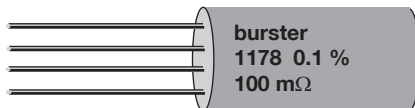
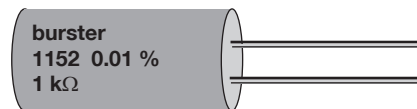
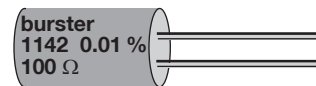


# Precision and High-Precision Resistors

Series 1140  
1150  
1160  
Model 1178

Code:	1100 EN
Delivery:	ex stock (standard values)
Warranty:	36 months



- $TC \leq 2 \text{ ppm/K}$  or  $\leq 10 \text{ ppm/K}$
- Class  $\pm 0.01 \%$  or  $\pm 0.02 \%$  or  $\pm 0.05 \%$  or  $\pm 0.1 \%$
- Production range from  $1 \text{ m}\Omega$  ...  $100 \text{ k}\Omega$
- Resistance material ZERANIN® or MANGANIN® or ISA-Ohm
- Standard values available from stock
- Custom resistance values available on request

## Application

Precision and high-precision resistors are used wherever the highest standards of temperature stability, error tolerance and durability are required.

Model 1142 and 1152 high-precision resistors, with tolerances at values of  $\leq 0.01\%$ , are equivalent to standard resistors and can be used as substitutes in many cases. Models 1152 and 1156 are available for higher loads up to 1 W.

If requirements for the temperature coefficients and long-term stability are less strict, MANGANIN® or ISA-Ohm resistors can be used.

The low-ohm model 1178 precision resistors feature separate current and voltage paths to compensate errors caused feed by line resistances. The separate current and voltage paths enable these resistors to be used as a high-precision shunt in many measurement arrangements.

## Description

The resistors are supplied with two connections on the front end (suitable for mounting on circuit boards).

The high-precision resistors comprise low-capacitance, low-inductance wire coils made of ZERANIN®, MANGANIN® or ISA-Ohm, which are encapsulated in small plastic cylinder housings.

Prior to trimming, the resistance bodies are exposed to a meticulous artificial aging procedure. This special process and trimming to approximately half of the nominal tolerance guarantee long-term stability of  $< 0.01\%$  (ZERANIN®) or  $< 0.02\%$  (MANGANIN® or ISA-Ohm) over the course of years.

The temperature coefficient with the MANGANIN® material attains values of  $\leq 10 \text{ ppm/K}$ . By selecting materials, values of  $\leq 2 \text{ ppm/K}$  are achieved with ZERANIN®.

Within the specified production range, any desired resistance value can be supplied.

Model	1142	1146	1152	1156	1164	1166	1178
<b>Standard values</b>							
1 mΩ, 2 mΩ, 5 mΩ, 10 mΩ, 20 mΩ, 50 mΩ, 100 mΩ, 200 mΩ, 500 mΩ, 1 Ω, 2 Ω							*
5 Ω		*		*		*	*
10 Ω, 20 Ω		*		*		*	
50 Ω		*		*		*	
100 Ω, 200 Ω, 500 Ω, 1 kΩ, 2 kΩ, 5 kΩ, 10 kΩ, 20 kΩ	*	*	*		*		
50 kΩ, 100 kΩ		*	*		*		
<b>Special values</b> Manufacturing range for custom Ω values	100 Ω up to 40 kΩ	5 Ω up to 100 kΩ	1156: 5 Ω up to 100 Ω 1152:100 Ω up to 100 kΩ		1166: 3 Ω up to 100 Ω 1164:100 Ω up to 100 kΩ		on request in the range of 1 mΩ up to 5 Ω
Error of tolerance	± 0.01 %	± 0.05 %	± 0.01 %	± 0.05 %	± 0.02 %	± 0.05 %	± 0.1 %
Resistance material	ZERANIN® selected	MANGANIN® or ISA-Ohm	ZERANIN® selected		MANGANIN® or ISA-Ohm		MANGANIN® or ISO-Ohm
Average temperature coefficient (+ 20 °C up to + 60 °C)	< ± 2 ppm/K	< ± 10 ppm/K	< ± 2 ppm/K		< ± 10 ppm/K		< ± 10 ppm/K
Ultimate load (Environmental temperature)	0.7 W	0.7 W	1 W		1 W		1 W (max. 6 A)
Long-term stability	0.01 % over years	0.02 % over years	0.01 % over years		0.02 % over years		0.02 % of years
Thermal resistance	90 K/W	90 K/W	60 K/W		60 K/W		60 K/W
<b>Dimensions</b>							
Weight	approx. 3 g	approx. 3 g	approx. 8 g		approx. 8 g		approx. 6 g

Operating voltage: max. 500 V  
 Calibration temperature: 23 °C  
 Balance point: for connecting wire of 5 mm range  
 Temperature operating range: 0 °C ... + 85 °C  
 Short-time over load: approx. 10 % < 1 min.  
 Specifications: according DIN 43783 part 1  
 (former VDE 410)

**Special values**

Extra charge per piece for special values, refer to order no. **1199S**

Minimum order quantity: 5 pcs of identical version,  
 smaller quantities are available on  
 extra charges.

Delivery: approx. 8 weeks

**Temperature dependence**

ZERANIN®:  $R_t = R_0(1 + a \cdot t + b \cdot t^2 + g \cdot t^3)$   
 $\alpha = 1.22 \cdot 10^{-5}$   
 $\beta = -2.12 \cdot 10^{-7}$   
 $\gamma = +9.44 \cdot 10^{-10}$

$t$  = Element temperature in °C  
 $R_0$  = Resistance value at 0 °C  
 $R_t$  = Resistance value at temperature  $t$

MANGANIN®:  $R_t = R_{20}(1 + \alpha_{20}(t - 20) + \beta(t - 20)^2)$   
 $\alpha_{20} = 0 \dots 20 \cdot 10^{-6}$   
 $\beta = -0.59 \cdot 10^{-6}$   
 $R_{20}$  = Resistance value at 20 °C

**Order Code**

5 pcs 1152 - 100.0 Ω (Standard model)  
 12 pcs 1146S - 153.8 Ω (Special model)