

Power Quality and Network Analyzer 96x96 mm, connection via CT

Cat. N°: 4 120 53



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1. DESCRIPTION - USE

Power quality and network analyzer with built-in memory. Measures the main electrical quantities of a single-phase or three-phase network and records real-time energy data and quality data of the power supply.

Measurement and recording of other specific values such as Interruptions, Flickers, DIPs, SWELLS, Rapid Voltage Changes (RVC) and Slow Voltage Changes (LVC), ensure a real monitoring of the quality of the power supply according to the EN 50160 standard.

By the Modbus RS485 communication (Module cat. n° 4 120 55) it is possible to query the device and access to the stored data. The insertion is done by measuring current transformers (CT).

2. RANGE

. Cat. N° 4 120 53: Power quality and network analyzer with built-in memory, 96x96 mm for installation on a door or full panel. The device can be equipped with several add-on modules to expand its functionality. (see § 8)

Dimensions:

- . Device: 96x96 mm.
- . Mounting cutout: 92x92 mm

Auxiliary supply:

- . 80 ÷ 265 V~, 47÷63 Hz
- . 100 ÷ 300 Vd.c.
- . Protected against reverse polarity

Rated current:

- . Rated current, In: 1 A or 5 A (via external current transformer x/1 A or x/5 A)
- . Max, current, Imax: 1,2 In
- x/1 A: 1,2 A
- x/5 A: 6 A

2. RANGE

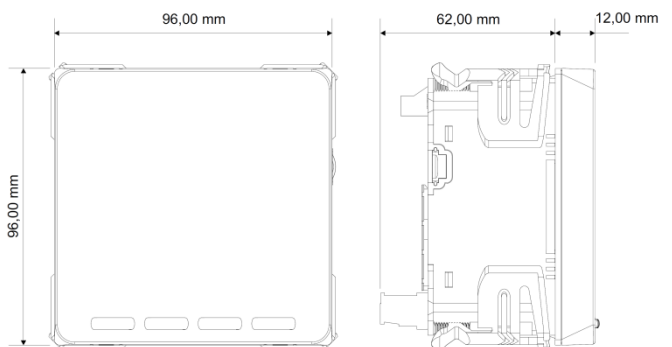
Insertion rated voltages:

- . Un: 50÷690 V~ (phase/phase)
- . Un: 30÷400 V~ (phase/neutral)

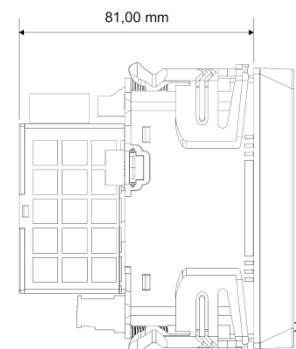
Rated frequency:

- . fn: 50 Hz
- . Admitted variation: 47÷63 Hz

3. OVERALL DIMENSIONS



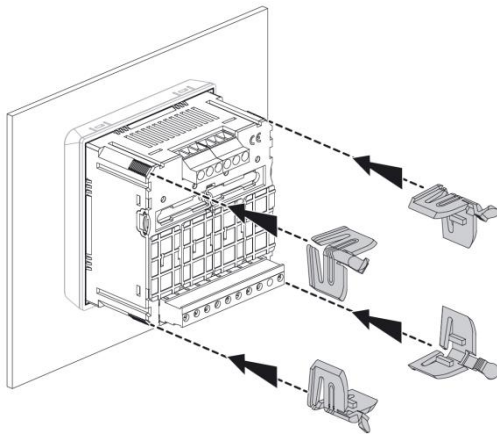
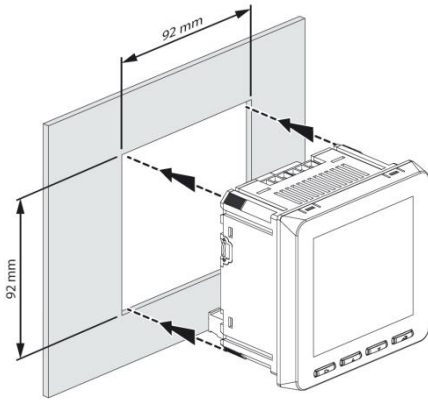
. with add-on modules



4. FIXING - CONNECTION

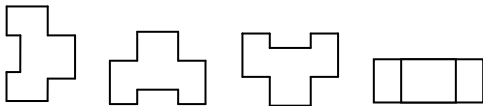
Fixing:

- . On door or full panel
- . Cutout 92x92 mm



Operating position:

- . Vertical
- . Horizontal
- . Upside down
- . On the side



Screw terminals:

- . Terminal depth: 8 mm.
- . Stripping length: 8 mm

Screw head:

- . Mixed, slotted and Philips PH1 (CTs terminals).
- . Mixed, slotted and Philips PH0 (Voltage measurement inputs and auxiliary supply)

Recommended tightening torque:

- . CTs terminals (I₁, I₂, I₃): 1 Nm.
- . Voltage measurement terminals (V₁, V₂, V₃, N), Auxiliary supply (Aux.): 0,6 Nm.

Tools required:

- . CTs terminals: flat screwdriver 5 mm or screwdriver PH1
- . Voltage measurement and aux. supply terminals: flat screwdriver 3 mm or screwdriver PH0
- . For fixing the device: no tools needed.

4. FIXING - CONNECTION (continued)

Connectable section:

- . Copper cables.
- . CTs Terminals

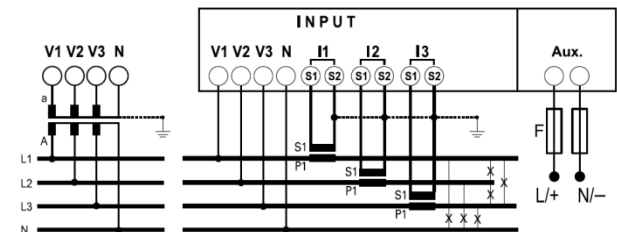
	Without ferrule	With ferrule
Rigid cable	0,05 to 6 mm ²	-
Flexible cable	0,05 to 4 mm ²	0,05 to 4 mm ²

. Other terminals

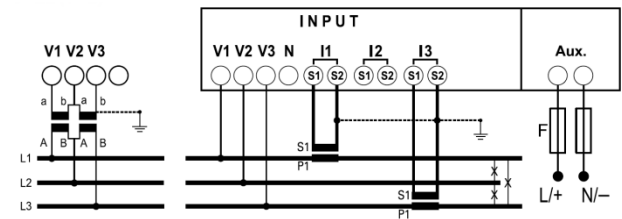
	Without ferrule	With ferrule
Rigid cable	0,05 to 4 mm ²	-
Flexible cable	0,05 to 2,5 mm ²	0,05 to 2,5 mm ²

Wiring diagrams:

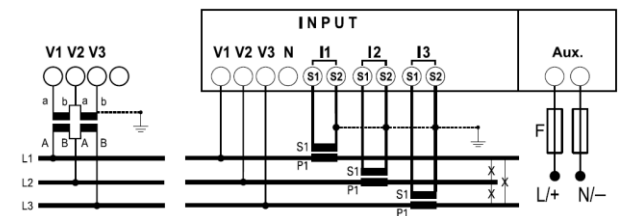
- . 4 wires three-phase network, 3 CT (3N-3E):



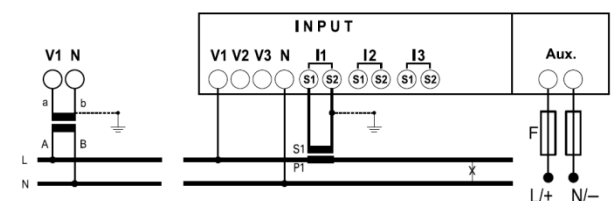
- . 3 wires three-phase network, 2 CT (3-2E):



- . 3 wires three-phase network, 3 CT (3-3E):



- . single phase network (1N-1E):



For all other wiring diagrams refer to the instruction sheet.

5. GENERAL CHARACTERISTICS

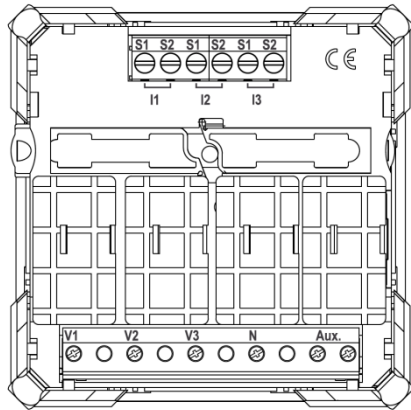
Front face marking:

. Marking by screen printing:



Terminals Marking:

. By permanent ink pad printing.



Display

- . Type: LCD back lighted.
- . Resolution: automatic adjustment of the display resolution for the decimal digits and for the engineering units as a function of the transformation ratio of the external current transformers (kTA^1) and, if any, if the external voltage transformers (kTV^2)
- ¹ $kTA = \text{external CTs ratio}$
 (ex. $800A / 5A, kTA = 160$).
- ² $kTV = \text{external VT ratio}$
 (ex. $600V / 100V, kTV = 6$). For direct connection $kTV = 1$.
 In the example, $kTA \times kTV = 160 \times 6 = 960$.
- . Refresh time: 1,1 sec.
- . Automatic backlight reduction, after 20 sec. of keyboard inactivity

Measuring sensors operating range:

- . Max. VT primary voltage: 150 kV
- . Max CTs primary current: 50 kA (CT = $x/5A$), 10 kA (CT = $x/1A$)
- . Max. product $kTA \times kTV = 2.000.000$ (CT = $x/5A$) and $10.000.000$ (CT = $x/1A$)

Note: Changing one of the parameters kTA or kTV in the setup menu of the device, all the energy counters are reset.

5. GENERAL CHARACTERISTICS (continued)

Count starting time:

. $t < 5$ sec (IEC/EN 62053-21, IEC/EN 62053-23).

Value display and Programming:

. Using front keyboard, 4 keys (refer to user manual).

Measured quantities and Accuracy class:

- . Current:
 - phase: I_1, I_2, I_3 (accuracy 0,5)
 - neutral: I_N (accuracy 2)
 - . Voltage (accuracy 0,5):
 - phase/phase: U_{12}, U_{23}, U_{31} ;
 - phase/neutral: V_{1N}, V_{2N}, V_{3N} .
 - . Frequency (accuracy 0,5)
 - . Power:
 - instantaneous active total power, phase, average value and max. average value (accuracy 0,5);
 - instantaneous reactive total power, phase, average value and max. average value (accuracy 1);
 - instantaneous apparent total power, phase, average value and max. average value (accuracy 1);
 - . Power factor a (accuracy 0,5).
 - . Energy:
 - total and partial active energy, positive and negative (accuracy 0,5);
 - total and partial reactive energy, positive and negative (accuracy 1).
 - total apparent energy (accuracy 1).
 - . THD (accuracy 2):
 - voltages THD: V_1, V_2, V_3 o U_{12}, U_{23}, U_{31} ;
 - currents THD: I_1, I_2, I_3, I_N .
 - . Harmonic analysis:
 - Voltages: odd harmonics up to 9th or 25th (in display); odd and even harmonics up to 50th (via communication RS485);
 - Currents: odd harmonics up to 9th or 25th (in display); odd and even harmonics up to 50th (via communication RS485);
 - . Power quality analysis (Class S):
 - Dips, Interruption, Swells, RVC's, SVC's Time stamp, Event duration, Residual voltages, Voltages Unbalance, Pinst (flicker)
- Measurements update period**
- . 1,1 s

5. GENERAL CHARACTERISTICS *(continued)*

Memory's characteristics:

- . Data are saved in a sliding-window not volatile memory (the oldest data are overwritten by the newest) with timestamp of the event.
- . Memory capacity: 8MB divided as follows:
 - 4 MB, dedicated to Real Time data
 - 39 MB, dedicated to Energy data
 - 100 kB, for Power quality analysis data (e.g. Dips, Interruptions, Swells,...)

Programmable parameters - Memory

- . Clock: hours, minutes, seconds
- . Date: day, month, year
- . Daylight Saving Time:
 - starting date and hour
 - ending date and hour
- . Sampling time of "Group 2" data: 5, 10, 15 minutes
- . Sampling time of "Group 1" data: 2, 5, 10, 30, 60 seconds - 2, 5, 10 minutes
- . Type of saved data: type 0 ÷ type 4 (see Table 1)
- . Power supply quality evaluation function
 - function calculated on phase (VF_n) or line-to-line (VFF) voltage
 - setting of the rated voltage value
 - detection threshold of slow voltage variations "SVC"
 - detection threshold of fast voltage variations "RVC"
 - detection threshold and hysteresis of voltage dips
 - detection threshold and hysteresis of voltage interruptions
 - detection threshold and hysteresis of voltage swell
- . Reset to zero of saved data stored in the memory

Table 1 - Saved data

Group 1	Type				
	0	1	2	3	4
Phase voltages: V ₁ , V ₂ , V ₃	✓	✓	--	✓	✗
Chained voltages: V ₁₂ , V ₂₃ , V ₃₁	✓	--	✓	--	✗
Active, Reactive and Apparent phase powers: P ₁ , P ₂ , P ₃ - Q ₁ , Q ₂ , Q ₃ - S ₁ , S ₂ , S ₃	✓	✓	--	--	✗
Voltages and Currents THD: THDV - THDI	✓	--	--	--	✗
Phase and Neutral currents: I ₁ , I ₂ , I ₃ , I _N	✓	✓	✓	✓	✗
Active, Reactive and Apparent three-phase powers: ΣP, ΣQ, ΣS	✓	✓	✓	✓	✗
Three-phase power factor: CPF	✓	✓	✓	✓	✗
Phase power factor: PF ₁ , PF ₂ , PF ₃	✓	✓	--	--	✗
Alarms status	✓	✓	✓	✓	✗
Frequency: f	✓	✓	✓	✓	✗

✓	Data saved automatically
✗	Item stored upon request
--	Item not stored

5. GENERAL CHARACTERISTICS *(continued)*

Table 1 - Saved data *(continued)*

Group 2	Type				
	0	1	2	3	4
Active energy, positive and negative: Ea+, Ea-	✓	✓	✓	✓	✓
Reactive energy, positive and negative: Er+, Er-	✓	✓	✓	✓	✓
Active, Reactive and Apparent three-phase power - average value and max. average value: ΣP, ΣQ, ΣS, ΔP, ΔQ, ΔS	✓	✓	✓	✓	✓

Availability of saved data:

. Data are saved in a sliding-window not volatile memory (the oldest data are overwritten by the newest) with timestamp of the event.

- Group 1 data:

According to the type (tyPE0 ÷ tyPE4) and the sampling time set, data are available for different periods of time before being replaced.

Data availability time is shown in Table 2

- Group 2 data:

Energy measurements are saved every 5, 10 or 15 minutes. Data availability time is shown in Table 3

Table 2 - Availability "Group 1" data

. values expressed in hours

Type	Sampling time (T)							
	2 s	5 s	10 s	30 s	60 s	2 min.	5 min.	10 min
0	18	45	91	273	546	1092	2730	5460
1	27	68	136	409	819	1638	4095	8190
2	50	125	250	750	1501	3003	7507	15015
3	45	113	227	682	1365	2730	6825	13650
4	$T = \lfloor \text{floor}(528/R\text{lenght}) * 8192 * \text{time}_{\text{sec}} \rfloor / 3600 \text{ sec}$ floor = function that returns the integer part of a number time_{sec} = time interval in seconds Rlength = record length in bytes - [Variable part + Fixed part] Example: 3V + 3I + Fixed part = 12+12 + 8 = 32							

Table 3 - Availability "Group 2" data

. values expressed in days

Sampling time	Memory capacity
5 min.	444
10 min.	888
15 min.	1333

Plastic material:

. Self-extinguishing polycarbonate.

Ambient operating temperature:

. Min. = - 5 °C Max. = + 55 °C.

Ambient storage temperature:

. Min. = - 25 °C Max. = + 70 °C.

5. GENERAL CHARACTERISTICS *(continued)*

Device protection:

. Recommended fuse 1 A type gG

Protection Index:

. Protection index of terminals against solid and liquid bodies (wired device): IP 20 (IEC/EN 60529).

. Protection index of the front face against solid and liquid bodies: IP 54 (IEC/EN 60529).

Impulse withstand voltage:

. Supply / Measuring inputs:

wave 1,2 / 50 μ s 0,5 J: 6kV

alternate current 50 Hz / 1 min.: 3 kV

. All circuits / earth:

alternate current 50 Hz / 1 min.: 4 kV

Pollution degree:

. 2

Installation category:

. III

Average weight per device:

. 0, 250 kg.

Volume when packed:

. 1,59 dm³.

Consumption (without add-on modules):

. $\leq 2,5$ VA (a.c. supply)

. $\leq 3,5$ W (d.c. supply)

Thermal power dissipated:

. ≤ 5 W.

Phase sequence correction diagnostic:

. In the software of the device there is a specific functionality to detect and correct problems concerning voltage and / or current connections.

The "Testing connections" functions can be activated with a specific password for connections 3-2E, 3-3E e 3N-3E.

Conditions for the execution of the function:

- multifunction device 4 120 53 must have current and voltage on each phase and the neutral, if present, must be connected to the corresponding terminal "N".

In addition, the test function requires:

- an electrical 120° three-phase system.

- a value of the power factor PF $> 0,5$ for 3N-3E and 3-3E or PF $> 0,71$ for 3-2E.

If the power factor of the system is not included in these ranges, the function cannot be used.

- no crossings between cables connected to secondary of CTs (ex. TA phase 1 \rightarrow terminals S1 and S2 of I1 and so on).

. Procedure's access codes:

3333: Start of diagnostic procedure

4444: Display of the current configuration

5555: Restore the default configuration (factory configuration)

5. GENERAL CHARACTERISTICS *(continued)*

6. COMPLIANCE AND APPROVALS

Compliance to standards:

- . Compliance with Directive on electromagnetic compatibility (EMC) n° 2014/30/EU
- . Compliance with low voltage directive n° 2014/35/EU.
- . Electromagnetic Compatibility:
 - emission according IEC/EN 61326-1, class B
 - immunity according IEC/EN 61326-1.
- . Active energy accuracy class: 0,5 (E_a, IEC/EN 61557-12).
- . Reactive energy accuracy class: 1 (E_{rv}, IEC/EN 61557-12).

Conformity table to IEC 61557-12 Edition 1 (08/2007)

Performance measuring and monitoring devices (PMD) characteristics		
Type of characteristic	Specification values	Other complementary characteristics
Power quality assessment function	-	-
Classification of PMD	SD / SS	-
Temperature	K55	-
Humidity + Altitude	Standard conditions	-
Active power and Active energy function performance class	0,5	-

6. COMPLIANCE AND APPROVALS *(continued)*

Conformity table to IEC 61557-12 Edition 1 (08/2007) *(continued)*

Function symbols	Function performance class according to IEC 61557-12	Measuring range	Other complementary characteristics
P	0,5	0,01 ÷ 1,2 A (x/1 A) 0,05 ÷ 6 A (x/5 A)	
Q _A , Q _V	1	0,02 ÷ 1,2 A (x/1 A) 0,1 ÷ 6 A (x/5 A)	
S _A , S _V	1	0,02 ÷ 1,2 A (x/1 A) 0,1 ÷ 6 A (x/5 A)	
E _a	0,5	0 ÷ 99999999 MWh	
E _{rA} , E _{rV}	1	0 ÷ 99999999 Mvarh	
E _{apA} , E _{apV}	1	0 ÷ 99999999 MVAh	-
f	0,5	45 ÷ 65 Hz	-
I	0,5	0,2 ÷ 1,2 A (x/1 A) 0,5 ÷ 6 A (x/5 A)	0,01 ÷ 1,2 A (x/1 A) 0,05 ÷ 6 A (x/5 A)
I _N , I _{Nc}	2	0,1 ÷ 1,2 A (x/1 A) 0,1 ÷ 6 A (x/5 A)	-
U	0,5	30 ÷ 400 V (Ph/N) 50 ÷ 690 V (Ph/Ph)	-
P _{FA} , P _{FV}	0,5	0,5 ind ÷ 0,8 cap	-
U _h	2	-	-
THD _u	2	-	-
I _h	2	-	-
THD _i	2	-	-
THD-R _i	2	-	-

Compliance IEC 61000-4-30			
Characteristics of "Power quality assessment functions"			
Function symbols	Function performance class according to IEC 61557-12	Measuring range	Other complementary characteristics
P _{inst}	S	-	-
U _{dip}	S	-	-
U _{swf}	S	-	-
U _{tr}	S	-	-
U _{int}	S	-	-
U _{nba}	S	-	-

6. COMPLIANCE AND APPROVALS *(continued)*

Definitions:

1 Dip

Dip is a temporary drop in mains voltage.

Dip begins when the RMS value of one or more supply voltages falls below a set threshold and it ends when the three voltages rise above the set threshold to which the hysteresis has been added.

2 Swell

Swell is a temporary overvoltage of the mains voltage.

Swell starts when the value of one or more supply voltages rises above a set threshold and ends when the three voltages fall below the set threshold minus the hysteresis.

3 Interruption

Interruption is a temporary drop in mains voltage.

Interruption begins when the RMS value of the three network voltages falls below a set threshold and ends when one of the voltages rises above the set threshold to which the hysteresis has been added.

4 RVC

Rapid Voltage Change is a fast variation in the power supply voltage.

It begins when the RMS value of one of the power voltages differs by more than a set value from the average of the last 100/120 (50 / 60Hz) RMS values calculated on the half cycle and ends when the average differs for less than the set value.

5 SVC

Slow Voltage Change is a slow change in voltage.

It is a percentage measurement of the voltage shunt.

$$\text{SVC} = \frac{N_{\text{Tm}} - N_{\text{OT}}}{N_{\text{Tm}}} * 100$$

N_{Tm} = Total number of measurements

N_{OT} = Number of measurements out of range

For each of the events described, the device saves:

- Time stamp : Event start date and time
- Duration of the event in msec (10 msec...60000 msec)
- Residual values per phase (RMS values reached by the network voltages during the event)

The device can save up to 3840 events.

Save mode: circular list where the oldest events are replaced by the most recent ones.

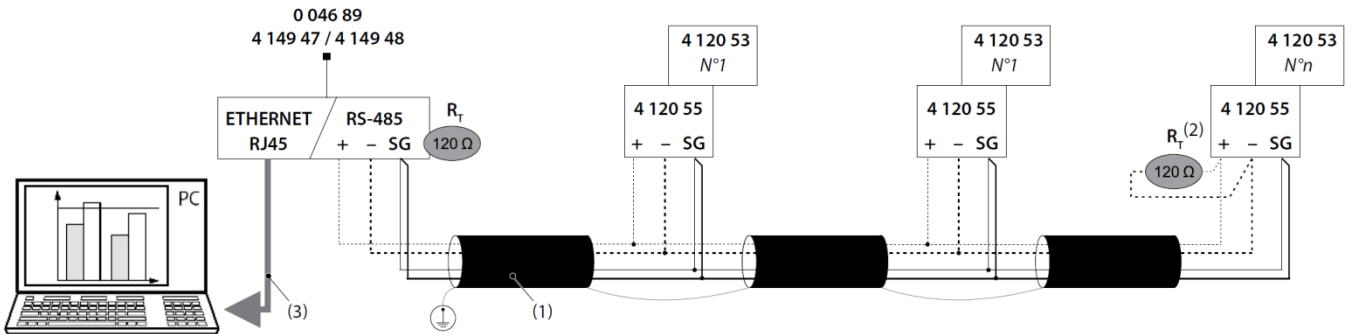
6 Pinst

The Flicker is the periodic variation of the intensity of an incandescent lamp due to a variation in the supply voltage.

Pinst is a measure of the sensation of instant flicker.

7.COMUNICATION

RS485 Wirina diagram (with add-on module 4 120 55):



(1) RS485: Prescribed use of Cable Belden 9842, Belden 3106A (or equivalent) for a maximum length of 1000 m, or Category 6 cable (FTP or UTP) for a maximum length of 50 m;

(2) Resistance not furnished

(3) Ethernet: Cat. 6 (FTP/UTP)

Modbus communication tables

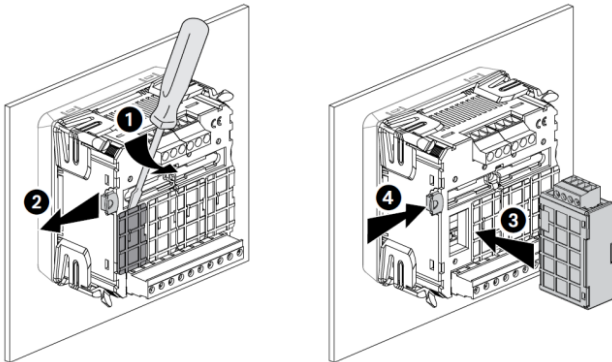
. Modbus communication tables are available at <http://ecatalogue-export.legrand.com>, typing "4 120 53" in the search field.

8.ADD-ON MODULES

Range:

- . 4 120 55: Modbus RS485 communication module
- . 4 120 57: 2 digital inputs / 2 relay outputs module
- . 4 120 58: Temperature measurement module from external Pt100 sensors
- . 4 120 59: 2 pulse outputs module
- . 4 120 60: 2 analogue outputs module, 0/4 ÷ 20 mA

Fixing:



Note: modules must be connected with the device 4 120 53 not supplied.

Screw terminals:

- . Terminal depth: 8 mm.
- . Stripping length: 8 mm

Screw head:

- . Screw slotted.

Recommended tightening torque:

- . 0,6 Nm.

8.ADD-ON MODULES *(continued)*

Tools required:

- . For inputs terminals (terminals "15-16" and "17-18"): flat screwdriver 2,5 mm
- . For outputs terminals (terminals "6-7", "8-9" and "+ - SG"): flat screwdriver 3,5 mm
- . For fixing the modules to the measuring device: flat screwdriver max. 5 mm.

Connectable section:

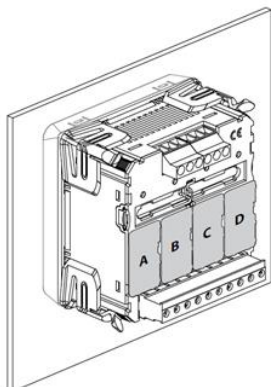
- . Inputs terminals
- . Copper cables.

	Without ferrule	With ferrule
Rigid cable	0,05 to 2,5 mm²	-
Flexible cable	0,05 to 1,5 mm²	0,05 to 1,5 mm²

- . Outputs terminals
- . Copper cables.

	Without ferrule	With ferrule
Rigid cable	0,05 a 4,5 mm²	-
Flexible cable	0,05 a 2,5 mm²	0,05 a 2,5 mm²

Associability table:



	A	B	C	D	
4 120 55	✓	✗	✗	✗	max. 1
4 120 57	✗	✗	✓	✓	max. 2
4 120 58	✗	✗	✗	✓	max. 1
4 120 59	✓	✓	✓	✓	max. 2
4 120 60	✗	✗	✓	✓	max. 2