

Annex to ISO/IEC 17025:2005 declaration of accreditation for registration number: **K 164**

of **Yokogawa Europe B.V.**
Yokogawa European Standards Laboratory

This annex is valid from: **24-06-2015** to **01-07-2019**

Replaces annex dated: **NA**

Location where activities are performed under accreditation

Head Office

Euroweg 2
3825 HD
Amersfoort
The Netherlands

| HCS code | Measured quantity, Range | Frequency | CMC ¹ | Remarks |
|----------|--------------------------|-----------|---|-----------------|
| LF | Electricity | | | |
| LF 0 0 | DC/LF Quantities | | | |
| LF 1 0 | Direct Voltage | | | |
| | 1 V; 1.018 V | | 1.5 μ V | Zener reference |
| | 10 V | | 15 μ V | |
| | 0.1 mV – 1 mV | | $(1.2 \cdot 10^{-4} - 1.2 \cdot 10^{-3}) \cdot U$ | Generate |
| | 1 mV – 10 mV | | $(1.8 \cdot 10^{-5} - 1.3 \cdot 10^{-4}) \cdot U$ | |
| | 10 mV – 100 mV | | $(2.0 \cdot 10^{-5} - 1.6 \cdot 10^{-4}) \cdot U$ | |
| | 100 mV – 200 mV | | $(1.6 \cdot 10^{-5} - 2.4 \cdot 10^{-5}) \cdot U$ | |
| | 200 mV – 2 V | | $(6 \cdot 10^{-6} - 9 \cdot 10^{-6}) \cdot U$ | |
| | 2 V – 10 V | | $(5 \cdot 10^{-6} - 8 \cdot 10^{-6}) \cdot U$ | |
| | 10 V – 20 V | | $(5 \cdot 10^{-6} - 7 \cdot 10^{-6}) \cdot U$ | |
| | 20 V – 200 V | | $(5 \cdot 10^{-6} - 6 \cdot 10^{-6}) \cdot U$ | |
| | 200 V – 1000 V | | $(9 \cdot 10^{-6} - 1.1 \cdot 10^{-5}) \cdot U$ | |
| | 1 V; 1.018 V | | 2.5 μ V | Measure |

This annex has been approved by:

Ir. J.C. van der Poel
Chief Executive

¹ Calibration and Measurement Capability (CMC): Demonstrated measurement uncertainty, with coverage probability of 95%, in a given measurement point or measurement range. Measurement uncertainty, U , is calculated according to EA-4/02 "Expression of the Uncertainty of Measurement in Calibration".

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|----------|---------------------------|-----------|---|------------|
| | 10 V | | 25 μ V | |
| | 0.1 mV – 1 mV | | $(1.2 \cdot 10^{-4} - 1.2 \cdot 10^{-3}) \cdot U$ | Measure |
| | 1 mV – 10 mV | | $(3.2 \cdot 10^{-5} - 1.7 \cdot 10^{-4}) \cdot U$ | |
| | 10 mV – 100 mV | | $(1.6 \cdot 10^{-5} - 2.2 \cdot 10^{-4}) \cdot U$ | |
| | 100 mV – 1 V | | $(6 \cdot 10^{-6} - 6 \cdot 10^{-5}) \cdot U$ | |
| | 1 V – 10 V | | $(7 \cdot 10^{-6} - 1.1 \cdot 10^{-4}) \cdot U$ | |
| | 10 V – 100 V | | $(8 \cdot 10^{-6} - 7 \cdot 10^{-5}) \cdot U$ | |
| | 100 V – 1100 V | | $(2.4 \cdot 10^{-5} - 2.4 \cdot 10^{-5}) \cdot U$ | |
| LF 2 1 | Direct Current | | | |
| | 100 μ A – 200 μ A | | $(4 \cdot 10^{-5} - 5 \cdot 10^{-5}) \cdot I$ | Generating |
| | 0.2 mA – 2 mA | | $(5 \cdot 10^{-5} - 2 \cdot 10^{-4}) \cdot I$ | |
| | 2 mA – 20 mA | | $(4 \cdot 10^{-5} - 2.8 \cdot 10^{-4}) \cdot I$ | |
| | 20 mA – 200 mA | | $(6 \cdot 10^{-5} - 2.8 \cdot 10^{-4}) \cdot I$ | |
| | 0.2 A – 2 A | | $(7 \cdot 10^{-5} - 4 \cdot 10^{-4}) \cdot I$ | |
| | 2 A – 10 A | | $(1.5 \cdot 10^{-5} - 4.3 \cdot 10^{-5}) \cdot I$ | |
| | 10 A – 35 A | | $(4 \cdot 10^{-4} - 5 \cdot 10^{-4}) \cdot I$ | |
| | 10 μ A – 100 μ A | | $(1.9 \cdot 10^{-5} - 4 \cdot 10^{-5}) \cdot I$ | Measure |
| | 100 μ A – 1 mA | | $(1.8 \cdot 10^{-5} - 1 \cdot 10^{-4}) \cdot I$ | |
| | 1 mA – 10 mA | | $(1.8 \cdot 10^{-5} - 1 \cdot 10^{-4}) \cdot I$ | |
| | 10 mA – 30 mA | | $(2.2 \cdot 10^{-5} - 5 \cdot 10^{-5}) \cdot I$ | |
| | 30 mA – 100 mA | | $(2.0 \cdot 10^{-5} - 4 \cdot 10^{-5}) \cdot I$ | |
| | 100 mA – 300 mA | | $(3 \cdot 10^{-5} - 4 \cdot 10^{-5}) \cdot I$ | |
| | 300 mA – 1 A | | $(6 \cdot 10^{-5} - 1.1 \cdot 10^{-4}) \cdot I$ | |
| | 3 A – 10 A | | $(1.3 \cdot 10^{-4} - 1.6 \cdot 10^{-4}) \cdot I$ | |
| | 10 A – 30 A | | $(4 \cdot 10^{-4} - 5 \cdot 10^{-4}) \cdot I$ | |

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|----------|--------------------------|------------------|---|---------------------|
| LF 3 1 | Alternating Voltage | | | |
| | 8 mV – 80mV | 53 Hz | $(3.0 \cdot 10^{-5} - 3.0 \cdot 10^{-4}) \cdot U$ | Generate / Measure |
| | 80 mV – 800mV | 53 Hz | $(3.0 \cdot 10^{-5} - 1.1 \cdot 10^{-4}) \cdot U$ | |
| | 800 mV – 8 V | 53 Hz | $(3.0 \cdot 10^{-5} - 1.3 \cdot 10^{-4}) \cdot U$ | |
| | 8 V – 80 V | 53 Hz | $(3.0 \cdot 10^{-5} - 1.5 \cdot 10^{-4}) \cdot U$ | |
| | 80 V – 800 V | 53 Hz | $(3.0 \cdot 10^{-5} - 1.5 \cdot 10^{-4}) \cdot U$ | |
| | | | | Generate |
| | 10 mV – 100 mV | 10 Hz – 40 Hz | $(1.2 \cdot 10^{-4} - 4 \cdot 10^{-3}) \cdot U$ | On impedance > 50MΩ |
| | | 40 Hz – 20 kHz | $(7 \cdot 10^{-5} - 1.5 \cdot 10^{-3}) \cdot U$ | On impedance > 50MΩ |
| | | 20 kHz – 100 kHz | $(7 \cdot 10^{-5} - 1.2 \cdot 10^{-3}) \cdot U$ | On impedance > 50MΩ |
| | | 100 kHz – 500kHz | $(8 \cdot 10^{-5} - 7 \cdot 10^{-3}) \cdot U$ | On impedance > 50MΩ |
| | | 500 kHz – 1 MHz | $(6 \cdot 10^{-4} - 1.5 \cdot 10^{-2}) \cdot U$ | On impedance > 50MΩ |
| | 100 mV – 1 V | 10 Hz – 40 Hz | $(6 \cdot 10^{-5} - 9 \cdot 10^{-4}) \cdot U$ | |
| | | 40 Hz – 20 kHz | $(5 \cdot 10^{-5} - 8 \cdot 10^{-4}) \cdot U$ | |
| | | 20 kHz – 100 kHz | $(5 \cdot 10^{-5} - 5 \cdot 10^{-3}) \cdot U$ | |
| | | 100 kHz – 500kHz | $(4 \cdot 10^{-4} - 6 \cdot 10^{-3}) \cdot U$ | |
| | | 500 kHz – 1 MHz | $(5 \cdot 10^{-4} - 1.3 \cdot 10^{-2}) \cdot U$ | |
| | 1 V – 10 V | 10 Hz – 40 Hz | $(5 \cdot 10^{-5} - 8 \cdot 10^{-4}) \cdot U$ | |
| | | 40 Hz – 20 kHz | $(5 \cdot 10^{-5} - 8 \cdot 10^{-4}) \cdot U$ | |
| | | 20 kHz – 100 kHz | $(5 \cdot 10^{-5} - 9 \cdot 10^{-4}) \cdot U$ | |
| | | 100 kHz – 500kHz | $(9 \cdot 10^{-5} - 5 \cdot 10^{-3}) \cdot U$ | |
| | | 500 kHz – 1 MHz | $(5 \cdot 10^{-4} - 2.5 \cdot 10^{-2}) \cdot U$ | |
| | 10 V – 100 V | 10 Hz – 40 Hz | $(9 \cdot 10^{-5} - 1.0 \cdot 10^{-3}) \cdot U$ | |
| | | 40 Hz – 20 kHz | $(7 \cdot 10^{-5} - 1.0 \cdot 10^{-3}) \cdot U$ | |
| | | 20 kHz – 100 kHz | $(6 \cdot 10^{-5} - 2.5 \cdot 10^{-3}) \cdot U$ | |
| | 100 V – 1100 V | 60 Hz – 400 Hz | $(6 \cdot 10^{-5} - 1.5 \cdot 10^{-3}) \cdot U$ | |
| | | 400 Hz – 1 kHz | $(6 \cdot 10^{-5} - 1.0 \cdot 10^{-3}) \cdot U$ | |

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| | 10 mV – 100 mV | 40 Hz – 100 kHz | $(1.0 \cdot 10^{-4} - 1 \cdot 10^{-2}) \cdot U$ | Measure |
| | 100 mV – 1 V | 40 Hz – 100 kHz | $(1.2 \cdot 10^{-4} - 6 \cdot 10^{-3}) \cdot U$ | |
| | 1 V – 10 V | 40 Hz – 100 kHz | $(9 \cdot 10^{-5} - 9 \cdot 10^{-4}) \cdot U$ | |
| | 10 V – 100 V | 40 Hz – 100 kHz | $(1.4 \cdot 10^{-4} - 4 \cdot 10^{-3}) \cdot U$ | |
| | 100 V – 1000 V | 40 Hz – 30 kHz | $(9 \cdot 10^{-5} - 1.6 \cdot 10^{-2}) \cdot U$ | |
| LF 4 1 | Alternating Current | | | |
| | 10mA – 1 A | 53 Hz | $(3 \cdot 10^{-5} - 2.4 \cdot 10^{-4}) \cdot I$ | Generate / Measure |
| | 1 A – 5 A | 53 Hz | $(4 \cdot 10^{-5} - 6 \cdot 10^{-5}) \cdot I$ | |
| | 5 A – 9 A | 53 Hz | $4 \cdot 10^{-5} \cdot I$ | |
| | 9 A – 24 A | 53 Hz | $5 \cdot 10^{-5} \cdot I$ | |
| | 24 A – 50 A | 53 Hz | $(4 \cdot 10^{-5} - 5 \cdot 10^{-5}) \cdot I$ | |
| | 50 A – 100 A | 53 Hz | $5 \cdot 10^{-5} \cdot I$ | |
| | 100 A – 600 A | 53 Hz | $(5 \cdot 10^{-5} - 8 \cdot 10^{-5}) \cdot I$ | |
| | 600 A – 1200 A | 53 Hz | $5 \cdot 10^{-5} \cdot I$ | |
| | 10 μA – 100 μA | 10 Hz – 40 Hz | $(4 \cdot 10^{-4} - 3 \cdot 10^{-3}) \cdot I$ | Generate |
| | | 40 Hz – 1 kHz | $(3 \cdot 10^{-4} - 4 \cdot 10^{-3}) \cdot I$ | |
| | | 1 kHz – 5 kHz | $(3 \cdot 10^{-4} - 3 \cdot 10^{-3}) \cdot I$ | |
| | | 5 kHz – 10 kHz | $(3 \cdot 10^{-4} - 7 \cdot 10^{-3}) \cdot I$ | |
| | 0.1 mA – 1 mA | 10 Hz – 40 Hz | $(2.6 \cdot 10^{-4} - 2.6 \cdot 10^{-3}) \cdot I$ | |
| | | 40 Hz – 1 kHz | $(2.2 \cdot 10^{-4} - 2.6 \cdot 10^{-3}) \cdot I$ | |
| | | 1 kHz – 5 kHz | $(2.2 \cdot 10^{-4} - 2.2 \cdot 10^{-3}) \cdot I$ | |
| | | 5 kHz – 10 kHz | $(2.2 \cdot 10^{-4} - 5 \cdot 10^{-3}) \cdot I$ | |
| | 1 mA – 10 mA | 10 Hz – 40 Hz | $(4 \cdot 10^{-4} - 4 \cdot 10^{-3}) \cdot I$ | |
| | | 40 Hz – 1 kHz | $(2.8 \cdot 10^{-4} - 4 \cdot 10^{-3}) \cdot I$ | |
| | | 1 kHz – 5 kHz | $(2.8 \cdot 10^{-4} - 3 \cdot 10^{-3}) \cdot I$ | |
| | | 5 kHz – 10 kHz | $(3 \cdot 10^{-4} - 5 \cdot 10^{-3}) \cdot I$ | |

| HCS code | Measured quantity, Range | Frequency | CMC ¹ | Remarks |
|----------|-----------------------------|-----------------|--|---|
| LF 4 2 | AC Current Ratio | | | |
| | Current transformer - ratio | 53 Hz | $(3.7 \cdot 10^{-5} - 5 \cdot 10^{-5}) \cdot I_{in}/I_{out}$ | Measure Primary: 100 A to 1200 A Secondary: 100 mA to 5 A |
| | Current transformer - phase | 53 Hz | 2.5 m° | Measure Primary: 100 A to 1200 A Secondary: 100 mA to 5 A |
| LF 5 1 | Power | | | |
| | 100 μW – 30 kW | DC | $(1.4 \cdot 10^{-5} - 4 \cdot 10^{-4}) \cdot W$ | Generate / Measure 100 mV – 1 kV 1 mA – 30 A |
| | 1 mW – 12 kW | 53 Hz | $(4 \cdot 10^{-5} - 1.0 \cdot 10^{-3}) \cdot W/VA$ | Generate / Measure 0.1 – 8 V 10 mA – 1200 A cos(φ) = 1 |
| | 0.1 W – 240 kW | 53 Hz | $(3 \cdot 10^{-5} - 1.0 \cdot 10^{-3}) \cdot W/VA$ | 10–200 V 10 mA – 1200 A 0 ≤ cos(φ) ≤ 1 |
| | 2 W – 960 kW | 53 Hz | $(4 \cdot 10^{-5} - 1.4 \cdot 10^{-3}) \cdot W/VA$ | 200–800 V 10 mA – 1200 A cos(φ) = 1 |
| | 0.1 mW – 100 mW | 53 Hz | $(3 \cdot 10^{-5} - 4 \cdot 10^{-5}) \cdot W/VA$ | 0.1 – 8 V 1 mA – 10 mA cos(φ) = 1 |
| | 10 mW – 2 W | 53 Hz | $(4 \cdot 10^{-5} - 1.8 \cdot 10^{-4}) \cdot W/VA$ | 10–200 V 1 mA – 10 mA 0 ≤ cos(φ) ≤ 1 |
| | 0.2 W – 8 W | 53 Hz | $(4 \cdot 10^{-5} - 1.3 \cdot 10^{-4}) \cdot W/VA$ | 200–800 V 1 mA – 10 mA cos(φ) = 1 |
| | 5 mW – 20 kW | 10 – 1 kHz | $(4 \cdot 10^{-4} - 1.8 \cdot 10^{-3}) W/VA$ | (1.0 – 1000) V 5 mA – 20 A 0.940 ≤ cos(φ) ≤ 1 |
| | 5 mW – 20 kW | 10 – 1 kHz | $(4 \cdot 10^{-4} - 5 \cdot 10^{-3}) W/VA$ | (1.0 – 1000) V 5 mA – 20 A 0 ≤ cos(φ) ≤ 0.940 |
| | 5 mW – 1.5 kW | 1 kHz – 100 kHz | $(4 \cdot 10^{-4} - 1.6 \cdot 10^{-2}) W/VA$ | (1.0 – 150) V 5 mA – 10 A 0.940 ≤ cos(φ) ≤ 1 |

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| | 5 mW – 1.5 kW | 1 kHz – 100 kHz | $(5 \cdot 10^{-4} - 5 \cdot 10^{-2}) \text{ W/VA}$ | (1.0 – 150) V 5 mA – 10 A $0 \leq \cos(\varphi) \leq 0.940$ |
| LF 6 2 | DC Resistance | | | |
| | 0.01 Ω | | 1.0 μΩ | Generate 4 wire |
| | 0.1 Ω | | 5 μΩ | Generate 4 wire |
| | 1 Ω | | 3 μΩ | Generate 4 wire |
| | 1.9 Ω | | 0.08 mΩ | Generate 4 wire |
| | 10 Ω | | 0.10 mΩ | Generate 4 wire |
| | 19 Ω | | 0.3 mΩ | Generate 4 wire |
| | 100 Ω | | 1.0 mΩ | Generate 4 wire |
| | 190 Ω | | 1.9 mΩ | Generate 4 wire |
| | 1 kΩ | | 10 mΩ | Generate 4 wire |
| | 1.9 kΩ | | 19 mΩ | Generate 4 wire |
| | 10 kΩ | | 0.08 Ω | Generate 4 wire |
| | 19 kΩ | | 0.15 Ω | Generate 4 wire |
| | 100 kΩ | | 0.8 Ω | Generate 4 wire |
| | 190 kΩ | | 1.5 Ω | Generate 4 wire |
| | 1 MΩ | | 0.012 kΩ | Generate 4 wire |
| | 1.9 MΩ | | 0.05 kΩ | Generate 4 wire |
| | 10 MΩ | | 0.7 kΩ | Generate 4 wire |
| | 19 MΩ | | 1.3 kΩ | Generate 4 wire |
| | 100 MΩ | | 35 kΩ | Generate 2 wire |
| | 1 Ω – 100 MΩ | | $(1.5 \cdot 10^{-4} - 5 \cdot 10^{-4}) \cdot R$ | Generate |
| | 1 mΩ – 10 mΩ | | $(1.4 \cdot 10^{-4} \cdot R - 1.8 \cdot 10^{-4}) \cdot R$ | Measure |
| | 10 mΩ – 100 mΩ | | $(5 \cdot 10^{-5} \cdot R - 6 \cdot 10^{-5}) \cdot R$ | |
| | 100 mΩ – 1 Ω | | $(1.7 \cdot 10^{-6} \cdot R - 3.0 \cdot 10^{-5}) \cdot R$ | |

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|----------|--------------------------|------------------|---|-----------------------------|
| | 1 Ω – 10 Ω | | $(1.0 \cdot 10^{-5} \cdot R - 1.1 \cdot 10^{-5}) \cdot R$ | |
| | 10 Ω – 100 Ω | | $(1.0 \cdot 10^{-5} \cdot R - 1.2 \cdot 10^{-5}) \cdot R$ | |
| | 100 Ω – 1 kΩ | | $8 \cdot 10^{-6} \cdot R$ | |
| | 1 kΩ – 10 kΩ | | $(6 \cdot 10^{-6} \cdot R - 1.7 \cdot 10^{-5}) \cdot R$ | |
| | 10 kΩ – 100 kΩ | | $(1.0 \cdot 10^{-5} - 7 \cdot 10^{-5}) \cdot R$ | |
| | 100 kΩ – 1 MΩ | | $(2.6 \cdot 10^{-5} - 2.3 \cdot 10^{-4}) \cdot R$ | |
| | 1 MΩ – 10 MΩ | | $(6 \cdot 10^{-5} - 5 \cdot 10^{-4}) \cdot R$ | |
| | 10 MΩ – 100 MΩ | | $(4 \cdot 10^{-4} - 4 \cdot 10^{-3}) \cdot R$ | |
| | 100 MΩ – 1 GΩ | | $(2.9 \cdot 10^{-3} - 2.8 \cdot 10^{-2}) \cdot R$ | |
| TF | Time and Frequency | | | |
| TF 2 1 | Frequency generation | 10 MHz | $2.0 \cdot 10^{-12} \cdot f$ | $\tau \geq 86.4 \text{ ks}$ |
| | Frequency measurement | 0.1 Hz – 225 MHz | $2 \cdot 10^{-9} \cdot f$ | $\tau = 1 \text{ s}$ |
| | | | $2 \cdot 10^{-10} \cdot f$ | $\tau = 10 \text{ s}$ |
| | | | $4 \cdot 10^{-10} \cdot f$ | $\tau = 100 \text{ s}$ |
| | | | $2 \cdot 10^{-11} \cdot f$ | $\tau = 1 \text{ ks}$ |
| | | | $3 \cdot 10^{-12} \cdot f$ | $\tau = 10 \text{ ks}$ |
| | | | $2 \cdot 10^{-12} \cdot f$ | $\tau = 100 \text{ ks}$ |

Remarks:

- The ambient temperature during calibration is nominally 23 °C.
- The measurements are carried out inside the permanent laboratory.

**Sensorik
Messtechnik**

nbn

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ELEKTRONIK
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