CMC 310

Technical Data

This technical data was extracted from the following manual: ENU 1012 05 01

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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 °C ± 5 °C (73 °F ± 9 °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 310* 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 310* 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 310*.

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 310*.

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.

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 310* test set.
2. At an ambient temperature of 23 °C, when operating the *CMC 310* 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 310* refer to a common internal time base that is specified as follows:

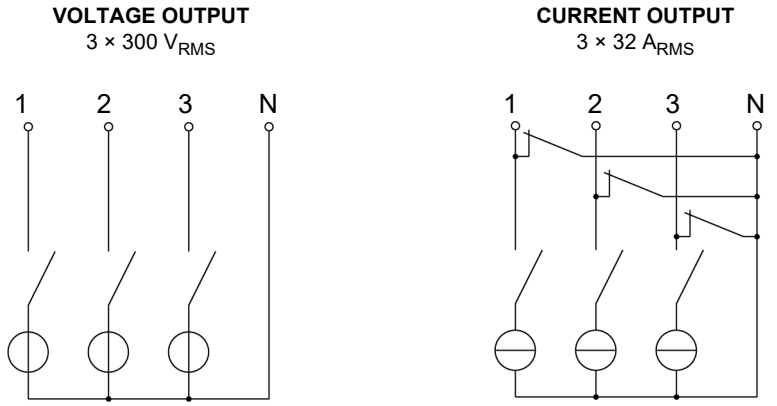
Characteristic	Specification
Clock performance	Stratum 3 (ANSI/T1.101-1987)
Frequency drift (over time) 24 hours 20 years	 <±0.37 ppm (±0.000037 %) <±4.60 ppm (±0.00046 %)
Frequency drift (over temperature range)	<±0.28 ppm (±0.000028 %)

1.4 Outputs

1.4.1 General generator outputs

General generator outputs data (analog current and voltage outputs)	
Frequency ranges[1]	Sinusoidal signals[2] 10 … 599 Hz
Frequency resolution (signal generation)	<5 µHz
Phase range φ	–360° ... +360°
Phase resolution	0.001°
Phase error	→ section 1.4.2 "Current outputs" on page 7 → section 1.4.3 "Voltage outputs" on page 10
Amplitude temperature drift	0.0025 %/°C

1. 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.
2. Amplitude derating for current outputs at frequencies above 380 Hz.



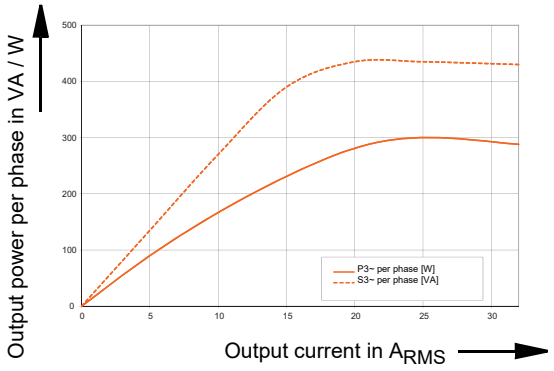
All voltages and current generators can independently be configured with respect to amplitude, phase angle, and frequency.

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

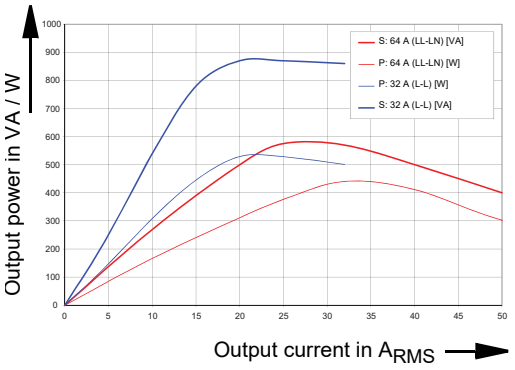
1.4.2 Current outputs

Current outputs[1]		
Output currents 3-phase AC (L-N) 1-phase AC (L-L)[2, 3] 1-phase AC (LL-LN)[2] DC (LL-LN)[2]	 3 × 0 ... 32 A 1 × 0 ... 32A 1 × 0 ... 64 A 1 × 0 ... ±90 A	
	Typical	Guaranteed
Output power[4] 3-phase AC (L-N) 1-phase AC (L-L)[2, 3] 1-phase AC (LL-LN)[2] DC (LL-LN)[2]	 3 × 430 VA at 25 A 1 × 870 VA at 25A 1 × 500 VA at 40A 1 × 700 W at ±40 A	 3 × 250 W at 20 A 1 × 530 W at 20 A 1 × 350 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	0 (DC) … 599 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	
Insulation	Reinforced insulation of power supply and all SELV interfaces	

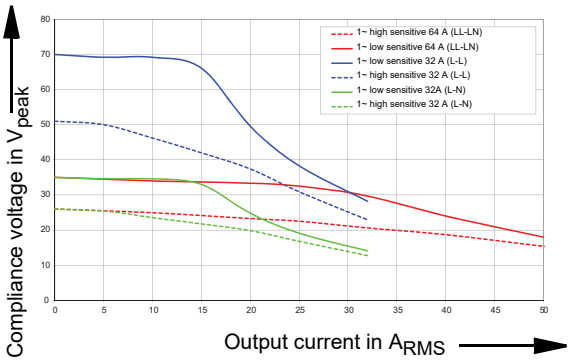
1. Data for 3-phase systems are valid for symmetric conditions (0°, 120°, 240°)
2. For wiring of single-phase modes → section 5 "Increasing the output power" on page 38.
3. Single-phase mode (in phase opposition).
4. Guaranteed data at 230 V power supply for ohmic loads (PF=1); typical data for inductive 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 Rload ≤ 0.5 Ω.
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 8)



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

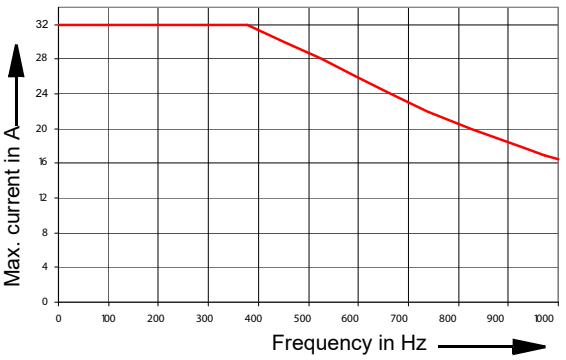


Guaranteed single phase output power curves (active power values in W are guaranteed; apparent power values in VA are typical values)

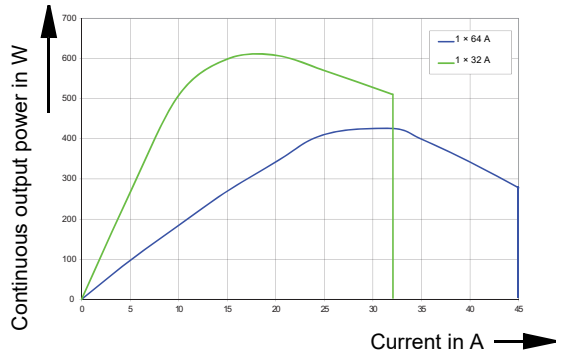


Typical compliance voltage (50/60 Hz)

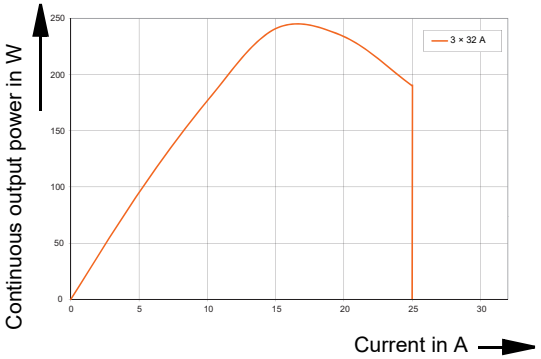
The low sensitive curves show the maximum available peak compliance voltage, which is mainly relevant for testing primary and electromechanical relays.



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 (t1 is the possible duration of a cold device).

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

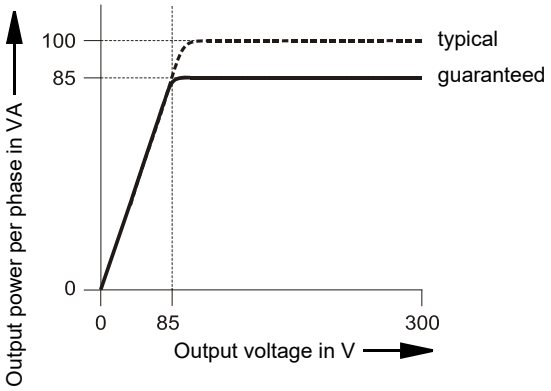
	I [A]	P [W]	Duty cycle	t_1 [min]	t_{on} [s]	t_{off} [s]
3 × 32 A (L–N)	0 ... 25	0 ... 600	100 %	>30	>1800	–
	26	700	80 %	7.5	80	20
	29	650	75 %	6.0	60	20
	32	600	71 %	3.5	50	20
1 × 64 A (LL–LN)	0 ... 40	0 ... 350	100 %	>30	>1800	–
	50	250	60 %	4.9	30	20
	60	150	43 %	2.6	15	20
	64	100	38 %	2.0	12	20

1.4.3 Voltage outputs

Voltage outputs		
Output voltages 3-phase AC (L-N) 1-phase AC (L-N) 1-phase AC (L-L) DC (L-N)	 3 × 0 ... 300 V 1 × 0 ... 300 V 1 × 0 ... 600 V 3 × 0 ... ±300 V	
	Typical	Guaranteed
Output power[1] 3-phase AC[2] 1-phase AC (L-N) 1-phase AC (L-L) DC (L-N)	 3 × 100 VA at 100 ... 300 V 1 × 200 VA at 100 ... 300 V 1 × 275 VA at 200 ... 600 V 1 × 420 W at 300 V_{DC}	 3 × 85 VA at 85 ... 300 V 1 × 150 VA at 75 ... 300 V 1 × 250 VA at 200 ... 600 V 1 × 360 W at 300 V_{DC}
Accuracy[3]	Error <0.03 % of rd. + 0.01 % of rg.	Error <0.08 % of rd. + 0.02 % of rg.
Harmonic distortion (THD+N)[4, 5]	0.015 %	<0.05 %
Phase error	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[6]	Sinusoidal signals	10 … 599 Hz
Resolution	Range I: Range II:	5 mV 10 mV
Short-circuit protection	Unlimited for L–N	
Connection	4 mm sockets	
Insulation	Reinforced insulation of power supply and all SELV interfaces.	

1. Guaranteed data for ohmic loads (PF = 1). Refer to the accompanying figures of the output power curves.
2. Data for 3-phase systems are valid for symmetric conditions (0°, 120°, 240°)
3. rd. = reading; rg. = range, whereas *n* % of rg. means: *n* % of upper range value
4. Valid for sinusoidal signals at 50/60 Hz.
5. Values at 20 kHz measurement bandwidth, nominal value, and nominal load
6. 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.

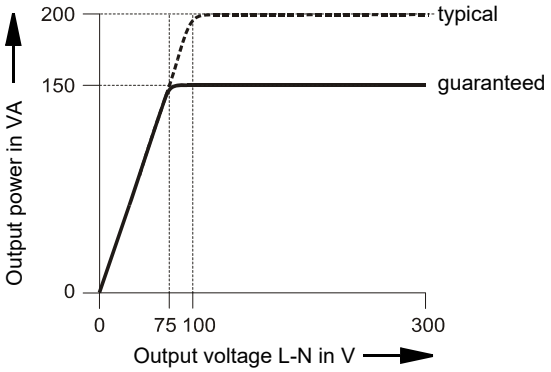
Power diagram for 3-phase operation



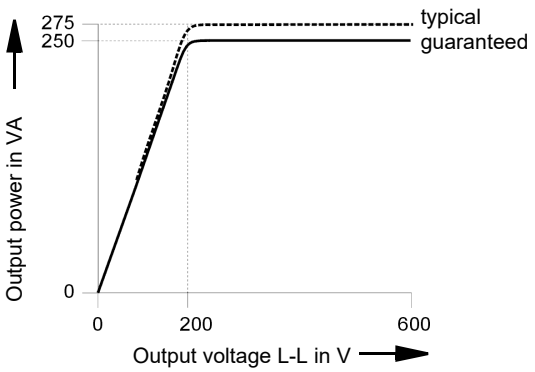
Power diagram for single-phase operation

Section 5.2 "Voltage outputs" on page 39

Single-phase operation L-N



Single-phase operation L-L

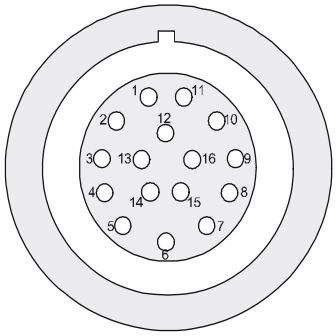


1.4.4 Low-level binary outputs (ext. Interf.)

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 1.5.2 "Counter inputs 100 kHz (low level)" on page 17.

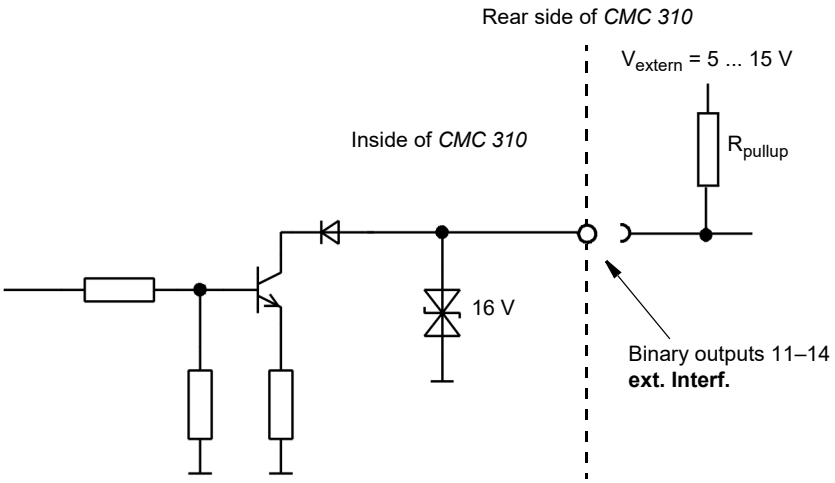
Pin assignment of the external interface **ext. Interf.** (upper 16-pole LEMO socket); view onto the connector from the cable wiring side:



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_{extern} = 5 V, R_{pullup} = 4.7 kΩ)
Connection	Connector **ext. Interf.** (*CMC 310* 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

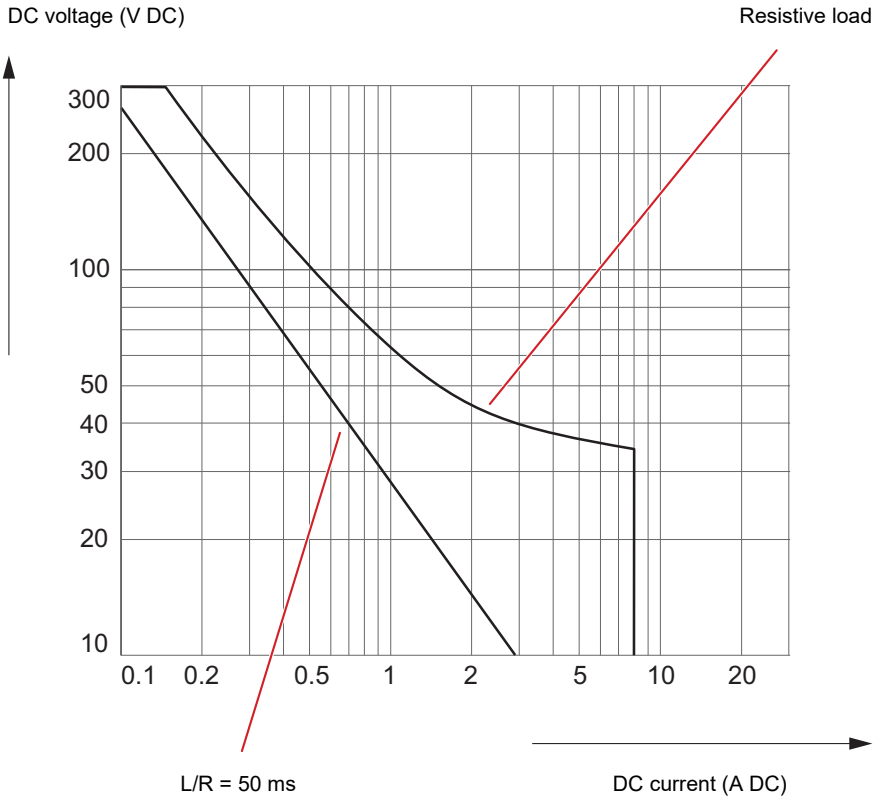
For a manufacturer description about the connection sockets **LL out** and the external interface **ext. Interf.**, visit the website www.lemo.com. You can order the LEMO cable directly from OMICRON.

1.4.5 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 V, I_{max} = 8 A, P_{max} = 2000 VA
DC loading capacity DC breaking capacity	→ "Load limit breaking capacity curve for binary output relays with DC voltages" on page 14.
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)
Overvoltage 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



1.4.6 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.

1.5 Inputs

1.5.1 Binary inputs

General data of binary inputs 1…6	
Number of binary inputs	6
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 16)
Counting function Counter frequency Pulse width	 <3 kHz (per input) >150 µs (for high and low signals)
Connection	4 mm sockets
Insulation	3 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	

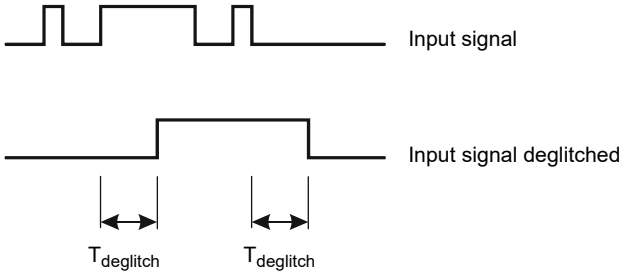
1. Valid for positive voltage signal edge; percentage is shown in respect to each range’s full-scale.

Data for potential-free operation	
Trigger criteria	
Logical 0	R >100 kΩ
Logical 1	R <10 kΩ
Input impedance	216 kΩ

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.



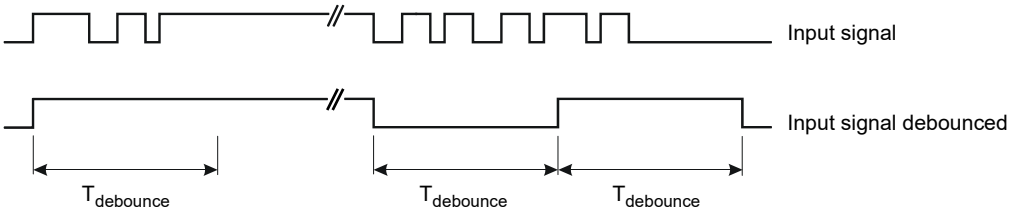
Debouncing input signals

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 310* 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.

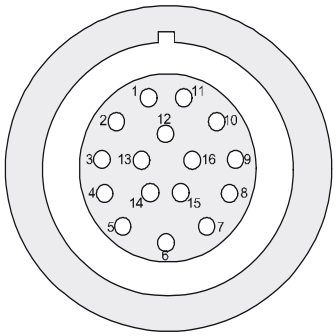


1.5.2 Counter inputs 100 kHz (low level)

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 1.4.4 "Low-level binary outputs (ext. Interf.)" on page 11.

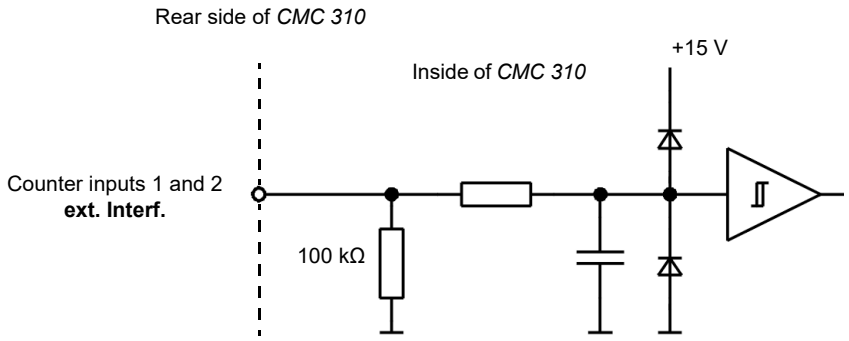
Pin assignment of the external interface **ext. Interf.** (upper 16-pole LEMO socket); view onto the connector from the cable wiring side:



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 Neg. edge	 Max. 8 V 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 310*)
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:



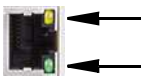
Manufacturer ordering information	
Connector for one-guide notch and pull relief (for **ext. Interf.**).	FGG.2B.316.CLAD 72Z
Black anti-bend cable cover.	GMA.2B.070 DN

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.

1.6 Technical data of the communication ports

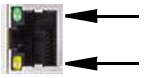
1.6.1 NET-2 board

The NET-2 board requires *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
	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 	Depending on the ETH type of your NET-2 interface board's counterpart, the status LED's behavior varies. Physical link established, port active: Mbit/s — Active LED ON 10 — yellow 100 — green 1000 — yellow + green If there is traffic via an **ETH** port, the active LEDs start blinking.
	ETH **P**ower **o**ver **E**thernet (PoE)	IEEE 802.3af compliant Port capability limited to 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

1.6.2 NET-1C board (legacy board)

NET-1C: USB port and Ethernet ports ETH1/ETH2		
	USB type	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 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 	• Physical link established, port active: green LED ON • Traffic via **ETH** port: yellow LED is blinking
	ETH **P**ower **o**ver **E**thernet (PoE)	IEEE 802.3af compliant Port capability limited to one Class 2 (6.49 W) power device

1.7 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

1.8 Mechanical data

Size, weight and protection	
Weight	13.1 kg (28.9 lb)
Dimensions W × H × D (without handle)	343 × 145 × 390 mm (13.5 × 5.7 × 15.4")
Housing	IP20 according to IEC 60529

1.9 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	Safety tested, Production monitored, TÜV SÜD, C US Manufactured under an ISO 9001 registered system.

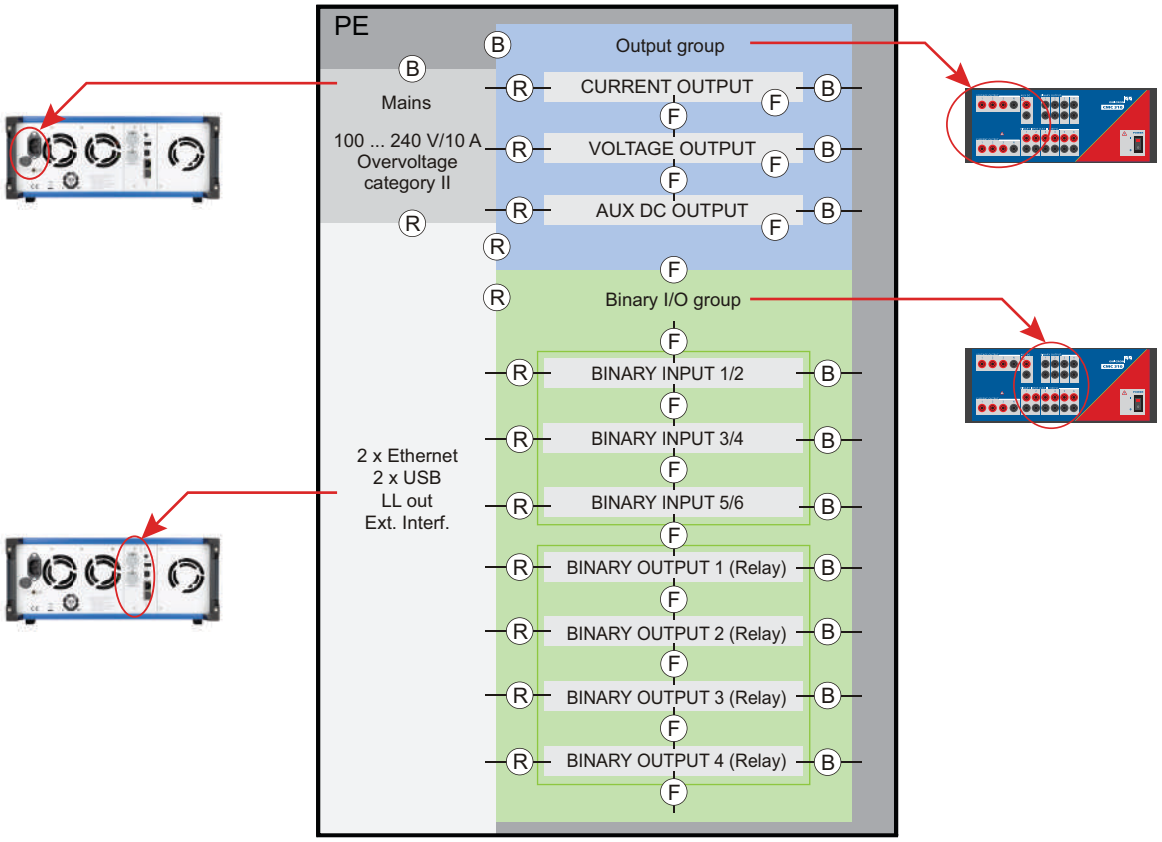
1.10 Electrical insulation groups

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.