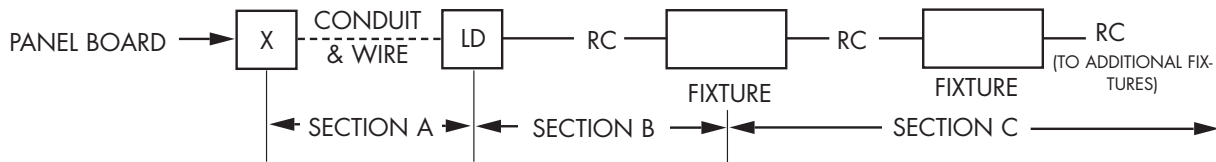


## VOLTAGE DROP GUIDE

### CONDITIONS

1. 20 amp branch circuit derated at 20% to 16 amps.
2. 4 ft. fluorescent fixtures having standard lamps and ballasts.
3. Section A, 50 ft. homerun from Electro/Connect® distribution point to panelboard with No.12 conductors.
4. Section B, 20 ft. branch cable from distribution point to first fixture in the run.
5. Section C, branch cables connecting fixtures, in two lengths:
  - a) 10 ft. cables for 8 ft. x 8 ft. square fixture layout.
  - b) 12 ft. cables for 8 ft. x 8 ft. staggered fixture layout.



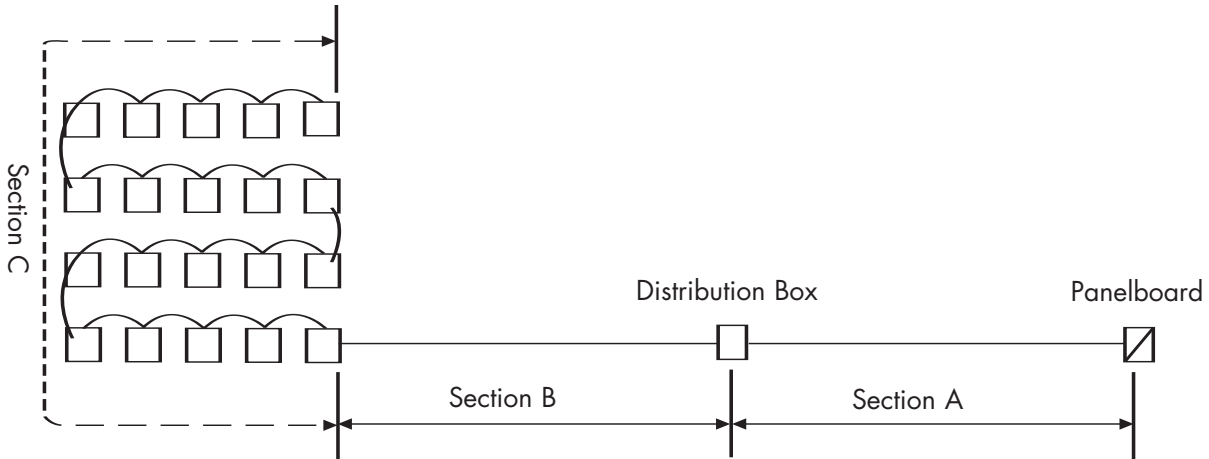
277 VOLT SYSTEM	2-LAMP		3-LAMP		4-LAMP	
	10' Cable	12' Cable	10' Cable	12' Cable	10' Cable	12' Cable
No. of fixtures in run	31	28	24	22	20	19
Line current (amps)	11.16	10.08	13.44	12.32	14.40	13.38
VOLTAGE DROP FOR 277 VOLTS						
Section A, 50' #12	.97	.88	1.17	1.08	1.25	1.19
Section B, 20' Cable	.79	.72	.95	.88	1.02	.97
Total A + B, volts	1.76	1.60	2.12	1.96	2.27	2.16
Section C, 10' Cables	6.54	-	6.06	-	5.35	-
Section C, 12' Cables	-	6.32	-	5.97	-	5.71
Total A + B + C, volts	8.30	7.92	8.18	7.93	7.62	7.87
Maximum Allowable Voltage Drop = 8.31 volts (3% of Line Voltage)						

120 VOLT SYSTEM	2-LAMP		3-LAMP		4-LAMP	
	10' Cable	12' Cable	10' Cable	12' Cable	10' Cable	12' Cable
No. of fixtures in run	12	11	8	8	7	7
Line current (amps)	9.60	8.80	10.24	10.24	11.20	11.20
VOLTAGE DROP FOR 120 VOLTS						
Section A, 50' #12	.83	.76	.89	.89	.97	.97
Section B, 20' Cable	.68	.63	.73	.73	.79	.79
Total A + B, volts	1.51	1.39	1.62	1.62	1.76	1.76
Section C, 10' Cables	2.06	-	1.42	-	1.33	-
Section C, 12' Cables	-	2.05	-	1.68	-	1.57
Total A + B + C, volts	3.57	3.44	3.04	3.30	3.09	3.33
Maximum Allowable Voltage Drop = 3.60 volts (3% of Line Voltage)						

## Voltage Drop Calculations

Calculations for voltage drop in Electro/Connect branch circuits utilize the same principles for voltage drop calculations in conventional "hard-wired" circuits. The tables which are included in this section are based on IEEE Recommended Practices for Electrical Power Systems in Commercial Buildings, Std. 241-1999 and are intended to serve as a quick reference for evaluating various Electro/Connect layout alternatives. Full voltage drop calculations should be made to insure that the final configurations are in conformance with codes.

### Electro/Connect Circuit Segments



The total voltage drop from the panelboard to the last device on a branch circuit run is determined by adding the incremental voltage drops of three segments of the branch circuit. These sections are differentiated primarily through consideration of the distribution of circuit phases and functional loading of the neutral conductors.

Section A - represents that portion of the branch circuit which carries complete multi-wire branch circuits (e.g., three phase, 4-wire). This section generally applies to those branch circuit runs which are hard-wired between the panelboard and the Electro/Connect distribution box.

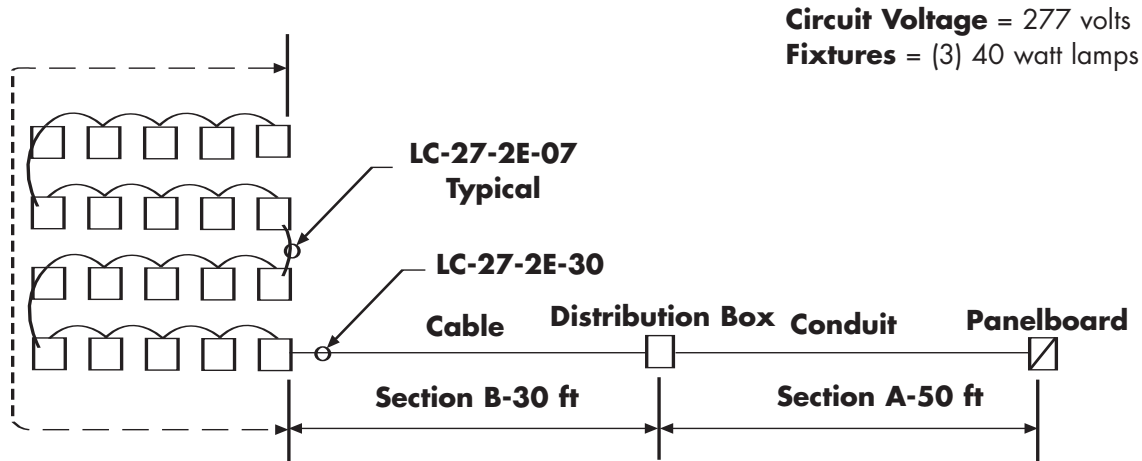
Section B - represents that portion of the branch circuit which carries full load current with the neutral conductor also carrying full load current. This section generally applies to cable runs from the distribution box to the first device which is loading the circuit (lighting fixture, convenience receptacle, etc.).

Section C - represents that portion of the branch circuit through which the load is equally distributed. The load current carried by each successive cable set decreases as each loading device is energized. For example, the cable set which connects to the last fixture of a lighting branch circuit carries only the load current of that one fixture, whereas the cable set which connects to the first fixture of that same branch circuit carries the total current of all fixtures on the circuit.

Tables A-2 through A-5 (on spec. sheets EC6002 & EC6003) provide a quick reference for determining the incremental voltage drop contributions of each section of the branch circuit run. These tables require only the input of two variables, the load current in amps, and the one-way run length of conductors in feet. Given these two variables for each section of the circuit, the incremental voltage drop can be read directly from its respective table. One-way length of conductor should include both the length of conductors in each table set and the length of conductors included with the devices.

## EXAMPLE

16 Fluorescent lighting fixtures on 5 ft x 5 ft centers.



- Step 1.** Determine allowable voltage drop.  
 Allowable voltage drop for the branch circuit segments A, B, and C, as defined by 1999 National Electric Code Section 210-19.a is a 3% circuit voltage.  
 Therefore, for 277 volt circuits +  $.03 \times 277$  volts = **8.3 volts.**
- Step 2.** Determine load current in amps for each segment of the branch circuit.  
 From table on page A-1, load current for sixteen 3-lamp, 277 volt fixtures = **8.96 amps.**
- Step 3.** Determine one-way length of run for each circuit segment.  
 Section A = 50 ft., Section B = 30 ft., Section C = 120 ft.  
 Note: To determine total length for Section C, the cable length between fixtures plus the length of the fixture internal wiring leads should be summed.  
 Thus, cable length of 7 ft. plus fixture internal wiring of 1 ft. = 8 ft. per fixture x 15 fixtures = **120 ft.**
- Step 4.** Read incremental voltage drops from tables A-2 through A-5.
- Section A Voltage Drop (assuming #12 AWG conductors).  
 From table A-2, 50 ft. at 9 amps = **.78 volts.**
  - Section B Voltage Drop  
 From table A-4, 30 ft. at 9 amps = **.96 volts.**
  - Section C Voltage Drop  
 From table A-5, 100 ft. at 9 amps = 1.59 volts  
 plus 20 ft. at 9 amps = .32 volts  
 Equals 120 ft. at 9 amps = **1.91 volts**
- Step 5.** Add incremental voltage drops for Sections A, B, and C and compare to maximum allowable voltage drop determined in Step 1 above.  
 $.78$  volts +  $.96$  volts +  $1.91$  volts = **3.65 volts.**  
 Voltage drop is within the allowable 8.3 volts maximum.

**Table A-1**  
**Load Current - amperes**  
**For Numbers of 4.ft. Fluorescent Fixtures**

Number of Fixtures	277v						120v					
	2-lamp		3-lamp		4-lamp		2-lamp		3-lamp		4-lamp	
	Std <sup>1</sup>	LFL <sup>2,3</sup>	Std <sup>1</sup>	LFL <sup>2,4</sup>	Std <sup>1</sup>	LFL <sup>2,5</sup>	Std <sup>1</sup>	LFL <sup>2,3</sup>	Std <sup>1</sup>	LFL <sup>2,4</sup>	Std <sup>1</sup>	LFL <sup>2,5</sup>
1	.36	.28	.56	—	.72	.66	.80	.73	1.28	—	1.60	1.46
2	.72	.56	1.12	.84	1.44	1.12	1.60	1.46	2.56	2.20	3.20	2.92
3	1.08	.84	1.68	—	2.16	1.68	2.40	2.19	3.84	—	4.80	4.38
4	1.44	1.12	2.24	1.68	2.88	2.24	3.20	2.92	5.12	4.40	6.40	5.84
5	1.80	1.40	2.80	—	3.60	2.80	4.00	3.65	6.40	—	8.00	7.30
6	2.16	1.68	3.36	2.52	4.32	3.36	4.80	4.38	7.68	6.60	9.60	8.76
7	2.52	1.96	3.92	—	5.04	3.92	5.60	5.11	8.96	—	11.20	10.22
8	2.88	2.24	4.48	3.36	5.76	4.48	6.40	5.85	10.24	8.80	12.80	11.68
9	3.24	2.52	5.04	—	6.48	5.04	7.20	6.57	11.52	—	14.40	13.14
10	3.60	2.80	5.60	4.20	7.20	5.60	8.00	7.30	12.80	11.00	—	14.60
11	3.96	3.08	6.16	—	7.92	6.16	8.80	8.03	14.08	—	—	—
12	4.32	3.36	6.72	5.04	8.64	6.72	9.60	8.76	15.36	13.20	—	—
13	4.68	3.64	7.28	—	9.36	7.28	10.40	9.49	—	—	—	—
14	5.04	3.92	7.84	5.88	10.08	7.84	11.20	10.22	—	15.40	—	—
15	5.40	4.20	8.40	—	10.80	8.40	12.00	10.95	—	—	—	—
16	5.76	4.48	8.96	6.72	11.52	8.96	12.80	11.68	—	—	—	—
17	6.12	4.76	9.52	—	12.24	9.52	13.60	12.41	—	—	—	—
18	6.48	5.04	10.08	7.56	12.96	10.08	14.40	13.14	—	—	—	—
19	6.84	5.32	10.64	—	13.68	10.64	15.20	13.87	—	—	—	—
20	7.20	5.60	11.20	8.40	14.40	11.20	—	14.60	—	—	—	—
21	7.56	5.88	11.76	—	15.12	11.76	—	—	—	—	—	—
22	7.92	6.16	12.32	9.24	15.84	12.32	—	—	—	—	—	—
23	8.28	6.44	12.88	—	—	12.88	—	—	—	—	—	—
24	8.64	6.72	13.44	10.08	—	13.44	—	—	—	—	—	—
25	9.00	7.00	14.00	—	—	14.00	—	—	—	—	—	—
26	9.36	7.28	14.56	10.92	—	14.56	—	—	—	—	—	—
27	9.72	7.56	15.12	—	—	15.12	—	—	—	—	—	—
28	10.08	7.84	15.68	11.76	—	15.68	—	—	—	—	—	—
29	10.44	8.12	—	—	—	—	—	—	—	—	—	—
30	10.80	8.40	—	12.60	—	—	—	—	—	—	—	—
31	11.16	8.68	—	—	—	—	—	—	—	—	—	—
32	11.52	8.96	—	13.44	—	—	—	—	—	—	—	—
33	11.88	9.24	—	—	—	—	—	—	—	—	—	—
34	12.24	9.52	—	14.28	—	—	—	—	—	—	—	—
35	12.60	9.80	—	—	—	—	—	—	—	—	—	—
36	12.96	10.08	—	15.12	—	—	—	—	—	—	—	—
37	13.32	10.36	—	—	—	—	—	—	—	—	—	—
38	13.68	10.64	—	—	—	—	—	—	—	—	—	—
39	14.04	10.92	—	—	—	—	—	—	—	—	—	—
40	14.40	11.20	—	—	—	—	—	—	—	—	—	—
41	14.76	11.48	—	—	—	—	—	—	—	—	—	—
42	15.12	11.76	—	—	—	—	—	—	—	—	—	—
43	15.48	12.04	—	—	—	—	—	—	—	—	—	—
44	15.84	12.32	—	—	—	—	—	—	—	—	—	—
45	—	12.60	—	—	—	—	—	—	—	—	—	—
46	—	12.88	—	—	—	—	—	—	—	—	—	—
47	—	13.16	—	—	—	—	—	—	—	—	—	—
48	—	13.44	—	—	—	—	—	—	—	—	—	—
49	—	13.72	—	—	—	—	—	—	—	—	—	—
50	—	14.00	—	—	—	—	—	—	—	—	—	—
51	—	14.28	—	—	—	—	—	—	—	—	—	—
52	—	14.56	—	—	—	—	—	—	—	—	—	—
53	—	14.84	—	—	—	—	—	—	—	—	—	—
54	—	15.12	—	—	—	—	—	—	—	—	—	—
55	—	15.40	—	—	—	—	—	—	—	—	—	—
56	—	15.68	—	—	—	—	—	—	—	—	—	—

**Footnotes:**

1. Load current for single units with standard lamps and standard ballast.
2. Load current for units with Watt-Miser II lamps and Advance Mark III ballasts.
3. Load current for 2-lamp single units with 2-lamp ballasts. Use same line current per pair of 1-lamp units having one 2-lamp ballast.
4. Load current per pair of 3-lamp units having three 2-lamp ballasts.
5. Load current for 4-lamp single units with two 2-lamp ballasts.

**ECT6002**

**Section A**  
**Voltage Drop**  
**Length-to-Neutral - Single Phase, 3-wire - Three Phase, 4 wire**

**Table A-2**  
**One Way Length of Run - In Feet**  
**No. 12 AWG**

amps

	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
1					.10	.12	.14	.16	.17	.19	.20	.22	.24	.26	.28	.30	.32	.33	.34	
2			.10	.14	.17	.21	.24	.28	.31	.35	.38	.42	.45	.49	.52	.56	.59	.63	.66	.70
3		.10	.16	.21	.26	.31	.36	.42	.47	.52	.57	.62	.68	.73	.78	.83	.88	.94	1.00	1.05
4		.14	.21	.28	.35	.42	.48	.55	.62	.69	.76	.82	.89	.96	1.03	1.10	1.16	1.23	1.30	1.37
5		.17	.26	.35	.42	.55	.61	.69	.78	.87	.95	1.03	1.12	1.21	1.29	1.37	1.46	1.55	1.63	1.71
6	.10	.21	.31	.42	.52	.62	.73	.83	.94	1.04	1.15	1.23	1.34	1.44	1.55	1.65	1.76	1.86	1.97	2.07
7	.12	.24	.36	.49	.61	.73	.85	.97	1.09	1.21	1.32	1.44	1.56	1.68	1.80	1.92	2.06	2.19	2.31	2.43
8	.14	.28	.42	.55	.69	.83	.97	1.11	1.25	1.39	1.52	1.65	1.78	1.91	2.04	2.17	2.30	2.43	2.55	2.68
9	.16	.31	.47	.62	.78	.94	1.09	1.25	1.40	1.56	1.72	1.87	2.02	2.18	2.34	2.49	2.64	2.80	2.96	3.11
10	.17	.35	.52	.69	.87	1.04	1.21	1.39	1.56	1.73	1.91	2.09	2.26	2.43	2.61	2.79	2.96	3.13	3.31	3.49
11	.19	.38	.57	.76	.95	1.14	1.33	1.52	1.71	1.90	2.09	2.28	2.47	2.66	2.85	3.05	3.24	3.43	3.62	3.81
12	.21	.42	.62	.83	1.04	1.25	1.45	1.66	1.87	2.08	2.28	2.49	2.69	2.90	3.11	3.31	3.52	3.63	3.83	4.04
13	.23	.45	.68	.90	1.13	1.35	1.58	1.80	2.03	2.25	2.48	2.70	2.93	3.15	3.36	3.58	3.79	4.01	4.22	4.44
14	.24	.49	.73	.97	1.21	1.45	1.70	1.94	2.18	2.42	2.67	2.91	3.15	3.39	3.63	3.88	4.12	4.36	4.60	4.84
15	.26	.52	.78	1.04	1.30	1.56	1.82	2.08	2.34	2.60	2.86	3.12	3.38	3.64	3.90	4.16	4.42	4.68	4.94	5.20
16	.28	.55	.83	1.11	1.39	1.66	1.94	2.22	2.49	2.77	3.05	3.32	3.60	3.88	4.16	4.43	4.71	4.79	5.06	5.34

**Table A-3**  
**One Way Length of Run - In Feet**  
**No. 10 AWG**

amps

	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
1									.10	.11	.12	.13	.14	.15	.16	.17	.18	.19	.20	.21
2					.11	.13	.15	.18	.20	.22	.24	.26	.28	.30	.32	.34	.36	.38	.40	.42
3			.10	.13	.17	.20	.23	.26	.30	.33	.36	.39	.43	.46	.49	.52	.56	.59	.62	.65
4			.13	.18	.22	.26	.31	.35	.39	.44	.48	.52	.57	.61	.65	.70	.74	.78	.83	.87
5		.11	.16	.22	.27	.33	.38	.44	.49	.55	.60	.66	.71	.77	.82	.88	.93	.99	1.04	1.10
6		.13	.20	.26	.33	.40	.46	.53	.59	.66	.72	.79	.85	.92	.98	1.05	1.11	1.18	1.24	1.31
7		.15	.23	.31	.38	.46	.54	.61	.69	.77	.84	.91	.99	1.07	1.14	1.22	1.30	1.37	1.45	1.53
8		.18	.26	.35	.44	.53	.61	.70	.79	.88	.96	1.05	1.14	1.23	1.31	1.40	1.49	1.58	1.66	1.75
9	.10	.20	.30	.39	.49	.59	.69	.79	.89	.99	1.08	1.18	1.28	1.38	1.48	1.58	1.68	1.77	1.87	1.97
10	.11	.22	.33	.44	.55	.66	.77	.88	.99	1.10	1.21	1.32	1.43	1.54	1.65	1.76	1.87	1.98	2.09	2.20
11	.12	.24	.36	.48	.60	.72	.84	.97	1.09	1.21	1.33	1.45	1.57	1.69	1.81	1.93	2.05	2.17	2.29	2.41
12	.13	.26	.40	.53	.66	.79	.92	1.05	1.18	1.32	1.43	1.56	1.69	1.82	1.95	2.08	2.21	2.34	2.47	2.60
13	.14	.29	.43	.57	.71	.86	1.00	1.14	1.28	1.43	1.57	1.71	1.85	2.00	2.14	2.28	2.42	2.57	2.71	2.85
14	.15	.31	.46	.61	.77	.92	1.07	1.23	1.38	1.53	1.69	1.84	1.99	2.15	2.30	2.45	2.61	2.76	2.91	3.07
15	.16	.33	.49	.66	.82	.99	1.15	1.32	1.48	1.64	1.81	1.97	2.14	2.30	2.47	2.63	2.80	2.96	3.13	3.29
16	.18	.35	.53	.70	.88	1.05	1.23	1.40	1.58	1.75	1.93	2.10	2.28	2.45	2.63	2.80	2.98	3.15	3.33	3.50

**ECT6003**

## Section B Voltage Drop

**Table A-4**  
**One Way Length of Run - In Feet**  
**No. 12 AWG**

amps	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
1			.11	.14	.18	.21	.25	.28	.32	.35	.39	.42	.46	.49	.53	.56	.60	.63	.67	.70
2		.14	.21	.28	.35	.42	.50	.57	.64	.71	.78	.85	.92	.99	1.06	1.13	1.20	1.27	1.34	1.41
3	.11	.21	.32	.42	.53	.64	.74	.85	.96	1.06	1.17	1.28	1.38	1.49	1.60	1.70	1.81	1.92	2.02	2.13
4	.14	.28	.42	.57	.71	.85	.99	1.13	1.27	1.42	1.56	1.70	1.84	1.98	2.12	2.27	2.41	2.55	2.69	2.83
5	.18	.35	.53	.71	.89	1.06	1.24	1.42	1.59	1.77	1.97	2.15	2.33	2.50	2.68	2.86	3.04	3.21	3.39	3.57
6	.21	.42	.64	.85	1.06	1.27	1.49	1.70	1.91	2.12	2.34	2.55	2.76	2.97	3.19	3.40	3.61	3.82	4.04	4.25
7	.25	.50	.74	.99	1.24	1.49	1.73	1.98	2.23	2.48	2.72	2.97	3.22	3.47	3.71	3.96	4.21	4.46	4.70	4.95
8	.28	.57	.85	1.13	1.42	1.70	1.98	2.27	2.55	2.83	3.12	3.40	3.68	3.96	4.24	4.72	5.01	5.29	5.57	5.86
9	.32	.64	.96	1.27	1.59	1.91	2.23	2.55	2.87	3.19	3.50	3.81	4.12	4.43	4.75	5.07	5.38	5.70	6.02	6.33
10	.35	.71	1.06	1.42	1.77	2.12	2.48	2.83	3.19	3.54	3.90	4.25	4.61	4.96	5.32	5.67	6.03	6.38	6.74	7.09
11	.39	.78	1.17	1.56	1.95	2.34	2.73	3.12	3.50	3.89	4.28	4.67	5.06	5.45	5.84	6.23	6.62	7.01	7.40	7.79
12	.42	.85	1.27	1.70	2.12	2.55	2.97	3.40	3.82	4.25	4.67	5.10	5.52	5.95	6.37	6.79	7.22	7.64	8.07	8.49
13	.46	.92	1.38	1.84	2.30	2.76	3.22	3.68	4.14	4.60	5.06	5.52	5.98	6.44	6.90	7.36	7.82	8.28	8.74	9.20
14	.50	.99	1.49	1.98	2.48	2.97	3.47	3.96	4.46	4.96	5.45	5.95	6.44	6.94	7.43	7.93	8.42	8.91	9.41	9.91
15	.53	1.06	1.59	2.12	2.66	3.19	3.72	4.25	4.78	5.31	5.84	6.37	6.90	7.44	7.97	8.50	9.03	9.57	10.10	10.63
16	.57	1.13	1.70	2.27	2.83	3.40	3.96	4.53	5.10	5.66	6.23	6.80	7.36	7.93	8.50	9.06	9.63	10.20	10.77	11.33

## Section C Voltage Drop

**Table A-5**  
**One Way Length of Run - In Feet**  
**No. 12 AWG**

amps	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
1			.06	.07	.09	.11	.13	.14	.16	.18	.20	.21	.23	.25	.27	.28	.30	.32	.34	.35
2		.07	.11	.14	.18	.21	.25	.28	.32	.35	.39	.42	.46	.49	.53	.56	.60	.63	.67	.70
3	.06	.11	.16	.21	.27	.32	.37	.42	.48	.53	.58	.63	.68	.72	.77	.82	.87	.91	.96	1.01
4	.07	.14	.21	.28	.36	.42	.50	.57	.64	.71	.78	.85	.92	1.00	1.07	1.14	1.21	1.29	1.35	1.41
5	.09	.18	.27	.35	.45	.53	.62	.71	.80	.89	.99	1.08	1.17	1.26	1.36	1.45	1.54	1.63	1.72	1.81
6	.11	.21	.32	.42	.53	.64	.75	.85	.96	1.06	1.17	1.28	1.39	1.49	1.61	1.72	1.83	1.94	2.04	2.15
7	.13	.25	.37	.50	.62	.74	.87	.99	1.12	1.24	1.36	1.48	1.61	1.73	1.85	1.98	2.10	2.22	2.35	2.47
8	.14	.28	.43	.57	.71	.85	.99	1.13	1.28	1.42	1.56	1.70	1.84	1.98	2.12	2.27	2.41	2.55	2.69	2.83
9	.16	.32	.48	.64	.80	.96	1.12	1.27	1.44	1.59	1.75	1.91	2.07	2.23	2.39	2.55	2.71	2.87	3.03	3.19
10	.18	.35	.53	.71	.89	1.06	1.24	1.42	1.60	1.77	1.94	2.11	2.28	2.46	2.64	2.82	3.00	3.17	3.35	3.53
11	.20	.39	.59	.78	.98	1.17	1.37	1.56	1.75	1.95	2.14	2.34	2.53	2.73	2.92	3.12	3.31	3.51	3.70	3.90
12	.21	.42	.64	.85	1.06	1.27	1.49	1.70	1.91	2.12	2.33	2.54	2.75	2.97	3.18	3.39	3.60	3.82	4.03	4.24
13	.23	.46	.69	.92	1.15	1.38	1.61	1.84	2.07	2.30	2.53	2.76	2.99	3.22	3.45	3.68	3.91	4.14	4.37	4.60
14	.25	.50	.75	.99	1.24	1.49	1.74	1.98	2.23	2.48	2.73	2.98	3.22	3.47	3.72	3.96	4.21	4.46	4.70	4.95
15	.27	.53	.80	1.06	1.33	1.59	1.86	2.12	2.39	2.66	2.92	3.19	3.45	3.72	3.98	4.25	4.51	4.78	5.04	5.31
16	.29	.57	.85	1.13	1.42	1.70	1.98	2.27	2.55	2.83	3.11	3.39	3.67	3.96	4.24	4.52	4.80	5.09	5.37	5.65

**ECT6003**