

Temperature Testing

28AWG TekPatch™



Data
Communications
Competence Center

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Test Summary

Berk-Tek 28 AWG TekPatch™ Mini-6 reduced-diameter patch cable was tested at elevated temperatures. The results of the testing validated the expected impact to channels for both conductor resistance and insertion loss.

Background

In order to validate the limitations placed upon a channel when a Berk-Tek 28 AWG patch cable is utilized, Nexans' Data Communications Competence Center conducted a series of experiments to determine the impact to the insertion loss budget due to length and temperature variables. Additionally, the impact to channel DC resistance was investigated as Power over Ethernet (PoE) employs a maximum DC loop resistance.

Equipment

ESPEC Environmental Chamber

Fluke DTX 1800 Handheld Ethernet Channel Tester

Test Setup

- 50 meter samples of Berk-Tek TekPatch™ Mini-6 were coiled in the environmental chamber. The ends of the samples were connectorized with plugs designed to fit the reduced gauge size.
- The 50 meter length was used to reduce high frequency noise floor issues with the Insertion Loss measurements.
- The test leads were minimized to a few inches outside the conditioned environment.
- The chamber temperature was set and the sample was allowed time to condition.
- The sample performance was measured using a Fluke DTX 1800 handheld test unit.
- Sample conditioning and measurement were repeated for each temperature.
- All link length calculations presume only the patch cord is at an elevated temperature. The horizontal cable is presumed to be 20 degrees Celsius.

Test Results

The sample exhibited margin to the conductor resistance specification. The effect of temperature on the resistance followed as expected based on the theoretical calculations.

	20 °C	30 °C	40 °C	50 °C	60 °C	75 °C
Measured	20.8	21.6	22.5	23.4	24.2	25.2
Limit	23.2	24.1	25.0	25.9	26.8	28.1
Ratio	90%	90%	90%	90%	90%	90%

Table 1: Measured Resistance (Ohms) Compared to Theoretical Limit

The change in the insertion loss of the cable followed as expected based on simple models of temperature dependence. A high degree of correlation between the measured and expected derated category 6 results was observed.

	20 °C	30 °C	40 °C	50 °C	60 °C	75 °C
Limit	1.9	1.98	2.05	2.18	2.3	2.48
Measured	1.87	1.91	2.0	2.02	2.14	2.37
Expected	1.83	1.90	1.98	2.10	2.21	2.39
Ratio	99%	97%	96%	93%	93%	95%

Table 2: Measured Insertion Loss Deration (Ratio) Compared to Theoretical Limit

The insertion loss proved the limiting parameter for channel length for this design. At no time did the conductor resistance exceed the PoE loop resistance requirements for the link implementations that are included in the Annex.

Conclusions

Insertion loss proved to be the limiting factor in determining the maximum horizontal link length across temperature. As the product is currently designed, conductor resistance is not a limitation to PoE or PoE+ provided the maximum lengths as outlined in the tables below are not exceeded. When utilizing the 28 AWG product at 20 degrees Celsius with LANmark™-6 or LANmark™-1000 horizontal cable, a maximum of six meters of patch may be used before the horizontal link length must be reduced below 90 meters. The allowable patch length increases to seven meters if LANmark™-2000 is utilized.

Annex: Maximum Link Lengths Based on Test Results

It is not recommend that horizontal cable lengths exceed 90 meters.

Table Set 1: 28 AWG with LANmark™-6 Horizontal

Installed at a 20C environment					
28 AWG Patch Length		Horizontal Cable Length		Total Channel Length	
Meters	Feet	Meters	Feet	Meters	Feet
2 to 6	7 to 20	90	295	92 to 96	302 to 315
7	23	88.7	291	95.7	314
8	26	86.8	285	94.8	311
9	30	84.9	279	93.9	308
10	33	83	272	93	305
20	66	64	210	84	276
30	98	45	148	75	246
40	131	26	85	66	217
50	164	7	23	57	187
53.7	176	0	0	53.7	176

Installed at a 30C environment					
28 AWG Patch Length		Horizontal Cable Length		Total Channel Length	
Meters	Feet	Meters	Feet	Meters	Feet
2 to 6	7 to 20	90	295	92 to 96	302 to 315
7	23	88.2	289	95.2	312
8	26	86.2	283	94.2	309
9	30	84.2	276	93.2	306
10	33	82.2	270	92.2	303
20	66	62.5	205	82.5	271
30	98	42.7	140	72.7	239
40	131	23	75	63.0	207
50	164	3.2	10	53.2	175
51.6	169	0	0	51.6	169

Installed at a 40C environment					
28 AWG Patch Length		Horizontal Cable Length		Total Channel Length	
Meters	Feet	Meters	Feet	Meters	Feet
2 to 5	7 to 16	90	295	92 to 95	302 to 312
6	20	89.7	294	95.7	314
7	23	87.6	288	94.6	310
8	26	85.6	281	93.6	307
9	30	83.5	274	92.5	304
10	33	81.5	267	91.5	300
20	66	61	200	81.0	266
30	98	40.4	133	70.4	231
40	131	19.9	65	59.9	197
49.7	163	0	0	49.7	163

Installed at a 50C environment					
28 AWG Patch Length		Horizontal Cable Length		Total Channel Length	
Meters	Feet	Meters	Feet	Meters	Feet
2 to 5	7 to 16	90	295	92 to 95	302 to 312
6	20	88.9	292	94.9	312
7	23	86.8	285	93.8	308
8	26	84.6	278	92.6	304
9	30	82.4	270	91.4	300
10	33	80.2	263	90.2	296
20	66	58.5	192	78.5	258
30	98	36.7	121	66.7	219
40	131	15	49	55	180
46.9	154	0	0	46.9	154

Installed at a 60C environment					
28 AWG Patch Length		Horizontal Cable Length		Total Channel Length	
Meters	Feet	Meters	Feet	Meters	Feet
2 to 5	7 to 16	90	295	92 to 95	302 to 312
6	20	88.2	289	94.2	309
7	23	85.9	282	92.9	305
8	26	83.6	274	91.6	301
9	30	81.3	267	90.3	296
10	33	79.0	259	89.0	292
20	66	56.0	184	76.0	249
30	98	33.1	108	63.1	207
40	131	10.1	33	50.1	164
44.4	146	0	0	44.4	146

Installed at a 75C environment					
28 AWG Patch Length		Horizontal Cable Length		Total Channel Length	
Meters	Feet	Meters	Feet	Meters	Feet
2 to 4	7 to 13	90.0	295	92 to 94	302 to 308
5	16	89.6	294	94.6	310
6	20	87.1	286	93.1	305
7	23	84.6	278	91.6	301
8	26	82.1	269	90.1	296
9	30	79.7	261	88.7	291
10	33	77.2	253	87.2	286
20	66	52.3	172	72.3	237
30	98	27.5	90	57.5	189
40	131	2.7	9	42.7	140
41.1	135	0	0	41.1	135

Table Set 2: 28 AWG with LANmark™-1000 Horizontal

Installed at a 20C environment					
28 AWG Patch Length		Horizontal Cable Length		Total Channel Length	
Meters	Feet	Meters	Feet	Meters	Feet
2 to 6	7 to 20	90	295	92 to 96	302 to 315
7	23	89.3	293	95.7	314
8	26	87.3	287	94.8	311
9	30	85.4	280	93.9	308
10	33	83.5	274	93	305
20	66	64.4	211	84	276
30	98	45.3	149	75	246
40	131	26.2	86	66	217
50	164	7.0	23	57	187
53.7	176	0	0	53.7	176

Installed at a 30C environment					
28 AWG Patch Length		Horizontal Cable Length		Total Channel Length	
Meters	Feet	Meters	Feet	Meters	Feet
2 to 6	7 to 20	90	295	92 to 96	302 to 315
7	23	88.7	291	95.7	314
8	26	86.7	285	94.7	311
9	30	84.7	278	93.7	308
10	33	82.8	272	92.8	304
20	66	62.9	206	82.9	272
30	98	43.0	141	73.0	239
40	131	23.1	76	63.1	207
50	164	3.2	11	53.2	175
51.6	169	0	0	51.6	169

Installed at a 40C environment					
28 AWG Patch Length		Horizontal Cable Length		Total Channel Length	
Meters	Feet	Meters	Feet	Meters	Feet
2 to 6	7 to 20	90	295	92 to 96	302 to 315
7	23	88.2	289	95.2	312
8	26	86.1	283	94.1	309
9	30	84.1	276	93.1	305
10	33	82.0	269	92.0	302
20	66	61.3	201	81.3	267
30	98	40.7	134	70.7	232
40	131	20.0	66	60.0	197
49.7	163	0.0	0	49.7	163

Installed at a 50C environment					
28 AWG Patch Length		Horizontal Cable Length		Total Channel Length	
Meters	Feet	Meters	Feet	Meters	Feet
2 to 5	7 to 16	90	295	92 to 95	302 to 312
6	20	89.5	294	95.5	313
7	23	87.3	286	94.3	309
8	26	85.1	279	93.1	306
9	30	82.9	272	91.9	302
10	33	80.8	265	90.8	298
20	66	58.9	193	78.9	259
30	98	37.0	121	67.0	220
40	131	15.1	50	55.1	181
46.9	154	0.0	0	46.9	154

Installed at a 60C environment					
28 AWG Patch Length		Horizontal Cable Length		Total Channel Length	
Meters	Feet	Meters	Feet	Meters	Feet
2 to 5	7 to 16	90	295	92 to 95	302 to 312
6	20	88.8	291	94.8	311
7	23	86.5	284	93.5	307
8	26	84.1	276	92.1	302
9	30	81.8	268	90.8	298
10	33	79.5	261	89.5	294
20	66	56.4	185	76.4	251
30	98	33.3	109	63.3	208
40	131	10.1	33	50.1	164
44.4	146	0.0	0	44.4	146

Installed at a 75C environment					
28 AWG Patch Length		Horizontal Cable Length		Total Channel Length	
Meters	Feet	Meters	Feet	Meters	Feet
2 to 5	7 to 16	90	295	92 to 95	302 to 312
6	20	87.7	288	93.7	307
7	23	85.2	279	92.2	302
8	26	82.7	271	90.7	297
9	30	80.2	263	89.2	293
10	33	77.7	255	87.7	288
20	66	52.7	173	72.7	238
30	98	27.7	91	57.7	189
40	131	2.7	9	42.7	140
41.1	135	0.0	0	41.1	135

Table Set 3: 28 AWG with LANmark™-2000 Horizontal

Installed at a 20C environment					
28 AWG Patch Length		Horizontal Cable Length		Total Channel Length	
Meters	Feet	Meters	Feet	Meters	Feet
2 to 7	7 to 23	90	295	92 to 97	302 to 318
8	26	89.1	292	97.1	319
9	30	87.2	286	96.2	316
10	33	85.2	280	95.2	312
20	66	65.7	216	85.7	281
30	98	46.2	152	76.2	250
40	131	26.7	88	66.7	219
50	164	7.2	24	57.2	188
53.7	176	0	0	53.7	176

Installed at a 30C environment					
28 AWG Patch Length		Horizontal Cable Length		Total Channel Length	
Meters	Feet	Meters	Feet	Meters	Feet
2 to 7	7 to 23	90	295	92 to 97	302 to 318
8	26	88.5	290	96.5	317
9	30	86.5	284	95.5	313
10	33	84.5	277	94.5	310
20	66	64.2	211	84.2	276
30	98	43.9	144	73.9	242
40	131	23.6	77	63.6	209
50	164	3.3	11	53.3	175
51.6	169	0	0	51.6	169

Installed at a 40C environment					
28 AWG Patch Length		Horizontal Cable Length		Total Channel Length	
Meters	Feet	Meters	Feet	Meters	Feet
2 to 7	7 to 23	90	295	92 to 97	302 to 318
8	26	87.9	288	95.9	315
9	30	85.8	281	94.8	311
10	33	83.7	275	93.7	307
20	66	62.6	205	82.6	271
30	98	41.5	136	71.5	235
40	131	20.5	67	60.5	198
49.7	163	0.0	0	49.7	163

Installed at a 50C environment					
28 AWG Patch Length		Horizontal Cable Length		Total Channel Length	
Meters	Feet	Meters	Feet	Meters	Feet
2 to 6	7 to 20	90	295	92 to 96	302 to 315
7	23	89.1	292	96.1	315
8	26	86.9	285	94.9	311
9	30	84.6	278	93.6	307
10	33	82.4	270	92.4	303
20	66	60.1	197	80.1	263
30	98	37.7	124	67.7	222
40	131	15.4	51	55.4	182
46.9	154	0.0	0	46.9	154

Installed at a 60C environment					
28 AWG Patch Length		Horizontal Cable Length		Total Channel Length	
Meters	Feet	Meters	Feet	Meters	Feet
2 to 6	7 to 20	90	295	92 to 96	302 to 315
7	23	88.2	289	95.2	312
8	26	85.9	282	93.9	308
9	30	83.5	274	92.5	303
10	33	81.1	266	91.1	299
20	66	57.5	189	77.5	254
30	98	33.9	111	63.9	210
40	131	10.3	34	50.3	165
44.4	146	0.0	0	44.4	146

Installed at a 75C environment					
28 AWG Patch Length		Horizontal Cable Length		Total Channel Length	
Meters	Feet	Meters	Feet	Meters	Feet
2 to 5	7 to 16	90	295	92 to 95	302 to 312
6	20	89.4	293	95.4	313
7	23	86.9	285	93.9	308
8	26	84.3	277	92.3	303
9	30	81.8	268	90.8	298
10	33	79.2	260	89.2	293
20	66	53.8	176	73.8	242
30	98	28.3	93	58.3	191
40	131	2.8	9	42.8	140
41.1	135	0.0	0	41.1	135

Data Communications Competence Center

Nexans' Data Communications Competence Center, located at the Berk-Tek Headquarters in New Holland, Pennsylvania, focuses on advanced product design, applications and materials development for networking and data communication cabling solutions. The Advanced Design and Applications team uses state-of-the-art, proprietary testing and modeling tools to translate emerging network requirements into new cabling solutions. The Advanced Materials Development and Advanced Manufacturing Processes teams utilize sophisticated analytical capabilities that facilitate the design of superior materials and processes. The Standardization and Technology group analyzes leading edge and emerging technologies and coordinates data communication standardization efforts to continuously refine Nexans' Technology Roadmap. An international team of experts in the fields of cable, connectors, materials, networking, standards, communications and testing supports the competence center. The competence center laboratories are a part of an extensive global R&D network.