Description

X110D is a high-performance monolithic low-noise amplifier designed using a GaAs pHEMT process to operate from 0.6GHz to 5GHz. It is integrated with an active bias network therein to provide stable bias current therefor at different temperature and process corners, and its internal bias current switching-off function can support TDD. Powered by a 2.7V~5.5V single supply and integrated with a matching network therein, X110D features low noise and high linearity, and requires only five components for peripheral applications. A 2mm×2mm DFN8L package is adopted.

Features

- 0.6GHz~5GHz broadband applications
- Low noise figure: 0.60dB@2.7GHz
- Gain: > 20dB@2.6GHz
- Wide operating voltage: +2.7V~+5.5V
- Adjustable bias current to meet different linearity requirements
- Integrated TTL logic disabling function

Features

Designation	Package Type	Package Size	Operating Temperature
X110D	DFN8L	2×2×0.85 mm^3	-40℃～105℃

Scope of Application

- Wireless communication
- 4G/5G communication base stations

Functional Block Diagram

The functional block diagram is shown in Figure 1.

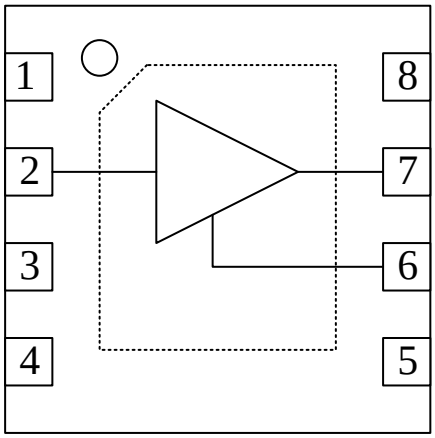


Figure 1 Functional Block Diagram of X110D

Pin Definitions

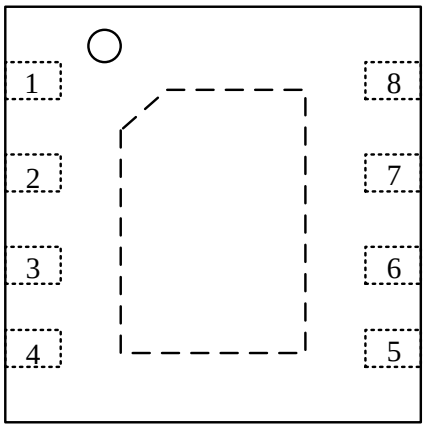


Figure 2 Layout of X110D Leading-out Terminals (Top View)

S/N	Designation	Type	Function Description
1	VBIAS	VB	Bias current control
2	RFIN	RFI	RF input externally connected to a blocking capacitor
3	NC	NC	No connection, PCB grounded
4	NC	NC	No connection, PCB grounded
5	NC	NC	No connection, PCB grounded
6	SHDN	DI	OFF control to operate at low level and turn off at high level
7	RFOUT	RFO	RF output externally connected to a blocking capacitor
8	NC	NC	No connection, PCB grounded

Note: RFI = RF input; RFO = RF output; VB = bias voltage; DI = digital input; NC= no connection

Absolute Maximum Ratings

(All voltages are referenced to GND)

Parameter	Symbol	Min.	Max.	Unit
Supply voltage	V_{DD}		7	V
Storage temperature	TS	-65	150	℃
Junction temperature	TJ		175	℃
） Lead temperature (10s)	TH		300	℃
RF input power (ON State) 10s	PRF		+31	dBm
RF input power (OFF State) 10s	PRF		+31	dBm
Control level	SHDN	0	7	V
ESD	CDM	CLASS C1		
	HBM	CLASS 1B		

Recommended Operating Conditions

Parameter	Symbol	Min.	Typical	Max.	Unit
Operating temperature range	TA	-40	+25	+105	℃
Supply voltage	V_{DD}	2.7	5	5.5	V

Electrical Characteristics

Electrical Characteristics of X110D at Normal Temperature

Characteristics	Conditions (Except as otherwise herein provided, T_A=25°C,V_{DD}=5V)	Limits			Unit
		Min.	Typical	Max.	
Operating current			65	80	mA
Gain	f_{RF}=0.6GHz~1.0GHz	21.0	23.8	--	dB
	f_{RF}=1.0GHz~1.6GHz	19.0	22.0	--	dB
	f_{RF}=1.6GHz~2.2GHz	19.0	21.0	--	dB
	f_{RF}=2.2GHz~2.7GHz	19.0	21.0	--	dB
	f_{RF}=2.7GHz~4.2GHz	19.5	23.0	--	dB
	f_{RF}=4.2GHz~5.0GHz	17.0	20.5		dB
Input return loss	f_{RF}=0.6GHz~5.0GHz	--	-13.0	-8.0	dB
Output return loss	f_{RF}=0.6GHz~5.0GHz	--	-19.0	-6.5	dB
Maximum input power	Power-on/SHDN LL	24	25	--	dBm
	Power-off/SHDN HL	24	25	--	dBm
Passband riplpe	Δf_{RF}=100MHz	--	0.60	1.5	dB
Noise figure	f_{RF}=0.6GHz~1.0GHz	--	0.60	0.80	dB
	f_{RF}=1.0GHz~1.6GHz	--	0.63	0.85	dB
	f_{RF}=1.6GHz~2.2GHz	--	0.65	0.85	dB
	f_{RF}=2.2GHz~2.7GHz	--	0.65	0.85	dB
	f_{RF}=2.7GHz~4.2GHz	--	0.70	0.90	dB
	f_{RF}=4.2GHz~5.0GHz	--	0.75	0.95	dB
Output 1dB compression point	f_{RF}=0.6GHz~1.6GHz	13.0	15.8	--	dBm
	f_{RF}=1.6GHz~2.2GHz	16.5	19.0	--	dBm
	f_{RF}=2.2GHz~2.7GHz	16.5	18.7	--	dBm
	f_{RF}=2.7GHz~4.2GHz	15.5	18.1	--	dBm
	f_{RF}=4.2GHz~5.0GHz	15.0	17.0		dBm
Output third-order intercept point	f_{RF}=0.6GHz~1.0GHz，P_{OUT}=5dBm，Δf=1MHz	31.0	34.5	--	dBm
	f_{RF}=1.0GHz~1.6GHz，P_{OUT}=5dBm，Δf=1MHz	29.5	33.5	--	dBm
	f_{RF}=1.6GHz~2.2GHz，P_{OUT}=5dBm，Δf=1MHz	28.5	32.5	--	dBm
	f_{RF}=2.2GHz~2.7GHz，P_{OUT}=5dBm，Δf=1MHz	29.0	32.5	--	dBm
	f_{RF}=2.7GHz~4.2GHz，P_{OUT}=5dBm，Δf=1MHz	28.5	34.5	--	dBm
	f_{RF}=4.2GHz~5.0GHz，P_{OUT}=5dBm，Δf=1MHz	27.5	30.5	--	dBm
Isolation	f_{RF}=0.6GHz~4.2GHz	--	-31	-20	dB
	f_{RF}=4.2GHz~5.0GHz	--	-20	-15	dB
	f_{RF}=0.6GHz~4.2GHz ，P_{IN}≤20dBm	--	--	-20	dB

SHDN shutdown isolation	f_{RF}=4.2GHz~5.0GHz ， P_{IN}≤6dBm	--	--	-10	dB
Control level	Power-on/SHDN LL	--	--	0.6	V
	Power-off/SHDN HL	1.2	--	V_{DD}	V
Turn-on time	50%SHDN to 90%RF	--	40	150	ns
Turn-off time	50%SHDN to 10%RF	--	40	150	ns
Spurious signals during switchover	Control signal 1KHz, spectrum integrating frequency 1Hz~6GHz	--	-20	-15	dBm
Thermal resistance, θ_{ja}		--	95	--	℃/W
Thermal resistance, θ_{jb}		--	32	--	℃/W
Thermal resistance, θ_{jc}		--	42	--	℃/W

Electrical Characteristics of X110D at Total Air Temperature

Characteristics	Condition (Except as otherwise herein provided, -40°C≤T_A≤105°C, V_{DD}=5V)	Limits			Unit
		Min.	Typical	Max.	
Operating current			65	100	mA
Gain	f_{RF}=0.6GHz~1.0GHz	19.0	23.8	--	dB
	f_{RF}=1.0GHz~1.6GHz	19.0	22.0	--	dB
	f_{RF}=1.6GHz~2.2GHz	19.0	21.0	--	dB
	f_{RF}=2.2GHz~2.7GHz	19.0	21.0	--	dB
	f_{RF}=2.7GHz~4.2GHz	17.0	23.0	--	dB
	f_{RF}=4.2GHz~5.0GHz	16.0	20.5	--	dB
Input return loss	f_{RF}=0.6GHz~5.0GHz	--	-13.0	-8.0	dB
Output return loss	f_{RF}=0.6GHz~5.0GHz	--	-19.0	-6.5	dB
Maximum input power	上电/SHDN 低电平 Power-on/SHDN LL	24	25	--	dBm
	下电/SHDN 高电平 Power-off/SHDN HL	24	25	--	dBm
Passband riplpe	Δf_{RF}=100MHz	--	0.60	1.5	dB
Noise figure	f_{RF}=0.6GHz~1.0GHz	--	0.60	1.20	dB
	f_{RF}=1.0GHz~1.6GHz	--	0.63	1.20	dB
	f_{RF}=1.6GHz~2.2GHz	--	0.65	1.20	dB
	f_{RF}=2.2GHz~2.7GHz	--	0.65	1.20	dB
	f_{RF}=2.7GHz~3.6GHz	--	0.65	1.40	dB
	f_{RF}=3.6GHz~4.2GHz	--	0.62	1.40	dB
	f_{RF}=4.2GHz~5.0GHz	--	0.75	1.60	dB
Output 1dB compression point	f_{RF}=0.6GHz~1.6GHz	13.0	15.8	--	dBm
	f_{RF}=1.6GHz~2.2GHz	15.0	19.0	--	dBm
	f_{RF}=2.2GHz~2.7GHz	16.0	18.7	--	dBm
	f_{RF}=2.7GHz~4.2GHz	15.0	18.1	--	dBm
	f_{RF}=4.2GHz~5.0GHz	14.0	17.0		dBm
Output third-order intercept point	f_{RF}=0.6GHz~1.0GHz，P_{OUT}=5dBm，Δf=1MHz	26.0	34.5	--	dBm
	f_{RF}=1.0GHz~1.6GHz， P_{OUT}=5dBm，Δf=1MHz	28.0	33.5	--	dBm

	f_{RF}=1.6GHz~2.2GHz， P_{OUT}=5dBm，Δf=1MHz	28.0	32.5	--	dBm
	f_{RF}=2.2GHz~2.7GHz， P_{OUT}=5dBm，Δf=1MHz	28.0	32.5	--	dBm
	f_{RF}=2.7GHz~4.2GHz， P_{OUT}=5dBm，Δf=1MHz	28.0	34.5	--	dBm
	f_{RF}=4.2GHz~5.0GHz， P_{OUT}=5dBm，Δf=1MHz	27.0	30.5	--	dBm
Isolation	f_{RF}=0.6GHz~4.2GHz	--	-31	-20	dB
	f_{RF}=4.2GHz~5.0GHz	--	-20	-15	dB
SHDN shutdown isolation	f_{RF}=0.6GHz~4.2GHz ， P_{IN}≤20dBm	--	--	-20	dB
	f_{RF}=4.2GHz~5.0GHz ， P_{IN}≤6dBm	--	--	-10	dB
Control level	Power-on/SHDN LL	--	--	0.6	V
	Power-off/SHDN HL	1.2	--	V_{DD}	V
Turn-on time	50%SHDN to 90%RF	--	40	150	ns
Turn-off time	50%SHDN to 10%RF	--	40	150	ns
Spurious signals during switchover	Control signal 1KHz, spectrum integrating frequency 1Hz~6GHz	--	-20	-15	dBm
Thermal resistance, θ_{ja}			95		℃/W
Thermal resistance, θ_{jb}			32		℃/W
Thermal resistance, θ_{jc}			42		℃/W

Typical Characteristic Curves

Based on the test and evaluation board CS-X110D-V5-20190819 of X110D, VDD=5V, and IDD=65mA, the following data compensate the loss of microstrip lines of the evaluation board.

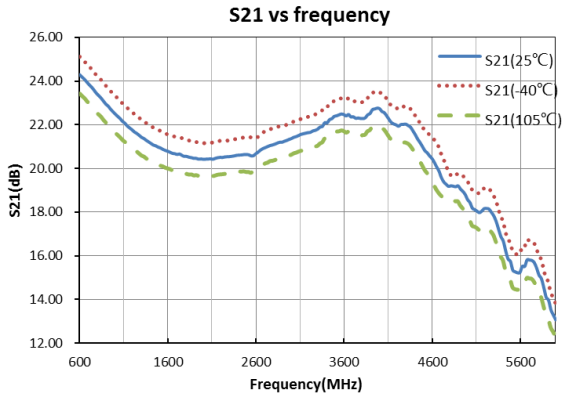


Figure 3 Gain Characteristics

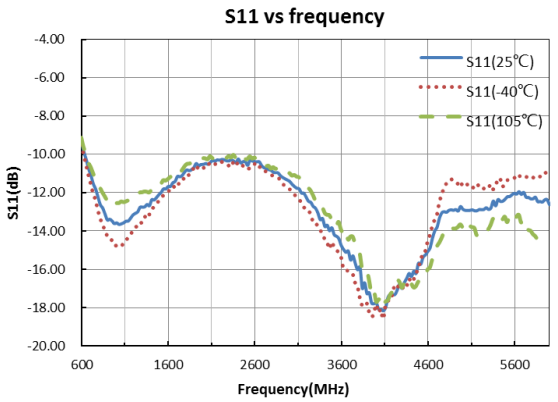


Figure 4 Input Return Losses

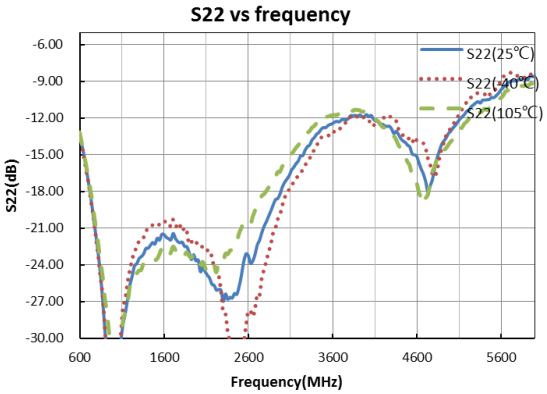


Figure 5 Output Return Losses

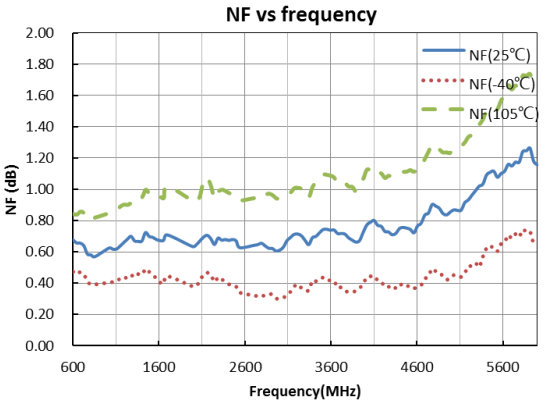


Figure 6 Noise Figure

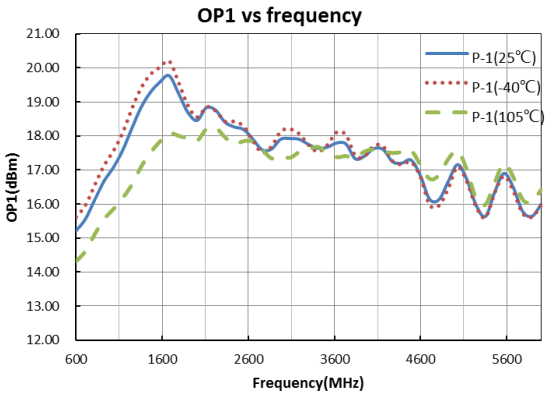


Figure 7 Output 1dB Compression Point

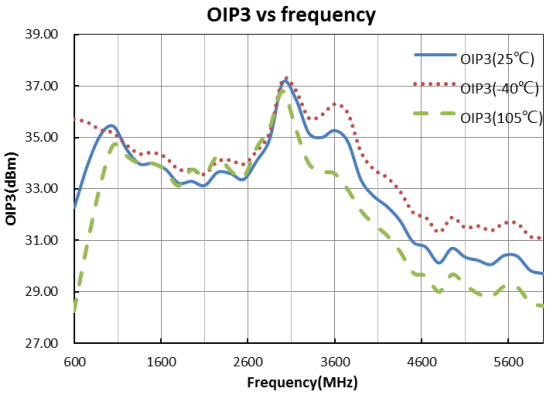


Figure 8 Output OIP3

Typical Applied Circuit

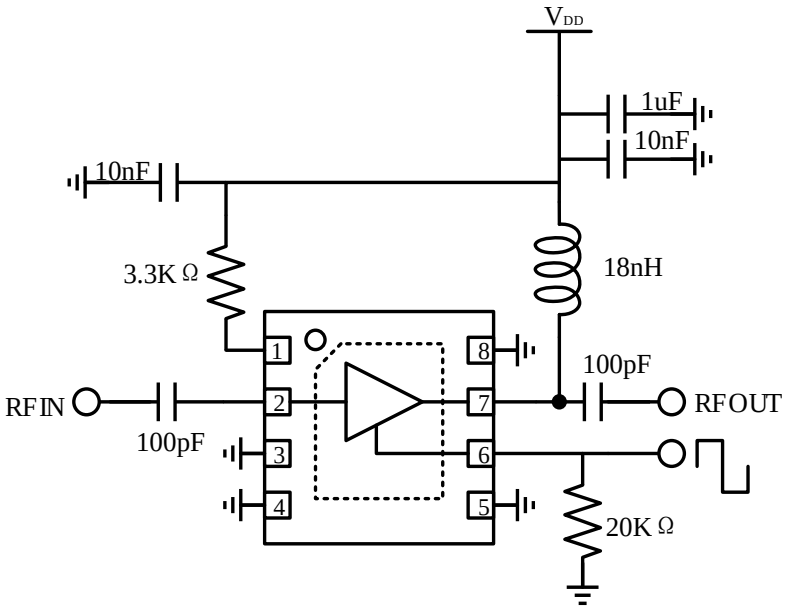


Figure 15 Typical Application Schematic Diagram of X110D

Product Identification Image and Pictures

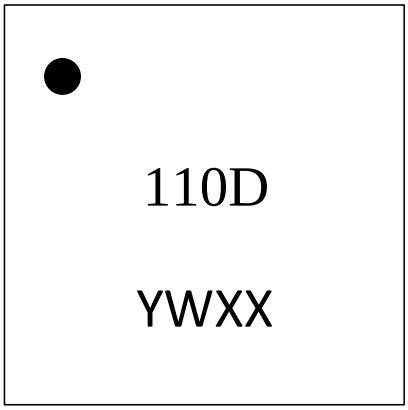
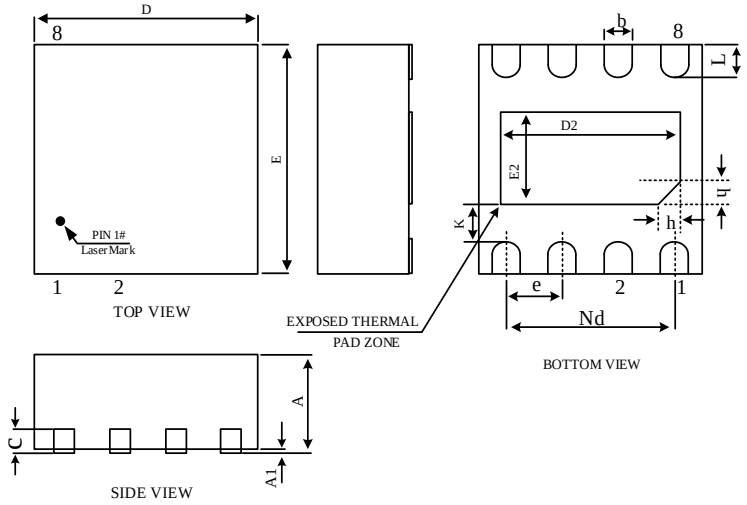


Figure 16 Product Identification

No.	Description
X110D	Model
Package Lot No.	The package lot number of the product, e.g., AB03 indicates the third batch of products ordered in the second week of 2019

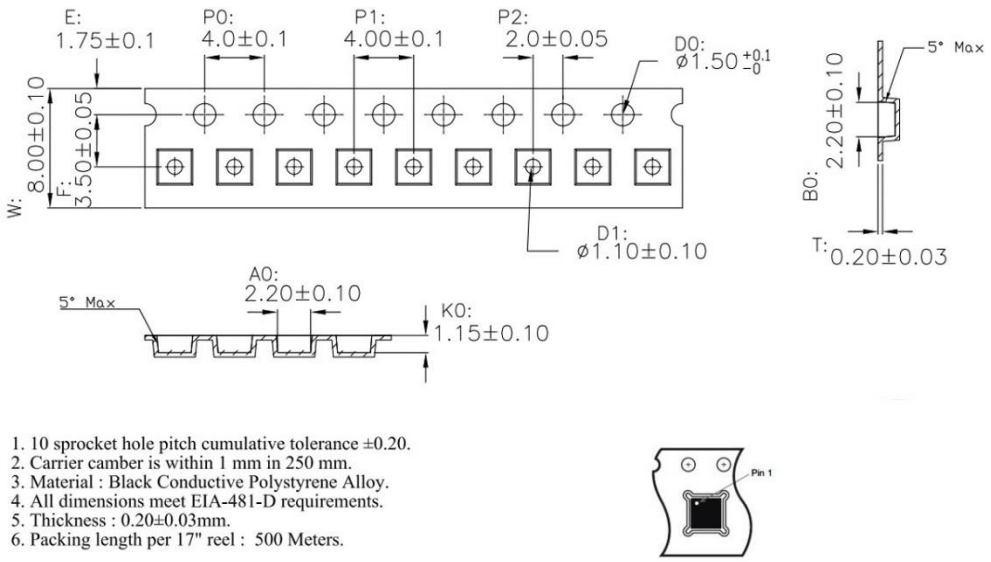
Package Outline



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	0.80	0.85	0.90
A1	0.00	0.02	0.05
b	0.20	0.25	0.30
c		0.203REF	
D	1.95	2.00	2.05
D2	1.55	1.60	1.65
Nd		1.50BSC	
e		0.50BSC	
E	1.95	2.00	2.05
E2	0.75	0.80	0.85
L	0.25	0.30	0.35
K	0.25	0.30	0.35
h		0.20REF	

Figure 17 X110D Package Outline

Reels Of The Package



1. 10 sprocket hole pitch cumulative tolerance ±0.20.
2. Carrier camber is within 1 mm in 250 mm.
3. Material : Black Conductive Polystyrene Alloy.
4. All dimensions meet EIA-481-D requirements.
5. Thickness : 0.20±0.03mm.
6. Packing length per 17" reel : 500 Meters.

Notes

1. Grounding: The metal base should be grounded with as many through holes as possible to reduce parasitic inductance.
2. The amplifier should be adopted according to the recommended typical applications.
3. Electrostatic discharge (ESD) damage protection: The amplifier is an ESD-sensitive device, and adequate ESD countermeasures should be taken during transmission, assembly and testing accordingly.
4. The Product Specification shall be subject to the date of release and shall be modified in due course without further notice.

Storage Conditions

1. The product is at a Moisture Sensitivity Level (MSL) 3, so it should be stored and used in accordance with the appropriate regulations of MSL 3.

Version Information

Version No.	Creation Date	Description	Page Changed
Rev 1.0	2019.11.30	First release	—
Rev 1.1	2020.04.02	Add information about ESD rating	—
Rev 1.2	2020.05.30	Add electrical characteristics at the total air temperature	—
Rev 1.3	2020.11.21	Add the maximum rating as well as voltage range of the control level	—

Rev 1.4	2020.12.14	Change the RF input power	—
Rev 1.5	2021.01.28	Add information about reels of the package and update the storage condition	—
Rev 1.6	2021.08.27	Change Turn-on/off time	P4、P5