

# DMOS 250mA Low-Dropout Regulator

## FEATURES

- **NEW DMOS TOPOLOGY:**  
Ultra Low Dropout Voltage:  
150mV typ at 250mA  
Output Capacitor *not* Required for Stability
- **FAST TRANSIENT RESPONSE**
- **VERY LOW NOISE:** 28µVrms
- **HIGH ACCURACY:** ±1.5% max
- **HIGH EFFICIENCY:**  
 $I_{GND} = 600\mu A$  at  $I_{OUT} = 250mA$   
Not Enabled:  $I_{GND} = 0.01\mu A$
- **2.5V, 2.8V, 2.85V, 3.0V, 3.3V, AND 5.0V  
ADJUSTABLE OUTPUT VERSIONS**
- **OTHER OUTPUT VOLTAGES AVAILABLE UPON  
REQUEST**
- **FOLDBACK CURRENT LIMIT**
- **THERMAL PROTECTION**
- **SMALL SURFACE-MOUNT PACKAGES:**  
SOT23-5, SOT223-5, and SO-8

## APPLICATIONS

- **PORTABLE COMMUNICATION DEVICES**
- **BATTERY-POWERED EQUIPMENT**
- **PERSONAL DIGITAL ASSISTANTS**
- **MODEMS**
- **BAR-CODE SCANNERS**
- **BACKUP POWER SUPPLIES**

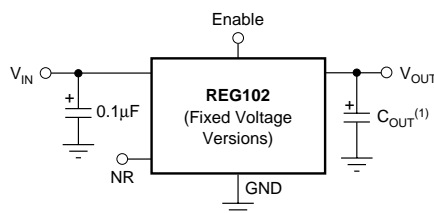
## DESCRIPTION

The REG102 is a family of low-noise, low-dropout linear regulators with low ground pin current. The new DMOS topology provides significant improvement over previous designs, including low-dropout voltage (only 150mV typ at full load), and better transient performance. In addition, no output capacitor is required for stability, unlike conventional low-dropout regulators that are difficult to compensate and require expensive low ESR capacitors greater than 1µF.

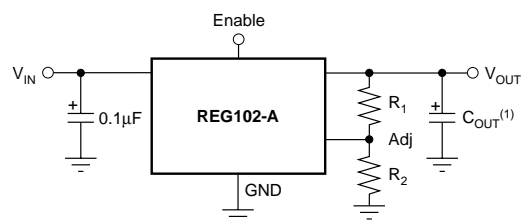
Typical ground pin current is only 600µA (at  $I_{OUT} = 250mA$ ) and drops to 10nA when not enabled. Unlike regulators with PNP pass devices, quiescent current remains relatively constant over load variations and under dropout conditions.

The REG102 has very low output noise (typically 28µVrms for  $V_{OUT} = 3.3V$  with  $C_{NR} = 0.01\mu F$ ), making it ideal for use in portable communications equipment. On-chip trimming results in high output voltage accuracy. Accuracy is maintained over temperature, line, and load variations. Key parameters are tested over the specified temperature range (–40°C to +85°C).

The REG102 is well protected—internal circuitry provides a current limit that protects the load from damage; furthermore, thermal protection circuitry keeps the chip from being damaged by excessive temperature. The REG102 is available in SOT23-5, SOT223-5, and SO-8 packages.



NR = Noise Reduction



NOTE: (1) Optional.



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PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

## ABSOLUTE MAXIMUM RATINGS<sup>(1)</sup>

Supply Input Voltage, $V_{IN}$ .....	-0.3V to 12V
Enable Input Voltage, $V_{EN}$ .....	-0.3V to $V_{IN}$
Feedback Voltage, $V_{FB}$ .....	-0.3V to 6.0V
NR Pin Voltage, $V_{NR}$ .....	-0.3V to 6.0V
Output Short-Circuit Duration .....	Indefinite
Operating Temperature Range ( $T_J$ ) .....	-55°C to +125°C
Storage Temperature Range ( $T_A$ ) .....	-65°C to +150°C
Lead Temperature (soldering, 3s) .....	+240°C

NOTE: (1) Stresses above these ratings may cause permanent damage. Exposure to absolute maximum conditions for extended periods may degrade device reliability.



## ELECTROSTATIC DISCHARGE SENSITIVITY

This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

## PACKAGE/ORDERING INFORMATION<sup>(1)</sup>

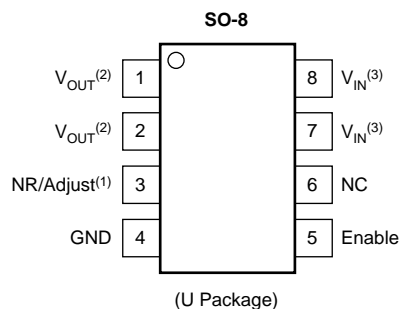
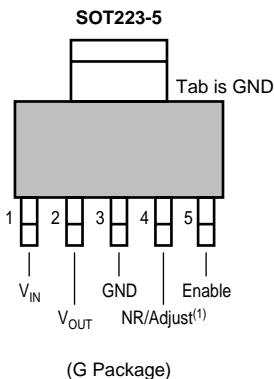
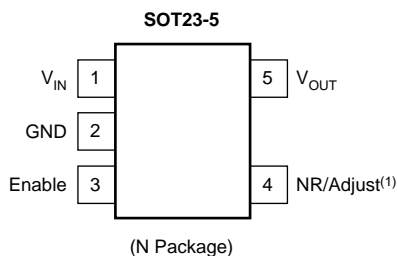
PRODUCT	$V_{OUT}$ <sup>(2)</sup>
REG102xx-yyy/zzz	<p>XX is package designator.</p> <p>YYYY is typical output voltage (5 = 5.0V, 2.85 = 2.85V, A = Adjustable).</p> <p>ZZZ is package quantity.</p>

(1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI website at [www.ti.com](http://www.ti.com).

(2) Output voltages from 2.5V to 5.1V in 50mV increments are available; minimum order quantities apply. Contact factory for details and availability.

## PIN CONFIGURATIONS

### Top View



- NOTES: (1) For REG102A-A: voltage setting resistor pin.  
 All other models: noise reduction capacitor pin.  
 (2) Both pin 1 and pin 2 must be connected.  
 (3) Both pin 7 and pin 8 must be connected.

# ELECTRICAL CHARACTERISTICS

**Boldface** limits apply over the specified temperature range,  $T_J = -40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ .

At  $T_J = +25^{\circ}\text{C}$ ,  $V_{IN} = V_{OUT} + 1\text{V}$  ( $V_{OUT} = 2.5\text{V}$  for REG102-A),  $V_{ENABLE} = 1.8\text{V}$ ,  $I_{OUT} = 5\text{mA}$ ,  $C_{NR} = 0.01\mu\text{F}$ , and  $C_{OUT} = 0.1\mu\text{F}^{(1)}$ , unless otherwise noted.

PARAMETER	CONDITION	REG102NA REG102GA REG102UA			UNITS
		MIN	TYP	MAX	
<b>OUTPUT VOLTAGE</b>					
Output Voltage Range	$V_{OUT}$				V
REG102-2.5			2.5		V
REG102-2.8			2.8		V
REG102-2.85			2.85		V
REG102-3.0			3.0		V
REG102-3.3			3.3		V
REG102-5			5		V
REG102-A		2.5		5.5	V
Reference Voltage	$V_{REF}$		1.26		V
Adjust Pin Current	$I_{ADJ}$		0.2	1	$\mu\text{A}$
Accuracy			$\pm 0.5$	$\pm 1.5$	%
<b>Over Temperature vs Temperature</b>	$dV_{OUT}/dT$		<b>50</b>	<b><math>\pm 2.3</math></b>	%
vs Line and Load		$I_{OUT} = 5\text{mA}$ to $250\text{mA}$ , $V_{IN} = (V_{OUT} + 0.4\text{V})$ to $10\text{V}$	$\pm 0.8$	$\pm 2.0$	ppm/ $^{\circ}\text{C}$
<b>Over Temperature</b>		<b><math>V_{IN} = (V_{OUT} + 0.6\text{V})</math> to <math>10\text{V}</math></b>		<b><math>\pm 2.8</math></b>	%
<b>DC DROPOUT VOLTAGE<sup>(2)</sup></b>	$V_{DROP}$				mV
For all models		$I_{OUT} = 5\text{mA}$	4	10	mV
<b>Over Temperature</b>		$I_{OUT} = 250\text{mA}$	150	220	mV
		$I_{OUT} = 250\text{mA}$		<b>270</b>	mV
<b>VOLTAGE NOISE</b>	$V_n$				$\mu\text{Vrms}$
$f = 10\text{Hz}$ to $100\text{kHz}$		$C_{NR} = 0$ , $C_{OUT} = 0$		$23\mu\text{Vrms/V} \cdot V_{OUT}$	$\mu\text{Vrms}$
Without $C_{NR}$ (all models)		$C_{NR} = 0.01\mu\text{F}$ , $C_{OUT} = 10\mu\text{F}$		$7\mu\text{Vrms/V} \cdot V_{OUT}$	$\mu\text{Vrms}$
With $C_{NR}$ (all fixed voltage models)					
<b>OUTPUT CURRENT</b>					
Current Limit <sup>(3)</sup>	$I_{CL}$	340	400	470	mA
<b>Over Temperature</b>		<b>300</b>		<b>490</b>	mA
Short-Circuit Current Limit	$I_{SC}$		150		mA
<b>RIPPLE REJECTION</b>					
$f = 120\text{Hz}$			65		dB
<b>ENABLE CONTROL</b>					
$V_{ENABLE}$ High (output enabled)	$V_{ENABLE}$	1.8		$V_{IN}$	V
$V_{ENABLE}$ Low (output disabled)		-0.2		0.5	V
$I_{ENABLE}$ High (output enabled)	$I_{ENABLE}$		1	100	nA
$I_{ENABLE}$ Low (output disabled)			2	100	nA
Output Disable Time			50		$\mu\text{s}$
Output Enable Softstart Time			1.5		ms
<b>THERMAL SHUTDOWN</b>					
Junction Temperature					$^{\circ}\text{C}$
Shutdown			160		$^{\circ}\text{C}$
Reset from Shutdown			140		$^{\circ}\text{C}$
<b>GROUND PIN CURRENT</b>					
Ground Pin Current	$I_{GND}$		400	500	$\mu\text{A}$
		$I_{OUT} = 5\text{mA}$	600	800	$\mu\text{A}$
		$I_{OUT} = 250\text{mA}$	0.01	0.2	$\mu\text{A}$
Enable Pin Low		$V_{ENABLE} \leq 0.5\text{V}$			
<b>INPUT VOLTAGE</b>	$V_{IN}$				
Operating Input Voltage Range <sup>(5)</sup>		1.8		10	V
Specified Input Voltage Range		$V_{IN} > 1.8\text{V}$	$V_{OUT} + 0.4$	10	V
<b>Over Temperature</b>		<b><math>V_{IN} &gt; 1.8\text{V}</math></b>	<b><math>V_{OUT} + 0.6</math></b>	<b>10</b>	V
<b>TEMPERATURE RANGE</b>					
Specified Range	$T_J$	-40		+85	$^{\circ}\text{C}$
Operating Range	$T_J$	-55		+125	$^{\circ}\text{C}$
Storage Range	$T_A$	-65		+150	$^{\circ}\text{C}$
Thermal Resistance					
SOT23-5 Surface-Mount	$\theta_{JA}$	Junction-to-Ambient	200		$^{\circ}\text{C/W}$
SO-8 Surface-Mount	$\theta_{JA}$	Junction-to-Ambient	150		$^{\circ}\text{C/W}$
SOT223-5 Surface-Mount	$\theta_{JC}$	Junction-to-Case	15		$^{\circ}\text{C/W}$
	$\theta_{JA}$	Junction-to-Ambient	See Figure 8		$^{\circ}\text{C/W}$

NOTES: (1) The REG102 does not require a minimum output capacitor for stability, however, transient response can be improved with proper capacitor selection.

(2) Dropout voltage is defined as the input voltage minus the output voltage that produces a 2% change in the output voltage from the value at  $V_{IN} = V_{OUT} + 1\text{V}$  at fixed load.

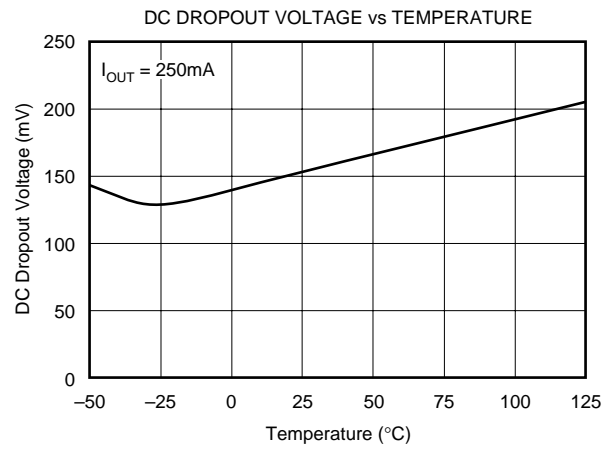
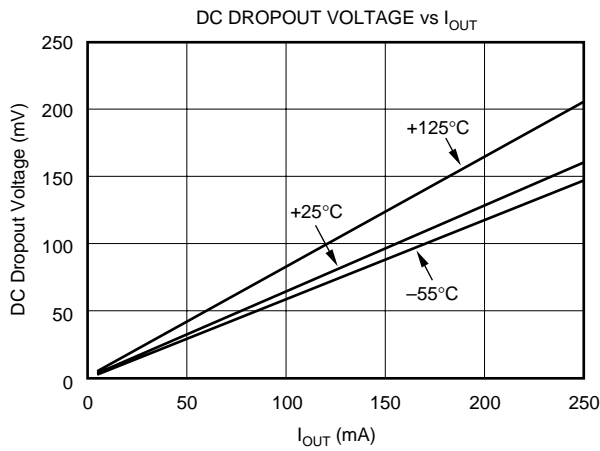
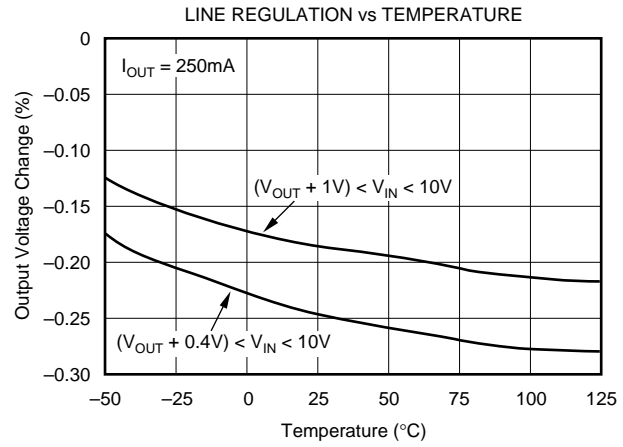
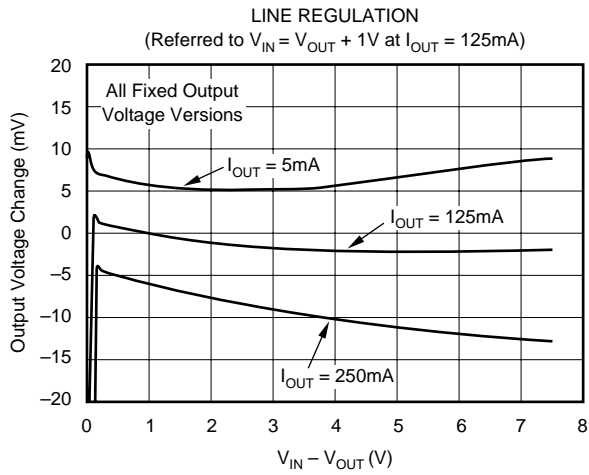
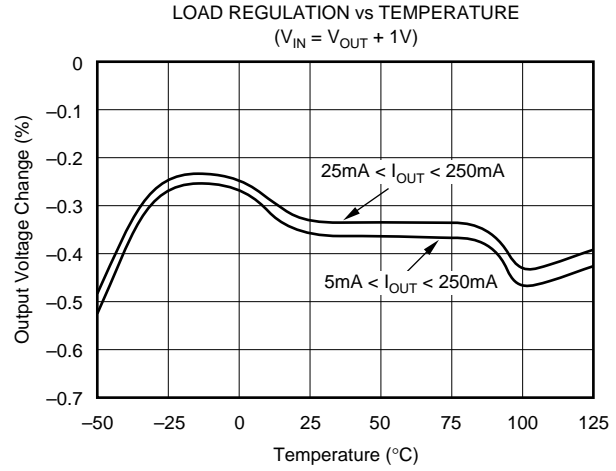
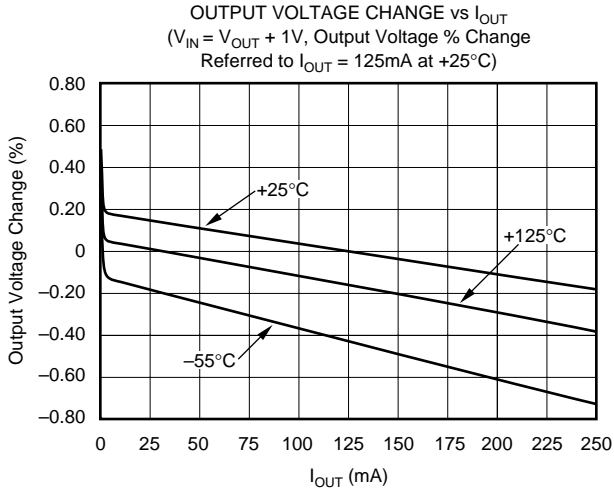
(3) Current limit is the output current that produces a 10% change in output voltage from  $V_{IN} = V_{OUT} + 1\text{V}$  and  $I_{OUT} = 5\text{mA}$ .

(4) For  $V_{ENABLE} > 6.5\text{V}$ , see typical characteristic  $I_{ENABLE}$  vs  $V_{ENABLE}$ .

(5) The REG102 no longer regulates when  $V_{IN} < V_{OUT} + V_{DROP(MAX)}$ . In dropout, the impedance from  $V_{IN}$  to  $V_{OUT}$  is typically less than  $1\Omega$  at  $T_J = +25^{\circ}\text{C}$ .

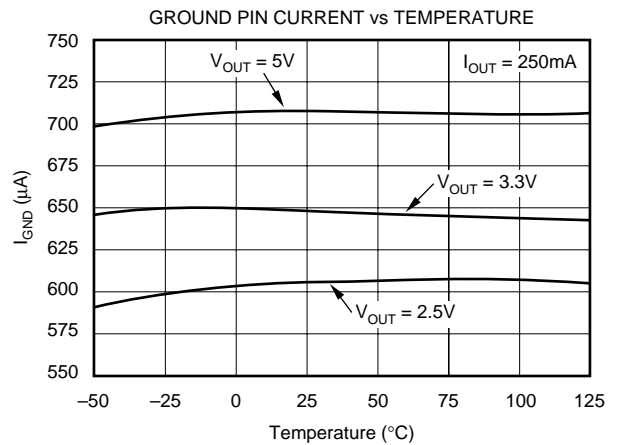
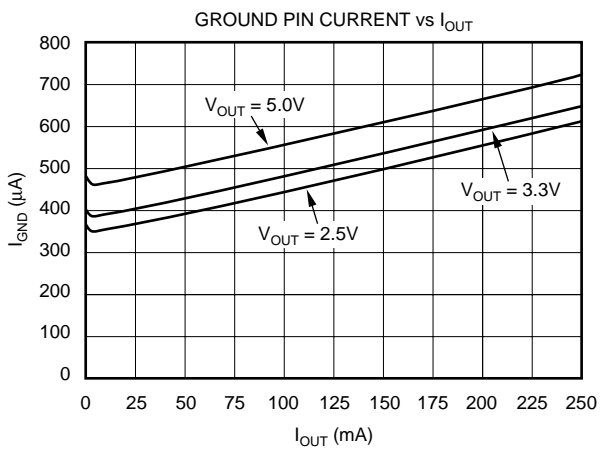
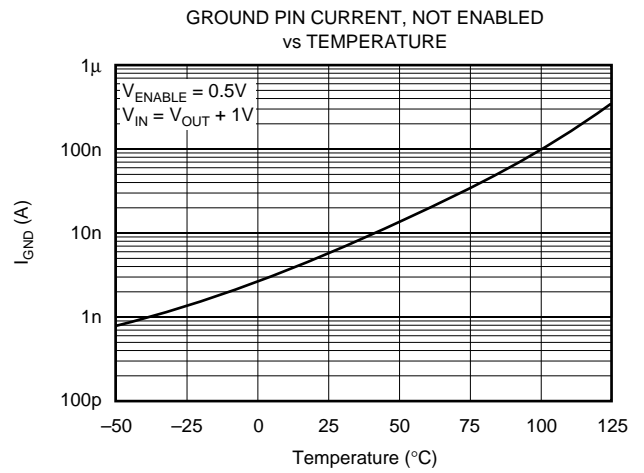
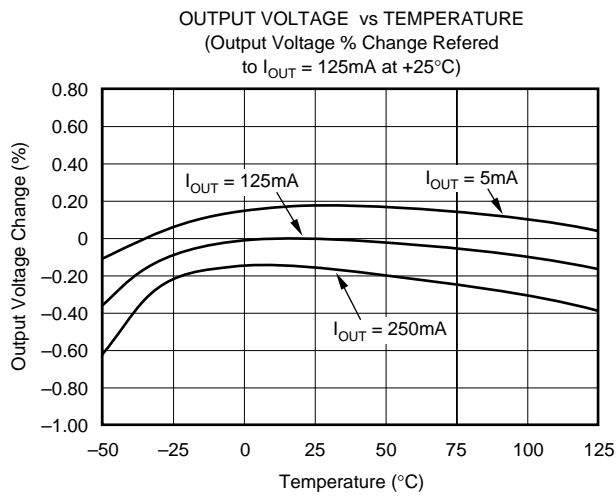
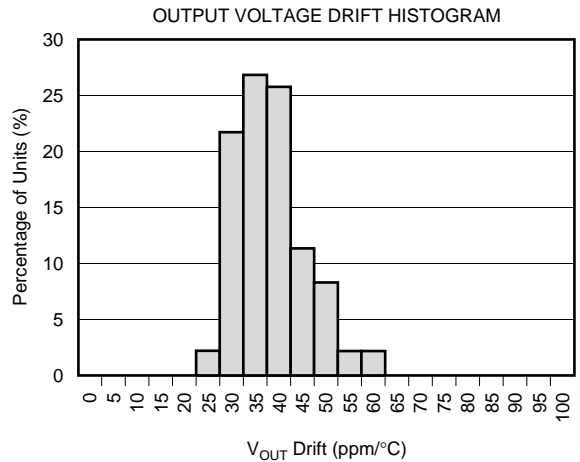
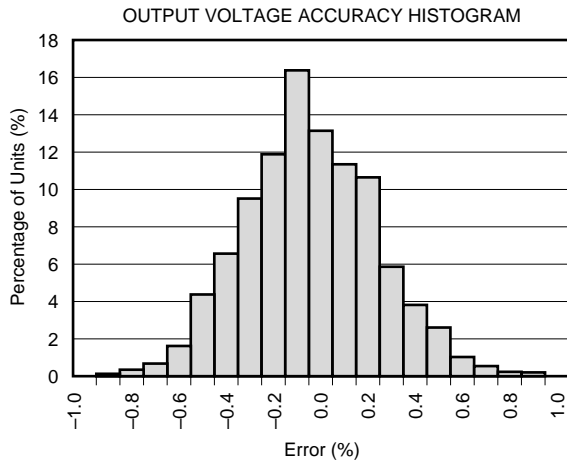
# TYPICAL CHARACTERISTICS

For all models, at  $T_J = +25^\circ\text{C}$  and  $V_{\text{ENABLE}} = 1.8\text{V}$ , unless otherwise noted.



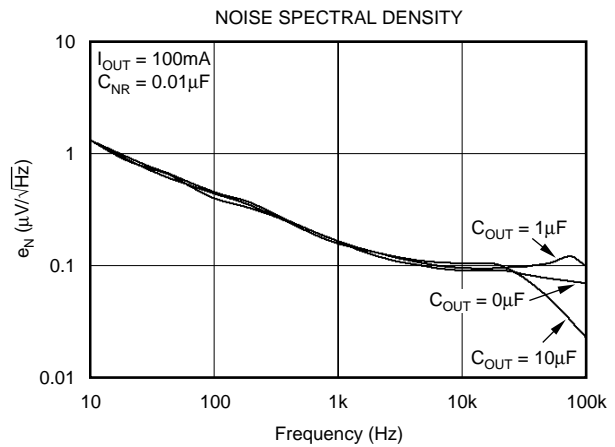
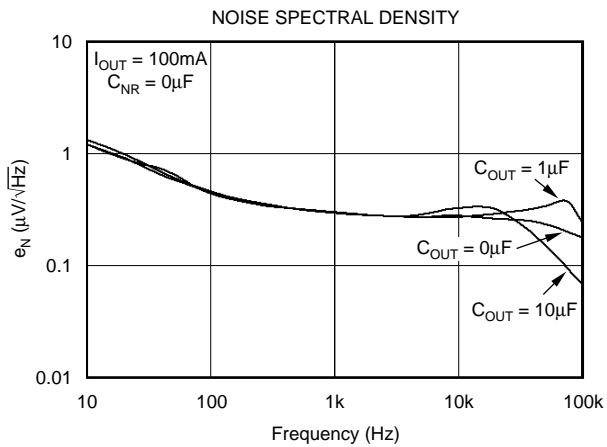
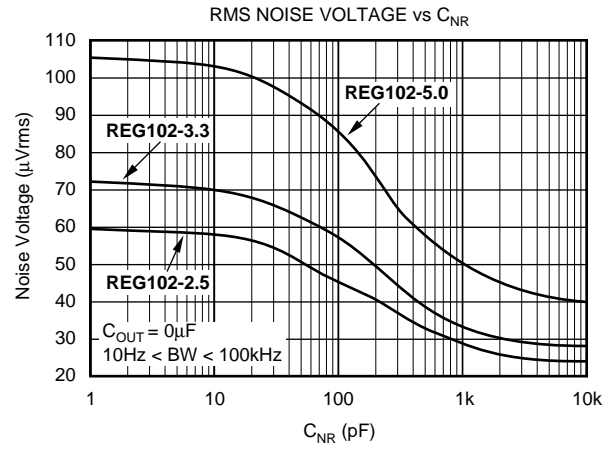
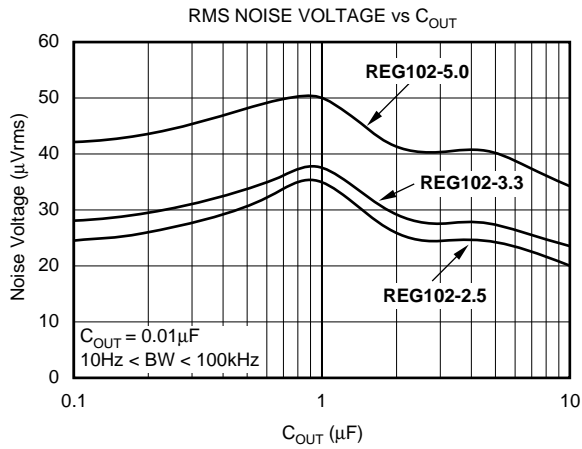
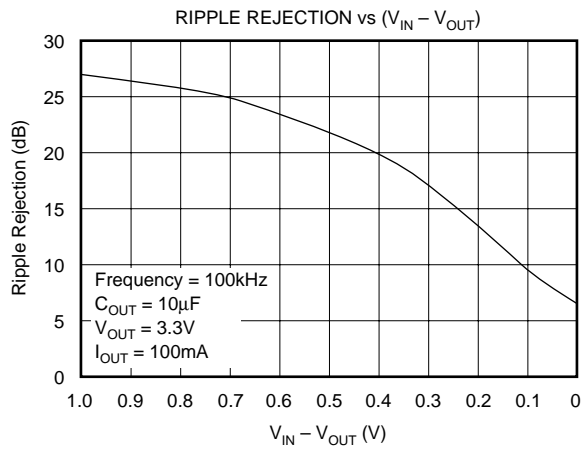
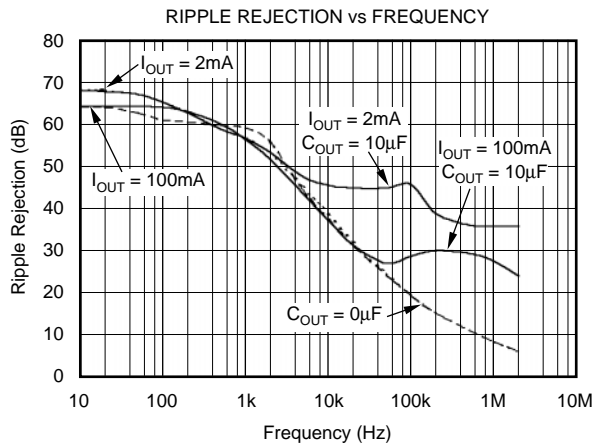
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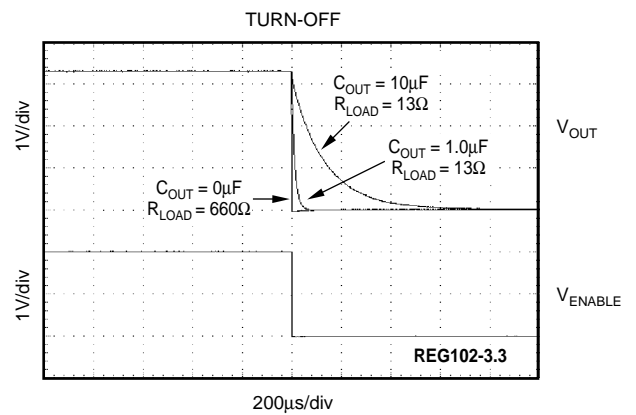
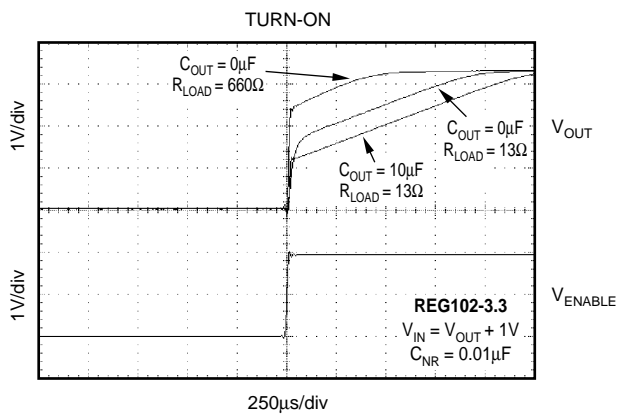
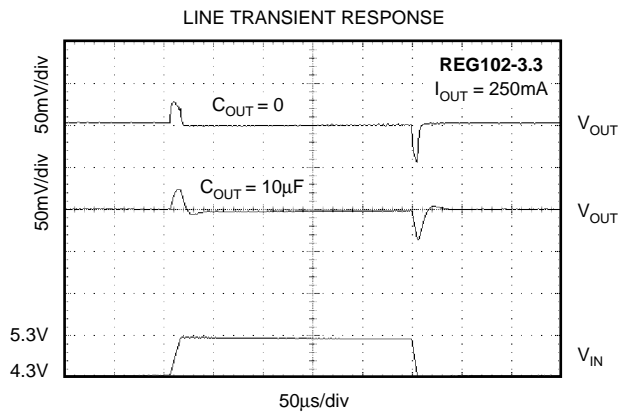
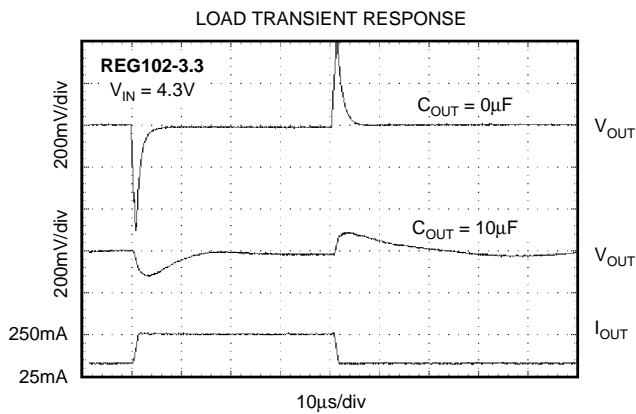
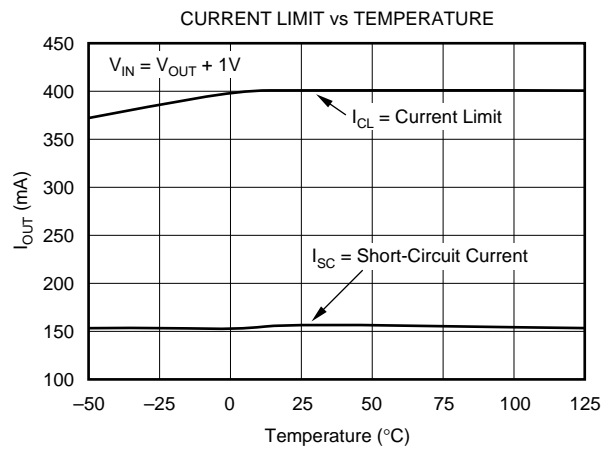
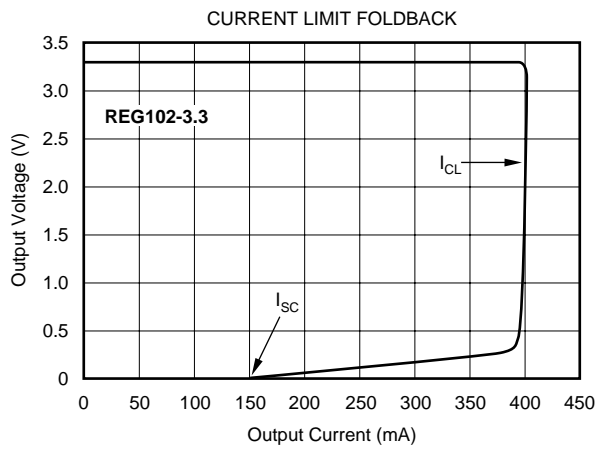
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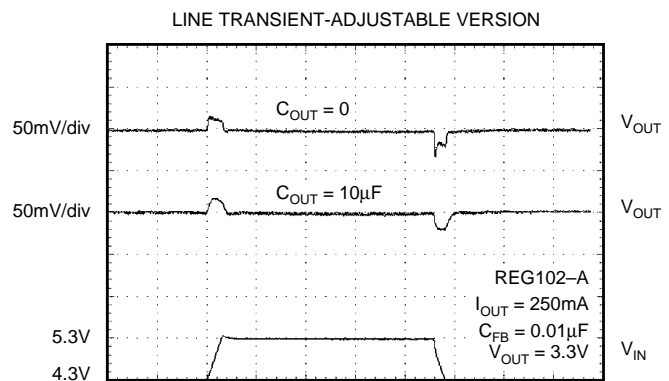
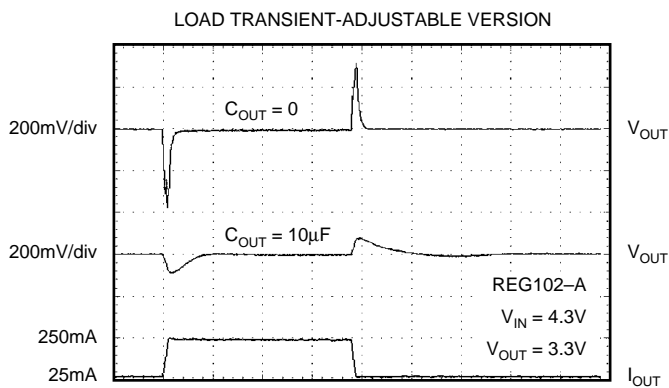
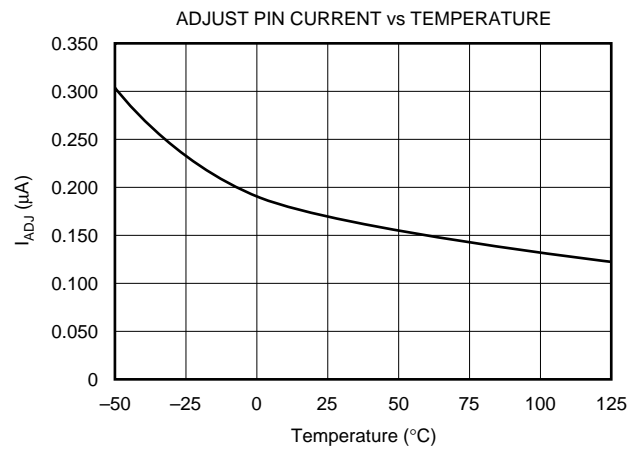
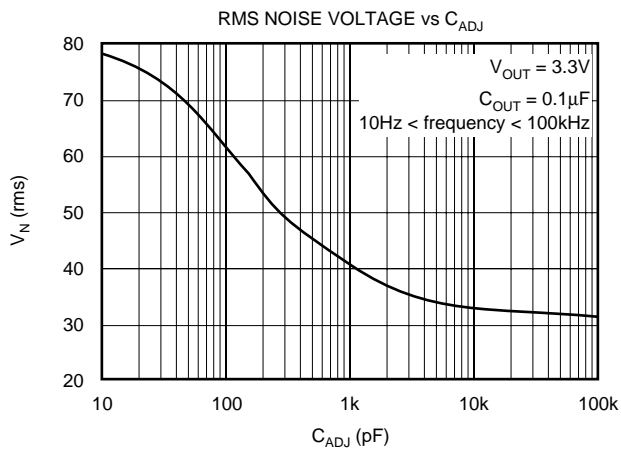
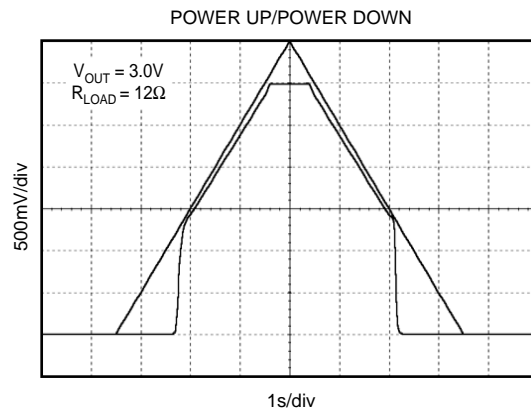
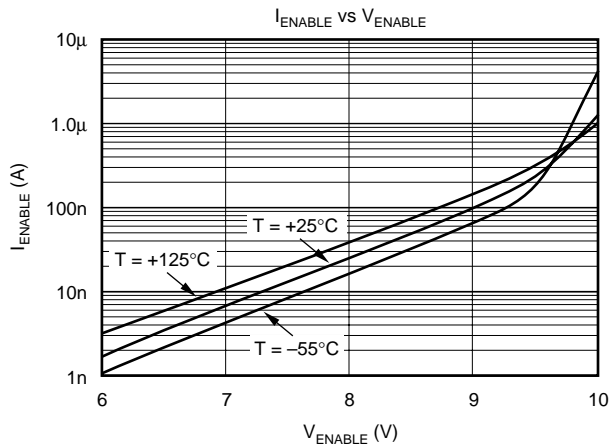
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# TYPICAL CHARACTERISTICS (Cont.)

For all models, at  $T_J = +25^\circ\text{C}$  and  $V_{\text{ENABLE}} = 1.8\text{V}$ , unless otherwise noted.





# BASIC OPERATION

The REG102 series of LDO (low dropout) linear regulators offers a wide selection of fixed output voltage versions and an adjustable output version as well. The REG102 belongs to a family of new generation LDO regulators that use a DMOS pass transistor to achieve ultra low-dropout performance and freedom from output capacitor constraints. Ground pin current remains under 1mA over all line, load, and temperature conditions. All versions have thermal and over-current protection, including foldback current limit.

The REG102 does not require an output capacitor for regulator stability and is stable over most output currents and with almost any value and type of output capacitor up to 10µF or more. For applications where the regulator output current drops below several milliamps, stability can be enhanced by adding a 1kΩ to 2kΩ load resistor, using capacitance values smaller than 10µF, or keeping the effective series resistance greater than 0.05Ω including the capacitor ESR and parasitic resistance in printed circuit board traces, solder joints, and sockets.

Although an input capacitor is not required, it is a good standard analog design practice to connect a 0.1µF low ESR capacitor across the input supply voltage. This is recommended to counteract reactive input sources and improve ripple rejection by reducing input voltage ripple.

Figure 1 shows the basic circuit connections for the fixed voltage models. Figure 2 gives the connections for the adjustable output version (REG102A) and example resistor values for some commonly used output voltages. Values for other voltages can be calculated from the equation shown in Figure 2.

## INTERNAL CURRENT LIMIT

The REG102 internal current limit has a typical value of 400mA. A foldback feature limits the short-circuit current to a typical short-circuit value of 150mA, which helps to protect

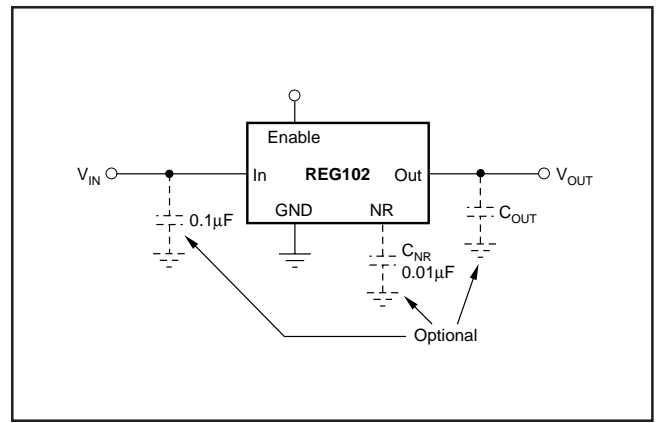


FIGURE 1. Fixed Voltage Nominal Circuit for the REG102.

the regulator from damage under all load conditions. A characteristic of  $V_{OUT}$  versus  $I_{OUT}$  is given in Figure 3 and in the Typical Characteristics section.

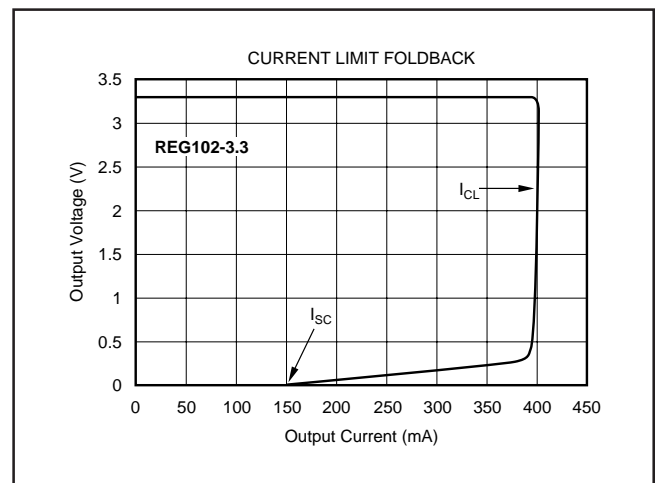


FIGURE 3. Foldback Current Limit of the REG102-3.3 at 25°C.

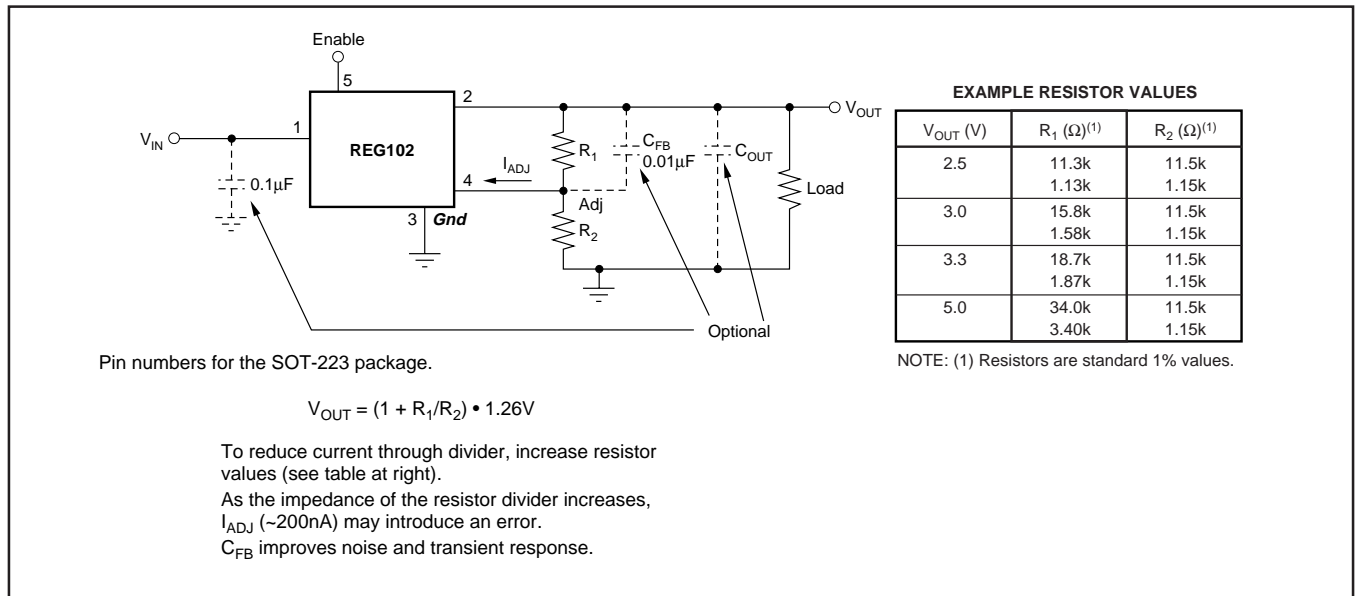


FIGURE 2. Adjustable Voltage Circuit for the REG102A.

## ENABLE

The Enable pin is active high and compatible with standard TTL-CMOS levels. Inputs below 0.5V (max) turn the regulator off and all circuitry is disabled. Under this condition, ground pin current drops to approximately 10nA. When not used, the Enable pin can be connected to  $V_{IN}$ . When a pull-up resistor is used, and operation below 1.8V is required, use pull-up resistor values below 50k $\Omega$ .

## OUTPUT NOISE

A precision bandgap reference is used to generate the internal reference voltage,  $V_{REF}$ . This reference is the dominant noise source within the REG102 and generates approximately 29 $\mu$ Vrms in the 10Hz to 100kHz bandwidth at the reference output. The regulator control loop gains up the reference noise, so that the noise voltage of the regulator is approximately given by:

$$V_N = 29\mu\text{Vrms} \frac{R_1 + R_2}{R_2} = 29\mu\text{Vrms} \cdot \frac{V_{OUT}}{V_{REF}} \quad (1)$$

As the value of  $V_{REF}$  is 1.26V, this relationship reduces to:

$$V_N = 23 \frac{\mu\text{Vrms}}{\text{V}} \cdot V_{OUT} \quad (2)$$

Connecting a capacitor,  $C_{NR}$ , from the Noise Reduction (NR) pin to ground forms a low-pass filter for the voltage reference. Adding  $C_{NR}$  (as shown in Figure 4) forms a low-pass filter for the voltage reference. For  $C_{NR} = 10\text{nF}$ , the total noise in the 10Hz to 100kHz bandwidth is reduced by approximately a factor of 2.8 for  $V_{OUT} = 3.3\text{V}$ . This noise reduction effect is shown in Figure 5 and as *RMS Noise Voltage vs  $C_{NR}$*  in the Typical Characteristics section.

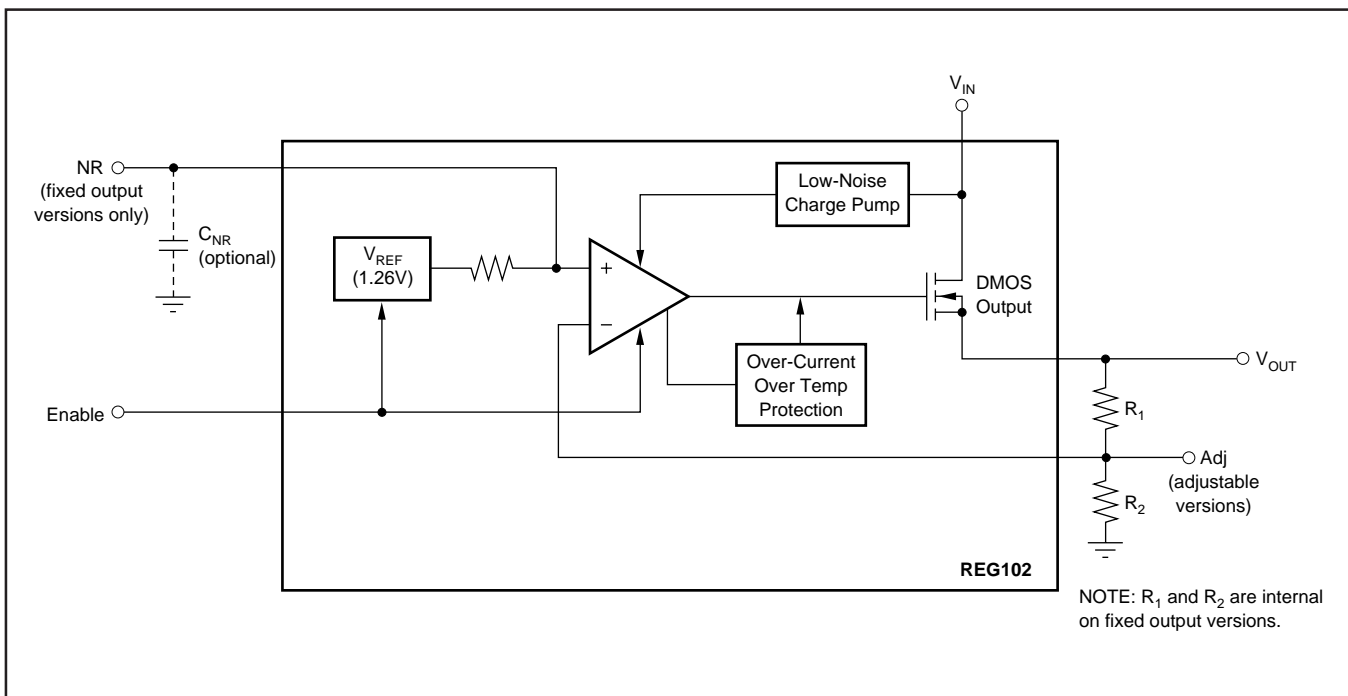


FIGURE 4. Block Diagram.

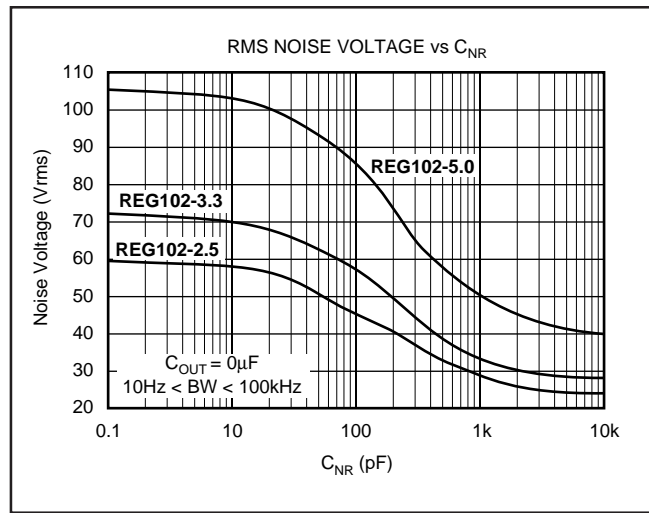


FIGURE 5. Output Noise versus Noise Reduction Capacitor.

Noise can be further reduced by carefully choosing an output capacitor,  $C_{OUT}$ . Best overall noise performance is achieved with very low ( $< 0.22\mu\text{F}$ ) or very high ( $> 2.2\mu\text{F}$ ) values of  $C_{OUT}$  (see the *RMS Noise Voltage vs  $C_{OUT}$*  typical characteristic).

The REG102 uses an internal charge pump to develop an internal supply voltage sufficient to drive the gate of the DMOS pass element above  $V_{IN}$ . The charge-pump switching noise (nominal switching frequency = 2MHz) is not measurable at the output of the regulator over most values of  $I_{OUT}$  and  $C_{OUT}$ .

The REG102 adjustable version does not have the noise-reduction pin available; however, the adjust pin is the summing junction of the error amplifier. A capacitor,  $C_{FB}$ , connected from the output to the adjust pin can reduce both the output noise and the peak error from a load transient (see the typical characteristics for output noise performance).

## DROPOUT VOLTAGE

The REG102 uses an N-channel DMOS as the pass element. When  $(V_{IN} - V_{OUT})$  is less than the drop-out voltage ( $V_{DROP}$ ), the DMOS pass device behaves like a resistor; therefore, for low values of  $(V_{IN} - V_{OUT})$ , the regulator input-to-output resistance is the  $R_{dsON}$  of the DMOS pass element (typically 600m $\Omega$ ). For static (DC) loads, the REG102 typically maintains regulation down to a  $(V_{IN} - V_{OUT})$  voltage drop of 150mV at full rated output current. In Figure 6, the bottom line (DC dropout) shows the minimum  $V_{IN}$  to  $V_{OUT}$  voltage drop required to prevent dropout under DC load conditions.

For large step changes in load current, the REG102 requires a larger voltage drop across it to avoid degraded transient response. The boundary of this transient drop-out region is shown as the top line in Figure 6 and values of  $V_{IN}$  to  $V_{OUT}$  voltage drop above this line insure normal transient response.

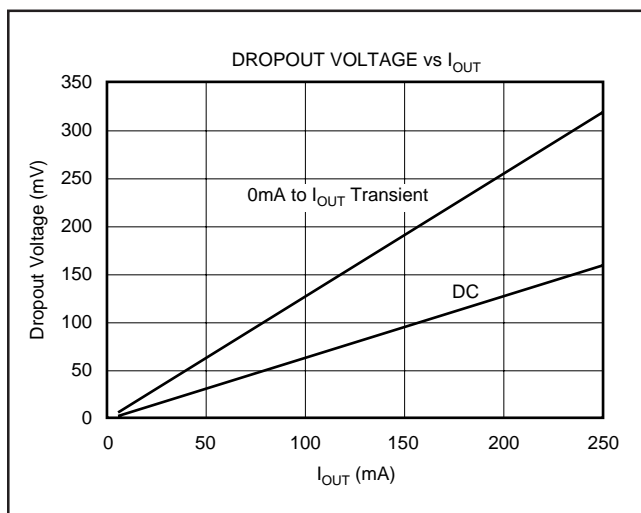


FIGURE 6. Transient and DC Dropout.

In the transient dropout region between DC and Transient, transient response recovery time increases. The time required to recover from a load transient is a function of both the magnitude and rate of the step change in load current and the available headroom  $V_{IN}$  to  $V_{OUT}$  voltage drop. Under worst-

case conditions (full-scale load change with  $(V_{IN} - V_{OUT})$  voltage drop close to DC dropout levels), the REG102 can take several hundred microseconds to re-enter the specified window of regulation.

## TRANSIENT RESPONSE

The REG102 response to transient line and load conditions improves at lower output voltages. The addition of a capacitor (nominal value 0.47 $\mu$ F) from the output pin to ground can improve the transient response. In the adjustable version, the addition of a capacitor,  $C_{FB}$  (nominal value 10nF), from the output to the adjust pin can also improve the transient response.

## THERMAL PROTECTION

Power dissipated within the REG102 can cause the junction temperature to rise. The REG102 has thermal shutdown circuitry that protects the regulator from damage which disables the output when the junction temperature reaches approximately 160°C, allowing the device to cool. When the junction temperature cools to approximately 140°C, the output circuitry is again enabled. Depending on various conditions, the thermal protection circuit can cycle on and off. This limits the dissipation of the regulator, but can have an undesirable effect on the load.

Any tendency to activate the thermal protection circuit indicates excessive power dissipation or an inadequate heat sink. For reliable operation, junction temperature must be limited to 125°C, maximum. To estimate the margin of safety in a complete design (including heat sink), increase the ambient temperature until the thermal protection is triggered; use worst-case loads and signal conditions. For good reliability, thermal protection should trigger more than 35°C above the maximum expected ambient condition of the application. This produces a worst-case junction temperature of 125°C at the highest expected ambient temperature and worst-case load.

The internal protection circuitry of the REG102 is designed to protect against overload conditions and is not intended to replace proper heat sinking. Continuously running the REG102 into thermal shutdown will degrade reliability.

## POWER DISSIPATION

The REG102 is available in three different package configurations. The ability to remove heat from the die is different for each package type and, therefore, presents different considerations in the printed circuit board (PCB) layout. The PCB area around the device that is free of other components moves the heat from the device to the ambient air. Although it is difficult to impossible to quantify all of the variables in a thermal design of this type, performance data for several simplified configurations are shown in Figure 7. In all cases, the PCB copper area is bare copper (free of solder resist mask), not solder plated, and are for 1-ounce copper. Using heavier copper will increase the effectiveness in moving the heat from the device. In those examples where there is copper on both sides of the PCB, no connection has been provided between the two sides. The addition of plated through holes will improve the heat sink effectiveness.

Power dissipation depends on input voltage, load conditions, and duty cycle and is equal to the product of the average output current times the voltage across the output element,  $V_{IN}$  to  $V_{OUT}$  voltage drop.

$$P_D = (V_{IN} - V_{OUT}) \cdot I_{OUT} \quad (3)$$

Power dissipation can be minimized by using the lowest possible input voltage necessary to assure the required output voltage.

## REGULATOR MOUNTING

The tab of the SOT-223 package is electrically connected to ground. For best thermal performance, this tab must be soldered directly to a circuit-board copper area. Increasing the copper area improves heat dissipation, as shown in Figure 8.

Although the tab of the SOT-223 is electrical ground, it is not intended to carry current. The copper pad that acts as a heat sink should be isolated from the rest of the circuit to prevent current flow through the device from the tab to the ground pin. Solder pad footprint recommendations for the various REG102 devices are presented in Application Bulletin *Solder Pad Recommendations for Surface-Mount Devices* (SBFA015), available from the Texas Instruments web site ([www.ti.com](http://www.ti.com)).

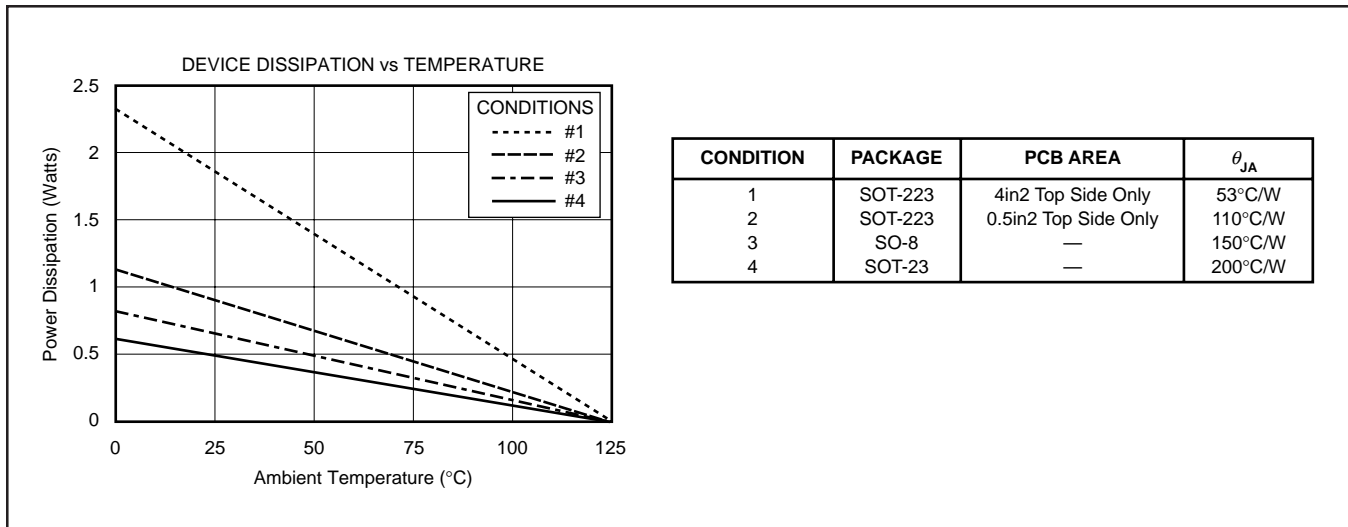


FIGURE 7. Maximum Power Dissipation versus Ambient Temperature for the Various Packages and PCB Heat Sink Configurations.

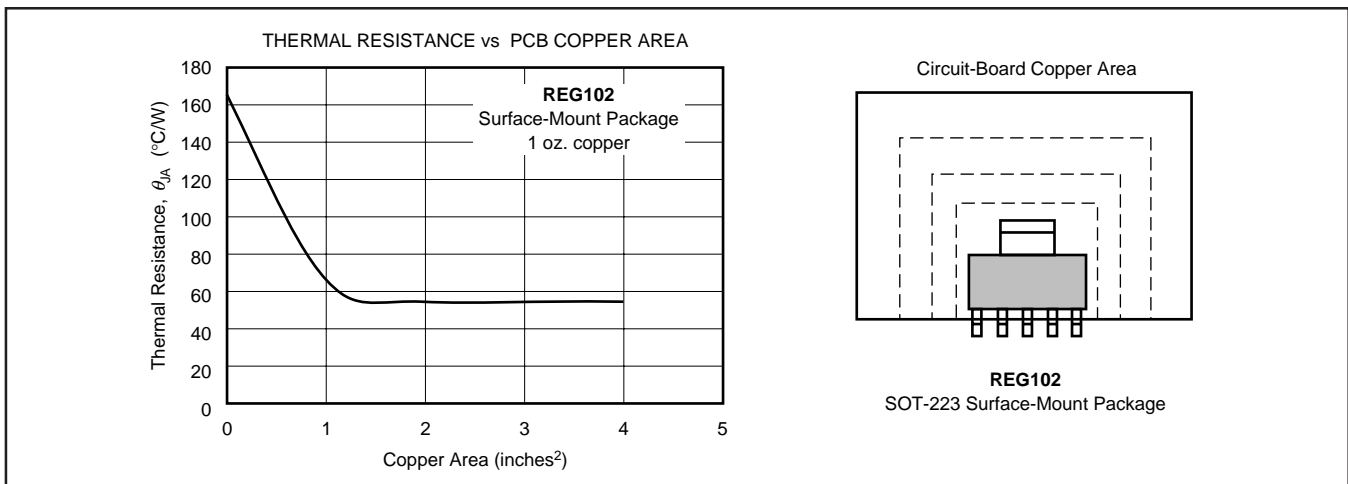


FIGURE 8. Thermal Resistance versus PCB Area for the Five-Lead SOT-223.

**PACKAGING INFORMATION**

Orderable part number	Status (1)	Material type (2)	Package   Pins	Package qty   Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
<a href="#">REG102GA-2.5</a>	Obsolete	Production	SOT-223 (DCQ)   6	-	-	Call TI	Call TI	-	R102G25
<a href="#">REG102GA-2.85</a>	Obsolete	Production	SOT-223 (DCQ)   6	-	-	Call TI	Call TI	-	R102285
<a href="#">REG102GA-3</a>	Active	Production	SOT-223 (DCQ)   6	78   TUBE	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	R102G30
<a href="#">REG102GA-3.3</a>	Active	Production	SOT-223 (DCQ)   6	78   TUBE	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	R102G33
<a href="#">REG102GA-3.3.B</a>	Active	Production	SOT-223 (DCQ)   6	78   TUBE	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	R102G33
<a href="#">REG102GA-3.3/2K5</a>	Active	Production	SOT-223 (DCQ)   6	2500   LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	R102G33
<a href="#">REG102GA-3.3/2K5.B</a>	Active	Production	SOT-223 (DCQ)   6	2500   LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	R102G33
<a href="#">REG102GA-3.3G4</a>	Active	Production	SOT-223 (DCQ)   6	78   TUBE	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	R102G33
<a href="#">REG102GA-3.A</a>	Active	Production	SOT-223 (DCQ)   6	78   TUBE	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	R102G30
<a href="#">REG102GA-3.B</a>	Active	Production	SOT-223 (DCQ)   6	78   TUBE	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	R102G30
<a href="#">REG102GA-5</a>	Active	Production	SOT-223 (DCQ)   6	78   TUBE	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	R102G50
<a href="#">REG102GA-5.B</a>	Active	Production	SOT-223 (DCQ)   6	78   TUBE	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	R102G50
<a href="#">REG102GA-A</a>	Active	Production	SOT-223 (DCQ)   6	78   TUBE	Yes	NIPDAU	Level-2-260C-1 YEAR	-	R102GA
<a href="#">REG102GA-A.B</a>	Active	Production	SOT-223 (DCQ)   6	78   TUBE	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	R102GA
<a href="#">REG102GA-A/2K5</a>	Active	Production	SOT-223 (DCQ)   6	2500   LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-	R102GA
<a href="#">REG102GA-A/2K5.B</a>	Active	Production	SOT-223 (DCQ)   6	2500   LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	R102GA
<a href="#">REG102GA-AG4</a>	Active	Production	SOT-223 (DCQ)   6	78   TUBE	Yes	NIPDAU	Level-2-260C-1 YEAR	See REG102GA-A	R102GA
<a href="#">REG102NA-2.5/250</a>	Obsolete	Production	SOT-23 (DBV)   5	-	-	Call TI	Call TI	-	RO2D
<a href="#">REG102NA-2.8/250</a>	Obsolete	Production	SOT-23 (DBV)   5	-	-	Call TI	Call TI	-	RO2E
<a href="#">REG102NA-2.85/250</a>	Obsolete	Production	SOT-23 (DBV)   5	-	-	Call TI	Call TI	-	RO2N
<a href="#">REG102NA-2.85/3K</a>	Active	Production	SOT-23 (DBV)   5	3000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-	RO2N
<a href="#">REG102NA-2.85/3K.A</a>	Active	Production	SOT-23 (DBV)   5	3000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	RO2N
<a href="#">REG102NA-2.85/3K.B</a>	Active	Production	SOT-23 (DBV)   5	3000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	RO2N
<a href="#">REG102NA-3.3/250</a>	Active	Production	SOT-23 (DBV)   5	250   SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	RO2C
<a href="#">REG102NA-3.3/250.B</a>	Active	Production	SOT-23 (DBV)   5	250   SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	RO2C
<a href="#">REG102NA-3.3/3K</a>	Active	Production	SOT-23 (DBV)   5	3000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	RO2C
<a href="#">REG102NA-3.3/3K.B</a>	Active	Production	SOT-23 (DBV)   5	3000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	RO2C
<a href="#">REG102NA-3/250</a>	Active	Production	SOT-23 (DBV)   5	250   SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	RO2G
<a href="#">REG102NA-3/250.A</a>	Active	Production	SOT-23 (DBV)   5	250   SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	RO2G

Orderable part number	Status (1)	Material type (2)	Package   Pins	Package qty   Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
REG102NA-3/250.B	Active	Production	SOT-23 (DBV)   5	250   SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	RO2G
REG102NA-3/250G4	Active	Production	SOT-23 (DBV)   5	250   SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	RO2G
<a href="#">REG102NA-3/3K</a>	Active	Production	SOT-23 (DBV)   5	3000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	RO2G
REG102NA-3/3K.A	Active	Production	SOT-23 (DBV)   5	3000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	RO2G
REG102NA-3/3K.B	Active	Production	SOT-23 (DBV)   5	3000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	RO2G
<a href="#">REG102NA-5/250</a>	Active	Production	SOT-23 (DBV)   5	250   SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	RO2B
REG102NA-5/250.B	Active	Production	SOT-23 (DBV)   5	250   SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	RO2B
REG102NA-5/250G4	Active	Production	SOT-23 (DBV)   5	250   SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	RO2B
<a href="#">REG102NA-5/3K</a>	Active	Production	SOT-23 (DBV)   5	3000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	RO2B
REG102NA-5/3K.B	Active	Production	SOT-23 (DBV)   5	3000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	RO2B
<a href="#">REG102NA-A/250</a>	Active	Production	SOT-23 (DBV)   5	250   SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-	RO2A
REG102NA-A/250.B	Active	Production	SOT-23 (DBV)   5	250   SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	RO2A
REG102NA-A/250G4	Active	Production	SOT-23 (DBV)   5	250   SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	See REG102NA-A/250	RO2A
<a href="#">REG102NA-A/3K</a>	Active	Production	SOT-23 (DBV)   5	3000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-	RO2A
REG102NA-A/3K.A	Active	Production	SOT-23 (DBV)   5	3000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	RO2A
REG102NA-A/3K.B	Active	Production	SOT-23 (DBV)   5	3000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	RO2A
<a href="#">REG102UA-2.5</a>	Obsolete	Production	SOIC (D)   8	-	-	Call TI	Call TI	-	REG 102U25
<a href="#">REG102UA-3</a>	Active	Production	SOIC (D)   8	75   TUBE	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	REG 102U30
<a href="#">REG102UA-3.3</a>	Active	Production	SOIC (D)   8	75   TUBE	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	REG 102U33
REG102UA-3.3.B	Active	Production	SOIC (D)   8	75   TUBE	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	REG 102U33
<a href="#">REG102UA-3.3/2K5</a>	Active	Production	SOIC (D)   8	2500   LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	REG 102U33
REG102UA-3.3/2K5.B	Active	Production	SOIC (D)   8	2500   LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	REG 102U33
REG102UA-3.A	Active	Production	SOIC (D)   8	75   TUBE	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	REG 102U30
REG102UA-3.B	Active	Production	SOIC (D)   8	75   TUBE	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	REG 102U30



Orderable part number	Status (1)	Material type (2)	Package   Pins	Package qty   Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
<a href="#">REG102UA-5</a>	Active	Production	SOIC (D)   8	75   TUBE	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	REG 102U50
REG102UA-5.B	Active	Production	SOIC (D)   8	75   TUBE	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	REG 102U50
<a href="#">REG102UA-5/2K5</a>	Active	Production	SOIC (D)   8	2500   LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	REG 102U50
REG102UA-5/2K5.B	Active	Production	SOIC (D)   8	2500   LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	REG 102U50
REG102UA-5G4	Active	Production	SOIC (D)   8	75   TUBE	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	REG 102U50

(1) **Status:** For more details on status, see our [product life cycle](#).

(2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

(4) **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

(6) **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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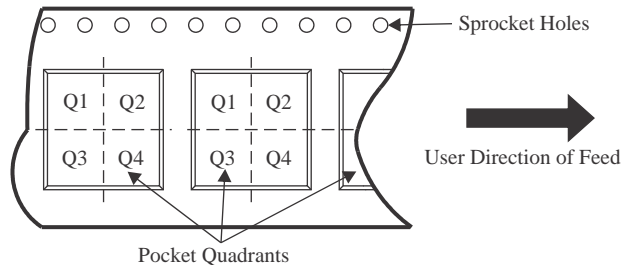
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## TAPE AND REEL INFORMATION



### QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
REG102GA-3.3/2K5	SOT-223	DCQ	6	2500	330.0	12.4	7.1	7.45	1.88	8.0	12.0	Q3
REG102GA-A/2K5	SOT-223	DCQ	6	2500	330.0	12.4	7.1	7.45	1.88	8.0	12.0	Q3
REG102NA-2.85/3K	SOT-23	DBV	5	3000	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
REG102NA-3.3/250	SOT-23	DBV	5	250	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
REG102NA-3.3/250	SOT-23	DBV	5	250	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
REG102NA-3.3/3K	SOT-23	DBV	5	3000	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
REG102NA-3/250	SOT-23	DBV	5	250	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
REG102NA-3/250	SOT-23	DBV	5	250	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
REG102NA-3/3K	SOT-23	DBV	5	3000	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
REG102NA-3/3K	SOT-23	DBV	5	3000	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
REG102NA-5/250	SOT-23	DBV	5	250	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
REG102NA-5/250	SOT-23	DBV	5	250	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
REG102NA-5/3K	SOT-23	DBV	5	3000	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
REG102NA-A/250	SOT-23	DBV	5	250	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
REG102NA-A/3K	SOT-23	DBV	5	3000	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
REG102UA-3.3/2K5	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
REG102UA-5/2K5	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1

**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
REG102GA-3.3/2K5	SOT-223	DCQ	6	2500	346.0	346.0	29.0
REG102GA-A/2K5	SOT-223	DCQ	6	2500	346.0	346.0	29.0
REG102NA-2.85/3K	SOT-23	DBV	5	3000	180.0	180.0	18.0
REG102NA-3.3/250	SOT-23	DBV	5	250	200.0	183.0	25.0
REG102NA-3.3/250	SOT-23	DBV	5	250	180.0	180.0	18.0
REG102NA-3.3/3K	SOT-23	DBV	5	3000	180.0	180.0	18.0
REG102NA-3/250	SOT-23	DBV	5	250	180.0	180.0	18.0
REG102NA-3/250	SOT-23	DBV	5	250	203.0	203.0	35.0
REG102NA-3/3K	SOT-23	DBV	5	3000	200.0	183.0	25.0
REG102NA-3/3K	SOT-23	DBV	5	3000	180.0	180.0	18.0
REG102NA-5/250	SOT-23	DBV	5	250	200.0	183.0	25.0
REG102NA-5/250	SOT-23	DBV	5	250	180.0	180.0	18.0
REG102NA-5/3K	SOT-23	DBV	5	3000	180.0	180.0	18.0
REG102NA-A/250	SOT-23	DBV	5	250	200.0	183.0	25.0
REG102NA-A/3K	SOT-23	DBV	5	3000	203.0	203.0	35.0
REG102UA-3.3/2K5	SOIC	D	8	2500	353.0	353.0	32.0
REG102UA-5/2K5	SOIC	D	8	2500	353.0	353.0	32.0

**TUBE**


\*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (μm)	B (mm)
REG102GA-3	DCQ	SOT-223	6	78	532.13	8.63	3.6	3.68
REG102GA-3.3	DCQ	SOT-223	6	78	532.13	8.63	3.6	3.68
REG102GA-3.3.B	DCQ	SOT-223	6	78	532.13	8.63	3.6	3.68
REG102GA-3.3G4	DCQ	SOT-223	6	78	532.13	8.63	3.6	3.68
REG102GA-3.A	DCQ	SOT-223	6	78	532.13	8.63	3.6	3.68
REG102GA-3.B	DCQ	SOT-223	6	78	532.13	8.63	3.6	3.68
REG102GA-5	DCQ	SOT-223	6	78	532.13	8.63	3.6	3.68
REG102GA-5.B	DCQ	SOT-223	6	78	532.13	8.63	3.6	3.68
REG102GA-A	DCQ	SOT-223	6	78	532.13	8.63	3.6	3.68
REG102GA-A.B	DCQ	SOT-223	6	78	532.13	8.63	3.6	3.68
REG102GA-AG4	DCQ	SOT-223	6	78	532.13	8.63	3.6	3.68
REG102UA-3	D	SOIC	8	75	506.6	8	3940	4.32
REG102UA-3.3	D	SOIC	8	75	506.6	8	3940	4.32
REG102UA-3.3.B	D	SOIC	8	75	506.6	8	3940	4.32
REG102UA-3.A	D	SOIC	8	75	506.6	8	3940	4.32
REG102UA-3.B	D	SOIC	8	75	506.6	8	3940	4.32
REG102UA-5	D	SOIC	8	75	506.6	8	3940	4.32
REG102UA-5.B	D	SOIC	8	75	506.6	8	3940	4.32
REG102UA-5G4	D	SOIC	8	75	506.6	8	3940	4.32

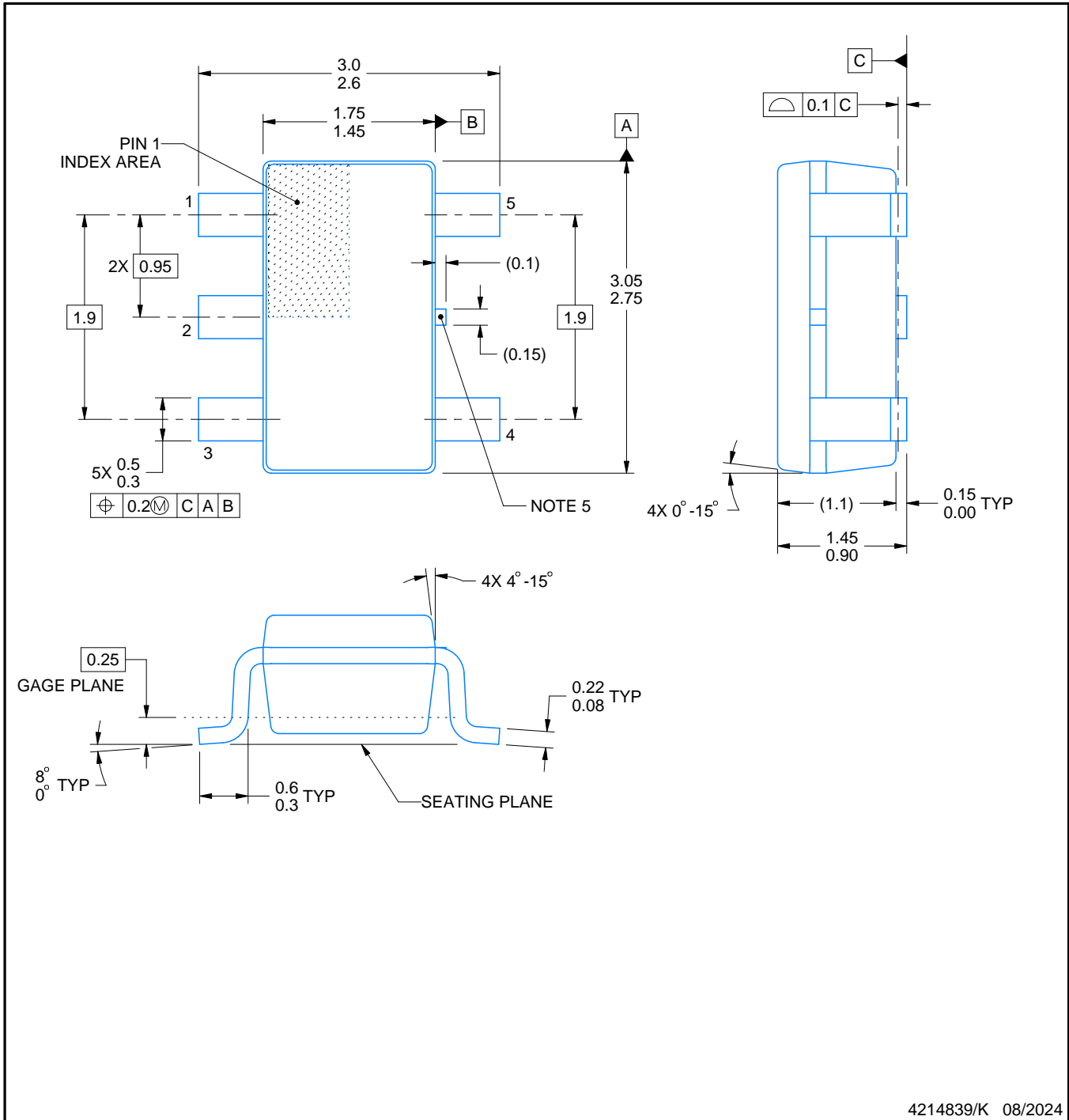
# DBV0005A



# PACKAGE OUTLINE

## SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



4214839/K 08/2024

### NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Reference JEDEC MO-178.
4. Body dimensions do not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.25 mm per side.
5. Support pin may differ or may not be present.

# EXAMPLE BOARD LAYOUT

DBV0005A

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE:15X



SOLDER MASK DETAILS

4214839/K 08/2024

NOTES: (continued)

- 6. Publication IPC-7351 may have alternate designs.
- 7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

DBV0005A

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



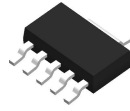
SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE:15X

4214839/K 08/2024

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

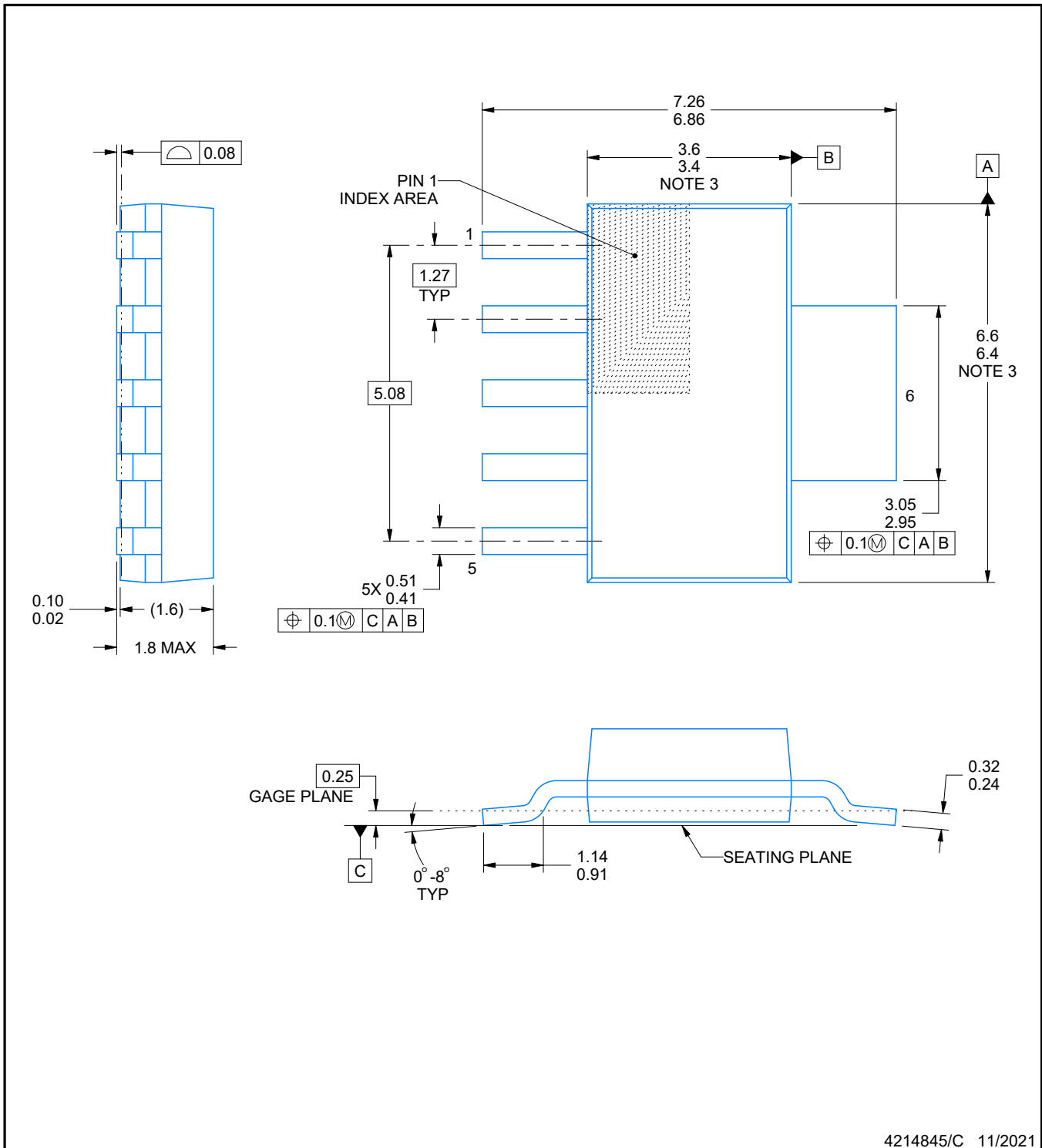
# DCQ0006A



# PACKAGE OUTLINE

## SOT - 1.8 mm max height

PLASTIC SMALL OUTLINE



4214845/C 11/2021

### NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.

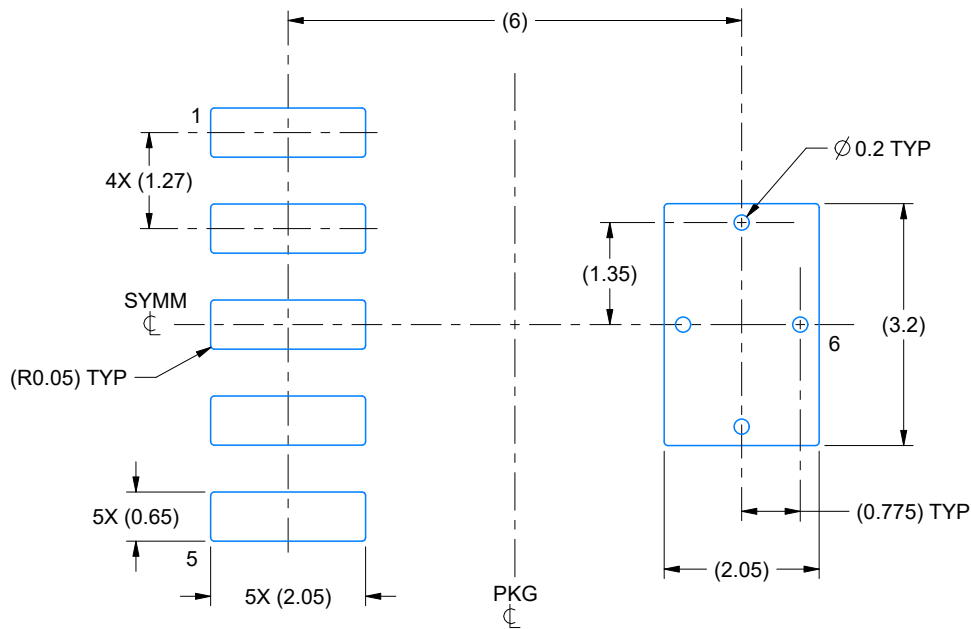


# EXAMPLE BOARD LAYOUT

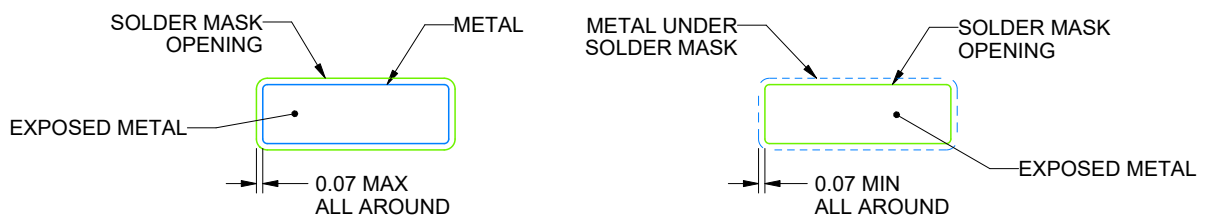
DCQ0006A

SOT - 1.8 mm max height

PLASTIC SMALL OUTLINE



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 10X



SOLDER MASK DETAILS

4214845/C 11/2021

NOTES: (continued)

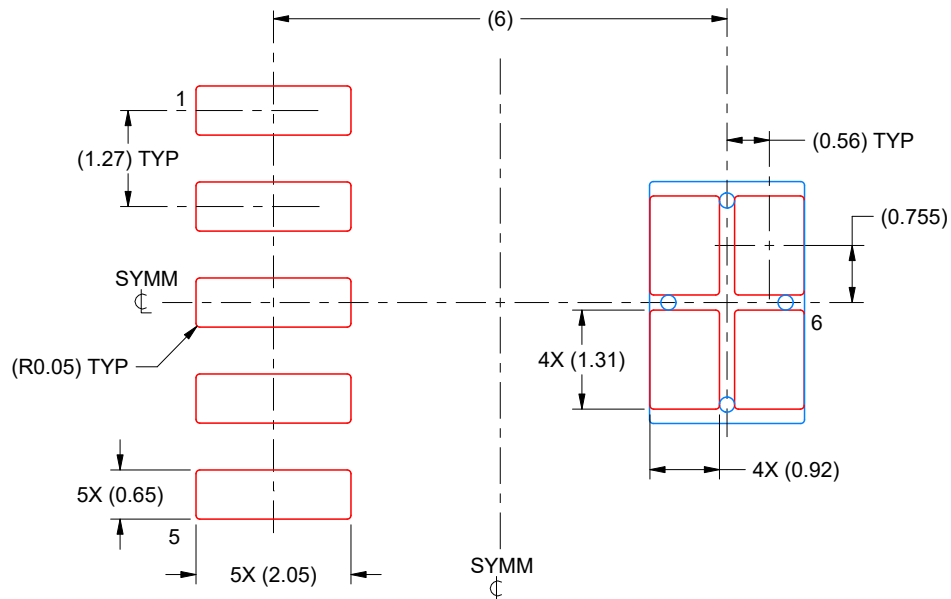
4. Publication IPC-7351 may have alternate designs.
5. Solder mask tolerances between and around signal pads can vary based on board fabrication site.
6. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.

# EXAMPLE STENCIL DESIGN

DCQ0006A

SOT - 1.8 mm max height

PLASTIC SMALL OUTLINE



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE: 10X

4214845/C 11/2021

NOTES: (continued)

7. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
8. Board assembly site may have different recommendations for stencil design.



D0008A

# PACKAGE OUTLINE

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



4214825/C 02/2019

NOTES:

- Linear dimensions are in inches [millimeters]. Dimensions in parenthesis are for reference only. Controlling dimensions are in inches. Dimensioning and tolerancing per ASME Y14.5M.
- This drawing is subject to change without notice.
- This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed  $.006$  [0.15] per side.
- This dimension does not include interlead flash.
- Reference JEDEC registration MS-012, variation AA.

# EXAMPLE BOARD LAYOUT

D0008A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



LAND PATTERN EXAMPLE  
 EXPOSED METAL SHOWN  
 SCALE:8X



SOLDER MASK DETAILS

4214825/C 02/2019

NOTES: (continued)

- 6. Publication IPC-7351 may have alternate designs.
- 7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

D0008A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



SOLDER PASTE EXAMPLE  
BASED ON .005 INCH [0.125 MM] THICK STENCIL  
SCALE:8X

4214825/C 02/2019

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

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