

## TRANSIENT THREATS

Lightning, switching and electromagnetic pulses (EMP) induce transient voltages which may damage electronic equipment. Equipments connected to open power lines, unshielded data or

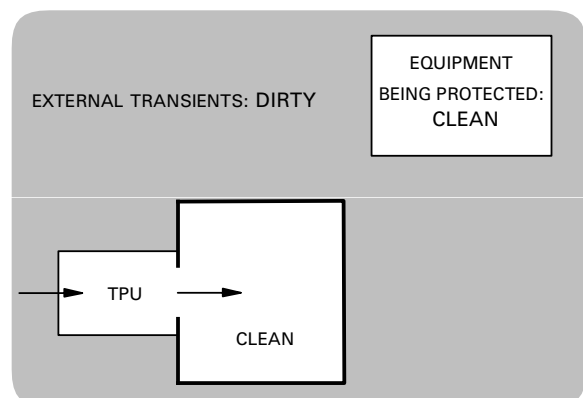
control lines and antennae are all vulnerable to transient voltages. E2V Technologies' range of Transient Protection Units (TPUs) provide the optimum protection for your equipment.



## PRINCIPLES OF PROTECTION

Equipments to be protected from transients are best contained within a metal enclosure which provides a **clean** environment from which transients are excluded.

Ideally, transient protectors are sited on the enclosure wherever power cables, data/control lines or antenna cables enter or leave.

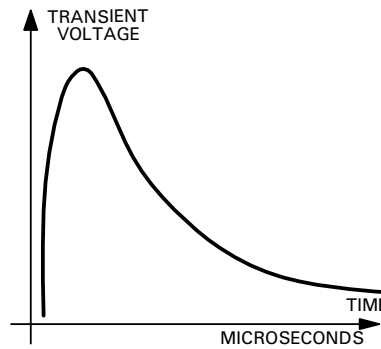


## TYPICAL TRANSIENTS

Transients induced in open power, data/communication, control lines or in antennae are typically of the form shown here; a fast rising voltage 'spike' followed by a slowly decaying 'tail'. The magnitude and duration of the pulse depends upon the source of the transient and the length and impedance of the line or antenna.

High voltage transients can cause insulation breakdown of devices within the equipment. In the case of semiconductors this can result in permanent damage.

It should be noted that all induced transients corrupt the information or signal. Transient protectors can only prevent damage to the equipment; loss of signal during the transient is unavoidable.



## E2V TECHNOLOGIES TRANSIENT PROTECTION UNITS

All E2V Technologies TPUs employ a fast acting spark gap in combination with other circuit elements to provide:

- **High impedance** in non-operating condition to minimise the effect on the normal operation of the equipment;
- **Fast switch-on** quickly shunting the transient away from the equipment being protected;
- **Fast recovery** quickly returning the equipment to normal operation and so minimising data loss.

The spark gap is specified to be capable of handling the transient pulse energy repeatedly without degradation, thus ensuring long life protection for the equipment. The additional circuit elements assist in the operation of the TPU as outlined in the following descriptions.

## MAINS POWER PROTECTORS

### Description

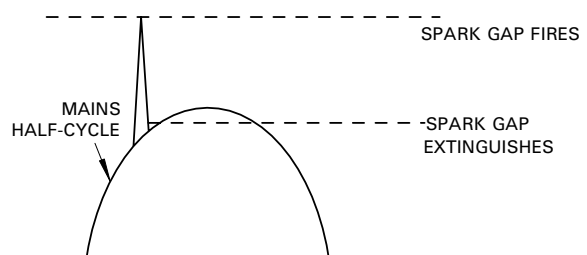
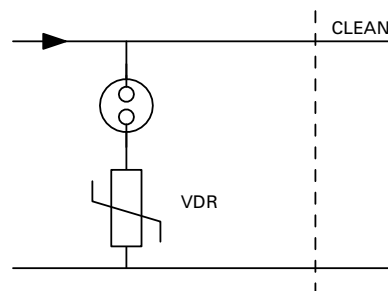
Mains power protectors employ a combination of spark gaps and Voltage Dependent Resistors (VDRs).

The spark gap fires at the start of the transient pulse whilst the VDR prevents power follow-through after the passage of the transient. The spark gap inhibits passive leakage problems which occur with VDRs alone, causing degradation of protection.

E2V Technologies Mains Power Protectors are specified for line voltages of up to 280 V<sub>rms</sub> (440 V line-to-line, 3-phase).

TPU31 and TPU4 are for protection of individual AC lines.

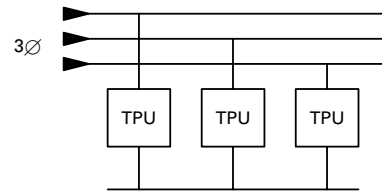
TPU3/1 and TPU3/3 incorporate more than one line protector within a single enclosure.



## Typical 3-phase applications

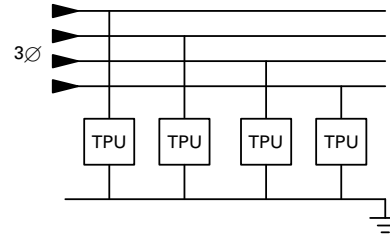
### 1. Common Delta Configuration

Typically used for grounded Neutral systems.



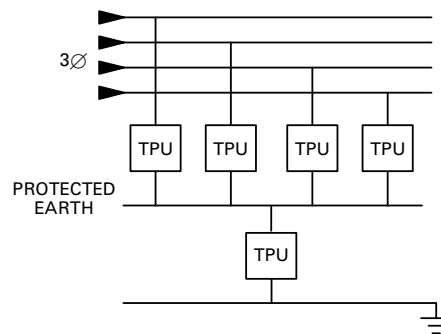
### 2. Three-Phase and Neutral

Typically used for floating Neutral systems.



### 3. Protected Earth Systems

Typically used on mobile installations such as shelters where the 'Protected Earth' can float from the external ground.



## Let-through performance

Performance is specified in terms of a maximum output voltage for a given input rate of rise. The TPU3 series has a specified output of 3.0 kV max for a 2.3 kV/ns input rate of rise, and the TPU4 an output of 2.5 kV max at 1 kV/ns. The transient energy transmission factor, which defines the proportion of incident energy which is transmitted through the TPU, is less than 2%.

## Mains filtering

Further protection can be provided by the use of filtering circuits integrated with the TPU. These, combined in a single enclosure, ensure that optimum protection is provided. Where it is impracticable to integrate the filter with the TPU, stand-alone mains filters can be used.



## SUPPLY LINE/CONTROL LINE PROTECTORS

### Description

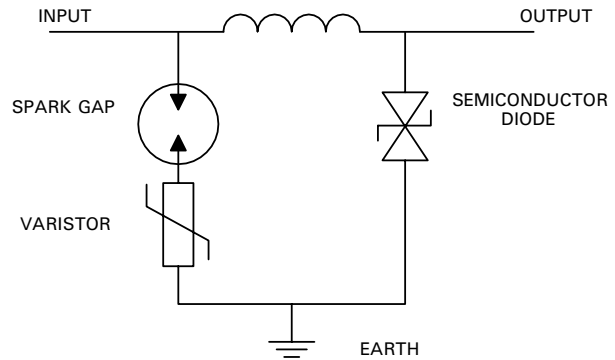
These are single-line hybrid transient protection devices designed for protection of control lines and low current supply lines. The units normally consist of a high speed spark gap, voltage dependent resistor and semiconductor second stage. Maximum line current is 6 A rms

These TPUs are supplied in three breakdown voltage ranges tailored to your circuits' needs. Devices can be used on AC or DC lines.

**Note:** TPU7P voltage ratings are expressed as rms values e.g. TPU7P/250 is for operation on 250 V<sub>rms</sub>, but would be satisfactory for a direct voltage line of 350 V (250 x √2).

### Let-through performance

Performance is specified in terms of an output voltage at a given input rate of rise. The output voltage for a 1 kV/ns input rate of rise is a maximum of 1.5 kV. The transient energy transmission factor is less than 10%.



### Multiple protection units

These single-line devices can be packaged to give multiple line units as required. A multiway unit would have a separate inner box to provide a 'dirty' input compartment and a 'clean' output compartment. Re-radiation of the transient cannot then occur between input and output.

## COMMUNICATIONS/DATA LINE PROTECTORS

### Description

The TPU7 and TPU7A devices are single-line hybrid transient protection units consisting of a high speed spark gap and a semiconductor second stage to provide maximum protection. The TPU7A incorporates a π filter network to limit still further the transient let-through.

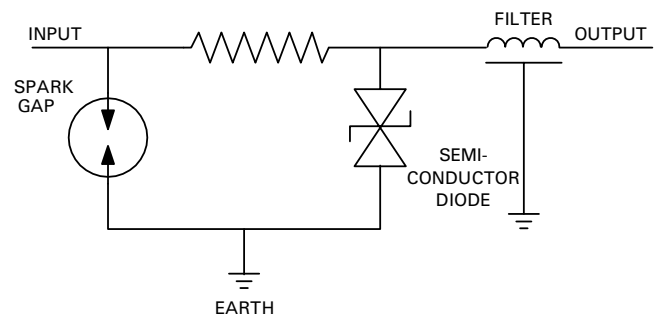
A range of TPU7 and TPU7A devices can be supplied with breakdown voltages between 7.5 V and 200 V.

**Note:** Voltage ratings for these devices are expressed as DC values.

### Let-through performance

Performance is specified in terms of an output voltage at a given input rate of rise. The output voltage depends upon the device working voltage and at an input rate of rise of 2 kV/ns is as follows:

TPU7/7.5 - 150	. . . . .	250 V
TPU7/151 - 200	. . . . .	300 V
TPU7A/0 - 200	. . . . .	200 V



### Multiple protection units

The single-line devices can be packaged to give multiple line units as required. A multiway unit would have a separate inner box to provide a 'dirty' input compartment and a 'clean' output compartment. Re-radiation of the transient cannot then occur between input and output.

## COAXIAL ANTENNA PROTECTORS

### Description

The TPU11 and TPU24/1 are fast reaction transient protection units for use in 50  $\Omega$  coaxial lines. The units consist of a high speed spark gap mounted in a matched housing. The TPU24/2 has been developed for use in 75  $\Omega$  coaxial systems.

### Frequency

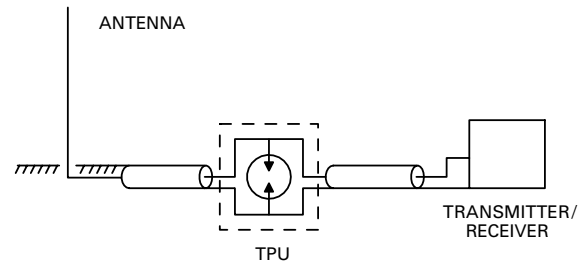
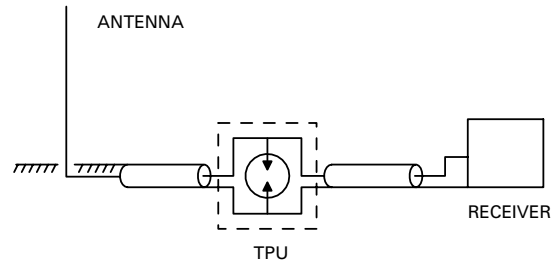
The TPU11 is specified to have an insertion loss of less than 0.2 dB and a VSWR of 1.2 maximum over the range DC to 500 MHz. The TPU24/1 and TPU24/2 are similarly specified from DC to 300 MHz.

### Connectors

This range of protectors is intended for insertion in antenna coaxial line. The TPU11 has N-type connectors; the TPU24/1 and TPU24/2 have BNC connectors.

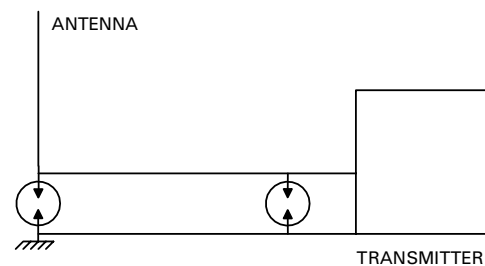
### Power Handling

These antenna protectors can also be used on Transmitter/Receivers of up to about 100 W at which the voltage breakdown of the spark gap is 200 V. Where lower power transmitters are used, a lower breakdown voltage can be specified providing lower let-through voltage from external lightning or transient pulses.



## HIGH POWER ANTENNA PROTECTORS

High power antennas of over 10 kW can be protected from lightning or EMP by the use of one or more spark gaps. The optimum positioning of these spark gaps depends upon the particular antenna configuration. Typically, protection is provided at the base of the antenna and at the transmitter housing or enclosure.



## SPECIFYING ANTENNA PROTECTION

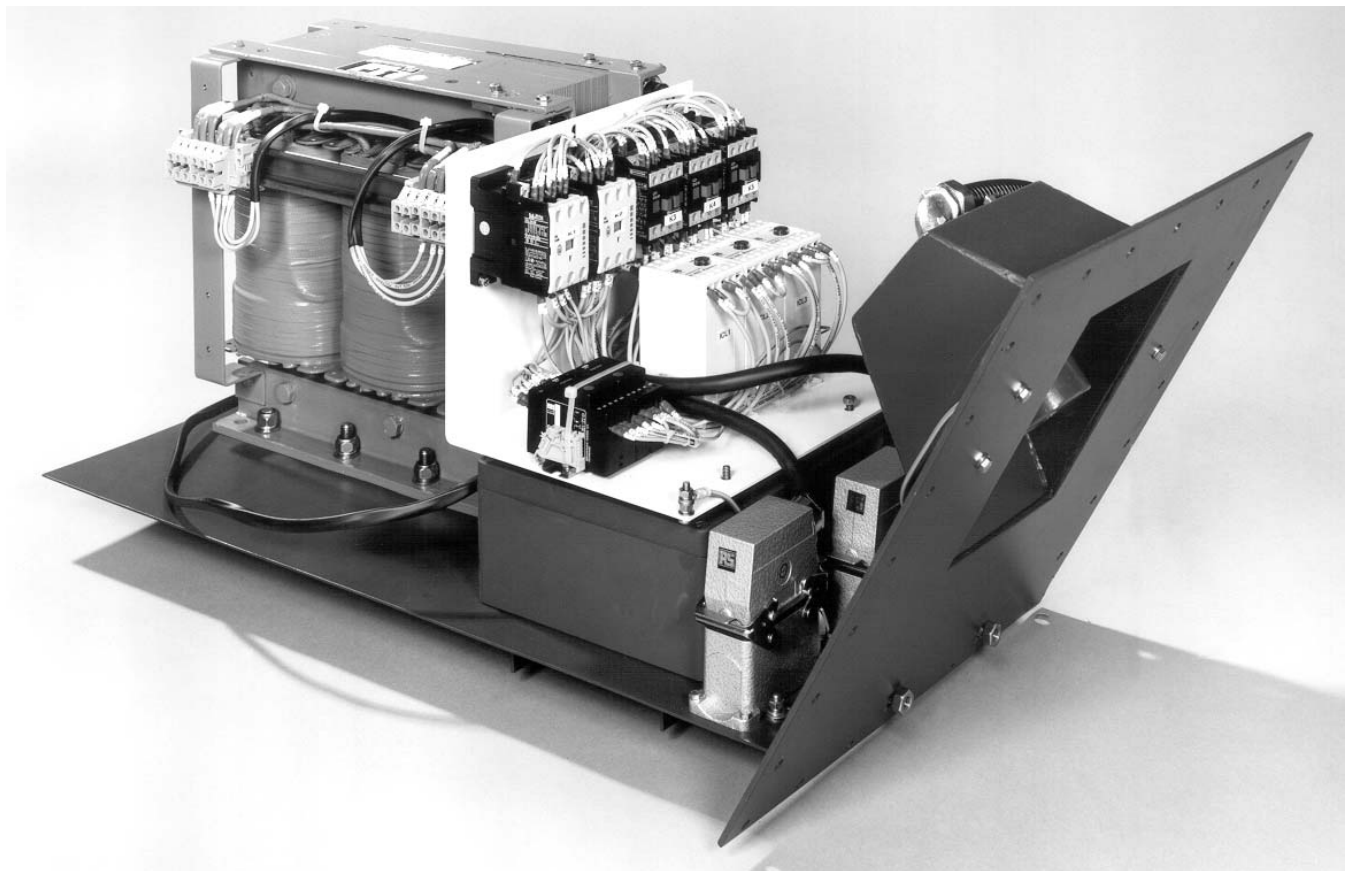
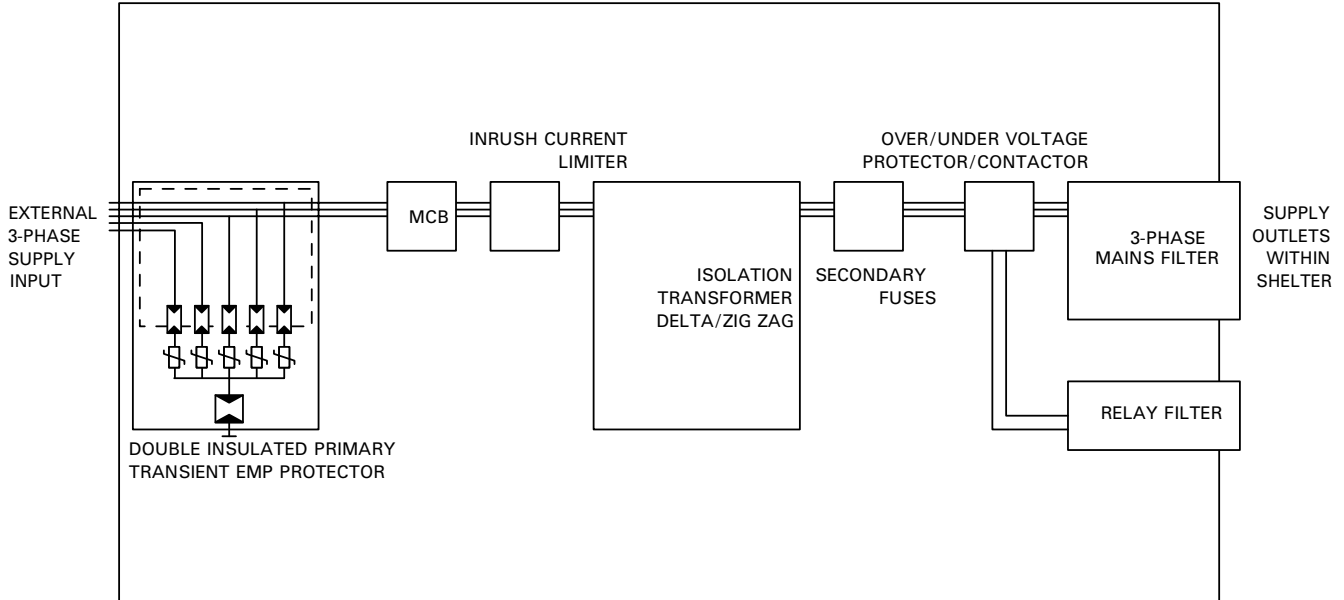
The key parameters necessary to specify antenna protection are:

Transient threat:	lightning, EMP
Transmission frequency not greater than	..... (GHz)
Transmitter power:	..... (max)
Let-through voltage:	..... (max)
Insertion loss:	..... (max)
VSWR:	..... (max)

# CUSTOMISED TRANSIENT PROTECTION SYSTEMS

E2V Technologies has a wide experience of specifying Transient Protection and offers a customised design and manufacturing capability for applications where performance is crucial, such as NEMP.

## Typical Customised Solution



This EMP mains supply is provided as a complete assembly for the customer to integrate within a shelter. Please refer to the E2V Technologies EMP booklet for more detailed treatment of the Nuclear EMP (NEMP) hazard.

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