

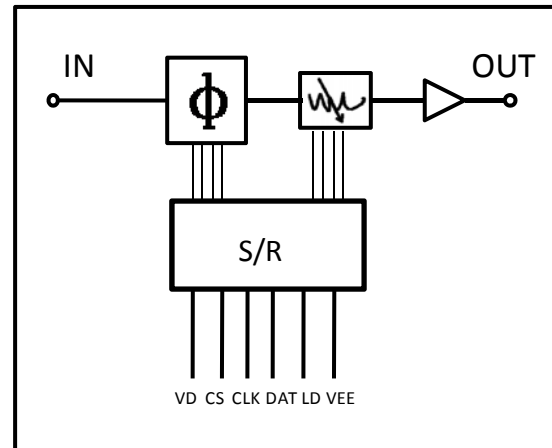
### Features

Frequency: 2~2.4GHz  
 Linear Gain: 16.5 dB  
 Phase Shift Step: 5.625°  
 Phase Shift Bit: 6  
 RMS Phase Error: 1.2°  
 Attenuation Step: 0.5 dB  
 Attenuation Bit: 6  
 RMS of Attenuation Accuracy: 0.4 dB  
 Supply Voltage: +5V/-5V  
 Supply Current: 90mA/-15mA  
 Control Voltage: 0/+5V  
 Chip Size: 3.2mm×3.2mm×0.1mm

### General Description

The HG133NA is a multi-function GaAs pHEMT chip which is operating between 2 and 2.4GHz. It includes an amplifier, 6-bit digital phase shifter, 6-bit digital attenuator, serial to parallel converter and so on.

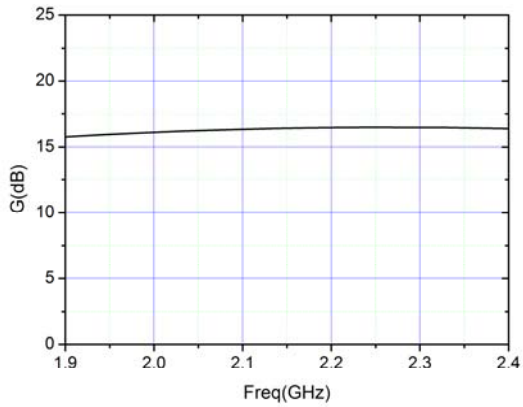
### Functional Diagram



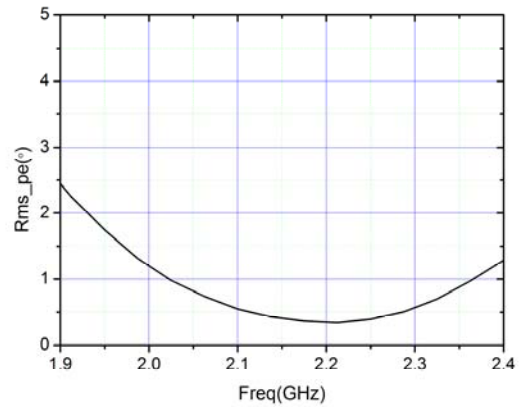
### Electrical Specifications ( $T_A=25\text{ }^\circ\text{C}$ , $V_D=\pm 5\text{V}$ , $V_{ctl}=0/+5\text{V}$ )

Parameter	Symbol	Unit	Min.	Typ.	Max
Frequency (GHz)	f	GHz	2~2.4		
Liner Gain	G	dB	—	16.5	—
Liner Gain Flatness	$\Delta G$	dB	—	$\pm 0.3$	—
Output Power for 1dB Compression	$P_{-1}(\text{OUT})$	dBm	—	19	—
RMS of Attenuation Accuracy	Rms_att	dB	—	0.4	—
Attenuator Phase Variation	$\Delta\Phi$	°	—	$\pm 2$	—
RMS Phase Error	Rms_pe	°	—	1.2	—
Phase Amplitude Variation	$\Delta A$	dB	—	$\pm 0.5$	—
Input VSWR	$VSWR_{in}$	-	—	1.5	—
Output VSWR	$VSWR_{out}$	-	—	1.4	—

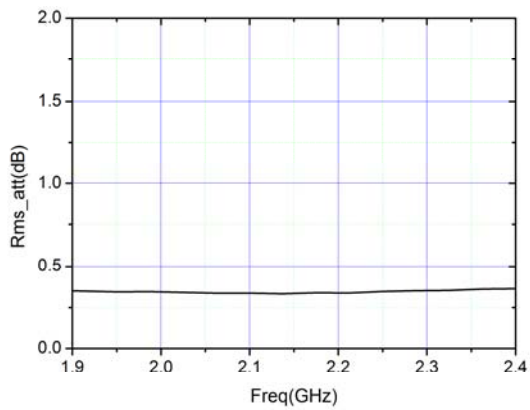
**Gain**



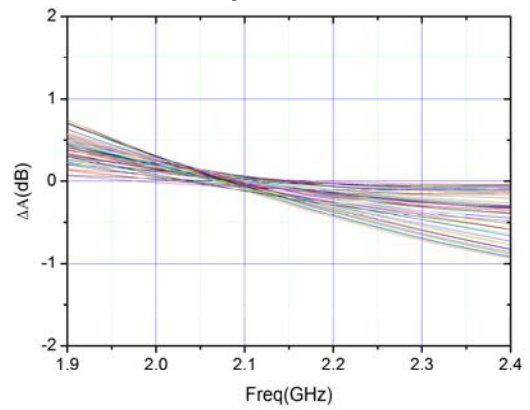
**RMS Phase Error**



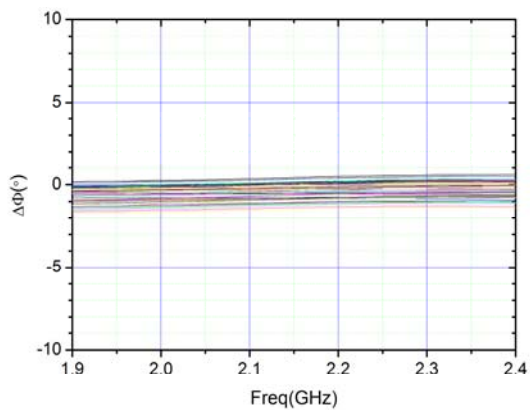
**RMS Attenuation Error**



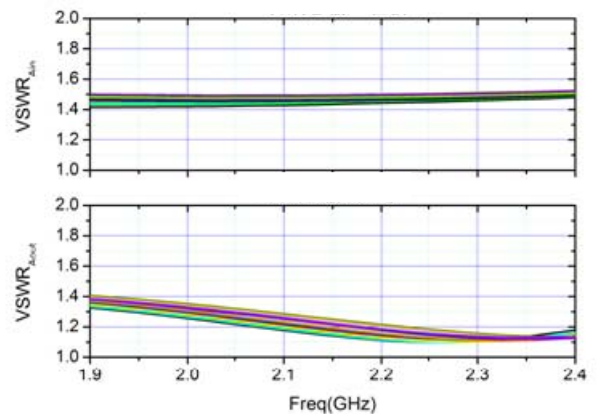
**Phase Amplitude Variation**



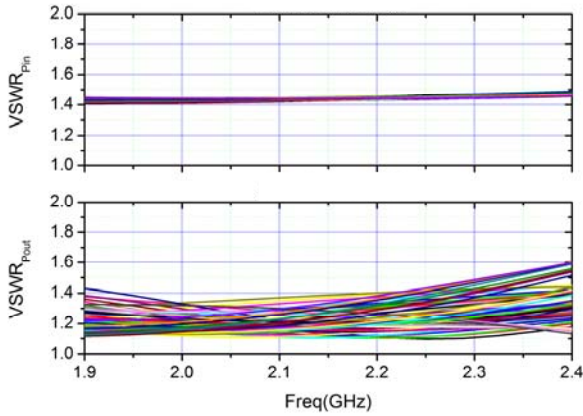
**Attenuation Phase Variation**



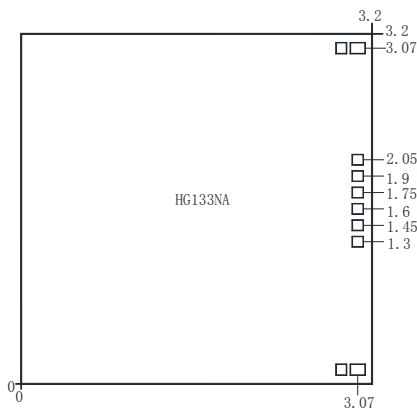
**Attenuator VSWR**



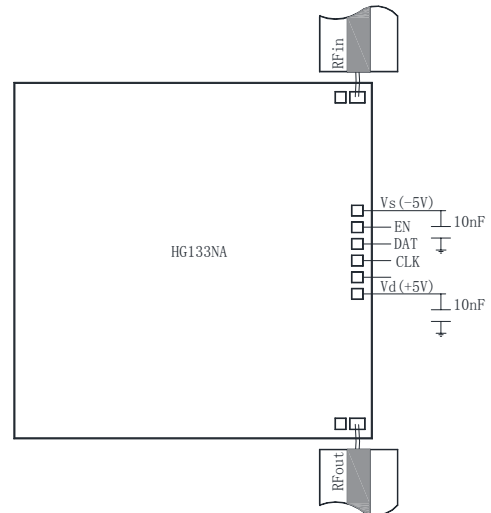
### Phase Shifter VSWR



### Outline Drawing (mm)



### Assembly Diagram



### Ports Description

NO.	Symbol	Function	Description
1	CLK	Clock signal	Falling edge sampling
2	DAT	D1-D6 Attenuate Control Ports	Input data at falling edge
		D7-D12 Phase Shift Control Ports	
3	EN	Enable port	Lock data at falling edge
4	Vs	Driver bias voltage, -5V	Suggesting connect to ground with 0.01uF capacitor
5	VD	Amplifier bias voltage, +5V	Suggesting connect to ground with 0.01uF capacitor

**Serial data bit and Truth table(0: 0V, 1: +5V)**

Data Bit	Attenuation Control Bit					
	D1	D2	D3	D4	D5	D6
Function	-16dB	-8dB	-4dB	-2dB	-1dB	-0.5dB
Reference State	0	0	0	0	0	0
Full State	1	1	1	1	1	1

Data Bit	Phase Shift Control Bit					
	D7	D8	D9	D10	D11	D12
Function	-5.625°	-11.25°	-22.5°	-45°	-90°	-180°
Reference State	0	0	0	0	0	0
Full State	1	1	1	1	1	1

Note: D1 First in.

**Absolute Maximum Ratings**

Supply Voltage	+5.5V
RF Input Power	+15dBm
Operating Temperature	-55°C ~ 125°C
Storage Temperature	-65°C ~ 150°C

**Notes:**

1. The chip should be stored in a dry and nitrogen environment, and used in a clean environment.
2. GaAs material is brittle, can not touch the surface of the chip, must be careful when using.
3. The chip is welding with conductive adhesive or alloy (alloy temperature should not exceed 300°C, and no more than 30 sec. ), and should make it fully grounded.
4. The chip microwave port and substrate gap is not exceeding 0.05mm, with  $\Phi 25\mu\text{m}$  double gold wire bonding, suggested length of gold wire 250~400 $\mu\text{m}$ .
5. Chip microwave port without DC blocking capacitor.
6. The chip is sensitive to static electricity, and should be protected against static electricity during storage and use.