



Technical Bulletin
PoE in Bundle of 24 to 192 Cables

Introduction

Power over Ethernet (PoE) is a technology that allows power and data to be delivered simultaneously through a conventional twisted-pair cable. This technology is commonly applied in monitoring systems (cameras), network repeaters, smart lighting, alarm systems, and other devices that support PoE.

It is possible to use 2 or 4 pairs for power delivery, depending on the power requirements of the device being powered (IEEE 802.3af, IEEE 802.3at, IEEE 802.3bt). For existing installations, the use of CAT.5e and CAT.6 categories is acceptable. However, for new installations focused on PoE, the TIA TSB-184-A guideline recommends CAT.6A or higher.

The main point of attention in these applications is the increase in temperature, which becomes more significant as cables are grouped into bundles. Considering that, this bulletin aims to assist in the parameterization of PoE applications so that the number of cables per bundle is properly limited to ensure safety, integrity, and performance.

NOTE

Cables used in PoE applications that are not arranged in a bundle are not covered by the scope of this bulletin.

Temperature Rise and Electrical Arcing in Connectors

Transmitting power and data over the same cable offers numerous benefits from an application standpoint. However, it is necessary to pay attention to some implications of this practice. The main concern in this case is the temperature rise¹, as the cable attenuation parameter is directly influenced by conductor temperature, which can lead to bit errors or even completely interrupt the connection.

¹ "Temperature rise" is understood as the difference between the ambient temperature and the maximum cable temperature during application.

In addition to communication parameters, the physical integrity of the cable can be compromised if its temperature exceeds its thermal rating. Physical safety of installations must be considered, as applying a certain cable category in bundles much larger than specified by standards can lead to overheating, potentially causing critical situations such as fire hazards. In this bulletin, the TIA TSB-184-A guideline will be used to define the limit of cables per bundle in PoE applications.

Another relevant point regarding PoE applications and network accessories is the electrical arcing generated in connectors during the disconnection of a powered device. This arcing can wear out or even permanently damage the contacts of the plug and connector, causing losses or even interrupting communication. The negative impact of electrical arcing on the application is closely related to the number of disconnections performed while PoE is active. Therefore, it is recommended to use high-quality connectors that meet standard requirements, especially regarding the gold plating of contacts. Validation tests for connectors in PoE applications are described in IEC 60512-99-002.

Cable Bundle Delimitation

PoE Type 4 (4PPoE)

In 2018, aiming to provide higher power through PoE, IEEE introduced 802.3bt Type 4, which offers a significant increase in power compared to previous versions. Table 1 shows all the parameters defined in this standard, as well as the devices that can be powered by each PoE type.

Table 1. Comparison among PoE Types 1, 2, 3, and 4 (Source: IEEE 802.3)

STANDARD	IEEE 802.3f	IEEE 802.3at	IEEE 802.3bt	
	PoE Type 1	PoE+ Type 2	PoE++ Type 3	4PPoE Type 4
PoE/Type Designation	PoE Type 1	PoE+ Type 2	PoE++ Type 3	4PPoE Type 4
Maximum Current per Pair (mA)	350	600	600	960
Number of Energized Pairs	2	2	4	4
Power at PSE (Power Sourcing Equipment)	15.4W	30W	60W	90W
Minimum Power at PD (Powered Device)	13W	25.5W	51W	71W
Type of Practical Applications	Biometric Access Router 802.n	IP Phone, Alarm System, Cameras, Lighting, LED...	Access Control, AP 802.11ac, Cameras, Laptop, Lighting, LED...	Desktop, Videoconferencing, TVs, Wi-Fi 802.11ax, Lighting, LED...

PoE Type 4 enables all four pairs for power delivery and features the highest power and current values among PoE standards, making it the stricter application in terms of thermal dissipation in twisted-pair cables.

TIA TSB-184-A

TIA TSB-184-A provides detailed instructions and guidelines for the use of twisted-pair cables in PoE technology. In this bulletin, this standard will be used to define the maximum number of cables per bundle that can be applied under PoE Type 4 parameters. Table 2 shows the maximum temperature rise specified in TIA TSB-184-A, considering the number of cables per bundle and the cable category:

Table 2. Temperature Rise Specified by TIA TSB-184-A for PoE Type 4

Number of Cables	Temperature Rise (°C)							
	5e Category		6 Category		6A Category		8 Category	
	Air	Duct	Air	Duct	Air	Duct	Air	Duct
1	1.12	1.69	0.81	1.30	0.71	1.09	0.49	0.81
7	3.51	5.16	2.61	3.96	2.26	3.29	1.42	2.33
19	6.74	9.68	5.09	7.43	4.36	6.10	2.52	4.13
24	7.91	11.29	6.00	8.67	5.13	7.11	2.90	4.74
37	10.73	15.16	8.21	11.63	6.98	9.49	3.79	6.18
48	12.96	18.20	9.97	13.95	8.45	11.35	4.47	7.27
52	13.75	19.26	10.59	14.77	8.97	12.00	4.70	7.64
61	15.49	21.61	11.97	16.56	10.12	13.43	5.21	8.46
64	16.06	22.37	12.42	17.14	10.50	13.90	5.38	8.73
74	17.92	24.88	13.90	19.06	11.73	15.43	5.91	9.59
91	21.01	29.00	16.36	22.21	13.77	17.93	6.79	10.99

97	22.07	30.42	17.22	23.30	14.48	18.80	7.09	11.47
100	22.60	31.13	17.64	23.84	14.83	19.23	7.23	11.70
127	27.28	37.35	21.39	28.59	17.94	22.99	8.52	13.76
169	34.33	46.64	27.05	35.70	22.63	28.61	10.40	16.76

Source: TIA TSB-184-A

For bundles of up to 24 cables, as highlighted in Table 2, the maximum temperature rise obtained is below the 15°C limit specified by TIA TSB-184-A. Therefore, based on these normative requirements, Lightera recommends that for PoE installations, cables should be installed in bundles of no more than 24 cables. It is important to emphasize that, although CAT 5e and CAT 6 categories are acceptable for bundles of 24 cables, CAT 6A is recommended for new PoE installations. This is because these cables operate at high transmission rates (10GBASE-T) and offer superior thermal performance compared to other categories.

Applications from 24 to 192 Cables/Bundle

In special cases that require a bundle larger than 24 cables, Lightera recommends using the Gigalan CAT.6A F/UTP CMR – LP 0.5A cable. This cable is UL 444 Limited Power certified, which allows PoE Type 4 applications in bundles of up to 192 cables without additional parameterization. For more information on PoE applications above 24 cables, visit:

[DOWNLOAD LINK](#)

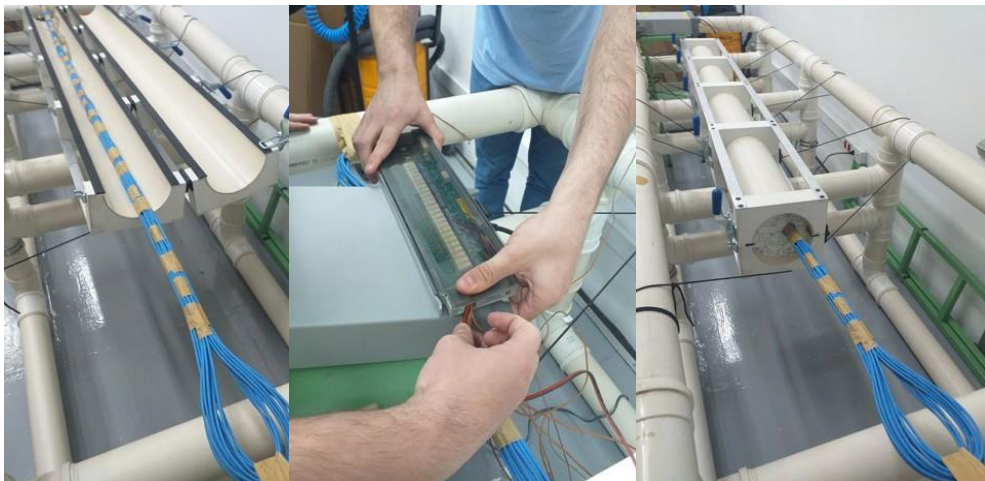
Lightera Cable Performance

The temperature rise data for Lightera cables was obtained through internal tests conducted in a thermally controlled environment (Figures 1, 2, and 3).

Figure 1. Arrangement of the 24-cable bundle

Figure 2. Thermocouple data acquisition system

Figure 3. Test in operation with ceramic fiber at the ends for thermal insulation



All cables were tested under PoE Type 4 conditions in a 24-cable bundle, making it possible to establish a performance comparison between Lightera cables and the normative requirements of TIA TSB-184-A (Table 3).

Lightera Cable Performance vs. TIA TSB-184-A

Table 3. PoE Type 4 Tests

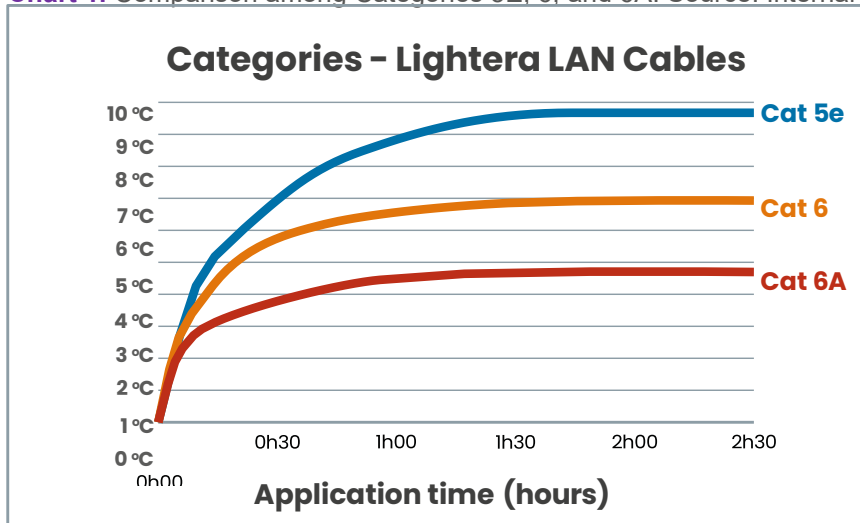
Bundle	Lightera Cables	Temperature Rise (Lightera)	TIA TSB-184-A (Normative Requirement)
24 Cables	DATA TRANSMISSION CABLE SOHOPLUS U/UTP CAT.5E 24AWGX4P CMX	9,72 °C	11,29 °C
24 Cables	DATA TRANSMISSION CABLE MULTILAN U/UTP CAT.5E 24AWGX4P CMX OUTDOOR (305m)	9,31 °C	11,29 °C
24 Cables	DATA TRANSMISSION CABLE SOHOPLUS U/UTP CAT.6 24AWGX4P CMX	6,98 °C	8,67 °C
24 Cables	DATA TRANSMISSION CABLE GIGALAN GREEN U/UTP CAT.6 23AWGX4P LSZH	6,34 °C	8,67 °C
24 Cables	DATA TRANSMISSION CABLE GIGALAN GREEN F/UTP CAT.6A 23AWGX4P LSZH	4,75 °C	7,11 °C

Source: Internal Testing (Lightera)

Considering the data in Table 3, it can be concluded that Lightera cables meet all the requirements specified in the TIA TSB-184-A standard, proving to be suitable for PoE Type 4 applications.

Chart 1 provides a detailed comparison of the temperature rise resulting from PoE application across different categories, highlighting Category 6A for its superior thermal performance compared to the other tested categories.

Chart 1. Comparison among Categories 5E, 6, and 6A. Source: Internal Testing (Lightera)

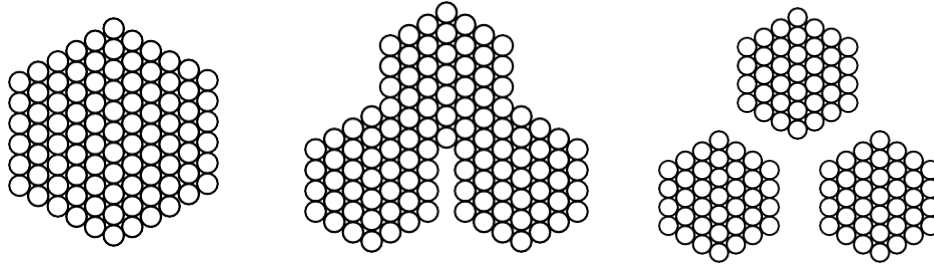


Furthermore, it is important to emphasize that CCA cables (copper-clad aluminum cables) should never be used in PoE installations under any circumstances, as they exhibit high temperature rise rates due to the aluminum composition of the conductor. Lightera cables are made with 100% copper conductors and feature low temperature rise, making them the ideal choice for your Power over Ethernet application.

Installation Best Practices - PoE

Temperature rise can be significantly reduced if certain installation guidelines are followed. Naturally, the cables located at the center of the bundle exchange less heat with the environment and, consequently, tend to heat up the most. Therefore, whenever feasible, it is advisable to split a large bundle with a high concentration of cables into smaller bundles, as illustrated in the figure below:

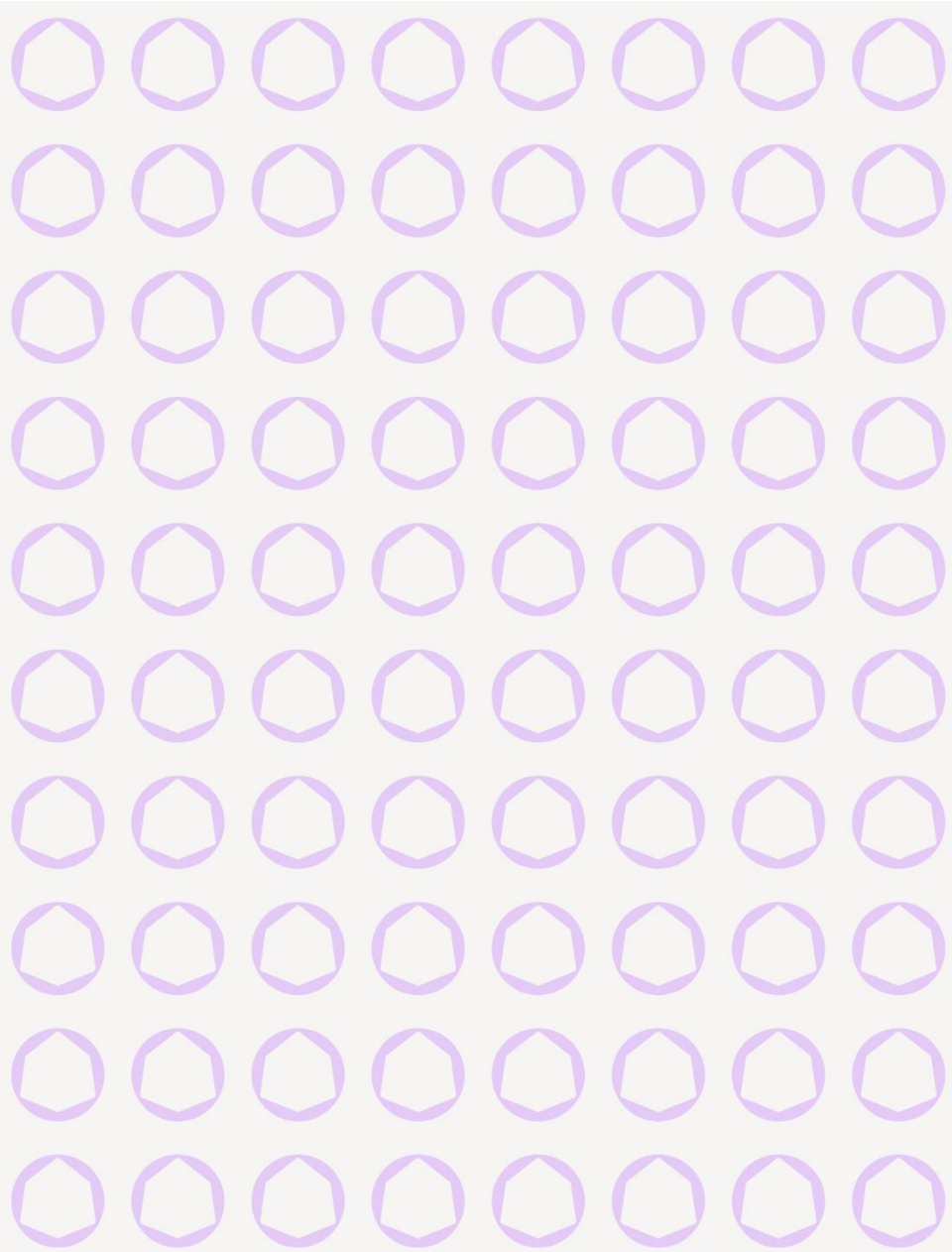
Figure 4. Bundle Arrangement. Source: TIA TSB-184-A



The reduction in temperature rise is significant: for the case shown in the center figure, the reduction is approximately 25% compared to a single large bundle. For the figure on the right, the reduction is around 30%. Therefore, whenever feasible, partitioning a large bundle into a series of smaller bundles is always recommended.

Another effective strategy is to mix cables that transmit only data within the same bundle. Since these cables are not carrying PoE, their temperature rise is less pronounced. Due to these characteristics, data-only cables should be placed in the center of the bundle, helping to “shield” PoE cables from the worst thermal dissipation scenario.

Finally, the use of accessories such as network certifiers can be extremely useful in the field, as they validate the link between active devices (PD and PSE) through PoE load testing.



 Lightera

