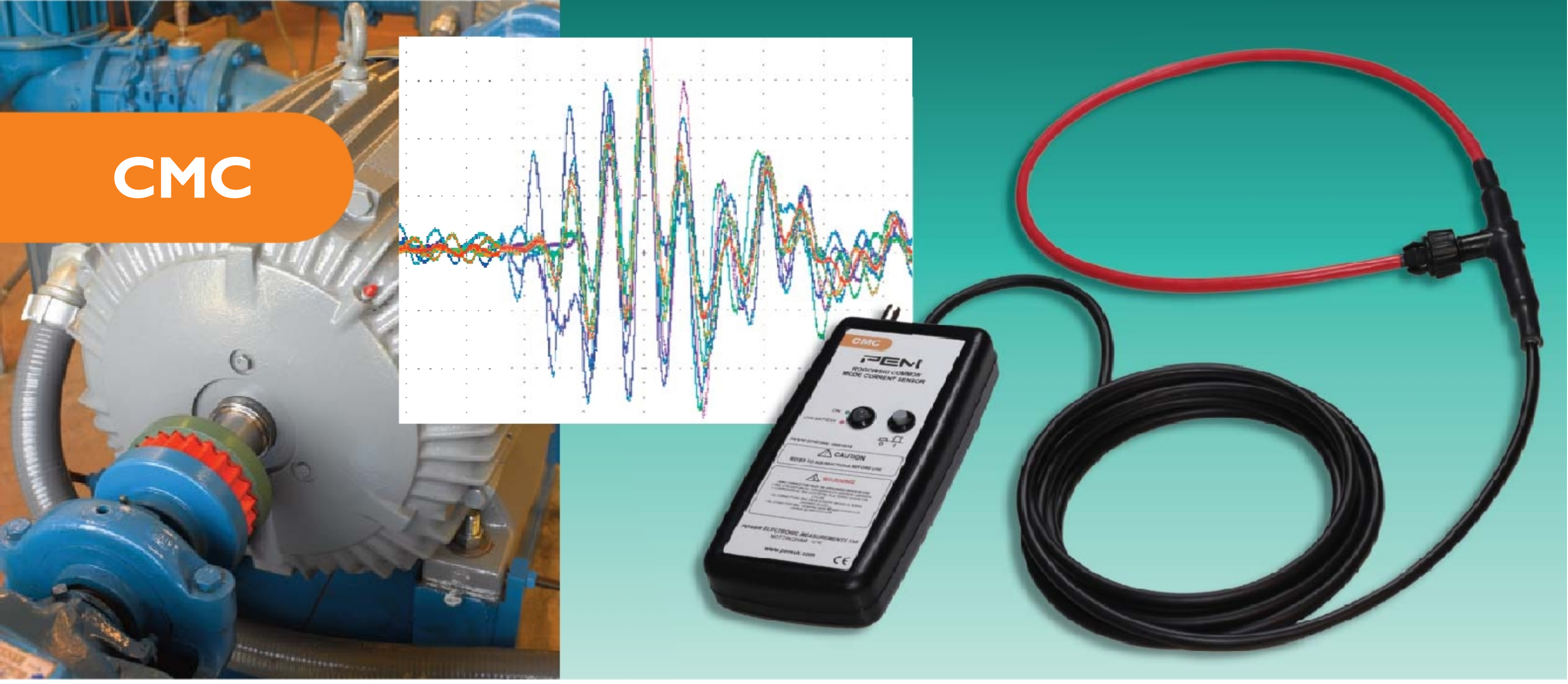


Rogowski probe for measuring hf common mode currents in VSDs

PEM has developed a flexible, clip-around, current probe to measure high frequency common mode currents which flow around a motor drive to ground via the bearings in large AC drive systems.

Common mode currents - the problem:

Variable Speed Drives (VSDs) used to control AC motors can produce large high frequency PWM voltages that can capacitively couple to the machine shaft. The voltages on the shaft can be sufficient to cause arcing currents to flow through the motor bearings to ground.

The discharging currents can cause heating and even melting of the surface of the bearing raceways. The damage caused by bearing currents can lead to premature failure of the motor drive as well and costly maintenance and down time.

CMC – an important tool for engineers:

The CMC is an important tool to identify the presence and severity of common mode currents in large motor drives. It is designed for use by experienced personnel with knowledge of AC drive systems. Once identified, the CMC will give an engineer a reference measurement which can be used to evaluate the effectiveness of steps taken to mitigate against bearing currents.

The probe is a modified version of our industry leading CWT range of Rogowski current sensors.

The CMC can also be used for in a variety of other applications where small, high frequency currents need to be measured.

The customised probe features:

- **An electrostatically screened Rogowski coil.** The screen attenuates the effects of unwanted interference due to capacitive coupling from local voltage sources
- **A low frequency (-3dB) bandwidth to attenuate large fundamental power frequency currents and magnetic fields.** This significantly improves the SNR for measurement of high frequency bearing currents
- **A high frequency (-3dB) bandwidth of $\geq$10MHz** for coil circumferences up to 1m
- **A wide range of Rogowski coil sizes** suitable for even the largest machine shafts

CMC

Model	**Sensitivity** (mV/A)	**Peak current** (A)	**Noise max** (mVp-p)	**LF (-3dB) bandwidth** (kHz)	**Typical LF (<1%) bandwidth** (kHz)	**Peak di/dt** (kA/µs)	**HF (-3dB) bandwidth** (MHz) *Coil length 1000mm*
CMC015	200.0	37.5	4.0	19.0	50.0	4.0	11.0
CMC03	100.0	75.0	4.0	6.0	15.0	8.0	13.0
CMC06	50.0	150.0	4.0	1.9	5.0	16.0	14.0

Output	±7.5V peak corresponding to 'Peak Current' into >100kΩ (e.g. DC 1MΩ oscilloscope)
Accuracy	Variation with conductor position in the coil typically ±3% of reading (for a 5cm^2 conductor) Linearity (with current magnitude) 0.05% of reading
Calibration	Calibrated to ±0.5% reading with conductor central in the coil loop
DC offset	±3mV maximum at 25^{0}C
Temperature	Coil and cable -20^{0}C to +90^{0}C. Integrator 0 to +40^{0}C
di/dt ratings	These are 'absolute maximum di/dt ratings' and values must not be exceeded: Absolute max. peak di/dt: 70kA/µs Absolute max. rms di/dt: 1.5kA/µs
Coil voltage	10kV peak Safe peak working voltage to earth. Rating established by a 15kVrms, 50Hz, 60sec flash test. Information about continuous use of the coils at high voltage can be obtained from PEM.

Key features

❶ **Coil length (circumference)**
500mm, 700mm, 1000mm - longer coils available on request

➲ **Coil cross-section (thickness)**
8.5mm max (14mm with removeable silicone sleeve – only for mechanical protection)

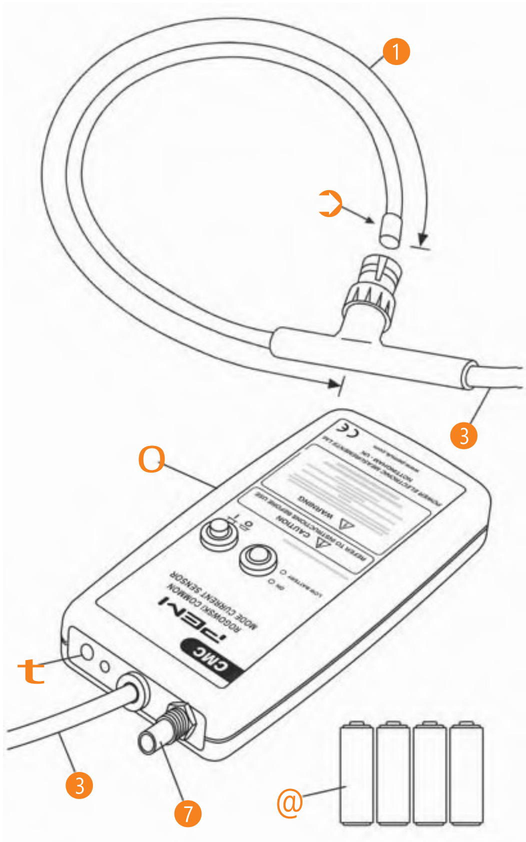
❸ **Cable length**
2.5m and 4m as standard (connecting cable coil to integrator)
- longer cables available on request.

@ **Battery options**
B-Standard: 4 x AA 1.5V alkali batteries. Lifetime typically 25 hours
R-Rechargeable: 4 x AA 1.2V NiMH batteries. Lifetime typically 10 hours. External adaptor recharges batteries and powers unit.

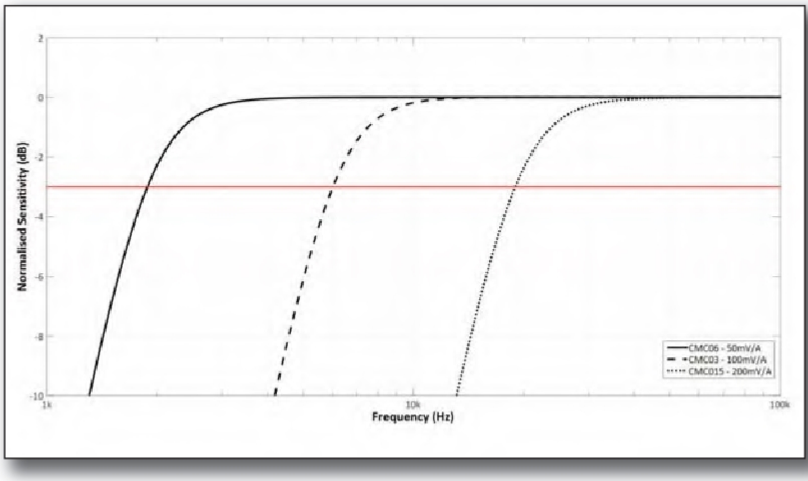
t **Socket for external power adaptor (1.3mm diameter)**
(adaptor available from PEM as an option)

0 **Electronics enclosure**
Dimensions H=183mm, W=93mm, D=32mm

❼ **Output BNC socket**
Supplied with 0.5m BNC:BNC cable.



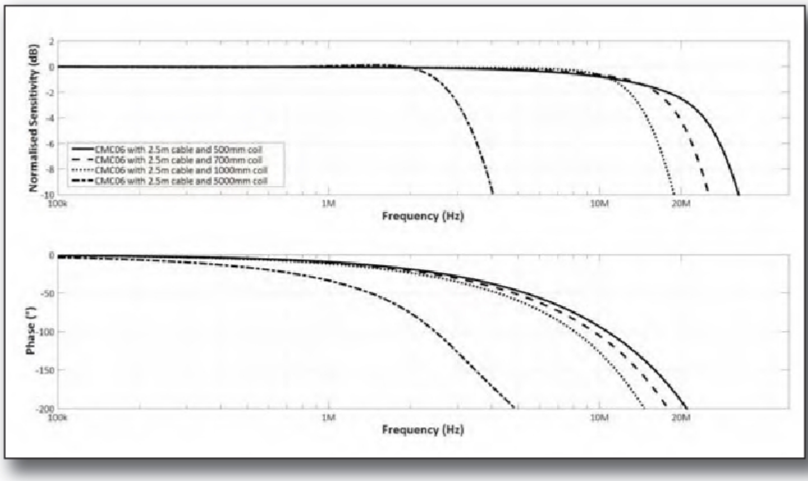
Typical performance characteristics



Low Frequency

The low frequency bandwidth is set to attenuate any large fundamental frequency currents and magnetic fields. The CMC06 integrator has a gain of typically -90dB at 50Hz, this means that if there is a 100Arms, 50Hz current passing through the coil the output of the CMC will be <0.2mVrms.

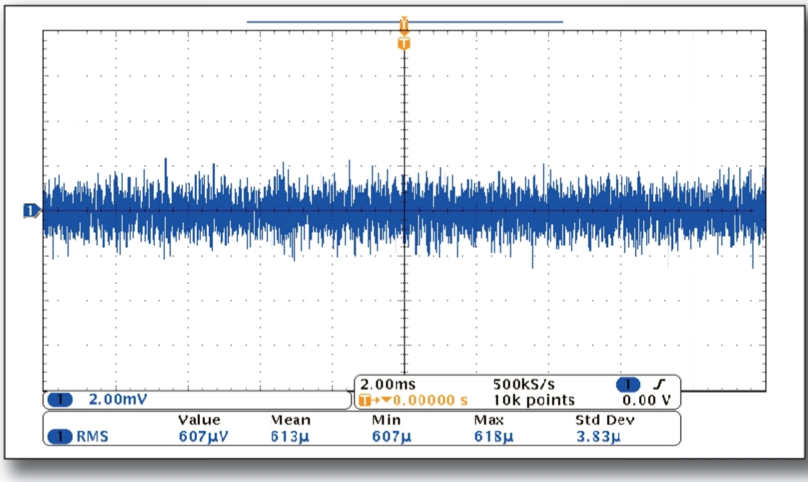
Typical low frequency amplitude response



High Frequency

The high frequency bandwidth of the CMC is determinded by the coil length, the cable length and the integrator design. The high frequency bandwidth for each model is quoted for a 2.5m cable and a 1000mm coil in the specification table.

Typical high frequency response -- Model CMC06 -- 50mV/A
Showing the variation of HF performance with coil length, 500mm coil up to 5000mm coil

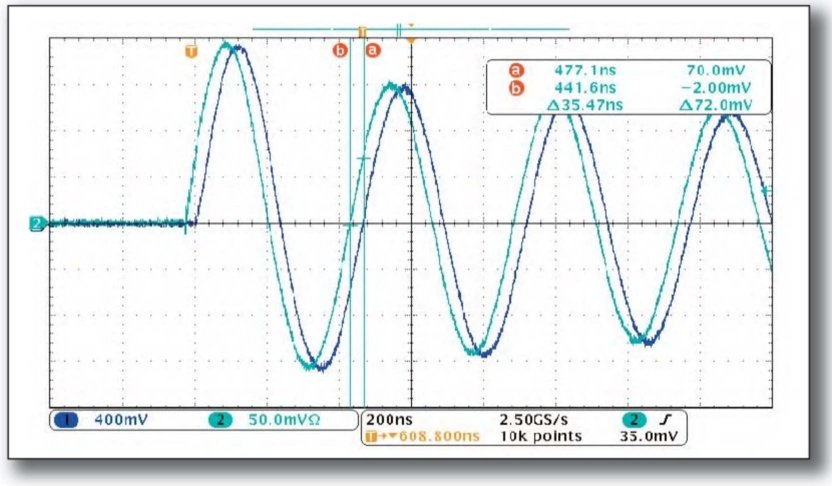


Noise

The low noise integrator design allows better measurement accuracy of high frequency currents and enables a wide dynamic measurement range.

Typical noise – Model CMC03
Ch1 - CMC03/B/2.5/1000
(Peak current 75A, Sensitivity 100mV/A)
Timebase 2ms/div

Performance



Delay

The trace shows the CMC03 measuring a 2MHz sinusoidal current source compared with a coaxial shunt measurement of the same current. There is a delay between the actual current and the output of the CMC which is predictable and is determined by the coil and cable length as well as the integrator design. The predicted delay for the CMC03B/2.5/1000 is 35ns.

2MHz damped sinusoidal current 16Apk

Ch1

- CMC03/B/2.5/1000 (Peak current 75A, Sensitivity 100mV/A)

Ch2

- Co-ax shunt 2GHz Timebase 200ns/div

Generating the order code

Type	/	Power supply	/	Cable length (m)	/	Coil circumference (mm)
e.g. CMC06 – 50mV/A battery supply, 2.5m cable from coil to integrator, 1000mm circumference coil						
CMC06	/	*B*	/	*2.5*	/	*1000*

If you have any queries regarding the CMC or require specifications outside our standard ranges please do not hesitate to contact us.