# Energy Management Power Analyzer Type APM14D

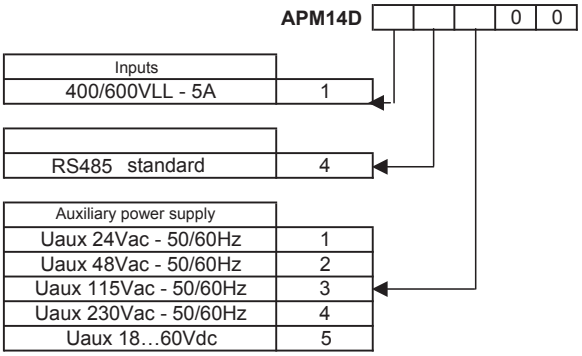

- Optional dual pulse output
- Alarms (visual only) $V_{LN}$, An
- Optional galvanically insulated measuring inputs

- Class 1 (active energy)
- C lass 2 (reactive energy)
- Accuracy ±0.5 F.S. (current/voltage)
- Power analyzer
- Display of instantaneous variables: 3x3 digit
- Display of energies: 8+1 digit
- System variables and phase measurements: W, $W_{dmd}$, var, VA, $VA_{dmd}$, PF, V, A, An, $A_{dmd}$, Hz
- $A_{max}$, $A_{dmd\ max}$, $W_{dmd\ max}$ indication
- Energy measurements: kWh and kvarh
- Hour counter (5+2 DGT)
- TRMS meas. of distorted sine waves (voltages/currents)
- Power supply: 24V, 48V, 115V, 230V, 50-60Hz; 18 to 60VDC
- Protection degree (front): IP40
- Front dimensions: 107.8x90mm
- Optional RS422/485 serial port

## Product Description

3-phase power analyzer with built-in programming key-pad. Particularly recommended for displaying the main electrical variables. Housing for DIN-rail mounting, (front) protection degree IP40, and optional RS485 serial port or dual pulse output. Parameters programmable by means of CptBSoft.

## Type Selection




## Input specifications

| | |
|---|---|
| Rated inputs | |
| Current "X-S options" | 3 (non insulated each other) |
| Current "SG-PG options" | 3 (insulated each other) |
| Voltage | 4 |
| Accuracy (display, RS485) (@25°C ±5°C, R.H. ≤60%) | with CT=1 and VT=1 A V5: 1150W-VA-var, FS:230VLN, 400VLL; AV6: 285W-VA-var, FS:57VLN, 100VLL |
| Current | 0.25 to 6A: ±(0.5% FS +1DGT) 0.03A to 0.25A: ±(0.5%FS+7DGT) |
| Neutral current | 0.25 to 6A: ±(1.5% FS +1DGT) 0.09A to 0.25A: ±(0.5% FS+7DGT) |
| Phase-phase voltage | ±(1.5% FS +1 DGT) |
| Phase-neutral voltage | ±(0.5% FS + 1 DGT) |
| Active and Apparent power, | 0.25 to 6A: ±(1% FS +1DGT); 0.03A to 0.25A: ±(1% FS+5DGT) |
| Reactive power | 0.25 to 6A: ±(2% FS +1DGT); 0.03A to 0.25A: ±(2% FS+5DGT) |
| Active energy "X-S option" | Class 2 (start up "I": 30mA) |
| Reactive energy "X-S option" | Class 3 (start up "I": 30mA) |
| Active energy "SG-PG opt." | Class 1 (start up "I": 30mA) |
| Reactive energy "SG-PG opt." | Class 2 (start up "I": 30mA) |
| Frequency | ±0.1Hz (48 to 62Hz) |
| Additional errors | |
| Humidity | ≤0.3% FS, 60% to 90% RH |
| Temperature drift | ≤ 200ppm/°C |
| Sampling rate | 1400 samples/s @ 50Hz 1700 samples/s @ 60Hz |
| Display refresh time | 700ms |
| Display | |
| Type | LED, 9mm |
| Read-out for instant. var. | 3x3 DGT |
| Read-out for energies | 3+3+3 DGT (Max indication: 999 999 99.9) |
| Read-out for hour counter | 1+3+3 DGT (Max. indication: 9 999 9.99) |

## Input specifications (cont.)

| | |
|---|---|
| Measurements | Current, voltage, power, power factor, frequency, energy, TRMS measurement of distorted waves. |
| Coupling type | Direct |
| Crest factor | < 3, max 10A peak |
| Input impedance | (X-S options) |
| 380/660V $_{L-L}$ (AV5) | 1 M Ω ±5% |
| 120/208V $_{L-L}$ (AV6) | 453 K Ω ±5% |
| Current | ≤ 0.02 Ω |

| | |
|---|---|
| Input impedance | (PG-SG options) |
| 380/660V $_{L-L}$ (AV5) | 1 M Ω ±1% |
| 120/208V $_{L-L}$ (AV6) | 1 M Ω ±1% |
| Current | ≤ 0.02 Ω |
| Frequency | 48 to 62 Hz |
| Overload protection | |
| Continuos voltage/current | 1.2 F.S. |
| For 500ms: voltge/current | 2 Un/36A |

## RS485 Serial Port Specifications

| | |
|---|---|
| RS422/RS485 (on request) | |
| Type | Multidrop bidirectional (static and dynamic variables) |
| Connections | 2 or 4 wires, max. distance 1200m, termination directly on the instrument |
| Addresses | 1 to 255, key-pad selectable |
| Protocol | MODBUS/JBUS |

| | |
|---|---|
| Data (bidir ectional) | |
| Dynamic (reading only) | System, phase variables and energies |
| Static (writing only | All configuration parameters |
| Data format | 1 bit di start , 8 data bit, no parity, 1 stop bit |
| Baud-rate | 9600 bit/s |

## CptBSoft softwar e: parameter programming and reading data

| | |
|---|---|
| CptBSoft | Multi language software to program the working parameters of the power analyzer and to r ead the energies and the instantaneous variables. The program runs under Windows 95/98/98SE/2000/ NT/XP. |

| | |
|---|---|
| Working mode | Two different working modes can be selected:<br>- management of a local RS485 network;<br>- management of communication from a single instrument to PC (RS232); |
| Data access | By means of RS485 serial port. |

## Dual pulse output

| | |
|---|---|
| Digital outputs (on request) | |
| Pulse outputs | |
| Number of outputs | 2 (one for kWh one for kvarh) |
| Number of pulses | From 0.01 to 999 in compliance with the following formula: [Psys max (kW or kvar) *pulses (pulses/kWh or kvarh)] <14400 |
| Output type | Relay<br>min current: 0.05A@250VAC/30VDC<br>max current: 5A@250VAC/30VDC |

| | |
|---|---|
| | Electrical life: min 2*10 $^{5}$ cycles<br>Mechanical life: 5*10 $^{6}$ cycles |
| Pulse duration | ≥100ms <120ms (ON)<br>≥100ms (OFF) |
| | Accor ding to EN622053-31 |
| Insulation | By means of relays,<br>4000 V $_{RMS}$ outputs to measuring inputs,<br>4000 V $_{RMS}$ output to supply input.<br>Insulation between the two outputs: 1000V $_{RMS}$ |

## Software functions

| | |
|---|---|
| Password | Numeric code of max. 3 digits; 2 protection levels of the programming data |
| 1st level | Password "0", no protection |
| 2nd level | Password from 1 to 999, all data are protected |
| System selection | 3-phase with/without n, unbal.<br>3-phase balanced<br>3-phase ARON, unbalanced<br>2-phase<br>Single phase |
| Transformer ratio | |
| CT | 1 to 999 |
| VT | 1.0 to 99.9 |
| Filter | |
| Operating range | 0 to 100% of the input display scale |
| Filtering coefficient | 1 to 16 |
| Filter action | Measurements, alarms, serial out. (fundamental var: V , A, W and their derived ones). |
| Displaying | Up to 3 variables per page |
| 3-phase system with neutral | Page 1: V L1, V L2, V L3<br>Page 2: V L12, V L23, V L31<br>Page 3: A L1, A L2, A L3<br>Page 4: A L1 dmd, A L2 dmd, A L3 dmd<br>Page 5: An, An Alarm<br>Page 6: W L1, W L2, W L3<br>Page 7: PF L1, PF L2, PF L3<br>Page 8: var L1, var L2, var L3<br>Page 9: VA L1, VA L2, VA L3<br>Page 10: VA Σ, W Σ, var Σ<br>Page 11: VA dmd, W dmd, Hz<br>Page 12: W dmd max (*)<br>Page 13: Wh (*)<br>Page 14: varh (*)<br>Page 15: VL-L Σ, PF Σ, VLN Alarm<br>Page 16: A max (*)<br>Page 17: A dmd max (*)<br>Page 18: hour counter (*)<br>(*) = These variables are stored in EEPROM when the instrument is switched off |
| Alarms | Programmable, for the VL Σ and An (neutral current).<br>Note: the alarm is only visual, by means of LED on the fr ont of the instrument. |
| Reset | Independent<br>alarm (VL Σ, An)<br>max: A dmd, W dmd<br>all ener gies (Wh, varh) and hour counter |

## Power Supply Specifications

| | |
|---|---|
| Auxiliary power supply | 230VAC<br>-15 +10%, 50-60Hz<br>115VAC<br>-15 +10%, 50-60Hz<br>48VAC<br>-15 +10%, 50-60Hz<br>24VAC<br>-15 +10%, 50-60Hz<br>18 to 60VDC |
| Power consumption | AC: 4.5 VA<br>DC: 4W |

## General Specifications

| | |
|---|---|
| Operating temperature | 0° to +50°C (32 to 122°F)<br>(RH < 90% non condensing) |
| Storage temperature | -30 to +60°C (-22 to 140°F)<br>(RH < 90% non condensing) |
| Installation category | Cat. III (IEC 60664, EN60664) |
| Insulation (for 1 minute) | 4000 VAC, 500VDC between mesuring inputs and power supply.<br>500VAC/DC between mesuring inputs and RS485.<br>4000VAC, 500VDC between power supply and RS485 |
| Dielectric strength | 4000 VAC (for 1 min) |
| EMC | |
| Emissions | EN50084-1 (class A)<br>residential environment, commerce and light industry |

## General Specifications (cont.)

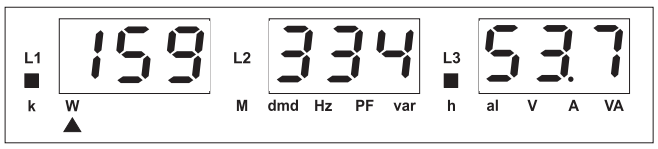
| | | | |
|---|---|---|---|
| EMC (cont.)<br>Immunity | EN61000-6-2 (class A)<br>industrial environment. | Housing<br>Dimensions (WxHxD)<br>Material | <br>107.8 x 90 x 64.5 mm<br>ABS<br>self-extinguishing: UL 94 V-0 |
| Pulse voltage (1.2/50µs) | EN61000-4-5 | Mounting | DIN-rail |
| Safety standards | IEC60664, EN60664 | Protection degree | Front: IP40 (standard)<br>Connections: IP20 |
| Approvals | CE, (cURus, CSA only "X" and "S" options) | Weight | Approx. 400 g (pack. incl.) |
| Connections 5(6) A<br>Max cable cross sect. area | Screw-type<br>2.5 mm $^2$ | | |

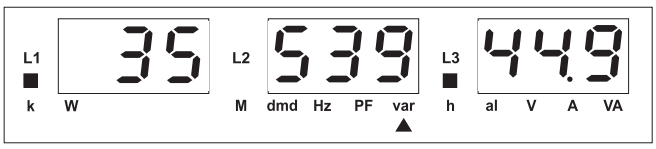
## Display pages

Display variables in 3-phase systems (in a 3-phase system with neutral)

| No | 1 st variable | 2 nd variable | 3 rd variable | Note |
|---|---|---|---|---|
| 1 | V L1 | V L2 | V L3 | |
| 2 | V L12 | V L23 | V L31 | Decimal point blinking on the right of the display |
| 3 | A L1 | A L2 | A L3 | |
| 4 | A L1 dmd | A L2 dmd | A L3 dmd | dmd = demand (integration time selectable from 1 to 30 minutes) |
| 5 | An | AL.n | | AL.n if neutral current alarm is active |
| 6 | W L1 | W L2 | W L3 | Decimal point blinking on the right of the display if generated power |
| 7 | PF L1 | PF L2 | PF L3 | |
| 8 | var L1 | var L2 | var L3 | Decimal point blinking on the right of the display if generated power |
| 9 | VA L1 | VA L2 | VA L3 | |
| 10 | VA system | W system | var system | |
| 11 | VA dmd (system) | W dmd (system) | Hz (system) | dmd = demand (integration time selectable from 1 to 30 minutes) |
| 12 | | W dmd MAX | | Maximum sys power demand |
| 13 | Wh (MSD) | Wh | Wh (LSD) | The total indication is given in max 3 groups of 3 digits. |
| 14 | varh (MSD) | varh | varh (LSD) | The total indication is given in max 3 groups of 3 digits. |
| 15 | V LL system | AL.U | PF system | AL.U= is activated only if one of VLN is not within the set limits. |
| 16 | A MAX | | | max. current among the three phases |
| 17 | A dmd max | | | max. dmd current among the three phases |
| 18 | h | | | hour counter |

MSD: most significant digit
LSD: least significant digit




1) Example of kWh visualization:
This example is showing 15 933 453.7 kWh

2) Example of kvarh visualization:
This example is showing 3 553 944.9 kvarh

Waveform of the signals that can be measured

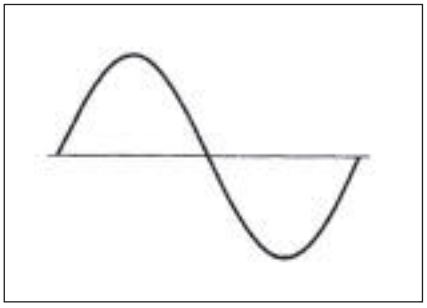


Figure A
Sine wave, undistorted
Fundamental content 100%
Harmonic content 0%
$A_{rms}$ = 1.1107 | A |

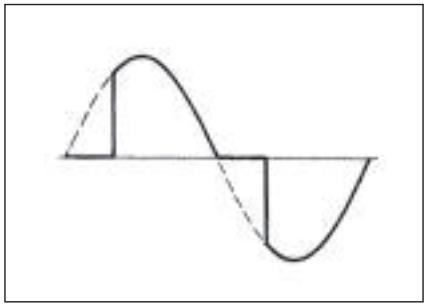


Figure B
Sine wave, indented
Fundamental content 10...100%
Harmonic content 0...90%
Frequency spectrum: 3rd to 16th harmonic
Additional err or: <1% FS

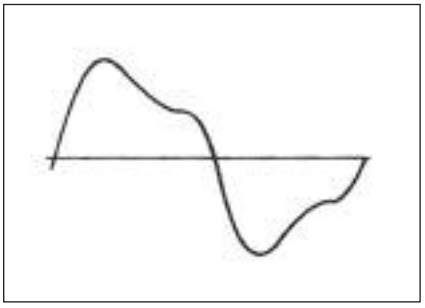
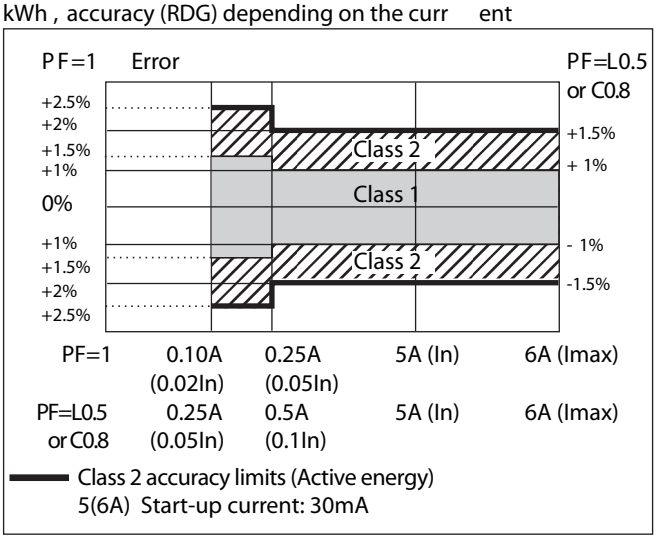


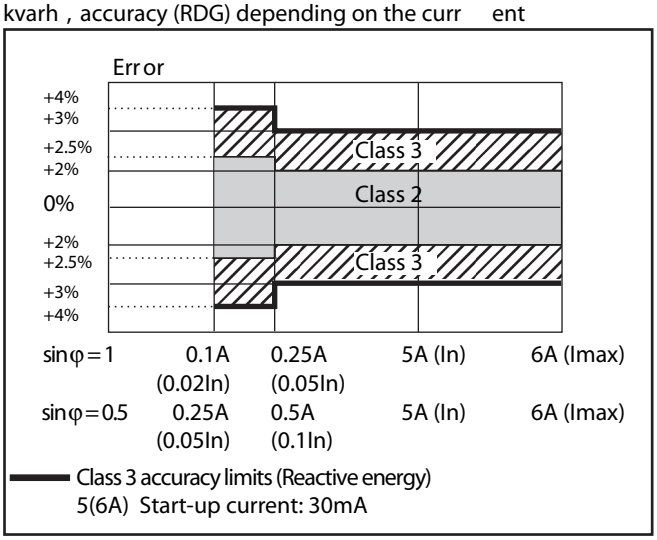
Figure C
Sine wave, distorted
Fundamental content 70...90%
Harmonic content 10...30%
Frequency spectrum: 3rd to 16th harmonic
Additional err or: <0.5% FS

## Accuracy

kWh , accuracy (RDG) depending on the curr ent




kvarh , accuracy (RDG) depending on the curr ent




: this graph is only referred to instrument models with the “SG or PG” option.

: this graph is only r eferred to instrument models with the “X or S” option.

## Used calculation formulas

Phase variables

Instantaneous effective voltage

$$V_{1N} = \sqrt{\frac{1}{n} \cdot \sum_{1}^{n} (V_{1N})_i^2}$$

Instantaneous active power

$$W_1 = \frac{1}{n} \cdot \sum_{1}^{n} (V_{1N})_i \cdot (A_1)_i$$

Instantaneous power factor

$$\cos\phi_1 = \frac{W_1}{VA_1}$$

Instantaneous effective current

$$A_1 = \sqrt{\frac{1}{n} \cdot \sum_{1}^{n} (A_1)_i^2}$$

Instantaneous apparent power

$$VA_1 = V_{1N} \cdot A_1$$

Instantaneous r eactive power

$$VAr_1 = \sqrt{(VA_1)^2 - (W_1)^2}$$

System variables

Equivalent 3-phase voltage

$$V_{\Sigma} = \frac{V_1 + V_2 + V_3}{3} * \sqrt{3}$$

3-phase reactive power

$$VAr_{\Sigma} = (VAr_1 + VAr_2 + VAr_3)$$

3-phase active power

$$W_{\Sigma} = W_1 + W_2 + W_3$$

3-phase apparent power

$$VA_{\Sigma} = \sqrt{W_{\Sigma}^2 + VAr_{\Sigma}^2}$$

3-phase power factor

$$\cos\phi_{\Sigma} = \frac{W_{\Sigma}}{VA_{\Sigma}}$$

Neutral current

$$An = \overline{A}_{L1} + \overline{A}_{L2} + \overline{A}_{L3}$$

## Used calculation formulas (cont.)

$$kWh_i = \int_{t_1}^{t_2} P_i(t)\,dt \cong \Delta t \sum_{n_1}^{n_2} P_{n,i}$$

$$kVarh_i = \int_{t_1}^{t_2} Q_i(t)\,dt \cong \Delta t \sum_{n_1}^{n_2} Q_{n,i}$$

Energy metering

Where:

i = considered phase (L1, L2 or L3)

P = active power

Q = reactive power

$t_1$, $t_2$ = starting and ending time points of consumption recording

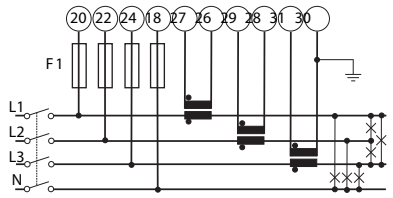
n = time unit

Δt = time interval between two successive power consumptions

$n_1$, $n_2$ = starting and ending discrete time points of consumption recording

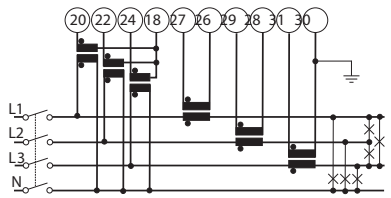
## Wiring diagrams

Fig. 1



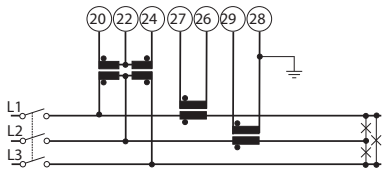

CT connection

Fig. 2



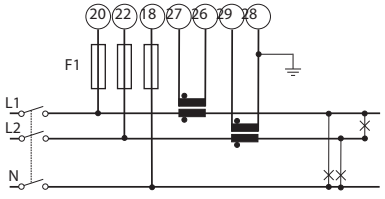

3CT and 3VT connection

Fig. 3



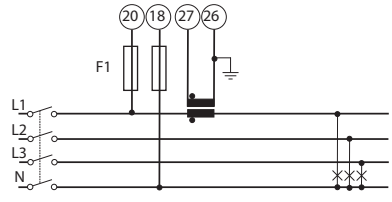

ARON and VT connection

Fig. 4



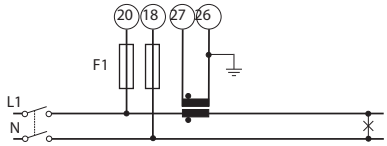

2-phase connection

Fig. 5




3-phase load balanced connection

Fig. 6




1-phase connection

F1= 315mA

NOTE: Only for "PG" and "SG" options: the current measuring inputs are galvanically insulated and therefore they can be connected to ground singly.

NOTE: For all models except for "PG" or "SG" the current inputs can be connected to the lines ONLY by means of current transformers. The direct connection is not allowed.

ATTENTION: only one ammeter input can be connected to earth, as shown in the electrical diagrams.

## RS485 port connections

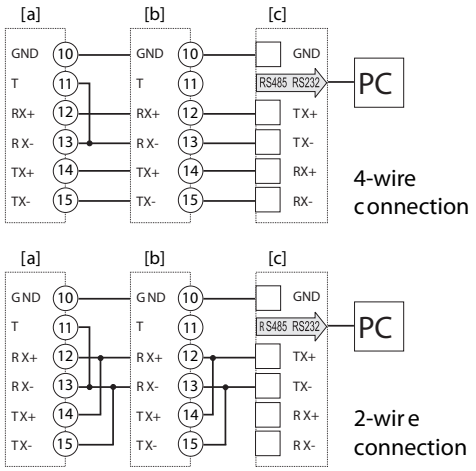
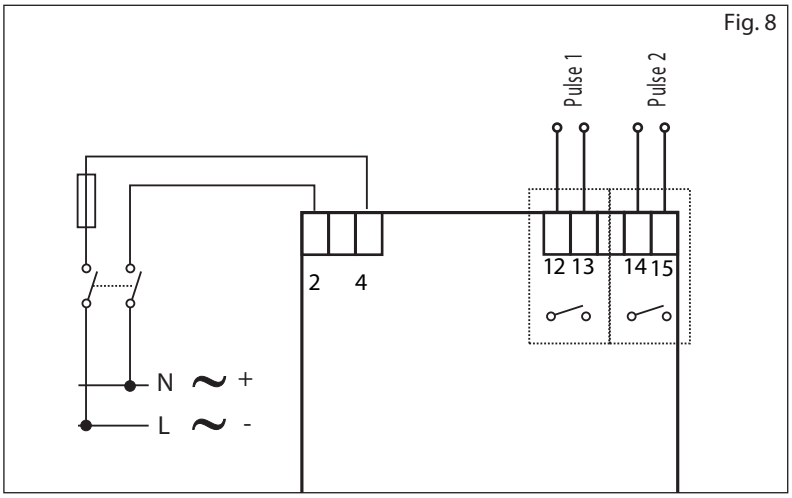
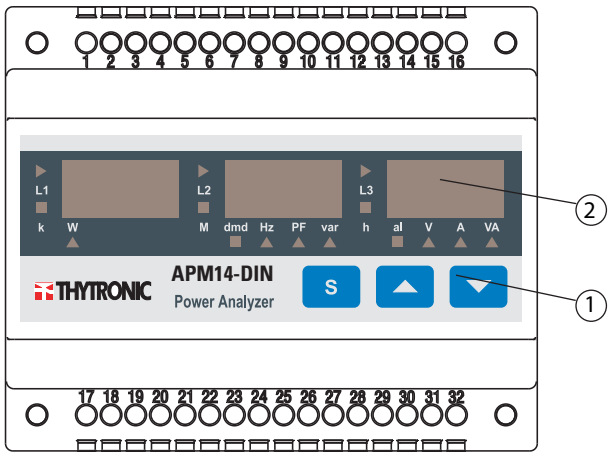



Fig. 7: a-Last instrument; b-1...n Instrument c-RS485/232 serial converter

## Dual pulse output connections




## Front Panel Description




1. Key-pad
   To program the configuration parameters and the display of the variables.

   S

   Key to enter pr ogramming and confirm selections;

   ▲ ▼

   Keys to:
   - programme values;
   - select functions;
   - display measuring pages.

2. Display
   LED-type with alphanumeric indications to:
   - display configuration parameters;
   - display all the measured variables.

## Dimensions and Panel Cut-out