

## IPC01 SERIES



### Industrial Power Controller IPC01 AC and DC ISOLATED OUTPUT



#### Features:

- UL508 and CSA C22.2 NO. 14-10 Recognized, (File number E354703)
- **Patent Pending – Power Control, Monitoring, and Load Protection**
- All solid-state circuitry, with no moving parts to wear, ensures a long life.
- Soft start for reduced EMI.
- High efficiency with less than 0.8V drop at full load.
- Compact panel mount “Hockey Puck” style package.
- No Output current de-rating is required for base plate temperatures of -40°C to +80°C.
- SPST, normally open power controller.
- UL94V-0 approved clear IP20 touch safe protection cover.
- MIL-STD-704A through E and MIL-STD-1760E I<sup>2</sup>t compliant.
- TTL / CMOS compatible Switch Status.
- AC devices designed for inductive load power factors to 0.75.
- AC devices designed with integrated load switching transient suppression.

#### Description:

##### The IPC combines both relay and circuit breaker functions.

The Isolated IPC is mechanically similar to the standardized industrial Solid State Relay. The functions include Soft Start load switching, I<sup>2</sup>t overload / fault protection that provides circuit breaker function to MIL-STD-1760E and load status signaling indicating switch output conditions of ON, OFF and Overload.

Inductive and optical coupling between the input circuits and output provides isolation of 1,500 VRMS. Power MOSFET output switches provide soft start and low ON voltage drop for improved thermal characteristics. The input Control logic and bias operates from a V<sub>DD</sub> of 5 to 32VDC. (See Figure 5)

Output current is monitored to control outputs during over-current conditions (see the I<sup>2</sup>t trip curves). Over-current conditions include Over-Load and Shorted Output during Turn-On. Open-collector Output Status indicates the state of the Output Switch MOSFET load driver. The output remains OFF until the short is removed and the unit's control line is toggled OFF and back ON. Locking the output OFF on an error condition prevents damage to the controller and further system damage caused by the short circuit. Output Status is an Active Low (Open Collector) for Controller OFF or Tripped conditions and High (pull up resistor) for a normally ON output state.

The IPC is designed for rated current over a Baseplate Temperature Range of -40°C to +80°C. This includes the operations of Soft Start at Command ON and Trip OFF on Over Load or Fault Conditions.

#### Applications:

- Aerospace Ground Support Equipment.
- Industrial and Commercial Lighting Systems.
- Commercial Test Equipment.
- Manufacturing Equipment.
- Energy Exploration Systems and Equipment.
- Communications Systems and Plants.
- Aircraft and Avionics Systems.
- Automation Equipment.
- Fabrication Equipment.
- Vending Machines.
- Selective Power Distribution.
- Laboratory Test Systems.
- Food Processing.



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### ABSOLUTE MAXIMUM RATINGS

Description	DC IPC	AC IPC
Isolation Voltage	1,500 VDC	1,500VDC
Load Voltage	75 / 400V VDC <sup>1,2</sup>	40 / 280VAC RMS
Load Current	Less Than 8 Times Rated Operating Current / Self Protecting <sup>3</sup>	Self Protecting to MIL-STD-1760E <sup>3</sup>
Bias supply voltage, V <sub>DD</sub>	-0.6 to 32 VDC	-0.6 to 32 VDC
Control Voltage	1 Volt above V <sub>DD</sub> / 1 Volt below Return	1 Volt above V <sub>DD</sub> / 1 Volt below Return
Operating Temperature, Case	-40°C to +80°C	-40°C to +80°C
Storage Temperature	-55°C to +85°C	-55°C to +85°C

1. External snubbing may be required for Power Controller protection.
2. Reversing output polarity on DC units may cause permanent damage.
3. The I<sup>2</sup>t circuit breaker function terminates AC overloads and fault currents per Figures 1 or 2 and DC overloads and fault currents per Figures 3 or 4.

### AC ELECTRICAL OUTPUT CHARACTERISTICS: T<sub>C</sub> = -40 to 80° C

Description <sup>1</sup>	Units	Device	
		40VAC / 10A	280VAC / 5A
Rated Operating Voltage	V <sub>RMS</sub>	0 – 40	0 - 280
Overvoltage (Maximum)	V <sub>RMS</sub>	45	310
Transients (Maximum)	V <sub>PEAK</sub>	64	424
Operating Frequency	Hz	50 – 450	50 - 450
Current Rating	A <sub>RMS</sub>	10	5
Interrupt Current Rating <sup>2,3</sup>	A <sub>PEAK</sub>	100	50
Turn-On / Turn-Off Time <sup>4</sup>	mSec	8	8
Turn-On / Turn-Off Delay <sup>6</sup>	mSec	12	12
Trip Shutdown Time <sup>3,5</sup>	µSec	35	35
Maximum Off-State Leakage @ Rated Voltage	µA	500	500
Maximum On-State Voltage Drop @ Rated Current	V <sub>RMS</sub>	0.75	0.75
Maximum On-State Resistance @ Rated Current	Ohms	0.15	0.30

1. This is not a “zero crossing Turn-On” IPC. Turn-On at other than zero-crossing will experience a “soft-start” voltage and current equal to the typical Turn-On Rise Time of 8m/sec. At 60 Hz this is ½ sin of the normal voltage rise and is 2.5 cycles for 400 Hz.
2. Steady state trip current is between 120% and 160% of rated current. See Figures 1 and 2.
3. I<sup>2</sup>t trip current is time dependent. See Figure 1 and Figure 2.
4. Output of 10 to 90% / 90 to 10%.
5. Output current measured from fault onset to 10% rated load.
6. “ON” command period is 1 sec minimum with a duty cycle of 10%.

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**DC ELECTRICAL OUTPUT CHARACTERISTICS:**  $T_C = -40$  to  $80^\circ C$

Description	Units	Device	
		75VDC / 10A	400VDC / 5A
Rated Operating Voltage	V	0 – 75	0 - 400
Transient Overvoltage <sup>1</sup>	V <sub>PEAK</sub>	95	475
Current Rating	A	10	5
Interrupt Current Rating <sup>2,6</sup>	%	120	160
Turn-On/Turn-Off Time <sup>5,7</sup>	mSec	6	6
Turn- On/Turn-Off Delay <sup>5</sup>	mSec	10	10
Trip Shutdown Time <sup>3,4</sup>	μSec	35	35
Maximum Off-State Leakage @ Rated Voltage	μA	500	500
Maximum On-State Voltage Drop @ Rated Current	V	0.75	0.75
Maximum On-State Resistance @ Rated Current	Ohms	0.08	0.16

1. Transient overvoltage exceeding this voltage may result in damage to the device.
2. Steady state trip current is between 120% and 160% of rated current. See Figures 3 and 4.
3.  $I^2t$  trip current is time dependent. See Figures 3 and 4.
4. Output current measured from fault onset to 10% rated load.
5. “ON” command period is 1 sec minimum with a duty cycle of 10%.
6. Inductive loads must be suppressed. Fault shutdown can be  $\leq 5\mu s$ .
7. Output of 10 to 90% / 90 to 10%.

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Industrial Power Controller

**AC & DC CHARACTERISTICS:**  $T_C = -40$  to  $80^\circ\text{C}$

Description	Units	AC and DC Devices
Bias supply, $V_{DD}$	VDC	5 to 32
Maximum Bias Current	mA	35
Maximum Control voltage range <sup>1</sup> (CMOS Configuration)	VDC	$-0.5$ to $\leq V_{DD}$
Minimum Turn-on Voltage ( $V_{IH}$ ) <sup>2</sup>	VDC	3.9
Maximum Turn-off Voltage ( $V_{IL}$ ) <sup>2</sup>	VDC	2.0
Trip Reset Time <sup>3</sup>	Seconds	100
Status Supply Voltage (open Collector)	VDC	32
Status off Leakage Current	$\mu\text{ADC}$	4
Status on Voltage	VDC	0.4
Junction Temperature	$^\circ\text{C}$	150
Thermal Resistance, $\theta_{JC}$	$^\circ\text{C}/\text{W}$	5
Output Capacitance	pF	3,000
Input to Output Capacitance	pF	25

1. Input transitions should be “bounce-less contact” with transitions of  $<1$  msec.
2. TTL Logic may require a pull-up resistor to ensure a “high” input condition.
3. The IPC has load current memory. A period of 100 seconds between an overload, or shorted load restart allows for full current startup.

**Table 1: Short circuit and Status Sequence**

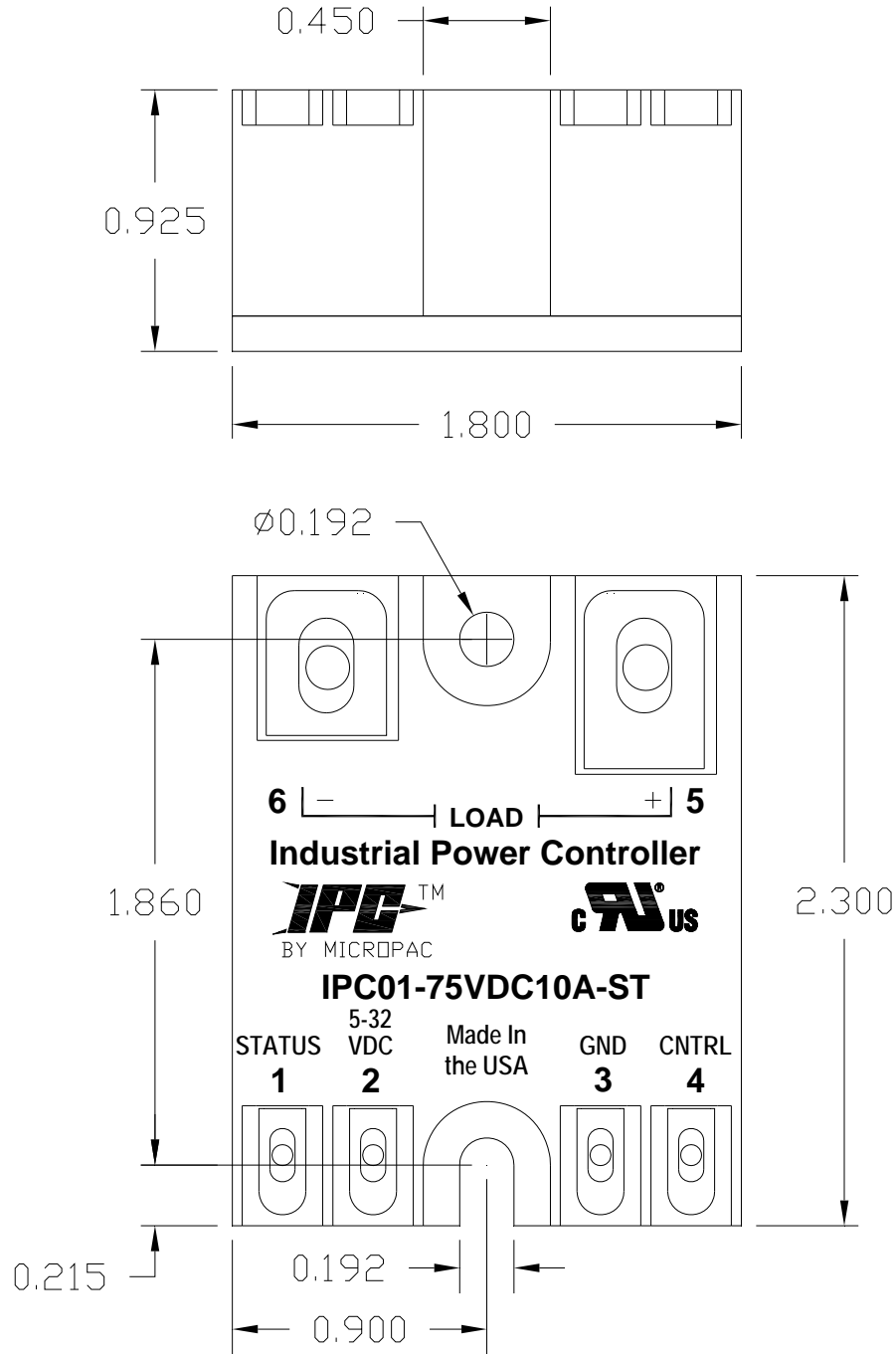
Shorted at Turn On						Shorted while On				
<b>Input Control</b>	0	1	1	0	1	1	1	1	0	1
<b>Load Current</b>	0	0	0	0	1	1	0	0	0	1
<b>Switch Status</b>	0	0	0	0	1	1	0	0	0	1
<b>Output</b>	Short Applied	Short Applied	Short Removed	Load	Load	Load	Short Applied	Short Removed	Load	Load

**Notes:**

1. Unit Powers up in the OFF condition with application of  $V_{DD}$ . **However, it is highly recommended that Control be held low (Off) during the initiation of Power to ensure there is no transient reset / start signaling.**
2. Fault Status reports only when  $V_{DD}$  is present.
3. An OFF Control to ON Control transition is required to first turn the Unit On.
4. A loss of  $V_{DD}$  will return the output state to OFF.
5. Truth Table Power sequencing: Output Status open collector pull-up resistor is assigned a separate and always on voltage producing a “1” when “Open”.

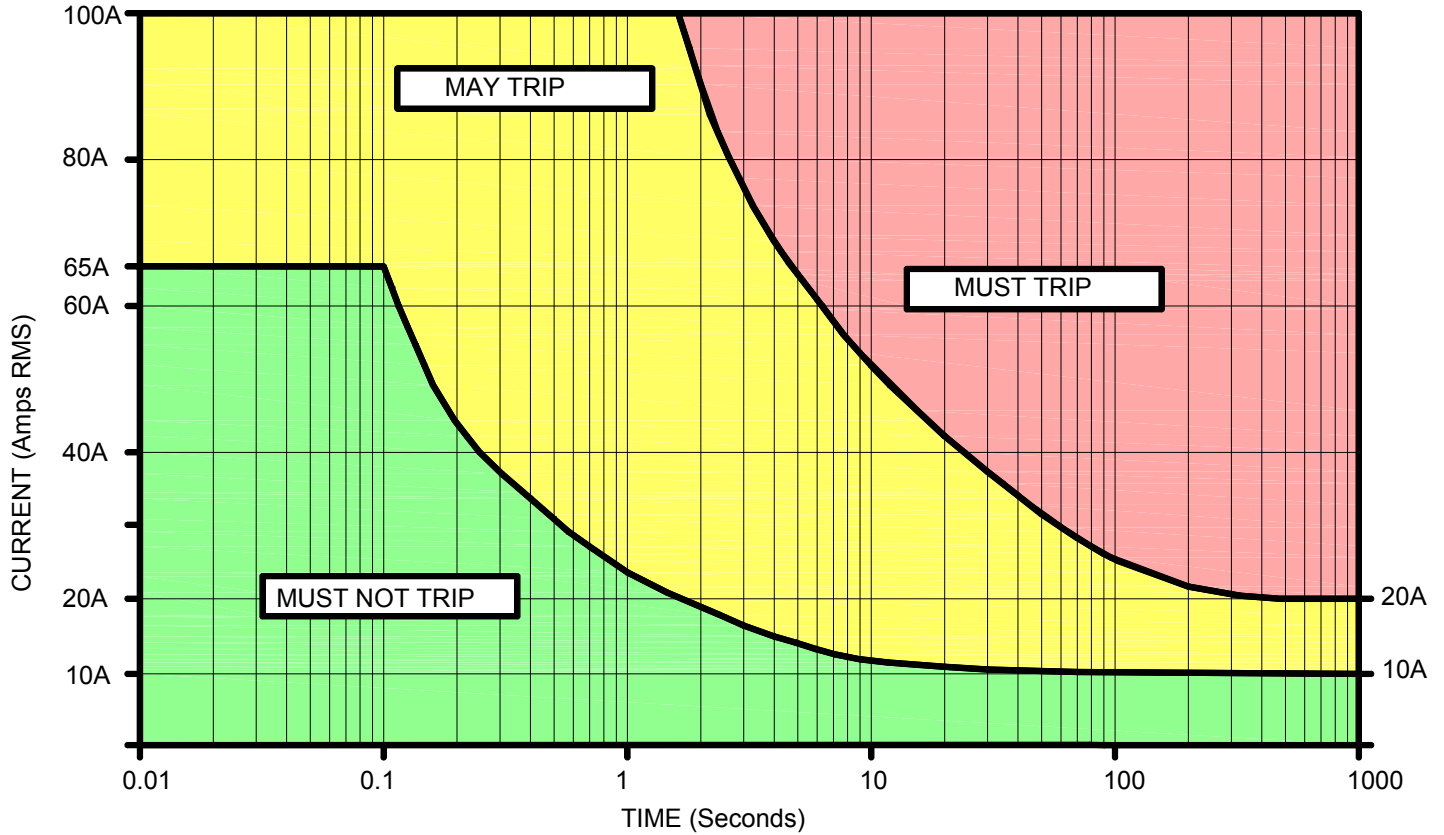
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**PACKAGE DIMENSIONS (Inches)**

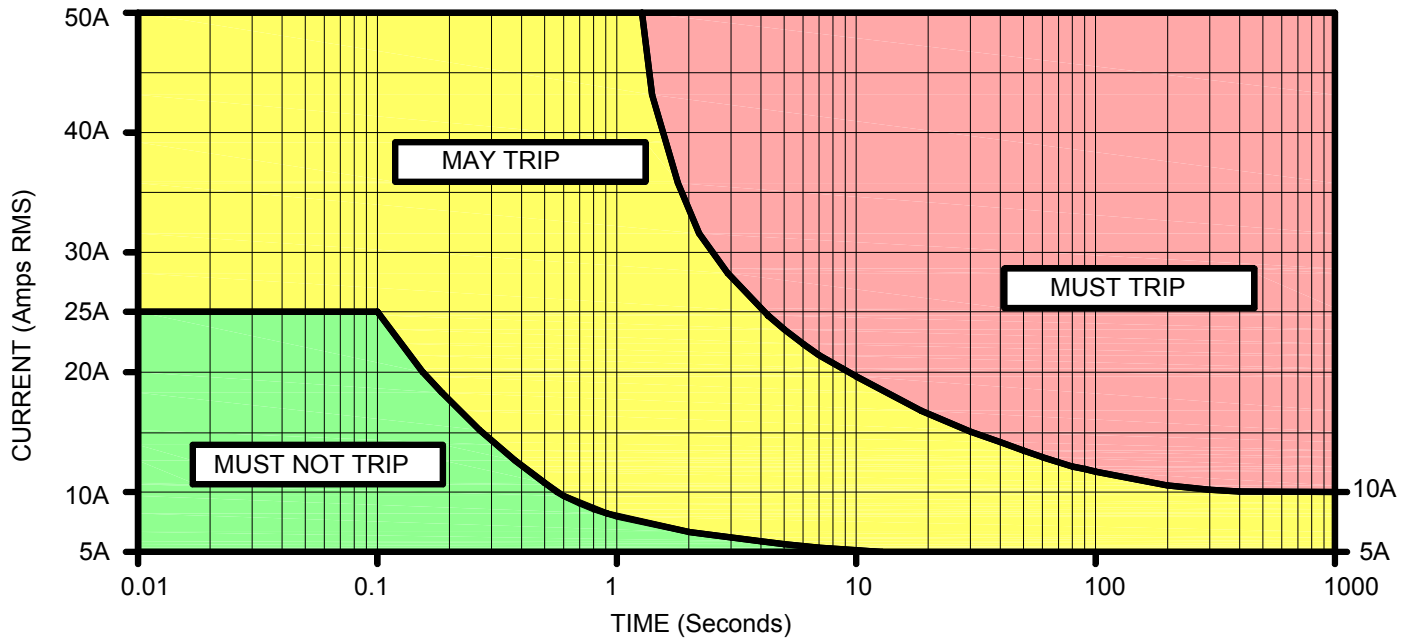


Pin Designation			
Pin 1	Status	Pin 4	Control
Pin 2	+ 5 to 32 VDC	Pin 5	Output (+ DC) (~AC)
Pin 3	Input GND	Pin 6	Output (- DC) (~AC)

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**FIGURE 1: TRIP CURVE for IPC01-40VAC10A**

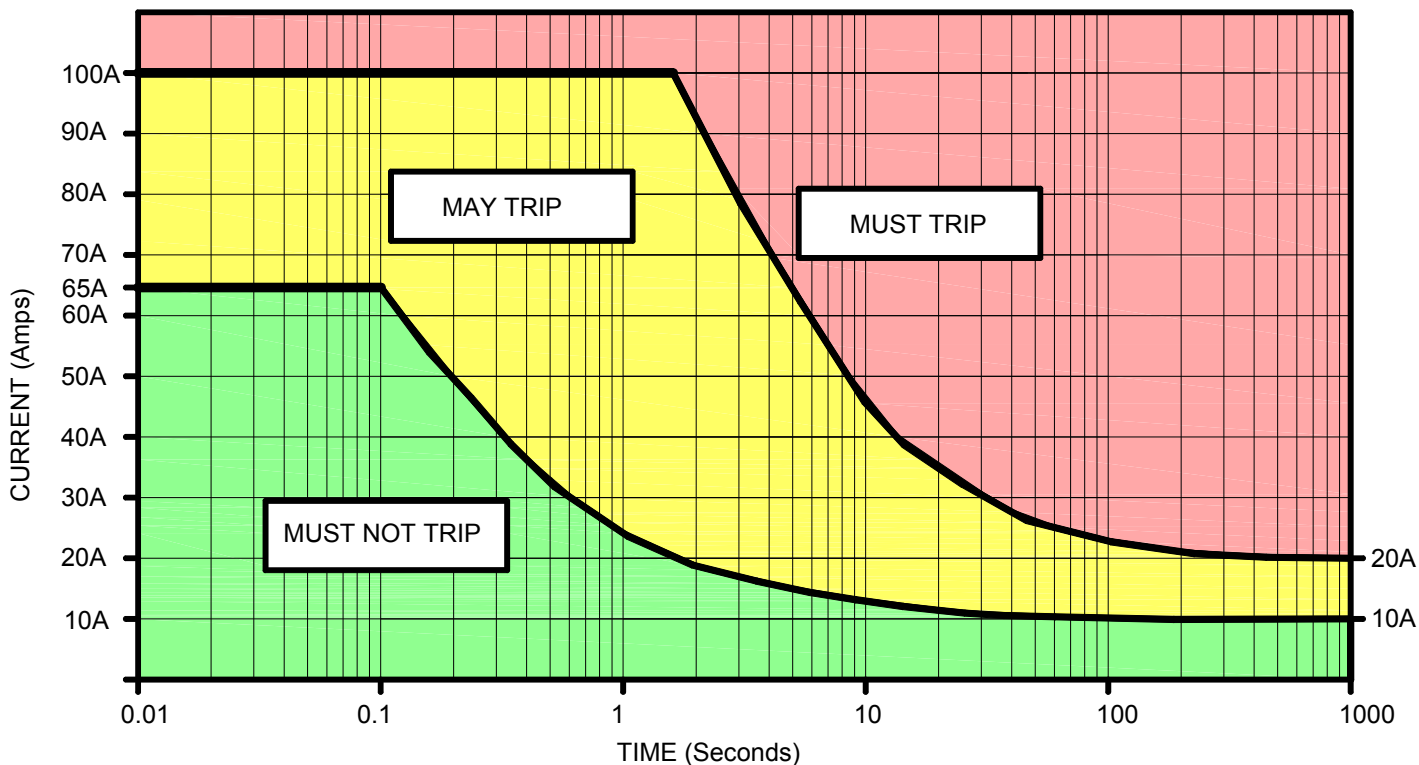


**FIGURE 2: TRIP CURVE for IPC01-280VAC5A**

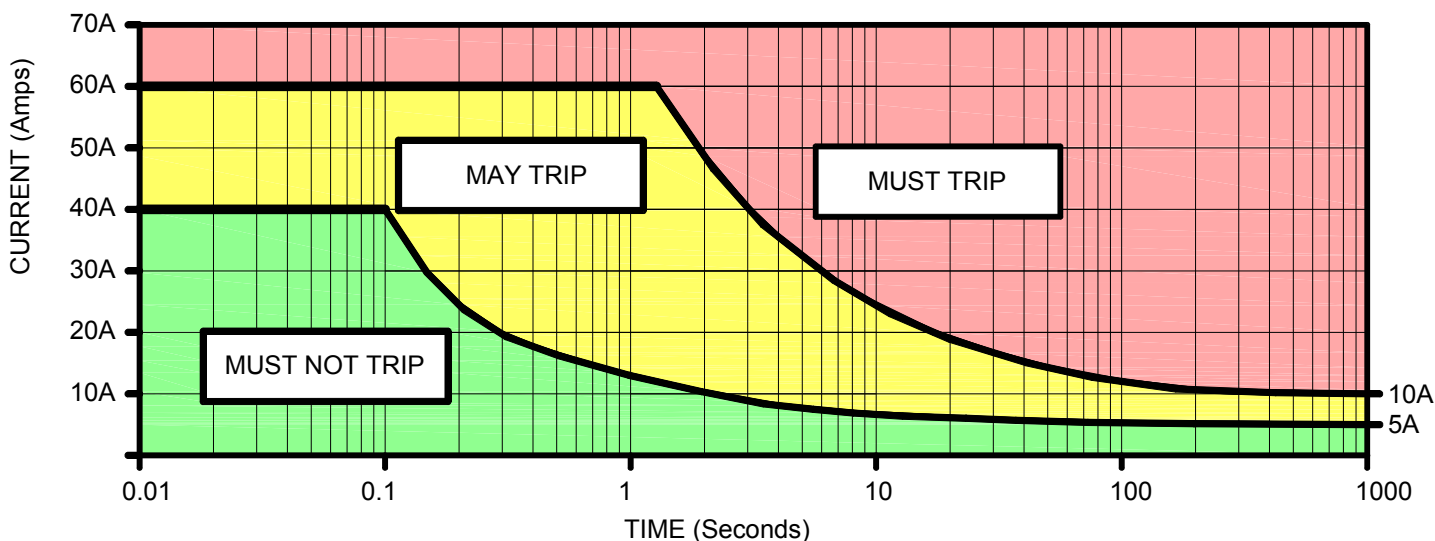
**Figure 1 & 2 Notes:**

1. Output currents are interrupted in the Must Trip / May Trip / Must Not Trip regions similar to MIL-STD-1760E.
2. Load fault current from the "ON" operating condition is limited by the source and load impedance.

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**FIGURE 3: TRIP CURVE for IPC01-75VDC10A.**

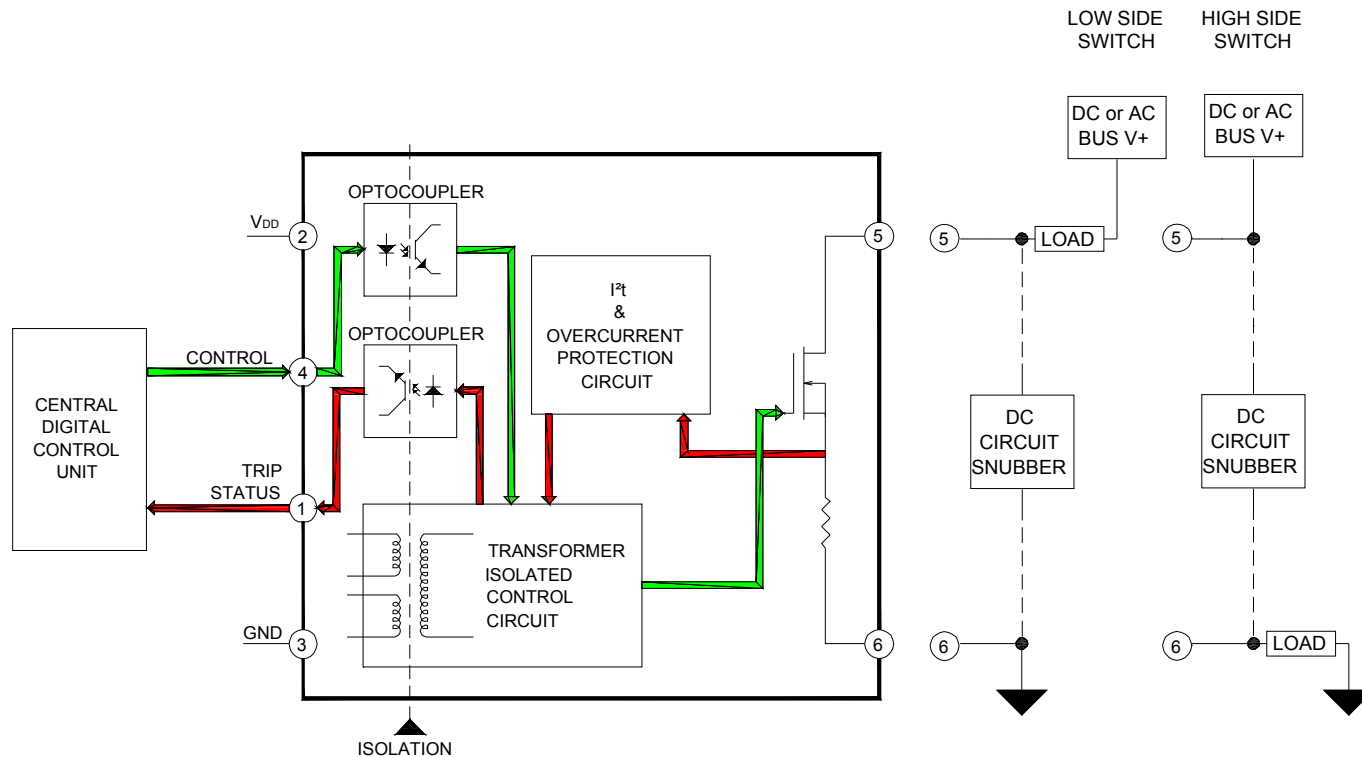


**FIGURE 4: TRIP CURVE for IPC01-400VDC5A.**

**Figure 3 & 4 Notes:**

1. Output currents are defined in the Must Trip / May Trip / Must Not Trip regions. Load fault current in the "ON" operating condition is limited by the source and load impedance.
2. Over current and fault trip currents terminate abruptly and may require external "snubbing" or clamping to prevent damage to the IPC.

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**FIGURE 5: Block Diagram and Function.**

High side (5) or low side (6) switch connections are facilitated by full isolation between Input Logic, Base Plate and Output Switch Connects.

Logic level Control input circuit drives an Opto-Coupler across the isolation to the switch circuits and a second Opto-Coupler returns a signal for the Open-collector Status Output. Control (4), Status (1),  $V_{DD}$  Input Power 5-32VDC (2) and GND (3) make up the Input isolation group.

A filtered DC to DC converter is driven from the input  $V_{DD}$  to power the secondary side circuits.

The Output circuit consists of Output MOSFETs connected at their sources through a current sense resistor and their Drains offered as the output switch.

In the DC version, the sense resistor is monitored by the  $I^2t$  detection circuit. A Fault Latch receives inputs from the  $I^2t$  detection circuit, the power supply and the control Opto-Coupler. Based on these inputs the Gates of the output MOSFETs are controlled. The Fault Latch also provides the Status signal.

In the AC version, an absolute amplifier rectifies the output current (voltage) of the sense resistor by the  $I^2t$  detection circuit. As in the case of the DC version, a Fault Latch receives inputs from the  $I^2t$  detection circuit, the power supply and the control Opto-Coupler. Based on these inputs the Gates of the output MOSFETs are controlled. The Fault Latch also provides the Status signal.

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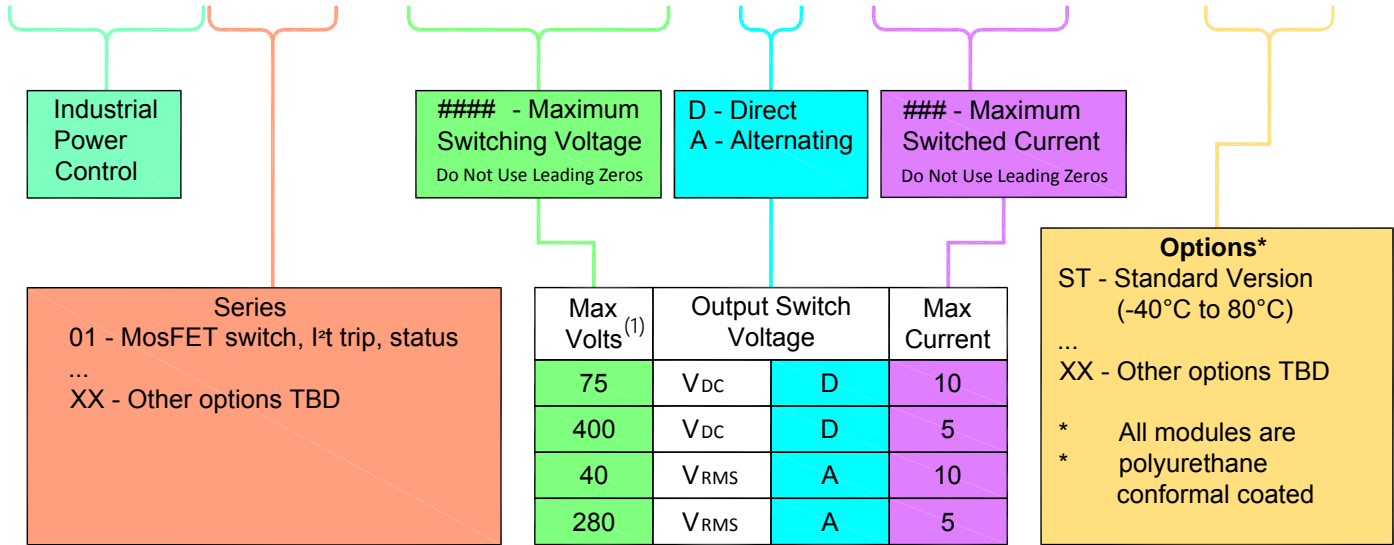


## Ordering / Part Number Structure

Example Part Number

IPC01-75VDC10A-ST

IPC01-####V\*C###A-\*\*



Notes: 1) Voltage range is from "0" volts to maximum volts specified.

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