Advanced Data Sheet

STQ-3016

2500 - 4000 MHz
Direct Quadrature Modulator

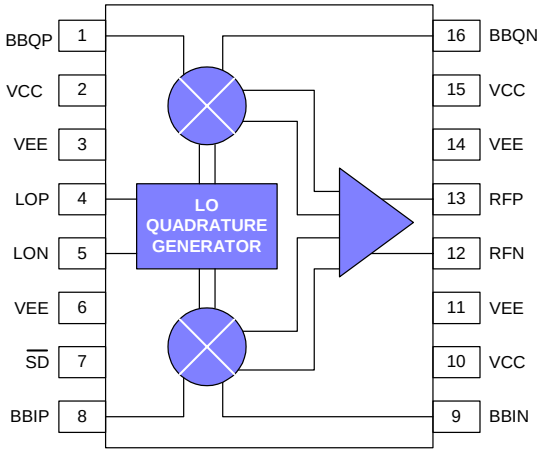
16 pin TSSOP with Exposed Pad
Package Body: 0.20 x 0.17 x 0.04 (inches)
5.0 x 4.4 x 1.0 (mm)

Product Description

The Stanford Microdevices' STQ-3016 is a direct quadrature modulator targeted for use in a wide range of communications systems. This device features a wide 2500-4000 MHz operating frequency band, excellent carrier and sideband suppression, and a low broadband noise floor.

The STQ-3016 uses silicon germanium device technology and delivers a typical output power of -13dBm with 50dB IM3 suppression. A shutdown feature is included that, when enabled, attenuates the output by 60dB.

Functional Block Diagram



Product Features

- **2500-4000 MHz operating frequency**
- **No external IF filter**
- **Very low noise floor performance**
- **Excellent carrier and sideband suppression**
- **Low LO drive requirements**
- **Shut-down feature**
- **Single 5 volt supply**
- **Supports wideband baseband input**

Applications

- **Digital communication system**
- **Spread spectrum communication systems**
- **GMSK, QPSK, QAM, SSB moduators**
- **Fixed wireless communication systems**

Key Specifications

Parameters	Test Conditions (V_s=5.0V, I=82mA, T=25ºC)	Unit	Min.	Typ.	Max.
Frequency Range		MHz	2500		4000
Output P1dB	f_{LO} = 3500 MHz	dBm		+1	
Carrier Feedthrough	f_{LO} = 3500 MHz, unoptimized	dBm		-40	
Sideband Suppression	f_{LO} = 3500 MHz	dB		33	
Broadband Noise Floor	f_{LO} = 3500 MHz, baseband inputs tied to 1.9V_{DC}, -20 MHz offset from carrier	dBm/Hz		-153	
LO Drive Level		dBm	-9	-6	-3
See page 2 for general test conditions					

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Absolute Maximum Ratings

Parameters	Value	Unit
Supply Voltage	6.0	V_{DC}
LO, RF Input	+10	dBm
Min Input Voltage (BBIP, BBIN, BBQP, BBQN)	0	V_{DC}
Max Input Voltage (BBIP, BBIN, BBQP, BBQN)	3	V_{DC}
Operating Temperature	-40 to +85	ºC
Storage Temperature	-65 to +150	ºC

Test Conditions

V_S	+5V
TA	+25ºC
Baseband Inputs	1.9V DC bias, 200kHz frequency, 300mVp-p per pin = 600mVp-p differential drive, I and Q signals in quadrature
LO Input	-5dBm @ 3500 MHz

Product Specifications – RF Output

Parameters	Additional Test Conditions	Unit	Min.	Typ.	Max.
Frequency Range		MHz	2500		4000
Output Power		dBm		-13	
RF Port Return Loss	3.2 to 3.8 GHz, matched to 50 ohm ref. on evaluation board	dB	14		
Output P1dB		dBm		+1	
Carrier Feedthrough	unoptimized	dBm		-40	
Sideband Suppression		dB		33	
IM3 Suppression	two-tone baseband input @ 600mVp-p differential per tone	dB		50	
Broadband Noise Floor	baseband inputs tied to 1.9V_{DC}, -20 MHz offset from carrier	dBm/Hz		-153	
Quadrature Phase Error		deg	-3		+3
I/Q Amplitude Balance		dB	-0.2		+0.2

Product Specifications - Modulation Input

Parameters	Additional Test Conditions	Unit	Min.	Typ.	Max.
Baseband Frequency Input	-3dB bandwidth, baseband inputs terminated in 50 ohms	MHz	DC		1000
Baseband Input Resistance	per pin	kohms		4.4	
Baseband Input Capacitance	per pin	pF		0.5	

Product Specifications - LO Input

Parameters	Additional Test Conditions	Unit	Min.	Typ.	Max.
Usable LO Frequency		MHz	2500		4000
LO Drive Level		dBm	-9	-6	-3
LO Port Return Loss	3.2 to 3.8 GHz, matched to 50 ohm ref. on evaluation board	dB	14		

Product Specifications – Miscellaneous

Parameters	Additional Test Conditions	Unit	Min.	Typ.	Max.
Shut-Down Attenuation		dB		60	
Shut-Down Pin Resistance	@ 1MHz	kohm		6.1	
Shut-Down Pin Capacitance	@ 1MHz	pF		0.7	
Shut-Down Input Thresholds		—		CMOS	
Shut-Down Settling Time		ns		<500	
Supply Voltage		V	+4.75	+5	+5.25
Supply Current		mA		82	
Device Thermal Resistance	junction-case	ºC/W		TBD	

Typical Device Performance

Fig. 1: SSB Power vs. LO Frequency

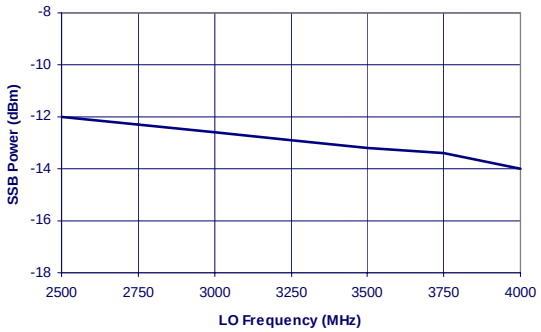


Fig. 2: Output P1dB vs. LO Frequency

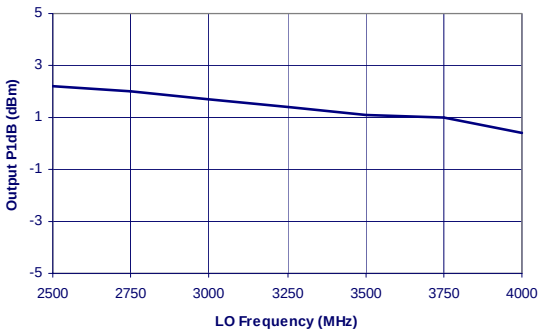


Fig. 3: Carrier Feedthrough vs. LO Frequency

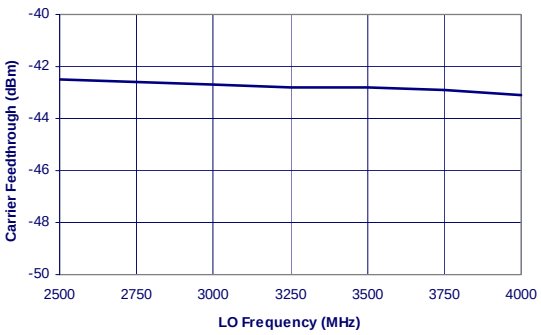
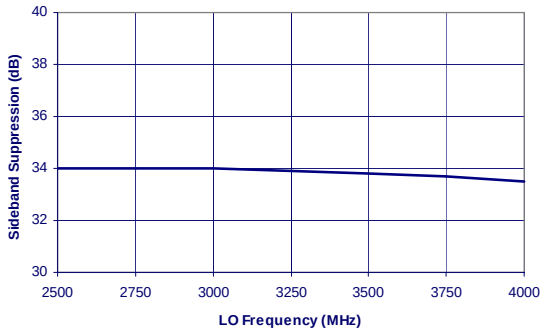


Fig. 4: Sideband Suppression vs. LO Frequency



Small Signal S-Parameters

RF Port

Frequency (MHz)	Single-Ended		Differential	
	Mag.	Ang.	Mag.	Ang.
2500	0.364	124.9	0.320	55.75
2600	0.367	123.1	0.330	54.86
2700	0.370	121.3	0.339	53.98
2800	0.373	119.6	0.349	53.12
2900	0.376	117.8	0.358	52.29
3000	0.379	116.1	0.366	51.48
3100	0.383	114.4	0.375	50.69
3200	0.386	112.8	0.384	49.92
3300	0.390	111.1	0.392	49.17
3400	0.393	109.5	0.400	48.44
3500	0.397	107.9	0.408	47.73
3600	0.401	106.4	0.416	47.04
3700	0.405	104.8	0.424	46.36
3800	0.409	103.3	0.432	45.7
3900	0.414	101.8	0.440	45.06
4000	0.418	100.3	0.447	44.43

LO Port

Frequency (MHz)	Single-Ended		Differential	
	Mag.	Ang.	Mag.	Ang.
2500	0.303	68.71	0.695	-109.9
2600	0.315	67.80	0.681	-114.4
2700	0.327	66.89	0.667	-118.9
2800	0.339	65.97	0.654	-123.4
2900	0.351	65.05	0.641	-127.9
3000	0.363	64.12	0.629	-132.5
3100	0.375	63.19	0.618	-137.0
3200	0.387	62.26	0.607	-141.6
3300	0.399	61.32	0.597	-146.2
3400	0.411	60.37	0.588	-150.8
3500	0.423	59.43	0.580	-155.3
3600	0.434	58.48	0.573	-159.9
3700	0.446	57.53	0.566	-164.5
3800	0.458	56.57	0.561	-169.0
3900	0.469	55.61	0.556	-173.5
4000	0.480	54.65	0.552	-178.0

Notes:
1. VCC = +5.0V, T = +25ºC.
2. For single-ended S-parameters, the corresponding differential pin is left floating.
3. Data is referenced to the foot of the package lead and does not include the applications circuit.
4. All data simulated.

Pin Out Description

Pin #	Function	Description	Additional Comments
1	BBQP	Q-channel baseband input, positive terminal	Nominal DC bias voltage is 1.9V (biased internally)
2	VCC	Positive supply (+5V)	
3	VEE	Ground	
4	LOP	Local oscillator input, positive terminal	Nominal DC voltage is 2.0V. Input should be AC-coupled.
5	LON	Local oscillator input, negative terminal	Nominal DC voltage is 2.0V. Input should be AC-coupled.
6	VEE	Ground	
7	$\overline{SD}$	Shut-down control	CMOS logic levels. Logic high = normal operation; logic low = shut-down enabled.
8	BBIP	I-channel baseband input, positive terminal	Nominal DC bias voltage is 1.9V (biased internally)
9	BBIN	I-channel baseband input, negative terminal	Nominal DC bias voltage is 1.9V (biased internally)
10	VCC	Positive supply (+5V)	
11	VEE	Ground	
12	RFN	RF output, negative terminal	Nominal DC voltage is 2.4V. Output should be AC-coupled.
13	RFP	RF output, positive terminal	Nominal DC voltage is 2.4V. Output should be AC-coupled.
14	VEE	Ground	
15	VCC	Positive supply (+5V)	
16	BBQN	Q-channel baseband input, negative terminal	Nominal DC bias voltage is 1.9V (biased internally)

Part Number Ordering Information

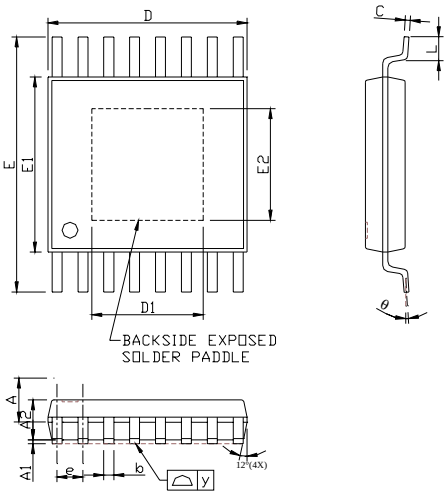
Part Number	Reel Size	Devices/Reel
STQ-3016	TBD	TBD

Caution: ESD Sensitive
Appropriate precaution in handling, packaging and testing devices must be observed.

Part Symbolization

The part will be symbolized with a "TBD" marking designator on the top surface of the package.

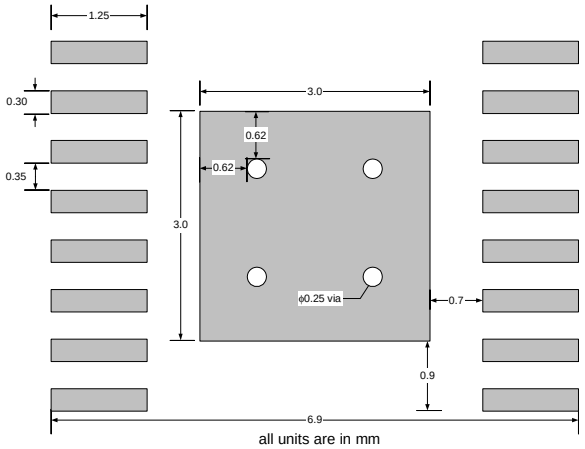
Package Dimensions



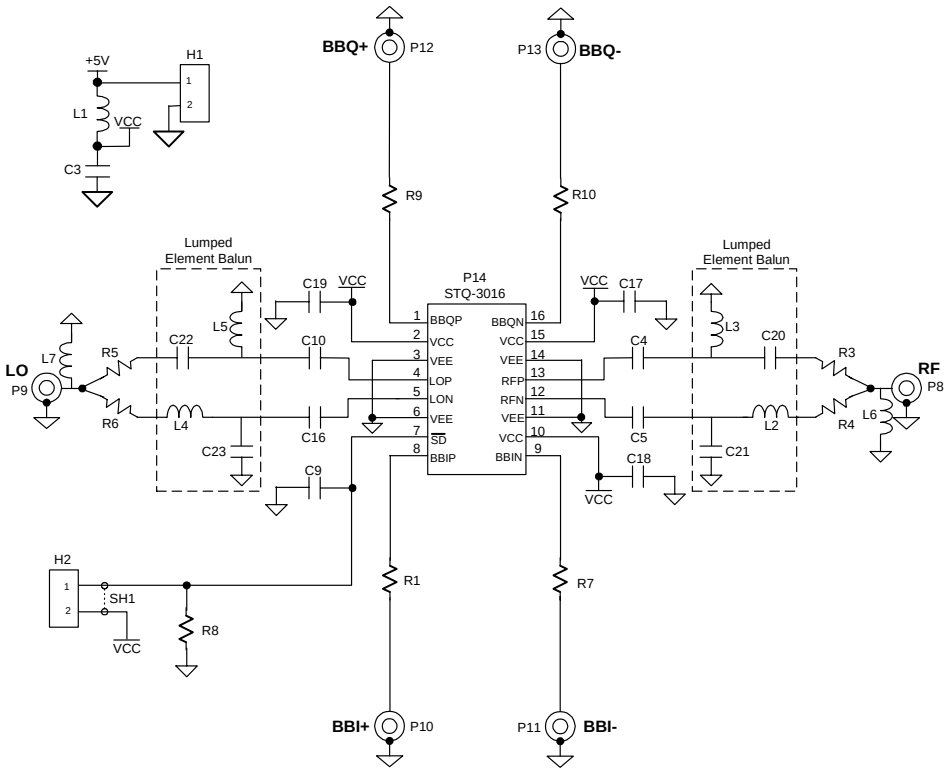
NOTE
1. PACKAGE BODY SIZES EXCLUDE MOLD FLASH PROTRUSIONS OR GATE BURRS
2. TOLERANCE ±0.1 mm UNLESS OTHERWISE SPECIFIED
3. COPLANARITY : 0.1 mm
4. CONTROLLING DIMENSION IS MILLIMETER. CONVERTED INCH DIMENSIONS ARE NOT NECESSARILY EXACT.
5. FOLLOWED FROM JEDEC MO-153

SYMBOLS	DIMENSIONS IN MILLIMETERS			DIMENSIONS IN INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	——	——	1.15	——	——	0.045
A1	0.00	——	0.10	0.000	——	0.004
A2	0.80	1.00	1.05	0.031	0.039	0.041
b	0.19	——	0.30	0.007	——	0.012
C	0.09	——	0.20	0.004	——	0.008
D	4.90	5.00	5.10	0.193	0.197	0.201
D1	——	2.80	——	——	0.110	——
E	——	6.40	——	——	0.252	——
E1	4.30	4.40	4.50	0.169	0.173	0.177
E2	——	2.80	——	——	0.110	——
e	——	0.65	——	——	0.026	——
L	0.45	0.60	0.75	0.018	0.024	0.030
y	——	——	0.10	——	——	0.004
θ	0°	——	8°	0°	——	8°

Test PCB Pad Layout



Demo Test Board Schematic



Bill of Materials (for evaluation at 3.5GHz)

Component Designator	Value	Qty	Vendor	Part Number	Description
P14		1	SMDI	STQ-3016	STQ-3016 SiGe Direct Quadrature Modulator
P8, P9, P10, P11, P12, P13		6	Johnson Components	142-0701-851	SMA connector, end launch with tab, for .062” thick board
H1, H2		2	AMP	640453-2	2-pin header, right angle
L1	1uH	1	Panasonic	ELJ-FA1R0KF2	Inductor, 1210 footprint, ±10% tolerance
R1, R7, R9, R10	200 ohm	4	Venkel	CR1206-8W-2000FT	Resistor, 1206 footprint, ± 1% tolerance
R8	10 kohm	1	Venkel	CR0603-16W-1002FT	Resistor, 0603 footprint, ±1% tolerance
C9, C17	1nF	2	Venkel	C0603COG500-102JNE	Capacitor, 0603 footprint, COG dielectric, ±5% tolerance
C3	2.2uF	1	Venkel	C1206Y5V160-225ZNE	Capacitor, 1206 footprint, Y5V dielectric, 16V rating
C4, C5, C10, C16, C18, C19	1.0pF	6	Venkel	C0603COG500-100JNE	Capacitor, 0603 footprint, COG dielectric, ±5% tolerance
SH1		1	3M	929950-00	Shunt for 2-pin header
L2, L3, L4, L5, L6, L7	2.2nH	6	TOKO	LL1608FS-F2N2S	Inductor, 0603 footprint, ±0.3nH tolerance
C20, C21, C22, C23	0.5pF	4	Venkel	C0603COG500-0R5CNE	Capacitor, 0603 footprint, COG dielectric, ±0.25pF tolerance
R3, R4, R5, R6	0 ohm	4	Venkel	CR0603-16W-000T	Resistor, 0603 footprint

Demo Test Board
(Fully Assembled PCB)