



## MODEL 9230A

# DC CURRENT SHUNT

*USE AS A PRECISION CURRENT SHUNT OR AS A STANDARD RESISTOR*



**G**uildline 9230A series of precision DC current shunts are true 4-terminal devices intended for the precise measurement of DC current. They are constructed from specially selected elements supported on an insulating base for mechanical stability and covered with a perforated metal cover to allow proper cooling while providing physical protection for the elements.

In the design of the 9230A special consideration has been given to the effects of power dissipation which introduce self heating errors, beyond the required specification even when at full power and operating in air. The type of material selected for the elements has a very low temperature coefficient and the size and number of elements chosen give the optimum surface area to dissipate the maximum specified power in air for a particular value. The performance of the 9230A shunts can be dramatically improved by operating them immersed in oil such as in Guildline 9730CR or 5010 constant temperature oil baths.

***The 9230A Series Precision DC Current Shunts are true 4-terminal devices intended for the precise measurement of d.c. current.***

### 9230A FEATURES

- > Low self-heating
- > Low temperature coefficient
- > Controlled current distribution through the element
- > Low thermal EMF's
- > Wide dynamic range
- > < 10 ppm long term stability
- > Air or oil cooled
- > Special Values available on request
- > Forced convection accessory available for improved power dissipation capability

The terminations of the shunts have been selected to give low thermal emf's and in the case of the higher current values, 300 amperes and above, to ensure that the current applied is distributed in a constant manner, independent of how the connecting leads are arranged.

The care and attention to the design criteria have produced a series of shunts with an extreme usable dynamic range virtually from zero to full rated current. The 9230A shunts are heat treated for excellent long term stability. Operated without stressing beyond 30% of rated current and maintained in a constant temperature oil bath the 9230A's stability enables it to be used as a standard reference resistor.

Special values in the range of 1 ohm to 10 $\mu$  ohms are available on request.

The 92310 forced convection unit with power supply is made available as an accessory to allow operation on the bench top at up to 100W dissipation with much improved repeatability and power coefficient performance.

The 9230A-15R is made available as a direct replacement for the older version model 9230/15 shunt.

# 9230A DC CURRENT SHUNT

## 9230A SERIES SPECIFICATIONS

Model	Maximum Current (A)		Nominal Value ( $\Omega$ ) (Note 2)	Nominal Initial Tolerance ( $\pm$ ppm) (Note 3)	Stability (12 Months) ( $\pm$ ppm)		Calibration Uncertainty ( $\pm$ ppm) (Note 5)	Temperature Coefficient ( $\pm$ ppm/ $^{\circ}$ C) (Note 6)
	92310 Option	Ambient Air (Note 1)			Stability	Accuracy (Note 4)		
9230A-10	10	7	1.0	100	10	20	8	4
9230A-15	15	7	0.5	100	10	20	8	4
9230A-15R (Note 10)	30	15	0.1	100	10	20	10	4
9230A-30	30	15	0.1	100	10	20	10	4
9230A-50	50	25	0.05	100	10	20	10	4
9230A-100	100	50	0.01	100	10	20	15	4
9230A-150	150	75	0.005	100	10	20	15	4
9230A-300	300	150	0.001	100	10	20	15	4
9230A-500	500	250	0.5m	100	10	20	15	4
9230A-1000	1000	500	0.1m	200	25	50	25	25
9230A-1500	1500	750	0.05m	200	25	50	25	25
9230A-3000	3000	1500	0.1 $\mu$	500	100	200	100	50

Model	Full Rated Power Accuracy 23 $\pm$ 1 $^{\circ}$ C (Note 7) ( $\pm$ ppm)	Power Coefficient (ppm/W) (Note 8)			Time Constant (Minutes) (Note 9)		Size (W x L x H) mm	Size (W x L x H) Inches	Weight
		92310 Option	Ambient Air	Flowing Oil	92310 Option (Note 9)	Ambient Air			
9230A-10	100	2	8	0.5	1.5	3	114 x 356 x 85	4.5 x 14 x 3.4	1.4 kg / 3.1 lbs
9230A-15	100	2	8	0.5	1.5	3	114 x 356 x 85	4.5 x 14 x 3.4	1.4 kg / 3.1 lbs
9230A-15R	100	2	8	0.5	1.5	3	114 x 356 x 85	4.5 x 14 x 3.4	1.4 kg / 3.1 lbs
9230A-30	100	2	8	0.5	1.5	3	114 x 356 x 85	4.5 x 14 x 3.4	1.4 kg / 3.1 lbs
9230A-50	100	2	8	0.5	1.5	3	114 x 356 x 85	4.5 x 14 x 3.4	2.1 kg / 4.6 lbs
9230A-100	100	2	8	0.5	2	5.5	114 x 356 x 139	4.5 x 14 x 5.5	2.2 kg / 4.9 lbs
9230A-150	100	2	8	0.5	2	6.5	114 x 356 x 139	4.5 x 14 x 5.5	2.5 kg / 5.5 lbs
9230A-300	100	2	8	0.5	2	7	114 x 406 x 96	4.5 x 16 x 3.8	5.0 kg / 11.2 lbs
9230A-500	100	3	10	0.8	2	7.5	114 x 406 x 96	4.5 x 16 x 3.8	5.8 kg / 12.9 lbs
9230A-1000	250	8	20	2.0	4	15	114 x 530 x 145	4.5 x 20.9 x 5.7	7.2 kg / 15.8 lbs
9230A-1500	250	10	30	3.0	5	20	114 x 530 x 145	4.5 x 20.9 x 5.7	7.8 kg / 17.2 lbs
9230A-3000	600	N/A	50	5.0	N/A	30	184 x 381 x 221	7.25 x 15.0 x 8.7	19 kg / 41.8 lbs
92310							121 x 242 x 69	4.75 x 9.5 x 2.7	1.0 kg / 2.1 lbs

**Note 1** – Maximum current for ambient air usage without damage to the unit is the same as the maximum current when used with the Forced Air Convection unit (92310). Use the power coefficient to determine accuracy when using applied currents above this rating.

**Note 2** – Custom values (Customer specified) of nominal resistance from 10  $\mu\Omega$  to 1 $\Omega$  are available by special order.

**Note 3** – Defined as maximum variation of resistance value as initially adjusted at time of sale.

**Note 4** – When used as a standard resistor at 1-Watt Level. Use power coefficient to determine specification above 1 Watt.

**Note 5** – Resistance values are expressed as a total uncertainty with a coverage factor of k = 2. Calibrated in air at 5W, 10W, 25W dissipation levels with natural convection cooling or 10W, 25W and 100W dissipation levels with forced convection cooling up to a maximum test current of 150A. Traceable report of calibration stating measured values and uncertainty is provided. Calibration at 1 Watt levels, special points in air or flowing oil are available upon request.

**Note 6** – Temperature Coefficient must be added to the uncertainty when working at temperatures outside 23 $^{\circ}$   $\pm$  1 $^{\circ}$  C.

**Note 7** – When used as a shunt, Full Rated Power is defined as 25W for ambient air and 100W for forced air-cooling or use in flowing oil.

**Note 8** – Power coefficient must be added to the uncertainty when used as a shunt above 25W for ambient air applications.

**Note 9** – Defined as the time for the resistance value to settle to within 10 ppm of the final value for any change in applied current. The time constant is 1 minute for flowing oil.

**Note 10** – The 9230A-15R is the direct replacement for the 9230/15 older version shunt

**Environment:**      **Operating**      18 $^{\circ}$  C to 28 $^{\circ}$  C      <70% non-condensing      **Storage**      -30 $^{\circ}$  C to 70 $^{\circ}$  C      <90% non-condensing

## 9230A ORDERING INFORMATION

9230A-Current Value	DC Current Shunt
9230A-XX	DC Special Value Shunt
92301	20A, 1m Lead Set
92302	100A, 1m Lead Set
92303	300A, 1m Lead Set
92304	20A, Xm Lead Set
92305	100A, Xm Lead Set
92306	300A, Xm Lead Set
92310	Forced Air Convection Unit
GCL	Contact Lubricant
TM9230A	Technical Manual (included)
	Certificate of Calibration (included)
	Report of Calibration (included)

## GUILDLINE IS DISTRIBUTED BY:

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