MP6231/MP6232

3.3V/5V, Dual-Channel 500mA Current-Limited Power Distribution Switches

The Future of Analog IC Technology

DESCRIPTION

The MP6231/MP6232 Power Distribution Switch features internal current limiting to prevent damage to host devices due to faulty load conditions. The MP6231/MP6232 analog switch has 85mΩ on-resistance and operates from 2.7V to 5.5V input. It is available with guaranteed current limits, making it ideal for load switching applications. The MP6231/MP6232 has built-in protection for both over current and increased thermal stress. For over current, the device will limit the current by changing to a constant current mode.

As the temperature increases as a result of short circuit, then the device will shut off. The device will recover once the device temperature reduces to approx 120°C.

The MP6231/MP6232 is available in 8-pin MSOP, SOIC package with exposed pad and 8-pin SOIC w/o exposed pad.

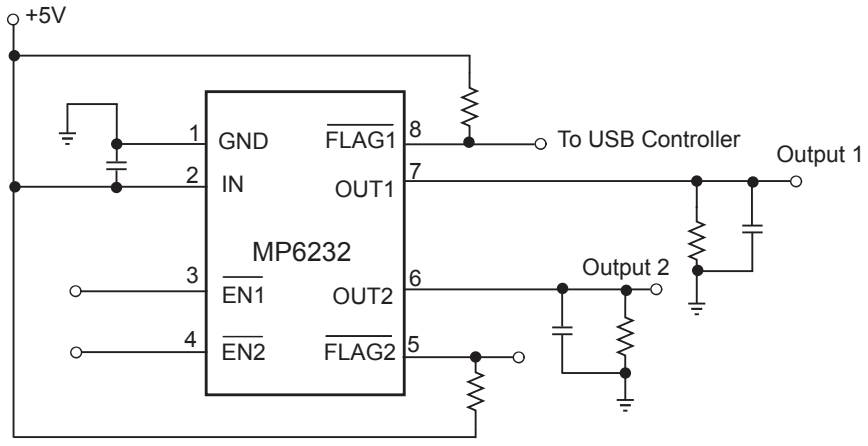
FEATURES

- 500mA Continuous Current
- Accurate Current Limit
- 2.7V to 5.5V Supply Range
- 140μA Quiescent Current
- 85mΩ MOSFET
- Thermal-Shutdown Protection
- Under-Voltage Lockout
- 8ms FLAG Deglitch Time
- No FLAG Glitch During Power Up
- Reverse Current Blocking
- Active High & Active Low Options
- UL File # E322138

APPLICATIONS

- Smartphone and PDA
- Portable GPS Device
- Notebook PC
- Set-top-box
- Telecom and Network Systems
- PC Card Hot Swap
- USB Power Distribution

TYPICAL APPLICATION



DUAL-CHANNEL

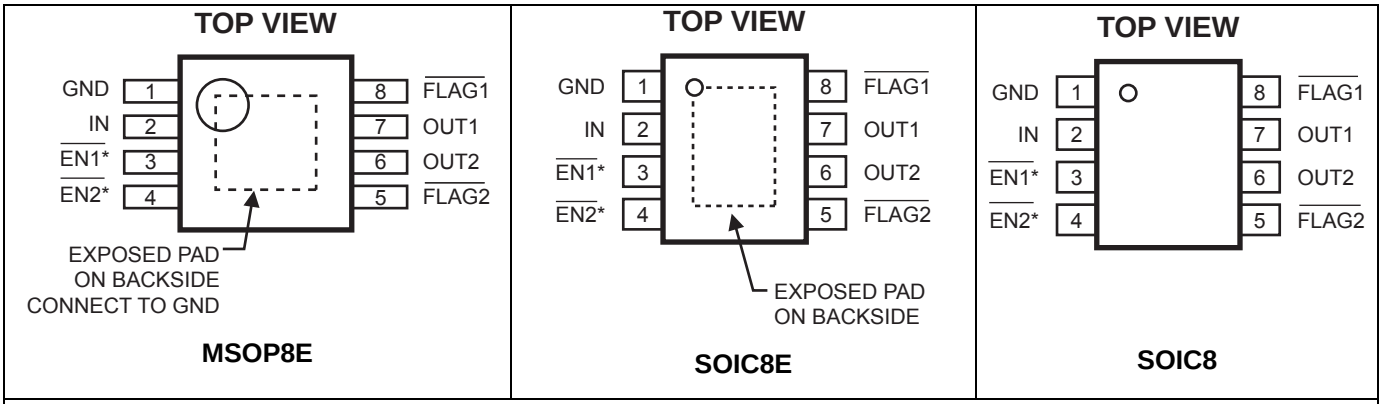
UL Recognized Component

ORDERING INFORMATION

Part Number	Enable	Switch	Maximum Continuous Load Current	Typical Short-Circuit Current @ T_A=25C	Package	Top Marking	Free Air Temperature (T_A)
MP6231DN*	Active High	Dual	0.5A	750mA	SOIC8E	MP6231DN	-40°C to +85°C
MP6231DH					MSOP8E	6231D	
MP6231DS					SOIC8		
MP6232DN	Active Low				SOIC8E	MP6232DN	
MP6232DH					MSOP8E	6232D	
MP6232DS					SOIC8		

* For Tape & Reel, add suffix –Z (e.g. MP6231DN–Z).
For RoHS compliant packaging, add suffix –LF (e.g. MP6231DN–LF–Z)

PACKAGE REFERENCE



MP6231/MP6232Dual-Channel

(* EN is active high for MP6231)

ABSOLUTE MAXIMUM RATINGS (1)

IN .....-0.3V to +6.0V
EN, FLAG, OUT to GND.....-0.3V to +6.0V
Continuous Power Dissipation (T_A = +25°C) (2)
SOIC8E..... 2.5W
MSOP8E..... 2.27W
SOIC8 ..... 1.4W
Junction Temperature.....150°C
Lead Temperature .....260°C
Storage Temperature..... -65°C to +150°C
Operating Junct. Temp. ..... -40°C to +125°C

Thermal Resistance (3)	θ_{JA}	θ_{JC}	
SOIC8E	50	10	°C/W
MSOP8E	55	12	°C/W
SOIC8	90	42	°C/W

Notes:

1) Exceeding these ratings may damage the device.
2) The maximum allowable power dissipation is a function of the maximum junction temperature T_J (MAX), the junction-to-ambient thermal resistance θ_{JA}, and the ambient temperature T_A. The maximum allowable continuous power dissipation at any ambient temperature is calculated by P_D (MAX) = (T_J (MAX)-T_A)/θ_{JA}. Exceeding the maximum allowable power dissipation will cause excessive die temperature, and the regulator will go into thermal shutdown. Internal thermal shutdown circuitry protects the device from permanent damage.
3) Measured on JESD51-7，4-layer PCB.

ELECTRICAL CHARACTERISTICS (4)

V_{IN}=5V, T_A=+25°C, unless otherwise noted.

Parameter	Condition	Min	Typ	Max	Units
IN Voltage Range		2.7		5.5	V
Supply Current	One Channel Enabled, I_{OUT}=0, One Switch ON		90	120	µA
Supply Current	Both Channels Enabled, I_{OUT}=0, Both Switches ON		140	160	µA
Shutdown Current	Device Disable, V_{OUT}=float, V_{IN}=5.5V		1		µA
Off Switch Leakage	Device Disable, V_{IN}=5.5V		1		µA
Current Limit		550		1100	mA
Trip Current	Current Ramp (slew rate≤100A/s) on Output		1.2	1.6	A
Under-voltage Lockout	Rising Edge	1.95		2.65	V
Under-voltage Hysteresis			250		mV
FET On Resistance	I_{OUT}=100mA , and -40°C<T_A<85°C		85	130	mΩ
EN Input Logic High Voltage		2			V
EN Input Logic Low Voltage				0.8	V
FLAG Output Logic Low Voltage	I_{SINK}=5mA			0.4	V
FLAG Output High Leakage Current	V_{IN}=V_{FLAG}=5.5V			1	µA
Thermal Shutdown			140		°C
Thermal Shutdown Hysteresis			20		°C
V_{OUT} Rising Time, Tr	V_{IN}=5.5V, C_L=1µF, R_L=11Ω		0.9		ms
	V_{IN}=2.7V, C_L=1µF, R_L=11Ω		1.7		ms
V_{OUT} Falling Time, Tf	V_{IN}=5.5V, C_L=1µF, R_L=11Ω			0.5	ms
	V_{IN}=2.7V, C_L=1µF, R_L=11Ω			0.5	ms
Turn On Time, Ton	C_L=100µF, R_L=11Ω			3	ms
Turn Off Time, Toff	C_L=100µF, R_L=11Ω			10	ms
FLAG Deglitch Time		4	8	15	ms
ENx Input Leakage			1		µA
Reverse Leakage Current	OUTX=5.5V, IN=GND		0.2		µA

Notes:

4) Production test at +25°C. Specifications over the temperature range are guaranteed by design and characterization.

PIN FUNCTIONS

MP6231/MP6232

SOIC8 SOIC8E MSOP8E	Name	Description
1	GND	Ground.
2	IN	Input Voltage. Accepts 2.7V to 5.5V input.
3	$\overline{EN1}$	Active Low: (MP6232), Active High: (MP6231)
4	$\overline{EN2}$	Active Low: (MP6232), Active High: (MP6231)
5	$\overline{FLAG2}$	IN-to-OUT2 Over-current, active-low output flag. Open-Drain.
6	OUT2	IN-to-OUT2 Power-Distribution Switch Output.
7	OUT1	IN-to-OUT1 Power-Distribution Switch Output
8	$\overline{FLAG1}$	IN-to-OUT1 Over-current, active-low output flag. Open-Drain.

TYPICAL PERFORMANCE CHARACTERISTICS

T_A = +25ºC, unless otherwise noted.

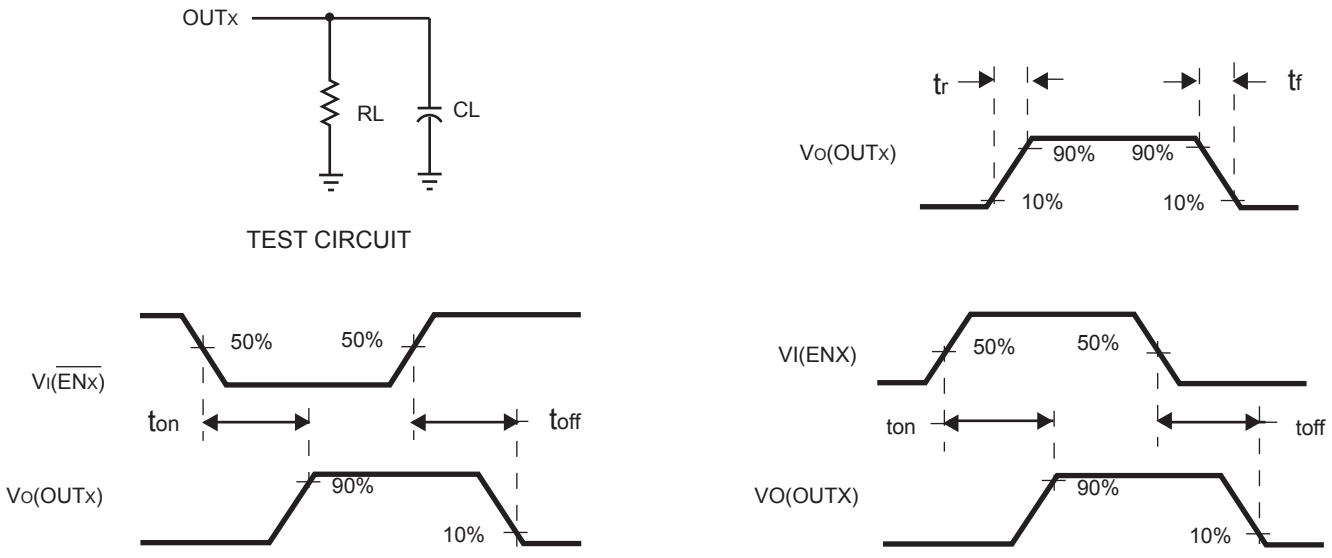


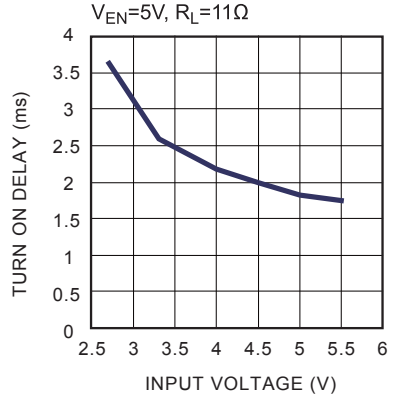
Figure 1—Test Circuit and Voltage Waveforms

TYPICAL PERFORMANCE CHARACTERISTICS

V_{IN}=5.5V, C_L = 1µF, T_A = +25ºC, unless otherwise noted.

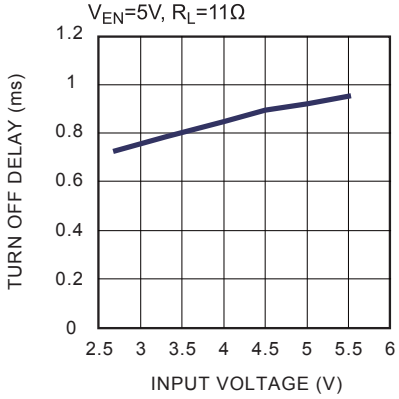
Turn on Delay vs. Input Voltage

V_{EN}=5V, R_L=11Ω



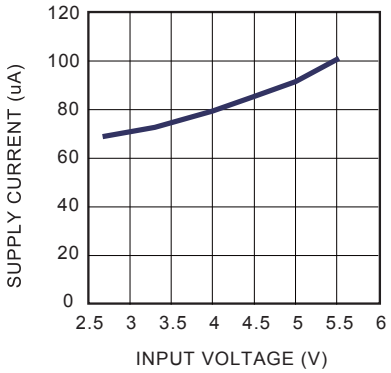
Turn off Delay vs. Input Voltage

V_{EN}=5V, R_L=11Ω



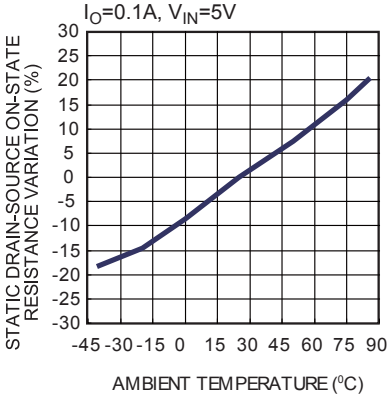
Supply Current, Output Enabled vs. Input Voltage

V_{EN}=5V



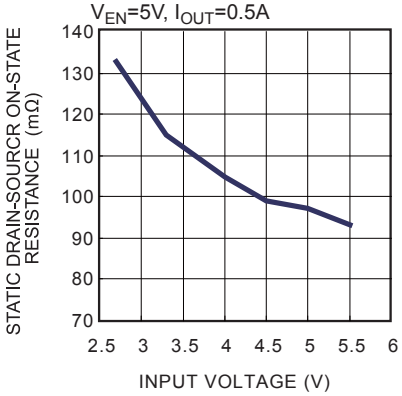
Static Drain-Source On-State Resistance Variation vs. Ambient Temperature

I_O=0.1A, V_{IN}=5V



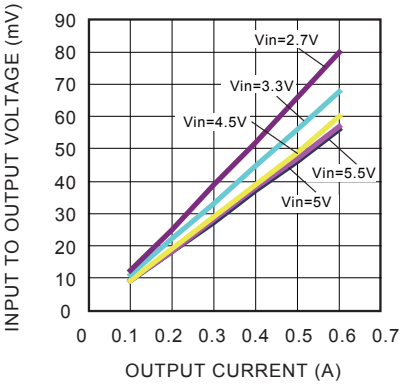
Static Drain-Source On-State Resistance vs. Input Voltage

V_{EN}=5V, I_{OUT}=0.5A



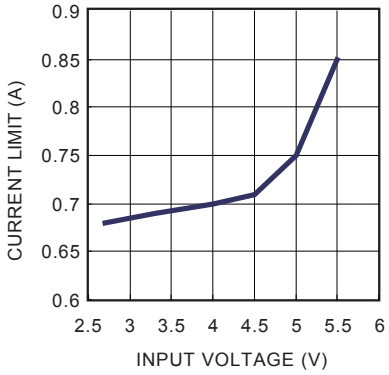
Input to Output Voltage vs. Load Current

V_{EN}=5V



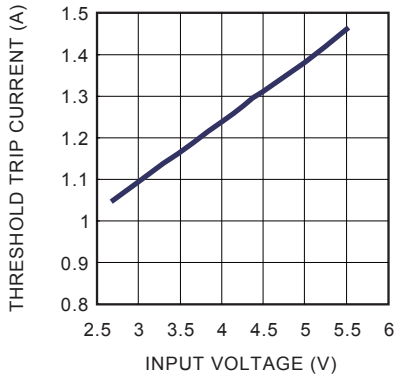
Current Limit vs. Input Voltage

V_{EN}=5V



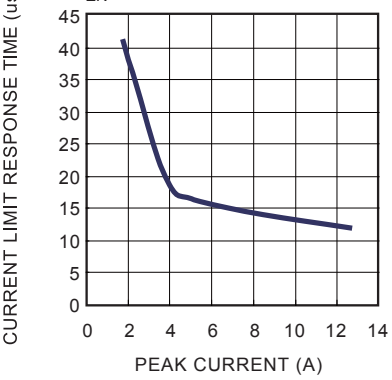
Threshold Trip Current vs. Input Voltage

V_{EN}=5V



Current Limit Response Time vs. Peak Current

V_{EN}=5V

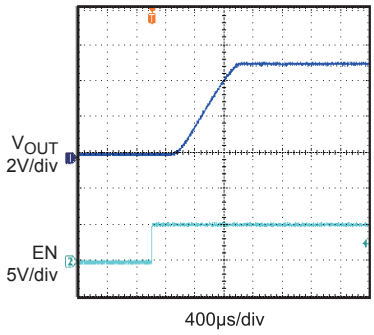


TYPICAL PERFORMANCE CHARACTERISTICS

V_{IN}=5.5V, C_L = 1µF, T_A = +25ºC, unless otherwise noted.

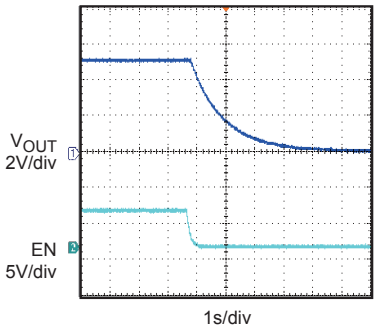
Turn On Delay and Rise Time with 0.1uF Load

V_{EN}=5V, C_L=0.1uF



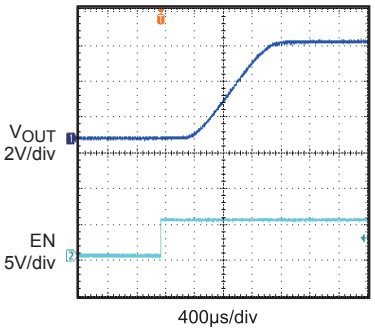
Turn Off Delay and Fall Time with 0.1uF Load

V_{EN}=5V, C_L=0.1uF



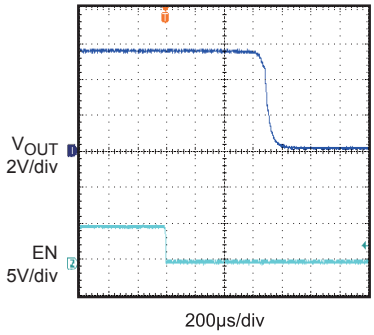
Turn On Delay and Rise Time with 1uF Load

V_{EN}=5V, R_L=11Ω, C_L=1uF



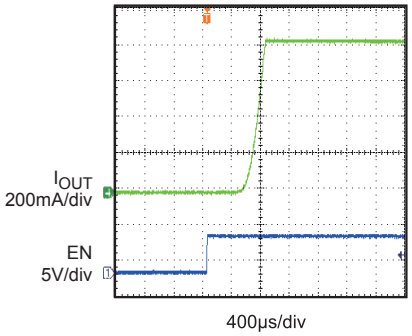
Turn Off Delay and Fall Time with 1uF Load

V_{EN}=5V, R_L=11Ω, C_L=1uF



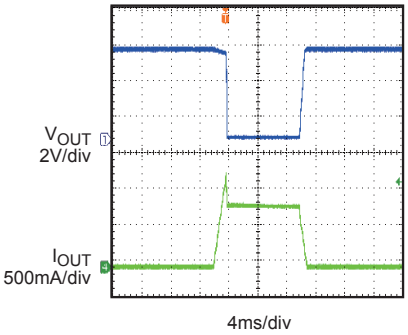
Short Circuit Current Device Enabled into Short

V_{EN}=5V, C_L=1uF



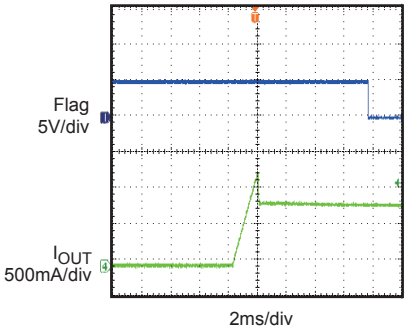
Threshold Trip Current with Ramped Load on Enabled Device

V_{EN}=5V, C_L=1uF



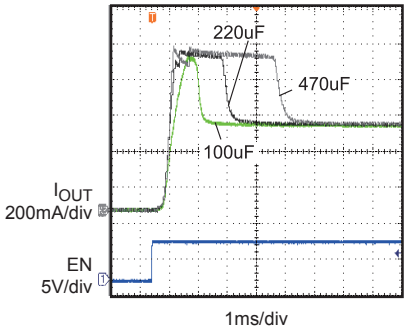
Ramped Load on Enabled Device

V_{EN}=5V, C_L=1uF



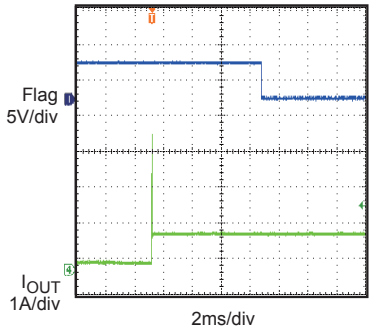
Inrush Current with Different Load Capacitance

V_{EN}=5V, R_L=11Ω,
Start up by EN



1Ω Load Connected to Enabled Device

V_{EN}=5V, C_L=1uF



FUNCTION BLOCK DIAGRAM

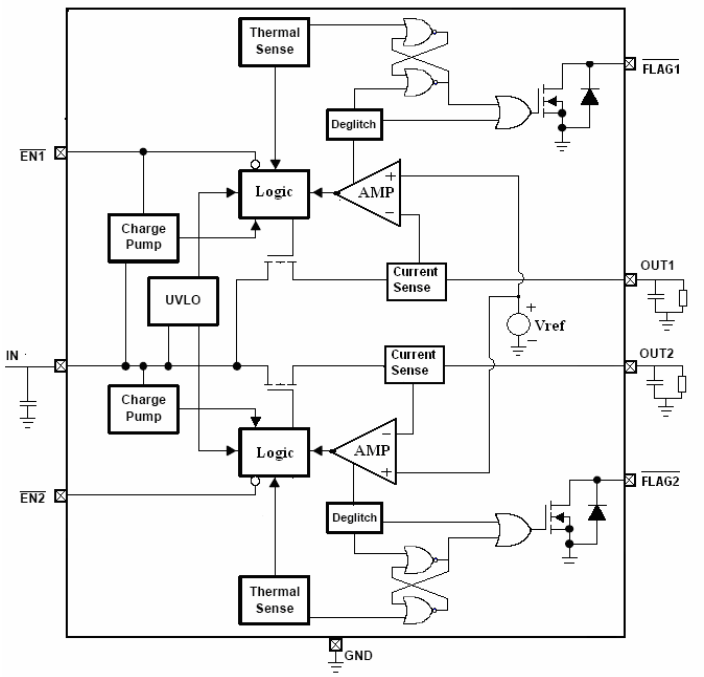


Figure 2—Functional Block Diagram

DETAILED DESCRIPTION

Over Current

When the load exceeds trip current (minimum threshold current triggering constant-current mode) or a short is present, MP6231/MP6232 switches into to a constant-current mode (current limit value). MP6231/MP6232 will be shutdown only if the overcurrent condition stays long enough to trigger thermal protection.

Trigger overcurrent protection for different overload conditions occurring in applications:

1) The output has been shorted or overloaded before the device is enabled or input applied. MP6231/MP6232 detects the short or overload and immediately switches into a constant-current mode.
2) A short or an overload occurs after the device is enabled. After the current-limit circuit has been tripped (reached the trip current threshold), the device switches into constant-current mode. However, high current may flow for a short period of time before the current-limit circuit can react.
3) Output current has been gradually increased beyond the recommended operating current. The load current rises until the trip current threshold is reached or until the thermal limit of the device is exceeded. The MP6231/MP6232 is capable of delivering current up to the trip current threshold without damaging the device. Once the trip threshold has been reached, the device switches into its constant-current mode.

Flag Response

The FLAG pin is an open drain configuration. This FAULT will report a fail mode after an 8ms deglitch timeout. This is used to ensure that no false fault signals are reported. This internal deglitch circuit eliminates the need for extend components. The FLAG pin is not deglitched during an over temp. or a voltage lockout.

Thermal Protection

The purpose of thermal protection is to prevent damage in the IC by allowing exceptive current to flow and heating the junction. The die temp. is internally monitored until the thermal limit is reached. Once this temp. is reached, the switch will turn off and allow the chip to cool. The switch has a built-in hysteresis.

Under-voltage Lockout (UVLO)

This circuit is used to monitor the input voltage to ensure that the MP6231/MP6232 is operating correctly. This UVLO circuit also ensures that there is no operation until the input voltage reaches the minimum spec.

Enable

The logic pin disables the chip to reduce the supply current. The device will operate once the enable signal reaches the appropriate level. The input is compatible with both COMS and TTL.

APPLICATION INFORMATION

Power-Supply Considerations

Over 10µF capacitor between IN and GND is recommended. This precaution reduces power-supply transients that may cause ringing on the input and improves the immunity of the device to short-circuit transients.

In order to achieve smaller output load transient, placing a high-value electrolytic capacitor on the output pin(s) is recommended when the output load is heavy.

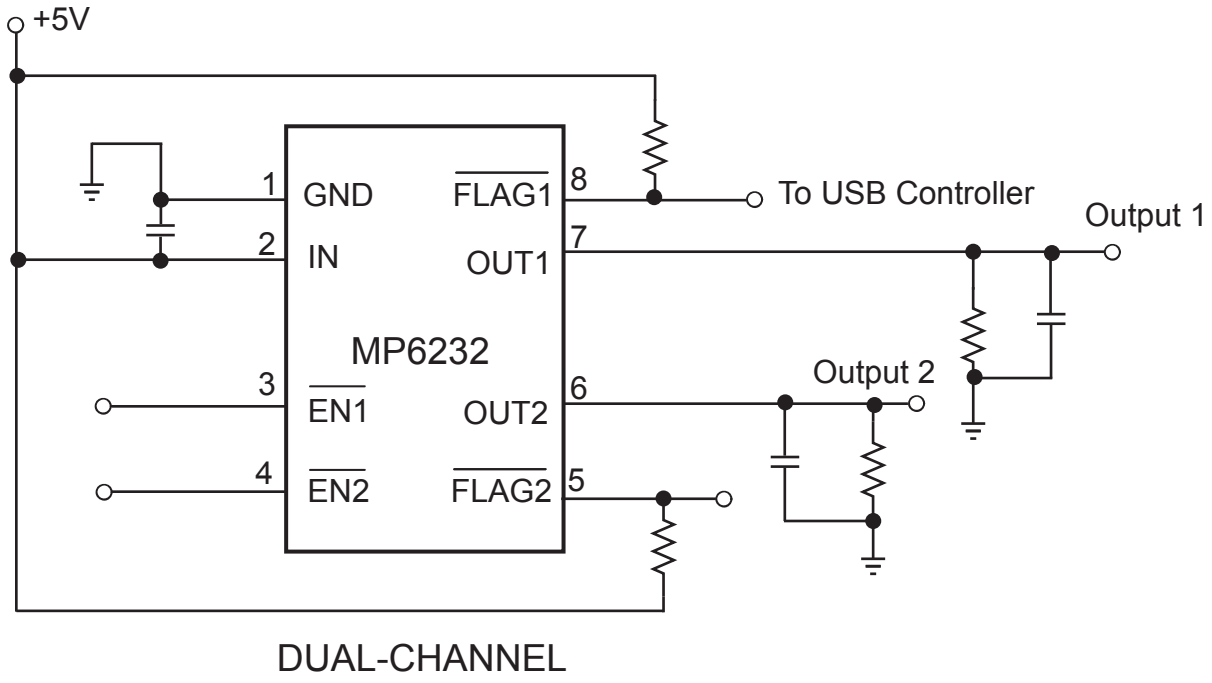
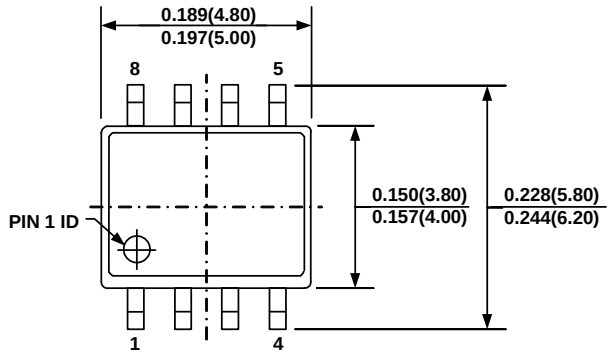


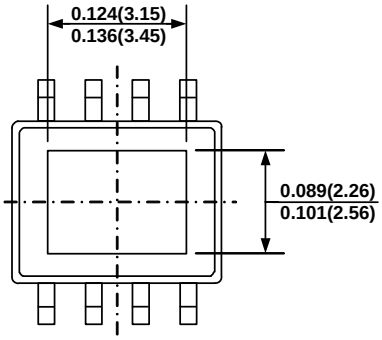
Figure 3—Application Circuit

PACKAGE INFORMATION

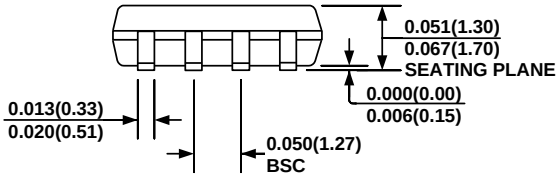
SOIC8E



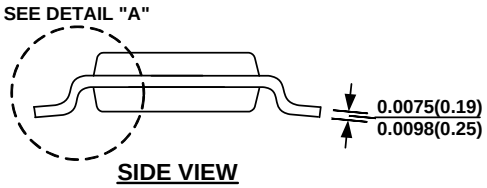
TOP VIEW



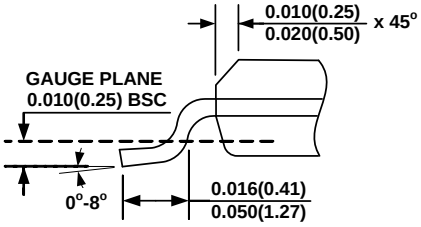
BOTTOM VIEW



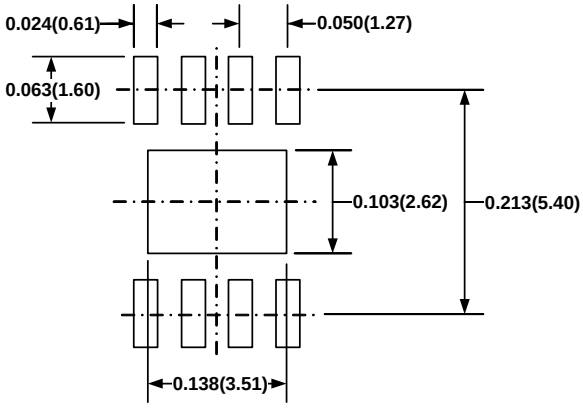
FRONT VIEW



SIDE VIEW



DETAIL "A"

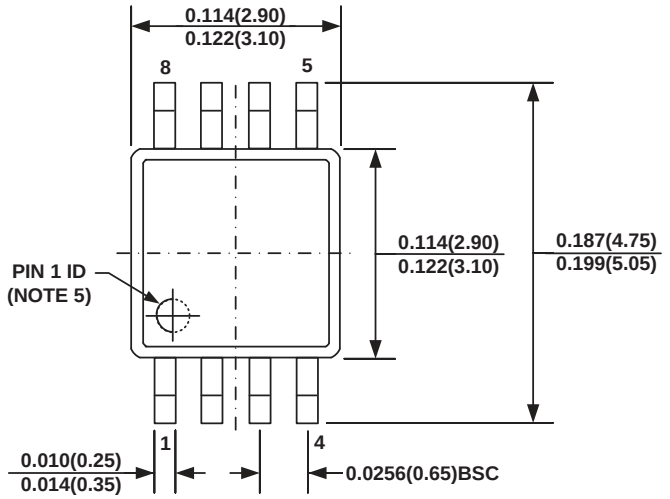


RECOMMENDED LAND PATTERN

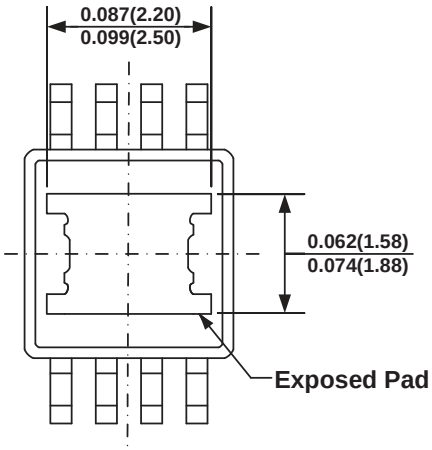
NOTE:

1) CONTROL DIMENSION IS IN INCHES. DIMENSION IN BRACKET IS IN MILLIMETERS.
2) PACKAGE LENGTH DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.
3) PACKAGE WIDTH DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSIONS.
4) LEAD COPLANARITY (BOTTOM OF LEADS AFTER FORMING) SHALL BE 0.004" INCHES MAX.
5) DRAWING CONFORMS TO JEDEC MS-012, VARIATION BA.
6) DRAWING IS NOT TO SCALE.

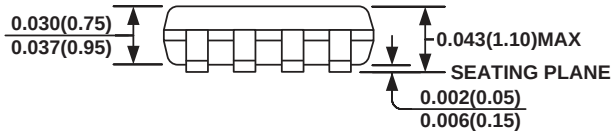
MSOP8E (EXPOSED PAD)



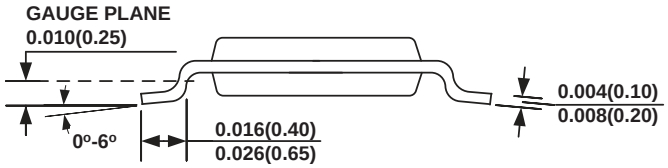
TOP VIEW



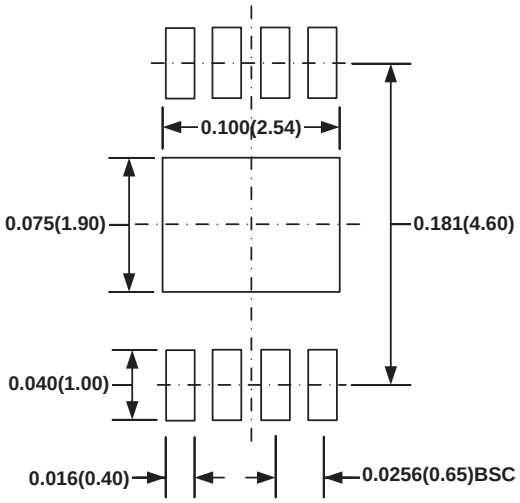
BOTTOM VIEW



FRONT VIEW



SIDE VIEW

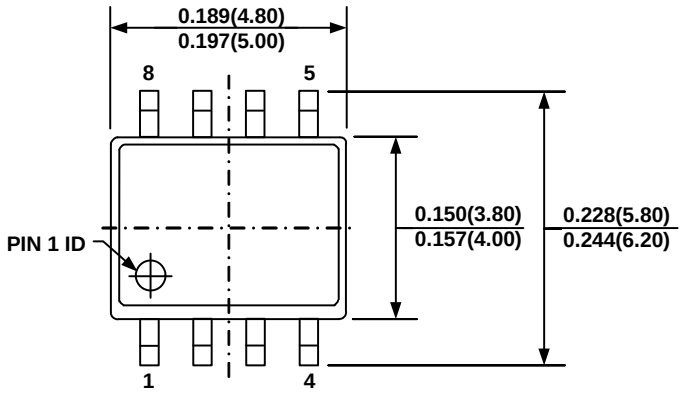


RECOMMENDED LAND PATTERN

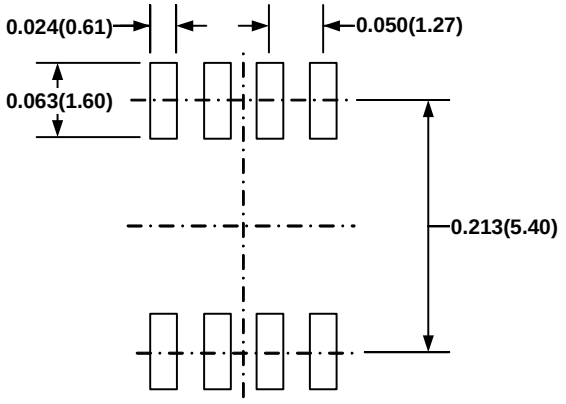
NOTE:

1) CONTROL DIMENSION IS IN INCHES. DIMENSION IN BRACKET IS IN MILLIMETERS.
2) PACKAGE LENGTH DOES NOT INCLUDE MOLD FLASH, PROTRUSION OR GATE BURR.
3) PACKAGE WIDTH DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION.
4) LEAD COPLANARITY (BOTTOM OF LEADS AFTER FORMING) SHALL BE 0.004" INCHES MAX.
5) PIN 1 IDENTIFICATION HAS HALF OR FULL CIRCLE OPTION.
6) DRAWING MEETS JEDEC MO-187, VARIATION AA-T.
7) DRAWING IS NOT TO SCALE.

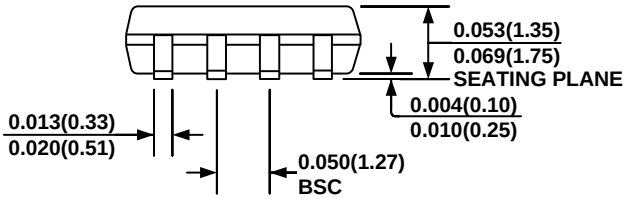
SOIC8



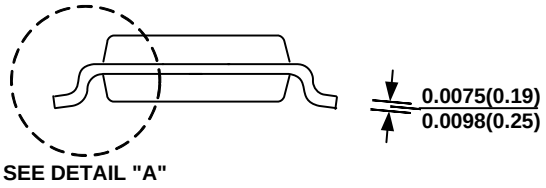
TOP VIEW



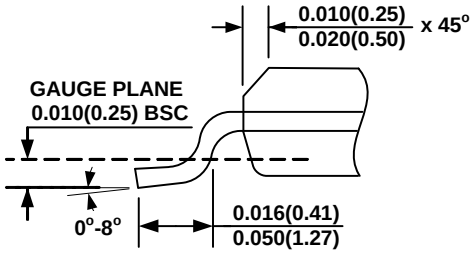
RECOMMENDED LAND PATTERN



FRONT VIEW



SIDE VIEW



DETAIL "A"

NOTE:

1) CONTROL DIMENSION IS IN INCHES. DIMENSION IN BRACKET IS IN MILLIMETERS.
2) PACKAGE LENGTH DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.
3) PACKAGE WIDTH DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSIONS.
4) LEAD COPLANARITY (BOTTOM OF LEADS AFTER FORMING) SHALL BE 0.004" INCHES MAX.
5) DRAWING CONFORMS TO JEDEC MS-012, VARIATION AA.
6) DRAWING IS NOT TO SCALE.