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SML33 / SMM33 / SMN33

Multipurpose Meters

These instruments have been designed to measure and monitor line and phase voltages, currents, active and reactive power, power factors, THD (Total Harmonic Distortion) in voltages and currents as well as frequency in single-phase and three-phase low voltage, high voltage, and very high voltage power systems. They further allow informative measurement of temperatures within a switchboard cabinet using an inbuilt temperature sensor.

Instruments of the SML 33 and SMM 33 line are identical from the wiring and operation's points of view, they only differ in physical design. The instruments feature three voltage measuring inputs of the nominal values up to 3 x 230 Vef, and three fully isolated current measuring inputs up to 5 Aef (from CT outputs). The SML 33 instruments have been designed for panel-mounted installation (96 x 96 mm or 144 x 144 mm) while the SMM 33 instruments have been designed for installation on a DIN EN 50022 rail (rail 35 mm, Modulbox width 5M – 89 mm).

The SMN33 instruments are very similar to the SMM33 instruments but they differs in current input character. The instrument's current inputs have been adopted to connect to special split core current transformers(these transformers are part of instrument shipment), that can be simply installed on supply cables. The SMN33 is thus convenient in applications where use of standard xxx/5 A CTs is impossible or not optimal.

As assortment of offered CTs starts at 5A nominal current model, the SMN33's can be installed at secondary circuit of standard xxx/5 A CTs whose current circuit may not be broken for a reason (for example because of billing measurement).

The SMN33 instrument's other features are identical to those of SMM33 with the following additional features:

- rendition and display of current through the PEN wire
- evaluation of maximum average three-phase active power
- a real time clock circuit backed up with an inbuilt accumulator and with a synchronization input (at instruments equipped with communication interface)

All types of instruments can be equipped with an RS 485 or RS 232 communication interface.

The RETIS software, which is supplied with each instrument that has the optional communication interface, allows viewing and archiving the data measured in a graphic format and it has a number of other features.

Connecting Instrument

The instrument's power supply voltage (see technical datasheet) must be connected to the AUX V terminals via a circuit breaking device (power switch – see installation wiring diagram). It has to be located right at the instrument within an easy reach by the operator. The circuit breaking device must be identified as the equipment power disconnection switch. A circuit breaker of the nominal value 1 A is a convenient circuit breaking device, its function and position however have to be clearly identified (using the '0' and 'I' symbols, respectively, in accordance with IEC EN 61010-1).

The phase voltages measured are connected to terminals L1, L2, L3 the common terminal to connect the neutral wire to being identified as N. It is suitable to protect the voltage lines measured for example with 1A fuse links. Measurement voltages can also be connected via metering voltage transformers.

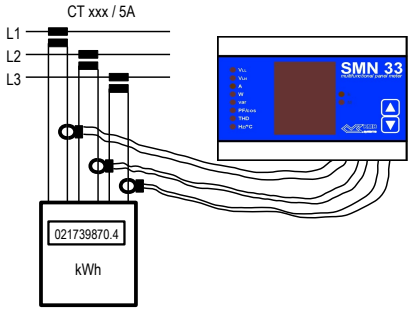
Current inputs :

- SML 33, SMM 33 : the current signals from 5A or 1A metering current transformers must be connected to the terminal pairs I1k, I1l, I2k, I2l, I3k, I3l
- SMN 33 : the „secondary" current transformers (which are standard accessory) must be clamped on measured wires and interconnected with delivered twisted-pair cables (of length max. 3 m) with corresponding terminal pairs I1k, I1l, I2k, I2l, I3k, I3l

Proper current signal polarity (k, l terminals) must be observed in both cases.

The SMN33 instrument's time synchronization terminals D- and D+ can be used for time synchonization for proper evaluation of maximum average three-phase active power time stamp. It is necessary to use free contact or semiconductor contact (see technical parameters). Note, the terminals D- and GND are galvanically connected !

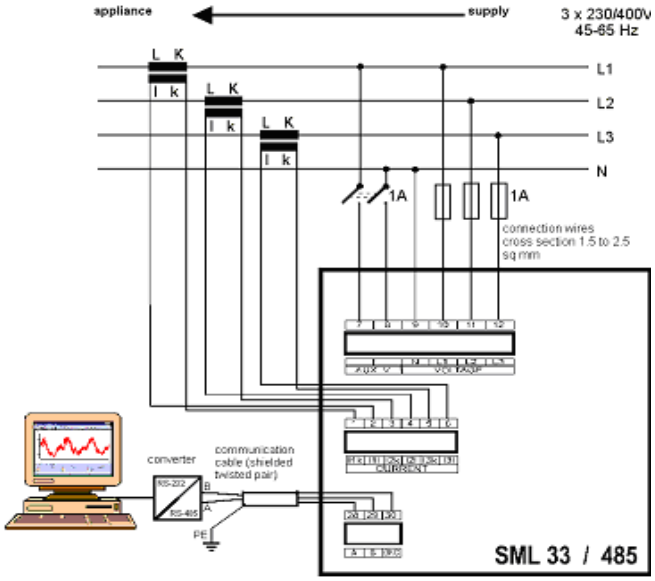
The communication line RS 485 uses terminals A, B with shielding at terminal GND. The final points of the communication line have to be fitted with terminating resistance. The communication line RS 232 uses terminals RxD, TxD and GND. See "Description of RETIS, Software for SML 33 and SMM 33" on the installation CD, which is part of package of the instruments with communication interface.



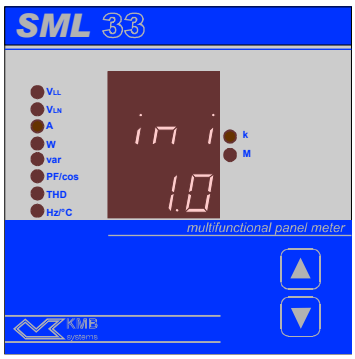
SMN 33 Current Inputs Connection

A connection wire's maximum cross section area is 2.5 square millimeters.

Elementary SML33 Instrument Connection



"N"(neutral) wire unconnected at "Delta"- and "Aron"-connection and L2-current input unconnected at "Aron"-connection too.



Operation

On connecting power supply the display shows 'ini', test of internal circuitry is carried out and the display's bottom line shows the software version or 'Err'. Then the instrument starts showing the measured values in accordance with its settings. If the instrument has a communication line, it can be set and its measured values read via the communication link using a PC.

Setting

In order to display true values of voltages, currents, and other quantities measured, the instrument must be set. The instrument setting is determined using parameters, especially the current transformer [CT] conversion, type of measurement voltage (direct measurement or via a voltage transformer [VT] and its conversion), and connection configuration (single-phase, two-phase, wye, delta, Aron).

By pressing the '▼' button for an extended time (about 6 seconds) you start the parameter edit mode. The display shows 'P.xx' / 'yyy' / 'zzz' where P.xx is the parameter being edited (display's upper line), yyy = value 1 (display's middle line), zzz = value 2 (display's lower line). A flashing value can be edited using the '▲' button and confirmed, then you proceed to another value using the '▼' button. The setting process is terminated by pressing the '▼' for an extended time again.

1. P.00 = edit mode on or off, yyy = '0' – edit enabled, yyy = '1' – edit disabled. If the edit mode is disabled, you can only view parameters and scroll through them using the '▼' button. To enable the edit mode again, you need to enter the passcode. Default setting: edit enabled.
   Edit enabling method: on simultaneous pressing of '▲' and '▼' the zzz section starts showing random generated numbers; if the number is odd, press '▲', if it is even, press '▼'.
2. P.01 = metering current transformer (CT), yyy = primary current in A / kA, zzz = --- / 1 / 5 A. Direct measurement (no CT): yyy = zzz = '---'. Default setting: direct measurement.
3. P.02 = metering voltage transformer (VT), yyy = primary voltage in V / kV, zzz = --- / 100 V. Direct measurement (no VT): yyy = zzz = '---'. Default setting: direct measurement.
4. P.03 = connection configuration, yyy = 1 – single-phase, yyy = 2 – two-phase, yyy = 3-Y – three-phase with neutral wire – wye connection, yyy = 3-D – three-phase without neutral wire – delta connection, yyy = A – three-phase Aron connection. Default setting: three-phase connection with neutral wire – wye configuration.
5. P.04 = display mode, yyy = 0 – values shown are switched every 3 seconds, yyy = 1 – value last selected is shown, yyy = 2 – value selected in zzz is shown after 10 seconds of no button operation (see table 1, appropriate LED is on too). Default setting: last selected value shown.
6. P.05 = displayed quantities, yyy = order of value (see table 1, appropriate LED is on too), zzz = 0 / 1 – value Not Shown / Shown, respectively. Default setting: all quantities shown.
7. P.06 = mains frequency setting, yyy = A50 / A60 – frequency is set automatically by measuring L1 input voltage if it is higher than 2 V at frequency from 45 to 64 Hz. If L1 voltage is outside these limits (input not connected, for example), 50 / 60 Hz frequency is applied.
8. P.07 = communication, yyy = 0 –KMB protocol, y = '1--' / '1-E' / '1-O' – Modbus protocol, no parity / even parity / odd parity. Default setting: KMB protocol.
9. P.08 = communication, yyy = Baud rate in kBaud, zzz = instrument address. Default setting: rate 9.6 kBd, address 1.
10. P.09 = time window of analyses P_{MAX}, yyy = period of time window in minutes (SMN33 only). Default setting: 15 min.

Example:

The current measured is connected via a metering CT with conversion 1,500 A / 5 A. You start the parameter edit mode by pressing the '▼' button for an extended time. *You may have to enable the edit mode.* By pressing '▼' you select parameter 01, by pressing '▲' you select the secondary current value and confirm by pressing '▼', by pressing '▲' select the primary current value (LEDs indicating order of magnitude and unit of measure, respectively) and complete by pressing '▼' for an extended time. *You may want to disable the edit mode.*

Table 1: List of Parameters

#	field	description	setting range	default setting	comment
P.00	yyy	passcode	0 / 1	0	as described above
P.01	yyy	CT conversion – primary current	1 A through 10 kA	---	preset values
	zzz	CT conversion – secondary current	--- / 1 A / 5 A	---	--- = direct measuring
P.02	yyy	VT conversion – primary voltage	0.1 kV through 400 kV	---	preset values
	zzz	VT conversion – secondary voltage	--- / 100 V	---	--- = direct measuring
P.03	yyy	connection configuration	1 / 2 / 3-y / 3-d / A	3-Y	as described above
P.04	yyy	display mode	0 / 1 / 2	1	as described above
	zzz	order of quantities: 1 – line voltage U_{L-L} 2 – phase voltage U_{L-N} 3 – current I_L 4 – active phase power 5 – active three-phase power 6 – reactive phase power 7 – reactive three-phase power 8 – phase power factor 9 – three-phase power factor 10 – cos φ (1st harmonic DPF only) 11 – harmonic distortion U_{L-L} 12 – harmonic distortion U_{L-N} 13 – harmonic distortion I_L 14 – frequency 15 – instrument ambient temperature 16 – time window of analyses P_{MAX}	1 through 15 / 16	2	[1] if 3 is selected, SMN33 displays I_{PEN} current in next step and upper display line shows -4- [2] if 5, 7 or 9 is selected, upper display line shows -3- (-2- with two-phase connection) and data are shown in middle display line [3] if 10 or 15 is selected, relevant LED flashes [4] if 11 through 13 is selected, THD LED as well as relevant quantity LED are on [5] 16 valid for SMN33 only
P.05	yyy	order of quantity	1 through 15 / 16	all enabled	
	zzz	quantity selected display enabled	0 / 1		
P.06	yyy	mains frequency	A50 / A60	A50	only if L1 voltage is out of range
P.07	yyy	communication protocol	0 / 1-- / 1-O / 1-E	0	as described above
P.08	yyy	communication baud rate in kBd	2.4 to 38.4	9.6	preset values
	zzz	communication address	1 through 255	1	autorepeat
P.09	yyy	time window of analyses P_{MAX}	15 / 30 / 60	15	valid for SMN33 only

Additional Features

Display brightness setting : If you press '▲' while 'ini' is displayed and release the button on software version display, all display segments will be lit and you can set their brightness by repeated pressing of '▲'. Pressing '▼' for an extended time completes the setting.

Measurement Data Display

A LED in the column on the front panel's left indicates a quantity (unit) measured. the currently measured values in each phase — with some quantities also three-phase values — can be viewed in three three-digit display lines (the upper line shows '-3-' for three-phase values). The LEDs on the right indicate the order of magnitude (shared by all three values). You can switch between the values measured using the ▲ and ▼ buttons.

The instrument measures True Root Mean Square values (TRMS) of voltages and currents.
U_{L-L} is shown in the order of U_{L1-L2}, U_{L2-L3}, U_{L3-L1}.
SMN 33 can additionally calculate current value I_{PEN} as instantaneous grad total of the currents I_{L1},I_{L2} & I_{L3}.
If single-phase connection is set, only single-phase values are shown.
If two-phase connection is set, two values are shown and only two-phase values of active and reactive power and power factor (there is shown "-2-" on the upper display).

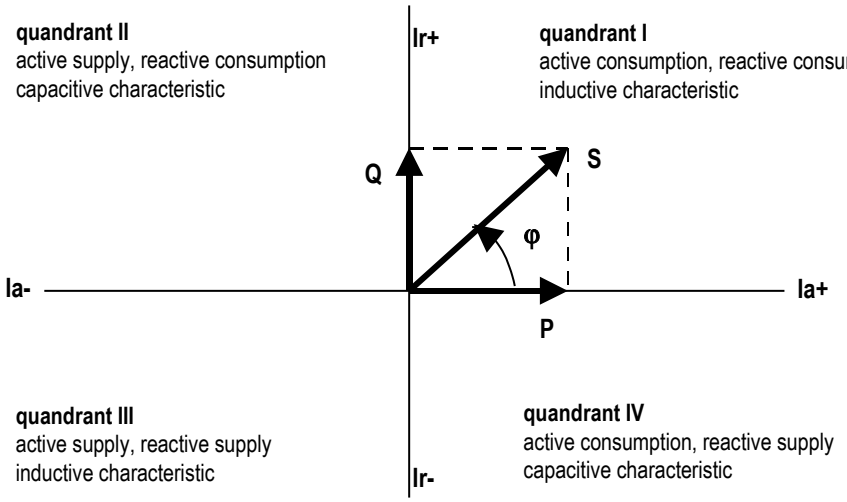
Table 2: List of Measured Quantities

U_{L-L}	line voltages	3-PF	3-phase power factor
U_{L-N}	phase voltages	cos φ	1st harmonic phase power factors
I	phase currents	$THDU_{L-L}$	harmonic distortion of line voltages
I_{PEN}*	neutral wire current	$THDU_{L-N}$	harmonic distortion of phase voltages
P	phase active powers	THDI	harmonic distortion of currents
3-P	3-phase active power	f	frequency
Q	phase reactive powers	T	instrument temperature
3-Q	3-phase reactive power	3-P_{MAX}*	maximum average 3-phase active power
PF	phase power factors		

*) … SMN33 instruments only

If delta connection is set, the phase voltage is measured against an artificial neutral potential which is indicated by flashing decimal point in the U_{L-N} values.
If "Aron" connection is set, only values I_{L1} and I_{L3} are shown in the currents and in the powers and power factors only three-phase values are shown (there is shown "-A-" on the upper display).
If current is drawn at a point of consumption, the decimal point flashes in active power values (Figure 2).
If the reactive power is of a capacitive characteristic rather than inductive, the decimal point flashes in reactive power values (Figure 2).
True power factor is shown (TPF or lambda).
Cos φ is shown in four quadrants and it is calculated from the angular shift between U_{L-N} and I_L. Reactive power's capacitive characteristic is indicated by letter 'c' before the decimal point in place of zero and active power is indicated by flashing decimal point in cos φ values (Figure 2).
The total harmonic distortion (THD) level in voltages and currents is measured for up to the 25th harmonic.
Calculation of the maximum active power P_{MAX} is to be executed only three-phase in the 15, 30 or 60 minutes interval according to the setting of P.09 parameter. Register clearing of the maximum active power P_{MAX} is to be executed with extended time pressing '▲' and after the sign **"Clr P"** is on has to be confirmed by pressing '▼'. If the procedure is finished the sign **"Clr P don"** is on.
Real time can be set and red and time of maximum power P_{MAX} can be red via communication port only.

Figure 2. Identification of consumption or supply and reactive power characteristic by phase shift (in accordance with IEC 375)



Elementary Formulas

The formulas apply to the default connection (wye configuration).
4 periods are measured at sampling rate 128 samples per period (n = 512).

phase voltage: $U_1 = \sqrt{\frac{1}{n}\sum_{i=1}^{n} U_{1i}^2}$ line voltage: $U_{12} = \sqrt{\frac{1}{n}\sum_{i=1}^{n} (U_{1i} - U_{2i})^2}$

current: $I_1 = \sqrt{\frac{1}{n}\sum_{i=1}^{n} I_{1i}^2}$ active power: $P_1 = \frac{1}{n}\sum_{i=1}^{n} U_{1i} \times I_{1i}$

reactive power: $\mathrm{var}_1 = \frac{1}{n}\sum_{i=1}^{n} U_{1(i-\pi/2)} \times I_{1i}$ power factor: $PF_1 = |P_1| / (U_1 \times I_1)$

3-phase active power: $P = P_1 + P_2 + P_3$ 3-phase reactive power: $\mathrm{var} = \mathrm{var}_1 + \mathrm{var}_2 + \mathrm{var}_3$

3-phase power factor: $PF = |P| / (U_1 \times I_1 + U_2 \times I_2 + U_3 \times I_3)$

total harmonic distortion: $THD_{U1} = \sqrt{\sum_{i=2}^{25} h_{U1i}^2} \times 100\%$ *(similar for $U_{L\text{-}L}$ and I_L)*

CT Assortment for SMN33 Instruments

type	meas. range [A]	ratio	inside diameter [mm]	dimensions[mm] / mass	design fig. No.
SWL-5A	0.01 ÷ 10 A	3000 : 1	10	25 x 33 x 41 / 60 g	1
SWL-50A	0.1 ÷ 100 A	3000 : 1	10	26 x 23 x 48 / 45 g	1
SWL-100A	0.1 ÷ 200 A	3000 : 1	16	31 x 30 x 54 / 85 g	1
SWL-200A	0.1 ÷ 300 A	3000 : 1	24	36 x 45 x 76 / 190 g	1
SWL-400A	0.1 ÷ 600 A	6000 : 1	35	60 x 40 x 80 / 310 g	1
SWL-600A	0.1 ÷ 800 A	9000 : 1	35	60 x 40 x 80 / 350 g	1
JC10F	0.01 ÷ 120 A	3000 : 1	10	23 x 26 x 50 / 45 g	2
JC16F	0.01 ÷ 200 A	3000 : 1	16	30 x 31 x 55 / 75 g	2
JC24F	0.01 ÷ 300 A	3000 : 1	24	45 x 34 x 75 / 150 g	2
JC36S-3	0.1 ÷ 650 A	3000 : 1	36	57 x 41 x 91 / 280 g	2

CT Design

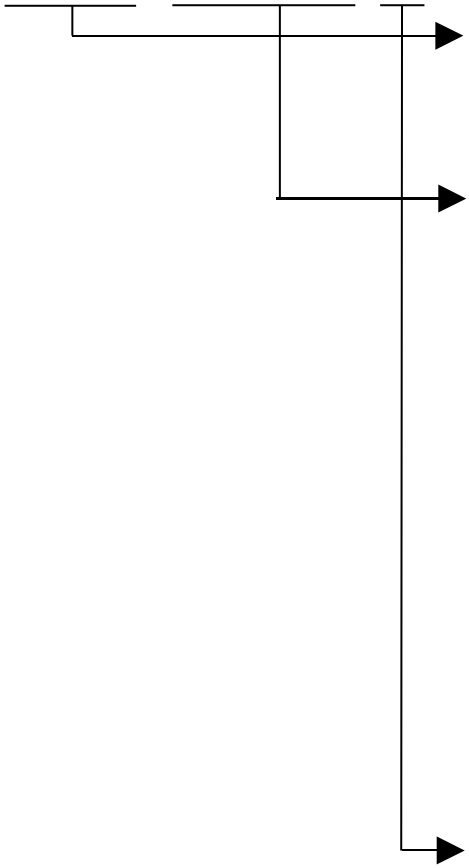
(screw terminals, snap-on lock)

Fig. 1 : Type SWL

Fig. 2 : Type JC

Model Marking

SMN 33 – 1 – 0005 / 4



instrument model :

SML33	3 voltage + 3 current inputs
SMM33	3 voltage + 3 current inputs
SMN33	3 voltage + 3 current inputs

type and range of CTs (for SMN33 only)

1 – 0005	SWL-5A, 5A
1 – 0050	SWL-50A, 50A
1 – 0100	SWL-100A, 100A
1 – 0200	SWL-200A, 200A
1 – 0400	SWL-400A, 400A
1 – 0600	SWL-600A, 600A
2 – 0005	JC10F, 5A
2 – 0025	JC10F, 25A
2 – 0050	JC10F, 50A
2 – 0075	JC10F, 75A
2 – 0100	JC16F, 100A
2 – 0150	JC16F, 150A
2 – 0200	JC24F, 200A
2 – 0250	JC24F, 250A
2 – 0300	JC36S-3, 300A
2 – 0400	JC36S-3, 400A
2 – 0500	JC36S-3, 500A
2 – 0600	JC36S-3, 600A

remote communication interface

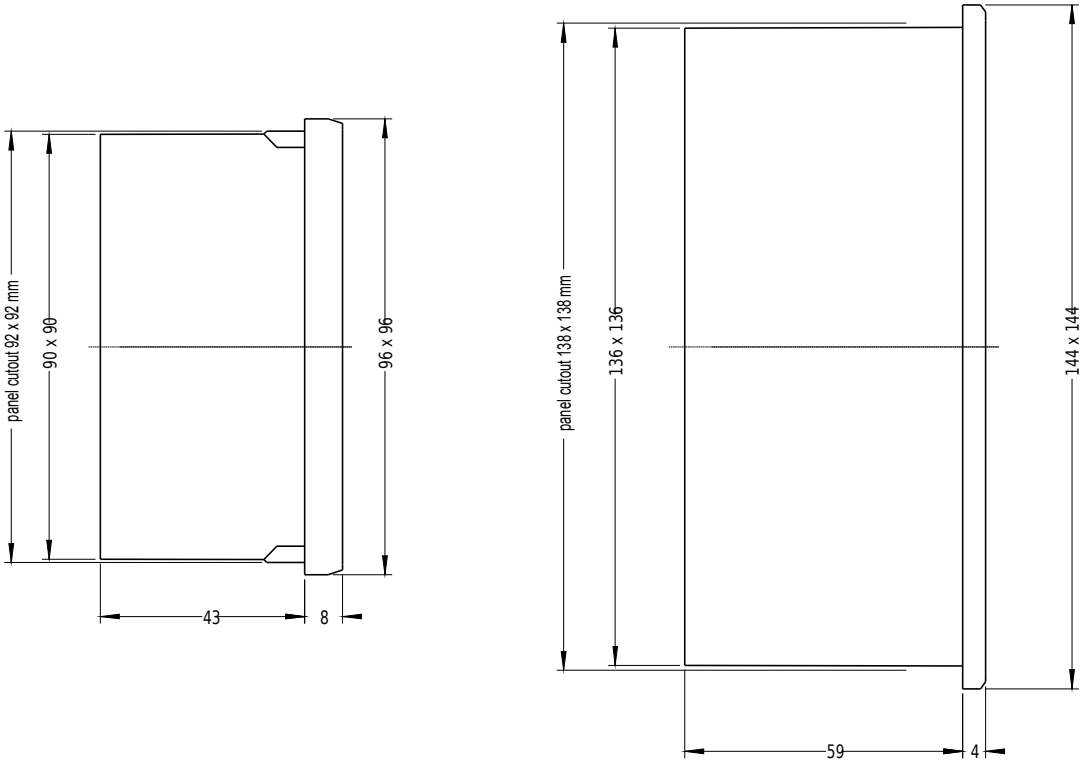
	without comm. interface
232	RS-232
485	RS-485

Technical Specifications

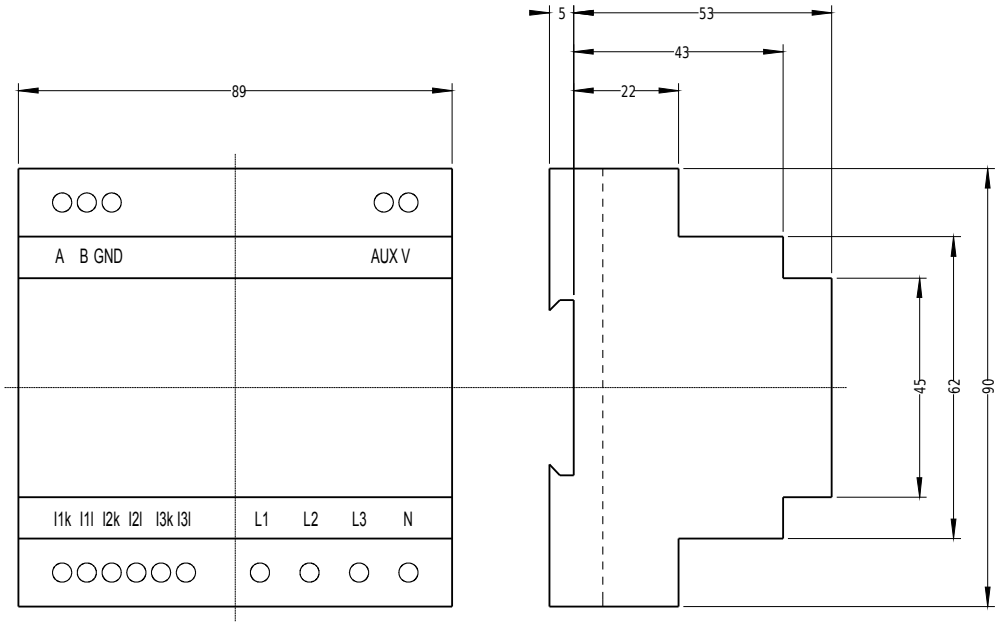
auxiliary supply voltage		wide range: 85 ÷ 275 V_{AC} / 45 ÷ 450 Hz, 80 ÷ 350 V_{DC}
power		3 VA / 3 W
overvoltage cat. and pollution degree		III / 2 – in compliance with IEC EN 61010-1
inputs		galvanically isolated, polarity insensitive
measured voltage (U_{nom} = 400/230 V_{AC})		4 ÷ 500 V_{AC} / 2.3 ÷ 285 V_{AC} (line / phase)
voltage measurement accuracy		± 0.5 % of rdg ± 0.1 % of rng ± 1 digit
input impedance		660 kΩ (L_i – N)
connection		single phase / two phases / wye / delta / Aron configuration
permanent overload (IEC 258)		2 x (that is 1,000 / 570 V)
surge overload		4 x for one second (that is 2,000 / 1,140 V)
frequency		45 ÷ 65 Hz
frequency measurement accuracy		±0.02%
measured current		SML33/SMM33 : 0.02 ÷ 7 A_{AC} (I_{NOM} = 5 A_{AC}) SMN33 : 0.02 ÷ 1.2 x I_{NOM} A_{AC} (I_{NOM} depends on used CT)
current measurement accuracy		SML33/SMM33 : ± 0.5 % of rdg ± 0.1 % of rng ± 1 digit SMN33 : ± 2 % of rng ± 1 digit
SML33	input power	< 0.25 VA (R_i < 10 mΩ)
SMM33	input wiring	galvanically isolated
	permanent overload	14 A_{AC}
	surge overload	70 A_{AC} for one second
SMN33	secondary CT wire length	max. 3m
	current wire diameter	10 ÷ 36 mm (depends on used CT)
measured temperature		-25 to 60 °C, ±3 °C
communication port		RS 485 or RS 232, galvanically isolated; KMB or Modbus-RTU protocol, communication rate 2.4 ÷ 38.4 kBd
synchronization input (SMN 33 only)		free or semiconductor contact , I_{MIN} = 10 mA, U_{MIN} = 10 V, R_{MAX} = 40 Ω, galvanically connected with communication port
active power (P_{nom} = 230* I_{NOM} W)		range limited by measurement voltage and current ranges
active power measurement accuracy		SML33/SMM33 : ±2 % ± 1 digit; SMN33 : ±4 % ± 1 digit (for PF>0.5)
reactive power (Q_{nom} = 230* I_{NOM} VA)		range limited by measurement voltage and current ranges
reactive power measur. accuracy		SML33/SMM33: ±2 % ± 1 digit; SMN33: ±4 % ± 1 digit (for PF < 0.7)
power factor(accuracy)		0.00 ÷ 1.00 (±2% ±1 digit)
cos φ (accuracy)		-1.00 ÷ +1.00 L,C (±2% ±1 digit)
THD (accuracy)		up to 25th harmonic, 0÷200%, (±2% ±1 digit, for U, I > 10% U_{NOM},I_{NOM})
operating environment		class C1 in compliance with IEC 654-1
operating temperature		-25 to 60°C
storage temperature		-40 to 85°C
operating and storage humidity		< 95% – noncondensation conditions
EMC – emission		EN 50081-2 ; EN 55011, class A ; EN 55022, class A (not for residential environments)
EMC – resistance		EN 61000-6-2
protection rating		IP 41 (IP 54 with cover film), back panel: IP 20
dimensions		SML 33: panel – 96x96 or 144x144 mm, SMM 33: rail – 89 x 90 mm
mass		0.3 kg

Mechanical Dimensions

SML 33:

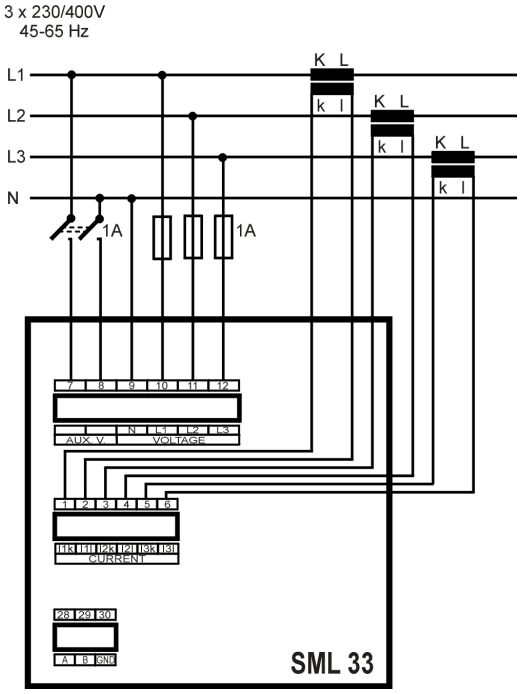


SMM 33 resp. SMN 33:

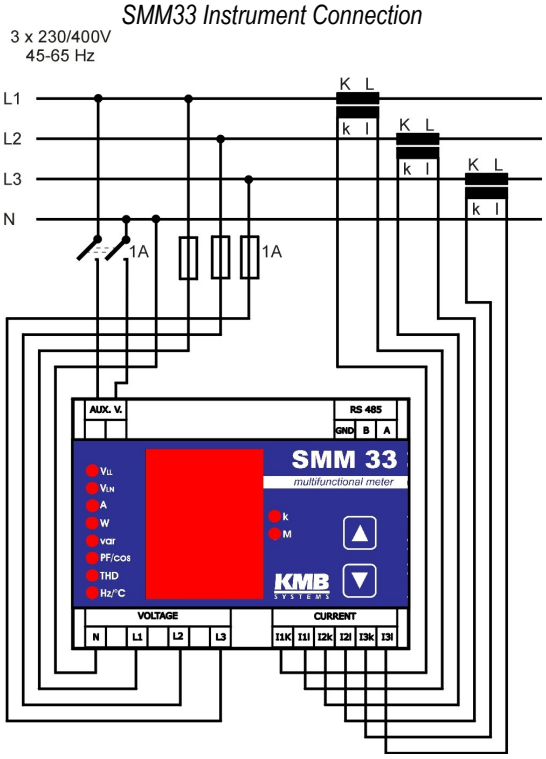


Schematic Diagrams

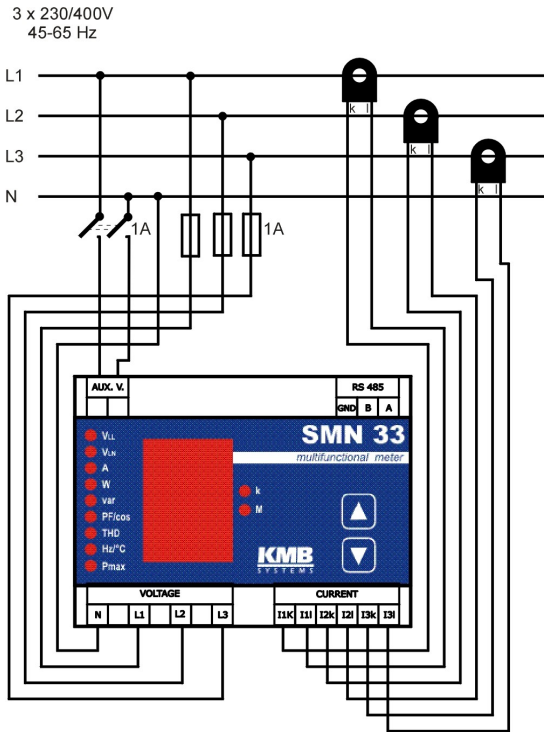
SML33 Instrument Connection



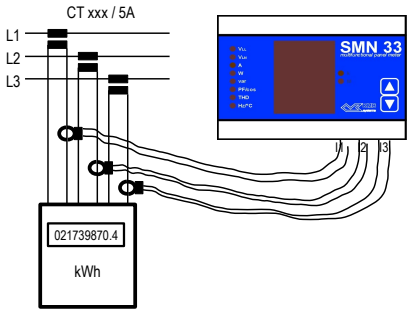
SMM33 Instrument Connection



SMN33 Instrument Standard Connection



SMN33 Instrument Alternative Connection



Maintenance, Service

The SML 33/SMM 33/SMN 33 instruments do not require any maintenance in their operation. For reliable operation it is only necessary to meet operating conditions specified and not expose the instrument to violent handling and activity of water or chemicals which could cause mechanical damage.

The instrument has mains fuse to disconnect it on incorrect power supply voltage connection or on a breakdown. The fuse is not accessible for a user, the instrument needs to be sent to the dealer that will arrange its replacement.

If the product has a breakdown, you need to complain to the supplier at their address:

Supplier: Manufacturer : KMB systems, s.r.o.
Dr. M. Horákové 559
460 06 LIBEREC 7
Czech Republic
telephone: +420 485 130 314
fax: +420 482 736 896
e–mail : kmb@kmb.cz
website : www.kmbsystems.eu

The product must be in proper package to prevent damage in transit. Description of the problem or its symptoms must be delivered together with the product.

If a warranty repair is claimed, the warranty certificate must be sent in. In case of an out–of–warranty repair you must enclose an order for the repair.

Warranty Certificate

Warranty period of 24 months from the date of purchase is provided for the instrument. Problems in the warranty period, provably because of faulty workmanship, design or inconvenient material, will be repaired free of charge by the manufacturer or an authorized servicing organization.

The warranty ceases even within the warranty period if the user makes unauthorized modifications or changes to the instrument, connects it to out-of-range quantities, if the instrument got damaged in out-of-specs falls or by improper handling or if it has been operated in contradiction with the technical specifications presented.

type of product: ..... serial number .....

date of dispatch: ..... final quality inspection: .....

manufacturer's seal:

date of purchase: ..... supplier's seal: