

# Circuit Protection Reference Guide

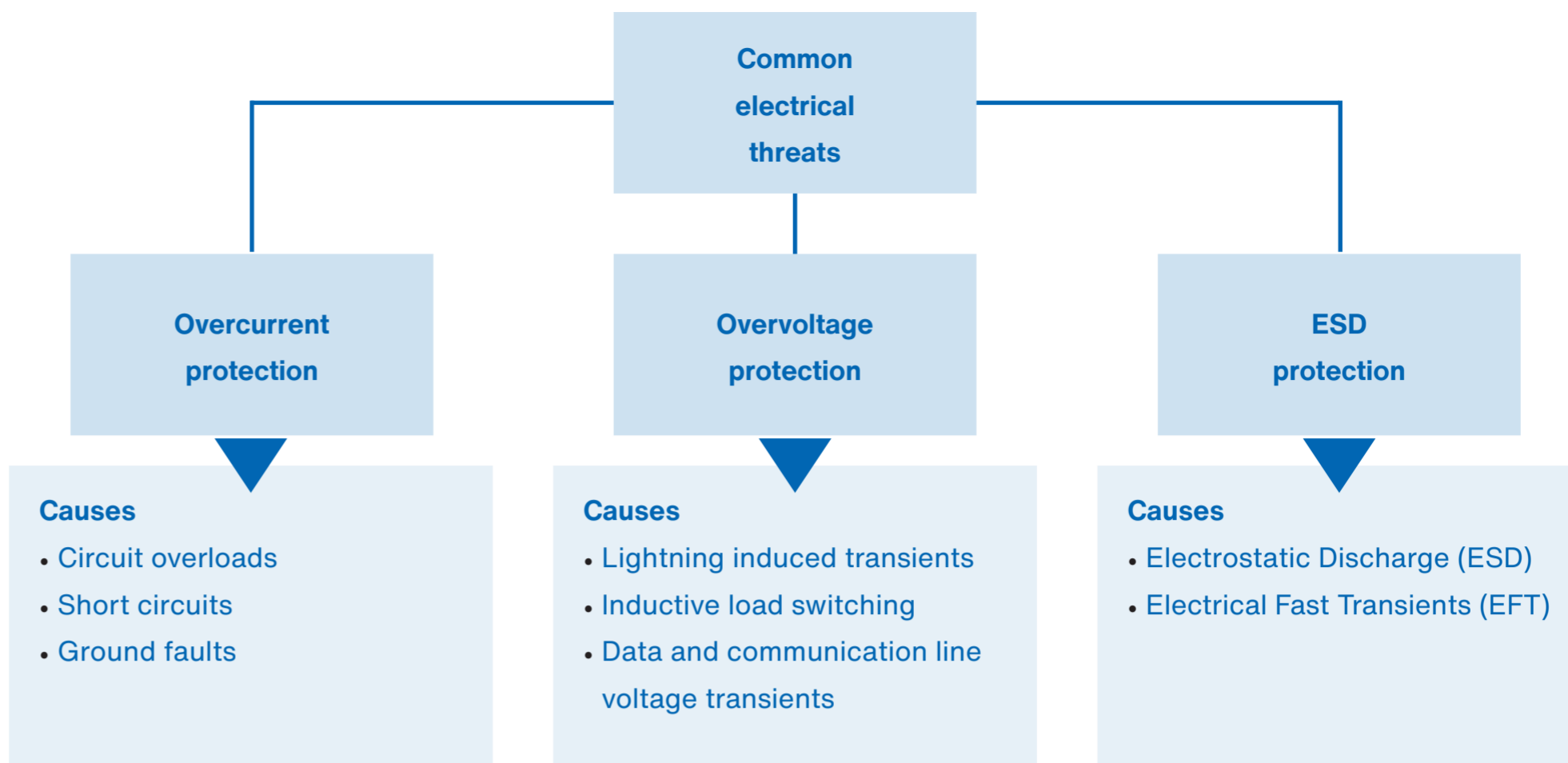
Overcurrent, overvoltage, and electrostatic discharge (ESD) are the three most critical events that can damage the components on a printed circuit board. They can occur externally, as with ESD or Lightning transients, or internally with circuit overloads and short circuits.

A variety of solutions exist to prevent damage to components and systems from these threats. This reference sheet describes the most common solutions used though is not an exhaustive listing. Suppliers such as Littelfuse offer solutions to almost any circuit protection requirement.



Source material for this guide provided by






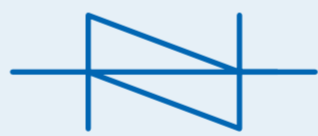
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## Overcurrent Protection

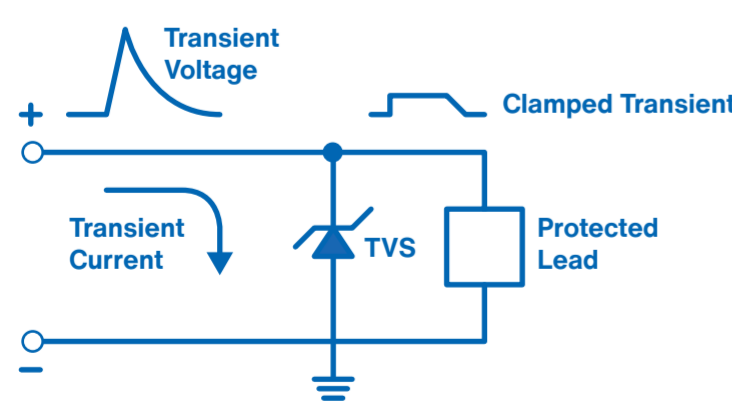
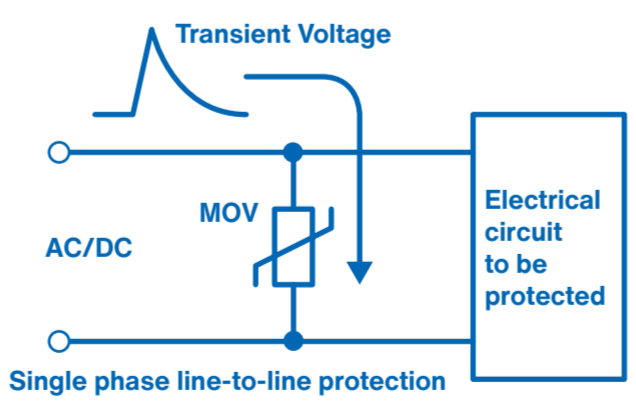
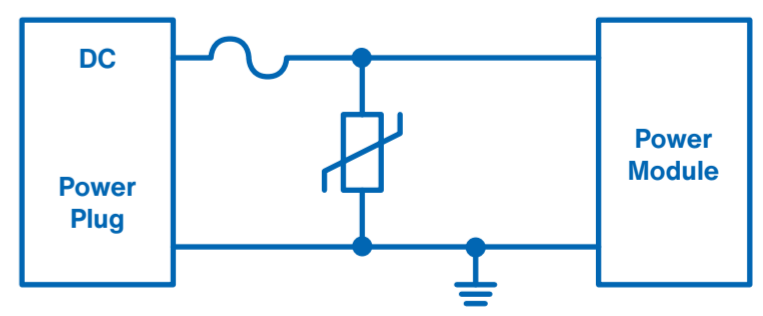
<p><b>Fuses</b></p>	<p>Fuses contain a metal wire or element that melts when its maximum rated current is exceeded. Completely disconnects the circuit protecting it from further damage. Non-resettable and must be replaced before the circuit will operate again.</p>	<p><b>PPTC Devices</b></p>	<p>Polyswitch Positive Temperature Coefficient (PPTC) is a resettable device that protects against overcurrent and short-circuits. Heats up when a fault condition occurs, increasing resistance and limiting current flow. Resets when fault condition is removed.</p>
			

## Overvoltage Protection (Including ESD & EFT)

<p><b>Varistors</b></p>	<p>A varistor is a voltage dependant resistor that has high resistance under normal operation but whose resistance drops rapidly when subject to a voltage surge or transient, conducting them safely to ground and protecting the circuit to which it is connected.</p>	<p><b>TVS Diodes</b></p>	<p>Transient Voltage Suppressor (TVS) Diodes become conductive when a voltage surge or transient occurs. Their fast response time makes them ideal for very fast transient such as Electrically Fast Transients (EFT) and Electrostatic Discharge (ESD). Also available as arrays for protecting multiple I/O or signal lines.</p>
			
<p><b>GDTs</b></p>	<p>Gas Discharge Tubes (GDT) are filled with ionising gas that becomes conductive when a voltage surge or transient occurs. This creates a low-resistance path, diverting transients to ground and protecting the circuit. Their high-energy capability makes them ideal for lightning surge protection, especially in outdoor telecoms equipment</p>	<p><b>Surge protection thyristors</b></p>	<p>Similar to TVS Diodes, Surge Protection Thyristors remain in an off state until a voltage surge or transient occurs. Their high current capability and fast response makes them ideal for use as lightning protection in telecoms equipment.</p>
			

## Example Circuits

Devices are most often used in combination to provide robust protection, however its helpful to understand some of the basic device functions and principles involved.

<p><b>TVS Diode</b></p>  <p>Conducts when transient voltage occurs, limiting it to the specified break down voltage of the diode</p> <p>Source: <a href="#">Analog Devices</a></p>	<p><b>Varistor</b></p>  <p>High resistance until surge or transient occurs causing resistance to drop, creating safe path to ground</p> <p>Source: <a href="#">Electrical4u</a></p>	<p><b>Fuse/Varistor Combination</b></p>  <p>Fuse provides overcurrent protection while the Varistor protects against surges and transients.</p> <p>Source: <a href="#">Littelfuse</a></p>
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