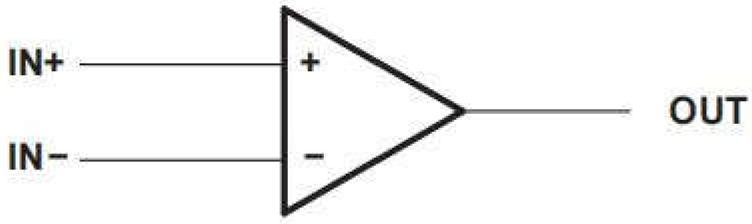
1. DESCRIPTION

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

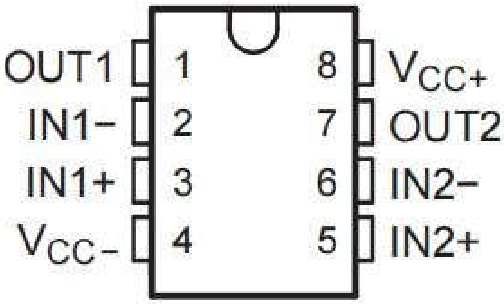
- Dual-Supply Operation . . . ±5 V to ±18 V
- Low Noise Voltage...... 5.0 nV/√Hz (Typical)
- Low Input Offset Voltage.......... 0.3mV (Typical)
- Low Total Harmonic Distortion.......0.003% (Typical)
- High Slew Rate...... 7 V/μs (Typical)
- High-Gain Bandwidth Product...... 16 MHz (Typical)
- High Open-Loop 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

XL33078P
XL33078DR
XL33078DGKR



(TOP VIEW)

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 VCC+ and VCC– .
(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 TJ (max), θJA, and TA. The maximum allowable power dissipation at any allowable ambient temperature is PD = (TJ (max) – TA)/θJA. Operating at the absolute maximum TJ 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 CHARACTERISICS

V_{CC-} = –15 V, V_{CC+} = 15 V, T_A = 25°C (unless otherwise noted)

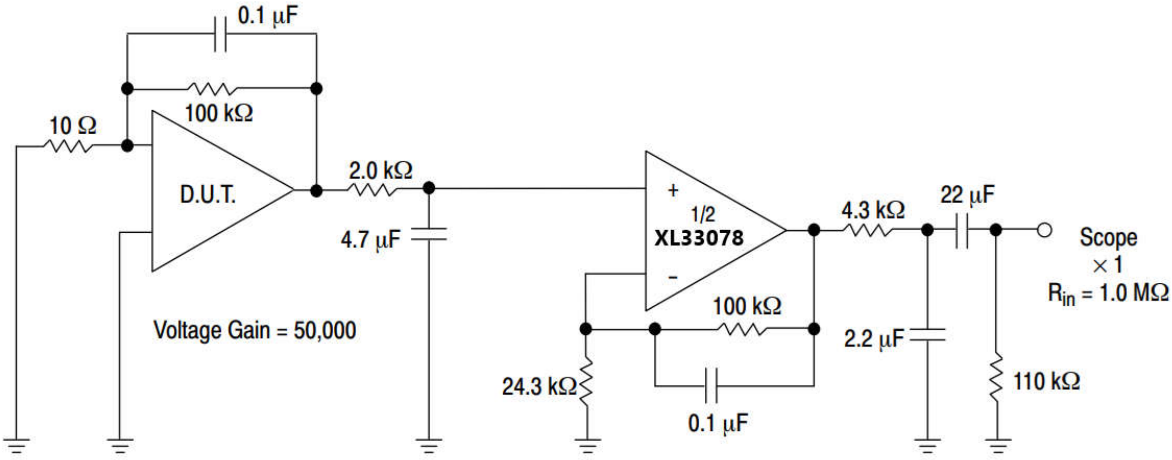
PARAMETER		TEST CONDITIONS			MIN	TYP	MAX	UNIT
V_{IO}	Input offset voltage	V_O = 0, R_S = 10 Ω, V_{CM} = 0		T_A = 25°C		0.3	3	mV
				T_A = –40°C to 85°C			4	
αV_{IO}	Input offset voltage temperature coefficient	V_O = 0, R_S = 10 Ω, V_{CM} = 0		T_A = –40°C to 85°C		2		∝V/°C
I_{IB}	Input bias current	V_O = 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 = 2k Ω	V_{OM+}	13.2	13.8		
				V_{OM-}	-13.2	-13.7		
			R_L = 10k 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 V, V_{CC+} = 15 V, T_A = 25°C (unless otherwise noted)

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

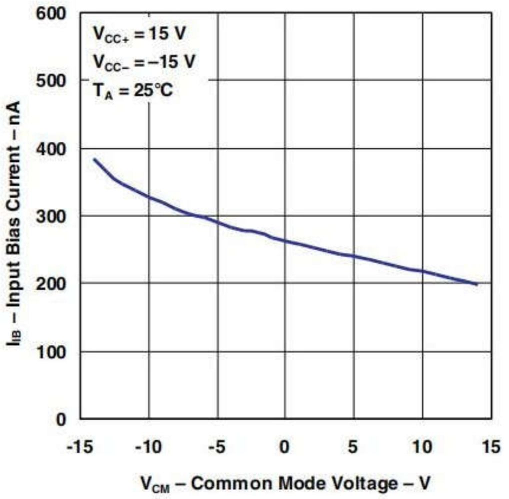


Note: All capacitors are non−polarized.

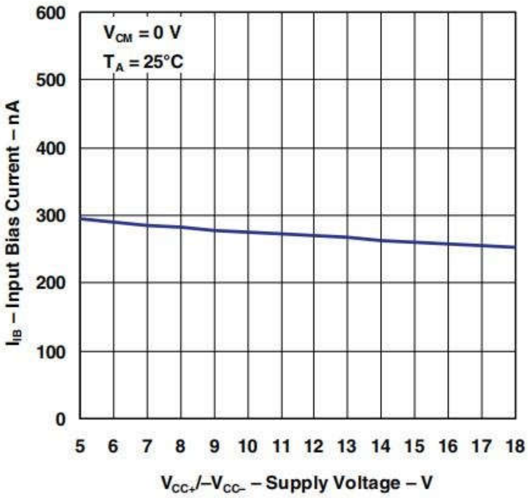
Figure 1. Voltage Noise Test Circuit (0.1 Hz to 10 Hz)

9. TYPICAL CHARACTERISTICS CURVE

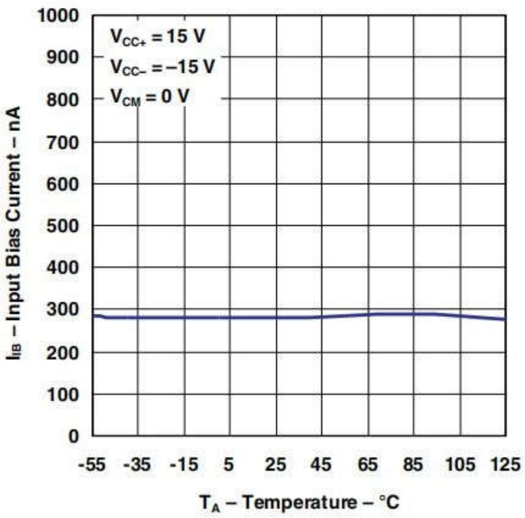
INPUT BIAS CURRENT VS COMMON-MODE VOLTAGE



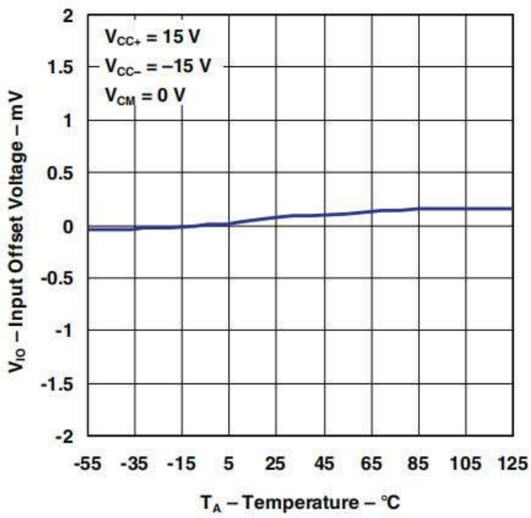
INPUT BIAS CURRENT VS SUPPLY VOLTAGE



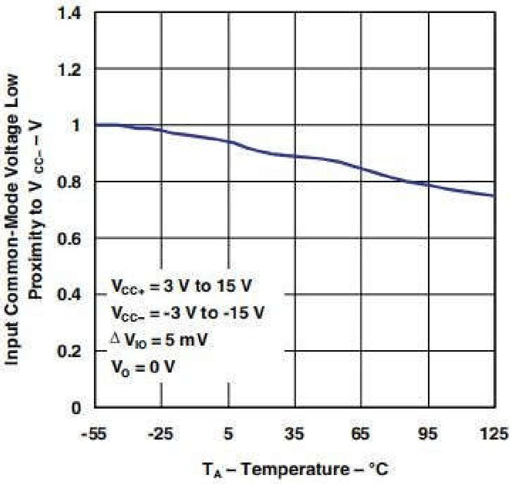
INPUT BIAS CURRENT VS TEMPERATURE



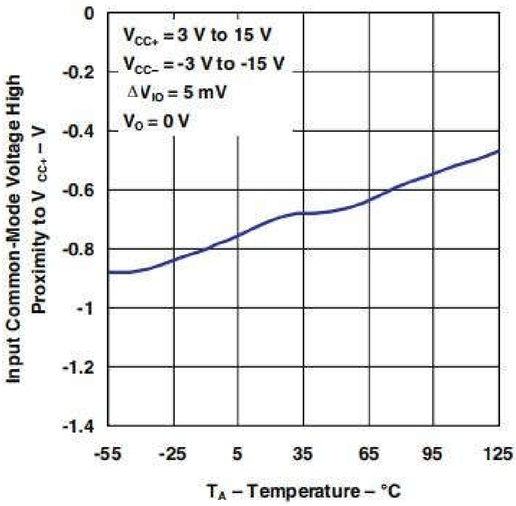
INPUT OFFSET VOLTAGE VS TEMPERATURE



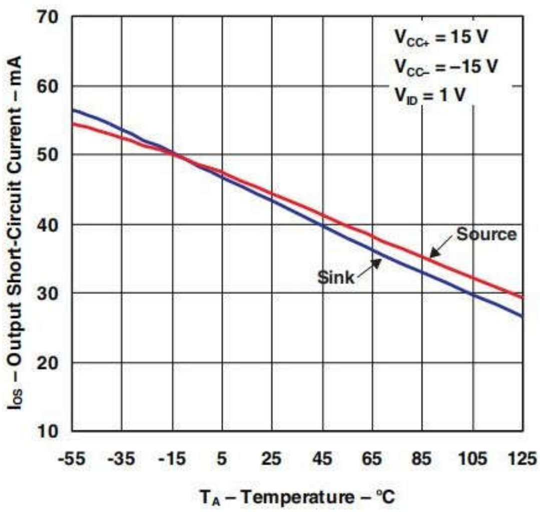
INPUT COMMON-MODE VOLTAGE LOW PROXIMITY TO V_{CC-} VS TEMPERATURE



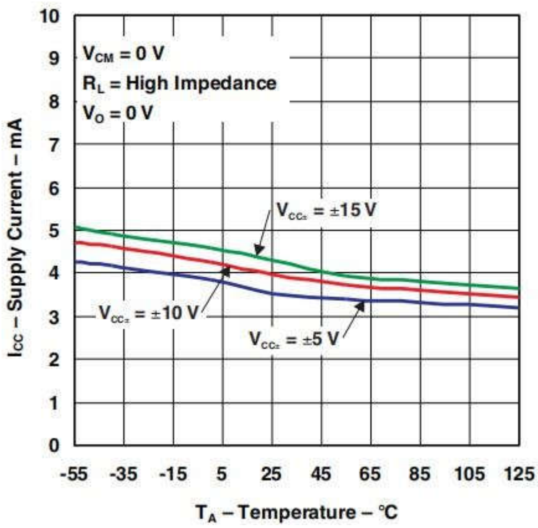
INPUT COMMON-MODE VOLTAGE HIGH PROXIMITY TO V_{CC+} VS TEMPERATURE



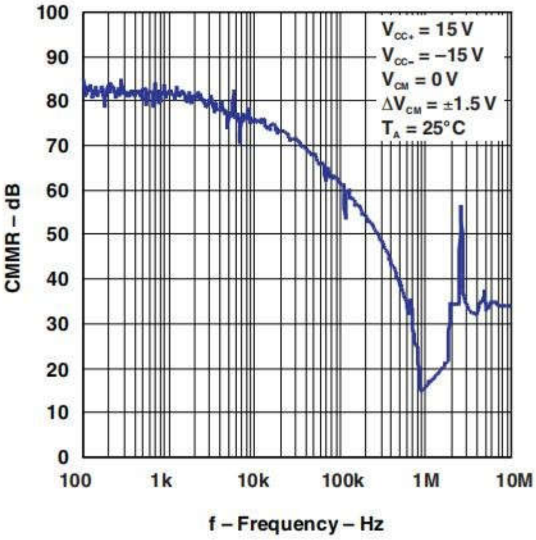
OUTPUT SHORT-CIRCUIT CURRENT VS TEMPERATURE



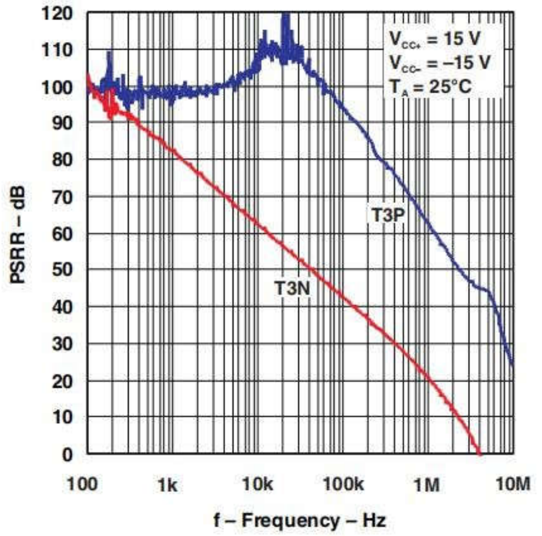
SUPPLY CURRENT VS TEMPERATURE



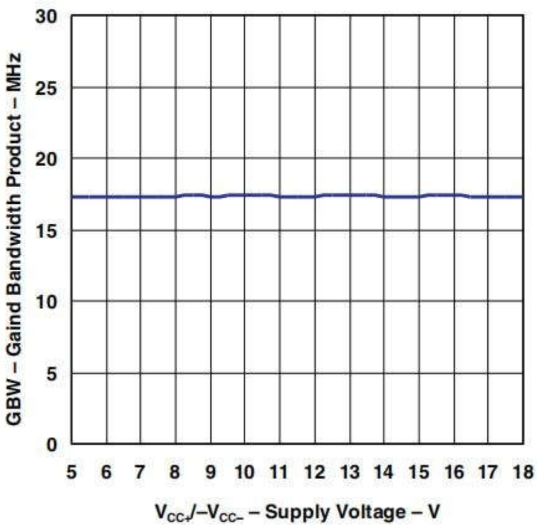
CMRR VS FREQUENCY



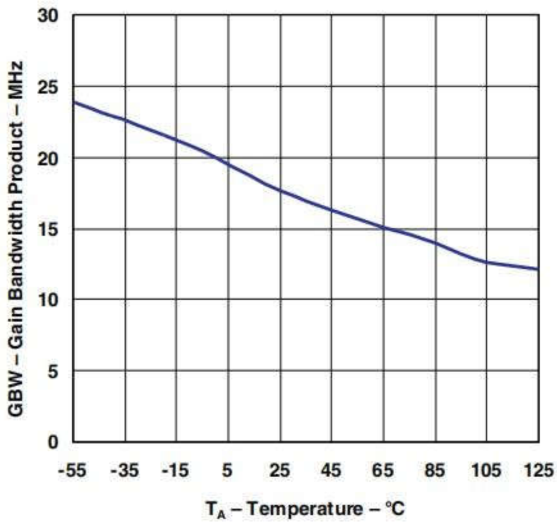
PSSR VS FREQUENCY



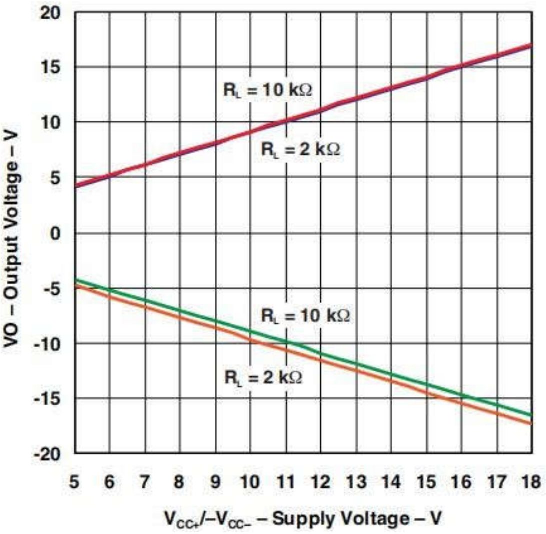
GAIN BANDWIDTH PRODUCT VS SUPPLY VOLTAGE



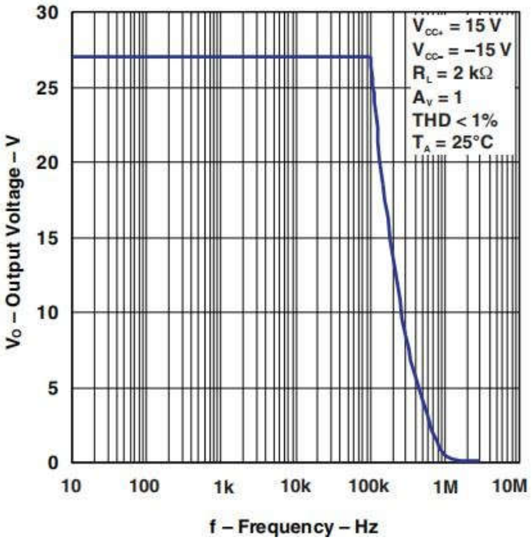
GAIN BANDWIDTH PRODUCT VS TEMPERATURE



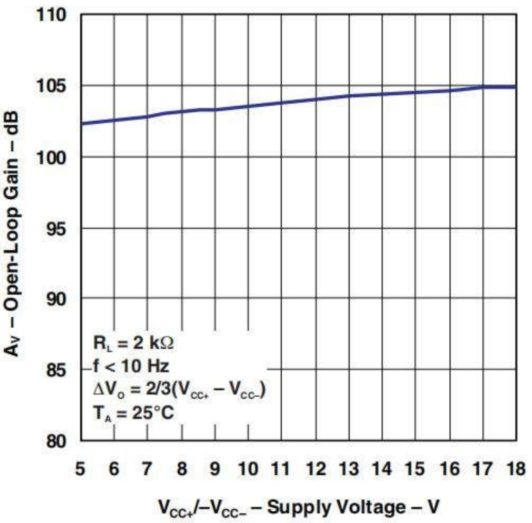
OUTPUT VOLTAGE VS SUPPLY VOLTAGE



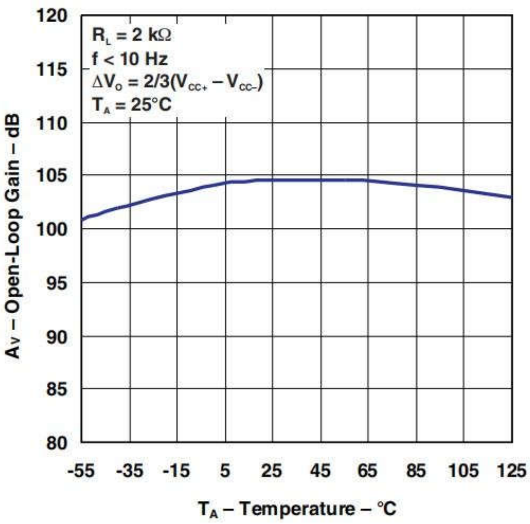
OUTPUT VOLTAGE VS FREQUENCY



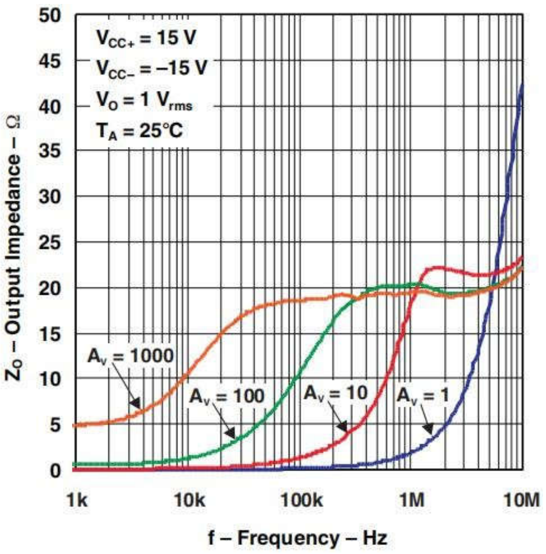
OPEN-LOOP GAIN VS SUPPLY VOLTAGE



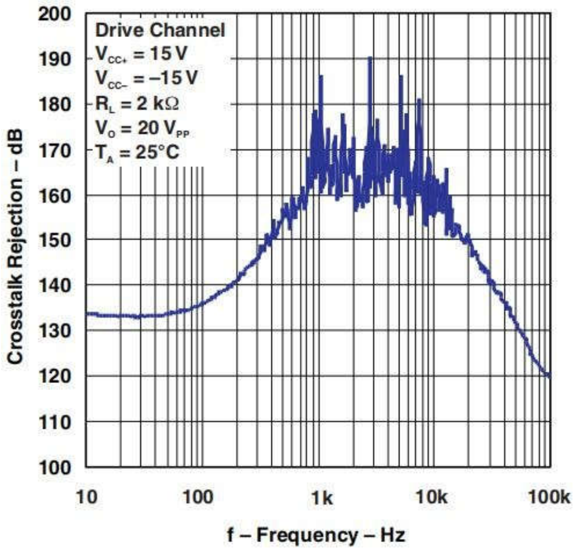
OPEN-LOOP GAIN VS TEMPERATURE



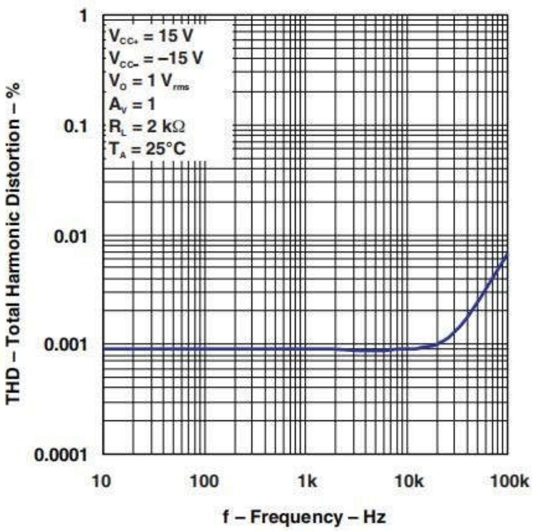
OUTPUT IMPEDANCE VS FREQUENCY



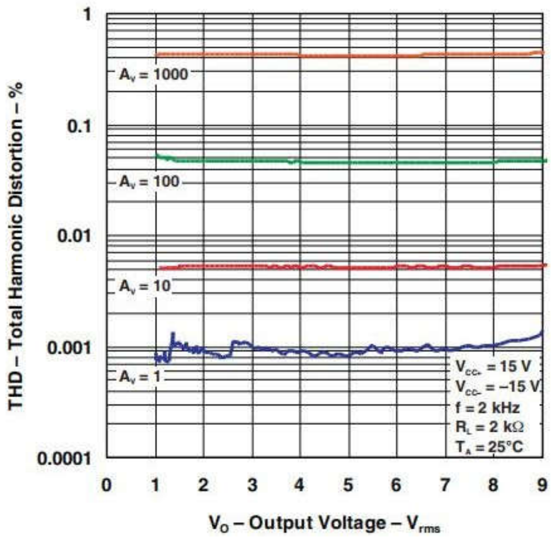
CROSSTALK REJECTION VS FREQUENCY



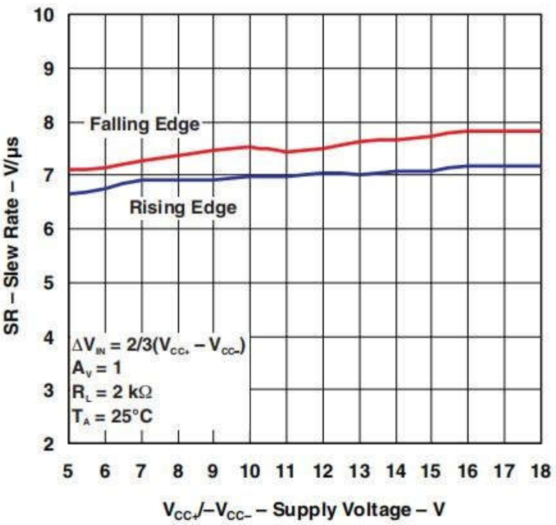
TOTAL HARMONIC DISTORTION VS FREQUENCY



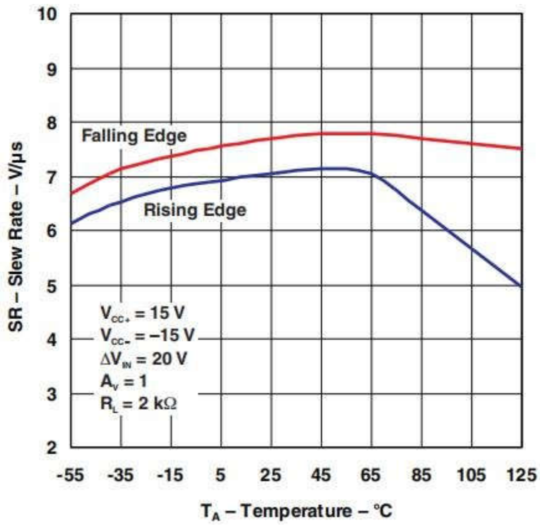
TOTAL HARMONIC DISTORTION VS OUTPUT VOLTAGE



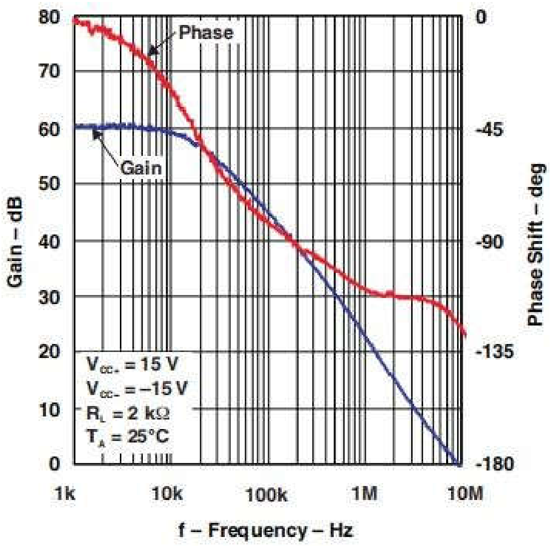
SLEW RATE VS SUPPLY VOLTAGE



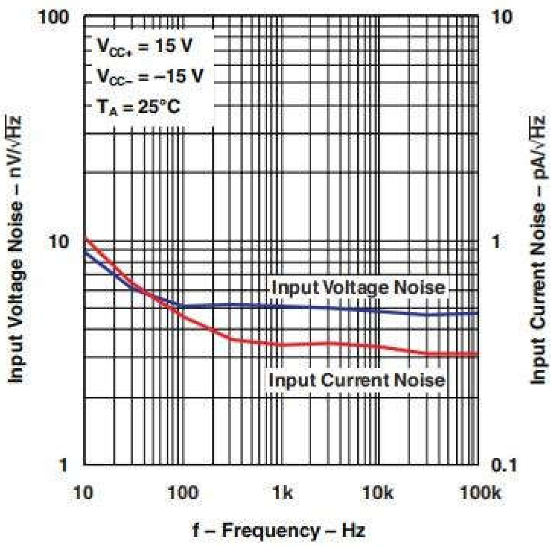
SLEW RATE VS TEMPERATURE



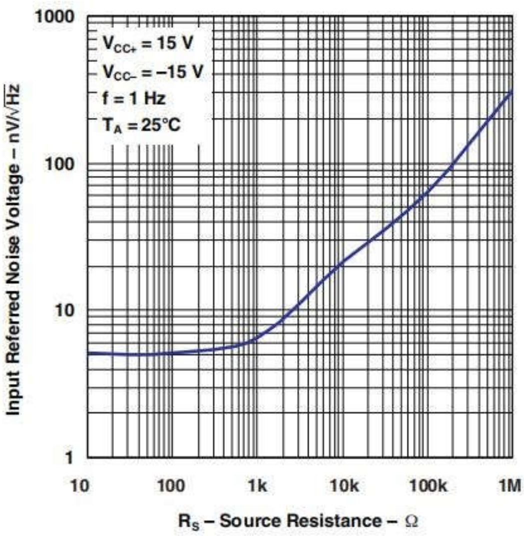
GAIN AND PHASE VS FREQUENCY



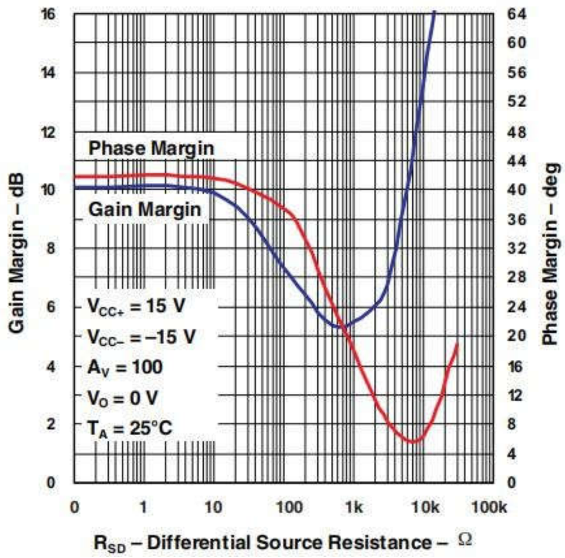
INPUT VOLTAGE AND CURRENT NOISE VS FREQUENCY



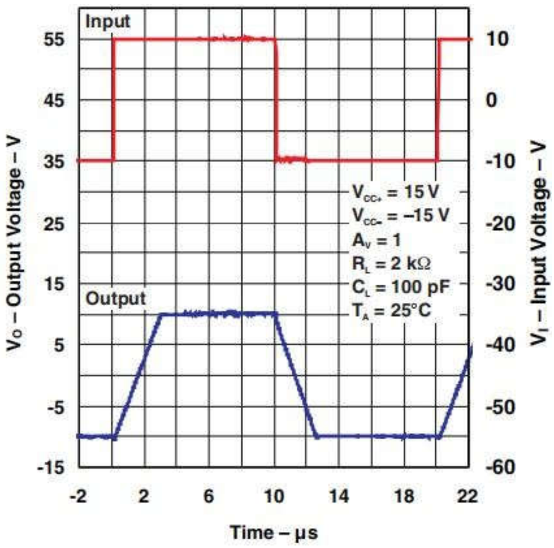
**INPUT REFERRED NOISE VOLTAGE
VS
SOURCE RESISTANCE**



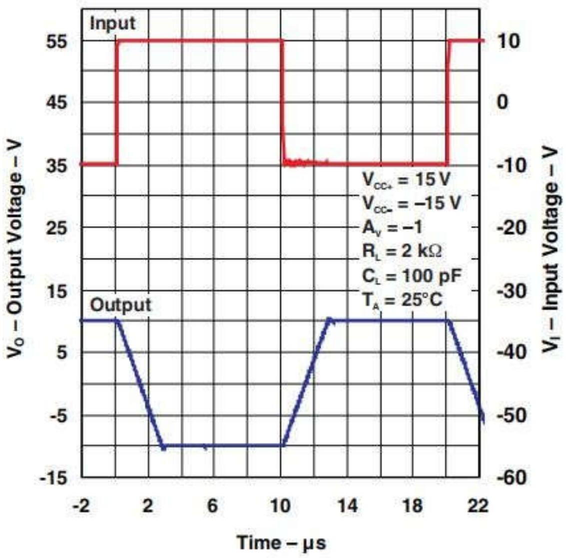
**GAIN AND PHASE MARGIN
VS
DIFFERENTIAL SOURCE RESISTANCE**



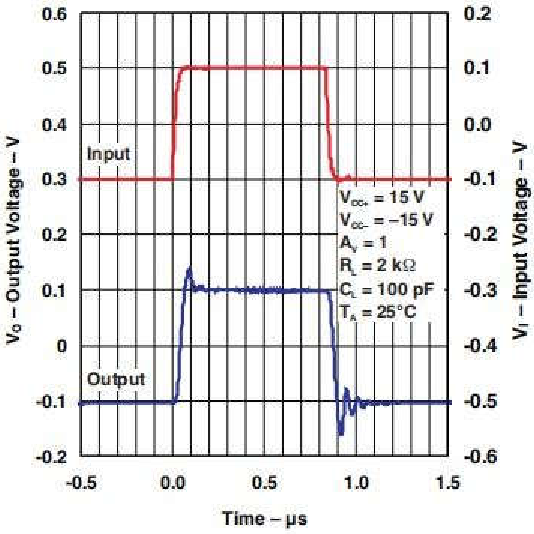
**LARGE SIGNAL TRANSIENT RESPONSE
(Av=1)**



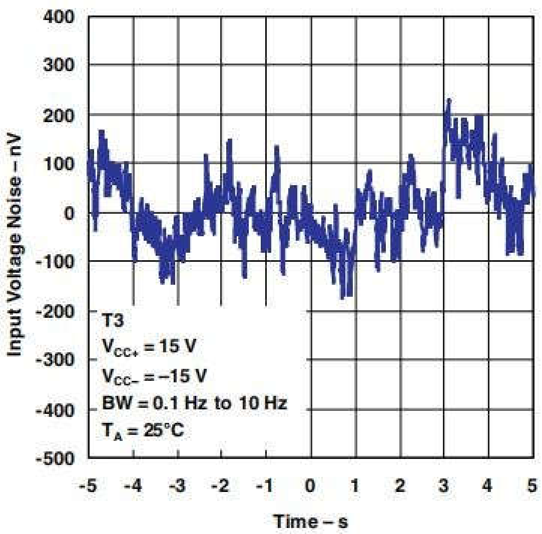
**LARGE SIGNAL TRANSIENT RESPONSE
(Av=-1)**



SMALL SIGNAL TRANSIENT RESPONSE



LOW_FREQUENCY NOISE

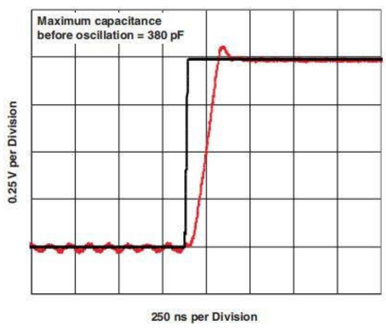


10. APPLICATION INFORMATION

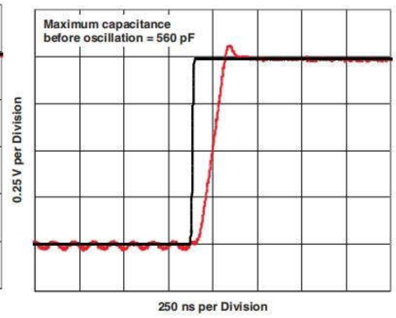
Output Characteristics

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).

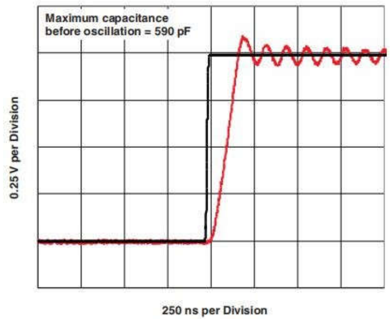
PULSE RESPONSE
(R_L= 600 Ω, C_L=380 pF)



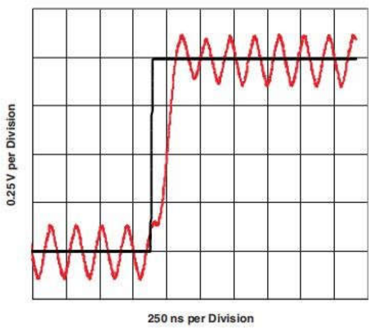
PULSE RESPONSE
(R_L= 2 kΩ, C_L=560 pF)



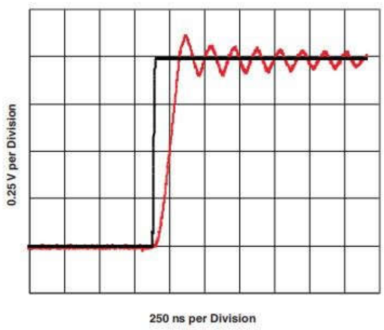
PULSE RESPONSE
(R_L = 10 kΩ, C_L=590 pF)



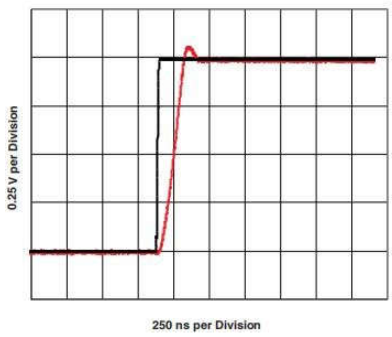
PULSE RESPONSE
(Ro=0Ω, Co=1000 pF,R_L=2 kΩ)



PULSE RESPONSE
(Ro=4 Ω, Co=1000 pF, R_L=2 kΩ)



PULSE RESPONSE
(Ro= 35 Ω, Co=1000 pF,R_L=2 kΩ)



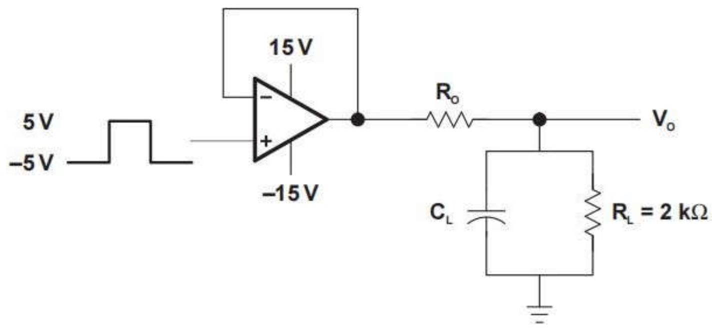


Figure 2. Output Characteristics

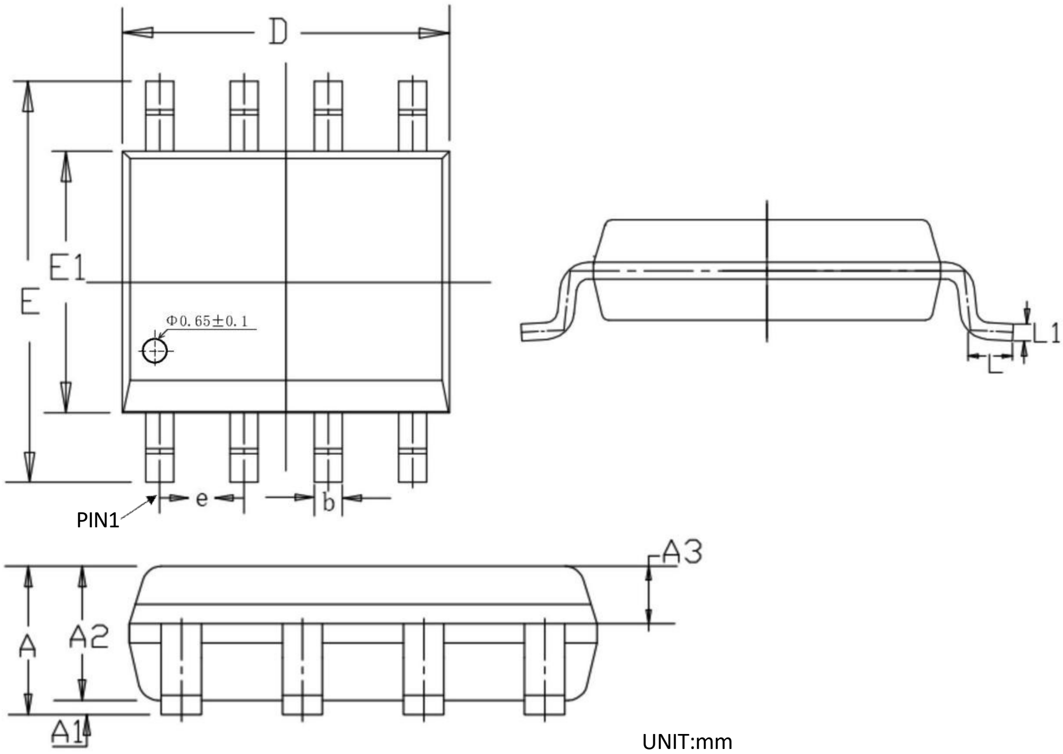
11. ORDERING INFORMATION

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

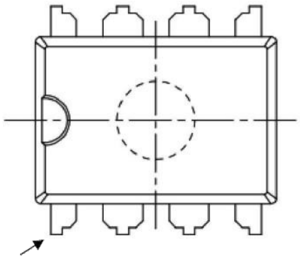
SOP8

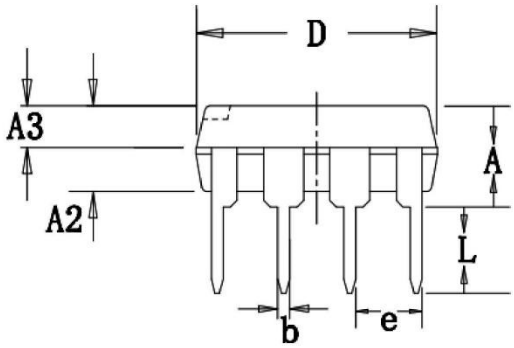


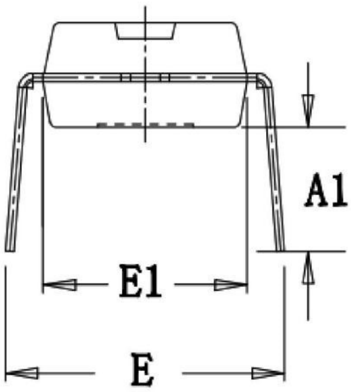
UNIT:mm

	MIN	NOM	MAX
A	1.450	1.550	1.650
A1	0.100	0.150	0.200
A2	1.300	1.400	1.500
A3	0.600	0.650	0.700
b	0.380	–	0.510
e	1.240	1.270	1.300
D	4.800	4.900	5.000
E	5.800	6.000	6.200
E1	3.800	3.900	4.000
L	0.450	0.600	0.750
L1	–	0.25BSC	–

DIP8



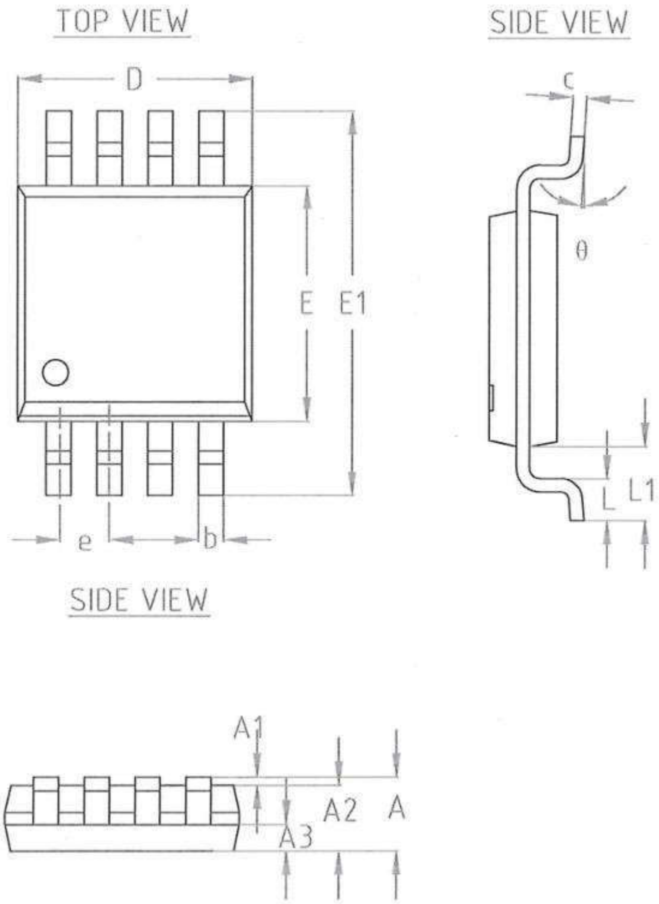




UNIT:mm

	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



SYMBOL	MIN	NOMINAL	MAX
	mm Dimensions		
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°