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Subject: E-FSA Addressable Loop Wiring

Appendix B of the E-FSA Technical Reference Manual (part number 3101202) includes calculations and charts for total wire and maximum wire distances for the addressable loop. This bulletin will try and clear up some possible confusion and explain where the numbers came from.

With the addressable loop you have to be concerned with both the total wire connected to the circuit (including all t-taps) as well as the distance from the panel to the device farthest away. There are two primary components that go into figuring out wire maximums: Wire capacitance and wire resistance.

First, maximum amount of wire connected to loop - The manual states you can have up to 20,000ft of total wire. This is based on the maximum allowable loop capacitance rating of 500,000pF divided by the cable capacitance rating (25pF/ft for 14 AWG, non shielded wire was used). Capacitance in parallel is additive, which is why you have to total up all the t-tap wire distances.

So then you may ask “What if I don’t have any t-taps, does that mean I can go 20K feet in a straight line?”. The answer is no, because the other part of the equation is wire resistance. The maximum allowable loop resistance is 66 ohms. Typical resistance for 14 AWG wire is 5.05 ohms per 1000ft pair. $66/5.05 \times 1000 = 13,069\text{ft}$.

If you look at Appendix B you’ll see charts with various cable types and the distances you can go on a fully loaded loop. These distances are from the panel to the farthest device (assuming a class B loop). Notice you do not see 20K feet anywhere. You may also wonder why we only show maxed out loops. You’d think you could go farther with fewer devices (therefore less load). Even with only one device on a loop using 14 AWG wire, however, you’re still limited to 13K feet because of the 66 ohms max loop resistance.

A copy of Appendix B follows for your reference.

Device loop maximum wire length worksheet

Use the instructions provided below to calculate the maximum wire length for a device loop. The maximum wire length is made up of two components: the total amount of wire and the longest circuit path.

Step 1: Total wire

Use the worksheet below to calculate the total amount of wire that you can use to construct a device loop. The total amount of wire is based on the cable manufacturer's capacitance per foot rating. In no case shall the total amount of wire exceed the values listed in Table 1.

$$\begin{array}{r}
 \text{Cable capacitance} \\
 \div \quad 500,000 \text{ pF} \\
 \hline
 \text{Total wire} \quad \text{pF/ft.} \\
 \hline
 \text{ft.}
 \end{array}$$

Table 1: Maximum amount of wire you can use to construct a device loop

Wire type	18 AWG or 0.75 sq mm	16 AWG or 1.0 sq mm	14 AWG or 1.5 sq mm
Twisted pair, nonshielded 25 pF/36 pF/38 pF	20,000 ft. (6096 m)	13,888 ft. (4233 m)	13,157 ft. (4010 m)
Twisted pair, shielded 58 pF/82 pF/84 pF	8,621 ft. (2628 m)	6,098 ft. (1859 m)	5,952 ft. (1814 m)
Nontwisted pair, nonshielded 20 pF/20 pF/20 pF	20,000 ft. (6096 m)	20,000 ft. (6096 m)	20,000 ft. (6096 m)

Step 2: Longest path

Use Table 2 or Table 3 to determine the device loop's longest circuit path. The longest circuit path is based on wire size and type, and the number of detectors and modules installed on the loop.

Note: When using the tables to calculate a wire length for the 64 point panel, do not exceed a total of 64 device addresses (any combination of detectors and modules).

In the illustration below, the longest circuit path (shown in bold lines) is 1,240 ft. (378 m). The total amount of wire comprising the loop is 1,640 ft. (500 m)

Device circuit path diagram

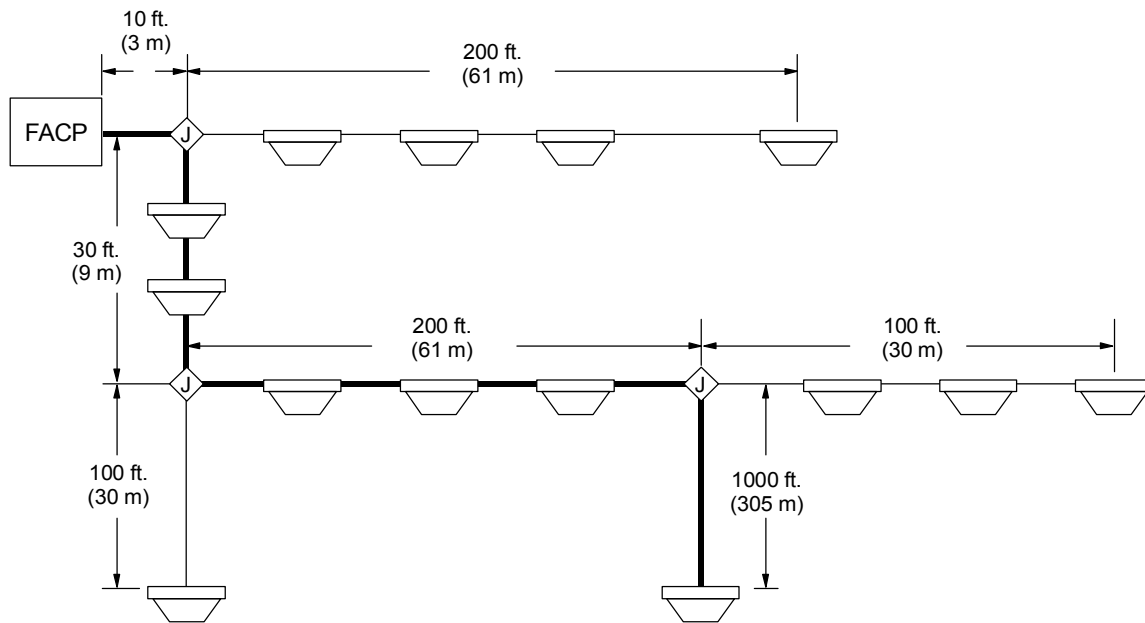


Table 2: Twisted shielded and nontwisted shielded

Sensors	Modules	Evenly distributed distance			End loaded distance		
		18 AWG	16 AWG	14 AWG	18 AWG	16 AWG	14 AWG
127	0	5172 ft. (1576 m)	6098 ft. (1858 m)	5952 ft. (1814 m)	5172 ft. (1576 m)	6098 ft. (1858 m)	5952 ft. (1814 m)
120	7	5172 ft. (1576 m)	6098 ft. (1858 m)	5952 ft. (1814 m)	5172 ft. (1576 m)	6098 ft. (1858 m)	5952 ft. (1814 m)
115	12	5172 ft. (1576 m)	6098 ft. (1858 m)	5952 ft. (1814 m)	5172 ft. (1576 m)	6098 ft. (1858 m)	5952 ft. (1814 m)
110	17	5172 ft. (1576 m)	6098 ft. (1858 m)	5952 ft. (1814 m)	5172 ft. (1576 m)	6098 ft. (1858 m)	5952 ft. (1814 m)
105	22	5172 ft. (1576 m)	6098 ft. (1858 m)	5952 ft. (1814 m)	5172 ft. (1576 m)	6098 ft. (1858 m)	5952 ft. (1814 m)
100	27	5172 ft. (1576 m)	6098 ft. (1858 m)	5952 ft. (1814 m)	5172 ft. (1576 m)	6098 ft. (1858 m)	5952 ft. (1814 m)
95	32	5172 ft. (1576 m)	6098 ft. (1858 m)	5952 ft. (1814 m)	5172 ft. (1576 m)	6098 ft. (1858 m)	5952 ft. (1814 m)
90	37	5172 ft. (1576 m)	6098 ft. (1858 m)	5952 ft. (1814 m)	5172 ft. (1576 m)	6098 ft. (1858 m)	5952 ft. (1814 m)
85	42	5172 ft. (1576 m)	6098 ft. (1858 m)	5952 ft. (1814 m)	5172 ft. (1576 m)	6098 ft. (1858 m)	5952 ft. (1814 m)
80	47	5172 ft. (1576 m)	6098 ft. (1858 m)	5952 ft. (1814 m)	5172 ft. (1576 m)	6098 ft. (1858 m)	5952 ft. (1814 m)
75	52	5172 ft. (1576 m)	6098 ft. (1858 m)	5952 ft. (1814 m)	5172 ft. (1576 m)	6098 ft. (1858 m)	5952 ft. (1814 m)

Table 2: Twisted shielded and nontwisted shielded

Sensors	Modules	Evenly distributed distance			End loaded distance		
		18 AWG	16 AWG	14 AWG	18 AWG	16 AWG	14 AWG
70	57	5172 ft. (1576 m)	6098 ft. (1858 m)	5952 ft. (1814 m)	5172 ft. (1576 m)	6098 ft. (1858 m)	5952 ft. (1814 m)
65	62	5172 ft. (1576 m)	6098 ft. (1858 m)	5952 ft. (1814 m)	5172 ft. (1576 m)	6098 ft. (1858 m)	5952 ft. (1814 m)
60	67	5172 ft. (1576 m)	6098 ft. (1858 m)	5952 ft. (1814 m)	5172 ft. (1576 m)	6098 ft. (1858 m)	5952 ft. (1814 m)
55	72	5172 ft. (1576 m)	6098 ft. (1858 m)	5952 ft. (1814 m)	5172 ft. (1576 m)	6098 ft. (1858 m)	5952 ft. (1814 m)
50	77	5172 ft. (1576 m)	6098 ft. (1858 m)	5952 ft. (1814 m)	5172 ft. (1576 m)	6098 ft. (1858 m)	5952 ft. (1814 m)
45	82	5172 ft. (1576 m)	6098 ft. (1858 m)	5952 ft. (1814 m)	5009 ft. (1526 m)	6098 ft. (1858 m)	5952 ft. (1814 m)
40	87	5172 ft. (1576 m)	6098 ft. (1858 m)	5952 ft. (1814 m)	4777 ft. (1456 m)	6098 ft. (1858 m)	5952 ft. (1814 m)
35	92	5172 ft. (1576 m)	6098 ft. (1858 m)	5952 ft. (1814 m)	4565 ft. (1391 m)	6098 ft. (1858 m)	5952 ft. (1814 m)
30	97	5172 ft. (1576 m)	6098 ft. (1858 m)	5952 ft. (1814 m)	4372 ft. (1332 m)	6098 ft. (1858 m)	5952 ft. (1814 m)
25	102	5172 ft. (1576 m)	6098 ft. (1858 m)	5952 ft. (1814 m)	4194 ft. (1278 m)	6098 ft. (1858 m)	5952 ft. (1814 m)
20	107	5172 ft. (1576 m)	6098 ft. (1858 m)	5952 ft. (1814 m)	4030 ft. (1228 m)	6098 ft. (1858 m)	5952 ft. (1814 m)
15	112	5172 ft. (1576 m)	6098 ft. (1858 m)	5952 ft. (1814 m)	3878 ft. (1182 m)	6098 ft. (1858 m)	5952 ft. (1814 m)
10	117	5172 ft. (1576 m)	6098 ft. (1858 m)	5952 ft. (1814 m)	3737 ft. (1139 m)	5938 ft. (1809 m)	5952 ft. (1814 m)
5	122	5172 ft. (1576 m)	6098 ft. (1858 m)	5952 ft. (1814 m)	3607 ft. (1099 m)	5730 ft. (1746 m)	5952 ft. (1814 m)
0	126	5172 ft. (1576 m)	6098 ft. (1858 m)	5952 ft. (1814 m)	3512 ft. (1070 m)	5580 ft. (1700 m)	5952 ft. (1814 m)

Table 3: Twisted nonshielded and nontwisted nonshielded

Sensors	Modules	Evenly distributed distance			End loaded distance		
		18 AWG	16 AWG	14 AWG	18 AWG	16 AWG	14 AWG
127	0	5172 ft. (1576 m)	8217 ft. (2504 m)	13069 ft. (3983 m)	5172 ft. (1576 m)	8217 ft. (2504 m)	13069 ft. (3983 m)
120	7	5172 ft. (1576 m)	8217 ft. (2504 m)	13069 ft. (3983 m)	5172 ft. (1576 m)	8217 ft. (2504 m)	13069 ft. (3983 m)
115	12	5172 ft. (1576 m)	8217 ft. (2504 m)	13069 ft. (3983 m)	5172 ft. (1576 m)	8217 ft. (2504 m)	13069 ft. (3983 m)
110	17	5172 ft. (1576 m)	8217 ft. (2504 m)	13069 ft. (3983 m)	5172 ft. (1576 m)	8217 ft. (2504 m)	13069 ft. (3983 m)

Table 3: Twisted nonshielded and nontwisted nonshielded

Sensors	Modules	Evenly distributed distance			End loaded distance		
		18 AWG	16 AWG	14 AWG	18 AWG	16 AWG	14 AWG
105	22	5172 ft. (1576 m)	8217 ft. (2504 m)	13069 ft. (3983 m)	5172 ft. (1576 m)	8217 ft. (2504 m)	13069 ft. (3983 m)
100	27	5172 ft. (1576 m)	8217 ft. (2504 m)	13069 ft. (3983 m)	5172 ft. (1576 m)	8217 ft. (2504 m)	13069 ft. (3983 m)
95	32	5172 ft. (1576 m)	8217 ft. (2504 m)	13069 ft. (3983 m)	5172 ft. (1576 m)	8217 ft. (2504 m)	13069 ft. (3983 m)
90	37	5172 ft. (1576 m)	8217 ft. (2504 m)	13069 ft. (3983 m)	5172 ft. (1576 m)	8217 ft. (2504 m)	13069 ft. (3983 m)
85	42	5172 ft. (1576 m)	8217 ft. (2504 m)	13069 ft. (3983 m)	5172 ft. (1576 m)	8217 ft. (2504 m)	13069 ft. (3983 m)
80	47	5172 ft. (1576 m)	8217 ft. (2504 m)	13069 ft. (3983 m)	5172 ft. (1576 m)	8217 ft. (2504 m)	13069 ft. (3983 m)
75	52	5172 ft. (1576 m)	8217 ft. (2504 m)	13069 ft. (3983 m)	5172 ft. (1576 m)	8217 ft. (2504 m)	13069 ft. (3983 m)
70	57	5172 ft. (1576 m)	8217 ft. (2504 m)	13069 ft. (3983 m)	5172 ft. (1576 m)	8217 ft. (2504 m)	13069 ft. (3983 m)
65	62	5172 ft. (1576 m)	8217 ft. (2504 m)	13069 ft. (3983 m)	5172 ft. (1576 m)	8217 ft. (2504 m)	13069 ft. (3983 m)
60	67	5172 ft. (1576 m)	8217 ft. (2504 m)	13069 ft. (3983 m)	5172 ft. (1576 m)	8217 ft. (2504 m)	13069 ft. (3983 m)
55	72	5172 ft. (1576 m)	8217 ft. (2504 m)	13069 ft. (3983 m)	5172 ft. (1576 m)	8217 ft. (2504 m)	13069 ft. (3983 m)
50	77	5172 ft. (1576 m)	8217 ft. (2504 m)	13069 ft. (3983 m)	5172 ft. (1576 m)	8217 ft. (2504 m)	13069 ft. (3983 m)
45	82	5172 ft. (1576 m)	8217 ft. (2504 m)	13069 ft. (3983 m)	5009 ft. (1526 m)	7958 ft. (2425 m)	12656 ft. (3857 m)
40	87	5172 ft. (1576 m)	8217 ft. (2504 m)	13069 ft. (3983 m)	4777 ft. (1456 m)	7689 ft. (2343 m)	12070 ft. (3678 m)
35	92	5172 ft. (1576 m)	8217 ft. (2504 m)	13069 ft. (3983 m)	4565 ft. (1391 m)	7253 ft. (2210 m)	11535 ft. (3515 m)
30	97	5172 ft. (1576 m)	8217 ft. (2504 m)	13069 ft. (3983 m)	4372 ft. (1332 m)	6945 ft. (2116 m)	11046 ft. (3366 m)
25	102	5172 ft. (1576 m)	8217 ft. (2504 m)	13069 ft. (3983 m)	4194 ft. (1278 m)	6662 ft. (2030 m)	10596 ft. (3229 m)
20	107	5172 ft. (1576 m)	8217 ft. (2504 m)	13069 ft. (3983 m)	4030 ft. (1228 m)	6402 ft. (1951 m)	10182 ft. (3103 m)
15	112	5172 ft. (1576 m)	8217 ft. (2504 m)	13069 ft. (3983 m)	3878 ft. (1182 m)	6161 ft. (1877 m)	9799 ft. (2986 m)
10	117	5172 ft. (1576 m)	8217 ft. (2504 m)	13069 ft. (3983 m)	3737 ft. (1139 m)	5938 ft. (1809 m)	9444 ft. (2878 ft.)
5	122	5172 ft. (1576 m)	8217 ft. (2504 m)	13069 ft. (3983 m)	3607 ft. (1099 m)	5730 ft. (1746 m)	9113 ft. (2777 m)
0	126	5172 ft. (1576 m)	8217 ft. (2504 m)	13069 ft. (3983 m)	3512 ft. (1070 m)	5580 ft. (1700 m)	8875 ft. (2705 m)