# 53502

## HIGH SIDE LATCHING SOLID STATE POWER CONTROLLER

*Mii*

**MICROCIRCUITS DIVISION**

**Features:**

- Switch Status Output
- I$^2$t Circuit Protection
- SPST, Normally Open
- 1A, 2A Pin Configurable Operating Current for 100V Version
- 1 or 2A Operating Current for 250V to 500V Versions
- Power FET Output with Low On-State Resistance
- Full Military Temperature Operation: -55ºC to +125ºC.
- Radiation Hardened capable.
- Military Environmental Screening Available

**Applications:**

- Ideal for 28V, 150V and 270V bus applications
- Aircraft Power Distribution
- Military/High Reliability Systems
- Satellite/Space Systems

## DESCRIPTION

The 53502 Solid State Power Controllers are lightweight, resistant to damage from shock and vibration, and immune to contact-related problems (contamination, arcing) associated with mechanical equivalents. They are offered as a Bus powered Version (Pin Out A) with configurable 1A / 2A Outputs for Bus voltages to 100V, 250V, 400V and 500V Versions or offered as a single output Current of 1 or 2A and a Power Bias input of 5, 12 or 15V (Pin Out B).

Transformer coupling between the input and output stages provides effective isolation up to 1000 V RMS. The Power FET output eliminates bipolar offset and minimizes output voltage drop.

The preferred control input is CMOS compatible operating from a bias supply of 4.5 to 5.5VDC. (See Figure 1)

Integral short-circuit protection, I$^2$T trip and output status is provided. This 100V unit is pin configurable for 1A or 2A output and the 250, 400 and 500V Units are set to 1 or 2A output. The output current flow is sensed while under load or while switching, and responds to an over-current with an I$^2$T trip curve by opening the output. An open-collector output status is available to indicate the switch state. The output will remain blocked indefinitely until the short is removed and the unit reset. This feature prevents damage to the controller and also averts further system failures that may be caused by the short circuit. Output Status is On (High) when the output is switched on and is Off (Low) whenever the output is commanded off or tripped. Resetting the unit is accomplished by recycling the input control.

These devices are available in a variety of quality levels from COTS to class K including any custom screening requirements and all components have radiation-hardened equivalents. The basic data sheet part is environmentally screened to H level in accordance with Table C-IX of MIL-PRF-38534 with no element evaluation or QCI.

## ABSOLUTE MAXIMUM RATINGS

Isolation voltage[1].................................................................................................................................1000 V RMS
Continuous operating output voltage[2] ...............................................................................100, 250, 400 or 500 VDC
Transient output voltage…………………………………………………………………… .....100, 250, 400 or 500 VDC
Load Current .......................................................................................................................................18A / Self Limiting
Bias supply voltage, $V_{DD}$ ............................................................................................................... 4.5 to 5.5 VDC
Operating temperature ..........................................................................................................-55ºC to +125ºC Case
Storage temperature ........................................................................................................................-55ºC to +125ºC

**Notes**:
[1] 60 Hz sine wave
[2] Reversing polarity on the output may cause permanent damage

## ELECTRICAL CHARACTERISTICS

$T_A$ = +25° C

| PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|
| **Input characteristics** | | | | | |
| **CMOS configurations (Figure 1)** | | | | | |
| Bias supply range, $V_{DD}$ | | 3.3 | | 5.5 | VDC |
| Bias current | Note 5 | | 5 | 10 | mA |
| Input current | 5 VDC Input | | | 500 | μA |
| Control voltage range | | -0.5 | | 5.5 | VDC |
| Turn-on voltage | At $V_{DD}$ = 5.0V | | 2.8 | 3.2 | VDC |
| Turn-off voltage | At $V_{DD}$ = 5.0V | 0.5 | 2.0 | | VDC |
| Dielectric strength | 60 Hz | 1000 | | | V RMS |
| Bus Return Bias Current: | 28V **Bus Voltage** | | 10 | 20 | mA |
| **Output characteristics** | | | | | |
| Output current, sustaining: | Steady state load | 1.2 / 2.4 | | 2.4 / 4.8 | A |
| Continuous blocking voltage | | | | 50 | VDC |
| On-state resistance, $R_{ds}$ (1A Configuration) | 25ºC Case | | See Table 1 | | Ohms |
| On-state resistance, $R_{ds}$ (2A Configuration) | 25ºC Case | | See Table 1 | | Ohms |
| Turn-on time @ 25ºC case | Figure 2 | | 0.8 | 2.0 | mS |
| Turn-off time @ 25ºC case | Figure 2 | | 0.5 | 1.0 | mS |
| Off-state leakage | At Rated Voltage | | 40 | 100 | μA |
| Output Capacitance | | | | 700 | pF |
| Load Start current | 25ºC | 6/12 | 7.5/15 | 9/18 | A |
| Short-circuit peak | | | | 100 | A |
| Trip Reset Time | Remove short / overload & Cycle input | 50 | | | mS |
| Status Output Specification Status Supply Voltage (open Collector) | | 5.0 | | 32 | VDC |
| Status off leakage current | VS = 30 VDC | | | 100 | μADC |
| Status off leakage current | VS = 15 VDC | | | 4 | μADC |
| Status on voltage | $I_{STATUS}$ = 5 MA | | | 0.4 | VDC |
| High-To-Low Transition Time | $I_{STATUS}$ = 5 MA | | 20 | 50 | μS |
| Junction temperature | | | | 150 | ºC |
| Thermal resistance, $\theta_{JA}$ | | | | 30 | ºC/W |
| $\theta_{JC}$ | | | | 5 | ºC/W |

APPLICATION NOTES:
1. Maximum input switching frequency not to exceed 10 Hz under normal conditions, or .5 Hz if output is shorted.
2. Input transitions should be <1 ms and duration and input source should be "bounceless contact" type.
3. Inductive loads must be suppressed.
4. Peak current that may flow when output is shorted.
5. Current from the Bus input on 100V units, Current to Bias input on 250, 400 and 500V units.

**Table 1**

| | 1A | 2A |
|---|---|---|
| | $R_{DS}$ On @ 25°C | Max |
| 100V | .1Ω | .075Ω |
| 250V | .15Ω | .12Ω |
| 400V | .35Ω | .30Ω |
| 500V | .45Ω | .4Ω |

Connect 6,7 or 7,8 for 1A
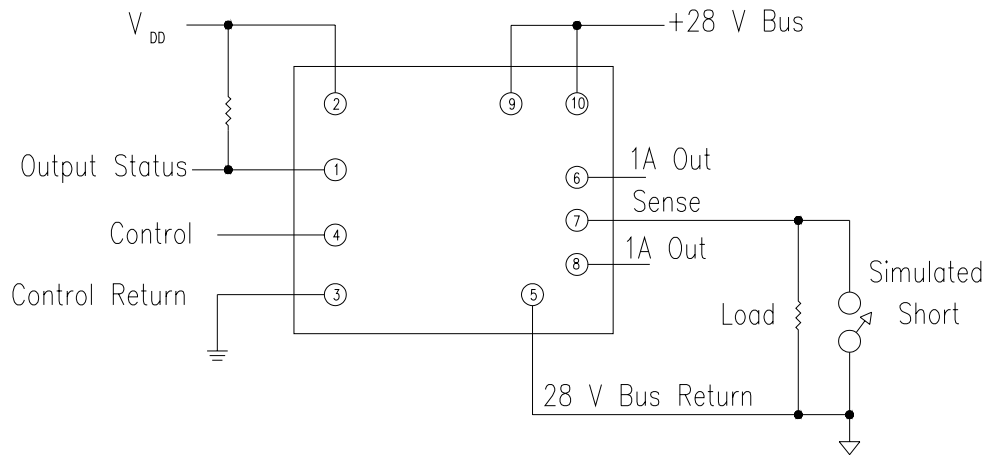Connect 6,7,8 for 2A



FIGURE 1

Figure 1 Typical Connection Diagram
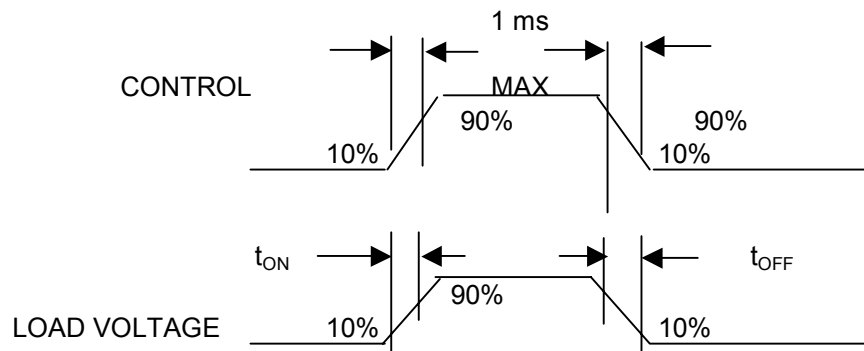for 100V Versions



Figure 2 Switching Characteristics

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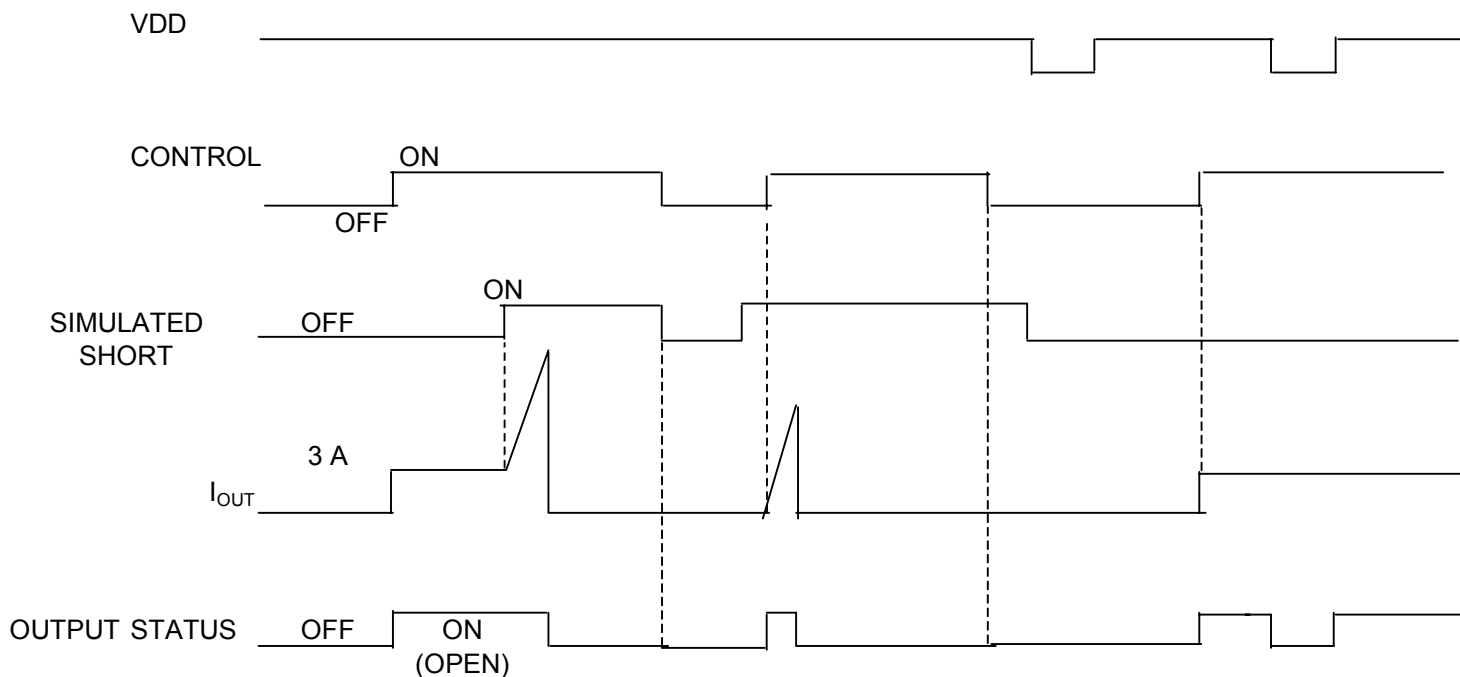
Figure 3 - TIMING DIAGRAM

Note 1: A turn-off into a short produces an increase in current to the initial $I^2T$ must trip value.
Note 2: Shorted while On from any On operating condition can have a $\mu s$ surge current of as much as 100A.
Note 3: Loss of and re-application of Bus power will result in a re-start (output open & Output Status low.)
Note 4: Output Status signal assumes a pull-up voltage is always present to produce a "1" when status is open.
Note 4. Latching feature on 250, 400, and 500V versions is dependant upon uninterrupted Bias Power.

Truth Table – Power Sequencing

| Bus Voltage | 0 | On | 0 | ⌐ (rising edge) | ⌐ (rising edge) | On | On |
|---|---|---|---|---|---|---|---|
| **V$_{DD}$** | 0 | 0 | On | ⌐ (rising edge) | ⌐ (rising edge) | ⎍ (pulse low) | ⎍ (pulse low) |
| **Control** | X | X | X | 0 | ⌐ (rising edge) | X | X |
| **I Out** | Open | Open | Open | Open | ⌐ (rising edge) | 0 | 1 |
| **Output Status** | Open "1" | Open "1" | 0 | 0 | ⎍ (pulse low) | ⎍ (pulse high) | Open "1" |
| **Short** | X | X | X | Off | Off | Off | Off |
| | | (Note 1) | (Note 1,2) | (Note 3) | (Note 3,4) | (Note 5) | (Note 5) |

Truth Table – Short circuit and Status

| | Turn on into Short Sequence | | | | | Short while on Sequence | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Control** | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 |
| **I out** | Off | Off | Off | Off | On | On | Off | Off | Off | On |
| **Output Status** | 0 | 0 | 0 | 0 | Open "1" | Open "1" | 0 | 0 | 0 | Open "1" |
| **Shorted Output** | Shorted | Shorted | X | Off | Off | Off | On | X | X | Off |

Note 1: Unit Powers up in the Off condition with application of either Bus power (Bias Power for 250, 400 or 500V Units) or V$_{DD}$.

Note 2: Output Status reports only when V$_{DD}$ is present.

Note 3: Control "0" Off must be invoked upon simultaneous applications of 5V and Bus Power for an unambiguous output and fault status.
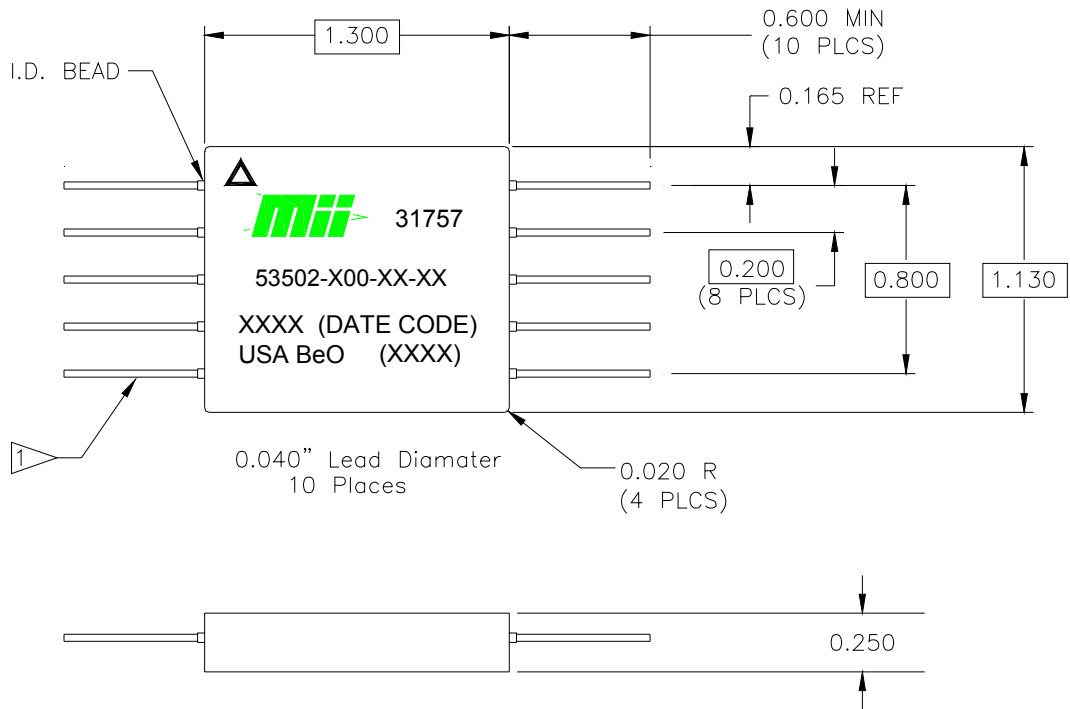
Note 4: An Off Control to On Control transition is required to first turn the Unit On.

Note 5: Loss of V$_{DD}$ will not change output state (with the presence of Bias Power on 250, 400 and 500V units).

Note 6: Truth Table-Power sequencing: Output Status open collector pull-up resistor is assigned a separate and always present voltage, producing a "1" when "Open".

**Package Dimensions**



| IN | 100V<br>CONNECTION | 250, 400, 400V<br>CONNECTION |
|---|---|---|
| 1 | OUTPUT STATUS | OUTPUT STATUS |
| 2 | $V_{DD}$ | Vdd |
| 3 | CONTROL RETURN | CONTROL RETURN |
| 4 | CONTROL | CONTROL |
| 5 | BUS RETURN | POWER BIAS RETURN |
| 6 | OUT (1A) | POWER BIAS |
| 7 | OUT SENSE | OUTPUT |
| 8 | OUT (1A) | OUTPUT |
| 9 | + BUS | +BUS |
| 10 | + BUS | +BUS |

Note: For 1A output, connect Pins 6 and 7 or Pins 7 and 8; for 2A output connect Pins 6, 7 and 8.

NOTES:
1) Initial current limits (NO TRIP and MUST TRIP) will be 6 and 9A for each of the 1A outputs.
2) 1A Output (Case pins 6 and 7 connected together). Output current per graph.
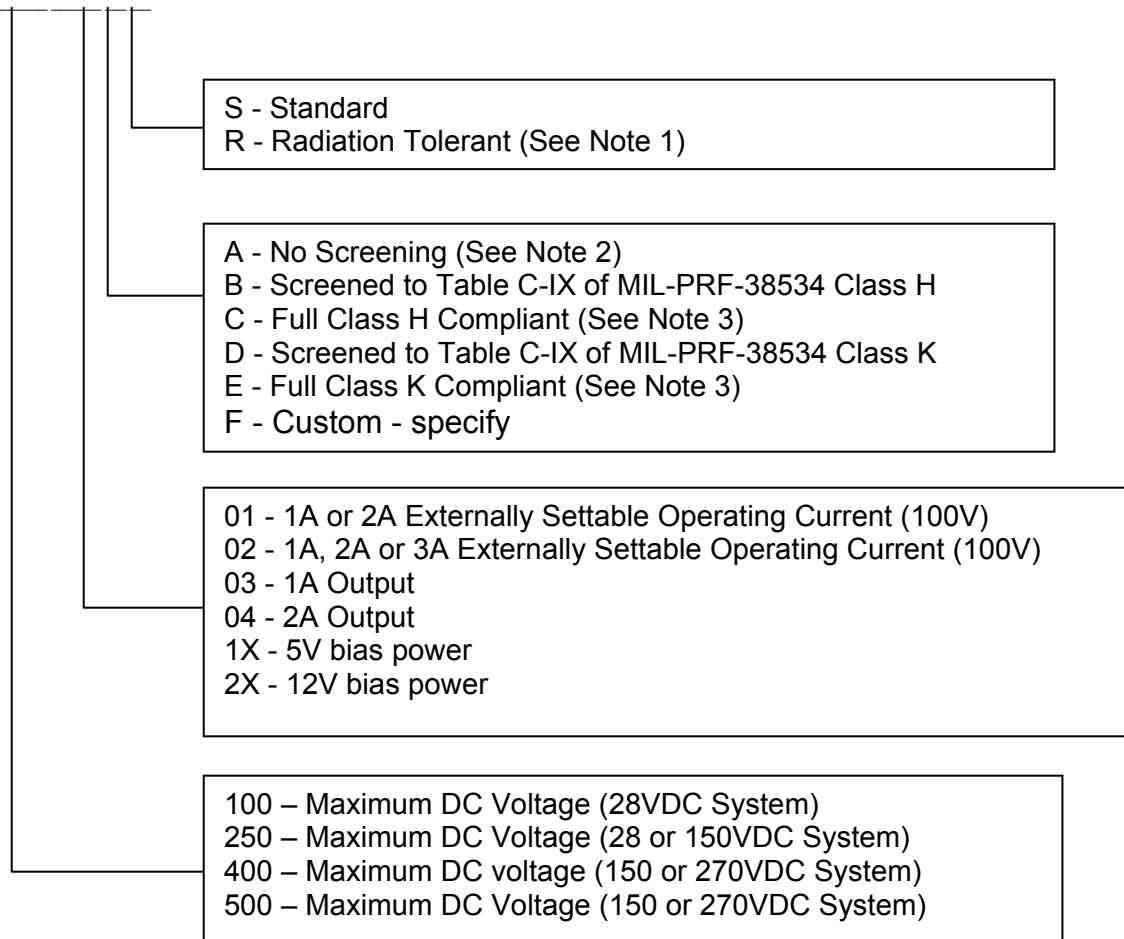3) 2A Output (Case pins 6, 7 and 8 connected together). Output current two times values of graph.



CURRENT (Amps) per Output

## Ordering Information:

**MPC-53502-XXX-XX-XX**

S - Standard
R - Radiation Tolerant (See Note 1)

A - No Screening (See Note 2)
B - Screened to Table C-IX of MIL-PRF-38534 Class H
C - Full Class H Compliant (See Note 3)
D - Screened to Table C-IX of MIL-PRF-38534 Class K
E - Full Class K Compliant (See Note 3)
F - Custom - specify

01 - 1A or 2A Externally Settable Operating Current (100V)
02 - 1A, 2A or 3A Externally Settable Operating Current (100V)
03 - 1A Output
04 - 2A Output
1X - 5V bias power
2X - 12V bias power

100 – Maximum DC Voltage (28VDC System)
250 – Maximum DC Voltage (28 or 150VDC System)
400 – Maximum DC voltage (150 or 270VDC System)
500 – Maximum DC Voltage (150 or 270VDC System)

NOTES:
1. Devices are radiation tolerant by design but are not lot tested. Micropac does not guarantee performance to any radiation level. Individual lots must be tested to guarantee performance.
2. Devices are electrically tested at -55°C, +25°C and +125°C with no environmental screening or qualification.
3. Fully compliant Class H or Class K devices will require Element Evaluation and QCI.
4. The 53502 SSPC will support xx Amp Operating Current up to xxx Volts (max.) For voltage and current requirements above this level please refer to the 53503 and 53504 datasheets.
5. Contact factory for custom voltage, current and feature combinations.

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Pg. 8 of 8