1 Product Applications and Functions

1.1 Applications

HX121840G16 is an Ku-Band Quad-Channel T/R module, mainly used in radar, communications, test and measurement, etc.

1.2 Functions

HX121840G16 has a transmit output power greater than 10W and integrates a high-power amplifier chip, a limiting low-noise amplifier chip, and an amplitude and phase multi-functional chip, etc. It enables functions such as transmit/receive switching of the solid-state array antenna, transmit signal power amplification, receive signal limiting protection and low-noise amplification, microwave signal attenuation and phase shifting,etc.

2 Performance and Technical Specifications

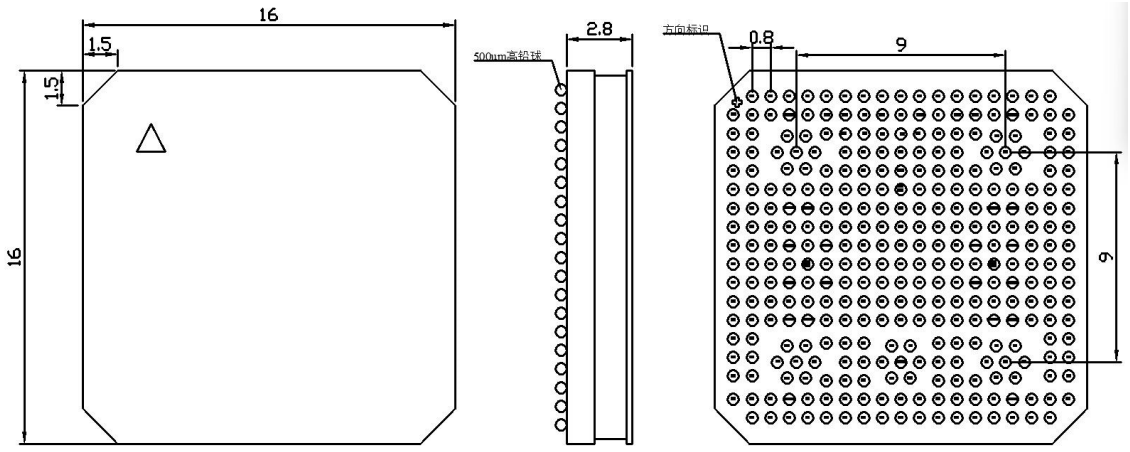
Table 1 Electrical Specifications

No.	Parameter	Test Conditions: unless otherwise specified Freq.: 12GHz～18GHz, VCC=+3.3V, VDD=+28V, VEE=-5V Multifunction Configuration Set to High P-1 Mode	Value		Unit
			Min	Max	
1	Tx Input VSWR	TA=+25℃,Pin=8dBm pulse width 100us,duty cycle 10% Tx Quiescent State,Single Channel	-	2.0	-
2	Tx Output Psat		40	-	dBm
3	Tx+28V Dynamic Peak Current		-	1700	mA
4	Tx Phase Shift RMS Accuracy (6-bit, step5.625°)	TA=+25℃,Saturation State,Single Channel pulse width 100us,duty cycle 10%	-	5	°
5	Tx +3.3V Quiescent Current	TA=+25 ℃, Tx Quiescent State,Single Channel pulse width 100us,duty cycle 10%	-	50	mA
6	Rx Small Signal Gain	TA=+25 ℃, Tx Quiescent State,Single Channel pulse width 100us,duty cycle 10%	20	-	dB
7	Rx Input VSWR	TA=+25℃,Pin=-30dBm Rx Quiescent State,Single Channel	-	2.0	-
8	Rx Output VSWR		-	2.2	-
9	Rx Noise Figure	TA=+25℃,Pin=-30dBm Rx Quiescent State,Single Channel	-	3.5	dB
10	Rx Input P-1dB	TA=+25℃,Pin=-30dBm Rx Quiescent State,Single Channel	-30	-	dBm
11	Rx Phase Shift RMS Accuracy	TA =+25℃,Pin=-30dBm,Single Channel	-	5	°

12	Rx Phase Shift Parasitic Amplitude Modulation RMS		-	0.8	dB
13	Rx Attenuation RMS Accuracy		-	1.5	dB
14	Rx Attenuation-Phase Shift RMS		-	9	°
15	Rx +3.3V Current	TA =+25℃,Pin=-30dBm,Single Channel	-	130	mA
16	-5V Current	T_A=+25℃	-	20	mA

3 Package and Pin Definition

The module is encapsulated in an HTCC ceramic housing with a hermetically sealed structure and a heat dissipation surface on top. The module is pre-fabricated with 500μm high lead balls (Sn10Pb90). The outline dimensions conform to GB/T 7092-2021, with dimensions are 16mm × 16mm × 2.8mm (excluding balls). The package shape should conform to the specifications in Figure 1.



Top View Bottom View

Figure 1 Module Outline

Table 2 Outline Dimensions

Symbol	Value(Unit:mm)		
	Min	Nominal	Max
Length	15.9	16.0	16.1
Width	15.9	16.0	16.1
Height	2.7	2.8	2.9

Table 4 SIP Bottom Pin Definition(Tentative)

S/N	No.	Symbol	Function
1	D2	RF1	Channel 1 RF Port
2	R2	RF2	Channel 2 RF Port
3	R18	RF3	Channel 3 RF Port
4	D18	RF4	Channel 4 RF Port
5	R10	RF_COM	Common RF Port
6	B6	LOAD	Latch signal,Rising edge triggered

7	B7	SYNC	Chip Select,Active Low
8	B8	SDI	Serial data,I/O auto-switch in 3-Wire SPI Mode, Input in 4-Wire Mode
9	B9	SCLK	Serial Clock
10	B10	SDO	Serial data output
11	B11	RESET	Reset Signal
12	B12	SW	T/R Switch,SW
13	B13	SW_T	T/R Switch,SW_T
14	B14	SW_R	T/R Switch,SW_R
15	F4、G4	VDD_28_1	Channel 1,+28V Input
16	N4、P4	VDD_28_2	Channel 2,+28V Input
17	N16、P16	VDD_28_3	Channel 3,+28V Input
18	F16、G16	VDD_28_4	Channel 4,+28V Input
19	B3	VEE_28_1	Channel 1,-28V Input
20	T3	VEE_28_2	Channel 2,-28V Input
21	T17	VEE_28_3	Channel 3-28V Input
22	B17	VEE_28_4	Channel 4,-28V Input
23	J4	VDD_5_1	Channel 1,+5V Input
24	L4	VDD_5_2	Channel 2,+5V Input
25	L16	VDD_5_3	Channel 3,+5V Input
26	J16	VDD_5_4	Channel 4,+5V Input
27	J6	VEE_5_1	Channel 1,-5V Input
28	L6	VEE_5_2	Channel 2,-5V Input
29	L14	VEE_5_3	Channel 3,-5V Input
30	J14	VEE_5_4	Channel 4,-5V Input
31	F10	DVDD_3R3	Digital Power Supply,+3.3V
32	K5、K15	AVCC_3R3	Analog Power Supply,+3.3V
33	E10	DGND	Digital Ground

Truth Table

1V1	1V2	TR1	TR2	Channel State
-28V	0	0	0	Tx
0	-28V	1	1	Rx
Note: "0" denotes TTL low level, 0V～0.2V. "1" denotes TTL high level, 4.2V～5.0V.				

4 Module Control Logic

4.1 Basic Functions in Module Control

1. Supports a primary serial shift register with a data length of 130 bits.
2. Supports a secondary data register bank consisting of 32 groups, each with 130-bit data length. Each group allows independent selection of input and output addressing.
3. Supports a functional parameter shift register with a data length of 12 bits.
4. Enables switch control data output based on serial input data and discrete signals.
5. Supports self-test data output, with test modes configurable via functional parameters.
6. Provides pulse signal detection and protection, with configurable protection thresholds.

7.Integrates an 8-channel, 8-bit ADC acquisition function, supporting protection control based on the acquisition results. The ADC can be enabled or disabled via control settings.

8.Supports an internal power-on reset function.

9.Includes a built-in 16-bit hardware version identifier, which can be read out through the self-test data output.

4.2 Major Registers in the Module

1) 26-bit serial data register reg_data1 [25:0]*5
2) Serial output register reg_dout
3) 32×26-bit second-level data register reg_data2[31:0][25:0]*5
4) 26-bit third-level output register reg_data3[25:0]*5
5) 12-bit serial function register reg_fun1[11:0]
6) 8-bit second-level function register reg_fun2*64
7) 8-bit temperature sampling result register ad_data[7:0][7:0]*8
8) Timer protection trigger counter pro_out_cnt[25:0]
9) Temperature protection trigger counter te_pro_cnt[25:0]
10) 32-bit pulse width protection counter prot_cnt[31:0]
11) Beamformer register beamformer[1023:0][7:0]

4.3 Control Timing Requirements

1) The typical clock frequency supported by the module's control logic timing is 20MHz, with a maximum support of 50MHz.
2) Function register input timing

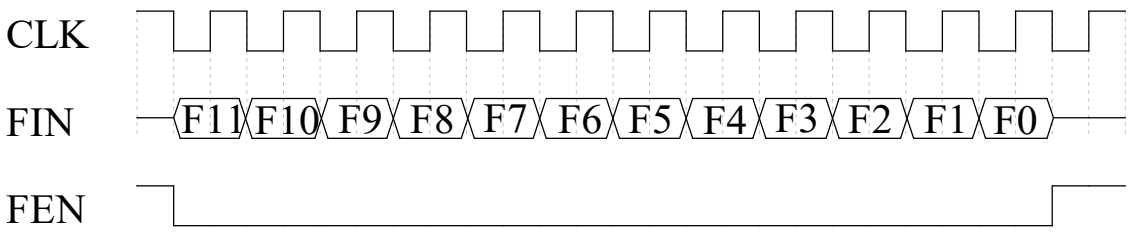


Figure 3 Function Register Input Timing

3) Serial data register input timing

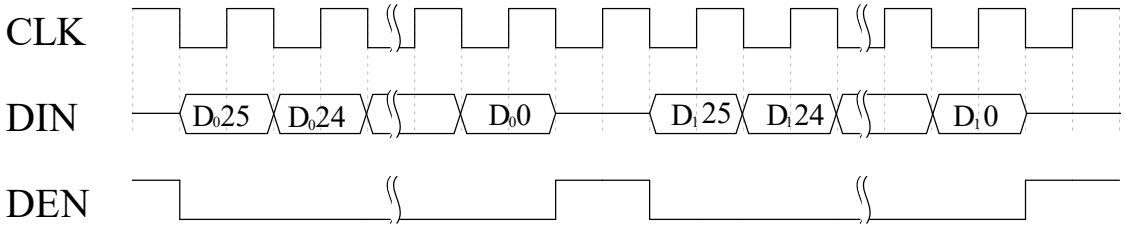


Figure 4 Serial Data Register Input Timing

4) Serial data register output timing

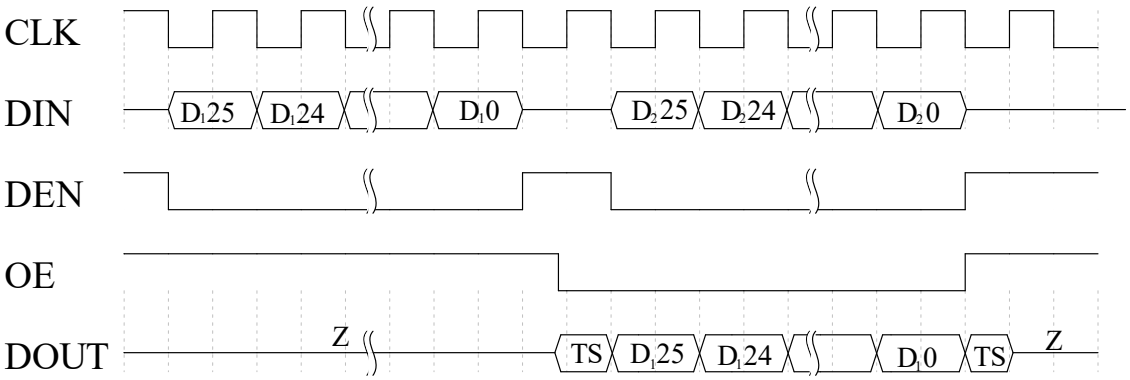


Figure 5 Serial Data Output Timing

5 Notes

1) Assemble and use the product in a clean environment.

2) For circuit board with ball attach, it is recommended to choose a board material with a coefficient of thermal expansion that is close to that of ceramics.

3) The product is electrostatic sensitive. Take precautions against static electricity during storage and use. Instruments and equipment should be properly grounded.

4) Store the component in a dry, nitrogen-filled environment.

5) Please contact the supplier if you have any problems.

6 Module Block Diagram

The HX121840G16 Ku-Band Quad-Channel T/R module functions to limit and amplify the received signal, and control its amplitude and phase. It also controls the amplitude and phase of the transmitted signal, and amplifies its output. See the appendix for the schematic diagram.

Appendix (Module Circuit Schematic)