

Ultra Precision, Low Noise Operational Amplifier

General Description

The LTA17(LTA217) provides high performance. Offsets down to $25\mu\text{V}$ and a maximum drift of $0.19\mu\text{V}/^\circ\text{C}$ make the LTA17 ideal for precision instrumentation applications. Exceptionally low noise ($e_n=9.8\text{nV}/\sqrt{\text{Hz}}$ @1kHz), a low 1/f noise corner frequency of 5 Hz, and the high gain of 116 dB, allow accurate high-gain amplification of low-level signals. The low input bias current of 1.8nA and offset current of 0.36nA are achieved by using a bias-current cancellation circuit.

The output stage has good load driving capability. A guaranteed output voltage swing is $20 V_{p-p}$ at 600Ω load resistance and low output distortion make the LTA17 an excellent choice for professional audio applications. PSRR 123 dB and CMRR 127 dB allow the circuit designer to achieve previous performance by discrete designs.

Low-cost, high-volume production of the LTA17 is achieved by using trimming circuit. This reliable and stable offset trimming scheme has proved its effectiveness over many years of production history. The LTA17 brings low-noise instrumentation-type performance to such diverse applications as wireless base station control circuits, optical network control circuits, sensors and controls, precision filters, low-speed signal conditioning for data acquisition systems, and precision instrumentation.

LTA17 is available in both SOIC-8L and MSOP-8L packages. LTA217 is available in SOIC-8L package.

Features and Benefits

- Low Noise: $0.38 \mu\text{V}_{p-p}$ (0.1 Hz to 10 Hz)
- $9.8\text{nV}/\sqrt{\text{Hz}}$ @1kHz
- Low Drift: $0.19\mu\text{V}/^\circ\text{C}$
- $0.33 \text{V}/\mu\text{s}$ Slew Rate
- 0.6 MHz Gain Bandwidth
- Low Input Offset Voltage: $25\mu\text{V}$
- Excellent CMRR: 127 dB
- High Open-Loop Gain: 116 dB

Applications

- Precision Instrumentation
- Test Equipment
- Data Acquisition
- Motor Phase Current Sense
- Transducer Amplifier

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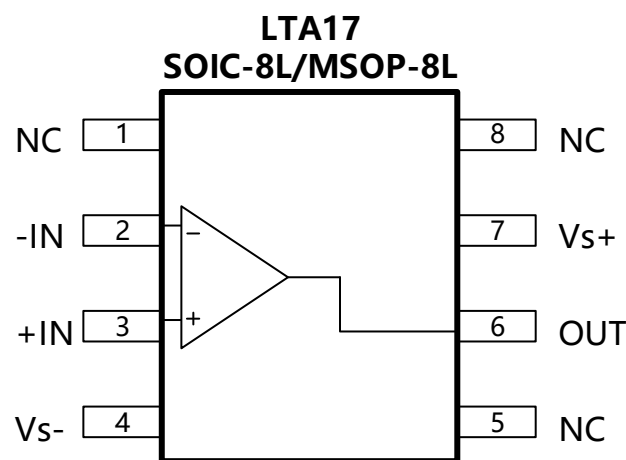
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Ordering Information

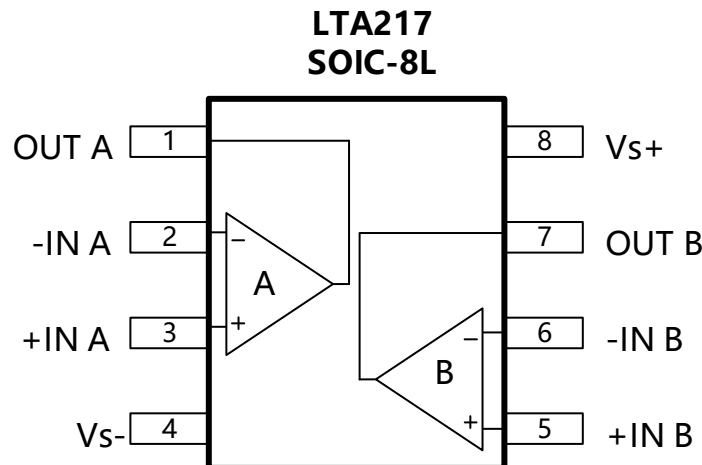
Part Number	Package Type	Package Size	Package Quantity	ECO Class	Mark Code
LTA17XS8/R8	SOIC-8L	4.90 mm * 3.92 mm	Tape and Reel, 4 000	Green (RoHS & no Sb/Br)	HJ17
LTA17XV8/R6	MSOP-8L	3.00 mm * 3.00 mm	Tape and Reel, 3 000	Green (RoHS & no Sb/Br)	HJ17
LTA217XS8/R8	SOIC-8L	4.90 mm * 3.92 mm	Tape and Reel, 4 000	Green (RoHS & no Sb/Br)	HJ217

Pin Configuration (Top View)



PIN Name	SOIC-8L, MSOP-8L	Description
NC	1, 8	No Connection.
-IN	2	Inverting input of the amplifier.
+IN	3	Non-inverting input of the amplifier.
V _{s-}	4	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 5 V to 36 V.
NC	5	No Connection.
OUT	6	Amplifier output.
V _{s+}	7	Positive power supply. The voltage is from 5 V to 36 V. Split supplies are possible as long as the voltage between V _{s+} and V _{s-} is from 5 V to 36 V.

Pin Configuration (Top View)



PIN Name	SOIC-8L	Description
OUT A	1	Amplifier A output.
-IN A	2	Inverting input A of the amplifier.
+IN A	3	Non-inverting input of the amplifier.
V _{s-}	4	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 5 V to 36 V.
+IN B	5	Non-inverting input of the amplifier. This pin has the same voltage range as -IN B.
-IN B	6	Inverting input B of the amplifier. The voltage range is from (V _{s-} - 0.1 V) to (V _{s+} - 1 V).
OUT B	7	Amplifier B output.
V _{s+}	8	Positive power supply. The voltage is from 5 V to 36 V. Split supplies are possible as long as the voltage between V _{s+} and V _{s-} is from 5 V to 36 V.

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Limiting Value

In accordance with the Absolute Maximum Rating System (IEC60134).

Parameter	Absolute Maximum Rating
Supply Voltage, V_{S+} to V_{S-}	40 V
Signal Input Terminals: Voltage	± 20 V
Signal Input Terminals: Current	Current Indefinite
Signal Differential Input Voltage	1.4 V
Output Short-Circuit	80 mA
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 Ratings

Parameter	Level	UNIT
Human body model (HBM), per ANSI/ESDA/JEDEC JS-001	± 2000	V
Charged device model (CDM), per ANSI/ESDA/JEDEC JS-002	± 2000	V

Thermal Information

Thermal Metric	Package	Level	Unit
θ_{JA} Package Thermal Resistance	SOIC-8L	125	°C/W
	MSOP-8L	216	

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Electrical Characteristics

Unless otherwise noted, $T_A=25^\circ\text{C}$, $V_S = \pm 15.0\text{ V}$

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
DC PERFORMANCE						
Input Offset Voltage	V_{OS}	$T_A=25^\circ\text{C}$		0.082		mV
		$T_A=-40^\circ\text{C}\sim 125^\circ\text{C}$			0.25	
Input Offset Voltage vs Temperature	dV_{OS} / dT				0.19	$\mu\text{V}/^\circ\text{C}$
Input Offset Current	I_{OS}	$T_A=25^\circ\text{C}$		0.14	0.36	nA
Input Bias Current	I_B	$T_A=25^\circ\text{C}$		1.8		nA
		$T_A=125^\circ\text{C}$			4.5	
Open-loop voltage gain	A_{VOL}	$V_S=5.0\text{V}$, $T_A=25^\circ\text{C}$		110		dB
		$V_S=5.0\text{V}$, $T_A=-40\sim 125^\circ\text{C}$	104			
		$V_S=30.0\text{V}$, $T_A=25^\circ\text{C}$		116		
		$V_S=30.0\text{V}$, $T_A=-40\sim 125^\circ\text{C}$	114			
NOISE and DISTORTION PERFORMANCE						
Input Voltage Noise Density	e_n	$f = 10\text{Hz}$		10.5		$\text{nV}/\sqrt{\text{Hz}}$
		$f = 100\text{Hz}$		10.2		$\text{nV}/\sqrt{\text{Hz}}$
		$f = 1\text{ kHz}$		9.8		$\text{nV}/\sqrt{\text{Hz}}$
Input Current Noise Density	I_n	$f = 10\text{ Hz}$		0.35		$\text{pA}/\sqrt{\text{Hz}}$
		$f = 100\text{ Hz}$		0.15		$\text{pA}/\sqrt{\text{Hz}}$
		$f = 1\text{ kHz}$		0.13		$\text{pA}/\sqrt{\text{Hz}}$
Input voltage noise	V_n	$f = 0.1\text{ to }10\text{ Hz}$		0.38		μV_{PP}
INPUT CHARACTERISTICS						
Input Common Mode Voltage Range	V_{CM}	$T_A=25^\circ\text{C}$	1.0		$V_S-1.1$	V
		$T_A=-40^\circ\text{C}\sim 125^\circ\text{C}$	1.0		$V_S-1.1$	
Common Mode Rejection Rate	CMRR	$V_S=30.0\text{V}$, $T_A=25^\circ\text{C}$, $V_{cm}=\pm 13\text{V}$		127		dB
		$T_A=-40\sim 125^\circ\text{C}$	122			
OUTPUT						
High output voltage swing	V_{OH}	$R_L=10.00\text{k}\Omega$ to $V_S/2$	± 12.5	± 13		mV
		$R_L=2.00\text{k}\Omega$ to $V_S/2$	± 12	± 12.8		
DYNAMIC PERFORMANCE						
Slew Rate	SR	$A_v=1$		0.33		$\text{V}/\mu\text{s}$
Gain bandwidth product	GBW	$G = 1$	0.4	0.6		MHz
POWER SUPPLY						
Operating Supply Voltage	V_S	$T_A = 25^\circ\text{C}$	3.0		29.9	V
		$T_A=-40\sim 125^\circ\text{C}$	3.0		29.9	
Power Supply Rejection Ratio	PSRR	$V_S=4.0\sim 28.0\text{V}$, $T_A=25^\circ\text{C}$		123		dB
		$T_A=-40\sim 125^\circ\text{C}$	120			
Quiescent Current (Per amplifier)	I_Q	$V_S=5.0\text{V}$, $T_A=25^\circ\text{C}$		1.0	2.0	mA
		$V_S=36.0\text{V}$, $T_A=25^\circ\text{C}$		1.3	2.6	
THERMAL CHARACTERISTICS						
Operating temperature range	T_A		-40		+125	$^\circ\text{C}$

Typical Characteristics

At $T_A = 25^\circ\text{C}$, $V_S = \pm 15\text{ V}$, unless otherwise noted.

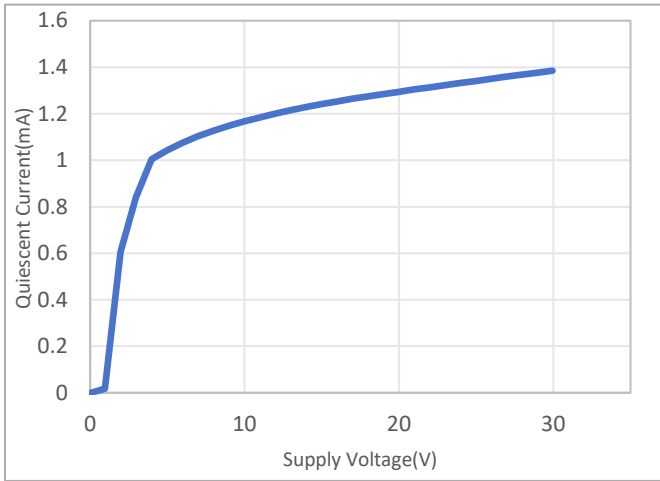


Figure 1. Quiescent Current vs Supply

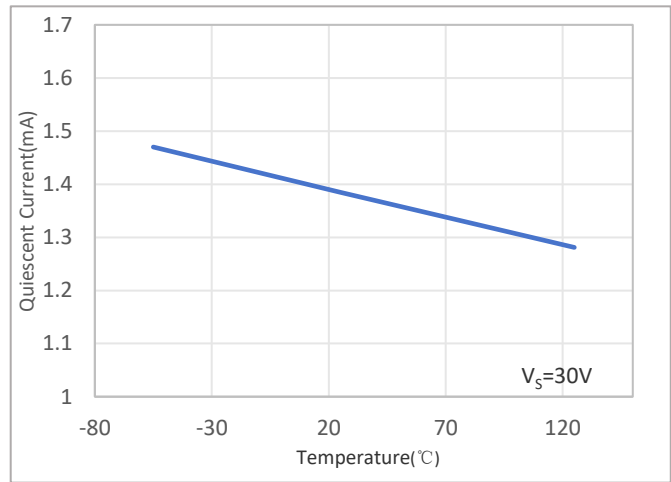


Figure 2. Quiescent Current vs Temperature

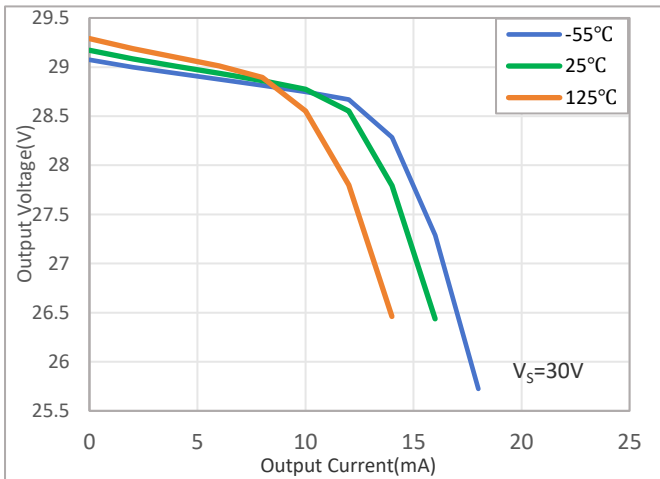


Figure 3. Output Voltage Swing as a function of Output Current (Sourcing, $V_S = 30\text{ V}$)

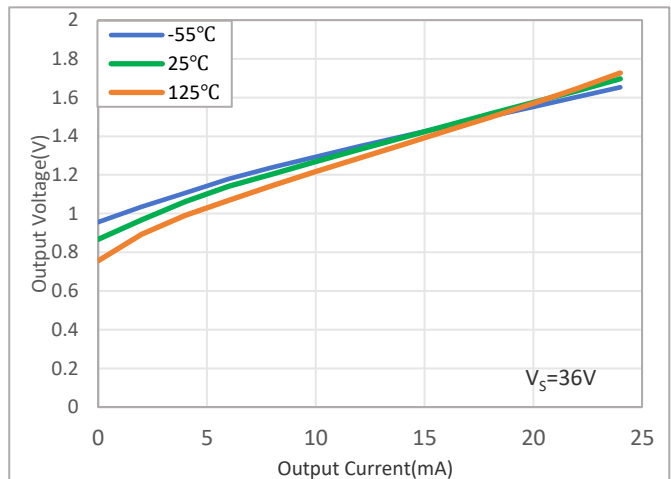


Figure 4. Output Voltage Swing as a function of Output Current (Sinking, $V_S = 30\text{ V}$)

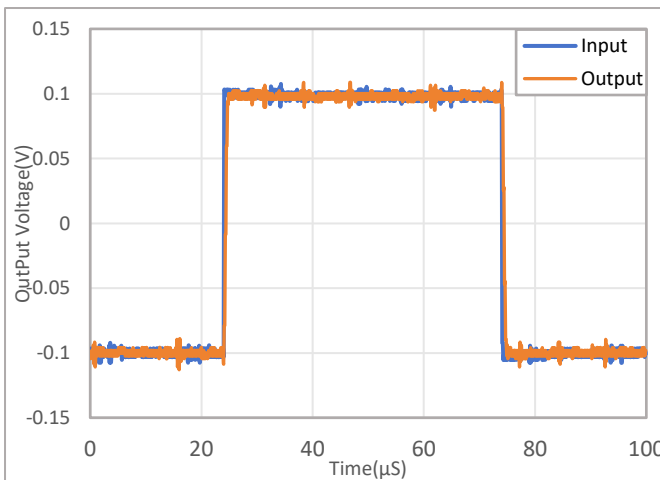


Figure 5. Small-Signal Step Response

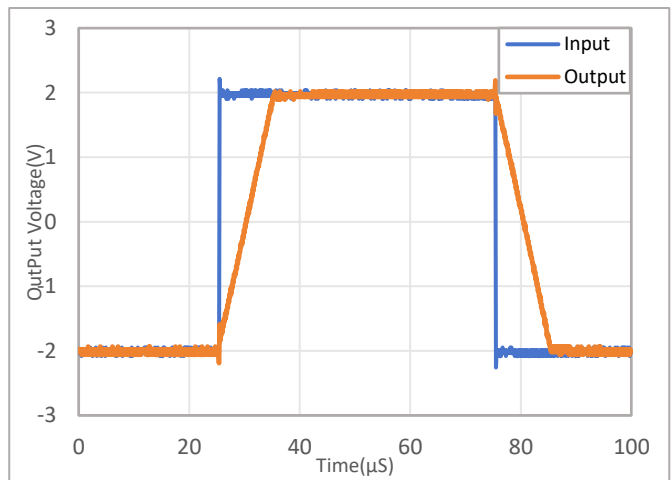


Figure 6. Large-Signal Step Response

Typical Characteristics

At $T_A = 25^\circ\text{C}$, $V_S = \pm 15\text{ V}$, unless otherwise noted.

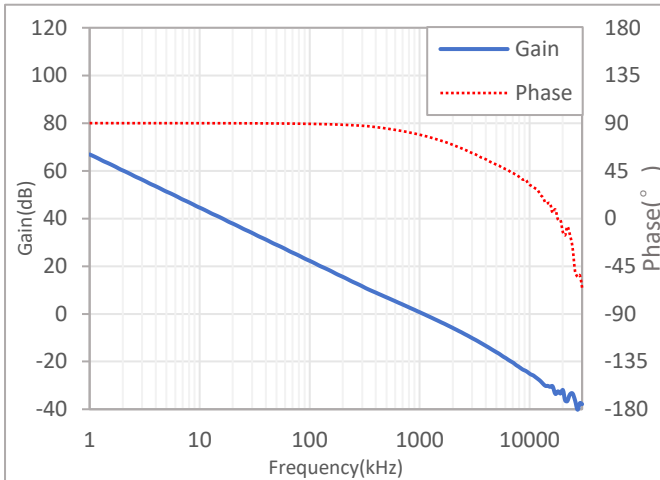


Figure 7. Open-Loop Gain and Phase vs. Frequency

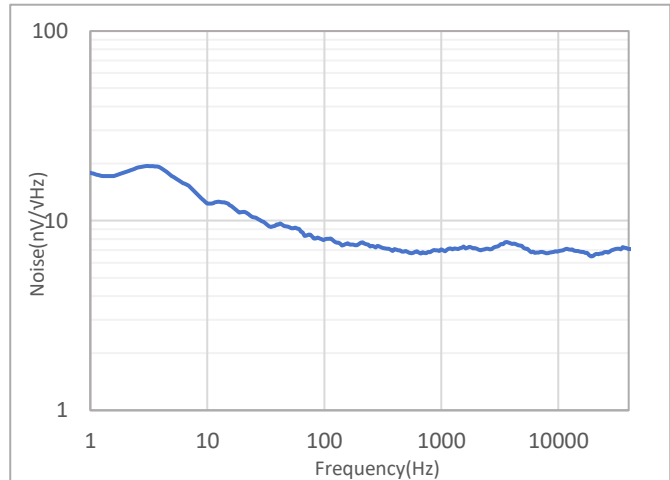


Figure 8. Voltage Noise Density vs. Frequency

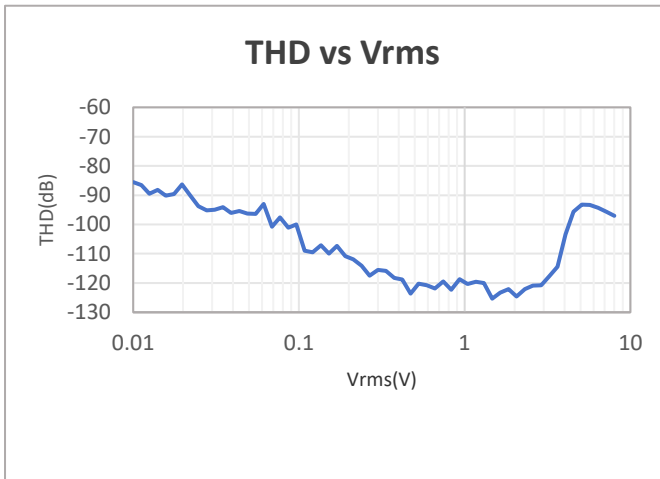


Figure 9. THD Test Results

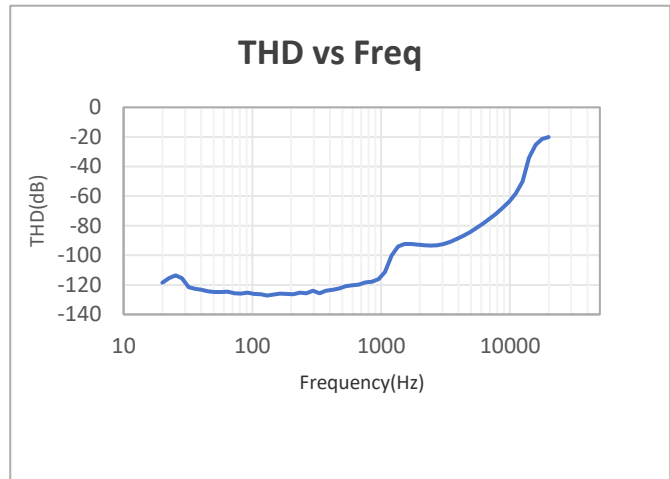


Figure 10. THD+N Test Results

Application Notes

LTA17 Series Op-Amps could be a good replacement of OP07, without removal of external compensation or nulling components. Additionally, the LTA17 may be fitted to unnullled 741 type sockets; however, if conventional 741 nulling circuitry is in use, it should be modified or removed to ensure correct LTA17 operation. LTA17 offset voltage may be nulled to zero (or other desired setting) using a potentiometer. The LTA17 provides stable operation with load capacitances of up to 1000 pF and $\pm 10V$ swings; larger capacitances should be decoupled with a 50 Ω resistor inside the feedback loop. Thermoelectric voltages generated by dissimilar metals at the input terminal contacts can degrade the drift performance. Best operation will be obtained when both input contacts are maintained at the same temperature.

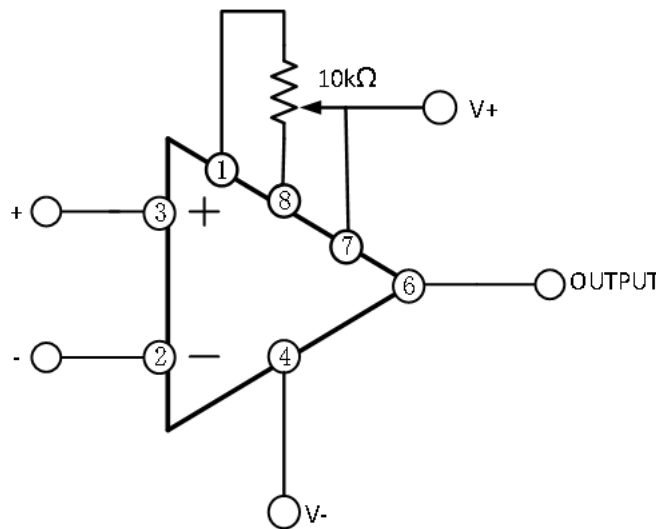


Figure 17 Offset Nulling Circuit

Offset Voltage Adjustment

The input offset voltage of the LTA17 is trimmed at wafer level. However, if further adjustment of V_{os} is necessary, a 10 k Ω trim potentiometer may be used. TCV_{os} is not degraded (see offset nulling circuit). Other potentiometer values from 1 k Ω to 1 M Ω can be used with a slight degradation (0.1 $\mu V/^{\circ}C$ to 0.2 $\mu V/^{\circ}C$) of TCV_{os} . Trimming to a value other than zero creates a drift of approximately $(V_{os}/300)$ $\mu V/^{\circ}C$. For example, the change in TCV_{os} will be 0.33 $\mu V/^{\circ}C$ if V_{os} is adjusted to 100 μV . The offset voltage adjustment range with a 10 k Ω potentiometer is ± 4 mV. If smaller adjustment range is required, the nulling sensitivity can be reduced by using a smaller pot in conjunction with fixed resistors. For example, the network shown in figure 18 will have a ± 280 μV adjustment range.

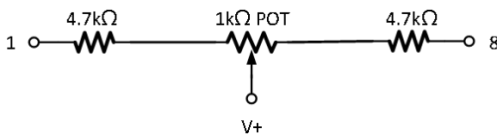


Figure 18 Offset Voltage Adjustment

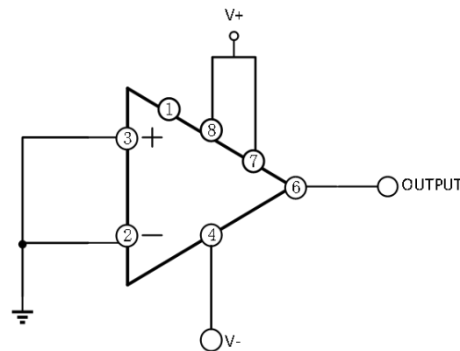
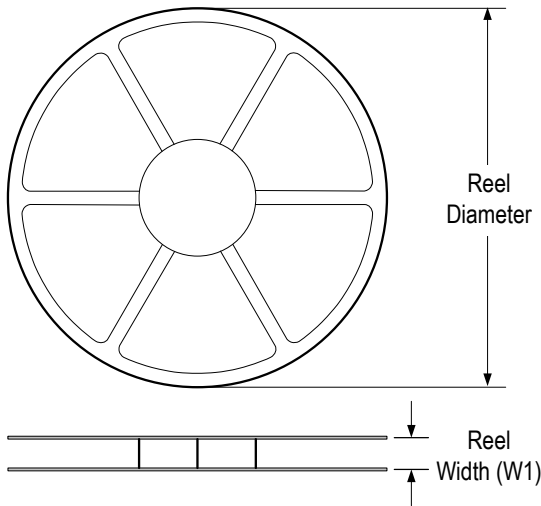


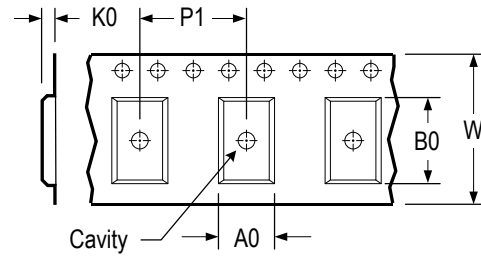
Figure 19 Burn-In Circuit

Tape and Reel Information

REEL DIMENSIONS

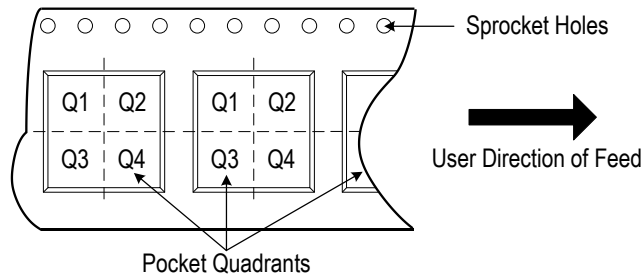


TAPE DIMENSIONS



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

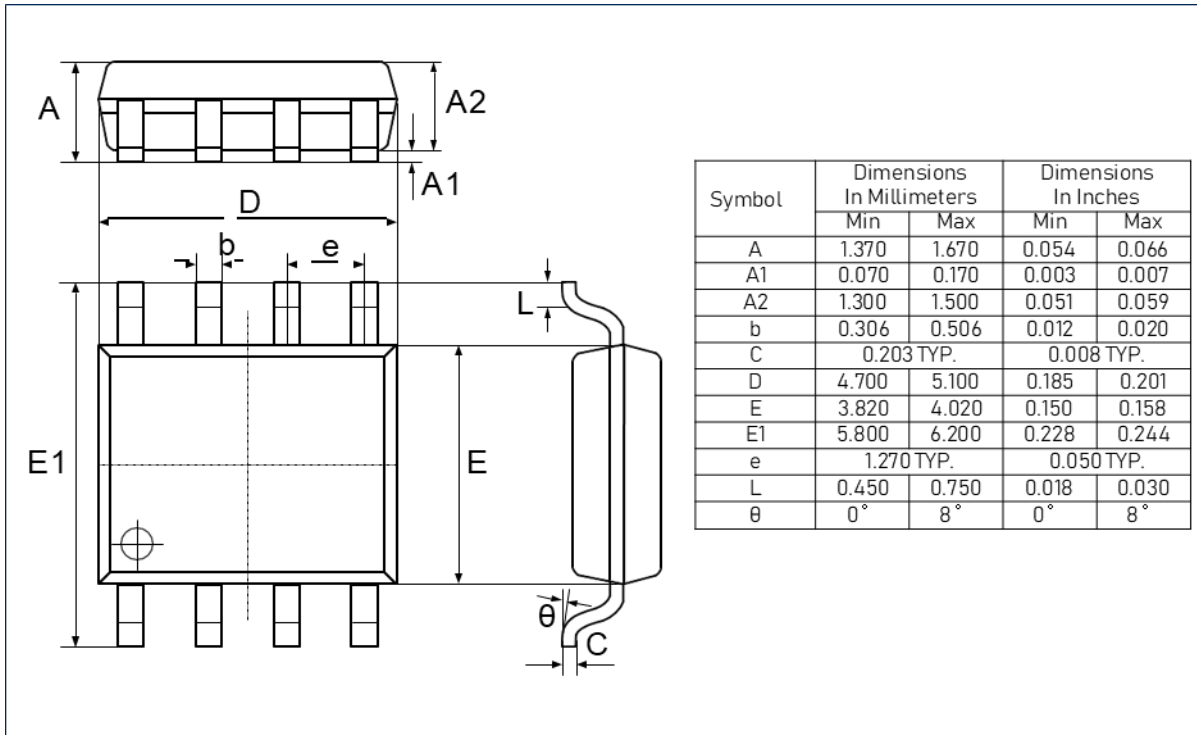


* All dimensions are nominal

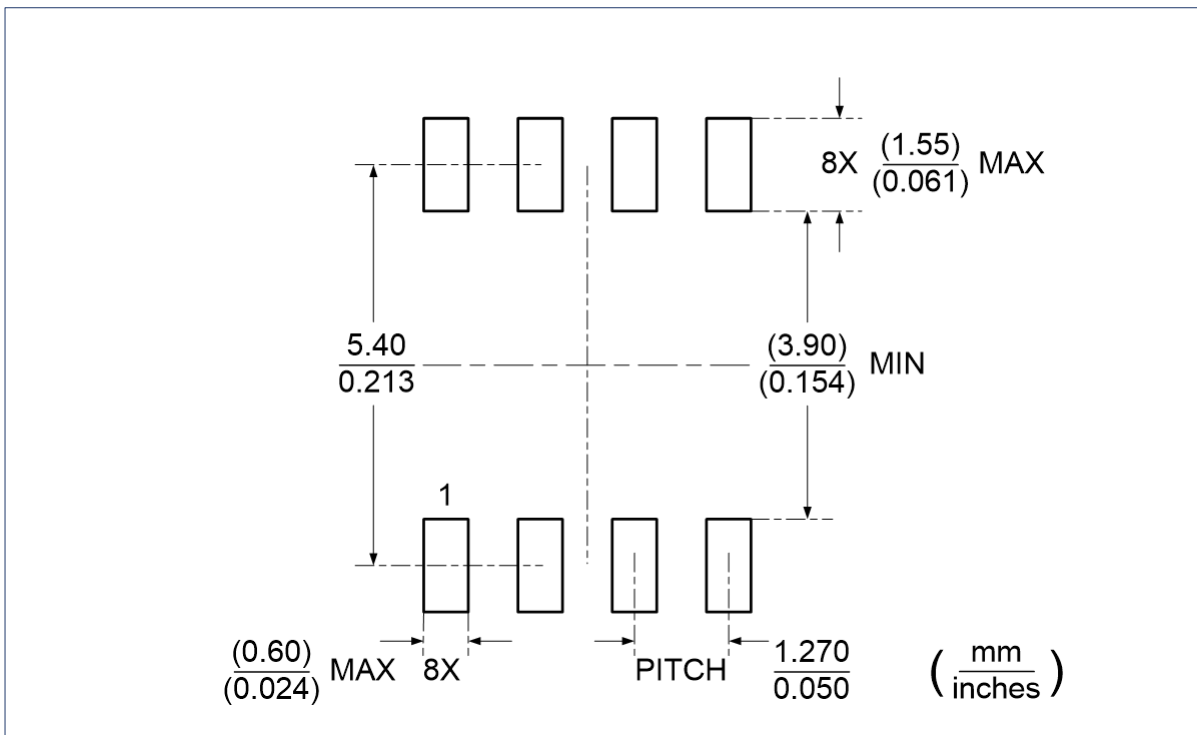
Device	Package Type	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin 1 Quadrant
LTA17XS8/R8	SOIC	8	4 000	330	12.5	6.6	5.3	2.0	8.0	12.0	Q1
LTA17XV8/R6	MSOP	8	3 000	330	12.5	5.0	3.5	2.0	8.0	12.0	Q1
LTA217XS8/R8	SOIC	8	4 000	330	12.5	6.6	5.3	2.0	8.0	12.0	Q1

Package Outlines

DIMENSIONS, SOIC-8L

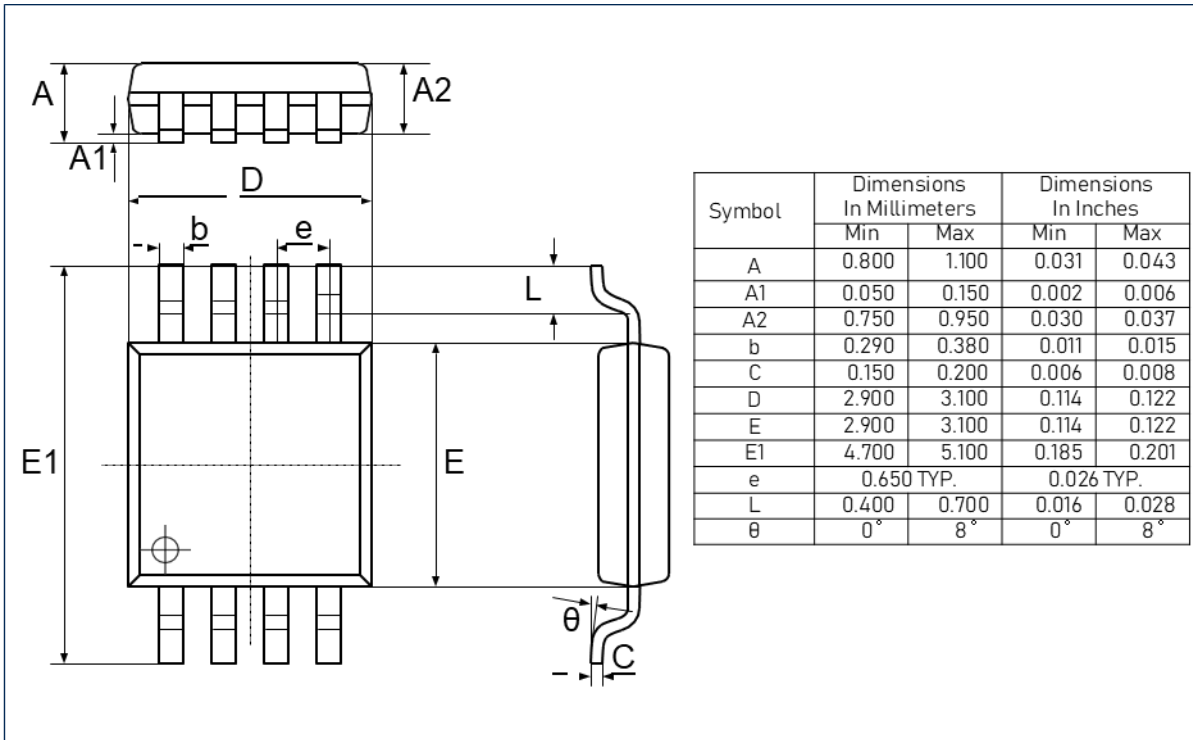


RECOMMENDED SOLDERING FOOTPRINT, SOIC-8L

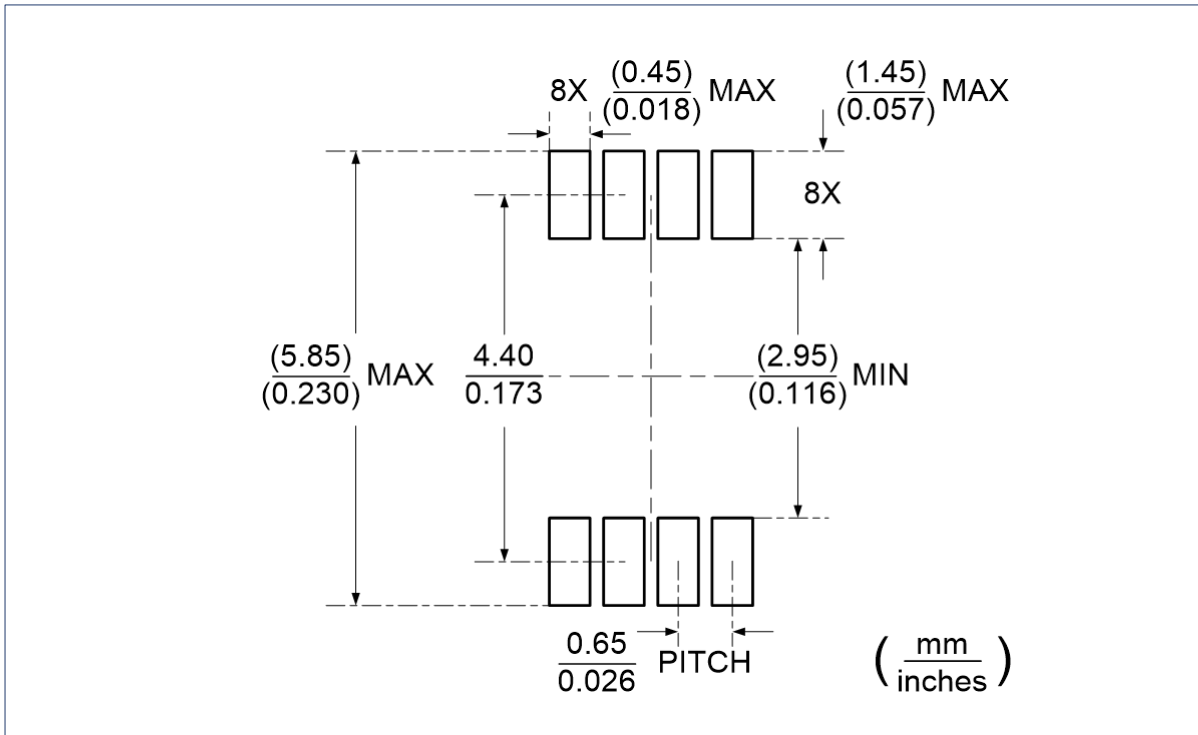


Package Outlines (cont.)

DIMENSIONS, MSOP-8L



RECOMMENDED SOLDERING FOOTPRINT, MSOP-8L



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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.