

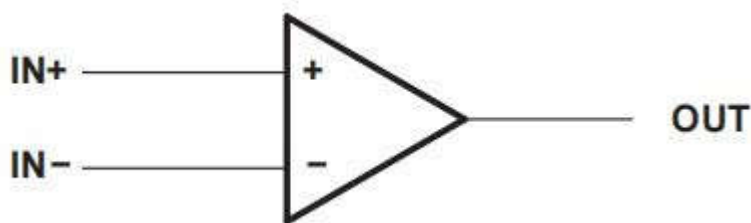
1. DESCRIPTION

The XL33078 series is a bipolar dual operational amplifier with high-performance specifications for use in quality audio and data-signal applications. This device operates over a wide range of single- and dual-supply voltages and offers low noise, high-gain bandwidth, and high slew rate. Additional features include low total harmonic distortion, excellent phase and gain margins, large output voltage swing with no deadband crossover distortion, and symmetrical sink/source performance.

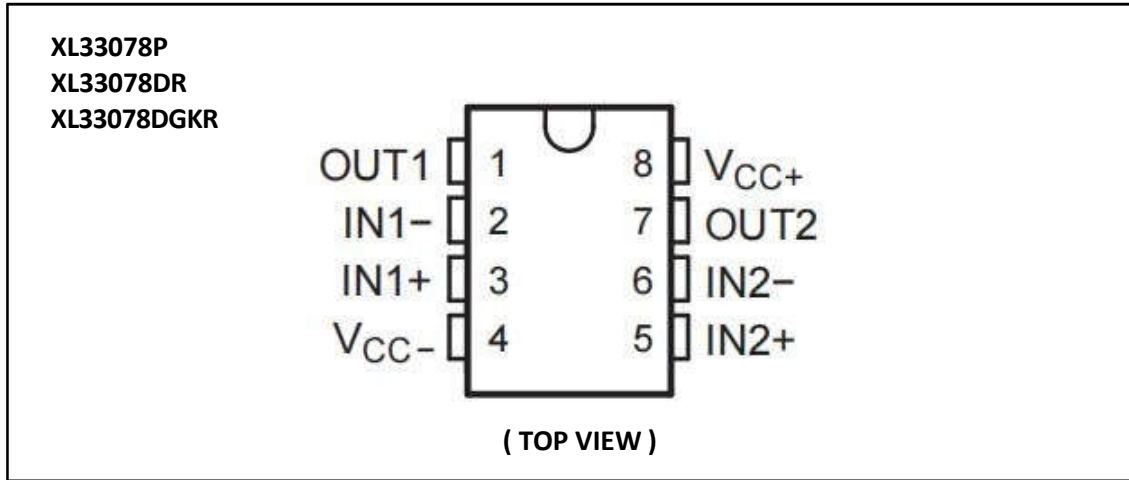
2. FEATURES

- Dual-Supply Operation . . . ± 5 V to ± 18 V
- Low Noise Voltage..... 5.0 nV/√Hz (Typical)
- Low Input Offset Voltage..... 0.3mV (Typical)
- Low Total Harmonic Distortion.....0.003% (Typical)
- High Slew Rate..... 7 V/μs (Typical)
- High-Gain Bandwidth Product..... 16 MHz (Typical)
- High Open-Loop AC Gain 800 at 20 kHz
- Large Output-Voltage Swing..... +14.1V to -14.6 V
- Excellent Gain and Phase Margins

3. SYMBOL (EACH AMPLIFIER)



4. PIN CONFIGURATIONS AND FUNCTIONS



5. ABSOLUTE MAXIMUM RATINGS⁽¹⁾

over operating free-air temperature range (unless otherwise noted)

		MIN	MAX	UNIT
V _{CC+}	Supply voltage ⁽²⁾		18	V
V _{CC-}	Supply voltage ⁽²⁾		-18	V
V _{CC+} - V _{CC-}	Supply voltage		36	V
	Input voltage, either input ⁽²⁾⁽³⁾		V _{CC+} or V _{CC-}	V
	Input current ⁽⁴⁾		±10	mA
	Duration of output short circuit ⁽⁵⁾		Unlimited	
θ _{JA}	Package thermal impedance, junction to free air ⁽⁶⁾⁽⁷⁾	SOP/VSSOP	105/180	°C/W
		DIP	90	
T _J	Operating virtual junction temperature		150	°C
T _{STG}	Storage temperature range	-65	150	°C

- (1) 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.
- (2) All voltage values, except differential voltages, are with respect to the midpoint between V_{CC+} and V_{CC-}.
- (3) The magnitude of the input voltage must never exceed the magnitude of the supply voltage.
- (4) Excessive input current will flow if a differential input voltage in excess of approximately 0.6 V is applied between the inputs, unless some limiting resistance is used.
- (5) The output may be shorted to ground or either power supply. Temperature and/or supply voltages must be limited to ensure the maximum dissipation rating is not exceeded.
- (6) Maximum power dissipation is a function of T_J (max), θ_{JA}, and T_A. The maximum allowable power dissipation at any allowable ambient temperature is PD = (T_J (max) - T_A)/θ_{JA}. Operating at the absolute maximum T_J of 150°C can affect reliability.
- (7) The package thermal impedance is calculated in accordance with JESD 51-7

6. RECOMMENDED OPERATING CONDITIONS

		MIN	MAX	UNIT
V _{CC-}	Supply voltage	-5	-15	V
V _{CC+}		5	15	
T _A	Operating free-air temperature range	-40	85	°C

7. ELECTRICAL CHARACTERISTICS

$V_{CC-} = -15\text{ V}$, $V_{CC+} = 15\text{ V}$, $T_A = 25^\circ\text{C}$ (unless otherwise noted)

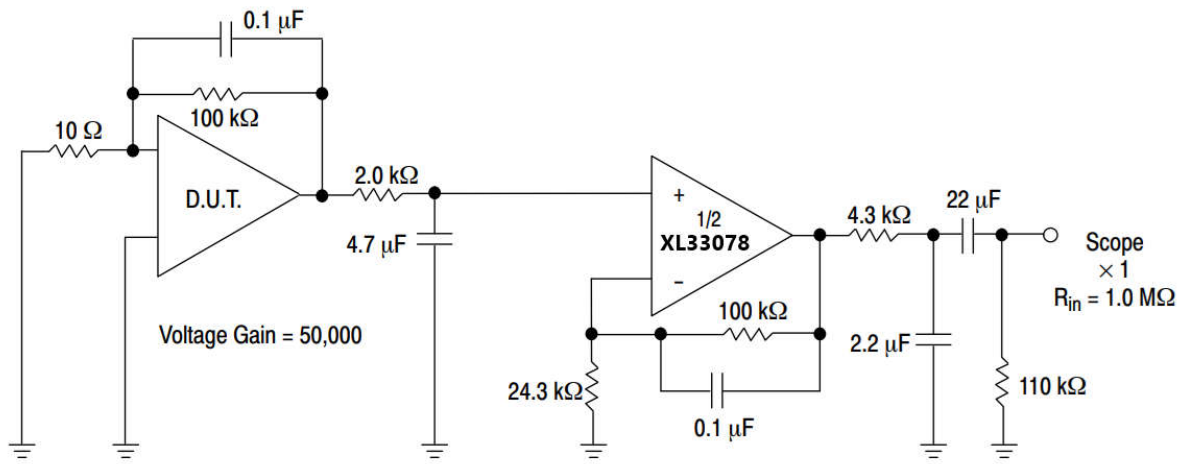
PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
V _{IO}	Input offset voltage	V _O = 0, R _S = 10 Ω, V _{CM} = 0	T _A = 25°C	0.3		3	mV
			T _A = −40°C to 85°C	4			
αV _{IO}	Input offset voltage temperature coefficient	V _O = 0, R _S = 10 Ω, V _{CM} = 0	T _A = −40°C to 85°C	2			∞V/°C
I _{IB}	Input bias current	V _O = 0, V _{CM} = 0	T _A = 25°C	350	780	nA	
			T _A = −40°C to 85°C	860			
I _{IO}	Input offset current	V _O = 0, V _{CM} = 0	T _A = 25°C	30	190	nA	
			T _A = −40°C to 85°C	220			
V _{ICR}	Common-mode input voltage range	ΔV _{IO} = 5 mV, V _O = 0		±13	±14		V
A _{VD}	Large-signal differential voltage amplification	R _L ≥ 2 kΩ, V _O = ±10 V	T _A = 25°C	90	110	dB	
			T _A = −40°C to 85°C	85			
V _{OM}	Maximum output voltage swing	V _{ID} = ±1 V	R _L = 600 Ω	V _{OM} +	10.7		V
				V _{OM} −	-11.9		
			R _L = 2 k Ω	V _{OM} +	13.2	13.8	
				V _{OM} −	-13.2	-13.7	
			R _L = 10 k Ω	V _{OM} +	13.5	14.1	
				V _{OM} −	-14	-14.6	
CMMR	Common-mode rejection ratio	V _{IN} = ±13 V		80	100	dB	
k _{SVR} ⁽¹⁾	Supply-voltage rejection ratio	V _{CC} + = 5 V to 15 V, V _{CC} − = −5 V to −15 V		80	105	dB	
I _{OS}	Output short-circuit current	V _{ID} = 1 V, Output to GND	Source current	15	30	mA	
			Sink current	-20	-35		
I _{CC}	Supply current (per channel)	V _O = 0	T _A = 25°C	2.6	5	mA	
			T _A = −40°C to 85°C	6.5			

NOTE: (1) Measured with $V_{CC\pm}$ differentially varied at the same time

8. OPERATING CHARACTERISTICS

$V_{CC-} = -15\text{ V}$, $V_{CC+} = 15\text{ V}$, $T_A = 25^\circ\text{C}$ (unless otherwise noted)

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
SR	Slew rate at unity gain	$A_{VD} = 1$, $V_{IN} = -10\text{ V}$ to 10 V , $R_L = 2\text{ k}\Omega$, $C_L = 100\text{ pF}$		4.5	7		V/ μs
GBW	Gain bandwidth product	$f = 100\text{ kHz}$		8	16		MHz
B_1	Unity gain frequency	Open loop			9		MHz
G_m	Gain margin	$R_L = 2\text{ k}\Omega$	$C_L = 0\text{ pF}$		-11		dB
			$C_L = 100\text{ pF}$		-6		
Φ_m	Phase margin	$R_L = 2\text{ k}\Omega$	$C_L = 0\text{ pF}$		55		deg
			$C_L = 100\text{ pF}$		40		
	Amp-to-amp isolation	$f = 20\text{ Hz}$ to 20 kHz			-120		dB
	Power bandwidth	$V_O = 27\text{ V}_{(PP)}$, $R_L = 2\text{ k}\Omega$, $\text{THD} \leq 1\%$			120		kHz
THD	Total harmonic distortion	$V_O = 3\text{ V}_{\text{rms}}$, $A_{VD} = 1$, $R_L = 2\text{ k}\Omega$, $f = 20\text{ Hz}$ to 20 kHz			0.002		%
Z_O	Open-loop output impedance	$V_O = 0$, $f = 9\text{ MHz}$			35		Ω
r_{id}	Differential input resistance	$V_{CM} = 0$			160		k Ω
C_{id}	Differential input capacitance	$V_{CM} = 0$			15		pF
V_n	Equivalent input noise voltage	$f = 1\text{ kHz}$, $R_S = 100\ \Omega$			5.0		nV/ $\sqrt{\text{Hz}}$
I_n	Equivalent input noise current	$f = 1\text{ kHz}$			1.5		pA/ $\sqrt{\text{Hz}}$

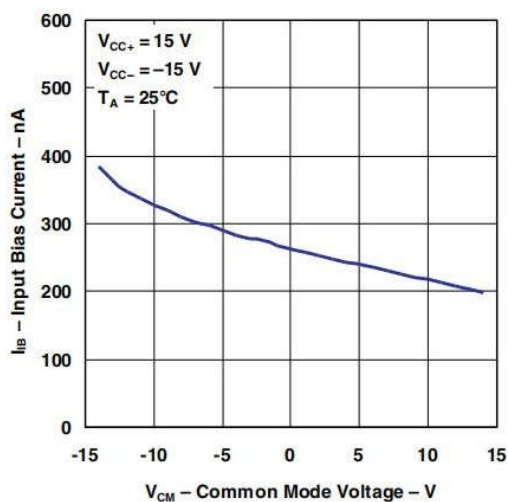


Note: All capacitors are non-polarized.

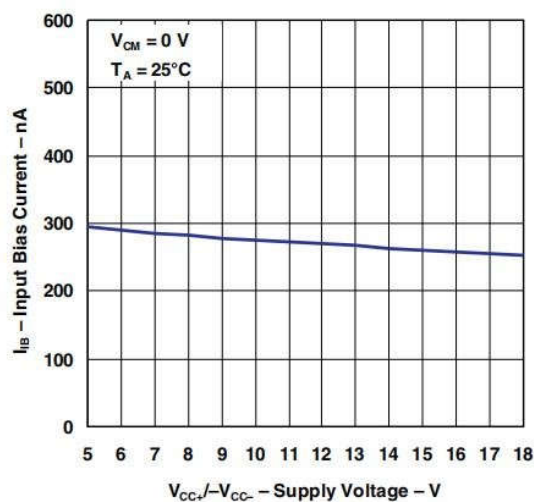
Figure 1. Voltage Noise Test Circuit (0.1 Hz to 10 Hz)

9. TYPICAL CHARACTERISTICS CURVE

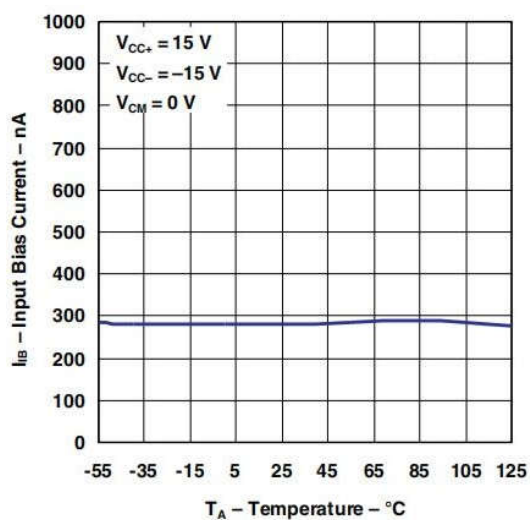
INPUT BIAS CURRENT
VS
COMMON-MODE VOLTAGE



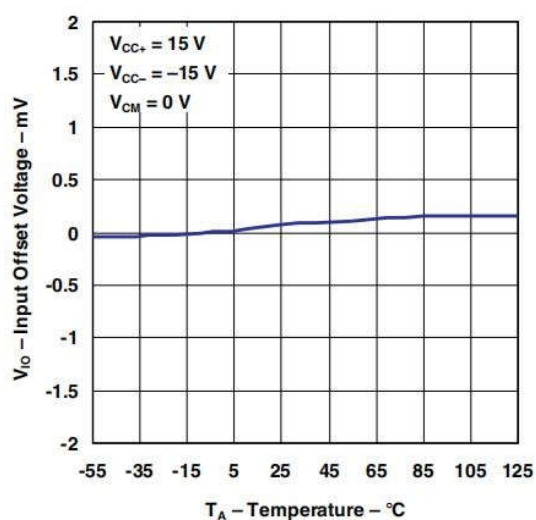
INPUT BIAS CURRENT
VS
SUPPLY VOLTAGE



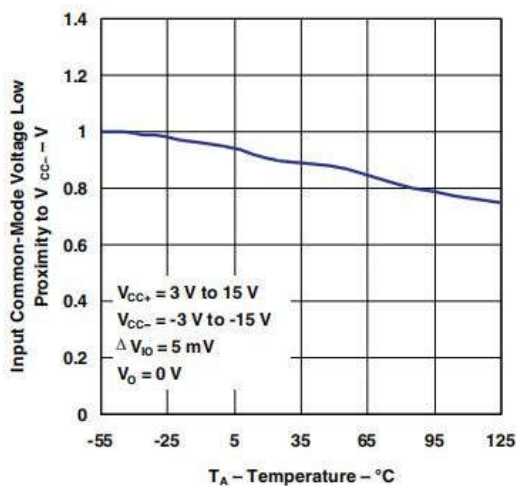
INPUT BIAS CURRENT
VS
TEMPERATURE



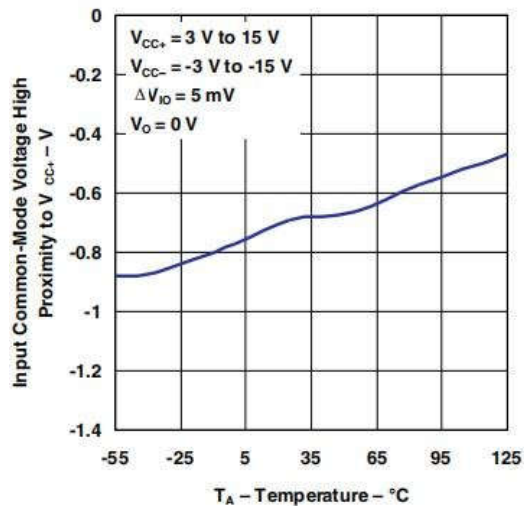
INPUT OFFSET VOLTAGE
VS
TEMPERATURE



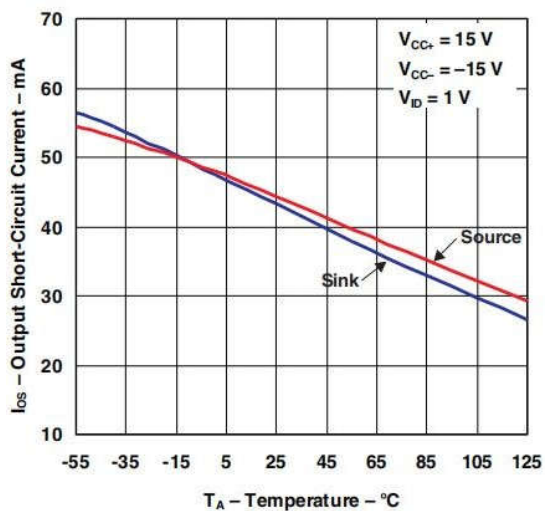
INPUT COMMON-MODE VOLTAGE
LOW PROXIMITY TO V_{CC-}
VS
TEMPERATURE



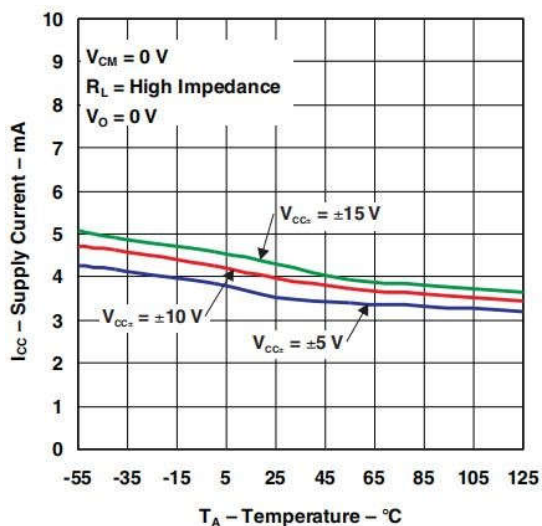
INPUT COMMON-MODE VOLTAGE
HIGH PROXIMITY TO V_{CC+}
VS
TEMPERATURE



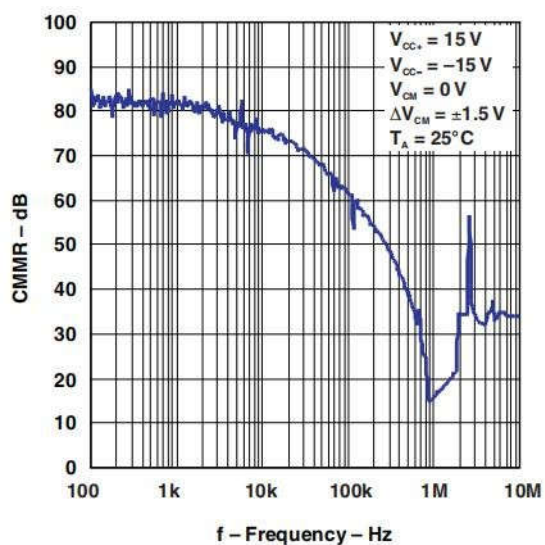
OUTPUT SHORT-CIRCUIT CURRENT
VS
TEMPERATURE



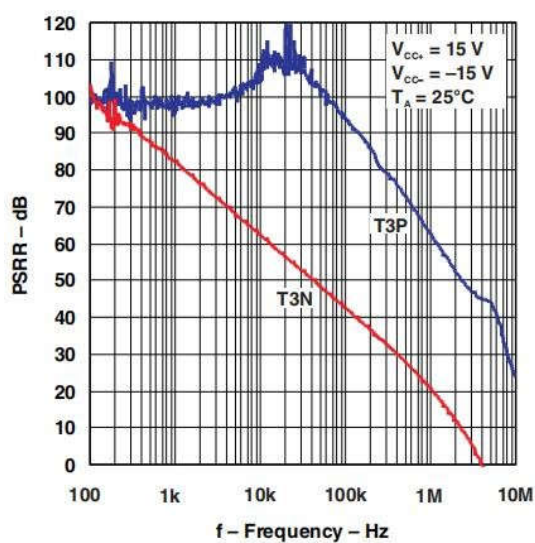
SUPPLY CURRENT
VS
TEMPERATURE



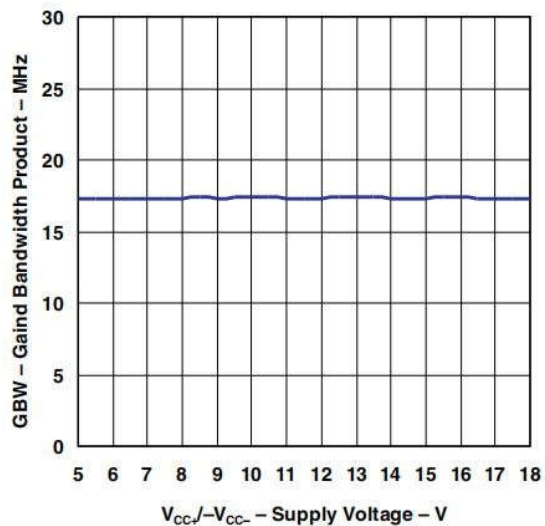
CMRR
VS
FREQUENCY



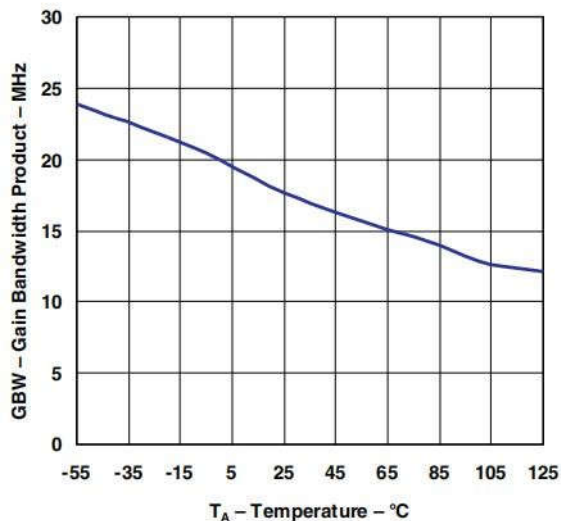
PSSR
VS
FREQUENCY



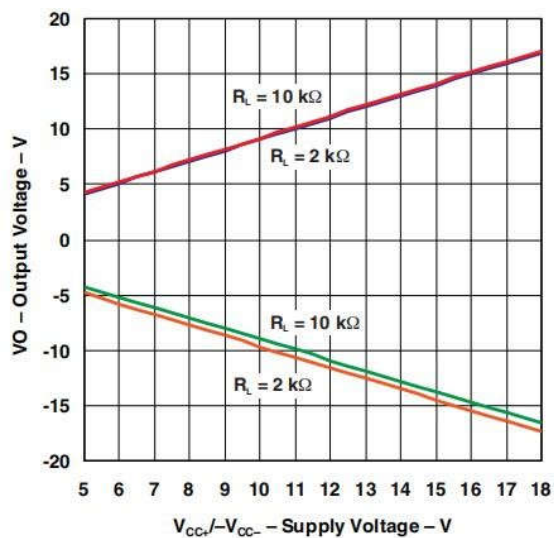
GAIN BANDWIDTH PRODUCT
VS
SUPPLY VOLTAGE



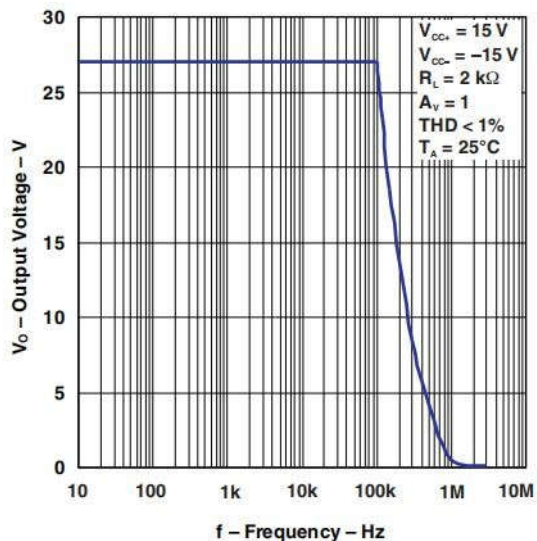
GAIN BANDWIDTH PRODUCT
VS
TEMPERATURE



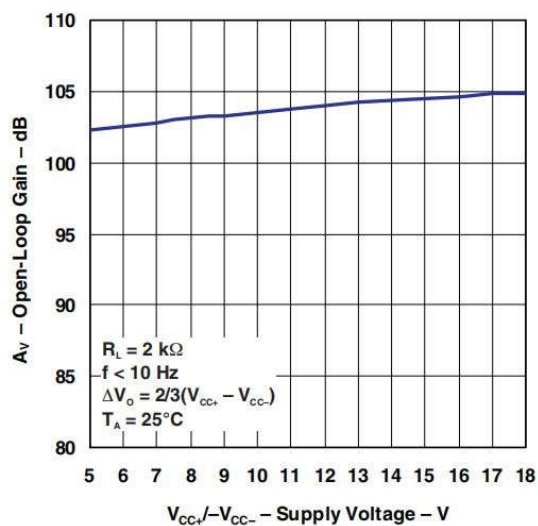
OUTPUT VOLTAGE
VS
SUPPLY VOLTAGE



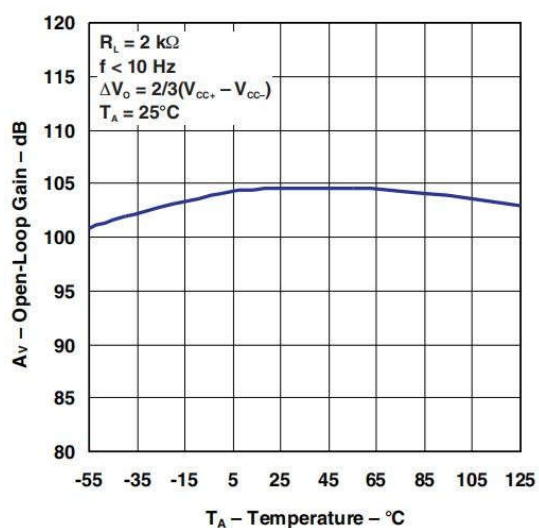
OUTPUT VOLTAGE
VS
FREQUENCY



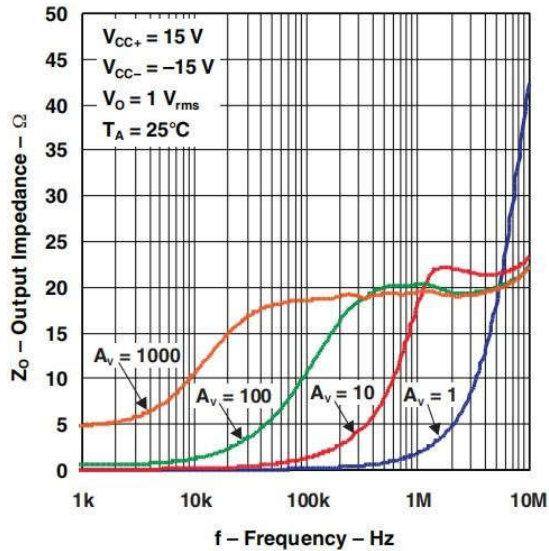
OPEN-LOOP GAIN
VS
SUPPLY VOLTAGE



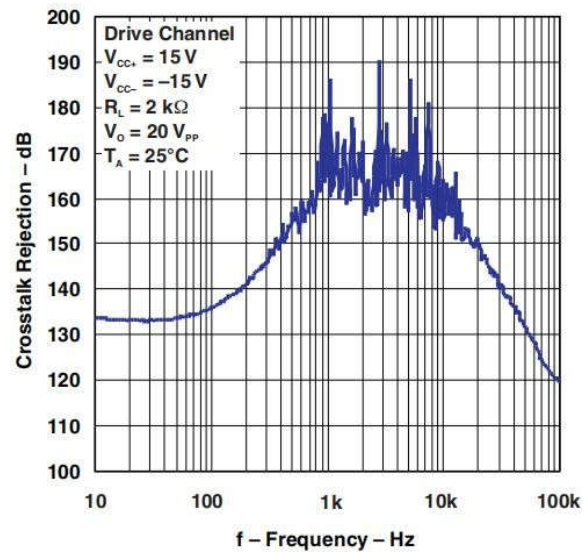
OPEN-LOOP GAIN
VS
TEMPERATURE



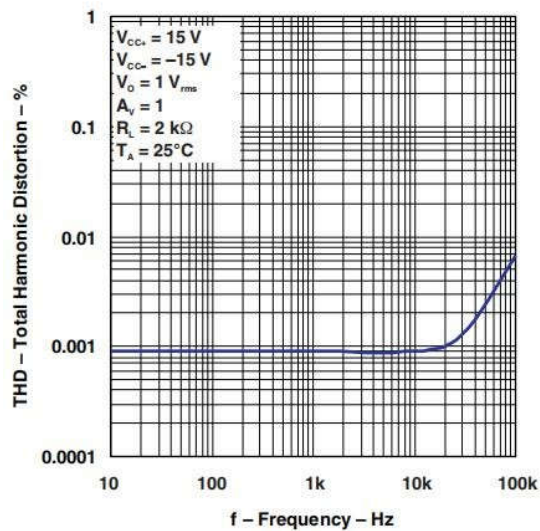
OUTPUT IMPEDANCE
VS
FREQUENCY



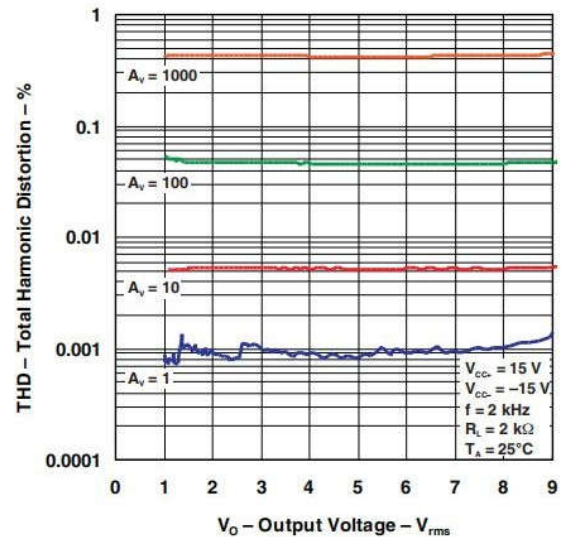
CROSSTALK REJECTION
VS
FREQUENCY



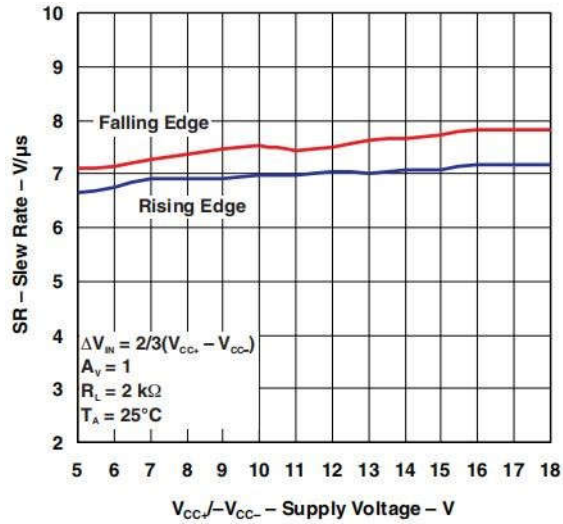
TOTAL HARMONIC DISTORTION
VS
FREQUENCY



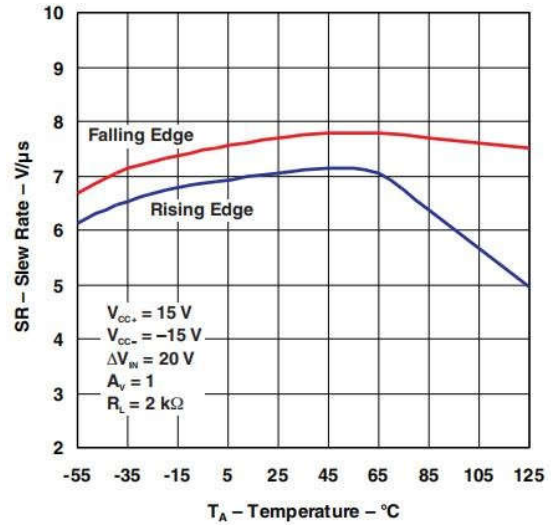
TOTAL HARMONIC DISTORTION
VS
OUTPUT VOLTAGE



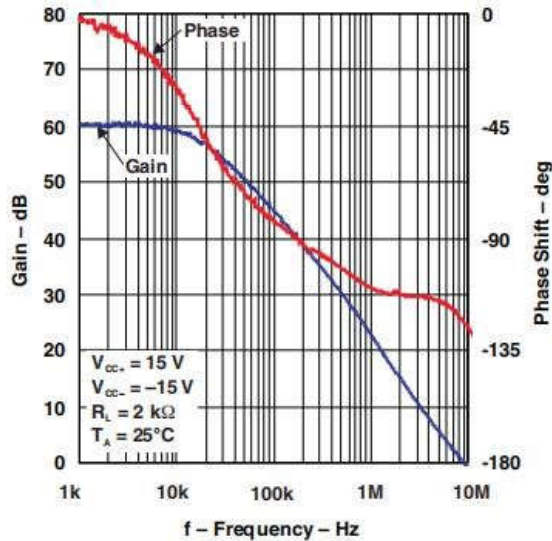
**SLEW RATE
VS
SUPPLY VOLTAGE**



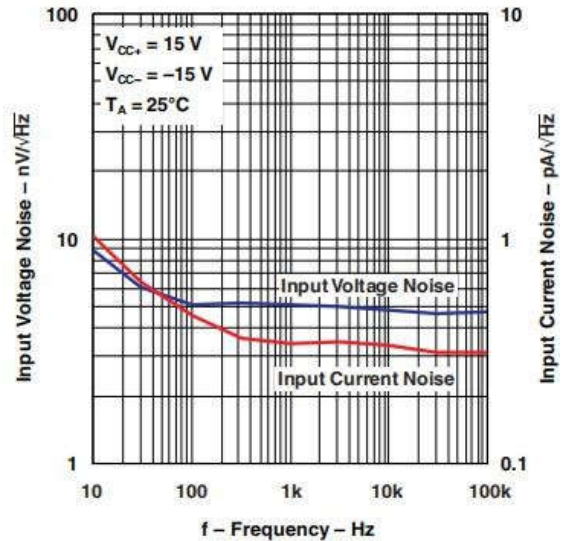
**SLEW RATE
VS
TEMPERATURE**



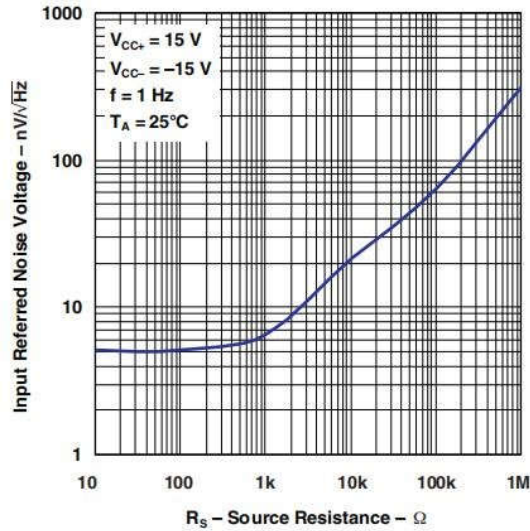
**GAIN AND PHASE
VS
FREQUENCY**



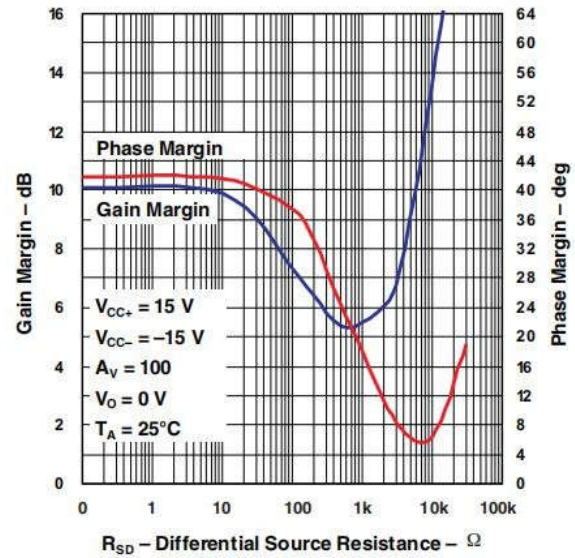
**INPUT VOLTAGE AND CURRENT NOISE
VS
FREQUENCY**



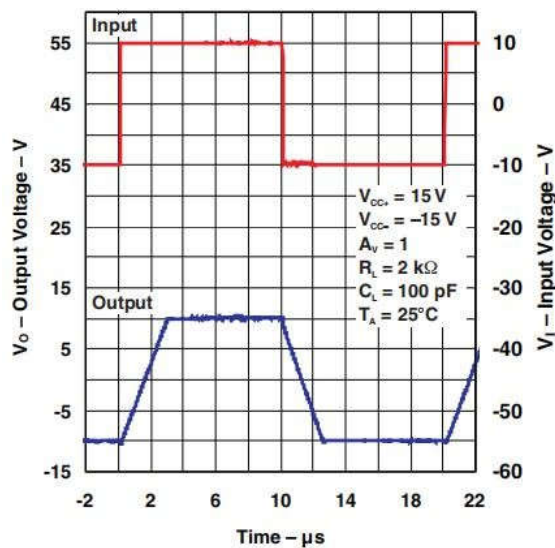
INPUT REFERRED NOISE VOLTAGE
VS
SOURCE RESISTANCE



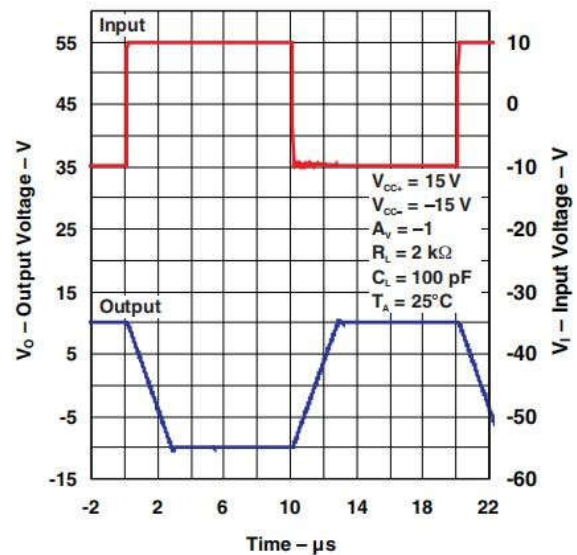
GAIN AND PHASE MARGIN
VS
DIFFERENTIAL SOURCE RESISTANCE



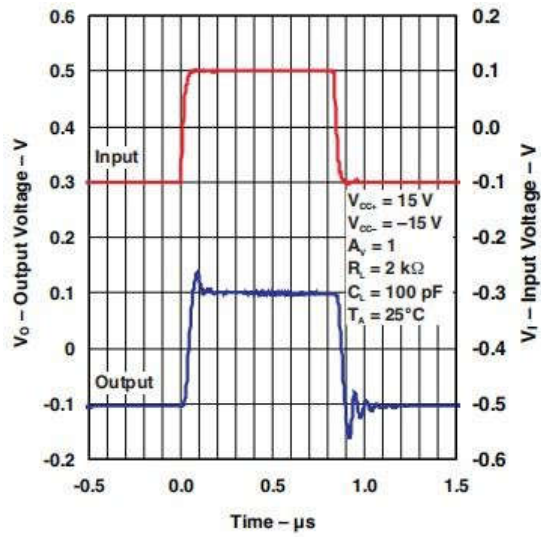
LARGE SIGNAL TRANSIENT RESPONSE
($A_V=1$)



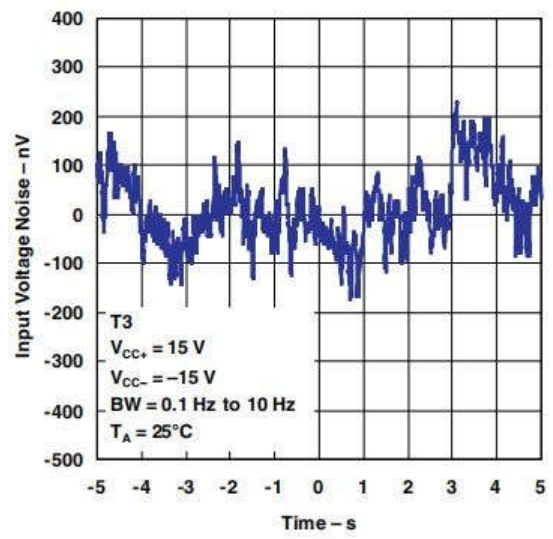
LARGE SIGNAL TRANSIENT RESPONSE
($A_V=-1$)



SMALL SIGNAL TRANSIENT RESPONSE



LOW_FREQUENCY NOISE



10. APPLICATION INFORMATION

Output Characteristics

All operating characteristics are specified with 100-pF load capacitance. The XL33078 can drive higher capacitance loads. However, as the load capacitance increases, the resulting response pole occurs at lower frequencies, causing ringing, peaking, or oscillation. The value of the load capacitance at which oscillation occurs varies from lot to lot. If an application appears to be sensitive to oscillation due to load capacitance, adding a small resistance in series with the load should alleviate the problem (see Figure 2).

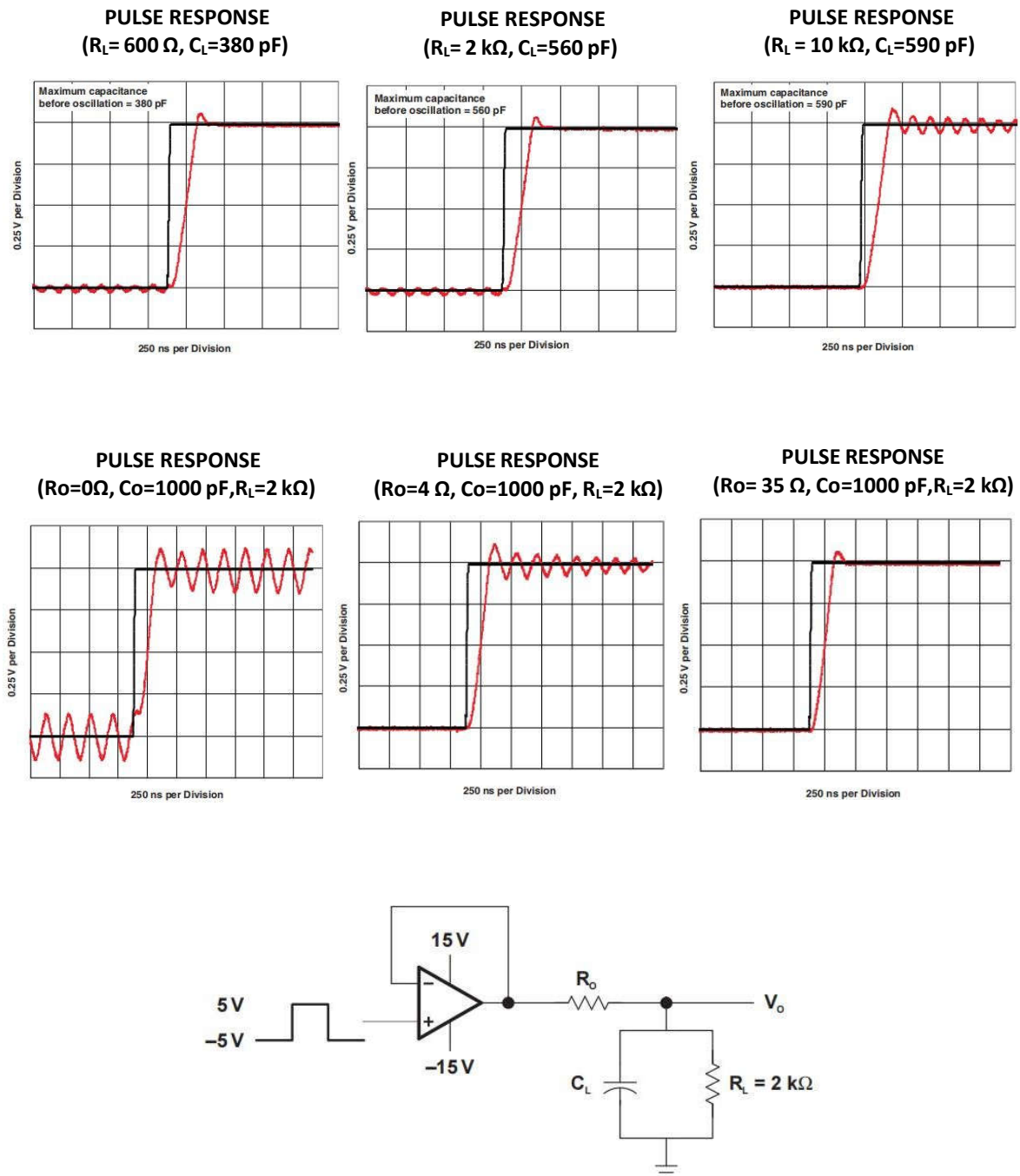


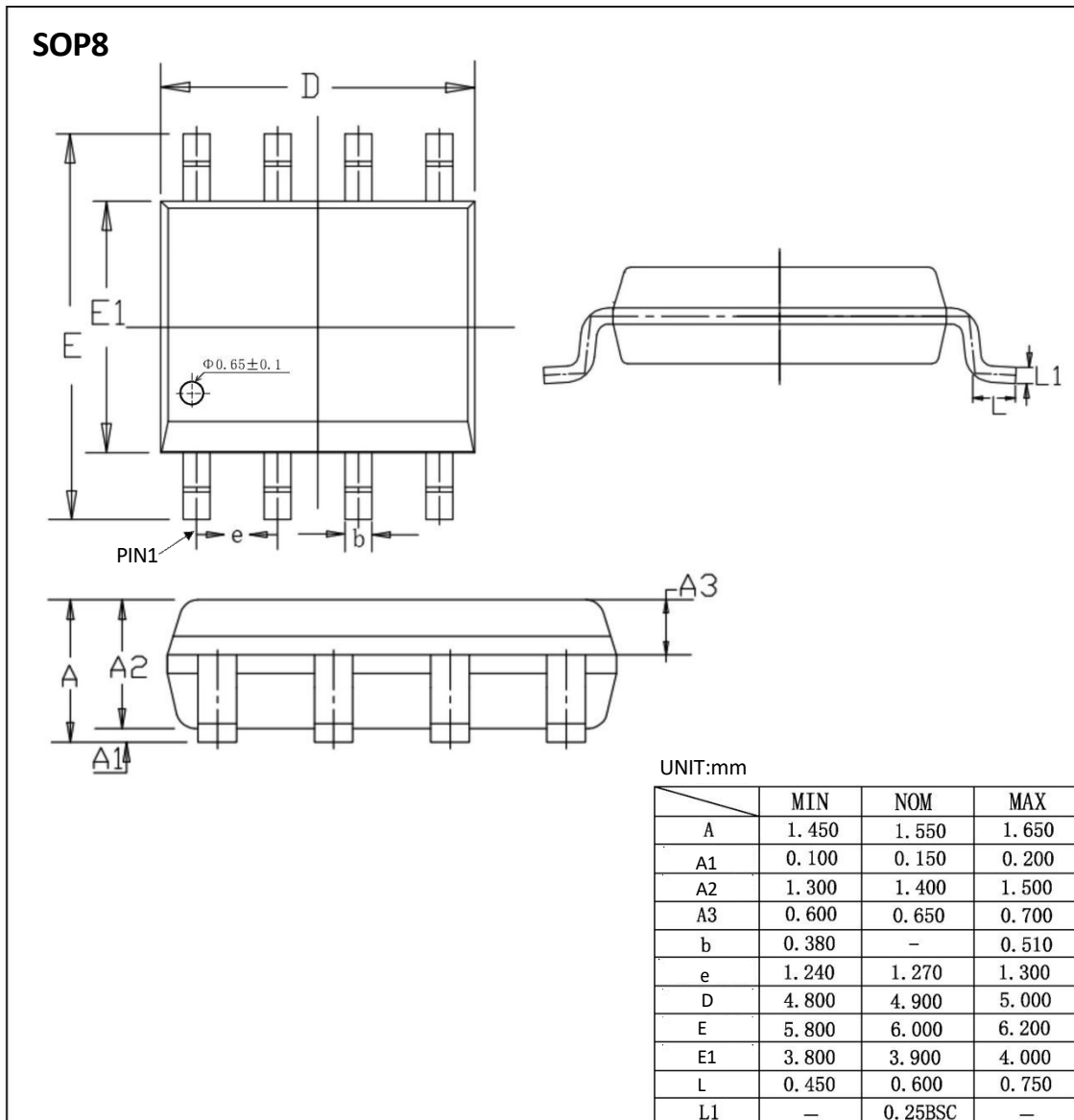
Figure 2. Output Characteristics

11. ORDERING INFORMATION

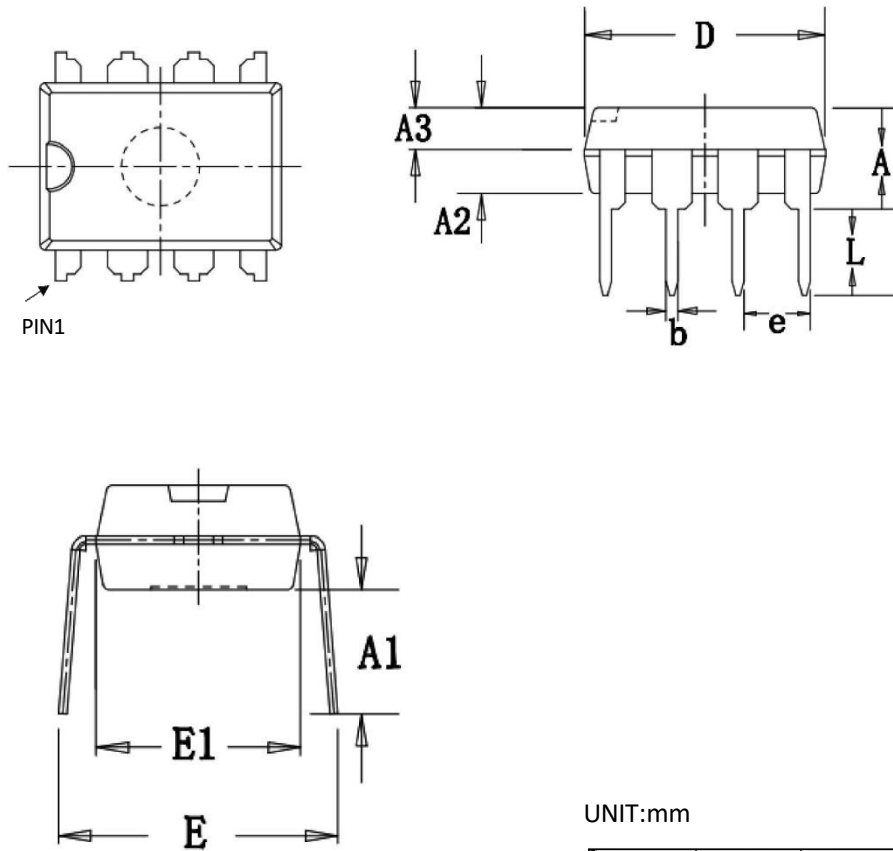
Ordering Information

Part Number	Device Marking	Package Type	Body size (mm)	Temperature (°C)	MSL	Transport Media	Package Quantity
XL33078P	XL33078P	DIP8	9.25 * 6.38	- 40 to 85	MSL3	Tube 50	2000
XL33078DR	XL33078	SOP8	4.90 * 3.90	- 40 to 85	MSL3	T&R	2500
XL33078DGKR	33078	VSSOP8	3.00 * 3.00	- 40 to 85	MSL3	T&R	2500

12. DIMENSIONAL DRAWINGS



DIP8

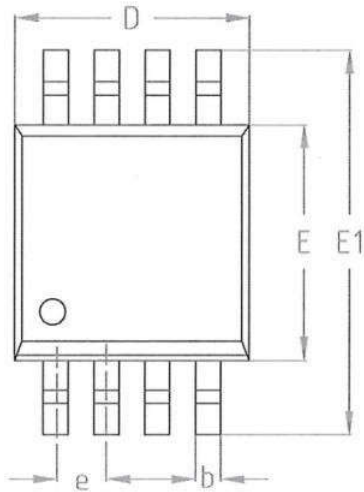


UNIT:mm

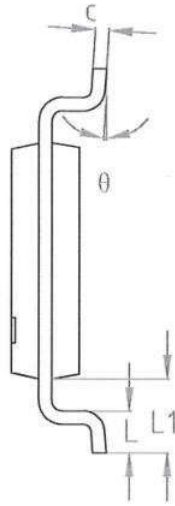
	MIN	NOM	MAX
A	3.600	3.800	4.000
A1	3.786	3.886	3.986
A2	3.200	3.300	3.400
A3	1.550	1.600	1.650
b	0.440	—	0.490
e	2.510	2.540	2.570
D	9.150	9.250	9.350
E	7.800	8.500	9.200
E1	6.280	6.380	6.480
L	3.000	—	—

VSSOP8

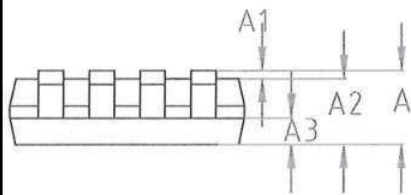
TOP VIEW



SIDE VIEW



SIDE VIEW



mm Dimensions			
SYMBOL	MIN	NOMINAL	MAX
A	—	—	1.10
A1	0.05	—	0.15
A2	0.75	0.85	0.95
A3	0.30	0.35	0.40
b	0.28	—	0.36
c	0.15	—	0.19
D	2.90	3.00	3.10
E	2.90	3.00	3.10
E1	4.70	4.90	5.10
e	0.65 BSC		
L1	0.95 REF		
L	0.40	—	0.70
θ	0°	—	8°

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