

**SYSTIMAX® Solutions**

## GigaSPEED® X10D F/UTP and S/FTP Cabling System

Earthing (Grounding) and Bonding Guidelines  
April 28, 2011

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# 1 Introduction

The earthing (grounding) and bonding of SYSTIMAX GigaSPEED X10D F/UTP and S/FTP cabling system in customer premises shall follow national and/or local electrical codes/standards if these codes/standards exist. Examples of these codes are NFPA 70/NEC (USA), BS 7671 (UK IEE Wiring Regulations) and VDE 0100 (Germany). Examples of these standards are ANSI/TIA-607-B, ANSI/TIA-568-C.) (USA), EN 50174-2 and EN 50310 (Europe) and IEC 60364-5-548 (International).

In this document, earthing is synonymous to grounding.

The IEC technical report TR 61000-5-2 and ANSI/TIA-607-B provide useful guidelines for the earthing and bonding of electrical and electronic systems and installations. This document is aimed at ensuring personnel safety and electromagnetic compatibility (EMC) among electrical and electronic equipment or systems.

This document outlines the earthing and bonding of SYSTIMAX GigaSPEED X10D F/UTP and S/FTP cabling system in customer premises in relation to safety, functional and electromagnetic performance and shall be used where specific national and/or local electrical codes/standards do not supersede.

The aim of the document is to achieve the following needs:

- Safety from electrical hazards
- Reliable signal reference within the network
- Satisfactory and/or enhanced electromagnetic performance for the network

## 2 Earthing and Bonding

It is important to remember that safety procedures for personnel protection will take precedence over EMC protection procedures. The primary goal of an earthing system is to assure personnel safety and protection of installations against damage. Two important phenomena are lightning and power system faults. These can cause circulation of large currents, which may create hazardous voltages in the installation. For lightning, the task of the earthing system is to provide a path to the soil for dangerous currents, while maintaining potential differences between any two points of an installation as low as possible. For power system faults, it provides a safe path for fault currents, while also maintaining potential differences between any two points of an installation as low as possible. Typically, fault currents will trip circuit breakers to remove power. Generally, national or local regulations specify maximum voltage values for personnel safety including provision for protective earth (PE) conductor practices.

The PE is a network of conductors that carry the currents related to safety to the main earth terminal. The main earth terminal is the point inside the building where all earth connections are gathered and where a physical connection to earth ground can be verified and assured.

However, these PE conductors alone are generally not sufficient to fulfill the EMC requirements. Low noise can only be achieved with the TN-S electrical distribution network. In a TN-S configuration, the neutral (N) and PE conductors are routed separately from the transformer or the feeding point and a continuous 5-conductor network L1/L2/L3/N/PE must exist in the building. The TN-S configuration is required for optimum EMC performance. With this, all power currents and voltages are normally isolated from the PE and from the rest of the earthing system in the building.

TR 61000-5-2 and ANSI/TIA-607-B specify additional earthing conductors and specific interconnection components and methods that augment the existing earthing system. This Telecommunications Earthing System provides an explicit earthing network that telecommunications installers can verify for personal safety and that minimizes interference from other building systems or equipment. Thus, a Telecommunications Earthing System allows telecommunications personnel to manage safety and performance in a way that is far less dependent on other building operations. Cable screens must be earthed to the Telecommunications Earthing System as outlined below.

Each telecommunications room of a building must have a connection point to the Telecommunications Earthing System to allow for bonding of equipment or systems, metallic cable baskets/trays, metallic water pipes, metallic floor tiles, racks, frames, etc. It is recommended to connect the various apparatus at the nearest connection point of this system in order to improve the EMC performance of an installation. These connection points should be sufficiently close to provide low impedance bonding. All earth connections should be kept as short and straight as possible to avoid creating a high impedance path.

# 3 Earthing of SYSTIMAX GigaSPEED X10D F/UTP and S/FTP Cabling System

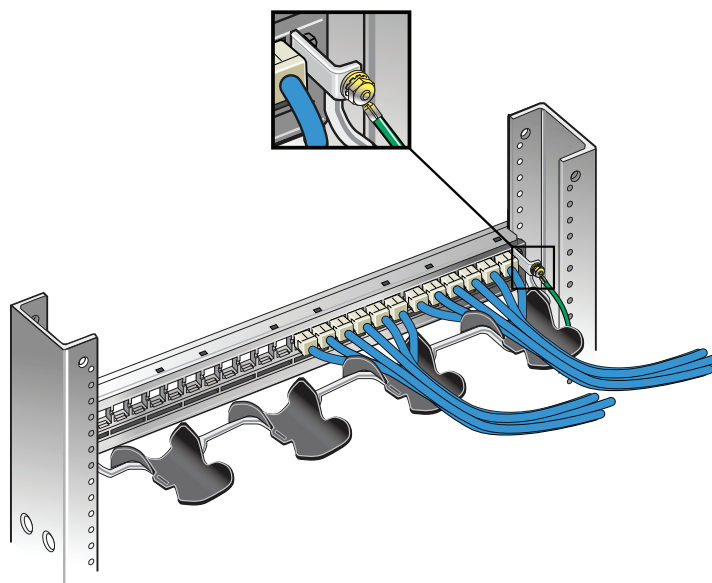
The SYSTIMAX GigaSPEED X10D F/UTP and S/FTP (shielded) cabling solution is an end-to-end system consisting of shielded cables, shielded cords, shielded outlet connectors and shielded patch panels. Table 1 provides a list of the various components. The cabling shall be installed according to the latest *SYSTIMAX X10D F/UTP Solution Design and Installation Guidelines*.

## SYSTIMAX GIGASPEED X10D FTP AND S/FTP COMPONENTS

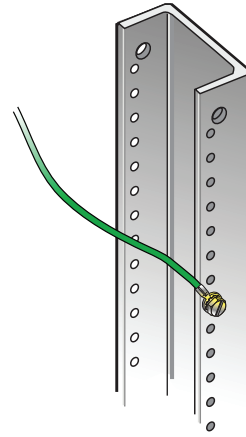
Cable	1291, 2291, 3291, 3297A, 3298A
Cord	G10FP
Connector	HGS620, MFP520
Patch Panel	360-IPR-MFTP-A-E-HD6B, 360-IPR-MFTP-E-HD6B, M3200

For SYSTIMAX GigaSPEED X10D shielded cable, the foil/braid and the drain wire (also referred to as a bonding conductor) are both conductive. A connection can be realised by folding the foil back over the outer sheath such that the metallic part of the foil makes contact with the metallic surface of the rear opening of the connector housing. This connection ensures high frequency performance. This must also be supported by connecting the drain wire to the appropriate contact of the connector. For the HGS620 connector, the drain wire shall be wrapped several times around the folded back foil, so that it comes in contact with the conductive springs of the cable end of the connector, per the HGS620 installation instructions. For the MFP520 connector, the drain wire shall be terminated into the bonding contact, per the MFP520 connector termination instructions. This ensures a direct connection through to the shielded plugs. The metal connector housing provides the bonding connection to the shielded patch panel. Earthing studs are available at the back of the shielded patch panels (See Figure 1).

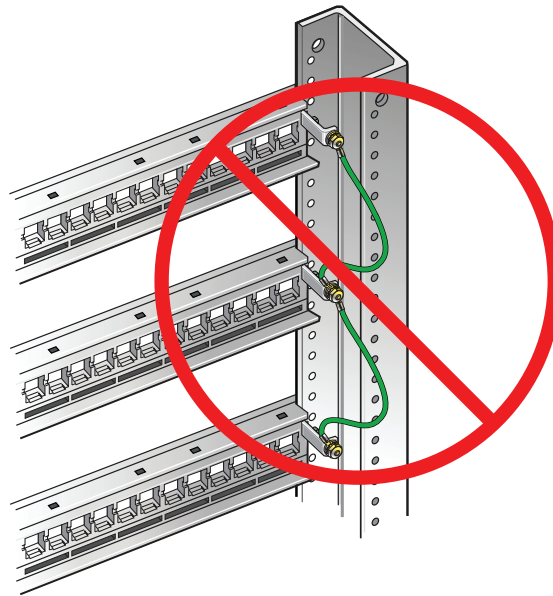
**Figure 1: Connecting the ground strap to the earthing stud on the back of the panel**



**Figure 2: Connection to ground strap to rail of frame using paint scraping washer**

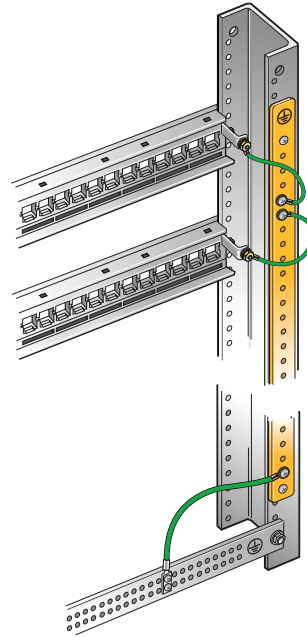


**Figure 3: Daisy chaining of ground straps is not allowed**



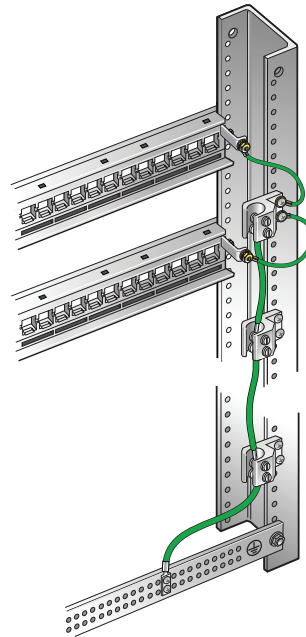
The individual panels must all be earthed. This may be accomplished by connecting a ground cable from the grounding stud of each individual panel to the rack. The minimum conductor size shall be AWG 12 or 4 mm<sup>2</sup>. The length of the bonding conductor should be as short as practical. For example, when bonding to the rack, the length should not be greater than 150 mm (6 inches). In the case of cabinets with a horizontal bus-bar at the bottom, the bonding conductor may be as long as 2 m (7 feet). Since the racks are generally painted with non-conductive paint, a paint scraping washer, must be used to ensure low impedance earthing contact. In some cases, and per European standards, the grounding of the cabinet rail may not be assumed, and one of the following methods should be used. The panels may be earthed by installing a ground cable from the panel earthing studs to a suitable vertical earthing bus-bar mounted within a cabinet/rack (figure 4) or to several earth terminal blocks mounted to the cabinet/rack vertical equipment mounting rail (Figure 5). The daisy-chaining of the panel grounding studs (figure 3) is not permitted. The earth terminal blocks shall be connected together using 14 mm<sup>2</sup> (6 AWG) insulated copper earth wires.

**Figure 4: Use of Vertical Grounding Bus-Bar**



Another method to ground the panels is the use of earthing terminals, with ground straps connected to each of the earthing terminals, and with the earthing terminals connected by a larger grounding strap to the telecommunications grounding bus-bar. See figure 5.

**Figure 5: Panels grounded to earthing terminals, then to the telecommunications grounding bus-bar**



All earth connections shall be crimped or screwed using components approved for the purpose.

The equipment cabinet/rack shall be earthed (see section 4.0).

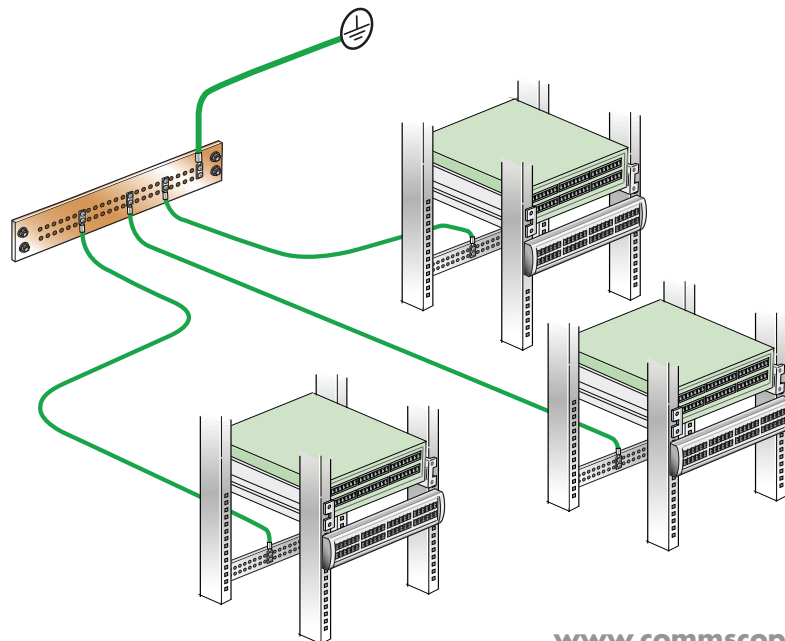
Earthing of equipment at the work area is usually accomplished through the PE conductor of the equipment power connection. If present, screen connections to the work area equipment shall be accomplished through the screen of the shielded work area patch cord extending from the TO to the equipment through the shielded modular jack contacts. Except when required by national/local code, the TO connector screen conductor should not be bonded to earth in the work area by any means other than through the screen of the shielded work area patch cord extending from the TO to equipment. In some countries it is recommended to ground the TO directly according to local code.

# 4 Earthing of Equipment Cabinet/Rack

The equipment cabinet/rack shall be earthed so that voltages that are induced into cabling (by lightning or other disturbances) are directed to earth (see Figure 6).

- Earthing shall be in accordance with applicable national or local electrical codes.
- The earth path shall be permanent and continuous.
- If multiple cabinets/racks are located within one area, a telecommunication earthing bus-bar shall be fitted within the area. This bus-bar shall be a predrilled copper bus-bar provided with holes for use with standard size lugs. It shall be at least 6 mm thick, 100 mm wide and variable in length. The length of the bus-bar shall be sufficient for the immediate requirements and have at least a 20% allowance for future growth. The bus-bar shall be isolated from its mounting point (a 50 mm separation is recommended) and a bonding connection made to the room's power service earth and the closest accessible building steel. If multiple cabinets/racks exist, each cabinet/rack shall be connected to the telecommunication earthing bar separately. This assures the continuity of the earth path from each cabinet/rack. Serial connection between cabinets/racks is not recommended. However, equipment vendors may require direct bonding between cabinets, but this must not be in place of the bus-bar connections.
- All the insulated earth wires shall be connected to the telecommunication earthing bar and must not be coiled or doubled-back on themselves. These wires shall have the following dimensions:
  - A minimum size of 25 mm<sup>2</sup> (3 AWG) for installations where no or a poor protective earth system exist (for example, in old buildings). The maximum length is 4 meters (13 ft). Larger size earth wires shall be used if the length is greater than 4 meters.
  - A minimum size of 14 mm<sup>2</sup> (6 AWG) for any other installations where a good protective earth system exist (for example, in buildings with a telecommunications earthing system). The maximum length is 4 meters (13 ft). Larger size earth wires shall be used if the length is greater than 4 meters.

If the telecommunication earthing bus-bar is located under a raised floor or above a false ceiling, an identification label shall be fixed to the floor or ceiling tile and to an adjacent wall to identify its position. The location of the telecommunication earthing bus-bar shall be such that it is accessible.



**Figure 6: Earthing and bonding of equipment cabinets and racks**

# 5 Operations Considerations

The grounding and bonding system should be maintained and monitored to ensure that it continues to provide good functional performance.

There are several evaluation methods, tools, and standards that may be used to understand and monitor this performance. CommScope recommends that these tools and methods be used to verify performance on a continual basis.

For example current probes may be used to measure the ground current in different bonding/earth conductors to gain insights into fault conditions as well as normal performance.

To ensure there are no ground loops, the voltage between any two points of a grounding system should not be greater than 1 V rms. For example, a measurement of greater than 1 V between the telecommunications outlet (TO) shield and the ground conductor of a power outlet in close proximity indicates that there is a problem with the grounding system that should be corrected.

A Residual End Operating Current (RCM) surveillance system may be deployed to continually monitor the current in the grounding system and generate alarms if the ground current exceeds the system threshold.

More information on grounding and bonding including operations considerations is available in EN 50310, EN 50174-2, IEC 60365-5-54, and ANSI/TIA-607-B.



## 6 References

EN 50310	Application of equipotential bonding and earthing in buildings with information technology equipment
EN 50174-2	Information Technology – Cabling installation – Part 2: Installation planning and practices inside buildings
IEC TR 61000-5-2	Installation and mitigation guidelines – Earthing and cabling
IEC 60364-4-41	Low-voltage electrical installations – Part 4-41: Protection for safety – Protection against electric shock
IEC 60364-5-54	Low-voltage electrical installations – Part 5-54: Selection and erection of electrical equipment – Earthing arrangements, protective conductors and protective bonding conductors
IEC 60364-4-444	Low-voltage electrical installations – Part 4-444: Protection for safety – Protection against voltage disturbances and electromagnetic disturbances
IEC 60364-5-548	Earthing arrangements and equipotential bonding for information technology installations
ANSI/TIA-607-B	Commercial building grounding and bonding requirements for Telecommunications
ANSI/TIA-568-C.0	Generic Telecommunications Cabling for Customer Premises
ETSI EN 300253	Environmental Engineering (EE); Earthing and bonding of telecommunication equipment in telecommunication centres



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