TLV6700-Q1 Micropower, 18-V Window Comparator With 400-mV Reference

1 Features

- Qualified for automotive applications
- AEC-Q100 qualified with the following results:
  - Device temperature Grade 1: –40°C to 125°C ambient operating temperature range
  - Device HBM ESD classification level H2
  - Device CDM ESD classification level C6
- Wide supply voltage range: 1.8 V to 18 V
- Adjustable threshold: down to 400 mV
- High threshold accuracy:
  - 0.5% Max at 25°C
  - 1.0% Max over temperature
- Low quiescent current: 5.5 µA (Typ)
- Open-drain outputs
- Internal hysteresis: 5.5 mV (Typ)
- Temperature range: –40°C to 125°C
- Package:
  - thin SOT-23-6
  - Leadless WSON-6

2 Applications

- Emergency call (eCall)
- Automotive head unit
- Instrument cluster
- On-board (OBC) & wireless charger

3 Description

The TLV6700-Q1 is a high voltage window comparator that operates over a 1.8 V to 18 V range. The device has two high-accuracy comparators with an internal 400-mV reference and two open-drain outputs rated to 18 V. The TLV6700-Q1 can be used as a window comparator or as two independent comparators; the monitored voltage can be set with the use of external resistors.

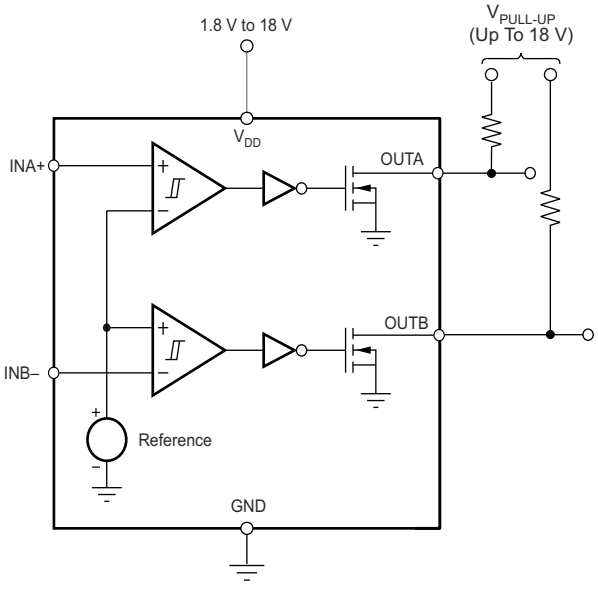
OUTA is driven low when the voltage at INA+ drops below ($V_{ITP} – V_{HYS}$), and goes high when the voltage returns above the respective threshold (V_{ITP}). OUTB is driven low when the voltage at INB– rises above V_{ITP}, and goes high when the voltage drops below the respective threshold ($V_{ITP} – V_{HYS}$). Both comparators in the TLV6700-Q1 include built-in hysteresis to reject brief glitches, thereby ensuring stable output operation without false triggering.

The TLV6700-Q1 is available in a Thin SOT-23-6 and leadless WSON-6; the comparators are specified over the junction temperature range of –40°C to 125°C.

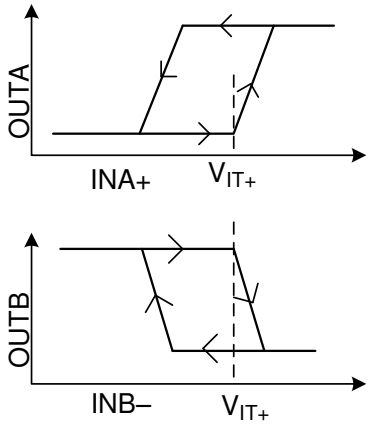
Device Information (1)

PART NUMBER	PACKAGE	BODY SIZE (NOM)
TLV6700-Q1	SOT-23 (6)	2.90 mm × 1.60 mm
	WSON (6)	1.50 mm × 1.50 mm

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



Simplified Block Diagram



Output Response

An IMPORTANT NOTICE at the end of this data sheet addresses availability, warranty, changes, use in safety-critical applications, intellectual property matters and other important disclaimers. PRODUCTION DATA.

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4 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

DATE	REVISION	NOTES
November 2020	*	Initial Release

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5 Device Comparison Table

Table 5-1. Industrial TLV67xx Comparator Family

PART NUMBER	CONFIGURATION	OPERATING VOLTAGE RANGE	THRESHOLD ACCURACY OVER TEMPERATURE
TLV6700	Window	1.8 V to 18 V	1%
TLV6703	Non-Inverting Single Channel	1.8 V to 18 V	1%
TLV6710	Window	1.8 V to 36 V	0.75%
TLV6713	Non-Inverting Single Channel	1.8 V to 36 V	0.75%

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6 Pin Configuration and Functions

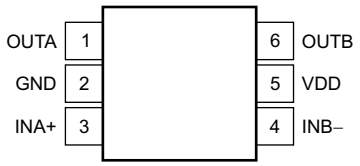


Figure 6-1. DDC Package, SOT-23-6, Top View

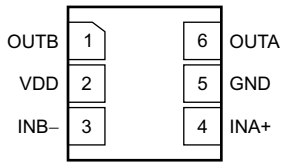


Figure 6-2. DSE Package, WSON-6, Top View

Table 6-1. Pin Functions

PIN			I/O	DESCRIPTION
NAME	DDC	DSE		
GND	2	5	—	Ground
INA+	3	4	I	This pin is connected to the voltage to be monitored with the use of an external resistor divider. When the voltage at this terminal drops below the threshold voltage (V_{ITP} – V_{HYS}), OUTA is driven low.
INB–	4	3	I	This pin is connected to the voltage to be monitored with the use of an external resistor divider. When the voltage at this terminal exceeds the threshold voltage (V_{ITP}), OUTB is driven low.
OUTA	1	6	O	INA+ comparator open-drain output. OUTA is driven low when the voltage at this comparator is below (V_{ITP} – V_{HYS}). The output goes high when the sense voltage returns above the respective threshold (V_{ITP}).
OUTB	6	1	O	INB– comparator open-drain output. OUTB is driven low when the voltage at this comparator exceeds V_{ITP}. The output goes high when the sense voltage returns below the respective threshold (V_{ITP} – V_{HYS}).
VDD	5	2	I	Supply voltage input. Connect a 1.8-V to 18-V supply to VDD to power the device. Good analog design practice is to place a 0.1-µF ceramic capacitor close to this pin.

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7 Specifications

7.1 Absolute Maximum Ratings

over operating temperature range (unless otherwise noted)(1)

		MIN	MAX	UNIT
Voltage(2)	V_{DD}	–0.3	20	V
	OUTA, OUTB	–0.3	20	V
	INA+, INB–	–0.3	7	V
Current	Output terminal current		40	mA
Operating junction temperature, T_J		–40	125	°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) All voltages are with respect to network ground terminal.

7.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human body model (HBM), per AEC Q100-002 (1)	±2500	V
		Charged-device model (CDM), per AEC Q100-011	±1000	

(1) JEC Q100-002 indicates that HBM stressing shall be in accordance with the ANSI/ESDA/JEDEC JS-001 specification.

7.3 Recommended Operating Conditions

over operating temperature range (unless otherwise noted)

			MIN	NOM	MAX	UNIT
V_{DD}	Supply voltage		1.8		18	V
V_I	Input voltage	INA+, INB–	0		6.5	V
V_O	Output voltage	OUTA, OUTB	0		18	V

7.4 Thermal Information

THERMAL METRIC(1)		DDC (SOT)	DSE (WSON)	UNIT
		6 PINS	6 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	204.6	194.9	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	50.5	128.9	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	54.3	153.8	°C/W
ψ_{JT}	Junction-to-top characterization parameter	0.8	11.9	°C/W
ψ_{JB}	Junction-to-board characterization parameter	52.8	157.4	°C/W
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance	N/A	N/A	°C/W

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

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7.5 Electrical Characteristics

Over the operating temperature range of T_J = –40°C to 125°C, and 1.8 V < V_{DD} < 18 V, unless otherwise noted. Typical values are at T_J = 25°C and V_{DD} = 5 V.

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$V_{(POR)}$	Power-on reset voltage(1)	V_{OL}max = 0.2 V, $I_{(OUTA/B)}$ = 15 µA			0.8	V
V_{IT+}	Positive-going input threshold voltage	V_{DD} = 1.8V and 18 V, T_J = 25°C	398	400	402.5	mV
		V_{DD} = 1.8V and 18 V, T_J = –40°C to 125°C	396		404	
$V_{IT–}$	Negative-going input threshold voltage	V_{DD} = 1.8V and 18 V, T_J = 25°C	391.6	394.5	397.5	mV
		V_{DD} = 1.8V and 18 V, T_J = –40°C to 125°C	387		400	
V_{hys}	Hysteresis voltage (hys = V_{IT+} – $V_{IT–}$)			5.5	12	mV
$I_{(INA+)}$	Input current (at the INA+ terminal)	V_{DD} = 1.8 V and 18 V, V_I = 6.5 V	–25	1	25	nA
$I_{(INB–)}$	Input current (at the INB– terminal)	V_{DD} = 1.8 V and 18 V, V_I = 0.1 V	–15	1	15	nA
V_{OL}	Low-level output voltage	V_{DD} = 1.8 V, I_O = 3 mA			250	mV
		V_{DD} = 5 V, I_O = 5 mA			250	
$I_{lkg(OD)}$	Open-drain output leakage-current	V_{DD} = 1.8 V and 18 V, V_O = V_{DD}			300	nA
		V_{DD} = 1.8 V, V_O = 18 V			300	
I_{DD}	Supply current	V_{DD} = 1.8 V, no load		5.5	11	µA
		V_{DD} = 5 V		6	13	
		V_{DD} = 12 V		6	13	
		V_{DD} = 18 V		7	13	
	Start-up delay(2)			150	450	µs
UVLO	Undervoltage lockout(3)	V_{DD} falling	1.3		1.7	V

(1) The lowest supply voltage (V_{DD}) at which output is active; $t_{r(VDD)}$ > 15 µs/V. Below $V_{(POR)}$, the output cannot be determined.
(2) During power on, V_{DD} must exceed 1.8 V for 450 µs (max) before the output is in a correct state.
(3) When V_{DD} falls below UVLO, OUTA is driven low and OUTB goes to high impedance. The outputs cannot be determined below $V_{(POR)}$.

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7.6 Timing Requirements

over operating temperature range (unless otherwise noted)

			MIN	NOM	MAX	UNIT
t_{PHL}	High-to-low propagation delay(1)	V_{DD} = 5 V, 10-mV input overdrive, R_P = 10 kΩ, V_{OH} = 0.9 × V_{DD}, V_{OL} = 400 mV, see Figure 7-1		18		µs
t_{PLH}	Low-to-high propagation delay(1)	V_{DD} = 5 V, 10-mV input overdrive, R_P = 10 kΩ, V_{OH} = 0.9 × V_{DD}, V_{OL} = 400 mV, see Figure 7-1		29		µs

(1) High-to-low and low-to-high refers to the transition at the input terminals (INA+ and INB–).

7.7 Switching Characteristics

Over operating temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_r	Output rise time	V_{DD} = 5 V, 10-mV input overdrive, R_P = 10 kΩ, V_O = (0.1 to 0.9) × V_{DD}		2.2		µs
t_f	Output fall time	V_{DD} = 5 V, 10-mV input overdrive, R_P = 10 kΩ, V_O = (0.1 to 0.9) × V_{DD}		0.22		µs

7.8 Timing Diagrams

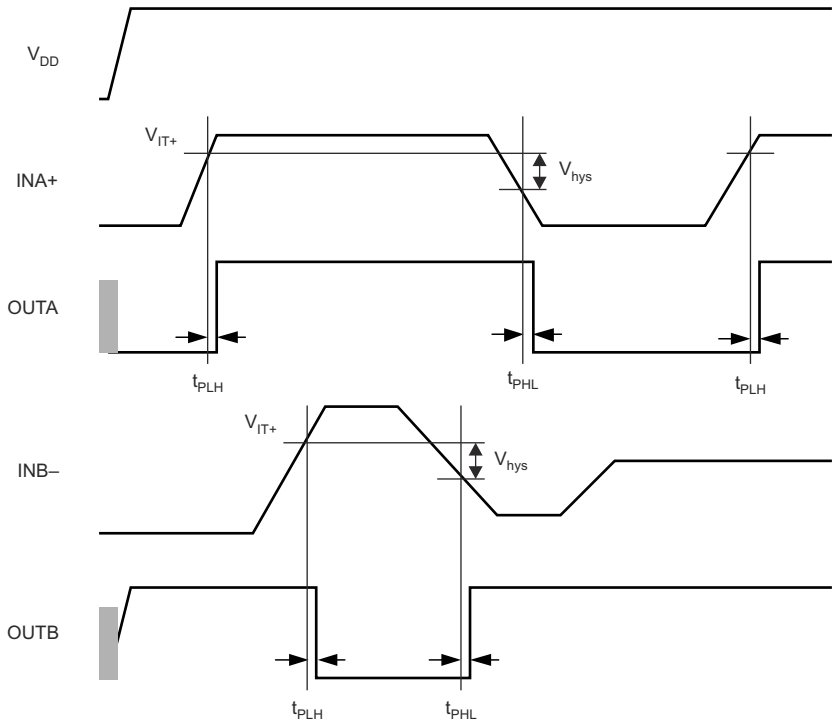


Figure 7-1. Timing Diagram

7.9 Typical Characteristics

at T_J = 25°C and V_{DD} = 5 V (unless otherwise noted)

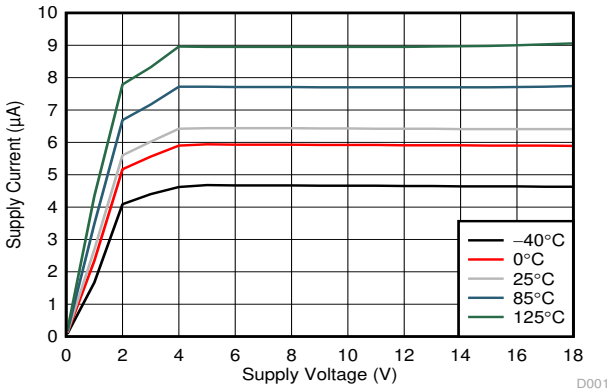


Figure 7-2. Supply Current (I_{DD}) vs Supply Voltage (V_{DD})

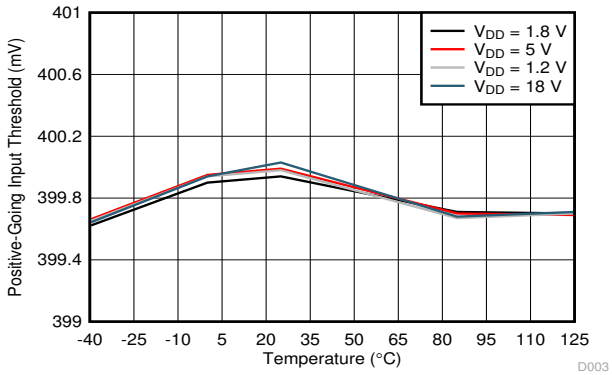


Figure 7-3. Rising Input Threshold Voltage (V_{IT+}) vs Temperature

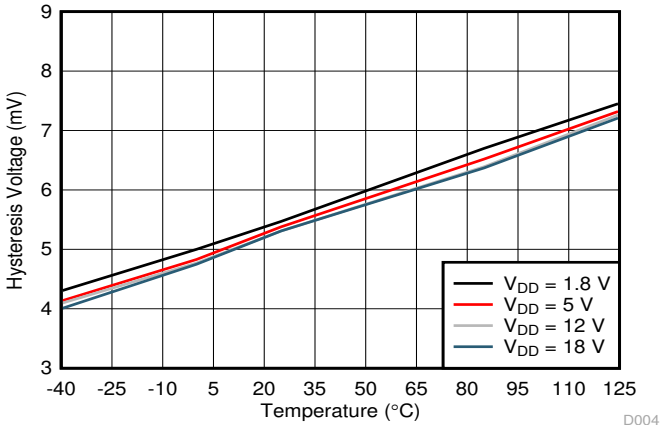


Figure 7-4. Hysteresis (V_{hys}) vs Temperature

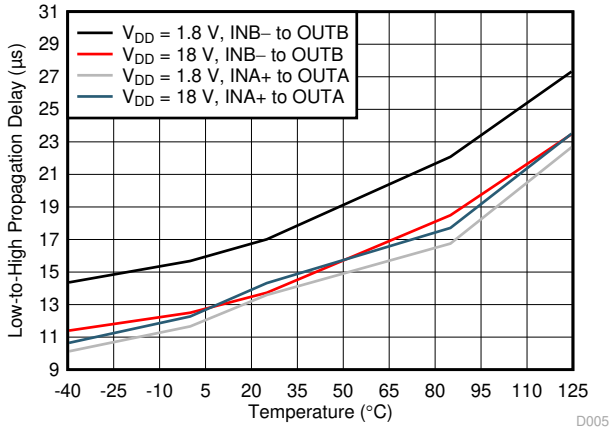


Figure 7-5. Propagation Delay vs Temperature (High-to-Low Transition at the Inputs)

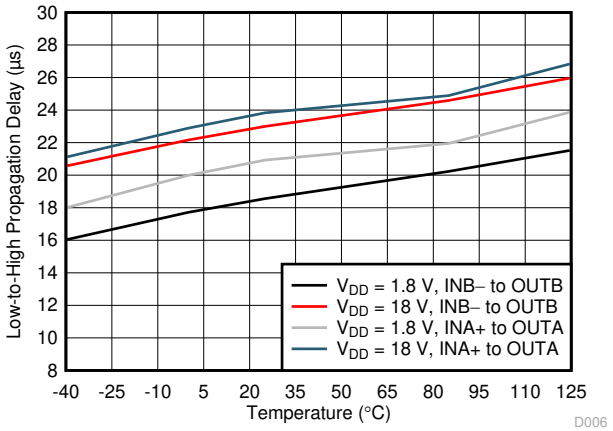
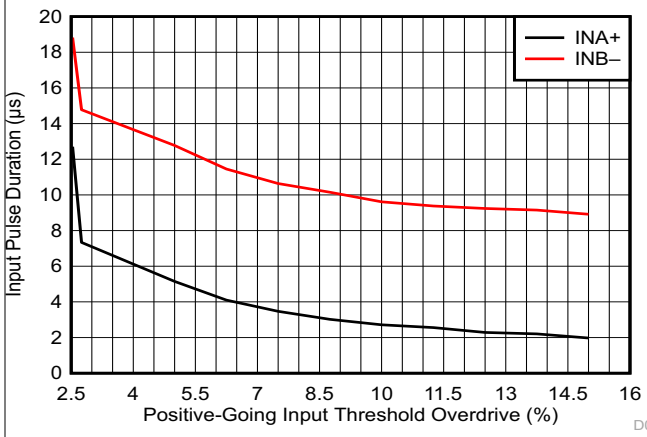


Figure 7-6. Propagation Delay vs Temperature (Low-to-High Transition at the Inputs)



INA+ = negative spike below $V_{IT–}$

INB– = positive spike above V_{IT+}

Figure 7-7. Minimum Pulse Duration vs Threshold Overdrive Voltage

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7.9 Typical Characteristics (continued)

at T_J = 25°C and V_{DD} = 5 V (unless otherwise noted)

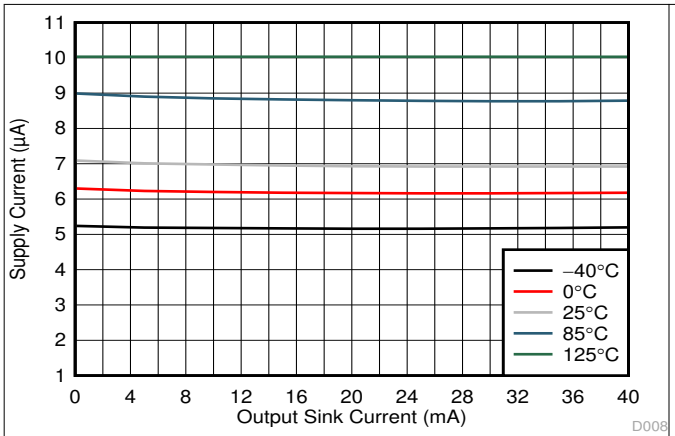


Figure 7-8. Supply Current (I_{DD}) vs Output Sink Current

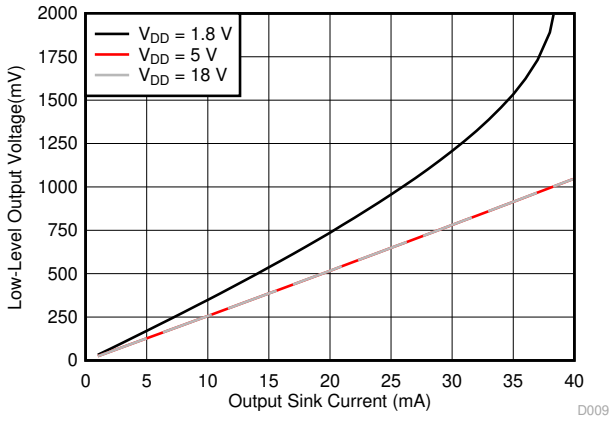


Figure 7-9. Output Voltage Low (V_{OL}) vs Output Sink Current (–40°C)

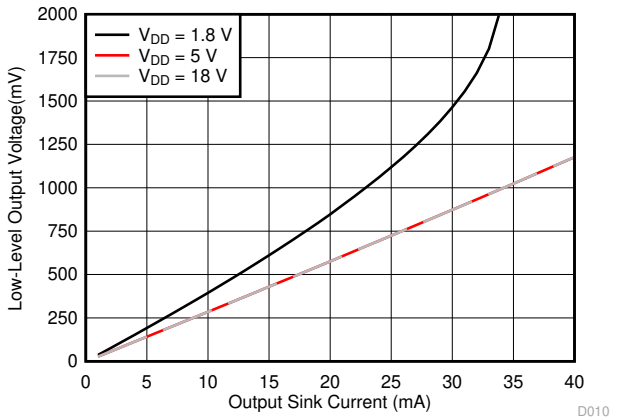


Figure 7-10. Output Voltage Low (V_{OL}) vs Output Sink Current (0°C)

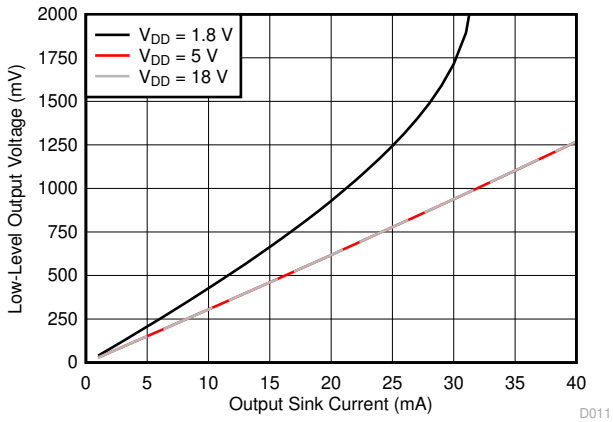


Figure 7-11. Output Voltage Low (V_{OL}) vs Output Sink Current (25°C)

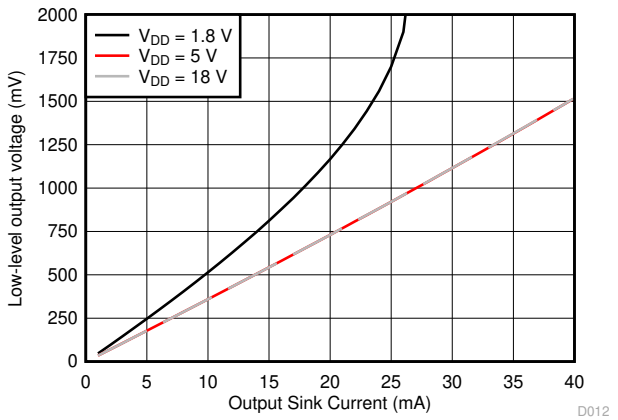


Figure 7-12. Output Voltage Low (V_{OL}) vs Output Sink Current (85°C)

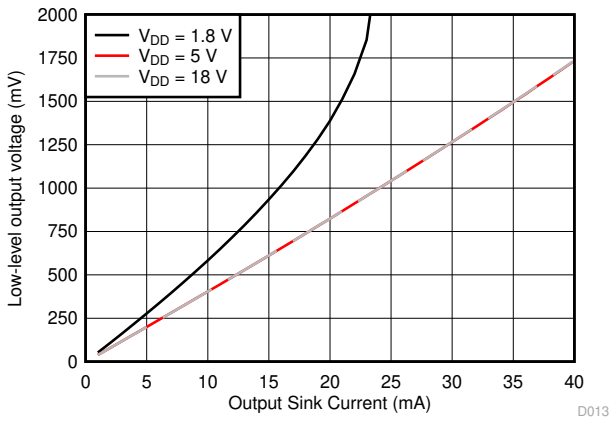


Figure 7-13. Output Voltage Low (V_{OL}) vs Output Sink Current (125°C)

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8 Detailed Description

8.1 Overview

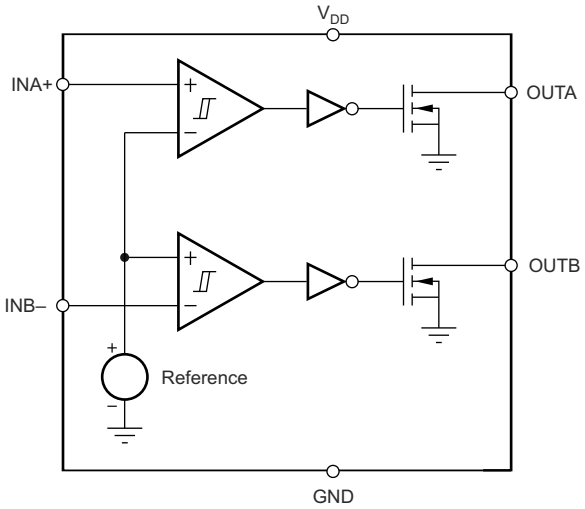
The TLV6700-Q1 device combines two comparators for overvoltage and undervoltage detection. The TLV6700-Q1 has a wide-supply voltage range (1.8 V to 18 V) with a high-accuracy rising-input threshold of 400 mV (1% over temperature) and built-in hysteresis. The outputs are also rated to 18 V, independant of supply voltage, and can sink up to 40 mA.

The TLV6700-Q1 is designed to assert the output signals, as shown in Table 8-1. Each input terminal can be set to monitor any voltage above 0.4 V using an external resistor divider network. Each input pin has very low input leakage current, allowing the use of large resistor dividers without sacrificing system accuracy. With the use of two input terminals of different polarities, the TLV6700-Q1 forms a window comparator. The relationship between the inputs and the outputs is shown in Table 8-1. Broad voltage thresholds can be supported that allow the device to be used in a wide array of applications.

Table 8-1. TLV6700 Truth Table

CONDITION	OUTPUT	OUTPUT STATE
INA+ > V_{IT+}	OUTA high	Output A high impedance
INA+ < V_{IT-}	OUTA low	Output A sinking
INB– > V_{IT+}	OUTB low	Output B sinking
INB– < V_{IT-}	OUTB high	Output B high impedance

8.2 Functional Block Diagram



8.3 Feature Description

8.3.1 Inputs (INA+, INB–)

The TLV6700-Q1 device combines two comparators. Each comparator has one external input (inverting and noninverting); the other input is connected to the internal reference. The comparator rising threshold is designed and trimmed to be equal to the reference voltage (400 mV). Both comparators also have a built-in falling hysteresis that makes the device less sensitive to supply rail noise and ensures stable operation.

The comparator inputs can swing from ground to 6.5 V, regardless of the device supply voltage used. Although not required in most cases, good analog design practice is to place a 1-nF to 10-nF bypass capacitor at the comparator input for extremely noisy applications to reduce sensitivity to transients and layout parasitics.

For comparator A, the corresponding output (OUTA) is driven to logic low when the input INA+ voltage drops below (V_{IT+} – V_{hys}). When the voltage exceeds V_{IT+}, the output (OUTA) goes to a high-impedance state; see Figure 7-1.

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For comparator B, the corresponding output (OUTB) is driven to logic low when the voltage at input INB– exceeds V_{IT+}. When the voltage drops below $V_{IT+} – V_{hys}$ the output (OUTB) goes to a high-impedance state; see Figure 7-1. Together, these comparators form a window-detection function as discussed in the *Section 8.3.3* section.

8.3.2 Outputs (OUTA, OUTB)

In a typical TLV6700-Q1 application, the outputs are connected to a GPIO input of the processor (such as a digital signal processor [DSP], central processing unit [CPU], field-programmable gate array [FPGA], or application-specific integrated circuit [ASIC]).

The TLV6700-Q1 device provides two open-drain outputs (OUTA and OUTB). Pullup resistors must be used to hold these lines high when the output goes to high impedance (not asserted). By connecting pullup resistors to the proper voltage rails, the outputs can be connected to other devices at the correct interface-voltage levels. The TLV6700-Q1 outputs can be pulled up to 18 V, independent of the device supply voltage. By using wired-OR logic, OUTA and OUTB can merge into one logic signal that goes low if either outputs are asserted because of a fault condition.

Table 8-1 and the *Section 8.3.1* section describe how the outputs are asserted or deasserted. See Figure 7-1 for a timing diagram that describes the relationship between threshold voltages and the respective output.

8.3.3 Window Comparator

The inverting and noninverting configuration of the comparators forms a window-comparator detection circuit using a resistor divider network, as illustrated in Figure 8-1 and Figure 8-2. The input terminals can monitor any system voltage above 400 mV with the use of a resistor divider network. The INA+ and INB– terminals monitor for undervoltage and overvoltage conditions, respectively.

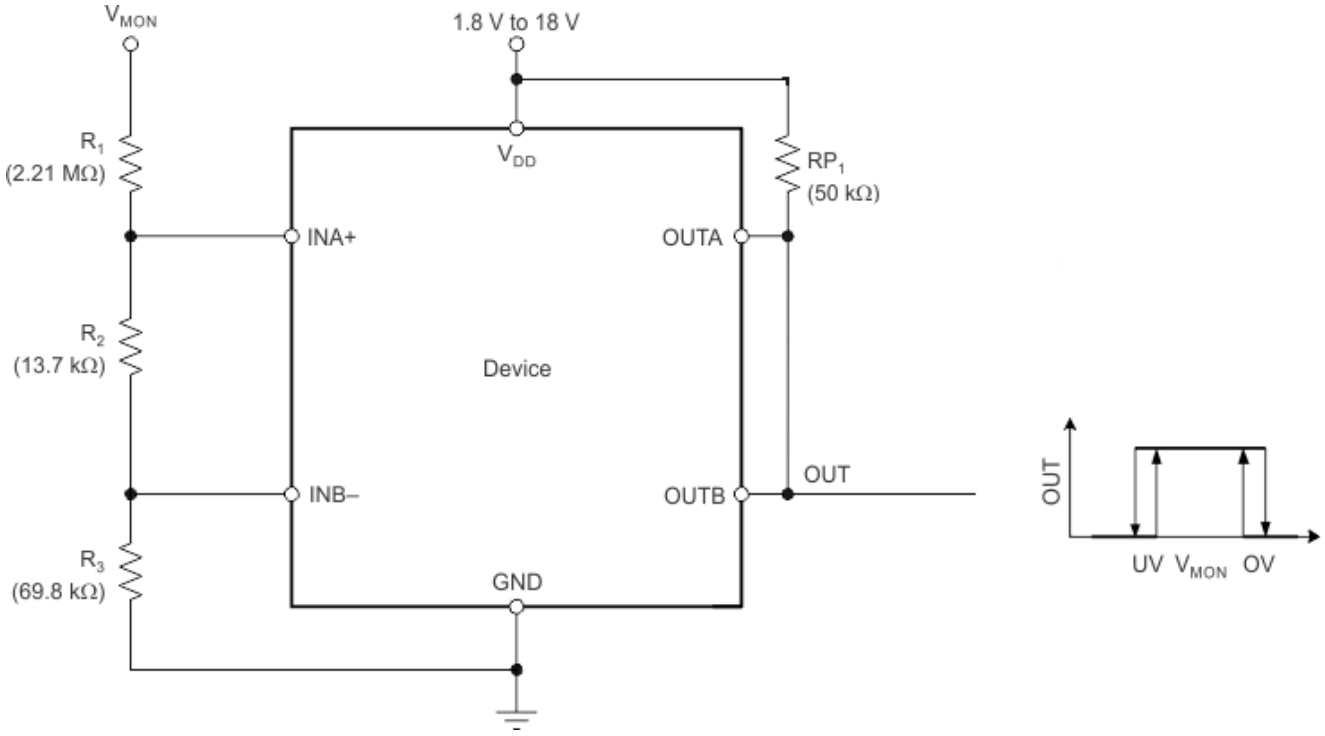


Figure 8-1. Window Comparator Block Diagram

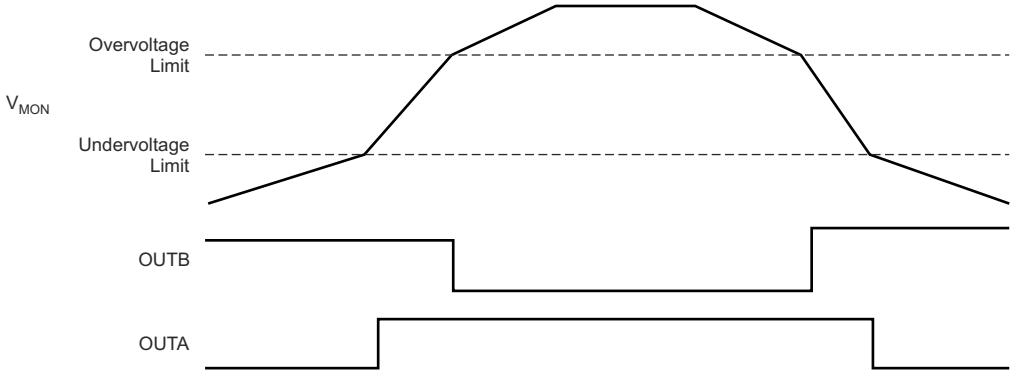


Figure 8-2. Window Comparator Timing Diagram

8.3.4 Immunity to Input Terminal Voltage Transients

The TLV6700-Q1 device is relatively immune to short voltage transient spikes on the input terminals. Sensitivity to transients depends on both transient duration and amplitude; see the *Minimum Pulse Duration vs Threshold Overdrive Voltage* curve (Figure 7-7) in the *Section 7.9* section.

8.4 Device Functional Modes

8.4.1 Normal Operation (V_{DD} > UVLO)

When the voltage on V_{DD} is greater than 1.8 V for at least 150 µs, the OUTA and OUTB signals correspond to the voltage on INA+ and INB– as listed in Table 8-1.

8.4.2 Undervoltage Lockout ($V_{(POR)} < V_{DD} <$ UVLO)

When the voltage on V_{DD} is less than the device UVLO voltage, and greater than the power-on reset voltage, $V_{(POR)}$, the OUTA and OUTB signals are asserted and high impedance, respectively, regardless of the voltage on INA+ and INB–.

8.4.3 Power-On Reset ($V_{DD} < V_{(POR)}$)

When the voltage on V_{DD} is lower than the required voltage to internally pull the asserted output to GND ($V_{(POR)}$), both outputs are in a high-impedance state.

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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

The TLV6700-Q1 device is a wide-supply voltage window comparator that operates over a V_{DD} range of 1.8 V to 18 V. The device has two high-accuracy comparators with an internal 400-mV reference and two open-drain outputs rated to 18 V for overvoltage and undervoltage detection. The device can be used either as a window comparator or as two independent voltage monitors. The monitored voltages are set with the use of external resistors.

9.1.1 V_{PULLUP} to a Voltage Other Than V_{DD}

The outputs are often tied to V_{DD} through a resistor. However, some applications may require the outputs to be pulled up to a higher or lower voltage than V_{DD} to correctly interface with the input terminals of other devices.

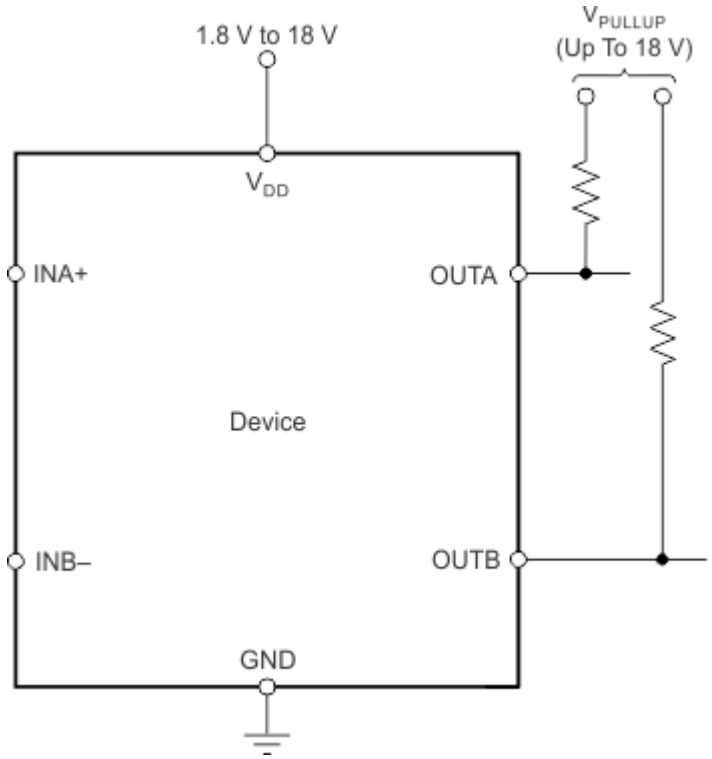


Figure 9-1. Interfacing to Voltages Other Than V_{DD}

9.1.2 Monitoring V_{DD}

Many applications monitor the same rail that is powering V_{DD}. In these applications the resistor divider is simply connected to the V_{DD} rail.

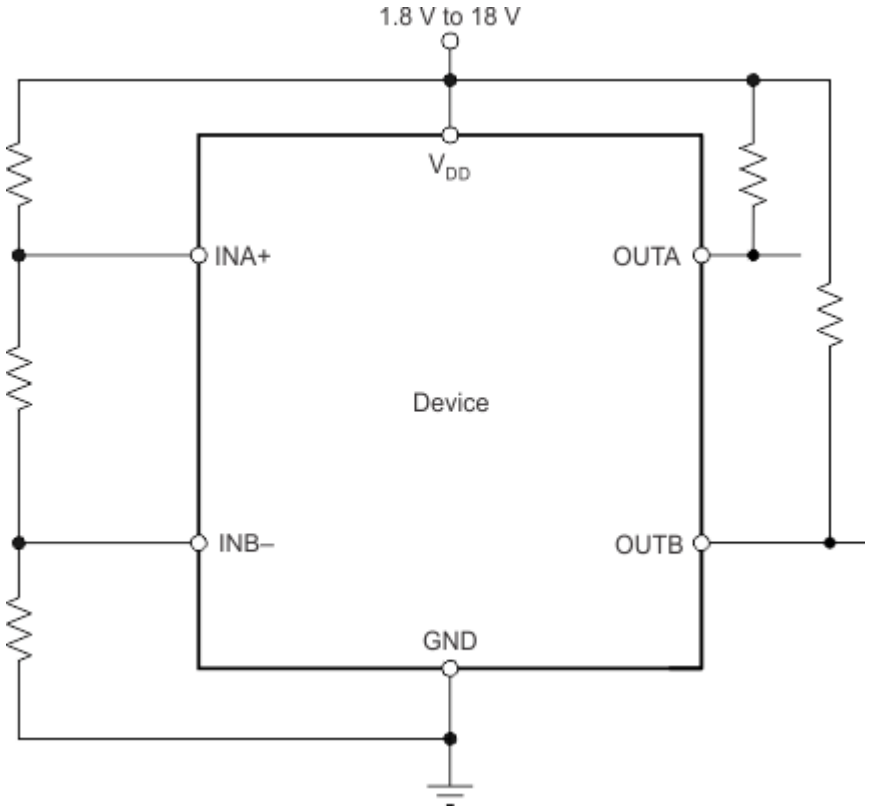
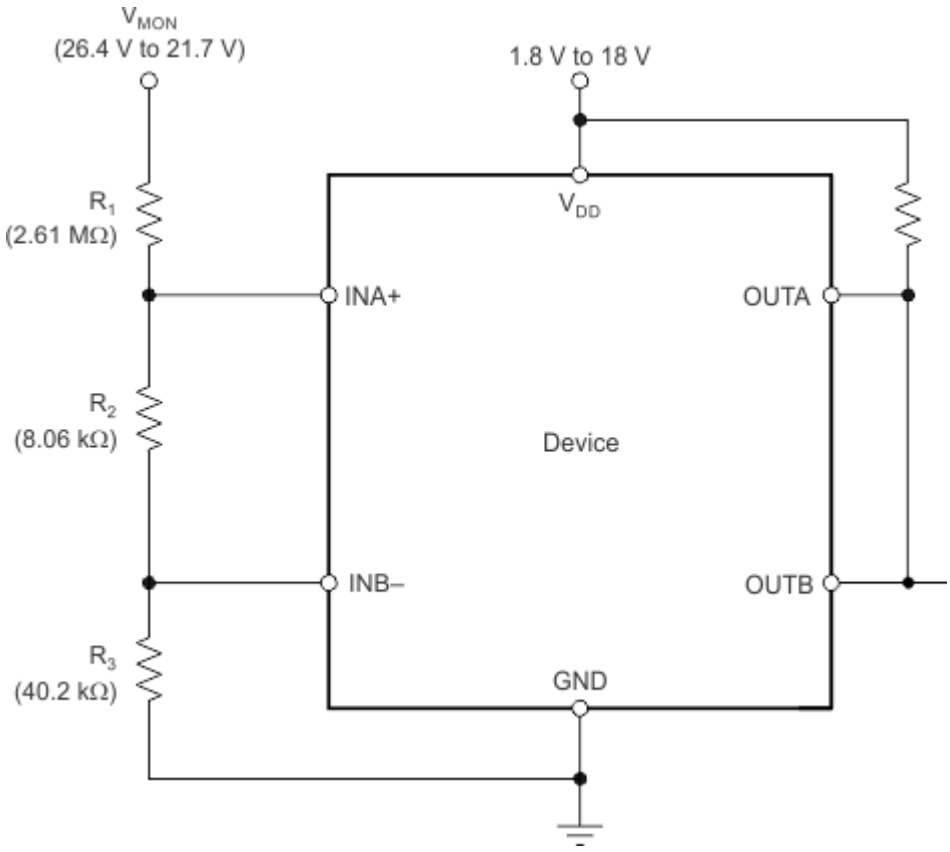


Figure 9-2. Monitoring the Same Voltage as V_{DD}

9.1.3 Monitoring a Voltage Other Than V_{DD}

Some applications monitor rails other than the one that is powering V_{DD}. In these types of applications the resistor divider used to set the desired thresholds is connected to the rail that is being monitored.

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The inputs can monitor a voltage higher than V_{DD}max with the use of an external resistor divider network.

Figure 9-3. Monitoring a Voltage Other Than V_{DD}

9.2 Typical Application

The TLV6700-Q1 device is a wide-supply voltage window comparator that operates over a V_{DD} range of 1.8 to 18 V. The monitored voltages are set with the use of external resistors, so the device can be used either as a window comparator or as two independent overvoltage and undervoltage monitors.

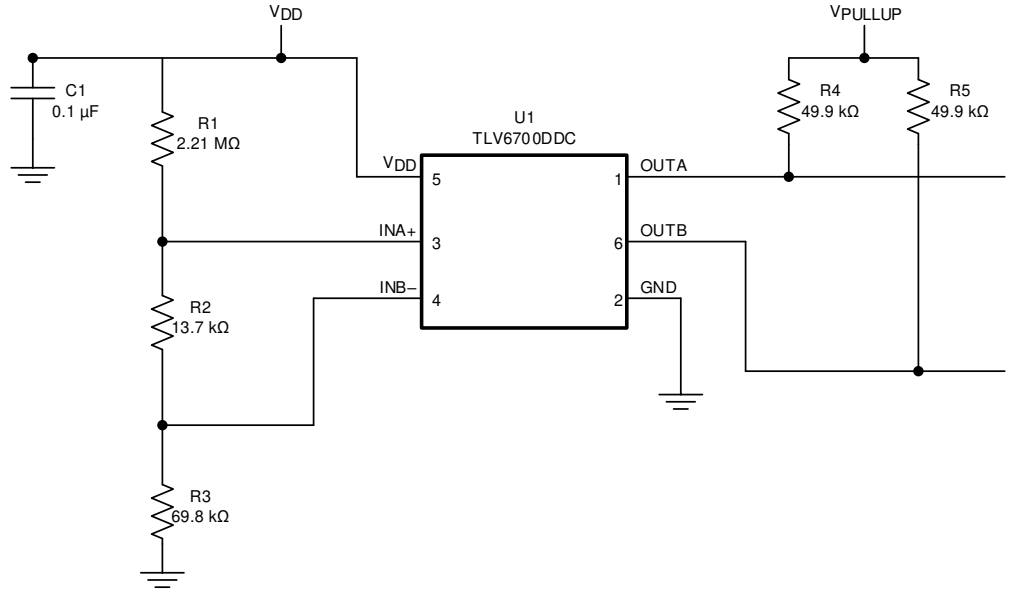


Figure 9-4. Typical Application Schematic

9.2.1 Design Requirements

For this design example, use the values summarized in Table 9-1 as the input parameters.

Table 9-1. Design Parameters

PARAMETER	DESIGN REQUIREMENT	DESIGN RESULT
Monitored voltage	12-V nominal rail with maximum rising and falling thresholds of ±10%	$V_{MON(UV)}$= 10.99 V (8.33%) ±2.94%, $V_{MON(OV)}$= 13.14 V (8.33%) ±2.94%

9.2.2 Detailed Design Procedure

9.2.2.1 Resistor Divider Selection

Use Equation 1 through Equation 4 to calculate the resistor divider values and target threshold voltages.

$$R_T = R_1 + R_2 + R_3 \quad (1)$$

Select a value for R_T such that the current through the divider is approximately 100 times higher than the input current at the INA+ and INB– terminals. The resistors can have high values to minimize current consumption as a result of low-input bias current without adding significant error to the resistive divider. See the application note *Optimizing Resistor Dividers at a Comparator Input* (SLVA450) for details on sizing input resistors.

Use Equation 2 to calculate the value of R_3.

$$R_3 = \frac{R_T}{V_{MON(OV)}} \times V_{IT+} \quad (2)$$

where:

$V_{MON(OV)}$ is the target voltage at which an overvoltage condition is detected

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Use Equation 3 or Equation 4 to calculate the value of R_2.

$$R_2 = \left(\frac{R_T}{V_{MON}\,(\text{no UV})} \times V_{IT+} \right) - R_3 \tag{3}$$

where:

$V_{MON(no\ UV)}$ is the target voltage at which an undervoltage condition is removed as V_{MON} rises

$$R_2 = \left(\frac{R_T}{V_{MON(UV)}} \times (V_{IT+} - V_{hys}) \right) - R_3 \tag{4}$$

where:

$V_{MON(UV)}$ is the target voltage at which an undervoltage condition is detected

The worst-case tolerance can be calculated by referring to Equation 13 in application report SLVA450, *Optimizing Resistor Dividers at a Comparator Input* (available for download at www.ti.com). An example of the rising threshold error, $V_{MON(OV)}$, is given in Equation 5.

$$\%\ ACC = \%\ TOL(V_{IT+(INB)}) + 2 \times \left(1 - \frac{V_{IT+(INB)}}{V_{MON(OV)}} \right) \times \%\ TOL_R = 1\% + 2 \times \left(1 - \frac{0.4}{13.2} \right) \times 1\% = 2.94\% \tag{5}$$

9.2.2.2 Pullup Resistor Selection

To ensure proper voltage levels, the pullup resistor value is selected by ensuring that the pullup voltage divided by the resistor does not exceed the sink-current capability of the device. This confirmation is calculated by verifying that the pullup voltage minus the output-leakage current ($I_{lkg(OD)}$) multiplied by the resistor is greater the desired logic-high voltage. These values are specified in the *Section 7.5* table.

Use Equation 6 to calculate the value of the pullup resistor.

$$\frac{(V_{HI} - V_{PU})}{I_{lkg(OD)}} \geq R_{PU} \geq \frac{V_{PU}}{I_O} \tag{6}$$

9.2.2.3 Input Supply Capacitor

Although an input capacitor is not required for stability, connecting a 0.1-µF low equivalent series resistance (ESR) capacitor across the V_{DD} terminal and GND terminal is good analog design practice. A higher-value capacitor may be necessary if large, fast rise-time load transients are anticipated, or if the device is not located close to the power source.

9.2.2.4 Input Capacitors

Although not required in most cases, for extremely noisy applications, placing a 1-nF to 10-nF bypass capacitor from the comparator inputs (INA+, INB–) to the GND terminal is good analog design practice. This capacitor placement reduces device sensitivity to transients.

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9.2.3 Application Curves

At T_J = 25°C

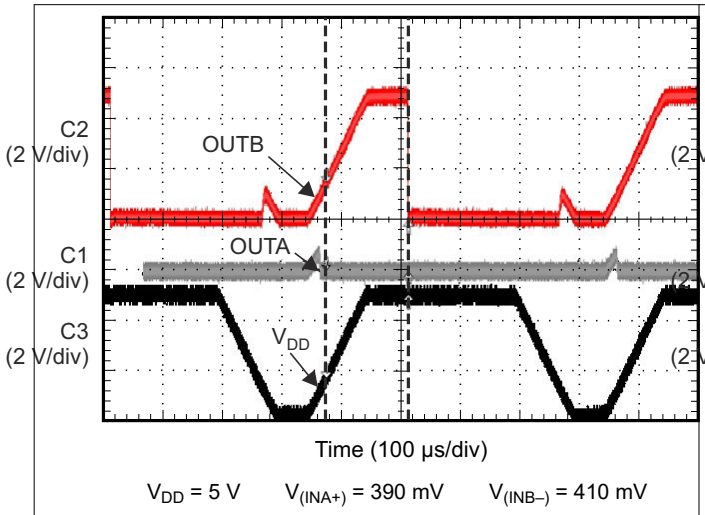


Figure 9-5. Start-Up Delay (OUT Pulled Up to V_{DD})

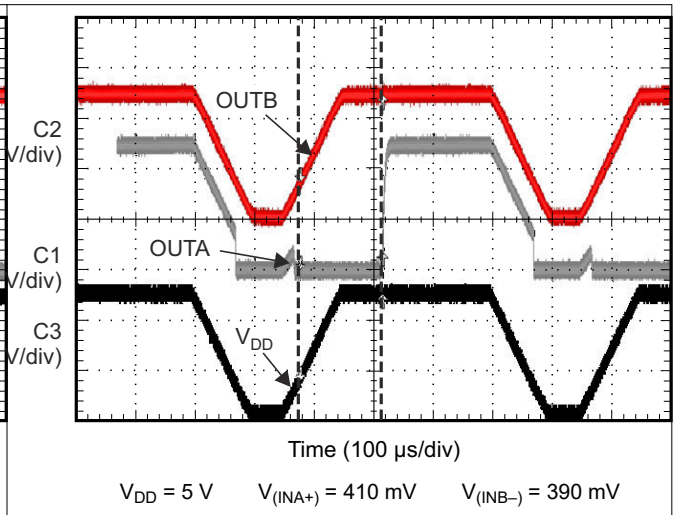


Figure 9-6. Start-Up Delay (OUT Pulled Up to V_{DD})

9.3 Do's and Don'ts

It is good analog design practice to have a 0.1-µF decoupling capacitor from V_{DD} to GND.

If the monitored rail is noisy, connect decoupling capacitors from the comparator inputs to GND.

Do not use resistors for the voltage divider that cause the current through them to be less than 100 times the input current of the comparators without also accounting for the effect to the accuracy.

Do not use pullup resistors that are too small, because the larger current sunk by the output then exceeds the desired low-level output voltage (V_{OL}).

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10 Power Supply Recommendations

The TLV6700-Q1 has a 20 V absolute maximum rating on the VDD pin, with a recommended operating condition of 18V. If the voltage supply that is providing power to VDD is susceptible to any large voltage transient that may exceed 20 V, or if the supply exhibits high voltage slew rates greater than 1 V/µs, take additional precautions. Place an RC filter between the supply and VDD to filter any high-frequency transient surges on the VDD pin. A 100-Ω resistor and 0.01-µF capacitor is required in these cases, as shown in Figure 10-1.

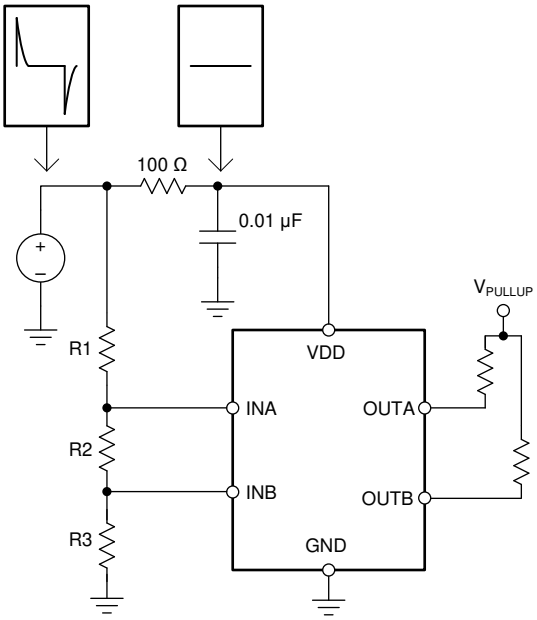


Figure 10-1. Using an RC Filter to Remove High-Frequency Disturbances on VDD

11 Layout

11.1 Layout Guidelines

Placing a 0.1-µF capacitor close to the V_{DD} terminal to reduce the input impedance to the device is good analog design practice. The pullup resistors can be separated if separate logic functions are needed (as shown in Figure 11-1) or both resistors can be tied to a single pullup resistor if a logical AND function is desired.

11.2 Layout Example

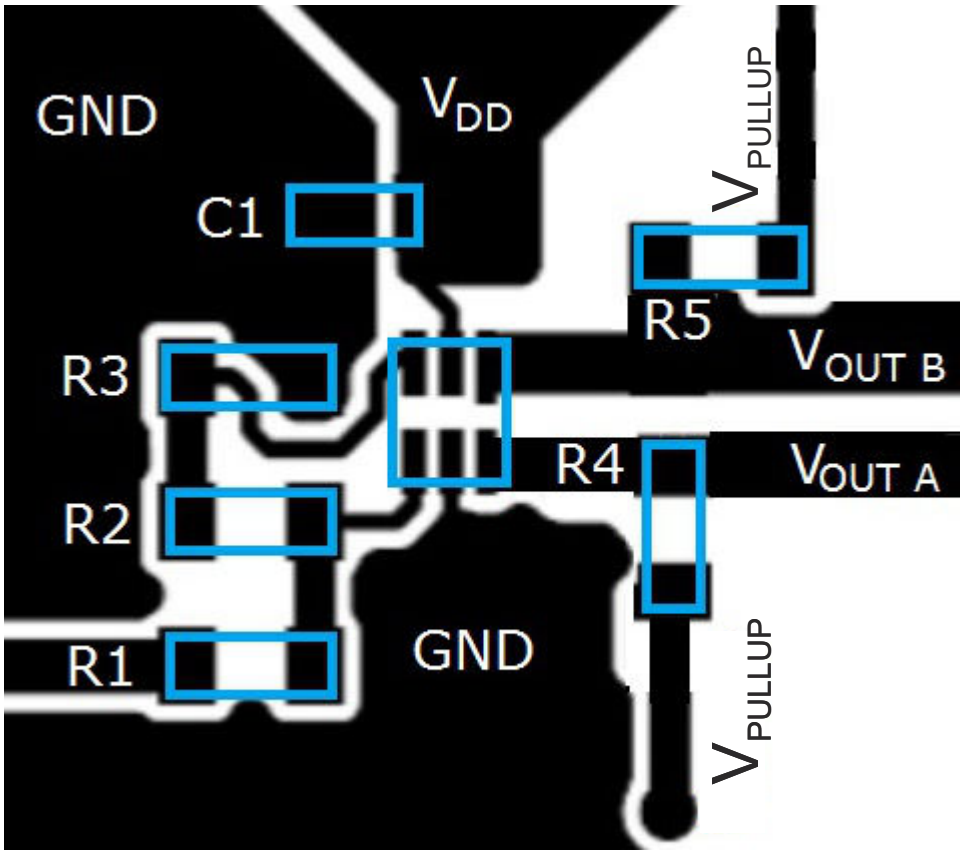


Figure 11-1. TLV6700 Layout Schematic

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12 Device and Documentation Support

12.1 Device Support

12.1.1 Development Support

The *DIP Adapter Evaluation Module* allows conversion of the SOT-23-6 package to a standard DIP-6 pinout for ease of prototyping and bench evaluation.

12.2 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.

12.3 Support Resources

TI E2E™ support forums are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

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12.4 Trademarks

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12.5 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.

12.6 Glossary

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.

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PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
TLV6700QDDCRQ1	ACTIVE	SOT-23-THIN	DDC	6	3000	RoHS & Green	NIPDAU	Level-2-260C-1 YEAR	-40 to 125	2DI1	Samples
TLV6700QDSERQ1	ACTIVE	WSON	DSE	6	3000	RoHS & Green	NIPDAUAG	Level-2-260C-1 YEAR	-40 to 125	K6	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 finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

OTHER QUALIFIED VERSIONS OF TLV6700-Q1 :

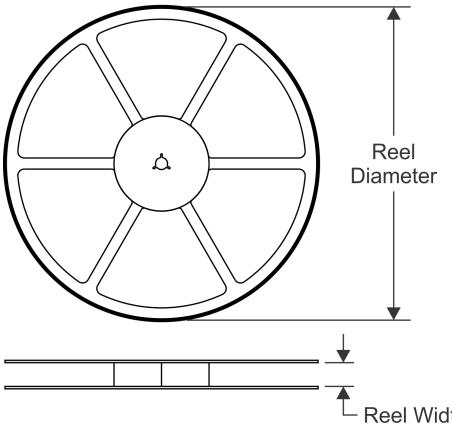
- Catalog: TLV6700

NOTE: Qualified Version Definitions:

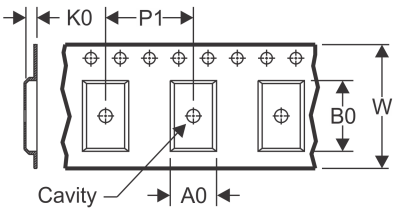
- Catalog - TI's standard catalog product

TAPE AND REEL INFORMATION

REEL DIMENSIONS

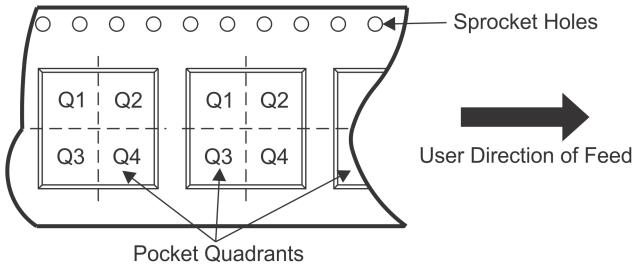


TAPE DIMENSIONS



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

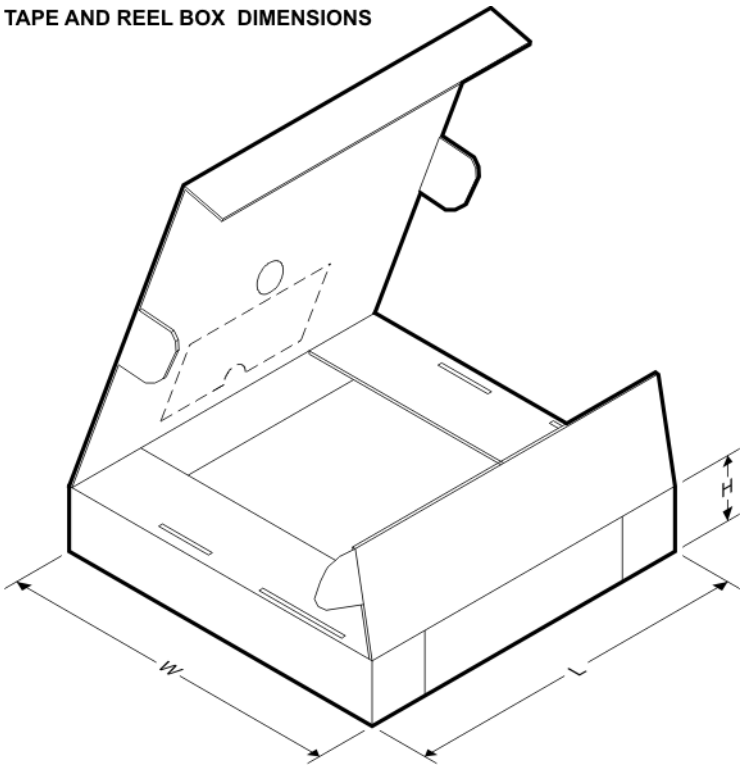
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
TLV6700QDDCRQ1	SOT-23-THIN	DDC	6	3000	180.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TLV6700QDSERQ1	WSON	DSE	6	3000	180.0	8.4	1.8	1.8	1.0	4.0	8.0	Q2

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

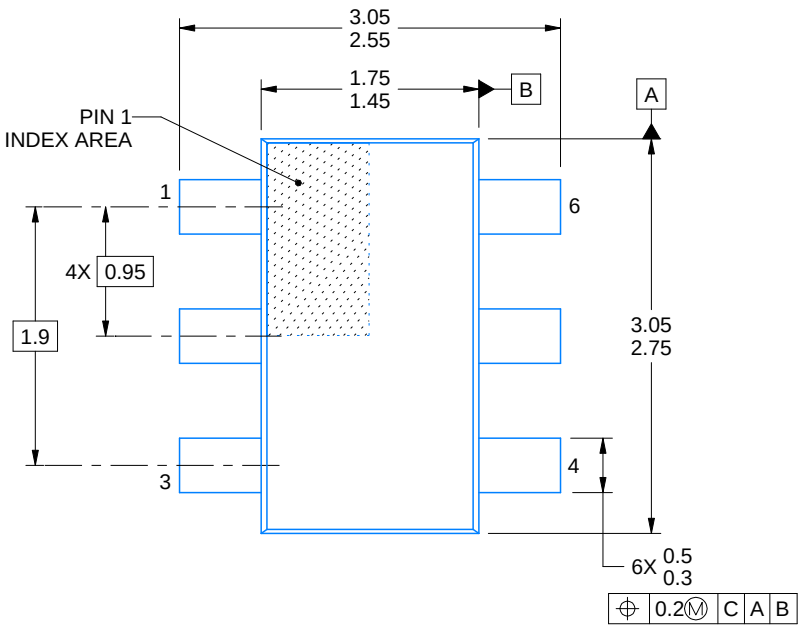
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TLV6700QDDCRQ1	SOT-23-THIN	DDC	6	3000	213.0	191.0	35.0
TLV6700QDSERQ1	WSON	DSE	6	3000	213.0	191.0	35.0

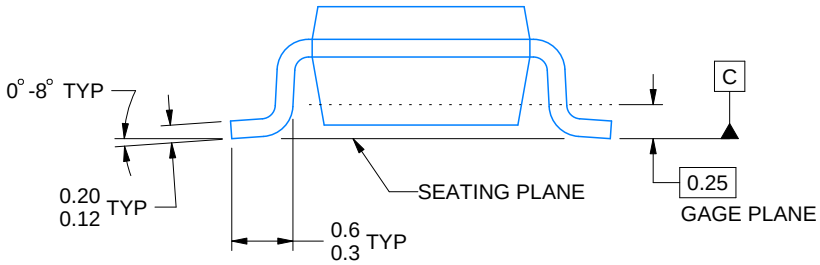
PACKAGE OUTLINE

DDC0006A

SOT - 1.1 max height

SOT

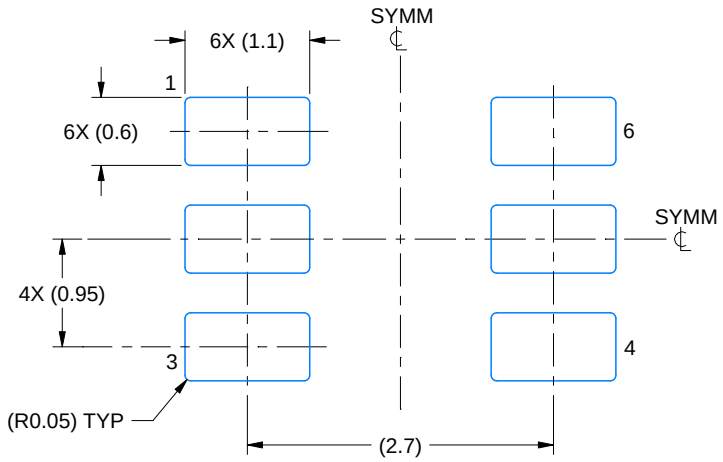




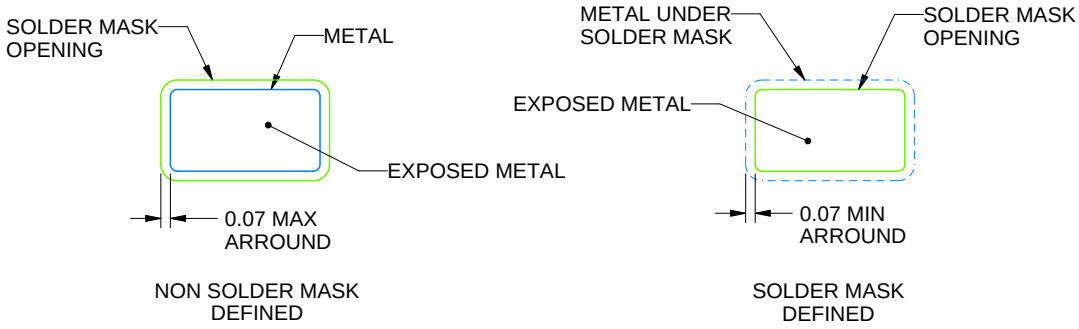
4214841/B 11/2020

NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Reference JEDEC MO-193.



LAND PATTERN EXAMPLE
EXPLOSED METAL SHOWN
SCALE:15X

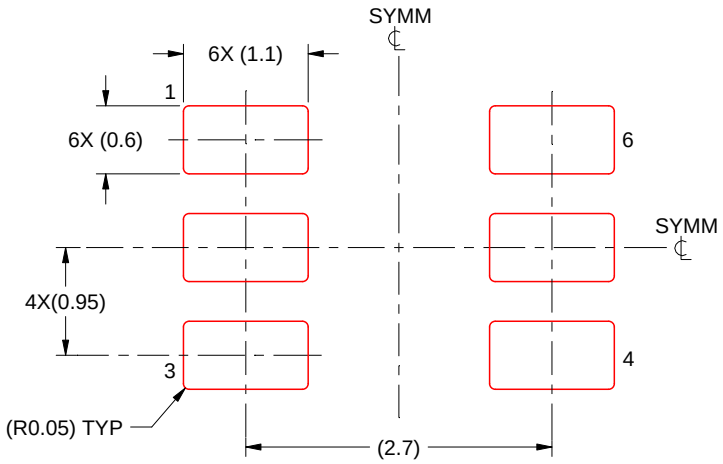


SOLDERMASK DETAILS

4214841/B 11/2020

NOTES: (continued)

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



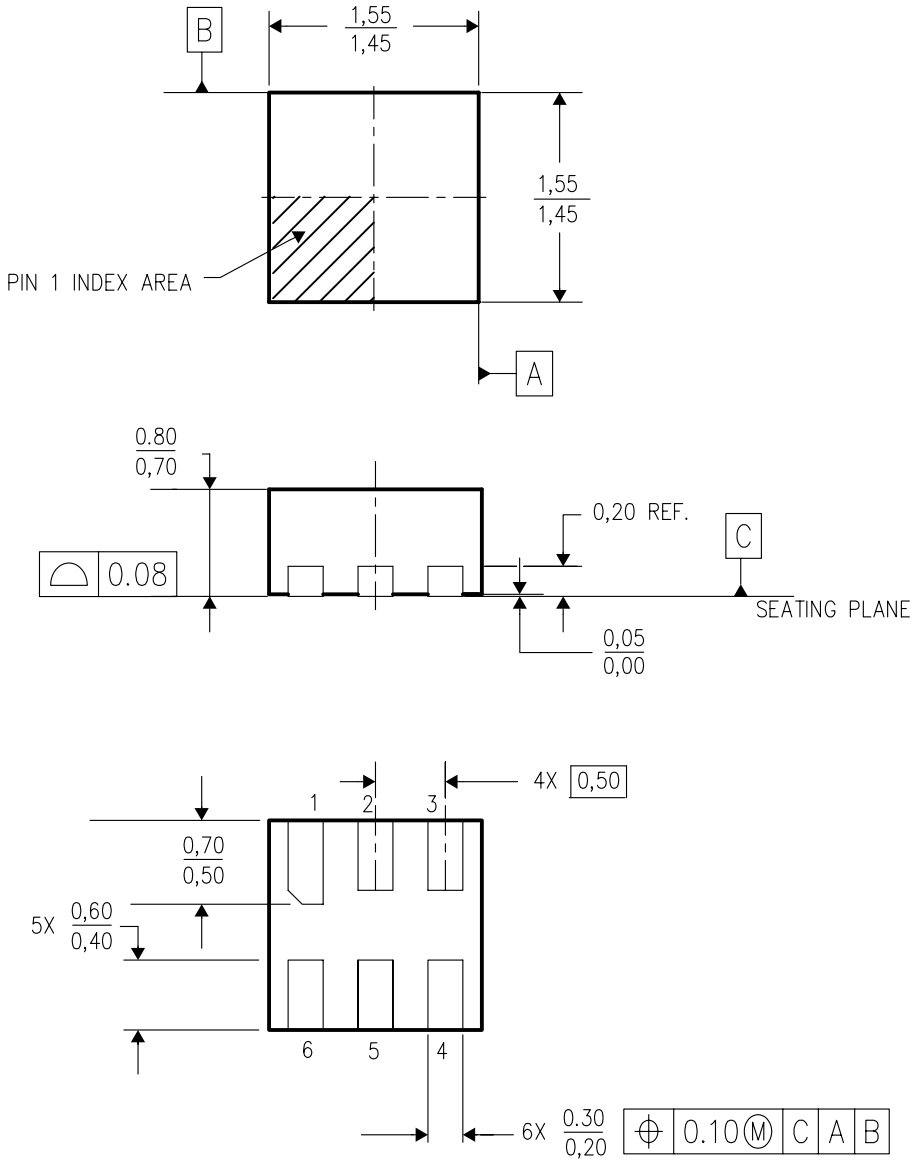
SOLDER PASTE EXAMPLE
BASED ON 0.125 THICK STENCIL
SCALE:15X

4214841/B 11/2020

NOTES: (continued)

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

DSE (S–PDSO–N6) PLASTIC SMALL OUTLINE



4207810/A 03/06

NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Small Outline No–Lead (SON) package configuration.
D. This package is lead–free.

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