

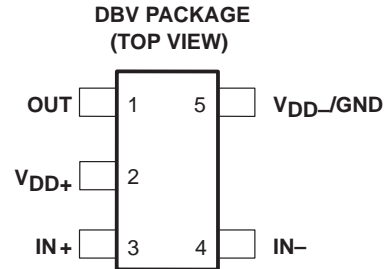
- Output Swing Includes Both Supply Rails
- Low Noise . . . 21 nV/√Hz Typ at f = 1 kHz
- Low Input Bias Current . . . 1 pA Typ
- Very Low Power . . . 11 μA Per Channel Typ
- Common-Mode Input Voltage Range Includes Negative Rail
- Wide Supply Voltage Range 2.7 V to 10 V
- Available in the SOT-23 Package
- Macromodel Included

description

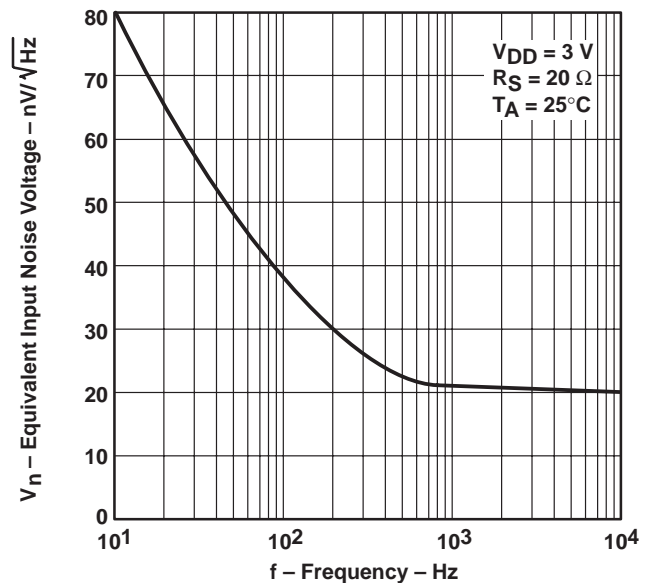
The TLV2711 is a single low-voltage operational amplifier available in the SOT-23 package. It consumes only 11 μA (typ) of supply current and is ideal for battery-power applications. Looking at Figure 1, the TLV2711 has a 3-V noise level of 21 nV/√Hz at 1 kHz; five times lower than competitive SOT-23 micropower solutions. The device exhibits rail-to-rail output performance for increased dynamic range in single- or split-supply applications. The TLV2711 is fully characterized at 3 V and 5 V and is optimized for low-voltage applications.

The TLV2711, 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 combined with 3-V 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).

With a total area of 5.6mm², the SOT-23 package only requires one-third the board space of the standard 8-pin SOIC package. This ultra-small package allows designers to place single amplifiers very close to the signal source, minimizing noise pick-up from long PCB traces.



EQUIVALENT INPUT NOISE VOLTAGE†
vs
FREQUENCY



† For all curves where $V_{DD} = 5$ V, all loads are referenced to 2.5 V.
For all curves where $V_{DD} = 3$ V, all loads are referenced to 1.5 V.

Figure 1. Equivalent Input Noise Voltage Versus Frequency

AVAILABLE OPTIONS

T_A	V_{IOmax} AT 25°C	PACKAGED DEVICES	SYMBOL	CHIP FORM‡ (Y)
		SOT-23 (DBV)†		
0°C to 70°C	3 mV	TLV2711CDBV	VAJC	TLV2711Y
-40°C to 85°C	3 mV	TLV2711IDBV	VAJI	

† The DBV package available in tape and reel only.

‡ Chip forms are tested at $T_A = 25^\circ\text{C}$ only.



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**TEXAS
INSTRUMENTS**

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TLV2711, TLV2711Y

Advanced LinCMOS™ RAIL-TO-RAIL

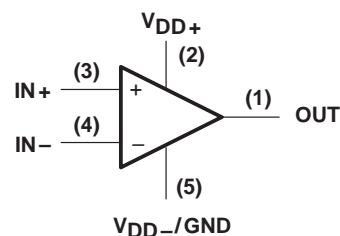
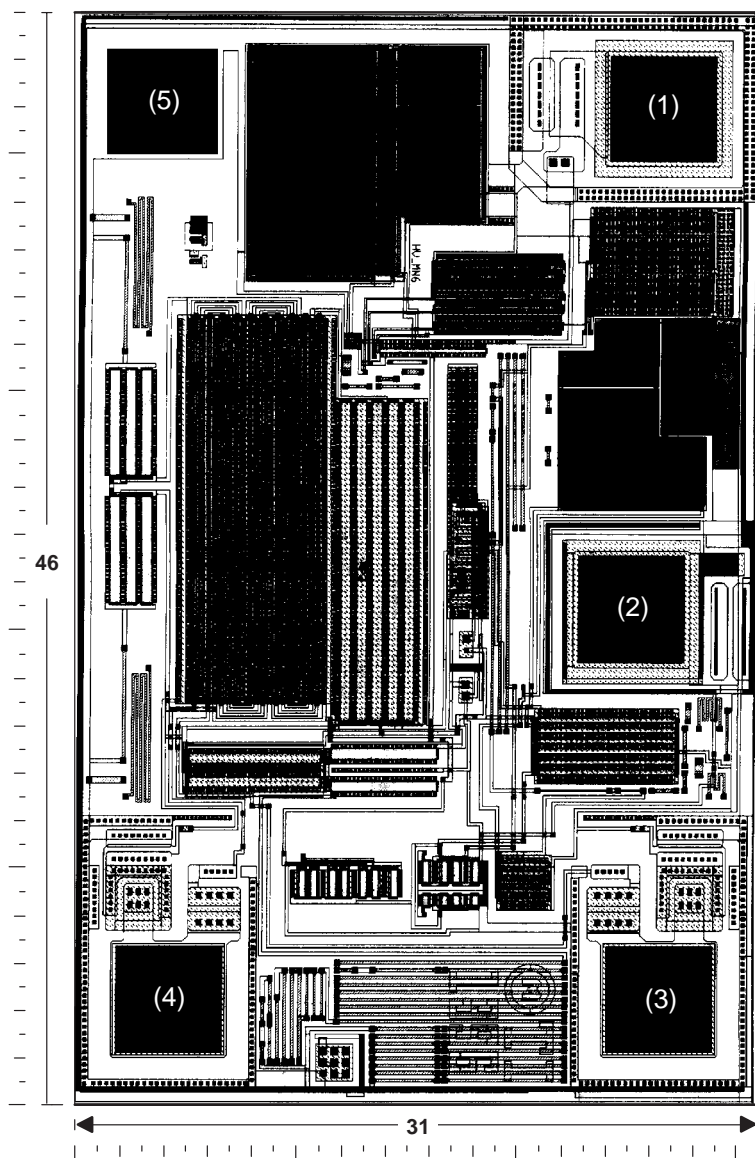
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TLV2711Y chip information

This chip, when properly assembled, displays characteristics similar to the TLV2711C. Thermal compression or ultrasonic bonding may be used on the doped-aluminum bonding pads. This chip may be mounted with conductive epoxy or a gold-silicon preform.

BONDING PAD ASSIGNMENTS



CHIP THICKNESS: 10 MILS TYPICAL

BONDING PADS: 4 × 4 MILS MINIMUM

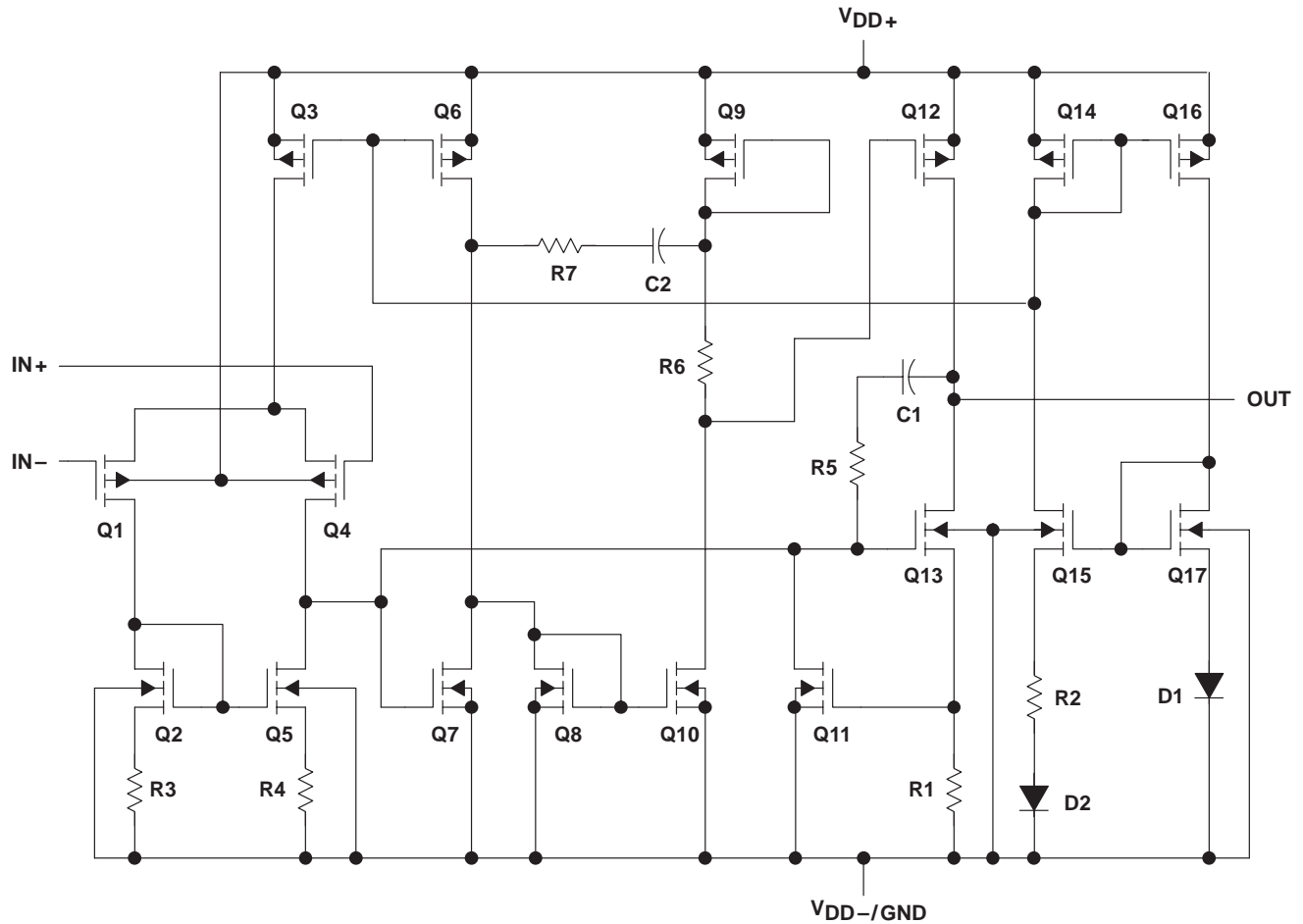
T_{Jmax} = 150°C

TOLERANCES ARE ±10%.

ALL DIMENSIONS ARE IN MILS.

PIN (2) IS INTERNALLY CONNECTED TO BACK SIDE OF CHIP.

equivalent schematic



COMPONENT COUNT†	
Transistors	23
Diodes	6
Resistors	11
Capacitors	2

† Includes both amplifiers and all ESD, bias, and trim circuitry

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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 range, V_I (any input, see Note 1)	$-0.3\text{ V to }V_{DD}$
Input current, I_I (each input)	$\pm 5\text{ mA}$
Output current, I_O	$\pm 50\text{ mA}$
Total current into V_{DD+}	$\pm 50\text{ mA}$
Total current out of V_{DD-}	$\pm 50\text{ mA}$
Duration of short-circuit current (at or below) 25°C (see Note 3)	unlimited
Continuous total power dissipation	See Dissipation Rating Table
Operating free-air temperature range, T_A : TLV2711C	$0^\circ\text{C to }70^\circ\text{C}$
TLV2711I	$-40^\circ\text{C to }85^\circ\text{C}$
Storage temperature range, T_{stg}	$-65^\circ\text{C to }150^\circ\text{C}$
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds: DBV package	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 V_{DD-} .
2. Differential voltages are at the noninverting input with respect to the inverting input. Excessive current flows when input is brought below $V_{DD-} - 0.3\text{ V}$.
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	$T_A \leq 25^\circ\text{C}$ POWER RATING	DERATING FACTOR ABOVE $T_A = 25^\circ\text{C}$	$T_A = 70^\circ\text{C}$ POWER RATING	$T_A = 85^\circ\text{C}$ POWER RATING
DBV	150 mW	1.2 mW/ $^\circ\text{C}$	96 mW	78 mW

recommended operating conditions

	TLV2711C		TLV2711I		UNIT
	MIN	MAX	MIN	MAX	
Supply voltage, V_{DD} (see Note 1)	2.7	10	2.7	10	V
Input voltage range, V_I	V_{DD-}	$V_{DD+} - 1.3$	V_{DD-}	$V_{DD+} - 1.3$	V
Common-mode input voltage, V_{IC}	V_{DD-}	$V_{DD+} - 1.3$	V_{DD-}	$V_{DD+} - 1.3$	V
Operating free-air temperature, T_A	0	70	-40	85	$^\circ\text{C}$

NOTE 1: All voltage values, except differential voltages, are with respect to V_{DD-} .

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

PARAMETER		TEST CONDITIONS		T _A [†]	TLV2711C			TLV2711I			UNIT
					MIN	TYP	MAX	MIN	TYP	MAX	
V _{IO}	Input offset voltage	V _{DD} ± = ±1.5 V, V _O = 0, V _{IC} = 0, R _S = 50 Ω		Full range	0.4 3			0.4 3			mV
αV _{IO}	Temperature coefficient of input offset voltage				1			1			μV/°C
	Input offset voltage long-term drift (see Note 4)			25°C	0.003			0.003			μV/mo
I _{IO}	Input offset current			25°C	0.5 60			0.5 60			pA
I _{IB}	Input bias current			Full range	150			150			
				25°C	60			60			
		Full range	1 150			1 150					
V _{ICR}	Common-mode input voltage range	V _{IO} ≤ 5 mV, R _S = 50 Ω		25°C	0 –0.3 to 2 to 2.2			0 –0.3 to 2 to 2.2			V
				Full range	0 to 1.7			0 to 1.7			
V _{OH}	High-level output voltage	I _{OH} = –100 μA		25°C	2.94			2.94			V
		I _{OH} = –250 μA		25°C	2.85			2.85			
				Full range	2.6			2.6			
V _{OL}	Low-level output voltage	V _{IC} = 1.5 V, I _{OL} = 50 μA		25°C	15			15			mV
		V _{IC} = 1.5 V, I _{OL} = 500 μA		25°C	150			150			
				Full range	500			500			
A _{VD}	Large-signal differential voltage amplification	V _{IC} = 1.5 V, V _O = 1 V to 2 V	R _L = 10 kΩ [‡]	25°C	3 7			3 7			V/mV
				Full range	1			1			
			R _L = 1 MΩ [‡]	25°C	600			600			
r _{i(d)}	Differential input resistance			25°C	10 ¹²			10 ¹²			Ω
r _{i(c)}	Common-mode input resistance			25°C	10 ¹²			10 ¹²			Ω
c _{i(c)}	Common-mode input capacitance	f = 10 kHz,		25°C	5			5			pF
z _o	Closed-loop output impedance	f = 7 kHz, A _V = 1		25°C	200			200			Ω
CMRR	Common-mode rejection ratio	V _{IC} = 0 to 1.7 V, R _S = 50 Ω, V _O = 1.5 V		25°C	65 83			65 83			dB
				Full range	60			60			
k _{SVR}	Supply voltage rejection ratio (ΔV _{DD} /ΔV _{IO})	V _{DD} = 2.7 V to 8 V, No load, V _{IC} = V _{DD} /2		25°C	80 95			80 95			dB
				Full range	80			80			
I _{DD}	Supply current	V _O = 1.5 V, No load		25°C	11 25			11 25			μA
				Full range	30			30			

† Full range for the TLV2711C is 0°C to 70°C. Full range for the TLV2711I is –40°C to 85°C.

‡ Referenced to 1.5 V

NOTE 4: Typical values are based on the input offset voltage shift observed through 500 hours of operating life test at $T_A = 150^\circ\text{C}$ extrapolated to $T_A = 25^\circ\text{C}$ using the Arrhenius equation and assuming an activation energy of 0.96 eV.

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

PARAMETER	TEST CONDITIONS	T_A^\dagger	TLV2711C			TLV2711I			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
SR Slew rate at unity gain	$V_O = 1.1\text{ V to }1.9\text{ V}, R_L = 10\text{ k}\Omega^\ddagger, C_L = 100\text{ pF}^\ddagger$	25°C	0.01	0.025		0.01	0.025		V/ μs
		Full range	0.005			0.005			
V_n Equivalent input noise voltage	$f = 10\text{ Hz}$	25°C		80			80		$\text{nV}/\sqrt{\text{Hz}}$
	$f = 1\text{ kHz}$	25°C		22			22		
$V_{N(PP)}$ Peak-to-peak equivalent input noise voltage	$f = 0.1\text{ Hz to }1\text{ Hz}$	25°C		660			660		nV
	$f = 0.1\text{ Hz to }10\text{ Hz}$	25°C		880			880		
I_n Equivalent input noise current		25°C		0.6			0.6		$\text{fA}/\sqrt{\text{Hz}}$
Gain-bandwidth product	$f = 10\text{ kHz}, R_L = 10\text{ k}\Omega^\ddagger, C_L = 100\text{ pF}^\ddagger$	25°C		56			56		kHz
B_{OM} Maximum output-swing bandwidth	$V_{O(PP)} = 1\text{ V}, R_L = 10\text{ k}\Omega^\ddagger, A_V = 1, C_L = 100\text{ pF}^\ddagger$	25°C		7			7		kHz
ϕ_m Phase margin at unity gain	$R_L = 10\text{ k}\Omega^\ddagger, C_L = 100\text{ pF}^\ddagger$	25°C		56°			56°		
Gain margin		25°C		20			20		dB

† Full range is -40°C to 85°C .

‡ Referenced to 1.5 V

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

PARAMETER		TEST CONDITIONS		T _A [†]	TLV2711C			TLV2711I			UNIT	
					MIN	TYP	MAX	MIN	TYP	MAX		
V _{IO}	Input offset voltage	V _{DD} ± = ±2.5 V, V _O = 0, V _{IC} = 0, R _S = 50 Ω		Full range	0.45 3			0.45 3			mV	
α _{VIO}	Temperature coefficient of input offset voltage				0.5			0.5			μV/°C	
	Input offset voltage long-term drift (see Note 4)			25°C	0.003			0.003			μV/mo	
I _{IO}	Input offset current			25°C	0.5 60			0.5 60			pA	
				Full range	150			150				
I _{IB}	Input bias current			25°C	1 60			1 60			pA	
		Full range	150			150						
V _{ICR}	Common-mode input voltage range	V _{IO} ≤ 5 mV R _S = 50 Ω		25°C	0 to 4	−0.3 to 4.2	0 to 4	−0.3 to 4.2	V			
				Full range	0 to 3.5		0 to 3.5					
V _{OH}	High-level output voltage	I _{OH} = −100 μA		25°C	4.95			4.95			V	
		I _{OH} = −250 μA		25°C	4.875			4.875				
				Full range	4.6			4.6				
V _{OL}	Low-level output voltage	V _{IC} = 2.5 V, I _{OL} = 50 μA		25°C	12			12			mV	
		V _{IC} = 2.5 V, I _{OL} = 500 μA		25°C	120			120				
				Full range	500			500				
A _{VD}	Large-signal differential voltage amplification	V _{IC} = 2.5 V, V _O = 1 V to 4 V	R _L = 10 kΩ [‡]	25°C	6	12	6	12	V/mV			
				Full range	3			3				
			R _L = 1 MΩ [‡]	25°C	800			800				
r _{i(d)}	Differential input resistance			25°C	10 ¹²			10 ¹²			Ω	
r _{i(c)}	Common-mode input resistance			25°C	10 ¹²			10 ¹²			Ω	
c _{i(c)}	Common-mode input capacitance	f = 10 kHz,		25°C	5			5			pF	
z _o	Closed-loop output impedance	f = 7 kHz, A _V = 1		25°C	200			200			Ω	
CMRR	Common-mode rejection ratio	V _{IC} = 0 to 2.7 V, R _S = 50 Ω		25°C	70	83	70	83	dB			
				Full range	70			70				
k _{SVR}	Supply voltage rejection ratio (ΔV _{DD} /ΔV _{IO})	V _{DD} = 4.4 V to 8 V, No load V _{IC} = V _{DD} /2,		25°C	80	95	80	95	dB			
				Full range	80			80				
I _{DD}	Supply current	V _O = 2.5 V, No load		25°C	13	25	13	25	μA			
				Full range	30			30				

† Full range for the TLV2711C is 0°C to 70°C. Full range for the TLV2711I is –40°C to 85°C.

‡ Referenced to 1.5 V

NOTE 5: Typical values are based on the input offset voltage shift observed through 500 hours of operating life test at $T_A = 150^\circ\text{C}$ extrapolated to $T_A = 25^\circ\text{C}$ using the Arrhenius equation and assuming an activation energy of 0.96 eV.

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

PARAMETER	TEST CONDITIONS	T_A †	TLV2711C			TLV2711I			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
SR Slew rate at unity gain	$V_O = 1.5\text{ V to }3.5\text{ V}, R_L = 10\text{ k}\Omega^\ddagger, C_L = 100\text{ pF}^\ddagger$	25°C	0.01	0.025		0.01	0.025		V/ μs
		Full range	0.005			0.005			
V_n Equivalent input noise voltage	$f = 10\text{ Hz}$	25°C		72			72		nV/ $\sqrt{\text{Hz}}$
	$f = 1\text{ kHz}$	25°C		21			21		
$V_{N(PP)}$ Peak-to-peak equivalent input noise voltage	$f = 0.1\text{ Hz to }1\text{ Hz}$	25°C		600			600		nV
	$f = 0.1\text{ Hz to }10\text{ Hz}$	25°C		800			800		
I_n Equivalent input noise current		25°C		0.6			0.6		fA/ $\sqrt{\text{Hz}}$
Gain-bandwidth product	$f = 10\text{ kHz}, R_L = 10\text{ k}\Omega^\ddagger, C_L = 100\text{ pF}^\ddagger$	25°C		65			65		kHz
B_{OM} Maximum output-swing bandwidth	$V_{O(PP)} = 2\text{ V}, R_L = 10\text{ k}\Omega^\ddagger, A_V = 1, C_L = 100\text{ pF}^\ddagger$	25°C		7			7		kHz
ϕ_m Phase margin at unity gain	$R_L = 10\text{ k}\Omega^\ddagger, C_L = 100\text{ pF}^\ddagger$	25°C		60°			60°		
Gain margin		25°C		22			22		dB

† Full range is -40°C to 85°C .

‡ Referenced to 1.5 V

electrical characteristics at $V_{DD} = 3\text{ V}, T_A = 25^\circ\text{C}$ (unless otherwise noted)

PARAMETER	TEST CONDITIONS	TLV2711Y			UNIT
		MIN	TYP	MAX	
V_{IO} Input offset voltage	$V_{DD\pm} = \pm 1.5\text{ V}, V_O = 0, V_{IC} = 0, R_S = 50\text{ }\Omega$		0.47		mV
I_{IO} Input offset current			0.5		pA
I_{IB} Input bias current			1		pA
V_{ICR} Common-mode input voltage range	$ V_{IO} \leq 5\text{ mV}, R_S = 50\text{ }\Omega$		-0.3 to 2.2		V
V_{OH} High-level output voltage	$I_{OH} = -100\text{ }\mu\text{A}$		2.94		V
	$I_{OH} = -200\text{ }\mu\text{A}$		2.85		
V_{OL} Low-level output voltage	$V_{IC} = 0, I_{OL} = 50\text{ }\mu\text{A}$		15		mV
	$V_{IC} = 0, I_{OL} = 500\text{ }\mu\text{A}$		150		
A_{VD} Large-signal differential voltage amplification	$V_{IC} = 1.5\text{ V}, V_O = 1\text{ V to }2\text{ V}$	$R_L = 10\text{ k}\Omega^\ddagger$	7		V/mV
		$R_L = 1\text{ M}\Omega^\ddagger$	600		
$r_{i(d)}$ Differential input resistance			10^{12}		Ω
$r_{i(c)}$ Common-mode input resistance			10^{12}		Ω
$c_{i(c)}$ Common-mode input capacitance	$f = 10\text{ kHz}$		5		pF
z_o Closed-loop output impedance	$f = 7\text{ kHz}, A_V = 1$		200		Ω
CMRR Common-mode rejection ratio	$V_{IC} = 0\text{ to }1.7\text{ V}, V_O = 1.5\text{ V}, R_S = 50\text{ }\Omega$		83		dB
k_{SVR} Supply voltage rejection ratio ($\Delta V_{DD}/\Delta V_{IO}$)	$V_{DD} = 2.7\text{ V to }8\text{ V}, V_{IC} = V_{DD}/2, \text{ No load}$		95		dB
I_{DD} Supply current	$V_O = 1.5\text{ V}, \text{ No load}$		11		μA

† Referenced to 1.5 V



electrical characteristics at $V_{DD} = 5\text{ V}$, $T_A = 25^\circ\text{C}$ (unless otherwise noted)

PARAMETER	TEST CONDITIONS	TLV2711Y			UNIT
		MIN	TYP	MAX	
V_{IO} Input offset voltage	$V_{DD} \pm \pm 2.5\text{ V}$, $R_S = 50\ \Omega$ $V_{IC} = 0$, $V_O = 0$,		0.45		mV
I_{IO} Input offset current			0.5		pA
I_{IB} Input bias current			1		pA
V_{ICR} Common-mode input voltage range	$ V_{IO} \leq 5\text{ mV}$, $R_S = 50\ \Omega$		-0.3 to 4.2		V
V_{OH} High-level output voltage	$I_{OH} = -100\ \mu\text{A}$		4.95		V
	$I_{OH} = -250\ \mu\text{A}$		4.875		
V_{OL} Low-level output voltage	$V_{IC} = 2.5\text{ V}$, $I_{OL} = 50\ \mu\text{A}$		12		mV
	$V_{IC} = 2.5\text{ V}$, $I_{OL} = 500\ \mu\text{A}$		120		
A_{VD} Large-signal differential voltage amplification	$V_{IC} = 2.5\text{ V}$, $V_O = 1\text{ V to }4\text{ V}$	$R_L = 10\text{ k}\Omega^\dagger$		12	V/mV
		$R_L = 1\text{ M}\Omega^\dagger$		800	
$r_{i(d)}$ Differential input resistance			10^{12}		Ω
$r_{i(c)}$ Common-mode input resistance			10^{12}		Ω
$c_{i(c)}$ Common-mode input capacitance	$f = 10\text{ kHz}$		5		pF
z_o Closed-loop output impedance	$f = 7\text{ kHz}$, $A_V = 1$		200		Ω
CMRR Common-mode rejection ratio	$V_{IC} = 0\text{ to }2.7\text{ V}$, $V_O = 2.5\text{ V}$, $R_S = 50\ \Omega$		83		dB
k_{SVR} Supply voltage rejection ratio ($\Delta V_{DD}/\Delta V_{IO}$)	$V_{DD} = 4.4\text{ V to }8\text{ V}$, $V_{IC} = V_{DD}/2$, No load		95		dB
I_{DD} Supply current	$V_O = 2.5\text{ V}$, No load		13		μA

† Referenced to 1.5 V

TYPICAL CHARACTERISTICS

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TYPICAL CHARACTERISTICS

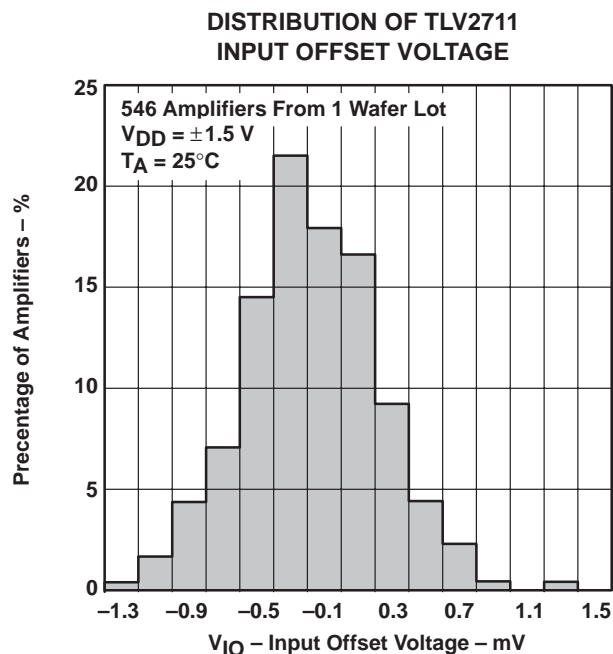


Figure 2

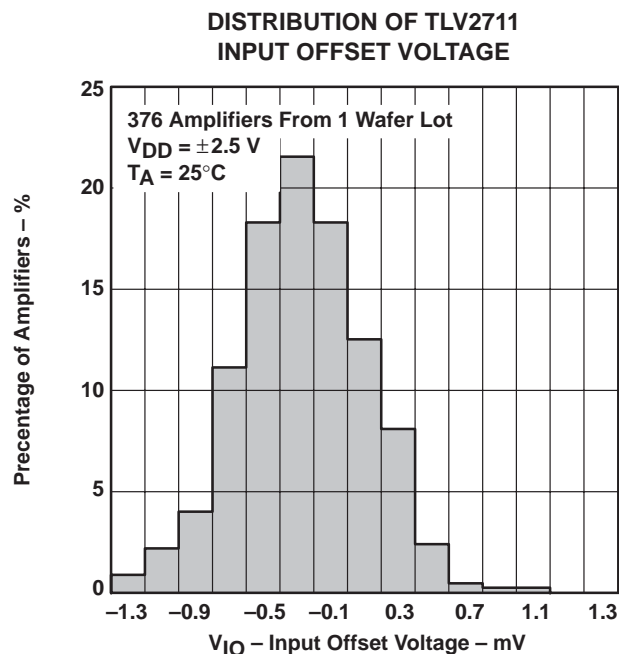


Figure 3

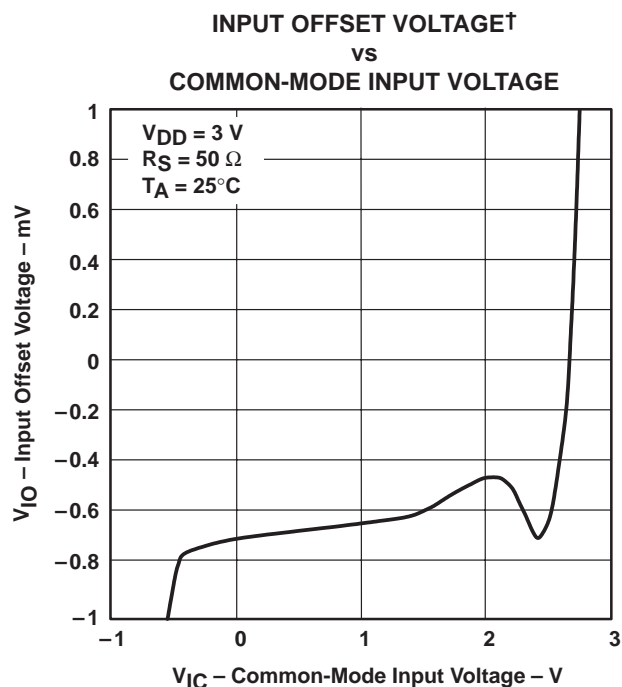


Figure 4

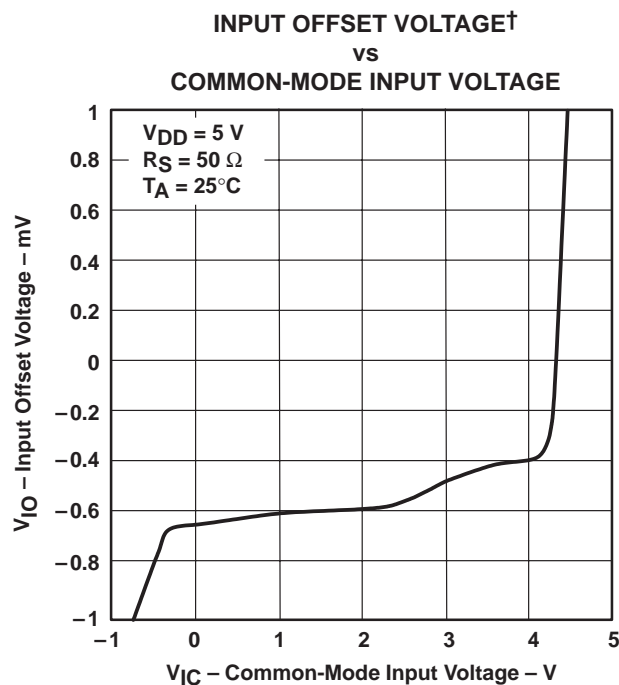


Figure 5

† For all curves where $V_{DD} = 5 \text{ V}$, all loads are referenced to 2.5 V. For all curves where $V_{DD} = 3 \text{ V}$, all loads are referenced to 1.5 V.

TYPICAL CHARACTERISTICS

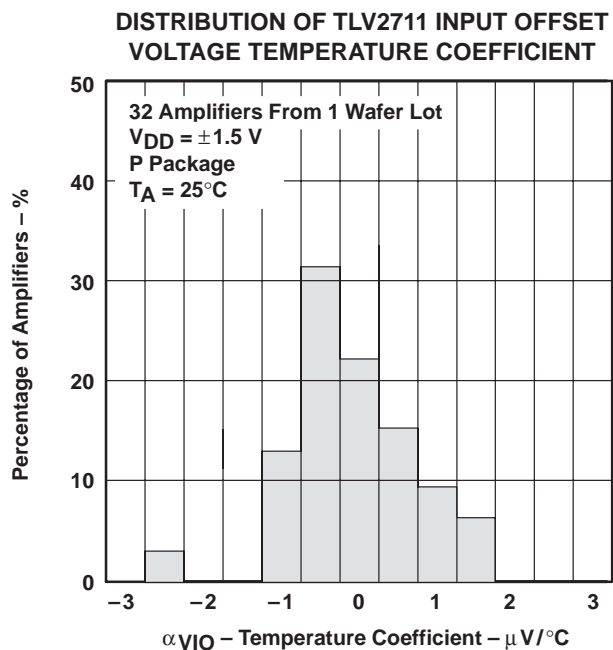


Figure 6

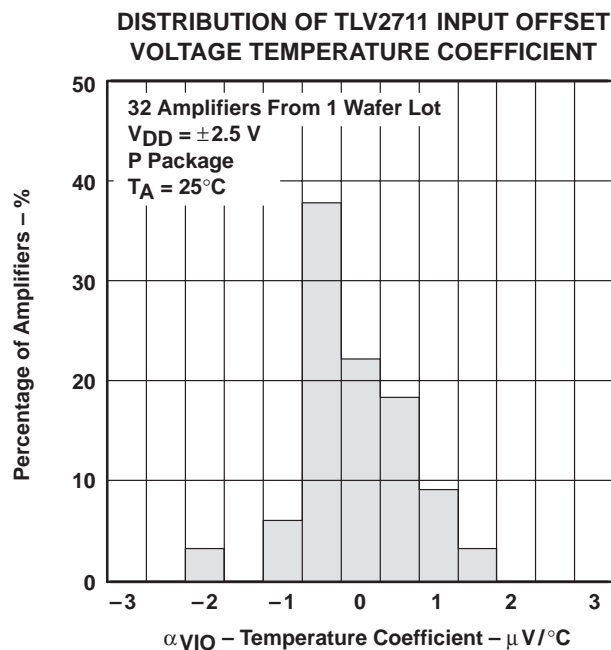


Figure 7

INPUT BIAS AND INPUT OFFSET CURRENTS† vs FREE-AIR TEMPERATURE

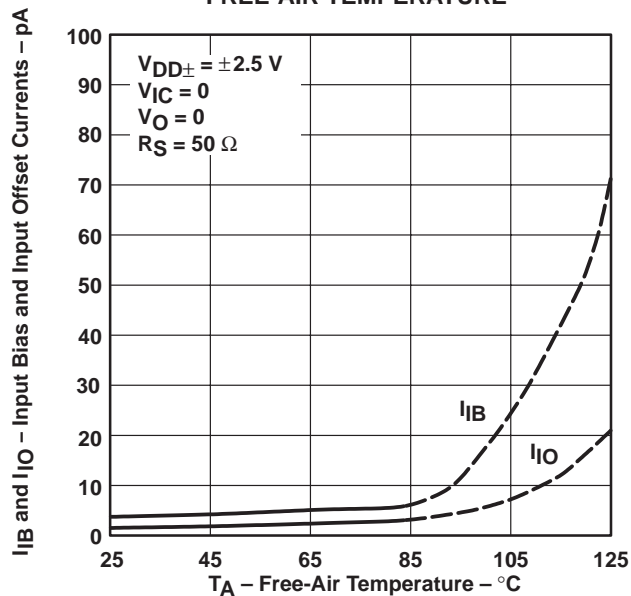


Figure 8

INPUT VOLTAGE vs SUPPLY VOLTAGE

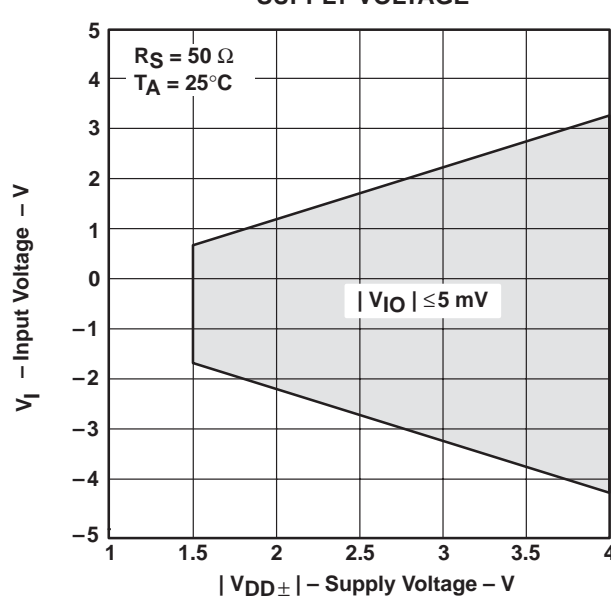
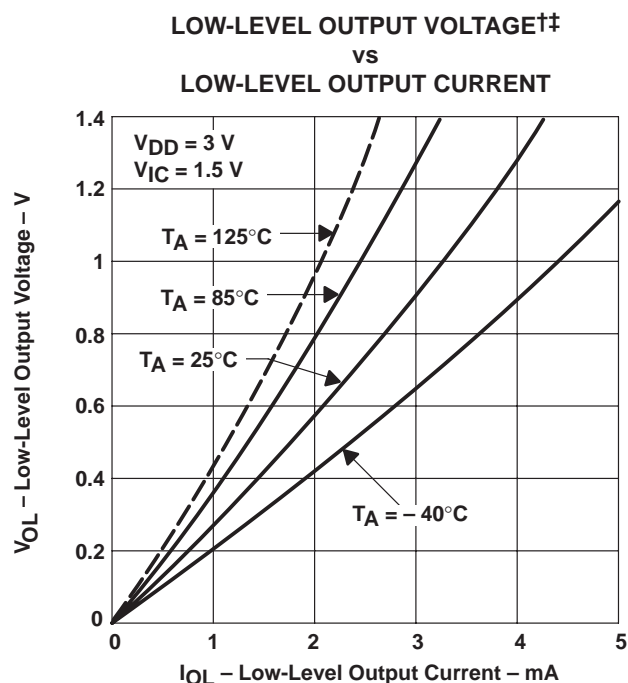
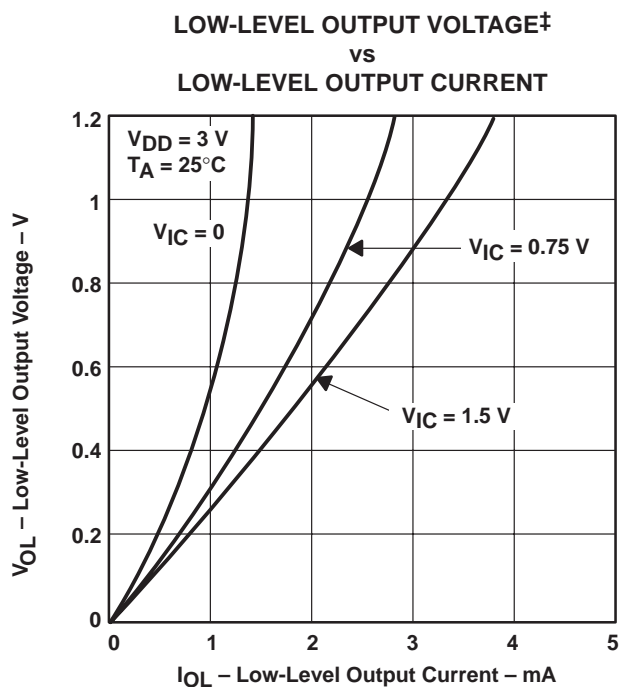
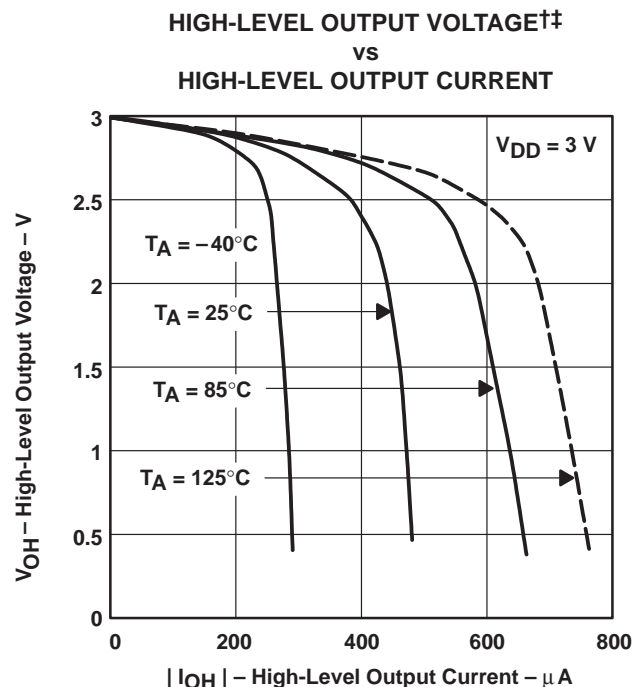
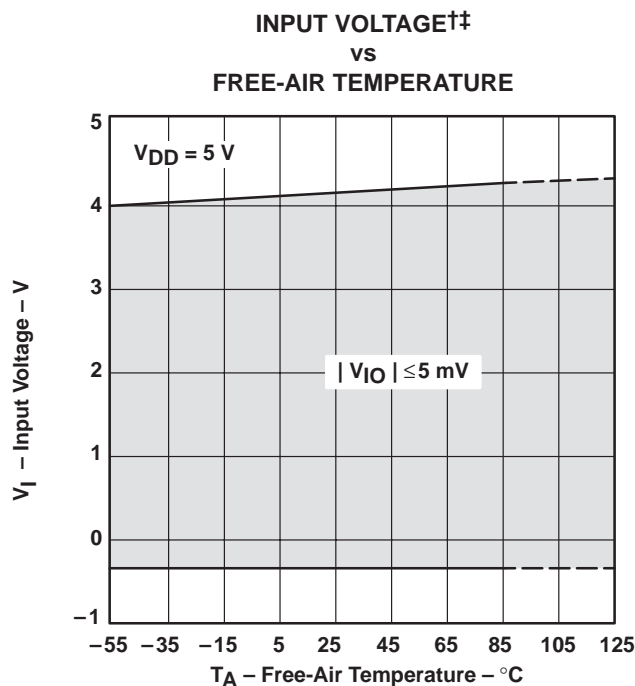


Figure 9

† Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

TYPICAL CHARACTERISTICS



† Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

‡ For all curves where $V_{DD} = 5$ V, all loads are referenced to 2.5 V. For all curves where $V_{DD} = 3$ V, all loads are referenced to 1.5 V.

TYPICAL CHARACTERISTICS

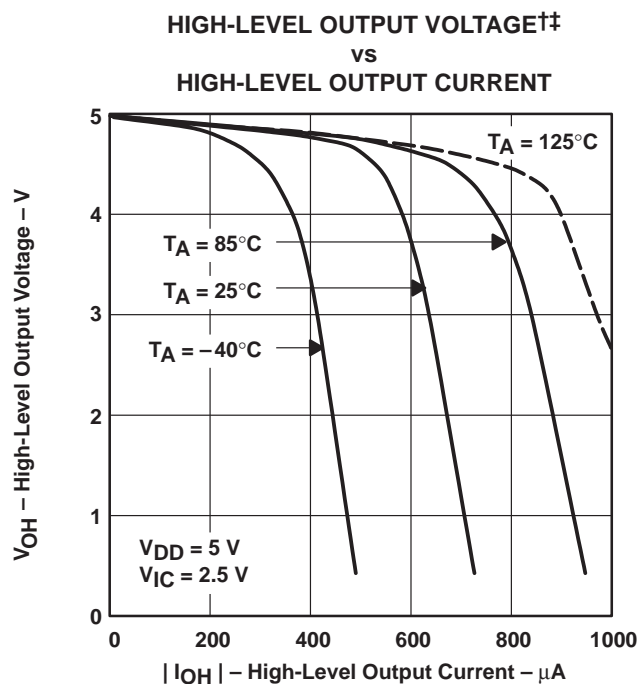


Figure 14

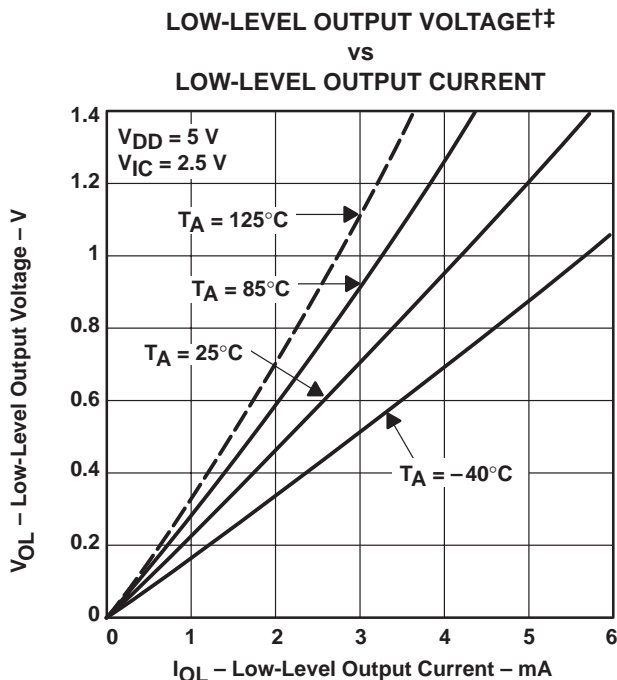


Figure 15

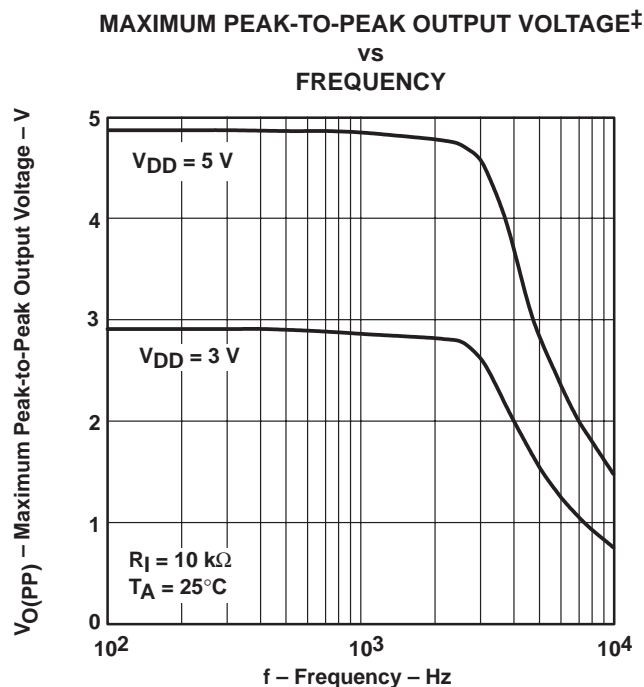


Figure 16

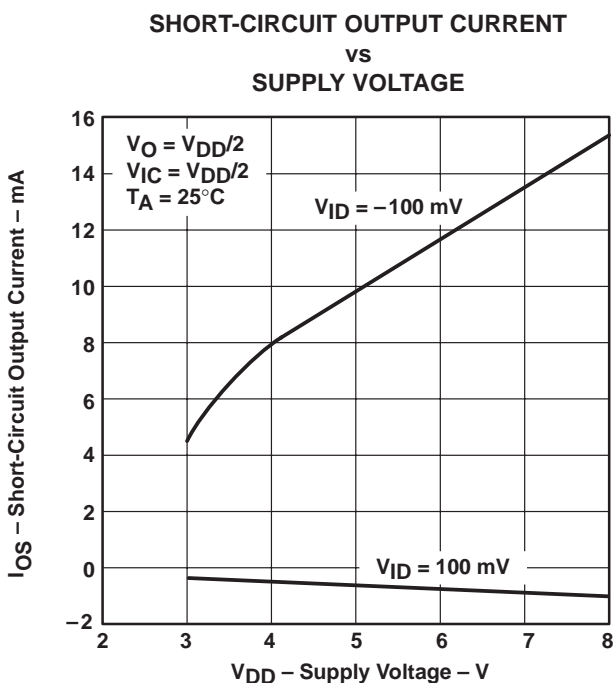
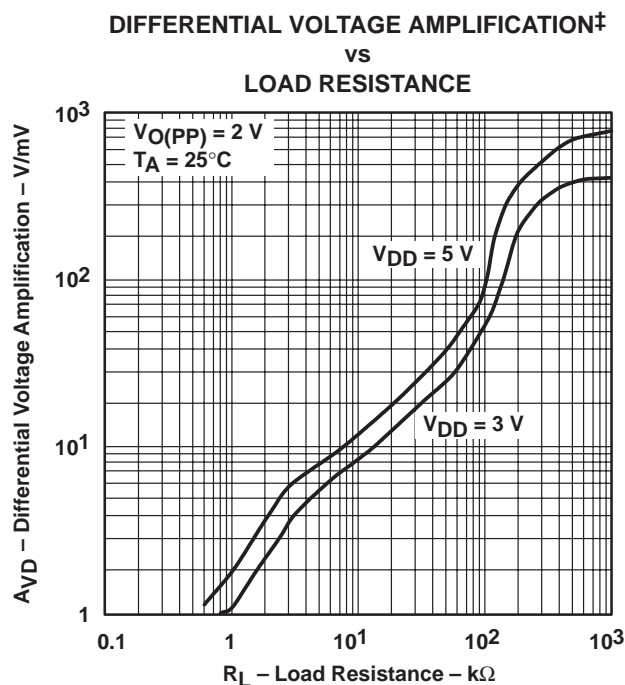
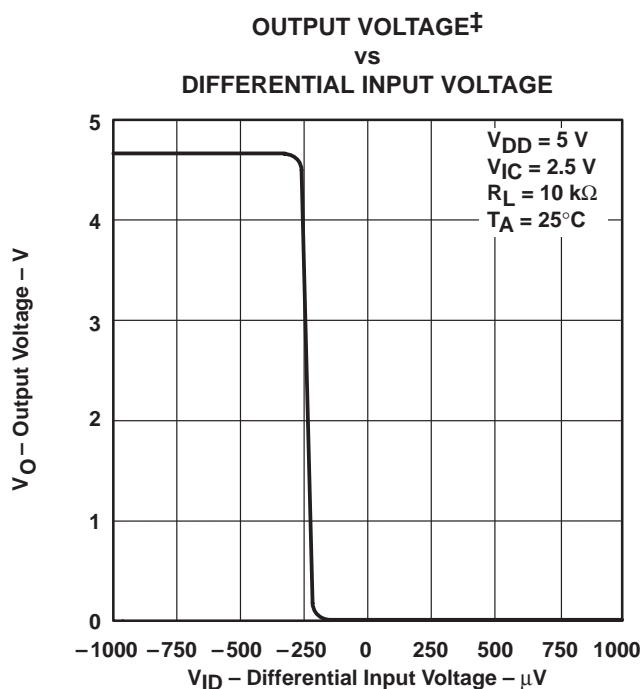
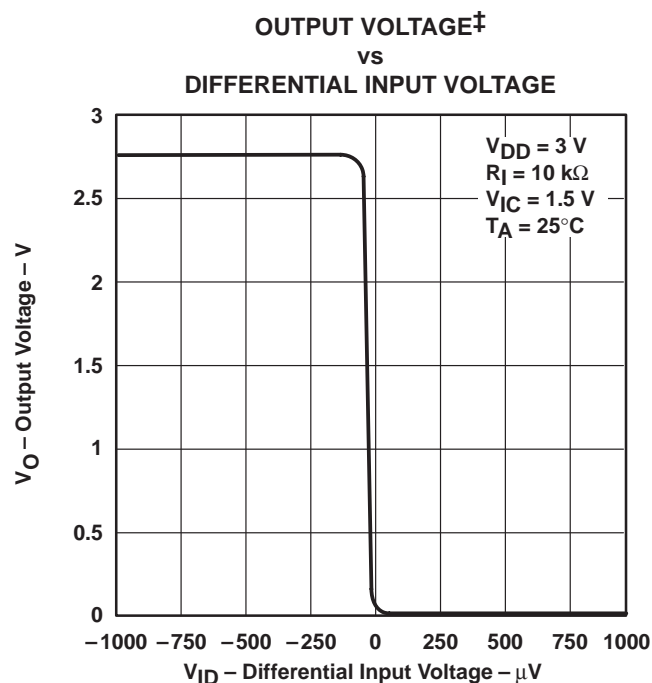
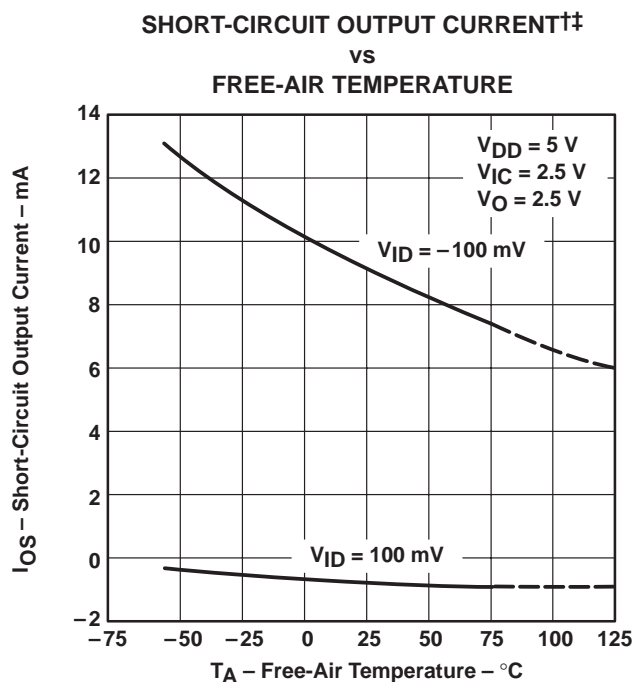


Figure 17

† Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

‡ For all curves where $V_{DD} = 5 V$, all loads are referenced to 2.5 V. For all curves where $V_{DD} = 3 V$, all loads are referenced to 1.5 V.

TYPICAL CHARACTERISTICS



† Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

‡ For all curves where $V_{DD} = 5\text{ V}$, all loads are referenced to 2.5 V. For all curves where $V_{DD} = 3\text{ V}$, all loads are referenced to 1.5 V.

TYPICAL CHARACTERISTICS

LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION AND PHASE MARGIN†

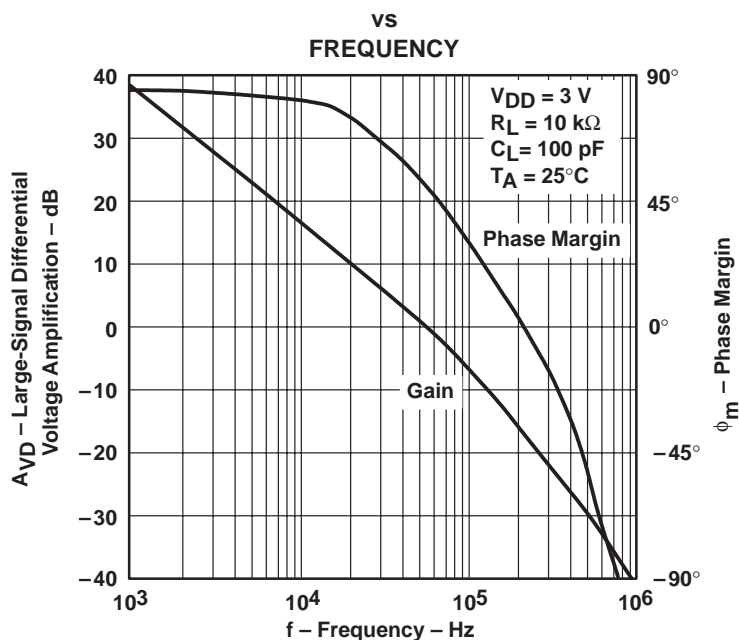


Figure 22

LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION AND PHASE MARGIN†

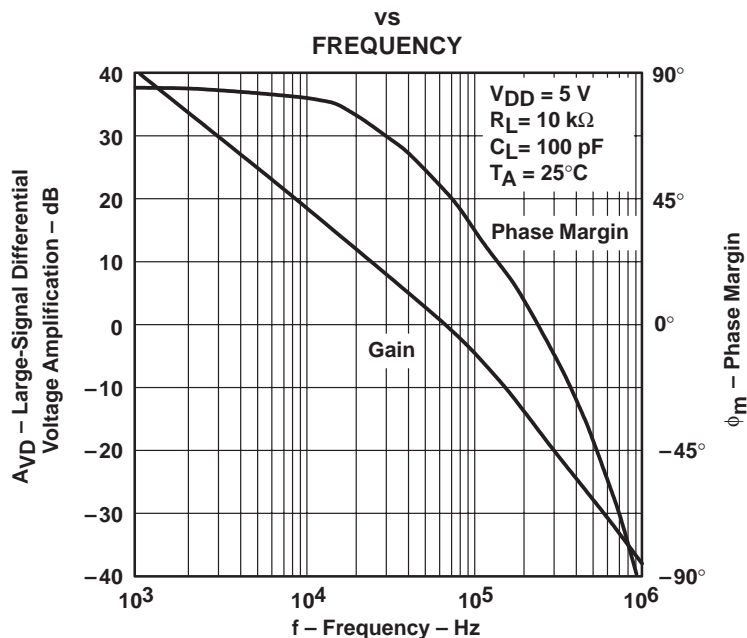


Figure 23

† For all curves where $V_{DD} = 5\text{ V}$, all loads are referenced to 2.5 V. For all curves where $V_{DD} = 3\text{ V}$, all loads are referenced to 1.5 V.

TYPICAL CHARACTERISTICS

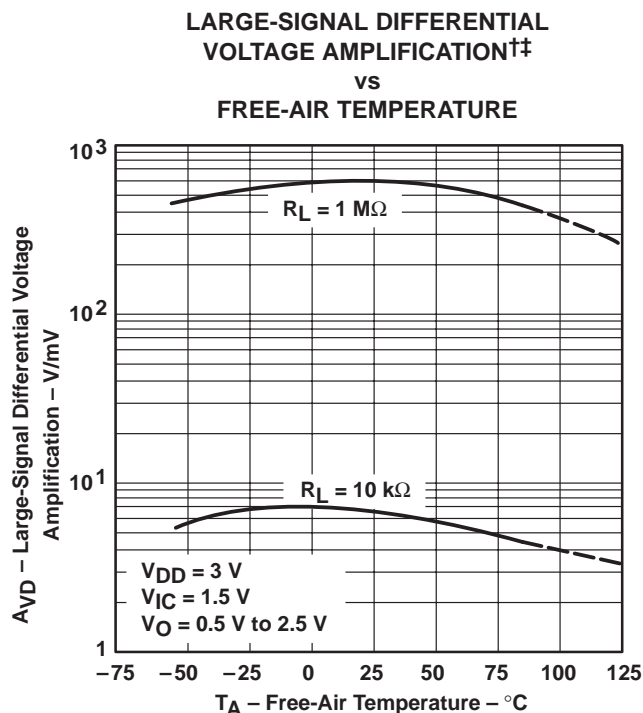


Figure 24

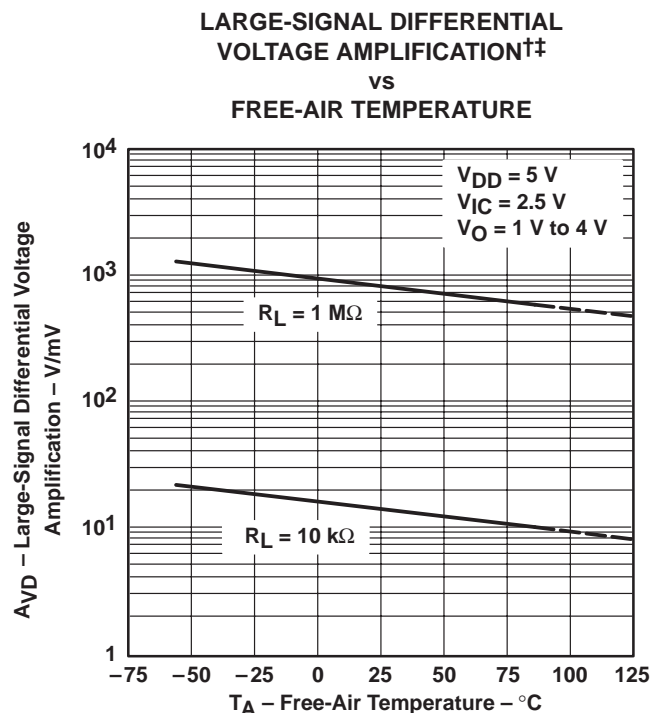


Figure 25

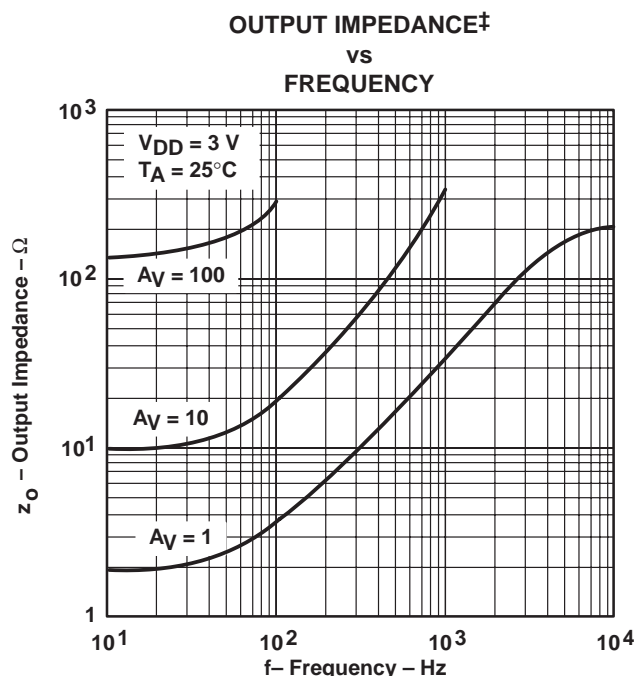


Figure 26

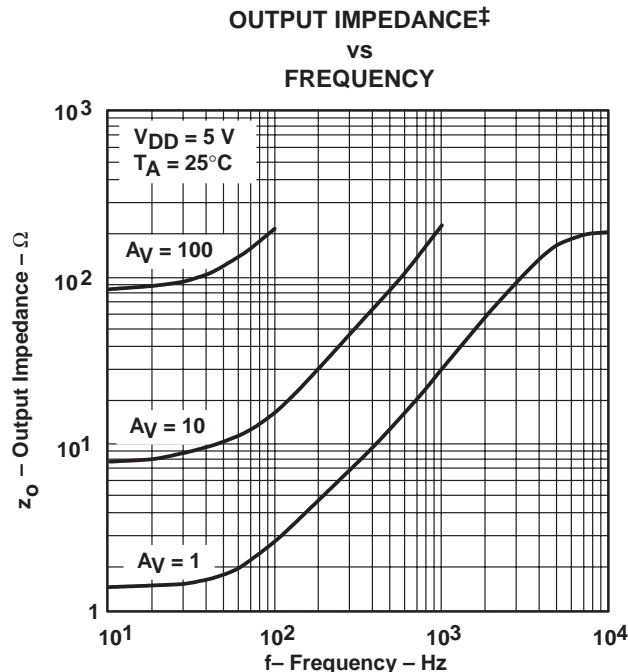


Figure 27

† Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

‡ For all curves where $V_{DD} = 5\text{ V}$, all loads are referenced to 2.5 V. For all curves where $V_{DD} = 3\text{ V}$, all loads are referenced to 1.5 V.

TYPICAL CHARACTERISTICS

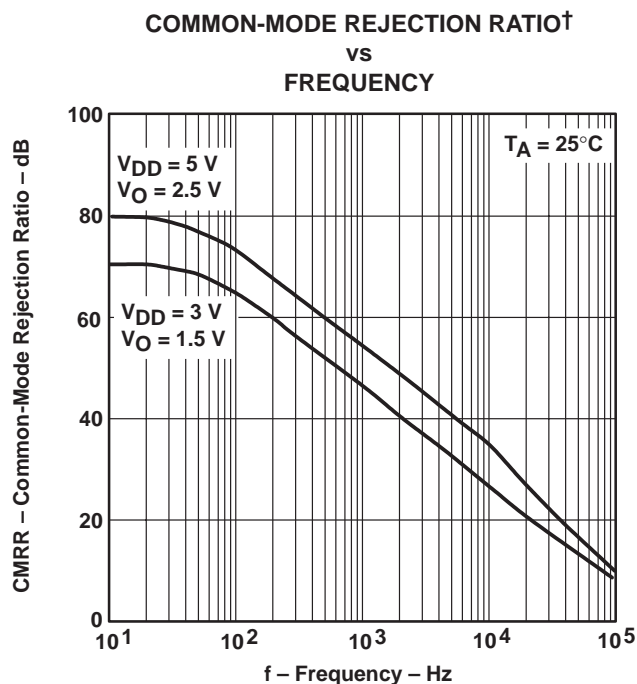


Figure 28

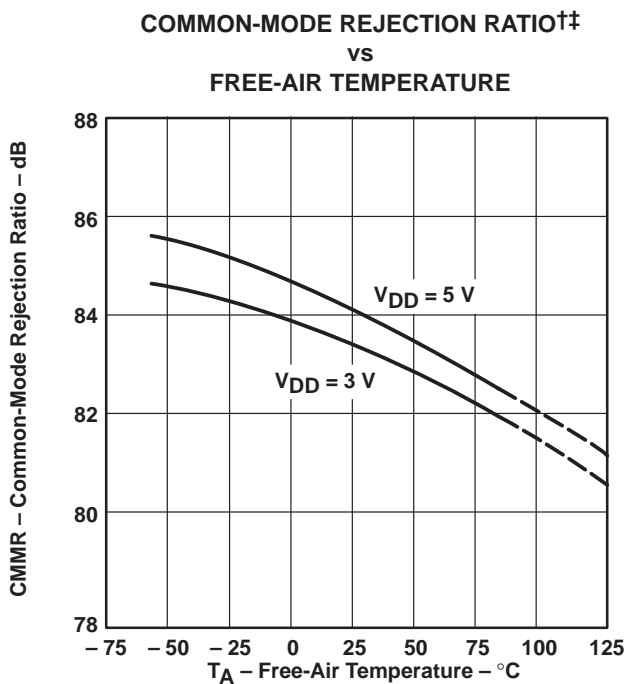


Figure 29

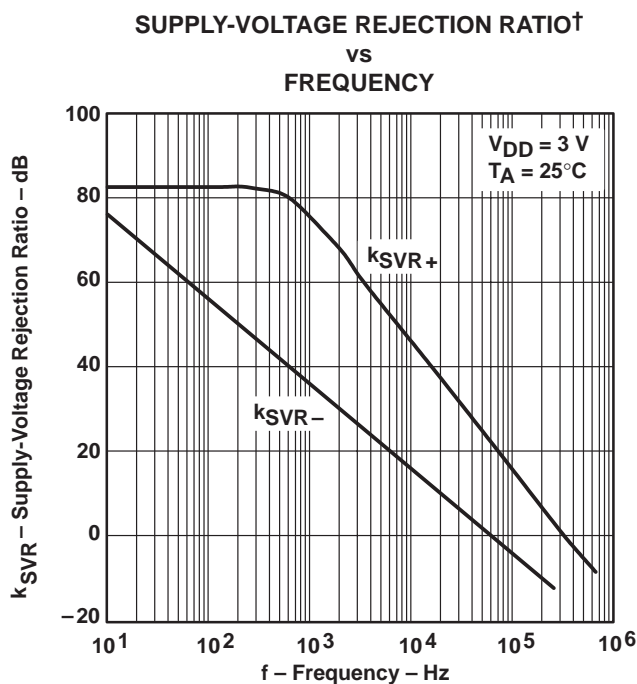


Figure 30

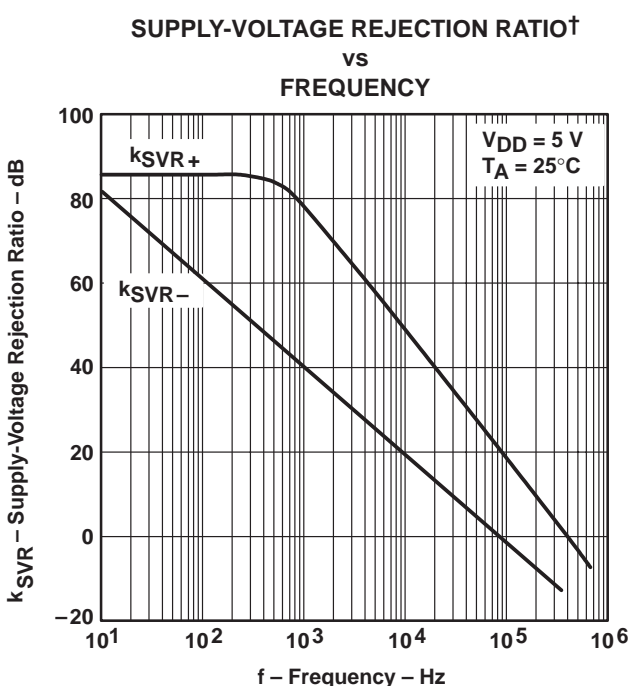


Figure 31

† For all curves where $V_{DD} = 5\text{ V}$, all loads are referenced to 2.5 V. For all curves where $V_{DD} = 3\text{ V}$, all loads are referenced to 1.5 V.

‡ Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

TYPICAL CHARACTERISTICS

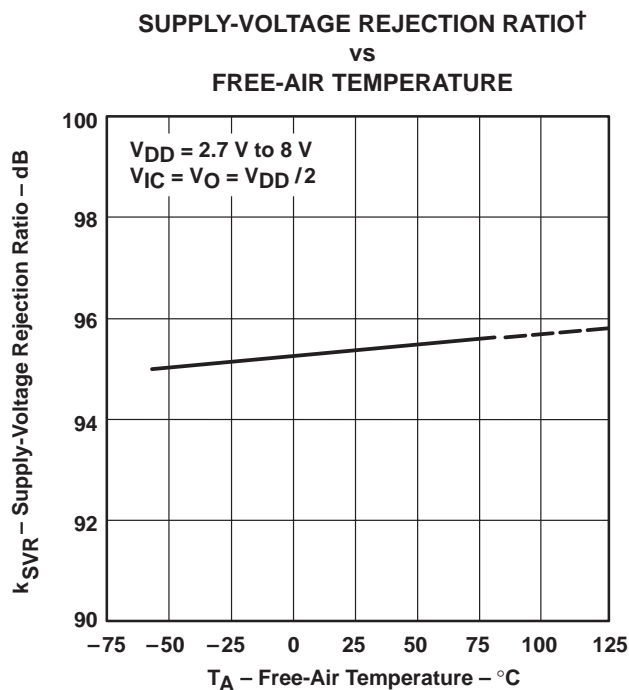


Figure 32

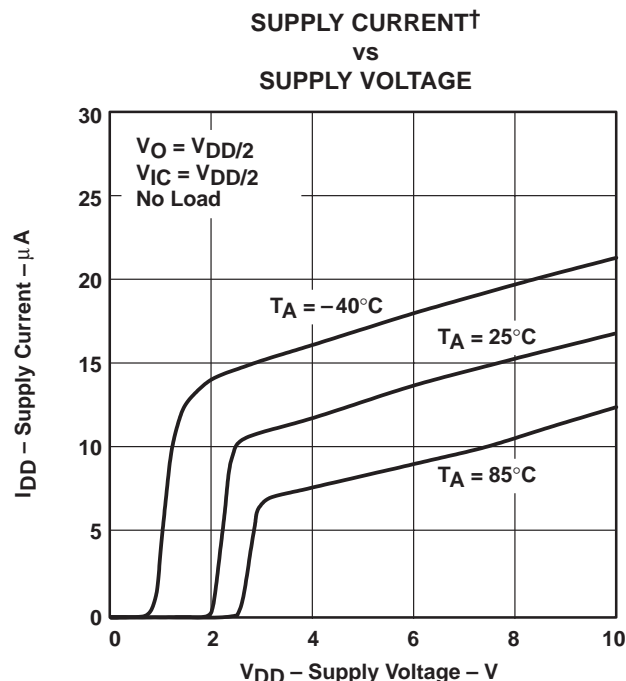


Figure 33

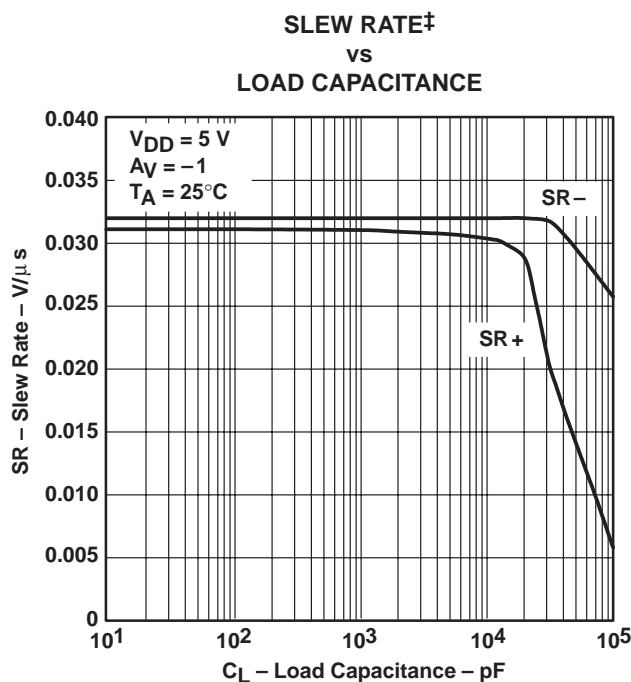


Figure 34

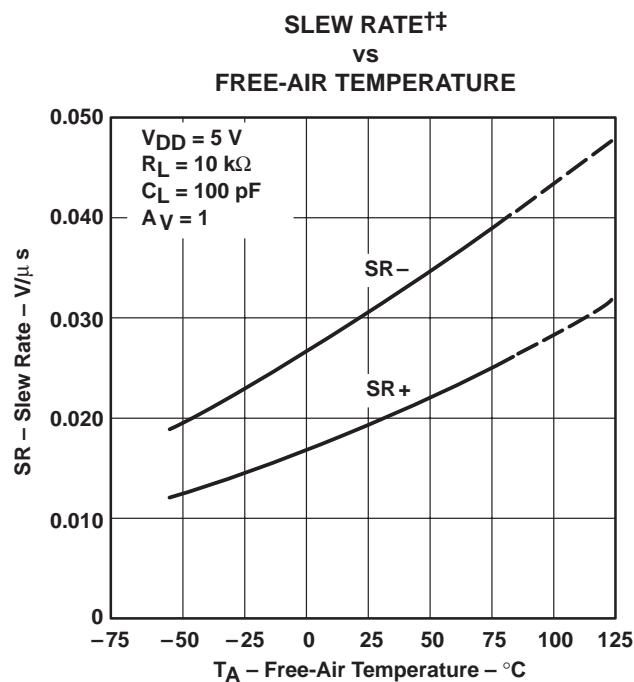


Figure 35

† Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

‡ For all curves where $V_{DD} = 5 \text{ V}$, all loads are referenced to 2.5 V. For all curves where $V_{DD} = 3 \text{ V}$, all loads are referenced to 1.5 V.

TYPICAL CHARACTERISTICS

INVERTING LARGE-SIGNAL PULSE
RESPONSE†

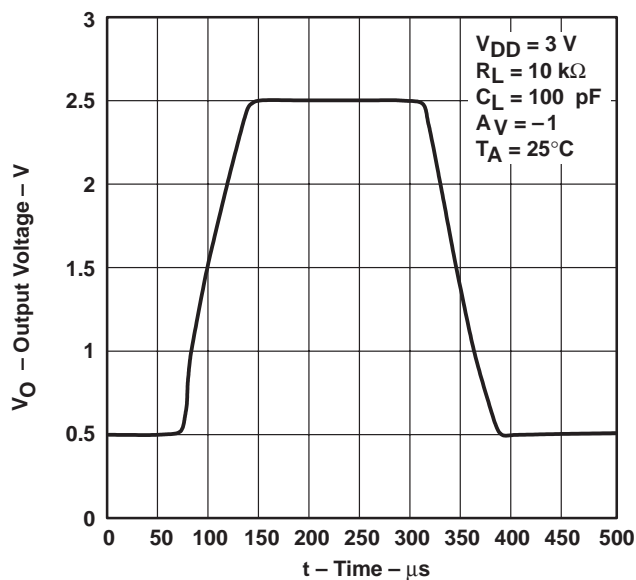


Figure 36

INVERTING LARGE-SIGNAL PULSE
RESPONSE†

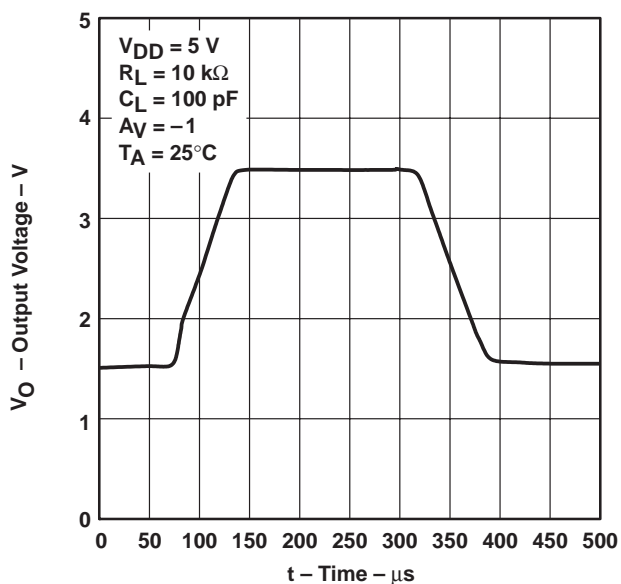


Figure 37

VOLTAGE-FOLLOWER LARGE-SIGNAL
PULSE RESPONSE†

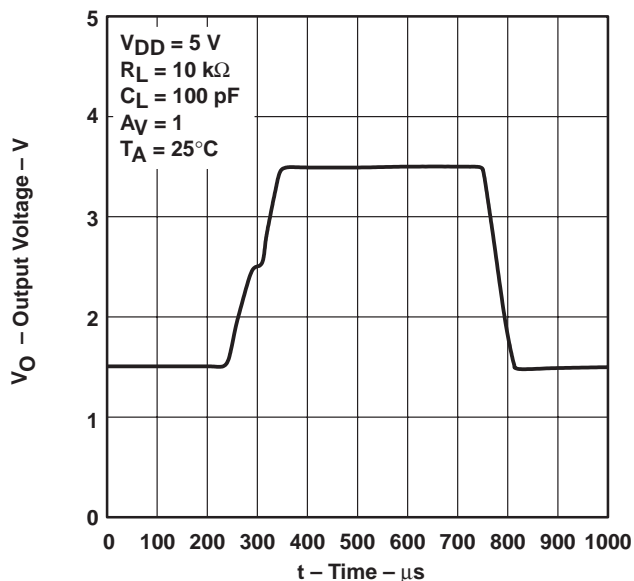


Figure 38

VOLTAGE-FOLLOWER LARGE-SIGNAL
PULSE RESPONSE†

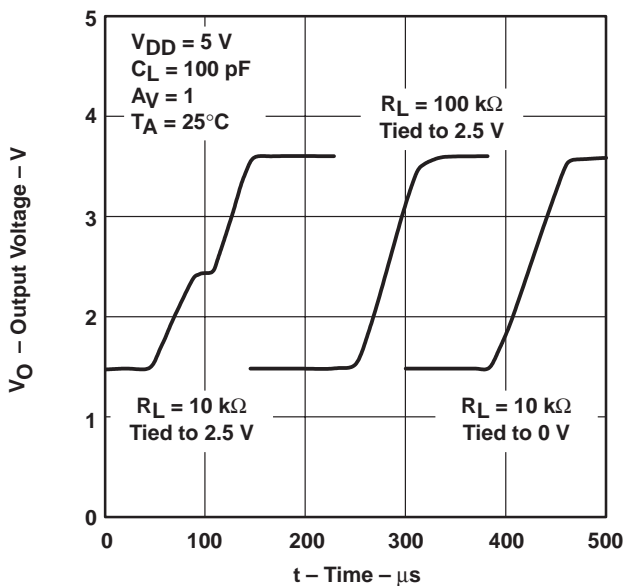


Figure 39

† For all curves where $V_{DD} = 5\text{ V}$, all loads are referenced to 2.5 V. For all curves where $V_{DD} = 3\text{ V}$, all loads are referenced to 1.5 V.

TYPICAL CHARACTERISTICS

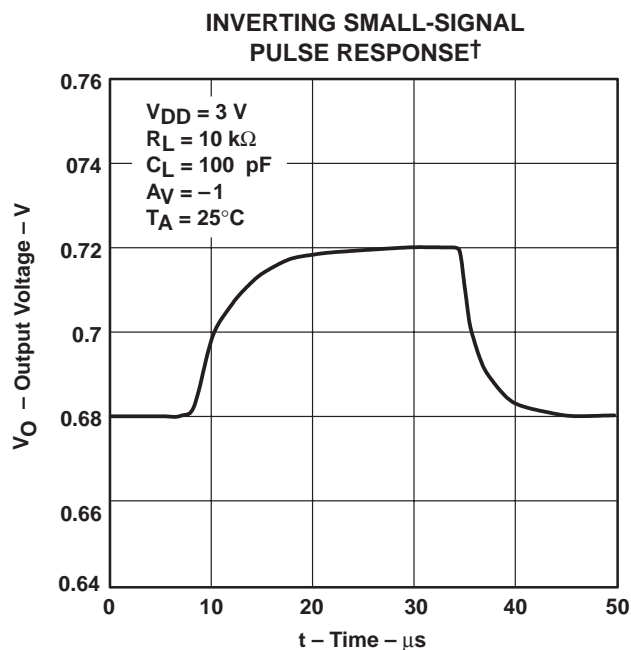


Figure 40

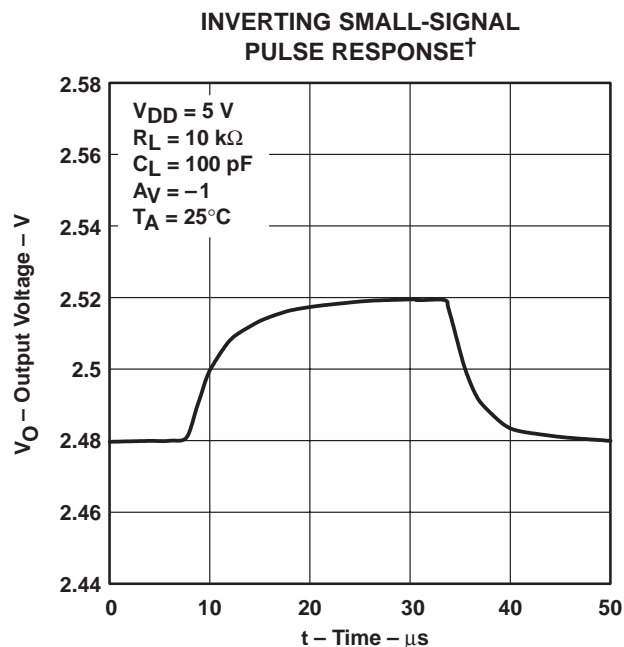


Figure 41

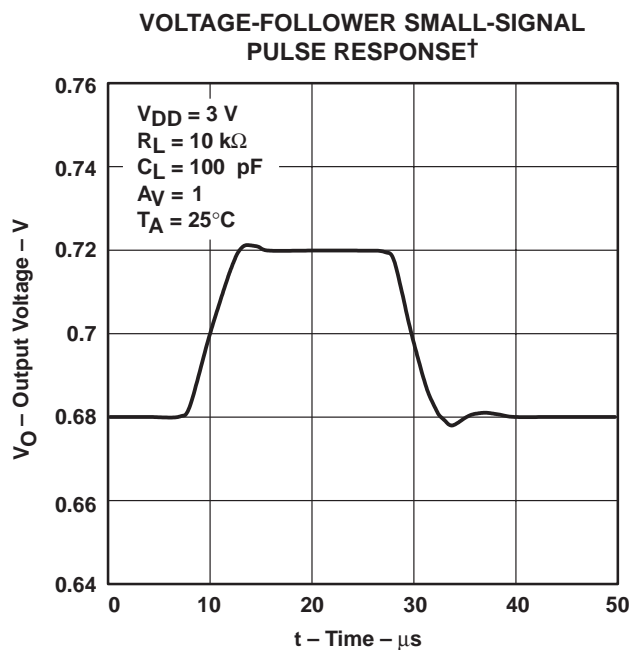


Figure 42

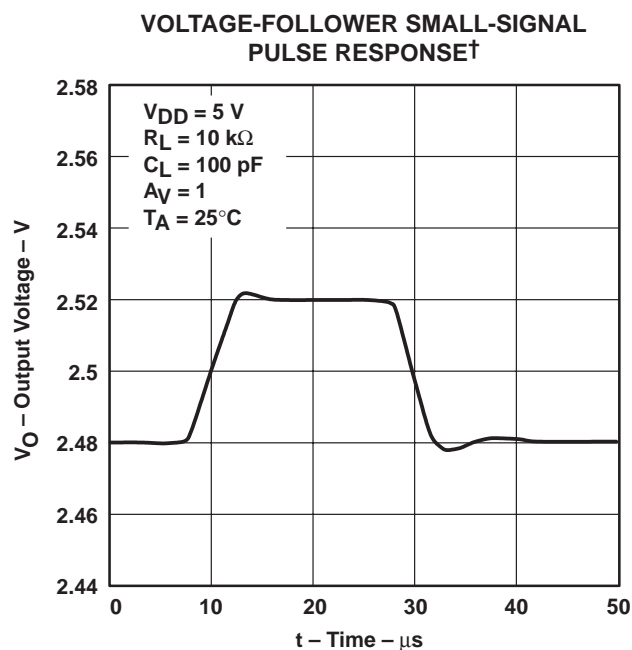


Figure 43

† For all curves where $V_{DD} = 5\text{ V}$, all loads are referenced to 2.5 V. For all curves where $V_{DD} = 3\text{ V}$, all loads are referenced to 1.5 V.

TYPICAL CHARACTERISTICS

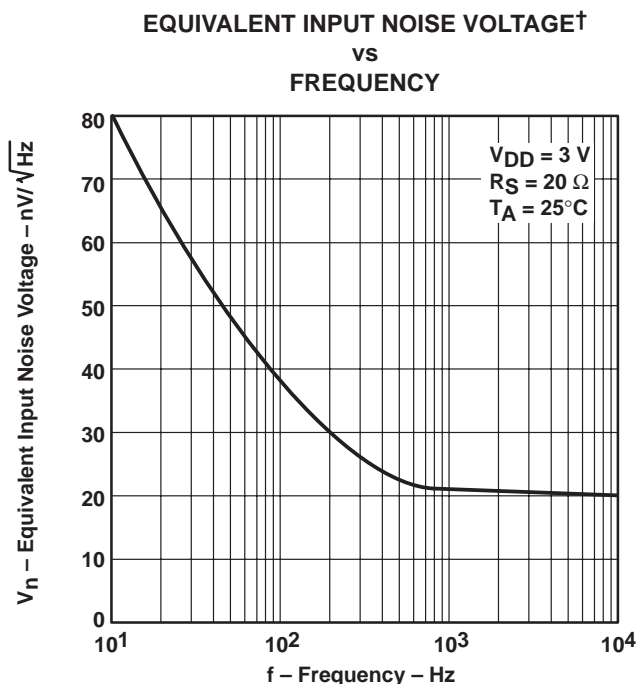


Figure 44

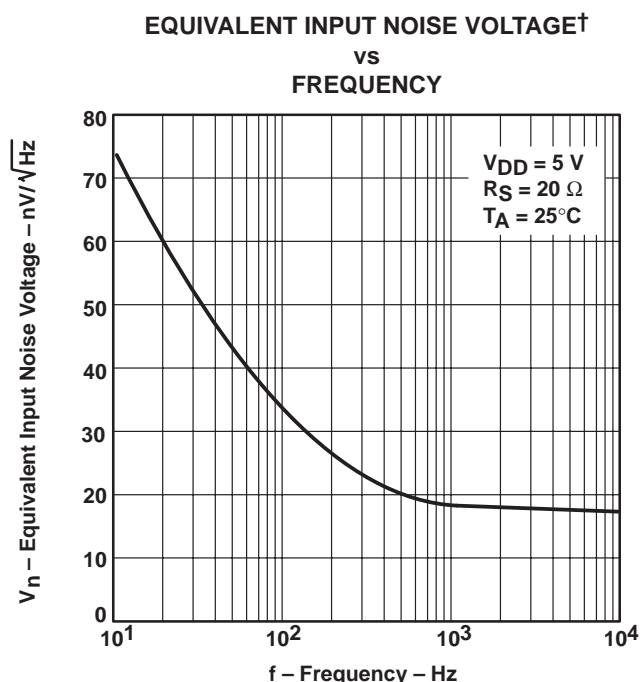


Figure 45

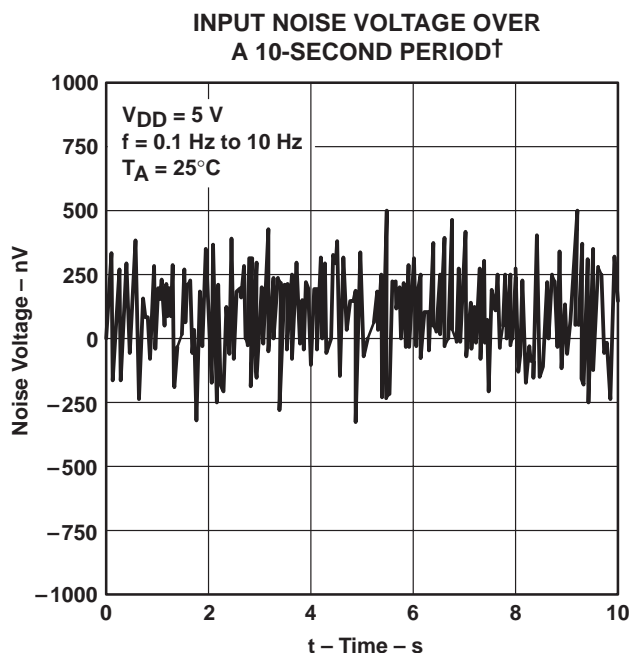


Figure 46

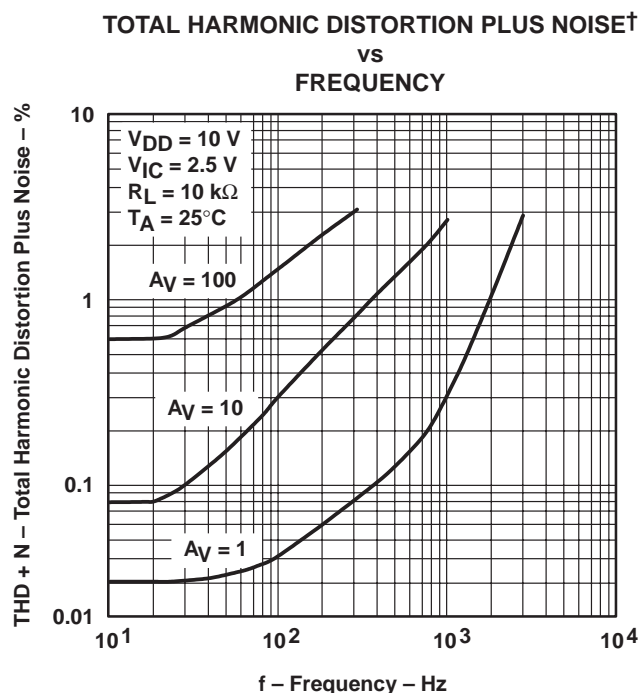


Figure 47

† For all curves where $V_{DD} = 5\text{ V}$, all loads are referenced to 2.5 V . For all curves where $V_{DD} = 3\text{ V}$, all loads are referenced to 1.5 V .

TYPICAL CHARACTERISTICS

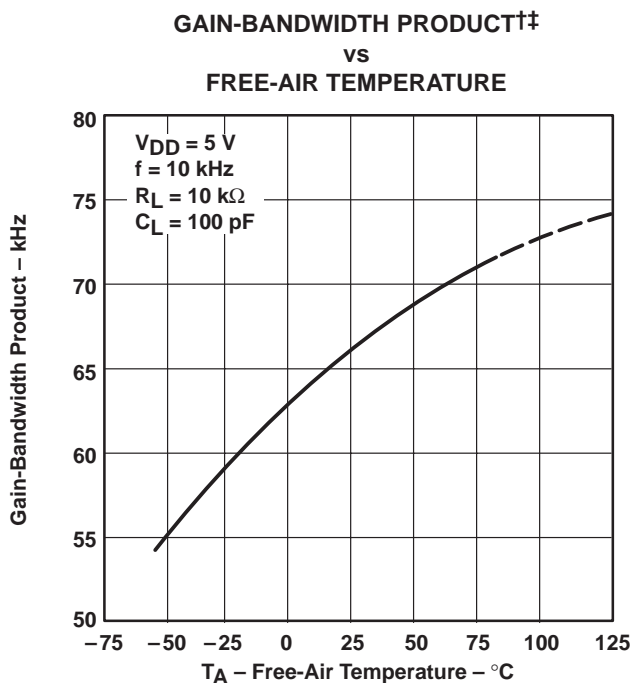


Figure 48

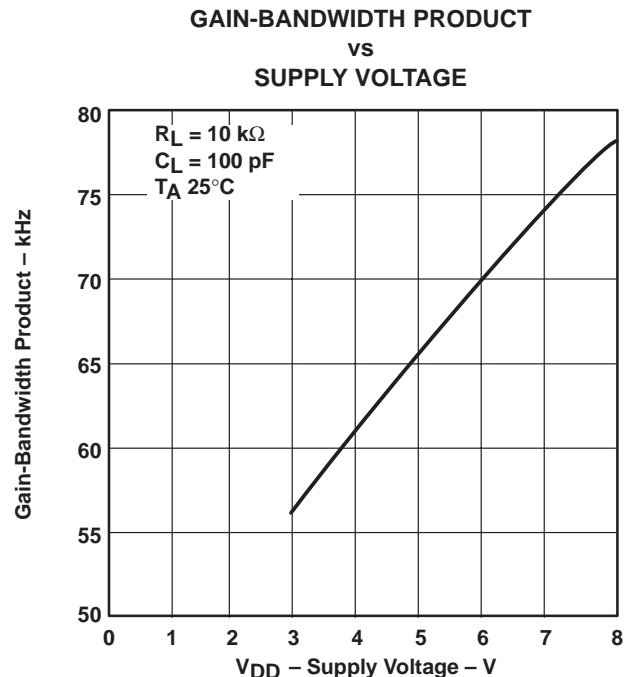


Figure 49

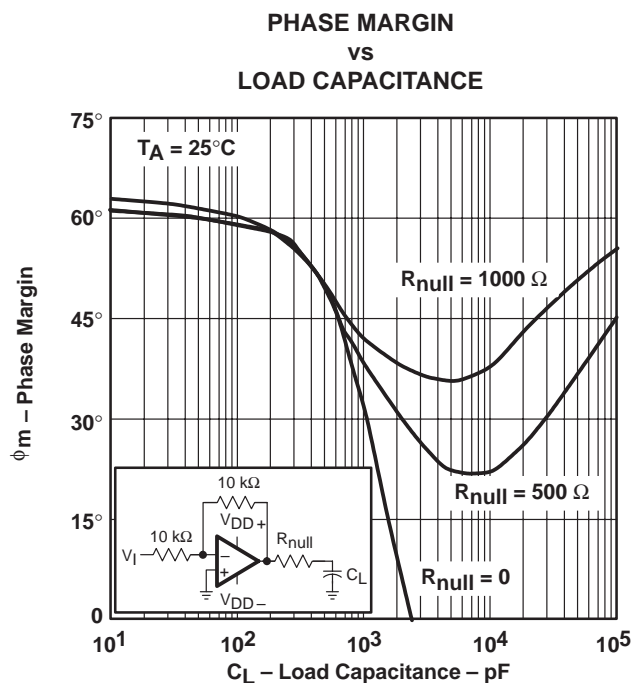


Figure 50

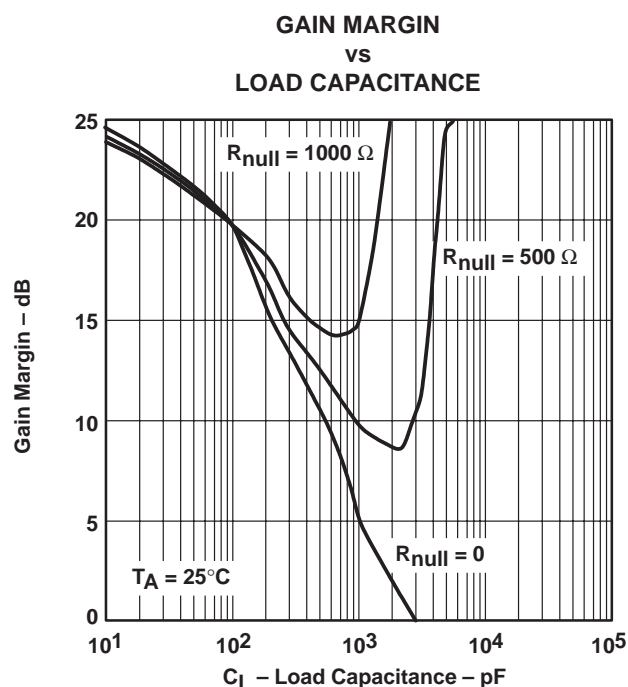


Figure 51

† Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

‡ For all curves where $V_{DD} = 5\text{ V}$, all loads are referenced to 2.5 V. For all curves where $V_{DD} = 3\text{ V}$, all loads are referenced to 1.5 V.

TYPICAL CHARACTERISTICS

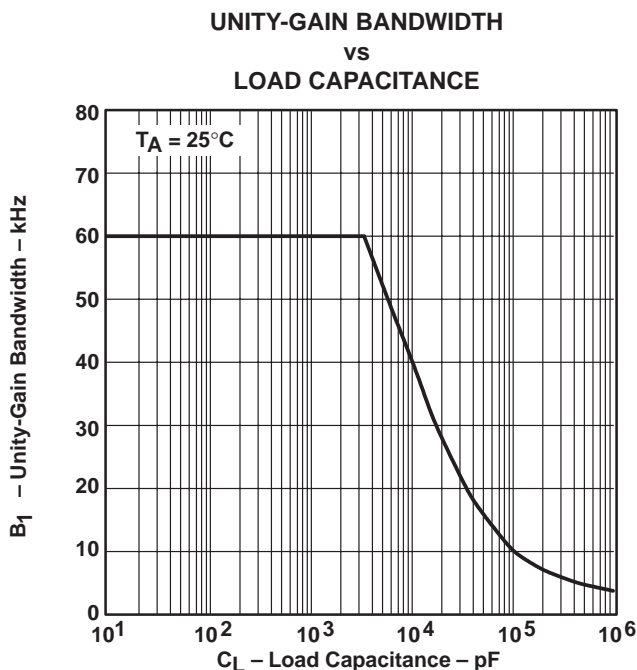


Figure 52

APPLICATION INFORMATION

driving large capacitive loads

The TLV2711 is designed to drive larger capacitive loads than most CMOS operational amplifiers. Figure 50 and Figure 51 illustrate its ability to drive loads up to 600 pF while maintaining good gain and phase margins ($R_{null} = 0$).

A smaller series resistor (R_{null}) at the output of the device (see Figure 53) improves the gain and phase margins when driving large capacitive loads. Figure 50 and Figure 51 show the effects of adding series resistances of 500 Ω and 1000 Ω . The addition of this series resistor has two effects: the first is that it adds a zero to the transfer function and the second is that it reduces the frequency of the pole associated with the output load in the transfer function.

The zero introduced to the transfer function is equal to the series resistance times the load capacitance. To calculate the improvement in phase margin, equation 1 can be used.

$$\Delta\phi_{m1} = \tan^{-1} (2 \times \pi \times \text{UGBW} \times R_{null} \times C_L) \quad (1)$$

Where :

$\Delta\phi_{m1}$ = Improvement in phase margin

UGBW = Unity-gain bandwidth frequency

R_{null} = Output series resistance

C_L = Load capacitance

APPLICATION INFORMATION

driving large capacitive loads (continued)

The unity-gain bandwidth (UGBW) frequency decreases as the capacitive load increases (see Figure 52). To use equation 1, UGBW must be approximated from Figure 52.

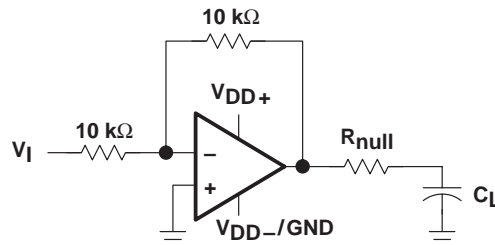


Figure 53. Series-Resistance Circuit

driving heavy dc loads

The TLV2711 is designed to provide better sinking and sourcing output currents than earlier CMOS rail-to-rail output devices. This device is specified to sink 500 μA and source 250 μA at $V_{\text{DD}} = 3\text{ V}$ and $V_{\text{DD}} = 5\text{ V}$ at a maximum quiescent I_{DD} of 25 μA . This provides a greater than 90% power efficiency.

When driving heavy dc loads, such as 10 k Ω , the positive edge under slewing conditions can experience some distortion. This condition can be seen in Figure 38. This condition is affected by three factors.

- Where the load is referenced. When the load is referenced to either rail, this condition does not occur. The distortion occurs only when the output signal swings through the point where the load is referenced. Figure 39 illustrates two 10-k Ω load conditions. The first load condition shows the distortion seen for a 10-k Ω load tied to 2.5 V. The third load condition shows no distortion for a 10-k Ω load tied to 0 V.
- Load resistance. As the load resistance increases, the distortion seen on the output decreases. Figure 39 illustrates the difference seen on the output for a 10-k Ω load and a 100-k Ω load with both tied to 2.5 V.
- Input signal edge rate. Faster input edge rates for a step input result in more distortion than with slower input edge rates.

TLV2711, TLV2711Y

Advanced LinCMOS™ RAIL-TO-RAIL

MICROPOWER SINGLE OPERATIONAL AMPLIFIERS

SLOS196A – AUGUST 1997 – REVISED MARCH 2001

APPLICATION INFORMATION

macromodel information

Macromodel information provided was derived using Microsim *Parts*™, the model generation software used with Microsim *PSpice*™. The Boyle macromodel (see Note 6) and subcircuit in Figure 54 are generated using the TLV2711 typical electrical and operating characteristics at $T_A = 25^\circ\text{C}$. 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 6: 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).

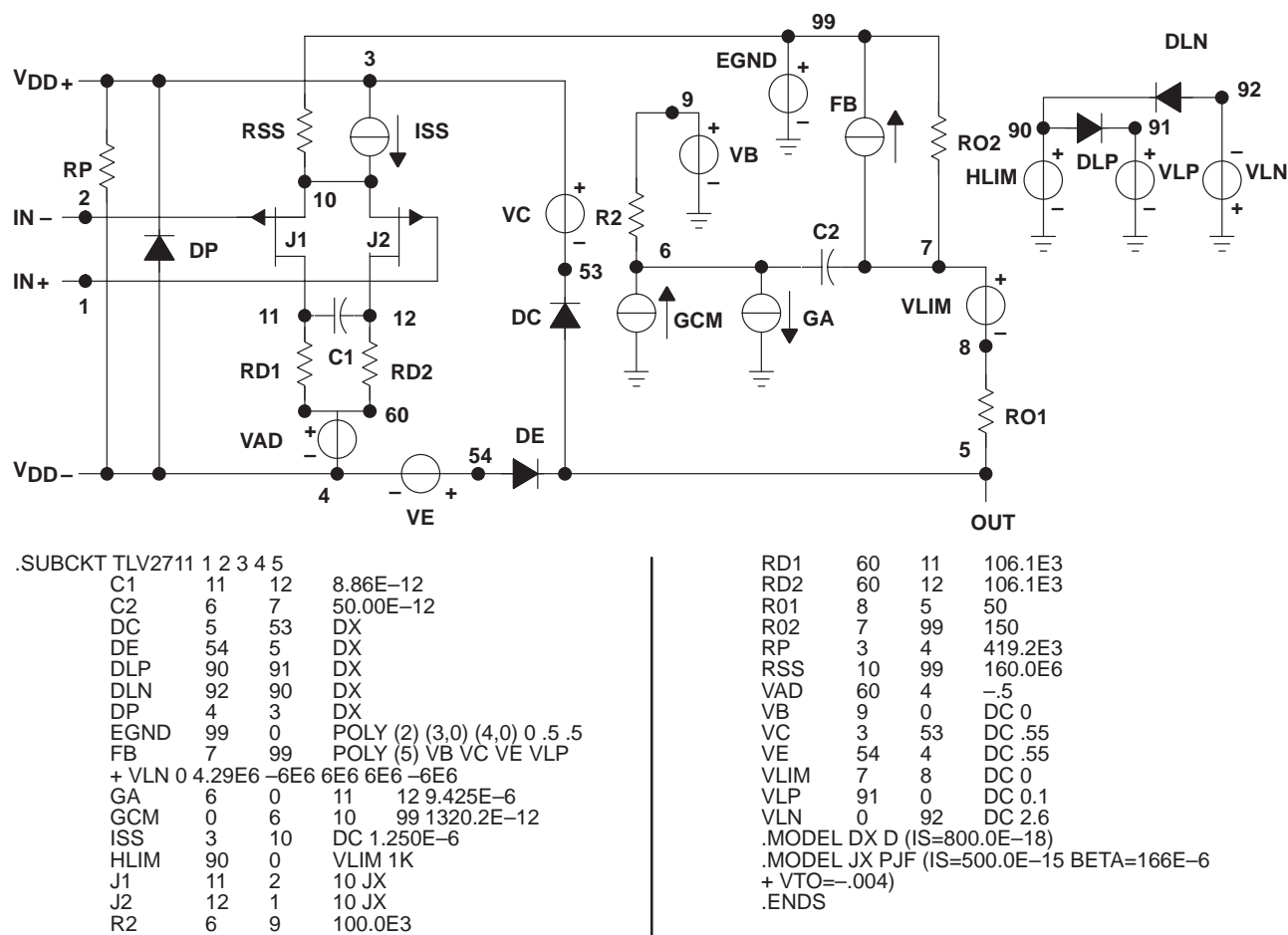


Figure 54. Boyle Macromodel and Subcircuit

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Macromodels, simulation models, or other models provided by TI, directly or indirectly, are not warranted by TI as fully representing all of the specification and operating characteristics of the semiconductor product to which the model relates.



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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)	Op Temp (°C)	Top-Side Markings (4)	Samples
TLV2711CDBV	OBSOLETE	SOT-23	DBV	5		TBD	Call TI	Call TI			
TLV2711CDBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	VAJC	Samples
TLV2711CDBVRG4	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	VAJC	Samples
TLV2711CDBVT	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM		VAJC	Samples
TLV2711CDBVTG4	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM		VAJC	Samples
TLV2711IDBV	OBSOLETE	SOT-23	DBV	5		TBD	Call TI	Call TI			
TLV2711IDBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	VAJI	Samples
TLV2711IDBVRG4	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	VAJI	Samples
TLV2711IDBVT	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM		VAJI	Samples
TLV2711IDBVTG4	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM		VAJI	Samples

(1) The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

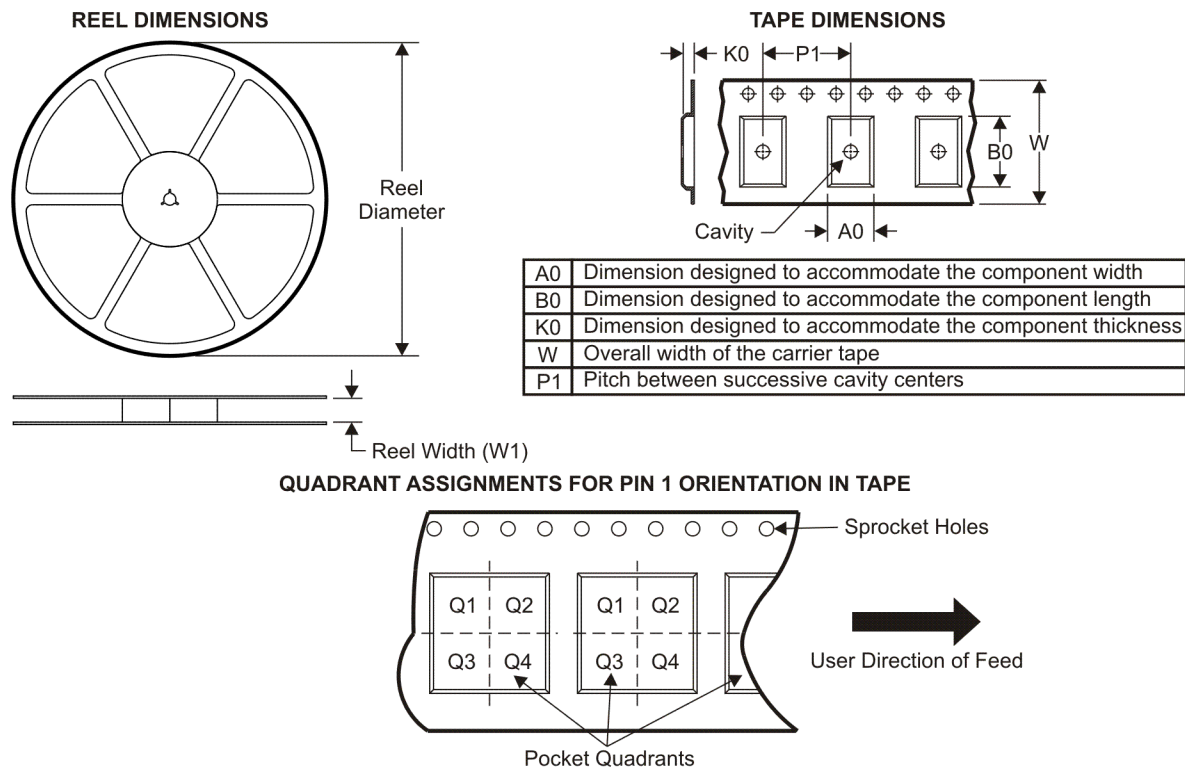
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

⁽⁴⁾ Multiple Top-Side Markings will be inside parentheses. Only one Top-Side 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 Top-Side Marking for that device.

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TAPE AND REEL INFORMATION


*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
TLV2711CDBVR	SOT-23	DBV	5	3000	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
TLV2711CDBVT	SOT-23	DBV	5	250	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
TLV2711IDBVR	SOT-23	DBV	5	3000	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
TLV2711IDBVT	SOT-23	DBV	5	250	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3

TAPE AND REEL BOX DIMENSIONS

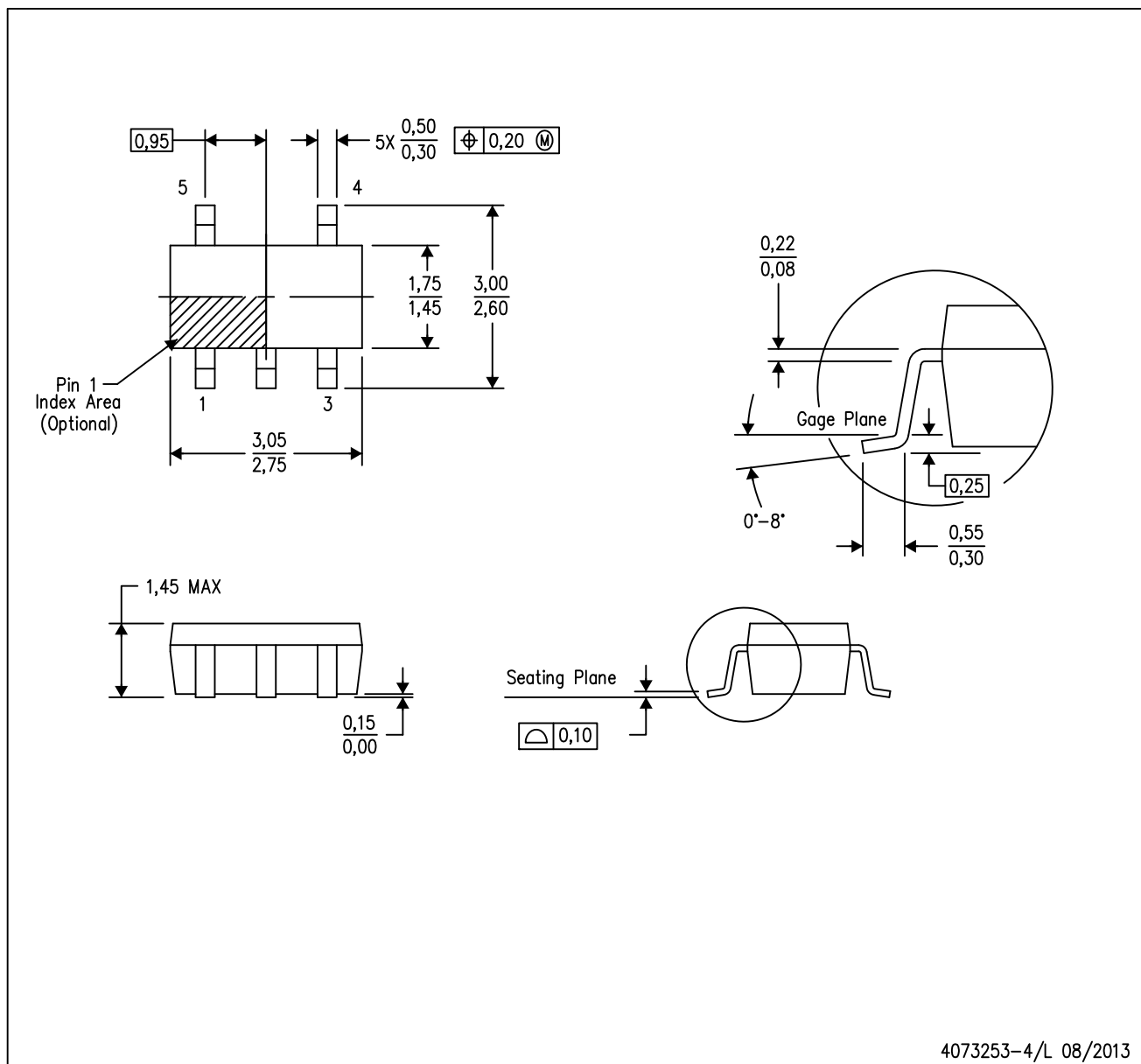


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TLV2711CDBVR	SOT-23	DBV	5	3000	180.0	180.0	18.0
TLV2711CDBVT	SOT-23	DBV	5	250	180.0	180.0	18.0
TLV2711IDBVR	SOT-23	DBV	5	3000	180.0	180.0	18.0
TLV2711IDBVT	SOT-23	DBV	5	250	180.0	180.0	18.0

DBV (R-PDSO-G5)

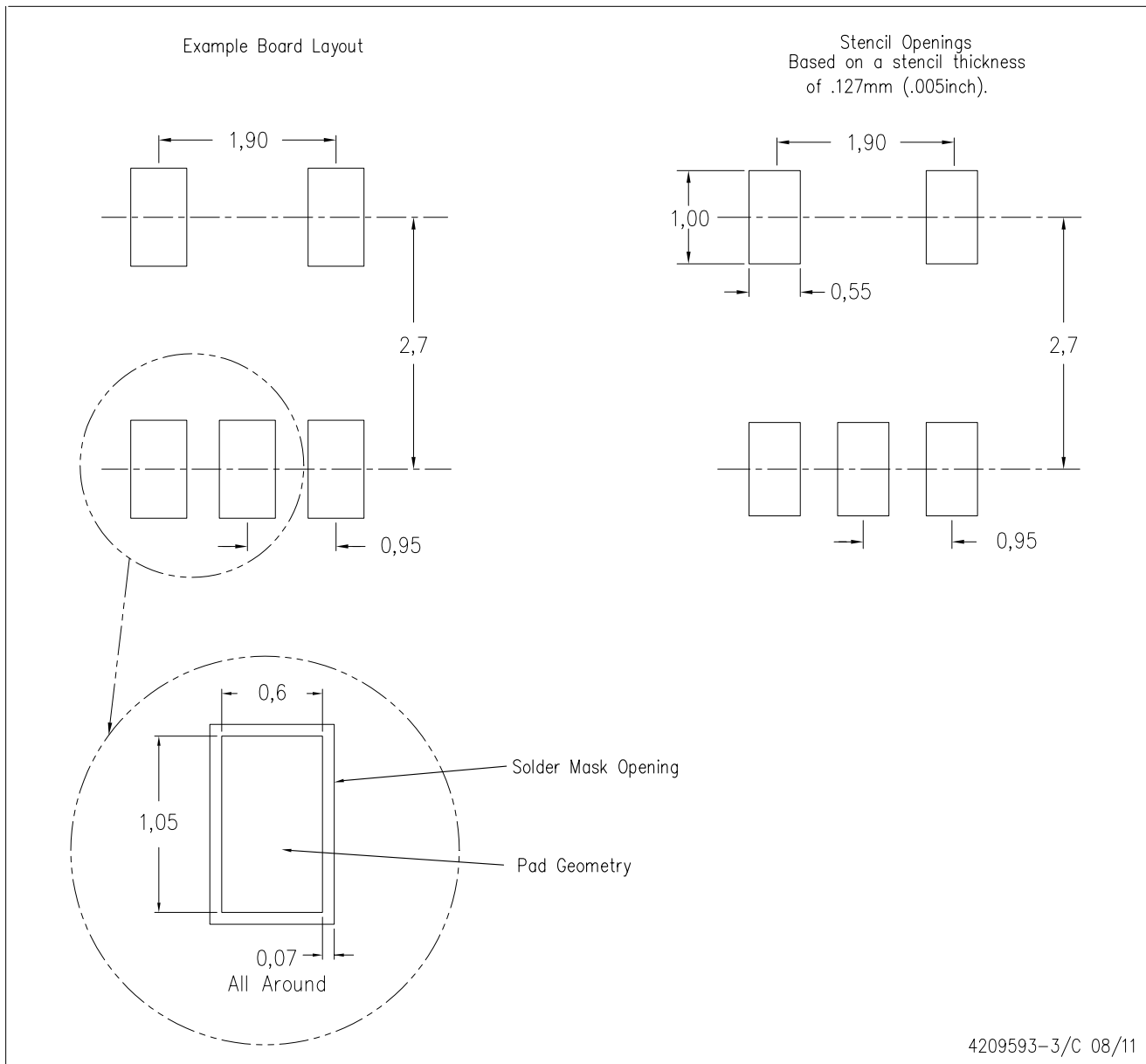
PLASTIC SMALL-OUTLINE PACKAGE



- 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. Mold flash and protrusion shall not exceed 0.15 per side.
 - D. Falls within JEDEC MO-178 Variation AA.

DBV (R-PDSO-G5)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
 - D. Publication IPC-7351 is recommended for alternate designs.
 - E. 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. Example stencil design based on a 50% volumetric metal load solder paste. Refer to IPC-7525 for other stencil recommendations.

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