

1/11/2008

# SKIN EFFECT

The AC resistance of copper wire is greater than the DC resistance due to "skin effect" (the concentration of current on the wire surface rather than through the entire wire area).

The table shows RAC/RDC for various wire sizes and frequencies. The bold highlighted ratios show the largest wire that can be used at each frequency, without exceeding a 5% increase over DC resistance.

AWG		FREQUENCY (RAC / RDC RATIO)								
SIZE	10 KHz	15 KHz	20 KHz	30 KHz	40 KHz	50 KHz	60 KHz	70 KHz	80 KHz	100 KHz
10	1.247	1.453	1.647	1.970	2.236	2.461	2.667	2.858	3.036	----
11	1.167	1.325	1.487	1.779	2.018	2.224	2.408	2.577	2.734	3.023
12	1.110	1.224	1.352	1.604	1.822	2.010	2.176	2.326	2.466	2.723
13	1.072	1.151	1.247	1.452	1.646	1.818	1.969	2.106	2.231	2.460
14	<b>1.046</b>	1.100	1.167	1.325	1.487	1.640	1.779	1.904	2.018	2.224
15	1.030	1.065	1.110	1.224	1.352	1.481	1.604	1.718	1.823	2.010
16	1.019	<b>1.041</b>	1.071	1.150	1.245	1.347	1.449	1.548	1.642	1.813
17	1.012	1.026	<b>1.046</b>	1.099	1.167	1.243	1.324	1.406	1.486	1.639
18	1.007	1.017	1.029	1.064	1.109	1.163	1.223	1.286	1.350	1.478
19	1.005	1.011	1.019	<b>1.041</b>	1.071	1.108	1.150	1.196	1.244	1.346
20	1.003	1.007	1.012	1.026	<b>1.046</b>	1.071	1.099	1.132	1.167	1.243
21	1.002	1.004	1.007	1.017	1.029	<b>1.045</b>	1.064	1.085	1.109	1.163
22	1.001	1.003	1.005	1.010	1.018	1.029	<b>1.041</b>	1.055	1.070	1.107
23	1.001	1.002	1.003	1.007	1.012	1.018	1.026	<b>1.035</b>	<b>1.046</b>	1.070
24	1.001	1.001	1.002	1.004	1.007	1.012	1.016	1.022	1.029	<b>1.045</b>
25	1.000	1.001	1.001	1.003	1.005	1.007	1.010	1.014	1.018	1.029
26	1.000	1.000	1.001	1.002	1.003	1.005	1.007	1.009	1.012	1.018

If a wire larger than the highlighted wire is needed, use multiple strands of smaller wire, twisted in a bundle. The resistance doubles for each 3 wire sizes smaller.

Example: One #12 AWG = Two # 15 AWG  
= Four #18 AWG

At 20 KHz, use 4 strands of #18 AWG, twisted in a bundle, instead of one #12 AWG. RAC/RDC of the bundle is equal to 1.029, which is acceptable.

**150 KHz**

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2.947

2..657

2.398

2.165

1.961

1.767

1.595

1.446

1.317

1.217

1.148

1.096

1.062

**1.040**

3.

ndle