

Product Features

- Operating Frequency: 1MHz ~ 8GHz
- Attenuation Range: 1dB LSB Steps to 31dB
- Parallel control interface
- TTL/CMOS Compatible Control
- Attenuation Accuracy: $(\pm(0.80+5\%))$ dB Max
- Supply Voltage: +5V/+3.3V
- Package: QFN16 (3mm x 3mm)

Application

- Microcellular
- UMTS/3G Infrastructure
- ISM, MMDS, WLAN, WiMAX
- Microwave Radio and VSAT
- Test Equipment and Sensors

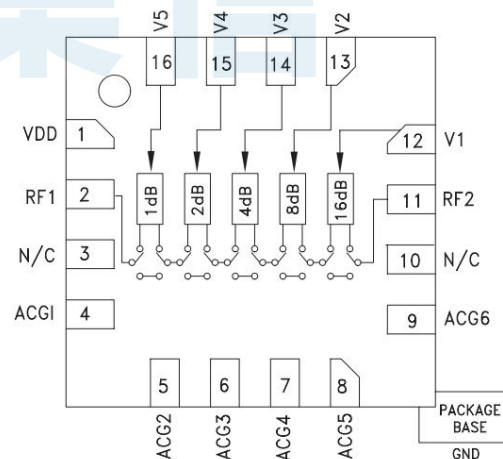
General Description

The BR9154FD is a broadband 5-bit GaAs IC digital attenuator in a low-cost leadless surface mount package. This single positive control line per bit digital attenuator incorporates off chip AC ground capacitors for near DC operation, making it suitable for a wide variety of RF and IF applications. Covering 1MHz to 8GHz, the insertion loss is less than 3.0dB typical. The attenuator bit values are 1(LSB), 2, 4, 8, and 16dB for a total attenuation of 31dB. Attenuation accuracy is excellent at $\pm(0.80+5\%)$ dB Max step error. Five TTL/CMOS control inputs are used to select each attenuation state. A single Vdd bias of +5V/+3.3V is required.

Ordering Information

Part Number	Package	Description
BR9154FD	QFN16	1MHz to 8GHz 5-Bit Parallel Digital Attenuator

Functional Block Diagram



Electrical Specifications

Parameters	Test Conditions	Min.	Typ.	Max.	Units
Insertion Loss	0.001GHz to 2.0GHz	-1.0	-1.2	-1.5	dB
	2.0GHz to 5.0GHz	-	-1.6	-1.9	
	5.0GHz to 8.0GHz	-	-2.5	-3.6	
Attenuation Range	0.001GHz to 8.0GHz	-	31	-	dB
Input Return Loss	0.001GHz to 8.0GHz	-	-20	-	dB
Output Return Loss	0.001GHz to 8.0GHz	-	-20	-	dB
Attenuation Accuracy: (Referenced to Insertion Loss)	0.001GHz to 8.0GHz	± (0.80+5%) Max.			dB
All attenuation states	6.0GHz to 8.0GHz	± (0.30+2%) Max.			
1dB to 16dB states 16dB to 31dB states	6.0GHz to 8.0GHz	± (0.60+2%) Max.			
Input Power for 1dB Compression	0.01GHz to 2.5GHz	-	34.5	-	dBm
Input Third-Order Intercept Point	0.03GHz to 4.2GHz	40.2	45.9	49.6	dBm
Switching Characteristics	200MHz		70	-	ns
Trise (50% CTL-90% RF)	16dB State	-	70	-	ns
Tfall (50% CTL-10% RF)		-			
Test conditions: VDD=+5V, I=2mA, IIP3 spacing=1MHz, Pin=0dBm/tone, TA=+25°C					

Absolute Maximum Ratings

Maximum Supply Voltage (VDD): +7V;

Maximum RF input power: +27dBm (All Atten. States);

Control Voltage Range: 0V ~ VDD;

Note: Operation of the device outside the parameter ranges given absolute-maximum-ratings conditions may cause permanent damage, and exposure to absolute-maximum-ratings conditions for extended periods will affect the reliability.

Recommended Operating Conditions

Supply Voltage: 5V/3.3V;

Control Voltage: 0V ~ 0.8V (low);

2.7V ~ VDD (high);

Storage Temperature: -65°C ~ +150°C;

Operating Temperature: -55°C ~ +125°C;

Supply Current: 2mA;

Note: When VDD=5V, Vctrl=0V/3.3V, the attenuator can work normally; But when VDD=3.3V, Vctrl=0V/5V, the attenuator can not work normally.

ESD Warnings

ELECTROSTATIC SENSITIVE DEVICE

OBSERVE HANDLING PRECAUTIONS

博瑞集信

Typical Performance(EVB test results)

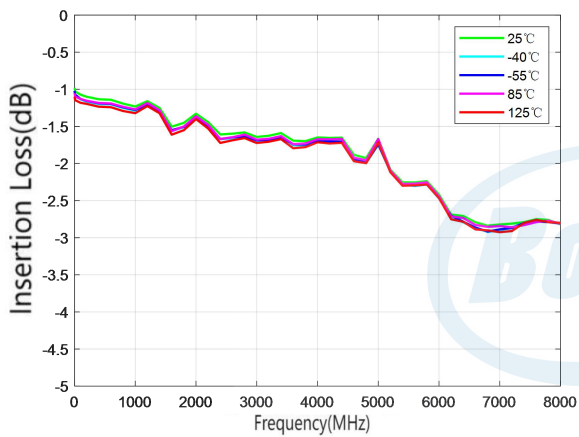
Parameters	Typ.							Units
	1	10	100	200	400	600	800	
Frequency	1	10	100	200	400	600	800	MHz
Insertion Loss	-1.0	-1.0	-1.1	-1.1	-1.1	-1.1	-1.2	dB
Attenuation Accuracy (1dB)	-0.02	-0.02	-0.03	-0.03	-0.02	-0.04	-0.04	dB
Attenuation Accuracy (2dB)	-0.03	-0.05	-0.06	-0.05	-0.06	-0.09	-0.09	dB
Attenuation Accuracy (4dB)	-0.03	-0.04	-0.05	-0.06	-0.09	-0.12	-0.13	dB
Attenuation Accuracy (8dB)	0.43	0.39	0.33	0.23	0.13	0.08	0.07	dB
Attenuation Accuracy (16dB)	0.67	0.63	0.48	0.25	0.07	0	-0.01	dB
Attenuation Accuracy (31dB)	0.98	0.94	0.75	0.46	0.09	-0.13	-0.23	dB
Input Return Loss	-17.05	-20.39	-20.49	-19.75	-18.98	-18.93	-19.05	dB
Output Return Loss	-16.93	-19.23	-20.46	-20.31	-19.74	-19.01	-18.47	dB
Input Power for 1dB Compression	-	27.6	25.6	28.7	35.4	35.4	36.3	dBm
Switching Characteristics	70, Trise (50% CTL-90% RF)				70, Tfall (50% CTL-10% RF)			ns
Test Conditions: VDD=+5V, I=2mA, TA=+25°C								

博瑞集信

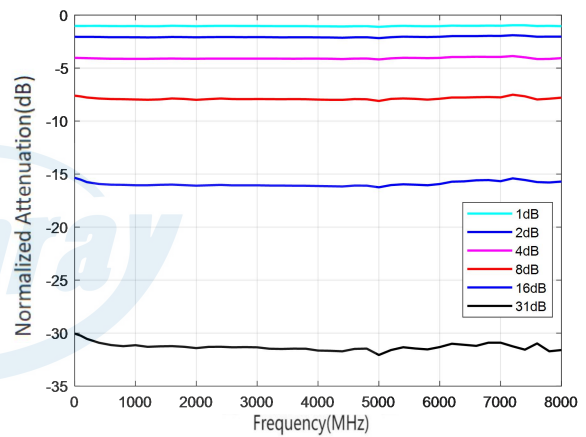


Parameters	Typ.							Units
Frequency	1000	1600	2000	2600	3000	3600	4000	MHz
Insertion Loss	-1.2	-1.5	-1.3	-1.6	-1.6	-1.7	-1.6	dB
Attenuation Accuracy (1dB)	-0.03	-0.01	-0.05	-0.02	-0.03	-0.05	-0.06	dB
Attenuation Accuracy (2dB)	-0.09	-0.07	-0.1	-0.07	-0.08	-0.09	-0.1	dB
Attenuation Accuracy (4dB)	-0.13	-0.1	-0.12	-0.11	-0.11	-0.12	-0.11	dB
Attenuation Accuracy (8dB)	0.04	0.13	0.01	0.08	0.08	0.08	0.03	dB
Attenuation Accuracy (16dB)	-0.05	0.01	-0.09	-0.06	-0.06	-0.1	-0.12	dB
Attenuation Accuracy (31dB)	-0.2	-0.16	-0.37	-0.26	-0.23	-0.38	-0.39	dB
Input Return Loss	-19.24	-18.5	-18.71	-20.84	-21.94	-23.29	-24.79	dB
Output Return Loss	-18.5	-18.65	-19.77	-21.79	-23.14	-24.93	-27.22	dB
Input Power for 1dB Compression	35.8	35	34.5	-	-	-	-	dBm
Switching Characteristics	70, Trise (50% CTL-90% RF)				70, Tfall (50% CTL-10% RF)			ns
Test Conditions: VDD=+5V, I=2mA, TA=+25°C								
Parameters	Typ.							Units
Frequency	4600	5000	5600	6000	6600	7000	8000	MHz
Insertion Loss	-1.9	-1.7	-2.3	-2.4	-2.8	-2.8	-2.8	dB
Attenuation Accuracy (1dB)	-0.05	-0.11	-0.04	-0.05	-0.01	-0.01	-0.05	dB
Attenuation Accuracy (2dB)	-0.1	-0.18	-0.06	-0.05	0.02	0.03	-0.03	dB
Attenuation Accuracy (4dB)	-0.11	-0.18	-0.04	-0.04	0.06	0.05	-0.06	dB
Attenuation Accuracy (8dB)	0.08	-0.1	0.1	0.11	0.25	0.24	0.21	dB
Attenuation Accuracy (16dB)	-0.08	-0.24	0	0.06	0.41	0.33	0.3	dB
Attenuation Accuracy (31dB)	-0.35	-0.57	-0.22	0.08	1.04	0.34	-0.3	dB

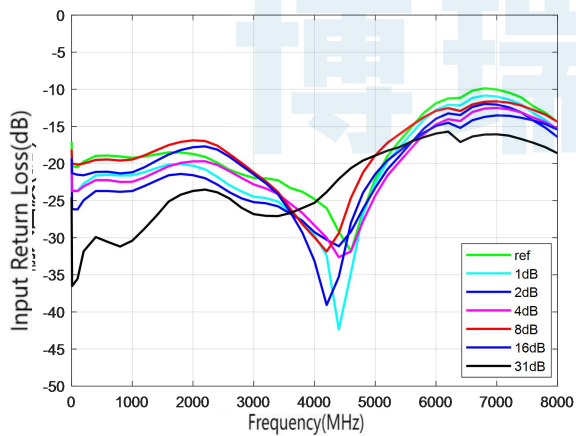
Input Return Loss	-31.8	-22.05	-15.07	-11.88	-10.18	-10.03	-14.41	dB
Output Return Loss	-46.38	-25.66	-17.05	-14.08	-11.64	-12.11	-21.81	dB
Input Power for 1dB Compression	-	-	-	-	-	-	-	dBm
Switching Characteristics	70, Trise (50% CTL-90% RF)				70, Tfall (50% CTL-10% RF)			ns
Test Conditions: VDD=+5V, I=2mA, TA=+25°C								



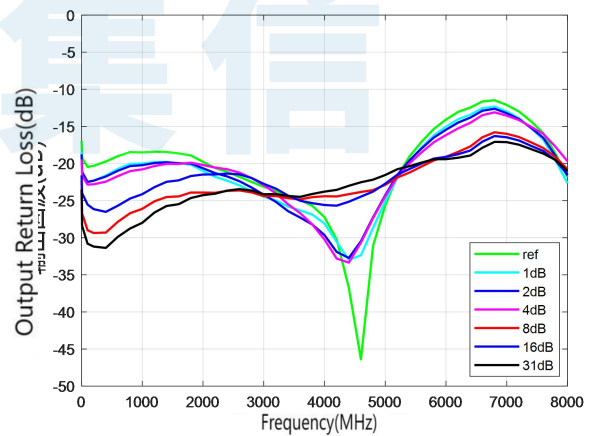
Insertion Loss vs. Frequency



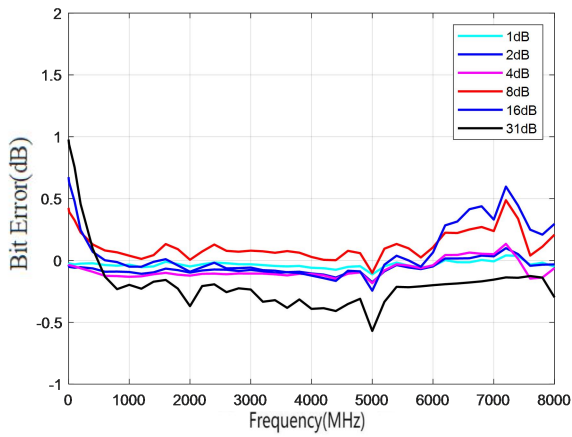
Normalized Attenuation vs. Frequency



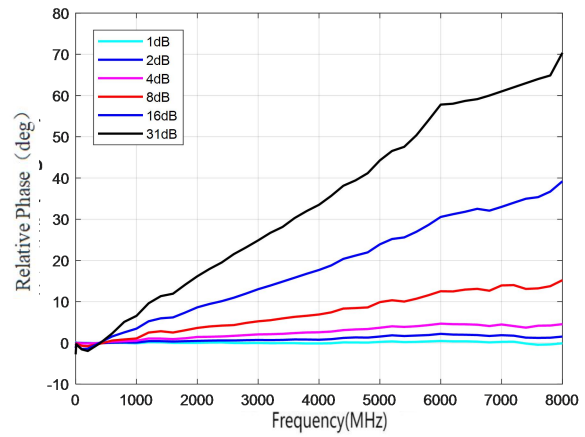
Input Return Loss vs. Frequency



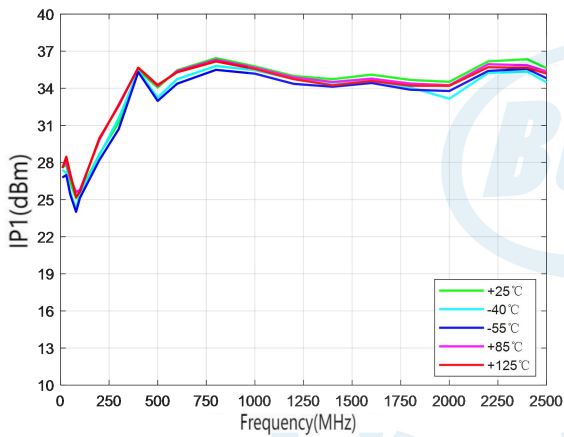
Output Return Loss vs. Frequency



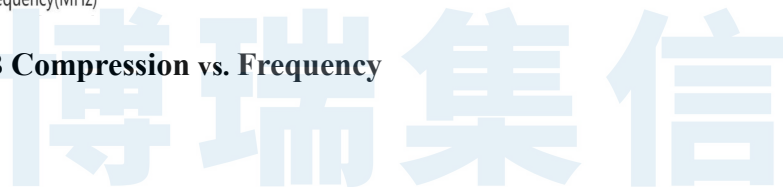
Bit Error vs. Frequency



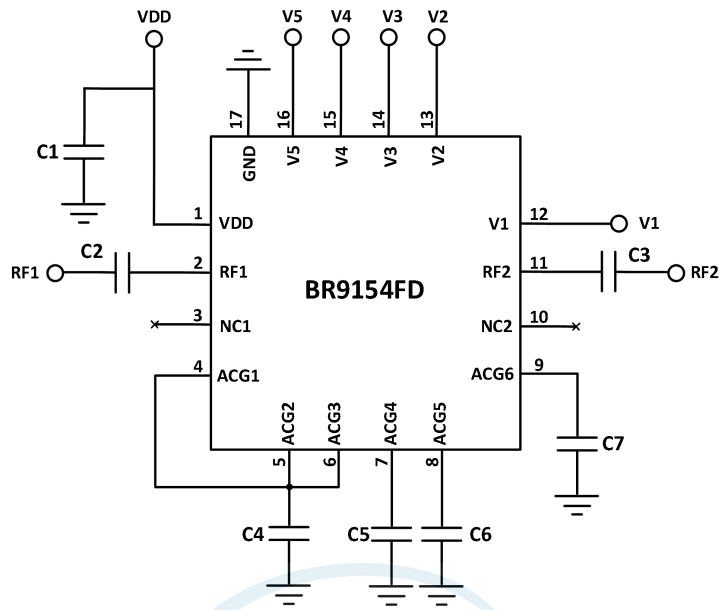
Relative Phase vs. Frequency



Input Power for 1dB Compression vs. Frequency

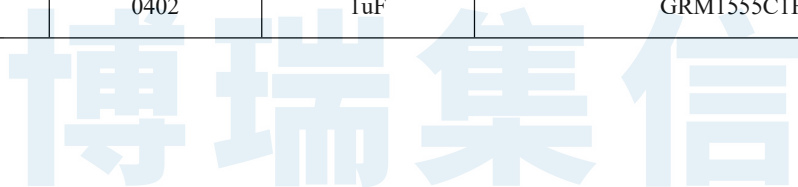


Typical Application Schematic



Bill of Material

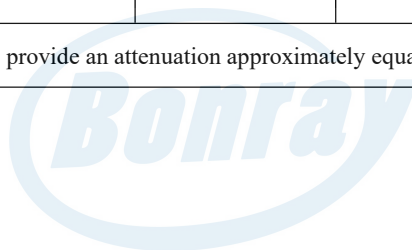
Reference Designator	Package Size	Value	P/N
C1	0402	1000pF	GRM155R71H102KA37D
C2, C3	0402	100nF	GRM155R71H104KE14D
C4 ~ C7	0402	1uF	GRM155C1H105JA01



Truth Table

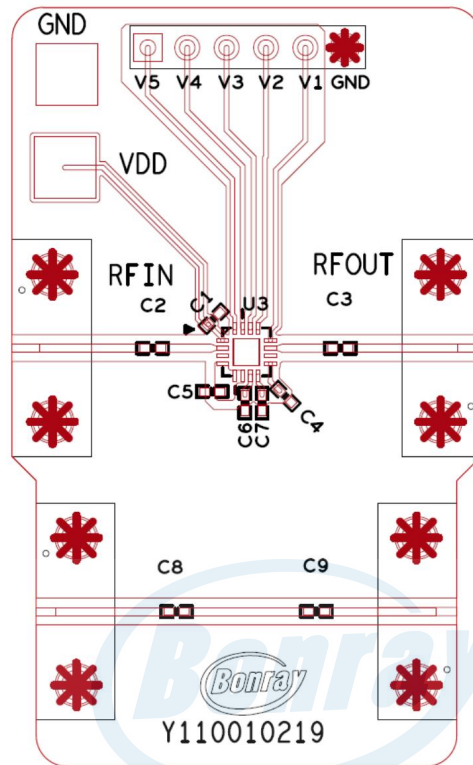
Control Voltage Input					Attenuated state RF1/RF2
V1 16dB	V2 8dB	V3 4dB	V4 2dB	V5 1dB	
High	High	High	High	High	Reference Insertion Loss
High	High	High	High	Low	1dB
High	High	High	Low	High	2dB
High	High	Low	High	High	4dB
High	Low	High	High	High	8dB
Low	High	High	High	High	16dB
Low	Low	Low	Low	Low	31dB

Note: Any combination of the above states will provide an attenuation approximately equal to the sum of the bits selected.

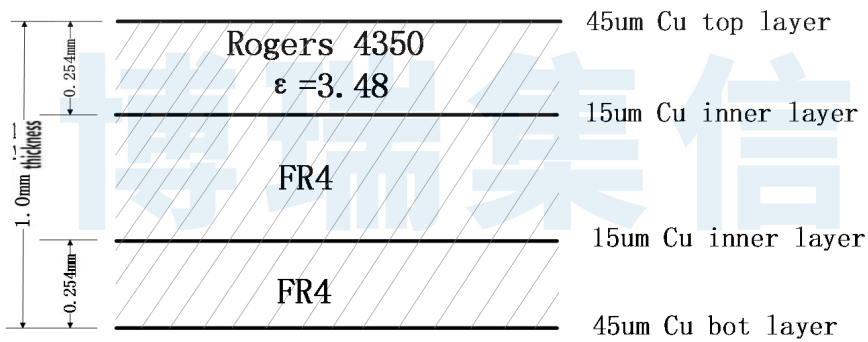


博瑞集信

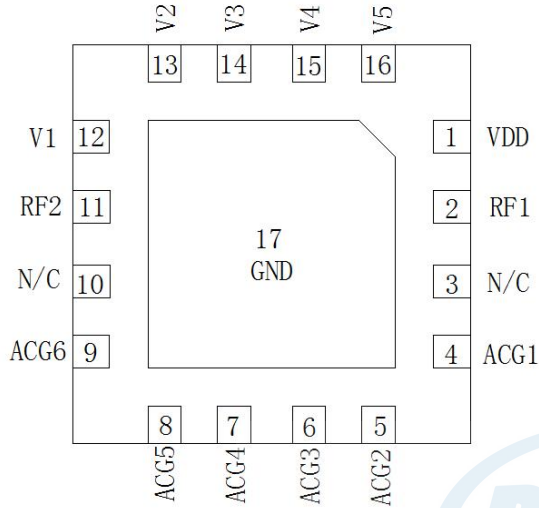
Evaluation PCB



PCB :



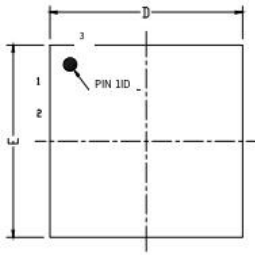
50 ohms Impedance Signal Lines: width=0.52mm, spacing=0.52mm

Pin Configuration and Description


Pin Numbers	Pin name	Description
1	VDD	Power supply pin.
2,11	RF1, RF2	Attenuator RF input/output pins. DC block is required.
3,10	N/C	No electrical connection. Provide grounded land pads for PCB mounting integrity.
4~9	ACG1 ~ ACG6	External capacitors to ground are recommended for low and high frequency operation. Select value for lowest frequency of operation. Place capacitor as close to pins as possible.
12~16	V1 ~ V5	Parallel control voltage input pins. Select the required attenuation. See Truth Table.
17	GND	RF/DC ground. Use recommended via pattern to minimize inductance and thermal resistant; see PCB Mounting Pattern for suggested footprint.

博瑞集信

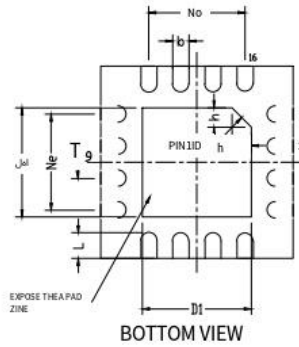
Package Dimensions (mm)



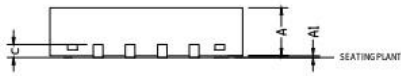
TOP VIEW



SIDB VIEW



BOTTOM VIEW



SIDB VIEW

SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	0.75	0.80	0.85
A1	0.01	0.02	0.05
b	0.20	0.25	0.30
c	0.270REF		
D	2.90	3.00	3.10
D1	1.60	1.70	1.80
e	0.50BSC		
Ne	1.50BSC		
Nd	1.50BSC		
E	2.90	3.00	3.10
E1	1.60	1.70	1.80
L	0.25	0.30	0.35
h	0.30	0.35	0.40



博瑞集信