



# ROGOWSKI COMMON MODE CURRENT SENSOR

## INSTRUCTIONS FOR USE **CMC**

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## INTRODUCTION

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The CMC Rogowski Common Mode Current Sensor from PEM combines high bandwidth performance with minimal disruption to the circuit under test. These instructions must be followed whenever the unit is used. They are intended to help you obtain the best and safest performance from the CMC sensor.

Throughout these instructions there are a number of warnings which must be observed to ensure safe operation of this unit. These warnings are identified by the following symbol:



The intended use is for the measurement of AC current. PEM accepts no responsibility for any damage resulting from careless use, or failure to observe these instructions.

PEM shall not be liable for any consequential damages, losses, costs or expenses arising from the use or misuse of this product however caused.

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## TECHNICAL SPECIFICATION

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<b>Peak Current</b>	Refer to ID Label
<b>Peak Output Voltage</b>	$\pm 7.5V$ (corresponding to $\pm$ Peak Current Rating)
<b>Output Cable</b>	0.5m BNC to BNC 50 $\Omega$ cable  In order to maintain safety, the BNC terminal must be connected to equipment that is separated from hazardous voltages by at least double insulation.
<b>Output Load</b>	$\geq 100k\Omega$ (for rated accuracy – recommend DC1M $\Omega$ on scope)
<b>Bandwidth (-3dB)</b>	Refer to the datasheet
<b>Operating Temp. Range</b>	0°C to +40°C ( <i>Integrator electronics</i> ) -40°C to +100°C ( <i>Coil and cable</i> )
<b>Accuracy (typ.)</b>	<b>(5% to 100% Peak Current)</b>
Calibration	Nominally $\pm 0.2\%$ with the conductor central in the Rogowski loop. (See the calibration certificate for further details)
Positional Accuracy	$\pm 2\%$ variation of accuracy with conductor position in the loop (see 'Obtaining The Best Measurement')
Linearity	$\pm 0.05\%$ of reading
Noise (Max)	Refer to datasheet

<b>Coil Insulation</b>	10kV peak
<b>Coil Bend Radius</b>	40mm
<b>Absolute di/dt Ratings</b>	70kA/μs (peak)   1.5kA/μs (rms)

<b>Environmental</b>	Indoor use / Altitude up to 2000m Installation Category III, Pollution Degree 2. Max. Rel. Humidity: 80% up to 31°C Decreasing Linearly to 50% at 40°C
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<b>Measurement Category</b>	Cat III 1000V
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### Operation with External Adaptor

DC Supply Voltage	12Vdc (±10%)
DC Quiescent Current	60mA @12VDC – ‘B’ version Standard Alkaline Battery 130mA @12VDC – ‘R’ version NiMH Rechargeable Battery
DC Socket Type	1.3mm Jack Socket – Centre Positive Tip

**The transducer should only be powered by the supplied mains adaptor.**

Adaptor Supply Voltage	100 – 240VAC
Adaptor Supply Frequency	50 - 60Hz
Adaptor Supply Current	450mA Max @ 100VAC Input
Supply Voltage Fluctuation	up to 10%

### Operation with Battery

Battery Supply	‘B’ version: 4 x 1.5V AA alkaline Battery Life: 30hrs typ. ‘R’ version: 4 x 1.2V NiMH rechargeable batteries Battery Life: 10hrs typ. (based on a 2000mAh cell) Typical Recharge Time: 40 hrs
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## STANDARDS AND APPROVALS

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**EMC Approvals**

EN61326-1:2013

FCC Title 47 (CFR:2010, Part 15b)

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**Safety Approvals**

EN61010-1:2010+A1:2019

EN61010-2-032:2012

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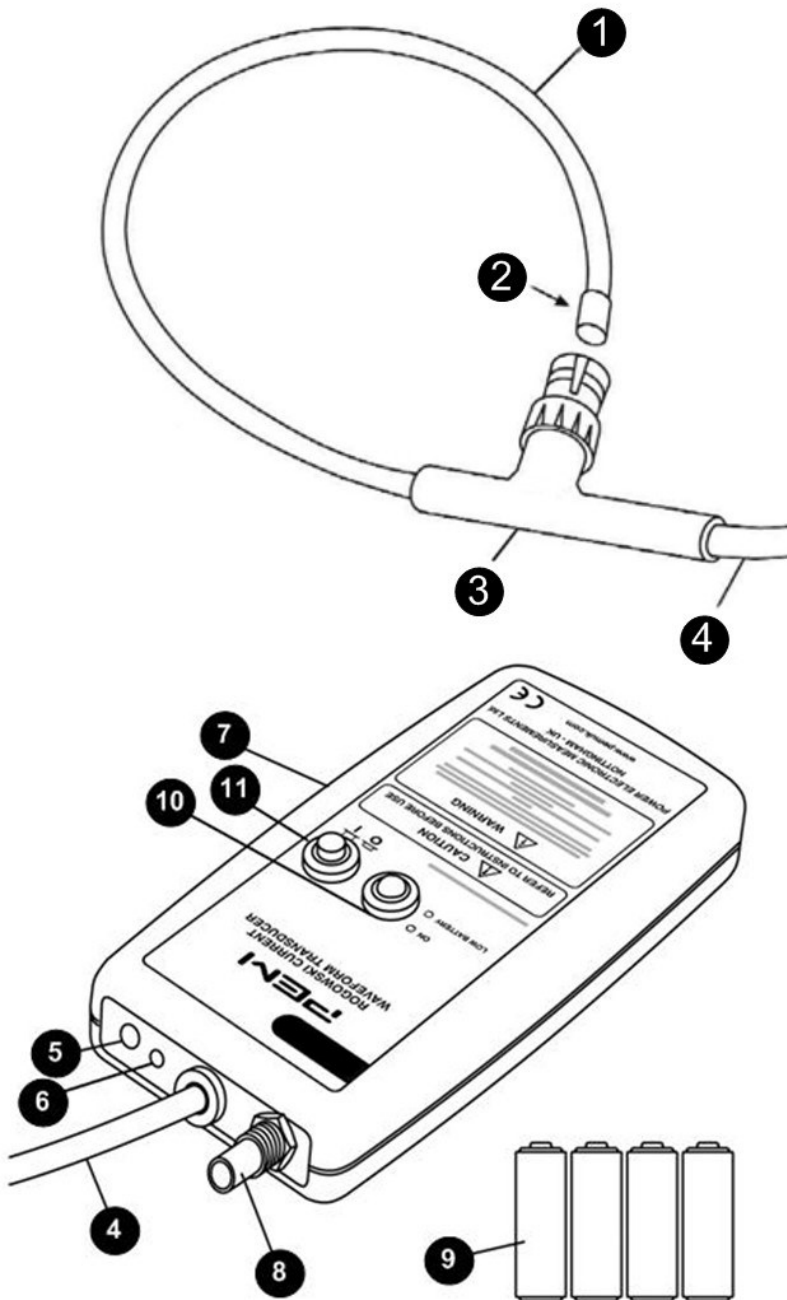
**Quality System**

ISO9001:2015

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# OVERVIEW: CMC



1. Rogowski Coil (Probe)
2. Probe 'Free End'
3. Ferrule
4. Connecting Cable
5. DC Power Socket
6. DC Power Status LED
7. Enclosure
8. BNC Output Socket
9. 4 x AA batteries
10. Status Indicator LED  
GREEN = ON  
RED = Battery LOW
11. Power Button

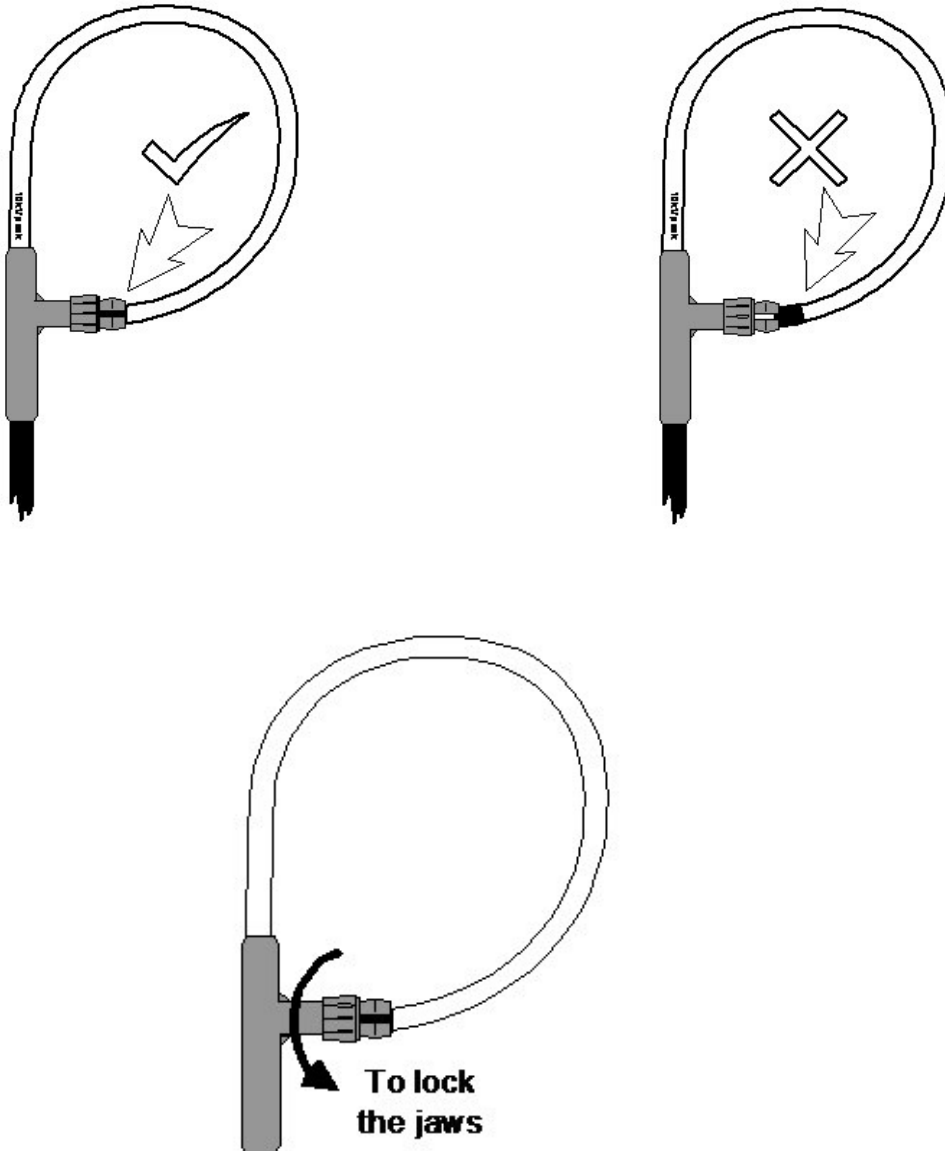
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## HANDLING INSTRUCTIONS

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The coil is fully inserted when the user feels the free-end of the coil engage with the internal click-in mechanism inside the ferrule.

Visual indication that the coil mechanism is fully inserted is provided by the black coil marker situated near the end of the coil, as shown below.



If the coil is to be left in-situ for any period of time or is used in an environment where the coil is subject to vibration, the locking nut should be engaged as shown in the diagram below.



The locking mechanism must not be actuated at temperatures below 0°C and care must be taken not to over-tighten the locking nut.



The minimum bend radius of this coil is 40mm. This is the minimum radius that the coil can be bent without risk of damaging the coil or shortening its life.

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## SAFETY AND PRE-USE CHECKS

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The CMC does not provide protection of the user from electric shock whilst applying or removing the probe from HAZARDOUS LIVE conductors.

The probe must only be applied to or removed from de-energised circuits.

The Rogowski coil must not be used if the coil is damaged or the probe wear indicator is visible. The wear indicator is a layer of contrasting colour under the outer surface of the coil.

If the CMC is used in a manner not specified by the manufacturer the protection provided by the equipment may be impaired.

### THE CMC ROGOWSKI COIL



The insulation around the Rogowski coil must be VISUALLY INSPECTED before use, and the CWT must **NOT BE USED** if there are signs of damage.



When bending the flexible coil around a conductor, avoid tight bends and sharp edges that could damage the coil.



The voltage rating is clearly labelled on the coil. For the CMC this is 10kV peak. Never use at voltages greater than this value. The removable silicone sleeve supplied with the coil provides additional mechanical protection.

The ratings are derived from the following standard test:  
15kV/60s/50Hz Sinewave



Voltage ratings are only valid if the 'free end' of the coil is fully inserted into the socket and remains fully inserted during use i.e. right up to the black indicator line on the free end of the coil.



The voltage ratings are appropriate for intermittent use of the CMC as a test instrument and not for continuous use in a permanent installation.

For information regarding permanent installation of PEM's Rogowski coils on high voltage equipment please consult PEM.



The user must ensure that the absolute maximum rated  $di/dt$  is not exceeded

### THE INTEGRATOR



The CMC must only be used with oscilloscopes or monitoring equipment which have their BNC INPUTS PROPERLY GROUNDED.



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## POWER OPTIONS

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The CMC can be powered by an external DC source or by one of two battery options. The battery option is displayed along with the model type on the serial number label and will state either standard non-rechargeable batteries **[B]** or rechargeable option **[R]**

### External Supply

The CMC can be powered by an external DC supply. The DC voltage must be 12V(±10%) using a suitably sized, centre positive connector. When the DC supply is present a RED indicating LED adjacent to the socket is illuminated.

### Standard Alkaline Batteries

Four fully charged AA alkaline batteries provide approx. 30 hours operation. Healthy batteries are indicated by the GREEN LED. If the LED is RED the batteries are depleted and must be replaced.

When the DC voltage is present the batteries are inoperative.

### Rechargeable Batteries

Four fully charged rechargeable AA cells provide approx. 10 hours operation. Healthy batteries are indicated by the GREEN LED. If the LED is RED the batteries are depleted and must be replaced or recharged.

When the DC supply is present the batteries are inoperative and the external DC voltage powers the sensor. In addition, when the DC supply is present (regardless of whether the CMC is ON or OFF) the rechargeable batteries are trickle-charged. [**R** Version Only]

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## REPLACING THE BATTERIES

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The circuit under test must be de-energised or the probe removed from the test circuit before replacing the batteries.

Low battery is indicated by a red LED located near the power switch. To replace the batteries, switch-off the CWT, remove the battery cover and replace with appropriate batteries for your CWT type.

Alkaline batteries that are deeply discharged are more prone to leaking. PEM strongly advise that for long-term storage, the batteries are removed from the instrument.

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## SWITCHING ON

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Before installing the CMC and taking a measurement refer to SAFETY AND PRE-USE CHECKS and HANDLING INSTRUCTIONS to ensure safe operation of your CMC.



Your CMC must only be used with oscilloscopes or monitoring equipment which have their BNC inputs properly grounded.



The probe must only be applied to or removed from de-energised circuits.

1. Connect the BNC output of the CMC to your grounded oscilloscope or current monitoring equipment.
2. Having carried out the VISUAL INSPECTION of the Rogowski coil, unclip the coil and wrap it around the de-energised conductor under test.
3. Insert the free end of the coil fully inside the ferrule.
4. Re-energise the conductor.
5. Use the push-button to switch ON by pressing and releasing the button, and to turn OFF by depressing the button fully; the LED indicates that the CMC is ON when the LED is GREEN.
6. After switch on the CMC may require a settling period of up to 2 minutes before providing an accurate measurement. The settling period is dependent on warm-up time and the low frequency bandwidth.
7. PEM recommend that the integrator is kept well away from any strong sources of electromagnetic interference when taking measurements.

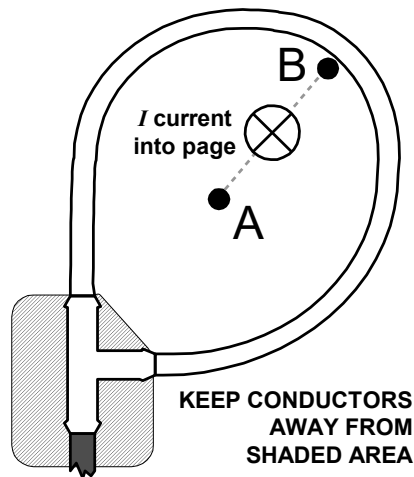
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## OBTAINING THE BEST MEASUREMENT

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The Rogowski coil should be positioned so that the conductor under test is encircled by the coil but is not adjacent to the cable attachment (see picture below). The arrows on the coil indicate the direction a positive current should flow through the coil loop in order to obtain a positive output voltage. The CMC has been calibrated with the conductor near the centre (position **A**), and this is the ideal position for accuracy.

For the best high frequency performance, the centre of the current should lie on the line shown **A** to **B**, where **B** is half way around the circumference of the coil.



## SENSITIVITY TO EXTERNAL CURRENTS AND VOLTAGES

The sensitivity of the CMC to currents that are outside the closed loop of the Rogowski coil is very small, provided that the external currents are less than the current rating of the transducer or that such currents are relatively distant from the coil. In the vicinity of a multi-turn conductor the effects are far stronger than from a single conductor carrying the same current, and such positions should be avoided.

If there is a surface with a high voltage very close to the coil and the voltage is subject to high rates of change (e.g.  $1\text{kV}/\mu\text{s}$ ) or high frequency oscillations in the MHz range, then measurement error can arise due to capacitive coupling to the coil. However, in the case of the CMC the Rogowski coil is fitted with an electrostatic screen underneath the coil insulation. This provides excellent immunity to fast transient voltages and greatly attenuates any electrostatic interference.

To check for any unwanted response to adjacent fields, it is recommended to quantify the output of the CMC when close to (but not encircling) the conductor under test. This will reveal the magnitude of any unwanted responses to currents close to, but outside, the coil.

## OUTPUT CABLES

Your CMC has been supplied with a 500mm BNC to BNC output. It is possible to use longer cables and these should be of a  $50\Omega$  single screened co-axial cable type.

PEM does not consider the use of extension cables to be problematic from the noise viewpoint but consideration should be given to the routing of very long cables.

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## **CLEANING AND DECONTAMINATION**

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To prevent surface contamination the Rogowski coil and cable should be inspected regularly.

The CWT must be disconnected from any external circuit and turned OFF prior to cleaning.

To clean the coil and cable use a mild detergent and a damp cloth to remove any contamination, wipe dry with clean cloth to remove the detergent and dry thoroughly before placing back into service.

PEM accepts no responsibility for the use of any other cleaning solvents or cleaning methods.

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## **WARRANTY**

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The coil is guaranteed to be free from defects due to materials and workmanship for 12 months and the integrator for 24 months from the date of despatch from Power Electronic Measurements Ltd.

In the event of a defect where the transducer has not been misused the CWT should be returned to PEM with all freight charges to be paid by the customer. Correction shall be in the form of repair or replacement.

Power Electronic Measurements Ltd shall not be liable for any consequential damages, losses, costs or expenses arising from the use or misuse of this product however caused.

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## **RETURNING YOUR CWT FOR RECALIBRATION OR REPAIR**

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To return the CWT for repair or recalibration please contact PEM in advance for shipping instructions by emailing [service@pemuk.com](mailto:service@pemuk.com) or visit our website, <http://www.pemuk.com/> for contact details and our returns procedure.

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## **END OF LIFE DISPOSAL**

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Once your probe reaches end of life it must be disposed of responsibly and recycled. The device must not be disposed of with household waste.

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For technical updates and the latest product releases please consult

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