

The Company and its Products

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GEC ALSTHOM T&D Protection & Control Limited is part of GEC ALSTHOM, one of the largest electrical power generation, transmission and distribution groups in the world.

It is an acknowledged world leader in the design and production of relays and instrumentation. This position has been achieved through a continuing policy of increasing investment in new product development.

The Company is represented all over the world and has its British base at Stafford.

GEC ALSTHOM T&D Protection & Control markets a quality range of electrical instrumentation serving the control requirements of the power generation, transmission, distribution and process markets.

This product range includes:

- Panel instruments (conforming to DIN, BS and ANSI standards)
- Istat electrical transducers
- MotorMaster motor protection relays
- Novar capacitor controllers
- R30 chart recorders
- Rotary and discrepancy switches
- Battery monitors
- PRIMA auxiliary relays

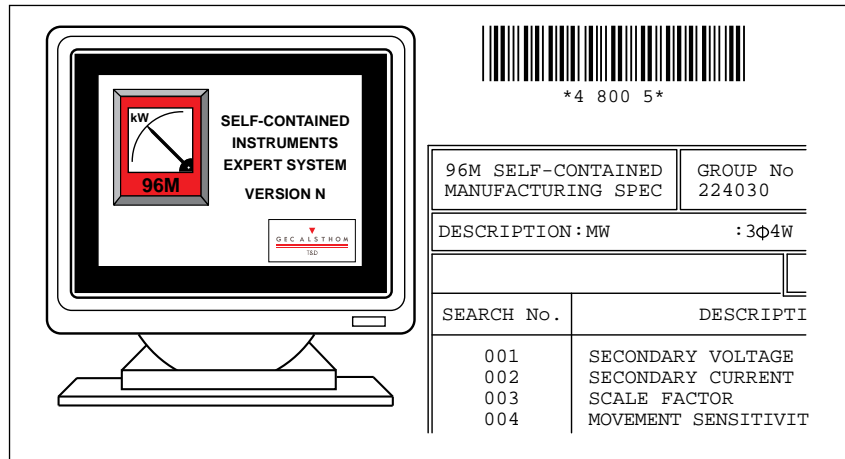
Expert technical support for product selection, application and after service is available through a network of over 80 established representatives around the world.

Manufacturing Facilities

The latest technologies are used in our order processing to minimise human error, enhance product reliability and improve service. Some of the innovative facilities are described below.

Expert system for order processing

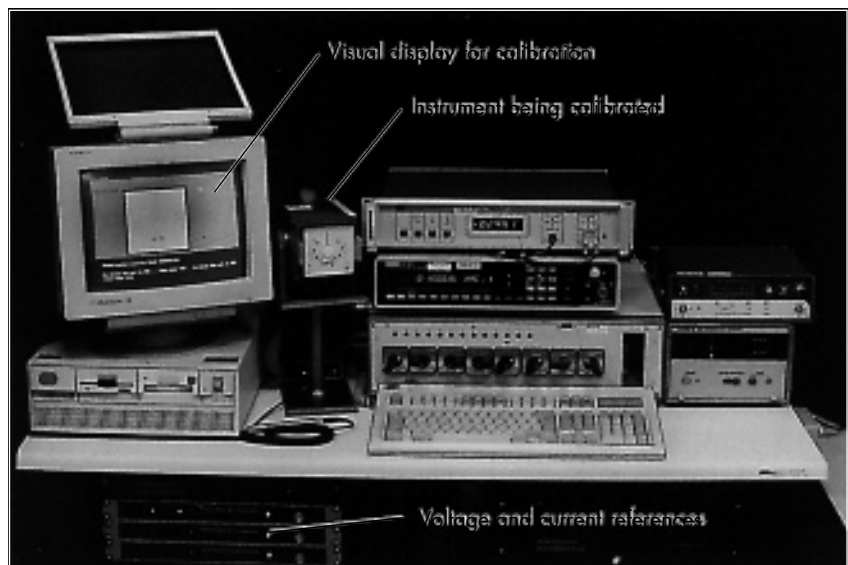
This database is used to produce manufacturing specifications and detail the variable components associated with the individual calibrations required for power instrumentation. This ensures repeatability, via model number, the next time a specific model type has to be produced. The computer also produces a series of bar codes which are used to generate the necessary labels and to identify the instrument in the manufacturing process.



Calibration data from test routines is used to produce scale shape.

Computerised testing

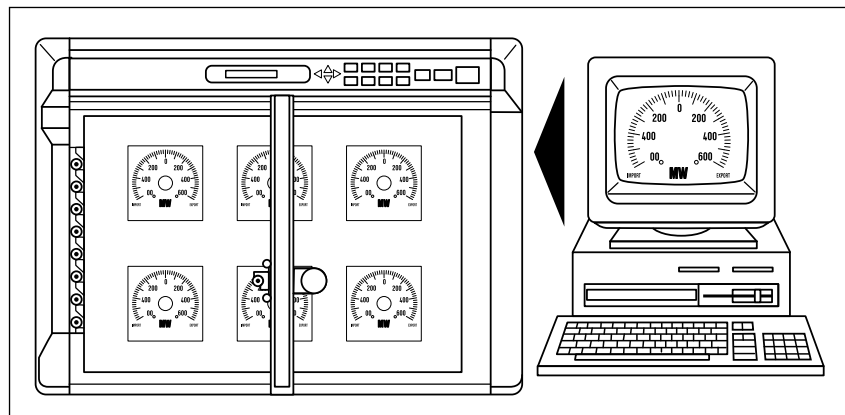
The computer configures the test bench for the given instrument application by reading the accompanying bar code using a light pen. A series of test routines is performed to generate the calibration information required to draw the instrument scale.



Computer aided test bench for self-contained power instruments

Automated dial marking

Dials are drawn from the calibration information generated by the test bench. The operation is controlled to ensure uniformity of appearance between instrument dials and permit multiple dials to be drawn.



Automatic dial marking using pen plotter.

The Metrik Range

The Metrik range of indicating instruments is suitable for both panel and switchboard mounting to monitor all power system parameters.

Features

- Models available in four sizes with 48mm, 72mm, 96mm and 144mm square bezels
- Housings manufactured from flame retardant material
- AC moving iron instruments utilise robust pivot and jewel movements and are true RMS sensing
- DC moving coil instruments incorporate taut band movements with low burdens
- Full range of self contained power instruments
- 90° and 240° scales available for most types of measurement with flat scale plates
- All 90° moving coil and moving iron instruments have slide-in scales
- Square bezel permits edge to edge mounting
- Single hole panel fixing
- Manufactured in an accredited ISO9001 environment
- Many items available ex-stock from our ISO9002 accredited Stock Centre

Benefits

- Suitable for all sizes of panel and all types of application
- Provides added safety and durability
- Suitable for use in areas of high vibration such as on generating equipment
Give accurate readings under harmonic rich conditions
- Especially suited for use with transducers for remote indication
- Less wiring and mounting space required than when using separate transducers and instruments
- Allows easy and accurate reading
- Simple modification for power system expansion. Panel manufacturers can stock a small range of movements to cover a wide range of requirements
- Maximises use of panel space
- Reduces installation costs
- Ensures highest quality and reliability
- Rapid delivery to site

Optional Features

The following optional features are available and must be requested at the time of order.

Scales

- Blank dials with pencil dots
- Non standard scale markings
- Non standard titles (non electrical quantities)
- Subtitles
- Endscale markings
- Dual scales (except 48mm)
- Spare scales (on loose dial plates)
- Black scale: white markings
- Centre zero scales
- Offset zero scales
- Right hand zero scales (240° only)
- Red line at position specified by customer
- Coloured markings: arcs or zones

Calibration

- Calibration at angle other than vertical
- Calibration to Class Index of 1.0
- Calibration at specified frequency other than 50Hz or 60Hz
- Terminal resistance other than standard
- Suppressed zero, mechanical or electrical
- Double rated instruments
- Certificates of test/conformance

Construction

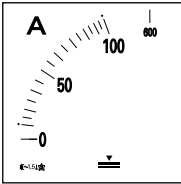
- Standard tropical finish, (sealing classification to permit operation at -10°C to +55°C at 98% relative humidity for 4 days)
- BASEEFA specification (240° moving coil only)
- Panel gaskets except 144mm
- Coloured bezels
- Adjustable red index pointer
- Low reflection glass window
- Toughened glass window
- Tagging

Instrument Scales

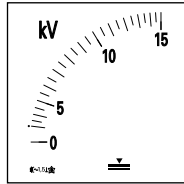
The following notes may be used as a guide to detail your scaling requirements:

Typical Instrument Scales

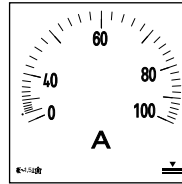
Moving iron instruments have compressed scales.



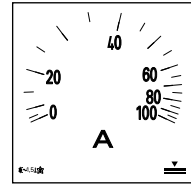
Short scale ammeter with 6 x overload for use on motor control gear.



Short scale voltmeter for use with 11kV/110V voltage transformer.

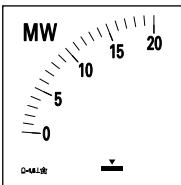


Long scale ammeter.

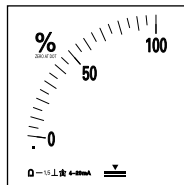


Long scale ammeter scaled to ESI 41-26.

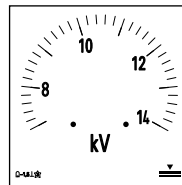
Moving coil instruments, including self contained power instruments, have linear scales.



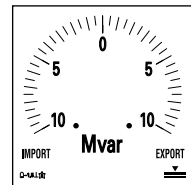
Short scale.



Short scale 4 ... 20mA electronically suppressed milliammeter.



Long scale 50% mechanically suppressed voltmeter.



Long scale centre zero varmeter.

Endscale values

Recommended endscale values

1	1.2	1.5	2	2.5	3	4	5	6	7.5	8	9
10	12	15	20	25	30	40	50	60	75	80	90
100	120	150	200	250	300	400	500	500	750	800	900
1000	1200	1500	2000	2500	3000	4000	5000	6000	7500	8000	9000

Scale selection

Moving iron ammeters

For CT operated instruments the scale selected is normally the same value as the CT Primary. For direct connected ammeters 20% continuous overload may be expected at peak times and the scaling should therefore take this into account.

Moving iron voltmeters

To allow for a healthy overload 20% overscale is normally added to the VT primary with selection to nearest recommended endscale value.

eg: 6.6kV VT +20% (7.92) Select scale 0 – 8kV.

Moving coil ammeters Milliameters

The majority of moving coil ammeters are transducer operated and therefore the scaling is normally equal to the transducer input.

Moving coil voltmeters Millivoltmeters

For millivoltmeters operated from DC shunts the scaling is normally equal to the primary shunt rating. Centre zero scaling for shunt operated millivoltmeters is sometimes required.

Rectified moving coil Power instruments

Refer to 'Moving iron' above.

Scaling is normally derived from the system VA

eg: for 3 phase 3 wire balanced load

VT: 11kV/110V CT: 800/5A

System rated at 15.25 MVA

Add 20% for healthy overload (18.29 MVA)

Select recommended end scale value 0...20.

Maximum demand ammeters Scaling is calculated at 120% of nominal current.

eg: for CT ratio of 400/5A

Scaling would be 0...480A corresponding to rating of 6A.

General Specifications

Specifications are in accordance with UL94VO (flame retardancy), DIN 43 700 (dimensions), DIN 43 802 (scales) and BS89 Part 1:1970, VDE 0401/10/59 and IEC 51 (performance).

Accuracy

Most instruments are calibrated to a Class Index (CI) of 1.5 as standard although certain instruments can be calibrated to a CI of 1.0 on request. A CI of 1.5 signifies an error of up to $\pm 1.5\%$ of full scale.

Voltage influence

Maximum additional error is not more than $\pm 1.5\%$ indication for $\pm 15\%$ voltage variation.

Frequency influence

For variations from nominal of $\pm 10\%$, the maximum additional error is $\pm 0.5\%$ of indication.

Power factor influence

For variations between unity and 0.5 lag or lead at any power factor up to half scale, the maximum additional error is $\pm 0.5\%$ of full scale deflection.

Between unity and zero p.f. lag or lead the maximum additional error is $\pm 1.0\%$ of full scale deflection.

Temperature influence

Maximum additional error is $\pm 0.05\%$ per $^{\circ}\text{C}$.

Operating temperature range

-10°C to $+55^{\circ}\text{C}$
(unless otherwise specified).

Relative humidity

Standard 90% RH for 4 days.

Tropicalised instruments for more onerous conditions can be provided on request.

Ingress protection

IP52 in accordance with IEC 529.
Improved rating available on request.

Dielectric level

2kV (rms) for one minute between movement and case.

Position of use

Vertical (unless otherwise specified).

Full scale deflection angle

Quadrant scale:	90°
Long scale:	240°
Synchrosopes and 4 quadrant PFI:	360°

Scale length (mm)

Size	Quadrant scale	Long scale
48mm	41	65
72mm	62	105
96mm	92	149
144mm	135	222

Pointer

Conforms to DIN 43 802

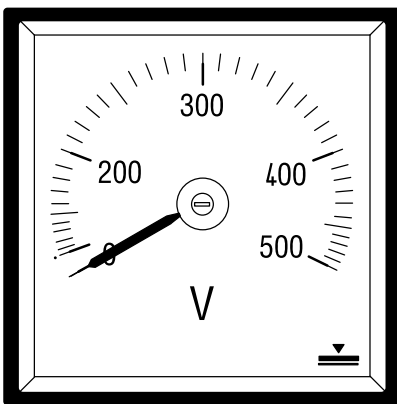
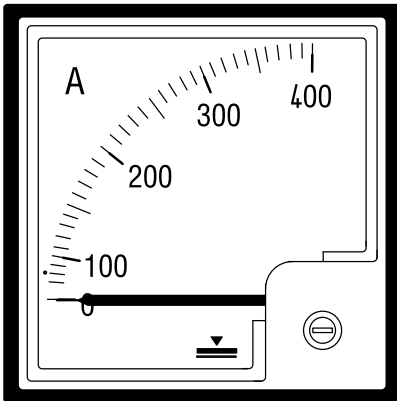
Scale plate

Flat. Graduation and markings to DIN 43 802

Case material

48mm, 72mm, 96mm, 144mm (90°):	Polycarbonate
144mm (240°):	Steel

Moving Iron Ammeters and Voltmeters



Moving iron indicators are suitable for a wide range of ac applications reading the true RMS value of the measured signal and are therefore well suited to use in harmonic rich environments.

They can be direct connected or transformer fed.

Instrument	Type reference	Range (ac)		Burden (VA)
		Min.	Max.	
48mm				
90° Ammeter	A48DI	100mA	40A	1.2
90° Voltmeter	V48DI	5V	600V	1.0
72mm				
90° Ammeter	A72DI	100mA	100A	0.6
240° Ammeter	A72LI	100mA	30A	0.8
90° Voltmeter	V72DI	5V	600V	2.1
240° Voltmeter	V72LI	5V	600V	1.9
96mm				
90° Ammeter	A96DI	100mA	100A	0.6
240° Ammeter	A96LI	100mA	30A	0.8
90° Voltmeter	V96DI	5V	600V	2.1
240° Voltmeter	V96LI	5V	600V	1.9
144mm				
90° Ammeter	A14DI	100mA	100A	1.7
240° Ammeter	A14LI	100mA	30A	2.1
90° Voltmeter	V14DI	20V	600V	4.3
240° Voltmeter	V14LI	20V	600V	6.0

Frequency 50Hz or 60Hz

AC Voltage

Overload ratings 1.2 x rated voltage continuously.
2 x rated voltage for 5s.

AC Current

2 x rated current continuously.
10 x rated current for 5s.

Ammeters for use on motor control gear are available with scales marked 6 x rated current. This value can be withstood for 15s.

Accuracy Class Index 1.5

Class Index 1.0 available on most long scale instruments

Class Index 1.5

Class Index 1.0 available on most long scale instruments

Information required with order

Type reference

Details of required scale and any optional features

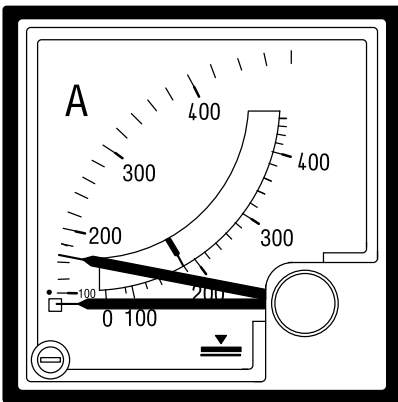
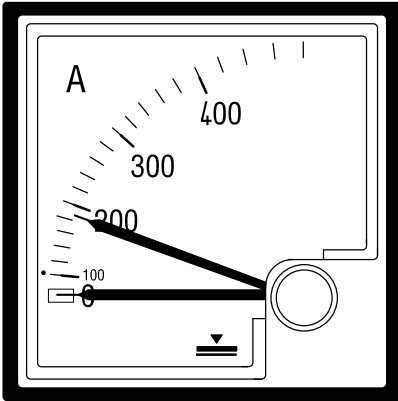
Details of required electrical rating or input transformer ratio and frequency

Example: Type reference A96LI
CT ratio 200/5A, 50Hz

Scale 0...200A

Supply with adjustable red index pointer

Maximum Demand Ammeters



The standard thermal demand ammeter displays the maximum average load for all types of electrical equipment. Operated on the bi-metal strip principle, the instrument is robust, reliable and sustains accuracy under extremes of ambient temperature. Due to an inherent time lag, the instrument is unaffected by momentary or short duration overloads.

A dual purpose version capable of both thermal and instantaneous indication is available. This comprises a thermal ammeter plus an instantaneous moving iron ammeter combined in a common case. Both versions offered can be supplied with or without a saturable current limit transformer accommodated within the instrument case.

Instrument	Type reference		
	72mm	96mm	144mm
Thermal unit only Time lag 8, 15, or 20 mins Time lag 30 mins	M72D	M96D M96Q	M14D
Combined unit Time lag 8, 15 or 20 mins Time lag 30 mins	M72DA	M96DA M96QA	M14DA

Current

5A standard, 1A available on request

Overload ratings

Designs with saturable CT, 40 x rated current for 0.5 second. This can be repeated 3 times at intervals not less than 1.5 seconds. Directly connected designs, 4 x rated current for 10 seconds.

Ambient temperature compensation range

-10°C to +60°C

Burdens

These are calculated at nominal current where scaling is 0 to 120% of the nominal value. That is, nominal current 5A and scaling 0 to 6A.

Item	Burden (VA)
Thermal movement	4.4
Thermal movement with current limit transformer	6
Moving iron movement	0.6 (additional)

Accuracy

Movement Class Index

Thermal	3.0
Moving iron	2.5

Information required with order

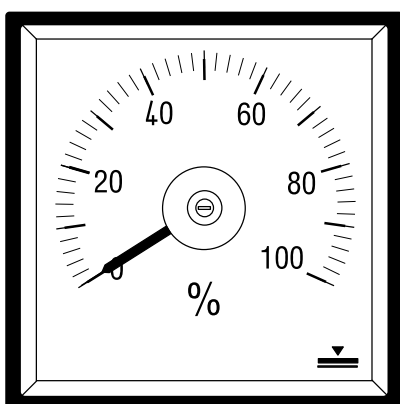
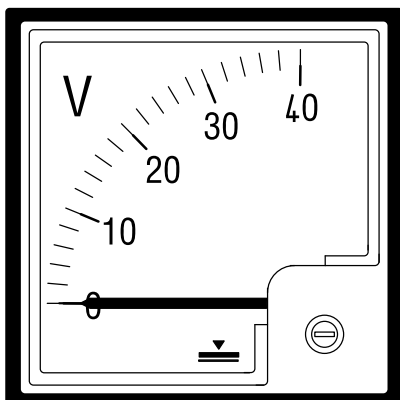
Type reference

CT ratio and frequency

Time lag

Example: Type reference M96DA
CT ratio 200/5 A, 50Hz
Time lag 20 mins

Moving Coil Ammeters and Voltmeters



Moving coil instruments are suitable for a wide range of dc applications, particularly for remote indication when used with a suitable transducer (see publications I4-025 and I4-028 for Istat 300 transducers).

Rectified instruments are available for ac applications and have a low burden. Scales are linear and can be drawn to suit customer specification together with any chosen title.

If a suppressed zero scale of greater than 50% is required, an expanded scale voltmeter can be supplied. Details provided on request.

Instrument	Type reference (See note)	Range	
		Min.	Max.
48mm			
90° Ammeter	A48DC	100µA dc	60A dc
	A48DR	1mA ac	60A ac
240° Ammeter	A48LC	500µA dc	60A dc
	A48LR	1mA ac	60A ac
90° Voltmeter	V48DC	50mV dc	600V dc
	V48DR	5V ac	600V ac
240° Voltmeter	V48LC	75mV dc	1000V dc
	V48LR	5V ac	1000V ac
72mm			
90° Ammeter	A72DC	100µA dc	60A dc
	A72DR	1mA ac	60A ac
240° Ammeter	A72LC	500µA dc	60A dc
	A72LR	1mA ac	60A ac
90° Voltmeter	V72DC	50 mV dc	600V dc
	V72DR	5V ac	600V ac
240° Voltmeter	V72LC	75mV dc	1000V dc
	V72LR	5V ac	1000V ac
96mm			
90° Ammeter	A96DC	100µA dc	60A dc
	A96DR	1mA ac	60A ac
240° Ammeter	A96LC	500µA dc	60A dc
	A96LR	1mA ac	60A ac
90° Voltmeter	V96DC	50mV dc	600V dc
	V96DR	5V ac	600V ac
240° Voltmeter	V96LC	75mV dc	1000V dc
	V96LR	5V ac	1000V ac
144mm			
90° Ammeter	A14DC	100µA dc	60A dc
	A14DR	1 mA ac	60A ac
240° Ammeter	A14LC	500µA dc	60A dc
	A14LR	1mA ac	60A ac
90° Voltmeter	V14DC	50mV dc	600V dc
	V14DR	5V ac	600V ac
240° Voltmeter	V14LC	75mV dc	1000V dc
	V14LR	5V ac	1000V ac

Note: Type references ending in C are for dc ratings: ac ratings are denoted by the letter R.

Movement resistances for dc milliammeters – Refer to factory

Frequency	AC rectifier instruments are calibrated on a sinusoidal waveform at 50Hz, but are suitable for use without significant error on any frequency from 20Hz to 10kHz (2.5kHz when internal CT is used).		
Overload ratings	AC and DC ammeters:	1.2 x rated current continuously 10 x rated current for 5s	
	AC and DC voltmeters	1.2 x rated voltage continuously 2 x rated voltage momentarily	
Standard sensitivity of voltmeters	1000 ohms per volt Shunt leads are available up to 7 metres long for connection between dc ammeter and external shunt.		
Accuracy		DC instruments	AC instruments
	Quadrant scale	1.5	2.5
	Long scale	1.5	1.5
	Class Index 1.0 available on most long scale instruments on request.		

Information required with order

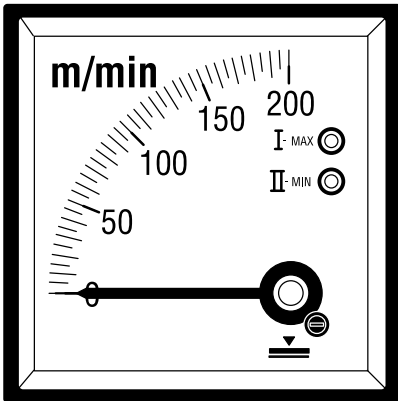
Type reference

Details of required scale and optional features

Details of required electrical rating or input transformer ratio and frequency

Example: Type reference A96LC
 0...10mA
 Scale 0...200A
 Supply with adjustable red index pointer

Meter Relays



Meter relays combine indication and control of ac or dc voltages and currents. They can be used with a variety of transducers or sensors and have a wide range of applications in the electrical and process industries.

Indication is by means of accurate and robust moving iron or moving coil movements. Each instrument has two independently adjustable alarm or control points which can be set anywhere on the scale by back-of-panel potentiometers. Two relay outputs are provided with adjustable time delay on pick-up or drop-off. The relays are available in combinations of high and low, two low or two high alarms: the configuration needs to be specified with order. LED indicators display when either of the two indicators trip.

Instrument reference	Type	Range	
		Min.	Max.
AC Moving Iron	C96DI	100mA 6V	5A 600V
DC Moving Coil	C96DC	15 μ A 10mV	5A 600V
AC Moving Coil	C96DR	15 μ A 60mV	5A 600V

Auxiliary supply	AC 110V, 120V, 220V, 240V (-10...+15%)	DC With an external dc/dc converter 12V, 24V, 48V, 110V (-10...+15%)
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Trip settings Each relay is independently adjustable in the range 0...100% of FSD by secure rear mounted potentiometers	Accuracy $\pm 5\%$ of FSD	Hysteresis 1% of FSD
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Time delay Each relay has an independently adjustable time delay in the range 0.6...30s
These can either apply on pick-up or drop-off.

Output relays Two changeover contacts
500VA (Max. 250V or 5A ac)

Frequency The indicating and alarm functions will operate satisfactorily over the frequency range 40...70Hz

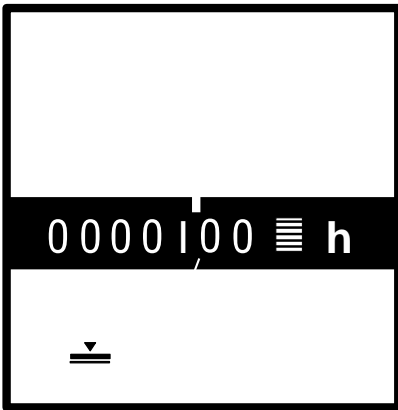
Burden	AC Inputs 4VA	DC inputs 5VA
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Information required with order

- Type reference
- Details of required scale and any optional features
- Details of required electrical rating
- Details of required auxiliary supply
- Time delay on pick-up or drop-off
- Relay configuration

Example: Type reference C96DC
Time delay on pick-up of high and low relays
Scale 0...100 M/MIN
Rating 0...10mA dc
Auxiliary supply 110V dc

Elapsed Time Meters



The seven digit cyclometer type indicator displays the cumulative operating time in hours for equipment such as X-ray machines, ventilating and heating systems, electronic valves, generators, stand-by pumps and furnaces.

The information helps in planning of maintenance schedules so that breakdowns in service are avoided.

Energised from the same power source as the apparatus being monitored, AC models are available in 48mm, 72mm and 96mm cases.

Instrument	Type reference
48mm	T48D
72mm	T72D
96mm	T96D

Standard input voltages AC

24V, 110V, 220/240V
(+10%, -15%)

DC

24V, 48V, 110V, 220/240V
(+10%, -10%)

Frequency

50Hz or 60Hz

Burden

2VA nominal

Registers

4mm high digits reading up to 99,999.99

Resolution

36 seconds

Information required with order

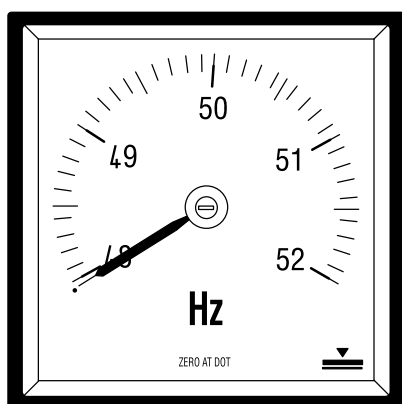
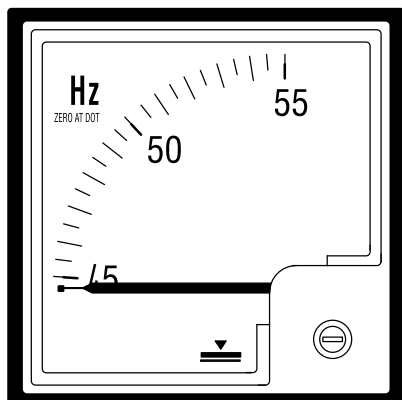
Type reference

Details of required electrical rating and frequency

Example: Type reference T96D

Rating 110V dc

Self-contained Frequency Meters



Instruments for local indication are usually supplied as self-contained units in sizes 72mm, 96mm and 144mm. Each instrument incorporates a moving coil movement driven by an internally mounted static circuit.

For remote indication, moving coil instruments can be supplied to operate with transducers from the GEC ALSTHOM T&D 'Istat 300' range. (See publications I4-025, I4-028).

Instrument	Type reference	Class
90° 72mm 96mm 144mm	F72D F96D F14D	0.5 0.5 0.5
240° 72mm 96mm	F72L F96L	0.5 0.5

Standard ranges: 45...55Hz
48...52Hz
55...65Hz
58...62Hz

Information required with order

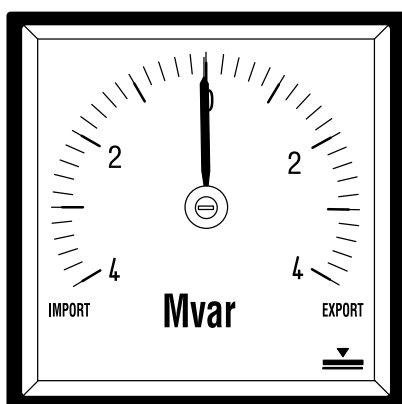
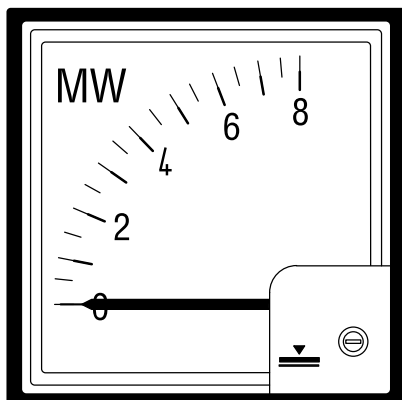
Type reference

Details of required scale and any optional features

Details of required electrical rating

Example: Type reference F96L
Scale 45...55Hz
Rating 110V

Self-contained Wattmeters and Varmeters



Instruments for local indication are usually supplied as self-contained units in sizes 96mm and 144mm. Each instrument incorporates a moving coil movement driven by an internally mounted static circuit.

For remote indication, moving coil instruments can be supplied to operate with transducers from the GEC ALSTHOM T&D 'Istat 300' range. (See publications I4-025, I4-028).

Instrument	Type reference	
	96mm	144mm
90° Wattmeter Single phase 3 phase 3 wire balanced load 3 phase 4 wire balanced load 3 phase 3 wire unbalanced load 3 phase 4 wire unbalanced load	W96QB1 W96QB3 W96QB4 W96QU3 W96QU4	W14QB1 W14QB3 W14QB4 W14QU3 W14QU4
240° Wattmeter Single phase 3 phase 3 wire balanced load 3 phase 4 wire balanced load 3 phase 3 wire unbalanced load 3 phase 4 wire unbalanced load	W96LB1 W96LB3 W96LB4 W96LU3 W96LU4	W14LB1 W14LB3 W14LB4 W14LU3 W14LU4
90° Varmeter Single phase 3 phase 3 wire balanced load 3 phase 4 wire balanced load 3 phase 3 wire unbalanced load 3 phase 4 wire unbalanced load	R96QB1 R96QB3 R96QB4 R96QU3 R96QU4	* R14QB3 R14QB4 R14QU3 R14QU4
240° Varmeter Single phase 3 phase 3 wire balanced load 3 phase 4 wire balanced load 3 phase 3 wire unbalanced load 3 phase 4 wire unbalanced load	R96LB1 R96LB3 R96LB4 R96LU3 R96LU4	* R14LB3 R14LB4 R14LU3 R14LU4

* Available as separate Istat 300 transducer and moving coil instrument.

Input ranges

Voltage 63.5V, 100V, 110V, 120V, 220V, 380V or 440V ac (Other inputs are available on request).	Current 1A or 5A ac	Frequency 50Hz or 60Hz
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Voltage range 70...120%	Current range 0...120%	Frequency range ±5Hz
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Burdens	Voltage 1.5VA	Current 0.3VA maximum
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Overload ratings	Voltage 1.2 x rated voltage continuously 2 x rated voltage for 5s	Current 3 x rated current 25 x rated current for 3s
-------------------------	--	--

Ambient temperature range -10°C to +60°C

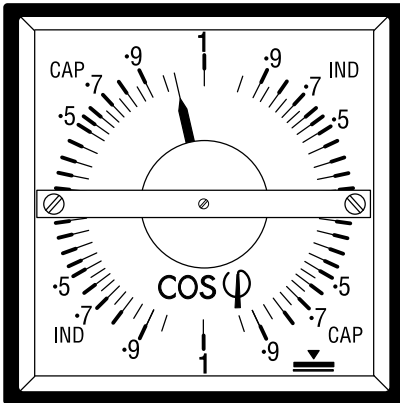
Accuracy Class Index 1.5
Class Index 1.0 available on long scale instruments on request.

Information required with order

Type reference
Details of required scale and any optional features
Details of CT and VT transformer inputs and frequency

Example: Type reference W96QB3
CT ratio 200/5A
VT ratio 11kV/110V
Frequency 50Hz
Scale 0...4MW

Self-contained Power Factor Indicators (Circular Scale)



These rugged moving iron indicators provide an accurate means to determine the power factor of a supply under any condition of load within specified limits, or to monitor the improvement when power factor correction equipment has been introduced.

The instrument measures accurately on reversal of power.

The upper and lower parts of the scale indicate demand and supply, export and import power factor respectively. These are marked from zero to unity inductive and capacitive (lag and lead).

Polyphase indicators are substantially free from frequency errors over the normal range, but single phase instruments are suitable for fixed frequency applications only.

A polyphase balanced load indicator is suitable for use up to 10% unbalanced load current.

An externally mounted phase splitting and voltage dropping unit is provided when one supply current transformer is used to feed a single phase or 3-phase 4-wire balanced load instrument. A voltage dropping unit is also provided above 150V for systems using two or three current transformers.

Instrument	Type reference	
	96mm	144mm
Single phase	P96RB1	P14RB1
3 phase 3 wire balanced load	P96RB3	P14RB3
3 phase 4 wire balanced load	P96RB4	P14RB4
3 phase 3 wire unbalanced load	P96RU3	P14RU3
3 phase 4 wire unbalanced load	P96RU4	P14RU4

Standard input ranges

Voltage	57.7V, 63.5V, 100V, 110V, 120V, 240V, 380V, 415V, 550V ac
Current	1A or 5A ac
Frequency	50Hz or 60Hz

Ambient temperature range -25°C to +40°C

Overload ratings

Voltage	1.2 x rated voltage continuously 2.0 x rated voltage momentarily	Current	1.2 x rated current continuously 10 x rated current momentarily
----------------	---	----------------	--

Burdens (at rated current and voltage)

System	Current circuit	Voltage circuit
Single phase	4.5VA	27mA
Polyphase balanced load (per circuit)	2.0VA	20mA
Polyphase unbalanced load (per circuit)	2.0VA	20mA

Accuracy For 40% to 120% of rated current input error 2 degrees electrical, that is, Class Index 2.5

Current influence
For 20% to 40% or 100% to 120% of rated current input – additional error 2 degrees electrical

Voltage influence
For ± 10% voltage variation from the nominal value – additional error 1 degree electrical

Unbalanced load influence
(i) Unbalanced load instrument which has one current input at 0.2 of the rated input additional error 4 degrees electrical
(ii) Polyphase balanced load instrument. For 10% unbalanced current – additional error 0.5 degrees electrical

Frequency influence
(i) Polyphase balanced and unbalanced load instruments additional error 0.25 degrees electrical per Hz
(ii) Single phase instrument – additional error 2 degrees electrical per Hz

Temperature influence
0.03 degrees electrical per °C

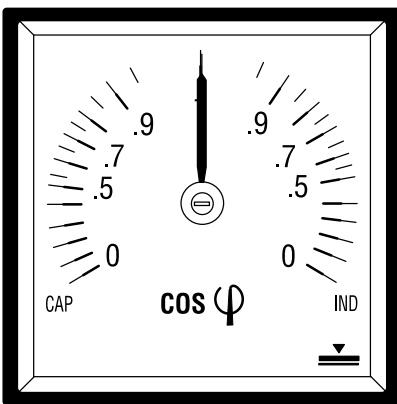
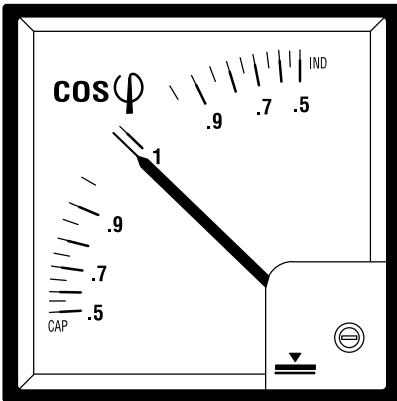
Information required with order

Type reference

Details of CT and VT transformer secondary inputs and frequency

Example: Type reference P96RU3
Current 5A
Voltage 110V
Frequency 50Hz

Self-contained Power Factor Indicators (Quadrant and Long Scale)



A self-contained indicator with quadrant and long scale is available in size 96mm.

The moving coil movement is driven by an internal transducer circuit.

Scales are central at unity and are available up to ± 180 electrical degrees.

For remote indication, moving coil instruments can be supplied to operate with transducers from the GEC ALSTHOM T&D 'Istat 300' range. (See publications I4-025, I4-028).

All instruments are 96 x 96 mm.

Instrument	Type reference
90° Single phase 3 phase 3 wire balanced load 3 phase 4 wire balanced load 3 phase 3 wire unbalanced load 3 phase 4 wire unbalanced load	P96QB1 P96QB3 P96QB4 P96QU3 P96QU4
240° Single phase 3 phase 3 wire balanced load 3 phase 4 wire balanced load 3 phase 3 wire unbalanced load 3 phase 4 wire unbalanced load	P96LB1 P96LB3 P96LB4 P96LU3 P96LU4

Standard Input Ranges Voltage

57.7V, 63.5V, 100V,
110V, 120V, 240V,
380V, 415V, 440V
ac

Current

1A or 5A ac

Frequency

50Hz or 60Hz

Voltage range

70...120%

Current range

20...200%

Frequency range

± 5 Hz

Burdens

Voltage circuit

1.5VA

Current circuit

0.3VA

Scales

0.5...1...0.5 cos ϕ
0...1...0 cos ϕ
1...0...1...0...1 cos ϕ

} lag upscale

Ambient temperature range

-10...+60°C

Frequency coefficient

± 0.5 degrees per Hz

Overload ratings

Voltage

1.2 x rated voltage continuously
2.0 x rated voltage for 5s

Current

3 x rated current continuously
25 x rated current for 3s

Accuracy

For 40% to 120% of rated current input
- error 2 degrees electrical, that is, Class Index 2.5

Current influence

For 20% to 40% or 120% to 200% of rated current input - additional error 2 degrees electrical

Voltage influence

For a voltage range of 70...120% of nominal, the variation does not exceed ± 2 electrical degrees

Unbalanced load influence

(i) Unbalanced load instrument which has one current input at 0.2 of the rated input - additional error 4 degrees electrical
(ii) Polyphase balanced load instrument. For 10% unbalanced current - additional error 0.5 degrees electrical

Temperature influence

0.03 degrees electrical per °C

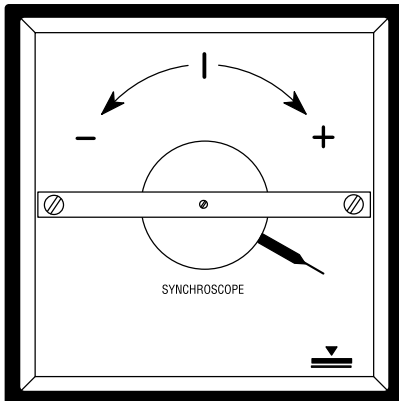
Information required with order

Type reference

Details of CT and VT transformer secondary inputs and frequency

Example: Type reference P96QB3
Current 5A
Voltage 110V
Scale 0.5...1...0.5 cos ϕ
Frequency 50Hz

Synchrosopes



A Synchroscope indicates the difference in phase angle and frequency between two alternators, or between an alternator and a supply system, when it is necessary to operate these in parallel. A zero difference is indicated when the pointer coincides with the synchronising mark and is stationary.

The speed and direction of the pointer shows whether the incoming machine is fast or slow. This is adjusted until the pointer is on the SLOW side of the synchronising mark, but moving very slowly in the FAST direction.

The incoming machine circuit can be closed when the pointer coincides with the synchronising mark. This method avoids imposing a momentary load on the running machine, or on the supply system. Although the synchroscope is a single phase instrument, it is used on polyphase systems and it is assumed that the phase relationships correspond.

Instruments are available in 96mm and 144mm cases. Each instrument below 150V input is provided with a separately accommodated phase splitter unit. Above 150V a similar unit with a phase splitter and voltage transformer is provided.

Instrument	Type reference
96mm	S96
144mm	S14

Standard input voltages Single phase 57.7V, 63.5V, 100V, 110V, 120V, 240V, 380V, 415V, 440V, 500V.

Although the instruments are intended for short period use only, those for 110V and below are continuously rated.

Instruments for higher voltages have a rating of 20 minutes.

Accuracy

These instruments generally comply with the requirements of BS89 & IEC51, with a maximum error of $\pm 2^\circ$ at synchronising point. This includes thermal error, voltage variation of $\pm 10\%$ from the nominal value, and temperature variation of $\pm 10^\circ\text{C}$ from the nominal (usually 20°C).

Voltage influence

For the 10% voltage variation from the nominal value - additional error 1 degree electrical.

Frequency influence

Additional error 0.1 degree electrical per Hz.

Position influence

For $\pm 5^\circ$ from the required mounting position - additional error 0.2 degree electrical.

Temperature influence

0.03 degree electrical per $^\circ\text{C}$.

Frequency difference

The pointer starts to rotate in the correct direction when the frequency difference between the incoming supply and the running supply has been reduced to 1.5Hz.

Frequency range

Between 47.5Hz and 51Hz for a 50Hz instrument.

Between 57.5 and 61Hz for a 60Hz instrument.

De-energisation

With one or both circuits de-energised, the pointer does not remain within 45 degrees of the synchronising mark.

Burdens

(at rated voltage)

Incoming 4.5VA Running 4.5VA

For voltages above 150V lamps are fed from VTs within the instrument internal box. Therefore it is essential, for correct calibration, to specify when ordering whether lamps are required bright or dark at synchronism.

For voltages up to 150V the lamps are fed from the main supply voltages so it is not necessary to state the use of the lamps. However, for lamps bright at synchronism, a polarity changing VT is necessary. This can be supplied, if specified on the order.

Information required with order

Type reference

Details of required electrical rating and frequency

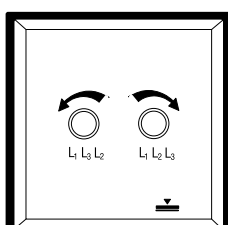
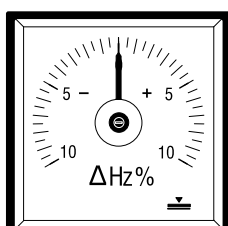
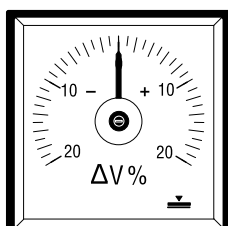
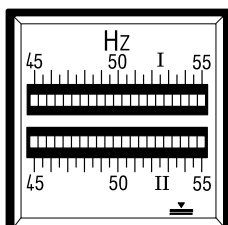
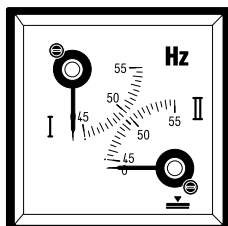
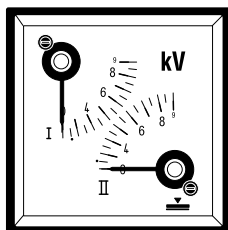
State whether lamps bright or dark at synchronism

Example: Type reference S96

Rating 110V, 50Hz

Lamps bright at synchronism

Self-contained Synchronising Instruments



Information required with order

Type reference

Details of required scale

Details of required electrical rating and frequency

Example: Type reference 2F96D

Scale 45...55Hz

Rating 110V, 50Hz

These types of instruments are used in synchronising schemes to ensure that the incoming and running supplies are of the same frequency, phase and voltage prior to connection.

Double Moving Iron Voltmeter, Class 1.5

This instrument can be fed either directly or from voltage transformers connected to each of the incoming and running supplies. Two quadrant scale moving iron movements are utilised.

Double Pointer Frequency meter, Class 0.5

This instrument can be fed either directly or from voltage transformers connected to each of the incoming and running supplies. Two quadrant scale movements are utilised. A choice of scales is offered to reflect the two standard operating frequencies:

Nominal frequency	Scale
50Hz	48...52Hz
60Hz	58...62Hz

Double Reed Frequency Meter, Class 0.5

This instrument differs from the pointer type in that the display is given by two rows of vibrating reeds, with 21 reeds per row. Two scales are offered as standard:

Nominal frequency	Scale
50Hz	45...55Hz
60Hz	55...65Hz

Differential Voltmeter, Class 1.5

This instrument is fed from two ac voltage supplies and displays the difference in percent of nominal volts. The scale supplied is $-20...0...+20\Delta V\%$ (+ indicates generator voltage is greater than line voltage).

Differential Frequency Meter, Class 0.3

This instrument is fed from two ac voltage supplies and displays the difference in frequency in percent of the nominal frequency.

The scale supplied is $-10...0...+10\Delta Hz\%$ (+ indicates generator frequency is greater than line frequency).

Phase Sequence Indicator

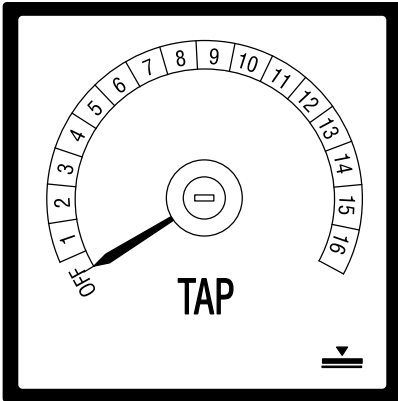
This instrument shows whether the phase rotation of the connected three phase supply is correct. Illumination of the red indicator shows incorrect phase rotation and green shows correct rotation.

Synchronising Instruments

Instrument	Type reference	Range (ac)		Burden
		Min.	Max.	
Double Moving Iron Voltmeter 96mm 144mm	2V96D	50V	500V	4VA
	2V14D	50V	500V	4VA
Double Pointer Frequency Meter 96mm 144mm	2F96D	50V	500V	1VA/ 100V
	2F14D	50V	500V	100V
Double Reed Frequency meter 96mm 144mm	2RF96D	50V	500V	1VA/ 100V
	2RF14D	50V	500V	100V
Differential Voltmeter 96mm 144mm	DV96D	50V	500V	2.5VA
	DV14D	50V	500V	2.5VA
Differential Frequency Meter* 96mm 144mm	DF96D	50V	500V	4VA
	DF14D	50V	500V	4VA
Phase Sequence Indicator 96mm 144mm	PSI96	100V	500V	3mA
	PSI14	100V	500V	3mA

* Note: Tolerance on line voltage supply is $\pm 15\%$.

Tap Position Indicators



Position indicators can be used for many remote monitoring applications.

For example, the positions of transformer taps, mechanical valves or sluice gates can be determined accurately.

Scale markings are kept to a minimum to present a clear pleasing appearance ensuring that the instruments can be read with ease from a distance of several feet. An internally mounted static circuit ensures that normal supply variations do not affect the stated accuracy.

Instrument	Type reference
144mm	U14L

Supply voltages

AC

63.5V, 100V, 110V, 120V,
220V, 380V, 415V, 440V
or 500V, 50Hz or 60Hz

DC

50V, 110V or 220V

Scales

Scales can be marked specifically for an application.

For example, a scale for a valve application may be marked as follows:

Shut $\frac{1}{4}$ $\frac{1}{2}$ $\frac{3}{4}$ Open

Accuracy

$\pm 1.5\%$ of scale length

Voltage influence

A static circuit is included which ensures that the effect of $\pm 10\%$ supply voltage variation does not affect the stated accuracy of indication.

When the the sensing resistor is positioned some distance away from the indicator the line impedance can affect the accuracy of indication. For example, an impedance of 10 ohms per line causes an indication error not greater than 0.25% at a 2.4k ohms sensing potentiometer.

Standard ranges – stepped resistors

Ohms per step	Minimum number of steps	Maximum number of steps
400	6	30

For special applications , resistance steps in excess of 30 can be arranged with a maximum resistance value between 480 ohms and 12k ohms.

Continuously variable potentiometers within the range 2.4k ohms to 12k ohms are available to suit customer's requirements for full scale deflection.

Information required with order

Type reference

Details of required electrical rating and frequency

Number of taps and resistance per tap

Scale required

Example: Type reference U14L

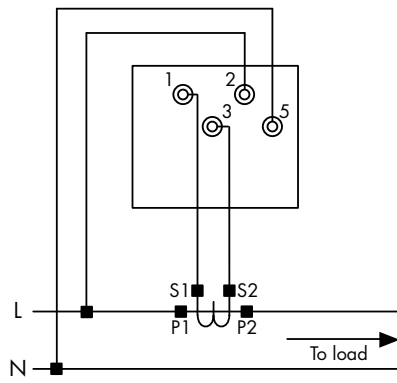
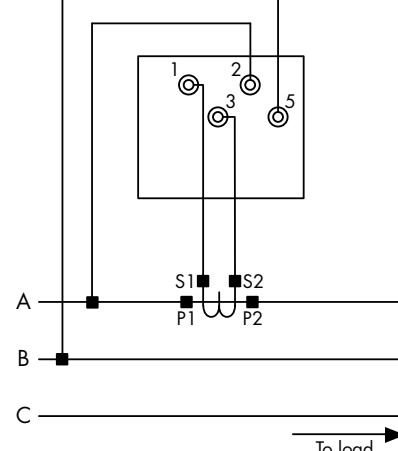
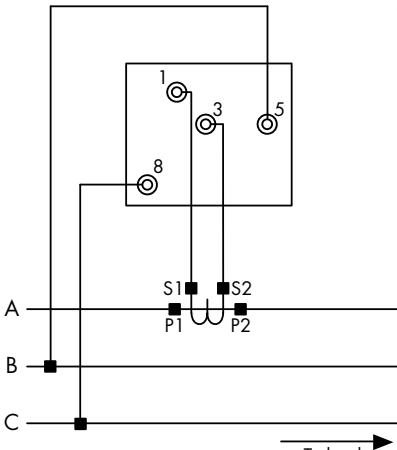
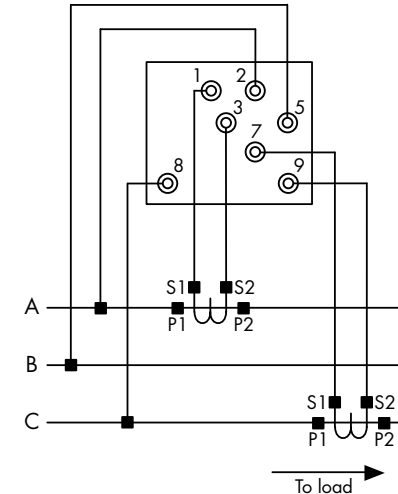
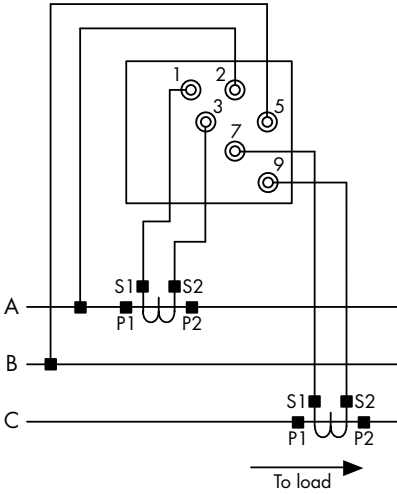
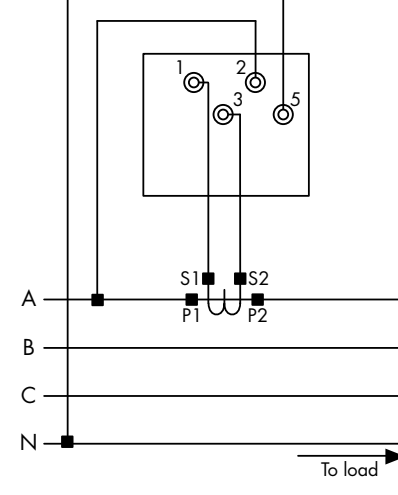
Rating 110V, 50Hz

17 taps @ 400 Ω /tap

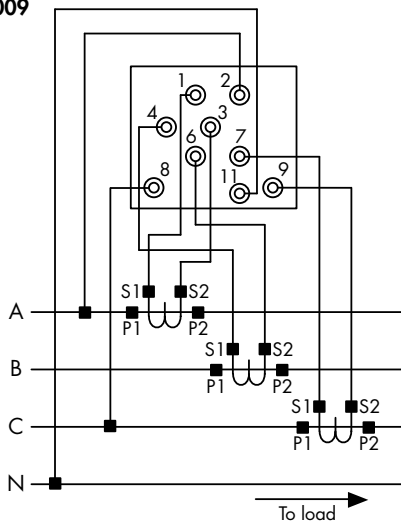
Scale OFF 1...18 TAP

Wiring Diagrams

(Voltage transformers not shown)

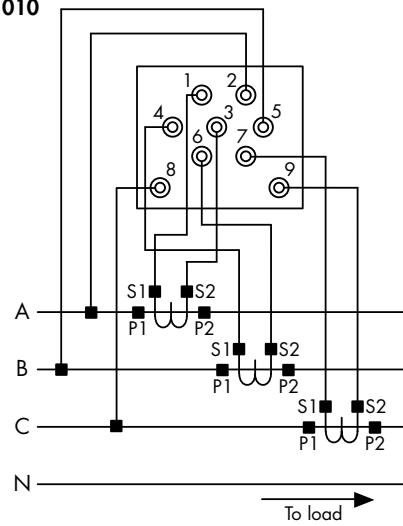
<p style="text-align: right;">TN 7369 001</p>  <p style="text-align: center;">Self-contained single phase 90° and 240° wattmeters, varmeters and power factor indicators</p>	<p style="text-align: right;">TN 7369 004</p>  <p style="text-align: center;">Self-contained 3 phase, 3 wire balanced load 90° and 240° wattmeters, varmeters and power factor indicators</p>
<p style="text-align: right;">TN 7369 003</p>  <p style="text-align: center;">Self-contained 3 phase, 3 wire balanced load 90° and 240° varmeter, cross connected</p>	<p style="text-align: right;">TN 7369 007</p>  <p style="text-align: center;">Self-contained 3 phase, 3 wire unbalanced load 90° and 240° wattmeters and varmeters</p>
<p style="text-align: right;">TN 7369 008</p>  <p style="text-align: center;">Self-contained 3 phase, 3 wire unbalanced load 90° and 240° power factor indicators</p>	<p style="text-align: right;">TN 7369 002</p>  <p style="text-align: center;">Self-contained 3 phase, 4 wire balanced load 90° and 240° wattmeters, varmeters and power factor indicators</p>

TN 7369 009



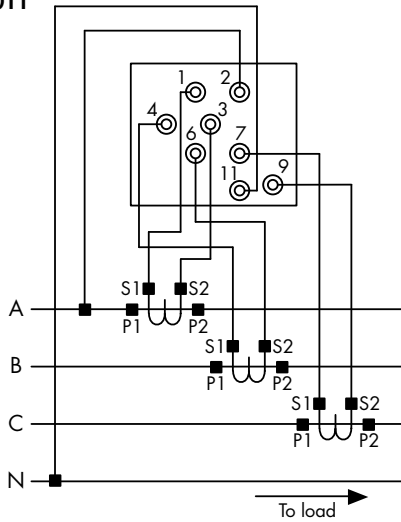
Self-contained 3 phase, 4 wire unbalanced load
(2 1/2 el) 90° and 240° **wattmeters**

TN 7369 010



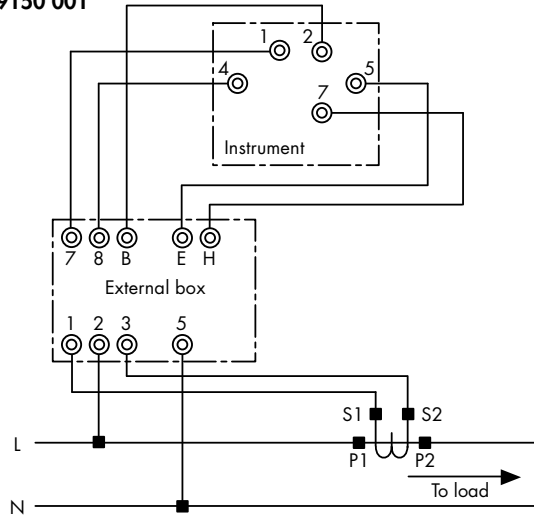
Self-contained 3 phase, 4 wire unbalanced load
(2 1/2 el) 90° and 240° **varmeters**

TN 7369 011



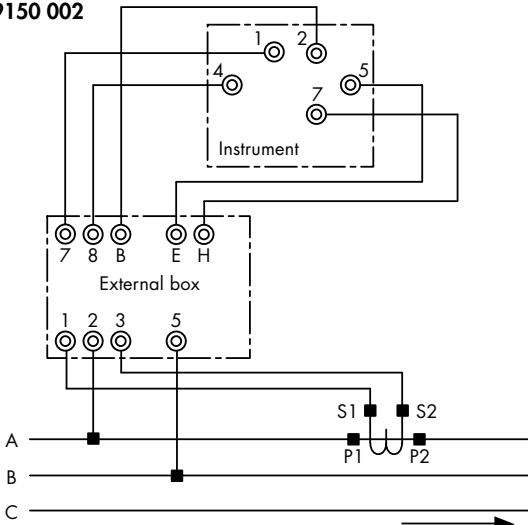
Self-contained 3 phase, 4 wire unbalanced load
90° and 240° **power factor indicator**

SS 9150 001



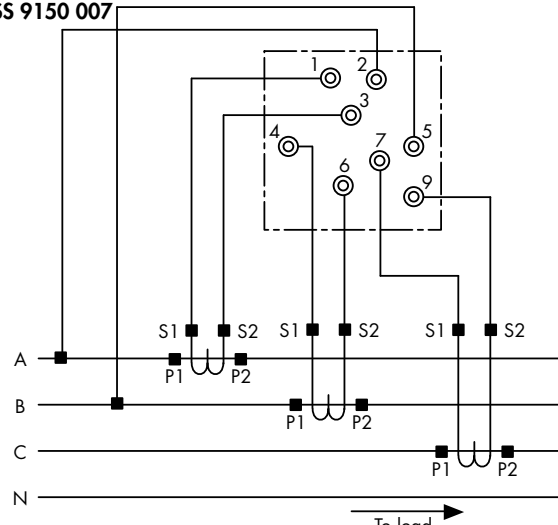
Single phase 360° **power factor indicator**

SS 9150 002



3 phase, 3 wire balanced load
360° **power factor indicator** with 1 CT – up to 660V

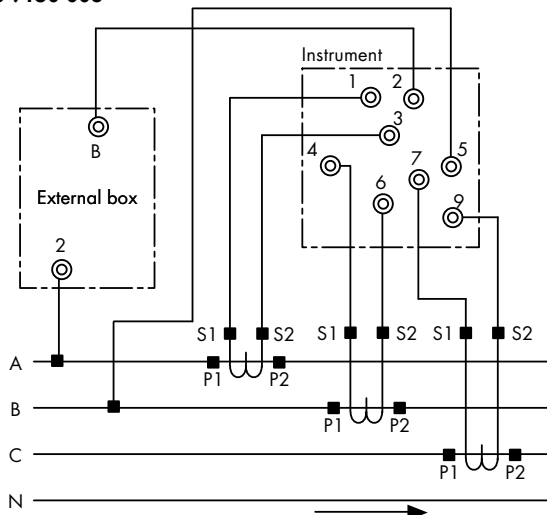
SS 9150 007



3 phase, 4 wire balanced load
360° **power factor indicator** – up to 150V

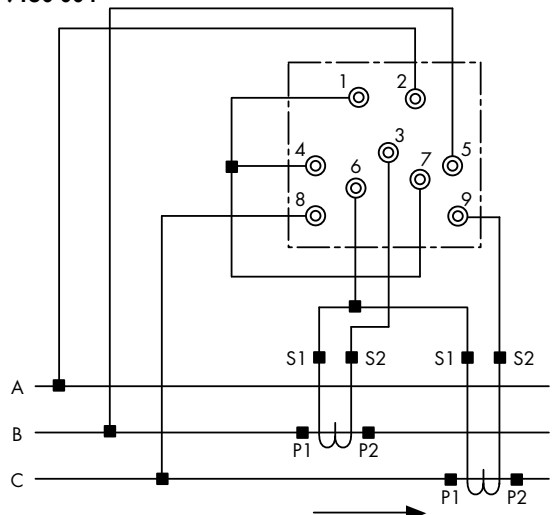
Voltage transformers not shown

SS 9150 008



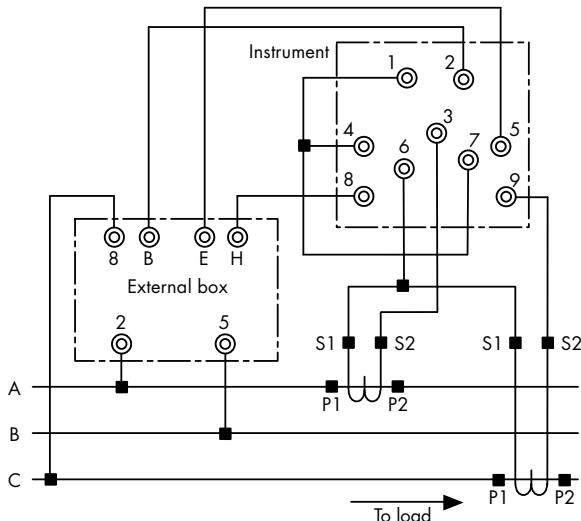
3 phase, 4 wire balanced load
360° power factor indicator – ratings 150V to 660V

SS 9150 004



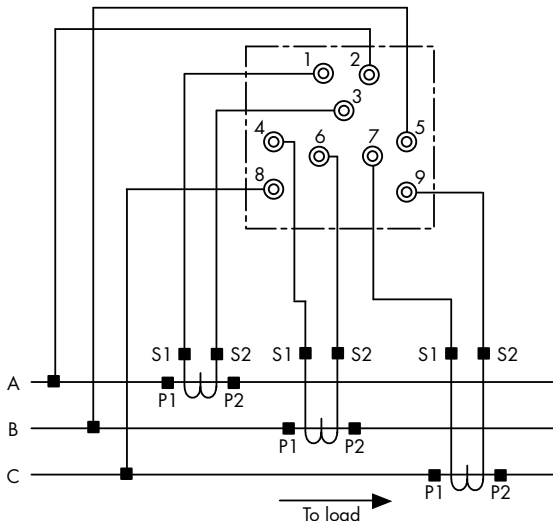
3 phase, 3 wire unbalanced load
360° power factor indicator using 2 CTs – up to 150V

SS 9150 006



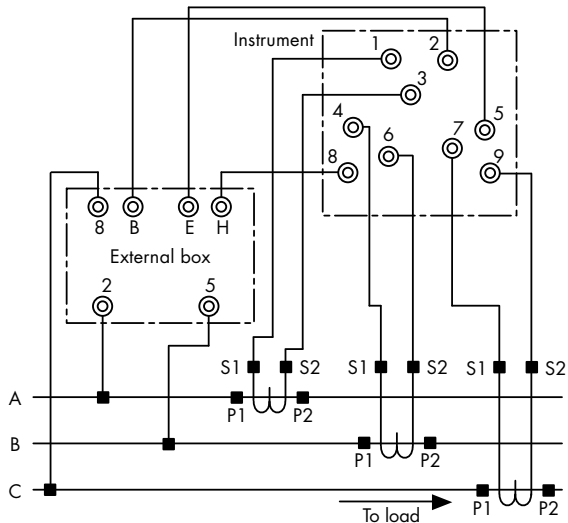
3 phase, 3 wire unbalanced load 360° power factor indicator using 2 CTs – ratings of 150V to 660V

SS 9150 003



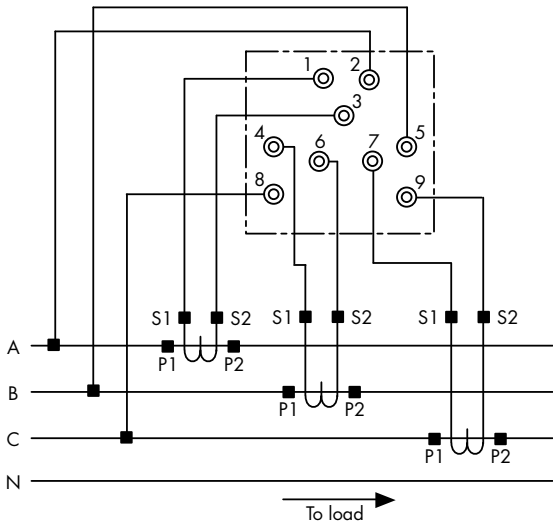
3 phase, 3 wire unbalanced load 360° power factor indicator using 3 CTs – up to 150V

SS 9150 005



3 phase, 3 wire unbalanced load 360° power factor indicator using 3 CTs – ratings of 150V to 660V

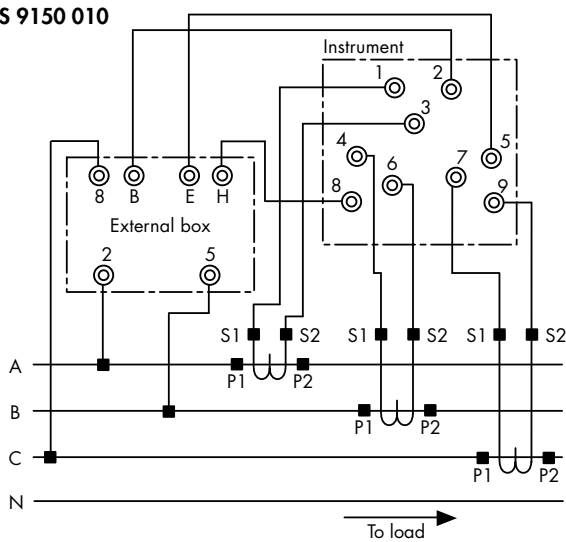
SS 9150 009



3 phase, 4 wire unbalanced load 360° power factor indicator – up to 150V

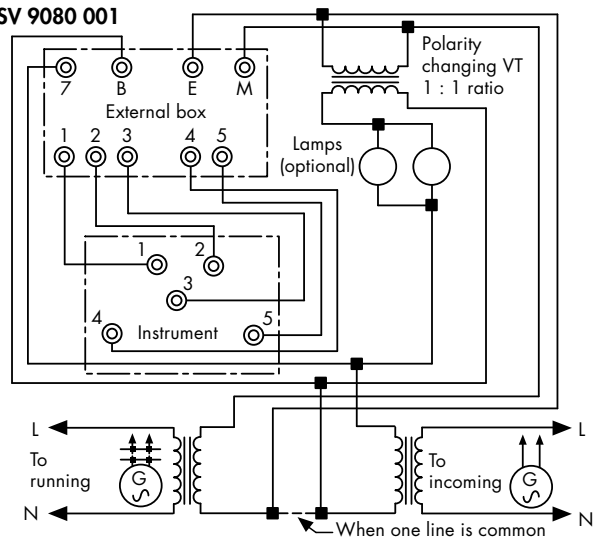
Voltage transformers not shown

SS 9150 010



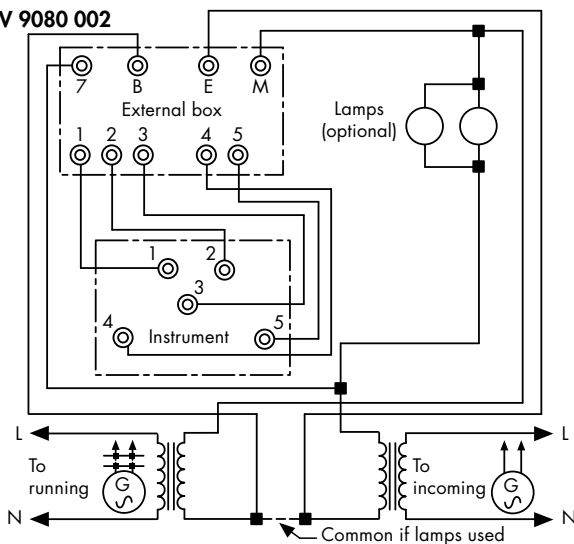
3 phase, 4 wire unbalanced load 360° **power factor indicator** – ratings of 150V to 660V

SV 9080 001



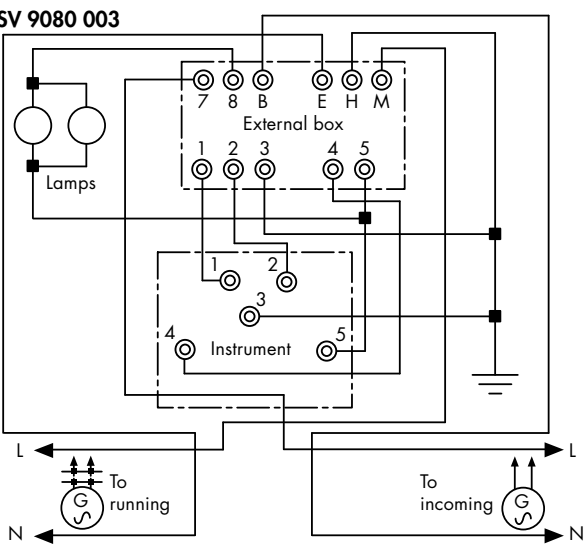
360° **synchroscope** – up to 150V earthed or insulated secondaries – lamps bright at synchronism

SV 9080 002



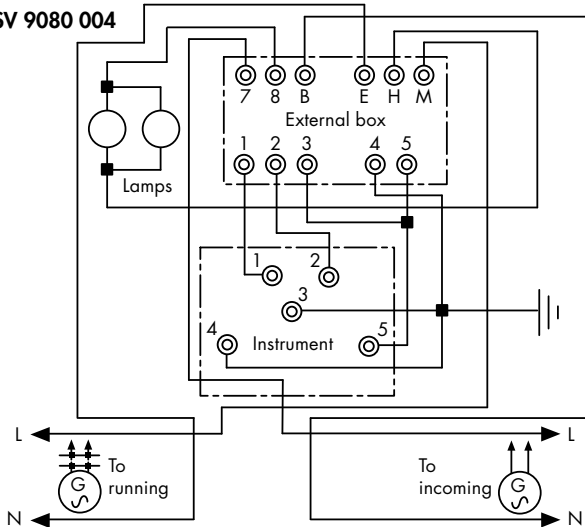
360° **synchroscope** – up to 150V earthed or insulated secondaries – lamps dark at synchronism

SV 9080 003



360° **synchroscope** – above 150V to 660V earthed or insulated secondaries – lamps bright at synchronism

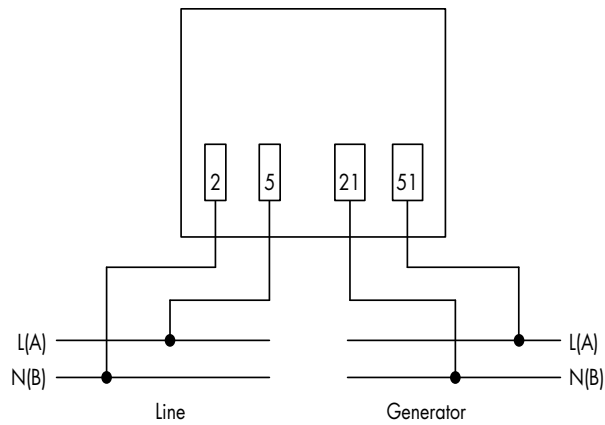
SV 9080 004



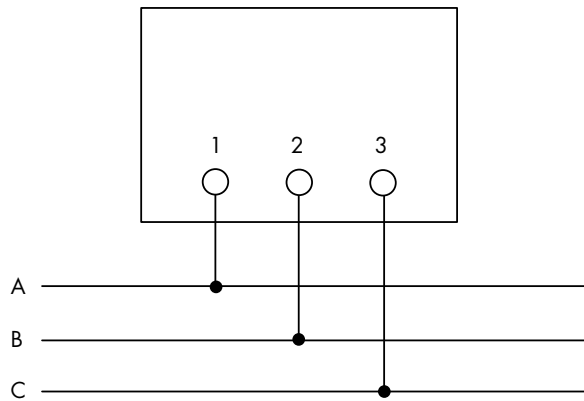
360° **synchroscope** – above 150V to 660V earthed or insulated systems – no lamps or lamps dark at synchronism

Voltage transformers not shown

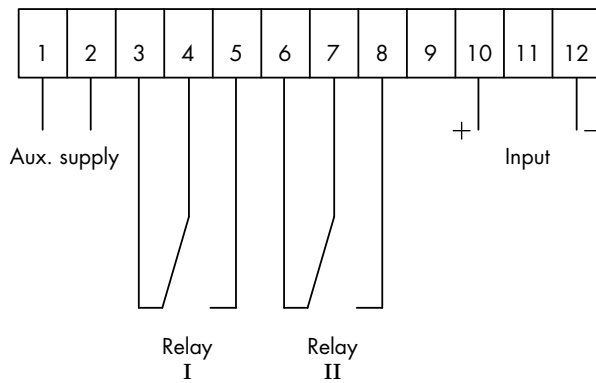
Double Voltmeter
Double Frequency Meter
 (pointer and reed type)
Differential Voltmeter
Differential Frequency Meter



Phase Sequence Indicator



Meter Relay



Tap position indicator

SR9105

Fig. 1 Self-contained inst. (sizes 96M, 144M) with combined switch tap board res. unit

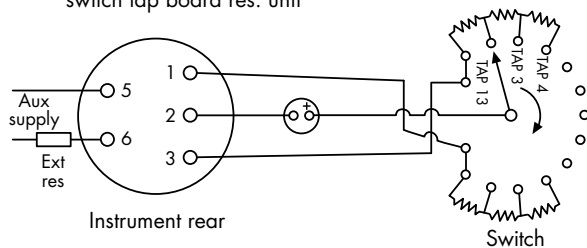
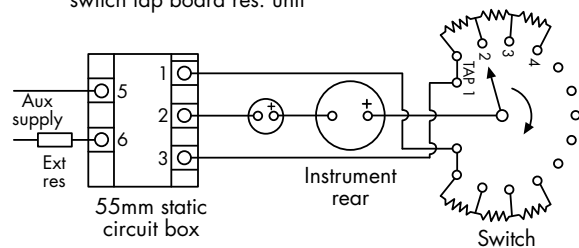



Fig. 2 Sizes 48M, 72M inst. with external box and combined switch tap board res. unit

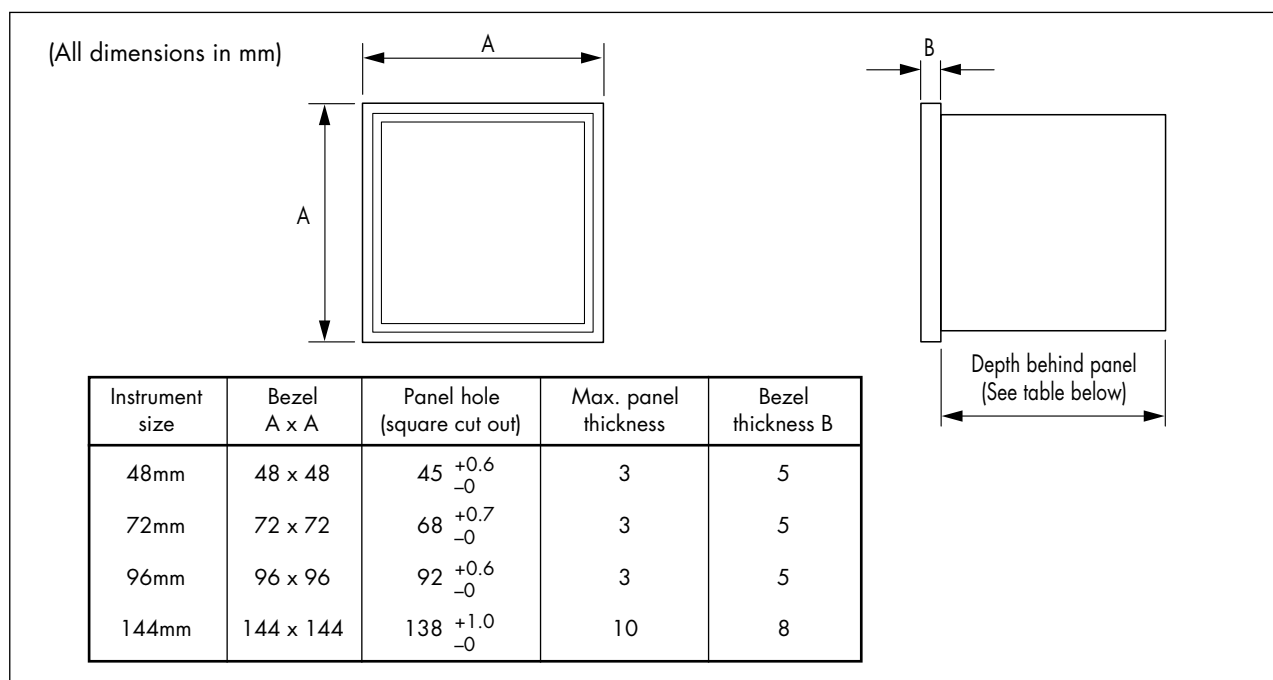


General Notes

- (1) External dropper res. only supplied when feeding tapped res. below 2400 ohms
- (2)  Position of remote indicator when used

Voltage transformers not shown

Outline and Dimensions



Instrument type	Maximum depth behind panel							
	48mm		72mm		96mm		144mm	
	90°	240°	90°	240°	90°	240°/ 360°	90°	240°/ 360°
Moving iron ammeter & voltmeter	81	81	86	81	86	81	128	107
Moving coil ammeter & voltmeter	84	108	89	103	89	103	105	137
Frequency meter	-	-	76	122	122	122	91	137
Maximum demand ammeter	-	-	59	-	98	-	80	-
Wattmeter and varmeter	-	-	-	-	120	120	137	137
Synchroscope	-	-	-	-	-	120*	-	137*
Power factor indicator	-	-	-	-	120	120*	-	137*
Time elapsed meter (digital)	-	60	-	60	-	60	-	-
Tap position indicator	-	-	-	-	-	120	-	137
Meter relay	-	-	-	-	77	-	-	-
Double voltmeter (2 x 90°)	-	-	-	-	51	-	76	-
Double frequency meter (2 x 90°)	-	-	-	-	51	-	76	-
Double frequency meter (Reed type)	-	-	-	-	73	-	82	-
Differential voltmeter	-	-	-	-	-	73	-	82
Differential frequency meter	-	-	-	-	-	111	-	110
Phase sequence indicator	-	-	-	-	73	-	82	-

* denotes 360° circular scale

Terminals

Moving iron ammeters and voltmeters

Sizes 48mm, 72mm, 96mm

M5 on voltmeters up to 650V and on ammeters up to 15A.

M6 on ammeters from 16A to 50A.

Size 144mm

M5 on voltmeters up to 650V and on ammeters up to 7.4A.

M6 on ammeters from 7.5A to 59A.

M8 from 60A to 119A.

M16 from 120A to 250A.

All other instruments

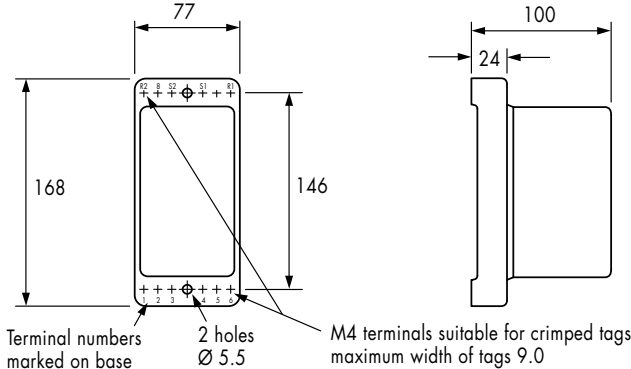
M5 on dc voltmeters up to 1000V and on ammeters up to 15A.

Ammeters from 16A to 40A have M6 terminals and M8 terminals from 50A to 60A.

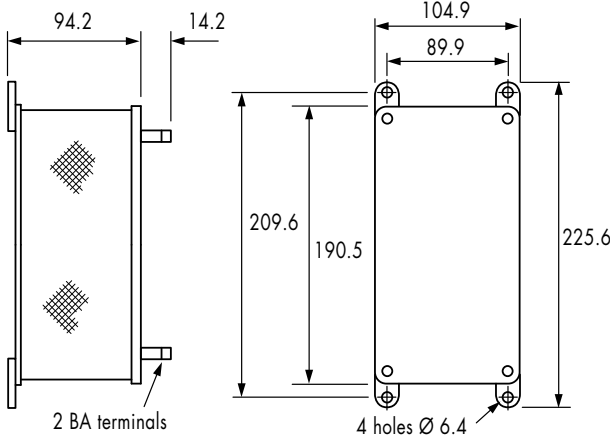
M5 on ac voltmeters and M5 clamp screws are fitted on ac ammeters up to 60A.

Outline and Dimensions for External Boxes

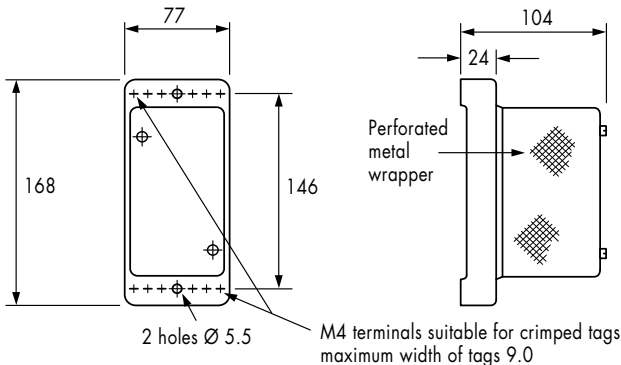
Used with synchroscope
up to 150V



Used with synchroscope
above 150V and
for phase splitting
(1 CT) applications



Used with 360° power factor
indicator for voltages above 150V
and for phase splitting
(1 CT) applications



CT housing for 48mm
rectified moving coil instruments
above 100mA

