

# DIO2022x

## 190 $\mu$ A, 3 MHz RRIO CMOS Amplifier

### Features

- Rail-to-rail input and output
- $\pm 1$  mV typical offset ( $V_{OS}$ )
- $V_{OSMAX}$  specificity:  $\pm 5$  mV
- Low distortion
- Gain bandwidth product: 3 MHz
- Wide supply range: 2.5 V to 5.5 V
- 190 $\mu$ A/Amplifier typical supply current
- Slew rate: 1.7 V/ $\mu$ s
- Small size packaging best for portable applications.
- DIO20221: available in SC70-5, SOT23-5  
DIO20222: available in MSOP-8, SOIC-8  
DIO20224: available in SOIC-14 & TSSOP-14

### Applications

- Portable equipment
- Active filters
- Data acquisition
- Portable equipment
- Test equipment
- Broadband communication
- Process control
- Audio and video processing

### Ordering Information

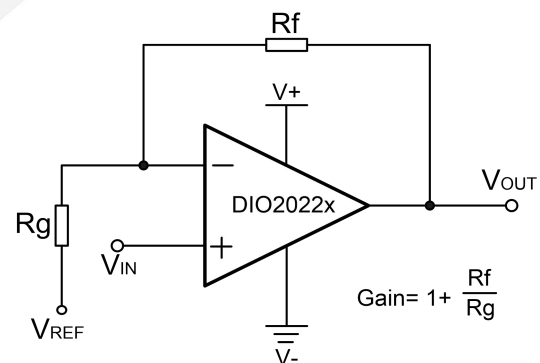
Order Part Number	Top Marking	RoHS	T <sub>A</sub>	Package	
DIO20221SC5	YWXC	Green	-40 to 125°C	SC70-5	Tape & Reel, 3000
DIO20221ST5	YWXC	Green	-40 to 125°C	SOT23-5	Tape & Reel, 3000
DIO20222MP8	DIO2022	Green	-40 to 125°C	MSOP-8	Tape & Reel, 3000
DIO20222SO8	DIO2022	Green	-40 to 125°C	SOIC-8	Tape & Reel, 2500
DIO20224CS14	DIO2024	Green	-40 to 125°C	SOIC-14	Tape & Reel, 2500
DIO20224CT14	DIO2024	Green	-40 to 125°C	TSSOP-14	Tape & Reel, 2500

### Descriptions

The DIO2022x is a rail-to-rail I/O operational amplifier which allows low load impedances to be driven. With a 3 MHz unity-gain frequency and low noise, low distortion and high output current capability, the DIO2022x provides excellent choice for high quality systems. The input common-mode voltage range includes ground, and the maximum input offset voltage is  $\pm 1$  mV (guaranteed). They are also capable of comfortably driving large capacitive loads.

DIO2022x is offered in RoHS or Green package and ESD (HBM) 8 kV. It is specified over the extended -40 to 125°C

### Typical Application



Non-Inverting Amplifier

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## 1. Pin Assignments

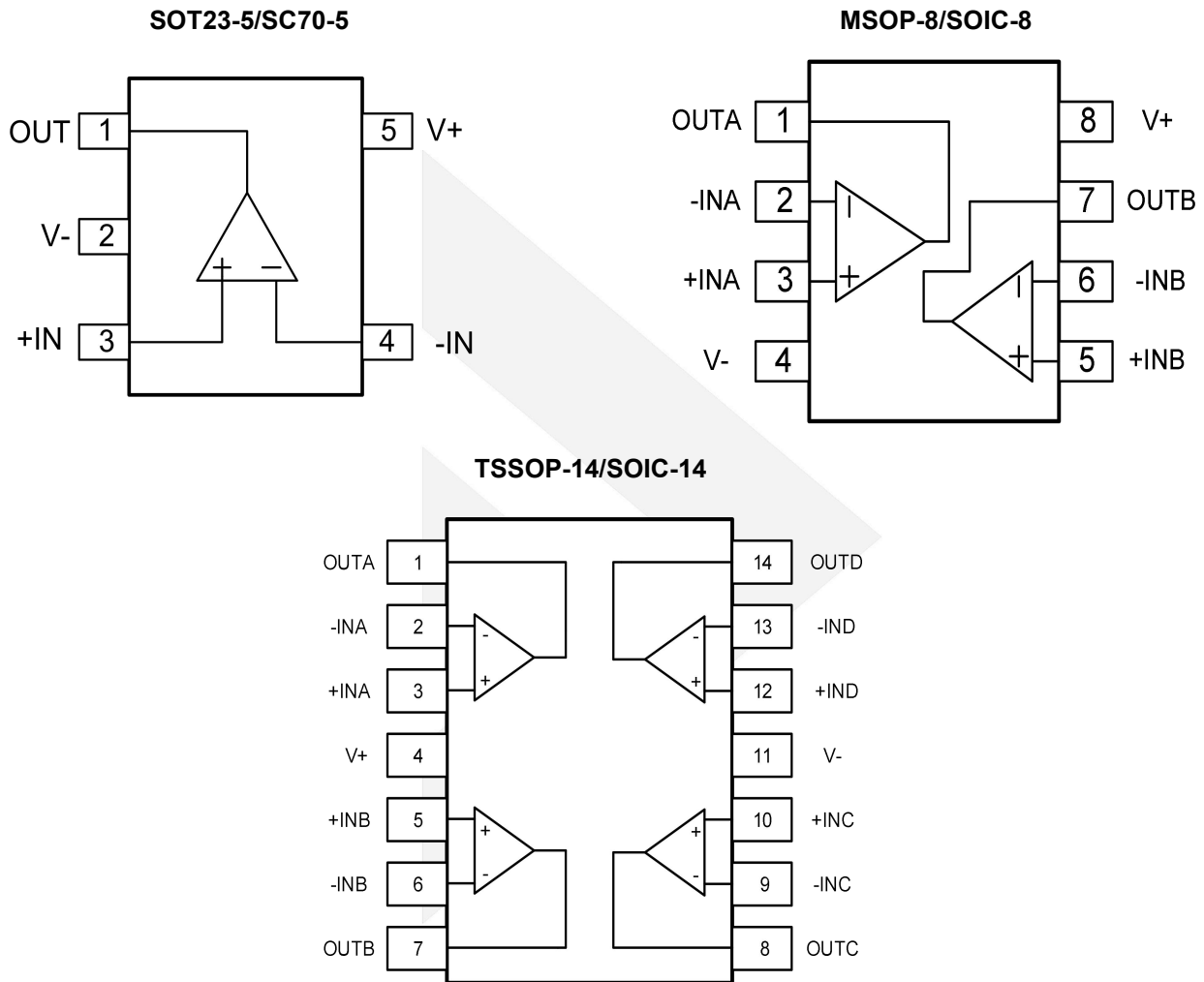


Figure 1. Pin assignment (top view)

## Pin Description

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

## 2. 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. DIOO does not recommend exceeding them or designing to Absolute Maximum Ratings.

Parameter		Rating	Unit
Supply voltage		7.5	V
Input voltage		(V <sub>-</sub> )-0.5 to (V <sub>+</sub> )+0.5	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	

## 3. Recommended Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual device operation to ensure optimal performance to the datasheet specifications.

Parameter		Rating	Unit
Supply voltage		2.5 to 5.5	V
Input voltage		0 to 5	V
Operating temperature range		-40 to 125	°C



## 4. Electrical Characteristics

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

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
<b>Input characteristics</b>						
$V_{OS}$	Input offset voltage	$-40^\circ\text{C} \leq T_A \leq 125^\circ\text{C}$ , $V_+ = 2.5\text{ V to } 5.5\text{ V}$		$\pm 1.0$	$\pm 5.0$	mV
$I_B$	Input bias current	$-40^\circ\text{C} \leq T_A \leq 125^\circ\text{C}$ , $V_+ = 2.5\text{ V to } 5.5\text{ V}$		10		pA
$I_{OS}$	Input offset current	$-40^\circ\text{C} \leq T_A \leq 125^\circ\text{C}$ , $V_+ = 2.5\text{ V to } 5.5\text{ V}$		1.0	10	pA
$V_{CM}$	Common mode voltage range	$V_+ = 5.5\text{ V}$	-0.1		( $V_+$ ) +0.1	V
CMRR	Common mode rejection ratio	$-40^\circ\text{C} \leq T_A \leq 125^\circ\text{C}$ , $V_{CM} = -0.1\text{ to } 5.6\text{ V}$ , $V_+ = 5.5\text{ V}$	80	120		dB
$A_{OL}$	Open loop voltage gain	$R_L = 600\ \Omega$ , $V_o = 0.1\text{ to } 4.9$	90	120		dB
$\Delta V_{OS}/\Delta T$	Input offset voltage drift	$-40^\circ\text{C} \leq T_A \leq 125^\circ\text{C}$		2.5		$\mu\text{V}/^\circ\text{C}$
<b>Output characteristics</b>						
	Output voltage swing from rail	$R_L = 600\ \Omega$ , $-40^\circ\text{C} \leq T_A \leq 125^\circ\text{C}$			0.1	V
		$R_L = 10\text{ k}\Omega$ , $-40^\circ\text{C} \leq T_A \leq 125^\circ\text{C}$			0.015	
$I_{OUT}$	Output current	$V_+ = 5\text{ V}$	80	85		mA
		$V_+ = 2.5\text{ V}$	5	15		
$R_o$	Closed loop output impedance	$f = 100\text{ kHz}$ , $G = +1$ , $V_+ = 5\text{ V}$		2.0		$\Omega$
		$f = 100\text{ kHz}$ , $G = +1$ , $V_+ = 2.5\text{ V}$		4.2		
<b>Power supply</b>						
PSRR	Power supply rejection ratio		70	80		dB
$I_S$	Supply current per channel/amp	$V_+ = 5\text{ V}$ , $-40^\circ\text{C} \leq T_A \leq 125^\circ\text{C}$		190	300	$\mu\text{A}$
		$V_+ = 2.5\text{ V}$ , $-40^\circ\text{C} \leq T_A \leq 125^\circ\text{C}$		160	280	
<b>Dynamic performance</b>						
GBP	Gain bandwidth product	$R_L = 10\text{ k}\Omega$		3.0		MHz
SR	Slew rate	$R_L = 600\ \Omega$ , $G = 1$ , 2 V output step		1.7		V/ $\mu\text{s}$
$t_s$	Setting time	$R_L = 600\ \Omega$ , $G = 1$ , 2 V output step			1.0	$\mu\text{s}$
$X_{talk}$	Channel separation	$f = 1\text{ kHz}$ , $R_L = 10\text{ k}\Omega$		110		dB
	Overload recovery time	$V_{IN} \times \text{Gain} = V_+$		1.0		$\mu\text{s}$
<b>Noise performance</b>						
THD	Total harmonic distortion	$f = 10\text{ kHz}$ , 1 V output step, $R_L = 600\ \Omega$ and 100 pF		0.015		%
$e_n$	Voltage noise density	$f = 1\text{ kHz}$ , $V_+ = 5\text{ V}$		27		nV/ $\sqrt{\text{Hz}}$
		$f = 10\text{ kHz}$ , $V_+ = 5\text{ V}$		18		

**Note:**

(1) Specifications subject to change without notice.

## 5. Typical Performance Characteristics

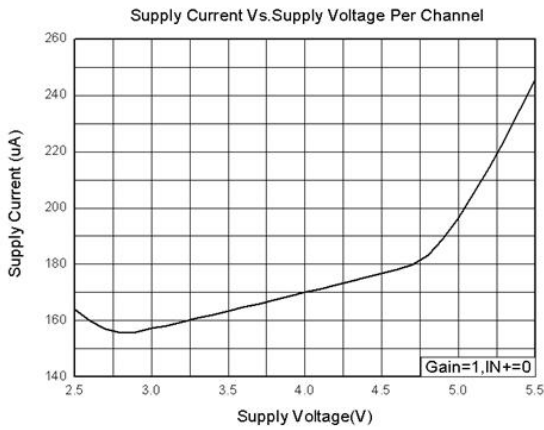


Figure 2 Supply current vs. Supply voltage per channel

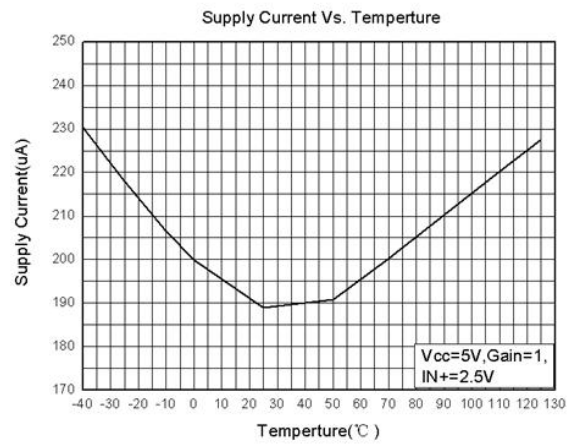


Figure 3 Supply current vs Temperature

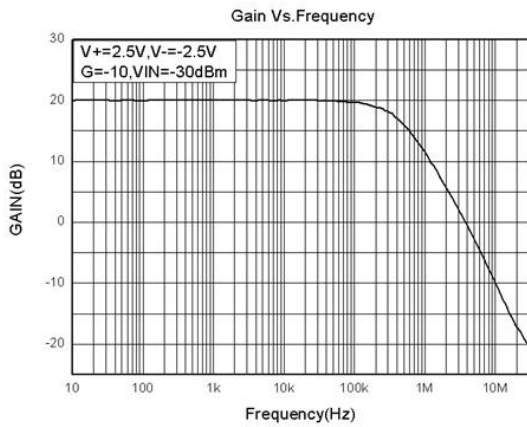


Figure 4 Gain vs. Frequency

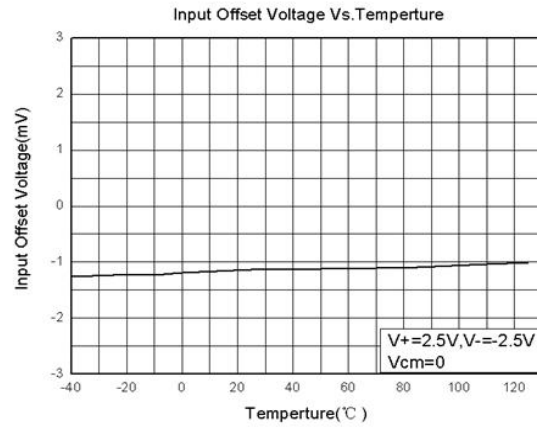


Figure 5 Input offset voltage vs. Temperature

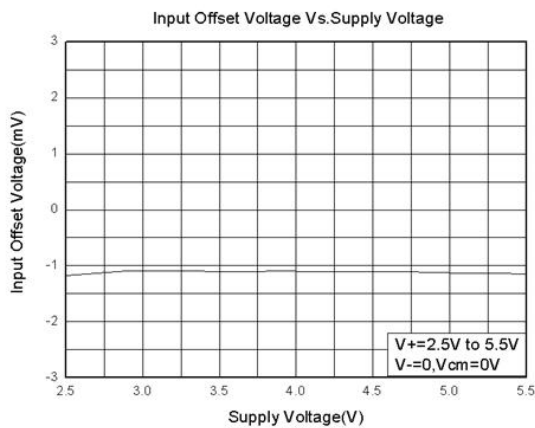


Figure 6 Input offset voltage vs. Supply voltage

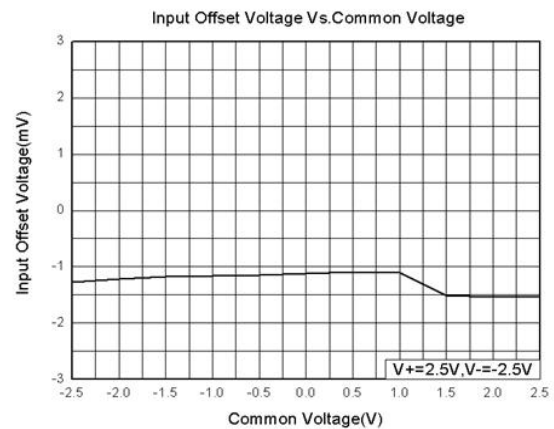


Figure 7 Input offset voltage vs. Common voltage

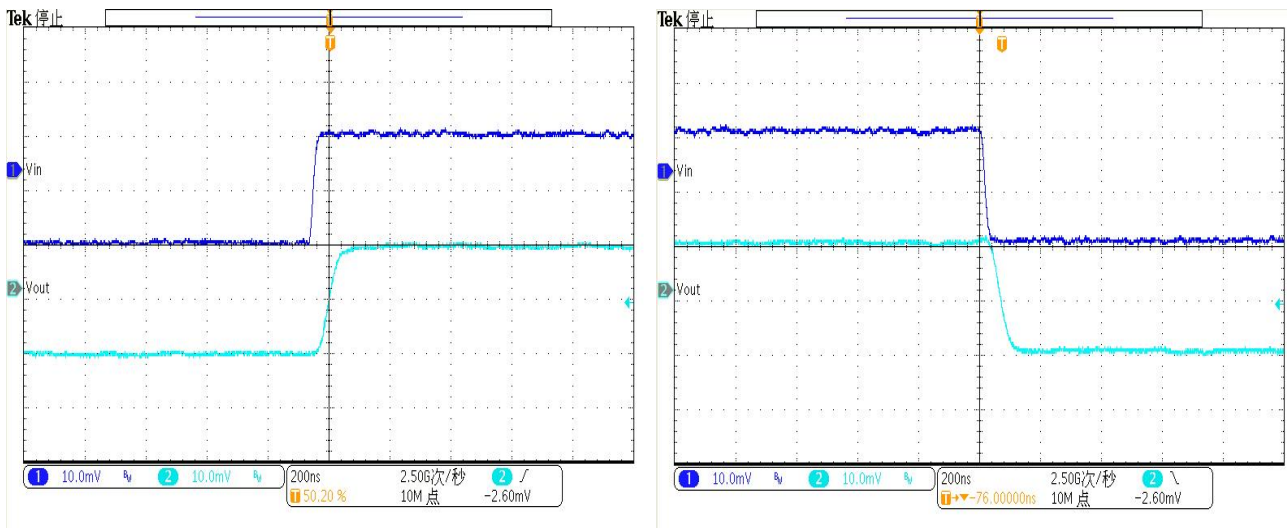


Figure 8 Small-signal response ( $V^+ = 5\text{ V}$ ,  $C_L = 200\text{ pF}$ )

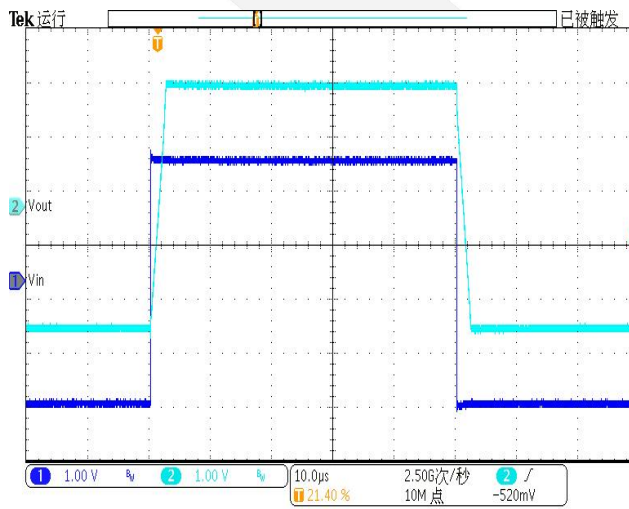
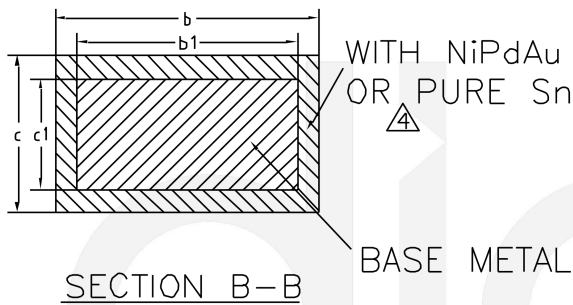
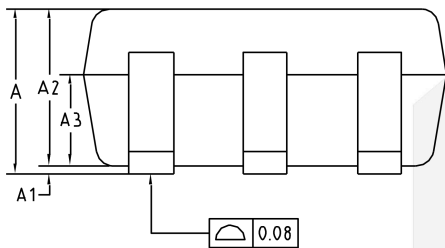
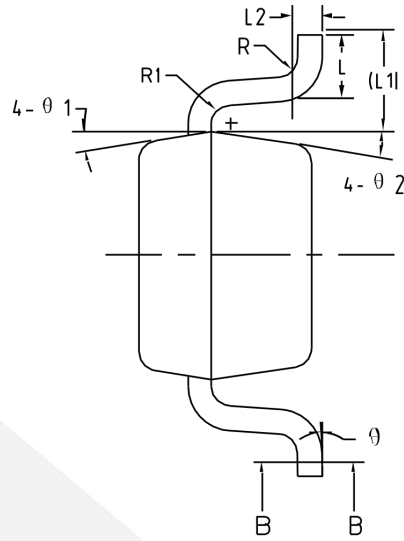
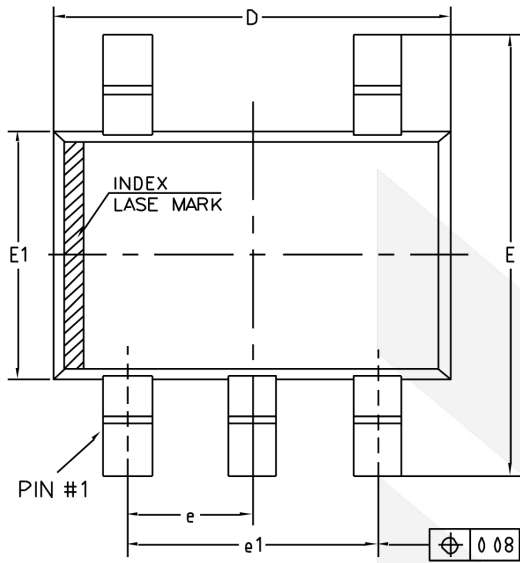


Figure 9 Large-signal response ( $V^+ = 5\text{ V}$ ,  $R_L = 1\text{ M}\Omega$ )



## 6. Physical Dimensions

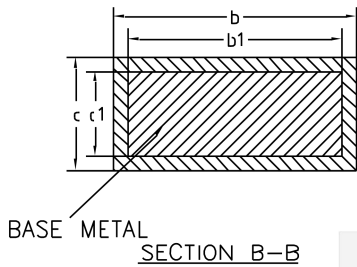
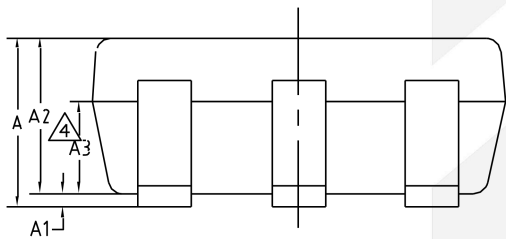
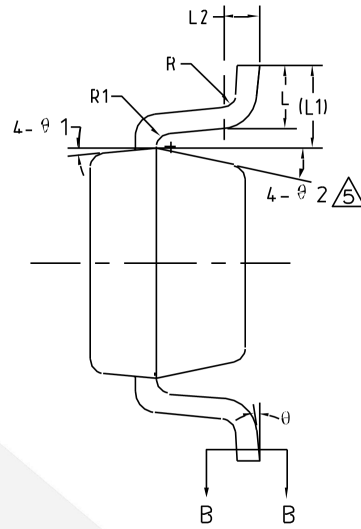
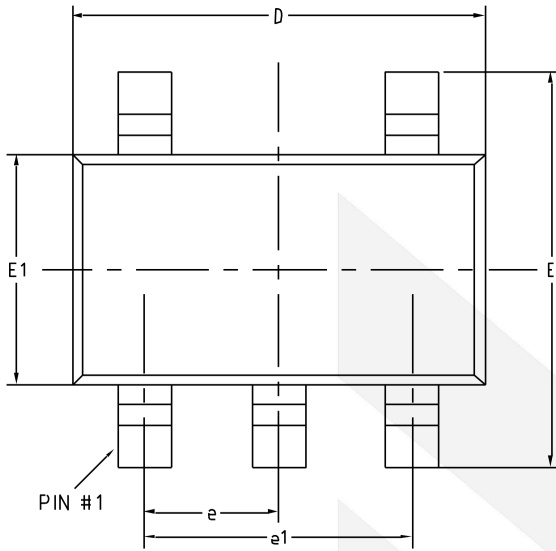
### 6.1 SC70-5



Common Dimensions (Units of measure = Millimeter)			
Symbol	Min	Nom	Max
A	0.85	-	1.05
A1	0	-	0.10
A2	0.80	0.90	1.00
A3	0.47	0.52	0.57
b	0.22	-	0.29
b1	0.22	0.25	0.28
c	0.115	-	0.15
c1	0.115	0.13	0.14
D	2.02	2.07	2.12
E	2.20	2.30	2.40
E1	1.25	1.30	1.35
e	0.65 BSC		
e1	1.30 BSC		
L	0.28	0.33	0.38
L1	0.50 REF		
L2	0.15 BSC		
R	0.10	-	-
R1	0.10	-	0.25
$\theta$	0°	-	8°
$\theta$ 1	6°	9°	12°
$\theta$ 2	6°	9°	12°

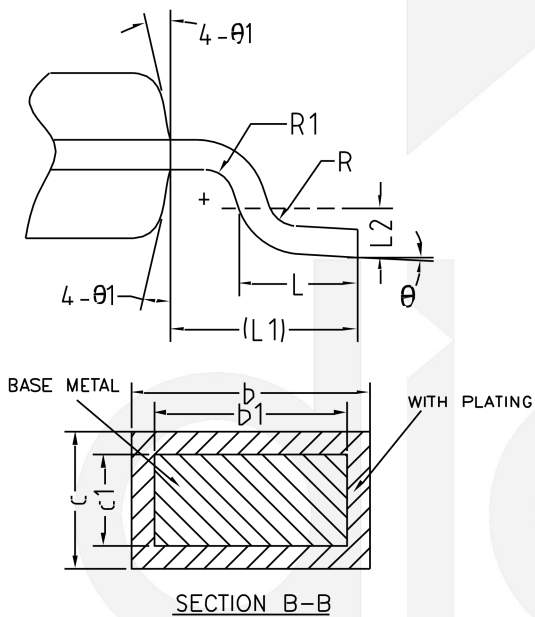
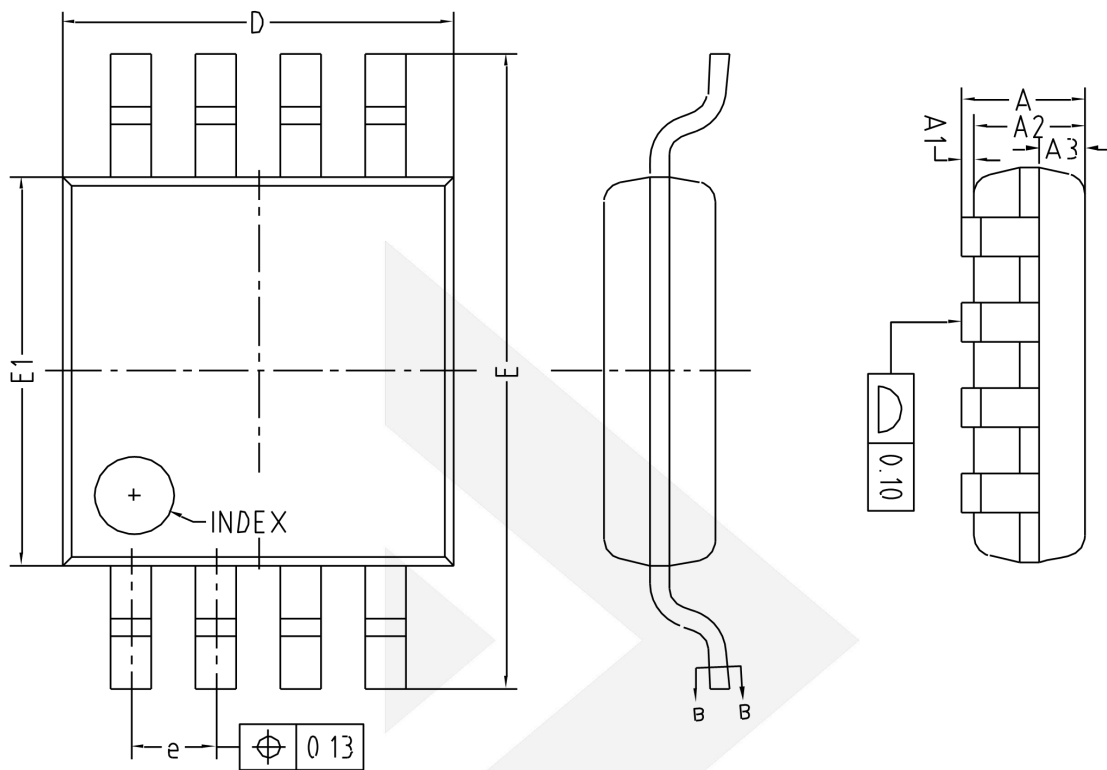


## 6.2 SOT23-5



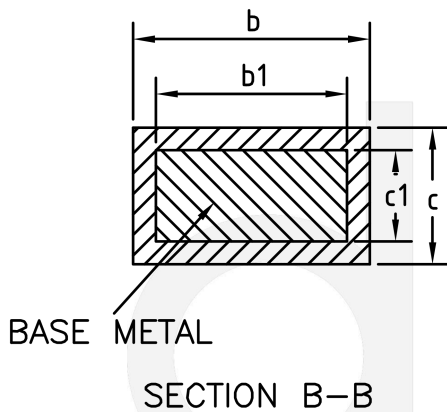
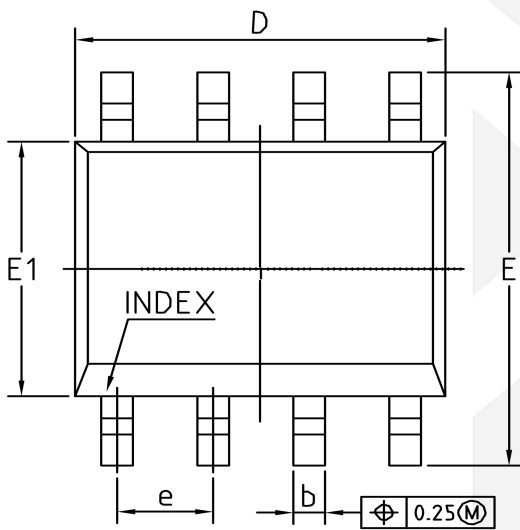
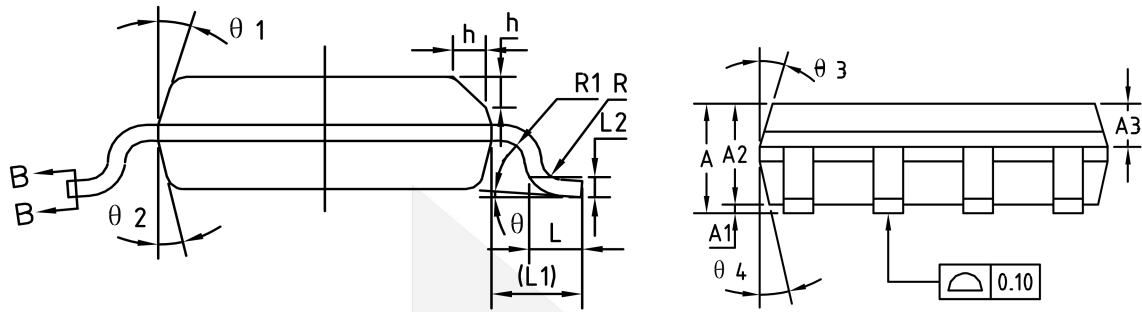
Common Dimensions (Units of measure = Millimeter)			
Symbol	Min	Nom	Max
A	-	-	1.25
A1	0	-	0.15
A2	1.00	1.10	1.20
A3	0.60	0.65	0.70
b	0.36	-	0.50
b1	0.36	0.38	0.45
c	0.14	-	0.20
c1	0.14	0.15	0.16
D	2.826	2.926	3.026
E	2.60	2.80	3.00
E1	1.526	1.626	1.726
e	0.90	0.95	1.00
e1	1.80	1.90	2.00
L	0.35	0.45	0.60
L1	0.59 REF		
L2	0.25 BSC		
R	0.10	-	-
R1	0.10	-	0.25
$\theta$	0°	-	8°
$\theta$ 1	3°	5°	7°
$\theta$ 2	6°	-	14°

## 6.3 MSOP-8



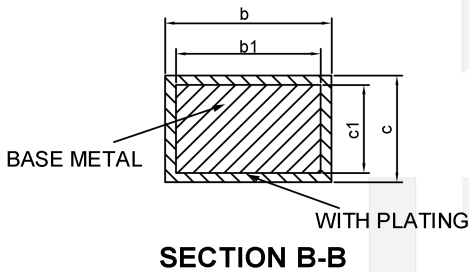
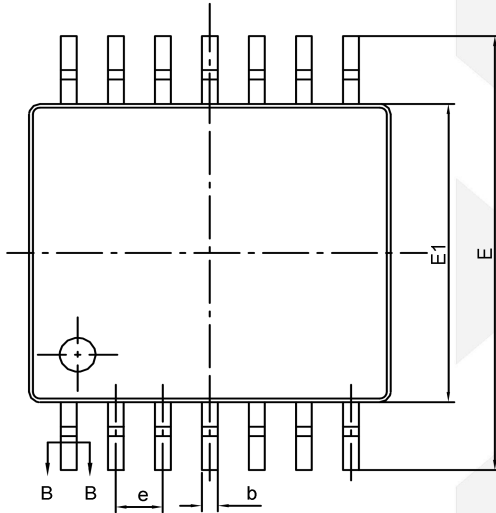
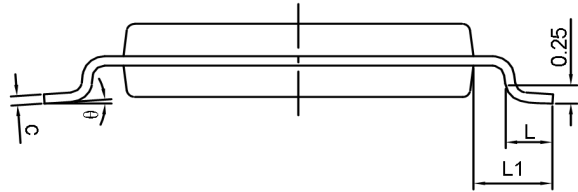
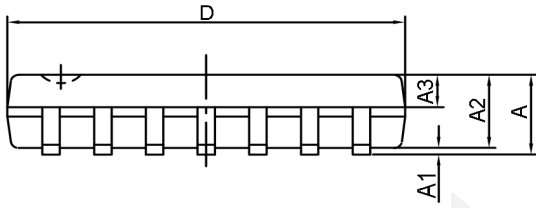
Common Dimensions (Units of Measure = Millimeter)			
Symbol	Min	Nom	Max
A	-	-	1.10
A1	0	-	0.15
A2	0.75	0.85	0.95
A3	0.25	0.35	0.39
b	0.28	-	0.37
b1	0.27	0.30	0.33
c	0.15	-	0.20
c1	0.14	0.15	0.16
D	2.90	3.00	3.10
E	4.70	4.90	5.10
E1	2.90	3.00	3.10
e	0.55	0.65	0.75
L	0.45	0.60	0.80
L1	0.95 REF		
L2	0.25 BSC		
R	0.07	-	-
R1	0.07	-	-
θ	0°	-	8°
θ1	9°	12°	15°

## 6.4 SOIC-8



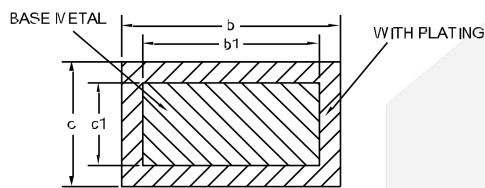
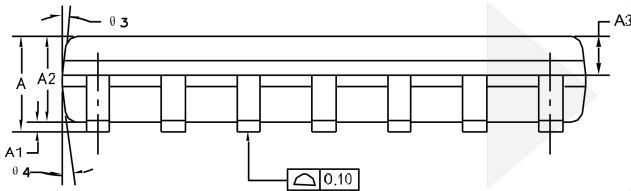
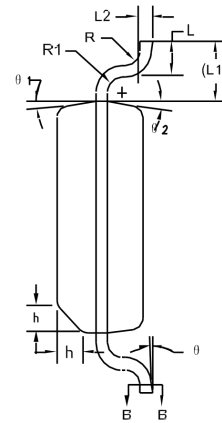
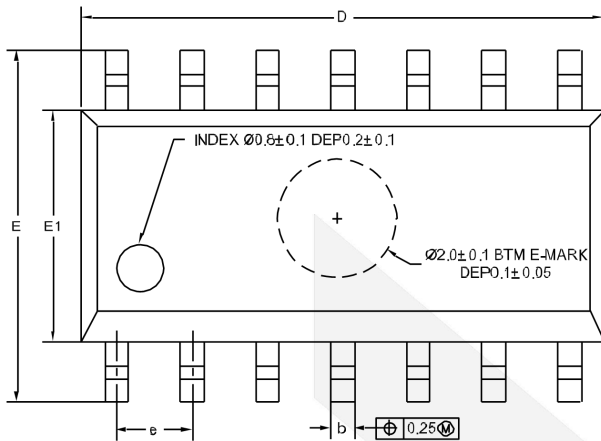
Common Dimensions (Units of measure = Millimeter)			
Symbol	Min	Nom	Max
A	1.35	1.55	1.75
A1	0.10	0.15	0.25
A2	1.25	1.40	1.65
A3	0.50	0.60	0.70
b	0.38	-	0.51
b1	0.37	0.42	0.47
c	0.17	-	0.25
c1	0.17	0.20	0.23
D	4.80	4.90	5.00
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e	1.27 BSC		
L	0.45	0.60	0.80
L1	1.04 REF		
L2	0.25 BSC		
R	0.07	-	-
R1	0.07	-	-
h	0.30	0.40	0.50
$\theta$	0°	-	8°
$\theta 1$	15°	17°	19°
$\theta 2$	11°	13°	15°
$\theta 3$	15°	17°	19°
$\theta 4$	11°	13°	15°

## 6.5 TSSOP-14



Common Dimensions (Units of Measure = Millimeter)			
Symbol	Min	Nom	Max
A	-	-	1.20
A1	0.05	-	0.15
A2	0.90	1.00	1.05
A3	0.39	0.44	0.49
b	0.20	-	0.30
b1	0.19	0.22	0.25
c	0.13	-	0.19
c1	0.12	0.13	0.14
D	4.86	4.96	5.06
E1	4.30	4.40	4.50
E	6.20	6.40	6.60
e	0.65 BSC		
L	0.45	-	0.75
L1	1.00 BSC		
$\theta$	0°	-	8°

## 6.6 SOIC-14



SECTION B-B

**Common Dimensions**  
(Units of measure = Millimeter)

Symbol	Min	Nom	Max
A	1.35	1.60	1.75
A1	0.10	0.15	0.25
A2	1.25	1.45	1.65
A3	0.55	0.65	0.75
b	0.36	-	0.49
b1	0.35	0.40	0.45
c	0.17	-	0.25
c1	0.17	0.20	0.23
D	8.53	8.63	8.73
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e	1.27 BSC		
L	0.45	0.60	0.80
L1	1.04 REF		
L2	0.25 BSC		
R	0.07	-	-
R1	0.07	-	-
h	0.30	0.40	0.50
$\theta$	0°		8°
$\theta 1$	6°	8°	10°
$\theta 2$	6°	8°	10°
$\theta 3$	5°	7°	9°
$\theta 4$	5°	7°	9°

## CONTACT US

Dioo is a professional design and sales corporation for high-quality and performance analog semiconductors. The company focuses on industry markets, such as, cell phone, handheld products, laptop, and medical equipment and so on. Dioo's product families include analog signal processing and amplifying, LED drivers and charger IC. Go to <http://www.dioo.com> for a complete list of Dioo product families.

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