HMC473MS8

GaAs MMIC VOLTAGE-VARIABLE ATTENUATOR, 0.45 - 2.2 GHz

Typical Applications

The HMC473MS8 is ideal for:

- Cellular, UMTS/3G Infrastructure
- Portable Wireless
- GPS

Features

Single Positive Voltage Control: 0 to +3V

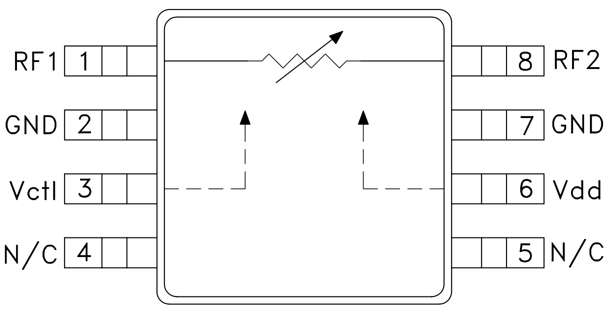
High Attenuation Range: 48 dB @ 0.9 GHz

High P1dB Compression Point: +15 dBm

Ultra Small Package: MSOP8

Replaces HMC173MS8

Functional Diagram



General Description

The HMC473MS8 is an absorptive voltage variable attenuator in an 8-lead MSOP package. The device operates with a +3.3V supply voltage and a 0 to +3V control voltage. Unique features include a high dynamic attenuation range of up to 48 dB and excellent power handling performance through all attenuation states. The HMC473MS8 is ideal for operation in wireless applications from 0.45 to 1.6 GHz. Operation from 1.7 to 2.2 GHz is possible with a reduced maximum attenuation of 29 to 32 dB. The HMC473MS8 can be used with an external driver circuit for improved control voltage linearity vs. attenuation.

Electrical Specifications, T_A = +25° C, Vdd = +3.3 Vdc, 50 Ohm System

Parameter		Min.	Typ.	Max.	Units
Insertion Loss (Min. Atten.) (Vctl = 0.0 Vdc)	0.45 - 0.8 GHz 0.8 - 1.0 GHz 1.0 - 1.6 GHz 1.6 - 2.0 GHz 2.0 - 2.2 GHz		1.8 1.9 2.4 2.8 3.0	2.2 2.3 2.9 3.3 3.5	dB dB dB dB dB
Attenuation Range (Vctl = 0 to +3 V)	0.45 - 0.8 GHz 0.8 - 1.0 GHz 1.0 - 1.6 GHz 1.6 - 2.0 GHz 2.0 - 2.2 GHz	34 43 32 27 24	39 48 37 32 29		dB dB dB dB dB
Return Loss (Vctl = 0 to +3 V)	0.45 - 0.8 GHz 0.8 - 1.0 GHz 1.0 - 1.6 GHz 1.6 - 2.0 GHz 2.0 - 2.2 GHz		15 14 11 10 9		 dB dB dB
Input Power for 0.1 dB Compression (0.9 GHz)	Min Atten. Atten. >2.0		20 5.5		dBm dBm
Input Power for 1.0 dB Compression (0.9 GHz)	Min Atten. Atten. >2.0	24 11	28 15		dBm dBm
Input Third Order Intercept (0.9 GHz, Two-tone Input Power = +5.0 dBm Each Tone)	Min Atten. Atten. >2.0		47 20		dBm dBm
Switching Characteristics tRISE, tFALL (10/90% RF) tON, tOFF (50% CTL to 10/90% RF)	0.45 - 2.2 GHz		 1.3 1.5		 µS µS

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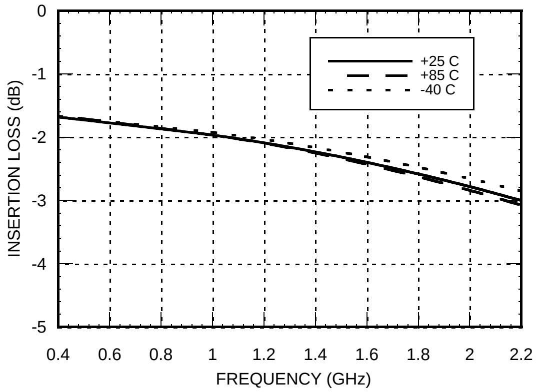
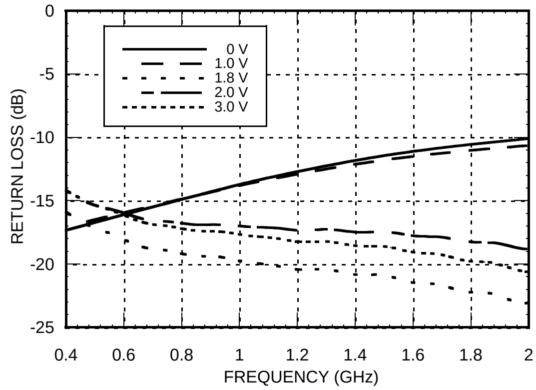
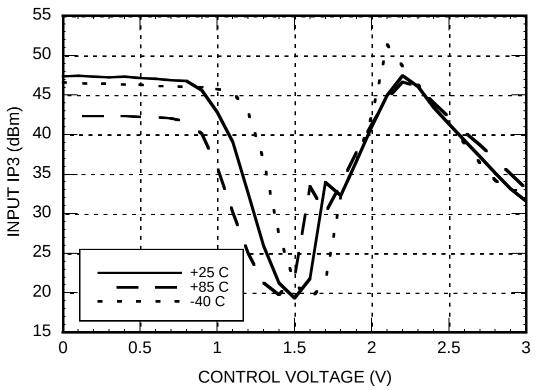
Insertion Loss vs. Temperature



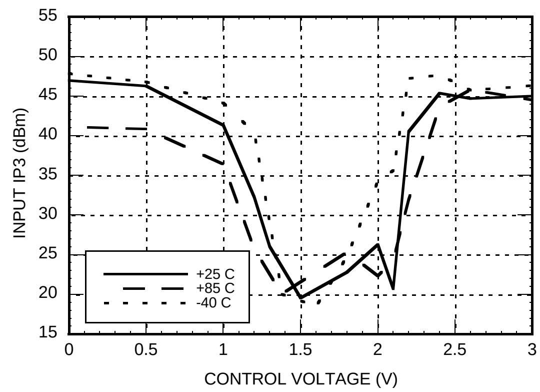
Return Loss vs. Control Voltage



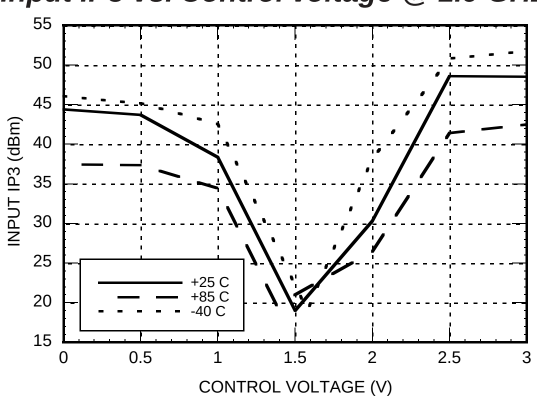
Input IP3 vs. Control Voltage @ 0.45 GHz



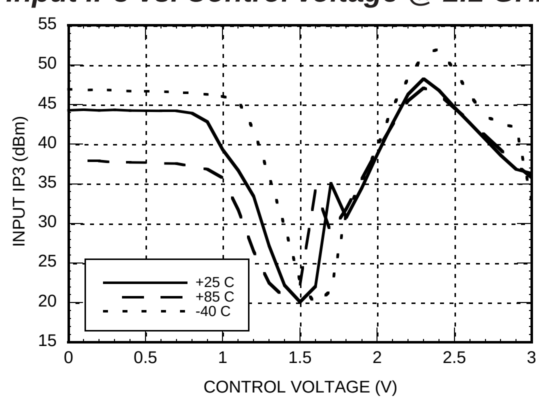
Input IP3 vs. Control Voltage @ 0.9 GHz



Input IP3 vs. Control Voltage @ 1.9 GHz



Input IP3 vs. Control Voltage @ 2.1 GHz



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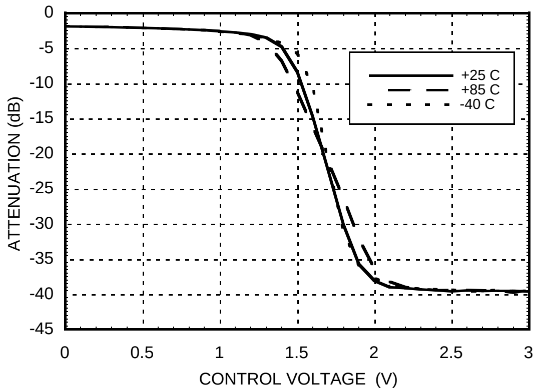
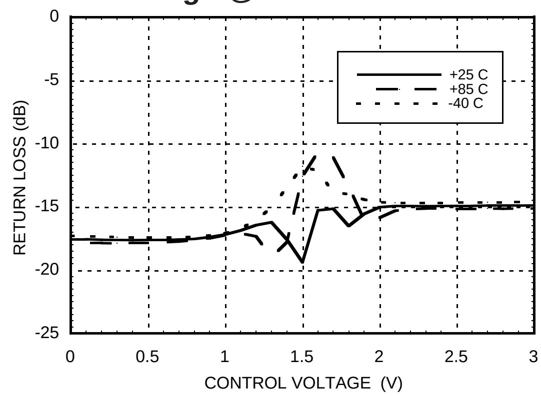
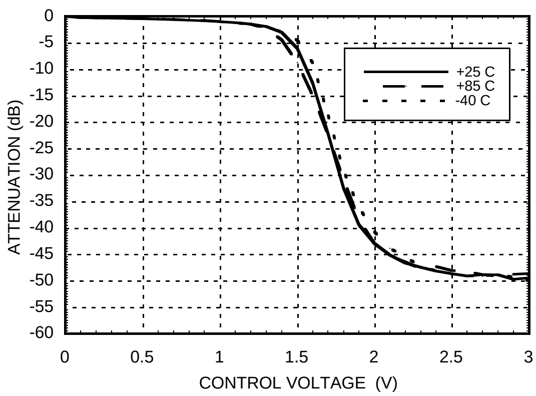
Relative Attenuation vs. Control Voltage @ 0.45 GHz



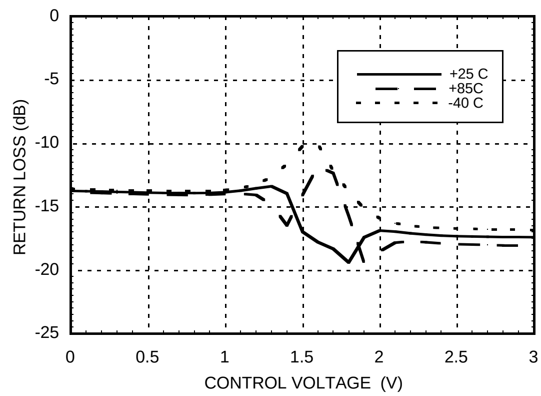
Return Loss vs. Control Voltage @ 0.45 GHz



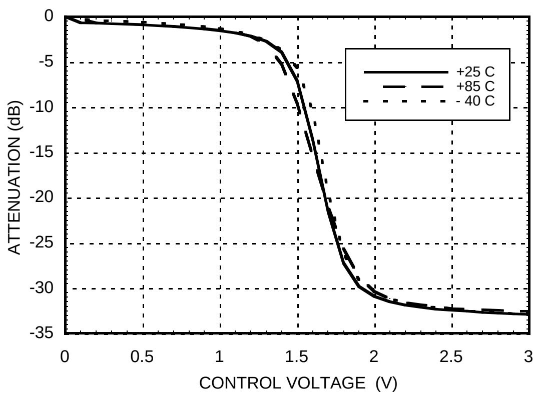
Relative Attenuation vs. Control Voltage @ 0.9 GHz



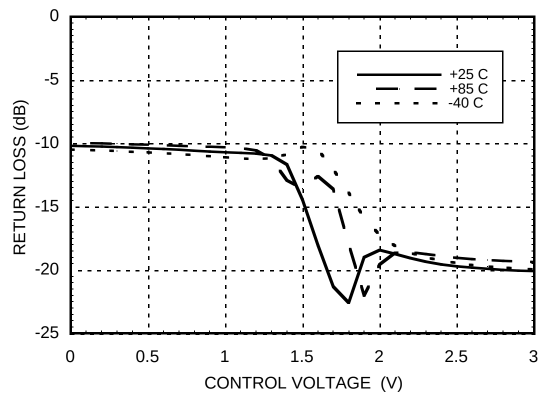
Return Loss vs. Control Voltage @ 0.9 GHz



Relative Attenuation vs. Control Voltage @ 1.9 GHz



Return Loss vs. Control Voltage @ 1.9 GHz



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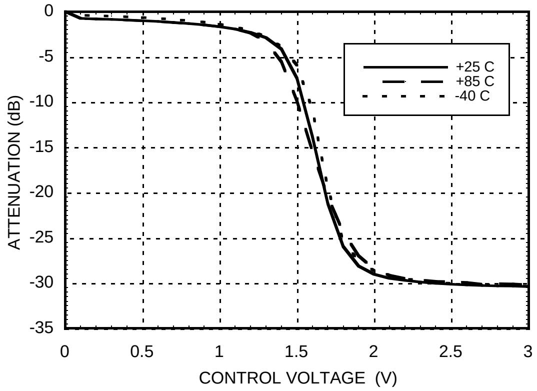
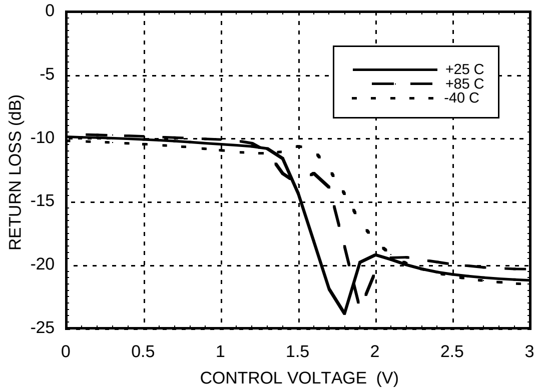
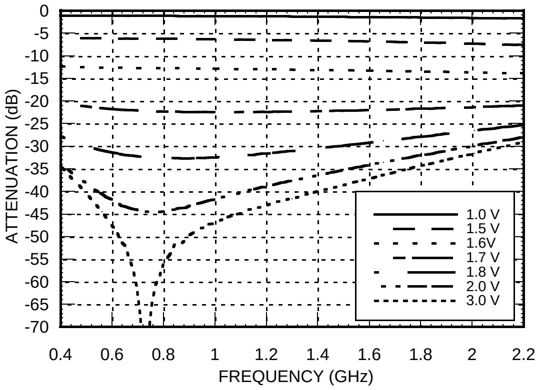
Relative Attenuation vs. Control Voltage @ 2.1 GHz



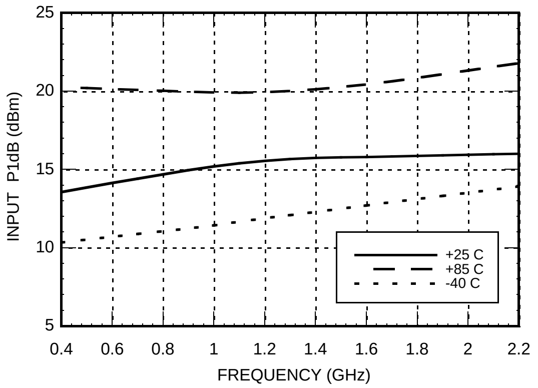
Return Loss vs. Control Voltage @ 2.1 GHz



Relative Attenuation vs. Control Voltage



Worse Case Input P1dB vs. Temperature



Absolute Maximum Ratings

V_{CTL}	-0.2 Vdc to Vdd	
Vdd	+8 Vdc	
Maximum Input Power Vdd = +3.3 Vdc	+29 dBm +21 dBm	Min. Atten. Attenuation >2 dB
Channel Temperature (Tc)	150 °C	
Thermal Resistance (R_{TH}) (junction to lead)	92 °C/W	
Storage Temperature	-65 to +150 °C	
Operating Temperature	-40 to +85 °C	

Control and Bias Voltage

V_{CTL}	0 to +3 Vdc @ 1 µA
Vdd	+3.3 Vdc +/- 0.1 Vdc @ 10 µA

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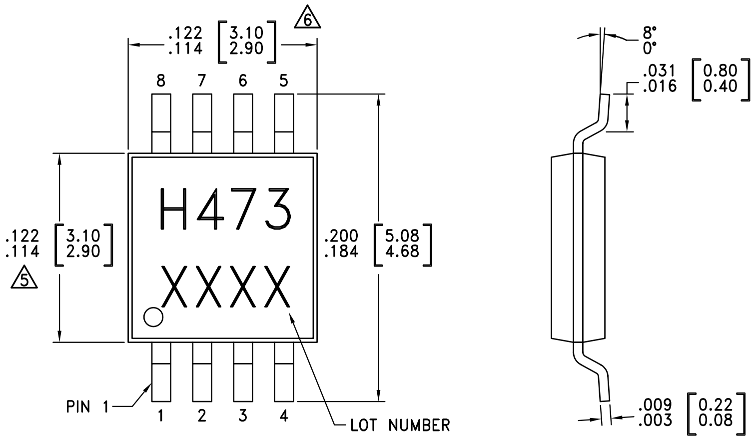
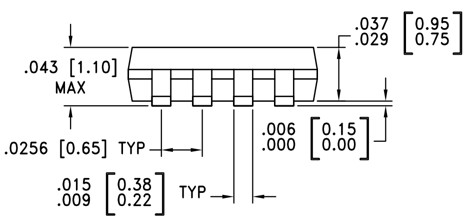
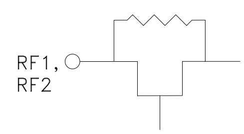
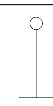
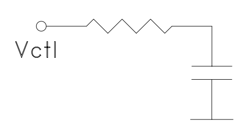
Outline Drawing





NOTES:
1. PACKAGE BODY MATERIAL: LOW STRESS INJECTION MOLDED PLASTIC SILICA AND SILICON IMPREGNATED.
2. LEADFRAME MATERIAL: COPPER ALLOY
3. LEADFRAME PLATING: Sn/Pb SOLDER
4. DIMENSIONS ARE IN INCHES [MILLIMETERS].
5. DIMENSION DOES NOT INCLUDE MOLDFLASH OF 0.15mm PER SIDE.
6. DIMENSION DOES NOT INCLUDE MOLDFLASH OF 0.25mm PER SIDE.
7. ALL GROUND LEADS MUST BE SOLDERED TO PCB RF GROUND.

Pin Descriptions

Pin Number	Function	Description	Interface Schematic
1, 8	RF1, RF2	These pins are DC coupled and matched to 50 Ohms. DC blocking capacitors are required. 330pF capacitors are supplied on evaluation board.	
2, 7	GND	Pins must connect to RF ground.	
3	Vctl	Control voltage	
4, 5	N/C	No Connection. These pins may be connected to RF ground. Performance will not be affected.	
6	Vdd	Supply Voltage.	

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Attenuation Linearizing Control Circuit For The HMC473MS8 Voltage Variable Attenuator

A driver circuit to improve the attenuation linearity of the HMC473MS8 can be implemented with a simple op-amp configuration. A *breakpoint* linearization circuit will scale the voltage supplied to the control line of the HMC473MS8, so that a more linear attenuation vs. control voltage slope can be achieved. A -3.3V and +3.3V supply is required.

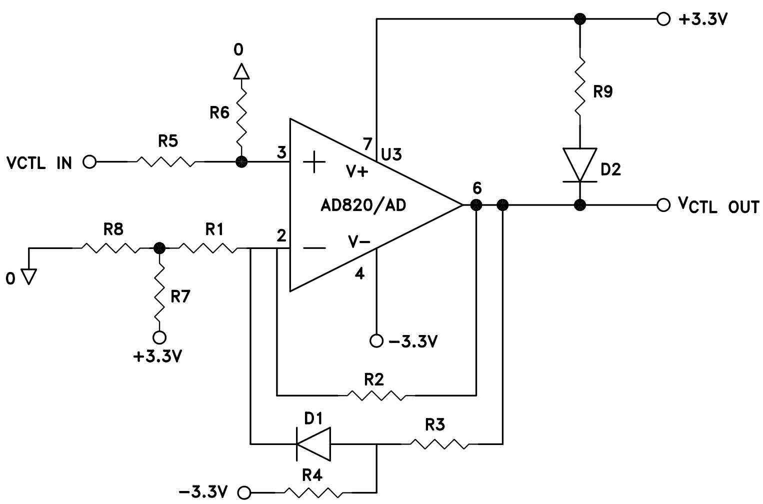
Diode and resistor values which define the op-amp gain, and breakpoint were selected to optimize a measured production lot of attenuators at 0.9 GHz. R7 may be varied to optimize the performance of any given attenuator. If the input voltage to the linearizing circuit will not drop below 1.0V, the R9 and D2 may be omitted, and this will greatly reduce the overall power consumption of the driver circuit.

The linearizing circuit has been optimized for 0.9 GHz attenuation applications. A similar approach may be used at other frequencies by adjusting R1 - R9 resistor values.

Required Parts List

Part	Description	Manufacturer
AD822	Op-Amp	Analog Devices
R1	10K ohms	Panasonic
R2	200K ohms	Panasonic
R3	7.5K ohms	Panasonic
R4	39K ohms	Panasonic
R5	220K ohms	Panasonic
R6	91K ohms	Panasonic
R7	910 ohms	Panasonic
R8	51 ohms	Panasonic
R9	100 ohms	Panasonic
D1, D2	LL4148 D-35	Digi-Key

Application Circuit



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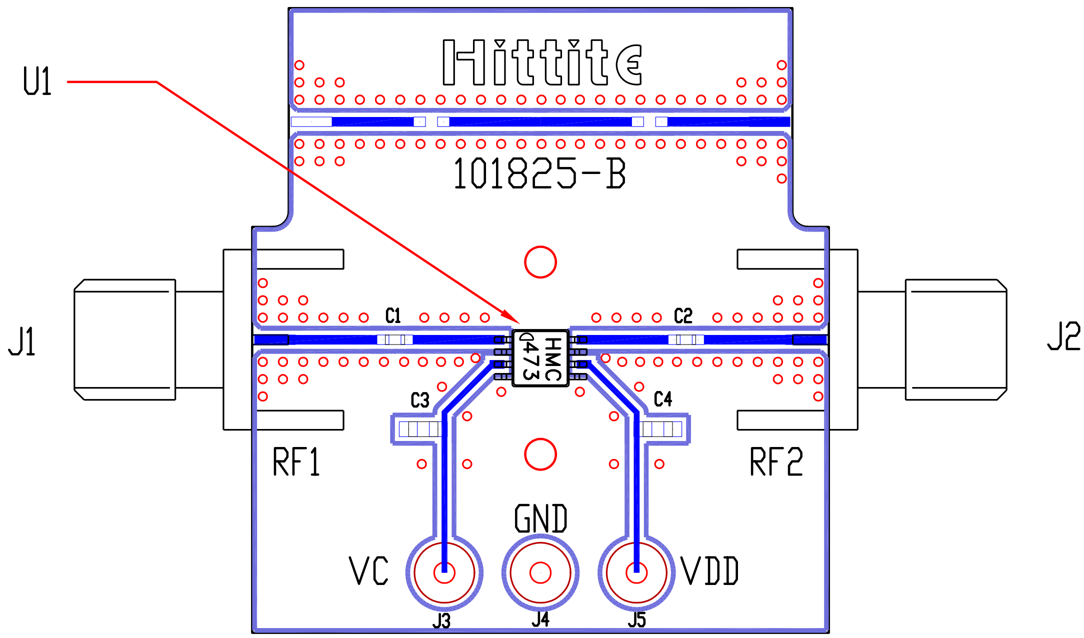
Evaluation PCB



The circuit board used in the final application should be generated with proper RF circuit design techniques. Signal lines at the RF ports should be 50 ohm impedance and the package ground leads should be connected directly to the PCB RF ground plane, similar to that shown above. The evaluation circuit board shown above is available from Hittite Microwave Corporation upon request.

List of Material

Item	Description
J1 - J2	PC Mount SMA RF Connector
J3 - J5	DC PIN
C1, C2	330pF capacitor, 0402 package
C3, C4	10KpF capacitor, 0603 package
U1	HMC473MS8
PCB*	101825 Eval Board
*Circuit Board Material: Rogers 4350	

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Notes: