

Introduction

Panduit is a leading supplier of Structured Cabling Systems and Unified Physical Infrastructure. Panduit solutions enable the physical infrastructure to be scalable, flexible, and easily manageable, while supporting Ethernet communications at ever-increasing data rates.

Panduit is aware of the many challenges presented by today's commonly used patch cords. These challenges include the amount of space required for cable management, restricted airflow, inconsistent performance characteristics between vendors, and the increasing pressure to find cost effective solutions.

Panduit has developed small diameter patch cords using 28 AWG conductors that can be used in Category 6A, Category 6, and Category 5e installations to facilitate deployments with improved wire management and airflow.

Background

Panduit 28 AWG Category 6A, Category 6, and Category 5e performance patch cords use the standard RJ45 plug interface and a significantly smaller cable with 28 AWG conductors. Typical Category 6A, 6, and 5e patch cords use 24 AWG conductors. While 24 AWG patch cabling is sufficient for many applications, it can present challenges with cable management. For example, cabinets populated with hundreds of patch cords may have issues with airflow, difficulty accessing certain ports, and trouble finding space for clean cable management. This can make simple moves, adds, and changes a challenge. Panduit 28 AWG patch cords alleviate many of these concerns by offering Category 6A, 6, and 5e performance using significantly smaller cable.

The main advantages of these patch cords are:

- Smaller diameter cords occupy less than ½ the space of traditional patch cords. This enables simplified wire management and improved airflow, reducing pathway fill and operating costs.
- Smaller wire gauge offers improved flexibility for easier moves, adds, and changes.
- Tighter bend radius provides ultimate flexibility in patch cable routing, dressing, and management.

While providing these benefits, the user should be aware of the following limitations:

- Higher attenuation, which means a higher de-rating factor must be used when designing channels.
- If running PoE, PoE+, or proposed PoE++ Type 3 and 4 applications, bundle size is limited due to heat dissipation.

Relationship to Standards

Performance Standards

ANSI/TIA-568-C.2 and ISO 11801 define performance standards for Ethernet communication systems and their sub-components. Panduit 28 AWG Category 6A, Category 6, and Category 5e performance patch cords exceed all patch cord electrical performance requirements, and are 100% tested to patch cord limits.

Panduit 28 AWG patch cords utilize 28 AWG conductors which do not meet the 22-26 AWG patch cord conductor size recommendation for patch cable in ANSI/TIA-568-C.2, resulting in an increased attenuation de-rating value of 1.9. As a result, when used with 90-meter permanent links Panduit 28 AWG Category 6A, Category 6, and Category 5e performance patch cords support 96-meter channels.

Connector Standards

IEC 60603-7 specifications include common dimensions, mechanical, electrical, and environmental characteristics (and applicable tests) for the plug and jack. These specifications ensure all plugs and jacks that are in compliance to this standard are intermateable. Panduit 28 AWG patch cord plugs meet all IEC 60603-7 requirements.

IEC 60352-3 governs solderless connections for insulation displacement contacts (IDCs). These tests ensure the jack contact / cable conductor interface maintains adequate performance for the life of the connector. Panduit developed Category 6A, Category 6, and Category 5e jack modules (CJT6X88TG**, CJT688TG**, and CJT5E88TG**) specifically designed to terminate 28AWG conductors and meet all requirements of IEC 60352-3. Jacks designed for 22-26AWG cable are not recommended for use with 28AWG stranded conductors.

IEC 60352-6 governs solderless connections for insulation piercing contacts (IPCs). While it may be a lesser-known specification, it is extremely relevant for plugs. These tests ensure the plug contact / cable conductor interface maintain acceptable performance for the life of the connection. Panduit 28 AWG patch cord plugs meet all IEC 60352-6 requirements.

Power over Ethernet

TSB-184A, "Guidelines for Supporting Power Delivery Over Balanced Twisted-Pair Cabling" is a technical service bulletin published by TIA. TSB-184A recommends a maximum temperature increase of 15 degrees Celsius over the ambient temperature for the center cable in a cable bundle operating at full PoE, PoE+ or PoE++ power. All Panduit cables are designed to properly deliver PoE, PoE+ or PoE++ power, including all of our 28AWG patch cords. Panduit 28 AWG patch cords will meet the temperature rise recommendation of PoE and PoE+ in bundles up to 48 cables, and PoE++ in bundles up to 24 cables.

Value Proposition

The table below provides a comparison of several important parameters for Panduit 28 AWG and Panduit 24 AWG patch cords.

Table 1 - Comparison of Panduit 28 AWG and 24 AWG Patch Cords

Parameter	Panduit 28 AWG Category 6A Patch Cords	Panduit 28 AWG Category 6 and 5e Patch Cords	Panduit 24 AWG Category 6A, 6, and 5e Patch Cords
Cable diameter	0.185 in (4.7mm)	0.15 in (3.8mm)	0.215-0.275 in (5.5-7.0mm)
Cable cross sectional area	0.027 in ² (17.3 mm ²)	0.017 in ² (11.3 mm ²)	0.036-0.59 in ² (23.8-38.5 mm ²)
Cable capacity of PRVF6 vertical manager – 35% fill	492	749	223-364
Recommended bend radius	0.74 in (19mm)	0.60 in (15mm)	1.00 in (25mm)
Attenuation de-rating factor	1.9	1.9	1.2
Maximum channel length with 10 meters of patch cords	93 meters	93 meters	100 meters
Maximum patch cord length used with 90m PL	6 meters	6 meters	10 meters
PoE/PoE+ use	Yes. Up to 48 cables per bundle	Yes. Up to 48 cables per bundle	Yes. Up to 100 cables per bundle
Proposed PoE++ Type 3 and 4 Use	Yes. Up to 24 cables per bundle	Yes. Up to 24 cables per bundle	Yes. Up to 72 (for 6 and 6A) or 48 (5e) cables per bundle
Exceeds applicable ANSI/TIA- 568-C.2 and ISO 11801 patch cord performance requirements	Yes	Yes	Yes
100% tested to patch cord performance requirements	Yes	Yes	Yes
Plug exceeds IEC 60603-7 and IEC 60352-6 specifications.	Yes	Yes	Yes
The plug is centered within the ANSI/TIA-568-C.2 range.	Yes	Yes	Yes
Plug contacts plated with 50 micro inches of gold and rated for 2500 cycles	Yes	Yes	Yes
Meets IEC 60352-3 specification when terminated to a jack	Yes Category 6A – CJT6X88TG** Shielded jack not available at this time.	Yes Category 6 – CJT688TG** Category 5e – CJT5E88TG**	Yes Category 6A – CJ6X88TG** Category 6 – CJ688TG** Category 5e – CJ5E88TG**
Part of Panduit Certification plus warranty	Yes	Yes	Yes

** = Color code.

Space Saving

Panduit 28 AWG Category 6A, Category 6, and Category 5e performance patch cords offer a significant space saving benefit over traditional 24 AWG patch cords. Figure 1 illustrates the difference in bundle size between Panduit 24 AWG and Panduit 28 AWG Category 6 performance patch cords. Figure 2 illustrates the physical differences between a Panduit 28 AWG and traditional 24 AWG patch cords of equal length (7-feet).

Figure 1

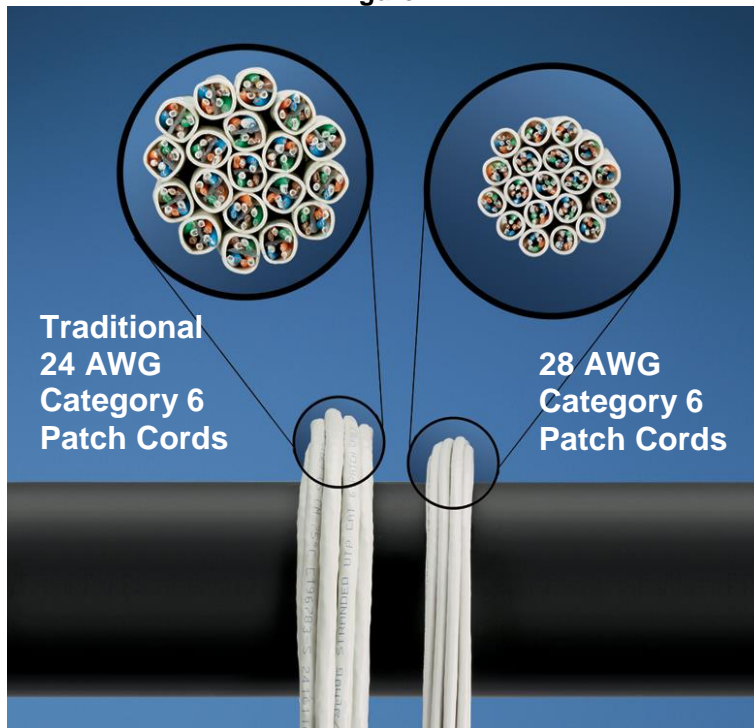


Figure 2



Length Guidelines

The maximum length of a channel depends on the de-rating factor of the cabling components within the channel (patch cords, equipment cords, and horizontal cabling). Panduit horizontal cable has a de-rating factor of 1. Panduit 24 AWG patch cords have a de-rating factor of 1.2. All Panduit 28 AWG patch cords have a de-rating factor of 1.9.

The maximum length of a channel (in meters) is calculated by:

$$(De\text{-}rating\ of\ patch * Patch\ Length) + (De\text{-}rating\ of\ horizontal * Horizontal\ Length) \leq 102\ m.$$

This equation supports the following example channel lengths and configurations using Panduit 28 AWG patch cords:

*Channel length with a **90 meter permanent link***

- 6 meters of total 28 AWG patch cord length
- 90 meters of total horizontal cable length
- **96 meter channel length**

*Channel length with **10 meters of 28 AWG patch cords***

- 10 meters of total 28 AWG patch cord length
- 83 meters of total horizontal cable length
- **93 meter channel length**

*Channel length of **100 meters***

- 2 meters of total 28 AWG patch cord length
- 98 meters of total horizontal cable length*
- **100 meter channel length**

* Note: 98 meters will not pass Permanent Link testing with a field tester; however, the total channel will pass channel testing and Ethernet traffic.

These channel configurations employing Panduit 28 AWG patch cords will exceed all Category 6A, Category 6, and Category 5e performance requirements defined in ANSI/TIA-568-C.2 and ISO11801.

Table 2 - Summary of total 28 AWG patch cord length vs. maximum channel length.

Total 28 AWG Patch Cord Length		Maximum 23 AWG Horizontal Cable Length		Maximum Total Channel Length	
Meters	Feet	Meters	Feet	Meters	Feet
2	7	98*	321	100	328
3	10	96*	314	99	324
4	13	94*	308	98	321
5	16	92*	301	97	317
6	20	90	295	96	315
7	23	88.5	290	95.5	313
8	26	86.5	283	94.5	309
9	30	84.5	277	93.5	307
10	33	83	272	93	305
11	36	81	265	92	301
12	39	79	259	91	298
13	43	77	252	90	295
14	46	75	246	89	292
15	49	73.5	241	88.5	290
16	52	71.5	234	87.5	286
17	56	69.5	228	86.5	284
18	59	67.5	221	85.5	280
19	62	65.5	214	84.5	276
20	66	64	209	84	275

* Horizontal cable lengths over 90 meters will not pass Permanent Link testing with a field tester, however the total channel will pass Channel testing and Ethernet traffic.

Note: Beyond 20 meters the maximum length of 28 AWG patch cords may be limited by DC Loop Resistance specifications. Panduit's 28 AWG Category 6A performance patch cords are limited to a maximum length of 40 meters in point-to-point applications (using only patch, with no horizontal cable).

Summary

Panduit 28 AWG Category 6A, Category 6, and Category 5e performance patch cords offer a variety of benefits to the end user such as utilizing less space, improving airflow and the potential for reduced operating costs. The improved flexibility saves time on moves, adds, and changes, while the tight bend radius enables improved cable routing and management in high density applications. Panduit 28 AWG patch cords provide a unique and useful cable management solution for today's enterprise & data center environments.

Panduit 28 AWG Patch Cord Ordering Guide		
Category	Part Number	Suffix
Category 6A	Unshielded: UTP28X**xx Shielded: STP28X**xx	** = length xx = color code^
Category 6	Unshielded: UTP28SP**xx	
Category 5e	Unshielded: UTP28CH**xx	
^ blank = off white, BU = blue, BL = black, GR = green, GY = gray, OR = orange, RD = red, VL = violet, YL = yellow		
UTP28X10BU = Category 6A Unshielded, 10-ft, blue STP28X3MGR = Category 6A Shielded, 3 meters, green UTP28SP7 = Category 6 Unshielded, 7-ft, off-white UTP28CH3MYL = Category 5e Unshielded, 3-meter, yellow		