



PolySwitch PPTC Device Principals of Operation

What they are, How they work, Where to use them

Using PPTCs to meet circuit protection requirements

Presented by

Jim Toth

Raychem Circuit Protection

What a PolySwitch™ Resettable PPTC Device is

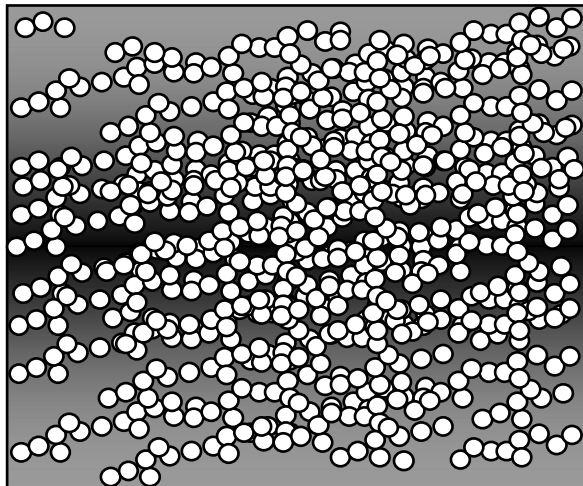
Raychem Circuit Protection's PolySwitch™ Polymeric Positive Temperature Coefficient (PPTC) devices are used to help protect against harmful overcurrent surges and overtemperature faults.

Like traditional fuses, these devices limit the flow of dangerously high current during fault conditions.

The PolySwitch device, however, resets after the fault is cleared and power to the circuit is removed, thereby reducing warranty, service and repair costs.

How a PolySwitch device works

UNDER NORMAL OPERATION

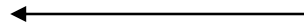


- At the operating current
- Many conductive paths
- Very low resistance

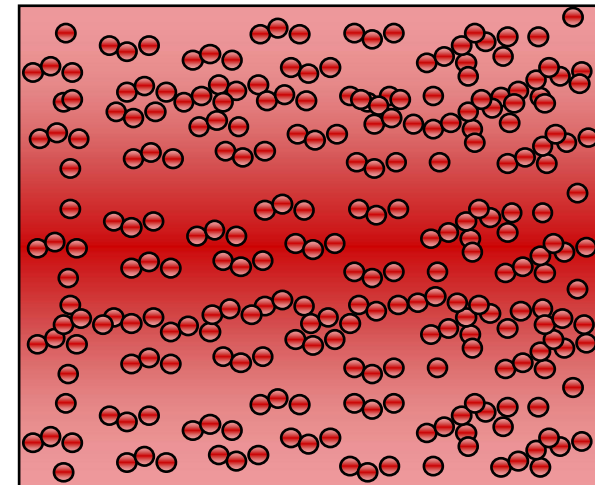
heats up



cools down



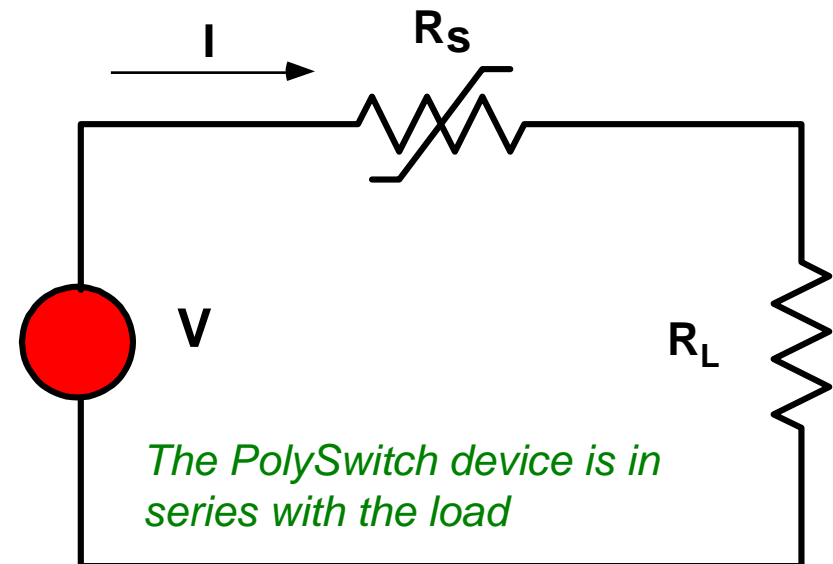
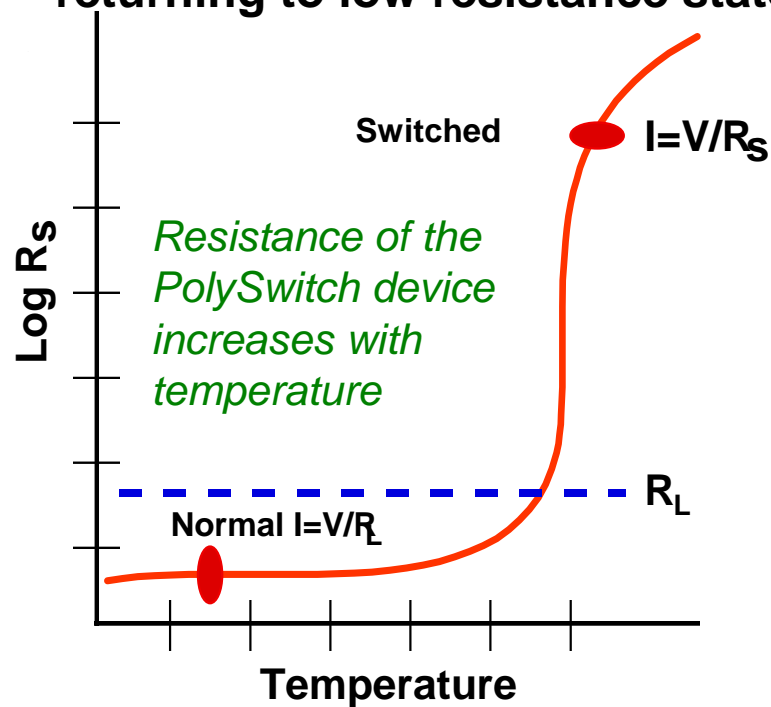
UNDER A FAULT CONDITION



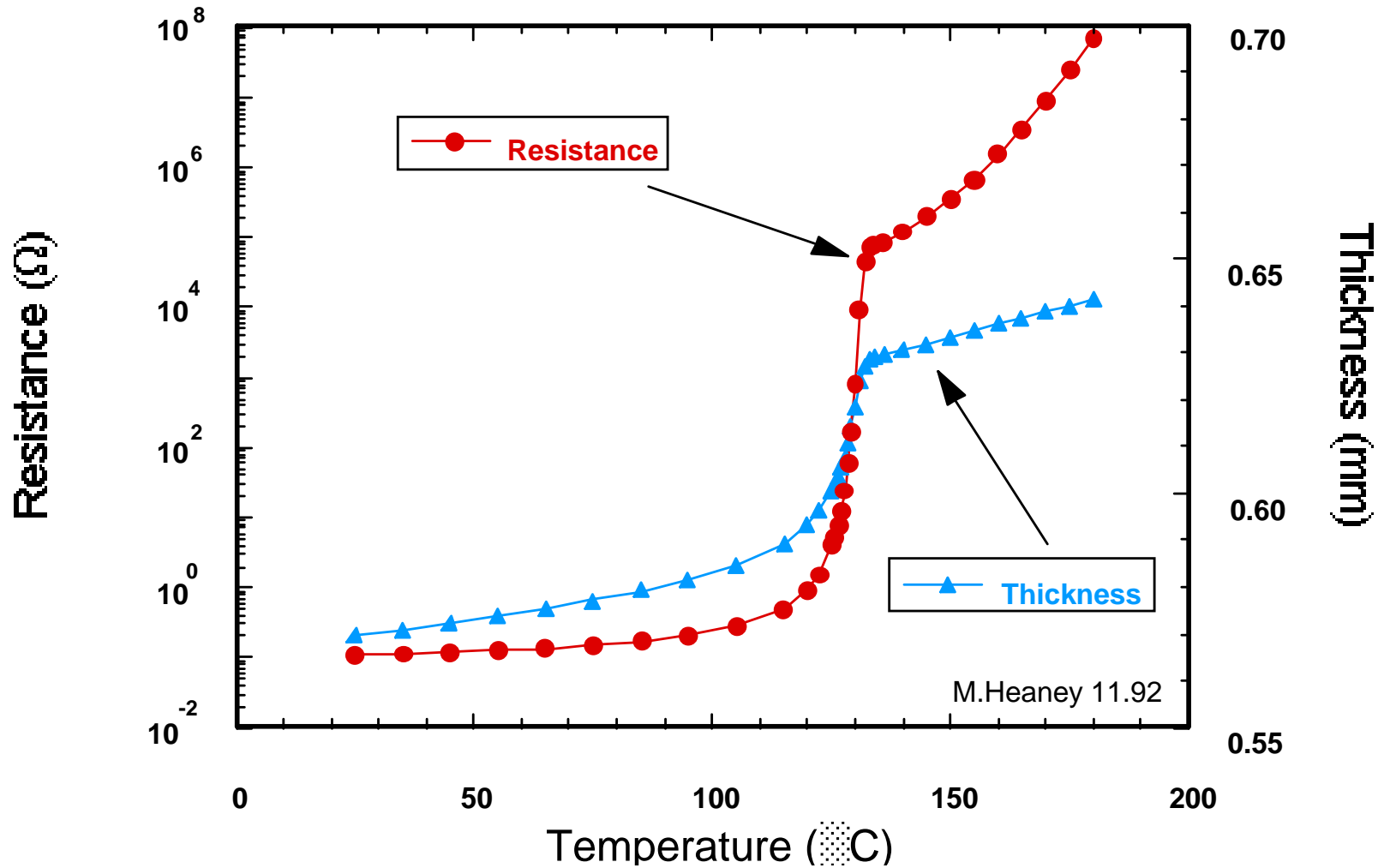
- Excessive current causes device to heat
- Fewer conductive paths
- High resistance
- Cools down and resets when fault removed

Why is a PPTC useful?

- Employed as series elements in circuit
- Under normal operating conditions, the PPTC remains low in resistance
- When a fault occurs, the PPTC heats up and increases in resistance thereby protecting the equipment from fault
- PPTC resets when power is removed, and fault is cleared, returning to low resistance state



PolySwitch PPTC Device Mechanism



PolySwitch Resettable PPTC Device Functionality

- A PPTC device acts like a fuse, however
 - ◆ it is a non-linear thermistor that limits current, so a small trickle current will continue to flow through the circuit
 - ◆ Under most conditions the PPTC will not reset until power is removed from the circuit

Device Type	Can provide OT/OC ¹ in same device?	Resettable functionality?	Reset Type	Tripped state leakage current?	Will cycle?	Latches once tripped?
Current Fuse	NO	NO	Replace	NO	NO	YES
Thermal fuse	SOMETIMES ²	NO	Replace	NO	NO	YES
Bimetal	YES	YES	Self reset ³	NO	YES	NO
Push-button breaker	NO	YES	Manual reset	NO	NO	YES
CPTC device	YES	YES	Self reset ⁴	YES	NO	YES
PPTC device	YES	YES	Self reset ⁴	YES	NO	YES

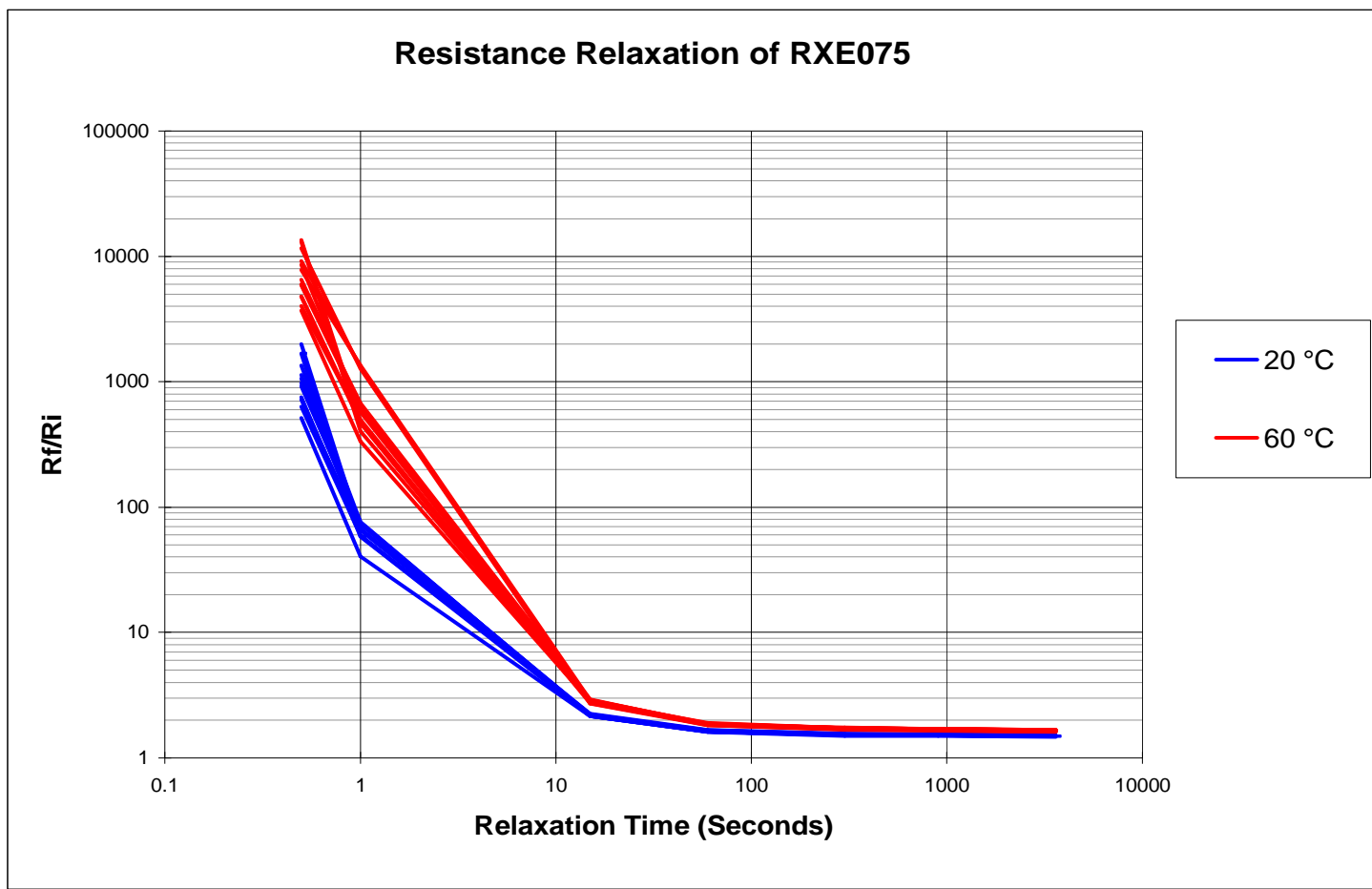
¹Overtemperature and overcurrent protection.

²Thermal fuses are not designed for overcurrent protection, and generally require large currents to trip.

³Periodically attempts to reset until fault and/or power is removed, or resets to low resistance state when bimetal cools.

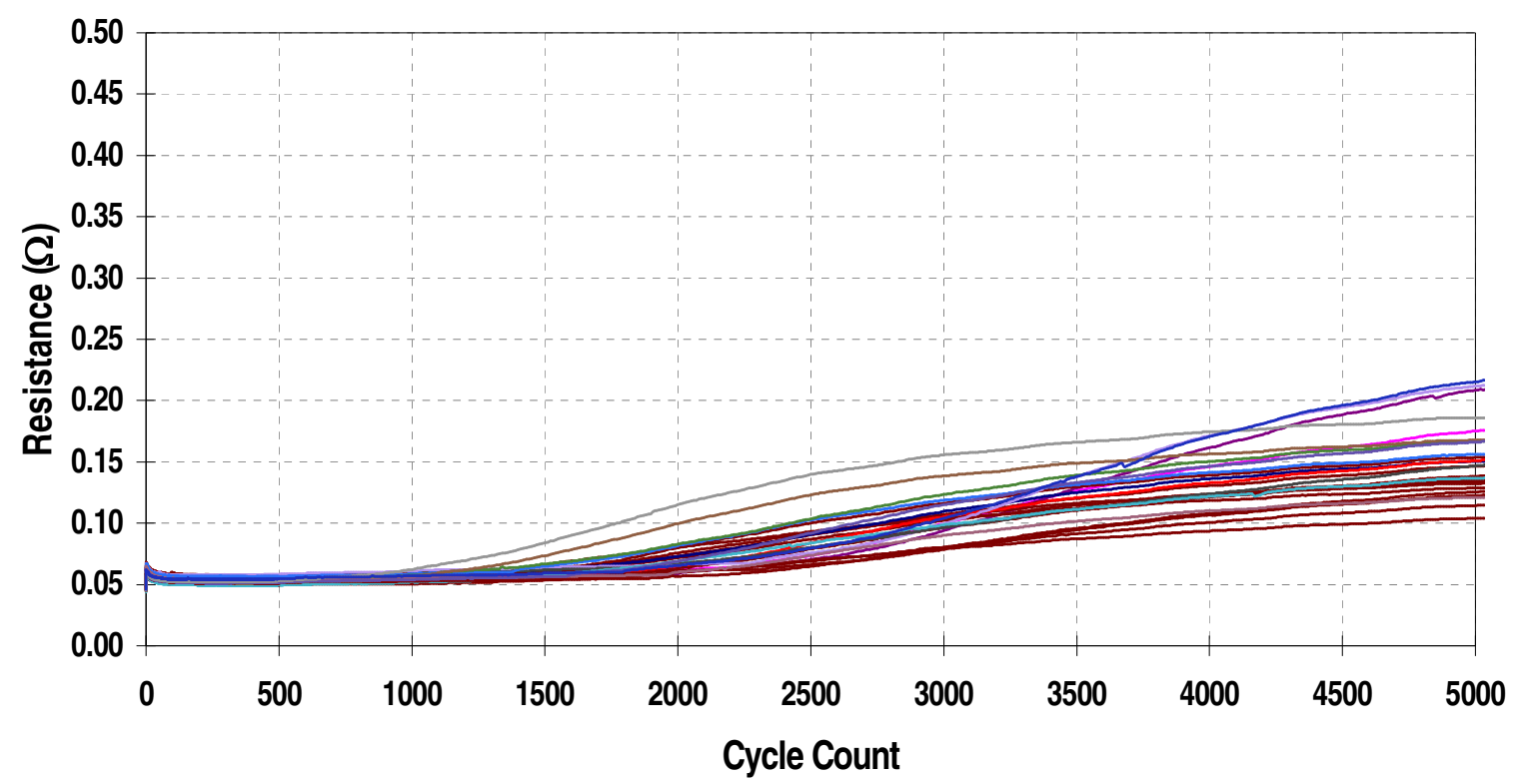
⁴Automatically resets to low-resistance state once the fault is cleared and power is removed.

Resistance Relaxation for RXE075



Effect of Extended Rapid Cycling

Cycle Life at 16V/100A - 5,000 cycles
RGE300



Benefits & Features of PolySwitch™ Resettable PPTC Devices

Benefits

- Reduced warranty and service costs
- Increased product reliability
- Superior shock and vibration withstand
- Wide variety of applications

Features

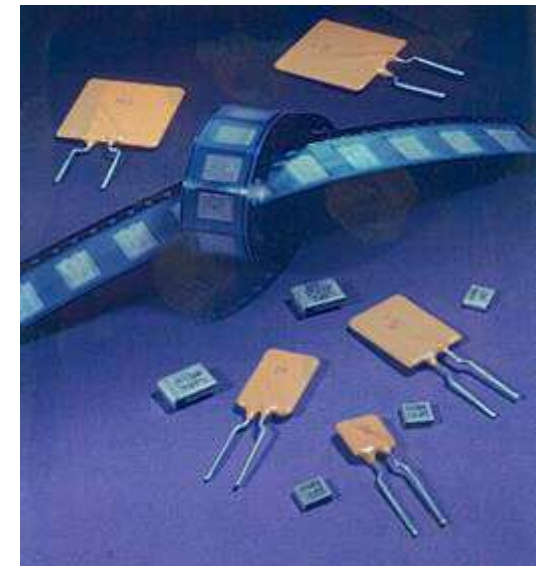
- Remotely resettable
- Testable
- Solid-state
- Wide variety of stock and custom form factors
- Low resistance devices available

Typical Applications

- **Computers and peripherals,**
 - ◆ USB ports, Firewire ports, disk drives
- **Rechargeable battery packs**
 - ◆ Cell phones, MP3 players, DSC's
- **Automotive electronics**
 - ◆ Window and door lock motors, entertainment and GPS systems
- **Telecommunications equipment**
 - ◆ Faxes, modems, routers, central office switching
- **Electrical equipment**
 - ◆ Security systems, solenoids, small and medium motors

Sample Application: Automotive Electronics Applications

- Since 1985, available as surface-mount and radial-leaded devices to help protect:
 - ◆ Electronic modules, and junction boxes
 - ◆ Power and signal distribution systems
 - ◆ Automotive actuators for power windows, mirrors, seat adjusters and door locks
- Protective devices that can be located strategically throughout the vehicle can help reduce wire harness size and weight



Sample Applications: DC Input Port Protection



Standard
DC Barrel Jack

Cell Phones



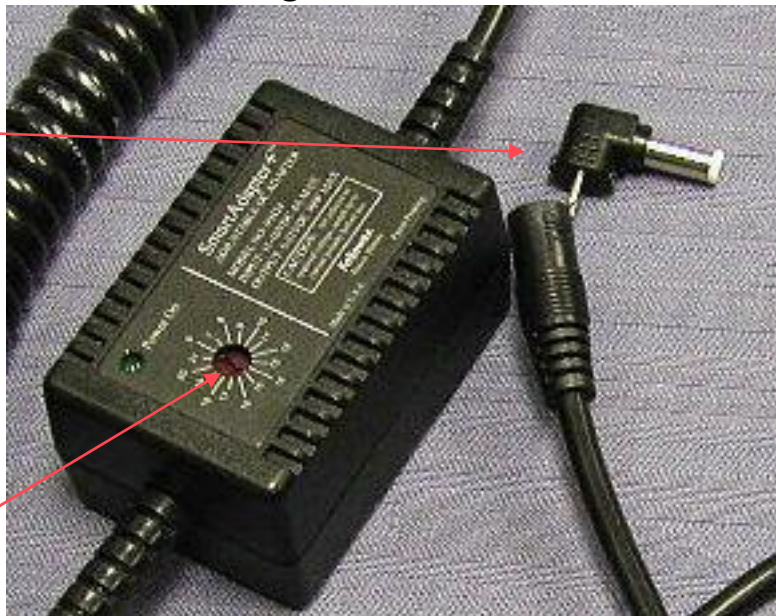
Custom DC
Connector

- PDAs
- Digital Cameras
- Portable DVD Players
- MP3 Players
- Portable Electronics

DC Input Port Protection: Misconnections

The power supply can not be guaranteed

DC Barrel Jack with Reversible Polarity
+/- , -/+



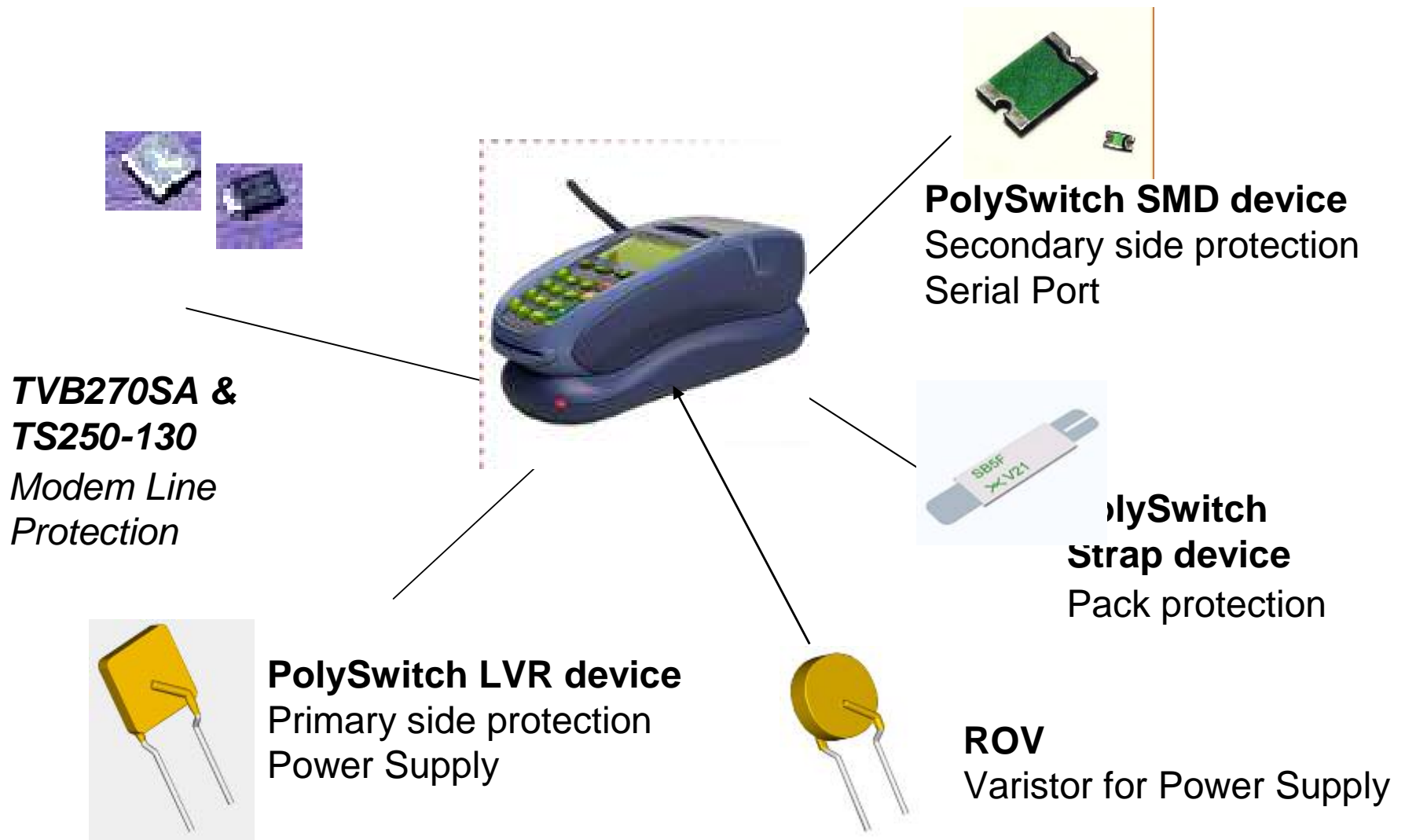
Variable Voltage



Custom-to-Standard Adaptor

Custom Connectors are not immune!

Sample Application: POS



Sample Application: Industrial

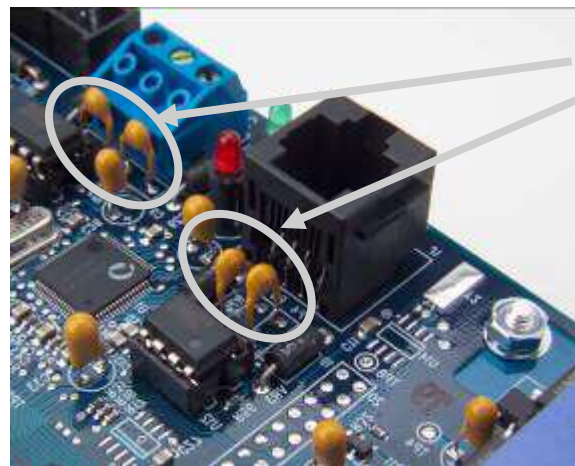
Power Management

AC Mains
OC Protection
PolySwitch LVR device

Input Power
OV Protection
ROV

Power Driver Protection

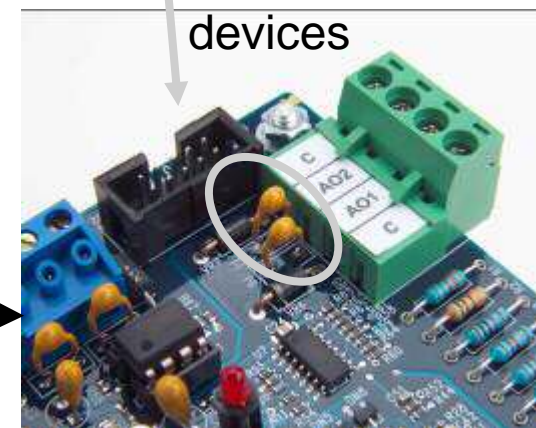
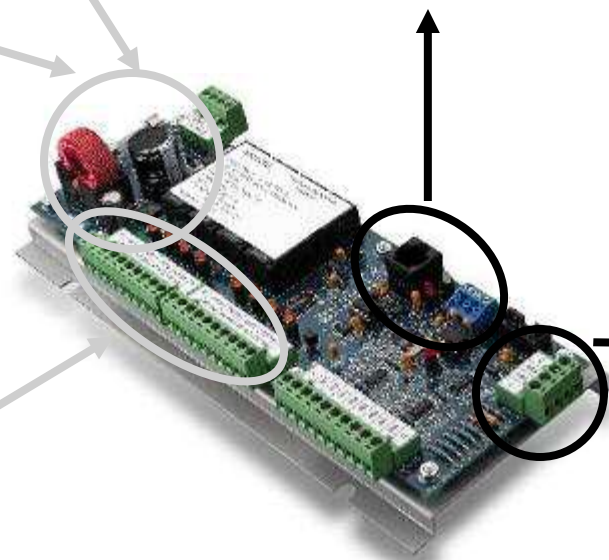
TRIAC, MOSFET, SCR
OC Protection
PolySwitch
LVR/RXE/RUE devices



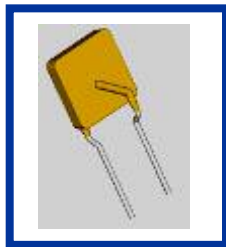
Comms I/O
OC Protection
PolySwitch
RXE, miniSMD
devices

Interface Protection

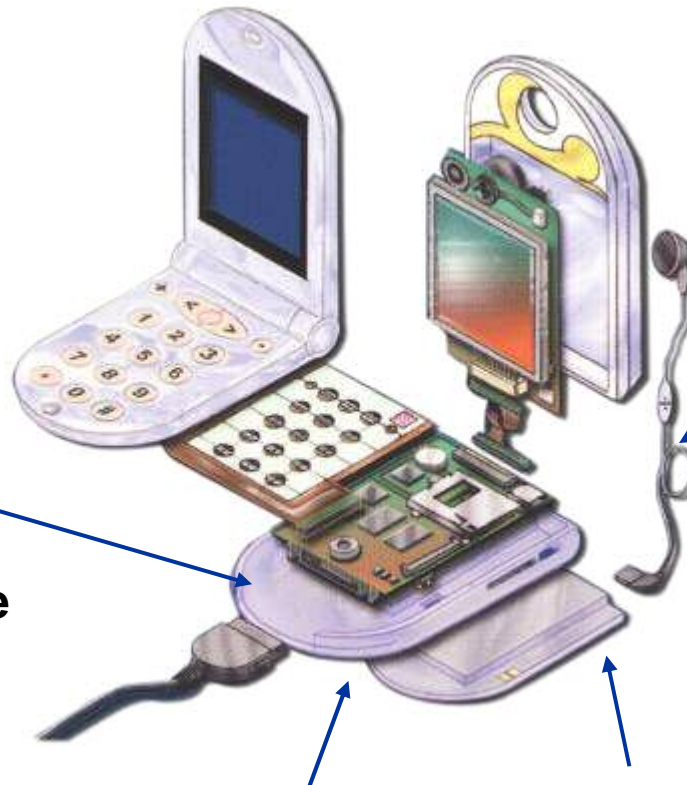
Analog I/O
OC Protection
PolySwitch
RXE/RTE/SMD
devices



Sample Application: Synergies in Mobile Phones



PolySwitch LVR device
Charger Overcurrent
Protection



PolySwitch Strap device
Battery Pack
Overcurrent
& Overtemperature
Protection



Chip fuses

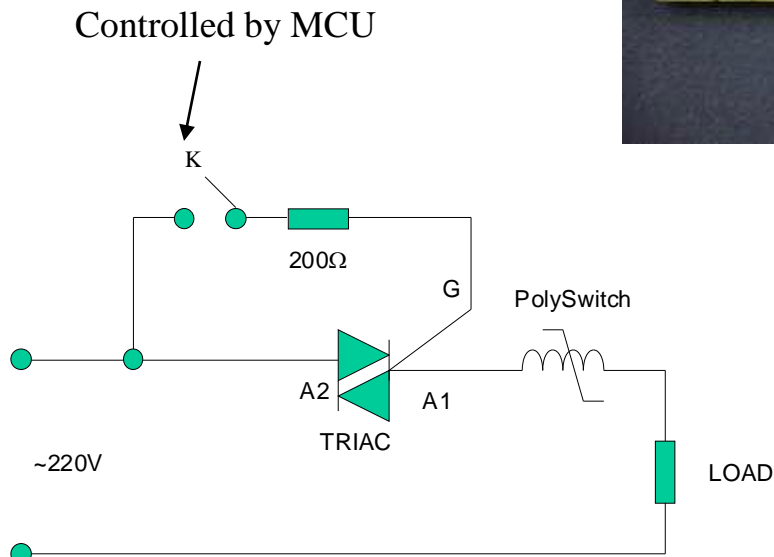
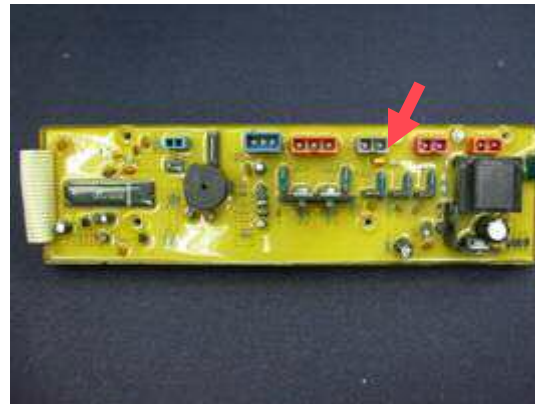


**PolySwitch
SMD Devices**

**Power Port OC
Protection**

Sample Application: Washing Machine Solenoid

Problem: Washing machine valve failure rate: 0.7%~3%
- Resulted in valve or controller board damage



Visit us at www.circuitprotection.com and check out our complete Circuit Protection solutions

PESD devices



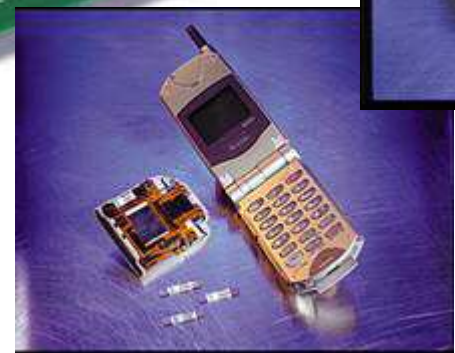
Fuses



GDTs and ROVs



Portable electronics



Wide Variety of form factors



PolySwitch Device family



Telecom



Technical Seminar Series

Be Smart — Choose the Right Part

Q&A Session Begins Now



Technical Seminar Series

Be Smart — Choose the Right Part

Resources & Links:

http://www.ttiinc.com/object/seminar_cp_resources.html