General Description

The LTA809x family (LTA8091, LTA8092, and LTA8094) is a new generation of high voltage (48 V), low noise, precision operational amplifiers. These devices offer outstanding dc precision and ac performance, including low offset (±25 µV typically), low offset drift (±1 µV/°C typically), 22-MHz bandwidth, and 4 nV/√Hz Input voltage noise density at 10 kHz. Unique features such as differential input-voltage range to the negative supply rail, high output current (±45 mA), high capacitive load drive of up to 1 nF, and high slew rate (20 V/µs) make the LTA809x high-performance operational amplifiers for high-voltage industrial applications.

The robust design of the LTA809x family provides ease-of-use to the circuit designer: integrated RF/EMI rejection filter, no phase reversal in overdrive conditions, and high electro-static discharge (ESD) protection. The LTA809x are optimized for operation at voltages from +4 V (±2 V) to +48 V (±24 V) over the extended temperature range of −40 °C to +125 °C.

The LTA8091 (single) is available in both SOT23-5L and SOIC-8L packages. The LTA8092 (dual) is offered in SOIC-8L and MSOP-8L packages. The quad-channel LTA8094 is offered in both SOIC-14L and TSSOP-14L packages.

Features and Benefits

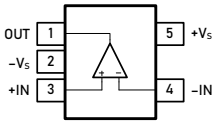
- Wide Supply: ±2 V to ±24 V, 4 V to 48 V
- Wide Bandwidth: 22 MHz GBW
- High Slew Rate: 20 V/µs
- Low Noise: 4 nV/√Hz at 10 kHz
- Low Offset Voltage: ±25 µV
- Low Offset Voltage Drift: ±1 µV/°C
- High Common-Mode Rejection: 120 dB
- Low Bias Current: ±5 pA
- EMI/RFI Filtered Inputs

Applications

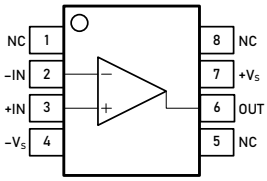
- High-Side and Low-Side Current Sensing
- Audio Preamplifier
- High Precision Comparator
- Multiplexed Data-Acquisition Systems
- High-Resolution ADC Driver Amplifiers
- SAR ADC Reference Buffers
- Test and Measurement Equipment
- Programmable Logic Controllers

Pin Configuration (Top View)

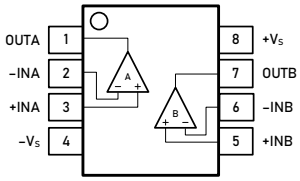
LTA8091
SOT23-5L



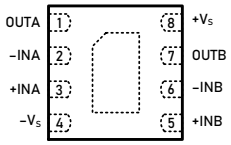
LTA8091
SOIC-8L



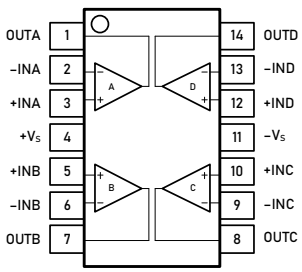
LTA8092
SOIC-8L / MSOP-8L



LTA8092
DFN3x3-8L



LTA8094
SOIC-14L / TSSOP-14L



Pin Description

Symbol	Description
–IN	Inverting input of the amplifier. The voltage range is from V_{S-} to V_{S+} – 2V.
+IN	Non-inverting input of the amplifier. This pin has the same voltage range as –IN.
$+V_S$	Positive power supply. The voltage is from 4V to 48V. Split supplies are possible as long as the voltage between V_{S+} and V_{S-} is from 4V to 48V.
$-V_S$	Negative power supply. It is normally tied to ground. It can also be tied to a voltage other than ground as long as the voltage between V_{S+} and V_{S-} is from 4V to 48V.
OUT	Amplifier output.

Ordering Information (1)

Type Number	Package Name	Package Quantity	Eco Class (2)	Marking Code (3)
LTA8091XT5/R6	SOT23-5L	Tape and Reel, 3 000	Green (RoHS & no Sb/Br)	H91
LTA8091XS8/R8	SOIC-8L	Tape and Reel, 4 000	Green (RoHS & no Sb/Br)	HV-91
LTA8092XS8/R8	SOIC-8L	Tape and Reel, 4 000	Green (RoHS & no Sb/Br)	HV-92
LTA8092XV8/R6	MSOP-8L	Tape and Reel, 3 000	Green (RoHS & no Sb/Br)	HV92
LTA8092XF8/R6	DFN3x3-8L	Tape and Reel, 3 000	Green (RoHS & no Sb/Br)	HV92
LTA8094XS14/R5	SOIC-14L	Tape and Reel, 2 500	Green (RoHS & no Sb/Br)	HV-94
LTA8094XT14/R6	TSSOP-14L	Tape and Reel, 3 000	Green (RoHS & no Sb/Br)	HV-94

(1) Please contact to your Linearin representative for the latest availability information and product content details.

(2) Eco Class - The planned eco-friendly classification: Pb-Free (RoHS) or Green (RoHS & Halogen Free).

(3) There may be multiple device markings, a varied marking character of "x" , or additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

Limiting Value – In accordance with the Absolute Maximum Rating System (IEC 60134).

Parameter	Absolute Maximum Rating
Supply Voltage, V_{S+} to V_{S-}	60 V
Signal Input Terminals: Voltage, Current	$-V_S$ – 0.3 V to $+V_S$ + 0.3 V, ±10 mA
Output Short-Circuit	Continuous
Storage Temperature Range, T_{stg}	–65 °C to +150 °C
Junction Temperature, T_J	150 °C
Lead Temperature Range (Soldering 10 sec)	260 °C

ESD Rating

Parameter	Item	Value	Unit
Electrostatic Discharge Voltage	Human body model (HBM), per MIL-STD-883J / Method 3015.9 (1)	±1 000	V
	Charged device model (CDM), per ESDA/JEDEC JS-002-2014 (2)	±1 000	
	Machine model (MM), per JESD22-A115C	±400	

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process. Manufacturing with less than 500-V HBM is possible if necessary precautions are taken.

(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process. Manufacturing with less than 250-V CDM is possible if necessary precautions are taken.

Electrical Characteristics

V_S = 4.5 V to 48 V, T_A = +25 °C, V_{CM} = V_S /2, V_O = V_S /2, and R_L = 10 kΩ connected to V_S /2, unless otherwise noted. Boldface limits apply over the specified temperature range, T_A = −40 °C to +125 °C.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
OFFSET VOLTAGE						
V_{OS}	Input offset voltage			±25	±100	µV
V_{OS} TC	Offset voltage drift	T_A = −40 to +125 °C		±1		µV/°C
PSRR	Power supply rejection ratio	V_S = 4.5 to 48 V, V_{CM} = 0.1 V		1		µV/V
		T_A = −40 to +125 °C		5		
INPUT BIAS CURRENT						
I_B	Input bias current			5		pA
		T_A = +85 °C		150		
		T_A = +125 °C		500		
I_{OS}	Input offset current			1		pA
NOISE						
V_n	Input voltage noise	f = 0.1 to 10 Hz		3.6		$µV_{P-P}$
e_n	Input voltage noise density	f = 1 kHz		8		nV/√Hz
		f = 10 kHz		4		
I_n	Input current noise density	f = 1 kHz		5		fA/√Hz
INPUT VOLTAGE						
V_{CM}	Common-mode voltage range		$-V_S$		$+V_S$−2	V
CMRR	Common-mode rejection ratio	V_S = 40 V, V_{CM} = 0 to 38 V		120		dB
		V_{CM} = 0.1 to 38 V, T_A = −40 to +125 °C		106		
		V_S = 5.0 V, V_{CM} = 0 to 3 V		85		
		V_{CM} = 0.1 to 3 V, T_A = −40 to +125 °C		72		
INPUT IMPEDANCE						
C_{IN}	Input capacitance	Differential		2.0		pF
		Common mode		3.5		
OPEN-LOOP GAIN						
A_{VOL}	Open-loop voltage gain	V_S = 40 V, V_O = 0.1 to 39.9 V		120		dB
		T_A = −40 to +125 °C		116		
		V_S = 5 V, V_O = 0.1 to 4.9 V		105		
		T_A = −40 to +125 °C		101		
FREQUENCY RESPONSE						
GBW	Gain bandwidth product			22		MHz
SR	Slew rate	V_S = 40 V, G = +1, 10 V step		20		V/µs
THD+N	Total harmonic distortion + noise	G = +1, f = 1 kHz, V_O = 3 V_{RMS}		0.0001		%
t_S	Settling time	To 0.1%, V_S = 40 V, G = +1, 5 V step		0.9		µs
		To 0.01%, V_S = 40 V, G = +1, 5 V step		2		
t_{OR}	Overload recovery time	V_{IN} × Gain > V_S		0.3		µs

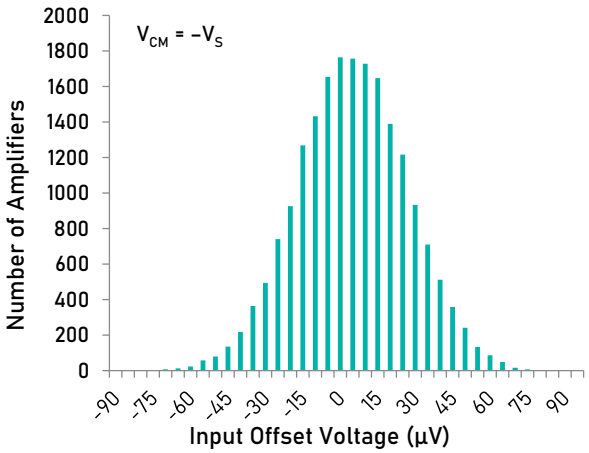
Electrical Characteristics (continued)

V_S = 4 V to 48 V, T_A = +25 °C, V_{CM} = V_S/2, V_O = V_S/2, and R_L = 10 kΩ connected to V_S/2, unless otherwise noted. Boldface limits apply over the specified temperature range, T_A = −40 °C to +125 °C.

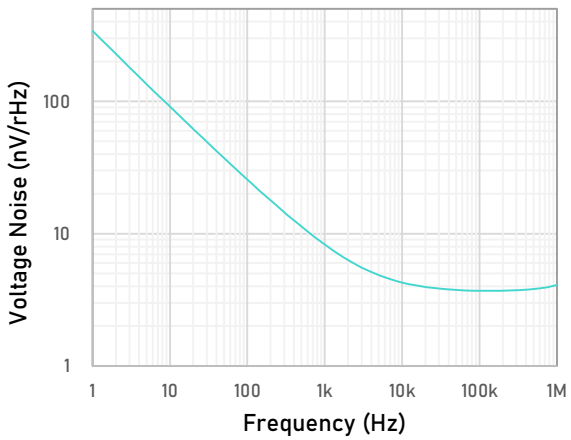
Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
OUTPUT						
V_{OH}	High output voltage swing	V_S = ±20 V, R_L = 10 kΩ		$+V_S$−97		mV
		V_S = ±20 V, R_L = 2 kΩ		$+V_S$−257		
V_{OL}	Low output voltage swing	V_S = ±20 V, R_L = 10 kΩ		$-V_S$+52		mV
		V_S = ±20 V, R_L = 2 kΩ		$-V_S$+232		
I_{SC}	Short-circuit current			±55		mA
POWER SUPPLY						
V_S	Operating supply voltage	T_A = −40 to +125 °C	4		48	V
I_Q	Quiescent current (per amplifier)	V_S = 5 V		4.4		mA
		V_S = 40 V		8.2		
THERMAL CHARACTERISTICS						
T_A	Operating temperature range		−40		+125	°C
θ_{JA}	Package Thermal Resistance	SOT23-5L		190		°C/W
		MSOP-8L		201		
		SOIC-8L		125		
		TSSOP-14L		112		
		SOIC-14L		115		

Typical Performance Characteristics

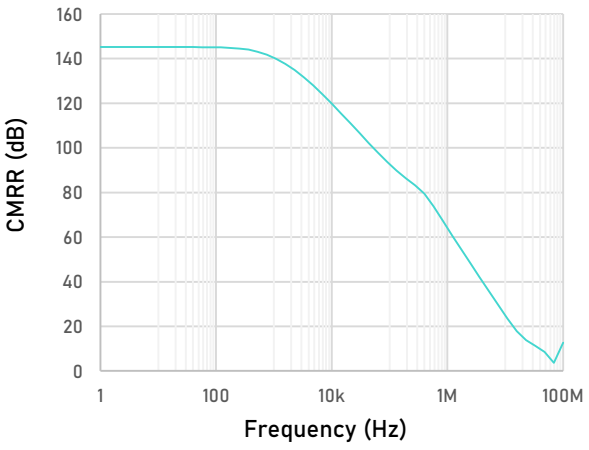
At T_A = +25 °C, V_{CM} = V_S /2, and R_L = 10 kΩ connected to V_S /2, unless otherwise noted.



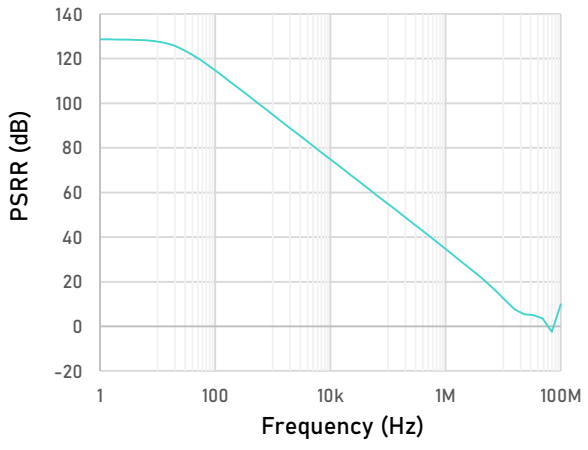
Offset Voltage Production Distribution



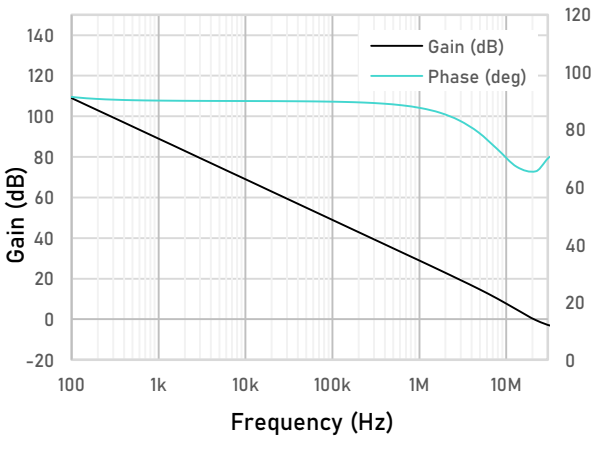
Input Voltage Noise Spectral Density as a function of Frequency



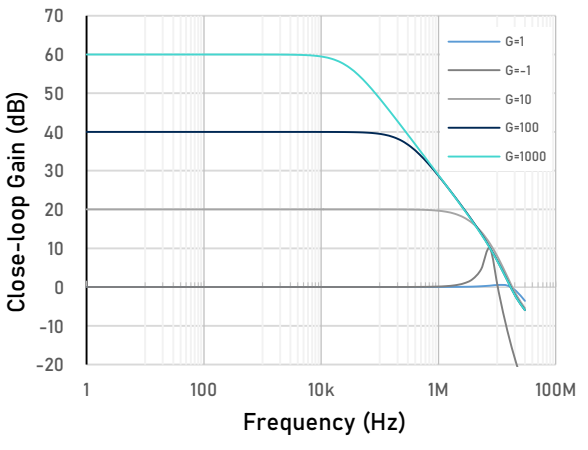
CMRR as a function of Frequency



PSRR as a function of Frequency



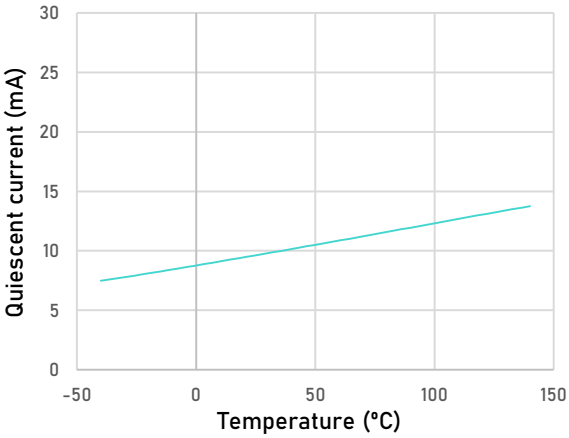
Open-loop Gain and Phase as a function of Frequency



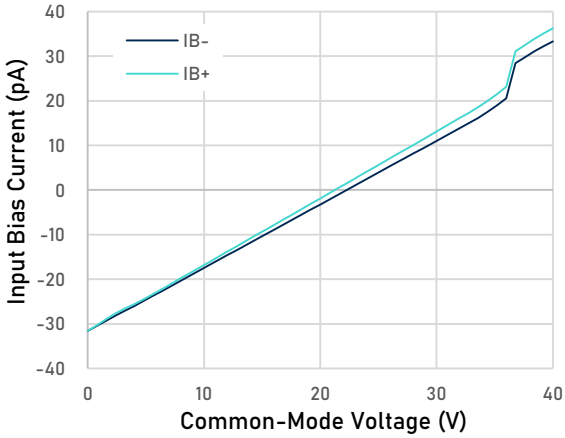
Close-loop Gain as a function of Frequency

Typical Performance Characteristics (Continued)

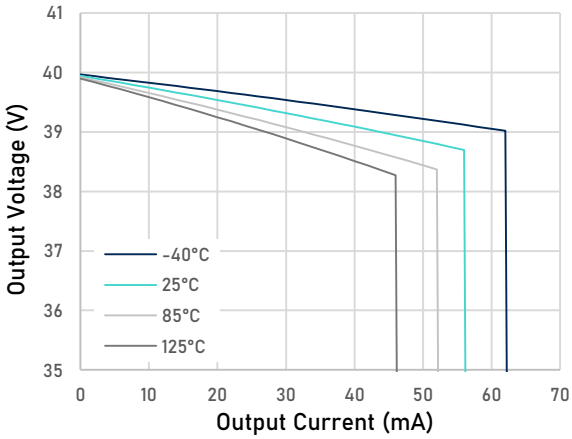
At T_A = +25 °C, V_{CM} = V_S /2, and R_L = 10 kΩ connected to V_S /2, unless otherwise noted.



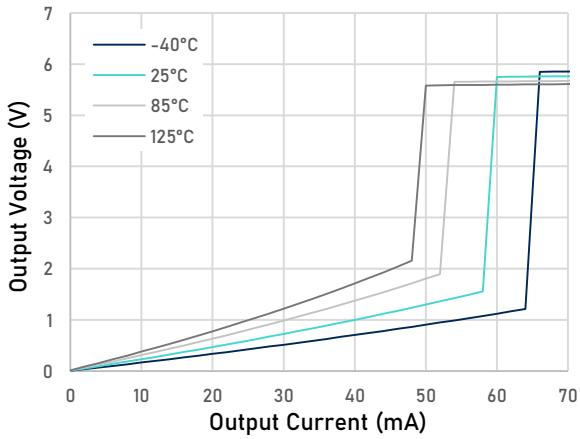
Quiescent Current as a function of Temperature



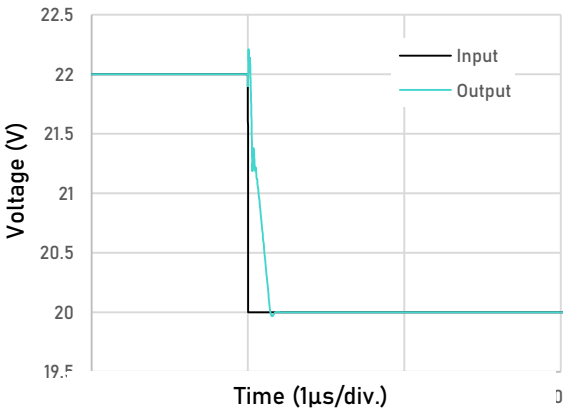
Bias Current as a function of Common-Mode Voltage



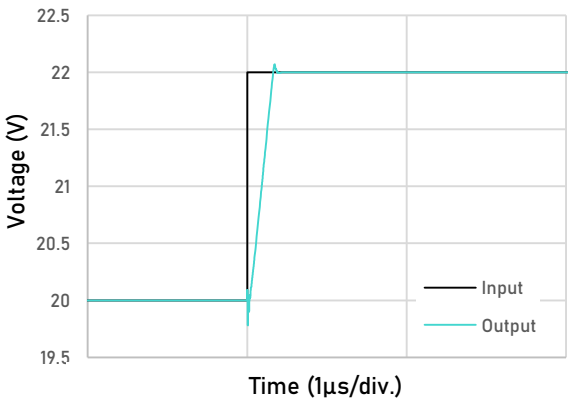
Output Voltage Swing as a function of Output Current (Sourcing, V_S = 40 V)



Output Voltage Swing as a function of Output Current (Sinking, V_S = 40 V)



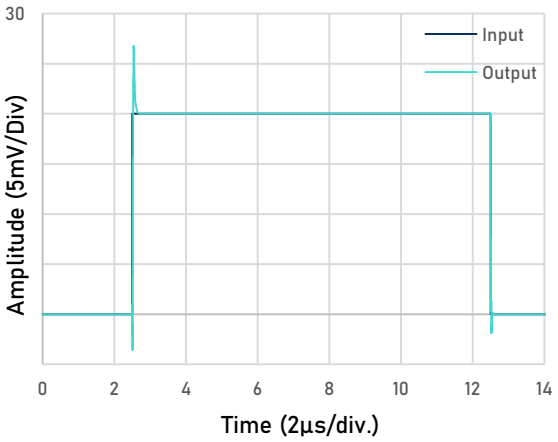
Large-Signal Step Response(Failing)



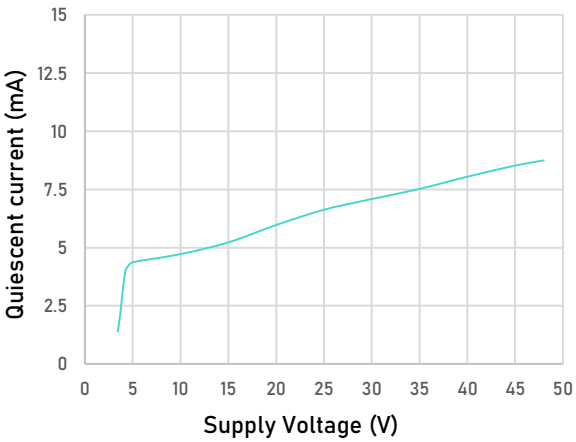
Large-Signal Step Response(Rising)

Typical Performance Characteristics (Continued)

At T_A = +25 °C, V_{CM} = V_S /2, and R_L = 10 kΩ connected to V_S /2, unless otherwise noted.



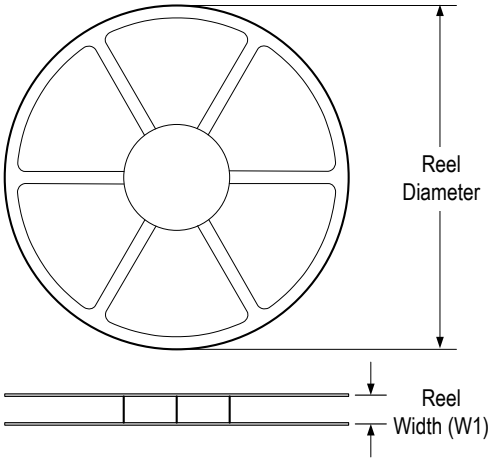
Small-Signal Step Response



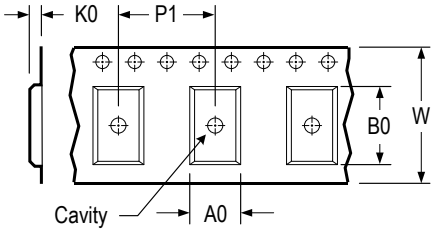
Quiescent Current as a function of Supply Voltage

Tape and Reel Information

REEL DIMENSIONS

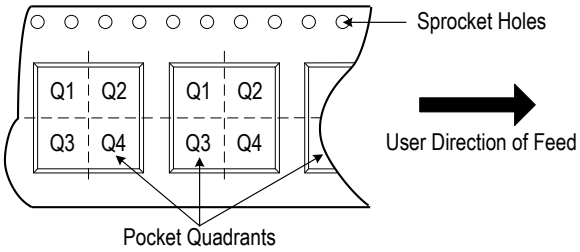


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

QUADRANT ASSIGNMENTS FOR PIN 1 ORIETATION IN TAPE

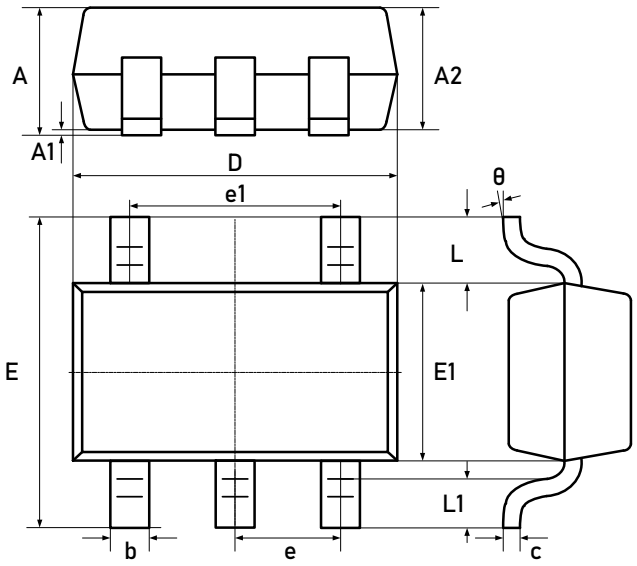


* All dimensions are nominal

Device	Package Type	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin 1 Quadrant
LTA8091XT5/R6	SOT23	5	3 000	178	9.0	3.3	3.2	1.5	4.0	8.0	Q3

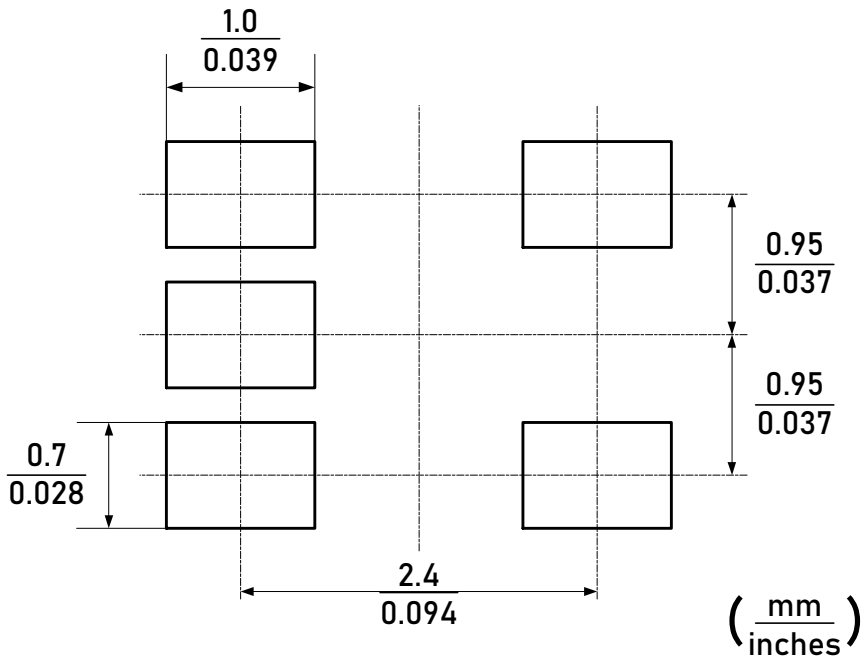
Package Outlines

DIMENSIONS, SOT23-5L



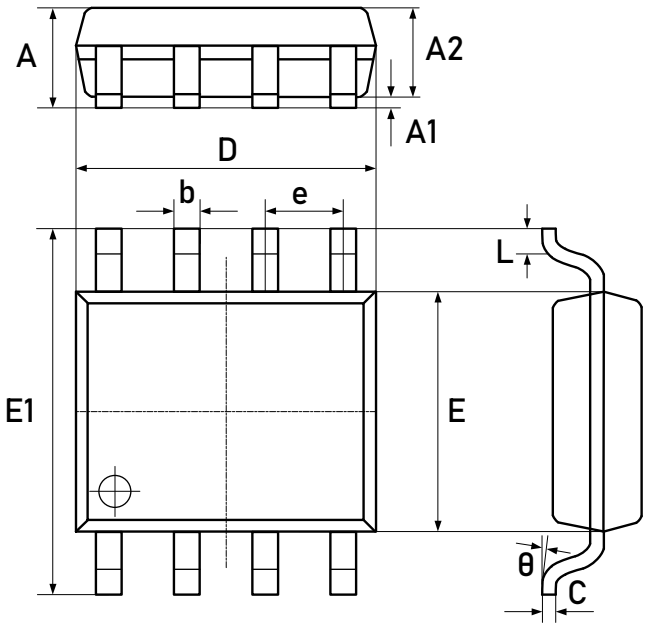
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	-	1.25	-	0.049
A1	0.04	0.10	0.002	0.004
A2	1.00	1.20	0.039	0.047
b	0.33	0.41	0.013	0.016
c	0.15	0.19	0.006	0.007
D	2.820	3.02	0.111	0.119
E1	1.50	1.70	0.059	0.067
E	2.60	3.00	0.102	0.118
e	0.95 BSC		0.037 BSC	
e1	1.90 BSC		0.075 BSC	
L	0.60 REF		0.024 REF	
L1	0.30	0.60	0.012	0.024
θ	0°	8°	0°	8°

RECOMMENDED SOLDERING FOOTPRINT, SOT23-5L



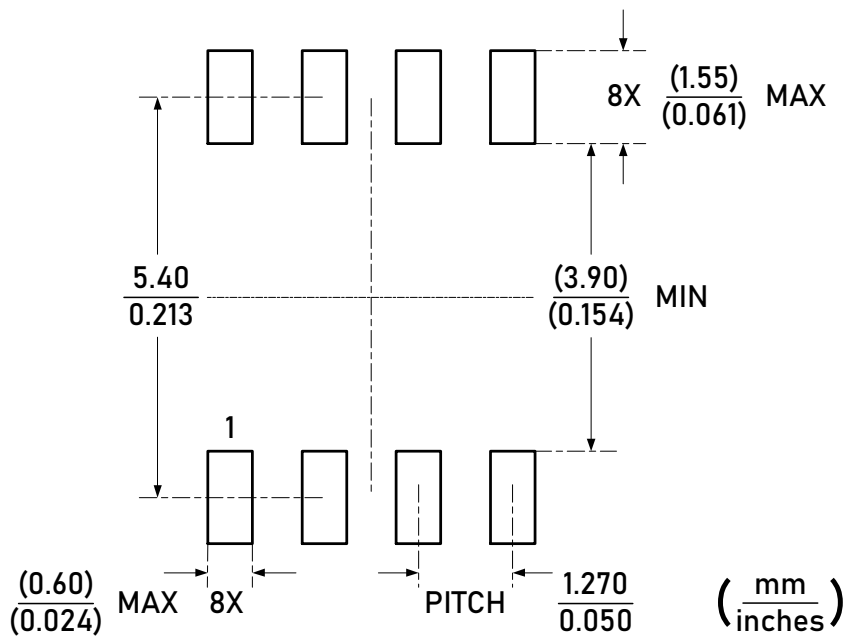
Package Outlines (continued)

DIMENSIONS, SOIC-8L



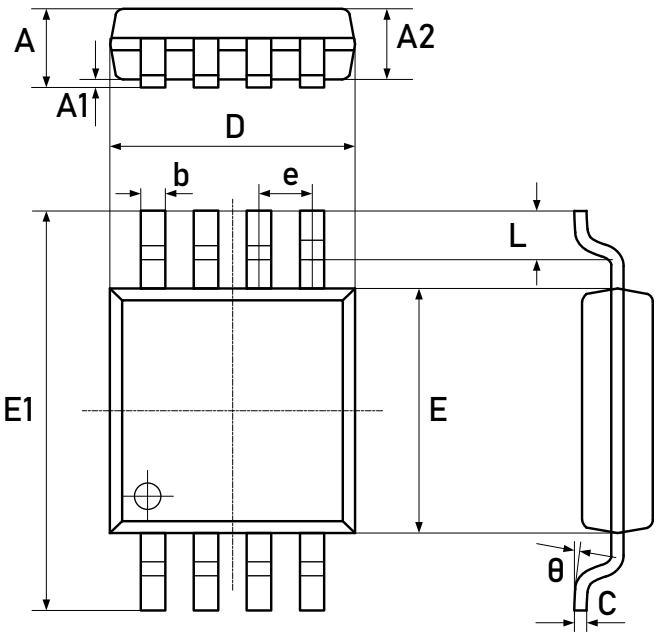
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.370	1.670	0.054	0.066
A1	0.070	0.170	0.003	0.007
A2	1.300	1.500	0.051	0.059
b	0.306	0.506	0.012	0.020
C	0.203 TYP.		0.008 TYP.	
D	4.700	5.100	0.185	0.201
E	3.820	4.020	0.150	0.158
E1	5.800	6.200	0.228	0.244
e	1.270 TYP.		0.050 TYP.	
L	0.450	0.750	0.018	0.030
θ	0°	8°	0°	8°

RECOMMENDED SOLDERING FOOTPRINT, SOIC-8L



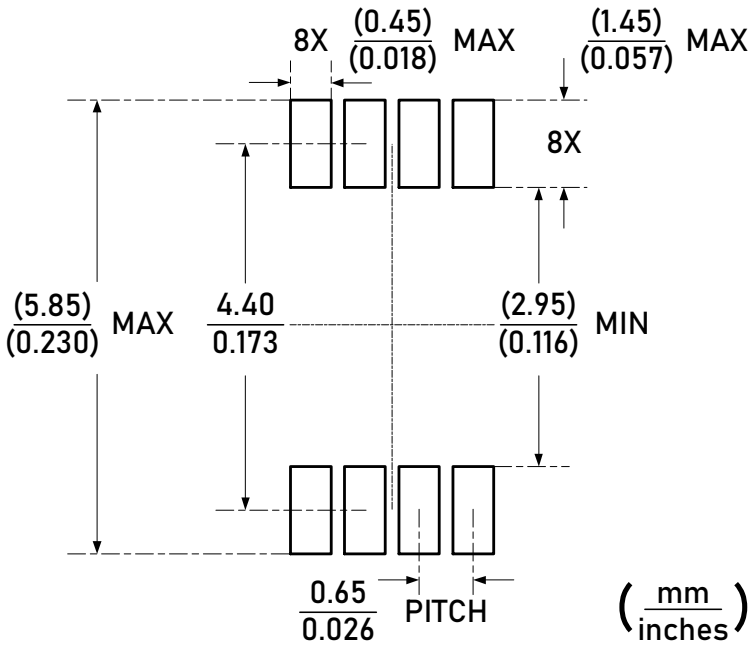
Package Outlines (continued)

DIMENSIONS, MSOP-8L



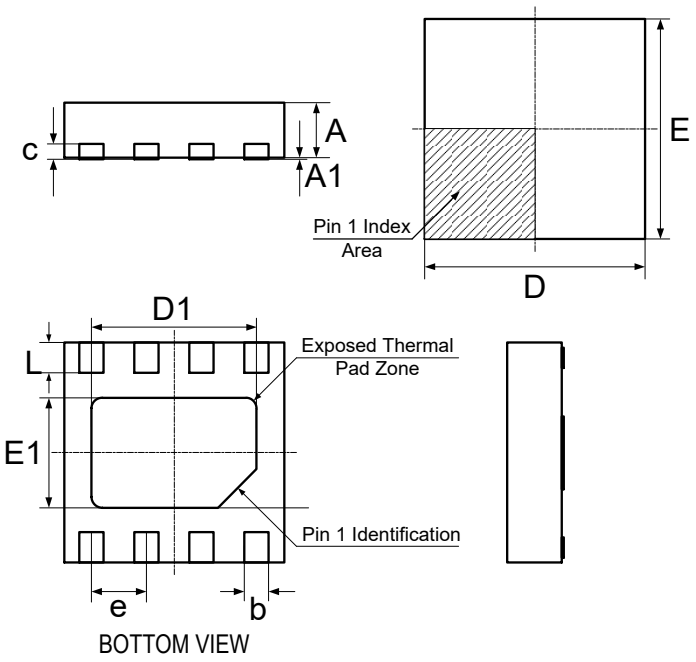
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.800	1.100	0.031	0.043
A1	0.050	0.150	0.002	0.006
A2	0.750	0.950	0.030	0.037
b	0.290	0.380	0.011	0.015
C	0.150	0.200	0.006	0.008
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
E1	4.700	5.100	0.185	0.201
e	0.650 TYP.		0.026 TYP.	
L	0.400	0.700	0.016	0.028
θ	0°	8°	0°	8°

RECOMMENDED SOLDERING FOOTPRINT, MSOP-8L



Package Outlines (continued)

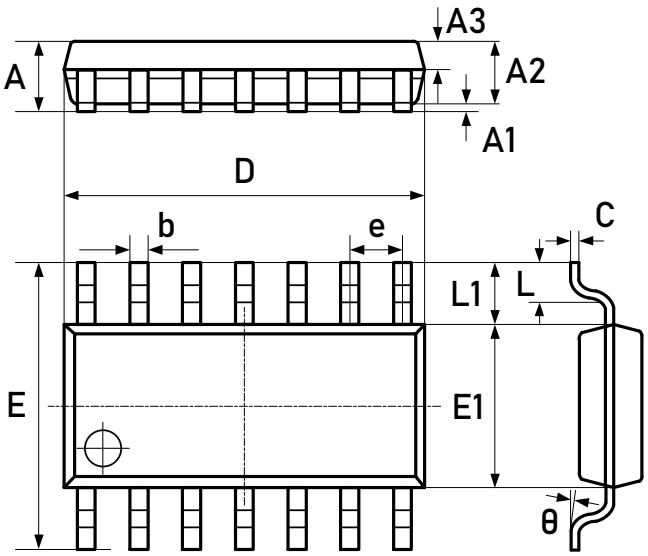
DIMENSIONS, DFN3x3-8L



Symbol	Millimeters		
	Min.	Nom.	Max.
A	0.70	0.75	0.80
A1	-	0.02	0.05
b	0.255	0.28	0.305
c	0.19	0.21	0.23
D	2.90	3.00	3.10
D1	2.25	2.30	2.35
E	2.90	3.00	3.10
E1	1.45	1.50	1.55
e	0.625	0.65	0.675
L	0.25	0.30	0.35

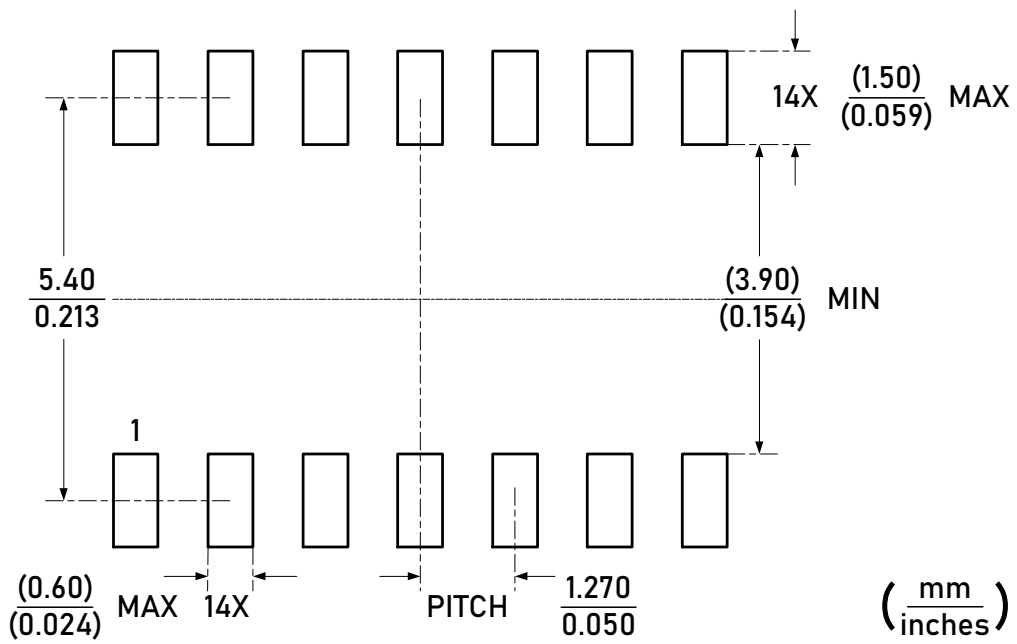
Package Outlines (continued)

DIMENSIONS, SOIC-14L



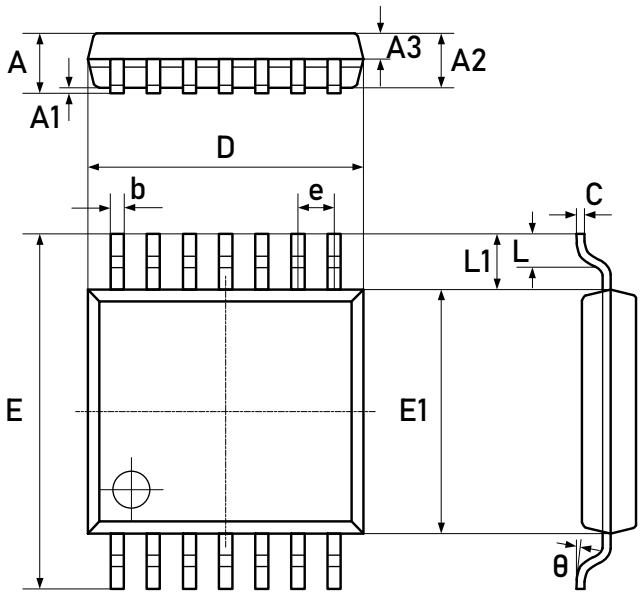
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.450	1.850	0.057	0.073
A1	0.100	0.300	0.004	0.012
A2	1.350	1.550	0.053	0.061
A3	0.550	0.750	0.022	0.030
b	0.406 TYP.		0.016 TYP.	
C	0.203 TYP.		0.008 TYP.	
D	8.630	8.830	0.340	0.348
E	5.840	6.240	0.230	0.246
E1	3.850	4.050	0.152	0.159
e	1.270 TYP.		0.050 TYP.	
L1	1.040 REF.		0.041 REF.	
L	0.350	0.750	0.014	0.030
θ	2°	8°	2°	8°

RECOMMENDED SOLDERING FOOTPRINT, SOIC-14L



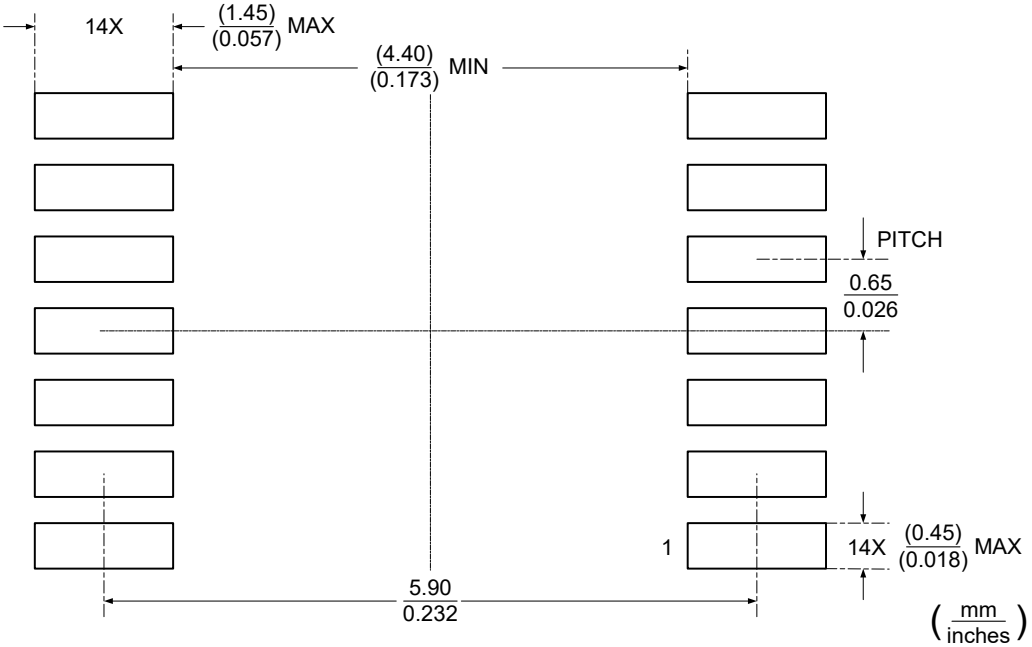
Package Outlines (continued)

DIMENSIONS, TSSOP-14L



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	0.900	1.050	0.035	0.041
A3	0.390	0.490	0.015	0.019
b	0.200	0.290	0.008	0.011
C	0.130	0.180	0.005	0.007
D	4.860	5.060	0.191	0.199
E	6.200	6.600	0.244	0.260
E1	4.300	4.500	0.169	0.177
e	0.650 TYP.		0.026 TYP.	
L1	1.000 REF.		0.039 REF.	
L	0.450	0.750	0.018	0.030
θ	0°	8°	0°	8°

RECOMMENDED SOLDERING FOOTPRINT, SOIC-14L



Important Notice

Linearin is a global fabless semiconductor company specializing in advanced high-performance high-quality analog/mixed-signal IC products and sensor solutions. The company is devoted to the innovation of high performance, analog-intensive sensor front-end products and modular sensor solutions, applied in multi-market of medical & wearable devices, smart home, sensing of IoT, intelligent industrial & smart factory (industrie 4.0), and automotives. Linearin's product families include widely-used standard catalog products, solution-based application specific standard products (ASSPs) and sensor modules that help customers achieve faster time-to-market products. Go to http://www.linearin.com for a complete list of Linearin product families.

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