- **Output Swing Includes Both Supply Rails**
- **Extended Common-Mode Input Voltage Range . . . 0 V to 4.25 V (Min) at 5-V Single Supply**
- **No Phase Inversion**
- **Low Noise . . . 16 nV/√Hz Typ at f = 1 kHz**
- **Low Input Offset Voltage**
  950 μV Max at T_A = 25°C (TLV244xA)
- **Low Input Bias Current . . . 1 pA Typ**
- **600-Ω Output Drive**
- **High-Gain Bandwidth . . . 1.8 MHz Typ**
- **Low Supply Current . . . 750 μA Per Channel Typ**
- **Macromodel Included**
- **Available in Q-Temp Automotive**
  HighRel Automotive Applications
  Configuration Control/Print Support
  Qualification to Automotive Standards

description

The TLV244x and TLV244xA are low-voltage operational amplifiers from Texas Instruments. The common-mode input voltage range of these devices has been extended over typical standard CMOS amplifiers, making them suitable for a wide range of applications. In addition, these devices do not phase invert when the common-mode input is driven to the supply rails. This satisfies most design requirements without paying a premium for rail-to-rail input performance. They also exhibit rail-to-rail output performance for increased dynamic range in single- or split-supply applications. This family is fully characterized at 3-V and 5-V supplies and is optimized for low-voltage operation. Both devices offer comparable ac performance while having lower noise, input offset voltage, and power dissipation than existing CMOS operational amplifiers. The TLV244x has increased output drive over previous rail-to-rail operational amplifiers and can drive 600-Ω loads for telecommunications applications.

HIGH-LEVEL OUTPUT VOLTAGE vs HIGH-LEVEL OUTPUT CURRENT

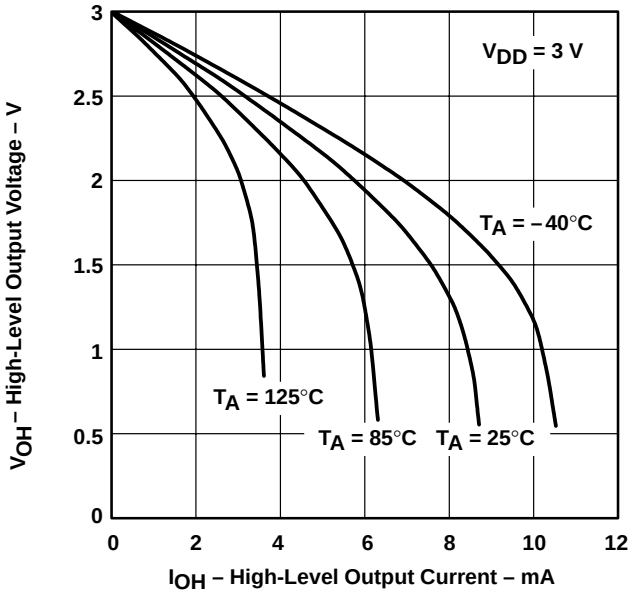

Figure 1

The other members in the TLV244x family are the low-power, TLV243x, and micro-power, TLV2422, versions.

The TLV244x, exhibiting high input impedance and low noise, is excellent for small-signal conditioning for high-impedance sources, such as piezoelectric transducers. Because of the micropower dissipation levels and low-voltage operation, these devices work well in hand-held monitoring and remote-sensing applications. In addition, the rail-to-rail output feature with single- or split-supplies makes this family a great choice when interfacing with analog-to-digital converters (ADCs). For precision applications, the TLV244xA is available with a maximum input offset voltage of 950 μV.

If the design requires single operational amplifiers, see the TI TLV2211/21/31. This is a family of rail-to-rail output operational amplifiers in the SOT-23 package. Their small size and low power consumption make them ideal for high density, battery-powered equipment.

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.

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TLV2442 AVAILABLE OPTIONS

T_A	V_{IO}max AT 25°C	PACKAGED DEVICES				
		SMALL OUTLINE (D)	CHIP CARRIER (FK)	CERAMIC DIP (JG)	TSSOP (PW)	CERAMIC FLAT PACK (U)
0°C to 70°C	2.5 mV	TLV2442CD	—	—	TLV2442CPW	—
–40°C to 85°C	950 µV 2.5 mV	TLV2442AID TLV2442ID	— —	— —	TLV2442AIPW —	— —
–40°C to 125°C	950 µV 2.5 mV	TLV2442AQD TLV2442QD	— —	— —	TLV2442AQPW TLV2442QPW	— —
–55°C to 125°C	950 µV 2.5 mV	— —	TLV2442AMFK TLV2442MFK	TLV2442AMJG TLV2442MJG	— —	TLV2442AMU TLV2442MU

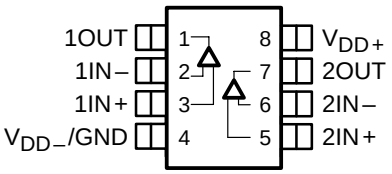
The D and PW packages are available taped and reeled. Add R suffix to device type (e.g., TLV2442CDR).

TLV2444 AVAILABLE OPTIONS

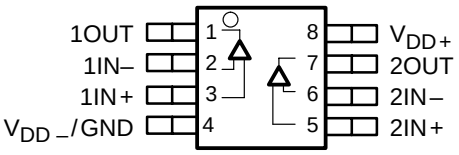
T_A	V_{IO}max AT 25°C	PACKAGED DEVICES	
		SMALL OUTLINE (D)	TSSOP (PW)
0°C to 70°C	2.5 mV	TLV2444CD	TLV2444CPW
–40°C to 125°C	950 µV 2.5 mV	TLV2444AID TLV2444ID	TLV2444AIPW TLV2444IPW

The D and PW packages are available taped and reeled. Add R suffix to device type (e.g., TLV2444CDR).

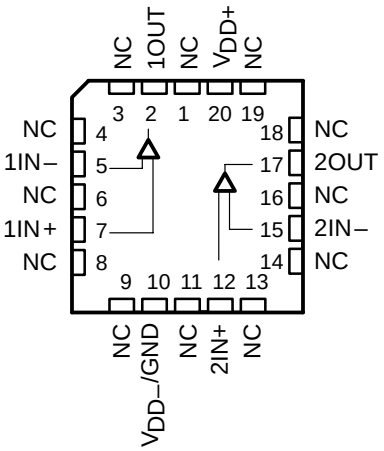
TLV2442
D OR JG PACKAGE
(TOP VIEW)



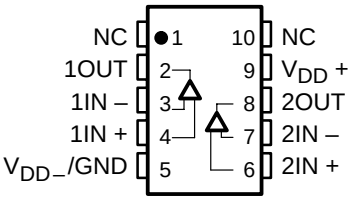
TLV2442
PW PACKAGE
(TOP VIEW)



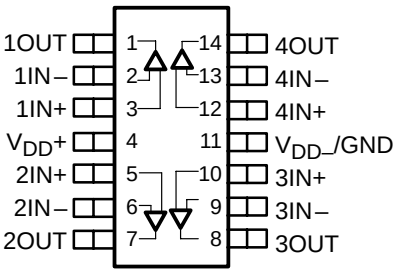
TLV2442
FK PACKAGE
(TOP VIEW)



TLV2442
U PACKAGE
(TOP VIEW)



TLV2444
D OR PW PACKAGE
(TOP VIEW)



NC – No internal connection

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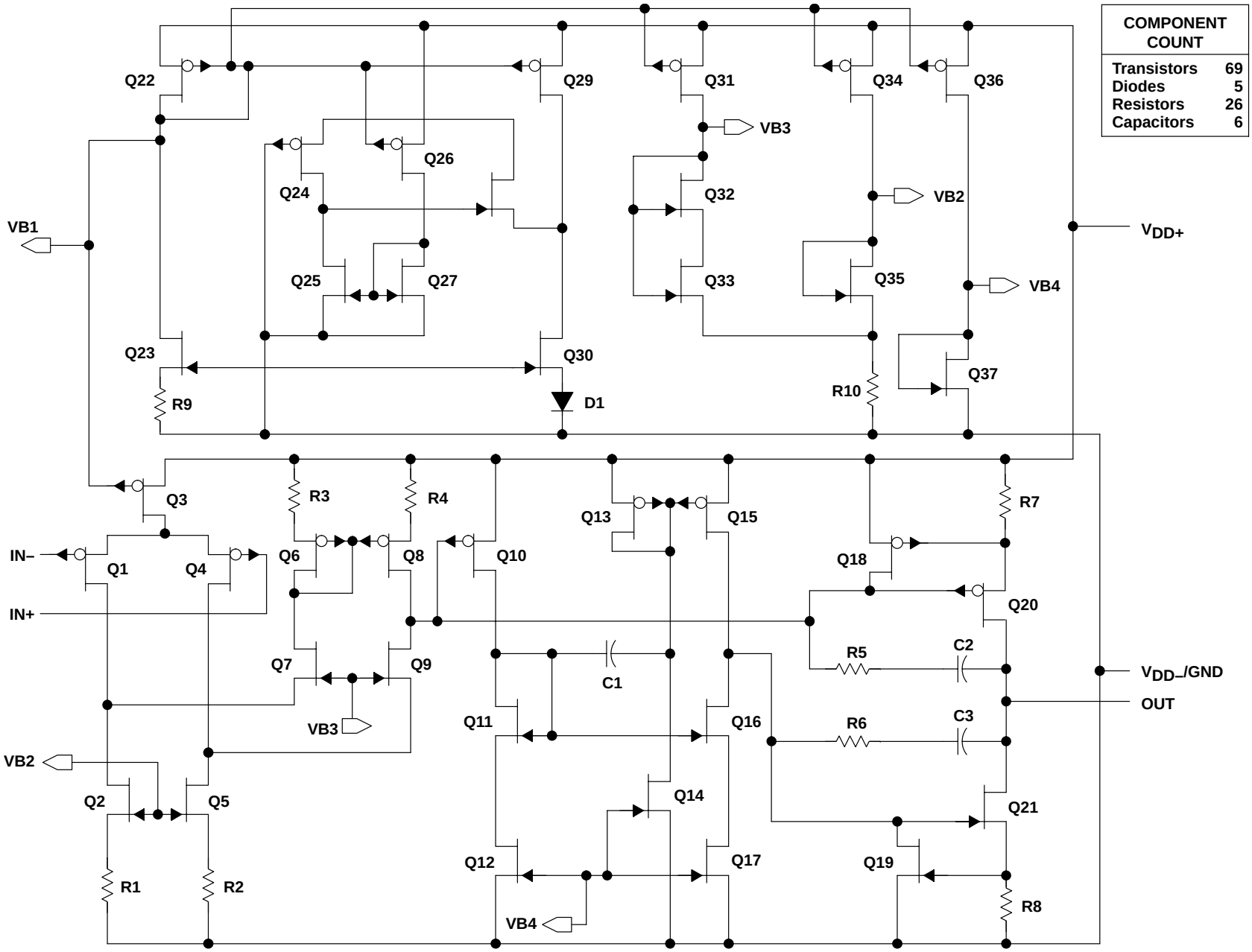
equivalent schematic (each amplifier)



COMPONENT COUNT	
Transistors	69
Diodes	5
Resistors	26
Capacitors	6

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

Supply voltage, V_{DD} (see Note 1) . . . . . 12 V
Differential input voltage, V_{ID} (see Note 2) . . . . . $\pm V_{DD}$
Input voltage, V_I (any input, see Note 1) . . . . . –0.3 V to V_{DD}
Input current, I_I (any input) . . . . . ±5 mA
Output current, I_O . . . . . ±50 mA
Total current into V_{DD+} . . . . . ±50 mA
Total current out of V_{DD-} . . . . . ±50 mA
Duration of short-circuit current at (or below) 25°C (see Note 3) . . . . . unlimited
Continuous total dissipation . . . . . See Dissipation Rating Table
Operating free-air temperature range, T_A: C suffix . . . . . 0°C to 70°C
I suffix (dual) . . . . . –40°C to 85°C
I suffix (quad) . . . . . –40°C to 125°C
Q suffix . . . . . –40°C to 125°C
M suffix . . . . . –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.

NOTES:
1. All voltage values, except differential voltages, are with respect to the midpoint between V_{DD+} and V_{DD-}.
2. Differential voltages are at IN+ with respect to IN–. Excessive current will flow if input is brought below V_{DD-} – 0.3 V.
3. The output may be shorted to either supply. Temperature and/or supply voltages must be limited to ensure that the maximum dissipation rating is not exceeded.

DISSIPATION RATING TABLE

PACKAGE	$T_A \le 25°C$ 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 (8)	725 mW	5.8 mW/°C	464 mW	377 mW	145 mW
D (14)	1022 mW	7.6 mW/°C	900 mW	777 mW	450 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
PW (8)	525 mW	4.2 mW/°C	336 mW	273 mW	105 mW
PW (14)	720 mW	5.6 mW/°C	634 mW	547 mW	317 mW
U	675 mW	5.4 mW/°C	432 mW	350 mW	135 mW

recommended operating conditions

	C SUFFIX		I SUFFIX		Q SUFFIX		M SUFFIX		UNIT
	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
Supply voltage, V_{DD}	2.7	10	2.7	10	2.7	10	2.7	10	V
Input voltage range, V_I	V_{DD-}	$V_{DD+} - 1$	V_{DD-}	$V_{DD+} - 1$	V_{DD-}	$V_{DD+} - 1.3$	V_{DD-}	$V_{DD+} - 1.3$	V
Common-mode input voltage, V_{IC}	V_{DD-}	$V_{DD+} - 1$	V_{DD-}	$V_{DD+} - 1$	$V_{DD-} + 2$	$V_{DD+} - 1.3$	$V_{DD-} + 2$	$V_{DD+} - 1.3$	V
Operating free-air temperature, T_A	0	70	–40	125	–40	125	–55	125	°C

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electrical characteristics at specified free-air temperature, V_{DD} = 3 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS		T_A†	TLV2442 MIN	TLV2442 TYP	TLV2442 MAX	UNIT
V_{IO}	Input offset voltage	V_{IC} = 1.5 V, V_O = 1.5 V, R_S = 50 Ω	TLV244xC TLV244xI	25°C		300	2000	µV
				Full range			2500	
			TLV244xAI	25°C		300	950	
				Full range			1500	
			TLV2442AQ TLV2442AM	25°C		300	950	
				Full range			1600	
α_{VIO}	Temperature coefficient of input offset voltage			25°C to 85°C		2		µV/°C
	Input offset voltage long-term drift (see Note 4)			25°C		0.002		µV/mo
I_{IO}	Input offset current			25°C		0.5	60	pA
				Full range			150	
I_{IB}	Input bias current			25°C		1	60	pA
				–40°C to 85°C			150	
				125°C			350	
			TLV2442Q/AQ TLV2442M/AM	Full range			260	
V_{ICR}	Common-mode input voltage range	$\lvert V_{IO}\rvert \le 5$ mV, R_S = 50 Ω		25°C	0 to 2.25	–0.25 to 2.5		V
				Full range	0 to 2			
				25°C to –55°C	0 to 2.25	–0.25 to 2.5		
				125°C	0 to 2			
V_{OH}	High-level output voltage	I_O = –100 µA		25°C		2.98		V
		I_O = –3 mA		25°C		2.5		
				Full range	2.25			
V_{OL}	Low-level output voltage	V_{IC} = 1.5 V, I_O = 100 µA		25°C		0.02		V
		V_{IC} = 1.5 V, I_O = 3 mA		25°C		0.63		
				Full range			1	
A_{VD}	Large-signal differential voltage amplification	V_O = 1 V to 2 V	R_L = 600 Ω	25°C	0.7	1		V/mV
				Full range	0.4			
			R_L = 1 MΩ	25°C		750		
r_{id}	Differential input resistance			25°C		1000		GΩ
r_i	Common-mode input resistance			25°C		1000		GΩ
c_i	Common-mode input capacitance	f = 10 kHz		25°C		8		pF
z_o	Closed-loop output impedance	f = 1 MHz, A_V = 10		25°C		130		Ω

† Full range for the C suffix is 0°C to 70°C. Full range for the dual I suffix is – 40°C to 85°C. Full range for the quad I suffix is – 40°C to 125°C. Full range for the Q suffix is – 40°C to 125°C. Full range for the M suffix is – 55°C to 125°C.

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at T_A = 150°C extrapolated to T_A = 25°C using the Arrhenius equation and assuming an activation energy of 0.96 eV.

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electrical characteristics at specified free-air temperature, V_{DD} = 3 V (unless otherwise noted) (continued)

PARAMETER		TEST CONDITIONS		T_A†	TLV2442 MIN	TLV2442 TYP	TLV2442 MAX	UNIT
CMRR	Common-mode rejection ratio	V_{IC} = 0 to 2.25 V, V_O = 1.5 V, R_S = 50 Ω		25°C	65	75		dB
				Full range	55			
			TLV2442Q/AQ TLV2442M/AM	Full range	50			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{DD\pm}/\Delta V_{IO}$)	V_{DD} = 2.7 V to 8 V, No load	$V_{IC} = V_{DD}/2$,	25°C	80	95		dB
				Full range	80			
I_{DD}	Supply current (per channel)	V_O = 1.5 V, No load		25°C		725	1100	µA
				Full range			1100	

† Full range for the C suffix is 0°C to 70°C. Full range for the dual I suffix is – 40°C to 85°C. Full range for the quad I suffix is – 40°C to 125°C. Full range for the Q suffix is –40°C to 125°C. Full range for the M suffix is – 55°C to 125°C.

operating characteristics at specified free-air temperature, V_{DD} = 3 V

PARAMETER		TEST CONDITIONS		T_A†	TLV244x MIN	TLV244x TYP	TLV244x MAX	UNIT
SR	Slew rate at unity gain	V_O = 1 V to 2 V, R_L = 600 Ω, C_L = 100 pF		25°C	0.65	1.3		V/µs
				Full range	0.65			
			TLV2442Q/AQ TLV2442M/AM	Full range	0.4			
V_n	Equivalent input noise voltage	f = 10 Hz		25°C		170		nV/√Hz
		f = 1 kHz		25°C		18		
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage	f = 0.1 Hz to 1 Hz		25°C		2.6		µV
		f = 0.1 Hz to 10 Hz		25°C		5.1		
I_n	Equivalent input noise current			25°C		0.6		fA/√Hz
THD + N	Total harmonic distortion plus noise	V_O = 0.5 V to 2.5 V, R_L = 600 Ω, f = 1 kHz	A_V = 1	25°C		0.08%		
			A_V = 10			0.3%		
			A_V = 100			2%		
	Gain-bandwidth product	f =10 kHz, C_L = 100 pF	R_L = 600 Ω,	25°C		1.75		MHz
B_{OM}	Maximum output-swing bandwidth	$V_{O(PP)}$ = 1 V, A_V = 1,	R_L = 600 Ω, C_L = 100 pF	25°C		0.9		MHz
t_s	Settling time	A_V = –1, Step = –2.3 V to 2.3 V, R_L = 600 Ω, C_L = 100 pF	To 0.1%	25°C		1.5		µs
			To 0.01%			3.2		
ϕ_m	Phase margin at unity gain	R_L = 600 Ω,	C_L = 100 pF	25°C		65°		
	Gain margin			25°C		9		dB

† Full range for the C suffix is 0°C to 70°C. Full range for the dual I suffix is – 40°C to 85°C. Full range for the quad I suffix is – 40°C to 125°C. Full range for the Q suffix is –40°C to 125°C. Full range for the M suffix is – 55°C to 125°C.

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electrical characteristics at specified free-air temperature, V_{DD} = 5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS			T_A†	TLV244x MIN	TLV244x TYP	TLV244x MAX	UNIT
V_{IO}	Input offset voltage	$V_{DD\pm}$ = ±2.5 V, V_O = 0,	V_{IC} = 0, R_S = 50 Ω	TLV244xC TLV244xI	25°C		300	2000	µV
					Full range			2500	
				TLV244xA	25°C		300	950	
					Full range			1500	
				TLV2442AQ TLV2442AM	25°C		300	950	
					Full range			1600	
α_{VIO}	Temperature coefficient of input offset voltage				25°C to 85°C		2		µV/°C
	Input offset voltage long-term drift (see Note 4)				25°C		0.002		µV/mo
I_{IO}	Input offset current				25°C		0.5	60	pA
					Full range			150	
I_{IB}	Input bias current				25°C		1	60	pA
					–40°C to 85°C			150	
					125°C			350	
				TLV2442Q/AQ TLV2442M/AM	Full range			260	
V_{ICR}	Common-mode input voltage range	$\|V_{IO}\| \le$ 5 mV,	R_S = 50 Ω		25°C	0 to 4.25	–0.25 to 4.5		V
					Full range	0 to 4			
V_{OH}	High-level output voltage	I_{OH} = –100 µA			25°C		4.97		V
		I_{OH} = –5 mA			25°C	4	4.35		
					Full range	4			
V_{OL}	Low-level output voltage	V_{IC} = 2.5 V,	I_{OL} = 100 µA		25°C		0.01		V
		V_{IC} = 2.5 V,	I_{OL} = 5 mA		25°C		0.8		
					Full range			1.25	
A_{VD}	Large-signal differential voltage amplification	V_{IC} = 2.5 V, V_O = 1 V to 4 V	R_L = 600 Ω‡		25°C	0.9	1.3		V/mV
					Full range	0.5			
			R_L = 1 MΩ‡		25°C		950		
r_{id}	Differential input resistance				25°C		1000		GΩ
r_i	Common-mode input resistance				25°C		1000		GΩ
c_i	Common-mode input capacitance	f = 10 kHz			25°C		8		pF
z_o	Closed-loop output impedance	f = 1 MHz,	A_V = 10		25°C		140		Ω
CMRR	Common-mode rejection ratio	V_{IC} = 0 to 4.25 V, R_S = 50 Ω	V_O = 2.5 V,		25°C	70	75		dB
					Full range	70			

† Full range for the C suffix is 0°C to 70°C. Full range for the dual I suffix is – 40°C to 85°C. Full range for the quad I suffix is – 40°C to 125°C. Full range for the Q suffix is –40°C to 125°C. Full range for the M suffix is – 55°C to 125°C.

‡ Referenced to 2.5 V

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at T_A = 150°C extrapolated to T_A = 25°C using the Arrhenius equation and assuming an activation energy of 0.96 eV.

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electrical characteristics at specified free-air temperature, V_{DD} = 5 V (unless otherwise noted) (continued)

PARAMETER		TEST CONDITIONS	T_A†	TLV244x MIN	TLV244x TYP	TLV244x MAX	UNIT
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{DD}/\Delta V_{IO}$)	V_{DD} = 4.4 V to 8 V, $V_{IC} = V_{DD}/2$, No load	25°C	80	95		dB
			Full range	80			
I_{DD}	Supply current (per channel)	V_O = 2.5 V, No load	25°C		750	1100	µA
			Full range			1100	

† Full range for the C suffix is 0°C to 70°C. Full range for the dual I suffix is – 40°C to 85°C. Full range for the quad I suffix is – 40°C to 125°C. Full range for the Q suffix is –40°C to 125°C. Full range for the M suffix is – 55°C to 125°C.

operating characteristics at specified free-air temperature, V_{DD} = 5 V

PARAMETER		TEST CONDITIONS		T_A†	TLV244x MIN	TLV244x TYP	TLV244x MAX	UNIT
SR	Slew rate at unity gain	V_O = 0.5 V to 2.5 V, R_L = 600 Ω‡, C_L = 100 pF‡		25°C	0.75	1.4		V/µs
				Full range	0.75			
			TLV2442Q/AQ TLV2442M/AM	Full range	0.5			
V_n	Equivalent input noise voltage	f = 10 Hz		25°C		130		nV/√Hz
		f = 1 kHz		25°C		16		
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage	f = 0.1 Hz to 1 Hz		25°C		1.8		µV
		f = 0.1 Hz to 10 Hz		25°C		3.6		
I_n	Equivalent input noise current			25°C		0.6		fA/√Hz
THD + N	Total harmonic distortion plus noise	V_O = 1.5 V to 3.5 V, f = 1 kHz, R_L = 600 Ω‡	A_V = 1	25°C		0.017%		
			A_V = 10			0.17%		
			A_V = 100			1.5%		
	Gain-bandwidth product	f =10 kHz, R_L = 600 Ω‡, C_L = 100 pF‡		25°C		1.81		MHz
B_{OM}	Maximum output-swing bandwidth	$V_{O(PP)}$ = 2 V, A_V = 1, R_L = 600 Ω‡, C_L = 100 pF‡		25°C		0.5		MHz
t_s	Settling time	A_V = –1, Step = 0.5 V to 2.5 V, R_L = 600 Ω‡, C_L = 100 pF‡	To 0.1%	25°C		1.5		µs
			To 0.01%			2.6		
ϕ_m	Phase margin at unity gain	R_L = 600 Ω‡, C_L = 100 pF‡		25°C		68°		
	Gain margin			25°C		8		dB

† Full range for the C suffix is 0°C to 70°C. Full range for the dual I suffix is – 40°C to 85°C. Full range for the quad I suffix is – 40°C to 125°C. Full range for the Q suffix is –40°C to 125°C. Full range for the M suffix is – 55°C to 125°C.
‡ Referenced to 2.5 V

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TYPICAL CHARACTERISTICS

Table of Graphs†

			FIGURE
V_{IO}	Input offset voltage	Distribution vs Common-mode input voltage	2, 3 4, 5
α_{VIO}	Input offset voltage temperature coefficient	Distribution	6, 7
I_{IB}/I_{IO}	Input bias and input offset currents	vs Free-air temperature	8
V_{OH}	High-level output voltage	vs High-level output current	9, 10
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$V_{O(PP)}$	Maximum peak-to-peak output voltage	vs Frequency	13
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V_O	Output voltage	vs Differential Input voltage	16, 17
A_{VD}	Differential voltage amplification	vs Load resistance	18
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SR	Slew rate	vs Load capacitance vs Free-air temperature	31 32
V_O	Inverting large-signal pulse response		33, 34
	Voltage-follower large-signal pulse response		35, 36
	Inverting small-signal pulse response		37, 38
	Voltage-follower small-signal pulse response		39, 40
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	Noise voltage	Over a 10-second period	43
THD + N	Total harmonic distortion plus noise	vs Frequency	44, 45
	Gain-bandwidth product	vs Free-air temperature vs Supply voltage	46 47
ϕ_m	Phase margin	vs Frequency vs Load capacitance	19, 20 48
	Gain margin	vs Load capacitance	49
B_1	Unity-gain bandwidth	vs Load capacitance	50

† For all graphs where V_{DD} = 5 V, all loads are referenced to 2.5 V.

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TYPICAL CHARACTERISTICS

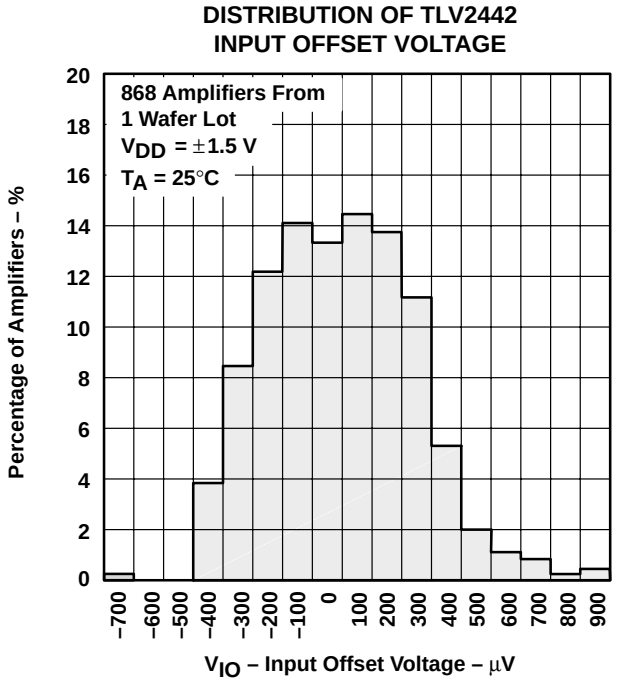

Figure 2

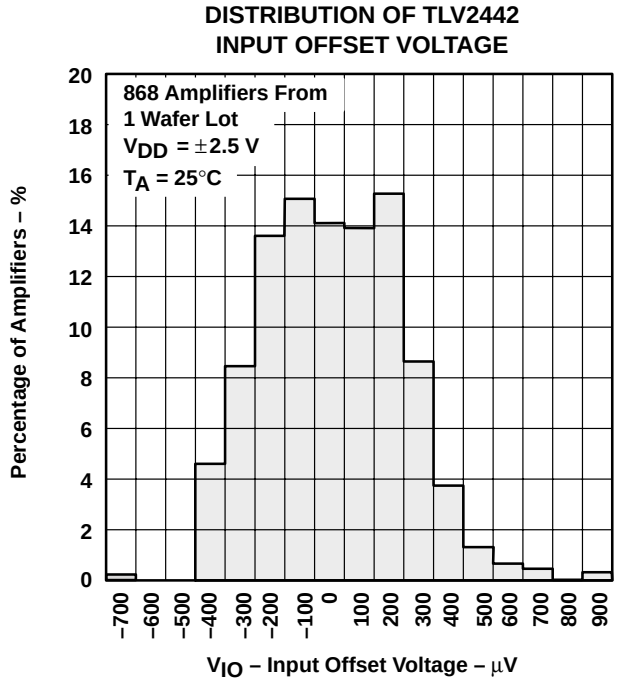

Figure 3

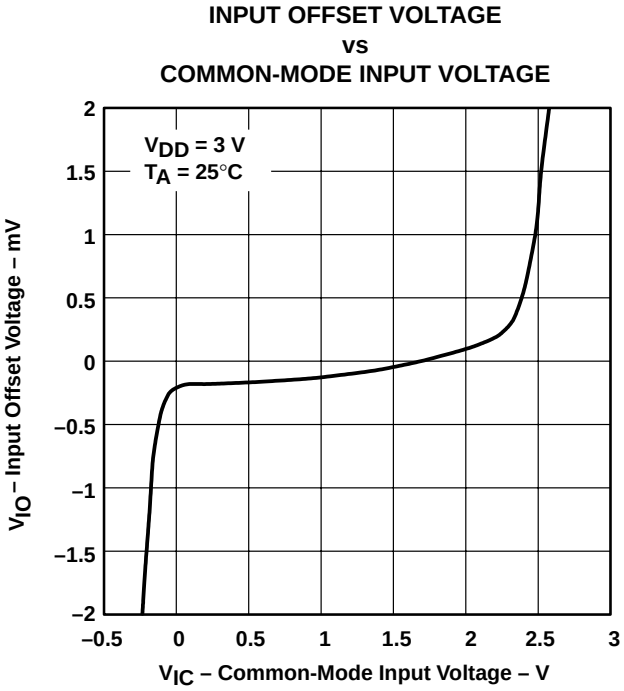

Figure 4

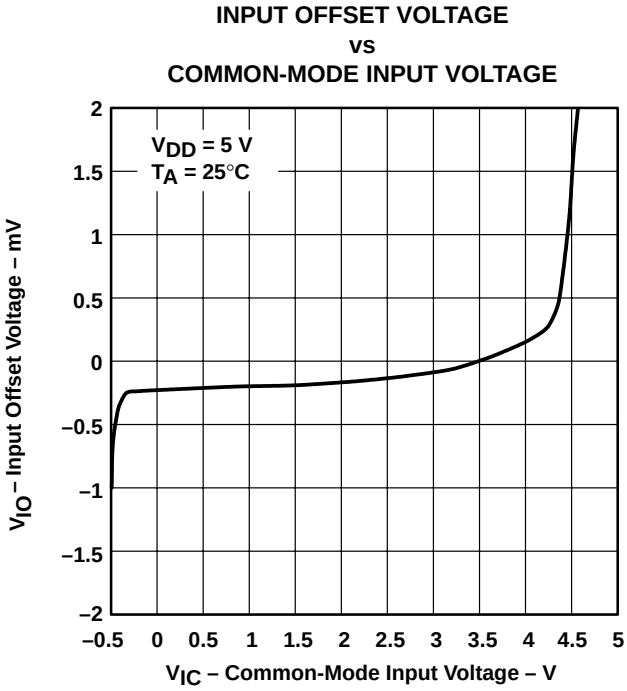

Figure 5

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TYPICAL CHARACTERISTICS

DISTRIBUTION OF TLV2442 INPUT OFFSET VOLTAGE TEMPERATURE COEFFICIENT

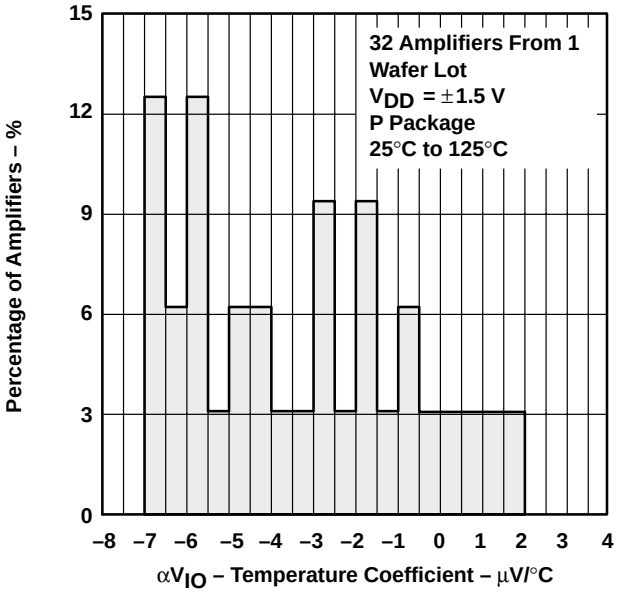

Figure 6

DISTRIBUTION OF TLV2442 INPUT OFFSET VOLTAGE TEMPERATURE COEFFICIENT

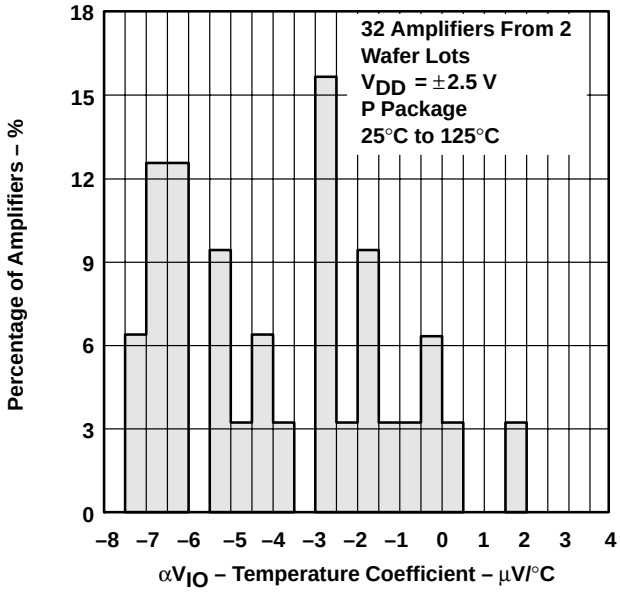

Figure 7

INPUT BIAS AND INPUT OFFSET CURRENTS vs FREE-AIR TEMPERATURE

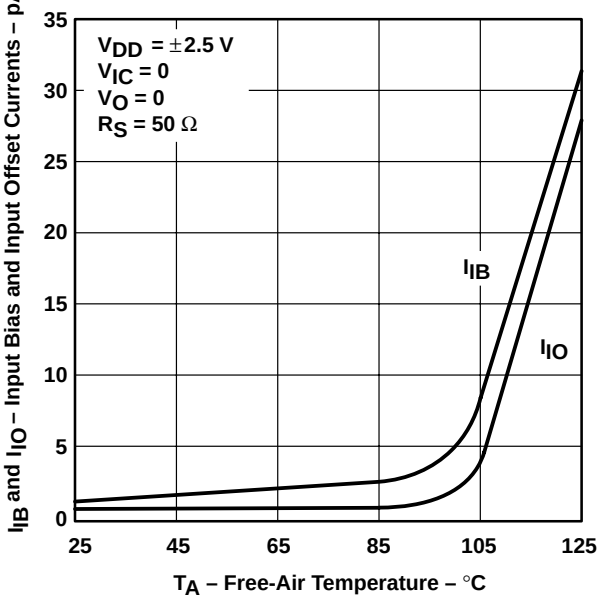

Figure 8

HIGH-LEVEL OUTPUT VOLTAGE vs HIGH-LEVEL OUTPUT CURRENT

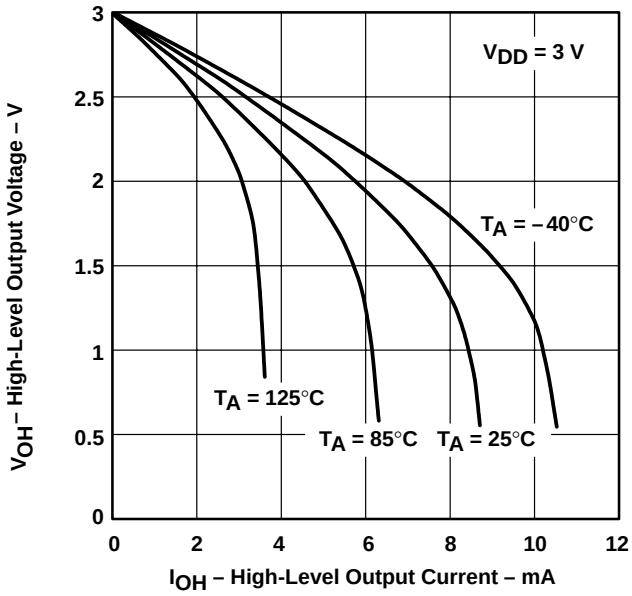

Figure 9

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TYPICAL CHARACTERISTICS

HIGH-LEVEL OUTPUT VOLTAGE vs HIGH-LEVEL OUTPUT CURRENT

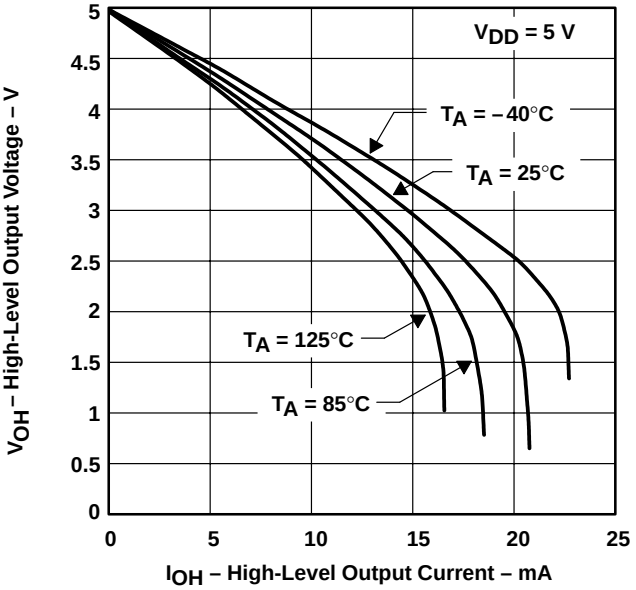

Figure 10

LOW-LEVEL OUTPUT VOLTAGE vs LOW-LEVEL OUTPUT CURRENT

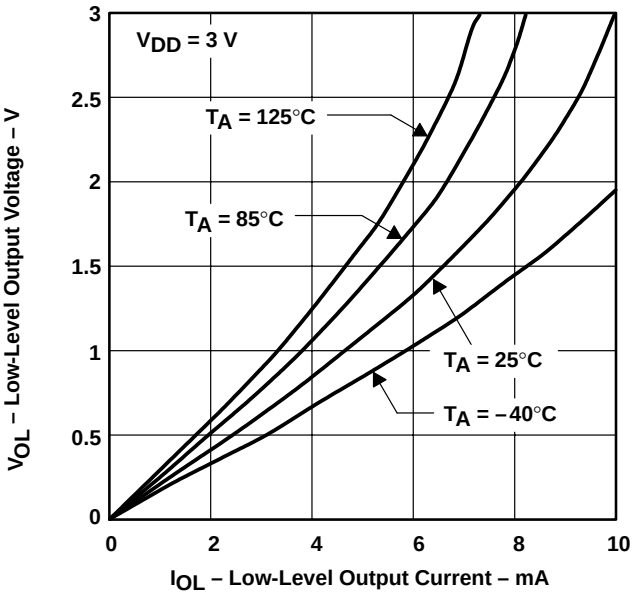

Figure 11

LOW-LEVEL OUTPUT VOLTAGE vs LOW-LEVEL OUTPUT CURRENT

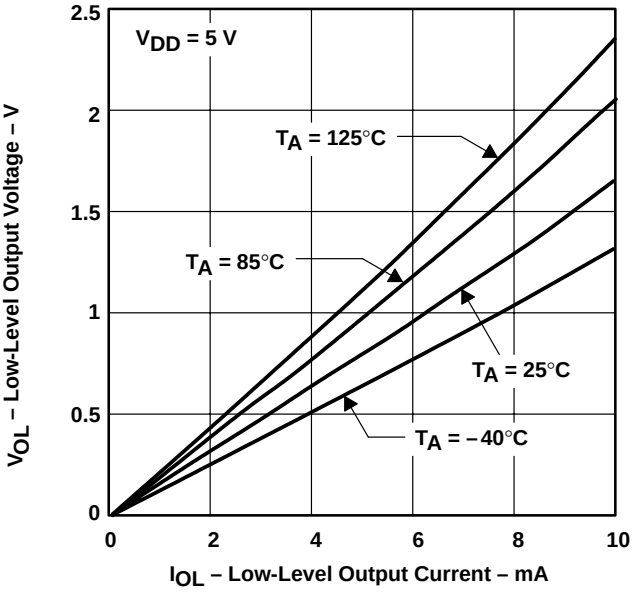

Figure 12

MAXIMUM PEAK-TO-PEAK OUTPUT VOLTAGE vs FREQUENCY

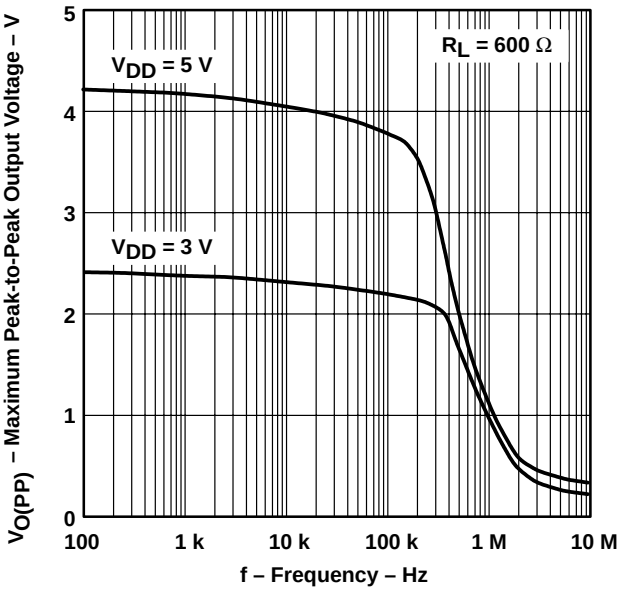

Figure 13

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TYPICAL CHARACTERISTICS

SHORT-CIRCUIT OUTPUT CURRENT vs SUPPLY VOLTAGE

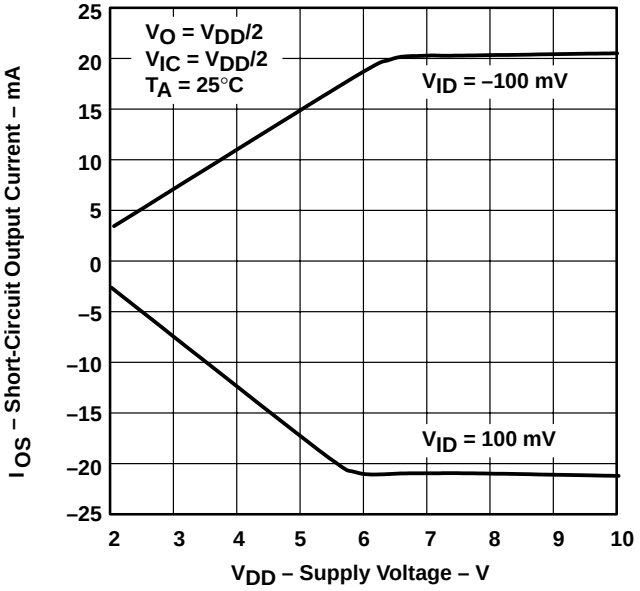

Figure 14

SHORT-CIRCUIT OUTPUT CURRENT vs FREE-AIR TEMPERATURE

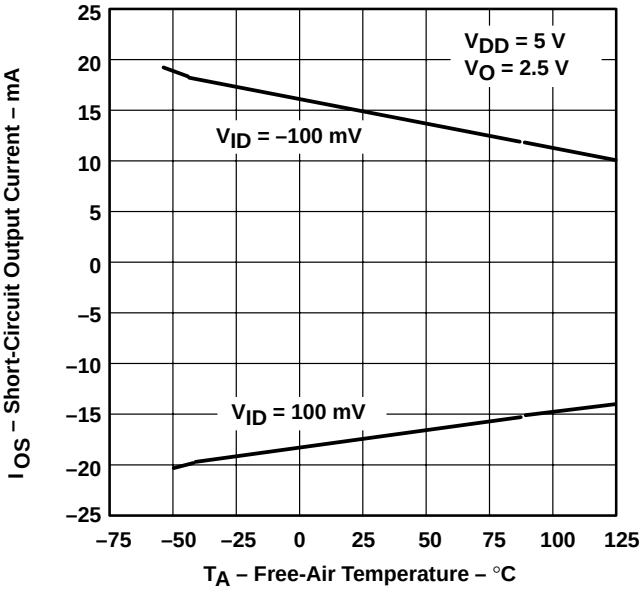

Figure 15

OUTPUT VOLTAGE vs DIFFERENTIAL INPUT VOLTAGE

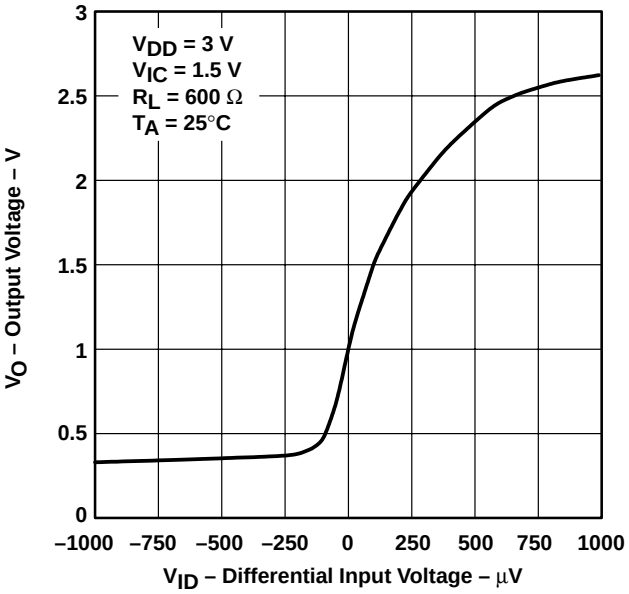

Figure 16

OUTPUT VOLTAGE vs DIFFERENTIAL INPUT VOLTAGE

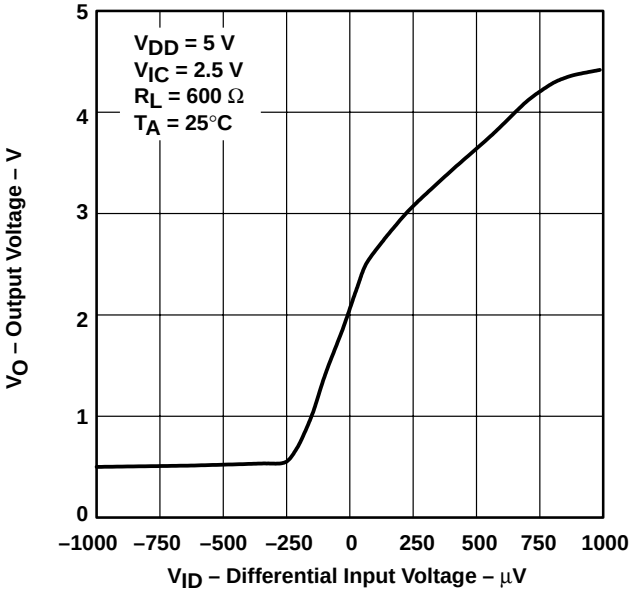

Figure 17

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TYPICAL CHARACTERISTICS

DIFFERENTIAL VOLTAGE AMPLIFICATION vs LOAD RESISTANCE

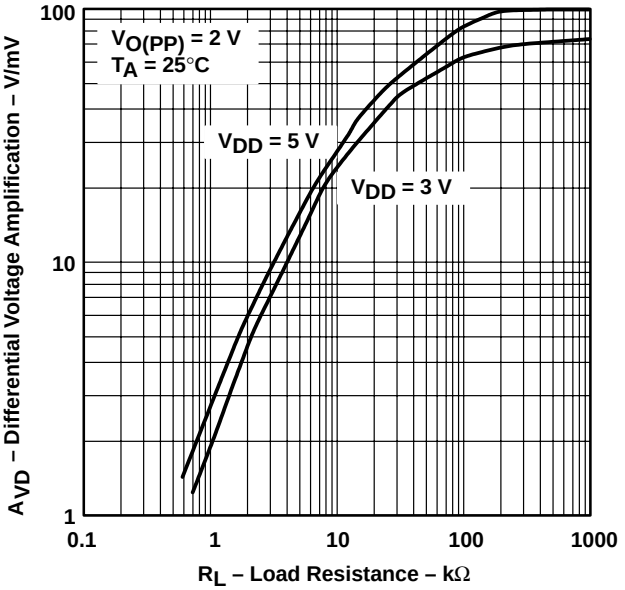

Figure 18

LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION AND PHASE MARGIN vs FREQUENCY

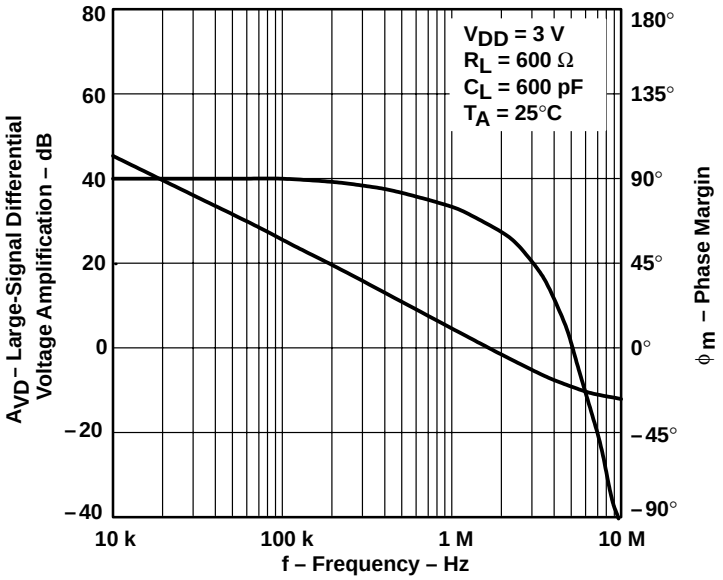

Figure 19

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TYPICAL CHARACTERISTICS

LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION AND PHASE MARGIN vs FREQUENCY

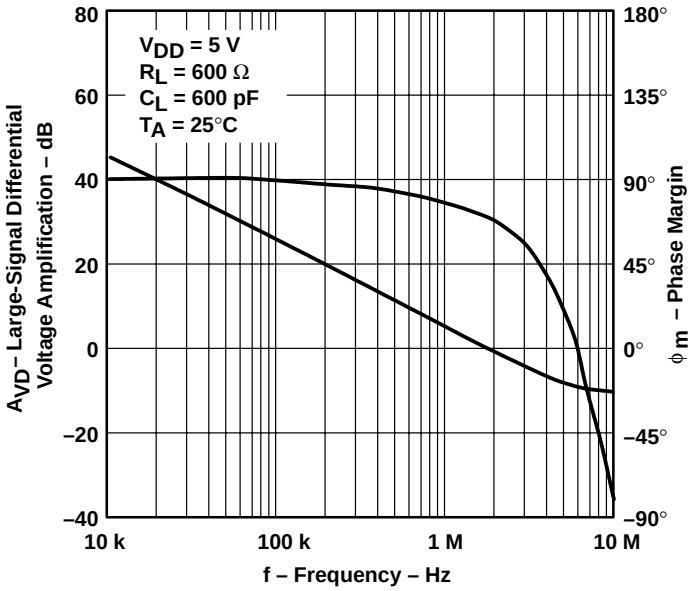

Figure 20

LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION vs FREE-AIR TEMPERATURE

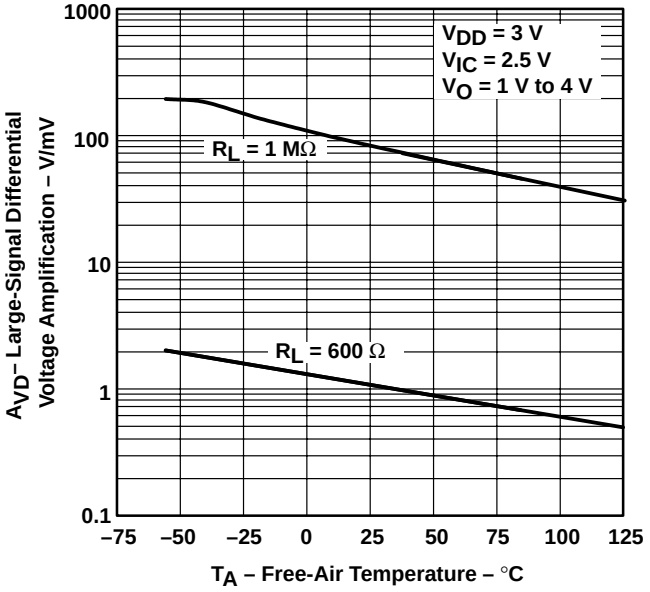

Figure 21

LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION vs FREE-AIR TEMPERATURE

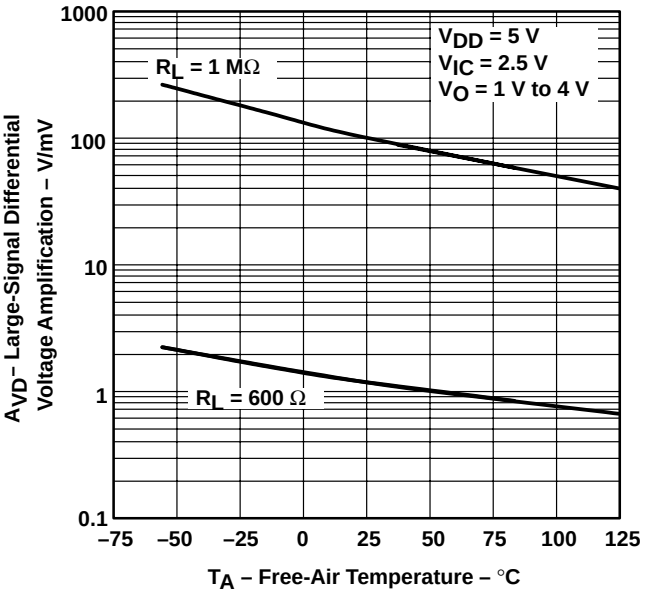

Figure 22

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TYPICAL CHARACTERISTICS

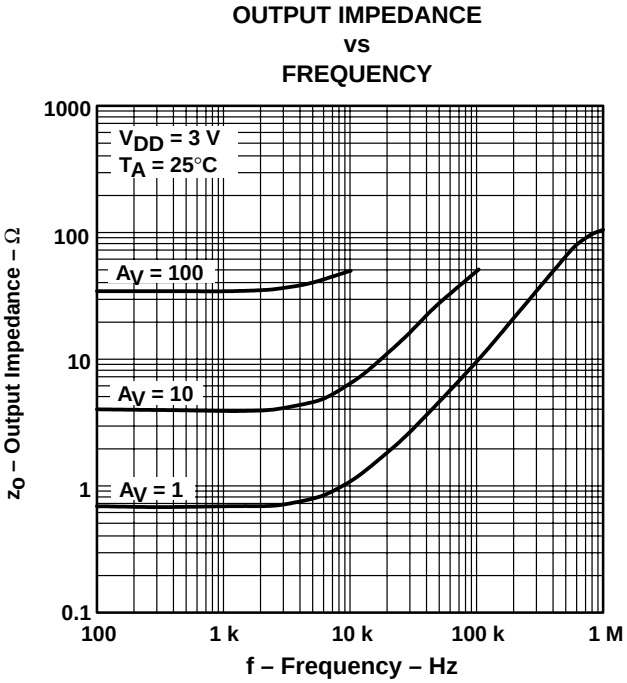

Figure 23

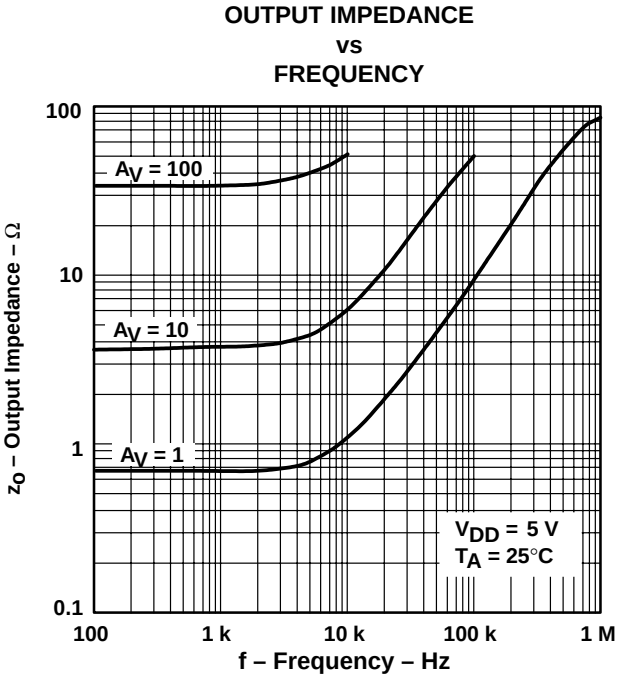

Figure 24

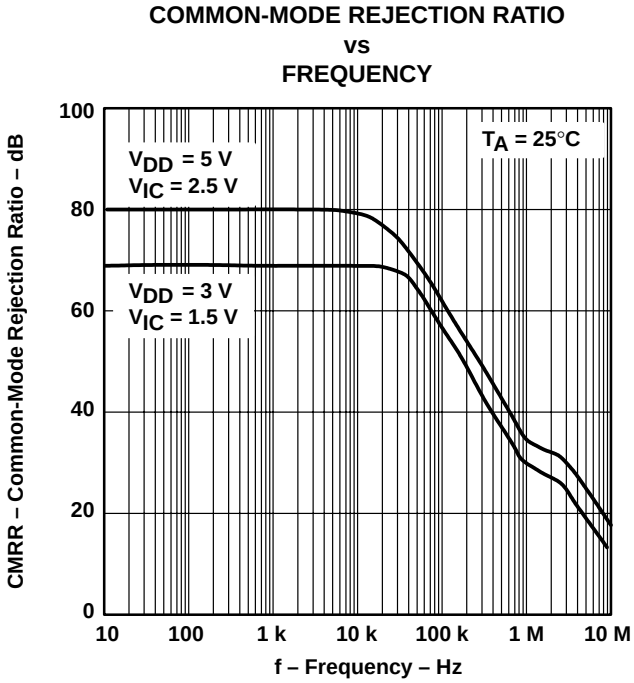

Figure 25

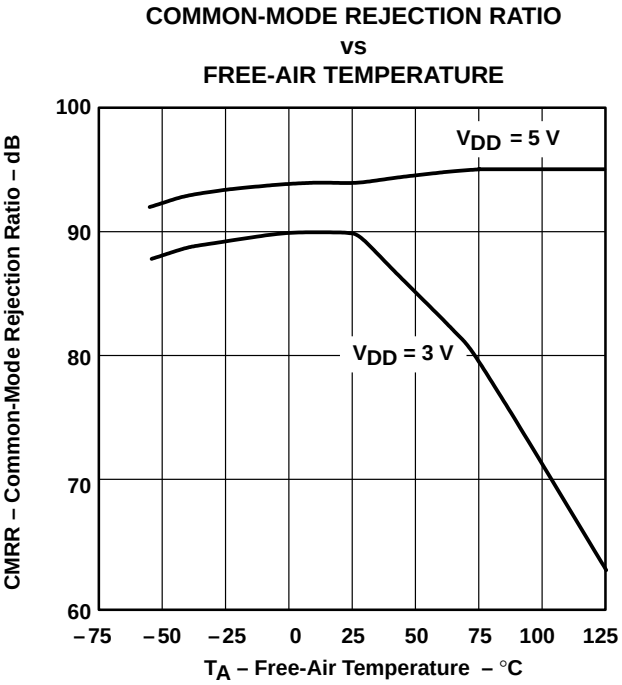

Figure 26

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TYPICAL CHARACTERISTICS

SUPPLY-VOLTAGE REJECTION RATIO vs FREQUENCY

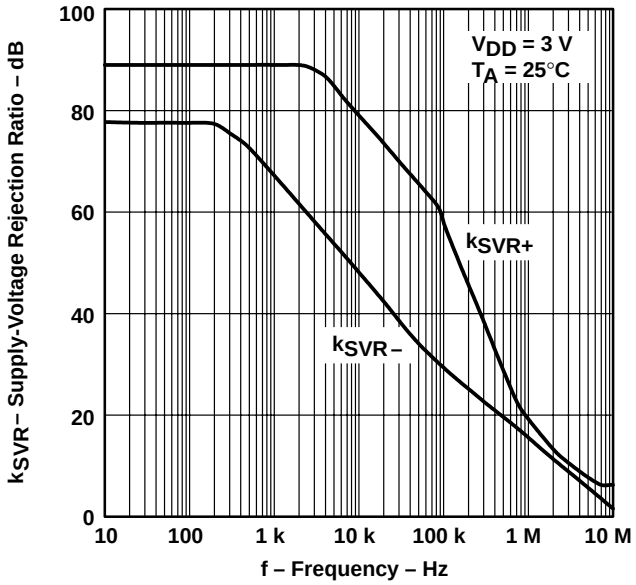

Figure 27

SUPPLY-VOLTAGE REJECTION RATIO vs FREQUENCY

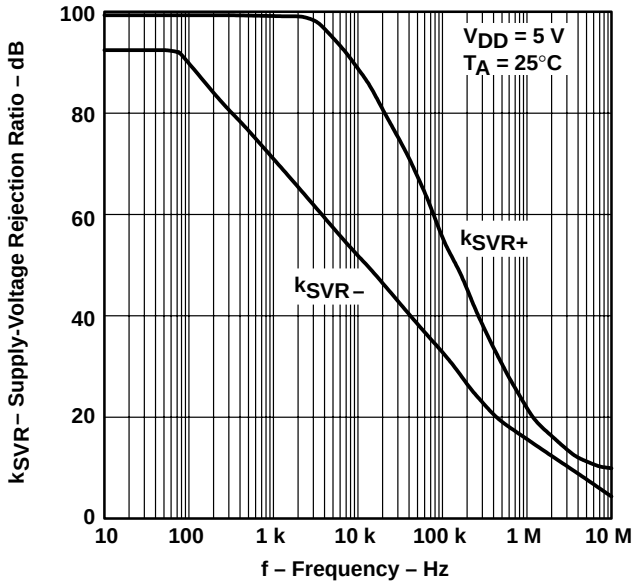

Figure 28

SUPPLY-VOLTAGE REJECTION RATIO vs FREE-AIR TEMPERATURE

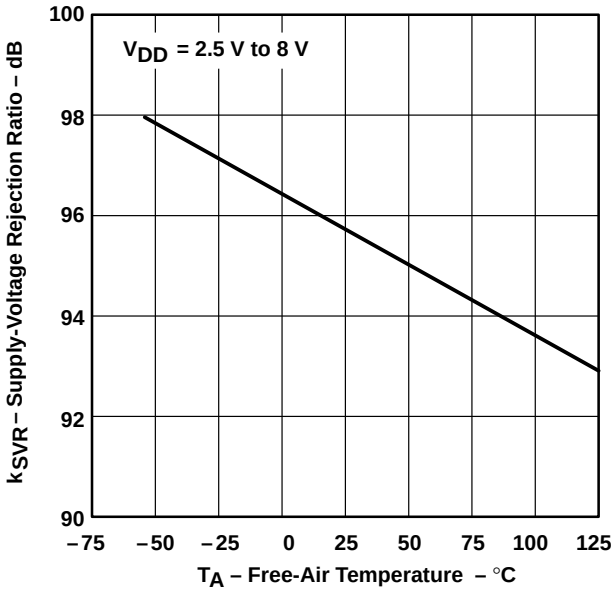

Figure 29

SUPPLY CURRENT vs SUPPLY VOLTAGE

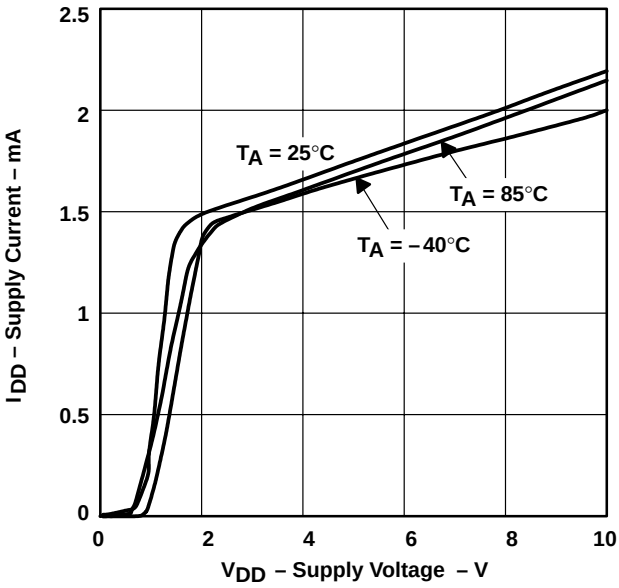

Figure 30

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TYPICAL CHARACTERISTICS

SLEW RATE vs LOAD CAPACITANCE

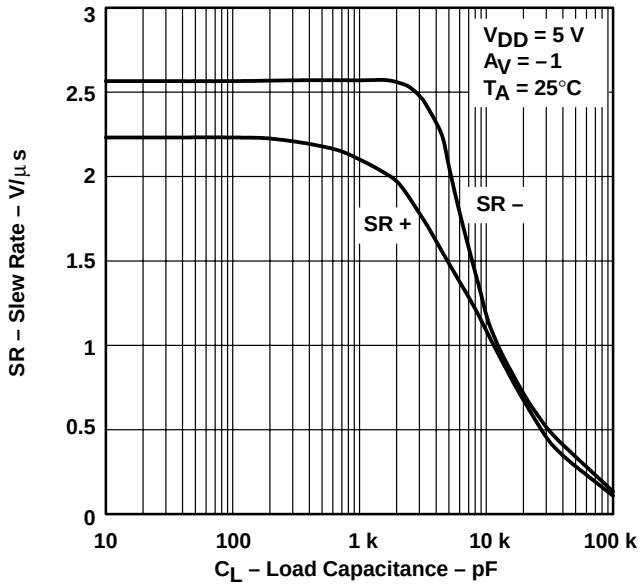

Figure 31

SLEW RATE vs FREE-AIR TEMPERATURE

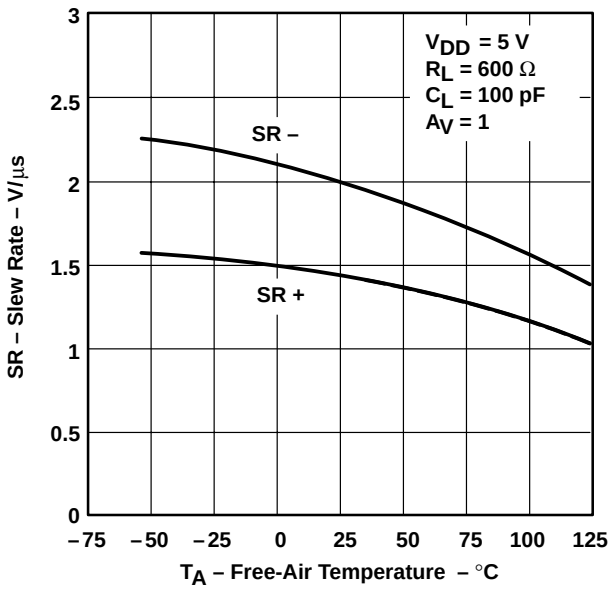

Figure 32

INVERTING LARGE-SIGNAL PULSE RESPONSE

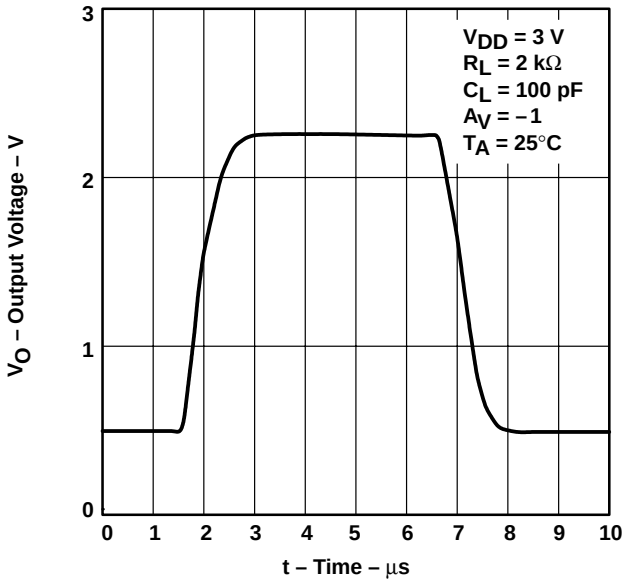

Figure 33

INVERTING LARGE-SIGNAL PULSE RESPONSE

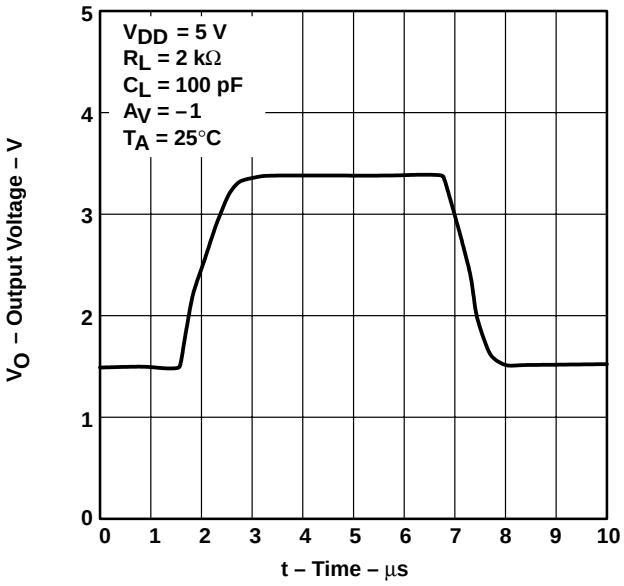

Figure 34

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TYPICAL CHARACTERISTICS

VOLTAGE-FOLLOWER LARGE-SIGNAL PULSE RESPONSE

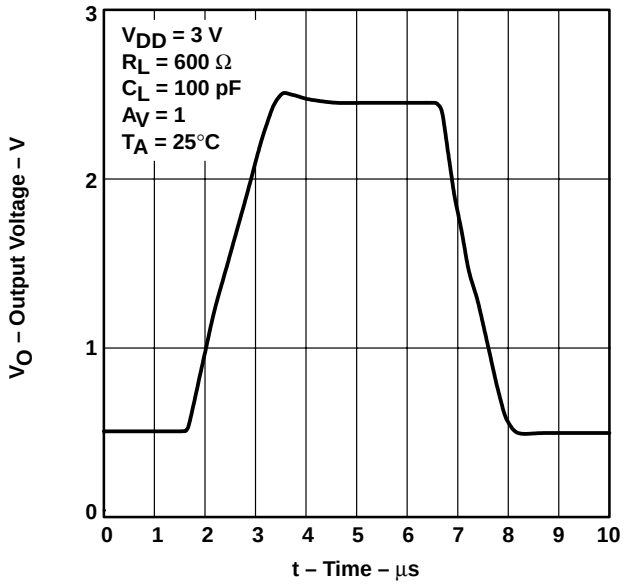

Figure 35

VOLTAGE-FOLLOWER LARGE-SIGNAL PULSE RESPONSE

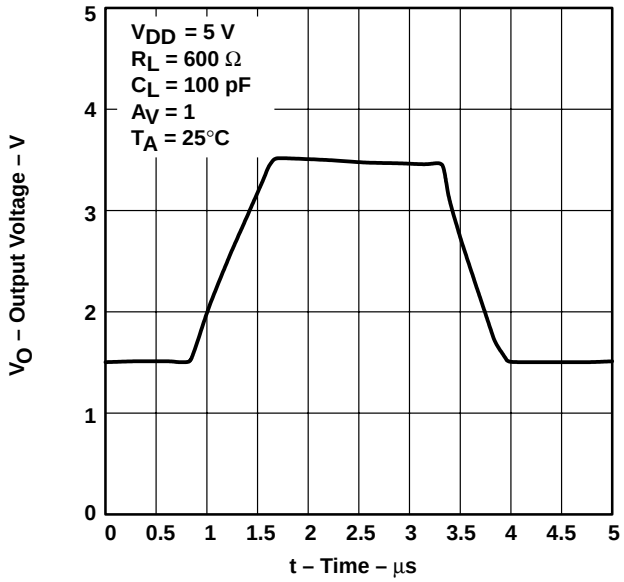

Figure 36

INVERTING SMALL-SIGNAL PULSE RESPONSE

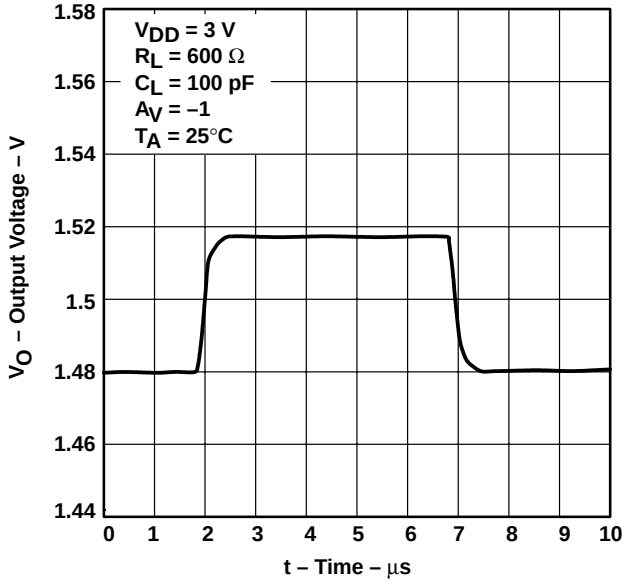

Figure 37

INVERTING SMALL-SIGNAL PULSE RESPONSE

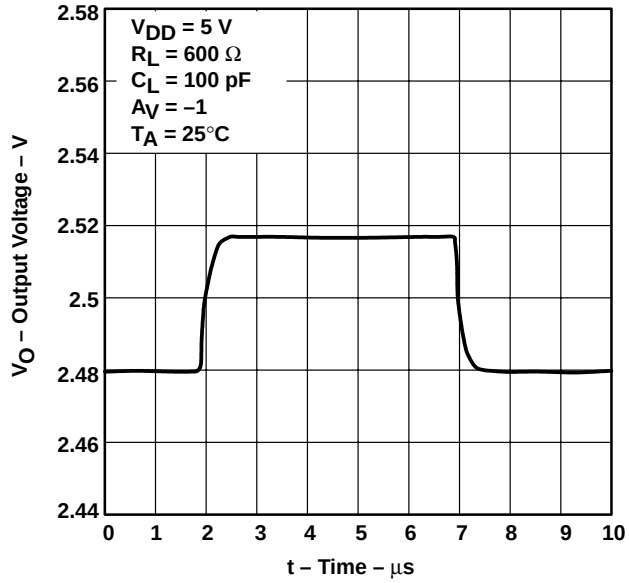

Figure 38

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TYPICAL CHARACTERISTICS

VOLTAGE-FOLLOWER SMALL-SIGNAL PULSE RESPONSE

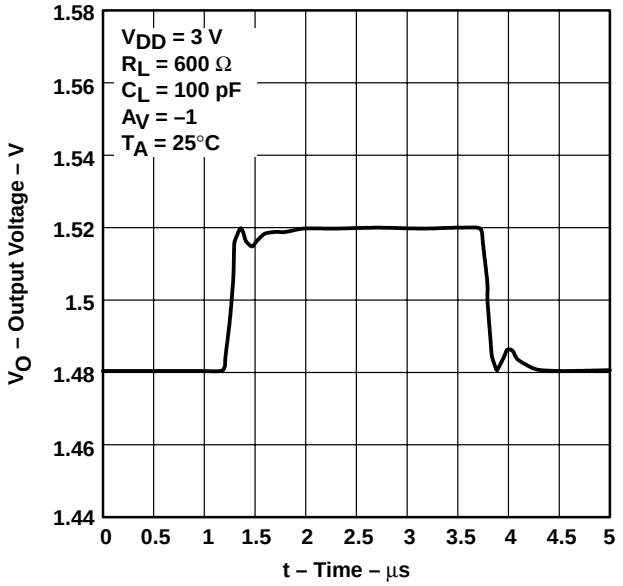

Figure 39

VOLTAGE-FOLLOWER SMALL-SIGNAL PULSE RESPONSE

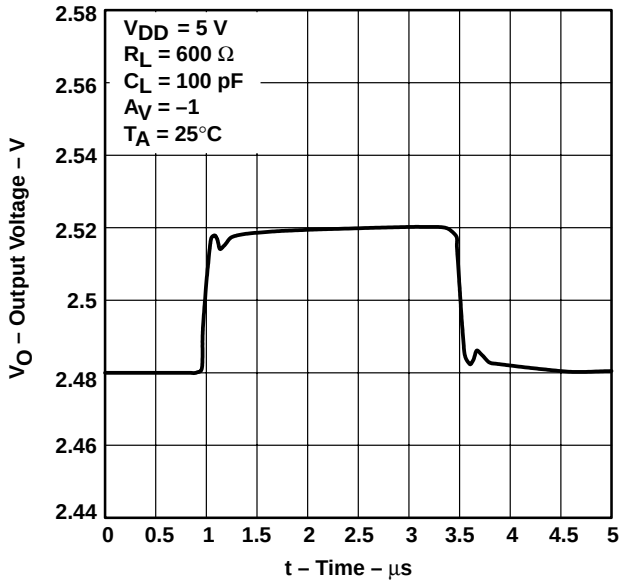

Figure 40

EQUIVALENT INPUT NOISE VOLTAGE vs FREQUENCY

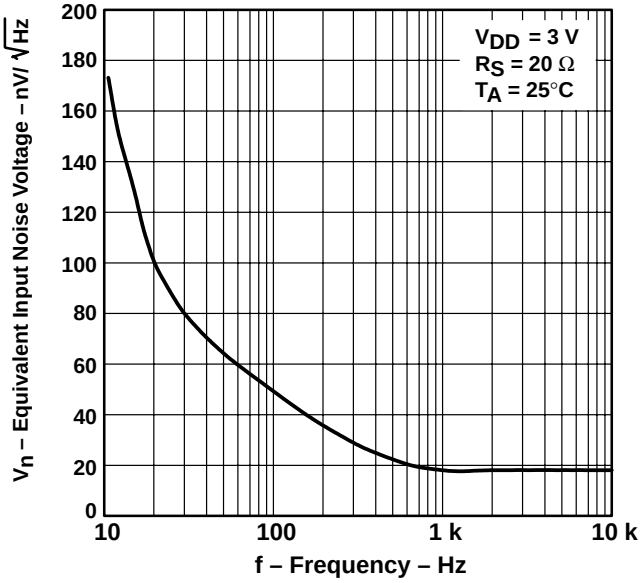

Figure 41

EQUIVALENT INPUT NOISE VOLTAGE vs FREQUENCY

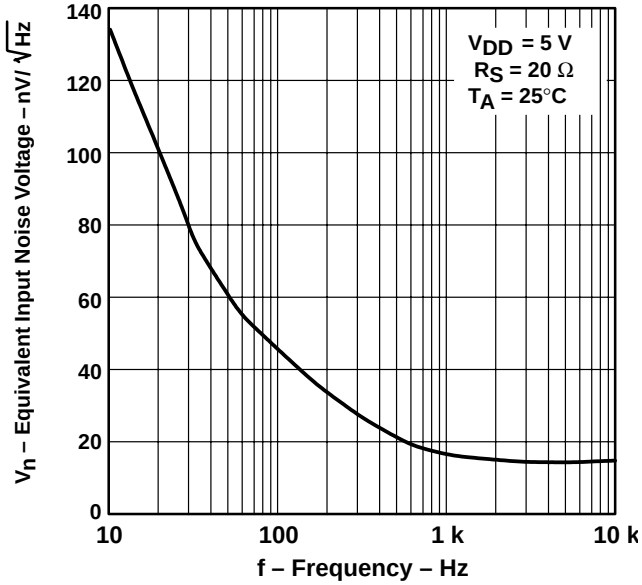

Figure 42

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TYPICAL CHARACTERISTICS

NOISE VOLTAGE
OVER A 10-SECOND PERIOD

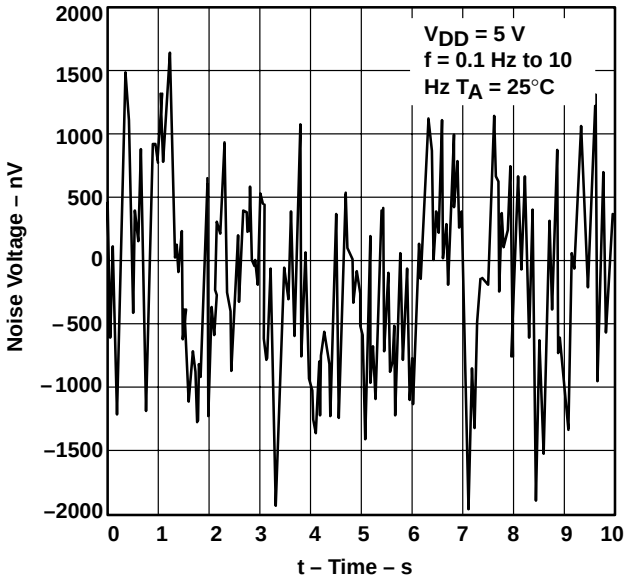

Figure 43

TOTAL HARMONIC DISTORTION PLUS NOISE
vs
FREQUENCY

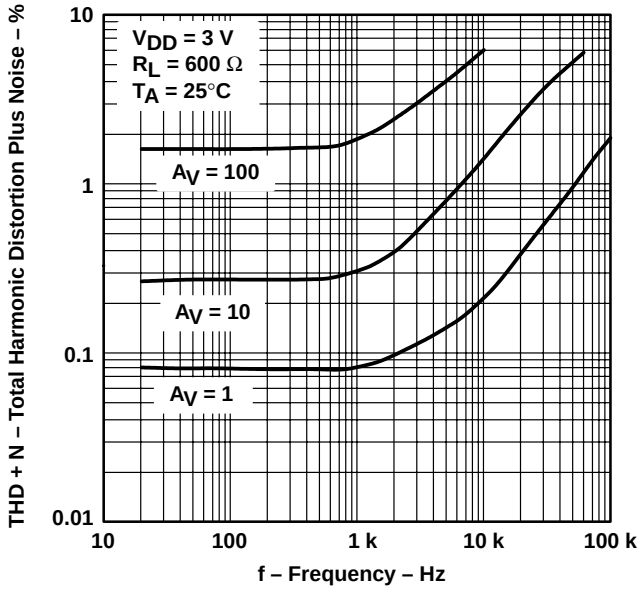

Figure 44

TOTAL HARMONIC DISTORTION PLUS NOISE
vs
FREQUENCY

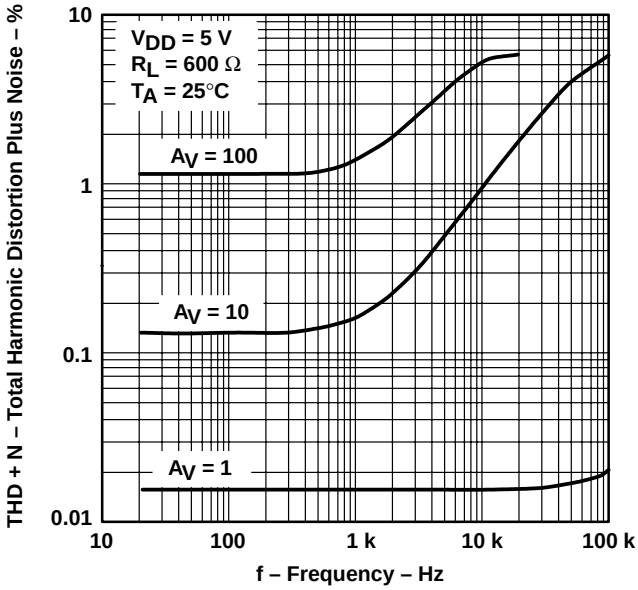

Figure 45

GAIN-BANDWIDTH PRODUCT
vs
FREE-AIR TEMPERATURE

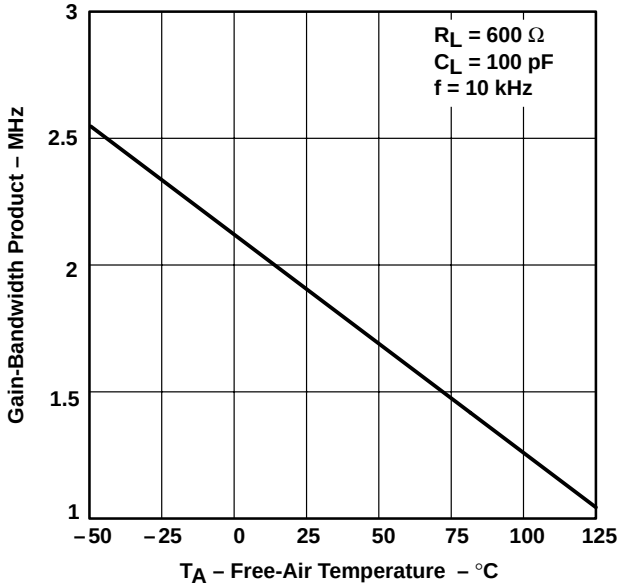

Figure 46

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TYPICAL CHARACTERISTICS

GAIN-BANDWIDTH PRODUCT vs SUPPLY VOLTAGE

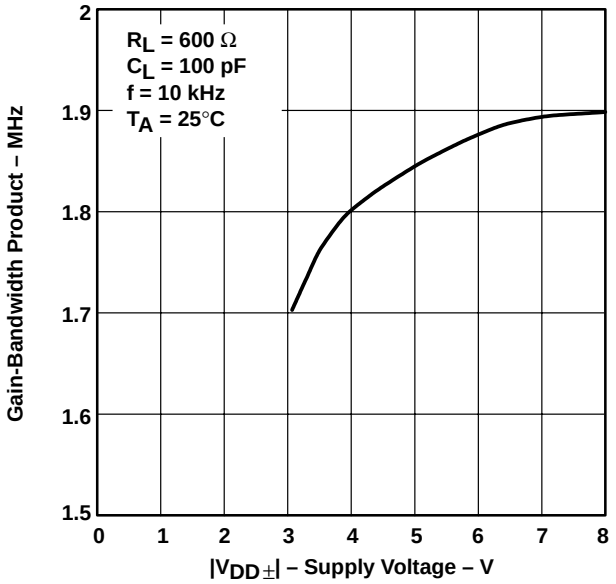

Figure 47

PHASE MARGIN vs LOAD CAPACITANCE

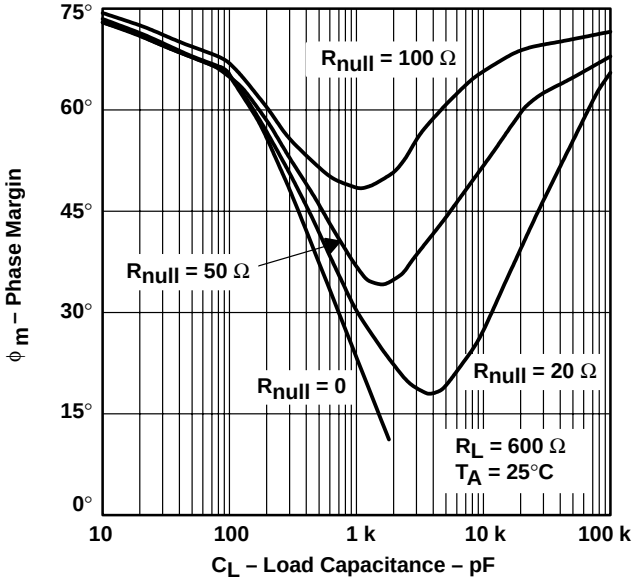

Figure 48

GAIN MARGIN vs LOAD CAPACITANCE

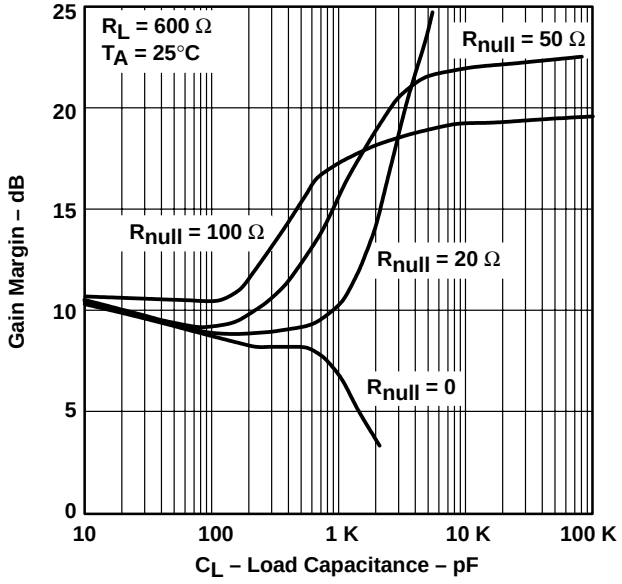

Figure 49

UNITY-GAIN BANDWIDTH vs LOAD CAPACITANCE

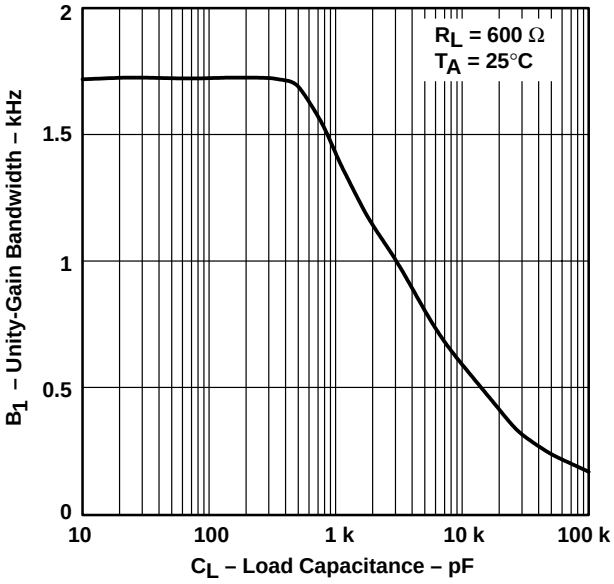

Figure 50

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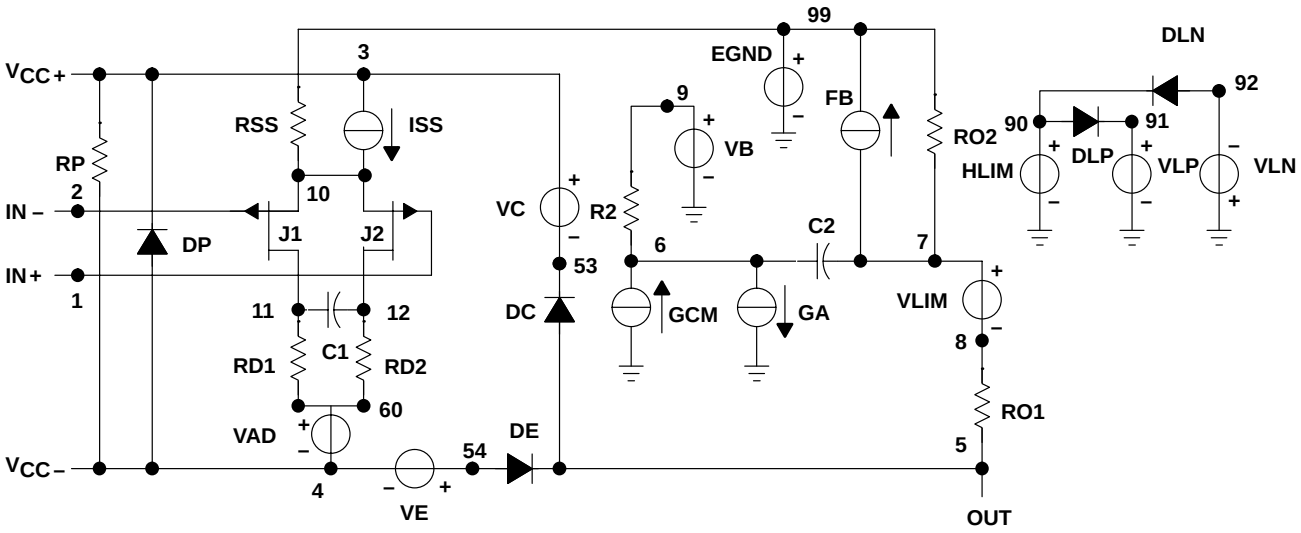
APPLICATION INFORMATION

macromodel information

Macromodel information provided was derived using *PSpice*™ *Parts*™ model generation software. The Boyle macromodel (see Note 5) and subcircuit in Figure 51 were generated using the TLV244x typical electrical and operating characteristics at $T_A = 25°C$. Using this information, output simulations of the following key parameters can be generated to a tolerance of 20% (in most cases):

- Maximum positive output voltage swing
- Maximum negative output voltage swing
- Slew rate
- Quiescent power dissipation
- Input bias current
- Open-loop voltage amplification
- Unity gain frequency
- Common-mode rejection ratio
- Phase margin
- DC output resistance
- AC output resistance
- Short-circuit output current limit

NOTE 5: G. R. Boyle, B. M. Cohn, D. O. Pederson, and J. E. Solomon, "Macromodeling of Integrated Circuit Operational Amplifiers," *IEEE Journal of Solid-State Circuits,* SC-9, 353 (1974).




```
.SUBCKT TLV2442 1 2 3 4 5
C1      11      12      14E–12
C2      6       7       60.00E–12
DC      5       53      DX
DE      54      5       DX
DLP     90      91      DX
DLN     92      90      DX
DP      4       3       DX
EGND    99      0       POLY (2) (3,0) (4,) 0 .5 .5
FB      7       99      POLY (5) VB VC VE VLP VLN 0
+ 984.9E3 –1E6 1E6 1E6 –1E6
GA      6       0       11      12 377.0E–6
GCM     0       6       10      99 134E–9
ISS     3       10      DC 216.0E–6
HLIM    90      0       VLIM 1K
J1      11      2       10 JX
J2      12      1       10 JX
R2      6       9       100.OE3
RD1     60      11      2.653E3
RD2     60      12      2.653E3
R01     8       5       50
R02     7       99      50
RP      3       4       4.310E3
RSS     10      99      925.9E3
VAD     60      4       –.5
VB      9       0       DC 0
VC      3       53      DC .78
VE      54      4       DC .78
VLIM    7       8       DC 0
VLP     91      0       DC 1.9
VLN     0       92      DC 9.4
.MODEL DX D (IS=800.0E–18)
.MODEL JX PJF (IS=1.500E–12BETA=1.316E-3
+ VTO=–.270)
.ENDS
```

Figure 51. Boyle Macromodel and Subcircuit

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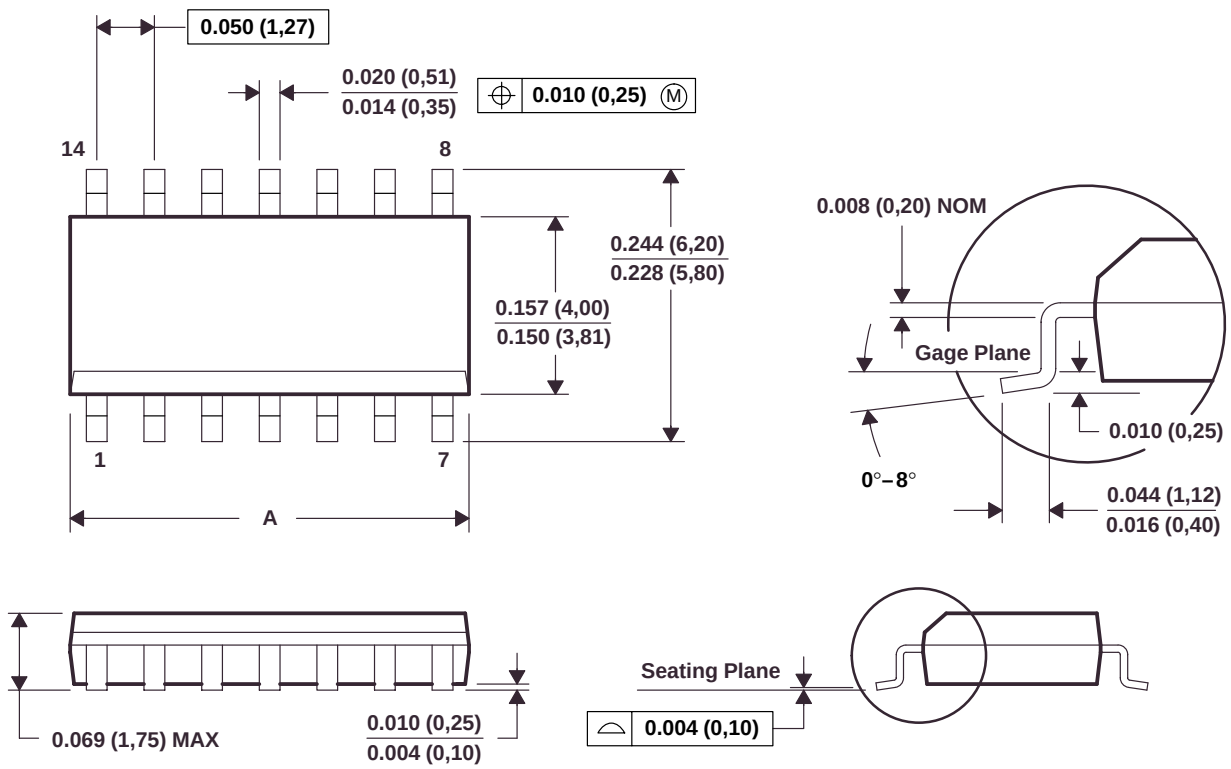
MECHANICAL DATA

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

14 PIN SHOWN



DIM \ PINS **	8	14	16
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: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion, not to exceed 0.006 (0,15).
D. Falls within JEDEC MS-012

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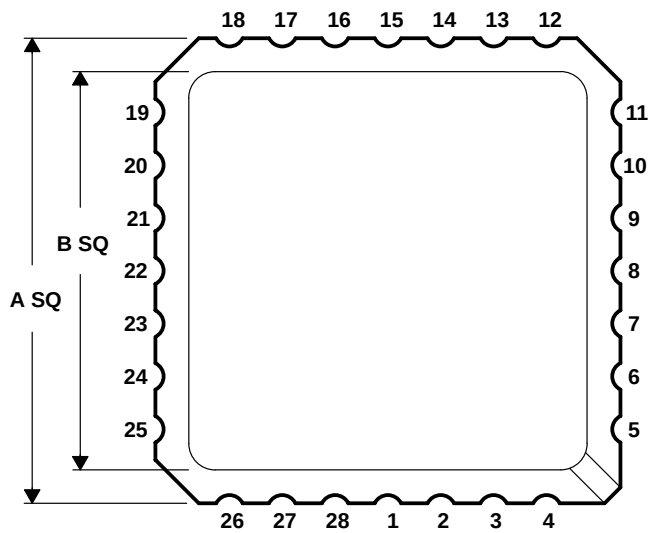
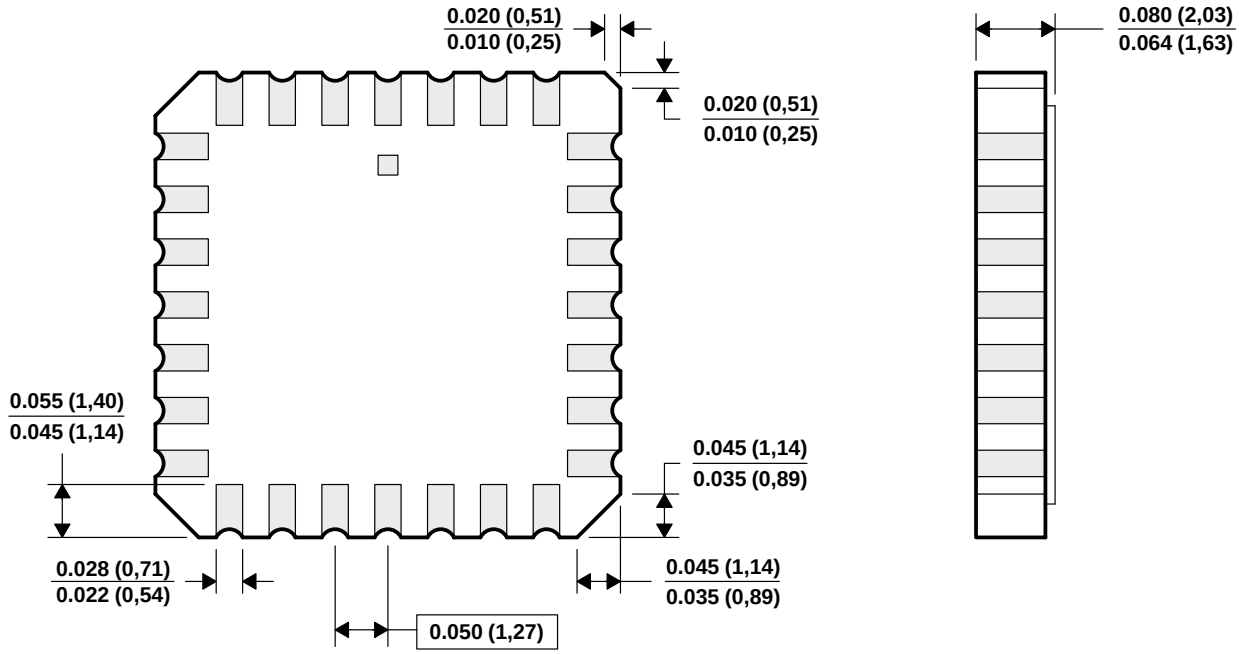
MECHANICAL DATA

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	0.739 (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 10/96

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 metal lid.
D. The terminals are gold plated.
E. Falls within JEDEC MS-004

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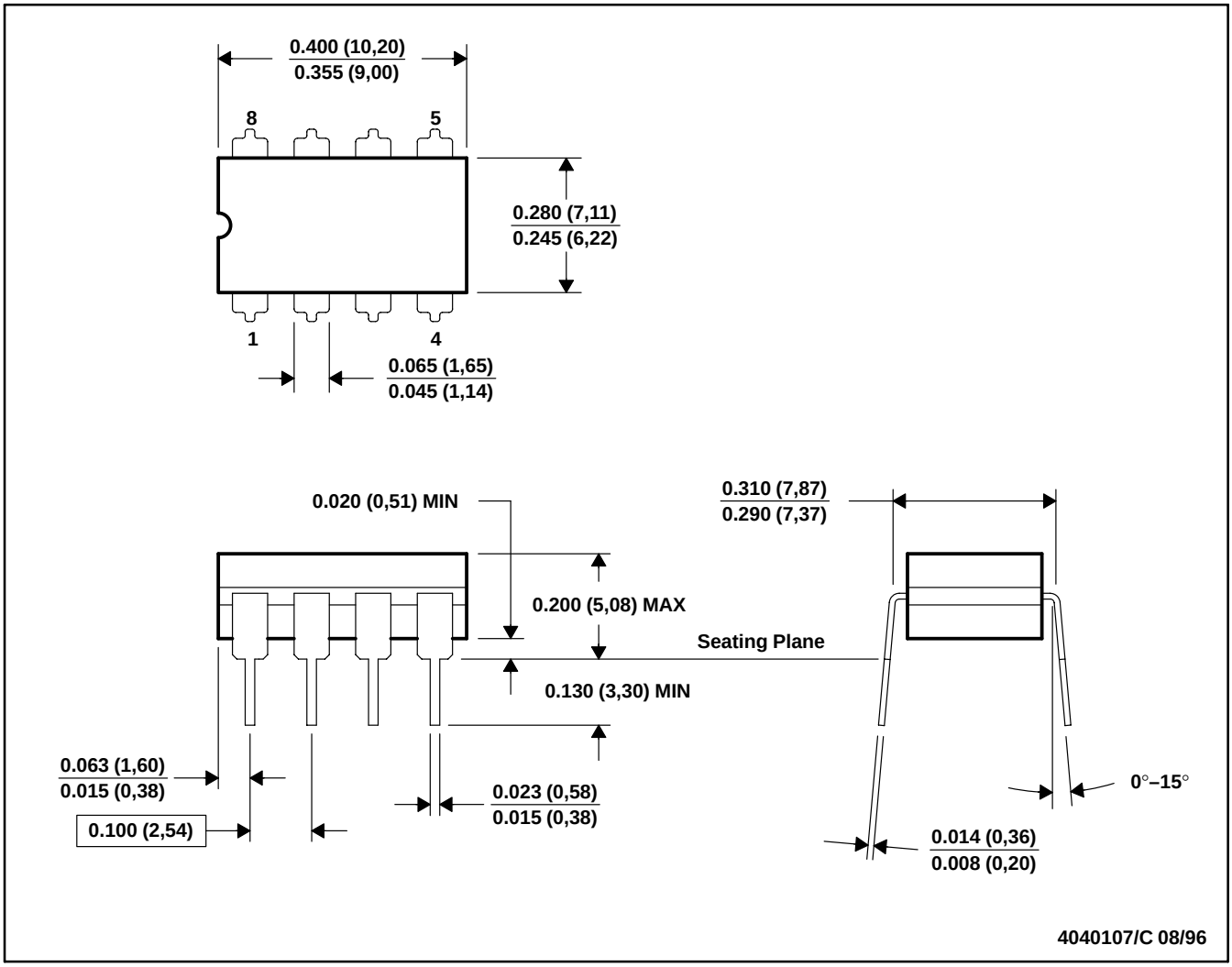
MECHANICAL DATA

JG (R-GDIP-T8) **CERAMIC DUAL-IN-LINE PACKAGE**



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 on press ceramic glass frit seal only.
E. Falls within MIL-STD-1835 GDIP1-T8

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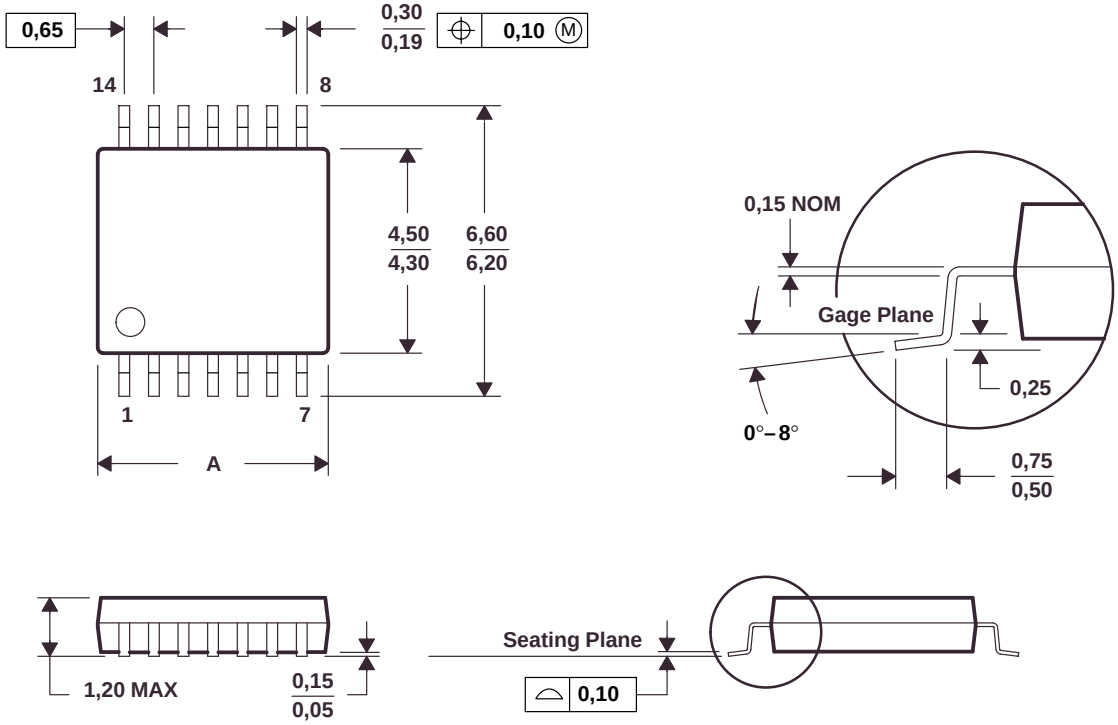
MECHANICAL DATA

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

14 PIN SHOWN



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

4040064/E 08/96

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.
D. Falls within JEDEC MO-153

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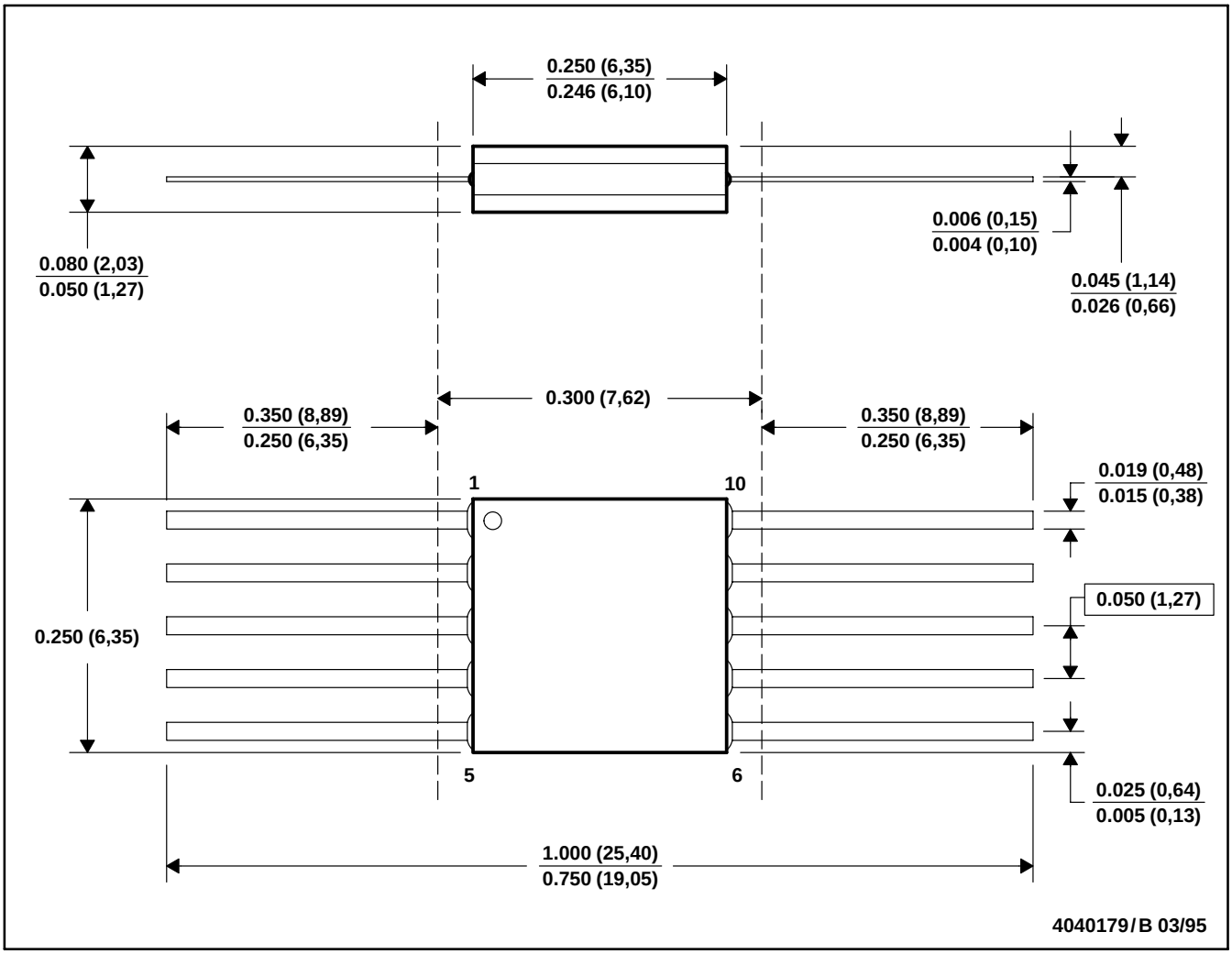
MECHANICAL DATA

U (S-GDFP-F10) **CERAMIC DUAL FLATPACK**



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 only.
E. Falls within MIL STD 1835 GDFP1-F10 and JEDEC MO-092AA

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PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)
5962-9751101Q2A	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type
5962-9751101QHA	ACTIVE	CFP	U	10	1	TBD	A42	N / A for Pkg Type
5962-9751101QPA	ACTIVE	CDIP	JG	8	1	TBD	A42	N / A for Pkg Type
5962-9751102Q2A	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type
5962-9751102QHA	ACTIVE	CFP	U	10	1	TBD	A42	N / A for Pkg Type
5962-9751102QPA	ACTIVE	CDIP	JG	8	1	TBD	A42	N / A for Pkg Type
TLV2442AID	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2442AIDG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2442AIDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2442AIDRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2442AIPW	ACTIVE	TSSOP	PW	8	150	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2442AIPWG4	ACTIVE	TSSOP	PW	8	150	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2442AIPWLE	OBSOLETE	TSSOP	PW	8		TBD	Call TI	Call TI
TLV2442AIPWR	ACTIVE	TSSOP	PW	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2442AIPWRG4	ACTIVE	TSSOP	PW	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2442AMFKB	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type
TLV2442AMJGB	ACTIVE	CDIP	JG	8	1	TBD	A42	N / A for Pkg Type
TLV2442AMUB	ACTIVE	CFP	U	10	1	TBD	A42	N / A for Pkg Type
TLV2442AQD	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2442AQDG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2442AQDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2442AQDRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2442AQPW	ACTIVE	TSSOP	PW	8	150	TBD	CU NIPDAU	Level-1-220C-UNLIM
TLV2442AQPWG4	ACTIVE	TSSOP	PW	8	150	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2442AQPWR	ACTIVE	TSSOP	PW	8	2000	TBD	CU NIPDAU	Level-1-220C-UNLIM
TLV2442AQPWRG4	ACTIVE	TSSOP	PW	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2442CD	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2442CDG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2442CDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2442CDRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS &	CU NIPDAU	Level-1-260C-UNLIM

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Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)
						no Sb/Br)		
TLV2442CPW	ACTIVE	TSSOP	PW	8	150	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2442CPWG4	ACTIVE	TSSOP	PW	8	150	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2442CPWLE	OBSOLETE	TSSOP	PW	8		TBD	Call TI	Call TI
TLV2442CPWR	ACTIVE	TSSOP	PW	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2442CPWRG4	ACTIVE	TSSOP	PW	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2442ID	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2442IDG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2442IDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2442IDRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2442MFKB	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type
TLV2442MJGB	ACTIVE	CDIP	JG	8	1	TBD	A42	N / A for Pkg Type
TLV2442MUB	ACTIVE	CFP	U	10	1	TBD	A42	N / A for Pkg Type
TLV2442QD	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2442QDG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2442QDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2442QDRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2442QPW	ACTIVE	TSSOP	PW	8	150	TBD	CU NIPDAU	Level-1-220C-UNLIM
TLV2442QPWG4	ACTIVE	TSSOP	PW	8	150	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2442QPWR	ACTIVE	TSSOP	PW	8	2000	TBD	CU NIPDAU	Level-1-220C-UNLIM
TLV2442QPWRG4	ACTIVE	TSSOP	PW	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2444AID	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2444AIDG4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2444AIPW	ACTIVE	TSSOP	PW	14	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2444AIPWG4	ACTIVE	TSSOP	PW	14	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2444AIPWR	ACTIVE	TSSOP	PW	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2444AIPWRG4	ACTIVE	TSSOP	PW	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2444CD	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2444CDG4	ACTIVE	SOIC	D	14	50	Green (RoHS &	CU NIPDAU	Level-1-260C-UNLIM

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Orderable Device	Status [1]	Package Type	Package Drawing	Pins	Package Qty	Eco Plan [2]	Lead/Ball Finish	MSL Peak Temp [3]
						no Sb/Br)		
TLV2444CDR	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	Call TI	Level-1-260C-UNLIM
TLV2444CDRG4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	Call TI	Level-1-260C-UNLIM
TLV2444CPW	ACTIVE	TSSOP	PW	14	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2444CPWG4	ACTIVE	TSSOP	PW	14	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2444CPWR	ACTIVE	TSSOP	PW	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2444CPWRG4	ACTIVE	TSSOP	PW	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2444ID	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2444IDG4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2444IDR	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2444IDRG4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2444IPWR	ACTIVE	TSSOP	PW	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2444IPWRG4	ACTIVE	TSSOP	PW	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

[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.

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.

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OTHER QUALIFIED VERSIONS OF TLV2442, TLV2442A, TLV2442AM, TLV2442M, TLV2444A :

- Automotive: TLV2442-Q1, TLV2442A-Q1, TLV2444A-Q1

NOTE: Qualified Version Definitions:

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

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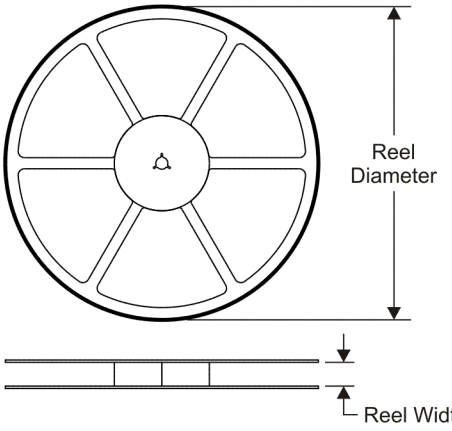
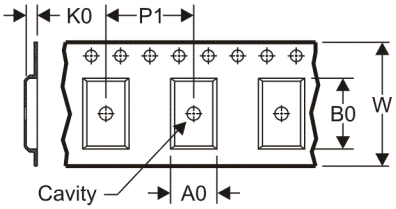
TAPE AND REEL INFORMATION

REEL DIMENSIONS

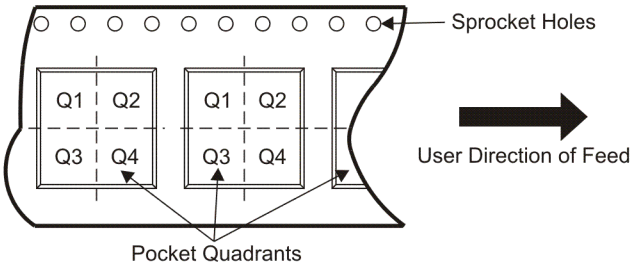


TAPE DIMENSIONS



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
TLV2442AIDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
TLV2442AIPWR	TSSOP	PW	8	2000	330.0	12.4	7.0	3.6	1.6	8.0	12.0	Q1
TLV2442AQPWR	TSSOP	PW	8	2000	330.0	12.4	7.0	3.6	1.6	8.0	12.0	Q1
TLV2442CDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
TLV2442CPWR	TSSOP	PW	8	2000	330.0	12.4	7.0	3.6	1.6	8.0	12.0	Q1
TLV2442IDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
TLV2442IDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
TLV2442QPWR	TSSOP	PW	8	2000	330.0	12.4	7.0	3.6	1.6	8.0	12.0	Q1
TLV2444AIPWR	TSSOP	PW	14	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
TLV2444CDR	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
TLV2444CPWR	TSSOP	PW	14	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
TLV2444IDR	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
TLV2444IPWR	TSSOP	PW	14	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1

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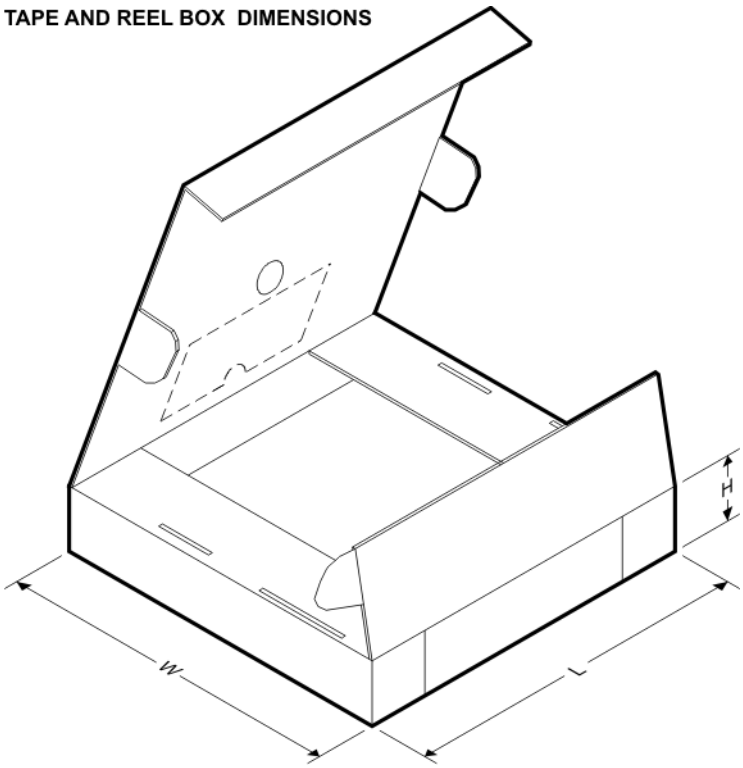
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TLV2442AIDR	SOIC	D	8	2500	340.5	338.1	20.6
TLV2442AIPWR	TSSOP	PW	8	2000	346.0	346.0	29.0
TLV2442AQPWR	TSSOP	PW	8	2000	346.0	346.0	29.0
TLV2442CDR	SOIC	D	8	2500	340.5	338.1	20.6
TLV2442CPWR	TSSOP	PW	8	2000	346.0	346.0	29.0
TLV2442IDR	SOIC	D	8	2500	340.5	338.1	20.6
TLV2442IDR	SOIC	D	8	2500	346.0	346.0	29.0
TLV2442QPWR	TSSOP	PW	8	2000	346.0	346.0	29.0
TLV2444AIPWR	TSSOP	PW	14	2000	346.0	346.0	29.0
TLV2444CDR	SOIC	D	14	2500	346.0	346.0	33.0
TLV2444CPWR	TSSOP	PW	14	2000	346.0	346.0	29.0
TLV2444IDR	SOIC	D	14	2500	346.0	346.0	33.0
TLV2444IPWR	TSSOP	PW	14	2000	346.0	346.0	29.0

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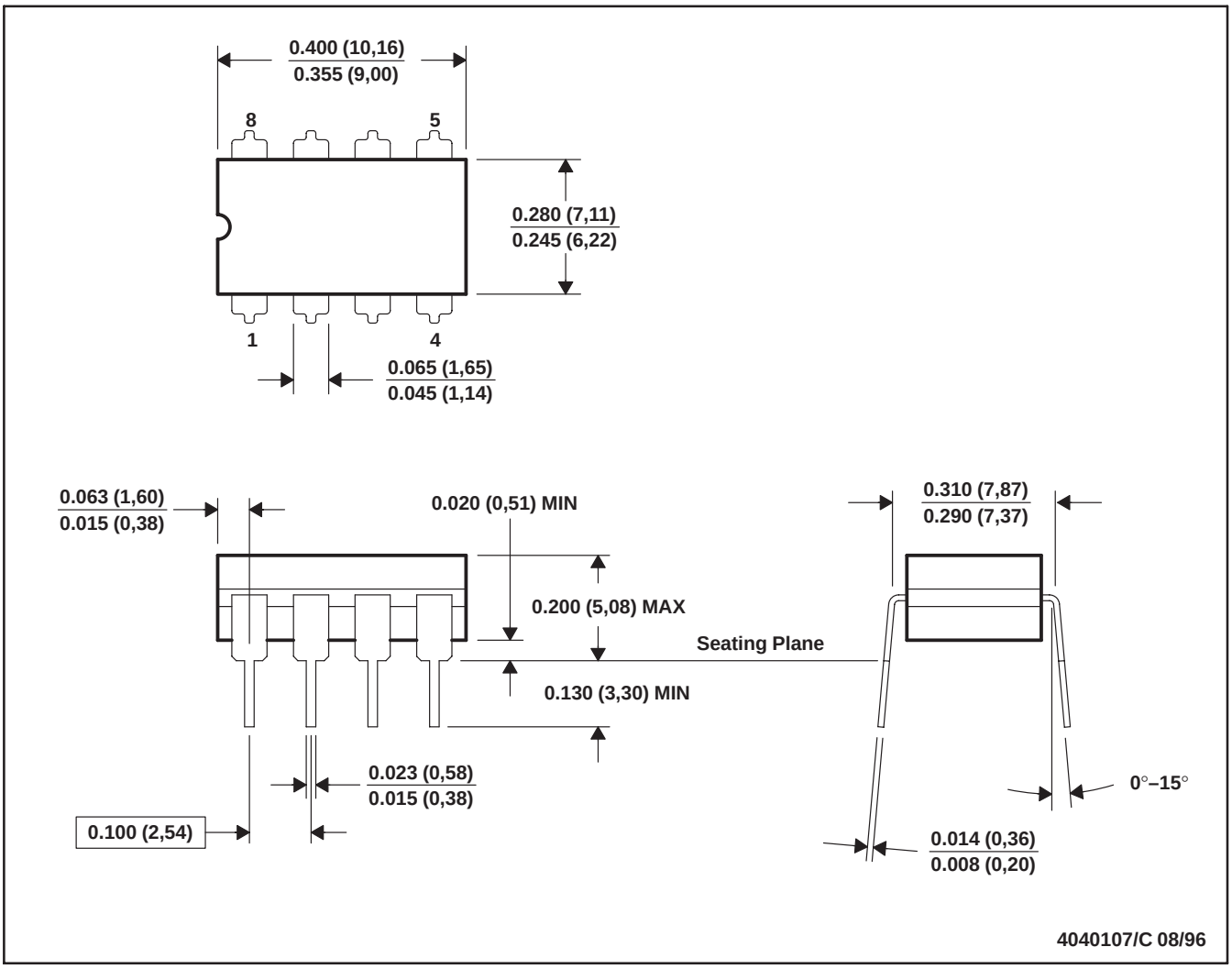
JG (R-GDIP-T8) **CERAMIC DUAL-IN-LINE**



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

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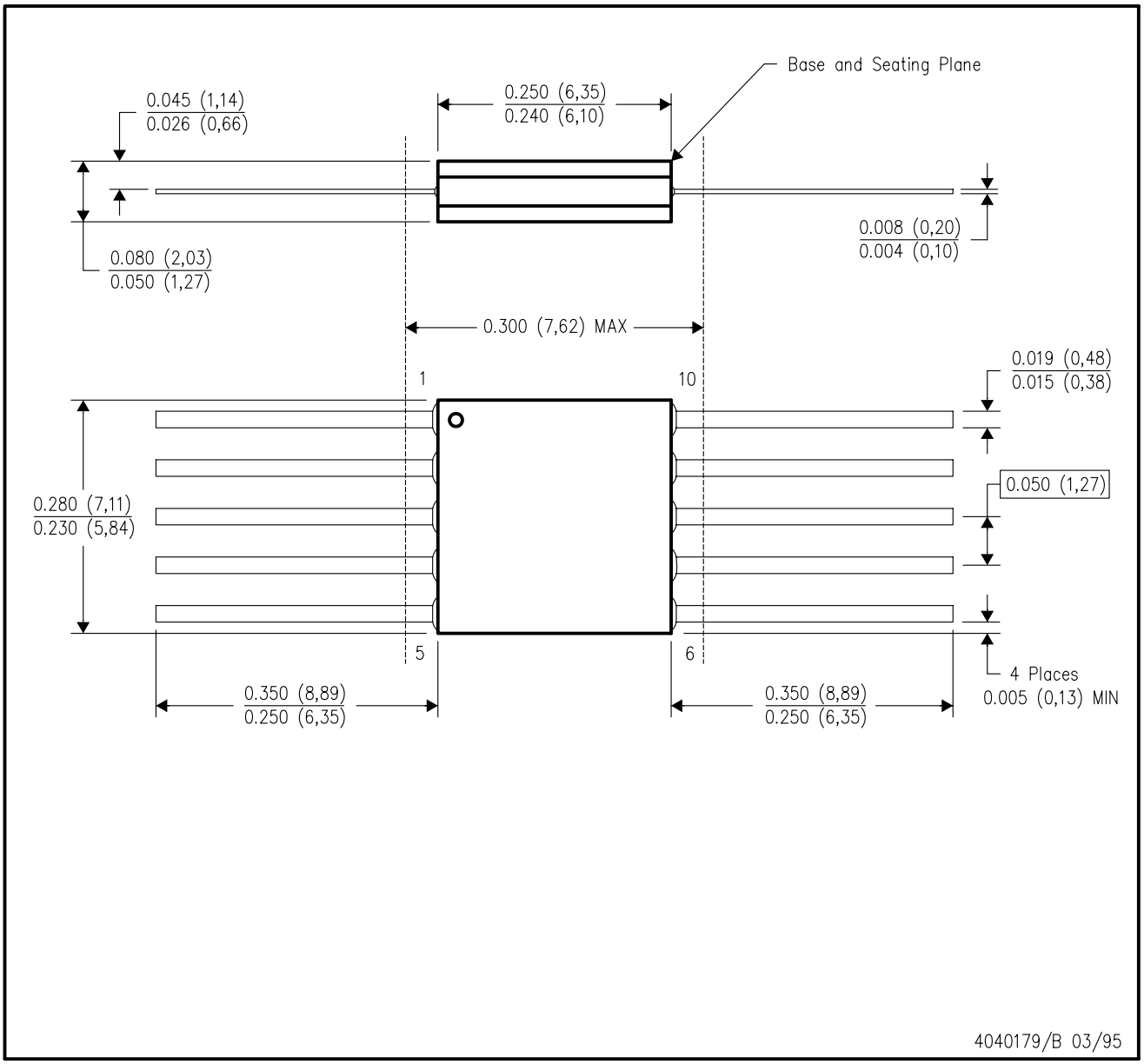
U (S–GDFP–F10) CERAMIC DUAL FLATPACK



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 only.
- E. Falls within MIL STD 1835 GDFP1–F10 and JEDEC MO–092AA

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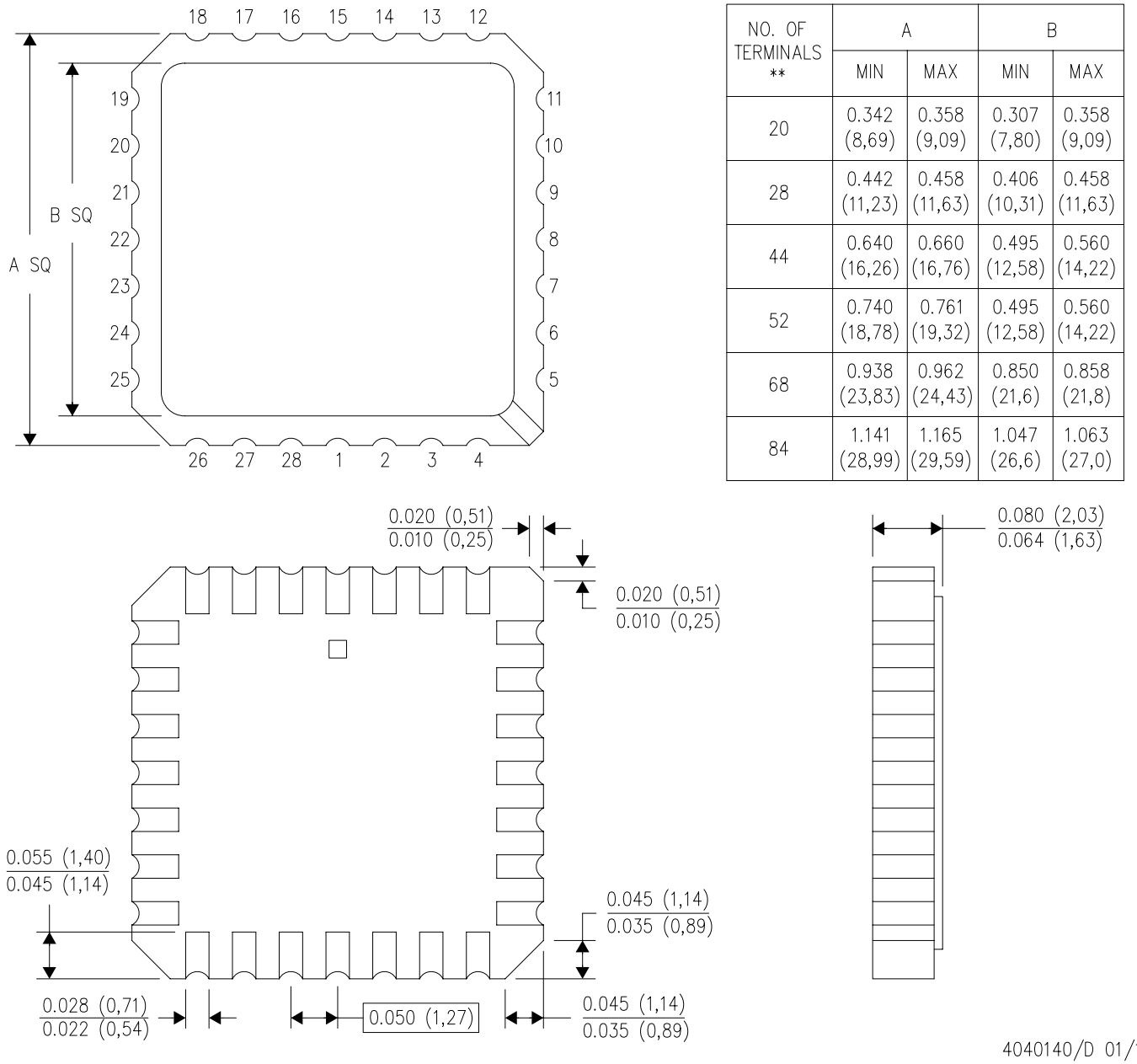
FK (S–CQCC–N**) LEADLESS CERAMIC CHIP CARRIER

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)

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

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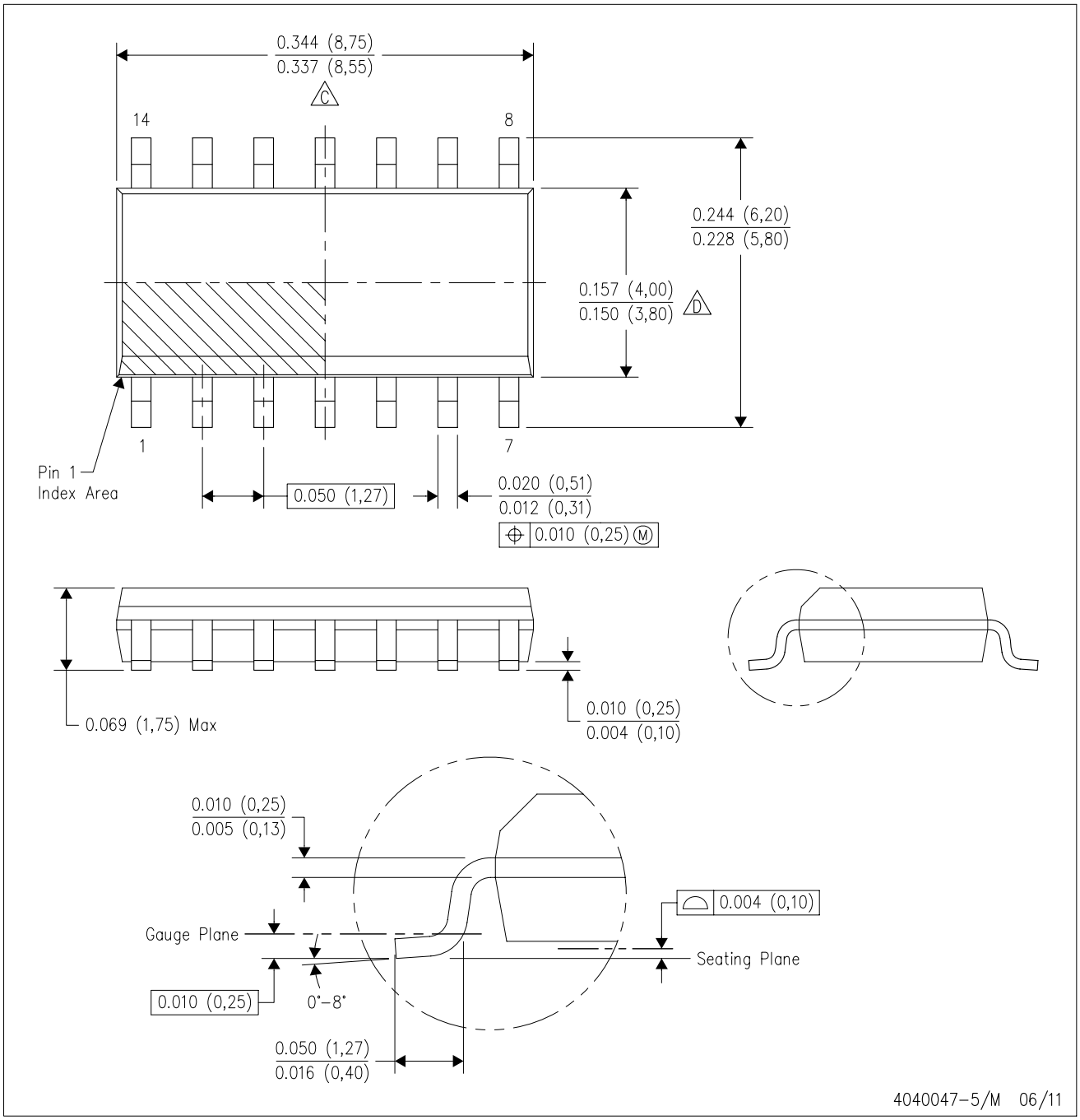
D (R–PDSO–G14) PLASTIC SMALL OUTLINE



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 AB.

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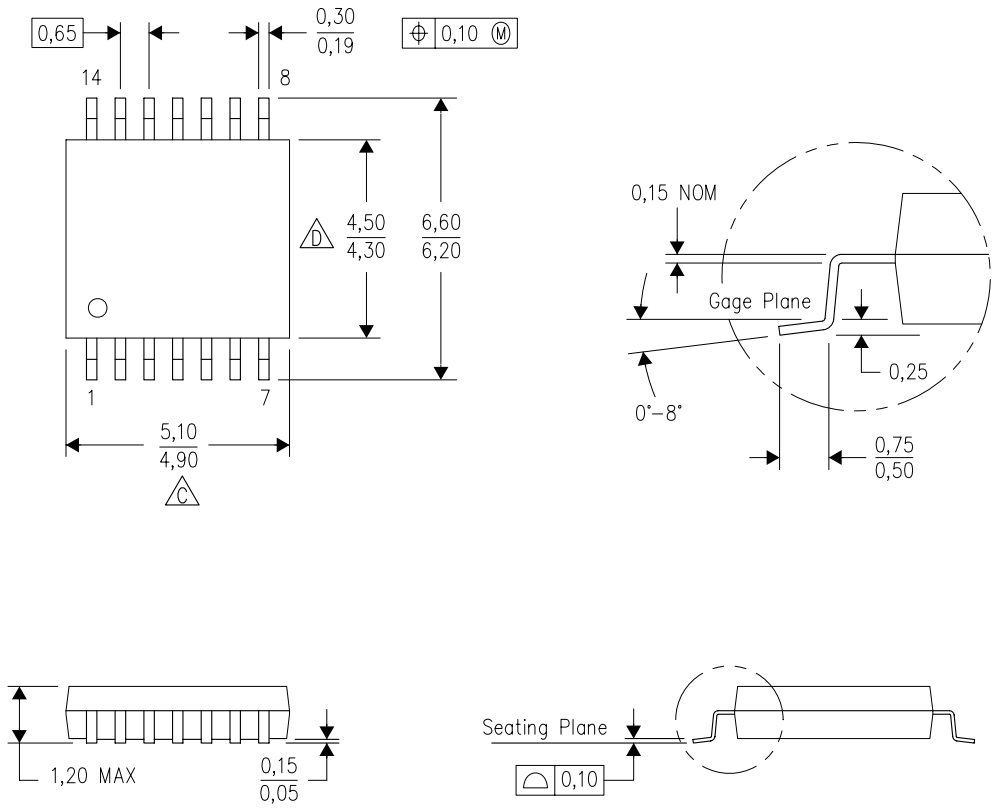
PW (R–PDSO–G14) PLASTIC SMALL OUTLINE



NOTES:
A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M–1994.
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 0,15 each side.
D. Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
E. Falls within JEDEC MO–153

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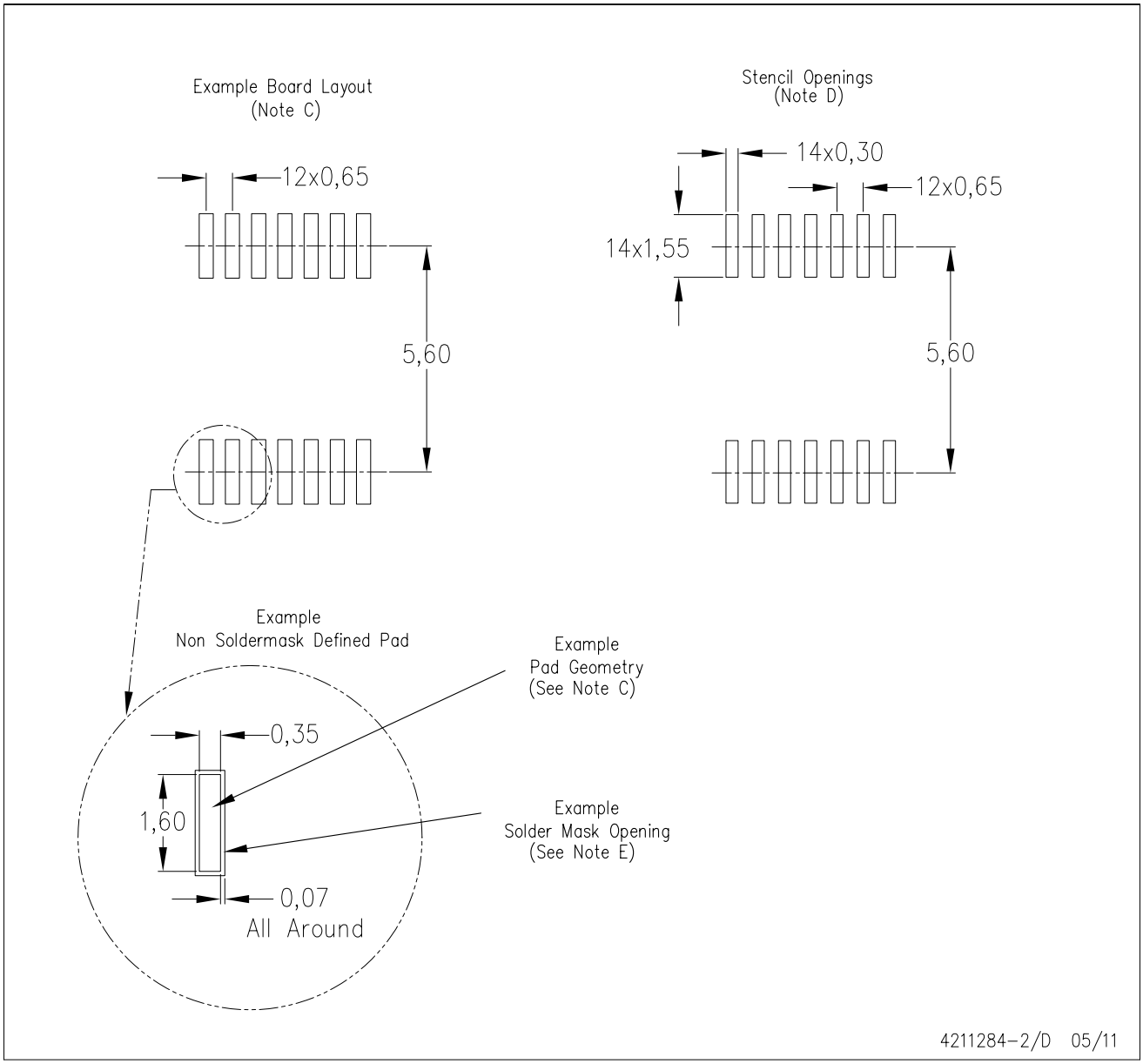
PW (R–PDSO–G14) PLASTIC SMALL OUTLINE



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.

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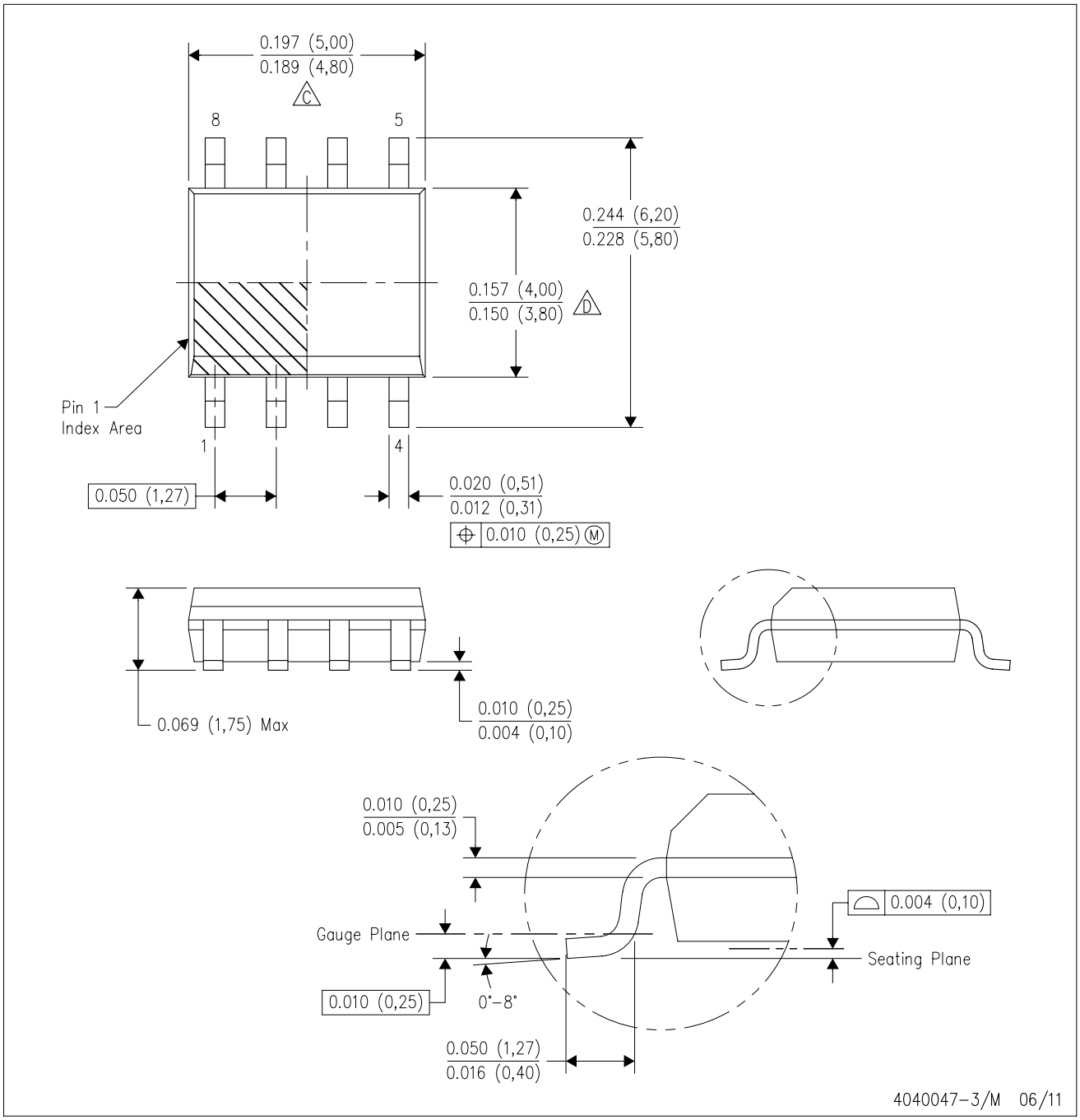
D (R–PDSO–G8) PLASTIC SMALL OUTLINE



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.

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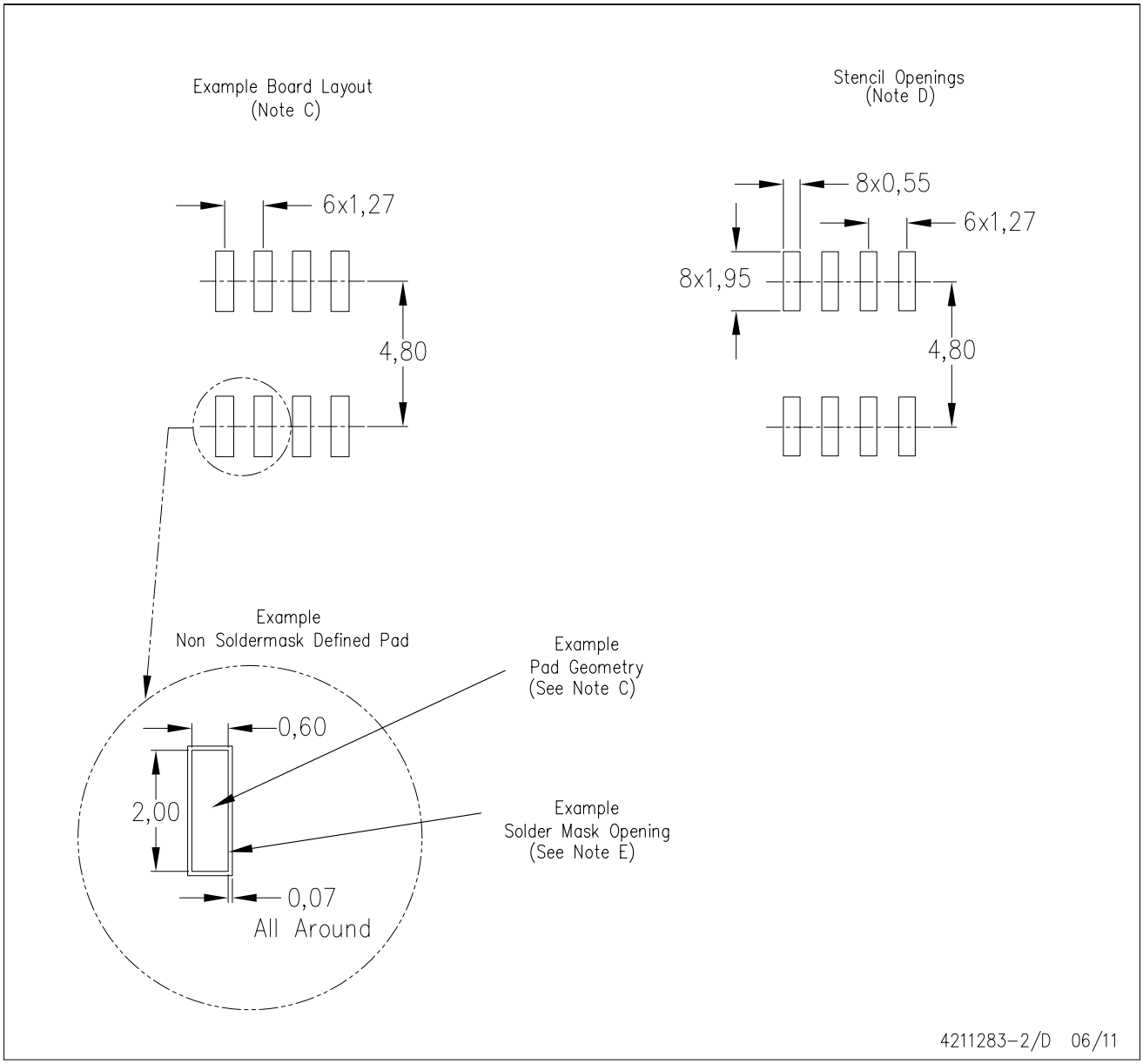
D (R–PDSO–G8) PLASTIC SMALL OUTLINE



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.

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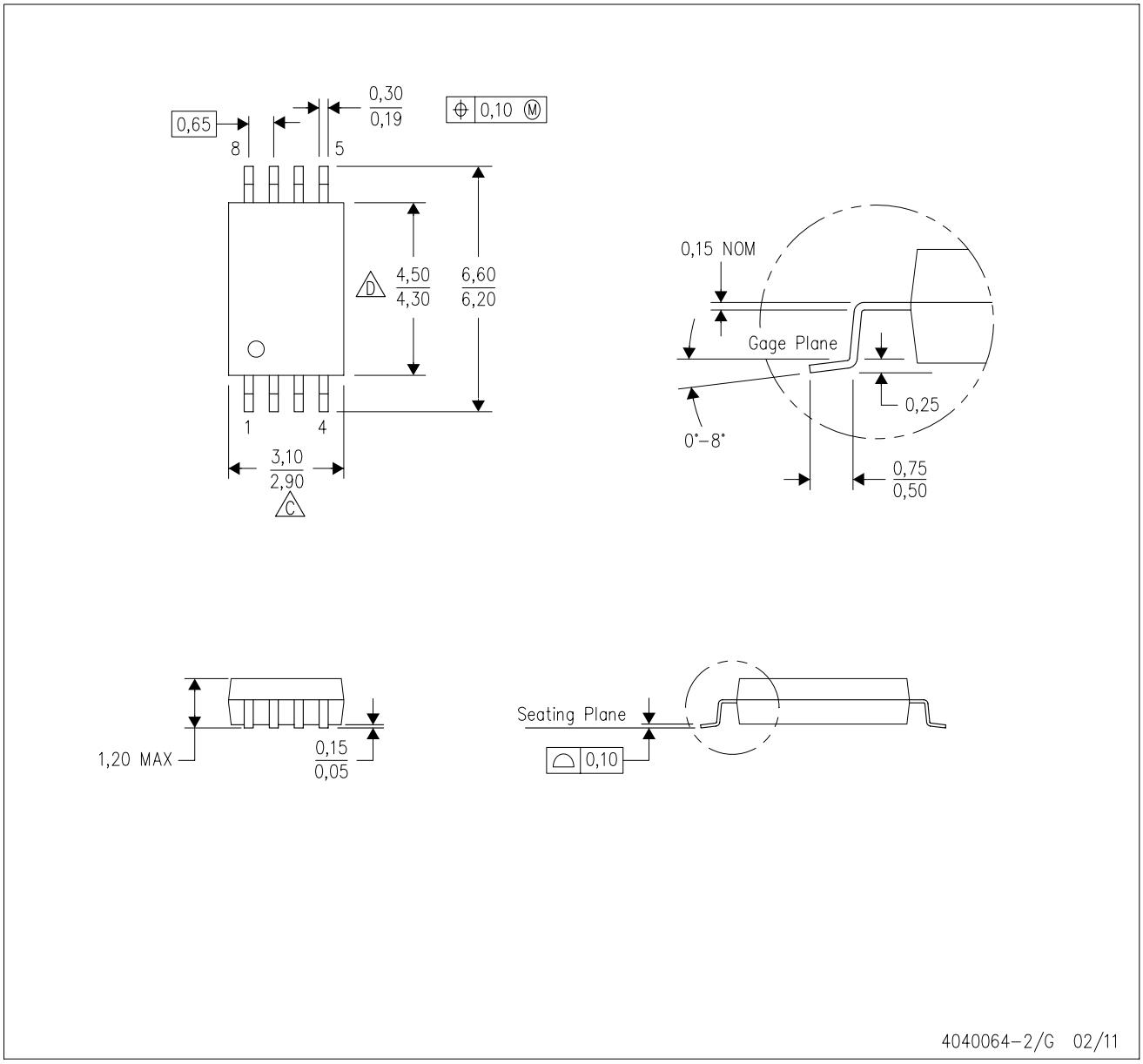
PW (R-PDSO-G8) PLASTIC SMALL OUTLINE



NOTES:
A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
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 0,15 each side.
D. Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
E. Falls within JEDEC MO-153

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