Dual USB Overcurrent Switch 750mA (V_{CC}) / 100mA (V_{SBY})

Features

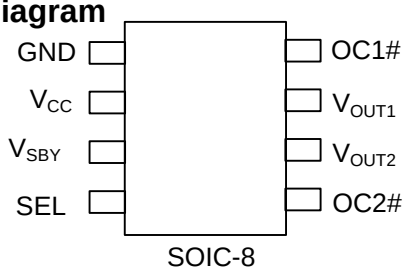
- Dual outputs, each with independent over-current protection circuitry and indicator
- Supports standby mode in PCs so that a peripheral can ramp down safely to a current <100mA
- Low ON-resistance switches
- Up to 750mA (V_{CC}) / 100mA (V_{SBY}) continuous current on each output
- Over-current limits at 750mA / 100mA respectively
- 10msec min fault blanking delay on OC# outputs prevents false overcurrent alarms
- Prevents backdrive current when host powered off
- Low operating current (95µA typ.)
- Low quiescent current when disabled (<1µA max)
- Small 8-Lead SOIC package

Applications

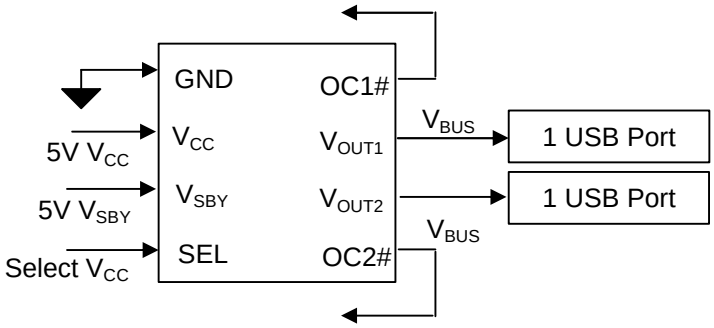
- PC motherboards with USB ports (i.e., can use a CM3501 for 2 ports or 2 CM3501s for 4 ports, etc)

The CM3501 also prevents backdrive current flowing into the host from the connected peripheral. This can occur when V_{CC} is removed as the host powers down, and the peripheral still has normal power applied. The 5V from the peripheral can therefore be linked to the host's V_{BUS}, potentially causing backdrive current into the host and overloading the peripheral power supply.

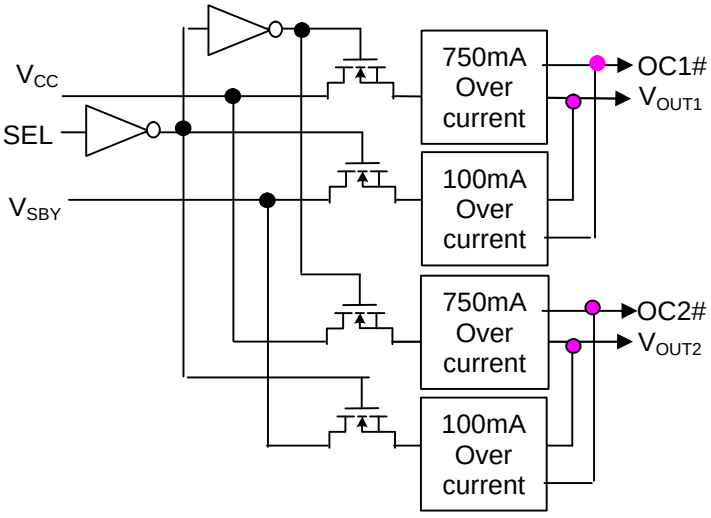
Pin Diagram



Typical Application Circuit



Simplified Electrical Schematic



Product Description

California Micro Devices' CM3501 is a dual port USB overcurrent power switch that selects between two independent 5V inputs available on a PC, depending on the state of a logic input (SEL). The device has two pairs of power switches, and each pair is an analog "OR" function, providing a continuous voltage at both outputs during power transfer beween inputs.

V_{CC} is the main 5V supply, which can be disabled in a PC, and V_{SBY} is the 5V standby supply which is powered up whenever the PC has power. When the 'SEL' pin is at logic high, V_{CC} is the assigned input power supply. When 'SEL' is at logic low, V_{SBY} is used to power the output, and no current is taken from V_{CC}. Both switches can be deselected and switched off by not driving (floating) the 'SEL' input, which places the chip in low power mode.

Both pairs of switches have over-current protection. Depending on whether 'SEL' is high or low, a current over 750mA or 100mA respectively out of either output causes the device to enter a constant-current mode, where the output voltage is progressively reduced to prevent the current from increasing further. Each output is independent of the other, so if one of the switches is switched on but is not in overcurrent mode then it will remain switched on. The OC# output becomes active only if the overcurrent condition exceeds a minimum continuous duration of 10ms.

If the overcurrent condition is severe enough that the part heats up to the thermal limit T_{MAX}, the switch turns off and the temperature cools down to T_{MIN}. The switch then turns on again, and the device heats up again, and so on, until the fault is removed.

C0970500

Absolute Maximum Ratings		
Parameter	Rating	Unit
ESD Protection (All pins, HBM)	± 2000	V
V_{CC}, V_{SBY} Input Voltage	+ 5.6, GND - 0.5	V
Storage Temperature Range Operating Ambient Operating Junction	-55 to +150 -40 to +85 -40 to +150*	°C
Output Current Loading	Internally limited	A
Package Power Dissipation	0.5	W

* - Internally limited

Operating Conditions (unless specified otherwise)		
Parameter	Range	Unit
V_{CC}, V_{SBY} Input Voltage	4.5 to 5.5	V
Ambient Temperature	-40 to +85	°C
I_{LOAD} per port V_{CC} V_{SBY}	0 to 750 0 to 100	mA

Electrical Operating Characteristics (over operating conditions unless specified otherwise)						
Symbol	Parameter	Conditions	MIN	TYP	MAX	UNIT
UVLO	V_{CC}/V_{SBY} voltage under which circuit locks out - will not operate	T=25°C		2.2	2.5	V
V_{OUT1}, V_{OUT2}	Output Voltage	I_{LOAD} = 500mA, V_{CC} = 5.0V, SEL = 5V, T = 25°C	4.9			V
R_{SW1}	V_{CC} Switch ON-Resistance	I_{LOAD} = 0 to 750mA; V_{CC} = 5V T=25°C		0.13	0.20	Ω
R_{SW2}	V_{SBY} Switch ON-Resistance	I_{LOAD} = 0 to 100mA; V_{SBY} = 5V T = 25°C			1.4	Ω
$I_{LIM\ VCC}$	V_{CC} over-current limit	V_{CC} = 5V	750			mA
$I_{LIM\ VSBY}$	V_{SBY} over-current limit	V_{SBY} = 5V	100			mA
t_{FBD}	Time delay from overcurrent detection to OC output indication (fault blanking delay)		10	20		ms
T_{MAX}	Temperature at which hot switch turns off during overcurrent			150		°C
T_{MIN}	Temperature at which cool switch turns on, after cooling from T_{MAX}			125		°C
$I_{R\ CC}$ $I_{R\ SBY}$	Reverse leakage from outputs to inputs – backdrive current	V_{CC} = 0V, V_{OUT} = 5V, SEL floating V_{SBY}= 0V, V_{OUT} = 5V, SEL floating		1 1		µA
$I_{CC\ ON}$	V_{CC} operating supply current	V_{CC} = 5V, SEL = high, I_{LOAD} = 0mA		95		µA
$I_{SBY\ OFF}$	V_{SBY} standby supply current	V_{SBY} = 5V, SEL=high, I_{LOAD} = 0mA		1		µA
$I_{SBY\ ON}$	V_{SBY} operating supply current	V_{SBY} = 5V, SEL = low, I_{LOAD} = 0mA		95		µA
$I_{CC\ H\ Q}$	V_{CC} higher, quiescent current	V_{CC} = 5V, V_{SBY} < V_{CC}, SEL floating		40		µA
$I_{SBY\ L\ Q}$	V_{SBY} lower, quiescent current	V_{CC} = 5V, V_{SBY} < V_{CC}, SEL floating		1		µA
$I_{CC\ L\ Q}$	V_{CC} lower, quiescent current	V_{CC} = 5V, V_{SBY} >V_{CC}, SEL floating		1		µA
$I_{SBY\ H\ Q}$	V_{SBY} higher, quiescent current	V_{CC} = 5V, V_{SBY} >V_{CC}, SEL floating		40		µA
$V_{IH\text{-}EN}$	EN# input Logic-1 threshold	V_{CC} = 5V	2			V
$V_{IL\text{-}EN}$	EN# input Logic-0 threshold	V_{CC} = 5V			0.8	V
$V_{OL\text{-}OC}$	OC# output Logic-0 threshold	I_{OC} = 1mA to V_{CC}			0.4	V

Pin Functions

V_{CC} is the higher current power source. Whenever the SEL pin is above 2V it will be selected, and V_{SBY} will be deselected.

V_{SBY} is the lower current power source. Whenever the SEL pin is below 0.8V it will be selected, and V_{CC} will be deselected. The two V_{SBY} power switches can only supply 100mA.

V_{OUT1} provides the power for a USB port. The internal MOSFET switches are designed for low voltage drops from the voltage input pins at their full rated currents.

V_{OUT2} provides the power for a second USB port. The internal MOSFET switches are designed for low voltage drops from the voltage input pins at their full rated currents.

Current loads of up to 750mA are allowed (from Vcc). Current loads above 750mA may cause the constant-current limiting circuit to operate – reducing the output voltage.

Continuous over-current loads will cause the part's internal temperature to rise. If the internal temperature exceeds 150'C then any switch that is in overcurrent mode will be immediately turned off. Any switch that is not in overcurrent mode will remain on – it will not be affected by the over-temperature detection. Once the part has cooled to 125'C then the switch or switches that were in overcurrent mode will be automatically turned on again.

During the cold-start interval when the input is initially applied, internal circuitry provides a soft turn-on for the switches, which limits peak in-rush current.

SEL is the 3-level logic input pin that is used to control which of the power switch pairs are turned on. Set SEL high to select V_{CC}, set SEL low to select V_{SBY}, or allow SEL to float to deselect both power switches. The external device driving the SEL pin must able to source and sink 100µA while maintaining the proper V_{IL}/V_{IH} levels.

OC1#, OC2# are independent, active low open-drain outputs, indicating an overcurrent fault condition has been detected at V_{OUT1} or V_{OUT2}. There is a built-in 10msec (min.) fault blanking period after the overcurrent fault condition has been detected, before these outputs become active. The OC# outputs become deasserted only when both the overcurrent condition stops and when the voltage drop across the switch is less than 1V. External pull-up resistors of 10k - 100k are required if the OC# outputs are used.

GND is the negative reference for all voltages.

Pin Functions

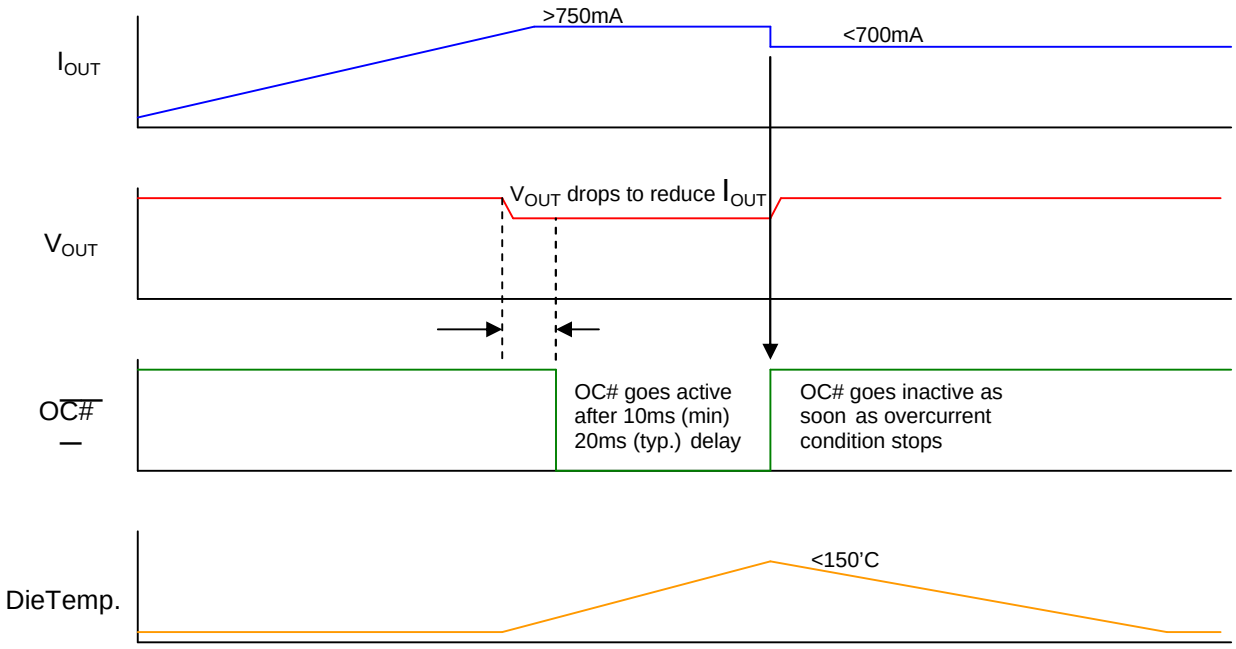
Pin No.	Symbol	Description
1	GND	Negative reference for all voltages.
2	V_{CC}	High current positive supply input.
3	V_{SBY}	Standby positive supply input. Also provides internal power.
4	SEL	3-level logic input. High = V_{CC}, Low = V_{SBY}, Floating = both off
5	OC2#	Active low when V_{OUT2} is in overcurrent mode.
6	V_{OUT2}	Output voltage internally switched to either V_{CC} or V_{SBY} input source.
7	V_{OUT1}	Output voltage internally switched to either V_{CC} or V_{SBY} input source.
8	OC1#	Active low when V_{OUT1} is in overcurrent mode.

STANDARD PART ORDERING INFORMATION

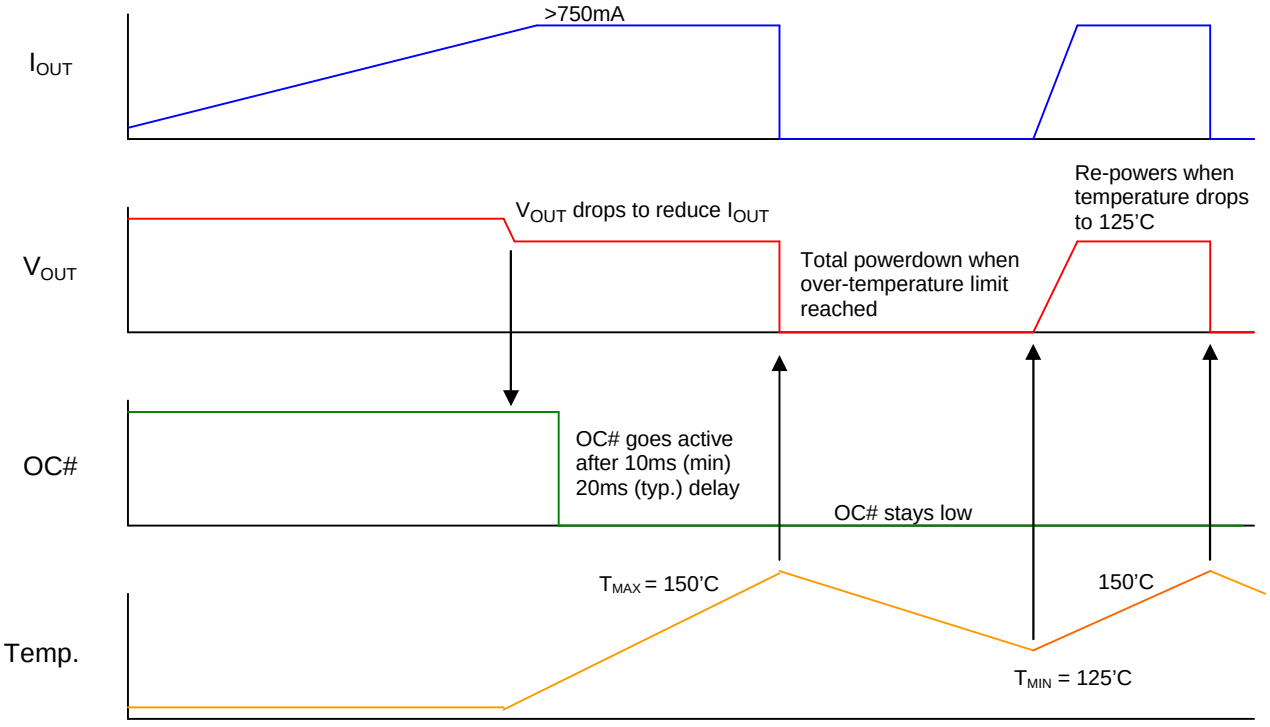
Pins	Package	Ordering Part Number[1]	Part Marking
8	SOIC	CM3501-02SN	CM3501-02SN

Note 1: Parts are shipped in Tape & Reel form unless otherwise specified.

OC# Response to Momentary Overcurrent Fault

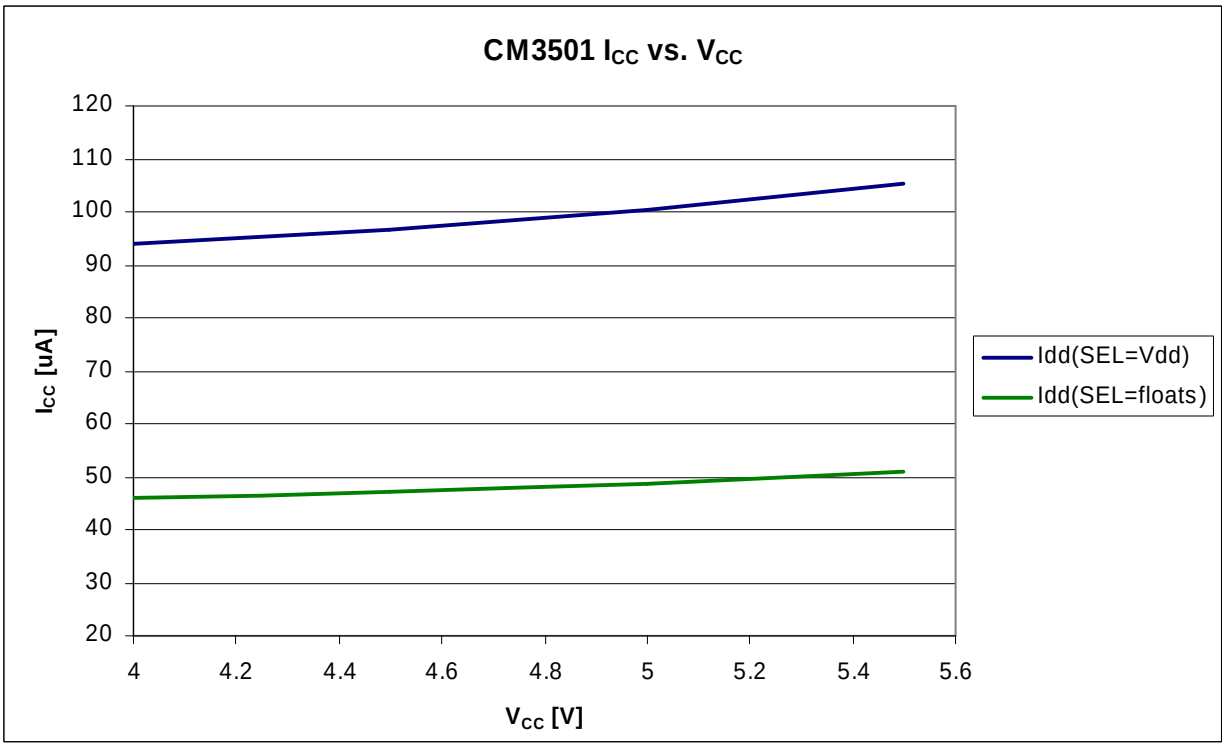


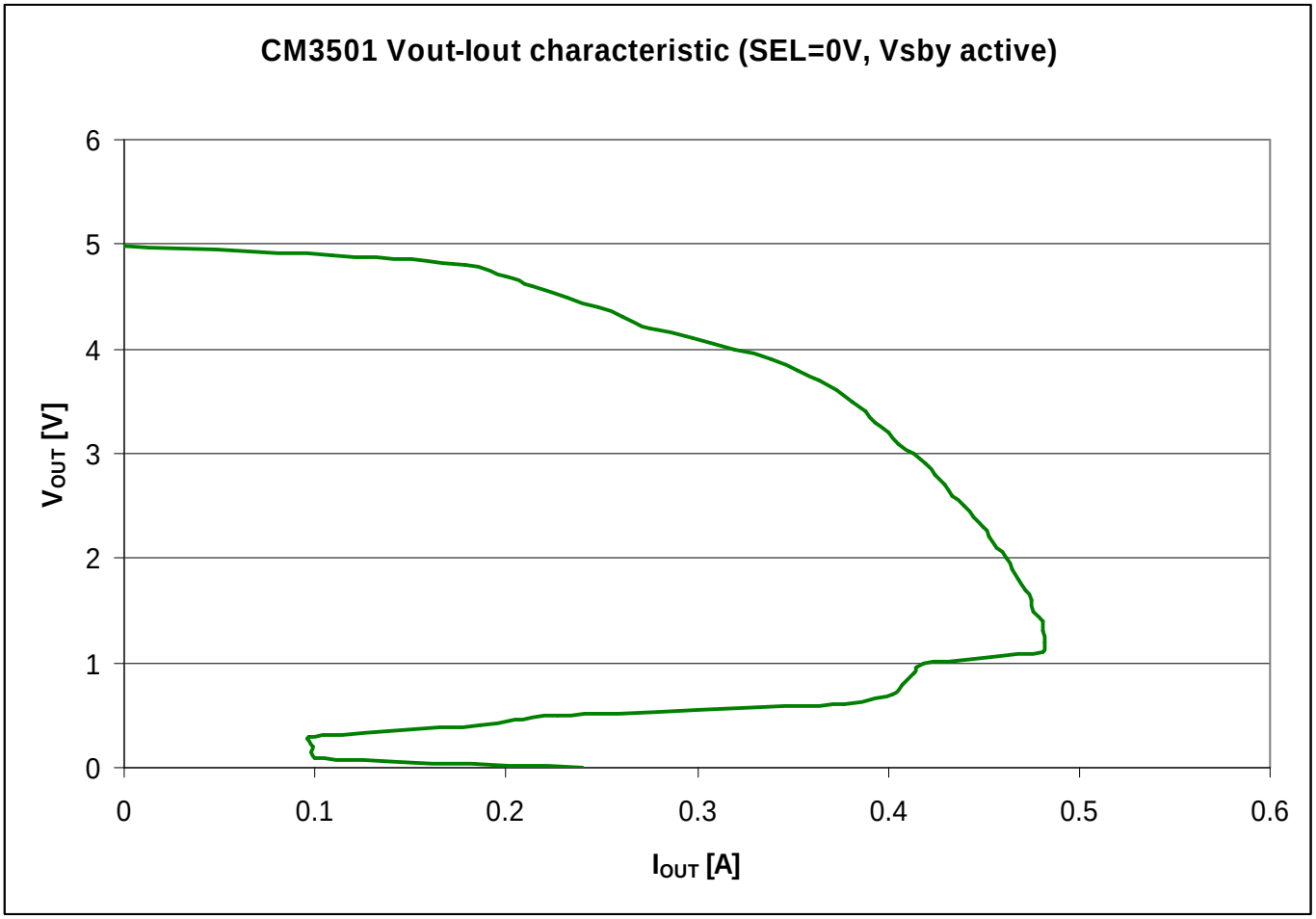
OC# Response to Continuous Overcurrent Fault

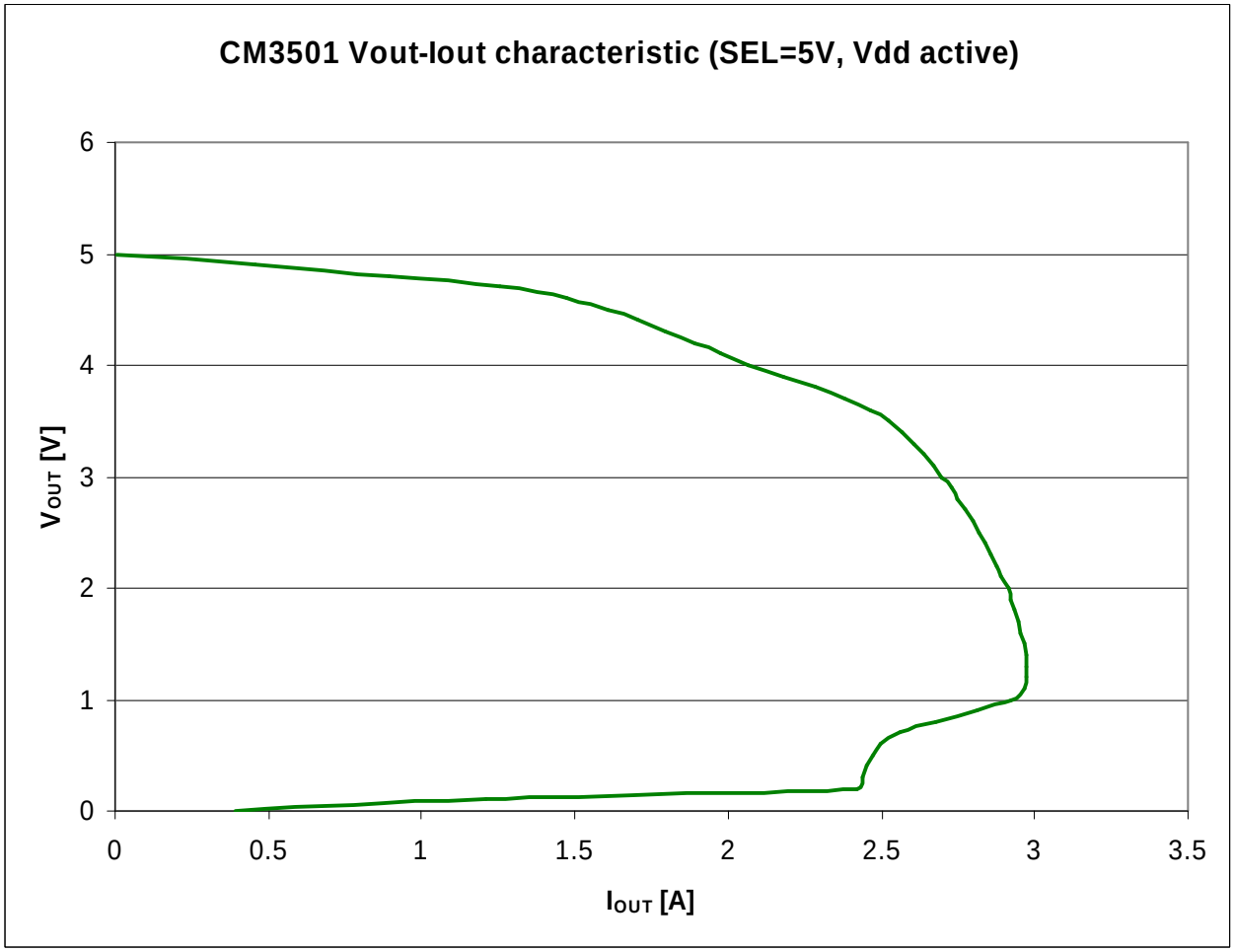


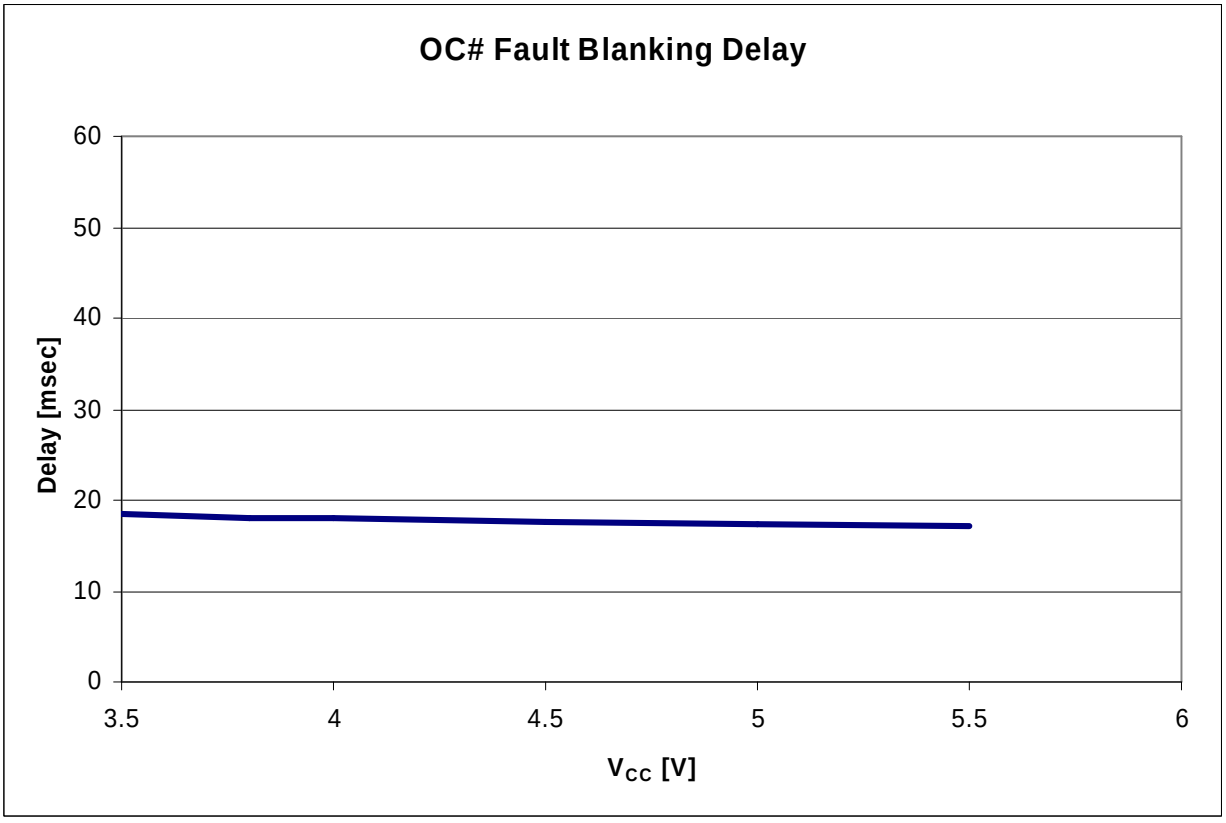
Note: The other port stays on (unless it is also in current limit.)

Typical Operating Characteristics









SOIC-8 Package Dimensions