Advanced Data Sheet

SCP-2016

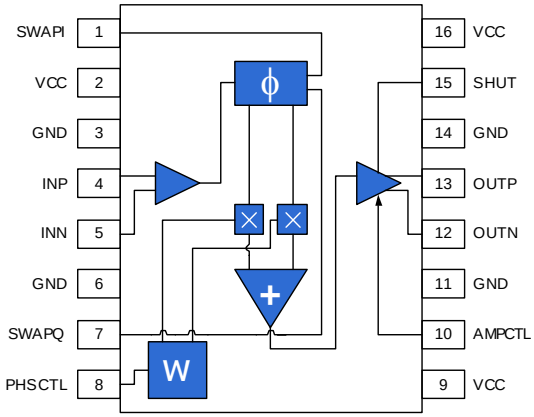
1800 - 2200 MHz High Linearity Silicon Germanium Polar Modulator

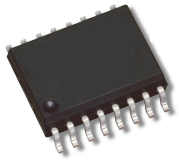
Product Description

The Stanford Microdevices' SCP-2016 polar modulator is a unique component designed to simplify the correction electronics used on high linearity power amplifiers. This high linearity device provides amplitude and phase adjustment through two independently modulated control voltages.

The SCP-2016 is fabricated using silicon germanium device technology and delivers 15dB of amplitude adjustment and greater than 360 degrees of phase adjustment. The broadband design of this component results in outstanding amplitude and phase flatness as required in many correction circuit architectures. This device also includes a fast shutdown feature that can be used to protect subsequent amplifier stages from excessive RF overdrive.

Functional Block Diagram





16 pin TSSOP with Exposed Pad
Package Body: 0.20 x 0.17 x 0.04 (inches)
5.1 x 4.5 x 1.1 (mm)

Product Features

- **High linearity**
- **Independent phase & amplitude control**
- **Fast shut down feature**

Applications

- **High power amplifier correction circuitry**
  - **Feedforward architectures**
  - **Pre-distortion architectures**

Key Specifications

Parameters	Test Conditions (V_{CC}=5.0V, I=150mA, T=25°C)	Unit	Min.	Typ.	Max.
RF Frequency Range		MHz	1800		2200
Input IP3		dBm		+40	
Amplitude Range		dB	-40		-20
Phase Range	continuous, any state	deg		180	
Phase Range	all states	deg	-360		+360
PM (from amplitude control)	over full range of amplitude control	deg	-0.5	0	+0.5
AM (from phase control)	over full range of phase control	dB	-1.0	0	+1.0
See page 2 for general test conditions					

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Absolute Maximum Ratings

Parameters	Value	Unit
Supply Voltage	+9.0	V_{DC}
RF Input (ampctl, phsctl, in, out)	+10	dBm
Min Control Voltage (ampctl, phsctl, swapi, swapq, shut)	0	V_{DC}
Max Control Voltage (ampctl, phsctl, swapi, swapq, shut)	+6.0	V_{DC}
Operating Temperature	-40 to +85	ºC
Storage Temperature	-40 to +150	ºC

Test Conditions

V_S	+8.0V
T-ambient	+25ºC
RF	-20 dBm, 1960 MHz
Control	ampctl = phsctl = +2.5V swapi = swapq = shut = 0 V

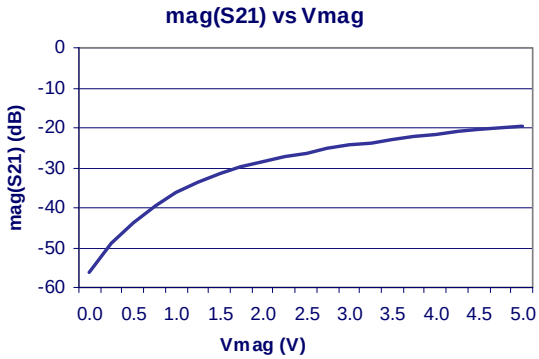
Product Specifications – RF

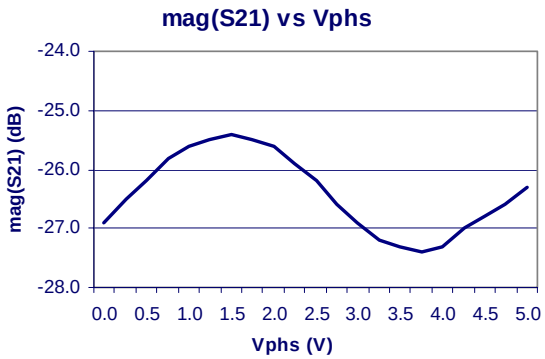
Parameters	Additional Test Conditions	Unit	Min.	Typ.	Max.
Frequency Range		MHz	1800		2200
Input IP3		dBm		+40	
Amplitude Range		dB	-40		-20
Phase Range (continuous)		deg		180	
Phase Range		deg	-360		+360
PM (from amplitude control)	for ampctl from +0.5 to +4.5V	deg	-0.5	0	+0.5
AM (from phase control)	for phsctl from +0.5 to +4.5V	dB	-1.0	0	+1.0
Gain Flatness	BW = 100 MHz	dB		0.1	
Group Delay Flatness	BW = 100 MHz	pS		15	
Noise Figure		dB		30	
VSWR (RF In)	50 ohm reference	—		1.5:1	
VSWR (RF Out)	50 ohm reference	—		1.5:1	

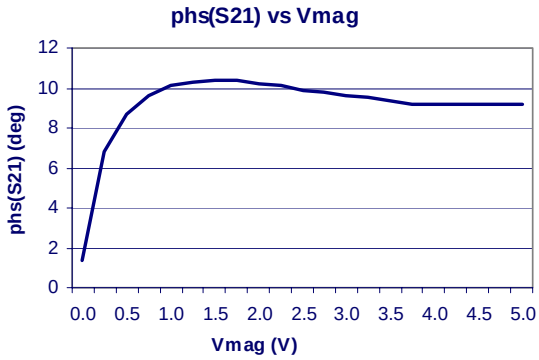
Product Specifications – Miscellaneous

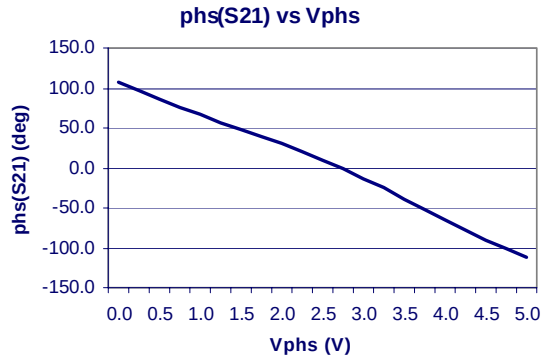
Parameters	Additional Test Conditions	Unit	Min.	Typ.	Max.
Control Voltage Range		V	0.5		4.5
Phase Control Slew Rate		deg/ns		10	
Amplitude Control Slew Rate		%/ns		50	
Shut-Down Attenuation		dB	70		
Logic Input Threshold	SWAPI, SWAPQ, SHUT	V	1.5		3.5
Shut-Down Settling Time	turn on or turn off	nS			50
Supply Voltage		V	+7.6	+8	+8.4
Supply Current		mA		150	
Device Thermal Resistance		ºC/W		TBD	

Typical Device Performance

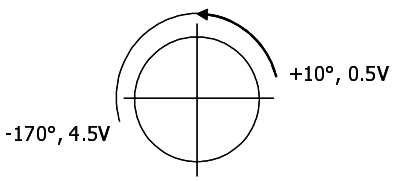




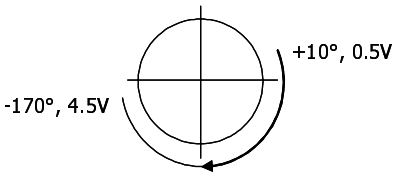




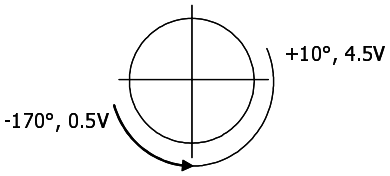
Phase Control Voltage vs. Phase (Degrees)



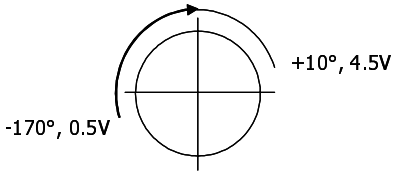
SWAPI=0V, SWAPQ=+5V



SWAPI=SWAPQ=+5V



SWAPI=+5V, SWAPQ=0V



SWAPI=SWAPQ=0V

Pin Out Description

Pin #	Function	Description	Additional Comments
1	SWAPI	Phase swap control input (I-axis)	5V CMOS levels
2	VCC	Positive power supply	
3	GND	Ground	
4	INP	RF input (+)	self-biasing; AC-couple
5	INN	RF input (-)	self-biasing; AC-couple
6	GND	Ground	
7	SWAPQ	Phase swap control input (Q-axis)	5V CMOS levels
8	PHSCTL	Phase control input	self-biasing; apply +0.5 to +4.5V
9	VCC	Positive power supply	
10	AMPCTL	Amplitude control input	self-biasing; apply +0.5 to +4.5V
11	GND	Ground	
12	OUTN	RF output (-)	self-biasing; AC-couple
13	OUTP	RF output (+)	self-biasing; AC-couple
14	GND	Ground	
15	SHUT	Shutdown control input	5V CMOS levels
16	VCC	Positive power supply	

Part Number Ordering Information

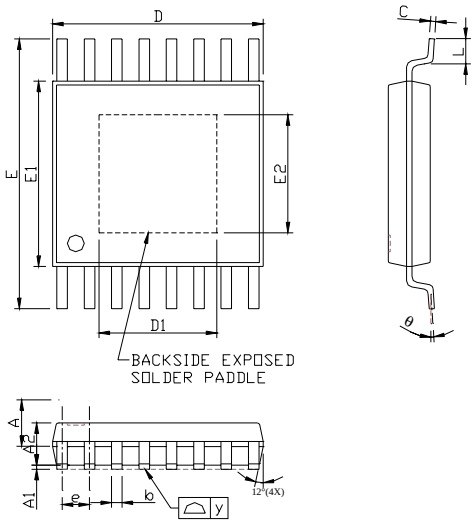
Part Number	Reel Size	Devices/Reel
SCP-2016	TBD	TBD

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.

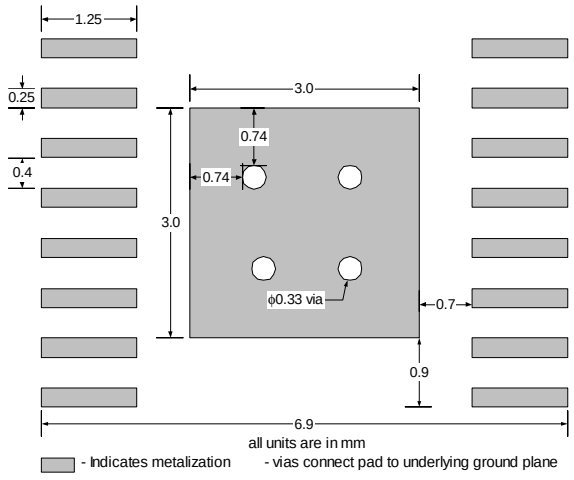
Package Dimensions



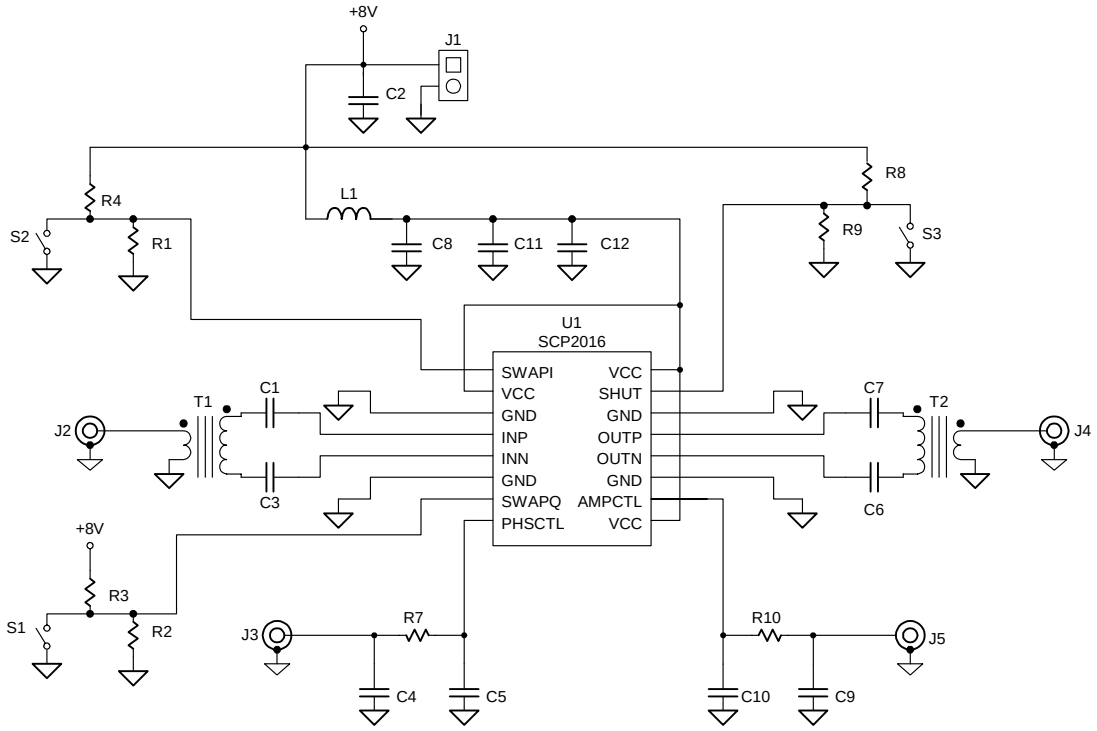
NOTE
1. PACKAGE BODY SIZES EXCLUDE MOLD FLASH PROTRUSIONS OR GATE BURRS
2. TOLERANCE ±0.1 mm UNLESS OTHERWISE SPECIFIED
3. COPLANARITY : 0.1 mm
4. CONTROLLING DIMENSION IS MILLIMETER. CONVERTED INCH DIMENSIONS ARE NOT NECESSARILY EXACT.
5. FOLLOWED FROM JEDEC MO-153

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



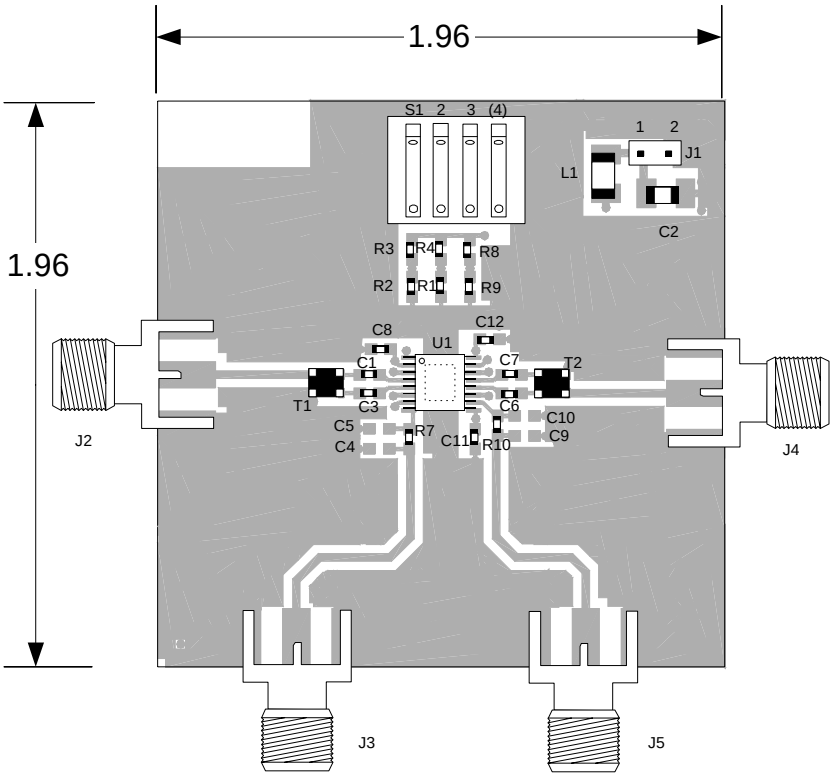
Demo Test Board Schematic



Bill of Materials

Component Designator	Value	Qty	Vendor	Part Number	Description
U1		1	SMDI	SCP-2016	Polar modulator
J1		1	Digikey-Sullins	S1312-02-ND	2 pin 0.1” power supply header
J2, J3, J4, J5		4	Johnson Components	142-0701-851	SMA end launch connectors
T1, T2		2	Panasonic	EHF-FD1619	RF transformer
C2	1uF	1	Venkel	C1206Y5V160-105ZNE	1206 size capacitor
L1	1uH	1	Digikey-Panasonic	PCD1008TR-ND	1210 size inductor
S1, S2, S3		1	Digikey-Grayhill	GH1104-ND	Quad DIP Switch
C11	1nF	1	Venkel	C0603COG500-102JNE	0603 size bypass capacitor
C1, C3, C6, C7	2.7pF	4	Venkel	C0603COG500-2R7CNE	0603 size coupling capacitor
C4, C5, C9, C10	—				not placed
C8, C12	33pF	2	Venkel	C0603COG500-330JNE	0603 size bypass capacitor
R7, R10	0 ohm	2	Venkel	CR0603-16W-000T	0603 size resistor
R3, R4, R8	3 kohm	3	Venkel	CR0603-16W-302JT	0603 size pull-up resistor
R1, R2, R9	5.1 kohm	3	Venkel	CR0603-16W-512JT	0603 size pull-down resistor

Demo Test Board
(Fully Assembled PCB)



Note: Dimensions in inches