- **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/$\sqrt{\text{Hz}}$ 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

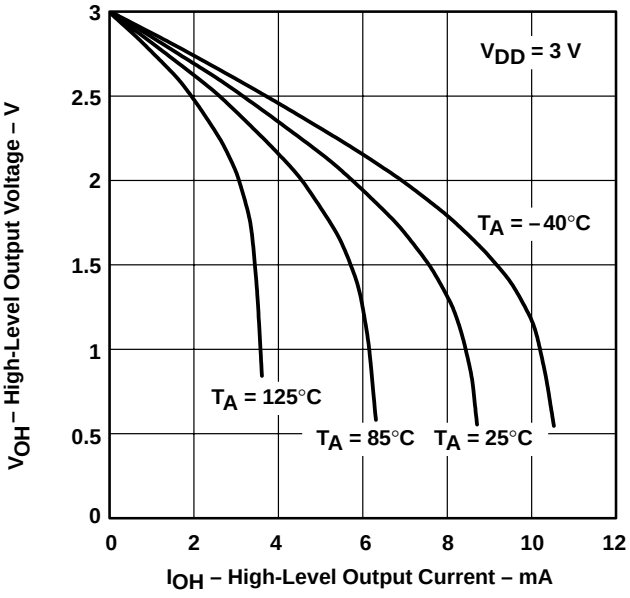


Figure 1

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

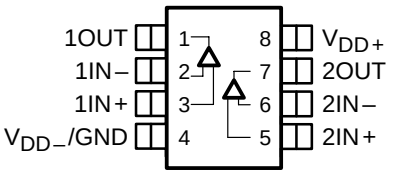
The D and PW packages are available taped and reeled. Add R suffix to device type (e.g., TLV2442CDR).

TLV2444 AVAILABLE OPTIONS

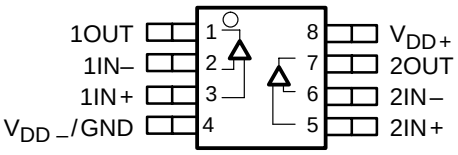
T_A	V_{IO}max AT 25°C	PACKAGED DEVICES	
		SMALL OUTLINE (D)	TSSOP (PW)
0°C to 70°C	2.5 mV	TLV2444CD	TLV2444CPW
–40°C to 125°C	950 µV 2.5 mV	TLV2444AID TLV2444ID	TLV2444AIPW TLV2444IPW

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

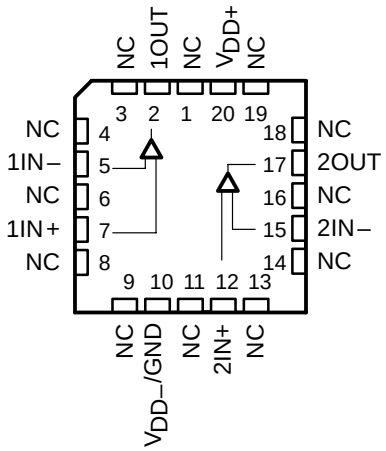
TLV2442
D OR JG PACKAGE
(TOP VIEW)



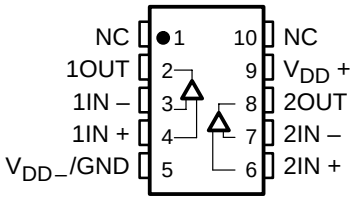
TLV2442
PW PACKAGE
(TOP VIEW)



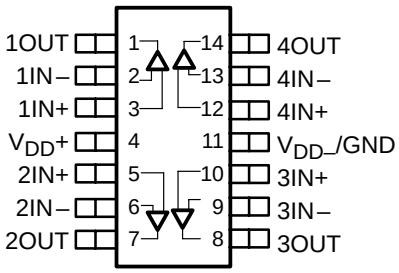
TLV2442
FK PACKAGE
(TOP VIEW)



TLV2442
U PACKAGE
(TOP VIEW)

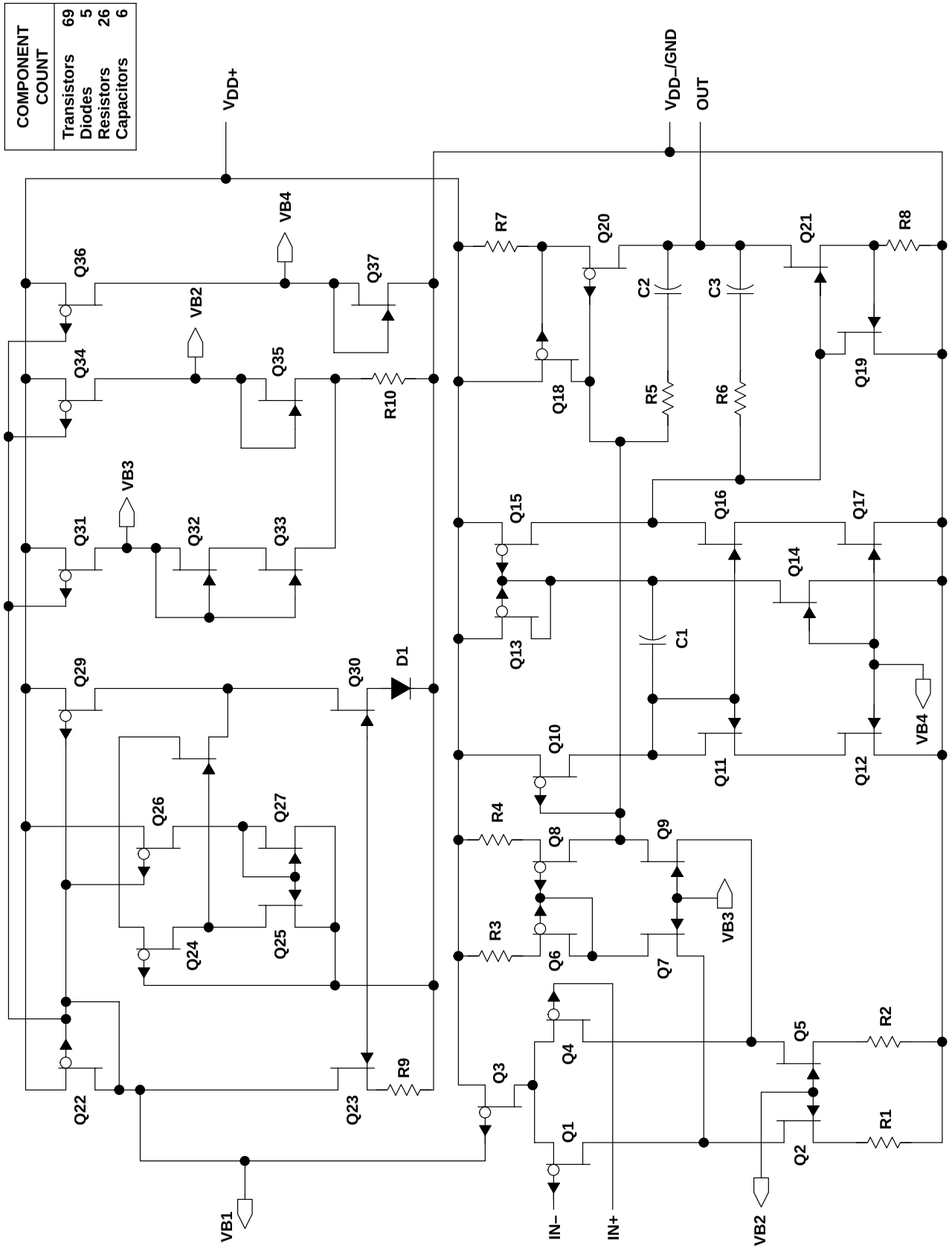


TLV2444
D OR PW PACKAGE
(TOP VIEW)



NC – No internal connection

equivalent schematic (each amplifier)



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

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

PARAMETER		TEST CONDITIONS			T_A†	TLV2442			UNIT
						MIN	TYP	MAX	
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.

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

PARAMETER		TEST CONDITIONS		T_A†	TLV2442			UNIT
					MIN	TYP	MAX	
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			UNIT
					MIN	TYP	MAX	
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.

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

PARAMETER		TEST CONDITIONS			T_A†	TLV244x			UNIT
						MIN	TYP	MAX	
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	$\lvert V_{IO}\rvert \le$ 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.

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

PARAMETER		TEST CONDITIONS	T_A†	TLV244x			UNIT
				MIN	TYP	MAX	
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			UNIT
					MIN	TYP	MAX	
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

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
V_{OL}	Low-level output voltage	vs Low-level output current	11, 12
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I_{OS}	Short-circuit output current	vs Supply voltage vs Free-air temperature	14 15
V_O	Output voltage	vs Differential Input voltage	16, 17
A_{VD}	Differential voltage amplification	vs Load resistance	18
A_{VD}	Large-signal differential voltage amplification and phase margin	vs Frequency	19, 20
	Large-signal differential voltage amplification	vs Free-air temperature	21, 22
z_o	Output impedance	vs Frequency	23, 24
CMRR	Common-mode rejection ratio	vs Frequency vs Free-air temperature	25 26
k_{SVR}	Supply-voltage rejection ratio	vs Frequency vs Free-air temperature	27, 28 29
I_{DD}	Supply current	vs Supply voltage	30
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
V_n	Equivalent input noise voltage	vs Frequency	41, 42
	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.

TYPICAL CHARACTERISTICS

DISTRIBUTION OF TLV2442
INPUT OFFSET VOLTAGE

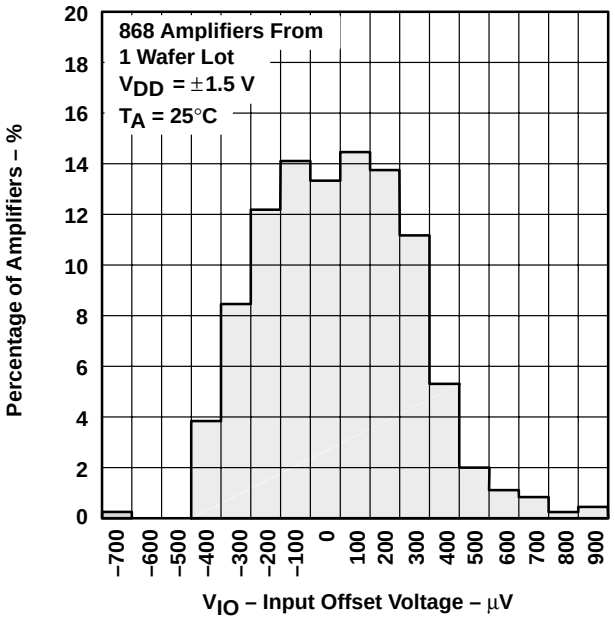


Figure 2

DISTRIBUTION OF TLV2442
INPUT OFFSET VOLTAGE

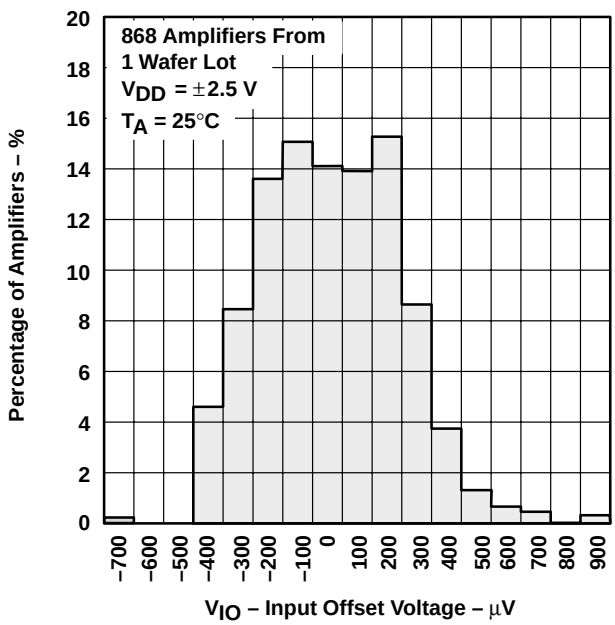


Figure 3

INPUT OFFSET VOLTAGE
vs
COMMON-MODE INPUT VOLTAGE

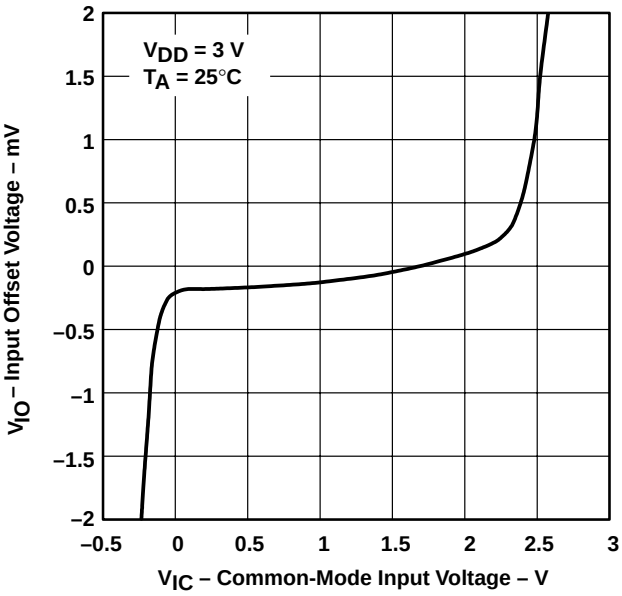


Figure 4

INPUT OFFSET VOLTAGE
vs
COMMON-MODE INPUT VOLTAGE

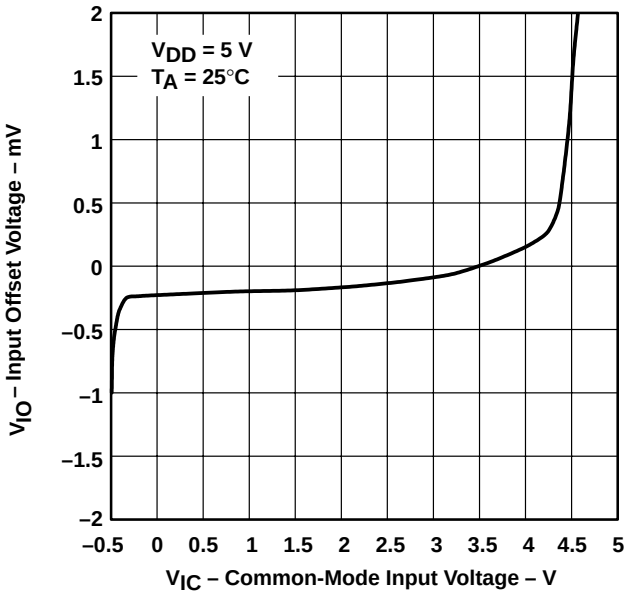


Figure 5

TYPICAL CHARACTERISTICS

DISTRIBUTION OF TLV2442 INPUT OFFSET VOLTAGE TEMPERATURE COEFFICIENT

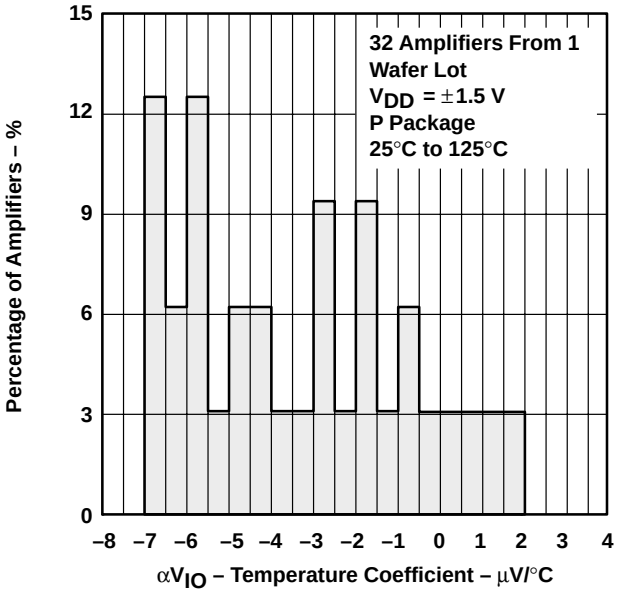


Figure 6

DISTRIBUTION OF TLV2442 INPUT OFFSET VOLTAGE TEMPERATURE COEFFICIENT

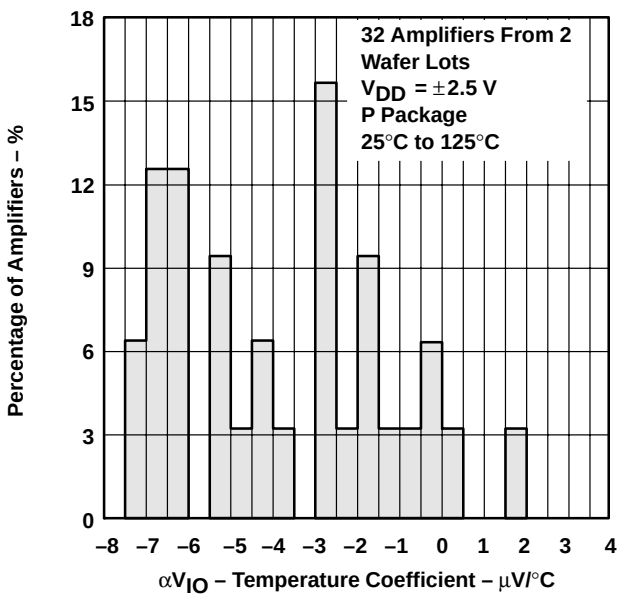


Figure 7

INPUT BIAS AND INPUT OFFSET CURRENTS vs FREE-AIR TEMPERATURE

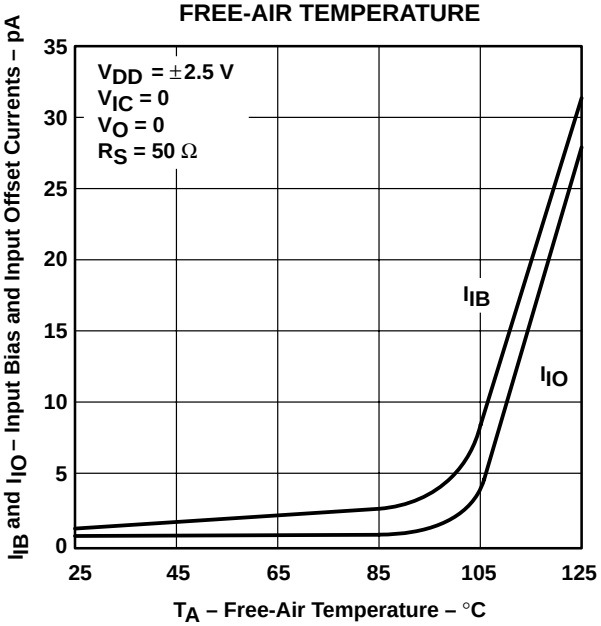


Figure 8

HIGH-LEVEL OUTPUT VOLTAGE vs HIGH-LEVEL OUTPUT CURRENT

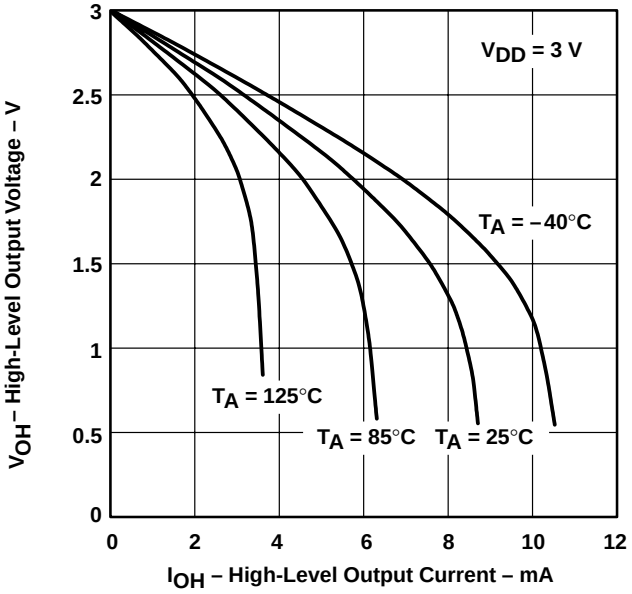


Figure 9

TYPICAL CHARACTERISTICS

HIGH-LEVEL OUTPUT VOLTAGE vs HIGH-LEVEL OUTPUT CURRENT

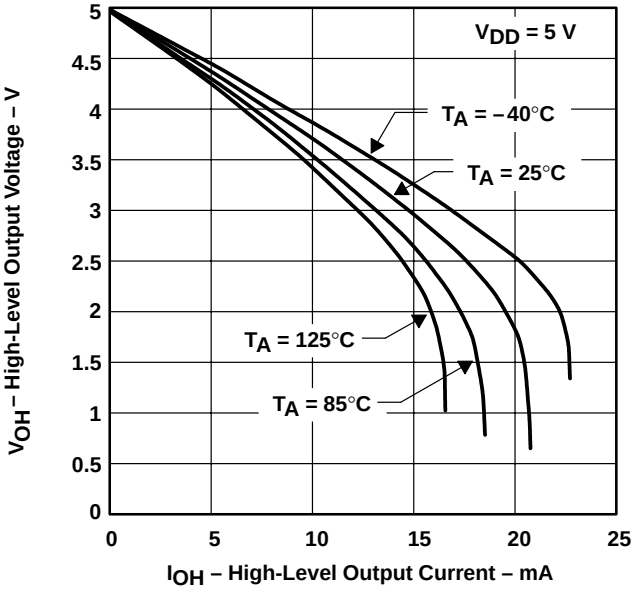


Figure 10

LOW-LEVEL OUTPUT VOLTAGE vs LOW-LEVEL OUTPUT CURRENT

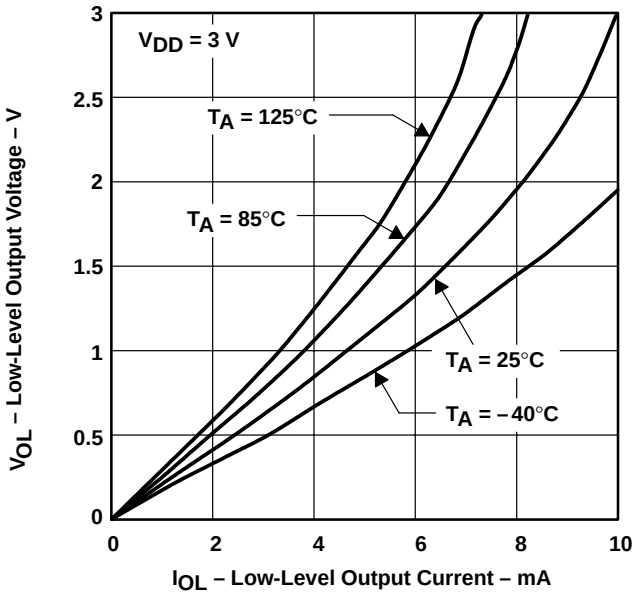


Figure 11

LOW-LEVEL OUTPUT VOLTAGE vs LOW-LEVEL OUTPUT CURRENT

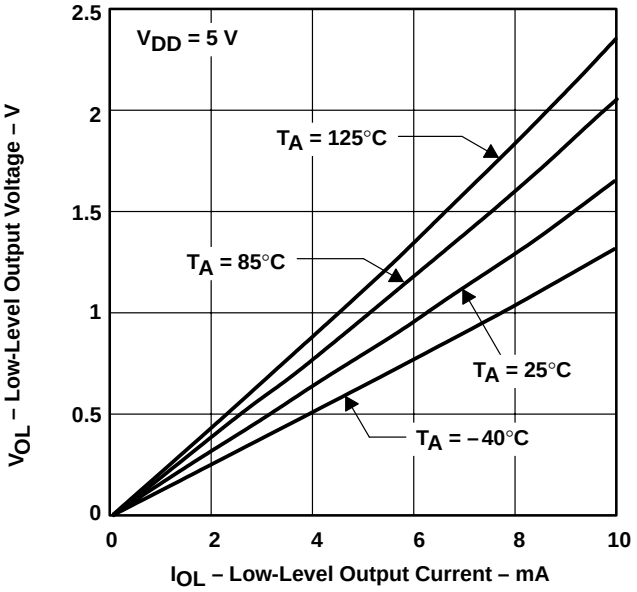


Figure 12

MAXIMUM PEAK-TO-PEAK OUTPUT VOLTAGE vs FREQUENCY

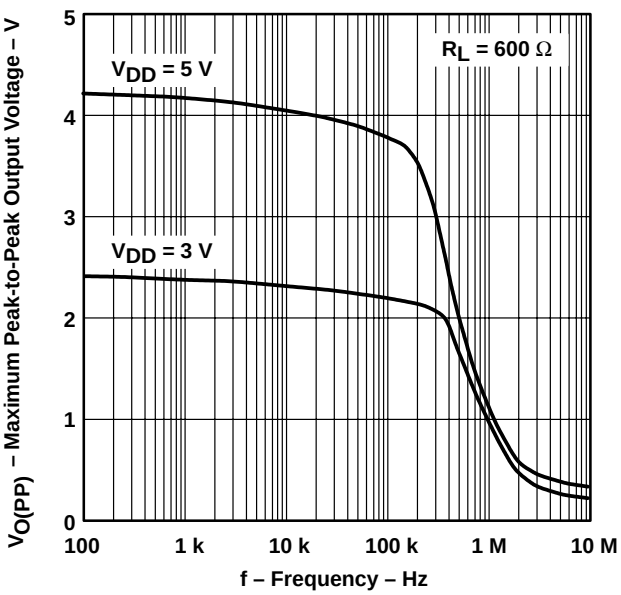


Figure 13

TYPICAL CHARACTERISTICS

SHORT-CIRCUIT OUTPUT CURRENT vs SUPPLY VOLTAGE

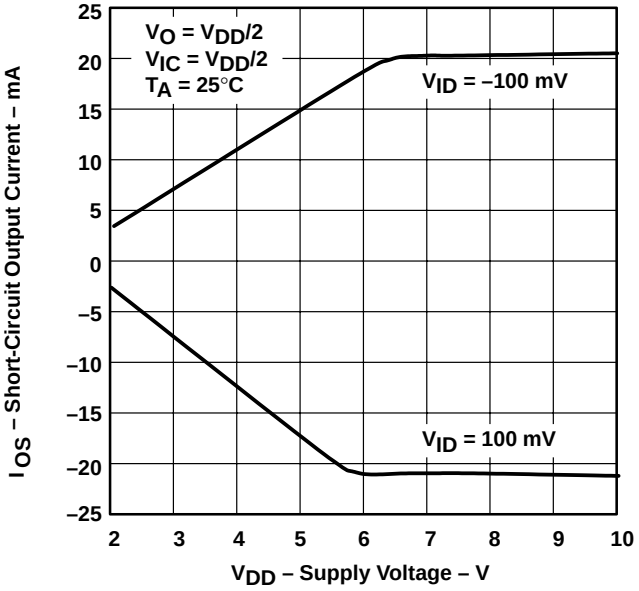


Figure 14

SHORT-CIRCUIT OUTPUT CURRENT vs FREE-AIR TEMPERATURE

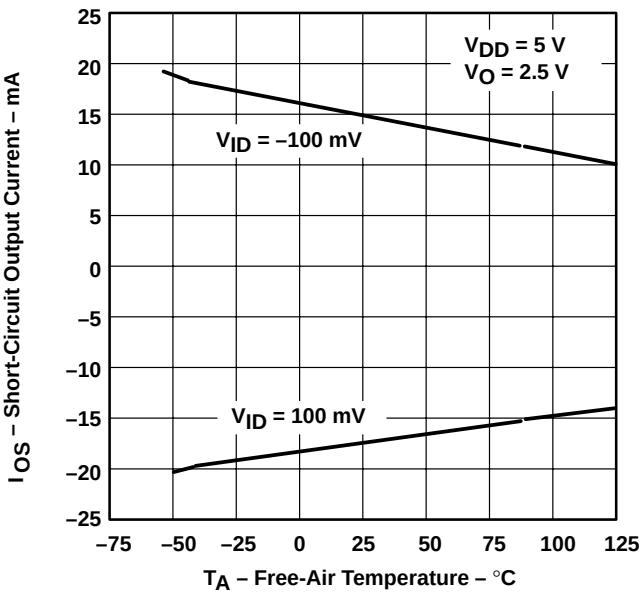


Figure 15

OUTPUT VOLTAGE vs DIFFERENTIAL INPUT VOLTAGE

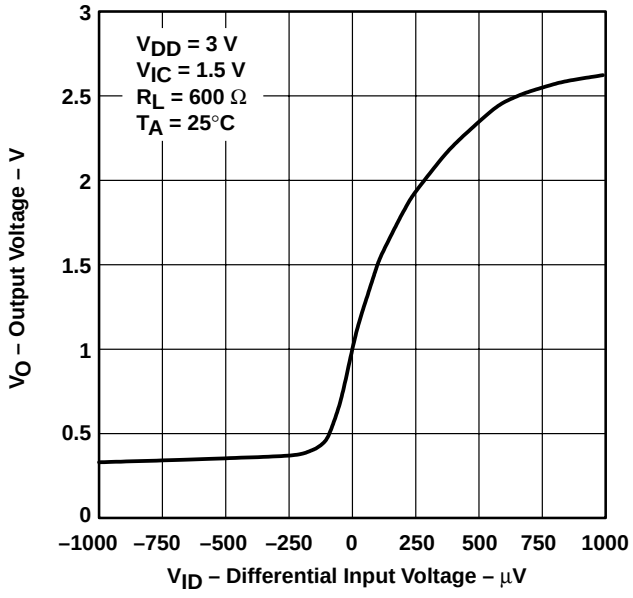


Figure 16

OUTPUT VOLTAGE vs DIFFERENTIAL INPUT VOLTAGE

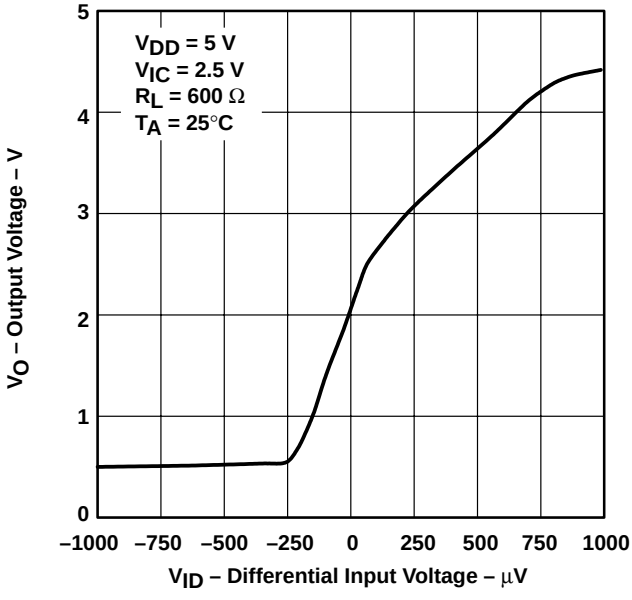


Figure 17

TYPICAL CHARACTERISTICS

DIFFERENTIAL VOLTAGE AMPLIFICATION vs LOAD RESISTANCE

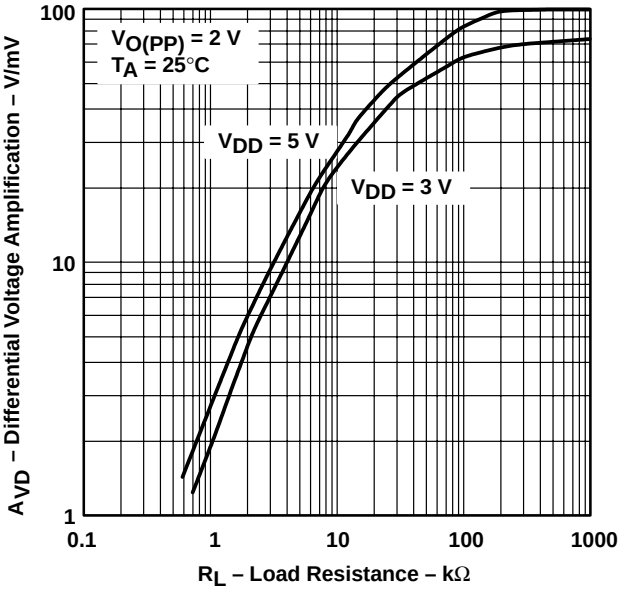


Figure 18

LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION AND PHASE MARGIN vs FREQUENCY

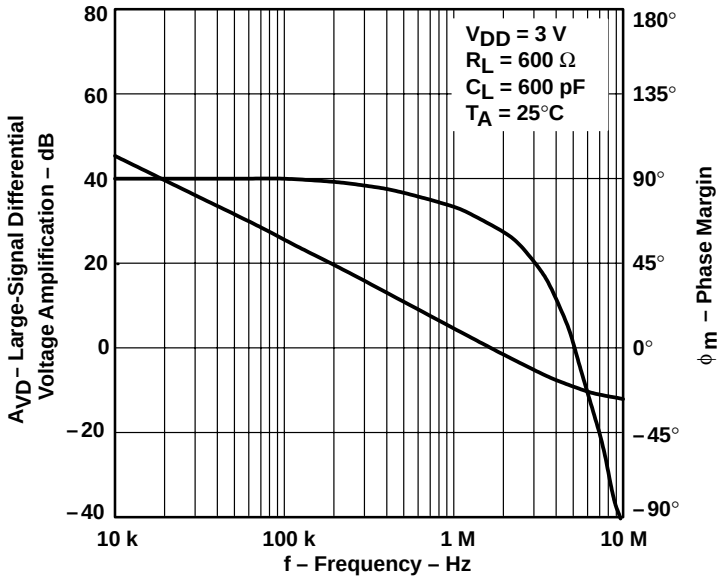


Figure 19

TYPICAL CHARACTERISTICS

LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION AND PHASE MARGIN vs FREQUENCY

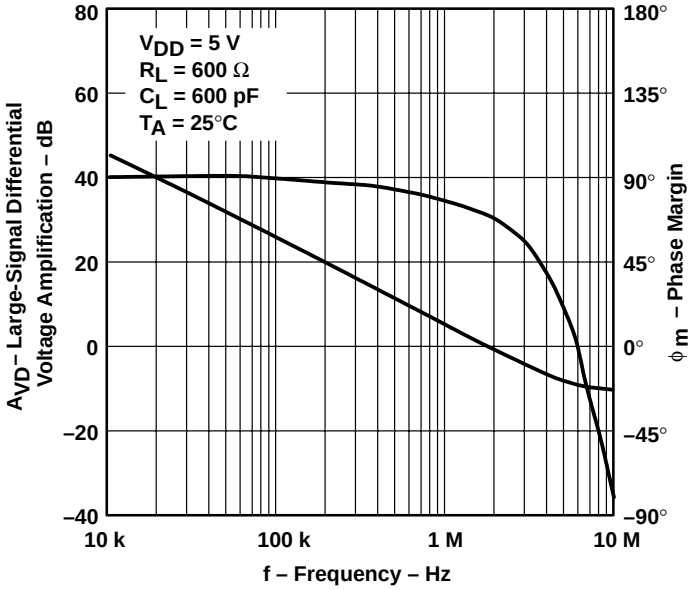


Figure 20

LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION vs FREE-AIR TEMPERATURE

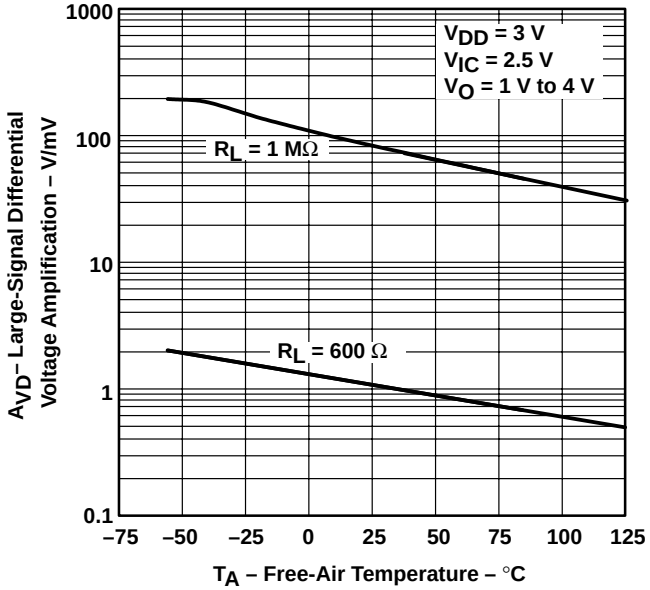


Figure 21

LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION vs FREE-AIR TEMPERATURE

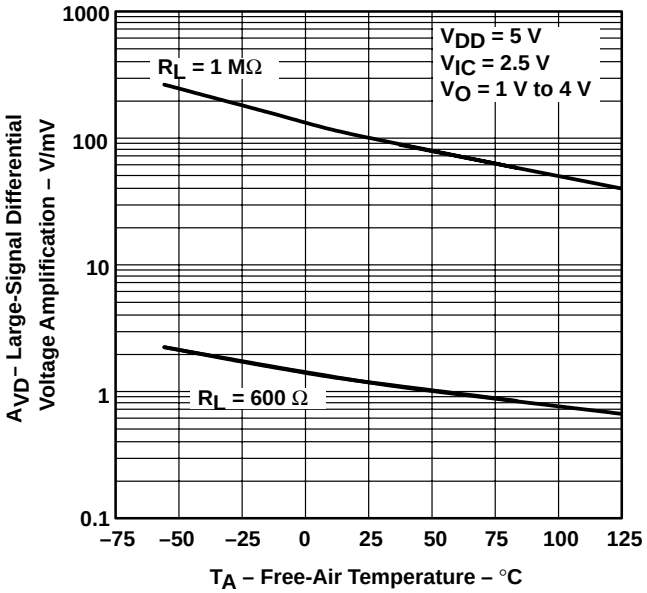


Figure 22

TYPICAL CHARACTERISTICS

OUTPUT IMPEDANCE vs FREQUENCY

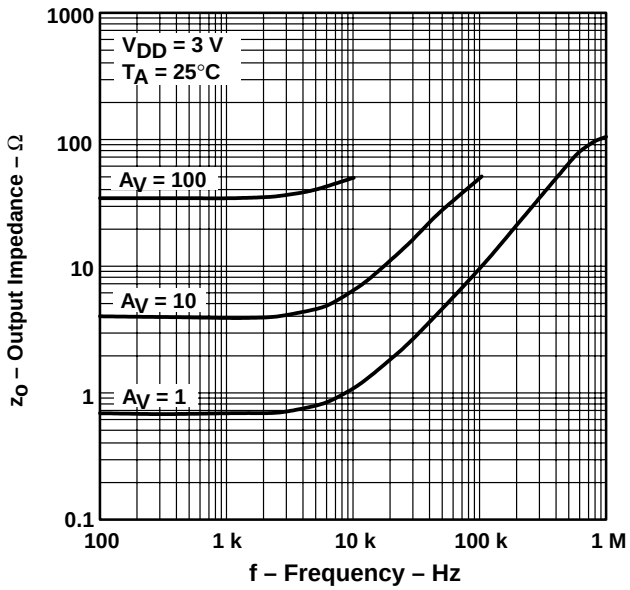


Figure 23

OUTPUT IMPEDANCE vs FREQUENCY

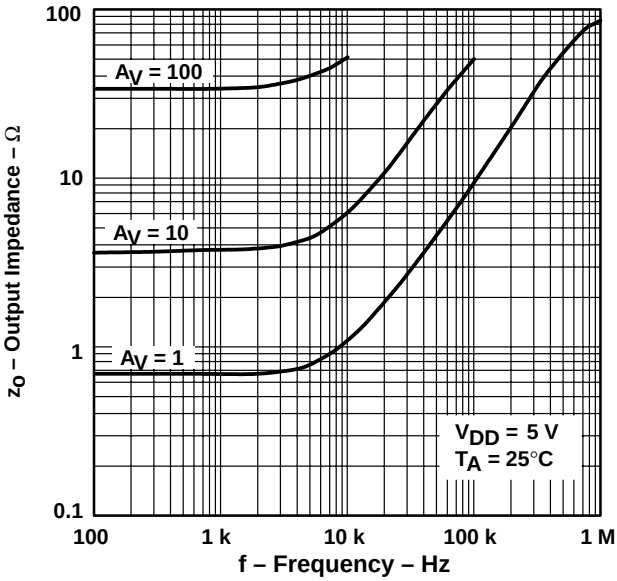


Figure 24

COMMON-MODE REJECTION RATIO vs FREQUENCY

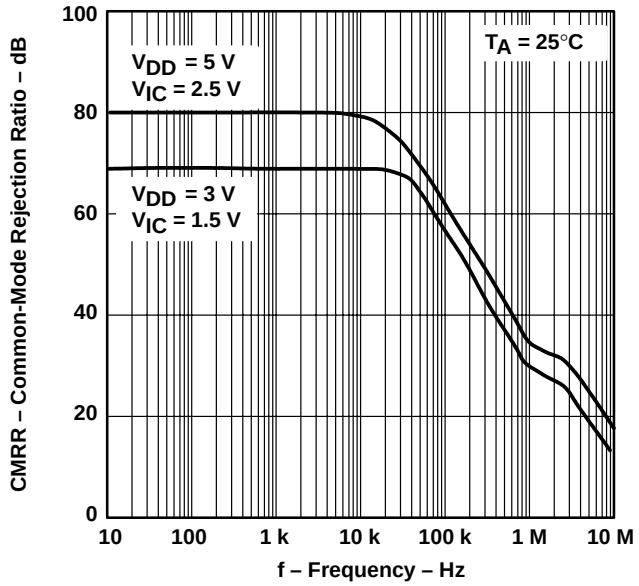


Figure 25

COMMON-MODE REJECTION RATIO vs FREE-AIR TEMPERATURE

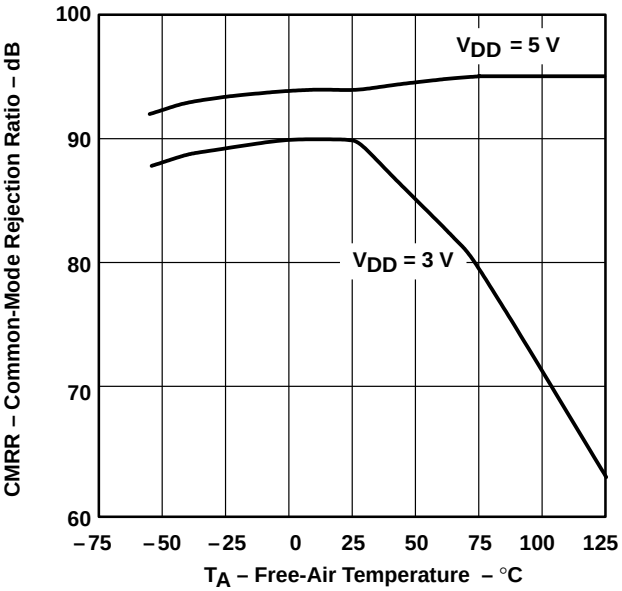


Figure 26

TYPICAL CHARACTERISTICS

SUPPLY-VOLTAGE REJECTION RATIO vs FREQUENCY

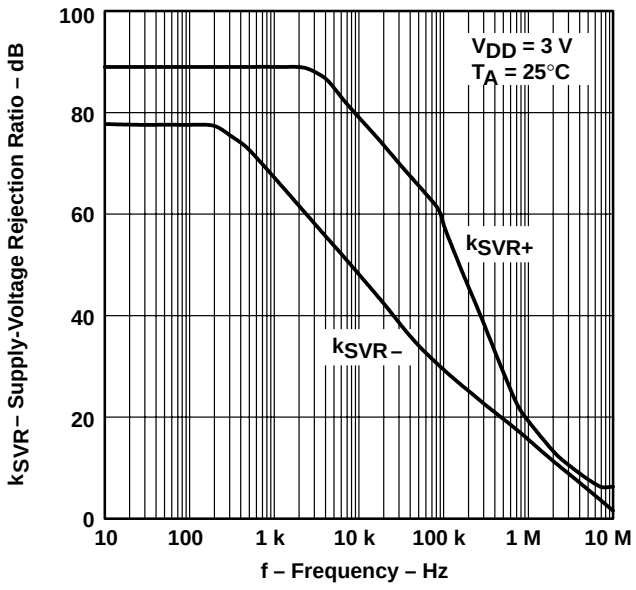


Figure 27

SUPPLY-VOLTAGE REJECTION RATIO vs FREQUENCY

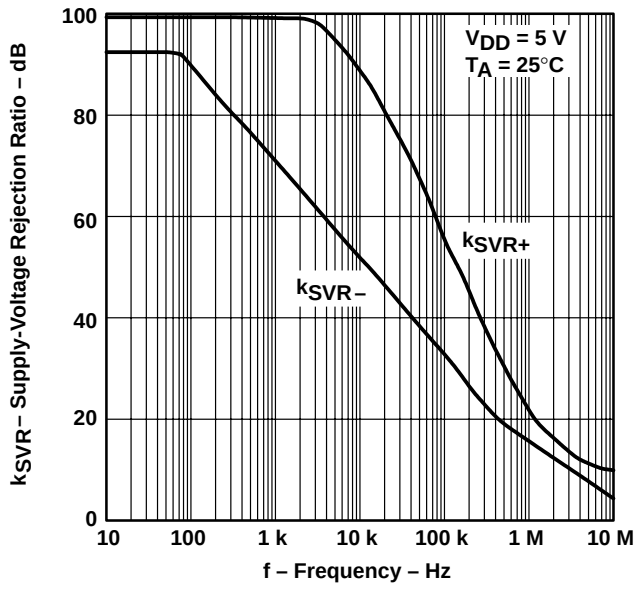


Figure 28

SUPPLY-VOLTAGE REJECTION RATIO vs FREE-AIR TEMPERATURE

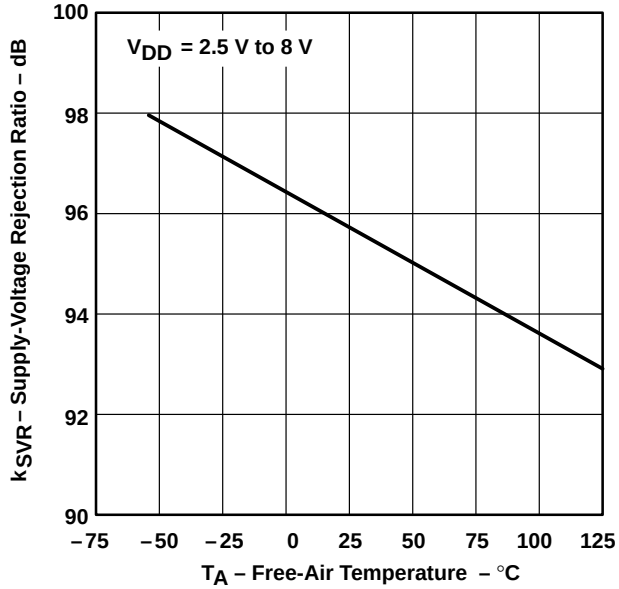


Figure 29

SUPPLY CURRENT vs SUPPLY VOLTAGE

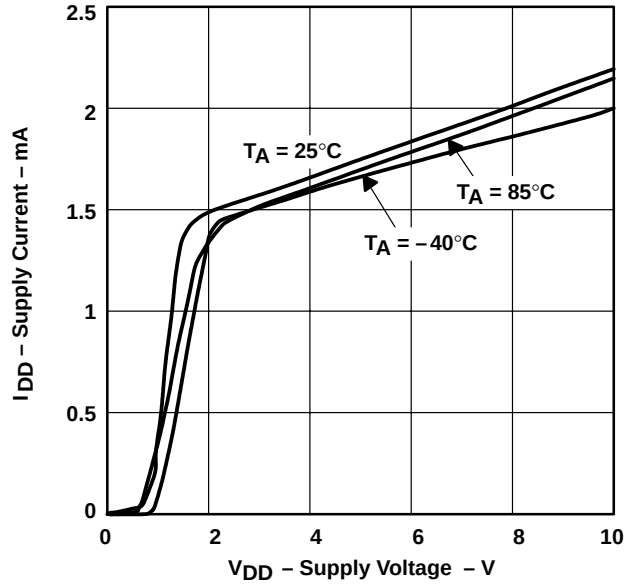


Figure 30

TYPICAL CHARACTERISTICS

SLEW RATE vs LOAD CAPACITANCE

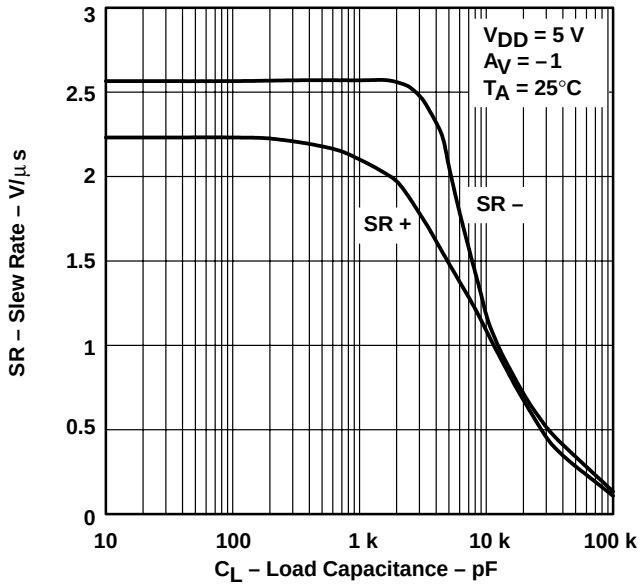


Figure 31

SLEW RATE vs FREE-AIR TEMPERATURE

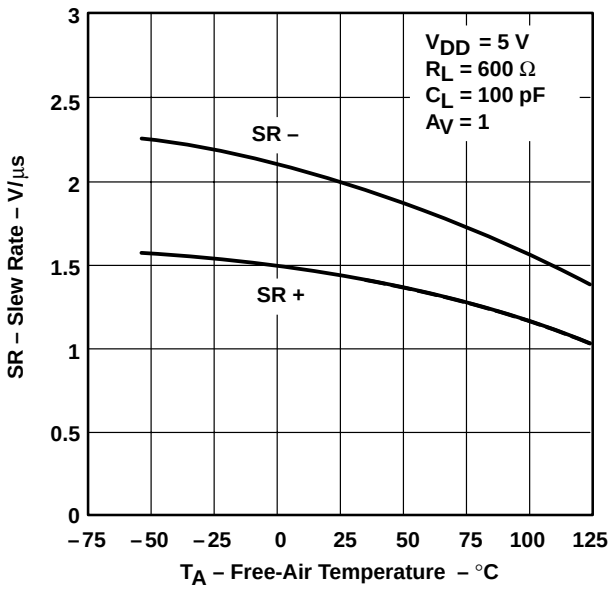


Figure 32

INVERTING LARGE-SIGNAL PULSE RESPONSE

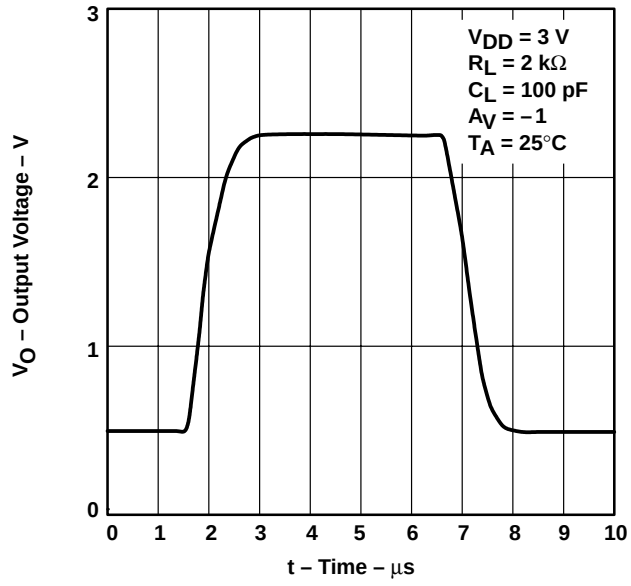


Figure 33

INVERTING LARGE-SIGNAL PULSE RESPONSE

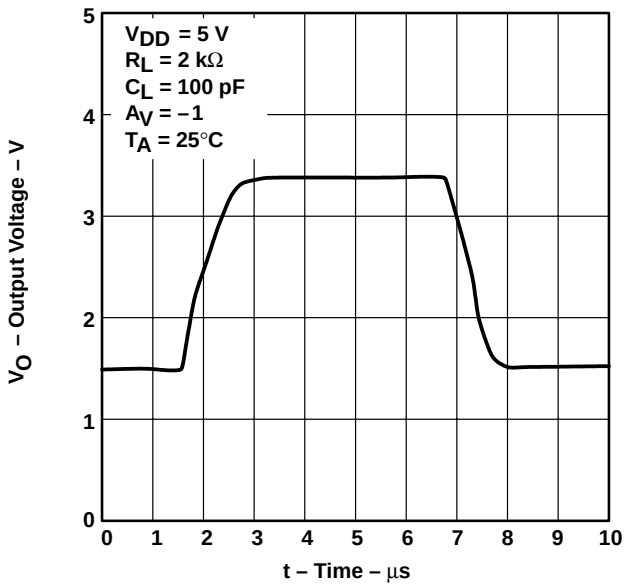


Figure 34

TYPICAL CHARACTERISTICS

**VOLTAGE-FOLLOWER
LARGE-SIGNAL PULSE RESPONSE**

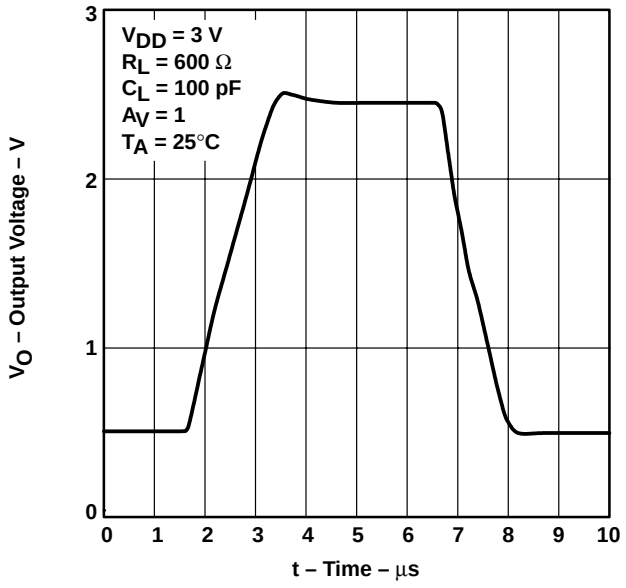


Figure 35

**VOLTAGE-FOLLOWER
LARGE-SIGNAL PULSE RESPONSE**

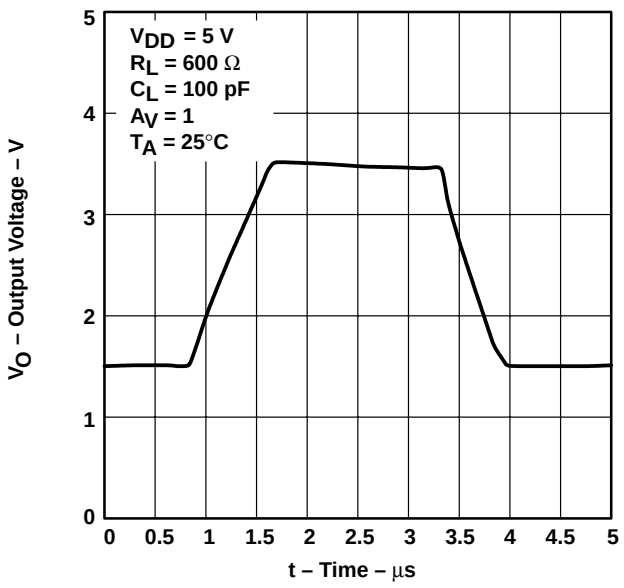


Figure 36

INVERTING SMALL-SIGNAL PULSE RESPONSE

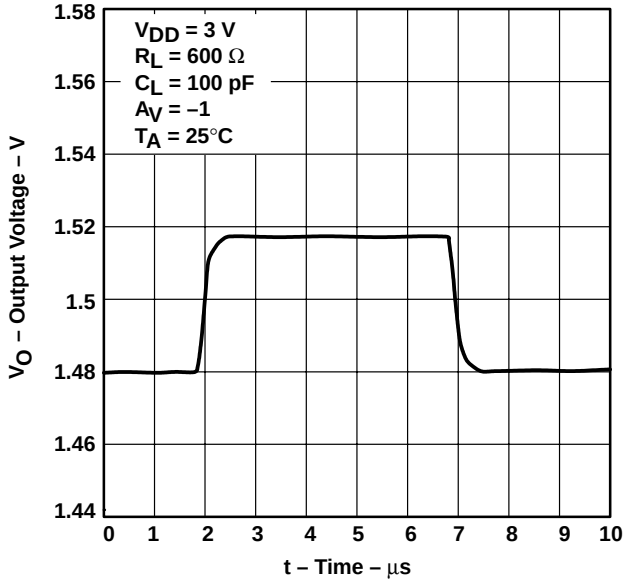


Figure 37

INVERTING SMALL-SIGNAL PULSE RESPONSE

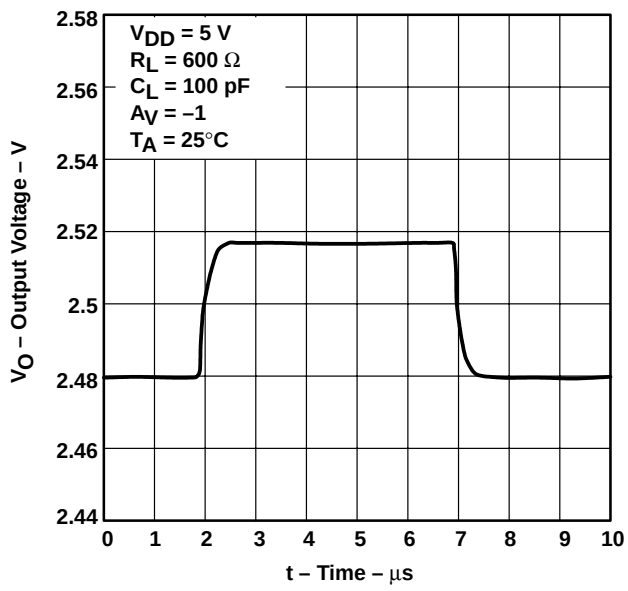


Figure 38

TYPICAL CHARACTERISTICS

VOLTAGE-FOLLOWER SMALL-SIGNAL PULSE RESPONSE

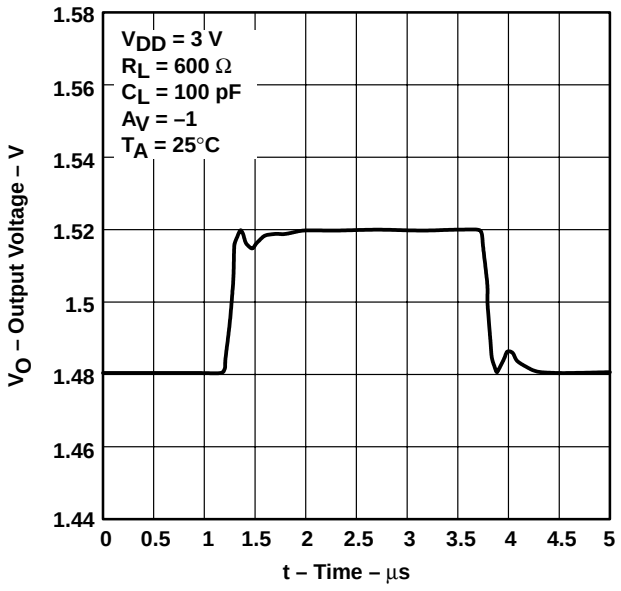


Figure 39

VOLTAGE-FOLLOWER SMALL-SIGNAL PULSE RESPONSE

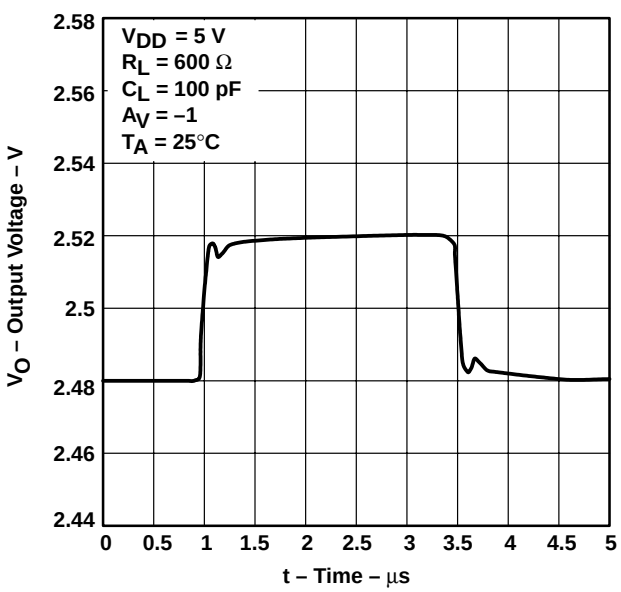


Figure 40

EQUIVALENT INPUT NOISE VOLTAGE vs FREQUENCY

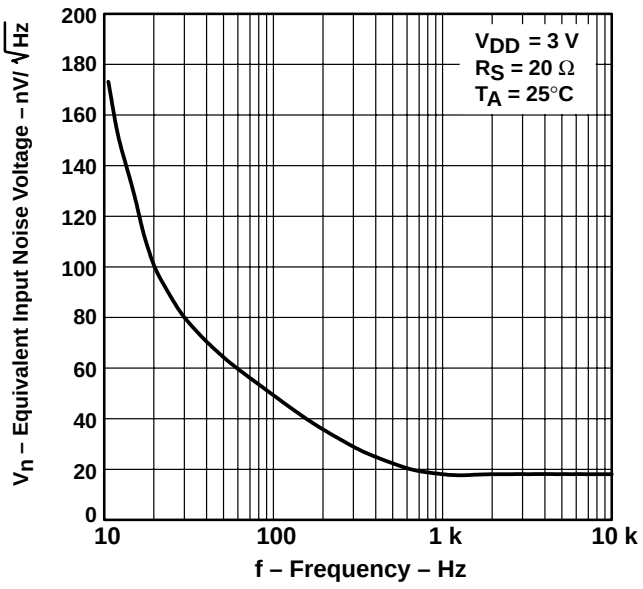


Figure 41

EQUIVALENT INPUT NOISE VOLTAGE vs FREQUENCY

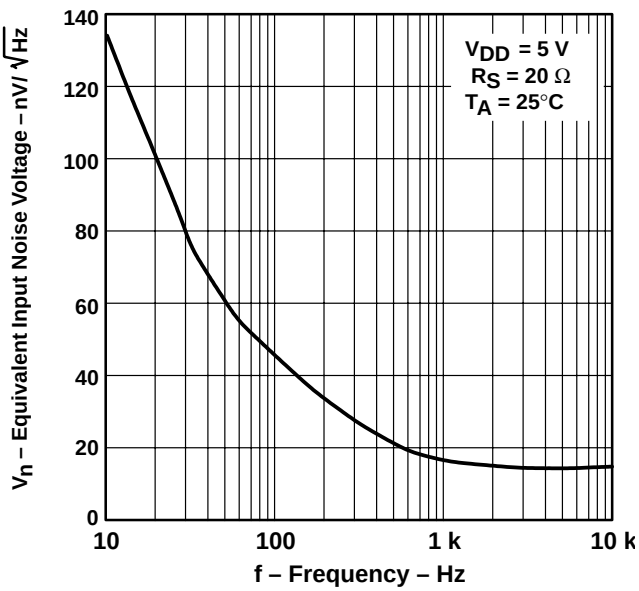


Figure 42

TYPICAL CHARACTERISTICS

NOISE VOLTAGE OVER A 10-SECOND PERIOD

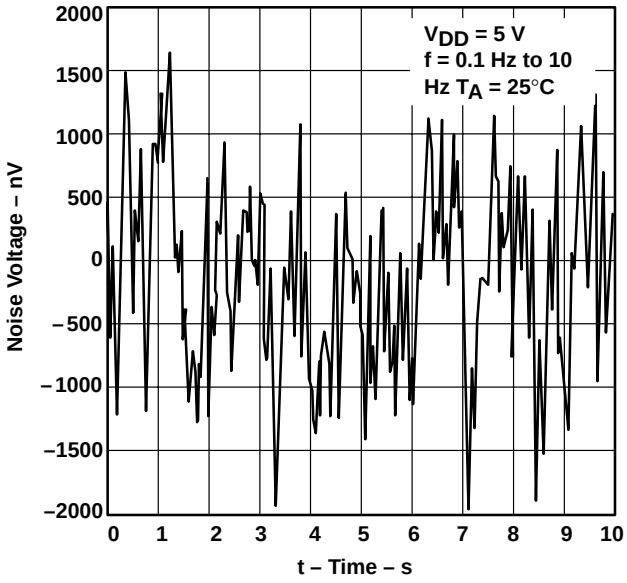


Figure 43

TOTAL HARMONIC DISTORTION PLUS NOISE vs FREQUENCY

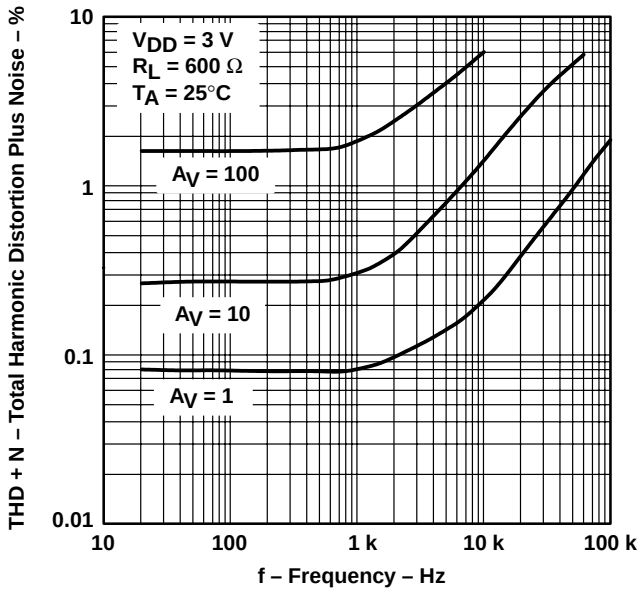


Figure 44

TOTAL HARMONIC DISTORTION PLUS NOISE vs FREQUENCY

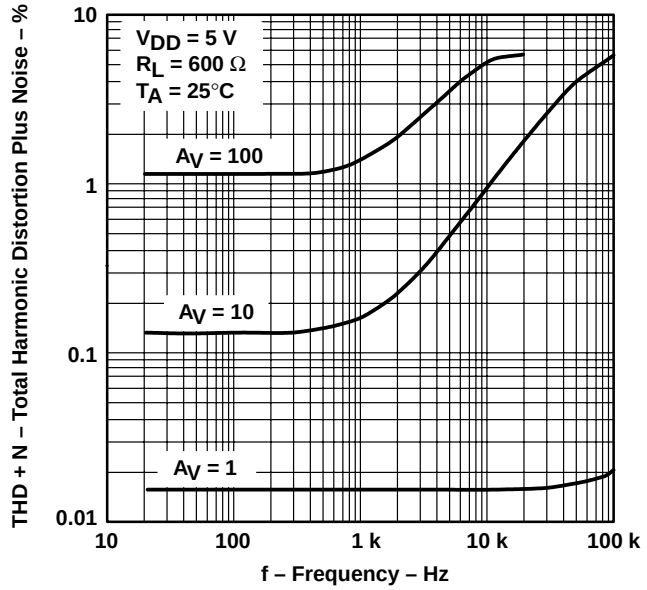


Figure 45

GAIN-BANDWIDTH PRODUCT vs FREE-AIR TEMPERATURE

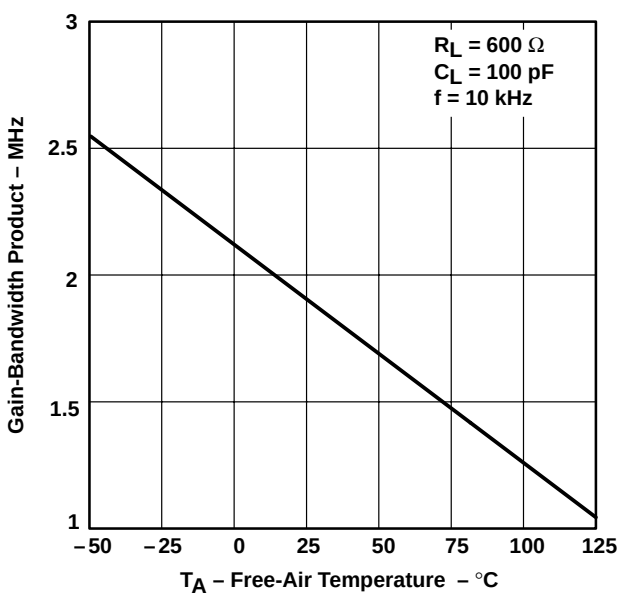


Figure 46

TYPICAL CHARACTERISTICS

GAIN-BANDWIDTH PRODUCT vs SUPPLY VOLTAGE

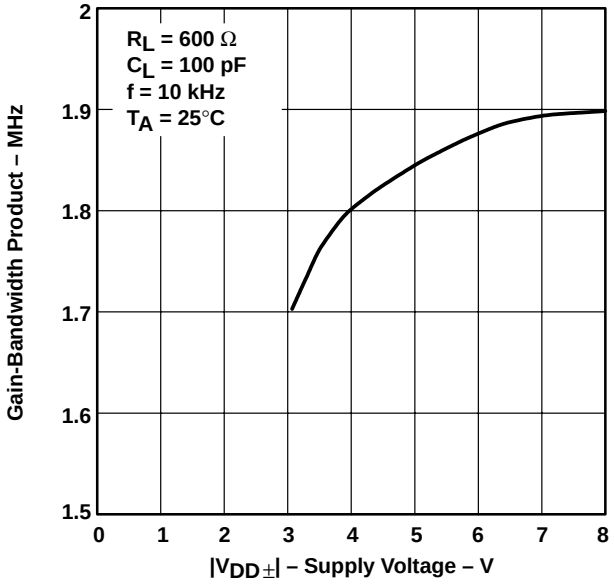


Figure 47

PHASE MARGIN vs LOAD CAPACITANCE

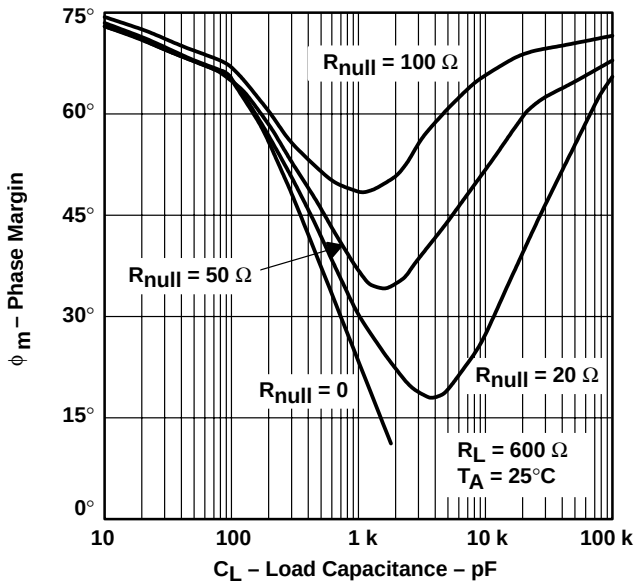


Figure 48

GAIN MARGIN vs LOAD CAPACITANCE

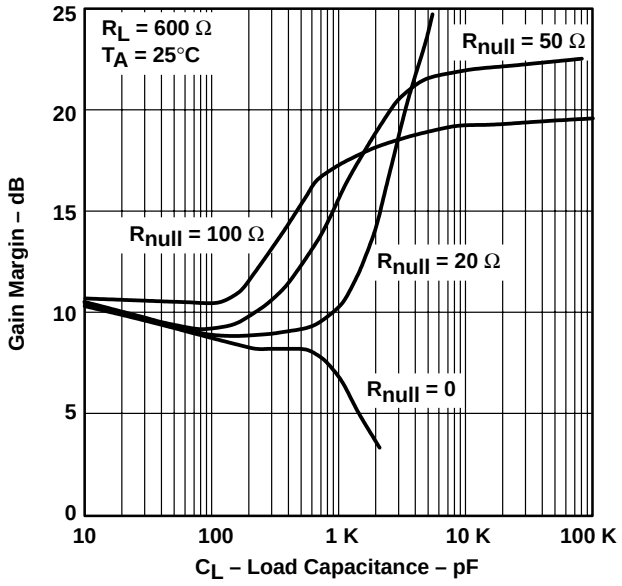


Figure 49

UNITY-GAIN BANDWIDTH vs LOAD CAPACITANCE

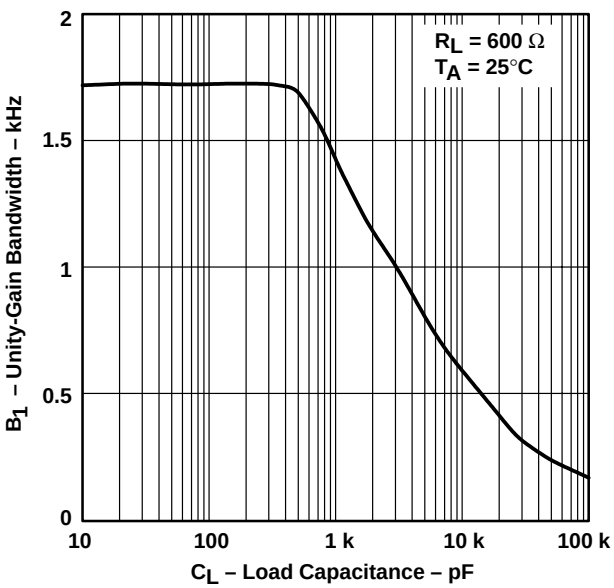


Figure 50

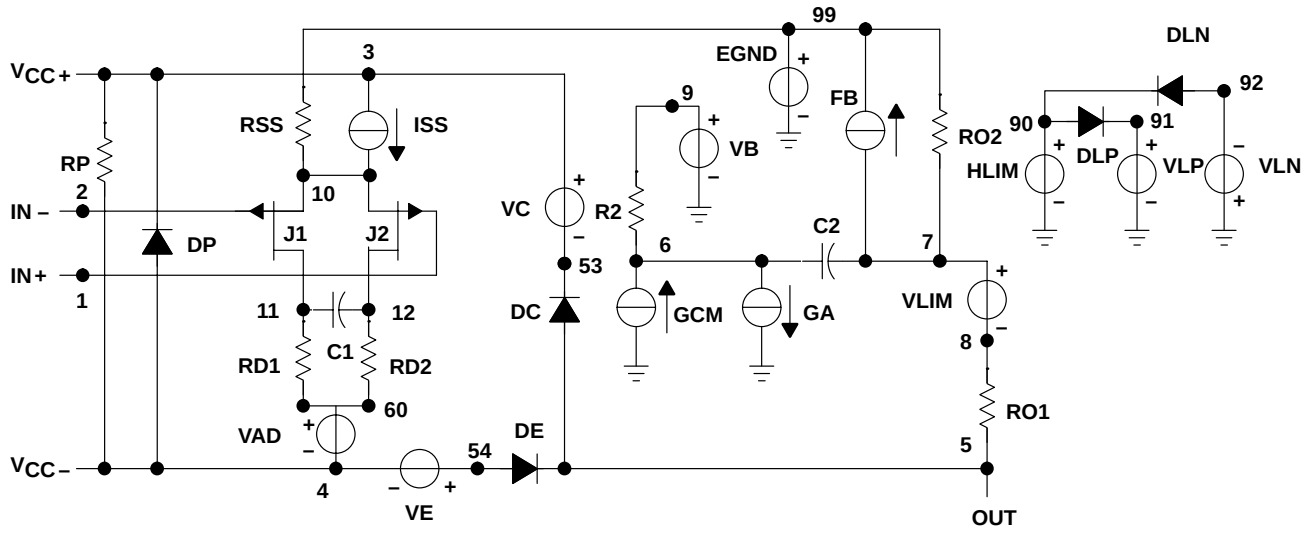
APPLICATION INFORMATION

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).




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.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
```

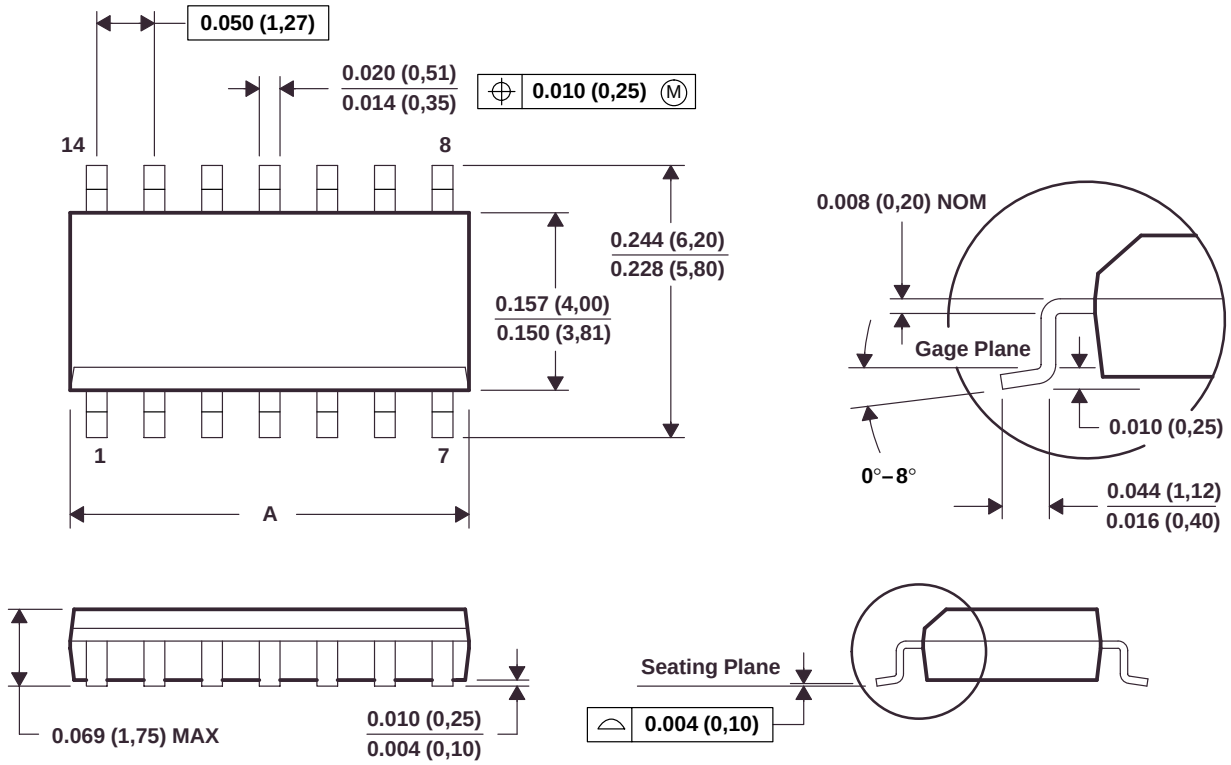
Figure 51. Boyle Macromodel and Subcircuit

PSpice and *Parts* are registered trademarks of MicroSim Corporation.

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)

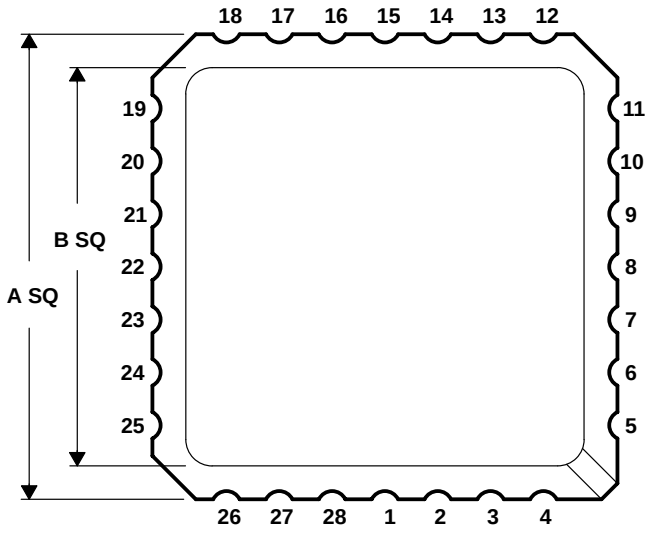
4040047/D 10/96

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

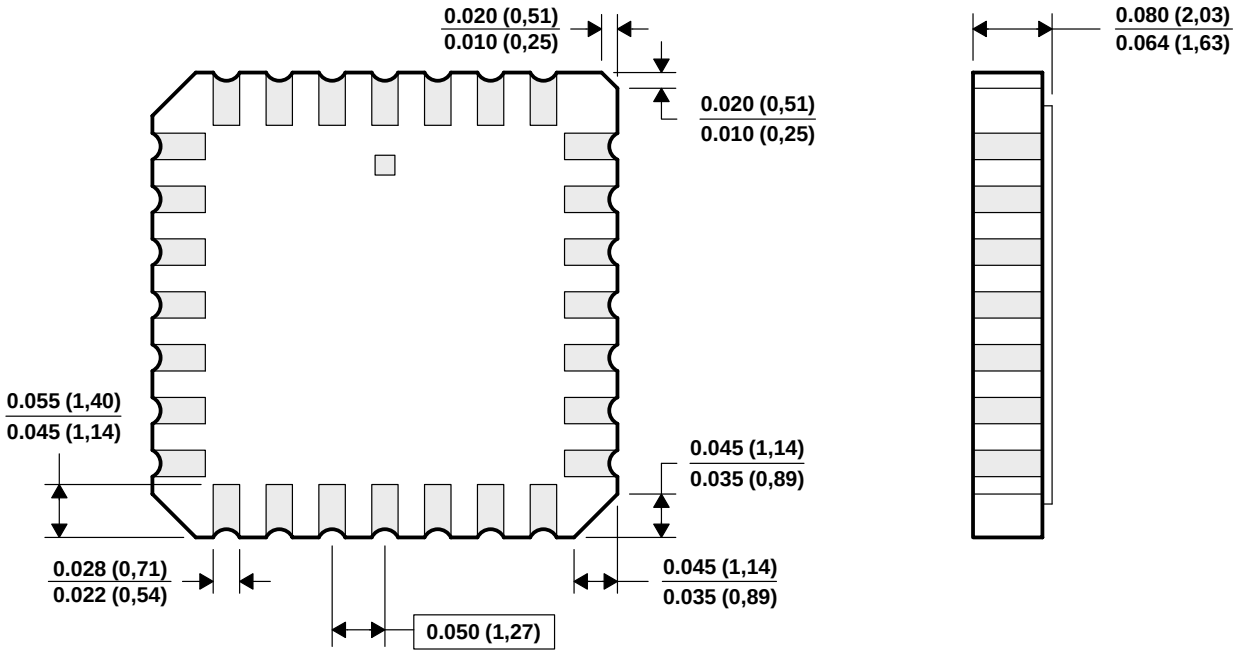
MECHANICAL DATA

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)

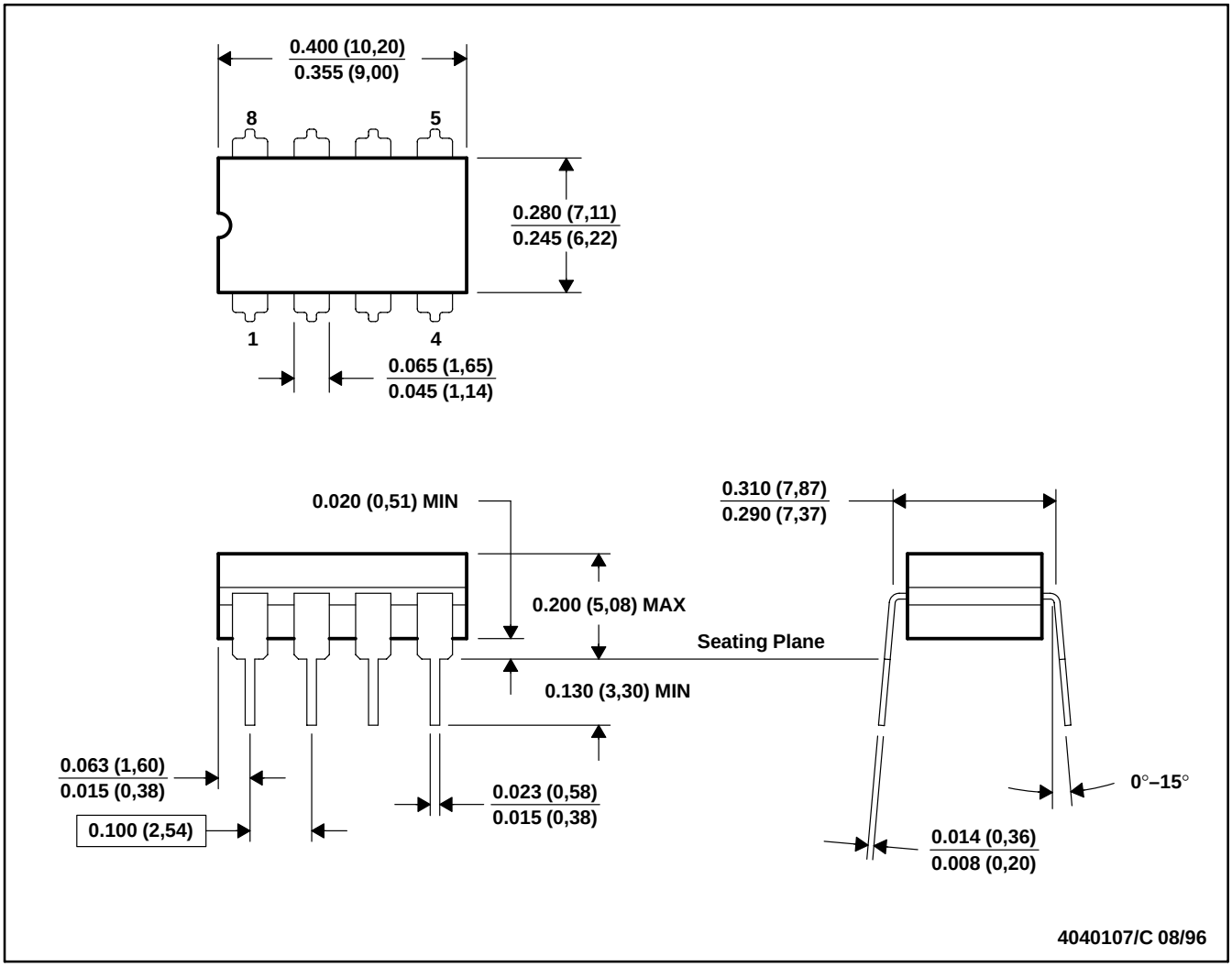


4040140/D 10/96

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

MECHANICAL DATA

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

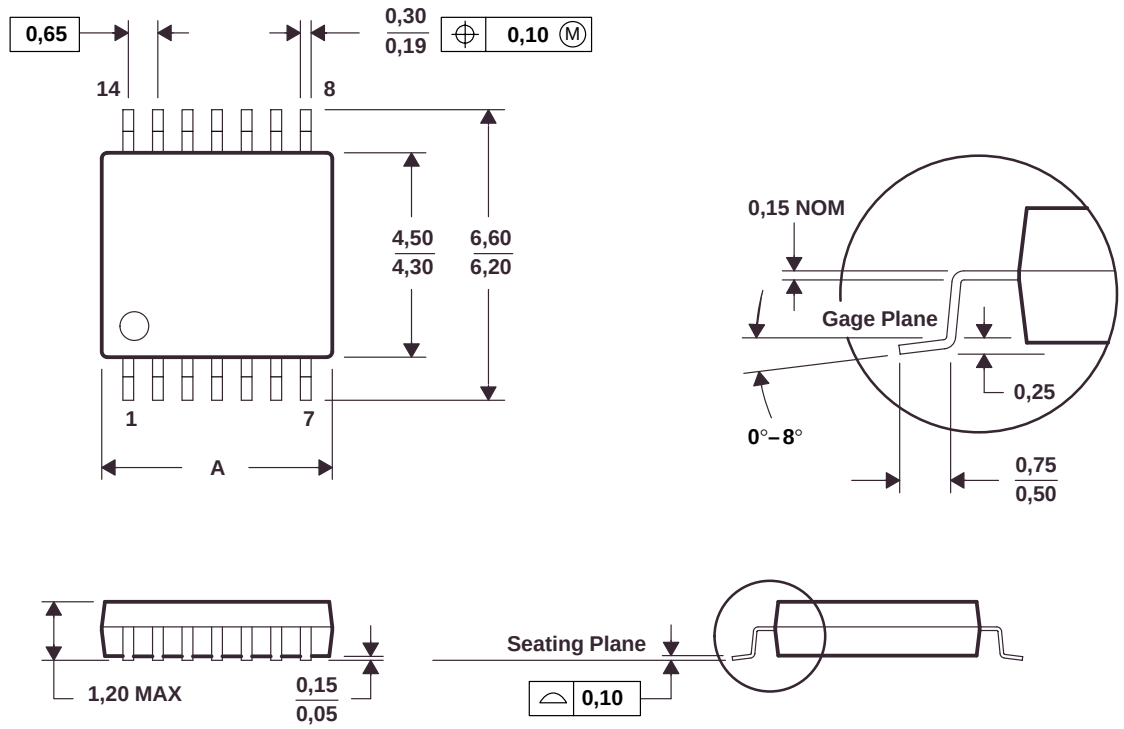


NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. This package can be hermetically sealed with a ceramic lid using glass frit.
D. Index point is provided on cap for terminal identification on press ceramic glass frit seal only.
E. Falls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

MECHANICAL DATA

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

14 PIN SHOWN



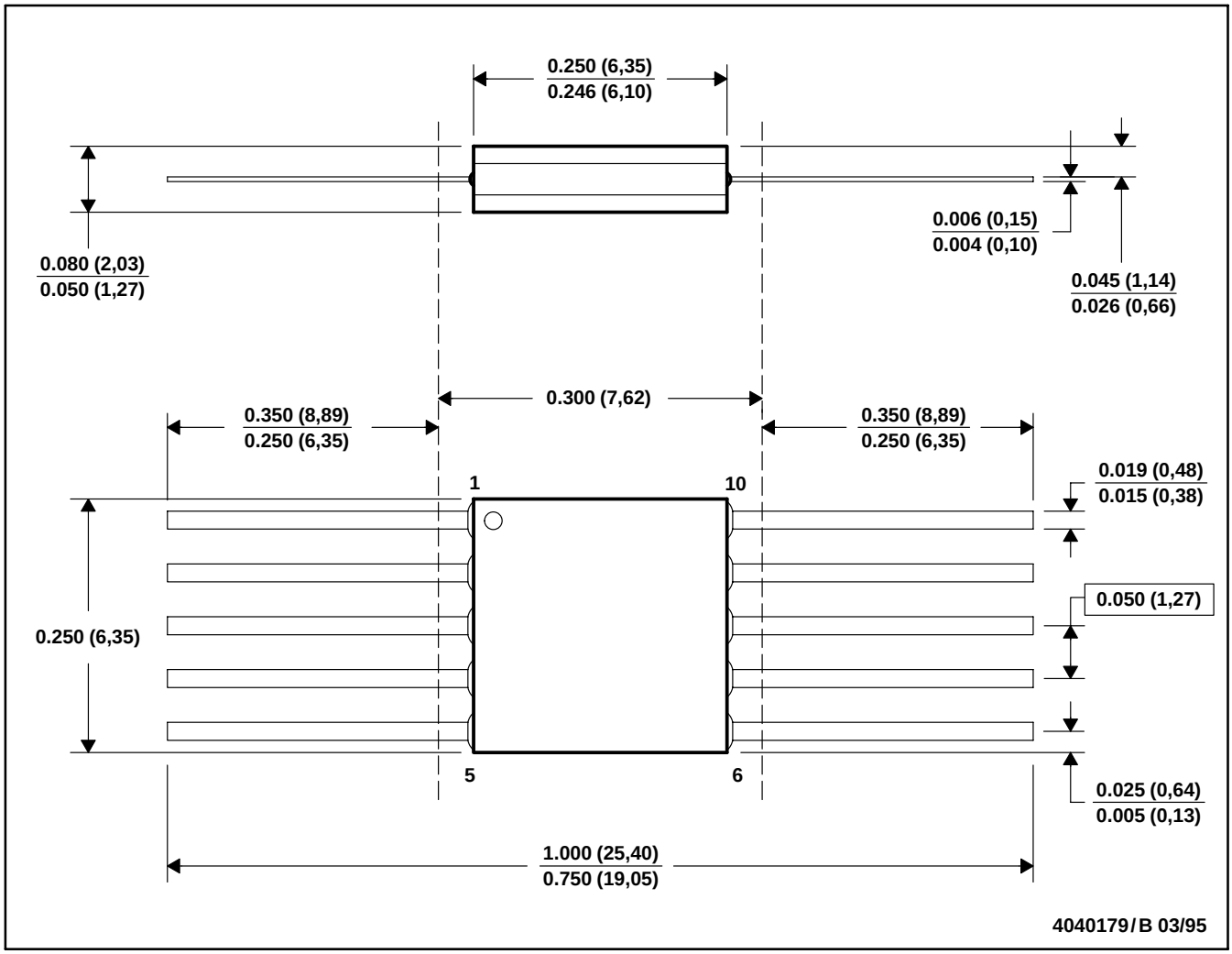
DIM \ PINS **	8	14	16	20	24	28
A MAX	3,10	5,10	5,10	6,60	7,90	9,80
A MIN	2,90	4,90	4,90	6,40	7,70	9,60

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

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

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
5962-9751101QPA	ACTIVE	CDIP	JG	8	1	TBD	Call TI	Call TI	-55 to 125	9751101QPA TLV2442M	Samples
5962-9751102QPA	ACTIVE	CDIP	JG	8	1	TBD	Call TI	Call TI	-55 to 125	9751102QPA TLV2442AM	Samples
TLV2442AID	ACTIVE	SOIC	D	8	75	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	2442AI	Samples
TLV2442AIDR	ACTIVE	SOIC	D	8	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	2442AI	Samples
TLV2442AIPW	ACTIVE	TSSOP	PW	8	150	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	TV2442	Samples
TLV2442AIPWR	ACTIVE	TSSOP	PW	8	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	2442AI	Samples
TLV2442AMJGB	ACTIVE	CDIP	JG	8	1	TBD	Call TI	Call TI	-55 to 125	9751102QPA TLV2442AM	Samples
TLV2442AQD	ACTIVE	SOIC	D	8	75	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	V2442A	Samples
TLV2442AQPW	ACTIVE	TSSOP	PW	8	150	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	2442AQ	Samples
TLV2442AQPWR	ACTIVE	TSSOP	PW	8	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	2442AQ	Samples
TLV2442CD	ACTIVE	SOIC	D	8	75	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	2442C	Samples
TLV2442CDR	ACTIVE	SOIC	D	8	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	2442C	Samples
TLV2442CPW	ACTIVE	TSSOP	PW	8	150	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	TV2442	Samples
TLV2442ID	ACTIVE	SOIC	D	8	75	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	2442I	Samples
TLV2442IDR	ACTIVE	SOIC	D	8	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	2442I	Samples
TLV2442MJGB	ACTIVE	CDIP	JG	8	1	TBD	Call TI	Call TI	-55 to 125	9751101QPA TLV2442M	Samples
TLV2442QPW	ACTIVE	TSSOP	PW	8	150	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	2442Q	Samples
TLV2442QPWR	ACTIVE	TSSOP	PW	8	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	2442Q	Samples
TLV2444AID	ACTIVE	SOIC	D	14	50	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	2444AI	Samples

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
TLV2444AIPW	ACTIVE	TSSOP	PW	14	90	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	2444AI	Samples
TLV2444AIPWR	ACTIVE	TSSOP	PW	14	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	2444AI	Samples
TLV2444AIPWRG4	ACTIVE	TSSOP	PW	14	2000	TBD	Call TI	Call TI	-40 to 125		Samples
TLV2444CD	ACTIVE	SOIC	D	14	50	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	2444C	Samples
TLV2444CDR	ACTIVE	SOIC	D	14	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	2444C	Samples
TLV2444CPW	ACTIVE	TSSOP	PW	14	90	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	2444C	Samples
TLV2444CPWR	ACTIVE	TSSOP	PW	14	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	2444C	Samples
TLV2444ID	ACTIVE	SOIC	D	14	50	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	2444I	Samples
TLV2444IDR	ACTIVE	SOIC	D	14	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	2444I	Samples
TLV2444IPWR	ACTIVE	TSSOP	PW	14	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	2444I	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) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".
RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.
Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

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

(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 finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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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 TLV2442, TLV2442A, TLV2442AM, TLV2442M :

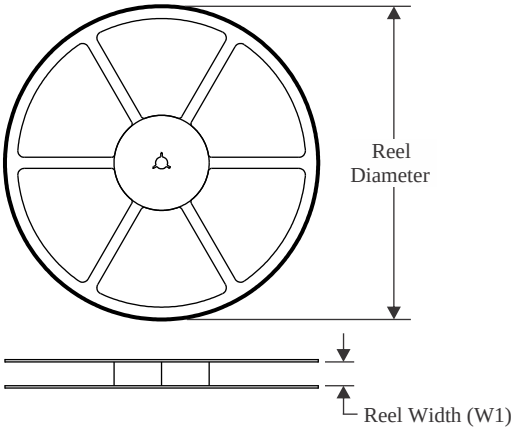
- Catalog : TLV2442A, TLV2442
- Automotive : TLV2442-Q1, TLV2442A-Q1, TLV2442A-Q1, TLV2442-Q1
- Military : TLV2442M, TLV2442AM

NOTE: Qualified Version Definitions:

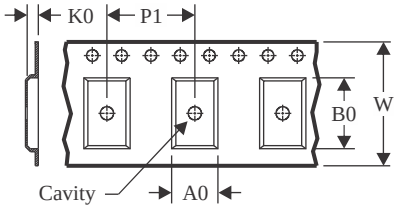
- Catalog - TI's standard catalog product
- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects
- Military - QML certified for Military and Defense Applications

TAPE AND REEL INFORMATION

REEL DIMENSIONS

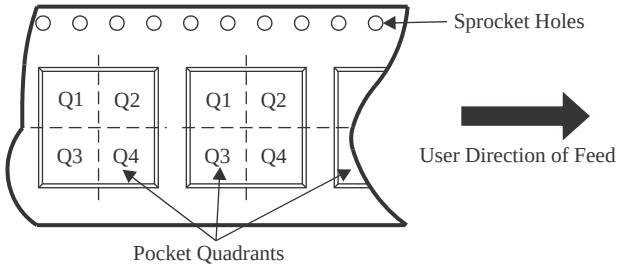


TAPE DIMENSIONS



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

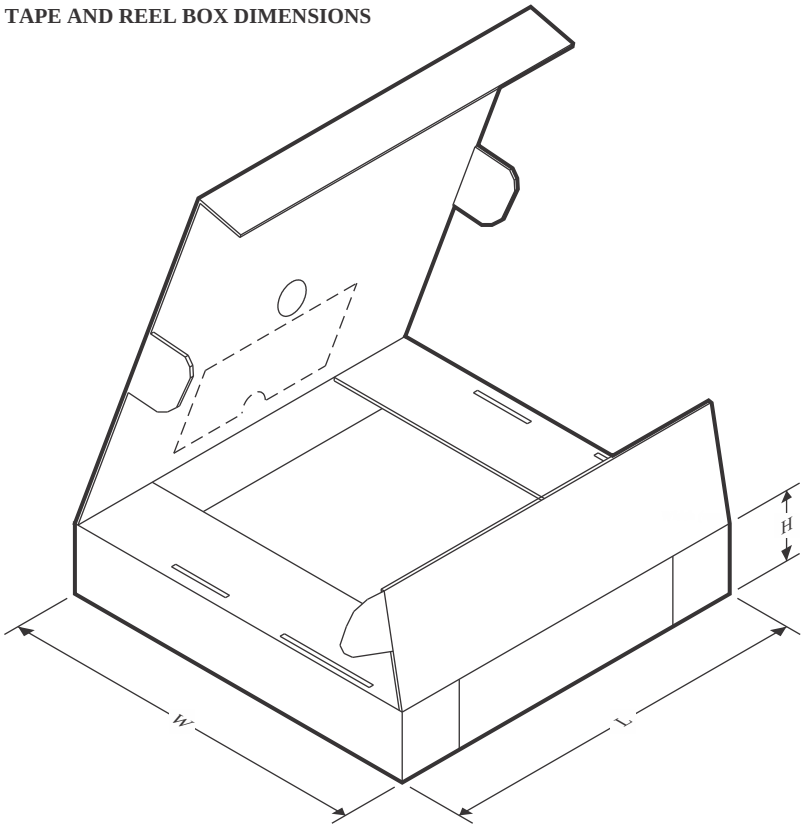
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
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

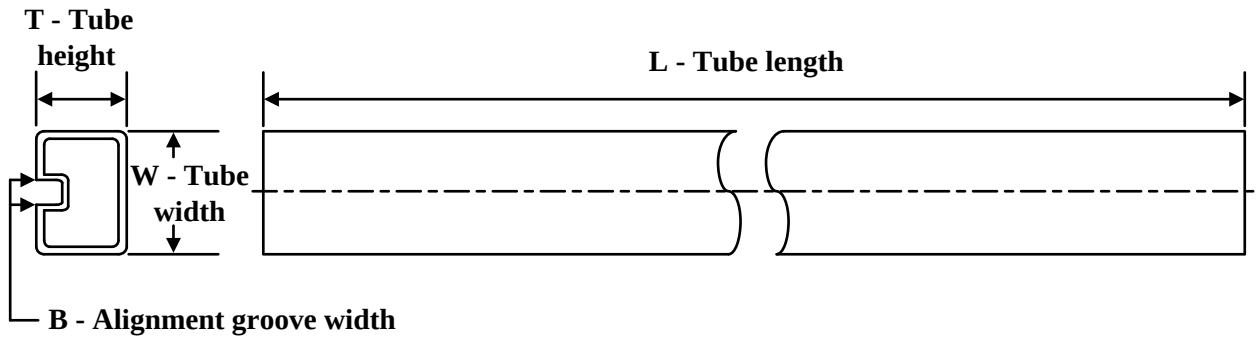
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TLV2442AIDR	SOIC	D	8	2500	340.5	336.1	25.0
TLV2442AIPWR	TSSOP	PW	8	2000	356.0	356.0	35.0
TLV2442AQPWR	TSSOP	PW	8	2000	356.0	356.0	35.0
TLV2442CDR	SOIC	D	8	2500	340.5	336.1	25.0
TLV2442IDR	SOIC	D	8	2500	340.5	336.1	25.0
TLV2442QPWR	TSSOP	PW	8	2000	356.0	356.0	35.0
TLV2444AIPWR	TSSOP	PW	14	2000	356.0	356.0	35.0
TLV2444CDR	SOIC	D	14	2500	350.0	350.0	43.0
TLV2444CPWR	TSSOP	PW	14	2000	356.0	356.0	35.0
TLV2444IDR	SOIC	D	14	2500	350.0	350.0	43.0
TLV2444IPWR	TSSOP	PW	14	2000	356.0	356.0	35.0

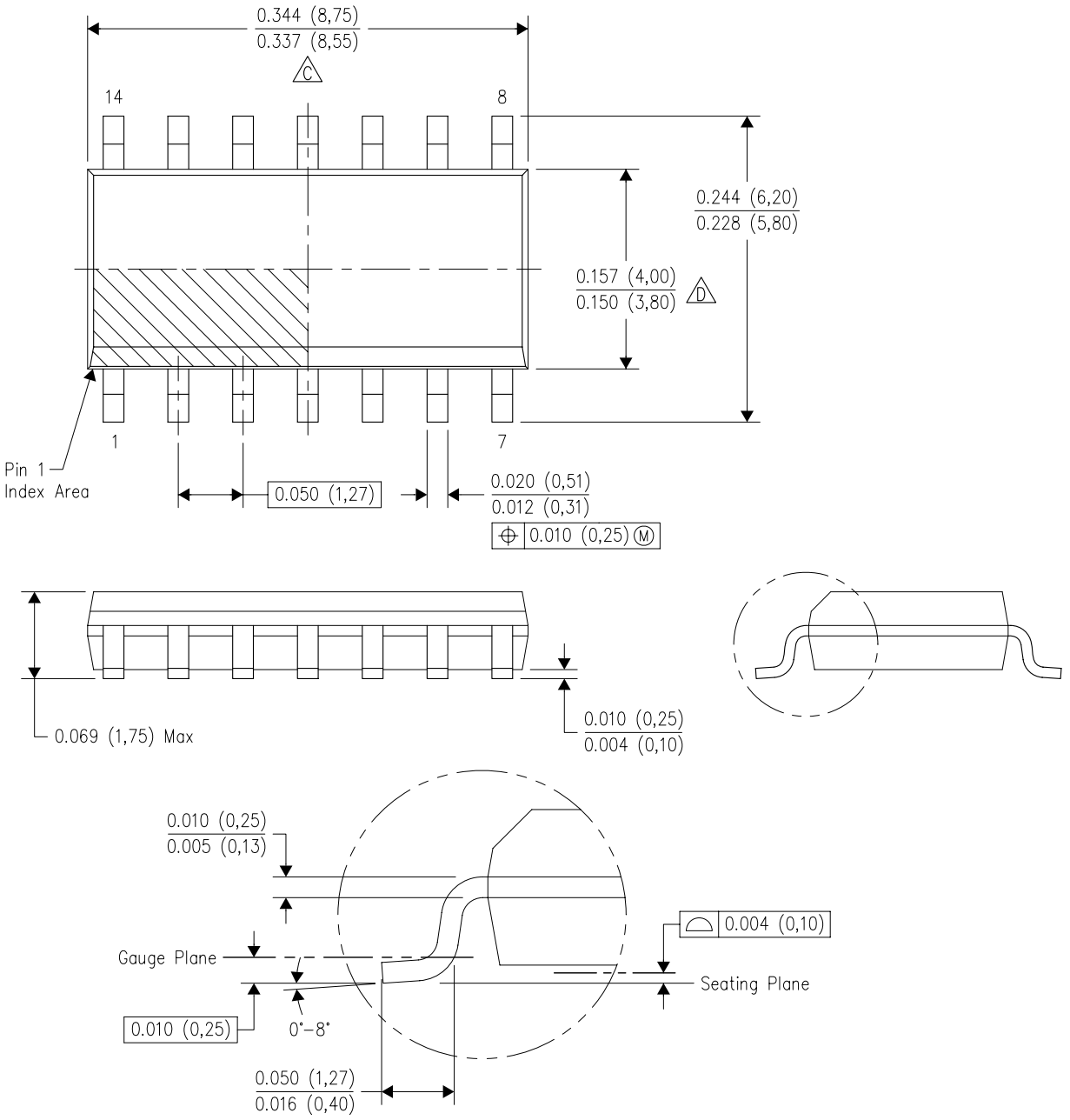
TUBE



*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (µm)	B (mm)
TLV2442AID	D	SOIC	8	75	507	8	3940	4.32
TLV2442AID	D	SOIC	8	75	505.46	6.76	3810	4
TLV2442AIPW	PW	TSSOP	8	150	530	10.2	3600	3.5
TLV2442AQD	D	SOIC	8	75	507	8	3940	4.32
TLV2442AQPW	PW	TSSOP	8	150	530	10.2	3600	3.5
TLV2442CD	D	SOIC	8	75	507	8	3940	4.32
TLV2442CD	D	SOIC	8	75	505.46	6.76	3810	4
TLV2442CPW	PW	TSSOP	8	150	530	10.2	3600	3.5
TLV2442ID	D	SOIC	8	75	505.46	6.76	3810	4
TLV2442ID	D	SOIC	8	75	507	8	3940	4.32
TLV2442QPW	PW	TSSOP	8	150	530	10.2	3600	3.5
TLV2444AID	D	SOIC	14	50	505.46	6.76	3810	4
TLV2444AIPW	PW	TSSOP	14	90	530	10.2	3600	3.5
TLV2444CD	D	SOIC	14	50	505.46	6.76	3810	4
TLV2444CPW	PW	TSSOP	14	90	530	10.2	3600	3.5
TLV2444ID	D	SOIC	14	50	505.46	6.76	3810	4

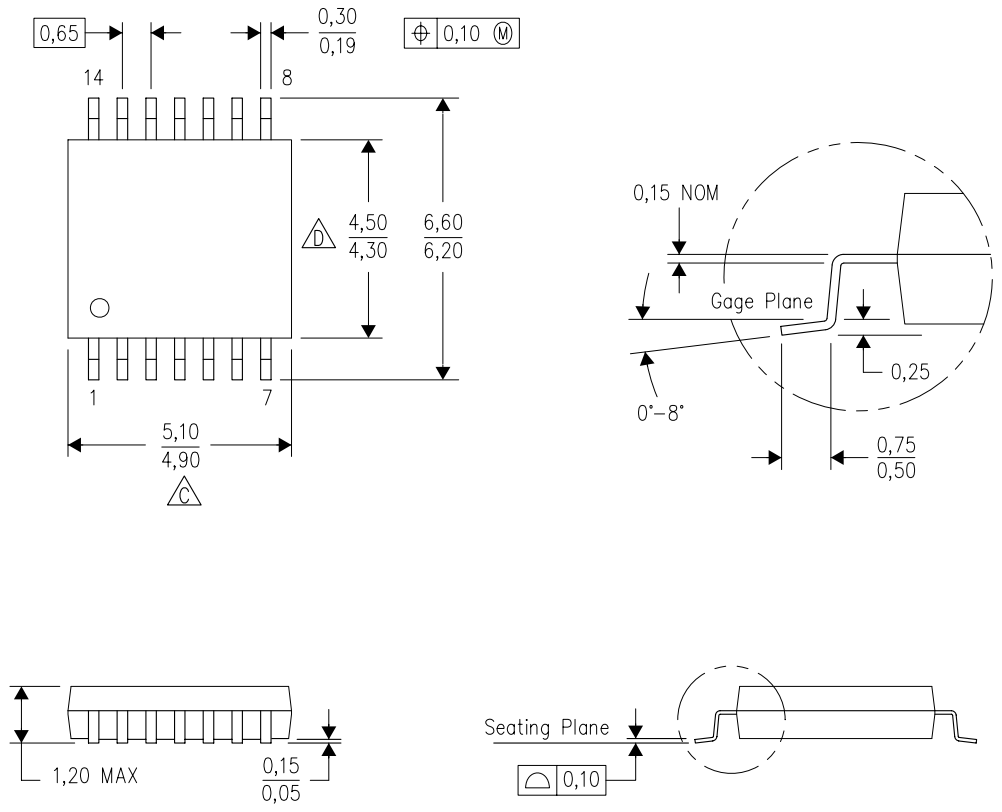
D (R–PDSO–G14) PLASTIC SMALL OUTLINE



4040047–5/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 AB.

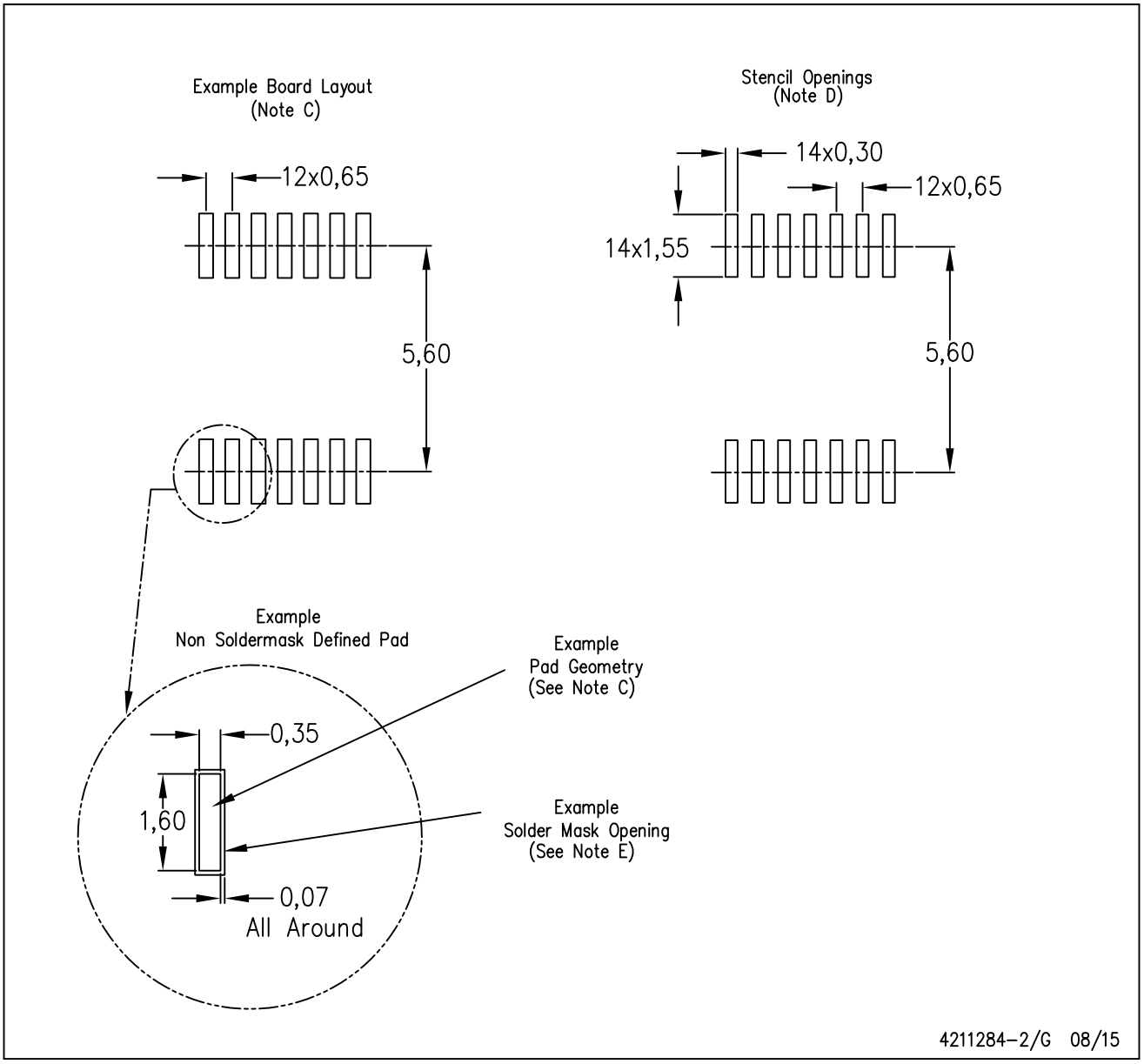
PW (R–PDSO–G14) PLASTIC SMALL OUTLINE



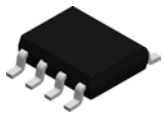
4040064–3/G 02/11

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

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.

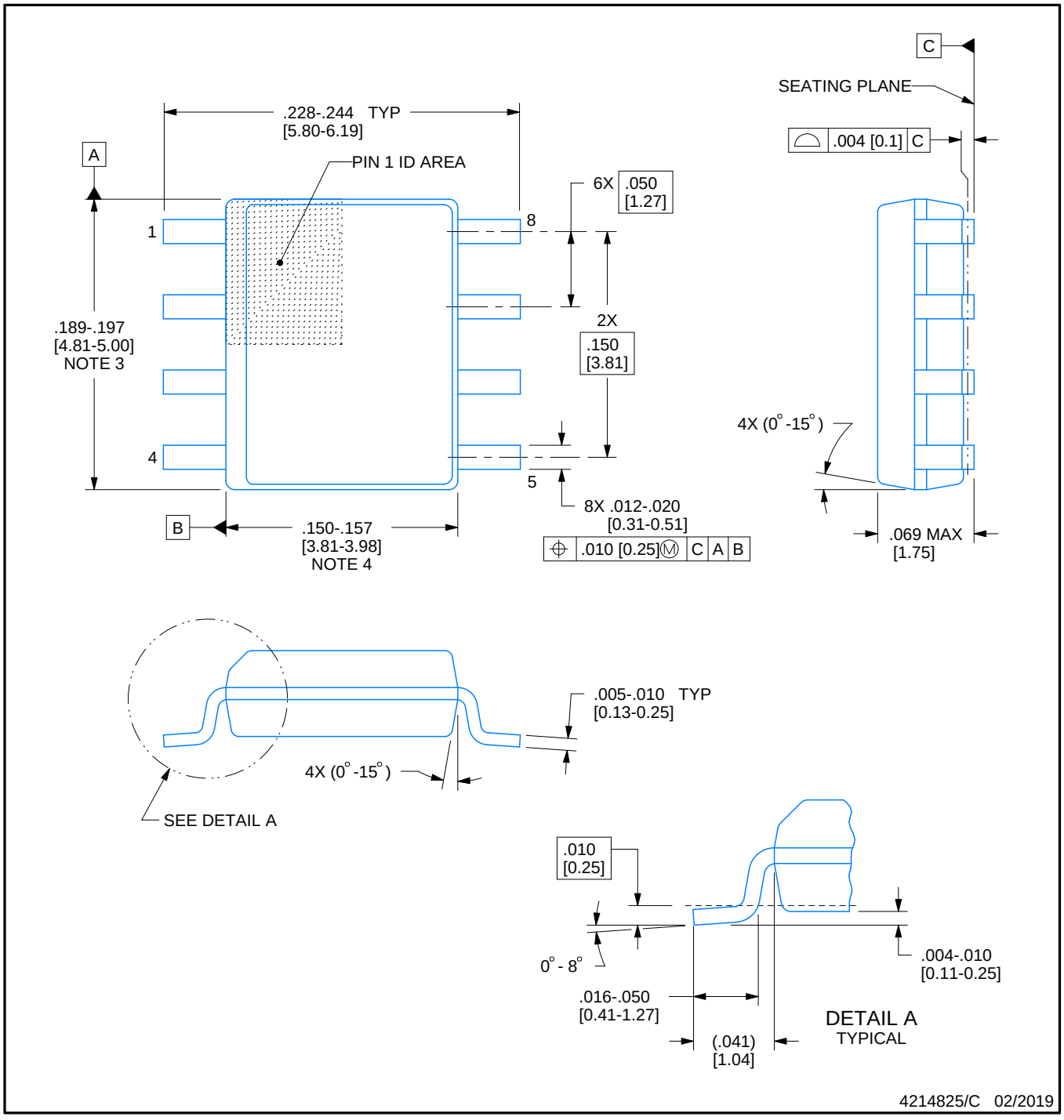


PACKAGE OUTLINE

D0008A

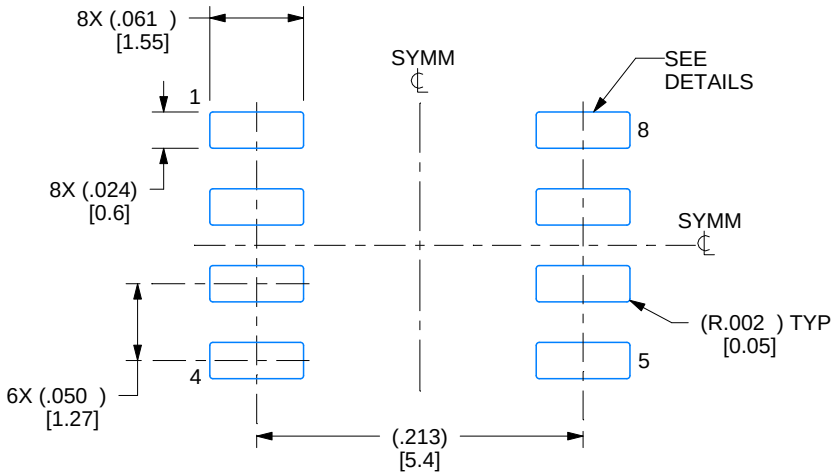
SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT

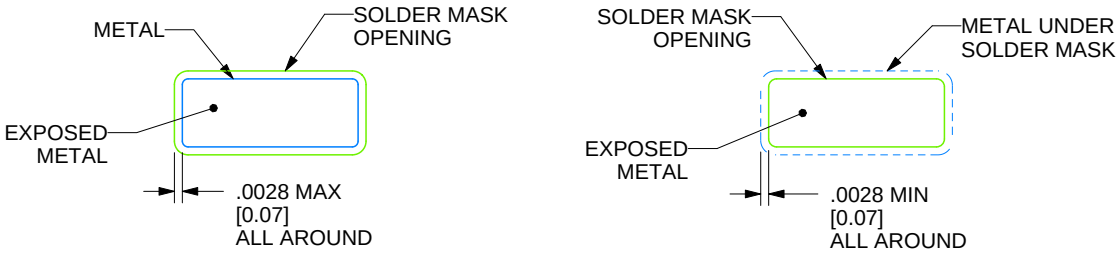


NOTES:

1. Linear dimensions are in inches [millimeters]. Dimensions in parenthesis are for reference only. Controlling dimensions are in inches. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 [0.15] per side.
4. This dimension does not include interlead flash.
5. Reference JEDEC registration MS-012, variation AA.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:8X



SOLDER MASK DETAILS

4214825/C 02/2019

NOTES: (continued)

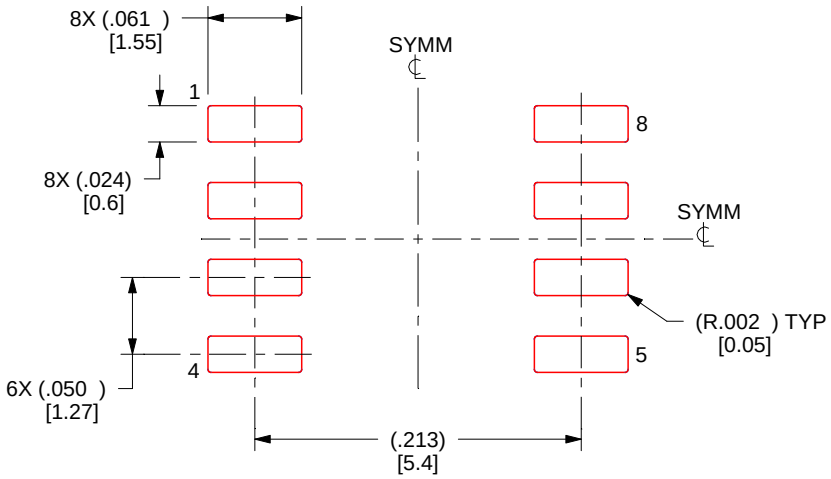
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

D0008A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



SOLDER PASTE EXAMPLE
BASED ON .005 INCH [0.125 MM] THICK STENCIL
SCALE:8X

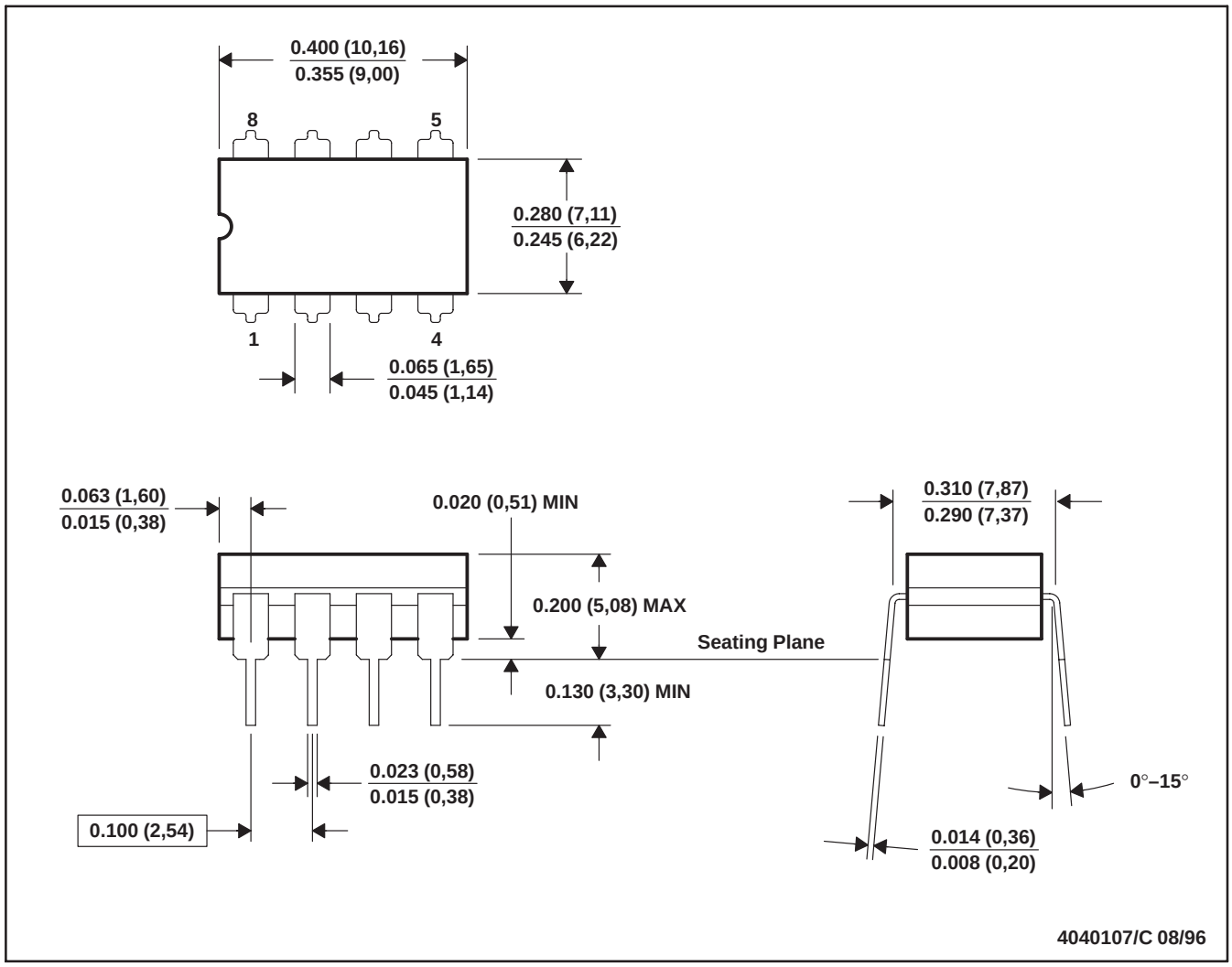
4214825/C 02/2019

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

MCER001A – JANUARY 1995 – REVISED JANUARY 1997

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



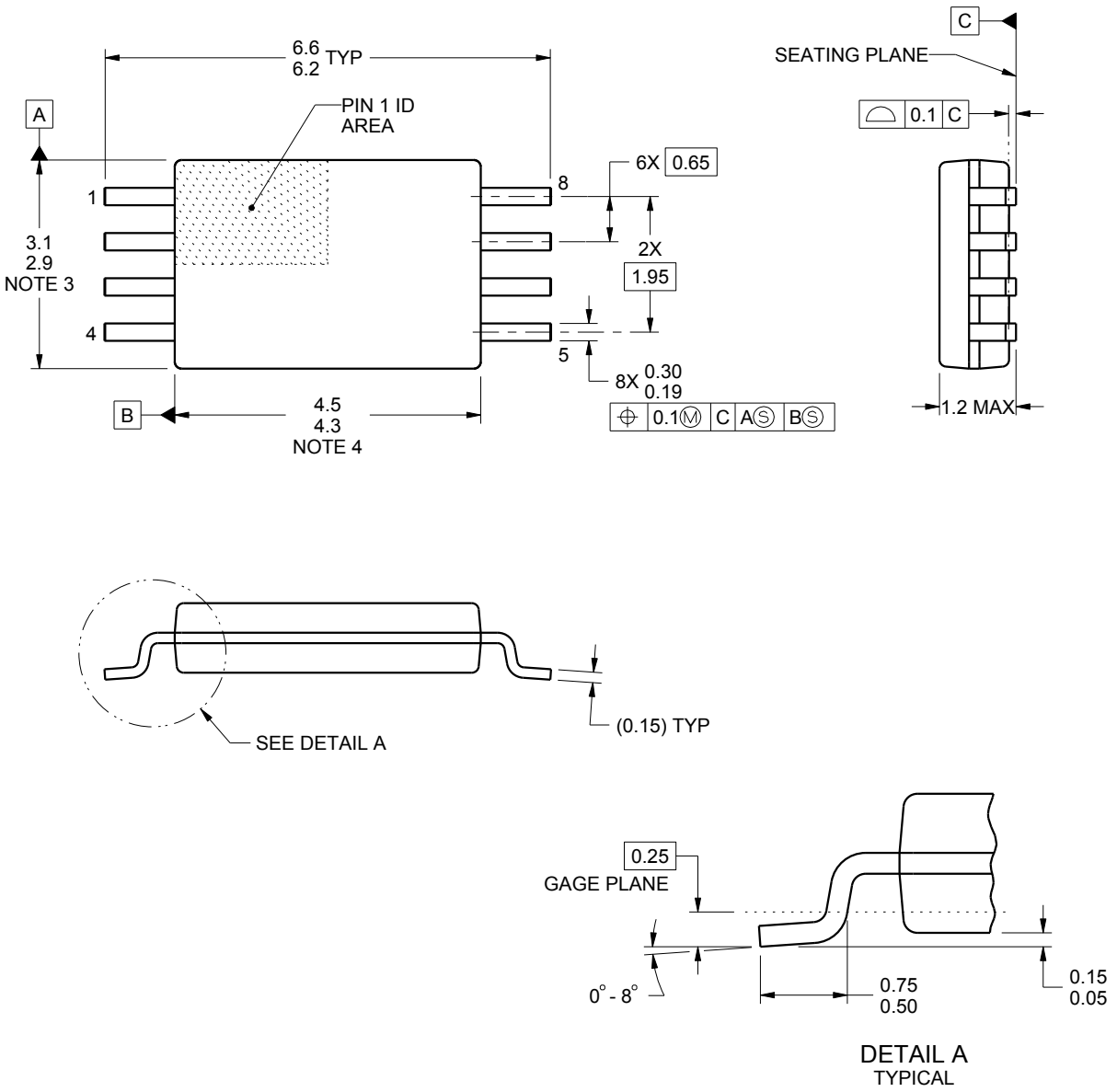
NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. This package can be hermetically sealed with a ceramic lid using glass frit.
D. Index point is provided on cap for terminal identification.
E. Falls within MIL STD 1835 GDIP1-T8

PACKAGE OUTLINE

PW0008A

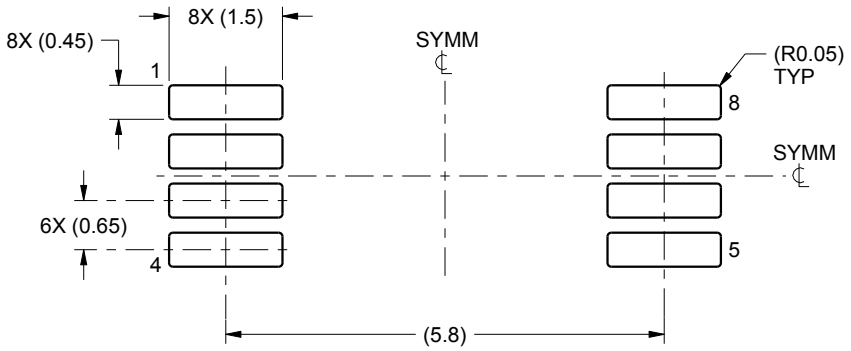
TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE

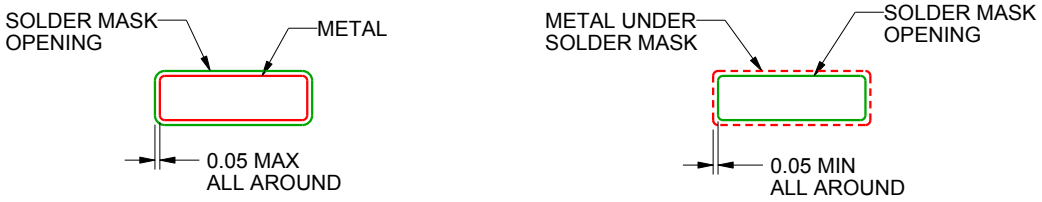


NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-153, variation AA.



LAND PATTERN EXAMPLE
SCALE:10X

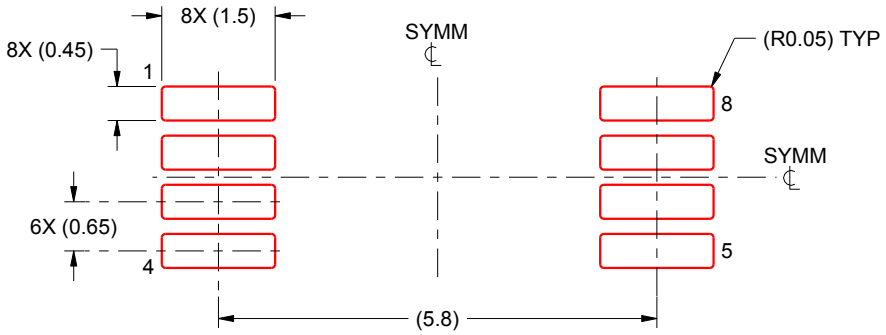


SOLDER MASK DETAILS
NOT TO SCALE

4221848/A 02/2015

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:10X

4221848/A 02/2015

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

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