

## DIO236XL

### Ultra Low Vos, Low Power Amplifier

#### Features

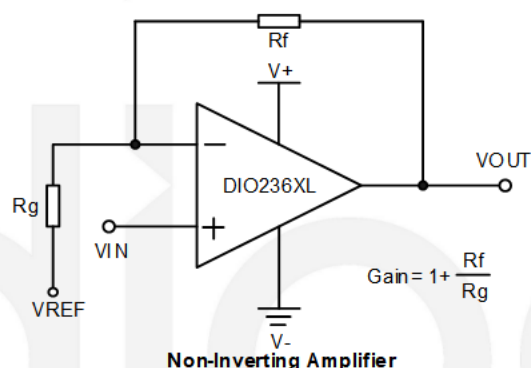
- Ultra low  $V_{OS}$ :  
DIO2361LA/2LA: 10  $\mu V$  (Max)  
DIO2361LB/2LB: 20  $\mu V$  (Max)  
DIO2361L/2L: 40  $\mu V$  (Max)  
DIO2361LM/2LM: 65  $\mu V$  (Max)
- Low power: 7.0  $\mu A$  (typ.)
- Unity gain stable
- Gain bandwidth product: 110 kHz (typ.)
- Wide supply range: 1.8 V to 5.5 V
- Packages: SOT23-5, SC70-5, SOIC-8, MSOP-8, DFN2\*2-8 and DFN3\*3-8
- Temperature range:  
-Industrial: -40°C to 85°C  
-Extended: -40°C to 125°C

#### Descriptions

The DIO236XL is a family of ultra low  $V_{OS}$  operational amplifier, with rail-to-rail CMOS input/output and single/dual channels selectable. DIO236XL family has a gain-bandwidth product of 110 kHz (typ.), wide operating supply voltage from 1.8 V to 5.5 V and broad output voltage swing.

The DIO236XL consumes ultra low power, with each channel 7.0  $\mu A$  (typ.) of bias current, which makes DIO236XL be ideal for battery powered device, temperature-sense device, etc.

#### Typical Applications



#### Applications

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

## Ordering Information

| Order Part Number | Top Marking | RoHS          | T <sub>A</sub> | Package  |                   |
|-------------------|-------------|---------------|----------------|----------|-------------------|
| DIO2361LASC5      | W36L        | Green or RoHS | -40 to 125°C   | SC70-5   | Tape & Reel, 3000 |
| DIO2361LAST5      | W36L        | Green or RoHS | -40 to 125°C   | SOT23-5  | Tape & Reel, 3000 |
| DIO2361LASO8      | D2361L      | Green or RoHS | -40 to 125°C   | SOIC-8   | Tape & Reel, 2500 |
| DIO2361LAMP8      | D2361L      | Green or RoHS | -40 to 125°C   | MSOP-8   | Tape & Reel, 3000 |
| DIO2361LBSC5      | W36L        | Green or RoHS | -40 to 125°C   | SC70-5   | Tape & Reel, 3000 |
| DIO2361LBST5      | W36L        | Green or RoHS | -40 to 125°C   | SOT23-5  | Tape & Reel, 3000 |
| DIO2361LBSO8      | D2361L      | Green or RoHS | -40 to 125°C   | SOIC-8   | Tape & Reel, 2500 |
| DIO2361LBMP8      | D2361L      | Green or RoHS | -40 to 125°C   | MSOP-8   | Tape & Reel, 3000 |
| DIO2361LSC5       | W36L        | Green or RoHS | -40 to 125°C   | SC70-5   | Tape & Reel, 3000 |
| DIO2361LST5       | W36L        | Green or RoHS | -40 to 125°C   | SOT23-5  | Tape & Reel, 3000 |
| DIO2361LSO8       | D2361L      | Green or RoHS | -40 to 125°C   | SOIC-8   | Tape & Reel, 2500 |
| DIO2361LMP8       | D2361L      | Green or RoHS | -40 to 125°C   | MSOP-8   | Tape & Reel, 3000 |
| DIO2361LMSC5      | W36L        | Green or RoHS | -40 to 125°C   | SC70-5   | Tape & Reel, 3000 |
| DIO2361LMST5      | W36L        | Green or RoHS | -40 to 125°C   | SOT23-5  | Tape & Reel, 3000 |
| DIO2361LMO8       | D2361L      | Green or RoHS | -40 to 125°C   | SOIC-8   | Tape & Reel, 2500 |
| DIO2361LMMP8      | D2361L      | Green or RoHS | -40 to 125°C   | MSOP-8   | Tape & Reel, 3000 |
| DIO2362LACN8      | 236L        | Green or RoHS | -40 to 125°C   | DFN2*2-8 | Tape & Reel, 3000 |
| DIO2362LACD8      | 2362L       | Green or RoHS | -40 to 125°C   | DFN3*3-8 | Tape & Reel, 5000 |
| DIO2362LASO8      | D2362L      | Green or RoHS | -40 to 125°C   | SOIC-8   | Tape & Reel, 2500 |
| DIO2362LAMP8      | D2362L      | Green or RoHS | -40 to 125°C   | MSOP-8   | Tape & Reel, 3000 |
| DIO2362LBCN8      | 236L        | Green or RoHS | -40 to 125°C   | DFN2*2-8 | Tape & Reel, 3000 |
| DIO2362LBCD8      | 2362L       | Green or RoHS | -40 to 125°C   | DFN3*3-8 | Tape & Reel, 5000 |
| DIO2362LBSO8      | D2362L      | Green or RoHS | -40 to 125°C   | SOIC-8   | Tape & Reel, 2500 |
| DIO2362LBMP8      | D2362L      | Green or RoHS | -40 to 125°C   | MSOP-8   | Tape & Reel, 3000 |
| DIO2362LCN8       | 236L        | Green or RoHS | -40 to 125°C   | DFN2*2-8 | Tape & Reel, 3000 |
| DIO2362LCD8       | 2362L       | Green or RoHS | -40 to 125°C   | DFN3*3-8 | Tape & Reel, 5000 |
| DIO2362LSO8       | D2362L      | Green or RoHS | -40 to 125°C   | SOIC-8   | Tape & Reel, 2500 |
| DIO2362LMP8       | D2362L      | Green or RoHS | -40 to 125°C   | MSOP-8   | Tape & Reel, 3000 |
| DIO2362LMCN8      | 236L        | Green or RoHS | -40 to 125°C   | DFN2*2-8 | Tape & Reel, 3000 |
| DIO2362LMCD8      | 2362L       | Green or RoHS | -40 to 125°C   | DFN3*3-8 | Tape & Reel, 5000 |
| DIO2362LMSO8      | D2362L      | Green or RoHS | -40 to 125°C   | SOIC-8   | Tape & Reel, 2500 |
| DIO2362LMMP8      | D2362L      | Green or RoHS | -40 to 125°C   | MSOP-8   | Tape & Reel, 3000 |

## Ordering Information Complimentary Note

Ordering Code = Part No. + Package Code

DIO2361LA/2LA  
DIO2361LB/2LB  
DIO2361L/2L  
DIO2361LM/2LM

SC5: stands for SC70-5  
ST5: stands for SOT23-5  
SO8: stands for SOIC-8  
MP8: stands for MSOP-8  
CN8: stands for DFN2\*2-8  
CD8: stands for DFN3\*3-8

## Pin Assignments

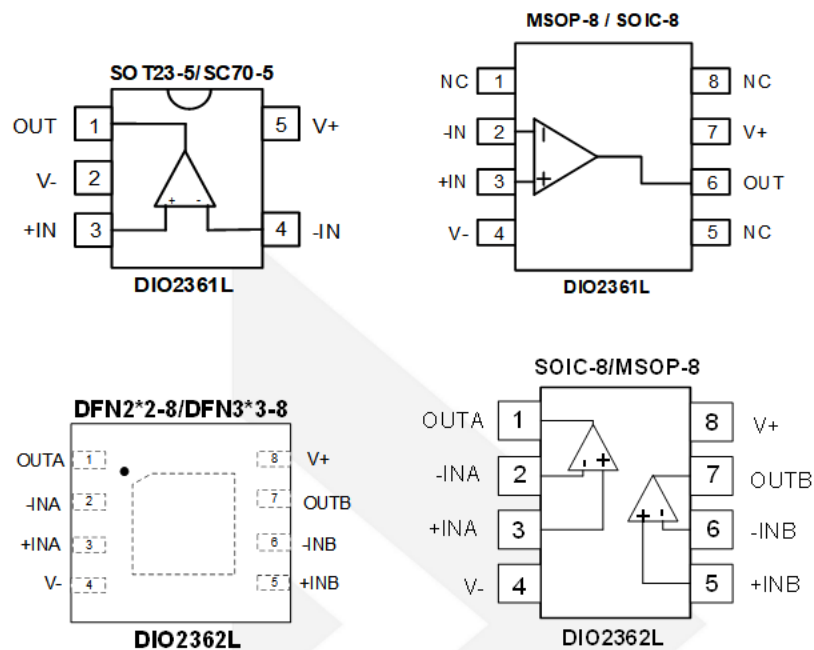


Figure 1. Top view

## Pin Description

| Pin name | Description     |
|----------|-----------------|
| V+       | Positive supply |
| V-       | Negative supply |
| +INX     | Positive Input  |
| -INX     | Negative Input  |
| OUTX     | Output          |
| NC       | No connect      |

## 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 ( $V^+$ – $V^-$ ) |                         | 7                                  | V    |
| Input voltage                    |                         | ( $V^-$ )-0.3 V to ( $V^+$ )+0.3 V | V    |
| Difference input voltage         |                         | $ V^+ - V^- $                      | V    |
| Storage temperature range        |                         | -65 to 150                         | °C   |
| Junction temperature             |                         | 150                                | °C   |
| Lead temperature range           |                         | 260                                | °C   |
| ESD                              | HBM, JEDEC: JESD22-A114 | 8                                  | 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              |  | 1.8 to 5.5 | V    |
| Input voltage               |  | 0 to 5     | V    |
| Operating temperature range |  | -40 to 125 | °C   |

## Electrical Characteristics

Typical value:  $V^+ = 5\text{ V}$ ,  $R_L = 1\text{ M}\Omega$  to  $V^+/2$ ,  $V_{CM} = 1/2\text{ V}^+$ ,  $T_A = 25^\circ\text{C}$ , unless otherwise specified.

| Symbol                 | Parameter                        | Conditions                                                            | Min           | Typ   | Max               | Unit    |
|------------------------|----------------------------------|-----------------------------------------------------------------------|---------------|-------|-------------------|---------|
| Input characteristics  |                                  |                                                                       |               |       |                   |         |
| V <sub>OS</sub>        | Input offset voltage             | V <sub>+</sub> = 1.8 V to 5.5 V                                       | DIO2361LA/2LA | -10   | 10                | μV      |
|                        |                                  |                                                                       | DIO2361LB/2LB | -20   | 20                |         |
|                        |                                  |                                                                       | DIO2361L/2L   | -40   | 40                |         |
|                        |                                  |                                                                       | DIO2361LM/2LM | -65   | 65                |         |
| I <sub>B</sub>         | Input bias current               | V <sub>+</sub> = 1.8 V to 5.5 V                                       |               | 10    |                   | pA      |
| I <sub>OS</sub>        | Input offset current             | V <sub>+</sub> = 1.8 V to 5.5 V                                       |               | 10    |                   | pA      |
| V <sub>CM</sub>        | Common mode voltage range        |                                                                       | -0.1          |       | (V <sub>+</sub> ) | V       |
| CMRR                   | Common mode rejection ratio      | -40°C ≤ T <sub>A</sub> ≤ 125°C                                        |               | 130   |                   | dB      |
| A <sub>OL</sub>        | Open loop voltage gain           | R <sub>L</sub> = 50 kΩ, V <sub>O</sub> = 0.1 to (V <sub>+</sub> )-0.1 | 80            | 110   |                   | dB      |
| ΔV <sub>OS</sub> /ΔT   | Input offset voltage drift       | -40°C ≤ T <sub>A</sub> ≤ 125°C                                        |               | 0.02  |                   | μV / °C |
| Output characteristics |                                  |                                                                       |               |       |                   |         |
| V <sub>OH</sub>        | Output voltage high              | R <sub>L</sub> = 50 kΩ, -40°C ≤ T <sub>A</sub> ≤ 125°C                |               | 4.992 |                   | V       |
| V <sub>OL</sub>        | Output voltage low               | R <sub>L</sub> = 50 kΩ, -40°C ≤ T <sub>A</sub> ≤ 125°C                |               | 8     |                   | mV      |
| I <sub>SC</sub>        | Output short circuit current     | Source I <sub>SC</sub> , V <sub>+</sub> = 5 V                         |               | 34    |                   | mA      |
|                        |                                  | Sink I <sub>SC</sub> , V <sub>+</sub> = 5 V                           |               | 34    |                   |         |
| Power supply           |                                  |                                                                       |               |       |                   |         |
| PSRR                   | Power supply rejection ration    |                                                                       | 100           |       |                   | dB      |
| I <sub>S</sub>         | Supply current per channel / amp | -40°C ≤ T <sub>A</sub> ≤ 125°C                                        |               | 7     | 11                | μA      |
| Dynamic performance    |                                  |                                                                       |               |       |                   |         |
| GBP                    | Gain bandwidth product           | C <sub>L</sub> = 100 pF, R <sub>L</sub> = 1 MΩ                        |               | 110   |                   | kHz     |
| SR                     | Slew rate                        | G = 1, 2 V output step                                                |               | 80    |                   | V/ms    |
| t <sub>s</sub>         | Setting time                     | G = 1, 2 V output step                                                |               | 2     |                   | ms      |
| φ <sub>m</sub>         | Phase margin                     |                                                                       |               | 70    |                   | Deg     |
| t <sub>or</sub>        | Overload recovery time           |                                                                       |               | 3.9   |                   | ms      |
| Noise performance      |                                  |                                                                       |               |       |                   |         |
| THD                    | Total harmonic distortion        | f = 1 kHz, 4 V <sub>PP</sub> , R <sub>L</sub> = 5 kΩ                  |               | 0.33  |                   | %       |
| e <sub>n</sub>         | Voltage noise density            | f = 1 kHz                                                             |               | 100   |                   | nV/√Hz  |

Specifications subject to change without notice.

### Typical Performance Characteristics

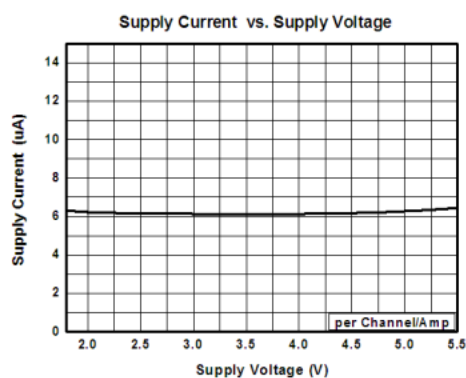


Figure 2.  $I_S$  vs.  $V_{CC}$

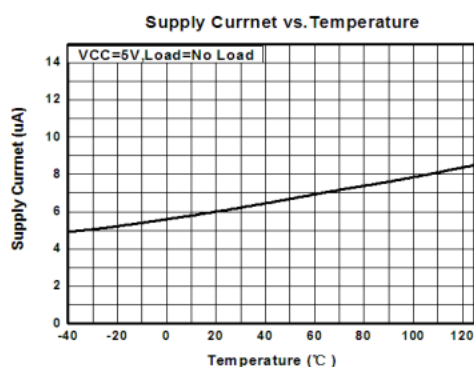


Figure 3.  $I_S$  vs. Temperature

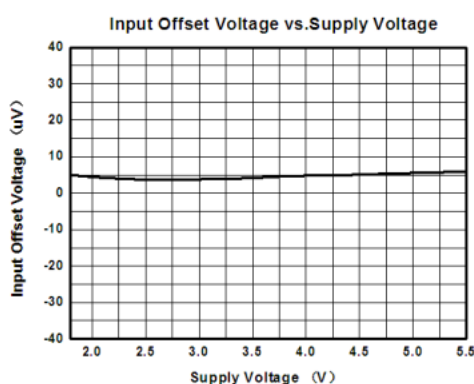


Figure 4.  $V_{OS}$  vs.  $V_{CC}$

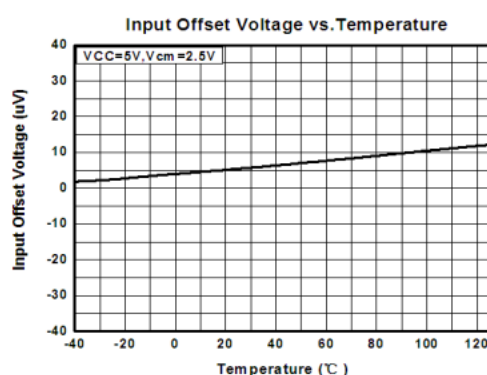


Figure 5.  $V_{OS}$  vs. Temperature

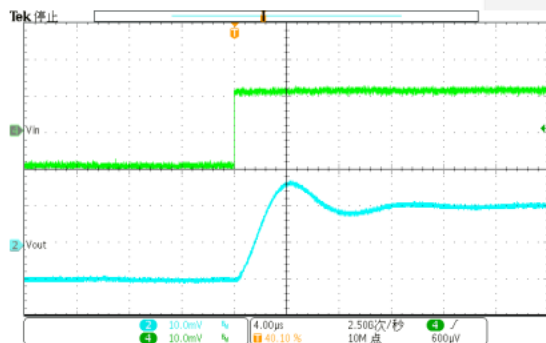


Figure 6. Small-signal response  
( $V_{CC} = 5\text{ V}$ ,  $C_L = 200\text{ pF}$ )

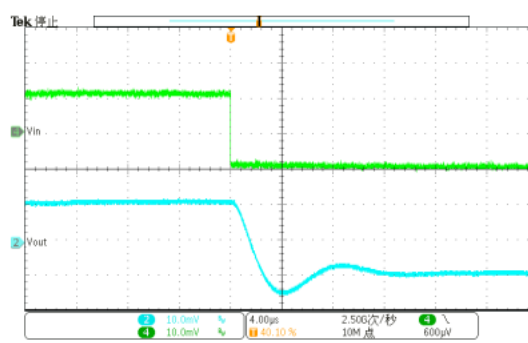


Figure 7. Small-signal response  
( $V_{CC} = 5\text{ V}$ ,  $C_L = 200\text{ pF}$ )

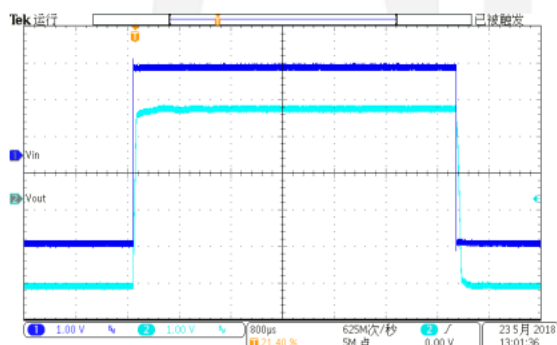
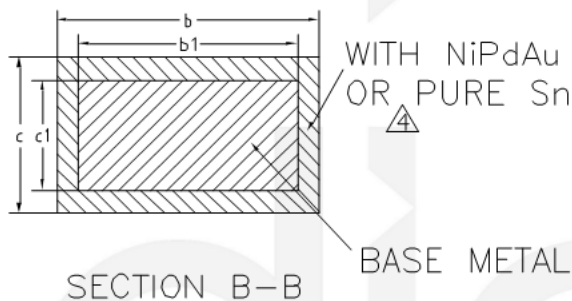
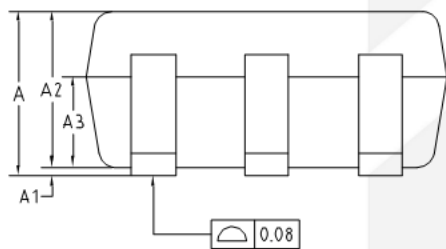
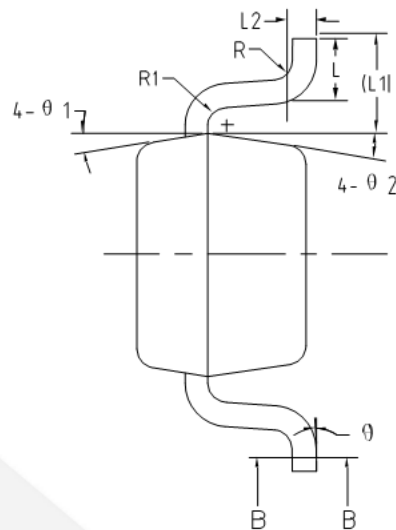
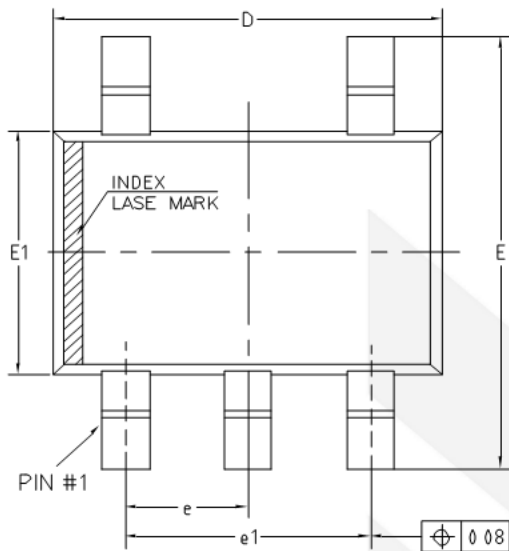


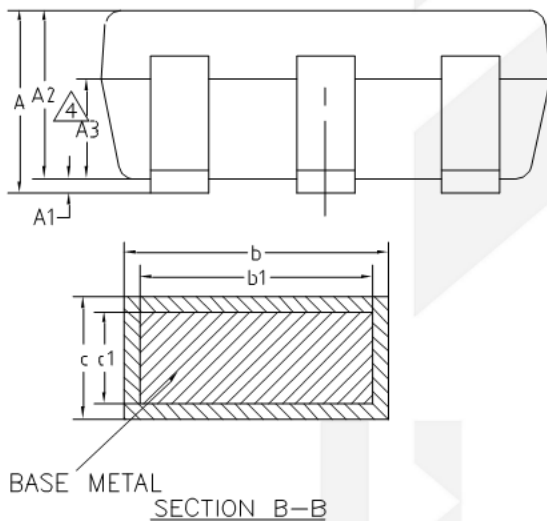
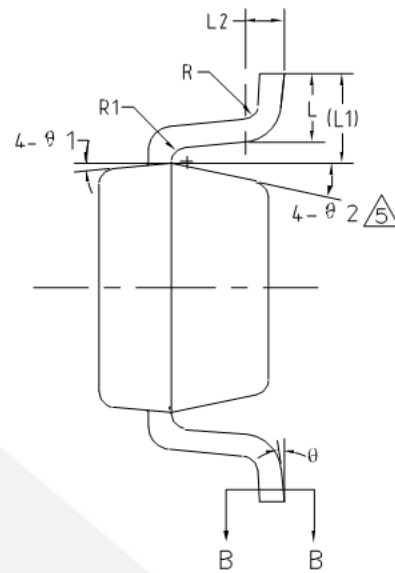
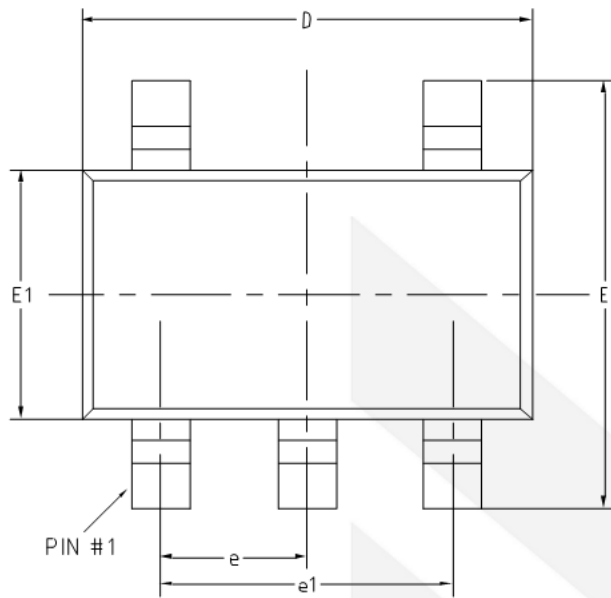
Figure 8. Large-signal response  
( $V_{CC} = 5\text{ V}$ ,  $R_L = 5.1\text{ k}\Omega$ )

## Physical Dimensions: SC70-5



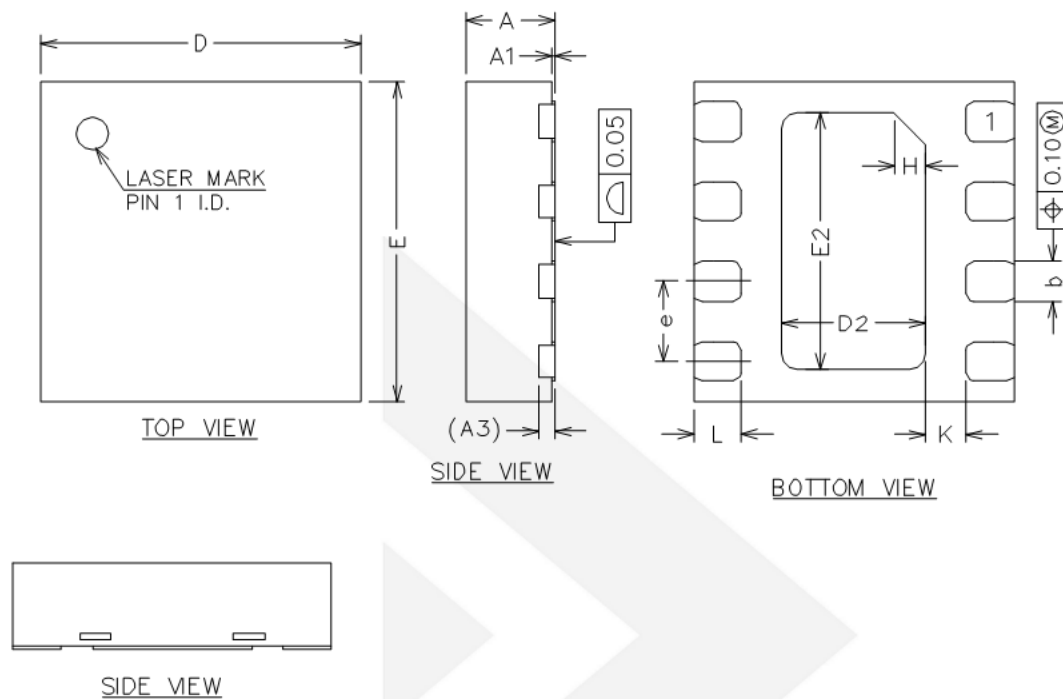
| Common Dimensions<br>(Units of measure = Millimeter) |          |      |      |
|------------------------------------------------------|----------|------|------|
| Symbol                                               | Min      | Nom  | Max  |
| A                                                    | 0.85     | -    | 1.05 |
| A1                                                   | 0        | -    | 0.10 |
| A2                                                   | 0.80     | 0.90 | 1.00 |
| A3                                                   | 0.47     | 0.52 | 0.57 |
| b                                                    | 0.23     | -    | 0.33 |
| b1                                                   | 0.22     | 0.25 | 0.28 |
| c                                                    | 0.12     | -    | 0.18 |
| 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 |
| θ                                                    | 0°       | -    | 8°   |
| θ1                                                   | 6°       | 9°   | 12°  |
| θ2                                                   | 6°       | 9°   | 12°  |

## Physical Dimensions: SOT23-5



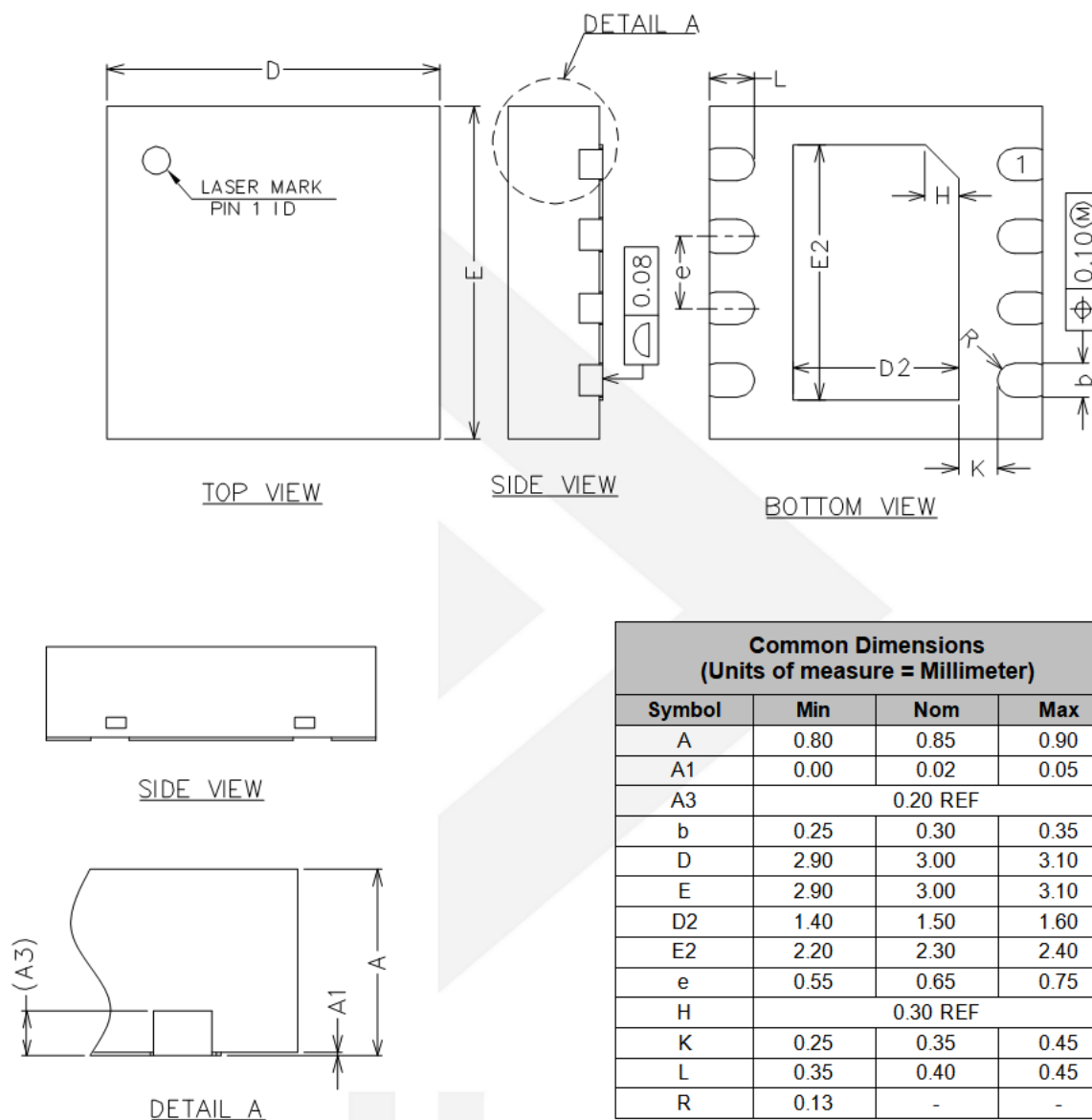
| Common Dimensions<br>(Units of measure = Millimeter) |          |       |       |
|------------------------------------------------------|----------|-------|-------|
| Symbol                                               | Min      | Nom   | Max   |
| A                                                    | -        | -     | 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  |
| θ                                                    | 0°       | -     | 8°    |
| θ1                                                   | 3°       | 5°    | 7°    |
| θ2                                                   | 6°       | -     | 14°   |

## Physical Dimensions: DFN2\*2-8

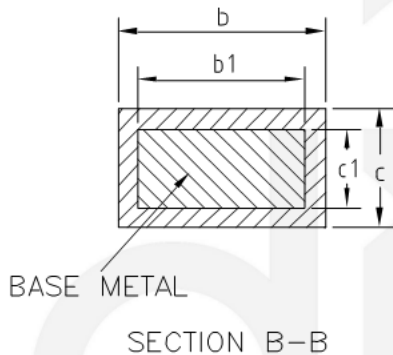
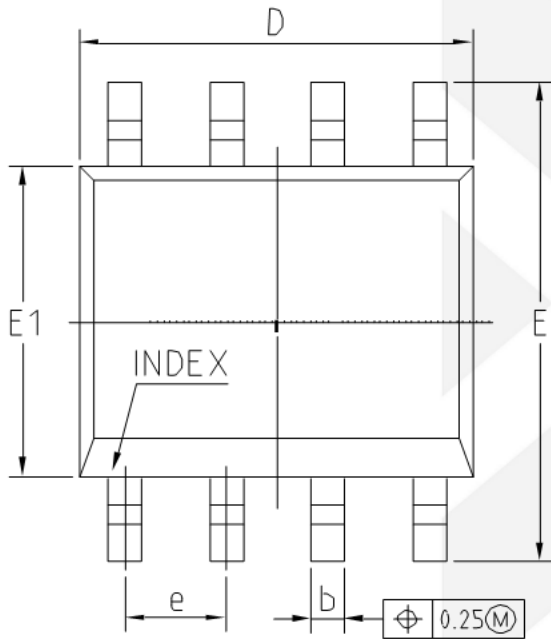
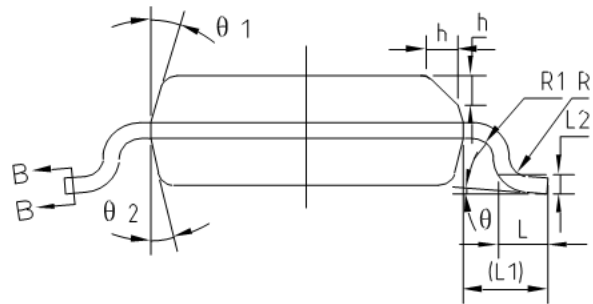
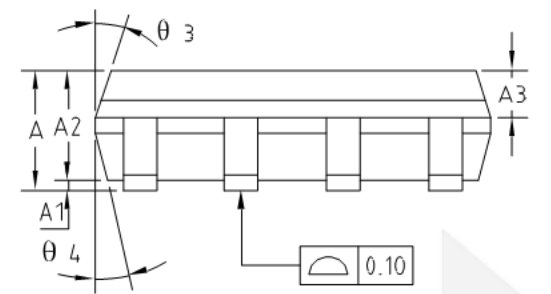


| Common Dimensions<br>(Units of measure = Millimeter) |          |      |      |
|------------------------------------------------------|----------|------|------|
| Symbol                                               | Min      | Nom  | Max  |
| A                                                    | 0.50     | 0.55 | 0.65 |
| A1                                                   | 0.00     | 0.02 | 0.05 |
| A3                                                   | 0.10 REF |      |      |
| b                                                    | 0.20     | 0.25 | 0.30 |
| D                                                    | 1.90     | 2.00 | 2.10 |
| E                                                    | 1.90     | 2.00 | 2.10 |
| D2                                                   | 0.80     | 0.90 | 1.00 |
| E2                                                   | 1.50     | 1.60 | 1.70 |
| e                                                    | 0.40     | 0.50 | 0.60 |
| H                                                    | 0.20 REF |      |      |
| K                                                    | 0.15     | 0.25 | 0.35 |
| L                                                    | 0.25     | 0.30 | 0.35 |

## Physical Dimensions: DFN3\*3-8

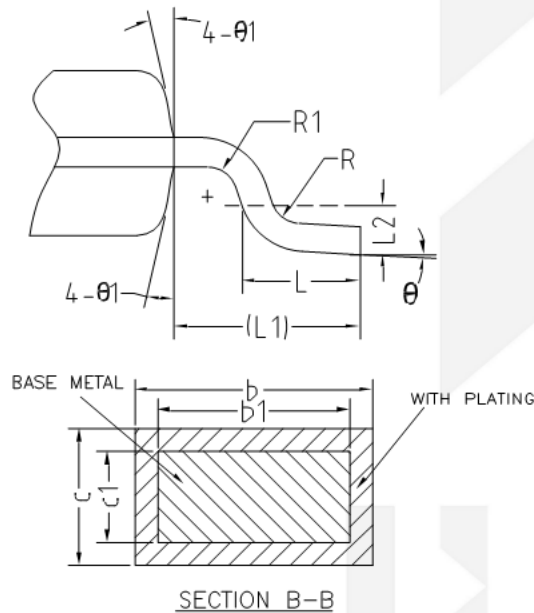
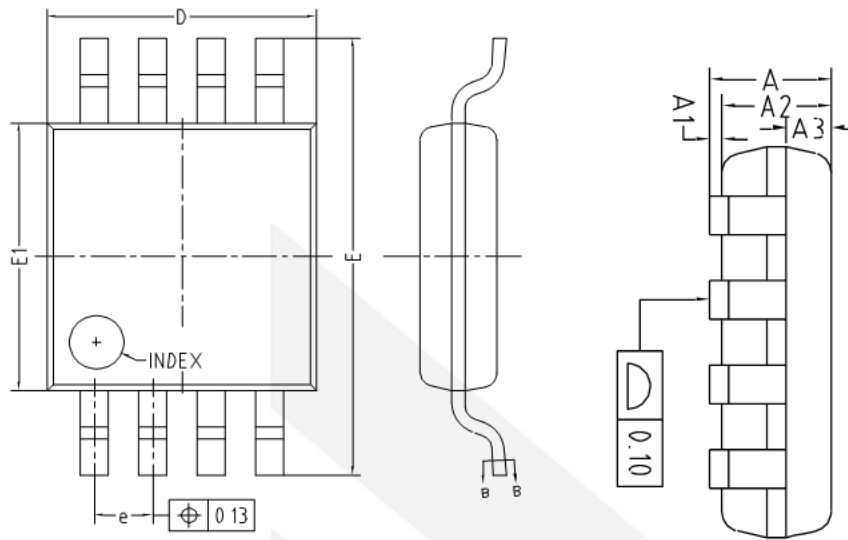


## Physical Dimensions: SOIC-8



| Common Dimensions<br>(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°  |

## Physical Dimensions: MSOP-8



| Common Dimensions<br>(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                                                   | 0.95 REF |      |      |
| L2                                                   | 0.25 BSC |      |      |
| R                                                    | 0.07     | -    | -    |
| R1                                                   | 0.07     | -    | -    |
| θ                                                    | 0°       | -    | 8°   |
| θ1                                                   | 9°       | 12°  | 15°  |



## DIO236XL

Ultra Low Vos, Low Power Amplifier

### 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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