

General Description

LTP8P45 is a CMOS low dropout (LDO) linear regulator that operates within a voltage range of 2.7V to 40V and can provide up to 450mA of output current. This high input voltage LDO is highly suitable for regulating high-performance analog and mixed signal circuits operating on tracks from 39V to 1.2V. This device adopts an advanced proprietary architecture, providing high power-supply rejection, low noise and achieving excellent line and load transient response through a small ceramic output capacitor of 2.2 μ F. For fixed options of 5V or lower, the LTP8P45 regulator output noise is 8.5 μ Vrms, independent of the output voltage. LTP8P45 offers multiple fixed output voltage options such as 1.2 V (adjustable), 1.8 V, 2.5 V, 3.3 V and 5.0 V.

The main package types of LTP8P45 are SOT23-5L, ESOP-8L, MSOP-8L, DFN2x2-6L and DFN3x3-8L. All package types operate within a temperature range of -40°C to 125°C.

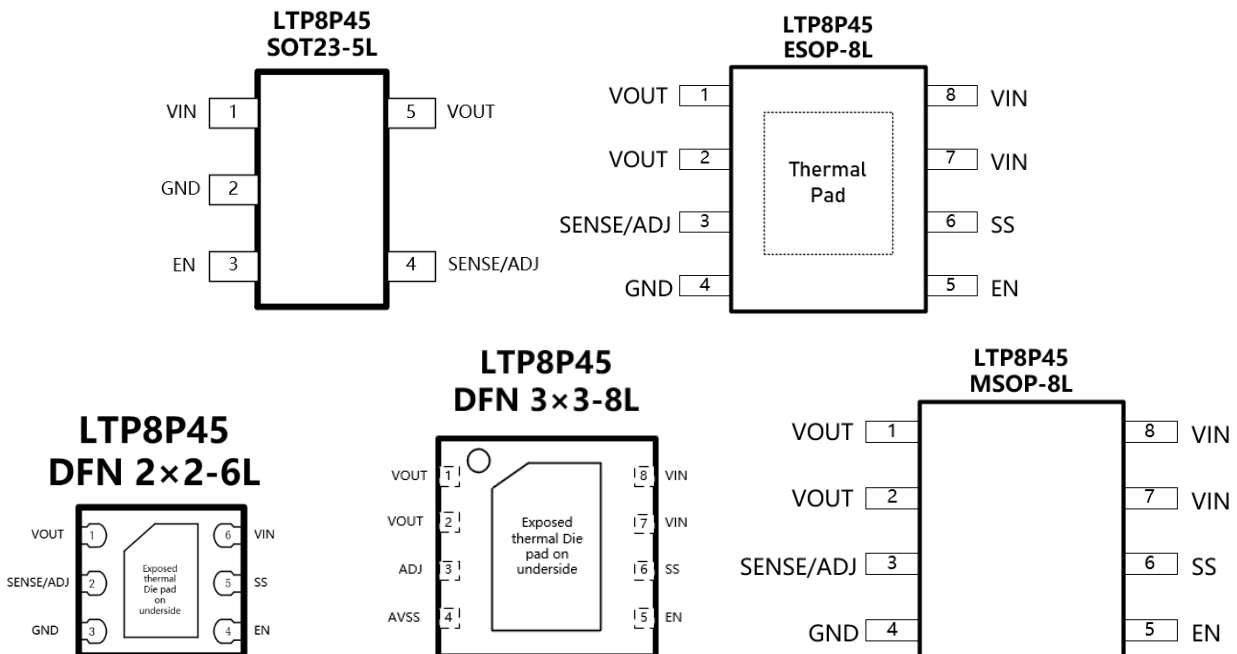
Features and Benefits

- PSRR of 86 dB at 10 kHz, 72 dB at 100 kHz, 64 dB at 1 MHz, $V_{OUT} = 5$ V, $V_{IN} = 7$ V
- Input voltage range: 2.7 V to 40 V
- Low shutdown current: 2.2 μ A at $EN = GND$ at $V_{IN} = 40$ V
- Fixed output voltage options: 1.2 V (adjustable), 1.8 V, 2.5 V, 3.3 V and 5.0 V

Applications

- Regulation to noise sensitive applications
-ADC, DAC circuits, precision amplifiers, power for V_{CO} V_{TUNE}
- Communications and infrastructure
- Medical and healthcare
- Industrial and instrumentation
- Automotive

Pin Configuration (Top View)



Pin Description

Symbol	Description
VIN	Regulator Input Supply. Bypass VIN to GND with a 2.2 μ F or greater capacitor.
VOUT	Regulated Output Voltage. Bypass VOUT to GND with a 2.2 μ F or greater capacitor.
GND	Ground.
EN	The Enable Pin Controls the Operation of the LDO. Drive EN high to turn on the regulator. Drive EN low to turn off the regulator. For automatic startup, connect EN to VIN.
SENSE/ADJ	Sense Input (SENSE). Connect to load. An external resistor divider may also be used to set the output voltage higher than the fixed output voltage (ADJ).
SS	Soft Start. An external capacitor connected to this pin determines the soft-start time. Leave this pin open for a typical 300 μ s start-up time. Do not ground this pin.

Absolute Maximum Ratings

Parameter	Absolute Maximum Rating
VIN to GND	-0.3 V to +44V
VOUT to GND	-0.3 V to VIN
EN to GND	-0.3 V to +44V
SENSE/ADJ to GND	-0.3 V to +6V
SS to GND	-0.3 V to VIN or +6V (whichever is less)
Storage Temperature Range, T _{stg}	-65°C to +150°C
Junction Temperature, T _j	150 °C
Operating Ambient Temperature (T _A) Range	-40°C to +125°C

ESD Rating

Parameter	Item	Value	Unit
Electrostatic Discharge Voltage	Human body model (HBM), per ANSI/ESDA/JEDEC JS-001	± 2500	V
	Charged device model (CDM), per ANSI/ESDA/JEDEC JS-002	± 2000	

Ordering Information

Type Number	Package Name	Package Quantity	Eco Class	Marking Code
LTP8P45-ANXT5/R6	SOT23-5L	Tape and Reel, 3 000	Green (RoHS & no Sb/Br)	P45A
LTP8P45-18NXT5/R6	SOT23-5L	Tape and Reel, 3 000	Green (RoHS & no Sb/Br)	P4518
LTP8P45-25NXT5/R6	SOT23-5L	Tape and Reel, 3 000	Green (RoHS & no Sb/Br)	P4525
LTP8P45-33NXT5/R6	SOT23-5L	Tape and Reel, 3 000	Green (RoHS & no Sb/Br)	P4533
LTP8P45-50NXT5/R6	SOT23-5L	Tape and Reel, 3 000	Green (RoHS & no Sb/Br)	P4550
LTP8P45-AEXS8/R8	ESOP-8L	Tape and Reel, 4 000	Green (RoHS & no Sb/Br)	P45A
LTP8P45-18EXS8/R8	ESOP-8L	Tape and Reel, 4 000	Green (RoHS & no Sb/Br)	P4518
LTP8P45-25EXS8/R8	ESOP-8L	Tape and Reel, 4 000	Green (RoHS & no Sb/Br)	P4525
LTP8P45-33EXS8/R8	ESOP-8L	Tape and Reel, 4 000	Green (RoHS & no Sb/Br)	P4533
LTP8P45-50EXS8/R8	ESOP-8L	Tape and Reel, 4 000	Green (RoHS & no Sb/Br)	P4550
LTP8P45-AXV8/R6	MSOP-8L	Tape and Reel, 3 000	Green (RoHS & no Sb/Br)	P45A
LTP8P45-18XV8/R6	MSOP-8L	Tape and Reel, 3 000	Green (RoHS & no Sb/Br)	P4518
LTP8P45-25XV8/R6	MSOP-8L	Tape and Reel, 3 000	Green (RoHS & no Sb/Br)	P4525
LTP8P45-33XV8/R6	MSOP-8L	Tape and Reel, 3 000	Green (RoHS & no Sb/Br)	P4533
LTP8P45-50XV8/R6	MSOP-8L	Tape and Reel, 3 000	Green (RoHS & no Sb/Br)	P4550
LTP8P45-AXF8/R10	DFN3x3-8L	Tape and Reel, 5 000	Green (RoHS & no Sb/Br)	P45A
LTP8P45-18XF8/R10	DFN3x3-8L	Tape and Reel, 5 000	Green (RoHS & no Sb/Br)	P4518
LTP8P45-25XF8/R10	DFN3x3-8L	Tape and Reel, 5 000	Green (RoHS & no Sb/Br)	P4525
LTP8P45-33XF8/R10	DFN3x3-8L	Tape and Reel, 5 000	Green (RoHS & no Sb/Br)	P4533
LTP8P45-50XF8/R10	DFN3x3-8L	Tape and Reel, 5 000	Green (RoHS & no Sb/Br)	P4550
LTP8P45-AXF6/R6	DFN2x2-6L	Tape and Reel, 3 000	Green (RoHS & no Sb/Br)	P45A
LTP8P45-18XF6/R6	DFN2x2-6L	Tape and Reel, 3 000	Green (RoHS & no Sb/Br)	P4518
LTP8P45-25XF6/R6	DFN2x2-6L	Tape and Reel, 3 000	Green (RoHS & no Sb/Br)	P4525
LTP8P45-33XF6/R6	DFN2x2-6L	Tape and Reel, 3 000	Green (RoHS & no Sb/Br)	P4533
LTP8P45-50XF6/R6	DFN2x2-6L	Tape and Reel, 3 000	Green (RoHS & no Sb/Br)	P4550

Electrical Characteristics

$V_{IN} = V_{OUT} + 1\text{ V}$ or 2.7 V , whichever is greater, $V_{OUT} = 5\text{ V}$, $EN = V_{IN}$, $I_{OUT} = 10\text{ mA}$, $C_{IN} = C_{OUT} = 2.2\text{ }\mu\text{F}$, $C_{SS} = 0\text{ pF}$, $T_A = 25^\circ\text{C}$ for typical specifications, $T_J = -40^\circ\text{C}$ to $+125^\circ\text{C}$ for minimum/maximum specifications, unless otherwise noted.

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Input Voltage Range	V_{IN}		2.7		40	V
Operating Supply Current	I_{GND}	$I_{OUT} = 0\text{ }\mu\text{A}$		190	250	μA
		$I_{OUT} = 200\text{ mA}$		591	700	
Shutdown Current	I_{GND-SD}	$EN = GND$		1.8		μA
		$EN = GND$, $V_{IN} = 40\text{ V}$		2.2	10	
Output Voltage Accuracy	V_{OUT}	$I_{OUT} = 10\text{ mA}$, $T_J = 25^\circ\text{C}$	-0.8		+0.8	%
		$100\text{ }\mu\text{A} < I_{OUT} < 200\text{ mA}$, $V_{IN} = (V_{OUT} + 1\text{ V})$ to 40 V , $T_J = -40^\circ\text{C}$ to $+85^\circ\text{C}$	-1.2		+1.5	
		$100\text{ }\mu\text{A} < I_{OUT} < 200\text{ mA}$, $V_{IN} = (V_{OUT} + 1\text{ V})$ to 40 V , $T_J = -40^\circ\text{C}$ to $+125^\circ\text{C}$	-1.8		+1.8	
Line Regulation	$\Delta V_{OUT} / \Delta V_{IN}$	$V_{IN} = (V_{OUT} + 1\text{ V})$ to 40 V	-0.01		+0.01	%/V
Load Regulation	$\Delta V_{OUT} / \Delta I_{OUT}$	$I_{OUT} = 100\text{ }\mu\text{A}$ to 200 mA		0.002	0.004	%/mA
Sense Input Bias Current	$SENSE_{1-BIAS}$	$100\text{ }\mu\text{A} < I_{OUT} < 200\text{ mA}$, $V_{IN} = (V_{OUT} + 1\text{ V})$ to 40 V		10	1000	nA
Dropout Voltage	$V_{DROPOUT}$	$I_{OUT} = 10\text{ mA}$		12	30	mV
		$I_{OUT} = 200\text{ mA}$		120	200	
Start-up Time	$T_{Start-up}$	$V_{OUT} = 5\text{ V}$		300		μs
Soft Start Source Current	$SS_{1-SOURCE}$	$SS = GND$		1.15		μA
Current-Limit Threshold	I_{LIMIT}		500	600	850	mA
Thermal Shutdown	TS_{SD}	T_J rising		150		$^\circ\text{C}$
	TS_{SD-HYS}	T_J falling		15		
Undervoltage Thresholds	$UVLO_{RISE}$				2.69	V
	$UVLO_{FALL}$		2.2			
	$UVLO_{HYS}$			160		mV

Electrical Characteristics (continued)

$V_{IN} = V_{OUT} + 1\text{ V}$ or 2.7 V , whichever is greater, $V_{OUT} = 5\text{ V}$, $EN = V_{IN}$, $I_{OUT} = 10\text{ mA}$, $C_{IN} = C_{OUT} = 2.2\text{ }\mu\text{F}$, $C_{SS} = 0\text{ pF}$, $T_A = 25^\circ\text{C}$ for typical specifications, $T_J = -40^\circ\text{C}$ to $+125^\circ\text{C}$ for minimum/maximum specifications, unless otherwise noted.

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Precision EN Input	EN_{HIGH}	$2.7\text{ V} \leq V_{IN} \leq 40\text{ V}$	0.99	1.05	1.12	V
	EN_{LOW}	$2.7\text{ V} \leq V_{IN} \leq 40\text{ V}$	0.81	0.87	0.93	
	EN_{HYS}	$2.7\text{ V} \leq V_{IN} \leq 40\text{ V}$		180		mV
	I_{EN-LKG}	$EN = V_{IN}$ to GND		0.12	1	μA
	T_{EN-DLY}	From EN rising from 0 V to V_{IN} to $0.1 \cdot V_{OUT}$		234		μs
OUTPUT NOISE	OUT_{NOISE}	10 Hz to 100kHz, all output voltage options		8.5		μV_{rms}
Power Supply Rejection Ratio	PSRR	1MHz, $V_{IN}=7\text{ V}$, $V_{OUT}=5\text{ V}$		64		dB
		100 kHz, $V_{IN}=7\text{ V}$, $V_{OUT}=5\text{ V}$		72		
		10 kHz, $V_{IN}=7\text{ V}$, $V_{OUT}=5\text{ V}$		86		

Theory of Operation

The LTP8P45 is available in five output-voltage options, including one adjustable version (1.2 V) and four fixed versions (1.8 V, 2.5 V, 3.3 V and 5.0 V). The LTP8P45 architecture allows any fixed output voltage to be set to a higher voltage with an external voltage divider. For example, a fixed 5 V output can be set to a 6 V output according to the following equation:

$$V_{OUT} = 5 \text{ V} (1 + R_1/R_2) \quad (1)$$

where R_1 and R_2 are the resistors in the output voltage divider shown in Figure 2.

To set the output voltage of the adjustable LTP8P45, replace 5 V in Equation 1 with 1.2 V. (The schematic is shown in Figure 1).

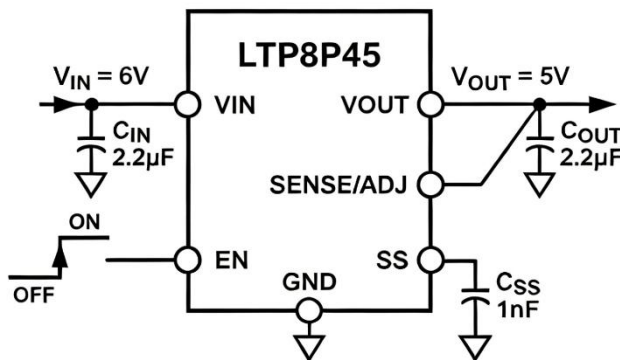


Figure 1. LTP8P45 with Fixed Output Voltage, 5 V

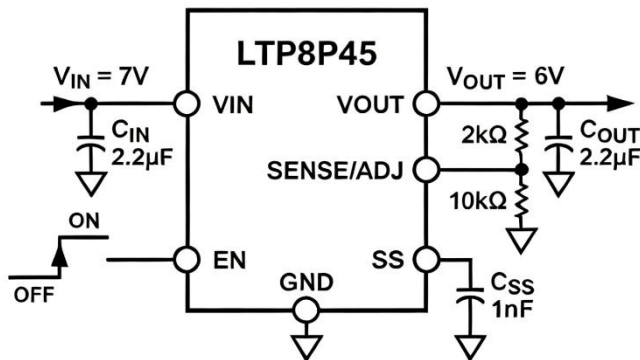


Figure 2. LTP8P45 with 5 V Output Adjusted to 6 V

It is recommended that the R_2 value be less than 200 kΩ to minimize errors in the output voltage caused by the SENSE/ADJ pin input current. For example, when R_1 and R_2 each equal 200 kΩ and the default output voltage is 1.2 V, the adjusted output voltage is 2.4 V. The output voltage error introduced by the SENSE/ADJ pin input current is 2 mV or 0.083%, assuming a typical SENSE/ADJ pin input current of 10 nA at 25°C.

The LTP8P45 uses the EN pin to enable and disable the VOUT pin under normal operating conditions. When EN is high, VOUT turns on, and when EN is low, VOUT turns off. For automatic startup, EN can be tied to VIN.

Applications Information

Soft Start

An external capacitor connected to the SS pin determines the soft start time. The SS pin can be left open for a typical 300 μ s start-up time. Do not ground this pin. When an external soft start capacitor (C_{SS}) is used, the soft start time is determined by the following equation:

$$SS_{TIME} \text{ (sec)} = t_{STARTUP \text{ (0 pF)}} + (0.6V \times C_{SS})/I_{SS} \quad (2)$$

where:

$t_{STARTUP \text{ (at 0 pF)}}$ is the start-up time at C_{SS} = 0 pF (typically 300 μ s).

C_{SS} is the soft start capacitor (F).

I_{SS} is the soft start current (typically 1.15 μ A).

Typical Characteristics

$V_{IN} = V_{OUT} + 1\text{ V}$ or 2.7 V , whichever is greater, $V_{OUT} = 3.3\text{ V}$, $EN = V_{IN}$, $I_{OUT} = 10\text{ mA}$, $C_{IN} = C_{OUT} = 2.2\text{ }\mu\text{F}$, $C_{SS} = 0\text{ pF}$, $T_A = 25^\circ\text{C}$ for typical specifications, $T_J = -40^\circ\text{C}$ to $+125^\circ\text{C}$ for minimum/maximum specifications, unless otherwise noted.

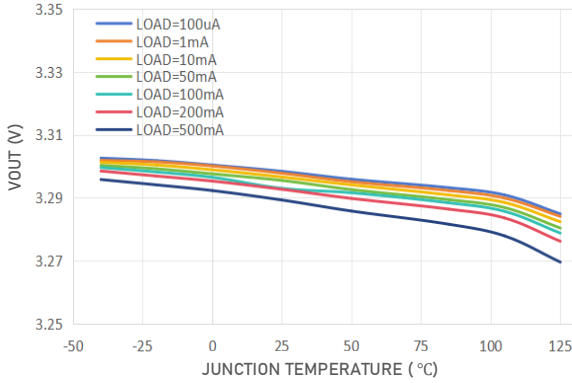


Figure 1. Output Voltage (V_{OUT}) vs. Junction Temperature, $V_{OUT} = 3.3\text{ V}$

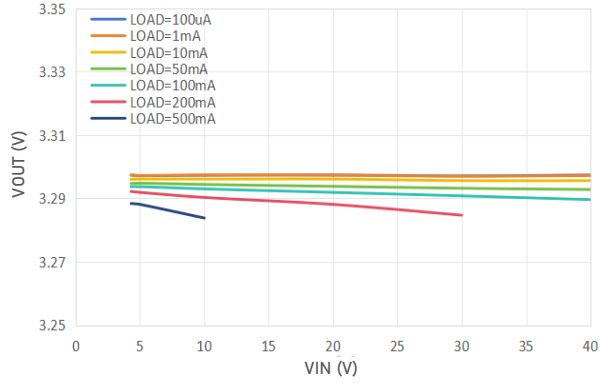


Figure 2. Output Voltage (V_{OUT}) vs. Input Voltage (V_{IN}), $V_{OUT} = 3.3\text{ V}$

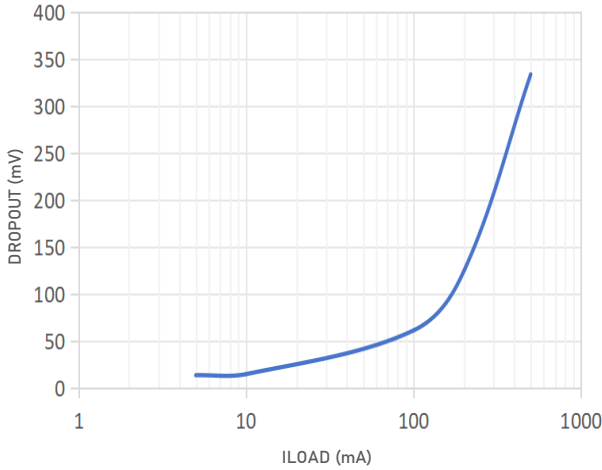


Figure 3. Dropout Voltage vs. Load Current (I_{LOAD}), $V_{OUT} = 3.3\text{ V}$

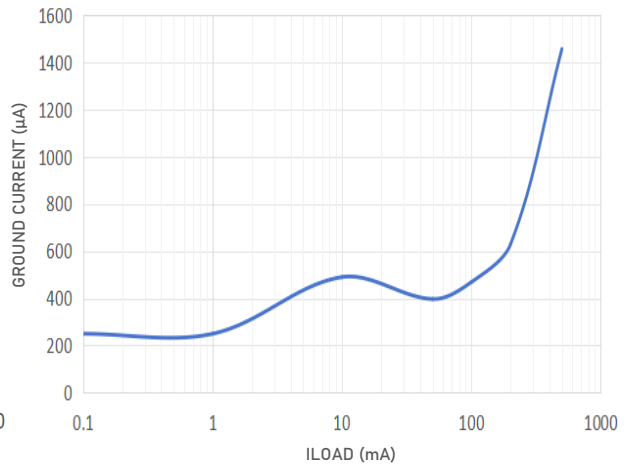


Figure 4. Ground Current vs. Load Current (I_{LOAD}), $V_{OUT} = 3.3\text{ V}$

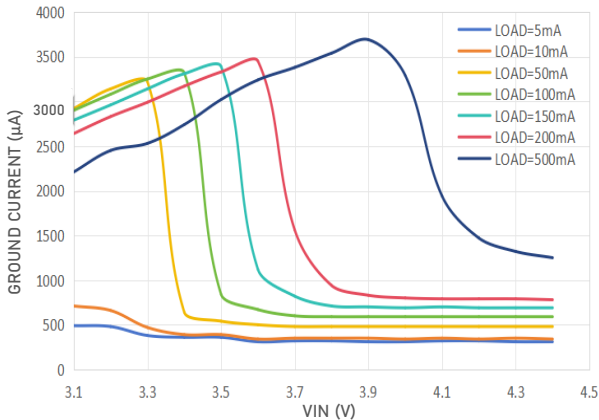


Figure 5. Ground Current vs. Input Voltage (V_{IN}) in Dropout, $V_{OUT} = 3.3\text{ V}$

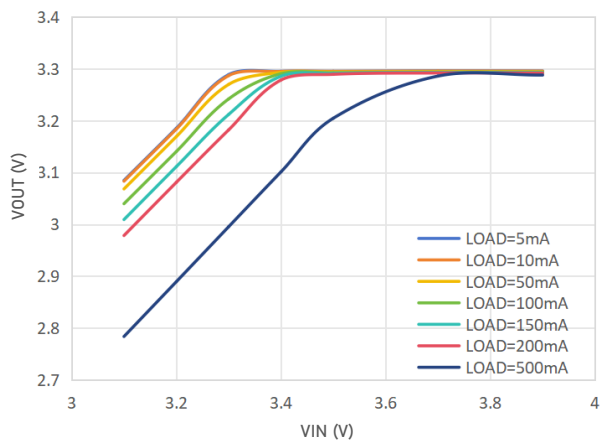


Figure 6. Output Voltage (V_{OUT}) vs. Input Voltage (V_{IN}) in Dropout, $V_{OUT} = 3.3\text{ V}$

Typical Characteristics (continued)

$V_{IN} = V_{OUT} + 1\text{ V}$ or 2.7 V , whichever is greater, $V_{OUT} = 5\text{ V}$, $EN = V_{IN}$, $I_{OUT} = 10\text{ mA}$, $C_{IN} = C_{OUT} = 2.2\text{ }\mu\text{F}$, $C_{SS} = 0\text{ pF}$, $T_A = 25^\circ\text{C}$ for typical specifications, $T_J = -40^\circ\text{C}$ to $+125^\circ\text{C}$ for minimum/maximum specifications, unless otherwise noted.

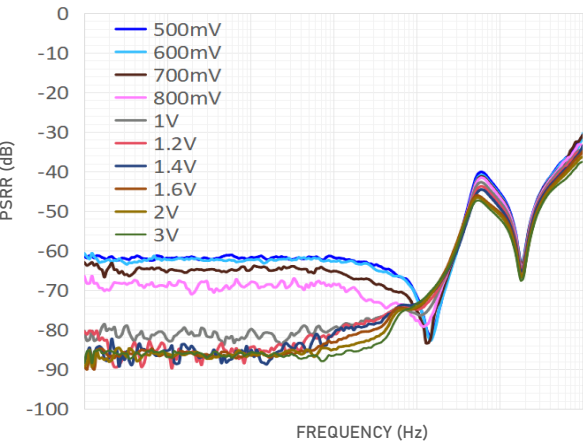


Figure 7. Power Supply Rejection Ratio (PSRR) vs. Frequency, $V_{OUT} = 3.3\text{ V}$, for Various Headroom Voltages

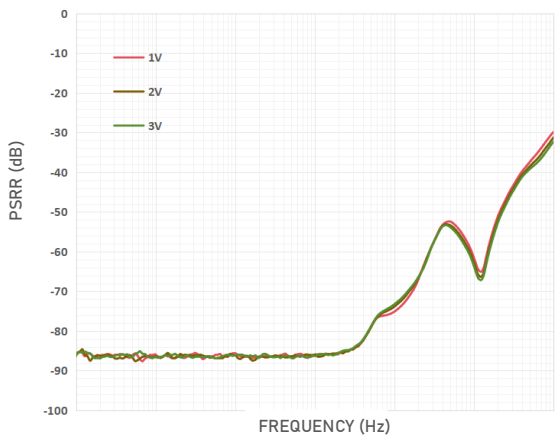


Figure 8. Power Supply Rejection Ratio (PSRR) vs. Frequency, $V_{OUT} = 5\text{ V}$, for Various Headroom Voltages

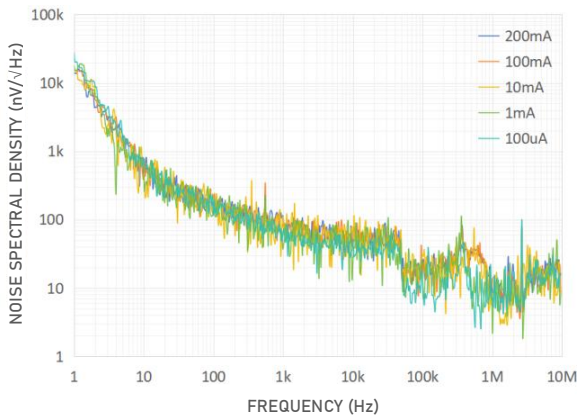
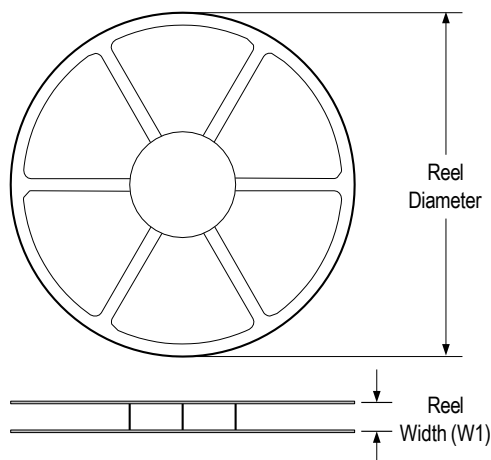


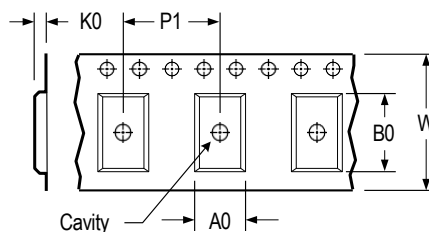
Figure 9. Output Noise Spectral Density vs. Frequency, for Different Loads

Tape and Reel Information

REEL DIMENSIONS

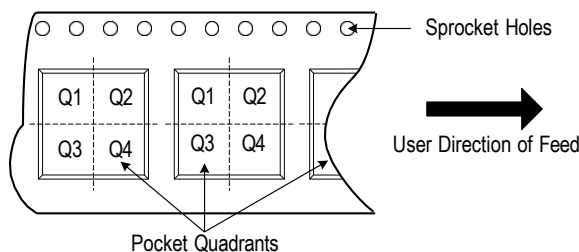


TAPE DIMENSIONS



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

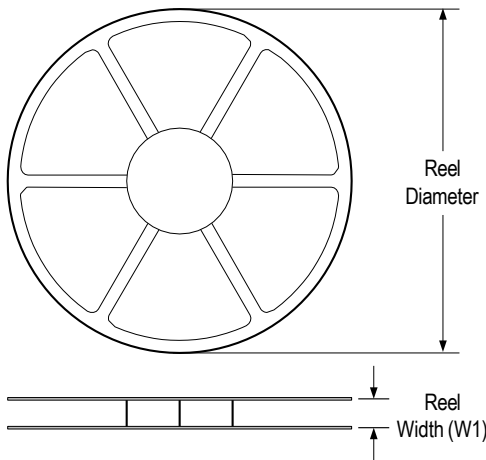


* All dimensions are nominal.

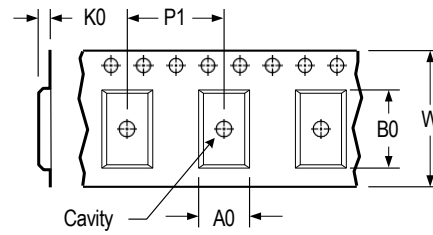
Device	Package Type	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin 1 Quadrant
LTP8P45-ANXT5/R6	SOT23	5	3 000	178	9.5	3.3	3.2	1.5	4.0	8.0	Q3
LTP8P45-18NXT5/R6	SOT23	5	3 000	178	9.5	3.3	3.2	1.5	4.0	8.0	Q3
LTP8P45-25NXT5/R6	SOT23	5	3 000	178	9.5	3.3	3.2	1.5	4.0	8.0	Q3
LTP8P45-33NXT5/R6	SOT23	5	3 000	178	9.5	3.3	3.2	1.5	4.0	8.0	Q3
LTP8P45-50NXT5/R6	SOT23	5	3 000	178	9.5	3.3	3.2	1.5	4.0	8.0	Q3
LTP8P45-AEXS8/R8	ESOP	8	4 000	330	12.5	6.6	5.3	2.0	8.0	12.0	Q1
LTP8P45-18EXS8/R8	ESOP	8	4 000	330	12.5	6.6	5.3	2.0	8.0	12.0	Q1
LTP8P45-25EXS8/R8	ESOP	8	4 000	330	12.5	6.6	5.3	2.0	8.0	12.0	Q1
LTP8P45-33EXS8/R8	ESOP	8	4 000	330	12.5	6.6	5.3	2.0	8.0	12.0	Q1
LTP8P45-50EXS8/R8	ESOP	8	4 000	330	12.5	6.6	5.3	2.0	8.0	12.0	Q1

Tape and Reel Information (continued)

REEL DIMENSIONS

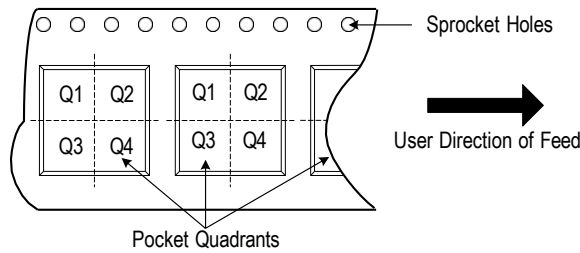


TAPE DIMENSIONS



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

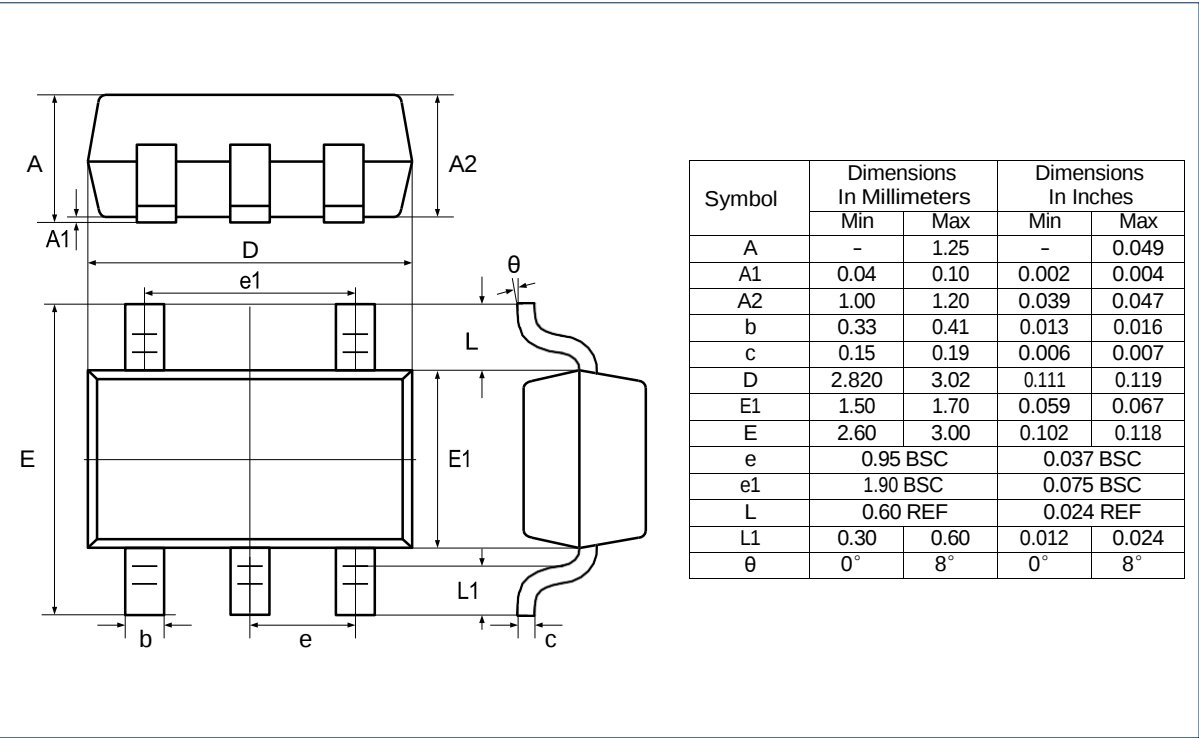


* All dimensions are nominal.

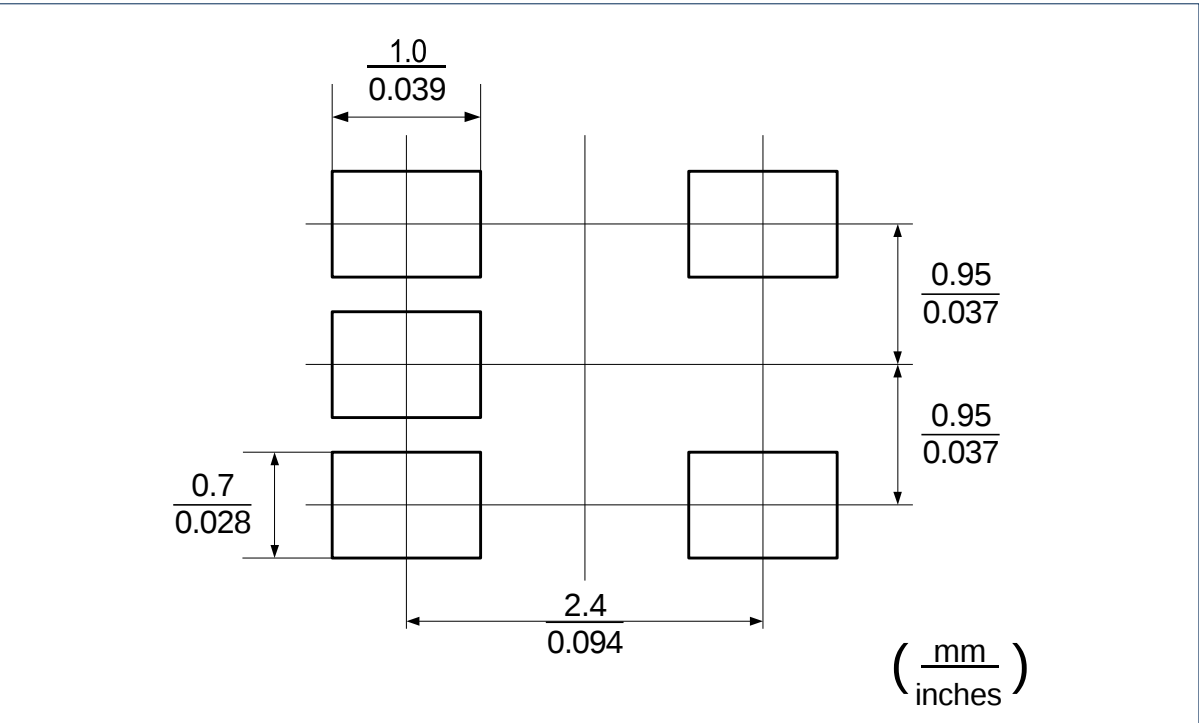
Device	Package Type	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin 1 Quadrant
LTP8P45-AXV8/R6	MSOP	8	3 000	330	12.5	5.0	3.5	2.0	8.0	12.0	Q1
LTP8P45-18XV8/R6	MSOP	8	3 000	330	12.5	5.0	3.5	2.0	8.0	12.0	Q1
LTP8P45-25XV8/R6	MSOP	8	3 000	330	12.5	5.0	3.5	2.0	8.0	12.0	Q1
LTP8P45-33XV8/R6	MSOP	8	3 000	330	12.5	5.0	3.5	2.0	8.0	12.0	Q1
LTP8P45-50XV8/R6	MSOP	8	3 000	330	12.5	5.0	3.5	2.0	8.0	12.0	Q1
LTP8P45-AXF8/R10	DFN3x3	8	5 000	330	12.5	3.3	3.3	1.1	8.0	12.0	Q1
LTP8P45-18XF8/R10	DFN3x3	8	5 000	330	12.5	3.3	3.3	1.1	8.0	12.0	Q1
LTP8P45-25XF8/R10	DFN3x3	8	5 000	330	12.5	3.3	3.3	1.1	8.0	12.0	Q1
LTP8P45-33XF8/R10	DFN3x3	8	5 000	330	12.5	3.3	3.3	1.1	8.0	12.0	Q1
LTP8P45-50XF8/R10	DFN3x3	8	5 000	330	12.5	3.3	3.3	1.1	8.0	12.0	Q1
LTP8P45-AXF6/R6	DFN2x2	6	3 000	178	9.5	2.2	2.2	1.0	4.0	8.0	Q1
LTP8P45-18XF6/R6	DFN2x2	6	3 000	178	9.5	2.2	2.2	1.0	4.0	8.0	Q1
LTP8P45-25XF6/R6	DFN2x2	6	3 000	178	9.5	2.2	2.2	1.0	4.0	8.0	Q1
LTP8P45-33XF6/R6	DFN2x2	6	3 000	178	9.5	2.2	2.2	1.0	4.0	8.0	Q1
LTP8P45-50XF6/R6	DFN2x2	6	3 000	178	9.5	2.2	2.2	1.0	4.0	8.0	Q1

Package Outlines

DIMENSIONS, SOT23-5L

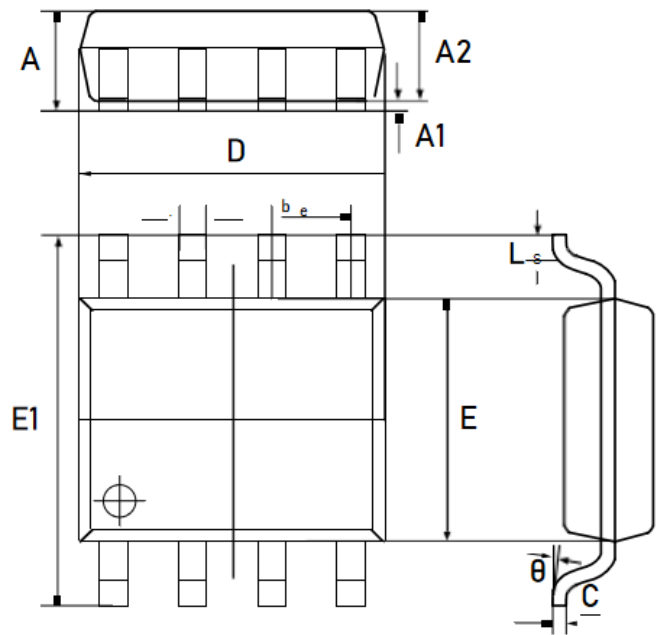


RECOMMENDED SOLDERING FOOTPRINT, SOT23-5L



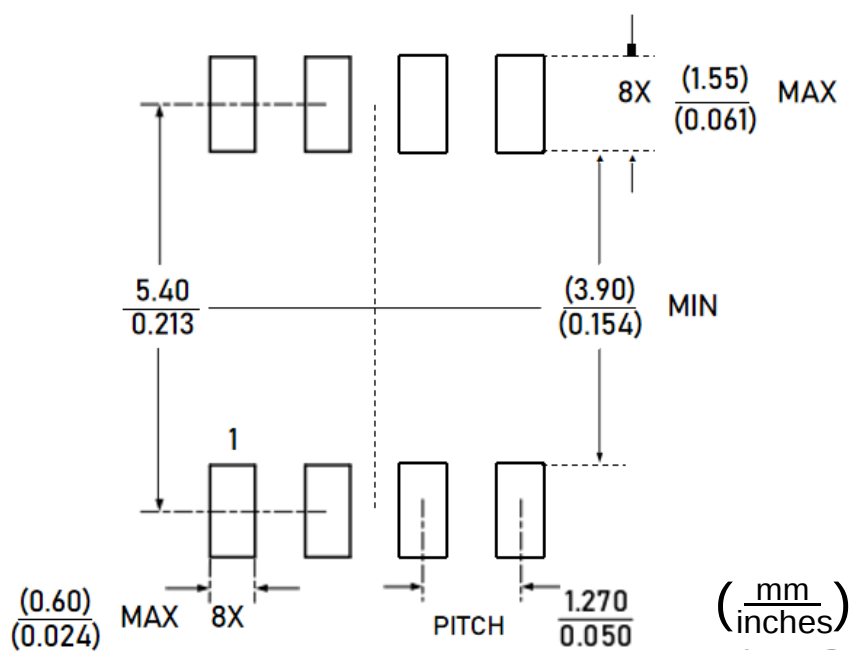
Package Outlines (continued)

DIMENSIONS, ESOP-8L



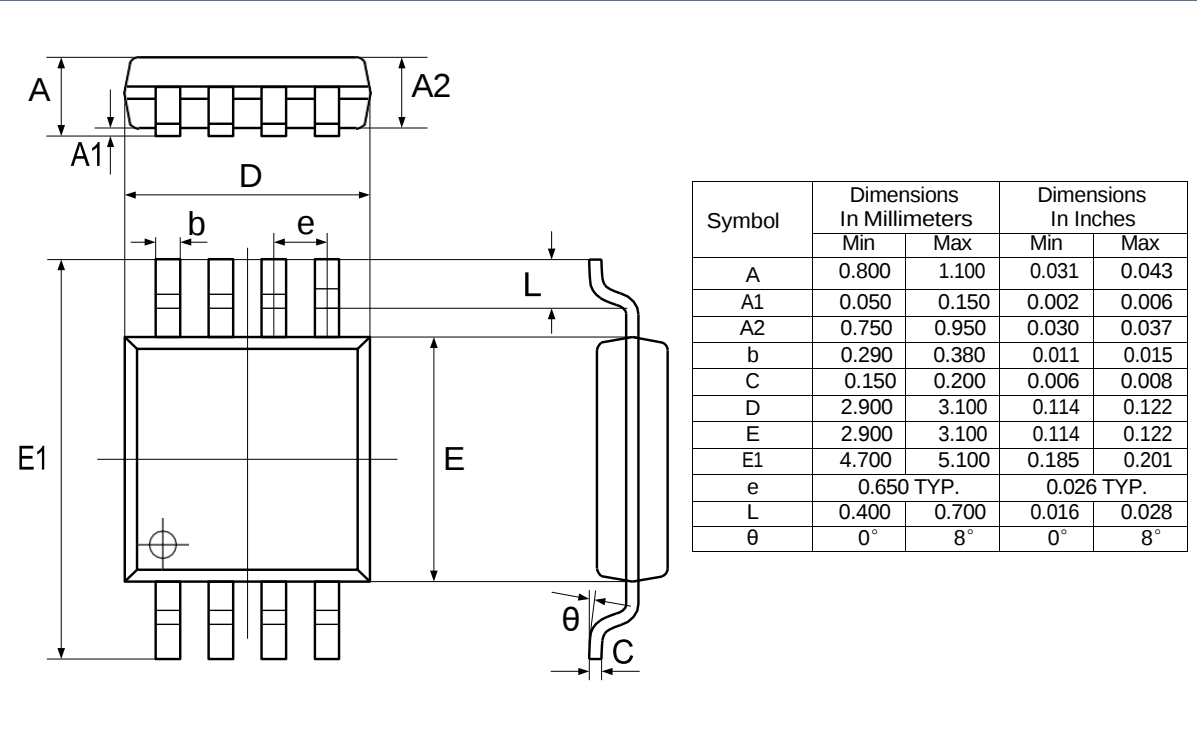
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.370	1.670	0.054	0.066
A1	0.070	0.170	0.003	0.007
A2	1.300	1.500	0.051	0.059
b	0.306	0.506	0.012	0.020
C	0.203 TYP.		0.008 TYP.	
D	4.700	5.100	0.185	0.201
E	3.820	4.020	0.150	0.158
E1	5.800	6.200	0.228	0.244
e	1.270 TYP.		0.050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

RECOMMENDED SOLDERING FOOTPRINT, ESOP-8L

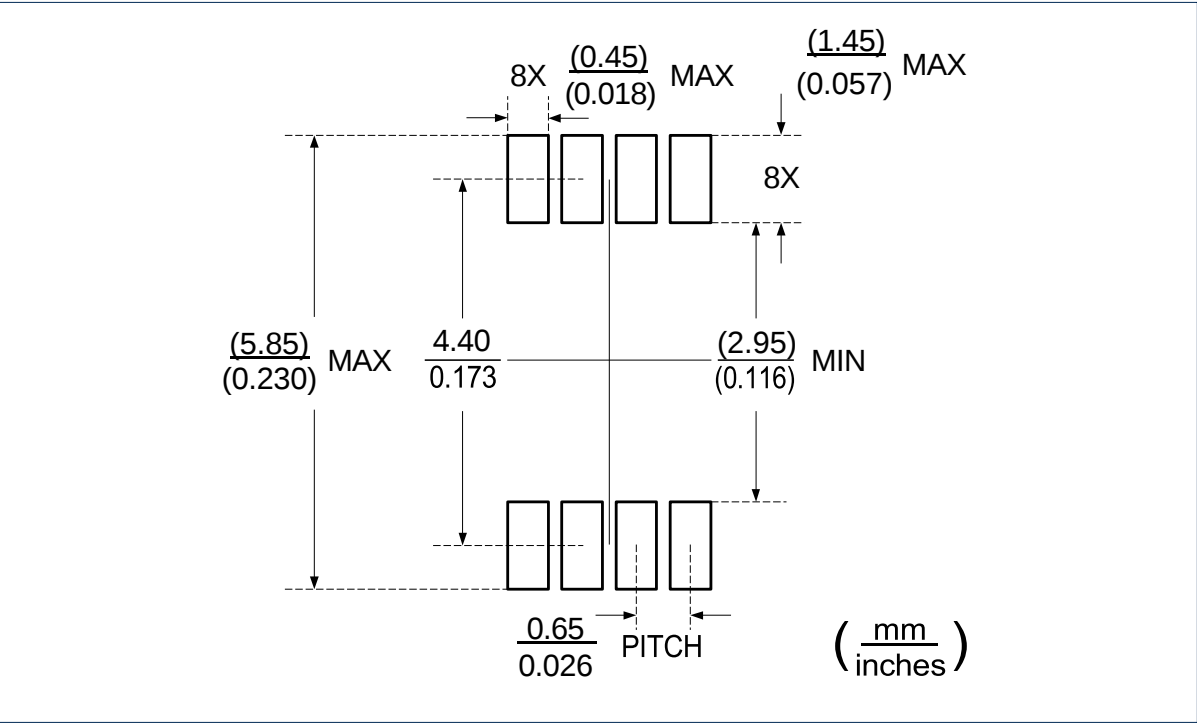


Package Outlines (continued)

DIMENSIONS, MSOP-8L

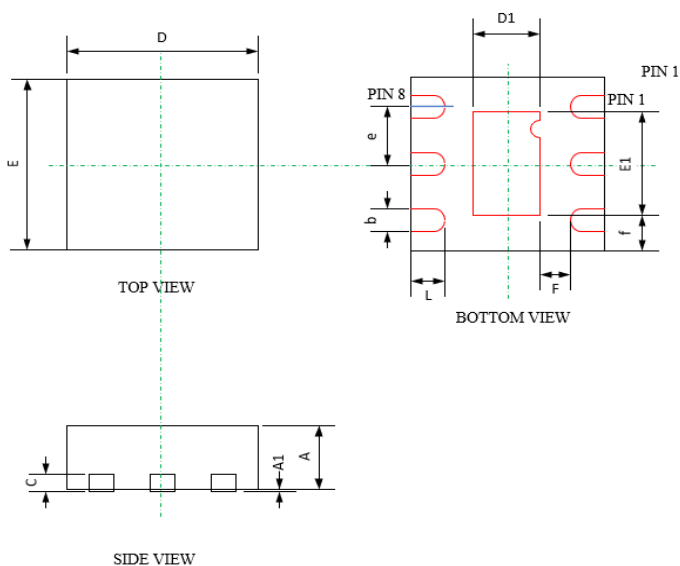


RECOMMENDED SOLDERING FOOTPRINT, MSOP-8L



Package Outlines (continued)

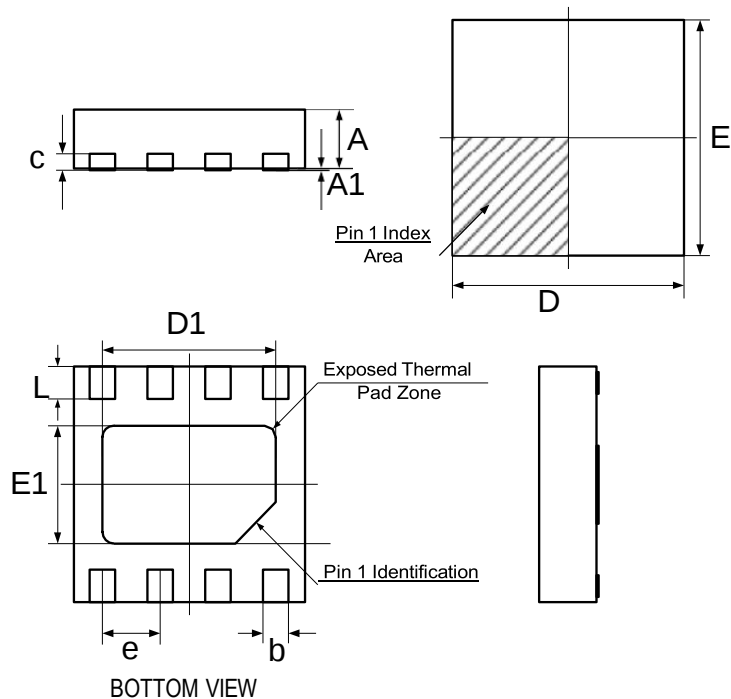
DIMENSIONS, DFN2x2-6L



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	0.700	0.750	0.800
A1	0.000	0.020	0.050
b	0.225	0.250	0.275
c	0.190	0.210	0.230
D	1.900	2.000	2.100
E	1.900	2.000	2.100
E1	1.150	1.200	1.250
D1	0.650	0.700	0.750
e	0.625	0.650	0.675
L	0.300	0.350	0.400
R	0.100		
F	0.280	0.300	0.320
f	0.380	0.400	0.420

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

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.