Product Features

Operating Frequency: 1MHz ~ 500MHz

Attenuation Range:

0.25dB LSB Steps to 31.75dB

Parallel Control Interface

TTL/CMOS-Compatible Control

+5V/+3.3V Supply Voltage

Package: QFN24

Application

Communication Base Stations

Test and Measurement Equipment

Shortwave Communications

VHF/UHF Stations

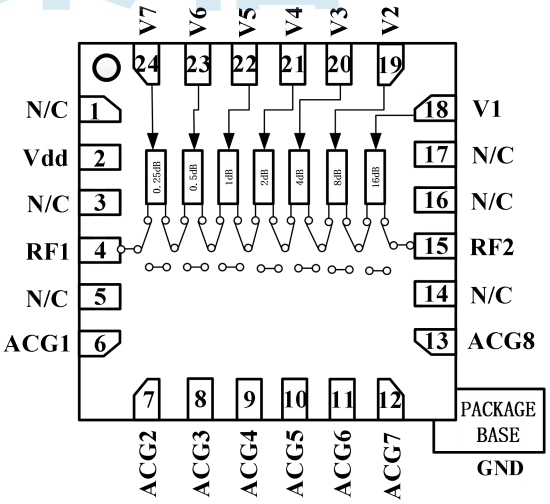
Ordering Information

Part Number	Package	Description
BR9158FP	QFN24	1MHz ~ 500MHz 7 Bit Parallel Digital Attenuator

General Description

The BR9158FP is a wideband 7-bit digital attenuator in a low-cost leadless surface-mount QFN24 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 a frequency band of 1MHz ~ 500MHz, the BR9158FP typically offers insertion loss of less than 0.6dB; and can be programmed to provide an attenuation range of 31.75dB in 0.25dB steps with maximum attenuation error of ± (0.1+4%* attenuation amount) dB. 7-bit TTL/CMOS control inputs are used to select each attenuation state. A single Vdd bias of +5V/+3.3V is required.

Functional Block Diagram



Electrical Specifications

Parameter	Test Conditions	Min.	Typ.	Max.	Units
Insertion Loss	1MHz to 500MHz	-0.28	-0.33	-0.54	dB
Attenuation Range	1MHz to 500MHz	0.25	-	31.75	dB
Input Return Loss	1MHz to 500MHz	-	-30.3	-	dB
Output Return Loss	1MHz to 500MHz	-	-29.4	-	dB
Attenuation Accuracy: (refer to Insertion Loss) 0.25dB ~ 16dB attenuation state 16.25dB to 31.75dB attenuation state 16.25dB ~ 31.75dB attenuation state	1MHz to 500MHz 1MHz to 200MHz 200MHz to 500MHz	+ / - 0.25 + / - 0.3 + / - 0.4			dB
Input Power for 0.1dB Compression	1MHz to 500MHz	19.4	27	28	dBm
Input Third-Order Interception	1MHz to 50MHz 60MHz to 500MHz	38 43	- -	- -	dBm dBm
Switching Characteristics Trise (50% CTL-90% RF) Tfall (50% CTL-10% RF)	200MHz at 16dB Attenuation State	- -	390 240	- -	 ns ns
Test Conditions: Vdd=+5V, I=3mA, IIP3 spacing=20KHz (within 50MHz), IIP3 spacing=1MHz, Pin=0dBm/tone, Temp. =+25°C					

Absolute Maximum Ratings

Maximum Operating Voltage (Vdd): +7V;

Maximum RF Input Power: +27dBm;

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 Threshold:

0 ~ 0.8V (low level);

2.7V ~ Vdd (high level);

Storage Temperature: -65℃ ~ +150℃;

Operating Temperature: -55℃ ~ +125℃;

Operating Current: 3mA;

Note: when Vdd=5V, Vctl=0V/3.3V can also work normally; But when Vdd=3.3V, Vctl=0V/5V will not work properly.

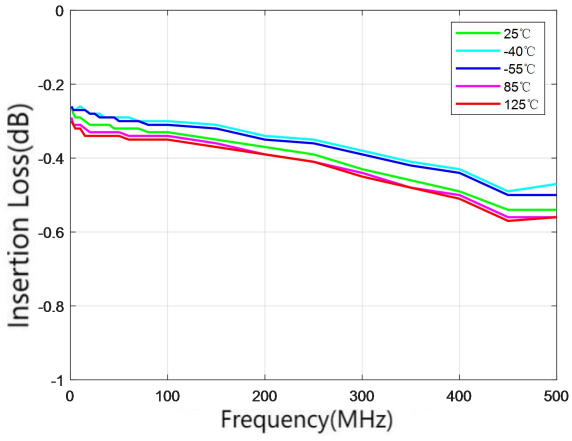
ESD WARNING

ELECTROSTATIC SENSITIVE DEVICE

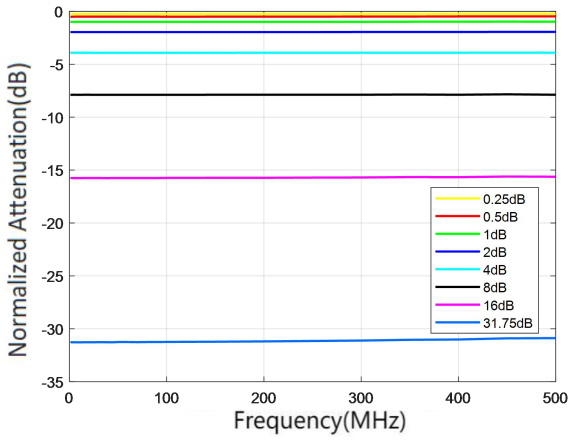
OBSERVE HANDLING PRECAUTIONS

Typical Performance (EVB test results)

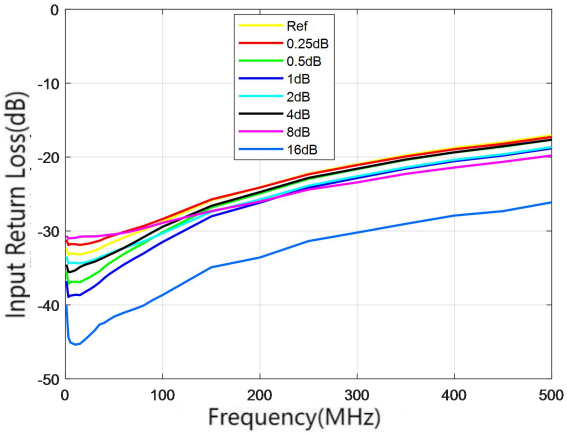
Parameter	Typ.							Units
Frequency	1	10	30	60	100	300	500	MHz
Reference Loss	-0.28	-0.29	-0.31	-0.32	-0.33	-0.43	-0.54	dB
Attenuation Accuracy (0.25dB)	0.01	0.00	0.00	0.00	0.01	0.01	0.02	dB
Attenuation Accuracy (0.5dB)	0.01	0.00	0.00	0.00	0.00	0.01	0.01	dB
Attenuation Accuracy (1dB)	0.02	0.01	0.01	0.01	0.01	0.02	0.02	dB
Attenuation Accuracy (2dB)	0.05	0.04	0.04	0.04	0.04	0.05	0.06	dB
Attenuation Accuracy (4dB)	0.09	0.09	0.08	0.09	0.09	0.09	0.09	dB
Attenuation Accuracy (8dB)	0.13	0.12	0.12	0.12	0.12	0.12	0.11	dB
Attenuation Accuracy (16dB)	0.27	0.25	0.25	0.26	0.26	0.31	0.38	dB
Attenuation Accuracy (31.75dB)	0.52	0.48	0.50	0.51	0.52	0.66	0.91	dB
Input Return Loss	-34.12	-34.93	-34.20	-32.52	-30.30	-22.76	-18.82	dB
Output Return Loss	-31.62	-32.22	-31.91	-30.81	-29.36	-23.57	-20.01	dB
Input Power for 0.1dB Compression	19.47	23.90	26.32	27.50	27.69	27.37	27.98	dBm
Input Third-Order Interception	38.6	46.3	45.3	44	43	45.8	43.5	dBm
Switching Time	390ns rise switch				240ns down switch			
Test Conditions: Vdd=+5V, I=3mA, IIP3 spacing=20KHz (within 50MHz), IIP3 spacing=1MHz, Pin=0dBm/tone, Temp=+25℃								



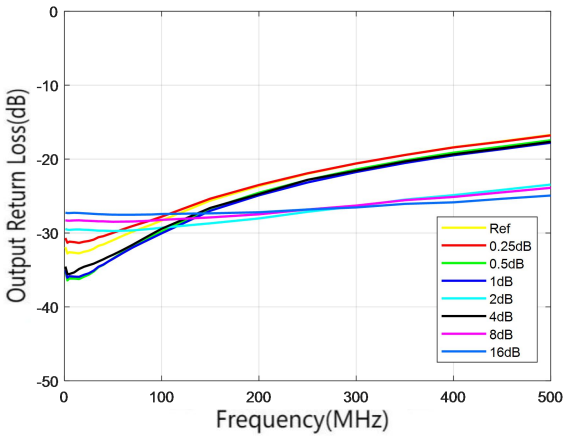
Insertion Loss



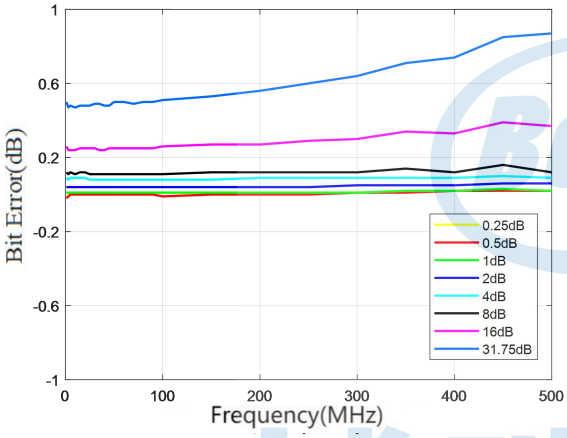
Normalized Attenuation



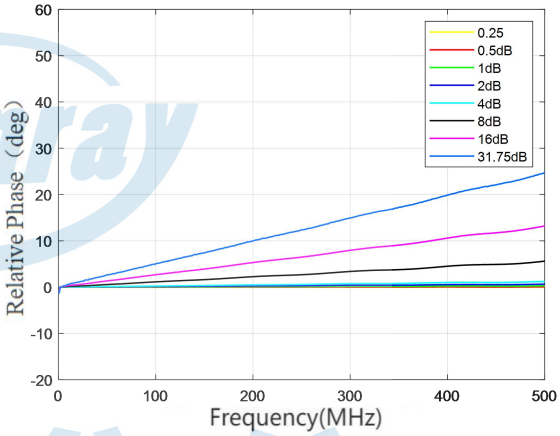
Input Return Loss



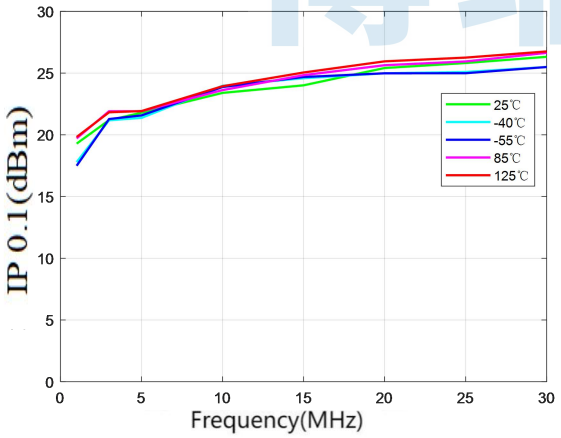
Output Return Loss



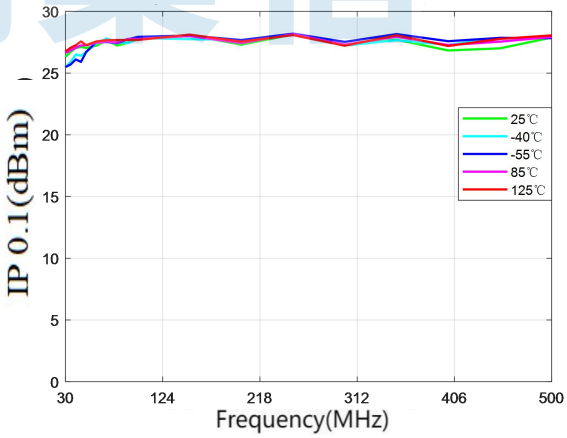
Bit Error



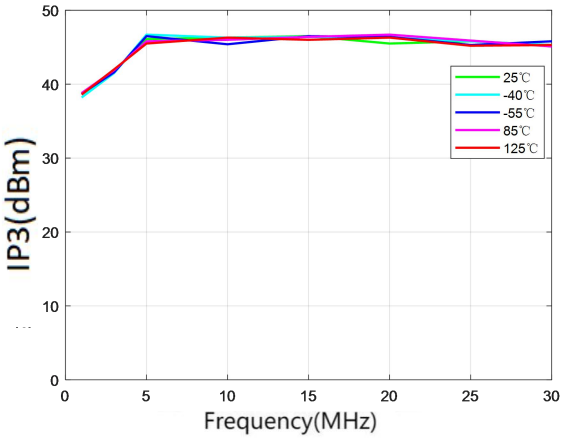
Relative Phase



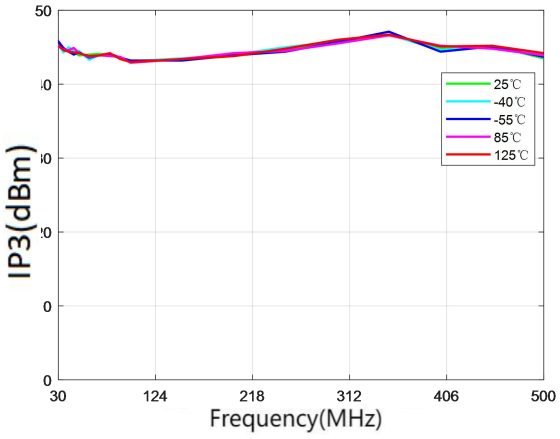
Input Power for 0.1dB Compression



Input Power for 0.1dB Compression

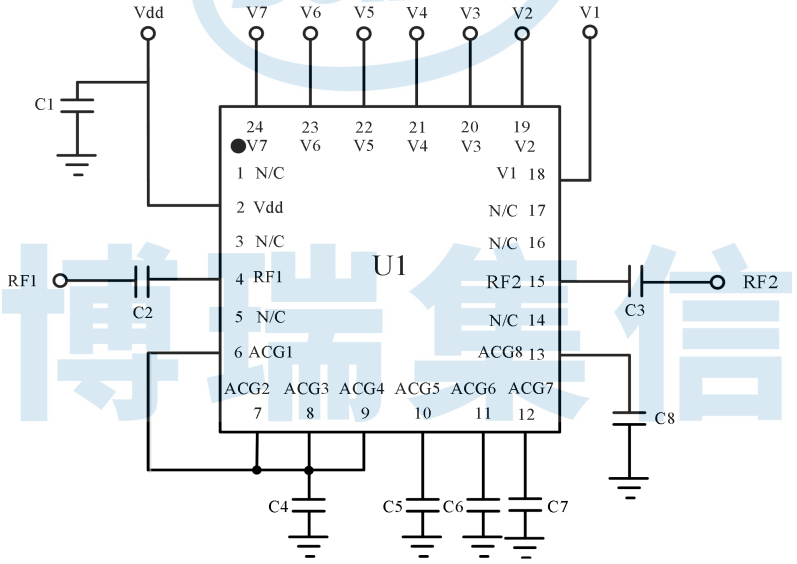


Input Third-Order Interception



Input Third-Order Interception

Typical Application Schematic



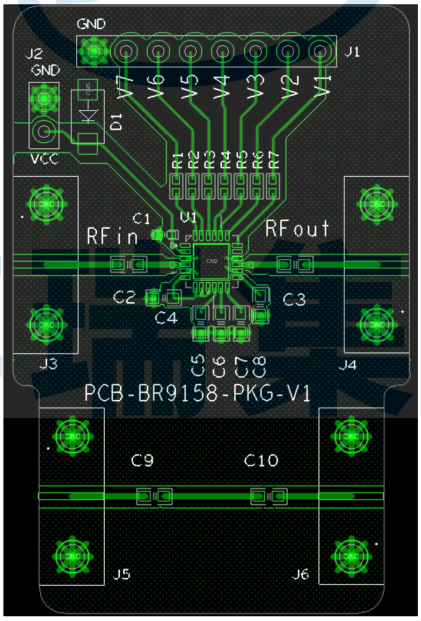
Bill of Material

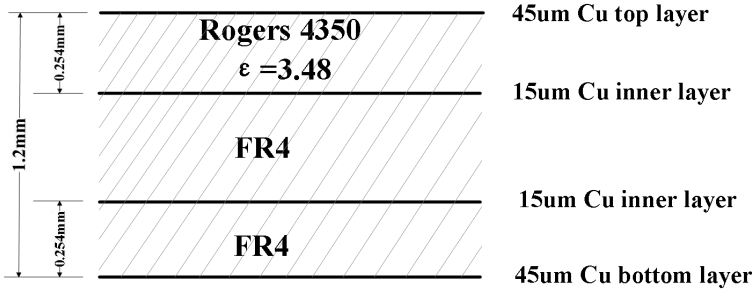
Reference Designator	Package	Description	P/N
C1	0402	1nF	GRM1555C1H102JA01D
C2, C3	0603	3.3uF	GCJ188C70J335KE02D
C4 ~ C8	0603	1uF	GCM188R71C105KA64D

Control Voltage Truth Table

Control Voltage Input							Attenuation State RF1/RF2
V1 16dB	V2 8dB	V3 4dB	V4 2dB	V5 1dB	V6 0.5 dB	V7 0.25 dB	
1	1	1	1	1	1	1	Insertion loss in reference state
1	1	1	1	1	1	0	0.25 dB
1	1	1	1	1	0	1	0.5 dB
1	1	1	1	0	1	1	1 dB
1	1	1	0	1	1	1	2 dB
1	1	0	1	1	1	1	4 dB
1	0	1	1	1	1	1	8 dB
0	1	1	1	1	1	1	16 dB
0	0	0	0	0	0	0	31.75 dB
Note: Any combination of the above states will provide an attenuation approximately equal to the sum of the bits selected.							

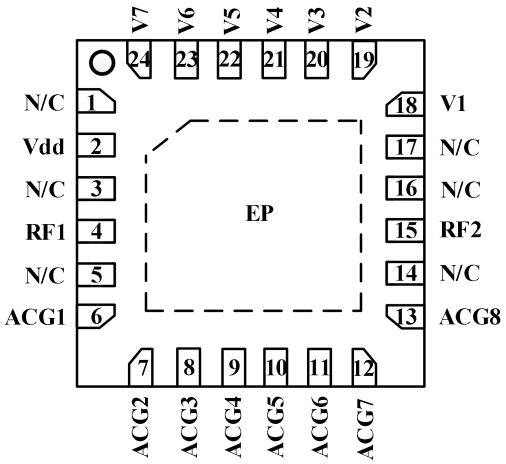
PCB Evaluation Board





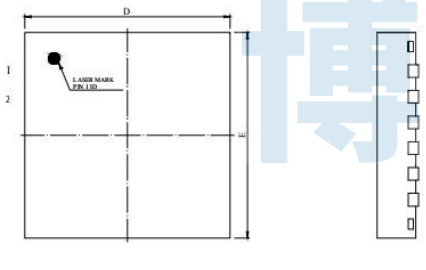
50ohm transmission line:
width=0.52mm,spacing=0.52mm

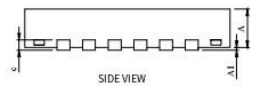
Pin Configuration and Description



Pin Number	Pin Name	Description
1,3,5, 14,16,17	N/C	No electrical connection. These pins should be connected to ground
2	Vdd	Supply power supply pin.
4, 15	RF1, RF2	Attenuator RF input/output pins. DC block is required.
6 ~ 13	ACG1 ~ ACG8	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.
18 to 24	V1 ~ V7	Parallel control voltage input pins. Select the required attenuation. See Truth Table.
-	EP	Exposed pin. The exposed pad must be connected to RF/DC ground.

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