4wr
72	60	1	1	1	30	53	4wr
73	60	1	1	1	-30	53	4wr
74	120	5	0	0	90	53	4wr
75	120	5	0	0	-90	53	4wr
76	120	5	5	5	60	53	4wr
77	120	5	5	5	-60	53	4wr
78	120	5	5	5	90	53	4wr

79	120	5	5	5	-90	53	4wr
80	120	5	5	5	30	53	4wr
81	120	5	5	5	-30	53	4wr
82	240	5	5	5	90	53	4wr
83	240	5	5	5	-90	53	4wr
84	240	5	5	5	60	53	4wr
85	240	5	5	5	-60	53	4wr
86	240	5	5	5	30	53	4wr
87	240	5	5	5	-30	53	4wr

2.3 Time schedule

The comparison was carried out in May 2011.

2.4 Reference standard, environmental conditions

EIM used as reference standard a three phase comparator of the type COM3003 manufactured by Zera. PTB used as standard a three phase comparator calibrated with the PTB primary standard.

The temperature during the measurements was $23^{o}C \pm 1^{o}C$ for both laboratories.

2.5 Comparison results and uncertainty

The transfer standard was first measured by PTB and then by EIM. Both laboratories presented the measurement results and the uncertainty budgets in a report which had the form of a calibration certificate. These measurement results are given in Appendix I.

Reference value

The reference value was given by PTB and it was an average of 10 error measurements. The reference values and the corresponding uncertainties for all the measurement points are shown in Appendix I.

The error measurement results of EIM and the corresponding uncertainties for all the measurement points are presented in Appendix II.

Comparison of PTB and EIM results

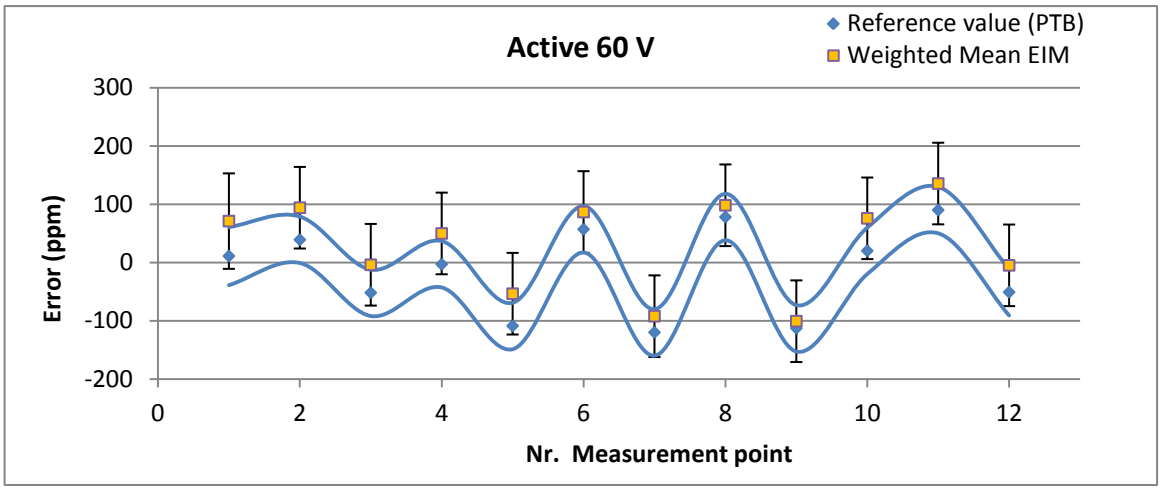
To compare EIM and PTB results, a graph is drawn for each group of measurements, in which the following are presented:

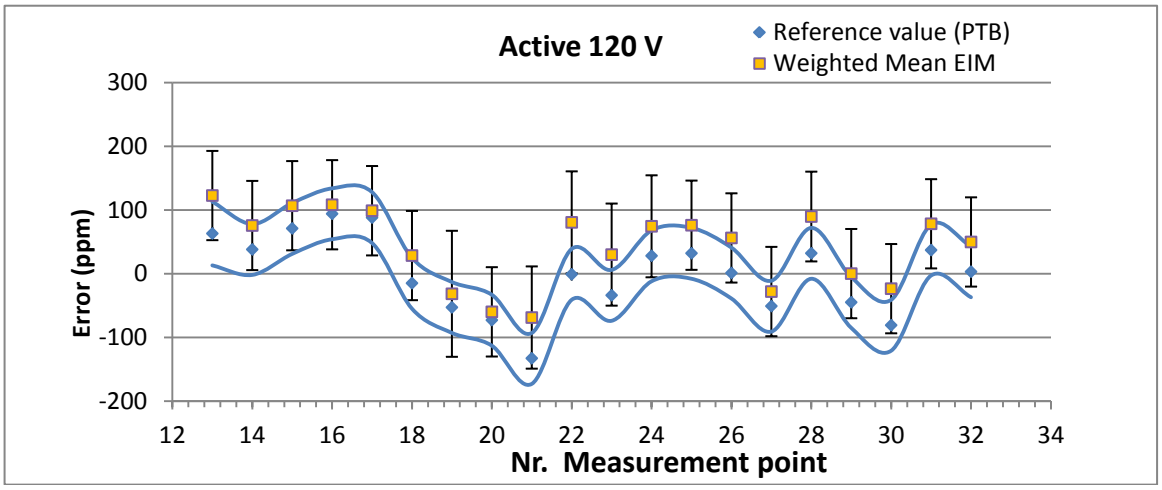
- The reference value as computed by PTB
- An envelope formed by the expanded uncertainty of the reference value given by PTB
- The result of EIM with an error bar equal to its expanded uncertainty

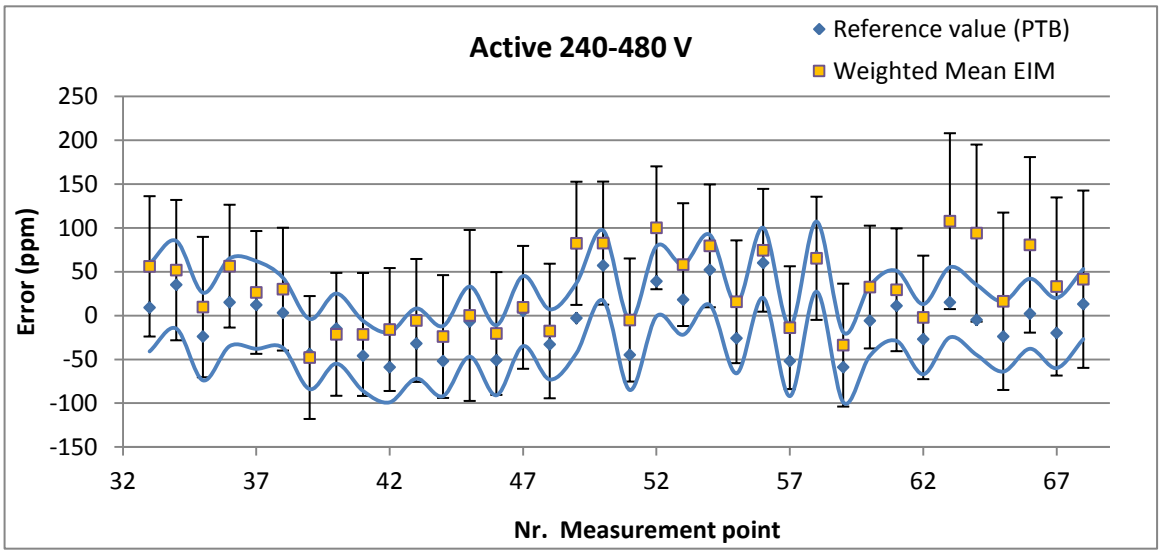
The uncertainties were described in detail in the laboratory reports and were computed assuming the following contributions:

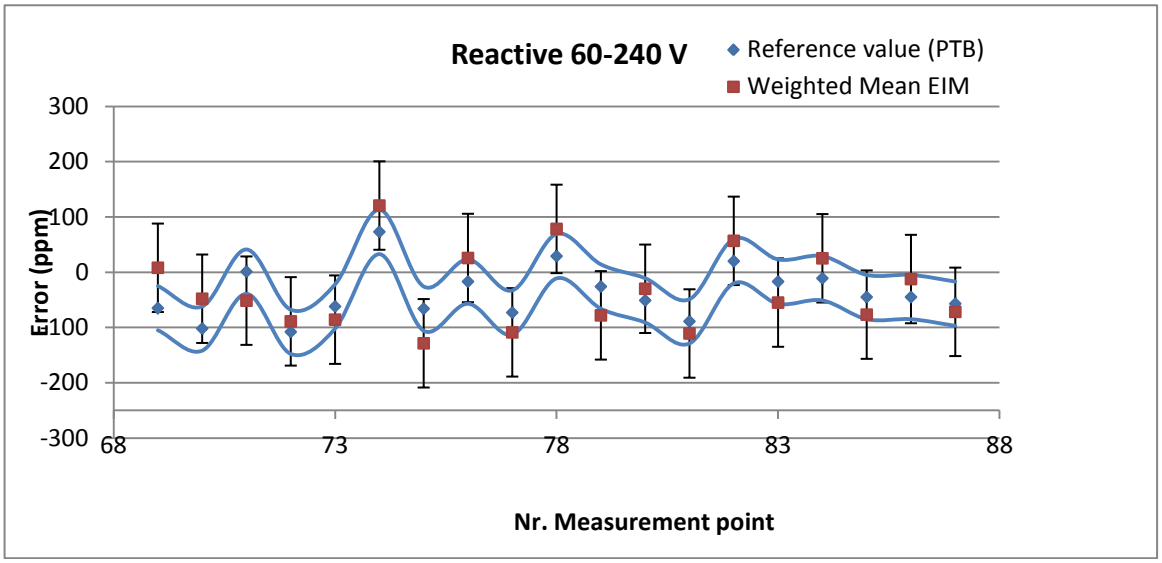
1. Reproducibility and repeatability of the measurements
2. Uncertainty of the reference standard (comparator)
3. Resolution of the travelling standard (TPZ) and reference standard (comparator)

The graphs are presented below:


Active 60 V
Reference value (PTB)
Weighted Mean EIM
Error (ppm)
300
200
100
0
-100
-200
0
2
4
6
8
10
12
Nr. Measurement point


Active 120 V
Reference value (PTB)
Weighted Mean EIM
Error (ppm)
300
200
100
0
-100
-200
12
14
16
18
20
22
24
26
28
30
32
34
Nr. Measurement point


Active 240-480 V
Reference value (PTB)
Weighted Mean EIM
Error (ppm)
250
200
150
100
50
0
-50
-100
-150
32
37
42
47
52
57
62
67
Nr. Measurement point



2.6 Evaluation of the results

According to EA-2/03 "Interlaboratory Comparisons", for the quantitative evaluation of the results the quantity E_n is computed, defined as

$$E_n = \frac{X_{LAB} - X_{REF}}{\sqrt{U^2(X_{LAB}) + U^2(X_{REF})}}$$, where

X_{LAB} is the result of the participating laboratory EIM
X_{REF} is the reference value as given by the participating laboratory PTB,
U_{LAB} is the expanded uncertainty of X_{LAB} and
U_{REF} is the expanded uncertainty of X_{REF}.
For a result to be acceptable the En ratio should be between -1 and +1 i.e. |En|<1.
In the following tables the computed values of *En* are presented for all measurement points:

Active Power 60 V

Nr.	***U1-3 (P-N)***	***I1***	***I2***	***I3***	***φ***	***f***	***Mode***	***En (EIM)***
No.	in V	in A	in A	in A	in °	in Hz		
1	60	0,05	0,05	0,05	0	53	4wa	**0.6**
2	60	1	0	0	0	53	4wa	**0.6**
3	60	1	1	1	0	53	4wa	**0.6**
4	60	1	1	1	30	53	4wa	**0.5**
5	60	1	1	1	-30	53	4wa	**0.5**
6	60	1	1	1	60	53	4wa	**0.3**
7	60	1	1	1	-60	53	4wa	**0.3**
8	60	1	1	1	75	53	4wa	**0.1**
9	60	1	1	1	-75	53	4wa	**0.1**
10	60	5	5	5	0	53	4wa	**0.6**

11	60	5	5	5	30	53	4wa	**0.5**
12	60	5	5	5	-30	53	4wa	**0.5**

Active Power 120 V

Nr.	***U_{1-3} (P-N)***	***I_1***	***I_2***	***I_3***	***φ***	***f***	***Mode***	***E_n (EIM)***
No.	in V	in A	in A	in A	in °	in Hz		
13	120	5	0	0	0	53	4wa	**0.6**
14	120	5	5	5	0	53	4wa	**0.4**
15	120	5	5	5	30	53	4wa	**0.3**
16	120	5	5	5	60	53	4wa	**0.2**
17	120	5	5	5	75	53	4wa	**0.1**
18	120	5	5	5	-30	53	4wa	**0.4**
19	120	5	5	5	-60	53	4wa	**0.2**
20	120	5	5	5	-75	53	4wa	**0.2**
21	120	0,005	0	0	0	53	4wa	**0.7**
22	120	0,01	0,01	0,01	0	53	4wa	**0.9**
23	120	0,02	0,02	0,02	0	53	4wa	**0.6**
24	120	0,05	0,05	0,05	0	53	4wa	**0.5**
25	120	0,1	0,1	0,1	0	53	4wa	**0.4**
26	120	0,2	0,2	0,2	0	53	4wa	**0.6**
27	120	0,5	0,5	0,5	0	53	4wa	**0.1**
28	120	1	0	0	0	53	4wa	**0.6**
29	120	1	1	1	0	53	4wa	**0.4**
30	120	2	2	2	0	53	4wa	**0.6**
31	120	5	5	5	0	53	4wa	**0.4**
32	120	10	10	10	0	53	4wa	**0.5**

Active Power 240-480 V

Nr.	***U_{1-3} (P-N)***	***I_1***	***I_2***	***I_3***	***φ***	***f***	***Mode***	***E_n (EIM)***
No.	in V	in A	in A	in A	in °	in Hz		
33	240	0,05	0,05	0,05	0	53	4wa	**0.4**
34	240	0,05	0,05	0,05	60	53	4wa	**0.2**
35	240	0,05	0,05	0,05	-60	53	4wa	**0.3**
36	240	0,1	0,1	0,1	0	53	4wa	**0.4**
37	240	0,1	0,1	0,1	60	53	4wa	**0.1**
38	240	0,1	0,1	0,1	-60	53	4wa	**0.3**
39	240	0,5	0,5	0,5	0	53	4wa	**0.2**
40	240	0,5	0,5	0,5	60	53	4wa	**-0.2**
41	240	0,5	0,5	0,5	-60	53	4wa	**0.3**
42	240	1	1	1	0	53	4wa	**0.4**

43	240	1	1	1	37	53	4wa	**0.3**
44	240	1	1	1	-37	53	4wa	**0.4**
45	240	1	1	1	60	53	4wa	**0.1**
46	240	1	1	1	-60	53	4wa	**0.3**
47	240	1	1	1	75	53	4wa	**0.0**
48	240	1	1	1	-75	53	4wa	**0.2**
49	240	2,5	2,5	2,5	0	53	4wa	**0.8**
50	240	2,5	2,5	2,5	60	53	4wa	**0.3**
51	240	2,5	2,5	2,5	-60	53	4wa	**0.4**
52	240	5	0	0	0	53	4wa	**0.6**
53	240	5	5	5	0	53	4wa	**0.4**
54	240	5	5	5	37	53	4wa	**0.3**
55	240	5	5	5	-37	53	4wa	**0.4**
56	240	5	5	5	60	53	4wa	**0.1**
57	240	5	5	5	-60	53	4wa	**0.4**
58	240	5	5	5	75	53	4wa	**0.0**
59	240	5	5	5	-75	53	4wa	**0.3**
60	240	10	10	10	0	53	4wa	**0.4**
61	240	10	10	10	60	53	4wa	**0.2**
62	240	10	10	10	-60	53	4wa	**0.3**
63	240	20	20	20	0	53	4wa	**0.8**
64	240	20	20	20	60	53	4wa	**0.9**
65	240	20	20	20	-60	53	4wa	**0.4**
66	480	20	20	20	0	53	4wa	**0.7**
67	480	20	20	20	60	53	4wa	**0.5**
68	480	20	20	20	-60	53	4wa	**0.2**

Reactive Power 60-240 V

Nr.	***U_{1-3} (P-N)***	***I_1***	***I_2***	***I_3***	***φ***	***f***	***Mode***	***E_n (EIM)***
No.	in V	in A	in A	in A	in °	in Hz		
69	60	1	1	1	90	53	4wr	**0.6**
70	60	1	1	1	60	53	4wr	**0.5**
71	60	1	1	1	-60	53	4wr	**-0.5**
72	60	1	1	1	30	53	4wr	**0.3**
73	60	1	1	1	-30	53	4wr	**-0.2**
74	120	5	0	0	90	53	4wr	**0.4**
75	120	5	0	0	-90	53	4wr	**-0.6**
76	120	5	5	5	60	53	4wr	**0.3**
77	120	5	5	5	-60	53	4wr	**-0.3**
78	120	5	5	5	90	53	4wr	**0.4**
79	120	5	5	5	-90	53	4wr	**-0.4**

80	120	5	5	5	30	53	4wr	**0.2**
81	120	5	5	5	-30	53	4wr	**-0.2**
82	240	5	5	5	90	53	4wr	**0.3**
83	240	5	5	5	-90	53	4wr	**-0.3**
84	240	5	5	5	60	53	4wr	**0.3**
85	240	5	5	5	-60	53	4wr	**-0.3**
86	240	5	5	5	30	53	4wr	**0.3**
87	240	5	5	5	-30	53	4wr	**-0.1**

3. Conclusion

From the above tables it is seen that for all the measurement points the E_n values are between -1 and +1, which proves that the agreement of EIM and PTB is good.

From the above evaluation it is concluded that the bilateral comparison between EIM and PTB has been satisfactory and successful.

Appendix I

Measurement results and uncertainty of PTB

Active Power 60 V

Nr.	$U_{1\text{-}3}$ (P-N)	I_1	I_2	I_3		f	**Mode**	*Relative error in 10^{-6}*	
No.	in V	in A	in A	in A	in °	in Hz		$\Delta\Sigma P_i/S$	U (PTB) k=2
1	60	0,05	0,05	0,05	0	53	4wa	17	50
2	60	1	0	0	0	53	4wa	42	40
3	60	1	1	1	0	53	4wa	-49	40
4	60	1	1	1	30	53	4wa	7	40
5	60	1	1	1	-30	53	4wa	-95	40
6	60	1	1	1	60	53	4wa	64	40
7	60	1	1	1	-60	53	4wa	-114	40
8	60	1	1	1	75	53	4wa	87	40
9	60	1	1	1	-75	53	4wa	-112	40
11	60	5	5	5	0	53	4wa	27	40
12	60	5	5	5	30	53	4wa	93	40

Active Power 120 V

Nr.	$U_{1\text{-}3}$ (P-N)	I_1	I_2	I_3		f	**Mode**	*Relative error in 10^{-6}*	
No.	in V	in A	in A	in A	in °	in Hz		$\Delta\Sigma P_i/S$	U (PTB) k=2
13	120	5	0	0	0	53	4wa	73	50
14	120	5	5	5	0	53	4wa	44	40
15	120	5	5	5	30	53	4wa	80	40
16	120	5	5	5	60	53	4wa	94	40
17	120	5	5	5	75	53	4wa	91	40
18	120	5	5	5	-30	53	4wa	-7	40
19	120	5	5	5	-60	53	4wa	-53	40
20	120	5	5	5	-75	53	4wa	-74	40
21	120	0,005	0	0	0	53	4wa	-128	40
22	120	0,01	0,01	0,01	0	53	4wa	2	40
23	120	0,02	0,02	0,02	0	53	4wa	-20	40
24	120	0,05	0,05	0,05	0	53	4wa	33	40
25	120	0,1	0,1	0,1	0	53	4wa	42	40
26	120	0,2	0,2	0,2	0	53	4wa	8	40
27	120	0,5	0,5	0,5	0	53	4wa	-35	40
28	120	1	0	0	0	53	4wa	43	40
29	120	1	1	1	0	53	4wa	-33	40
30	120	2	2	2	0	53	4wa	-72	40
31	120	5	5	5	0	53	4wa	45	40
32	120	10	10	10	0	53	4wa	13	40

Active Power 240-480 V

Nr.	$U_{1\text{-}3}$ (P-N)	I_1	I_2	I_3		f	**Mode**	*Relative error in 10^{-6}*	
No.	in V	in A	in A	in A	in °	in Hz		$\Delta\Sigma P_i/S$	U (PTB) k=2
33	240	0,05	0,05	0,05	0	53	4wa	15	50
34	240	0,05	0,05	0,05	60	53	4wa	36	50
35	240	0,05	0,05	0,05	-60	53	4wa	-22	50
36	240	0,1	0,1	0,1	0	53	4wa	22	50
37	240	0,1	0,1	0,1	60	53	4wa	16	50
38	240	0,1	0,1	0,1	-60	53	4wa	6	40
39	240	0,5	0,5	0,5	0	53	4wa	-68	40
40	240	0,5	0,5	0,5	60	53	4wa	-9	40
41	240	0,5	0,5	0,5	-60	53	4wa	-43	40
42	240	1	1	1	0	53	4wa	-51	40
43	240	1	1	1	37	53	4wa	-28	40
44	240	1	1	1	-37	53	4wa	-54	40
45	240	1	1	1	60	53	4wa	-9	40
46	240	1	1	1	-60	53	4wa	-44	40
47	240	1	1	1	75	53	4wa	7	40
48	240	1	1	1	-75	53	4wa	-35	40
49	240	2,5	2,5	2,5	0	53	4wa	18	40
50	240	2,5	2,5	2,5	60	53	4wa	56	40
51	240	2,5	2,5	2,5	-60	53	4wa	-40	40
52	240	5	0	0	0	53	4wa	50	40
53	240	5	5	5	0	53	4wa	27	40
54	240	5	5	5	37	53	4wa	58	40
55	240	5	5	5	-37	53	4wa	-18	40
56	240	5	5	5	60	53	4wa	67	40
57	240	5	5	5	-60	53	4wa	-44	40
58	240	5	5	5	75	53	4wa	69	40
59	240	5	5	5	-75	53	4wa	-58	40
60	240	10	10	10	0	53	4wa	-1	40
61	240	10	10	10	60	53	4wa	12	40
62	240	10	10	10	-60	53	4wa	-24	40
63	240	20	20	20	0	53	4wa	23	40
64	240	20	20	20	60	53	4wa	0	40
65	240	20	20	20	-60	53	4wa	-22	40
66	480	20	20	20	0	53	4wa	7	40
67	480	20	20	20	60	53	4wa	-17	40
68	480	20	20	20	-60	53	4wa	20	40

Reactive Power 60-240 V

Nr.	$U_{1\text{-}3}$ (P-N)	I_1	I_2	I_3		f	**Mode**	*Relative error in 10^{-6}*	
No.	in V	in A	in A	in A	in °	in Hz		$\Delta\Sigma P_i/S$	U (PTB) k=2
69	60	1	1	1	90	53	4wr	-50	40
70	60	1	1	1	60	53	4wr	-94	40
71	60	1	1	1	-60	53	4wr	-8	40
72	60	1	1	1	30	53	4wr	-113	40
73	60	1	1	1	-30	53	4wr	-64	40
74	120	5	0	0	90	53	4wr	82	40
75	120	5	0	0	-90	53	4wr	-77	40
76	120	5	5	5	60	53	4wr	-2	40
77	120	5	5	5	-60	53	4wr	-79	40
78	120	5	5	5	90	53	4wr	44	40
79	120	5	5	5	-90	53	4wr	-41	40
80	120	5	5	5	30	53	4wr	-52	40
81	120	5	5	5	-30	53	4wr	-94	40
82	240	5	5	5	90	53	4wr	28	40
83	240	5	5	5	-90	53	4wr	-24	40
84	240	5	5	5	60	53	4wr	-5	40
85	240	5	5	5	-60	53	4wr	-53	40
86	240	5	5	5	30	53	4wr	-41	40
87	240	5	5	5	-30	53	4wr	-65	40

Appendix II

Measurement results and uncertainty of EIM

1. *Active Power at 60V*

	Input from ZERA						*TPZ*	
Nr.	*Voltage* [V]	*Current* [A]	*angle* Φ [^{0}]	*frequency* [Hz]	*phases in use*	*Measure Mode*	*Error* (ppm)	*Uncertainty (k = 2)* (ppm)
1	60	0.05	0	53	all	4wa	71	82
2	60	1	0	53	1	4wa	94	70
3	60	1	0	53	all	4wa	-4	70
4	60	1	30	53	all	4wa	50	70
5	60	1	-30	53	all	4wa	-54	70
6	60	1	60	53	all	4wa	87	70
7	60	1	-60	53	all	4wa	-92	70
8	60	1	75	53	all	4wa	98	70
9	60	1	-75	53	all	4wa	-101	70
11	60	5	0	53	all	4wa	76	70
12	60	5	30	50	all	4wa	136	70

Bilateral three-phase ac power comparison at 50 Hz

2. *Active power at 120V*

	Input from ZERA						*TPZ*	
Nr.	*Voltage* [V]	*Current* [A]	*angle* Φ [^{0}]	*frequency* [Hz]	*phases in use*	*Measure Mode*	*Error* (ppm)	*Uncertainty (k = 2)* (ppm)
13	120	5	0	53	1	4wa	123	70
14	120	5	0	53	all	4wa	76	70
15	120	5	30	53	all	4wa	107	70
16	120	5	60	53	all	4wa	108	70
17	120	5	75	53	all	4wa	99	70
18	120	5	-30	53	all	4wa	28	70
19	120	5	-60	53	all	4wa	-32	99
20	120	5	-75	53	all	4wa	-60	70
21	120	0.005	0	53	1	4wa	-69	80
22	120	0.01	0	53	all	4wa	80	80
23	120	0.02	0	53	all	4wa	30	80
24	120	0.05	0	53	all	4wa	74	80
25	120	0.1	0	53	all	4wa	76	70
26	120	0.2	0	53	all	4wa	56	70
27	120	0.5	0	53	all	4wa	-28	70
28	120	1	0	53	1	4wa	90	70
29	120	1	0	53	all	4wa	0	70
30	120	2	0	53	all	4wa	-24	70
31	120	5	0	53	all	4wa	78	70
32	120	10	0	53	all	4wa	50	70

3. *Active power at* 240-480V

	Input from ZERA						*TPZ*	
Nr.	*Voltage* [V]	*Current* [A]	*angle* Φ [^{0}]	*frequency* [Hz]	*phases in use*	*Measure Mode*	*Error* (ppm)	*Uncertainty (k = 2)* (ppm)
33	240	0.05	0	53	all	4wa	56	80
34	240	0.05	60	53	all	4wa	52	80
35	240	0.05	-60	53	all	4wa	10	80
36	240	0.1	0	53	all	4wa	56	70
37	240	0.1	60	53	all	4wa	26	70
38	240	0.1	-60	53	all	4wa	30	70
39	240	0.5	0	53	all	4wa	-48	70
40	240	0.5	60	53	all	4wa	-22	70
41	240	0.5	-60	53	all	4wa	-22	70
42	240	1	0	53	all	4wa	-16	70
43	240	1	37	53	all	4wa	-6	70
44	240	1	-37	53	all	4wa	-24	70
45	240	1	60	53	all	4wa	0	98
46	240	1	-60	53	all	4wa	-21	70
47	240	1	75	53	all	4wa	9	70
48	240	1	-75	53	all	4wa	-18	77
49	240	2.5	0	53	all	4wa	82	70
50	240	2.5	60	53	all	4wa	83	70
51	240	2.5	-60	53	all	4wa	-5	70
52	240	5	0	53	1	4wa	100	70
53	240	5	0	53	all	4wa	58	70
54	240	5	37	53	all	4wa	79	70
55	240	5	-37	53	all	4wa	16	70
56	240	5	60	53	all	4wa	74	70
57	240	5	-60	53	all	4wa	-14	70
58	240	5	75	53	all	4wa	65	70
59	240	5	-75	53	all	4wa	-34	70
60	240	10	0	53	all	4wa	32	70
61	240	10	60	53	all	4wa	29	70
62	240	10	-60	53	all	4wa	-2	70
63	240	20	0	53	all	4wa	108	100
64	240	20	60	53	all	4wa	94	101
65	240	20	-60	53	all	4wa	16	101
66	480	20	0	53	all	4wa	81	100
67	480	20	60	53	all	4wa	33	102
68	480	20	-60	53	all	4wa	41	101

4. *Reactive power at 60, 120*, 240 V

	Input from ZERA						*TPZ*	
Nr.	*Voltage* [V]	*Current* [A]	*angle* Φ [^{0}]	*frequency* [Hz]	*phases in use*	*Measure Mode*	*Error* (ppm)	*Uncertainty (k = 2)* (ppm)
69	60	1	90	53	all	4wr	8	80
70	60	1	60	53	all	4wr	-48	80
71	60	1	-60	53	all	4wr	-52	80
72	60	1	30	53	all	4wr	-89	80
73	60	1	-30	53	all	4wr	-86	80
74	120	5	90	53	1	4wr	121	80
75	120	5	-90	53	1	4wr	-129	80
76	120	5	60	53	all	4wr	26	80
77	120	5	-60	53	all	4wr	-109	80
78	120	5	90	53	all	4wr	78	80
79	120	5	-90	53	all	4wr	-78	80
80	120	5	30	53	all	4wr	-30	80
81	120	5	-30	53	all	4wr	-111	98
82	240	5	90	53	all	4wr	57	81
83	240	5	-90	53	all	4wr	-55	80
84	240	5	60	53	all	4wr	25	80
85	240	5	-60	53	all	4wr	77	80
86	240	5	30	53	all	4wr	-12	80
87	240	5	-30	53	all	4wr	-72	80