04 Analogue Measuring Instruments

ANALOGUE MEASURING INSTRUMENTS

Analogue instruments register a value to be measured and show it on an analogue display, usually by a pointer on a scale. So the value is displayed in a stepless and continuous way. In opposition to digital displays, instabilities and tendencies of a value can be recognized faster and more intuitively on an analogue display. On the other hand at analogue displays exact numerical values are more difficult to read compared to a digital instrument (reading error).

Analogue instruments are on hand for a broad band of electrical values. They are available in the standardized dimensions 48x48mm, 72x72mm, 96x96mm and 144x144mm. Other executions on request.

Technical Features

Unless another indication in the instrument, the following specification apply:

Accuracy (according to IEC 60051 and UNE-EN 60051)

Class: as marked on the scale

The accuracy class of an analogue measuring instrument indicates the maximun error expresed in percentage of the full-scale value for any measurement made under the so-called reference conditions. Thus, a 500V voltmeter of class index 1.5 guarantees tha its maximun error will be 7,5 V.

Electrical:

Overload (according IEC 60051 and UNE-EN 60051)

- Continuous overload: 1,2 times rated value
- Voltmeters and frequency meters: 2 times Un, 5 seconds (EQ: máx 100 V)
- Ammeters:
  10 times In, 1 second for BIQ and BOQ
  10 times In, 5 seconds
  (máx. 200 A for EQ48n, 250 A for other EQ)
  Maximum voltage related to earth (according to IEC and UNE-EN61010-1)
- EQ72n, EQ96n, EQ144n, PQ72n, PQ96n, PQ144n:
  600V, measurment category II
- Other instruments: 600V, category II / 300V, category III

Power consumption:

- EQ..n: EQ Ammeter < 15 VA ; < 0.5 VA / > 15 A ; 0.8VA
  EQ Voltmeter < 4.5 VA
- PQ..n: Voltmeters: Current 1 mA for ranges up to 1000 V
  Ammeters: Voltage drop 60 mV for ranges up to 100 A
- PR..n: Voltmeters < 1 VA
- FA..n: < 7 VA
- BIQ..n: < 2.5 VA
- BOQ..n: < 3.4 VA
- PAQ..n: Voltmeters: Current 1 mA for ranges up to 1000 V
  Ammeters: Voltage 60 mV for ranges up to 100 A
- FAG..n: < 7 VA

Constructive:

Housings according to DIN IEC 61554, in V0 self-extinguishing thermoplastic material according to UL 94.

Grado de protección parte frontal (según IEC y EN 60529)

- BIQ..n y BOQ..n: IP40
- Other instruments: IP52 - Standard execution
  IP54 -Tropical version

Environmental

This instrument is suitable for indoor installations with the following characteristics.

Operation temperature:	-10 ... 55 ° C
Storage temperature:	-25 ... 65 ° C
Reference temperature:	23 ° C
Maximum relative humidity:	80% up to 31°C, decreasing linearly up to 50% at 40°C, and to 25% at 55°C
Altitude:	up to 2000m
Pollution degree:	II (according IEC 61010-1 and UNE-EN 61010-1)
Vibration resistance:	1,5 g a 50 Hz (10-150-10 Hz / 0,15 mm)
Shock resistance:	15 g 11 ms

Housing

Unless otherwise indicated, the housings are flush mounting into panels according to DIN 43718 standard, sizes 48x48, 72x72, 96x96 y 144x144.
Made of self-extinguishing plastic material V0 according to UL-94.
The window is made of glass. As special executions it can be anti-reflexive glass or unbreakable polycarbonate.

Degree of protection

IP 52 for EQ/PQ/FA housing front
IP 40 for BIQ/BOQ housing front
IP 00 for clamps without electric shock protection
IP 10 for clamps with fixing electric shock protection
(except for 48 and EQ/PQ aminstruments higher than 6A)
IP 20 for clamps with electric shock protection

Bezel according to DIN 43718

Narrow bezel , black colour, similar to RAL 9005.

Fixing

Instruments 48n:	2x grip screw
Instruments 72n and 96n:	2x snap closure (plastic clamp)
Instruments 144n:	4x grip screw

Insulation

The nominal circuit voltage (circuit insulation voltage) of measuring instruments is 650 V, withstanding a test voltage of 2 kV , at 50Hz during 1 minute.

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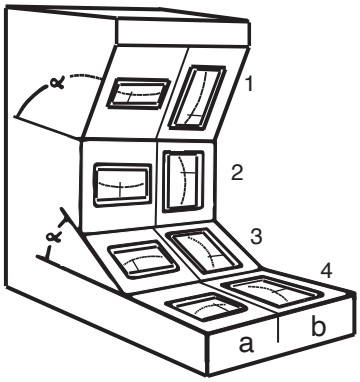
Position

The standard mounting position is standard. The instruments are calibrated - if not indicated differently - for vertical purpose (pos.2). If other mountin positios are required (horizontal or inclined), please indicate the angle of inclination (see figure).



1	∝ > 90°
2	⊥ = 90°
3	∝ < 90°
4	⌐ = 0°

Scales and Pointers

The scales are made with coarse-fine graduation, according to DIN 43802, in black on white ground. In the drawing, scales are shown for the standard measuring ranges, depending on the scale length. Other divisions, coloured strokes or stripes, additional lettering, double scales, scales with double numbering or executions of the scales and mark in white or yellow on black ground can be made as well as special executions.

The pointers have the same colour as the scale (black), except for maximum demand indicators. For making a determined value on the scale by the user, we provide instruments with a front adjustable red marking pointer.

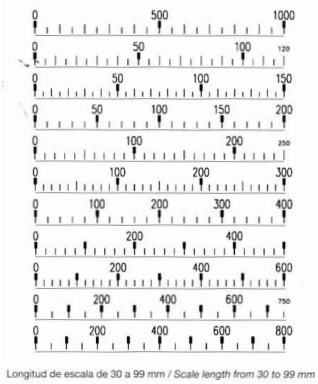
Scales

The final scale values are determined according to the following norm line: 1-1,2-1,5-2-2,5-3-4-5-6-7,5-8 and multiples of 10.

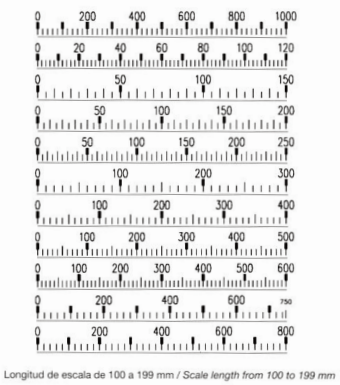
In case of instruments for current transformer connection this norm line is additionally supplemented with the standard values 1,25-1,6-1,8 and multiples of 10.

Special adjustment according to norm line in any measuring size, as for example „%“, „m/s“, „Upm“, „bar“ etc.

Special adjustment beyond the norm line, measuring size in any order.



Longitud de escala de 30 a 99 mm / *Scale length from 30 to 99 mm*



Longitud de escala de 100 a 199 mm / *Scale length from 100 to 199 mm*

Interchangeable scales

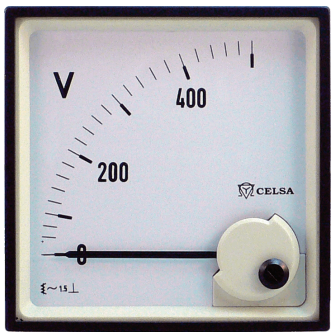
The product line has interchangeable scales. Such scales allows an easy exchange and fix. If you need to change the dial of the instrument, open the lid and replace the dial the close the lid. This procedure must be carried out with the instrument disconnected.

Instructions

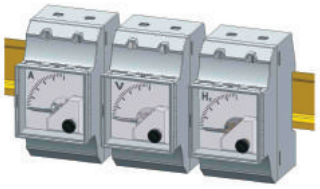
DIN 43700	Instruments for table installation, nominal and cut-out dimensions and sample size
DIN 43701	Electrical control panel measuring instruments
DIN 43718	Front frame and front plates
DIN 43780	Performance specifications for direct acting indicating instruments and their accessories
DIN 43802	Scales and pointers for electrical measuring instruments
DIN 16257	Nominal positons and position signs for measuring instruments
DIN 57410/VDE 0410	Safety requirements for indicating and writing measuring instruments and their accessories
VDE 0411	Protective measures for electronic measuring instruments
VDE 0110	Determinations for the measurements of the air and leakage path of electrical resources
DIN 40050	Degrees of protection; foreign material and waterproofing for electrical resources
VDE/VDI 3540 sheet 2	Reliability of measuring - control- and regulation instruments climatic classes for instruments and accessories).
DIN 43807	Connections and clamps
DIN 46200/46282	Connecting bolts
UL 94 V-0	According to the UL Burning property class
2006/95/EG	Rule of low tension
2004/108/EG	Rule of EMV

CE certified

EQ - Moving iron instruments



- For AC current frequency range 15 - 400 Hz
- For AC voltages frequecny range 15 - 100 Hz
- Class 1.5



Description

The moving-iron panel meters are mainly used for the measurement of AC currents for frequency range of 15...400Hz and voltages in the frequency range of 15...100Hz. They indicate the rms value of the wave, even with high harmonics, with a minor ininfluence on the accuracy. Our instruments are normally calibrated for sinusoidal AC.

For current above 100A or high voltages, the instruments must be connected through measuring transformers.

Movin iron instruments can be connected in any order without observation of polarity (ki) on the current transformer.

Electical Data

Overload capacity according to DIN 43780

Continuously	1,2 times rated value
Short duration	10 x IN 5 s in ammeters
	2 x UN 5 s in voltmeters

The setting time is approximately 1 minute.

Consumption

Ammeters up to 15 A	0,5 VA
Ammeters more than 15 A	0,8 VA
Voltmeter between	1 – 4,5 VA

Moving iron instruments

Moving-iron movement with silicone oil damping. Pivot suspension with spring loaded jewel bearings for vibration and shock resistance.

Scales

90° scale, cmpressed at the beginning. Coarse-fine division. For ammeters with overload scaling, it covers between 10% (for 1,2In) y el 35% (for 5In) of the total scale lenght.

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Mounting in DIN rail (EQ35n)

For measuring current and voltage in panel boards with 35 mm DIN rail according DIN 50 022.

Dimensions: 85 x 45 x 65 mm / Weight: 0.1 Kg

The instruments of this line are adapted by their dimensions to common installations devices. The installation width of the instruments of 45 mm corresponds approx. for 3 units. They can easily mounted on DIN rail bars by snap on mounting.

The terminals are protected against accidental contact.

The movin iron meter is jewelled with silicon oil damping.

Comsumption

Amperímetro	max. 0,5 VA
Voltímetro	max. 2,5 VA

Consumption of EQ35p

Ammeter between	max. 0,5 VA
Ammeter 5 A	max. 0,5 VA
Voltmeter between	max. 2,5 VA
Voltmeter 100 V	max. 2,5 VA
Voltmeter 110 V	max. 2,5 VA

Table for norm scales of voltmeters for connection to voltage transformer

* Voltmeter for connection to voltage transformer:	sec. 100 V or 110 V	
	Prim.Rated Voltage	**Scale**
	500 V	0... 600 V
	600 V	0... 720 V
	1 KV	0... 1,2 KV
The final scale value is 1.2 times the rated voltage, for example:	3 KV	0... 3,6 KV
	5 KV	0... 6 KV
	6 KV	0... 7,2 KV
for connection to transformer sec. 100 V the measuring range is 0...120 V	10 KV	0... 12 KV
	10 KV	0... 18 KV
	15 KV	0... 18 KV
for connection to transformer sec. 110 V the measuring range is 0...132 V	20 KV	0... 24 KV
	25 KV	0... 30 KV
	30 KV	0... 36 KV
Please indicate primary voltage, scale and secondary voltage when ordering..	33 KV	0... 40 KV
	60 KV	0... 72 KV
	100 K	0... 120 KV

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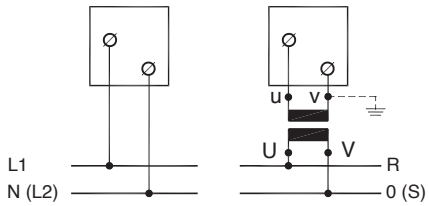
Standard measuring ranges

AC Voltages	AC Current
6 V (except EQ35n)	100 mA
10 V (except EQ35n)	150 mA
15 V (except EQ35n)	250 mA
25 V (except EQ35n)	400 mA
40 V (except EQ35n)	600 mA
60 V (except EQ35n)	1 A
100 V	1.5 A
120 V	2.5 A
132 V (except EQ35n)	4 A
150 V	5 A
250 V	6 A
300 V	10 A
400 V (except EQ35n)	15 A
500 V	20 A (except EQ35n)
600 V (except EQ35n)	25 A (except EQ35n)
750 V (except EQ48n/EQ35n)	30 A (except EQ35n)
	40 A (except EQ35n)
	50 A (except EQ35n)
	60 A (except EQ35n)
	100 A (except EQ48n/EQ35n)
For connection to voltage transformer .../100 V secondary .../110 V secondary	For connection to current transformer .../1 A secondary .../5 A secondary

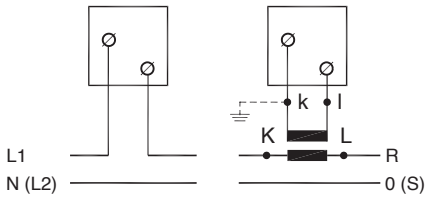
Other measuring ranges on request.

Connection diagrams

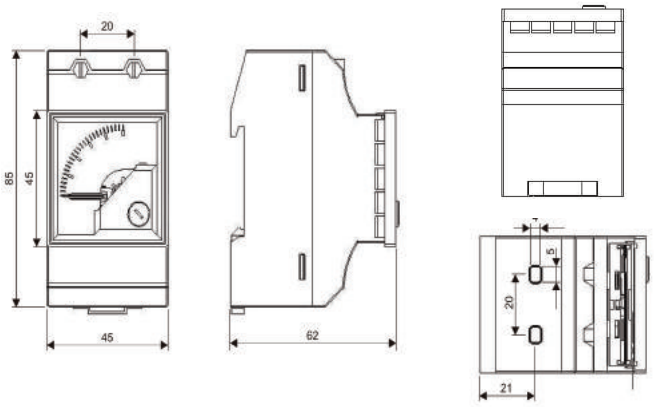
Voltmeter:



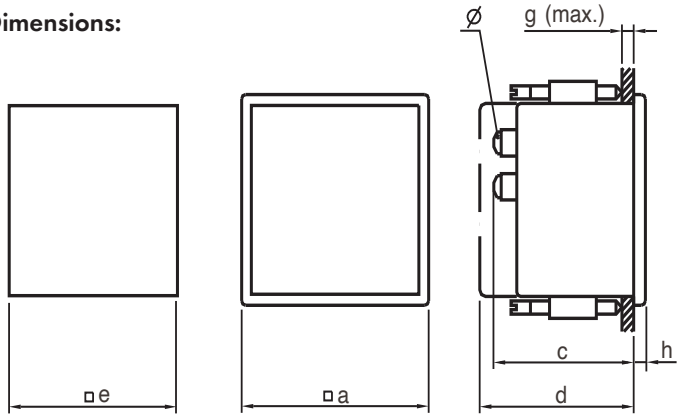
Ammeter:



Dimensions EQ35n:



Dimensions:



Dimensions in mm / Weight in gramme

Type		a	c	d	e	g	h	Ø	Weight
EQ 48n	> 30 A	48	64	72	45 $^{+0,6}$	28	5	M6	155
	others	48	54	62,5	45 $^{+0,6}$	28	5	M4	145
EQ 72n	> 60 A	72	68	76	65 $^{+0,7}$	8*	5	M8	230
	30< I < 60 A	72	64	76	65 $^{+0,7}$	8*	5	M6	210
	others	72	60	76	65 $^{+0,7}$	8*	5	M4	190
EQ 96n	> 60 A	96	68	76	92 $^{+0,8}$	8*	5	M6	300
	25 < I < 60 A	96	64	76	92 $^{+0,8}$	8*	5	M8	280
	others	96	60	76	92 $^{+0,8}$	8*	5	M4	250
EQ 144n	> 60 A	144	67	75	138 $^{+1}$	41	8	M6	450
	30< I < 60 A	144	62	69,5	138 $^{+1}$	41	8	M8	430
	others	144	54	62	138 $^{+1}$	41	8	M4	400

*26 mm with screw clamps

Fixing clamps included without extra charge

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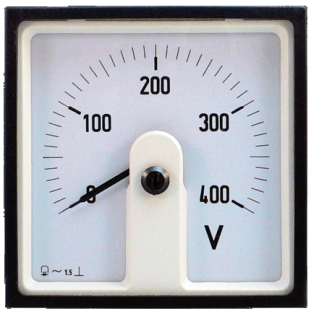
PR / PAR - Moving coil instruments with rectifier



- For direct measurement of the alternating current and voltage

or

- For connection at the current and voltage transformer
- Class 1.5

PR with 90° scale

PAR with 240° round scale

Description

The moving-coil rectifier panel meter are suitable for measuring sinusoidal AC currents and voltages. The frequency range for voltmeters an milliammeters up to 600 mA is 25 to 10.000 Hz.

For current higher than 1A - 5A, the frequency can not exceed 50 or 60 Hz. (On request: 400 Hz).

It is possible to measure higher currents and voltages connecting the instruments through suitable measuring transformers.

Internal resistance, consumption approx.				
Measuring range	**PAR 48n**	**PAR 72n**	**PAR 96n**	**PAR 144n**
6 - 60 V	1 mA			
100 - 600 V	1.12 mA			
200 - 600 µA	0.01 - 1.64 m VA			
1 -250 mA	1.6 mVA - 0.76 VA			
400 mA - 5 A	0.38 VA			

Electrical data

Overload capacity according to DIN 43780

Continuously	1,2 times rated value
Short duration	10 x IN 5 s ammeters
	2 x UN 5 s voltmeters

The setting time is approximately 1 minute.

Consumption

Voltmeterr:	aprox.. 1 mA
Ammeter:	up to 800 mA:
	1 up to 1.5 V voltage drop
	from 800 mA: aprox. 0.25 VA

Moving coil instruments with rectifier

SSelf-shielding moving-coil rectifier system, with core magnet movement and hairsprings for the creation of the restoring torque. Pivot suspension with spring loaded jewel bearings for vibration and shock resistance.

Scales

90° scale (PR..)/ 240° scale (PAR...n), practically linear. Slightly compressed at the beginning for voltmeters under 40V. The graduations at the beginning of the scale are electrically suppressed in rated value voltmeters. o-fino.

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Standard Measuring Ranges

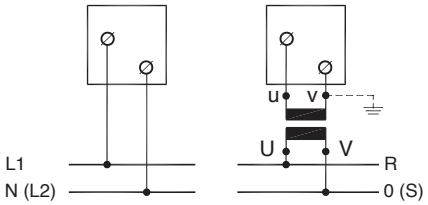
AC Voltage	AC Current PR..n	PAR..n
	1 mA	1 mA
6 V	1,5 mA	1,5 mA
10 V	2,5 mA	2,5 mA
15 V	4 mA	4 mA
25 V	6 mA	6 mA
40 V	10 mA	10 mA
60 V	15 mA	15 mA
132 V	25 mA	25 mA
150 V	40 mA	40 mA
250 V	60 mA	60 mA
300 V	100 mA	100 mA
400 V	150 mA	150 mA
500 V	250 mA	250 mA
600 V	400 mA	400 mA
	600 mA	600 mA
	1 A*	1 A*
	1,5 A*	1,5 A*
	2,5 A*	2,5 A*
	4 A*	4 A*
	6 A*	6 A*
	10 A*	10 A*
For connection to voltage transformer .../100 V secondary .../110 V secondary	For connection to current transformer .../1 A secondary .../5 A secondary	

*At PR48n/PAR48n with external transformers

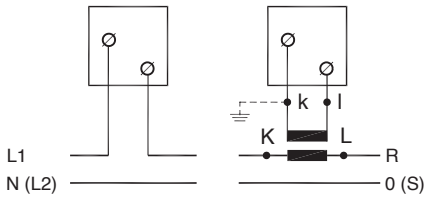
Other measuring ranges on request.

Connection diagrams

Voltmeter:



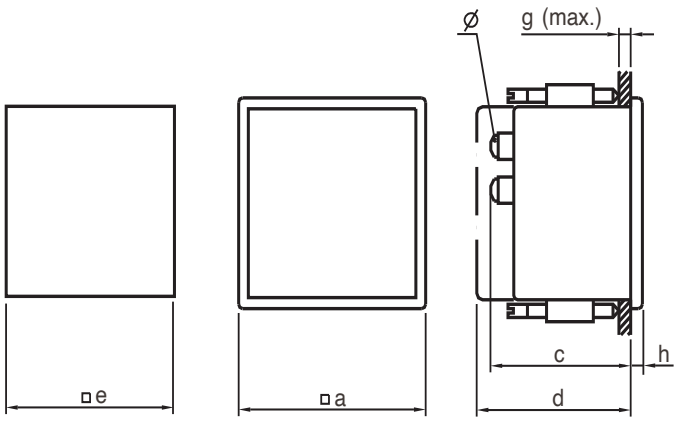
Ammeter:



Dimensions in mm / Weight in gramme

Typ	a	c	d	e	g	h	Weight
PR 48n	48	55	62	45 $^{+0,6}$	28	5	280
PR 72n	72	55	74	68 $^{+0,7}$	8[1]	5	290
PR 96n	96	55	74	92 $^{+0,8}$	8[1]	5	375
PR 144n	144	53	74	138 $^{+1}$	40	5	690
PAR 48n	48	53	64	45 $^{+0,6}$	26	5	235
PAR 72n	72	53	64	68 $^{+0,7}$	40	5	560
PAR 96n	96	53	64	92 $^{+0,8}$	40	5	515
PAR 144n	144	53	64	138 $^{+1}$	40	5	740

*26 mm with screw clamps



EQ..n SWT-3 / EQ..n SWT-6 Moving iron voltmeter with selector switch

- Clase 1.5

Description

Three-phase voltmeters are used for measuring the voltages between phases, or phase-phase and phase-neutral in a line. They incorporate a switch in order to select the wires between which the measurement is desired. The EQ..n SWT-3 also has a position of disconnection in the switch (OFF). Their frequency range is 25 to 100 Hz. They indicate the rms value of the voltage, even with high harmonics, with a minor influence on the accuracy.

Electrical data

Overload capacity according to DIN 43780

Continuously	1,2 times rated value
Short duration	2 x UN 5 s voltmeters

The setting time is approximately 1 minute.

Consumption 3,5 VA max.

Moving iron voltmeter

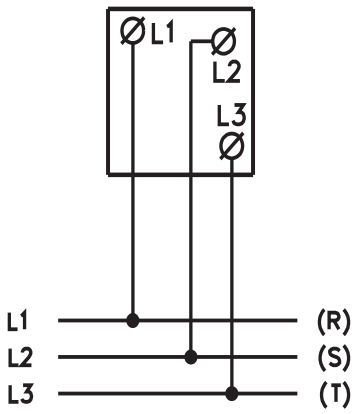
Moving-iron movement with silicone oil damping in the voltmeters.They use hairsprings for the creation of the restoring torque, and pivot suspension with spring-loaded jewel bearings for vibration and shock resistance.

Scales

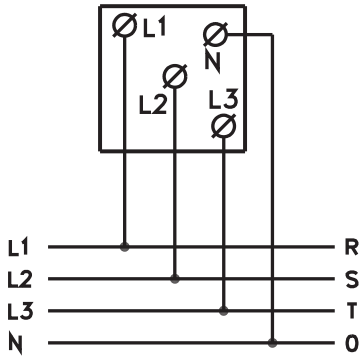
90° scale with coarse-fine division. Scales are practically linear for ammeters, and compressed at the beginning for the voltmeters.

Connection diagrams

EQ...SWT-3



EQ...SWT-6



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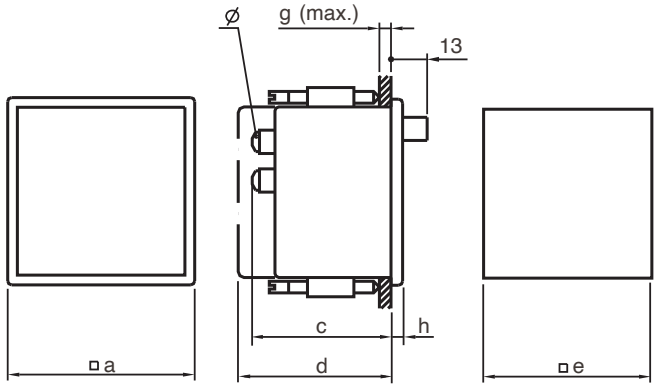
Technical Features

Type			EQ72n SWT-6	EQ96n SWT-6	EQ72n SWT-3	EQ96n SWT-3
Front frame (mm)			72 x 72	96 x 96	72 x 72	96 x 96
Scale length (mm)			91	97	91	97
Panel cut-out (mm)			66 $^{+0,7}$	92 $^{+0,8}$	66 $^{+0,7}$	92 $^{+0,8}$
Installatiom depth (mm)			55	55	55	55
Switch settings	Measuring range					
6 positions without zero position L3-L1, L2-L3, L1-L2, L1-N, L2-N, L3-N	V=	150	●	●	-	-
		250	●	●	-	-
		300	●	●	-	-
		400	●	●	-	-
		500	●	●	-	-
		600	●	●	-	-
	For connection to voltage transformer	.../100*	●	●	-	-
		.../110*	●	●	-	-
Switch settings	Measuring range					
3 position with zero position L1-L3, L2-L3, L1-L2, OFF	V=	150	-	-	●	●
		250	-	-	●	●
		300	-	-	●	●
		400	-	-	●	●
		500	-	-	●	●
		600	-	-	●	●
	For connection to voltage transformer	.../100*	-	-	●	●
		.../110*	-	-	●	●
Terminal cover according to VGB 4 included			●	●	●	●

* Please indicate primary voltage and final scale value when ordering

Dimensions in mm / Weight in gramme

Type	a	b	c	d	e	f	g	h	Ø	Weight
EQ72n SWT-3/-6	72	-	53	68	68 $^{+0,7}$	-	40	5	M4	190
EQ96n SWT-3/-6	96	-	53	68	92 $^{+0,8}$		40	5	M4	230



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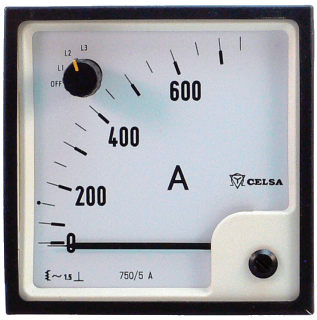
EQ..n SWT - Moving iron voltinstruments with integrated ammeter switch



- Class 1.5

Description

They are an ammeter for measuring the current in each phase of a 50-60 Hz three-phase line. Three-phase voltmeters are used for measuring the voltages between phases, or phase-phase and phase-neutral in a line. They incorporate a switch in order to select the wires between which the measurement is desired. The EQ..n SWT also has a position of disconnection in the switch (OFF). They indicate the rms value of the voltage, even with high harmonics, with a minor influence on the accuracy.

Please indicate on order if instruments are connected directly (max. 10 A), or to a current transformer. In this case, please indicate ratio of current transformer).

Electrical data

Overload capacity according to DIN 43780

Continuously	1,2 times rated value
Short duration	2 x UN 5 s voltmeters

The setting time is approximately 1 minute.

Consumption 1VA per phase

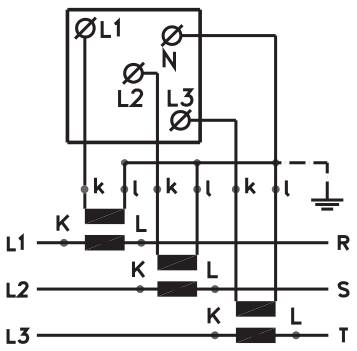
Moving iron

Moving coil with rectifier system in the ammeter, self-shielding movement, with core magnet. They use hairsprings for the creation of the restoring torque, and pivot suspension with spring-loaded jewel bearings for vibration and shock resistance

Scales

90° scale with coarse-fine division. Scales are practically linear.

Connection diagram switchable ammeter



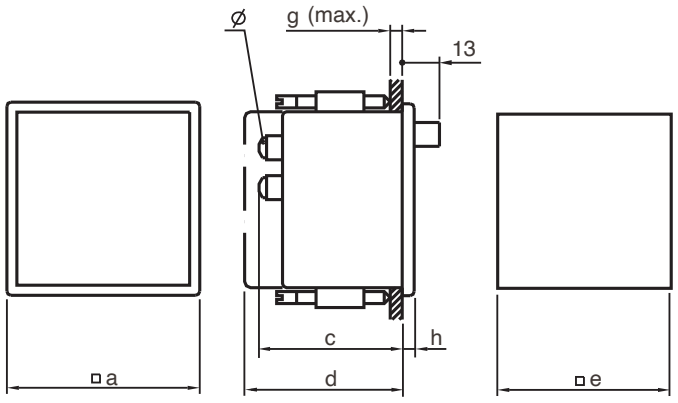
Technical Features

Type		EQ72n SWT	EQ96n SWT
Front frame (mm)		72 x 72	96 x 96
Scale length (mm)		91	97
Weight (g)		190	230
Panel cut-out (mm)		66 +0,7	92 +0,8
Installation depth (mm)		55	55
Switch settings	Measuring range		
4 positions L1, L2, L3, OFF	mA= 400	❍	❍
	600	❍	❍
	A= 1	❍	❍
	1,5	❍	❍
	2,5	❍	❍
	4	❍	❍
	6	❍	❍
	For connection at .../5	●	●
	the current .../1	●	●
Terminal cover according to VGB 4 included		●	●

● available ❍ on request

Dimensions in mm / Weight in gramme

Modelo	a	b	c	d	e	f	g	h	Ø	weight
EQ72n SWT	72	-	53	68	68 +0,7	-	40	5	M4	190
EQ96n SWT	96	-	53	68	92 +0,8		40	5	M4	230



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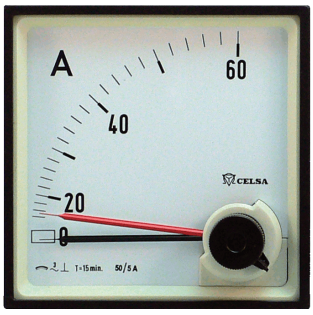
BIQ...n - Maximum deman indicators



- Class 3
- For connection to current transformers
- Secondary 5 A or 1 A
- With interchangeable scale

Description

The movement consists of a bimetallic spiral which is expanded by the heat caused by the current circulating in it, driving the pointer. A second spiral, mounted in opposition, compensates the effect of the ambient temperature. The ambient temperature which can oscillate from -10°C up to +55 °C.

Due to its long response time, shor interval current peaks are not registered and the instrument indicates by a black pointer the mean of the r.m.s. current in a specified period of time (15 minutes). The maximum indication is registered by the position of the red pointer, dragged by the black one. By means of a sealable knob it is possible to resetthe red pointer to the position of the black one in order to make a new reading. The maximum demamd meters are used to monitor lias in feeders, transformers and electrical installations in general.

Overload capacity according to DIN 43780

Continuously	1,2 times nominal value
Short duration	10 times nominal value

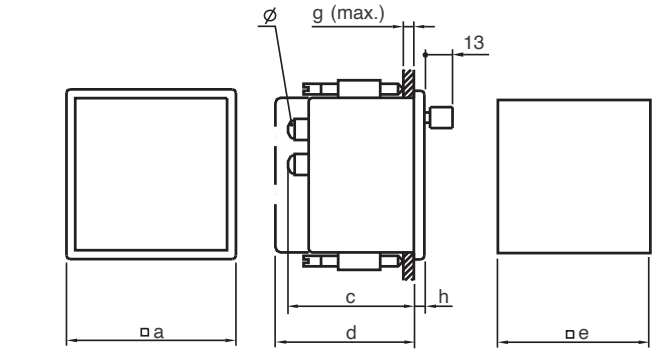
Saturing current transformers shall be used to protect the instruments against overloads exceeding this rating.

Scales

The full -scale value is 1.2 times I_n, (I_n is the rated primary current of the current transformer). 90° scale, quadratic. Coarse-fine division.

Dimensions in mm / Weight in gramme

Type		a	c	d	e	g	h	Ø	Weight
BIQ72n	.../5 A	72	55	74	$68^{+0,7}$	8^{1}	4,6	M6	190
	.../1 A	72	55	74	$68^{+0,7}$	8^{1}	4,6	M4	190
BIQ96n	.../5 A	96	55	74	$92^{+0,8}$	8^{1}	5	M6	250
	.../1 A	96	55	74	$92^{+0,8}$	8^{1}	5	M8	250

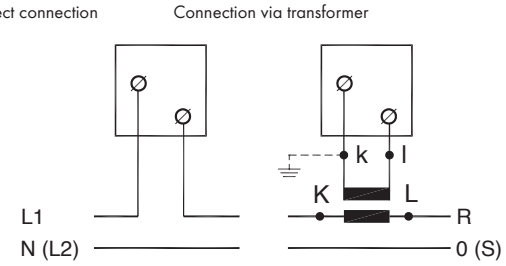


Technical Features

Type		BIQ72	BIQ96n
Front frame	(mm)	72 x 72	96 x 96
Scale length	(mm)	91	97
Consumption	.../5A .../1A	2,5 VA 1,6 VA	2,5 VA 1,6 VA
Setting time at transformer 15 min	..../5A .../1A	● ●	● ●
Transformer primary current (A) = 100%		Final scale value (A) = 120% Primary rated current + 20% overload	
A	5	6	6
	10	12	12
	15	18	18
	20	24	24
	25	30	30
	30	36	36
	40	48	48
	50	60	60
	60	72	72
	75	90	90
	100	120	120
	125	150	150
	150	180	180
	200	240	240
	250	300	300
	300	360	360
	400	480	480
	500	600	600
	600	720	720
	750	900	900
	800	960	960
	1,0 kA	1,2 kA	1,2 kA
	1,2 kA	1,4 kA	1,4 kA
	1,5 kA	1,8 kA	1,8 kA
	2,0 kA	2,4 kA	2,4 kA
	2,5 kA	3,0 kA	3,0 kA
	3,0 kA	3,6 kA	3,6 kA
	4,0 kA	4,8kA	4,8kA
Terminal cover		●	●

Backside terminal cover for protection according to VBG 4
(Please indicate when ordering)

Connection diagrams BIQ



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BOQ...n - Combined maximum demand indicators

- Clase 3 (Maximum demand indicator) y 1.5 (Moving iron ammeter)
- For connection to current transformers
- Secondary 5 A or 1 A
- With interchangeable scale

Description

The maximum demand indicator consists of a bimetallic spiral which is expanded by the heat caused by the current circulating in it, driving the pointer. A second spiral, mounted in the opposition, compensates the effect of the ambient temperature. The ammeter uses a moving-iron movement with silicone oil damping and pivot suspension with spring loaded jewel bearings for vibration and shock resistance. They combine a maximum demand meter and a moving iron ammeter in one instrument. Due to its long response time, shor interval current peaks are not registered and the instrument indicates by a black pointer the mean of the r.m.s. current in a specified period of time (15 minutes). The maximum indication is registered by the position of the red pointer, dragged by the black one. By means of a sealable knob it is possible to resetthe red pointer to the position of the black one in order to make a new reading. Moreover, they use the moving iron ammeter for measuring the rms value of the current at any racy.

Overload capacity according to DIN 43780

Continuously	1,2 times nominal value
Short duration	10 times nominal value

Saturing current transformers shall be used to protect the instruments against overloads exceeding this rating.

Scales

The full -scale value is 1.2 times I_n, (I_n is the rated primary current of the current transformer). 90° scale, quadratic. Coarse-fine division.

Technical Features

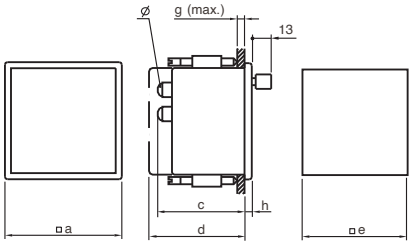
Type		BOQ72	BOQ96n
Front frame	(mm)	72 x 72	96 x 96
Scale length (mm)	Bimetallic Moving iron	52 61	71 90
Consumption	.../5A .../1A	3,4 VA 2,5 VA	3,4 VA 2,5 VA
Setting time at transformer 15 min	..../5A .../1A	● ●	● ●
Transformer primary current (A) = 100%		Final scale value (A) Bimetallic system 20% overload = 120%	Moving iron system 20% overload = 120%
A	5	6	6
	10	12	12
	15	18	18
	20	24	24
	25	30	30
	30	36	36
	40	48	48
	50	60	60
	60	72	72
	75	90	90
	100	120	120
	125	150	150
	150	180	180
	200	240	240
	250	300	300
	300	360	360
	400	480	480
	500	600	600
	600	720	720
	750	900	900
	800	960	960
	1,0 kA	1,2 kA	1,2 kA
	1,2 kA	1,4 kA	1,4 kA
	1,5 kA	1,8 kA	1,8 kA
	2,0 kA	2,4 kA	2,4 kA
	2,5 kA	3,0 kA	3,0 kA
	3,0 kA	3,6 kA	3,6 kA
	4,0 kA	4,8kA	4,8kA
Terminal cover		●	●

Backside terminal cover for protection according to VBG 4 (Please indicate when ordering)

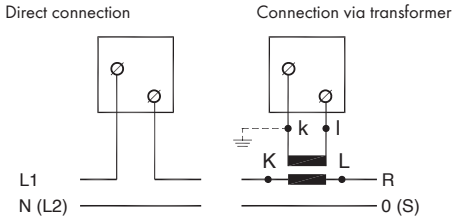
Dimensions in mm / Weight in gramme

Modelo		a	c	d	e	g	h	Ø	Weight
BOQ72n	.../5 A	72	55	74	$68^{+0,7}$	8^{1}	4,6	M8	230
	.../1 A	72	55	74	$68^{+0,7}$	8^{1}	4,6	M4	220
BOQ96n	.../5 A	96	55	74	$92^{+0,8}$	8^{1}	5	M6	290
	.../1 A	96	55	74	$92^{+0,8}$	8^{1}	5	M8	280

On request: Other dimensions



Connection diagrams BOQ



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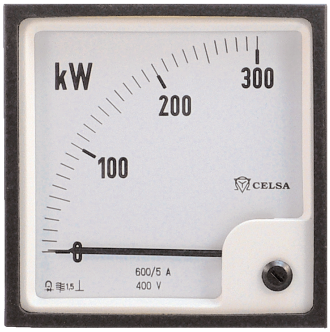
DQ...n - Wattemeter Active Power



- For alternating current 50-60 Hz
- Class 1.5
- Scale 90°

Description

DQ wattmeters are used for active power measurement. There are versions for single-phase AC and three-phase with 3 or 4 wires for balanced and unbalanced loads. The frequency range is 50 - 60 Hz.

Ferrodynamic system, with one measuring element for DQ/1w, DQ/1d and DQ/1; two elements for DQ/2 (aron system), and 2 $^{1/2}$ elements for DQ/3. Eddy-current damping, with pivot suspension and spring-loaded jewel bearings for vibration and shock resistance.

Consumption

The consumption per current path is < 0,2 VA

The current consumption in the voltage path is < 3,9 VA

Scales

90° scale, practically linear. Coarse-fine division- The full-scale value must be between 0.2 and 2 times rated apparent power, which is calculated as follows:

- For single-phase AC:
  S(W) = Primary voltage (V) x Primary current (A)

- For three-phase AC:
  S(W) = √3x Primary line-to-line voltage (V) x Primary current (A)

Unless otherwise indicated, the full-scale value is calculated by rounding S down to one of the following standard value: 1 - 1,2 - 1, 5 - 2 - 2,5 3 - 4 - 5 - 6 - 7,5 - 8 or their decimal multiples.

.

On request: Zero center. Por example, -100-0-100kW

Overload capacity according to DIN 43780

Overload capacity continuously 1,2 I_n.

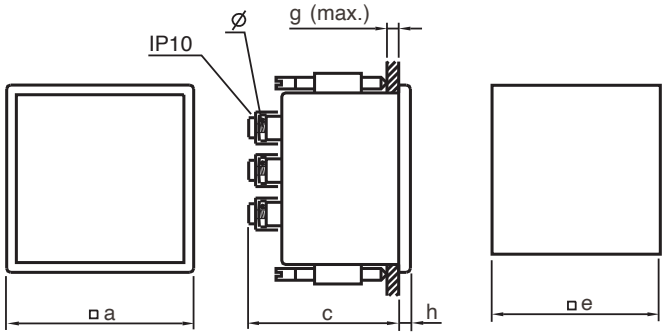
Dimensions in mm						
Type	**a**	**c**	**e**	**g**	**h**	**Ø**
DQ96n/1w, /1d, /1	96	134	$92^{+0,8}$	40	5,5	M4
DQ96n/2, /3	96	134	$92^{+0,8}$	40	5,5	M4
DQ144n/1w. /1d, /1	144	134	138^{+1}	40	5,5	M4
DQ144n/2, /3	144	134	138^{+1}	40	5,5	M4

Technical Features

Front frame (mm)			96 x 96	144 x 144
Scale length (mm)			97	146
Weight (g)			a = 650 b = 650 c = 750 d = 900	a = 900 b = 950 c = 1000 d = 1100
Measuring range	**U (V)**	**I (A)**	**Type**	**Type**
Single-phase AC			**DQ96n/1w**	**DQ144n/1w**
a ~	57,7 - 63,5 100 - 110 - 127 230 - 400	5 1	● ●	● ●
Three-phase AC, three wires, balanced load			**DQ96n/1d**	**DQ144n/1d**
b ≋	100 - 110 - 230 400 440 - 500	5 1	● ●	● ●
Three-phase AC, three wires, unbalanced load			**DQ96n/2**	**DQ144n/2**
c ≋	100 - 110 - 230 400 440 - 500	5 1	● ●	● ●
Three-phase AC, four wires, balanced load			**DQ96n/1**	**DQ144n/1**
d ≋	100 - 110 - 230 400 440 - 500	5 1	● ●	● ●
Three-phase AC, four wires, unbalanced load			**DQ96n/3**	**DQ144n/3**
e ≋	100 - 110 - 230 400 440 - 500	5 1	● ●	● ●

● available ❍ on request

Connection diagrams see page 4/16.



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DQ..n/b - Varmeters Power Reactive

- For alternating current 50-60 Hz
- Class 1.5
- Scale 90°

Description

DQ varmeters are used for reactive power measurement. There are versions for single-phase AC and three-phase with 3 or 4 wires for balanced and unbalanced loads. The frequency range is 50 - 60 Hz.

Ferrodynamic system, with one measuring element for DQ/1wb, DQ/1db and DQ/1b; two elements for DQ/2 (aron system), and 2 $^{1/2}$ elements for DQ/3b. Eddy-current damping, with pivot suspension and spring-loaded jewel bearings for vibration and shock resistance.

Consumption

The consumption per current path is < 0,2 VA

The current consumption in the voltage path is < 3,9 VA

Scales

90° scale, practically linear. Coarse-fine division- The full-scale value must be between 0.2 and 2 times rated apparent power, which is calculated as follows:

- For single-phase AC:
  S(W) = Primary voltage (V) x Primary current (A)

- For three-phase AC:
  S(W) = √3x Primary line-to-line voltage (V) x Primary current (A)

Unless otherwise indicated, the full-scale value is calculated by rounding S down to one of the following standard value: 1 - 1,2 - 1, 5 - 2 - 2,5 3 - 4 - 5 - 6 - 7,5 - 8 or their decimal multiples.

.

On request: Zero center. Por example, -100-0-100kW

Overload capacity according to DIN 43780

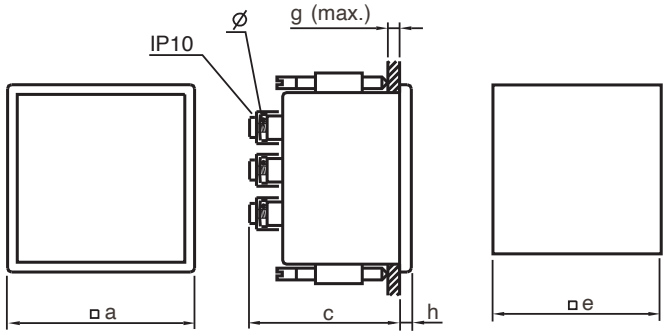
Overload capacity continuously 1,2 I_n.

Technical Features

Front frame	(mm)		96 x 96	144 x 144
Scale length	(mm)		97	146
Weight	(g)		a = 460 b = 510 c = 695 d = 725	a = 720 b = 770 c = 960 d = 990
Measuring range	**U (V)**	**I (A)**	**Type**	**Type**
Single-phase AC			**DQ96n/1wb**	**DQ144n/1wb**
a ~	57,7 - 63,5 100 - 110 - 127	5	●	●
	230 - 400	1	●	●
Three-phase AC, three wires, balanced load			**DQ96n/1db**	**DQ144n/1db**
b ≋	100 - 110 - 230 400	5	●	●
	440 - 500	1	●	●
Three-phase AC, three wires, unbalanced load			**DQ96n/2b**	**DQ144n/2b**
c ≋	100 - 110 - 230 400	5	●	●
	440 - 500	1	●	●
Three-phase AC, four wires, balanced load			**DQ96n/1b**	**DQ144n/1b**
d ≋	100 - 110 - 230 400	5	●	●
	440 - 500	1	●	●
Three-phase AC, four wires, unbalanced load			**DQ96n/3b**	**DQ144n/3b**
e ≋	100 - 110 - 230 400	5	●	●
	440 - 500	1	●	●

● available ❍ on request

Connection diagrams see page 4/16.



Dimensions in mm

Type	a	c	e	g	h	Ø
DQ96n/1wb, /1db, /1b	96	134	$92^{+0,8}$	40	5,5	M4
DQ96n/2b, /3b	96	134	$92^{+0,8}$	40	5,5	M4
DQ144n/1wb, /1db, /1b	144	134	138^{+1}	40	5,5	M4
DQ144n/2b, /3b	144	134	138^{+1}	40	5,5	M4

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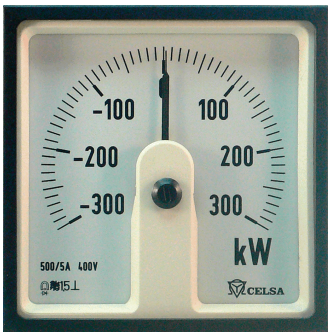
DAQ...n - Wattemeter Active Power



- For alternating current 50-60 Hz
- Class 1.5
- Scale 240°

Description

DQ wattmeters are used for active power measurement. There are versions for single-phase AC and three-phase with 3 or 4 wires for balanced and unbalanced loads. The frequency range is 50 - 60 Hz.

Ferrodynamic system, with one measuring element for DAQ/1w, DAQ/1d and DAQ/1; two elements for DAQ/2 (aron system), and 2 $^{1/2}$ elements for DAQ/3. Eddy-current damping, with pivot suspension and spring-loaded jewel bearings for vibration and shock resistance.

Consumption

The consumption per current path is < 0,2 VA

The current consumption in the voltage path is < 3,9 VA

Scales

90° scale, practically linear. Coarse-fine division- The full-scale value must be between 0.2 and 2 times rated apparent power, which is calculated as follows:

- For single-phase AC:
  S(W) = Primary voltage (V) x Primary current (A)

- For three-phase AC:
  S(W) = √3x Primary line-to-line voltage (V) x Primary current (A)

Unless otherwise indicated, the full-scale value is calculated by rounding S down to one of the following standard value: 1 - 1,2 - 1, 5 - 2 - 2,5 3 - 4 - 5 - 6 - 7,5 - 8 or their decimal multiples.

.

On request: Zero center. Por example, -100-0-100kW

Overload capacity according to DIN 43780

Overload capacity continuously 1,2 I_n.

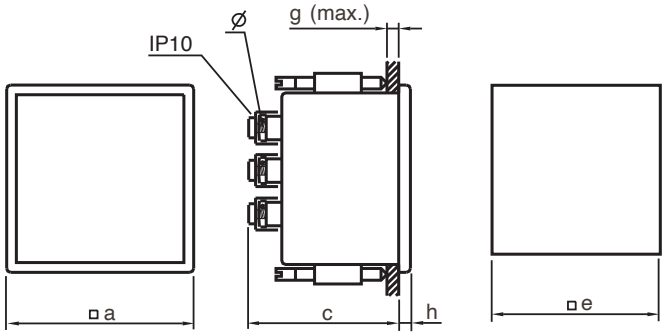
Dimensions en mm						
Type	**a**	**c**	**e**	**g**	**h**	**Ø**
DAQ96n/1w, /1d, /1	96	134	$92^{+0,8}$	40	5,5	M4
DAQ96n/2, /3	96	134	$92^{+0,8}$	40	5,5	M4
DAQ144n/1w, /1d, /1	144	134	138^{+1}	40	5,5	M4
DAQ144n/2, /3	144	134	138^{+1}	40	5,5	M4

Technical Features

Front frame	(mm)		96 x 96	144 x 144
Scale length	(mm)		142	230
Weight	(g)		a = 460 b = 510 c = 695 d = 725	a = 900 b = 950 c = 1000 d = 1100
Measuring range	**U (V)**	**I (A)**	**Type**	**Type**
Single-phase AC			**DAQ 96n/1w**	**DAQ 144n/1w**
a ~	57,7 - 63,5 100 - 110 - 127 230 - 400	5 1	● ●	● ●
Three-phase AC, three wires, balanced load			**DAQ 96n/1d**	**DAQ 144n/1d**
b ≋	100 - 110 - 230 400 440 - 500	5 1	● ●	● ●
Three-phase AC, three wires, unbalanced load			**DAQ 96n/2**	**DAQ 144n/2**
c ≋	100 - 110 - 230 400 440 - 500	5 1	● ●	● ●
Three-phase AC, four wires, balanced load			**DAQ 96n/1**	**DAQ 144n/1**
d ≋	100 - 110 - 230 400 440 - 500	5 1	● ●	● ●
Three-phase AC, four wires, unbalanced load			**DAQ 96n/3**	**DAQ 144n/3**
e ≋	100 - 110 - 230 400 440 - 500	5 1	● ●	● ●

● available ❍ on request

Connection diagrams see page 4/16.



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DAQ..n/b - Varmeters Power Reactive

- For alternating current 50-60 Hz
- Class 1.5
- Scale 240°

Description

DAQ varmeters are used for reactive power measurement. There are versions for single-phase AC and three-phase with 3 or 4 wires for balanced and unbalanced loads. The frequency range is 50 - 60 Hz.

Ferrodynamic system, with one measuring element for DAQ/1wb, DQ/1db and DQ/1b; two elements for DQ/2 (aron system), and 2 $^{1/2}$ elements for DQ/3b. Eddy-current damping, with pivot suspension and spring-loaded jewel bearings for vibration and shock resistance.

Consumption

The consumption per current path is < 0,2 VA

The current consumption in the voltage path is < 3,9 VA

Scales

90° scale, practically linear. Coarse-fine division- The full-scale value must be between 0.2 and 2 times rated apparent power, which is calculated as follows:

- For single-phase AC:
  S(W) = Primary voltage (V) x Primary current (A)

- For three-phase AC:
  S(W) = √3x Primary line-to-line voltage (V) x Primary current (A)

Unless otherwise indicated, the full-scale value is calculated by rounding S down to one of the following standard value: 1 - 1,2 - 1, 5 - 2 - 2,5 3 - 4 - 5 - 6 - 7,5 - 8 or their decimal multiples.

.

On request: Zero center. Por example, -100-0-100kW

Overload capacity according to DIN 43780

Overload capacity continuously 1,2 I_n.

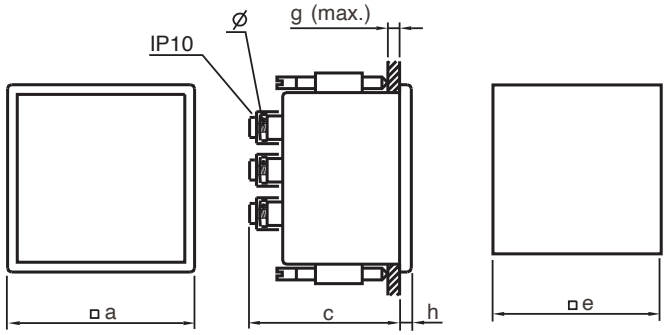
Dimensions in mm						
Type	**a**	**c**	**e**	**g**	**h**	**Ø**
DAQ96n/1wb, /1db, /1b	96	134	$92^{+0,8}$	40	5,5	M4
DAQ96n/2b, /3b	96	134	$92^{+0,8}$	40	5,5	M4
DAQ144n/1wb, /1db, /1b	144	134	138^{+1}	40	5,5	M4
DAQ144n/2b, /3b	144	134	138^{+1}	40	5,5	M4

Technical Features

Front frame (mm)			96 x 96	144 x 144
Scale length (mm)			142	230
Weight (g)			a = 460 b = 510 c = 695 d = 725	a = 720 b = 770 c = 960 d = 990
Measuring range	**U (V)**	**I (A)**	**Type**	**Tyoe**
Single-phase AC			**DAQ 96n/1wb**	**DAQ 144n/1wb**
a ~	57,7 - 63,5 100 - 110 - 127 230 - 400	5 1	● ●	● ●
Three-phase AC, three wires, balanced load			**DAQ 96n/1db**	**DAQ 144n/1db**
b ≋	100 - 110 - 230 400 440 - 500	5 1	● ●	● ●
Three-phase AC, three wires, unbalanced load			**DAQ 96n/2b**	**DAQ 144n/2b**
c ≋	100 - 110 - 230 400 440 - 500	5 1	● ●	● ●
Three-phase AC, four wires, balanced load			**DAQ 96n/1b**	**DAQ 144n/1b**
d ≋	100 - 110 - 230 400 440 - 500	5 1	● ●	● ●
Three-phase AC, four wires, unbalanced load			**DAQ 96n/3b**	**DAQ 144n/3b**
e ≋	100 - 110 - 230 400 440 - 500	5 1	● ●	● ●

● available ❍ on request

Connection diagrams see page 4/16.



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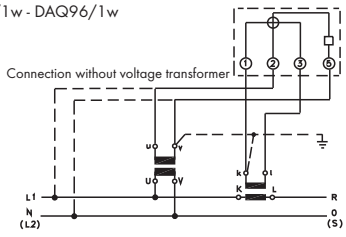
Connection diagrams:

Active power

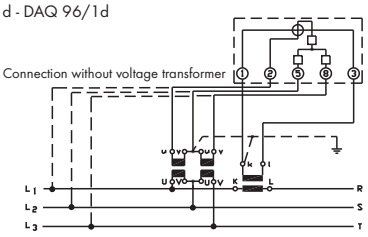
DQ -96/1w - DAQ96/1w

Connection without voltage transformer



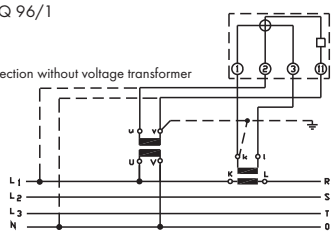
DQ-96/1d - DAQ 96/1d

Connection without voltage transformer



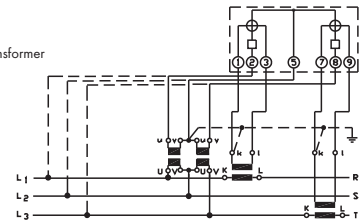
DQ 96/1 -DAQ 96/1

Connection without voltage transformer



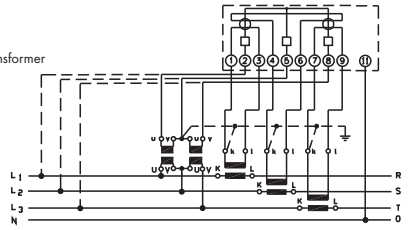
DQ-96/2 - DAQ 96/2

Connection without voltage transformer



DQ-96/3 - DAQ-96/3

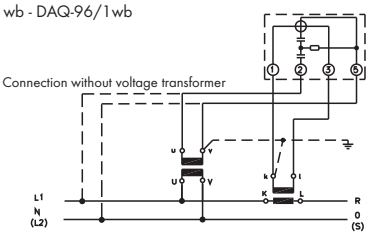
Connection without voltage transformer



Reactive power

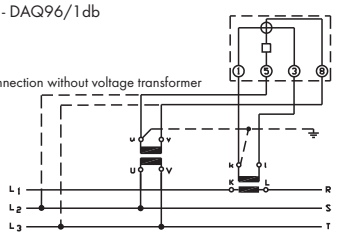
DQ 96/1wb - DAQ-96/1wb

Connection without voltage transformer



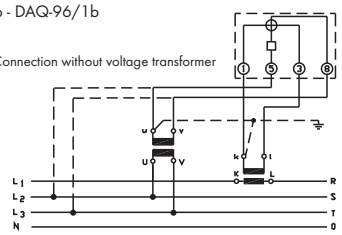
DQ 96/1db - DAQ96/1db

Connection without voltage transformer



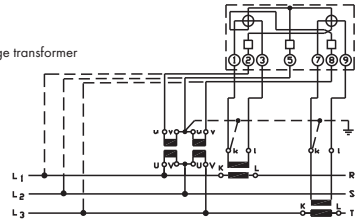
DQ 96/1b - DAQ-96/1b

Connection without voltage transformer



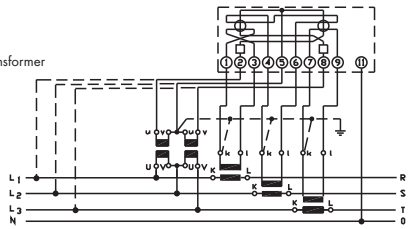
DQ96/2b - DAQ96/2b

Connection without voltage transformer



DQ96/3b - DAQ96/3b

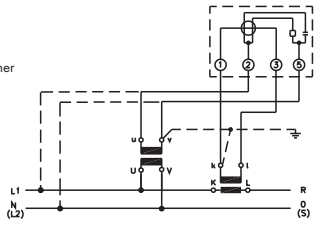
Connection without voltage transformer



Power factor

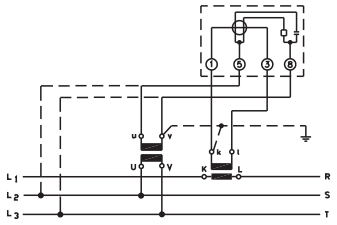
DPQ96n/1 - EPA96n/1

Connection without voltage transformer



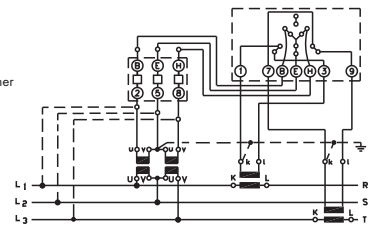
DPQ96n/2 - EPA96n/2

Connection without voltage transformer



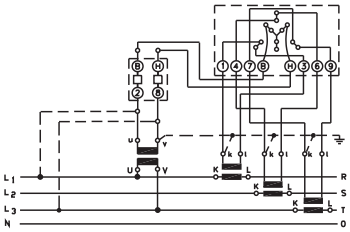
DPQ96n/3

Connection without voltage transformer



DPQ96n/3

Connection without voltage transformer



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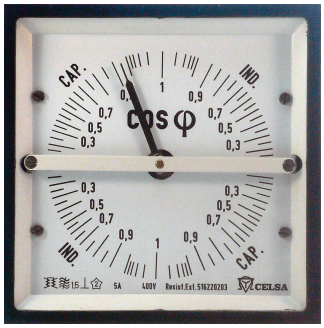
DPQ - Power factor meter

DPQ/1



DPQ/3

- Class 1.5
- For alternating current 50 or 60 Hz

Description

The DPQ are used for power factor (cos φ) measurement. There are versions for single-phse and three-phase AC, for balanced or unbalanced load. Versions .../2 and .../3 are suitable for lines with or without neutral. The frequency is 50 or 60 Hz. The DPQ../1 y ../2 are used for crossed-coils electrodynamic system. The DPQ../3, a moving-iron quotientmeter. All of them are equipped with eddy-current damping, pivot suspension and spring-loaded jewel bearings (without spring for DPQ.../3) for vibration and shock resistance. DPQ types have neither mechanical restoring torque non zero adjuster. Therefore, the pointer has not a determinate position when the instrument is disconnected.

Scales

Non-linear 90° (DPQ.../1 and /2) or 360° (DPQ.../3) scales. Coarse-fine division. The DPQ.../3 is able to measure the power factor in the four quadrants (active power exported or imported, with inductive or capacitive power factor).

Standard scale execution:

cap. 0,5-1-0,5 ind.
cap. 0,8-1-0,3 ind.
cap. 0,8-1-0,8 ind.

Technical Features DPQ/1/2

Front frame	(mm)	96 x 96
Scale length	(mm)	97
Consumption	Current 5A Current 1A Voltage	max. 1 VA max. 1 VA max. 3 VA

Voltage U (V)	Current I (A)	Type
Single-phase AC	~	**DPQ 96n/1**
57,5 - 100 - 110 - 120 220 - 230 - 240	5	●
380 - 400 440 - 500	1	●
Three-phase AC, balanced load	≋	**DPQ 96n/2**
57,5 - 100 - 110 - 120 220 - 230 - 240	5	●
380 - 400 440 - 500	1	●
Terminal cover		●

Technical Features DPQ/3

Front frame	(mm)		96 x 96
Scale length	(mm)		200
Weight	(g)	(with external shunt)	1450
Consumption			max. 30 mA

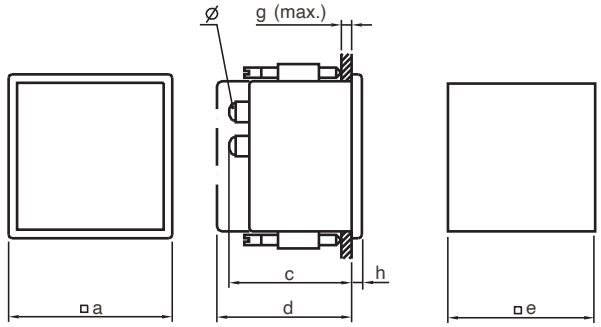
Volatge U (V)		Current (A)	Type
Three-phase AC, unbalanced load		20 ... 120%	**DPQ 96s/3**
100 - 110 230	±15 ≋	5	●
400 440		1	●
Terminal cover			❍

● available ❍ on request

On request: other dimensions

Dimensions in mm / Weight in gramme

Type	a	c	d	e	g	h	Ø	Weight
DPQ96n/1, /2	96	55	65	92 $^{+0,8}$	40	5	M4	600
DPQ 96s/3	96	125	151	92 $^{+0,8}$	10	5	M4	1450



Connection diagrams see page 4/16.

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EPA...n - Power factor meter

- For alternating current 50 or 60 Hz
- Class 1.5
- Scale 240°

Description

The EPA are used for power factor (cos φ) measurement. There are versions for single-phse and three-phase AC, for balanced. neutral. The frequency is 50 or 60 Hz. They embody a moving-coil movement with electronic transducer. All of them are equipped with eddy-current damping, pivot suspension and spring-loaded jewel bearings for vibration and shock resistance.

Scales

Non-linear 240° scales. Coarse-fine division. The EPA can be furnished with scales covering phase angle spans from 90 up to 260 electric degrees.

Standard scale execution:

cap. 0,5-1-0,5 ind.
cap. 0,8-1-0,3 ind.
cap. 0,8-1-0,8 ind.

Technical Features

Front frame (mm)		96 x 96
Scale length (mm)		142
Voltage U (V)	**Current I (A)**	**Type**
Single-phase AC	~	**EPA 96n/1**
57,7 - 100 - 110 - 120 220 - 230 240	5	●
380 - 400 440 - 500	1	●
Three-phase AC, balanced load	≋	**EPA 96n/2**
57,7 - 100 - 110 - 120 220 - 230 240	5	●
380 - 400 440 - 500	1	●
Terminal cover		❍

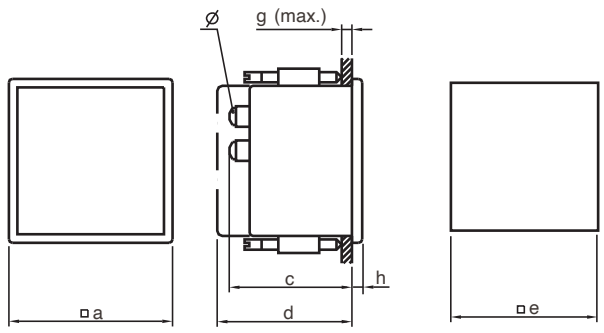
● available ❍ on request

On request: other dimensions

Connection diagrams see page 4/16.

Dimensions in mm / Weight in gramme

Type	a	c	d	e	g	h	Ø	Weight
EPA96n/1, /2	96	106	132	92 $^{+0,8}$	40	5	M4	680



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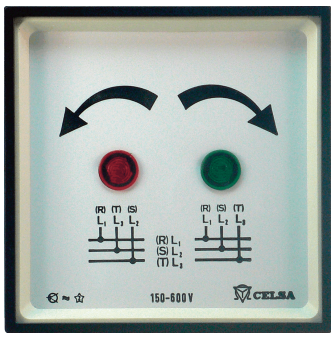
ISE - Phase sequence indicators



- ISE/1 for three-phase current
- ISE/2 for three-phase current with switch contact

Description

Phase sequence indicators allow to determinate the phase sequence in a 3-phase network. They use an electric circuit, without moving parts. Whe the instrument is connected, if the phase-sequence is correct a grenn light shices. Otherwise, a red light does.

- ISE72n/1 and ISE96n/1: Indicators for panel mounting are suited for permanet connections at voltages between 150 and 600V.
- ISE 96s/2: Indicator for panel mounting. It also incorporates a change-over relay, with potential-free output contacts. When the sequence is not correct or the instrument is disconnected, the relay de-energizes (closed circuit principle). Thus, an alarm can be triggered or any corrective action can be taken.

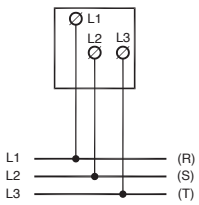
Technical Features ISE96/2:

Voltage:	110 / 230 / 400 / 440 V
	50 or 60 Hz
Switching range:	U_N +20 % up to -20% U_N
Relay output:	1 isolated change-over contact (changer)
Switching capacity at ohmic load:	1 x10^6.
Maximal switching current:	6 A, 250 V max. 300 W at alternating voltage

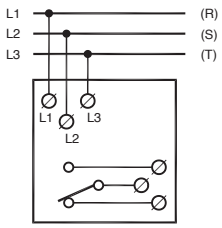
Connetion diagrams:

ISE 72n/1

ISE 96n/1



ISE96s/2



Technical Features

Type	ISE 72n/1	ISE 96n/1	ISE 96s/2
Front frame (mm)	72 x 72	96 x 96	96 x 96
Consumption (VA)	1,5	1,5	1,5
Voltage (V)			
150 - 600 V	●	●	–
110 V	–	–	❍
230 V	–	–	❍
400 V	–	–	❍
440 V	–	–	❍
500 V	–	–	❍
Termincal covers	●	●	❍

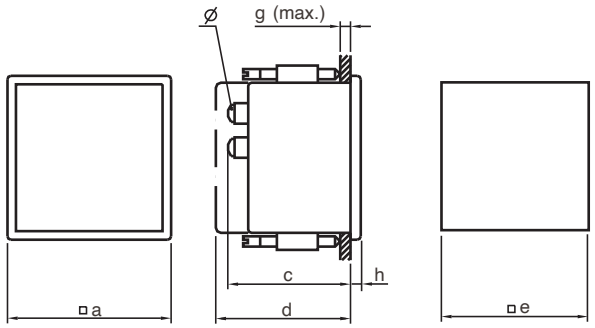
● available ❍ on request

Backside terminal cover for protection according to VBG 4

(Please indicate when ordering.)

Dimensions in mm / Weight in gramme

Type	a	c	d	e	g	h	Ø	Weight
ISE72n/1	72	58	76	68 $^{+0,7}$	40	4,6	M4	270
ISE96n/1	96	58	76	92 $^{+0,8}$	40	5	M4	350
ISE96s/2	96	78	95	92 $^{+0,8}$	10	5	M4	575



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FA...n / FAG...n - Pointer frequency meter

FA

FAG

- Class 0.5
- FA with 90° scale
- FAG with 240° scale

Description

The pointer frequency meters are used to measure frequencies in power supplies in span of rated frequencies. They have better resolution than reed frequency meters. Moving-coil instrument with electronic transducer. Movement with hairsprings for the creation of the resorting torque. Pivot suspension with spring-loaded jewel bearings for vibration and shock resistance.

Admissible change in rating voltage: ± 20 %
External magnet field: 0.5 mT

Scales

90° (FA..n) or 240° (FAG..n) scales, practically linear. Coarse-finde division.

Technical Features

Type		FA 72n	FA 96n	FA 144n	FAG 72n	FAG 96n
Front frame	(mm)	72 x 72	96 x 96	144 x 144	72 x 72	96 x 96
Scale length	(mm)	63	97	146	106	142
Consumption		< 7VA	< 7VA	< 7VA	< 7VA	< 7VA
Range (Hz)	**U(V)**					
45 - 55	100	●	●	❍	●	❍
45 - 55	110	●	●	❍	●	❍
45 - 55	230	●	●	❍	●	❍
45 - 55	400	●	●	❍	●	❍
45 - 55	440	●	●	❍	●	❍
45 - 55	500	❍	❍	❍	❍	❍
45 - 65	100	●	●	❍	●	❍
45 - 65	110	●	●	❍	●	❍
45 - 65	230	●	●	❍	●	❍
45 - 65	400	●	●	❍	●	❍
45 - 65	440	●	●	❍	●	❍
45 - 65	500	❍	❍	❍	❍	❍
55 - 65	100	●	●	❍	●	❍
55 - 65	110	●	●	❍	●	❍
55 - 65	230	●	●	❍	●	❍
55 - 65	400	●	●	❍	●	❍
55 - 65	440	●	●	❍	●	❍
55 - 65	500	❍	❍	❍	❍	❍
Terminal covers		●	●	❍	●	❍

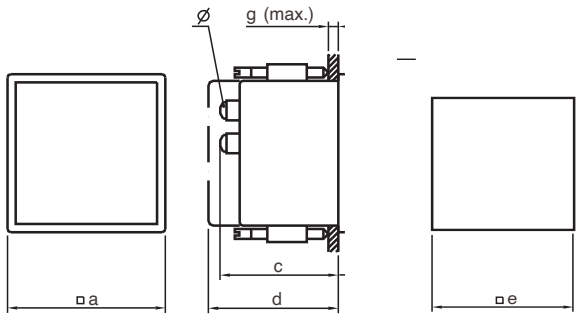
● available ❍ on request

Backside terminal cover for protection according to VBG 4
(Please indicate when ordering.)

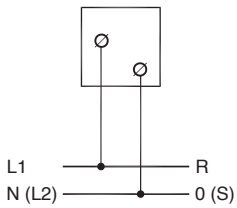
On request: dimensions 48 x 48 mm and 144 x 144 mm.

Dimensions in mm / Weight in gramme

Type	a	c	d	e	g	h	Ø	Weight
FA72n	72	55	75	68 $^{+0,7}$	8[1]	4,6	M4	210
FA96n	96	55	75	92 $^{+0,8}$	8[1]	5	M4	280
FA144n	144	53	53	138 $^{+1}$	40	5,5	M4	490
FAG72n	72	53	53	68 $^{+0,7}$	40	5	M4	210
FAG96n	96	53	53	92 $^{+0,8}$	40	5,5	M4	280
FAG144n	144	53	53	138 $^{+1}$	40	5,5	M4	490



Connection diagrams



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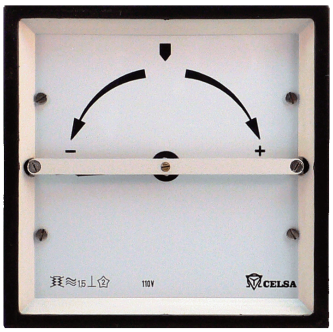
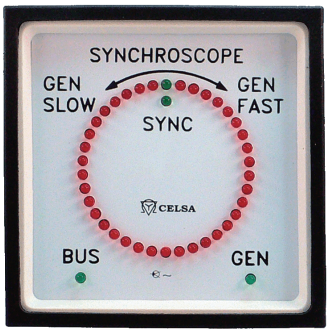
SQ - Synchroscopes



SQ...s



SQ96n

- For alternating current 50-60 Hz
- Analogue execution
- Digital LED execution

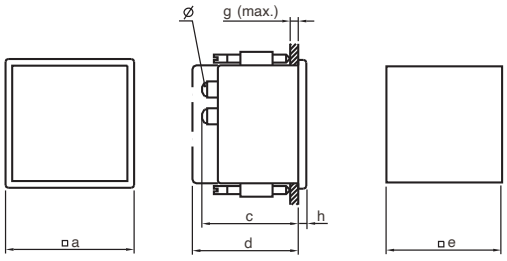
Description SQ... analogue

This instrument use a moving-iron rationmeter, with eddy-current damping. Only when the pointer stops on the scale mark, the frequencies and phase angles of the voltages of both generatos are the same. If it stops on another point, there is phase displacement between both voltages or at least one generator is disconnected. When the frequency difference is less than approximately 1.5Hz, the pointer rotates in the direction marked as "+" (if the frequency of the generator G2 is higher than the frequency of G1) or in the direction marked as "-" (if the frequency of G2 is lower).

Description SQ... digital

This instrument shows as well the phasing and the frequency of two current circuits to each other. Only if phasing and frequency are the same the green LEDs are flashing in the middle on the top. When there are different phasings or frequencies the red LEDs are flashing, depending on degree of deviation per size of difference more on the left or more on the right.

Dimensions in mm / Weight in gramme								
Type	**a**	**c**	**d**	**e**	**g**	**h**	**Ø**	**Weight**
SQ96n/1 -/2	96	107	119	92 $^{+0,8}$	40	5	M4	680
SQ96s/1 -/2	96	136	76	92 $^{+0,8}$	10	5	M4	1100
SQ144s/1 -/2	144	136	95	144^{+1}	1	5,5	M4	1800

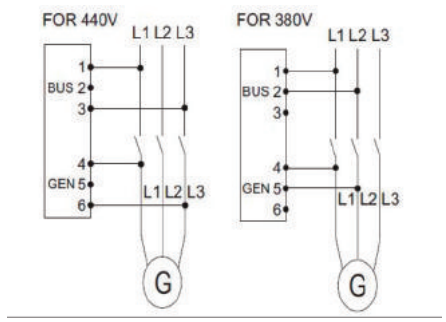


Technical Features

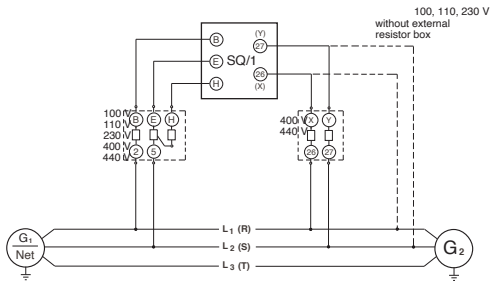
Marco (mm)	96 x 96	96 x 96	144 x 144
Measuring range U (V)	**Digital type**	**Analogue type**	**Analogue type**
Single-phase AC	**SQ 96n/1**	**SQ 96s/1**	**SQ 144s/1**
Consumptiom	max.6 VA	5 VA	max.25 mA
100 / Ã3*	❍	❍	❍
100 / Ã3*	❍	❍	❍
100 - 110*	●	●	❍
230*	●	●	❍
Three-phase, 3 wire balanced load	**SQ 96n/2**	**SQ 96s/2**	**SQ 144s/2**
Consumption	max.6 VA	5 VA	max.25 mA
100	●	●	❍
110	●	●	❍
230*	●	●	❍
400*	●	●	❍
440*	●	●	❍
Terminal covers	–	●	–

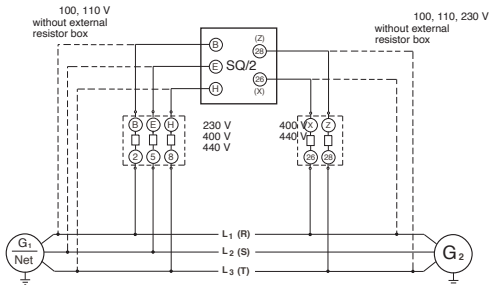
● available ❍ on request
*with separated series resistor (external) / only analogue type

Connection diagrams: SQ96n LED execution



Connection diagrams: SQ96s/SQ144s analogue execution





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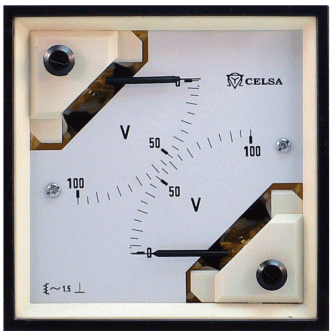
EQD - Double voltmeter



- Class 1.5
- 2 scales of 90°

Description

They use two independent moving-iron movements with silicone oil damping and pivot suspension by means of spring-loaded jewel bearings for vibration and shock resistance.

Scales

Two scales of 90° compressed at the beginning. Coarse-fine division.

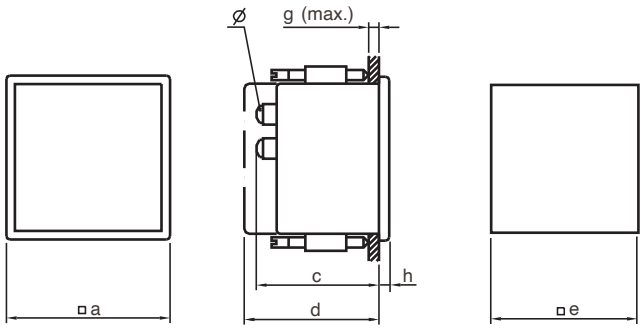
Technical Features		
Type		**EQD 96n**
Front frame	(mm)	96 x 96
Scale length	(mm)	2 x 54
Weight	(g)	305
Consumption		2 x max.4.5
Voltage (V)		
2 x	100[1)]	●
2 x	110[1)]	●
2 x	150	●
2 x	230	●
2 x	250	●
2 x	300	●
2 x	500	●
Tapas cubrebornas		❍

● available ❍ on request

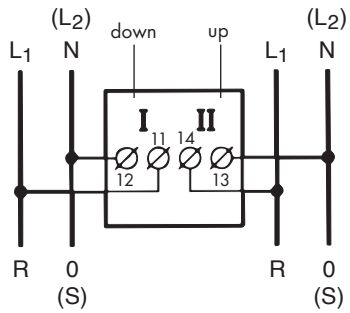
[1)] When connecting to the voltage transformer the indication of the transformer ratio is required.

Dimensions in mm / Weight in gramme								
Type	**a**	**c**	**d**	**e**	**g**	**h**	**Ø**	**Weight**
EQD96n	96	53	64	92 $^{+0,8}$	26	5,5	M4	405

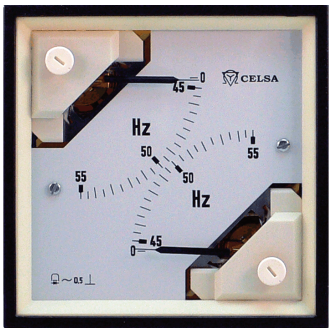
On request: Dimensions 144 x 144 mm



Connection diagrams



FAD - Double Pointer frequency meter



FAD

- Sistema de hierro movíl con convertidor electrónico
- Para corriente alterna 50 - 60 Hz

Description

The instruments have 2 independent moving coil movements to measure the frequency for example between 2 generators or one generator and the net. These instruments are made of a moving coil movement with electronic transducer. The meter movements are jewelled and shock-proofed by sprung storage of jewels.

The indication is mainly independent of curves, form errors and fluctuations of the measuring voltage.

Admissible change in rating voltage: ± 20 %

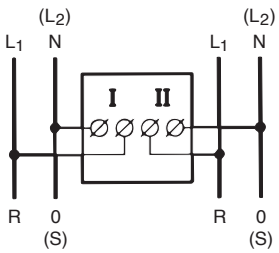
External magnet field: 0.5 mT

Technical Features

Type	FAD96n
Front frame (mm)	96 x 96
Scale length (mm)	2 x 54
Consumption	max 3
Voltage (V)	
100	●
110	●
230	●
400	●
500	❍
Terminal covers	●

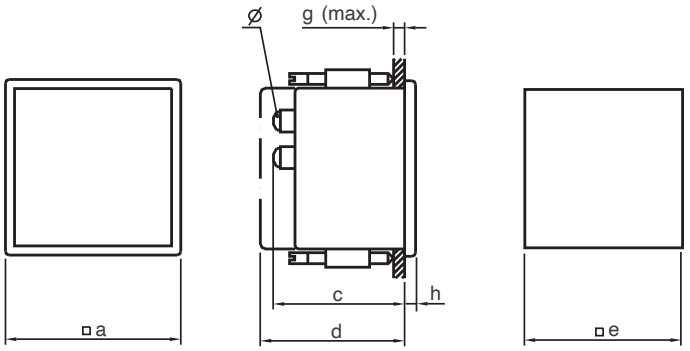
● available ❍ on request

Connection diagrams



Dimensions in mm / Weight in gramme

Type	a	c	d	e	g	h	Ø	Weight
FAD96n	96	53	64	92 +0,8	26	5,5	M4	260



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SW - Synchronising wall bracket

- Double voltmeters
- Double frequency meters
- Sincronoscopio (Monofásico o Trifásico)

Description

Synchronizing instruments are used for the connection in parallel of one AC generator with another or with the network. This operation must be carried out when the phase sequence is the same and the three following conditions are fulfilled:

- Equal voltages
- Equal frequencies
- The generator and network voltages have equal phase

Otherwise, serius damages to the installation may occur.

In order to check to check the fulfilment of each condition, several instrument are used. The three instruments are usually mounted in a synchronizing wall bracket (type SW). Supplies two different types: SW96 (for three 96 x 96 mm instruments) and SW144 (for three 144 x 144 mm instruments).

Technical Features

Type	SW96/1s	SW96/2s	SW144/1s	SW144/2s
Equipment	1 x EQD96s 1 x FD96s 1 x SQ6s/1	1 x EQD96s 1 x FD96s 1 x SQ96s/2	1 x EQD144s 1 x FD144s 1 x SQ96s/1	1 x EQD144s 1 x FD144s 1 x SQ96s/2
	❍	❍	❍	❍

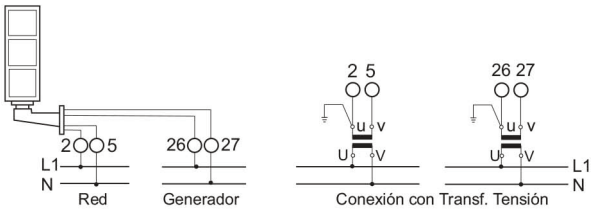
● available ❍ on request

Dimensions in mm / Weight in gramme

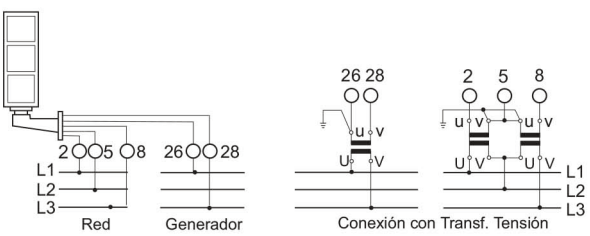
Type	a	b	c	d	e	f	g	Weight
SW96...	410	223	176	80	60	500	120	5700
SW144...	576	258	176	115	85	692	170	9100

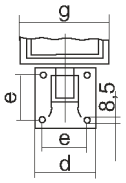
Connection diagrams

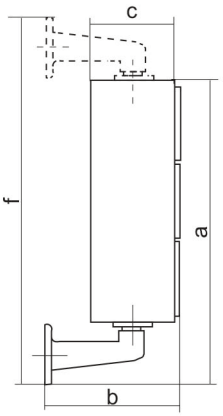
Single-phase



Three-phase







PQ / PAQ - Moving coil instruments

- For DC voltage / current
- Class 1.5
- PQ scale 90°
- PAQ scale 240°

Description

Moving-coil panel meters are suitable for measuring DC currents and voltages. Their main feature is their low power consumption. Connected to measuring transducers and with suitable dial, they can be used for measurement in other quantities. For currents above 100A they must be connected through a shunt. In this case, the instruments aare adjusted for a copper twin-wire connection cable. Self-shielding moving-coil system, with core magnet and hairsprings for the creation of the restoring torque. Pivot suspension with spring loaded jewel bearings for vibration and shock resistance.

Electrical data

Continuously	1.2 times
Short duration	10x I_N 5 s for aminstruments
	2xU_N 5 s for voltinstruments

Scales

90° (PQ..n) or 240° (PAQ..n) scales, practically linear. Coarse-fine division.

Internal resistance, consumption approx. in Ohm				
Measuring range		**PQ35p**	**PQ ..n**	**PAQ ...n**
µA	25		240 mV	
	40		374 mV	
	60	200 mV	600 mV	
	100	200 mV	400 mV	
	150	200 mV	600 mV	
	250	200 mV	140 mV	810 mV
	400	200 mV	540 mV	900 mV
	600	200 mV	540 mV	900 mV
mA	1	200 mV	37 mV	490 mV
	1,5	200 mV	60 mV	425 mV
	2,5	200 mV	60 mV	760 mV
	4	200 mV	60 mV	950 mV
	6	200 mV	60 mV	60 mV
	4-20	200 mV	1,5 V	1,5 V
	10-800	200 mV	60-70 mV	60-125 mV
A	1-100	15A 200 mV	60-100 mV	60 mV
	.../60...150mV	12 Ω	5 mA	67/200Ω/V
mV	15-40	1000 Ω/V	200 Ω/V	67 Ω/V
	15-40	1000 Ω/V	200 Ω/V	67 Ω/V
	60-100	1000 Ω/V	1000 Ω/V	67 Ω/V
	150-600	1000 Ω/V	1000 Ω/V	200 Ω/V
	750	1000 Ω/V	1000 Ω/V	200 Ω/V
V	1	1000 Ω/V	1000 Ω/V	200 Ω/V
	1,5-600	1000 Ω/V	1000 Ω/V	1000 Ω/V

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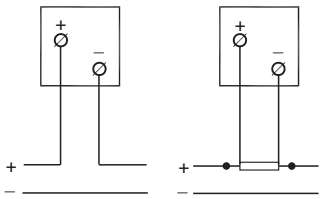
Standard Measuring Ranges

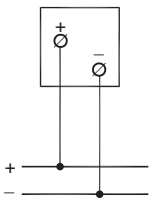
DC Voltage	DC Current
15 mV	100 µA
25 mV	150 µA
40 mV	250µ A
60 mV	400 µA
100 mV	600 µA
150 mV	1 mA
250 mV	1,5 mA
400 mV	2,5 mA
600 mV	4 mA
1 V	6 mA
1,5 V	10 mA
2,5 V	15 mA
4 V	20 mA
6 V	25 mA
10 V	40 mA
15 V	60 mA
25 V	100 mA
40 V	150 mA
60 V	250 mA
100 V	400 mA
150 V	500 mA
250 V	600 mA
300 V	1 A
400 V	1,5 A
500 V	2,5 A
600 V	4 A
	6 A
	10 A
	15 A
	25 A (except PQ35n)
	40 A (except PQ35n)
	60 A (except PQ35n)
	100 A (except PQ48n/PQ35n)
For connection to shunt	Standard signals
.../60 mV secondary	20 mA
.../150 mV secondary	4-20 mA
.../300 mV secondary	1 mA

Connection diagrams

Ammeter

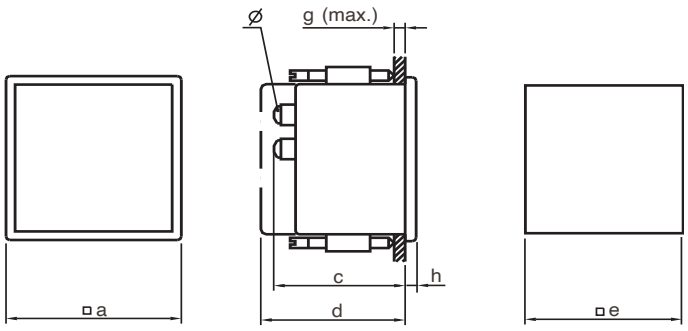


Voltmeter



Dimensions in mm / Weight in gramme

Type		a	c	d	e	g	h	Ø	Weight
PQ 48n	< 5... 60 A	48	70	73	45 $^{+0,6}$	28	5	M6	205
	others	48	55	62	45 $^{+0,6}$	28	5	M4	150
PQ 72n	> 60 A	72	81	-	68 $^{+0,7}$	8[1]	5	M8	285
	5... < 60 A	72	70	75	68 $^{+0,7}$	8[1]	5	M6	265
	others	72	55	75	68 $^{+0,7}$	8[1]	5	M4	210
PQ 96n	> 60 A	96	81	-	92 $^{+0,8}$	8[1]	5	M8	350
	5... < 60 A	96	70	75	92 $^{+0,8}$	8[1]	5	M6	330
	others	96	55	75	92 $^{+0,8}$	8[1]	5	M4	275
PQ 144n	> 60 A	144	81	-	138 $^{+1}$	40	8	M8	505
	5... < 60 A	144	70	75	138 $^{+1}$	40	8	M6	485
	others	144	53	64	138 $^{+1}$	40	8	M4	430
PAQ 48n	10... 40 A	48	70	73	45 $^{+0,6}$	26	5	M6	230
	others	48	53	64	45 $^{+0,6}$	26	5	M4	210
PAQ 72n	> 60 A	72	78	-	68 $^{+0,7}$	40	5	M8	320
	6... < 60 A	72	68	-	68 $^{+0,7}$	40	5	M6	385
	others	72	53	64	68 $^{+0,7}$	40	5	M4	290
PAQ 96n	> 60 A	96	78	-	92 $^{+0,8}$	40	5	M8	395
	6... < 60 A	96	68	-	92 $^{+0,8}$	40	5	M6	460
	others	96	53	64	92 $^{+0,8}$	40	5	M4	370
PAQ 144n	> 60 A	144	78	-	138 $^{+1}$	40	8	M8	680
	6... < 60 A	144	68	-	138 $^{+1}$	40	8	M6	720
	others	144	53	64	138 $^{+1}$	40	8	M4	650



Instruments with contacts

The contact instruments combine an electronic relay with a measuring instrument. They can be used in a wide range of applications, including all those cases in which it is required to control a quantity within a specified range of values.

There are different types, in order to control:

- Direct current or voltage (type PQC)
- Alternating current or voltage (type EQC)

There are different versions, according to the control type:

- Diffrent type (.../1): They have one control channel for controlling the minimum value, and another one for the maximum value.
- Cascade type (.../2): They have two control channels, for two maximum set points..

Each channel is completely independent, and controls an output relay, with potential-free change-over contacts. The set point is adjusted by means of a potentiometer at the rear side of the instrument, between 0 and 100% of the measuring instrument. With a second potentiometer it is possible to set a time delay from 0 to 30 seconds, since the set point limit is reached till the tripping of the relay. This is optically signalled by a red LED on the dial of the instrument. The delays are not accumulative, so that an oscillation around the set point doe not cause the tripping, unless its period be long enough.

Each instrument combines an electromechanical measuring system and an electronic circuit for the control of the output relays. The measuring system are:

- EQC: Moving iron system, with silicone oil damping.
- PQC: Self-shielded moving coil system, with core magnet.

All of them use hairsprings for the creation of the restoring torque, and pivot suspension with spring loaded jewel bearings for vibration and shock resistance.

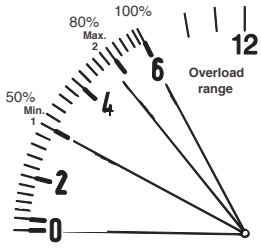
EQC:	EQC 96s/1	1 max. and 1 min. contact
	EQC 96s/2	2 max. (or 2 min.) contacts
PQC:	PQC 96s/1	1 max. and 1 min. contact
	PQC 96s/2	2 max. (or 2 min.) contacts
ISE/2:	1 contact, switches at wrong phase sequence	

Versions

Differentiated regulation: (.../1)

(Minimum contact at 50 % and maximum contact at 80 %)

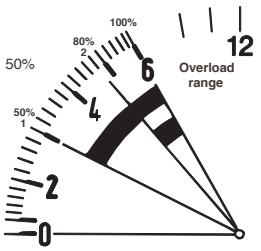
As long as the pointer is in the working range, e.g. the measuring value is higher than 50 % and less than 80 % both channels and both illuminating diodes on the scale are inactivated. If the measuring value sinks under 50 % e.g. the pointer is between 0 and 50 % so the channel I is activated, the minimum contact has switched and the illuminating diode on the scale is lighting. If the measuring value is higher than 80 % and 100 % so the channel II is avticated, the maximum contact has switched and the illuminating diode for channel II is lighting while channel I is inactivated again.



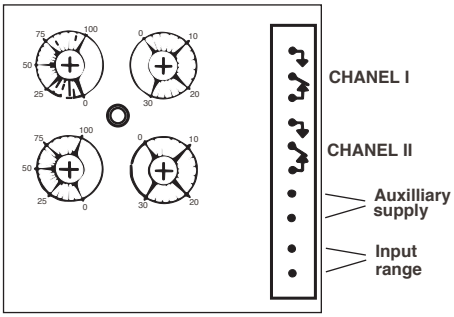
Step regulation : (.../2)

(2 maximum contact at 50 % and at 80 %)

The working range is between 0 and 50 % of the scale. If the measuring value is under 50 % both channels and illuminating diodes are inactivated and the first maximum contact was switched on. If the measuring value reaches 80 % or more both channels are activated, e.g. also channel II is switched on and both illuminating diodes are lighting.



Rear view:



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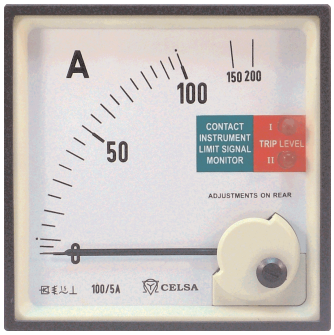
EQC96n - Moving iron instrument with electronic limit control



- For AC current and AC voltage
- Class 1,5

Backside adjustment

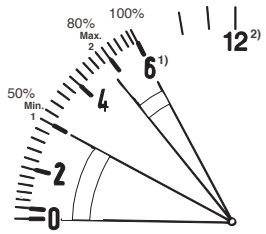
Description

Moving-iron movement with silicone oil damping with an additionally electronic limit control.Pivot suspension with spring loaded jewel bearings for vibration and shock resistance.

Auxilliary supply:	230 V ~ ± 10 % (50-60 Hz)
	other voltages on request
Output relays:	2 changeover relays, potential free
Hysteresis:	2 % of the full scale
Repetibility:	1 % of the full scale
Adjustment	
with potentiometer:	from 0 to 100 % of the nominal range of scale[1] Tolerance ± 5 %
Time delay:	0 to 20 sec. ± 3 sec.

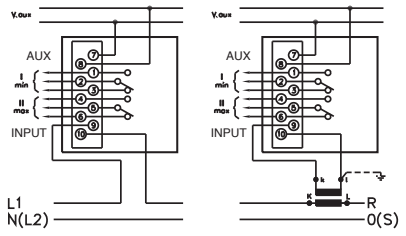
[1] Nominal current input range

[2] Nominal 100 % for voltage inputs or ammeter without overload.

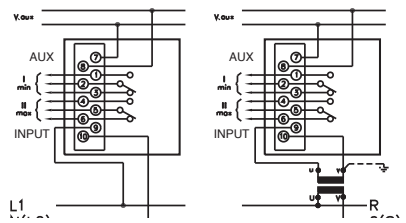


Connection diagrams

Ammeter



Voltmeter



Technical Features

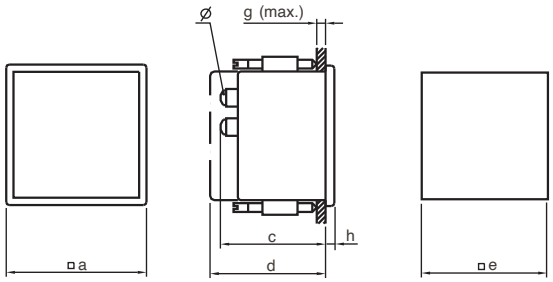
Type		EQC 96n/1	EQC 96n/2 max. EQC 96n/2min.
Front frame	(mm)	96 x 96	96 x 96
Scale length	(mm)	94	94
Weight	(g)	540	540
Output relay		1 max. + 1 min.	2 max. (or 2 min)
Burden auxiliary supply	(VA)	3	3

Standard Measuring Ranges

AC Voltage AC	AC Current
6 V	
10 V	100 mA
15 V	150 mA
25 V	250 mA
40 V	400 mA
60 V	600 mA
100 V	1 A
150 V	1,5 A
250 V	2,5 A
300 V	4 A
400 V	6 A
500 V	
600 V	
For voltage transformers	For current transformers
.../ 100 V secundario	.../ 1 A
.../ 110 V secundario	.../ 5 A

Dimensions en mm

Type	a	c	d	e	g	h	Terminals
EQC 96n	96	99	-	92 $^{+0,8}$	26	5,5	Screw terminals



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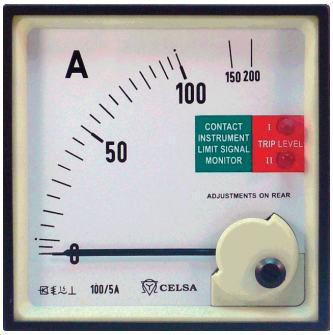
PQC96n - Moving coil instrument with electronic limit control



- For DC current and DC voltage
- Class 1,5

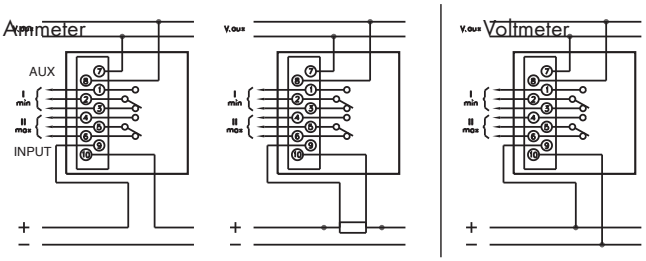
Backside adjustment

Description

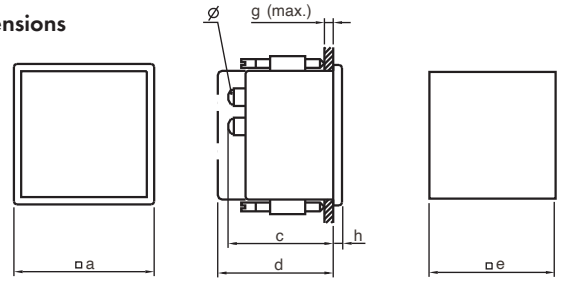
Self-shielding moving-coil system, with core magnet and hairsprings for the creation of the restoring torque, with an ddditionally electronic limit control. Pivot suspension with spring loaded jewel bearings for vibration and shock resistance.

Auxilliary supply:	230 V ~ ± 10 % (50-60 Hz) other voltages on request
Output relays:	2 changeover relays, potential free
Hysteresis:	2 % of the full scale
Repetibility:	1 % of the full scale
Adjustment with potentiometer:	from 0 to 100 % of the nominal range of scale[1]) Tolerance ± 5 %
Time delay:	0 to 30 sec. ± 3 sec. Tolerance ± 5 %

Connection diagrams



Dimensions



Características Técnicas

Type		PQC 96n/1	PQC 96n/2 max. PQC 96n/2min.
Front frame	(mm)	96 x 96	96 x 96
Scale length	(mm)	94	94
Weight	(g)	540	540
Output relay		1 max. + 1 min.	2 max. (or 2 min)
Burden auxiliary supply (VA)		3	3

Standard Measuring Ranges

DC Voltage		DC Current	
40 mV	5 V	20 µA	4 mA
50 mV	6 V	25 µA	5 mA
60 mV	10 V	40 µA	6 mA
100 mV	15 V	50 µA	10 mA
150 mV	25 V	60 µA	15 mA
250 mV	40 V	100 µA	20 mA
300 mV	50 V	150 µA	25 mA
400 mV	60 V	200 µA	40 mA
500 mV	100 V	300 µA	50 mA
600 mV	150 V	400 µA	60 mA
800 mV	250 V	500 µA	1 A
1 V	300 V	600 µA	1,5 A
1,5 V	400 V	1 mA	2,5 A
2,5 V	500 V	1,5 mA	4 A
		2,5 mA	5 A
For connection to shunt .../ 60 mV .../ 150 mV		Standard signals 20 mA 4-20 mA 1 mA	

Dimensions in mm

Type	a	c	d	e	g	h	Terminals
PQC 96n	96	99	-	92 $^{+0,8}$	26	5,5	screw terminals

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