

CN8551, CN8552, CN8554 **Zero-Drift, Low-Noise Rail-to-Rail I/O, CMOS** **Operational Amplifiers**

Features

- Rail-to-Rail Input and Output
- Input Offset Drift: 0.005 $\mu\text{V}/^{\circ}\text{C}$
- Low Offset Voltage: 1 μV
- Supply Voltage Range: 1.8V to 5.5V
- Gain Bandwidth Product: 1.7MHz
- Slew Rate: 1.0V/ μs
- Micro Power: 0.46mA/Amplifier Typical Supply Current
- Overload Recovery Time: 8.5 μs
- Low Noise: 1 $\mu\text{Vp-p}$ (0.01-10Hz)
- High Gain: 130dB
- CMRR: 125dB; PSRR: 130dB
- Small Packaging: Available in Green SOT/SOP/DFN/MSOP/TSOP 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

Descriptions

The CN8551, CN8552, CN8554 families of products are CMOS operational amplifier offering very low offset voltage (1 μV typical) and near-zero drift over time and temperature.

The op-amps provide 1.7MHz bandwidth at a low current consumption of 460 μA per amplifier and slew rate of 1V/ μs , offering excellent CMRR without the crossover associated with traditional complementary input stage, making this device an excellent choice for sensor interface, active filter, low voltage or battery-operated systems.

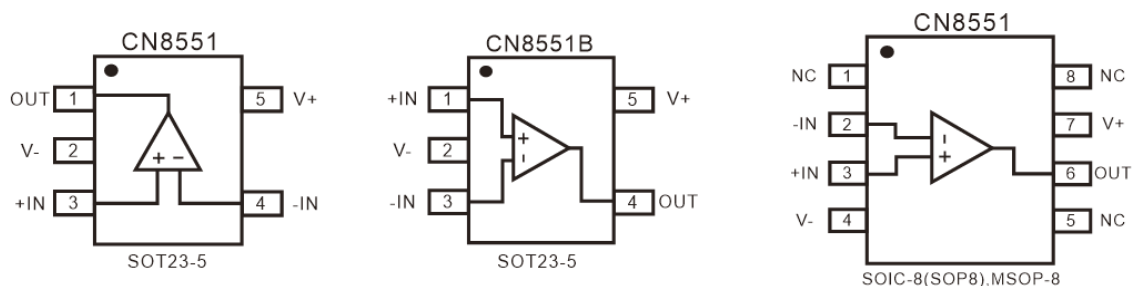
The CN8551, CN8552, CN8554 families of products are offered in Green SOT/SOP/DFN/MSOP/TSOP packages, and are specified over the extended -40°C to $+125^{\circ}\text{C}$ temperature range.

 Device Information ⁽¹⁾

PART NUMBER	PACKAGE	BODY SIZE(NOM)
CN8551	SOT23-5	2.90mm $\times$ 1.60mm
	SOT23-6	2.90mm $\times$ 1.60mm
	SOIC-8 (SOP8)	4.90mm $\times$ 3.90mm
	MSOP-8	3.00mm $\times$ 3.00mm
CN8552	SOIC-8 (SOP8)	4.90mm $\times$ 3.90mm
	MSOP-8	3.00mm $\times$ 3.00mm
	TSSOP-8	3.00mm $\times$ 4.40mm
	MSOP-10	3.00mm $\times$ 3.00mm
	TDFN2 $\times$ 2-8L	2.00mm $\times$ 2.00mm
	TDFN3 $\times$ 3-8L	3.00mm $\times$ 3.00mm
CN8554	SOIC-14 (SOP14)	8.65mm $\times$ 3.90mm
	TSSOP-14	5.00mm $\times$ 4.40mm
	TDFN3 $\times$ 2-14L	3.00mm $\times$ 2.00mm

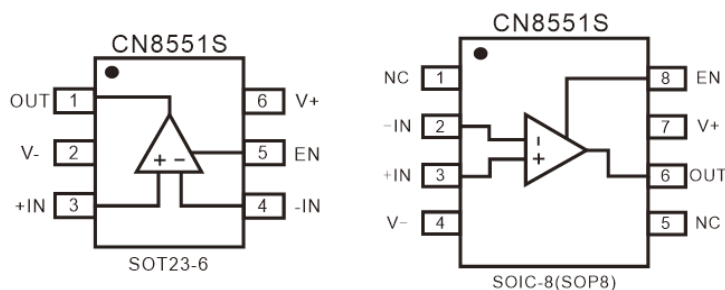
(1) For all available packages, see the orderable addendum at the end of the data sheet.

Pin Configuration and Functions (Top View)



Pin Description

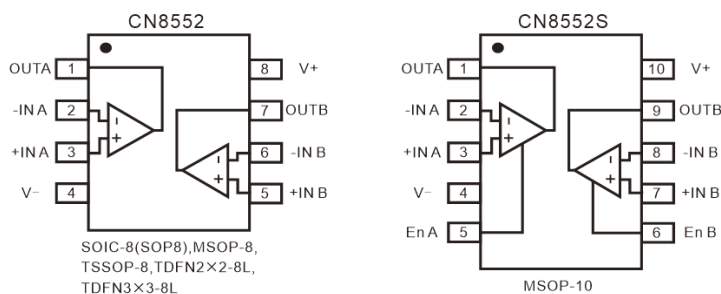
NAME	PIN			I/O	DESCRIPTION
	CN8551	CN8551B	CN8551		
	SOT23-5	SOT23-5	SOIC-8(SOP8)/MSOP8		
-IN	4	3	2	I	Negative (inverting) input
+IN	3	1	3	I	Positive (noninverting) input
NC	-	-	1,5,8	-	No internal connection (can be left floating)
OUT	1	4	6	O	Output
V-	2	2	4	-	Negative (lowest) power supply
V+	5	5	7	-	Positive (highest) power supply



Pin Description

NAME	PIN		I/O	DESCRIPTION
	CN8551S			
	SOT23-5	SOIC-8(SOP8)		
-IN	4	2	I	Negative (inverting) input
+IN	3	3	I	Positive (noninverting) input
OUT	1	1,5,8	O	No internal connection (can be left floating)
EN	5	6	I	Enable pin, this pin turns the regulator on or off. Low=disabled, high = normal operation (pin must be driven)
NC	-	1,5	-	No internal connection (can be left floating)
V-	2	4	-	Negative (lowest) power supply
V+	6	7	-	Positive (highest) power supply

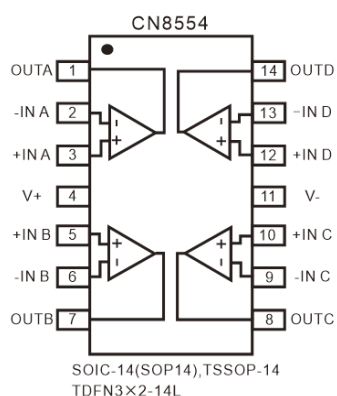
Pin Configuration and Functions (Top View)



Pin Description

NAME	PIN		I/O	DESCRIPTION
	CN8552	CN8552S		
	SOIC-8(SOP8), MSOP8, TSSOP-8, TDFN2×2-8L, TDFN3×3-8L	MSOP10		
-INA	2	2	I	Inverting input, channel A
+INA	3	3	I	Noninverting input, channel A
-INB	6	8	I	Inverting input, channel B
+INB	5	7	I	Noninverting input, channel B
OUTA	1	1	O	Output, channel A
OUTB	7	9	O	Output, channel B
EnA	-	5	I	Enable pin, channel A. This pin turns the regulator on or off. Low = disabled, high = normal operation (pin must be driven)
EnB	-	6	I	Enable pin, channel A. This pin turns the regulator on or off. Low = disabled, high = normal operation (pin must be driven)
V-	4	4	-	Negative (lowest) power supply
V+	8	10	-	Positive (highest) power supply

Pin Configuration and Functions (Top View)



Pin Description

NAME	PIN	I/O	DESCRIPTION
	CN8554		
	SOIC-14(SOP14), TSSOP-14, TDFN3x2-14L,		
-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, $V_S=(V^+) - (V^-)$		7	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)	-120	120	mA
	Output short-circuit (4)	Continuous		
Temperature	Operating range, T _A	-40	125	°C
	Junction, T _J		150	
	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 ± 20 mA or less.

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

ESD Ratings

			VALUE	UNIT
V(ESD)	Electrostatic discharge	Human-body model (HBM)	± 8000	V
		Machine Model (MM)	± 400	

Recommended Operating Conditions

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

		MIN	NOM	MAX	UNIT
Supply voltage, $V_S=(V^+) - (V^-)$	Single-supply	1.8		5.5	V
	Dual-supply	± 0.9		± 2.75	

Thermal Information: CN8551

THERMAL METRIC ⁽¹⁾		CN8551				UNIT
		5PINS		8PINS		
		SOT23-5	SOT23-6	SOIC-8	MSOP8	
R _{ΘJA}	Junction-to-ambient thermal resistance	273.8	187.3	116	165	°C/W
R _{ΘJC(top)}	Junction-to-case(top) thermal resistance	126.8	126.5	60	53	°C/W
R _{ΘJB}	Junction-to-board thermal resistance	85.9	32.6	56	87	°C/W
Ψ _{JT}	Junction-to-top characterization parameter	10.9	24.1	12.8	4.9	°C/W
Ψ _{JB}	Junction-to-board characterization parameter	84.9	32.1	98.3	85	°C/W
R _{ΘJC(bot)}	Junction-to-case(bottom) thermal resistance	N/A	N/A	N/A	N/A	°C/W

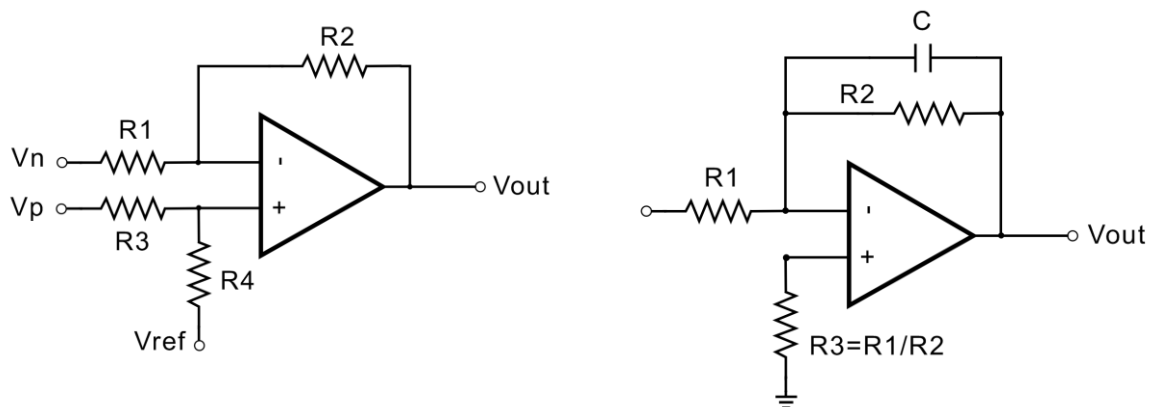
Thermal Information: CN8552

THERMAL METRIC ⁽¹⁾		CN8552						UNIT
		8PINS						
		SOIC-8	MSOP-8	TSSOP-8	MSOP-10	TDFN2 ×2-8L	TDFN33 ×2-8L	
R _{ΘJA}	Junction-to-ambient thermal resistance	116	165	200.7	169.5	80.1	66.9	°C/W
R _{ΘJC(top)}	Junction-to-case(top) thermal resistance	60	53	95.4	84.1	100	54.5	°C/W
R _{ΘJB}	Junction-to-board thermal resistance	56	87	128.6	113	45	40.4	°C/W
Ψ _{JT}	Junction-to-top characterization parameter	12.8	4.9	27.2	15.8	6.8	1.9	°C/W
Ψ _{JB}	Junction-to-board characterization parameter	98.3	85	127.2	111.6	45.2	40.4	°C/W
R _{ΘJC(bot)}	Junction-to-case(bottom) thermal resistance	N/A	N/A	N/A	N/A	N/A	N/A	°C/W

Thermal Information: CN8554

THERMAL METRIC ⁽¹⁾		CN8554		UNIT
		14PINS		
		SOIC-14	TSSOP-14	
R _{ΘJA}	Junction-to-ambient thermal resistance	83.8	120.8	°C/W
R _{ΘJC(top)}	Junction-to-case(top) thermal resistance	70.7	34.3	°C/W
R _{ΘJB}	Junction-to-board thermal resistance	59.5	62.8	°C/W
Ψ _{JT}	Junction-to-top characterization parameter	11.6	1	°C/W
Ψ _{JB}	Junction-to-board characterization parameter	37.7	56.5	°C/W
R _{ΘJC(bot)}	Junction-to-case(bottom) thermal resistance	N/A	N/A	°C/W

Typical Application Circuit



Difference Amplifier

Low Pass Active Filter

Ordering Informatio

Order Part Number	Top Marking	Pb-Free	T _A	Package	
CN8551ST5	CN8551ST5	Yes	-40 to +125°C	SOT23-5	Tape & Reel, 3000
CN8551BST5	CN8551BST5	Yes	-40 to +125°C	SOT23-5	Tape & Reel, 3000
CN8551SST6	CN8551SST6	Yes	-40 to +125°C	SOT23-6	Tape & Reel, 3000
CN8551SP8	CN8551SP8	Yes	-40 to +125°C	SOIC-8	Tape & Reel, 4000
CN8551SSP8	CN8551SSP8	Yes	-40 to +125°C	SOIC-8	Tape & Reel, 4000
CN8552SP8	CN8552SP8	Yes	-40 to +125°C	SOIC-8	Tape & Reel, 4000
CN8552SMP10	CN8552SMP10	Yes	-40 to +125°C	MSOP-10	Tape & Reel, 4000
CN8552MP8	CN8552MP8	Yes	-40 to +125°C	MSOP-8	Tape & Reel, 4000
CN8552DN8	CN8552DN8	Yes	-40 to +125°C	TDFN-8	Tape & Reel, 5000
CN8554SP14	CN8554SP14	Yes	-40 to +125°C	SOP-14	Tape & Reel, 4000
CN8554TP14	CN8554TP14	Yes	-40 to +125°C	TSSOP-14	Tape & Reel, 4000

Electrical Characteristics: VS = +5V

(At VS = 5V, TA = +25°C, RL = 100kΩ connected to VS/2, unless otherwise noted)

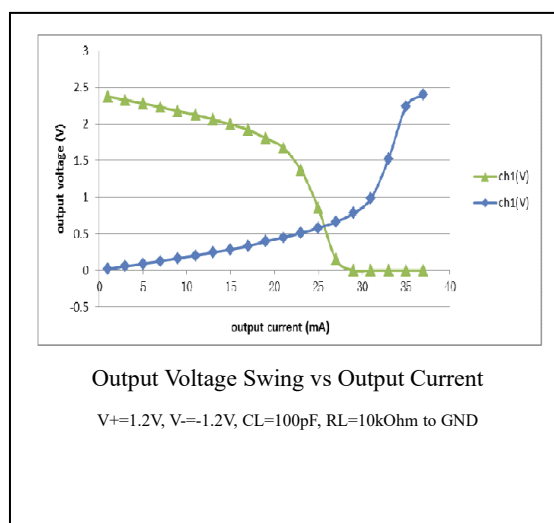
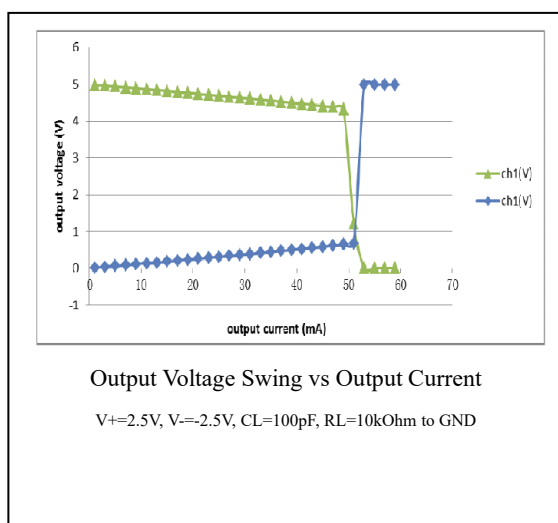
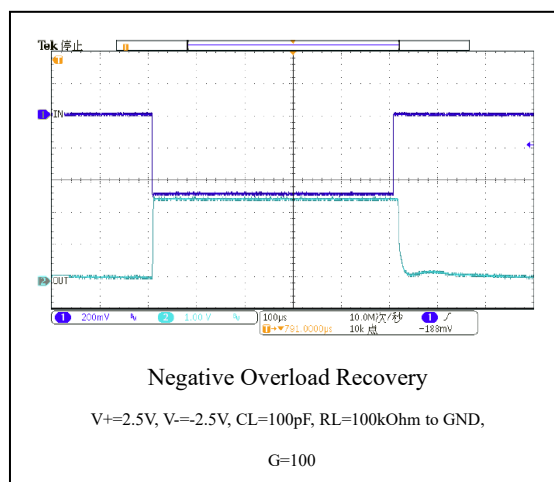
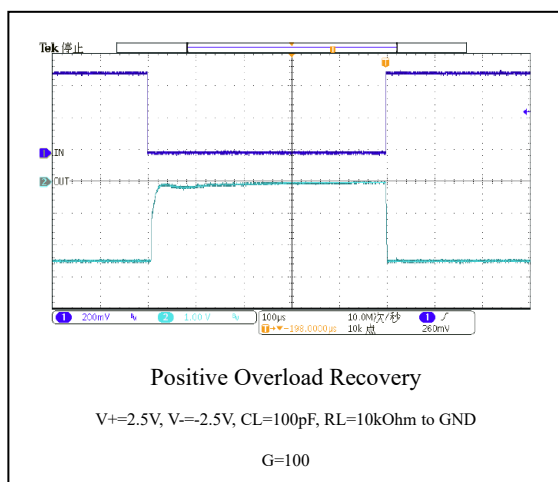
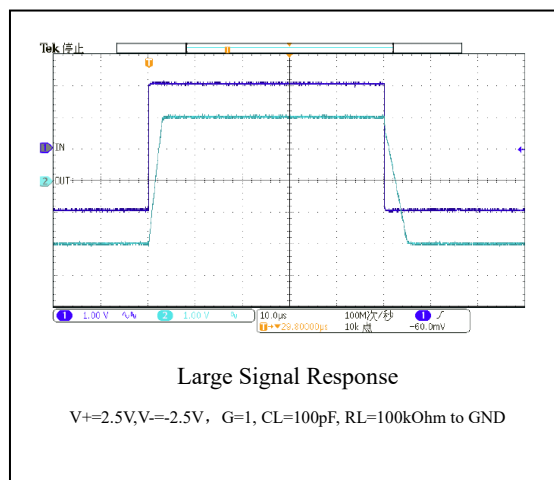
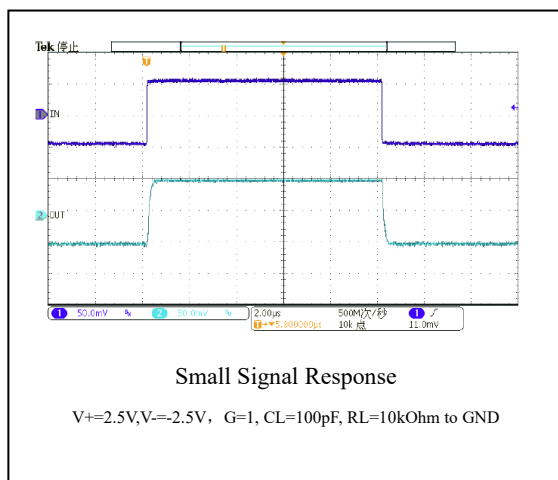
Parameter	Test Conditions	Min.	Typ.	Max.	Unit
DYNAMIC PERFORMANCE					
Gain-Bandwidth Product (GBP)	RL = 100KΩ		1.7		MHz
Slew Rate	CL=60Pf, G=+1		1		V/us
Positive Overload Recovery Time	Gain=-100X, VIN=500mVpp		8		us
Negative Overload Recovery Time	Gain=-100X, VIN=500mVpp		9		us
DC PERFORMANCE					
Input Offset Voltage (VOS)	VCM = 2.5V		1	5	uV
Input Offset Voltage Drift	RL = 100kΩ, VOUT = 0.15V to 4.85V		0.005		uV/deg
Large Signal Voltage Gain (AVO)			130		dB
INPUT CHARACTERISTICS					
Input Common Mode Voltage Range (VCM)	G=101, V+=2.5/0.9	-0.1		+0.1	V
Common Mode Rejection Ratio (CMRR)	V-=2.5/0.9V		125		dB
OUTPUT CHARACTERISTICS					
Output Voltage Swing from Rail	RL=10K		30	50	mV
	RL=10K, TA=-40°C to 125°C		70	70	mV
Output Current (IOUT)	VCC=5V		46		mA
POWER SUPPLY					
Operating Voltage Range	IOUT = 0mA	1.8		5.5	V
Quiescent Current (per Amplifier)	VS = 5V,		0.43		mA
Power Supply Rejection Ratio (PSRR)	VCM = (-VS) + 0.5V		130		dB
NOISE/DISTORTION PERFORMANCE					
Voltage Noise Density (en)	f=10kHz		40		nV/rtHz
Total Harmonic Distortion (THD)	V+=5V, Vo=1Vpp 1KHz		0.006		%

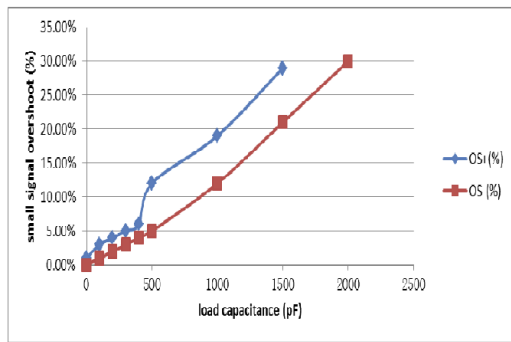
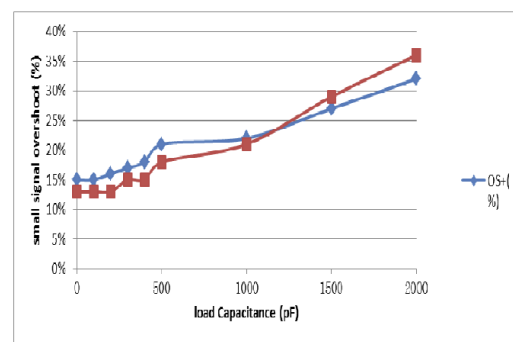
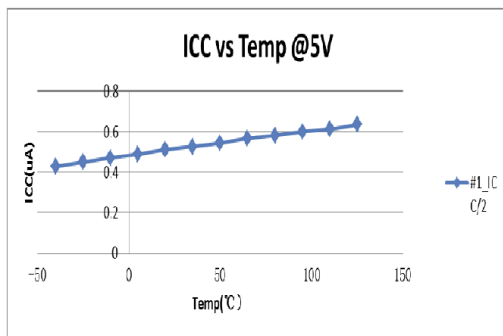
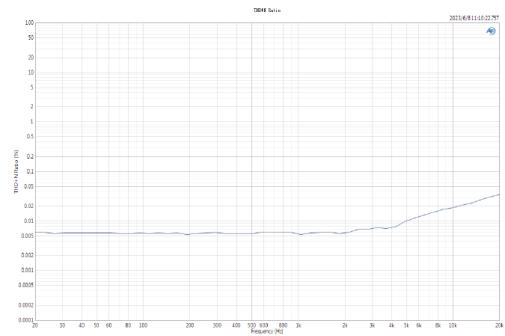
Note 1: Stresses listed as the above “Absolute Maximum Ratings” may cause permanent damage to the device.

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=+2.5V, RL = 10kΩ connected to GND, unless otherwise noted.




Overshoot (OS) vs Load Capacitance
 $V+=2.5V, V-=-2.5V, R_L=10k\Omega$ to GND

Overshoot (OS) vs Load Capacitance
 $V+=1.2V, V-=-1.2V, R_L=10k\Omega$ to GND

ICC vs Temp
 $V+=2.5V, V-=-2.5V, C_L=100pF, R_L=10k\Omega$ to GND

THD vs Frequency
 $V+=2.5V, V-=-2.5V, V_{in}=1V_{pp}, C_L=100pF, R_L=10k\Omega$ to GND

Power Supply Layout and Bypass

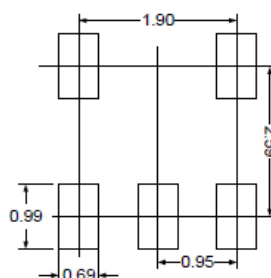
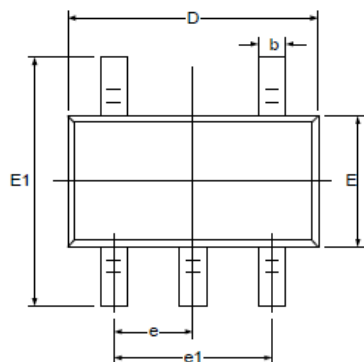
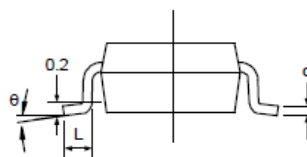
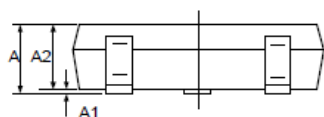
The CN855X OPA's power supply pin (VDD for single-supply) should have a local bypass capacitor (i.e., 0.01 μ F to 0.1 μ F) within 2mm for good high frequency performance. It can also use a bulk capacitor (i.e., 1 μ F or larger) within 100mm to provide large, slow currents. This bulk capacitor can be 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

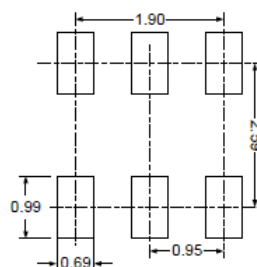
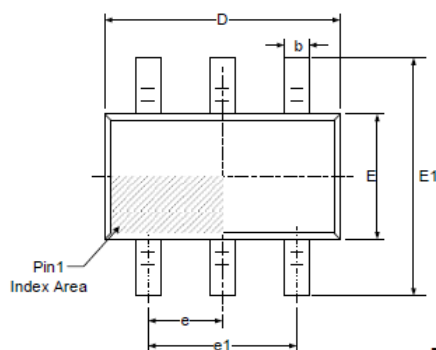
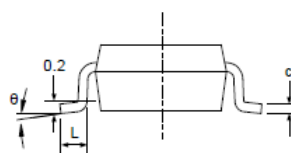
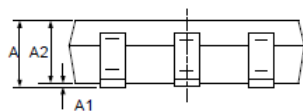
To ensure optimum performance at the PCB level, care must be taken in the design of the board layout. To avoid leakage currents, the surface of the board should be kept clean and free of moisture. Coating the surface creates a barrier to moisture accumulation and helps reduce parasitic resistance on 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 feedback 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.

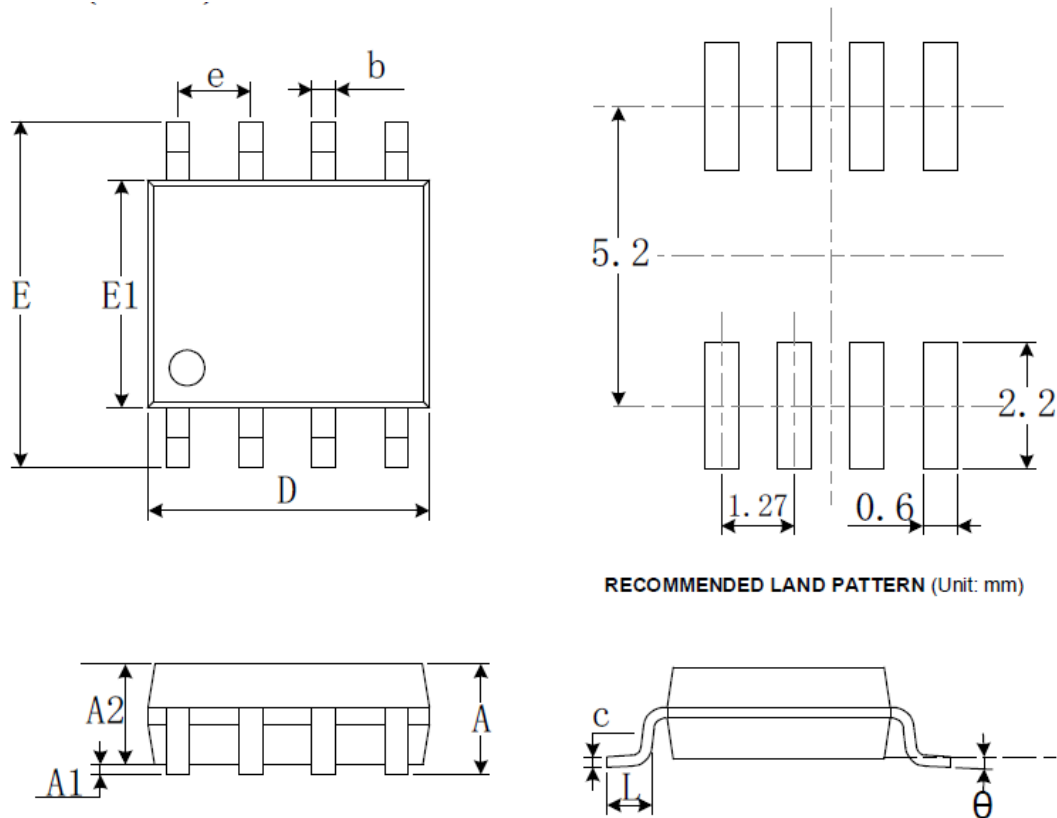
The use of a ground plane is highly recommended. A ground plane reduces EMI noise and also helps to maintain a constant temperature across the circuit board.

Package Outline And Physical Dimensions: SOT23-5

RECOMMENDED LAND PATTERN (Unit: mm)


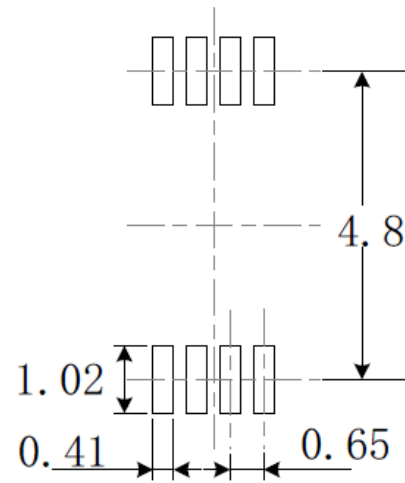
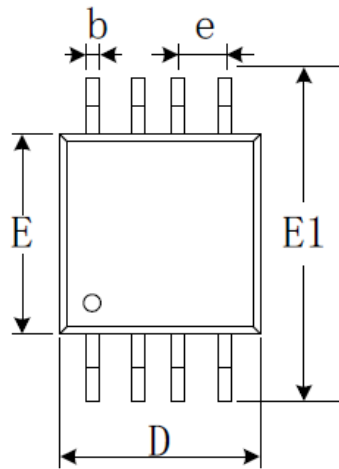
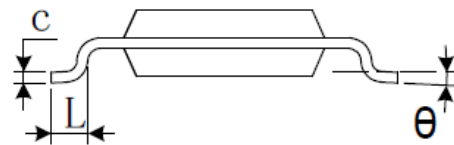
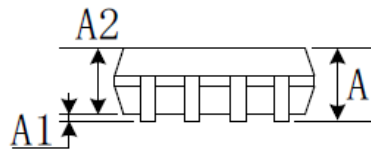
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)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


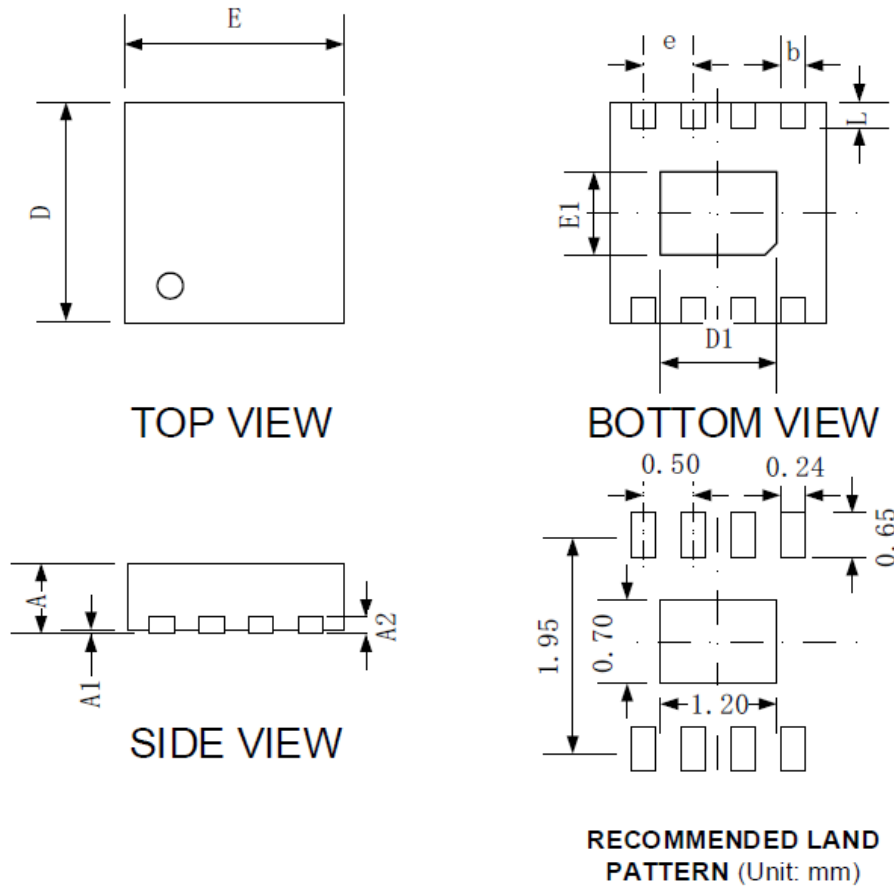
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)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

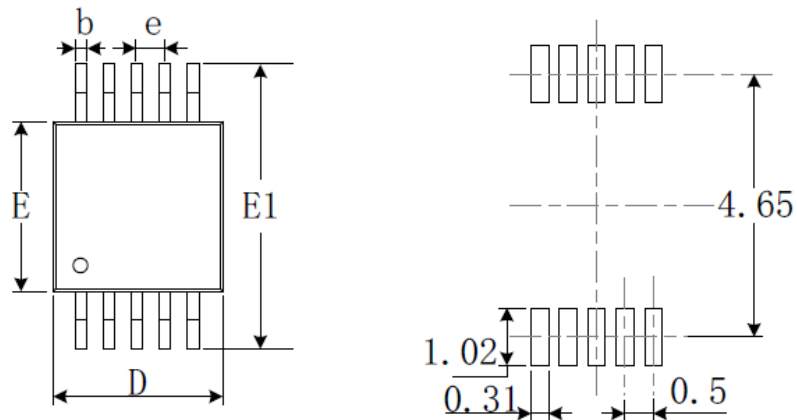
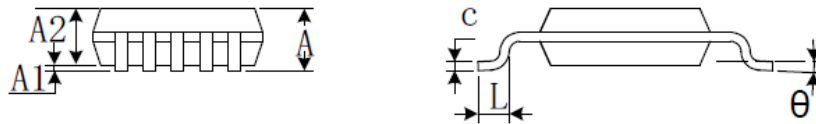
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D	4.800	5.000	0.189	0.197
e	1.270(BSC)		0.050(BSC)	
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150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


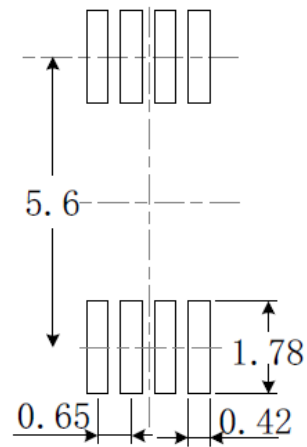
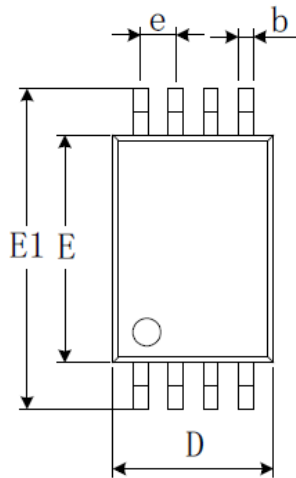
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
e	0.650(BSC)		0.026(BSC)	
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187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

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


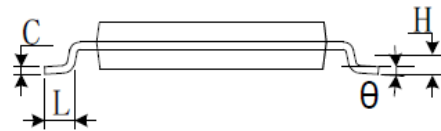
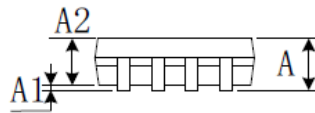
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.700	0.800	0.028	0.031
A1	0.000	0.050	0.000	0.002
A2	0.203(TYP)		0.008(TYP)	
b	0.180	0.300	0.007	0.012
D	1.900	2.100	0.075	0.083
D1	1.100	1.300	0.043	0.051
E	1.900	2.100	0.075	0.083
E1	0.600	0.800	0.024	0.031
e	0.500(TYP)		0.020(TYP)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

Package Outline And Physical Dimensions: MSOP-10

RECOMMENDED LAND PATTERN (Unit: mm)


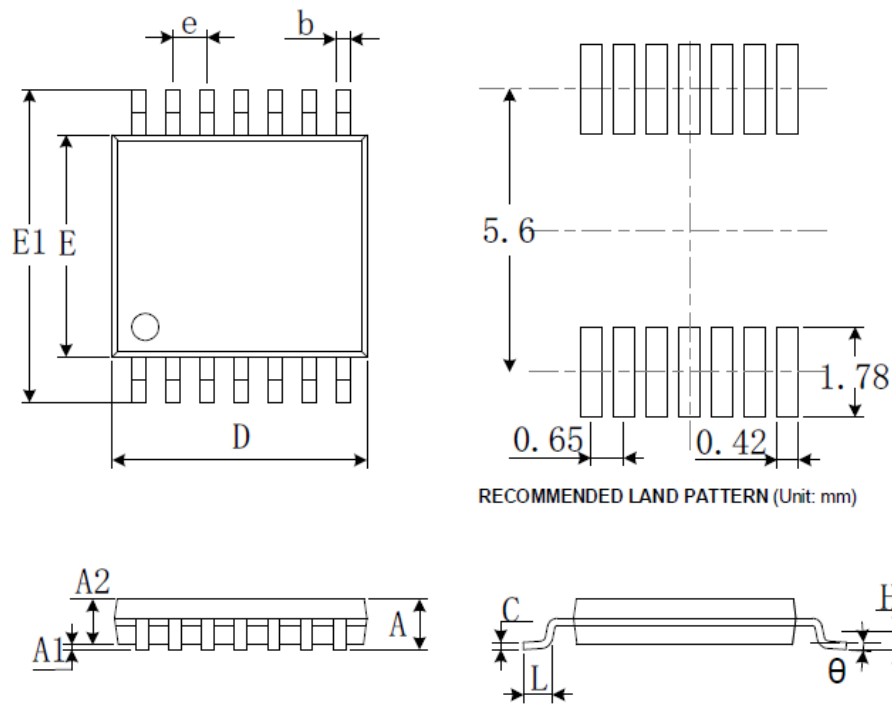
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.180	0.280	0.007	0.011
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
e	0.50(BSC)		0.020(BSC)	
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187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

Package Outline And Physical Dimensions: TSSOP-8


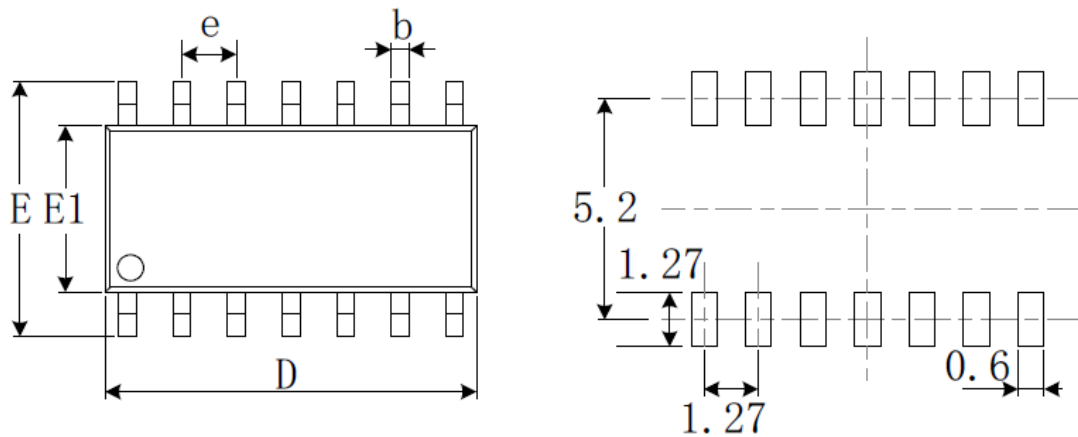
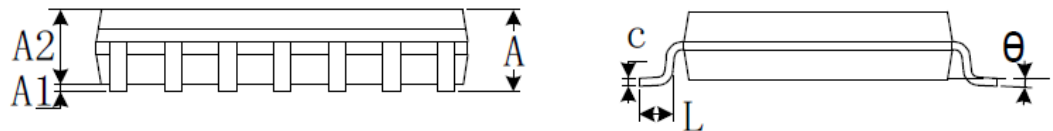
RECOMMENDED LAND PATTERN (Unit: mm)



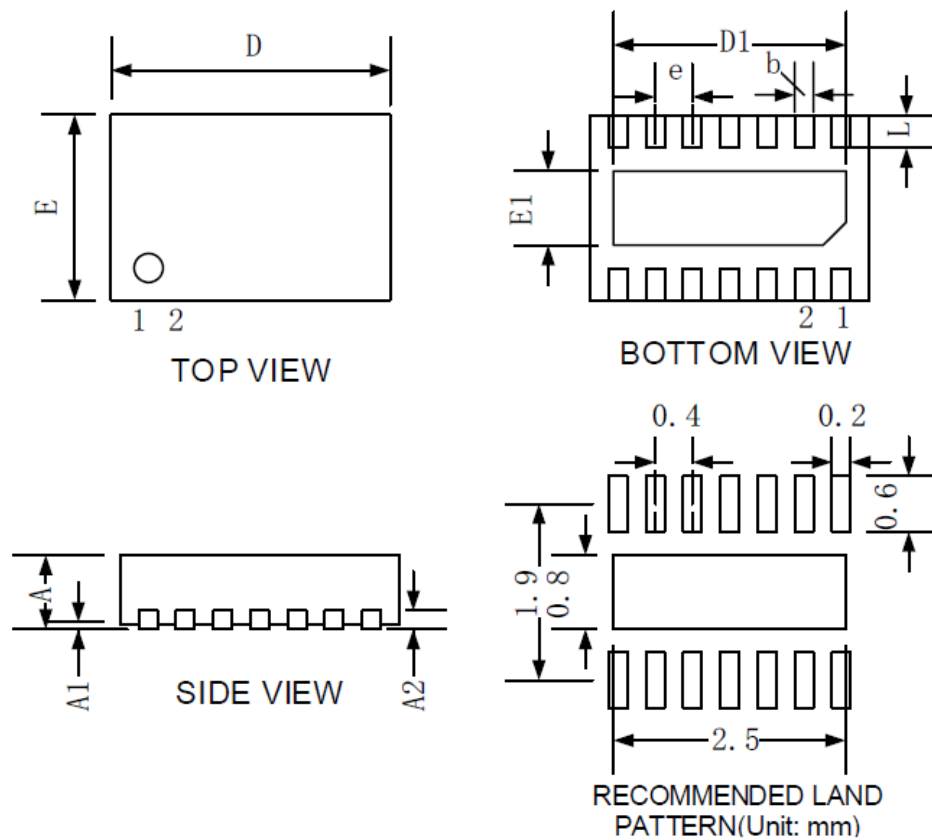
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A		1.200		0.047
A1	0.050	0.150	0.002	0.006
A2	0.800	1.050	0.031	0.041
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
D	2.900	3.100	0.114	0.122
E	4.300	4.500	0.169	0.177
E1	6.250	6.550	0.246	0.258
e	0.650(BSC)		0.026(BSC)	
L	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: TSSOP-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°

Package Outline And Physical Dimensions: TDFN-3x2-14L


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	0.200		0.008	
b	0.150	0.250	0.006	0.010
D	2.900	3.100	0.114	0.122
D1	2.400	2.600	0.094	0.102
E	1.900	2.100	0.075	0.083
E1	0.700	0.900	0.028	0.035
e	0.400 TYP		0.016 TYP	
L	0.300	0.400	0.012	0.016