

## Key comparisons CCEM-K11 and CCEM-K11.1

MEASURAND : AC/DC voltage transfer difference

NOMINAL VOLTAGE : 10 mV

FREQUENCY : 1 kHz, 20 kHz, 100 kHz and 1 MHz

$x_i$  : measurement result of laboratory  $i$  corrected as explained in section 6 of the Final Report

$U_{Lab i}$  : expanded uncertainty ( $k = 2$ ) of  $x_i$

Lab $i$	$x_i$	$U_{Lab i}$	$x_i$	$U_{Lab i}$	$x_i$	$U_{Lab i}$	$x_i$	$U_{Lab i}$	Date of measurement
	/ ( $\mu V/V$ )	/ ( $\mu V/V$ )	/ ( $\mu V/V$ )	/ ( $\mu V/V$ )	/ ( $\mu V/V$ )	/ ( $\mu V/V$ )	/ ( $\mu V/V$ )	/ ( $\mu V/V$ )	
	Frequency 1 kHz		Frequency 20 kHz		Frequency 100 kHz		Frequency 1 MHz		
SP	-0.7	22.2	-0.7	22.8	1.7	33.3	-4.4	100.7	Sep 01
PTB	-4.6	41.1	-11.7	42.4	-6.2	45.2	-20.6	107.3	Oct 01
NPL	-2.1	30.2	-2.8	30.5	6.4	42.2	-21.9	283.6	Dec 01
VSL	-7.1	40.1	-5.7	40.4	-2.2	50.2	50.1	300.7	Jan 02
SP	-1.2	22.2	-2.3	22.6	0.6	33.2	1.1	100.1	Jul 02
NMIA	1.4	14.3	3.4	16.9	9.7	42.2	26.9	108.9	Aug 02
INTI	14.3	26.2	12.4	29.5	15.5	46.2	-5.0	111.8	Oct 02
SP	0.9	22.2	1.3	22.6	-2.1	33.3	2.5	101.8	Jan 03
NRC	9.6	36.1	3.2	32.4	9.9	61.1	65.3	92.2	Feb 03
SP	1.9	22.2	4.3	22.6	-1.5	33.2	-2.8	100.4	Jun 03
A*STAR	0.2	34.1	-0.7	37.4	-6.6	44.2	-18.3	370.7	Jul 03
NIM	-39.0	78.0	-26.7	78.2	4.2	96.1	161.2	188.2	Aug 03
SP	0.8	22.2	-0.6	22.6	-1.1	33.2	12.1	101.5	Oct 03
SP	-0.7	22.2	-0.8	22.7	1.2	33.2	-6.8	100.5	Jun 04
NIST	7.3	36.5	25.8	38.9	0.3	50.6	43.1	143.1	Aug 04
SP	-0.9	22.2	-1.1	22.8	1.1	33.3	-1.8	101.3	Feb 05

Laboratories participant in CCEM-K11.1

## Key comparisons CCEM-K11 and CCEM-K11.1

MEASURAND : AC/DC voltage transfer difference

NOMINAL VOLTAGE : 100 mV

FREQUENCY : 1 kHz, 20 kHz, 100 kHz and 1 MHz

$x_i$  : measurement result of laboratory  $i$  corrected as explained in section 6 of the Final Report

$U_{Lab i}$  : expanded uncertainty ( $k = 2$ ) of  $x_i$

Lab $i$	$x_i$	$U_{Lab i}$	$x_i$	$U_{Lab i}$	$x_i$	$U_{Lab i}$	$x_i$	$U_{Lab i}$	Date of measurement
	/ ( $\mu V/V$ )	/ ( $\mu V/V$ )	/ ( $\mu V/V$ )	/ ( $\mu V/V$ )	/ ( $\mu V/V$ )	/ ( $\mu V/V$ )	/ ( $\mu V/V$ )	/ ( $\mu V/V$ )	
	Frequency 1 kHz		Frequency 20 kHz		Frequency 100 kHz		Frequency 1 MHz		
SP	-0.3	6.7	-0.2	6.9	0.2	13.1	0.4	62.8	Sep 01
PTB	-0.2	3.0	-0.6	5.0	0.1	6.8	-35.4	50.6	Oct 01
NPL	-5.6	9.1	-3.5	9.1	-1.0	13.1	-25.2	67.5	Dec 01
VSL	-2.2	8.1	0.6	12.1	1.0	15.1	-8.0	101.3	Jan 02
SP	0.4	6.7	0.9	6.9	0.6	13.1	-6.4	62.2	Jul 02
NMIA	-0.6	6.0	2.6	7.1	0.5	16.1	5.6	77.7	Aug 02
INTI	-0.6	10.0	0.6	10.1	1.4	21.1	-36.9	62.1	Oct 02
SP	0.6	6.7	-0.4	6.9	0.1	13.2	10.3	65.2	Jan 03
NRC	0.2	5.1	-0.5	6.1	5.1	7.3	6.4	32.9	Feb 03
SP	-0.3	6.7	-0.3	6.9	-1.1	13.1	-1.2	62.5	Jun 03
A*STAR	-3.8	18.0	-4.5	24.0	-4.2	27.1	-12.8	87.9	Jul 03
NIM	3.2	14.0	-3.5	16.0	9.7	30.0	64.8	99.4	Aug 03
SP	-0.5	6.7	-0.4	6.9	-0.4	13.2	1.1	63.6	Oct 03
SP	0.0	6.7	0.0	6.9	0.1	13.1	-8.0	62.8	Jun 04
NIST	-1.4	12.0	-3.1	12.4	4.3	22.7	-6.4	71.8	Aug 04
SP	0.1	6.7	0.3	6.9	0.6	13.2	3.9	64.1	Feb 05

Laboratories participant in CCEM-K11.1

## Key comparison SIM.EM-K11

MEASURAND : AC-DC transfer difference

VOLTAGE : 100 mV

FREQUENCY : 1 kHz, 20 kHz, 100 kHz and 1 MHz

$\delta_{\text{Lab } i\text{-SIM}}$ : result of measurement carried out by laboratory *i* participant in SIM.EM-K11

$U_{\text{Lab } i\text{-SIM}}$ : expanded uncertainty ( $k = 2$ ) of  $\delta_{\text{Lab } i\text{-SIM}}$

$u_{\text{Lab } i\text{-SIM}}$ : standard uncertainty ( $k = 1$ ) of  $\delta_{\text{Lab } i\text{-SIM}}$

Lab <i>i</i>	$\delta_{\text{Lab } i\text{-SIM}}$	$U_{\text{Lab } i\text{-SIM}}$	$\delta_{\text{Lab } i\text{-SIM}}$	$U_{\text{Lab } i\text{-SIM}}$	$\delta_{\text{Lab } i\text{-SIM}}$	$U_{\text{Lab } i\text{-SIM}}$	$\delta_{\text{Lab } i\text{-SIM}}$	$U_{\text{Lab } i\text{-SIM}}$	Date of measurement
	/ $\mu\text{V/V}$	/ $\mu\text{V/V}$	/ $\mu\text{V/V}$	/ $\mu\text{V/V}$	/ $\mu\text{V/V}$	/ $\mu\text{V/V}$	/ $\mu\text{V/V}$	/ $\mu\text{V/V}$	
	Frequency 1 kHz		Frequency 20 kHz		Frequency 100 kHz		Frequency 1 MHz		
INTI	8.7	12.6	3.0	13	19.0	25	14.0	75	04 Mar to 16 Apr 04
INMETRO	8.0	8.0	-2.0	8.0	18.0	13.0	79.0	98.0	28 Jun to 28 Jul 04
CENAM	7.5	23	-6.0	23	21.6	23	59.9	42	26 to 30 Aug 04
NRC	9.5	9.5	-1.8	8.5	24.1	10.3	75.0	23.0	Sep to Oct 04

Lab <i>i</i>	$\delta_{\text{Lab } i\text{-SIM}}$	$u_{\text{Lab } i\text{-SIM}}$	$\delta_{\text{Lab } i\text{-SIM}}$	$u_{\text{Lab } i\text{-SIM}}$	$\delta_{\text{Lab } i\text{-SIM}}$	$u_{\text{Lab } i\text{-SIM}}$	$\delta_{\text{Lab } i\text{-SIM}}$	$u_{\text{Lab } i\text{-SIM}}$	Date of measurement
	/ $\mu\text{V/V}$	/ $\mu\text{V/V}$	/ $\mu\text{V/V}$	/ $\mu\text{V/V}$	/ $\mu\text{V/V}$	/ $\mu\text{V/V}$	/ $\mu\text{V/V}$	/ $\mu\text{V/V}$	
	Frequency 1 kHz		Frequency 20 kHz		Frequency 100 kHz		Frequency 1 MHz		
UTE	14.0	7.5	-2.0	7.7	18.0	18	26	52	18 May to 22 Jun 04

## Key comparison EUROMET.EM-K11

MEASURAND : AC-DC transfer difference

VOLTAGE : 10 mV and 100 mV

FREQUENCY : 1 kHz, 20 kHz, 100 kHz and 1 MHz

The values reported by the participants in EUROMET.EM-K11 are given in Table 9 (page 14) and Table 10 (page 18) of the EUROMET.EM-K11 Final Report for 100 mV and 10 mV, respectively. Measurements were conducted between June 2005 and April 2008. The results after correction for the drift of the travelling standard are reported in Section 6.1.8 of the EUROMET.EM-K11 Final Report (page 22 to page 29).

## Key comparisons CCEM-K11, CCEM-K11.1, SIM.EM-K11 and EUROMET.EM-K11

MEASURAND : AC/DC voltage transfer difference

### Key comparisons CCEM-K11 and CCEM-K11.1

NOMINAL VOLTAGE : 10 mV and 100 mV

FREQUENCY : 1 kHz, 20 kHz, 100 kHz and 1 MHz

For each nominal value of the voltage and for each frequency, the key comparison reference value,  $x_R$ , is calculated as the weighted mean of the results of all participants in CCEM-K11. The value of the mean of the seven results of SP is used for the computation of  $x_R$ , see equations 10 and 11 of the Final Report. The standard uncertainty  $u_R$  of  $x_R$  is computed as given in section 6.1.4 of the Final Report.

	Frequency 1 kHz		Frequency 20 kHz		Frequency 100 kHz		Frequency 1 MHz	
	$x_R$ / ( $\mu\text{V/V}$ )	$2u_R$ / ( $\mu\text{V/V}$ )	$x_R$ / ( $\mu\text{V/V}$ )	$2u_R$ / ( $\mu\text{V/V}$ )	$x_R$ / ( $\mu\text{V/V}$ )	$2u_R$ / ( $\mu\text{V/V}$ )	$x_R$ / ( $\mu\text{V/V}$ )	$2u_R$ / ( $\mu\text{V/V}$ )
10 mV	1.6	9.2	1.0	10.4	2.8	15.8	24	49
100 mV	-0.5	2.3	-0.3	2.9	1.6	4.5	-7	27

The degree of equivalence of laboratory  $i$  with respect to the key comparison reference value is given by a pair of terms, both expressed in  $\mu\text{V/V}$ :  $D_i = (x_i - x_R)$  and its expanded uncertainty  $U_i$  ( $k = 2$ ). The equations for the computation of  $U_i$  are given in section 6.1.6 of the Final Report.

The degree of equivalence between two laboratories  $i$  and  $j$  is given by a pair of terms, both expressed in  $\mu\text{V/V}$ :  $D_{ij} = (x_i - x_j)$  and its expanded uncertainty  $U_{ij}$  ( $k = 2$ ). The equations for the computation of  $U_{ij}$  are given in section 6.1.7 of the Final Report.

## Linking key comparison SIM.EM-K11 to key comparison CCEM-K11

NOMINAL VOLTAGE : 100 mV

FREQUENCY : 1 kHz, 20 kHz, 100 kHz and 1 MHz

INTI and NRC provide the link between SIM.EM-K11 and CCEM-K11. The linkage process is described in section 11 of the SIM.EM-K11 Final Report.

The degree of equivalence of laboratory  $i$  participant in SIM.EM-K11 with respect to the CCEM-K11 key comparison reference value is given by a pair of terms both expressed in  $\mu V/V$ :  $D_i$  and  $U_i$ , its expanded uncertainty ( $k = 2$ ).

Pair-wise degrees of equivalence inside SIM.EM-K11 are not computed.

## Linking key comparison EUROMET.EM-K11 to key comparison CCEM-K11

NOMINAL VOLTAGE : 10 mV and 100 mV

FREQUENCY : 1 kHz, 20 kHz, 100 kHz and 1 MHz

The degrees of equivalence relative to the EUROMET.EM-K11 reference value are reported in Table 19 (page 30) and in Table 20 (page 33) of the EUROMET.EM-K11 Final Report for 100 mV and 10 mV, respectively.

SP, PTB and VSL then provide the link between EUROMET.EM-K11 and CCEM-K11. The linkage process is described in Sections 6.1.10, 6.1.11 and 6.1.12 of the EUROMET.EM-K11 Final Report.

The degree of equivalence of laboratory  $i$  participant in EUROMET.EM-K11 with respect to the CCEM-K11 key comparison reference value is given by a pair of terms both expressed in  $\mu V/V$ :  $D_i$  and  $U_i$ , its expanded uncertainty ( $k = 2$ ).

Pair-wise degrees of equivalence inside EUROMET.EM-K11 are reported in Appendix 1 of the EUROMET.EM-K11 Final Report.

Key comparisons CCEM-K11, CCEM-K11.1 and EUROMET.EM-K11

MEASURAND : AC/DC voltage transfer difference

NOMINAL VOLTAGE : 10 mV

FREQUENCY : 1 kHz

Lab j →

Lab i ↓

	$D_i$ $U_i$ / ( $\mu$ V/V)		PTB		NPL		NMi-VSL		NMIA		INTI		NRC		SPRING		NIM		SP		NIST		
	$D_{ij}$ / ( $\mu$ V/V)	$U_{ij}$ / ( $\mu$ V/V)	$D_{ij}$ / ( $\mu$ V/V)	$U_{ij}$ / ( $\mu$ V/V)	$D_{ij}$ / ( $\mu$ V/V)	$U_{ij}$ / ( $\mu$ V/V)	$D_{ij}$ / ( $\mu$ V/V)	$U_{ij}$ / ( $\mu$ V/V)	$D_{ij}$ / ( $\mu$ V/V)	$U_{ij}$ / ( $\mu$ V/V)	$D_{ij}$ / ( $\mu$ V/V)	$U_{ij}$ / ( $\mu$ V/V)	$D_{ij}$ / ( $\mu$ V/V)	$U_{ij}$ / ( $\mu$ V/V)	$D_{ij}$ / ( $\mu$ V/V)	$U_{ij}$ / ( $\mu$ V/V)	$D_{ij}$ / ( $\mu$ V/V)	$U_{ij}$ / ( $\mu$ V/V)	$D_{ij}$ / ( $\mu$ V/V)	$U_{ij}$ / ( $\mu$ V/V)	$D_{ij}$ / ( $\mu$ V/V)	$U_{ij}$ / ( $\mu$ V/V)	
PTB	-6	40																					
NPL	-4	29	2	51			5	50	-4	33	-16	40	-12	47	-2	45	37	84	-2	37	-9	47	
VSL	-9	39	-3	57	-5	50			-9	42	-21	48	-17	54	-7	53	32	88	-7	46	-14	54	
NMIA	0	11	6	43	4	33	9	42			-13	30	-8	39	1	37	40	79	1	26	-6	39	
INTI	13	25	19	49	16	40	21	48	13	30			5	44	14	43	53	82	14	34	7	45	
NRC	8	35	14	55	12	47	17	54	8	39	-5	44			9	50	49	86	10	42	2	51	
A*STAR	-1	33	5	53	2	45	7	53	-1	37	-14	43	-9	50			39	85	0	40	-7	50	
NIM	-41	78	-34	88	-37	84	-32	88	-40	79	-53	82	-49	86	-39	85			-39	81	-46	86	
SP	-2	20	5	47	2	37	7	46	-1	26	-14	34	-10	42	0	40	39	81			-7	43	
NIST	6	38	12	55	9	47	14	54	6	39	-7	45	-2	51	7	50	46	86	7	43			

JV	5	31
INRIM	-17	26
BEV	6	38
MKEH	1	26
IPQ	2	61
CEM	-5	45
MIRS/SIQ/Metrology	0	74
MIKES	13	33
Trescal	-16	46
LNE	2	23
METAS	-30	38
UME	5	51
NMISA	-6	62
CMI	2	58
EIM	4	88
NPLI	-7	26
VNIIM	2	29

Red: participants in CCEM-K11

Green: participant in CCEM-K11.1 only

Brown: participants in EUROMET.EM-K11 only

Key comparisons CCEM-K11, CCEM-K11.1 and EUROMET.EM-K11

MEASURAND : AC/DC voltage transfer difference

NOMINAL VOLTAGE : 10 mV

FREQUENCY : 20 kHz

Lab j →

Lab i ↓

	$D_i$ $U_i$ / (μV/V)		PTB		NPL		NMi-VSL		NMIA		INTI		NRC		SPRING		NIM		SP		NIST	
	$D_{ij}$ / (μV/V)	$U_{ij}$ / (μV/V)	$D_{ij}$ / (μV/V)	$U_{ij}$ / (μV/V)	$D_{ij}$ / (μV/V)	$U_{ij}$ / (μV/V)	$D_{ij}$ / (μV/V)	$U_{ij}$ / (μV/V)	$D_{ij}$ / (μV/V)	$U_{ij}$ / (μV/V)	$D_{ij}$ / (μV/V)	$U_{ij}$ / (μV/V)	$D_{ij}$ / (μV/V)	$U_{ij}$ / (μV/V)	$D_{ij}$ / (μV/V)	$U_{ij}$ / (μV/V)	$D_{ij}$ / (μV/V)	$U_{ij}$ / (μV/V)	$D_{ij}$ / (μV/V)	$U_{ij}$ / (μV/V)	$D_{ij}$ / (μV/V)	$U_{ij}$ / (μV/V)
PTB	-13	41																				
NPL	-4	29	9	52			3	50	-6	34	-15	42	-6	44	-2	48	24	84	-3	37	-29	49
VSL	-7	39	6	58	-3	50			-9	43	-18	49	-9	51	-5	54	21	88	-6	46	-32	56
NMIA	2	14	15	45	6	34	9	43			-9	33	0	36	4	40	30	80	3	27	-22	42
INTI	11	28	24	51	15	42	18	49	9	33			9	43	13	47	39	83	12	36	-13	48
NRC	2	31	15	53	6	44	9	51	0	36	-9	43			4	49	30	84	3	39	-23	50
A*STAR	-2	36	11	56	2	48	5	54	-4	40	-13	47	-4	49			26	86	-1	43	-26	53
NIM	-28	78	-15	89	-24	84	-21	88	-30	80	-39	83	-30	84	-26	86			-27	81	-52	87
SP	-1	21	12	47	3	37	6	46	-3	27	-12	36	-3	39	1	43	27	81			-26	44
NIST	25	40	38	57	29	49	32	56	22	42	13	48	23	50	26	53	52	87	26	44		

JV	11	32
INRIM	-18	25
BEV	0	38
MKEH	-3	26
IPQ	-6	60
CEM	-4	45
MIRS/SIQ/Metrology	-12	73
MIKES	8	32
Trescal	-26	46
LNE	6	26
METAS	-42	37
UME	7	51
NMISA	17	60
CMI	1	62
EIM	-3	83
NPLI	-8	25
VNIIM	20	30

Red: participants in CCEM-K11

Green: participant in CCEM-K11.1 only

Brown: participants in EUROMET.EM-K11 only

Key comparisons CCEM-K11 and CCEM-K11.1

MEASURAND : AC/DC voltage transfer difference

NOMINAL VOLTAGE : 10 mV

FREQUENCY : 100 kHz

Lab j →

Lab i ↓

	$D_i$ $U_i$ / (μV/V)		PTB		NPL		NMI-VSL		NMIA		INTI		NRC		SPRING		NIM		SP		NIST	
	$D_{ij}$ / (μV/V)	$U_{ij}$ / (μV/V)	$D_{ij}$ / (μV/V)	$U_{ij}$ / (μV/V)	$D_{ij}$ / (μV/V)	$U_{ij}$ / (μV/V)	$D_{ij}$ / (μV/V)	$U_{ij}$ / (μV/V)	$D_{ij}$ / (μV/V)	$U_{ij}$ / (μV/V)	$D_{ij}$ / (μV/V)	$U_{ij}$ / (μV/V)	$D_{ij}$ / (μV/V)	$U_{ij}$ / (μV/V)	$D_{ij}$ / (μV/V)	$U_{ij}$ / (μV/V)	$D_{ij}$ / (μV/V)	$U_{ij}$ / (μV/V)	$D_{ij}$ / (μV/V)	$U_{ij}$ / (μV/V)	$D_{ij}$ / (μV/V)	$U_{ij}$ / (μV/V)
PTB	-9	43			-13	62	-4	67	-16	62	-22	64	-16	76	0	63	-10	106	-6	56	-6	68
NPL	4	40	13	62			9	66	-3	59	-9	62	-3	74	13	61	2	105	6	53	6	66
VSL	-5	48	4	67	-9	66			-12	65	-18	68	-12	79	4	67	-6	108	-2	60	-3	71
NMIA	7	39	16	62	3	59	12	65			-6	62	0	74	16	61	6	105	10	53	9	66
INTI	13	44	22	64	9	62	18	68	6	62			6	76	22	64	11	106	16	57	15	68
NRC	7	59	16	76	3	74	12	79	0	74	-6	76			16	75	6	114	10	69	10	79
A*STAR	-9	42	0	63	-13	61	-4	67	-16	61	-22	64	-16	75			-11	106	-7	55	-7	67
NIM	1	95	10	106	-2	105	6	108	-6	105	-11	106	-6	114	11	106			4	101	4	108
SP	-3	30	6	56	-6	53	2	60	-10	53	-16	57	-10	69	7	55	-4	101			0	60
NIST	-3	53	6	68	-6	66	3	71	-9	66	-15	68	-10	79	7	67	-4	108	0	60		

JV	19	73
INRIM	-32	45
BEV	-3	46
MKEH	-9	37
IPQ	-10	71
CEM	-2	65
MIRS/SIQ/Metrology	-10	123
MIKES	-1	45
Trescal	-32	67
LNE	-5	33
METAS	-44	58
UME	-19	60
NMISA	2	139
CMI	1	84
EIM	39	90
NPLI	-22	30
VNIIM	62	69

Red: participants in CCEM-K11

Green: participant in CCEM-K11.1 only

Brown: participants in EUROMET.EM-K11 only



Key comparisons CCEM-K11 and CCEM-K11.1

MEASURAND : AC/DC voltage transfer difference

NOMINAL VOLTAGE : 10 mV

FREQUENCY : 1 MHz

Lab j →

Lab i ↓

	$D_i$ $U_i$ / (μV/V)		PTB		NPL		NMi-VSL		NMIA		INTI		NRC		SPRING		NIM		SP		NIST	
	$D_{ij}$ / (μV/V)	$U_{ij}$ / (μV/V)	$D_{ij}$ / (μV/V)	$U_{ij}$ / (μV/V)	$D_{ij}$ / (μV/V)	$U_{ij}$ / (μV/V)	$D_{ij}$ / (μV/V)	$U_{ij}$ / (μV/V)	$D_{ij}$ / (μV/V)	$U_{ij}$ / (μV/V)	$D_{ij}$ / (μV/V)	$U_{ij}$ / (μV/V)	$D_{ij}$ / (μV/V)	$U_{ij}$ / (μV/V)	$D_{ij}$ / (μV/V)	$U_{ij}$ / (μV/V)	$D_{ij}$ / (μV/V)	$U_{ij}$ / (μV/V)	$D_{ij}$ / (μV/V)	$U_{ij}$ / (μV/V)	$D_{ij}$ / (μV/V)	$U_{ij}$ / (μV/V)
<b>PTB</b>	-44	100			1	302	-71	318	-48	151	-16	149	-86	140	-2	383	-182	212	-21	141	-64	177
<b>NPL</b>	-46	281	-1	302			-72	413	-49	303	-17	304	-87	297	-4	466	-183	340	-22	300	-65	317
<b>VSL</b>	26	298	71	318	72	413			23	319	55	320	-15	314	68	477	-111	354	50	316	7	332
<b>NMIA</b>	3	102	48	151	49	303	-23	319			32	154	-38	142	45	386	-134	216	27	147	-16	179
<b>INTI</b>	-29	105	16	149	17	304	-55	320	-32	154			-70	144	13	384	-166	214	-5	143	-48	181
<b>NRC</b>	42	84	86	140	87	297	15	314	38	142	70	144			84	382	-96	209	65	134	22	168
<b>A*STAR</b>	-42	369	2	383	4	466	-68	477	-45	386	-13	384	-84	382			-180	413	-18	382	-61	397
<b>NIM</b>	138	184	182	212	183	340	111	354	134	216	166	214	96	209	180	413			161	208	118	236
<b>SP</b>	-24	94	21	141	22	300	-50	316	-27	147	5	143	-65	134	18	382	-161	208			-43	173
<b>NIST</b>	19	151	64	177	65	317	-7	332	16	179	48	181	-22	168	61	397	-118	236	43	173		

<b>JV</b>	8	269
<b>INRIM</b>	-141	142
<b>BEV</b>	-49	148
<b>MKEH</b>	-172	233
<b>IPQ</b>	79	287
<b>CEM</b>	2	168
<b>MIRS/SIQ/Metrology</b>	31	754
<b>MIKES</b>	-38	147
<b>Trescal</b>	-126	207
<b>LNE</b>	-	-
<b>METAS</b>	-151	129
<b>UME</b>	-51	132
<b>NMISA</b>	-579	758
<b>CMI</b>	40	243
<b>EIM</b>	126	190
<b>NPLI</b>	-2	83
<b>VNIIM</b>	53	178

Red: participants in CCEM-K11

Green: participant in CCEM-K11.1 only

Brown: participants in EUROMET.EM-K11 only

Key comparisons CCEM.K11, CCEM-K11.1, SIM.EM-K11 and EUROMET.EM-K11

MEASURAND : AC/DC voltage transfer difference

NOMINAL VOLTAGE : 100 mV

FREQUENCY : 1 kHz

Lab i ↓			Lab j →																			
	$D_i$ $I$ ( $\mu$ V/V)	$U_i$ $I$ ( $\mu$ V/V)	PTB		NPL		NMI-VSL		NMIA		INTI		NRC		SPRING		NIM		SP		NIST	
			$D_{ij}$ $I$ ( $\mu$ V/V)	$U_{ij}$ $I$ ( $\mu$ V/V)	$D_{ij}$ $I$ ( $\mu$ V/V)	$U_{ij}$ $I$ ( $\mu$ V/V)	$D_{ij}$ $I$ ( $\mu$ V/V)	$U_{ij}$ $I$ ( $\mu$ V/V)	$D_{ij}$ $I$ ( $\mu$ V/V)	$U_{ij}$ $I$ ( $\mu$ V/V)	$D_{ij}$ $I$ ( $\mu$ V/V)	$U_{ij}$ $I$ ( $\mu$ V/V)	$D_{ij}$ $I$ ( $\mu$ V/V)	$U_{ij}$ $I$ ( $\mu$ V/V)	$D_{ij}$ $I$ ( $\mu$ V/V)	$U_{ij}$ $I$ ( $\mu$ V/V)	$D_{ij}$ $I$ ( $\mu$ V/V)	$U_{ij}$ $I$ ( $\mu$ V/V)	$D_{ij}$ $I$ ( $\mu$ V/V)	$U_{ij}$ $I$ ( $\mu$ V/V)	$D_{ij}$ $I$ ( $\mu$ V/V)	$U_{ij}$ $I$ ( $\mu$ V/V)
<b>PTB</b>	0.3	2.5			5.4	9.4	2.0	8.4	0.4	6.5	0.5	10.4	-0.4	5.9	3.6	18.2	-3.3	14.4	-0.2	7.2	1.2	12.5
<b>NPL</b>	-5.1	8.9	-5.4	9.4			-3.4	12.0	-5.0	10.8	-4.9	13.5	-5.8	10.4	-1.8	20.2	-8.8	16.7	-5.6	11.3	-4.2	15.2
<b>VSL</b>	-1.7	7.9	-2.0	8.4	3.4	12.0			-1.6	10.0	-1.6	12.8	-2.4	9.5	1.6	19.8	-5.4	16.2	-2.2	10.5	-0.8	14.6
<b>NMIA</b>	-0.1	5.7	-0.4	6.5	5.0	10.8	1.6	10.0			0.0	11.7	-0.9	7.8	3.2	19.0	-3.8	15.3	-0.6	9.0	0.8	13.5
<b>INTI</b>	-0.1	9.9	-0.5	10.4	4.9	13.5	1.6	12.8	0.0	11.7			-0.9	11.3	3.2	20.6	-3.8	17.3	-0.6	12.1	0.8	15.7
<b>NRC</b>	0.7	4.8	0.4	5.9	5.8	10.4	2.4	9.5	0.9	7.8	0.9	11.3			4.0	18.7	-2.9	14.9	0.2	8.4	1.6	13.1
<b>A*STAR</b>	-3.3	18.0	-3.6	18.2	1.8	20.2	-1.6	19.8	-3.2	19.0	-3.2	20.6	-4.0	18.7			-7.0	22.8	-3.8	19.0	-2.4	21.7
<b>NIM</b>	3.7	13.9	3.3	14.4	8.8	16.7	5.4	16.2	3.8	15.3	3.8	17.3	2.9	14.9	7.0	22.8			3.2	15.5	4.6	18.5
<b>SP</b>	0.5	6.5	0.2	7.2	5.6	11.3	2.2	10.5	0.6	9.0	0.6	12.1	-0.2	8.4	3.8	19.0	-3.2	15.5			1.4	13.8
<b>NIST</b>	-0.9	12.3	-1.2	12.5	4.2	15.2	0.8	14.6	-0.8	13.5	-0.8	15.7	-1.6	13.1	2.4	21.7	-4.6	18.5	-1.4	13.8		
<b>UTE</b>	5.2	18.1																				
<b>INMETRO</b>	-0.8	12.8																				
<b>CENAM</b>	-1.3	25.1																				
<b>JV</b>	0.8	14.3																				
<b>INRIM</b>	-10.0	10.0																				
<b>BEV</b>	2.4	12.7																				
<b>MKEH</b>	1.6	8.0																				
<b>IPQ</b>	9.5	41.2																				
<b>CEM</b>	3.4	10.8																				
<b>MIRS/SIQ/Metrology</b>	4.4	30.3																				
<b>MIKES</b>	1.4	6.2																				
<b>Trescal</b>	-8.7	8.5																				
<b>LNE</b>	2.6	7.5																				
<b>METAS</b>	-11.1	13.3																				
<b>UME</b>	1.1	13.6																				
<b>NMISA</b>	6.9	18.0																				
<b>CMI</b>	2.3	19.4																				
<b>EIM</b>	1.6	5.6																				
<b>NPLI</b>	-7.7	11.5																				
<b>VNIIM</b>	1.4	10.4																				

Red: participants in CCEM-K11  
 Green: participant in CCEM-K11.1 only  
 Blue: participants in SIM.EM-K11 only  
 Brown: participants in EUROMET.EM-K11 only

Key comparisons CCEM.K11, CCEM-K11.1, SIM.EM-K11 and EUROMET.EM-K11

MEASURAND : AC/DC voltage transfer difference

NOMINAL VOLTAGE : 100 mV

FREQUENCY : 20 kHz

Lab i ↓			Lab j →																			
	$D_i$	$U_i$	PTB		NPL		NMI-VSL		NMIA		INTI		NRC		SPRING		NIM		SP		NIST	
	$I$ ( $\mu$ V/V)	$I$ ( $\mu$ V/V)	$D_{ij}$	$U_{ij}$	$D_{ij}$	$U_{ij}$	$D_{ij}$	$U_{ij}$	$D_{ij}$	$U_{ij}$	$D_{ij}$	$U_{ij}$	$D_{ij}$	$U_{ij}$	$D_{ij}$	$U_{ij}$	$D_{ij}$	$U_{ij}$	$D_{ij}$	$U_{ij}$	$D_{ij}$	$U_{ij}$
PTB	-0.3	4.3			2.9	10.1	-1.2	12.9	-3.2	8.5	-1.2	11.1	-0.1	7.8	3.9	24.5	2.9	16.8	-0.6	8.4	2.5	13.5
NPL	-3.2	8.7	-2.9	10.1			-4.1	15.0	-6.1	11.4	-4.1	13.5	-3.0	10.9	1.0	25.7	0.0	18.5	-3.5	11.4	-0.4	15.5
VSL	0.9	11.8	1.2	12.9	4.1	15.0			-2.0	13.9	0.0	15.7	1.1	13.5	5.1	26.9	4.1	20.1	0.6	13.9	3.7	17.4
NMIA	2.9	6.7	3.2	8.5	6.1	11.4	2.0	13.9			2.0	12.3	3.0	9.4	7.0	25.1	6.0	17.6	2.6	9.9	5.7	14.4
INTI	0.9	9.8	1.2	11.1	4.1	13.5	0.0	15.7	-2.0	12.3			1.0	11.8	5.0	26.1	4.0	18.9	0.6	12.2	3.7	16.0
NRC	-0.2	5.6	0.1	7.8	3.0	10.9	-1.1	13.5	-3.0	9.4	-1.0	11.8			4.0	24.8	3.0	17.2	-0.5	9.2	2.6	13.8
A*STAR	-4.2	23.9	-3.9	24.5	-1.0	25.7	-5.1	26.9	-7.0	25.1	-5.0	26.1	-4.0	24.8			-1.0	28.8	-4.5	24.9	-1.4	27.0
NIM	-3.2	15.8	-2.9	16.8	0.0	18.5	-4.1	20.1	-6.0	17.6	-4.0	18.9	-3.0	17.2	1.0	28.8			-3.5	17.2	-0.4	20.3
SP	0.3	6.5	0.6	8.4	3.5	11.4	-0.6	13.9	-2.6	9.9	-0.6	12.2	0.5	9.2	4.5	24.9	3.5	17.2			3.1	14.2
NIST	-2.8	12.7	-2.5	13.5	0.4	15.5	-3.7	17.4	-5.7	14.4	-3.7	16.0	-2.6	13.8	1.4	27.0	0.4	20.3	-3.1	14.2		

UTE	-1.1	18.2
INMETRO	-1.1	12.5
CENAM	-5.1	24.9

JV	0.3	15.6
INRIM	-8.4	10.4
BEV	0.4	14.1
MKEH	0.5	9.9
IPQ	6.1	48.3
CEM	-7.9	11.4
MIRS/SIQ/Metrology	1.1	30.5
MIKES	0.2	7.8
Trescal	-9.0	9.1
LNE	0.5	9.1
METAS	-12.1	10.0
UME	5.0	15.1
NMISA	6.5	18.7
CMI	3.4	21.7
EIM	2.8	6.6
NPLI	-1.8	12.2
VNIIM	18.2	14.1

Red: participants in CCEM-K11  
 Green: participant in CCEM-K11.1 only  
 Blue: participants in SIM.EM-K11 only  
 Brown: participants in EUROMET.EM-K11 only

Key comparisons CCEM.K11, CCEM-K11.1, SIM.EM-K11 and EUROMET.EM-K11

MEASURAND : AC/DC voltage transfer difference

NOMINAL VOLTAGE : 100 mV

FREQUENCY : 100 kHz

Lab i ↓			Lab j →																			
	$D_i$	$U_i$	PTB		NPL		NMI-VSL		NMIA		INTI		NRC		SPRING		NIM		SP		NIST	
	$I$ ( $\mu$ V/V)	$I$ ( $\mu$ V/V)	$D_{ij}$	$U_{ij}$	$D_{ij}$	$U_{ij}$	$D_{ij}$	$U_{ij}$	$D_{ij}$	$U_{ij}$	$D_{ij}$	$U_{ij}$	$D_{ij}$	$U_{ij}$	$D_{ij}$	$U_{ij}$	$D_{ij}$	$U_{ij}$	$D_{ij}$	$U_{ij}$	$D_{ij}$	$U_{ij}$
PTB	-1.5	6.0			1.2	14.5	-0.9	16.3	-0.4	17.3	-1.3	21.7	-5.0	9.9	4.3	27.7	-9.6	30.6	0.1	14.3	-4.2	23.9
NPL	-2.6	12.7	-1.2	14.5			-2.0	20.0	-1.5	20.7	-2.4	24.8	-6.1	14.9	3.2	30.1	-10.7	32.8	-1.0	18.6	-5.4	26.3
VSL	-0.6	14.7	0.9	16.3	2.0	20.0			0.5	22.0	-0.4	25.8	-4.1	16.7	5.2	31.0	-8.7	33.6	1.0	20.0	-3.3	27.4
NMIA	-1.1	15.8	0.4	17.3	1.5	20.7	-0.5	22.0			-0.9	26.5	-4.6	17.7	4.7	31.5	-9.2	34.1	0.5	20.8	-3.8	27.9
INTI	-0.2	20.8	1.3	21.7	2.4	24.8	0.4	25.8	0.9	26.5			-3.7	22.3	5.6	34.0	-8.3	36.4	1.4	24.5	-3.0	31.0
NRC	3.5	6.6	5.0	9.9	6.1	14.9	4.1	16.7	4.6	17.7	3.7	22.3			9.3	28.1	-4.6	30.9	5.1	14.9	0.8	23.8
A*STAR	-5.8	26.9	-4.3	27.7	-3.2	30.1	-5.2	31.0	-4.7	31.5	-5.6	34.0	-9.3	28.1			-13.9	40.2	-4.2	29.8	-8.5	35.3
NIM	8.1	29.9	9.6	30.6	10.7	32.8	8.7	33.6	9.2	34.1	8.3	36.4	4.6	30.9	13.9	40.2			9.7	32.5	5.4	37.7
SP	-1.6	12.8	-0.1	14.3	1.0	18.6	-1.0	20.0	-0.5	20.8	-1.4	24.5	-5.1	14.9	4.2	29.8	-9.7	32.5			-4.3	26.2
NIST	2.7	23.1	4.2	23.9	5.4	26.3	3.3	27.4	3.8	27.9	3.0	31.0	-0.8	23.8	8.5	35.3	-5.4	37.7	4.3	26.2		
UTE	-2.5	38.0																				
INMETRO	-2.5	17.8																				
CENAM	1.1	26.0																				
JV	1.9	28.7																				
INRIM	-19.2	13.7																				
BEV	-2.6	18.9																				
MKEH	-5.3	18.7																				
IPQ	6.6	61.5																				
CEM	-11.4	31.1																				
MIRS/SIQ/Metrology	-7.5	50.7																				
MIKES	-2.7	10.2																				
Trescal	-14.6	14.5																				
LNE	-4.5	15.4																				
METAS	-16.0	15.4																				
UME	-8.7	18.0																				
NMISA	9.9	35.8																				
CMI	-4.2	30.1																				
EIM	-4.9	9.4																				
NPLI	-19.4	14.4																				
VNIIM	66.6	34.0																				

Red: participants in CCEM-K11  
 Green: participant in CCEM-K11.1 only  
 Blue: participants in SIM.EM-K11 only  
 Brown: participants in EUROMET.EM-K11 only

Key comparisons CCEM.K11, CCEM-K11.1, SIM.EM-K11 and EUROMET.EM-K11

MEASURAND : AC/DC voltage transfer difference

NOMINAL VOLTAGE : 100 mV

FREQUENCY : 1 MHz

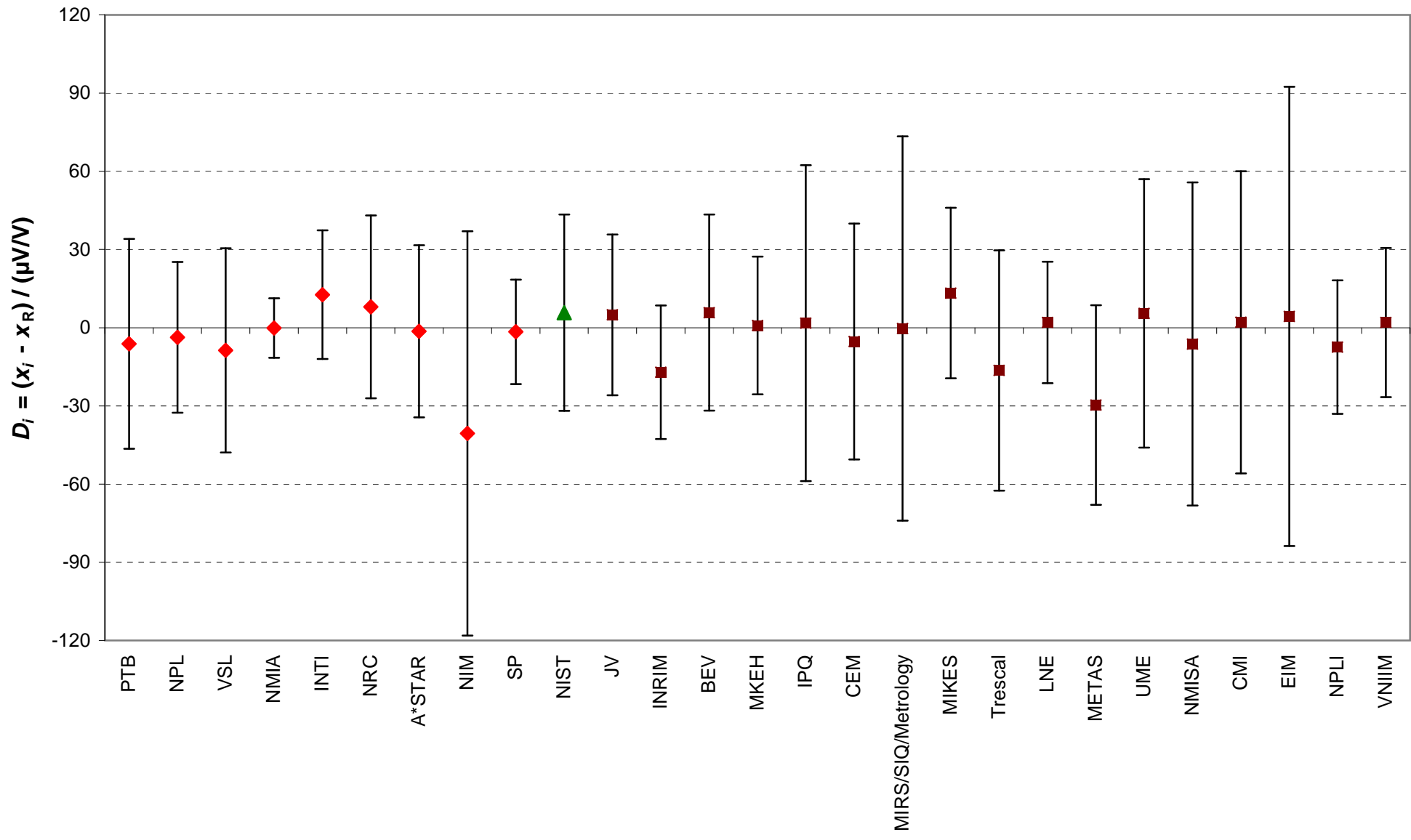
Lab i ↓			Lab j →																			
	$D_i$	$U_i$	PTB		NPL		NMI-VSL		NMIA		INTI		NRC		SPRING		NIM		SP		NIST	
	$I$ ( $\mu$ V/V)		$D_{ij}$	$U_{ij}$	$D_{ij}$	$U_{ij}$	$D_{ij}$	$U_{ij}$	$D_{ij}$	$U_{ij}$	$D_{ij}$	$U_{ij}$	$D_{ij}$	$U_{ij}$	$D_{ij}$	$U_{ij}$	$D_{ij}$	$U_{ij}$	$D_{ij}$	$U_{ij}$	$D_{ij}$	$U_{ij}$
PTB	-28	50			-10	79	-27	109	-41	90	2	68	-42	59	-23	94	-100	106	-35	72	-29	92
NPL	-18	67	10	79			-17	122	-31	101	12	90	-32	73	-12	111	-90	121	-25	92	-19	101
VSL	-1	101	27	109	17	122			-14	126	29	117	-14	106	5	134	-73	142	-8	119	-2	127
NMIA	13	77	41	90	31	101	14	126			43	98	-1	85	18	117	-59	126	6	101	12	108
INTI	-30	62	-2	68	-12	90	-29	117	-43	98			-43	71	-24	98	-102	109	-37	79	-31	97
NRC	13	32	42	59	32	73	14	106	1	85	43	71			19	96	-58	105	6	69	13	77
A*STAR	-6	88	23	94	12	111	-5	134	-18	117	24	98	-19	96			-78	125	-13	101	-7	114
NIM	72	99	100	106	90	121	73	142	59	126	102	109	58	105	78	125			65	110	71	123
SP	7	63	35	72	25	92	8	119	-6	101	37	79	-6	69	13	101	-65	110			6	94
NIST	1	77	29	92	19	101	2	127	-12	108	31	97	-13	77	7	114	-71	123	-6	94		

UTE	-34	111
INMETRO	19	105
CENAM	0	57

JV	11	111
INRIM	-59	71
BEV	-29	76
MKEH	-44	155
IPQ	-37	92
CEM	-47	92
MIRS/SIQ/Metrology	-56	403
MIKES	-31	56
Trescal	-58	62
LNE	-	-
METAS	-57	74
UME	-23	61
NMISA	194	193
CMI	-57	92
EIM	-40	50
NPLI	106	58
VNIIM	229	127

Red: participants in CCEM-K11  
 Green: participant in CCEM-K11.1 only  
 Blue: participants in SIM.EM-K11 only  
 Brown: participants in EUROMET.EM-K11 only

**CCEM-K11, -K11.1 and EUROMET.EM-K11 AC/DC voltage transfer difference: 1 kHz, 10 mV**  
**Degrees of equivalence,  $D_i$  and expanded uncertainty  $U_i$  ( $k = 2$ )**

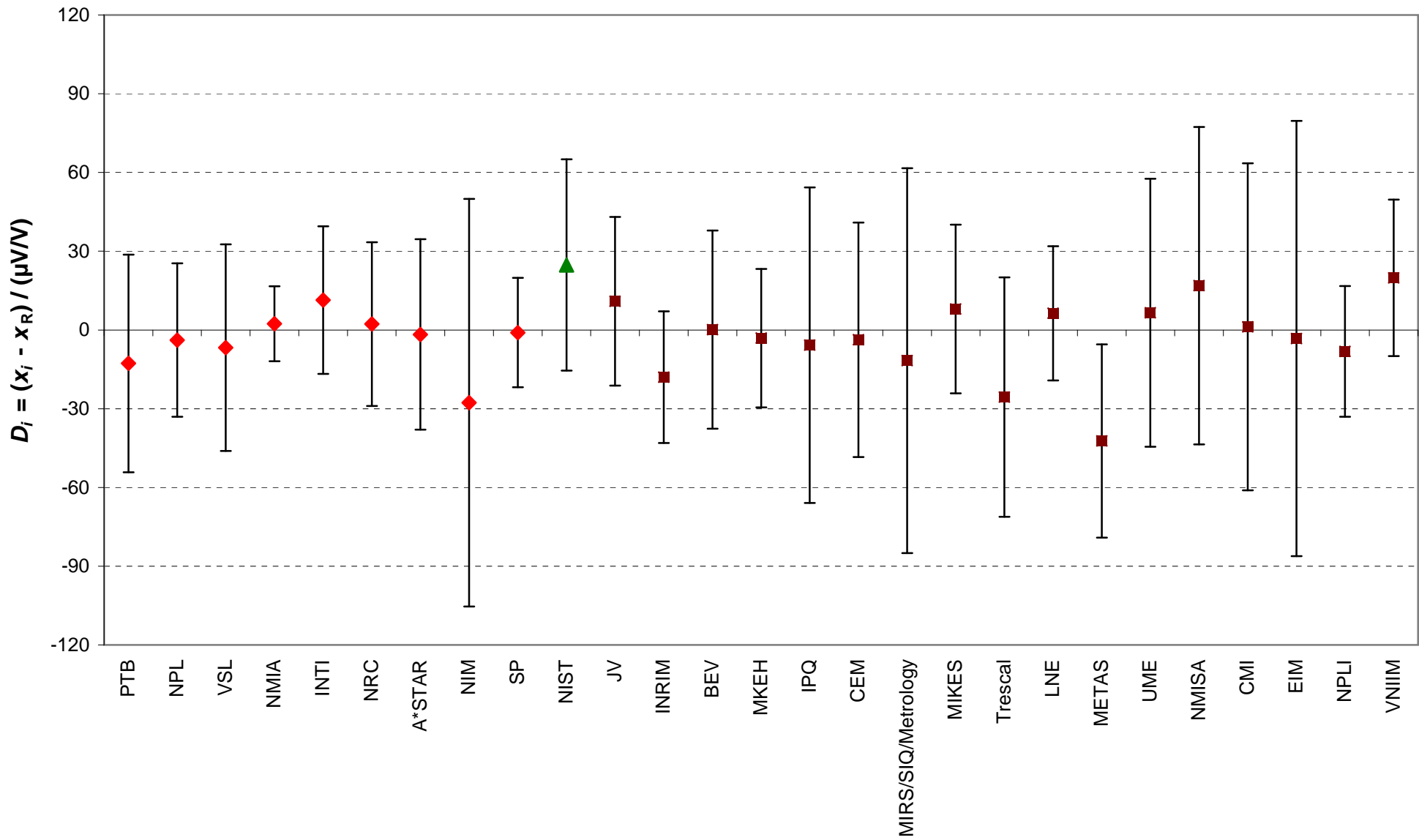


**Red diamonds:** participants in CCEM-K11

**Green triangle:** participant in CCEM-K11.1 only

**Brown squares:** participants in EUROMET.EM-K11 only

**CCEM-K11, -K11.1 and EUROMET.EM-K11 AC/DC voltage transfer difference: 20 kHz, 10 mV**  
**Degrees of equivalence,  $D_i$  and expanded uncertainty  $U_i$  ( $k = 2$ )**

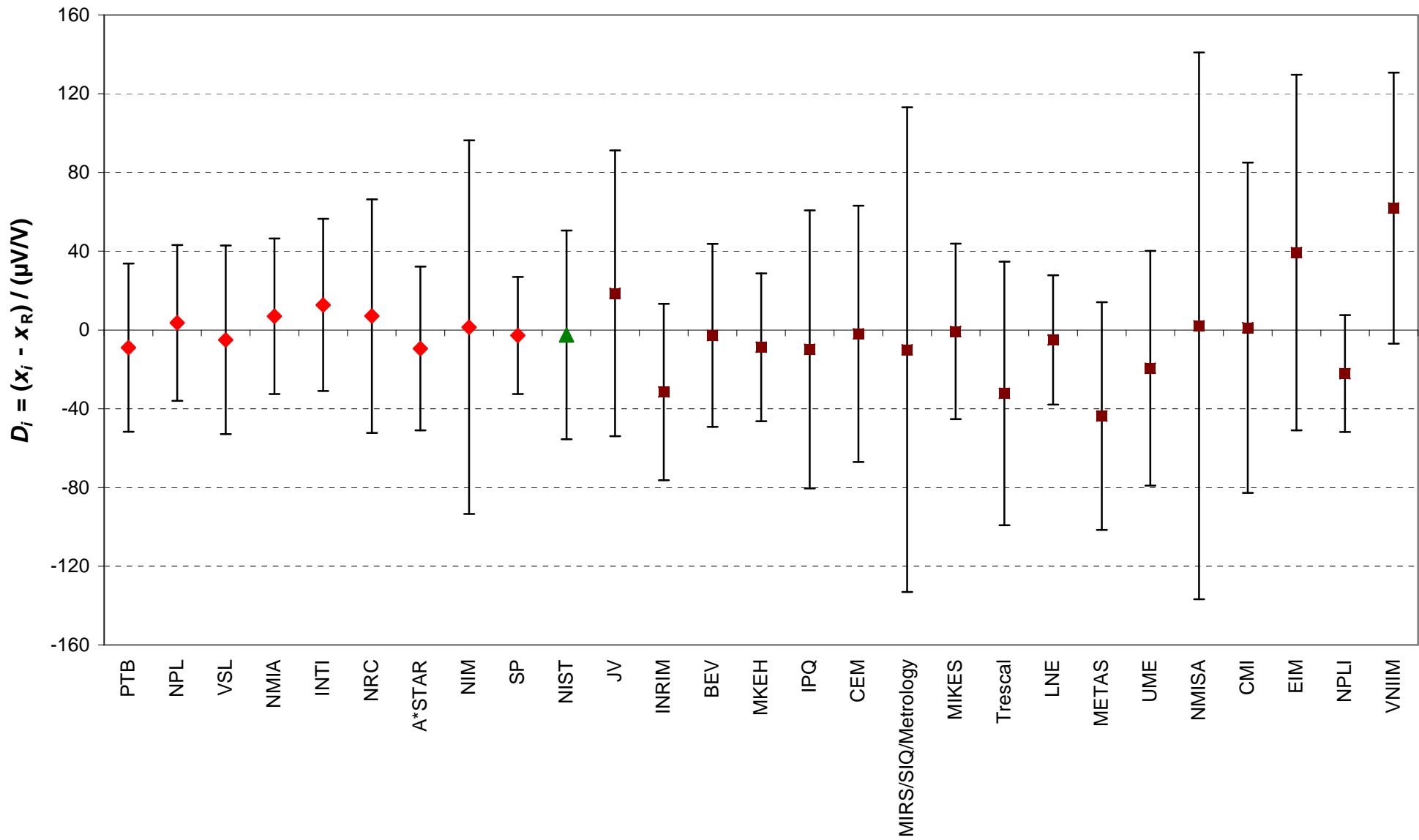


**Red diamonds:** participants in CCEM-K11

**Green triangle:** participant in CCEM-K11.1 only

**Brown squares:** participants in EUROMET.EM-K11 only

**CCEM-K11, -K11.1 and EUROMET.EM-K11 AC/DC voltage transfer difference: 100 kHz, 10 mV**  
**Degrees of equivalence,  $D_i$  and expanded uncertainty  $U_i$  ( $k = 2$ )**



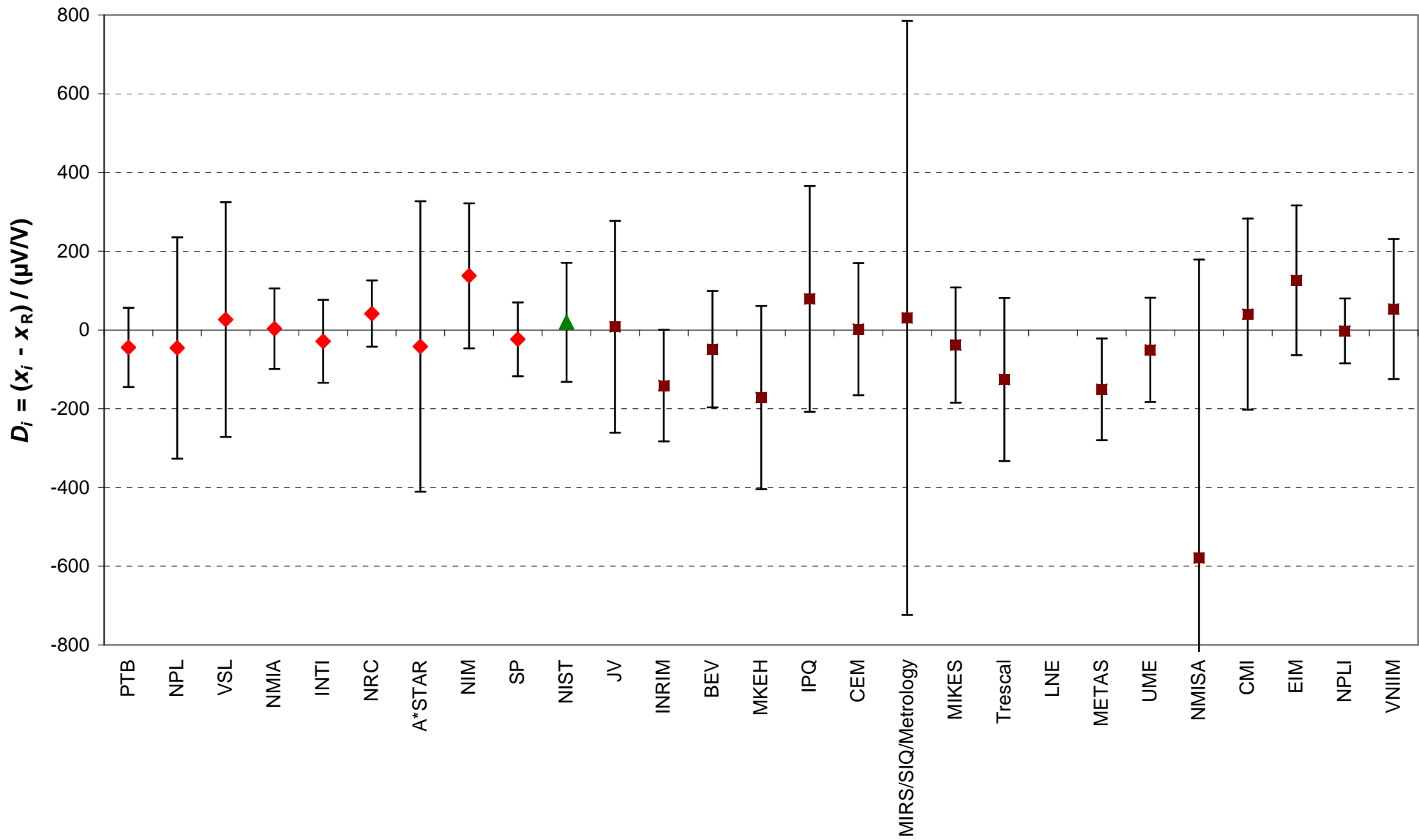
**Red diamonds:** participants in CCEM-K11

**Green triangle:** participant in CCEM-K11.1 only

**Brown squares:** participants in EUROMET.EM-K11 only



**CCEM-K11, -K11.1 and EUROMET.EM-K11 AC/DC voltage transfer difference: 1 MHz, 10 mV**  
**Degrees of equivalence,  $D_i$  and expanded uncertainty  $U_i$  ( $k = 2$ )**

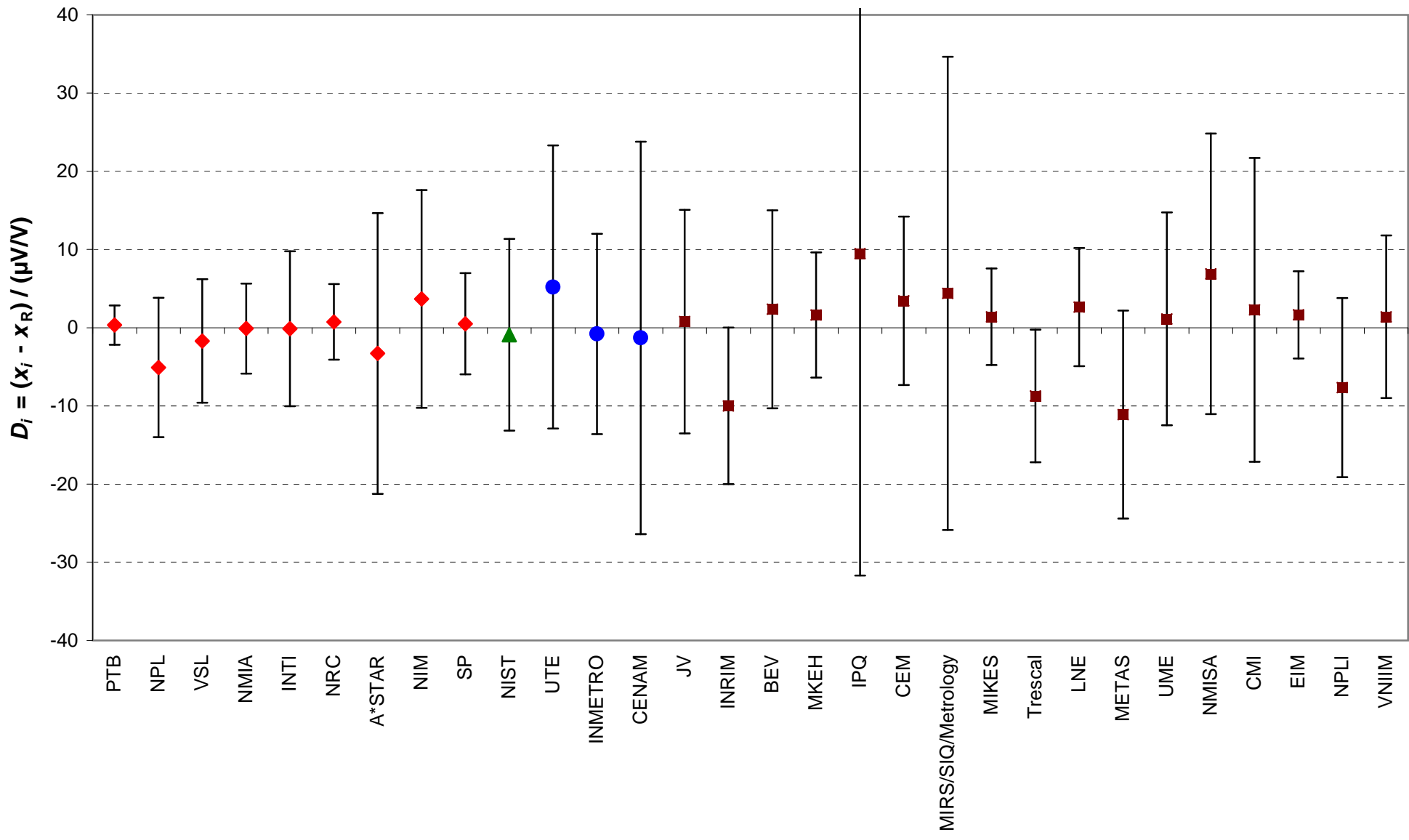


**Red diamonds:** participants in CCEM-K11

**Green triangle:** participant in CCEM-K11.1 only

**Brown squares:** participants in EUROMET.EM-K11 only

**CCEM-K11, -K11.1, SIM and EUROMET.EM-K11 AC/DC voltage transfer difference: 1 kHz, 100 mV  
Degrees of equivalence,  $D_i$  and expanded uncertainty  $U_i$  ( $k = 2$ )**



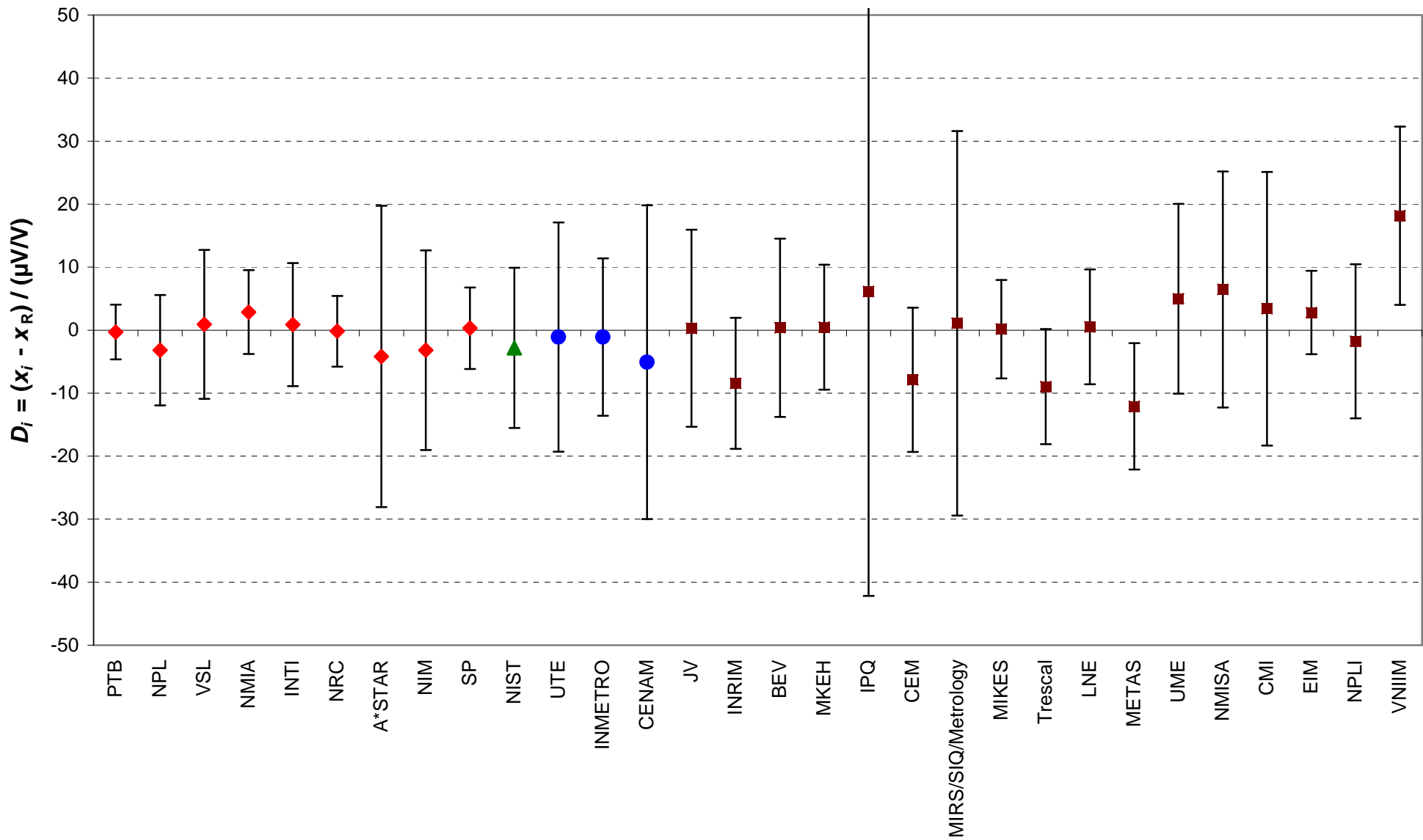
**Red diamonds:** participants in CCEM-K11

**Green triangle:** participant in CCEM-K11.1 only

**Blue circles:** participants in SIM.EM-K11 only

**Brown squares:** participants in EUROMET.EM-K11 only

CCEM-K11, -K11.1, SIM and EUROMET.EM-K11 AC/DC voltage transfer difference: 20 kHz, 100 mV  
 Degrees of equivalence,  $D_i$  and expanded uncertainty  $U_i$  ( $k = 2$ )



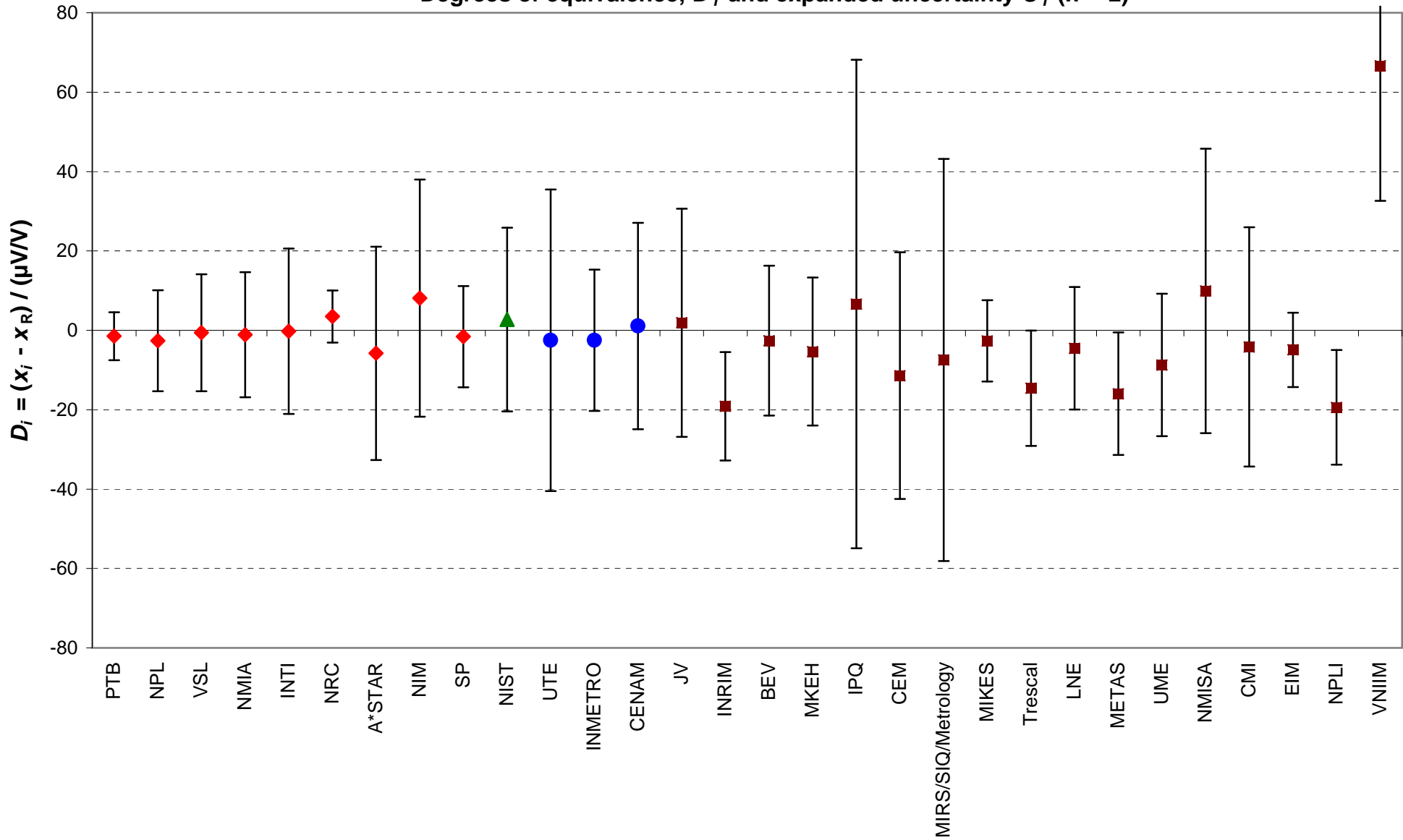
Red diamonds: participants in CCEM-K11

Green triangle: participant in CCEM-K11.1 only

Blue circles: participants in SIM.EM-K11 only

Brown squares: participants in EUROMET.EM-K11 only

CCEM-K11, -K11.1, SIM and EUROMET.EM-K11 AC/DC voltage transfer difference: 100 kHz, 100 mV  
 Degrees of equivalence,  $D_i$  and expanded uncertainty  $U_i$  ( $k = 2$ )



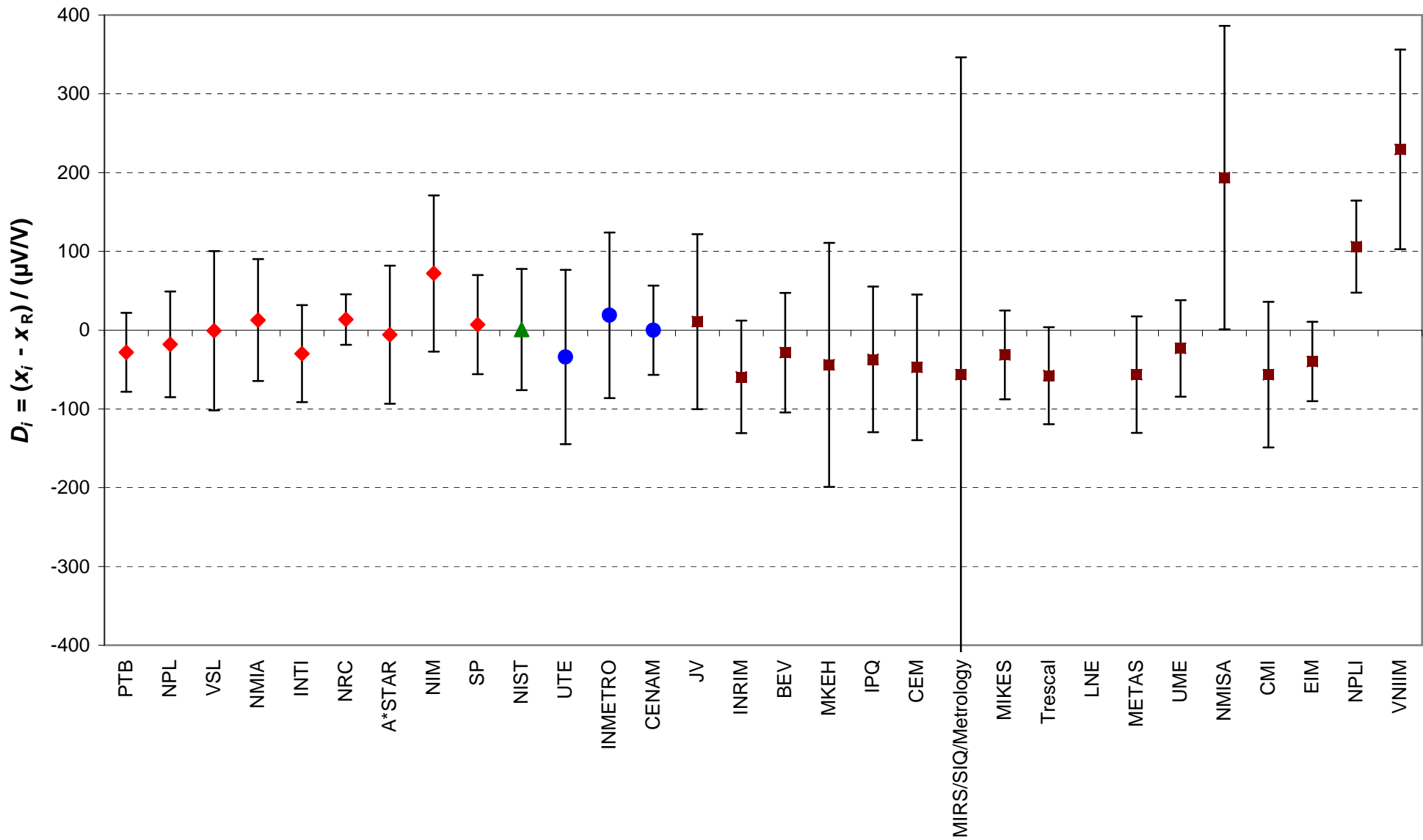
Red diamonds: participants in CCEM-K11

Green triangle: participant in CCEM-K11.1 only

Blue circles: participants in SIM.EM-K11 only

Brown squares: participants in EUROMET.EM-K11 only

**CCEM-K11, -K11.1, SIM and EUROMET.EM-K11 AC/DC voltage transfer difference: 1 MHz, 100 mV  
Degrees of equivalence,  $D_i$  and expanded uncertainty  $U_i$  ( $k = 2$ )**



**Red diamonds:** participants in CCEM-K11

**Green triangle:** participant in CCEM-K11.1 only

**Blue circles:** participants in SIM.EM-K11 only

**Brown squares:** participants in EUROMET.EM-K11 only