TLC2940
HIGH-PERFORMANCE CMOS VOLTAGE-CONTROLLED OSCILLATOR

SLAS244 – OCTOBER 1999

- **Stable Oscillation Using External Resistor**
- **Lock Frequency Range:**
  - **35 MHz to 75 MHz (V_{DD} = 5 V ± 0.25 V, T_A = –20°C to 85°C)**
  - **28 MHz to 50 MHz (V_{DD} = 3 V ± 0.15 V, T_A = –20°C to 85°C)**
- **Operating Free-Air Temperature Range, T_A = –20°C to 85°C**
- **8-Pin Thin Shrinked Small-Outline Package**

PW PACKAGE
(TOP VIEW)

description

The TLC2940 is a high-performance analog voltage-controlled oscillator (VCO) using Texas Instruments 0.8-µm CMOS process. The VCO oscillating operation can be performed by an external bias resistor connected to the internal oscillation circuitry, and the oscillation frequency range is set by this bias resistor. The lock frequency range for PLL applications is from 35 MHz to 75 MHz (over operating free-air temperature range, V_{DD} = 5 V ± 5%), and from 28 MHz to 50 MHz (over operating free-air temperature range, V_{DD} = 3 V ± 5%). The stable analog PLL can be configured within these frequency ranges.

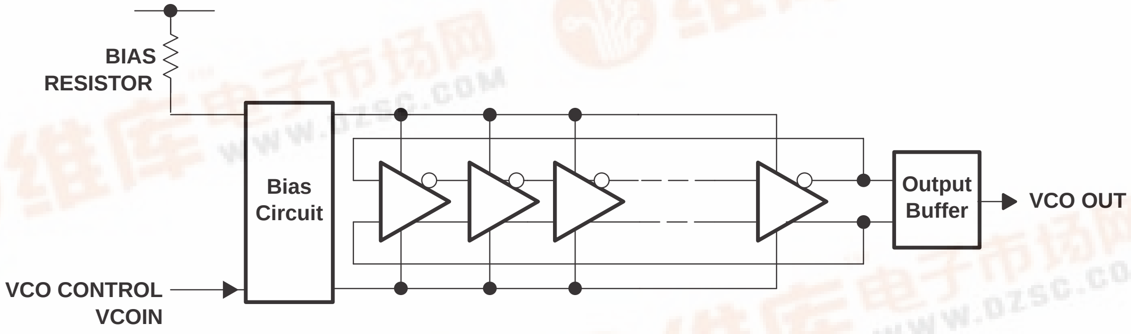
The device is available in an 8-pin TSSOP surface-mount package.

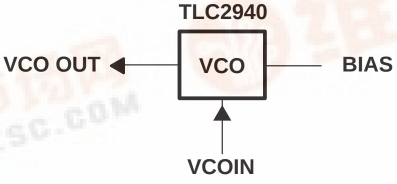
The PLL block is configured using a counter, a required LPF, and a phase frequency detector (PFD).

AVAILABLE OPTIONS

T_A	PACKAGE TSSOP (PW)
–20°C to 85°C	TLC2940IPW

functional block diagram





Terminal Functions

TERMINAL		I/O†	DESCRIPTION
NAME	NO.		
BIAS	7	M	Bias supply terminal for internal VCO. The resistor should be located between V_{DD} and this terminal.
FREFINPUT	3	I	Not used. This terminal should be tied to ground.
GND	5	PS	Ground
LOGIC V_{DD}	1	PS	Power supply for the internal logic circuitry (PFD portion, input/output portion). It is recommended that this terminal is separated from the VCO supply voltage terminal.
PFD OUT	4	O	Not used. This terminal should be unconnected (open).
VCOIN	6	I	VCO control voltage input.
VCO OUT	2	O	VCO output. This terminal is tied to a low level at inhibit status.
VCO V_{DD}	8	PS	Supply voltage for VCO analog portion.

† I: Input, O: Output, PS: Power supply/GND, M: Others

detailed description

The TLC2940 is an analog VCO IC that generates a frequency that is a multiple of a reference frequency for a PLL block configuration. Normally, a PLL block is composed of a VCO, a phase frequency detector, counter logic, and a loop filter.

The following is a description for the analog VCO of the TLC2940.

The built-in analog VCO is composed of a ring oscillator portion for oscillation operation and a bias control portion to generate a bias level to supply to the ring oscillator. The oscillation operation is performed by a bias resistor (R_{BIAS}) connected between the bias control (pin 7) and the supply voltage (pin 8). The VCO oscillation frequency is determined by this resistor value, R_{BIAS}, that is, the oscillation frequency decreases as the resistor value increases, and the oscillation frequency increases as the resistor value decreases. The lock frequency range is from 35 MHz to 75 MHz with a R_{BIAS} of 1.5 kΩ to 4.3 kΩ at 5-V operation and from 28 MHz to 50 MHz with a R_{BIAS} of 1.5 kΩ to 2.7 kΩ at 3-V operation over the recommended supply voltage and operating free-air temperature range.

Refer to the curves shown in the typical characteristics section for the lock frequency ranges with varying R_{BIAS} values.

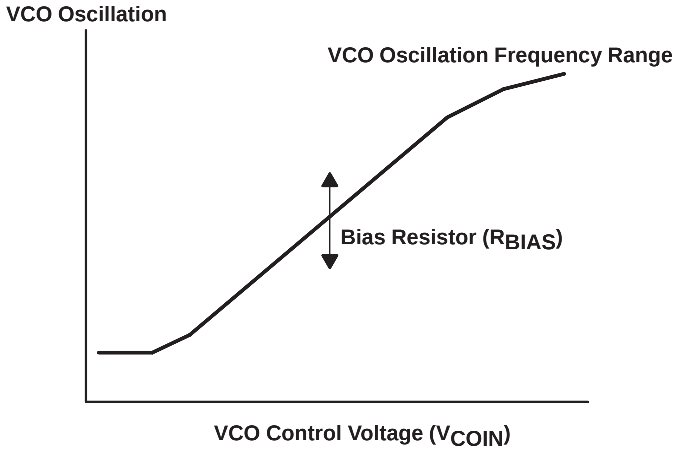


Figure 1. VCO Oscillation Frequency Range Setting

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

Supply voltage (any supply), V_{DD} (see Note 1)	7 V
Input voltage range (any input), V_I (see Note 1)	–0.5 V to V_{DD} + 0.5 V
Input current (any input), I_I	±20 mA
Output current (any output), I_O	±20 mA
Continuous total power dissipation (T_A = 25°C or below), P_D (see Note 2)	700 mW
Operating free-air temperature range, T_A	–20°C to 85°C
Storage temperature range, T_{stg}	–65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	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.

NOTES: 1. All voltage values are with respect to network GND terminals.
2. For operation above 25°C free-air temperature, derate linearly at the rate of 5.6 mW/°C.

recommended operating conditions

PARAMETER			MIN	NOM	MAX	UNIT
Supply voltage, V_{DD} (any supply, see Notes 3 and 4)	3-V operation		2.85	3	3.15	V
	5-V operation		4.75	5	5.25	
Input voltage, V_I (inputs except VCO IN)			0		V_{DD}	V
Output current, I_O (any output)			0		±2	mA
VCO control voltage at VCO IN			1		V_{DD}–0.5	V
Lock frequency	3-V operation	R_{BIAS} = 1.5 kΩ	42		50	MHz
		R_{BIAS} = 1.8 kΩ	37		47	
		R_{BIAS} = 2.2 kΩ	33		45	
		R_{BIAS} = 2.7 kΩ	28		42	
	5-V operation	R_{BIAS} = 1.5 kΩ	65		75	
		R_{BIAS} = 2.4 kΩ	50		65	
		R_{BIAS} = 3.3 kΩ	43		56	
		RBIAS = 4.3 kΩ	35		50	
VCO oscillation frequency setting resistor, R_{BIAS}	3-V operation		1.5		2.7	kΩ
	5-V operation		1.5		4.3	
Operating free-air temperature, T_A			–20		85	°C

NOTES: 3. It is recommended that the logic supply terminal (LOGIC V_{DD}) and the VCO supply terminal (VCO V_{DD}) should be at the same voltage and separate from each other.
4. The bypass capacitor should be located as close as possible to each power supply.
5. The FREFINPUT (pin 3) and PFD OUT (pin 4) terminals are input/output terminals preset for logic function respectively. In normal operation, the FREFINPUT shoud be tied to GND and PDF OUT should be left unconnected (open).

electrical characteristics over recommended operating free-air temperature range, V_{DD} = 3 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{OH}	High-level output voltage, VCO OUT	I_{OH} = –2 mA	2.4			V
V_{OL}	Low-level output voltage, VCO OUT	I_{OL} = 2 mA			0.3	V
$Z_{i(VCOIN)}$	Input impedance at VCOIN	VCO IN = 1/2 V_{DD}		10		MΩ
$I_{DD(VCO)}$	Supply current	See Note 6		6	10	mA
f_{osc}	Oscillation frequency	R_{BIAS} = 2.4 kΩ, VCOIN = 1/2 V_{DD}	32	40	48	MHz
t_r	Output rise time	VCOIN = 0 V, R_{BIAS} =2.4 kΩ , C_L = 15 pF		13		ns
t_f	Output fall time	VCOIN = 0 V, R_{BIAS} =2.4 kΩ , C_L = 15 pF		6		ns
	Output duty ratio	R_{BIAS} = 2.4 kΩ, VCOIN = 1/2 V_{DD}, See Note 7	40%	44%	60%	
$\alpha_{(fosc)}$	Temperature coefficient of oscillation frequency	VCOIN = 1/2 V_{DD}, R_{BIAS} = 2.4 kΩ, T_A = –20°C to 85°C		0.07		%/°C
$k_{SVS(fosc)}$	Supply voltage coefficient of oscillation frequency	VCOIN = 1.5 V, R_{BIAS} = 2.4 kΩ, V_{DD} = 2.7 V to 3.3 V		0.01		%/mV

NOTES: 6. VCOIN = 1/2 V_{DD}, R_{BIAS} = 2.4 kΩ, current through pin 1 and 8.
7. The maximum and minimum value of this parameter are not production tested.

electrical characteristics over recommended operating free-air temperature range, V_{DD} = 5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{OH}	High-level output voltage, VCO OUT	I_{OH} = –2 mA	4.5			V
V_{OL}	Low-level output voltage, VCO OUT	I_{OL} = 2 mA			0.5	V
$Z_{i(VCOIN)}$	Input impedance at VCOIN	VCOIN = 1/2 V_{DD}		10		MΩ
$I_{DD(VCO)}$	Supply current	See Note 6		16	30	mA
f_{osc}	Oscillation frequency	R_{BIAS} = 2.4 kΩ, VCOIN = 1/2 V_{DD}	45	65	85	MHz
t_r	Output rise time	VCOIN = 0 V, R_{BIAS} =2.4 kΩ , C_L = 15 pF		5.8		ns
t_f	Output fall time	VCOIN = 0 V, R_{BIAS} =2.4 kΩ , C_L = 15 pF		3.2		ns
	Output duty ratio	R_{BIAS} = 2.4 kΩ, VCOIN = 1/2 V_{DD}, See Note 7	40%	46%	60%	
$\alpha_{(fosc)}$	Temperature coefficient of oscillation frequency	VCOIN = 1/2 V_{DD}, R_{BIAS} = 2.4 kΩ, T_A = –20°C to 85°C		0.06		%/°C
$k_{SVS(fosc)}$	Supply voltage coefficient of oscillation frequency	VCOIN = 2.5 V, R_{BIAS} = 2.4 kΩ, V_{DD} = 4.5 V to 5.5 V		0.005		%/mV

NOTES: 6. VCOIN = 1/2 V_{DD}, R_{BIAS} = 2.4 kΩ, current through pin 1 and 8.
7. The maximum and minimum value of this parameter are not production tested.

PARAMETER MEASUREMENT INFORMATION

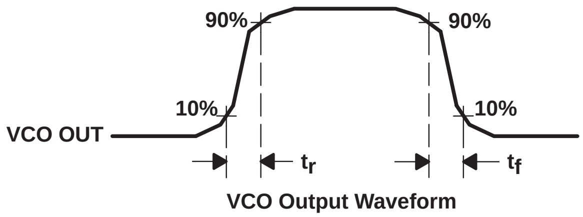


Figure 2. VCO Output Waveform

TYPICAL CHARACTERISTICS

VCO OSCILLATION FREQUENCY
vs
VCO CONTROL VOLTAGE

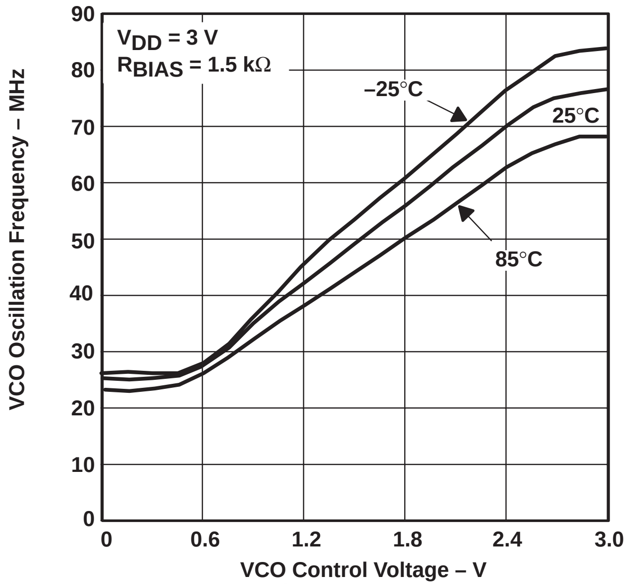


Figure 3

VCO OSCILLATION FREQUENCY
vs
VCO CONTROL VOLTAGE

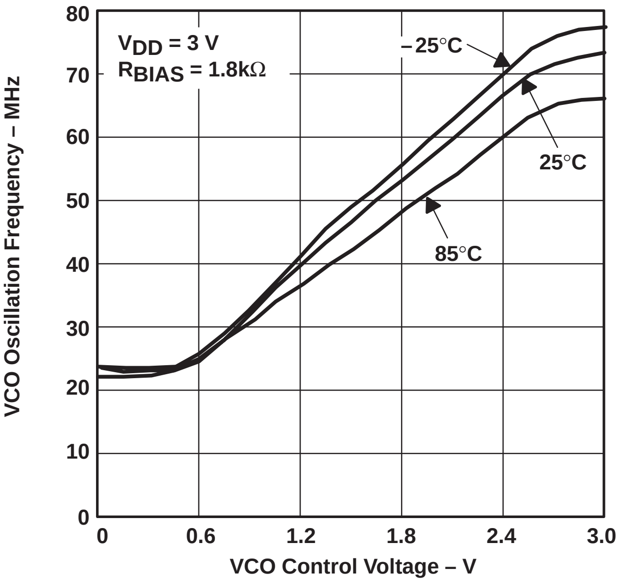


Figure 4

VCO OSCILLATION FREQUENCY
vs
VCO CONTROL VOLTAGE

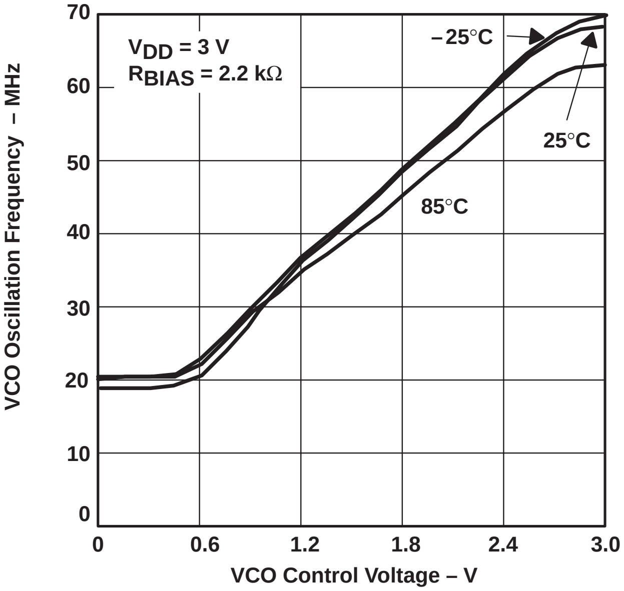


Figure 5

VCO OSCILLATION FREQUENCY
vs
VCO CONTROL VOLTAGE

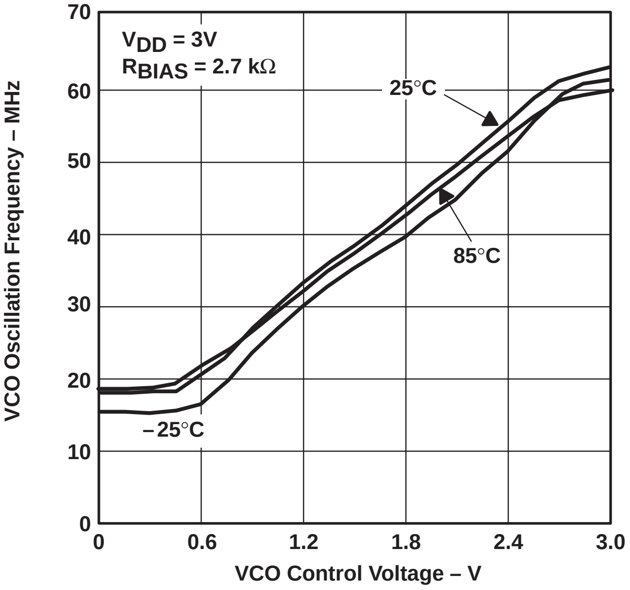


Figure 6

TYPICAL CHARACTERISTICS

VCO OSCILLATION FREQUENCY vs VCO CONTROL VOLTAGE

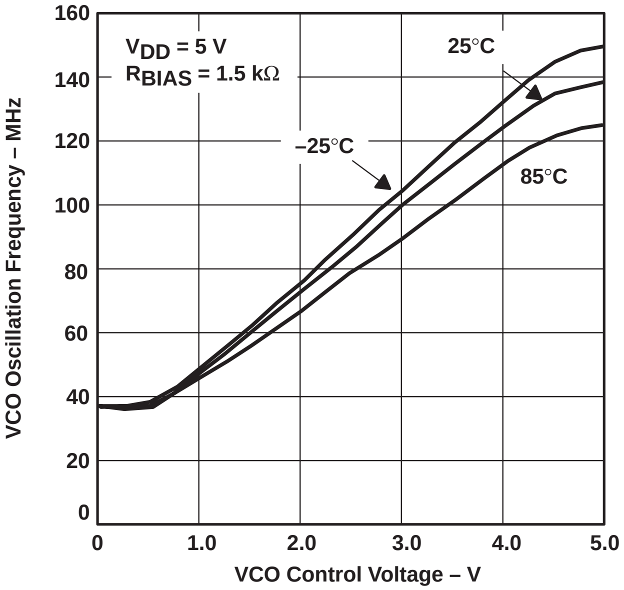


Figure 7

VCO OSCILLATION FREQUENCY vs VCO CONTROL VOLTAGE

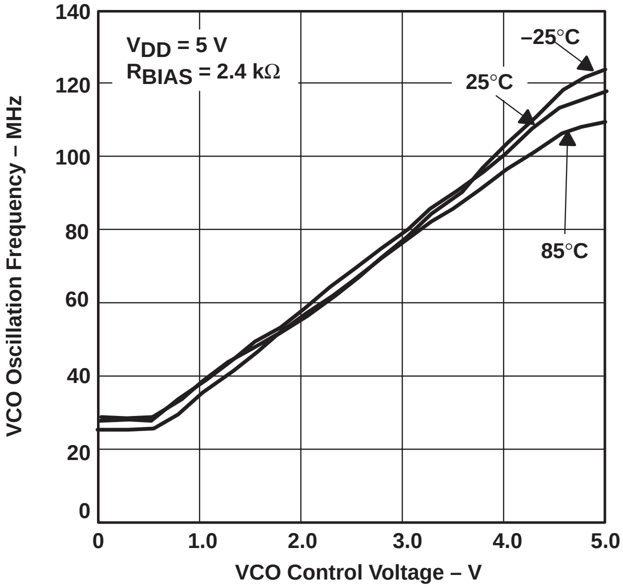


Figure 8

VCO OSCILLATION FREQUENCY vs VCO CONTROL VOLTAGE

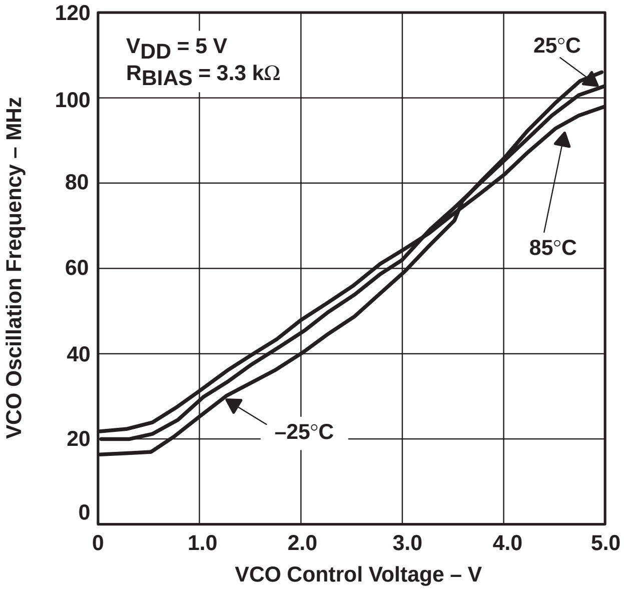


Figure 9

VCO OSCILLATION FREQUENCY vs VCO CONTROL VOLTAGE

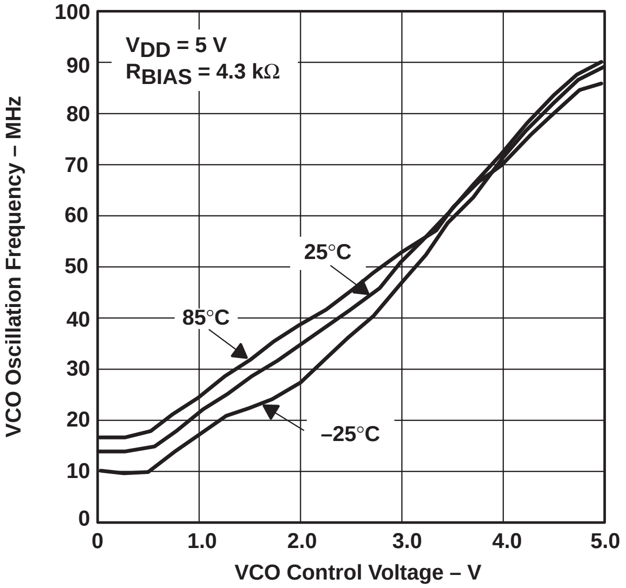
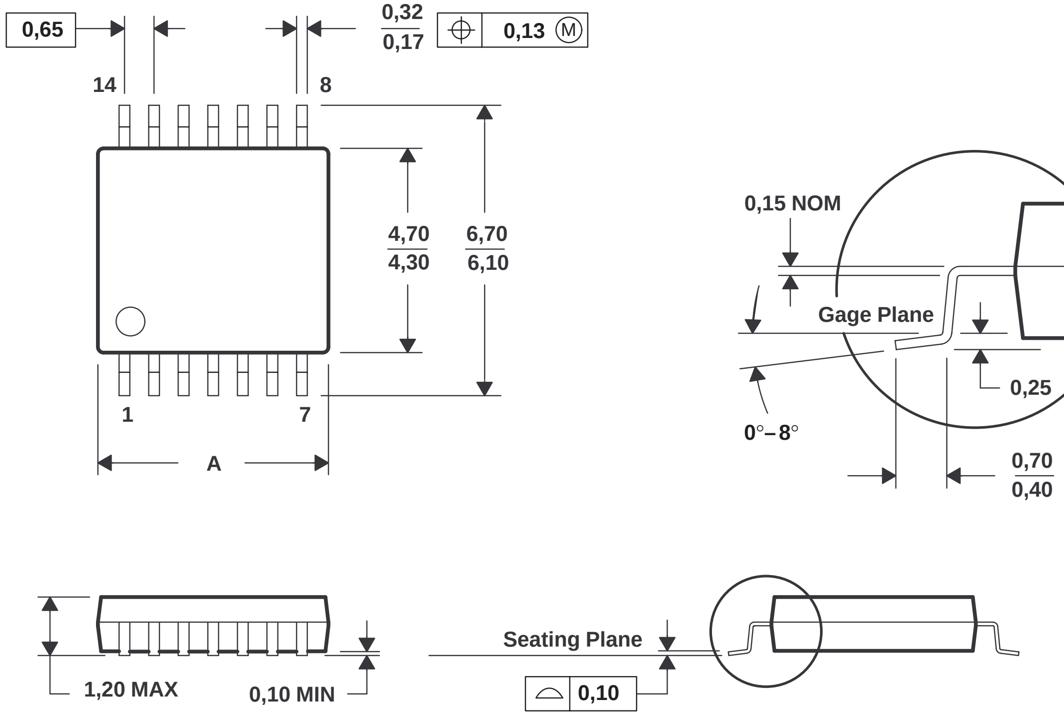


Figure 10

MECHANICAL DATA

PW (R-PDSO-G)** **PLASTIC SMALL-OUTLINE PACKAGE**

14 PIN SHOWN



PINS ** DIM	8	14	16	20	24	28
A MAX	3,30	5,30	5,30	6,80	8,10	10,00
A MIN	2,90	4,90	4,90	6,40	7,70	9,60

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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 not to exceed 0,15.

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