Obtain accurate ratios with standard resistors

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When choosing resistor values for voltage dividers, designers usually select a convenient value for one resistor—such as 1 kΩ, 10 kΩ, and so forth—and solve for the other in terms of the required divider ratio. But that procedure typically results in a nonstandard value for the second resistor in the divider. The problem is that custom resistors with nonstandard values are expensive.

Most of the time, though, some combined standard values can supply very close to the desired ratio. With a calculator or computer program, a user can select the resistor pair to a desired degree of accuracy—standard values of 2%, 1%, and 0.1%—and avoid the cost of custom resistors. More universally applicable, though, is a comprehensive list *(see the table)*.

Given are values for ratios, D, from 0.01 to 0.49, and users must supply the appropriate decade value. For values of $0.51 \leq D \leq 0.99$, merely enter the table with the value 1-D and reverse the values listed for R_1 and R_2. (Of course, for $D = 0.5$, $R_1 = R_2$.)

Accordingly, if the ratio $D = 0.9$, from the ratio column on the listing at $D\text{-}1 = 0.1$ for a 2% tolerance, select from the $R_1 = 1.87$ and from the R_2 column the value for $R_2 = 16.9$. Of course, these values must be multiplied by the appropriate decade to 1.87 kΩ and 16.9 kΩ, or say, 18.7 kΩ and 169 kΩ, as required, thereby allowing the divider to draw a current level suited to the design. The usual method with standard resistor sizes would have given $R_1 = 1.0$, and $R_2 = 9.09$, the closest standard value, giving a 0.9009 ratio.

The ratios obtained with values from the table are more accurate: 0.9004 from the 2% column, 0.9003 from the 1% column, and 0.9000 (exact) from the 0.1% column.

Standard-resistor ratios

Ratio (D)	Tolerance					
	2%		1%		0.1%	
	R_1	R_2	R_1	R_2	R_1	R_2
0.01	100.00	1.00	100.00	1.00	198.00	2.00
0.02	56.20	1.15	137.00	2.80	102.00	2.08
0.03	36.50	1.15	280.00	8.66	38.80	1.20
0.04	27.40	1.15	102.00	4.22	24.00	1.00
0.05	24.90	1.33	21.50	1.13	23.40	1.23
0.06	17.80	1.15	21.50	1.37	17.40	1.11
0.07	115.00	8.66	18.20	1.37	18.20	1.37
0.08	11.50	1.00	11.50	1.00	11.50	1.00
0.09	10.00	1.00	10.00	1.00	18.20	1.80
0.10	16.90	1.87	10.20	1.13	9.09	1.01
0.11	13.30	1.62	17.40	2.15	8.98	1.11
0.12	11.50	1.54	11.00	1.50	11.00	1.50
0.13	13.30	1.96	11.30	1.69	10.70	1.60
0.14	11.50	1.87	10.70	1.74	12.90	2.10
0.15	16.20	2.87	11.30	2.00	10.20	1.80
0.16	13.30	2.49	10.50	2.00	10.50	2.00
0.17	18.70	3.83	18.70	3.83	18.70	3.83
0.18	11.50	2.49	13.70	3.01	13.70	3.01
0.19	4.87	1.15	4.32	1.02	19.10	4.48
0.20	16.90	4.22	10.20	2.55	10.20	2.55
0.21	11.50	3.01	4.02	1.07	4.02	1.07
0.22	4.02	1.15	11.50	3.24	11.50	3.24
0.23	3.83	1.15	3.57	1.07	6.26	1.87
0.24	19.60	6.19	4.75	1.50	3.61	1.14
0.25	11.50	3.83	10.20	3.40	3.12	1.04
0.26	11.50	4.02	10.20	3.57	3.70	1.30
0.27	11.50	4.22	3.09	1.15	3.65	1.35
0.28	11.50	4.42	2.74	1.07	3.24	1.26
0.29	11.50	4.64	2.49	1.02	10.70	4.37
0.30	11.50	4.87	2.49	1.07	2.80	1.20
0.31	11.50	5.11	2.55	1.15	3.65	1.64
0.32	11.50	5.36	2.43	1.15	2.21	1.04
0.33	11.50	5.62	2.80	1.37	4.02	1.98
0.34	11.50	5.90	2.67	1.37	1.98	1.02
0.35	11.50	6.19	10.70	5.76	2.34	1.26
0.36	4.64	2.61	4.32	2.43	2.08	1.17
0.37	1.96	1.15	1.96	1.15	1.89	1.11
0.38	1.87	1.15	1.74	1.07	10.10	6.19
0.39	1.78	1.15	2.15	1.37	13.70	8.76
0.40	1.96	1.33	1.50	1.00	1.50	1.00
0.41	11.50	7.87	1.54	1.07	1.54	1.07
0.42	11.50	8.25	1.58	1.15	1.45	1.05
0.43	2.15	1.62	2.15	1.62	1.67	1.26
0.44	1.40	1.10	1.40	1.10	1.40	1.10
0.45	1.62	1.33	1.62	1.33	1.43	1.17
0.46	1.96	1.69	1.33	1.13	1.35	1.15
0.47	1.69	1.47	6.98	6.19	5.30	4.70
0.48	1.15	1.05	1.62	1.50	1.30	1.20
0.49	1.69	1.62	1.69	1.62	2.32	2.23