USB / RS232 / SPI

Programmable Attenuator RUDAT-13G-90

50Ω 0 – 90 dB, 0.5 dB step 10 to 13000 MHz

Installation CD

Case Style: QF2252

The Big Deal

- High Frequency, 13 GHz
- Wide attenuation range, 90 dB
- Fine attenuation resolution, 0.5 dB
- Compact size, 2.0 x 3.0 x 0.6”
- **USB, RS232** *and* **SPI** control

Product Overview

Mini-Circuits’ RUDAT-13G-90 is a general purpose programmable RF attenuator supporting frequencies from 10 to 13000 MHz with attenuation from 0 to 90 dB in 0.5 dB steps. Its unique design maintains linear attenuation change per dB, even at the highest attenuation and frequency settings. The attenuator is controlled via USB, RS232 or SPI. It comes housed in a compact, shielded metal case with SMA(F) input/output RF ports (RF ports are interchangeable), a USB type Mini-B socket, and a 9-pin D-sub(F) RS232 and SPI port. Power can be supplied via either USB or the D-sub port.

The RUDAT-13G-90 is supplied with our easy-to-install, user-friendly GUI software, API objects for Windows® environments, and complete programming instructions for 32 and 64 bit Windows® and Linux® operating systems. See p. 9 for a complete list of included accessories.

Key Features

Feature	Advantages
USB control	The RUDAT-13G-90 can be controlled from any Windows® or Linux® computer with a USB connection. The device draws all power requirements through the USB port.
RS232 and SPI control	The user may also control the RUDAT-13G-90 via RS232 or SPI connection, allowing serial synchronous or a-synchronous communication with the device.
Programmable attenuation sweep and Hop sequences	The RUDAT-13G-90 can be programmed with a timed sequence of attenuation settings, to run without any additional external control
Plug-and-Play – no additional device drivers required.	Fast and easy setup and installation. The RUDAT-13G-90 interfaces with various third-party software, making it easy to integrate into existing setups.
90 dB attenuation range.	The RUDAT-13G-90 provides high-accuracy attenuation up to 90 dB in 0.5 dB steps, allowing the user precise level control over a broad attenuation range.
High linearity	Typical input IP3 of +41 dBm up to 13000 MHz

USB / RS232 / SPI

Programmable Attenuator

RUDAT-13G-90

50Ω 0 – 90 dB, 0.5 dB step 10 to 13000 MHz

Features

- USB, RS232 and SPI control
- Very good attenuation accuracy, ±0.6 dB typ.
- Short attenuation transition time (900 ns)
- Excellent RF shielding
- Interchangeable Input/Output ports
- Plug & Play device – no drivers required
- Supports a wide range of programming environments (See application note **AN-49-001** for details)

Installation CD

Case Style: QF2252

Included Accessories

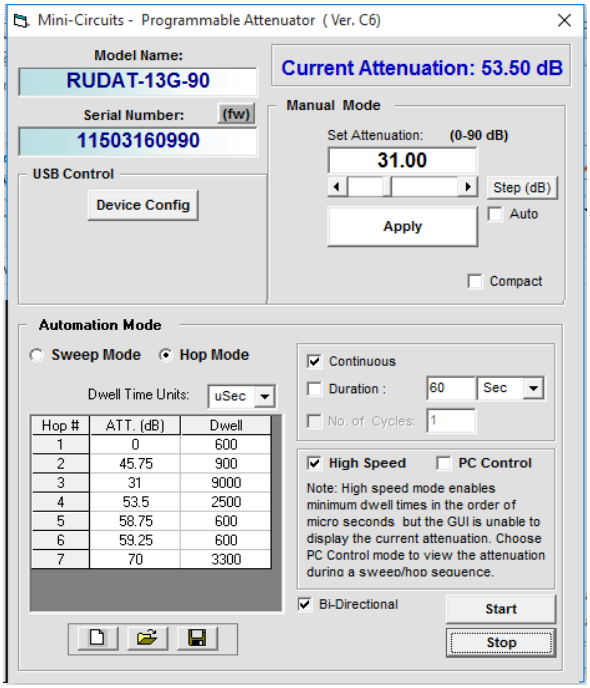
Model No.	Description	Qty.
MUSB-CBL-3+	2.6 ft. USB cable	1
PC-DAT-CD	Software Installation CD	1

Applications

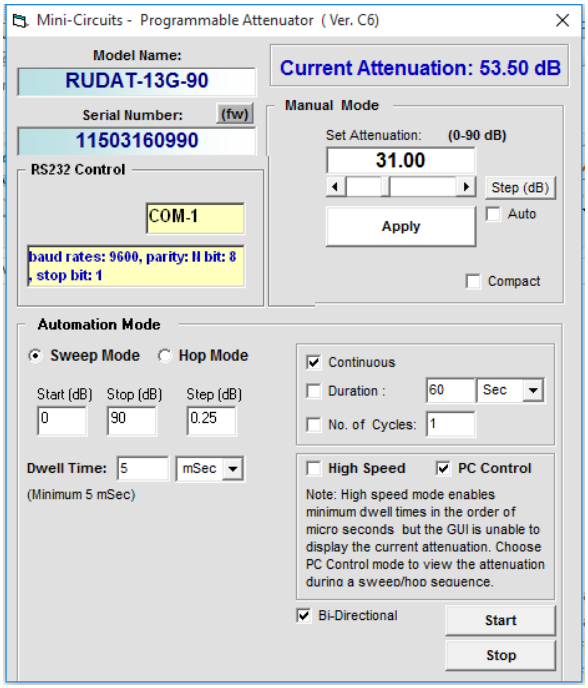
- Automated production test equipment (ATE)
- Laboratory instrumentation
- Transmission loss / fading simulation (eg: Bluetooth / WI-FI / DVB / V-SAT / microwave backhaul)
- Cellular handover testing (eg: GSM / UMTS / CDMA / LTE / 5G)
- Receiver sensitivity testing (eg: GPS)
- C-Band / X-Band radar testing

RoHS Compliant
See our web site for RoHS Compliance methodologies and qualifications

Mini-Circuits Graphical User Interface for RUDAT-Series Programmable Attenuator



RUDAT GUI screen (USB control, Hop mode)



RUDAT GUI screen (RS232 control, Sweep mode)

For programming instructions, see **programming guide** on Mini-Circuits' website.

Electrical Specifications [1] at 0°C to 50°C

Parameter	Frequency range	Conditions	Min.	Typ.	Max.	Units
Attenuation range	10 - 13000 MHz	0.5 dB step	0	–	90	dB
Attenuation accuracy [2]	10 - 500 MHz	@ 0.5 - 3.5 dB	–	±0.90	±(15% of nominal value+0.9)	dB
		@ 4 - 45 dB	–	±1.30	±(2% of nominal value+1.5)	
		@ 45.5 - 90 dB	–	±0.90	±(4.5% of nominal value+0.3)	
	500 - 5000 MHz	@ 0.5 - 3.5 dB	–	±0.35	±(10% of nominal value+0.9)	
		@ 4 - 45 dB	–	±0.60	±(2% of nominal value+1.3)	
		@ 45.5 - 90 dB	–	±1.55	±(4% of nominal value+1.4)	
	5000 - 11000 MHz	@ 0.5 - 3.5 dB	–	±0.35	±(10% of nominal value+1.0)	
		@ 4 - 45 dB	–	±0.65	±(2% of nominal value+1.3)	
		@ 45.5 - 90 dB	–	±1.10	±(3.5% of nominal value+0.7)	
	11000 - 13000 MHz	@ 0.5 - 3.5 dB	–	±0.35	±(10% of nominal value+1.0)	
		@ 4 - 45 dB	–	±0.90	±(4.5% of nominal value+1.3)	
		@ 45.5 - 90 dB	–	±0.80	±(4% of nominal value+1.0)	
Insertion Loss	10 - 500 MHz	@ 0 dB	–	7.0	8.0	dB
	500 - 5000 MHz		–	9.5	12.0	
	5000 - 11000 MHz		–	12.5	15.5	
	11000 - 13000 MHz		–	14.5	17.5	
Input operating power [3] (RF In and RF Out ports)	10 - 400 MHz	@ 0 - 90 dB	–	–	Note 4	dBm
	400 - 13000 MHz		–	–	+23	
Isolation In-Out	10 - 13000 MHz	Note 5	–	100	–	dB
IP3 Input [6]	100 - 13000 MHz	@ 0 dB setting (P_{IN}=+5 dBm)	–	+41	–	dBm
VSWR	10 - 500 MHz	@ 0 - 3.5 dB	–	2.00	–	:1
		@ 4 - 45 dB		1.45	2.20	
		@ 45.5 - 90 dB	–	1.30	1.75	
	500 - 11000 MHz	@ 0 - 3.5 dB	–	1.50	–	
		@ 4 - 45 dB		1.35	2.00	
		@ 45.5 - 90 dB	–	1.35	1.85	
	11000 - 13000 MHz	@ 0 - 90 dB	–	1.35	2.00	
Min Dwell Time [7]	10 - 13000 MHz	High speed mode	–	600	–	µsec
Attenuation Transition Time [8]	10 - 13000 MHz	–	–	900	–	nsec
Supply Voltage (via USB or D-Sub)	–	–	4.75	5	5.25	V
DC current draw (via USB or D-Sub)	–	@ 0 dB	–	190	230	mA
	–	@ 90 dB		105	130	
RS232 logic levels	Meets RS232 standard at all voltages with RS232 communications set to 9600 bps; 8 bit word; no parity; stop bit = '1'.					

[1] Attenuator RF ports are interchangeable, and support simultaneous, bidirectional signal transmission, however the specifications are guaranteed for the RF in and RF out as noted on the label. There may be minor changes in performance when injecting signals to the RF Out port.
[2] Max accuracy defined as ±[absolute error+% of attenuation setting] for example when setting the attenuator to 80 dB attenuation the maximum error at 12000 MHz will be: ±(0.04x80+1)= ±(3.2+1)= ± 4.2 dB
[3] Total operating input power from both RF In and RF Out ports. Compression level not noted as it exceeds max safe operating power level.
[4] Derate linearly from +23 dBm at 400 MHz to +10 dBm at 10 MHz.
[5] Isolation is defined as max attenuation plus insertion loss; this is the path loss through the attenuator when initially powered up. After a brief delay (~0.5 sec typically) the attenuator will revert to a user defined "power-up" state (either max attenuation or a pre-set value).
[6] Tested with 1 MHz span between signals. IP3 degrades below 100 MHz.
[7] Minimum Dwell Time is the time the RUDAT will take to respond to a command to change attenuation states.
[8] Attenuation Transition Time is specified as the time between starting to change the attenuation state and settling on the requested attenuation state..

Absolute Maximum Ratings

Operating Temperature		-40°C to 85°C
Storage Temperature		-55°C to 100°C
Voltage input at D-Sub Pin#6-9		0V to +3.6V
Voltage input at D-Sub Pin#3		-30V to +30V
Voltage input at D-Sub Pin#2		0V to +4V
Voltage input at D-Sub Pin#1		-1V to +6V
V_{USB} Max.		6V
Total RF power for RF In & RF Out	@ 10 - 400 MHz	Derates linearly from +25 @ 400 MHz to +13 @ 10 MHz
	@ 400 - 13000 MHz	+25 dBm

Permanent damage may occur if any of these limits are exceeded. Operating in the range between operating power limits and absolute maximum ratings for extended periods of time may result in reduced life and reliability.

Minimum System Requirements

Interface	USB HID or RS232 protocols
Host operating system - USB Control	**Windows 32/64 Bit operating system:** Windows 98®, Windows XP®, Windows Vista®, Windows 7®, Windows 8.®, Windows 10.® **Linux® support:** 32/64 Bit operating system
Host operating system - RS232 Control	Any computer with a serial port and RS232 support
Hardware	Pentium® II or better

Connections

RF IN	(SMA female)
RF OUT	(SMA female)
USB	(USB type Mini-B female)
RS232 & SPI*	(9 Pin D-Sub female)

*9 Pin D-Sub Pin Connections

PIN Number	Function
1	+5 V_{DC} [9]
2	RS232 Transmit
3	RS232 Receive
4	Not Connected
5	GND
6	Factory Use
7	SPI LE
8	SPI Clock
9	SPI Data In

[9] Pin#1 can be used as supply voltage (+) pin instead of USB connection. When USB power is connected, Pin#1 may be connected to GND or supply voltage (+) or remain disconnected.

SPI communication parameters

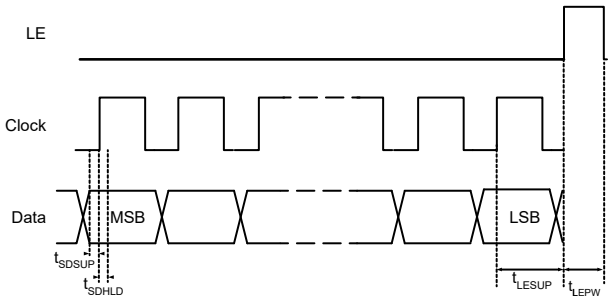
Parameter	Conditions		Min.	Typ.	Max.	Units
Voltage levels	Logic High Voltage	Input	2.1	–	3.3	V
	Logic Low Voltage	Input	0	–	0.8	
Control Current	Per pin		–	–	1	mA
Clock Frequency	–		–	–	10	MHz

The SPI control used a 8-bit serial in, parallel-out shift register buffered by a transparent latch with Data, Clock, and Latch Enable (LE) voltages compatible with LVTTL. The Data and Clock inputs allow data to be serially entered into the shift register, a process that is independent of the state of the LE input.

The LE input controls the latch. When LE is HIGH, the latch is transparent and the contents of the serial shift register control the switch. When LE is brought LOW, data in the shift register is latched.

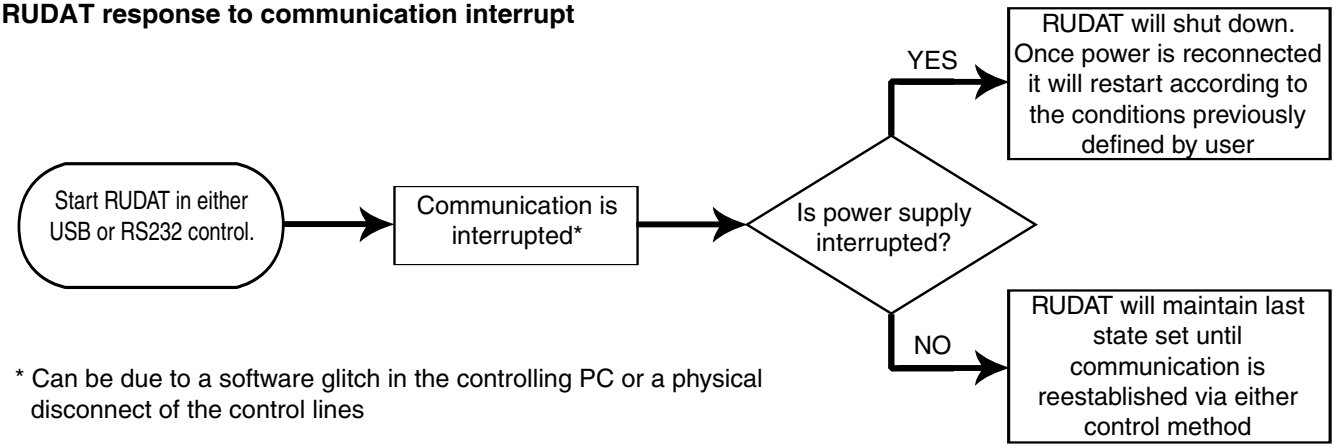
The shift register should be loaded while LE is held LOW to prevent the attenuation state from changing as data is entered. The LE input should then be toggled HIGH and brought LOW again, latching the new data. The timing for this operation is defined by the SPI Timing Diagram and SPI Interface AC Characteristics below.

SPI timing diagram



SPI Interface AC Characteristics				
Symbol	Parameter	Min.	Max.	Units
f_{clk}	Serial data clock frequency		20	MHz
t_{clkH}	Serial clock HIGH time	5		ns
t_{clkL}	Serial clock LOW time	5		ns
t_{LESUP}	LE set-up time after last clock falling edge	30		ns
t_{LEPW}	LE minimum pulse width	20		ns
t_{SDSUP}	Serial data set-up time before clock rising edge	5		ns
t_{SDHLD}	Serial data hold time after clock falling edge	5		ns

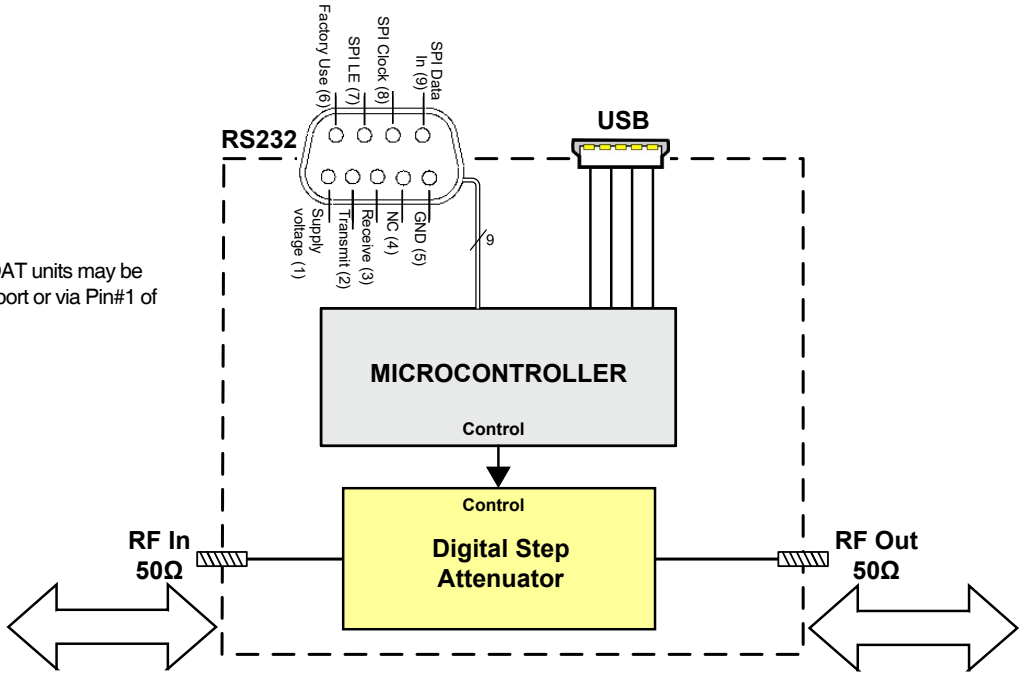
RUDAT response to communication interrupt



* Can be due to a software glitch in the controlling PC or a physical disconnect of the control lines

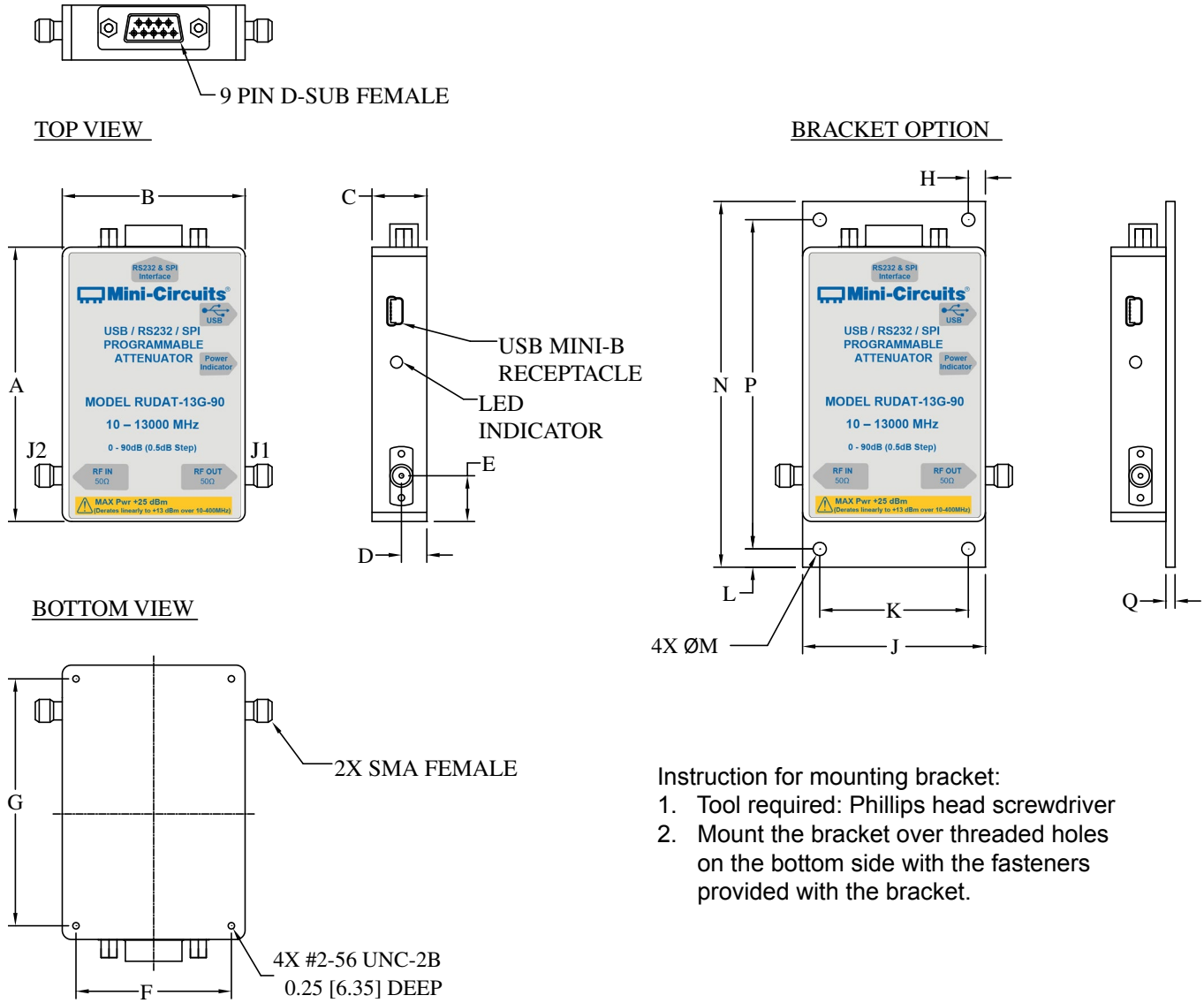
Block Diagram

The $5V_{DC}$ for RUDAT units may be input via the USB port or via Pin#1 of the D-Sub port.



Simultaneous, bidirectional RF signal transmission with symmetrical performance

Outline Drawing (QF2252)



Instruction for mounting bracket:

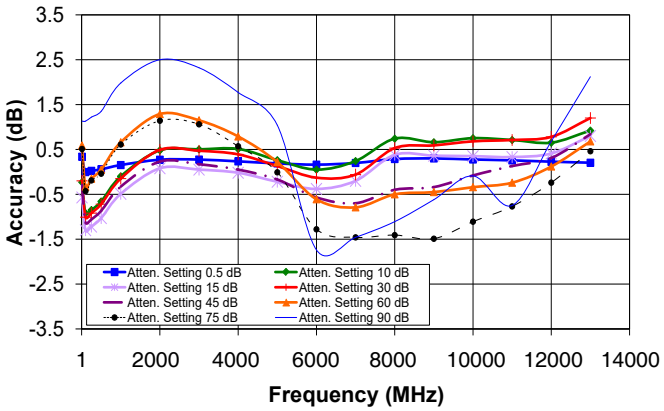
1. Tool required: Phillips head screwdriver
2. Mount the bracket over threaded holes on the bottom side with the fasteners provided with the bracket.

Outline Dimensions (inch / mm)

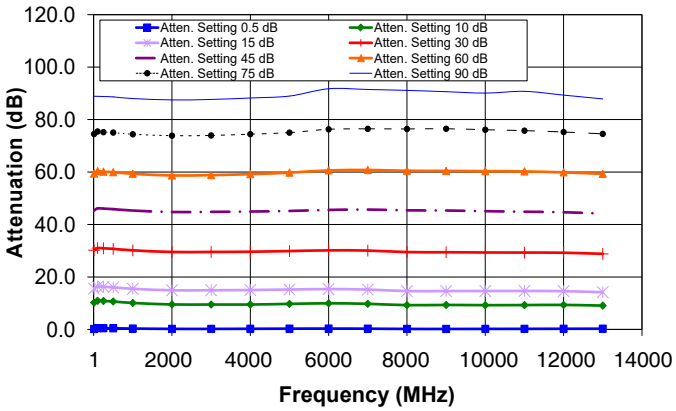
A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	WT. GRAMS
3.00	**2.00**	**0.60**	**0.28**	**0.50**	**1.700**	**2.700**	**0.188**	**2.00**	**1.625**	**0.200**	**0.144**	**4.00**	**3.600**	**0.100**	130
76.2	50.8	15.2	7.1	12.7	43.18	68.58	4.76	50.8	41.28	5.08	3.66	101.6	91.44	2.54	

Typical Performance Curves

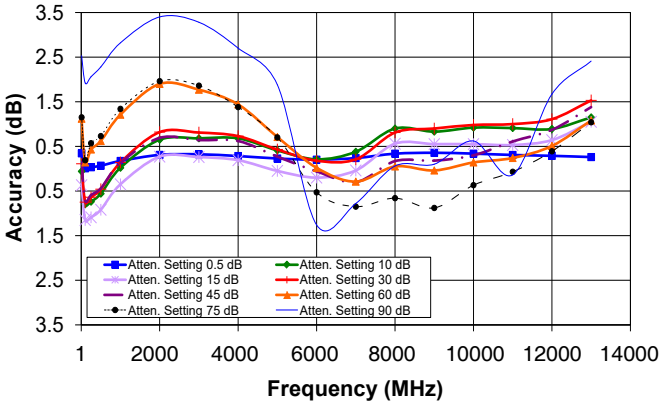
Attenuation Accuracy @ +25°C vs. Frequency over Attenuation settings



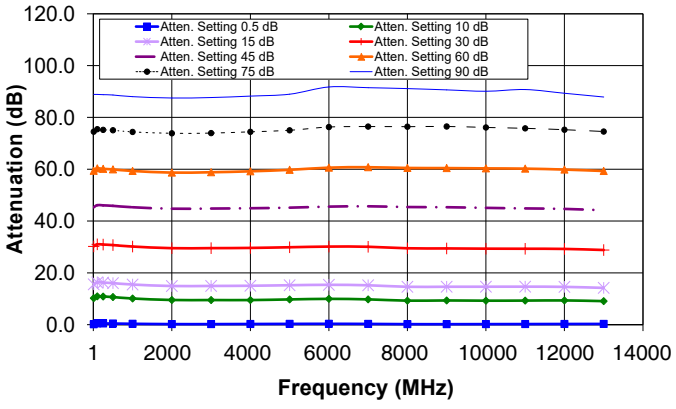
Attenuation relative to Insertion Loss @ +25°C vs. Frequency over Attenuation settings



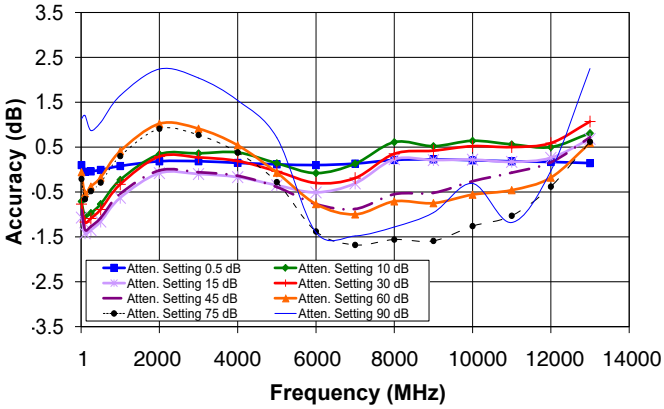
Attenuation Accuracy @ 0°C vs. Frequency over Attenuation settings



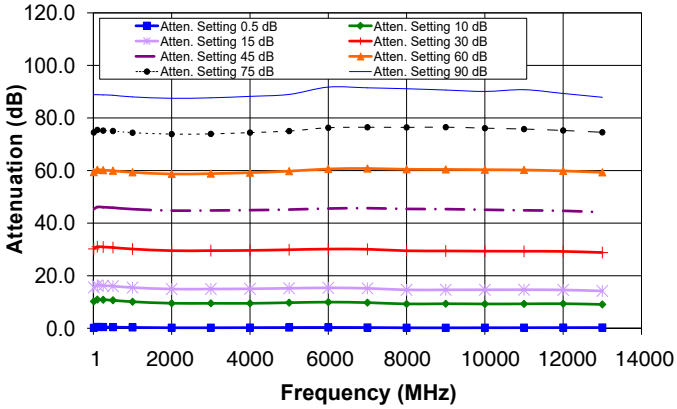
Attenuation relative to Insertion Loss @ 0°C vs. Frequency over Attenuation settings



Attenuation Accuracy @ +50°C vs. Frequency over Attenuation settings

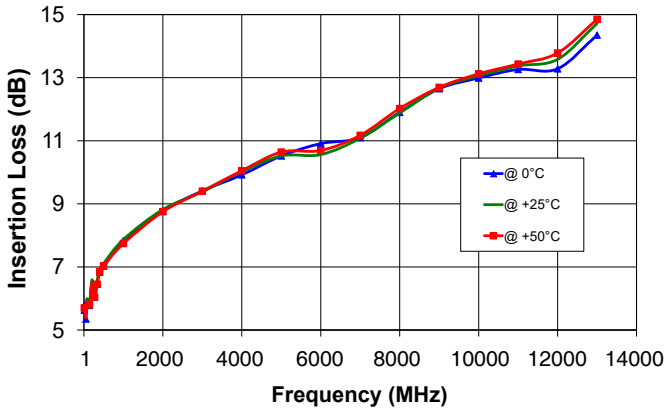


Attenuation relative to Insertion Loss @ +50°C vs. Frequency over Attenuation settings

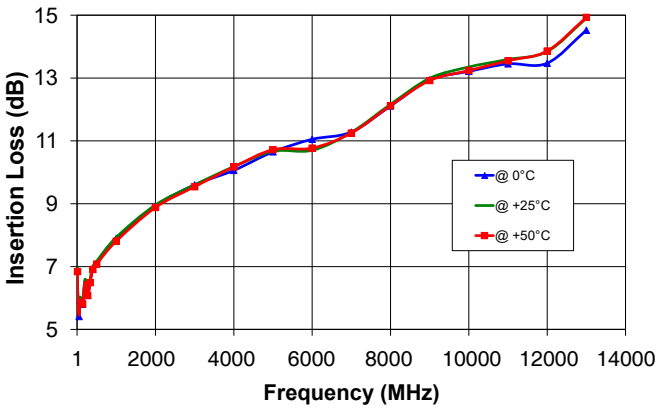


Typical Performance Curves (Continued)

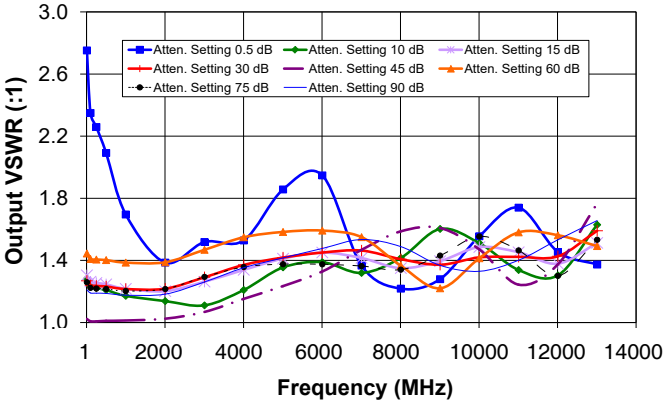
Insertion Loss @ Input Power 0dBm vs. Frequency over Temperatures



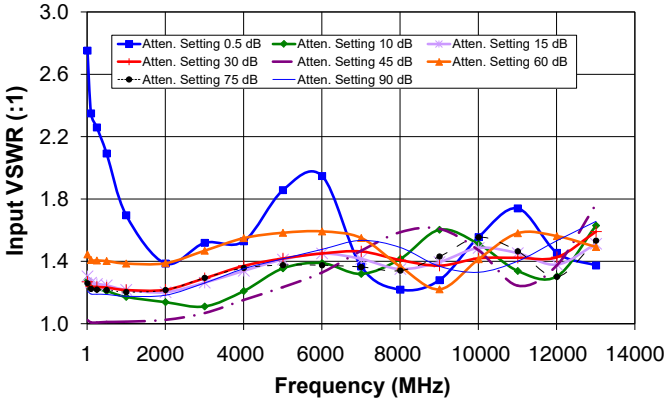
Insertion Loss @ Input Power +23 dBm vs. Frequency over Temperatures



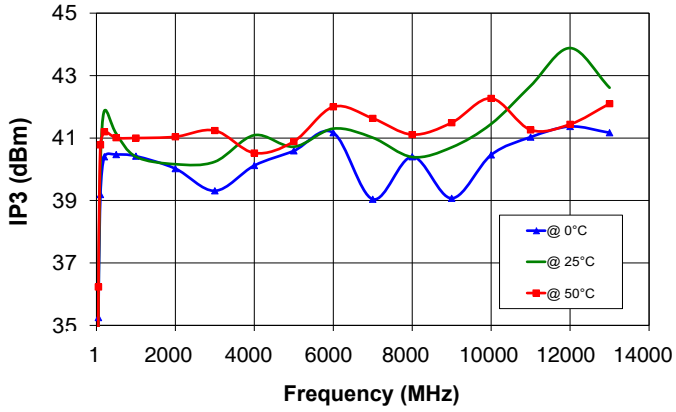
Ouput VSWR @ +25°C vs. Frequency over Attenuation settings



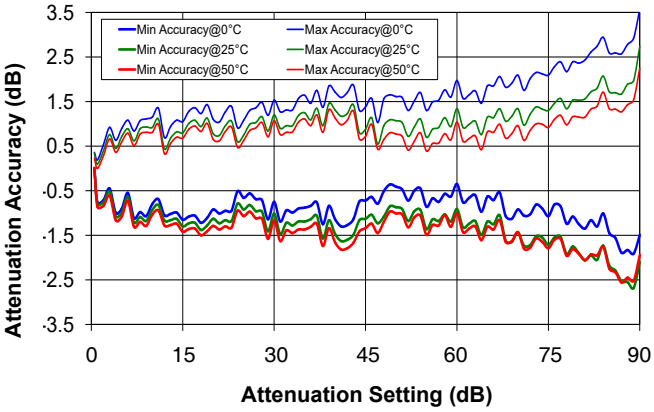
Input VSWR @ +25°C vs. Frequency over Attenuation settings



Input IP3 @ 0dB Attenuation vs. Frequency over Temperatures

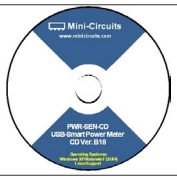


Typical Attenuation Accuracy vs. Attenuation settings over Temperature



Ordering Information

Model	Description
RUDAT-13G-90	USB/RS232 Programmable Attenuator

Included Accessories	Part No.	Description
	PC-DAT-CD	Software CD
	MUSB-CBL-3+	2.6 ft (0.8 m) USB Cable: USB type A(Male) to USB type Mini-B(Male)

Optional Accessories	Description
MUSB-CBL-3+ (spare)	2.6 ft (0.8 m) USB Cable: USB type A(Male) to USB type Mini-B(Male)
MUSB-CBL-7+	6.6 ft (2.0 m) USB Cable: USB type A(Male) to USB type Mini-B(Male)
D-SUB9-MF-6+	6 ft RS232 Cable: 9 pin D-sub(Male) to 9 pin D-sub(Female)
USB-AC/DC-5 [10,11]	AC/DC 5V_{DC} Power Adapter with US, EU, IL, UK, AUS, and China power plugs
BKT-3901+	Bracket kit including 3.75” x 2.00” bracket, mounting screws and washers

[10] The USB-AC/DC-5 may be used to provide the 5V_{DC} power input via USB port if operating the RUDAT with RS232, and power via D-Sub is not available. Not required if using USB control.

[11] Power plugs for other countries are also available, if you need a power plug for a country not listed in the table please contact apps@minicircuits.com or check http://www.minicircuits.com/contact/offices.html for regional offices e-mail and phone numbers.

Additional Notes

A. Performance and quality attributes and conditions not expressly stated in this specification document are intended to be excluded and do not form a part of this specification document.

B. Electrical specifications and performance data contained in this specification document are based on Mini-Circuit’s applicable established test performance criteria and measurement instructions.

C. The parts covered by this specification document are subject to Mini-Circuits standard limited warranty and terms and conditions (collectively, “Standard Terms”); Purchasers of this part are entitled to the rights and benefits contained therein. For a full statement of the Standard Terms and the exclusive rights and remedies thereunder, please visit Mini-Circuits’ website at www.minicircuits.com/MCLStore/terms.jsp