

- 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 RESET Output (TPS3836), RESET Output (TPS3837), or Open-Drain RESET Output (TPS3838)
- Manual Reset
- 5-Pin SOT-23 Package
- Temperature Range  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$

- Applications Include
  - Applications Using Low-Power DSPs, Microcontrollers, or Microprocessors
  - Portable/Battery-Powered Equipment
  - Intelligent Instruments
  - Wireless Communication Systems
  - Notebook Computers
  - Automotive Systems
  - Applications Using the MSP430

### description

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

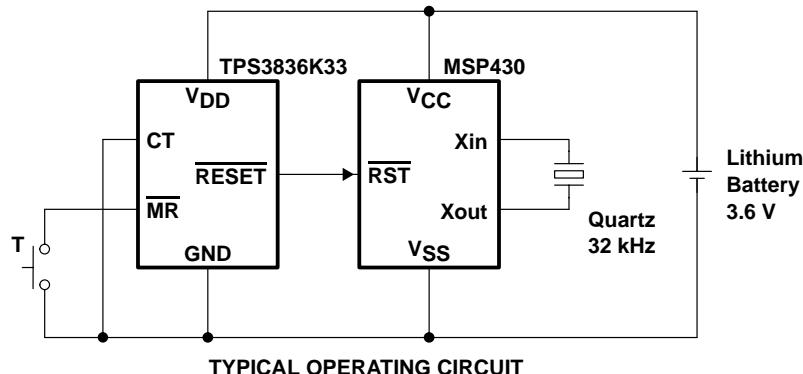
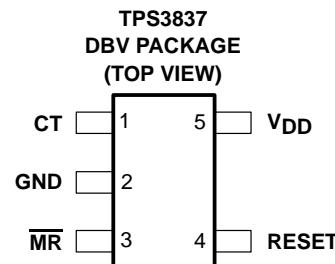
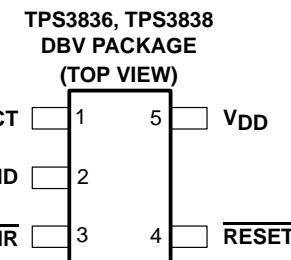
During power on, RESET is asserted when the supply voltage  $V_{DD}$  becomes higher than 1.1 V. Thereafter, the supervisory circuit monitors  $V_{DD}$  and keeps RESET output active as long as  $V_{DD}$  remains below the threshold voltage  $V_{IT}$ . An internal timer delays the return of the output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

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

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

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

The TPS3836 has an active-low push-pull RESET output. The TPS3837 has active-high push-pull RESET, and TPS3838 integrates an active-low open-drain RESET output.



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**description (continued)**

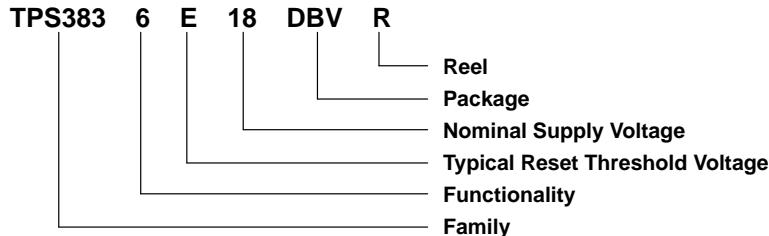
The product spectrum is designed for supply voltages of 1.8 V, 2.5 V, 3 V, and 3.3 V. The circuits are available in a 5-pin SOT-23 package. The TPS3836, TPS3837, TPS3838 families are characterized for operation over a temperature range of  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ .

**PACKAGE INFORMATION**

TA	DEVICE NAME		THRESHOLD VOLTAGE	SYMBOL
$-40^{\circ}\text{C}$ to $85^{\circ}\text{C}$	TPS3836E18DBVR†	TPS3836E18DBVT‡	1.71 V	PDNI
	TPS3836J25DBVR†	TPS3836J25DBVT‡	2.25 V	PDSI
	TPS3836H30DBVR†	TPS3836H30DBVT‡	2.79 V	PHRI
	TPS3836L30DBVR†	TPS3836L30DBVT‡	2.64 V	PCAI
	TPS3836K33DBVR†	TPS3836K33DBVT‡	2.93 V	PDTI
	TPS3837E18DBVR†	TPS3837E18DBVT‡	1.71 V	PDOI
	TPS3837J25DBVR†	TPS3837J25DBVT‡	2.25 V	PDRI
	TPS3837L30DBVR†	TPS3837L30DBVT‡	2.64 V	PCBI
	TPS3837K33DBVR†	TPS3837K33DBVT‡	2.93 V	PDUI
	TPS3838E18DBVR†	TPS3838E18DBVT‡	1.71 V	PDQI
	TPS3838J25DBVR†	TPS3838J25DBVT‡	2.25 V	PDPI
	TPS3838L30DBVR†	TPS3838L30DBVT‡	2.64 V	PCCI
	TPS3838K33DBVR†	TPS3838K33DBVT‡	2.93 V	PDVI

† The DBVR passive indicates tape and reel of 3000 parts.

‡ The DBVT passive indicates tape and reel of 250 parts.

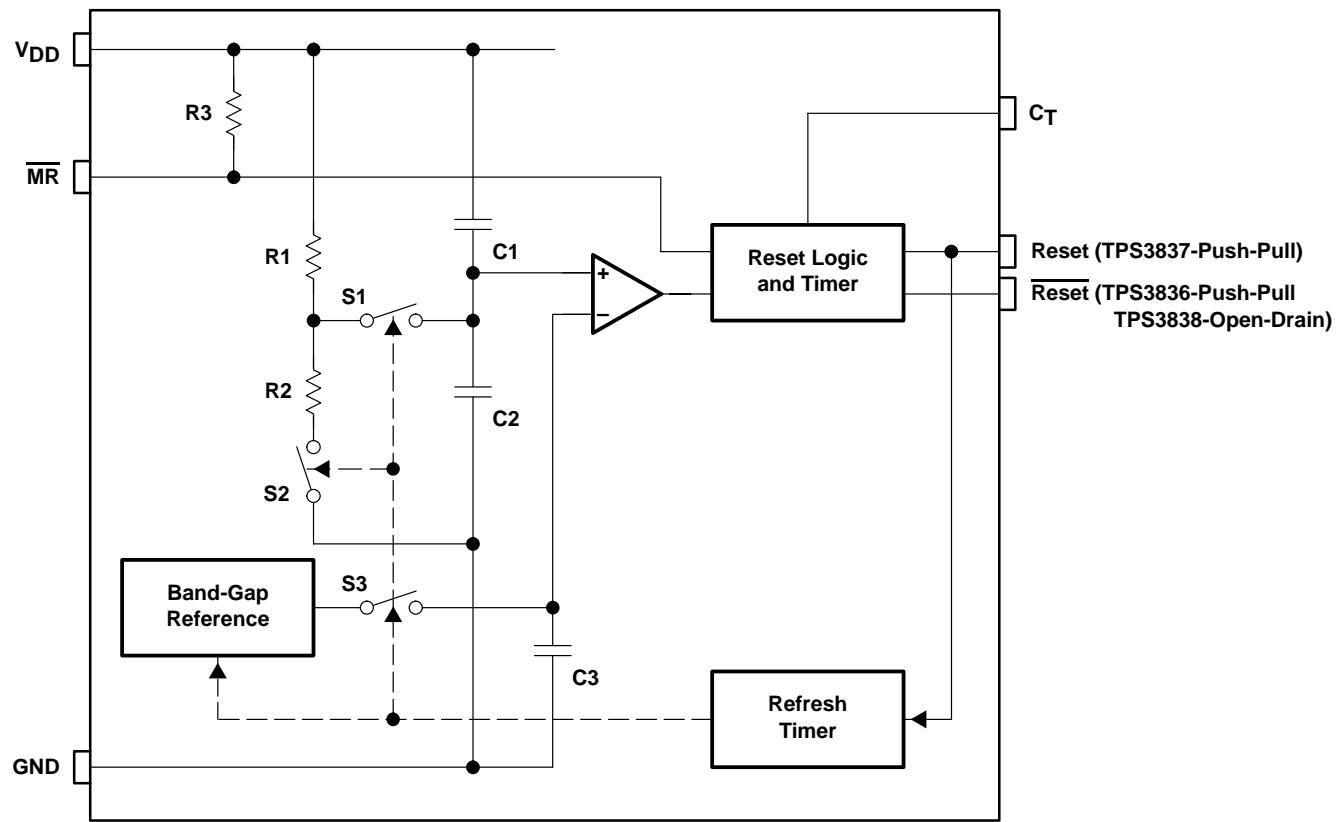
**ORDERING INFORMATION****FUNCTION TABLE TPS3836, TPS3837, TPS3838**

$\overline{\text{MR}}$	$\overline{\text{VDD}} > \overline{\text{VIT}}$	$\overline{\text{RESET}}^{\$}$	$\overline{\text{RESET}}^{\dagger}$
L	0	L	H
L	1	L	H
H	0	L	H
H	1	H	L

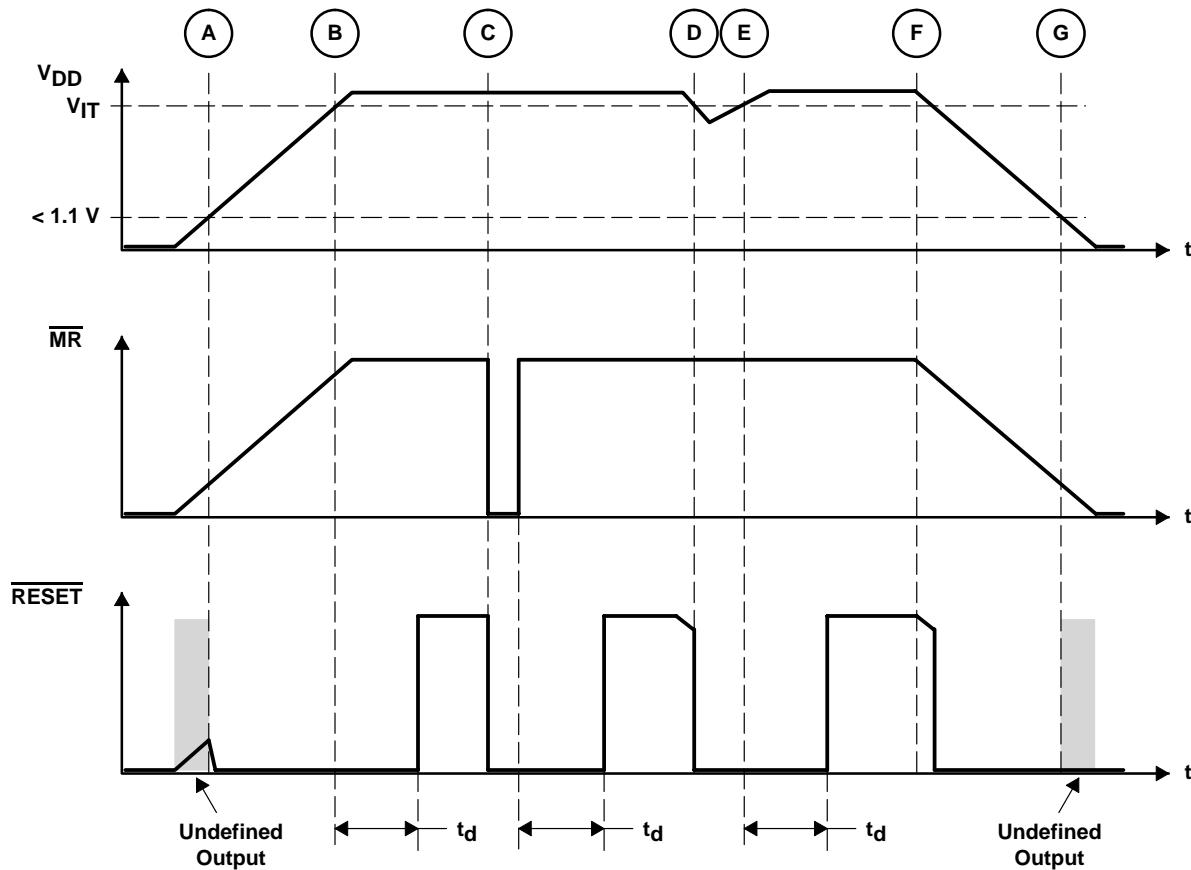
§ TPS3836 and TPS3838

¶ TPS3837

functional block diagram



## timing diagram



**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 $V_I > V_{DD}$ ) . . . . .	±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°C to 85°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	$T_A < 25^\circ C$ POWER RATING	DERATING FACTOR ABOVE $T_A = 25^\circ C$	$T_A = 70^\circ C$ POWER RATING	$T_A = 85^\circ C$ POWER RATING
DBV	437 mW	3.5 mW/°C	280 mW	227 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	85	°C

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

PARAMETER		TEST CONDITION	MIN	TYP	MAX	UNIT		
$V_{OH}$	High-level output voltage	RESET (TPS3836)	$V_{DD} = 3.3 \text{ V}$ , $I_{OH} = -2 \text{ mA}$	0.8 $\times$ $V_{DD}$		V		
			$V_{DD} = 6 \text{ V}$ , $I_{OH} = -3 \text{ mA}$					
		RESET (TPS3837)	$V_{DD} = 1.8 \text{ V}$ , $I_{OH} = -1 \text{ mA}$					
			$V_{DD} = 3.3 \text{ V}$ , $I_{OL} = -2 \text{ mA}$					
$V_{OL}$	Low-level output voltage	RESET (TPS3836/8)	$V_{DD} = 1.8 \text{ V}$ , $I_{OL} = 1 \text{ mA}$	0.4		V		
			$V_{DD} = 3.3 \text{ V}$ , $I_{OL} = 2 \text{ mA}$					
		RESET (TPS3837)	$V_{DD} = 3.3 \text{ V}$ , $I_{OL} = 2 \text{ mA}$					
			$V_{DD} = 6 \text{ V}$ , $I_{OL} = 3 \text{ mA}$					
Power-up reset voltage (see Note 2)	TPS3836/8	$V_{DD} \geq 1.1 \text{ V}$ , $I_{OL} = 50 \mu\text{A}$	0.2		0.8 $\times$ $V_{DD}$	V		
	TPS3837	$V_{DD} \geq 1.1 \text{ V}$ , $I_{OH} = -50 \mu\text{A}$						
$V_{IT}$	Negative-going input threshold voltage (see Note 3)	TPS383xE18	$T_A = -40^\circ\text{C} \text{ to } 85^\circ\text{C}$	1.66	1.71	1.74		
		TPS383xJ25		2.18	2.25	2.29		
		TPS383xH30		2.70	2.79	2.85		
		TPS383xL30		2.56	2.64	2.69		
		TPS383xK33		2.84	2.93	2.99		
$V_{hys}$	Hysteresis at $V_{DD}$ input	1.7 V $< V_{IT} < 2.5 \text{ V}$	30		mV			
		2.5 V $< V_{IT} < 3.5 \text{ V}$	40					
		3.5 V $< V_{IT} < 5 \text{ V}$	50					
$I_{IH}$	High-level input current	MR (see Note 4)	$\overline{MR} = 0.7 \times V_{DD}$ , $V_{DD} = 6 \text{ V}$	-40	-60	-100		
		CT	$CT = V_{DD} = 6 \text{ V}$	-25	25	nA		
$I_{IL}$	Low-level input current	MR (see Note 4)	$\overline{MR} = 0 \text{ V}$ , $V_{DD} = 6 \text{ V}$	-130	-200	-340		
		CT	$CT = 0 \text{ V}$ , $V_{DD} = 6 \text{ V}$	-25	25	nA		
$I_{OH}$	High-level output current	TPS3838	$V_{DD} = V_{IT} + 0.2 \text{ V}$ , $V_{OH} = V_{DD}$	25		nA		
$I_{DD}$	Supply current		$V_{DD} > V_{IT}$ , $V_{DD} < 3 \text{ V}$	220	400	nA		
			$V_{DD} > V_{IT}$ , $V_{DD} > 3 \text{ V}$	250	450			
			$V_{DD} < V_{IT}$	10	15			
Internal pullup resistor at $\overline{MR}$				30		k $\Omega$		
$C_I$	Input capacitance at $\overline{MR}$ , CT	$V_I = 0 \text{ V} \text{ to } V_{DD}$		5		pF		

NOTES:

2. The lowest voltage at which  $\overline{\text{RESET}}$  output becomes active.  $t_r$ ,  $V_{DD} \geq 15 \mu\text{s}/\text{V}$
3. To ensure best stability of the threshold voltage, a bypass capacitor (ceramic, 0.1  $\mu\text{F}$ ) should be placed near the supply terminal.
4. If manual reset is unused,  $\overline{MR}$  should be connected to  $V_{DD}$  to minimize current consumption.

**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 $\overline{MR}$	$V_{DD} \geq V_{IT} + 0.2 \text{ V}$ ,	$V_{IL} = 0.3 \times V_{DD}$ ,	1			$\mu\text{s}$

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

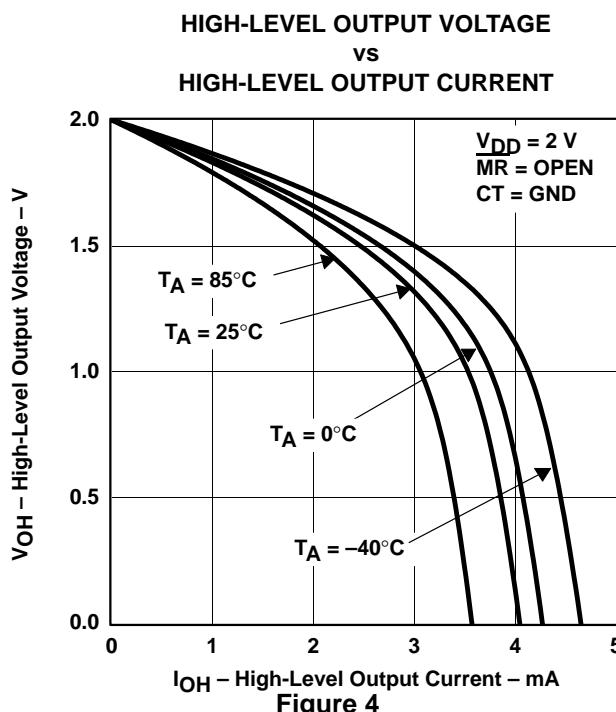
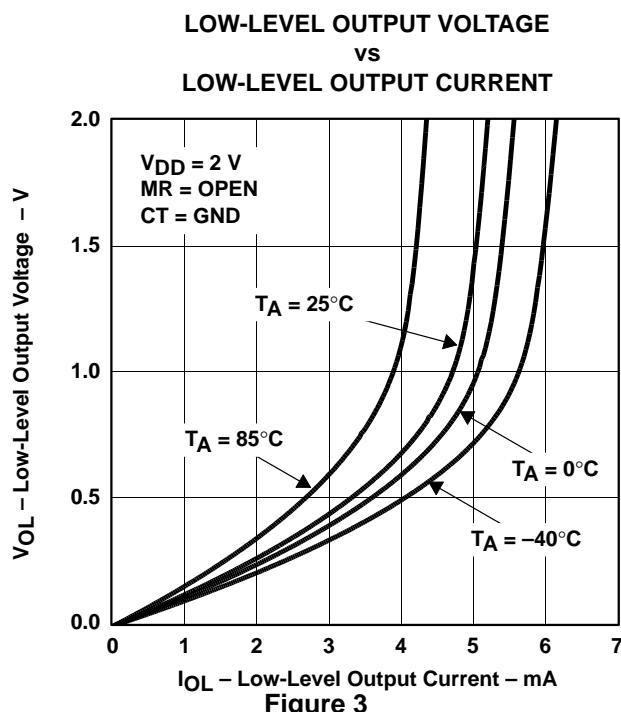
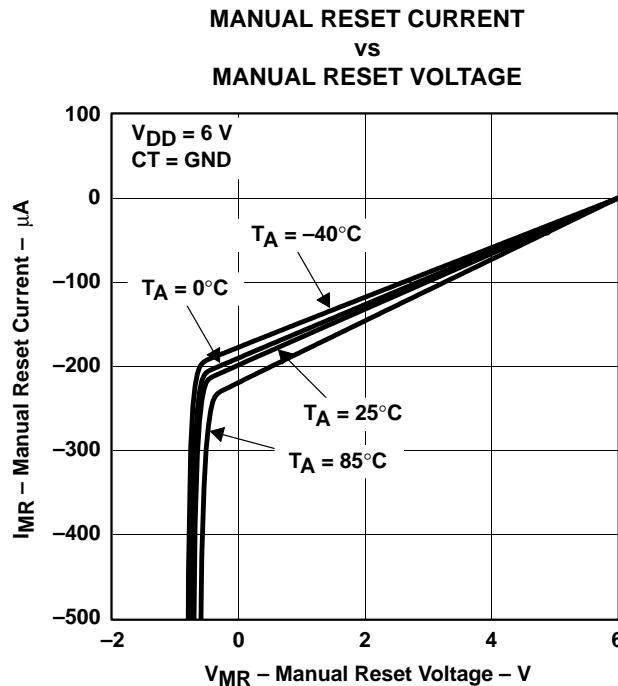
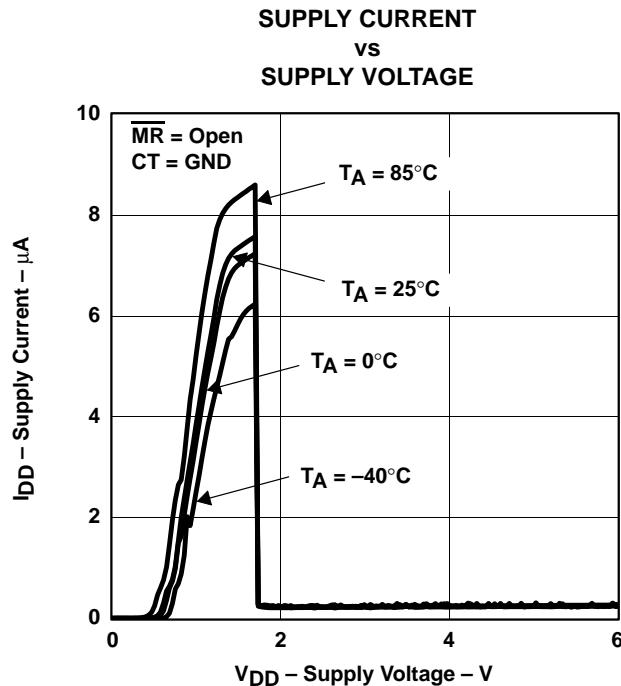
PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$t_d$ Delay time		$V_{DD} \geq V_{IT} + 0.2 \text{ V}$ , $MR = 0.7 \times V_{DD}$ , $CT = \text{GND}$ , See timing diagram	5	10	15	ms
		$V_{DD} \geq V_{IT} + 0.2 \text{ V}$ , $MR = 0.7 \times V_{DD}$ , $CT = V_{DD}$ , See timing diagram	100	200	300	
$t_{PHL}$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

**TYPICAL CHARACTERISTICS**

**Table of Graphs**

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

## TYPICAL CHARACTERISTICS



TYPICAL CHARACTERISTICS

NORMALIZED RESET THRESHOLD  
 VOLTAGE  
 VS  
 FREE-AIR TEMPERATURE

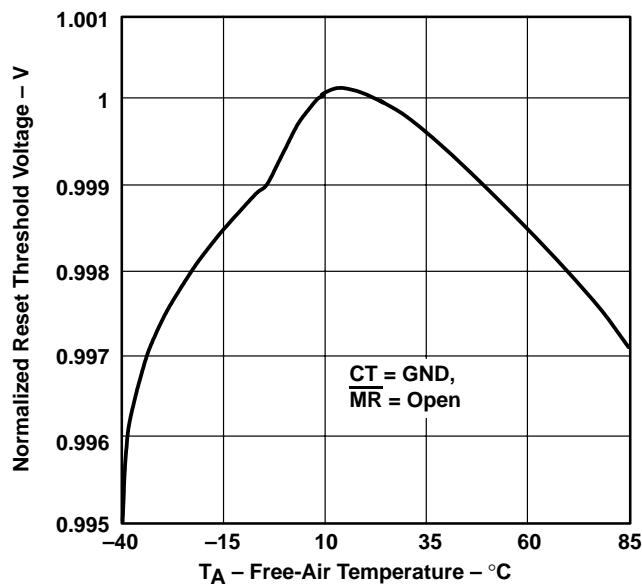


Figure 5

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

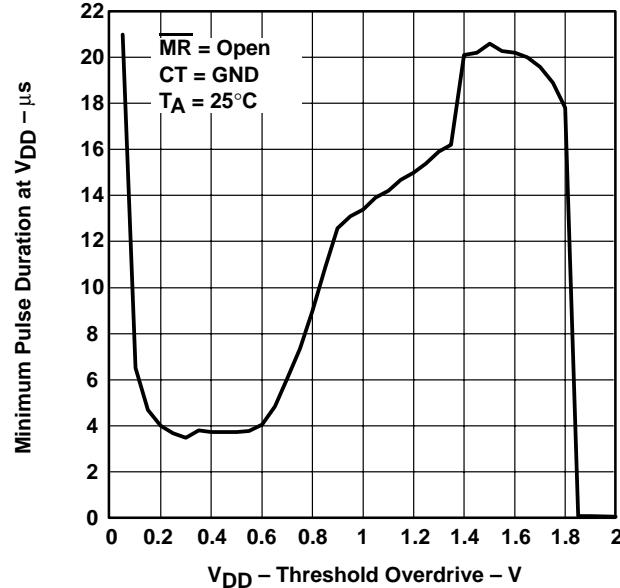


Figure 6

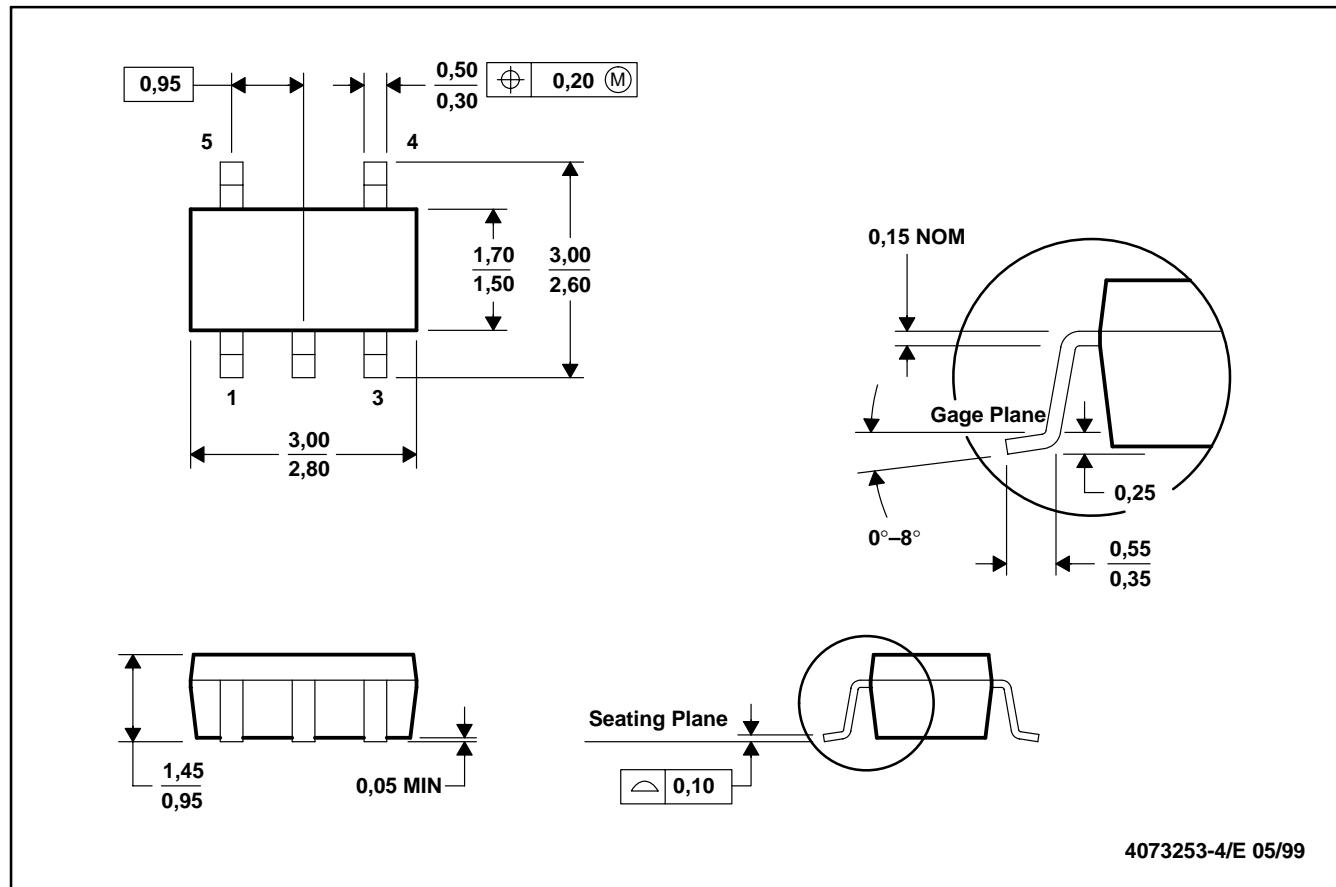
**TPS3836E18 / J25 / H30 / L30 / K33  
 TPS3837E18 / J25 / L30 / K33, TPS3838E18 / J25 / L30 / K33  
 NANOPOWER SUPERVISORY CIRCUITS**

SLVS292B – JUNE 2000 – REVISED DECEMBER 2002

**MECHANICAL DATA**

**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. Body dimensions do not include mold flash or protrusion.  
 D. Falls within JEDEC MO-178

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