Excellent Integrated System Limited

Stocking Distributor

Click to view price, real time Inventory, Delivery & Lifecycle Information:

Texas Instruments
TL5001CDR

For any questions, you can email us directly:
sales@integrated-circuit.com

TL5001, TL5001A
PULSE-WIDTH-MODULATION CONTROL CIRCUITS

SLVS084F – APRIL 1994 – REVISED JANUARY 2002

- **Complete PWM Power Control**
- **3.6-V to 40-V Operation**
- **Internal Undervoltage-Lockout Circuit**
- **Internal Short-Circuit Protection**
- **Oscillator Frequency . . . 20 kHz to 500 kHz**
- **Variable Dead Time Provides Control Over Total Range**
- **±3% Tolerance on Reference Voltage (TL5001A)**
- **Available in Q-Temp Automotive HighRel Automotive Applications Configuration Control / Print Support Qualification to Automotive Standards**

D, JG OR P PACKAGE
(TOP VIEW)

OUT	1	8 GND
V_{CC}	2	7 RT
COMP	3	6 DTC
FB	4	5 SCP

FK PACKAGE
(TOP VIEW)

NC, OUT, NC, GND, NC
3, 2, 1, 20, 19

NC	4	18 NC
V_{CC}	5	17 RT
NC	6	16 NC
COMP	7	15 DTC
NC	8	14 NC

9, 10, 11, 12, 13
NC, FB, NC, SCP, NC

description

The TL5001 and TL5001A incorporate on a single monolithic chip all the functions required for a pulse-width-modulation (PWM) control circuit. Designed primarily for power-supply control, the TL5001/A contains an error amplifier, a regulator, an oscillator, a PWM comparator with a dead-time-control input, undervoltage lockout (UVLO), short-circuit protection (SCP), and an open-collector output transistor. The TL5001A has a typical reference voltage tolerance of ±3% compared to ±5% for the TL5001.

The error-amplifier common-mode voltage ranges from 0 V to 1.5 V. The noninverting input of the error amplifier is connected to a 1-V reference. Dead-time control (DTC) can be set to provide 0% to 100% dead time by connecting an external resistor between DTC and GND. The oscillator frequency is set by terminating RT with an external resistor to GND. During low V_{CC} conditions, the UVLO circuit turns the output off until V_{CC} recovers to its normal operating range.

The TL5001C and TL5001AC are characterized for operation from −20°C to 85°C. The TL5001I and TL5001AI are characterized for operation from −40°C to 85°C. The TL5001Q and TL5001AQ are characterized for operation from −40°C to 125°C. The TL5001M and TL5001AM are characterized for operation from −55°C to 125°C.

AVAILABLE OPTIONS

T_A	PACKAGED DEVICES			
	SMALL OUTLINE (D)	PLASTIC DIP (P)	CERAMIC DIP (JG)	CHIP CARRIER (FK)
−20°C to 85°C	TL5001CD	TL5001CP	—	—
	TL5001ACD	TL5001ACP	—	—
−40°C to 85°C	TL5001ID	TL5001IP	—	—
	TL5001AID	TL5001AIP	—	—
−40°C to 125°C	TL5001QD	—	—	—
	TL5001AQD	—	—	—
−55°C to 125°C	—	—	TL5001MJG	TL5001MFK
	—	—	TL5001AMJG	TL5001AMFK

The D package is available taped and reeled. Add the suffix R to the device type (e.g., TL5001CDR).
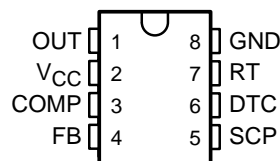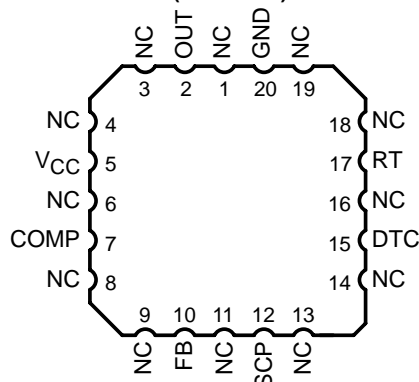
Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

TEXAS INSTRUMENTS

POST OFFICE BOX 655303 ● DALLAS, TEXAS 75265

1

TL5001, TL5001A
PULSE-WIDTH-MODULATION CONTROL CIRCUITS

SLVS084F – APRIL 1994 – REVISED JANUARY 2002

schematic for typical application
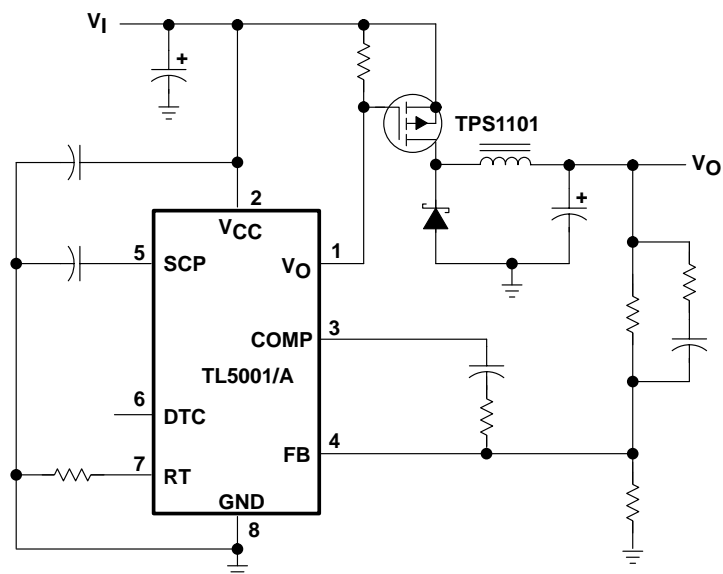
functional block diagram

TEXAS INSTRUMENTS
POST OFFICE BOX 655303 ● DALLAS, TEXAS 75265

detailed description

voltage reference

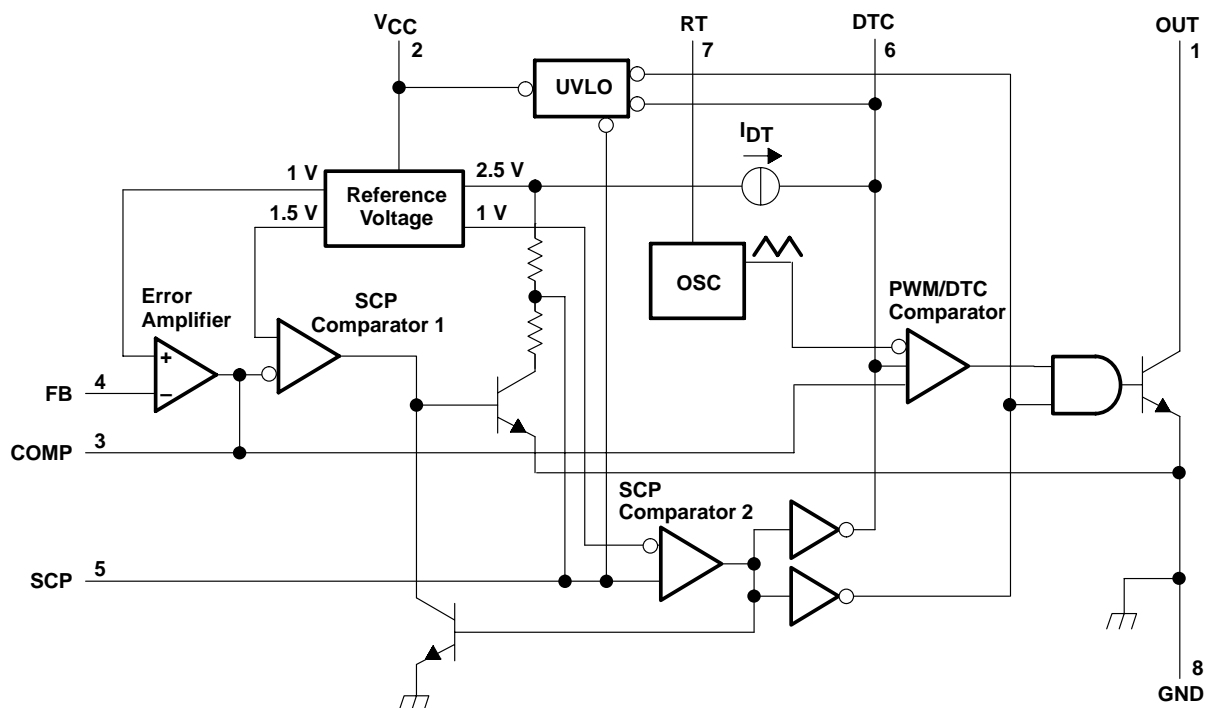A 2.5-V regulator operating from V_{CC} is used to power the internal circuitry of the TL5001 and TL5001A and as a reference for the error amplifier and SCP circuits. A resistive divider provides a 1-V reference for the error amplifier noninverting input which typically is within 2% of nominal over the operating temperature range.

error amplifier

The error amplifier compares a sample of the dc-to-dc converter output voltage to the 1-V reference and generates an error signal for the PWM comparator. The dc-to-dc converter output voltage is set by selecting the error-amplifier gain (see Figure 1), using the following expression:
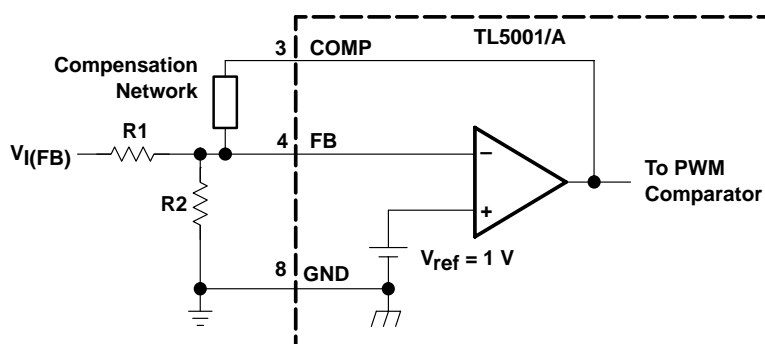
$$V_O = (1 + R1/R2)\ (1\ V)$$

Figure 1. Error-Amplifier Gain Setting

The error-amplifier output is brought out as COMP for use in compensating the dc-to-dc converter control loop for stability. Because the amplifier can only source 45 μA, the total dc load resistance should be 100 kΩ or more.

oscillator/PWM

The oscillator frequency (f_{osc}) can be set between 20 kHz and 500 kHz by connecting a resistor between RT and GND. Acceptable resistor values range from 15 kΩ to 250 kΩ. The oscillator frequency can be determined by using the graph shown in Figure 5.

The oscillator output is a triangular wave with a minimum value of approximately 0.7 V and a maximum value of approximately 1.3 V. The PWM comparator compares the error-amplifier output voltage and the DTC input voltage to the triangular wave and turns the output transistor off whenever the triangular wave is greater than the lesser of the two inputs.

dead-time control (DTC)

DTC provides a means of limiting the output-switch duty cycle to a value less than 100%, which is critical for boost and flyback converters. A current source generates a reference current (I_{DT}) at DTC that is nominally equal to the current at the oscillator timing terminal, RT. Connecting a resistor between DTC and GND generates a dead-time reference voltage (V_{DT}), which the PWM/DTC comparator compares to the oscillator triangle wave as described in the previous section. Nominally, the maximum duty cycle is 0% when V_{DT} is 0.7 V or less and 100% when V_{DT} is 1.3 V or greater. Because the triangle wave amplitude is a function of frequency and the source impedance of RT is relatively high (1250 Ω), choosing R_{DT} for a specific maximum duty cycle, D, is accomplished using the following equation and the voltage limits for the frequency in question as found in Figure 11 (V_{osc}max and V_{osc}min are the maximum and minimum oscillator levels):

![Texas Instruments logo]

TL5001, TL5001A
PULSE-WIDTH-MODULATION CONTROL CIRCUITS

SLVS084F – APRIL 1994 – REVISED JANUARY 2002

dead-time control (DTC) (continued)

$$R_{DT} = \left(R_t + 1250\right)\left[D\left(V_{osc}max - V_{osc}min\right) + V_{osc}min\right]$$

Where

R_{DT} and R_t are in ohms, D in decimal

Soft start can be implemented by paralleling the DTC resistor with a capacitor (C_{DT}) as shown in Figure 2. During soft start, the voltage at DTC is derived by the following equation:

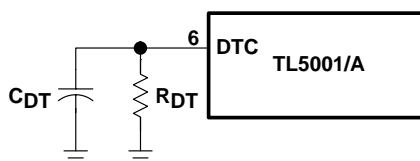$$V_{DT} \approx I_{DT}R_{DT}\left(1-e^{\left(-t/R_{DT}C_{DT}\right)}\right)$$

Figure 2. Soft-Start Circuit

If the dc-to-dc converter must be in regulation within a specified period of time, the time constant, $R_{DT}C_{DT}$, should be $t_0/3$ to $t_0/5$. The TL5001/A remains off until $V_{DT} \approx 0.7$ V, the minimum ramp value. C_{DT} is discharged every time UVLO or SCP becomes active.

undervoltage-lockout (UVLO) protection

The undervoltage-lockout circuit turns the output transistor off and resets the SCP latch whenever the supply voltage drops too low (approximately 3 V at 25°C) for proper operation. A hysteresis voltage of 200 mV eliminates false triggering on noise and chattering.

short-circuit protection (SCP)

The TL5001/A includes short-circuit protection (see Figure 3), which turns the power switch off to prevent damage when the converter output is shorted. When activated, the SCP prevents the switch from being turned on until the internal latching circuit is reset. The circuit is reset by reducing the input voltage until UVLO becomes active or until the SCP terminal is pulled to ground externally.

When a short circuit occurs, the error-amplifier output at COMP rises to increase the power-switch duty cycle in an attempt to maintain the output voltage. SCP comparator 1 starts an RC timing circuit when COMP exceeds 1.5 V. If the short is removed and the error-amplifier output drops below 1.5 V before time out, normal converter operation continues. If the fault is still present at the end of the time-out period, the timer sets the latching circuit and turns off the TL5001/A output transistor.

TEXAS
INSTRUMENTS

Distributor of Texas Instruments: Excellent Integrated System Limited
Datasheet of TL5001CDR - IC REG CTRLR PWM 8SOIC
Contact us: sales@integrated-circuit.com Website: www.integrated-circuit.com

TL5001, TL5001A
PULSE-WIDTH-MODULATION CONTROL CIRCUITS

SLVS084F – APRIL 1994 – REVISED JANUARY 2002

short-circuit protection (SCP) (continued)
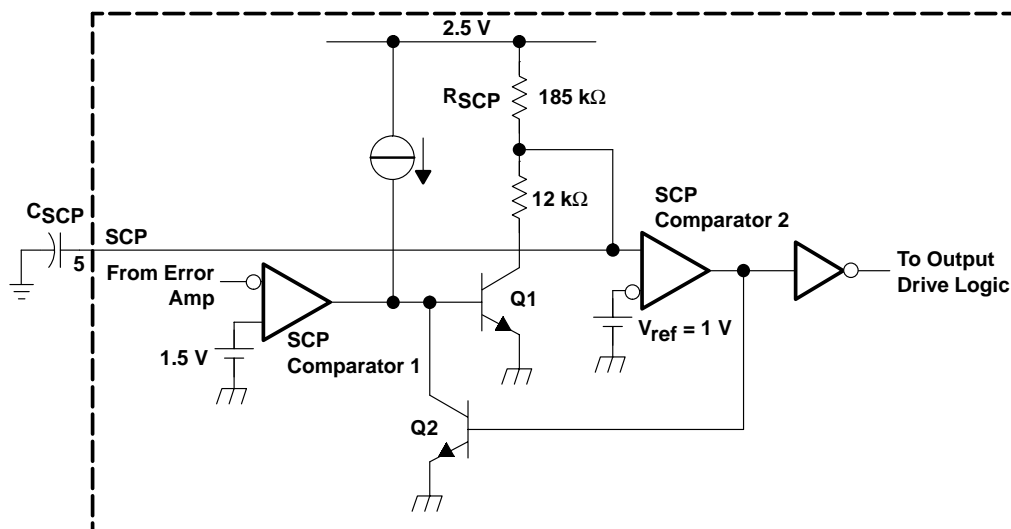
Figure 3. SCP Circuit

The timer operates by charging an external capacitor (C_{SCP}), connected between the SCP terminal and ground, towards 2.5 V through a 185-kΩ resistor (R_{SCP}). The circuit begins charging from an initial voltage of approximately 185 mV and times out when the capacitor voltage reaches 1 V. The output of SCP comparator 2 then goes high, turns on Q2, and latches the timer circuit. The expression for setting the SCP time period is derived from the following equation:

$$V_{SCP} = (2.5 - 0.185)\left(1 - e^{-t/\tau}\right) + 0.185$$

Where

$$\tau = R_{SCP}C_{SCP}$$

The end of the time-out period, t_{SCP}, occurs when $V_{SCP} = 1$ V. Solving for C_{SCP} yields:

$$C_{SCP} = 12.46 \times t_{SCP}$$

Where

t is in seconds, C in μF.

t_{SCP} must be much longer (generally 10 to 15 times) than the converter start-up period or the converter will not start.

output transistor

The output of the TL5001/A is an open-collector transistor with a maximum collector current rating of 21 mA and a voltage rating of 51 V. The output is turned on under the following conditions: the oscillator triangle wave is lower than both the DTC voltage and the error-amplifier output voltage, the UVLO circuit is inactive, and the short-circuit protection circuit is inactive.

TL5001, TL5001A
PULSE-WIDTH-MODULATION CONTROL CIRCUITS

SLVS084F – APRIL 1994 – REVISED JANUARY 2002

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

Supply voltage, V_{CC} (see Note 1)	41 V
Amplifier input voltage, $V_{I(FB)}$	20 V
Output voltage, V_O, OUT	51 V
Output current, I_O, OUT	21 mA
Output peak current, $I_{O(peak)}$, OUT	100 mA
Continuous total power dissipation	See Dissipation Rating Table
Operating ambient temperature range, T_A: TL5001C, TL5001AC	−20°C to 85°C
TL5001I, TL5001AI	−40°C to 85°C
TL5001Q, TL5001AQ	−40°C to 125°C
TL5001M, TL5001AM	−55°C to 125°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.

NOTE 1:   All voltage values are with respect to network ground terminal.

DISSIPATION RATING TABLE

PACKAGE	$T_A \leq 25°C$ POWER RATING	DERATING FACTOR ABOVE $T_A = 25°C$	$T_A = 70°C$ POWER RATING	$T_A = 85°C$ POWER RATING	$T_A = 125°C$ POWER RATING
D	725 mW	5.8 mW/°C	464 mW	377 mW	145 mW
FK	1375 mW	11.0 mW/°C	880 mW	715 mW	275 mW
JG	1050 mW	8.4 mW/°C	672 mW	546 mW	210 mW
P	1000 mW	8.0 mW/°C	640 mW	520 mW	200 mW

recommended operating conditions

		MIN	MAX	UNIT
Supply voltage, V_{CC}		3.6	40	V
Amplifier input voltage, $V_{I(FB)}$		0	1.5	V
Output voltage, V_O, OUT			50	V
Output current, I_O, OUT			20	mA
COMP source current			45	μA
COMP dc load resistance		100		kΩ
Oscillator timing resistor, R_t		15	250	kΩ
Oscillator frequency, f_{OSC}		20	500	kHz
Operating ambient temperature, T_A	TL5001C, TL5001AC	−20	85	°C
	TL5001I, TL5001AI	−40	85	
	TL5001Q, TL5001AQ	−40	125	
	TL5001M, TL5001AM	−55	125	

TEXAS INSTRUMENTS

POST OFFICE BOX 655303 ● DALLAS, TEXAS 75265

TL5001, TL5001A
PULSE-WIDTH-MODULATION CONTROL CIRCUITS

SLVS084F – APRIL 1994 – REVISED JANUARY 2002

electrical characteristics over recommended operating free-air temperature range, V_{CC} = 6 V, f_{osc} = 100 kHz (unless otherwise noted)

reference

PARAMETER	TEST CONDITIONS	TL5001C, TL5001I			TL5001AC, TL5001AI			UNIT
		MIN	TYP†	MAX	MIN	TYP†	MAX	
Output voltage	COMP connected to FB	0.95	1	1.05	0.97	1	1.03	V
Input regulation	V_{CC} = 3.6 V to 40 V		2	12.5		2	12.5	mV
Output voltage change with temperature	T_A = −20°C to 25°C (C suffix)	−10	−1	10	−10	−1	10	mV/V
	T_A = −40°C to 25°C (I suffix)	−10	−1	10	−10	−1	10	
	T_A = 25°C to 85°C	−10	−2	10	−10	−2	10	

† All typical values are at T_A = 25°C.

undervoltage lockout

PARAMETER	TEST CONDITIONS	TL5001C, TL5001I			TL5001AC, TL5001AI			UNIT
		MIN	TYP†	MAX	MIN	TYP†	MAX	
Upper threshold voltage	T_A = 25°C		3			3		V
Lower threshold voltage	T_A = 25°C		2.8			2.8		V
Hysteresis	T_A = 25°C	100	200		100	200		mV
Reset threshold voltage	T_A = 25°C	2.1	2.55		2.1	2.55		V

† All typical values are at T_A = 25°C.

short-circuit protection

PARAMETER	TEST CONDITIONS	TL5001C, TL5001I			TL5001AC, TL5001AI			UNIT
		MIN	TYP†	MAX	MIN	TYP†	MAX	
SCP threshold voltage	T_A = 25°C	0.95	1.00	1.05	0.97	1.00	1.03	V
SCP voltage, latched	No pullup	140	185	230	140	185	230	mV
SCP voltage, UVLO standby	No pullup		60	120		60	120	mV
Input source current	T_A = 25°C	−10	−15	−20	−10	−15	−20	μA
SCP comparator 1 threshold voltage			1.5			1.5		V

† All typical values are at T_A = 25°C.

oscillator

PARAMETER	TEST CONDITIONS	TL5001C, TL5001I			TL5001AC, TL5001AI			UNIT
		MIN	TYP†	MAX	MIN	TYP†	MAX	
Frequency	R_t = 100 kΩ		100			100		kHz
Standard deviation of frequency			15			15		kHz
Frequency change with voltage	V_{CC} = 3.6 V to 40 V		1			1		kHz
Frequency change with temperature	T_A = −40°C to 25°C	−4	−0.4	4	−4	−0.4	4	kHz
	T_A = −20°C to 25°C	−4	−0.4	4	−4	−0.4	4	kHz
	T_A = 25°C to 85°C	−4	−0.2	4	−4	−0.2	4	kHz
Voltage at RT			1			1		V

† All typical values are at T_A = 25°C.

TL5001, TL5001A
PULSE-WIDTH-MODULATION CONTROL CIRCUITS

SLVS084F – APRIL 1994 – REVISED JANUARY 2002

electrical characteristics over recommended operating free-air temperature range, V_{CC} = 6 V, f_{osc} = 100 kHz (unless otherwise noted) (continued)

dead-time control

PARAMETER		TEST CONDITIONS	TL5001C, TL5001I			TL5001AC, TL5001AI			UNIT
			MIN	TYP†	MAX	MIN	TYP†	MAX	
Output (source) current	TL5001C	$V_{(DT)}$ = 1.5 V	$0.9 \times I_{RT}$‡		$1.1 \times I_{RT}$	$0.9 \times I_{RT}$‡		$1.1 \times I_{RT}$	μA
	TL5001I	$V_{(DT)}$ = 1.5 V	$0.9 \times I_{RT}$‡		$1.2 \times I_{RT}$	$0.9 \times I_{RT}$‡		$1.2 \times I_{RT}$	
Input threshold voltage		Duty cycle = 0%	0.5	0.7		0.5	0.7		V
		Duty cycle = 100%		1.3	1.5		1.3	1.5	

† All typical values are at T_A = 25°C.
‡ Output source current at RT

error amplifier

PARAMETER		TEST CONDITIONS	TL5001C, TL5001I			TL5001AC, TL5001AI			UNIT
			MIN	TYP†	MAX	MIN	TYP†	MAX	
Input voltage		V_{CC} = 3.6 V to 40 V	0		1.5	0		1.5	V
Input bias current				−160	−500		−160	−500	nA
Output voltage swing	Positive		1.5	2.3		1.5	2.3		V
	Negative			0.3	0.4		0.3	0.4	V
Open-loop voltage amplification				80			80		dB
Unity-gain bandwidth				1.5			1.5		MHz
Output (sink) current		$V_{I(FB)}$ = 1.2 V, COMP = 1 V	100	600		100	600		μA
Output (source) current		$V_{I(FB)}$ = 0.8 V, COMP = 1 V	−45	−70		−45	−70		μA

† All typical values are at T_A = 25°C.

output

PARAMETER	TEST CONDITIONS	TL5001C, TL5001I			TL5001AC, TL5001AI			UNIT
		MIN	TYP†	MAX	MIN	TYP†	MAX	
Output saturation voltage	I_O = 10 mA		1.5	2		1.5	2	V
Off-state current	V_O = 50 V, V_{CC} = 0			10			10	μA
	V_O = 50 V			10			10	
Short-circuit output current	V_O = 6 V		40			40		mA

† All typical values are at T_A = 25°C.

total device

PARAMETER		TEST CONDITIONS	TL5001C, TL5001I			TL5001AC, TL5001AI			UNIT
			MIN	TYP†	MAX	MIN	TYP†	MAX	
Standby supply current	Off state			1	1.5		1	1.5	mA
Average supply current		R_t = 100 kΩ		1.4	2.1		1.4	2.1	mA

† All typical values are at T_A = 25°C.

TEXAS INSTRUMENTS
POST OFFICE BOX 655303 ● DALLAS, TEXAS 75265

electrical characteristics over recommended operating free-air temperature range, V_{CC} = 6 V, f_{osc} = 100 kHz (unless otherwise noted)

reference

PARAMETER	TEST CONDITIONS		TL5001Q, TL5001M			TL5001AQ, TL5001AM			UNIT
			MIN	TYP†	MAX	MIN	TYP†	MAX	
Output voltage	T_A = 25°C	COMP connected to FB	0.95	1.00	1.05	0.97	1.00	1.03	V
	T_A = MIN to MAX		0.93	0.98	1.07	0.94	0.98	1.06	
Input regulation	T_A = MIN to MAX	V_{CC} = 3.6 V to 40 V		2	12.5		2	12.5	mV
Output voltage change with temperature	T_A = MIN to MAX		*−6	2	*6	*−6	2	*6	%

† All typical values are at T_A = 25°C.
*Not production tested.

undervoltage lockout

PARAMETER	TEST CONDITIONS	TL5001Q, TL5001M			TL5001AQ, TL5001AM			UNIT
		MIN	TYP†	MAX	MIN	TYP†	MAX	
Upper threshold voltage	T_A = MIN, 25°C		3.00			3.00		V
	T_A = MAX		2.55			2.55		
Lower threshold voltage	T_A = MIN, 25°C		2.8			2.8		V
	T_A = MAX		2.0			2.0		
Hysteresis	T_A = MIN to MAX	100	200		100	200		mV
Reset threshold voltage	T_A = MIN, 25°C	2.10	2.55		2.10	2.55		V
	T_A = MAX	0.35	0.63		0.35	0.63		

† All typical values are at T_A = 25°C.

short-circuit protection

PARAMETER	TEST CONDITIONS		TL5001Q, TL5001M			TL5001AQ, TL5001AM			UNIT
			MIN	TYP†	MAX	MIN	TYP†	MAX	
SCP threshold voltage	T_A = MIN, 25°C		0.95	1.00	1.05	0.97	1.00	1.03	V
	T_A = MAX		0.93	0.98	1.07	0.94	0.98	1.06	
SCP voltage, latched	T_A = MIN to MAX	No pullup	140	185	230	140	185	230	mV
SCP voltage, UVLO standby	T_A = MIN to MAX	No pullup		60	120		60	120	mV
Equivalent timing resistance	T_A = MIN to MAX			185			185		kΩ
SCP comparator 1 threshold voltage	T_A = MIN to MAX			1.5			1.5		V

† All typical values are at T_A = 25°C.

TL5001, TL5001A
PULSE-WIDTH-MODULATION CONTROL CIRCUITS

SLVS084F – APRIL 1994 – REVISED JANUARY 2002

electrical characteristics over recommended operating free-air temperature range, V_{CC} = 6 V, f_{osc} = 100 kHz (unless otherwise noted) (continued)

oscillator

PARAMETER	TEST CONDITIONS		TL5001Q, TL5001M			TL5001AQ, TL5001AM			UNIT
			MIN	TYP†	MAX	MIN	TYP†	MAX	
Frequency	T_A = MIN to MAX	R_t = 100 kΩ		100			100		kHz
Standard deviation of frequency	T_A = MIN to MAX			2			2		kHz
Frequency change with voltage	T_A = MIN to MAX	V_{CC} = 3.6 V to 40 V		1			1		kHz
Frequency change with temperature	T_A = MIN to MAX	Q suffix	*−6	3	*6	*−6	3	*6	kHz
		M suffix	*−9	5	*9	*−9	5	*9	
Voltage at RT	T_A = MIN to MAX			1			1		V

† All typical values are at T_A = 25°C.
*Not production tested.

dead-time control

PARAMETER	TEST CONDITIONS		TL5001Q, TL5001M			TL5001AQ, TL5001AM			UNIT
			MIN	TYP†	MAX	MIN	TYP†	MAX	
Output (source) current	T_A = MIN to MAX	$V_{(DT)}$ = 1.5 V	$0.9 \times I_{RT}$‡		$1.1 \times I_{RT}$	$0.9 \times I_{RT}$‡		$1.1 \times I_{RT}$	μA
Input threshold voltage	T_A = 25°C	Duty cycle = 0%	0.5	0.7		0.5	0.7		V
		Duty cycle = 100%		1.3	1.5		1.3	1.5	
	T_A = MIN to MAX	Duty cycle = 0%	0.4	0.7		0.4	0.7		
		Duty cycle = 100%		1.3	1.7		1.3	1.7	

† All typical values are at T_A = 25°C.
‡ Output source current at RT

error amplifier

PARAMETER	TEST CONDITIONS		TL5001Q, TL5001M			TL5001AQ, TL5001AM			UNIT
			MIN	TYP†	MAX	MIN	TYP†	MAX	
Input bias current	T_A = MIN to MAX			−160	−500		−160	−500	nA
Output voltage swing	Positive	T_A = MIN to MAX	1.5	2.3		1.5	2.3		V
	Negative			0.3	0.4		0.3	0.4	V
Open-loop voltage amplification	T_A = MIN to MAX			80			80		dB
Unity-gain bandwidth	T_A = MIN to MAX			1.5			1.5		MHz
Output (sink) current	T_A = MIN to MAX	$V_{I(FB)}$ = 1.2 V, COMP = 1 V	100	600		100	600		μA
Output (source) current	T_A = MIN, 25°C	$V_{I(FB)}$ = 0.8 V, COMP = 1 V	−45	−70		−45	−70		μA
	T_A = MAX		−30	−45		−30	−45		

† All typical values are at T_A = 25°C.

TEXAS INSTRUMENTS

POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

electrical characteristics over recommended operating free-air temperature range, V_{CC} = 6 V, f_{osc} = 100 kHz (unless otherwise noted) (continued)

output

PARAMETER	TEST CONDITIONS		TL5001Q, TL5001M			TL5001AQ, TL5001AM			UNIT
			MIN	TYP†	MAX	MIN	TYP†	MAX	
Output saturation voltage	T_A = MIN to MAX	I_O = 10 mA		1.5	2		1.5	2	V
Off-state current	T_A = MIN to MAX	V_O = 50 V, V_{CC} = 0			10			10	μA
		V_O = 50 V			10			10	
Short-circuit output current	T_A = MIN to MAX	V_O = 6 V		40			40		mA

† All typical values are at T_A = 25°C.

total device

PARAMETER	TEST CONDITIONS		TL5001Q, TL5001M			TL5001AQ, TL5001AM			UNIT
			MIN	TYP†	MAX	MIN	TYP†	MAX	
Standby supply current	Off state	T_A = MIN to MAX		1	1.5		1	1.5	mA
Average supply current	T_A = MIN to MAX	R_t = 100 kΩ		1.4	2.1		1.4	2.1	mA

† All typical values are at T_A = 25°C.

TL5001, TL5001A
PULSE-WIDTH-MODULATION CONTROL CIRCUITS

SLVS084F – APRIL 1994 – REVISED JANUARY 2002

PARAMETER MEASUREMENT INFORMATION
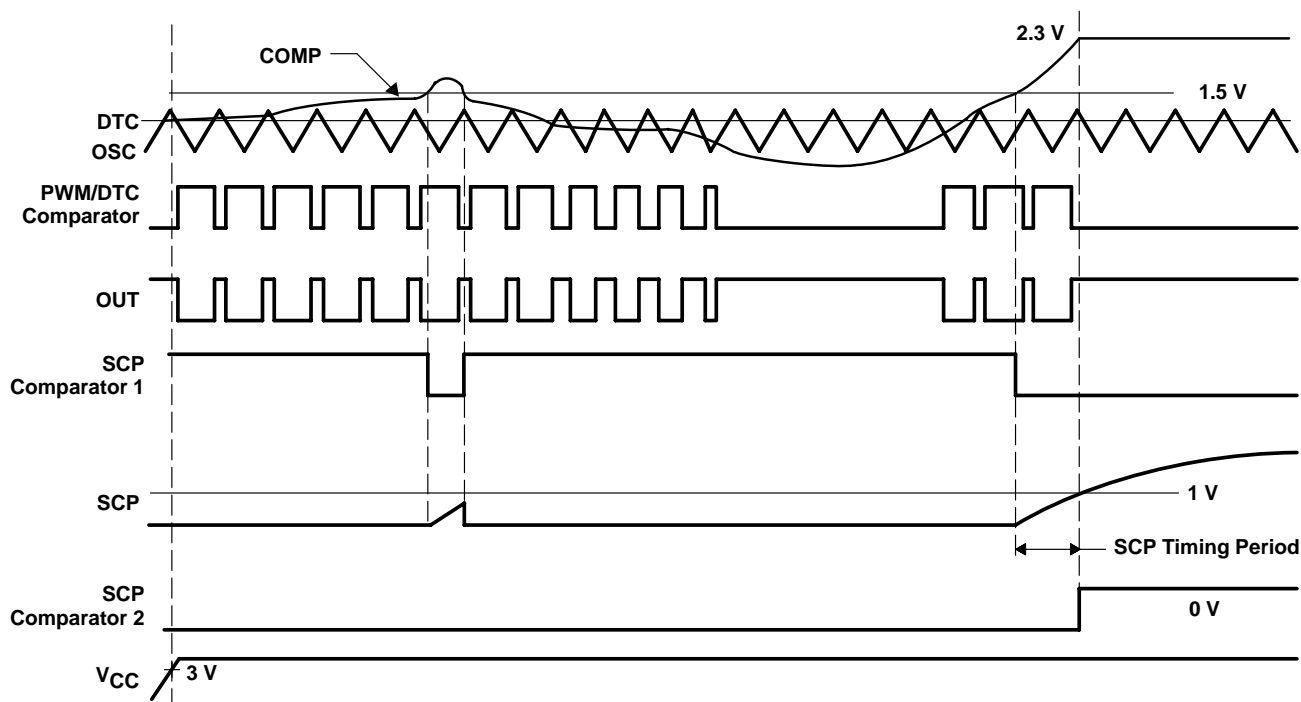
NOTE A: The waveforms show timing characteristics for an intermittent short circuit and a longer short circuit that is sufficient to activate SCP.

Figure 4. PWM Timing Diagram

![Texas Instruments logo]

POST OFFICE BOX 655303 ● DALLAS, TEXAS 75265

TYPICAL CHARACTERISTICS

OSCILLATOR FREQUENCY
vs
TIMING RESISTANCE

V_{CC} = 6 V
DT Resistance = R_t
T_A = 25°C

f_{osc} – Oscillator Frequency – Hz

R_t – Timing Resistance – Ω

Figure 5

OSCILLATION FREQUENCY
vs
AMBIENT TEMPERATURE

V_{CC} = 6 V
R_t = 100 kΩ
DT Resistance = 100 kΩ

f_{osc} – Oscillation Frequency – kHz

T_A – Ambient Temperature – °C

Figure 6

REFERENCE OUTPUT VOLTAGE
vs
POWER-SUPPLY VOLTAGE

T_A = 25°C
FB and COMP
Connected Together

V_{ref} – Reference Output Voltage – V

V_{CC} – Power-Supply Voltage – V

Figure 7

REFERENCE OUTPUT VOLTAGE FLUCTUATION
vs
AMBIENT TEMPERATURE

V_{CC} = 6 V
FB and COMP
Connected Together

ΔV_{ref} – Reference Output Voltage Fluctuation – %

T_A – Ambient Temperature – °C

Figure 8

TL5001, TL5001A
PULSE-WIDTH-MODULATION CONTROL CIRCUITS

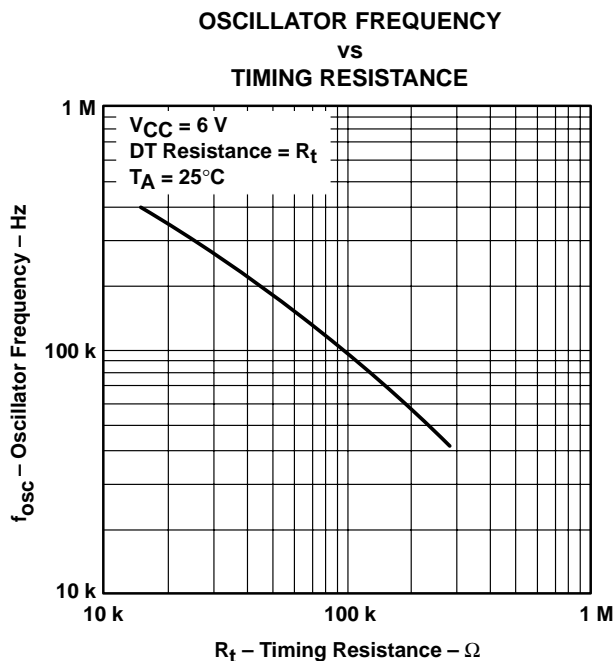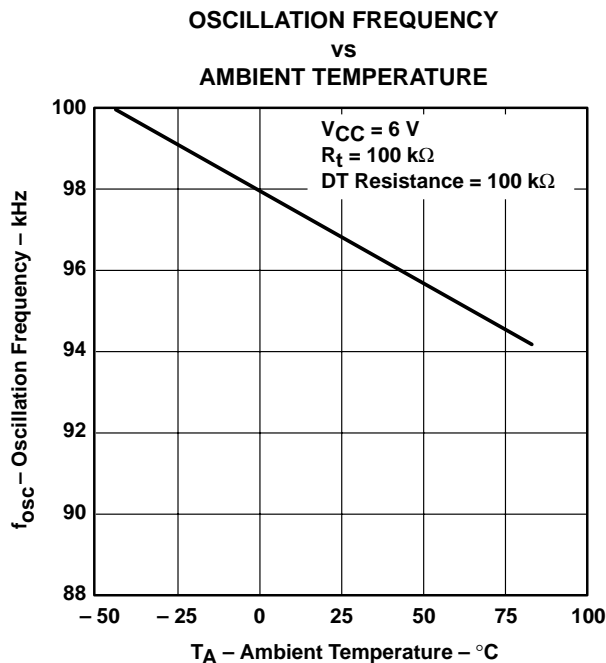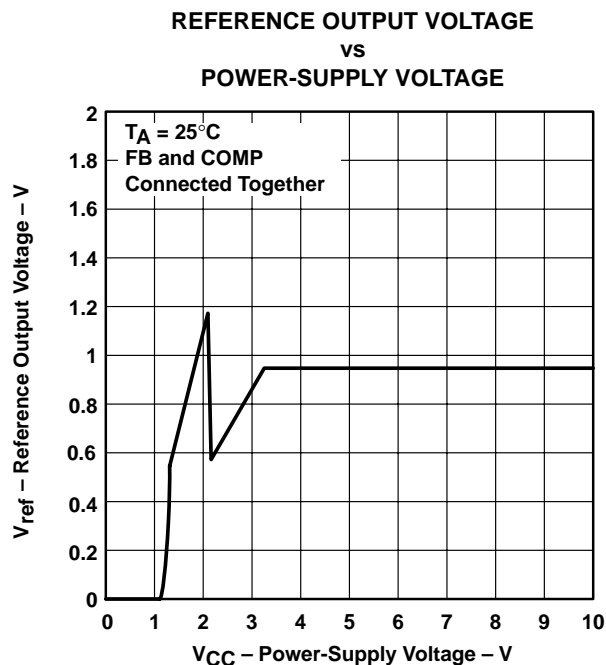SLVS084F – APRIL 1994 – REVISED JANUARY 2002

TYPICAL CHARACTERISTICS

AVERAGE SUPPLY CURRENT
vs
POWER-SUPPLY VOLTAGE

Figure 9

AVERAGE SUPPLY CURRENT
vs
AMBIENT TEMPERATURE

Figure 10

PWM TRIANGLE WAVE AMPLITUDE VOLTAGE
vs
OSCILLATOR FREQUENCY

Figure 11

ERROR AMPLIFIER OUTPUT VOLTAGE
vs
OUTPUT (SINK) CURRENT

Figure 12

TEXAS
INSTRUMENTS

POST OFFICE BOX 655303 ● DALLAS, TEXAS 75265

TYPICAL CHARACTERISTICS

ERROR AMPLIFIER OUTPUT VOLTAGE
vs
OUTPUT (SOURCE) CURRENT

Figure 13

ERROR AMPLIFIER OUTPUT VOLTAGE
vs
AMBIENT TEMPERATURE

Figure 14

ERROR AMPLIFIER OUTPUT VOLTAGE
vs
AMBIENT TEMPERATURE

Figure 15

ERROR AMPLIFIER OPEN-LOOP GAIN AND
PHASE SHIFT
vs
FREQUENCY

Figure 16

TEXAS
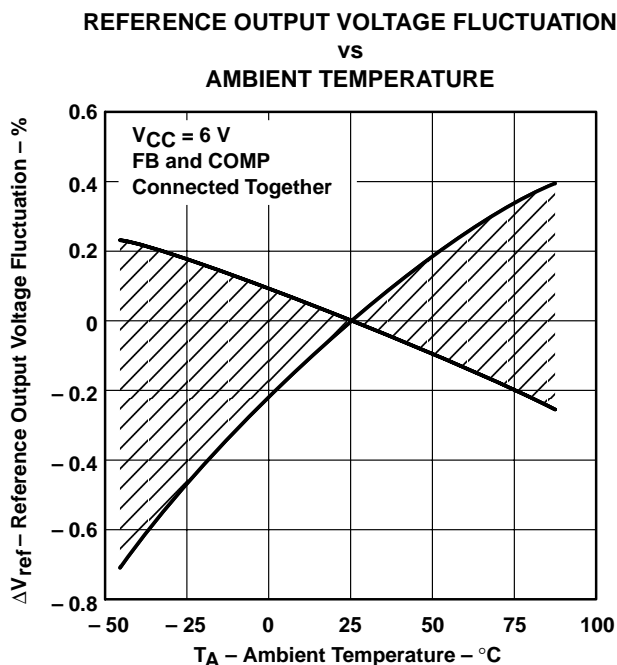**INSTRUMENTS**

POST OFFICE BOX 655303 ● DALLAS, TEXAS 75265

15
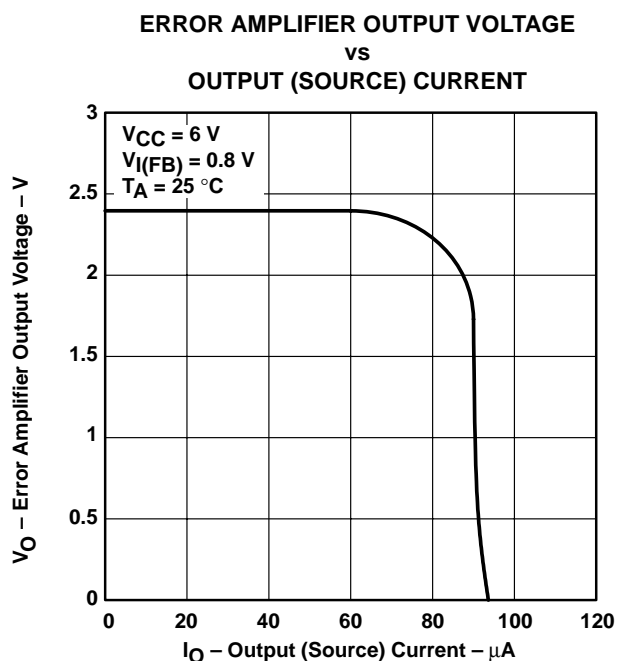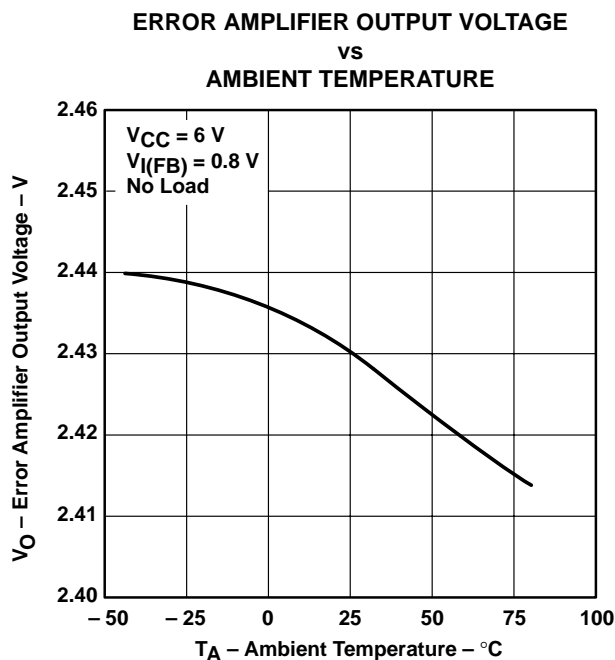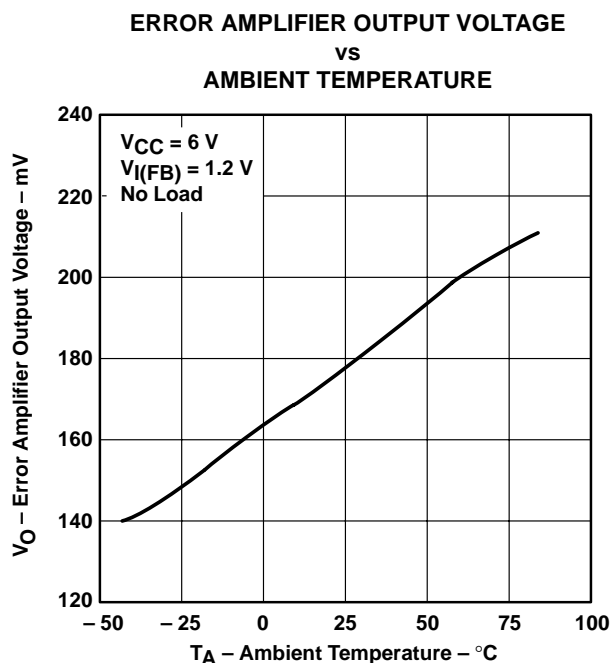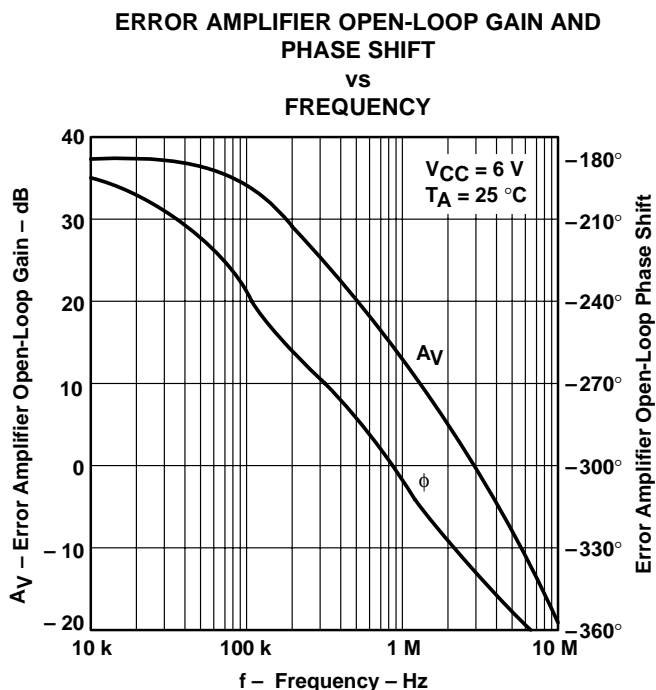
TL5001, TL5001A
PULSE-WIDTH-MODULATION CONTROL CIRCUITS

SLVS084F – APRIL 1994 – REVISED JANUARY 2002

TYPICAL CHARACTERISTICS

OUTPUT DUTY CYCLE
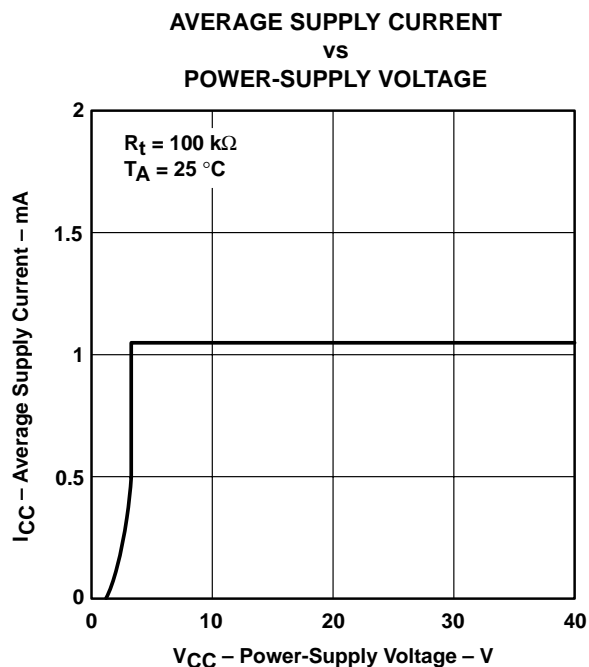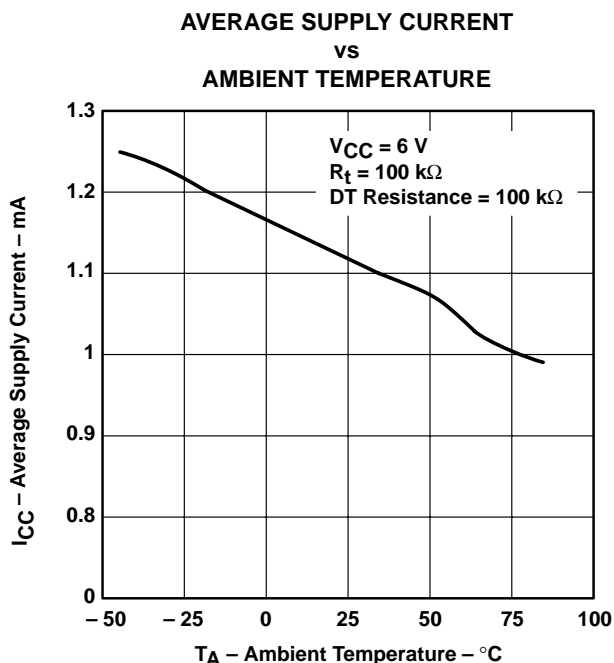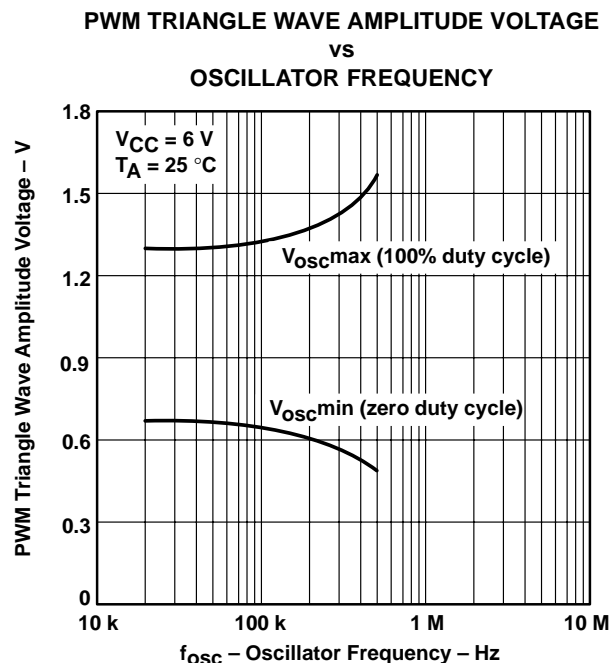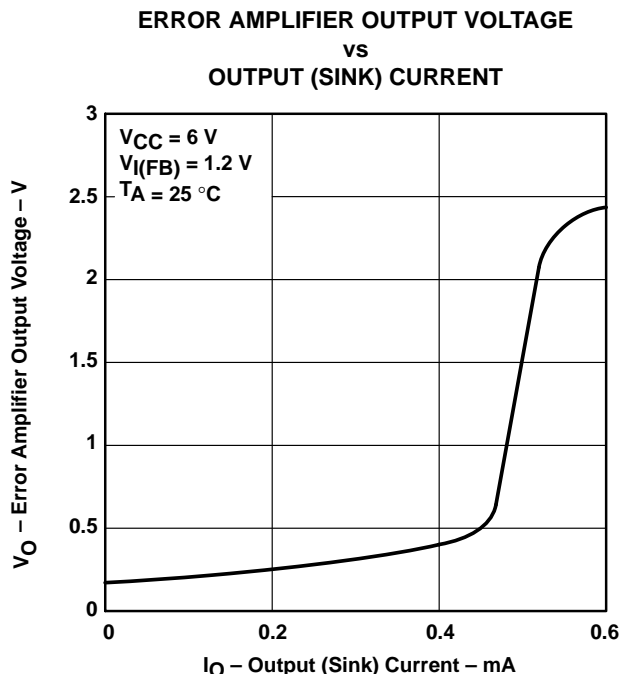**vs**
DTC VOLTAGE

V_{CC} = 6 V
R_t = 100 kΩ
T_A = 25 °C
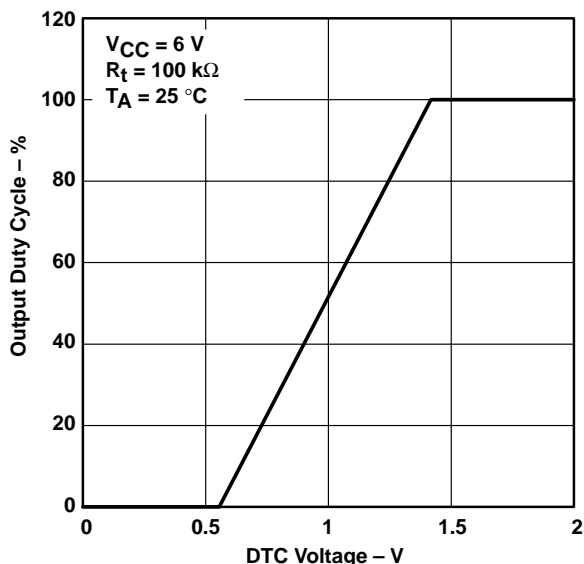
Figure 17

SCP TIME-OUT PERIOD
vs
SCP CAPACITANCE

V_{CC} = 6 V
R_t = 100 kΩ
DT Resistance = 200 kΩ
T_A = 25 °C
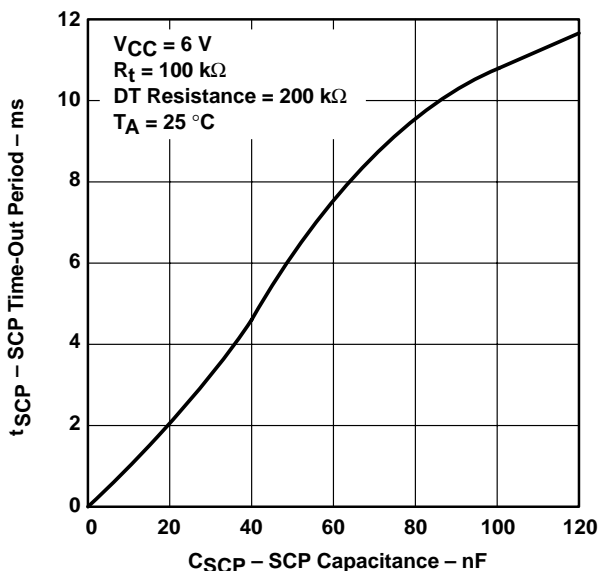
Figure 18

DTC OUTPUT CURRENT
vs
RT OUTPUT CURRENT

DT Voltage = 1.3 V
T_A = 25 °C
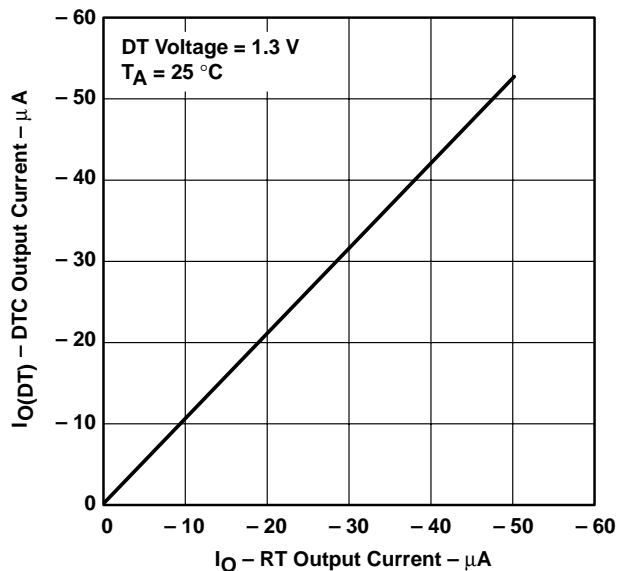
Figure 19

OUTPUT SATURATION VOLTAGE
vs
OUTPUT (SINK) CURRENT

V_{CC} = 6 V
T_A = 25 °C

Figure 20

TEXAS INSTRUMENTS
POST OFFICE BOX 655303 ● DALLAS, TEXAS 75265

16
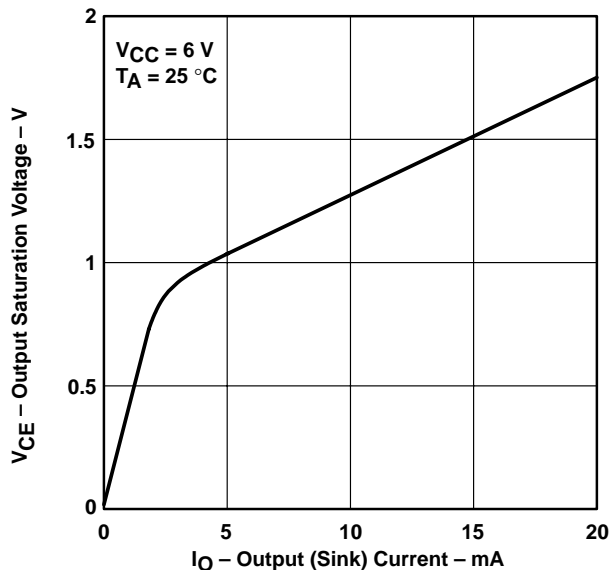
APPLICATION INFORMATION
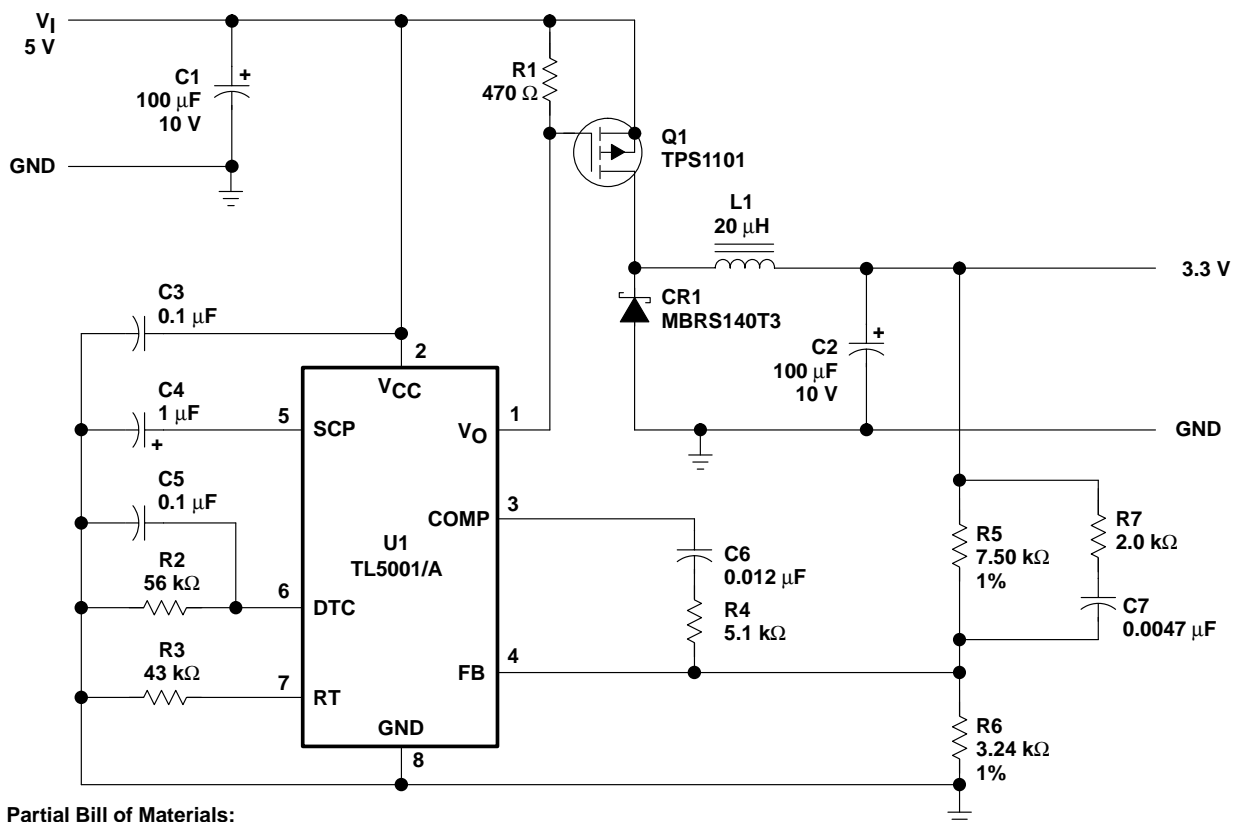
Partial Bill of Materials:

U1	TL5001/A	**Texas Instruments**
Q1	TPS1101	**Texas Instruments**
LI	CTX20-1 or	**Coiltronics**
	23 turns of #28 wire on	
	Micrometals No. T50-26B core	
C1	TPSD107M010R0100	**AVX**
C2	TPSD107M010R0100	**AVX**
CR1	MBRS140T3	**Motorola**

NOTES: A. Frequency = 200 kHz
    B. Duty cycle = 90% max
    C. Soft-start time constant (TC) = 5.6 ms
    D. SCP TC = 70 msA

Figure 21. Step-Down Converter

TL5001, TL5001A
PULSE-WIDTH-MODULATION CONTROL CIRCUITS

SLVS084F – APRIL 1994 – REVISED JANUARY 2002

MECHANICAL DATA

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

14 PIN SHOWN

PINS **	8	14	16
DIM			
A MAX	0.197 (5,00)	0.344 (8,75)	0.394 (10,00)
A MIN	0.189 (4,80)	0.337 (8,55)	0.386 (9,80)

4040047 / D 10/96
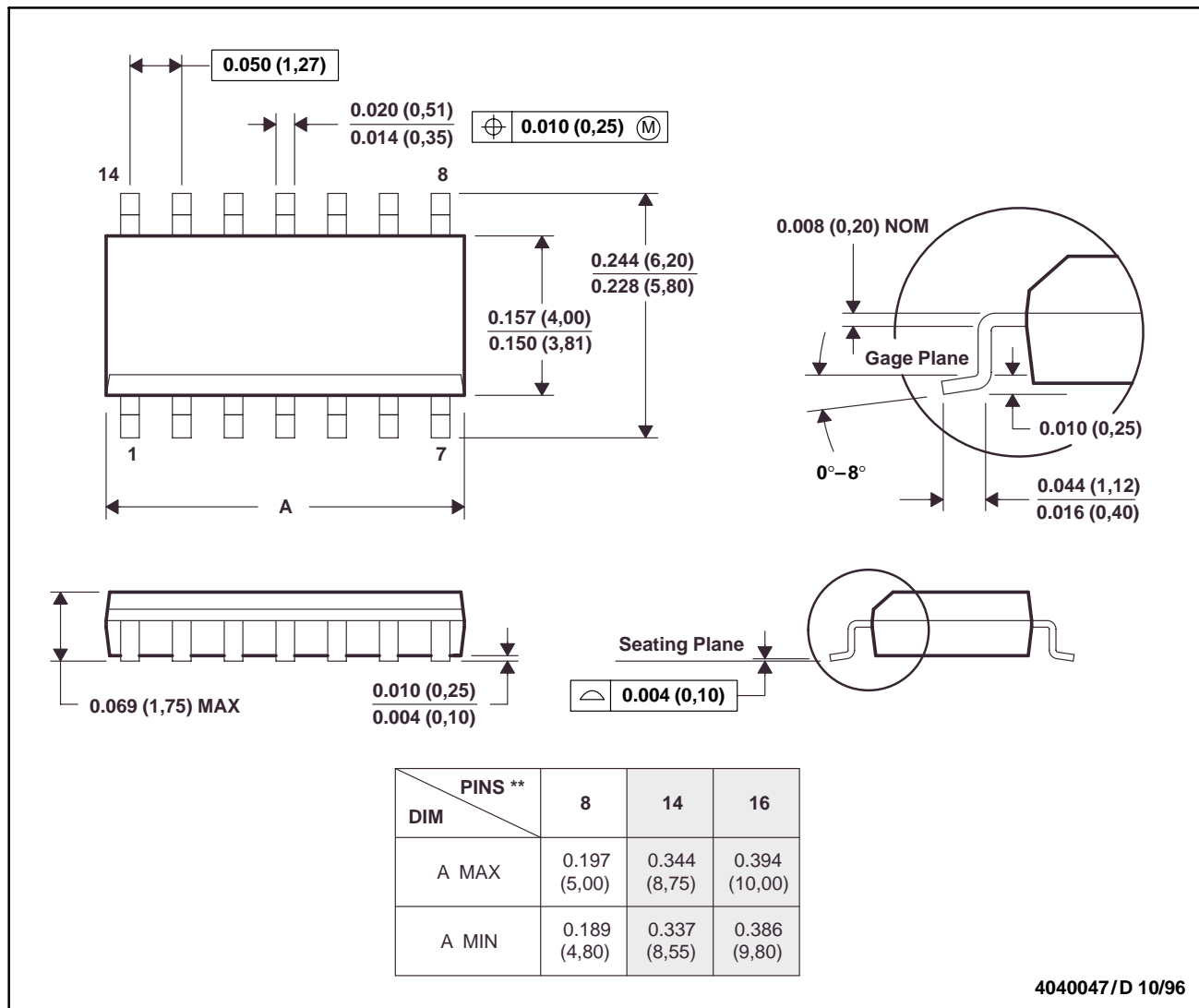
NOTES: B. All linear dimensions are in inches (millimeters).
C. This drawing is subject to change without notice.
D. Body dimensions do not include mold flash or protrusion, not to exceed 0.006 (0,15).
E. Falls within JEDEC MS-012

![Texas Instruments logo]
TEXAS INSTRUMENTS
POST OFFICE BOX 655303 ● DALLAS, TEXAS 75265

18

MECHANICAL DATA

FK (S-CQCC-N)**   **LEADLESS CERAMIC CHIP CARRIER**

28 TERMINALS SHOWN
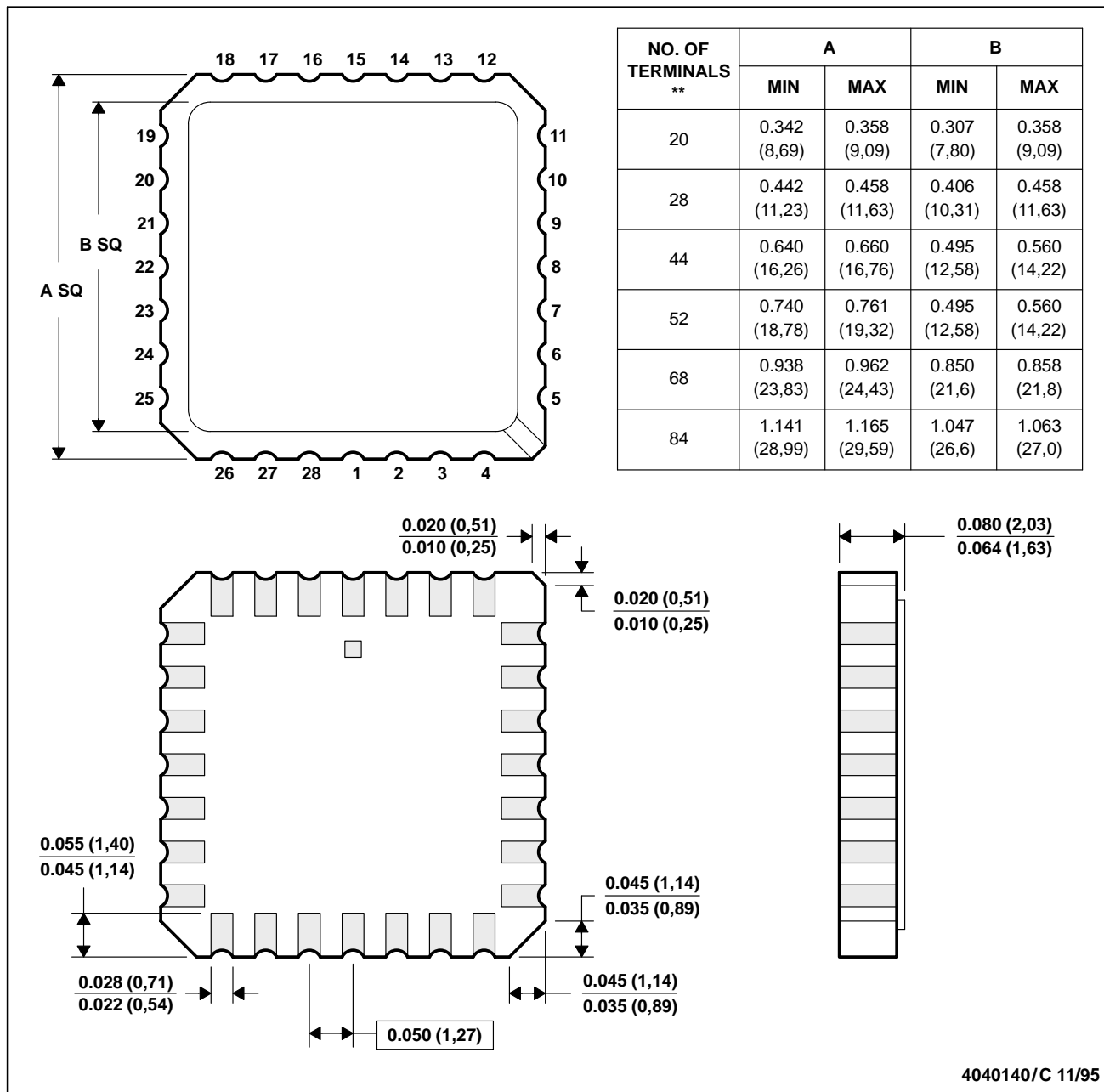
NO. OF TERMINALS **	A		B	
	MIN	MAX	MIN	MAX
20	0.342 (8,69)	0.358 (9,09)	0.307 (7,80)	0.358 (9,09)
28	0.442 (11,23)	0.458 (11,63)	0.406 (10,31)	0.458 (11,63)
44	0.640 (16,26)	0.660 (16,76)	0.495 (12,58)	0.560 (14,22)
52	0.740 (18,78)	0.761 (19,32)	0.495 (12,58)	0.560 (14,22)
68	0.938 (23,83)	0.962 (24,43)	0.850 (21,6)	0.858 (21,8)
84	1.141 (28,99)	1.165 (29,59)	1.047 (26,6)	1.063 (27,0)

4040140/C 11/95

NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. This package can be hermetically sealed with a metal lid.
D. The terminals are gold-plated.
E. Falls within JEDEC MS-004

![Texas Instruments logo]
TEXAS INSTRUMENTS

Distributor of Texas Instruments: Excellent Integrated System Limited
Datasheet of TL5001CDR - IC REG CTRLR PWM 8SOIC
Contact us: sales@integrated-circuit.com Website: www.integrated-circuit.com

PACKAGE OPTION ADDENDUM

www.ti.com

29-Apr-2016

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
5962-9958301QPA	ACTIVE	CDIP	JG	8	1	TBD	A42	N / A for Pkg Type	-55 to 125	9958301QPA TL5001M	Samples
5962-9958302Q2A	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type	-55 to 125	5962-9958302Q2A TL5001 AMFKB	Samples
5962-9958302QPA	ACTIVE	CDIP	JG	8	1	TBD	A42	N / A for Pkg Type	-55 to 125	9958302QPA TL5001AM	Samples
TL5001ACD	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-20 to 85	5001AC	Samples
TL5001ACDG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-20 to 85	5001AC	Samples
TL5001ACDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-20 to 85	5001AC	Samples
TL5001ACDRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-20 to 85	5001AC	Samples
TL5001AID	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	5001AI	Samples
TL5001AIDG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	5001AI	Samples
TL5001AIDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	5001AI	Samples
TL5001AIDRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	5001AI	Samples
TL5001AIP	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	-40 to 85	TL5001AIP	Samples
TL5001AIPE4	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	-40 to 85	TL5001AIP	Samples
TL5001AMFKB	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type	-55 to 125	5962-9958302Q2A TL5001 AMFKB	Samples
TL5001AMJGB	ACTIVE	CDIP	JG	8	1	TBD	A42	N / A for Pkg Type	-55 to 125	9958302QPA TL5001AM	Samples

PACKAGE OPTION ADDENDUM

www.ti.com

29-Apr-2016

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
TL5001AQD	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	5001AQ	Samples
TL5001AQDG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM		5001AQ	Samples
TL5001AQDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	5001AQ	Samples
TL5001AQDRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM		5001AQ	Samples
TL5001CD	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-25 to 85	5001C	Samples
TL5001CDG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-25 to 85	5001C	Samples
TL5001CDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-25 to 85	5001C	Samples
TL5001CDRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-25 to 85	5001C	Samples
TL5001CP	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	-25 to 85	TL5001CP	Samples
TL5001CPE4	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	-25 to 85	TL5001CP	Samples
TL5001CPS	ACTIVE	SO	PS	8	80	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM		T5001	Samples
TL5001CPSLE	OBSOLETE	SO	PS	8		TBD	Call TI	Call TI			
TL5001CPSR	ACTIVE	SO	PS	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-25 to 85	T5001	Samples
TL5001CPSRG4	ACTIVE	SO	PS	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-25 to 85	T5001	Samples
TL5001ID	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	5001I	Samples
TL5001IDG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	5001I	Samples
TL5001IDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	5001I	Samples
TL5001IDRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	5001I	Samples

Addendum-Page 2

PACKAGE OPTION ADDENDUM

www.ti.com   29-Apr-2016

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
TL5001IP	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	-40 to 85	TL5001IP	Samples
TL5001IPE4	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	-40 to 85	TL5001IP	Samples
TL5001IPSR	ACTIVE	SO	PS	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM		Z5001	Samples
TL5001MJG	ACTIVE	CDIP	JG	8	1	TBD	A42	N / A for Pkg Type	-55 to 125	TL5001MJG	Samples
TL5001MJGB	ACTIVE	CDIP	JG	8	1	TBD	A42	N / A for Pkg Type	-55 to 125	9958301QPA TL5001M	Samples
TL5001QD	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	5001Q	Samples
TL5001QDG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM		5001Q	Samples
TL5001QDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	5001Q	Samples
TL5001QDRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM		5001Q	Samples

(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) 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)

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

Distributor of Texas Instruments: Excellent Integrated System Limited
Datasheet of TL5001CDR - IC REG CTRLR PWM 8SOIC
Contact us: sales@integrated-circuit.com Website: www.integrated-circuit.com

PACKAGE OPTION ADDENDUM

(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.

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

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 TL5001, TL5001A, TL5001AM, TL5001M :
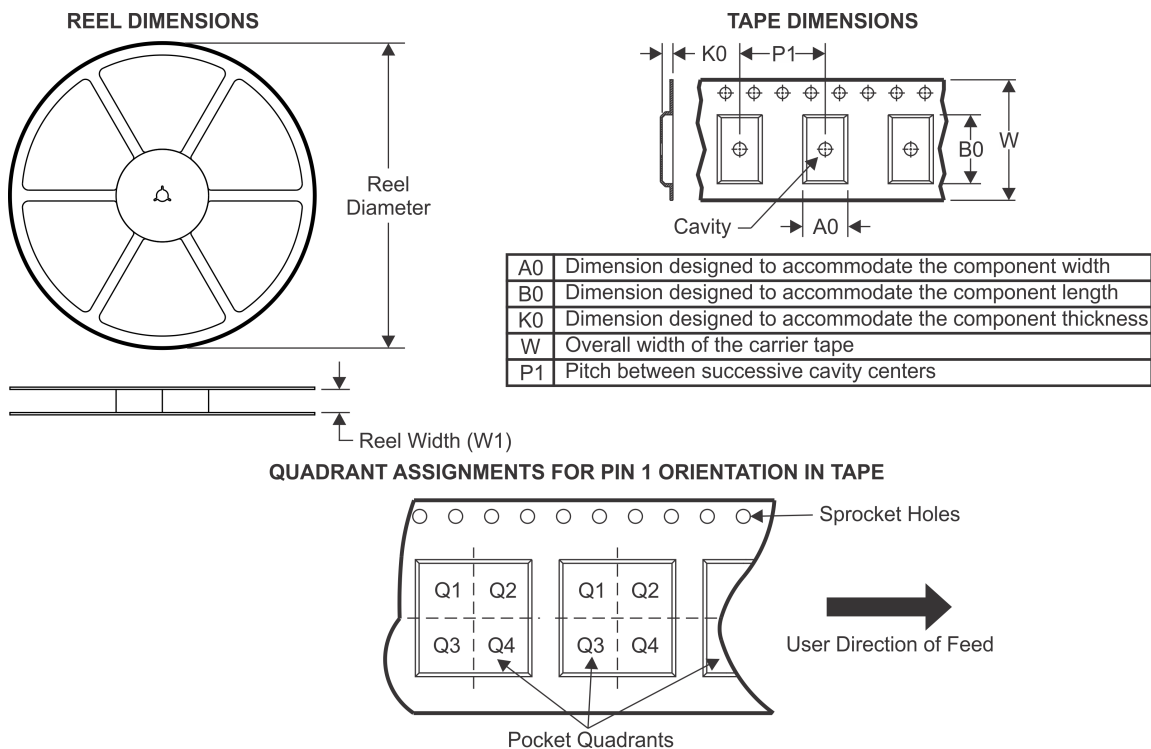
- Catalog: TL5001A, TL5001

- Automotive: TL5001A-Q1, TL5001A-Q1

- Military: TL5001M, TL5001AM

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product

- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects

- Military - QML certified for Military and Defense Applications

TEXAS INSTRUMENTS

PACKAGE MATERIALS INFORMATION

www.ti.com

13-Feb-2016

TAPE AND REEL INFORMATION

REEL DIMENSIONS

TAPE DIMENSIONS

A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

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
TL5001ACDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
TL5001AIDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
TL5001AQDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
TL5001AQDRG4	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
TL5001CDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
TL5001CPSR	SO	PS	8	2000	330.0	16.4	8.2	6.6	2.5	12.0	16.0	Q1
TL5001IDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
TL5001IPSR	SO	PS	8	2000	330.0	16.4	8.2	6.6	2.5	12.0	16.0	Q1
TL5001QDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
TL5001QDRG4	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1

TEXAS INSTRUMENTS

PACKAGE MATERIALS INFORMATION

www.ti.com

13-Feb-2016

TAPE AND REEL BOX DIMENSIONS
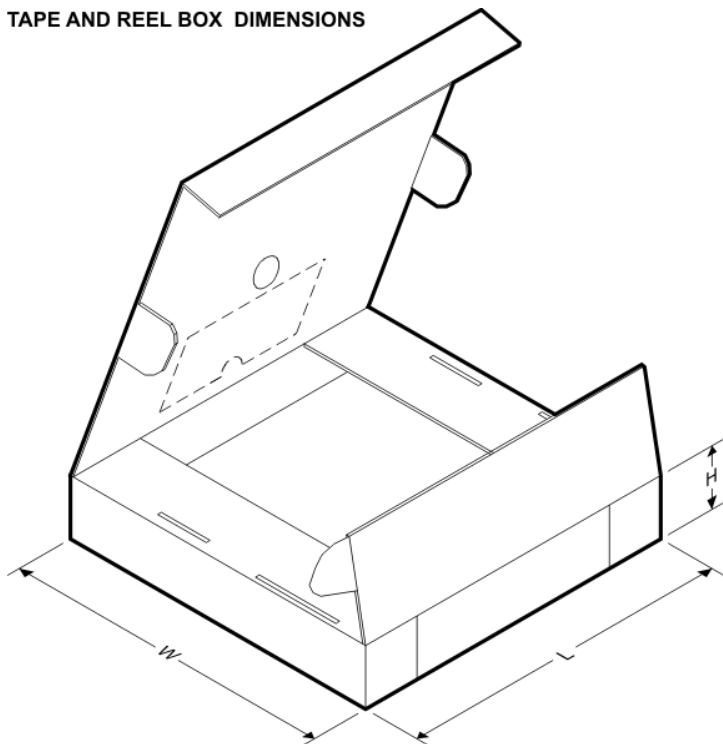
*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TL5001ACDR	SOIC	D	8	2500	340.5	338.1	20.6
TL5001AIDR	SOIC	D	8	2500	340.5	338.1	20.6
TL5001AQDR	SOIC	D	8	2500	367.0	367.0	38.0
TL5001AQDRG4	SOIC	D	8	2500	367.0	367.0	38.0
TL5001CDR	SOIC	D	8	2500	340.5	338.1	20.6
TL5001CPSR	SO	PS	8	2000	367.0	367.0	38.0
TL5001IDR	SOIC	D	8	2500	340.5	338.1	20.6
TL5001IPSR	SO	PS	8	2000	367.0	367.0	38.0
TL5001QDR	SOIC	D	8	2500	367.0	367.0	38.0
TL5001QDRG4	SOIC	D	8	2500	367.0	367.0	38.0

MECHANICAL DATA

JG (R-GDIP-T8)   **CERAMIC DUAL-IN-LINE**
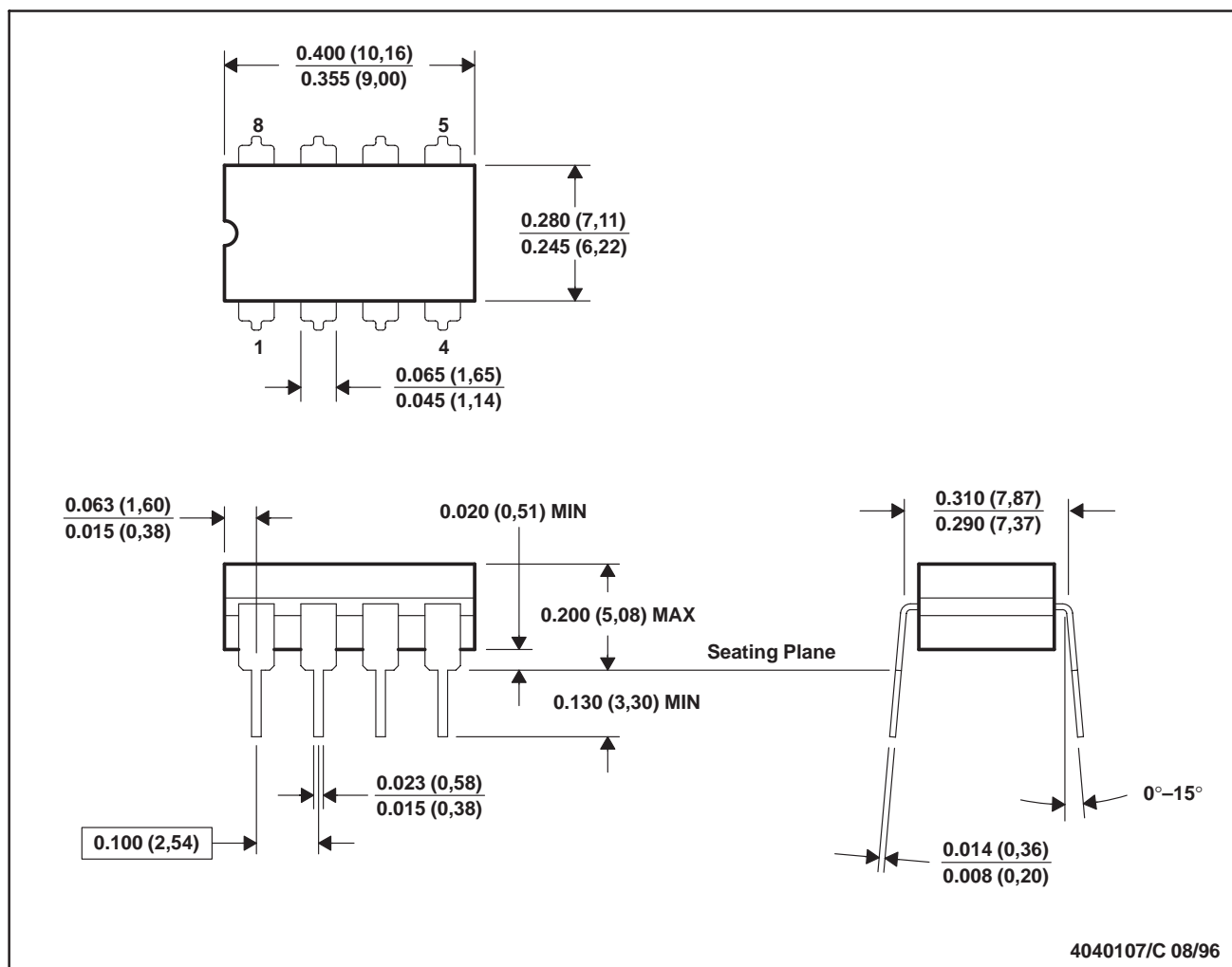
0.400 (10,16)
0.355 (9,00)

8   5

0.280 (7,11)
0.245 (6,22)

1   4

0.065 (1,65)
0.045 (1,14)

0.063 (1,60)
0.015 (0,38)

0.020 (0,51) MIN

0.310 (7,87)
0.290 (7,37)

0.200 (5,08) MAX

Seating Plane

0.130 (3,30) MIN

0.023 (0,58)
0.015 (0,38)

0°–15°

0.100 (2,54)

0.014 (0,36)
0.008 (0,20)

4040107/C 08/96

NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. This package can be hermetically sealed with a ceramic lid using glass frit.
D. Index point is provided on cap for terminal identification.
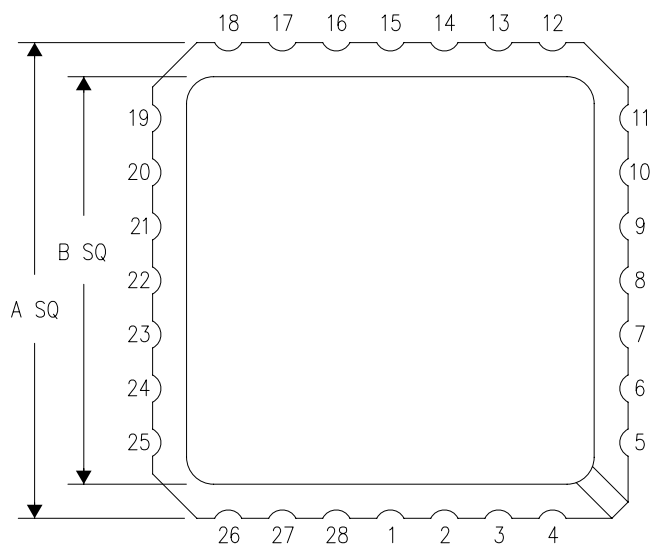E. Falls within MIL STD 1835 GDIP1-T8

TEXAS INSTRUMENTS
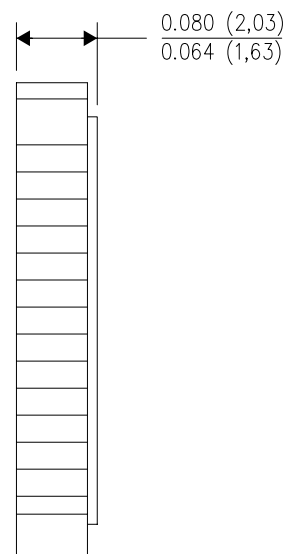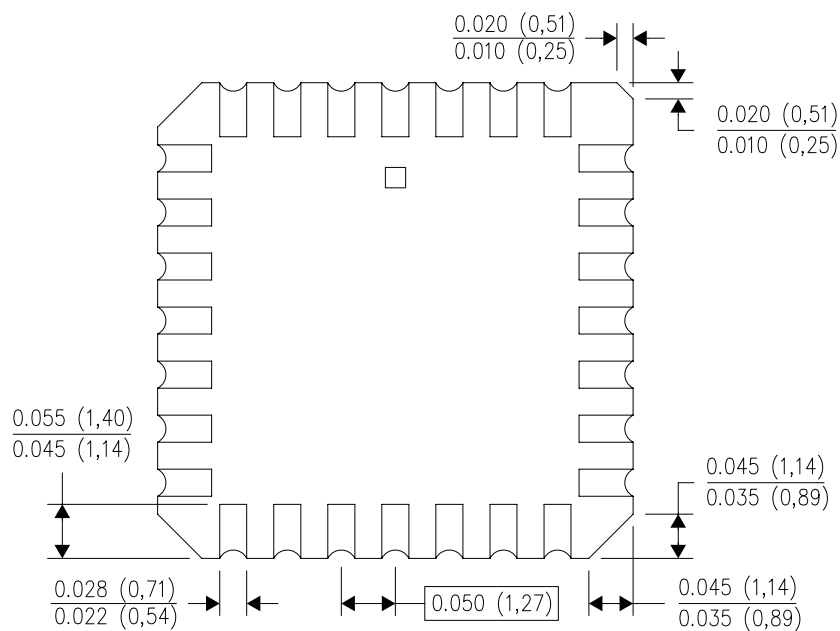POST OFFICE BOX 655303 ● DALLAS, TEXAS 75265

Distributor of Texas Instruments: Excellent Integrated System Limited
Datasheet of TL5001CDR - IC REG CTRLR PWM 8SOIC
Contact us: sales@integrated-circuit.com Website: www.integrated-circuit.com

MECHANICAL DATA

FK (S−CQCC−N**)   LEADLESS CERAMIC CHIP CARRIER
28 TERMINAL SHOWN

| NO. OF TERMINALS **	A		B	
	MIN	MAX	MIN	MAX
20	0.342 (8,69)	0.358 (9,09)	0.307 (7,80)	0.358 (9,09)
28	0.442 (11,23)	0.458 (11,63)	0.406 (10,31)	0.458 (11,63)
44	0.640 (16,26)	0.660 (16,76)	0.495 (12,58)	0.560 (14,22)
52	0.740 (18,78)	0.761 (19,32)	0.495 (12,58)	0.560 (14,22)
68	0.938 (23,83)	0.962 (24,43)	0.850 (21,6)	0.858 (21,8)
84	1.141 (28,99)	1.165 (29,59)	1.047 (26,6)	1.063 (27,0)

4040140/D 01/11

NOTES: A.   All linear dimensions are in inches (millimeters).
         B.   This drawing is subject to change without notice.
         C.   This package can be hermetically sealed with a metal lid.
         D.   Falls within JEDEC MS−004

TEXAS INSTRUMENTS
www.ti.com

MECHANICAL DATA

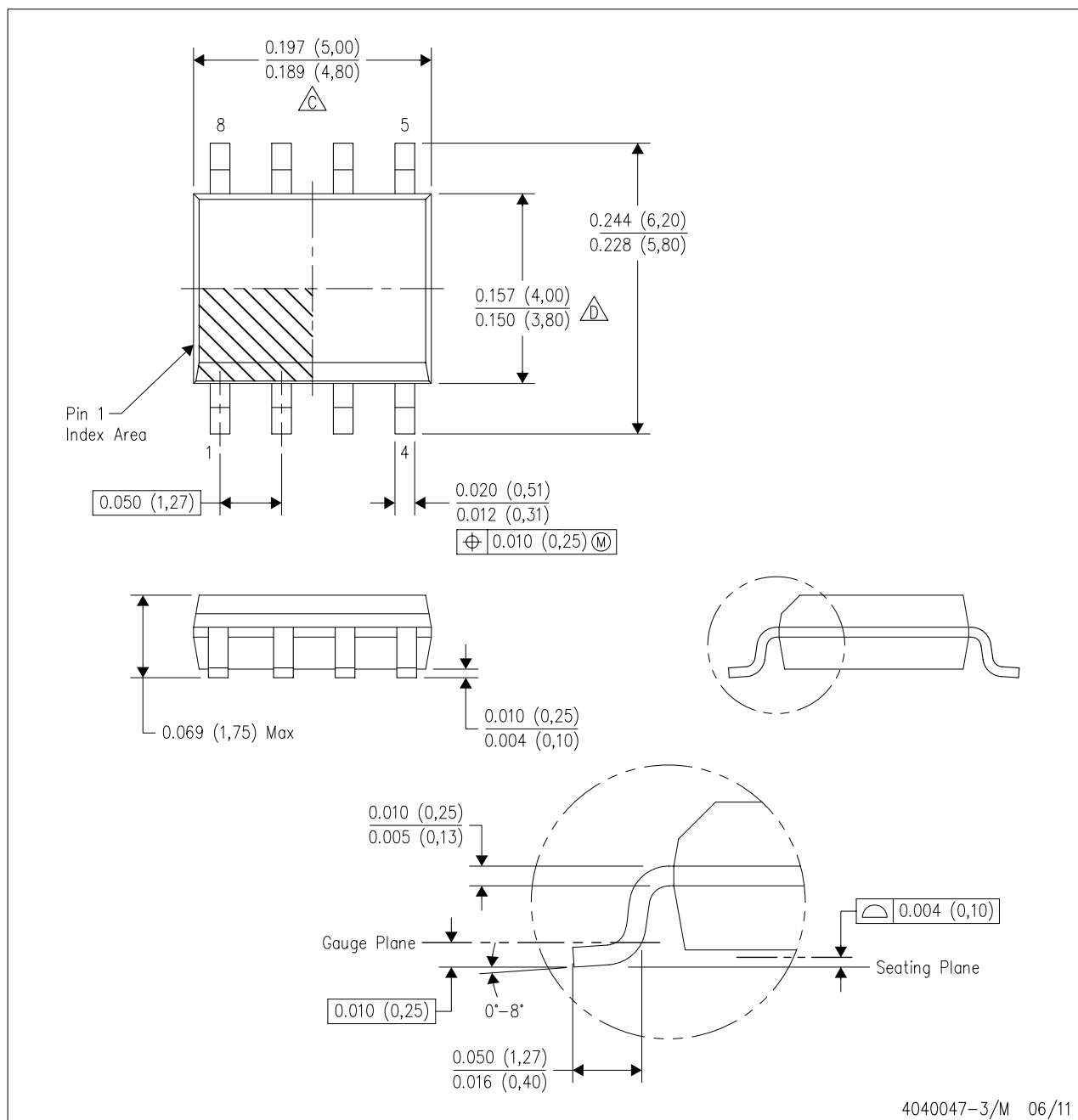P (R−PDIP−T8)　　　　　　　　　　PLASTIC DUAL−IN−LINE PACKAGE
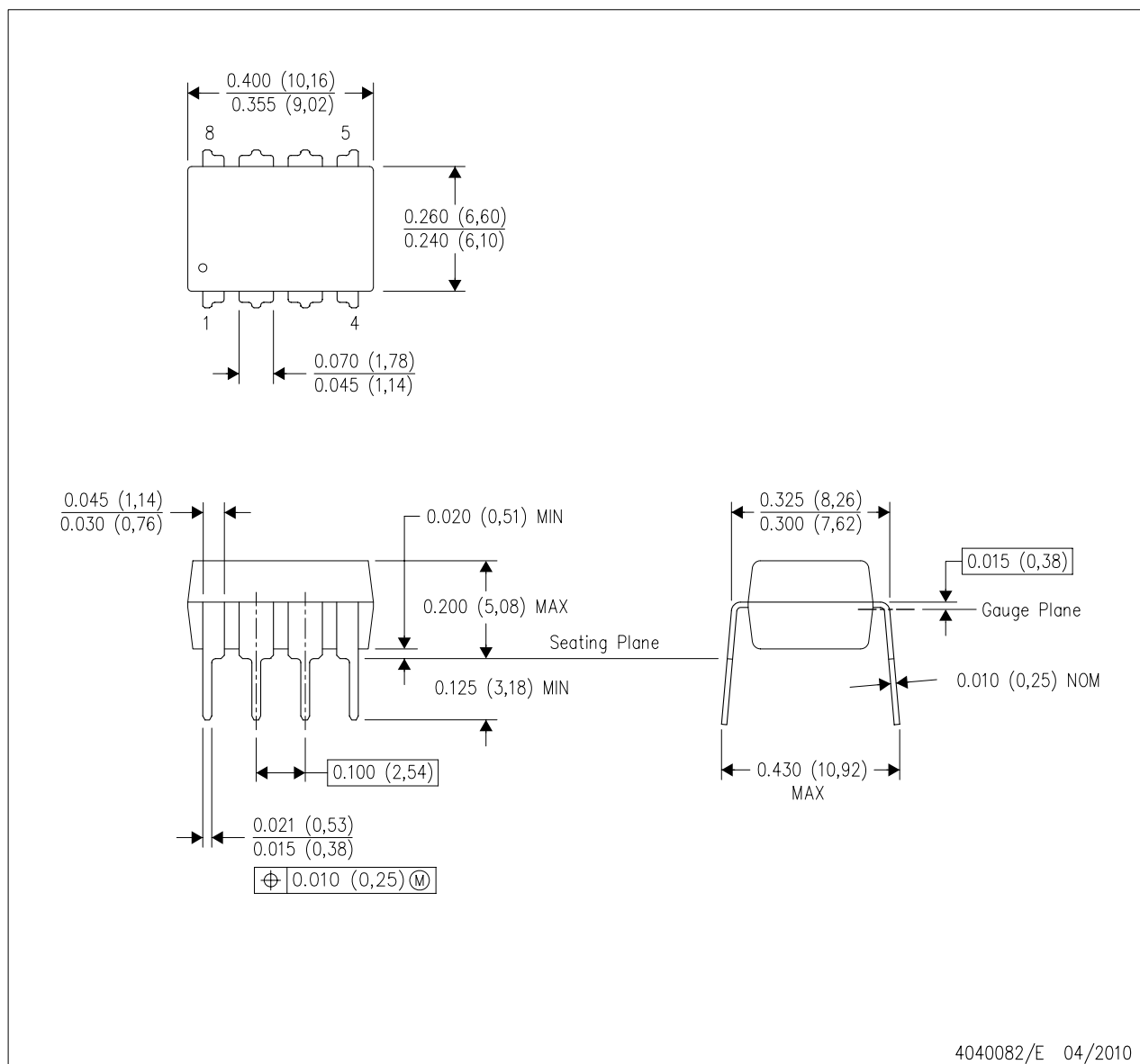
4040082/E 04/2010

NOTES:　A.　All linear dimensions are in inches (millimeters).
　　　　　B.　This drawing is subject to change without notice.
　　　　　C.　Falls within JEDEC MS−001 variation BA.

TEXAS
INSTRUMENTS
www.ti.com

MECHANICAL DATA

D (R−PDSO−G8)   PLASTIC SMALL OUTLINE

0.197 (5,00)
0.189 (4,80)

8   5

0.244 (6,20)
0.228 (5,80)

0.157 (4,00)
0.150 (3,80)

Pin 1
Index Area

1   4

0.050 (1,27)

0.020 (0,51)
0.012 (0,31)

0.010 (0,25) M

0.069 (1,75) Max

0.010 (0,25)
0.004 (0,10)

0.010 (0,25)
0.005 (0,13)

Gauge Plane

0.004 (0,10)

Seating Plane

0.010 (0,25)   0°–8°
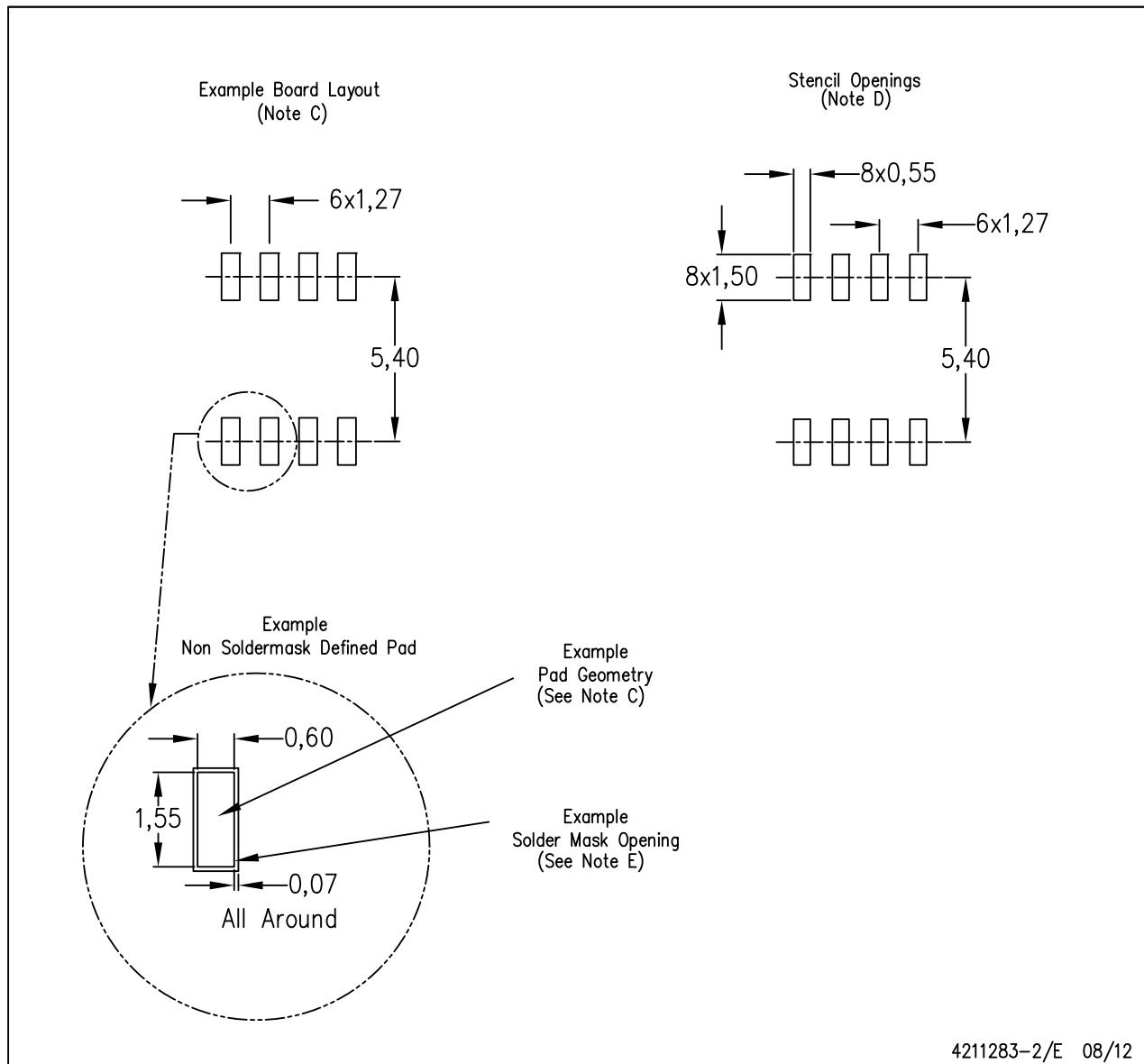
0.050 (1,27)
0.016 (0,40)

4040047−3/M   06/11

NOTES: A.   All linear dimensions are in inches (millimeters).
         B.   This drawing is subject to change without notice.
         C.   Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall
              not exceed 0.006 (0,15) each side.
         D.   Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
         E.   Reference JEDEC MS−012 variation AA.

TEXAS INSTRUMENTS
www.ti.com

LAND PATTERN DATA

D (R−PDSO−G8) PLASTIC SMALL OUTLINE

Example Board Layout
(Note C)

6x1,27

5,40

Stencil Openings
(Note D)

8x0,55

8x1,50

6x1,27

5,40

Example
Non Soldermask Defined Pad

Example
Pad Geometry
(See Note C)

0,60

1,55

0,07

All Around
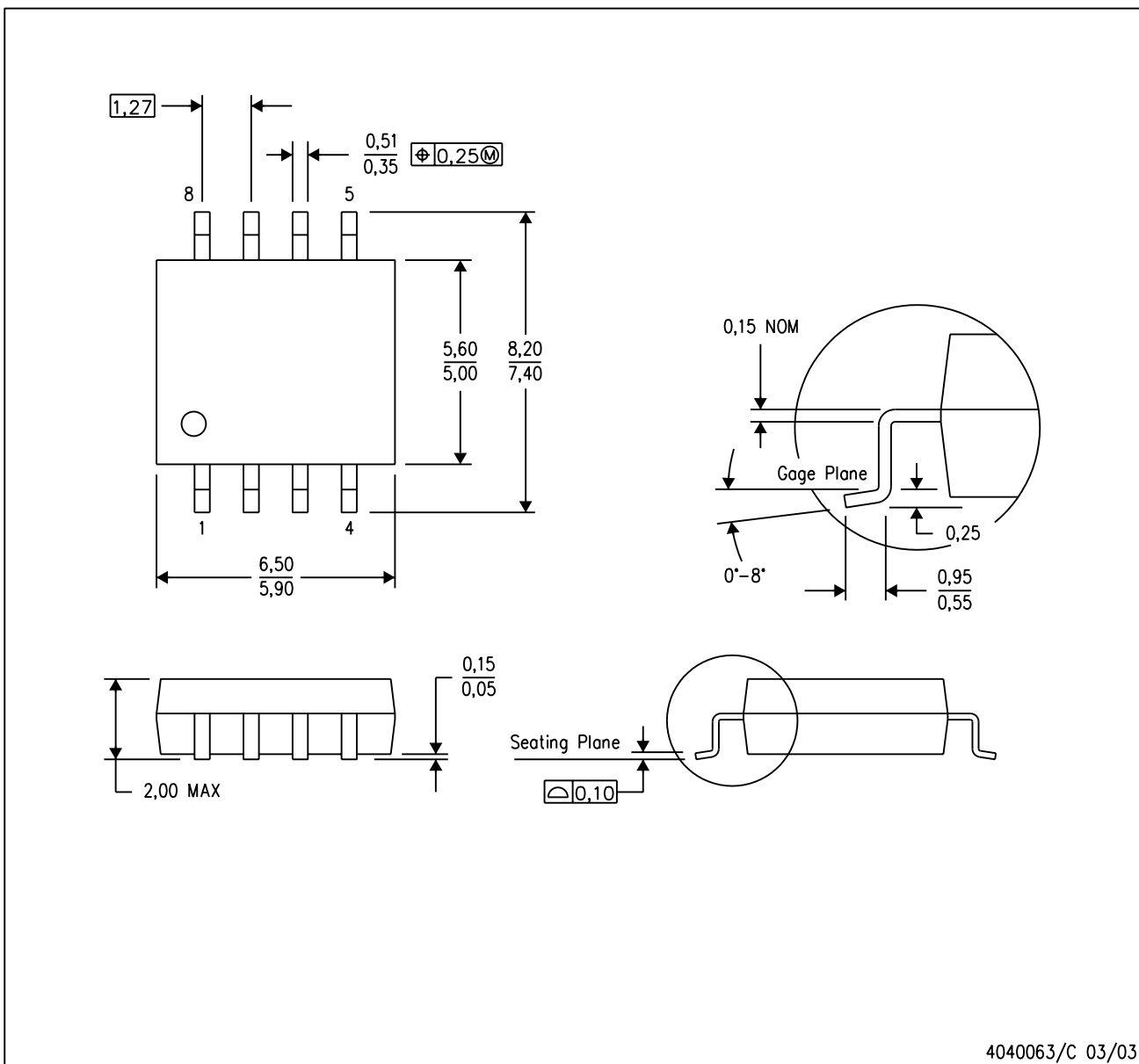
Example
Solder Mask Opening
(See Note E)

4211283−2/E 08/12

NOTES: A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Publication IPC−7351 is recommended for alternate designs.
D. 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. Refer to IPC−7525 for other stencil recommendations.
E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

MECHANICAL DATA

PS (R-PDSO-G8)   **PLASTIC SMALL-OUTLINE PACKAGE**

1,27

0,51
0,35   ⊕ 0,25 Ⓜ

8   5

5,60   8,20
5,00   7,40

1   4

6,50
5,90

0,15 NOM

Gage Plane

0°–8°

0,25

0,95
0,55

0,15
0,05

2,00 MAX

Seating Plane

☐ 0,10

4040063/C 03/03

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.

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products		Applications	
Audio	www.ti.com/audio	Automotive and Transportation	www.ti.com/automotive
Amplifiers	amplifier.ti.com	Communications and Telecom	www.ti.com/communications
Data Converters	dataconverter.ti.com	Computers and Peripherals	www.ti.com/computers
DLP® Products	www.dlp.com	Consumer Electronics	www.ti.com/consumer-apps
DSP	dsp.ti.com	Energy and Lighting	www.ti.com/energy
Clocks and Timers	www.ti.com/clocks	Industrial	www.ti.com/industrial
Interface	interface.ti.com	Medical	www.ti.com/medical
Logic	logic.ti.com	Security	www.ti.com/security
Power Mgmt	power.ti.com	Space, Avionics and Defense	www.ti.com/space-avionics-defense
Microcontrollers	microcontroller.ti.com	Video and Imaging	www.ti.com/video
RFID	www.ti-rfid.com		
OMAP Applications Processors	www.ti.com/omap	**TI E2E Community**	e2e.ti.com
Wireless Connectivity	www.ti.com/wirelessconnectivity		