How to Select SPDs for Data, Signaling & Control Circuits

Knowing where to install surge protection can be difficult. To ensure cost-effective protection is provided for data, signaling and control circuits, two issues need to be considered:

- Where should the SPD(s) be installed?
- What type of SPD is appropriate for each circuit type and location?

Where should the SPD(s) be installed?

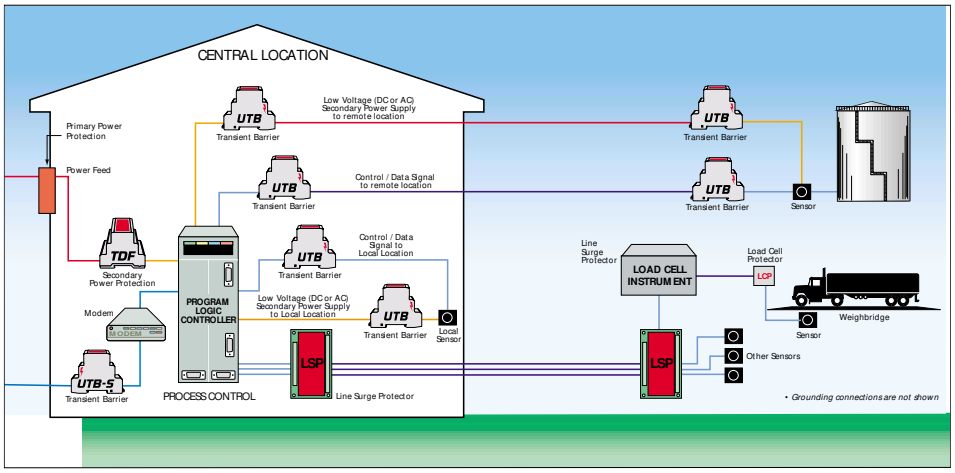
Communications devices are at risk from transients being induced onto the signal lines interconnecting these devices. The use of surge protection barriers, installed at either end of the lines, provides cost effective mitigation. The highest risk is posed by communication or signal lines that enter/exit the building. In such circumstances, protection devices should be installed at the point-of-entry or at the equipment termination itself. Internal wiring which extends more than 30-50' should also be protected. Twisting and/or shielding of cables provides a level of protection, however this should not be regarded as sufficient for the sensitive interfaces that characterize today's communication devices.

How to select an SPD for a given location

Five parameters must be considered to ensure that surge protection devices for use on data, signaling or control circuits are effective and do not adversely affect operation of the circuit.

1. SPDs are designed to clamp the excess transient voltage to safe levels sustainable by the equipment, yet should not interfere with the normal signaling voltages. As a guide, the **SPD clamping voltage** should be selected to be approximately 20% higher than the circuit's peak working voltage.
2. The **line current** rating of the SPD should be sufficient to handle the maximum expected signaling current.
3. The **SPD bandwidth** should be sufficient to allow correct operation of the system without adverse attenuation. This ensures that the attenuation of the SPD at the nominal operating frequency of the system does not exceed the stated limit. For most SPDs, frequency attenuation data or a maximum recommended baud rate is generally specified.
4. The connection termination, mounting method, number of lines to be protected and other **physical aspects** must be considered.
5. The SPD surge rating should be appropriate for the intended location. For circuits internal to the building, surge ratings of 1-5kA are generally sufficient. For the protection of circuits that connect to exposed lines entering/exiting the facility, 10-20kA is recommended.

Alternatively a **Protocol** or standard may be specified that defines the above parameters. As an example, the CRITEC DEP-RS232/9/9 is designed to protect circuits meeting the V.24 EIA-232 specifications. As items 1-3 are defined by the Standard the DEP-RS232/9/9 will work on any circuit employing the RS-233 signal protocol.



Common Protocols used in Process Control & Automation and Signaling applications

The blue CRITEC "Process Control and Automation, Surge Protection At a Glance" brochure (S253S) is designed to assist understanding the application of the different CRITEC data, signaling and control SPDs. It also gives the fundamental product selection criteria for any protection application, namely:
1) Peak working voltage
2) Maximum Line current
3) Frequency
4) Termination connection.

The document also mentions that protocols or industry standards are often used to describe the details of a signaling circuit. Where the protocol is known, this often eliminates the need to find out 1-3, and occasionally 4.

This document describes some common protocols and the appropriate SPD, or SPD series. As can be seen a number of different SPDs often meet the requirements defined by the protocol, so the final choice of which SPD to use may be based on the connection method or number of lines to protect.

Protocol/Standard	Description	Applicable SPD Series (1)
RS-232 (V.24)	Unbalanced, bi-directional communication circuit most commonly used between older PCs and printers/plotter. Also used in industrial applications for temporary low distance connections such as connection of PC to download program to a PLC etc (>50ft). Although this standard allows up to +/- 25V signaling, use of more than +/- 12V is very uncommon.	▪ **DEP-RS232** Series(3) ▪ **UTB-18**(2) ▪ **LSP10-18**(2)
RS-422 (V.11)	Industrial version of RS232 where balance signaling is used to allow transmission of signals a greater distance (4000ft). Only allows connection between two devices. 0-5V signaling used.	▪ **DEP-RS422/9/9** ▪ **UTB-9**(2) ▪ **LSP10-9**(2) ▪ **LAN RJ45**
RS-423	Similar to RS-232, but +/- 5V signaling used.	▪ **DEP-RS232** Series(3) ▪ **UTB-9**(2) ▪ **LSP10-9**(2) ▪ **LAN RJ45**
RS-449	Based on RS422 but with defined DB-25 connector.	▪ **DEP-RS232/25/25**
RS-485	Similar to RS-422 but this protocol allows multiple devices to communicate on the one circuit. For industrial applications this is the most popular RS protocol. Note that although this standard does not define the DB pin connections, a DB9 connection is most common. 0-5V signaling used.	▪ **DEP-RS422/9/9** ▪ **UTB-9**(2) ▪ **LSP10-9**(2)
RS-499	A RS232 system with defined 37 and 9 pin connector. The DEP-RS232/9/9 is used on circuits using the DB9 connector.	▪ **DEP-RS232/9/9**

Ethernet 10 Base T 100 Base T Cat 4 Cable Cat 5 Cable	Ethernet is the term used to describe a family of computer communication protocols. Within this family is ▪ 10 Base T, a 10MHz communication system using twisted pair or coaxial cables ▪ 100 Base T, a 100MHz communication system using twisted pair cables. Cable specification Cat 4 defines capability to allow up to 10 Base T operation, while Cat 5 cable allows up to 100 Base T operation. Note that many 10 Base T systems are operated on Cat 5 cabling systems.	10 Base T: ▪ For systems with RJ45 Connectors use the **LAN-RJ45.** ▪ For coaxial systems use the **LAN-TWL.** 100 Base T: ▪ Use **LAN-RJ45.**
Token Ring		▪ **LAN-BNC**
ArcNet		▪ **LAN-BNC**
CCTV	Closed Circuit TV signal	▪ **ECX06 BNCY** ▪ **LAN-BNC/75**
E1 T1 (2Mbit)	E1 is a high speed telephone signal (1.5Mbit) used to connect customer equipment to a telephone exchange T1 is the high speed connection (2Mbit) used for connection between telecommunication network equipment Although not common in the USA, where the Krone termination system is used the HSP10K-230V should be used for wet lines and the HSP10K-72V for dry lines.	▪ For "dry"(4) coaxial circuits use **DTI-1B.** ▪ For hardwired circuits refer Note (4).
Telephone Line		▪ **UTB-S, UTB-T** ▪ **SLP1-RJ11**

4-20mA	Connection to industrial transducers (Probably the most common industrial circuit type)	▪ **UTB-36**(2) ▪ **LPS10-36**(2)
0-20mA	Connection to industrial transducers	▪ **UTB-36**(2) ▪ **LPS10-36**(2)
0-10V	Connection to industrial transducers	▪ **UTB-18**(2) ▪ **LSP10-18**(2)
+/- 10V	Connection to industrial transducers	▪ **UTB-18**(2) ▪ **LPS10-18**(2)
0-20V	Connection to industrial transducers	▪ **UTB-36**(2) ▪ **LPS10-36**(2)
Strain gauge Load cells		▪ **LCP Series**
ControlNet	Common industrial PLC communication circuit	▪ **LAN-BNC**

(1) Some of these protocols do not define the actual connector or pin configuration, and in some cases not all lines as defined in the standard will be used, please refer to documentation for the circuit/equipment to be protected to ensure adequate protection is provided and that the SPD will not interfere with normal circuit operation.

(2) The quantity of UTBs/LSPs required will be dependant upon the number of wires being used in the signaling circuit:

- Each UTB will protect one pair of wires
- Each LSP will protect 5 balanced pairs or ten unbalanced pairs.

RS-485 and RS-422 are generally implemented in a two or four wire configuration (half and full duplex – i.e. one way and two way communication). The UTB-9 and LSP10-9 can be used with two wire systems, but care is needed when using LSP10-9 or 2 x UTB-9 for four wire systems. Due to internal capacitance differences between devices this may adversely affect communications.

(3) The DEP-RSxxx family has several products as both DB25 and DB9 (25 pin and 9 pin) connectors are used. For 25 pin connectors the DEP-RS232/25/9 provides protection to the most commonly used 9 pins (A RS-232 circuit can use as little as two wires, the DEP cut sheet details the actual pins protected). The DEP-RS232/25/25 should be used where the number of wires to be protected is unknown or where all wires are not protected by the standard DEP-RS232/25/9 product. For DB9 connectors the DEP-RS232/9/9 should be used for RS232 circuits – all pins are protected as standard. For RS422 or RS485 the DEP-RS422/9/9 should be used.

DEP Series	Connector	# Pins protected	Peak working voltage	Protocol
DEP-RS232/25/9	DB25 M/F	9	15V	RS232, RS423
DEP-RS232/25/25	DB25 M/F	25	15V	RS232, RS423, RS449
DEP-RS232/9/9	DB9 M/F	9	15V	RS232, RS423, RS499
DEP-RS422/9/9	DB9 M/F	9	9V	RS422, RS485

(4) There are two forms of T1/E1 Lines, "wet" and "dry". "Wet" lines are those that superimposed a power supply (40-160mA, typ 60V) to power remote repeaters. SPDs for "wet" lines must feature a higher working voltage rating. "Wet" lines are normally only found within the Telecommunication carriers network, while those lines at the customer connection point will normally be "dry".

For exposed "wet" lines the UTB-S is recommended. If UL Recognition is required the lower performance UTB-T should be used.

For exposed "dry" lines the UTB-18 is recommended. For low exposure applications the RJ45 connected LAN RJ45 can be used. If UL Recognition is required the lower performance UTB-T should be used.

T1/E1 Lines comprise of a separate TX and RX pair, thus where UTBs are to be use 2 units will be required for each "circuit".