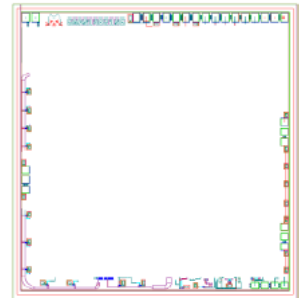


AMT1310

7 - 13GHz Multi-Function Chip



Key Features :

- Frequency range : 7 – 13GHz
- Receiver/Transmitter gain : -1/4.5dB
- Receiving/Transmitting P-1 : 8/10dBm
- Phase shift bit : 6 bits
- Phase shift step : 5.625°
- Phase shift RMS : 4°, phase shift additive attenuation ± 1 dB
- Attenuation bit : 6 bits
- Attenuation step : 0.5dB
- Attenuation RMS : 0.5dB, attenuation additive phase shift $\pm 5^\circ$
- Delay digit : 2 bits
- Delay step : 25ps
- Delay RMS : 3ps, delay additive attenuation ± 0.5 dB
- Input/output standing wave : 1.2
- Operating voltage VDD/VD: 5V
- Operation voltage VSS : -5V
- Control method : TTL serial control
- Chip dimensions : 4.2mm x 4.3mm x 0.1mm
- Applications : wireless communication, transceiver module, radio telecommunication etc.

Description :

AMT1310 is a multi-function chip incorporating with amplifier, switch, 6-digit attenuator, 6-digit phase shifter, control driver etc. functions X band MMIC, it is designed by Gallium Arsenide (GaAs) pHEMT process. The chip uses +5V/-5V voltage operation, control level is TTL (high level compatible with 3.3V and 5V), with serial control for phase shift and attenuation. This chip is designed with ground through metal vias on the back technology. All chip products p are 100% RF tested.

Absolute Maximum Ratings (Ta = 25°C)

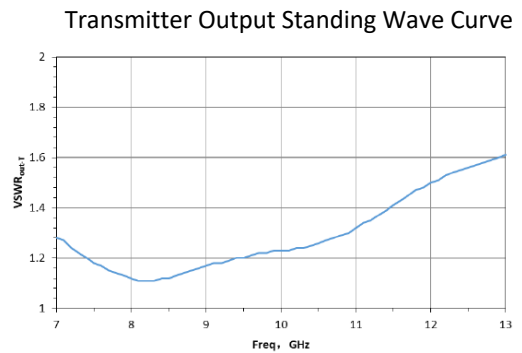
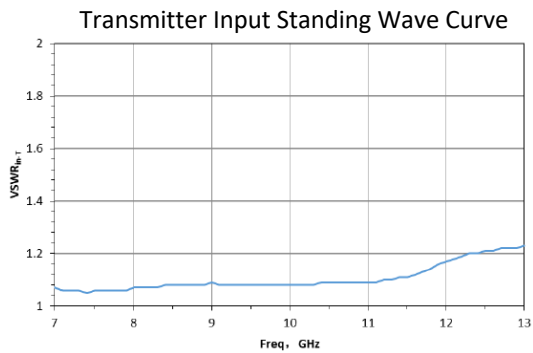
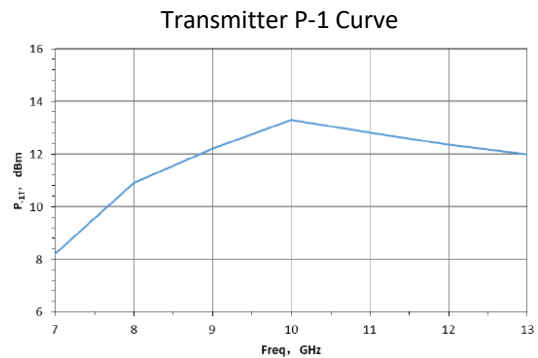
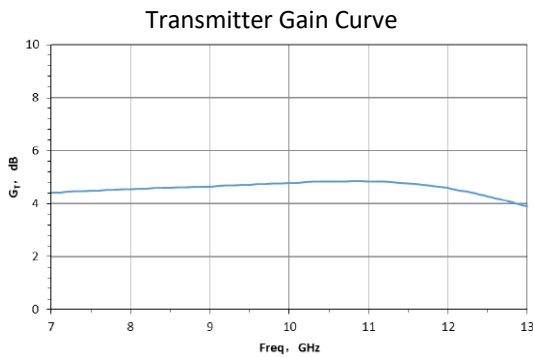
Symbol	Parameter	Value	Remark
$V_{CLK}/V_{CS}/V_{SI}/V_{LD}/V_{TR}/V_{TP}$	Control voltage	+6V	
VDD/VD	Operation voltage	+7V	
VSS	Operation voltage	-6V	
Pin	Max. Input Signal Power	+20dBm	
Tch	Operation Temperature	150°C	
Tm	Sintering Temperature	310°C	30s, N ₂ protection
Tstg	Storage Temperature	-65 ~ +150°C	

[1] Operation outside any of the Absolute Maximum Ratings may cause permanent device damage.

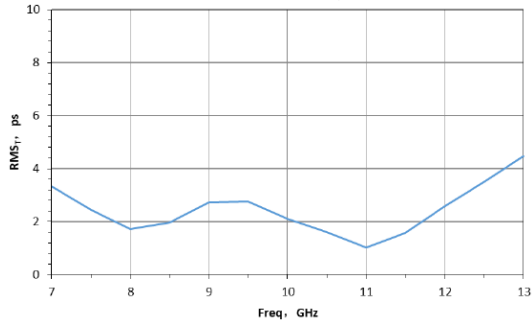
Electrical Characteristics (Ta = 25°C)

Symbol	Parameter	Value			Unit	Remark
		Min	Typical	Max		
F	Frequency		7 ~ 13		GHz	
G _R	Receiver gain	-2	-1	-0.5	dB	
P _{-1R}	Receiver output at P-1 point	6	8	10	dBm	
G _T	Transmitter gain	4	4.5	5	dB	
P _{-1T}	Transmitter output at P-1 point	8	10	13	dBm	
PS	Phase shift range	5.625 – 354.375 (6 bits phase shift)			°	
Δat	Phase shift additive attenuation variation	-1	-	+1	dB	
RMS _P	Phase shift RMS	-	4	5	°	
ATT	Attenuation range	0.5 – 31.5 (6 bits attenuation)			dB	
Δps	Attenuation additive phase shift variation	-5	-	+5	°	
RMS _A	Attenuation RMS	-	0.5	0.6	dB	
TTD	Delay range	25 ~ 75 (two digit delay)			ps	
Δat-ttd	Delay amplitude variation	-0.5		+0.5	dB	
RMS _T	Delay RMS		3	5	ps	
VSWR	Input Output Standing Wave	-	1.2	1.6		
I _{DD}	Operation current	-	5	-	mA	
I _{SS}	Operation current	-	19	-	mA	
I _D	Operation current	-	22	-	mA	

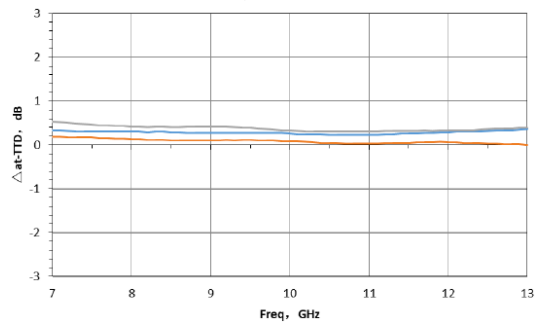
Typical Performance



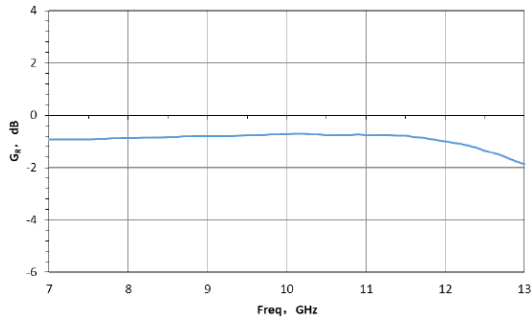
Transmit 4 State Delay RMS Curve



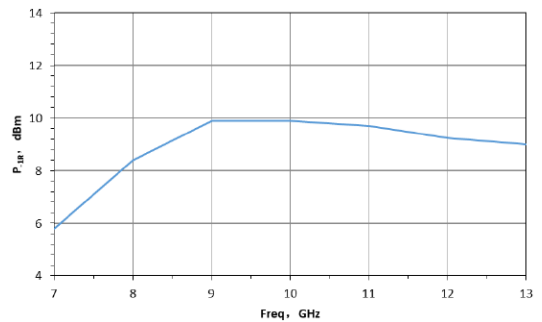
Transmit 4 State Delay Additive Attenuation Curve



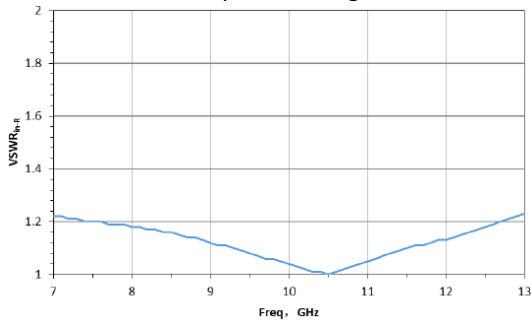
Receiver Gain Curve



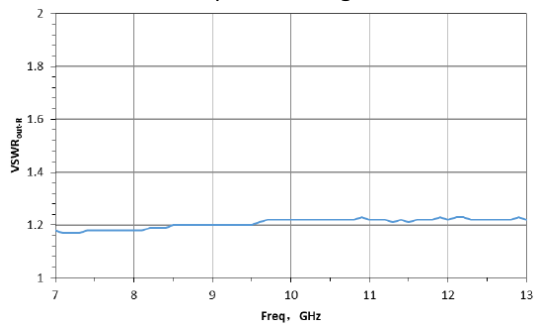
Receiver P-1 Curve



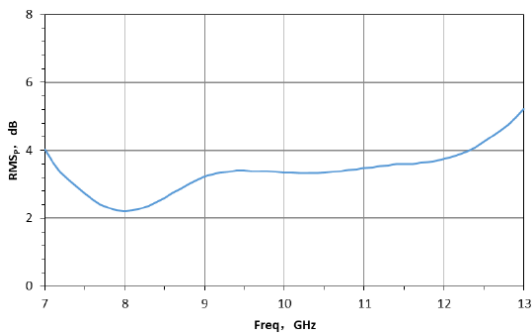
Receiver Input Standing Wave Curve



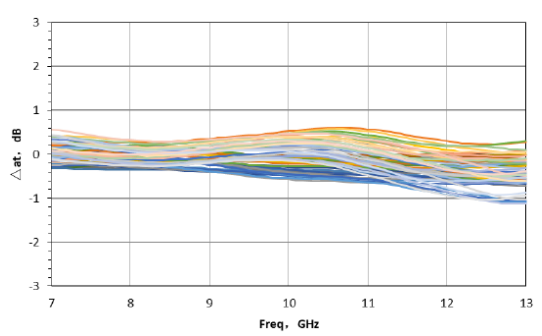
Receiver Output Standing Wave Curve

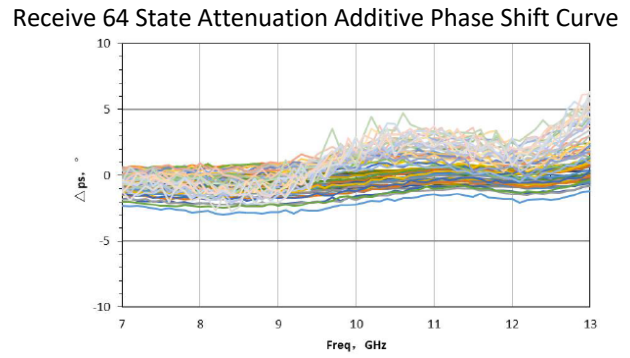
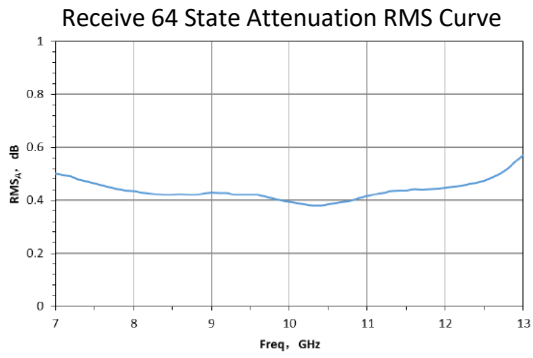


Receive 64 State Phase Shift RMS Curve

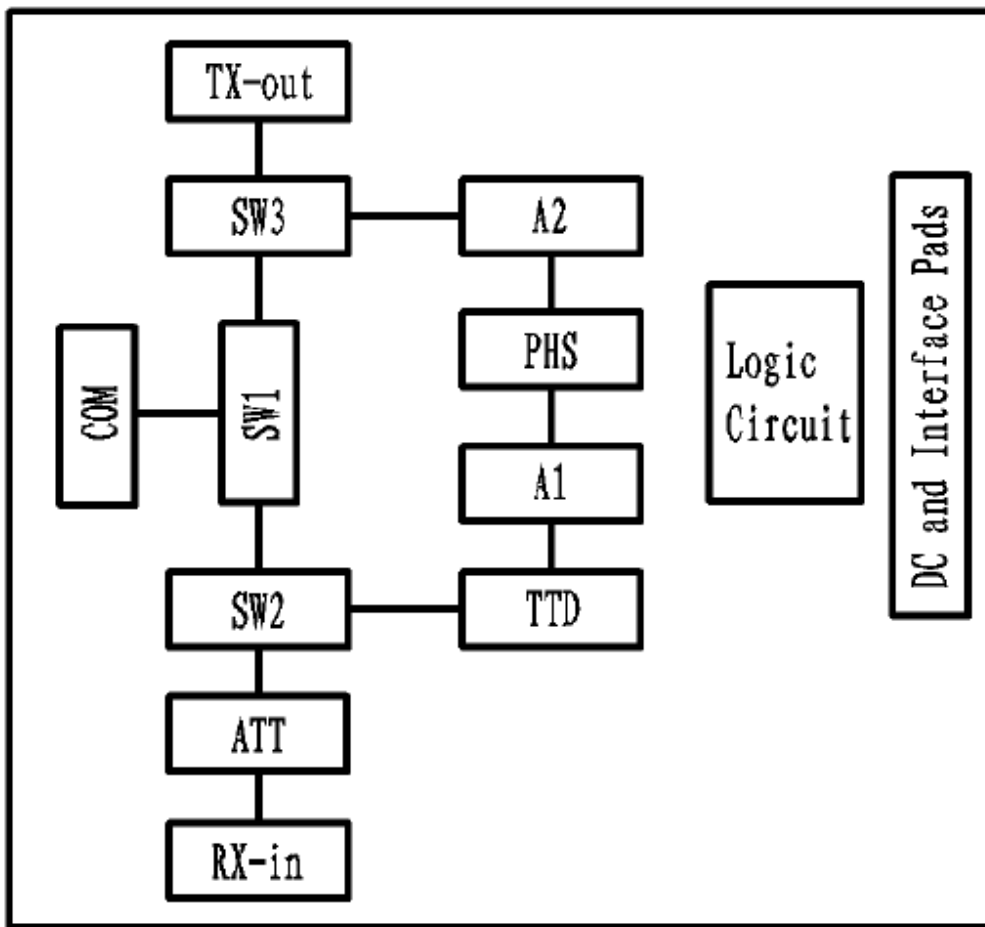


Receive 64 State Phase Shift Additive Attenuation Curve

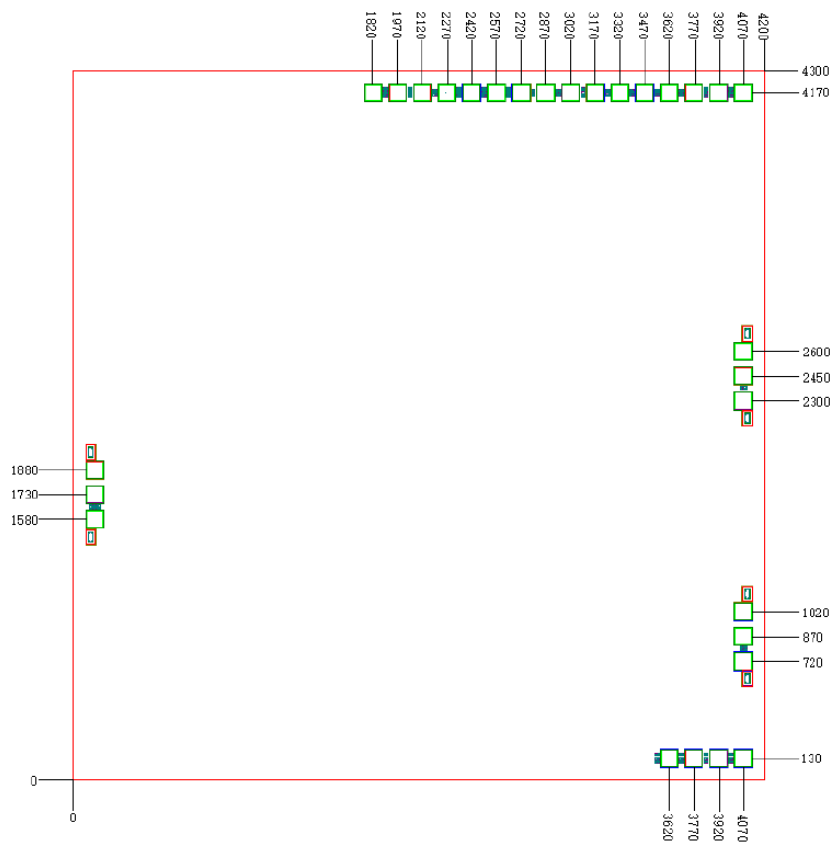




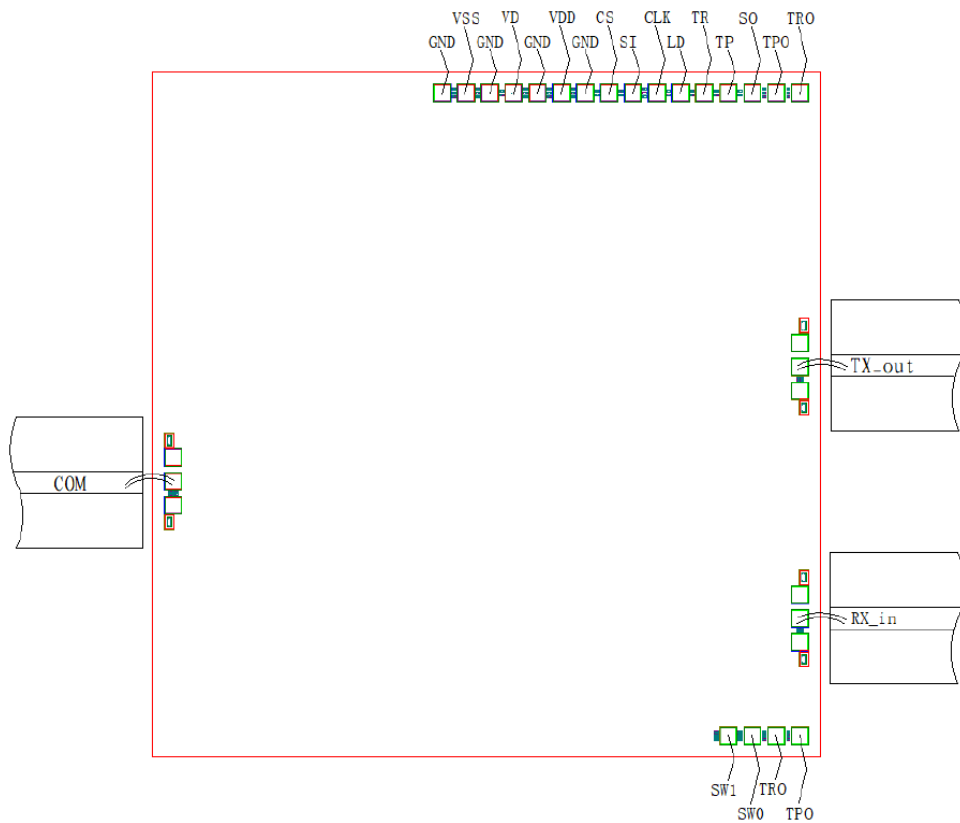
Internal Functional Block Diagram



Chip Dimensions (Unit : μm)



Chip Layout Diagram



Solder Pad Definition

Name	Dimension	Remark
RX_in/TX_out	100μm x 100μm	Receiver Input/Transmitter Output
COM	100μm x 100μm	Receiver Output/Transmitter Input
TPO/TR0/SO	100μm x 100μm	TTL, Output : transmit control/receive control/serial control word
VEE/VDD/VD	100μm x 100μm	Power Supply Pad : -5V/+5V/+5V
CS/CLK/SI/LD/TR/TP	100μm x 100μm	TTL, Control Signal Input, rate 40M
GND	100μm x 100μm	Grand Pad
SW0/SW1	100μm x 100μm	DCFL, TR switch control output

Control Explanation

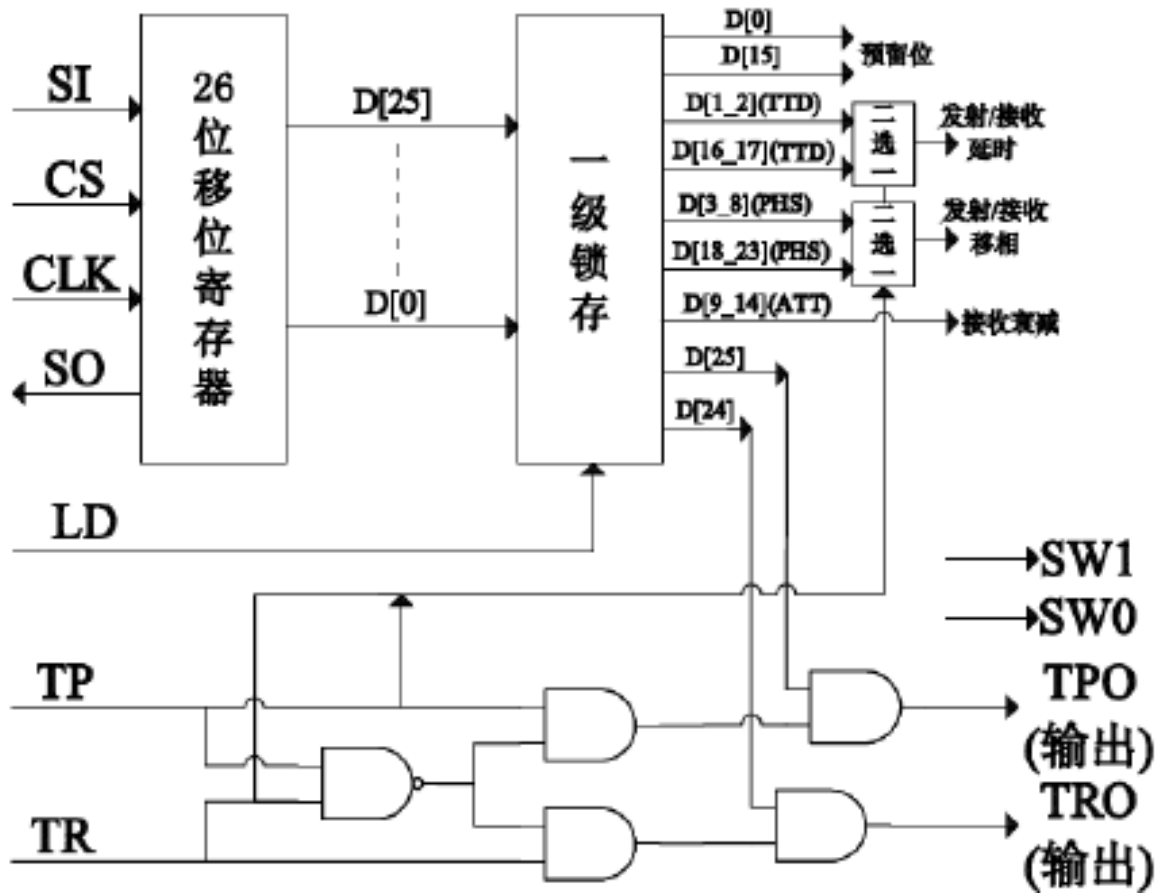
Signal Function Definition

No.	Signal	Level	Function		Remark	
			"0"	"1"		
1	TR	Input (TTL Level)	-	Receive	Receive control signal	
2	TP	Input (TTL Level)	-	Transmit	Transmit control signal	
3	CS	Input (TTL Level)	Load data	Hold data	Chip select signal, low active	
4	CLK	Input (TTL Level)	-	-	Clock signal, rising edge active	
5	LD	Input (TTL Level)	-	-	Data ready signal, rising edge active	
6	DATA	Bit 0 ~ 15	Input (TTL Level)	-	-	Reserved bit
		Bit 1 ~ Bit 14, Bit 6 ~ Bit 23	Input (TTL Level)	Off	On	Phase shift attenuation delay control signal : On means phase shifter, attenuator, and delay in control.
		Bit 24	Input (TTL Level)	-	Operate	Receive enable signal : Operate means normal receive state
		Bit 25	Input (TTL Level)	-	Operate	Transmit enable signal : Operate means normal transmit state.
7	TR0	Output (TTL Level)	-	-	Receive control signal	
8	TPO	Output (TTL Level)	-	-	Transmit control signal	
9	SO	Output (TTL Level)	-	-	Output SI control signal : when new serial control word input into shift register, original word in register will be output from SO port.	

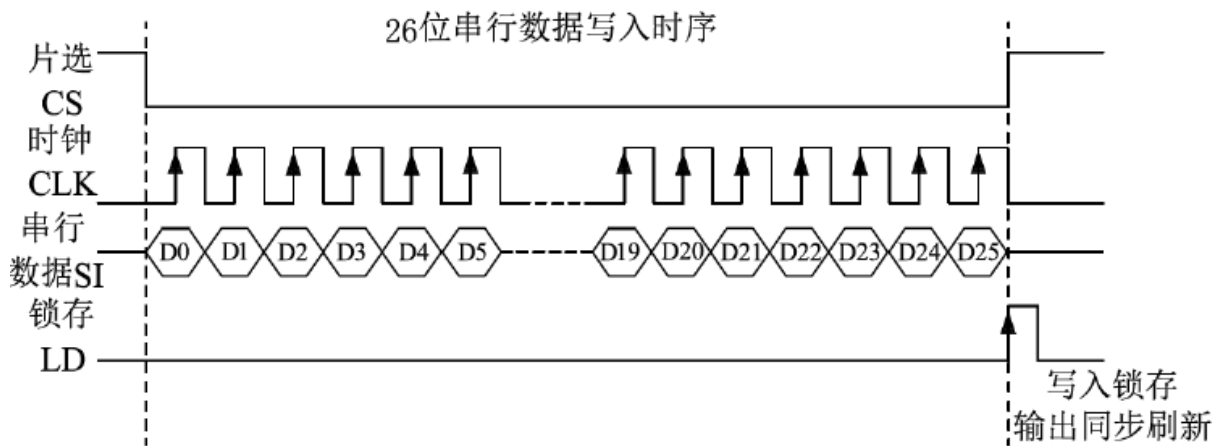
Serial Control Word Definition

BIT	Description	
BIT0	-	Reserved bit
BIT1	25ps	Receive delay
BIT2	50ps	
BIT3	5.625 °	Receive phase shift
BIT4	11.25 °	
BIT5	22.5 °	
BIT6	45 °	
BIT7	90 °	
BIT8	180 °	
BIT9	0.5 dB	Receive attenuation
BIT10	1 dB	
BIT11	2 dB	
BIT12	4 dB	
BIT13	8 dB	
BIT14	16 dB	
BIT15	-	Reserved bit
BIT16	25ps	Transmit delay
BIT17	50ps	
BIT18	5.625 °	Transmit phase shift
BIT19	11.25 °	
BIT20	22.5 °	
BIT21	45 °	
BIT22	90 °	
BIT23	180 °	
BIT24	RXEN	Receive enable
BIT25	TXEN	Transmit enable

Control Circuit Diagram



Timing



Switch Logic State Truth Table

Input (TTL)				Microwave Switch State		
RXEN	TXEN	TR	TP	COM-RX	COM-TX	COM-Load
1	X	1	0	On	Off	Off
X	1	0	1	Off	On	Off
Other combination				Off	Off	On

Output Signal Description and State

Input (TTL)				Output Port			
RXEN	TXEN	TR	TP	TP0	TR0	SW0	SW1
1	X	1	0	0V	+3.3V	0V	-5V
X	1	0	1	+3.3V	0V	-5V	-0V
Other combination				0V	0V	0V	-5V

Please see appendix A for details.