

- Qualified for Automotive Applications
  - Customer-Specific Configuration Control Can Be Supported Along With Major-Change Approval
  - ESD Protection Exceeds 2000 V Per MIL-STD-883, Method 3015; Exceeds 200 V Using Machine Model (C = 200 pF, R = 0)
  - Supply Current of 220 nA (Typ)
  - Precision Supply Voltage Supervision Range: 1.8 V, 2.5 V, 3.0 V, 3.3 V
  - Power-On Reset Generator With Selectable Delay Time of 10 ms or 200 ms
  - Push/Pull  $\overline{\text{RESET}}$  Output (TPS3836), RESET Output (TPS3837), or Open-Drain  $\overline{\text{RESET}}$  Output (TPS3838)
  - Manual Reset
  - 5-Pin SOT-23 Package
  - Temperature Range:  $-40^{\circ}\text{C}$  to  $125^{\circ}\text{C}$
- Applications Include
    - Applications Using Automotive Low-Power DSPs, Microcontrollers, or Microprocessors
    - Battery-Powered Equipment
    - Intelligent Instruments
    - Wireless Communication Systems
    - Automotive Systems

## description

The TPS3836, TPS3837, TPS3838 families of supervisory circuits provide circuit initialization and timing supervision, primarily for DSP and processor-based systems.

During power on,  $\overline{\text{RESET}}$  is asserted when the supply voltage  $V_{\text{DD}}$  becomes higher than 1.1 V. Thereafter, the supervisory circuit monitors  $V_{\text{DD}}$  and keeps  $\overline{\text{RESET}}$  output active as long as  $V_{\text{DD}}$  remains below the threshold voltage  $V_{\text{IT}}$ . An internal timer delays the return of the output to the inactive state (high) to ensure proper system reset. The delay time starts after  $V_{\text{DD}}$  has risen above the threshold voltage  $V_{\text{IT}}$ .

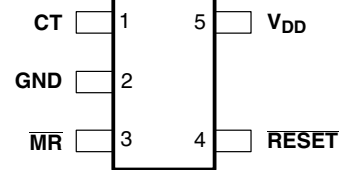
When CT is connected to GND a fixed delay time of typical 10 ms is asserted. When connected to  $V_{\text{DD}}$  the delay time is typically 200 ms.

When the supply voltage drops below the threshold voltage  $V_{\text{IT}}$ , the output becomes active (low) again.

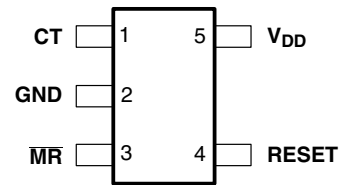
All the devices of this family have a fixed-sense threshold voltage  $V_{\text{IT}}$  set by an internal voltage divider.

The TPS3836 has an active-low push-pull  $\overline{\text{RESET}}$  output. The TPS3837 has active-high push-pull RESET, and TPS3838 integrates an active-low open-drain  $\overline{\text{RESET}}$  output.

TPS3836, TPS3838  
 DBV PACKAGE  
 (TOP VIEW)



TPS3837  
 DBV PACKAGE  
 (TOP VIEW)



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.

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

 **TEXAS  
 INSTRUMENTS**

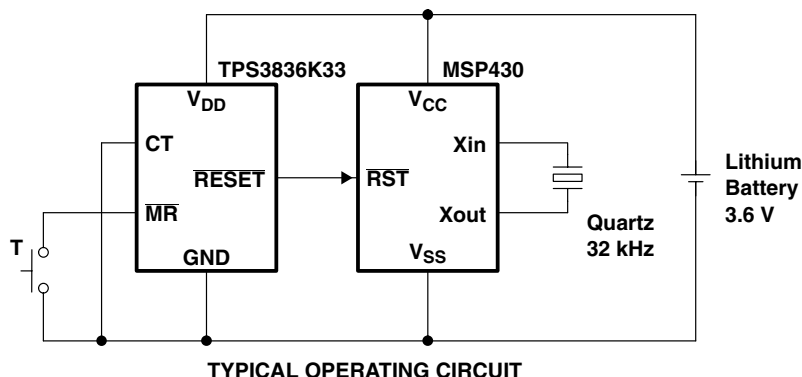
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**TPS3836E18-Q1 / J25-Q1 / H30-Q1 / L30-Q1 / K33-Q1**  
**TPS3837E18-Q1 / J25-Q1 / L30-Q1 / K33-Q1, TPS3838E18-Q1 / J25-Q1 / L30-Q1 / K33-Q1**  
**NANOPOWER SUPERVISORY CIRCUITS**

SGLS141A – DECEMBER 2002 – REVISED JANUARY 2007

**description (continued)**



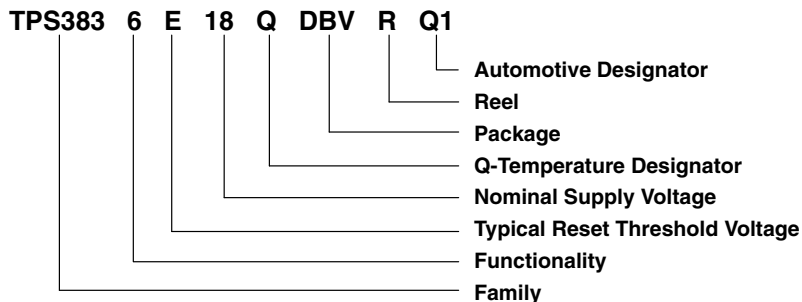
The product spectrum is designed for supply voltages of 1.8 V, 2.5 V, 3 V, and 3.3 V. The circuits are available in a 5-pin SOT-23 package. The TPS3836-Q-Q1, TPS3837-Q-Q1, TPS3838-Q-Q1 families are characterized for operation over a temperature range of  $-40^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ .

**PACKAGE INFORMATION**

$T_A$	DEVICE NAME	THRESHOLD VOLTAGE	SYMBOL
$-40^{\circ}\text{C}$ to $125^{\circ}\text{C}$	TPS3836E18QDBVRQ1†	1.71 V	PDNQ
	TPS3836J25QDBVRQ1†	2.25 V	PDSQ
	TPS3836H30QDBVRQ1†	2.79 V	PHRQ
	TPS3836L30QDBVRQ1†	2.64 V	PCAQ
	TPS3836K33QDBVRQ1†	2.93 V	PDTQ
	TPS3837E18QDBVRQ1†	1.71 V	PDOQ
	TPS3837J25QDBVRQ1†	2.25 V	PDRQ
	TPS3837L30QDBVRQ1†	2.64 V	PCBQ
	TPS3837K33QDBVRQ1†	2.93 V	PDUQ
	TPS3838E18QDBVRQ1†	1.71 V	PDQQ
	TPS3838J25QDBVRQ1†	2.25 V	PDPQ
	TPS3838L30QDBVRQ1†	2.64 V	PCCQ
	TPS3838K33QDBVRQ1†	2.93 V	PDVQ

† DBVR indicates tape and reel of 3000 parts.

**ORDERING INFORMATION**



**TPS3836E18-Q1 / J25-Q1 / H30-Q1 / L30-Q1 / K33-Q1**  
**TPS3837E18-Q1 / J25-Q1 / L30-Q1 / K33-Q1, TPS3838E18-Q1 / J25-Q1 / L30-Q1 / K33-Q1**  
**NANOPOWER SUPERVISORY CIRCUITS**

SGLS141A – DECEMBER 2002 – REVISED JANUARY 2007

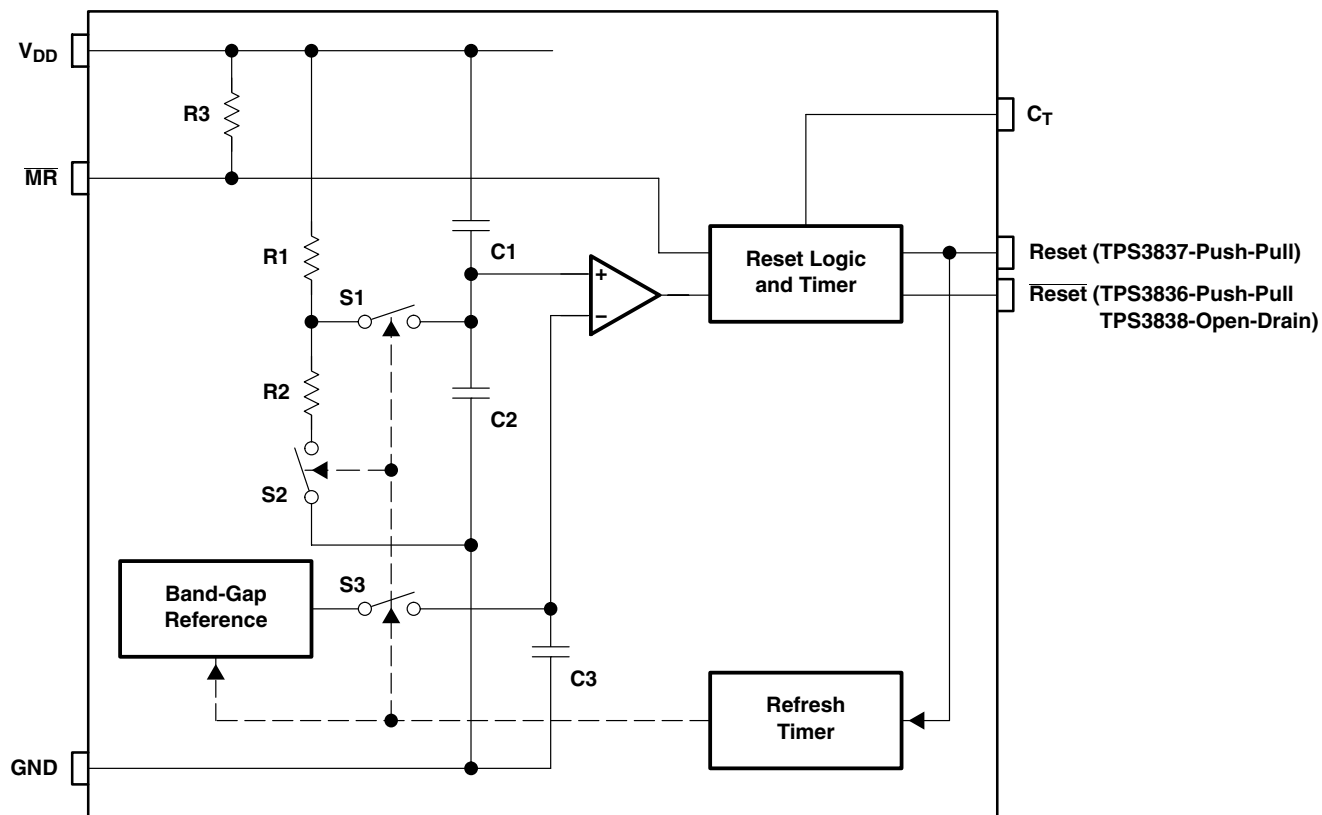
FUNCTION TABLE TPS3836, TPS3837, TPS3838

MR	$V_{DD} > V_{IT}$	RESET <sup>†</sup>	RESET <sup>‡</sup>
L	0	L	H
L	1	L	H
H	0	L	H
H	1	H	L

† TPS3836 and TPS3838

‡ TPS3837

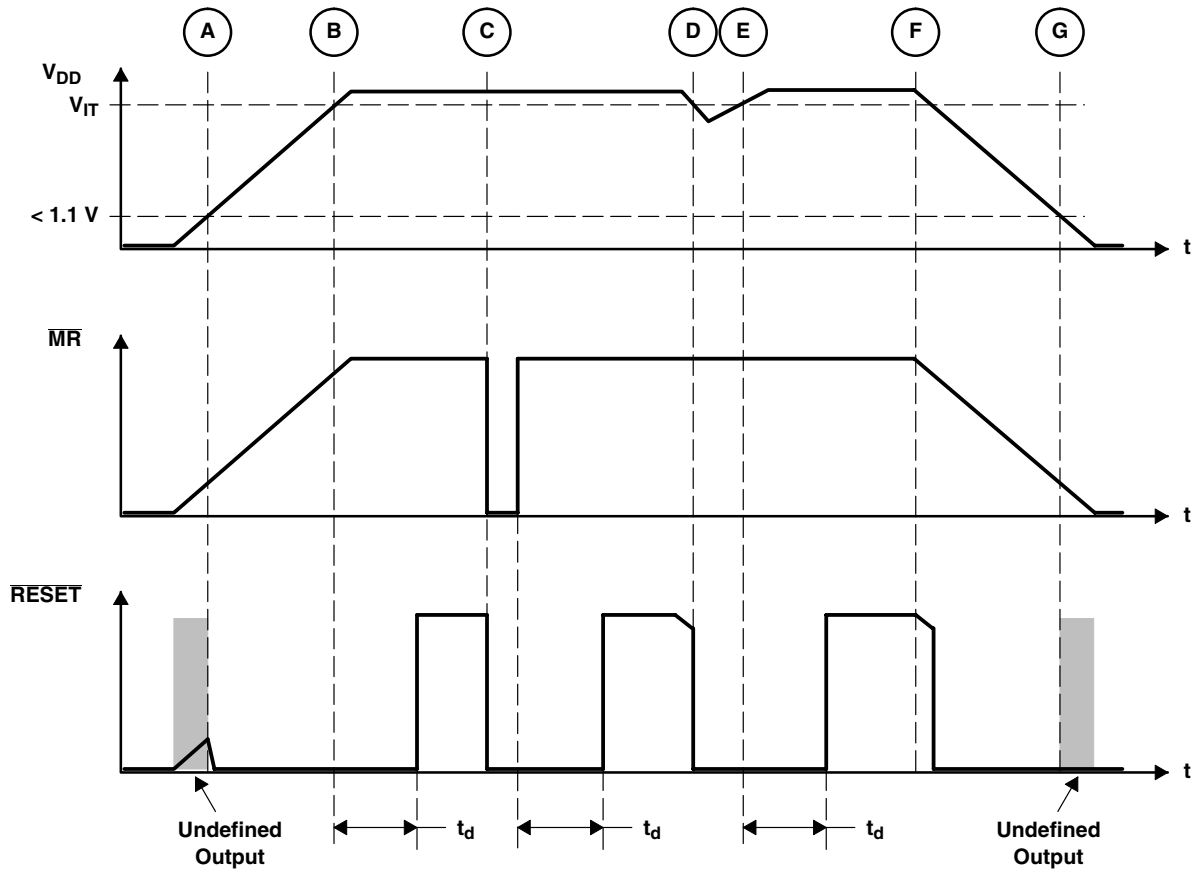
**functional block diagram**



TPS3836E18-Q1 / J25-Q1 / H30-Q1 / L30-Q1 / K33-Q1  
 TPS3837E18-Q1 / J25-Q1 / L30-Q1 / K33-Q1, TPS3838E18-Q1 / J25-Q1 / L30-Q1 / K33-Q1  
 NANOPOWER SUPERVISORY CIRCUITS

SGLS141A – DECEMBER 2002 – REVISED JANUARY 2007

timing diagram



**TPS3836E18-Q1 / J25-Q1 / H30-Q1 / L30-Q1 / K33-Q1**  
**TPS3837E18-Q1 / J25-Q1 / L30-Q1 / K33-Q1, TPS3838E18-Q1 / J25-Q1 / L30-Q1 / K33-Q1**  
**NANOPOWER SUPERVISORY CIRCUITS**

SGLS141A – DECEMBER 2002 – REVISED JANUARY 2007

**absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†**

Supply voltage, $V_{DD}$ (see Note 1) .....	7 V
All other pins (see Note 1) .....	-0.3 V 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 $V_I > V_{DD}$ ) .....	$\pm 10$ mA
Output clamp current, $I_{OK}$ ( $V_O < 0$ or $V_O > V_{DD}$ ) .....	$\pm 10$ mA
Continuous total power dissipation .....	See Dissipation Rating Table
Operating free-air temperature range, $T_A$ .....	-40°C to 125°C
Storage temperature range, $T_{stg}$ .....	-65°C to 150°C
Soldering temperature .....	260°C

† 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.

NOTE 1: All voltage values are with respect to GND. For reliable operation, the device must not be operated at 7 V for more than  $t=1000$  h continuously

**DISSIPATION RATING TABLE**

PACKAGE	$T_A < 25^\circ\text{C}$ POWER RATING	DERATING FACTOR ABOVE $T_A = 25^\circ\text{C}$	$T_A = 70^\circ\text{C}$ POWER RATING	$T_A = 85^\circ\text{C}$ POWER RATING	$T_A = 125^\circ\text{C}$ POWER RATING
DBV	437 mW	3.5 mW/°C	280 mW	227 mW	87 mW

**recommended operating conditions at specified temperature range**

	MIN	MAX	UNIT
Supply voltage, $V_{DD}$	1.6	6	V
Input voltage, $V_I$	0	$V_{DD} + 0.3$	V
High-level input voltage, $V_{IH}$	$0.7 \times V_{DD}$		V
Low-level input voltage, $V_{IL}$		$0.3 \times V_{DD}$	V
Input transition rise and fall rate at $\overline{MR}$ , $\Delta t/\Delta V$		100	ns/V
Operating free-air temperature range, $T_A$	-40	125	°C



**TPS3836E18-Q1 / J25-Q1 / H30-Q1 / L30-Q1 / K33-Q1**  
**TPS3837E18-Q1 / J25-Q1 / L30-Q1 / K33-Q1, TPS3838E18-Q1 / J25-Q1 / L30-Q1 / K33-Q1**  
**NANOPOWER SUPERVISORY CIRCUITS**

SGLS141A – DECEMBER 2002 – REVISED JANUARY 2007

**electrical characteristics over recommended operating conditions (unless otherwise noted)**

PARAMETER		TEST CONDITION		MIN	TYP	MAX	UNIT
V <sub>OH</sub>	High-level output voltage	RESET (TPS3836)	V <sub>DD</sub> = 3.3 V, I <sub>OH</sub> = -2 mA	0.8 × V <sub>DD</sub>			V
			V <sub>DD</sub> = 6 V, I <sub>OH</sub> = -3 mA				
		RESET (TPS3837)	V <sub>DD</sub> = 1.8 V, I <sub>OH</sub> = -1 mA				
			V <sub>DD</sub> = 3.3 V, I <sub>OL</sub> = -2 mA				
V <sub>OL</sub>	Low-level output voltage	RESET (TPS3836/8)	V <sub>DD</sub> = 1.8 V, I <sub>OL</sub> = 1 mA			0.4	V
			V <sub>DD</sub> = 3.3 V, I <sub>OL</sub> = 2 mA				
		RESET (TPS3837)	V <sub>DD</sub> = 3.3 V, I <sub>OL</sub> = 2 mA				
			V <sub>DD</sub> = 6 V, I <sub>OL</sub> = 3 mA				
Power-up reset voltage (see Note 2)		TPS3836/8	V <sub>DD</sub> ≥ 1.1 V, I <sub>OL</sub> = 50 μA			0.2	V
		TPS3837	V <sub>DD</sub> ≥ 1.1 V, I <sub>OH</sub> = -50 μA	0.8 × V <sub>DD</sub>			
V <sub>IT</sub>	Negative-going input threshold voltage (see Note 3)	TPS383xE18		1.64	1.71	1.76	V
		TPS383xJ25		2.16	2.25	2.30	
		TPS383xH30		2.70	2.79	2.85	
		TPS383xL30		2.54	2.64	2.71	
		TPS383xK33		2.82	2.93	3.10	
V <sub>hys</sub>	Hysteresis at V <sub>DD</sub> input		1.7 V < V <sub>IT</sub> < 2.5 V			30	mV
			2.5 V < V <sub>IT</sub> < 3.5 V			40	
			3.5 V < V <sub>IT</sub> < 5 V			50	
I <sub>IH</sub>	High-level input current	MR̄ (see Note 4)	MR̄ = 0.7 × V <sub>DD</sub> , V <sub>DD</sub> = 6 V	-40	-60	-100	μA
		CT	CT = V <sub>DD</sub> = 6 V	-25		25	nA
I <sub>IL</sub>	Low-level input current	MR̄ (see Note 4)	MR̄ = 0 V, V <sub>DD</sub> = 6 V	-130	-200	-340	μA
		CT	CT = 0 V, V <sub>DD</sub> = 6 V	-25		25	nA
I <sub>OH</sub>	High-level output current	TPS3838	V <sub>DD</sub> = V <sub>IT</sub> + 0.2 V, V <sub>OH</sub> = V <sub>DD</sub>			25	nA
I <sub>DD</sub>	Supply current		V <sub>DD</sub> > V <sub>IT</sub> , V <sub>DD</sub> < 3 V		220	500	nA
			V <sub>DD</sub> > V <sub>IT</sub> , V <sub>DD</sub> > 3 V		250	550	
			V <sub>DD</sub> < V <sub>IT</sub>			10	25
Internal pullup resistor at MR̄					30		kΩ
C <sub>I</sub>	Input capacitance at MR̄, CT		V <sub>I</sub> = 0 V to V <sub>DD</sub>		5		pF

- NOTES: 2. The lowest voltage at which RESET output becomes active. t<sub>r</sub>, V<sub>DD</sub> ≥ 15 μs/V  
3. To ensure best stability of the threshold voltage, a bypass capacitor (ceramic, 0.1 μF) should be placed near the supply terminal.  
4. If manual reset is unused, MR should be connected to V<sub>DD</sub> to minimize current consumption.



**TPS3836E18-Q1 / J25-Q1 / H30-Q1 / L30-Q1 / K33-Q1**  
**TPS3837E18-Q1 / J25-Q1 / L30-Q1 / K33-Q1, TPS3838E18-Q1 / J25-Q1 / L30-Q1 / K33-Q1**  
**NANOPOWER SUPERVISORY CIRCUITS**

SGLS141A – DECEMBER 2002 – REVISED JANUARY 2007

**timing requirements at  $R_L = 1\text{ M}\Omega$ ,  $C_L = 50\text{ pF}$ ,  $T_A = 25^\circ\text{C}$**

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$t_w$	Pulse width	at $V_{DD}$ $V_{IH} = V_{IT} + 0.2\text{ V}$ , $V_{IL} = V_{IT} - 0.2\text{ V}$	6			$\mu\text{s}$
		at $\overline{\text{MR}}$ $V_{DD} \geq V_{IT} + 0.2\text{ V}$ , $V_{IH} = 0.7 \times V_{DD}$ , $V_{IL} = 0.7 \times V_{DD}$	1			$\mu\text{s}$

**switching characteristics at  $R_L = 1\text{ M}\Omega$ ,  $C_L = 50\text{ pF}$ ,  $T_A = 25^\circ\text{C}$**

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$t_d$	Delay time	$V_{DD} \geq V_{IT} + 0.2\text{ V}$ , $\overline{\text{MR}} = 0.7 \times V_{DD}$ , $\text{CT} = \text{GND}$ , See timing diagram	5	10	15	ms
		$V_{DD} \geq V_{IT} + 0.2\text{ V}$ , $\overline{\text{MR}} = 0.7 \times V_{DD}$ , $\text{CT} = V_{DD}$ , See timing diagram	100	200	300	
$t_{PHL}$	Propagation (delay) time, high-to-low-level output	$V_{DD}$ to $\overline{\text{RESET}}$ delay (TPS3836, TPS3838) $V_{IL} = V_{IT} - 0.2\text{ V}$ , $V_{IH} = V_{IT} + 0.2\text{ V}$			10	$\mu\text{s}$
		$V_{IL} = 1.6\text{ V}$			50	
$t_{PLH}$	Propagation (delay) time, low-to-high-level output	$V_{DD}$ to $\overline{\text{RESET}}$ delay (TPS3837) $V_{IL} = V_{IT} - 0.2\text{ V}$ , $V_{IH} = V_{IT} + 0.2\text{ V}$			10	$\mu\text{s}$
		$V_{IL} = 1.6\text{ V}$			50	
$t_{PHL}$	Propagation (delay) time, high-to-low-level output	$\overline{\text{MR}}$ to $\overline{\text{RESET}}$ delay (TPS3836, TPS3838) $V_{DD} \geq V_{IT} + 0.2\text{ V}$ , $V_{IL} = 0.3 \times V_{DD}$			0.1	$\mu\text{s}$
$t_{PLH}$	Propagation (delay) time, low-to-high-level output	$\overline{\text{MR}}$ to $\overline{\text{RESET}}$ delay (TPS3837) $V_{IL} = 0.7 \times V_{DD}$			0.1	$\mu\text{s}$

## TYPICAL CHARACTERISTICS

**Table of Graphs**

			FIGURE
$I_{DD}$	Supply current	vs Supply voltage	1
$I_{MR}$	Manual reset current	vs Manual reset voltage	2
$V_{OL}$	Low-level output voltage	vs Low-level output current	3
$V_{OH}$	High-level output voltage	vs High-level output current	4
	Normalized reset threshold voltage	vs Free-air temperature	5
	Minimum pulse duration at $V_{DD}$	vs $V_{DD}$ Threshold overdrive	6



TYPICAL CHARACTERISTICS

SUPPLY CURRENT  
 vs  
 SUPPLY VOLTAGE

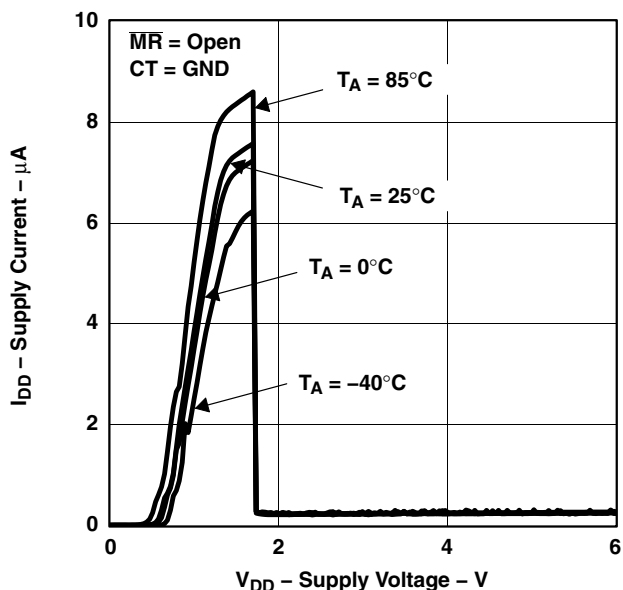


Figure 1

MANUAL RESET CURRENT  
 vs  
 MANUAL RESET VOLTAGE

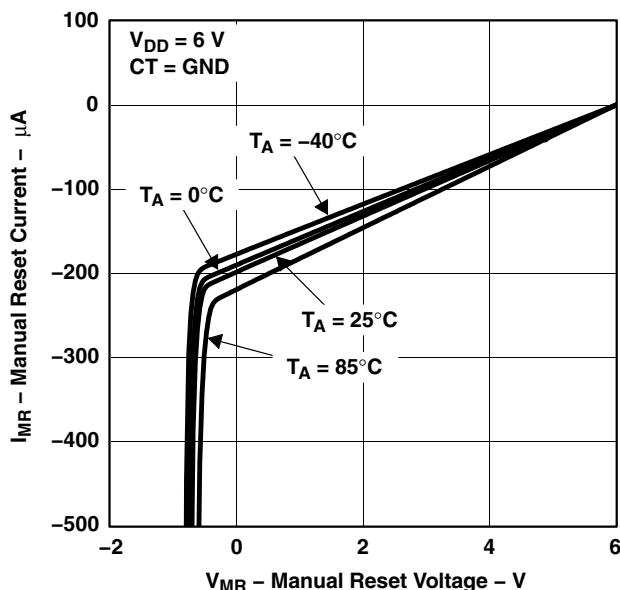


Figure 2

LOW-LEVEL OUTPUT VOLTAGE  
 vs  
 LOW-LEVEL OUTPUT CURRENT

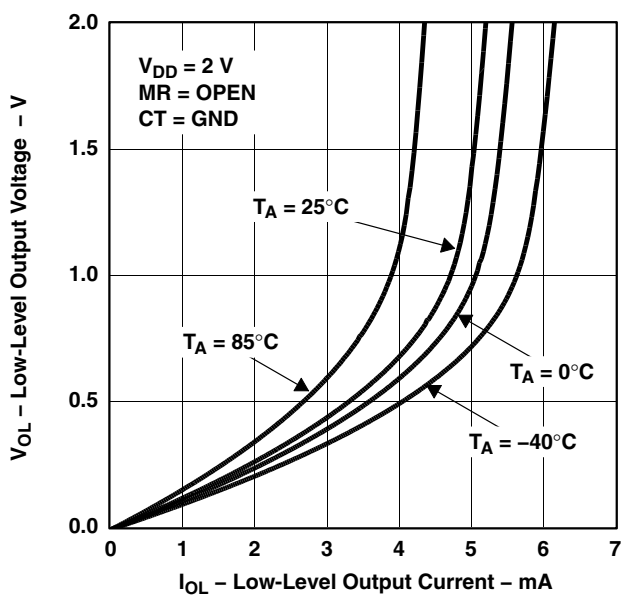


Figure 3

HIGH-LEVEL OUTPUT VOLTAGE  
 vs  
 HIGH-LEVEL OUTPUT CURRENT

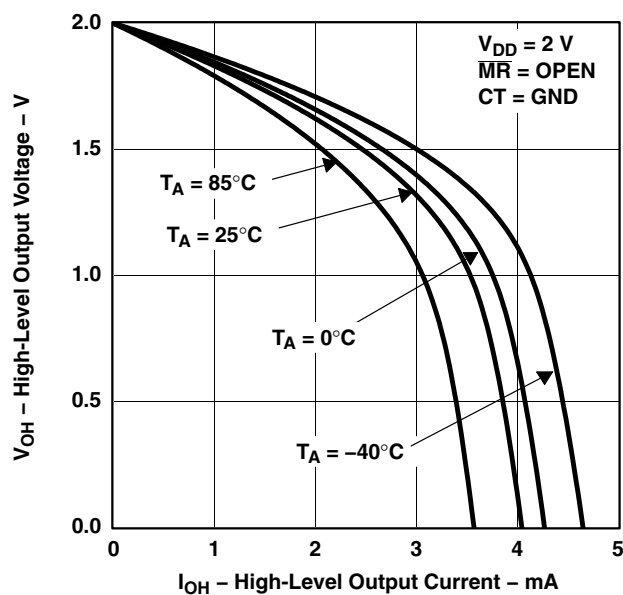
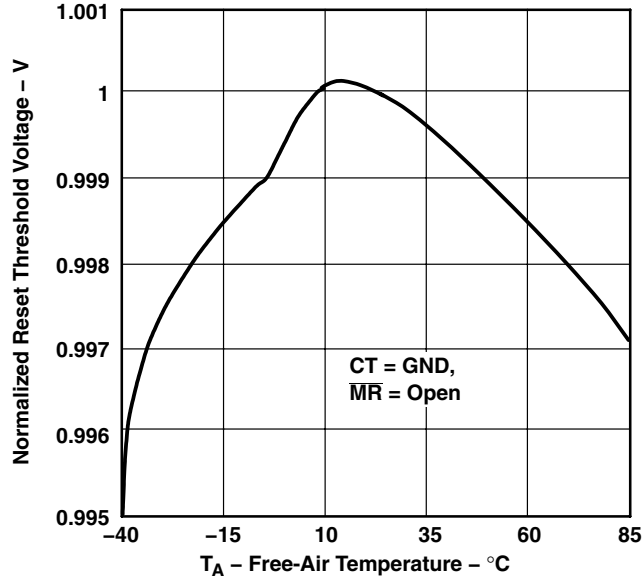


Figure 4



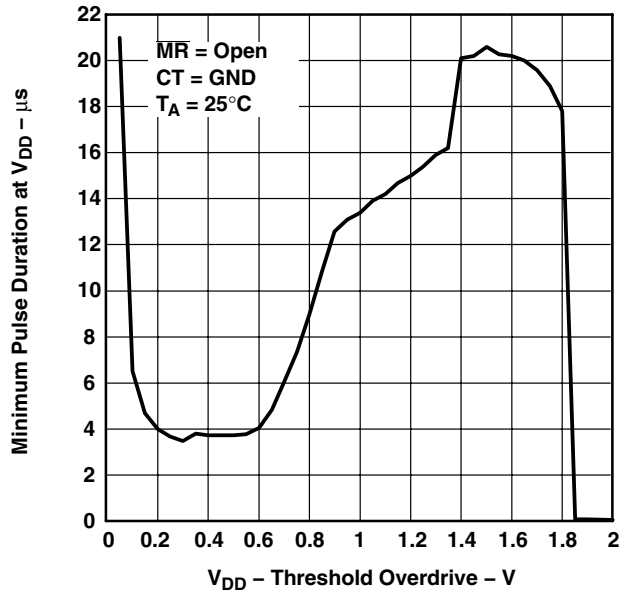
**TYPICAL CHARACTERISTICS**

**NORMALIZED RESET THRESHOLD VOLTAGE  
 vs  
 FREE-AIR TEMPERATURE**



**Figure 5**

**MINIMUM PULSE DURATION AT V<sub>DD</sub>  
 vs  
 V<sub>DD</sub> THRESHOLD OVERDRIVE**



**Figure 6**

**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
2U3838K33QDBVRG4Q1	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	PDVQ	<a href="#">Samples</a>
TPS3836J25QDBVRQ1	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	PDSQ	<a href="#">Samples</a>
TPS3836K33QDBVRQ1	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	PDTQ	<a href="#">Samples</a>
TPS3836L30QDBVRQ1	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	PCAQ	<a href="#">Samples</a>
TPS3838K33QDBVRQ1	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	PDVQ	<a href="#">Samples</a>

(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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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 TPS3836-Q1, TPS3838-Q1 :**

- Catalog: [TPS3836](#), [TPS3838](#)
- Enhanced Product: [TPS3836-EP](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Enhanced Product - Supports Defense, Aerospace and Medical Applications

**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
2U3838K33QDBVRG4Q1	SOT-23	DBV	5	3000	180.0	9.0	3.15	3.2	1.4	4.0	8.0	Q3
TPS3836J25QDBVRQ1	SOT-23	DBV	5	3000	180.0	9.0	3.15	3.2	1.4	4.0	8.0	Q3
TPS3836K33QDBVRQ1	SOT-23	DBV	5	3000	180.0	9.0	3.15	3.2	1.4	4.0	8.0	Q3
TPS3836L30QDBVRQ1	SOT-23	DBV	5	3000	180.0	9.0	3.15	3.2	1.4	4.0	8.0	Q3
TPS3838K33QDBVRQ1	SOT-23	DBV	5	3000	180.0	9.0	3.15	3.2	1.4	4.0	8.0	Q3

**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

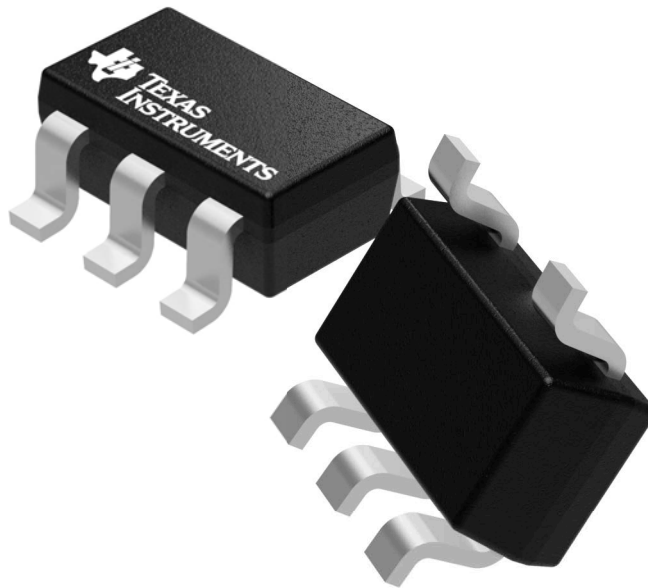
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
2U3838K33QDBVRG4Q1	SOT-23	DBV	5	3000	182.0	182.0	20.0
TPS3836J25QDBVRQ1	SOT-23	DBV	5	3000	182.0	182.0	20.0
TPS3836K33QDBVRQ1	SOT-23	DBV	5	3000	182.0	182.0	20.0
TPS3836L30QDBVRQ1	SOT-23	DBV	5	3000	182.0	182.0	20.0
TPS3838K33QDBVRQ1	SOT-23	DBV	5	3000	182.0	182.0	20.0

## GENERIC PACKAGE VIEW

DBV 5

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



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

4073253/P

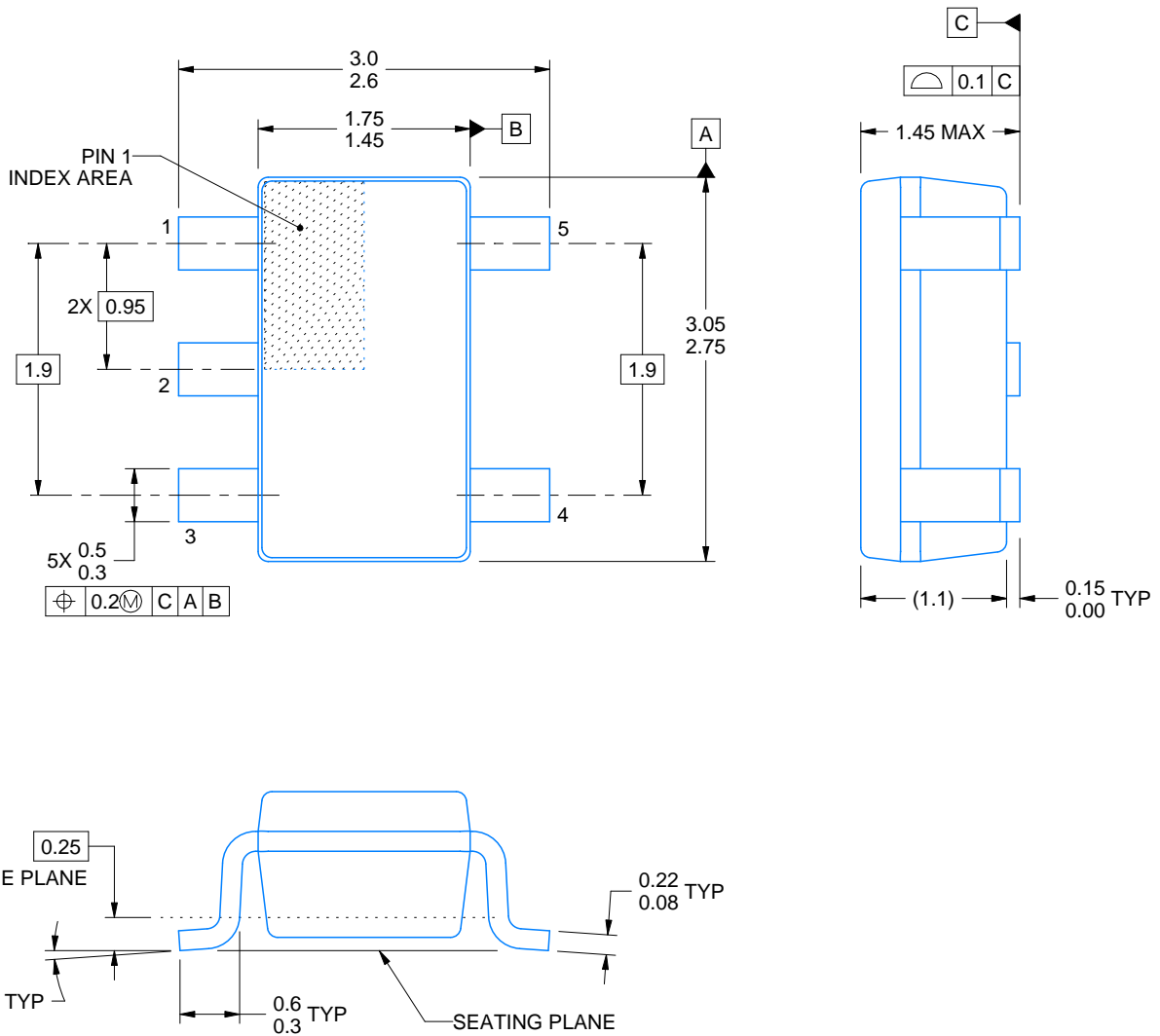
DBV0005A



# PACKAGE OUTLINE

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



4214839/C 04/2017

NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Reference JEDEC MO-178.



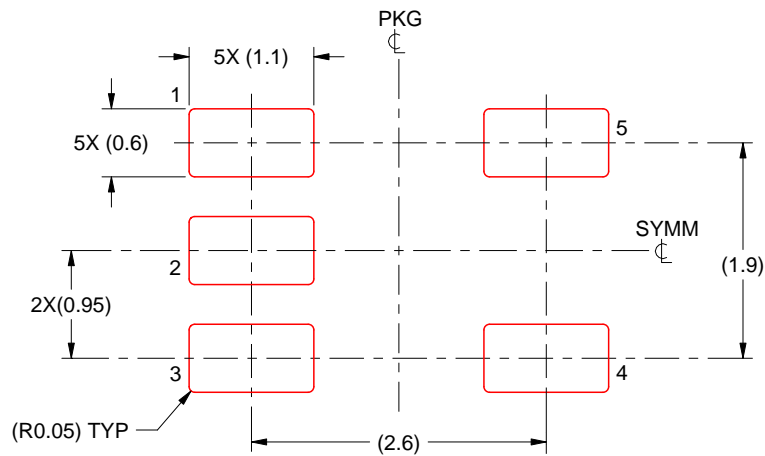


# EXAMPLE STENCIL DESIGN

DBV0005A

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



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

4214839/C 04/2017

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.

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