



TLV741P 150-mA, Low-Dropout Regulator With Foldback Current Limit for Portable Devices

1 Features

- Input Voltage Range: 1.4 V to 5.5 V
- Stable Operation With 1- μ F Ceramic Capacitors
- Foldback Overcurrent Protection
- Packages:
 - 5-Pin SOT-23
- Very Low Dropout: 230 mV at 150 mA
- Accuracy: 1%
- Low I_Q : 50 μ A
- Available in Fixed-Output Voltages: 1 V to 3.3 V
- High PSRR: 65 dB at 1 kHz
- Active Output Discharge (P Version Only)

2 Applications

- PDAs and Battery-Powered Portable Devices
- MP3 Players and Other Hand-Held Products
- WLAN and Other PC Add-On Cards

3 Description

The TLV741P low-dropout (LDO) linear regulator is a low quiescent current LDO with excellent line and load transient performance and is designed for power-sensitive applications. This device provides a typical accuracy of 1%.

The TLV741P device is designed to be stable with a small, 1- μ F output capacitor.

The TLV741P device provides inrush current control during device power up and enabling. The TLV741P device limits the input current to the defined current limit to avoid large currents from flowing from the input power source. This functionality is especially important in battery-operated devices.

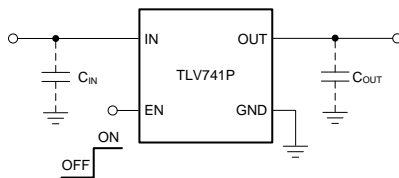
The TLV741P is available in a standard DBV (SOT-23) package. The TLV741P provides an active pulldown circuit to quickly discharge output loads.

Device Information⁽¹⁾

| DEVICE NAME | PACKAGE | BODY SIZE |
|-------------|------------|-------------------|
| TLV741P | SOT-23 (5) | 2.90 mm x 1.60 mm |

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

Typical Application Circuit



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Dropout Voltage vs Output Current

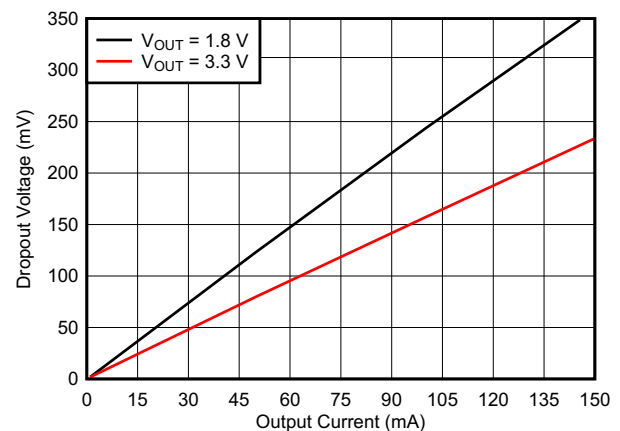


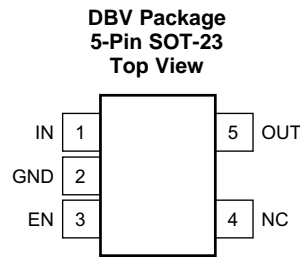
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4 Revision History

| DATE | REVISION | NOTES |
|-----------|----------|------------------|
| July 2017 | * | Initial release. |

5 Pin Configurations and Functions



NC- no internal connection

Pin Functions

| PIN | | I/O | DESCRIPTION |
|-------------|-----|-----|---|
| NAME | NO. | | |
| EN | 3 | I | Enable pin. Driving EN over 0.9 V turns on the regulator. Driving EN below 0.4 V puts the regulator into shutdown mode. |
| GND | 2 | — | Ground pin |
| IN | 1 | I | Input pin. TI recommends using a small capacitor from this pin to ground. See Input and Output Capacitor Considerations in Feature Description for more details. |
| NC | 4 | — | No internal connection |
| OUT | 5 | O | Regulated output voltage pin. For best transient response, TI recommends using a small 1-μF ceramic capacitor from this pin to ground. See Input and Output Capacitor Considerations in Feature Description for more details. |
| Thermal pad | — | — | The thermal pad is electrically connected to the GND node. Connect to the GND plane for improved thermal performance. |

6 Specifications

6.1 Absolute Maximum Ratings

over operating junction temperature range ($T_J = 25^{\circ}\text{C}$), unless otherwise noted. All voltages are with respect to GND.⁽¹⁾

| | | MIN | MAX | UNIT |
|-------------------------------|--------------------------------|---|----------------|--------------------|
| Voltage | Input, V_{IN} | −0.3 | 6 | V |
| | Enable, V_{EN} | −0.3 | $V_{IN} + 0.3$ | |
| | Output, V_{OUT} | −0.3 | 3.6 | |
| Current | Maximum output, $I_{OUT(max)}$ | Internally limited | | |
| Output short-circuit duration | | Indefinite | | |
| Total power dissipation | Continuous, $P_{D(tot)}$ | See Thermal Information | | |
| Temperature | Junction, T_J | −55 | 125 | $^{\circ}\text{C}$ |
| | Storage, T_{stg} | −55 | 150 | $^{\circ}\text{C}$ |

- (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.

6.2 ESD Ratings

| | | VALUE | UNIT |
|-------------------------------------|--|-------|------|
| $V_{(ESD)}$ Electrostatic discharge | Human body model (HBM), per ANSI/ESDA/JEDEC JS-001, all pins ⁽¹⁾ | ±2000 | V |
| | Charged device model (CDM), per JEDEC specification JESD22-C101, all pins ⁽²⁾ | ±500 | |

- (1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.

- (2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

6.3 Recommended Operating Conditions

over operating junction temperature range (unless otherwise noted)

| | | MIN | NOM | MAX | UNIT |
|-----------|--------------------------------------|-----|-----|----------|--------------------|
| V_{IN} | Input voltage | 1.4 | | 5.5 | V |
| V_{EN} | Enable range | 0 | | V_{IN} | V |
| I_{OUT} | Output current | 0 | | 150 | mA |
| C_{IN} | Input capacitor | 0 | 1 | | μF |
| C_{OUT} | Output capacitor | 1 | | 100 | μF |
| T_J | Operating junction temperature range | −40 | | 125 | $^{\circ}\text{C}$ |

6.4 Thermal Information

| THERMAL METRIC ⁽¹⁾ | | TLV741P | UNIT |
|-------------------------------|--|--------------|-----------------------------|
| | | DBV (SOT-23) | |
| | | 5 PINS | |
| $R_{\theta JA}$ | Junction-to-ambient thermal resistance | 249 | $^{\circ}\text{C}/\text{W}$ |
| $R_{\theta JC(top)}$ | Junction-to-case (top) thermal resistance | 172.7 | $^{\circ}\text{C}/\text{W}$ |
| $R_{\theta JB}$ | Junction-to-board thermal resistance | 76.7 | $^{\circ}\text{C}/\text{W}$ |
| Ψ_{JT} | Junction-to-top characterization parameter | 49.7 | $^{\circ}\text{C}/\text{W}$ |
| Ψ_{JB} | Junction-to-board characterization parameter | 75.8 | $^{\circ}\text{C}/\text{W}$ |
| $R_{\theta JC(bot)}$ | Junction-to-case (bottom) thermal resistance | N/A | $^{\circ}\text{C}/\text{W}$ |

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

6.5 Electrical Characteristics

over operating temperature range $T_J = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$, $V_{IN(nom)} = V_{OUT(nom)} + 0.5\text{ V}$ or $V_{IN(nom)} = 2\text{ V}$ (whichever is greater), $I_{OUT} = 1\text{ mA}$, $V_{EN} = V_{IN}$, and $C_{OUT} = 1\text{ }\mu\text{F}$, unless otherwise noted. Typical values are at $T_J = 25^{\circ}\text{C}$.

| PARAMETER | | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|----------------------------------|------------------------------|---|---|-------|-----|------|---------------------|
| V_{IN} | Input voltage range | | | 1.4 | | 5.5 | V |
| V_{OUT} | Output voltage range | | | 1 | | 3.3 | V |
| DC output accuracy | | $V_{OUT} \geq 1.8\text{ V}$ $T_J = 25^{\circ}\text{C}$ | | -1% | | 1% | |
| | | $V_{OUT} < 1.8\text{ V}$ $T_J = 25^{\circ}\text{C}$ | | -20 | | 20 | mV |
| | | $V_{OUT} \geq 1.2\text{ V}$ $-40^{\circ}\text{C} \leq T_J \leq 125^{\circ}\text{C}$ | | -1.5% | | 1.5% | |
| | | $V_{OUT} < 1.2\text{ V}$ $-40^{\circ}\text{C} \leq T_J \leq 125^{\circ}\text{C}$ | | -50 | | 50 | mV |
| $\Delta V_{OUT(\Delta V_{IN})}$ | Line regulation | Maximum $\{V_{OUT(nom)} + 0.5\text{ V}$ $V_{IN} = 2\text{ V}\} \leq V_{IN} \leq 5.5\text{ V}$ | | | 1 | 5 | mV |
| $\Delta V_{OUT(\Delta I_{OUT})}$ | Load regulation | $0\text{ mA} \leq I_{OUT} \leq 150\text{ mA}$ | | | 10 | 30 | mV |
| V_{DO} | Dropout voltage | $V_{OUT} = 0.98 \times V_{OUT(nom)}$, $T_J = -40^{\circ}\text{C}$ to 85°C | $1\text{ V} \leq V_{OUT} < 1.8\text{ V}$ $I_{OUT} = 150\text{ mA}$ | | 600 | 900 | mV |
| | | | $V_{OUT} = 1.1\text{ V}$ $I_{OUT} = 100\text{ mA}$ | | 470 | 600 | |
| | | | $1.8\text{ V} \leq V_{OUT} < 2.1\text{ V}$ $I_{OUT} = 30\text{ mA}$ | | 70 | | |
| | | | $1.8\text{ V} \leq V_{OUT} < 2.1\text{ V}$ $I_{OUT} = 150\text{ mA}$ | | 350 | 575 | |
| | | | $2.1\text{ V} \leq V_{OUT} < 2.5\text{ V}$ $I_{OUT} = 30\text{ mA}$ | | 90 | | |
| | | | $2.1\text{ V} \leq V_{OUT} < 2.5\text{ V}$ $I_{OUT} = 150\text{ mA}$ | | 290 | 481 | |
| | | | $2.5\text{ V} \leq V_{OUT} < 3\text{ V}$ $I_{OUT} = 30\text{ mA}$ | | 50 | | |
| | | | $2.5\text{ V} \leq V_{OUT} < 3\text{ V}$ $I_{OUT} = 150\text{ mA}$ | | 246 | 445 | |
| | | $V_{OUT} = 0.98 \times V_{OUT(nom)}$, $T_J = -40^{\circ}\text{C}$ to 125°C | $1\text{ V} \leq V_{OUT} < 1.8\text{ V}$ $I_{OUT} = 150\text{ mA}$ | | 600 | 1020 | |
| | | | $V_{OUT} = 1.1\text{ V}$ $I_{OUT} = 100\text{ mA}$ | | 470 | 720 | |
| | | | $1.8\text{ V} \leq V_{OUT} < 2.1\text{ V}$ $I_{OUT} = 150\text{ mA}$ | | 350 | 695 | |
| | | | $2.1\text{ V} \leq V_{OUT} < 2.5\text{ V}$ $I_{OUT} = 150\text{ mA}$ | | 290 | 601 | |
| | | | $2.5\text{ V} \leq V_{OUT} < 3\text{ V}$ $I_{OUT} = 150\text{ mA}$ | | 246 | 565 | |
| | | | $3\text{ V} \leq V_{OUT} < 3.6\text{ V}$ $I_{OUT} = 150\text{ mA}$ | | 230 | 540 | |
| | | | | | | | |
| | | | | | | | |
| I_{GND} | Ground pin current | $I_{OUT} = 0\text{ mA}$ | | | 50 | 75 | μA |
| $I_{SHUTDOWN}$ | Shutdown current | $V_{EN} \leq 0.4\text{ V}$, $2\text{ V} \leq V_{IN} \leq 5.5\text{ V}$ $T_J = 25^{\circ}\text{C}$ | | | 0.1 | 1 | μA |
| PSRR | Power-supply rejection ratio | $V_{IN} = 3.3\text{ V}$ $V_{OUT} = 2.8\text{ V}$ $I_{OUT} = 30\text{ mA}$ | $f = 100\text{ Hz}$ | | 70 | | dB |
| | | | $f = 10\text{ kHz}$ | | 55 | | |
| | | | $f = 1\text{ MHz}$ | | 55 | | |
| V_n | Output noise voltage | BW = 100 Hz to 100 kHz $V_{IN} = 2.3\text{ V}$ $V_{OUT} = 1.8\text{ V}$ $I_{OUT} = 10\text{ mA}$ | | | 73 | | μV_{RMS} |
| t_{STR} | Start-up time ⁽¹⁾ | $C_{OUT} = 1\text{ }\mu\text{F}$ $I_{OUT} = 150\text{ mA}$ | | | 100 | | μs |

(1) Start-up time is the time from EN assertion to $(0.98 \times V_{OUT(nom)})$.

Electrical Characteristics (continued)

over operating temperature range $T_J = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$, $V_{IN(nom)} = V_{OUT(nom)} + 0.5\text{ V}$ or $V_{IN(nom)} = 2\text{ V}$ (whichever is greater), $I_{OUT} = 1\text{ mA}$, $V_{EN} = V_{IN}$, and $C_{OUT} = 1\text{ }\mu\text{F}$, unless otherwise noted. Typical values are at $T_J = 25^{\circ}\text{C}$.

| PARAMETER | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|----------------|-----------------------|--|-----|------|----------|--------------------|
| V_{HI} | Enable high (enabled) | | 0.9 | | V_{IN} | V |
| V_{LO} | Enable low (disabled) | | 0 | | 0.4 | V |
| I_{EN} | EN pin current | $EN = 5.5\text{ V}$ | | 0.01 | | μA |
| $R_{PULLDOWN}$ | Pulldown resistor | $V_{IN} = 4\text{ V}$ | | 120 | | Ω |
| I_{LIM} | Output current limit | $V_{IN} = 3.8\text{ V}$ $V_{OUT} = 3.3\text{ V}$ $T_J = -40\text{ to }85^{\circ}\text{C}$ | 180 | | | mA |
| | | $V_{IN} = 2.25\text{ V}$ $V_{OUT} = 1.8\text{ V}$ $T_J = -40\text{ to }85^{\circ}\text{C}$ | 180 | | | |
| | | $V_{IN} = 2\text{ V}$ $V_{OUT} = 1.2\text{ V}$ $T_J = -40\text{ to }85^{\circ}\text{C}$ | 180 | | | |
| I_{SC} | Short-circuit current | $V_{OUT} = 0\text{ V}$ | | 40 | | mA |
| T_{SD} | Thermal shutdown | Shutdown, temperature increasing | | 158 | | $^{\circ}\text{C}$ |
| | | Reset, temperature decreasing | | 140 | | |

7 Typical Characteristics

over operating temperature range $T_J = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$, $V_{IN} = V_{OUT(nom)} + 0.5\text{ V}$ or 2 V (whichever is greater), $I_{OUT} = 10\text{ mA}$, $V_{EN} = V_{IN}$, $C_{OUT} = 1\text{ }\mu\text{F}$, and $V_{OUT(nom)} = 1.8\text{ V}$ (unless otherwise noted). Typical values are at $T_J = 25^{\circ}\text{C}$.

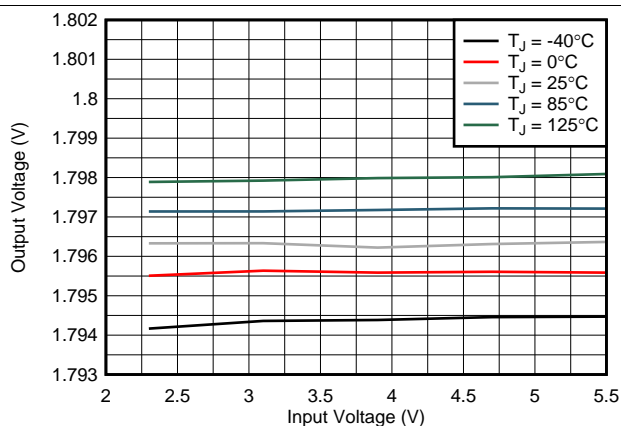


Figure 1. 1.8-V Line Regulation vs V_{IN} and Temperature

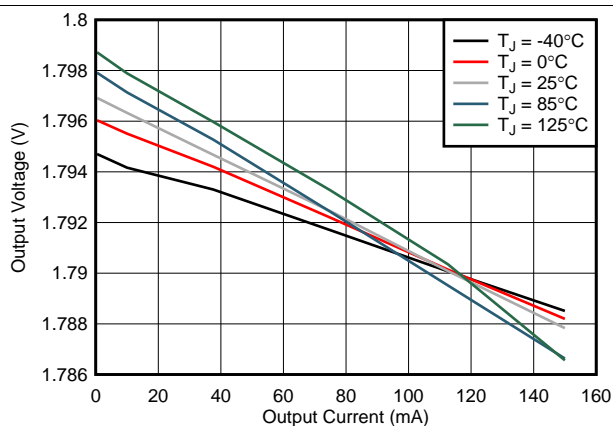


Figure 2. 1.8-V Load Regulation vs I_{OUT} and Temperature

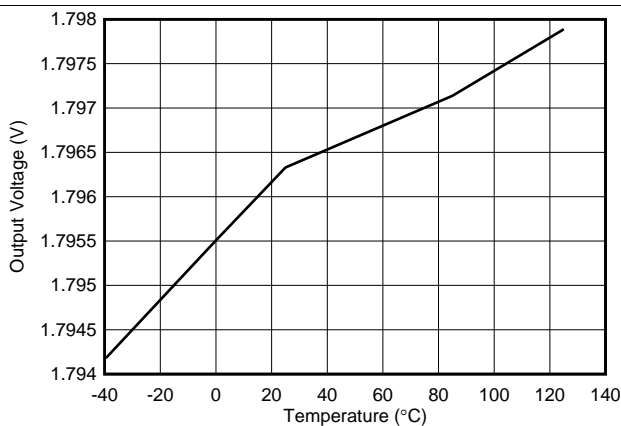


Figure 3. 1.8-V Output Voltage Over Temperature

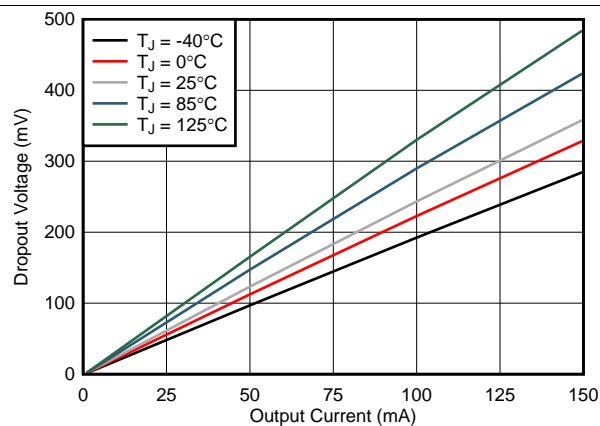


Figure 4. 1.8-V Dropout Voltage vs I_{OUT} and Temperature

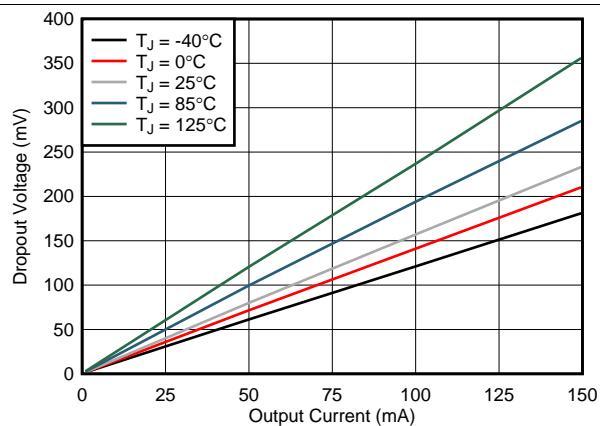


Figure 5. 3.3-V Dropout Voltage vs I_{OUT} and Temperature

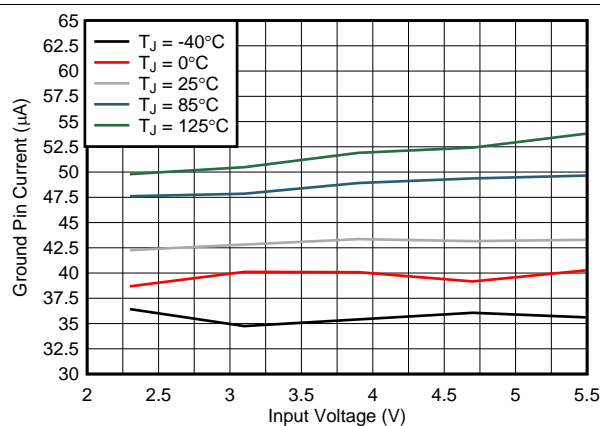


Figure 6. Ground Pin Current vs V_{IN} and Temperature

Typical Characteristics (continued)

over operating temperature range $T_J = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$, $V_{IN} = V_{OUT(nom)} + 0.5\text{ V}$ or 2 V (whichever is greater), $I_{OUT} = 10\text{ mA}$, $V_{EN} = V_{IN}$, $C_{OUT} = 1\text{ }\mu\text{F}$, and $V_{OUT(nom)} = 1.8\text{ V}$ (unless otherwise noted). Typical values are at $T_J = 25^{\circ}\text{C}$.

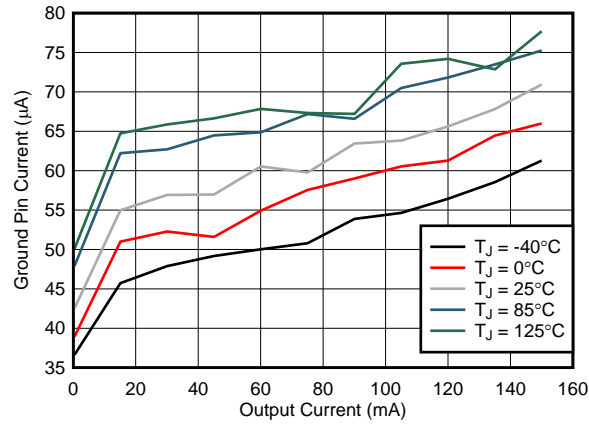


Figure 7. Ground Pin Current vs I_{OUT} and Temperature

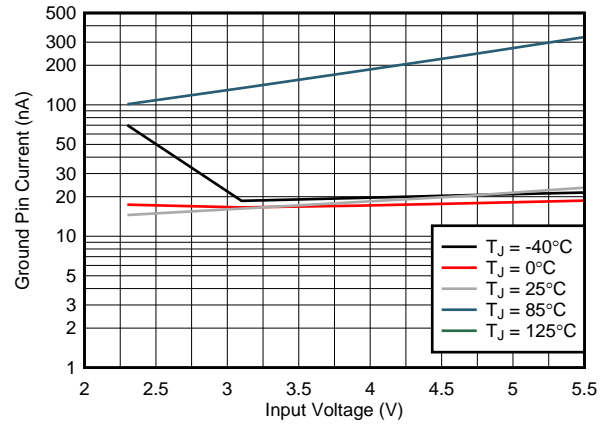


Figure 8. Shutdown Current vs V_{IN} and Temperature

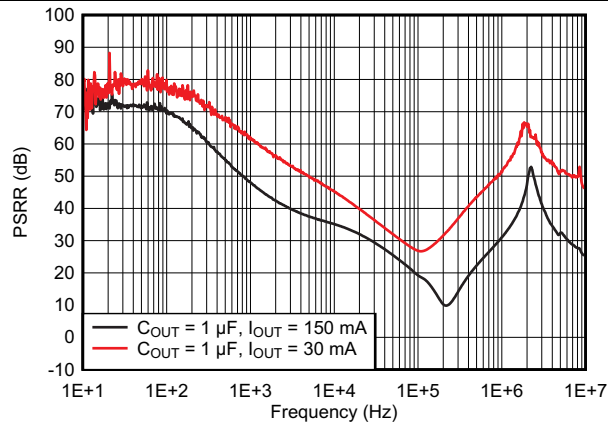


Figure 9. Power-Supply Rejection Ratio Over C_{OUT}

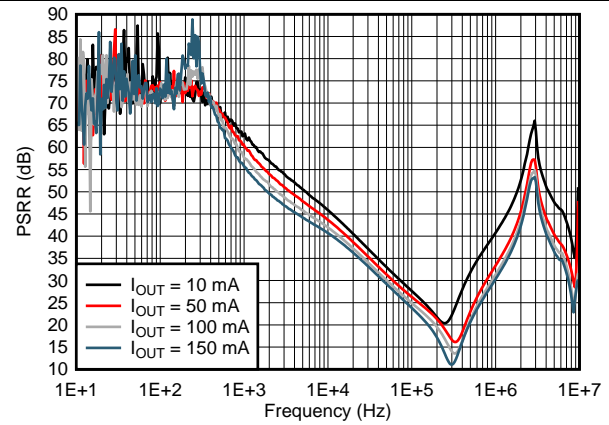


Figure 10. Power-Supply Rejection Ratio Over I_{OUT}

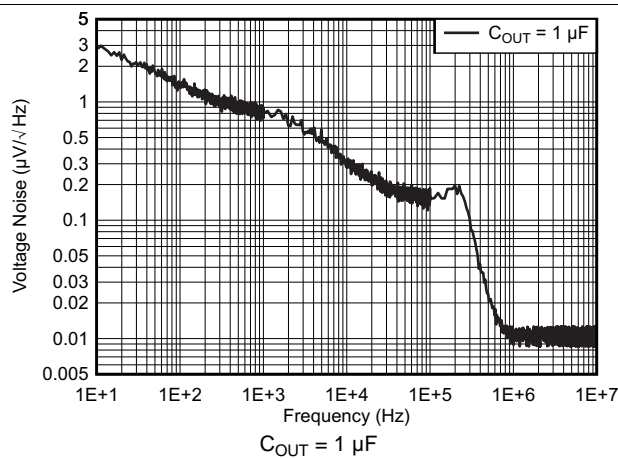


Figure 11. Output Spectral Noise Density

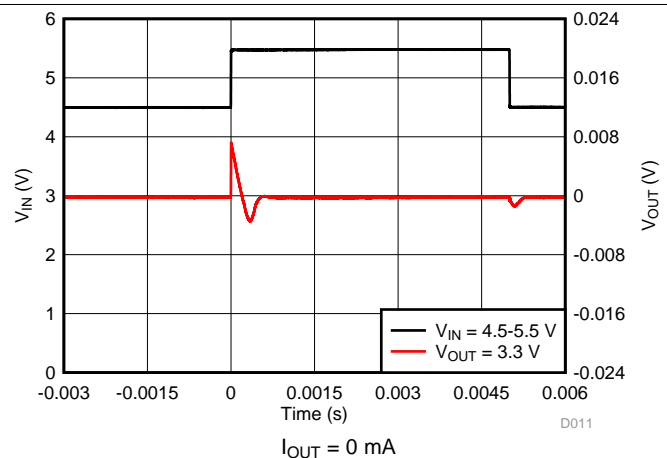


Figure 12. Line Transient

Typical Characteristics (continued)

over operating temperature range $T_J = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$, $V_{IN} = V_{OUT(nom)} + 0.5\text{ V}$ or 2 V (whichever is greater), $I_{OUT} = 10\text{ mA}$, $V_{EN} = V_{IN}$, $C_{OUT} = 1\text{ }\mu\text{F}$, and $V_{OUT(nom)} = 1.8\text{ V}$ (unless otherwise noted). Typical values are at $T_J = 25^{\circ}\text{C}$.

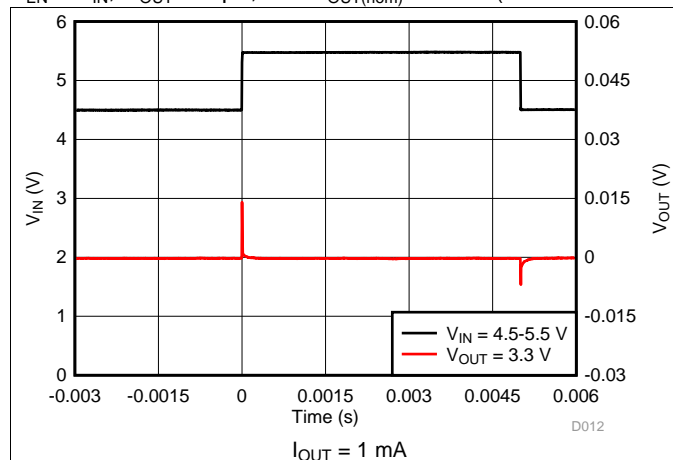


Figure 13. Line Transient

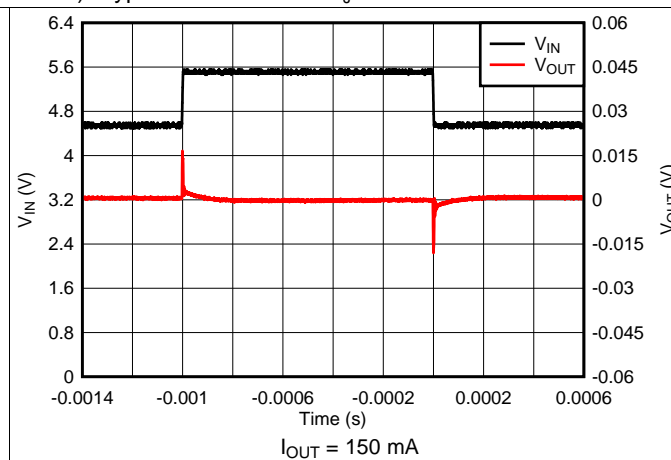


Figure 14. Line Transient

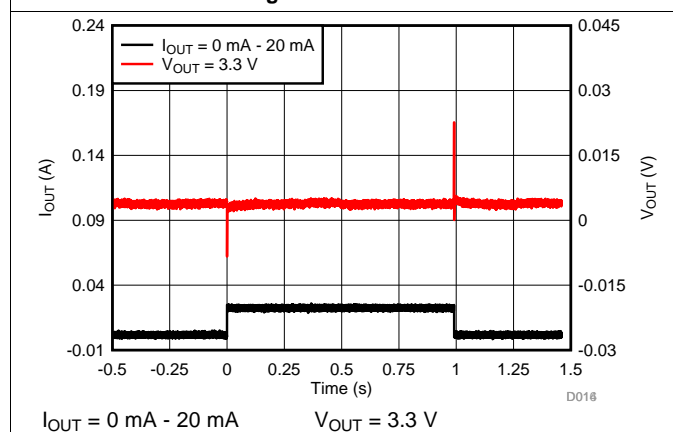


Figure 15. Load Transient

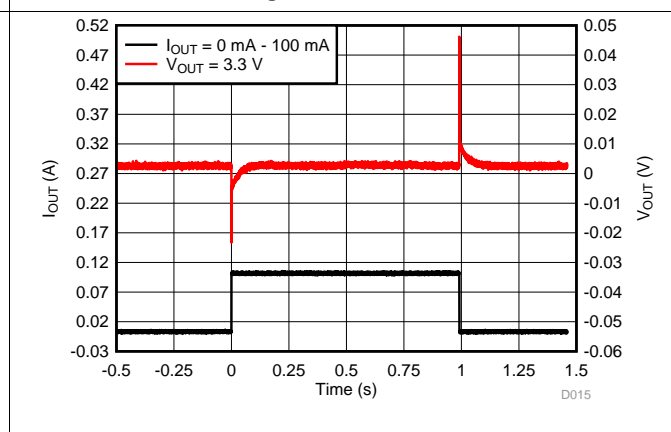


Figure 16. Load Transient

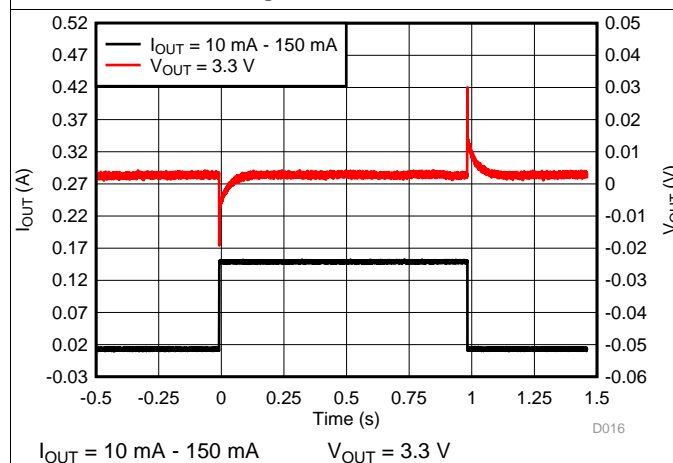


Figure 17. Load Transient

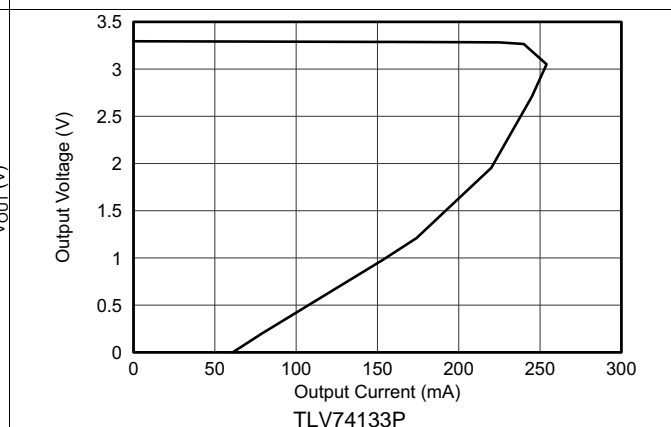


Figure 18. 3.3-V Output Voltage vs Output Current (Foldback Current Limit)

Typical Characteristics (continued)

over operating temperature range $T_J = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$, $V_{IN} = V_{OUT(nom)} + 0.5\text{ V}$ or 2 V (whichever is greater), $I_{OUT} = 10\text{ mA}$, $V_{EN} = V_{IN}$, $C_{OUT} = 1\text{ }\mu\text{F}$, and $V_{OUT(nom)} = 1.8\text{ V}$ (unless otherwise noted). Typical values are at $T_J = 25^{\circ}\text{C}$.

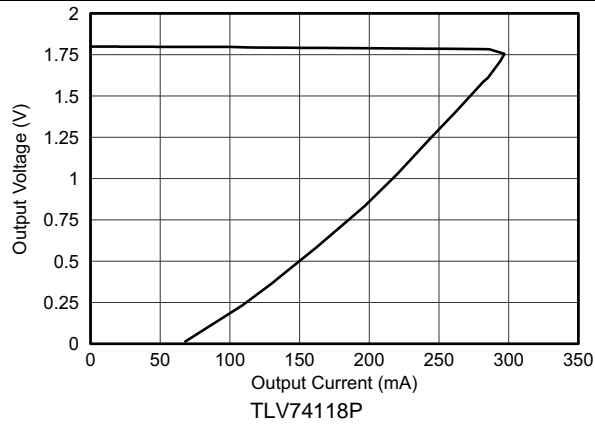


Figure 19. 1.8-V Output Voltage vs Output Current (Foldback Current Limit)

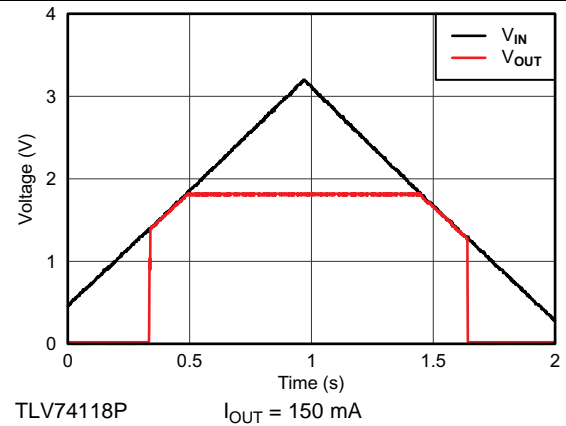


Figure 20. V_{IN} Power-Up and Power-Down

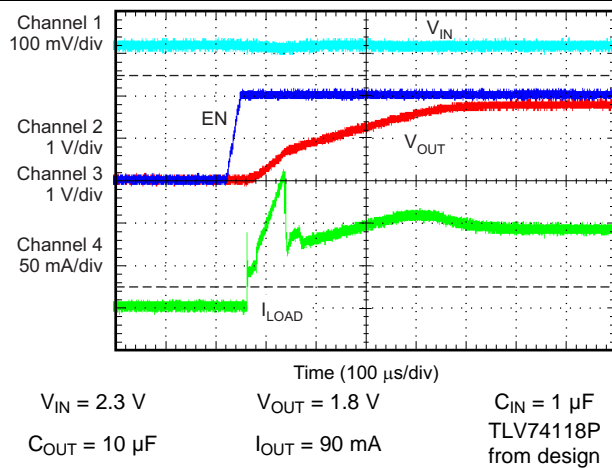


Figure 21. Start-Up With EN

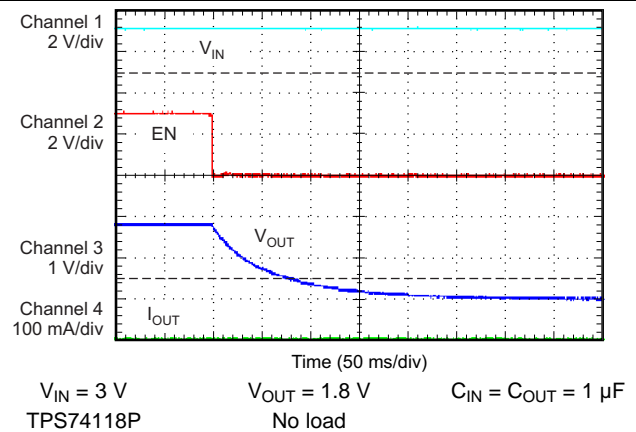


Figure 22. Shutdown Response With Enable

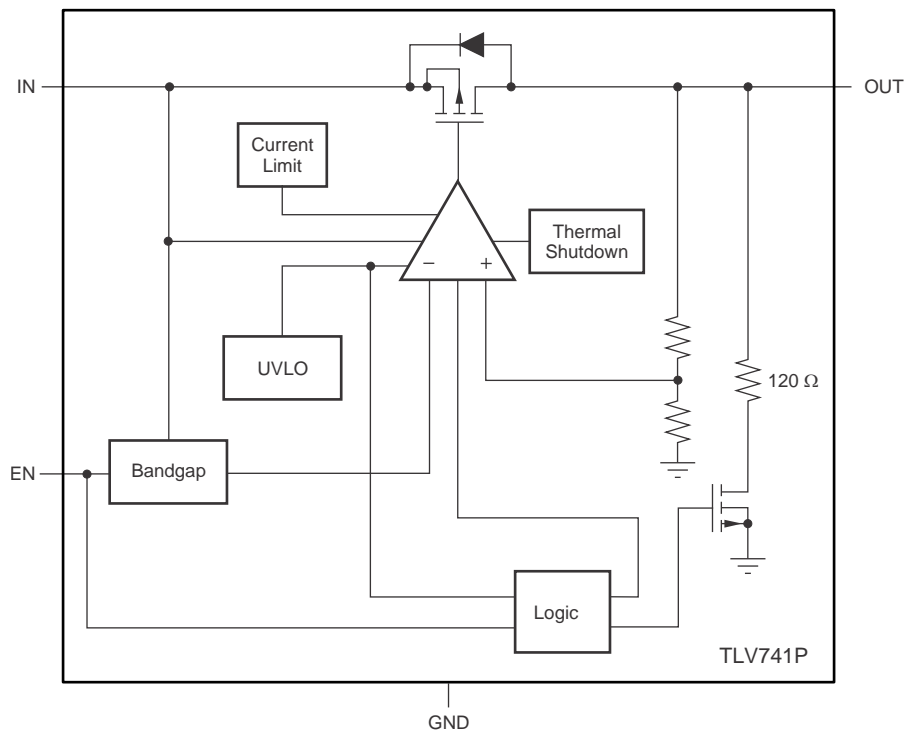
8 Detailed Description

8.1 Overview

The TLV741P device belongs to a new family of next-generation value low-dropout (LDO) regulators. The TLV741P device consumes low quiescent current and delivers excellent line and load transient performance. These characteristics, combined with low noise, very good PSRR with little ($V_{IN} - V_{OUT}$) headroom makes the device suitable for RF portable applications.

This regulator offers current limit and thermal protection. Device operating junction temperature is -40°C to $+125^{\circ}\text{C}$.

8.2 Functional Block Diagrams



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Figure 23. TLV741P Block Diagram

8.3 Feature Description

8.3.1 Undervoltage Lockout (UVLO)

The TLV741P device uses a UVLO circuit that disables the output until the input voltage is greater than the rising UVLO voltage. The 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, $V_{IN(min)}$. During UVLO disable, the output of the TLV741P version is connected to ground with a 120-Ω pulldown resistor.

8.3.2 Shutdown

The enable pin (EN) is active high. Enable the device by forcing the EN pin to exceed $V_{EN(high)}$ (0.9 V, minimum). Turn off the device by forcing the EN pin to drop below 0.4 V. If shutdown capability is not required, connect EN to IN.

The TLV741P has an internal pulldown MOSFET 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. The time constant is calculated in [Equation 1](#).

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

8.3.3 Foldback Current Limit

The TLV741P device has an internal foldback current limit that helps protect the regulator during fault conditions. The current supplied by the device is gradually reduced while the output voltage decreases. When the output shorts, the LDO supplies a typical current of 40 mA. Output voltage is not regulated when the device is in current limit, and is calculated by [Equation 2](#):

$$V_{OUT} = I_{LIMIT} \times R_{LOAD} \quad (2)$$

The PMOS pass transistor dissipates $[(V_{IN} - V_{OUT}) \times I_{LIMIT}]$ until thermal shutdown is triggered and the device turns off. The internal thermal shutdown circuit turns on the device during cool down. If the fault condition continues, the device cycles between current limit and thermal shutdown. See [Thermal Information](#) for more details.

The TLV741P PMOS pass element has a built-in body diode that conducts current when the voltage at OUT exceeds the voltage at IN. This current is not limited, so if extended reverse voltage operation is anticipated, TI recommends externally limiting the rated output current to 5%.

8.3.4 Thermal Protection

Thermal protection disables the output when the junction temperature rises to approximately 158°C, allowing the device to cool. When the junction temperature cools to approximately 140°C, the output circuitry is again enabled. Depending on power dissipation, thermal resistance, and ambient temperature, the thermal protection circuit may cycle on and off. This cycling limits regulator dissipation, which protects the device from damage as a result of overheating.

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.

The TLV741P internal protection circuitry is designed to protect against overload conditions. This circuitry is not intended to replace proper heat sinking. Continuously running the TLV741P device into thermal shutdown degrades device reliability.

8.4 Device Functional Modes

8.4.1 Normal Operation

The device regulates to the nominal output voltage under the following conditions:

- The input voltage is at least as high as $V_{IN(min)}$.
- The input voltage is greater than the nominal output voltage added to the dropout voltage.
- 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.
- The device junction temperature is less than the maximum specified junction temperature.

8.4.2 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 mode. In this mode of operation, the output voltage is the same as the input voltage minus the dropout voltage. The transient performance of the device is significantly degraded because the pass device is in the linear region and no longer controls the current through the LDO. Line or load transients in dropout can result in large output voltage deviations.

8.4.3 Disabled

The device is disabled under the following conditions:

- The enable voltage is less than the enable falling threshold voltage or has not yet exceeded the enable rising threshold.
- The device junction temperature is greater than the thermal shutdown temperature.

[Table 1](#) lists conditions that result in different operating modes.

Table 1. Device Functional Mode Comparison

| OPERATING MODE | PARAMETER | | | |
|---|---|-------------------------|---------------------|----------------------|
| | V_{IN} | V_{EN} | I_{OUT} | T_J |
| Normal mode | $V_{IN} > V_{OUT(nom)} + V_{DO}$ and $V_{IN} > V_{IN(min)}$ | $V_{EN} > V_{EN(high)}$ | $I_{OUT} < I_{LIM}$ | $T_J < 125^{\circ}C$ |
| Dropout mode | $V_{IN(min)} < V_{IN} < V_{OUT(nom)} + V_{DO}$ | $V_{EN} > V_{EN(high)}$ | — | $T_J < 125^{\circ}C$ |
| Disabled mode (any true condition disables the device) | — | $V_{EN} < V_{EN(low)}$ | — | $T_J > 158^{\circ}C$ |

9 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.

9.1 Application Information

9.1.1 Input and Output Capacitor Considerations

The TLV741P device uses an advanced internal control loop to obtain stable operation by using an input or output capacitor. An output capacitance of 1 μF or larger generally provides good dynamic response. TI recommends using X5R- and X7R-type ceramic capacitors because these capacitors have minimal variation in value and equivalent series resistance (ESR) over temperature.

Although an input capacitor is not required for stability, it is good analog design practice to connect a 0.1- μF to 1- μF capacitor from IN to GND. This capacitor counteracts reactive input sources and improves transient response, input ripple, and PSRR. TI recommends using an input capacitor if the source impedance is more than 0.5 Ω . A higher-value capacitor may be necessary if large, fast, rise-time load transients are anticipated or if the device is located several inches from the input power source.

9.1.2 Dropout Voltage

The TLV741P device uses a PMOS pass transistor to achieve low dropout. When $(V_{\text{IN}} - V_{\text{OUT}})$ 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 $R_{\text{DS(on)}}$ of the PMOS pass element. V_{DO} scales approximately with output current because the PMOS device behaves like a resistor in dropout. As with any linear regulator, PSRR and transient response are degraded as $(V_{\text{IN}} - V_{\text{OUT}})$ approaches dropout.

9.1.3 Transient Response

As with any regulator, increasing the size of the output capacitor reduces over- and undershoot magnitude but increases the duration of the transient response.

9.2 Typical Application

Several versions of the TLV741P device are suitable for powering the [MSP430 microcontroller](#).

[Figure 24](#) shows a diagram of the TLV741P device powering an MSP430 microcontroller. [Table 2](#) lists potential applications of some voltage versions.

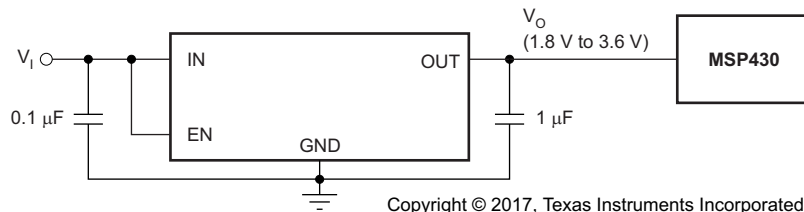


Figure 24. TLV741P Device Powering A Microcontroller

Table 2. Typical MSP430 Applications

| DEVICE | V _{OUT} (TYPICAL) | APPLICATION |
|------------|-------------------------------|---|
| TLV741P18P | 1.8 V | Allows for lowest power consumption with many MSP430s |
| TLV741P25P | 2.5 V | 2.2-V supply required by many MSP430s for flash programming and erasing |

9.2.1 Design Requirements

[Table 3](#) lists the design requirements.

Table 3. Design Parameters

| PARAMETER | DESIGN REQUIREMENT |
|-----------------------------|------------------------------------|
| Input voltage | 4.2 V to 3 V (Lithium Ion battery) |
| Output voltage | 1.8 V, ±1% |
| DC output current | 10 mA |
| Peak output current | 75 mA |
| Maximum ambient temperature | 65°C |

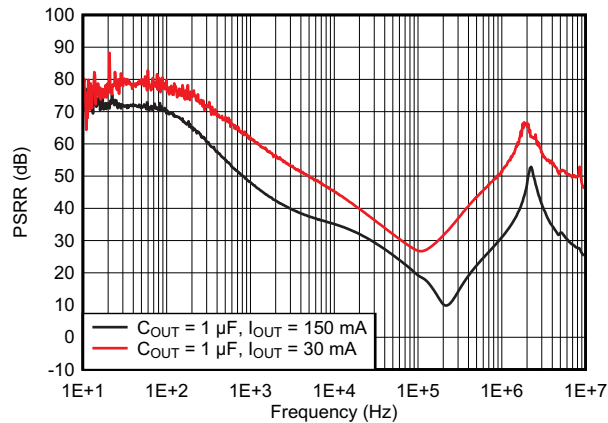
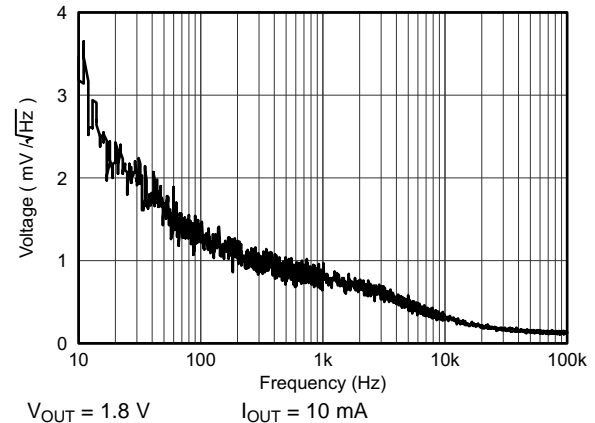
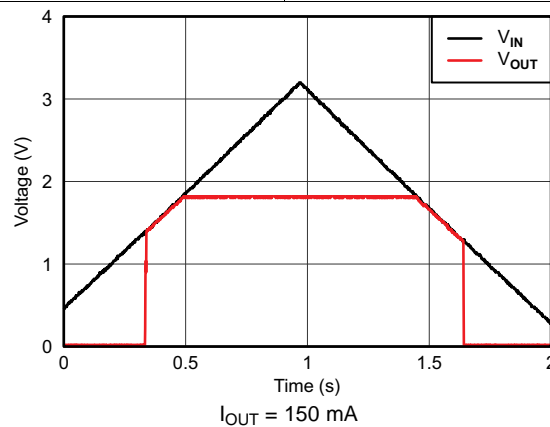
9.2.2 Detailed Design Procedure

An input capacitor is not required for this design because of the low impedance connection directly to the battery.

A small output capacitor allows for the minimal possible inrush current during start-up, ensuring the 180-mA maximum input current limit is not exceeded.

See [Figure 29](#) to verify that the maximum junction temperature is not exceeded.

9.2.3 Application Curves


Figure 25. Power-Supply Rejection Ratio vs Frequency

Figure 26. Output Spectral Noise Density

Figure 27. V_{IN} Power Up and Power Down

9.3 Do's and Don'ts

Place at least one 1- μ F ceramic capacitor as close as possible to the OUT pin of the regulator for best transient performance.

Place at least one 1- μ F capacitor as close as possible to the IN pin for best transient performance.

Do not place the output capacitor more than 10 mm away from the regulator.

Do not exceed the absolute maximum ratings.

Do not continuously operate the device in current limit or near thermal shutdown.

10 Power-Supply Recommendations

This device is designed to operate from an input voltage supply range from 1.4 V to 5.5 V. The input voltage range must provide adequate headroom for the device to have a regulated output. This input supply must be well-regulated and stable. If the input supply is noisy, additional input capacitors with low ESR can help improve the output noise performance.

11 Layout

11.1 Layout Guidelines

11.1.1 Board Layout Recommendations to Improve PSRR and Noise Performance

Input and output capacitors must be placed as close to the device pins as possible. To improve AC performance (such as PSRR, output noise, and transient response), TI recommends that the board be designed with separate ground planes for V_{IN} and V_{OUT} , with the ground plane connected only at the device GND pin. In addition, the output capacitor ground connection must be connected directly to the device GND pin. High-ESR capacitors may degrade PSRR performance.

11.2 Layout Examples

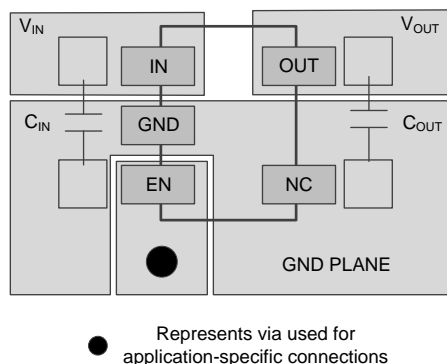


Figure 28. SOT-23 Layout Example

11.3 Power Dissipation

The ability to remove heat from the die is different for each package type, presenting 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. Performance data for JEDEC low- and high-K boards are given in [Thermal Information](#). Using heavier copper increases the effectiveness in removing heat from the device. The addition of plated through-holes to heat-dissipating layers also improves the heat sink effectiveness.

Power dissipation depends on input voltage and load conditions. Power dissipation (P_D) can be approximated by the product of the output current times the voltage drop across the output pass element (V_{IN} to V_{OUT}), as shown in [Equation 3](#):

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

[Figure 29](#) shows the maximum ambient temperature versus the power dissipation of the TLV741P device. This figure assumes the device is soldered on a JEDEC standard, high-K layout with no airflow over the board. Actual board thermal impedances vary widely. If the application requires high power dissipation, having a thorough understanding of the board temperature and thermal impedances is helpful to ensure the TLV741P device does not operate above a junction temperature of 125°C.

Power Dissipation (continued)

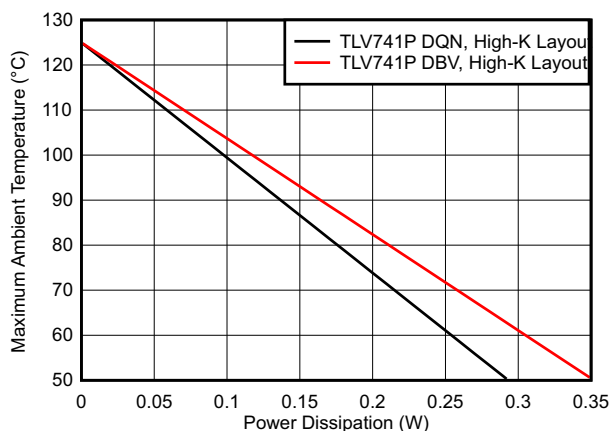


Figure 29. Maximum Ambient Temperature vs Device Power Dissipation

Estimate junction temperature by using the Ψ_{JT} and Ψ_{JB} thermal metrics, shown in [Thermal Information](#). These metrics are a more accurate representation of the heat transfer characteristics of the die and the package than $R_{\theta JA}$. The junction temperature can be estimated with [Equation 4](#):

$$\Psi_{JT}: T_J = T_T + \Psi_{JT} \cdot P_D$$

$$\Psi_{JB}: T_J = T_B + \Psi_{JB} \cdot P_D$$

where

- P_D is the power dissipation shown by [Equation 3](#),
 - T_T is the temperature at the center-top of the device package,
 - T_B is the PCB temperature measured 1 mm away from the device package on the PCB surface.
- (4)

NOTE

Both T_T and T_B can be measured on actual application boards using a thermogun (an infrared thermometer).

For more information about measuring T_T and T_B , see [Using New Thermal Metrics](#), available for download at www.ti.com.

12 Device and Documentation Support

12.1 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.

12.2 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.

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12.4 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.

12.5 Glossary

[SLYZ022](#) — *TI Glossary*.

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

13 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 |
|------------------|---------------|--------------|--------------------|------|----------------|----------------------------|-------------------------|----------------------|--------------|-------------------------|---------|
| TLV74110PDBVR | PREVIEW | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | | |
| TLV74111PDBVR | PREVIEW | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | | |
| TLV74112PDBVR | PREVIEW | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | | |
| TLV74115PDBVR | PREVIEW | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | | |
| TLV74118PDBVR | PREVIEW | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | | |
| TLV74125PDBVR | PREVIEW | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | | |
| TLV741285PDBVR | PREVIEW | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | | |
| TLV74128PDBVR | PREVIEW | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | | |
| TLV74130PDBVR | PREVIEW | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | | |
| TLV74133PDBVR | PREVIEW | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | | |

(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.

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TAPE AND REEL INFORMATION


*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 |
|---------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TLV74111PDBVR | SOT-23 | DBV | 5 | 3000 | 178.0 | 9.0 | 3.3 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|---------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TLV74111PDBVR | SOT-23 | DBV | 5 | 3000 | 180.0 | 180.0 | 18.0 |

DBV (R-PDSO-G5)

PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
 - D. Falls within JEDEC MO-178 Variation AA.

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