PRELIMINARY DATASHEET

CGY2173UH/C2

6-bit 6GHz-18GHz Phase Shifter

DESCRIPTION

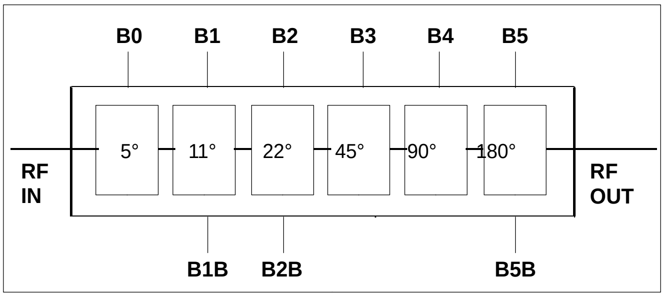
The CGY2173UH is a high performance GaAs MMIC 6–bit Phase Shifter operating from 6 GHz up to 18 GHz.

The CGY2173UH has a nominal phase shifting range of 0 – 360° in 5.625° steps and uses an optimum combination of switched line and high pass/low pass filters to obtain very low phase error and insertion loss variations. It can be used in Radar, Telecommunication and Instrumentation applications.

The die is manufactured using OMMIC's 0.18 µm gate length PHEMT Technology. The MMIC uses gold bonding pads and backside metallization and is fully protected with Silicon Nitride passivation to obtain the highest level of reliability. This technology has been evaluated for Space applications and is on the European Preferred Parts List of the European Space Agency. It has been developed and evaluated for Space in the frame of ESA European Component Initiative

FEATURES

- Operating Range : 6 GHz to 18 GHz
- Insertion Loss : 13 dB at 12 GHz
- Phase Shift Range = 360°
- RMS Phase Error ≈ 4° @ 12 GHz
- Input P1dB ≈ +27 dBm @ 12 GHz
- S_{11} & S_{22} < -12 dB @ 12 GHz (All states)
- 0 / -3V Control Lines
- Chip size = 3250 x 3500 µm
- Tested, Inspected Known Good Die (KGD)
- Space and MIL-STD Available
- Developed and Evaluated for Space in the frame of ESA European Component Initiative



Block Diagram of the 6-Bit 6-18 GHz Phase Shifter

APPLICATIONS

- Radar
- Telecommunication
- Instrumentation

RoHS Compliant

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LIMITING VALUES

T_{amb} = 25 ℃ unless otherwise noted

Symbol	Parameter	Conditions	MIN.	MAX.	UNIT
P_N	Phase Shift control inputs		-4	+0.5	V
P_{IN}	Input power	P_{RF} at RFIN		+33	dBm
T_j	Junction temperature			+150	°C
T_{stg}	Storage temperature		-55	+150	°C

OPERATING CONDITIONS

T_{amb} = 25 ℃ unless otherwise noted

Symbol	Parameter	Conditions	MIN.	MAX.	UNIT
P_N	Phase Shift control inputs		-3	0	V
P_{IN}	Input power	P_{RF} at RFIN		+30	dBm
T_{amb}	Ambient temperature		-40	+85	℃

THERMAL CHARACTERISTICS

Symbol	Parameter	Value	UNIT
$R_{th(j-a)}$	Thermal resistance from junction to ambient (T_a = 25 ℃)	NA	°C/W

CHARACTERISTICS

T_{amb} = 25 °C – RF Performance measured on wafer.

Symbol	Parameter	Conditions	MIN.	TYP.	MAX.	UNIT
BW	Bandwidth		6		18	GHz
RF Performance at 12 GHz unless specified						
IL	Insertion Loss			13		dB
NF	Noise Figure at reference state			13		dB
PH_{range}	Phase range			360		°
S_{11}	Input reflection coefficient	At RF IN		-20	-12	dB
S_{22}	Output reflection coefficient	At RF OUT		-20	-12	dB
$PH_{error\ (RMS)}$	RMS Phase error vs phase setting (see Note 1)			4		°
$PH_{error\ (MAX)}$	Maximum Phase error vs phase setting			10		°
$ATT_{variation\ (RMS)}$	RMS Attenuation variation with phase setting (see Note 1)			0.6		dB
$ATT_{variation\ (MAX)}$	Maximum Attenuation variation with phase setting			1		dB
P_{1dB}	Input 1dB compression point			+27		dBm

Note 1 : The RMS value is the root mean square of the error defined as below :

$$x_{RMS} = \sqrt{\frac{1}{N}\sum_{i=1}^{N} x_i^2} = \sqrt{\bar{x}_i^{\,2} + \sigma_{x_i}^2}$$

Where x_i is the difference between the measured value and the theoretical value (x_i is the error), $\bar{x}_i$ is the mean value of the N x_i, and σ_{x_i} is the standard deviation of x_i.

Caution : This device is a high performance RF component and can be damaged by inappropriate handling. Standard ESD precautions should be followed. OMMIC document "OM-CI-MV/ 001/ PG" contains more information on the precautions to take.

CONTROL VOLTAGE

State	MIN.	TYP.	MAX.	UNIT
Low (0)	-3.5	-3	-2.5	V
High (1)	-0.1	0	+0.1	V

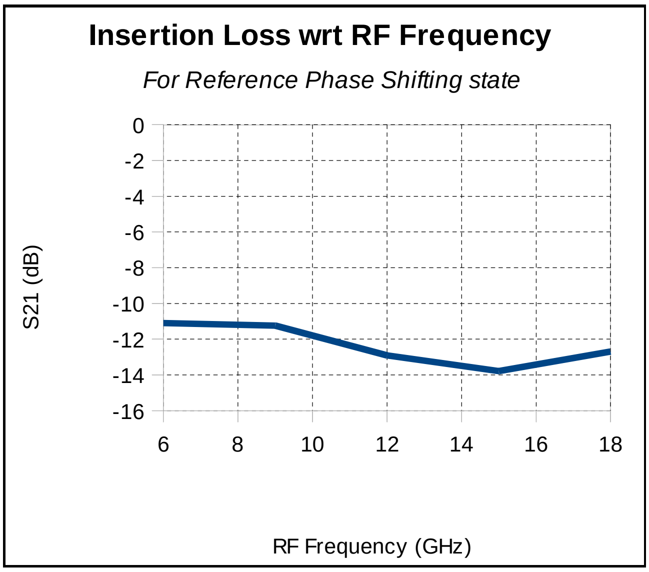
LOGIC TRUTH TABLE

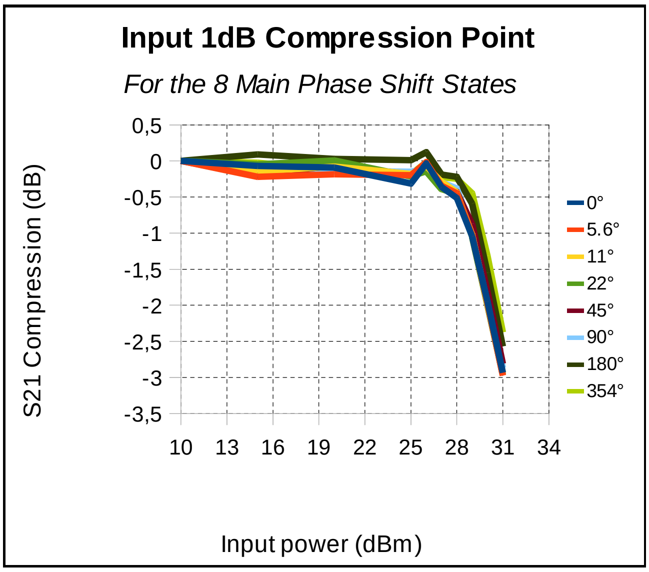
	B0	B1	B1B	B2	B2B	B3	B4	B5	B5B
Nominal Phase Shift	-5.625°	-11.25°	-11.25°	-22.5°	-22.5°	-45°	-90°	-180°	-180°
Pad	B0	B1	B1B	B2	B2B	B3	B4	B5	B5B
Phase Shift activated	1	1	0	1	0	1	1	1	0
Reference state	0	0	1	0	1	0	0	0	1

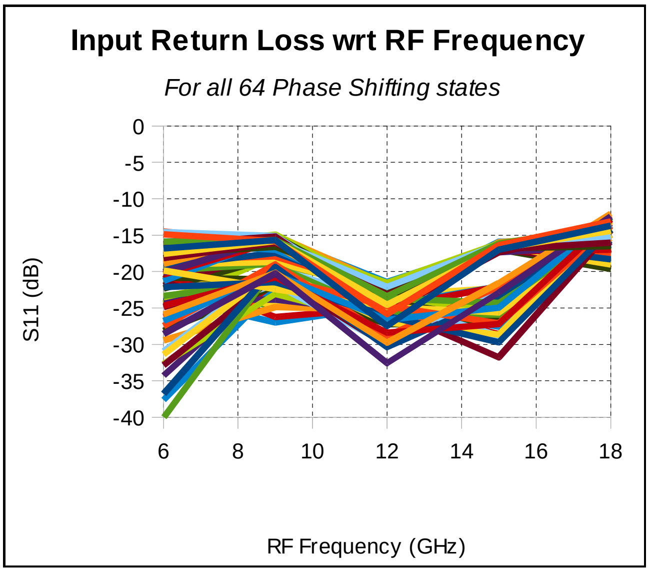
	B0	B1	B1B	B2	B2B	B3	B4	B5	B5B
Phase Shift (°)	-5.625°	-11.25°	-11.25°	-22.5°	-22.5°	-45°	-90°	-180°	-180°
0	0	0	1	0	1	0	0	0	1
-5.625	1	0	1	0	1	0	0	0	1
-11.25	0	1	0	0	1	0	0	0	1
-22.5	0	0	1	1	0	0	0	0	1
-45	0	0	1	0	1	1	0	0	1
-90	0	0	1	0	1	0	1	0	1
-180	0	0	1	0	1	0	0	1	1
-354.375	1	1	0	1	0	1	1	1	0

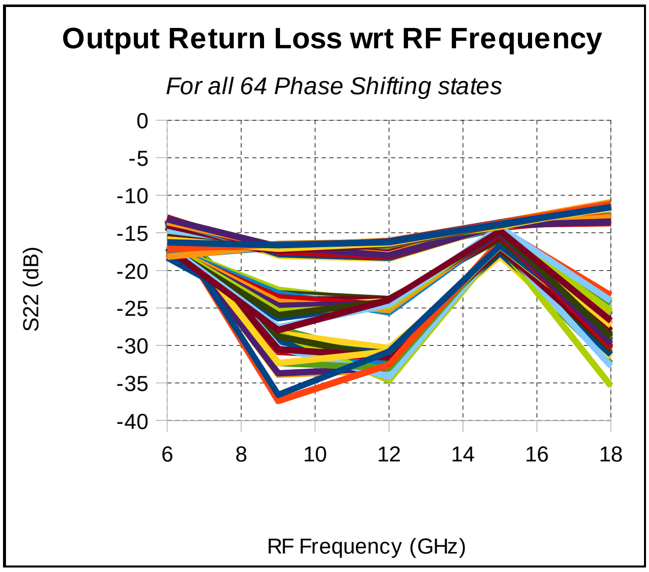
ON WAFER MEASUREMENTS – S PARAMETERS

Measured on wafer @ T = 25 °C



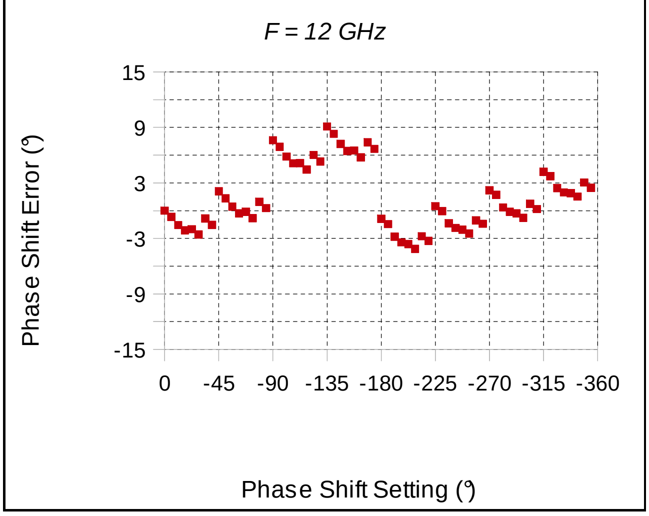




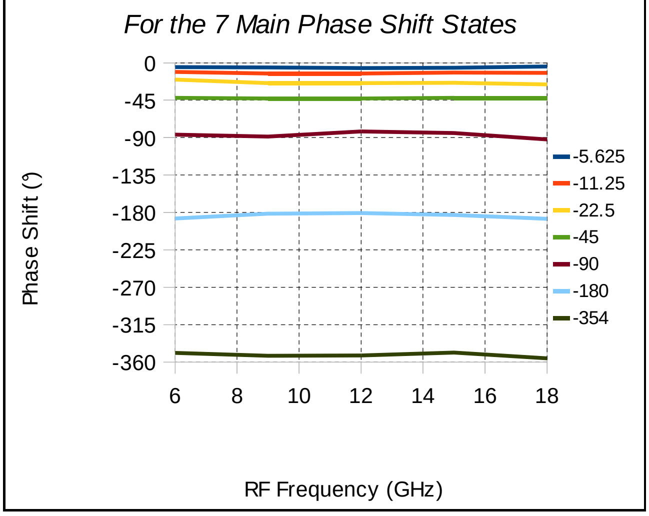


ON WAFER MEASUREMENTS – PHASE SHIFTING ERRORS

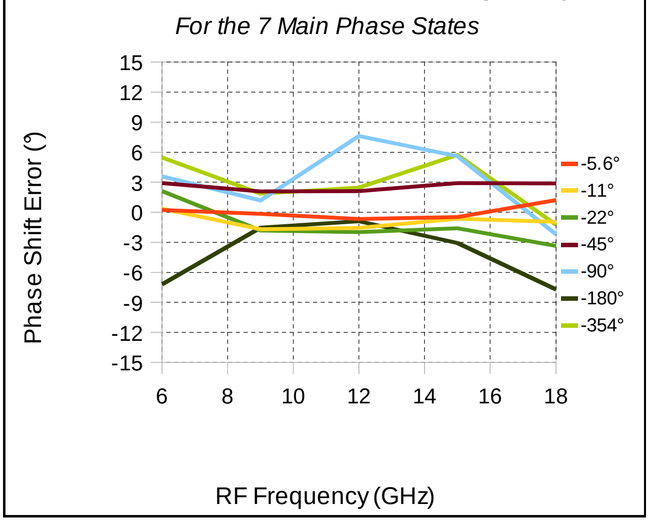
Measured on wafer @ T = 25 ℃



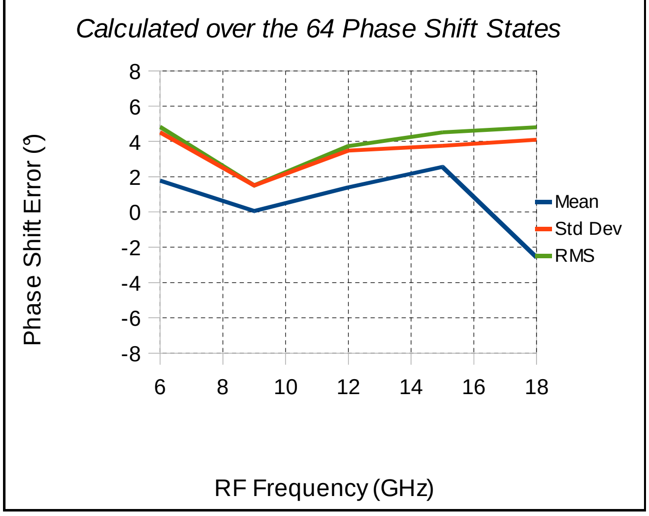
Phase Shift Error wrt Phase Shift Setting



Phase Shifting wrt RF Frequency



Phase Shift Error wrt RF Frequency



Phase Shift Error wrt RF Frequency

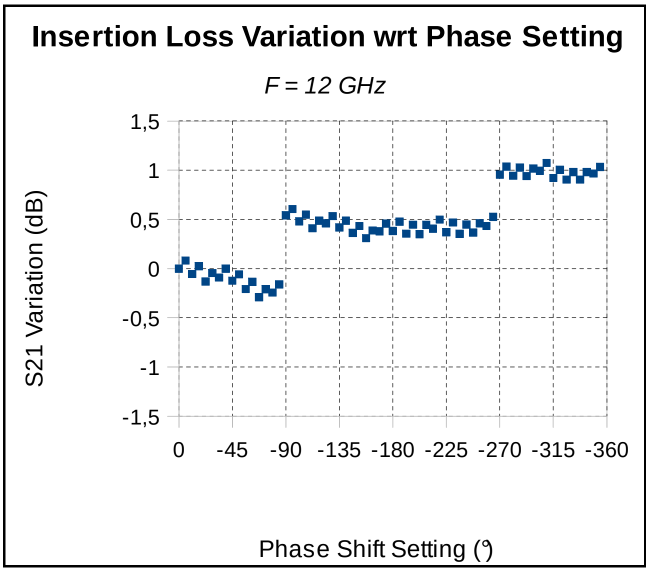
Note : The RMS value is the root mean square of the error defined as below :

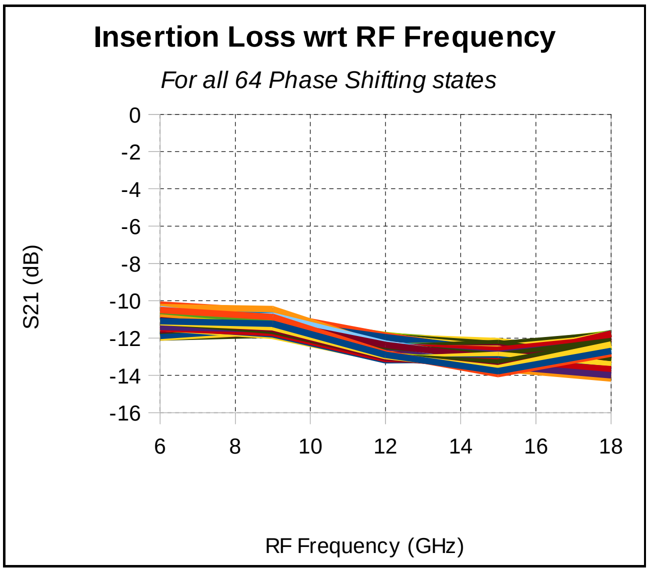
$$x_{RMS} = \sqrt{\frac{1}{N}\sum_{i=1}^{N} x_i^2} = \sqrt{\bar{x_i}^2 + \sigma_{x_i}^2}$$

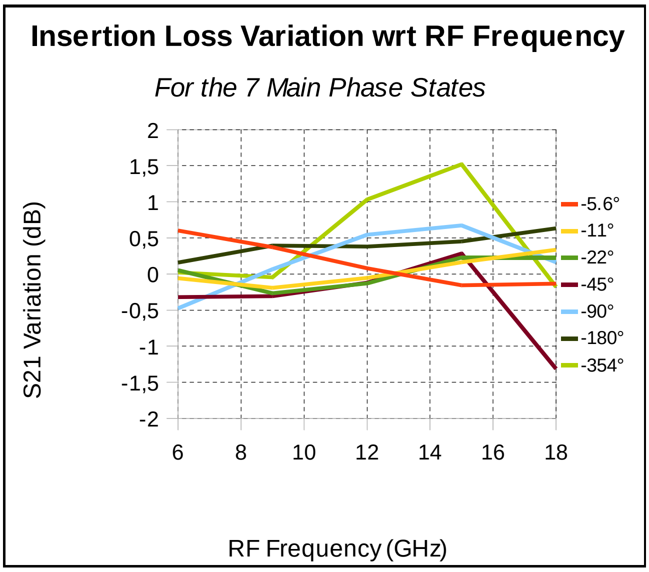
Where x_i is the difference between the measured value and the theoretical value (x_i is the error), $\bar{x_i}$ is the mean value of the N x_i, and σ_{x_i} is the standard deviation of x_i.

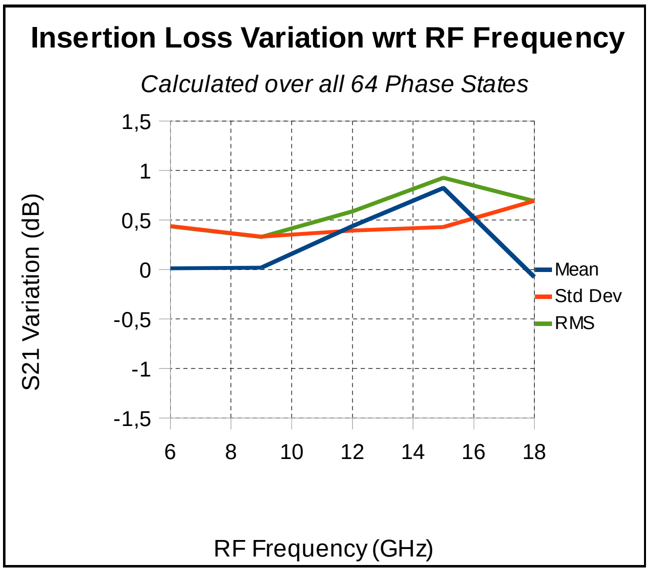
ON WAFER MEASUREMENTS – INSERTION LOSS VARIATIONS

Measured on wafer @ T = 25 ℃









Note : The RMS value is the root mean square of the error defined as below :

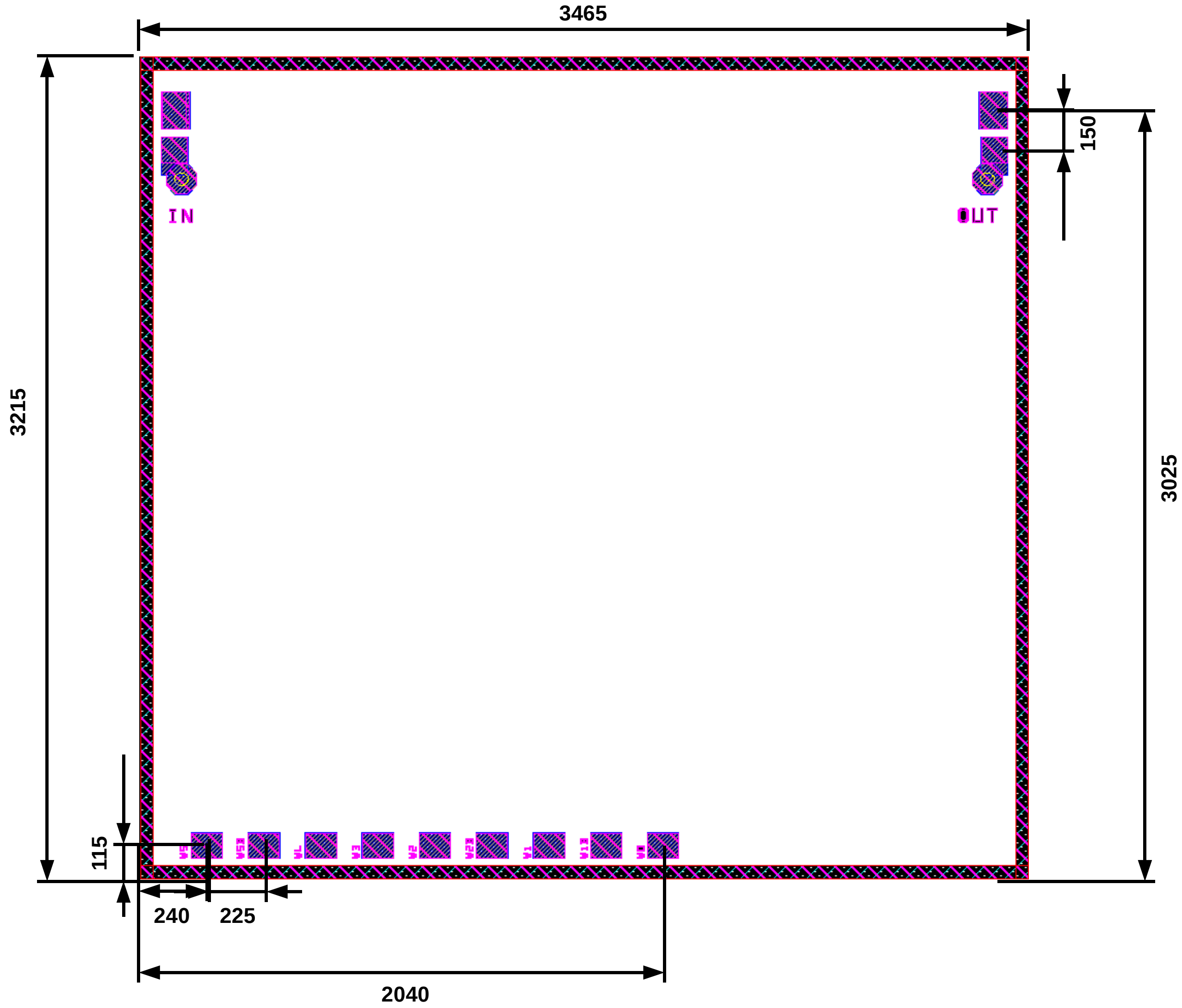
$$x_{RMS} = \sqrt{\frac{1}{N}\sum_{i=1}^{N} x_i^2} = \sqrt{\bar{x_i}^2 + \sigma_{x_i}^2}$$

Where x_i is the difference between the measured value and the theoretical value (x_i is the error), $\bar{x_i}$ is the mean value of the N x_i, and σ_{x_i} is the standard deviation of x_i.

MECHANICAL INFORMATION

Chip size = 3250 x 3500 µm (3215 x 3465 µm ± 5 µm after dicing)

- DC Pads = 100 x 125 µm, spacing = 100 µm, top metal = Au
- RF Pads = 110 x 150 µm, top metal = Au
- Chip Thickness 100 µm



Caution : This device is a high performance RF component and can be damaged by inappropriate handling. Standard ESD precautions should be followed. OMMIC document "OM-CI-MV/ 001/ PG" contains more information on the precautions to take.

PAD POSITION

PAD NAME	SYMBOL	COORDINATES		DESCRIPTION
		X	Y	
IN	RF IN	120	3025	RF Input Port
OUT	RF OUT	3345	3025	RF Output Port
V5	B5	240	115	180° cell control
V5B	B5B	465	115	180° complementary cell control
V4	B4	690	115	90° complementary cell control
V3	B3	915	115	45° cell control
V2	B2	1140	115	22° cell control
V2B	B2B	1365	115	22° complementary cell control
V1	B1	1590	115	11° cell control
V1B	B1B	1815	115	11° complementary cell control
V0	B0	2040	115	5° cell control

X=0, Y=0 at bottom left corner.

DEFINITIONS

Limiting values definition

Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.

Application information

Applications that are described herein for any of these products are for illustrative purposes only. OMMIC makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

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ORDERING INFORMATION

Generic type	Package type	Version	Sort type	Description
CGY2173	UH	C2	-	6-bit 6-18 GHz Phase Shifter

RoHS Compliant

Document History : Version 1.1, Last Update 14/06/2013