



EDITION 39  
VOLUME 1

# 12 TOP CABLE DESIGN PRINCIPLES AND SOLUTIONS FOR DATA CENTER SAFETY

## COMPOSED BY

Dr. Yuhsin Hawig, VP of Applications Engineering  
Edwin Marquez, Director of Applications Engineering



## 1. VOLTAGE DROP FOR LONG RUNS

When installing long cable runs in data centers or critical infrastructure sites, voltage drop is an essential factor. Electrical resistance increases proportionally with circuit length; therefore, longer circuits have higher resistance and, consequently, greater voltage drop. Additionally, higher current loads contribute to increased voltage drop. The NEC® limits voltage drop to a maximum of 3% for branch circuits and 5% overall for feeders and branch circuits combined. Using larger conductors helps reduce resistance, making cable upsizing an effective way to minimize voltage drop. Furthermore, copper has lower electrical resistance than aluminum, making it the preferred material for long runs. Southwire offers a free online tool to help with voltage drop calculations.



## 2. AMPACITY DERATING ON CABLING

Ampacity derating is essential when designing cable systems to ensure conductors operate safely under different environmental and installation conditions. Derating factors include, but are not limited to, nearby heat sources, ambient temperature, the number of current-carrying conductors, and the spacing between conductors. When multiple conductors are grouped together, heat dissipation becomes more challenging, which can lead to thermal runaway. To prevent overheating, ampacity derating must comply with NEC 310.15. Southwire's CableTechSupport™ Services offer comprehensive ampacity modeling for complex cable routings, including those in data centers and utility projects.



## 3. SHORT CIRCUIT CALCULATIONS

The simplest way to safeguard data centers from short-circuit events is by implementing overcurrent protection with time-graded discrimination between protective devices. Conductors must be properly sized according to their short-circuit capacity to withstand fault conditions without damage. For UL-83 thermoplastic-insulated cables (such as THHN and THWN-2), the short-circuit operating temperature is 150°C. Conversely, UL-44 listed cables with thermoset insulation (such as XHHW-2 and RHW-2) are rated for 250°C during short-circuit conditions. Southwire's CableTechSupport™ services offer free engineering calculations, including short-circuit validations, and have published conductor damage curves for all UL insulation types.



## 4. ARC FLASH MODELING

Hyperscale data centers operate with increasingly powerful and compact electrical systems, often at 400V or higher. Elevated voltages increase the severity of arc flash events, which can damage sensitive equipment and pose serious safety risks to personnel. To reduce these risks, data centers should adhere to the IEEE 1584 guide for performing arc flash hazard calculations. This standard provides mathematical models that enable designers and facility operators to determine arc-flash hazard boundaries and the incident energy levels to which workers may be exposed while working on or near energized equipment. Implementing parallel system designs with properly rated circuit breakers, arc flash detection devices, and suitable personal protective equipment (PPE) for all team members can significantly improve safety.



Southwire

**CABLETECH  
SUPPORT™**

Services

### CABLETECHSUPPORT™ SERVICES

Southwire's CableTechSupport™ Services team includes professionals with advanced qualifications such as Ph.D., MBA, and Master of Science in Electrical Engineering (MSEE) degrees, along with certified medium-voltage (MV) splicers and licensed Professional Engineers (PE). Each year, the team fulfills over 20,000 technical requests, supporting specifiers, contractors, and installers in meeting project requirements. Our whitepapers and smart calculators empower users to independently



select appropriate products and solutions. Scan the QR code to access the electrical industry's most comprehensive technical library.



STRONG.  
SUSTAINABLE.  
SOUTHWIRE.

THE  
COPPER  
MARK

RESPONSIBLY  
PRODUCED  
COPPER

### WE DELIVER POWER...RESPONSIBLY®

In 2022, Southwire partnered with The Copper Mark®, supporting responsible copper production through globally recognized standards. The Copper Mark provides a comprehensive social and environmental governance framework, and Southwire is committed to following best practices in sourcing and manufacturing copper products. We offer more than 180 Reinforced, Resilient, and Reliable wire and cable products for residential, commercial, industrial, and utility applications.



Scan the QR code to access our engineering spec library and explore solutions that support your project's sustainability objectives.



Southwire®



## 5. OPERATION AND MAINTENANCE

Power cables used in data centers must meet industry standards to ensure safety. These standards include NEC, NFPA, UL, CSA, ICEA, and IEEE. Special attention should be given to two recently revised standards:

ANSI/NETA ECS-2024, which emphasizes the importance of safe and reliable operation of electrical power equipment and systems. Southwire recommends performing partial discharge testing, VLF or AC withstand testing, or insulation resistance testing on power cables before energization.

NFPA 70B (2023), which now makes electrical equipment maintenance a mandatory requirement rather than just a recommended practice. Data center owners must formalize their electrical maintenance programs and perform regular maintenance procedures on both power cables and protective devices.



## 6. PRE-TERMINATED CABLES

Southwire offers customized Qwik Whip™ cable assemblies to connect power distribution units (PDUs) from the main low-voltage (LV) switchboard to server racks. With a quick turnaround, a wide selection of receptacles, various color options, and adjustable lengths, we provide tailor-made cables to meet exact specifications. Our data center cabling solutions aim to reduce labor costs and enhance operational flexibility. By incorporating divisionary panels and strategic cable routing to the racks, our UL-listed assemblies eliminate the need to secure cables every 4.5 feet, allowing for fully flexible power distribution and easier installation.



## 7. TC-ER BRANCH CIRCUIT WHIPS

Southwire's preconfigured PDU whips are designed for large-scale projects to lower labor costs and reduce commissioning time. The whip configuration terminated with an IEC connector and lugs are available in sizes from 8 to 2 AWG. Each assembly is typically 50 feet long, simplifying estimating and lead time planning. Ordered materials are configured with a cable calculator to include actual footage, wire marking, and verification of termination types. Each assembly is UL-listed and made in the USA from domestic cable products. Every whip is tested for dielectric withstand (HIPOT) at twice-rated circuit voltage, plus 1500V, along with pin-to-pin continuity to ensure there is no arcing or shorting of conductors within the assembly.



## 8. TYPE W ALTERNATIVE

Type W portable power cable is an extra-hard usage cable, ideal for use with submersible pumps. However, it is not allowed for permanent building wiring under NEC Article 400 (Flexible Cords and Flexible Cables) and therefore cannot be installed in raceways, including cable trays, at data centers. A labor-saving alternative is Southwire's Machine FLEX® Type TC-ER. For example, the 5-conductor design in 6 AWG is about 28% lighter and 25% smaller in overall diameter compared to its Type W equivalent. Besides the risk of inspector rejection, using bulky Type W cable also raises the chance of overfilling cable trays, which can cause overheating and thermal runaway conditions.

For more information, please contact [CableTechSupport@southwire.com](mailto:CableTechSupport@southwire.com) or visit [Southwire.com](http://Southwire.com)



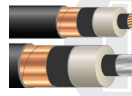
## 9. VARIABLE FREQUENCY DRIVES

Data centers often incorporate Variable Frequency Drives (VFDs) in their cooling systems to boost energy efficiency and performance. While VFDs offer significant operational advantages, they can also cause electrical disturbances, particularly, leakage currents to ground. These unintended currents can disrupt nearby sensitive communication systems, posing risks to reliability and signal integrity. To mitigate these disturbances, it is essential to utilize shielded VFD cables that meet relevant UL and ICEA standards. Proper installation, following the NEC and the cable manufacturer's guidelines, is crucial for safety and reliability.



## 10. FLEXIBLE TRAY CABLES UP TO 1KV

Tray cables are often chosen for data centers. The conductors can be made with Class K flexible stranded copper wires according to ASTM, B172, or B174. An 8 AWG conductor with 168 fine wire strands provides high flexibility and can greatly reduce labor time during installation compared to a standard 8 AWG conductor with only 19 strands. This Southwire product is very versatile, as it is multi-listed as TC-ER per UL-1277 for tray cables, UL-758 for AWM, and CSA C22.2 No. 239 for CIC. It is rated for operation up to 90°C in dry locations and supports up to 1000V AC or DC systems, which are increasingly needed for mission-critical projects.



## 11. EPR & TRXLPE INSULATED MV

MV-105 cables, according to UL-1072, can be made with either EPR for cable trays or TRXLPE insulation for conduits. Southwire has qualified both materials to meet the strictest industry standards, including ICEA S-93-639 and AEIC CS8. With data centers operating near 100% load, TRXLPE insulation is often preferred because of its lower dielectric losses compared to heavily filled EPR. TRXLPE MV products provide better energy efficiency, especially at the highest system voltage of 35 kV. Also, the 133% insulation level has become more popular, as its thicker wall reduces electrical stress compared to the 100% level, potentially increasing cable lifespan. Southwire's low-friction SIMpull® PVC jacket for MV-105 cables makes installation into trays or underground conduits easier.



## 12. ALL-IN-ONE CABLE REPAIR

Southwire's Re<sup>3</sup>™ Cable Repair Kit is compatible with most common cable types, including building wires, tray cables, and MV power cables. However, conductors, shields, or products with severe damage from extreme weather events, such as storms, fires, or floods, cannot be repaired. This all-in-one kit contains an abrasive strip, a wipe pack, one roll of primary repair tape, one roll of protective finishing tape, and detailed instructions. Available for same-day shipping, this eco-friendly solution helps repair minor surface damage on new cables, restoring their original integrity, and reducing waste.

