DIO264X

Low Power, High Speed, Rail-to-Rail Input and Output CMOS Amplifiers

Features

- Rail-to-rail input and output
- Supply voltage range: 2.7 V to 13.2 V
- Supply current (no load): 7 mA / channel
- Low offset voltage: 11 mV (max)
- Output voltage swing 20 mV from Rails
- High gain-bandwidth product:
  100 MHz when V+ = 5 V
- Slew rate (A_V = −1): 85 V/µs
- Settling time: 80 ns
- Input voltage noise (100 kHz) 30 nV/√Hz
- Output short protection
- Available packages:
  DIO2641: SOT23-5/SOIC-8
  DIO2642: SOIC-8/MSOP-8
  DIO2644: TSSOP-14/SOIC-14

Applications

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

Descriptions

The DIO2641 (single), DIO2642 (dual), and DIO2644 (quad) are amplifiers with low noise, low voltage, and low power operation. The DIO2641/2/4 has a high gain-bandwidth product of 100 MHz, exceptionally high output current (approximately 50 mA) at low cost, and reduced power consumption when compared to existing devices with similar performance.

The DIO2641/2/4 is designed to provide optimal performance in low voltage and low noise systems. All these chips provide rail-to-rail output swing into heavy loads. Fast output Slew Rate (85 V/µs) ensures large peak-to-peak output swings can be maintained even at higher speeds.

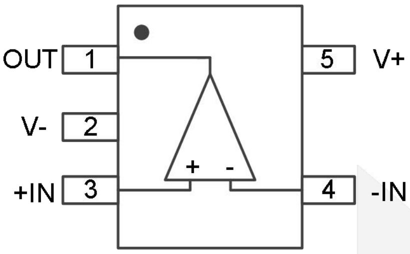
They are specified over the extended industrial temperature range (-40°C to 125°C). The operating range is from 2.7 V to 13.2 V.

Ordering Information

Order Part Number	Top Marking		T_A	Package	
DIO2641ST5	WF4A	RoHS/Green	-40 to 125°C	SOT23-5	Tape & Reel, 3000
DIO2641SO8	DIOBF4A	RoHS/Green	-40 to 125°C	SOIC-8	Tape & Reel, 2500
DIO2642SO8	DIOBF4B	RoHS/Green	-40 to 125°C	SOIC-8	Tape & Reel, 2500
DIO2642MP8	DIOBF4B	RoHS/Green	-40 to 125°C	MSOP-8	Tape & Reel, 3000
DIO2644SO14	DIOBF4D	RoHS/Green	-40 to 125°C	SOIC-14	Tape & Reel, 2500
DIO2644TP14	DIOBF4D	RoHS/Green	-40 to 125°C	TSSOP-14	Tape & Reel, 2500

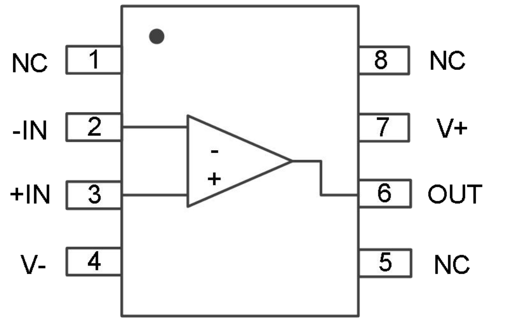
Pin Assignments

DIO2641



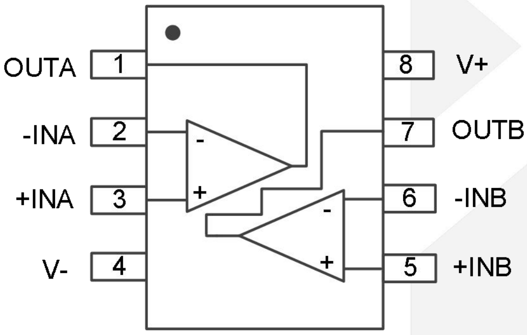
SOT23-5

DIO2641



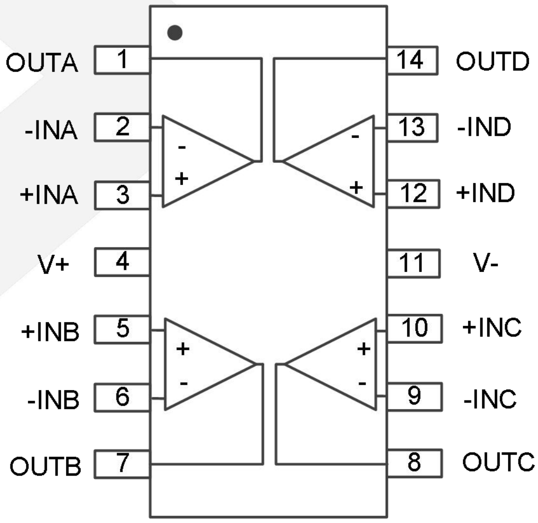
SOIC-8

DIO2642



SOIC-8/MSOP-8

DIO2644



TSSOP-14/SOIC-14

Pin assignment (Top View)

Pin Description

Pin name	Description
V+	Positive supply
V-	Negative supply
+IN (+INA/+INB/+INC/+IND)	Positive input (channel A/B/C/D)
-IN (-INA/-INB/-INC/-IND)	Negative input (channel A/B/C/D)
OUT (OUTA/OUTB/OUTC/OUTD)	Output (channel A/B/C/D)
NC	Do not connect

Absolute Maximum Ratings

Stresses beyond those listed under the Absolute Maximum Rating table 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.

<table>
<tr><th>Symbol</th><th colspan="3">Parameter</th><th>Rating</th><th>Unit</th></tr>
<tr><td>V_{CC}</td><td colspan="3">Supply voltage</td><td>13.5</td><td>V</td></tr>
<tr><td>V_{IN}</td><td colspan="3">Input voltage</td><td>(V-)-0.5 to (V+)+0.5</td><td>V</td></tr>
<tr><td>T_{STG}</td><td colspan="3">Storage temperature Range</td><td>-65 to 150</td><td>°C</td></tr>
<tr><td>T_J</td><td colspan="3">Junction temperature</td><td>150</td><td>°C</td></tr>
<tr><td>T_L</td><td colspan="3">Lead temperature Range</td><td>260</td><td>°C</td></tr>
<tr><td rowspan="5">$R_{\theta JA}$</td><td rowspan="5">Junction-to-ambient thermal resistance</td><td rowspan="2">DIO2641</td><td>SOT23-5</td><td>265</td><td rowspan="5">°C/W</td></tr>
<tr><td>SOIC-8</td><td>190</td></tr>
<tr><td colspan="2">DIO2642</td><td>235</td></tr>
<tr><td rowspan="2">DIO2644</td><td>SOIC-14</td><td>145</td></tr>
<tr><td>TSSOP-14</td><td>155</td></tr>
<tr><td rowspan="2">ESD</td><td colspan="3">Human body model (HBM), JEDEC JS-001, all pins</td><td>8</td><td>kV</td></tr>
<tr><td colspan="3">Charged device model (CDM), per JEDEC specification JESD22-C101, all pins</td><td>2</td><td>kV</td></tr>
<tr><td colspan="4">Latch up</td><td>200</td><td>mA</td></tr>
</table>

Recommended Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. DIOO does not recommend exceeding them or designing to absolute maximum ratings.

Symbol	Parameter	Rating	Unit
V_{CC}	Supply voltage	2.7 to 13.2	V
T_A	Operating temperature range	-40 to 125	°C

3 V Electrical Characteristics

Typical value: T_A= 25°C, V+ = 3 V, V− = 0 V, V_{CM} = V+ /2, R_L = 2 kΩ to V+/2, unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Power supply						
PSRR	Power supply rejection ratio	V+ = 3.0 V to 3.5 V, V_{CM} = 1.5 V		95		dB
I_S	Supply current (per channel)	No load		7		mA
Input characteristics						
V_{OS}	Input offset voltage				±9.5	mV
C_{IN}	Common mode input capacitance			6		pF
V_{CM}	Input common-mode voltage range	Low rail		0		V
		High rail		3		V
CMRR	Common mode rejection ratio	V_{CM} stepped from 0 V to 1.5 V		90		dB
A_V	Open loop voltage gain	R_L = 2 kΩ to V+ /2		101		dB
$\Delta V_{OS}/\Delta T$	Input offset average drift	Offset voltage average drift determined by dividing the change in V_{OS} at temperature extremes by the total temperature change.		±10		μV/°C
Output characteristics						
I_{SC}	Output short circuit current	Sourcing to V-		110		mA
		Sinking to V+		110		mA
I_{OUT}	Output current	V_{OUT} = 0.5 V from V+		38		mA
		V_{OUT} = 0.5 V from V-		36		mA
V_{OUT}	Output swing high	R_L = 2 kΩ to V+ /2	2.98	2.985		V
	Output swing low	R_L = 2 kΩ to V+ /2	15	20		mV
Dynamic performance						
BW	−3 dB BW	A_V = +1, V_{OUT} = 200 mV_{PP}		90		MHz
		A_V = +2, V_{OUT} = 200 mV_{PP}		40		MHz
		A_V = −1, V_{OUT} = 20 0mV_{PP}		39		MHz
PBW	Full power bandwidth	A_V = +1, −1 dB, V_{OUT} = 1 V_{PP}		20		MHz
X_{TALK}	Channel-to-channel crosstalk	f = 80 kHz, receiver: R_F = Rg = 510 Ω, A_V = +2		87		dB
SR	Slew rate	A_V = −1, V_I = 2 V_{PP}		65		V/μs
t_S	Settling time	V_{OUT} = 2 V_{PP}, ±0.1%, 8 pF load, V_S = 5 V		85		ns
Noise performance						
THD	Total harmonic distortion	f = 1 kHz, V_{OUT} = 2 V_{PP}, A_V = −1, R_L = 100 Ω to V+ /2		80		dB

		f = 1 kHz, V_{OUT} = 2 V_{PP}, A_V = −1, R_L = 2 kΩ to V+ /2		95		dB
e_n	Input-referred voltage noise	f = 100 kHz		30		nV/√Hz

Specifications subject to change without notice.

5 V Electrical Characteristics

Typical value: T_A = 25°C, V+ = 5 V, V− = 0 V, V_{CM} = V+ /2, R_L = 2 kΩ to V+/2, unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Power supply						
PSRR	Power supply rejection ratio	V+ = 4 V to 6 V		95		dB
I_S	Supply current (per channel)	No load		7		mA
Input characteristics						
V_{OS}	Input offset voltage				±11	mV
C_{IN}	Common mode input capacitance			6		pF
V_{CM}	Input common-mode voltage range	Low rail		0		V
		High rail		5		V
CMRR	Common mode rejection ratio	V_{CM} stepped from 0 V to 3.5 V		90		dB
A_V	Open loop voltage gain	R_L = 2 kΩ to V+ /2		97		dB
$\Delta V_{OS}/\Delta T$	Input offset average drift	Offset voltage average drift determined by dividing the change in V_{OS} at temperature extremes by the total temperature change.		±10		μV/°C
Output characteristics						
I_{SC}	Output short circuit current	Sourcing to V-		110		mA
		Sinking to V+		120		mA
I_{OUT}	Output current	V_{OUT} = 0.5 V from V+		52		mA
		V_{OUT} = 0.5 V from V-		40		mA
V_{OUT}	Output swing high	R_L = 2 kΩ to V+ /2	4.98	4.985		V
	Output swing low	R_L = 2 kΩ to V+ /2	15	20		mV
Dynamic performance						
BW	−3 dB BW	A_V = +1, V_{OUT} = 200 mV_{PP}		100		MHz
		A_V = +2, V_{OUT} = 200 mV_{PP}		42		MHz
		A_V = −1, V_{OUT} = 200 mV_{PP}		42		MHz
PBW	Full power bandwidth	A_V = +1, −1 dB, V_{OUT} = 2 V_{PP}		20		MHz
X_{TALK}	Channel-to-channel crosstalk	f = 80 kHz, Receiver: R_F = Rg = 510 Ω, A_V = +2		87		dB

SR	Slew rate	A_V = −1, V_{IN} = 2 V_{PP}		85		V/μs
t_S	Settling time	V_{OUT} = 2 V_{PP}, ±0.1%, 8 pF Load		80		ns
Noise performance						
THD	Total harmonic distortion	f = 1 kHz, V_O = 2 V_{PP}, A_V = −1, R_L = 100 Ω to V+ /2		80		dB
		f = 1 kHz, V_{OUT} = 2V_{PP}, A_V = −1, R_L = 2 kΩ to V+ /2		95		dB
e_n	Input-referred voltage noise	f = 100 kHz		30		nV/√Hz

Specifications subject to change without notice.

±5 V Electrical Characteristics

Typical value: T_A = 25°C, V+ = 5 V, V− = -5 V, V_{CM} = 0 V, R_L = 2 kΩ to ground, unless otherwise specified.

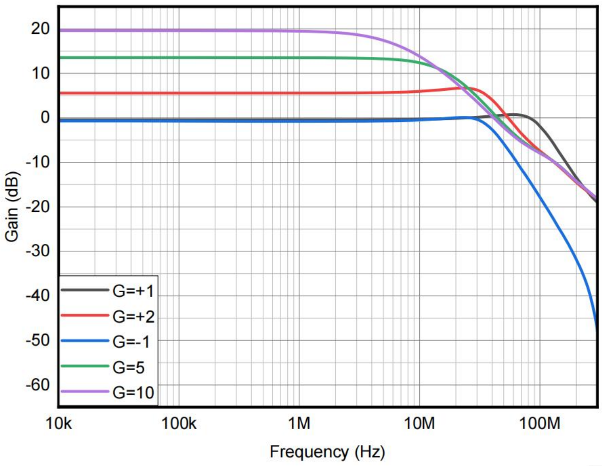
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Power supply						
PSRR	Power supply rejection ratio	V+ = 4 V to 6 V, V_{CM} = 0 V		95		dB
I_S	Supply current (per channel)	No load		7		mA
Input characteristics						
V_{OS}	Input offset voltage				±11	mV
C_{IN}	Common mode input capacitance			6		pF
V_{CM}	Input common-mode voltage range	Low rail		-5		V
		High rail		5		V
CMRR	Common mode rejection ratio	V_{CM} stepped from 0 V to 3.5 V		90		dB
A_V	Open loop voltage gain	R_L = 2 kΩ		96		dB
$\Delta V_{OS}/\Delta T$	Input offset average drift	Offset voltage average drift determined by dividing the change in V_{OS} at temperature extremes by the total temperature change.		±10		μV/°C
Output characteristics						
I_{SC}	Output short circuit current	Sourcing to V-		70		mA
		Sinking to V+		70		mA
I_{OUT}	Output current	V_{OUT} = 0.5 V from V+		54		mA
		V_{OUT} = 0.5 V from V-		40		mA
V_{OUT}	Output swing high	R_L = 2 kΩ	4.98	4.985		V
	Output swing low	R_L = 2 kΩ	15	20		mV
Dynamic performance						
BW	−3 dB BW	A_V = +1, V_{OUT} = 200 mV_{PP}		105		MHz

		A_V = +2, V_{OUT} = 200 mV_{PP}		46		MHz
		A_V = −1, V_{OUT} = 200 mV_{PP}		44		MHz
PBW	Full power bandwidth	A_V = +1, −1 dB, V_{OUT} = 2 V_{PP}		20		MHz
X_{TALK}	Channel-to-channel crosstalk	f = 1 kHz, receiver, R_F = Rg = 510 Ω, A_V = +2		87		dB
SR	Slew rate	A_V = −1, V_{IN} = 2V_{PP}		85		V/μs
t_S	Settling time	V_{OUT} = 2 V_{PP}, ±0.1%, 8 pF load, V_S = 5 V		80		ns
Noise performance						
THD	Total harmonic distortion	f = 1 kHz, V_{OUT} = 2 V_{PP}, A_V = −1, R_L = 100 Ω to V+ /2		80		dB
		f = 1 kHz, V_{OUT} = 2 V_{PP}, A_V = −1, R_L = 2 kΩ to V+ /2		95		dB
e_n	Input-referred voltage noise	f = 100 kHz		30		nV/√Hz

Specifications subject to change without notice.

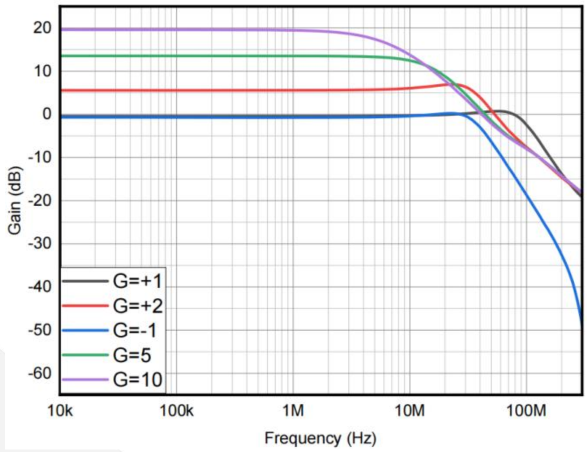
Typical Performance Characteristics

V+ = +5, V− = −5 V, $R_F = R_L$ = 2 kΩ. Unless otherwise specified.



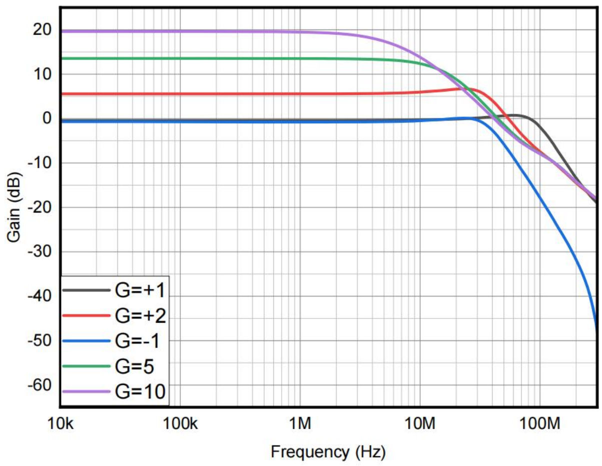
V_{CC} = 3 V, V_{OUT} = 0.2 VPP

Figure 2. Closed loop gain vs. Frequency for various gain



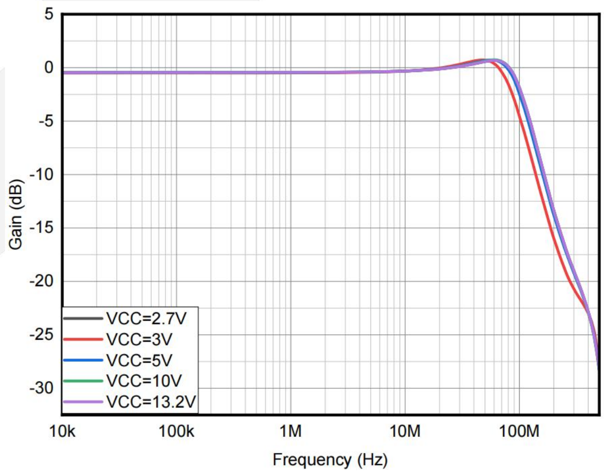
V_{CC} = 5 V, V_{OUT} = 0.2 VPP

Figure 3. Closed loop gain vs. Frequency for various gain



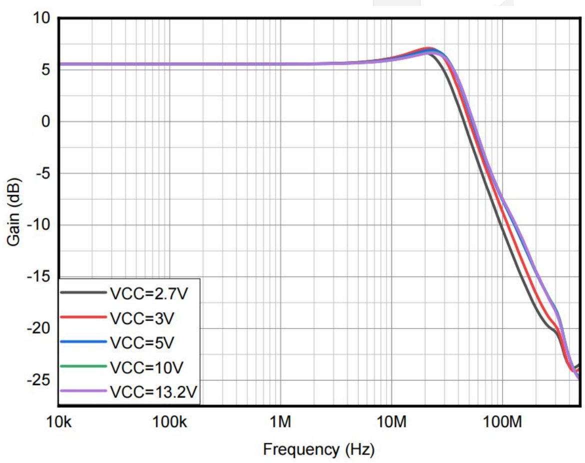
V_{CC} = 10 V, V_{OUT} = 0.2 VPP

Figure 4. Closed loop gain vs. Frequency for various gain



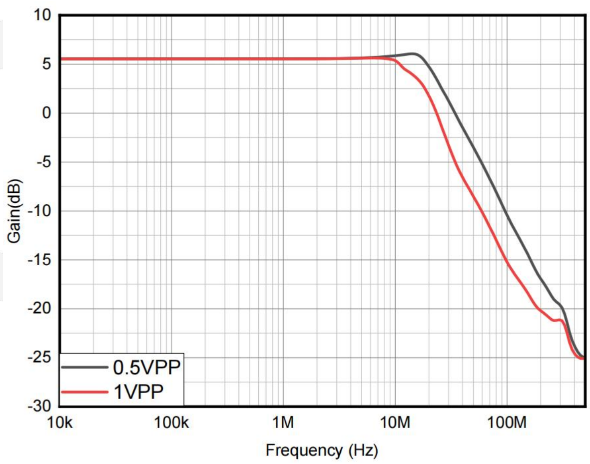
G = +1, V_{OUT} = 0.2 VPP

Figure 5. Closed loop frequency response for various supplies



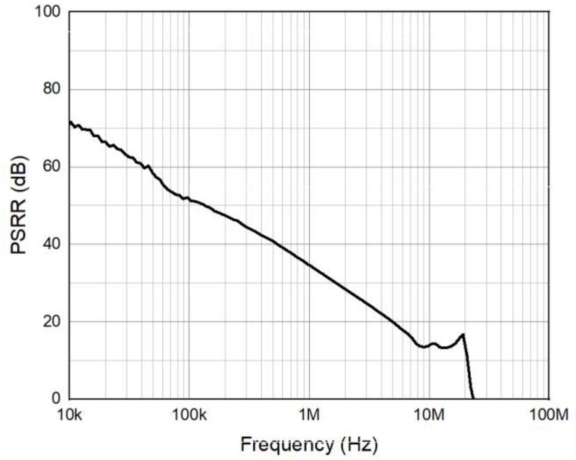
G = +2, V_{OUT} = 0.2 VPP

Figure 6. Closed loop frequency response for various supplies



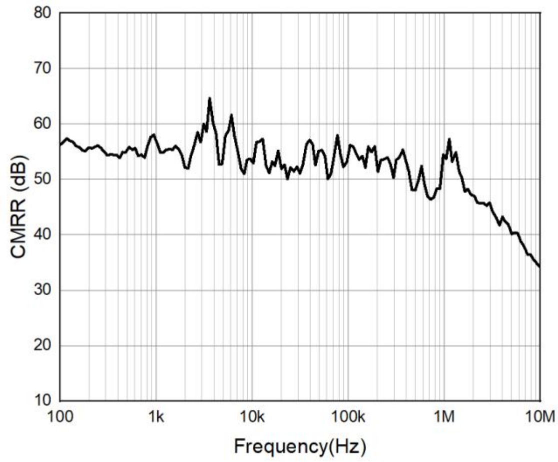
V_{CC} = 10 V, G = +2

Figure 7. Large signal frequency response



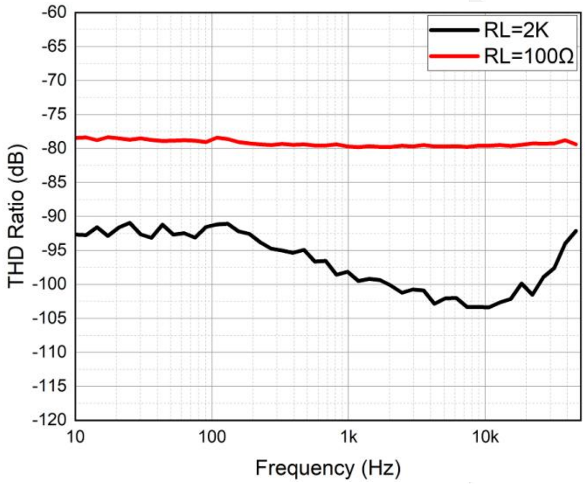
V_S = 5 V, A_V = +1

Figure 8. PSRR vs. Frequency



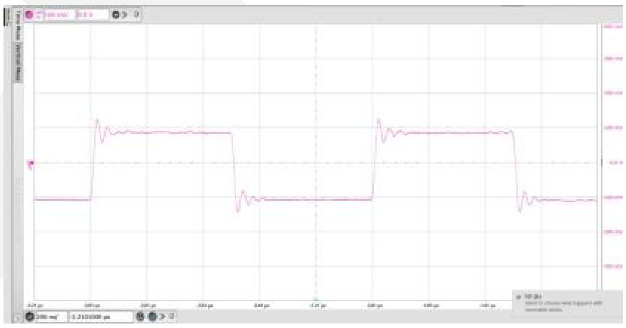
V_S = 5 V, A_V = +2

Figure 9. CMRR vs. Frequency



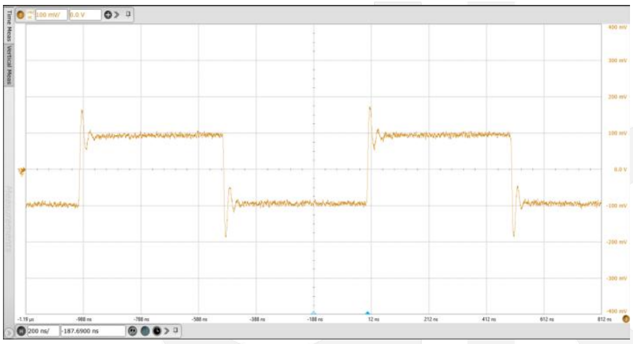
V_{CC} = ±5 V, V_{IN} = 2 V_{PP}, G = -1

Figure 10. THD ratio vs. Frequency



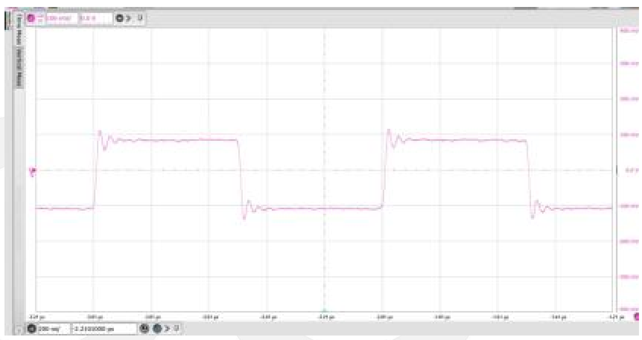
V_{CC} = 3 V, V_{OUT} = 0.2 V_{PP}, G = -1

Figure 11. Small signal step response



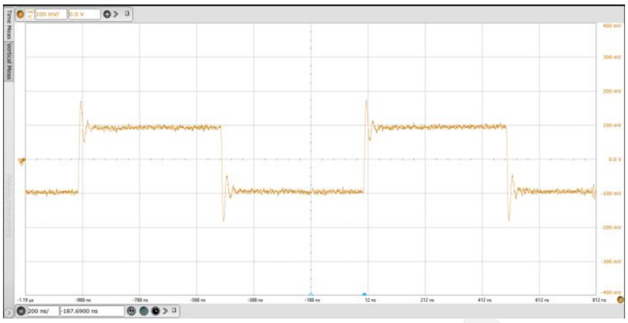
V_{CC} = 3 V, V_{OUT} = 0.2 VPP, G = 2

Figure 12. Small signal step response



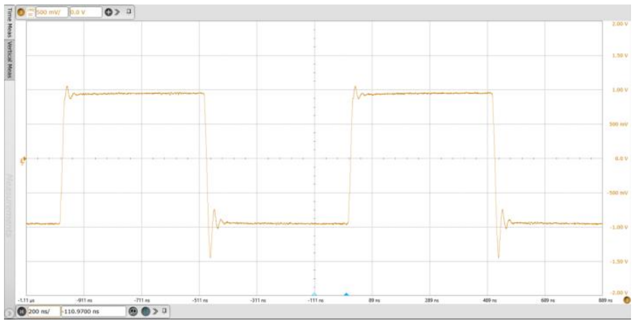
V_{CC} = 10 V, V_{OUT} = 0.2 V_{PP}, G = -1

Figure 13. Small signal step response



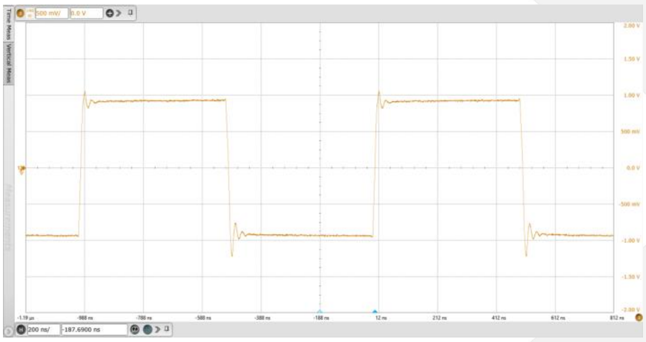
V_{CC} = 10 V, V_{OUT} = 0.2 VPP, G = 2

Figure 14. Small signal step response



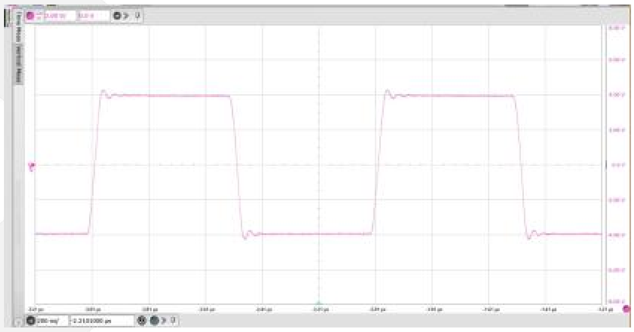
V_{CC} = 10 V, V_{OUT} = 2 VPP, G = 2

Figure 15. Large signal step response



V_{CC} = 10 V, V_{OUT} = 2 VPP, G = -1

Figure 16. Large signal step response



V_{CC} = 10 V, V_{OUT} = 8 V_{PP}, G = -1

Figure 17. Large signal step response

Typical Application

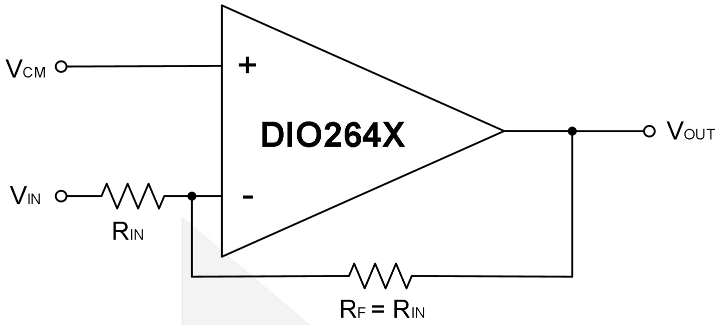


Figure 14. gain = -1

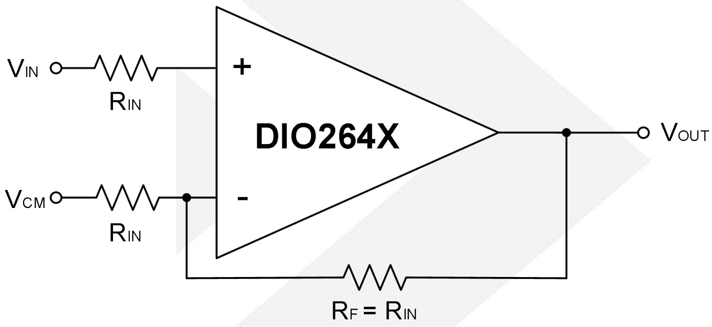


Figure 15. gain = 2

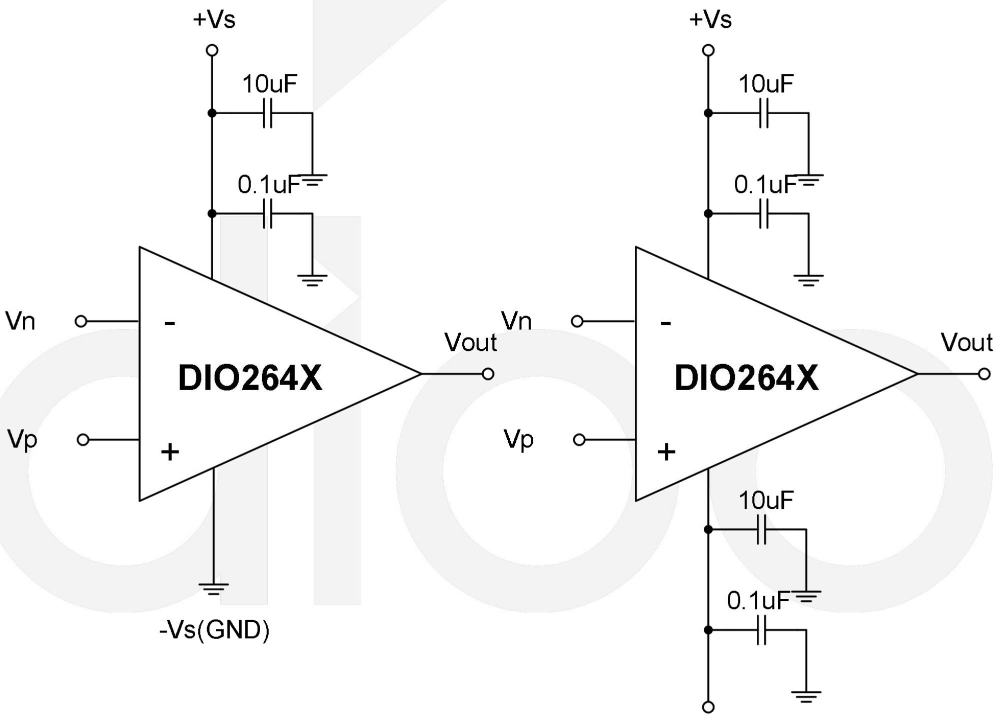


Figure 16. Amplifier with bypass capacitors

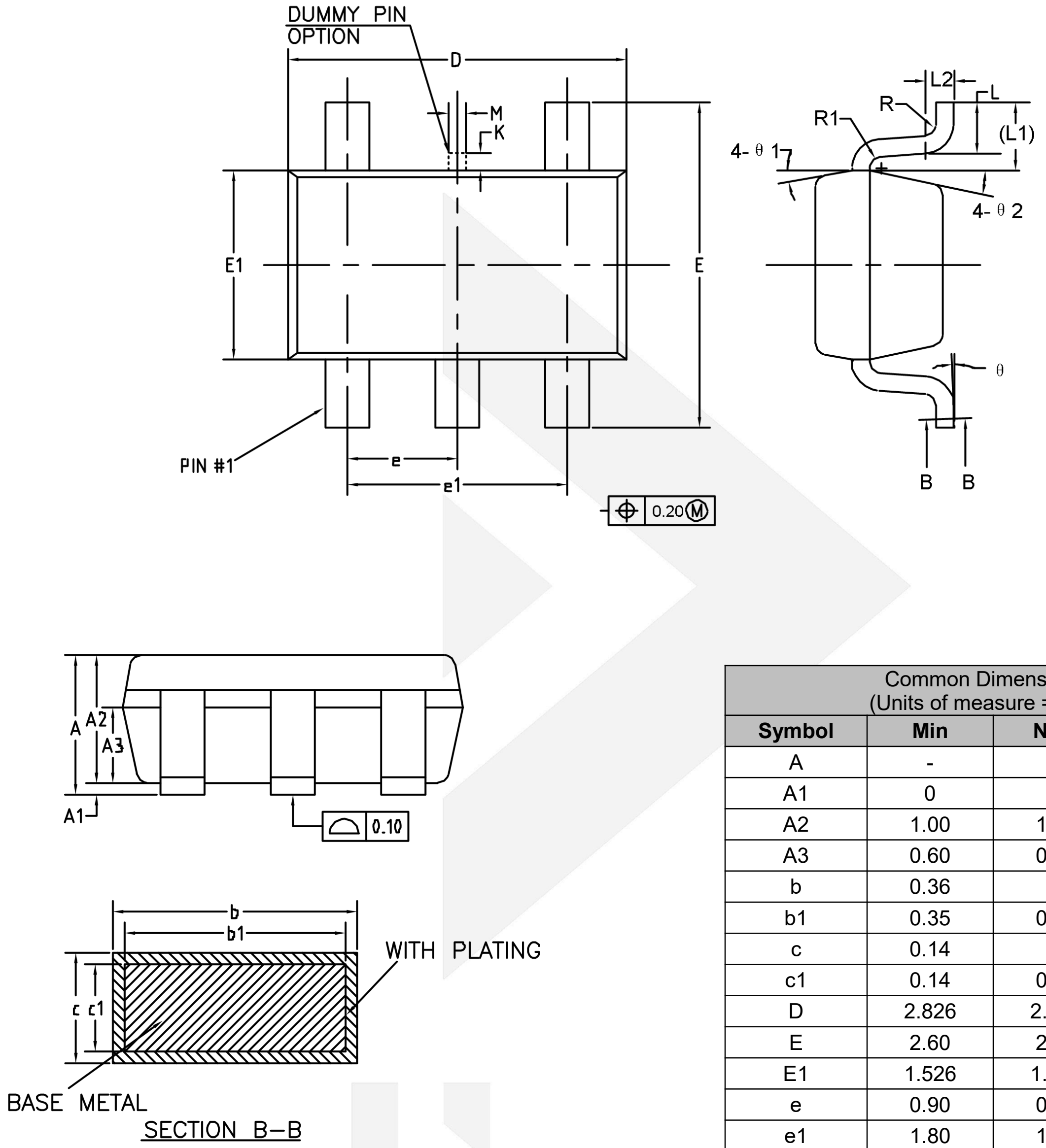
Feature Description

The DIO264X series is designed for high-voltage, high-speed amplifier applications. The DO264X has low power dissipation, due to the lower supply current. Push-pull output stage is capable of 50 mA output current (at 0.5 V from the supply rails) while the device consumes only 7 mA of total supply current per channel. As high-performance devices, due to the subtleties of applications, it is recommended to evaluate performance under actual operating conditions to ensure the chip meets all specifications.

As a rail-to-rail output Op Amp, the DIO2641B has a wide power supply voltage range from 2.7 V to 13.2 V. Even when the device is supplied with 3 V, the -3 dB BW (at A_V = +1) is typically 90 MHz. Production testing guarantees that process variations will not compromise speed.

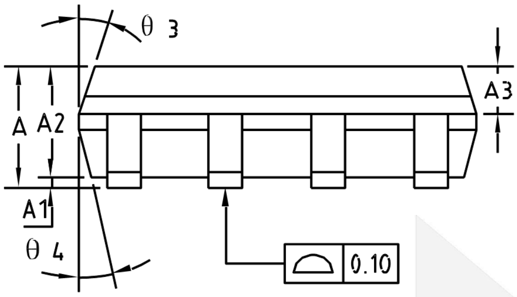
The DIO264X device family can operate off a single supply or with dual supplies. The input CM capability of the parts (CMVR) extends down to the V- rail to simplify single supply applications. Supplies should be decoupled with low inductance, often ceramic, capacitors to ground less than 0.5 inches from the device pins. The use of the ground plane is recommended, and as in most high-speed devices, it is advisable to remove the ground plane close to device-sensitive pins such as the inputs.

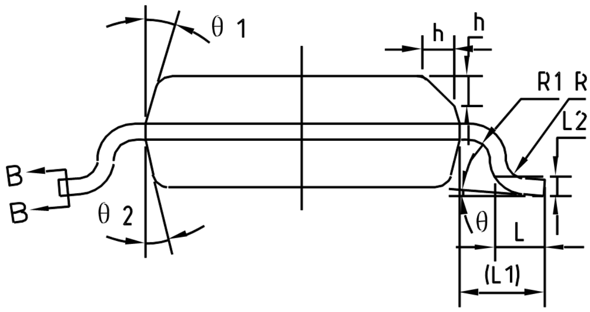
Physical Dimensions: SOT23-5

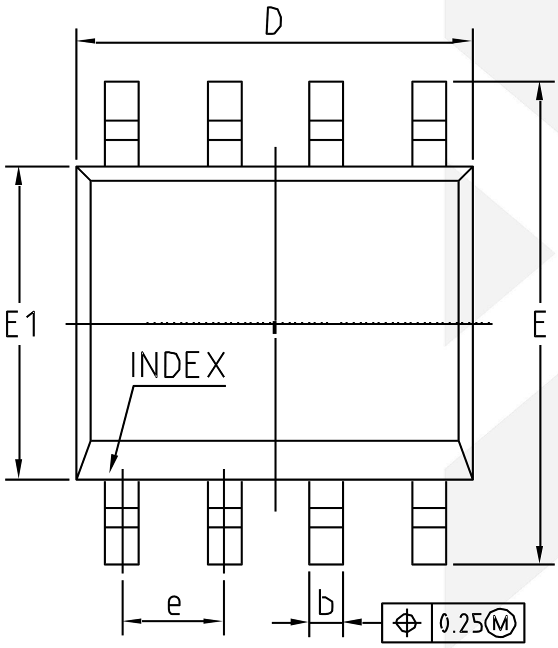


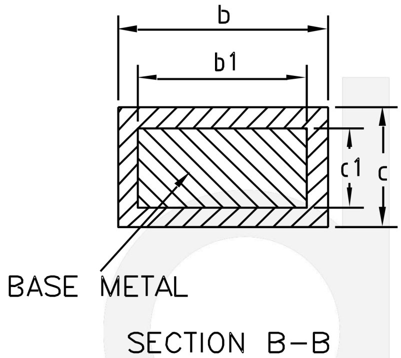
Common Dimensions (Units of measure = mm)			
Symbol	**Min**	**Nom**	**Max**
A	-	-	1.25
A1	0	-	0.15
A2	1.00	1.10	1.20
A3	0.60	0.65	0.70
b	0.36	-	0.45
b1	0.35	0.38	0.41
c	0.14	-	0.20
c1	0.14	0.15	0.16
D	2.826	2.926	3.026
E	2.60	2.80	3.00
E1	1.526	1.626	1.726
e	0.90	0.95	1.00
e1	1.80	1.90	2.00
K	0	-	0.25
L	0.30	0.40	0.60
L1	0.59REF		
L2	0.25BSC		
M	0.10	0.15	0.25
R	0.05	-	0.20
R1	0.05	-	0.20
Θ	0°	-	8°
Θ1	8°	10°	12°
Θ2	10°	12°	14°

Physical Dimensions: SOIC-8



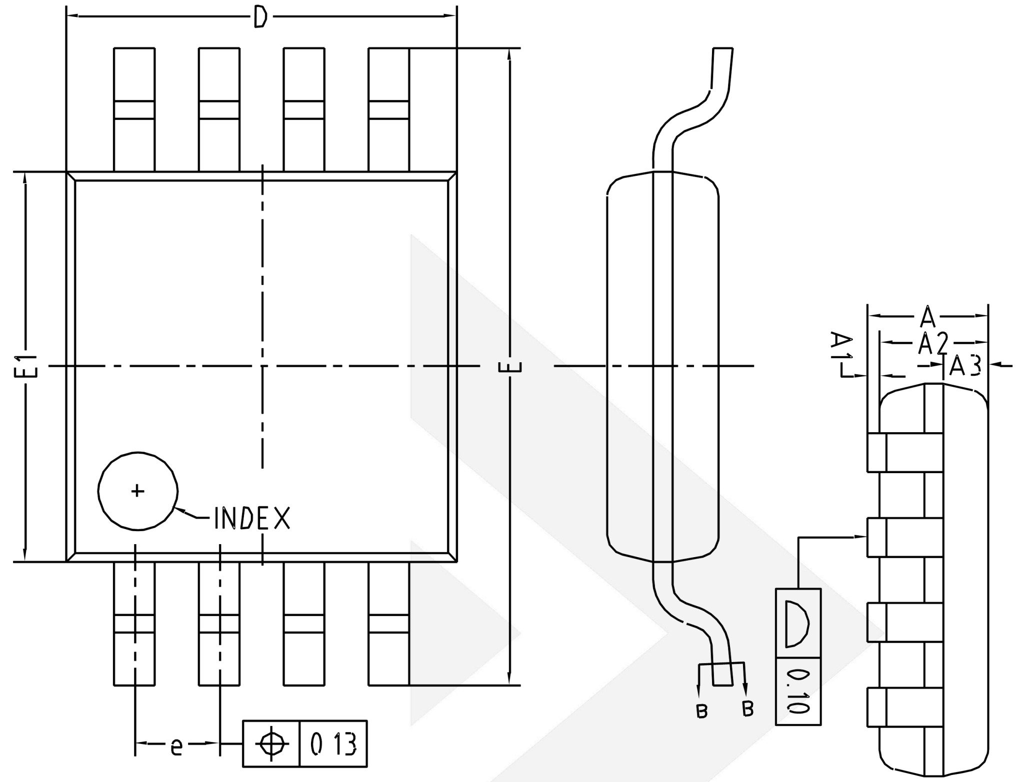


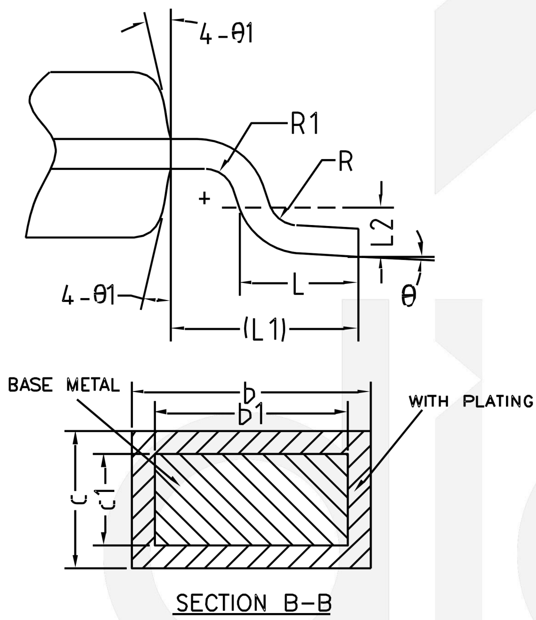




Common Dimensions (Units of measure = mm)			
Symbol	Min	Nom	Max
A	1.35	1.55	1.75
A1	0.10	0.15	0.25
A2	1.25	1.40	1.65
A3	0.50	0.60	0.70
b	0.38	-	0.51
b1	0.37	0.42	0.47
c	0.17	-	0.25
c1	0.17	0.20	0.23
D	4.80	4.90	5.00
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e		1.27BSC	
L	0.45	0.60	0.80
L1		1.04REF	
L2		0.25BSC	
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°

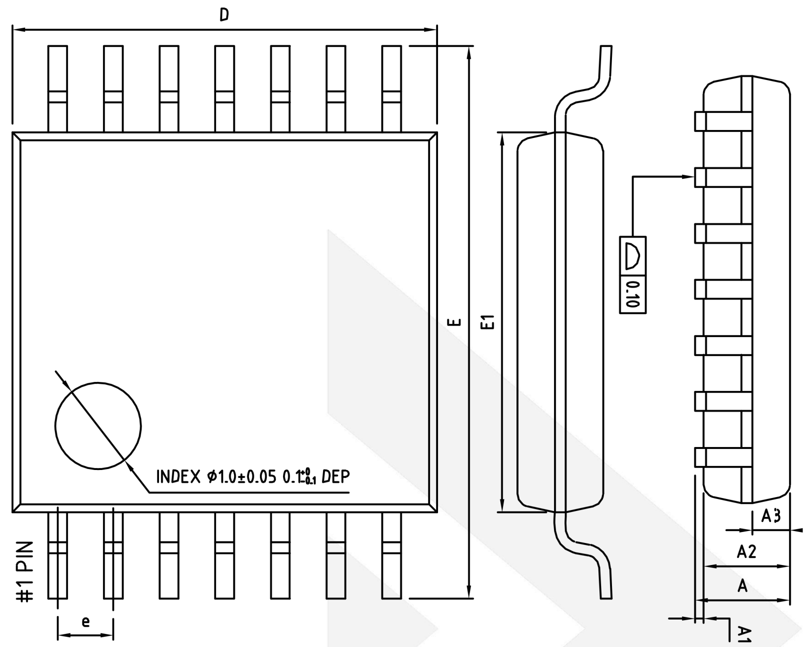
Physical Dimensions: MSOP-8

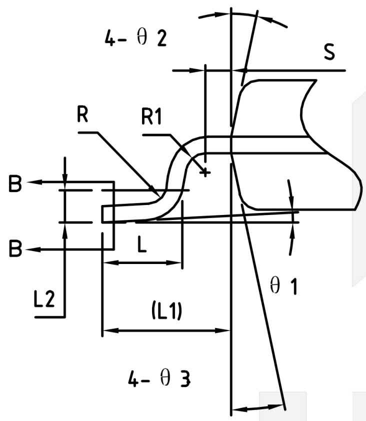


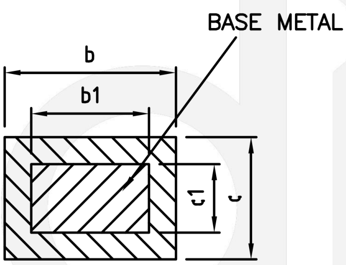


Common Dimensions (Units of measure = mm)			
Symbol	**Min**	**Nom**	**Max**
A	-	-	1.10
A1	0	-	0.15
A2	0.75	0.85	0.95
A3	0.25	0.35	0.39
b	0.28	-	0.37
b1	0.27	0.30	0.33
c	0.15	-	0.20
c1	0.14	0.15	0.16
D	2.90	3.00	3.10
E	4.70	4.90	5.10
E1	2.90	3.00	3.10
e	0.55	0.65	0.75
L	0.40	0.60	0.80
L1		0.95REF	
L2		0.25BSC	
R	0.07	-	-
R1	0.07	-	-
Θ	0°	-	8°
Θ1	9°	12°	15°

Physical Dimensions: TSSOP-14



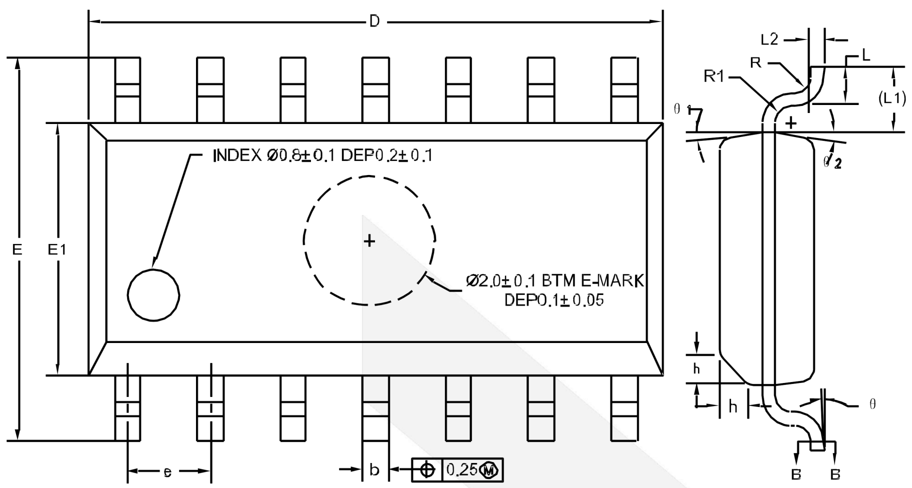


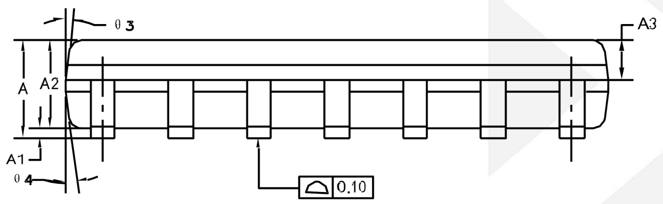


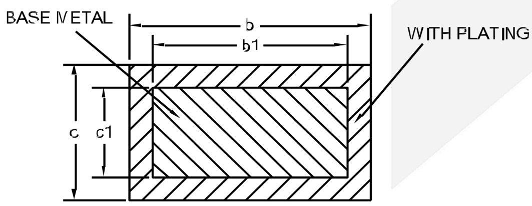
SECTION B—B

Common Dimensions (Units of measure = mm)			
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	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	-	-
Θ1	0°	-	8°
Θ2	10°	12°	14°
Θ3	10°	12°	14°

Physical Dimensions: SOIC-14







SECTION B-B

Common Dimensions (Units of measure = mm)			
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		1.27BSC	
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	6°	8°	10°
Θ2	6°	8°	10°
Θ3	5°	7°	9°
Θ4	5°	7°	9°

CONTACT US

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

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