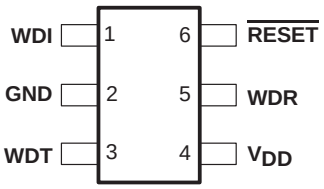
features

- **Window-Watchdog With Programmable Delay and Window Ratio**
- **6-Pin SOT-23 Package**
- **Supply Current of 9 μA (Typ)**
- **Power On Reset Generator With a Fixed Delay Time of 25 ms**
- **Precision Supply Voltage Monitor 2.5 V, 3 V, 3.3 V, 5 V**
- **Open-Drain Reset Output**
- **Temperature Range . . . –40°C to 85°C**

typical applications

- **Applications Using DSPs, Microcontrollers, or Microprocessors**
- **Safety Critical Systems**
- **Automotive Systems**
- **Heating Systems**

TPS3813
DBV PACKAGE
(TOP VIEW)



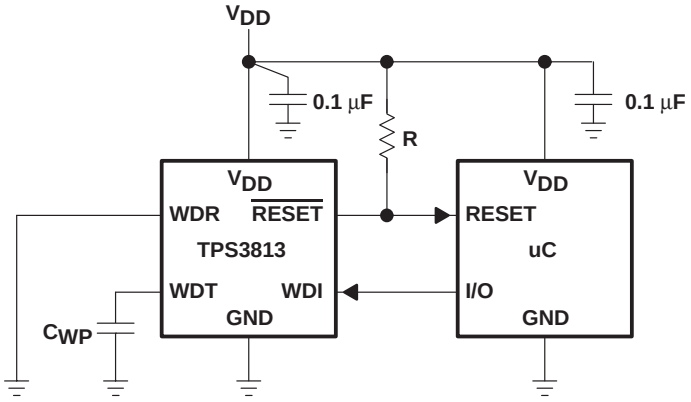
description

The TPS3813 family of supervisory circuits provides circuit initialization and timing supervision, primarily for DSPs and processor-based systems.

During power on, $\overline{\text{RESET}}$ is asserted when supply voltage (V_{DD}) becomes higher than 1.1 V. Thereafter, the supervisory circuit monitors V_{DD} and keeps $\overline{\text{RESET}}$ 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, t_d = 25 ms typical, starts after V_{DD} has risen above the threshold voltage (V_{IT}). When the supply voltage drops below the threshold voltage (V_{IT}), the output becomes active (low) again. No external components are required. All the devices of this family have a fixed-sense threshold voltage (V_{IT}) set by an internal voltage divider.

For safety critical applications the TPS3813 family incorporates a so-called window-watchdog with programmable delay and window ratio. The upper limit of the watchdog time-out can be set by either connecting WDT to GND, V_{DD}, or using an external capacitor. The lower limit and thus the window ratio is set by connecting WDR to GND or V_{DD}. The supervised processor now needs to trigger the TPS3813 within this window not to assert a $\overline{\text{RESET}}$.

typical operating circuit



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.

description continued

The product spectrum is designed for supply voltages of 2.5 V, 3 V, 3.3 V, and 5 V. The circuits are available in a 6-pin SOT–23 package.

The TPS3813 devices are characterized for operation over a temperature range of –40°C to 85°C.

PACKAGE INFORMATION

T_A	DEVICE NAME	THRESHOLD VOLTAGE	MARKING
–40°C to 85°C	TPS3813J25DBV	2.25 V	PCDI
	TPS3813L30DBV	2.64 V	PEZI
	TPS3813K33DBV	2.93 V	PFAI
	TPS3813I50DBV	4.55 V	PFBI

ordering information

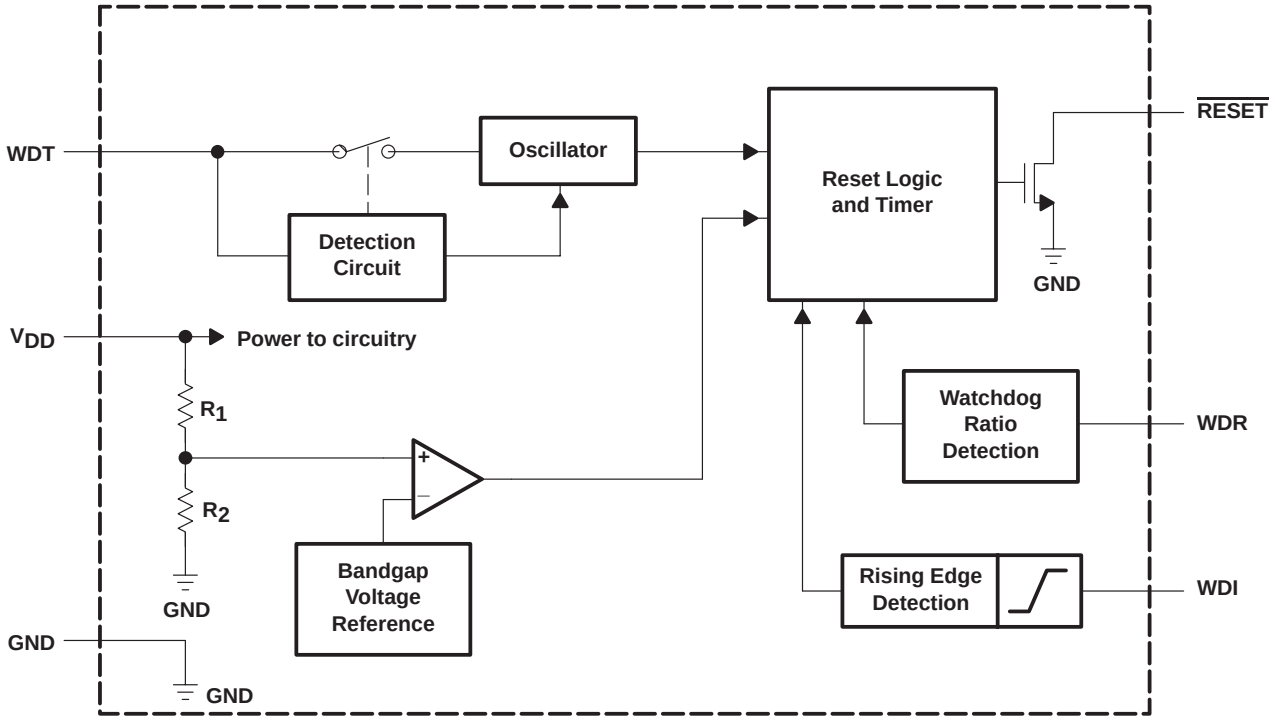
TPS381 3 J 25 DBV R

- R — Reel
- DBV — Package
- 25 — Nominal Supply Voltage
- J — Nominal Threshold Voltage
- 3 — Functionality
- TPS381 — Family

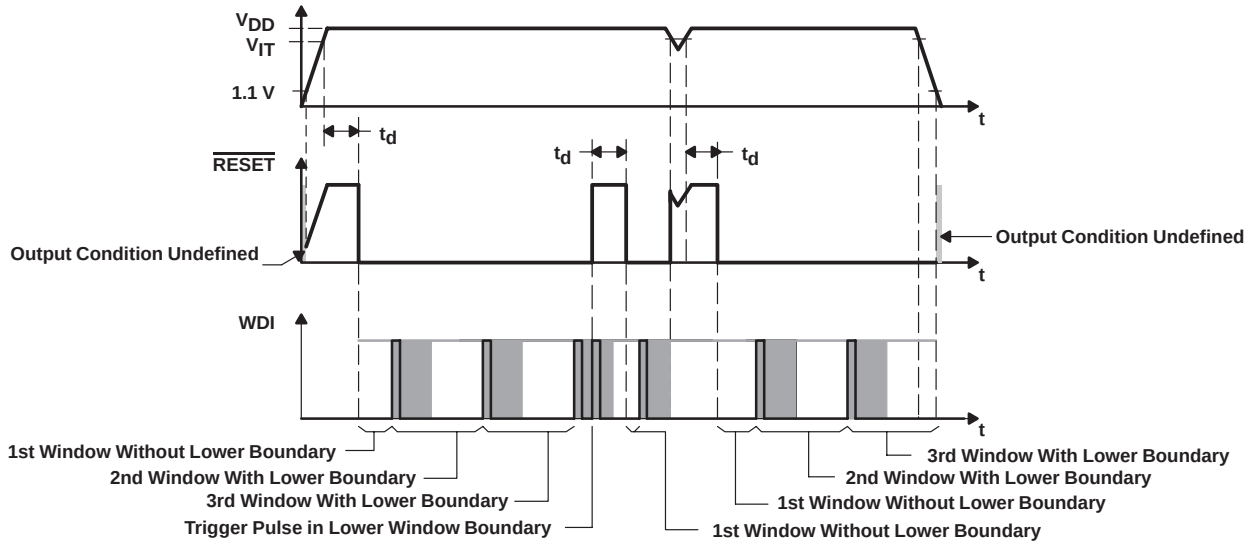
TPS3813
FUNCTION/TRUTH TABLE

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

functional schematic



timing diagram



Terminal Functions

TERMINAL NAME	TERMINAL NO.	I/O	DESCRIPTION
GND	2	I	Ground
$\overline{\text{RESET}}$	6	O	Open-drain reset output
V_{DD}	4	I	Supply voltage and supervising input
WDI	1	I	Watchdog timer input
WDR	5	I	Selectable watchdog window ratio input
WDT	3	I	Programmable watchdog delay input

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

Supply voltage, V_{DD} (see Note1) . . . . . 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 $V_I > V_{DD}$) . . . . . ±20 mA
Output clamp current, I_{OK} ($V_O < 0$ or $V_O > V_{DD}$) . . . . . ±20 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 should not be operated at 7 V for more than t = 1000h continuously.

DISSIPATION RATING TABLE

PACKAGE	T_A <25°C POWER RATING	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 at specified temperature range

	MIN	MAX	UNIT
Supply voltage, V_{DD}	2	6	V
Input voltage, V_I	0	V_{DD} + 0.3	V
High-level input voltage, V_{IH}	0.7 x V_{DD}		V
Low-level input voltage, V_{IL}		0.3 x V_{DD}	V
Input transition rise and fall rate, $\Delta t/\Delta V$		100	ns/V
Pulse width of WDI trigger pulse, t_w	50		ns
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} = 2 V to 6 V, I_{OL} = 500 µA			0.2	V
			V_{DD} = 3.3 V I_{OL} = 2 mA			0.4	
			V_{DD} = 6 V, I_{OL} = 4 mA			0.4	
	Power up reset voltage (see Note 2)		$V_{DD} \geq$ 1.1 V, I_{OL}= 50 µA			0.2	V
V_{IT}	Negative-going input threshold voltage (see Note 3)	TPS3813J25	T_A = –40°C – 85°C	2.2	2.25	2.3	V
		TPS3813L30		2.58	2.64	2.7	
		TPS3813K33		2.87	2.93	3	
		TPS3813I50		4.45	4.55	4.65	
V_{hys}	Hysteresis	TPS3813J25			30		mV
		TPS3813L30			35		
		TPS3813K33			40		
		TPS3813I50			60		
I_{IH}	High-level input current	WDI, WDR	WDI = V_{DD} = 6 V, WDR = V_{DD} = 6 V	–25		25	nA
		WDT	$\overline{WDT}$ = V_{DD} = 6 V, $V_{DD} > V_{IT}$ $\overline{RESET}$ = High	–100		100	
I_{IL}	Low-level input current	WDI, WDR	WDI = 0 V, WDR = 0 V, V_{DD} = 6 V	–25		25	
		WDT	WDT = 0 V, $V_{DD} > V_{IT}$, $\overline{RESET}$ = High	–100		100	
I_{OH}	High-level output current		$V_{DD} = V_{IT}$ + 0.2 V, $V_{OH} = V_{DD}$			25	nA
I_{DD}	Supply current		V_{DD} = 2 V output unconnected		9	13	µA
			V_{DD} = 5 V output unconnected		20	25	
C_i	Input capacitance		V_I = 0 V to V_{DD}		5		pF

NOTES: 2. The lowest supply voltage at which $\overline{RESET}$ becomes active. t_r,$V_{DD} \geq$ 15 µs/V.
3. To ensure best stability of the threshold voltage, a bypass capacitor (ceramic, 0.1 µF) should be placed near to the supply terminals.

timing requirements at R_L = 1 MΩ, C_L = 50 pF, T_A = –40°C to 85°C

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_w	Pulse width at V_{DD}	$V_{DD} = V_{IT-}$ + 0.2 V, $V_{DD} = V_{IT-}$ – 0.2 V	3			µs

switching characteristics at R_L = 1 MΩ, C_L = 50 pF, T_A = –40°C to 85°C

PARAMETER			TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_d	Delay time		$V_{DD} \geq V_{IT}$ + 0.2 V, See timing diagram	15	25	35	ms
$t_{t(out)}$	Watchdog time-out	Upper limit	WDT = 0 V	0.15	0.25	0.35	s
			WDT = V_{DD}	1.5	2.5	3.5	
			WDT = Programmable (see Note 4)		See Note 5		ms
	Watchdog window ratio		WDR = 0 V, WDT = 0 V		1:31.8		
			WDR = 0 V, WDT = V_{DD}		1:32		
			WDR = 0 V, WDT = Programmable		1:25.8		
			WDR = V_{DD}, WDT = 0 V		1:124.9		
			WDR = V_{DD}, WDT = V_{DD}		1:127.7		
t_{PHL}	Propagation (delay) time, high-to-low-level output	V_{DD} to $\overline{\text{RESET}}$ delay	$V_{IL} = V_{IT}$ – 0.2 V, $V_{IH} = V_{IT}$ + 0.2 V		30	50	µs

NOTES: 4. 155 pF < $C_{(EXT)}$ < 63 nF
5. $C_{(EXT)}$ ÷ 15.55 pF + 1 x 6.25 ms

TYPICAL CHARACTERISTICS

SUPPLY CURRENT vs SUPPLY VOLTAGE

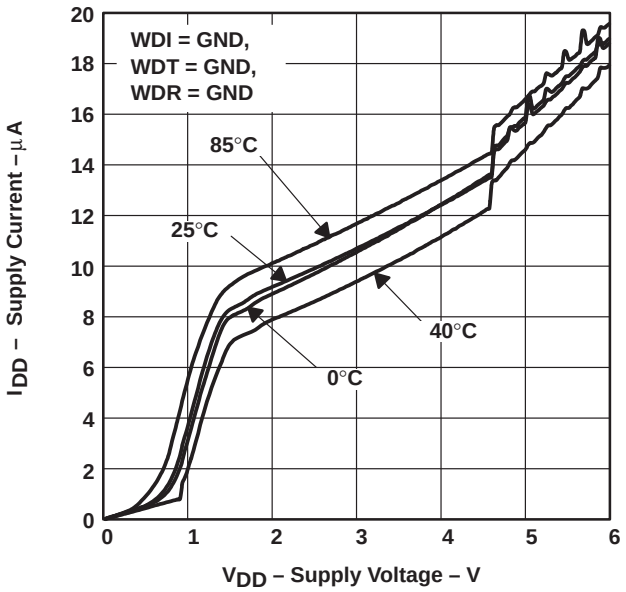


Figure 1

LOW-LEVEL OUTPUT VOLTAGE vs LOW-LEVEL OUTPUT CURRENT

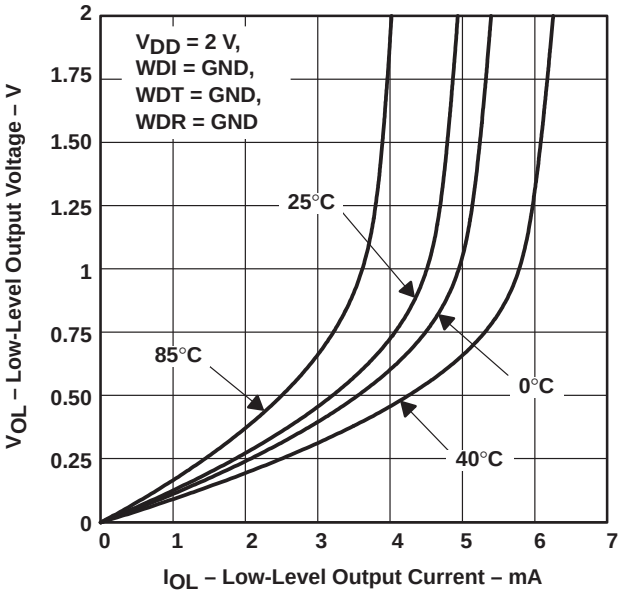


Figure 2

INPUT CURRENT vs INPUT VOLTAGE AT WDT

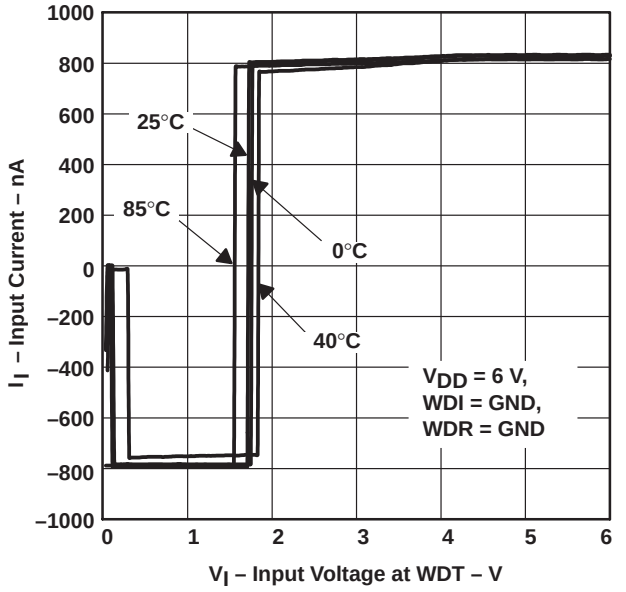


Figure 3

NORMALIZED INPUT THRESHOLD VOLTAGE vs FREE-AIR TEMPERATURE AT V_{DD}

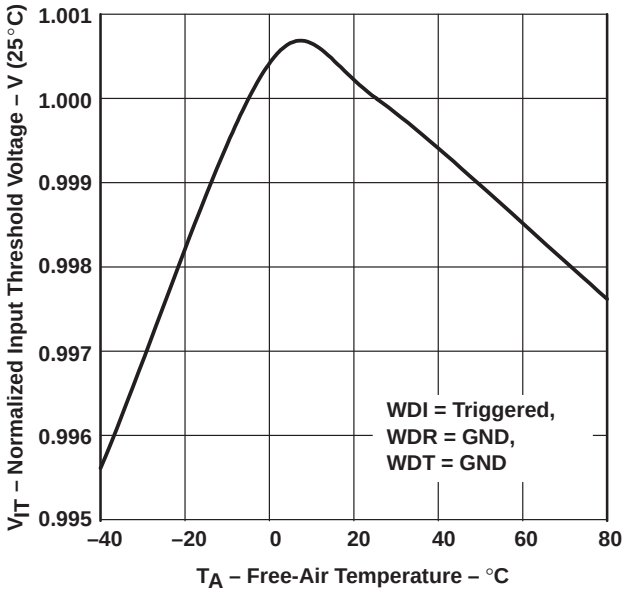


Figure 4

TYPICAL CHARACTERISTICS

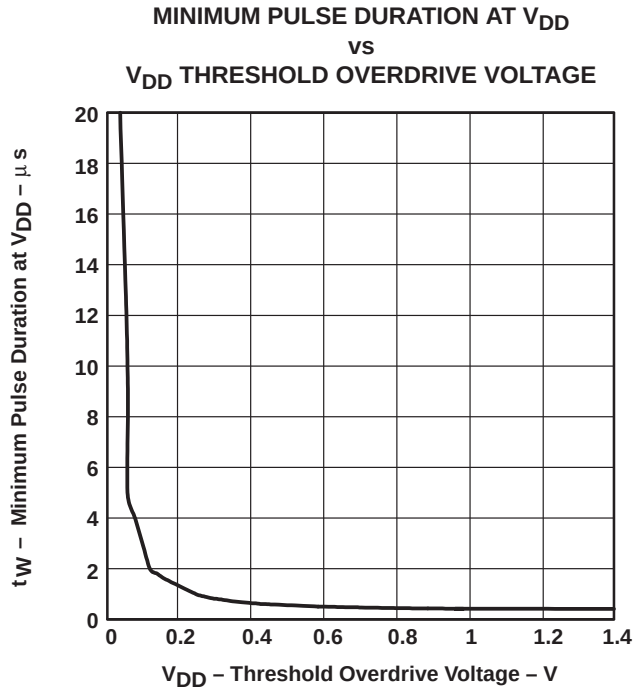
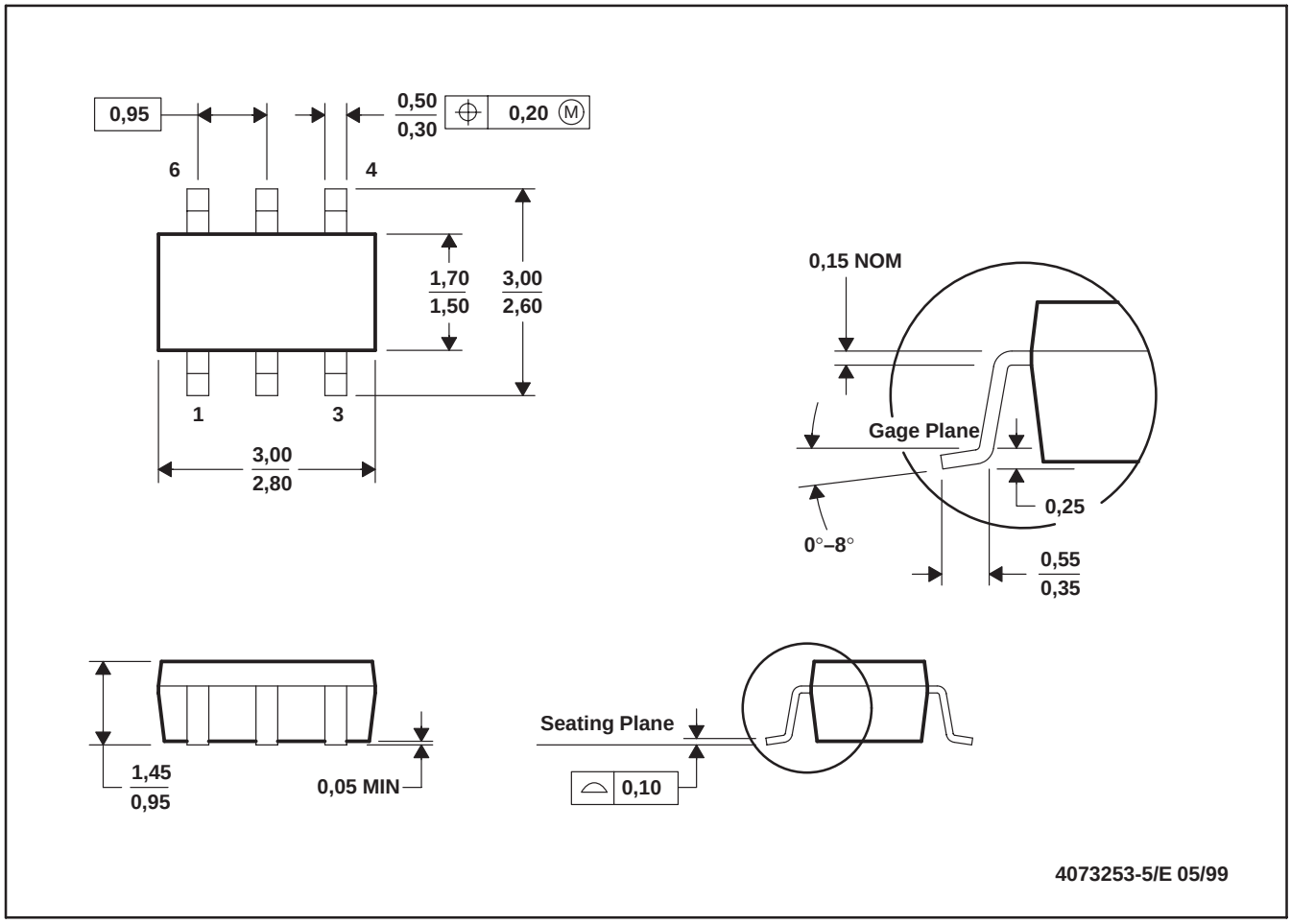


Figure 5

MECHANICAL DATA

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. Body dimensions do not include mold flash or protrusion.

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