
High Voltage, Precision, Zero-drift, Instrumentation Amplifier

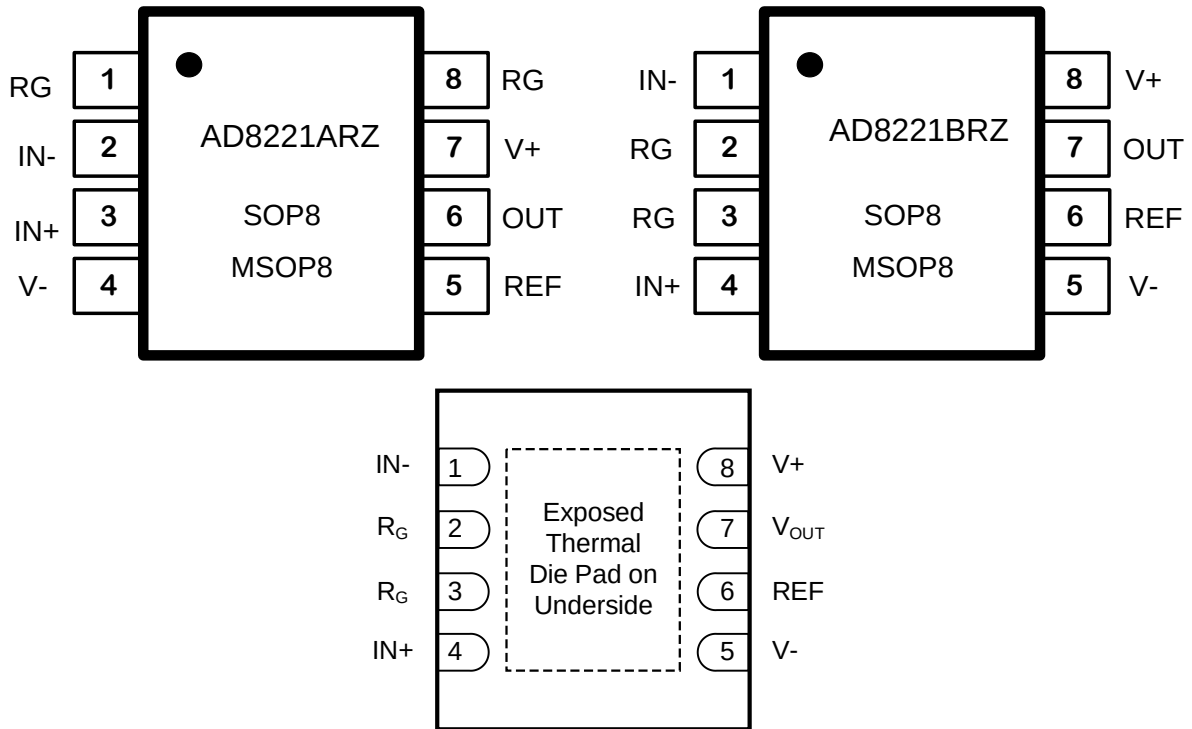
Features

- Excellent DC specifications
 - ◆ Small voltage offset: $\pm 50\mu\text{V}$ (MAX)
 - ◆ Small voltage offset drift: $0.2\mu\text{V}/^\circ\text{C}$ (MAX)
 - ◆ Small input bias current: 1.5nA (MAX)
- Excellent AC specifications
 - ◆ CMRR: 80dB @ G=1 (MIN)
 - ◆ Small input noise: $15\text{nV}/\sqrt{\text{Hz}}$ @ G=10
 - ◆ Input noise (0.1 Hz to 10 Hz): $1\mu\text{V}$ p-p
 - ◆ -3dB Bandwidth: 1.6MHz
 - ◆ Slew rate: 5V/us
- Gain set with 1 external resistor (gain range 1 to 1,000)
- SUPPLY VOLTAGE: $\pm 2\text{V}$ to $\pm 18\text{V}$
- RAIL to RAIL for VOLTAGE OUTPUT
- Operating Temperature: -45°C to $+125^\circ\text{C}$
- SOP8, MSOP8 & DFN3X3-8 PACKAGE

Applications

- Weigh scales for bridge amplifiers
- Medical and ECG Amplifiers
- Industrial Process Control
- Precision data acquisition system
- Pressure sensors
- Precision current measurement

Pin Configuration



PIN NAME	AD8221X DESCRIPTION
IN-	Negative Input
IN+	Positive Input.
RG	Gain setting
VREF	Reference Input.
OUT	Output
V+	Positive power supply
V-	Negative power supply
Thermal pad	Exposed thermal die pad is internally connected to –Vs. Connect externally to –Vs or leave floating.

Order Information

Model Name	Order Number	Package	Transport Media, Quantity	Package Marking
AD8221	AD8221ARZ-R7	8-Pin SOP8	Tape and Reel, 4,000	AD8221
	AD8221BRZ-R7	8-Pin SOP8	Tape and Reel, 4,000	AD8221B
	AD8221AR	8-Pin MSOP8	Tape and Reel, 3,000	AD8221
	AD8221BR	8-Pin MSOP8	Tape and Reel, 3,000	AD8221B
	AD8221CR	8-Pin DFN3X3	Tape and Reel, 4,000	8221

Absolute Maximum Ratings ^{Note 1}

Supply Voltage40V

Input Voltage.....(V-) – 0.3 to (V+) + 0.3V

Differential Input Voltage (V+) – (V-)

Input Current: IN+, IN- ^{Note 2}±10mA

Operating Temperature Range.....–40°C to 125°C

Maximum Working Junction Temperature..... 150°C

Storage Temperature Range..... –65°C to 150°C

Lead Temperature (Soldering, 10 sec)260°C

Note 1: Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime.

Note 2: The inputs are protected by ESD protection diodes to power supply.

ESD, Electrostatic Discharge Protection

Symbol	Parameter	Condition	Minimum Level	Unit
HBM	Human Body Model ESD	ANSI/ESDA/JEDEC JS-001	3	kV
CDM	Charged Device Model ESD	ANSI/ESDA/JEDEC JS-002	1.5	kV

Thermal Resistance

Package Type	θ_{JA}	θ_{JC}	Unit
8-Pin SOP8	158	43	°C/W
8-Pin MSOP8	210	45	°C/W
DFN3X3-8	51	60	°C/W

Electrical Characteristics

The specifications are at TA = 25°C, V+ = +15V, V- = -15V, REF = 0V, unless otherwise noted

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
INPUT						
V _{OSI}	Input Stage Offset Voltage	At RTI		±10	±50	μV
		At RTI, -40°C to 125°C		±0.1	±0.2	μV/°C
V _{OSO}	Output Stage Offset Voltage	At RTI		±100	±300	μV
		At RTI, -40°C to 125°C		±0.2	±0.3	μV/°C
V _{OS}	Offset Voltage	At RTI		±10 ±100/G	±50 ±300/G	μV
V _{OS} TC	Input Offset Voltage Drift	-40°C to 125°C			±0.2 ±0.3/G	μV/°C
V _{CM}	Common-mode Input Range	-40°C to 125°C	(V-) +0.1		(V+) - 1.5	V
CMRR	Common Mode Rejection Ratio	CMRR at DC, G=1	80	100		dB
		CMRR at DC, G=10	100	120		dB
		CMRR at DC, G=100	110	130		
		CMRR at DC, G=1000	120	140		
I _B	Input Bias Current			0.3	1.5	nA
		-40°C to 125°C		10		pA/°C
I _{OS}	Input Offset Current			0.3	1.5	nA
		-40°C to 125°C		10		pA/°C
Input impedance	Input impedance	Differential		57 6		GΩ pF
		Common mode		44 14		GΩ pF
PSRR	Power Supply Rejection Ratio	G=1	100	120		dB
		G=10	110	130		dB
		G=100	120	138		dB
		G=1000	130	140		dB
RIN	Reference input			20		kΩ
NOISE RTI						
e _n	Input Voltage Noise Density	f = 1kHz, G=10		15		nV/√Hz
		f = 0.1Hz to 10Hz, G=1		1		μV p-p
OUTPUT						
G	G = 1 + (49.4 kΩ/RG)		1		1000	V/V
GE	Gain Error	G=1		±0.01%	±0.05%	
		G=10		±0.1%	±0.15%	
		G=100		±0.1%	±0.2%	
		G=1000		±0.3%	±0.6%	
G TC	Gain Vs Temperature	-40°C to 125°C, G=1		1	5	ppm/°C

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I _{SC}	Short circuit current	-40°C to 125°C		±70		mA
V _{OH}	Output Swing from Supply Rail	-40°C to 125°C, R _L = 10 kΩ		0.12	0.2	V
V _{OL}	Output Swing from Supply Rail	-40°C to 125°C, R _L = 10 kΩ		0.05	0.1	V
FREQUENCY RESPONSE						
BW	-3dB Bandwidth	G=1		1600		kHz
		G=10		400		kHz
		G=100		100		kHz
		G=1000		11		kHz
ST	Setting time to 0.01%	G=1		2.1		μs
SR	Slew Rate	G=1		5		V/μs
		G=100		2.5		V/μs
POWER SUPPLY						
V+	Supply Voltage		±2		±18	V
I _Q	Quiescent Current			3.8	4.5	mA
TEMPERATURE RANGE						
Specified range			-40		125	°C

Typical Performance Characteristics

The AD8221X is used for characteristics at $T_A = 25^\circ\text{C}$, $V_s = \pm 15\text{V}$, $R_L = 10\text{ k}\Omega$, unless otherwise noted.

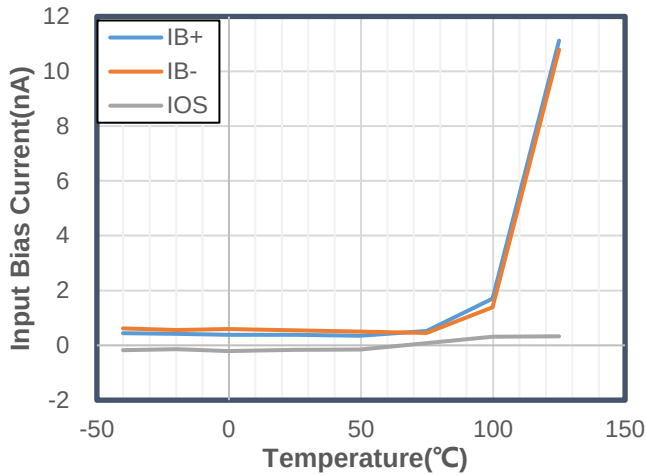


Figure 1 IB Vs. Temperature

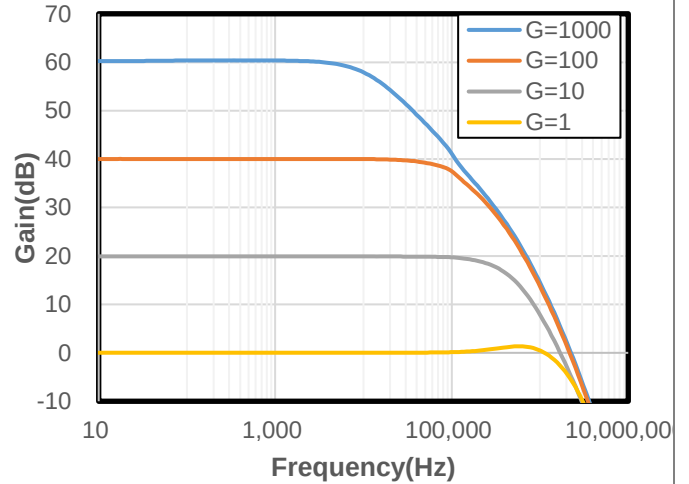


Figure 2 Gain Vs. Frequency

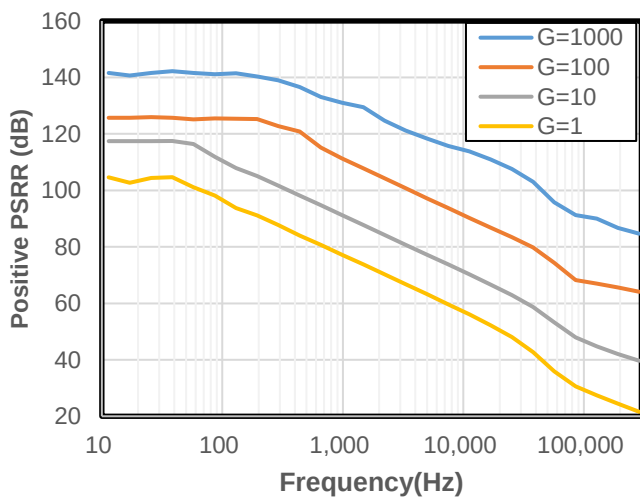


Figure 3 Positive PSRR Vs. Frequency

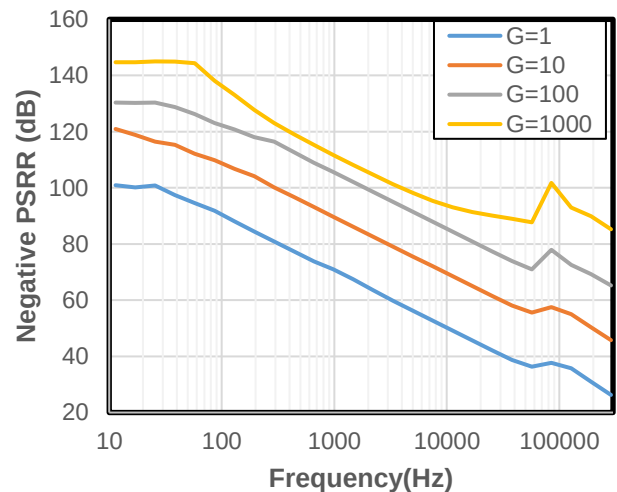


Figure 4 Negative PSRR Vs. Frequency

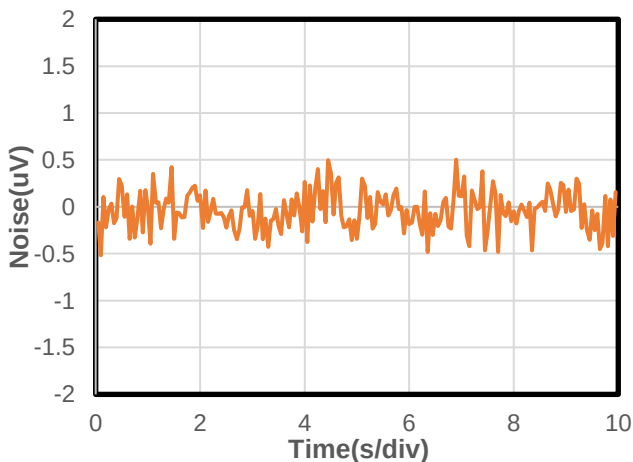


Figure 5 0.1Hz to 10Hz RTI Noise

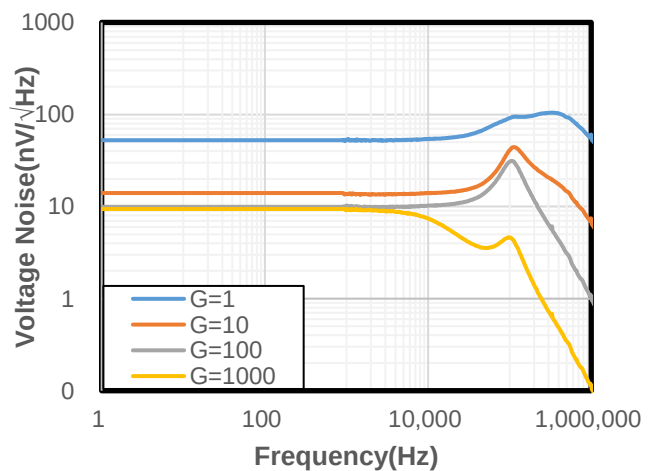


Figure 6 Noise Density Vs Frequency

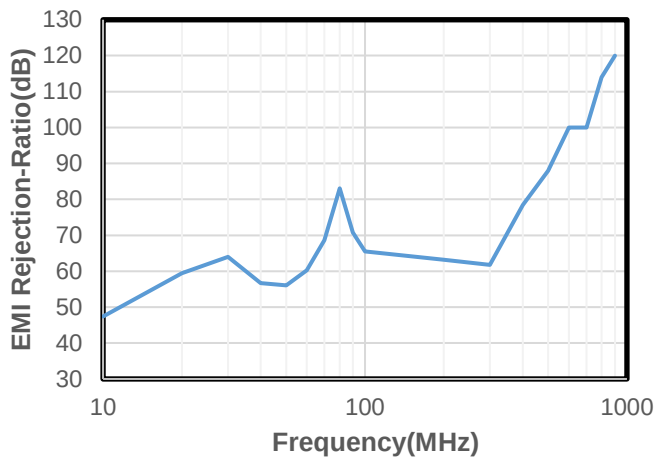


Figure 7 EMIRR

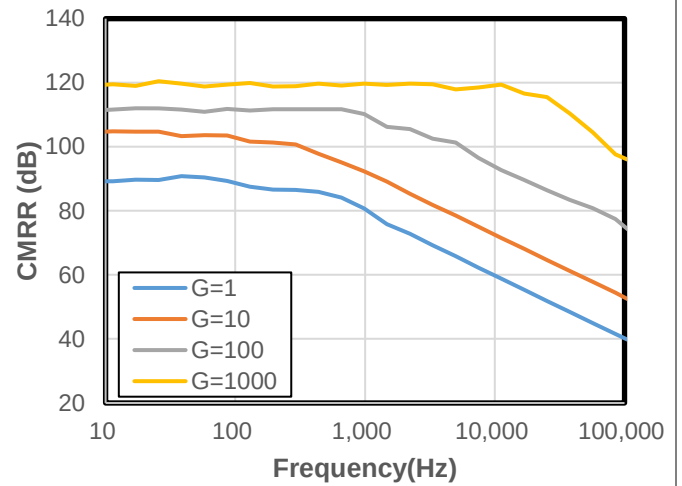


Figure 8 CMRR Vs. Frequency

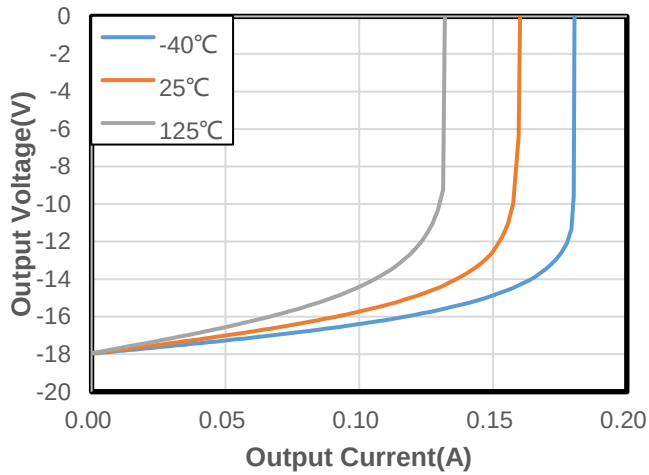


Figure 9 Negative Output Voltage Swing Vs. Output Current

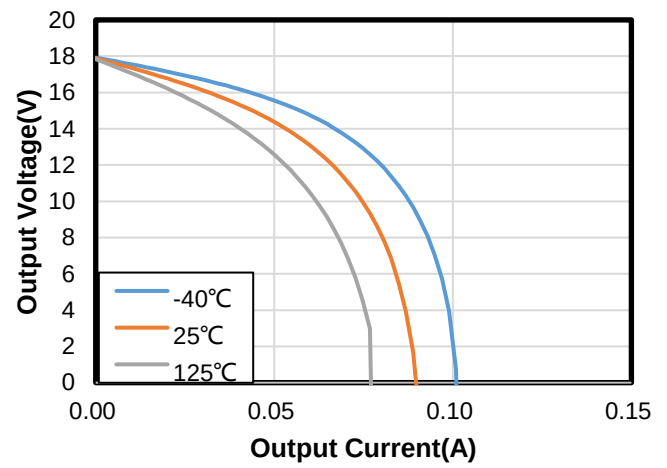


Figure 10 Positive Output Voltage Swing Vs. Output Current

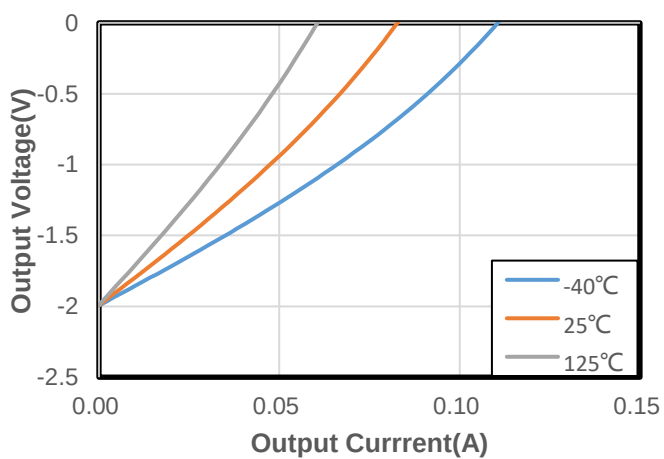


Figure 11 Negative Output Voltage Swing Vs. Output Current

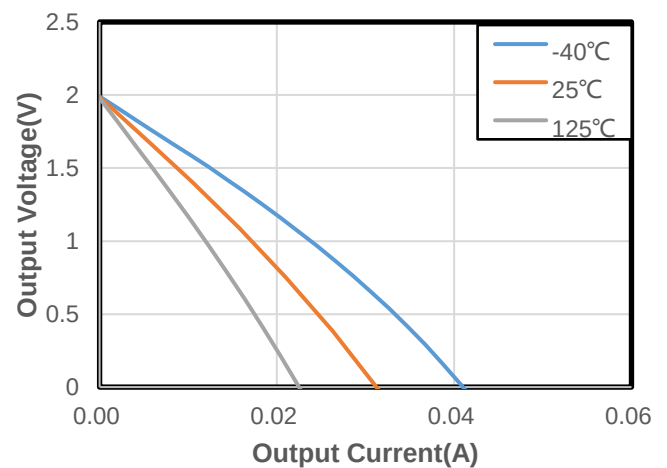


Figure 12 Positive Output Voltage Swing Vs. Output Current

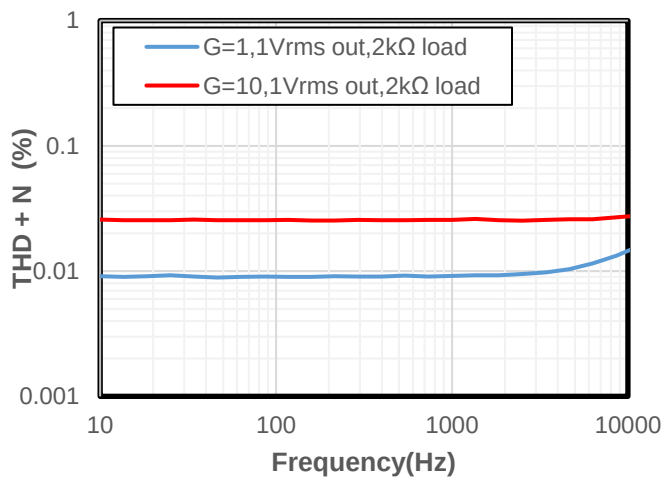


Figure 13 THD + N Vs. Frequency

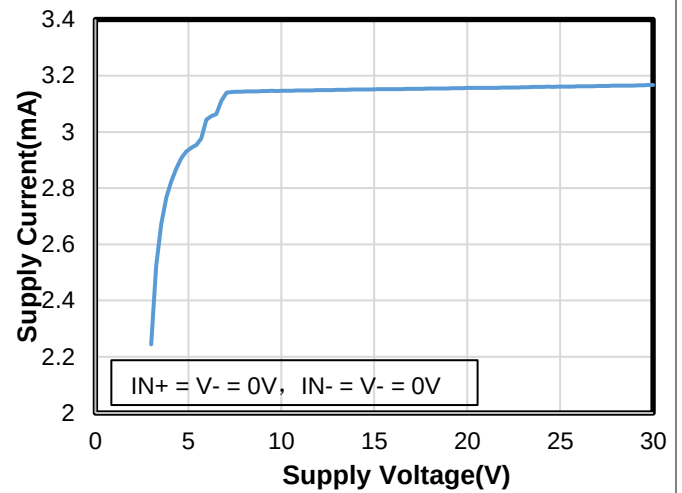


Figure 14 Supply Current Vs. Voltage

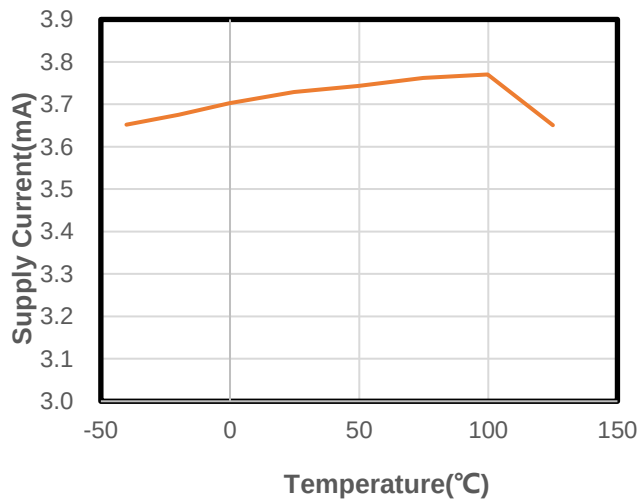


Figure 15 Supply Current Vs. Temp

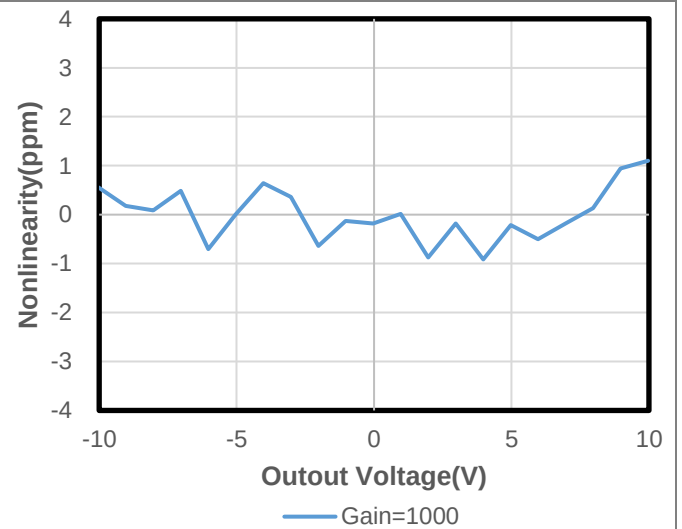


Figure 16 Gain Nonlinearity

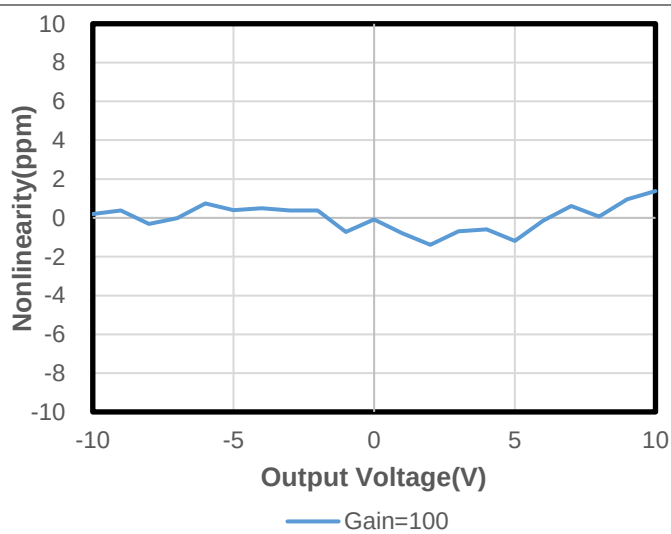


Figure 17 Gain Nonlinearity

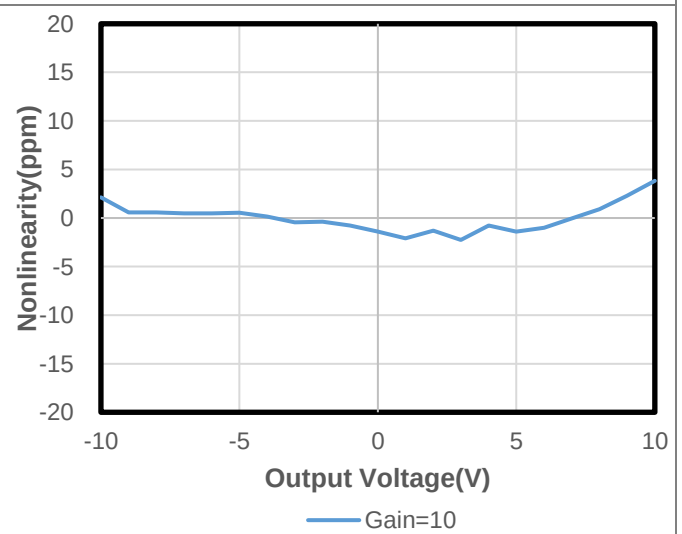


Figure 18 Gain Nonlinearity

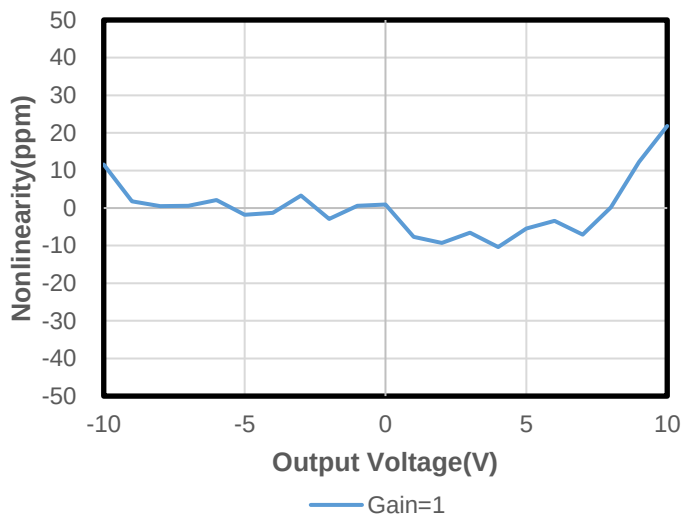


Figure 19 Gain Nonlinearity



Voltage: 2V/div for Output, Time: 10us/div G=1, VREF = GND; VIN=10VPP, Load R=10K

Figure 20 Slew Rate



Voltage: 5V/div for Output, Time: 2us/div G=10, VREF = GND; VIN=10VPP, Load R=10K C=100pF

Figure 21 Positive Overload Recovery



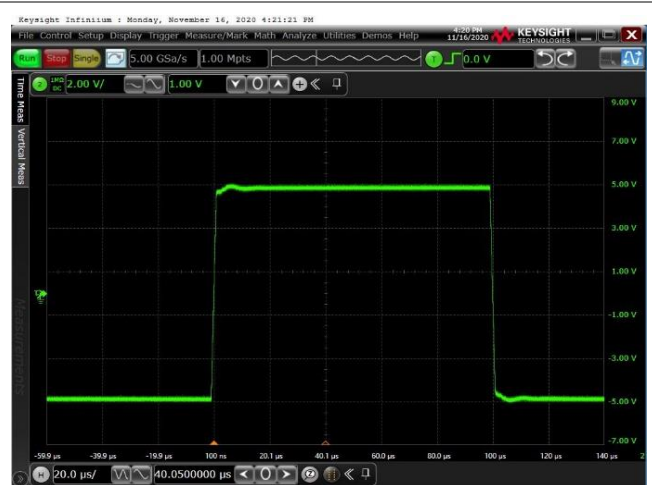
Voltage: 5V/div for Output, Time: 2us/div G=10, VREF = GND; VIN=10VPP, Load R=10K C=100pF

Figure 22 Negative Overload Recovery



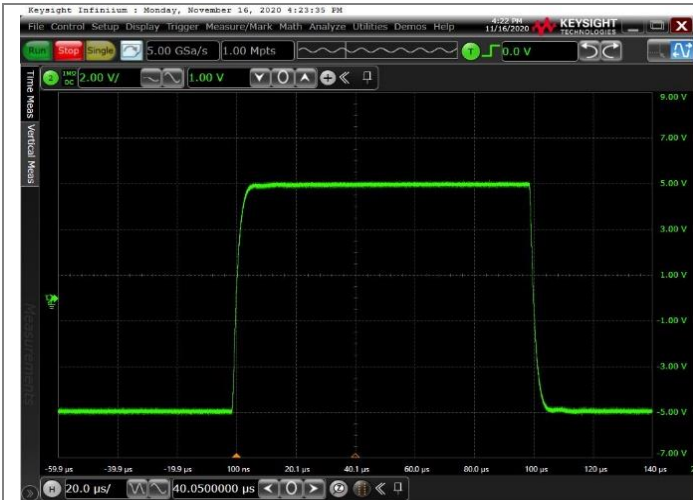
Voltage: 2V/div for Output, Time: 10us/div G=1, VREF = GND; VIN=10VPP, Load R=10K C=100pF

Figure 23 Large-Signal Pulse Response



Voltage: 2V/div for Output, Time: 20us/div G=10, VREF = GND; VIN=1VPP, Load R=10K C=100pF

Figure 24 Large-Signal Pulse Response



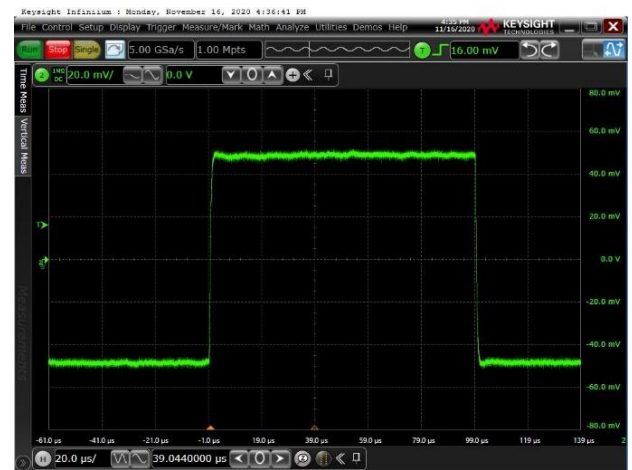
Voltage: 2V/div for Output, Time: 20us/div G=100, VREF = GND; VIN=0.1VPP, Load R=10K C=100pF
Figure 25 Large-Signal Pulse Response



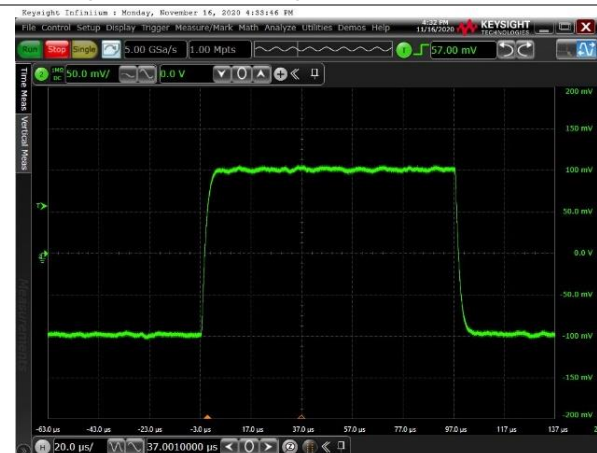
Voltage: 2V/div for Output, Time: 50us/div G=1000, VREF = GND; VIN=10mVPP, Load R=10K C=100pF
Figure 26 Large-Signal Pulse Response



Voltage: 25mV/div for Output, Time: 10us/div G=1, VREF = GND; VIN=100mVPP, Load R=10K C=100pF
Figure 27 Small-Signal Pulse Response



Voltage: 20mV/div for Output, Time: 20us/div G=10, VREF = GND; VIN=10mVPP, Load R=10K C=100pF
Figure 28 Small-Signal Pulse Response



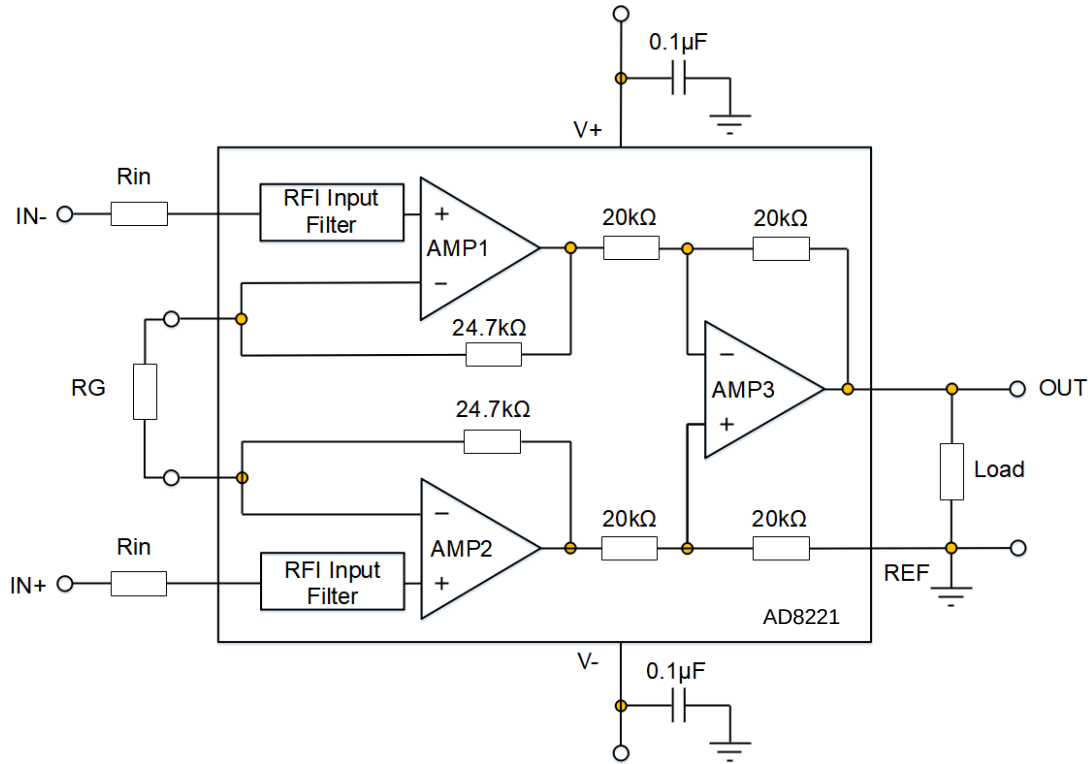
Voltage: 50mV/div for Output, Time: 20us/div G=100, VREF = GND; VIN=2mVPP, Load R=10K C=100pF
Figure 29 Small-Signal Pulse Response



Voltage: 500mV/div for Output, Time: 50us/div G=10, VREF = GND; VIN=2mVPP, Load R=10K C=100pF
Figure 30 Small-Signal Pulse Response

Applications Information

AD8221X Application block diagram

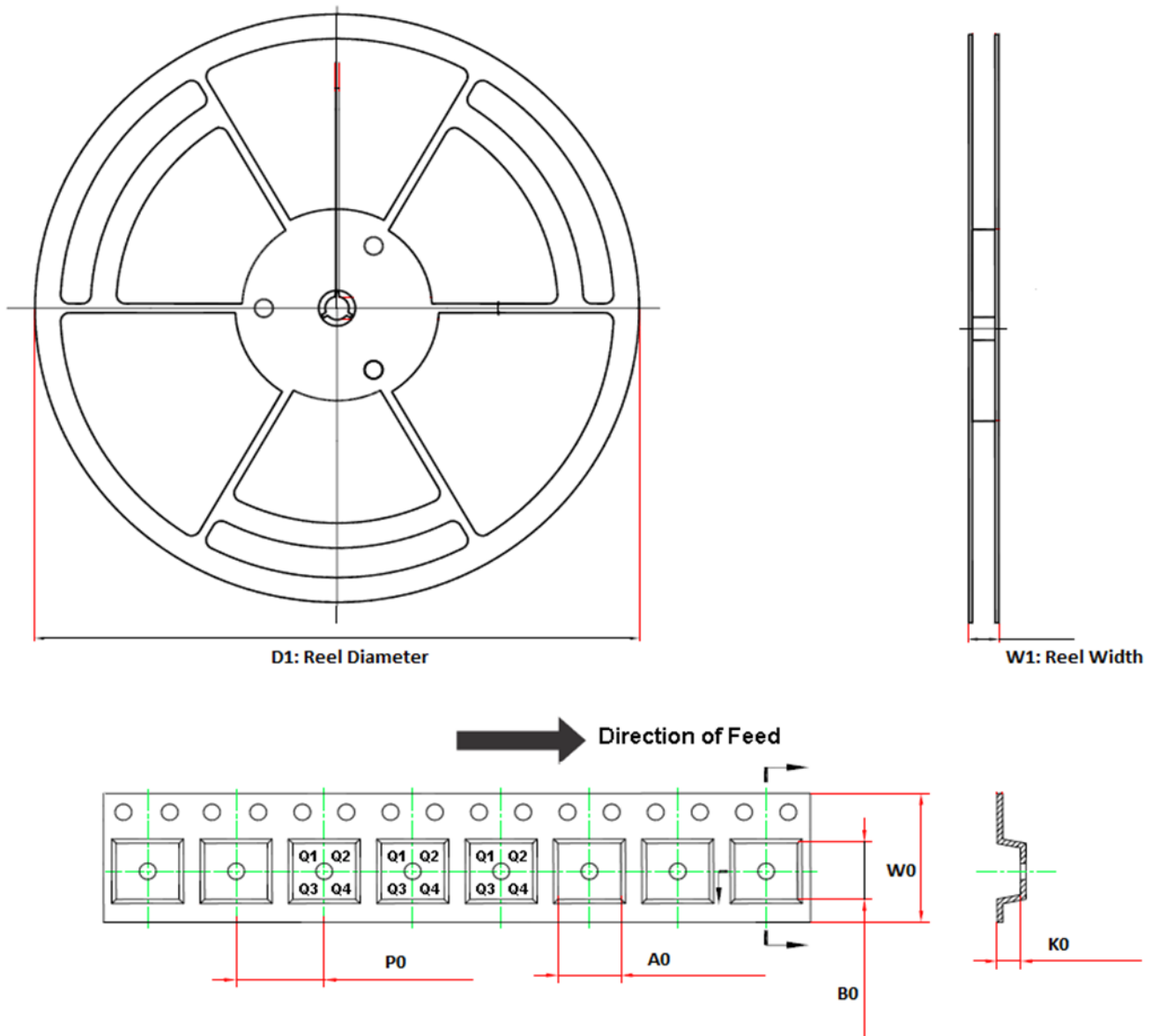


Selecting GAIN Resistor

The gain of the AD8221X is set by a single external resistor, R_G , connected between R_G pins. The value of R_G is selected according to below Equation. AD8221X can be set as $G = 1$ when no gain resistor is used. Gain accuracy is determined by the accuracy of R_G . The stability and temperature drift of the external gain setting resistor, R_G , also affects gain. The contribution of R_G to gain accuracy and drift can be determined from below equation.

$$G = 1 + \frac{49.4k}{R_G}$$

TAPE AND REEL INFORMATION



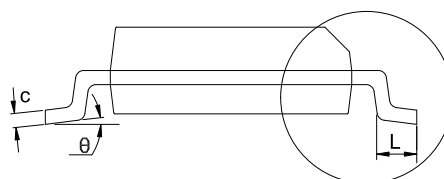
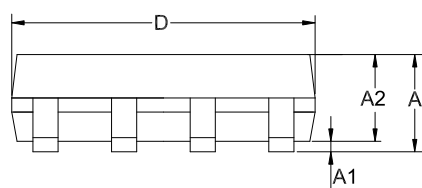
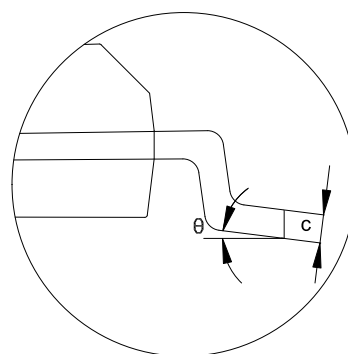
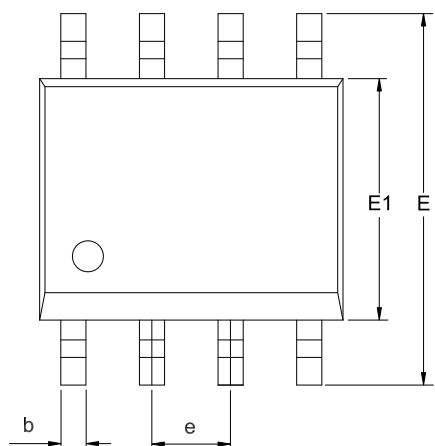
Order Number	Package	D1 (mm)	W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	W0 (mm)	Pin1 Quadrant
AD8221ARZ-R7	8-Pin SOP	330.0	17.6	6.4	5.4	2.1	8.0	12.0	Q1
AD8221BRZ-R7	8-Pin SOP	330.0	17.6	6.4	5.4	2.1	8.0	12.0	Q1
AD8221AR	8-Pin MSOP	330.0	17.6	5.2	3.3	1.5	8.0	12.0	Q1
AD8221BR	8-Pin MSOP	330.0	17.6	5.2	3.3	1.5	8.0	12.0	Q1
AD8221CR	DFN3X3-8	330.0	16.8	3.3	3.3	1.1	8.0	12.0	Q2

Package Outline Dimensions

SOIC-8

Package Outline Dimensions

SO1(SOP-8-A)



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.050	0.250	0.002	0.010
A2	1.250	1.550	0.049	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D	4.700	5.100	0.185	0.201
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150	0.157
e	1.270 BSC		0.050 BSC	
L	0.400	1.000	0.016	0.039
θ	0	8°	0	8°

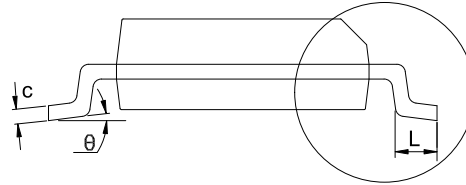
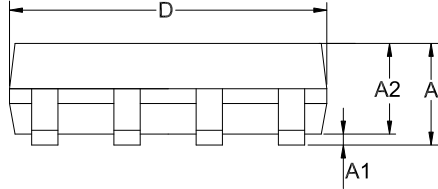
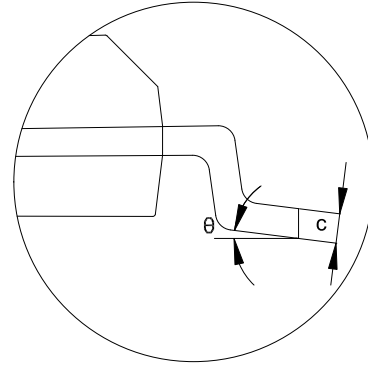
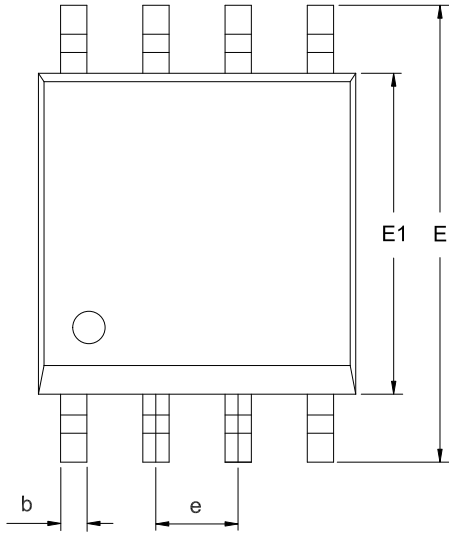
NOTES

1. Do not include mold flash or protrusion.
2. This drawing is subject to change without notice.

MSOP8

Package Outline Dimensions

VS1(MSOP-8-A)



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.800	1.100	0.031	0.043
A1	0.050	0.150	0.002	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
E	4.700	5.100	0.185	0.201
E1	2.900	3.100	0.114	0.122
e	0.650 BSC		0.026 BSC	
L	0.400	0.800	0.016	0.031
θ	0	8°	0	8°

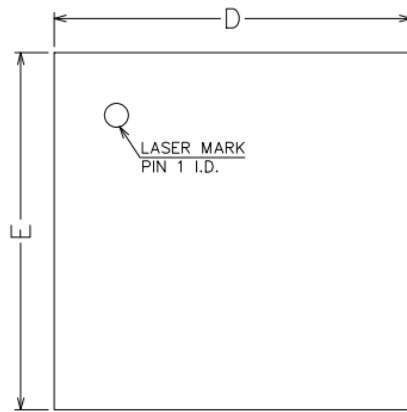
NOTES

1. Do not include mold flash or protrusion.
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DFN3X3-8

Package Outline Dimensions

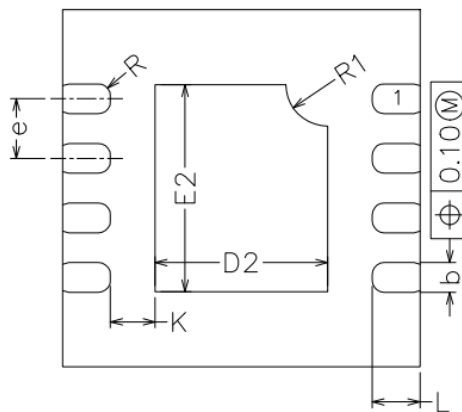
DF7(DFN3X3-8-D)



TOP VIEW



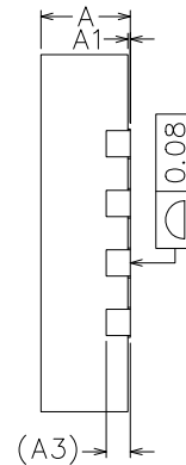
SIDE VIEW



BOTTOM VIEW

NOTES

1. Do not include mold flash or protrusion.
2. This drawing is subject to change without notice.



SIDE VIEW

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.700	0.800	0.028	0.031
A1	0.000	0.050	0.000	0.002
b	0.200	0.300	0.008	0.012
A3	0.150	0.250	0.006	0.010
D	2.900	3.100	0.114	0.122
D2	1.350	1.550	0.053	0.061
E	2.900	3.100	0.114	0.122
E2	1.640	1.840	0.065	0.072
e	0.500 BSC		0.020 BSC	
L	0.300	0.500	0.012	0.020