

## DIO32358

### 1.4MHz, 60 $\mu$ A, Rail-to-Rail I/O CMOS Amplifier

#### Features

- Rail-to-Rail Input and Output
- Maxim offset ( $V_{OS}$ ): @  $>0mV$
- Unity Gain Stable
- Gain Bandwidth Product: 1.4MHz
- Very low input bias currents: 5pA
- Wide supply range: 2.0V to 5.5V
- Input Voltage Range: 0V to +5V
- Ultra low power: 60 $\mu$ A per channel
- Small size packaging best for portable applications, available in SOIC-8 and MSOP-8

#### Applications

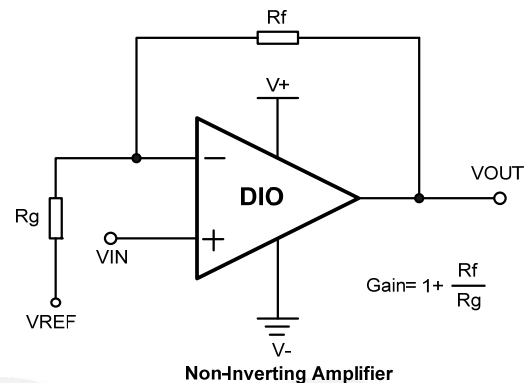
- ASIC Input or Output Amplifier
- Sensor Interface
- Piezo Electric Transducer Amplifier
- Medical Instrumentation
- Audio Output
- Portable Systems
- Smoke Detectors
- Notebook PC
- Battery-Powered equipment

#### Descriptions

DIO32358 is rail-to-rail CMOS operational amplifiers with ultra low offset. Features include wide input common-mode voltage range and broad output voltage swing with operating supply voltage from 2.0V to 5.5V. Products are fully specified over the extended  $-40$  to  $+125^{\circ}C$  temperature range.

DIO32358 provide 1.4MHz bandwidth consuming ultra low current of 60 $\mu$ A per channel. Very low input bias currents of 5pA enable them ideal for integrators, photodiode amplifiers, and piezoelectric sensors.

#### Typical Application



## Ordering Information

Order Part Number	Top Marking		T <sub>A</sub>	Package	
DIO32358MP8	DIO2358	RoHS or Green	-40 to +125°C	MSOP-8	Tape & Reel, 3000
DIO32358SO8	DIO2358	RoHS or Green	-40 to +125°C	SOIC-8	Tape & Reel, 2500

## Pin Assignments

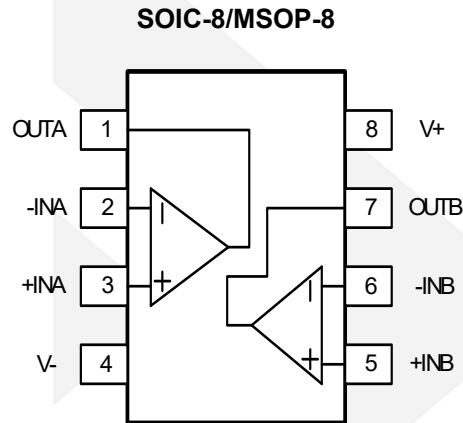


Figure 1 Pin Assignment

## Pin Description

Pin name	Description
V+	Positive supply
V-	Negative supply
+INX	Positive Input
-INX	Negative Input
OUTX	Output

## Absolute Maximum Ratings

Stresses beyond those listed under “Absolute Maximum Rating” may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other condition beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Parameter		Rating	Unit
Supply Voltage		7	V
Input Voltage		(V <sub>-</sub> )-0.5 to 7	V
Storage Temperature Range		-65 to 150	°C
Junction Temperature		150	°C
Lead Temperature Range		260	°C
ESD	HBM, JEDEC: JESD22-A114	8	kV
	CDM, JEDEC: JESD22-C101	2	

## Recommended Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual device operation to ensure optimal performance to the datasheet specifications. DIOO does not recommend exceeding them or designing to Absolute Maximum Ratings.

Parameter		Rating	Unit
Supply Voltage		2.1 to 5.5	V
Input Voltage		0 to 5	V
Operating Temperature Range		-40 to 125	°C



## Electrical Characteristics

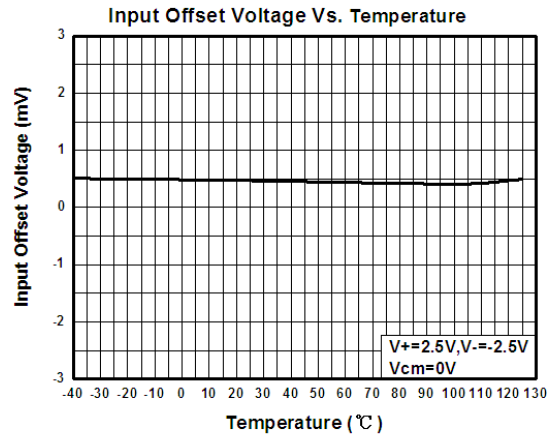
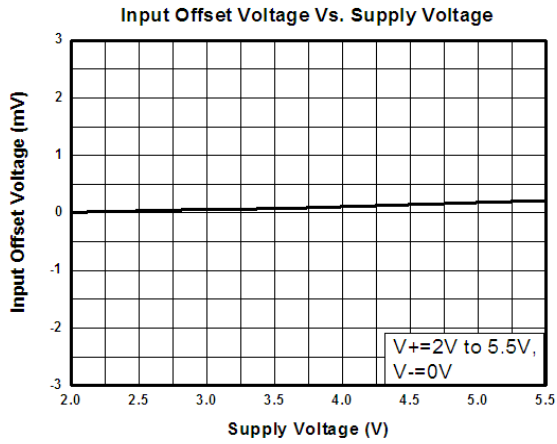
Typical value:  $V_+ = 5V$ ,  $R_L = 100k\Omega$  to  $V_+/2$ ,  $T_A = 25^\circ C$ , unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
<b>INPUT CHARACTERISTICS</b>						
$V_{OS}$	Input Offset Voltage	$-40^\circ C \leq T_A \leq 125^\circ C$ , $V_+ = 2V$ to $5V$	0	3	6	mV
$I_B$	Input Bias Current	$-40^\circ C \leq T_A \leq 125^\circ C$ , $V_+ = 2V$ to $5V$		5		pA
$I_{OS}$	Input Offset Current	$-40^\circ C \leq T_A \leq 125^\circ C$ , $V_+ = 2V$ to $5V$		5		pA
$V_{CM}$	Common Mode Voltage Range		0.1		( $V_+$ ) +0.1	V
CMRR	Common Mode Rejection Ratio	$-40^\circ C \leq T_A \leq 125^\circ C$ , $V_{CM} = -0.1$ to $(V_+) + 0.1$		75		dB
$A_{OL}$	Open Loop Voltage Gain	$R_L = 5k\Omega$ , $V_O = 0.1$ to $(V_+) - 0.1$	80	100		dB
		$R_L = 200k\Omega$ , $V_O = 0.1$ to $(V_+) - 0.1$	90	110		
$\Delta V_{OS}/\Delta T$	Input Offset Voltage Drift	$-40^\circ C \leq T_A \leq 125^\circ C$			5	$\mu V/^\circ C$
<b>OUTPUT CHARACTERISTICS</b>						
$V_{OH}$	Output Voltage High	$V_+ = 5V$ , $R_L = 100k\Omega$ , $-40^\circ C \leq T_A \leq 125^\circ C$		4.995		V
		$V_+ = 2.0V$ , $R_L = 100k\Omega$ , $-40^\circ C \leq T_A \leq 125^\circ C$		1.958		
$V_{OL}$	Output Voltage Low	$V_+ = 5V$ , $R_L = 100k\Omega$ , $-40^\circ C \leq T_A \leq 125^\circ C$		5		mV
		$V_+ = 2.0V$ , $R_L = 100k\Omega$ , $-40^\circ C \leq T_A \leq 125^\circ C$		5		
$I_{SC}$	Output Short Circuit Current	Source $I_{SC}$ , $V_+ = 5V$		40		mA
		Sink $I_{SC}$ , $V_+ = 5V$		40		
<b>POWER SUPPLY</b>						
PSRR	Power Supply Rejection Ration		65	85		dB
$I_S$	Supply Current per Channel/Amp	$-40^\circ C \leq T_A \leq 125^\circ C$		60		$\mu A$
<b>DYNAMIC PERFORMANCE</b>						
GBP	Gain Bandwidth Product	$R_L = 100K$ , $C_L = 100pF$		1.4		MHz
SR	Slew Rate	$G = 1$ , 2V Output Step		0.6		$V/\mu s$
$t_s$	Setting Time	$G = 1$ , 2V Output Step		2.4		$\mu s$
<b>NOISE PERFORMANCE</b>						
THD	Total Harmonic Distortion	$f = 10kHz$ , 2V Output Step, $R_L = 10k\Omega$		0.019		%
$e_n$	Voltage Noise Density	$f = 1kHz$		45		$nV/\sqrt{Hz}$
		$f = 10kHz$		35		

Specifications subject to change without notice.

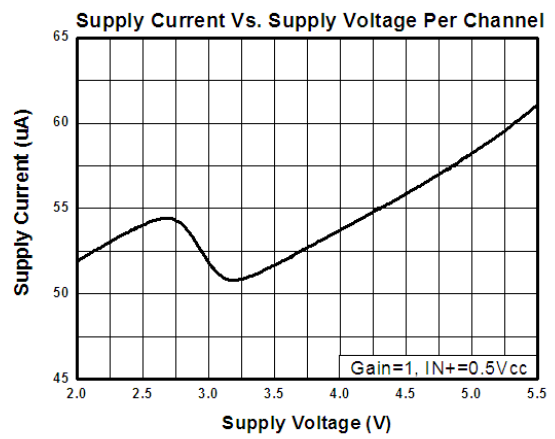
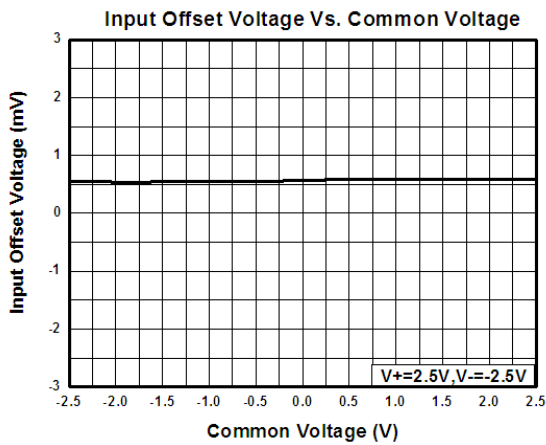
## Typical Performance Characteristics

All typical value are at  $V_+ = 2.5V$ ,  $V_- = -2.5V$ ,  $T_A = 25^\circ C$ , unless otherwise specified.



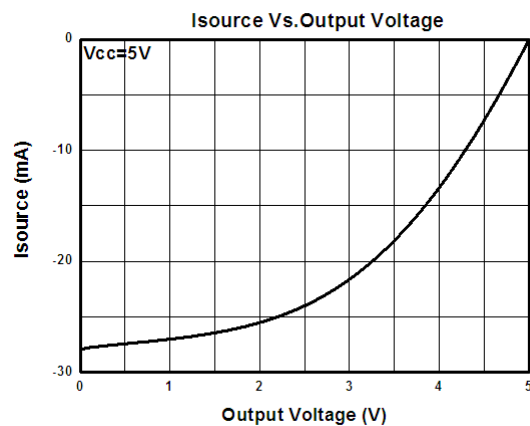
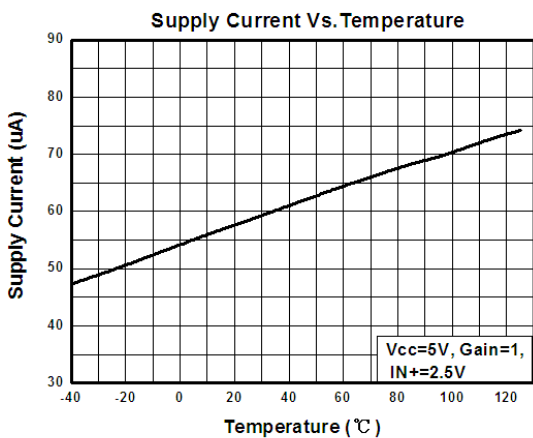
**Input Offset Voltage Vs. Supply Voltage**

**Input Offset Voltage Vs. Temperature**



**Input Offset Voltage Vs. Common Voltage**

**Supply Current Vs. Supply Voltage Per Channel**

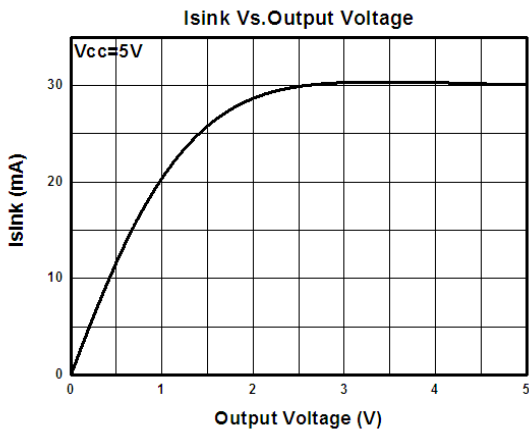


**Supply Current Vs. Temperature**

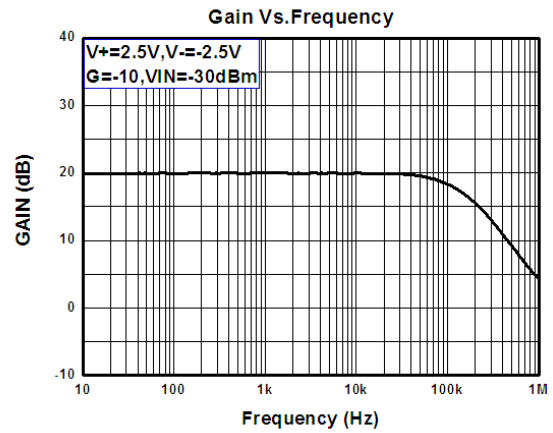
**Isource Vs. Output Voltage**

## Typical Performance Characteristics(continued)

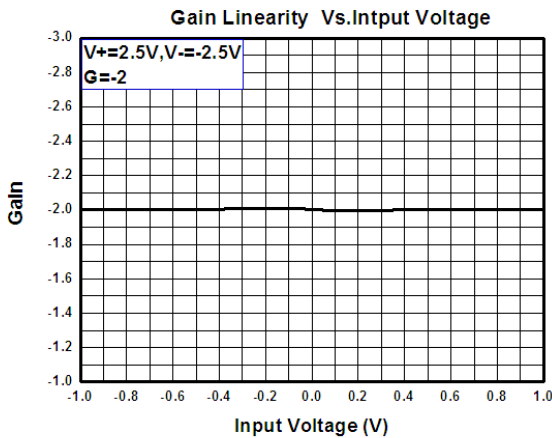
All typical value are at  $V_+=2.5V$ ,  $V_-=-2.5V$ ,  $T_A = 25^\circ C$ , unless otherwise specified.



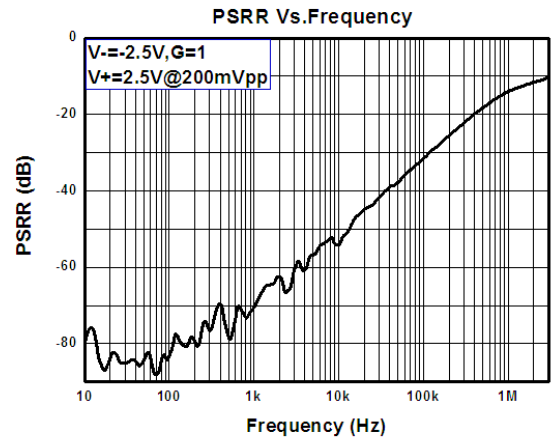
Isink Vs. Output Voltage



Gain Vs. Frequency



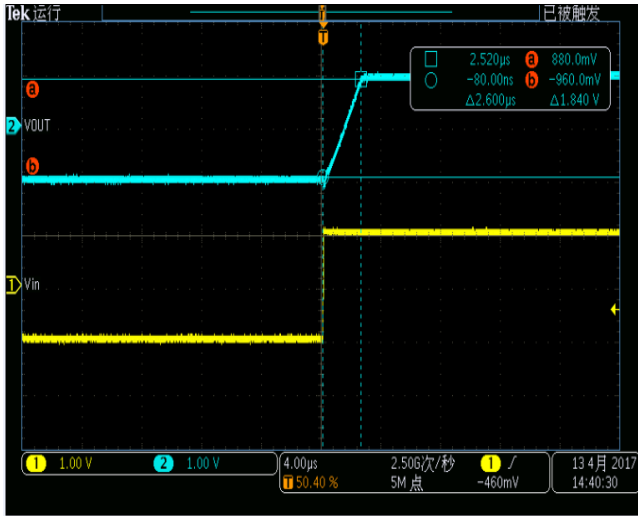
Gain Linearity Vs. Input Voltage



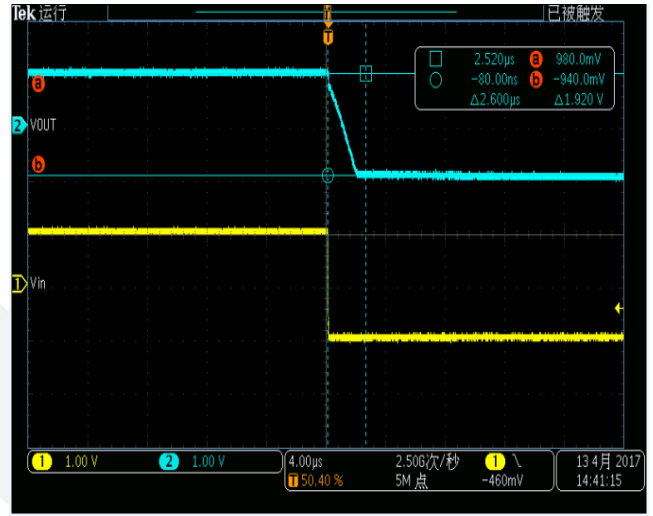
PSRR Vs. Frequency

## Typical Performance Characteristics(continued)

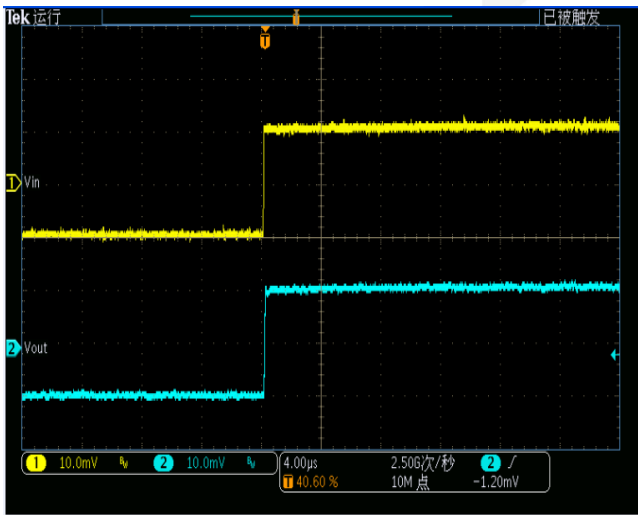
All typical value are at  $V_+ = 2.5V$ ,  $V_- = -2.5V$ ,  $G = 1$ ,  $R_L = 1M\Omega$ ,  $T_A = 25^\circ C$ , unless otherwise specified.



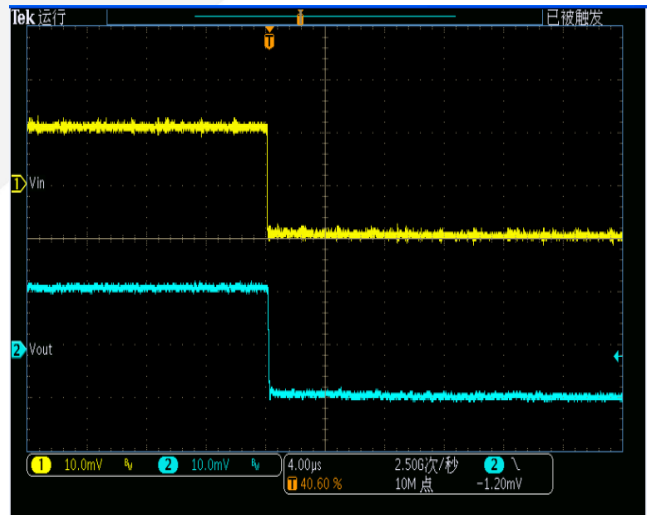
Slew Rate



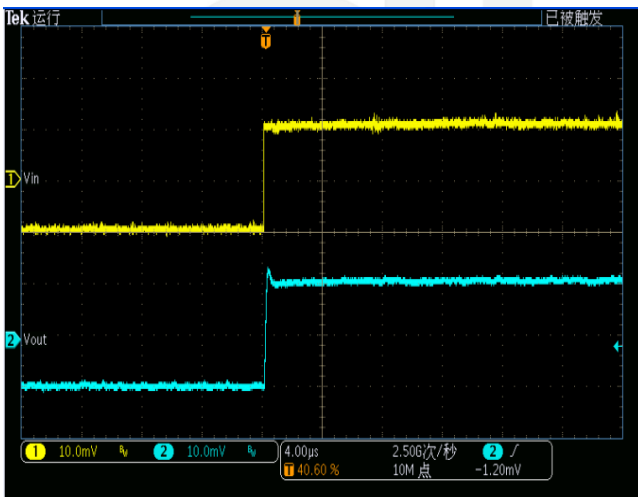
Slew Rate



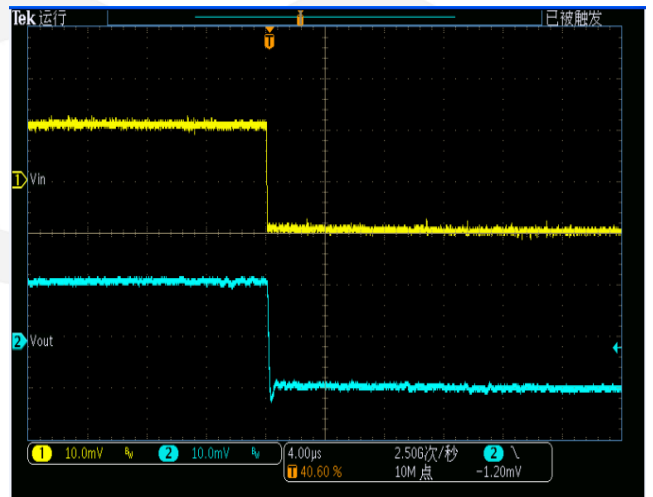
Small-Signal Response ( $C_L = \text{No Load}$ )



Small-Signal Response ( $C_L = \text{No Load}$ )

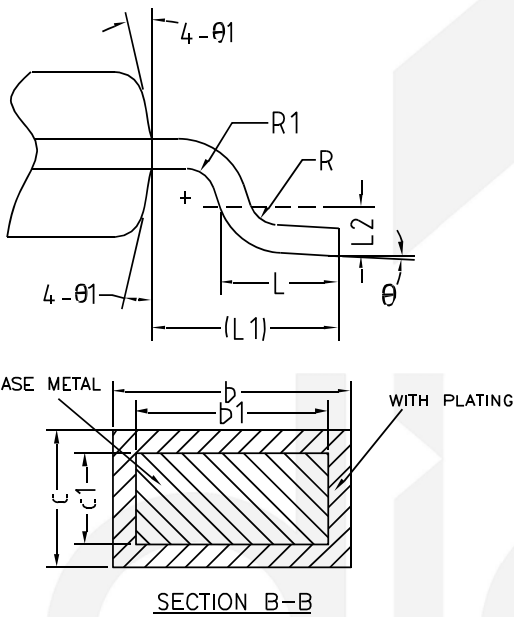
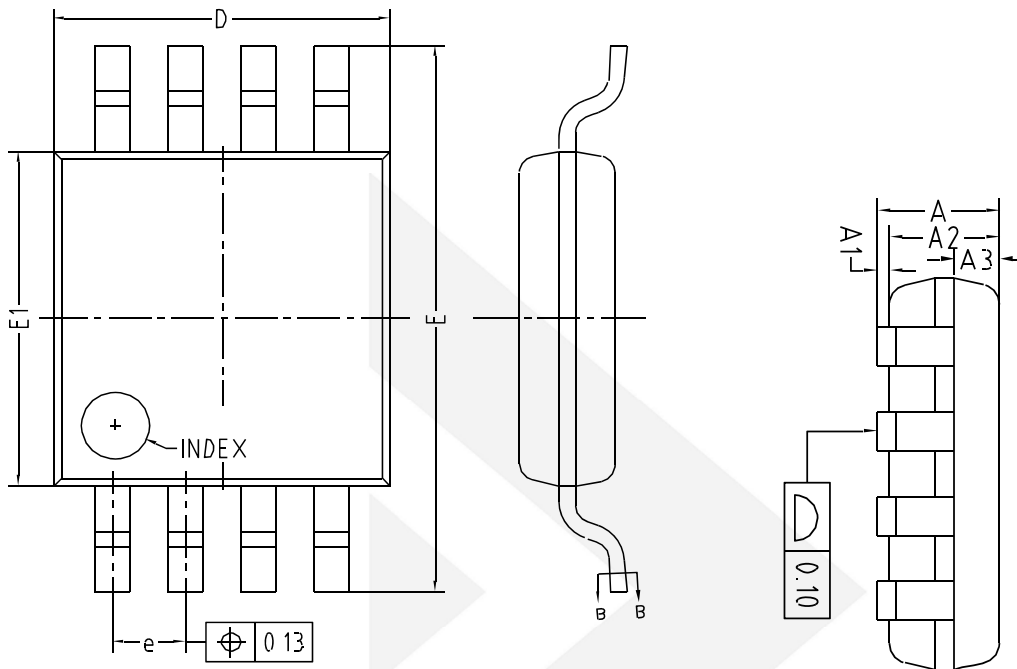


Small-Signal Response ( $C_L = 200pF$ )



Small-Signal Response ( $C_L = 200pF$ )

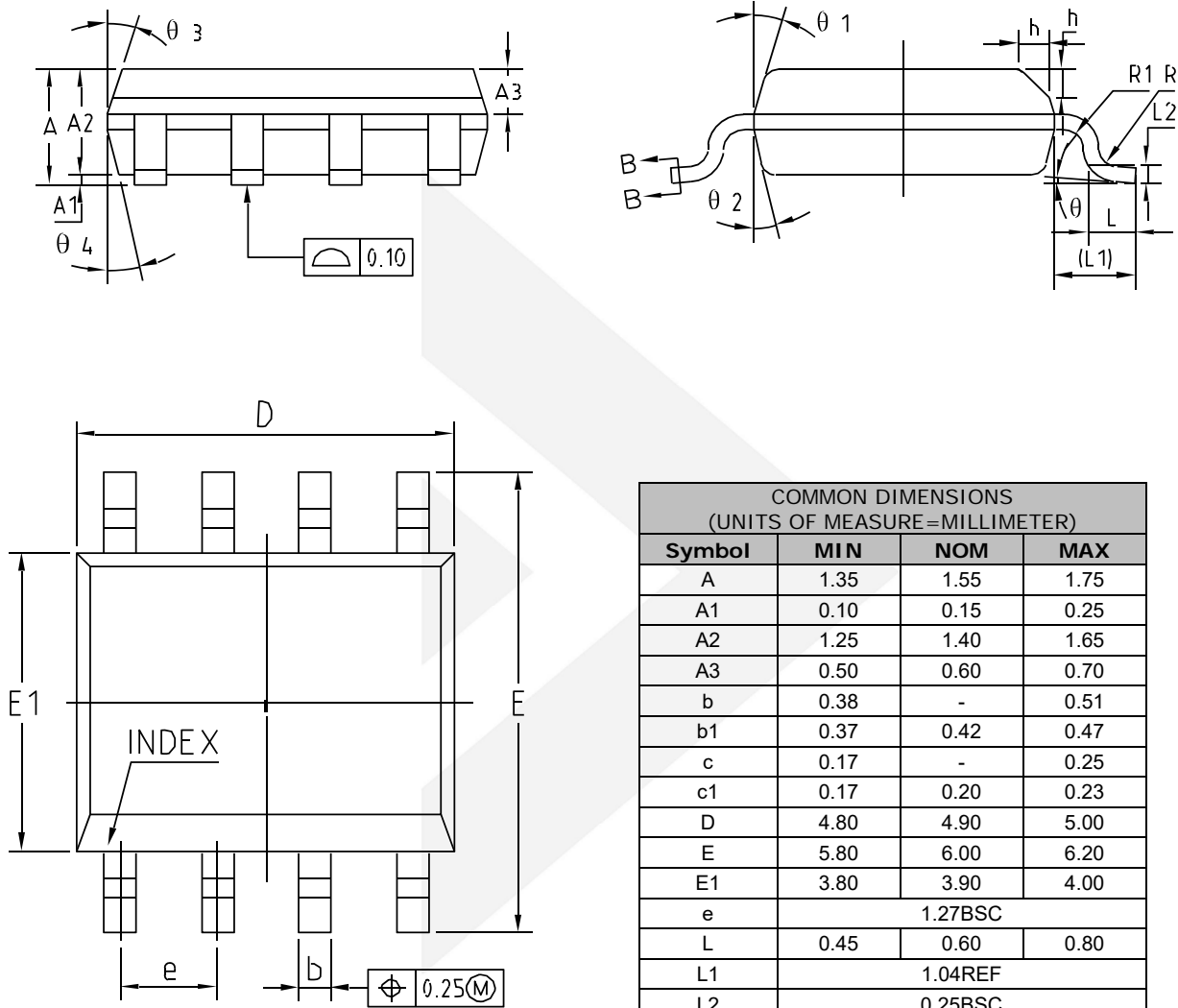
## Physical Dimensions: MSOP-8



COMMON DIMENSIONS (UNITS OF MEASURE=MILLIMETER)			
Symbol	MIN	NOM	MAX
A	-	-	1.10
A1	0	-	0.15
A2	0.75	0.85	0.95
A3	0.25	0.35	0.39
b	0.28	-	0.37
b1	0.27	0.30	0.33
c	0.15	-	0.20
c1	0.14	0.15	0.16
D	2.90	3.00	3.10
E	4.70	4.90	5.10
E1	2.90	3.00	3.10
e	0.55	0.65	0.75
L	0.45	0.60	0.80
L1	0.95REF		
L2	0.25BSC		
R	0.07	-	-
R1	0.07	-	-
θ	0°	-	8°
θ1	9°	12°	15°



## Physical Dimensions: SOIC-8



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