CN2211, CN2212, CN2214
3-36V 1.3MHz Single/Dual/Quad Operational Amplifier

Features

- Supply Voltage Range: 3V to 36V
- Rail-to-Rail Output
- Gain Bandwidth Product: 1.3MHz
- Unit Gain Stable
- Low Input Offset Voltage 0.6mV typical
- Slew Rate: 0.7V/us
- 0.2mA/Amplifier Typical Supply Current
- Can work as comparator
- Small Packaging: Available in Green SOT/SOP/DFN/MSOP/TSSOP Packages

Applications

- Active Filters
- Photodiode Amplifier
- Piezoelectric Sensors
- Test Equipment
- Medical Instrumentation
- Audio Output
- Portable Systems
- Smoke Detectors
- Notebook PC
- Mobile Communication
- Sensor Interface
- Battery Equipment
- DSP Interface
- ASIC Input
- A/D Output Amplifier

Descriptions

The CN2211, CN2212, CN2214 families of products are single/dual/quad rail-to-rail output operational amplifier respectively offering low cost and high performance. They have a wide input common-mode voltage range and rail-to-rail output voltage swing, running at single supply voltage from 3V to 36V.

The op-amps provide 1.3 MHz bandwidth at a low current consumption of 0.2mA per amplifier, offering excellent overall performance. The op-amps exhibit low noise and distortion, low offset and high output current capability, making this device an excellent choice for sensor interface, active filter, low voltage or battery-operated systems.

The CN2211, CN2212, CN2214 families of products are offered in Green SOT/SOP/DFN/MSOP/TSSOP packages ,and are specified over the extended -40℃ to +125℃ temperature range.

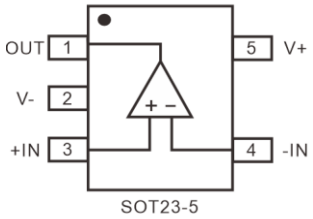
Device Information (1)

PART NUMBER	PACKAGE	BODY SIZE(NOM)
CN2211	SOT23-5	2.90mm×1.60mm
	SOT23-6	2.90mm×1.60mm
	SOIC-8 (SOP8)	4.90mm×3.90mm
CN2212	SOIC-8 (SOP8)	4.90mm×3.90mm
	MSOP-8	3.00mm×3.00mm
	TSSOP-8	3.00mm×4.40mm
	MSOP-10	3.00mm×3.00mm
	TDFN2×2-8L	2.00mm×2.00mm
CN2214	SOIC-14 (SOP14)	8.65mm×3.90mm
	TSSOP-14	5.00mm×4.40mm

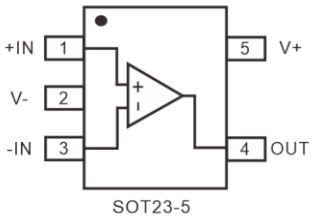
(1) For all available packages, see the orderable addendum at the end of the data sheet.

Pin Configuration and Functions (Top View)

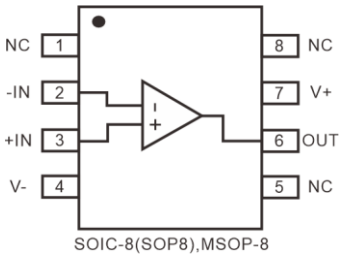
CN2211



CN2211B



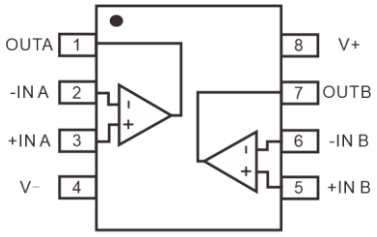
CN2211



Pin Description

NAME	PIN			I/O	DESCRIPTION
	CN2211	CN2211B	CN2211		
	SOT23-5	SOT23-5	SOIC-8(SOP8)/MSOP8		
-IN	4	3	2	I	Negative (inverting) input
+IN	3	1	3	I	Positive (noninverting) input
NC	-	-	1,5,8	-	No internal connection (can be left floating)
OUT	1	4	6	O	Output
V-	2	2	4	-	Negative (lowest) power supply
V+	5	5	7	-	Positive (highest) power supply

CN2212



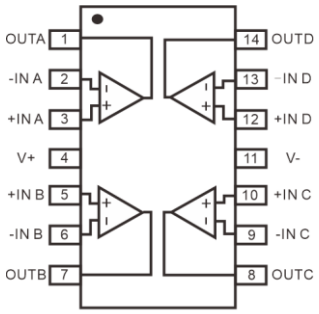
SOIC-8(SOP8),MSOP-8,
TSSOP-8,TDFN2×2-8L,
TDFN3×3-8L

Pin Description

NAME	PIN	I/O	DESCRIPTION
	CN2212		
	SOIC-8(SOP8), MSOP8, TSSOP-8,TDFN2×2-8L, TDFN3×3-8L		
-INA	2	I	Inverting input, channel A
+INA	3	I	Noninverting input, channel A
-INB	6	I	Inverting input, channel B
+INB	5	I	Noninverting input, channel B
OUTA	1	O	Output, channel A
OUTB	7	O	Output, channel B
V-	4	-	Negative (lowest) power supply
V+	8	-	Positive (highest) power supply

Pin Configuration and Functions (Top View)

CN2214



SOIC-14(SOP14),TSSOP-14
TDFN3×2-14L

Pin Description

NAME	PIN	I/O	DESCRIPTION
	CN2214		
	SOIC-14(SOP14), TSSOP-14, TDFN3×2-14L,		
-INA	2	I	Inverting input, channel A
+INA	3	I	Noninverting input, channel A
-INB	6	I	Inverting input, channel B
+INB	5	I	Noninverting input, channel B
-INC	9	I	Inverting input, channel C
+INC	10	I	Noninverting input, channel C
-IND	13	I	Inverting input, channel D
+IND	12	I	Noninverting input, channel D
OUTA	1	O	Output, channel A
OUTB	7	O	Output, channel B
OUTC	8	O	Output, channel C
OUTD	14	O	Output, channel D
V-	11	-	Negative (lowest) power supply
V+	4	-	Positive (highest) power supply

SPECIFICATIONS

Absolute Maximum Ratings

Over operating free-air temperature range (unless otherwise noted) (1)

			MIN	MAX	UNIT
Voltage	Supply, Vs=(V+) - (V-)			44	V
	Signal input pin (2)		(V-)-0.5	(V+) +0.5	
	Signal output pin (3)		(V-)-0.5	(V+) +0.5	
Current	Signal input pin (2)		-10	10	mA
	Signal output pin (3)		-100	100	mA
	Output short-circuit (4)		Continuous		
θ_{JA}	Package thermal impedance (5)	SOT23-5		230	°C/W
		SOP8		110	
		MSOP8		170	
		SOP14		105	
		TSSOP14		90	
Temperature	Operating range, T_A		-40	125	℃
	Junction, T_J (6)		-40	160	
	Storage, T_{stg}		-65	150	

(1) Stresses above these ratings may cause permanent damage. Exposure to absolute maximum conditions for extended periods may degrade device reliability. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those specified is not implied.

(2) Input terminals are diode-clamped to the power-supply rails. Input signals that can swing more than 0.5V beyond the supply rails should be current-limited to 10mA or less.

(3) Output terminals are diode-clamped to the power-supply rails. Output signals that can swing more than 0.5V beyond the supply rails should be current-limited to ±25mA or less.

(4) Short-circuit to ground, one amplifier per package.

(5) The package thermal impedance is calculated in accordance with JESD-51.

(6) The maximum power dissipation is a function of $T_{J(MAX)}$, $R_{\theta JA}$, and T_A. The maximum allowable power dissipation at any ambient temperature is $P_D = (T_{J(MAX)} - T_A) / R_{\theta JA}$. All numbers apply for packages soldered directly onto a PCB.

ESD Ratings

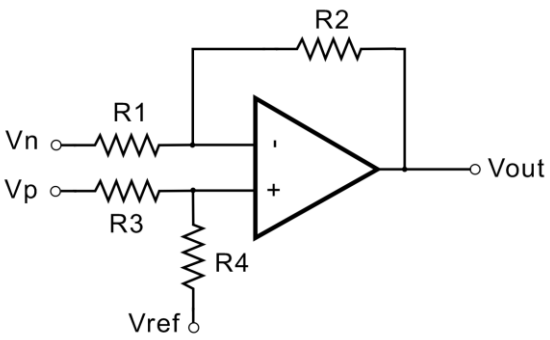
			VALUE	UNIT
V(ESD)	Electrostatic discharge	Human-body model (HBM)	±1000	V
		Charge Discharge Mode (CDM)	±1000	

Recommended Operating Conditions

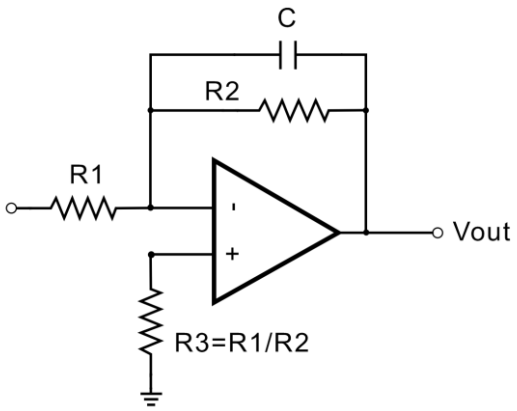
Over operating free-air temperature range (unless otherwise noted)

		MIN	NOM	MAX	UNIT
Supply voltage，Vs= (V+) - (V-）	Single-supply	3	36	40	V
	Dual-supply	±1.5	±18	±20	

Typical Application Circuit



Difference Amplifier



Low Pass Active Filter

Ordering Informatio

Order Part Number	Top Marking	Pb-Free	T_A	Package	
CN2211ST5	CN2211ST5	Yes	-40 to +125°C	SOT23-5	Tape & Reel, 3000
CN2211BST5	CN2211BST5	Yes	-40 to +125°C	SOT23-5	Tape & Reel, 3000
CN2211SP8	CN2211SP8	Yes	-40 to +125°C	SOIC-8	Tape & Reel, 4000
CN2212SP8	CN2212SP8	Yes	-40 to +125°C	SOIC-8	Tape & Reel, 4000
CN2212SSP8	CN2212SSP8	Yes	-40 to +125°C	SOIC-8	Tape & Reel, 4000
CN2212MP8	CN2212MP8	Yes	-40 to +125°C	MSOP-8	Tape & Reel, 4000
CN2212DN8	CN2212DN8	Yes	-40 to +125°C	TDFN-8	Tape & Reel, 5000
CN2214SP14	CN2214SP14	Yes	-40 to +125°C	SOP-14	Tape & Reel, 4000
CN2214TP14	CN2214TP14	Yes	-40 to +125°C	TSSOP-14	Tape & Reel, 4000

Electrical Characteristics: VDD = 36V, VSS=0V

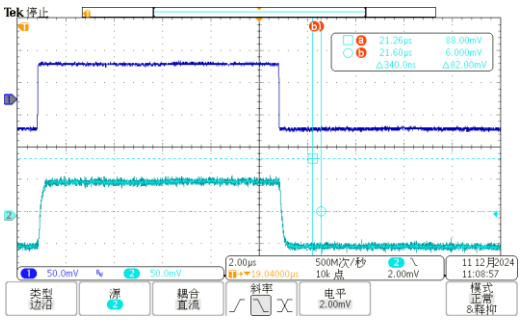
(At V_{DD} = 36V, T_A = +25℃, R_L = 100kΩ connected to V_{DD}/2, unless otherwise noted)

Parameter	Test Conditions	Min.	Typ.	Max	Unit
DYNAMIC PERFORMANCE					
Gain-Bandwidth Product (GBP)	RL = 100kΩ		1.3		MHz
Slew Rate	2Vpp Step, AV = 1		0.7		V/us
Settling Time to 0.1% (Ts)	0.2Vpp Step, AV = 1		0.8		us
Overload Recovery Time	Gain=100, VIN=250mVpp		1		us
DC PERFORMANCE					
Input Offset Voltage (VOS)	VCM = VDD/2	-3.0	0.5	3.0	mV
Input Offset Voltage Drift	RL = 100kΩ, VOUT = 0.25V to VS-0.25V		0.5		uV/deg
Large Signal Voltage Gain (AVO)			110		dB
INPUT CHARACTERISTICS					
Input Common Mode Voltage Range (VCM)		VSS		VDD-1.5	V
Common Mode Rejection Ratio (CMRR)	VCM = -0.1V to VDD-1.5V VDD=36V, VID=36V		100		dB
Different Input Current			10		nA
OUTPUT CHARACTERISTICS					
Output Voltage Swing from Rail	RL = 100 kΩ		0.05		V
	RL = 10 kΩ		0.1		V
Output Current (IOUT)			25		mA
POWER SUPPLY					
Operating Voltage Range	IOUT = 0mA	3	36	40	V
Quiescent Current (per Amplifier)	VS = 5V, VCM = (-VS) + 0.5V		0.2		mA
Power Supply Rejection Ratio (PSRR)			100		dB
NOISE/DISTORTION PERFORMANCE					
Voltage Noise Density (en)	F=1kHz		55		nV/rtHz
	F=10kHz		35		nV/rtHz
Total Harmonic Distortion (THD)	1kHz,G=+1,RL=100K		0.002		%

Note 1: Stresses listed as the above "Absolute Maximum Ratings" may cause permanent damage to the device. These are for stress ratings. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may remain possibility to affect device reliability.

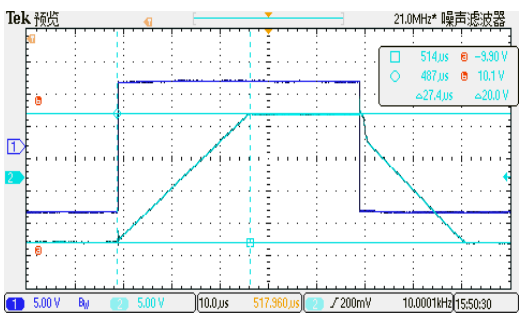
Typical Performance Characteristics

At TA = +25C, Vs=+-18V, RL = 100kΩ connected to GND, unless otherwise noted.



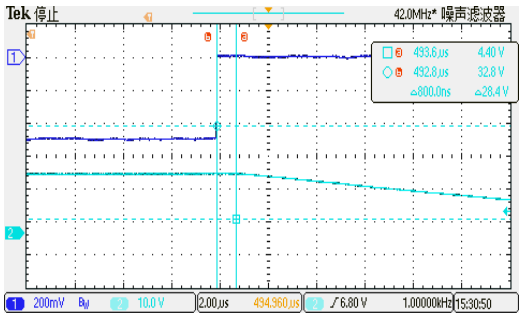
Small Signal Response

V+=18V,V-=-18V，G=1, CL=100pF, RL=100k hm to GND



Large Signal Response

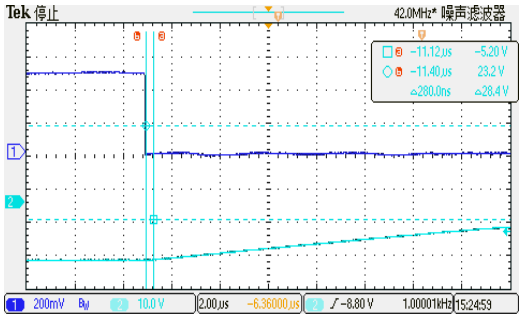
V+=18V,V-=-18V，G=1, CL=100pF, RL=100kOhm to GND



Positive Overload Recovery

V+=18V, V-=-18V, CL=100pF, RL=100kOhm to GND

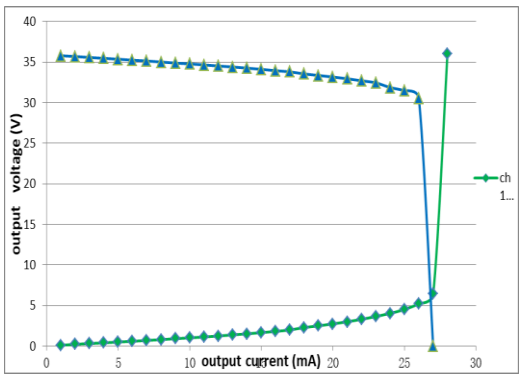
G=100



Negative Overload Recovery

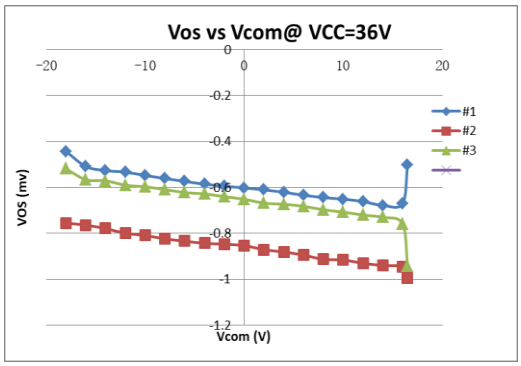
V+=18V, V-=-18V, CL=100pF, RL=100kOhm to GND,

G=100



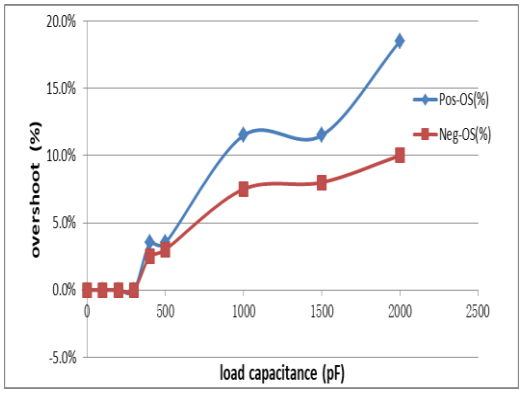
Output Voltage Swing vs Output Current

V+=18V, V-=-18V, CL=100pF, RL=100kOhm to GND



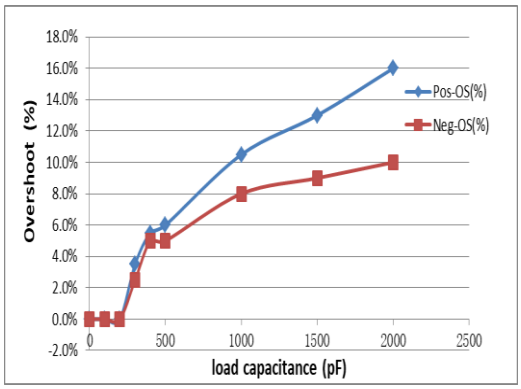
Voff vs Vcom（input common mode voltage）

V+=18V, V-=-18V, CL=100pF, RL=100kOhm to GND



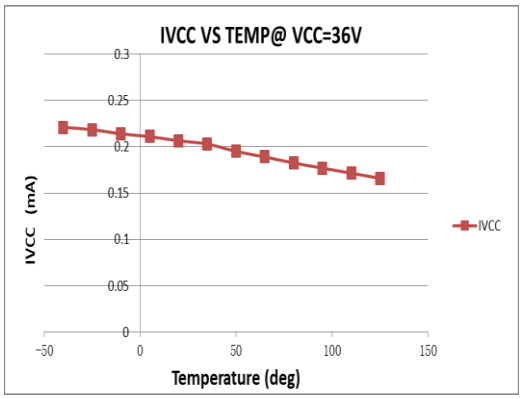
Overshoot (OS) vs Load Capacitance

V+=18V ,V-=-18V, RL=100kOhm to GND



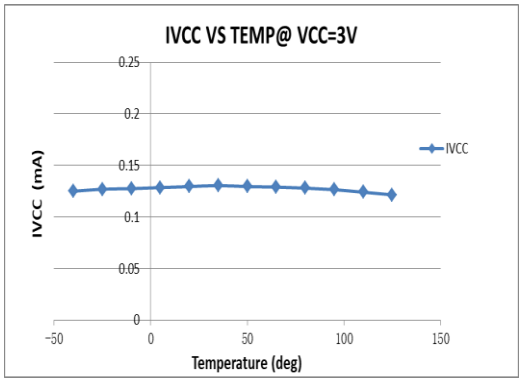
Overshoot (OS) vs Load Capacitance

V+=1.5V ,V-=-1.5V, RL=100kOhm to GND



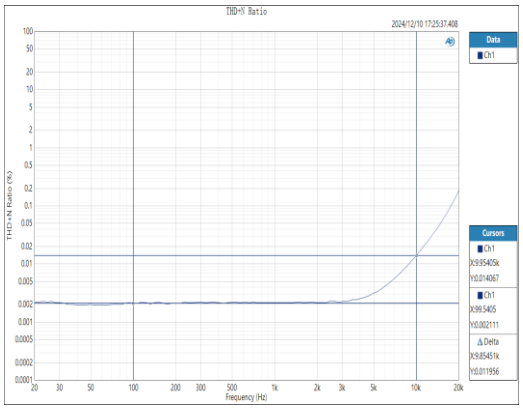
ICC vs Temp

V+=18V ,V-=-18V, CL=100pf RL=100kOhm to GND



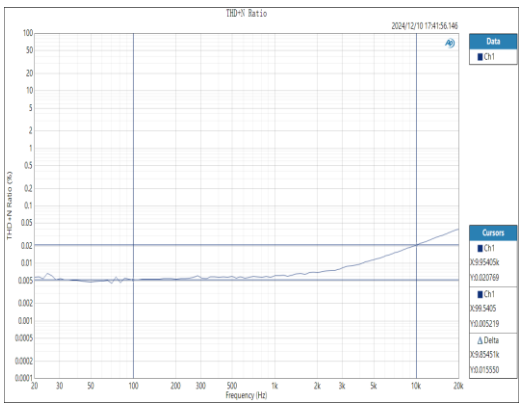
ICC vs Temp

V+=1.5V ,V-=-1.5V, CL=100pf RL=100kOhm to GND



THD vs Frequency

V+=18V ,V-=-18V, Vin=10Vpp, CL=100pf RL=100kOhm to GND



THD vs Frequency

V+=1.5V ,V-=-1.5V, Vin=1Vpp, CL=100pf RL=100kOhm to GND

Power Supply Layout and Bypass

The CN221X OPA's power supply pin (VDD for single-supply) should have a local bypass capacitor (i.e., 0.01μF to 0.1μF) within 2mm for good high frequency performance. It can also use a bulk capacitor (i.e., 1μF or larger) within 100mm to provide large, slow currents. This bulk capacitor can be shared with other analog parts. Ground layout improves performance by decreasing the amount of stray capacitance and noise at the OPA's inputs and outputs. To decrease stray capacitance, minimize PC board lengths and resistor leads, and place external components as close to the op amps' pins as possible.

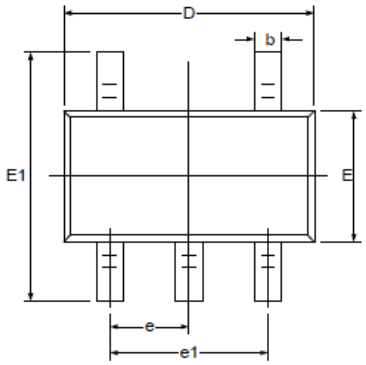
Proper Board Layout

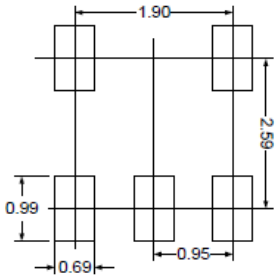
To ensure optimum performance at the PCB level, care must be taken in the design of the board layout. To avoid leakage currents, the surface of the board should be kept clean and free of moisture. Coating the surface creates a barrier to moisture accumulation and helps reduce parasitic resistance on the board. Keeping supply traces short and properly bypassing the power supplies minimizes power supply disturbances due to output current variation, such as when driving an ac signal into a heavy load. Bypass capacitors should be connected as closely as possible to the device supply pins. Stray capacitances are a concern at the outputs and the inputs of the amplifier. It is recommended that signal traces be kept at least 5mm from supply lines to minimize coupling.

A variation in temperature across the PCB can cause a mismatch in the Seebeck voltages at solder joints and other points where dissimilar metals are in contact, resulting in thermal voltage errors. To minimize these thermocouple effects, orient resistors so heat sources warm both ends equally. Input signal paths should contain matching numbers and types of components, where possible to match the number and type of thermocouple junctions. For example, dummy components such as zero value resistors can be used to match real resistors in the opposite input path. Matching components should be located in close proximity and should be oriented in the same manner. Ensure leads are of equal length so that thermal conduction is in equilibrium. Keep heat sources on the PCB as far away from amplifier input circuitry as is practical.

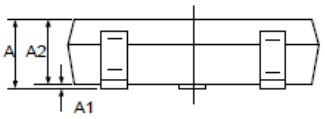
The use of a ground plane is highly recommended. A ground plane reduces EMI noise and also helps to maintain a constant temperature across the circuit board.

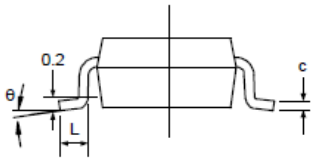
Package Outline And Physical Dimensions: SOT23-5





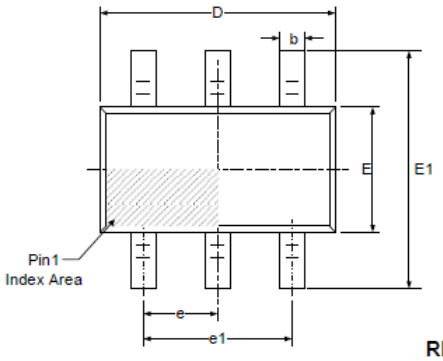
RECOMMENDED LAND PATTERN (Unit: mm)

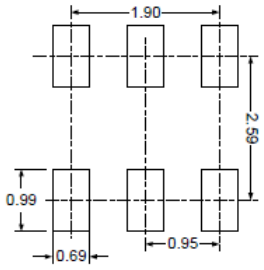




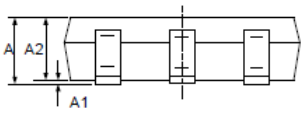
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

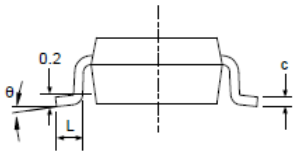
Package Outline And Physical Dimensions: SOT23-6





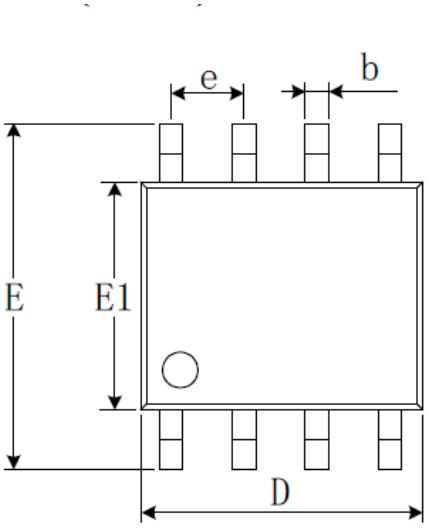
RECOMMENDED LAND PATTERN (Unit: mm)

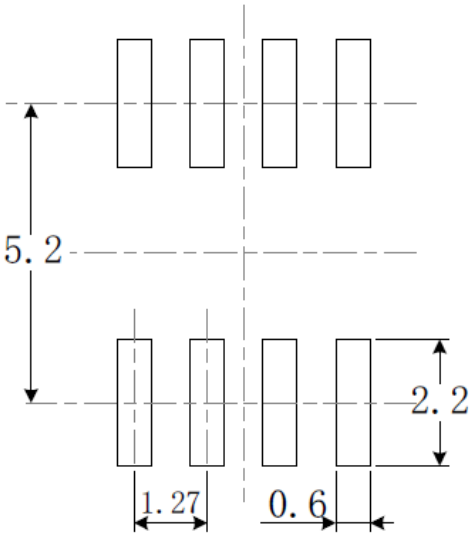




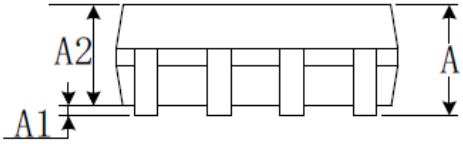
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

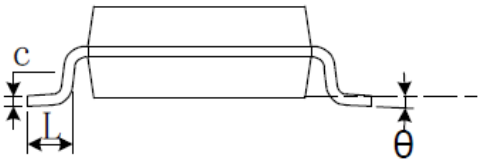
Package Outline And Physical Dimensions: SOIC-8





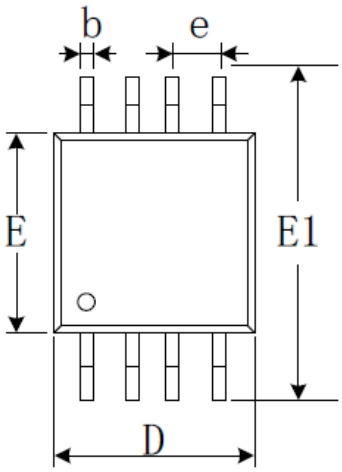
RECOMMENDED LAND PATTERN (Unit: mm)

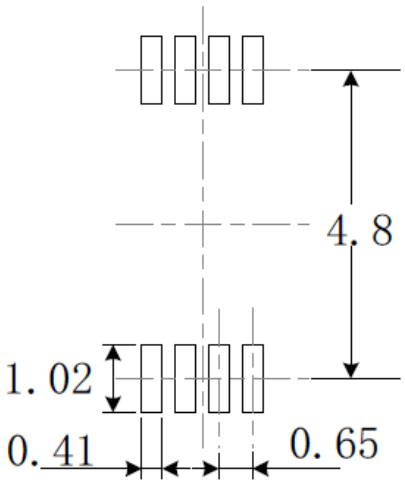




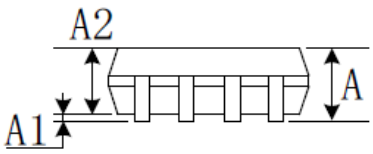
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D	4.800	5.000	0.189	0.197
e	1.270(BSC)		0.050(BSC)	
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150	0.157
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

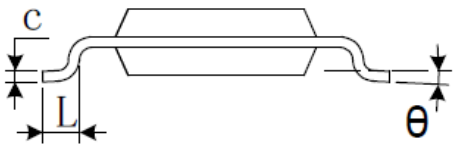
Package Outline And Physical Dimensions: MSOP-8





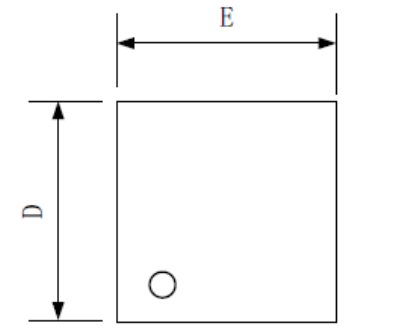
RECOMMENDED LAND PATTERN (Unit: mm)



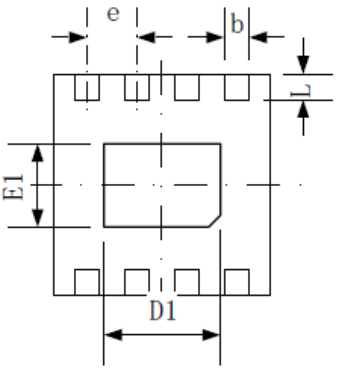


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
e	0.650(BSC)		0.026(BSC)	
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
L	0.400	0.800	0.016	0.031
θ	0°	6°	0°	6°

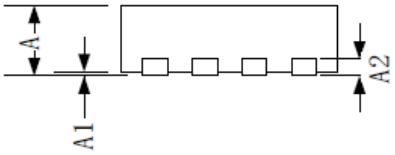
Package Outline And Physical Dimensions: TDFN -2x2-8L



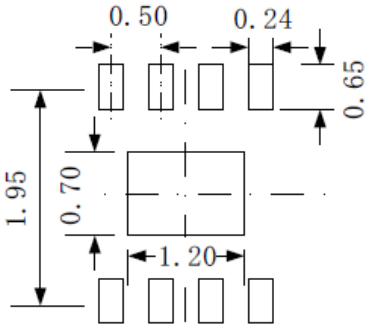
TOP VIEW



BOTTOM VIEW



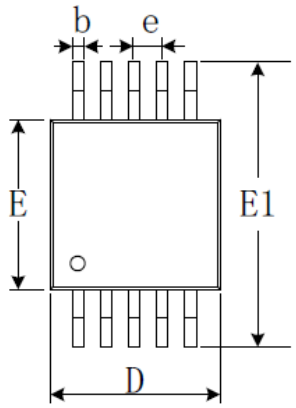
SIDE VIEW

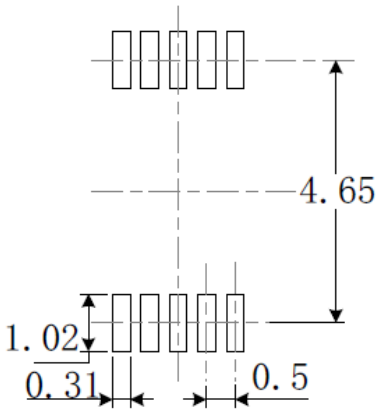


RECOMMENDED LAND PATTERN (Unit: mm)

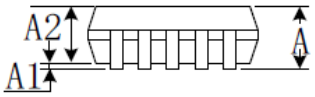
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.700	0.800	0.028	0.031
A1	0.000	0.050	0.000	0.002
A2	0.203(TYP)		0.008(TYP)	
b	0.180	0.300	0.007	0.012
D	1.900	2.100	0.075	0.083
D1	1.100	1.300	0.043	0.051
E	1.900	2.100	0.075	0.083
E1	0.600	0.800	0.024	0.031
e	0.500(TYP)		0.020(TYP)	
L	0.250	0.450	0.010	0.018

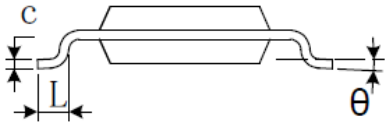
Package Outline And Physical Dimensions: MSOP-10





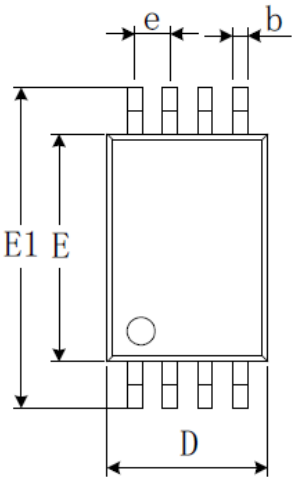
RECOMMENDED LAND PATTERN (Unit: mm)

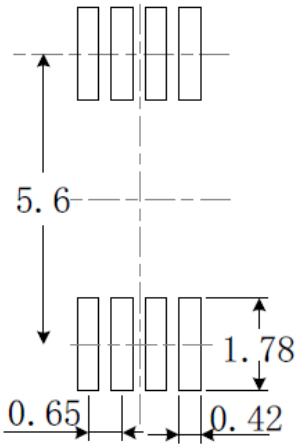




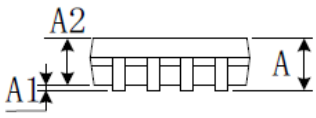
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.180	0.280	0.007	0.011
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
e	0.50(BSC)		0.020(BSC)	
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
L	0.400	0.800	0.016	0.031
θ	0°	6°	0°	6°

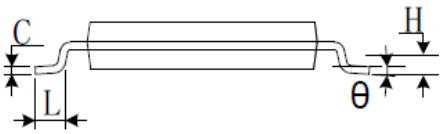
Package Outline And Physical Dimensions: TSSOP-8





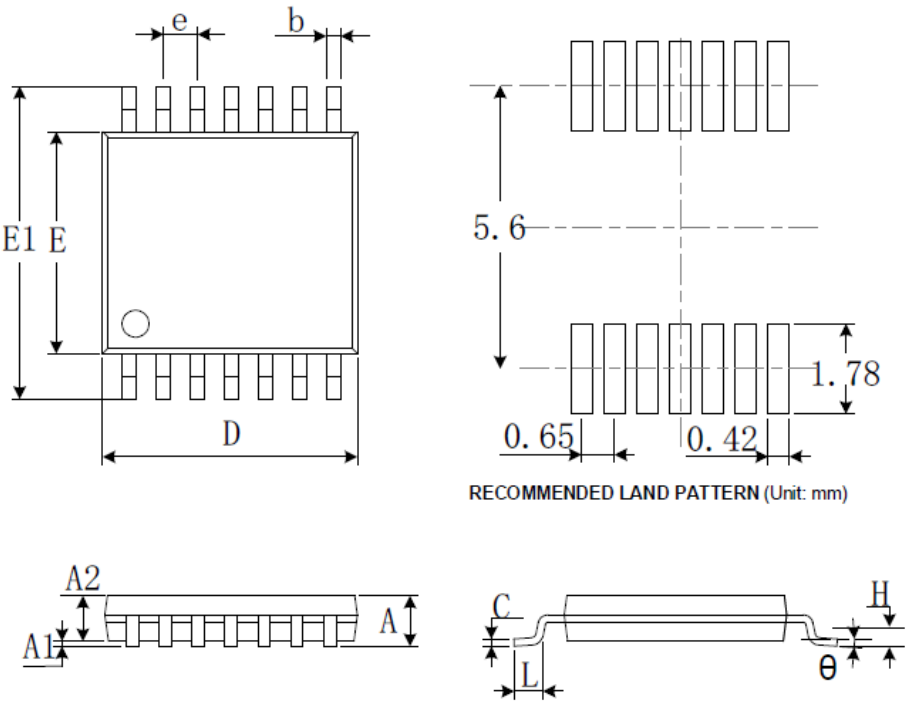
RECOMMENDED LAND PATTERN (Unit: mm)





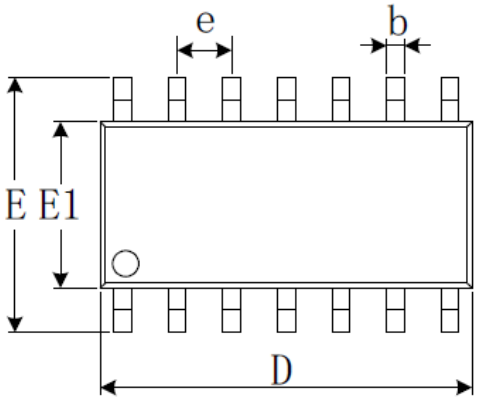
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A		1.200		0.047
A1	0.050	0.150	0.002	0.006
A2	0.800	1.050	0.031	0.041
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
D	2.900	3.100	0.114	0.122
E	4.300	4.500	0.169	0.177
E1	6.250	6.550	0.246	0.258
e	0.650(BSC)		0.026(BSC)	
L	0.500	0.700	0.020	0.028
H	0.25(TYP)		0.01(TYP)	
θ	1°	7°	1°	7°

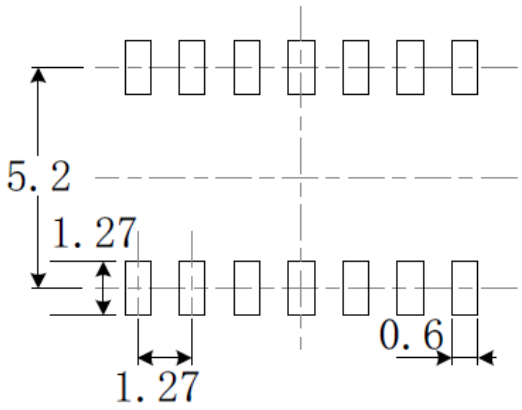
Package Outline And Physical Dimensions: TSSOP-14



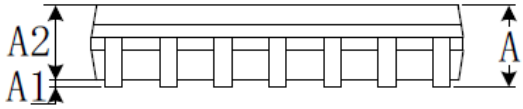
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A		1.200		0.047
A1	0.050	0.150	0.002	0.006
A2	0.800	1.050	0.031	0.041
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
D	4.860	5.100	0.191	0.201
E	4.300	4.500	0.169	0.177
E1	6.250	6.550	0.246	0.258
e	0.650(BSC)		0.026(BSC)	
L	0.500	0.700	0.020	0.028
H	0.25(TYP)		0.01(TYP)	
θ	1°	7°	1°	7°

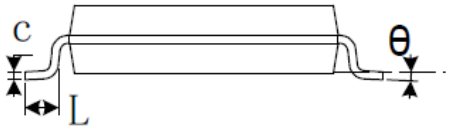
Package Outline And Physical Dimensions: SOP-14





RECOMMENDED LAND PATTERN (Unit: mm)





Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.310	0.510	0.012	0.020
c	0.100	0.250	0.004	0.010
D	8.450	8.850	0.333	0.348
e	1.270(BSC)		0.050(BSC)	
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150	0.157
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°