

# T1/E1 Equipment

## Application Overview

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### Problem/Solution

T1/E1 is a digital transmission link with a capacity of 1.544/2.048 Mbps. T1/E1 systems use two copper pairs and are used extensively for connecting networks across remote distances. Line repeaters are required approximately every 6,000 feet to boost signals and maintain signal integrity. Figure 1 depicts the T1/E1 system architecture. The line regenerators may be powered from the central office.

Since T1/E1 equipment connects to the copper infrastructure of the Public Switched Telephone Network (PSTN), it is subject to overcurrent and overvoltage hazards from AC power cross, power induction, and lightning surges. PolySwitch resettable devices and SiBar thyristors provide coordinated resettable protection against these faults, thereby protecting equipment from damage and minimizing field service and warranty costs.

### Typical Protection Requirements

Loop powering is generally done with a phantom powering scheme, applying +130V on the transmit pair and -130V on the receive pair. Some systems may be powered at up to  $\pm 150V$ . Loop currents in the range of 60mA-140mA are common. Signal levels on the transmit pair (TX) are typically between 2.4V and 3.6V and up to 12V on the receive (RX) pair due to standing waves.

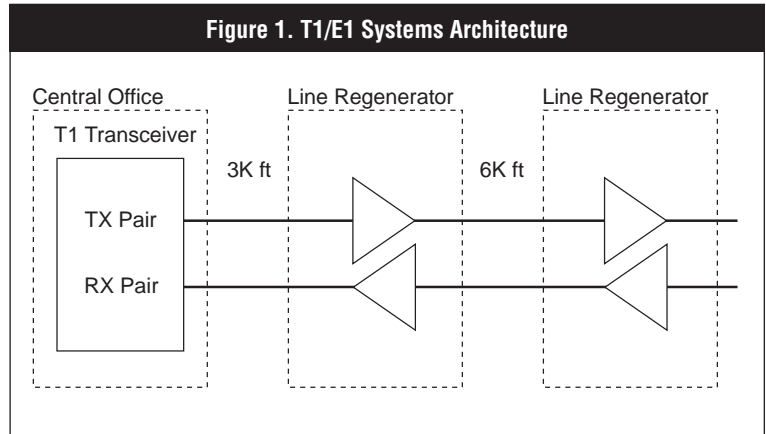


Figure 1. T1/E1 Systems Architecture

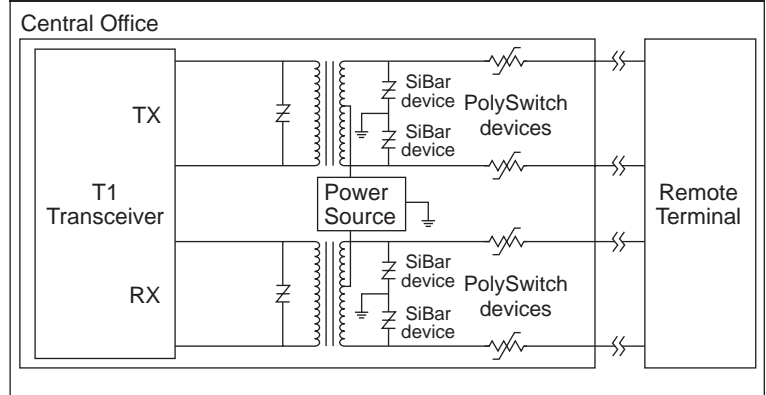
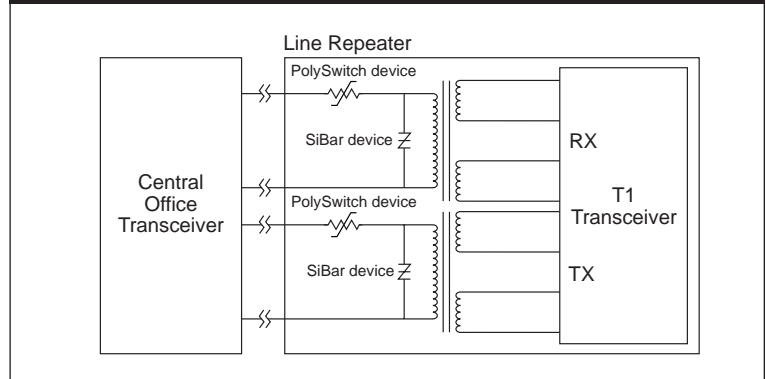


Figure 2. T1/E1 Central Office Transceiver Protection



At the central office (CO), the equipment is grounded, therefore longitudinal protection is required. See Figure 2 for recommended protection circuitry. At the line repeaters the equipment is generally ungrounded, therefore only metallic protection is needed. See Figure 3 for recommended protection circuitry.

### Device Selection for Agency Approval Requirements

Protection for telecommunications network equipment is typically designed to meet the requirements of Telcordia GR-1089 for North America installations and of ITU-T K.20 for installations in the rest of the world. Protection for customer

premise equipment is typically designed to meet the requirements of UL60950 and TIA-968-A for North American use and of ITU-T K.21 for rest-of-world use. Overviews of the requirements for each of these standards can be found as separate application notes in this Databook.

PolySwitch devices should be selected with voltage ratings based on the regulatory standards for which the equipment is being designed. Surface-mount TS600, TSM600, and radial-lead TR600 devices are applicable for North American GR-1089 standards and for UL60950 standards, while surface-mount TS250 and TSV250 and radial-lead

TR250 devices are applicable for ITU-T K.20/21 standards as well as for Telcordia GR-1089 intrabuilding level protection.

SiBar TVB170SA and TVB170SC, and TVB270SB devices with off-state voltage ( $V_{DM}$ ) ratings of 170V are applicable for T1/E1 systems with loop powering up to 150V. For systems with higher expected voltages, designers should consult Section 4 for higher rated devices.

Tables 1 and 2 provide recommended PolySwitch and SiBar devices for T1/E1 applications.

**Table 1. Recommended Circuit Protection Devices for T1/E1 Central Office Transceivers**

Regulatory Standard	PolySwitch Device	SiBar Device
Telcordia GR-1089	TSM600-250	
	TS600-200-RA-B-0.5 (SMT)	TVB170SB
	TR600-160 (Thru-hole)	
	TR600-160-RA-B-0.5 (Thru-hole)	
UL1459/UL60950, TIA-968-A	TS600-170 (SMT)	TVB170SA (ungrounded)
	TRF600-150 (Thru-hole)	TVB170SB (grounded)
	TR600-160-RA (Thru-hole)	
ITU-T K.20/21, Telcordia GR-1089 Intrabuilding/Short-haul	TS250-130 (SMT)	TVB170SA
	TSV250-130 (SMT)	
	TR250-145 (Thru-hole)	
	TRF250-180 (Thru-hole)	

**Table 2. Recommended Circuit Protection Devices for T1/E1 Line Repeaters**

Regulatory Standard	PolySwitch Device	SiBar Device
Telcordia GR-1089	TSM600-250 (SMT)	TVB170SC (grounded)
	TS600-200-RA (SMT)	TVB170SB
	TR600-160 (Thru-hole)	
	TR600-160-RA (Thru-hole)	
UL1459/UL60950, TIA-968-A	TSM600-250 (SMT)	TVB170SC (grounded)
	TS600-170 (SMT)	TVB170SA (ungrounded)
	TRF600-150 (Thru-hole)	TVB170SB (grounded)
	TR600-160-RA (Thru-hole)	
ITU-T K.20/21, Telcordia GR-1089 Intrabuilding/Short-haul	TS250-130 (SMT)	TVB170SA (grounded)
	TSV250-130 (SMT)	
	TR250-145 (Thru-hole)	
	TRF250-180 (Thru-hole)	