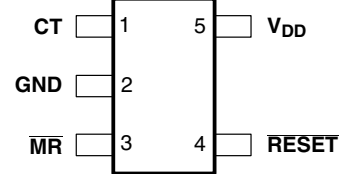


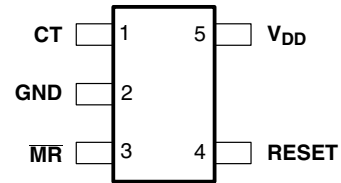
- Qualified for Automotive Applications
- Customer-Specific Configuration Control Can Be Supported Along With Major-Change Approval
- ESD Protection Exceeds 2000 V Per MIL-STD-883, Method 3015; Exceeds 200 V Using Machine Model (C = 200 pF, R = 0)
- Supply Current of 220 nA (Typ)
- Precision Supply Voltage 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

TPS3836, TPS3838  
 DBV PACKAGE  
 (TOP VIEW)



TPS3837  
 DBV PACKAGE  
 (TOP VIEW)



## 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.



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**

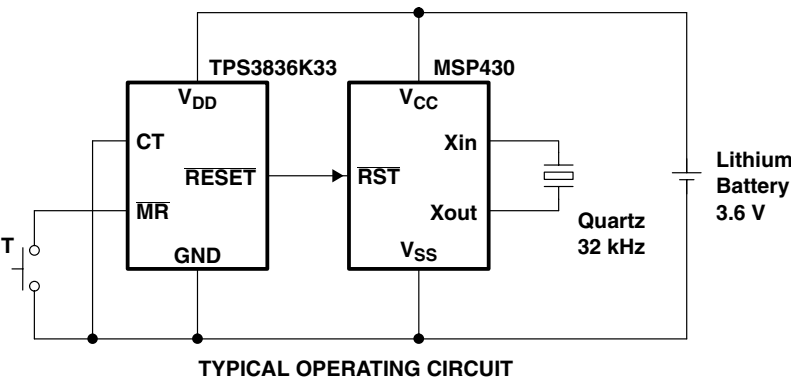
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TPS3836E18-Q1 / J25-Q1 / H30-Q1 / L30-Q1 / K33-Q1  
 TPS3837E18-Q1 / J25-Q1 / L30-Q1 / K33-Q1, TPS3838E18-Q1 / J25-Q1 / L30-Q1 / K33-Q1  
 NANOPOWER SUPERVISORY CIRCUITS

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description (continued)



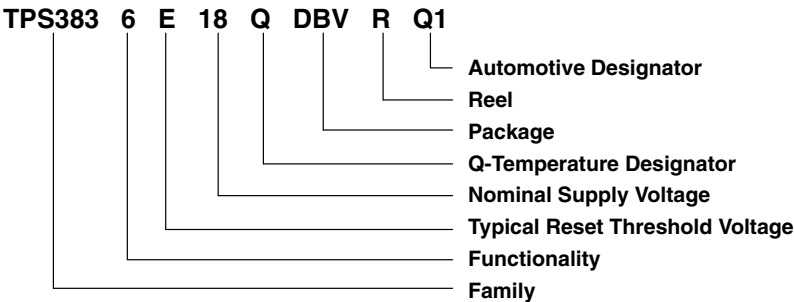
The product spectrum is designed for supply voltages of 1.8 V, 2.5 V, 3 V, and 3.3 V. The circuits are available in a 5-pin SOT-23 package. The TPS3836-Q-Q1, TPS3837-Q-Q1, TPS3838-Q-Q1 families are characterized for operation over a temperature range of –40°C to 125°C.

PACKAGE INFORMATION

T <sub>A</sub>	DEVICE NAME	THRESHOLD VOLTAGE	SYMBOL
–40°C to 125°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**

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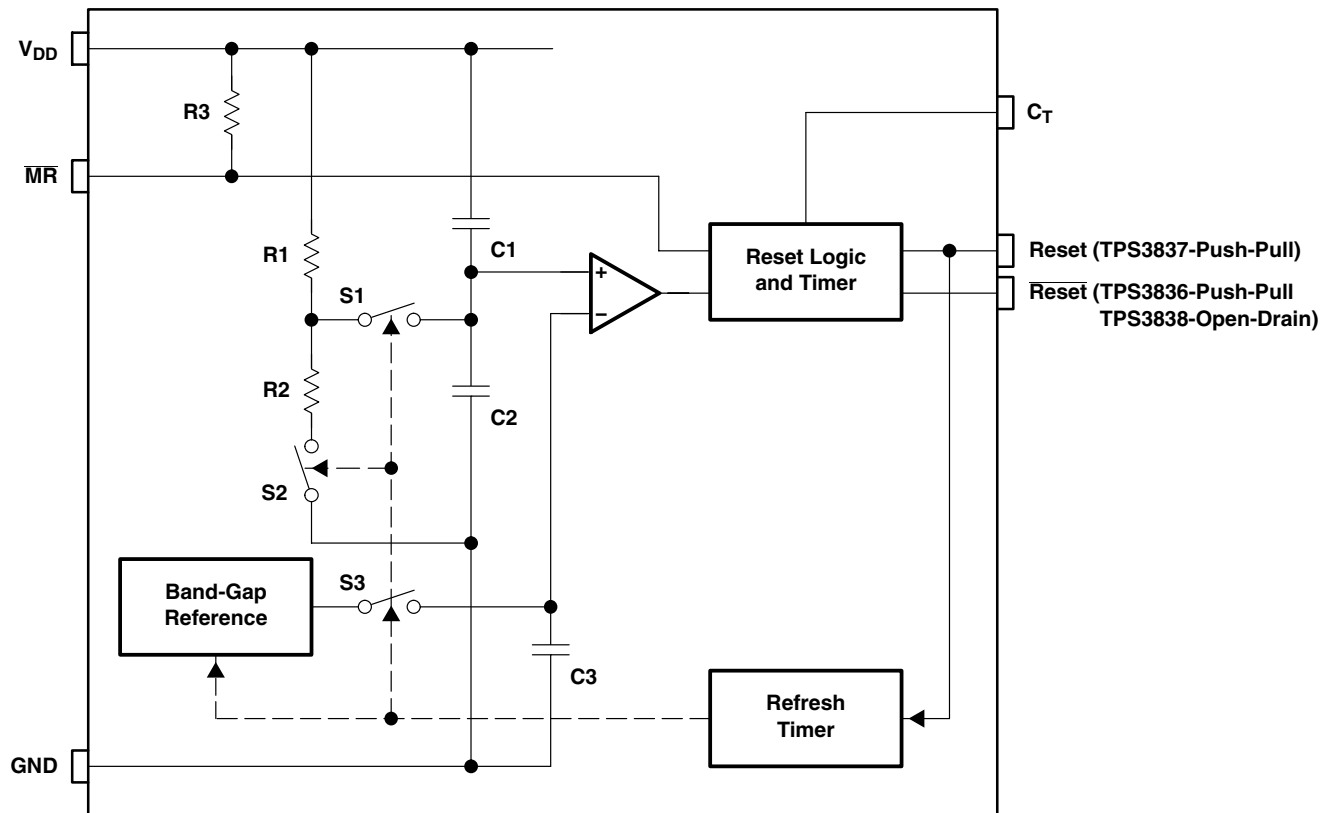
FUNCTION TABLE TPS3836, TPS3837, TPS3838

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

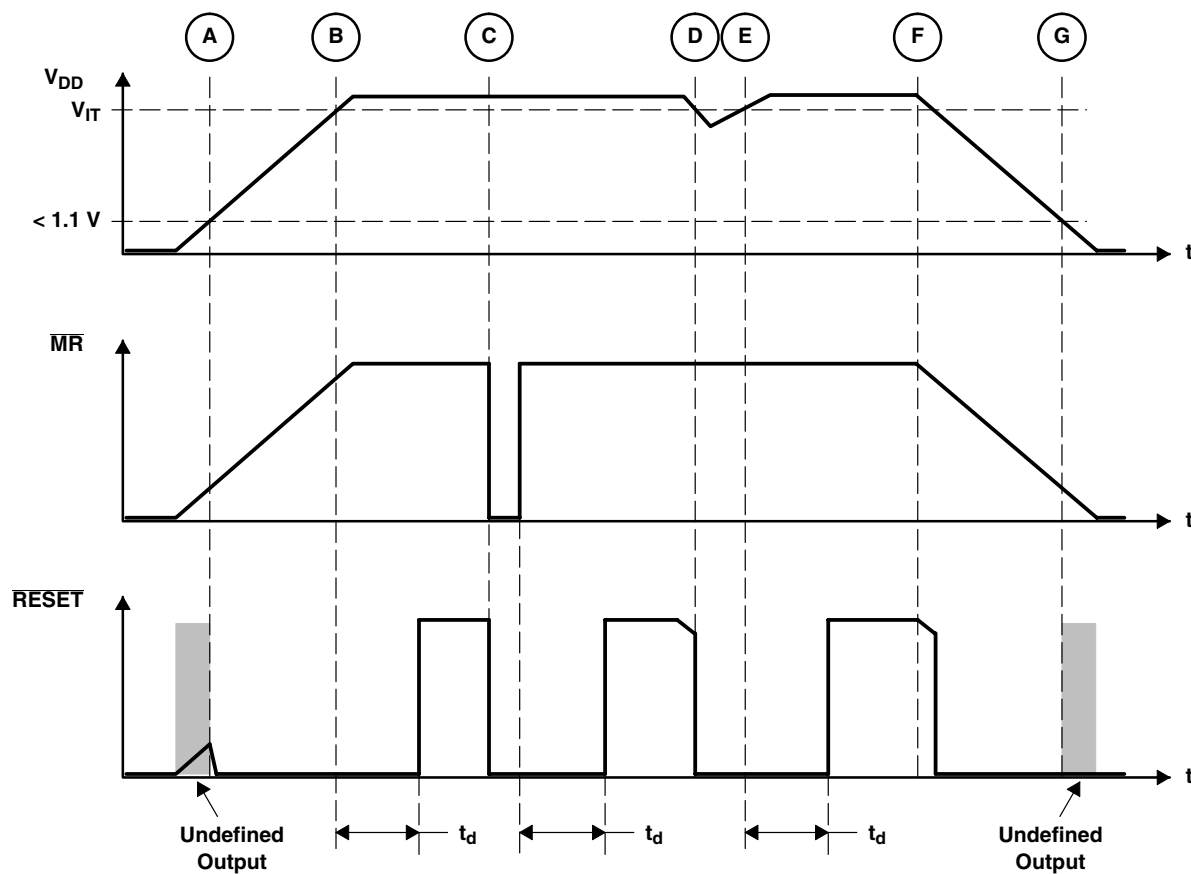
<sup>†</sup> TPS3836 and TPS3838

<sup>‡</sup> TPS3837

**functional block diagram**



## 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**

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

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

<sup>†</sup> 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



## 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	0.8 × V <sub>DD</sub>		0.2	V
		TPS3837	V <sub>DD</sub> ≥ 1.1 V,	I <sub>OH</sub> = −50 μA				
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	MR (see Note 4)	MR = 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	MR (see Note 4)	MR = 0 V,	V <sub>DD</sub> = 6 V	−130	−200	−340	μA
		CT	CT = 0 V,		V <sub>DD</sub> = 6 V	−25	25	
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	μA	
Internal pullup resistor at MR					30			kΩ
C <sub>I</sub>	Input capacitance at MR, 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.  $t_r$ ,  $V_{DD} \geq 15\text{ }\mu\text{s/V}$

3. To ensure best stability of the threshold voltage, a bypass capacitor (ceramic,  $0.1\text{ }\mu\text{F}$ ) should be placed near the supply terminal.

4. If manual reset is unused, MR should be connected to  $V_{DD}$  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**

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**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 $\overline{\text{MR}}$ $V_{DD} \geq V_{IT} + 0.2\text{ V}$ , $V_{IH} = 0.7 \times V_{DD}$ , $V_{IL} = 0.3 \times V_{DD}$	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 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 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 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 RESET delay (TPS3837) $V_{IL} = 0.7 \times V_{DD}$			0.1	$\mu\text{s}$

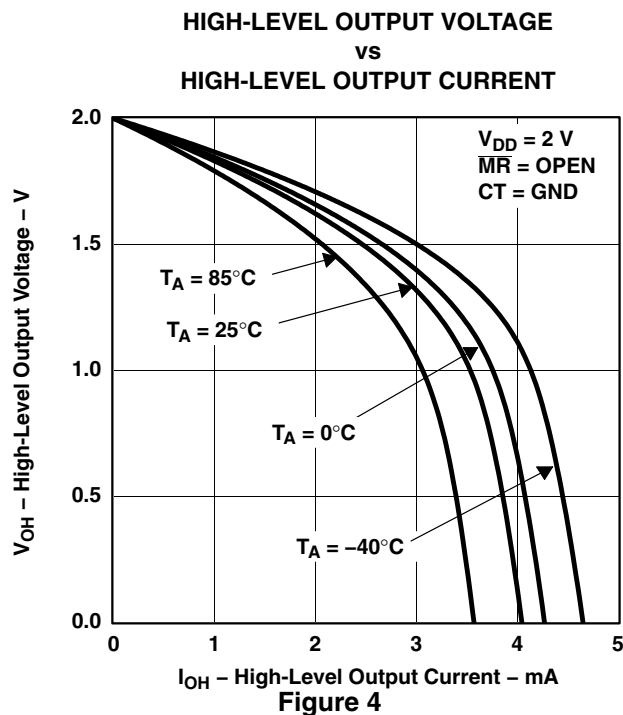
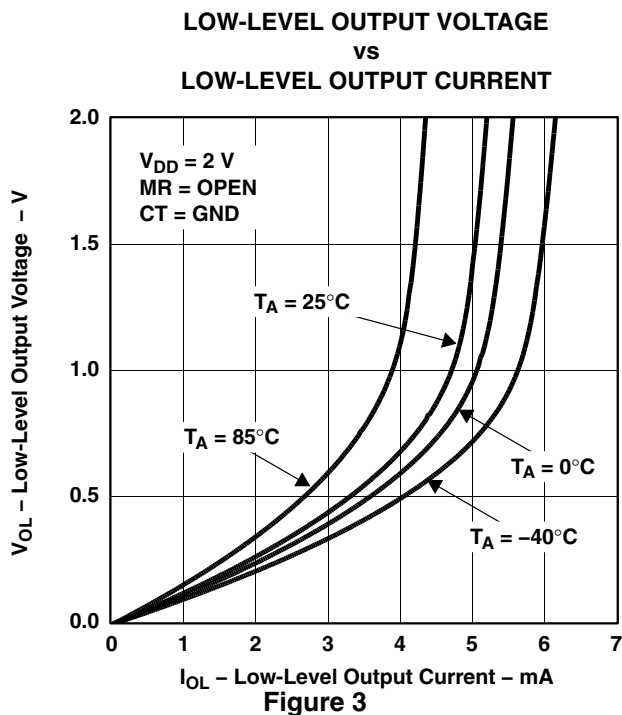
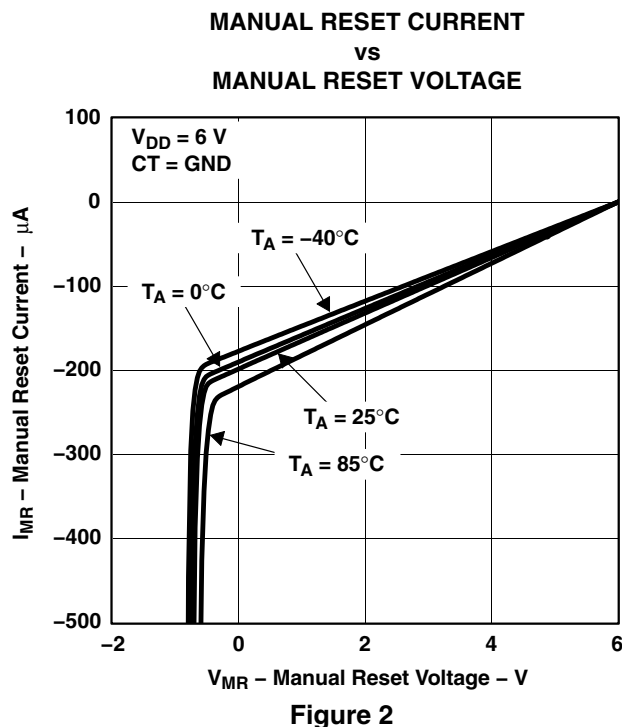
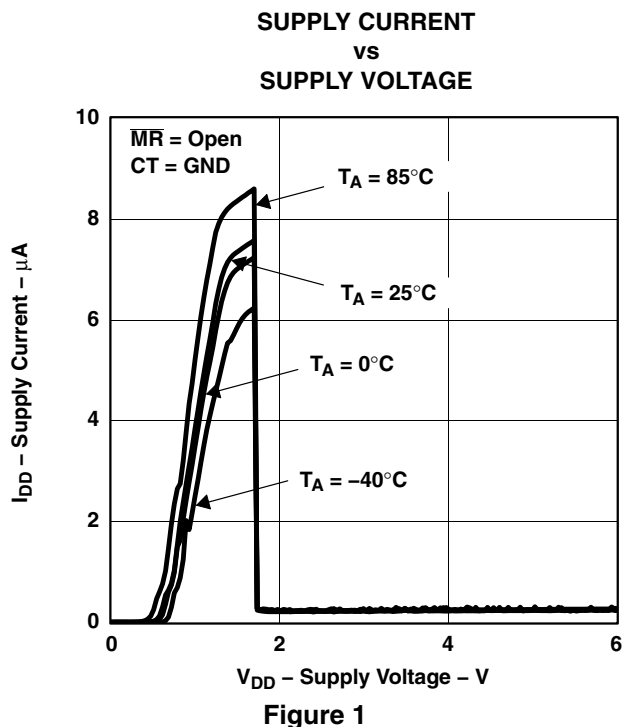
## TYPICAL CHARACTERISTICS

**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

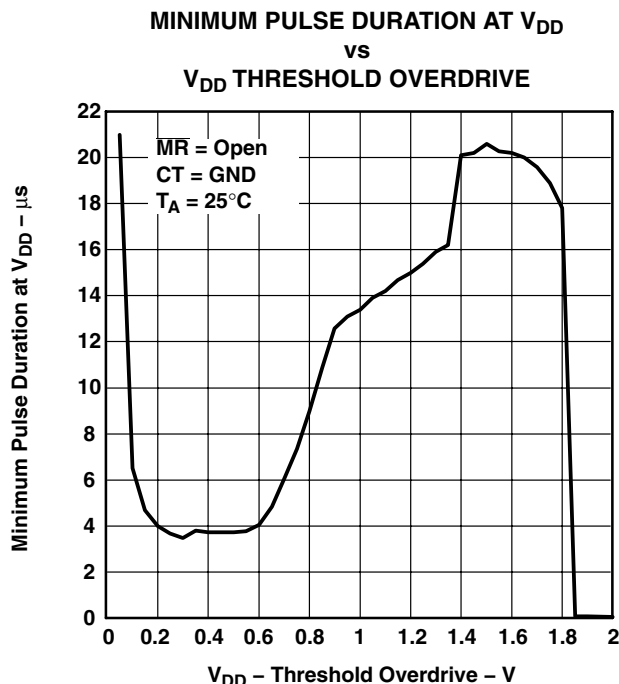
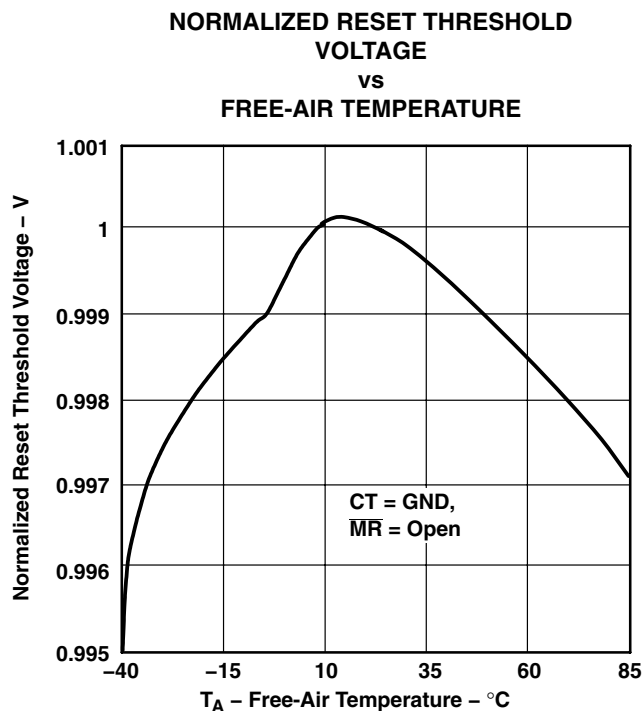


## TYPICAL CHARACTERISTICS





## TYPICAL CHARACTERISTICS



**PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/ Ball Finish	MSL Peak Temp <sup>(3)</sup>	Samples (Requires Login)
2U3836E18QDBVRG4Q1	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
2U3836H30QDBVRG4Q1	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
2U3836J25QDBVRG4Q1	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
2U3836K33QDBVRG4Q1	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
2U3836L30QDBVRG4Q1	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
2U3837E18QDBVRG4Q1	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
2U3837J25QDBVRG4Q1	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
2U3837K33QDBVRG4Q1	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
2U3837L30QDBVRG4Q1	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
2U3838E18QDBVRG4Q1	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
2U3838J25QDBVRG4Q1	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
2U3838K33QDBVRG4Q1	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
2U3838L30QDBVRG4Q1	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
TPS3836E18QDBVRQ1	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
TPS3836H30QDBVRQ1	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
TPS3836J25QDBVRQ1	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
TPS3836K33QDBVRQ1	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/ Ball Finish	MSL Peak Temp <sup>(3)</sup>	Samples (Requires Login)
TPS3836L30QDBVRQ1	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
TPS3837E18QDBVRQ1	ACTIVE	SOT-23	DBV	5		TBD	Call TI	Call TI	
TPS3837J25QDBVRQ1	ACTIVE	SOT-23	DBV	5		TBD	Call TI	Call TI	
TPS3837K33QDBVRQ1	ACTIVE	SOT-23	DBV	5		TBD	Call TI	Call TI	
TPS3837L30QDBVRQ1	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
TPS3838E18QDBVRQ1	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
TPS3838J25QDBVRQ1	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
TPS3838K33QDBVRQ1	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
TPS3838L30QDBVRQ1	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	

<sup>(1)</sup> 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.

<sup>(2)</sup> 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)

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

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**OTHER QUALIFIED VERSIONS OF TPS3836E18-Q1, TPS3836H30-Q1, TPS3836J25-Q1, TPS3836K33-Q1, TPS3836L30-Q1, TPS3837E18-Q1, TPS3837J25-Q1, TPS3837K33-Q1, TPS3837L30-Q1, TPS3838E18-Q1, TPS3838J25-Q1, TPS3838K33-Q1, TPS3838L30-Q1 :**

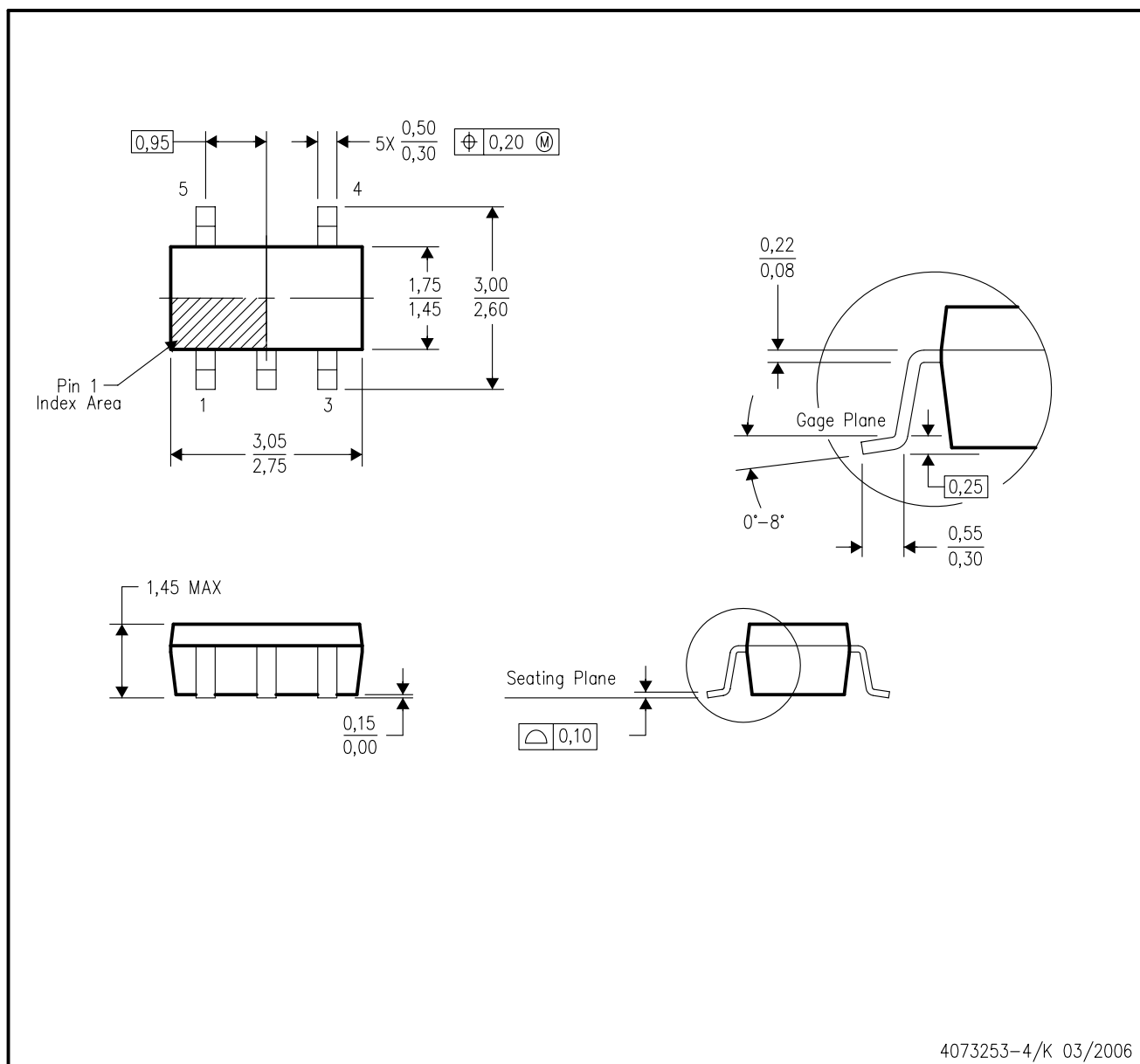
- Catalog: [TPS3836E18](#), [TPS3836H30](#), [TPS3836J25](#), [TPS3836K33](#), [TPS3836L30](#), [TPS3837E18](#), [TPS3837J25](#), [TPS3837K33](#), [TPS3837L30](#), [TPS3838E18](#), [TPS3838J25](#), [TPS3838K33](#), [TPS3838L30](#)
- Enhanced Product: [TPS3836J25-EP](#), [TPS3836L30-EP](#), [TPS3837K33-EP](#)

NOTE: Qualified Version Definitions:

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

DBV (R-PDSO-G5)

PLASTIC SMALL-OUTLINE PACKAGE



4073253-4/K 03/2006

- 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.

DBV (R-PDSO-G5)

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.

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