



Flex current clamps
A 1501, A 1502 and A 1503
Instruction Manual
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Mark on your equipment certifies that it meets European Union requirements for EMC, LVD, ROHS regulations

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1 Introduction

Flexible Current Clamps A 1501, A 1502 and A 1503 are based on Rogowski coil principle and can measure alternating currents on low and medium power installations. Unlike standard current transformers, this type of current sensor does not use magnetic cores. The transformation principle is based on an air core. It presents virtually no load to the system under test, has a low phase shift and excellent frequency response.

They consist of current sensor of different lengths and active electronic for multiple current range, as shown on table below. User should select sensor length according to the current conductor diameter where measurements will be performed.

| Model | Flexible sensor length | Maximal conductor diameter | Nominal current range | Effective measurement range |
|--------|------------------------|----------------------------|-----------------------|-----------------------------|
| A 1501 | 25 cm / 10 in | 7 cm / 2,7 in | 30 A | 3 A ... 45 A |
| A 1502 | 48 cm / 19 in | 14 cm / 5,5 in | 300 A | 15 A ... 450 A |
| | | | 3000A | 80 A ... 4500 A |
| A 1503 | 90 cm / 35 in | 27 cm / 10,6 in | 60 A | 6 A ... 90 A |
| | | | 600 A | 30 A ... 900 A |
| | | | 6000A | 160 A ... 9000 A |

Embedded electronic module provides automatic clamp recognition (for Metrel instruments) and current range switching. Module is powered directly from attached instrument, so clamp does not require additional power supply. The flexible sensor permits measurements on conductors where standard clamp-on current transformers cannot be used. It is particularly useful for installation in tight spaces, or around breaker panels, cable bundles, wide or large bus bars and irregular shapes. Additionally, clamps can't be damaged by overloads; they are insensitive to DC current, and measure only the AC component of the current.

2 Main features

- Range setup from the instrument, no additional range setup needed
- Power supply for electronic module is assured from the instrument
- Waterproof sensor
- Minimum angle shift to accomplish accurate power measurements
- High accuracy
- Total rejection of DC component
- Friendly-use of the closing-opening system of the current sensor (even if wearing gloves) due to its highly ergonomic design
- Very light, flexible and fully adaptable to busbar trunking system and insulated cables
- Strengthened security, regardless the working environment industrial or services

3 Safety



Read the operating instructions before use and follow all safety instructions.



If the test equipment is used in a manner that is not specified in this user manual, the protection provided by the equipment might be impaired!



Adhere to local and national safety codes. Individual protective equipment must be used to prevent shock and arc blast injury where hazardous live conductors are exposed.



Before each use, inspect the Current Clamps and its latching system for any damage. Pay particular attention to the insulation surrounding the flexible measuring head. Look for cracks or missing portions of the clamp housing or output cable insulation. Also look for loose or weakened components.



Do not use a clamp that is cracked, damaged, or has a defective cable.



Never use the clamp on a circuit with voltages higher than 1000 V CAT III or 600 V CAT IV.



De-energize the installation on which current will be measured or adopt safe operating procedures during application and removal of the current clamp.



Use extreme caution when working around bare conductors or bus bars.



Do not use the Current Clamp to measure bare conductors carrying a voltage from 30 V up to 1000 V unless you are wearing protective clothing suitable for high-voltage work. Contact with the conductor could result in electric shock. Always use appropriate equipment for personal protection.



Use caution when working with voltages above 60 V dc, 30 V ac rms or 42 V ac peak. Such voltages pose a shock hazard.

4 Symbols

| Symbol | Description |
|--------|--|
| | Important information. Refer to the manual. |
| | Risk of Electric Shock. |
| | Product is protected by Double/Reinforced insulation |
| | Do not apply around or remove from HAZARDUS LIVE conductors. |
| | Do not dispose of this product as unsorted municipal waste. Contact Metrel or a qualified recycler for disposal. |
| | Complies with the relevant European standards. |

5 Typical applications

5.1 Power Quality Measurement

Current clamps have linear response through wide frequency bandwidth (see Figure 7 and Figure 11). Therefore they are well suited for:

- Power Quality auditing,
- EN 50160 or troubleshooting. Particularly for:
- Current distortion measurement
- Inrush measurement
- Functional testing of appliances, machines, etc.

High precision (see Figure 5 and Figure 9) and wide measurement range can cover most of practical LV current measurements.

5.2 Energy and Power Measurement

Current clamps have small phase shift (see Figure 8 and Figure 12) over wide frequency range.

Therefore they are well suited for:

- Power and energy measurements (active, reactive, apparent)
- Power factor measurements
- Power/Energy efficiency

6 Connecting and using clamps in the field

1. Wrap the flexible measuring head around the conductor to be tested and close coupling

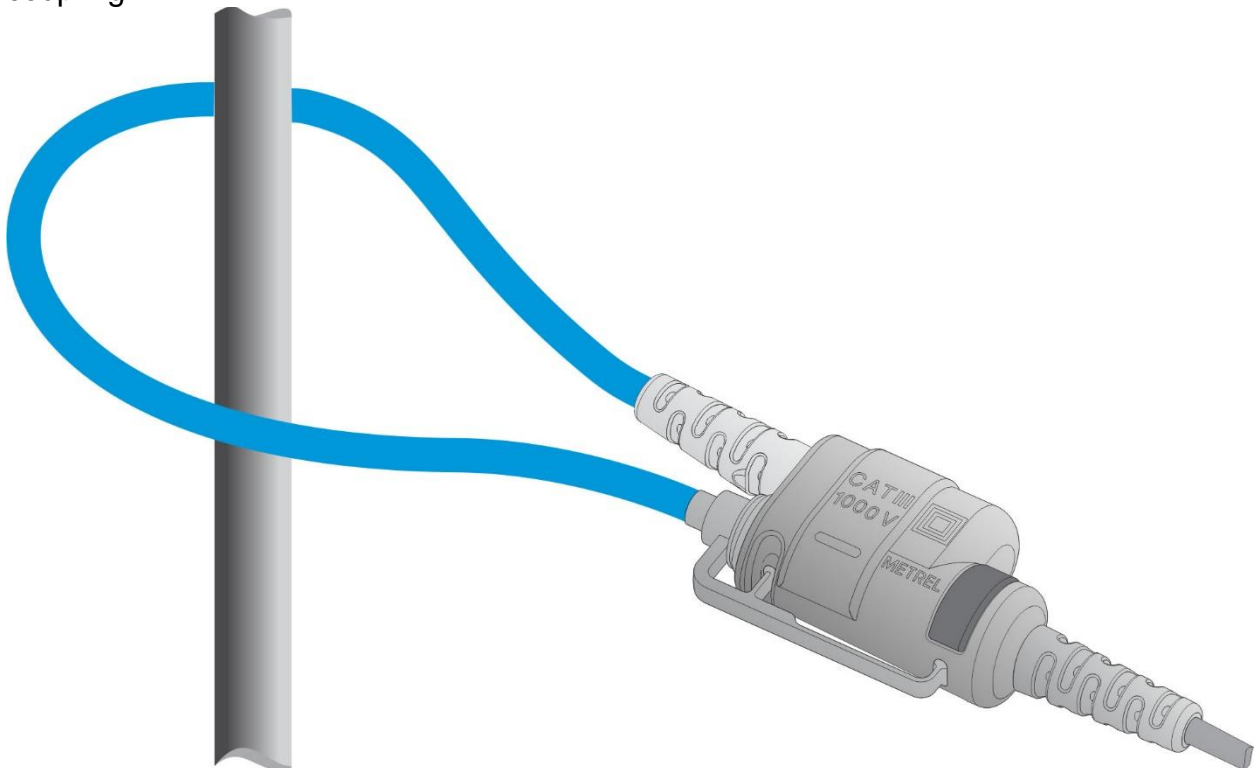


Figure 1: Flex clamps connection

- It is very important that the conductor is in the centre and perpendicular to the current sensor as much as possible, in order to minimise position measurement error.
- Minimise influence of adjacent current-carrying conductors, and measure at the point where they are far away from each other.
- Make sure that the arrow marked on the clamp coupling points toward the correct orientation for correct phase.
- Keep the clamp coupling more than 2.5 cm (1 in) away from conductor.

2. Connect Flexible Current Clamps to the desired input on the measuring instrument

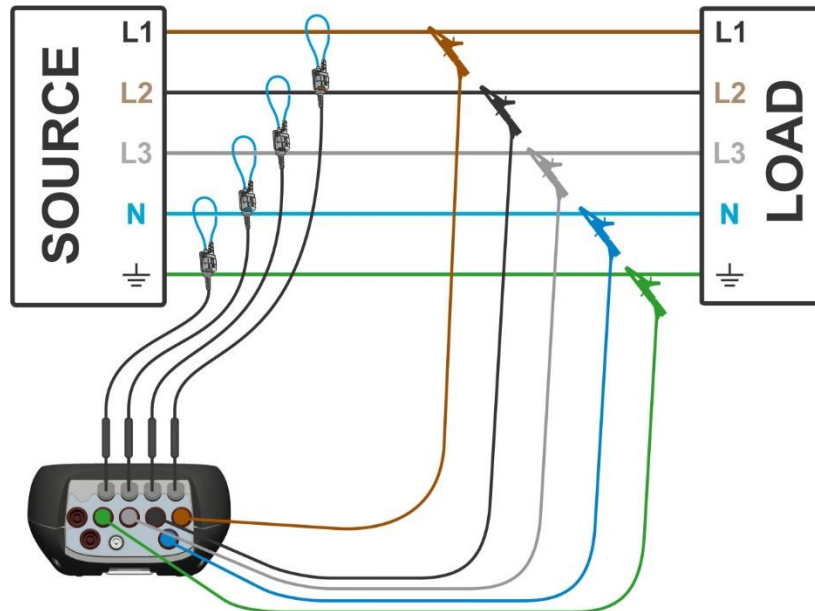
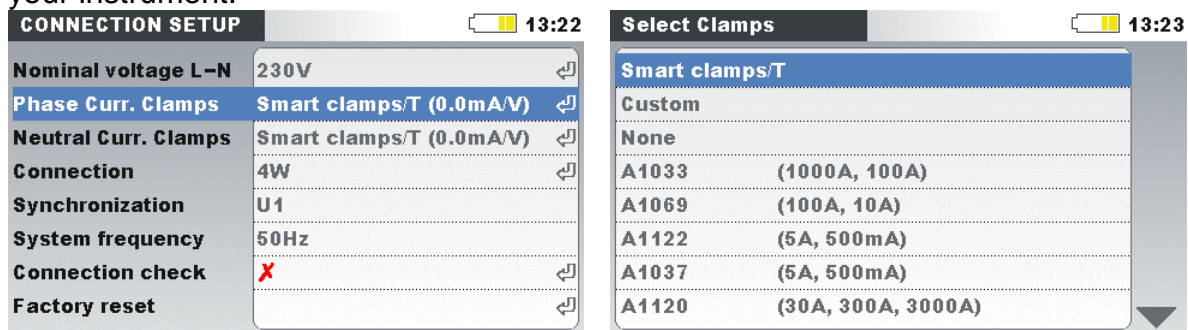
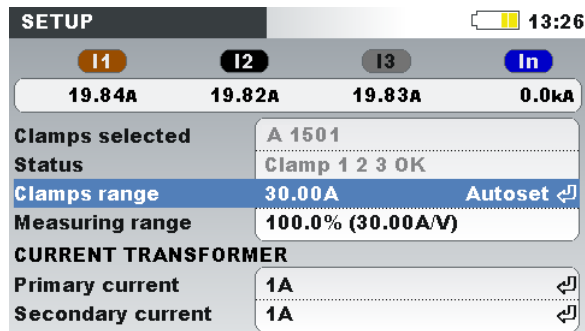


Figure 2: 3-phase 4-wire system

3. Select Phase and Neutral clamps to **Smart Clamp** in Connection setup menu on your instrument.



4. Select appropriate Current clamp range.
5. Observe the current value and waveform on the instrument's display. If desired, select the lower range on the measurement instrument.



6.1 Effective current measuring range

Technical specification of current clamp present many different errors which are influenced by various parameters (position, temperature). Most of them can be minimised in controlled laboratory use. However in the field ideal measurement condition can hardly be met. Therefore we recommend selecting clamp measuring range according to the **Effective measurement range**, shown in table below. Effective measurement range is range where measurement error is less than 5 % of measured value (reading), and includes all relevant errors (residual noise, clamp accuracy, position sensitivity and instrument accuracy).

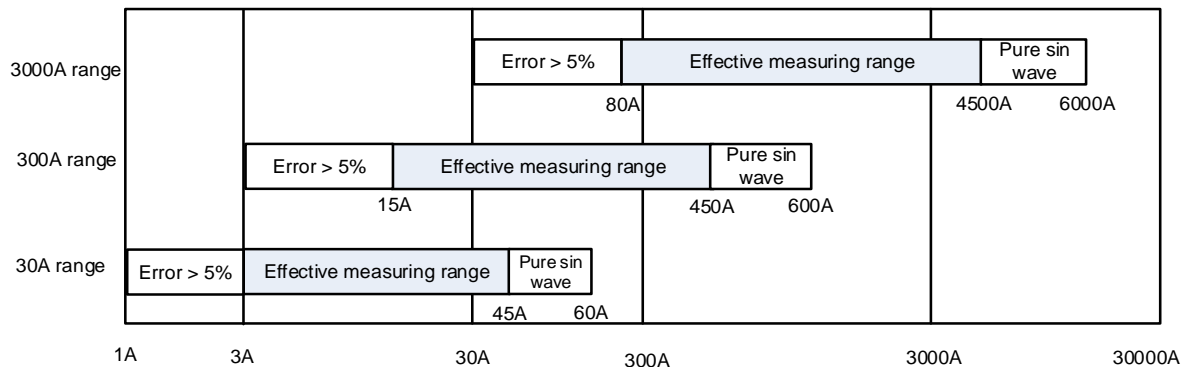


Figure 3: A 1501 and A 1502 effective measuring range (error is <5% of m.v.)

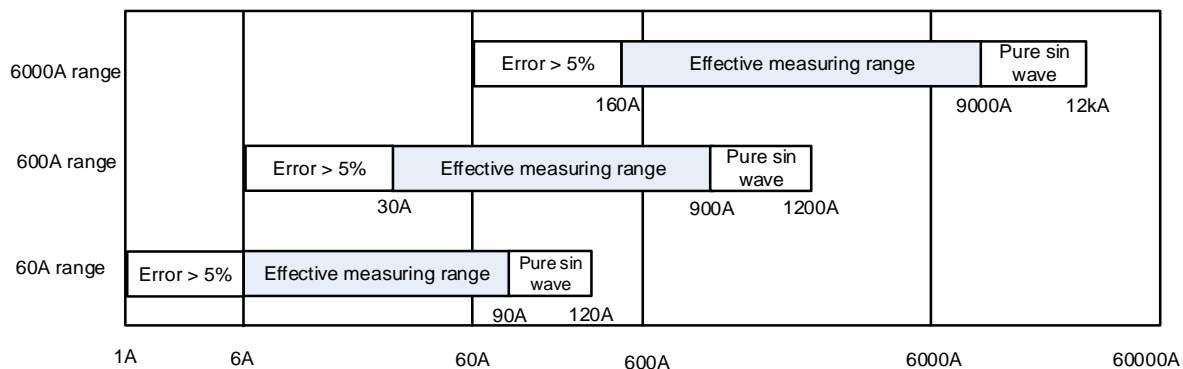


Figure 4: A 1503 effective measuring range (error is <5% of m.v.)

7 Technical specifications

7.1 A 1501 and A 1502

| FEATURES | DESCRIPTION | NOTES |
|--|---|-------|
| Length of the sensor | A 1501 – 25 cm / 10 in A 1502 – 48 cm / 25 in | |
| Max. conductor diameter | A 1501 – 7 cm / 2,7 in A 1502 – 14 cm / 5,5 in | |
| Nominal current range | 30 A / 300 A / 3000 A ac rms, with current crest factor 3 | |
| Effective measuring range | 30A range: 3 A ... 45 A 300A range: 15 A ... 450 A 3000A range: 80 A ... 4500 A | 3,5 |
| Maximal current | 60 A / 600 A / 6000 A of pure sinus current | |
| Bandwidth | 10 Hz ... 8 kHz | 1 |
| Accuracy | ±1.2 % of reading | 2,3 |
| Position sensitivity | ±1 % of nominal current range | |
| Temperature dependency | +/-0.01 % of reading / °C | |
| Residual current (noise) | 30A range: 0.12 A 300A range: 0.3 A 3000A range: 3 A | 3 |
| Phase error | <0.2° @ 50 Hz <3° @ 1.5 kHz | |
| External magnetic field rejection in reference to adjacent conductor | Min. 40 dB (< 1% of adjacent conductor current) | 4 |
| Electrical Safety | Double insulation EN 61010 – CAT III / 1000 V up to 3000 m | |
| Pollution degree | 2 | |
| Working and storage temperature range: | Flexible current sensor: -20 ... 85 °C Other clamp parts: -20 ... 70 °C | |
| Humidity | 95 % RH (0 °C ... 40 °C), non-condensing | |
| Weight of flexible sensor | A 1501 – < 150 g A 1502 – < 170 g | |
| Water and dust proofing | IP 65 | |

1. Limits of bandwidth corresponding to a relative gain > - 3 dB
2. Reference conditions:
 - Frequency 50/60 Hz;
 - conductor is in the centre and perpendicular to the current clamps;
 - temperature 23 °C;
 - Clamps connected to MI 2892 Power Master;
 - Laboratory environment.

$$3. \text{ Measurement error} = \sqrt{\left(\frac{I_{\text{Residual}}}{I_{\text{Measured}}} \cdot 100\right)^2 + \text{Accuracy}_{\text{Clamp}}^2 + \text{Position}^2 + \text{Accuracy}_{\text{MI2892}}^2}$$

4. Adjacent conductor ≥ 20 cm from current clamps.
5. With accuracy: ±5 % of reading from the MI 2892 Power Master in real conditions (with position, residual current, and intrinsic errors included)

7.1.1 Range 30A - Typical Characteristics

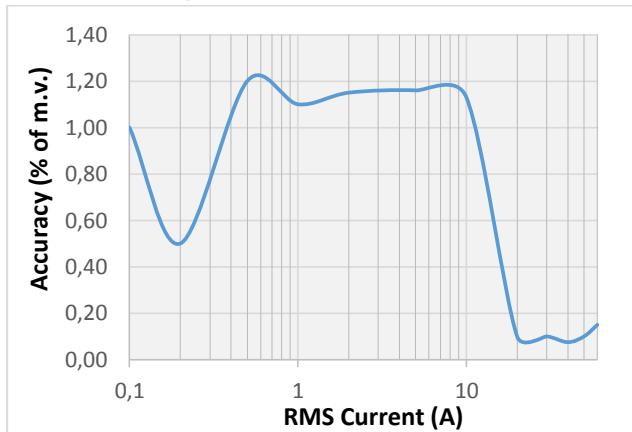


Figure 5: RMS Accuracy (50 Hz)

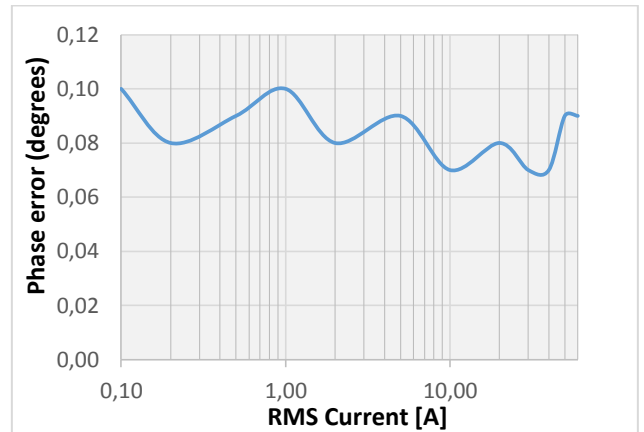


Figure 6: Phase error (50 Hz)

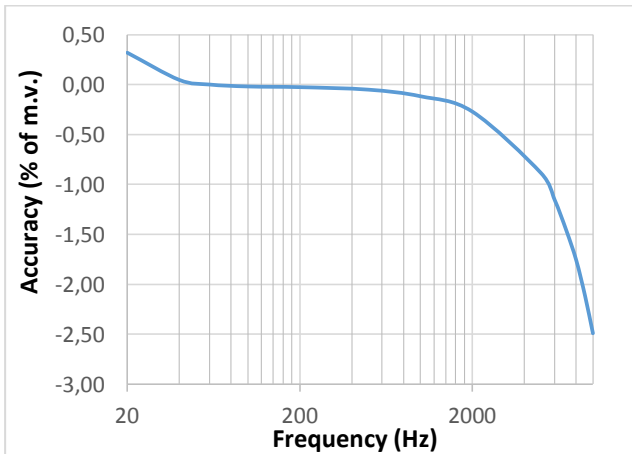


Figure 7: Frequency Accuracy (30Arms)

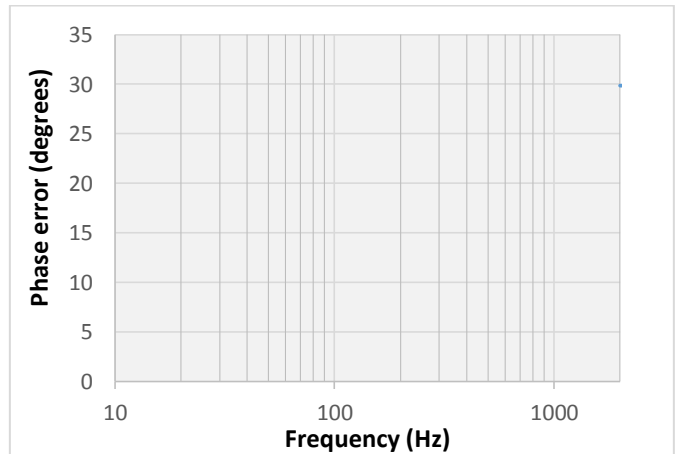


Figure 8: Phase error (30Arms)

7.2 A 1503

| FEATURES | DESCRIPTION | NOTES |
|--|--|-------|
| Length of the sensor | 90 cm / 35 in | |
| Max. conductor diameter | 27 cm / 10,6 in | |
| Nominal current range | 60 A / 600 A / 6000 A ac rms, with crest factor 3 or less | |
| Effective measuring range | 60A range: 6 A ... 90 A 600A range: 30 A ... 900 A 6000A range: 160 A ... 9000 A | 3,5 |
| Maximal current | 120 A / 1200 A / 12000 A of pure sinus current | |
| Bandwidth | 10 Hz ... 8 kHz | 1 |
| Accuracy | ±1.2 % of reading | 2, 3 |
| Position sensitivity | ±2 % of nominal current range | |
| Temperature dependency | ± 0.02 % of reading / °C | 5 |
| External magnetic field rejection in reference to adjacent conductor | 40 dB (1 % of adjacent conductor current) | 4 |
| Residual current (noise) | 60A range: 0.24 A 600A range: 0.6 A 6000A range: 6 A | 3 |
| Phase error | <0.2° @ 50 Hz <3° @ 1.5 kHz | |
| Electrical Safety | Double insulation EN 61010 – CAT III / 1000 V up to 3000 m | |
| Pollution degree | 2 | |
| Working and storage temperature range: | Flexible current sensor: -20 ... 85 °C Other clamp parts: -20 ... 70 °C | |
| Humidity | 95 % RH (0 °C ... 40 °C), non-condensing | |
| Weight of flexible sensor | < 200 g | |
| Water and dust proofing | IP 65 | |

1. Limits of bandwidth corresponding to a relative gain > - 3 dB

2. Reference conditions:

- Frequency: 50/60 Hz;
- Temperature: 23 °C;
- Conductor is in the centre and perpendicular to the current clamps;
- Clamps connected to MI 2892 Power Master;
- Laboratory environment.

3. $Measurement\ error = \sqrt{\left(\frac{I_{Residual}}{I_{Measured}} \cdot 100\right)^2 + Accuracy_{Clamp}^2 + Position^2 + Accuracy_{MI2892}^2}$

4. Adjacent conductor ≥ 10 cm from current clamps.

5. With accuracy: ±5 % of reading from the MI 2892 Power Master in real conditions (with position, residual current, and intrinsic errors included)

7.2.1 Range 60A - Typical Characteristics

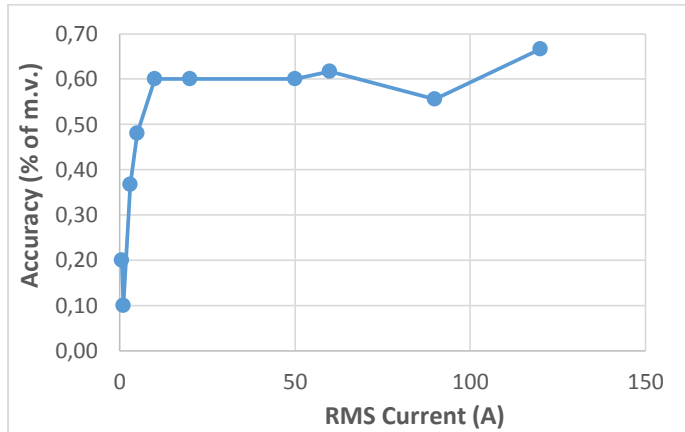


Figure 9: RMS Accuracy (50 Hz)

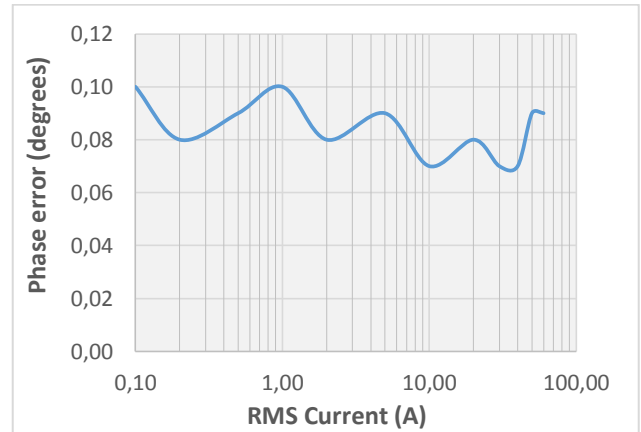


Figure 10: Phase error (50 Hz)

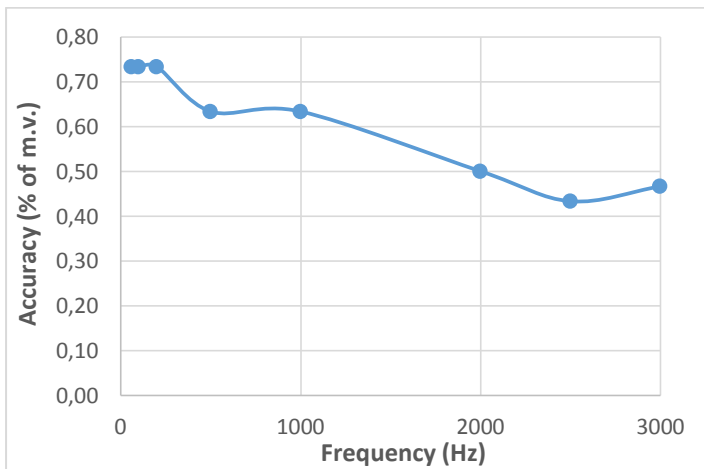


Figure 11: RMS Accuracy (60A)

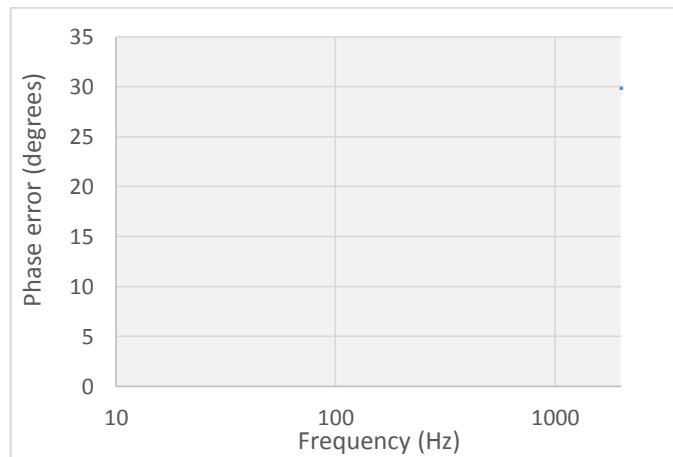


Figure 12: Phase error (60 A)

8 Cleaning

Use soft patch, slightly moistened with soap water or alcohol, to clean the surface of the clamps and leave it to dry totally, before using it.



Do not use liquids based on petrol or hydrocarbons!



Do not spill cleaning liquid over the device!

9 Service

For repairs under or out of warranty time please contact your Metrel distributor for further information.

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