

DIO235X

12 μ V V_{OS} , 1.2MHz, RRIO CMOS High-Precision Amplifier

Features

- Rail-to-Rail Input and Output
- Low offset (V_{OS}): 12 μ V typ.
- Input offset drift: 0.01 μ V/ $^{\circ}$ C
- Unity Gain Stable
- Gain Bandwidth Product: 1.2MHz
- Very low input bias currents: 20pA
- Wide supply range: 2.5V to 5.5V
- Single Supply Operation
- Low power: 0.73mA per channel
- Small size packaging best for portable applications:
DIO2351: SOT23-5, SOIC-8
DIO2352: SOIC-8, MSOP-8 and TSSOP-8
DIO2354: TSSOP-14

Applications

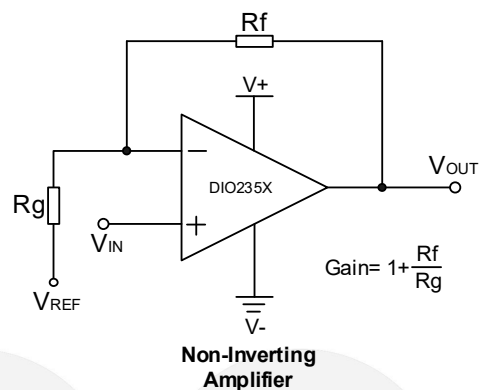
- Temperature measurement
- Pressure sensor
- Precision current sensing
- Strain Gage Amplifier
- Medical instrument
- Thermocouple amplifier
- Handheld Test Equipment

Descriptions

The DIO235X is an ultra-low offset voltage rail-to-rail input and output voltage feedback amplifier. They have a wide input common-mode voltage range and output voltage swing, and take the operating supply voltage is from 2.5 to 5.5V. They provide 1.2MHz bandwidth.

The DIO235X features an offset voltage of only 12 μ V and drift of 0.01 μ V/ $^{\circ}$ C, which makes the product perfect in applications of intolerant errors. Temperature/position/pressure sensors and medical equipment can benefit greatly from nearly zero drift over their operating temperature range.

Typical Application



Ordering Information

| Order Part Number | Top Marking | | T_A | Package | |
|-------------------|-------------|------------|-------------------------|----------|-------------------|
| DIO2351ST5 | YWXM | Green/RoHS | -40 to 125 $^{\circ}$ C | SOT23-5 | Tape & Reel, 3000 |
| DIO2351SO8 | DIO2351 | Green/RoHS | -40 to 125 $^{\circ}$ C | SOIC-8 | Tape & Reel, 2500 |
| DIO2352MP8 | DIO2352 | Green/RoHS | -40 to 125 $^{\circ}$ C | MSOP-8 | Tape & Reel, 3000 |
| DIO2352SO8 | DIO2352 | Green/RoHS | -40 to 125 $^{\circ}$ C | SOIC-8 | Tape & Reel, 2500 |
| DIO2352TP8 | DIO2352 | Green/RoHS | -40 to 125 $^{\circ}$ C | TSSOP-8 | Tape & Reel, 3000 |
| DIO2354CT14 | DIO2354 | Green/RoHS | -40 to 125 $^{\circ}$ C | TSSOP-14 | Tape & Reel, 2500 |

Pin Assignments

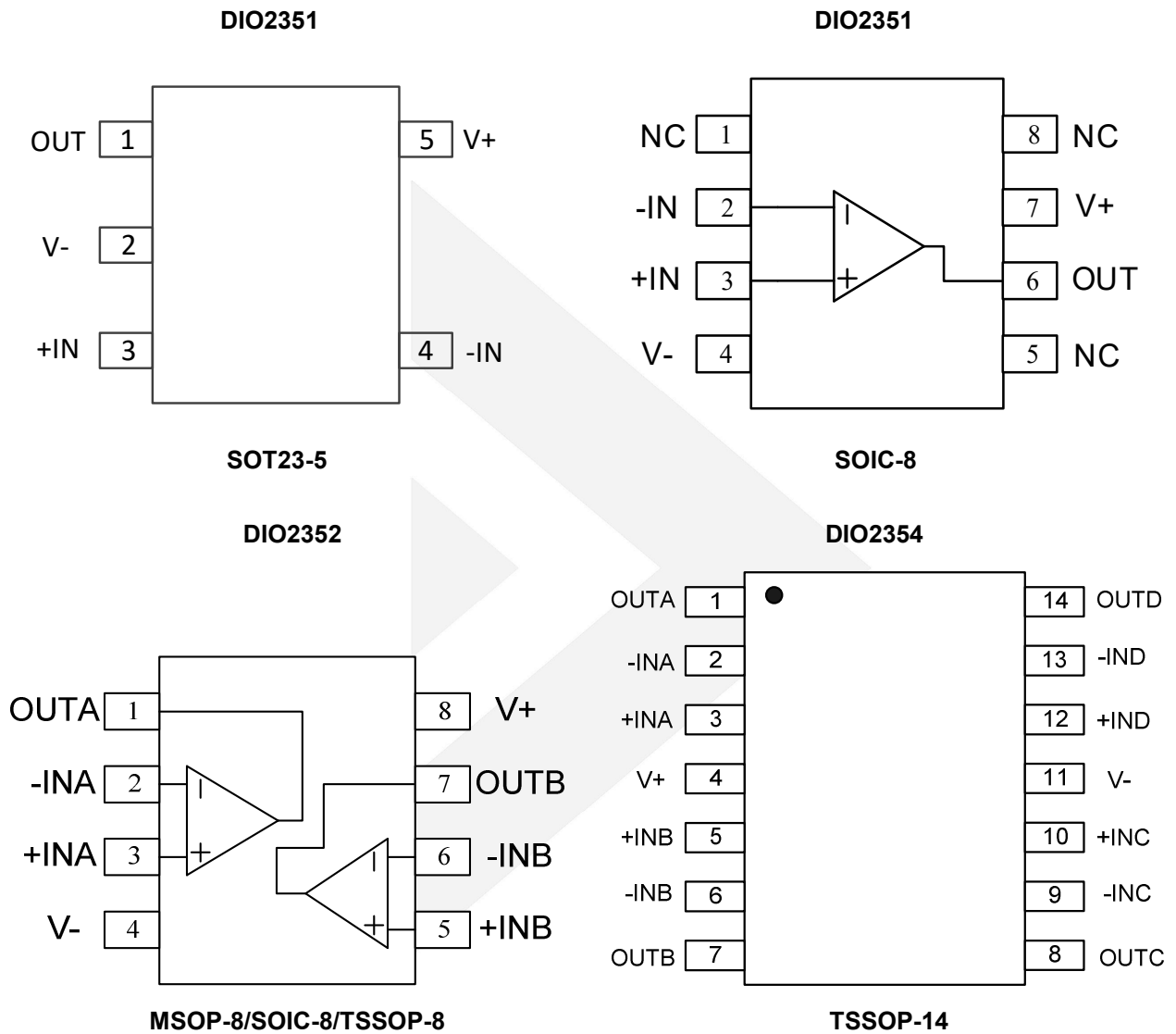


Figure 1 Pin Assignment

Pin Description

| Pin name | Description |
|--------------|-----------------|
| V+ | Positive supply |
| V- | Negative supply |
| +IN(A/B/C/D) | Positive Input |
| -IN(A/B/C/D) | Negative Input |
| OUT(A/B/C/D) | 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 | | 7.5 | V |
| Input Voltage | | (-Vs)-0.3 to (+Vs) +0.3V | V |
| TSSOP-14 θ_{JA} | | 110 | $^{\circ}\text{C}/\text{W}$ |
| Storage Temperature Range | | -65 to 150 | $^{\circ}\text{C}$ |
| Junction Temperature | | 150 | $^{\circ}\text{C}$ |
| Lead Temperature Range | | 260 | $^{\circ}\text{C}$ |
| ESD | HBM, JEDEC: JESD22-A114 | 7 | kV |

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 | | 2.5 to 5.5 | V |
| Input Voltage | | 0 to 5 | V |
| Operating Temperature Range | | -40 to 125 | $^{\circ}\text{C}$ |

Electrical Characteristics

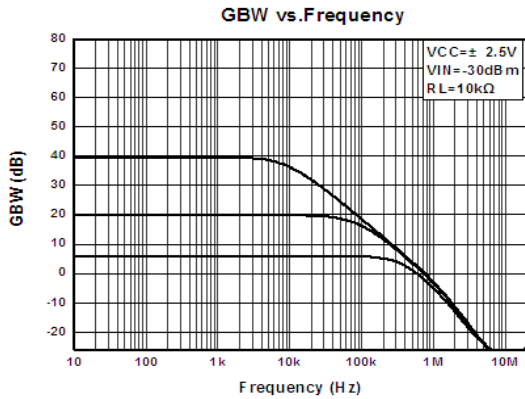
Typical value: $V_+ = 5V$, $R_L = 100k\Omega$ to $V_+/2$, $T_A = 25^\circ C$, unless otherwise specified.

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|-------------------------------|--------------------------------|--------------------------------------------------------------|------|--------|------|------------------|
| INPUT CHARACTERISTICS | | | | | | |
| V_{OS} | Input Offset Voltage | | -30 | 12 | 30 | μV |
| I_B | Input Bias Current | | | 20 | | pA |
| CMRR | Common Mode Rejection Ratio | $V_{CM} = -0.1$ to $(V_+) + 0.1$ | | 80 | | dB |
| A_{OL} | Open Loop Voltage Gain | $R_L = 10k\Omega$, $V_O = 0.1$ to $(V_+) - 0.1$ | | 150 | | dB |
| $\Delta V_{OS}/\Delta T$ | Input Offset Voltage Drift | $-40^\circ C \leq T_A \leq 125^\circ C$ | | 0.01 | | $\mu V/^\circ C$ |
| OUTPUT CHARACTERISTICS | | | | | | |
| V_{OH} | Output Voltage High | $R_L = 100k\Omega$, $-40^\circ C \leq T_A \leq 125^\circ C$ | | 4.998 | | V |
| | | $R_L = 10k\Omega$, $-40^\circ C \leq T_A \leq 125^\circ C$ | | 4.99 | | |
| V_{OL} | Output Voltage Low | $R_L = 100k\Omega$, $-40^\circ C \leq T_A \leq 125^\circ C$ | | 1.2 | | mV |
| | | $R_L = 10k\Omega$, $-40^\circ C \leq T_A \leq 125^\circ C$ | | 7.3 | | |
| I_O | Output Current | Source Current | | 55 | | mA |
| | | Sink Current | | 55 | | |
| POWER SUPPLY | | | | | | |
| PSRR | Power Supply Rejection Ration | $V_S = 2.7V$ to $5.5V$ | | 105 | | dB |
| I_S | Supply Current per Channel/Amp | $-40^\circ C \leq T_A \leq 125^\circ C$ | | 730 | | μA |
| DYNAMIC PERFORMANCE | | | | | | |
| GBP | Gain Bandwidth Product | | | 1.2 | | MHz |
| SR | Slew Rate | $G=1$, 2V Output Step | | 1 | | V/ μs |
| | Overload Recovery Time | | | 8 | | μs |
| t_S | Setting Time | $G=1$, 2V Output Step | | 2 | | μs |
| NOISE PERFORMANCE | | | | | | |
| THD | Total Harmonic Distortion | $f=1kHz$, 2V Output Step, $R_L=10k\Omega$, | | 0.0014 | | % |
| e_n | Voltage Noise Density | $f=1kHz$ | | 40 | | nV/ \sqrt{Hz} |

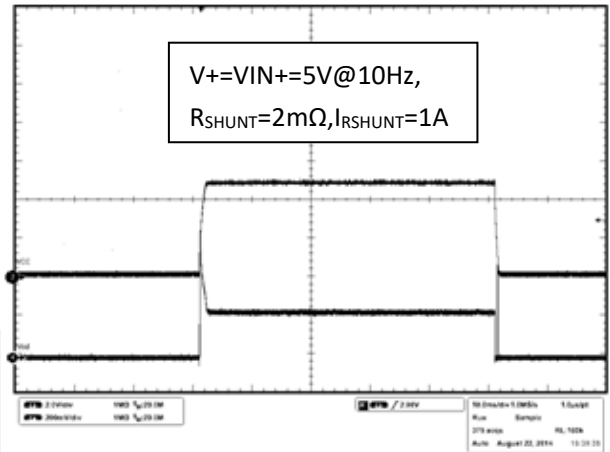
Specifications subject to change without notice.

Typical Performance Characteristics

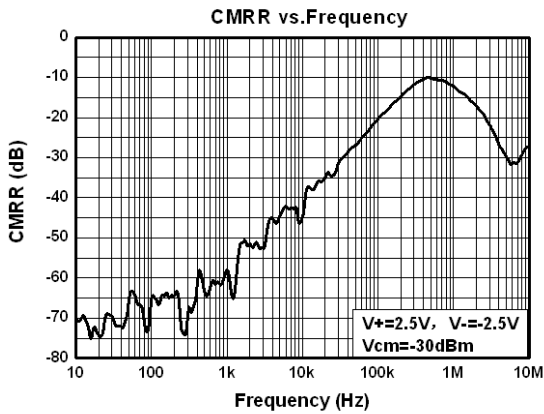
All typical value are at $V_+ = 5V$, $R_L = 200k\Omega$ to $V_+/2$, $T_A = 25^\circ C$, unless otherwise specified.



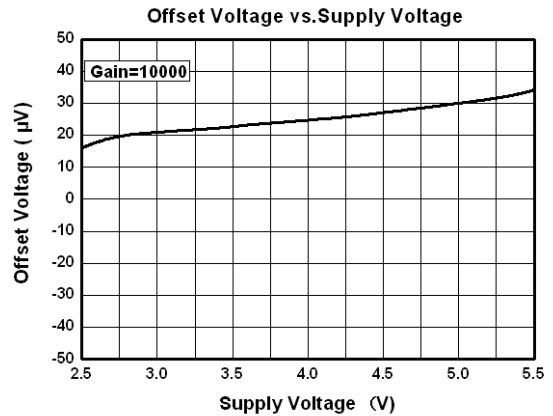
GBW vs. Frequency



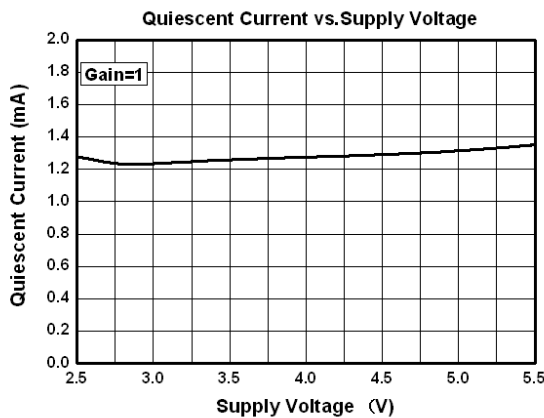
Start Off Recovery



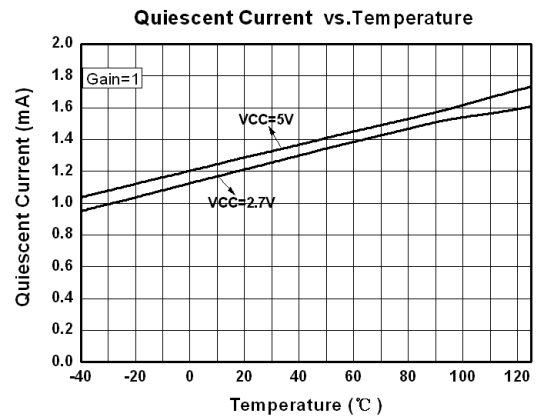
CMRR vs. frequency



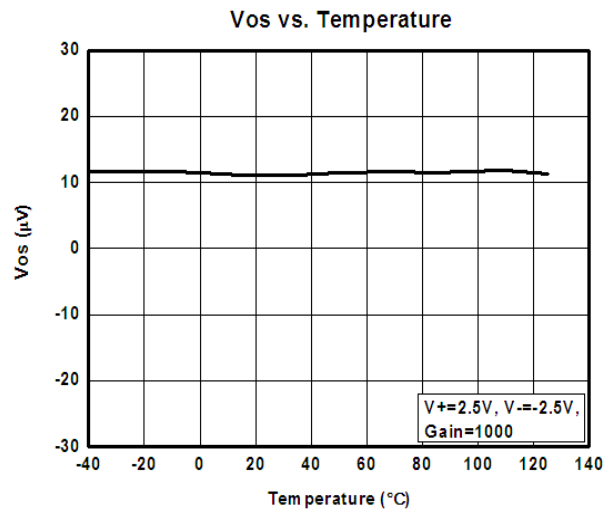
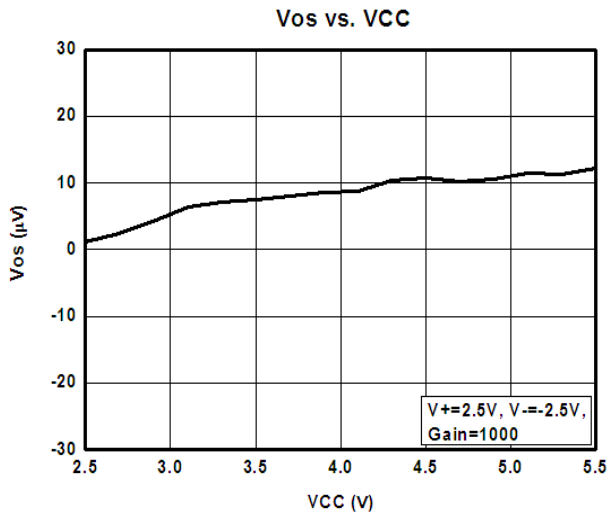
Offset Voltage vs. Supply Voltage



Offset Voltage vs. Supply Voltage



Quiescent Current vs. Temperature

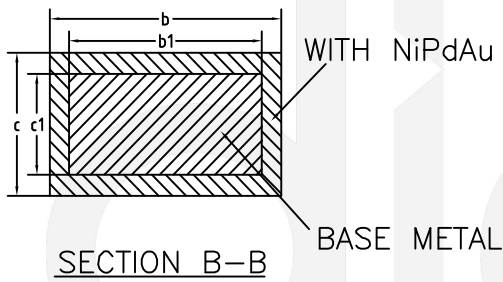
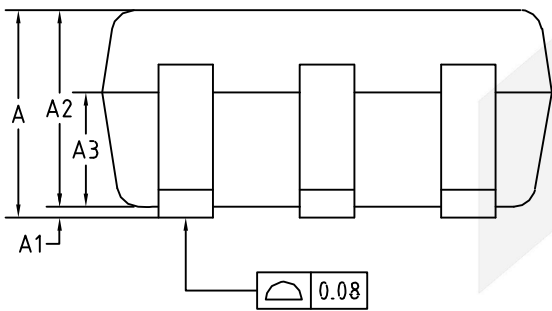
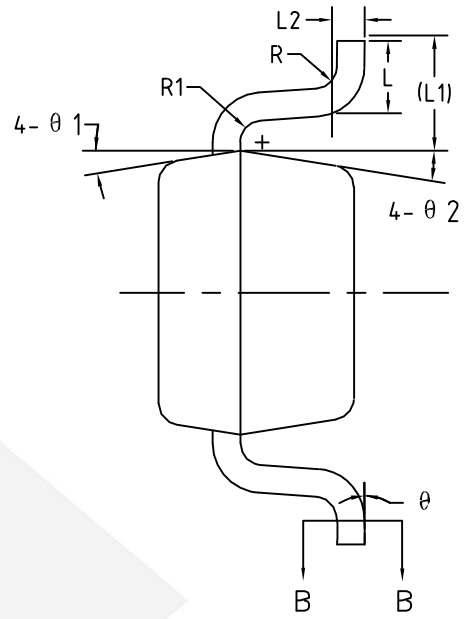
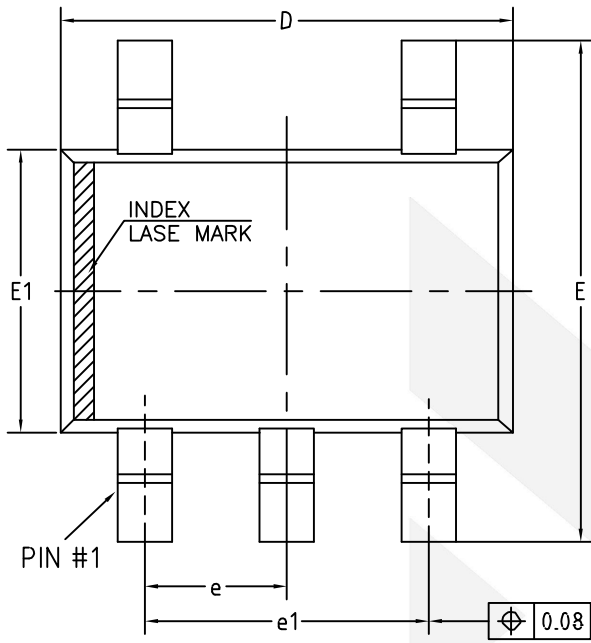


V_{os} vs. VCC

V_{os} vs. Temperature

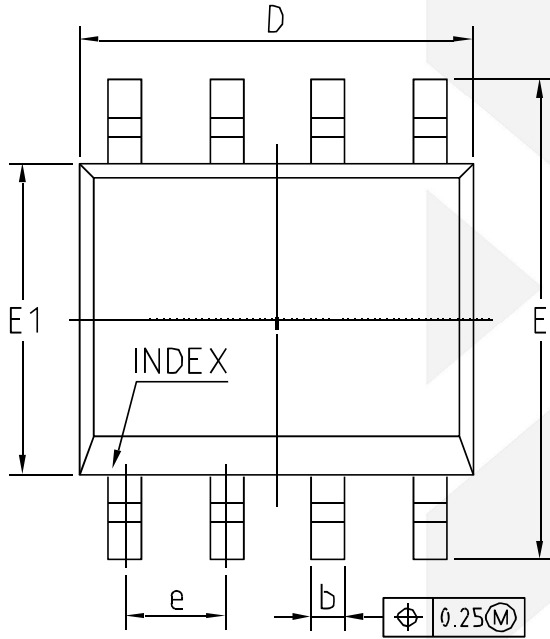
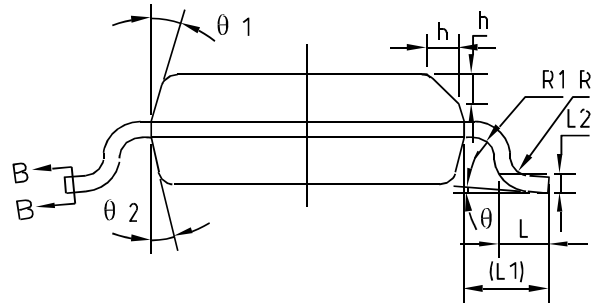
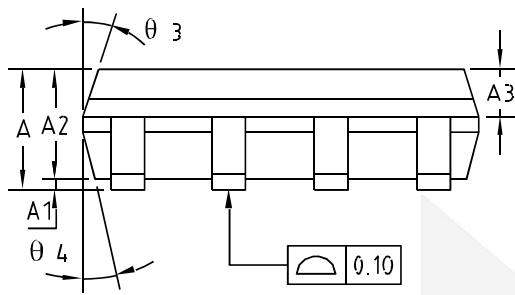
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Physical Dimensions: SOT23-5

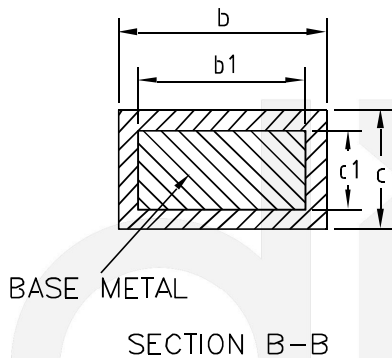


| COMMON DIMENSIONS (UNITS OF MEASURE=MILLIMETER) | | | |
|----------------------------------------------------|---------|-------|-------|
| Symbol | MIN | NOM | MAX |
| A | - | - | 1.25 |
| A1 | 0 | - | 0.15 |
| A2 | 1.00 | 1.10 | 1.20 |
| A3 | 0.60 | 0.65 | 0.70 |
| b | 0.36 | - | 0.50 |
| b1 | 0.36 | 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 | 0.59REF | | |
| L2 | 0.25BSC | | |
| R | 0.10 | - | - |
| R1 | 0.10 | - | 0.25 |
| θ | 0° | - | 8° |
| $\theta 1$ | 3° | 5° | 7° |
| $\theta 2$ | 6° | - | 14° |

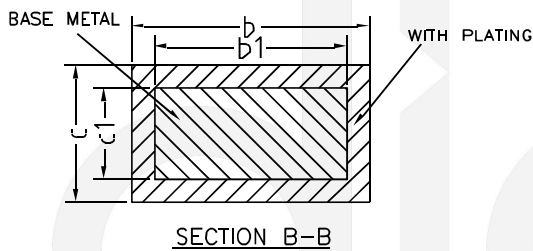
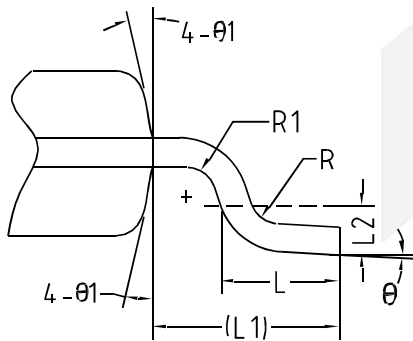
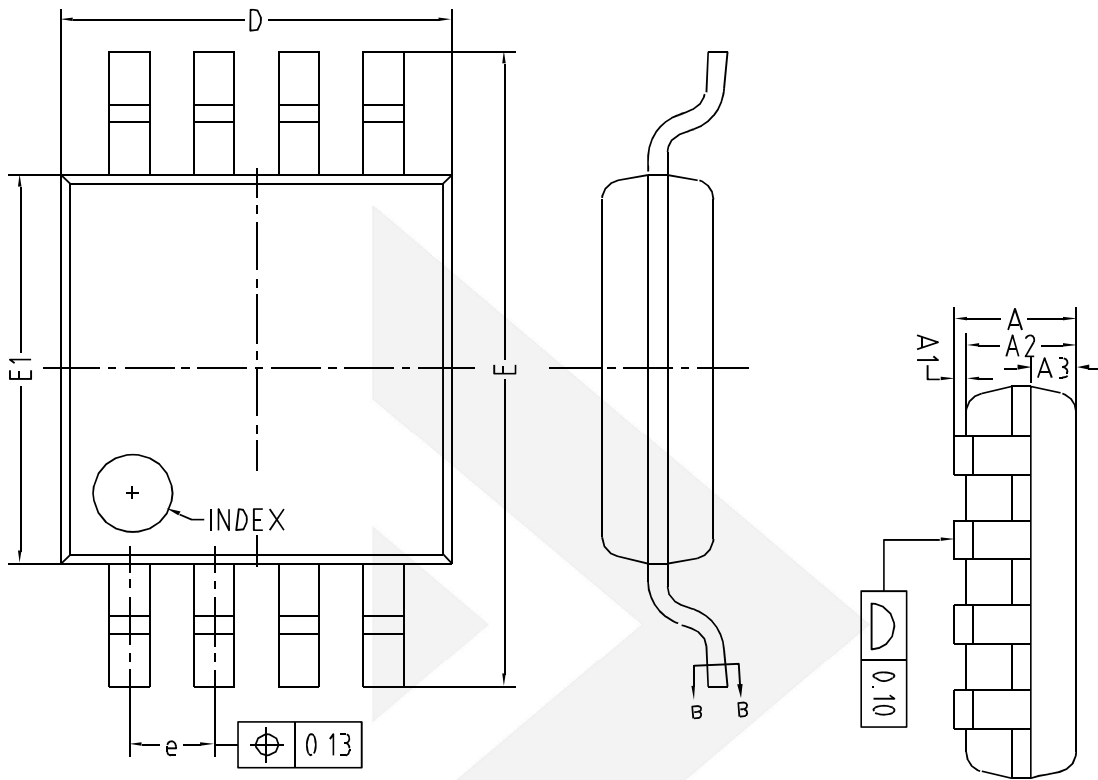
Physical Dimensions: SOIC-8



| 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 | 1.27BSC | | |
| L | 0.40 | 0.60 | 0.80 |
| L1 | 1.04REF | | |
| L2 | 0.25BSC | | |
| R | 0.07 | - | - |
| R1 | 0.07 | - | - |
| h | 0.30 | 0.40 | 0.50 |
| θ | 0° | - | 8° |
| $\theta 1$ | 15° | 17° | 19° |
| $\theta 2$ | 11° | 13° | 15° |
| $\theta 3$ | 15° | 17° | 19° |
| $\theta 4$ | 11° | 13° | 15° |

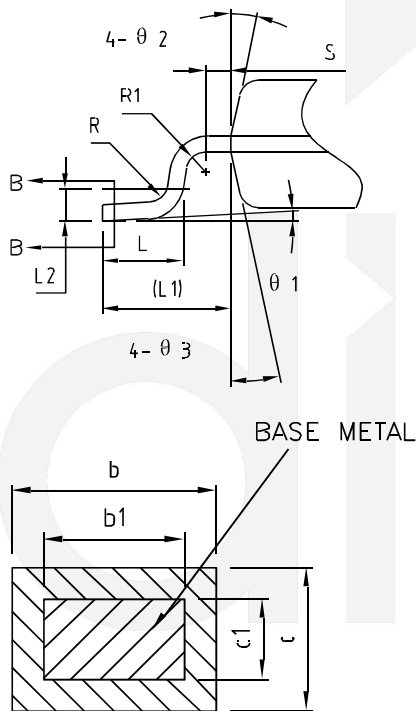
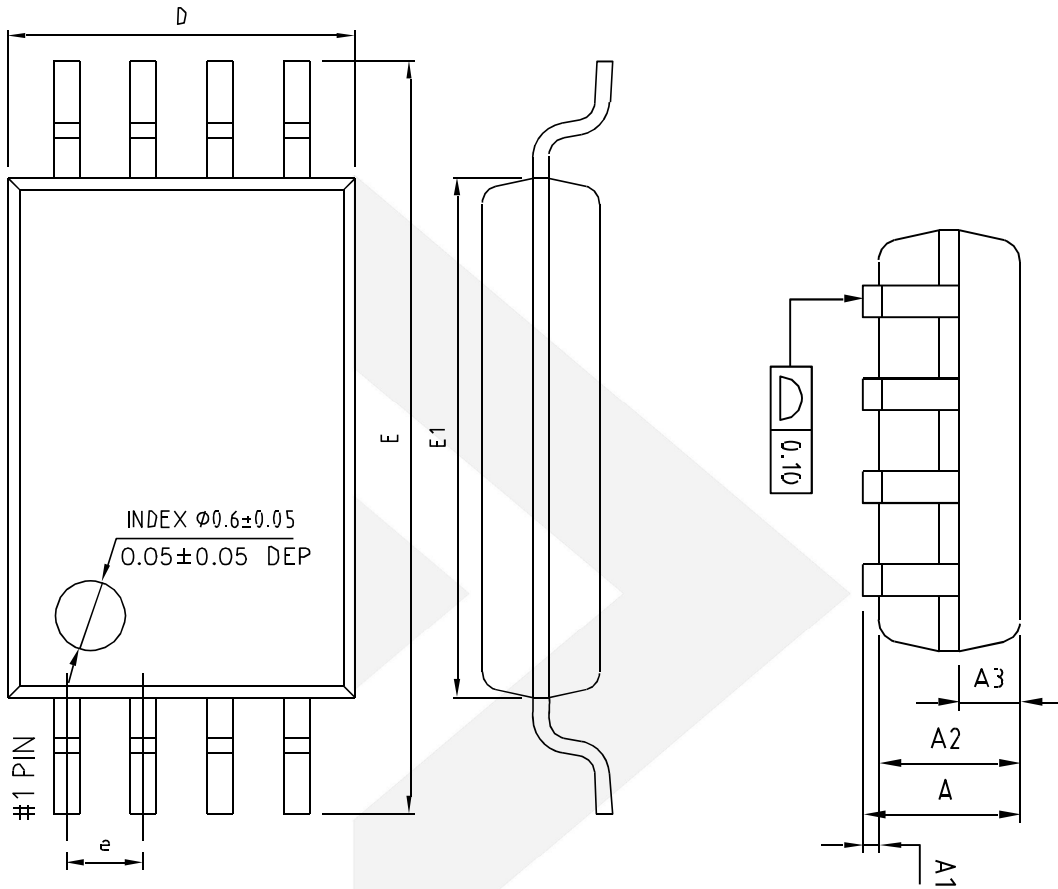


Physical Dimensions: MSOP-8



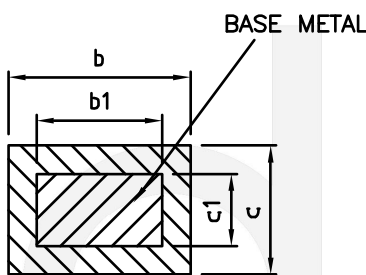
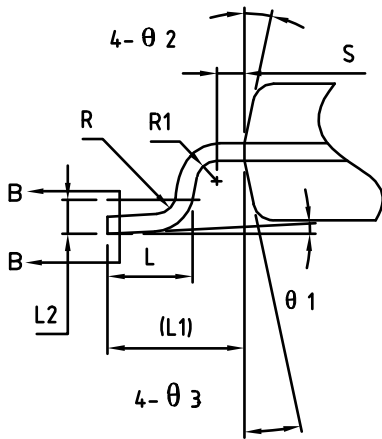
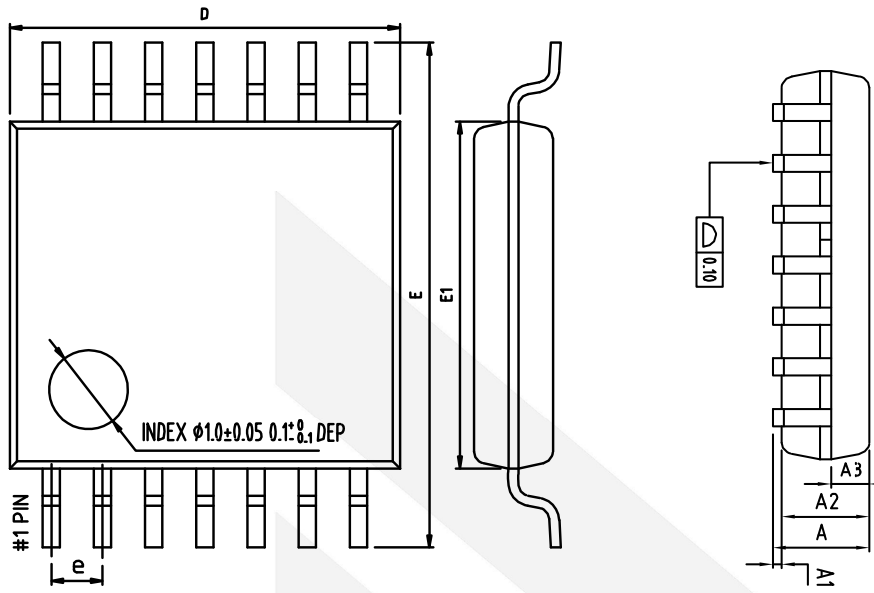
| COMMON DIMENSIONS (UNITS OF MEASURE=MILLIMETER) | | | |
|----------------------------------------------------|---------|------|------|
| Symbol | MIN | NOM | MAX |
| A | - | - | 1.10 |
| A1 | 0 | - | 0.15 |
| A2 | 0.75 | 0.85 | 0.95 |
| A3 | 0.25 | 0.35 | 0.39 |
| b | 0.28 | - | 0.37 |
| b1 | 0.27 | 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 | 0.40 | 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: TSSOP-8



| 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 | 0.34 | 0.44 | 0.54 |
| b | 0.20 | - | 0.28 |
| b1 | 0.20 | 0.22 | 0.24 |
| c | 0.10 | - | 0.19 |
| c1 | 0.10 | 0.13 | 0.15 |
| D | 2.83 | 2.93 | 3.03 |
| E | 6.20 | 6.40 | 6.60 |
| E1 | 4.30 | 4.40 | 4.50 |
| e | 0.65BSC | | |
| L | 0.45 | 0.60 | 0.75 |
| L1 | 1.00REF | | |
| L2 | 0.25BSC | | |
| R | 0.09 | - | - |
| R1 | 0.09 | - | - |
| S | 0.20 | - | - |
| $\theta 1$ | 0° | - | 8° |
| $\theta 2$ | 10° | 12° | 14° |
| $\theta 3$ | 10° | 12° | 14° |

Physical Dimensions: TSSOP-14



SECTION B-B

| Symbol | MIN | NOM | MAX |
|------------|---------|------|------|
| A | - | - | 1.2 |
| A1 | 0.05 | - | 0.15 |
| A2 | 0.90 | 1.00 | 1.05 |
| A3 | 0.34 | 0.44 | 0.54 |
| b | 0.20 | - | 0.28 |
| b1 | 0.20 | 0.22 | 0.24 |
| c | 0.10 | - | 0.19 |
| c1 | 0.10 | 0.13 | 0.15 |
| D | 4.86 | 4.96 | 5.06 |
| E | 6.20 | 6.40 | 6.60 |
| E1 | 4.30 | 4.40 | 4.50 |
| e | 0.65BSC | | |
| L | 0.45 | 0.60 | 0.75 |
| L1 | 1.00REF | | |
| L2 | 0.25BSC | | |
| R | 0.09 | - | - |
| R1 | 0.09 | - | - |
| S | 0.20 | - | - |
| $\theta 1$ | 0° | - | 8° |
| $\theta 2$ | 10° | 12° | 14° |
| $\theta 3$ | 10° | 12° | 14° |

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.

For additional product information, or full datasheet, please contact with our Sales Department or Representatives.

