M40 / M30 (RS 485 interface)

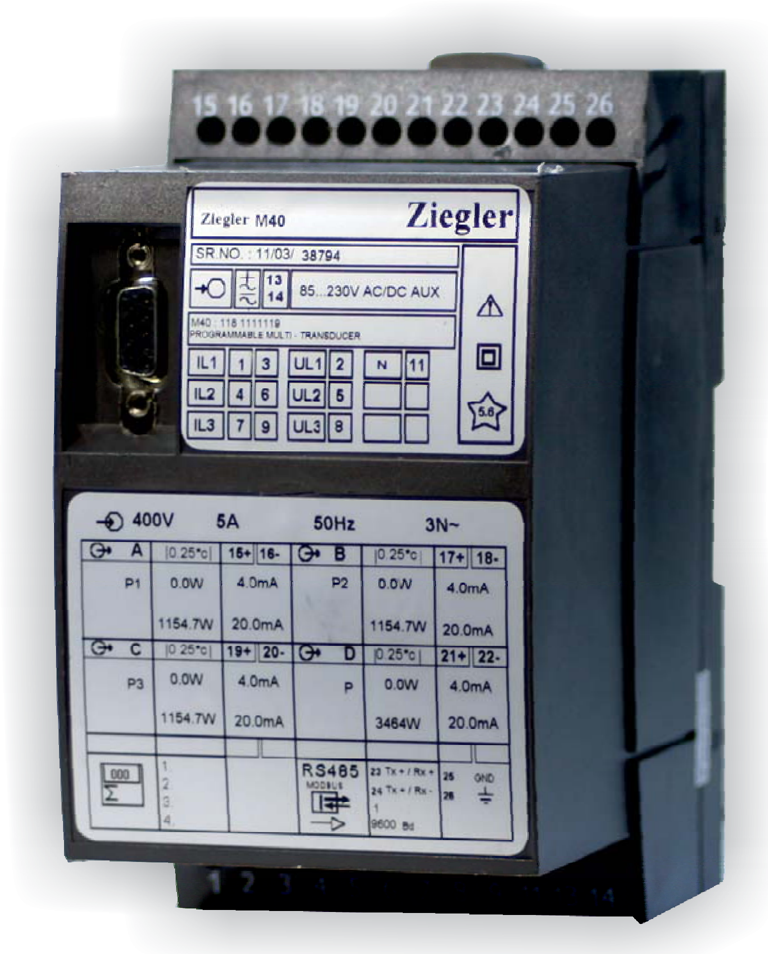


Fig.1

Application

for the measurement of electrical variables in heavy current power system

485 bus interface (MODBUS®). It supervises several variables of an electrical power system simultaneously and generates 4 proportional analogue output signals.
The RS 485 interface enables the user to determine the number of variables to be supervised (up to the maximum available). The levels of all internal counters that have been configured (max. 4) can also viewed. Provision is made for programming the M40 via the bus. A standard EIA 485 interface can be used, but there is no dummy load resistor for the bus.

to which a PC with the corresponding software can be connected for programming or accessing and executing useful ancillary functions. This interface is needed for bus operation to configure the device address, the Baud rate and possibly increasing the telegram waiting time (if the master is too slow) defined in the MODBUS ® protocol.
The usual methods of connection, the types of measured variables, their ratings, the transfer characteristic for each output and the type of internal energy metering are the main parameters that can be programmed.
The ancillary functions include a power system check, provision for displaying the measured variably on a PC monitor, the simulation of the outputs for test purposes and a facility for printing nameplates.

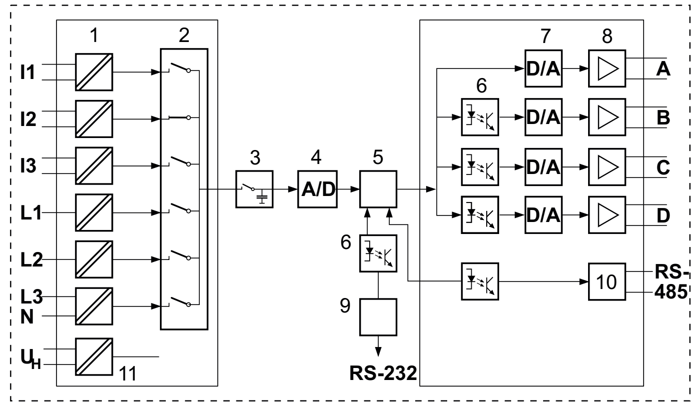
concerning electromagnetic compatibility(EMC) and safety (IEC 1010 resp. EN 61 010). It was developed and is manufactured and tested in strict accordance with the quality assurance standard ISO 9001.

Features / Benefits

- Simultaneous measurement of several variables of a heavy-current power system / Full supervision of an asymmetrically loaded four-wire power system, rated current 1 to 6 A, rated voltage 57 to 400 V (phase to neutral) or 100 to 693 V (phase-to-phase)
- For all heavy-current power system variables
- 4 analogue outputs
- Input voltage up to 693 V (phase-to-phase)
- Universal analogue outputs (programmable)
- High accuracy: U/I 0.2% and P 0.25% (under reference conditions)
- 4 integrated energy meters, storage every each 203 s, storage for: 20 years
- Windows software with password protection for programming, data analysis, power system status simulation, acquisition of meter data and making settings
- DC-,AC-power pack with wide power supply tolerance / universal
-

securing it with screws to a wall or panel

Measured variables	Output	Types
Current, voltage (rms), active/reactive/apparent power cos , sin , power factor RMS value of the current with wire setting range (bimetal measuring function) Slave pointer function for the measurement of the RMS value IB Frequency Average value of the currents with sign of the active power (power system only)	4 analogue outputs and bus interface RS 485 (MODBUS)	M40
	2 analogue outputs and 4 digital outputs or	M24
	4 analogue outputs and 2 digital outputs see Data Sheet DME 424/442-1 Le	M42
	Data bus LON see Data Sheet DME 400-1 Le	M00



1 = Input transformer
2 = Multiplexer
3 = Latching stage
4 = A/D converter
5 = Microprocessor
6 = Electrical insulation
7 = D/A converter
8 = Output amplifier / Latching stage
9 = Programming interface RS-232
10 = Bus RS 485 (MODBUS)
11 = Power supply

Fig. 2. Block diagram.

The RS 485 interface of the M 40 is galvanically isolated from all other circuits. For an optimal data transmission the devices are connected via a 3-wire cable, consisting of a twisted pair cable (for data lines) and a shield. There is no termination required. A shield both prevents the coupling of external noise to the bus and limits emissions from the bus. The shield must be connected to solid ground
You can connect up to 32 members to the bus (including master). Basically devices of different manufacturers can be connected to the bus, if they use the standard MODBUS® protocol. Devices without galvanically isolated bus interface are not allowed to be connected to the shield.
The optimal topology for the bus is the daysi chain connection from node 1 to node 2 to node n. The bus must form a single continuous path, and the nodes in the middle of the bus must have short stubs. Longer stubs would have a negative impact on signal quality (reflexion at the end). A star or even ring topology is not allowed.

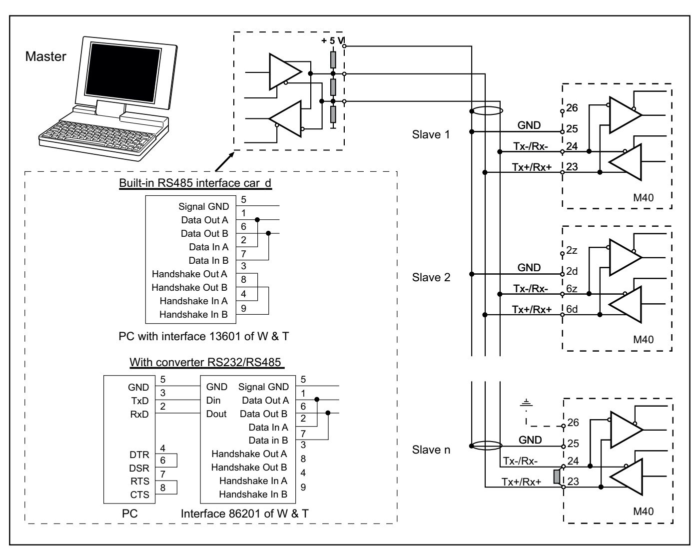


Fig. 6

There is no bus termination required due to low data rate. If you got problems when using long cables you can terminate the bus at both ends with the characteristic impedance of the cable (normally about 120). Interface converters RS 232 RS 485 or RS 485 interface cards often have a built-in termination network which can be connected to the bus. The second impedance then can be connected directly between the bus terminals of the device far most.

RS 485 interface can be realized by means of PC built-in interface cards or interface converters. Both is shown using i.e. the interfaces 13601 and 86201 of W & T (Wiesemann & Theis GmbH). They are configured for a 2-wire application with automatic control of data direction. These interfaces provide a galvanical isolation and a built-in termination network.

Important

Each device connected to the bus must have a unique address
All devices must be adjusted to the same baudrate.

Symbols

Symbols	Meaning
X	Measured variable
X0	Lower limit of the measured variable
X1	Break point of the measured variable
X2	Upper limit of the measured variable
Y	Output variable
Y0	Lower limit of the output variable
Y1	Break point of the output variable
Y2	Upper limit of the output variable
U	Input voltage
Ur	Rated value of the input voltage
U 12	Phase-to-phase voltage L1 – L2
U 23	Phase-to-phase voltage L2 – L3
U 31	Phase-to-phase voltage L3 – L1
U1N	Phase-to-neutral voltage L1 – N
U2N	Phase-to-neutral voltage L2 – N
U3N	Phase-to-neutral voltage L3 – N
UM	Average value of the voltages
	(U1N + U2N + U3N) / 3
I	Input current
I1	AC current L1
I2	AC current L2
I3	AC current L3
Ir	Rated value of the input current
IM	Average value of the currents (I1 + I2 + I3) / 3
IMS	Average value of the currents and sign of the
	active power (P)
IB	RMS value of the current with wire setting range (bimetal measuring function)
IBT	Response time for IB
BS	Slave pointer function for the measurement of the RMS value IB
BST	Response time for BS
φ	Phase-shift between current and voltage
F	Frequency of the input variable
Fn	Rated frequency
P	Active power of the system P = P1 + P2 + P3
P1	Active power phase 1
	(phase-to-neutral L1 –N)
P2	Active power phase 2
	(phase-to-neutral L2 –N)
P3	Active power phase 3 (phase-to-neutral L3 – N)

Symbols	Meaning (Continuation)
Q	Reactive power of the system Q = Q1 + Q2 + Q3
Q1	Reactive power phase 1 (phase-to-neutral L1 – N)
Q2	Reactive power phase 2 (phase-to-neutral L2 – N)
Q3	Reactive power phase 3 (phase-to-neutral L3 – N)
S	Apparent power of the system $S = \sqrt{I_1^2 + I_2^2 + I_3^2} \cdot \sqrt{U_1^2 + U_2^2 + U_3^2}$
S1	Apparent power phase 1 (phase-to-neutral L1 – N)
S2	Apparent power phase 2 (phase-to-neutral L2 – N)
S3	Apparent power phase 3 (phase-to-neutral L3 – N)
Sr	Rated value of the apparent power of the system
PF	Active power factor cos j = P/S
PF1	Active power factor phase 1 P1/S1
PF2	Active power factor phase 2 P2/S2
PF3	Active power factor phase 3 P3/S3
QF	Reactive power factor sin j = Q/S
QF1	Reactive power factor phase 1 Q1/S1
QF2	Reactive power factor phase 2 Q2/S2
QF3	Reactive power factor phase 3 Q3/S3
LF	Power factor of the system LF = sgnQ · (1 – PF)
LF1	Power factor phase 1 sgnQ1 · (1 – PF1)
LF2	Power factor phase 2 sgnQ2 · (1 – PF2)
LF3	Power factor phase 3 sgnQ3 · (1 – PF3)
c	Factor for the intrinsic error
R	Output load
Rn	Rated burden
H	Power supply
Hn	Rated value of the power supply
CT	c.t. ratio
VT	v.t. ratio

Technical data

Inputs

Input variables	see Table 2 and 3
Measuring ranges	see Table 2 and 3
Waveform	Sinusoidal
Rated frequency	50…60 Hz; 16 2/3 Hz
Own Consumption [VA]	Voltage circuit: $\le U^2/400$ k Condition: Characteristic XH01 … XH10 Current circuit: 0.3 VA · I/5 A

Continuous thermal ratings of inputs

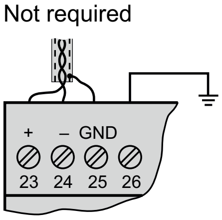
Current circuit	10 A 400 V single-phase AC system 693 V three-phase system
Voltage circuit	480 V single-phase AC system 831 V three-phase system

Short-time thermal rating of inputs

Input variable	Number of inputs	Duration of overload	Interval between two overloads
Current circuit	400 V single-phase AC system 693 V three-phase system		
100 A	5	3 s	5 min.
250 A	1	1 s	1 hour
Voltage circuit	1 A, 2 A, 5 A		
Single-phase AC system 600 V H_{intern}:1.5 Ur	10	10 s	10 s
Three-phase system 1040 V H_{intern}:1.5 Ur	10	10 s	10 s

MODBUS® (Bus interface RS-485)

Terminals	Screw terminals, terminals 23, 24, 25 and 26
Connecting cable	Screened twisted pair
Max. distance	Approx. 1200 m (approx. 4000 ft.)
Baudrate	1200 … 9600 Bd (programmable)
Number of bus stations	32 (including master)
Dummy load	Not required



MODBUS® is a registered trademark of the Schneider Automation Inc.

Analogue outputs

For the outputs A, B, C and D:

Output variable Y	Impressed DC current	Impressed DC voltage
Full scale Y2	see “Ordering information”	see “Ordering information”
Limits of output signal for input overload and/or R = 0	1.25 · Y2	40 mA
R → ∞	30 V	1.25 Y2
Rated useful range of output load	$0 \le \frac{7.5\ V}{Y2} \le \frac{15\ V}{Y2}$	$\frac{Y2}{2\ mA} \le \frac{Y2}{1\ mA} \le \infty$
AC component of output signal (peak-to-peak)	≤ 0.005 Y2	≤ 0.005 Y2

The outputs A, B, C and D may be either short or open-circuited. They are electrically insulated from each other and from all other circuits (floating).
All the full-scale output values can be reduced subsequently using the programming software, but a supplementary error results.
The hardware full-scale settings for the analogue outputs may also be changed subsequently. Conversion of a current to a voltage output or vice versa is also possible. This necessitates changing resistors on the output board. The full-scale values of the current and voltage outputs are set by varying the effective value of two parallel resistors (better resolution). The values of the resistors are selected to achieve the minimum absolute error. Calibration with the programming software is always necessary following conversion of the outputs. Refer to the Operating Instructions
Caution: The warranty is void if the device is tampered with!

System response

Accuracy class (the reference value is the full-scale value Y2)

Measured variable	Condition	Accuracy class*
System: Active, reactive and apparent power	0.5 ≤ X2/Sr ≤ 1.5 0.3 ≤ X2/Sr < 0.5	0.25 c 0.5 c
Phase: Active, reactive and apparent power	0.167 ≤ X2/Sr ≤ 0.5 0.1 ≤ X2/Sr < 0.167	0.25 c 0.5 c
Power factor, active power and reactive power	0.5Sr ≤ S ≤ 1.5 Sr, (X2 - X0) = 2	0.25 c
	0.5Sr ≤ S ≤ 1.5 Sr, 1 ≤ (X2 - X0) < 2	0.5 c
	0.5Sr ≤ S ≤ 1.5 Sr, 0.5 ≤ (X2 - X0) < 1	1.0 c
	0.1Sr ≤ S < 0.5Sr, (X2 - X0) = 2	0.5 c
	0.1Sr ≤ S < 0.5Sr, 1 ≤ (X2 - X0) < 2	1.0 c
	0.1Sr ≤ S < 0.5Sr, 0.5 ≤ (X2 - X0) < 1	2.0 c
AC voltage	0.1 Ur ≤ U ≤ 1.2 Ur	0.2 c
AC current/ current averages	0.1 Ir ≤ I ≤ 1.5 Ir	0.2 c
System frequency	0.1 Ur ≤ U ≤ 1.2 Ur resp. 0.1 Ir ≤ I ≤ 1.5 Ir	0.15 + 0.03 c (f_N = 50...60 Hz) 0.15 + 0.1 c (f_N = 16 2/3 Hz)
Pulse	acc. to IEC 1036 0.1 Ir ≤ I ≤ 1.5 Ir	1.0

* Basic accuracy 0.5 c for applications with phase-shift

Duration of the measurement cycle	Approx. 0.5 to s 1.2 s at 50 Hz, depending on measured variable and programming
Response time	1 … 2 times the measurement cycle

Factor c (the highest value applies):

Linear characteristic	$c = \dfrac{1 - \frac{Y0}{Y2}}{1 - \frac{X0}{X2}}$ or c = 1
Bent characteristic X0≤ X ≤ X1	$c = \dfrac{Y1 - Y0}{X1 - X0} \cdot \dfrac{X2}{Y2}$ or c = 1
X1 < X ≤ X2	$c = \dfrac{1 - \frac{Y1}{Y2}}{1 - \frac{X1}{X2}}$ or c = 1

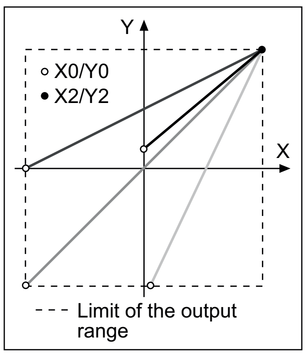


Fig. 3. Examples of settings with linear characteristic.

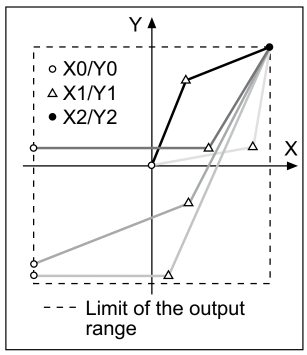


Fig. 4. Examples of settings with bent characteristic.

Reference conditions

Ambient temperature	+ 23°C + 1 K
Pre-conditioning	30 min. acc. to DIN EN 60 688 Section 4.3, Table 2
Input variable	Rated useful range
Power supply	H = Hn + 1%
Active/reactive factor	cos Φ = 1 resp. sin Φ = 1
Frequency	50 … 60 Hz, 16 2/3 Hz
Waveform	Sinusoidal, form factor 1.1107
Output load	DC current output $R_N = \dfrac{7.5\ V}{Y2} \pm 1\%$ DC voltage output $R_N = \dfrac{Y2}{1\ mA} \pm 1\%$
Miscellaneous	DIN EN 60 688

Influencing quantities and permissible variations

Acc. to DIN IEC 688

Power supply →○

DC-, AC-power pack (DC and 50 … 60 Hz)

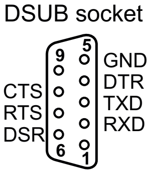
Ta ble 1: Rated voltages and tolerances

Rated voltage U_N	T olerance
24 … 60 V DC/AC	DC – 15 … + 33% AC 10%
85 … 230 V DC/AC	

Consumption ≤ 9 W resp.≤ 10 VA

Interface RS 232 C

DSUB socket 9-pin



The interface is electrically insulated from all other circuits.

Ambient conditions

Climatic rating	Climate class 3 acc. to VDI/VDE 3540
Variations due to ambient temperature	+ 0.1% / 10 K
Nominal range of use for temperature	0…15…30…45°C(usage group II)
Storage temperature	– 40 to + 85°C
Annual mean relative humidity	≤ 75%

Applicable standards and regulations

DIN EN 60 688	converting AC electrical variables into analogue and digital signals
IEC 1010 or EN 61 010	Safety regulations for electrical measuring, control and laboratory equipment
EN 60529	Protection types by case (code IP)
IEC 255-4 Part E5	High-frequency disturbance test (static relays only)
IEC 1000-4-2, 3, 4, 6	Electromagnetic compatibility for industrialprocess measurement and control equipment
VDI/VDE 3540, page 2	Reliability of measuring and control equipment (classification of climates)
DIN 40 110	AC quantities
DIN 43 807	Terminal markings
IEC 68 /2-6	Basic environmental testing procedures, vibration, sinusoidal
EN 55011	Electromagnetic compatibility of data processing and telecommunication equipment Limits and measuring principles for radio interference and information equipment
IEC 1036	Alternating current static watt-hour meters for active energy (classes 1 and 2)
DIN 43864	Current interface for the transmission of impulses between impulse encoder counter and tarif meter
UL 94	Tests for flammability of plastic materials for parts in devices and appliances

Safety

Protection class	II
Enclosure protection	IP 40, housing IP 20, terminals
Overvoltage category	III
Insulation test (versus earth)	Input voltage AC 400 V Input current AC 400 V Output DC 40 V Power supply AC 400 V DC 230 V
Surge test	5 kV; 1.2/50s; 0.5 Ws
Test voltages	50 Hz, 1 min. according to DIN EN 61 010-1 5550 V, inputs versus all other circuits as well as outer surface 3250 V, input circuits versus each other 3700 V, power supply versus outputs and SCI as well as outer surface 490 V, outputs & SCI versus each other & versus outer surface

Vibration withstand

(tested according to DIN EN 60 068-2-6)

Acceleration	± 2 g
Frequency range	10 … 150 … 10 Hz, rate of frequency sweep: 1 octave/minute
Number of cycles	10 in each of the three axes
Result	No faults occurred, no loss of accuracy and no problems with the snap fastener

Installation data

Housing	HousingT24 See Section "Dimensioned drawings"
Housing material	Lexan 940 (polycarbonate), flammability class V-0 acc. to UL 94, self-extinguishing, non-dripping, free of halogen
Mounting	For snapping onto top-hat rail (35 x15 mm or 35 x 7.5 mm) acc. to EN 50 022 or directly onto a wall or panel using the pull-out screw hole brackets
Orientation	Any
Weight	Approx. 0.7 kg

Terminals

Type	Screw terminals with wire guards
Max. wire gauge	< 4.0 mm^2 single wire or 2 x 2.5 mm^2 fine wire

Table 3: Programming

DESCRIPTION		Application		
		A11 … A16	A34	A24 / A44
1. Application (system)				
Single-phase AC		A11	—	—
3-wire, 3-phase symmetric load, phase-shift U: L1-L2, I: L1 *		A12	—	—
3-wire, 3-phase symmetric load		A13	—	—
4-wire, 3-phase symmetric load		A14	—	—
3-wire, 3-phase symmetric load, phase-shift U: L3-L1, I: L1 *		A15	—	—
3-wire, 3-phase symmetric load, phase-shift U: L2-L3, I: L1 *		A16	—	—
3-wire, 3-phase asymmetric load		—	A34	—
4-wire, 3-phase asymmetric load		—	—	A44
4-wire, 3-phase asymmetric load, open-Y		—	—	A24
2. Input voltage				
Rated value Ur = 57.7 V		U01	—	—
Rated value Ur = 63.5 V		U02	—	—
Rated value Ur = 100 V		U03	—	—
Rated value Ur = 110 V		U04	—	—
Rated value Ur = 120 V		U05	—	—
Rated value Ur = 230 V		U06	—	—
Rated value Ur [V]		U91	—	—
Rated value Ur = 100 V		U21	U21	U21
Rated value Ur = 110 V		U22	U22	U22
Rated value Ur = 115 V		U23	U23	U23
Rated value Ur = 120 V		U24	U24	U24
Rated value Ur = 400 V		U25	U25	U25
Rated value Ur = 500 V		U26	U26	U26
Rated value Ur [V]		U93	U93	U93
Lines U01 to U06: Only for single phase AC current or 4-wire, 3-phase symmetric load Line U91: Ur [V] 57 to 400 Line U93: Ur [V] > 100 to 693				
3. Input current				
Rated value Ir = 1 A V1		V1	V1	
Rated value Ir = 2 A V2		V2	V2	
Rated value Ir = 5 A V3		V3	V3	
Rated value Ir > 1 to 6 [A]		V9	V9	V9

* Basic accuracy 0.5 c

Table 3 continued on next page!

Continuation "Table 3: Programming"

DESCRIPTION				Application		
				A11 … A16	A34	A24 / A44
4. Primary rating (primary transformer)						
Without specification of primary rating				W0	W0	W0
CT = ____ A / ____ A		VT = ____ kV / ____ V		W9	W9	W9
Line W9: Specify transformer ratio prim./sec., e.g. 1000/5 A; 33 kV/110 V						
5. Measured variable, output A						
Not used				AA000	AA000	AA000
		Initial value X0	Final value X2			
U	System	X0 = 0	X2 = Ur*	AA001	——	——
U12	L1-L2	X0 = 0	X2 = Ur*	——	AA001	AA001
U	System	0 ≤ X0 ≤ 0.9 · X2	0.8 · Ur ≤ X2 ≤ 1.2 · Ur*	AA901	——	——
U1N	L1-N	0 ≤ X0 ≤ 0.9 · X2	0.8 · Ur/√3 ≤ X2 ≤ 1.2 · Ur/√3 *	——	——	AA902
U2N	L2-N	0 ≤ X0 ≤ 0.9 · X2	0.8 · Ur/√3 ≤ X2 ≤ 1.2 · Ur/√3 *	——	——	AA903
U3N	L3-N	0 ≤ X0 ≤ 0.9 · X2	0.8 · Ur/√3 ≤ X2 ≤ 1.2 · Ur/√3*	——	——	AA904
U12	L1-L2	0 ≤ X0 ≤ 0.9 · X2	0.8 · Ur X2 ≤ 1.2 · Ur*	——	AA905	AA905
U23	L2-L3	0 ≤ X0 ≤ 0.9 · X2	0.8 · Ur X2 ≤ 1.2 · Ur *	——	AA906	AA906
U31	L3-L1	0 ≤ X0 ≤ 0.9 · X2	0.8 · Ur X2 ≤ 1.2 · Ur *	——	AA907	AA907
I	System	0 ≤ X0 ≤ 0.8 · X2	0.5 · Ir ≤ X2 ≤ 1.5 · Ir	AA908	——	——
I1	L1	0 ≤ X0 ≤ 0.8 · X2	0.5 · Ir ≤ X2 ≤ 1.5 · Ir	——	AA909	AA909
I2	L2	0 ≤ X0 ≤ 0.8 · X2	0.5 · Ir ≤ X2 ≤ 1.5 · Ir	——	AA910	AA910
I3	L3	0 ≤ X0 ≤ 0.8 · X2	0.5 · Ir ≤ X2 ≤ 1.5 · Ir	——	AA911	AA911
P	System	–X2≤ X0 ≤ 0.8 · X2	0.3 ≤ X2 / Sr 1.5	AA912	AA912	AA912
P1	L1	–X2≤ X0 ≤ 0.8 · X2	0.1 ≤ X2 / Sr 0.5	——	——	AA913
P2	L2	–X2≤ X0 ≤ 0.8 · X2	0.1 ≤ X2 / Sr 0.5	——	——	AA914
P3	L3	–X2≤ X0 ≤ 0.8 · X2	0.1 ≤ X2 / Sr 0.5	——	——	AA915
Q	System	–X2≤ X0 ≤ 0.8 · X2	0.3 ≤ X2 / Sr 1.5	AA916	AA916	AA916
Q1	L1	–X2≤ X0 ≤ 0.8 · X2	0.1 ≤ X2 / Sr 0.5	——	——	AA917
Q2	L2	–X2≤ X0 ≤ 0.8 · X2	0.1 ≤ X2 / Sr 0.5	——	——	AA918
Q3	L3	–X2≤ X0 ≤ 0.8 · X2	0.1 ≤ X2 / Sr 0.5	——	——	AA919
PF	System	–1 ≤ X0 ≤ (X2 – 0.5)	0 ≤ X2 ≤ 1	AA920	AA920	AA920
PF1	L1	–1 ≤ X0 ≤ (X2 – 0.5)	0 ≤ X2 ≤ 1	——	——	AA921
PF2	L2	–1 ≤ X0 ≤ (X2 – 0.5)	0 ≤ X2 ≤ 1	——	——	AA922
PF3	L3	–1 ≤ X0 ≤ (X2 – 0.5)	0 ≤ X2 ≤ 1	——	——	AA923
QF	System	–1 ≤ X0 ≤ (X2 – 0.5)	0 ≤ X2 ≤ 1	AA924	AA924	AA924
QF1	L1	–1 ≤ X0 ≤ (X2 – 0.5)	0 ≤ X2 ≤ 1	——	——	AA925
QF2	L2	–1 ≤ X0 ≤ (X2 – 0.5)	0 ≤ X2 ≤ 1	——	——	AA926
QF3	L3	–1 ≤ X0 ≤ (X2 – 0.5)	0 ≤ X2 ≤ 1	——	——	AA927
F		15.3 Hz ≤ X0 ≤ X2 – 1 Hz	X0 + 1 Hz≤ X2 ≤65 Hz	AA928	AA928	AA928
S	system	0 ≤ X0 ≤ 0.8 · X2	0.3 ≤ X2 / Sr 1.5	AA929	AA929	AA929
S1	L1	0 ≤ X0 ≤ 0.8 · X2	0.1 ≤ X2 / Sr 0.5	——	——	AA930
S2	L2	0 ≤ X0 ≤ 0.8 · X2	0.1 ≤ X2 / Sr 0.5	——	——	AA931
S3	L3	0 ≤ X0 ≤ 0.8 · X2	0.1 ≤ X2 / Sr 0.5	——	——	AA932
IM	System	0 ≤ X0 ≤ 0.8 · X2	0.5 · Ir ≤ X2 ≤ 1.5 · Ir	——	AA933	AA933
IMS	System	–X2 ≤ X0 ≤ 0.8 · X2	0.5 · Ir ≤ X2 ≤ 1.5 · Ir	——	AA934	AA934
LF	System	–1 ≤ X0 ≤ (X2 – 0.5)	0 ≤ X2 ≤ 1	AA935	AA935	AA935
LF1	L1	–1 ≤ X0 ≤ (X2 – 0.5)	0 ≤ X2 ≤ 1	——	——	AA936
LF2	L2	–1 ≤ X0 ≤ (X2 – 0.5)	0 ≤ X2 ≤ 1	——	——	AA937
LF3	L3	–1 ≤ X0 ≤ (X2 – 0.5)	0 ≤ X2 ≤ 1	——	——	AA938
IB	System	X0 = 0 1≤ IBT ≤ 30 min	0.5 · Ir≤ X2 ≤ 1.5 · Ir	AA939	——	——
IB1	L1	X0 = 0 1≤ IBT ≤ 30 min	0.5 · Ir≤ X2 ≤ 1.5 · Ir	——	AA940	AA940
IB2	L2	X0 = 0 1≤ IBT ≤ 30 min	0.5 · Ir≤ X2 ≤ 1.5 · Ir	——	AA941	AA941
IB3	L3	X0 = 0 1≤ IBT ≤ 30 min	0.5 · Ir≤ X2 ≤ 1.5 · Ir	——	AA942	AA942
BS	System	X0 = 0 1≤ BST ≤ 30 min	0.5 · Ir≤ X2 ≤ 1.5 · Ir	AA943	——	——
BS1	L1	X0 = 0 1≤ BST ≤ 30 min	0.5 · Ir≤ X2 ≤ 1.5 · Ir	——	AA944	AA944
BS2	L2	X0 = 0 1≤ BST ≤ 30 min	0.5 · Ir≤ X2 ≤ 1.5 · Ir	——	AA945	AA945
BS3	L3	X0 = 0 1≤ BST ≤ 30 min	0.5 · Ir≤ X2 ≤ 1.5 · Ir	——	AA946	AA946
UM	System	0≤ X0 ≤ 0.8 · X2	0.8 · Ur≤ X2 ≤ 1.2 · Ur*	——	——	AA947

* Where the power supply is taken from the measured voltage, the transmitter only operates in the range U = 0.8 Ur … 1.2 Ur and the specified accuracy is only guaranteed in the range U = 0.9 Ur … 1.1 Ur.

Table 3 continued on next page!

Continuation "Table 3: Programming"

DESCRIPTION	Application A11 … A16	A34	A24 / A44
6. Output signal, output A Initial value Y0 / Final value Y2 DC current: Y0 = 0, Y2 = 20 mA –Y2 ≤ Y0 ≤ 0.2 · Y2, 1 mA ≤ Y2 ≤ 20 mA DC voltage –Y2 ≤ Y0 ≤ 0.2 · Y2, 1 V ≤ Y2 ≤ 10 V	AB01 AB91 AB92	AB01 AB91 AB92	AB01 AB91 AB92
7. Characteristic, output A Linear Bent (X0 + 0.015 · X2) ≤ X1 ≤ 0.985 · X2 Y0 ≤ Y1 ≤ Y2	AC01 AC91	AC01 AC91	AC01 AC91
8. Limits, output A Standard Ymin = Y0 – 0.25 Y2 Ymax = 1.25 Y2 (Y0 – 0.25 Y2) ≤ Ymin ≤ Y0 Y2 ≤ Ymax ≤ 1.25 Y2	AD01 AD91	AD01 AD91	AD01 AD91
9. Measured variable, output B Same as output A, but markings start with a capital B	BA …	BA …	BA …
10. Output signal, output B Same as output A, but markings start with a capital B	BB ..	BB ..	BB ..
11. Characteristic, output B Same as output A, but markings start with a capital B	BC ..	BC ..	BC ..
12. Limits, output B Same as output A, but markings start with a capital B	BD ..	BD ..	BD ..
13. Measured variable, output C Same as output A, but markings start with a capital C	CA …	CA …	CA …
14. Output signal, output C Same as output A, but markings start with a capital C	CB ..	CB ..	CB ..
15. Characteristic, output C Same as output A, but markings start with a capital C	CC ..	CC ..	CC ..
16. Limits, output C Same as output A, but markings start with a capital C	CD ..	CD ..	CD ..
17. Measured variable, output D Same as output A, but markings start with a capital D	DA ..	DA ..	DA ..
18. Output signal, output D Same as output A, but markings start with a capital D	DB ..	DB ..	DB ..

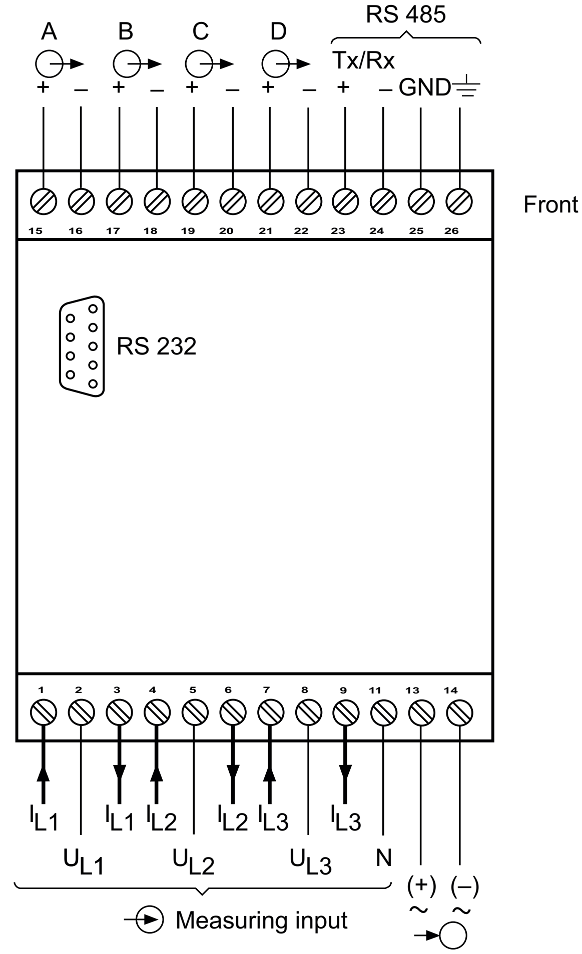
Table 3 continued on next page!

Continuation "Table 3: Programming"

DESCRIPTION	Application		
	A11 … A16	A34	A24 / A44
19. Characteristic, output D Same as output A, but markings start with a capital D	DC ..	DC ..	DC ..
20. Limits, output D Same as output A, but markings start with a capital D	DD ..	DD ..	DD ..
21. Power meter 1 Not used	EA00	EA00	EA00
I System [Ah]	EA50	—	—
I1 L1 [Ah]	—	EA51	EA51
I2 L2 [Ah]	—	EA52	EA52
I3 L3 [Ah]	—	EA53	EA53
S System [VAh]	EA54	EA54	EA54
S1 L1 [VAh]	—	—	EA55
S2 L2 [VAh]	—	—	EA56
S3 L3 [VAh]	—	—	EA57
P System (incoming) [Wh]	EA58	EA58	EA58
P1 L1 (incoming) [Wh]	—	—	EA59
P2 L2 (incoming) [Wh]	—	—	EA60
P3 L3 (incoming) [Wh]	—	—	EA61
Q System (inductive) [Varh]	EA62	EA62	EA62
Q1 L1 (inductive) [Varh]	—	—	EA63
Q2 L2 (inductive) [Varh]	—	—	EA64
Q3 L3 (inductive) [Varh]	—	—	EA65
P System (outgoing) [Wh]	EA66	EA66	EA66
P1 L1 (outgoing) [Wh]	—	—	EA67
P2 L2 (outgoing) [Wh]	—	—	EA68
P3 L3 (outgoing) [Wh]	—	—	EA69
Q System (capacitive) [Varh]	EA70	EA70	EA70
Q1 L1 (capacitive) [Varh]	—	—	EA71
Q2 L2 (capacitive) [Varh]	—	—	EA72
Q3 L3 (capacitive) [Varh]	—	—	EA73
22. Energy meter 2 Same as energy meter 1, but markings start with a capital F	FA ..	FA ..	FA ..
23. Energy meter 3 Same as energy meter 1, but markings start with a capital G	GA ..	GA ..	GA ..
24. Energy meter 4 Same as energy meter 1, but markings start with a capital H	HA ..	HA ..	HA ..

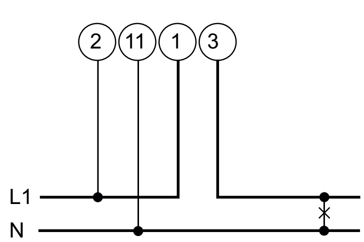
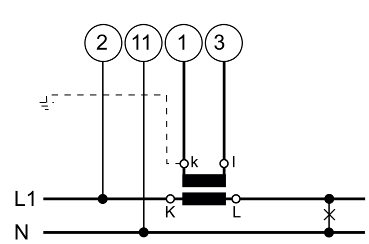
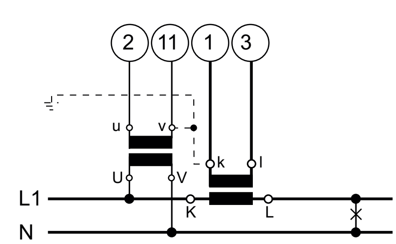
Electrical Connections

Function			Connect.
Measuring input	AC current	IL1	1 / 3
		IL2	4 / 6
		IL3	7 / 9
	AC voltage	UL1	2
		UL2	5
		UL3	8
		N	11
Outputs	Analogue		
	A	+	15
		–	16
	B	+	17
		–	18
	C	+	19
		–	20
	D	+	21
		–	22
RS 485 (MODBUS)		Tx+/Rx+	23
		Tx–/Rx–	24
		GND	25
		⏚	26
Power supply	AC	~	13
		~	14
	DC	+	13
		–	14



If power supply is taken from the measured voltage internal connections are as follow:

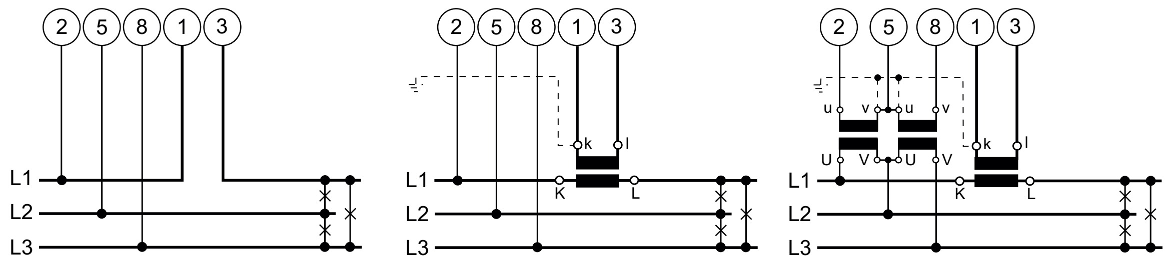
Application (system)	Internal connection Terminal / System
Single-phase AC current	2 / 11 (L1 – N)
4-wire 3-phase symmetric load	2 / 11 (L1 – N)
All other (apart from A15 / A16 / A24)	2 / 5 (L1 – L2)

Measuring inputs	
System / application	Terminals
Single-phase AC system	  

Measuring inputs

System / application	Terminals

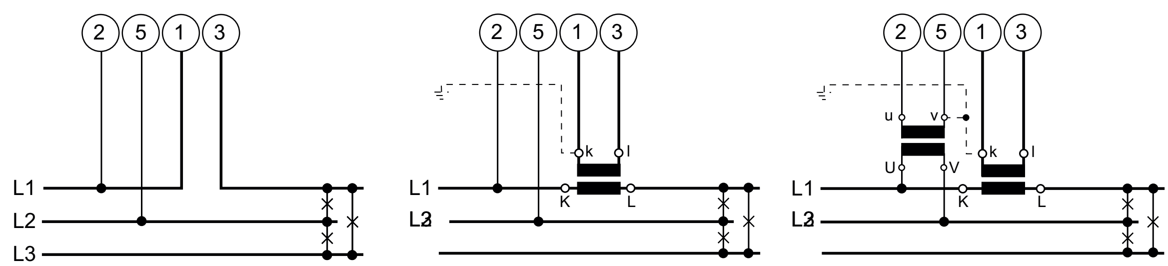
3-wire 3-phase symmetric load I: L1



Connect the voltage according to the following table for current measurement in L2 or L3:

Current transf.	Terminals		2	5	8
L2	1	3	L2	L3	L1
L3	1	3	L3	L1	L2

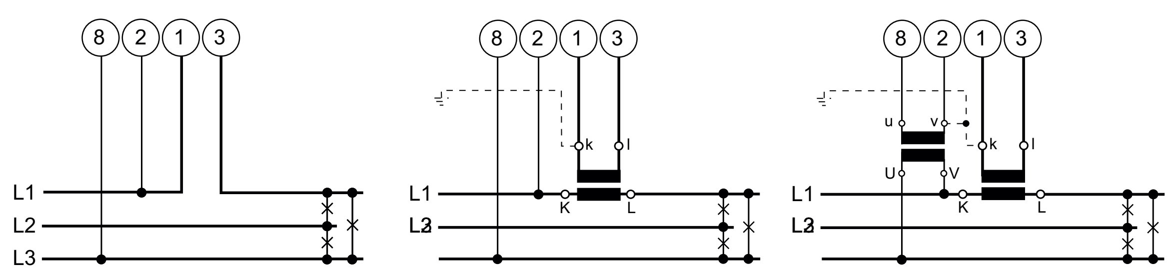
3-wire 3-phase symmetric load Phase-shift U: L1 – L2 I: L1



Connect the voltage according to the following table for current measurement in L2 or L3:

Current transf.	Terminals		2	5
L2	1	3	L2	L3
L3	1	3	L3	L1

3-wire 3-phase symmetric load Phase-shift U: L3 – L1 I: L1



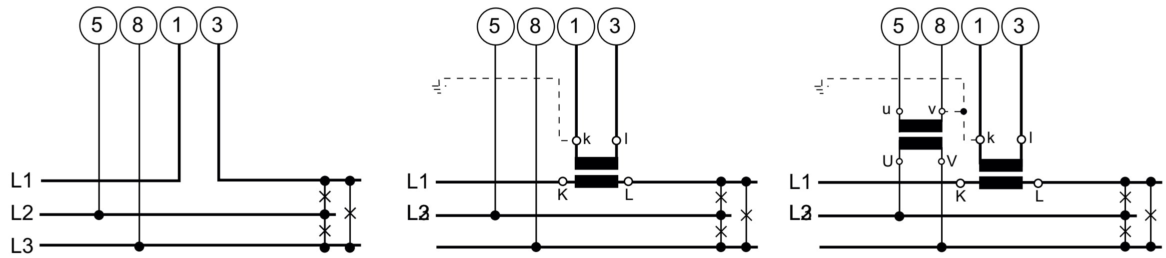
Connect the voltage according to the following table for current measurement in L2 or L3:

Current transf.	Terminals		8	2
L2	1	3	L1	L2
L3	1	3	L2	L3

Measuring inputs

System / application	Terminals
3-wire 3-phase symmetric load Phase-shift U: L2 – L3 I: L1	see diagrams below
4-wire 3-phase symmetric load I: L1	see diagrams below
3-wire 3-phase asymmetric load	see diagrams below

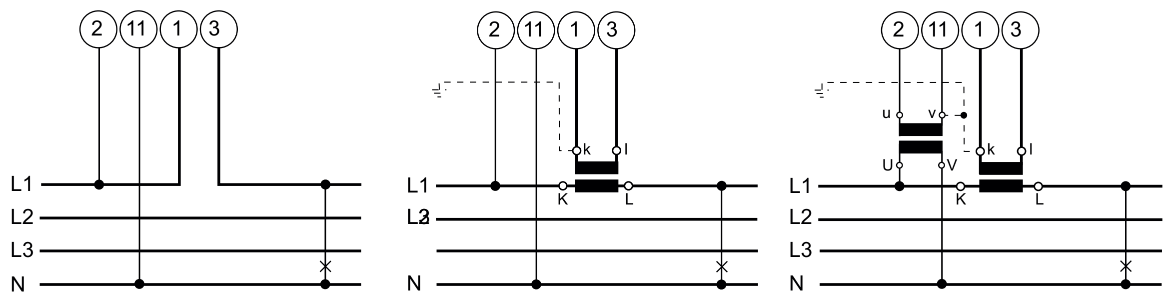
3-wire 3-phase symmetric load, Phase-shift U: L2 – L3, I: L1



Connect the voltage according to the following table for current measurement in L2 or L3:

Current transf.	Terminals		5	8
L2	1	3	L3	L1
L3	1	3	L1	L2

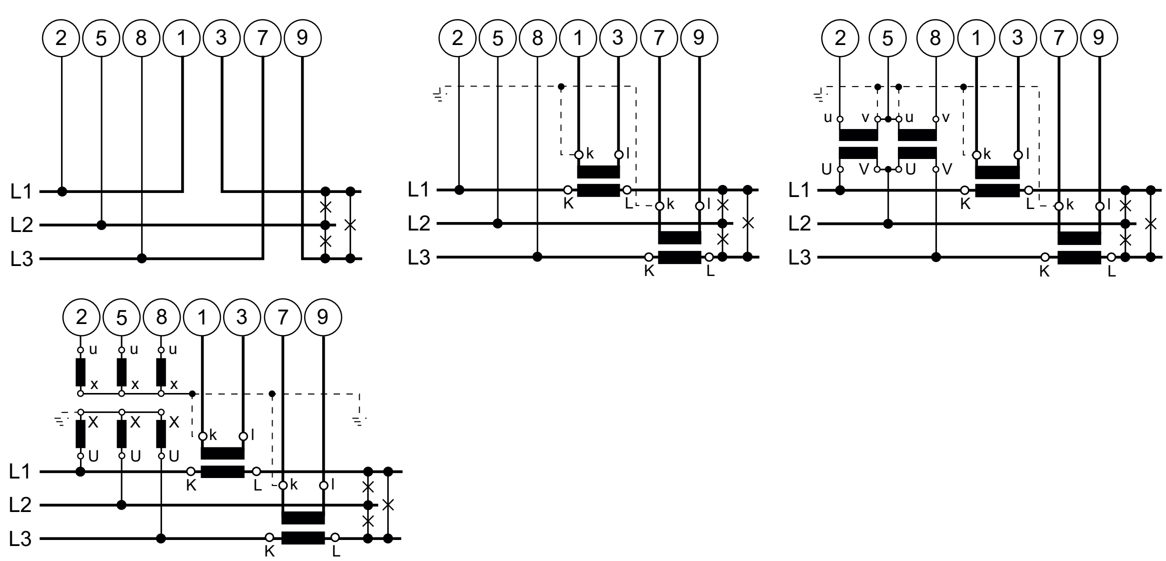
4-wire 3-phase symmetric load, I: L1

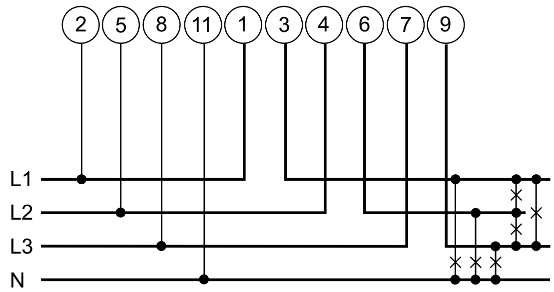


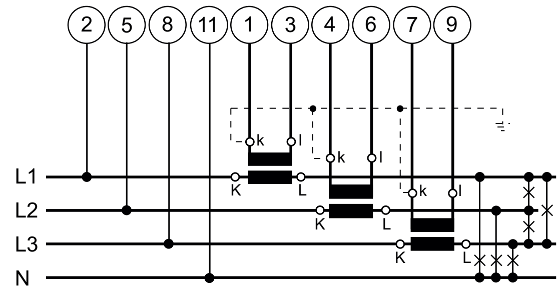
Connect the voltage according to the following table for current measurement in L2 or L3:

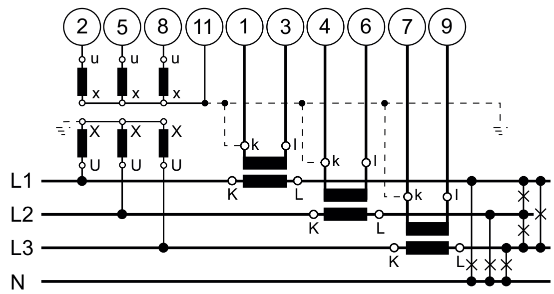
Current transf.	Terminals		2	11
L2	1	3	L2	N
L3	1	3	L3	N

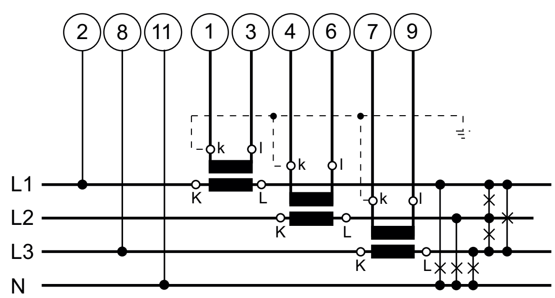
3-wire 3-phase asymmetric load

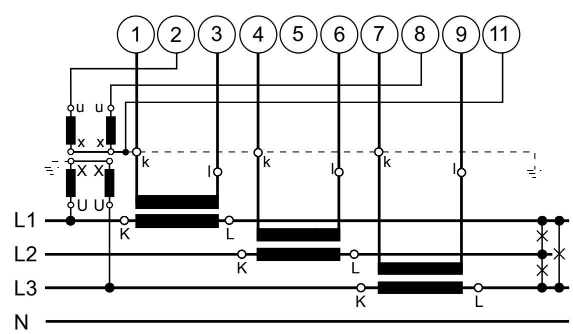


<table>
<tr><th colspan="2">Measuring input</th></tr>
<tr><th>System / application</th><th>Terminals</th></tr>
<tr><td>3-phase
3-wire
asymmetric
load</td><td>






3 single-pole insulated voltage transformers in high-voltage system</td></tr>
<tr><td>4-wire
asymmetric
load,
3-phase
Open Y
Connection*</td><td>


Low-voltage system


2 single-pole insulated voltage transformers in high-voltage system</td></tr>
</table>

Relationship between PF, QF and LF

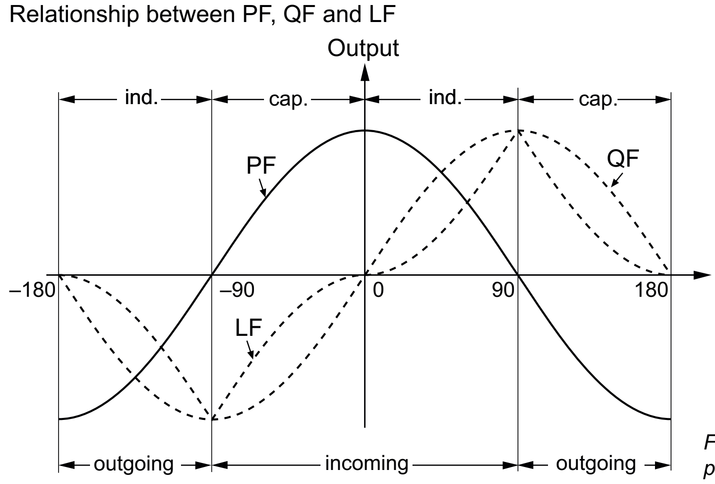


Fig. 5. Active power PF ——, reactive power QF ------, power factor LF – ––.

Dimensioned drawings

All Dimensions are in mm

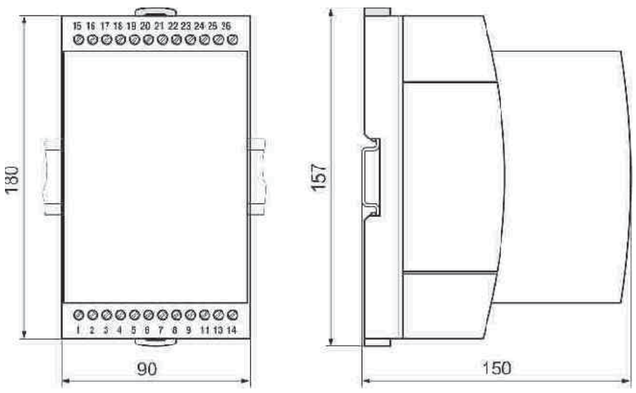


Fig. 7. M40 in housing T24 clipped onto a top-hat rail (35 x15 mm or 35 x 7.5 mm, acc. to EN 50 022).

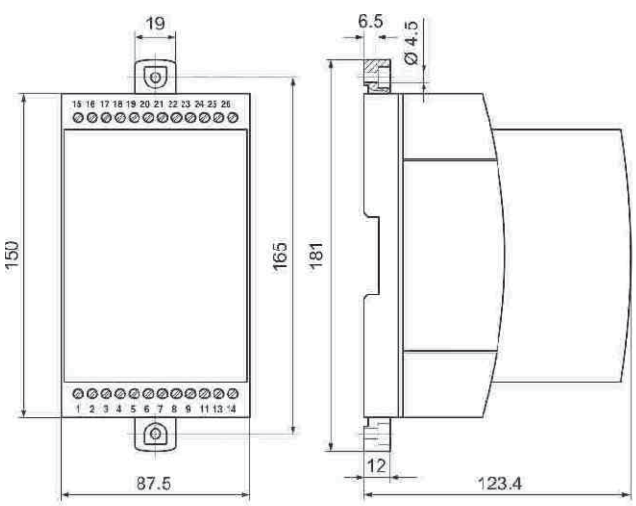


Fig. 8. M40 in housing T24 screw hole mounting brackets pulled out.

Table 4: Accessories

1	Programming Cable
2	Transducer configuration software for M40, version 1.30
3	Software Metrawin 10 for M40
4	Operating Instructions M40
5	Interface Definition M40

Ordering Information

DESCRIPTION	MARKING
1. Mechanical design Housing T24 for rail and wall mounting	M40 / M30#- 1
2. Rated frequency	
1) 50 Hz (60 Hz possible without additional error; 16 2/3 Hz, additional error 1.25 · c)	1
2) 60 Hz (50 Hz possible without additional error; 16 2/3 Hz, additional error 1.25 · c)	2
3) 16 2/3 Hz (not re-programming by user, 50/60 Hz possible, but with additional error 1.25 · c)	3
3. Power supply Nominal range	
7) DC/AC 24 … 60 V	7
8) DC/AC 85 … 230 V	8
4. Power supply connection	
1) External (standard)	1
2) Internal from voltage input	2
Line 2: Not available for rated frequency 16 2/3 Hz and applications A15 / A16 / A24 (see Table 3) Caution: The power supply voltage must agree with the input voltage (Table 3)	

M30- Only with 3 Analog Outputs available and without MODBUS (RS 485).
On demand MODBUS can be accumulated at extra cost. All Dimensions & Features remains same as M 40

DESCRIPTION		MARKING
5. Full-scale output signal, output A		
1) Output A, Y2 = 20 mA (standard)		1
9) Output A, Y2 [mA]		9
Z) Output A, Y2 [V]		Z
Line 9: Full-scale current Y2 [mA] 1 to 20		
Line Z: Full-scale voltage Y2 [V] 1 to 10		
6. Full-scale output signal, output B		
1) Output B, Y2 = 20 mA (standard)		1
9) Output B, Y2 [mA]		9
Z) Output B, Y2 [V]		Z
7. Full-scale output signal, output C		
1) Output C, Y2 = 20 mA (standard)		1
9) Output C, Y2 [mA]		9
Z) Output C, Y2 [V]		Z
8. Full-scale output signal, output D		
1) Output D, Y2 = 20 mA (standard)		1
9) Output D, Y2 [mA]		9
Z) Output D, Y2 [V]		Z
9. Test certificate		
0) None supplied		0
1) Supplied		1
10. Programming		
0) Basic		0
9) According to specification		9
Line 0: Not available if the power supply is taken from the voltage input		
Line 9: All the programming data must be entered on Form W 2389e and the form must be included with the order.		

ZIEGLER INSTRUMENTS
Schnepfenreuther Weg 6, D-90425 Nürnberg, Germany.
TEL. (+49)(911) 38 492 45 E-MAIL info@ziegler-instruments.com
FAX. (+49)(911) 32 26 212 WEBSITE www.ziegler-instruments.com

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