

Product Features

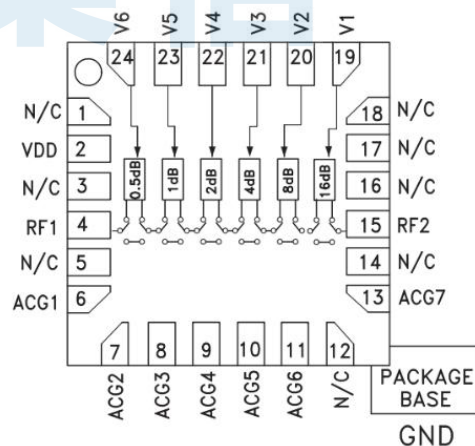
- Frequency: DC ~ 8GHz
- Attenuation Range: 0.5dB LSB Steps to 31.5dB
- Parallel Control Interface
- TTL-/CMOS-Compatible Control
- Supply Voltage: +5V/+3.3V
- Package: QFN24 (4mm x 4mm)

Application

- Communication Base Station
- Test Equipment
- Point-to-point Communication
- VHF/UHF Radio Station
- Microcellular /3G/4G and UWB

General Description

BR9153FP is a broadband 6-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 DC to 8GHz, the insertion loss is less than 2.0dB typical. The attenuator bit values are 0.5(LSB), 1, 2, 4, 8, and 16dB for a total attenuation of 31.5dB. Six TTL/CMOS control inputs are used to select each attenuation state. A single Vdd bias of +5V/+3.3V is required.

Functional Block Diagram

Ordering Information

Part	Package	Description
BR9153FP	QFN24	DC ~ 8GHz 6-Bit Parallel Digital Attenuator

Electrical Specifications

Parameters	Test Conditions	Min.	Typ.	Max.	Units
Insertion Loss	0.001GHz to 3.0GHz	1.0	1.3	1.6	dB
	3.0GHz to 8.0GHz	1.5	2.0	2.3	
Attenuation Range	0.001GHz to 8.0GHz	-	31.5	-	dB
Input Return Loss	0.001GHz to 8.0GHz	-	-15	-	dB
Output Return Loss	0.001GHz to 8.0GHz	-	-15	-	dB
Attenuation Accuracy: (Referenced to Insertion Loss)					
All Attenuation States	0.001GHz to 1.0GHz		±0.5		dB
0.5dB to 3.5dB states	1.0GHz to 2.2GHz		±0.1		
4.0dB ~ 31.5dB state	2.2GHz to 3.0GHz		±0.1		
All Attenuation States	3.0GHz to 8.0GHz		±0.7		
Input Power for 1dB Compression	0.6GHz to 2.7GHz	35.5	36.5	37.5	dBm
Input Third-Order Intercept Point	0.015GHz to 4.2GHz	42.1	-	48.3	dBm
Switching Characteristics					
Trise (50% CTL-90% RF)	200MHz	-	81	-	ns
Tfall (50% CTL-10% RF)	16dB State	-	52	-	ns
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.

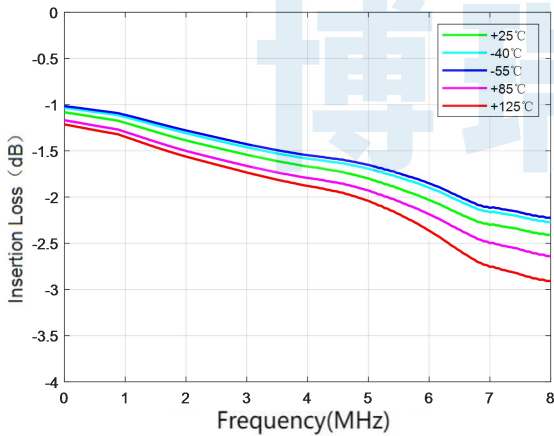
**ESD WARNING****ELECTROSTATIC SENSITIVE DEVICE****OBSERVE HANDLING PRECAUTIONS**

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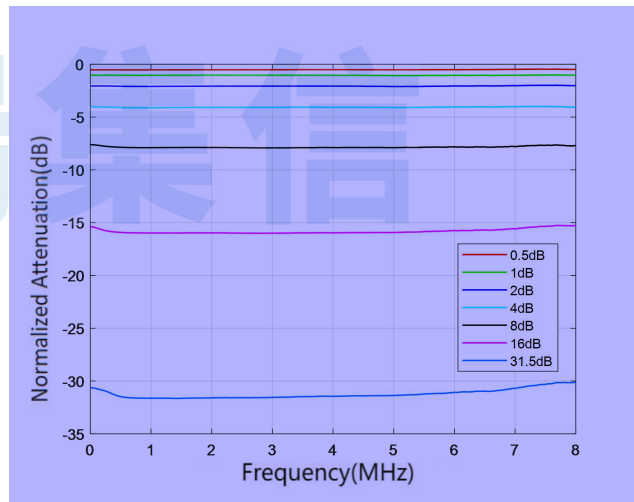
Typical Performance (EVB test results)

Parameters	Typ.							Units
	1	30	100	400	1000	4000	8000	
Frequency	1	30	100	400	1000	4000	8000	MHz
Insertion Loss	-1	-1	-1	-1.1	-1.1	-1.7	-2.3	dB
Attenuation Accuracy (0.5dB)	0.00	0.00	-0.07	-0.03	-0.03	0.00	0.00	dB
Attenuation Accuracy (1dB)	0.00	0.00	-0.07	-0.07	-0.03	-0.03	0.00	dB
Attenuation Accuracy (2dB)	0.00	-0.03	-0.07	-0.10	-0.13	-0.07	-0.03	dB
Attenuation Accuracy (4dB)	0.00	0.00	-0.07	-0.10	-0.13	-0.07	-0.07	dB
Attenuation Accuracy (8dB)	0.37	0.40	0.33	0.13	0.07	0.07	0.30	dB
Attenuation Accuracy (16dB)	0.57	0.57	0.47	0.07	-0.03	0.00	0.70	dB
Attenuation accuracy (31.5dB)	0.87	0.83	0.70	0.13	-0.20	-0.03	1.30	dB
Input Return Loss	-22.79	-25.30	-25.41	-24.55	-23.48	-25.85	-22.25	dB
Output Return Loss	-23.05	-25.24	-25.39	-25.30	-24.16	-37.85	-19.57	dB
Switching Characteristics	80.6 Trise (50% CTL-90% RF)				51.9 Tfall (50% CTL-10% RF)			ns

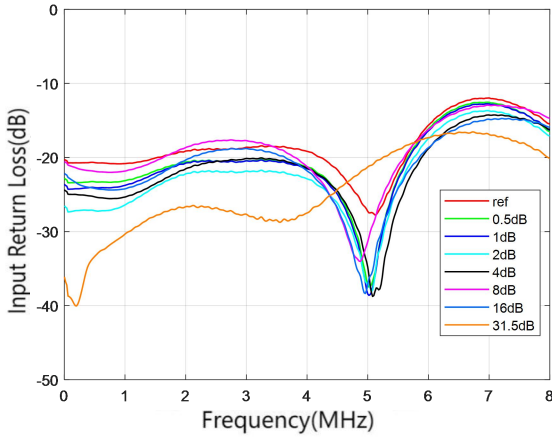
Test Conditions: VDD=+5V, I=2mA, TA=+25°C



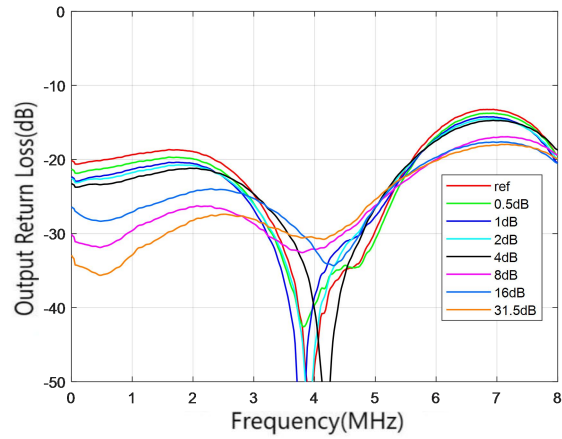
Insertion Loss vs.Freq



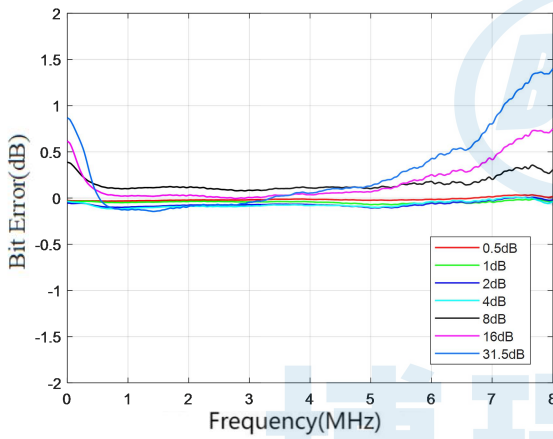
Normalized Attenuation vs.Freq



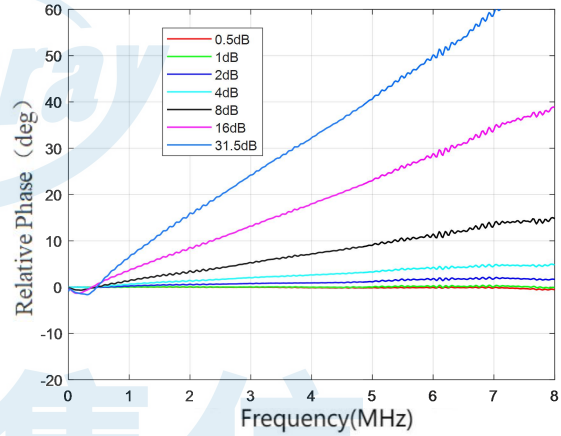
Input Return Loss vs.Freq



Output Return Loss vs.Freq

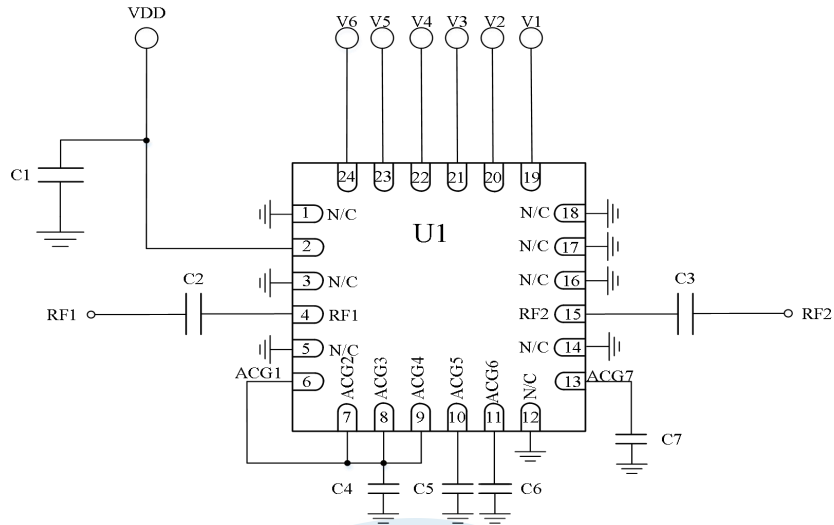


Attenuation Error vs.Freq



Relative Phase vs.Freq

Typical Application Schematic



Bill of Material

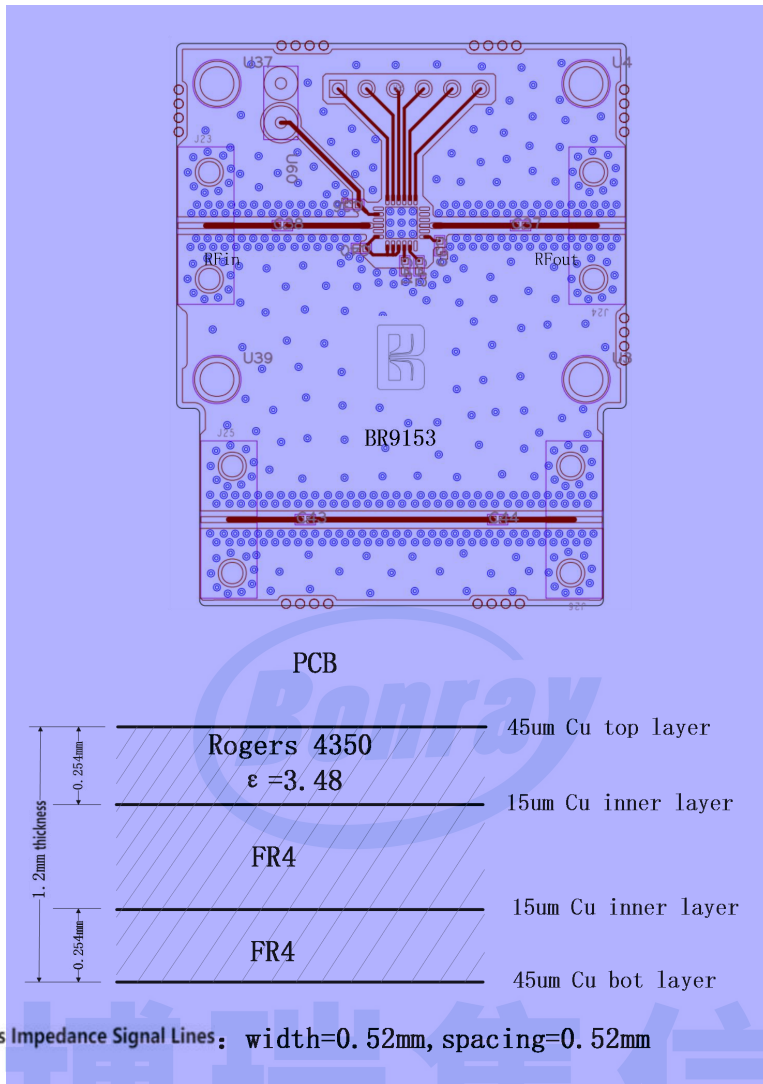
Designator	Package	Description	Part Number
C1	0402	1nF	GRM155R71H102KA37D
C2, C3	0402	100nF	GRM155R71H104KE14D
C4 ~ C7	0402	1uF	GRM1555C1H105JA01

Truth Table

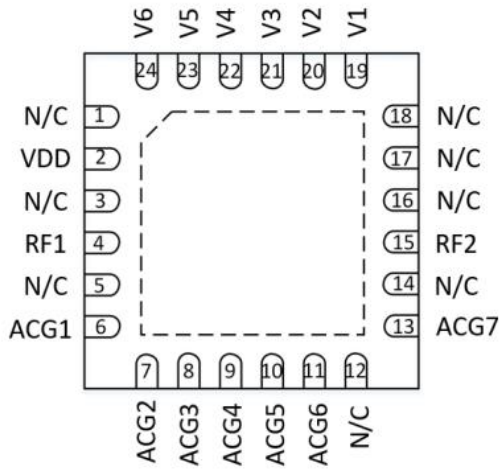
Control Voltage Input						Attenuation State
V1	V2	V3	V4	V5	V6	RF1/RF2
16dB	8dB	4dB	2dB	1dB	0.5dB	
High	High	High	High	High	High	Reference Insertion Loss
High	High	High	High	High	Low	0.5dB
High	High	High	High	Low	High	1dB
High	High	High	Low	High	High	2dB
High	High	Low	High	High	High	4dB
High	Low	High	High	High	High	8dB
Low	High	High	High	High	High	16dB
Low	Low	Low	Low	Low	Low	31.5dB

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

PCB Evaluation Board



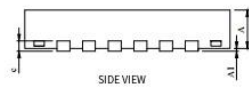
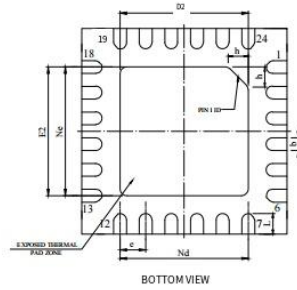
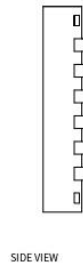
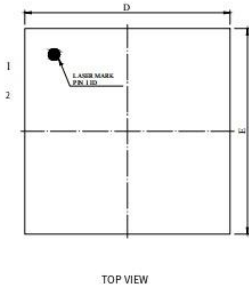
Pin Configuration and Description



Pin Number	Pin Name	Description
1,3,5,12, 14,16,17,18	N/C	No electrical connection. Provide grounded land pads for PCB mounting integrity.
2	VDD	Power supply pin.
4,15	RF1, RF2	Attenuator RF input/output pins. DC block is required.
6~11,13	ACG1~AC G7	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.
19~24	V1~V6	Parallel control voltage input pins. Select the required attenuation. See Truth Table.
-	EP	RF/DC ground. Use recommended via pattern to minimize inductance and thermal resistant; see PCB Mounting Pattern for suggested footprint.

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Package Dimensions (mm)



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	3.90	4.00	4.10
D2	2.60	2.70	2.80
e	0.50BSC		
Ne	2.50BSC		
Nd	2.50BSC		
E	3.90	4.00	4.10
E2	2.60	2.70	2.80
L	0.35	0.40	0.45
h	0.35	0.40	0.45



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