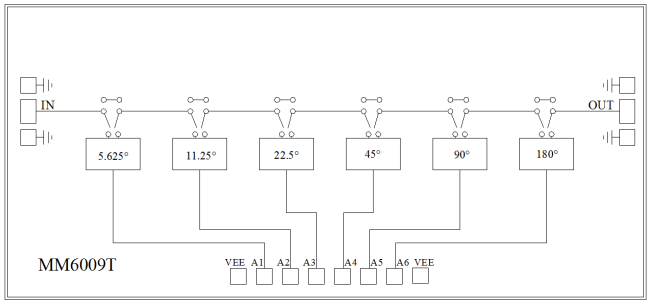
V2.0.0

GaAs MMIC
6-Bit Digital Control Phase Shifter
2.7-3.5GHz

Features

- 6-Bit Digital Control Phase Shifter
- Phase Shift Range: 354°
- Phase Shift Accuracy RMS: 1.6°
- Insertion Loss: 5.0dB Typical
- Amplitude Variation: 0.7dB Typical
- TTL Control : Low(0 to 0.8V)
  High (2 to 5V)
- Power Supply: -5V
- Input/Output: 50Ω
- Chip Size: 3.7 x 1.7 x 0.1mm

Functional Block Diagram



Typical Applications

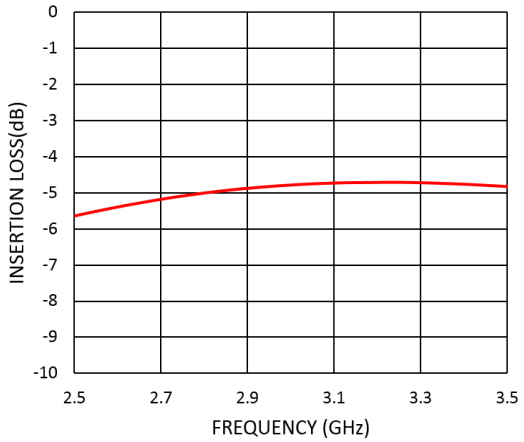
- Test Instrumentation
- Microwave Radio & VSAT
- Military & Space
- Telecom Infrastructure
- Fiber Optics

Electrical Specifications

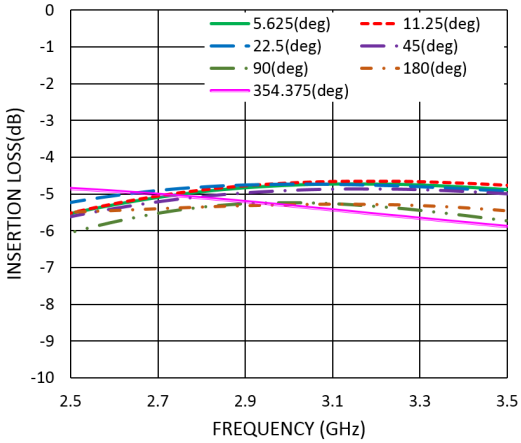
TA = +25°C, VEE = -5V, VCTL = 0/+3V~ +5V

Parameters	Min.	Typ.	Max.	Units
Frequency	2.7		3.5	GHz
Insertion Loss		5.0	6.0	dB
Insertion Loss Variation		1.0		dB
Phase Range		354		°
Control Bits		6		bit
Control Step Size		5.625		°
Phase Shift Accuracy RMS		1.6		°
Phase-shifting Amplitude Modulation		±0.5		dB
Amplitude Variation		0.7		dB
Input Return Loss		-15		dB
Output Return Loss		-14		dB
P1dB - Input 1dB Compression		25		dBm
Switching Speed		20		ns

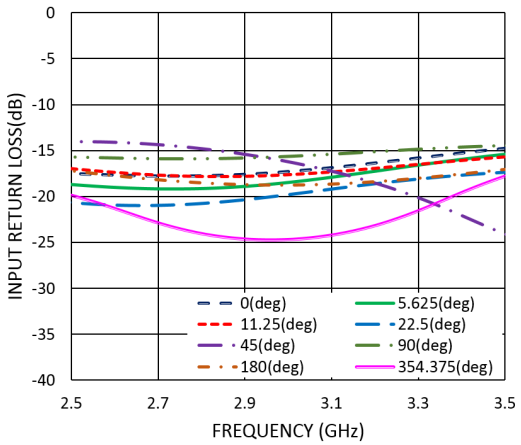
Insertion Loss vs. Frequency



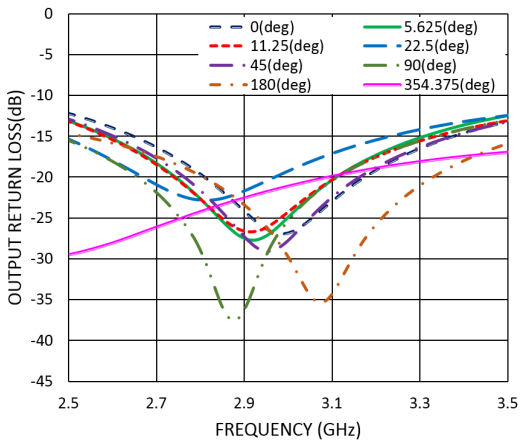
Insertion Loss vs. Frequency



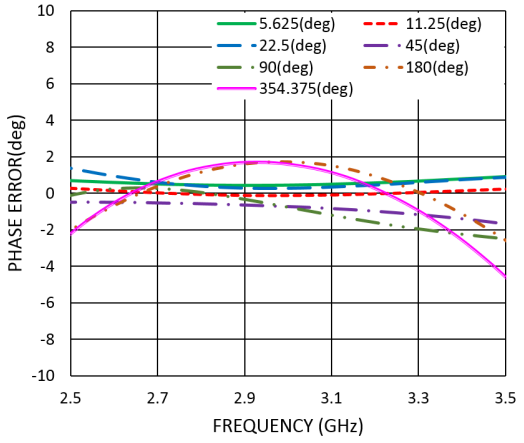
Input Return Loss vs. Frequency



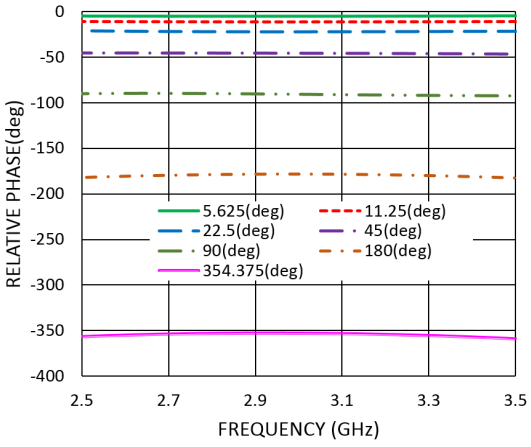
Output Return Loss vs. Frequency



Phase Error vs. Frequency

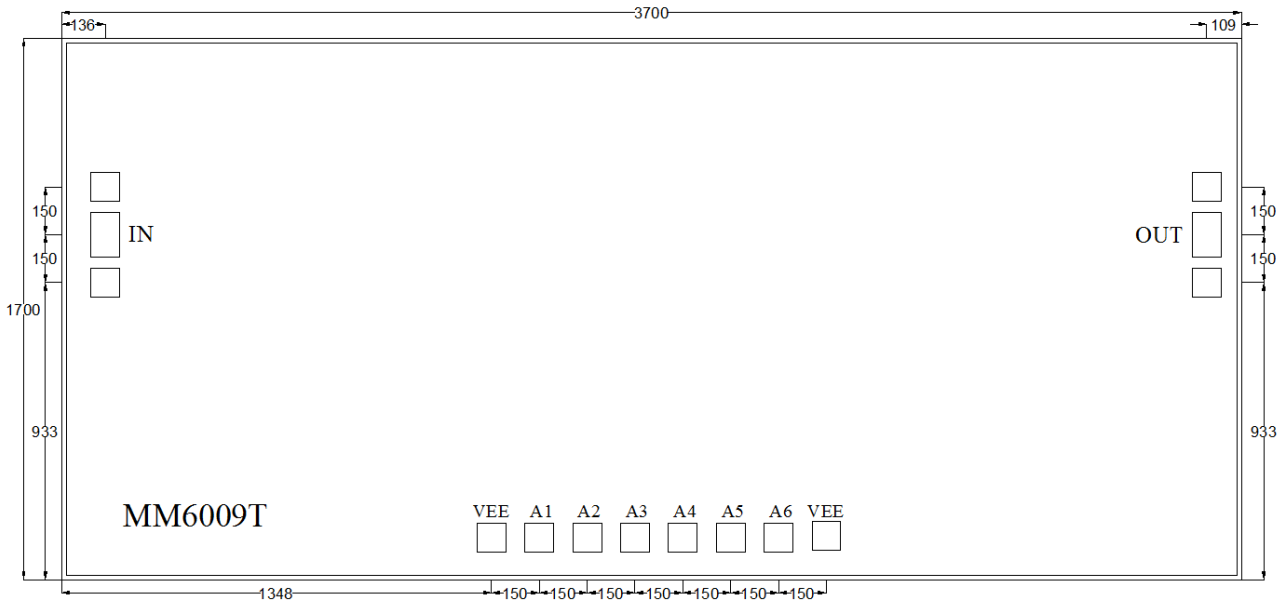


Relative Phase Shift vs. Frequency



Outline Drawing:

All Dimensions in µm



Truth Table

Control Voltage Input						Phase Shift (Degrees)
A1	A2	A3	A4	A5	A6	
0	0	0	0	0	0	0(Reference)
1	0	0	0	0	0	5.625
0	1	0	0	0	0	11.25
0	0	1	0	0	0	22.5
0	0	0	1	0	0	45
0	0	0	0	1	0	90
0	0	0	0	0	1	180
1	1	1	1	1	1	354.375

Bias Voltages

VEE	-6V

Control Voltage

State	Bias Condition
Low(0)	0 to 0.8V
High(1)	2 to 5V

Absolute Maximum Ratings

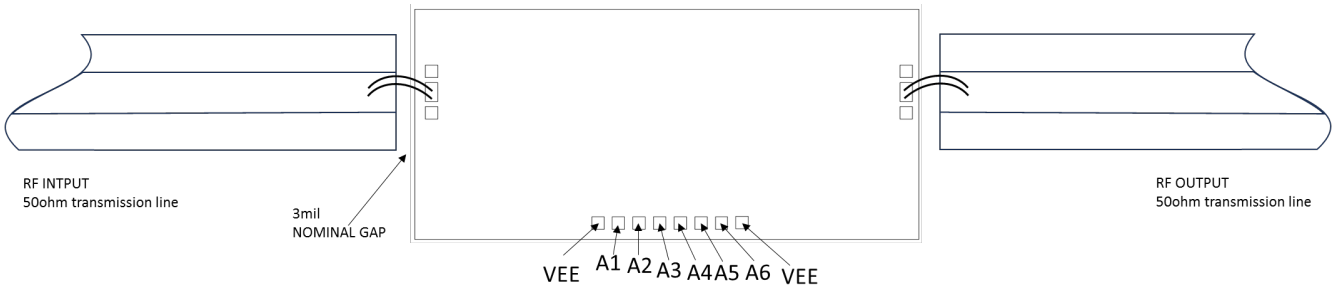
RF Input Power (RFIN)	+30dBm
Control Voltage	-0.5V to 8V
Channel Temperature	175°C
Operating Temperature	-55°C to +85 °C
Storage Temperature	-65°C to +175 °C
ESD Sensitivity (HBM)	Class 1A

Notes:

1. Die thickness: 100µm
2. VEE/A1~A6 bond pad is 90*90µm^2
3. RF bond pad is 90*140µm^2
4. Bond pad metalization: Gold
5. Backside metalization: Gold

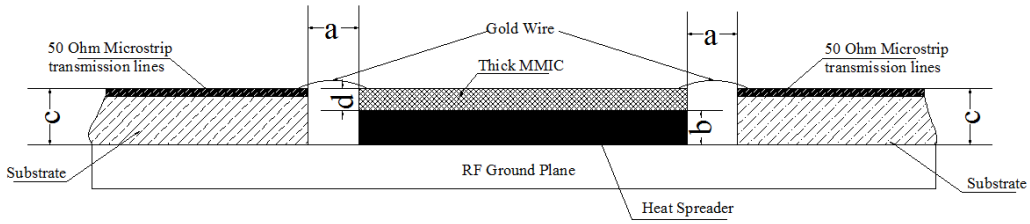
ELECTROSTATIC SENSITIVE DEVICE
OBSERVE HANDLING PRECAUTIONS

Assembly Drawing



No	Function	Description
1	RF IN	RF signal input terminal
2	RF OUT	RF signal output terminal
3	VEE	Digital circuit power port, connect to -5V power supply voltage
4	A1,A2,A3,A4,A5,A6	Control pad, see truth table and control voltage table.
5	Die Bottom	Die bottom must be connected to RF and dc ground.

Mounting & Bonding Technigues for MMICs



Direct Mounting

1.Typically, the die is mounted directly on the ground plane.
2.If the thickness difference between the substrate (thickness c) and the die (thickness d) exceeds 0.05 mm (i.e., c – d > 0.05 mm), it is recommended to first mount the die on a heat spreader, then attach the heat spreader to the ground plane.
3.Heat Spreader Material: Molybdenum-copper (MoCu) alloy is commonly used.
4.Heat Sink Thickness (b): Should be within the range of (c – d – 0.05 mm) to (c – d + 0.05 mm).
5.Spacing (a): The gap between the bare die and the 50Ω transmission line should typically be 0.05 mm to 0.1 mm. If the application frequency is higher than 40GHz, then this gap is recommended to be 0.05mm

Wire Bonding Interconnection

The connection between the die and the 50Ω transmission line is usually made using 25 µm diameter gold (Au) wires, bonded via wedge bonding or ball bonding processes.

Die Attachment Methods

1.Conductive Epoxy:

After adhesive application, cure according to the manufacturer's recommended temperature profile.

2.Au-Sn80/20 Eutectic Bonding:

Use preformed Au-Sn80/20 solder preforms.
Perform bonding in an inert atmosphere (N_2 or forming gas: 90% N_2 + 10% H_2).
Keep the time above 320°C to less than 20 seconds to prevent excessive intermetallic formation.