

### XPerts in Power – Module 12

### Output Protection

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### Module Contents

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### Why do we need output protection?

- Protect the power supply from the customer's equipment
- Protect the customer's equipment from the power supply

**In most cases if the power supply suffers any single fault condition it WILL NOT damage the customer's equipment.**

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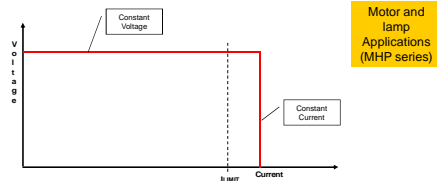
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## OUTPUT CURRENT - Constant current

Constant current limiting is to hold the output current at a specified value once the loading achieves a certain value. This scheme is mainly used for over current protection but it must be noted that in fault conditions the load sees a continuous high current.



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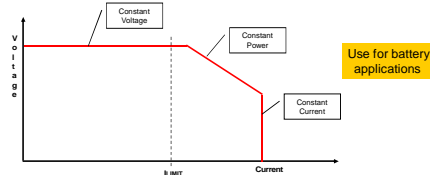
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## OUTPUT CURRENT - Constant power

A constant power output is implemented on supplies that power multiple electrical sub-circuits, or devices that require a high in-rush current at start up. The constant power output ensures that the output current is maintained in overload condition, and the output voltage is reduced in proportion to the excess power required.



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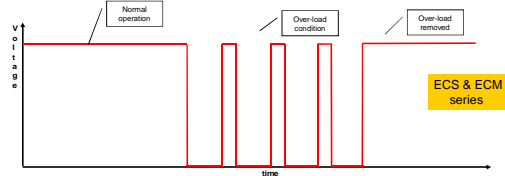
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## OUTPUT CURRENT – Trip & restart ‘hiccup’

When the current-sense circuit sees an over-current event, the controller shuts off the power supply for a given time and then tries to start up the power supply again. If the over-load condition has been removed, the power supply will startup and operate normally; otherwise, the controller will see another over-current event and shut off the power supply again, repeating the previous cycle. Long term trip and restart can be stressful to the supply.



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### OUTPUT CURRENT - Current foldback

Foldback current limiting decreases the output current and voltage when a short or abnormal load ( too low a load resistance ) is presented to the output. The output current and voltage decrease with the decreasing load resistance. This will reduce unnecessary current flow through the supply and power loss at the output

The graph shows Voltage on the y-axis and Current on the x-axis. A horizontal line represents 'Constant Voltage'. A diagonal line sloping downwards from the horizontal line represents 'Foldback Current'. The intersection of these two lines is marked as the 'Foldback point'. A vertical dashed line extends from the foldback point to the x-axis, labeled  $I_{LIMIT}$ . A yellow box labeled 'Multi Output RCL' is located to the right of the graph.

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### OUTPUT CURRENT - Fuses

When connected in series to a circuit, positive temperature coefficient ( PTC ) resettable fuses remain at extremely low resistance and allow the electrical current to flow through it without any restriction. When overcurrent situations occur, PTC resettable fuses limit the current to a very small value (nearly to "open state") and therefore protect the circuit from being damaged by the high current.

The diagram shows a circuit with a 'Power Source', a 'Fusible PTC', and a 'Load' connected in series. To the left, a circular diagram illustrates the 'Normal operation condition' (low resistance) and 'Trip condition' (high resistance) of the PTC fuse, with arrows indicating 'Heating up' and 'Cooling down'. To the right, a graph plots 'RESISTANCE (ohms)' on a logarithmic y-axis (from  $10^{-1}$  to  $10^3$ ) against 'TEMPERATURE °C' on the x-axis (from 0 to 200). The curve shows low resistance at low temperatures and a sharp increase in resistance as temperature rises above 100°C.

Effectively latches the PSU off ( multi o/p RCL )

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### OUTPUT POWER - Total power limiting

Power limiting is probably the most popular and least expensive method to protect against output overpower demands. When an overpower error is detected by the primary circuit, it reduces the power switch on period, hence all output voltages reduce to very low values. Normal operation resumes when the short is removed.

The circuit diagram shows a multi-output power supply with a transformer, rectifier, and three output filters. A red circle highlights the power switch on period. To the right, a graph shows 'Output voltage' on the y-axis and 'Time' on the x-axis. Three output voltages are shown: 'Output1', 'Output2', and 'Output3'. All three voltages drop to zero simultaneously when an overpower error occurs and remain at zero until the error is cleared.

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### OUTPUT VOLTAGE - Crowbar

Overvoltage can damage customers equipment, to prevent this an overvoltage crowbar or clamp circuit can be used.

When the SCR turns on, it places a short circuit directly across the output, thereby protecting the load circuitry. This short remains in place until the power supply is turned off and reset. This method is always used in conjunction with foldback current limiting.

The graph shows output voltage on the y-axis and time on the x-axis. It starts with a horizontal line labeled 'Normal operation'. This line rises to a point labeled 'Crowbar threshold'. After this point, the voltage drops sharply to a lower level labeled 'Crowbar active'. A label 'Lost regulation' points to the rising portion of the line. A schematic diagram to the right shows a power supply connected to a load. A Zener diode is connected between the output and a control line that triggers an SCR, which is connected in parallel with the load.

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### OUTPUT VOLTAGE – Electronic over voltage

If an excursion of the output is detected beyond set limits the output is turned off. This is normally performed via a secondary feedback loop to the primary control circuit in case the primary feedback loop is faulty.

The diagram shows a complex electronic circuit for overvoltage protection. It includes a transformer, various resistors, capacitors, and integrated circuits. A red line highlights a feedback path from the output back to the control circuit. Labels include 'OUTPUT', 'OVERVOLT', and 'CONTROL'.

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XP Power

A collection of various XP Power power supply units and modules, including different sizes and shapes, some with connectors and others as bare components.

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