

Dual Voltage Detector with Adjustable Hysteresis

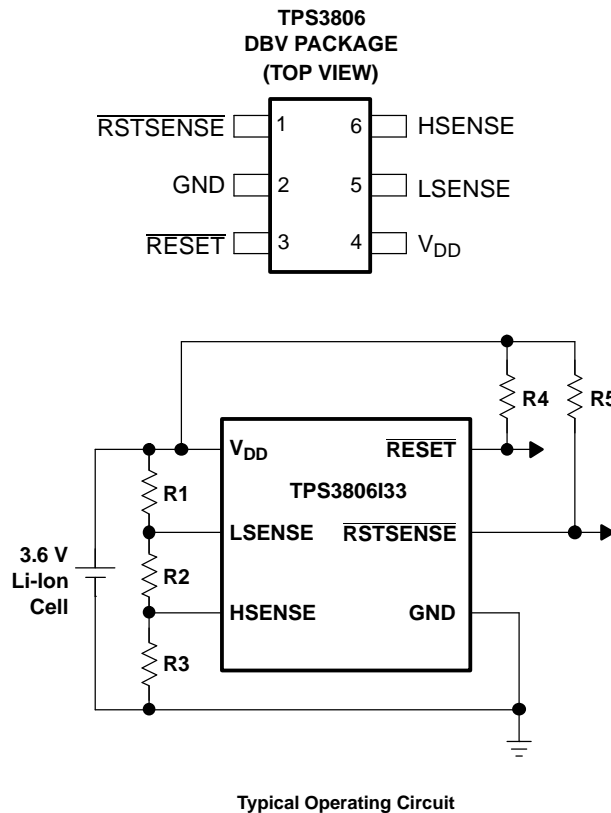
FEATURES

- Dual Voltage Detector With Adjustable Hysteresis 3.3-V/Adjustable and 2-V/Adjustable
- Assured Reset at $V_{DD} = 0.8\text{ V}$
- Supply Current: $3\ \mu\text{A}$ Typical at $V_{DD} = 3.3\text{ V}$
- Independent Open-Drain Reset Outputs
- Temperature Range: -40°C to $+85^{\circ}\text{C}$
- 6-Pin SOT-23 Package

DESCRIPTION

The TPS3806 integrates two independent voltage detectors for battery voltage monitoring. During power-on, $\overline{\text{RESET}}$ and $\overline{\text{RSTSENSE}}$ are asserted when supply voltage V_{DD} or the voltage at LSENSE input become higher than 0.8 V. Thereafter, the supervisory circuit monitors V_{DD} and LSENSE, keeping $\overline{\text{RESET}}$ and $\overline{\text{RSTSENSE}}$ active as long as V_{DD} and LSENSE remain below the threshold voltage, V_{IT} . As soon as V_{DD} or LSENSE rise above the threshold voltage V_{IT} , $\overline{\text{RESET}}$ or $\overline{\text{RSTSENSE}}$ is deasserted, respectively. The TPS3806 device has a fixed-sense threshold voltage V_{IT} set by an internal voltage divider at V_{DD} and an adjustable second-LSENSE input. In addition, an upper voltage threshold can be set at HSENSE to allow a wide adjustable hysteresis window.

The devices are available in a 6-pin SOT-23 package. The TPS3806 device is characterized for operation over a temperature range of -40°C to $+85^{\circ}\text{C}$.



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.



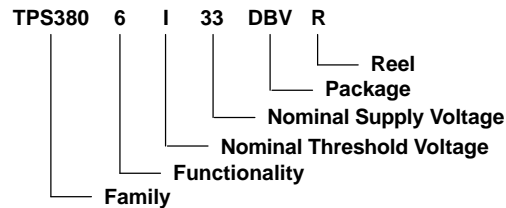
This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

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.

ORDERING INFORMATION⁽¹⁾

T _A	DEVICE NAME		THRESHOLD VOLTAGE		MARKING
			V _{DD}	SENSE	
-40°C to +85°C	TPS3806J20DBVR ⁽²⁾	TPS3806J20DBVT ⁽³⁾	1.8 V	1.207 V	PGQI
	TPS3806I33DBVR ⁽²⁾	TPS3806I33DBVT ⁽³⁾	3 V	1.207 V	PGPI

- (1) For the most current package and ordering information, see the Package Option Addendum located at the end of this data sheet or refer to our web site at www.ti.com.
 (2) The DBVR passive indicates tape and reel containing 3000 parts.
 (3) The DBVT passive indicates tape and reel containing 250 parts.



ABSOLUTE MAXIMUM RATINGS

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

	TPS3806J20, TPS3806I33	UNIT
Supply voltage, V _{DD} ⁽²⁾	7	V
All other pins ⁽²⁾	-0.3 to 7	V
Maximum low-output current, I _{OL}	5	mA
Maximum high-output current, I _{OH}	-5	mA
Input clamp current, I _{IK} (V _I < 0 or V _I > V _{DD})	±10	mA
Output clamp current, I _{OK} (V _O < 0 or V _O > V _{DD})	±10	mA
Continuous total power dissipation	See Dissipation Rating Table	
Operating free-air temperature range, T _A	-40 to +85	°C
Storage temperature range, T _{stg}	-65 to +150	°C
Soldering temperature	+260	°C

- (1) Stresses beyond those listed under absolute maximum ratings may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under recommended operating conditions is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
 (2) All voltage values are with respect to GND. For reliable operation, the device must not be continuously operated at 7 V for more than t = 1000 h.

DISSIPATION RATING TABLE

PACKAGE	T _A < 25°C	DERATING FACTOR ABOVE T _A = 25°C	T _A = 70°C POWER RATING	T _A = 85°C POWER RATING
DBV	437 mW	3.5 mW/°C	280 mW	227 mW

RECOMMENDED OPERATING CONDITIONS

	MIN	MAX	UNIT
Supply voltage, V_{DD}	1.3	6	V
Input voltage, V_I	0	$V_{DD} + 0.3$	V
Operating free-air temperature range, T_A	-40	+85	°C

ELECTRICAL CHARACTERISTICS

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

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT		
V_{OL}	Low-level output voltage	$V_{DD} = 1.5\text{ V}, I_{OL} = 1\text{ mA}$						
		$V_{DD} = 3.3\text{ V}, I_{OL} = 2\text{ mA}$			0.3	V		
		$V_{DD} = 6\text{ V}, I_{OL} = 3\text{ mA}$						
Power-up reset voltage ⁽¹⁾		$V_{DD} \geq 0.8\text{ V}, I_{OL} = 50\text{ }\mu\text{A}$			0.2	V		
V_{IT}	Negative-going input threshold voltage ⁽²⁾	LSENSE	$T_A = +25^\circ\text{C}$	1.198	1.207	1.216	V	
		TPS3806J20		1.787	1.8	1.813		
		TPS3806I33		2.978	3.0	3.022		
	LSENSE	$T_A = 0^\circ\text{C to } +70^\circ\text{C}$	TPS3806J20	1.188	1.207	1.226	V	
				TPS3806I33	1.772	1.8		1.828
				TPS3806I33	2.952	3.0		3.048
	LSENSE	$T_A = -40^\circ\text{C to } +85^\circ\text{C}$	TPS3806J20	1.183	1.207	1.231	V	
				TPS3806I33	1.764	1.8		1.836
				TPS3806I33	2.94	3.0		3.06
V_{hys}	Hysteresis	$1.2\text{ V} < V_{IT} < 2.5\text{ V}$		60		mV		
		$2.5\text{ V} < V_{IT} < 3.5\text{ V}$		90				
I_I	Input current	LSENSE, HSENSE	-25		25	nA		
I_{OH}	High-level output current	$V_{DD} = V_{IT} + 0.2\text{ V}, V_{OH} = V_{DD}$			300	nA		
I_{DD}	Supply current	$V_{DD} = 3.3\text{ V}, \text{Output unconnected}$		3	5	μA		
		$V_{DD} = 6\text{ V}, \text{Output unconnected}$		4	6			
C_i	Input capacitance	$V_I = 0\text{ V to } V_{DD}$		1		pF		

(1) The lowest supply voltage at which RESET becomes active. $t_{r,VDD} \geq 15\text{ }\mu\text{s/V}$

(2) To ensure best stability of the threshold voltage, place a bypass capacitor (ceramic, 0.1 μF) near the supply terminals.

SWITCHING CHARACTERISTICS

at $R_L = 1\text{ M}\Omega, C_L = 50\text{ pF}, T_A = -40^\circ\text{C to } +85^\circ\text{C}$

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PHL}	Propagation (delay) time, high-to-low-level output	V_{DD} to RESET delay	$V_{IH} = 1.05 \times V_{IT},$ $V_{IL} = 0.95 \times V_{IT}$	5	100	μs
		LSENSE to $\overline{\text{RSTSENSE}}$ delay				
t_{PLH}	Propagation (delay) time, low-to-high-level output	V_{DD} to RESET delay				
		HSENSE to $\overline{\text{RSTSENSE}}$ delay				

TIMING REQUIREMENTS

at $R_L = 1\text{ M}\Omega, C_L = 50\text{ pF}, T_A = -40^\circ\text{C to } +85^\circ\text{C}$

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_w	Pulse width	At V_{DD}	$V_{IH} = 1.05 \times V_{IT}, V_{IL} = 0.95 \times V_{IT}$	5.5		μs
		At SENSE				

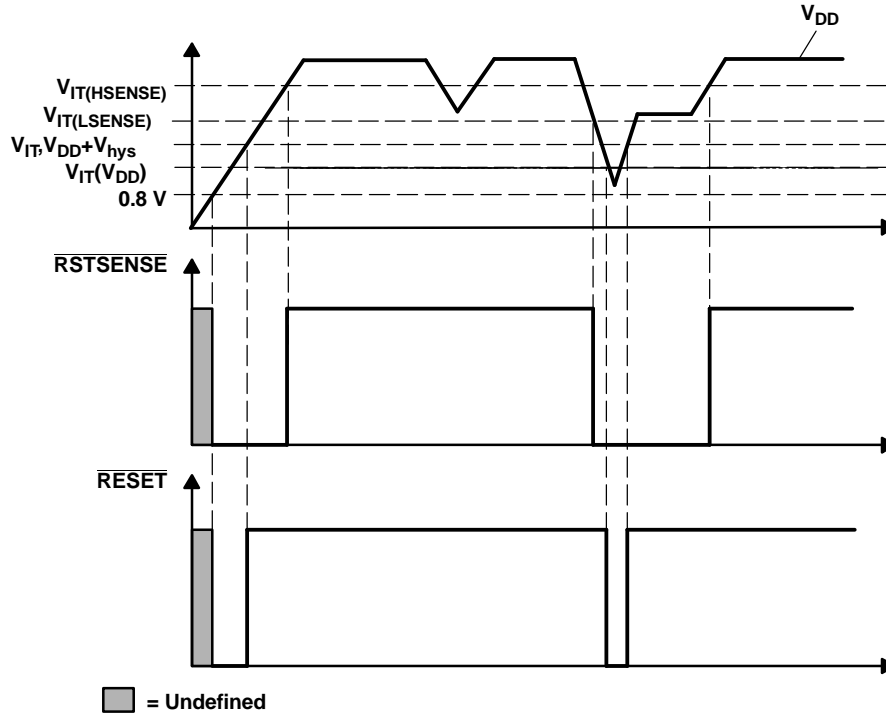


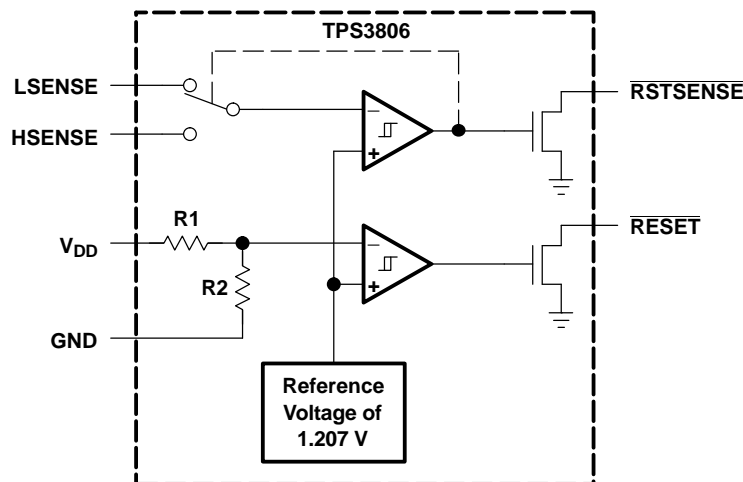
Table 1. TERMINAL FUNCTIONS

TERMINAL		I/O	DESCRIPTION
NAME	NO.		
GND	2	I	Ground
HSENSE	6	I	Adjustable hysteresis input
LSENSE	5	I	Adjustable sense input
\overline{RESET}	3	O	Active-low open drain reset output (from V_{DD})
$\overline{RSTSENSE}$	1	O	Active-low open-drain reset output (from LSENSE)
V_{DD}	4	I	Input supply voltage and fixed sense input

FUNCTION/TRUTH TABLE

TPS3806			
$V_{DD} > V_{IT}$	\overline{RESET}	LSENSE > V_{IT}	$\overline{RSTSENSE}$
0	L	0	L
1	H	1	H

FUNCTIONAL BLOCK DIAGRAM



Detailed Description

Operation

The TPS3806 is used for monitoring battery voltage and asserting $\overline{\text{RESET}}$ when a battery gets discharged below a certain threshold voltage. The battery voltage is monitored by a comparator via an external resistor divider. When the voltage at the LSENSE input drops below the internal reference voltage the $\overline{\text{RSTSENSE}}$ output pulls low. The output remains low until the battery is replaced, or recharged above a second higher trip-point, set at HSENSE. A second voltage can be monitored at V_{DD} . The independent $\overline{\text{RESET}}$ output pulls low when the voltage at V_{DD} drops below the fixed threshold voltage. Because the TPS3806 outputs are open-drain MOSFETs, most applications may require a pull-up resistor.

Programming the Threshold Voltage Levels

The low-voltage threshold at LSENSE is calculated according to Equation 1:

$$V_{(\text{LSENSE})} = V_{\text{ref}} \left(\frac{R1 + R2 + R3}{R2 + R3} \right) \quad (1)$$

where $V_{\text{ref}} = 1.207 \text{ V}$

The high-voltage threshold at HSENSE is calculated as shown in Equation 2:

$$V_{(\text{HSENSE})} = V_{\text{ref}} \left(\frac{R1 + R2 + R3}{R3} \right) \quad (2)$$

where $V_{\text{ref}} = 1.207 \text{ V}$

To minimize battery current draw it is recommended to use 1-M Ω as the total resistor value $R_{(\text{tot})}$, with $R_{(\text{tot})} = R1 + R2 + R3$.

TYPICAL CHARACTERISTICS

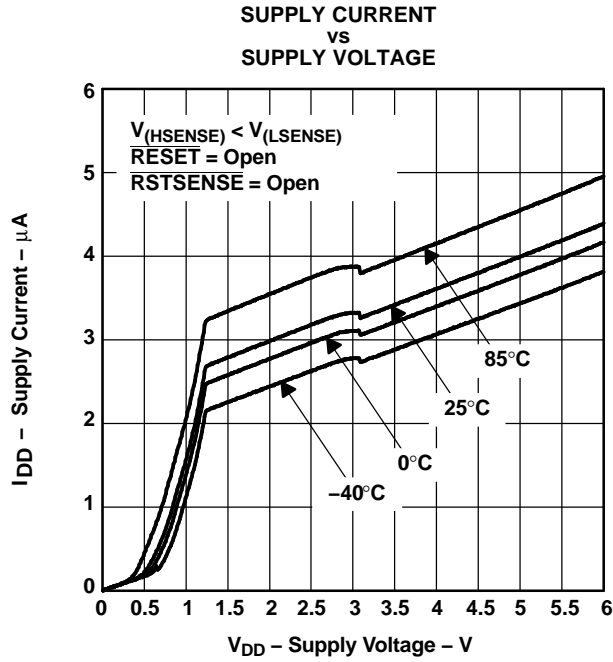


Figure 1.

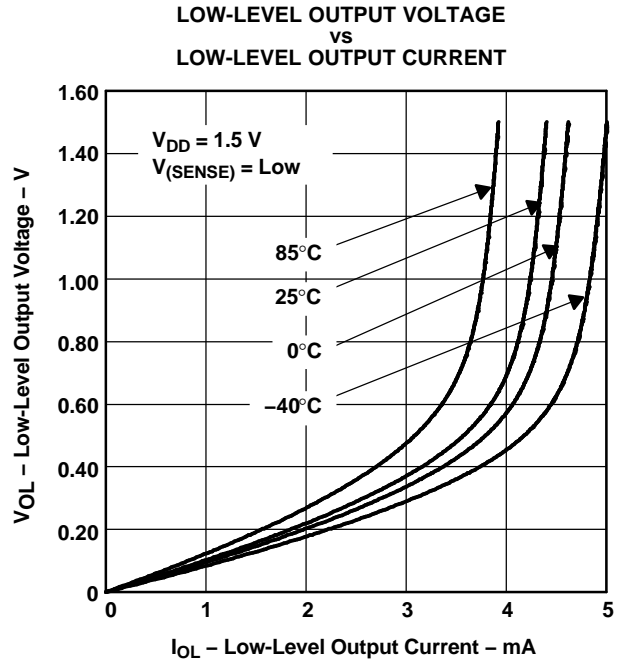


Figure 2.

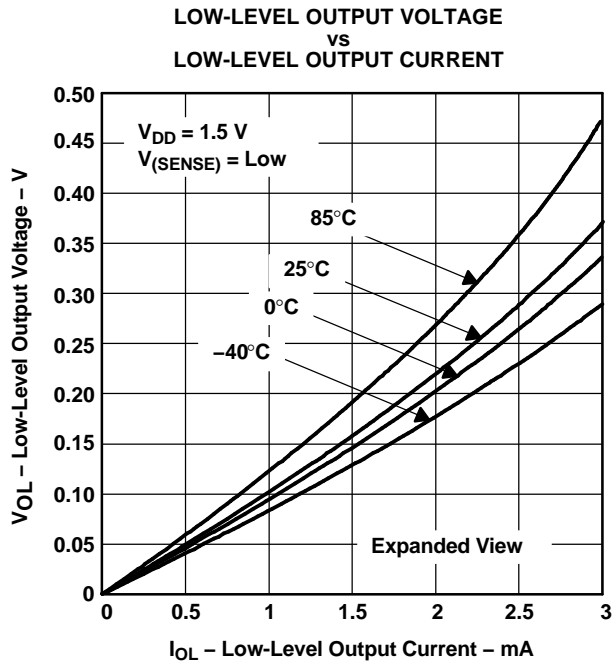


Figure 3.

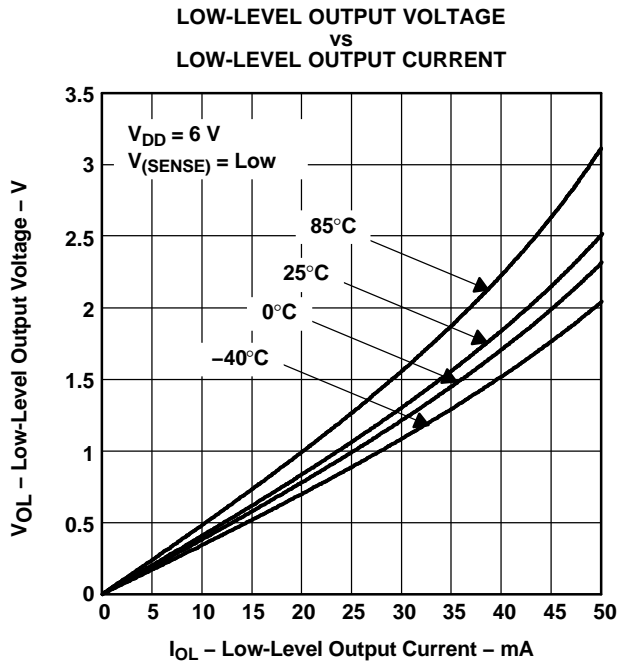


Figure 4.

TYPICAL CHARACTERISTICS (continued)

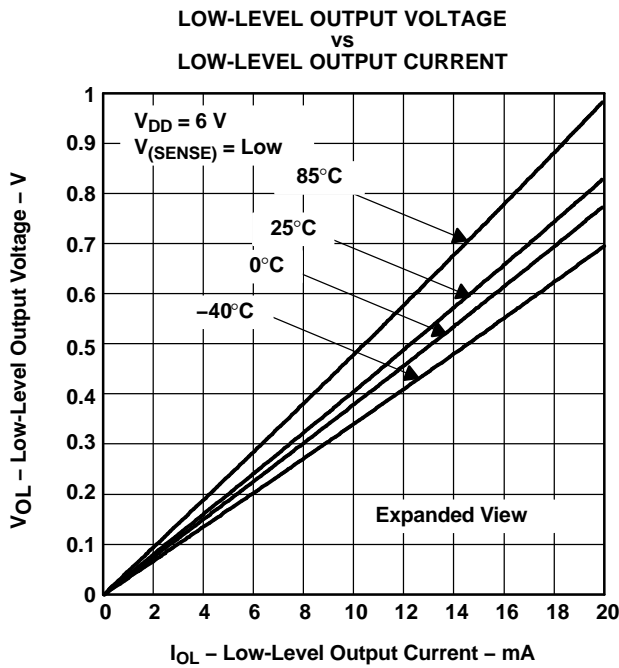


Figure 5.

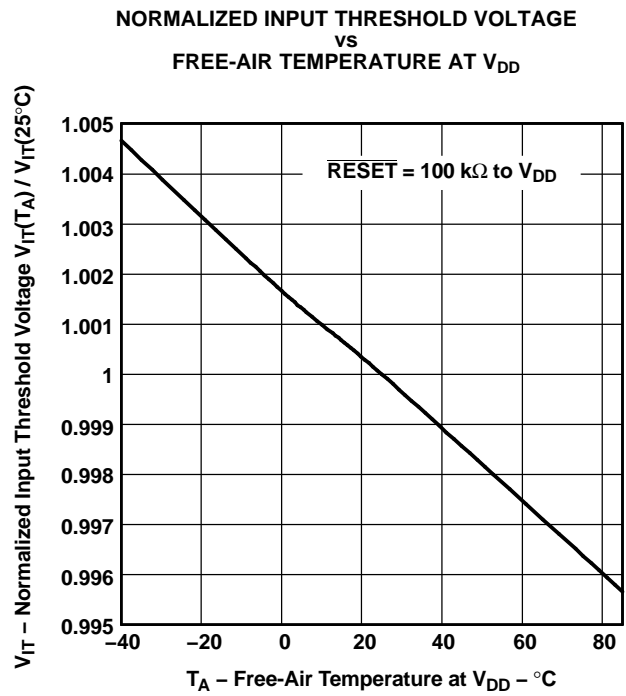


Figure 6.

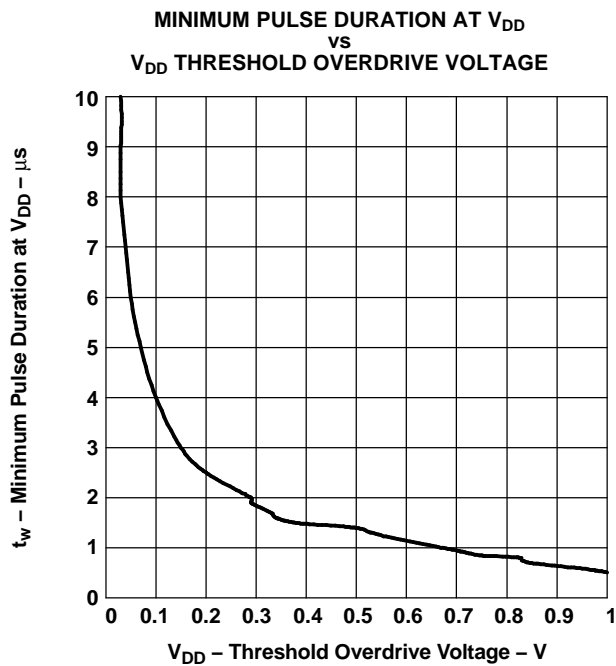


Figure 7.

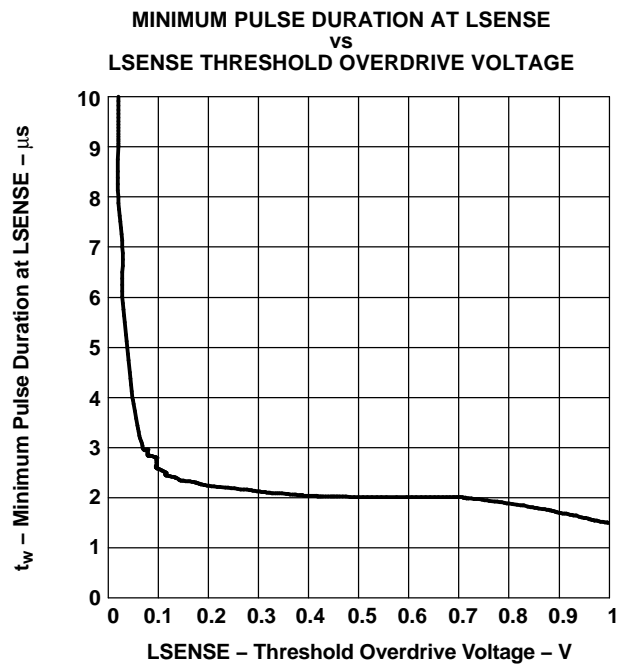


Figure 8.

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
TPS3806I33DBVR	ACTIVE	SOT-23	DBV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PGPI	Samples
TPS3806I33DBVRG4	ACTIVE	SOT-23	DBV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PGPI	Samples
TPS3806I33DBVT	ACTIVE	SOT-23	DBV	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PGPI	Samples
TPS3806I33DBVTG4	ACTIVE	SOT-23	DBV	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PGPI	Samples
TPS3806J20DBVR	ACTIVE	SOT-23	DBV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PGQI	Samples
TPS3806J20DBVT	ACTIVE	SOT-23	DBV	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PGQI	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.

OBSELETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(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.

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

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 TPS3806I33 :

- Automotive: [TPS3806I33-Q1](#)

NOTE: Qualified Version Definitions:

- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects

TAPE AND REEL INFORMATION

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TPS3806I33DBVR	SOT-23	DBV	6	3000	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TPS3806I33DBVR	SOT-23	DBV	6	3000	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
TPS3806I33DBVT	SOT-23	DBV	6	250	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TPS3806I33DBVT	SOT-23	DBV	6	250	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
TPS3806J20DBVR	SOT-23	DBV	6	3000	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
TPS3806J20DBVT	SOT-23	DBV	6	250	178.0	9.0	3.23	3.17	1.37	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)
TPS3806I33DBVR	SOT-23	DBV	6	3000	203.0	203.0	35.0
TPS3806I33DBVR	SOT-23	DBV	6	3000	180.0	180.0	18.0
TPS3806I33DBVT	SOT-23	DBV	6	250	203.0	203.0	35.0
TPS3806I33DBVT	SOT-23	DBV	6	250	180.0	180.0	18.0
TPS3806J20DBVR	SOT-23	DBV	6	3000	180.0	180.0	18.0
TPS3806J20DBVT	SOT-23	DBV	6	250	180.0	180.0	18.0

MECHANICAL DATA

DBV (R-PDSO-G6)

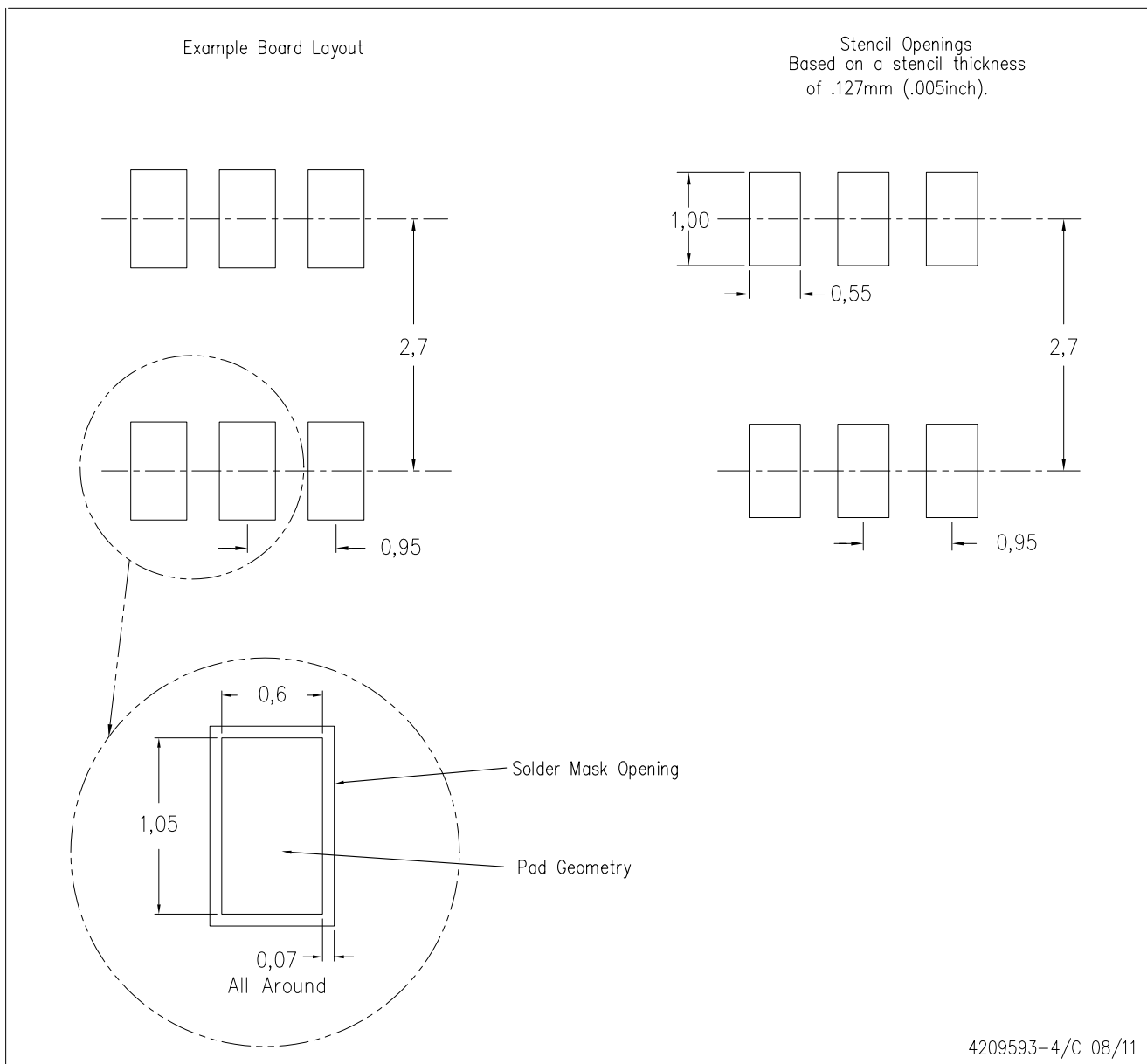
PLASTIC SMALL-OUTLINE PACKAGE



- 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. Leads 1,2,3 may be wider than leads 4,5,6 for package orientation.
- Falls within JEDEC MO-178 Variation AB, except minimum lead width.

DBV (R-PDSO-G6)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
 - D. Publication IPC-7351 is recommended for alternate designs.
 - E. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Example stencil design based on a 50% volumetric metal load solder paste. Refer to IPC-7525 for other stencil recommendations.

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products

Audio	www.ti.com/audio
Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DLP® Products	www.dlp.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
OMAP Applications Processors	www.ti.com/omap
Wireless Connectivity	www.ti.com/wirelessconnectivity

Applications

Automotive and Transportation	www.ti.com/automotive
Communications and Telecom	www.ti.com/communications
Computers and Peripherals	www.ti.com/computers
Consumer Electronics	www.ti.com/consumer-apps
Energy and Lighting	www.ti.com/energy
Industrial	www.ti.com/industrial
Medical	www.ti.com/medical
Security	www.ti.com/security
Space, Avionics and Defense	www.ti.com/space-avionics-defense
Video and Imaging	www.ti.com/video

TI E2E Community

e2e.ti.com