15-20A/120V BRANCH CIRCUIT VOLTAGE-DROP, AVAILABLE SHORT-CIRCUIT CURRENT & CONDUCTOR HEATING CALCULATIONS														
FOR A 15A/120V CIRCUIT														
OUTLET DISTANCE	DESIGNATOR		At Panel	2	25	50	**52**	65	70	74	100	125	150	175
15A VD	%	0.7	1.0	1.2	2.9	4.8	**5.0**	6.0	6.3	6.7	8.7	10.6	12.5	14.4
ASCC	amps	2143	1500	1300	514	310	**301**	250	237	225	173	142	120	104
MULTIPLE	times	143	100	87	34	21	**20**	17	16	15	12	9	8	7
I^2T	amps-squared-seconds	76,684	37,575	28,240	4,411	1,606	**1,508**	1,048	937	842	**MAX SAFE I2T = 47,000 amps-squared-seconds****			
R/ft- #14AWG-CU	ohms		0.00307											
FOR A 20A/120V CIRCUIT														
OUTLET DISTANCE			At Panel	2	25	50	**62**	88	100	125	150	175	200	225
20A VD	%	0.7	1.0	1.1	2.6	4.2	**5.0**	6.7	7.4	9.0	10.7	12.3	13.9	15.5
ASCC	amps	2857	2000	1772	767	474	**401**	300	269	221	188	163	144	129
MULTIPLE	times	143	100	89	38	24	**20**	15	13	11	9	8	7	6
I^2T	amps-squared-seconds	136,327	66,800	52,438	9,819	3,757	**2,684**	1,505	**MAX SAFE I2T = 120,125 amps-squared-seconds****					
R/ft- #12AWG-CU	ohms		0.00193											

**MAX SAFE LIMIT as defined by International Cable Engineers Association, publication P32-382, June 4,2007, page 4: Allowable Short Circuit Currents for Thermoplastic Copper Conductors Rated 75 deg C Maximum Continuous Operation

ABBREVIATIONS:	
OUTLET DISTANCE	the 1-way distance along a run of wire or cable from the head of a branch circuit to the outlet-under-test
VD:	voltage-drop (as measured using the rated load of the circuit from a point on the circuit expressed by the outlet distance) NOTE: voltage-drop measurements, when taken on a live circuit, incorporate all upstream combined impedances from the source of the voltage to the point of the measurement, including source impedance.
ASCC	available short-circuit current at the point of the measurement
multiple	available short-circuit current expressed as a multiple of the rating of the circuit
I^2T	formula expressing conductor heating as a function of current held over time on a wire of a given size
R/ft	resistance per foot of length of copper wire of a given size

EXPLANATION

This chart illustrates the fixed relationships in a 120-volt branch circuit between Voltage-Drop (VD), Available Short Circuit Current (ASCC, both in amps and as a multiple of the breaker's handle rating) and the degree of conductor heating (I2T) generated at various distances in a hypothetical branch circuit when subjected to a short-circuit of 1-cycle in duration. One cycle has been selected because this is the circuit clearing time that can be expected when the instantaneous response of a thermal/magnetic circuit breaker is engaged.

The top portion of the chart illustrates the characteristics of a 15A branch circuit and the bottom portion the same for a 20-amp circuit. The rows in each chart illustrate the values of voltage-drop (VD), available short-circuit current (ASCC), the multiple of the circuit breaker's handle-rating represented by the corresponding ASCC, and the conductor heating (I^2T) generated by the ASCC during 1-cycle at several points along hypothetical 15 and 20-amp branch circuits indicated in the top row as distances in feet from the panel. VD at the panelboard or load center is assumed to be 1%. Higher or lower panelboard VD readings will result in correspondingly higher or lower VD readings at outlets downstream.

The column highlighted in gray in each chart illustrates the VD, ASCC and its corresponding multiple of the circuit breaker rating, and the I^2T heating of the circuit for a 1-cycle fault. Notice that for a 120V circuit a VD of 5% results in an ASCC that is 20 times the ampacity (breaker handle-rating) of the circuit and that I^2T heating is limited to very low levels.