

**Product Features**

- Frequency: 2.6GHz ~ 3.6GHz
- Phase Shift Range: 360° , LSB=5.625°
- Insertion Loss: 4.4dB@3GHz
- Input Return Loss: 15.3dB@3GHz
- RMS Phase Error: 4.8°
- Supply Voltage: -5V
- Control Level: 0/+5V
- Package: QFN24 (4mm\*4mm)

**Apply**

- Radar
- Data Link
- Satellite Communication

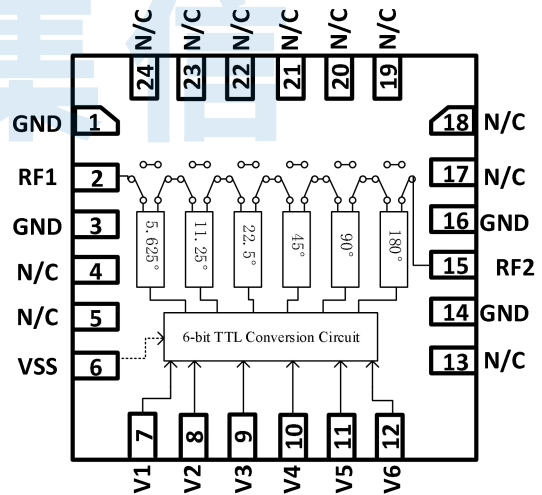
**General Description**

The BR9596FPJ is a 6 - Bit Parallel Digital-Controlled Phase Shifter chip covering a frequency range of 2.6 GHz to 3.6 GHz. It utilizes 0 V / +5 V logic control and requires an external -5 V power supply for biasing. The chip provides a phase shift step of 5.625°, a full 360° phase shift range, with a typical phase accuracy RMS of 4.8° and a typical insertion loss of 4.4 dB. It is suitable for a wide range of applications including Radar, Data Link, and Satellite Communication systems.

**Ordering Information**

Part Number	Package	Description
BR9596FPJ	QFN24	2.6GHz ~ 3.6GHz 6-Bit Parallel Digital-Controlled Phase Shifter

**Functional Block Diagram**



**Electrical Specifications (Temp=+25°C)**

Parameters	Test condition	Min.	Typ.	Max.	Units
Insertion Loss (Reference State)	2600MHz	-	-4.4	-	dB
	3000MHz	-	-4.4	-	
	3600MHz	-	-4.6	-	
Input Return Loss (Reference State)	2600MHz	-	-13.4	-	dB
	3000MHz	-	-15.3	-	
	3600MHz	-	-22.2	-	
Output Return Loss (Reference State)	2600MHz	-	-17.2	-	dB
	3000MHz	-	-22.2	-	
	3600MHz	-	-17.7	-	
Phase Shift Amplitude Modulation	2600MHz	-0.3	-	0.7	dB
	3000MHz	-0.2	-	0.9	
	3600MHz	-0.5	-	1.2	
RMS Phase Error	2600MHz	-	5.9	-	°
	3000MHz	-	4.8	-	
	3600MHz	-	3.5	-	
Input Power for 1dB Compression (Reference State)	2600MHz	-	27.9	-	dBm
	3000MHz	-	24.6	-	
	3600MHz	-	22.6	-	

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**Absolute Maximum Ratings**

Maximum RF Input Power: +27dBm

Maximum Supply Voltage: -5.5V

**Recommended Operating Conditions**

Control Voltage Threshold: 0~0.5V ( “0” level)

2.7V~5V ( “1” level)

Control Current: 1.1mA@5V

Storage Temperature: -65°C~+150°C

Operating Temperature: -55°C~+125°C

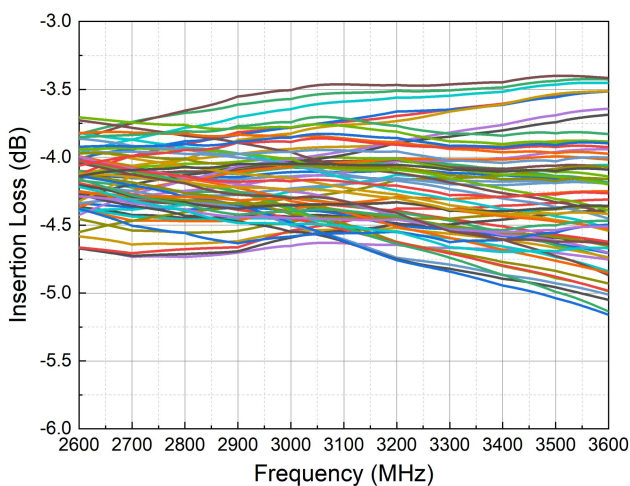
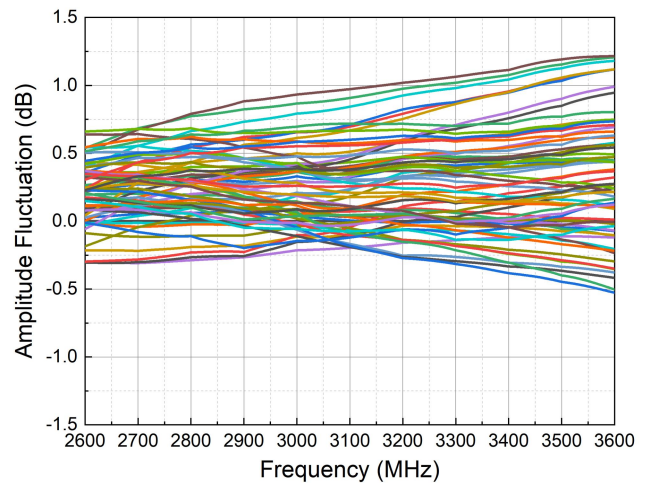
Note: Operation of the device outside the parameter ranges given absolute-maximum-ratings conditions may cause permanent damage, and exposure to absolute-maximum-ratings conditions for extended periods will affect the reliability.

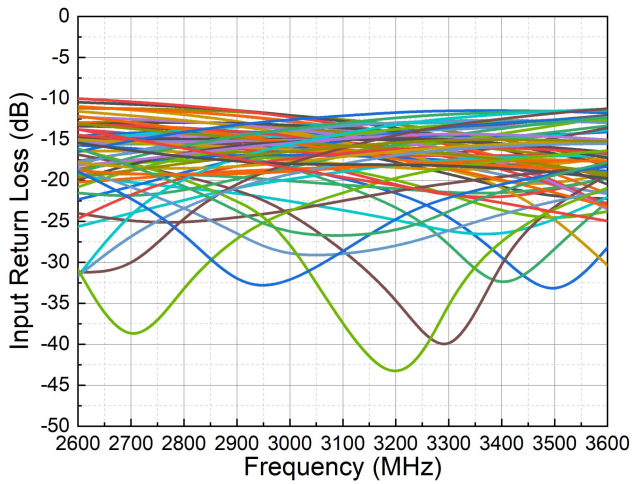
**ESD WARNING****ELECTROSTATIC SENSITIVE DEVICE****OBSERVE HANDLING PRECAUTIONS**  
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**Typical Performance (Temp=+25°C, EVB Test Results )**

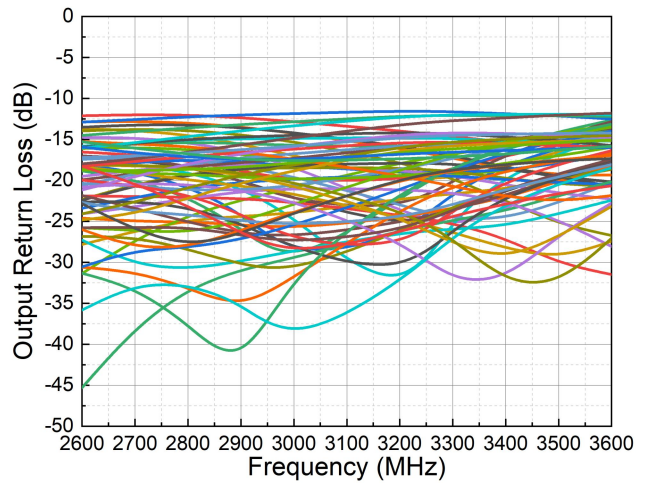
Parameters	Typ.										Units
	2600	2700	2800	2900	3000	3200	3300	3400	3500	3600	
Frequency											MHz
Phase Error (5.625°)	-0.9	-1.2	-1.3	-1.3	-1.2	-1.1	-1.1	-1.0	-0.8	-0.5	°
Phase Error (11.25°)	-2.1	-2.0	-1.9	-1.9	-1.8	-1.4	-1.3	-1.2	-1.1	-0.8	°
Phase Error (22.5°)	0.0	-0.3	-0.3	-0.3	-0.4	-0.7	-0.8	-0.9	-1.1	-1.2	°
Phase Error (45°)	-1.6	-1.6	-1.4	-0.9	-0.6	-0.1	0.5	0.9	1.3	1.5	°
Phase Error (90°)	-2.6	-3.2	-3.1	-2.9	-2.1	-0.8	-0.1	0.7	1.5	2.0	°
Phase Error (180°)	-3.8	-2.8	-2.0	-1.6	-1.1	-0.8	-1.1	-1.6	-2.4	-3.4	°
Insertion Loss (Reference State)	-4.4	-4.4	-4.4	-4.4	-4.4	-4.5	-4.5	-4.6	-4.6	-4.6	dB
Input Return Loss (Reference State)	-13.4	-13.5	-13.8	-14.4	-15.3	-17.7	-19.2	-20.8	-22.1	-22.2	dB
Output Return Loss (Reference State)	-17.2	-17.5	-18.4	-20.0	-22.2	-25.7	-23.8	-21.2	-19.2	-17.7	dB
Input Power for 1dB Compression (Reference State)	27.9	27.5	26.4	25.7	24.6	23.2	23.2	22.9	22.8	22.6	dBm

Test Conditions: Pin=0dBm, Temp=+25°C

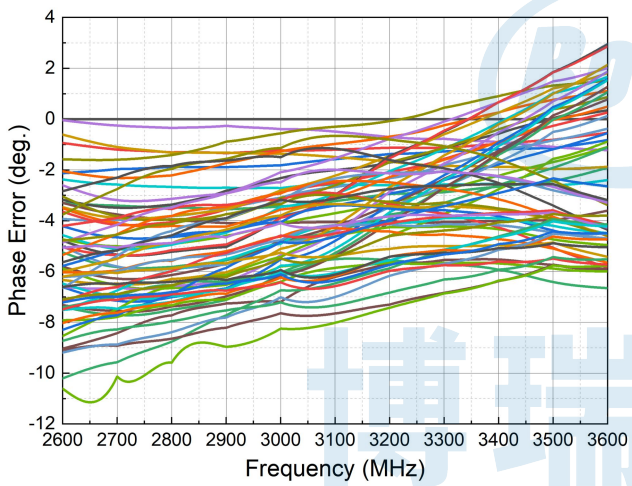

**All-State Insertion Loss vs. Freq**

**All-State Phase-Shift Amplitude Variation vs. Freq**



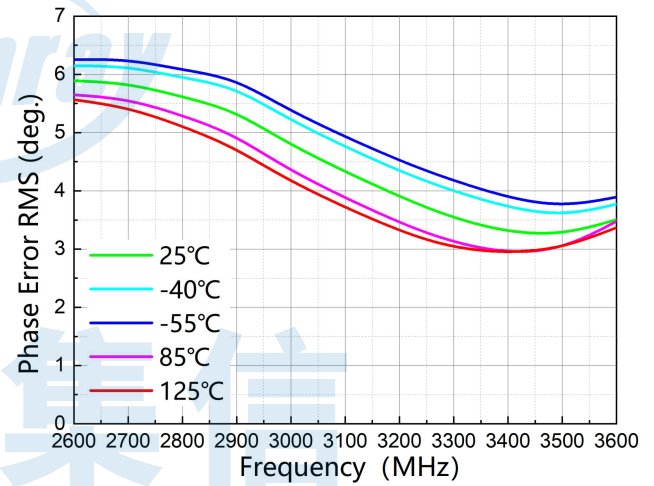
All-State Input Return Loss vs. Freq



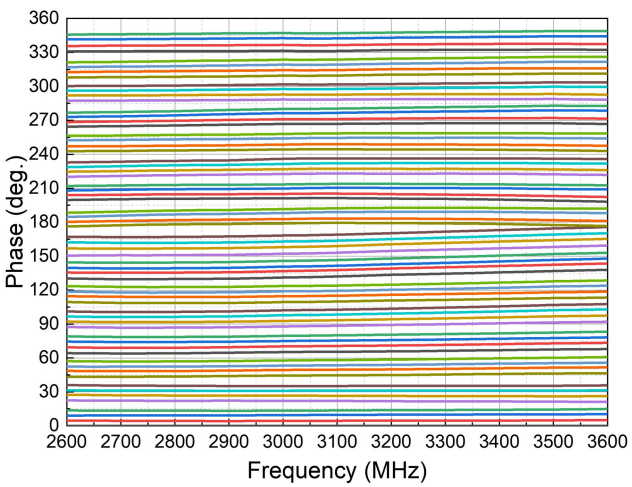
All-State Output Return Loss vs. Power



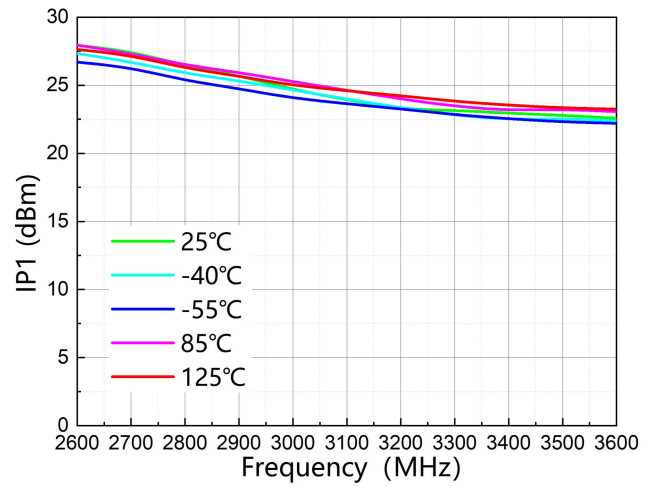
All-State Phase Accuracy vs. Freq



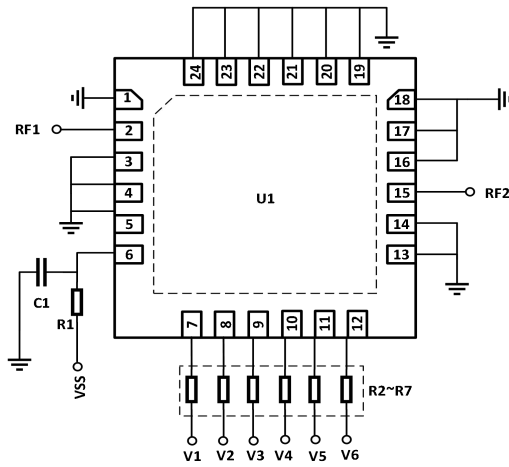
RMS Phase Error vs. Freq



All-State Phase Shift vs. Freq



Reference-State IP1 vs. Freq

**Typical Application Schematic**

**Bill of Material**

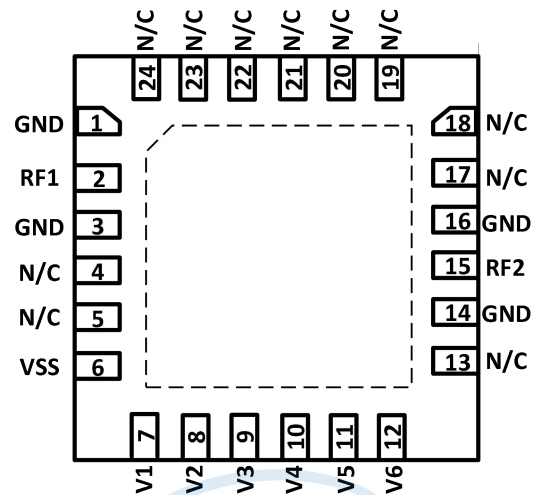
Designator	Package	Description	Part Number
U1	QFN24	/	BR9596FPJ
R1	0402	0Ω	RC0402FR-070RL
R2~R7	0402	1.3KΩ	RC0402JR-071K3L
C1	0402	1nF	GRM1555C1H102JA01D

**Truth Table**

State	5.625°	11.25°	22.5°	45°	90°	180°
	V1	V2	V3	V4	V5	V6
Reference State	0	0	0	0	0	0
5.625°	1	0	0	0	0	0
11.25°	0	1	0	0	0	0
22.5°	0	0	1	0	0	0
45°	0	0	0	1	0	0
90°	0	0	0	0	1	0
180°	0	0	0	0	0	1

“0” level range: 0~0.5V; “1” level range: 2.7~5V

## Pin Configuration and Description

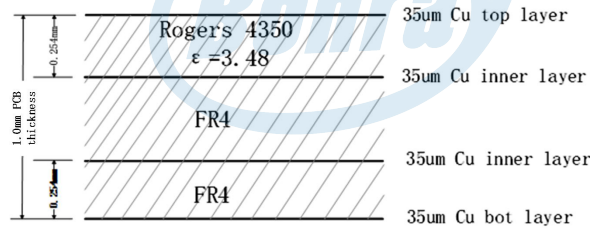
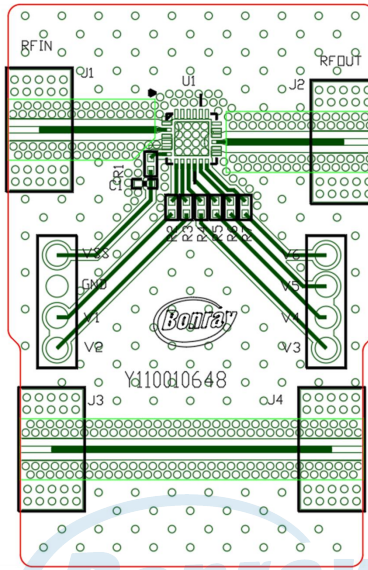


Pin Configuration

## Pin Description

Pin Number	Pin Name	Description
6	VSS	Voltage Supply Pin.
2,15	RF1, RF2	RF Pin, DC-coupled and matched to 50 Ω. If the RF potential is not 0 V, an external DC-blocking capacitor is required.
7~12	V1~V6	Control Pin. The control logic is detailed in the truth table.
1,3,14,16	GND	Ground Pin. Exposed ground paddle must be connected to RF/DC ground
4、5、13、17~24	NC	No Internal Connection. It is recommended to connect this pin to ground during use.
-	EP	The exposed backside pad must be properly grounded during use.

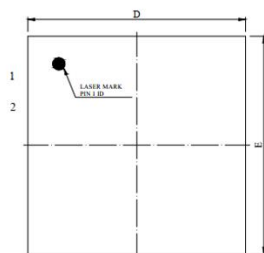
PCB Evaluation Board



50 Ω line: width=0.53mm, spacing=0.6mm

Evaluation Board Information

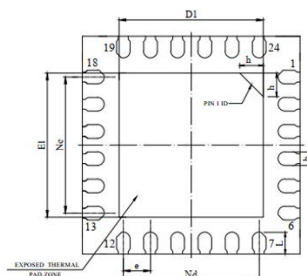
Package Dimensions (mm)



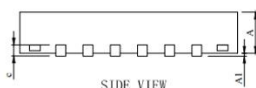
TOP VIEW



SIDE VIEW



BOTTOM VIEW



SIDE VIEW

SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	0.70	0.75	0.80
A1	--	0.02	0.05
b	0.20	0.25	0.30
c	0.203REF		
D	3.90	4.00	4.10
D1	2.60	2.70	2.80
e	0.50BSC		
Ne	2.50BSC		
Nd	2.50BSC		
E	3.90	4.00	4.10
E1	2.60	2.70	2.80
L	0.35	0.40	0.45
h	0.30	0.35	0.40