

Analog Devices Welcomes Hittite Microwave Corporation

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OBSOLETE

HMC538LP4 / 538LP4E

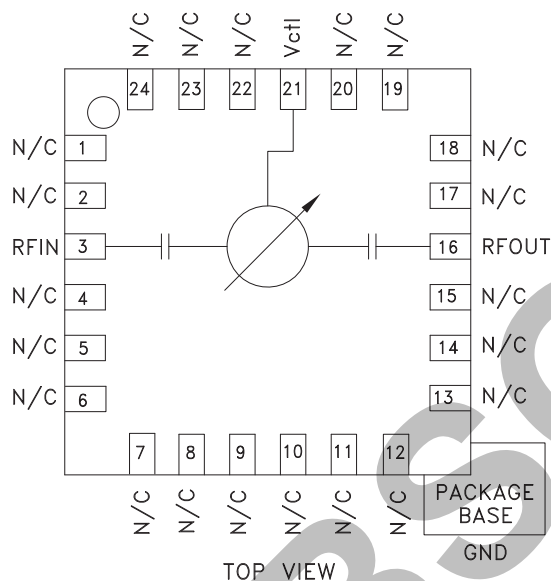
**600° ANALOG PHASE SHIFTER,
6 - 15 GHz**

Typical Applications

The HMC538LP4 / HMC538LP4E is ideal for:

- Fiber Optics
- Military
- Test Equipment

Functional Diagram



Features

- Available as Lead Free
- Wide Bandwidth: 6 - 15 GHz
- >600° Phase Shift
- Single Positive Voltage Control
- QFN Leadless SMT Package, 16 mm²

General Description

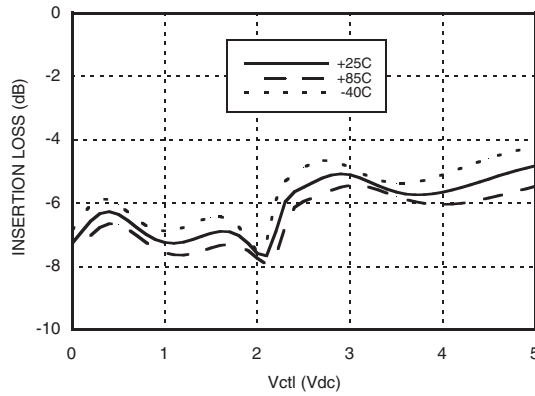
The HMC538LP4(E) are Analog Phase Shifters which are controlled via an analog control voltage from 0 to +5V. The HMC538LP4(E) provides a continuously variable phase shift of 0 to 800 degrees at 6 GHz, and 0 to 450 degrees at 16 GHz, with consistent insertion loss versus phase shift. The phase shift is monotonic with respect to control voltage. The control port has a modulation bandwidth of 50 MHz. The low insertion loss and compact size enable this part to be used in a wide range of applications, including the phase adjustment of clocks in fiber optic systems and test equipment. The HMC538LP4(E) is housed in leadless QFN surface mount packages and are available in both standard and RoHS compliant versions.

Electrical Specifications, $T_A = +25^\circ \text{C}$, 50 Ohm System

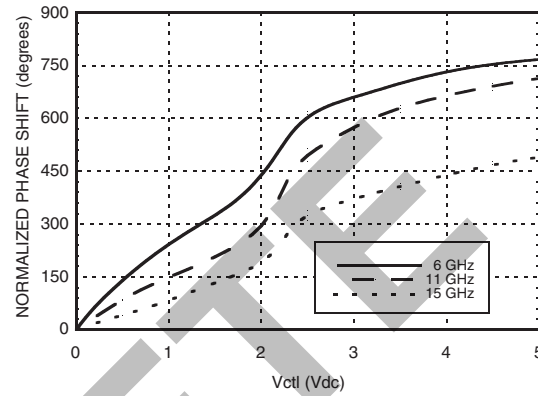
Parameter	Frequency (GHz)	Min.	Typ.	Max.	Units
Phase Shift Range	6 - 10 GHz 10 - 15 GHz	600 360	800 600		degrees degrees
Insertion Loss	6 - 15 GHz		8	11	dB
Return Loss (Input and Output)	6 - 15 GHz		7		dB
Control Voltage Range	6 - 15 GHz		0 - 5		Volt
Modulation Bandwidth	6 - 15 GHz		50		MHz
Phase Voltage Sensitivity	6 - 15 GHz		120		deg /Volt
Insertion Phase Temperature Sensitivity	6 - 15 GHz		0.5		deg /°C

600° ANALOG PHASE SHIFTER, 6 - 15 GHz

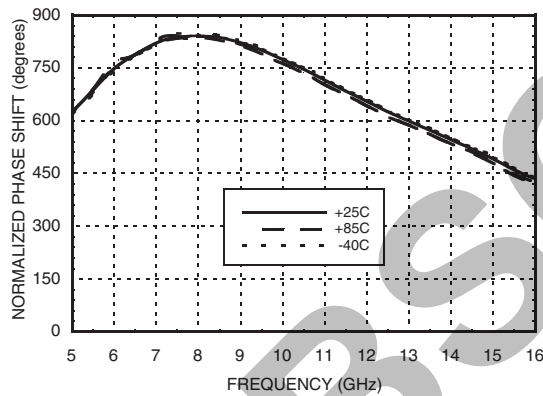
Insertion Loss vs. Control Voltage @ 11 GHz



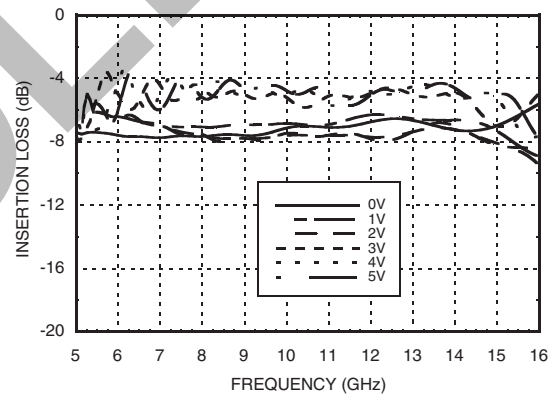
Phase Shift vs. Control Voltage



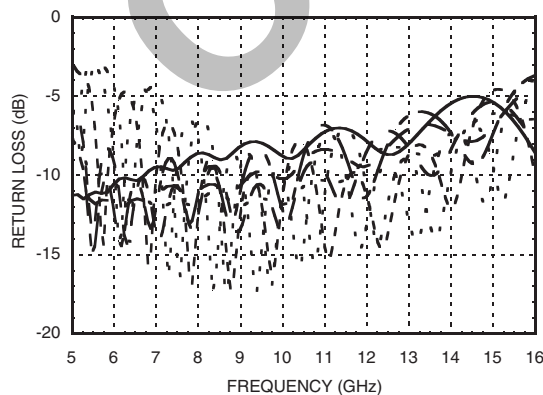
**Phase Shift vs. Frequency @ $V_{ctl} = 5V$
(Relative to $V_{ctl} = 0V$)**



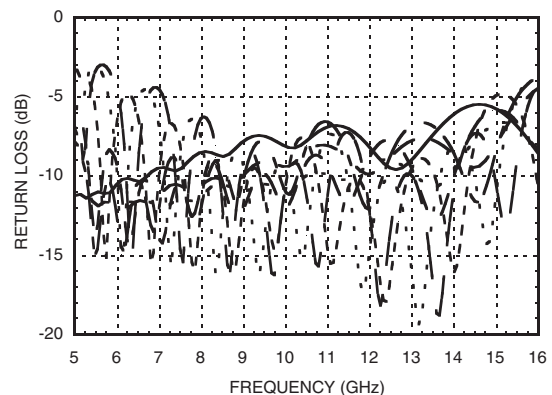
Insertion Loss vs. Frequency



**Input Return Loss vs. Frequency,
 $V_{ctl} = 0$ to +5V**

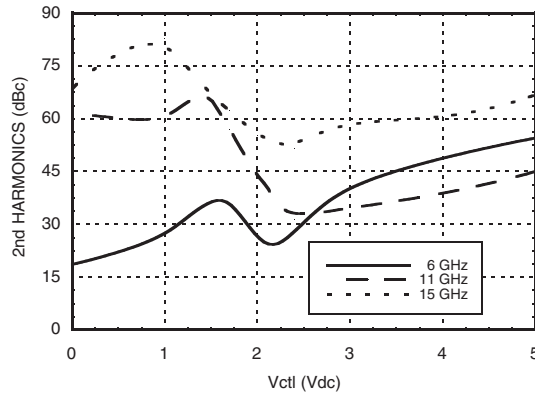


**Output Return Loss vs. Frequency,
 $V_{ctl} = 0$ to +5V**

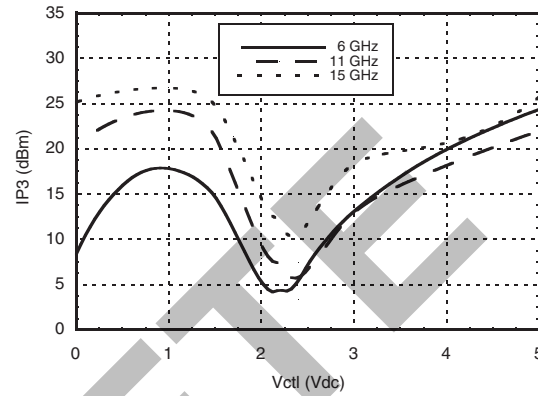


600° ANALOG PHASE SHIFTER, 6 - 15 GHz

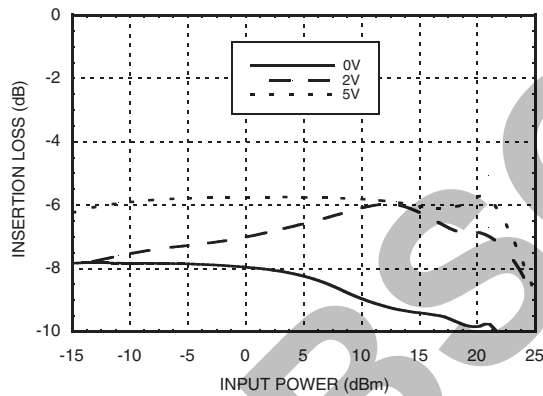
**Second Harmonics vs. Control Voltage,
Pin = -10 dBm**



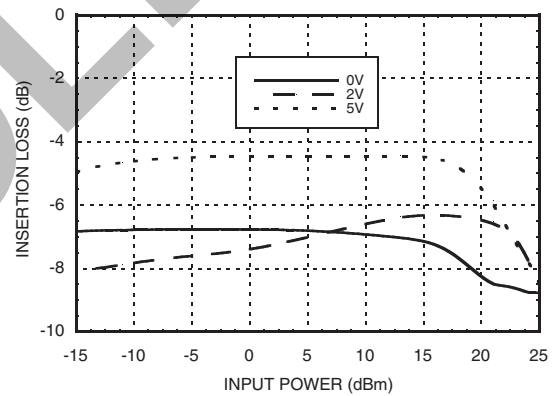
Input IP3 vs. Control Voltage



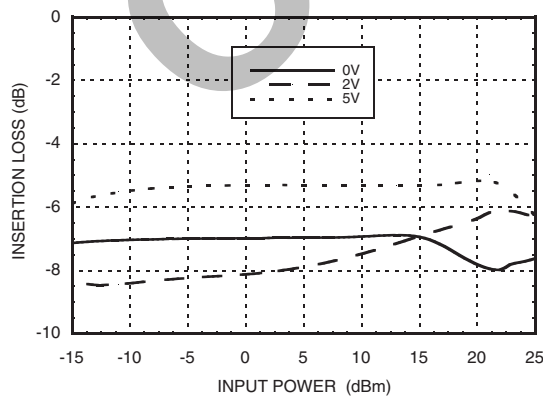
Insertion Loss vs. Pin @ 7 GHz



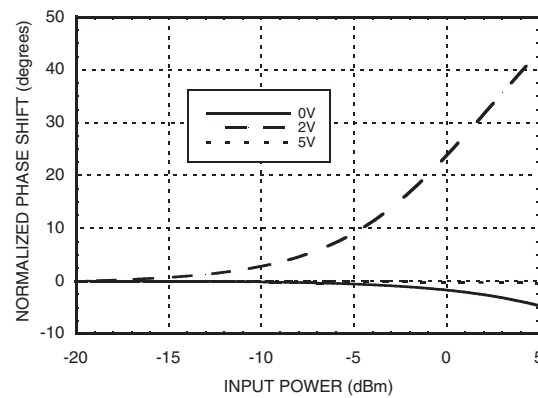
Insertion Loss vs. Pin @ 11 GHz



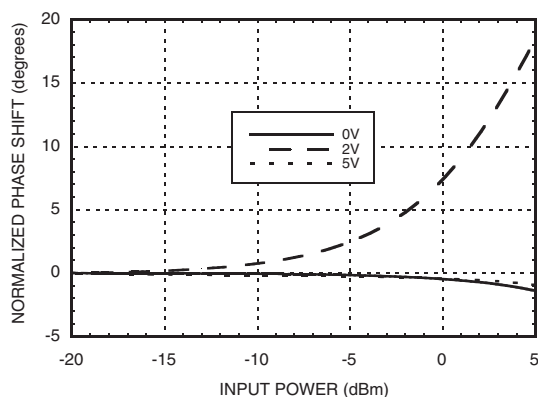
Insertion Loss vs. Pin @ 15 GHz



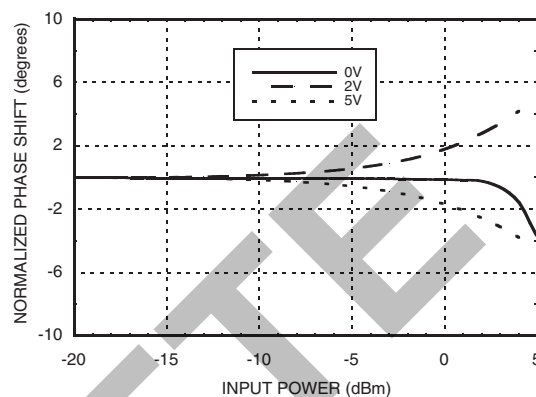
Phase Shift vs. Pin @ 7 GHz



Phase Shift vs. Pin @ 11 GHz



Phase Shift vs. Pin @ 15 GHz



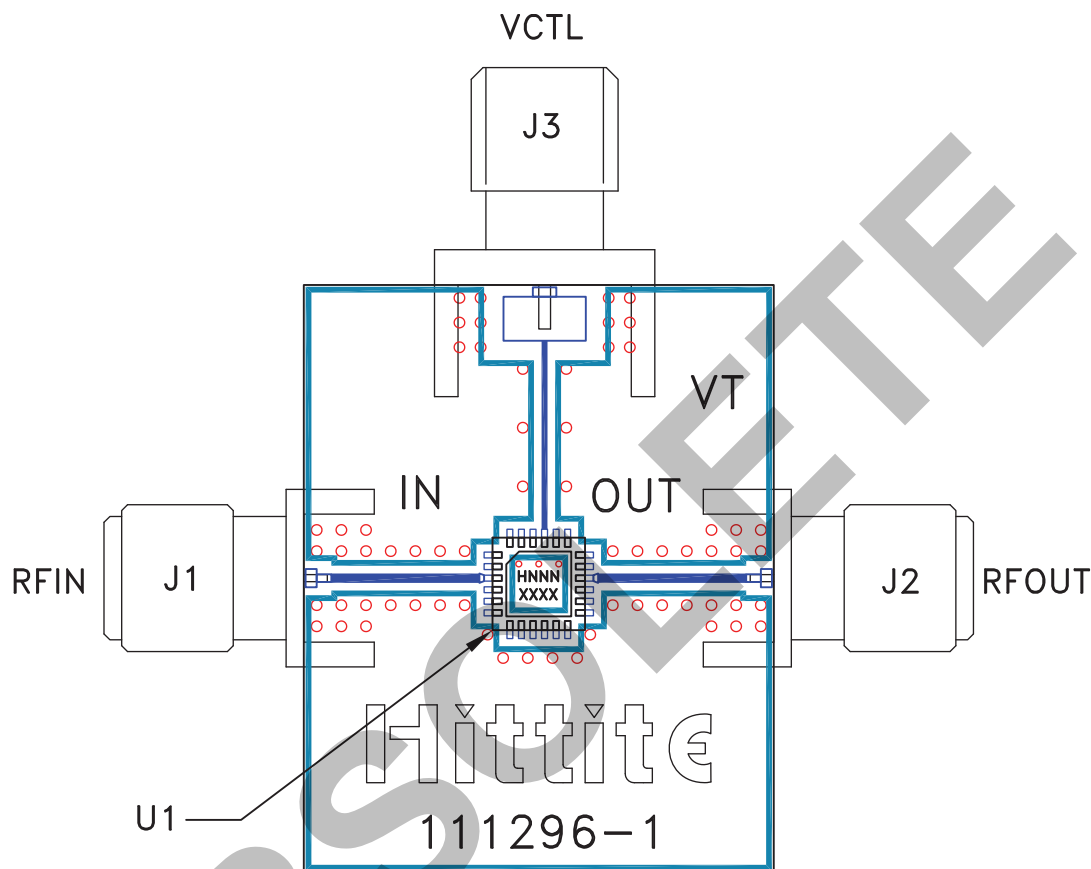
Absolute Maximum Ratings

Control Voltage (Vctl)	-1 Vdc to +8 Vdc
Input Power (RFin)	+25 dBm
Channel Temperature (Tc)	150 °C
Continuous P _{diss} (T = 85 °C) (derate 21 mW/°C above 85 °C)	1.36 W
Thermal Resistance (junction to ground paddle)	48 °C/W
Storage Temperature	-65 to +150 °C
Operating Temperature	-40 to +85 °C
ESD Sensitivity (HBM)	Class 1A



**ELECTROSTATIC SENSITIVE DEVICE
OBSERVE HANDLING PRECAUTIONS**

Evaluation PCB



List of Materials for Evaluation PCB 108812 ^[1]

Item	Description
J1 - J3	PCB Mount SMA RF Connector
U1	HMC538LP4 / HMC538LP4E Analog Phase Shifter
PCB [2]	111296 Evaluation PCB

[1] Reference this number when ordering complete evaluation PCB

[2] Circuit Board Material: Rogers 4350

The circuit board used in the final application should use RF circuit design techniques. Signal lines should have 50 ohm impedance while the package ground leads and exposed paddle should be connected directly to the ground plane similar to that shown. A sufficient number of via holes should be used to connect the top and bottom ground planes. The evaluation board should be mounted to an appropriate heat sink. The evaluation circuit board shown is available from Hittite upon request.