

Typical Installation Guide

Introduction

The electricity industry is evolving. This includes: changes to standards and best practices including the adoption of technologies defined in IEC 61850; the impetus to build smarter, environmentally-friendly and more secure electricity networks as described under the Smart Grid Initiative; and the need for more accurate time synchronization for use in real-time monitoring, frequency stability, fault detection and protection schemes.

This document outlines some of the most typical examples of Tekron devices providing isolation, noise immunity, and expandability of substation time synchronization architecture.

Electrical Isolation

In power stations and electrical substations time synchronization sub-systems, electrical isolation is required to avoid the formation of ground loops and protect against transients during normal and fault operating conditions.

Isolation is recommended between:

1. Time sync generator to the equipment being synchronized
2. Primary and secondary protection schemes
3. Bays and panels of equipment

Providing isolation in copper-based time sync architecture

Tekron clocks and Isolated Timing Repeater products have been designed for 2.5kV electrical isolation. The TCG 01-E GPS clock (shown in the following diagrams) has built-in isolation on all outputs for isolation between the device and any of the equipment being synchronised. Isolated Timing Repeaters provide isolation between equipment being time synced by a single multi-drop cable from the TCG 01-E.

Providing isolation through fiber-based time sync architecture

The Isolated Timing Repeater also comes in an ST fiber optic version that allows “daisy-chaining” of the time synchronization signals via multimode fiber. It therefore becomes practical to implement a fiber-based time synchronization architecture catering for a wide variety of Intelligent Electronic Devices (IED's) requiring time synchronization signals at the various voltage levels they require.

Noise Immunity

Power stations and electrical substations are filled with Electromagnetic Interference (EMI) and transients. Signal lines referenced to ground can be corrupted due to these conditions.

Tekron clocks and Isolated Timing Repeater products are designed with balanced inputs and outputs which allow the use of twisted pair cabling to distribute time synchronization signals, and provide excellent noise immunity from induced voltages in the noisy substation environment.

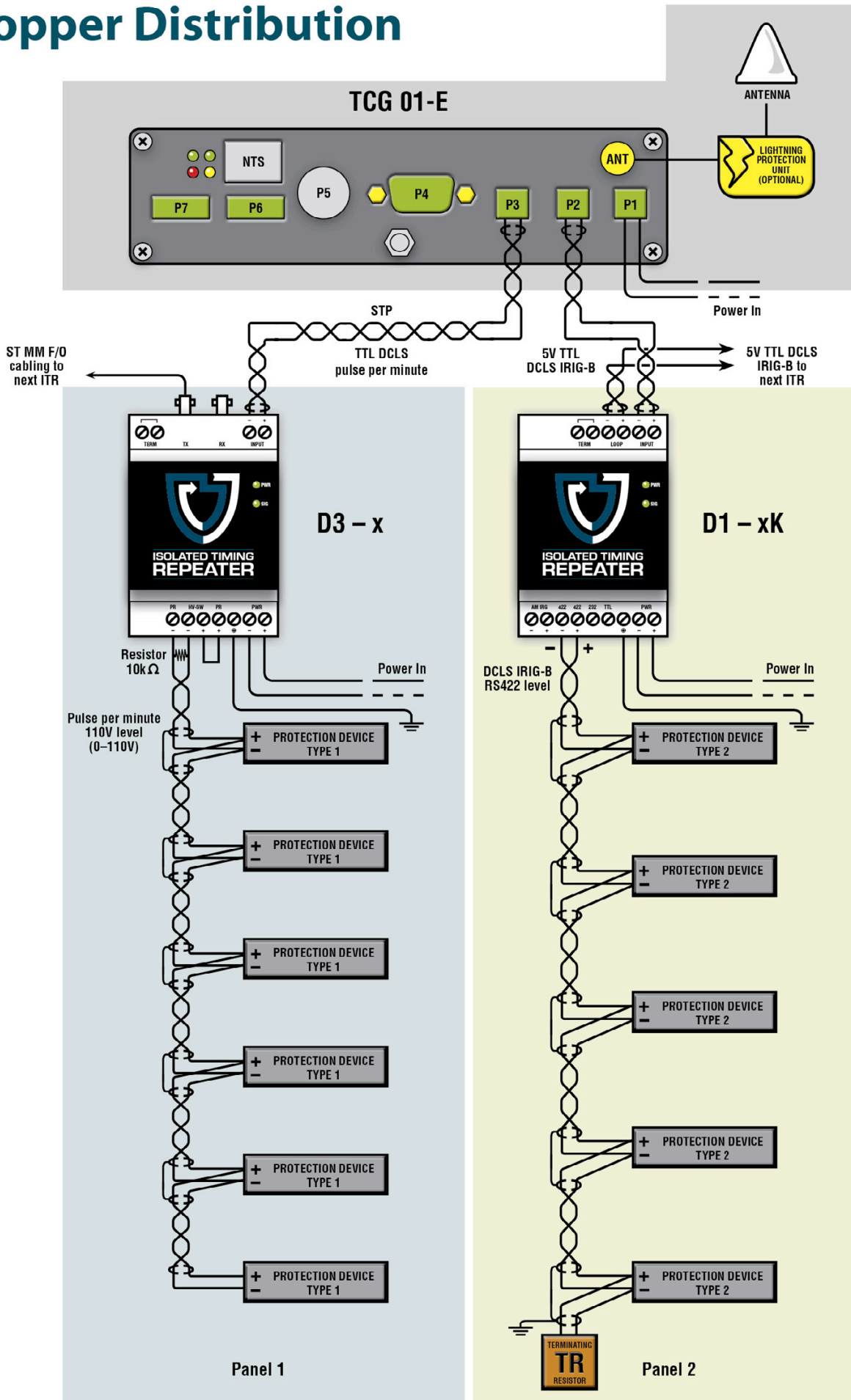


Check the Installation and Safety section at the end of the guide for power and grounding notes.

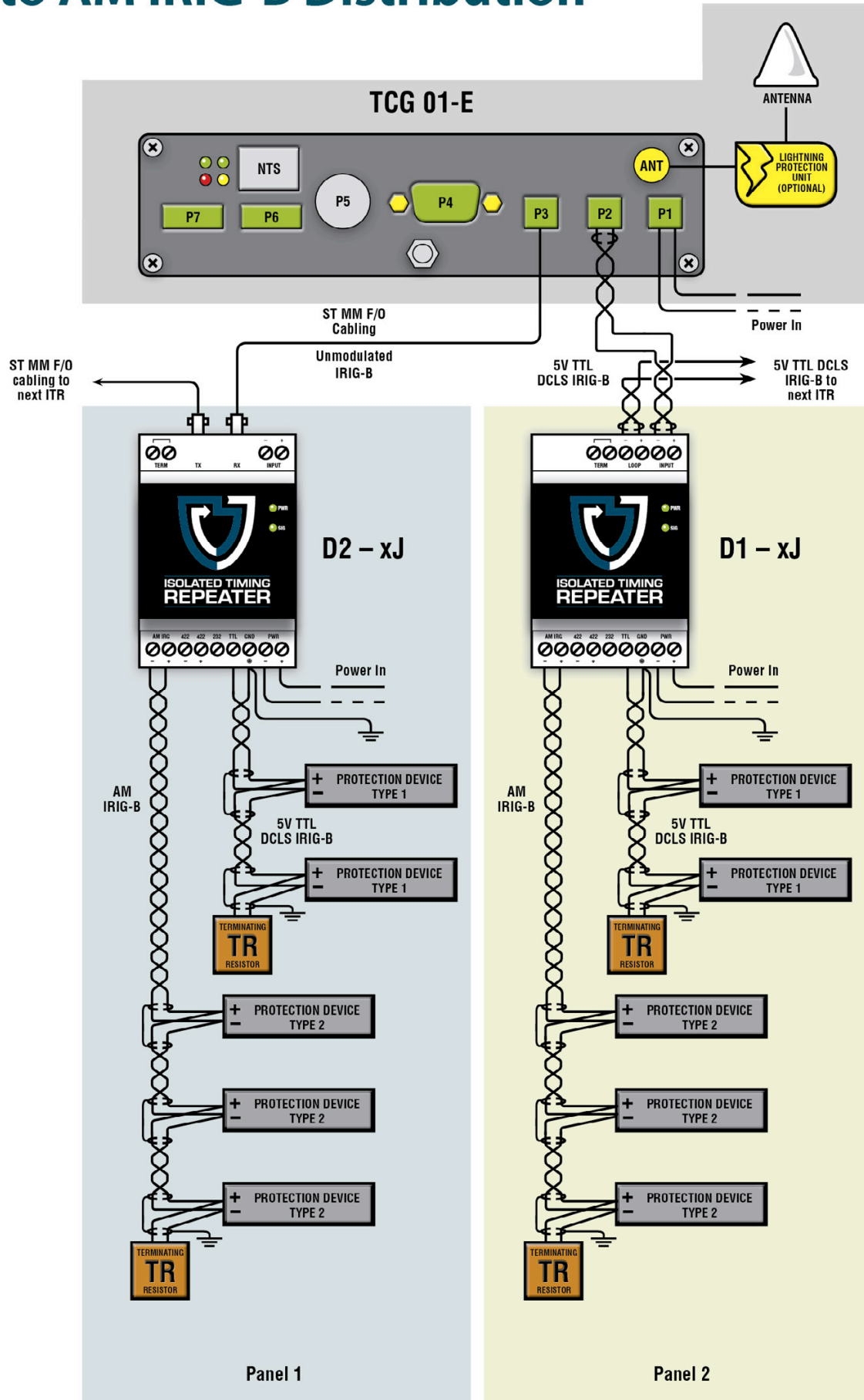
Abbreviations:

DCLS – Direct Current Level Shift
 EMI – Electromagnetic Interference
 IED – Intelligent Electronic Device
 IRIG – Inter-Range Instrumentation Group
 ITR – Isolated Timing Repeater
 ST MM F/O – Straight Tip Multi-Mode Fiber Output
 STP – Shielded Twisted Pair
 TR – Terminating Resistor
 TTL – Transistor-Transistor Logic

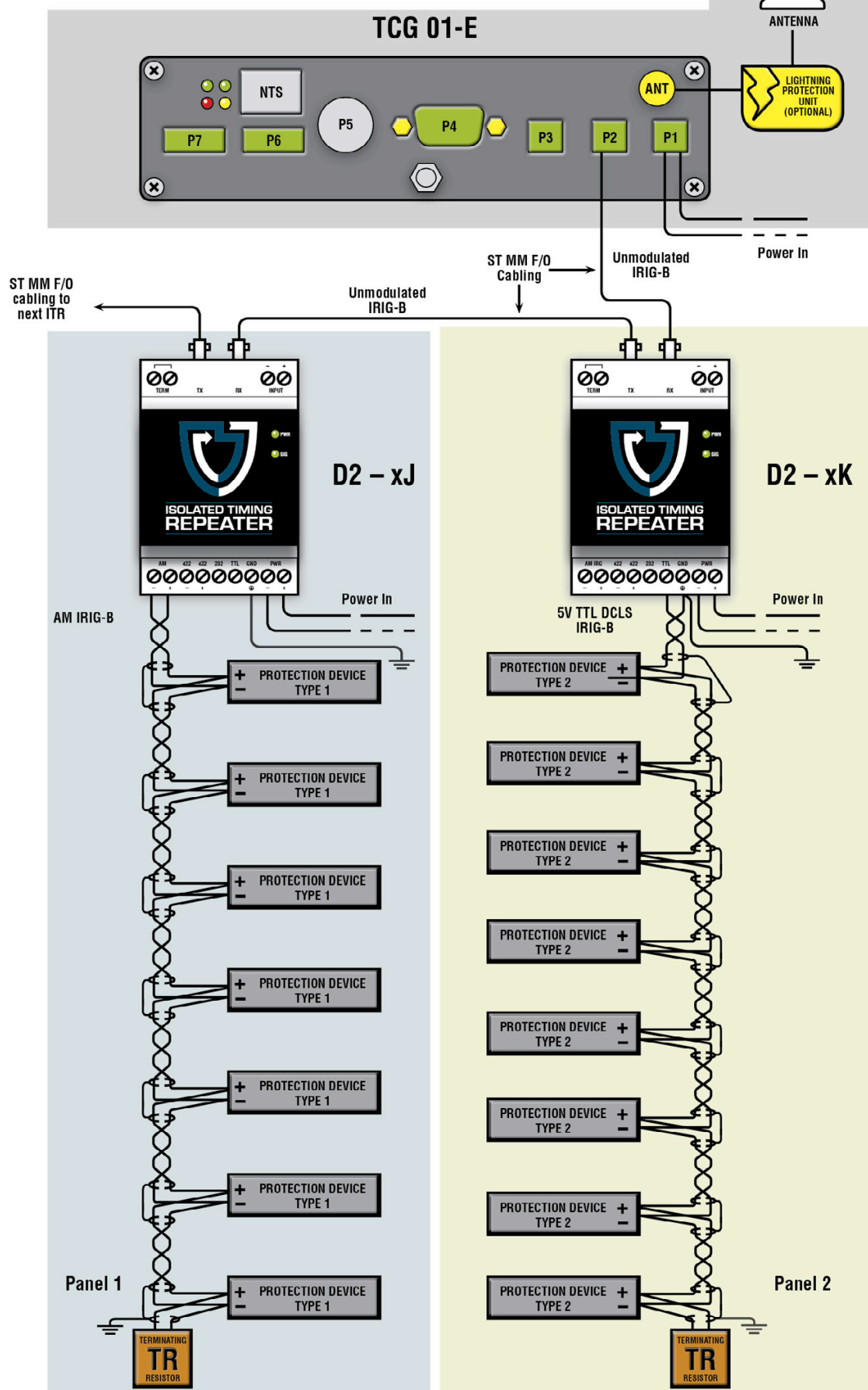
Copper Distribution



DC to AM IRIG-B Distribution



Fiber Distribution



Installation and Safety Notes

Connecting the DC power supply:

1. IMPORTANT: Always follow the operating voltage range displayed on the side of the case before applying power to the device.
2. The Isolated Timing Repeater (ITR) does not contain an internal fuse. An external fuse (2A) must always be used when connecting the device to a DC power source.
3. Because the ITR does not include a power switch, install a circuit disconnect in series with the DC power input.
4. Use 14 AWG /1.5 mm² wire (minimum) for a DC power source connection, and ensure that the screw terminals are tightened.
5. The DC power supply in the ITR is DC isolated.
6. The DC power inputs are polarity protected, therefore, the power supply cables are interchangeable.

Connecting the grounding terminal

The ground terminal enables a secure connection from the ITR to a reliable earthing point.



How to calculate load on the terminating resistor using STP cabling:

Assuming use of STP cable with minimal resistance:

AM IRIG-B Circuit		TTL DCLS IRIG-B Circuit	
Calculate load:	$R_L = \left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_n} \right)^{-1}$		$I_L = I_1 + I_2 + I_3 + I_n + \left(\frac{V_s}{R_{term}} \right)$
Calculate resistor:	$R_{term} = \left(\left[\frac{R_s \times V_{req}}{V_{out} - V_{req}} \right]^{-1} - (R_L)^{-1} \right)^{-1}$		I_L must not exceed I_s
Where:	V_{req} = Is the minimum required voltage of the IED V_{out} = Is the AM IRIG-B source Voltage R_s = Is the output impedance of the AM IRIG-B source R_L = Is the total load R_{term} = Is the required terminating resistor value		V_s = TTL DCLS IRIG-B source output voltage (V) I_s = TTL DCLS IRIG-B source output current (A) I_L = Is the total load (A) R_{term} = Terminating resistor (Ω) NB: R_{term} is based on cable impedance characteristic which is usually 120 or 150 Ohms or greater for STP