

Highway Protection Unit

090605

Revision 1.05

Contents

REVISION HISTORY	2
OVERVIEW	3
FEATURES	3
PROTECTION LAYERS	3
Spark-Gaps	3
Resettable Fuses.....	3
Transient Voltage Suppressers	3
Earth <> Common Coupling.....	3
TERMINATION	4
CONNECTIONS	4
Pinout	4
J1 – Network.....	4
J2 – Protected RS485 Module(s)	4
Earthing	4
Data Lines	4
Figure 1 - EIA-485 Waveform	4
SPECIFICATION	5
Caveats	5
Environmental	5
Electrical	5
Per Line	5
Per Line to Common	5
Per Line/Common to Earth.....	5
Common to Earth	5
Mechanical	5
Construction	5
Dimensions.....	5
Weight	5
VISUALISATION	6
Figure 2 – TSU Module	6
Figure 3 - Rear View – Similar Item.....	6
PRICE	6

Revision History

- 1.01 - 090418 Draft
- 1.02 - 090425 Various corrections/additions – Specification
- 1.03 - 090507 Name change and CAD view added
- 1.04 - 090508 Corrected Dimensions
- 1.05 – 090605 Added photo of assembled PCB, removed interim CAD view

Overview

EIA-485, (formerly RS485), transmission lines use differential balanced line over twisted pair and it can span relatively large distances (up to 4000 feet or just over 1200 metres). However, they are susceptible to damage from lightning strikes; across a typical site, voltages in the order of a thousand volts can be developed across the ground resistance. This effect can cause the demise of equipment that is wired between such points. Cabling within a building, or inter-cubicle, will not require this consideration.

Two-wire, (half-duplex), EIA-485 slave devices often use an isolated driver, rated for ~1500V isolation. Since it is easy to foresee voltages exceeding this level, damage is likely to occur in the isolating transformer, via the inter-winding capacitance. The isolation is to obviate ground loops, but it is not able to afford the required level of protection under surge conditions.

The following passive module was developed to counter the problem, by placing a multi-layered protection barrier at the point at which the cabling leaves the building. Allowing surge voltages to reach a slave device would be too late to prevent damage, so there is little point in placing protection on the vulnerable slave unit itself. EIA-485 slaves may be interconnected in a specific building and only require one unit to protect the cluster.

The concept of a protection barrier that is ultimately sacrificial is presented. In a worst-case scenario, the card can be destroyed; this is preferable to compromising the entire network.

Features

- Lightning Protection for Low Voltage Data Signal Lines
- Three-Stage Protection
- Sneak/Fault Current Protection
- Resettable Solid-State Fuses - PTCs
- Low Capacitance for High Speed Data
- Fast Response Time

Protection Layers

Three-stage protection is afforded by both series and shunt methods.

Spark-Gaps

The first level of defence uses spark gaps to bypass voltages in excess of ~100V. Once triggered, these provide a very low impedance to the incoming surge.

Resettable Fuses

Positive Temperature Coefficient, (PTC), Fuses in each line are tripped by the current flowing in the following Tranzorb/TVS section. The excessive current may result from the Spak-Gap's clamping voltage, or from sneak and fault currents. Once tripped and with the source removed, one minute must be allowed for the devices to cool and regain their low impedance state. The PTCs increase their resistance by several orders of magnitude when over currents exceed safe levels. A normal state resumes when over currents are removed. The ability to self-restore in this manner significantly increases suppresser performance and survivability.

Transient Voltage Suppressers

Tranzorb/TVS diodes are used to clamp the respective lines to safe voltage levels. Significant current flowing through these devices will cause the above fuses to rupture. Steering diodes isolate the signal lines from the TVS' ~10nF capacitance.

Earth <> Common Coupling

To prevent an otherwise floating network from adopting large static, or common-mode voltages, the protector provides a defined leakage path for dc and a coupling capacitor for ac.

Termination

An EIA-5485 multi-drop network will consist of a series of point-to-point wired nodes, connected as a line or bus. A termination resistor, usually 120R, should be connected on the last and first connections to the bus. This will reduce reflections and provide a lower impedance to disruptive noise.

Connections

This unit is suitable for a two-wire, half-duplex, EIA-485 configuration; a four-wire, full-duplex system can use two Protectors.

Two Cage-Clamp™ connector blocks are provided, the four-way is the network-side and the three-way connects to the Slave(s).

Pinout

J1 – Network

- 1 C
- 2 B
- 3 A
- 4 Earth

J2 – Protected RS485 Module(s)

- 1 C`
- 2 B`
- 3 A`

Earthing

The Highway Protector requires a solid earth connection, which transiently, can return hundreds of Amps. This is the path used to divert lightning-induced pulses. J1-4 **must** be attached to a building approved ground.

Data Lines

Data lines are denoted by the letters 'A' & 'B'; the B line is positive (compared to 'A') when the line is idle (i.e., data is 1). In addition to the 'A' and 'B' connections, the EIA standard also specifies a third interconnection point called 'C', which is the common signal reference ground.

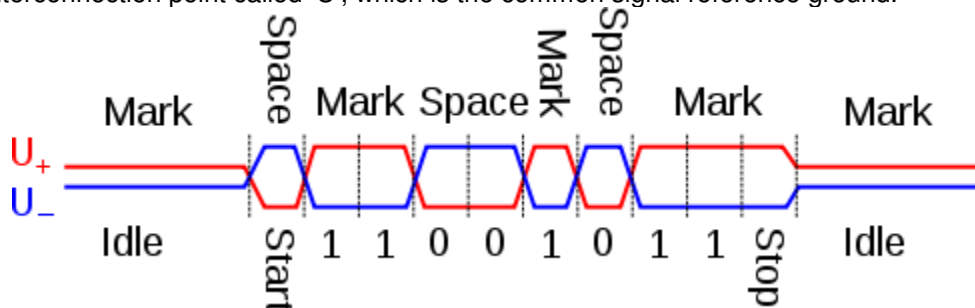


Figure 1 - EIA-485 Waveform

The EIA-485 signalling specification states that signal 'A' is the inverting or '-' pin and signal 'B' is the non-inverting or '+' pin.

Specification

Caveats

- Do not place this product in service on any signal line capable of supplying more than 100mA continuously.
- The Highway Protection Units are intended for indoor use on communication loop circuits that have been isolated from the Public Switch Telephone Network.

Environmental

Operating/Storage Temperature: 40 °C to +80 °C

Electrical

Per Line

Maximum Continuous Current: 100mA
Resistance, PTC: 5-8Ohms

Per Line to Common

TVS Peak Pulse Power: 1500W for 1ms
Capacitance: <30pF
Voltage Clamp Range: -7 to +12V
Peak Surge Current:

Per Line/Common to Earth

Surge Arrester Type: Non radioactive
DC Spark-over: 90V +/-20%
Impulse Spark-over: <500V @ 100 V/μs; <600V @ 1kV/μs
Impulse Discharge Current: 5kA (8/20μs wave)
Surge Lifetime: >100 occurrences (2kA, 8/20μs waves)

Common to Earth

Resistance: 1MΩ
Capacitance: 1nF

Mechanical

Construction

The unit is built on a small footprint FR4 Double-Sided, Plated-Through Hole Printed Circuit Board. Substantial copper tracks are employed for both heat transfer and the high potential currents.

Dimensions

Length x Width x Height: 90 x 50 x 20mm

Weight

<40g

Mounting

Four corner-located, M3-clearance mounting holes are provided. These are electrically connected to the Earth terminal of the module.

A suitable dove-grey painted mounting box is: RS #517-3866

<http://uk.rs-online.com/web/search/searchBrowseAction.html?method=getProduct&R=5173866>

Overall Size: 114 x 64 x 30mm

Visualisation

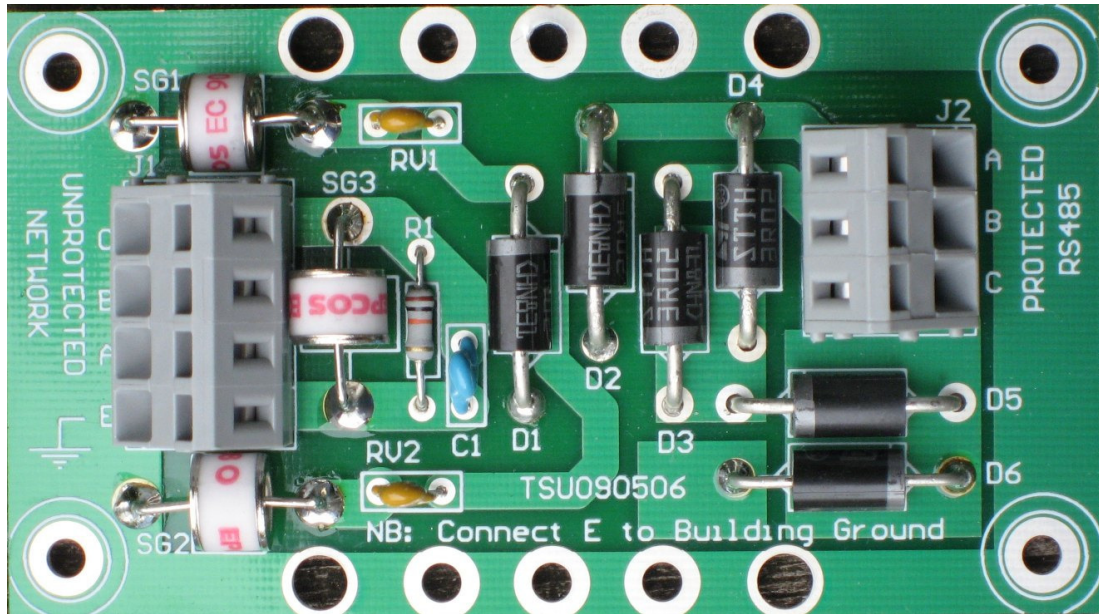
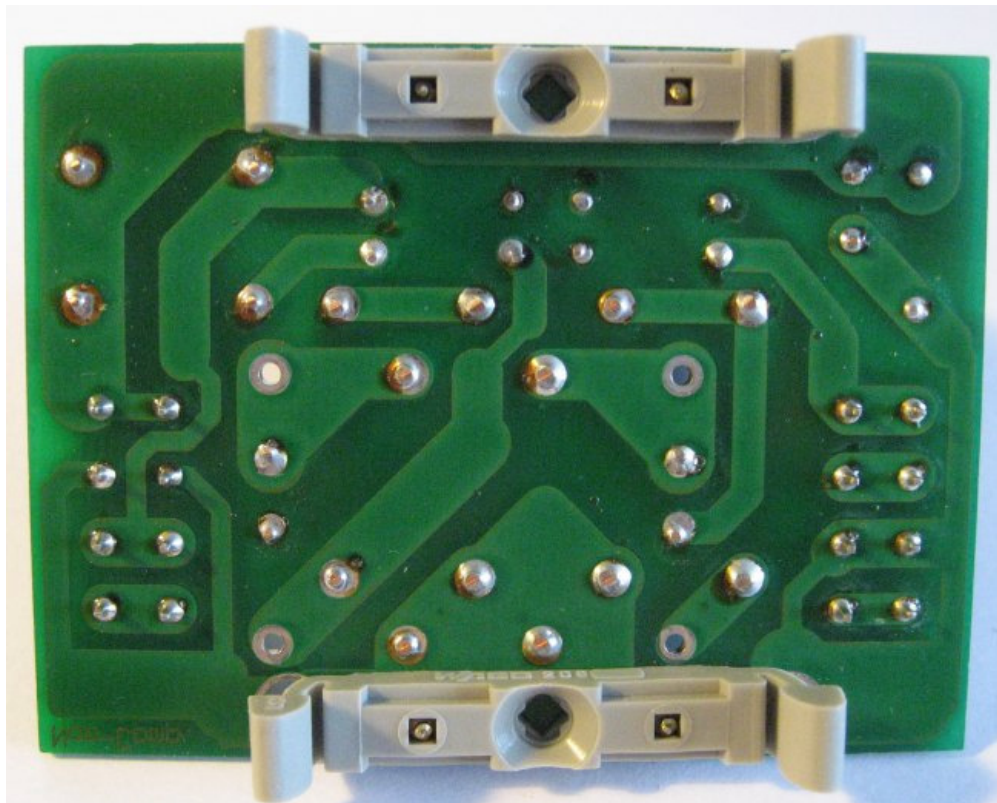


Figure 2 – TSU Module

Figure 3 - Rear View – Similar Item



Price

£50 each, in 100+ quantities.