Zone Cabling and Coverage Area Planning Guide: 60W PoE Lighting Applications

Considered an integral component of the Internet of Things (IoT), smart or intelligent lighting solutions consist of a system of lighting fixtures, commonly called luminaires (surfaced mounted or recessed) or troffers (designed to fit into a modular dropped ceiling grid), which can be controlled, monitored, and powered over one centralized network. Deployment of smart lighting systems over balanced twisted-pair cabling is becoming increasingly popular due to the ease and benefits of using Ethernet communication for control and deploying remote powering technology, such as 60W Power over Ethernet[1] (Type 3 PoE), to safely energize the lighting grid. These systems are commonly referred to as PoE lighting. To maximize efficiency, PoE lighting luminaires typically utilize light emitting diode (LED) technology, which offers the benefits of lower power consumption and less heat generation than other luminaire design alternatives. The power saving opportunities and deployment flexibility associated with smart PoE lighting systems are significant and changing the landscape of structured cabling design.

PoE lighting systems are extremely sophisticated and rely on a well-designed infrastructure of high performance balanced twisted-pair cabling, network electronics, and software connecting and communicating with IP (internet protocol) addressable luminaires, dimmers, sensors, and controllers to deliver maximum performance, comfort, and energy savings benefits. Because of the wide range of expertise needed to specify, install, and manage the many components in a PoE lighting system, most customers rely on a lighting engineer or architect to design a reflected ceiling plan (RCP) for the building space. This Planning Guide provides guidance on the selection, design, and deployment of a structured balanced twisted-pair cabling system that is well optimized to support a wide range of PoE lighting applications.

PoE Lighting Benefits

Today, PoE lighting solutions globally illuminate over one billion square feet of commercial space. Explosive growth is predicted for the smart lighting industry because, in addition to having the potential to reduce energy costs by up to 90%, these systems lower capital lighting investment, improve safety and comfort, and integrate with all IoT-enabled building automation systems. In fact, Gartner Inc. predicts the number of smart lighting deployments to grow from 46 million units in 2015 to 2.54 billion units in 2020[2].

Device Type	Number of devices per 950m² (10,000ft²)	CAPEX Savings (USD)
PoE Lighting	250	$18,000
Wireless Access Points	5	$4,000
Public Address	4	$3,000
Access Controls	4	$3,000
Security Cameras	4	$3,000
HVAC	4	$3,000
Life Safety	4	$3,000
Digital Signage	2	$1,500
IP Clocks	2	$1,500
Intercom	2	$1,500
Other	12	$9,000
Total	293	$50,500

Table 1: *Breakdown of IoT Devices and CAPEX Savings per 950m² (10,000ft²) in a PoE Optimized Automated Building*

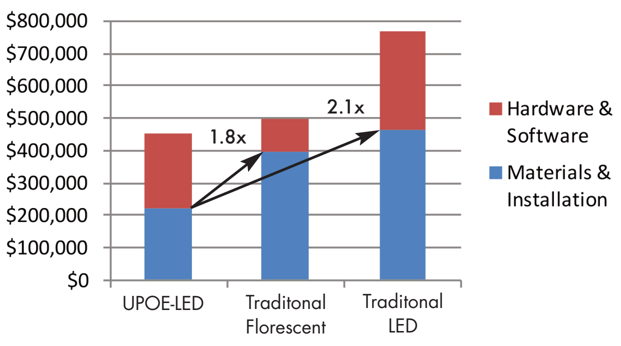


Figure 1: *Upfront Cost Comparison for a 3,250m² (35,000ft²) building in New York City*

Lower capital and labor investment: An analysis of converged Ethernet applications in highly automated building spaces performed by Siemon, with input from intelligent building partners, demonstrates that deployment of PoE lighting solutions over structured telecommunications cabling delivers a typical capital expenditure (CAPEX) savings of USD $19.40 per m² (USD $1.80 per ft²) compared to traditional lighting implementations. Table 1 breaks down the number of IoT devices deployed per 950m² (10,000ft²) in a PoE optimized automated building space and the realized CAPEX for each application. As demonstrated, PoE lighting opportunities alone comprise 35% of the possible CAPEX savings in an IoT enabled building! In addition, a comparison performed by Cisco® of the upfront labor and installation investment and upfront hardware and software investment costs between traditional fluorescent, traditional LED, and 60W UPOE[3]-enabled LED lighting deployments in a 3,250m² (35,000ft²) building in New York City clearly demonstrates that PoE-enabled lighting systems have the lowest cost of ownership. As shown by the blue bars in figure 1[4], the upfront materials and installation cost of a traditional low voltage LED lighting system is more than double that of a UPOE-enabled LED system, and even a traditional fluorescent lighting system is 1.8x times more costly than a UPOE-enabled system. When hardware and software costs are considered, the UPOE-enabled system is still the winner – offering a 41% overall cost savings compared to a traditional low voltage LED lighting design and a 14% cost savings compared to a traditional fluorescent lighting system." Here is the text with change marks. Additional savings are realized when energy costs are factored into the analysis. Ongoing improvements in LED luminosity efficiency and luminaire optimization will contribute to additional cost savings in the future.

Safe low voltage operation: Unlike traditional lighting systems supported by 120 V - 60 Hz or 230 V - 50 Hz alternating current (sometimes called "mains electricity" or "AC") circuits running over 12 - 14 AWG electrical cable, PoE lighting is deployed over familiar and user-friendly balanced twisted-pair cabling and is a safety extra-low voltage (SELV) application. This means that the 50 - 55 V direct current (DC) levels used to power PoE lighting system circuits pose no safety risk to the installer when these systems are deployed or upgraded, and no special electrical licensing is required. Since transmission performance can be adversely affected due to substandard installation practices, Siemon recommends that all PoE lighting systems be installed by a cabling professional properly trained in structured cabling installation methods.

Earth and tenant friendly: PoE lighting solutions make for a more comfortable environment for building occupants. Specifically, studies indicate that fluorescent lighting can lead to headaches and eye strain, as well as the potential for seizures for those with photosensitive epilepsy. Not only do LED luminaires and troffers eliminate these health concerns, but the fixtures themselves consume nearly half the electricity of equivalent fluorescents, emit less than half the carbon emissions of fluorescents, and contain no hazardous mercury. With a lifespan nearly five times that of fluorescents, combined with improved durability and no sensitivity to temperature or humidity, LEDs also greatly reduce maintenance costs.

Integration with IoT applications: The Internet of Things is the quintessential converged cabling application that will enable the exchange of data between the nearly 50 billion IP-enabled devices anticipated by 2020.[5] Merging and facilitating communication between HVAC, security, audio/video, access control, digital signage, wireless, lighting, and other Ethernet-enabled devices over one structured cabling network is proven to reduce operation expenses and increase energy conservation, facilitate infrastructure and asset management, and make for a more pleasant and safer environment. Management of multiple building automation and IP devices over one network eliminates proprietary cabling, reduces pathway redundancy, and supports faster device and system rollouts and upgrades. PoE lighting systems additionally benefit from deployment over structured cabling because they can receive centralized back-up power from the telecommunications room (also called the server room) and respond accordingly when integrated with occupancy, temperature, safety, energy, and other sensors and systems.

LED Lighting Luminaire Configurations

In a smart PoE lighting design, structured cabling connects an Ethernet switch port capable of providing DC power directly to an LED lighting fixture or to a "node", which branches power and data off to an LED lighting fixture or fixtures, a device such as a sensor, and a controller. In commercial environments, the LED lighting fixture is most often a troffer, but may be any type of luminaire design. Troffers are commonly offered in 2x2 (600mm x 600mm or 2ft x 2ft), 2x4 (600mm x 1200mm or 2ft x 4ft), and 1x4 (300mm x 1200mm or 1ft x 4ft) configurations as shown in figure 2.

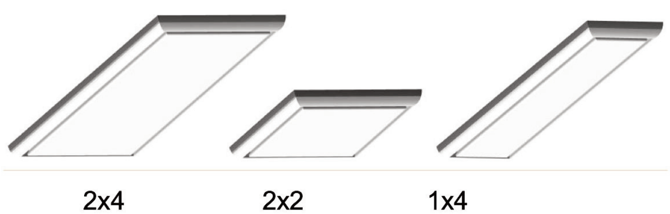
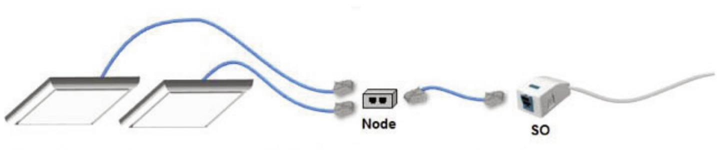
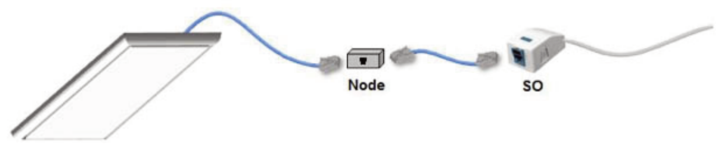


Figure 2: *Common Troffer Configurations*

Depending upon the PoE lighting system, troffer size, and manufacturer, one node may serve one or two troffers as well as optionally incorporate a data port for control (e.g. a dimmer or a sensor). The four most common LED lighting luminaire configurations are shown in figure 3. For all LED lighting luminaire configurations, the maximum power supported by each structured cabling channel and node, if present, should not exceed 60W.



A: 2x2 Node Centric - *Two 2x2 troffers share one node, which is connected to structured cabling via a service outlet (SO) or the service connection point (SCP)*



B: 2x4 Node Centric - *Each 2x4 troffer requires its own node, which is connected to structured cabling via a service outlet (SO) or the service connection point (SCP)*

C: 2x2 Fixture Centric - *Each 2x2 troffer connects to the structured cabling via a service outlet (SO) or the service connection point (SCP)*

D: 2x4 Fixture Centric - *Each 2x4 troffer connects to the structured cabling via a service outlet (SO) or the service connection point (SCP)*

Figure 3: *Typical LED Lighting Troffer Configurations*

Zone Cabling for PoE Lighting

Zone cabling is an industry-recognized structured cabling deployment strategy that is highly suited to support arrangements of devices, such as luminaires and lighting controllers, which are logically distributed throughout a ceiling space. A zone cabling design for PoE lighting consists of horizontal cable run from the floor distributor in the telecommunications room (TR) to an intermediate connection point called the service concentration point (SCP), which is an outlet housed in a zone enclosure located in the ceiling space. Due to the density of PoE lighting devices, zone enclosures typically accommodate 96 SCP outlets and may be designed to replace a ceiling tile in drop ceiling applications. A cable or cord connects each SCP outlet in the zone enclosure to either a service outlet (SO) or directly to a PoE lighting device as shown in figure 4. In lighting applications, this type of zone topology – where all of the PoE switches are located in the TR – is sometimes referred to as a "centralized" deployment.

With the few exceptions highlighted in this Planning Guide, a zone cabling design for PoE lighting is very similar to a zone cabling design for building automation systems and other IP devices, and Siemon guidelines for zone cabling and coverage area planning[6] should be followed. Because of the high number of PoE lighting devices in an enterprise space and the static nature of the lighting environment (there are few adds, moves, and changes), Siemon recommends that the zone cabling system supporting PoE lighting devices overlay the zone cabling system supporting other building automation and IP devices. This means that a dedicated zone enclosure will provide SCP outlet connections for PoE lighting devices and a separate zone enclosure will provide SCP connections to all other building automation and IP devices. In the unlikely event that additional SCP outlets beyond what are available at the dedicated PoE lighting zone enclosure are needed, they can be accessed from an adjacent zone enclosure used to support other IP devices.

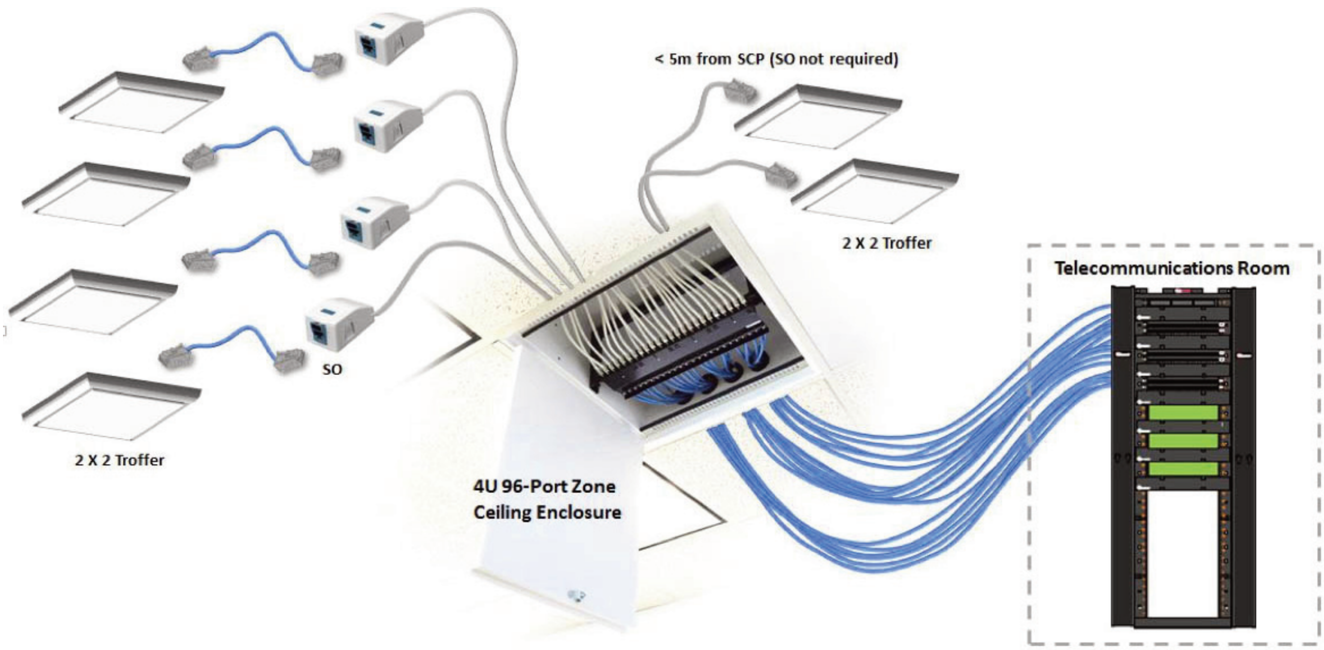


Figure 4: *Example Zone Cabling for 2x2 Fixture Centric PoE Lighting Design*

Coverage Areas and Location of Zone Enclosures

According to ISO/IEC and TIA Standards, the area served by a device is called its coverage area. For the purpose of this Planning Guide, the term coverage area is extended to describe the space that serves multiple PoE lighting devices and their individual coverage areas. Siemon recommends that PoE lighting device coverage areas be planned to have a radius no greater than 13m (43ft) to optimize the number of cables (i.e. more than 96 cables becomes difficult to manage) needed to support the typical density of PoE lighting devices in this space and to align with other zone cabling systems supporting fifth generation (i.e. IEEE 802.11ac) and future Wi-Fi applications. This practical guidance also simplifies the design task of overlaying the zone cabling system supporting building automation and other IP devices with the zone cabling system supporting PoE lighting devices.

Although multiple coverage areas may be arranged in a variety of patterns throughout a building space (e.g. hexagon-shaped, grid-shaped or leg-shaped), a grid-based pattern most easily supports a PoE lighting system deployment because luminaires are typically arranged in a grid-based fashion. In this case, a coverage area with a 13m (43ft) radius translates to an 18m x 18m (60ft x 60ft) grid. Multiple coverage areas may be arranged throughout the building space to support PoE lighting connections and devices as needed. Unless the TR has limited accessibility, coverage areas that are in close proximity to the TR can be connected directly to the floor distributor without passing through an SCP. For optimized design efficiency, Siemon recommends that zone enclosures be positioned at least 30m (100ft) from the TR.

Zone enclosures should be centrally located within their respective coverage area, and the recommended number of SCP outlets present is dependent upon troffer size and whether the PoE lighting system is node or fixture centric. Siemon recommends that the number of available SCP connections within the dedicated lighting zone enclosure should be no less than 24 (e.g. for small PoE lighting deployments or PoE lighting systems supported by zone enclosures located on a wall) and should not exceed 96. If more than 96 SCP connections are required, then multiple zone enclosures should be deployed to ensure that cable bundle sizes are manageable and that remote powering current-induced heat buildup within cable bundles is controlled. Example connection counts for common PoE lighting system configurations and recommended SCP sizing are shown in table 2.

In the unusual case that one dedicated lighting zone enclosure serves more than one PoE lighting coverage area, the area comprised of the multiple coverage areas is referred to as the zone area. Figure 5 shows an example coverage area schematic for a 2x2 node centric PoE lighting design with four environmental sensors present. For simplicity, cabling is only shown to a sampling of nodes and one sensor.

Luminaire Configuration	Devices and Connections 18m x 18m (60ft x60ft)	Recommended Zone Enclosure Configuration*
2x2 Node Centric	144 2x2 troffers 72 nodes (2 luminaires share 1 node)	Deploy one 96-port enclosure
2x4 Node Centric	72 2x4 troffers 72 nodes	Deploy one 96-port enclosure
2x2 Fixture Centric	144 2x2 troffers 144 SO or SCP outlets	Deploy two 96-port enclosures
2x4 Fixture Centric	72 2x4 troffers 72 SO or SCP outlets	Deploy one 96-port enclosure
*These design recommendations allow for deployment of additional SCP outlets that can provide connections to controllers, dimmers, sensors, etc.		

Table 2: *Example Connection Counts for Common PoE Lighting System Configurations and Recommended Zone Enclosure Sizing*

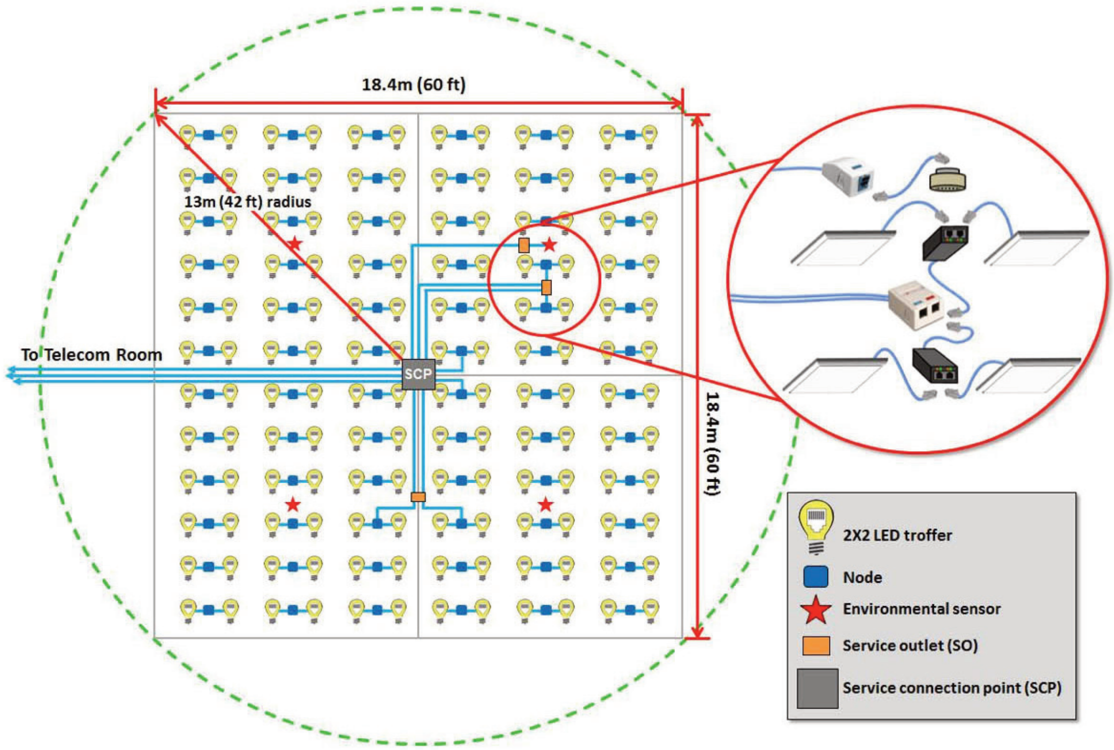


Figure 5: *Example 18m x 18m (60ft x 60ft) Coverage Area for a 2x2 Node Centric PoE Lighting Design with Four Environmental Sensors*

Service Outlet (SO), Cord, and Other Connections within Coverage Areas

ISO/IEC and TIA intelligent building cabling specifications do not require an SO to be present in a zone cabling infrastructure if an SCP is present. However, because PoE lighting devices can be located far away from the SCP, SOs can facilitate labeling and administration, simplify field testing, eliminate the need to install long lengths of cable when devices are added, and remove the concern of abandoned cable when devices are taken out of service. For these benefits, Siemon suggests that an SO be used if a PoE lighting device is more than 5m (16ft) from an SCP.

Consideration of the placement of telecommunications hardware and equipment in air handling spaces may be necessary. For example, in some jurisdictions, the service outlet, in addition to the zone enclosure and associated cords and cabling, may need to be plenum rated.

Siemon recommends that solid conductor cables be used exclusively in spaces that do not have environmental control (e.g. ceilings and warehouses) because stranded conductor cables exhibit higher DC resistance and are more likely to exhibit degraded transmission performance at elevated temperature. In temperature controlled spaces, Siemon recommends that PoE lighting device connections to an SO or SCP should not exceed 5m (16ft) if stranded conductor cords are used.

PoE Applications and Effects on Cabling

While power levels of up to 100W may safely be deployed over balanced twisted-pair cabling, 60W of power is generally considered to ideally balance cost, efficiency, and performance in PoE lighting applications. The technology supporting power sourcing equipment and powered devices operating at 60W, including Cisco UPOE and emerging IEEE 802.3 Type 3 PoE technology, is fully developed and commercially available. These systems provide 600mA of current per twisted-pair at a typical operating voltage of 50 - 55 V DC and use an identical delivery method as previous generation 30W Type 2 PoE equipment, with the exception that power is applied over all four pairs instead of just two. Fortunately, the temperature rise profiles developed by ISO/IEC and TIA for 600mA current levels assumed that all four pairs were energized and are directly relevant to cables supporting 60W PoE lighting systems. As a result, no new data generation or profiling by Standards bodies was required for this application. Standards, such as ISO/IEC TS 29125[7] and TSB-184-A[8] contain useful cabling media and selection guidance for support of up to 100W remote powering applications.

The potential for heat buildup within cable bundles and electrical arcing damage to connector contacts supporting remote powering applications is well understood[9], and the careful selection of cabling and components for support of 60W PoE lighting systems can minimize or even completely mitigate performance degradation due to these two factors. While never significant enough to cause cables to melt or conductors to short, internal temperature rise within bundled cables increases conductor resistance, which leads to power and efficiency losses, and increased insertion loss, which may require overall channel length to be reduced. In addition to the consideration of heat buildup, it's important that critical connecting hardware contact mating surfaces are not damaged when modular plugs and outlets are unmated when remote powering current loads are present. While the current level associated with this arc poses no risk to humans, arcing creates an electrical breakdown of gases in the surrounding environment that results in erosion and pitting damage on the plated contact surface at the arcing location. The end result can range from increased resistance causing power delivery inefficiencies to compromised connector reliability.

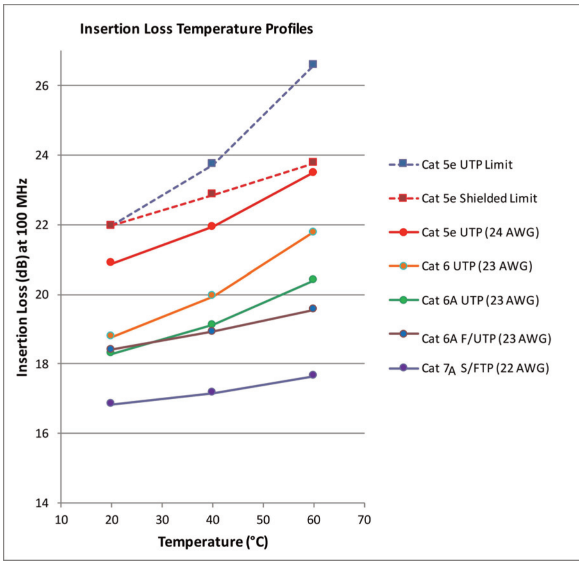


***Figure 6:** Measured Insertion Loss for Siemon Cables at 20°C, 40°C, and 60°C Compared to Category 5e Limits for UTP and Shielded Cables*

Induced Temperature Rise Due to Remote Powering Currents and CableVoltage Drop

The impact of cable temperature rise on insertion loss and DC resistance must be considered when developing balanced twisted-pair media recommendations for support of 60W PoE lighting applications. Figure 6 shows measured insertion loss at 100 MHz for Siemon category 5e UTP, category 6 UTP, category 6A UTP, category 6A F/UTP, and category 7_A S/FTP cables at 20°C (68°F), 40°C (104°F), and 60°C (140°F) compared to the temperature adjusted category 5e insertion loss limits for UTP and shielded cables. Category 5e limits were used in this analysis because PoE lighting systems commonly operate at 1,000 Mb/s or lower data speeds. It can be clearly observed that all Siemon cables exhibit headroom to the scaled category 5e insertion loss limits for UTP and shielded cables.

Headroom to the baseline category 5e cable insertion loss limit at 20°C (68°F) and knowledge of the bundled heat dissipation profiles for different Siemon cable types were used to develop installation guidelines for cabling supporting 60W PoE lighting applications in higher temperature environments. Insertion loss headroom and greater thermal stability are key performance differentiators that allow Siemon to guarantee support of 60W (600mA per pair) PoE lighting applications operating at 1000BASE-T or lower speed data rates in the following free air (i.e. non-conduit) installation conditions without the need for channel length de-rating:

- Bundles of up to 96 Siemon category 5e UTP cables may be deployed for up to 100 meters in ambient temperatures up to 45°C (113°F)
- Bundles of up to 96 Siemon category 6 UTP cables may be deployed for up to 100 meters in ambient temperatures up to 50°C (122°F)
- Bundles of up to 96 Siemon category 6A UTP cables may be deployed for up to 100 meters in ambient temperatures up to 55°C (131°F)
- Bundles of up to 96 Siemon shielded category 6A or category 7_A cables may be deployed for up to 100 meters in ambient temperatures up to 60°C (140°F)

Consult the infrastructure design experts at Siemon for information on bundle size recommendations for cables installed in conduit and other enclosed pathways.

It is important to keep in mind that temperatures in enclosed and confined spaces can increase rapidly when exposed to external heat sources such as radiated sunlight and HVAC exhaust. Since there is no easy method to monitor temperature or cool pathways, the recommended approach to minimize the risks associated with elevated temperatures is to select cabling media that is rated for operation in higher ambient temperature environments.

> *"Since Siemon's shielded category 6A and category 7_A cables are mechanically rated for operation up to 75°C (167°F), they are also ideal for support of up to 100W (1A per pair) PoE lighting and general intelligent building applications. Bundles of up to 96 Siemon shielded category 6A or category 7_A cables deployed for up to 100 meters in ambient temperatures up to 60°C (140°F) are guaranteed to support 100W (1A per pair) remote powering applications operating at 1000BASE-T or lower speed data rates in free air (i.e. non-conduit) installations."*

Cables rated for operation at temperatures higher than the ISO/IEC and TIA specified upper operating temperature of 60°C (140°F) offer additional flexibility for deployment of greater than 60W remote powering applications. Since Siemon's shielded category 6A and category 7_A cables are mechanically rated for operation up to 75°C (167°F), they are also ideal for support of up to 100W (1A per pair) PoE lighting and general intelligent building applications. Bundles of up to 96 Siemon shielded category 6A or category 7_A cables deployed for up to 100 meters in ambient temperatures up to 60°C (140°F) are guaranteed to support 100W (1A per pair) remote powering applications operating at 1000BASE-T or lower speed data rates in free air (i.e. non-conduit) installations. The superior heat dissipation and extended temperature rating of Siemon's shielded category 6A and category 7_A cables easily accommodates a bundled cable temperature rise of less than 15°C (27°F). Consult the infrastructure design experts at Siemon for information on bundle size recommendations for cablesinstalled in conduit and other enclosed pathways.

Increased DC resistance at elevated temperatures directly correlates to increased power loss. The DC resistance and voltage drop of the Siemon cables under test were measured at 60°C (140°F) with 600mA constant current applied per pair and used to calculate the power losses shown in table 3. PoE lighting and other remote powering equipment will operate more efficiently and have lower operating expenditure (OPEX) when deployed over cabling exhibiting lower DC resistance. Siemon shielded category 6A and category 7_A cabling is recommended for optimum support of 60W PoE lighting applications operating at 1000BASE-T or lower speed data rates.

Siemon Cable	Maximum DC Resistance (Single Conductor) at 60°C (140°F)	Power Loss per 100m (328ft)
Category 5e UTP (24 AWG)	10.9Ω	7.8W
Category 6 UTP (23 AWG)	9.0Ω	6.5W
Category 6A UTP (23 AWG)	8.7Ω	6.3W
Category 6A F/UTP (23 AWG)	8.8Ω	6.3W
Category 7_A S/FTP (22 AWG)	6.3Ω	4.5W

Table 3: *DC Resistance and Power Loss for Siemon Cables at 60°C, 600mA Applied per Pair*

These cables offer both the efficiency benefits of low DC resistance and the flexibility to install bundles of up to 96 cables up to the maximum ambient temperature of 60°C (140°F) without the need for channel length de-rating. In addition, these cables will support remote powering currents up to 60W (600mA per pair) and 10GBASE T for Wi-Fi and other high speed applications with minimal need for channel length de-rating (e.g. link length is reduced from 90 meters to 86 meters at 60°C (140°F) ambient when Siemon shielded category 6A cabling is deployed and no length reduction is necessary at 70°C (170°F) ambient when Siemon shielded category 7_A cabling is deployed.)

Siemon 60W PoE Lighting Extended Reach Solutions

Cables and cabling systems exhibiting headroom to baseline category 5e transmission requirements (i.e. insertion loss, DC loop resistance, propagation delay, and delay skew) at 20°C (68°F) can also support 60W PoE lighting applications operating at 1000BASE-T or lower speed data rates over distances greater than 100m (328ft) at higher than ambient temperatures. Extended distance support can be calculated for a single cable up to 60°C (140°F) or for a bundle of 96 cables up to the maximum ambient temperature that ensures cable bundle temperature will not exceed 60°C (140°F) when 60W (600mA per pair) power loads are applied. Maximum channel support length is derived by comparing transmission performance of the cable to the 100m (328ft) baseline category 5e horizontal cable requirements specified in IEC 61156-5[12] and ANSI/TIA-568-C.2[13] and assumes that the channel includes up to 10m (33ft) of stranded conductor cord cable deployed in climate controlled space(s).

Siemon guarantees extended distance channel support of 60W (600mA per pair) PoE lighting applications operating at 1000BASE-T or lower speed data rates as described in table 4. Note that these extended distance capabilities are uniquely supported by Siemon cabling solutions. Choosing Siemon shielded category 6A and higher performing cables to support 60W (600mA per pair) PoE lighting applications significantly simplifies cabling infrastructure design by eliminating the need to reduce channel lengths to offset increased insertion loss due to elevated temperature environments or heat buildup with the cable bundle caused by 60W remote power delivery. Choosing Siemon category 7_A cabling extends the distance over which 60W (600mA per pair) PoE lighting applications operating at 1000BASE-T or lower speed data rates can be deployed to an astounding 122m (400ft) in unbundled configurations and 120m (394ft) in bundled configurations!

Contact arcing under load

Unmating a modular outlet-plug connection under any remote powering load produces an arc that erodes the gold plated modular outlet-plug contact surfaces at the arcing location. When this erosion occurs in the area of the fully mated contact position, the result is an unreliable connection. Accordingly, Standards recommend that connecting hardware used for remote powering applications exhibit reliable performance for mating and un-mating under applicable levels of electrical power and load.

All Siemon Z-MAX®, MAX® and TERA® modular outlets utilize a patented curved or "crowned" contact shape[10] to ensure that arcing will occur in the initial contact "wipe" area on both modular outlet and plug contacts and will not affect mating integrity in the fully seated contact position. These modular outlets and plugs have been third party verified to meet IEC 60512-99-001[11] specifications up to 60W (600mA per pair) and testing up to 100W (1A per pair) will be initiated when Standards bodies finalize a test method.

Siemon Cable	Single Channel[a] Length (One Unbundled Cable)	Bundled Channel[a] Length (Bundles of 96 Cables
Category 6A UTP (23 AWG)	102m (331ft) at 60°C (140°F)	100m (335ft) at 55°C[b] (131°F)
Category 6A F/UTP (23 AWG)	102m (331ft) at 60°C (140°F)	100m (335ft) at 60°C[b] (140°F)
Category 7_A S/FTP (22 AWG)	122m (400ft) at 60°C (140°F)	120m (394ft) at 60°C[c] (140°F)

[a] It is assumed that the channel includes up to 10m (33ft) of stranded conductor cord cable that is deployed in climate controlled space(s)

[b] Temperature rise within the bundle is maximum 5°C (9°F)

[c] Temperature rise within the bundle is maximum 2°C (4°F)

***Table 4:** Siemon Cable Extended Distance Channel Support of 60W (600mA per pair) PoE Lighting Applications Operating at 1000BASE-T or Lower Speed Data Rates*

The Benefits of Using a Digital Lighting Partner

There are a large number of variables that must be considered prior to identifying the PoE lighting system that is best suited for a particular building environment, and the process to design and deploy lighting devices and balanced twisted-pair cabling in coverage areas can be complex and confusing. As a result, Siemon recommends the use of a digital lighting partner to provide assistance in designing and installing the low voltage cabling system for PoE lighting deployments. Digital lighting partners are certified cabling design and installation experts that ensure customers receive an infrastructure design optimally suited for the specified PoE lighting system. Contact the experts at Siemon for additional information.

Glossary

- ***Coverage area (PoE lighting):*** A space, commonly sized at 18m x 18m (60ft x 60ft), that contains at least one dedicated lighting zone enclosure and serves multiple PoE lighting devices and their individual coverage areas.
- ***Direct Current (DC):*** The flow of electrons (i.e. electric charge) in one direction within an electrical conductor.
- ***Direct Current (DC) power:*** Energy supplied by constant unidirectional voltage and constant current sources.
- ***Direct Current (DC) loop resistance:*** A measure of the resistance of flow of electrical current when the two conductors in a twisted-pair are joined at one end to form a continuous circuit.
- ***Direct Current (DC) resistance:*** A measure of the resistance of flow of electrical current of a conductor.
- ***Insertion loss:*** A measure of the decrease in signal strength along the length of transmission line.
- ***Light Emitting Diode (LED):*** An energy efficient semiconductor diode that glows when current flows through it.
- ***Luminaire:*** A self-contained lighting unit or fixture.
- ***Node:*** A lighting component that receives power and data from network equipment and distributes it to LED luminaires.
- ***Power over Ethernet (PoE):*** An IEEE 802.3 standardized power distribution system whereby low voltage DC power (i.e.<100 VA) is transmitted along with data over balanced twisted-pair cabling.
- ***Propagation delay:*** The amount of time that passes between when a signal is transmitted at one end of a cabling channel and when it is received at the opposite end of a transmission line.
- ***Propagation delay skew:*** The difference between the arrival times of the pair with the least delay and the pair with the most delay at the receiving end of a transmission line.
- ***Reflected Ceiling Plan (RCP):*** A schematic for architects, designers, and electricians, showing the location of light fixtures, lighting panels, troffers, and other lighting-related components and devices that may be suspended from the ceiling.
- ***Remote power:*** Low voltage DC power (i.e. <100 VA) that is transmitted along with data over balanced twisted-pair cabling.
- ***Service Concentration Point (SCP):*** The intermediate connection point, typically consisting of a modular outlet housed in a zone enclosure, between a horizontal cable run from the floor distributor in the telecommunications room (TR) and the end-point device or service outlet (SO) it serves.
- ***Service Outlet (SO):*** A modular outlet providing a building device connection.
- ***Troffer:*** A type of luminaire that is rectangular and designed to fit into a modular dropped ceiling grid.
- ***Zone area (PoE lighting):*** The area comprised of multiple coverage areas in the unusual case that one dedicated lighting zone enclosure serves more than one coverage area.
- ***Zone enclosure (ZE):*** A housing for service concentration point (SCP) outlets.

Summary of Siemon 60W PoE Lighting Media and Zone cabling and Coverage Area Design Recommendations

Media recommendations:

- Siemon shielded category 6A and category 7_A cabling is recommended for optimum support of 60W (600mA per pair) PoE lighting applications operating at 1000BASE-T or lower speed data rates for maximum efficiency and optimum installation flexibility for ambient temperatures up to 60°C (140°F).
- Siemon guarantees support of PoE lighting applications up to 60W (600mA per pair) operating at 1000BASE-T or lower speed data rates in the following free-air (i.e. non-conduit) installation conditions without the need for channel length de-rating:
  - Bundles of up to 96 Siemon category 5e UTP cables may be deployed for up to 100 meters in ambient temperatures up to 45°C (113°F)
  - Bundles of up to 96 Siemon category 6 UTP cables may be deployed for up to 100 meters in ambient temperatures up to 50°C (122°F)
  - Bundles of up to 96 Siemon category 6A UTP cables may be deployed for up to 100 meters in ambient temperatures up to 55°C (131°F)
  - Bundles of up to 96 Siemon shielded category 6A or category 7_A cables may be deployed for up to 100 meters in ambient temperatures up to 60°C (140°F)
- Siemon guarantees support of all remote powering applications up to 100W (1A per pair) operating at 1000BASE-T or lower speed data rates in the following free-air (i.e. non-conduit) installation condition without the need for channel length de-rating:
  - Bundles of up to 96 Siemon shielded category 6A or category 7_A cables may be deployed for up to 100 meters in ambient temperatures up to 60°C (140°F)
- Consult the infrastructure design experts at Siemon for information on bundle size recommendations for cables installed in conduit and other enclosed pathways.
- Siemon category 7_A cabling extends the distance over which 60W (600mA per pair) PoE lighting applications operating at 1000BASE-T or lower speed data rates may be deployed to 122m (400ft) in unbundled configurations and 120m (394ft) in bundled configurations.
- Solid conductor cables should be used exclusively in spaces that do not have environmental control (e.g. ceilings and warehouses) for optimum thermal performance.
- Use of stranded conductor cables for PoE lighting or device connections should not exceed 5m (16ft)
- Connecting hardware should be third party verified to meet IEC 60512-99-001 to ensure reliable performance when mating and un-mating under 60W PoE lighting electrical power and load.

Topology and design recommendations:

- The zone cabling system supporting PoE lighting should overlay the zone cabling system supporting building automation devices.
- A dedicated zone enclosure should provide SCP outlet connections for PoE lighting applications and a separate zone enclosure should provide SCP connections to all building automation and other IP devices.
- The PoE lighting device coverage area should be a 18m x 18m (60ft x 60ft) grid pattern to optimize the number of cables needed to support the typical density of PoE lighting devices and to align with other zone cabling systems supporting fifth generation (IEEE 802.11ac) and future Wi-Fi applications.
- Zone enclosures should be centrally located within PoE lighting coverage areas.
- The number of available SCP connections in a zone enclosure should not be less than 24 or more than 96.
- SOs located within 30m (100ft) of the TR may be served directly from the horizontal distributor in the TR (no SCP required).

Annex A: *Siemon Dedicated Lighting SCP and SO Solutions Part Number Table*

Size	Part Number	Description	May Be Used in Plenum Spaces[a]	Application Space		
				Ceiling	Wall	Service Outlet
1-port	MX-SMZ1, MX-SM1	Z-MAX and MAX Surface Mount Boxes	✓	✓	✓	✓
2-port	MX-SMZ2, MX-SM2	Z-MAX and MAX Surface Mount Boxes	✓	✓	✓	✓
3-port	SP-3	Surface Pack Box	✓	✓	✓	✓
4-port	MX-SMZ4, MX-SM4	Z-MAX and MAX Surface Mount Boxes	✓	✓	✓	✓
6-port	MX-SMZ6, MX-SM6	Z-MAX and MAX Surface Mount Boxes	✓	✓	✓	✓
6-port	SP-6	Surface Pack Box	✓	✓	✓	✓
24 ports	ZU-MX-24P	MAX Zone Unit Enclosure	✓	✓	✓	
24 - 96 ports	ZU-C4P-K02	2ft x 2ft Ceiling Enclosure[b]	✓	✓		

[a] Use Siemon plenum rated IC and ZC6A series cords when an end-to-end plenum solution is required.
[b] Provides up to 4U of mounting space

References

[1] IEEE 802.3bt™, "Amendment: Physical Layer and Management Parameters for DTE Power via MDI over 4 Pair, 2017*

[2] Gartner, Inc., "Market Trends: The Five Phases That Smart Lighting Providers Must Address to Be Successful in the Internet of Things", 2015

[3] Cisco Universal Power Over Ethernet (UPOE) extends the IEEE Std 802.3™-2015 Type 2 Data Terminal Equipment (DTE) Power via the Media Dependent Interface (MDI) Enhancements standard to double the power per port to 60 watts

[4] Reproduced with permission by Cisco

[5] Cisco, "The Internet of Things - How the Next Evolution of the Internet Is Changing Everything", 2011

[6] Siemon white paper, "Zone Cabling and Coverage Area Planning Guide", 2015

[7] ISO/IEC TS 29125, "Information Technology – Telecommunications Cabling Requirements for Remote Powering of Terminal Equipment", 2017*

[8] TIA TSB-184-A, "Guidelines for Supporting Power Delivery Over Balanced Twisted-Pair Cabling", 2017

[9] Siemon white paper, "Advantages of Using Siemon Shielded Cabling Systems To Power Remote Network Devices", 2013

[10] Siemon white paper, "Siemon Jacks Crowned King of PoE", 2016

[11] IEC 60512-99-001, "Connectors for Electronic Equipment - Tests and Measurements - Part 99-001: Test Schedule for Engaging and Separating Connectors under Electrical Load - Test 99a: Connectors used in Twisted Pair Communication Cabling with Remote Power", 2012

[12] IEC 61156-5, "Multicore and Symmetrical Pair/Quad Cables for Digital Communications – Part 5: Symmetrical Pair/Quad Cables with Transmission Characteristics up to 1 000 MHz – Horizontal Floor Wiring – Sectional Specification", 2012

[13] ANSI/TIA-568-C.2, "Balanced Twisted-Pair Telecommunications Cabling and Components Standard", 2009

* estimated

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