

Description

X134 9KHz~4GHz 6-bit digital attenuator, which is integrated with a fixed gain attenuator, an oscillator, a charge pump, a serial-to-parallel conversion circuit, a level conversion circuit and other circuits therein, is a monolithic integrated circuit manufactured by an SOI process. No DC level is output from the RF port of the chip, and the control port thereof is compatible with TTL level. The QFN24 package with dimensions of 4mm×4mm is adopted.

Features

- Operating frequency 9KHz~4GHz
- 步进0.5dB
- Step 0.5dB
- Max. attenuation 31.5dB
- Low insertion loss
- Low overshoot
- High linearity

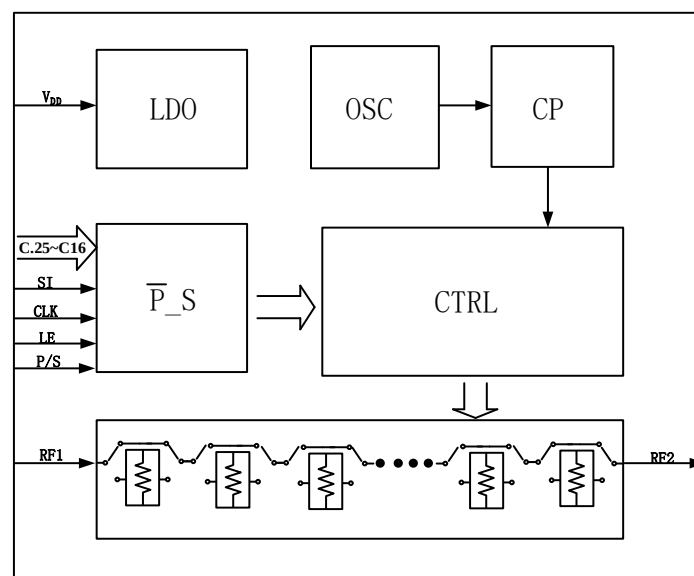
Features

Designation	Package Type	Operating Temperature
X134	QFN24	-40℃~105℃

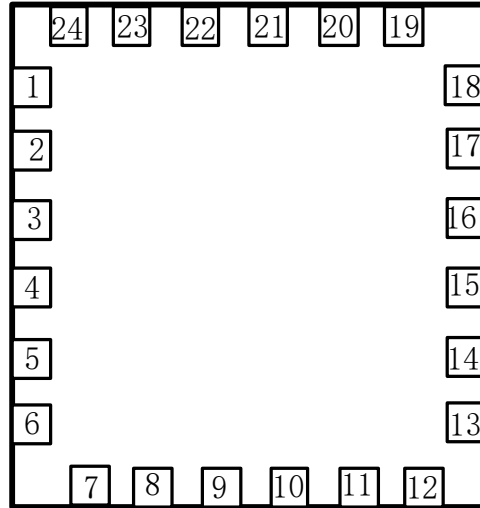
Scope of Application

- Wireless communication systems
- RF transceiver systems

Functional Block Diagram



Layout of Pins



Pin Definitions

S/N	Symbol	Description	S/N	Symbol	Description
1	NC	NC	13	GND	Ground
2	VDD	Power supply	14	NC	NC
3	NC	No connection	15	RF2	RF output
4	RF1	RF input	16	NC	NC
5	NC	NC	17	NC	NC
6	GND	Ground	18	NC	NC
7	GND	Ground	19	C16	Parallel port control, 16dB
8	GND	Ground	20	C8	Parallel port control, 8dB
9	GND	Ground	21	C4	Parallel port control, 4dB
10	GND	Ground	22	C2	Parallel port control, 2dB
11	GND	Ground	23	C1	Parallel port control, 1dB
12	NC	NC	24	C0.5*	Parallel port control, 0.5dB

Absolute Maximum Ratings

(All voltages are referenced to GND)

Parameter	Min.	Max.	Unit
Supply voltage range		6	V
Control voltage range		6	V
Input signal power		31	dBm
Storage temperature	-65	150	°C
ESD(HBM)		1000	V
ESD(CDM)		500	V

Recommended Operating Conditions

Parameter	Min.	Typical	Max.	Unit
Supply voltage	2.7	3.3	5.5	V
Digital high level	1.1		V _{DD}	V
Digital low level	-0.3		0.7	dBm
Operating temperature range	-40	+25	+105	°C
Max. junction temperature (10-year life)			125	°C

Electrical Characteristics

(Test conditions: except as otherwise herein provided, -40°C≤TA≤105°C, VDD=3.3V, VCTRL=0V/3.3V, RLOAD=50Ω, PIN=0dBm)

Characteristics	Symbol	Conditions		Parameters		Unit
			Min.	Typical	Max.	
Operating current	I _{CC}		--	180	300	uA
Insertion loss	IL	9KHz~1.0GHz	--	1.3	1.8	dB
		1GHz~2.2GHz	--	1.6	2.3	dB
		2.2GHz~4.0GHz		2.0	2.8	dB
Attenuator step	ATT _{step}		--	0.5	--	dB
Attenuation range	ATT _R	0.5 dB	0		31.5	dB
Attenuator error	ATT _{err}	9KHz~2.2GH	--	±(0.15+1% of set)	±(0.15+2.5% of set)	dB
		2.2GHz~3GHz	--	±(0.15+2% of set)	±(0.15+2.5% of set)	
		3GHz~4GHz	--	±(0.25+2.5% of set)	±(0.25+4.5% of set)	
Input return loss	S ₁₁		10	12	--	dB
Output return loss	S ₂₂		10	14	--	dB
Switching speed	T _{sw}	50% CTRL to 10% or 90% RF	--	70	100	ns
Input IP3	IIP3	Pin=18dBm/tone, 20MHz Spacing	50	55	--	dBm
Input 0.1dB compression point	P _{-0.1}		29	30	--	dBm
Switch glitch	Glitch	Greater than 100ns after gain switching	--	0.03	0.3	dB
Spurious signals	Spur	<100MHz	--	-95	-90	dBm
		100MHz~6GHz	--	-115	-110	

Control Logic

Table 1. Truth Table in Control Mode

Parallel control settings						Attenuation
C16	C8	C4	C2	C1	C0.5	
L	L	L	L	L	L	Reference IL
L	L	L	L	L	H	0.5dB
L	L	L	L	H	L	1dB
L	L	L	H	L	L	2dB
L	L	H	L	L	L	4dB
L	H	L	L	L	L	8dB
H	L	L	L	L	L	16dB
H	H	H	H	H	H	31.5dB

Test Curve

Test conditions: Except as otherwise herein provided, $T_A = 25^\circ\text{C}$ and $V_{DD} = 3.3\text{V}$, $Z_S = Z_L = 50\Omega$

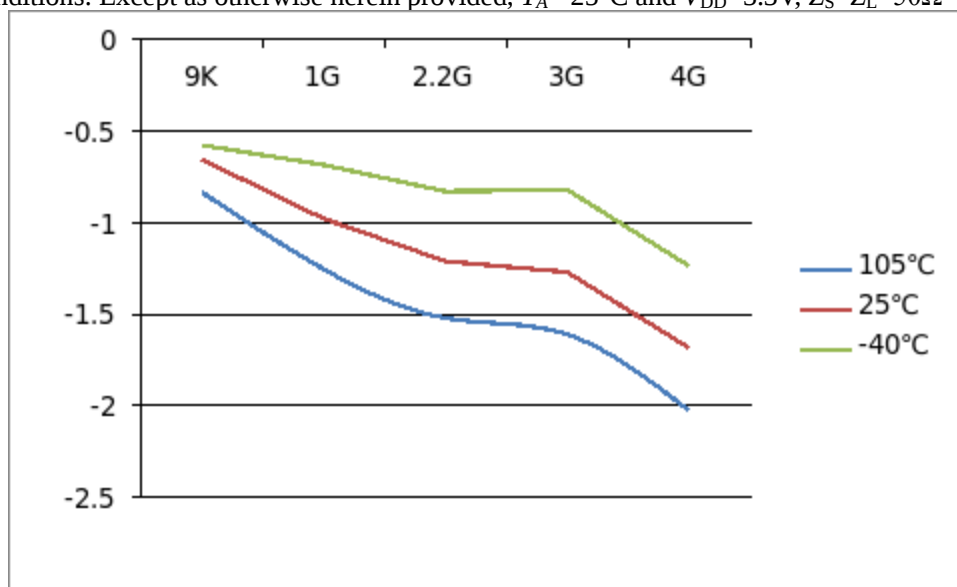


Figure 1 Insertion Losses

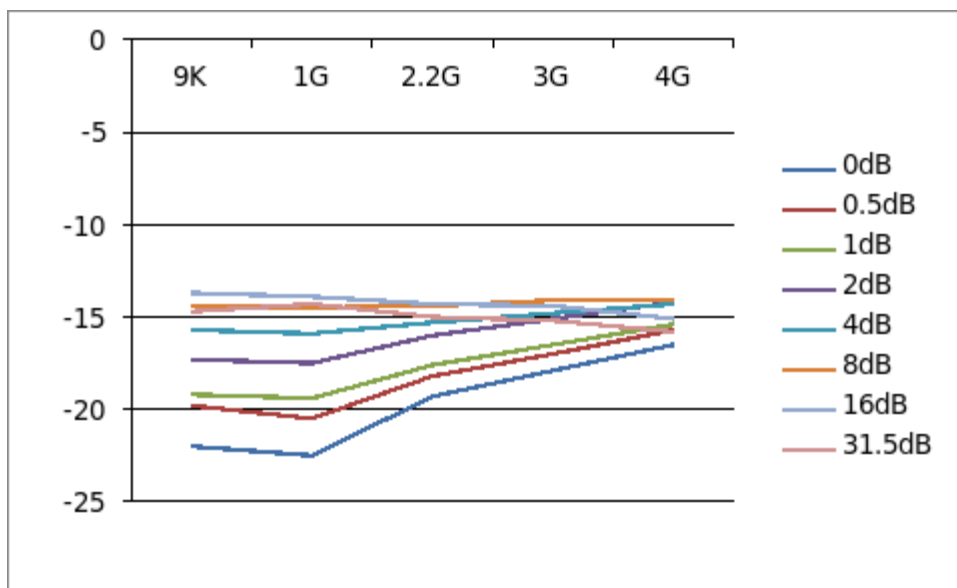


Figure 2 Input Return Losses

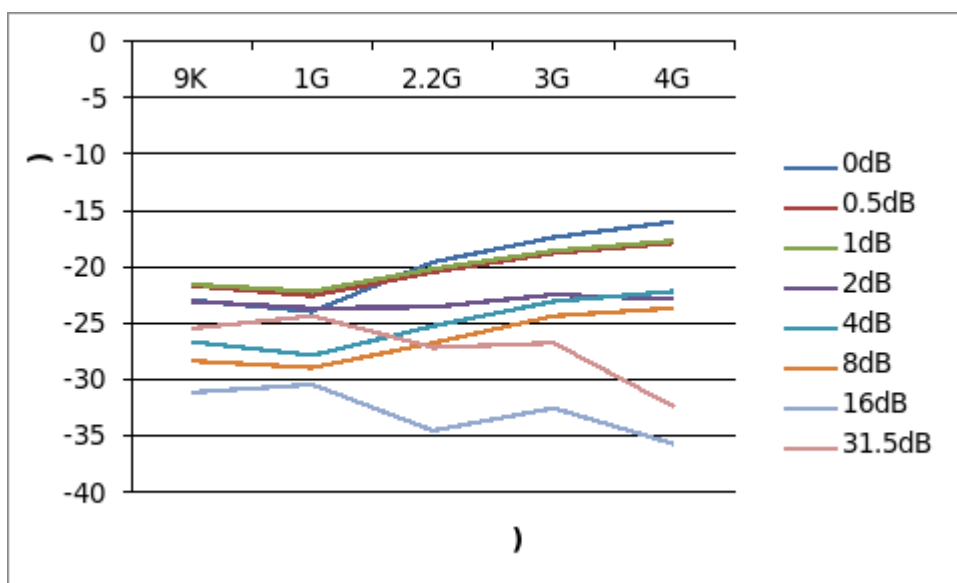


Figure 3 Output Return Losses

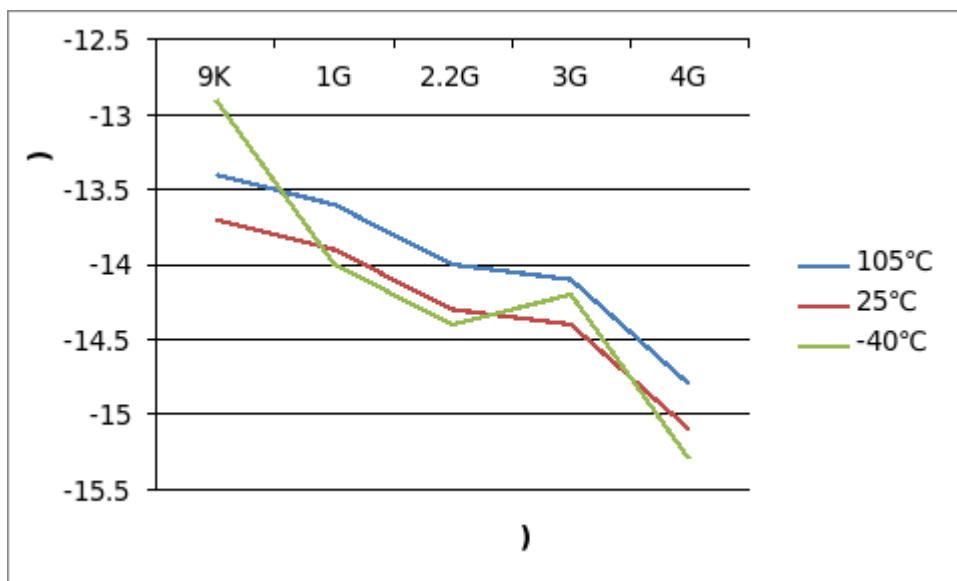


Figure 4 Input Return Losses at Three Temperatures (at 16dB)

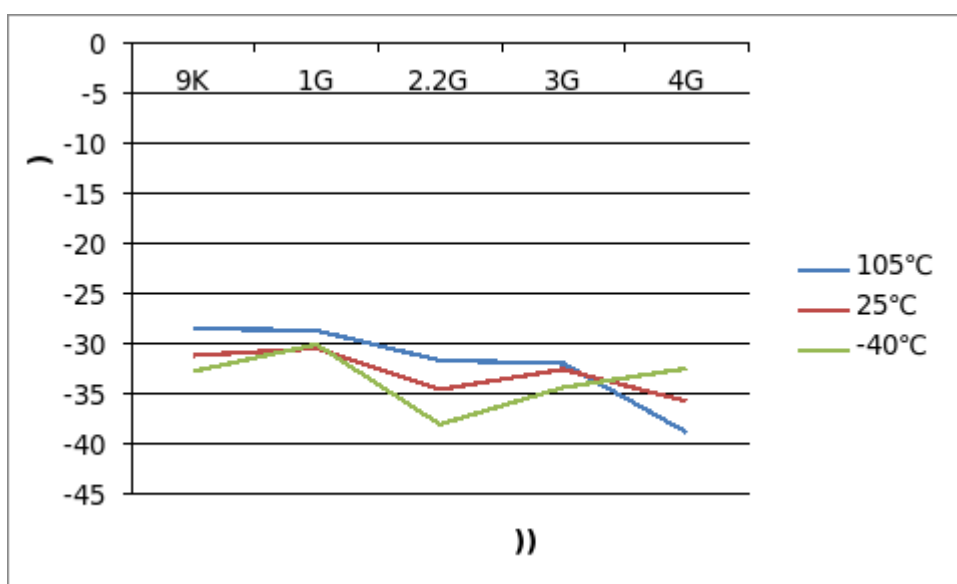


Figure 5 Output Return Losses at 16dB

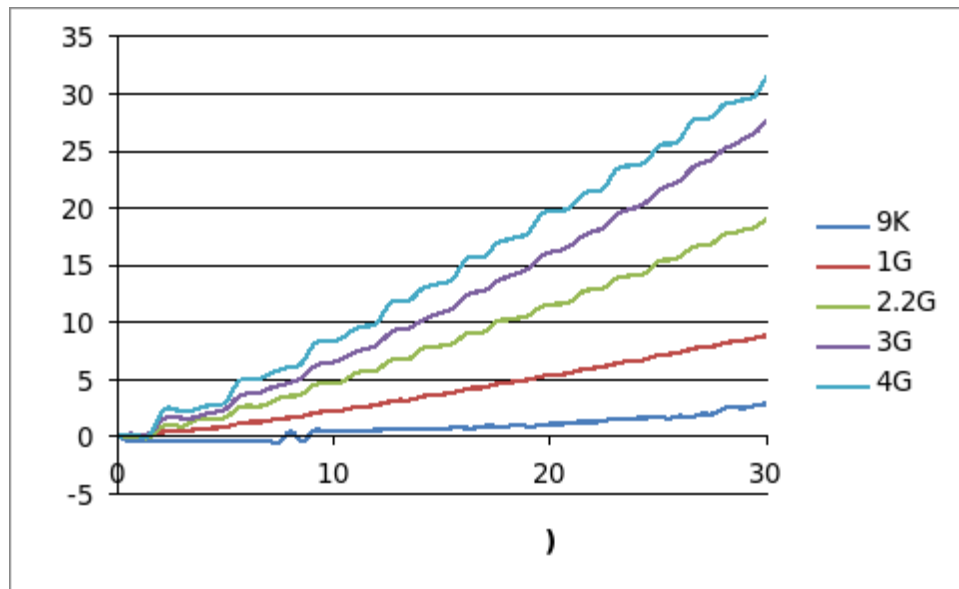


Figure 6 Additional Phase Shift VS Attenuation VS Frequency

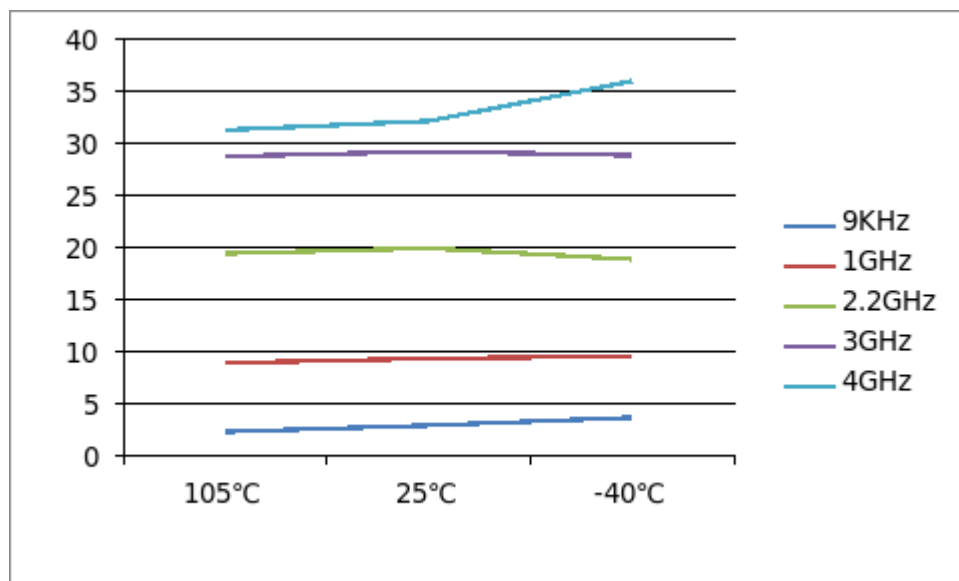


Figure 7 Additional Phase Shift at 31.5dB VS Temperature at Different Frequencies

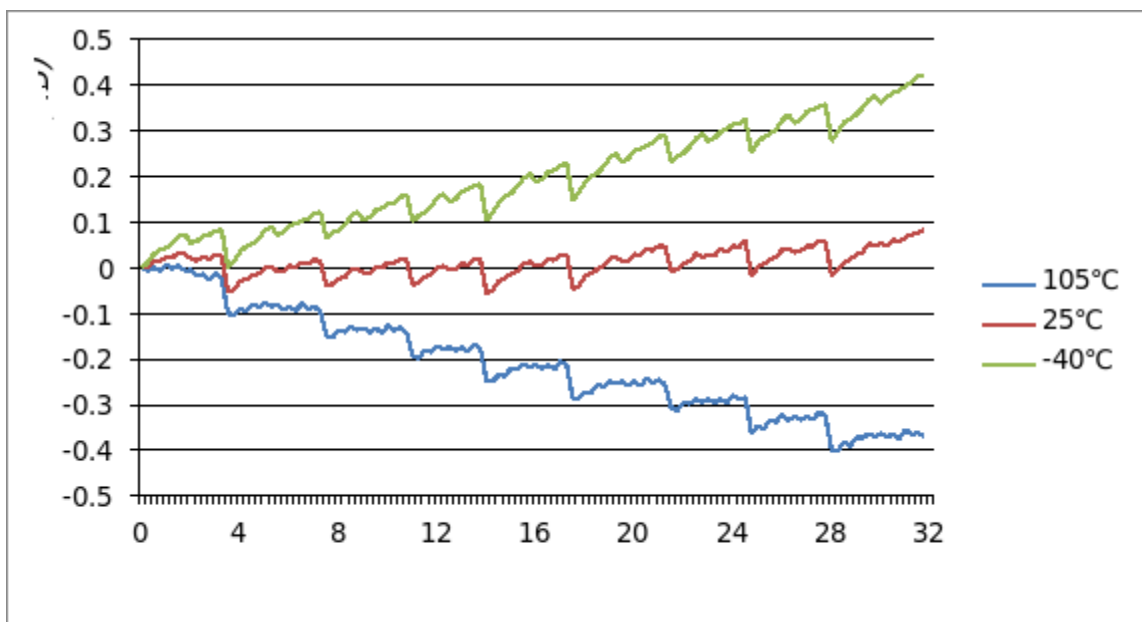


Figure 8 Attenuation Error at 900KHz VS Temperature

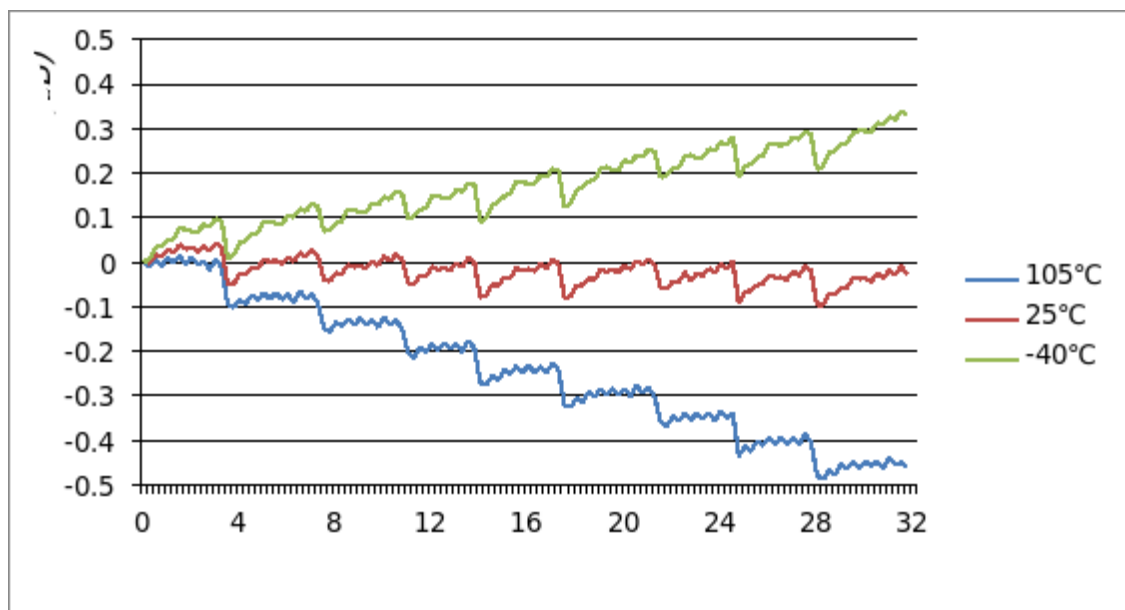


Figure 9 Attenuation Error at 1000MHz VS Temperature

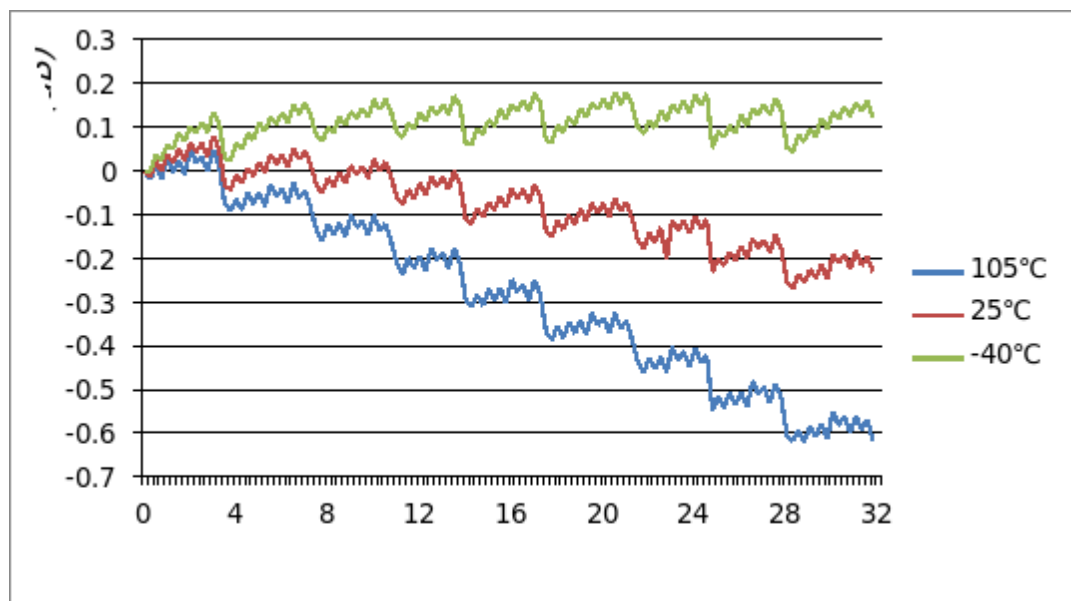


Figure 10 Attenuation Error at 2200MHz VS Temperature

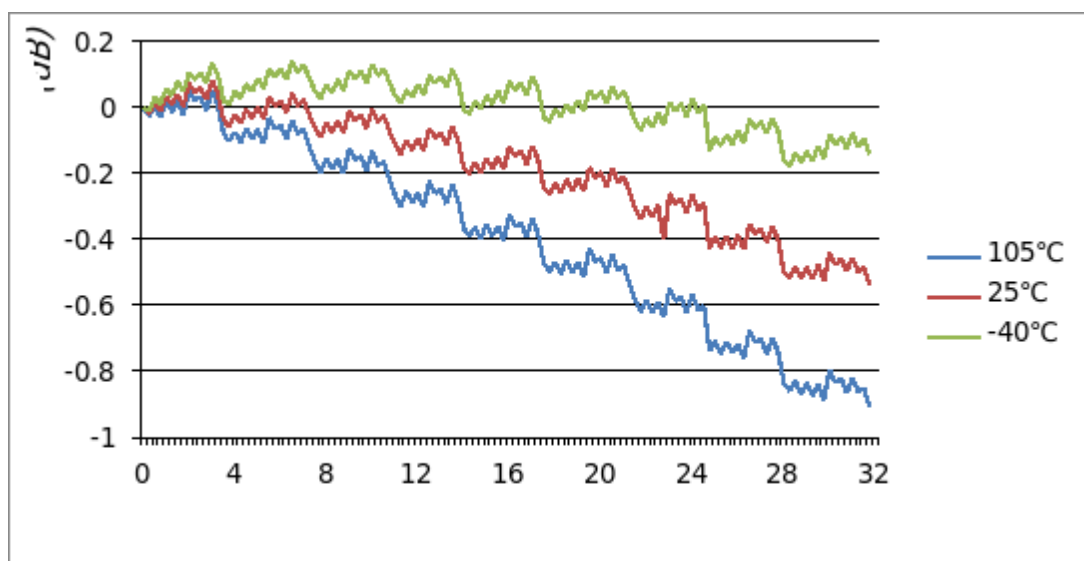


Figure 11 Attenuation Error at 3000MHz VS Temperature

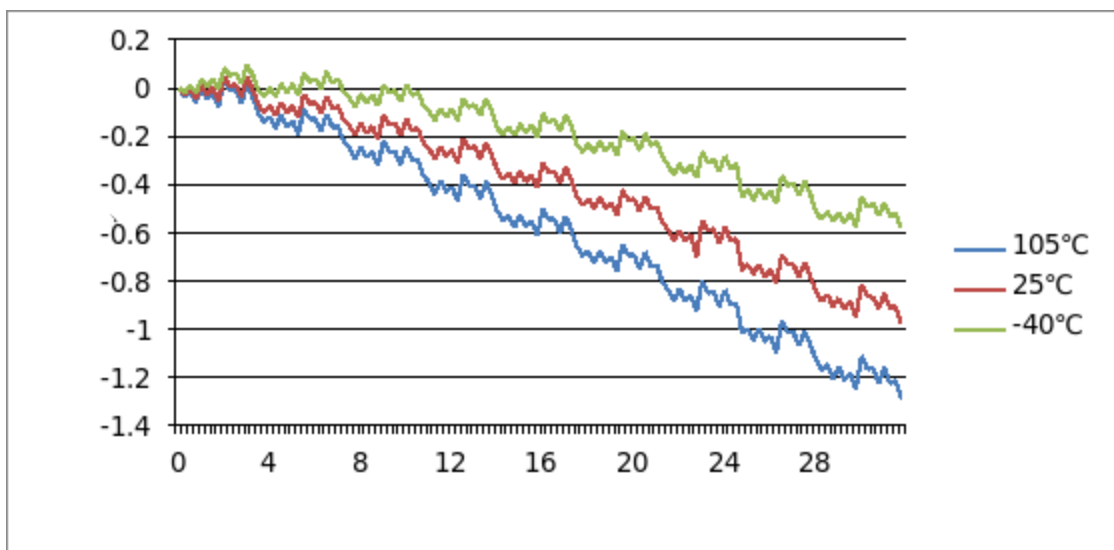


Figure12 Attenuation Error at 4000MHz VS Temperature

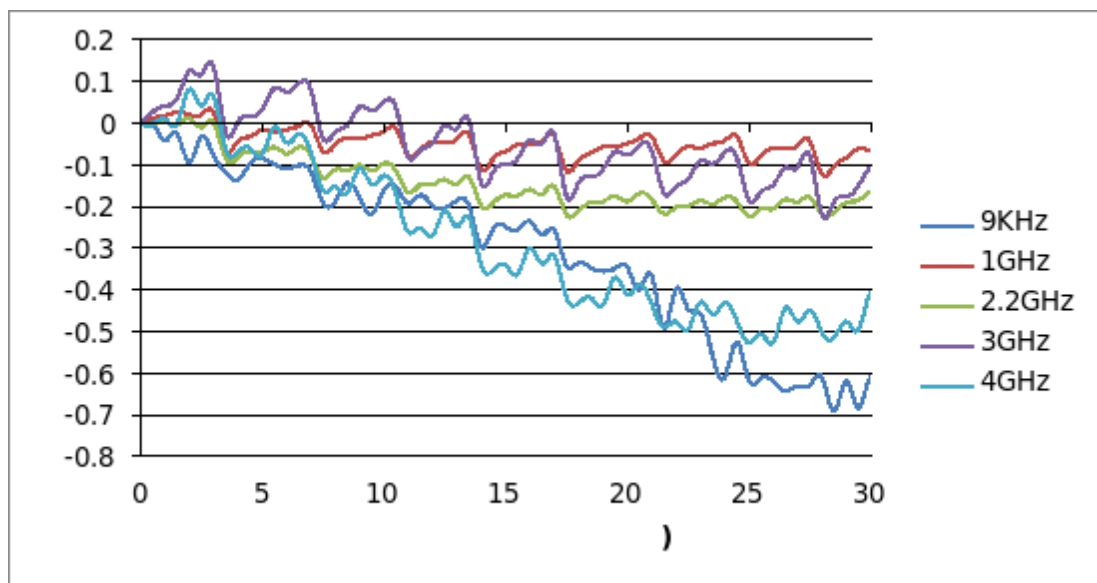


Figure13 Step Error VS Frequency

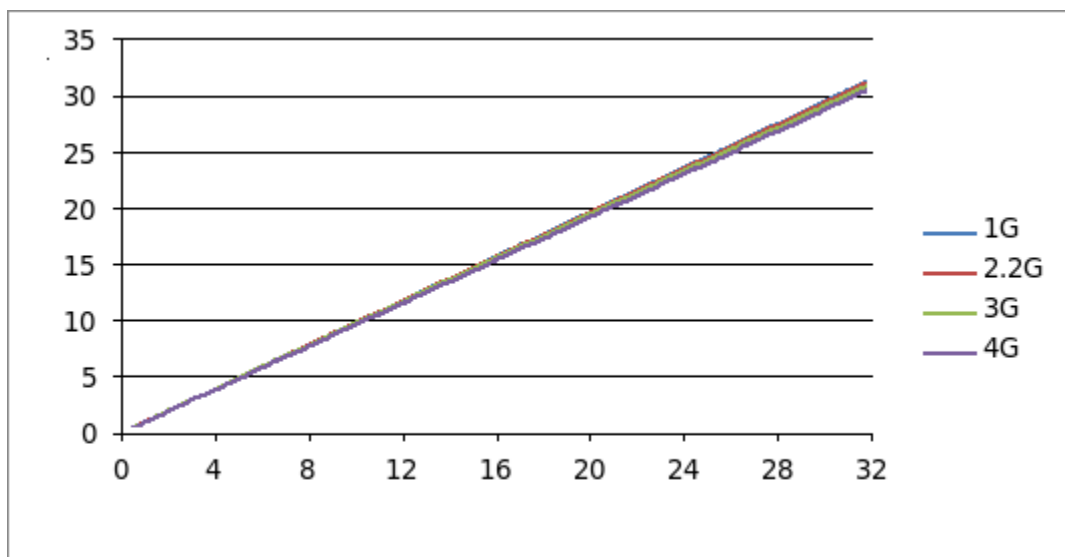


Figure 14 Comparison of Actual Attenuation and Ideal Attenuation

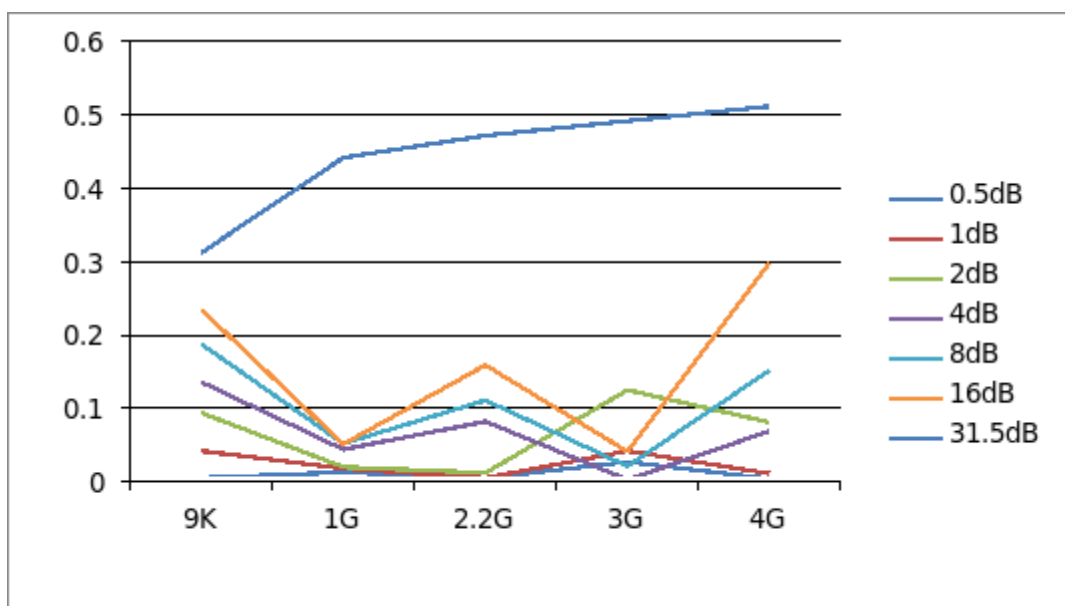


Figure 15 Main Step Attenuation Error VS Frequency

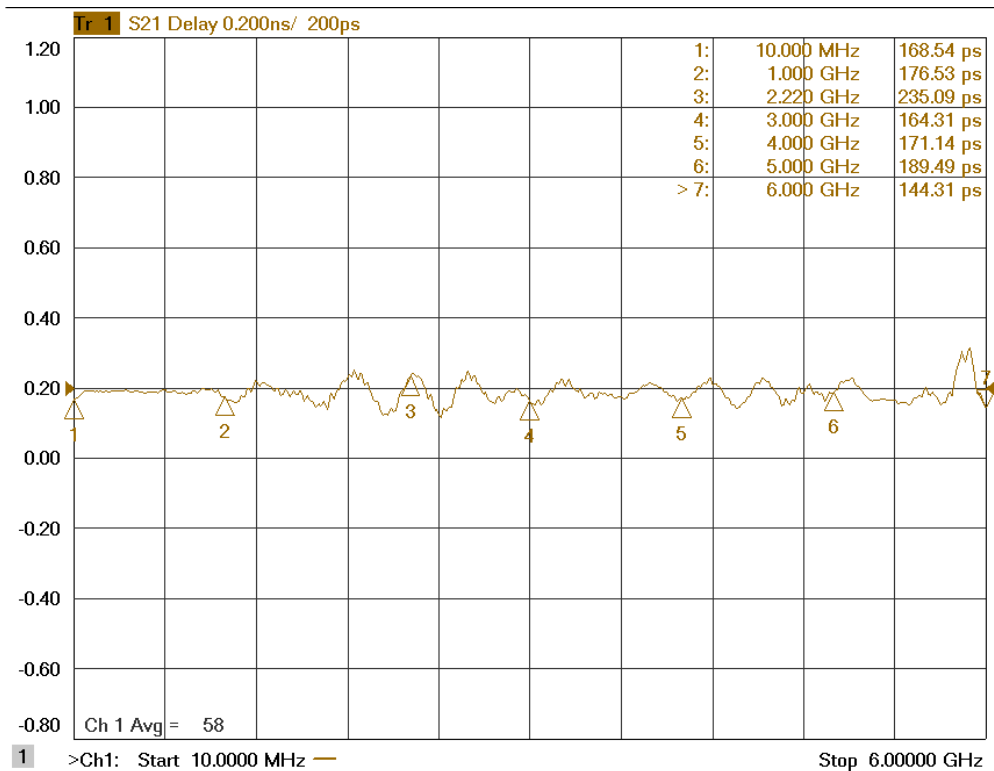
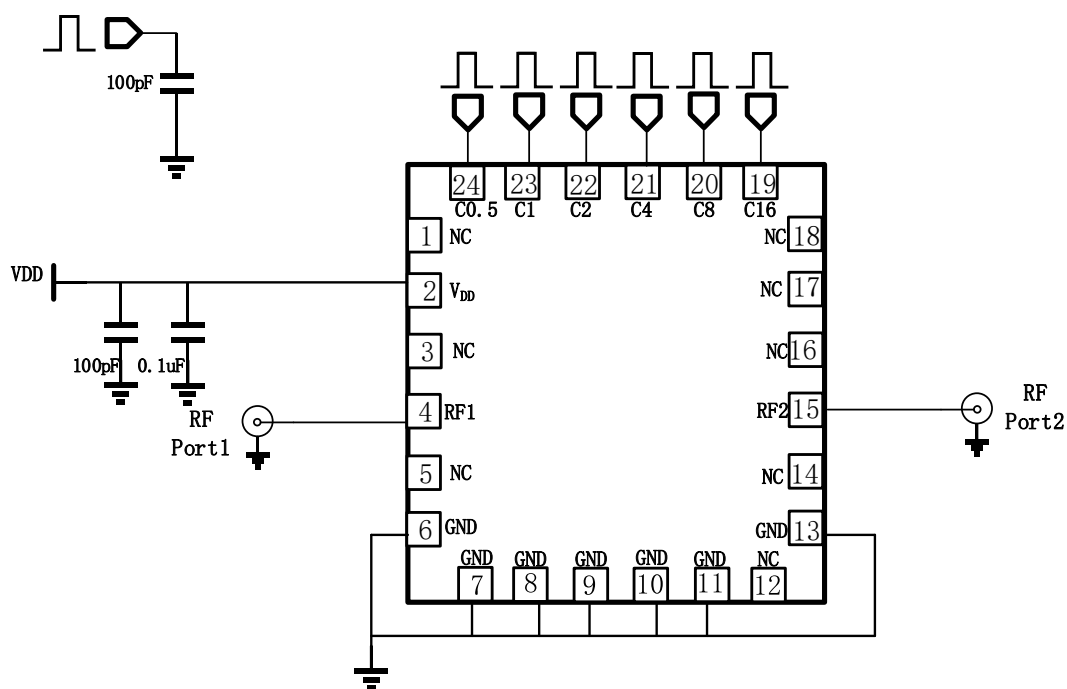


Figure 16 Delay VS Frequency

Typical Applied Circuit



Notes: 1. When the voltage of all DC operating points of the peripheral circuit is 0V, no blocking capacitor is required for each RF port.

2. When the voltage of all DC operating points of the peripheral circuit is not 0V, a blocking capacitor is required for each RF port.

3. A 200K pull-down resistor is built in each of the control ports C0.5~C16.

Package Outline

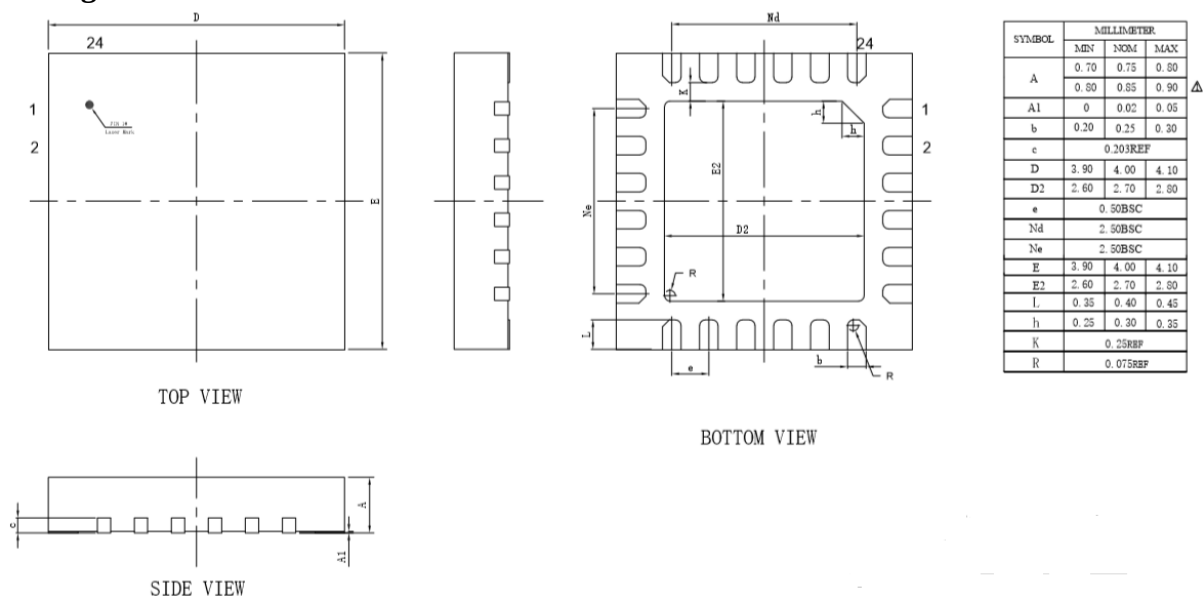
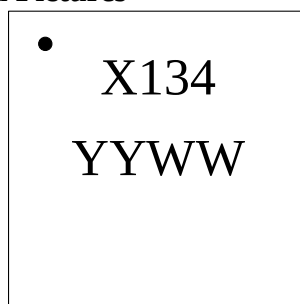


Figure 17 X134 Package Outline

Product Identification Image and Pictures



Code	Description
X134	Model
YYWW	Year and week, where YY indicates the last two digits of the year, and WW is the week

Moisture Sensitivity Level

X134 is available in a 24-pin 4×4 mm QFN package at a Moisture Sensitivity Level (MSL) 3.

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 Condition

1. The product can be stored in sealed packages for up to 36 months when the temperature is less than 30°C and the humidity is less than 60%.
2. When components are to be used in the reflow soldering process or other high-temperature processes after the package is opened, the components are required to be:
 - a) Completed within 12 hours and in a plant environment where the temperature is less than 30°C and the relative humidity is $\leq 60\%$.
 - b) Stored at 10% relative humidity.
 - c) Baked at 125°C for 4h to remove the internal moisture before use.

Version Information

Version No.	Creation Date	Description	Page Changed
Rev 0.1	2020.10.12	Pre-release	
Rev 1.0	2020.11.10	Official release in which the insertion loss and the attenuator error in the electrical characteristics table are updated according to the measured data	P3