

DIO20881/1D/2/4

600nA, Rail-to-Rail Input/ Output Low Power Amplifier

Features

- Ultra low power: 600nA per channel
- Unity Gain Stable
- Gain Bandwidth Product: 14kHz
- Wide supply range: 1.4V to 5.5V
- Available in SOT23-5, SOT23-6, SOIC-8, MSOP-8, SOP-14 and TSSOP-14 packages
- Temperature Range:
 - Industrial: -40°C to +85°C
 - Extended: -40°C to +125°C

Typical Applications



Descriptions

DIO2088x is a family of ultra low power operational amplifier, with rail-to-rail CMOS input/output and single/dual channels selectable. DIO2088x family has a gain-bandwidth product of 14kHz, wide operating supply voltage from 1.4V to 5.5V and broad output voltage swing.

DIO2088x consumes ultra low power, with each channel 600nA of bias current, which makes DIO2088x be ideal for battery powered device, temperature-sense device, etc.

The DIO2088x operational amplifier family is available in single (DIO20881/1D), and dual (DIO20882), and quad (DIO20884) configurations. Furthermore, the DIO20881 is offered in the 5-lead SOT23 package. All types of amplifiers are fully specified over the extended -40°C to +125°C temperature range.

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 | | T _A | Package | |
|-------------------|-------------|---------------|----------------|----------|-------------------|
| DIO20881ST5 | YW(X)Z | Green or RoHS | -40 to +125°C | SOT23-5 | Tape & Reel, 3000 |
| DIO20881SO8 | DIO2081 | Green or RoHS | -40 to +125°C | SOIC-8 | Tape & Reel, 2500 |
| DIO20881MP8 | DIO2081 | Green or RoHS | -40 to +125°C | MSOP-8 | Tape & Reel, 3000 |
| DIO20881DST6 | YWDL | Green or RoHS | -40 to +125°C | SOT23-6 | Tape & Reel, 3000 |
| DIO20881DSO8 | D20881D | Green or RoHS | -40 to +125°C | SOIC-8 | Tape & Reel, 2500 |
| DIO20881DMP8 | D20881D | Green or RoHS | -40 to +125°C | MSOP-8 | Tape & Reel, 3000 |
| DIO20882SO8 | DIO2082 | Green or RoHS | -40 to +125°C | SOIC-8 | Tape & Reel, 2500 |
| DIO20882MP8 | DIO2082 | Green or RoHS | -40 to +125°C | MSOP-8 | Tape & Reel, 3000 |
| DIO20884CS14 | DIO2084 | Green or RoHS | -40 to +125°C | SOP-14 | Tape & Reel, 2500 |
| DIO20884TP14 | DIO2084 | Green or RoHS | -40 to +125°C | TSSOP-14 | Tape & Reel, 2500 |

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 |
| SHDN | Active Low Shutdown |

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-)-0.3V to (V+)+0.3V | 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 |
| | 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 | | 1.4 to 5.5 | V |
| Input Voltage | | 0 to 5 | V |
| Operating Temperature Range | | -40 to 125 | °C |



Electrical Characteristics

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

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|-------------------------------|------------------------------------|--|------|---------|---------------------|-------------------|
| INPUT CHARACTERISTICS | | | | | | |
| V_{OS} | Input Offset Voltage | $-40^{\circ}C \leq T_A \leq 125^{\circ}C$, $V_{+}=1.4V$ to $5.5V$ | -2 | | +2 | mV |
| I_B | Input Bias Current | $V_{+}=1.4V$ to $5.5V$ | | 1 | | pA |
| I_{OS} | Input Offset Current | $V_{+}=1.4V$ to $5.5V$ | | 1 | | pA |
| V_{CM} | Common Mode Voltage Range | | -0.1 | | (V_{+}) +0.1 | V |
| CMRR | Common Mode Rejection Ratio | $-40^{\circ}C \leq T_A \leq 125^{\circ}C$, | 100 | | | dB |
| A_{OL} | Open Loop Voltage Gain | $R_L=50k\Omega$, $V_O=0.1$ to $(V_{+})-0.1$ | 70 | 87 | | dB |
| $\Delta V_{OS}/\Delta T$ | Input Offset Voltage Drift | $-40^{\circ}C \leq T_A \leq 125^{\circ}C$ | | ± 5 | | $\mu V/^{\circ}C$ |
| OUTPUT CHARACTERISTICS | | | | | | |
| V_{OH} | Output Voltage High | $R_L=50k\Omega$ $-40^{\circ}C \leq T_A \leq 125^{\circ}C$ | | 4.992 | | V |
| V_{OL} | Output Voltage Low | $R_L=50k\Omega$ $-40^{\circ}C \leq T_A \leq 125^{\circ}C$ | | 8 | 15 | mV |
| I_{SC} | Output Short Circuit Current | Source I_{SC} , $V_{+}=5V$ | | 30 | | mA |
| | | Sink I_{SC} , $V_{+}=5V$ | | 30 | | |
| POWER SUPPLY | | | | | | |
| PSRR | Power Supply Rejection Ration | | 100 | | | dB |
| I_Q | Supply Current per Channel/Amp | $-40^{\circ}C \leq T_A \leq 125^{\circ}C$ | | 600 | 1000 | nA |
| $I_{Q(off)}$ | Supply Current in Shutdown | $V_{SHDN}=0V$ | | 3 | | nA |
| I_{SHDN} | Shutdown Pin Current | | | -10 | | pA |
| I_{LEAK} | Output Leakage Current in Shutdown | $V_{SHDN}=0V$ | | 3.6 | | pA |
| V_{IL} | SHDN Input Low Voltage | Disable | | | 0.5 | V |
| V_{IH} | SHDN Input High Voltage | Enable | 1.1 | | | V |
| DYNAMIC PERFORMANCE | | | | | | |
| GBP | Gain Bandwidth Product | $C_L=60pF$ | | 14 | | kHz |
| SR | Slew Rate | $G=1$, 2V Output Step | | 3.5 | | V/ms |
| t_s | Setting Time | $G=1$, 2V Output Step | | 150 | | μs |
| Θ_m | Phase Margin | | | 49 | | Deg |
| t_r | Overload Recovery Time | | | 110 | | μs |
| NOISE PERFORMANCE | | | | | | |
| THD | Total Harmonic Distortion | $f=100Hz$, $4V_{PP}$, $R_L=50k\Omega$, | | 0.09 | | % |
| e_n | Voltage Noise Density | $f=1kHz$ | | 190 | | nV/\sqrt{Hz} |

Specifications subject to change without notice.

Typical Performance Characteristics

Supply Current vs. Supply Voltage



Supply Current vs. Temperature



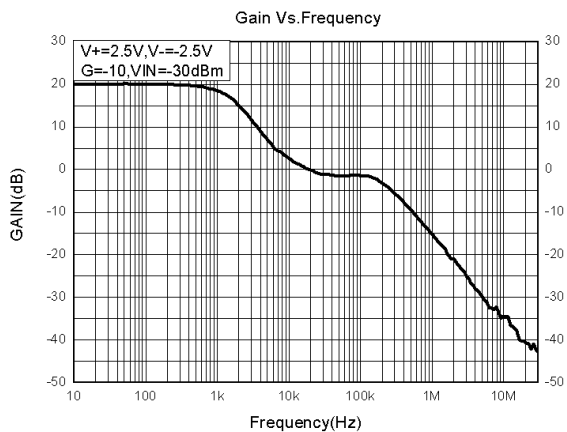
ISOURCE vs. Output Voltage



ISINK vs. Output Voltage



Gain vs. Frequency



Input Offset Voltage vs. Temperature



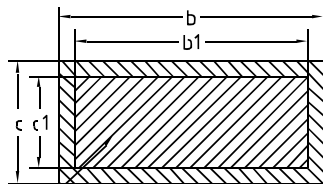
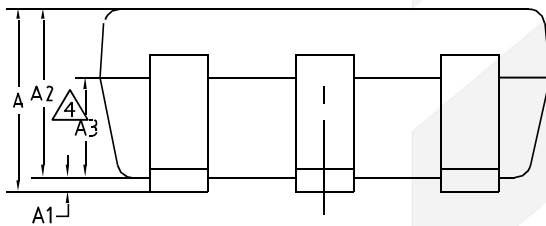
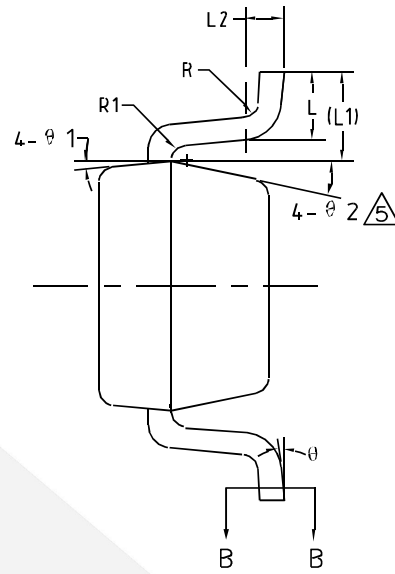
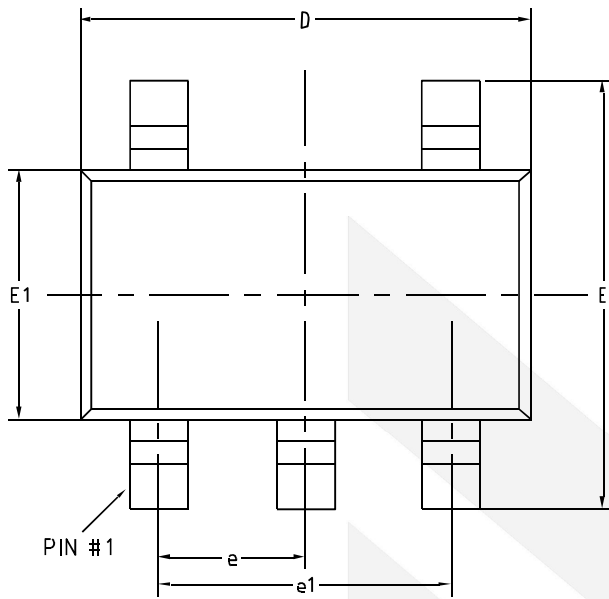
Input Offset Voltage vs. Supply Voltage



Input Offset Voltage vs. Common Voltage



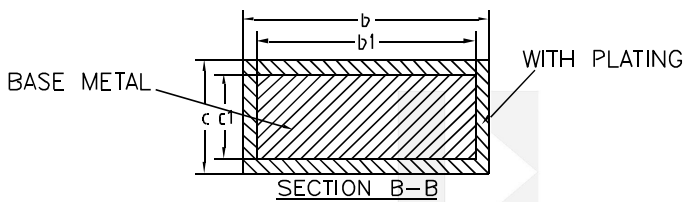
Physical Dimensions: SOT23-5



BASE METAL
SECTION B-B

| 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° |
| θ1 | 3° | 5° | 7° |
| θ2 | 6° | - | 14° |

Physical Dimensions: SOT23-6

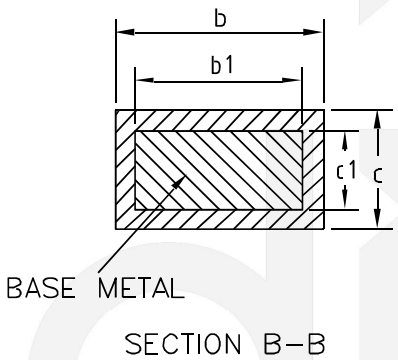


| COMMON DIMENSIONS (UNITS OF MEASURE=MILLIMETER) | | | |
|--|---------|-------|-------|
| Symbol | MIN | NOM | MAX |
| A | - | - | 1.25 |
| A1 | 0 | - | 0.15 |
| A2 | 1.00 | 1.10 | 1.20 |
| A3 | 0.60 | 0.65 | 0.70 |
| b | 0.36 | - | 0.50 |
| b1 | 0.36 | 0.38 | 0.45 |
| c | 0.14 | - | 0.20 |
| c1 | 0.14 | 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 |
| Theta | 0° | - | 8° |
| Theta 1 | 3° | 5° | 7° |
| Theta 2 | 6° | - | 14° |

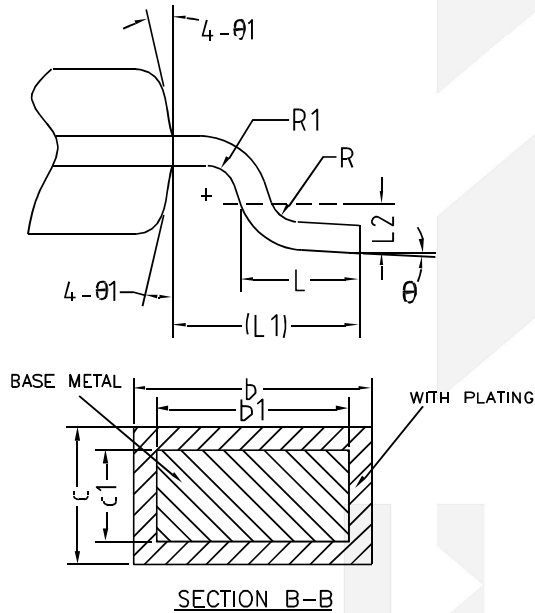
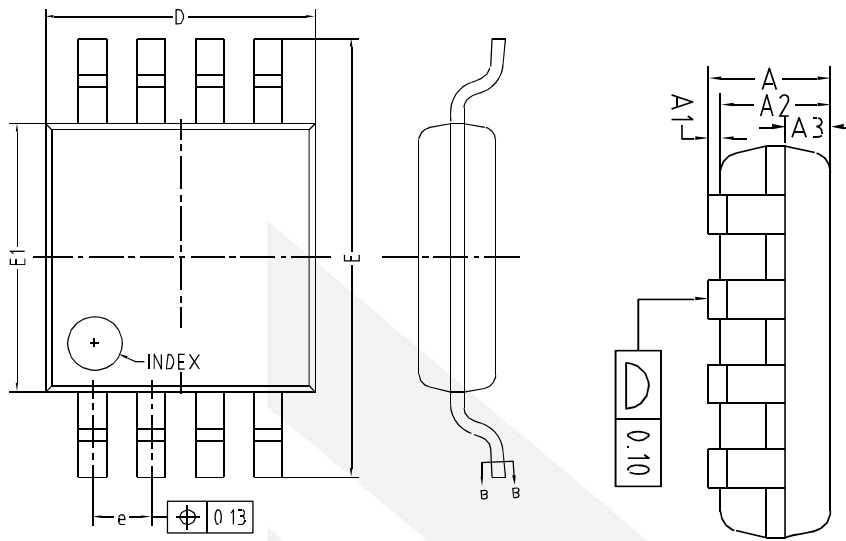
Physical Dimensions: SOIC-8



| 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 | 0.45 | 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° |
| θ1 | 15° | 17° | 19° |
| θ2 | 11° | 13° | 15° |
| θ3 | 15° | 17° | 19° |
| θ4 | 11° | 13° | 15° |

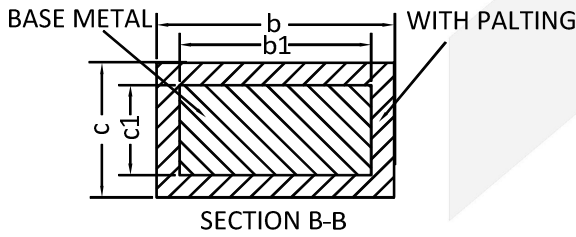
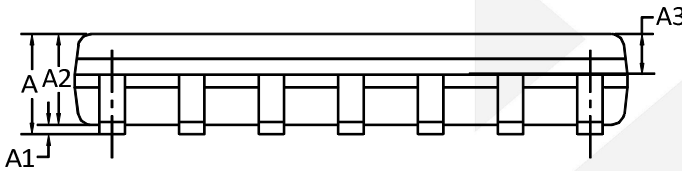


Physical Dimensions: MSOP-8



| 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: SOP-14

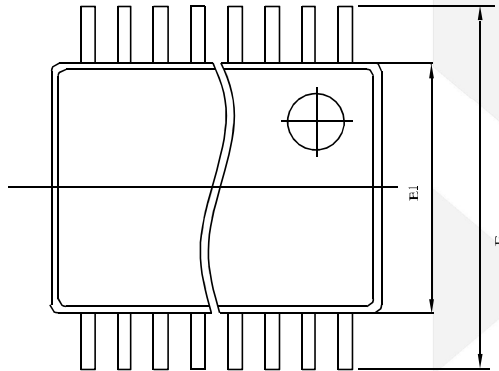


| COMMON DIMENSIONS (UNITS OF MEASURE=MILLIMETER) | | | |
|--|---------|------|------|
| Symbol | MIN | NOM | MAX |
| A | 1.35 | 1.60 | 1.75 |
| A1 | 0.10 | 0.15 | 0.25 |
| A2 | 1.25 | 1.45 | 1.65 |
| A3 | 0.55 | 0.65 | 0.75 |
| b | 0.36 | - | 0.49 |
| b1 | 0.35 | 0.40 | 0.45 |
| c | 0.17 | - | 0.25 |
| c1 | 0.17 | 0.20 | 0.23 |
| D | 8.45 | 8.65 | 8.85 |
| E | 5.80 | 6.00 | 6.20 |
| E1 | 3.70 | 3.90 | 4.10 |
| e | 1.27BSC | | |
| h | 0.25 | - | 0.50 |
| L | 0.45 | 0.60 | 0.80 |
| L1 | 1.05BSC | | |
| θ | 0° | - | 8° |

Physical Dimensions: TSSOP-14



TOP VIEW



BOTTOM VIEW

| COMMON DIMENSIONS (UNITS OF MEASURE=MILLIMETER) | | |
|--|---------|------|
| Symbol | Min | Max |
| A | | 1.2 |
| A1 | 0.05 | 0.15 |
| A2 | 0.8 | 1.05 |
| E | 6.25 | 6.55 |
| E1 | 4.3 | 4.5 |
| D | 4.9 | 5.1 |
| L | | 1 |
| L1 | 0.45 | 0.75 |
| e | 0.65 | |
| b | 0.19 | 0.3 |
| R1 | 0.15TYP | |
| R2 | 0.15TYP | |
| A-A | 0.09 | 0.2 |
| $\theta 1$ | 12° TYP | |
| $\theta 2$ | 12° TYP | |
| $\theta 3$ | 0° | 8° |

