2.4 GHz High-Efficiency, High-Gain Power Amplifier Module

SST12LP17E

Data Sheet

SST12LP17E is a 2.4 GHz high-efficiency, fully-matched power amplifier module based on the highly-reliable InGaP/GaAs HBT technology. It is designed in compliance with IEEE 802.11b/g/n applications and typically provides 28 dB gain with 28% power-added efficiency at 21dBm. SST12LP17E has excellent linearity, providing 3% EVM at typically 18 dBm, while meeting 802.11g spectrum mask at 21.5 dBm. This power amplifier requires no external RF matching, and only requires one external DC-bias capacitor to meet the specified performance. It offers high-speed power-up/-down control through a single reference voltage pin and includes a temperature-stable, VSWR insensitive power detector voltage output. SST12LP17E is offered in a super-thin (0.4mm maximum) 8-contact X2SON package and a 8-contact USON package.

Features

- **Input/Output ports internally matched to 50Ω and DC decoupled**
- **High gain:**
  - Typically 28 dB gain across 2.4–2.5 GHz
- **High linear output power:**
  - >24 dBm P1dB
    - Single-tone measurement. Please refer to “Absolute Maximum Stress Ratings” on page 5
  - Meets 802.11g OFDM ACPR requirement up to 21.5 dBm
  - 3% EVM up to 18 dBm for 54 Mbps 802.11g signal
  - 2.5% EVM up to 17 dBm for 802.11n, MCS7, 40 MHz
  - Meets 802.11b ACPR requirement up to 22.5 dBm
  - Meets Bluetooth® spectrum mask for 3 Mbps at 17 dBm typical
- **High power-added efficiency/Low operating current for 802.11b/g/n applications**
  - ~28%/138 mA @ P_{OUT} = 21.5 dBm for 802.11g
  - ~33%/155 mA @ P_{OUT} = 22.5 dBm for 802.11b
- **Single-pin low I_{REF} power-up/down control**
  - I_{REF} <2 mA
- **Low idle current**
  - ~60 mA I_{CQ}
- **High-speed power-up/down**
  - Turn on/off time (10%- 90%) <100 ns
  - Typical power-up/down delay with driver delay included <200 ns
- **Low shut-down current (~2 µA)**
- **Stable performance over temperature**
  - ~2 dB gain variation between -40°C to +85°C
  - ~1 dB power variation between -40°C to +85°C
- **Excellent on-chip power detection**
  - >15 dB dynamic range, dB-wise linear
  - VSWR insensitive, temperature stable
- **Packages available**
  - 8-contact X2SON – 2mm x 2mm x 0.4mm
  - 8-contact USON – 2mm x 2mm x 0.6mm
- **Non-Pb (lead-free), RoHS compliant, and Halogen free**

Applications

- **WLAN (IEEE 802.11b/g/n)**
- **Bluetooth®**
- **Cordless phones**
- **2.4 GHz ISM wireless equipment**

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Product Description

The SST12LP17E is a versatile power amplifier based on the highly-reliable InGaP/GaAs HBT technology.The input/output RF ports are fully matched to 50Ω internally. These RF ports are DC decoupled and require no DC-blocking capacitors or matching components. This helps reduce the system board's Bill of Materials (BOM) cost.

SST12LP17E is a 2.4 GHz fully-integrated, high-efficiency Power Amplifier module designed in compliance with IEEE 802.11b/g/n applications. It typically provides 28 dB gain with 28% power-added efficiency (PAE) @ POUT = 21.5 dBm for 802.11g and 33% PAE @ POUT = 22.5 dBm for 802.11b.

This power amplifier has excellent linearity, typically 3% added EVM at 18 dBm output power which is essential for 54 Mbps 802.11g operation while meeting 802.11g spectrum mask at 21.5 dBm and 802.11b spectrum mask at 22.5 dBm. Using MCS7 modulation, with 40 MHz bandwidth, the SST12LP17E provides 17 dBm at 2.5% EVM.

The device also features easy board-level usage along with high-speed power-up/down control through a single combined reference voltage pin. Ultra-low reference current (total I_{REF} ~2 mA) makes the SST12LP17E controllable by an on/off switching signal directly from the baseband chip. These features, coupled with low operating current, make the SST12LP17E ideal for the final stage power amplification in battery-powered 802.11b/g/n WLAN transmitter and Bluetooth applications.

The SST12LP17E has an excellent on-chip, single-ended power detector, which features wide dynamic-range, >15 dB, with dB-wise linear performance. The excellent on-chip power detector provides a reliable solution to board-level power control.

The SST12LP17E is offered in both 8-contact X2SON and 8-contact USON packages. See Figure 2 for pin assignments and Table 1 for pin descriptions.

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Functional Blocks

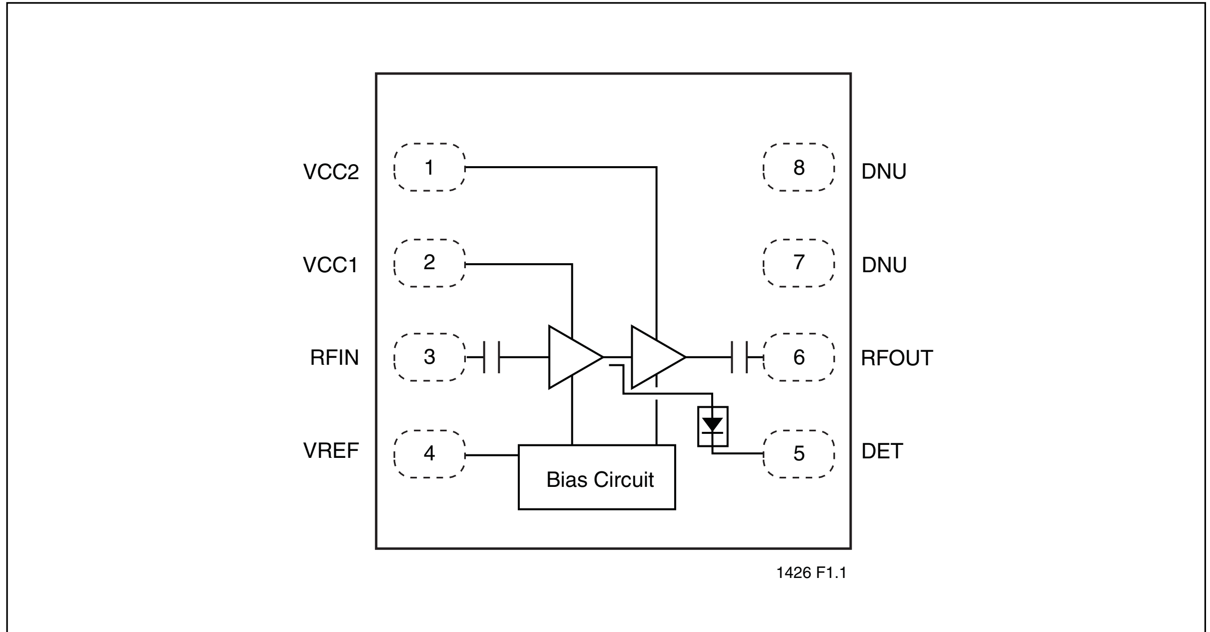

Figure 1: Functional Block Diagram

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Pin Assignments

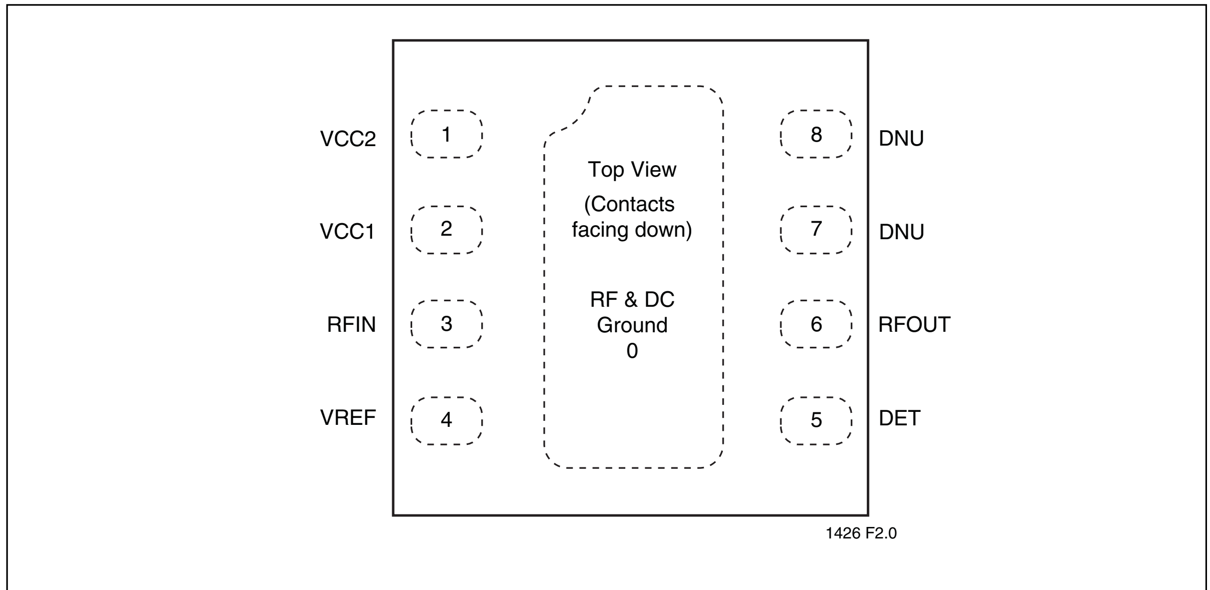

Figure 2: Pin Assignments for 8-contact X2SON and 8-contact USON

Pin Descriptions

Table 1: Pin Description

Symbol	Pin No.	Pin Name	Type[1]	Function
GND	0	Ground		Low inductance ground pad
VCC2	1	Power Supply	PWR	Power supply, 2nd stage
VCC1	2	Power Supply	PWR	Power supply, 1st stage
RFIN	3		I	RF input, DC decoupled
VREF	4		PWR	1st and 2nd stage idle current control
DET	5		O	On-chip power detector
RFOUT	6		O	RF output, DC decoupled
DNU	7	Do Not Use		Do not use or connect
DNU	8	Do Not Use		Do not use or connect

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1. I=Input, O=Output

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Electrical Specifications

The DC and RF specifications for the power amplifier are specified below. Refer to Table 3 for the DC voltage and current specifications. Refer to Figures 3 through 8 for the RF performance.

Absolute Maximum Stress Ratings (Applied conditions greater than those listed under "Absolute Maximum Stress Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these conditions or conditions greater than those defined in the operational sections of this data sheet is not implied. Exposure beyond absolute maximum stress rating conditions may affect device reliability.)

Input power to pin 3 (P_{IN}) . . . . +5 dBm
Average output power from Pin 6 (P_{OUT})[1] . . . . +25.5 dBm
Supply Voltage at pins 1 and 2 (V_{CC})[2] . . . . -0.3V to +6.0V
Reference voltage to pin 4 (V_{REF}) . . . . -0.3V to +3.3V
DC supply current (I_{CC})[3] . . . . 300 mA
Operating Temperature (T_A) . . . . -40ºC to +85ºC
Storage Temperature (T_{STG}) . . . . -40ºC to +120ºC
Maximum Junction Temperature (T_J) . . . . +150ºC
Surface Mount Solder Reflow Temperature . . . . 260°C for 10 seconds
ESD Level for Human Body Model, HBM 1250V

1. Never measure with CW source. Pulsed single-tone source with <50% duty cycle is recommended. Exceeding the maximum rating of average output power could cause permanent damage to the device.
2. V_{CC} maximum rating of 6.0V for RF output power levels up to 10 dBm.
3. Measured with 100% duty cycle 54 Mbps 802.11g OFDM Signal

Table 2: Operating Range

Range	Ambient Temp	V_{CC}
Industrial	-40°C to +85°C	3.0V to 4.6V

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Table 3: DC Electrical Characteristics at 25°C

Symbol	Parameter	Min.	Typ	Max.	Unit
V_{CC}	Supply Voltage at pins 1 and 2	3.0	3.3	4.6	V
I_{CQ}	Idle current to meet EVM ~3% @ 18 dBm Output Power, 802.11g OFDM 54 Mbps signal		60		mA
V_{REG}	Reference Voltage for pin 4		2.9		V
I_{CC}	Current consumption to meet 802.11g OFDM 54 Mbps spectrum mask @ 21.5 dBm		138		mA
	Current consumption to meet 802.11b DSSS 54 Mbps spectrum mask @ 22 dBm		155		mA
	Current consumption to meet EVM ~3% @ 18 dBm Output Power with 802.11g OFDM 54 Mbps signal		105		mA

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Table 4: RF Characteristics at 25°C

Symbol	Parameter	Min.	Typ	Max.	Unit
F_{L-U}	Frequency range	2412		2484	MHz
G	Small signal gain	27	28		dB
G_{VAR1}	Gain variation over band (2412–2484 MHz)			±0.5	dB
G_{VAR2}	Gain ripple over channel (20 MHz)		0.2		dB
2f, 3f, 4f, 5f	Harmonics at 23 dBm, without external filters			-40	dBc
EVM	EVM @ 18 dBm output with 802.11g OFDM 54 Mbps signal		3		%
	EVM @ 17 dBm output with MCS7-40 MHz band-width		2.5		%
P_{OUT}	Output Power to meet 802.11g OFDM 54 Mbps spectrum mask	20.5	21.5		dBm
	Output Power to meet 802.11b DSSS 1 Mbps spectrum mask	21	22.5		dBm

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Table 5: Characteristics at 25°C for Bluetooth Applications

Symbol	Parameter	Min.	Typ	Max.	Unit
F_{L-U}	Frequency range	2412		2484	MHz
G	Small signal gain (configured as shown in Figure 9 on page 10)	26	28		dB
	Small signal gain (V_{REF} = 3.0V with 1.5kΩ series resistor)	23	26		dB
ICC	DC current at 17 dBm CW (configured as shown in Figure 9 on page 10)		100		mA
	DC current at 12 dBm CS (V_{REF} = 3.0V with 1.5kΩ series resistor)		50		mA
Power	Meeting Bluetooth spectrum power density using 3 Mbps modulation (-20 dBm at 1.5 MHz and -40 dBm at 2.5 MHz, 100 kHz RBW) (configured as shown in Figure 9 on page 10)		17		dBm
	Meeting Bluetooth spectrum power density using 3 Mbps modulation (-20 dBm at 1.5 MHz and -40 dBm at 2.5 MHz, 100 kHz RBW) (V_{REF} = 3.0V with 1.5kΩ series resistor)		12		dBm

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Typical Performance Characteristics

Test Conditions: V_{CC} = 3.3V, T_A = 25°C, unless otherwise specified

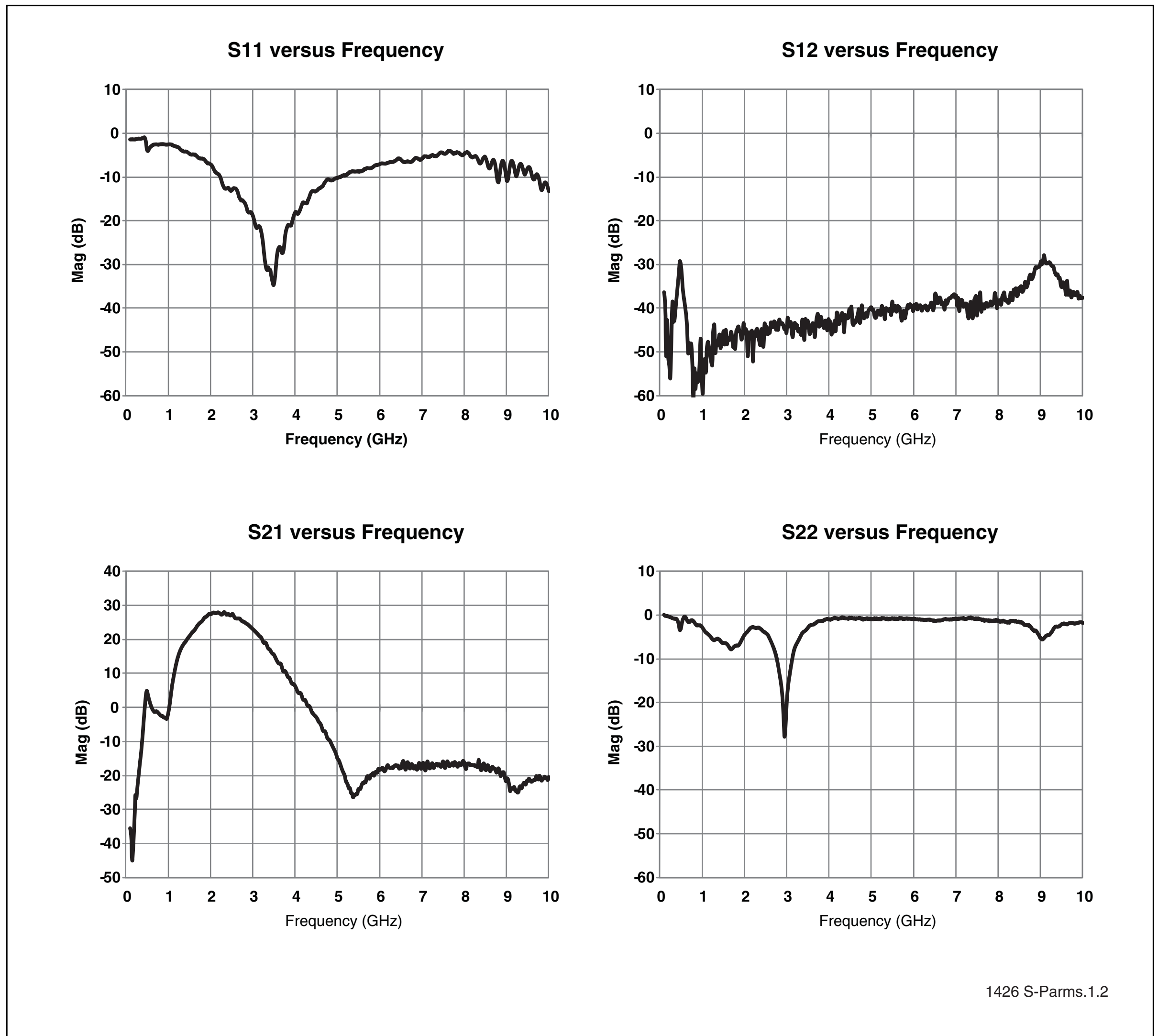

Figure 3: S-Parameters

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Typical Performance Characteristics

Test Conditions: V_{CC} = 3.3V, T_A = 25°C, 54 Mbps 802.11g OFDM Signal Equalizer Training Setting using Channel Estimation Sequence only

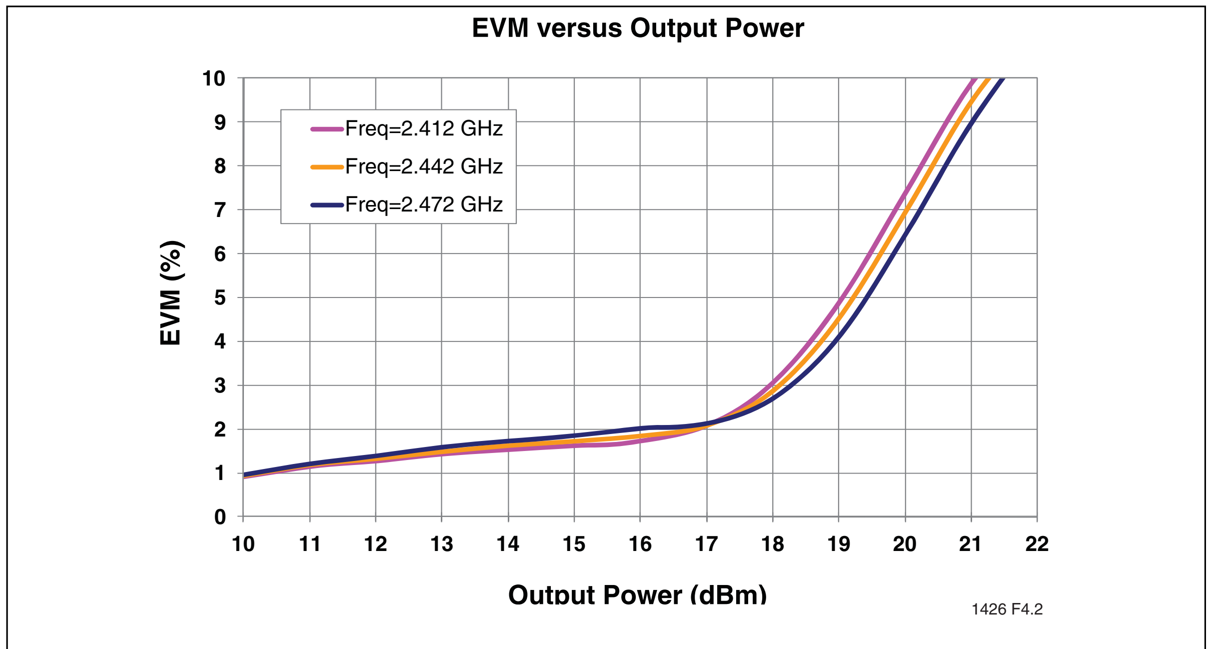

Figure 4: EVM versus Output Power

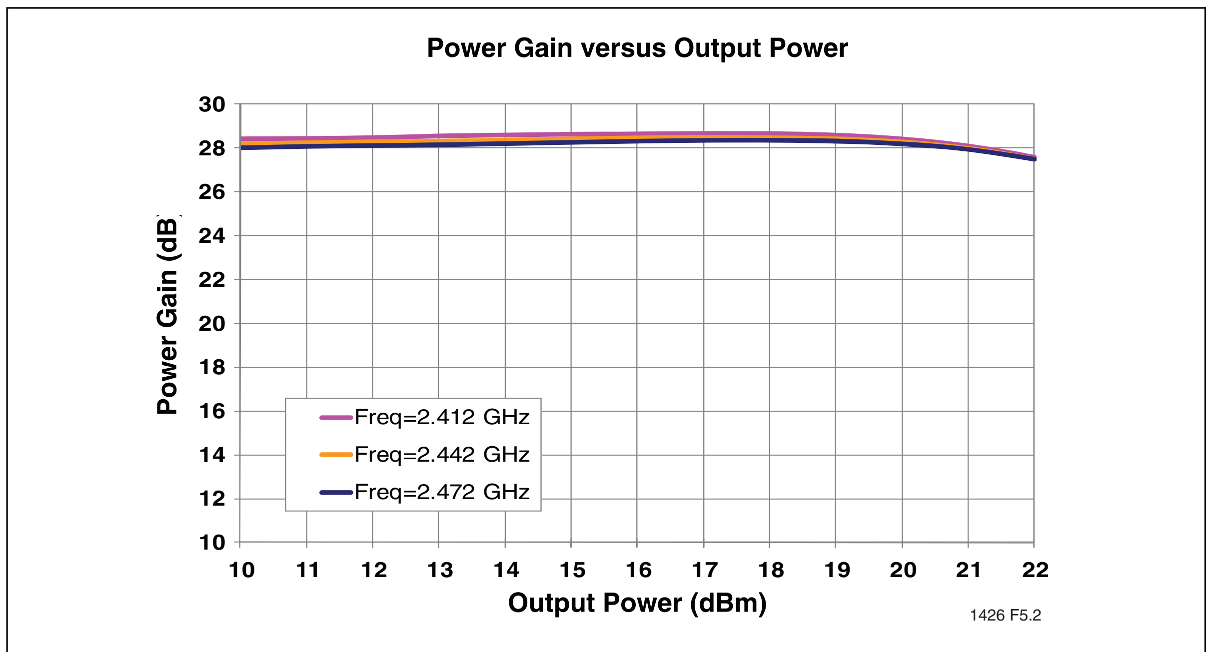

Figure 5: Power Gain versus Output Power

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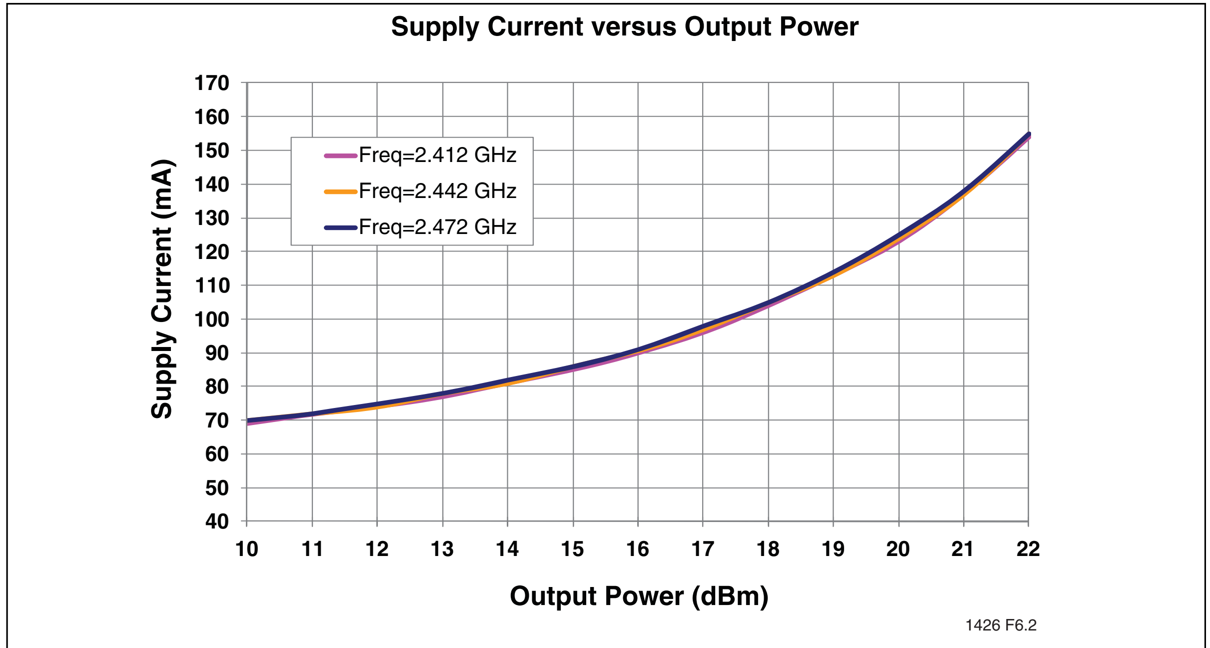

Figure 6: Total Current Consumption for 802.11g operation versus Output Power

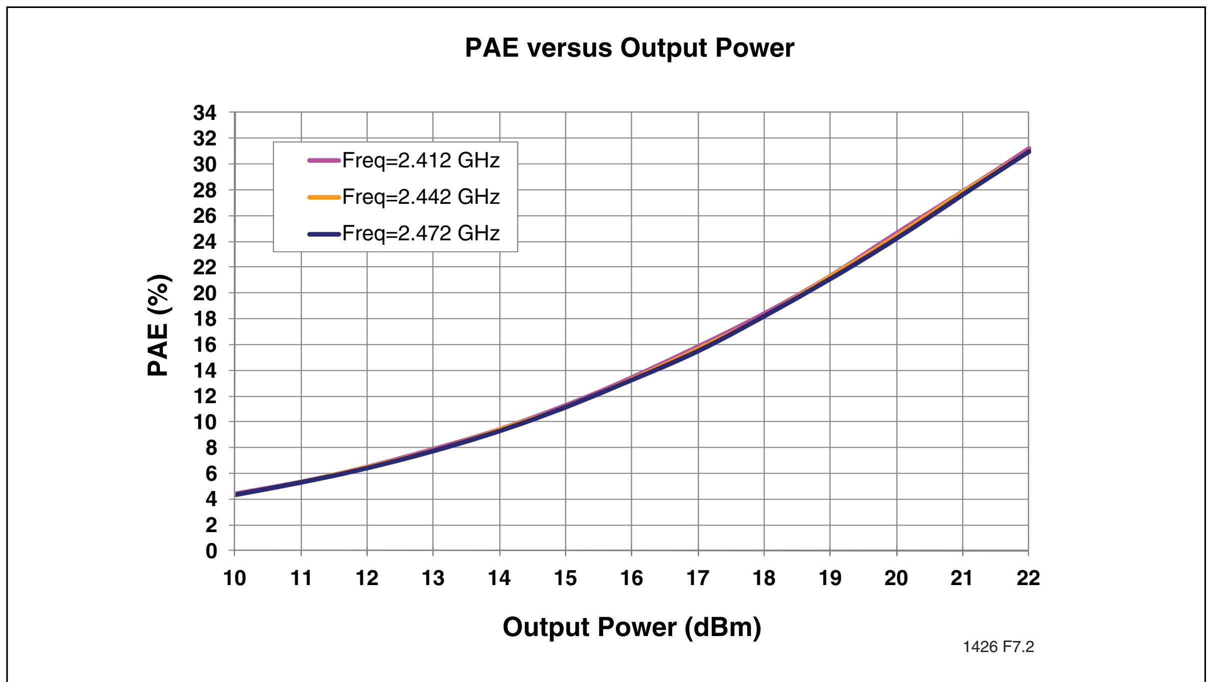

Figure 7: PAE versus Output Power

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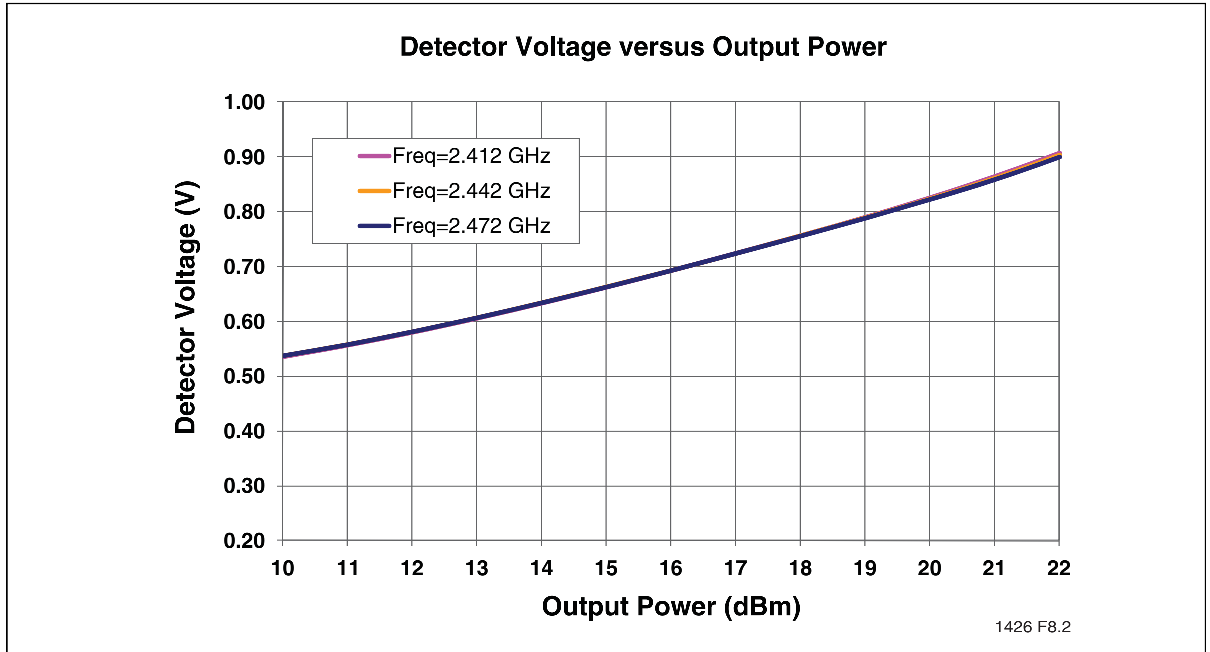

Figure 8: Detector Characteristics versus Output Power

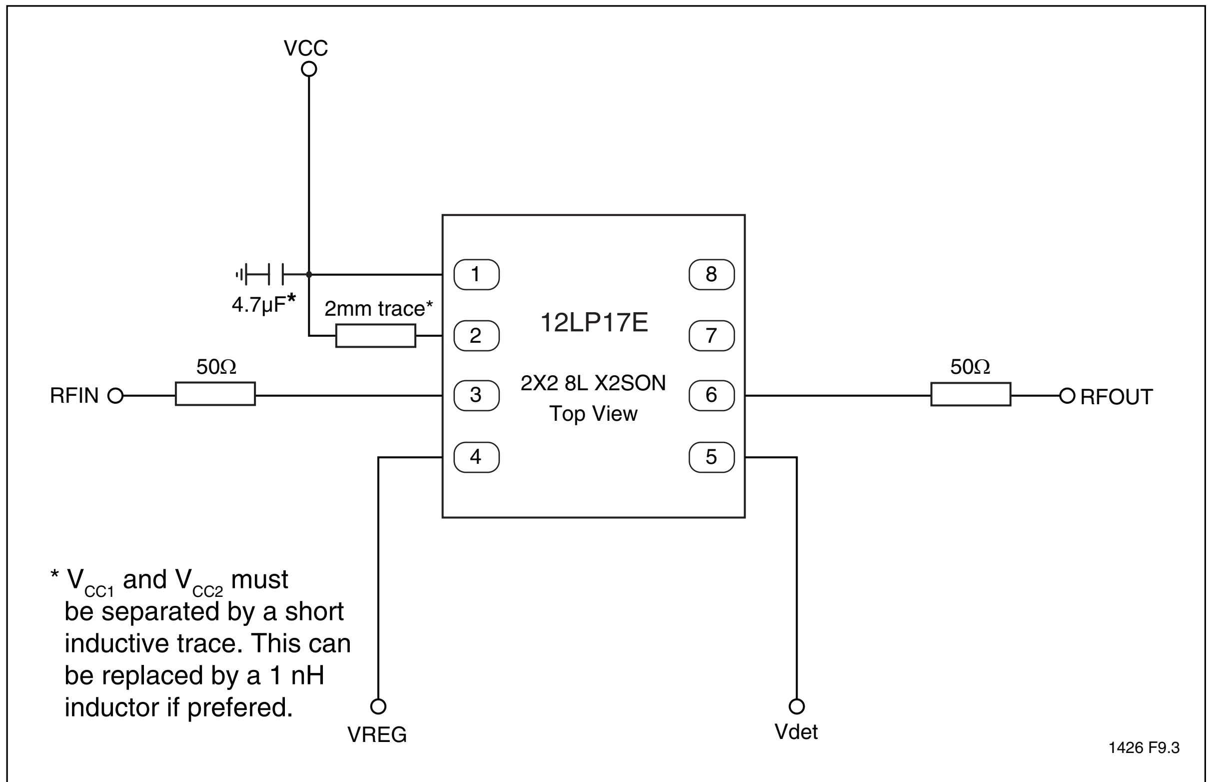

Figure 9: Typical Schematic for High-Efficiency 802.11b/g/n Applications

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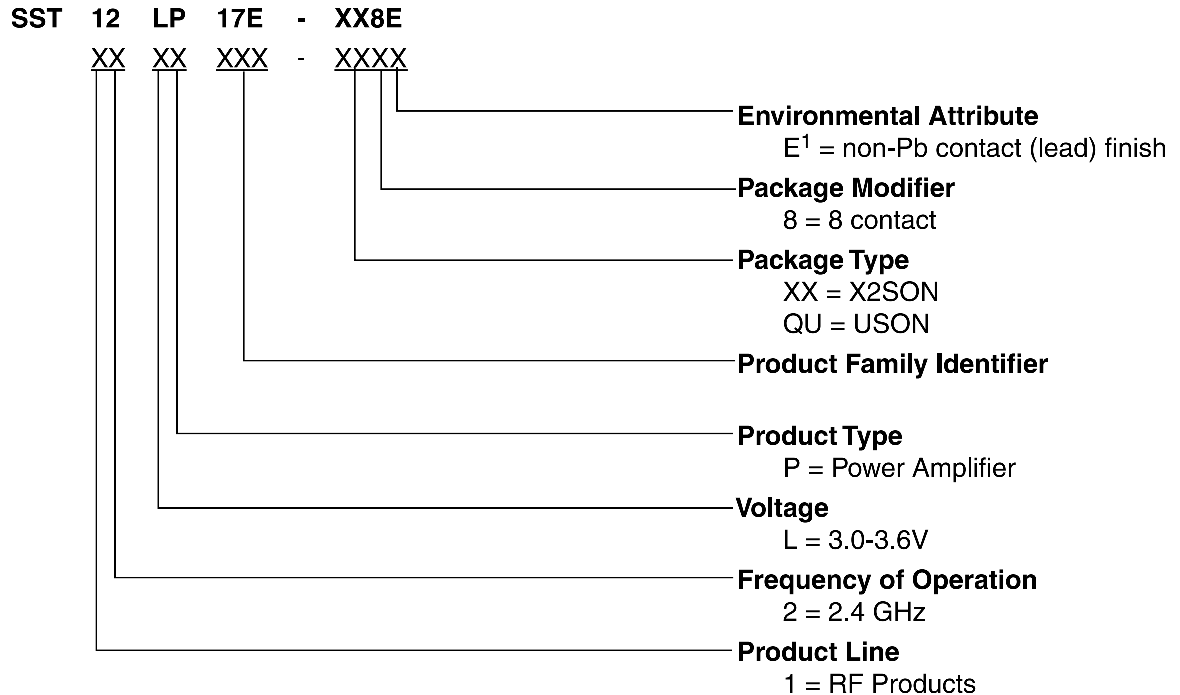
Product Ordering Information



1. Environmental suffix "E" denotes non-Pb solder. SST non-Pb solder devices are "RoHS Compliant".

Valid combinations for SST12LP17E

SST12LP17E-XX8E SST12LP17E-QU8E

SST12LP17E Evaluation Kits

SST12LP17E-XX8E-K SST12LP17E-QU8E-K

Note: Valid combinations are those products in mass production or will be in mass production. Consult your SST sales representative to confirm availability of valid combinations and to determine availability of new combinations.

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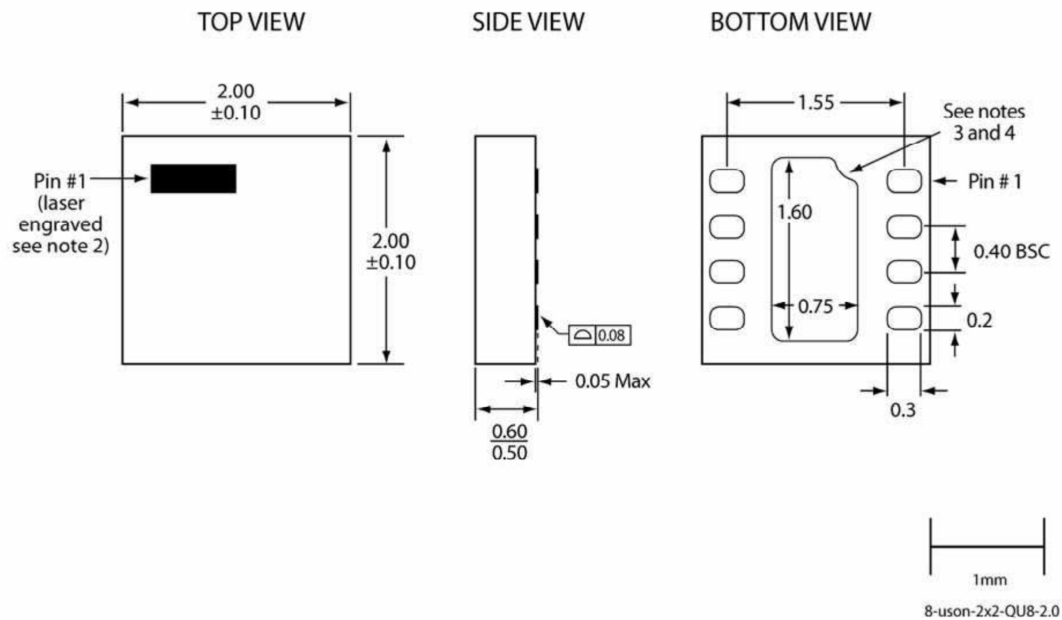
Packaging Diagrams

8-Lead Ultra Thin Small Outline No-Leads (QU8E/F) - 2x2 mm Body [USON]

Note:	For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



Note:
1. Similar to JEDEC JEP95 XQFN/XSON variants, though number of contacts and some dimensions are different.
2. The topside pin #1 indicator is laser engraved; its approximate shape and location is as shown.
3. From the bottom view, the pin #1 indicator may be either a curved indent or a 45-degree chamfer.
4. The external paddle is electrically connected to the die back-side and to VSS.
   This paddle must be soldered to the PC board; it is required to connect this paddle to the VSS of the unit.
   Connection of this paddle to any other voltage potential will result in shorts and electrical malfunction of the device.
5. Untoleranced dimensions are nominal target dimensions.
6. All linear dimensions are in millimeters (max/min).

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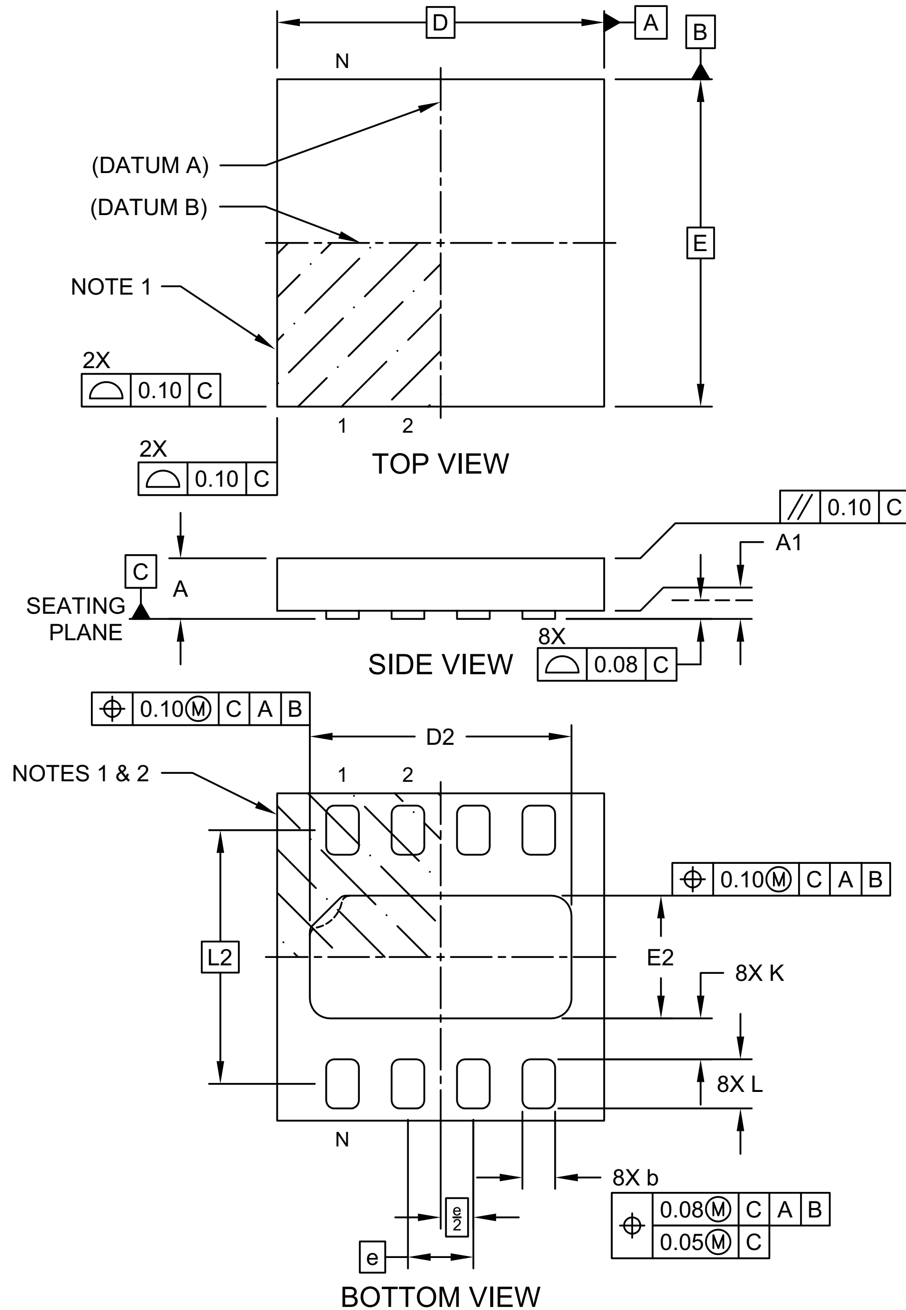
8-Terminal Super-Thin Plastic Small Outline, No Lead Package (XX8E) - 2x2x0.4 mm (Max) Body [X2SON]

Note:	For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



Microchip Technology Drawing C04-201-XX8E-A Sheet 1 of 2

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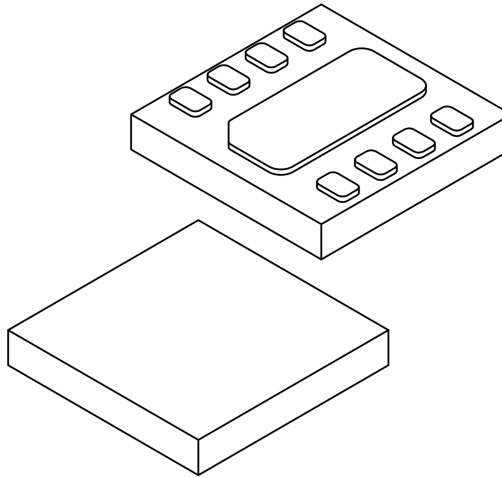
8-Terminal Super-Thin Plastic Small Outline, No Lead Package (XX8E) - 2x2x0.4 mm (Max) Body [X2SON]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Number of Terminals	N		8	
Pitch	e		0.40 BSC	
Overall Height	A	0.34	0.37	0.40
Standoff	A1	0.00	0.02	0.05
Overall Width	E		2.00 BSC	
Exposed Pad Width	E2	0.70	0.75	0.80
Overall Length	D		2.00 BSC	
Exposed Pad Length	D2	1.55	1.60	1.65
Terminal Width	b	0.15	0.20	0.25
Terminal Length	L	0.25	0.30	0.35
Terminal Center-to-Center	L2		1.55 BSC	
Terminal-to-Exposed-Pad	K	0.20	-	-

Notes:

1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. Pin 1 index on exposed pad may be curved indentation or 45° chamfer
3. Package is saw singulated
4. Dimensioning and tolerancing per ASME Y14.5M

   BSC: Basic Dimension. Theoretically exact value shown without tolerances.

   REF: Reference Dimension, usually without tolerance, for information purposes only.

Microchip Technology Drawing C04-201-XX8E-A Sheet 2 of 2

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Table 6: Revision History

Revision	Description	Date
00	• Initial release of data sheet	Apr 2010
A	• Modified “Features”, “Product Description” on page 2, Table 1 on page 4, Table 3 on page 5, Table 4 on page 6, Figure 1 on page 3, and Figure 9 on page 10. • Replaced Figures 3-8.	Apr 2011
B	• Updated document type to “Data Sheet” • Changed supply voltage in “Electrical Specifications” on page 5 • Revised VCC values in Table 3 on page 5	Oct 2011
C	• Updated package to 8-contact X2SON (XX8) • Revised performance information to reflect new package type including Tables 2, 3, and 4 • Revised Supply Voltage on page 5.	Feb 2012
D	• Added QU8 package information • Updated maximum supply voltage from 5.5V to 6.0V in “Absolute Maximum Stress Ratings” on page 5 • Updated Supply Voltage from 4.2 to 4.6 in Table 3 on page 5	Mar 2012
E	• Updated package drawings to reflect new Pin 1 indicator	Jul 2012
F	• Updated Figure 1 on page 3 • Updated Figure 9 on page 10 • Added Table 5 on page 6 • Updated “Features” on page 1 • Added ESD information to “Electrical Specifications” on page 5	Mar 2014
G	• Updated “Features” on page 1 and “Product Description” on page 2 • Revised Table 4 on page 6	Oct 2014

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Memory sizes denote raw storage capacity; actual usable capacity may be less.

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