RF2802

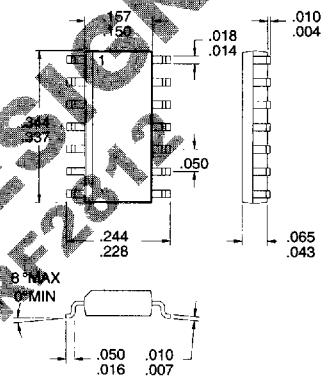
VHF QUADRATURE MODULATOR

Typical Applications

- Analog Communication Systems
- Digital Communication Systems
- Single Sideband Modulation
- Commercial and Consumer Systems
- Portable Battery Powered Equipment
- Image-Reject Upconverter

Product Description

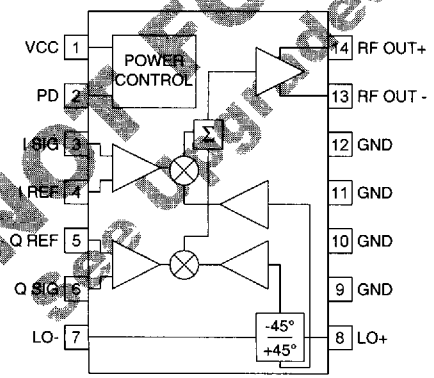
The RF2802 is a monolithic integrated universal modulation system capable of generating modulated AM, PM, or compound carriers in the VHF frequency range. The IC contains all of the required components to implement the modulation function including differential amplifiers for the baseband inputs, a 90°-hybrid phase splitter, limiting LO amplifiers, two balanced mixers, a combining amplifier, and an output RF amplifier which will drive a 200Ω to 400Ω load. Component matching, which can only be accomplished with monolithic construction, is used to full advantage to obtain excellent amplitude balance and high phase accuracy.



Package Style: SOP-14

Optimum Technology Matching™ Applied

☑ Si BJT ☐ GaAs HBT ☐ GaAs MESFET
☐ Si Bi-CMOS



Functional Block Diagram

Features

- 3V to 6V Power Supply
- Integrated Quadrature Network
- Excellent Amplitude & Phase Balance
- Digitally Controlled Power Down Mode
- 50MHz Modulation Bandwidth
- 50MHz to 250MHz Operation

Ordering Information

RF2802	VHF Quadrature Modulator
RF2802 PCBA	Fully Assembled Evaluation Board

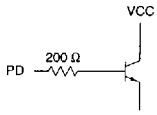
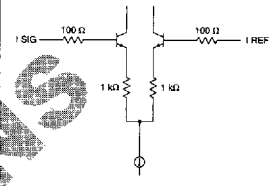
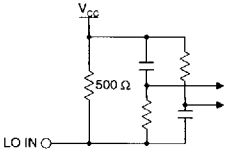
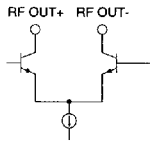
RF Micro Devices, Inc.
7625 Thorndike Road
Greensboro, NC 27409, USA
Tel (910) 664 1233
Fax (910) 664 0454
http://www.rfmd.com

Absolute Maximum Ratings

Parameter	Rating	Unit
Supply Voltage	-0.5 to +7.0	V_{DC}
Power Down Voltage	V_{CC}+0.4	V_{DC}
Input LO Level	+10	dBm
Input Modulation Level	2	V_{PP}
Operating Ambient Temperature	-40 to +85	°C
Storage Temperature	-40 to +150	°C

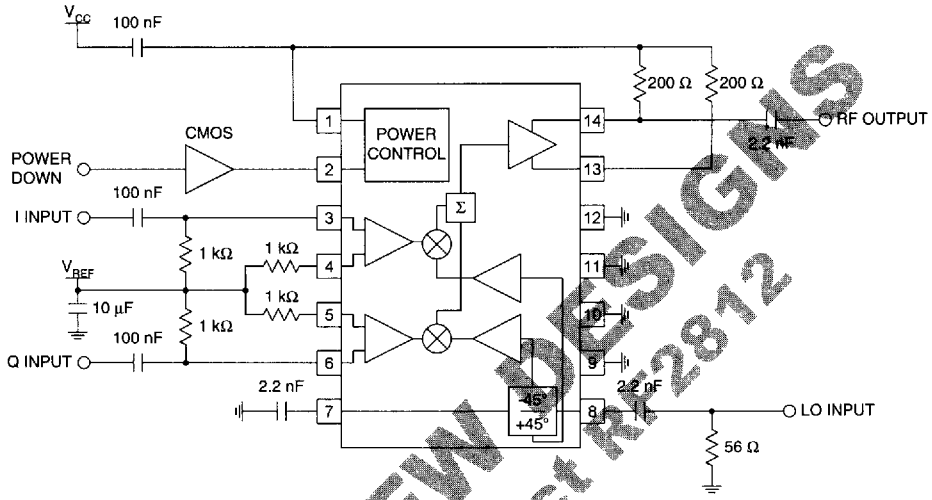
Caution! ESD sensitive device.

Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
Carrier Input					T=25°C, V_{CC}=5.0V
Frequency Range		50-250		MHz	
Power Level		-20 to +6		dBm	
Input Impedance		200		Ω	At 150MHz
I/Q Amplitude Error		0.1		dB	
Modulation Input					
Frequency Range		DC-50		MHz	
Reference Voltage		1.8 to 3.0		V	
Maximum Modulation		1.5		V_{P-P}	I and Q signals
Quadrature Phase Error		±2		°	
DC Offset		3		mV	I_{sig} - I_{ref} and Q_{sig} - Q_{ref}
RF Output					LO power=-10dBm, LO freq=200MHz, SSB, V_{MOD}=480mV_{PP}
Output Power	-6	-3		dBm	1dB compression
Output Impedance		Balanced Open Collector		Ω	
Output Load		200		Ω	Balanced
Output Noise Floor		<-135		dBm/Hz	
Output IP3		+10		dBm	
Sideband Suppression	20	30		dB	
Carrier Suppression	18	35		dB	
Power Down					
Turn On/Off Time		<100		ns	
PD Input Resistance		>50		kΩ	
PD "OFF" Voltage	1.0	1.2		V	Threshold voltage of the input.
PD "ON" Voltage		V_{CC}		V	Threshold voltage of the input.
Power Supply					
Voltage		5		V	Specifications
		2.7 to 6.0		V	Operating limits
Current		18	25	mA	Operating
		3	10	µA	Power Down

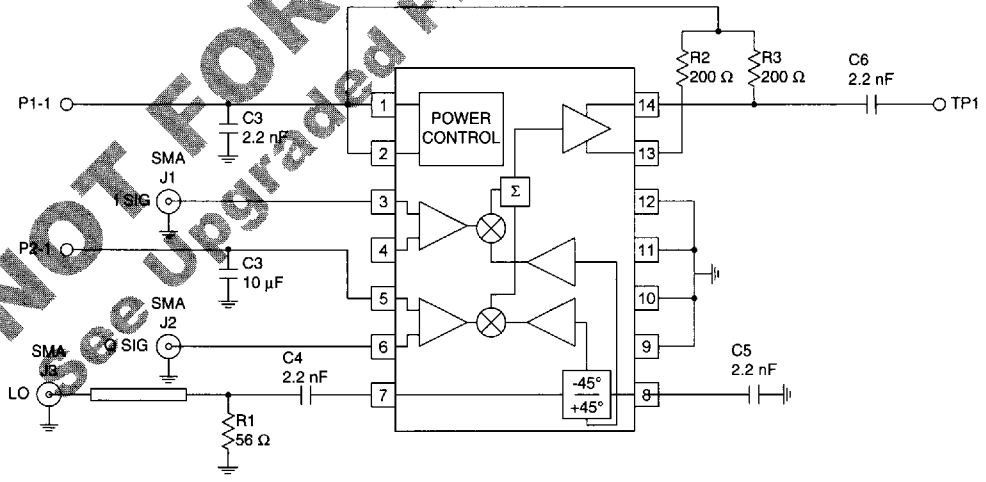
Pin	Function	Description	Interface Schematic
1	VCC	Power supply pin. An external 2.2nF bypass capacitor is recommended if no other bypass capacitor is nearby.	
2	PD	Power Down control. When this pin is "low", all circuits are shut off. A "low" is typically 1.2V or less at room temperature. When this pin is "high", all circuits are operating normally. A "high" is V_{CC}. If PD is below V_{CC} output power and performance will be degraded. Operating in this region is not recommended.	
3	I SIG	Baseband input to the I mixer. This pin is DC coupled. Maximum output power is obtained when the input signal has a peak to peak amplitude of 1.5V. The recommended DC level for this pin is 2.5V when the power supply is 5V, and 1.8V when the power supply is 3V. If the power supply voltage is 3V, the maximum modulation signal should not exceed $0.6V_{PP}$. The peak minimum voltage on this pin (VREF - peak modulation amplitude) should never drop below 1.3V. The peak maximum voltage on this pin (VREF + peak modulation amplitude) should never exceed 4.0V. The input impedance is very high for frequencies up to 10MHz. Above 10MHz this input looks capacitive. The SIG and REF inputs are inputs of a differential amplifier. Therefore the REF and SIG inputs are interchangeable. If swapping the I SIG and I REF pins, the Q SIG and Q REF also need to be swapped to maintain the correct phase. It is also possible to drive the SIG and REF inputs in a balanced mode. This will increase the gain.	
4	I REF	Reference voltage for the I mixer. This voltage should be the same as the DC voltage supplied to the I SIG pin.	See pin 3.
5	Q REF	Reference voltage for the Q mixer. This voltage should be the same as the DC voltage supplied to the Q SIG pin.	Same as pin 4.
6	Q SIG	Base band input to the Q mixer. This pin is DC coupled. Maximum output power is obtained when the input signal has a peak to peak amplitude of 1.5V. The recommended DC level for this pin is 2.5V when the power supply is 5V, and 1.8V when the power supply is 3V. If the power supply voltage is 3V, the maximum modulation signal should not exceed $0.6V_{P-P}$. The peak minimum voltage on this pin (VREF - peak modulation amplitude) should never drop below 1.3V. The peak maximum voltage on this pin (VREF + peak modulation amplitude) should never exceed 4.0V. The input impedance is very high for frequencies up to 10MHz. Above 10MHz this input looks capacitive.	Same as pin 3.
7	LO-	Balanced LO input. When the LO is driven single ended this pin should be connected to a 2.2nF capacitor to ground. This pin has an internal pull-up resistor to V_{CC}, and an external DC blocking capacitor is recommended.	
8	LO+	Balanced LO input. This pin has an internal pull-up resistor to V_{CC}, and an external DC blocking capacitor is recommended. When the LO is driven single ended an external 56Ω may be connected to provide a match.	Same as pin 7.
9	GND	Ground connection. This pin should be connected directly to the ground plane.	
10	GND	Same as pin 9.	
11	GND	Same as pin 9.	
12	GND	Same as pin 9.	
13	RF OUT-	Balanced RF output. This pin is an open collector output. An external pull-up resistor is needed for the circuit to operate. The maximum resistor value is 200Ω; this will give the maximum output voltage. If a more linear operation is required the resistor value can be lowered to reduce output swing. The output impedance will be approximately equal to the resistor value. Even when a single ended output is used the pull-up resistor should be connected.	

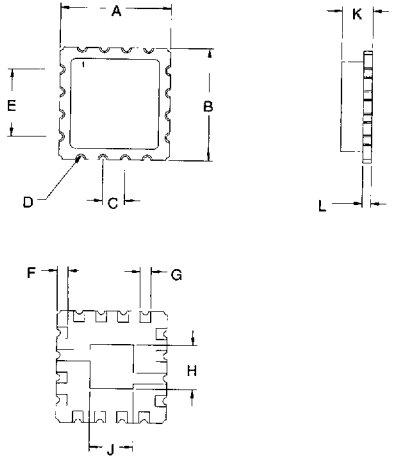
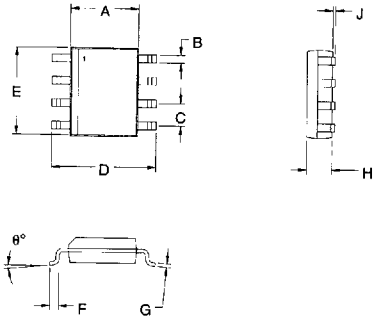
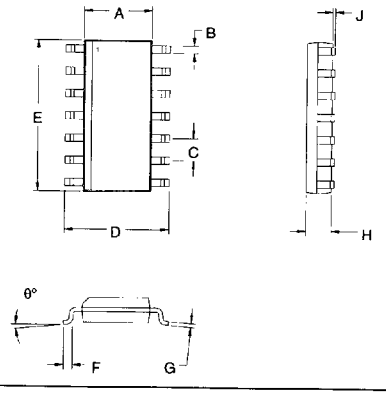
14	RF OUT+	Balanced RF output. This pin is an open collector output. An external pull-up resistor is needed for the circuit to operate. The maximum resistor value is 200Ω; this will give the maximum output voltage. If a more linear operation is required the resistor value can be lowered to reduce output swing. The output impedance will be approximately equal to the resistor value.	See pin 13.

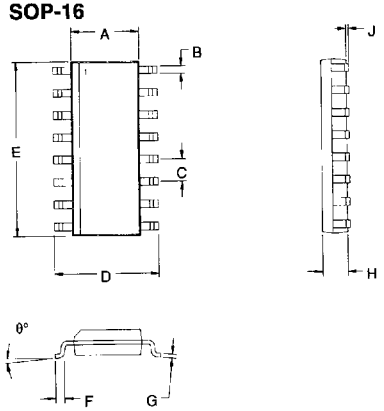
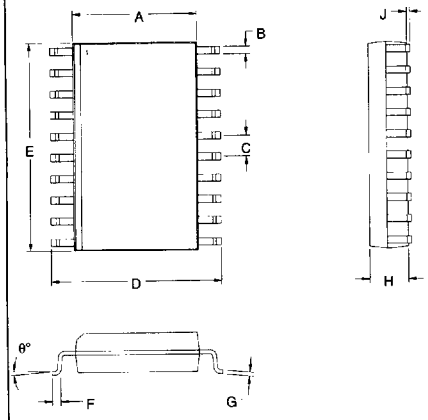
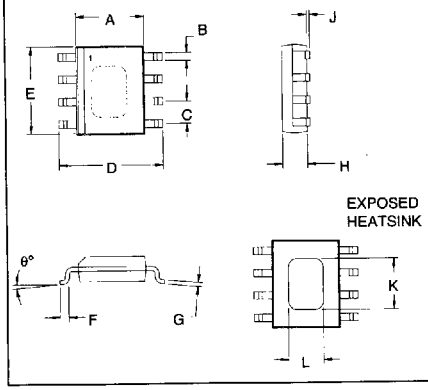
Application Schematic

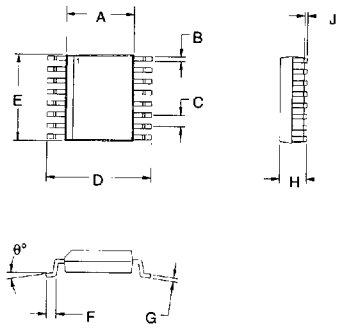
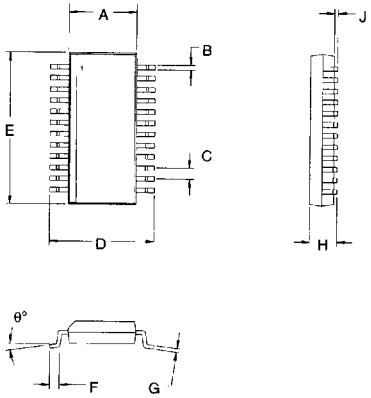
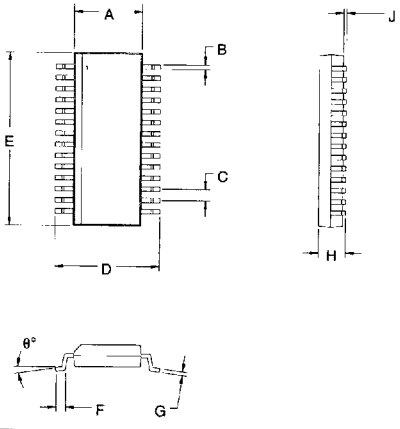


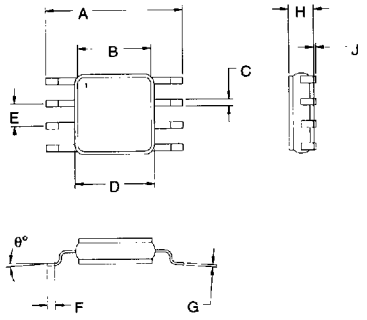
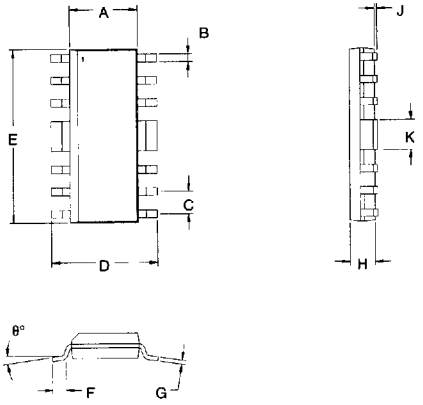
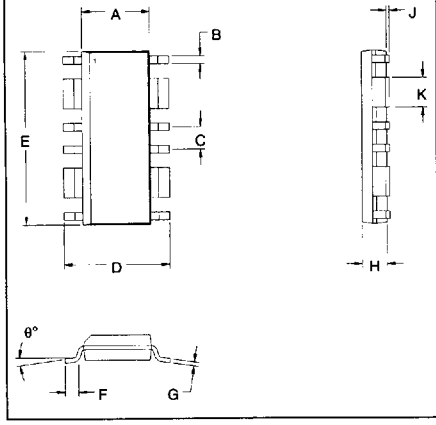
Evaluation Board Schematic



Package Drawing	Dimension	Measurement (mm)		Measurement (inches)	
		Typical	Tolerance	Typical	Tolerance
QLCC-16 	A	6.35	±0.20	0.250	±0.008
	B	6.35	±0.20	0.250	±0.008
	C	1.27		0.050	
	D	Radius 0.20		Radius 0.008	
	E	3.81		0.150	
	F	0.64	±0.20	0.025	±0.008
	G	0.64		0.025	
	H	2.49		0.098	
	J	2.49		0.098	
	K	1.78	±0.13	0.070	±0.005
	L	0.51	±0.05	0.020	±0.002
SOP-8 	A	3.90	±0.05	0.154	±0.002
	B	0.43		0.017	
	C	1.27		0.050	
	D	6.00	±0.10	0.236	±0.004
	E	4.90	±0.20	0.193	±0.008
	F	0.50	±0.05	0.020	±0.002
	G	0.20		0.008	
	H	1.37	±0.05	0.054	±0.002
	J	0.10 Min		0.004 Min	
	θ	5°		5°	
SOP-14 	A	3.90	±0.09	0.154	±0.004
	B	0.41	±0.05	0.016	±0.002
	C	1.27		0.050	
	D	6.00	±0.20	0.236	±0.008
	E	8.65	±0.09	0.340	±0.003
	F	0.84	±0.43	0.033	±0.017
	G	0.22	±0.03	0.009	+0.001, -0.002
	H	1.61	±0.09	0.063	+0.004, -0.003
	J	0.18	+0.07, -0.08	0.007	±0.003
	θ	0° to 8°		0° to 8°	

Package Drawing	Dimension	Measurement (mm)		Measurement (inches)	
		Typical	Tolerance	Typical	Tolerance
SOP-16 	A	3.90	±0.09	0.154	±0.004
	B	0.41	±0.05	0.016	±0.002
	C	1.27		0.050	
	D	6.00	±0.20	0.236	±0.008
	E	9.89	±0.09	0.390	+0.003, -0.004
	F	0.84	±0.43	0.033	±0.017
	G	0.22	±0.03	0.009	+0.001, -0.002
	H	1.41	±0.09	0.063	+0.004, -0.003
	J	0.18	+0.07, -0.08	0.007	±0.003
	θ	0° to 8°		0° to 8°	
SOP-20 	A	7.50	±0.10	0.295	±0.004
	B	0.41	±0.05	0.016	±0.002
	C	1.27		0.050	
	D	10.31	±0.20	0.406	±0.008
	E	12.75	±0.10	0.502	±0.004
	F	0.76	±0.25	0.030	±0.010
	G	0.27	±0.05	0.011	±0.002
	H	2.34		0.092	
	J	0.20	±0.10	0.008	±0.004
	θ	0° to 8°		0° to 8°	
PSOP-8 	A	3.91	+0.08, -0.10	0.154	+0.003, -0.004
	B	0.41	±0.08	0.016	±0.003
	C	1.27		0.050	
	D	6.02	±0.18	0.237	±0.007
	E	4.90	+0.08, -0.10	0.193	+0.003, -0.004
	F	0.64	+0.25, -0.23	0.025	+0.010, -0.009
	G	0.23	+0.03, -0.05	0.009	+0.001, -0.002
	H	1.47	±0.08	0.058	±0.003
	J	0.18	±0.08	0.007	±0.003
	K	2.92	±0.20	0.115	±0.008
	L	2.00	±0.20	0.079	±0.008
	θ	0° to 8°		0° to 8°	

Package Drawing	Dimension	Measurement (mm)		Measurement (inches)	
		Typical	Tolerance	Typical	Tolerance
SSOP-16 	A	3.90	±0.09	0.154	±0.003
	B	0.26	±0.05	0.010	±0.002
	C	0.64		0.025	
	D	6.00	±0.20	0.236	±0.008
	E	4.89	±0.09	0.192	±0.003
	F	0.84	±0.43	0.033	±0.017
	G	0.22	±0.03	0.009	+0.001, -0.002
	H	1.55	±0.20	0.061	+0.007, -0.008
	J	0.18	+0.07, -0.08	0.007	±0.003
	θ	0° to 8°		0° to 8°	
SSOP-24 	A	3.90	±0.09	0.154	±0.003
	B	0.26	±0.05	0.010	±0.002
	C	0.64		0.025	
	D	6.00	±0.20	0.236	±0.008
	E	8.60	±0.09	0.340	±0.003
	F	0.84	±0.43	0.033	±0.017
	G	0.22	±0.03	0.009	+0.001, -0.002
	H	1.55	±0.20	0.061	+0.007, -0.008
	J	0.18	+0.07, -0.08	0.007	±0.003
	θ	0° to 8°		0° to 8°	
SSOP-28 	A	3.90	±0.09	0.154	±0.003
	B	0.26	±0.05	0.010	±0.002
	C	0.64		0.025	
	D	6.00	±0.20	0.236	±0.008
	E	9.89	±0.09	0.340	+0.003, -0.004
	F	0.84	±0.43	0.033	±0.017
	G	0.22	±0.03	0.009	+0.001, -0.002
	H	1.55	±0.20	0.061	+0.007, -0.008
	J	0.18	+0.07, -0.08	0.007	±0.003
	θ	0° to 8°		0° to 8°	

Package Drawing	Dimension	Measurement (mm)		Measurement (inches)	
		Typical	Tolerance	Typical	Tolerance
SOP-8-C 	A	7.87	±0.13	0.310	±0.005
	B	4.22	Square	0.166	Square
	C	0.38	±0.05	0.015	±0.002
	D	4.57	Max	0.180	Max
	E	1.27		0.050	
	F	0.38	±0.05	0.015	±0.002
	G	0.13	±0.03	0.005	±0.001
	H	1.45	Max	0.057	Max
	J	0 to 0.10		0 to 0.004	
	θ	0° to 4°		0° to 4°	
SOP-16 Batwing 	A	3.91	±0.10	0.154	±0.004
	B	0.43	±0.08	0.017	±0.003
	C	1.27		0.050	
	D	6.02	±0.18	0.237	±0.007
	E	9.88	±0.08	0.389	±0.003
	F	0.64	+0.25, -0.23	0.025	+0.010, -0.009
	G	0.23	±0.03	0.009	±0.001
	H	1.45	+0.05, -0.08	0.057	+0.002, -0.003
	J	0.17	+0.06, -0.08	0.007	+0.002, -0.003
	K	1.69	+0.06, -0.07	0.067	+0.002, -0.003
	θ	0° to 8°		0° to 8°	
SOP-16 QBW1 	A	3.91	±0.10	0.154	±0.004
	B	0.43	±0.08	0.017	±0.003
	C	1.27		0.050	
	D	6.02	±0.18	0.237	±0.007
	E	9.88	±0.08	0.389	±0.003
	F	0.64	+0.25, -0.23	0.025	+0.010, -0.009
	G	0.23	±0.03	0.009	±0.001
	H	1.45	+0.05, -0.08	0.057	+0.002, -0.003
	J	0.17	+0.06, -0.08	0.007	+0.002, -0.003
	K	1.69	+0.06, -0.07	0.067	+0.002, -0.003
	θ	0° to 8°		0° to 8°	

Package Drawing	Dimension	Measurement (mm)		Measurement (inches)	
		Typical	Tolerance	Typical	Tolerance
TQFP-48	A	8.99	±0.20	0.354	±0.008
	B	8.99	±0.20	0.354	±0.008
	C	7.01	+0.18, -0.20	0.276	+0.007, -0.008
	D	7.01	+0.18, -0.20	0.276	+0.007, -0.008
	E	0.23	±0.05	0.009	±0.002
	F	0.51		0.020	
	G	0.13	Max	0.005	Max
	H	0.99	±0.05	0.039	±0.002
	J	0.05 to 0.15		0.002 to 0.006	
	θ	0° to 7°		0° to 7°