

Programmable Attenuator

RUDAT-6000-110

50Ω 0 – 110 dB, 0.25 dB step 1 to 6000 MHz

The Big Deal

- Wide attenuation range, 110 dB
- Fine attenuation resolution, 0.25 dB
- High speed attenuation switching (650 ns)
- Compact size, 2.0 x 3.0 x 0.6"
- **USB and RS232** control



Case Style: MS1813



Installation CD



Product Overview

Mini-Circuits' RUDAT-6000-110 is a general purpose programmable RF attenuator supporting frequencies from 1 to 6000 MHz with attenuation from 0 to 110 dB in 0.25 dB steps. Its unique design maintains linear attenuation change per dB, even at the highest attenuation settings. The attenuator is controlled via USB or RS232 ports. It comes housed in a rugged, shielded metal case with input/output SMA(F) RF ports (input/output ports are interchangeable), a USB type Mini-B socket, and a 9-pin D-sub(F) RS232 port. Power can be supplied via either USB or the D-sub port.

The RUDAT-6000-110 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. 8 for a complete list of included accessories.

Key Features

Feature	Advantages
USB control	The RUDAT-6000-110 can be controlled from any Windows® or Linux® computer with a USB connection. The device draws all power requirements through the USB port.
RS232 control	The user may also control the RUDAT-6000-110 via RS232 connection, allowing serial communication with the device.
Programmable attenuation sweep and Hop sequences	The RUDAT-6000-110 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-6000-110 interfaces with various third-party software, making it easy to integrate into existing setups.
110 dB attenuation range.	The RUDAT-6000-110 provides high-accuracy attenuation up to 110 dB in 0.25 dB steps, allowing the user precise level control over a broad attenuation and frequency range.
High linearity	Typical input IP3 of +53 dBm up to 6000 MHz

Trademarks: Windows is a registered trademark of Microsoft Corporation in the United States and other countries. Linux is a registered trademark of Linus Torvalds. Pentium is a registered trademark of Intel Corporation. Neither Mini-Circuits nor the Mini-Circuits RUDAT-series attenuators are affiliated with or endorsed by the owners of the above referenced trademarks

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Programmable Attenuator

RUDAT-6000-110

50Ω 0 – 110 dB, 0.25 dB step 1 to 6000 MHz

Features

- USB and RS232 control
- Very good attenuation accuracy, ± 0.45 dB typ.
- High speed attenuation switching (650 ns)
- Sweep and Hop attenuation sequences
- Extremely low leakage
- Interchangeable Input/Output ports
- Plug & Play device – no drivers required
- User-friendly Windows® Graphical User Interface
- Supports a wide range of programming environments (See application note [AN-49-001](#) for details)
- Optional mounting bracket, see page 5



Installation CD

Case Style: MS1813

Included Accessories

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

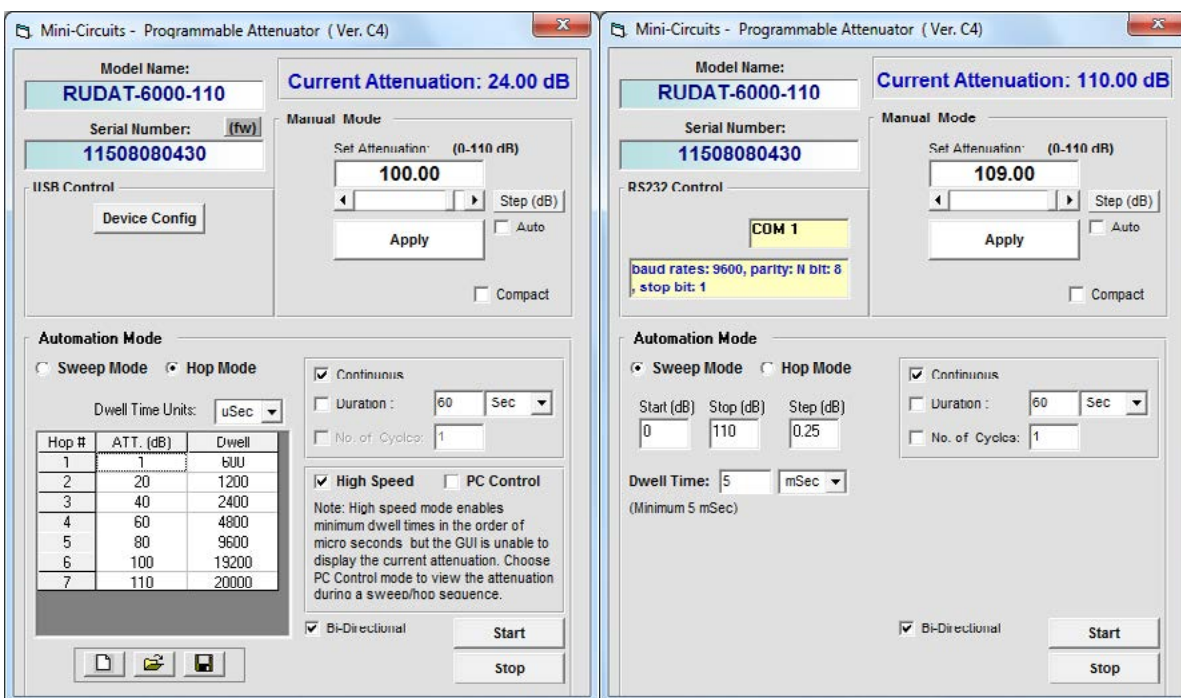
Applications

- Automated Test Equipment (ATE)
- WiMAX, 3G, 4G, LTE, DVB Fading Simulators
- Laboratory Instrumentation
- Production Test
- Handover system Evaluation
- Power level cycling

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	1 - 6000 MHz	0.25 dB step	0	–	110	dB
Attenuation accuracy ²	1 - 2000 MHz	@ 0.25 - 10 dB	–	±0.15	±(0.25+8% of nominal value)	dB
		@ 10.25 - 40 dB	–	±0.55	±(0.4+5% of nominal value)	
		@ 40.25 - 90 dB	–	±0.50	±(0.8+2% of nominal value)	
		@ 90.25 - 110 dB	–	±0.70	±(-1.3+4% of nominal value)	
	2000 - 4000 MHz	@ 0.25 - 10 dB	–	±0.15	±(0.2+6% of nominal value)	
		@ 10.25 - 40 dB	–	±0.50	±(0.8+3% of nominal value)	
		@ 40.25 - 90 dB	–	±0.25	±(1.1+1% of nominal value)	
		@ 90.25 - 110 dB	–	±0.35	±(-1.2+3.5% of nominal value)	
	4000 - 6000 MHz	@ 0.25 - 10 dB	–	±0.10	±(0.2+6% of nominal value)	
		@ 10.25 - 40 dB	–	±0.40	±(0.55+5% of nominal value)	
		@ 40.25 - 90 dB	–	±0.60	±(1.7+1% of nominal value)	
		@ 90.25 - 110 dB	–	±0.80	±(-1.1+4% of nominal value)	
Insertion Loss	1 - 2000 MHz	@ 0 dB	–	6.5	8.5	dB
	2000 - 4000 MHz		–	9.0	10.5	
	4000 - 6000 MHz		–	9.5	11.5	
Isolation In-Out	1 - 6000 MHz	Note 3	–	124	–	dB
Input operating power ⁴ (RF In and RF Out out ports)	1 - 10 MHz	@ 0 - 110 dB	–	–	+10	dBm
	10 - 6000 MHz		–	–	+20	
IP3 Input ⁵	1 - 3000 MHz	@ 0 dB setting (P _{IN} =+10 dBm)	–	+53	–	dBm
	3000 - 6000 MHz		–	+51	–	
VSWR	1 - 500 MHz	@ 0 - 20 dB	–	1.30	–	:1
		@ 20.25 - 110 dB	–	1.05	–	
	500 - 4000 MHz	@ 0 - 20 dB	–	1.10	–	
		@ 20.25 - 110 dB	–	1.05	–	
	4000 - 6000 MHz	@ 0 - 20 dB	–	1.30	–	
		@ 20.25 - 110 dB	–	1.15	–	
Switching Speed	1 - 6000 MHz	Note 6	–	650	–	nsec
Min Dwell Time	1 - 6000 MHz	High speed mode	–	600	–	μsec
Supply Voltage ⁷	–	via USB port or D-Sub Pin#1	4.75	5	5.25	V
DC current draw	–		–	60	80	mA
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 100 dB attenuation the maximum error at 5000 MHz will be: ±(-1.1+0.04x100)= ±(-1.1+4)= ± 2.9 dB

³ 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).

⁴ Total operating input power from both RF In and RF Out out ports. Compression level not noted as it exceeds max safe operating power level.

⁵ Tested with 1 MHz span between signals.

⁶ Switching speed specified without communication delays, USB communication delays (in PC Control mode) on the order of 3.5 msec.

⁷ Power on sequence for RS232 control: Connect 5V power followed by the control lines.

Absolute Maximum Ratings

Operating Temperature	0°C to 50°C
Storage Temperature	-20°C to 85°C
Voltage input at RS232 receive pin	-30V to +30V
Voltage input at RS232 transmit pin	0V to +4V
Voltage input at RS232 Pin#1	-1V to +6V
V _{USB} Max.	6V
Total RF power for RF In & RF Out	@ 10 to 6000 MHz +23 dBm @ 1 to 10 MHz +13 dBm

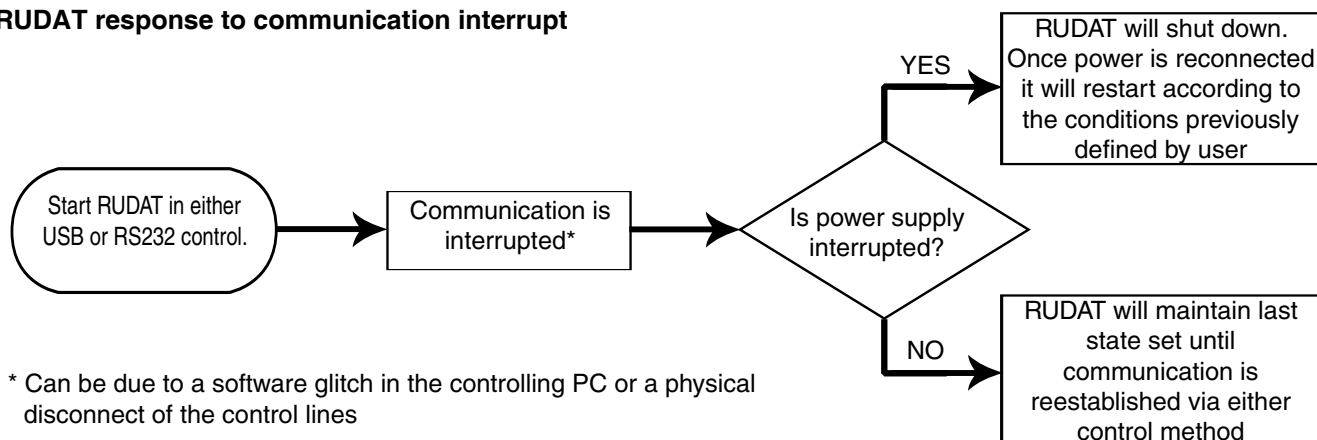
Permanent damage may occur if any of these limits are exceeded. Operation in the range between the max operating power and the absolute maximum rating for extended periods of time may result in reduced life and reliability.

Minimum System Requirements

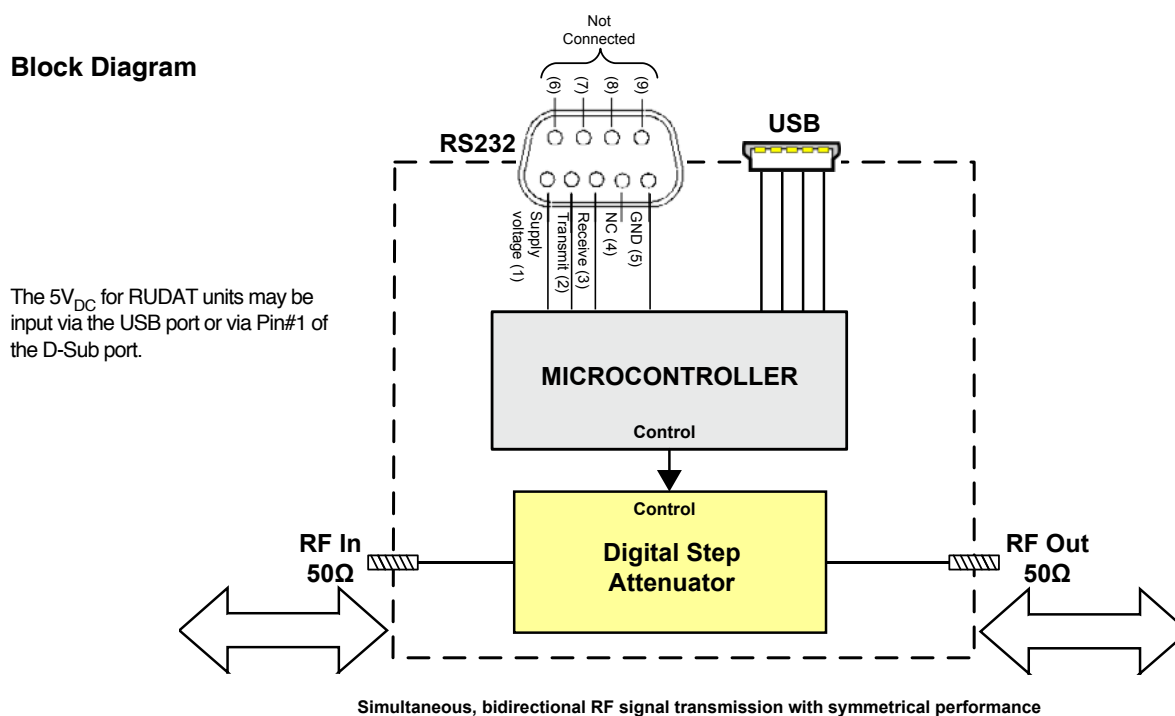
Interface	USB HID or RS232 protocols
Host operating system - USB Control	Windows 32/64 Bit operating system: Windows 98®, Windows XP®, Windows Vista®, Windows 7®, Windows 8® Linux® support: 32/64 Bit operating system
Host operating system - RS232 Control	Any computer with a serial port and RS232 support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



RUDAT response to communication interrupt



Block Diagram



Connections

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

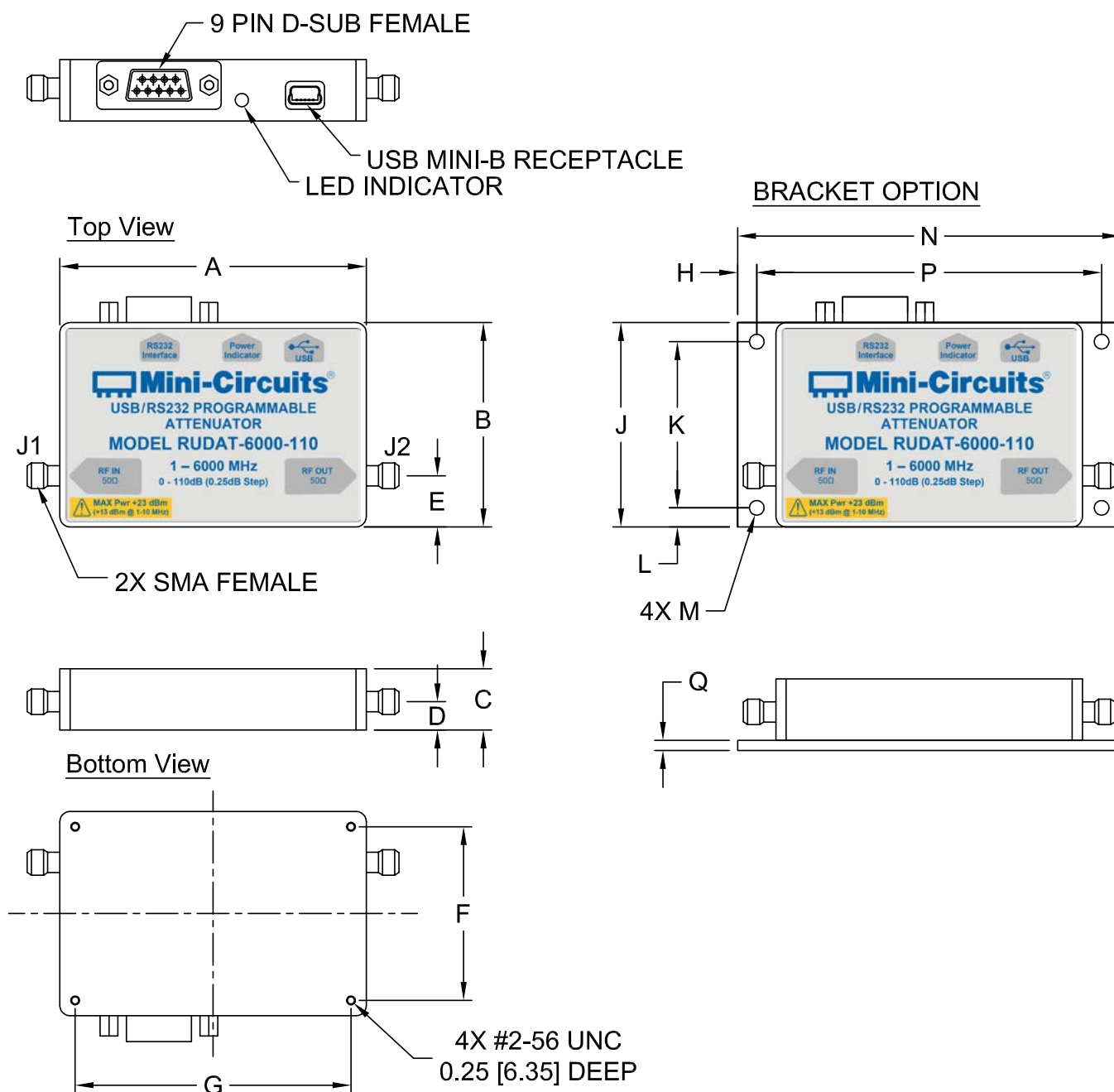
*9 Pin D-Sub Pin Connections

PIN Number	Function
2	Transmit
3	Receive
5	GND
1	+5 V _{DC} ^{8,9}
4,6-9	Not Connected

⁸ 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.

⁹ Power on sequence for RS232 control: Connect 5V power followed by the control lines.

Outline Drawing (MS1813)

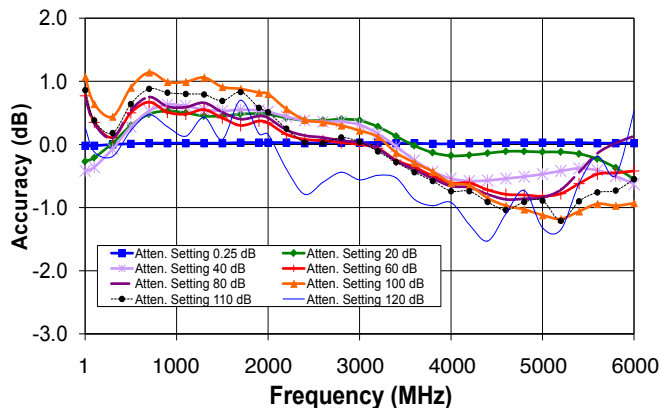


Outline Dimensions (inch mm)

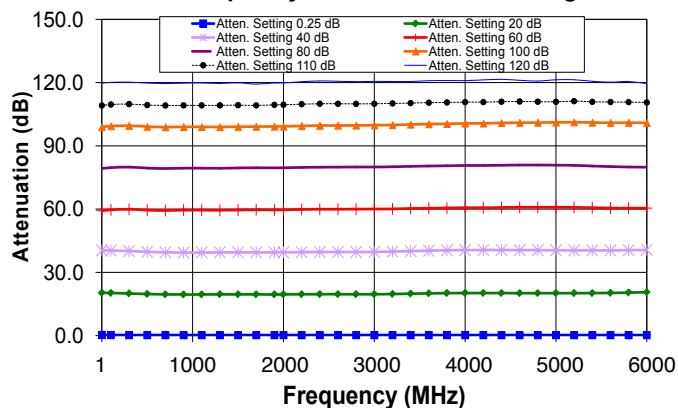
A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	WT. GRAMS
3.00	2.00	0.60	0.28	0.50	1.700	2.700	0.188	2.00	1.625	0.188	0.144	3.75	3.375	0.100	130
76.2	50.8	15.24	7.1	12.7	43.18	68.58	4.76	50.80	41.28	4.76	3.66	95.25	85.72	2.54	

Typical Performance Curves

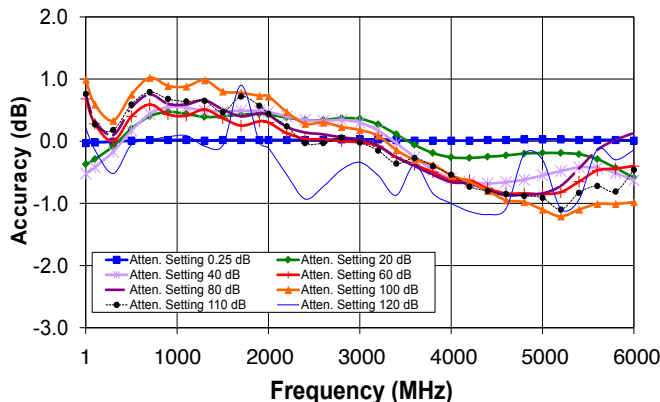
**Attenuation Accuracy @ +25°C
vs. Frequency over Attenuation settings**



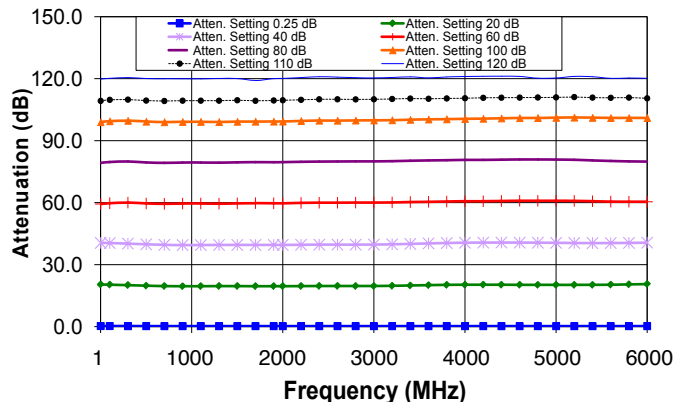
**Attenuation relative to Insertion Loss @ +25°C
vs. Frequency over Attenuation settings**



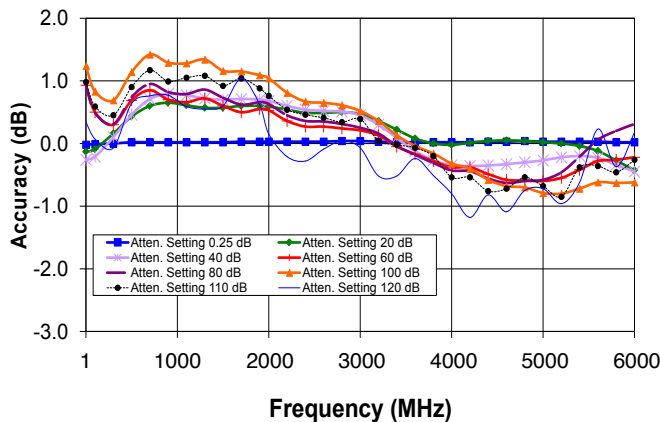
**Attenuation Accuracy @ 0°C
vs. Frequency over Attenuation settings**



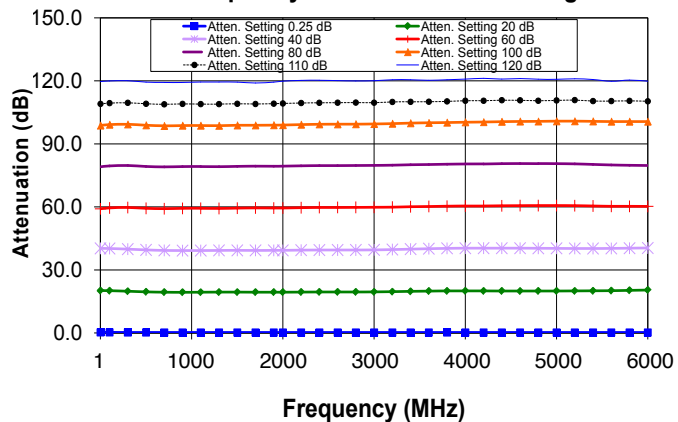
**Attenuation relative to Insertion Loss @ 0°C
vs. Frequency over Attenuation settings**



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

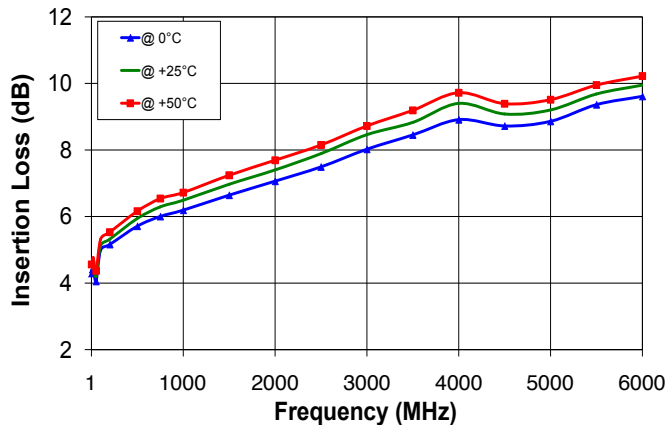


**Attenuation relative to Insertion Loss @ +50°C
vs. Frequency over Attenuation settings**

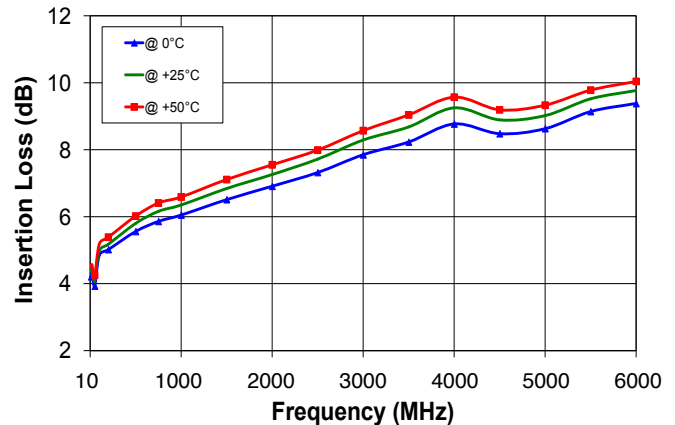


Typical Performance Curves (Continued)

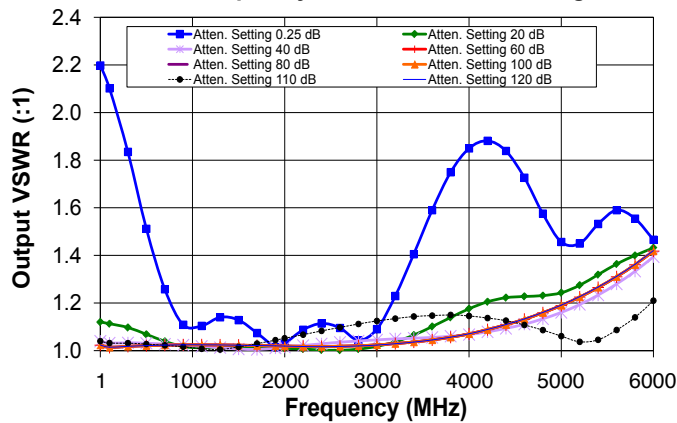
**Insertion Loss @ Input Power 0dBm
vs. Frequency over Temperatures**



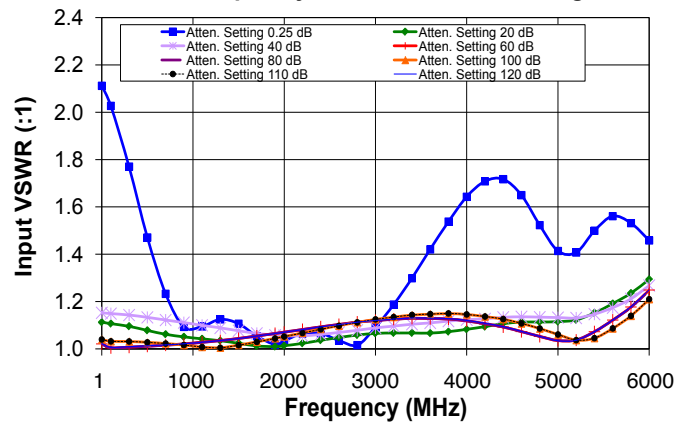
**Insertion Loss @ Input Power +20 dBm
vs. Frequency over Temperatures**



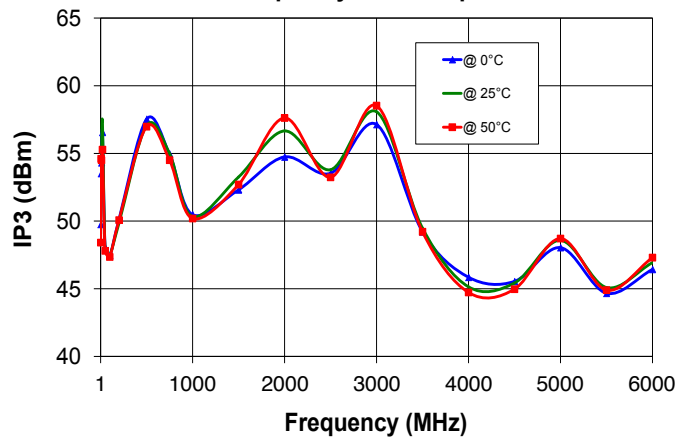
**Output VSWR @ +25°C
vs. Frequency over Attenuation settings**



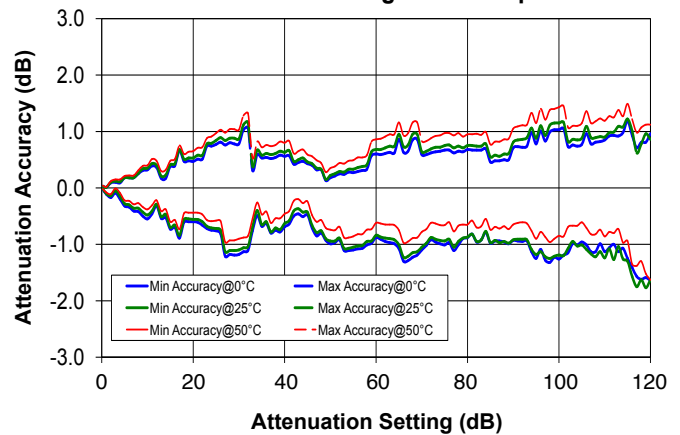
**Input VSWR @ +25°C
vs. Frequency over Attenuation settings**



**Input IP3 @ 0dB Attenuation
vs. Frequency over Temperatures**



**Typical Attenuation Accuracy
vs. Attenuation settings over Temperature**



Ordering Information

Model	Description
RUDAT-6000-110	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. 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

