

## 6-18GHz Phase-shifter GaAs Monolithic Microwave IC

### Description

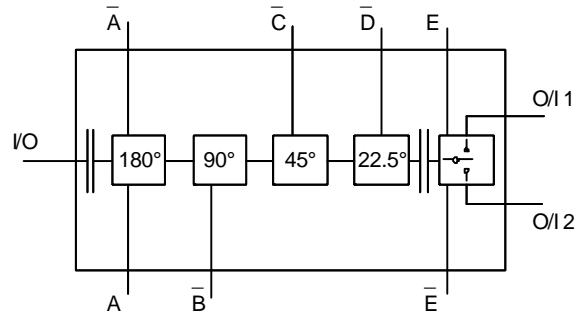
The CHP4511-99F is a 4-bit digital phase-shifter with an output single pole double through (SPDT) switch. It is designed for 6 to 18GHz frequency range applications. The backside of the chip is both RF and DC grounded.

The circuit is manufactured with a Power pHEMT process, 0.25µm gate length, via holes through the substrate, air bridges and electron beam gate lithography.

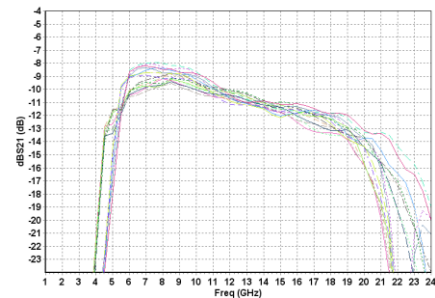
It is available in chip form.

### Main Features

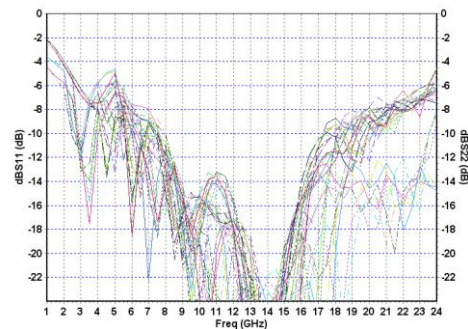
- Broadband performances : 6-18GHz
- 22.5° phase step
- Losses < 15dB
- 22dBm input power at -1dBc
- I/O reversible.
- Adaptive SPDT
- 0/-5V control voltage
- Chip size: 4.62 x 3.0 x 0.1mm



### Typical on wafer measurements



*dB(S21) for 16 states*



*dB(S11) and dB(S22) for 16*

### Main Characteristics

Tamb. = 25°C

Symbol	Parameter	Min	Typ	Max	Unit
Fop	Operating frequency range	6		18	GHz
G	Small signal gain	-15		-7	dB
Poi1	Output power at 1dB compression		10		dBm
Vctrl	Voltage control	-5		0	V

ESD Protection: Electrostatic discharge sensitive device. Observe handling precautions !

Ref. : DSCHP45110301 - 27 Oct 20

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Specifications subject to change without notice

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## Electrical Characteristics

Low level control voltage = -5V, High level control voltage = 0V  
 Pin = 5dBm on the input, output on SPDT 1 or 2

Tamb = +25°C

	Parameter	Conditions	Min	typ.	Max	Unit
Fop	Operating frequency range		6		18	GHz
Phrange	Phase shifter range		0	to	360	deg.
Phstep	Phase step			22.5		deg
S11	Input reflection coefficient				-6	dB
S22	Output reflection coefficient				-7	dB
S22off	Output reflection coefficient path OFF				-15	dB
IL	Insertion loss	6 to 14GHz 15 to 18GHz			13 15	dB
ISO	Isolation between Output 1 and 2		25	35		dB
AV	Amplitude variation			-1.5 / +2.5		dB
Pio1dB	Output Power @1dB compression	In => out1 or 2		10		dBm
Poi1dB	Output Power @1dB compression	out1 or 2 => in		12		dBm

	Parameter	Conditions	average	std dev	pk to pk	Unit
PPE	Peak Phase Error	state 22.5° state 45° state 90° state 180°	22.5° ±5 45° ±5 90° ±5 180° ±10	< 3° < 6° < 6° < 6°	±6° / average ±10° / average ±10° / average ±10° / average	deg

### Peak Phase Error (PPE) definition:

$PPE_{(i)} = \text{measured\_phase}(S21)_{(i)} - \text{measured\_phase}(S21)_{(0)} - \text{theoretical\_phase}_{(i)}$   
 (20 = state  $\in [0,15]$ )

### Amplitude variation (AV) definition:

$AV_{(i)} = \text{measured\_dB}(S21)_{(i)} - \text{measured\_dB}(S21)_{(0)}$  (i) = state  $\in [0,15]$

## Absolute Maximum Ratings

Tamb = +25°C

Operation of this device above anyone of these paramaters may cause permanent damage.

Symbol	Parameter	Values	Unit
Vgi	Phase shifter control voltage	-7 to +0.6	V
Pin	Maximum peak input power overdrive (1)	+30	dBm
Top	Operating temperature range	-40 to +70	°C
Tstg	Storage temperature range	-55 to +150	°C

(2) duration < 1s.

## Phase Shifter Control Interface

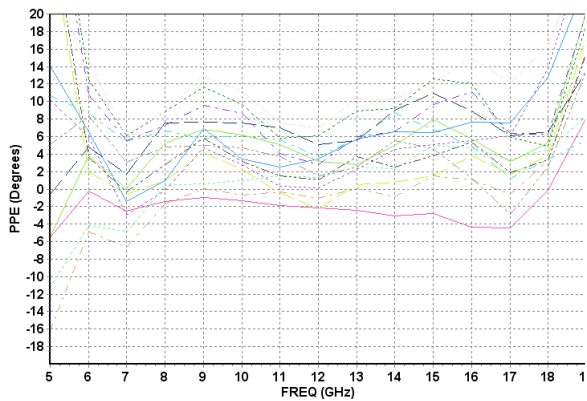
The 4-bit phase shifter is controlled by 5 voltages:

State	TOTAL PHASE SHIFT	$\bar{D}$ 25°	$\bar{C}$ 45°	$\bar{B}$ 90°	A 180°	$\bar{A}$ 180°
0	0°	0	0	0	-5V	0
1	22.5°	-5V	0	0	-5V	0
2	45°	0	-5V	0	-5V	0
3	67.5°	-5V	-5V	0	-5V	0
4	90°	0	0	-5V	-5V	0
5	112.5°	-5V	0	-5V	-5V	0
6	135°	0	-5V	-5V	-5V	0
7	157.5°	-5V	-5V	-5V	-5V	0
8	180°	0	0	0	0	-5V
9	202.5°	-5V	0	0	0	-5V
10	225°	0	-5V	0	0	-5V
11	247.5°	-5V	-5V	0	0	-5V
12	270°	0	0	-5V	0	-5V
13	292.5°	-5V	0	-5V	0	-5V
14	315°	0	-5V	-5V	0	-5V
15	337.5°	-5V	-5V	-5V	0	-5V

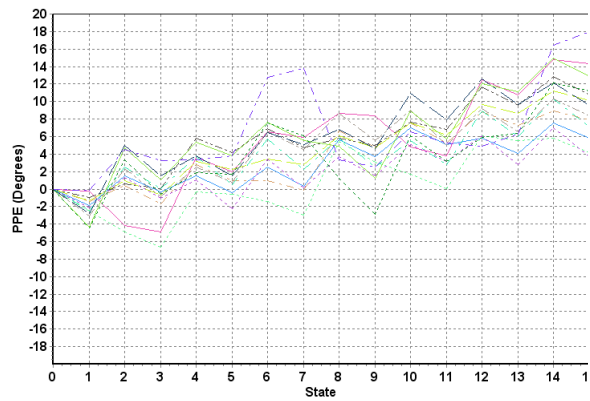
The SPDT switch allows to choice one of the output path:

SPDT Control		Output Selected
E	$\bar{E}$	
0	-5V	O/I 1
-5V	0	O/I 2

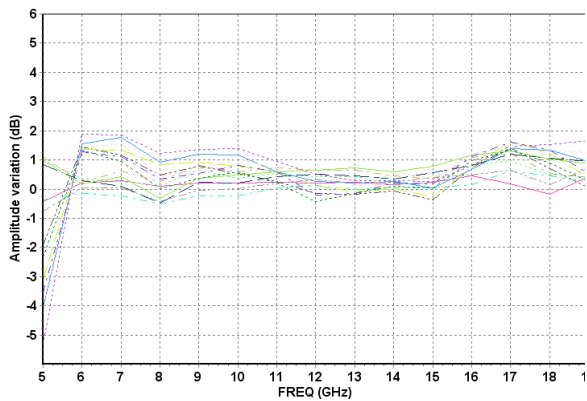
## Typical on wafer [S] measurements at +25°C



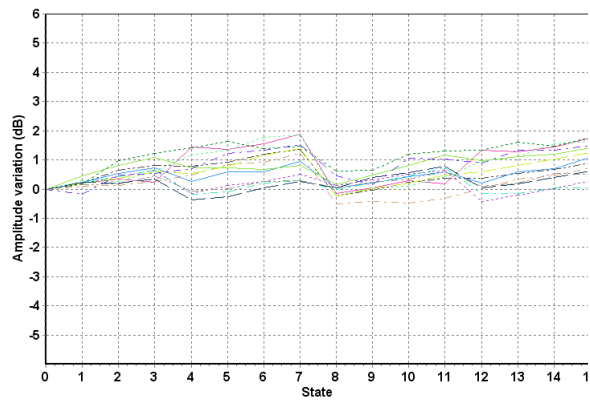
Peak phase error versus frequency for all states



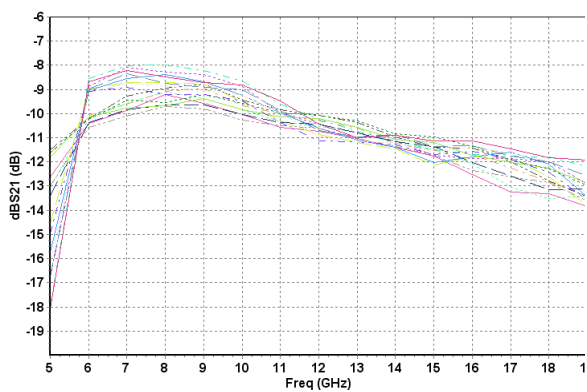
Peak phase error versus states  
6GHz < frequency < 18GHz



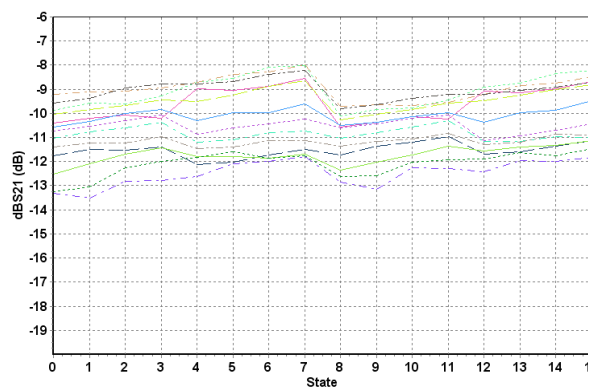
Amplitude variation versus frequency for all states



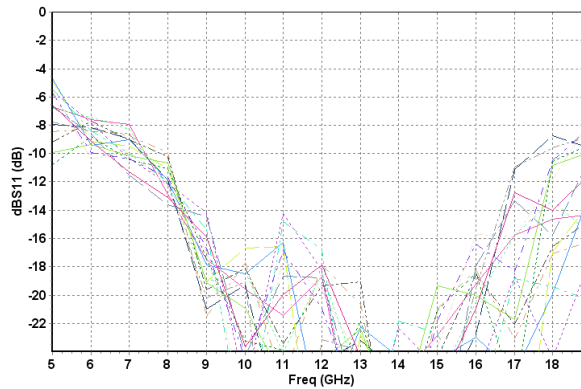
Amplitude variation versus states  
6GHz < frequency < 18GHz



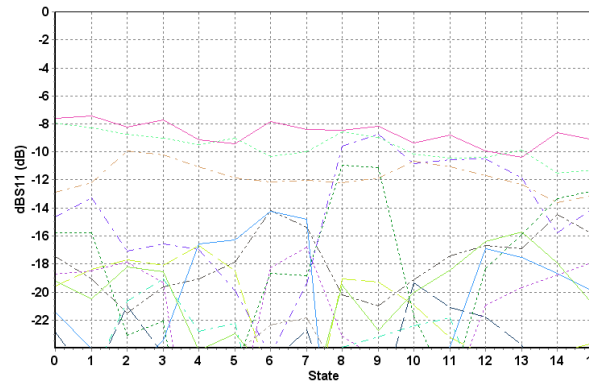
dB(S21) versus frequency for all states



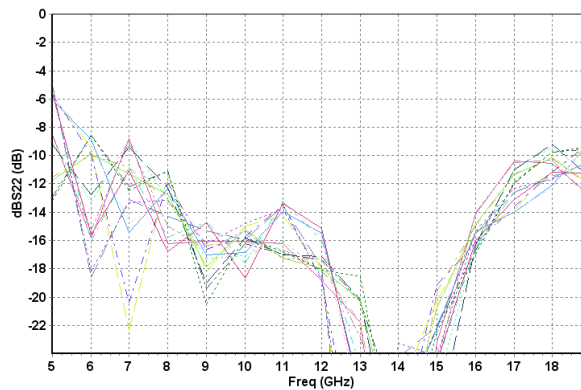
dB(S21) versus states  
6GHz < frequency < 18GHz



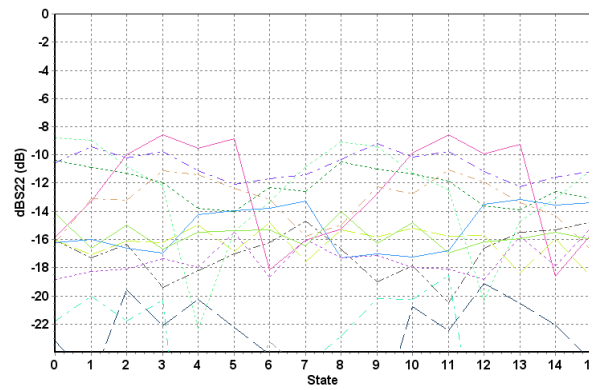
dB(S11) versus frequency for all states



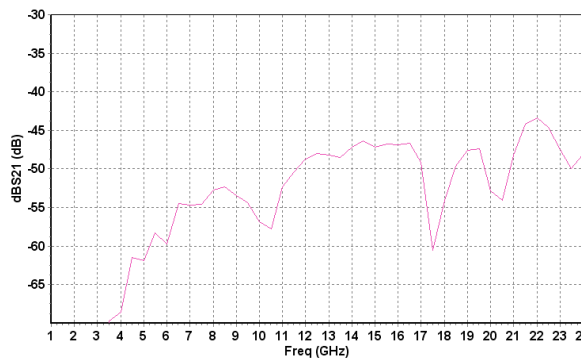
dB(S11) versus states  
6GHz < frequency < 18GHz



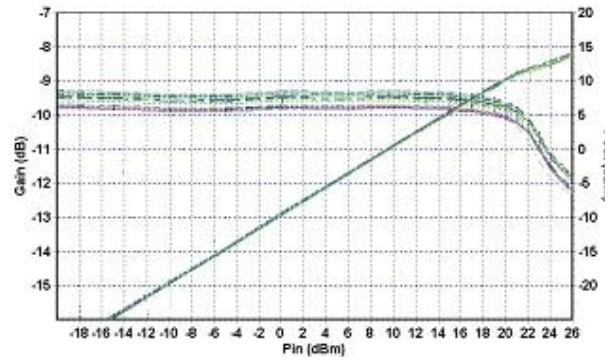
dB(S22) versus frequency for all states



dB(S22) versus states  
6GHz < frequency < 18GHz

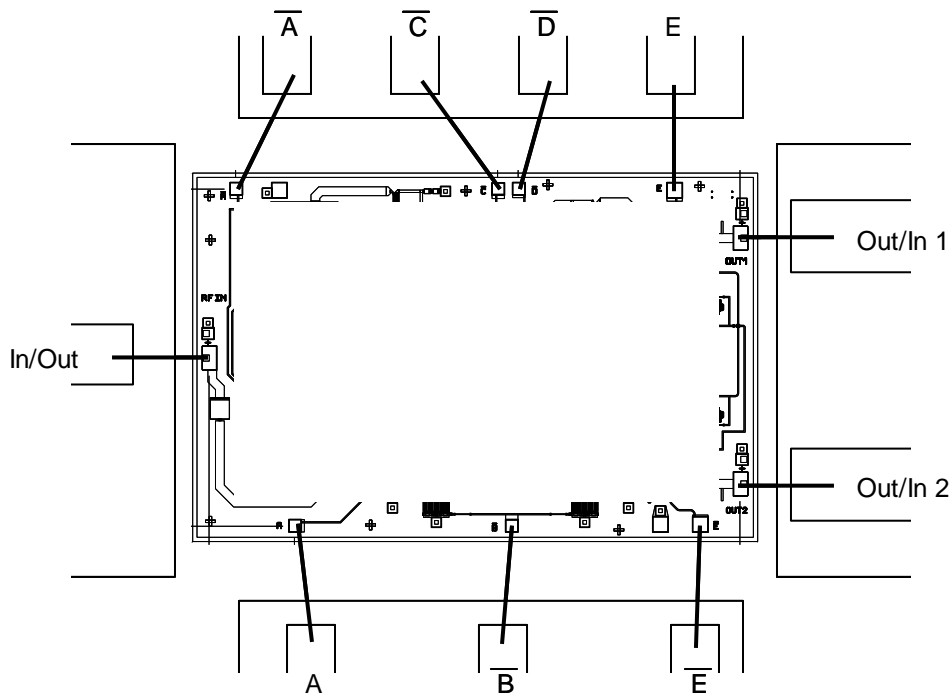


dB(S21) for path OFF: in => out1, state 0

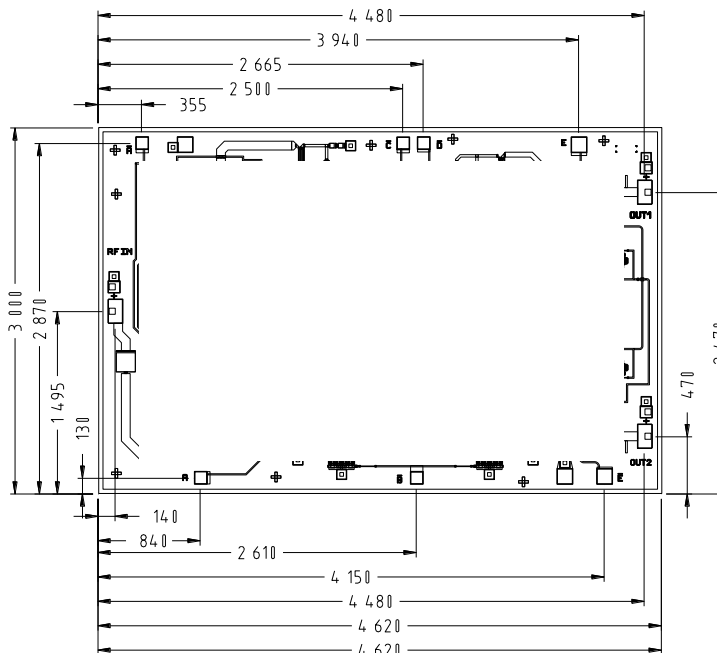


Gain and output power at 12GHz (input to output1)  
(20 samples)

## Chip Assembly and Mechanical Data



Note: 25 $\mu$ m diameter gold wire is recommended



UNITS :  $\mu$ m  
Tol :  $\pm 35\mu$ m

### Bonding pad positions.

(Chip thickness: 100 $\mu$ m.all dimensions are in micrometers)

**Notes**



## Ordering Information

Chip form : CHP4511-99F

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