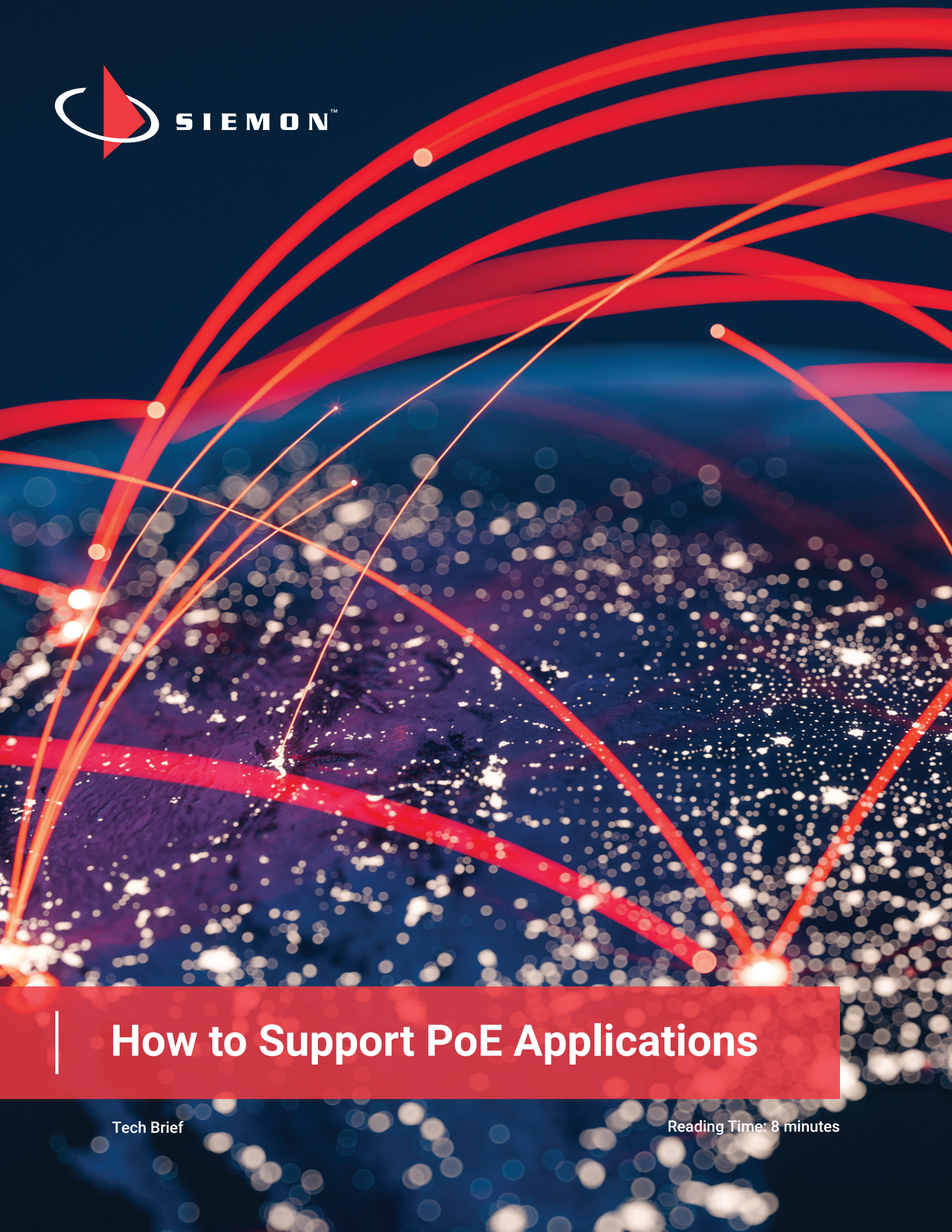


How to Support PoE Applications

Tech Brief

Reading Time: 8 minutes

The ability to deliver DC power to IP-based devices over twisted-pair copper cabling using remote powering technology like Power over Ethernet (PoE) and Power over HDBaseT (POH) has made a significant impact on today's network infrastructure deployments. Today more than 100 million PoE-enabled ports are shipping annually, and it's no wonder considering the benefits that remote powering delivers – faster deployment, 75% less cost than an AC power run and the ability to receive centralized back-up power, just to name a few.

The first generation of PoE, IEEE 802.3af Type 1 (15W), was used for powering lower-power devices like IP clocks, VoIP phones and simple security cameras. With the development of IEEE 802.3at Type 2 (30W), higher level IEEE 802.3bt Type 3 (60W) and Type 4 (90W), and POH (100W) for AV applications, remote powering technology now powers everything from wireless access points, advanced pan-tilt-zoom cameras, access control devices and LED lights, to video displays, point of sale machines and even computers and laptops.

With today's higher levels of remote powering comes the potential for heat build-up within cable bundles and electrical arcing damage to connector contacts, which can lead to power and efficiency losses, performance degradation and the potential for damaged connecting hardware. Deploying a structured cabling infrastructure for today's converged networks that delivers remote power to a wide range of devices requires a robust combination of cables and connectivity designed from the outset to provide superior remote powering support – Siemon's PowerGUARD® + technology was designed to be the ideal solution for those PoE applications.

To support the latest Power over Ethernet applications (IEEE 802.3bt PoE up to Type 4 (90W), Siemon solutions provide the best performance with the easiest installation practice. Taking into consideration the latest ISO/IEC 14763-2 Standard, defining remote powering classes and associated installation practices to ensure a reliable PoE support, Siemon overcame those aspects with its PowerGUARD® + technology on three different levels to achieve best in class PoE support.

Innovative Outlet Design

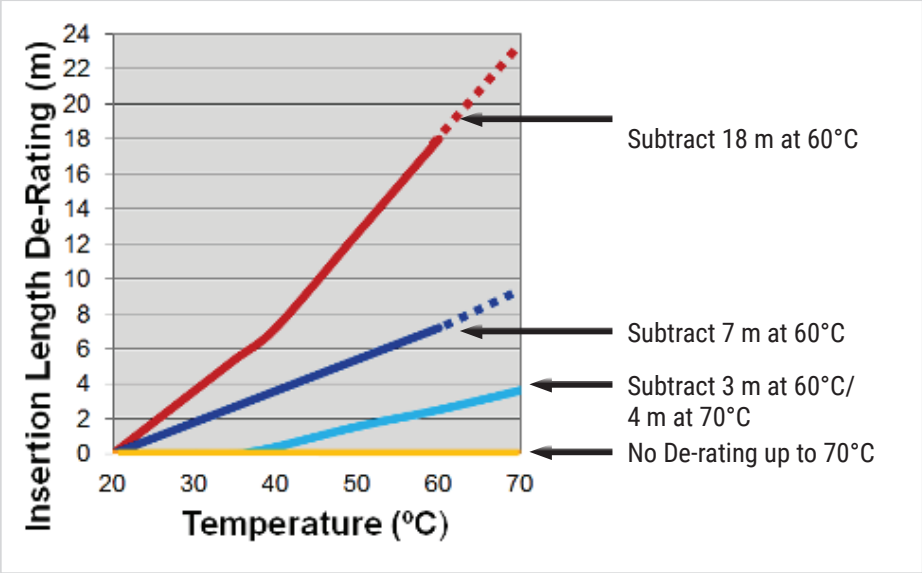
The first level to be considered is related to the connectors. Contacts within RJ-45 style connecting hardware are plated (typically with gold or palladium), and un-mating a jack-plug connection while transmitting PoE or PoH produces an arc that erodes the plated jack-plug contact surfaces at the arcing location. When this erosion occurs in the area of the fully mated position on an RJ-45 connector, the result is an unreliable connection that can cause degraded network performance and increased bit error rates. Therefore, a recommendation would be to ensure connectors are compliant to the IEC 60512-99-2.

Siemon's Z-MAX®, UltraMAX™ and TERA® connectors include our patented PowerGUARD® + technology, which features a crowned jack contact shape that places arcing damage to both the plug and jack contacts away from the final mated position. This allows you to connect and disconnect to the latest remote power applications with zero-risk and with full compliance to the IEC standards. Siemon can provide third party certification showing compliance to IEC 60512-99-2. Further, understanding that many cable runs are installed in areas that are not temperature controlled and that PoE enabled links tend to generate heat when bundled, Siemon connectors are rated for use in plenum spaces and up to 75°C to operate for the long term in this environment.

Advanced Cable Construction

The second level relates to the cable itself. Remote powering applications can exhibit temperature rise within bundled cable configurations, which is even more of a concern in higher power Type 3 and Type 4 PoE and PoH applications. Temperature rise can increase insertion loss and premature aging of jacketing materials that can have an irreversible effect on transmission performance.

The temperature dependence of cables is recognized in cabling standards and both the TIA and ISO specify an insertion loss length de-rating factor at temperatures above 20°C (68°F). Reducing link length to meet these requirements can impact infrastructure design strategies and flexibility. In addition, for remote powering applications greater than 60W, the NFPA National Electric Code® (NEC) restricts the number of cables allowed in a bundle based on the size (AWG) and temperature rating of the cable. It is also worth noting that other institutions, such as the International Electrotechnical Commission (IEC), follow a similar approach and de-rate the maximum length and restrict the bundle size based on ambient temperature, type of pathways, and the resistance & diameter of the cable assuming the cable are rated up to 60°C.



Siemon's category 6A Tri-Layer (TL) UTP cable, category 6A shielded and category 7/7A fully-shielded cables with PowerGUARD® + technology are qualified for mechanical reliability in high temperature environments up to 75°C.

75°C rated cable uses higher-quality materials and this ensures superior heat dissipation and extremely stable transmission performance, supporting decreased length de-rating, as shown in the graph, and reduced bundling requirements. View maximum recommended bundle sizes for Siemon cables.

World-Class Installation Practices

The third level to ensure system reliability is installation practices. Siemon is an organization that actively participates in the development of international cabling standards and has a philosophy of recommending that installations be designed and deployed around these globally accepted and broadly considered requirements. This approach ensures support of applications that may be designed to run on installed premises cabling today and for the next 25 years, backed by a comprehensive Siemon warranty.

It is well understood that deploying higher remote powering applications, such as Power over Ethernet (PoE) Type 4 and Power over HDBaseT (PoH), over balanced twisted-pair cabling produces a small degree of heat build-up within bundled horizontal cables. This heat build-up does not affect safety but can affect transmission performance and long-term mechanical reliability. This can vary over differing cable categories and constructions as, for example, cables with larger conductors inherently have less heat build-up due to lower resistance and cables with metallic elements have less heat build-up due to superior heat dissipation properties. Different pathway styles (e.g., conduit versus free air) can also affect heat build-up within cable bundles. The ISO/IEC 14763-2 standard describes installation practices including average current, ambient temperature, cable bundling, pathway considerations, cable types and labeling and is a great reference point when planning your design.

Managing cable bundle size is important to ensure that heat build-up does not exceed the mechanical rating of the cables and that appropriate channel length de-rating is applied to offset additional insertion loss due to increased ambient temperature. While the ISO/IEC TS 29125 and TIA TSB-184-A standards address recommendations for cabling supporting remote powering applications, these technical bulletins are generic in nature and not directly applicable to Siemon cables, which, depending on cable type, can support higher mechanical temperature ratings and offer superior heat dissipation.

When in doubt about cable mechanical or heat dissipation capability, installation environment, or remote powering application, a conservative practice is to limit maximum bundle size to 24 cables. (This should be applied as a worst-case e.g. to Type 4 PoE with a max ambient temp of 60°C. With the exception of the few instances, this is easy to remember practice addresses the majority of media, environmental, and application scenarios.

The Role of Remote Powering Classes

The ISO/IEC 14763-2 standard describes Remote Powering (RP) classes allowed to connect, with or without control, a powered device. RP3 will avoid controlling the attachment of any remote powered device as the planning of the infrastructure is based on a full PoE Type 4 Installation practice. While RP1 and RP2 require users to control the attachment of device to avoid overloading of the system. Outside RP1, Remote Powering classes will require some planning of the cabling installation, RP3 being the most restrictive.

			Controls Required During	
RP Category	**ic average**	**ic**	**Attachment of Remote Powering / PoE Device**	**Planning of Cabling Installation**
RP1	≤ 212 mA	≤ 500 mA	Yes	Yes, Low Requirement
RP2	> 212 mA ≤ 500 mA	≤ 500 mA	Yes	Yes, Medium Requirement
RP3	Unrestricted up to ≤ 500 mA	≤ 500 mA	No	Yes High Requirement

Remote Powering Classes in accordance with ISO/IEC 14763-2 i_c = Current per conductor

Despite installation practices described in this IEC standard, giving some rules on cable length de-rating, based on 60°C cable, around: maximum bundling recommendations dependent on pathway type, cable type, ambient temperature and labeling requirements, Siemon solutions, by design, make the cabling infrastructure installation very simple. In fact, with the following recommendation, Siemon complies with PoE or RP-related standard requirements and overcomes the most common planning difficulties:

- Use Siemon Z-MAX®/UltraMAX™/TERA® connectivity to avoid arcing issues. Siemon crowned contact design
- Specify Siemon cable and connectors, which are rated up to 75°C and ideally suited to support data and power at elevated ambient temperatures.
- Use Siemon category 6A/class EA shielded solutions and higher for optimal heat dissipation in bundled cables.
- Consider Shielded Category 7A TERA Cable and 6A Z-MAX Connectivity together to avoid the need to derate the channel. A Powerful Combination for Today's Converged Networks
- Have a conservative practice of using 24 cables in a bundle as a maximum.
- Try to use open pathways, with bundle separation of about 15mm, to cool by convection.
- Ensure RP class information is included on all labeling to support standards compliance.

There is a lot more to cabling system performance than just buying good quality cable and connecting hardware. In order to ensure full bandwidth potential, a structured cabling system needs to be properly designed, installed, and administered. In recognition of these critical factors, Siemon has developed the Siemon Cabling System Certified Installer Program and developed a global network of Certified Installers (CI[SM]). By utilizing CIs, single-site, multi-site and multi-national customers can be assured of consistent quality and the best performance standards anywhere in the world. When the Siemon Cabling System is installed by a Siemon Certified Installer, end user benefits include a 25-year warranty on applications and products, including the support of RP classes.

Labels to identify RP class

Derating and Bundling Recommendations

The table below illustrates the worst case recommended length derating based on the cable used and the ambient temperature that the cable operates within.

Cable Type	Siemon Cat. 6A F/UTP LSOH	Generic Cat. 6A UTP LSOH	Siemon Tri Layer Cat. 6A UTP	Siemon Cat. 6 UTP PVC E2 & E3	Siemon Cat. 7A S/FTP TERA Cable
Cable Bundle Size	24	24	24	1	24
Derating required in meters @ 60°C to meet POE Type 4 & RP3	3	18	3	18	0
Derating required in meters @ 55°C to meet POE Type 4 & RP3	2	16	2	16	0
Derating required in meters @ 50°C to meet POE Type 4 & RP3	1.5	14	1.5	14	0
Derating required in meters @ 45°C to meet POE Type 4 & RP3	1	11	1	11	0
Derating required in meters @ 40°C to meet POE Type 4 & RP3	0.5	8	0.5	8	0
Derating required in meters @ 35°C to meet POE Type 4 & RP3	0	5	0	5	0
Derating required in meters @ 30°C to meet POE Type 4 & RP3	0	3	0	3	0
Derating required in meters @ 25°C to meet POE Type 4 & RP3	0	2	0	2	0
Derating required in meters @ 20°C to meet POE Type 4 & RP3	0	0	0	0	0

Max height of 60mm assumes a 10°C allowable temperature rise in the cable tray with a 5°C headroom to ensure the maximum mechanical temperature rating of the cable is not exceeded.

The table below depicts recommended bundle sizes for Siemon horizontal cables supporting a variety of remote powering applications. Note that these bundling recommendations are applicable to cables installed in all pathway types, so they are more conservative than would be specified for cables in free air (i.e. non-conduit) installations. Consult the infrastructure design experts at Siemon for information on bundle size recommendations for cables installed in open pathways.

Application	Current Per Pair (mA)	Minimum Power at PSE Output	Maximum Recommended Siemon Horizontal Cable Bundle Size				
			Cat. 5e UTP	Cat. 6	Cat. 6A UTP	Cat. 6A Shielded	Cat. 7A Shielded
IEEE 802.3af POE, Type 1	350	15.5 W / 2 Pairs	384 a, d	384 a, d	384 b, d	384 c, d	384 c, d
IEEE 802.3at POE, Type 2	600	30 W / 2 Pairs	192 a, d	192 a, d	192 b, d	192 c, d	192 c, d
IEEE 802.3bt POE, Type 3	600	60 W / 2 Pairs	96 a	96 a	96 b	96 c	96 c
IEEE 802.3bt POE, Type 4 (Max Ambient 45°C)	960	90 W / 4 Pairs	24	24	36	48	72
IEEE 802.3af POE, Type 4 (Max Ambient 55°C)			6	6	24	36	60
IEEE 802.3af POE, Type 1 (Max Ambient 60°C)			1	1	1	24	48
HDBaseT PoH	1000	100 W / 4 Pairs	Same as IEEE 802.3bt PoE Type 4				

a) Maximum ambient temperature allowed is 45°C
b) Maximum ambient temperature allowed is 55°C
c) Maximum ambient temperature allowed is 60°C
d) Bundle sizes larger than 96 are not recommended due to challenges with cable management
e) Including Tri-layer (TL) UTP cables

Note 1: Bundling recommendations are applicable to cables installed in all pathway types (e.g. conduit, basket/ladder tray, j-hooks, etc.)
Note 2: Bundle size is calculated assuming a 10°C allowable temperature rise per bundle with a 5°C headroom to ensure the maximum mechanical temperature rating of the cable is not exceeded
Note 3: Bundle sizes are conservatively recommended to align with typical patch panel sizing
Note 4: Solid cords are recommended when the ambient temperature is greater than 30°C

Loose Lay Recommendations

Cabling standard 14763-2 provides installation guidelines as it relates to remote power. Both bundling and loose laying cable are allowable.

For loose laying cables, the standard shows ratios for width to height of cables and provides a comparison to bundling. The results are similar but loose laying has a slight advantage for cable tray capacity.

The table below illustrates the worst case recommended length derating based on the cable used and the ambient temperature for open pathways (e.g. cable tray).

The open pathway shall be limited to 60mm physical height (fill) to allow for heat dissipation. Refer to your Siemon Representative for access to our Cable Tray Fill Calculator. Tray calculations as follows:

- 50mm High Cable Tray (100% Physically Full)
- 100mm High Cable Tray (60% Physically Full)
- 150mm High Cable Tray (40% Physically Full)

Siemon Cat. 6A F/UTP LSOH and Tri Layer Cat. 6A UTP Loose Lay to Meet POE Type 4 and RP3	Ambient Temperature	Derating Value (m)
Max High of 60mm in Open Pathway (Cable Tray/Basket)	60°C	3
Max High of 60mm in Open Pathway (Cable Tray/Basket)	55°C	2
Max High of 60mm in Open Pathway (Cable Tray/Basket)	50°C	1.5
Max High of 60mm in Open Pathway (Cable Tray/Basket)	45°C	1
Max High of 60mm in Open Pathway (Cable Tray/Basket)	40°C	0.5
Max High of 60mm in Open Pathway (Cable Tray/Basket)	35°C	0

Max height of 60mm assumes a 10°C allowable temperature rise in the cable tray with a 5°C headroom to ensure the maximum mechanical temperature rating of the cable is not exceeded.

Maintaining System Assurance

There is a lot more to cabling system performance than just buying good quality cable and connecting hardware. In order to ensure full bandwidth potential, a structured cabling system needs to be properly designed, installed, and administered. In recognition of these critical factors, Siemon has developed the Siemon Cabling System Certified Installer Program and developed a global network of Certified Installers (CI[SM]). By utilizing CIs, single-site, multi-site and multi-national customers can be assured of consistent quality and the best performance standards anywhere in the world. When the Siemon Cabling System is installed by a Siemon Certified Installer, end user benefits include a 25-year warranty on applications and products, including the support of RP classes.

PoE and RP Support in Summary

PowerGUARD® +

Data | Power | Reach | Delivered

The use of Siemon PowerGUARD® + technology in combination with our installation recommendation give you the opportunity to support Remote powering applications with best performance and the easiest installation practice. If you have any questions pertaining to this system update or other related issues, please contact our Technical Services Staff at The Siemon Company in Watertown CT at 1-800-365-2285 or your regional international sales office.

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