

## General Description

The LTA8281, LTA8282 and LTA8284 (LTA828x) are a family of low power, 48 V wide supply voltage, low noise, rail-to-rail output operational amplifiers capable of operating on supplies ranging from +4.5 V ( $\pm 2.25$  V) to +48 V ( $\pm 24$  V). This new generation of high-voltage CMOS operational amplifiers, in conjunction with the LTA829x, LTA827x and LTA826x, provide a family of bandwidth, noise, and power options to meet the needs of a wide variety of applications. The LTA828x devices offer outstanding dc precision and ac performance, including low offset ( $\pm 0.5$  mV typically), low offset drift ( $\pm 2$   $\mu\text{V}/^\circ\text{C}$  typically), 10 MHz bandwidth, and 8 nV/ $\sqrt{\text{Hz}}$  input voltage noise density at 10 kHz. Unique features such as differential input-voltage range to the negative supply rail, high output current ( $\pm 45$  mA), high capacitive load drive of up to 1 nF, and high slew rate (9 V/ $\mu\text{s}$ ) make the LTA828x high-performance operational amplifiers for high-voltage industrial applications.

The robust design of the LTA828x 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 LTA828x are optimized for operation at voltages from +4.5 V ( $\pm 2.25$  V) to +48 V ( $\pm 24$  V) over the extended temperature range of  $-40$   $^\circ\text{C}$  to  $+125$   $^\circ\text{C}$ .

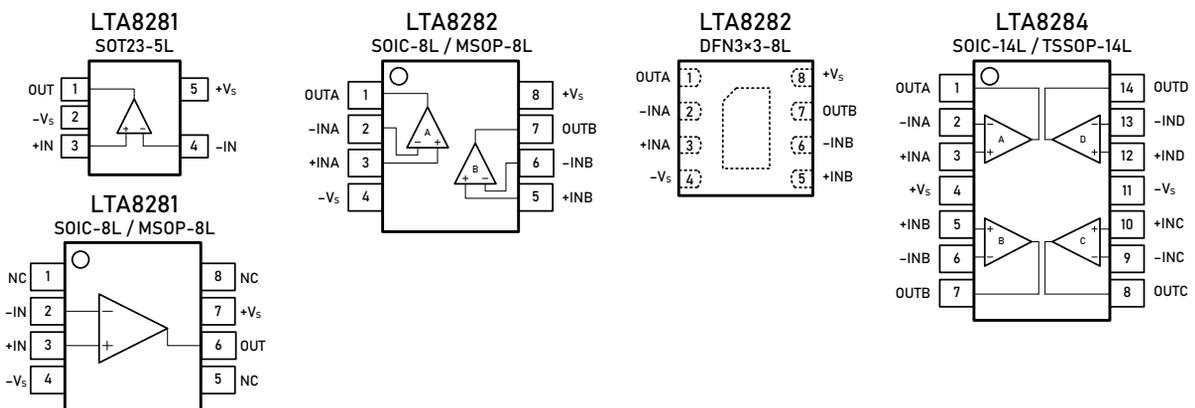
## Features and Benefits

- Wide Supply:  $\pm 2.25$  V to  $\pm 24$  V, 4.5 V to 48 V
- Low Offset Voltage:  $\pm 0.5$  mV Typically
- Low Offset Voltage Drift:  $\pm 2$   $\mu\text{V}/^\circ\text{C}$
- High Common-Mode Rejection: 112 dB
- Gain Bandwidth: 10 MHz
- Slew Rate: 9 V/ $\mu\text{s}$
- Low Noise: 8 nV/ $\sqrt{\text{Hz}}$  at 10 kHz
- Low Bias Current:  $\pm 10$  pA
- Rail-to-Rail Output

## Applications

- Tracking Amplifier in Power Modules
- Merchant Power Supplies
- High-Side and Low-Side Current Sensing
- High Precision Comparator
- Battery-Powered Instruments
- Test and Measurement Equipment
- Multiplexed Data-Acquisition Systems
- Programmable Logic Controllers

## Pin Configuration (Top View)



## Pin Description

Symbol	Description
-IN	Inverting input of the amplifier. The voltage range is from $V_{S-}$ to $V_{S+} - 1.5$ V.
+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 4.5 V to 48 V. Split supplies are possible as long as the voltage between $V_{S+}$ and $V_{S-}$ is from 4.5 V to 48 V.
-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 4.5 V to 48 V.
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>
LTA8281XT5/R6	SOT23-5L	Tape and Reel, 3 000	Green (RoHS & no Sb/Br)	H81
LTA8281XS8/R8	SOIC-8L	Tape and Reel, 4 000	Green (RoHS & no Sb/Br)	HV-81
LTA8281XV8/R6	MSOP-8L	Tape and Reel, 3 000	Green (RoHS & no Sb/Br)	HV81
LTA8282XS8/R8	SOIC-8L	Tape and Reel, 4 000	Green (RoHS & no Sb/Br)	HV-82
LTA8282XV8/R6	MSOP-8L	Tape and Reel, 3 000	Green (RoHS & no Sb/Br)	HV82
LTA8282XF8/R10	DFN3x3-8L	Tape and Reel, 3 000	Green (RoHS & no Sb/Br)	HV82
LTA8284XS14/R5	SOIC-14L	Tape and Reel, 2 500	Green (RoHS & no Sb/Br)	HV-84
LTA8284XT14/R6	TSSOP-14L	Tape and Reel, 3 000	Green (RoHS & no Sb/Br)	HV-84

(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, $\pm 10$ 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>	2 000	V
	Charged device model (CDM), per ESDA/JEDEC JS-002-2014 <sup>(2)</sup>	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

$V_S = 4.5 \text{ V to } 48 \text{ V}$ ,  $T_A = +25 \text{ }^\circ\text{C}$ ,  $V_{CM} = V_{OUT} = V_S/2$ , and  $R_L = 10 \text{ k}\Omega$  connected to  $V_S/2$ , unless otherwise noted. Boldface limits apply over the specified temperature range,  $T_A = -40 \text{ }^\circ\text{C to } +125 \text{ }^\circ\text{C}$ .

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
<b>OFFSET VOLTAGE</b>						
Input offset voltage	$V_{OS}$			$\pm 0.5$	$\pm 1.8$	mV
Offset voltage drift	$V_{OS \text{ TC}}$	$T_A = -40 \text{ to } +125 \text{ }^\circ\text{C}$		$\pm 2$		$\mu\text{V}/^\circ\text{C}$
Power supply rejection ratio	PSRR	$V_S = 4.5 \text{ to } 48 \text{ V}$ , $V_{CM} = 0.1 \text{ V}$		5		$\mu\text{V}/\text{V}$
		$T_A = -40 \text{ to } +125 \text{ }^\circ\text{C}$		10		
<b>INPUT BIAS CURRENT</b>						
Input bias current	$I_B$			10		pA
		$T_A = -40 \text{ to } +85 \text{ }^\circ\text{C}$		150		
		$T_A = -40 \text{ to } +125 \text{ }^\circ\text{C}$		600		
Input offset current	$I_{OS}$			5		pA
<b>NOISE</b>						
Input voltage noise	$V_n$	$f = 0.1 \text{ to } 10 \text{ Hz}$		4		$\mu\text{V}_{P-P}$
Input voltage noise density	$e_n$	$f = 1 \text{ kHz}$		10		$\text{nV}/\sqrt{\text{Hz}}$
		$f = 10 \text{ kHz}$		8		
Input current noise density	$I_n$	$f = 1 \text{ kHz}$		5		$\text{fA}/\sqrt{\text{Hz}}$
<b>INPUT VOLTAGE</b>						
Common-mode voltage range	$V_{CM}$		$-V_S$		$+V_S - 1.5$	V
Common-mode rejection ratio	CMRR	$V_S = 40 \text{ V}$ , $V_{CM} = 0 \text{ to } 38 \text{ V}$		112		dB
		$V_{CM} = 0.1 \text{ to } 38 \text{ V}$ , $T_A = -40 \text{ to } +125 \text{ }^\circ\text{C}$		100		
		$V_S = 5 \text{ V}$ , $V_{CM} = 0 \text{ to } 3.5 \text{ V}$		93		
		$V_{CM} = 0.1 \text{ to } 3 \text{ V}$ , $T_A = -40 \text{ to } +125 \text{ }^\circ\text{C}$		82		
<b>INPUT IMPEDANCE</b>						
Input capacitance	$C_{IN}$	Differential		2.0		pF
		Common mode		3.5		
<b>OPEN-LOOP GAIN</b>						
Open-loop voltage gain	$A_{VOL}$	$V_S = 40 \text{ V}$ , $V_O = 0.1 \text{ to } 39.9 \text{ V}$		126		dB
		$T_A = -40 \text{ to } +125 \text{ }^\circ\text{C}$		118		
		$V_S = 5 \text{ V}$ , $V_O = 0.1 \text{ to } 4.9 \text{ V}$		116		
		$T_A = -40 \text{ to } +125 \text{ }^\circ\text{C}$		108		
<b>FREQUENCY RESPONSE</b>						
Gain bandwidth product	GBW			10		MHz
Slew rate	SR	$V_S = 40 \text{ V}$ , $G = +1$ , 10 V step		9		V/ $\mu\text{s}$
Total harmonic distortion + noise	THD+N	$G = +1$ , $f = 1 \text{ kHz}$ , $V_O = 3 V_{RMS}$		0.0002		%
Settling time	$t_S$	To 0.1%, $V_S = 40 \text{ V}$ , $G = +1$ , 5 V step		1.6		$\mu\text{s}$
		To 0.01%, $V_S = 40 \text{ V}$ , $G = +1$ , 5 V step		3.5		
Overload recovery time	$t_{OR}$	$V_{IN} \times \text{Gain} > V_S$		0.6		$\mu\text{s}$

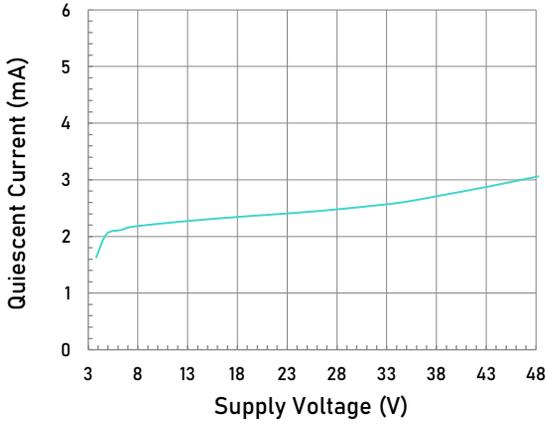
## Electrical Characteristics (continued)

$V_S = 4\text{ V to }48\text{ V}$ ,  $T_A = +25\text{ }^\circ\text{C}$ ,  $V_{CM} = V_{OUT} = V_S/2$ , and  $R_L = 10\text{ k}\Omega$  connected to  $V_S/2$ , unless otherwise noted. Boldface limits apply over the specified temperature range,  $T_A = -40\text{ }^\circ\text{C to }+125\text{ }^\circ\text{C}$ .

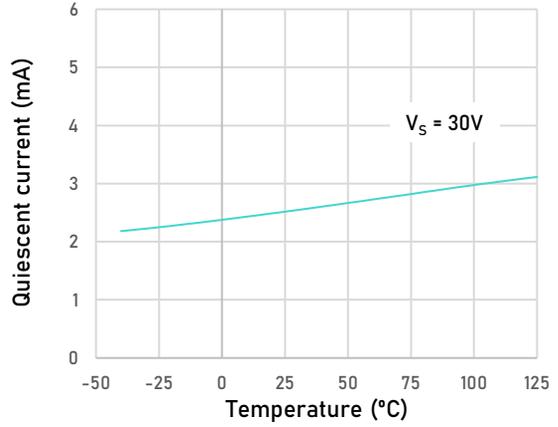
Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
<i>OUTPUT</i>						
High output voltage swing	$V_{OH}$	$V_S = \pm 20\text{ V}$ , $R_L = 10\text{ k}\Omega$		$+V_S - 95$		mV
		$V_S = \pm 20\text{ V}$ , $R_L = 2\text{ k}\Omega$		$+V_S - 255$		
Low output voltage swing	$V_{OL}$	$V_S = \pm 20\text{ V}$ , $R_L = 10\text{ k}\Omega$		$-V_S + 60$		mV
		$V_S = \pm 20\text{ V}$ , $R_L = 2\text{ k}\Omega$		$-V_S + 240$		
Short-circuit current	$I_{SC}$			$\pm 45$		mA
<i>POWER SUPPLY</i>						
Operating supply voltage	$V_S$	$T_A = -40\text{ to }+125\text{ }^\circ\text{C}$	4.5		48	V
Quiescent current (per amplifier)	$I_Q$	$V_S = 5\text{ V}$		2.05		mA
		$V_S = 40\text{ V}$		2.75		
<i>THERMAL CHARACTERISTICS</i>						
Operating temperature range	$T_A$		-40		+125	$^\circ\text{C}$
Package Thermal Resistance	$\theta_{JA}$	SOT23-5L		190		$^\circ\text{C/W}$
		MSOP-8L		201		
		SOIC-8L		125		
		TSSOP-14L		112		
		SOIC-14L		115		

### Typical Performance Characteristics

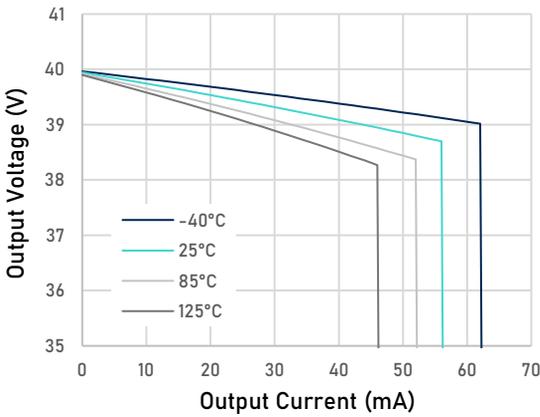
At  $T_A = +25^\circ\text{C}$ ,  $V_{CM} = V_S/2$ , and  $R_L = 10\text{ k}\Omega$  connected to  $V_S/2$ , unless otherwise noted.



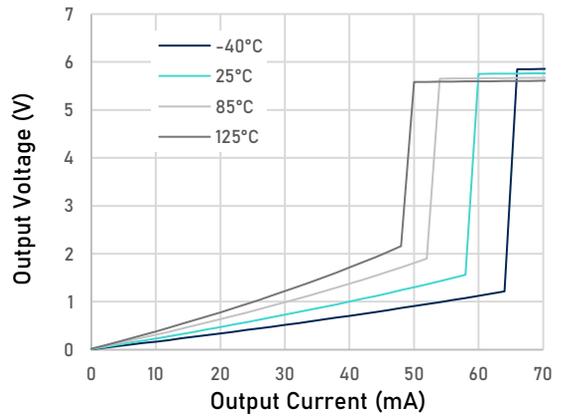
Quiescent Current as a function of Supply Voltage



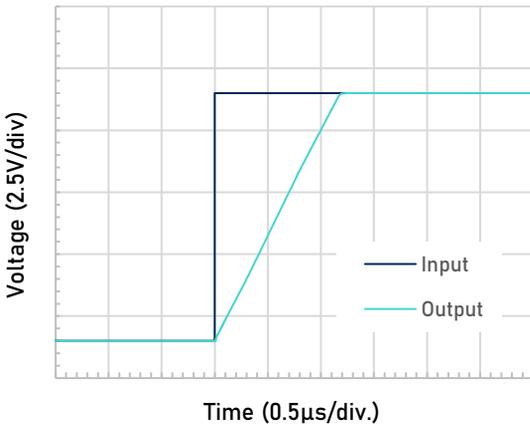
Quiescent Current as a function of Temperature



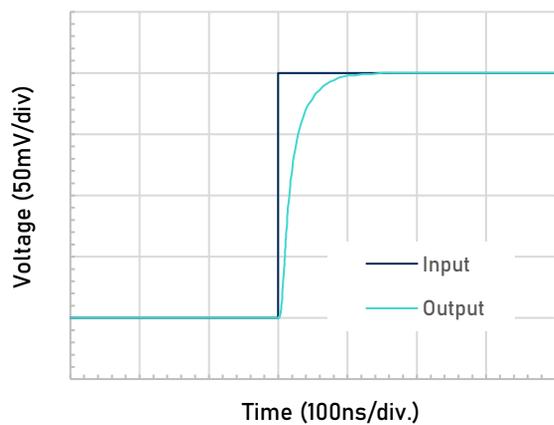
Output Voltage Swing as a function of Output Current (Sourcing,  $V_S = 40\text{ V}$ )



Output Voltage Swing as a function of Output Current (Sinking,  $V_S = 40\text{ V}$ )



Large-Signal Step Response(Failing)

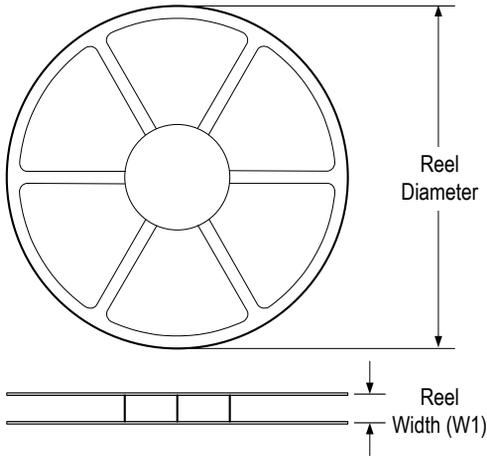


Small-Signal Step Response

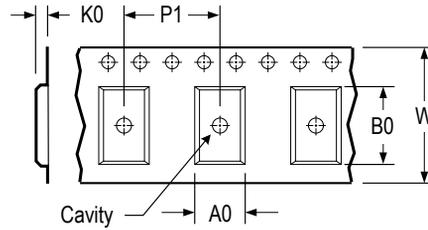
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## Tape and Reel Information

### REEL DIMENSIONS

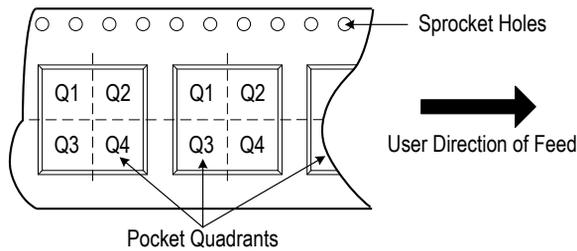


### TAPE DIMENSIONS



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

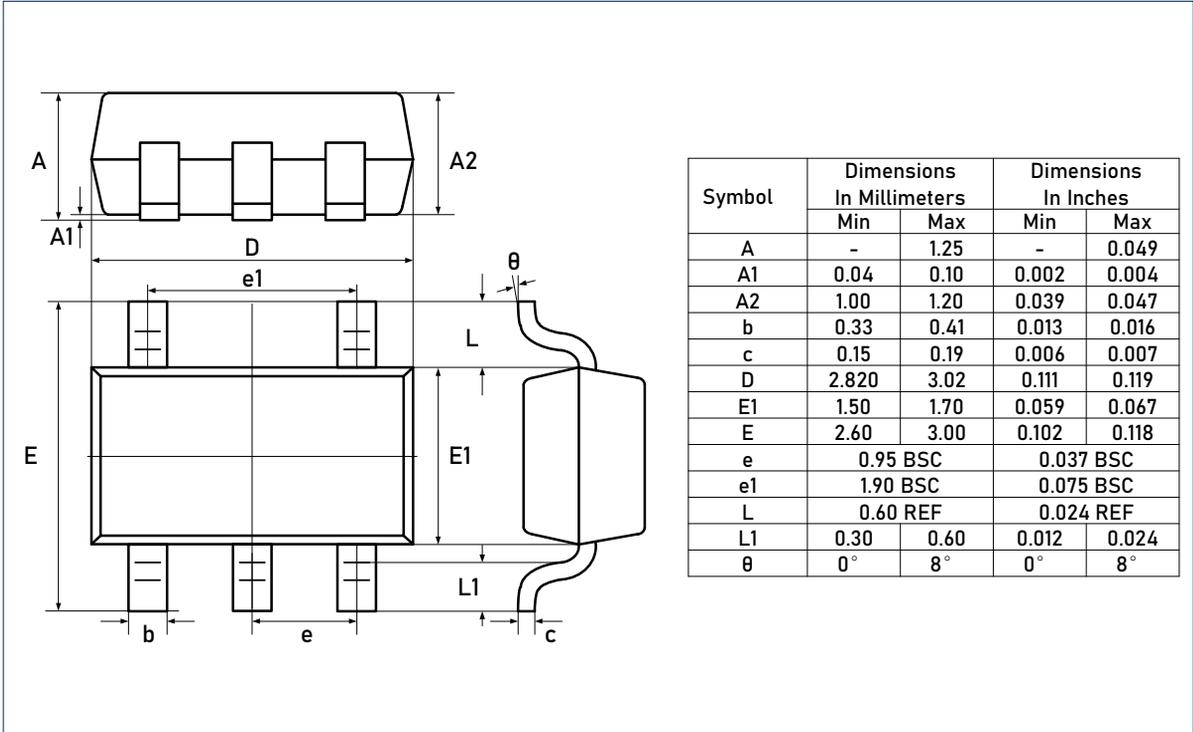


\* All dimensions are nominal

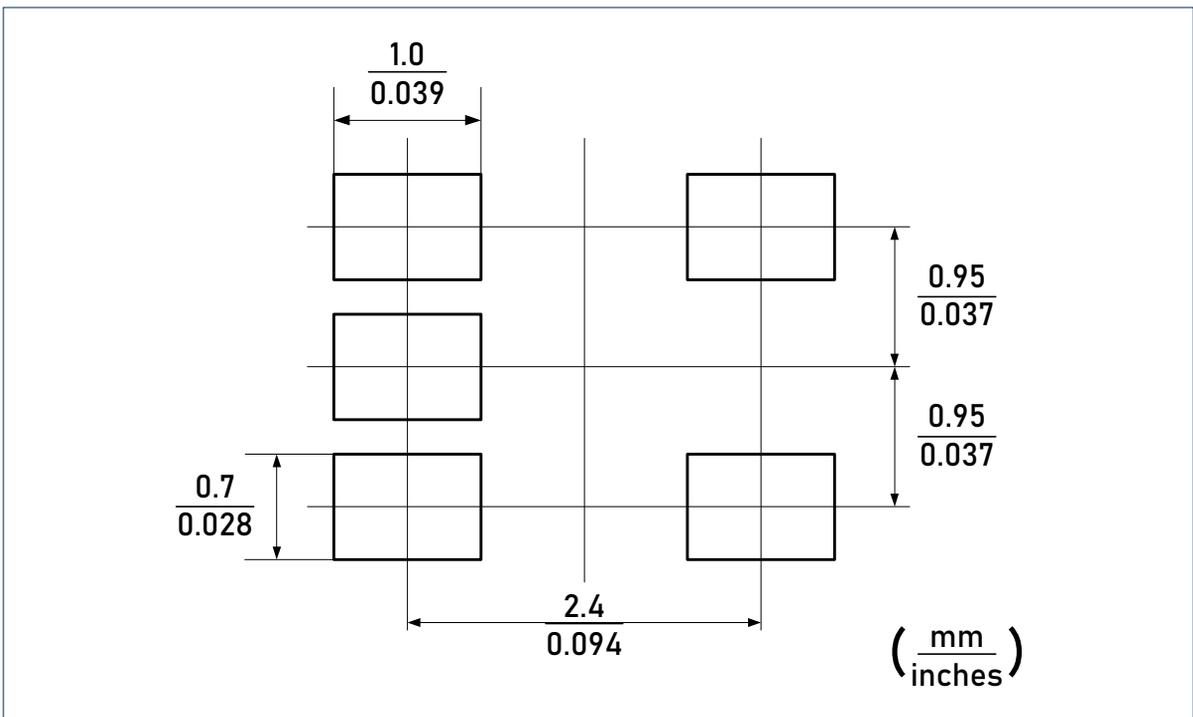
Device	Package Type	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin 1 Quadrant
LTA8281XT5/R6	SOT23	5	3 000	178	9.0	3.3	3.2	1.5	4.0	8.0	Q3

### Package Outlines

#### DIMENSIONS, SOT23-5L



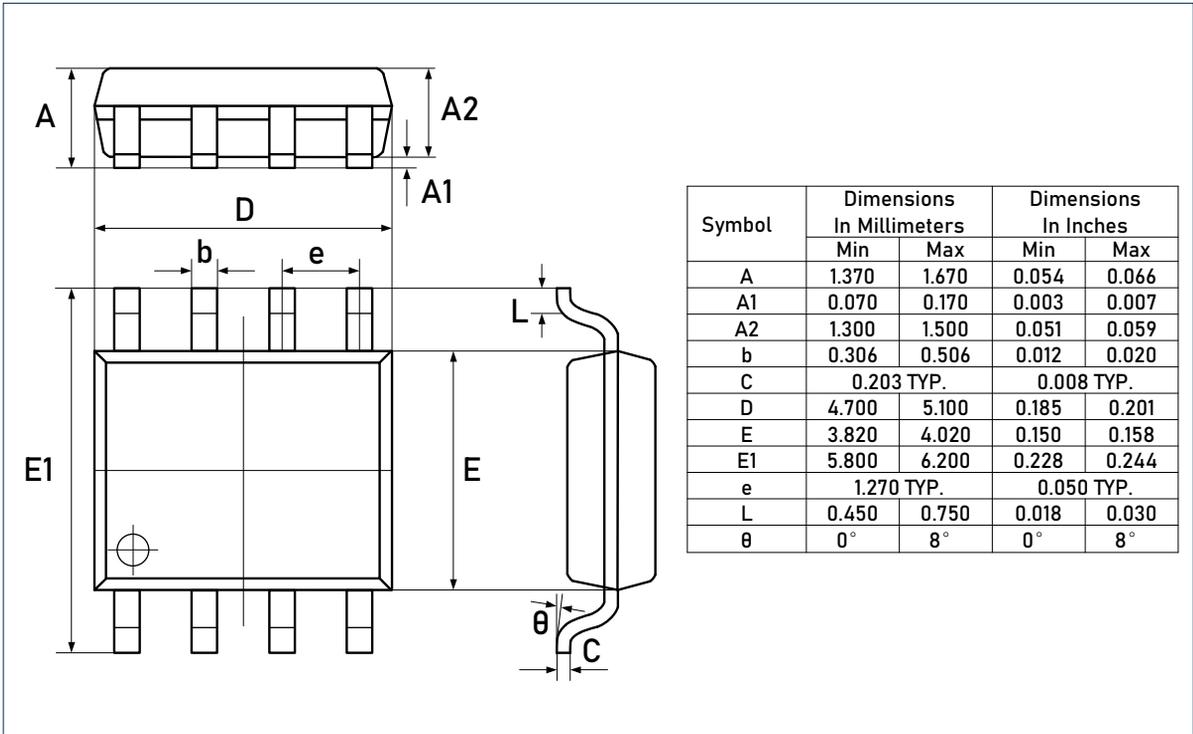
#### RECOMMENDED SOLDERING FOOTPRINT, SOT23-5L



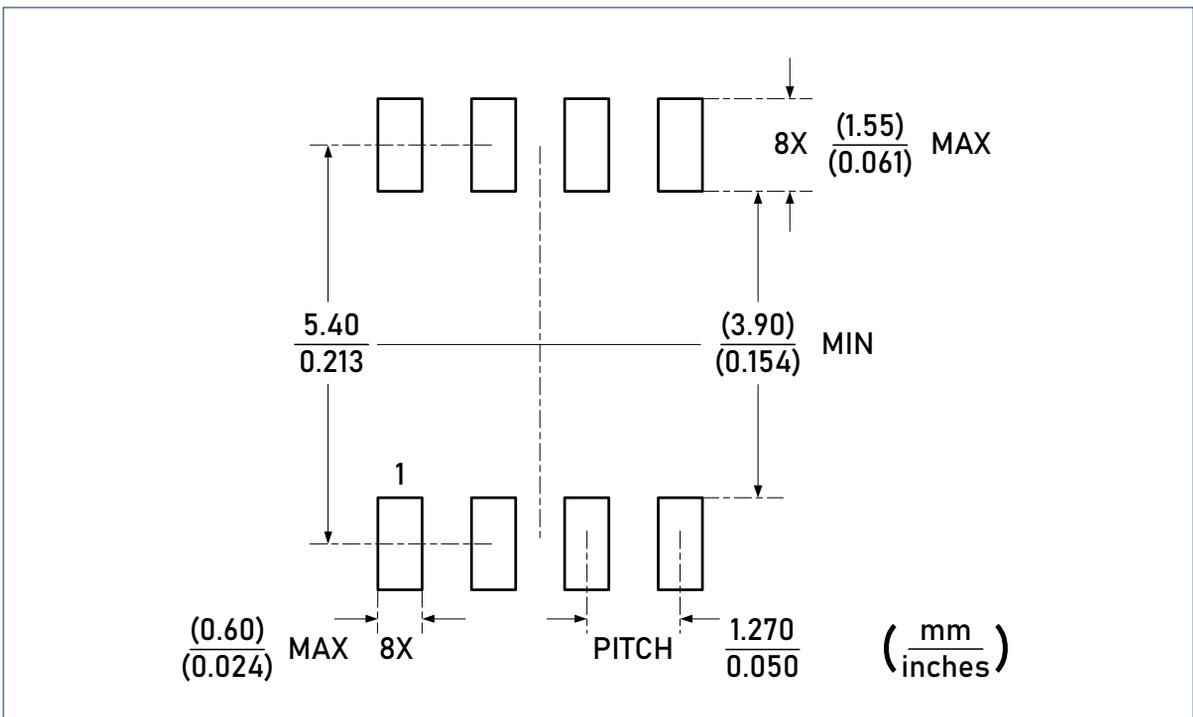
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Package Outlines (continued)

DIMENSIONS, SOIC-8L



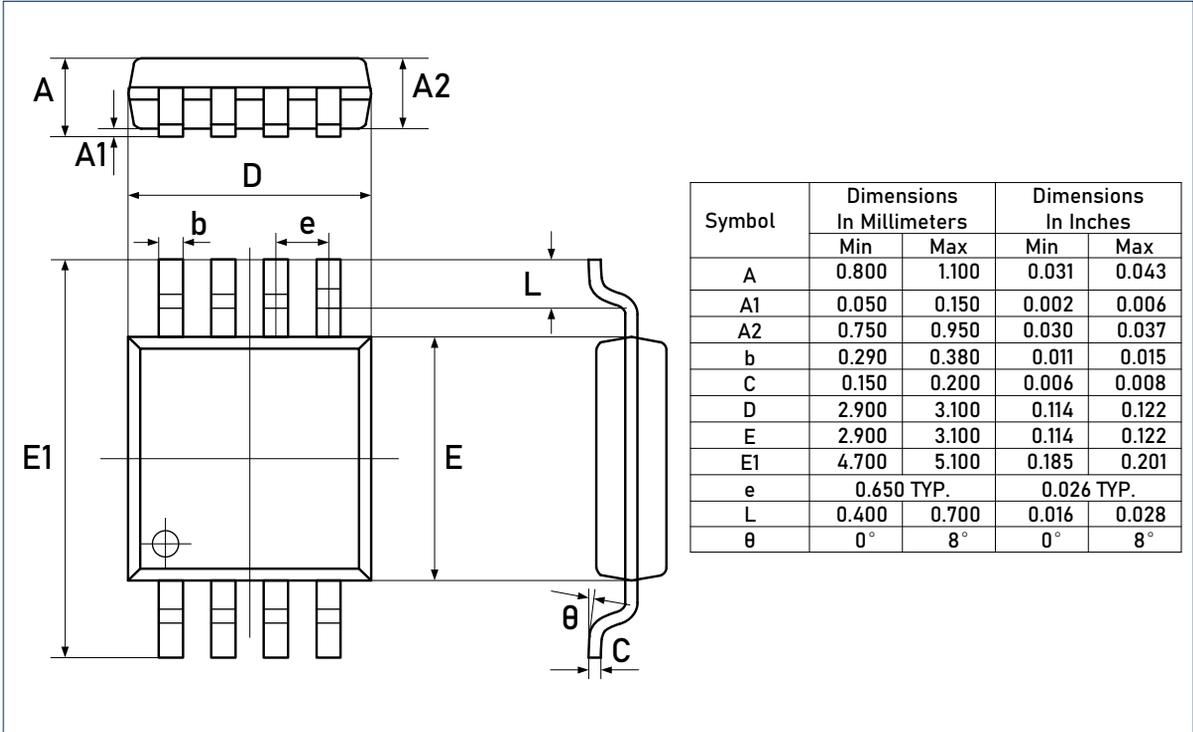
RECOMMENDED SOLDERING FOOTPRINT, SOIC-8L



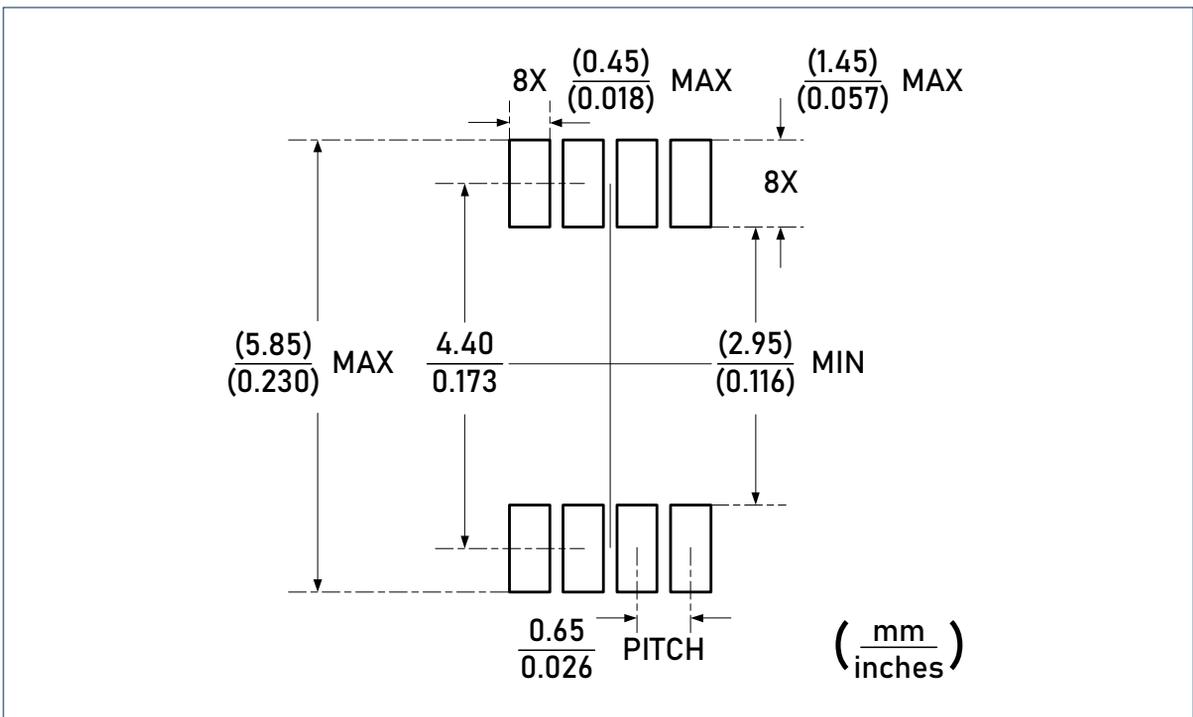
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Package Outlines (continued)

DIMENSIONS, MSOP-8L



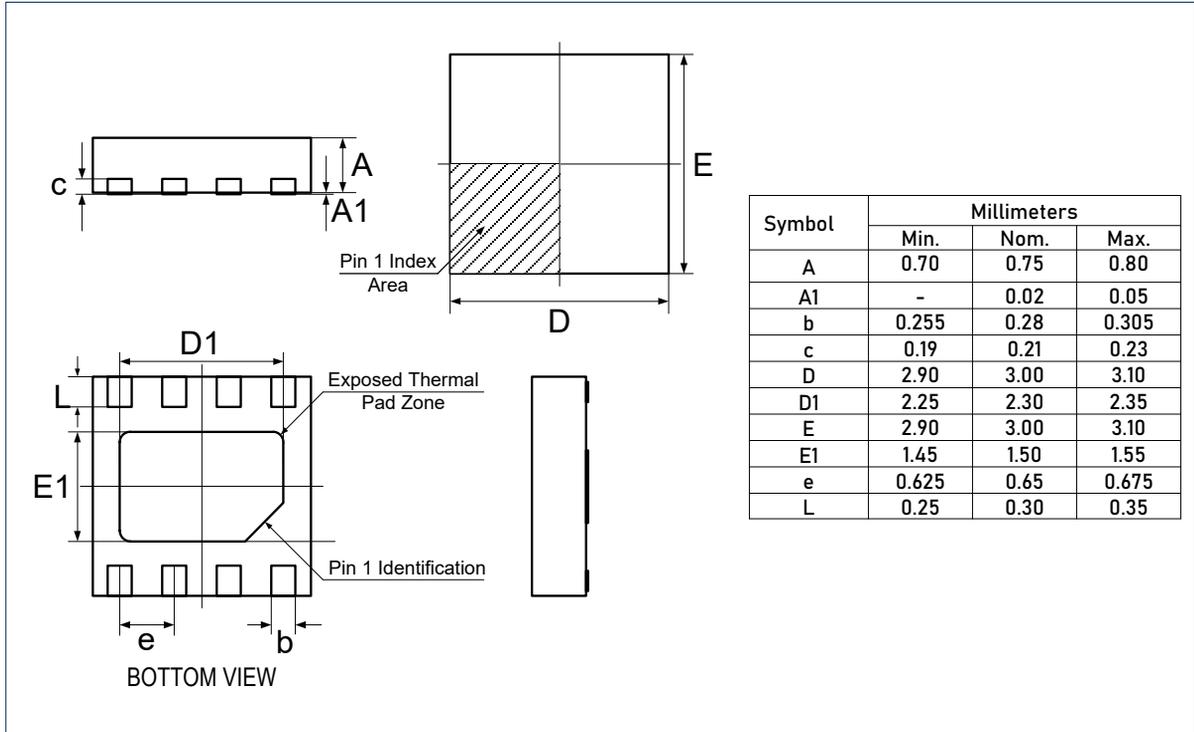
RECOMMENDED SOLDERING FOOTPRINT, MSOP-8L



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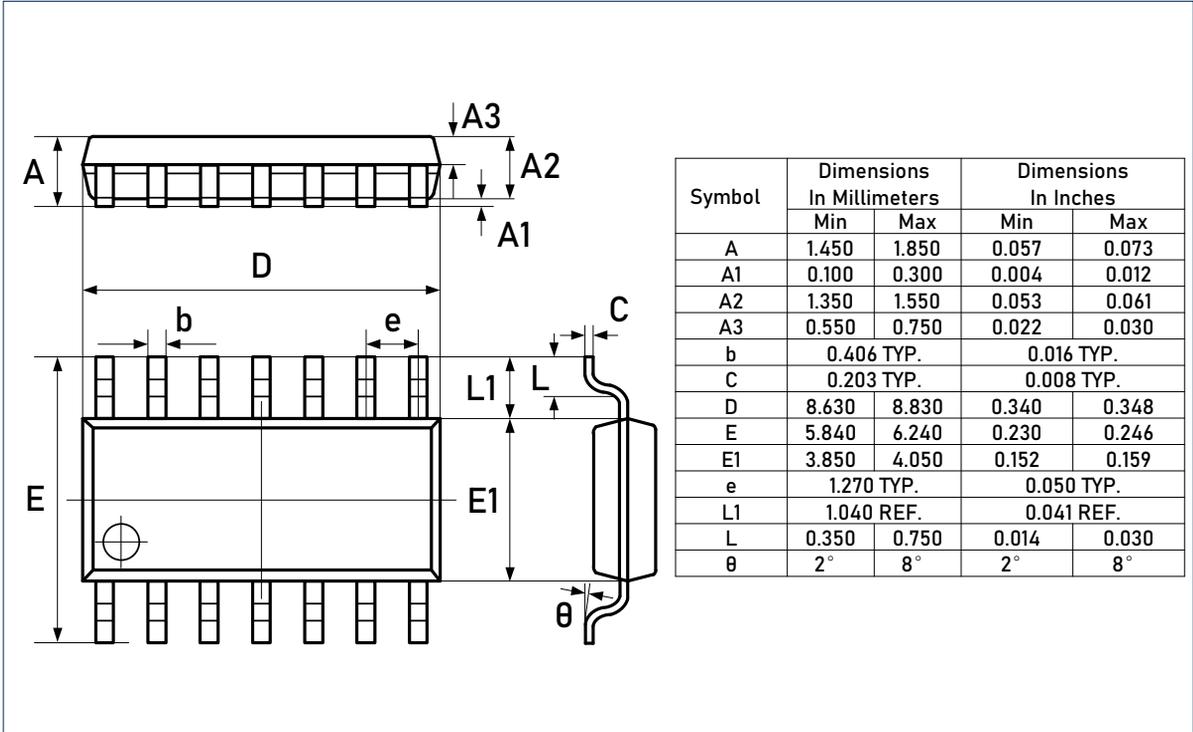
## Package Outlines (continued)

## DIMENSIONS, DFN3x3-8L

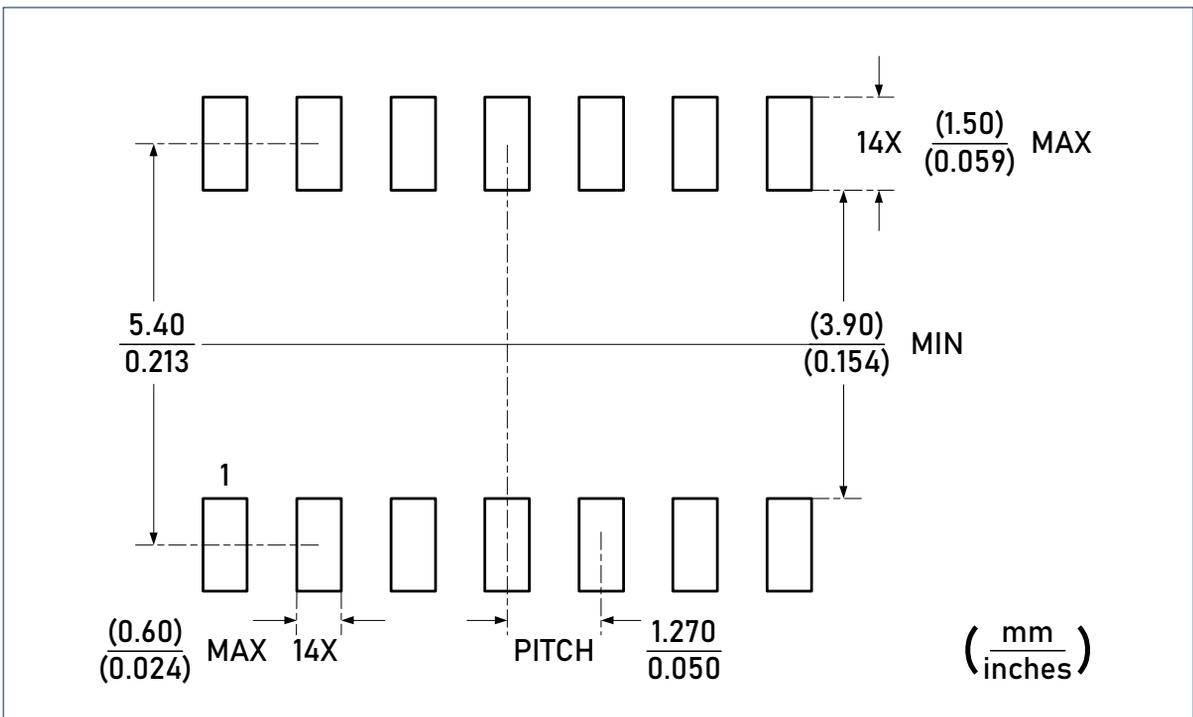


Package Outlines (continued)

DIMENSIONS, SOIC-14L



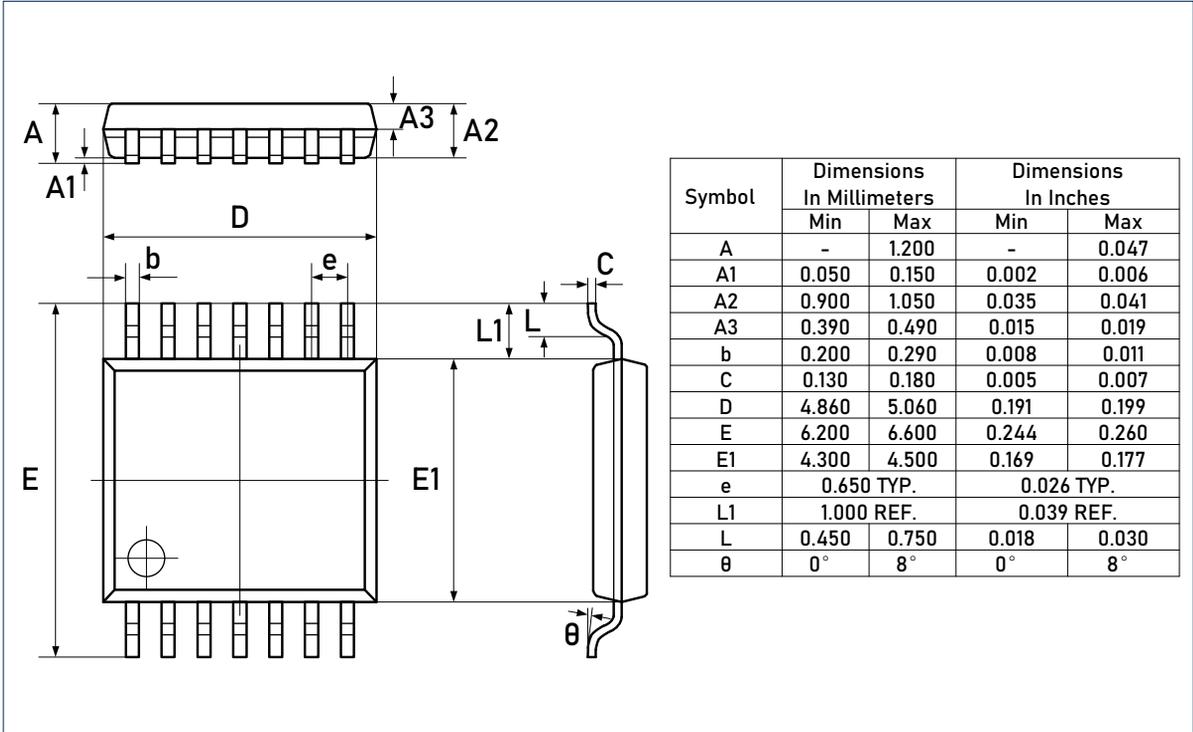
RECOMMENDED SOLDERING FOOTPRINT, SOIC-14L



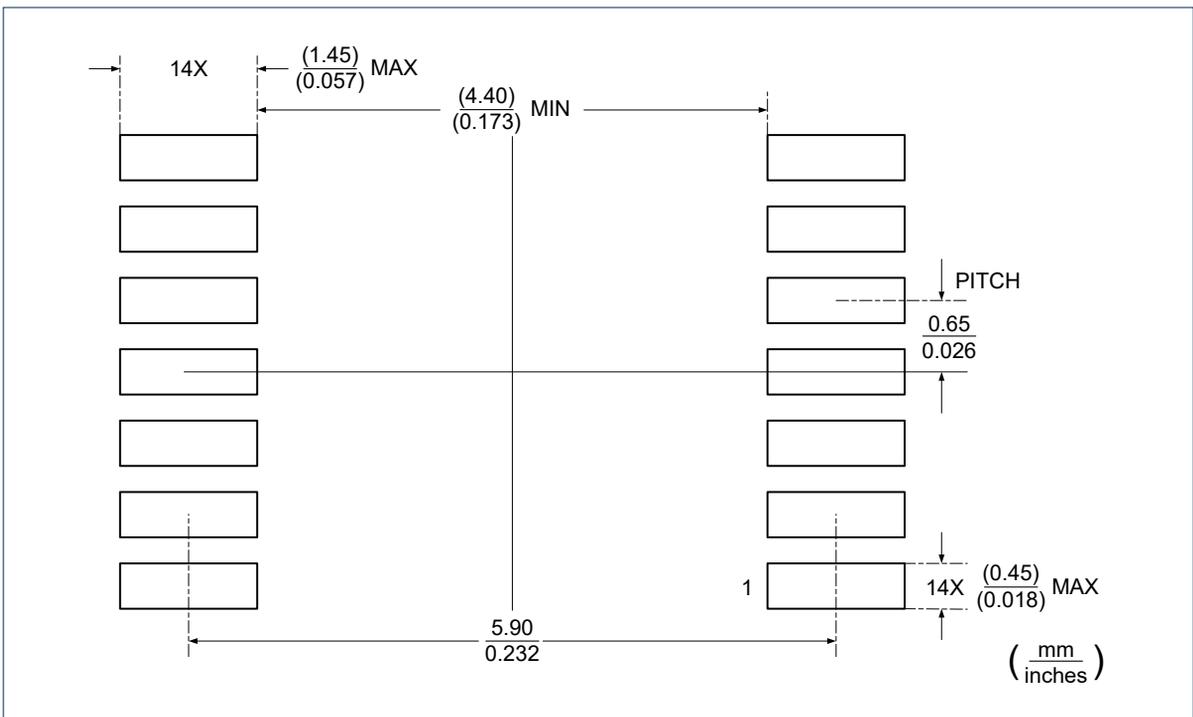
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Package Outlines (continued)

DIMENSIONS, TSSOP-14L



RECOMMENDED SOLDERING FOOTPRINT, SOIC-14L



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## Important Notice

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