

36V, 3.5MHz, 15V/μs Op Amps

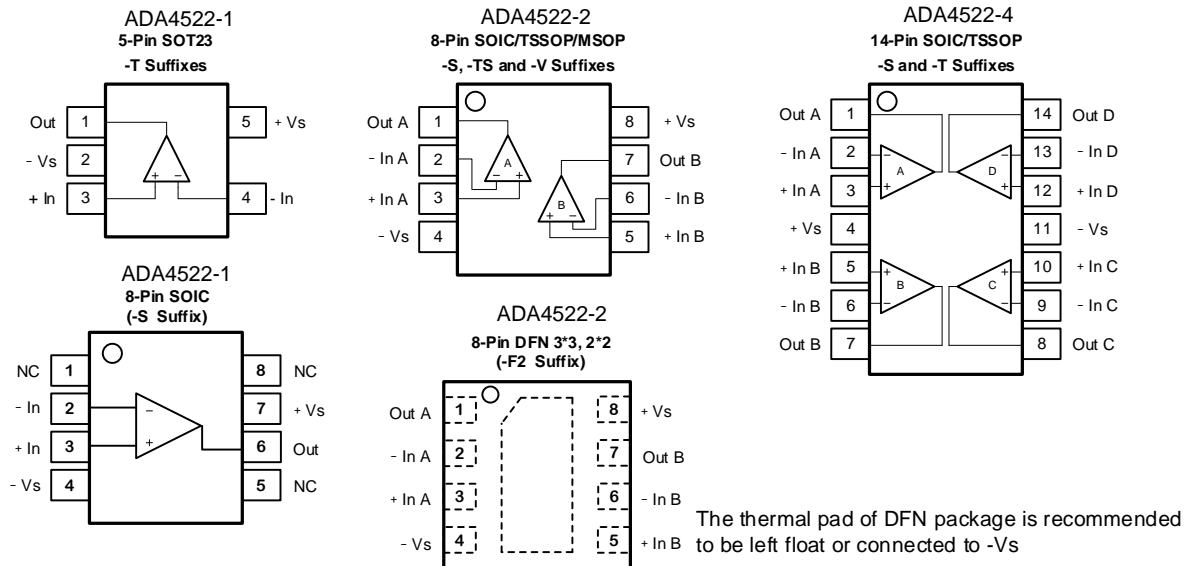
Features

- Supply Voltage: 3V to 36V
- Low Supply Current: Maximum 1000μA per channel
- Differential Input Voltage Range to Supply Rail, can Work as Comparator
- Input Rail to -Vs, Rail to Rail Output
- Fast Response: 3.5 MHz Bandwidth, 15V/μs Slew Rate, 100ns Overload Recovery
- Low Offset Voltage:
 - ±2mV Maximum at 25°C,
 - ±2.5mV Maximum at -40°C to 85°C
 - ±3mV Maximum at -40°C to 125°C
- Very Low THD+N: 0.0005% at Gain = 1, 1kHz
- Excellent EMIRR: 60dB at 900MHz
- 2KV HBM, 1KV CDM, 150mA Latch Up
- 40°C to 125°C Operation Temperature Range

Applications

- Sensor Interface
- Motor Control
- Industrial Control
- Audio

Pin Configuration





Order Information

Order Number	Operating Temperature Range	Package	Marking Information	MSL	Transport Media, Quantity
ADA4522-1ARZ-R7	-40 to 125°C	8-Pin SOIC	ADA4522-1	3	Tape and Reel, 4000
ADA4522-1AR	-40 to 125°C	5-Pin SOT23	4522	3	Tape and Reel, 3000
ADA4522-2ARZ	-40 to 125°C	8-Pin SOIC	ADA4522-2	3	Tape and Reel, 4000
ADA4522-2A	-40 to 125°C	8-Pin DFN 2*2	4522 XXXX	3	Tape and Reel, 3000
ADA4522-2B	-40 to 125°C	8-Pin DFN 3*3	4522 XXXX	3	Tape and Reel, 4000
ADA4522-2AR	-40 to 125°C	8-Pin TSSOP	ADA4522-2	3	Tape and Reel, 3000
ADA4522-2BR	-40 to 125°C	8-Pin MSOP	ADA4522-2	3	Tape and Reel, 3000
ADA4522-4AR	-40 to 125°C	14-Pin SOIC	ADA4522-4	3	Tape and Reel, 2500
ADA4522-4BR	-40 to 125°C	14-Pin TSSOP	ADA4522-4	3	Tape and Reel, 3000

Absolute Maximum Ratings

Parameters	Rating
Supply Voltage, (+V _S)– (-V _S)	40 V
Input Voltage	(-V _S) – 0.3 to (+V _S) + 0.3
Differential Input Voltage	(+V _S) - (-V _S)
Input Current: +IN, –IN ^{Note 2}	±10mA
Output Short-Circuit Duration ^{Note 3}	Infinite
Maximum Junction Temperature	150°C
Operating Temperature Range	–40 to 125°C
Storage Temperature Range	–65 to 150°C
Lead Temperature (Soldering, 10 sec)	260°C

ESD Rating

Symbol	Parameter	Condition	Minimum Level	Unit
HBM	Human Body Model ESD	ANSI/ESDA/JEDEC JS-001	2	kV
CDM	Charged Device Model ESD	ANSI/ESDA/JEDEC JS-002	1	kV

Thermal Information

Package Type	θ _{JA}	θ _{JC}	Unit
5-Pin SOT23	250	81	°C/W
8-Pin SOIC	158	43	°C/W
8-Pin TSSOP	191	44	°C/W
8-Pin DFN 3*3	120	50	°C/W
8-Pin MSOP	210	45	°C/W
14-Pin SOIC	120	36	°C/W
14-Pin TSSOP	180	35	°C/W

Electrical Characteristics

All test condition is $V_S = 30V$, $T_A = 25^\circ C$, $R_L = 10k\Omega$ to $V_S/2$, unless otherwise noted.

Symbol	Parameter	Conditions	T_A	Min	Typ	Max	Unit
Power Supply							
V_S	Supply Voltage Range			3		36	V
I_Q	Quiescent Current per Amplifier	$V_S = 30V, ADA4522-1$			1000	1500	μA
			$-40^\circ C$ to $125^\circ C$			1700	μA
		$V_S = 5V, ADA4522-1$			850	1300	μA
			$-40^\circ C$ to $125^\circ C$			1500	μA
		$V_S = 30V, ADA4522-2/4$			700	1000	μA
			$-40^\circ C$ to $125^\circ C$			1200	μA
$V_S = 5V, ADA4522-2/4$			600	850	μA		
	$-40^\circ C$ to $125^\circ C$			1000	μA		
PSRR	Power Supply Rejection Ratio	$V_S = 3V$ to $36V$		95	120		dB
			$-40^\circ C$ to $125^\circ C$	90			dB
Input Characteristics							
V_{OS}	Input Offset Voltage	$V_S = 30V, V_{CM} = 0V$ to $28V$		-2	0.1	2	mV
			$-40^\circ C$ to $85^\circ C$	-2.5		2.5	mV
			$-40^\circ C$ to $125^\circ C$	-3		3	mV
		$V_S = 30V, V_{CM} = 28.5V$		-3		3	mV
			$-40^\circ C$ to $125^\circ C$	-4		4	mV
		$V_S = 5V, V_{CM} = 2.5V$		-2	0.1	2	mV
$-40^\circ C$ to $125^\circ C$	-3			3	mV		
$V_{OS\ TC}$	Input Offset Voltage Drift		$-40^\circ C$ to $125^\circ C$		2		$\mu V/^\circ C$
I_B	Input Bias Current				25		pA
		$-40^\circ C$ to $85^\circ C$			80		pA
		$-40^\circ C$ to $125^\circ C$			1000		pA
I_{OS}	Input Offset Current				25		pA
I_{IN}	Different Input Current	$V_S = 36V, V_{ID} = 36V$			10		nA
			$-40^\circ C$ to $125^\circ C$			100	
C_{IN}	Input Capacitance	Differential Mode			5		pF
		Common Mode			2.5		pF
A_V	Open-loop Voltage Gain			105	120		dB
		$-40^\circ C$ to $125^\circ C$		100			dB
V_{CMR}	Common-mode Input Voltage Range			(V-)		(V+) - 1.5	V
CMRR	Common Mode Rejection Ratio	$V_{CM} = 0V$ to $28V$		105	130		dB
			$-40^\circ C$ to $125^\circ C$	100			dB

Output Characteristics								
V _{OH}	Output Swing from Positive Rail	R _{LOAD} = 10kΩ to V _S /2			200	300	mV	
			-40°C to 125°C			450		mV
		R _{LOAD} = 2kΩ to V _S /2			1.1	1.4		V
			-40°C to 125°C				2	
V _{OL}	Output Swing from Negative Rail	R _{LOAD} = 10kΩ to V _S /2			200	300	mV	
			-40°C to 125°C				450	mV
		R _{LOAD} = 2kΩ to V _S /2			0.8	1		V
			-40°C to 125°C					1.6
I _{sc}	Output Short-Circuit Current			25	32		mA	
			-40°C to 85°C	20			mA	
			-40°C to 125°C	15			mA	
AC Specifications								
GBW	Gain-Bandwidth Product				3.5		MHz	
SR	Slew Rate	G = 1, 10V step			15		V/μs	
			Open Loop		9	15		V/μs
			-40°C to 85°C	7				V/μs
			-40°C to 125°C	6				V/μs
t _{OR}	Overload Recovery				100		ns	
t _S	Settling Time, 0.1%	G = -1, 10V step			0.8		μs	
	Settling Time, 0.01%				1		μs	
PM	Phase Margin	V _S = 36V, R _L =10K, C _L =100pF			60		°	
GM	Gain Margin	V _S = 36V, R _L =10K, C _L =100pF			15		dB	
Noise Performance								
E _N	Input Voltage Noise	f = 0.1Hz to 10Hz			1.7		μV _{RMS}	
e _N	Input Voltage Noise Density	f = 1kHz			30		nV/√Hz	
i _N	Input Current Noise	f = 1kHz			2		fA/√Hz	
THD+N	Total Harmonic Distortion and Noise	f = 1kHz, G = 1, R _L = 10kΩ, V _{OUT} = 6V _{RMS}			0.0005		%	

Typical Performance Characteristics

$V_s = \pm 15V$, $V_{cm} = 0V$, $R_L = 10k\Omega$, unless otherwise specified.

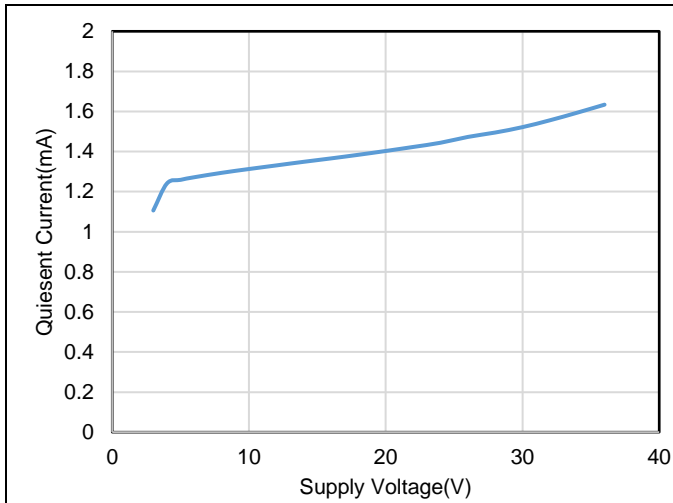


Figure 1. Quiescent Current vs. Supply Voltage, 2ch 4522-2

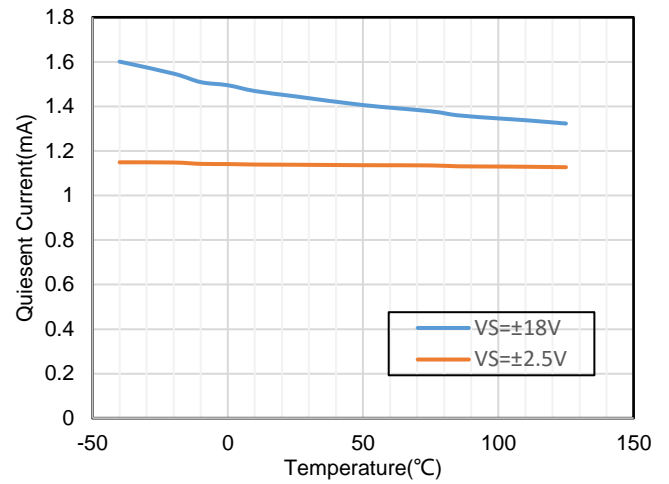


Figure 2. Quiescent Current vs. Temperature, 2ch 4522-2

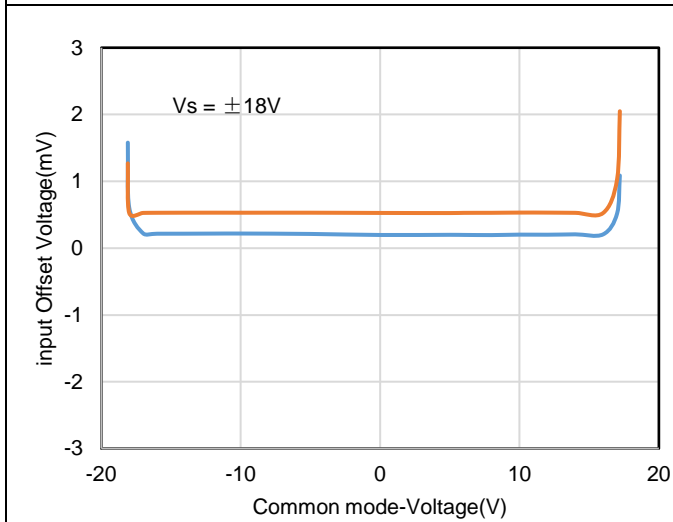


Figure 3. Offset Voltage vs. Common Mode Voltage

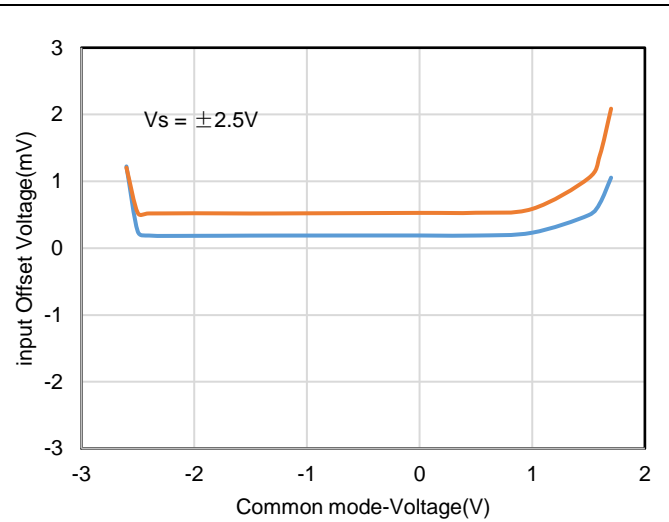


Figure 4. Offset Voltage vs. Common Mode Voltage

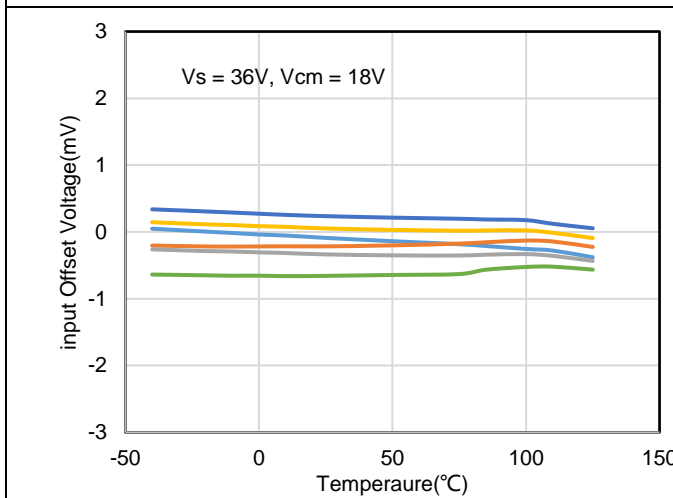


Figure 5. V_{OS} vs. Temperature

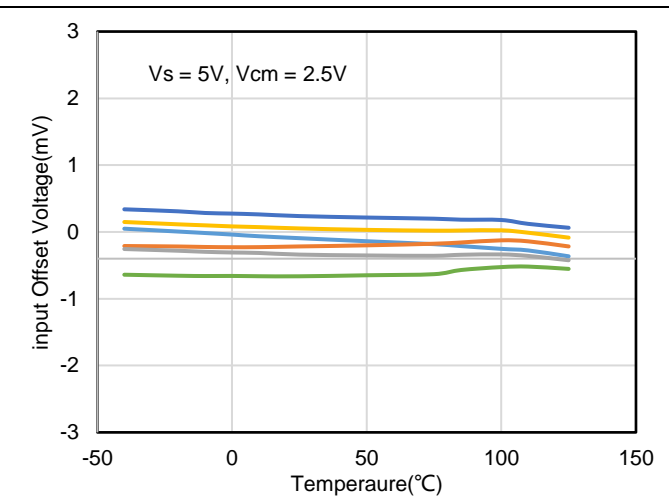


Figure 6. V_{OS} vs. Temperature

$V_s = \pm 15V$, $V_{CM} = 0V$, $R_L = 10k\Omega$, unless otherwise specified.

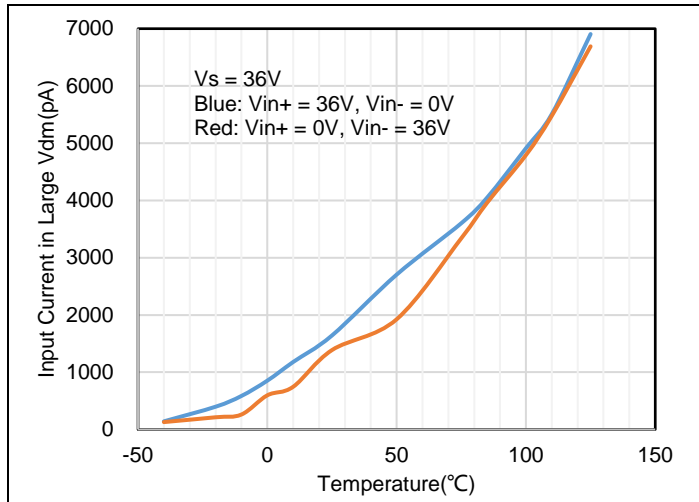


Figure 7. Input Current in Large Vdm vs. Temperature

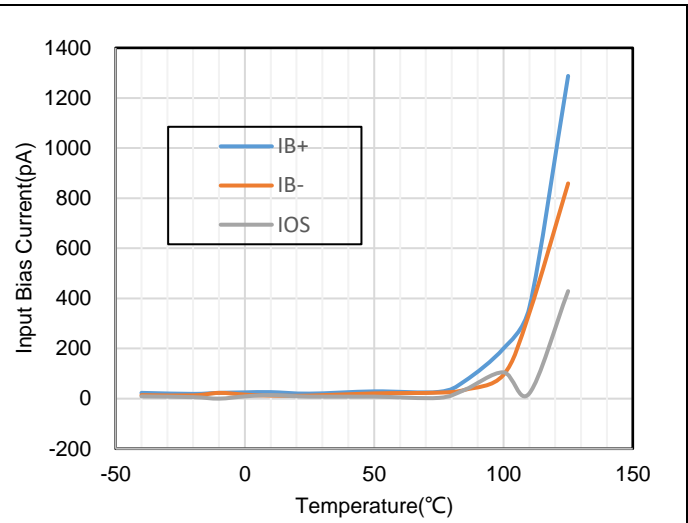


Figure 8. I_B vs. Temperature

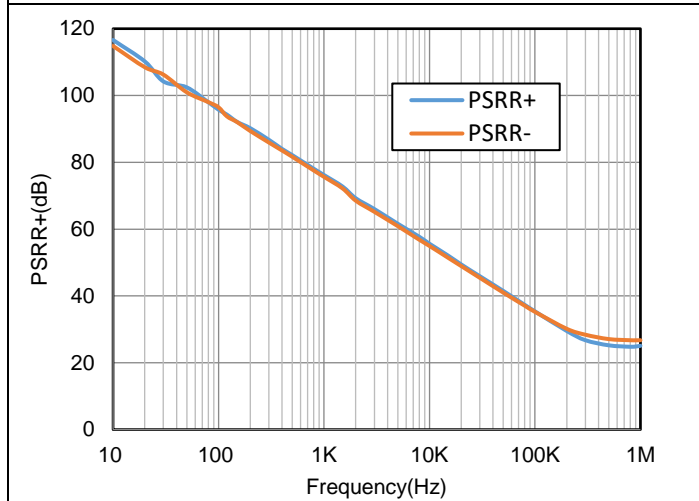


Figure 9. PSRR vs. Frequency

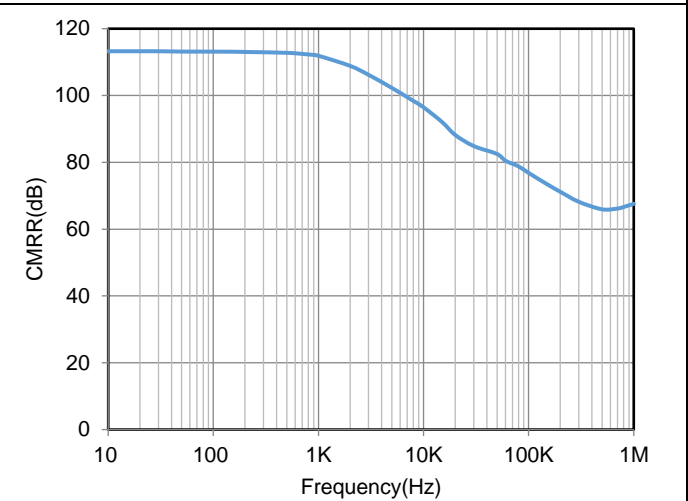


Figure 10. CMRR vs. Frequency

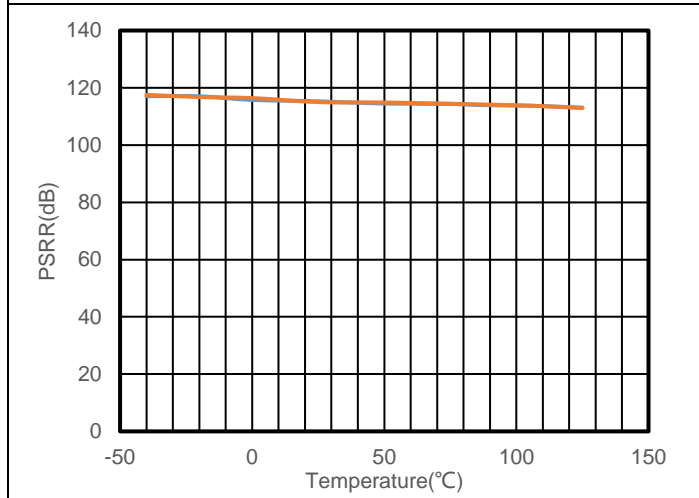


Figure 11. PSRR vs. Temperature

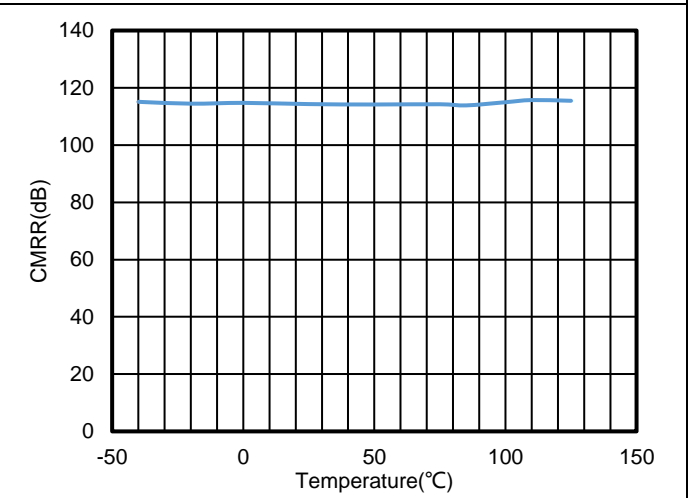


Figure 12. CMRR vs. Temperature

$V_s = \pm 15V$, $V_{CM} = 0V$, $R_L = 10k\Omega$, unless otherwise specified.

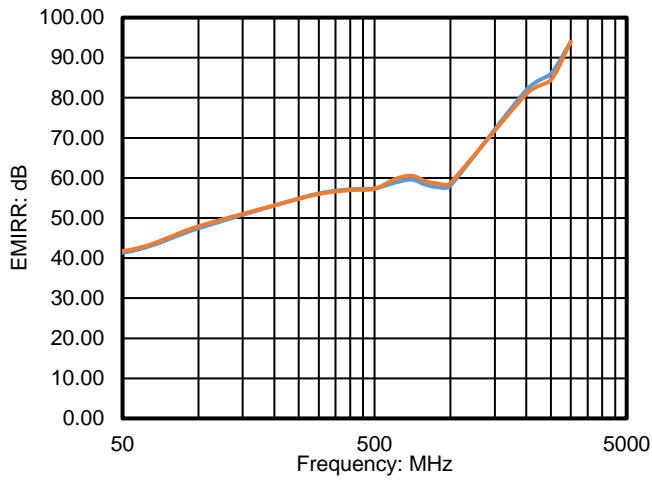


Figure 13. EMIRR+ vs. Frequency

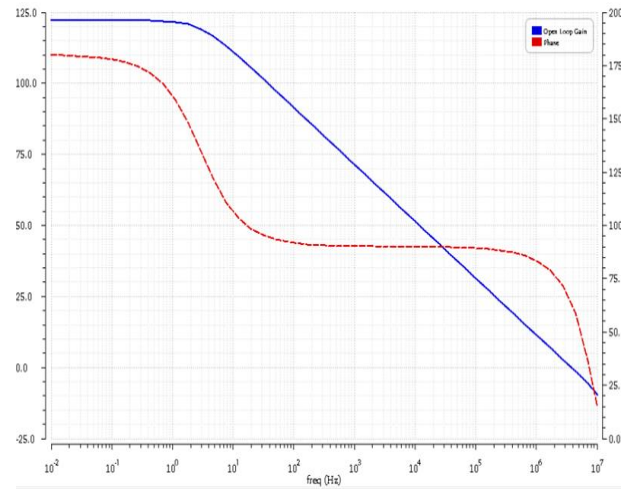


Figure 14. Open Loop Gain and Phase vs. Frequency

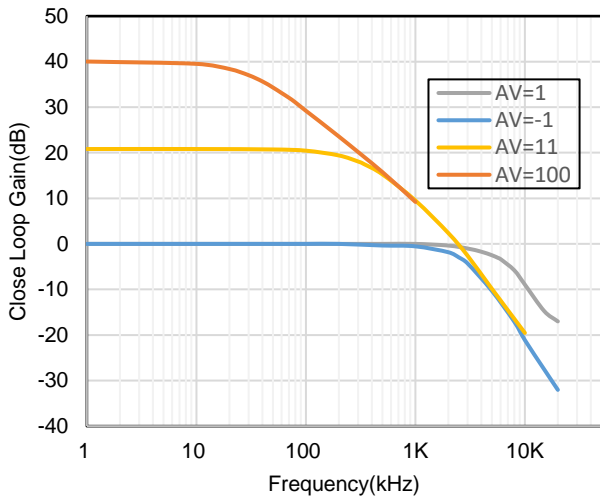
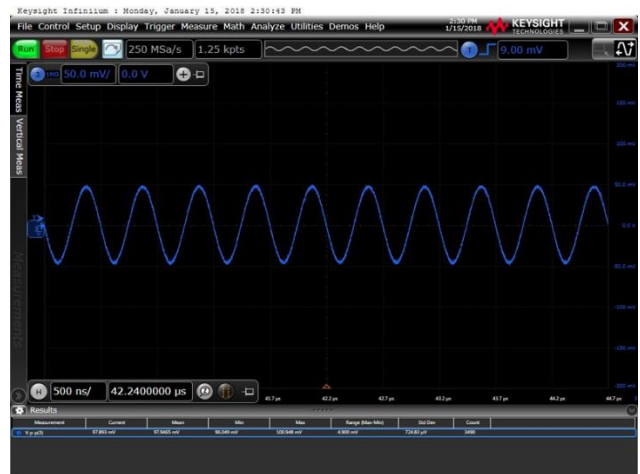


Figure 15. Close Loop Gain and Phase vs. Frequency



$V_s = \pm 1.5V$, $V_{IN} = 100mV_{PP}$, $R_L = 10K$, $C_L = 100pF$, $G = 1$

Figure 16. Waveform under 3V Supply Voltage

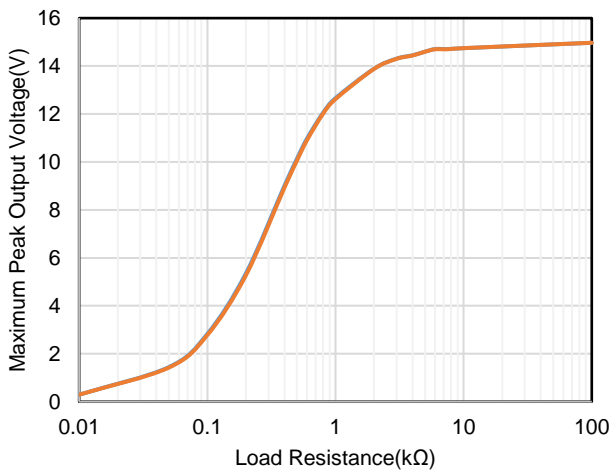


Figure 17. Maximum Peak Output Voltage vs. Load Resistance

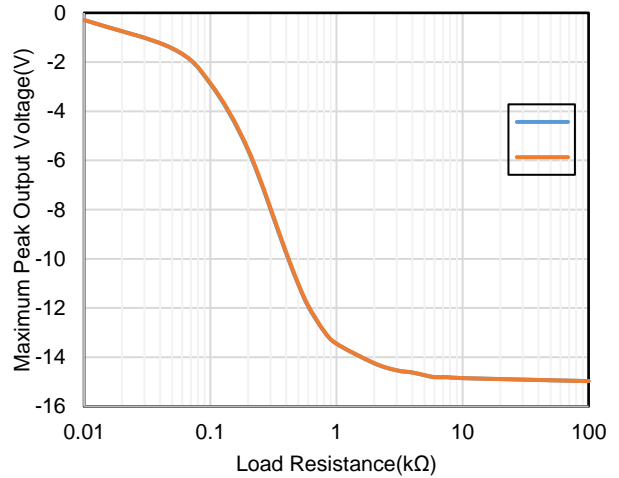


Figure 18. Maximum Peak Output Voltage vs. Load Resistance

$V_s = \pm 15V$, $V_{CM} = 0V$, $R_L = 10k\Omega$, unless otherwise specified.

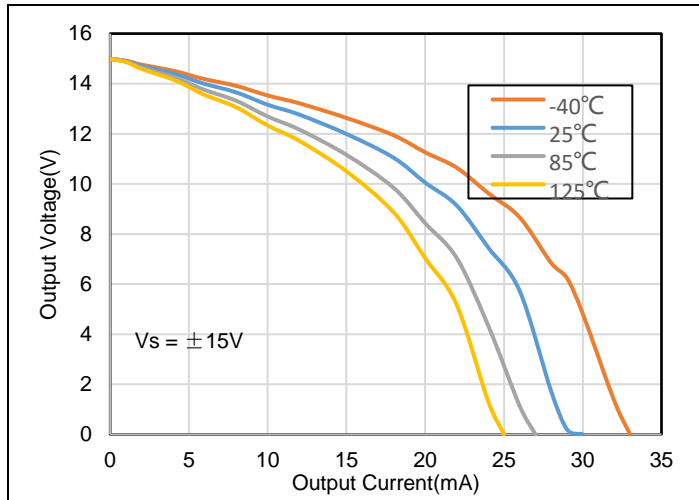


Figure 19. Positive Output Voltage vs. Output Current

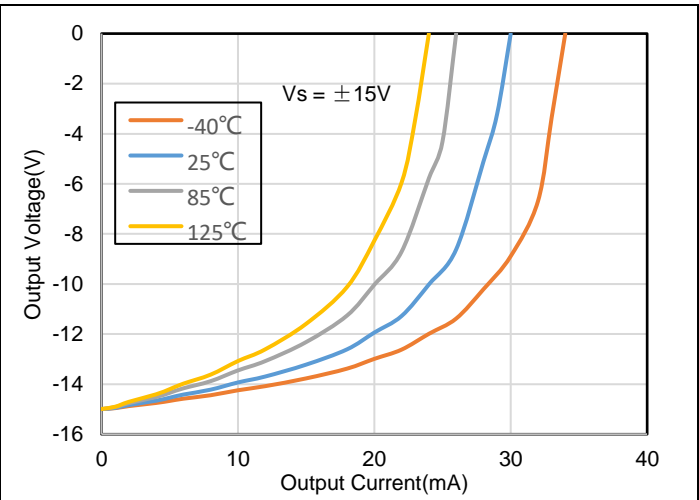


Figure 20. Negative Output Voltage vs. Output Current

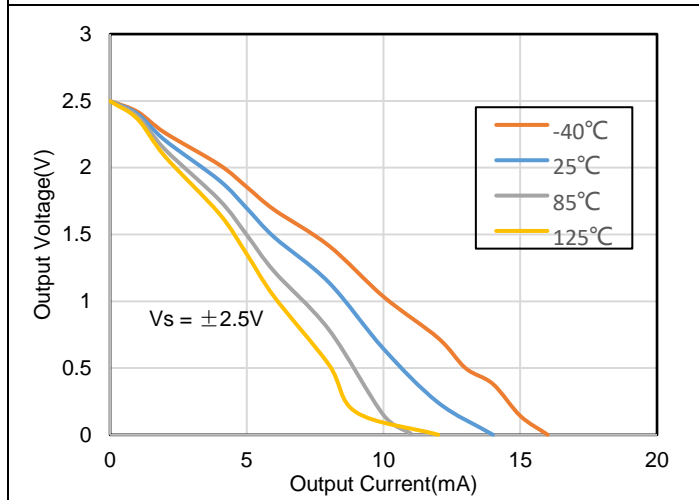


Figure 21. Positive Output Voltage vs. Output Current

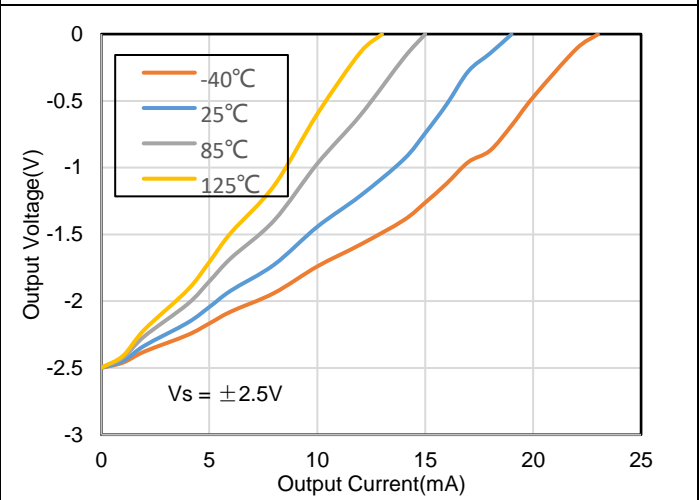


Figure 22. Negative Output Voltage vs. Output Current



Voltage: 1V/div, Time: 200ns/div
 $V_s = 5V$, $V_{IN} = 2V$, $R_L = \text{Open}$, $G = 3$
 Figure 23. Positive Overload Recovery

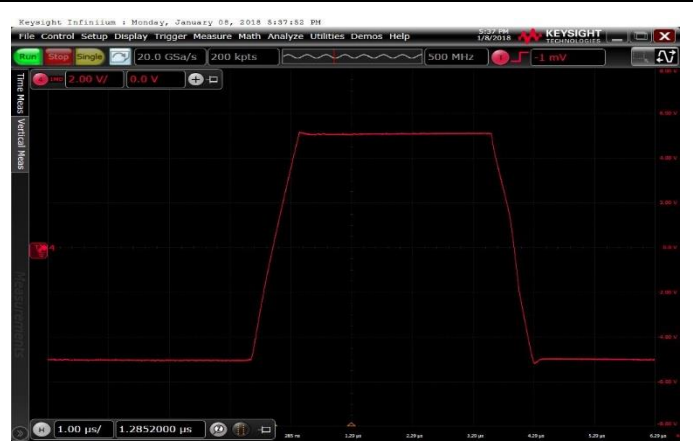


Voltage: 1V/div, Time: 200ns/div
 $V_s = 5V$, $V_{IN} = 2V$, $R_L = \text{Open}$, $G = 3$
 Figure 24. Negative Overload Recovery

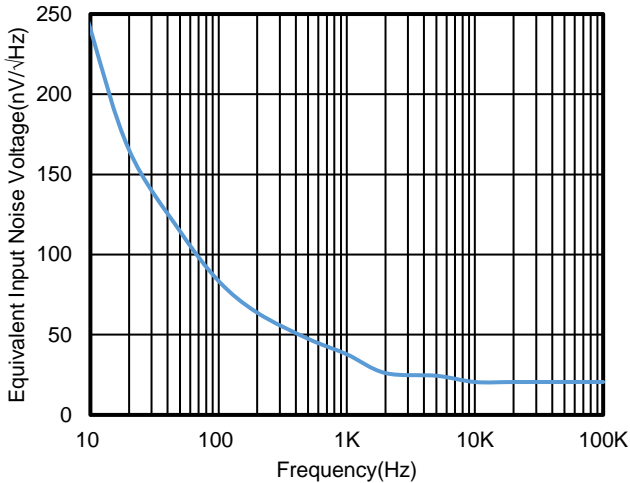
$V_s = \pm 15V$, $V_{CM} = 0V$, $R_L = 10k\Omega$, unless otherwise specified.



Voltage: 20mV/div, Time: 100ns/div
 $V_s = \pm 15V$, $R_L = 2K$, $C_L = 100pF$, $G = 1$
 Figure 25. 100mV Signal Step Response

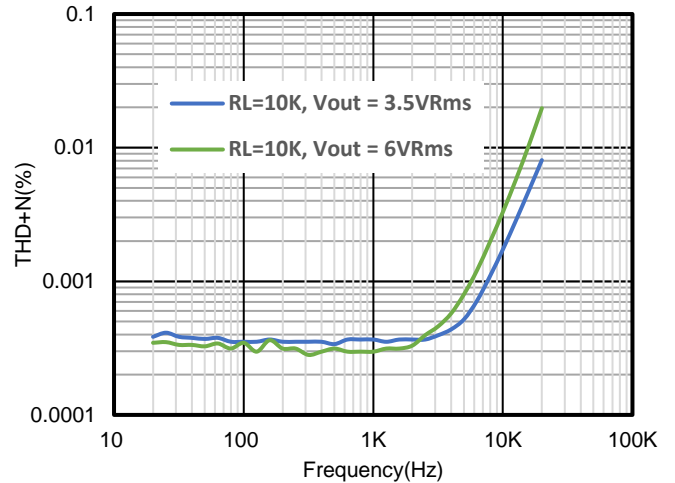


Voltage: 2V/div, Time: 1μs/div
 $V_s = \pm 15V$, $R_L = 2K$, $C_L = 100pF$, $G = 1$
 Figure 26. 10V Signal Step Response



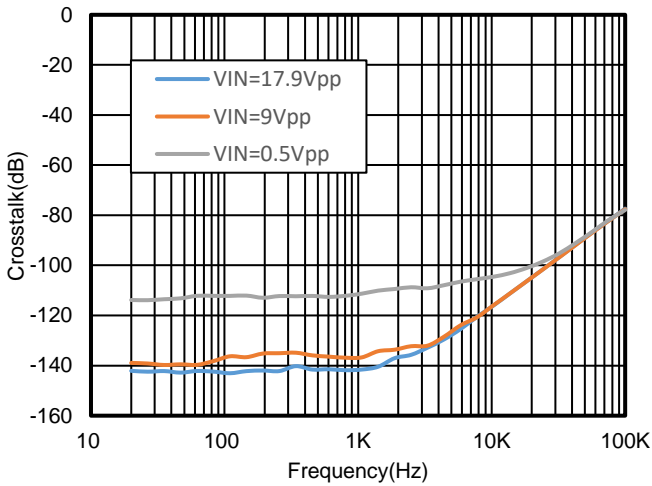
$V_s = \pm 15V$, $V_{CM} = 0V$

Figure 27. Voltage Noise Spectral Density vs. Frequency



$V_s = \pm 15V$, $V_{CM} = 0V$, $G = 1$

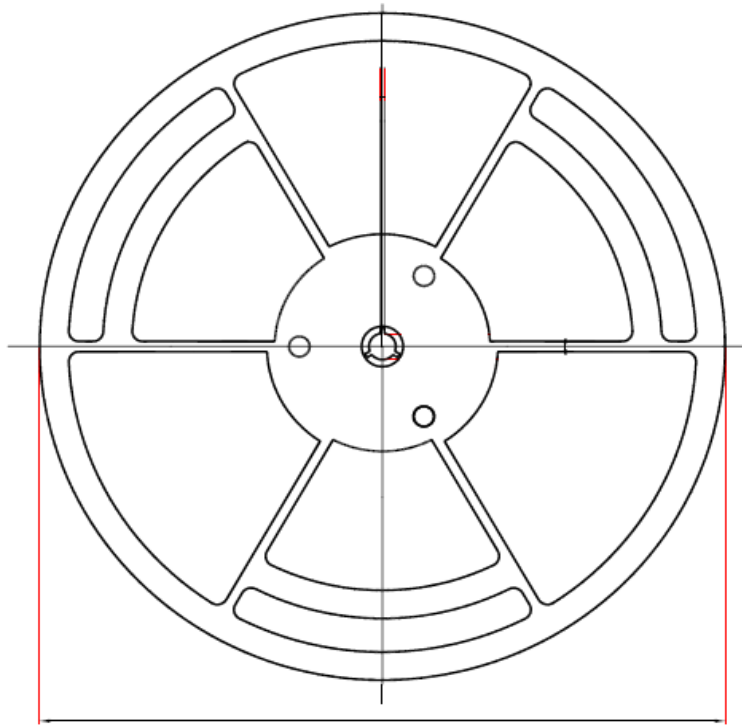
Figure 28. THD+N vs. Frequency



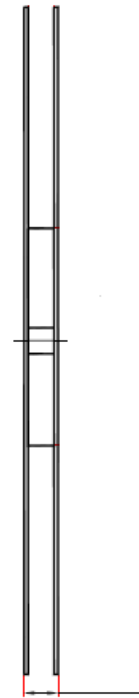
$V_s = \pm 15V$, $V_{CM} = 0V$

Figure 29. Crosstalk vs. Frequency

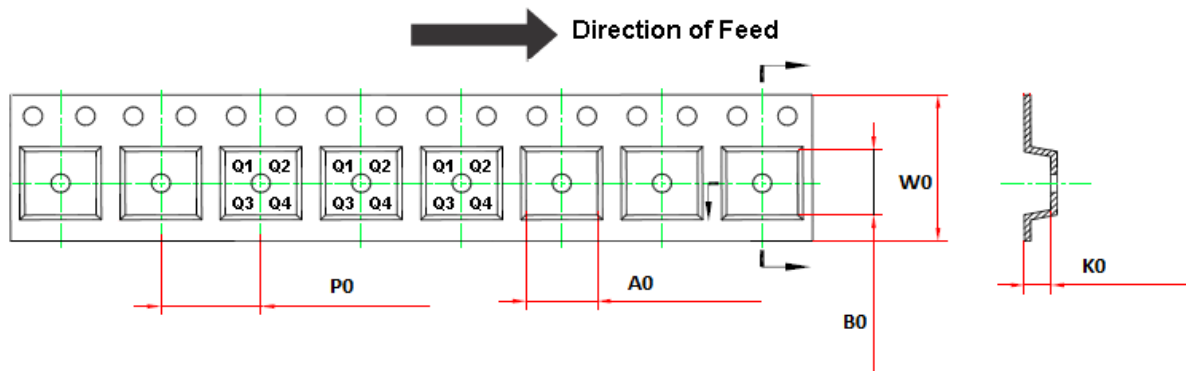
Tape and Reel Information



D1: Reel Diameter

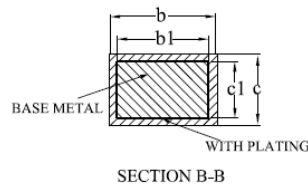
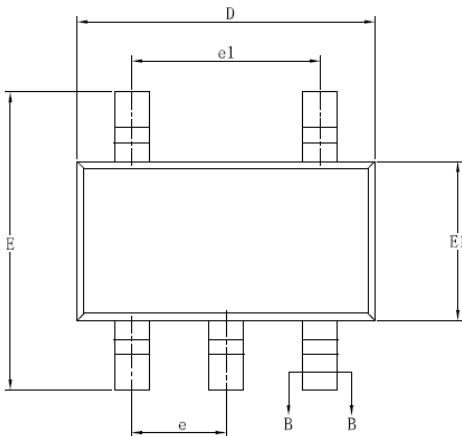
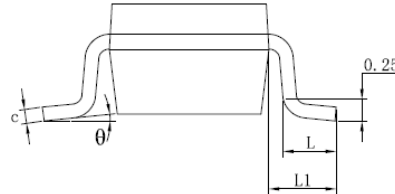
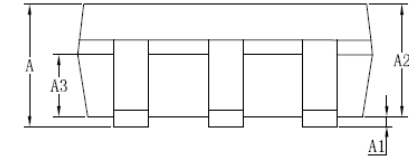


W1: Reel Width



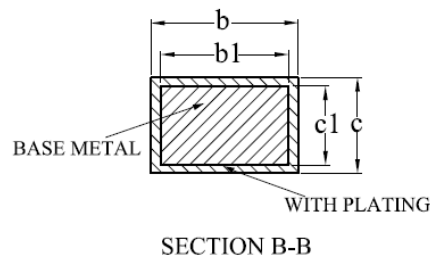
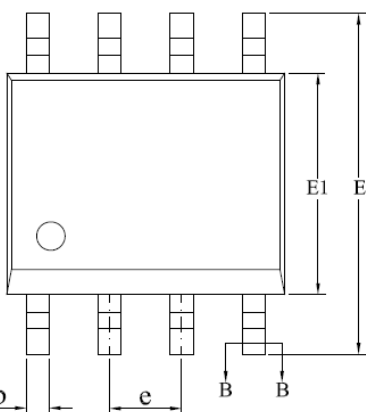
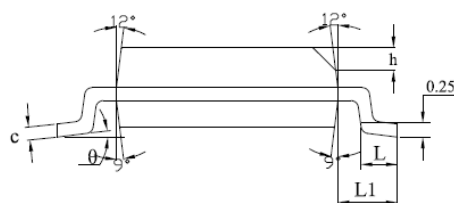
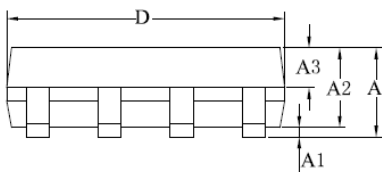
Package Outline Dimensions

SOT23-5

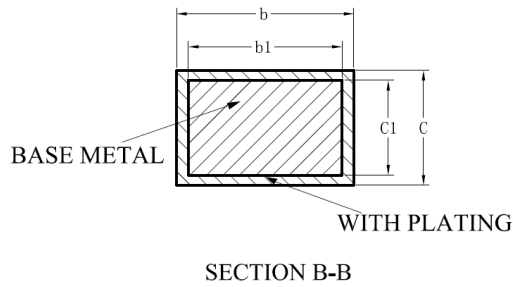
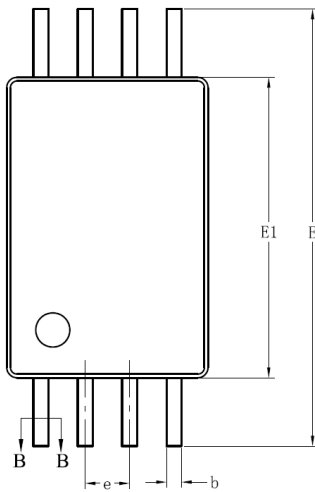
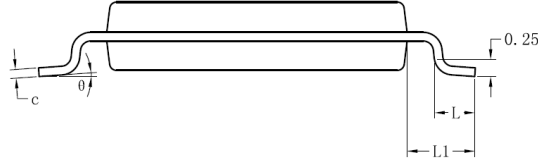
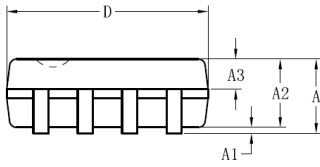


SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	—	—	1.25
A1	0.04	—	0.10
A2	1.00	1.10	1.20
A3	0.60	0.65	0.70
b	0.33	—	0.41
b1	0.32	0.35	0.38
c	0.15	—	0.19
c1	0.14	0.15	0.16
D	2.82	2.92	3.02
E	2.60	2.80	3.00
E1	1.50	1.60	1.70
e	0.95BSC		
e1	1.90BSC		
L	0.30	—	0.60
L1	0.60REF		
θ	0	—	8°

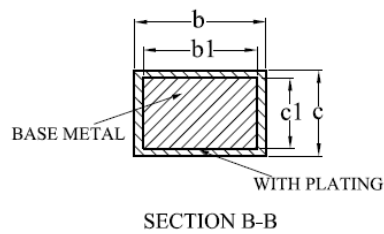
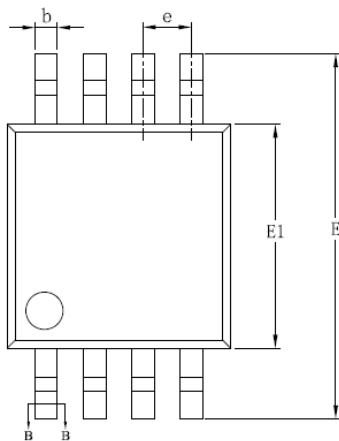
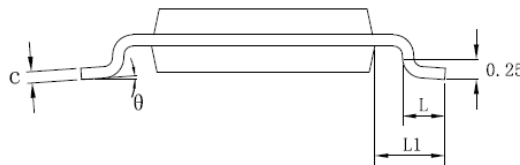
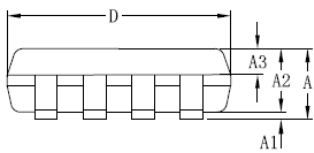
SOIC-8



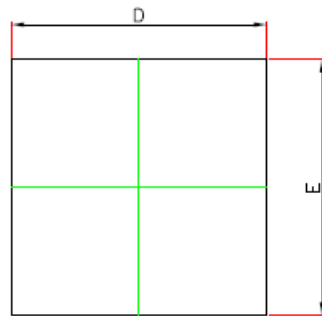
SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	—	—	1.75
A1	0.10	—	0.225
A2	1.30	1.40	1.50
A3	0.60	0.65	0.70
b	0.39	—	0.47
b1	0.38	0.41	0.44
c	0.20	—	0.24
c1	0.19	0.20	0.21
D	4.80	4.90	5.00
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e	1.27BSC		
h	0.25	—	0.50
L	0.50	—	0.80
L1	1.05REF		
θ	0	—	8°

TSSOP-8


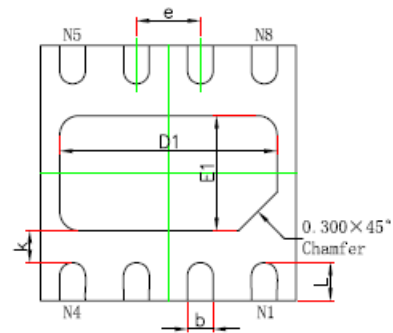
SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	—	—	1.20
A1	0.05	—	0.15
A2	0.90	1.00	1.05
A3	0.39	0.44	0.49
b	0.20	—	0.28
b1	0.19	0.22	0.25
c	0.13	—	0.17
c1	0.12	0.13	0.14
D	2.90	3.00	3.10
E1	4.30	4.40	4.50
E	6.20	6.40	6.60
e	0.65BSC		
L	0.45	—	0.75
L1	1.00REF		
θ	0	—	8°

MSOP-8


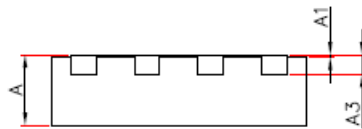
SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	—	—	1.10
A1	0.05	—	0.15
A2	0.75	0.85	0.95
A3	0.30	0.35	0.40
b	0.28	—	0.36
b1	0.27	0.30	0.33
c	0.15	—	0.19
c1	0.14	0.15	0.16
D	2.90	3.00	3.10
E	4.70	4.90	5.10
E1	2.90	3.00	3.10
e	0.65BSC		
L	0.40	—	0.70
L1	0.95REF		
θ	0	—	8°

DFN8 2*2


TOP VIEW

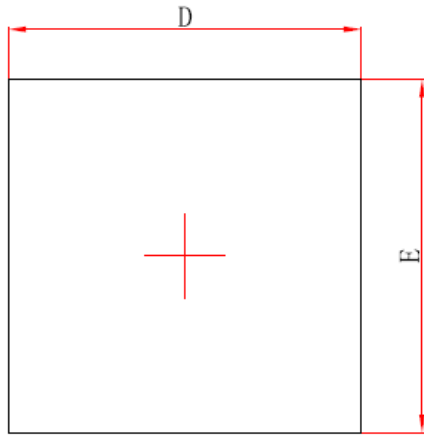
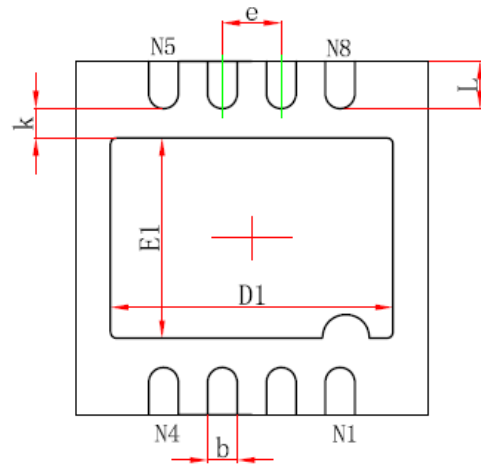
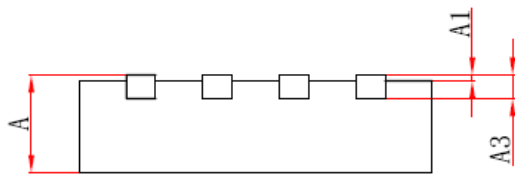


BOTTOM VIEW

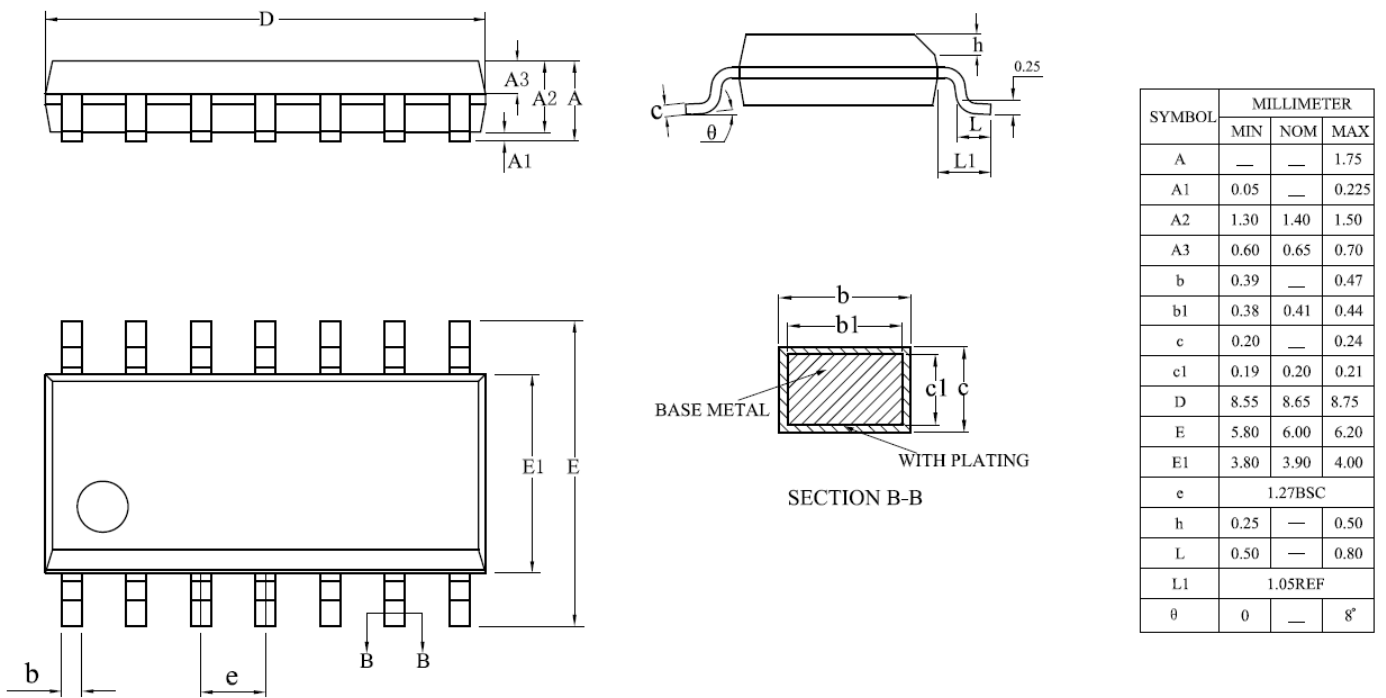


SIDE VIEW

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Norm.		Norm.	
A	0.550+/-0.050		0.022+/-0.002	
A1	0.000	0.050	0.000	0.002
A3	0.152REF.		0.006REF.	
D	2.000+/-0.100		0.079+/-0.004	
E	2.000+/-0.100		0.079+/-0.004	
D1	1.700+/-0.100		0.067+/-0.004	
E1	0.900+/-0.100		0.035+/-0.004	
k	0.200MIN.		0.008MIN.	
b	0.200+/-0.050		0.008+/-0.002	
e	0.500TYP.		0.020TYP.	
L	0.300+/-0.050		0.012+/-0.002	

DFN8 3*3

Top View

Bottom View

Side View

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	0.700/0.800	0.800/0.900	0.028/0.031	0.031/0.035
A1	0.000	0.050	0.000	0.002
A3	0.203REF.		0.008REF.	
D	2.924	3.076	0.115	0.121
E	2.924	3.076	0.115	0.121
D1	2.300	2.500	0.091	0.098
E1	1.600	1.800	0.063	0.071
k	0.200MIN.		0.008MIN.	
b	0.200	0.300	0.008	0.012
e	0.500TYP.		0.020TYP.	
L	0.324	0.476	0.013	0.019

SOIC-14

TSSOP-14
