

## General Description

The LTA604x family true single-supply voltage feedback operational amplifiers feature high speed performance with 100 MHz of small signal bandwidth and 107 V/ $\mu$ s slew rate. The products are specified for +3 V, +5 V, and  $\pm$ 5 V supplies, input common mode voltage range extends to 0.2 V below  $V_{S-}$  and 1 V from  $V_{S+}$ , and output voltage range extends to within 500 mV of either supply rail, allowing wide dynamic range especially desirable in low voltage applications. The LTA604xC also offer excellent signal quality of low distortion (-53 dBc with a 2  $V_{PP}$ , 5 MHz output signal) and fast settling time (66 ns to 0.1%), which make them ideal as buffers to single-supply ADCs.

Operating on supplies from +2.5 V to +12.6 V and dual supplies up to  $\pm$ 6.3 V, the LTA604x are ideal for a wide range of applications, from battery-operated systems with large bandwidth requirements to high speed systems where component density requires lower power dissipation. The single version LTA6041 device is available in micro-size SOT23-5L and SOIC-8L packages. The dual LTA6042 device is offered in MSOP-8L and SOIC-8L packages. The quad LTA6044 device is offered in SOIC-14L and TSSOP-14L packages.

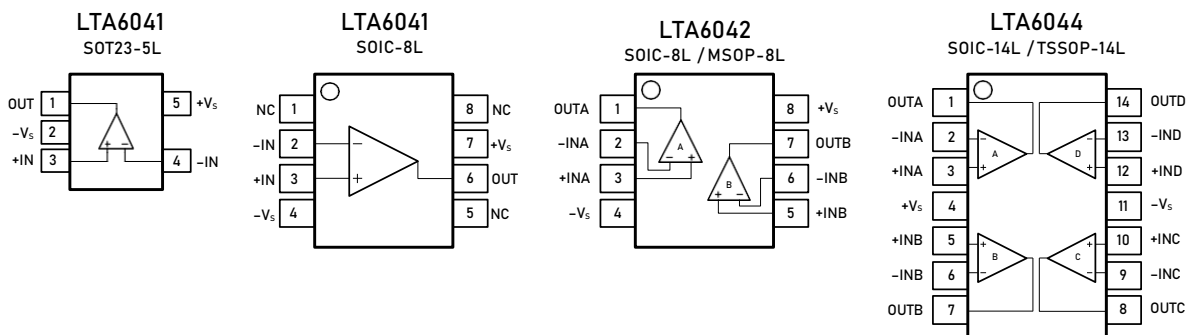
## Features and Benefits

- High Speed and Fast Settling on  $\pm$ 5 V
  - 105 MHz, -3 dB bandwidth ( $G = +1$ )
  - 107 V/ $\mu$ s slew rate
  - 66 ns settling time to 0.1%
- Fully specified at +3 V, +5 V, and  $\pm$ 5 V Supplies
- Low Input Bias Current 4 pA
- Input Common Mode Voltage 0.2 V Beyond  $V_{S-}$ , 1 V from  $V_{S+}$
- Output Voltage Swing 500 mV from Rails
- Output Short Circuit Current 150 mA
- Linear Output Current  $\pm$  70 mA
- Operating Temperature Range -40°C to +125°C (except SOT23-5L)

## Applications

- High speed, battery-operated systems
- High component density systems
- Portable test instruments
- A/D buffers
- Active filters
- High speed, set-and-demand amplifiers

## Pin Configuration (Top View)



## Pin Description

Symbol	Description
-IN	Inverting input of the amplifier. The voltage range is from $V_{S-} - 0.2V$ to $V_{S+} - 1V$ .
+IN	Non-inverting input of the amplifier. This pin has the same voltage range as -IN.
+V <sub>S</sub>	Positive power supply. The voltage is from 2.5V to 12.6V. Split supplies are possible as long as the voltage between $V_{S+}$ and $V_{S-}$ is from 2.5V to 12.6V.
-V <sub>S</sub>	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 2.5V to 12.6V.
OUT	Amplifier output.
NC	No connection

## Ordering Information <sup>(1)</sup>

Type Number	Package Name	Package Quantity	Eco Class <sup>(2)</sup>	Marking Code <sup>(3)</sup>
LTA6041XT5/R6	SOT23-5L	Tape and Reel, 3 000	Green (RoHS & no Sb/Br)	W41
LTA6041XS8/R8	SOIC-8L	Tape and Reel, 4 000	Green (RoHS & no Sb/Br)	W6041
LTA6042XS8/R8	SOIC-8L	Tape and Reel, 4 000	Green (RoHS & no Sb/Br)	W6042
LTA6042XV8/R6	MSOP-8L	Tape and Reel, 3 000	Green (RoHS & no Sb/Br)	W6042
LTA6044XS14/R5	SOIC-14L	Tape and Reel, 2 500	Green (RoHS & no Sb/Br)	W6044
LTA6044XT14/R6	TSSOP-14L	Tape and Reel, 3 000	Green (RoHS & no Sb/Br)	W6044

- (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 $V_{S-}$	13.5 V
Signal Input Terminals: Voltage, Current	$-V_{S-} - 0.5 V$ to $+V_{S+} + 0.5 V$ , $\pm 10$ mA
Output Short-Circuit	Continuous
Storage Temperature Range, $T_{stg}$	$-65$ 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 <sup>(1)</sup>	$\pm 4\ 000$	V
	Charged device model (CDM), per ESDA/JEDEC JS-002-2014 <sup>(2)</sup>	$\pm 2\ 000$	

- (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

$V_S = 3\text{ V}$ ,  $T_A = +25\text{ }^\circ\text{C}$ ,  $V_{CM} = V_O = V_S/2$ , and  $R_L = 2\text{ k}\Omega$  to  $V_S/2$ , unless otherwise noted.  
Boldface limits apply over the specified temperature range,  $T_A = -40\text{ }^\circ\text{C}$  to  $+125\text{ }^\circ\text{C}$ .

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
<b>DYNAMIC PERFORMANCE</b>						
BW <sub>-3dB</sub>	-3 dB Small Signal Bandwidth	$G = +1, V_O = 0.2V_{PP}$		95		MHz
		$G = +2, -1, V_O = 0.2V_{PP}$		38		
BW <sub>0.1dB</sub>	Bandwidth for 0.1 dB Flatness	$G = +2, V_O = 0.2V_{PP}, R_L = 150\Omega$ to $V_S/2$ , $R_F = 402\Omega$		8.5		MHz
SR	Slew rate	$G = -1, V_O = 2\text{ V}$ step		98		V/ $\mu\text{s}$
BW <sub>FP</sub>	Full Power Response	$G = +1, V_O = 1V_{PP}$		11		MHz
t <sub>s</sub>	Settling time to 0.1%	$G = -1, V_O = 2\text{ V}$ step		66		ns
<b>NOISE/DISTORTION PERFORMANCE</b>						
THD	Total harmonic distortion	$f_C = 5\text{ MHz}, V_O = 2V_{PP}, G = +2$		-36		dBc
e <sub>n</sub>	Input voltage noise density	$f = 100\text{ kHz}$		27		nV/ $\sqrt{\text{Hz}}$
i <sub>n</sub>	Input current noise density	$f = 10\text{ kHz}$		3		pA/ $\sqrt{\text{Hz}}$
DG	Differential Gain Error (NTSC)	$G = +2, R_L = 150\Omega$ to $V_S/2$		0.17		%
		$R_L = 1\text{ k}\Omega$ to $V_S/2$		0.03		
DP	Differential Phase Error (NTSC)	$G = +2, R_L = 150\Omega$ to $V_S/2$		0.05		deg.
		$R_L = 1\text{ k}\Omega$ to $V_S/2$		0.03		
<b>DC PERFORMANCE</b>						
V <sub>OS</sub>	Input offset voltage			$\pm 3$	$\pm 15$	mV
V <sub>OS TC</sub>	Offset voltage drift	$T_A = -40$ to $+125\text{ }^\circ\text{C}$		$\pm 5$		$\mu\text{V}/^\circ\text{C}$
I <sub>B</sub>	Input bias current			4		pA
I <sub>OS</sub>	Input offset current			2		pA
A <sub>VOL</sub>	Open-loop voltage gain	$R_L = 2\text{ k}\Omega$ to $V_S/2, V_O = 0.5\text{ V}$ to $2.5\text{ V}$		95		dB
		$R_L = 150\Omega$ to $V_S/2, V_O = 0.5\text{ V}$ to $2.5\text{ V}$		82		
<b>INPUT CHARACTERISTICS</b>						
R <sub>IN</sub>	Input Resistance	Common mode		1		G $\Omega$
C <sub>IN</sub>	Input capacitance	Common mode		2		pF
V <sub>CM</sub>	Common-mode voltage range	CMRR $\geq 50\text{ dB}$	-0.2		2	V
CMRR	Common-mode rejection ratio	$V_{CM} = 0\text{ V}$ to $1.5\text{ V}$		85		dB
<b>OUTPUT</b>						
V <sub>OH</sub>	High output voltage swing	$R_L = 2\text{ k}\Omega$ to $V_S/2$		2.97		V
		$R_L = 150\Omega$ to $V_S/2$		2.85		
V <sub>OL</sub>	Low output voltage swing	$R_L = 2\text{ k}\Omega$ to $V_S/2$		30		mV
		$R_L = 150\Omega$ to $V_S/2$		230		
I <sub>OUT</sub>	Output Current	$V_{OUT} = 0.5\text{ V}$ from either supply		$\pm 60$		mA
I <sub>SC</sub>	Short-circuit current			$\pm 110$		mA
C <sub>LOAD</sub>	Capacitive load drive	$G = +2$		40		pF

## Electrical Characteristics

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
<b>POWER SUPPLY</b>						
$V_S$	Operating supply range		2.5		12.6	V
$I_Q$	Quiescent current /Amplifier			4.1		mA
PSRR	Power supply rejection ratio	$V_S = 3.0$ to $3.5$ V		70		dB

$V_S = 5$  V,  $T_A = +25$  °C,  $V_{CM} = V_O = V_S/2$ , and  $R_L = 2$  k $\Omega$  to  $V_S/2$ , unless otherwise noted.  
Boldface limits apply over the specified temperature range,  $T_A = -40$  °C to  $+125$  °C.

## DYNAMIC PERFORMANCE

$BW_{-3dB}$	-3 dB Small Signal Bandwidth	$G = +1, V_O = 0.2V_{PP}$	100			MHz
		$G = +2, -1, V_O = 0.2V_{PP}$	38			
$BW_{0.1dB}$	Bandwidth for 0.1 dB Flatness	$G = +2, V_O = 0.2V_{PP}, R_L = 150\Omega$ to $V_S/2$ , $R_F = 402\Omega$		8		MHz
SR	Slew rate	$G = -1, V_O = 2V$ step		102		V/ $\mu$ s
$BW_{FP}$	Full Power Response	$G = +1, V_O = 2V_{PP}$		14		MHz
$t_s$	Settling time to 0.1%	$G = -1, V_O = 2V$ step		66		ns

## NOISE/DISTORTION PERFORMANCE

THD	Total harmonic distortion	$f_C = 5$ MHz, $V_O = 2V_{PP}, G = +2$		-49		dBc
$e_n$	Input voltage noise density	$f = 100$ kHz		27		nV/ $\sqrt$ Hz
$I_n$	Input current noise density	$f = 10$ kHz		3		pA/ $\sqrt$ Hz
DG	Differential Gain Error (NTSC)	$G = +2, R_L = 150\Omega$ to $V_S/2$		0.16		%
		$R_L = 1k\Omega$ to $V_S/2$		0.05		
DP	Differential Phase Error (NTSC)	$G = +2, R_L = 150\Omega$ to $V_S/2$		0.05		deg.
		$R_L = 1k\Omega$ to $V_S/2$		0.01		

## DC PERFORMANCE

$V_{OS}$	Input offset voltage			$\pm 2$	$\pm 15$	mV
$V_{OS\ TC}$	Offset voltage drift	$T_A = -40$ to $+125$ °C		$\pm 5$		$\mu$ V/ $^{\circ}$ C
$I_B$	Input bias current			4		pA
$I_{OS}$	Input offset current			2		pA
$A_{VOL}$	Open-loop voltage gain	$R_L = 2k\Omega$ to $V_S/2, V_O = 0.5V$ to $2.5V$		98		dB
		$R_L = 150\Omega$ to $V_S/2, V_O = 0.5V$ to $2.5V$		82		

## INPUT CHARACTERISTICS

$R_{IN}$	Input Resistance	Common mode		1		G $\Omega$
$C_{IN}$	Input capacitance	Common mode		2		pF
$V_{CM}$	Common-mode voltage range	CMRR $\geq 50$ dB		-0.2	4	V
CMRR	Common-mode rejection ratio	$V_{CM} = 0V$ to $1.5V$		95		dB

## OUTPUT

$V_{OH}$	High output voltage swing	$R_L = 2k\Omega$ to $V_S/2$		4.9		V
		$R_L = 150\Omega$ to $V_S/2$		4.8		

## Electrical Characteristics

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
$V_{OL}$	Low output voltage swing	$R_L = 2k\Omega$ to $V_S/2$		60		mV
		$R_L = 150\Omega$ to $V_S/2$		370		
$I_{OUT}$	Output Current	$V_{OUT} = 0.5V$ from either supply		$\pm 65$		
$I_{SC}$	Short-circuit current			$\pm 130$		mA
$C_{LOAD}$	Capacitive load drive	$G = +2$		40		pF
<b>POWER SUPPLY</b>						
$V_S$	Operating supply range		2.5		12.6	V
$I_Q$	Quiescent current /Amplifier			4.2		mA
PSRR	Power supply rejection ratio	$V_S = 4.0$ to $6V$		78		dB

$V_S = 10V$ ,  $T_A = +25^\circ C$ ,  $V_{CM} = V_O = V_S/2$ , and  $R_L = 2k\Omega$  to  $V_S/2$ , unless otherwise noted.  
Boldface limits apply over the specified temperature range,  $T_A = -40^\circ C$  to  $+125^\circ C$ .

## DYNAMIC PERFORMANCE

$BW_{-3dB}$	-3 dB Small Signal Bandwidth	$G = +1$ , $V_O = 0.2V_{PP}$		105		MHz
		$G = +2$ , $-1$ , $V_O = 0.2V_{PP}$		43		
$BW_{0.1dB}$	Bandwidth for 0.1 dB Flatness	$G = +2$ , $V_O = 0.2V_{PP}$ , $R_L = 150\Omega$ to $V_S/2$ , $R_F = 402\Omega$		6		MHz
SR	Slew rate	$G = -1$ , $V_O = 2V$ step		107		V/ $\mu s$
$BW_{FP}$	Full Power Response	$G = +1$ , $V_O = 2V_{PP}$		16		MHz
$t_S$	Settling time to 0.1%	$G = -1$ , $V_O = 2V$ step		66		ns

## NOISE/DISTORTION PERFORMANCE

THD	Total harmonic distortion	$f_C = 5MHz$ , $V_O = 2V_{PP}$ , $G = +2$		-53		dBc
$e_n$	Input voltage noise density	$f = 100kHz$		27		nV/ $\sqrt{Hz}$
$i_n$	Input current noise density	$f = 10kHz$		3		pA/ $\sqrt{Hz}$
DG	Differential Gain Error (NTSC)	$G = +2$ , $R_L = 150\Omega$ to $V_S/2$		0.15		%
		$R_L = 1k\Omega$ to $V_S/2$		0.02		
DP	Differential Phase Error (NTSC)	$G = +2$ , $R_L = 150\Omega$ to $V_S/2$		0.05		deg.
		$R_L = 1k\Omega$ to $V_S/2$		0.02		

## DC PERFORMANCE

$V_{OS}$	Input offset voltage			$\pm 2$	$\pm 15$	mV
$V_{OS TC}$	Offset voltage drift	$T_A = -40$ to $+125^\circ C$		$\pm 5$		$\mu V/^\circ C$
$I_B$	Input bias current			4		pA
$I_{OS}$	Input offset current			2		pA
$A_{VOL}$	Open-loop voltage gain	$R_L = 2k\Omega$ to $V_S/2$ , $V_O = 0.5V$ to $2.5V$		96		dB
		$R_L = 150\Omega$ to $V_S/2$ , $V_O = 0.5V$ to $2.5V$		82		

## INPUT CHARACTERISTICS

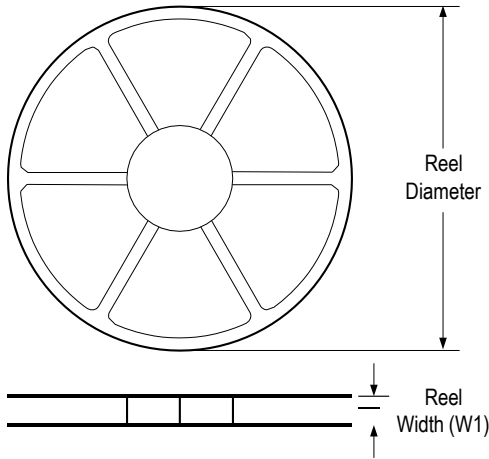
$R_{IN}$	Input Resistance	Common mode		1		G $\Omega$
$C_{IN}$	Input capacitance	Common mode		2		pF

## Electrical Characteristics

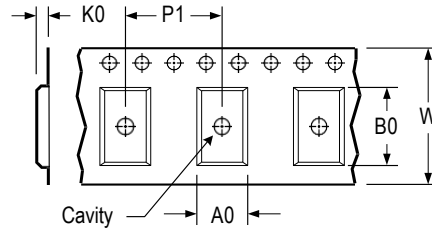
Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
$V_{CM}$	Common-mode voltage range	$CMRR \geq 50dB$	-0.2		9	V
CMRR	Common-mode rejection ratio	$V_{CM} = 0V$ to 1.5 V		95		dB
<b>OUTPUT</b>						
$V_{OH}$	High output voltage swing	$R_L = 2k\Omega$ to $V_S/2$		4.91		V
		$R_L = 150\Omega$ to $V_S/2$		4.52		
$V_{OL}$	Low output voltage swing	$R_L = 2k\Omega$ to $V_S/2$		-4.9		V
		$R_L = 150\Omega$ to $V_S/2$		-4.5		
$I_{OUT}$	Output Current	$V_{OUT} = 0.5V$ from either supply		$\pm 70$		
$I_{SC}$	Short-circuit current			$\pm 150$		mA
$C_{LOAD}$	Capacitive load drive	$G = +2$		40		pF
<b>POWER SUPPLY</b>						
$V_S$	Operating supply range		2.5		12.6	V
$I_Q$	Quiescent current /Amplifier			4.4		mA
PSRR	Power supply rejection ratio	$V_S = \pm 4.5 V$ to $\pm 5.5 V$		78		dB
<b>THERMAL CHARACTERISTICS</b>						
$T_A$	Operating temperature range	SOT23-5L	-40		+85	°C
		Other packages	-40		+125	
$\theta_{JA}$	Package Thermal Resistance	SOT23-5L		190		°C/W
		MSOP-8L		201		
		SOIC-8L		125		
		TSSOP-14L		112		
		SOIC-14L		115		

## Tape and Reel Information

### REEL DIMENSIONS

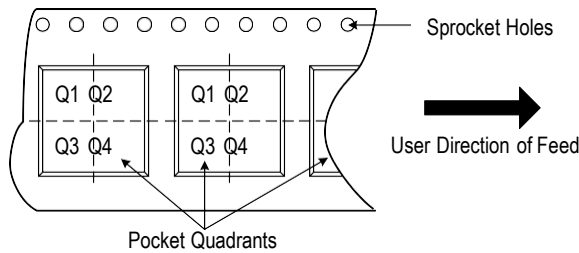


### TAPE DIMENSIONS



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 ORIENTATION IN TAPE

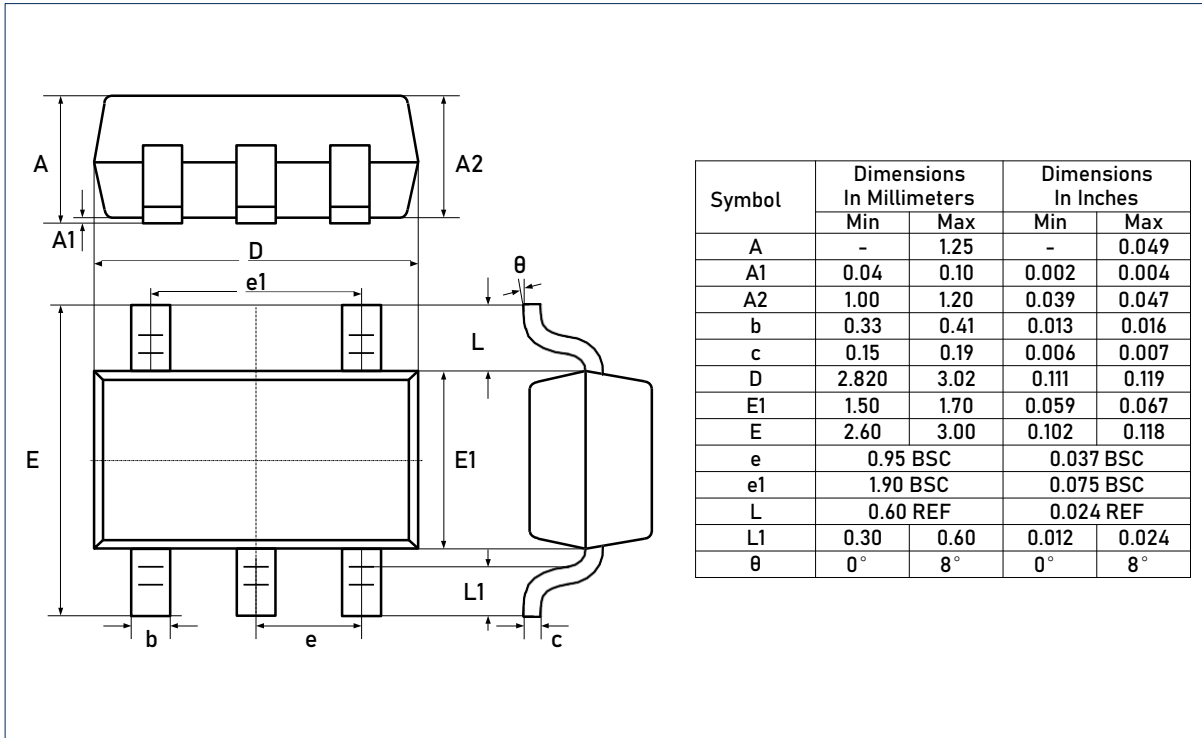


\* All dimensions are nominal

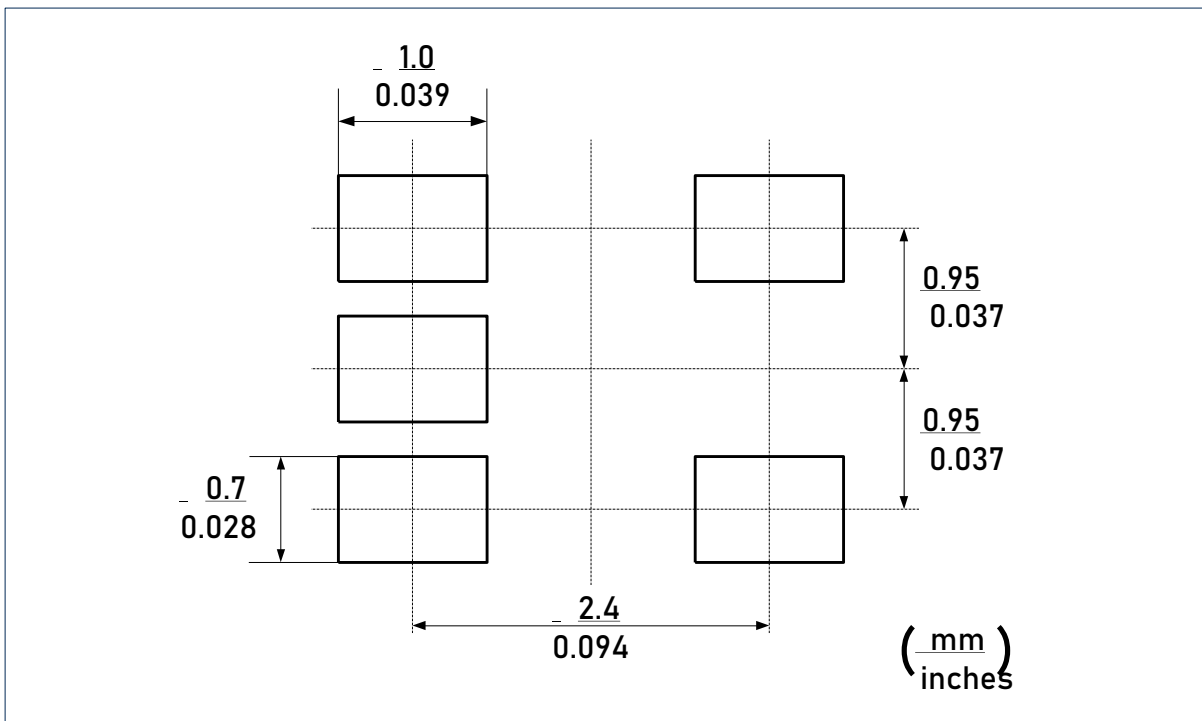
Device	Package Type	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin 1 Quadrant
LTA6041XT5/R6	SOT23	5	3 000	178	9.0	3.3	3.2	1.5	4.0	8.0	Q3
LTA6041XS8/R8	SOIC	8	4 000	330	12.4	6.6	5.3	2.0	8.0	12.0	Q1
LTA6042XS8/R8	SOIC	8	4 000	330	12.4	6.6	5.3	2.0	8.0	12.0	Q1
LTA6042XV8/R6	MSOP	8	3 000	330	12.4	5.0	3.5	2.0	8.0	12.0	Q1
LTA6044XS14/R5	SOIC	14	2 500	330	18	8.5	1.1	2.0	8.5	1.6	Q1
LTA6044XT14/R6	TSSOP	14	3 000	330	18	8.5	1.1	2.0	8.5	1.6	Q1

Package Outlines

DIMENSIONS, SOT23-5L



RECOMMENDED SOLDERING FOOTPRINT, SOT23-5L

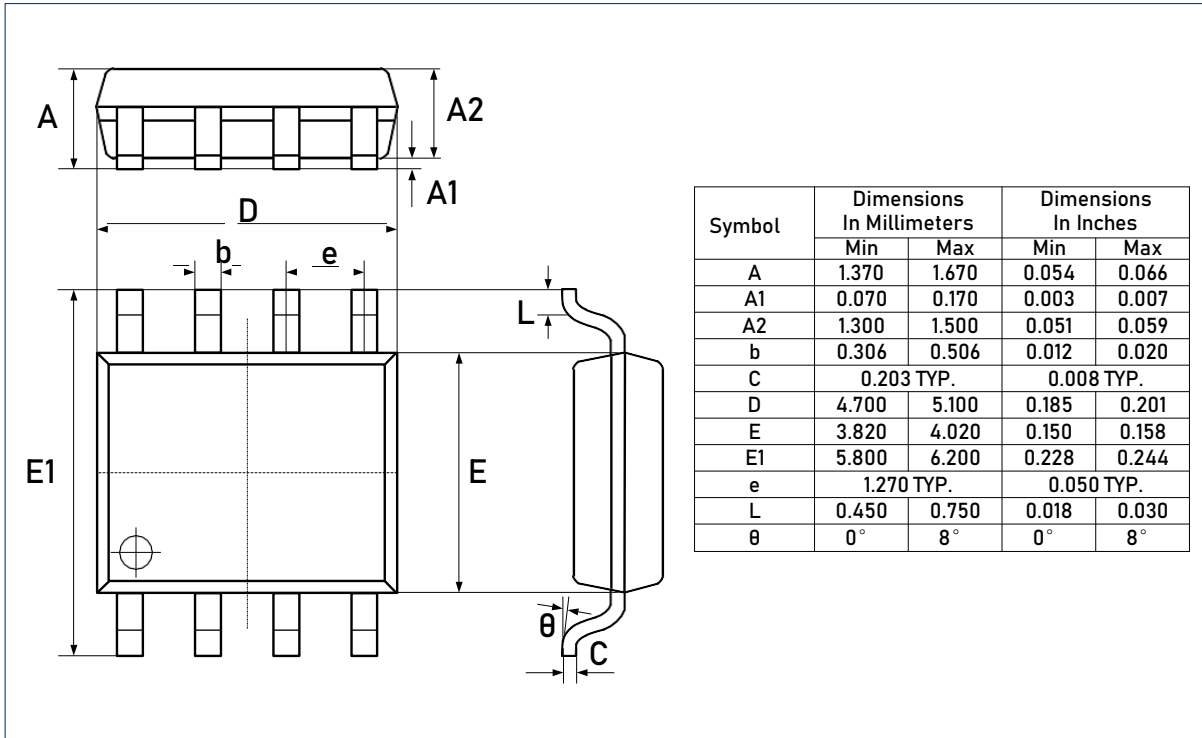


CAUTION: These devices are sensitive to electrostatic discharge; follow proper IC Handling Procedures.  
Linearin and designs are registered trademarks of Linearin Technology Corporation.  
© Copyright Linearin Technology Corporation. All Rights Reserved.  
All other trademarks mentioned are the property of their respective owners.

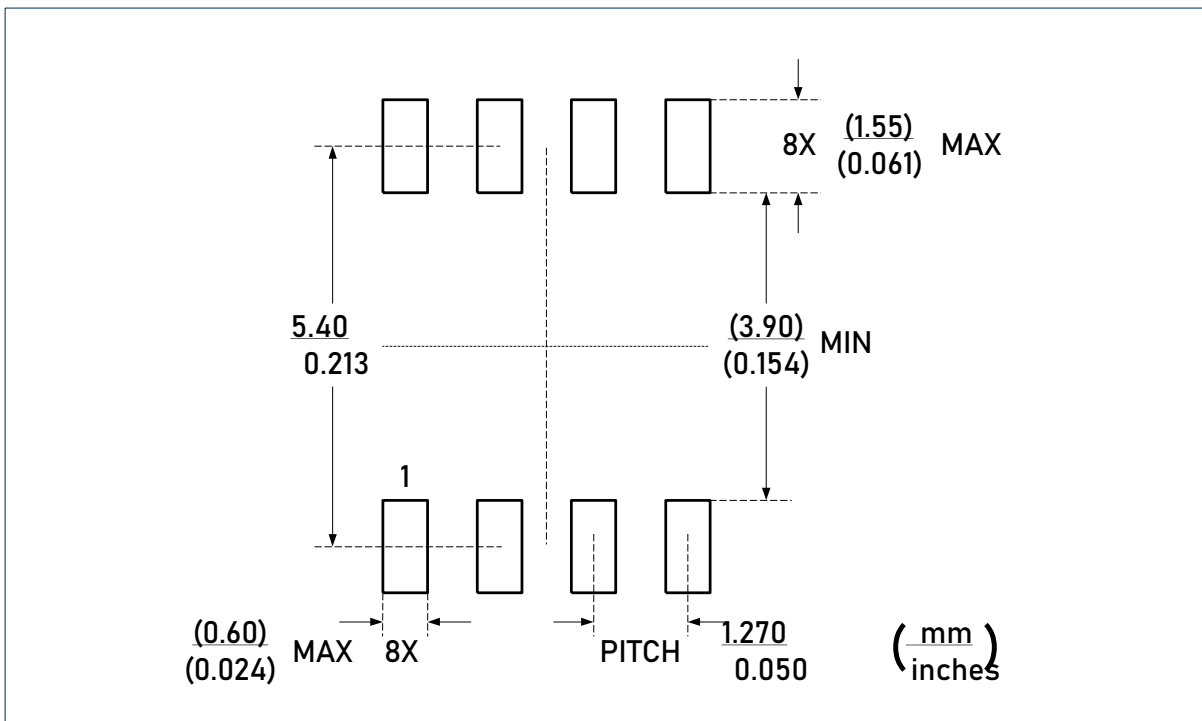


Package Outlines (continued)

DIMENSIONS, SOIC-8L



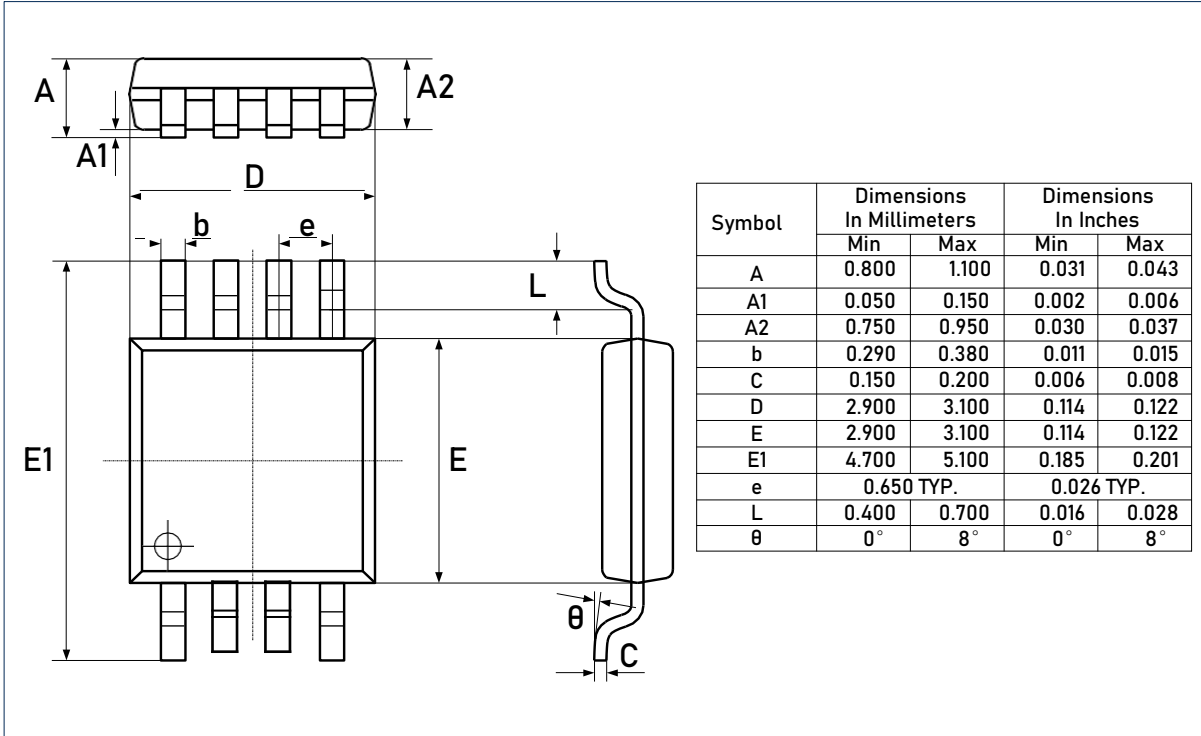
RECOMMENDED SOLDERING FOOTPRINT, SOIC-8L



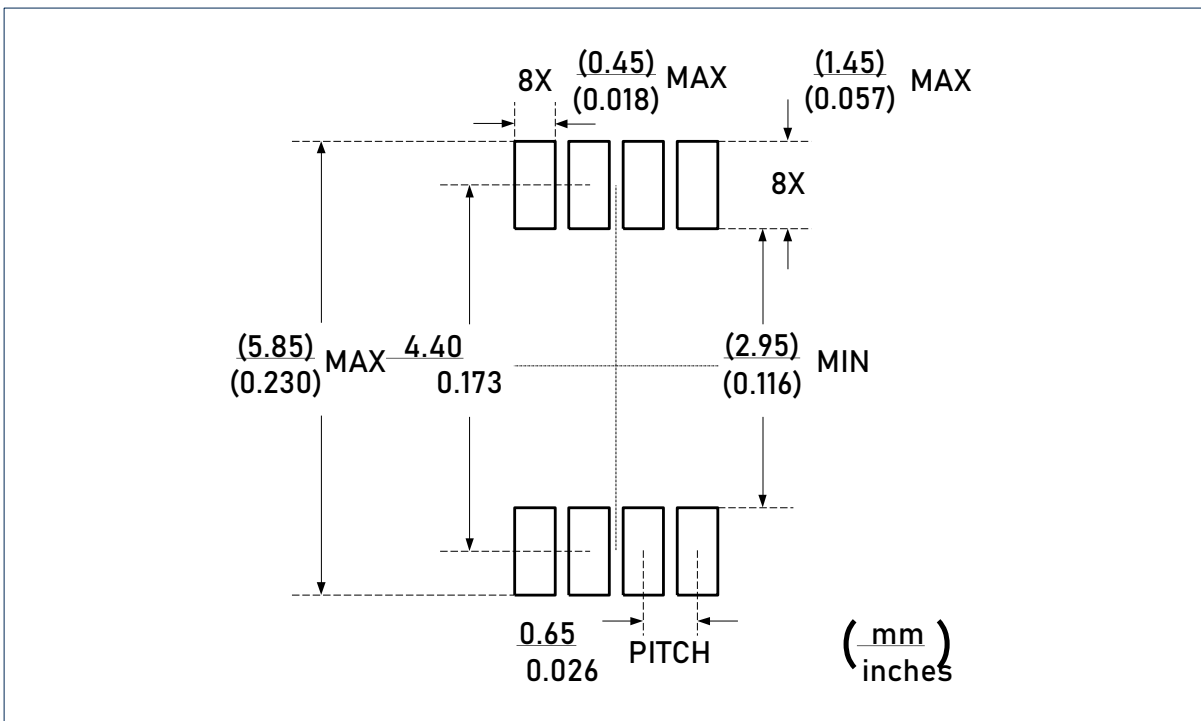
CAUTION: These devices are sensitive to electrostatic discharge; follow proper IC Handling Procedures.  
 Linearin and designs are registered trademarks of Linearin Technology Corporation.  
 © Copyright Linearin Technology Corporation. All Rights Reserved.  
 All other trademarks mentioned are the property of their respective owners.

Package Outlines (continued)

DIMENSIONS, MSOP-8L



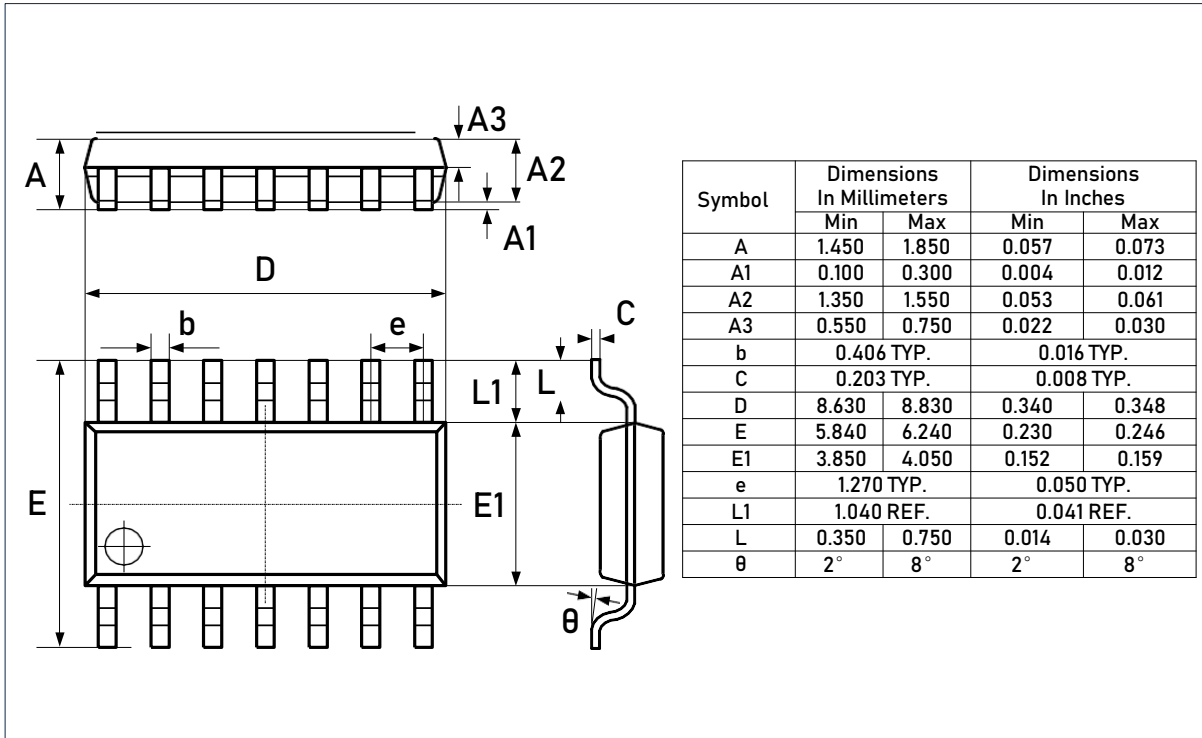
RECOMMENDED SOLDERING FOOTPRINT, MSOP-8L



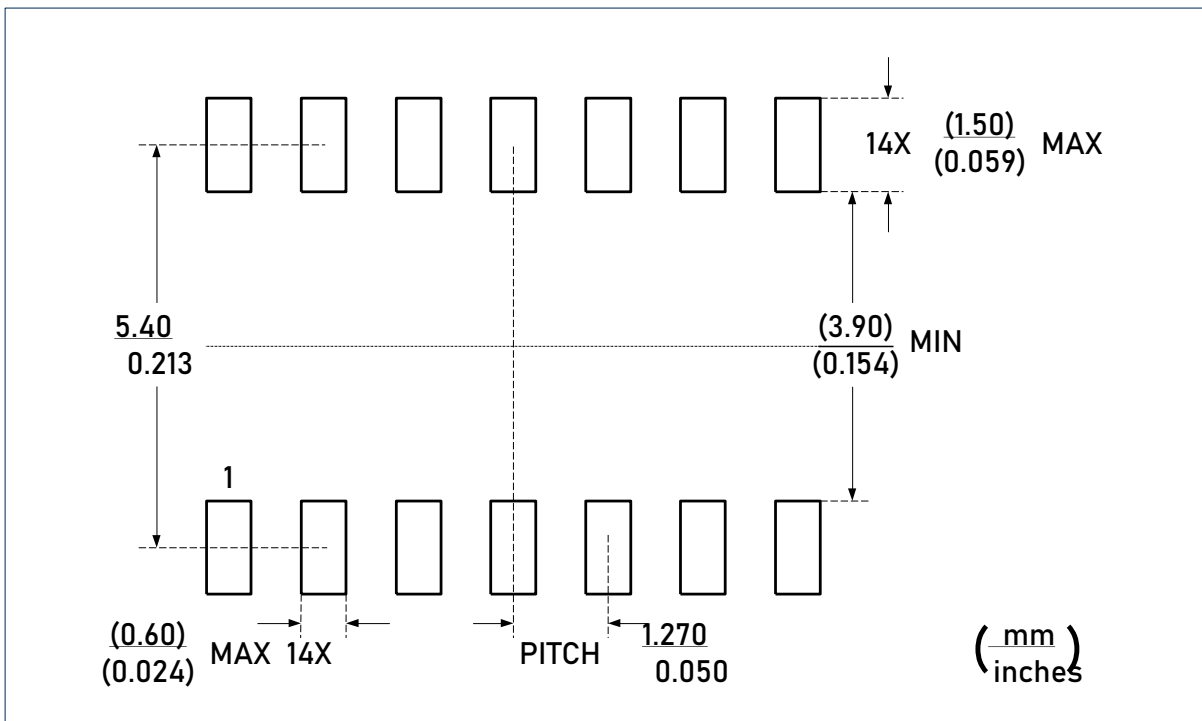
CAUTION: These devices are sensitive to electrostatic discharge; follow proper IC Handling Procedures.  
 Linearin and designs are registered trademarks of Linearin Technology Corporation.  
 © Copyright Linearin Technology Corporation. All Rights Reserved.  
 All other trademarks mentioned are the property of their respective owners.

Package Outlines (continued)

DIMENSIONS, SOIC-14L



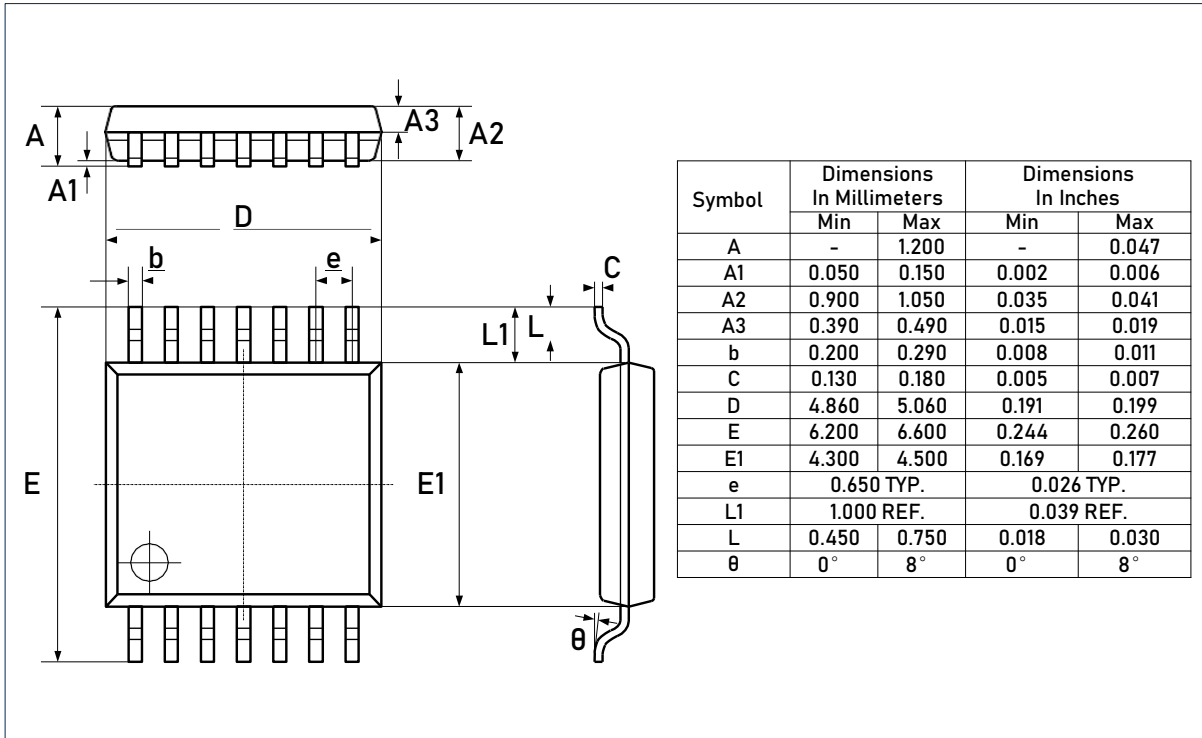
RECOMMENDED SOLDERING FOOTPRINT, SOIC-14L



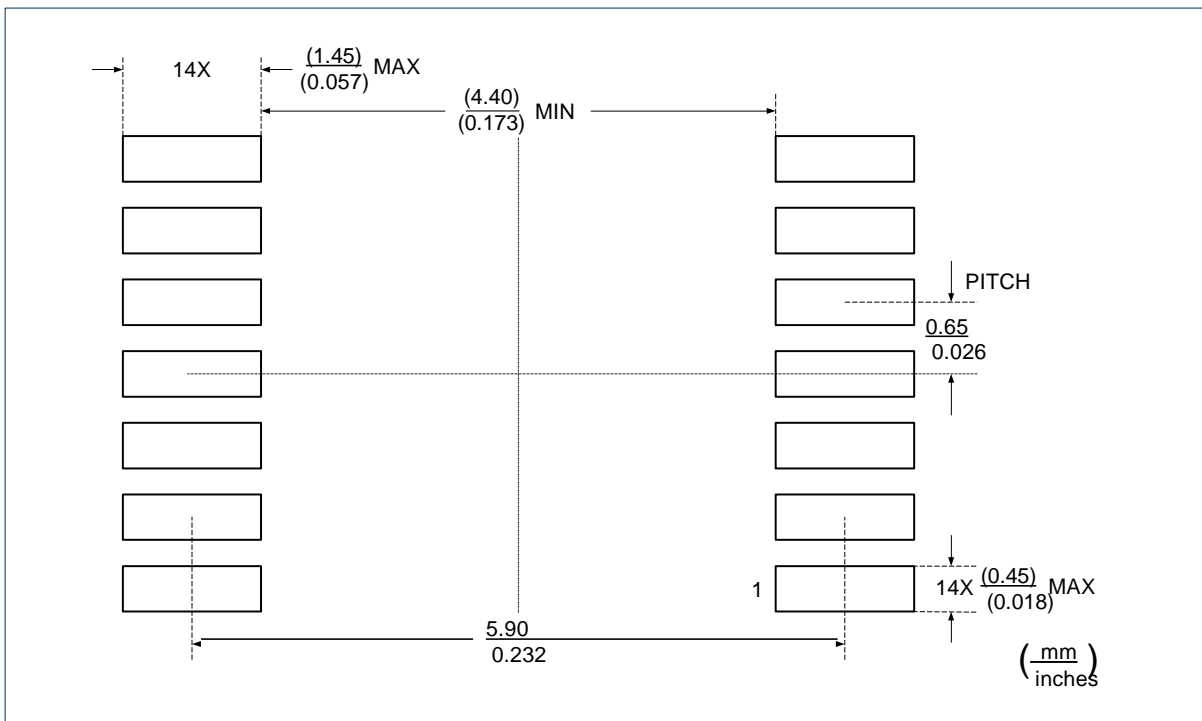
CAUTION: These devices are sensitive to electrostatic discharge; follow proper IC Handling Procedures.  
 Linearin and designs are registered trademarks of Linearin Technology Corporation.  
 © Copyright Linearin Technology Corporation. All Rights Reserved.  
 All other trademarks mentioned are the property of their respective owners.

Package Outlines (continued)

DIMENSIONS, TSSOP-14L



RECOMMENDED SOLDERING FOOTPRINT, TSSOP-14L



CAUTION: These devices are sensitive to electrostatic discharge; follow proper IC Handling Procedures.  
 Linearin and designs are registered trademarks of Linearin Technology Corporation.  
 © Copyright Linearin Technology Corporation. All Rights Reserved.  
 All other trademarks mentioned are the property of their respective owners.

## 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 (industry 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.

For additional product information, or full datasheet, please contact with the Linearin's Sales Department or Representatives.