

Selecting 1% Resistors

Introduction

Many of the application notes in this section make reference to, or specify the use of, $\pm 1\%$ metal-film resistors. The table below lists all readily available, E-96 series, 1% resistor values. Please see the component suppliers index for the name and address of 1% resistor suppliers.

Using the Table

Using the table is straightforward. First determine the required value. Then, using just the first three digits of the required value, find the closest number to the three digits in the table — disregard the decimal points for this step. For example, your calculations indicate that a $1,342\Omega$ resistor is needed for an input-scaling circuit. The first three digits are "134". The closest value to 134 in the table is "13.3". Multiply 13.3 by 100. The result, $1,330\Omega$, is the closest commercially-available resistor value, commonly referred to as $1.33k\Omega$.

The total number of resistors available is not infinite; most manufacturers stock values from 10Ω through $10,000,000\Omega$ (10 Megohm). This means you can apply multipliers of $1 (10^0)$ through $1,000,000 (10^6)$ to the numbers in the table. The most common wattage ratings are 1/8 and 1/4 Watt; though 1/2 and 1 Watt units are also available. Values above 1 Megohm are usually more available in ratings of 1/4 Watt or higher.

Voltage Rating

Two other resistor parameters to be aware of are working voltage and temperature coefficient of resistance (TCR). Most 1/4-Watt resistors are rated for 200V continuous operation. 1/2 Watt

and higher types can be obtained with ratings in excess of 500V. Resistor voltage ratings are a very important consideration when designing dividers with input voltages greater than 200Vdc or 120Vac. A safety-minded point to keep in mind when designing any type of input divider is to always use resistor values that add up to at least 1 Megohm. Doing so will generally allow the use of readily available 1/4-Watt resistors.

Temperature Coefficient

Applications using 3½ digit meters (DMS-30 and DMS-20) can use resistors with TCR's of 50 to 100ppm. TCR is normally specified in ppm/°C (parts per million per degree Centigrade). 4½ digit meters should use 25ppm, or better, resistors. To put this into terminology that is more easily understood, one count ("001") on the display of a DMS-20 meter is 500ppm. One count ("0001") on a DMS-40 meter is 50ppm!

As a worst-case example, assume two ± 100 ppm resistors are used in a ten-to-one input divider for a DMS-40PC and the ambient temperature goes up by 2°C. If one resistor has a TCR of +100ppm and the other has a TCR of -100ppm, a total change of $200\text{ppm}/^\circ\text{C} \times 2^\circ\text{C} = 400\text{ppm}$ would occur. Since one count on the display is 50ppm, the meter's reading would change by $400/50 = 8$ counts. In some applications, 8 counts may be a very significant change!

E-96 ($\pm 1\%$) Decade Values Table

10.0	10.2	10.5	10.7	11.0	11.3	11.5	11.8
12.1	12.4	12.7	13.0	13.3	13.7	14.0	14.3
14.7	15.0	15.4	15.8	16.2	16.5	16.9	17.4
17.8	18.2	18.7	19.1	19.6	20.0	20.5	21.0
21.5	22.1	22.6	23.2	23.7	24.3	24.9	25.5
26.1	26.7	27.4	28.0	28.7	29.4	30.1	30.9
31.6	32.4	33.2	34.0	34.8	35.7	36.5	37.4
38.3	39.2	40.2	41.2	42.2	43.2	44.2	45.3
46.4	47.5	48.7	49.9	51.1	52.3	53.6	54.9
56.2	57.6	59.0	60.4	61.9	63.4	64.9	66.5
68.1	69.8	71.5	73.2	75.0	76.8	78.7	80.6
82.5	84.5	86.6	88.7	90.9	93.1	95.3	97.6

Color	Band 1	Band 2	Band 3	Band 4	Band 5
Black	0	0	0	10^0	
Brown	1	1	1	10^1	$\pm 1\%$
Red	2	2	2	10^2	
Orange	3	3	3	10^3	
Yellow	4	4	4	10^4	
Green	5	5	5	10^5	$\pm 0.5\%$
Blue	6	6	6	10^6	$\pm 0.25\%$
Violet	7	7	7	10^7	$\pm 0.1\%$
Gray	8	8	8	10^8	
White	9	9	9	10^9	
Gold				10^{-1}	

