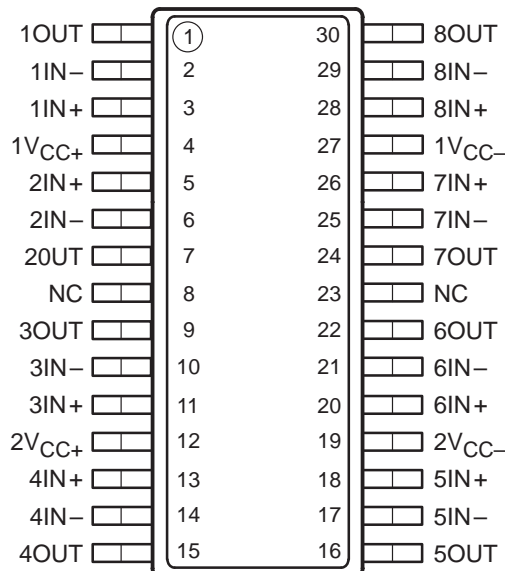


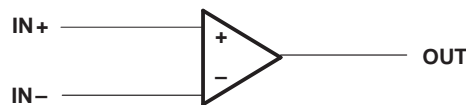
- **Trimmed Offset Voltage**
10 mV Max at $T_A = 25^\circ\text{C}$, $V_{DD} = 5\text{ V}$
- **Input Offset Voltage Drift . . . Typically**
0.1 $\mu\text{V}/\text{Month}$, Including the First 30 Days
- **Wide Range of Supply Voltages**
3 V to 16 V
- **Single-Supply Operation**
- **Common-Mode Input Voltage Range**
Extends Below the Negative Rail
- **Low Noise . . . Typically** 25 nV/ $\sqrt{\text{Hz}}$
at $f = 1\text{ kHz}$
- **Output Voltage Range Includes Negative Rail**
- **ESD-Protection Circuitry**
- **Small-Outline Package Option Also Available in Tape and Reel**
- **Designed-In Latch-Up Immunity**

DB PACKAGE
(TOP VIEW)



NC – No internal connection

symbol (each amplifier)



description

The TLC274x2 octal operational amplifier incorporates low offset-voltage drift, high input impedance, low noise, and speeds approaching that of general-purpose BiFET devices into a single package. This device uses Texas Instruments silicon-gate LinCMOS™ technology, which provides offset voltage stability far exceeding the stability available with conventional metal-gate processes.

The extremely high input impedance, low bias currents, and high slew rates make this a cost-effective device ideal for applications that have previously been reserved for BiFET and NFET products. These advantages, in combination with good common-mode rejection and supply-voltage rejection, make this device a good choice for new state-of-the-art designs as well as for upgrading existing designs.

In general, many features associated with bipolar technology are available on LinCMOS™ operational amplifiers without the power penalties of bipolar technology. General applications such as transducer interfacing, analog calculations, amplifier blocks, active filters, and signal buffering are easily designed with the TLC274x2. The device also exhibits low-voltage single-supply operation, making them ideally suited for remote and inaccessible battery-powered applications. The common-mode input voltage range includes the negative rail. The device inputs and outputs are designed to withstand –100-mA surge currents without sustaining latch-up.

AVAILABLE OPTION

T_A	V_{IOmax} AT 25°C	PACKAGE
		SMALL OUTLINE (DB)†
0°C to 70°C	10 mV	TLC274x2DBLE

† The DB package is only available left-end taped and reeled.

LinCMOS is a trademark of Texas Instruments Incorporated.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.



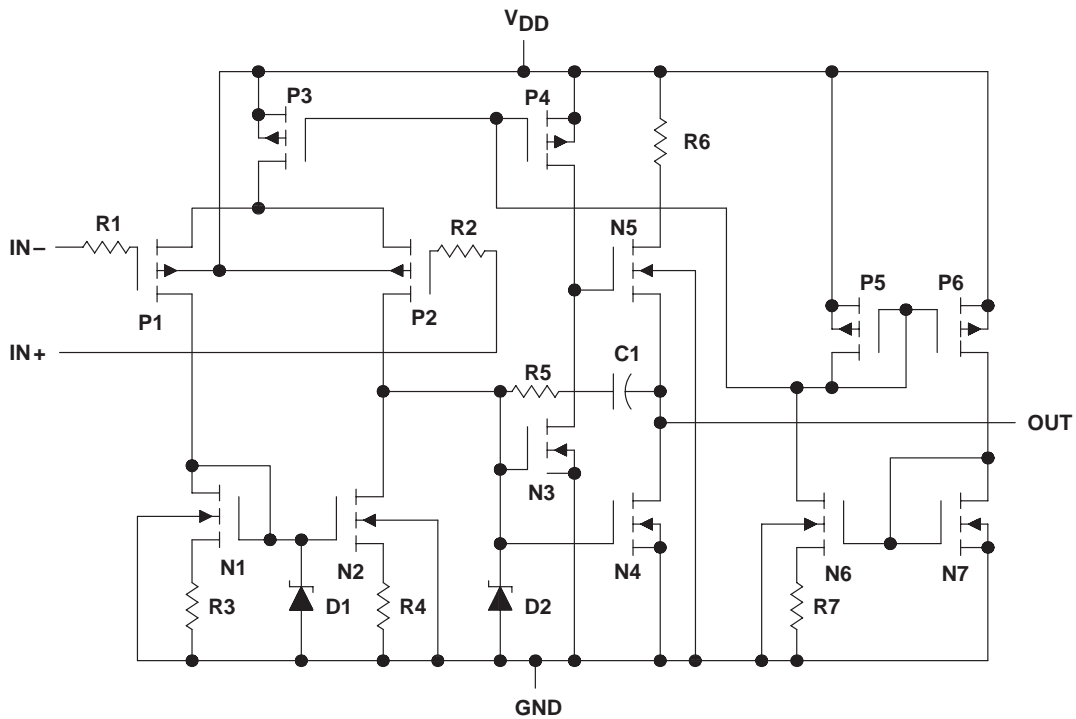
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description (continued)

The TLC274x2 incorporates internal ESD-protection circuits that prevent functional failures at voltages up to 2000 V as tested under MIL-STD-883C, Method 3015.2; however, exercise care in handling this device as exposure to ESD can result in the degradation of the device parametric performance.

The TLC274x2 is characterized for operation from 0°C to 70°C.

equivalent schematic (each amplifier)



COMPONENT COUNT	
Resistors	56
Transistors	80
Diodes	16
Capacitors	8

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

Supply voltage, V_{DD} (see Note 1)	18 V
Differential input voltage, V_{ID} (see Note 2)	$V_{DD} \pm$
Input voltage range, V_I (any input)	-0.3 V to V_{DD}
Input current, I_I	± 5 mA
Output current, I_O (each output)	± 30 mA
Total current into V_{DD}	45 mA
Total current out of GND	45 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, T_A	0°C to 70°C
Storage temperature range	-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 network ground.
 2. Differential voltages are at IN+ with respect to IN-.
 3. The output can be shorted to either supply. Temperature and/or supply voltages must be limited to ensure that the maximum dissipation rating is not exceeded (see application section).

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
DB	1024 mW	8.2 mW/°C	655 mW

recommended operating conditions

		MIN	MAX	UNIT
Supply voltage, V_{DD}		3	16	V
Common-mode input voltage, V_{IC}	$V_{DD} = 5$ V	-0.2	3.5	V
	$V_{DD} = 10$ V	-0.2	8.5	
Operating free-air temperature, T_A		0	70	°C

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

PARAMETER		TEST CONDITIONS		T_A^\dagger	MIN	TYP	MAX	UNIT
V_{IO}	Input offset voltage	$V_O = 1.4\text{ V}$, $R_S = 50\ \Omega$,	$V_{IC} = 0$, $R_L = 10\text{ k}\Omega$	25°C	1.1		10	mV
				Full range			12	
α_{VIO}	Average temperature coefficient of input offset voltage			25°C to 70°C		1.8		$\mu\text{V}/^\circ\text{C}$
I_{IO}	Input offset current (see Note 4)	$V_O = 2.5\text{ V}$,	$V_{IC} = 2.5\text{ V}$	25°C	0.1			pA
				70°C	7	300		
I_{IB}	Input bias current (see Note 4)	$V_O = 2.5\text{ V}$,	$V_{IC} = 2.5\text{ V}$	25°C	0.6			pA
				70°C	40	600		
V_{ICR}	Common-mode input voltage range (see Note 5)			25°C	-0.2 to 4	-0.3 to 4.2		V
				Full range	-0.2 to 3.5			V
V_{OH}	High-level output voltage	$V_{ID} = 100\text{ mV}$,	$R_L = 10\text{ k}\Omega$	25°C	3.2	3.8		V
				0°C	3	3.8		
				70°C	3	3.8		
V_{OL}	Low-level output voltage	$V_{ID} = -100\text{ mV}$,	$I_{OL} = 0$	25°C		0	50	mV
				0°C		0	50	
				70°C		0	50	
A_{VD}	Large-signal differential voltage amplification	$V_O = 0.25\text{ V to }2\text{ V}$,	$R_L = 10\text{ k}\Omega$	25°C	5	23		V/mV
				0°C	4	27		
				70°C	4	20		
CMRR	Common-mode rejection ratio	$V_{IC} = V_{ICRmin}$		25°C	65	80		dB
				0°C	60	84		
				70°C	60	85		
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{DD}/\Delta V_{IO}$)	$V_{DD} = 5\text{ V to }10\text{ V}$,	$V_O = 1.4\text{ V}$	25°C	65	95		dB
				0°C	60	94		
				70°C	60	96		
I_{DD}	Supply current (four amplifiers)	$V_O = 2.5\text{ V}$, No load	$V_{IC} = 2.5\text{ V}$,	25°C	2.7	6.4		mA
				0°C	3.1	7.2		
				70°C	2.3	5.2		

† Full range is 0°C to 70°C.

- NOTES: 4. The typical values of input bias current and input offset current below 5 pA were determined mathematically.
 5. This range also applies to each input individually.

electrical characteristics at specified free-air temperature, $V_{DD} = 10\text{ V}$ (unless otherwise noted)

PARAMETER		TEST CONDITIONS		T_A^\dagger	MIN	TYP	MAX	UNIT
V_{IO}	Input offset voltage	$V_O = 1.4\text{ V}$, $R_S = 50\ \Omega$,	$V_{IC} = 0$, $R_L = 10\text{ k}\Omega$	25°C	1.1		10	mV
				Full range			12	
α_{VIO}	Average temperature coefficient of input offset voltage			25°C to 70°C		2		$\mu\text{V}/^\circ\text{C}$
I_{IO}	Input offset current (see Note 4)	$V_O = 0.5\text{ V}$,	$V_{IC} = 5\text{ V}$	25°C	0.1			pA
				70°C	7	300		
I_{IB}	Input bias current (see Note 4)	$V_O = 5\text{ V}$,	$V_{IC} = 5\text{ V}$	25°C	0.7			pA
				70°C	50	600		
V_{ICR}	Common-mode input voltage range (see Note 5)			25°C	-0.2 to 9	-0.3 to 9.2		V
				Full range	-0.2 to 8.5			V
V_{OH}	High-level output voltage	$V_{ID} = 100\text{ mV}$,	$R_L = 10\text{ k}\Omega$	25°C	8	8.5		V
				0°C	7.8	8.5		
				70°C	7.8	8.4		
V_{OL}	Low-level output voltage	$V_{ID} = -100\text{ mV}$,	$I_{OL} = 0$	25°C		0	50	mV
				0°C		0	50	
				70°C		0	50	
A_{VD}	Large-signal differential voltage amplification	$V_O = 1\text{ V to }6\text{ V}$,	$R_L = 10\text{ k}\Omega$	25°C	10	36		V/mV
				0°C	7.5	42		
				70°C	7.5	32		
CMRR	Common-mode rejection ratio	$V_{IC} = V_{ICRmin}$		25°C	65	85		dB
				0°C	60	88		
				70°C	60	88		
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{DD}/\Delta V_{IO}$)	$V_{DD} = 5\text{ V to }10\text{ V}$,	$V_O = 1.4\text{ V}$	25°C	65	95		dB
				0°C	60	94		
				70°C	60	96		
I_{DD}	Supply current (four amplifiers)	$V_O = 5\text{ V}$, No load	$V_{IC} = 5\text{ V}$,	25°C	3.8	8		mA
				0°C	4.5	8.8		
				70°C	3.2	6.8		

† Full range is 0°C to 70°C.

- NOTES: 4. The typical values of input bias current and input offset current below 5 pA were determined mathematically.
 5. This range also applies to each input individually.

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

PARAMETER		TEST CONDITIONS		T_A	MIN	TYP	MAX	UNIT
SR	Slew rate at unity gain	$R_L = 10\ \Omega$, $C_L = 20\ \text{pF}$, See Figure 1	$V_{I(PP)} = 1\ \text{V}$	25°C		3.6		V/ μs
				0°C		4		
				70°C		3		
			$V_{I(PP)} = 2.5\ \text{V}$	25°C		2.9		
				0°C		3.1		
				70°C		2.5		
V_n	Equivalent input noise voltage	$f = 1\ \text{kHz}$, See Figure 2	$R_S = 20\ \Omega$,	25°C		25		nV/ $\sqrt{\text{Hz}}$
B_{OM}	Maximum output-swing bandwidth	$V_O = V_{OH}$, $R_L = 10\ \text{k}\Omega$,	$C_L = 20\ \text{pF}$, See Figure 1	25°C		320		kHz
				0°C		340		
				70°C		260		
B_1	Unity-gain bandwidth	$V_I = 10\ \text{mV}$, See Figure 3	$C_L = 20\ \text{pF}$,	25°C		1.7		MHz
				0°C		2		
				70°C		1.3		
ϕ_m	Phase margin	$V_I = 10\ \text{mV}$, $C_L = 20\ \text{pF}$,	$f = B_1$,	25°C		46°		
				0°C		47°		
				70°C		44°		

operating characteristics at specified free-air temperature, $V_{DD} = 10\ \text{V}$

PARAMETER		TEST CONDITIONS		T_A	MIN	TYP	MAX	UNIT
SR	Slew rate at unity gain	$R_L = 10\ \Omega$, $C_L = 20\ \text{pF}$, See Figure 1	$V_{I(PP)} = 1\ \text{V}$	25°C		5.3		V/ μs
				0°C		5.9		
				70°C		4.3		
			$V_{I(PP)} = 5.5\ \text{V}$	25°C		4.6		
				0°C		5.1		
				70°C		3.8		
V_n	Equivalent input noise voltage	$f = 1\ \text{kHz}$, See Figure 2	$R_S = 20\ \Omega$,	25°C		25		nV/ $\sqrt{\text{Hz}}$
B_{OM}	Maximum output-swing bandwidth	$V_O = V_{OH}$, $R_L = 10\ \text{k}\Omega$,	$C_L = 20\ \text{pF}$, See Figure 1	25°C		200		kHz
				0°C		220		
				70°C		140		
B_1	Unity-gain bandwidth	$V_I = 10\ \text{mV}$, See Figure 3	$C_L = 20\ \text{pF}$,	25°C		2.2		MHz
				0°C		2.5		
				70°C		1.8		
ϕ_m	Phase margin	$V_I = 10\ \text{mV}$, $C_L = 20\ \text{pF}$,	$f = B_1$, See Figure 3	25°C		49°		
				0°C		50°		
				70°C		46°		



PARAMETER MEASUREMENT INFORMATION

single-supply versus split-supply test circuits

Because the TLC274x2 is optimized for single-supply operation, circuit configurations used for the various tests often present some inconvenience since the input signal, in many cases, must be offset from ground. This inconvenience can be avoided by testing the device with split supplies and the output load tied to the negative rail. A comparison of single-supply versus split-supply test circuits is shown below. The use of either circuit gives the same result.

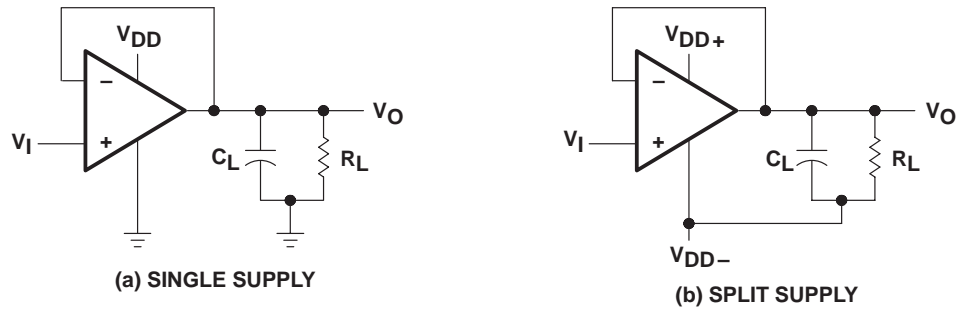


Figure 1. Unity-Gain Amplifier

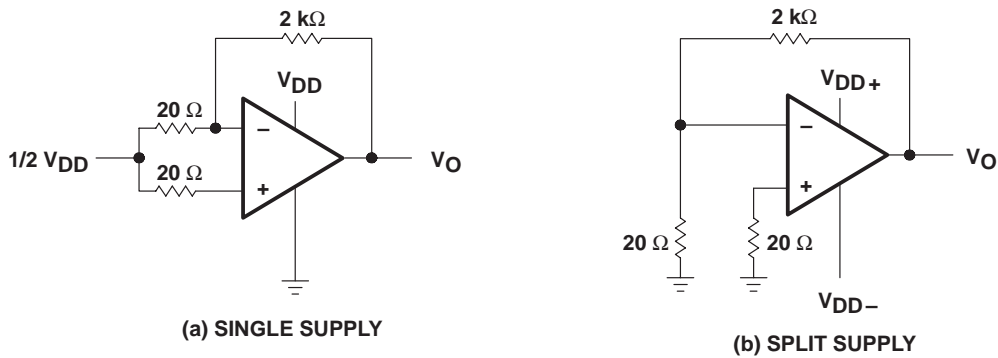


Figure 2. Noise-Test Circuit

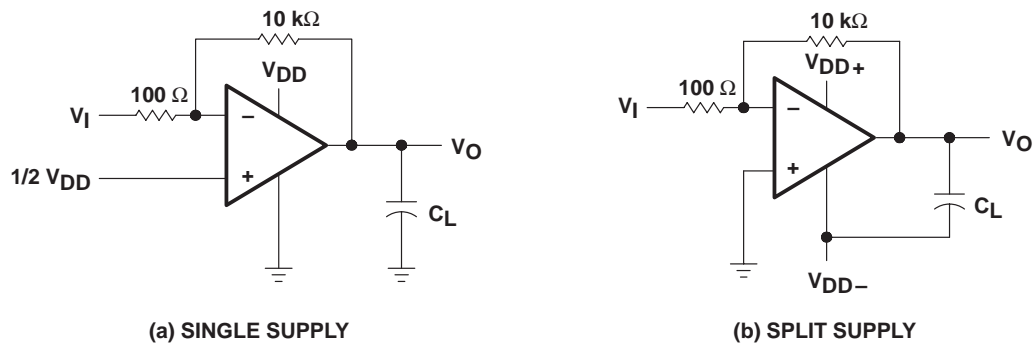


Figure 3. Gain-of-100 Inverting Amplifier

TYPICAL CHARACTERISTICS

Table of Graphs

		FIGURE
V _{OH}	High-level output voltage	vs High-level output current
		vs Supply voltage
		vs Free-air temperature
V _{OL}	Low-level output voltage	vs Common-mode input voltage
		vs Differential input voltage
		vs Free-air temperature
		vs Low-level output current
A _{VD}	Large-signal differential voltage amplification	vs Supply voltage
		vs Free-air temperature
		vs Frequency
I _{IB}	Input bias current	vs Free-air temperature
I _{IO}	Input offset current	vs Free-air temperature
V _{IC}	Common-mode input voltage	vs Supply voltage
I _{DD}	Supply current	vs Supply voltage
		vs Free-air temperature
SR	Slew rate	vs Supply voltage
		vs Free-air temperature
	Normalized slew rate	vs Free-air temperature
V _{O(PP)}	Maximum peak-to-peak output voltage	vs Frequency
B ₁	Unity-gain bandwidth	vs Free-air temperature
		vs Supply voltage
φ _m	Phase margin	vs Supply voltage
		vs Free-air temperature
		vs Load capacitance
V _n	Equivalent input noise voltage	vs Frequency
		Phase shift
		vs Frequency

TYPICAL CHARACTERISTICS

HIGH-LEVEL OUTPUT VOLTAGE
 vs
 HIGH-LEVEL OUTPUT CURRENT

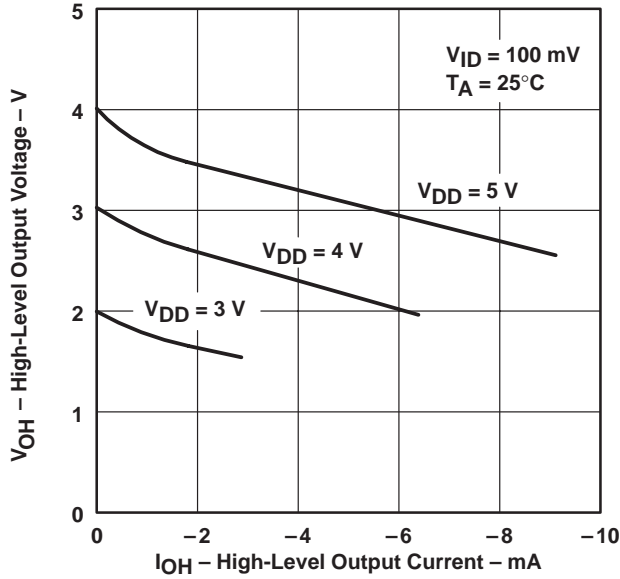


Figure 4

HIGH-LEVEL OUTPUT VOLTAGE
 vs
 HIGH-LEVEL OUTPUT CURRENT

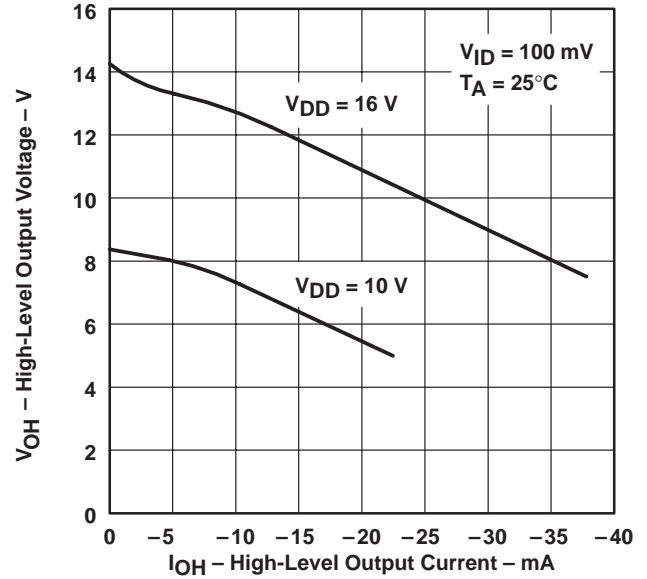


Figure 5

HIGH-LEVEL OUTPUT VOLTAGE
 vs
 SUPPLY VOLTAGE

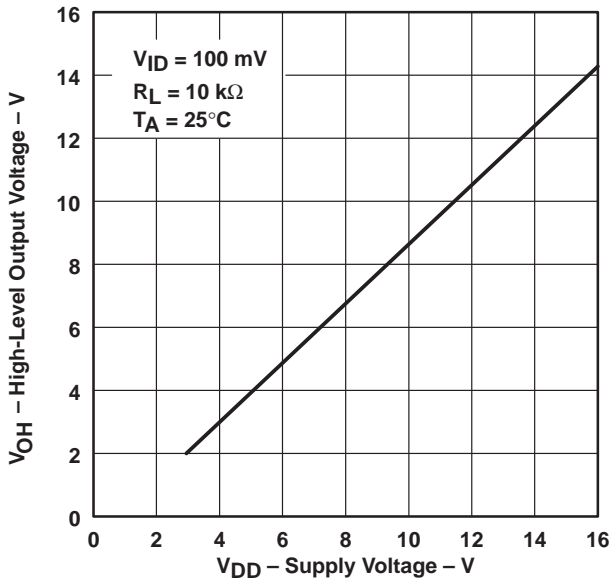


Figure 6

HIGH-LEVEL OUTPUT VOLTAGE
 vs
 FREE-AIR TEMPERATURE

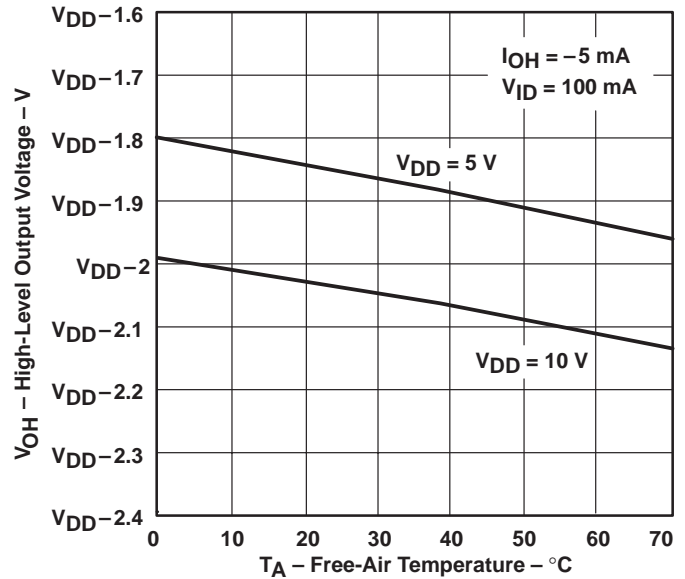


Figure 7

TYPICAL CHARACTERISTICS

LOW-LEVEL OUTPUT VOLTAGE
 vs
 COMMON-MODE INPUT VOLTAGE

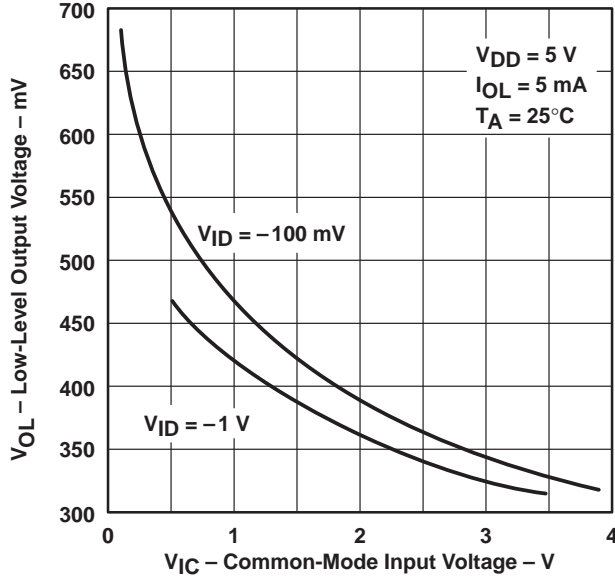


Figure 8

LOW-LEVEL OUTPUT VOLTAGE
 vs
 COMMON-MODE INPUT VOLTAGE

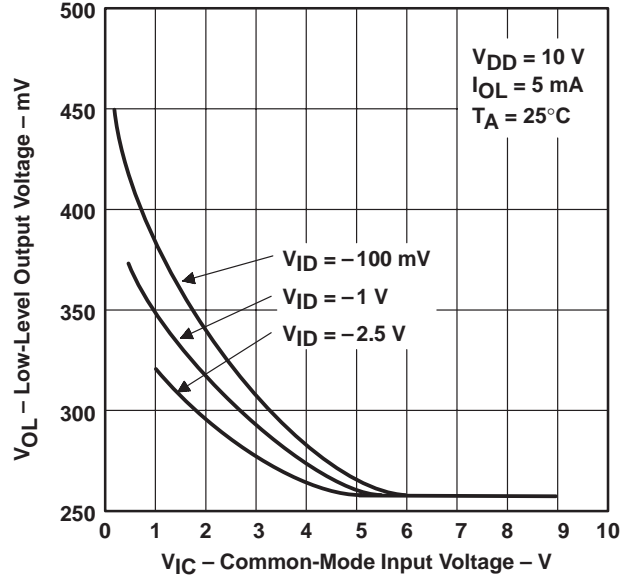


Figure 9

LOW-LEVEL OUTPUT VOLTAGE
 vs
 DIFFERENTIAL INPUT VOLTAGE

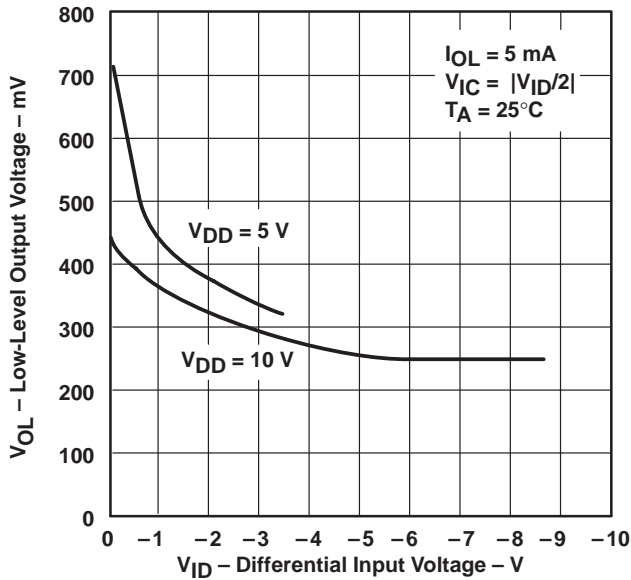


Figure 10

LOW-LEVEL OUTPUT VOLTAGE
 vs
 FREE-AIR TEMPERATURE

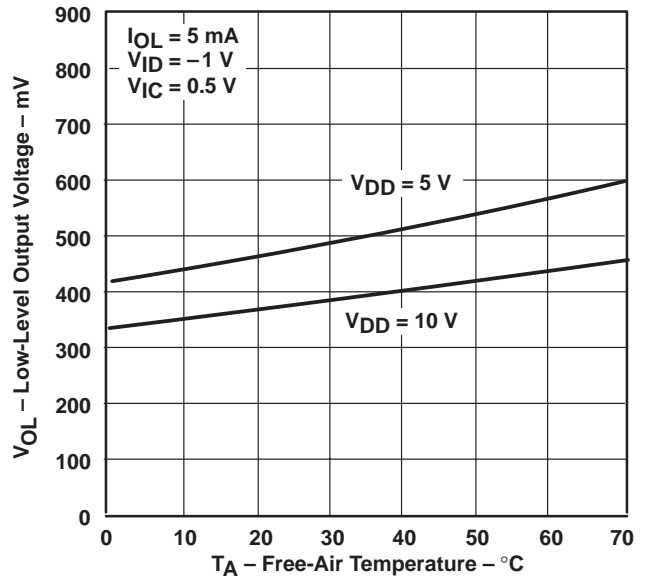


Figure 11

TYPICAL CHARACTERISTICS

LOW-LEVEL OUTPUT VOLTAGE
 vs
 LOW-LEVEL OUTPUT CURRENT

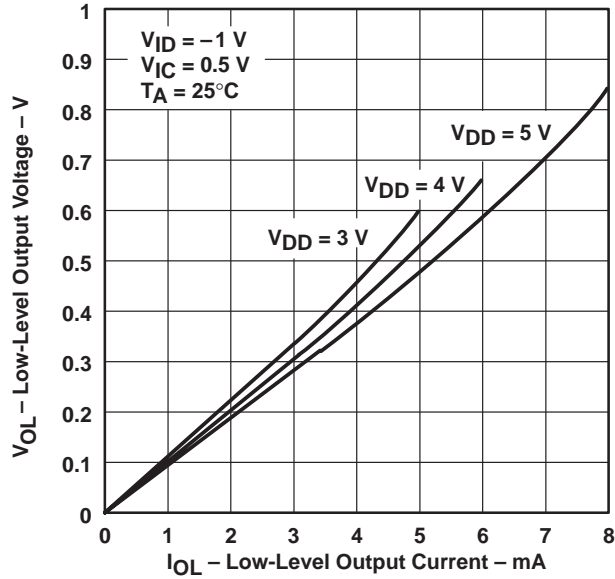


Figure 12

LOW-LEVEL OUTPUT VOLTAGE
 vs
 LOW-LEVEL OUTPUT CURRENT

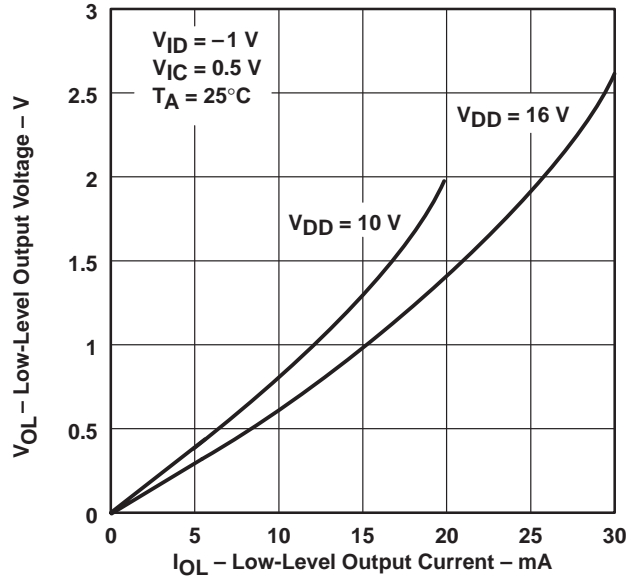


Figure 13

LARGE-SIGNAL
 DIFFERENTIAL VOLTAGE AMPLIFICATION
 vs
 SUPPLY VOLTAGE

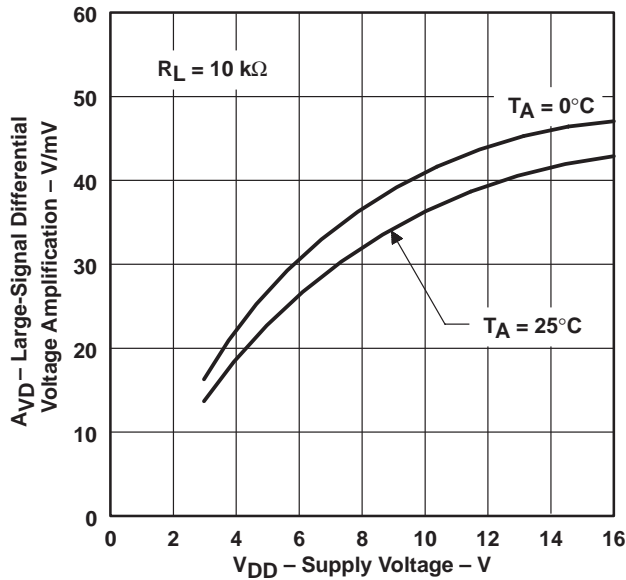


Figure 14

LARGE-SIGNAL
 DIFFERENTIAL VOLTAGE AMPLIFICATION
 vs
 FREE-AIR TEMPERATURE

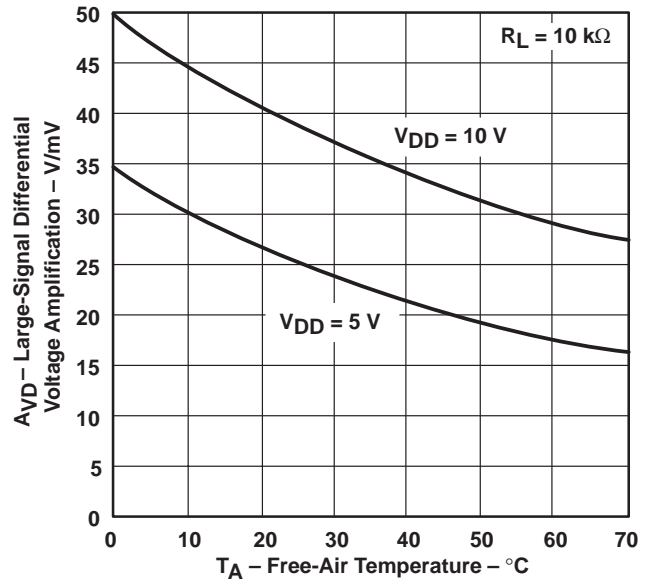
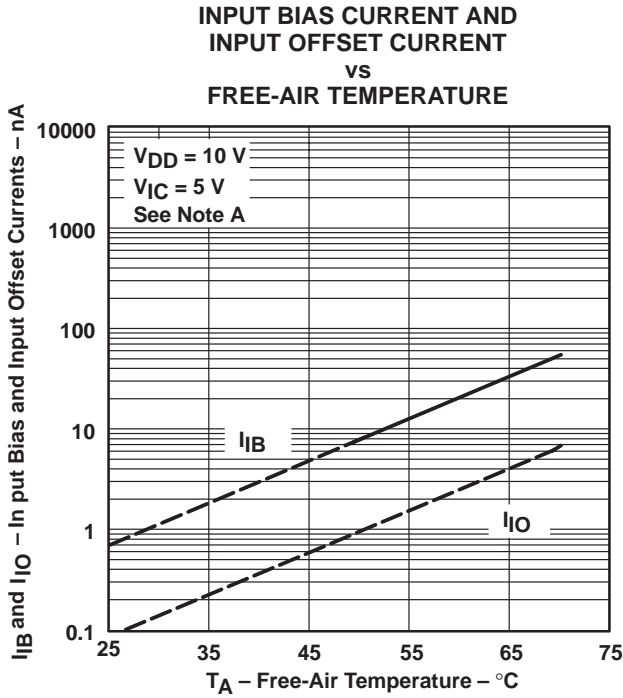


Figure 15

TYPICAL CHARACTERISTICS



NOTE A: The typical values of input bias current and input offset current below 5 pA were determined mathematically.

Figure 16

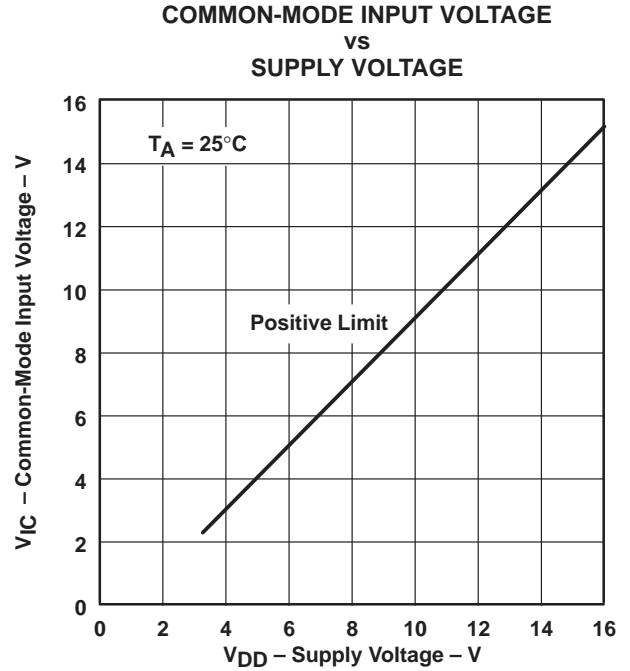


Figure 17

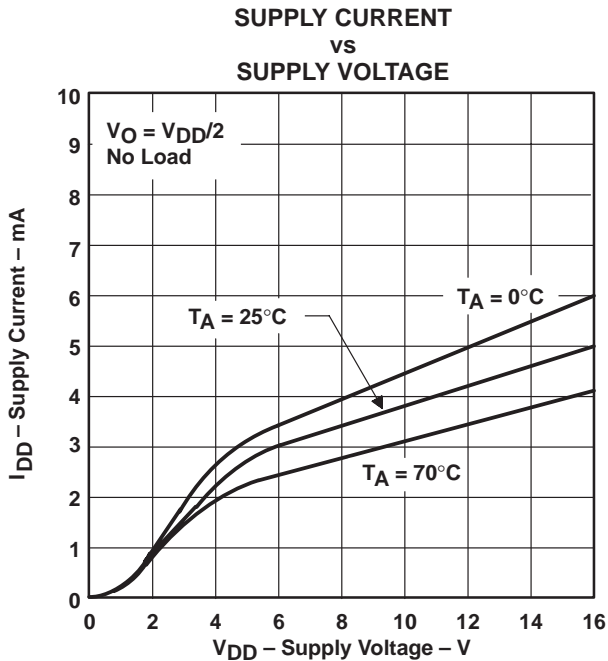


Figure 18

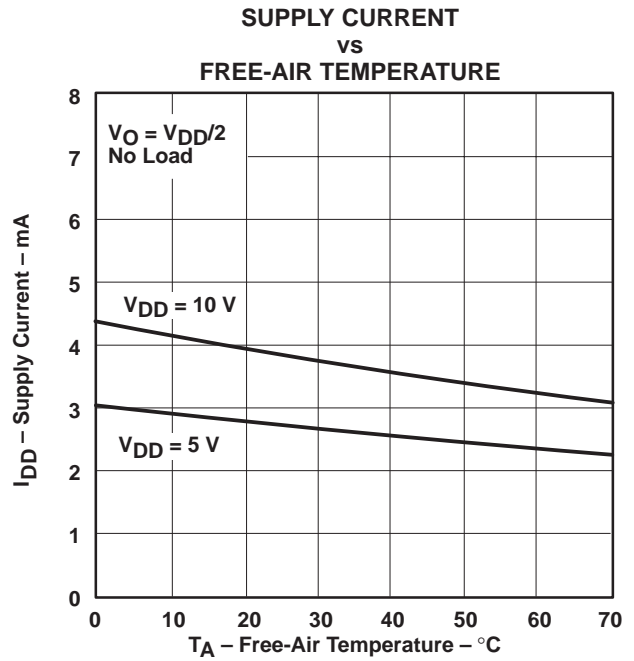


Figure 19

TYPICAL CHARACTERISTICS

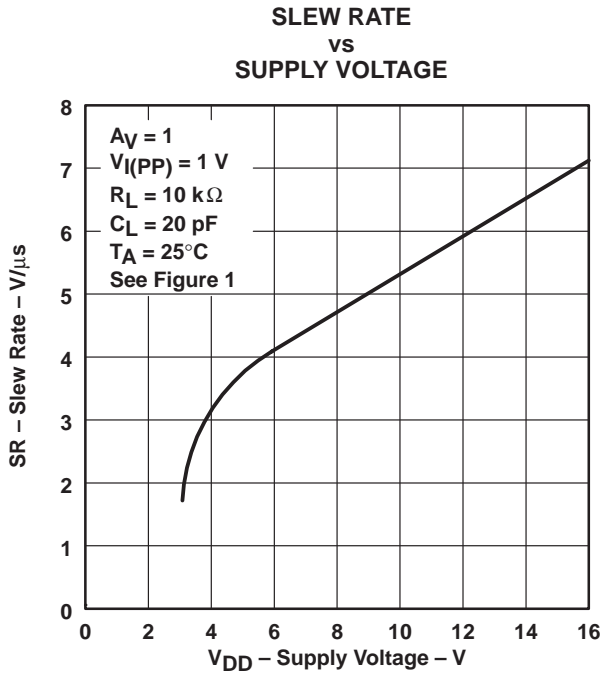


Figure 20

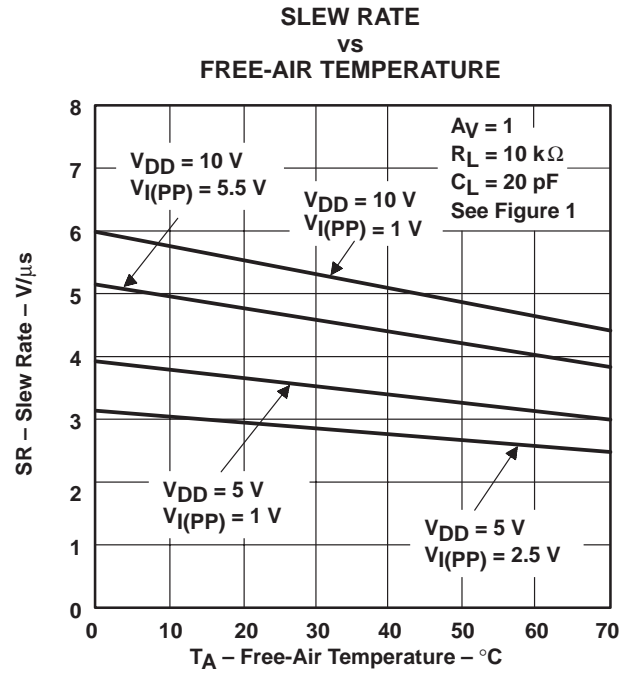


Figure 21

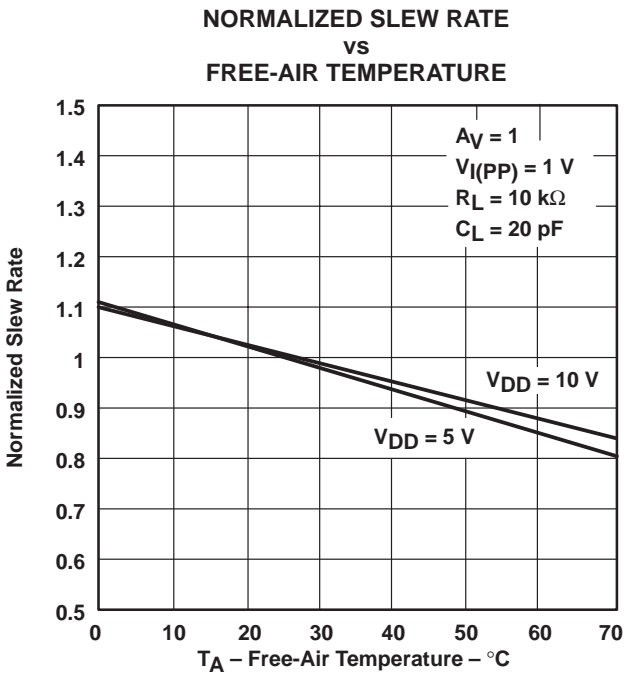


Figure 22

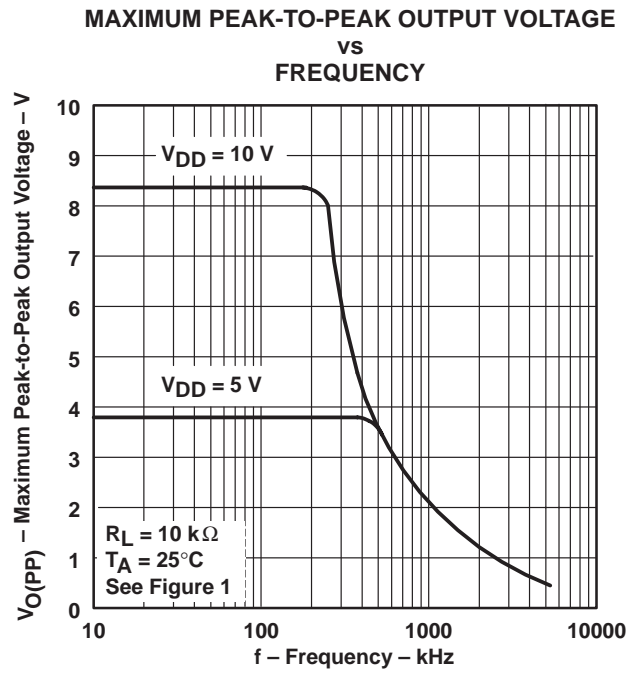
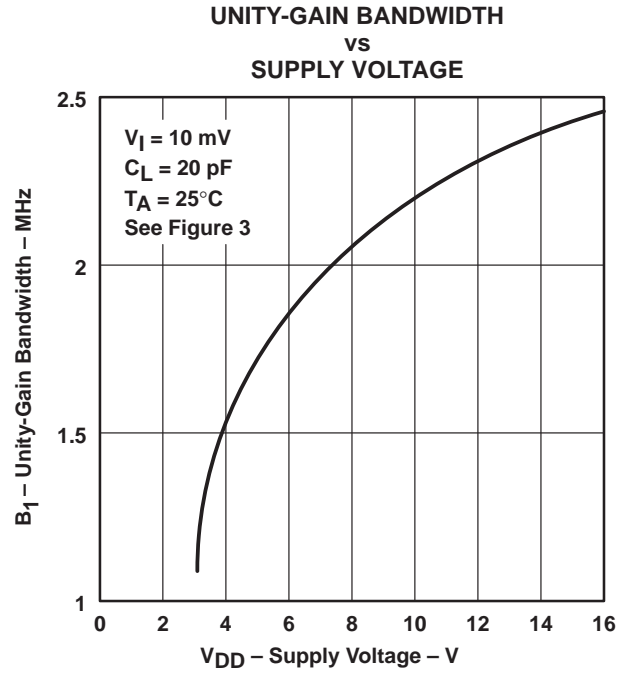
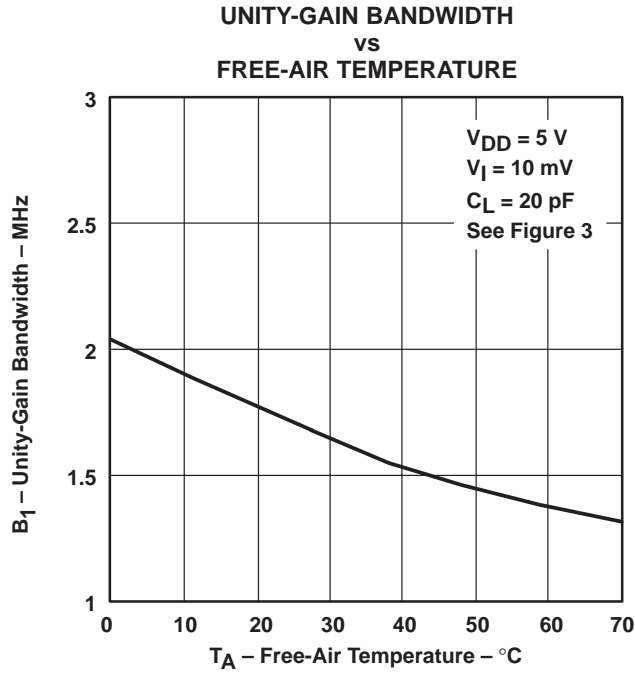
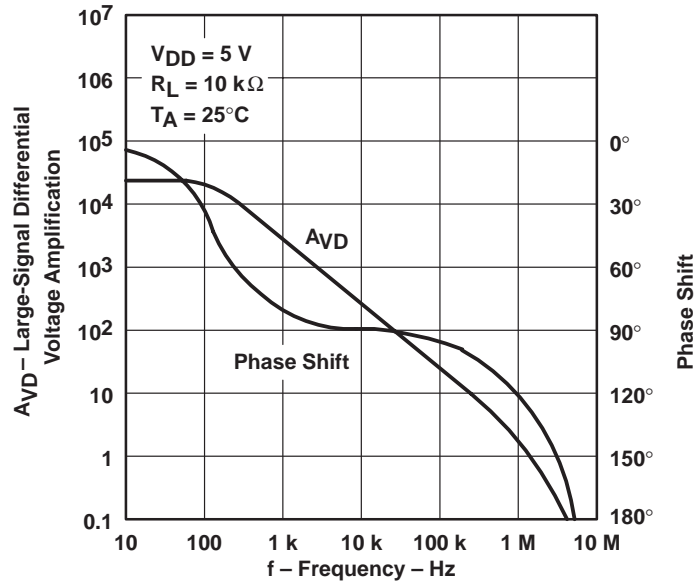


Figure 23

TYPICAL CHARACTERISTICS



**LARGE-SIGNAL DIFFERENTIAL VOLTAGE
 AMPLIFICATION AND PHASE SHIFT
 vs
 FREQUENCY**



TYPICAL CHARACTERISTICS

LARGE-SIGNAL DIFFERENTIAL VOLTAGE
 AMPLIFICATION AND PHASE SHIFT
 VS
 FREQUENCY

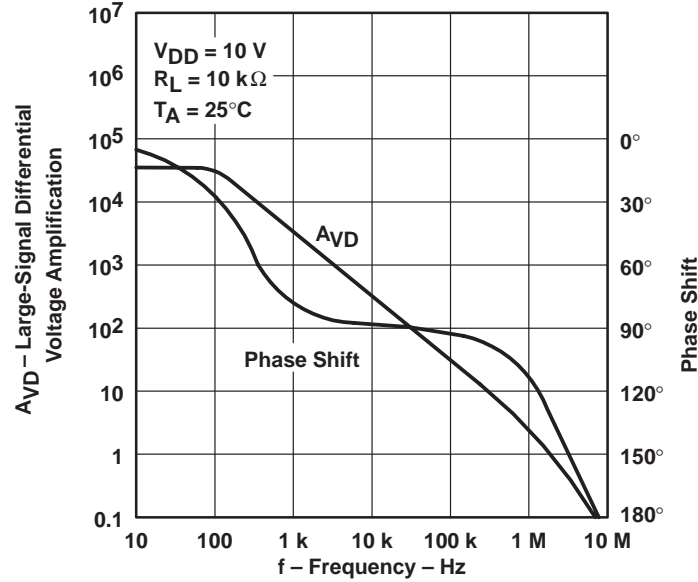


Figure 27

PHASE MARGIN
 vs
 SUPPLY VOLTAGE

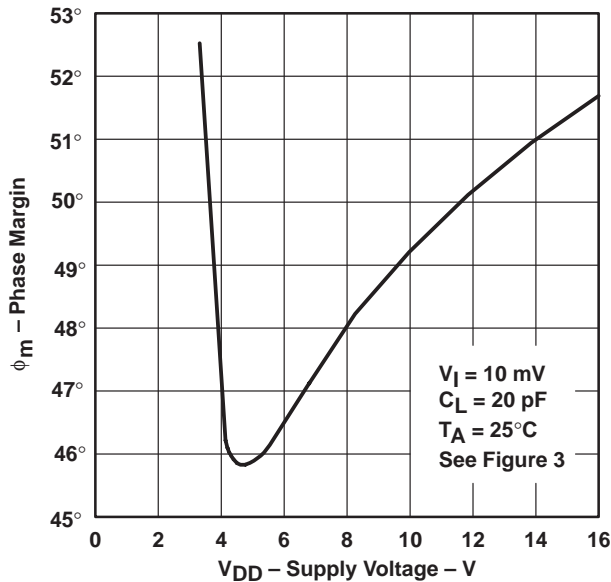


Figure 28

PHASE MARGIN
 vs
 FREE-AIR TEMPERATURE

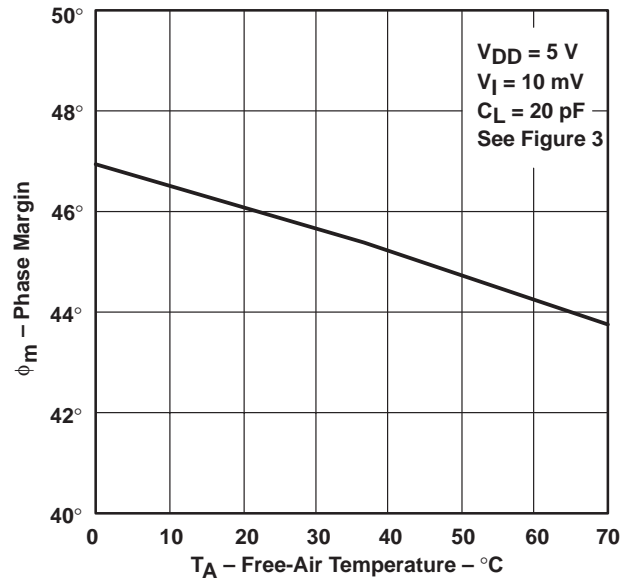


Figure 29

TYPICAL CHARACTERISTICS

PHASE MARGIN
 vs
 CAPACITIVE LOAD

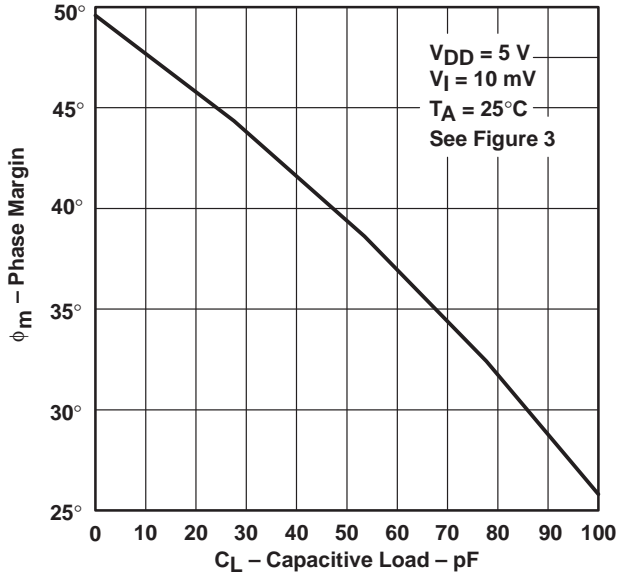


Figure 30

EQUIVALENT INPUT NOISE VOLTAGE
 vs
 FREQUENCY

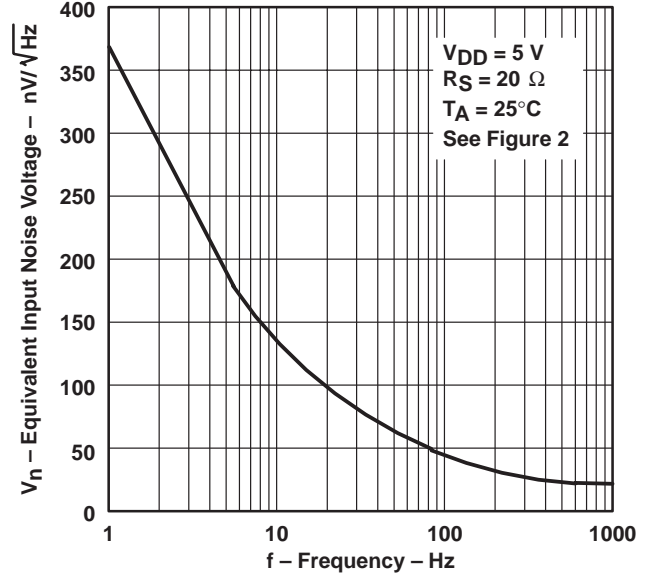


Figure 31

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