

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:
105 MHz when $V_+ = 5$ V
- Slew rate ($V_+ = 5$ V, $A_V = -1$): 85 V/ μ s
- Settling time ($V_+ = 5$ V, ± 5 V) : 80 ns
- Input voltage noise (100 kHz) 30 nV/ $\sqrt{\text{Hz}}$
- 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

Ordering Information

Order Part No.	Top Marking	RoHS	T _A	Package	
DIO2641ST5	WF4A	Green	-40 to 125°C	SOT23-5	Tape & Reel, 3000
DIO2641SO8	DIOBF4A	Green	-40 to 125°C	SOIC-8	Tape & Reel, 2500
DIO2642SO8	DIOBF4B	Green	-40 to 125°C	SOIC-8	Tape & Reel, 2500
DIO2642MP8	DIOBF4B	Green	-40 to 125°C	MSOP-8	Tape & Reel, 3000
DIO2644SO14	DIOBF4D	Green	-40 to 125°C	SOIC-14	Tape & Reel, 2500
DIO2644TP14	DIOBF4D	Green	-40 to 125°C	TSSOP-14	Tape & Reel, 2500

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 105 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/ μ s) 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.

Pin Assignments

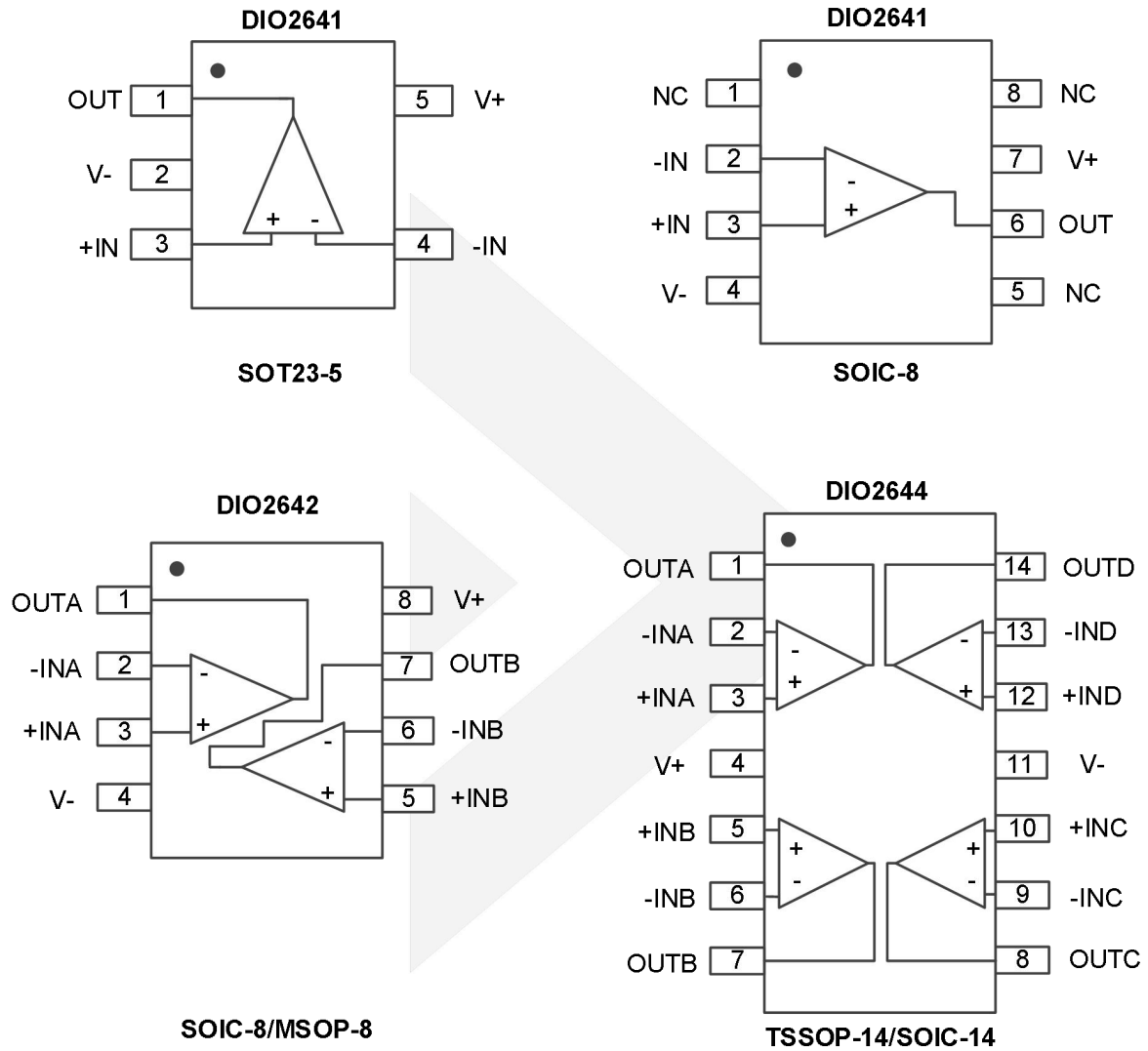


Figure 1. Pin assignment (Top view)

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.

Symbol	Parameter			Rating	Unit
V _{CC}	Supply voltage			13.5	V
V _{IN}	Input voltage			(V ₋)-0.5 to (V ₊)+0.5	V
T _{STG}	Storage temperature range			-65 to 150	°C
T _J	Junction temperature			150	°C
T _L	Lead temperature range			260	°C
R _{θJA}	Junction-to-ambient thermal resistance	DIO2641	SOT23-5	265	°C/W
			SOIC-8	190	
		DIO2642		235	
		DIO2644	SOIC-14	145	
			TSSOP-14	155	
ESD	Human body model (HBM), JEDEC JS-001, all pins			8	kV
	Charged device model (CDM), per JEDEC specification JESD22-C101, all pins			2	kV
Latch up				200	mA

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: $T_A = 25^\circ\text{C}$, $V_+ = 3\text{ V}$, $V_- = 0\text{ V}$, $V_{CM} = V_+ / 2$, $R_L = 2\text{ k}\Omega$ to $V_+ / 2$, unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Power supply						
PSRR	Power supply rejection ratio	$V_+ = 3.0\text{ V}$ to 3.5 V , $V_{CM} = 1.5\text{ V}$		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	$R_L = 2\text{ k}\Omega$ 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		$\mu\text{V}/^\circ\text{C}$
Output characteristics						
I_{SC}	Output short circuit current	Sourcing to V_-		110		mA
		Sinking to V_+		110		mA
I_{OUT}	Output current	$V_{OUT} = 0.5\text{ V}$ from V_+		38		mA
		$V_{OUT} = 0.5\text{ V}$ from V_-		36		mA
V_{OUT}	Output swing high	$R_L = 2\text{ k}\Omega$ to $V_+ / 2$	2.98	2.985		V
	Output swing low	$R_L = 2\text{ k}\Omega$ to $V_+ / 2$	15	20		mV
Dynamic performance						
BW	-3 dB BW	$A_V = +1$, $V_{OUT} = 200\text{ mV}_{PP}$		90		MHz
		$A_V = +2$, $V_{OUT} = 200\text{ mV}_{PP}$		40		MHz
		$A_V = -1$, $V_{OUT} = 200\text{ mV}_{PP}$		39		MHz
PBW	Full power bandwidth	$A_V = +1$, -1 dB, $V_{OUT} = 1\text{ V}_{PP}$		20		MHz
X_{TALK}	Channel-to-channel crosstalk	$f = 80\text{ kHz}$, receiver: $R_F = R_g = 510\ \Omega$, $A_V = +2$		87		dB
SR	Slew rate	$A_V = -1$, $V_I = 2\text{ V}_{PP}$		65		V/ μs
t_S	Settling time	$V_{OUT} = 2\text{ V}_{PP}$, $\pm 0.1\%$, 8 pF load, $V_S = 5\text{ V}$		85		ns
Noise performance						
THD	Total harmonic distortion	$f = 1\text{ kHz}$, $V_{OUT} = 2\text{ V}_{PP}$, $A_V = -1$, $R_L = 100\ \Omega$ to $V_+ / 2$		80		dB
		$f = 1\text{ kHz}$, $V_{OUT} = 2\text{ V}_{PP}$, $A_V = -1$, $R_L = 2\text{ k}\Omega$ to $V_+ / 2$		95		dB
e_n	Input-referred voltage noise	$f = 100\text{ kHz}$		30		nV/ $\sqrt{\text{Hz}}$

Note:

(1) Specifications subject to change without notice.

5 V Electrical Characteristics

Typical value: $T_A = 25^\circ\text{C}$, $V_+ = 5\text{ V}$, $V_- = 0\text{ V}$, $V_{CM} = V_+ / 2$, $R_L = 2\text{ k}\Omega$ to $V_+ / 2$, unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Power supply						
PSRR	Power supply rejection ratio	$V_+ = 4\text{ V to } 6\text{ V}$		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	$R_L = 2\text{ k}\Omega$ 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		$\mu\text{V}/^\circ\text{C}$
Output characteristics						
I_{SC}	Output short circuit current	Sourcing to V_-		110		mA
		Sinking to V_+		120		mA
I_{OUT}	Output current	$V_{OUT} = 0.5\text{ V}$ from V_+		52		mA
		$V_{OUT} = 0.5\text{ V}$ from V_-		40		mA
V_{OUT}	Output swing high	$R_L = 2\text{ k}\Omega$ to $V_+ / 2$	4.98	4.985		V
	Output swing low	$R_L = 2\text{ k}\Omega$ to $V_+ / 2$	15	20		mV
Dynamic performance						
BW	-3 dB BW	$A_V = +1$, $V_{OUT} = 200\text{ mV}_{PP}$		100		MHz
		$A_V = +2$, $V_{OUT} = 200\text{ mV}_{PP}$		42		MHz
		$A_V = -1$, $V_{OUT} = 200\text{ mV}_{PP}$		42		MHz
PBW	Full power bandwidth	$A_V = +1$, -1 dB, $V_{OUT} = 2\text{ V}_{PP}$		20		MHz
X_{TALK}	Channel-to-channel crosstalk	$f = 80\text{ kHz}$, Receiver: $R_F = R_g = 510\ \Omega$, $A_V = +2$		87		dB
SR	Slew rate	$A_V = -1$, $V_{IN} = 2\text{ V}_{PP}$		85		V/ μs
t_S	Settling time	$V_{OUT} = 2\text{ V}_{PP}$, $\pm 0.1\%$, 8 pF Load		80		ns
Noise performance						
THD	Total harmonic distortion	$f = 1\text{ kHz}$, $V_O = 2\text{ V}_{PP}$, $A_V = -1$, $R_L = 100\ \Omega$ to $V_+ / 2$		80		dB
		$f = 1\text{ kHz}$, $V_{OUT} = 2\text{ V}_{PP}$, $A_V = -1$, $R_L = 2\text{ k}\Omega$ to $V_+ / 2$		95		dB
e_n	Input-referred voltage noise	$f = 100\text{ kHz}$		30		nV/ $\sqrt{\text{Hz}}$

Note:

(1) Specifications subject to change without notice.

±5 V Electrical Characteristics

Typical value: $T_A = 25^\circ\text{C}$, $V_+ = 5\text{ V}$, $V_- = -5\text{ V}$, $V_{CM} = 0\text{ V}$, $R_L = 2\text{ k}\Omega$ to ground, unless otherwise specified.

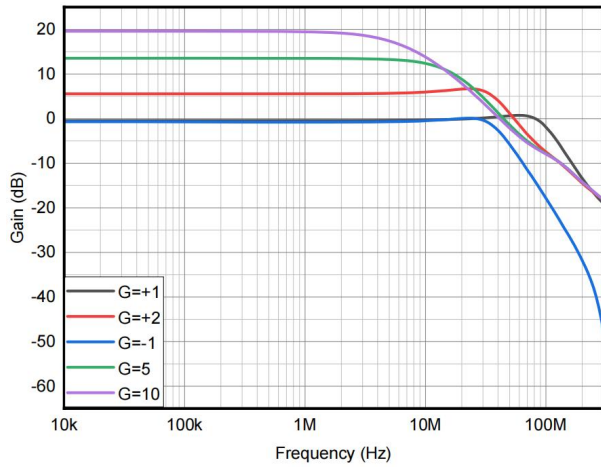
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Power supply						
PSRR	Power supply rejection ratio	$V_+ = 4\text{ V to }6\text{ V}$, $V_{CM} = 0\text{ V}$		95		dB
I_S	Supply current (per channel)	No load		7		mA
Input characteristics						
V_{OS}	Input offset voltage				±11	mV
C_{IN}	Common mode input 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	$R_L = 2\text{ k}\Omega$		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		$\mu\text{V}/^\circ\text{C}$
Output characteristics						
I_{SC}	Output short circuit current	Sourcing to V_-		70		mA
		Sinking to V_+		70		mA
I_{OUT}	Output current	$V_{OUT} = 0.5\text{ V from }V_+$		54		mA
		$V_{OUT} = 0.5\text{ V from }V_-$		40		mA
V_{OUT}	Output swing high	$R_L = 2\text{ k}\Omega$	4.98	4.985		V
	Output swing low	$R_L = 2\text{ k}\Omega$	15	20		mV
Dynamic performance						
BW	-3 dB BW	$A_V = +1$, $V_{OUT} = 200\text{ mV}_{PP}$		105		MHz
		$A_V = +2$, $V_{OUT} = 200\text{ mV}_{PP}$		46		MHz
		$A_V = -1$, $V_{OUT} = 200\text{ mV}_{PP}$		44		MHz
PBW	Full power bandwidth	$A_V = +1$, -1 dB, $V_{OUT} = 2\text{ V}_{PP}$		20		MHz
X_{TALK}	Channel-to-channel crosstalk	$f = 1\text{ kHz}$, receiver, $R_F = R_g = 510\text{ }\Omega$, $A_V = +2$		87		dB
SR	Slew rate	$A_V = -1$, $V_{IN} = 2\text{ V}_{PP}$		85		V/ μs
t_S	Settling time	$V_{OUT} = 2\text{ V}_{PP}$, $\pm 0.1\%$, 8 pF load, $V_S = 5\text{ V}$		80		ns
Noise performance						
THD	Total harmonic distortion	$f = 1\text{ kHz}$, $V_{OUT} = 2\text{ V}_{PP}$, $A_V = -1$, $R_L = 100\text{ }\Omega$ to $V_+ / 2$		80		dB
		$f = 1\text{ kHz}$, $V_{OUT} = 2\text{ V}_{PP}$, $A_V = -1$, $R_L = 2\text{ k}\Omega$ to $V_+ / 2$		95		dB
e_n	Input-referred voltage noise	$f = 100\text{ kHz}$		30		nV/ $\sqrt{\text{Hz}}$

Note:

(1) Specifications subject to change without notice.

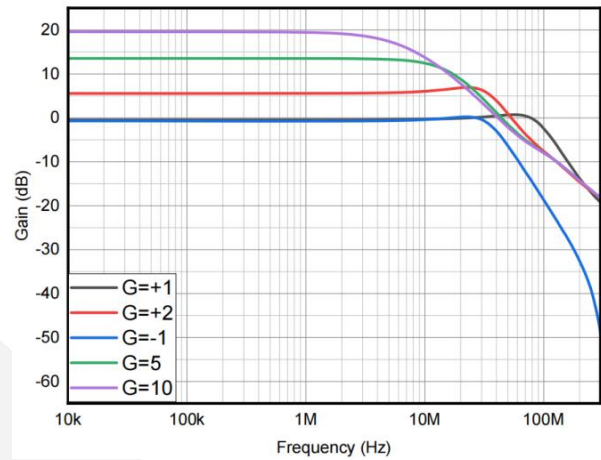
Typical Performance Characteristics

$V_+ = +5$, $V_- = -5$ V, $R_F = R_L = 2$ k Ω , unless otherwise specified.



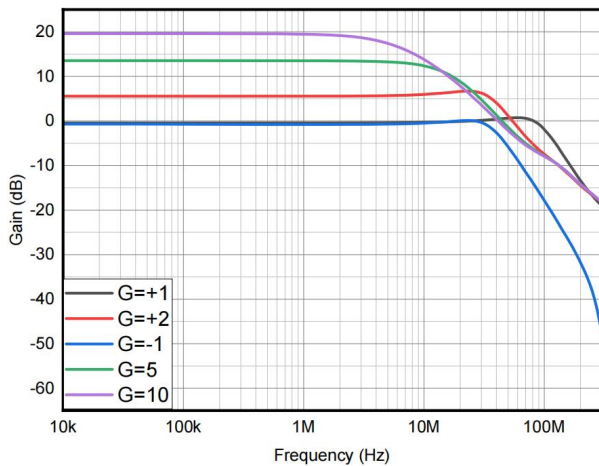
$V_{CC} = 3$ V, $V_{OUT} = 0.2$ V_{PP}

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



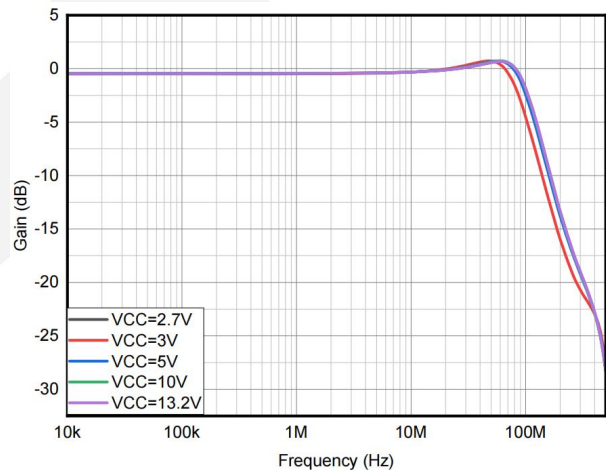
$V_{CC} = 5$ V, $V_{OUT} = 0.2$ V_{PP}

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



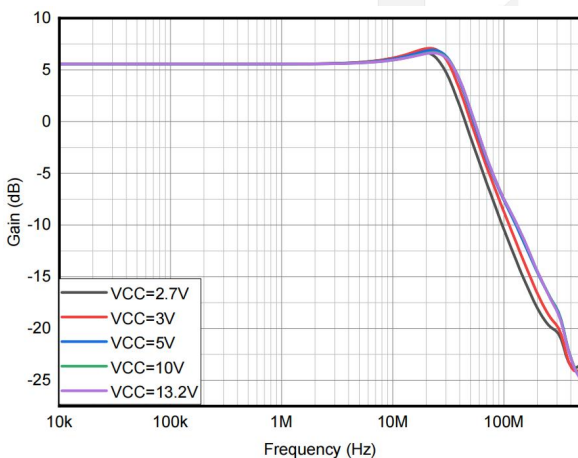
$V_{CC} = 10$ V, $V_{OUT} = 0.2$ V_{PP}

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



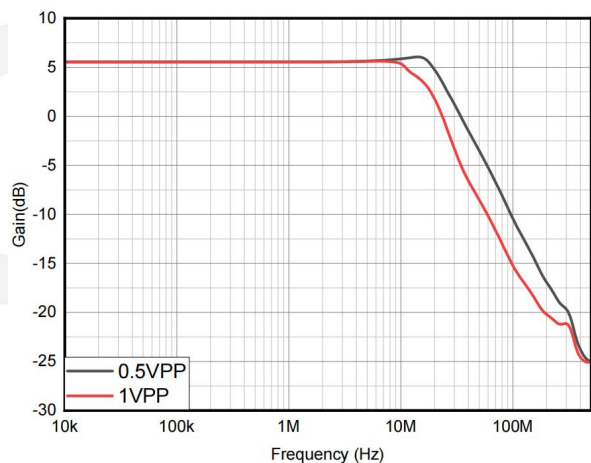
$G = +1$, $V_{OUT} = 0.2$ V_{PP}

Figure 5. Closed loop frequency response for various supplies



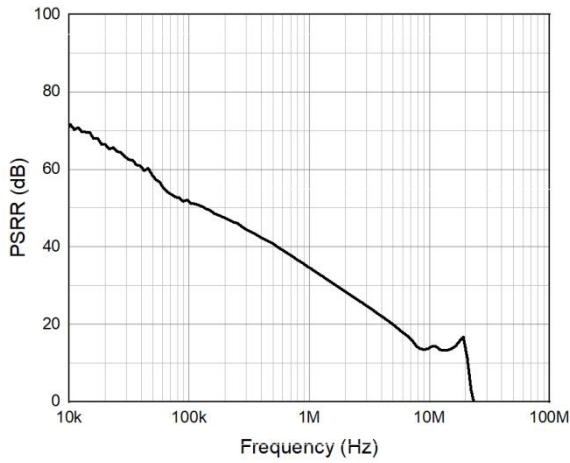
$G = +2$, $V_{OUT} = 0.2$ V_{PP}

Figure 6. Closed loop frequency response for various supplies



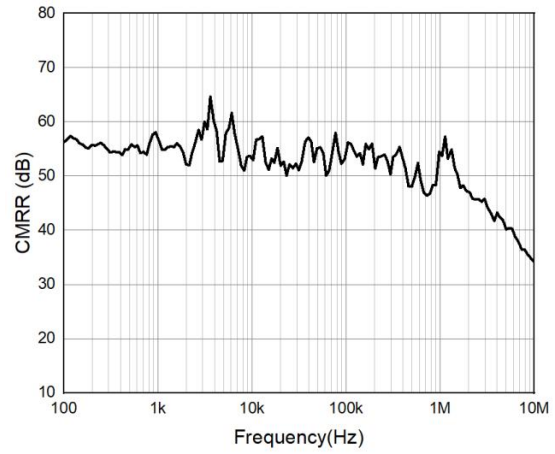
$V_{CC} = 10$ V, $G = +2$

Figure 7. Large signal frequency response



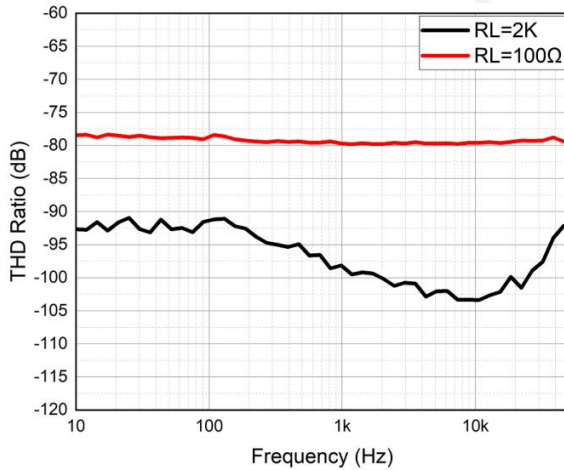
$V_S = 5\text{ V}, A_V = +1$

Figure 8. PSRR vs. Frequency



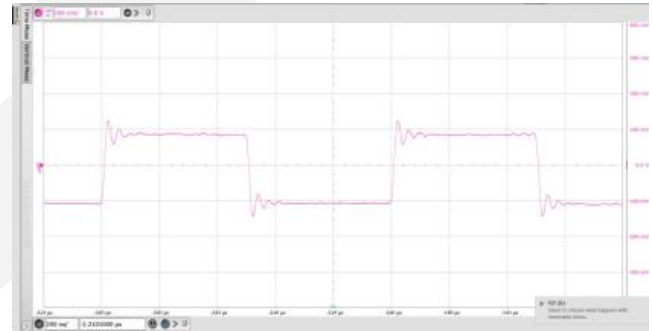
$V_S = 5\text{ V}, A_V = +2$

Figure 9. CMRR vs. Frequency



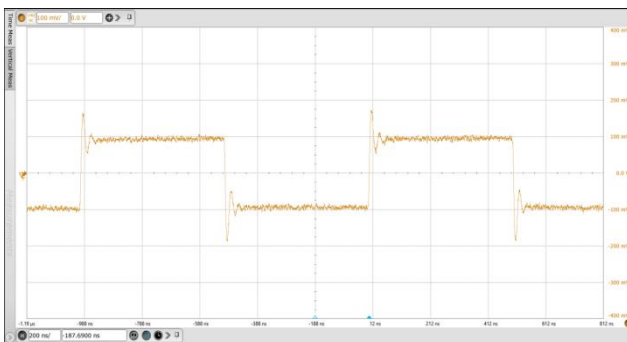
$V_{CC} = \pm 5\text{ V}, V_{IN} = 2\text{ V}_{PP}, G = -1$

Figure 10. THD Ratio vs. Frequency



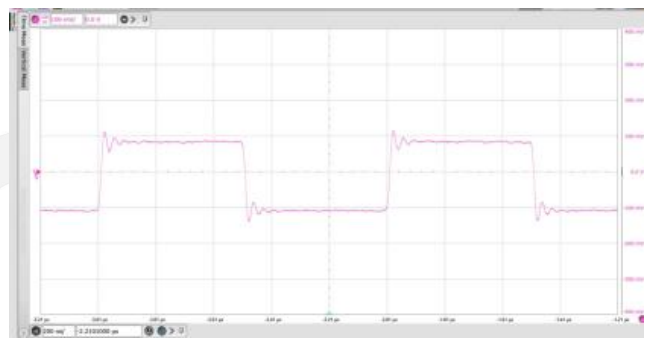
$V_{CC} = 3\text{ V}, V_{OUT} = 0.2\text{ V}_{PP}, G = -1$

Figure 11. Small signal step response



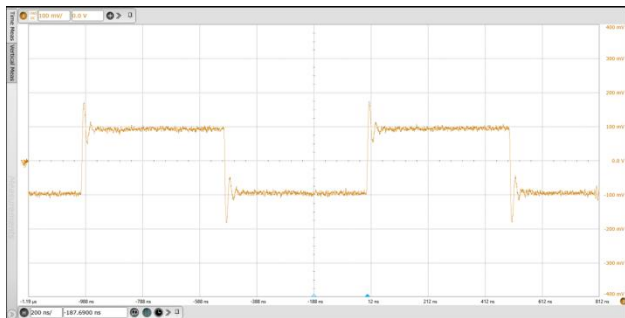
$V_{CC} = 3\text{ V}, V_{OUT} = 0.2\text{ V}_{PP}, G = 2$

Figure 12. Small signal step response



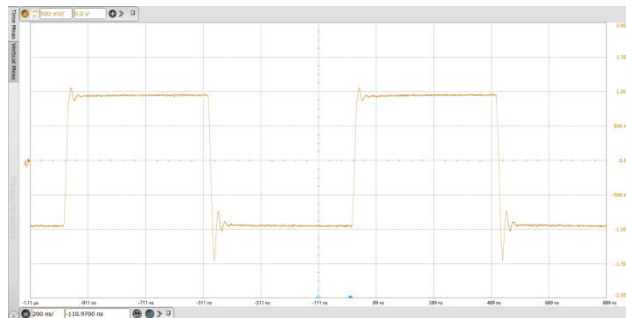
$V_{CC} = 10\text{ V}, V_{OUT} = 0.2\text{ V}_{PP}, G = -1$

Figure 13. Small signal step response



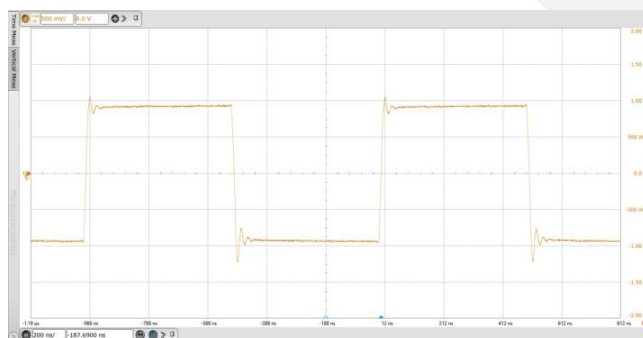
$V_{CC} = 10\text{ V}$, $V_{OUT} = 0.2\text{ V}_{PP}$, $G = 2$

Figure 14. Small signal step response



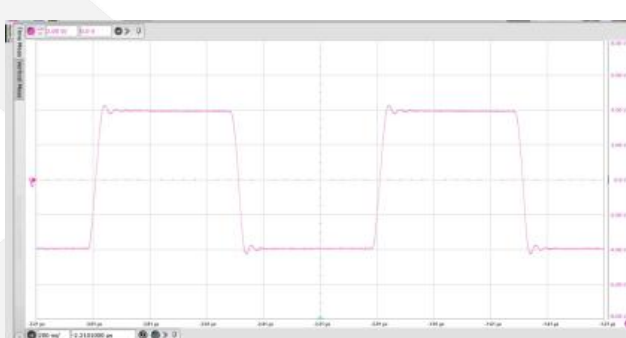
$V_{CC} = 10\text{ V}$, $V_{OUT} = 2\text{ V}_{PP}$, $G = 2$

Figure 15. Large signal step response



$V_{CC} = 10\text{ V}$, $V_{OUT} = 2\text{ V}_{PP}$, $G = -1$

Figure 16. Large signal step response



$V_{CC} = 10\text{ V}$, $V_{OUT} = 8\text{ V}_{PP}$, $G = -1$

Figure 17. Large signal step response

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Typical Application

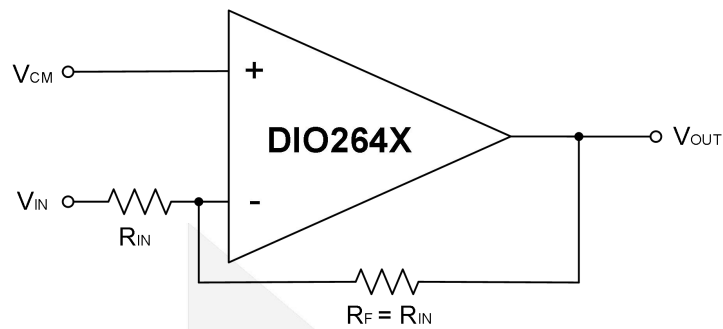


Figure 18. gain = -1

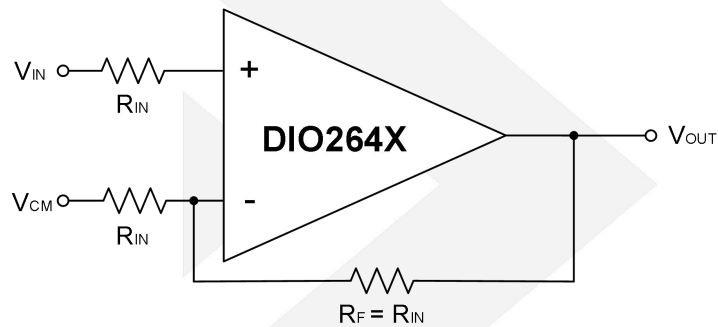


Figure 19. gain = 2

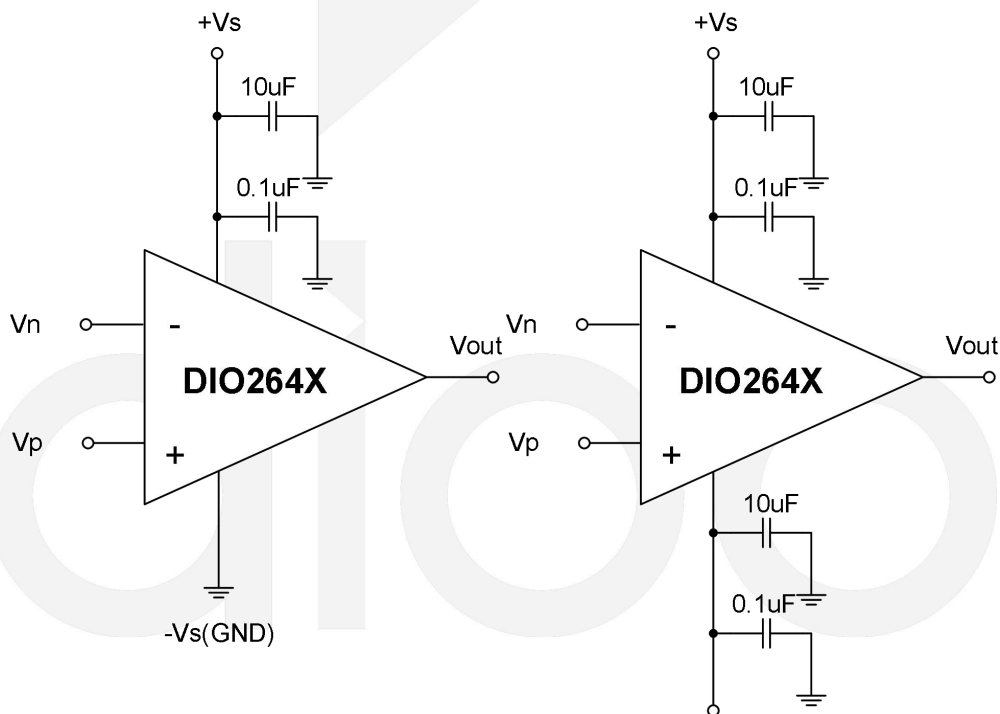


Figure 20. Amplifier with bypass capacitors

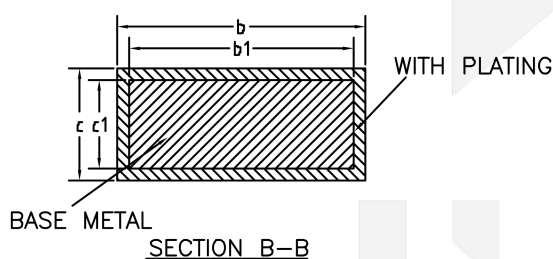
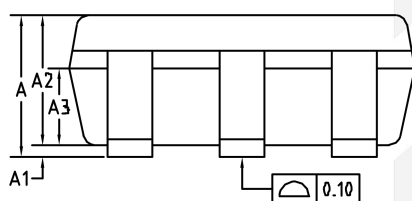
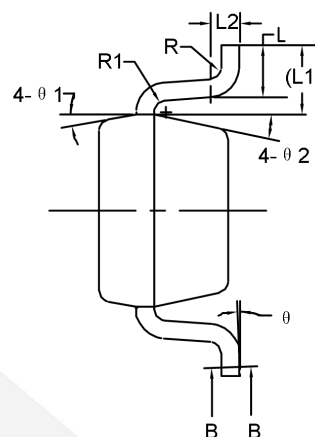
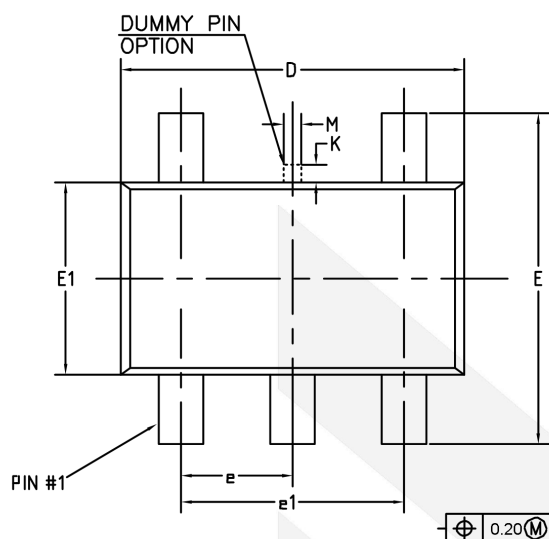
Feature Description

The DIO264X series is designed for high-voltage, high-speed amplifier applications. The DIO264X has low power dissipation, due to the lower supply current. Push-pull output stage is capable of approximately 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 DIO264X 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 1.5 cm 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.

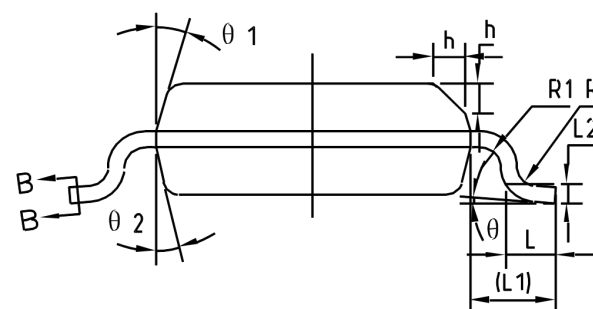
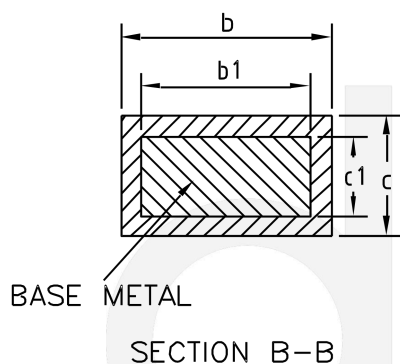
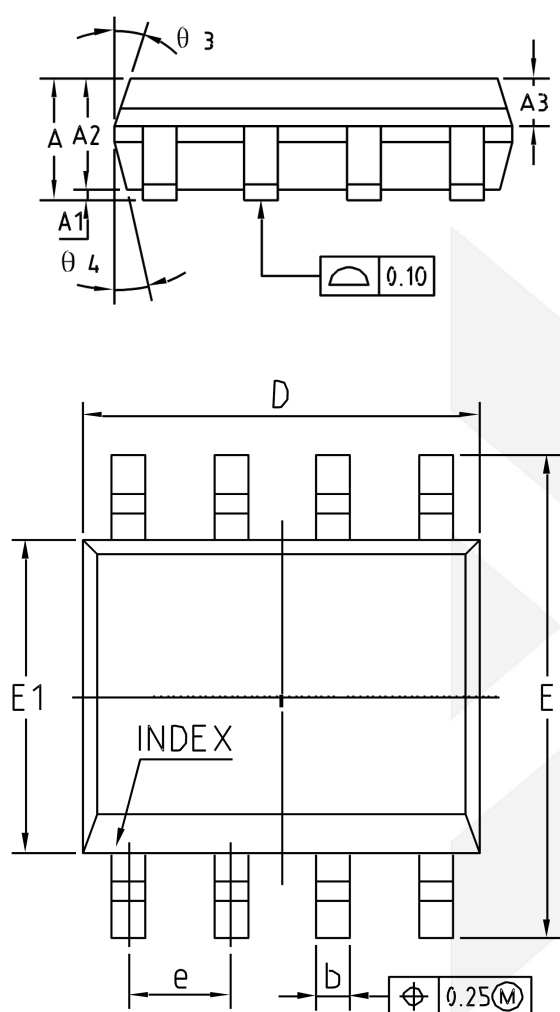
Physical Dimensions: SOT23-5



Common Dimensions (Units of measure = 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	-	0.45
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	0.59 REF		
L2	0.25 BSC		
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°

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

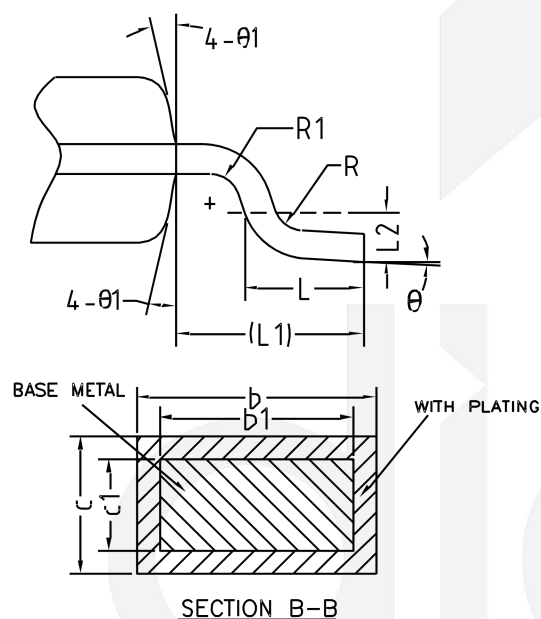
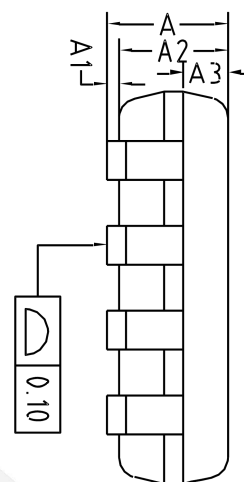
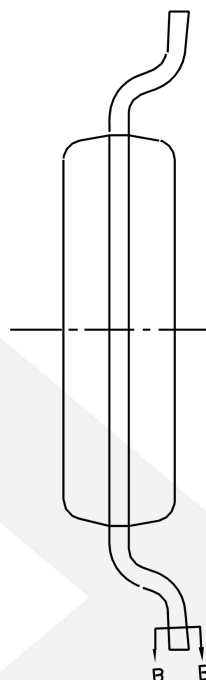
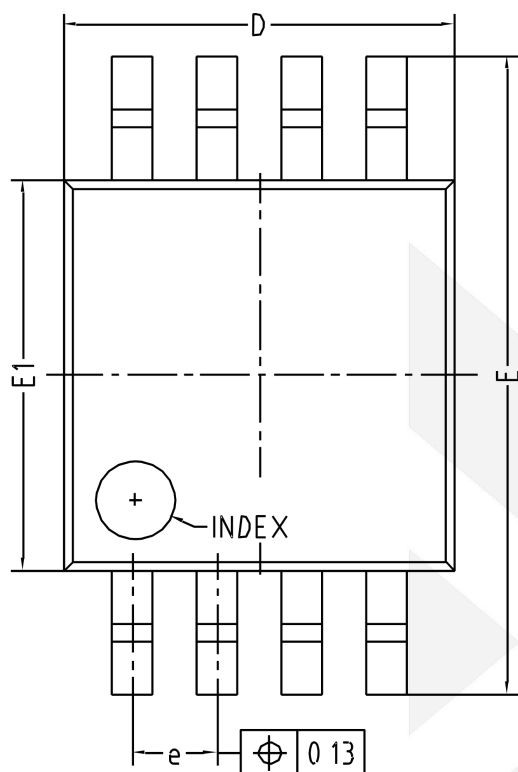
Physical Dimensions: SOIC-8



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	1.27 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
θ	0°	-	8°
θ1	15°	17°	19°
θ2	11°	13°	15°
θ3	15°	17°	19°
θ4	11°	13°	15°

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

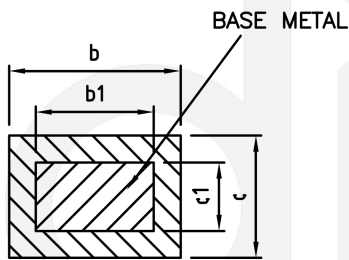
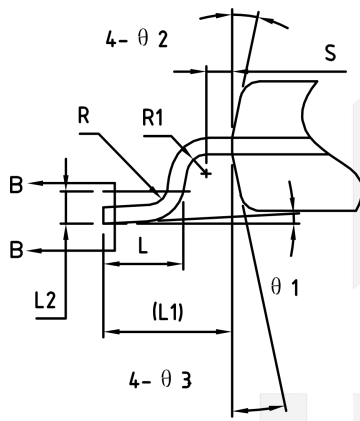
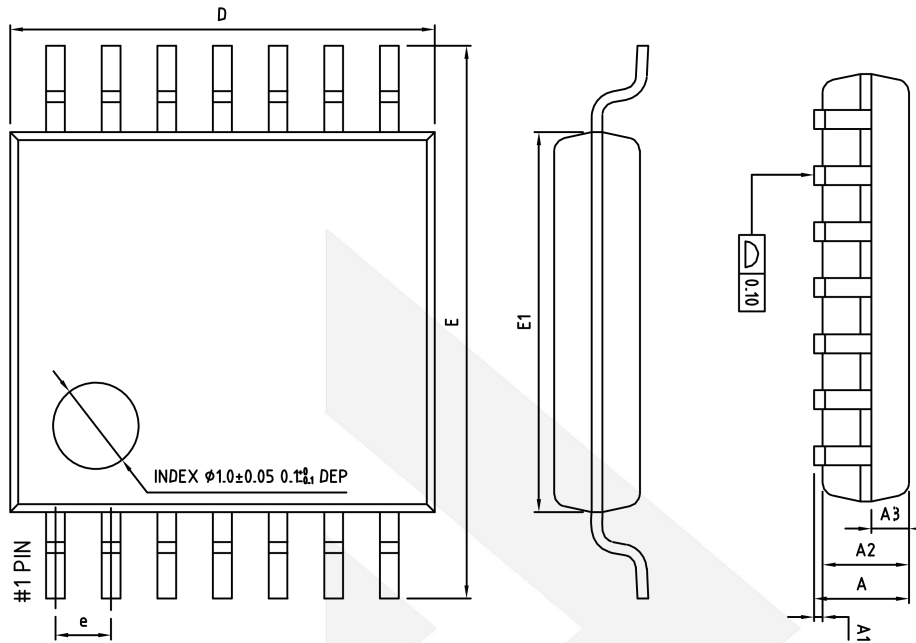
Physical Dimensions: MSOP-8



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°

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

Physical Dimensions: TSSOP-14



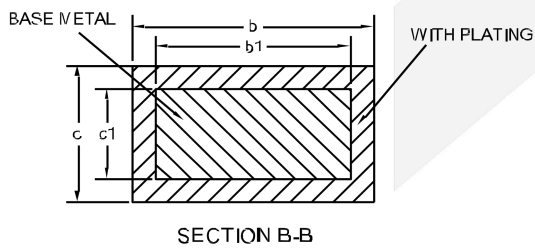
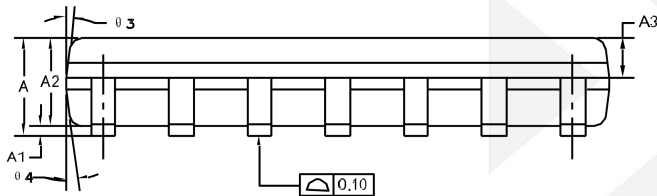
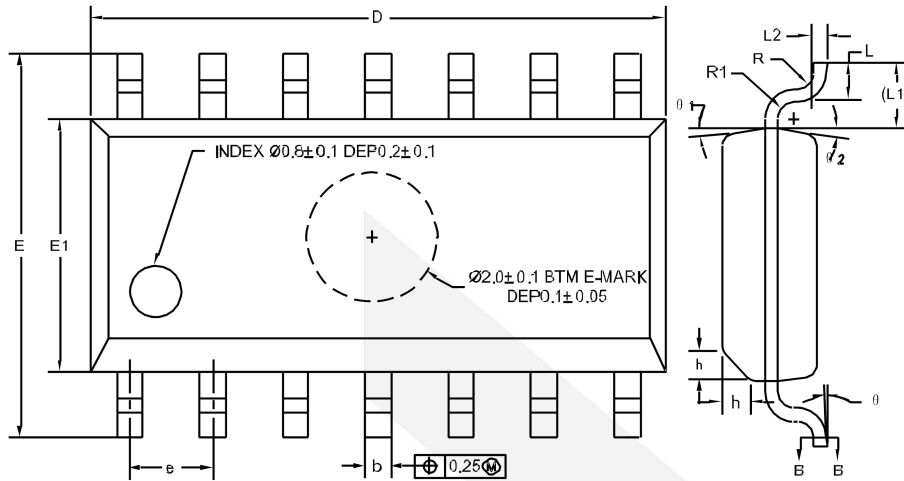
SECTION B-B

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	4.86	4.96	5.06
E	6.20	6.40	6.60
E1	4.30	4.40	4.50
e	0.65 BSC		
L	0.45	0.60	0.75
L1	1.00 REF		
L2	0.25 BSC		
R	0.09	-	-
R1	0.09	-	-
S	0.20	-	-
Θ1	0°	-	8°
Θ2	10°	12°	14°
Θ3	10°	12°	14°

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

Physical Dimensions: SOIC-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	8.53	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
θ	0°	-	8°
θ1	6°	8°	10°
θ2	6°	8°	10°
θ3	5°	7°	9°
θ4	5°	7°	9°

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

CONTACT US

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