TLV755P 500-mA, Low I_Q, Small Size, Low Dropout Regulator

1 Features

- Input Voltage Range: 1.45 V to 5.5 V
- Low I_Q: 25 µA (Typical)
- Low Dropout:
  - 238 mV (Maximum) at 500 mA (3.3 V_{OUT})
- Output Accuracy: 1% (Maximum at 85°C)
- Built-In Soft-Start With Monotonic V_{OUT} Rise
- Foldback Current Limit
- Active Output Discharge
- High PSRR: 46 dB at 100 kHz
- Stable With a 1-µF Ceramic Output Capacitor
- Packages:
  - 2.9-mm × 1.6-mm SOT-23-5
  - 1-mm x 1-mm X2SON-4
  - 2 mm × 2 mm WSON-6

2 Applications

- Set-Top Boxes, TV, and Gaming Consoles
- Portable and Battery-Powered Equipment
- Desktop, Notebooks, and Ultrabooks
- Tablets and Remote Controls
- White Goods and Appliances
- Grid Infrastructure and Protection Relays
- Camera Modules and Image Sensors

3 Description

The TLV755P is an ultra-small, low quiescent current, low-dropout regulator (LDO) that sources 500 mA with good line and load transient performance. The TLV755P is optimized for a wide variety of applications by supporting an input voltage range from 1.45 V to 5.5 V. To minimize cost and solution size, the device is offered in fixed output voltages ranging from 0.6 V to 5 V to support the lower core voltages of modern microcontrollers (MCUs). Additionally, the TLV755P has a low I_Q with enable functionality to minimize standby power. This device features an internal soft-start to lower inrush current, thus providing a controlled voltage to the load and minimizing the input voltage drop during start up. When shutdown, the device actively pulls down the output to quickly discharge the outputs and ensure a known start-up state.

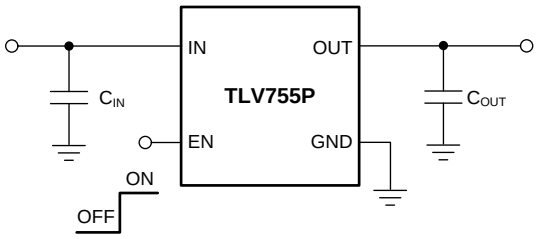
The TLV755P is stable with small ceramic output capacitors allowing for a small overall solution size. A precision band-gap and error amplifier provides a typical accuracy of 1%. All device versions have integrated thermal shutdown, current limit, and undervoltage lockout (UVLO). The TLV755P has an internal foldback current limit that helps reduce the thermal dissipation during short-circuit events.

Device Information(1)

PART NUMBER	PACKAGE	BODY SIZE (NOM)
TLV755P	X2SON (4)	1.00 mm × 1.00 mm
	SOT-23 (5)	2.90 mm × 1.60 mm
	SON (6)	2.00 mm × 2.00 mm

(1) For all available packages, see the orderable addendum at the end of the data sheet.

Typical Application



Startup Waveform

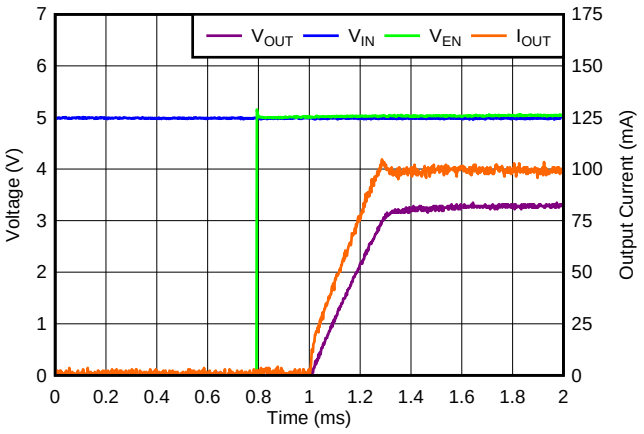


Table of Contents

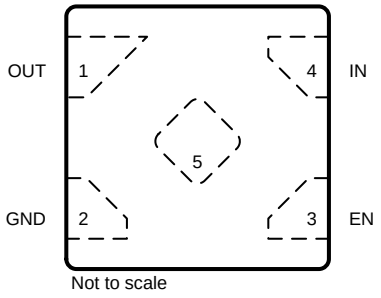
4 Revision History

Changes from Original (November 2017) to Revision A **Page**

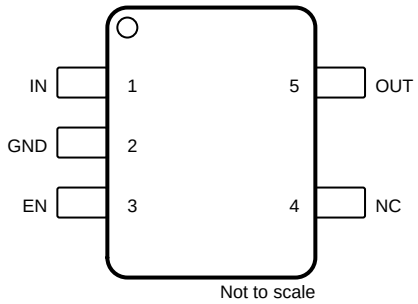
- Released to production ... 1

5 Pin Configuration and Functions

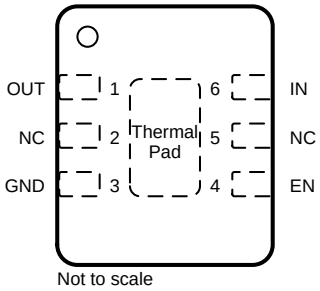
DQN Package
4-Pin X2SON
Top View



DBV Package
5-Pin SOT-23
Top View



DRV Package
6-Pin WSON With Exposed Thermal Pad
Top View



NC = no internal connection.

Pin Functions

PIN				I/O	DESCRIPTION
NAME	DQN	DBV	DRV		
EN	3	3	4	I	Enable pin. Drive EN greater than V_{HI} to turn on the regulator. Drive EN less than V_{LO} to place the LDO into shutdown mode.
GND	2	2	3	—	Ground pin.
IN	4	1	6	I	Input pin. A capacitor with a value of 1 µF or larger is required from this pin to ground(1). See the *Input and Output Capacitor Selection* section for more information.
NC	—	4	2, 5	—	No internal connection.
OUT	1	5	1	O	Regulated output voltage pin. A capacitor with a value of 1 µF or larger is required from this pin to ground(1). See the *Input and Output Capacitor Selection* section for more information.
Thermal pad	Pad	—	Pad	—	Connect the thermal pad to a large-area ground plane. The thermal pad is internally connected to GND.

(1) The nominal input and output capacitance must be greater than 0.47 µF; throughout this document the nominal derating on these capacitors is 50%. Make sure that the effective capacitance at the pin is greater than 0.47 µF.

6 Specifications

6.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)(1)

	MIN	MAX	UNIT
Supply voltage, V_{IN}	-0.3	6.0	V
Enable voltage, V_{EN}	-0.3	6.0	V
Output voltage, V_{OUT}	-0.3	V_{IN} + 0.3(2)	V
Operating junction temperature range, T_J	-40	150	°C
Storage temperature, T_{stg}	-65	150	°C

(1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
(2) The absolute maximum rating is V_{IN} + 0.3 V or 6.0 V, whichever is smaller

6.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001(1)	±1000	V
		Charged-device model (CDM), per JEDEC specification JESD22-C101(2)	±500	

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process. Manufacturing with less than 500-V HBM is possible with the necessary precautions.
(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process. Manufacturing with less than 250-V CDM is possible with the necessary precautions.

6.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)

		MIN	NOM	MAX	UNIT
V_{IN}	Input voltage	1.45		5.5	V
V_{OUT}	Output voltage	0.6		5.0	V
V_{EN}	Enable voltage	0		5.5	V
I_{OUT}	Output current	0		500	mA
C_{IN}	Input capacitor	1			µF
C_{OUT}	Output capacitor	1		200	µF
f_{EN}	Enable toggle frequency			10	kHz
T_J	Junction temperature	–40		125	°C

6.4 Thermal Information

THERMAL METRIC(1)		TLV755			UNIT
		DQN (X2SON)	DBV (SOT-23-5)	DRV (SON)	
		4 PINS	5 PINS	6 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	168.4	231.1	100.2	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	139.1	118.4	108.5	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	101.4	64.4	64.3	°C/W
ψ_{JT}	Junction-to-top characterization parameter	5.6	28.4	10.4	°C/W
ψ_{JB}	Junction-to-board characterization parameter	101.7	63.8	64.8	°C/W
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance	88.4	N/A	34.7	°C/W

(1) For more information about traditional and new thermal metrics, see the Semiconductor and IC Package Thermal Metrics application report.

6.5 Electrical Characteristics

at operating temperature range (T_J = –40°C to 125°C), V_{IN} = $V_{OUT(NOM)}$ + 0.5 V or 2.0 V (whichever is greater), I_{OUT} = 1 mA, V_{EN} = V_{IN}, and C_{IN} = C_{OUT} = 1 µF, unless otherwise noted. All typical values at T_J = 25°C.

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
V_{IN}	Input voltage			1.45		5.5	V
V_{OUT}	Output voltage			0.6		5.0	V
	Output accuracy	-40°C ≤ T_J ≤ +85°C, DBV and DRV package		-1%		1%	
		V_{OUT} ≥ 1.0 V, DQN package		-1.2%		1.2%	
		-40°C ≤ T_J ≤ +85°C; 0.6 V ≤ V_{OUT} < 1.0 V		-10		10	mV
		V_{OUT} ≥ 1 V		-1.5%		1.5%	
		0.6 V ≤ V_{OUT} < 1 V		-15		15	mV
(ΔVOUT) ΔVIN	Line regulation	V_{OUT} + 0.5 V ≤ V_{IN} ≤ 5.5 V, V_{OUT} > 1.5 V			2		mV
ΔVOUT/ ΔIOUT	Load regulation	0.1 mA ≤ I_{OUT} ≤ 500 mA	DQN package		0.036		V/A
			DBV package		0.060		
			DRV package		0.044		
I_{GND}	Ground current	T_J = 25°C, I_{OUT} = 0 mA		14	25	31	µA
		-40°C ≤ T_J ≤ +85°C, I_{OUT} = 0 mA				33	
		-40°C ≤ T_J ≤ +125°C, I_{OUT} = 0 mA				40	
I_{SHDN}	Shutdown current	V_{EN} ≤ 0.4 V, 1.4 V ≤ V_{IN} ≤ 5.5 V, -40°C ≤ T_J ≤ +125°C			0.1	1	µA
I_{CL}	Output current limit	V_{IN} = V_{OUT}+ $V_{DO(MAX)}$ + 0.25 V	V_{OUT} = V_{OUT} - 0.2 V, V_{OUT} ≤ 1.5V	560	720	865	mA
			V_{OUT} = 0.9 x V_{OUT}, 1.5V < V_{OUT} ≤ 4.5V	560	720	865	
I_{SC}	Short circuit current limit	V_{OUT} = 0 V			355		mA
V_{DO}	Dropout voltage	I_{OUT} = 500mA, -40°C ≤ T_J ≤ +85°C	0.6 V ≤ V_{OUT} < 0.8 V		675	1080	mV
			0.8 V ≤ V_{OUT} < 1.0V		600	930	
			1.0 V ≤ V_{OUT} < 1.2 V		550	780	
			1.2 V ≤ V_{OUT} < 1.5 V		500	630	
			1.5 V ≤ V_{OUT} < 1.8 V		350	400	
			1.8 V ≤ V_{OUT} < 2.5 V		325	380	
			2.5 V ≤ V_{OUT} < 3.3 V		250	300	
			3.3 V ≤ V_{OUT} < 5.0 V		150	215	
		I_{OUT} = 500mA, -40°C ≤ T_J ≤ +125°C	0.6 V ≤ V_{OUT} < 0.8 V			1140	
			0.8 V ≤ V_{OUT} < 1.0 V			985	
			1.0 V ≤ V_{OUT} < 1.2 V			825	
			1.2 V ≤ V_{OUT} < 1.5 V			665	
			1.5 V ≤ V_{OUT} < 1.8 V			425	
			1.8 V ≤ V_{OUT} < 2.5 V			400	
			2.5 V ≤ V_{OUT} < 3.3 V			325	
			3.3 V ≤ V_{OUT} < 5.0 V			238	
PSRR	Power-supply rejection ratio	f = 1 kHz, V_{IN} = V_{OUT} + 1 V, I_{OUT} = 50 mA			52		dB
		f = 100 kHz, V_{IN} = V_{OUT} + 1 V, I_{OUT} = 50 mA			46		
		f = 1 MHz, V_{IN} = V_{OUT} + 1 V, I_{OUT} = 50 mA			52		
V_N	Output noise voltage	BW = 10 Hz to 100 kHz; V_{OUT} = 1.2 V, I_{OUT} = 500 mA			71.5		$µV_{RMS}$
V_{UVLO}	Undervoltage lockout	V_{IN} rising		1.21	1.3	1.44	V
$V_{UVLO,HYST}$	Undervoltage lockout hysteresis	V_{IN} falling			40		mV
t_{STR}	Startup time				550		µs
V_{HI}	EN pin high voltage (enabled)			1			V

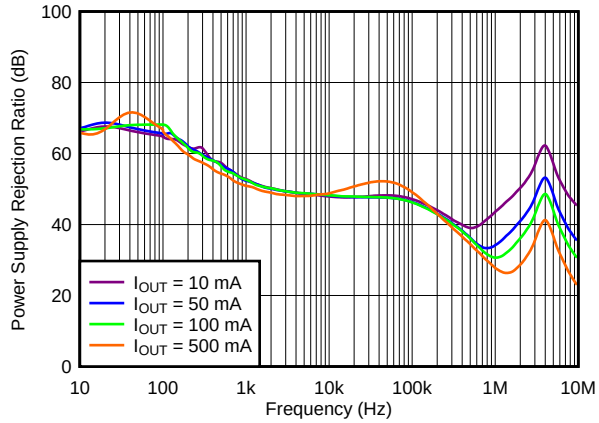
Electrical Characteristics (continued)

at operating temperature range (T_J = –40°C to 125°C), V_{IN} = $V_{OUT(NOM)}$ + 0.5 V or 2.0 V (whichever is greater), I_{OUT} = 1 mA, V_{EN} = V_{IN}, and C_{IN} = C_{OUT} = 1 μF, unless otherwise noted. All typical values at T_J = 25°C.

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{LO}	EN pin low voltage (enabled)				0.3	V
I_{EN}	Enable pin current	EN = 5.5V		10		nA
T_{SD}	Thermal shutdown	Shutdown, temperature increasing		165		°C
		Reset, temperature decreasing		155		
$R_{PULLDOWN}$	Pulldown resistance	V_{IN} = 5.5V		120		Ω

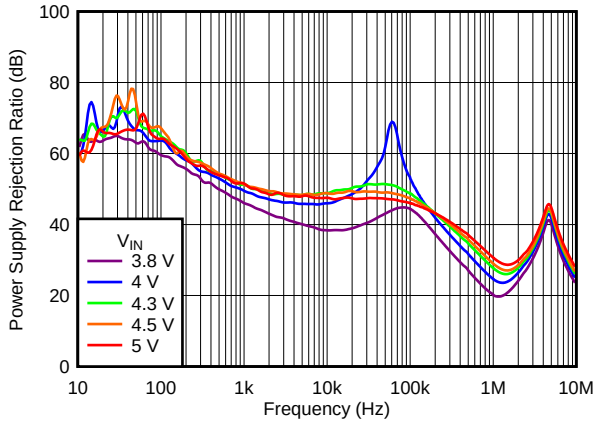
6.6 Typical Characteristics

at operating temperature T_J = 25°C, V_{IN} = $V_{OUT(NOM)}$ + 0.5 V or 1.45 V (whichever is greater), I_{OUT} = 1 mA, V_{EN} = V_{IN}, and C_{IN} = C_{OUT} = 1 µF (unless otherwise noted)



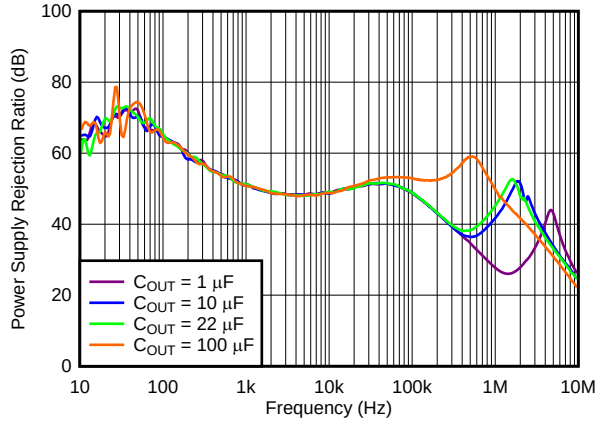
V_{IN} = 4.3 V, V_{OUT} = 3.3 V, C_{OUT} = 1 µF

Figure 1. PSRR vs Frequency and I_{OUT}



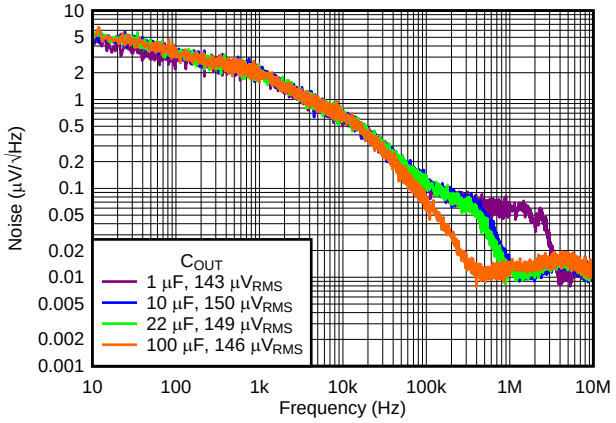
V_{OUT} = 3.3 V, C_{OUT} = 1 µF, I_{OUT} = 500 mA

Figure 2. PSRR vs Frequency and V_{IN}



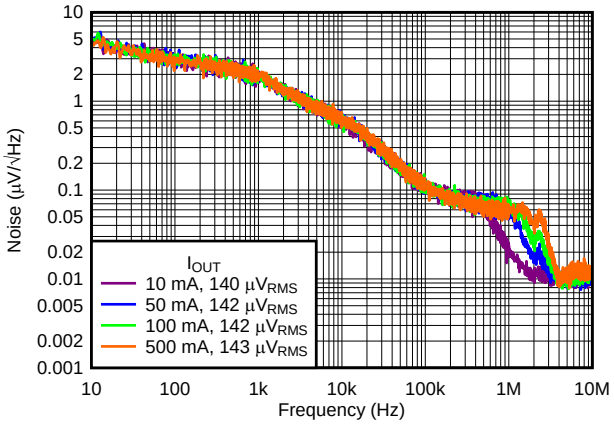
V_{IN} = 4.3 V, V_{OUT} = 3.3 V, I_{OUT} = 500 mA

Figure 3. PSRR vs Frequency and C_{OUT}



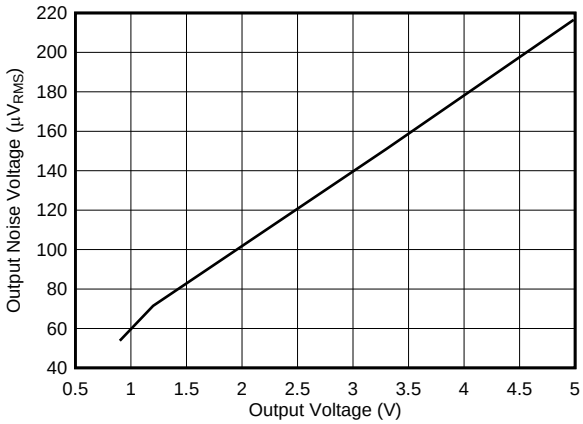
V_{OUT} = 3.3 V, V_{RMS} BW = 10 Hz to 100 kHz

Figure 4. Output Spectral Noise Density vs Frequency and C_{OUT}



V_{OUT} = 3.3 V, I_{OUT} = 500 mA, C_{OUT} = 1 µF, V_{RMS} BW = 10 Hz to 100 kHz

Figure 5. Output Spectral Noise Density vs Frequency and I_{OUT}

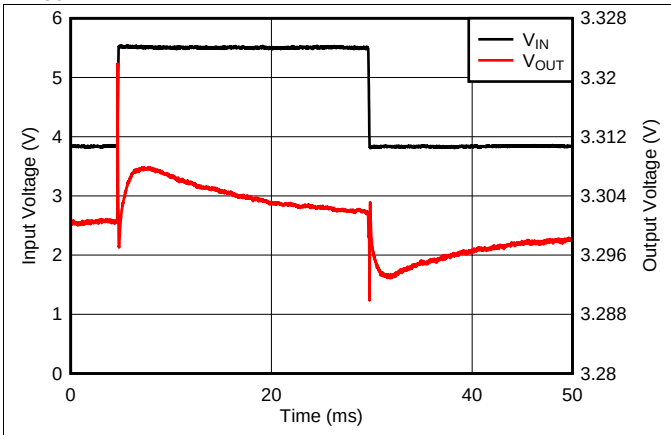


I_{OUT} = 500 mA, C_{OUT} = 1 µF, V_{RMS} BW = 10 Hz to 100 kHz

Figure 6. Output Noise Voltage vs V_{OUT}

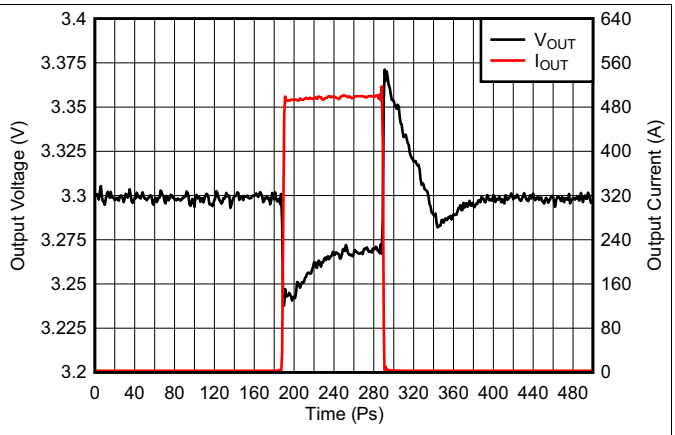
Typical Characteristics (continued)

at operating temperature T_J = 25°C, V_{IN} = $V_{OUT(NOM)}$ + 0.5 V or 1.45 V (whichever is greater), I_{OUT} = 1 mA, V_{EN} = V_{IN}, and C_{IN} = C_{OUT} = 1 µF (unless otherwise noted)



V_{OUT} = 3.3 V, C_{OUT} = 1 µF, V_{IN} slew rate = 1 V/µs

Figure 7. Line Transient



V_{IN} = 5 V, V_{OUT} = 3.3 V, C_{OUT} = 1 µF, I_{OUT} slew rate = 1 A/µs

Figure 8. 3.3-V, 1-mA to 500-mA Load Transient

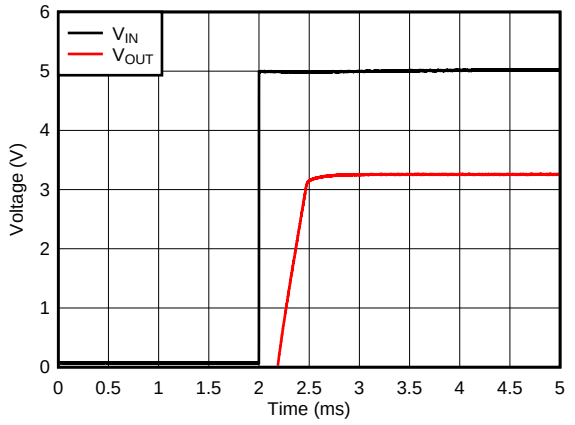


Figure 9. V_{IN} = V_{EN} Power-Up

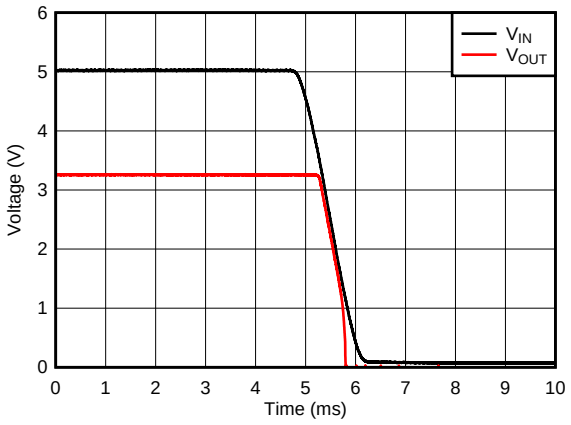
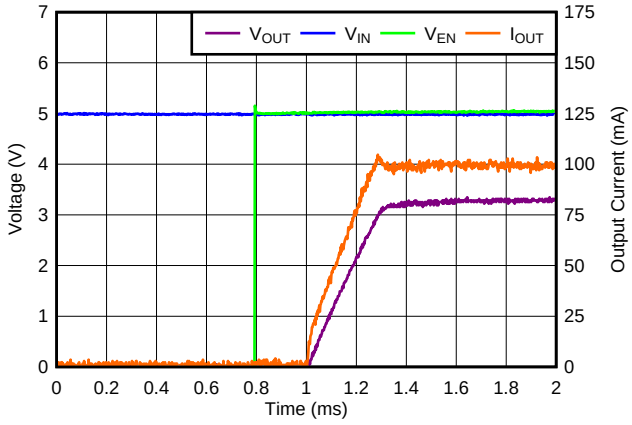


Figure 10. V_{IN} = V_{EN} Shutdown



V_{IN} = 5 V, I_{OUT} = 100 mA, V_{EN} slew rate = 1 V/µs, V_{OUT} = 3.3 V

Figure 11. EN Startup

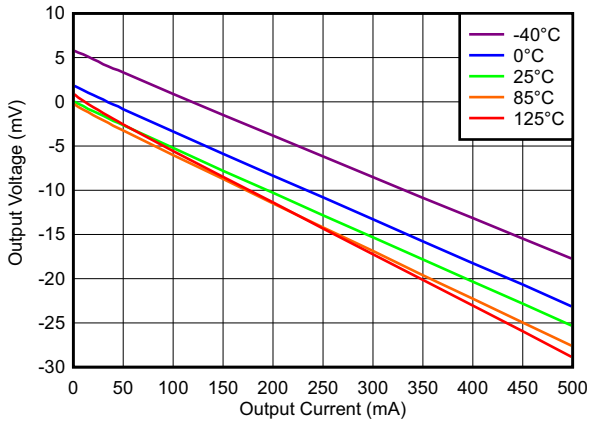


Figure 12. Load Regulation vs I_{OUT}

Typical Characteristics (continued)

at operating temperature T_J = 25°C, V_{IN} = $V_{OUT(NOM)}$ + 0.5 V or 1.45 V (whichever is greater), I_{OUT} = 1 mA, V_{EN} = V_{IN}, and C_{IN} = C_{OUT} = 1 µF (unless otherwise noted)

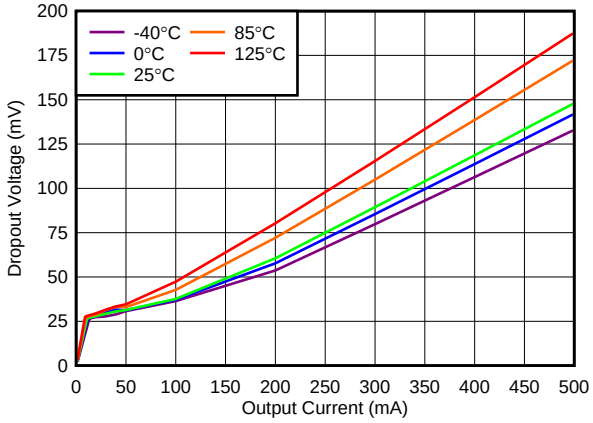


Figure 13. 3.3-V Dropout Voltage vs I_{OUT}

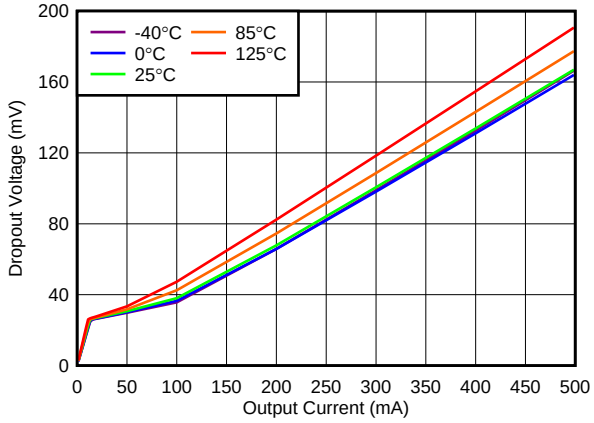
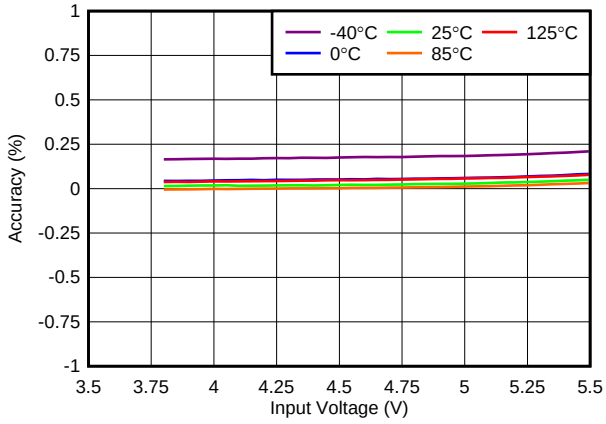
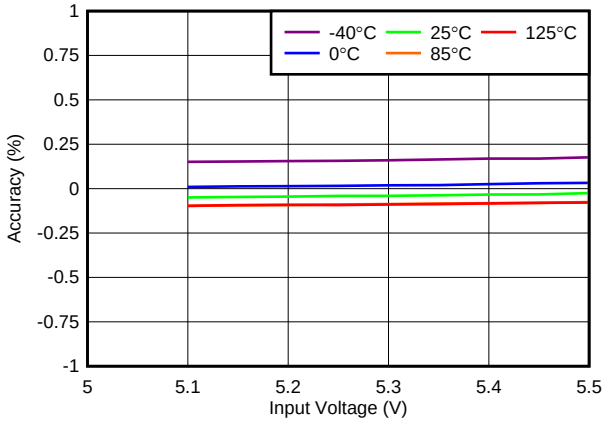


Figure 14. 5.0-V Dropout Voltage vs I_{OUT}



V_{OUT} = 3.3 V, I_{OUT} = 1 mA

Figure 15. 3.3-V Regulation vs V_{IN} (Line Regulation)



I_{OUT} = 1 mA, V_{OUT} = 5 V

Figure 16. 5.0-V Accuracy vs V_{IN} (Line Regulation)

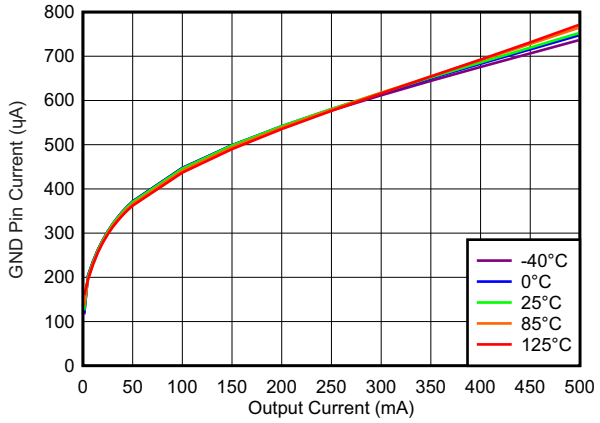
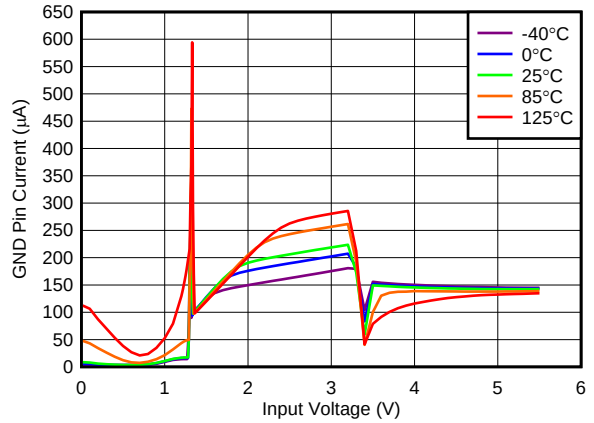


Figure 17. I_{GND} vs I_{OUT}



V_{OUT} = 3.3 V, I_{OUT} = 1 mA

Figure 18. I_{GND} vs V_{IN}

Typical Characteristics (continued)

at operating temperature T_J = 25°C, V_{IN} = $V_{OUT(NOM)}$ + 0.5 V or 1.45 V (whichever is greater), I_{OUT} = 1 mA, V_{EN} = V_{IN}, and C_{IN} = C_{OUT} = 1 µF (unless otherwise noted)

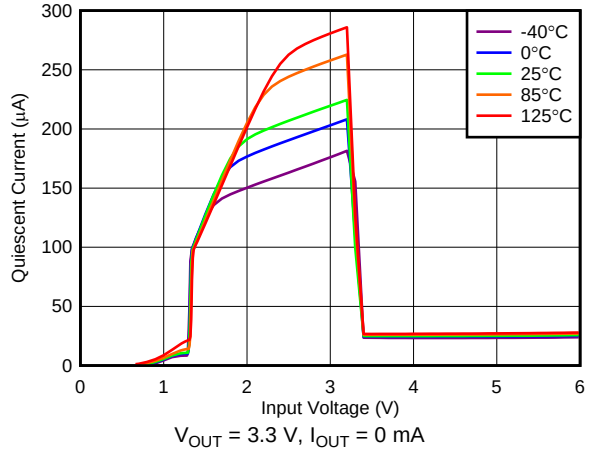


Figure 19. I_Q vs V_{IN}

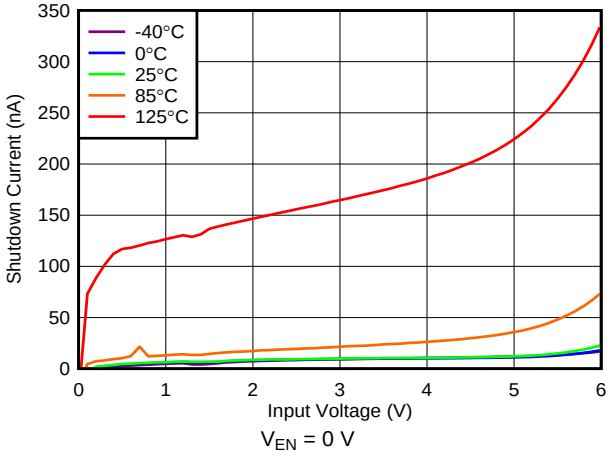


Figure 20. I_{SHDN} vs V_{IN}

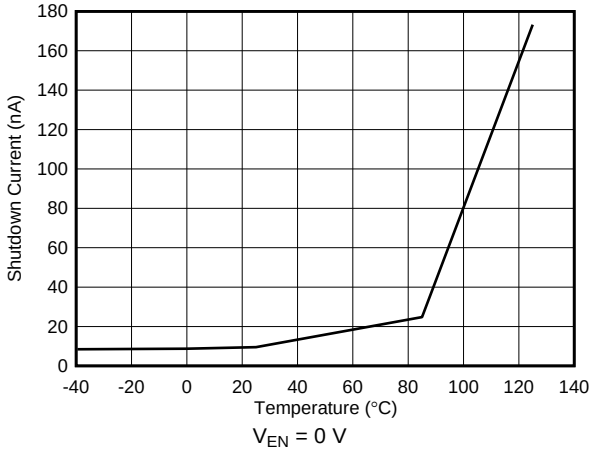


Figure 21. I_{SHDN} vs Temperature

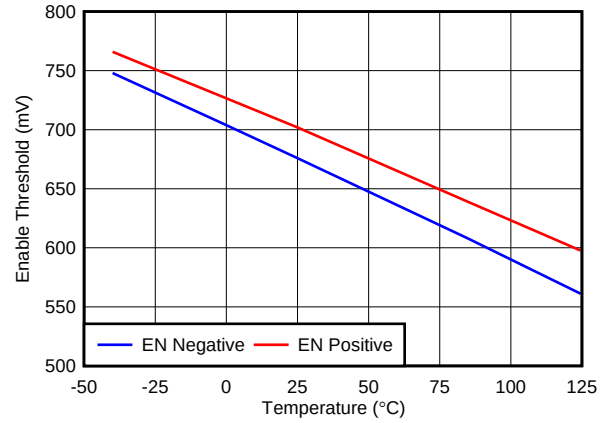


Figure 22. Enable Threshold vs Temperature

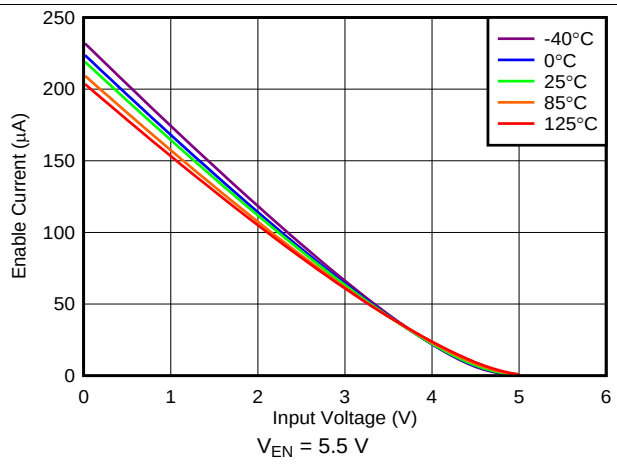


Figure 23. I_{EN} vs V_{IN}

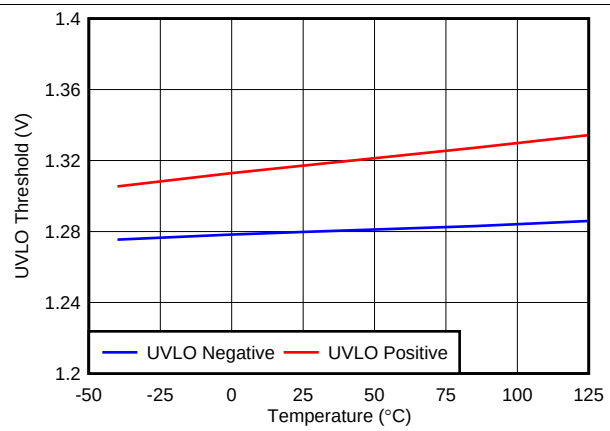


Figure 24. UVLO Threshold vs Temperature

Typical Characteristics (continued)

at operating temperature T_J = 25°C, V_{IN} = $V_{OUT(NOM)}$ + 0.5 V or 1.45 V (whichever is greater), I_{OUT} = 1 mA, V_{EN} = V_{IN}, and C_{IN} = C_{OUT} = 1 µF (unless otherwise noted)

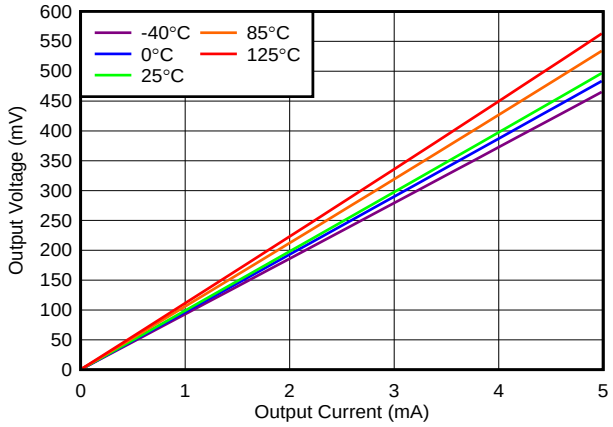


Figure 25. V_{OUT} vs I_{OUT} Pulldown Resistor

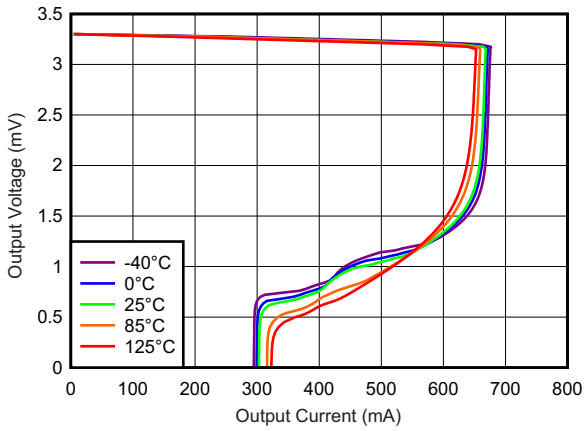


Figure 26. 3.3-V Foldback Current Limit, V_{OUT} vs I_{OUT}

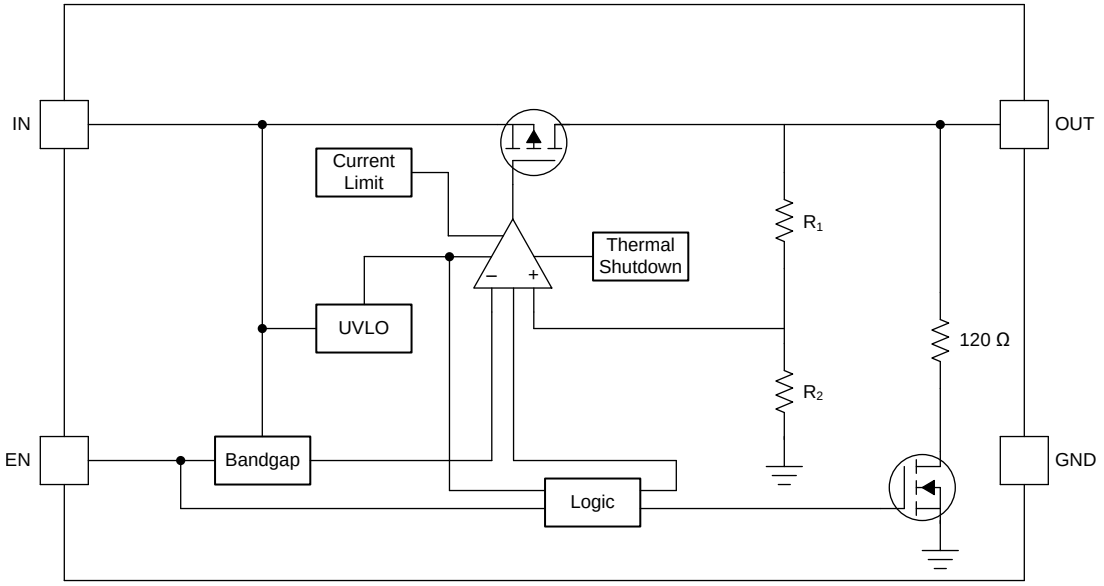
7 Detailed Description

7.1 Overview

The TLV755P belongs to a family of next-generation, low-dropout regulators (LDOs). This device consumes low quiescent current and delivers excellent line and load transient performance. The TLV755P is optimized for a wide variety of applications by supporting an input voltage range from 1.45 V to 5.5 V. To minimize cost and solution size, the device is offered in fixed output voltages ranging from 0.6 V to 5 V to support the lower core voltages of modern microcontrollers (MCUs).

This regulator offers foldback current limit, shutdown, and thermal protection. The operating junction temperature is –40°C to +125°C.

7.2 Functional Block Diagram



NOTE: R_2 = 550 kΩ, R_1 = adjustable.

7.3 Feature Description

7.3.1 Undervoltage Lockout (UVLO)

An undervoltage lockout (UVLO) circuit disables the output until the input voltage is greater than the rising UVLO voltage (V_{UVLO}). This circuit ensures that the device does not exhibit any unpredictable behavior when the supply voltage is lower than the operational range of the internal circuitry. When V_{IN} is less than V_{UVLO}, the output is connected to ground with a 120-Ω pulldown resistor.

7.3.2 Enable (EN)

The enable pin (EN) is active high. Enable the device by forcing the EN pin to exceed V_{HI}. Turn off the device by forcing the EN pin below V_{LO}. If shutdown capability is not required, connect EN to IN.

The device has an internal pulldown that connects a 120-Ω resistor to ground when the device is disabled. The discharge time after disabling depends on the output capacitance (C_{OUT}) and the load resistance (R_L) in parallel with the 120-Ω pulldown resistor. Equation 1 calculates the time constant τ:

$$\tau = \frac{120 \cdot R_L}{120 + R_L} \cdot C_{OUT} \quad (1)$$

Feature Description (continued)

The EN pin is independent of the input pin (IN), but if the EN pin is driven to a higher voltage than V_{IN}, the current into the EN pin increases. This effect is illustrated in Figure 23. When the EN voltage is higher than the input voltage there is an increased current flow into the EN pin. If this increased flow causes problems in the application, sequence the EN pin after V_{IN} is high, or to tie EN to V_{IN} to prevent this flow increase from happening. If EN is driven to a higher voltage than V_{IN}, limit the frequency on EN to below 10 kHz.

7.3.3 Internal Foldback Current Limit

The TLV755P has an internal current limit that protects the regulator during fault conditions. The current limit is a hybrid scheme with brick wall until the output voltage is less than 0.4 V × $V_{OUT(NOM).}$ When the voltage drops below 0.4 V × $V_{OUT(NOM)}$, a foldback current limit is implemented that scales back the current as the output voltage approaches GND. When the output shorts, the LDO supplies a typical current of I_{SC}. The output voltage is not regulated when the device is in current limit. In this condition, the output voltage is the product of the regulated current and the load resistance. When the device output shorts, the PMOS pass transistor dissipates power [(V_{IN} – V_{OUT}) × I_{SC}] until thermal shutdown is triggered and the device turns off. After the device cools down, the internal thermal shutdown circuit turns the device back on. If the fault condition continues, the device cycles between current limit and thermal shutdown.

The foldback current-limit circuit limits the current that is allowed through the device to current levels lower than the minimum current limit at nominal V_{OUT} current limit (I_{CL}) during start up. See Figure 26 for typical current limit values. If the output is loaded by a constant-current load during start up, or if the output voltage is negative when the device is enabled, then the load current demanded by the load may exceed the foldback current limit and the device may not rise to the full output voltage. For constant-current loads, disable the output load until the output has risen to the nominal voltage.

Excess inductance can cause the current limit to oscillate. Minimize the inductance to keep the current limit from oscillating during a fault condition.

7.3.4 Thermal Shutdown

Thermal shutdown protection disables the output when the junction temperature rises to approximately 165°C. Disabling the device eliminates the power dissipated by the device, allowing the device to cool. When the junction temperature cools to approximately 155°C, the output circuitry is enabled again. Depending on power dissipation, thermal resistance, and ambient temperature, the thermal protection circuit may cycle on and off. This cycling limits regulator dissipation that protects the circuit from damage as a result of overheating.

Activating the thermal shutdown feature usually indicates excessive power dissipation as a result of the product of the (V_{IN} – V_{OUT}) voltage and the load current. For reliable operation, limit junction temperature to a maximum of 125°C. To estimate the margin of safety in a complete design, increase the ambient temperature until the thermal protection is triggered; use worst-case loads and signal conditions.

The internal protection circuitry protects against overload conditions but is not intended to be activated in normal operation. Continuously running the device into thermal shutdown degrades device reliability.

7.4 Device Functional Modes

Table 1 lists a comparison between the normal, dropout, and disabled modes of operation.

Table 1. Device Functional Modes Comparison

OPERATING MODE	PARAMETER			
	V_{IN}	EN	I_{OUT}	T_J
Normal(1)	$V_{IN} > V_{OUT(NOM)} + V_{DO}$	$V_{EN} > V_{HI}$	$I_{OUT} < I_{CL}$	$T_J < T_{SD}$
Dropout(1)	$V_{IN} < V_{OUT(NOM)} + V_{DO}$	$V_{EN} > V_{HI}$	—	$T_J < T_{SD}$
Disabled(2)	$V_{IN} < V_{UVLO}$	$V_{EN} < V_{LO}$	—	$T_J > T_{SD}$

(1) All table conditions must be met.
(2) The device is disabled when any condition is met.

7.4.1 Normal Operation

The device regulates to the nominal output voltage when all of the following conditions are met.

- The input voltage is greater than the nominal output voltage plus the dropout voltage ($V_{OUT(NOM)} + V_{DO}$)
- The enable voltage has previously exceeded the enable rising threshold voltage and has not decreased below the enable falling threshold
- The output current is less than the current limit ($I_{OUT} < I_{CL}$)
- The device junction temperature is less than the thermal shutdown temperature ($T_J < T_{SD}$)

7.4.2 Dropout Operation

If the input voltage is lower than the nominal output voltage plus the specified dropout voltage, but all other conditions are met for normal operation, the device operates in dropout. In this mode, the output voltage tracks the input voltage. During this mode, the transient performance of the device degrades because the pass device is in a triode state and no longer controls the output voltage of the LDO. Line or load transients in dropout can result in large output-voltage deviations.

When the device is in a steady dropout state (defined as when the device is in dropout, $V_{IN} < V_{OUT(NOM)} + V_{DO}$, right after being in a normal regulation state, but not during startup), the pass-FET is driven as hard as possible when the control loop is out of balance. During the normal time required for the device to regain regulation, $V_{IN} \geq V_{OUT(NOM)} + V_{DO}$, V_{OUT} can overshoot $V_{OUT(NOM)}$ during fast transients.

7.4.3 Disabled

The output is shut down by forcing the enable pin below V_{LO}. When disabled, the pass device is turned off, internal circuits are shut down, and the output voltage is actively discharged to ground by an internal switch from the output to ground. The active pulldown is on when sufficient input voltage is provided.

8 Application and Implementation

NOTE

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

8.1 Application Information

8.1.1 Input and Output Capacitor Selection

The TLV755P requires an output capacitance of 0.47 µF or larger for stability. Use X5R- and X7R-type ceramic capacitors because these capacitors have minimal variation in capacitance value and equivalent series resistance (ESR) over temperature. When selecting a capacitor for a specific application, consider the DC bias characteristics for the capacitor. Higher output voltages cause a significant derating of the capacitor. As a general rule, ceramic capacitors must be derated by 50%. For best performance, TI recommends a maximum output capacitance value of 200 µF.

Place a 1 µF or greater capacitor on the input pin of the LDO. Some input supplies have a high impedance. Placing a capacitor on the input supply reduces the input impedance. The input capacitor counteracts reactive input sources and improves transient response and PSRR. If the input supply has a high impedance over a large range of frequencies, several input capacitors are used in parallel to lower the impedance over frequency. Use a higher-value capacitor if large, fast, rise-time load transients are expected, or if the device is located several inches from the input power source.

8.1.2 Dropout Voltage

The TLV755P uses a PMOS pass transistor to achieve low dropout. When (V_{IN} – V_{OUT}) is less than the dropout voltage (V_{DO}), the PMOS pass device is in the linear region of operation and the input-to-output resistance is the $R_{DS(ON)}$ of the PMOS pass element. V_{DO} scales linearly with the output current because the PMOS device functions like a resistor in dropout mode. As with any linear regulator, PSRR and transient response degrade as (V_{IN} – V_{OUT}) approaches dropout operation. See Figure 13 and Figure 14 for typical dropout values.

8.1.3 Exiting Dropout

Some applications have transients that place the LDO into dropout, such as slower ramps on V_{IN} during start-up. As with other LDOs, the output may overshoot on recovery from these conditions. A ramping input supply causes an LDO to overshoot on start-up when the slew rate and voltage levels are in the correct range; see Figure 27. Use an enable signal to avoid this condition.

Application Information (continued)

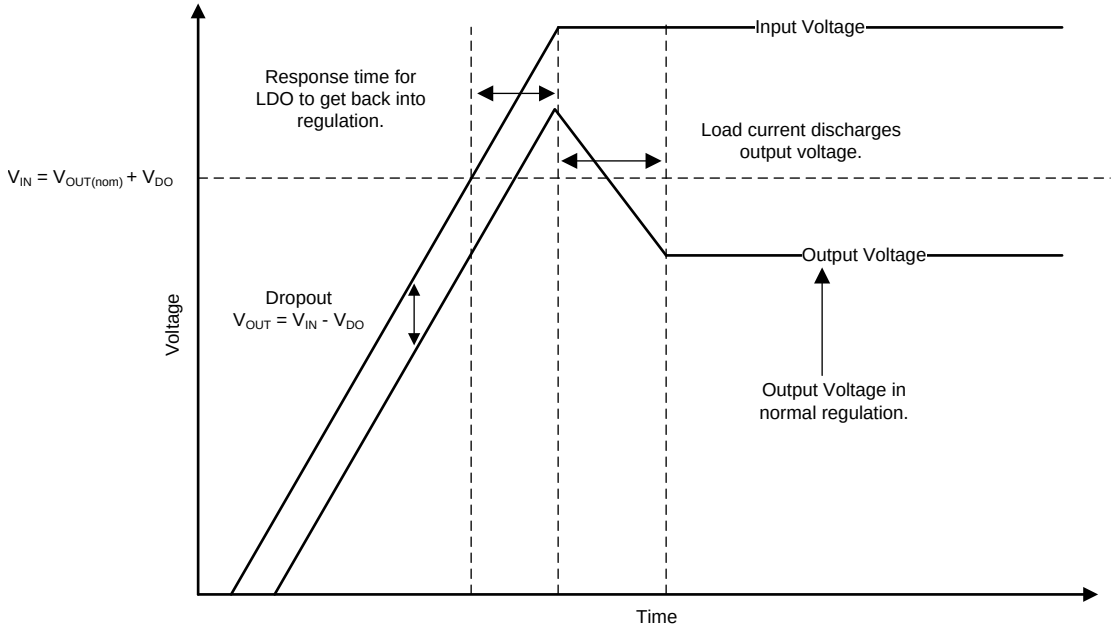


Figure 27. Startup Into Dropout

Line transients out of dropout can also cause overshoot on the output of the regulator. These overshoots are caused by the error amplifier having to drive the gate capacitance of the pass element and bring the gate back to the correct voltage for proper regulation. Figure 28 illustrates what is happening internally with the gate voltage and how overshoot can be caused during operation. When the LDO is placed in dropout, the gate voltage (VGS) is pulled all the way down to ground to give the pass device the lowest on-resistance as possible. However, if a line transient occurs while the device is in dropout, the loop is not in regulation and can cause the output to overshoot until the loop responds and the output current pulls the output voltage back down into regulation. If these transients are not acceptable, then continue to add input capacitance in the system until the transient is slow enough to reduce the overshoot.

Application Information (continued)

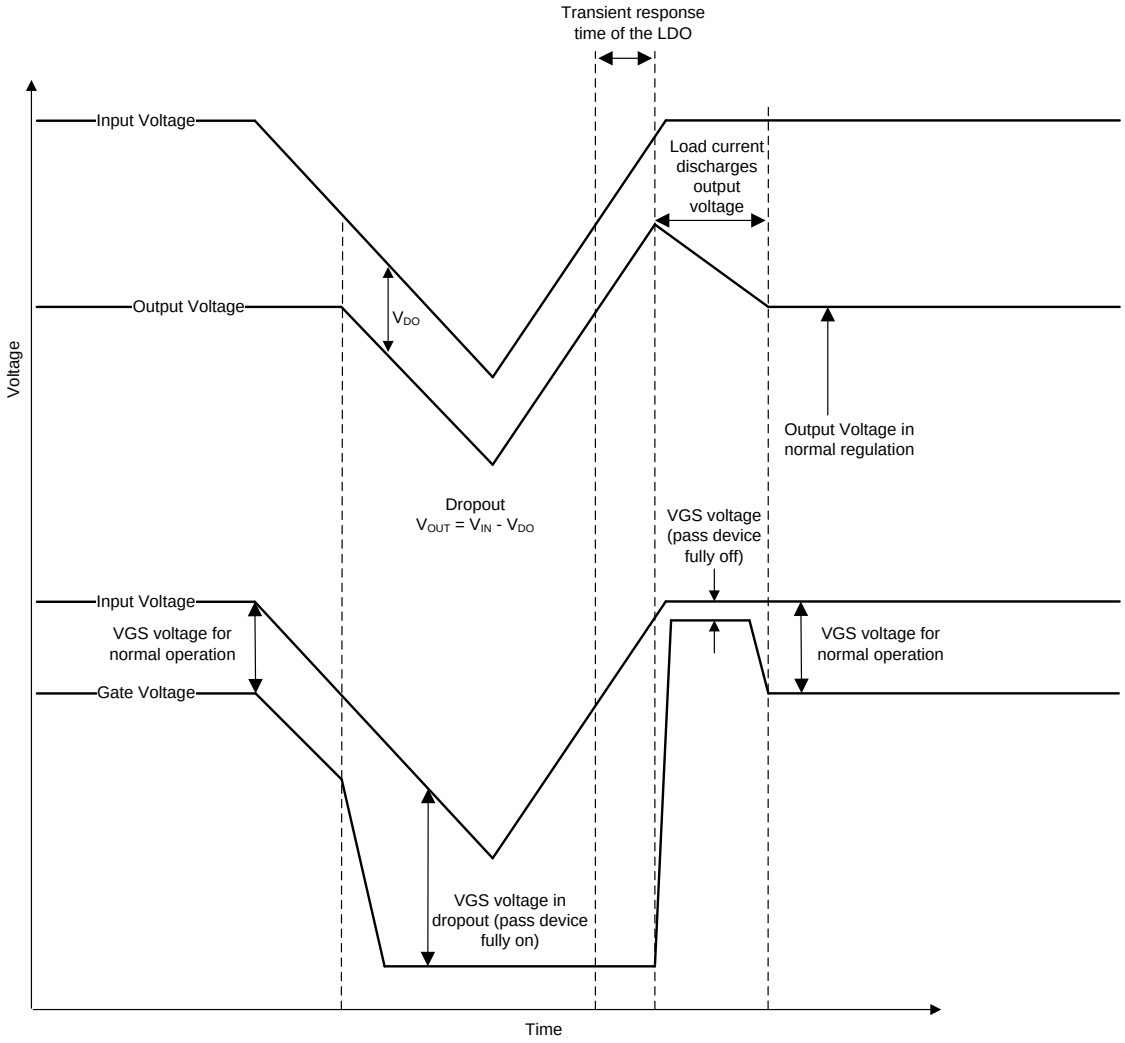


Figure 28. Line Transients From Dropout

8.1.4 Reverse Current

As with most LDOs, excessive reverse current can damage this device.

Reverse current flows through the body diode on the pass element instead of the normal conducting channel. At high magnitudes, this current flow degrades the long-term reliability of the device, as a result of one of the following conditions:

- Degradation caused by electromigration
- Excessive heat dissipation
- Potential for a latch-up condition

Conditions where reverse current can occur are outlined in this section, all of which can exceed the absolute maximum rating of $V_{OUT} > V_{IN} + 0.3$ V:

- If the device has a large C_{OUT} and the input supply collapses with little or no load current
- The output is biased when the input supply is not established
- The output is biased above the input supply

Application Information (continued)

If reverse current flow is expected in the application, external protection must be used to protect the device. Figure 29 shows one approach of protecting the device.

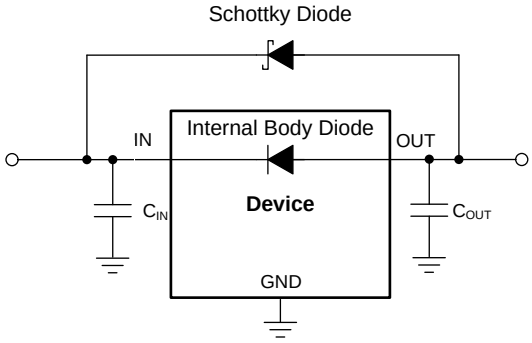


Figure 29. Example Circuit for Reverse Current Protection Using a Schottky Diode

8.1.5 Power Dissipation (P_D)

Circuit reliability demands that proper consideration be given to device power dissipation, location of the circuit on the printed circuit board (PCB), and correct sizing of the thermal plane. The PCB area around the regulator must be as free of other heat-generating devices as possible that cause added thermal stresses.

As a first-order approximation, power dissipation in the regulator depends on the input-to-output voltage difference and load conditions. Use Equation 2 to approximate P_D:

$$P_D = (V_{IN} – V_{OUT}) \times I_{OUT} \quad (2)$$

Power dissipation must be minimized to achieve greater efficiency. This minimizing process is achieved by selecting the correct system voltage rails. Proper selection helps obtain the minimum input-to-output voltage differential. The low dropout of the device allows for maximum efficiency across a wide range of output voltages.

The main heat-conduction path for the device is through the thermal pad on the package. As such, the thermal pad must be soldered to a copper pad area under the device. This pad area contains an array of plated vias that conduct heat to inner plane areas or to a bottom-side copper plane.

The maximum allowable junction temperature (T_J) determines the maximum power dissipation for the device. According to Equation 3, power dissipation and junction temperature are most often related by the junction-to-ambient thermal resistance ($R_{\theta JA}$) of the combined PCB, device package, and the temperature of the ambient air (T_A).

$$T_J = T_A + R_{\theta JA} \times P_D \quad (3)$$

Unfortunately, this thermal resistance ($R_{\theta JA}$) is dependent on the heat-spreading capability built into the particular PCB design, and therefore varies according to the total copper area, copper weight, and location of the planes. The $R_{\theta JA}$ value is only used as a relative measure of package thermal performance. $R_{\theta JA}$ is the sum of the package junction-to-case (bottom) thermal resistance ($R_{\theta JCbot}$) plus the thermal resistance contribution by the PCB copper.

Application Information (continued)

8.1.5.1 Estimating Junction Temperature

The JEDEC standard recommends the use of psi (Ψ) thermal metrics to estimate the junction temperatures of the LDO when in-circuit on a typical PCB board application. These metrics are not thermal resistances, but offer practical and relative means of estimating junction temperatures. These psi metrics are independent of the copper-spreading area. The key thermal metrics (Ψ_{JT} and Ψ_{JB}) are used in accordance with Equation 4 and are described in the table.

$$\Psi_{JT}: T_J = T_T + \Psi_{JT} \times P_D$$
$$\Psi_{JB}: T_J = T_B + \Psi_{JB} \times P_D$$

where:

- P_D is the power dissipated as shown in Equation 2
- T_T is the temperature at the center-top of the device package
- T_B is the PCB surface temperature measured 1 mm from the device package and centered on the package edge

(4)

8.2 Typical Application

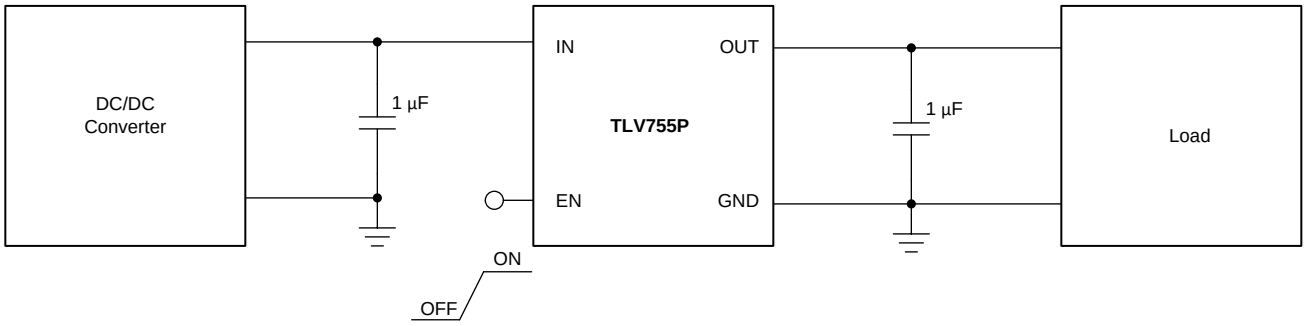


Figure 30. TLV755P Typical Application

8.2.1 Design Requirements

Table 2 lists the design requirements for this application.

Table 2. Design Parameters

PARAMETER	DESIGN REQUIREMENT
Input voltage	4.3 V
Output voltage	3.3 V
Input current	500 mA (maximum)
Output load	250-mA DC
Maximum ambient temperature	70°C

8.2.2 Detailed Design Procedure

8.2.2.1 Input Current

During normal operation, the input current to the LDO is approximately equal to the output current of the LDO. During startup, the input current is higher as a result of the inrush current charging the output capacitor. Use Equation 5 to calculate the current through the input.

$$I_{OUT(t)} = \left[\frac{C_{OUT} \times dV_{OUT}(t)}{dt}\right] + \left[\frac{V_{OUT}(t)}{R_{LOAD}}\right]$$

where:

- $V_{OUT}(t)$ is the instantaneous output voltage of the turn-on ramp
- $dV_{OUT}(t) / dt$ is the slope of the V_{OUT} ramp
- R_{LOAD} is the resistive load impedance (5)

8.2.2.2 Thermal Dissipation

The junction temperature can be determined using the junction-to-ambient thermal resistance ($R_{\theta JA}$) and the total power dissipation (P_D). Use Equation 6 to calculate the power dissipation. Multiply P_D by $R_{\theta JA}$ as Equation 7 shows and add the ambient temperature (T_A) to calculate the junction temperature (T_J).

$$P_D = (I_{GND} + I_{OUT}) \times (V_{IN} - V_{OUT}) \quad (6)$$

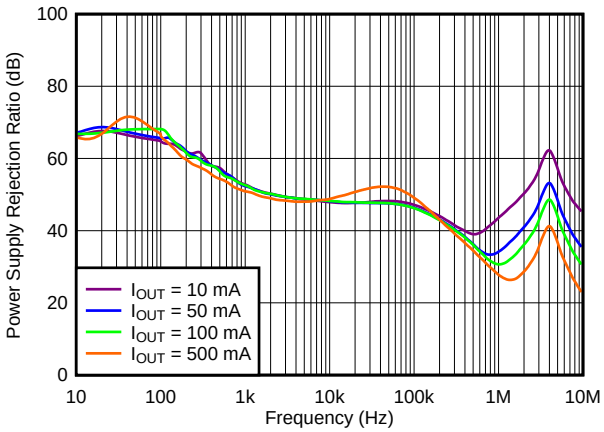
$$T_J = R_{\theta JA} \times P_D + T_A \quad (7)$$

Calculate the maximum ambient temperature as Equation 8 shows if the ($T_{J(MAX)}$) value does not exceed 125°C. Equation 9 calculates the maximum ambient temperature with a value of 99.95°C.

$$T_{A(MAX)} = T_{J(MAX)} - R_{\theta JA} \times P_D \quad (8)$$

$$T_{A(MAX)} = 125°C - 100.2°C/W \times (4.3\ V - 3.3\ V) \times (0.25\ A) = 99.95°C \quad (9)$$

8.2.3 Application Curve



V_{IN} = 4.3 V, V_{OUT} = 3.3 V

Figure 31. PSRR vs Frequency (4.3 V to 3.3 V)

9 Power Supply Recommendations

Connect a low output impedance power supply directly to the IN pin of the TLV755P. If the input source is reactive, consider using multiple input capacitors in parallel with the 1-µF input capacitor to lower the input supply impedance over frequency.

10 Layout

10.1 Layout Guidelines

- Place input and output capacitors as close as possible to the device.
- Use copper planes for device connections to optimize thermal performance.
- Place thermal vias around the device to distribute the heat.

10.2 Layout Examples

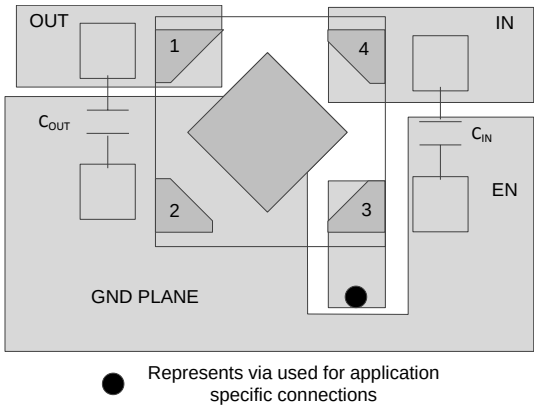


Figure 32. Layout Example for the DQN Package

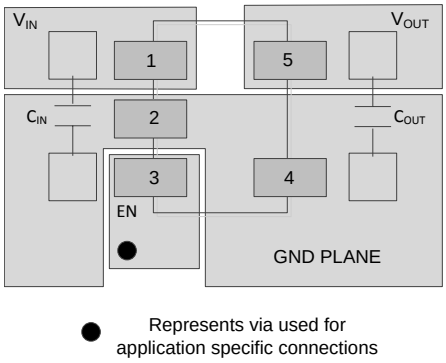


Figure 33. Layout Example for the DBV Package

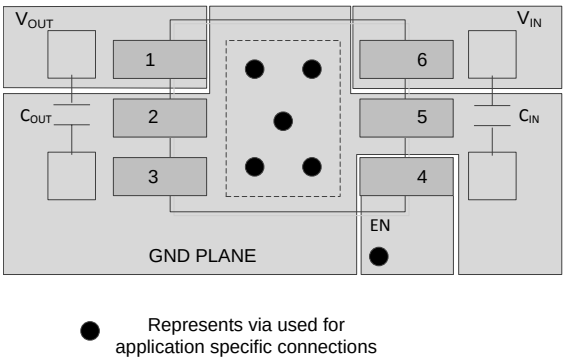


Figure 34. Layout Example for the DRV Package

11 Device and Documentation Support

11.1 Device Support

11.1.1 Device Nomenclature

Table 3. Device Nomenclature(1)(2)

PRODUCT	V_{OUT}
TLV755**xx(x)Pyyyz**	**xx(x)** is the nominal output voltage. For output voltages with a resolution of 100 mV, two digits are used in the ordering number; otherwise, three digits are used (for example, 28 = 2.8 V; 125 = 1.25 V). **P** indicates an active output discharge feature. All members of the TLV755P family actively discharge the output when the device is disabled. **yyy** is the package designator. **z** is the package quantity. R is for reel (3000 pieces), T is for tape (250 pieces).

(1) For the most current package and ordering information see the Package Option Addendum at the end of this document, or visit the device product folder on www.ti.com.
(2) Output voltages from 0.6 V to 5 V in 50-mV increments are available. Contact the factory for details and availability.

11.2 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. In the upper right corner, click on *Alert me* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

11.3 Community Resources

The following links connect to TI community resources. Linked contents are provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's Terms of Use.

TI E2E™ Online Community ***TI's Engineer-to-Engineer (E2E) Community.*** Created to foster collaboration among engineers. At e2e.ti.com, you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

Design Support ***TI's Design Support*** Quickly find helpful E2E forums along with design support tools and contact information for technical support.

11.4 Trademarks

E2E is a trademark of Texas Instruments.
All other trademarks are the property of their respective owners.

11.5 Electrostatic Discharge Caution

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.

11.6 Glossary

SLYZ022 — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

12 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
TLV75507PDQNR	ACTIVE	X2SON	DQN	4	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	KD	Samples
TLV75507PDQNT	ACTIVE	X2SON	DQN	4	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	KD	Samples
TLV75509PDBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU | CU SN	Level-1-260C-UNLIM	-40 to 125	1HAF	Samples
TLV75509PDQNR	ACTIVE	X2SON	DQN	4	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	AX	Samples
TLV75509PDQNT	ACTIVE	X2SON	DQN	4	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	AX	Samples
TLV75509PDRVR	ACTIVE	WSON	DRV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	1HDH	Samples
TLV75510PDBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU | CU SN	Level-1-260C-UNLIM	-40 to 125	1FPF	Samples
TLV75510PDQNR	ACTIVE	X2SON	DQN	4	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	KE	Samples
TLV75510PDQNT	ACTIVE	X2SON	DQN	4	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	KE	Samples
TLV75510PDRVR	ACTIVE	WSON	DRV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	1GUH	Samples
TLV75511PDQNR	ACTIVE	X2SON	DQN	4	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	E8	Samples
TLV75512PDBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU | CU SN	Level-1-260C-UNLIM	-40 to 125	1FQF	Samples
TLV75512PDQNR	ACTIVE	X2SON	DQN	4	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	AG	Samples
TLV75512PDQNT	ACTIVE	X2SON	DQN	4	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	AG	Samples
TLV75512PDRVR	ACTIVE	WSON	DRV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	1GVH	Samples
TLV75515PDBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU | CU SN	Level-1-260C-UNLIM	-40 to 125	1FRF	Samples
TLV75515PDQNR	ACTIVE	X2SON	DQN	4	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	KF	Samples

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
TLV75515PDQNT	ACTIVE	X2SON	DQN	4	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	KF	Samples
TLV75515PDRVR	ACTIVE	WSON	DRV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	1GWH	Samples
TLV755185PDQNR	ACTIVE	X2SON	DQN	4	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	EZ	Samples
TLV75518PDBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU | CU SN	Level-1-260C-UNLIM	-40 to 125	1FSF	Samples
TLV75518PDQNR	ACTIVE	X2SON	DQN	4	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	AI	Samples
TLV75518PDQNT	ACTIVE	X2SON	DQN	4	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	AI	Samples
TLV75518PDRVR	ACTIVE	WSON	DRV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	1GXH	Samples
TLV75519PDBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU | CU SN	Level-1-260C-UNLIM	-40 to 125	1HBF	Samples
TLV75519PDQNR	ACTIVE	X2SON	DQN	4	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	B5	Samples
TLV75519PDQNT	ACTIVE	X2SON	DQN	4	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	B5	Samples
TLV75519PDRVR	ACTIVE	WSON	DRV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	1HEH	Samples
TLV75525PDBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU | CU SN	Level-1-260C-UNLIM	-40 to 125	1FTF	Samples
TLV75525PDQNR	ACTIVE	X2SON	DQN	4	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	AJ	Samples
TLV75525PDQNT	ACTIVE	X2SON	DQN	4	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	AJ	Samples
TLV75525PDRVR	ACTIVE	WSON	DRV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	1GZH	Samples
TLV75528PDBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU | CU SN	Level-1-260C-UNLIM	-40 to 125	1FUF	Samples
TLV75528PDQNR	ACTIVE	X2SON	DQN	4	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	KG	Samples
TLV75528PDQNT	ACTIVE	X2SON	DQN	4	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	KG	Samples

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
TLV75528PDRVR	ACTIVE	WSON	DRV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	1H1H	Samples
TLV75529PDBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU | CU SN	Level-1-260C-UNLIM	-40 to 125	1HCF	Samples
TLV75529PDRVR	ACTIVE	WSON	DRV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	1HFH	Samples
TLV75530PDBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU | CU SN	Level-1-260C-UNLIM	-40 to 125	1FVF	Samples
TLV75530PDQNR	ACTIVE	X2SON	DQN	4	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	KI	Samples
TLV75530PDQNT	ACTIVE	X2SON	DQN	4	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	KI	Samples
TLV75530PDRVR	ACTIVE	WSON	DRV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	1H2H	Samples
TLV75533PDBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU | CU SN	Level-1-260C-UNLIM	-40 to 125	1FWF	Samples
TLV75533PDQNR	ACTIVE	X2SON	DQN	4	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	AN	Samples
TLV75533PDQNT	ACTIVE	X2SON	DQN	4	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	AN	Samples
TLV75533PDRVR	ACTIVE	WSON	DRV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	1H3H	Samples

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".
RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.
Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

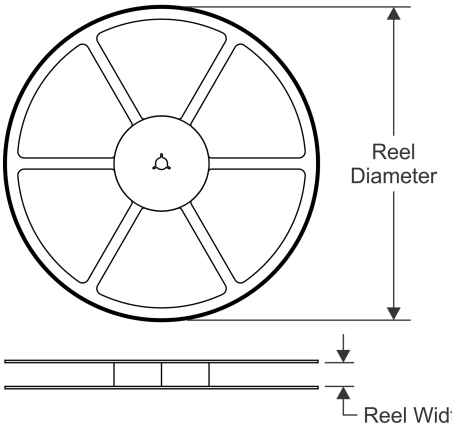
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

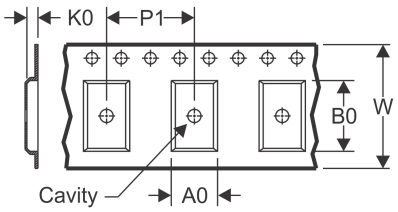
(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

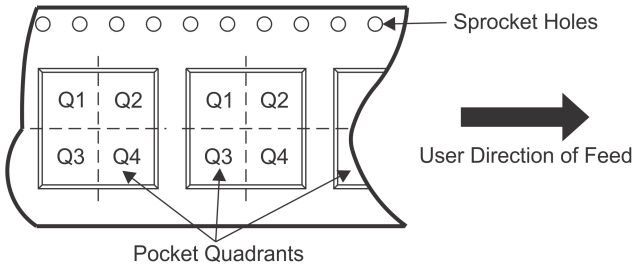


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE

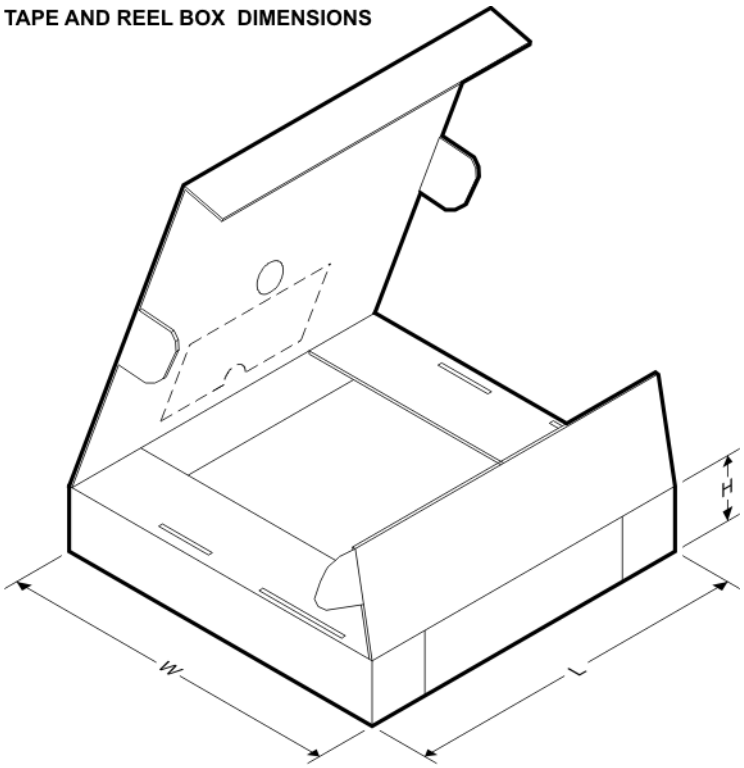


*All dimensions are nominal

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
TLV75507PDQNR	X2SON	DQN	4	3000	180.0	8.4	1.16	1.16	0.63	4.0	8.0	Q2
TLV75507PDQNR	X2SON	DQN	4	3000	180.0	9.5	1.16	1.16	0.5	4.0	8.0	Q2
TLV75507PDQNT	X2SON	DQN	4	250	180.0	8.4	1.16	1.16	0.63	4.0	8.0	Q2
TLV75507PDQNT	X2SON	DQN	4	250	180.0	9.5	1.16	1.16	0.5	4.0	8.0	Q2
TLV75509PDBVR	SOT-23	DBV	5	3000	180.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TLV75509PDBVR	SOT-23	DBV	5	3000	178.0	9.0	3.3	3.2	1.4	4.0	8.0	Q3
TLV75509PDQNR	X2SON	DQN	4	3000	180.0	8.4	1.16	1.16	0.63	4.0	8.0	Q2
TLV75509PDQNR	X2SON	DQN	4	3000	180.0	9.5	1.16	1.16	0.5	4.0	8.0	Q2
TLV75509PDQNT	X2SON	DQN	4	250	180.0	9.5	1.16	1.16	0.5	4.0	8.0	Q2
TLV75509PDQNT	X2SON	DQN	4	250	180.0	8.4	1.16	1.16	0.63	4.0	8.0	Q2
TLV75509PDRVR	WSON	DRV	6	3000	180.0	8.4	2.3	2.3	1.15	4.0	8.0	Q2
TLV75510PDBVR	SOT-23	DBV	5	3000	180.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TLV75510PDQNR	X2SON	DQN	4	3000	180.0	9.5	1.16	1.16	0.5	4.0	8.0	Q2
TLV75510PDQNT	X2SON	DQN	4	250	180.0	9.5	1.16	1.16	0.5	4.0	8.0	Q2
TLV75510PDRVR	WSON	DRV	6	3000	180.0	8.4	2.3	2.3	1.15	4.0	8.0	Q2
TLV75511PDQNR	X2SON	DQN	4	3000	180.0	9.5	1.16	1.16	0.5	4.0	8.0	Q2
TLV75512PDBVR	SOT-23	DBV	5	3000	180.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TLV75512PDQNR	X2SON	DQN	4	3000	180.0	9.5	1.16	1.16	0.5	4.0	8.0	Q2

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
TLV75512PDQNT	X2SON	DQN	4	250	180.0	9.5	1.16	1.16	0.5	4.0	8.0	Q2
TLV75512PDRVR	WSON	DRV	6	3000	180.0	8.4	2.3	2.3	1.15	4.0	8.0	Q2
TLV75515PDBVR	SOT-23	DBV	5	3000	180.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TLV75515PDBVR	SOT-23	DBV	5	3000	178.0	9.0	3.3	3.2	1.4	4.0	8.0	Q3
TLV75515PDQNR	X2SON	DQN	4	3000	180.0	9.5	1.16	1.16	0.5	4.0	8.0	Q2
TLV75515PDQNT	X2SON	DQN	4	250	180.0	9.5	1.16	1.16	0.5	4.0	8.0	Q2
TLV75515PDRVR	WSON	DRV	6	3000	180.0	8.4	2.3	2.3	1.15	4.0	8.0	Q2
TLV755185PDQNR	X2SON	DQN	4	3000	180.0	9.5	1.16	1.16	0.5	4.0	8.0	Q2
TLV75518PDBVR	SOT-23	DBV	5	3000	180.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TLV75518PDBVR	SOT-23	DBV	5	3000	178.0	9.0	3.3	3.2	1.4	4.0	8.0	Q3
TLV75518PDQNR	X2SON	DQN	4	3000	180.0	9.5	1.16	1.16	0.5	4.0	8.0	Q2
TLV75518PDQNT	X2SON	DQN	4	250	180.0	9.5	1.16	1.16	0.5	4.0	8.0	Q2
TLV75518PDRVR	WSON	DRV	6	3000	180.0	8.4	2.3	2.3	1.15	4.0	8.0	Q2
TLV75519PDBVR	SOT-23	DBV	5	3000	180.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TLV75519PDQNR	X2SON	DQN	4	3000	180.0	9.5	1.16	1.16	0.5	4.0	8.0	Q2
TLV75519PDQNR	X2SON	DQN	4	3000	180.0	8.4	1.16	1.16	0.63	4.0	8.0	Q2
TLV75519PDQNT	X2SON	DQN	4	250	180.0	9.5	1.16	1.16	0.5	4.0	8.0	Q2
TLV75519PDQNT	X2SON	DQN	4	250	180.0	8.4	1.16	1.16	0.63	4.0	8.0	Q2
TLV75519PDRVR	WSON	DRV	6	3000	180.0	8.4	2.3	2.3	1.15	4.0	8.0	Q2
TLV75525PDBVR	SOT-23	DBV	5	3000	180.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TLV75525PDBVR	SOT-23	DBV	5	3000	178.0	9.0	3.3	3.2	1.4	4.0	8.0	Q3
TLV75525PDQNR	X2SON	DQN	4	3000	180.0	9.5	1.16	1.16	0.5	4.0	8.0	Q2
TLV75525PDQNT	X2SON	DQN	4	250	180.0	9.5	1.16	1.16	0.5	4.0	8.0	Q2
TLV75525PDRVR	WSON	DRV	6	3000	180.0	8.4	2.3	2.3	1.15	4.0	8.0	Q2
TLV75528PDBVR	SOT-23	DBV	5	3000	180.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TLV75528PDQNR	X2SON	DQN	4	3000	180.0	9.5	1.16	1.16	0.5	4.0	8.0	Q2
TLV75528PDQNT	X2SON	DQN	4	250	180.0	9.5	1.16	1.16	0.5	4.0	8.0	Q2
TLV75528PDRVR	WSON	DRV	6	3000	180.0	8.4	2.3	2.3	1.15	4.0	8.0	Q2
TLV75529PDBVR	SOT-23	DBV	5	3000	180.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TLV75529PDRVR	WSON	DRV	6	3000	180.0	8.4	2.3	2.3	1.15	4.0	8.0	Q2
TLV75530PDBVR	SOT-23	DBV	5	3000	180.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TLV75530PDQNR	X2SON	DQN	4	3000	180.0	9.5	1.16	1.16	0.5	4.0	8.0	Q2
TLV75530PDQNT	X2SON	DQN	4	250	180.0	9.5	1.16	1.16	0.5	4.0	8.0	Q2
TLV75530PDRVR	WSON	DRV	6	3000	180.0	8.4	2.3	2.3	1.15	4.0	8.0	Q2
TLV75533PDBVR	SOT-23	DBV	5	3000	178.0	9.0	3.3	3.2	1.4	4.0	8.0	Q3
TLV75533PDBVR	SOT-23	DBV	5	3000	180.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TLV75533PDQNR	X2SON	DQN	4	3000	180.0	9.5	1.16	1.16	0.5	4.0	8.0	Q2
TLV75533PDQNT	X2SON	DQN	4	250	180.0	9.5	1.16	1.16	0.5	4.0	8.0	Q2
TLV75533PDRVR	WSON	DRV	6	3000	180.0	8.4	2.3	2.3	1.15	4.0	8.0	Q2

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TLV75507PDQNR	X2SON	DQN	4	3000	183.0	183.0	20.0
TLV75507PDQNR	X2SON	DQN	4	3000	184.0	184.0	19.0
TLV75507PDQNT	X2SON	DQN	4	250	183.0	183.0	20.0
TLV75507PDQNT	X2SON	DQN	4	250	184.0	184.0	19.0
TLV75509PDBVR	SOT-23	DBV	5	3000	210.0	185.0	35.0
TLV75509PDBVR	SOT-23	DBV	5	3000	180.0	180.0	18.0
TLV75509PDQNR	X2SON	DQN	4	3000	183.0	183.0	20.0
TLV75509PDQNR	X2SON	DQN	4	3000	184.0	184.0	19.0
TLV75509PDQNT	X2SON	DQN	4	250	184.0	184.0	19.0
TLV75509PDQNT	X2SON	DQN	4	250	183.0	183.0	20.0
TLV75509PDRVR	WSON	DRV	6	3000	210.0	185.0	35.0
TLV75510PDBVR	SOT-23	DBV	5	3000	210.0	185.0	35.0
TLV75510PDQNR	X2SON	DQN	4	3000	184.0	184.0	19.0
TLV75510PDQNT	X2SON	DQN	4	250	184.0	184.0	19.0
TLV75510PDRVR	WSON	DRV	6	3000	210.0	185.0	35.0
TLV75511PDQNR	X2SON	DQN	4	3000	184.0	184.0	19.0
TLV75512PDBVR	SOT-23	DBV	5	3000	210.0	185.0	35.0
TLV75512PDQNR	X2SON	DQN	4	3000	184.0	184.0	19.0
TLV75512PDQNT	X2SON	DQN	4	250	184.0	184.0	19.0
TLV75512PDRVR	WSON	DRV	6	3000	210.0	185.0	35.0

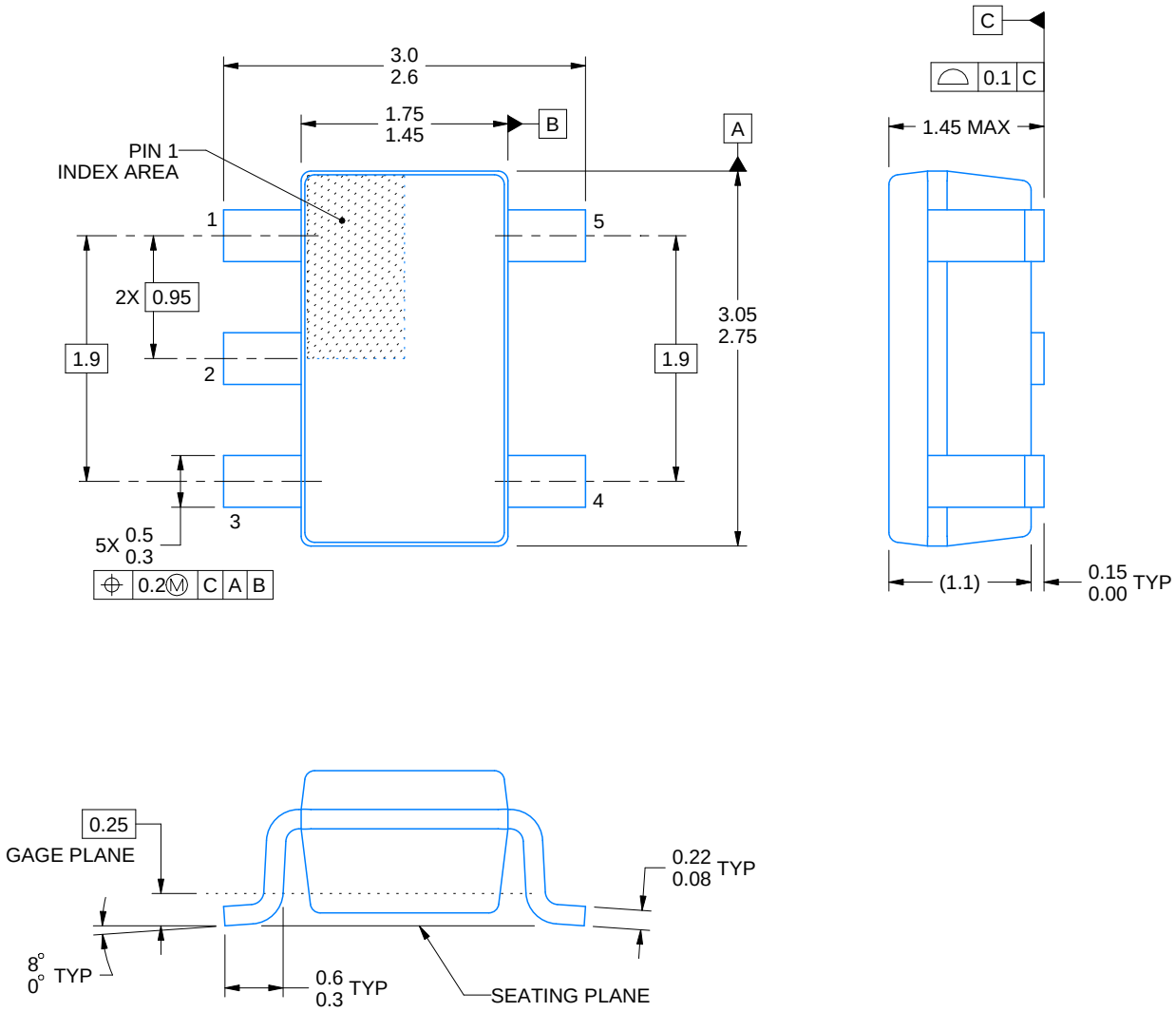
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TLV75515PDBVR	SOT-23	DBV	5	3000	210.0	185.0	35.0
TLV75515PDBVR	SOT-23	DBV	5	3000	180.0	180.0	18.0
TLV75515PDQNR	X2SON	DQN	4	3000	184.0	184.0	19.0
TLV75515PDQNT	X2SON	DQN	4	250	184.0	184.0	19.0
TLV75515PDRVR	WSON	DRV	6	3000	210.0	185.0	35.0
TLV755185PDQNR	X2SON	DQN	4	3000	184.0	184.0	19.0
TLV75518PDBVR	SOT-23	DBV	5	3000	210.0	185.0	35.0
TLV75518PDBVR	SOT-23	DBV	5	3000	180.0	180.0	18.0
TLV75518PDQNR	X2SON	DQN	4	3000	184.0	184.0	19.0
TLV75518PDQNT	X2SON	DQN	4	250	184.0	184.0	19.0
TLV75518PDRVR	WSON	DRV	6	3000	210.0	185.0	35.0
TLV75519PDBVR	SOT-23	DBV	5	3000	210.0	185.0	35.0
TLV75519PDQNR	X2SON	DQN	4	3000	184.0	184.0	19.0
TLV75519PDQNR	X2SON	DQN	4	3000	183.0	183.0	20.0
TLV75519PDQNT	X2SON	DQN	4	250	184.0	184.0	19.0
TLV75519PDQNT	X2SON	DQN	4	250	183.0	183.0	20.0
TLV75519PDRVR	WSON	DRV	6	3000	210.0	185.0	35.0
TLV75525PDBVR	SOT-23	DBV	5	3000	210.0	185.0	35.0
TLV75525PDBVR	SOT-23	DBV	5	3000	180.0	180.0	18.0
TLV75525PDQNR	X2SON	DQN	4	3000	184.0	184.0	19.0
TLV75525PDQNT	X2SON	DQN	4	250	184.0	184.0	19.0
TLV75525PDRVR	WSON	DRV	6	3000	210.0	185.0	35.0
TLV75528PDBVR	SOT-23	DBV	5	3000	210.0	185.0	35.0
TLV75528PDQNR	X2SON	DQN	4	3000	184.0	184.0	19.0
TLV75528PDQNT	X2SON	DQN	4	250	184.0	184.0	19.0
TLV75528PDRVR	WSON	DRV	6	3000	210.0	185.0	35.0
TLV75529PDBVR	SOT-23	DBV	5	3000	210.0	185.0	35.0
TLV75529PDRVR	WSON	DRV	6	3000	210.0	185.0	35.0
TLV75530PDBVR	SOT-23	DBV	5	3000	210.0	185.0	35.0
TLV75530PDQNR	X2SON	DQN	4	3000	184.0	184.0	19.0
TLV75530PDQNT	X2SON	DQN	4	250	184.0	184.0	19.0
TLV75530PDRVR	WSON	DRV	6	3000	210.0	185.0	35.0
TLV75533PDBVR	SOT-23	DBV	5	3000	180.0	180.0	18.0
TLV75533PDBVR	SOT-23	DBV	5	3000	210.0	185.0	35.0
TLV75533PDQNR	X2SON	DQN	4	3000	184.0	184.0	19.0
TLV75533PDQNT	X2SON	DQN	4	250	184.0	184.0	19.0
TLV75533PDRVR	WSON	DRV	6	3000	210.0	185.0	35.0

PACKAGE OUTLINE

DBV0005A

SOT-23 - 1.45 mm max height

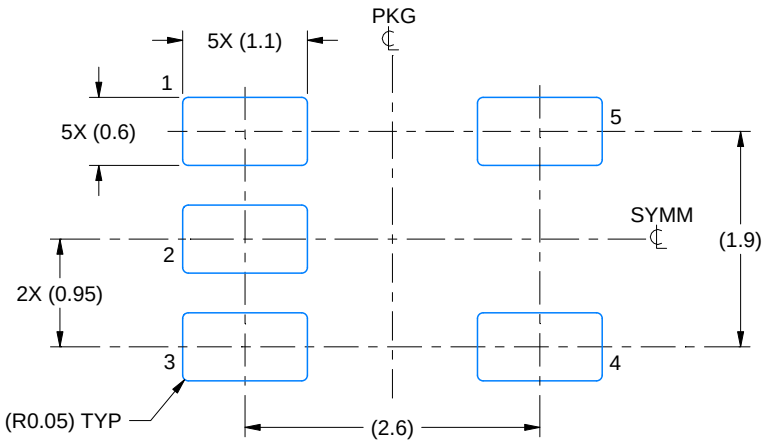
SMALL OUTLINE TRANSISTOR



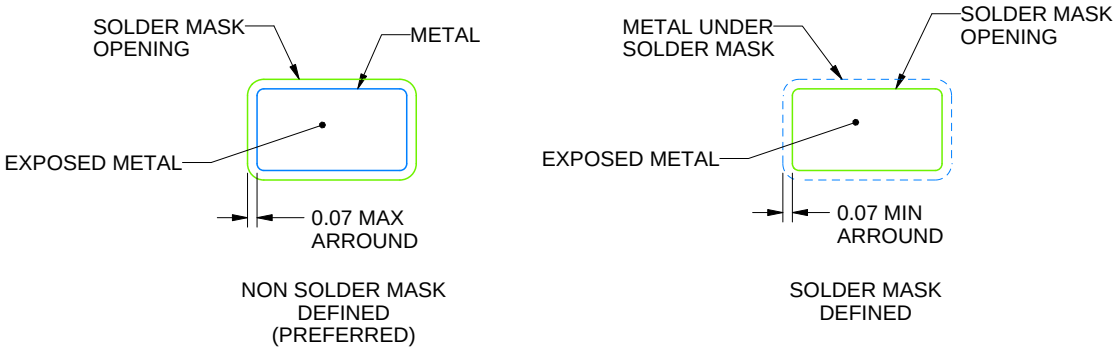
4214839/D 11/2018

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. Refernce JEDEC MO-178.
4. Body dimensions do not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:15X

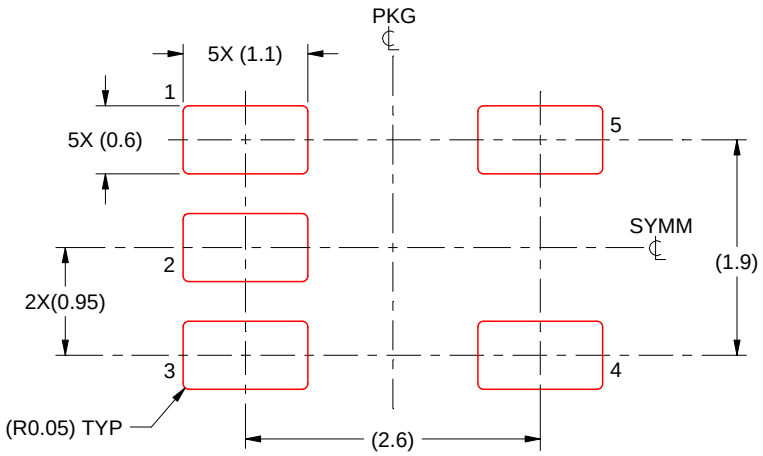


SOLDER MASK DETAILS

4214839/D 11/2018

NOTES: (continued)

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



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

4214839/D 11/2018

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.

GENERIC PACKAGE VIEW

DQN 4 X2SON - 0.4 mm max height

PLASTIC SMALL OUTLINE - NO LEAD

Images above are just a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.

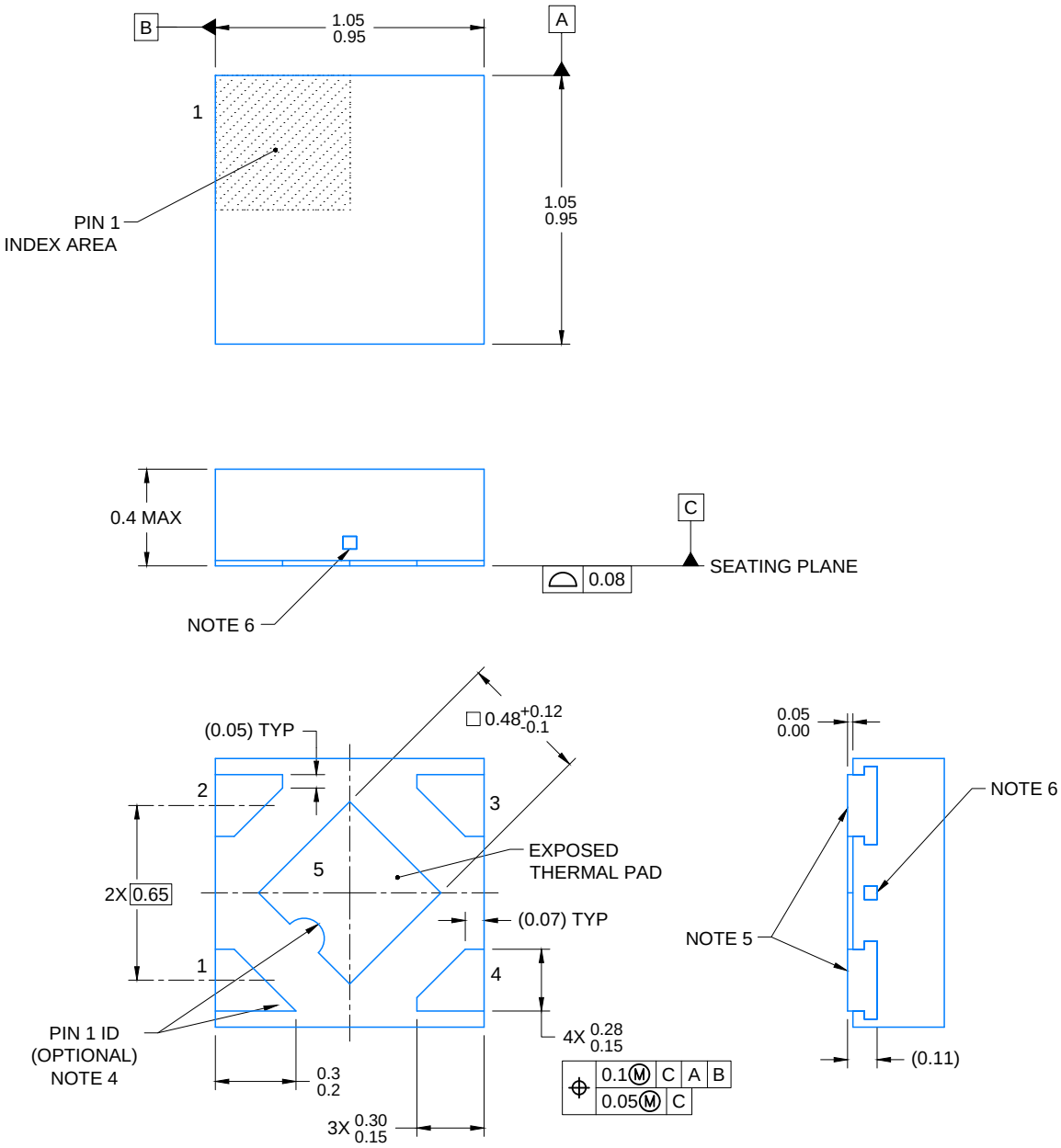
4210367/F

PACKAGE OUTLINE

DQN0004A

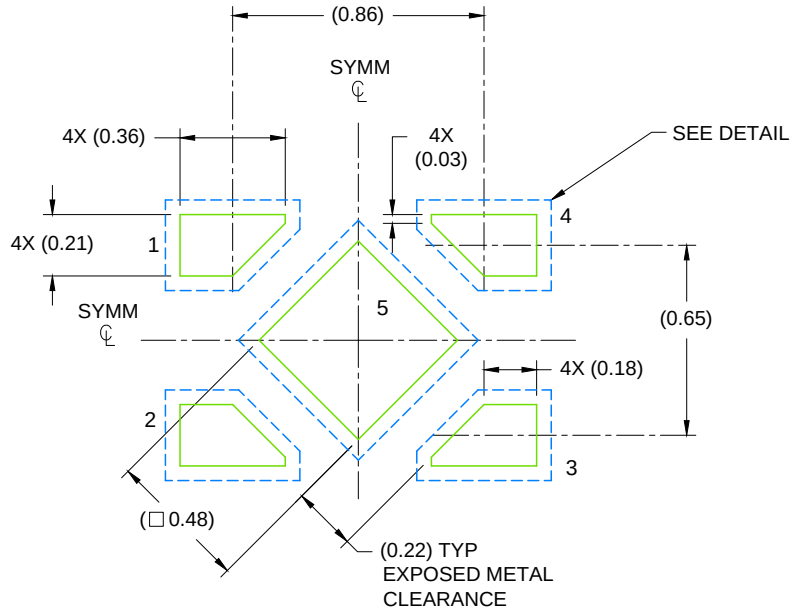
X2SON - 0.4 mm max height

PLASTIC SMALL OUTLINE - NO LEAD



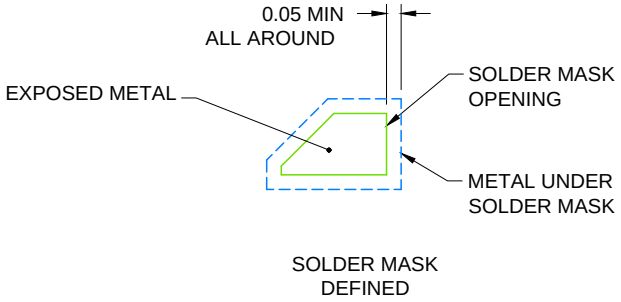
NOTES:

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. The package thermal pad must be soldered to the printed circuit board for optimal thermal and mechanical performance.
4. Features may not exist. Recommend use of pin 1 marking on top of package for orientation purposes.
5. Shape of exposed side leads may differ.
6. Number and location of exposed tie bars may vary.



LAND PATTERN EXAMPLE

SCALE: 40X

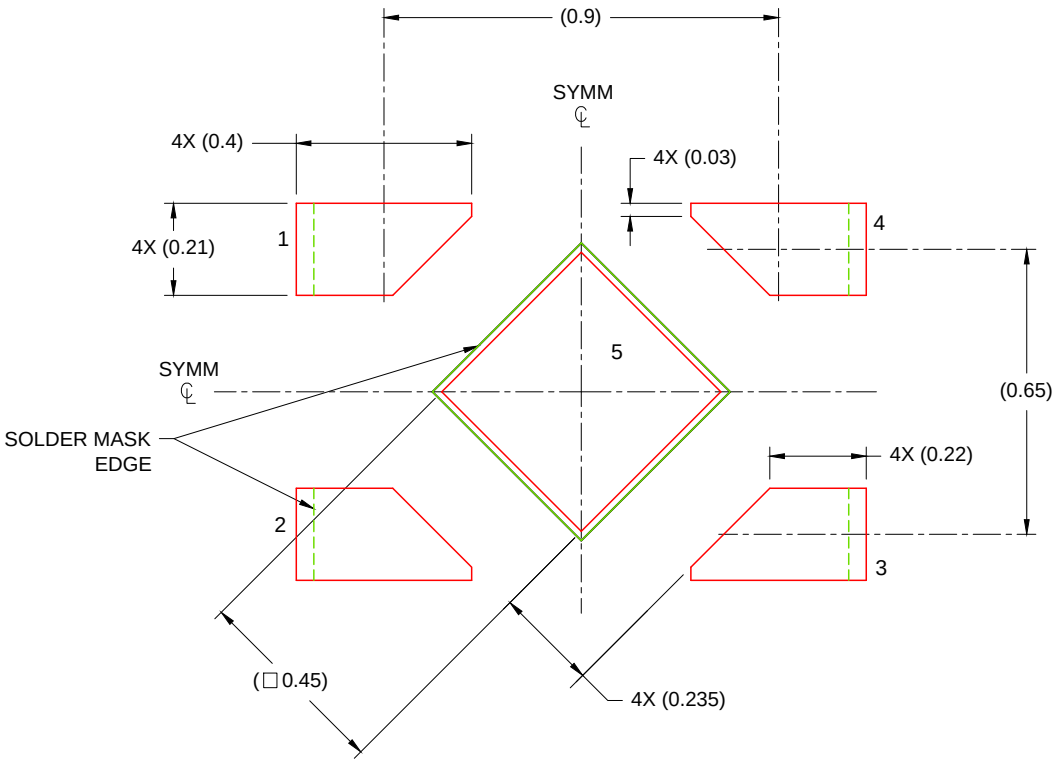


SOLDER MASK DETAIL

4215302/E 12/2016

NOTES: (continued)

7. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/slua271).
8. If any vias are implemented, it is recommended that vias under paste be filled, plugged or tented.



SOLDER PASTE EXAMPLE
BASED ON 0.075 - 0.1mm THICK STENCIL

EXPOSED PAD
88% PRINTED SOLDER COVERAGE BY AREA
SCALE: 60X

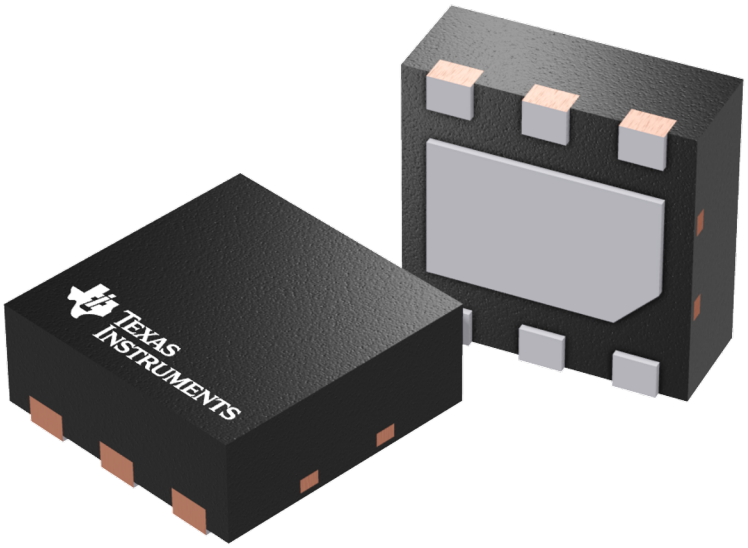
4215302/E 12/2016

NOTES: (continued)

9. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

DRV 6 WSON - 0.8 mm max height

PLASTIC SMALL OUTLINE - NO LEAD



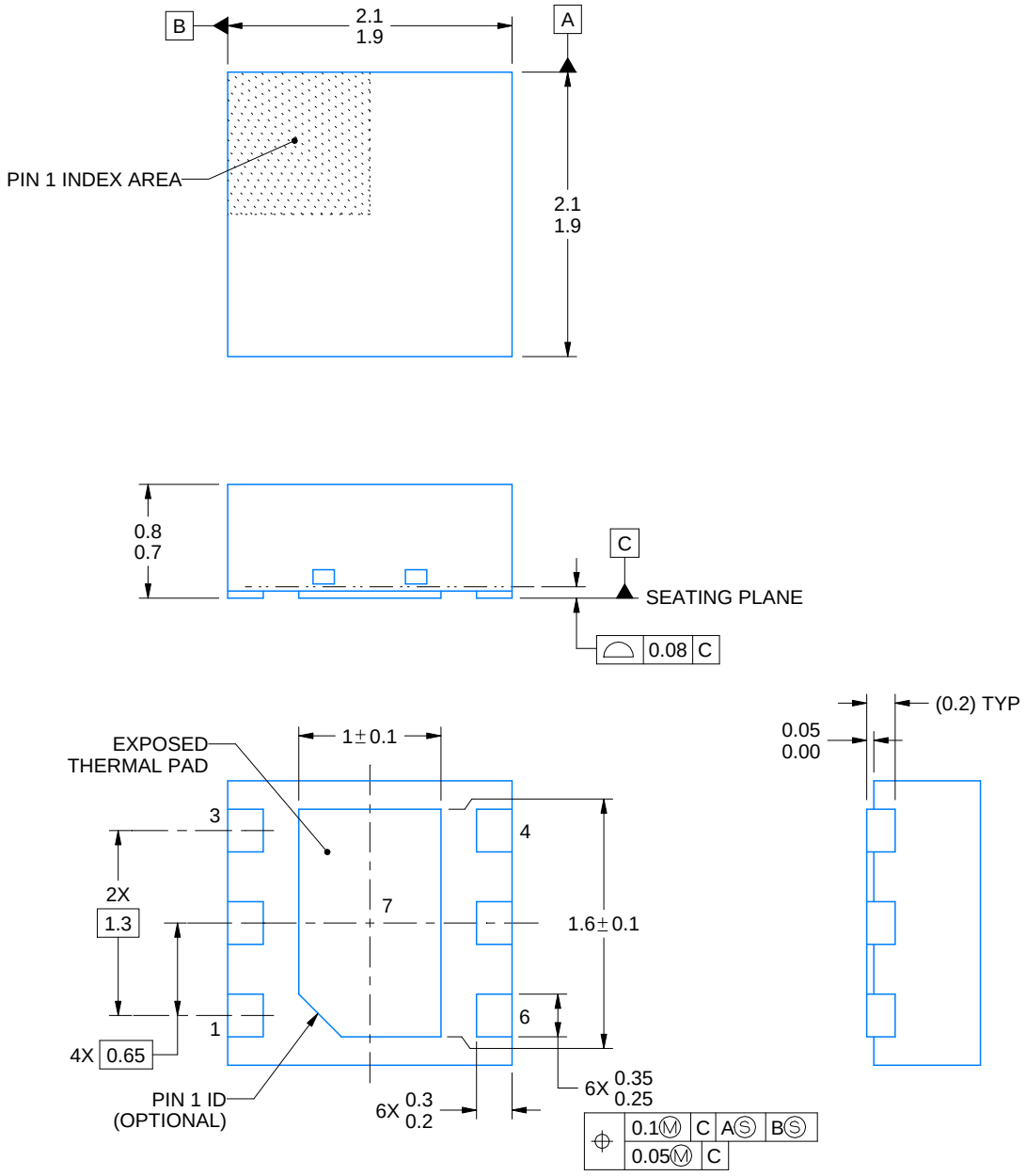
Images above are just a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.

PACKAGE OUTLINE

DRV0006A

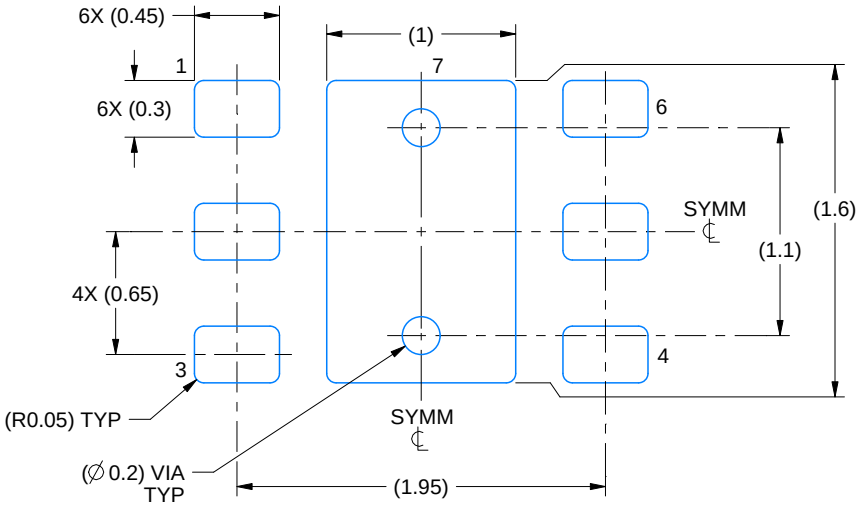
WSON - 0.8 mm max height

PLASTIC SMALL OUTLINE - NO LEAD

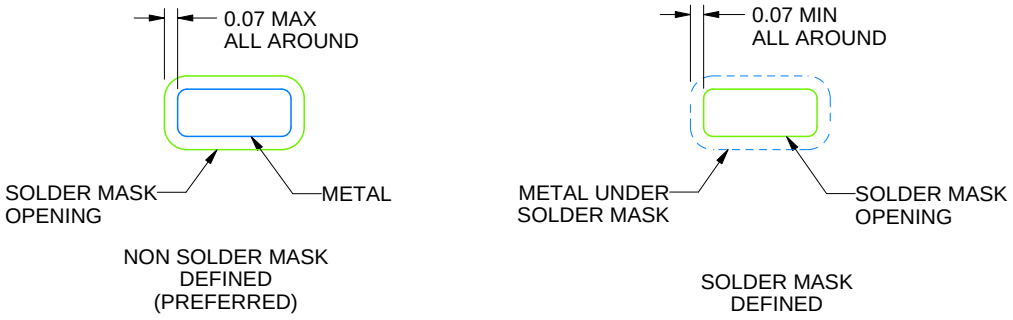


NOTES:

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. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.



LAND PATTERN EXAMPLE
SCALE:25X



SOLDER MASK DETAILS

4222173/B 04/2018

NOTES: (continued)

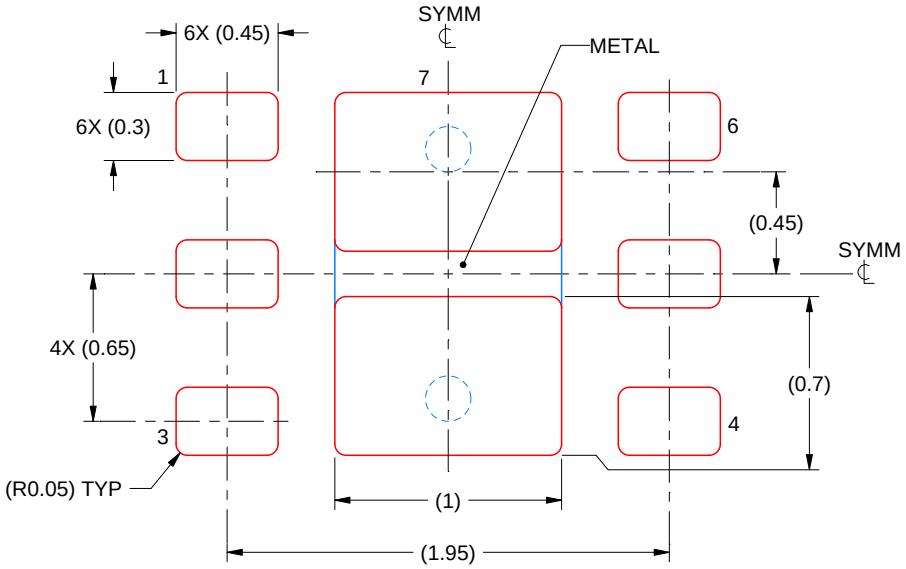
4. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/slua271).
5. Vias are optional depending on application, refer to device data sheet. If some or all are implemented, recommended via locations are shown.

EXAMPLE STENCIL DESIGN

DRV0006A

WSON - 0.8 mm max height

PLASTIC SMALL OUTLINE - NO LEAD



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL

EXPOSED PAD #7
88% PRINTED SOLDER COVERAGE BY AREA UNDER PACKAGE
SCALE:30X

4222173/B 04/2018

NOTES: (continued)

6. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

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