

**Features:**

- Conformal coated open frame / PC Board design
- Light weight – 200 grams
- Operation temperature of -40°C to +85°C
- SPST, normally open DC power control
- MIL-STD-704E and MIL-STD-1760E compliant I<sup>2</sup>T overload protected output with Switch Status Output
- I<sup>2</sup>c telemetry reporting of Switch voltage, current and base-plate temperature
- Power MOSFET output with Low on-state resistance

**DESCRIPTION:**

This Isolated DC IPC is a low mass open construction DC switch intended for applications within an enclosure. In addition to load switching, the incorporated I<sup>2</sup>t overload protection / fault protection provides a circuit breaker function. A status output signals output switch conditions of On / Off and Overload. An I<sup>2</sup>c interface communicates switch voltage, current and base plate temperature.

Transformer and opto-coupling isolate the output to all Control / Status and Data lines and base plate to 1,500 VDC. Power MOSFETs output switch provides soft start and low On voltage drop for cool operation.

The Logic Control input operates from a bias supply of 18 to 32V.

This IPC combines the functionality of a relay and circuit breaker. Output current is monitored for over-current with an I<sup>2</sup>T trip curve. Fault currents beyond the I<sup>2</sup>T trip limits are terminated instantly. Over-current conditions include Over-Load and Shorted Output during Turn-On. An open-collector Output Status is available to indicate the State of the Output Switch MOSFETs. The output remains blocked until the short is removed and the unit reset. Output Status is an Active Low for Control Off or Tripped condition and High into a pull up resistance for a (Control High) Normally On Output State. Controlling the IPC Off then back on resets a Tripped condition.

**Application:**

- 270V 60A Power Switching

**ABSOLUTE MAXIMUM RATINGS**

|                                            |                                                                 |
|--------------------------------------------|-----------------------------------------------------------------|
| Isolation voltage .....                    | 1500 VDC                                                        |
| Load Voltage <sup>1</sup> .....            | 475 VDC                                                         |
| Load Current <sup>2</sup> .....            | Not more Than 5 Times Rated Operating Current / Self Protecting |
| Bias supply voltage, V <sub>DD</sub> ..... | -0.6 to 32 VDC                                                  |
| Control Voltage .....                      | 1 Volt above V <sub>DD</sub> / 1 Volt below Return              |
| Operating temperature .....                | -40°C to +85°C Case                                             |
| Storage temperature .....                  | -55°C to +125°C                                                 |

**Notes:**

<sup>1</sup> Reversing output polarity may cause permanent damage

<sup>2</sup> The (circuit breaker) I<sup>2</sup>t function immediately terminates surge currents per Figure 2 or 3.

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**ELECTRICAL CHARACTERISTICS:**  $T_C = -40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$  unless specified.

| PARAMETER                                                | TEST CONDITIONS                                        | MIN   | TYP            | MAX     | UNITS                |
|----------------------------------------------------------|--------------------------------------------------------|-------|----------------|---------|----------------------|
| <b>Output characteristics</b>                            |                                                        |       |                |         |                      |
| Operating Voltage                                        | *Intended system voltage                               |       | 270            |         | VDC                  |
| Continuous blocking voltage                              | Output device Rating                                   |       |                | 475     | VDC                  |
| Rated Output Current                                     | 270V system                                            |       |                | 50      | ADC                  |
| Output Current Shutdown                                  | 270V system (Figure 3)                                 | 50    | 60             | 70      | ADC                  |
| Load Start current for up to 50ms adjust range           | 270V system (Figure 3)                                 | 100   |                | 300     | ADC                  |
| Maximum On Stage Voltage drop                            | 25°C @ 50A (phase 1)                                   |       |                | 1.25    | VDC                  |
| On-state resistance, $R_{ds}$                            | 25°C @ 50A (phase 1)                                   |       |                | 0.025   | Ohms                 |
| Turn-on time / Rise Time                                 | Figure 2                                               | 0.2   | 4.0/1.0        | 5.0/3.0 | mS                   |
| Turn-off time / Fall Time                                | Figure 2                                               | 0.2   | 4.0/1.0        | 5.0/3.0 | mS                   |
| Maximum Off State leakage                                | @ Continuous Blocking Voltage                          |       |                | 500     | $\mu\text{A}$        |
| Snubbing                                                 | Internal between output connections                    |       |                | 7       | $\mu\text{H}$        |
| <b>Input characteristics</b>                             |                                                        |       |                |         |                      |
| <b>CMOS configurations (Figure 1)</b>                    |                                                        |       |                |         |                      |
| Bias supply range, $V_{DD}$                              | MIL-STD-704A Compliant (50V peak)                      | 18    | 28             | 32      | VDC                  |
| Bias current                                             |                                                        |       | 50             | 80      | mA                   |
| Control voltage range                                    |                                                        | -0.5  |                | 5.5     | VDC                  |
| Turn-on voltage                                          | Phase 1                                                |       | 2.9            |         | VDC                  |
| Turn-off voltage                                         | Phase 1                                                |       | 2.9            |         | VDC                  |
| <b>Status Output Specification</b>                       |                                                        |       |                |         |                      |
| Trip Reset Time                                          | Remove overload & Cycle input                          | 50    |                |         | mS                   |
| Status Supply Voltage (open Collector)                   | MIL-STD-704A Compliant                                 |       |                | 32      | VDC                  |
| Status off leakage current                               | $V_S = 15\text{ VDC}$                                  |       |                | 4       | $\mu\text{ADC}$      |
| Status on voltage                                        | $I_{\text{STATUS}} = 5\text{ MA @ }25^{\circ}\text{C}$ |       |                | 0.4     | VDC                  |
| High-To-Low Transition Time                              | $I_{\text{STATUS}} = 5\text{ MA}$                      |       | 20             | 50      | $\mu\text{S}$        |
| <b>General Specifications</b>                            |                                                        |       |                |         |                      |
| <b>@ 25°C</b>                                            |                                                        |       |                |         |                      |
| Dielectric withstanding                                  | Output to all Inputs and base                          | 1,500 |                |         | VDC                  |
| Junction temperature                                     |                                                        |       |                | 150     | $^{\circ}\text{C}$   |
| Thermal resistance, $\theta_{JC}$                        |                                                        |       |                | 0.13    | $^{\circ}\text{C/W}$ |
| Output Capacitance                                       |                                                        |       | 30,000         |         | pF                   |
| Input to Output Capacitance                              |                                                        |       | 250            |         | pF                   |
| <b>Data Communication I<sup>2</sup>C B / Phase 2 - 3</b> |                                                        |       |                |         |                      |
| Address                                                  | 4 bits / jumper programmable                           |       |                |         |                      |
| Data:                                                    |                                                        |       |                |         |                      |
| Switch Voltage / Resolution                              |                                                        |       | 0.0735V        |         | LSB                  |
| Switch Voltage / Accuracy                                |                                                        |       | $\pm 5\%$ F.S. |         |                      |
| Output Current / Resolution                              |                                                        |       | 25.5mA         |         | LSB                  |
| Output Current / Accuracy                                |                                                        |       | $\pm 5\%$      |         |                      |
| Temperature / Resolution                                 |                                                        |       | 0.0367°C       |         | LSB                  |
| Temperature / Accuracy                                   |                                                        |       | 2.0°C          |         |                      |
| Mass                                                     |                                                        |       |                | 200     | gram                 |

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## NOTES:

- 1) Minimum Commanded "Off" or "On" time is 100msec.
- 2) These IPCs have load current memory. Allow 100 seconds between overload or shorted load restarts for full current startup.
- 3) Input transitions should be "bounce-less contact" with transitions of <1 msec.
- 4) Inductive loads must be suppressed for operational command transients and Internal Fault shutdown times as short as 5 $\mu$ s.

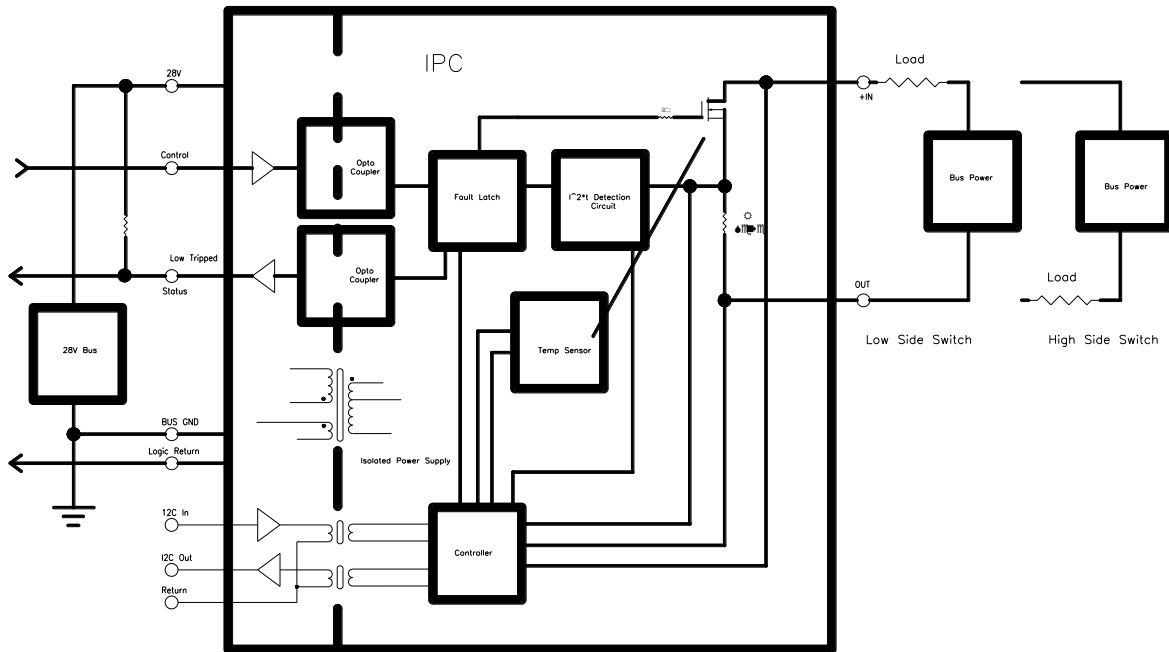
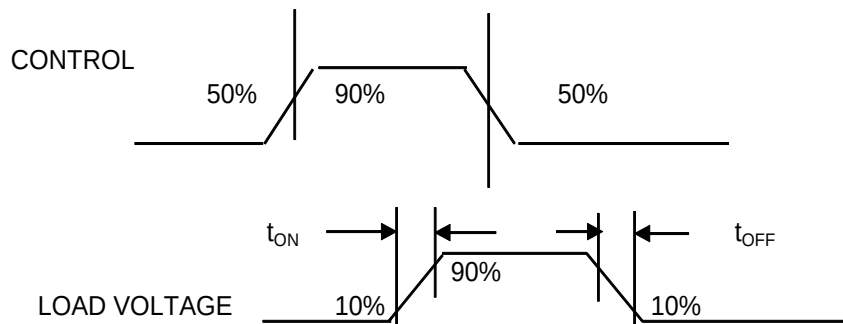


FIGURE 1

Full isolation between Input Logic, Output Switch Connects and Base allows high or low side switch connections.



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Figure 2 Switching Characteristics

|                       | Turn on into Short Sequence |         |     |     |          | Short while on Sequence |     |     |     |          |
|-----------------------|-----------------------------|---------|-----|-----|----------|-------------------------|-----|-----|-----|----------|
| <b>Control</b>        | 0                           | 1       | 1   | 0   | 1        | 1                       | 1   | 1   | 0   | 1        |
| <b>I out</b>          | Off                         | Off     | Off | Off | On       | On                      | Off | Off | Off | On       |
| <b>Switch Status</b>  | 0                           | 0       | 0   | 0   | Open "1" | Open "1"                | 0   | 0   | 0   | Open "1" |
| <b>Shorted Output</b> | Shorted                     | Shorted | X   | Off | Off      | Off                     | On  | X   | X   | Off      |

Truth Table – Short circuit and Status

## Notes:

- 1) Unit Powers up in the OFF condition with application of Primary power.
- 2) Fault Status reports only when Primary Power 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".

I<sup>2</sup>c Data Protocol:

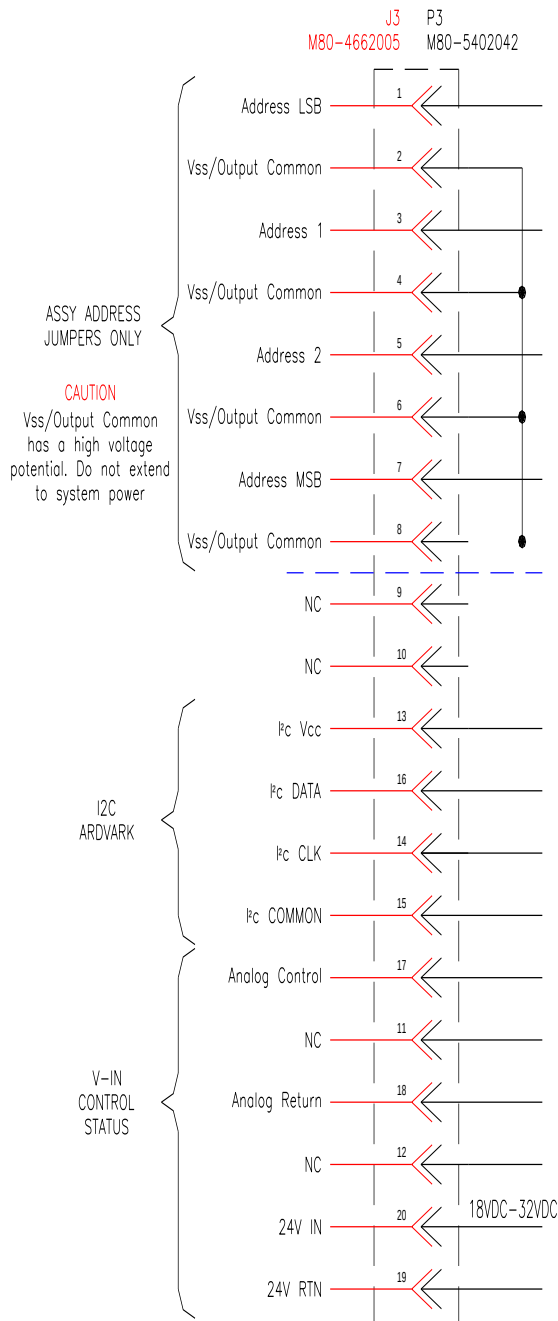
The data string is organized as a 8 byte string.

String (8 bytes)    Data

|   |                    |
|---|--------------------|
| 0 | LSB Status Input   |
| 1 | MSB Status Input   |
| 2 | LSB Switch Voltage |
| 3 | MSB Switch Voltage |
| 4 | LSB Current Output |
| 5 | MSB Current Output |
| 6 | LSB Temperature    |
| 7 | MSB Temperature    |

I<sup>2</sup>c address is 7 bits. The 4 bit address is located from bit 3, to bit 7. A cont of 10 is added to the incoming address to position the 4 hardwired bits. Over bits 3 to 7.

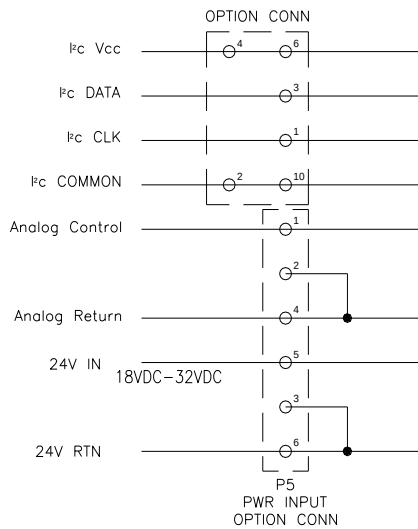
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### J3 / P3 Pin Assignment:

- 1... Address LSB.
- 2... V<sub>SS</sub> / Output Common.
- 3... Address 1.
- 4... V<sub>SS</sub> / Output Common.
- 5... Address 3.
- 6... V<sub>SS</sub> / Output Common.
- 7... Address MSB.
- 8... V<sub>SS</sub> / Output Common.
- 9, 10, 11, 12... No Connect – isolation barrier.
- 13... I<sup>2</sup>c Vcc – 3.3V out or 5.5V max in.
- 14... I<sup>2</sup>c CLK.
- 15... I<sup>2</sup>c Common – Return.
- 16... I<sup>2</sup>c Data.
- 17... Analog Control.
- 18... Analog Return.
- 19... 24V Return.
- 20... 24V In.

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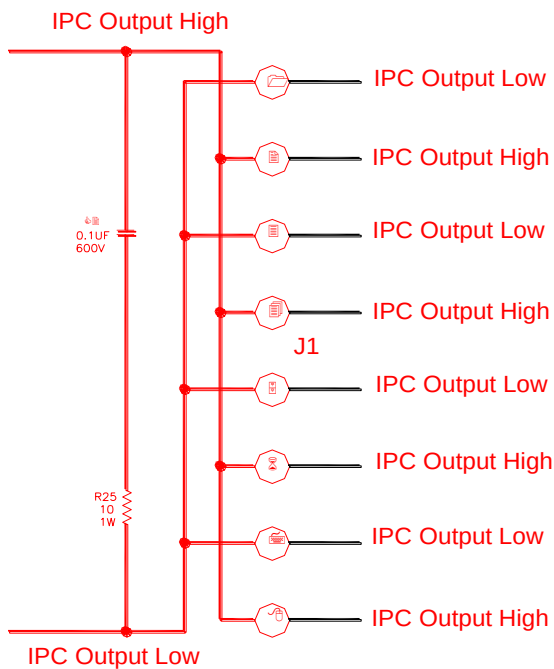
P6... I<sup>2</sup>c Arrdvark TP240141 I<sup>2</sup>c/SPI:  
Pin Assignment (un-modified)

- 1... I<sup>2</sup>c Clock
- 2, 10... I<sup>2</sup>c Common
- 3... I<sup>2</sup>c Data
- 4, 6... I<sup>2</sup>c VCC

P5... Analog signals and Power:

- 1... Analog Control.
- 2, 4... Analog Common, Return.
- 5... 24V In. (18VDC to 32VDC).
- 3, 6... 24V Return.

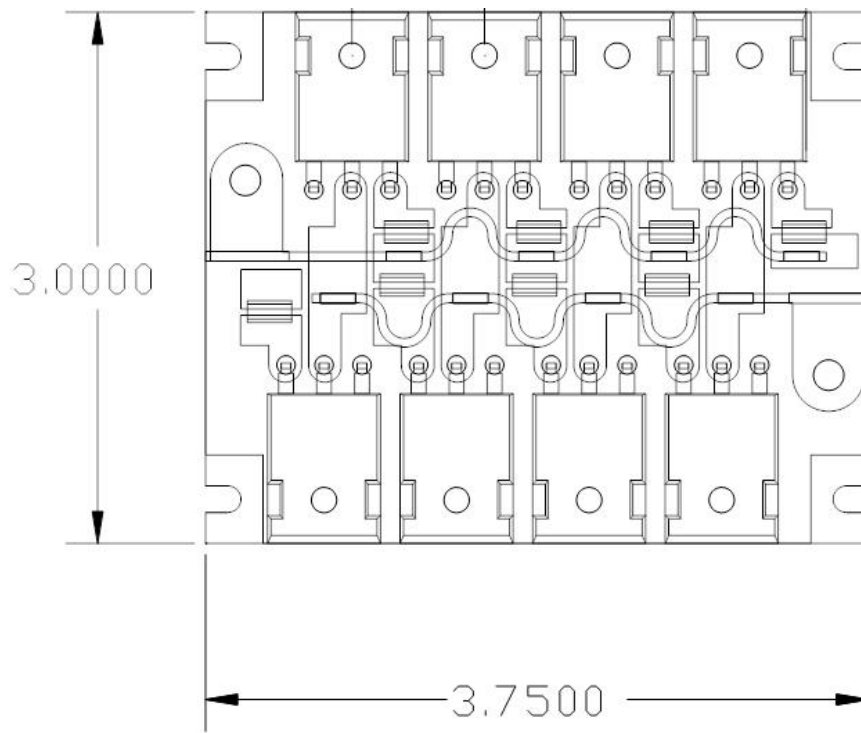
NOTE: Analog Return and 24V Return are not connected at the Power Controller to prevent ground loops at system level. These points must be connected external to the Power Controller for correct operation.



Output Connections:

- 1, 3, 5, 7... Output Switch Connections – Most negative.
- 2, 4, 6, 8... Output Switch Connections – Most positive.

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**Package Dimensions**

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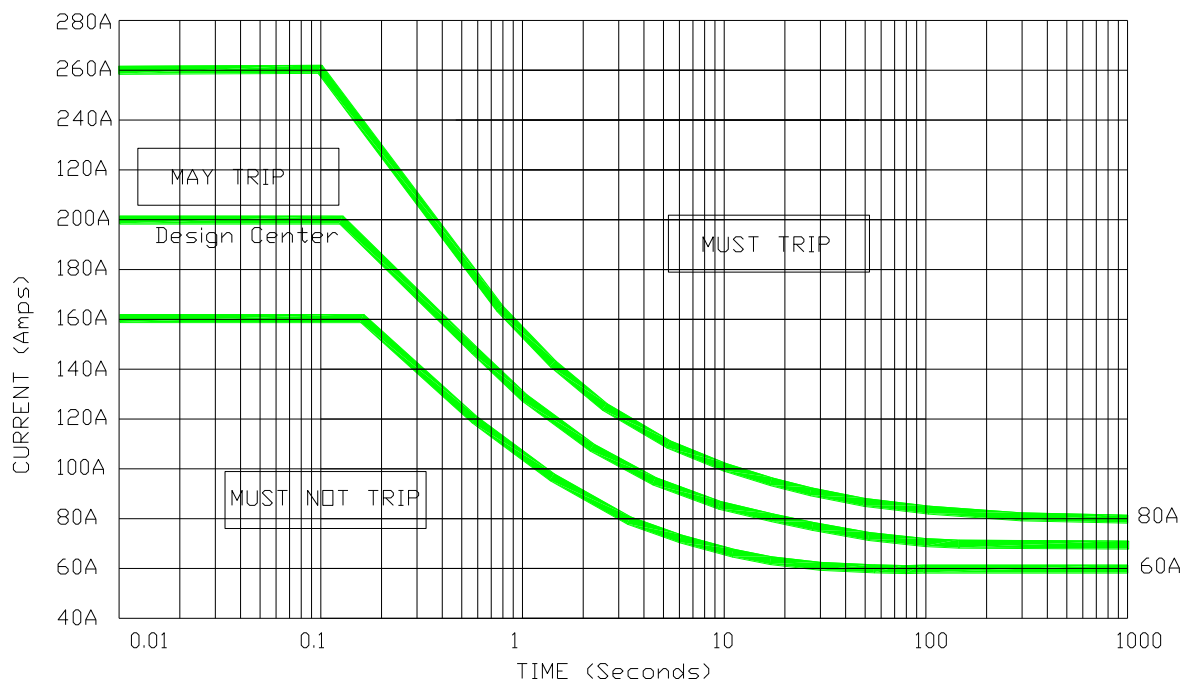


FIGURE 3

**TRIP CURVE NOTES:**

- 1) Output currents are interrupted in the Must Trip / May Trip / Must Not Trip per the following graph.
- 2) Output (sustaining) Current is 60 to 80A.
- 3) Load fault current from the "ON" operating condition are limited by the source and load impedance.
- 4) Over current and fault trip currents terminate abruptly and are snubbed for up to 3μH of load inductance.

**Product Status:**

This document contains information on a product under development. Micropac reserves the right to change this product.

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