

CMC 353

Technical Data



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1 Technical data

1.1 Calibration and guaranteed values

We recommend that you send in your test sets for calibration at least once a year.

The drift of test equipment, that is, the deterioration of accuracy over time, depends strongly on environmental conditions and the application field. Excessive use or mechanical and/or thermal stress may result in the need for shorter calibration intervals.

Moderate working environments, on the other hand, allow you to increase the calibration interval to once every 2 or even 3 years.

- ▶ Particularly in cases of extended calibration intervals, verify the accuracy of the test set by cross-referencing the measurement results with traceable reference equipment either on a regular basis or prior to use. You can, for example, use a typical, often-used device under test as a reference, or use measurement equipment with a certified high accuracy.

Should the test equipment fail, immediately contact OMICRON Support for calibration or repair. Do not try to use it anymore.

Guaranteed values

- The values apply at $23\text{ °C} \pm 5\text{ °C}$ ($73\text{ °F} \pm 9\text{ °F}$), and after a warm-up time greater than 25 minutes.
- Guaranteed values of the generator outputs:
The values are valid in the frequency range from 10 to 100 Hz unless specified otherwise. Given maximum phase errors relate to the voltage amplifier outputs.
- Accuracy data for analog outputs are valid in the frequency range from 0 to 100 Hz unless specified otherwise.
- The given input/output accuracy values relate to the range limit value (% of range limit value).

1.2 Main power supply

Main power supply	
Connection	C14 connector according to IEC 60320-1.
Voltage, single phase	
Nominal voltage	100 ... 240 V _{AC}
Operational range	85 ... 264 V _{AC}
Power fuse	T 12.5 AH 250 V (5 × 20 mm) Schurter ordering number 0001.2515. For more information, visit the website www.schurter.com .
Nominal supply current	Max. 12 A @ 110 V; max. 10 A @ 230 V
Frequency	
Nominal frequency	50/60 Hz
Operational range	45 ... 65 Hz
Overvoltage category	II

1.2.1 Operational limits in conjunction with a weak power supply input voltage

In general, the maximum output power of the *CMC 353* is limited by the power supply input voltage. If the power supply input voltage is less than 120 V_{AC}, it is possible to supply the *CMC 353* with 2 phases (L-L, for example with a NEMA 6 240 V U.S. Standard) instead of the normal phase-neutral (L-N) operation in order to increase the power supply input voltage.

In order to limit the internal losses and to maximize the output power of the voltage amplifier, always set the maximum test object voltage to the minimum value possible for the test.

Apart from the reduction of the available total output power, a weak power supply input does not further affect the technical data of the *CMC 353*.

Typical total output power at different power supply voltages

Power supply	Current amplifier	Voltage amplifier	AUX DC
230 V ¹	3 × 250 W at 20 A	3 × 85 W at 85 V	45 W at 110 V
115 V ¹	3 × 250 W at 20 A	3 × 85 W at 85 V	45 W at 110 V
100 V ¹	3 × 200 W at 20 A	3 × 85 W at 85 V	45 W at 110 V
90 V ¹	3 × 150 W at 20 A	3 × 85 W at 85 V	45 W at 110 V

1. After 10 min of continuous operation at full output power, a duty cycle of 10 min on/10 min off is required at an ambient temperature of 23 °C.

1.2.2 Operational limits with current and voltage amplifier in parallel

A parallel operation of current and voltage amplifier lowers the maximum output power of the CMC 353.

To limit the internal losses and to maximize the output power of the voltage amplifier, set the maximum test object voltage to the minimum value possible for the test. To minimize no load losses, do not route unused amplifiers in the **Hardware Configuration**.

Typical test set uptime for different power outputs

Current amplifier	Voltage amplifier	t1 ¹
3 × 200 W at 20 A	3 × 60 W at 85 V	>1800 s ²
3 × 250 W at 20 A	3 × 85 W at 85 V	600 s
3 × 430 W at 20 A	3 × 100 W at 85 V	500 s

1. t1 = maximum possible uptime for a cold CMC 353 test set.
2. At an ambient temperature of 23 °C, when operating the CMC 353 test set with a low power supply, allow a duty cycle of 10 min on/10 min off.

1.3 System clock accuracy

All signals generated or measured by the CMC 353 refer to a common internal time base that is specified as follows:

Characteristic	Specification
Clock performance	Stratum 3 (ANSI/T1.101-1987)
Frequency drift (over time)	
24 hours	<±0.37 ppm (±0.000037 %)
20 years	<±4.60 ppm (±0.00046 %)
Frequency drift (over temperature range)	<±0.28 ppm (±0.000028 %)

1.4 Synchronization

Synchronization of system clock

By synchronizing the system clock to an external time base, the system clock accuracy can be improved up to the level of the external time base. Synchronizing the system clock additionally makes the absolute time available in the system. The absolute time is used to tag measurement results, start distributed tests at the same time, and generate and measure synchrophasors.

The following specifications refer to the internal time base. For the absolute time accuracy of the outputs and inputs, the inherent error of the respective channel itself has to be added.

Characteristic	Specification
IEEE 1588-2008 (v2) Offset (UTC) Pulling range Supported profiles Supported sources	Error $< \pm 1 \mu\text{s}$ $\pm 100 \text{ ppm } (\pm 0.01 \%)$ IEEE C37.238-2011 (Power Profile: v1) IEEE C37.238-2017 (Power Profile: v2) IEC/IEEE 61850-9-3-2016: Communication Networks and Systems for Power Utility Automation – Part 9-3: Precision Time Protocol Profile for Power Utility Automation (Utility Profile). OMICRON <i>CMGPS 588</i> , <i>OTMC 100</i> or any Precision Time Protocol source (PTP grandmaster clock).
IRIG-B Offset (UTC) Pulling range Supported sources	Error $< \pm 1 \mu\text{s}$ $\pm 100 \text{ ppm } (\pm 0.01 \%)$ Third-party IRIG-B sources with OMICRON <i>CMIRIG-B</i> accessory.

Absolute time synchronization

The voltage and current outputs can be synchronized to an absolute time base like IRIG-B and IEEE 1588 to generate output signals synchronous to the time source. This can be used to test phasor measurement units (PMU) by generating reference signals.

Absolute timing accuracy ¹		
	Typical	Guaranteed
Voltage output	Error $< \pm 1 \mu\text{s}$	Error $< \pm 5 \mu\text{s}$
Current output	Error $< \pm 5 \mu\text{s}$	Error $< \pm 20 \mu\text{s}$

1. Valid for a phasor with a frequency of 50/60 Hz.

Synchronization to external analog signal

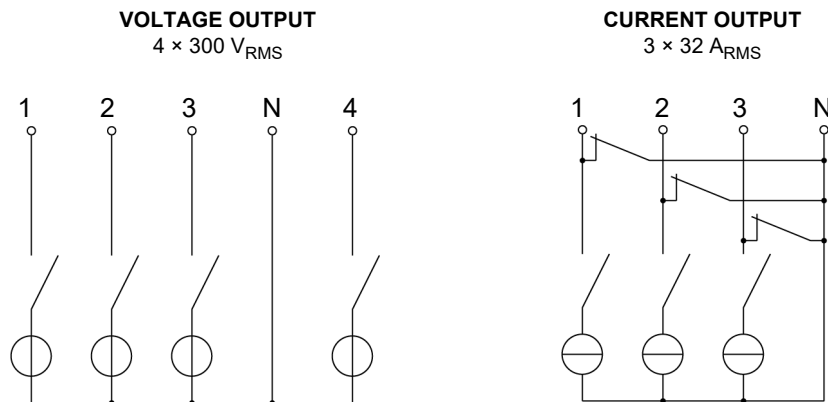
The phase and frequency of the voltage and current outputs can be synchronized to a reference input signal of 10 ... 300 V / 15 ... 70 Hz applied to binary input 10. In contrast to the synchronization of the system clock, this kind of synchronization influences the frequency and phase of the signal generation directly.

The possible accuracy depends on the quality of the synchronization signal because the synchronization uses the zero crossings of the signal.

1.5 Outputs

1.5.1 General generator outputs

General generator outputs data (analog current and voltage outputs, and LL out outputs)	
Frequency ranges	→ section 1.5.3 "Current outputs" on page 10. → section 1.5.4 "Voltage outputs" on page 13. → section 1.5.5 "Low-level outputs LL out for external amplifiers" on page 14.
Frequency resolution (signal generation)	<5 μ Hz
Bandwidth (-3 dB)	3.1 kHz
Phase range φ	-360° ... +360°
Phase resolution	0.001°
Phase error	→ section 1.5.3 "Current outputs" on page 10. → section 1.5.4 "Voltage outputs" on page 13. → section 1.5.5 "Low-level outputs LL out for external amplifiers" on page 14.
Amplitude temperature drift	0.0025 %/°C



All voltages and current generators can independently be configured with respect to amplitude, phase angle, and frequency.

All outputs are monitored. Overload conditions prompt a notification in the control software.

1.5.2 Extended frequency range

In selected *Test Universe* modules, the *CMC 353* supports a mode for generating stationary signals of up to 3 kHz. This mode corrects the phase and gain errors of the output filter. The 3 dB bandwidth of this filter limits the amplitude at 3 kHz to about 70 % of the maximum range value. The application of the extended frequency range is the generation of harmonics and interharmonics.

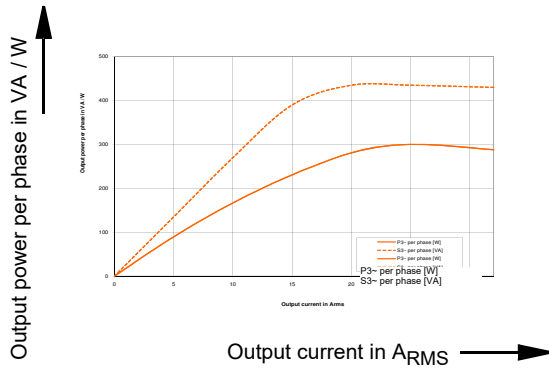
Extended frequency range (1 ... 3 kHz)		
	Typical	Guaranteed
Low-level outputs ¹	Phase error <0.25° Amplitude error <0.25 %	Phase error <1° Amplitude error <1 %
Voltage amplifier	Phase error <0.25° Amplitude error <0.25 %	Phase error <1° Amplitude error <1 %

1. No extended frequency range support for external amplifiers.

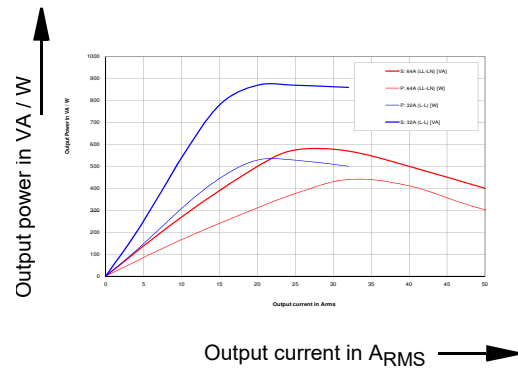
1.5.3 Current outputs

Current outputs ¹		
Output currents		
3-phase AC (L-N)	3 × 0 ... 32 A	
1-phase AC (L-L) ^{2, 3}	1 × 0 ... 32A	
1-phase AC (LL-LN) ²	1 × 0 ... 64 A	
DC (LL-LN) ²	1 × 0 ... ±90 A	
	Typical	Guaranteed
Output power ⁴		
3-phase AC (L-N)	3 × 430 VA at 25 A	3 × 250 W at 20 A
1-phase AC (L-L) ^{2, 3}	1 × 870 VA at 25A	1 × 530 W at 20 A
1-phase AC (LL-LN) ²	1 × 500 VA at 40A	1 × 350 W at 40 A
DC (LL-LN) ²	1 × 700 W at ±40 A	1 × 500 W at ±40 A
Accuracy ⁵		
$R_{load} \leq 0.5 \Omega$	Error <0.05 % of rd. + 0.02 % of rg.	Error <0.15 % of rd. + 0.05 % of rg.
Harmonic distortion (THD+N) ^{6, 7}	0.05 %	<0.15 %
Phase error ⁶	0.05°	<0.2°
DC offset current	<3 mA	<10 mA
Frequency range ^{8, 9}	Sinusoidal signals Harmonics/interharmonics Transient signals	0 (DC) ... 1000 Hz 10 ... 1000 Hz 0 (DC) ... 3100 Hz
Resolution	1 mA, 2 mA (2 phases in parallel), ...	
Trigger on overload	Timer accuracy error <1 ms.	
Short-circuit protection	Unlimited	
Open-circuit protection	Open outputs (open-circuit) permitted.	
Connection	4 mm socket, generator combination socket ¹⁰ .	
Insulation	Reinforced insulation of power supply and all SELV interfaces.	

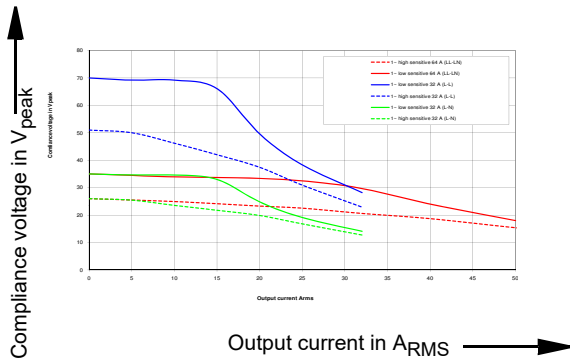
1. Data for 3-phase systems are valid for symmetric conditions (0°, 120°, 240°).
2. For wiring of single-phase modes → section 5 "Increasing the output power" on page 46.
3. Single-phase mode (in phase opposition).
4. Guaranteed data at 230 V power supply for ohmic loads (PF=1); typical data for inductive loads.
→ Section 1.2.1 "Operational limits in conjunction with a weak power supply input voltage" on page 4.
5. rd. = reading; rg. = range, whereas *n* % of rg. means: *n* % of upper range value.
6. Valid for sinusoidal signals at 50/60 Hz and $R_{load} \leq 0.5 \Omega$.
7. Values at 20 kHz measurement bandwidth, nominal value, and nominal load.
8. For injections longer than 1 minute, the maximum fundamental frequency is limited to 587 Hz to comply with international trade restrictions for frequency-controlled signal generators. For other options, please contact OMICRON Support.
9. Amplitude derating at >380 Hz (→ "Current derating at high frequencies for sinusoidal signals." on page 11).
10. For currents >32 A, connect the test object only to the 4 mm sockets and not to the generator combination socket.



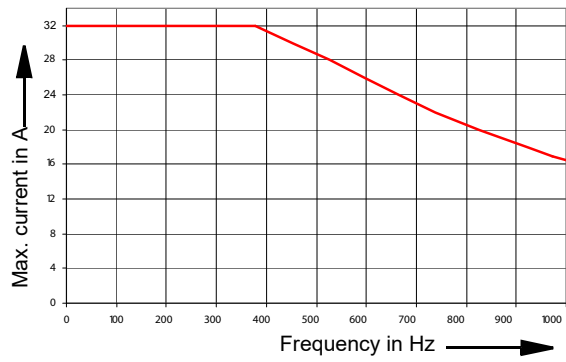
Guaranteed output power per phase of a group (active power values in W are guaranteed; apparent power values in VA are typical values).



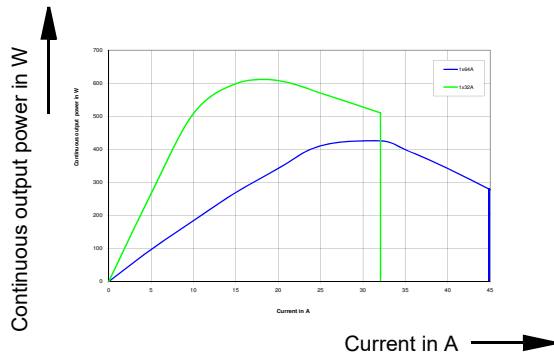
Guaranteed single phase output power curves (active power values in W are guaranteed; apparent power values in VA are typical values).



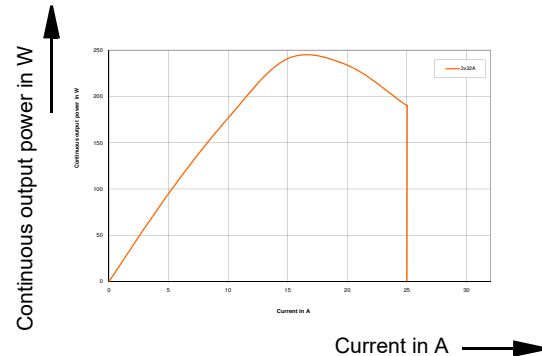
Typical compliance voltage (50/60 Hz)
 The high and low sensitive curves correspond to the overload detection sensitivity settings in the *Test Universe* software. The low sensitive curves show the maximum available peak compliance voltage, which is mainly relevant for testing primary and electromechanical relays.



Current derating at high frequencies for sinusoidal signals.



Typical continuous output current and output power at 23 °C; single-phase mode.



Typical continuous output current and output power at 23 °C; 3- and 6-phase mode.

The continuous operating range is given by the area below the curves in the figures above.

Due to the large number of operating modes, it is not possible to give universally applicable curves for the discontinuous mode. However, the examples given below can be used instead to gain feeling for the possible output durations (t_1 is the possible duration of a cold device).

Typical duty cycles for operation at ambient temperature of 23 °C

	I [A]	P [W]	Duty cycle	t_1 [min]	t_{on} [s]	t_{off} [s]
3 × 32 A (L–N)	0 ... 25	0 ... 600	100 %	>30	>1800	–
	26	700	80 %	7.5	80	20
	29	650	75 %	6.0	60	20
	32	600	71 %	3.5	50	20
1 × 64 A (LL–LN)	0 ... 40	0 ... 350	100 %	>30	>1800	–
	50	250	60 %	4.9	30	20
	60	150	43 %	2.6	15	20
	64	100	38 %	2.0	12	20

1.5.4 Voltage outputs

4 voltage outputs		
Output voltages		
4-phase AC (L-N) ¹	4 × 0 ... 300 V	
3-phase AC (L-N)	3 × 0 ... 300 V	
2-phase AC (L-L) ²	2 × 0 ... 600 V	
1-phase AC (L-N)	1 × 0 ... 300 V	
1-phase AC (L-L)	1 × 0 ... 600 V	
DC (L-N)	4 × 0 ... ±300 V	
	Typical	Guaranteed
Output power ³		
4-phase AC ⁴	4 × 75 VA at 100 ... 300 V	4 × 50 VA at 85 ... 300 V
3-phase AC ⁵	3 × 100 VA at 100 ... 300 V	3 × 85 VA at 85 ... 300 V
2-phase AC (L-L)	2 × 138 VA at 200 ... 600 V	2 × 125 VA at 200 ... 600 V
1-phase AC (L-N)	1 × 200 VA at 100 ... 300 V	1 × 150 VA at 75 ... 300 V
1-phase AC (L-L)	1 × 275 VA at 200 ... 600 V	1 × 250 VA at 200 ... 600 V
DC (L-N)	1 × 420 W at 300 V _{DC}	1 × 360 W at 300 V _{DC}
Accuracy ⁶	Error <0.03 % of rd. + 0.01 % of rg.	Error <0.08 % of rd. + 0.02 % of rg.
Harmonic distortion (THD+N) ^{7, 8}	0.015 %	<0.05 %
Phase error ⁷	0.02°	<0.1°
DC offset voltage	<20 mV	<100 mV
Voltage ranges	Range I: Range II:	0 ... 150 V 0 ... 300 V
Frequency ranges ^{9, 10}	Sinusoidal signals Harmonics/interharmonics ¹¹ Transient signals	10 ... 1000 Hz 10 ... 3000 Hz 0 (DC) ... 3100 Hz
Resolution	Range I: Range II:	5 mV 10 mV
Short-circuit protection	Unlimited for L–N	
Connection	4 mm sockets; generator combination socket V _{L1} –V _{L3} .	
Insulation	Reinforced insulation of power supply and all SELV interfaces.	

1. a) $V_{L4}(t)$ automatically calculated: $V_{L4} = (V_{L1} + V_{L2} + V_{L3}) * C$. C: configurable constant from –100 to +100.

b) V_{L4} can be configured by software in frequency, phase, and amplitude.

2. Without common neutral (N).

3. Guaranteed data for ohmic loads (PF = 1). Refer to the accompanying figures of the output power curves.

4. Data for 4-phase systems are valid for symmetric conditions (0°, 90°, 180°, 270°).

5. Data for 3-phase systems are valid for symmetric conditions (0°, 120°, 240°).

6. rd. = reading; rg. = range, whereas n % of rg. means: n % of upper range value.

7. Valid for sinusoidal signals at 50/60 Hz.

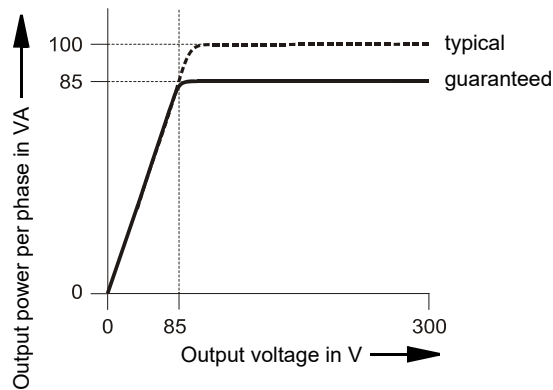
8. Values at 20 kHz measurement bandwidth, nominal value, and nominal load.

9. For injections longer than 1 minute, the maximum fundamental frequency is limited to 587 Hz to comply with international trade restrictions for frequency-controlled signal generators. For other options, please contact OMICRON Support.

10. Amplitude derating at >1000 Hz.

11. Signals above 1000 Hz are only supported in selected software modules.

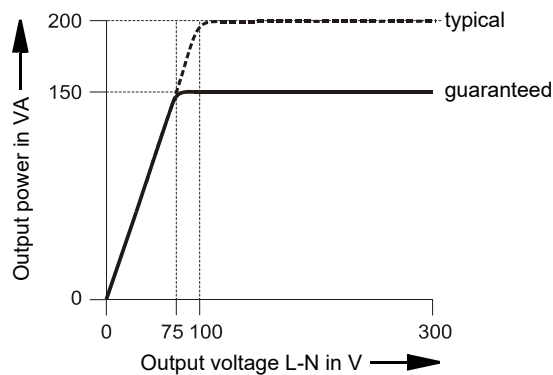
Power diagram for 3-phase operation



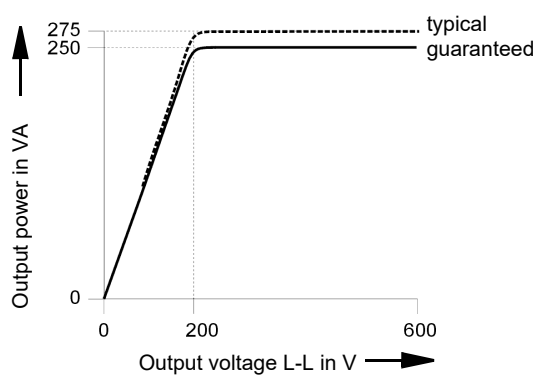
Power diagram for single-phase operation

→ Section 5.2 "Voltage outputs" on page 47.

Single-phase operation L-N



Single-phase operation L-L



1.5.5 Low-level outputs LL out for external amplifiers

Note: The low-level outputs **LL out 7–12** are only available if the option *LLO-2* is installed.

Both SELV interface connectors **LL out 1–6** as well as the optional **LL out 7–12** (if applicable) hold 2 independent generator triples each. These 6 high-accuracy analog signal sources per connector can be used to either control an external amplifier or to directly provide low-level outputs.

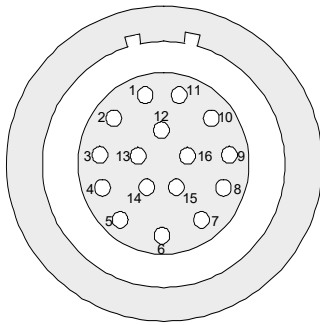
In addition, each SELV interface connector provides a serial digital interface (pins 8–16; see below) that transmits control and monitor functions between the *CMC 353* and the external amplifiers.

Supported devices are the *CMS 356* or the discontinued devices *CMA 156*, *CMA 56*, *CMS 156*, *CMS 251* and *CMS 252*.

The low-level outputs are short-circuit-proof and continually monitored for overload. They are separated through reinforced insulation from the power input and from the voltage and current outputs. They deliver calibrated signals in the range from 0 to 7 V_{eff} nominal (0 to $\pm 10 V_{\text{peak}}$).

Both the selection of the particular amplifier as well as the specification of the range of the amplifier takes place in the software.

Pin assignment of **LL out 1–6** (lower 16-pole LEMO socket); view onto the connector from the cable wiring side:



Pin	Function LL out 1–6	Function LL out 7–12
1	LL out 1	LL out 7
2	LL out 2	LL out 8
3	LL out 3	LL out 9
4	Neutral (N) connected to GND	
5	LL out 4	LL out 10
6	LL out 5	LL out 11
7	LL out 6	LL out 12
8–16	For internal purposes	
Housing	Screen connection	

LL out 1–3 and LL out 4–6 (and optionally LL out 7–9 and LL out 10–12) each make up a selectable voltage or current triple.

6 outputs "LL out 1–6" and 6 (optional) outputs "LL out 7–12"		
Output voltage range	0 ... $\pm 10 V_{\text{peak}}^1$ (SELV)	
Output current	Max. 1 mA	
	Typical	Guaranteed
Accuracy	Error <0.025 %	Error <0.07 % for 1 ... 10 V_{peak}
Harmonic distortion (THD+N) ²	<0.015 %	<0.05 %
Phase error ³	0.02°	<0.1°
DC offset voltage	<150 μV	<1.5 mV
Frequency range ⁴	Sinusoidal signals Harmonics/interharmonics ⁵ Transient signals	0 (DC) ... 1000 Hz 10 ... 3000 Hz 0 (DC) ... 3100 Hz
Resolution	<250 μV	
Unconventional CT/VT simulation	Linear or Rogowski ⁶ mode (transient and sinewave)	
Short-circuit protection	Unlimited to GND	
Overload indication	Yes	
Insulation	Reinforced insulation to all other potential groups of the test equipment. GND is connected to protective earth (PE).	

1. Input OMICRON amplifier nominal: 0 ... 5 V_{RMS} .
2. Values at nominal voltage (10 V_{peak}), 50/60 Hz, and 20 kHz measurement bandwidth.
3. Valid for sinusoidal signals at 50/60 Hz.
4. Amplitude derating at >1000 Hz.
5. Signals above 1000 Hz are only supported in selected software modules.
6. When simulating Rogowski sensors, the output voltage is proportional to the derivative of the current with respect to time (di(t)/dt).

Manufacturer ordering information	
Connector for two-guide notches and pull relief (for LL out)	FGB.2B.316.CLAD 72Z
Black anti-bend cable cover	GMA.2B.070 DN

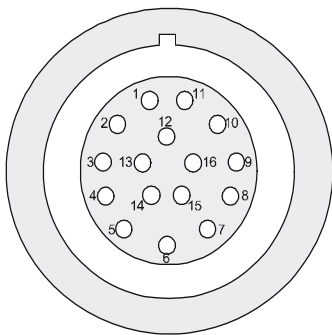
For a manufacturer description about the connection sockets **LL out** and the external interface **ext. Interf.**, visit the website www.lemo.com. You can order the LEMO cable directly from OMICRON.

1.5.6 Low-level binary outputs (ext. Interf.)

The SELV interface connector **ext. Interf.** holds 4 additional transistor binary outputs (**BINARY OUTPUT 11–14**). Unlike regular relay outputs, **BINARY OUTPUT 11–14** are bounce-free binary outputs and have a minimal reaction time.

In addition, 2 high-frequency counter inputs for up to 100 kHz are available for the testing of energy meters. They are described in section 1.6.2 "Counter inputs 100 kHz (low level)" on page 21.

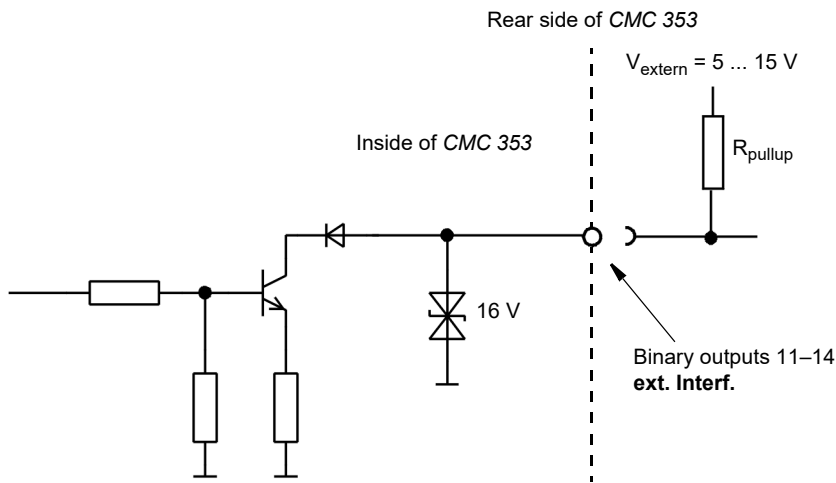
Pin assignment of the external interface **ext. Interf.** (upper 16-pole LEMO socket); view onto the connector from the cable wiring side:



Pin	Function
Pin 1	Counter input 1
Pin 2	Counter input 2
Pin 3	Reserved
Pin 4	Neutral (N) connected to GND
Pin 5	Binary output 11
Pin 6	Binary output 12
Pin 7	Binary output 13
Pin 8	Binary output 14
Pin 9–16	Reserved
Housing	Screen connection

4 low-level transistor binary outputs (BINARY OUTPUT 11–14)	
Type	Open-collector transistor outputs; external pull-up resistor.
Rated voltage	Max. ±16 V
Rated current	Max. 5 mA (current limited); min. 100 µA.
Update rate	10 kHz
Rise time	<3 µs ($V_{\text{extern}} = 5 \text{ V}$, $R_{\text{pullup}} = 4.7 \text{ k}\Omega$)
Connection	Connector ext. Interf. (CMC 353 rear side).
Insulation	Reinforced insulation to all other potential groups of the test equipment. GND is connected to protective earth (PE).

Circuit diagram of **ext. Interf.** binary transistor outputs 11–14:



Manufacturer ordering information	
Connector for one-guide notch and pull relief (for ext. Interf.)	FGG.2B.316.CLAD 72Z
Black anti-bend cable cover	GMA.2B.070 DN

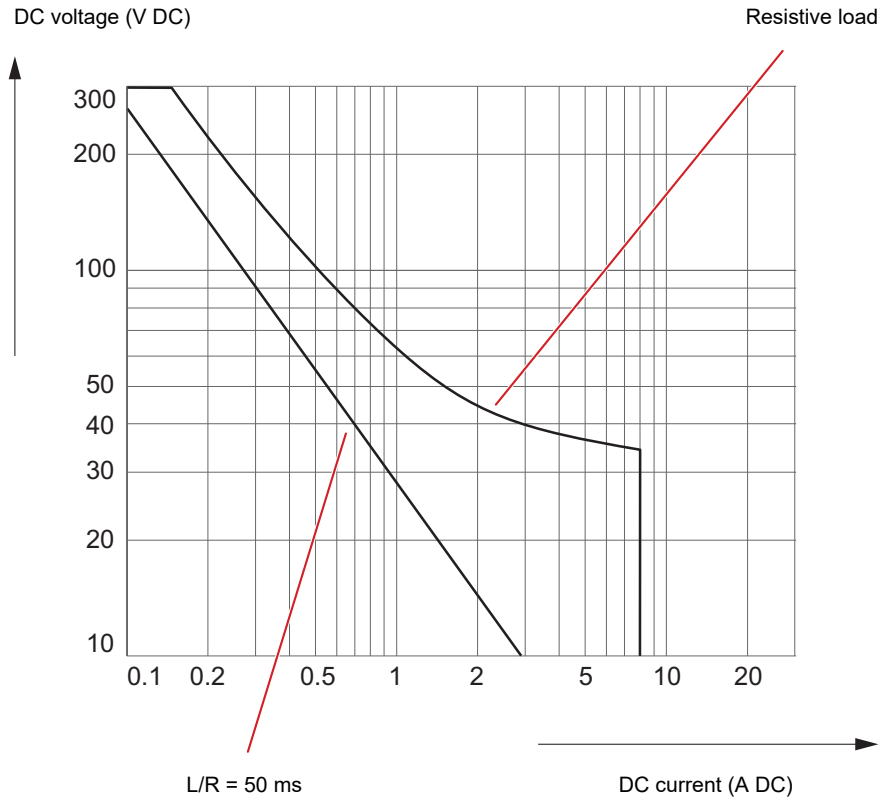
For a manufacturer description about the connection sockets **LL out** and the external interface **ext. Interf.**, visit the website www.lemo.com. You can order the LEMO cable directly from OMICRON.

1.5.7 Binary output relays

4 binary output relays (BINARY OUTPUT 1–4)	
Type	Potential-free contacts; software-controlled.
Connection	4 mm sockets
AC loading capacity AC breaking capacity	$V_{\max} = 300 \text{ V}$, $I_{\max} = 8 \text{ A}$, $P_{\max} = 2000 \text{ VA}$.
DC loading capacity DC breaking capacity	→ "Load limit breaking capacity curve for binary output relays with DC voltages." on page 18.
Inrush current	15 A (max. 4 s at 10 % duty cycle)
Carry capacity	5 A continuous at 60 °C (140 °F).
Electrical lifetime	100 000 switching cycles at 230 V_{AC} /8 A and ohmic load.
Operate time	Max. 10 ms (no bouncing)
Release time	Max. 5 ms (no bouncing)
Oversvoltage category	II, according to IEC 61010-1.

The accompanying diagram shows the load limit curve for DC voltages. For AC voltages, a maximum power of 2000 VA is achieved.

Load limit breaking capacity curve for binary output relays with DC voltages.



1.5.8 DC supply (AUX DC)

DC supply (AUX DC)		
Voltage ranges	0 ... 66 V _{DC} (max. 0.8 A) 0 ... 132 V _{DC} (max. 0.4 A) 0 ... 264 V _{DC} (max. 0.2 A)	
Power	Max. 50 W	
Accuracy ¹	Typical	Guaranteed
	Error <2 %	Error <5 %
Resolution	<70 mV	
Connection	4 mm sockets on front panel.	
Short-circuit protection	Yes	
Overload indication	Yes	
Insulation	Reinforced insulation from power supply and all SELV interfaces.	

1. Percentage is with respect to each range's full-scale.

1.6 Inputs

1.6.1 Binary inputs

General data of binary inputs 1...10	
Number of binary inputs	10
Trigger criteria	Potential-free or DC-voltage compared to threshold voltage.
Reaction time	Max. 220 µs
Sampling rate	10 kHz
Time resolution	100 µs
Maximum measuring time	Unlimited
Debounce/deglitch time	0 ... 25 ms (→ page 20)
Counting function	
Counter frequency	<3 kHz (per input)
Pulse width	>150 µs (for high and low signals)
Connection	4 mm sockets
Insulation	5 galvanically insulated binary groups with each 2 inputs having its own GND. Functional insulation to the power outputs, DC inputs and between galvanically separated groups. Reinforced insulation from all SELV interfaces and from power supply.

Data for potential-sensing operation		
Range/resolution	20 ... 300 V 0 ... 20 V	500 mV 50 mV
Maximum input voltage	CAT IV: 150 V CAT III: 300 V	
Threshold voltage accuracy ¹	5 % of rd. + 0.5 % of rg.	
Typical threshold voltage hysteresis	Range 20 ... 300 V: 900 mV Range 0 ... 20 V: 60 mV	
Input impedance	Threshold 20 ... 300 V: 135 kΩ Threshold 0 ... 20 V: 210 kΩ	

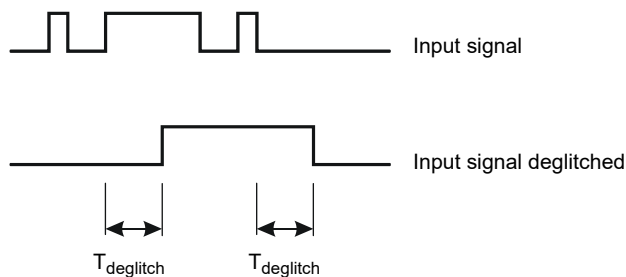
1. Valid for positive voltage signal edge; percentage is shown in respect to each range's full-scale.

Data for potential-free operation	
Trigger criteria	
Logical 0	$R > 100 \text{ k}\Omega$
Logical 1	$R < 10 \text{ k}\Omega$
Input impedance	216 $\text{k}\Omega$

Deglitching input signals

In order to suppress short spurious pulses, a deglitching algorithm could be configured. The deglitch process results in an additional dead time and introduces a signal delay. In order to be detected as a valid signal level, the level of an input signal must have a constant value at least during the deglitch time.

The figure below illustrates the deglitch function.



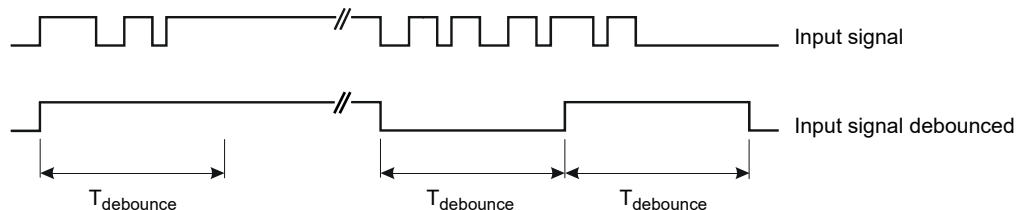
Debouncing input signals

For input signals with a bouncing characteristic, a debounce function can be configured. This means that the first change of the input signal causes the debounced input signal to be changed and then be kept on this signal value for the duration of the debounce time.

The debounce function is placed after the deglitch function described above and both are realized by the firmware of the *CMC 353* and are calculated in real time.

The figure below illustrates the debounce function. On the right-hand side of the figure, the debounce time is too short. As a result, the debounced signal rises to "high" once again, even while the input signal is still bouncing and does not drop to a low level until another T_{debounce} period has expired.

The figure below illustrates the debounce function.

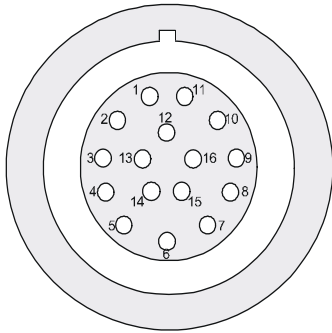


1.6.2 Counter inputs 100 kHz (low level)

The SELV interface connector **ext. Interf.** holds 2 high-frequency counter inputs for up to 100 kHz which are used for testing energy meters.

In addition, 4 additional transistor binary outputs (**BINARY OUTPUT 11–14**) are available. They are described in section 1.5.6 "Low-level binary outputs (ext. Interf.)" on page 16.

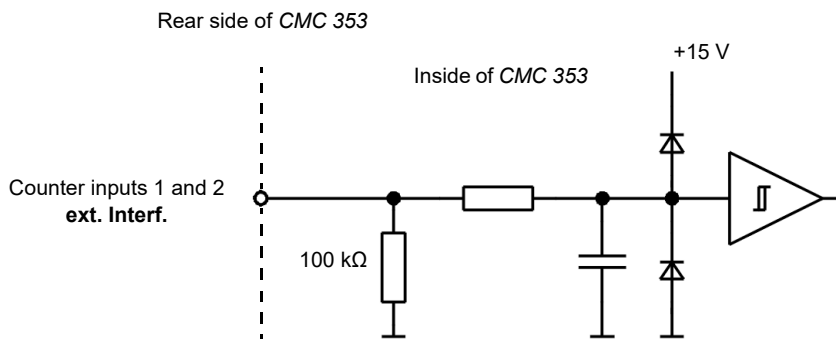
Pin assignment of the external interface **ext. Interf.** (upper 16-pole LEMO socket); view onto the connector from the cable wiring side:



Pin	Function
Pin 1	Counter input 1
Pin 2	Counter input 2
Pin 3	Reserved
Pin 4	Neutral (N) connected to GND
Pin 5	Binary output 11
Pin 6	Binary output 12
Pin 7	Binary output 13
Pin 8	Binary output 14
Pin 9–16	Reserved
Housing	Screen connection

2 counter inputs	
Maximum counter frequency	100 kHz
Pulse width	>3 μs (high and low signal)
Switch threshold	
Pos. edge	Max. 8 V
Neg. edge	Min. 4 V
Hysteresis	Typ. 2 V
Rise and fall times	<1 ms
Maximum input voltage	±30 V
Connection	Socket ext. Interf. (rear side of CMC 353)
Insulation	Reinforced insulation to all other potential groups of the test equipment. GND is connected to protective earth (PE).

Circuit diagram of **ext. Interf.** counter inputs 1 and 2:



Manufacturer ordering information	
Connector for one-guide notch and pull relief (for ext. Interf.)	FGG.2B.316.CLAD 72Z
Black anti-bend cable cover	GMA.2B.070 DN

For a manufacturer description about the connection sockets **LL out 1–6** and external interface **ext. Interf.**, visit the website www.lemo.com. You can order the LEMO cable directly from OMICRON.

1.7 IEC 61850 protocols

IEC 61850 GOOSE	
Simulation	Mapping of binary outputs to data attributes in published GOOSE messages. Number of virtual binary outputs: 360. Number of GOOSE to be published: 128.
Subscription	Mapping of data attributes from subscribed GOOSE messages to binary inputs. Number of virtual binary outputs: 360. Number of GOOSE to be published: 128.
Performance	Type 1A; Class P2/3 (IEC 61850-5). Processing time (application to network or vice versa): <1 ms.
VLAN support	Selectable priority and VLAN-ID.




IEC 61850 Sampled Values (Publishing)	
Specification	According to the "Implementation Guideline for Digital Interface to Instrument Transformers Using IEC 61850-9-2" of the UCA International Users Group and the "IEC 61869-9 Instrument transformers – Part 9: Digital interface for instrument transformers".
Sample rate	<ul style="list-style-type: none"> • 4000 Hz (80 SPC @ 50 Hz) – 1 sample per packet • 4800 Hz (80 SPC @ 60 Hz) – 1 sample per packet • 4800 Hz – 2 samples per packet • 5760 Hz – 1 sample per packet • 12800 Hz (256 SPC @ 50 Hz) – 8 samples per packet • 14400 Hz – 6 samples per packet • 15360 Hz (256 SPC @ 60 Hz) – 8 samples per packet
Synchronization	Synchronization attribute (smpSynch) can follow the synchronization status of the test set or be set to distinct values. Sample count (smpCnt) zero is aligned with top of the second (IRIG-B and PPS). For the accuracy data → section "Absolute time synchronization" on page 6.
VLAN support	Selectable priority and VLAN-ID.
Maximum number of SV streams	<i>Test Universe</i> : 3 <i>RelaySimTest</i> : 4

1.8 Technical data of the communication ports

1.8.1 NET-2 board

The NET-2 board requires a *Test Universe* software version **3.00 SR2** (or later), or a *CMControl* software version 2.30 (or later).






NET-2: 2 × USB port and Ethernet ports ETH1/ETH2									
	USB type	USB 2.0 high speed up to 480 Mbit/s.							
	USB connector	USB type A (for future use of USB peripherals).							
	Output current	Max. 500 mA							
	USB type	USB 2.0 high speed up to 480 Mbit/s; USB 1.1-compatible.							
	USB connector	USB type B (connect to computer).							
	USB cable	USB 2.0 high speed type A-B, 2 m/6 ft							
	ETH type	10/100/1000Base-TX ¹ (twisted pair, auto-MDI/MDIX or auto-crossover).							
	ETH connector	RJ45							
	ETH cable type	Shielded LAN cable of category 5 (CAT5) or better.							
	ETH port status LED	<p>Depending on the ETH type of your NET-2 interface board's counterpart, the status LED's behavior varies.</p> <p>Physical link established, port active:</p> <table border="1"> <thead> <tr> <th>Mbit/s</th> <th>Active LED ON</th> </tr> </thead> <tbody> <tr> <td>10</td> <td>yellow</td> </tr> <tr> <td>100</td> <td>green</td> </tr> <tr> <td>1000</td> <td>yellow + green</td> </tr> </tbody> </table> <p>If there is traffic via an ETH port, the active LEDs start blinking.</p>	Mbit/s	Active LED ON	10	yellow	100	green	1000
Mbit/s	Active LED ON								
10	yellow								
100	green								
1000	yellow + green								
ETH Power over Ethernet (PoE)	IEEE 802.3af compliant	Port capability limited to one Class 1 (3.84 W) and one Class 2 (6.49 W) power device.							

1. 10Base = 10 Mbit/s transfer rate
 100Base = 100 Mbit/s transfer rate
 1000Base = 1000 Mbit/s transfer rate

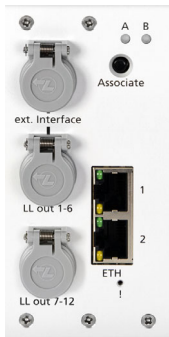
1.8.2 NET-1C board (legacy board)





NET-1C: USB port and Ethernet ports ETH1/ETH2		
 USB	USB type ¹	USB 2.0 full speed up to 12 Mbit/s.
	USB connector	USB type B (connect to computer).
	USB cable	USB 2.0 high speed type A-B, 2 m/6 ft.
 ETH	ETH type	10/100Base-TX (10/100Mbit, twisted pair, auto-MDI/MDIX or auto-crossover).
	ETH connector	RJ45
	ETH cable type	Shielded LAN cable of category 5 (CAT5) or better.
	ETH port status LED 	<ul style="list-style-type: none"> Physical link established, port active: green LED ON. Traffic via ETH port: yellow LED is blinking.
	ETH Power over Ethernet (PoE)	IEEE 802.3af compliant Port capability limited to one Class 1 (3.84 W) and one Class 2 (6.49 W) power device.

1. For the **USB** port to work, the NET-1C board requires a *Test Universe* software version 3.00 (or later) plus the matching *CMC* firmware

1.8.3 NET-1B board (legacy board)



NET-1B: Ethernet ports ETH1 and ETH2		
 ETH	Type	10/100Base-TX (10/100Mbit, twisted pair, auto-MDI/MDIX or auto-crossover).
	Connector	RJ45
	Cable type	Shielded LAN cable of category 5 (CAT5) or better.
	ETH port status LED 	<ul style="list-style-type: none"> Physical link established, port active: green LED ON. Traffic via ETH port: yellow LED is blinking.
ETH Power over Ethernet (PoE)	IEEE 802.3af compliant Port capability limited to one Class 1 (3.84 W) and one Class 2 (6.49 W) power device.	

1.9 Environmental conditions

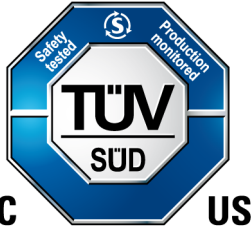
Climate	
Operating temperature	0 ... +50 °C (+32 ... +122 °F). A 50 % duty cycle may apply above +30 °C (+86 °F).
Storage	−25 ... +70 °C (−13 ... +158 °F)
Maximum altitude	2000 m (6560 ft)
Humidity	5 ... 95 % relative humidity; no condensation.
Climate	Tested according to IEC 60068-2-78.

Shock and vibration	
Vibration	Tested according to IEC 60068-2-6; frequency range 10 ... 150 Hz; 2 g (20 sweeps).
Shock	Tested according to IEC 60068-2-27; 15 g/11 ms, half-sinusoid, each axis.

1.10 Mechanical data

Size, weight and protection	
Weight	13.3 kg (29.3 lb)
Dimensions W × H × D (without handle)	343 × 145 × 390 mm (13.5 × 5.7 × 15.4")
Housing	IP20 according to IEC 60529.

1.11 Safety standards, electromagnetic compatibility (EMC) and certificates

Electromagnetic interference (EMI)	
Europe	EN 61326-1; EN 61000-6-4; EN 61000-3-2/3; EN 55032 (Class A)
International	IEC 61326-1; IEC 61000-6-4; IEC 61000-3-2/3; CISPR 32 (Class A)
USA	47 CFR 15 Subpart B (Class A) of FCC
Electromagnetic susceptibility (EMS)	
Europe	EN 61326-1; EN 61000-6-2; EN 61000-4-2/3/4/5/6/8/11/16/18; EN 61000-6-5
International	IEC 61326-1; IEC 61000-6-2; IEC 61000-4-2/3/4/5/6/8/11/16/18; IEC 61000-6-5
Safety standards	
Europe	EN 61010-1; EN 61010-2-030
International	IEC 61010-1; IEC 61010-2-030
USA	UL 61010-1; UL 61010-2-030
Canada	CAN/CSA-C22.2 No 61010-1; CAN/CSA-C22.2 No 61010-2-030
Certificate	<div style="text-align: center;">  <p>C US</p> </div> <p>Manufactured under an ISO 9001 registered system.</p>

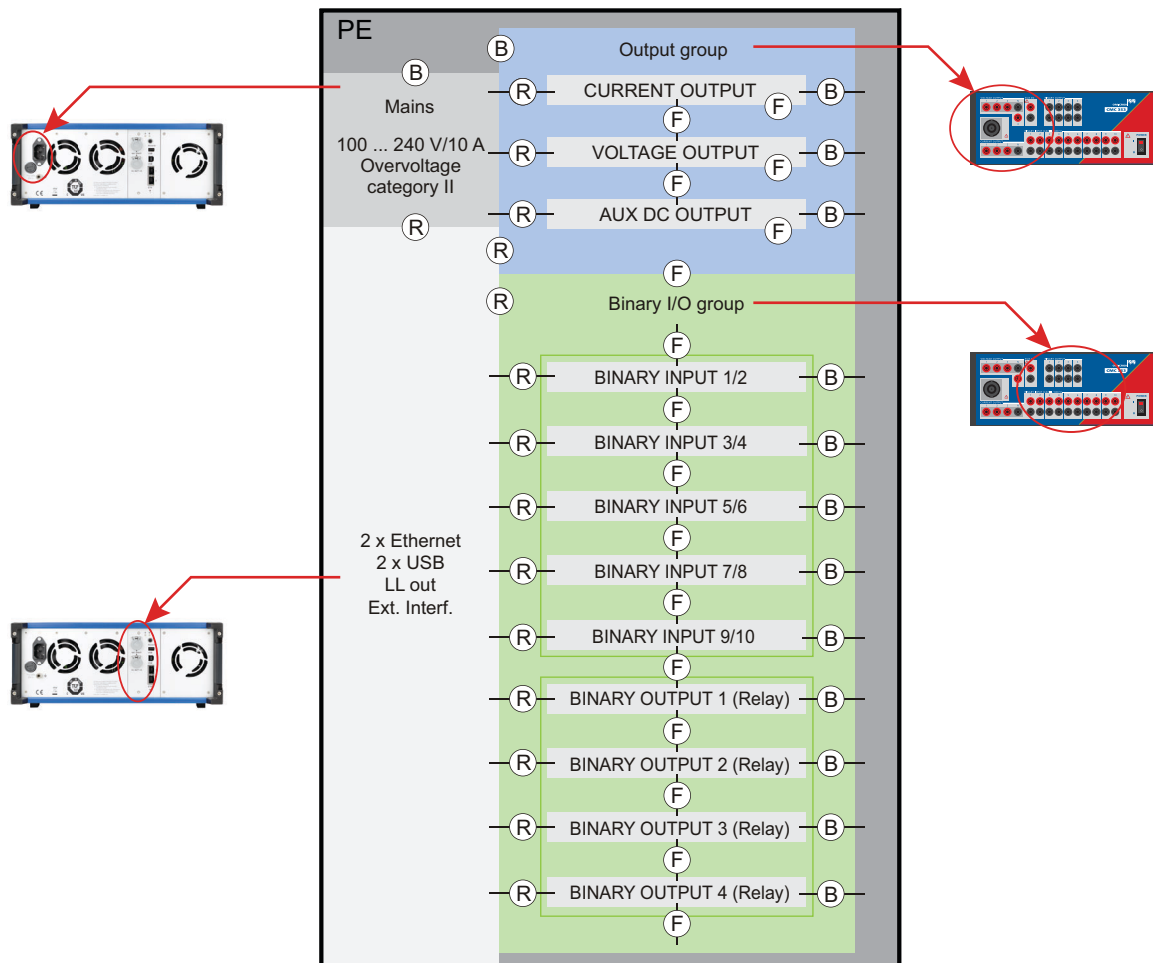
1.12 Electrical insulation groups

The following chapter shows how the inputs and outputs of *CMC* test sets are insulated against PE and each other.

B = Basic insulation

R = Reinforced insulation

F = Functional insulation



Insulation designed for pollution degree 2.