

FEATURES

- > 30 dB Attenuator Range
- 0.5 dB Step Size
- Optional Level Flatness Correction
- Optional Internal Amplifier
- SPI & USB Control

DESCRIPTION

The **MLAT-Series** of Programmable Attenuators are general purpose single channel programmable attenuators suitable for a wide range of applications. They provide 0 to 30 dB attenuation in 0.5 dB steps over the 10 MHz to 21 GHz frequency range. The attenuator is housed in a compact package with SMA Female RF Connectors. A standard 10 pin and a USB Micro B are provided for power and control ports. The attenuator can be controlled via USB or SPI. Full software support is provided in the user manual and can be downloaded from our web site. Optional temperature ranges are available on special order.

APPLICATIONS

Test Equipment



Model No. **MLAT-1000A**

RF Specifications

Option A

| Parameter | Frequency Range | Condition | Min. | Typ. | Max. | Units |
|---------------------------------------|-----------------|----------------|------|------------------------|----------------------------|-------|
| Operating Frequency | - | - | 0.01 | 0.01 - 26.5 | 21.0 | GHz |
| Nominal Impedance | 0.01 - 21.0 GHz | - | - | 50.0 | - | Ohms |
| Attenuation Range | 0.01 - 21.0 GHz | 0.5 dB Steps | 0 | - | 31.5 | dB |
| Insertion Loss | .01 - 8 GHz | - | - | 2.8 | 3.3 | dB |
| | 8 - 15 GHz | @ 0 dB | - | 4.9 | 5.4 | |
| | 15 - 21.0 GHz | - | - | 6.5 | 7.0 | |
| VSWR (All Ports) | .01 - 8 GHz | - | - | 1.4:1 | 1.7:1 | |
| | 8 - 15 GHz | 0 - 31.5 dB | - | 1.7:1 | 2.0:1 | |
| | 15 - 21.0 GHz | - | - | 1.9:1 | 2.1:1 | |
| Attenuation Accuracy ¹ | .01 - 8 GHz | - | - | - | +/- (0.5 + 1.5% of State) | dB |
| | 8 - 15 GHz | 0 - 31.5 dB | - | - | +/- (0.75 + 2.5% of State) | |
| | 15 - 21.0 GHz | - | - | - | +/- (1.0 + 3.0% of State) | |
| Monotonicity | - | - | - | 0.01 - 21.0 | - | GHz |
| J1 (RF Input Power, CW) ³ | 0.01 - 21.0 GHz | 0 - 31.5 dB | - | - | 28 | dBm |
| J2 (RF Output Power, CW) ³ | 0.01 - 21.0 GHz | 0 - 31.5 dB | - | - | 19 | dBm |
| Input IP3 ² | - | 0 - 31.5 dB | - | 50 | - | dBm |
| Switching Time ⁴ | 0.01 - 21.0 GHz | - | - | 20 | - | us |
| Supply Voltage (VDC) | - | J1, 10 Pin SPI | 4.0 | 5.0 | 6.0 | Volts |
| | | J2, USB | 4.0 | 5.0 | 6.0 | |
| Supply Current | - | - | - | 50.0 | - | mA |
| Digital Control Logic | - | - | - | 2.7, 3.3, and 5V Logic | - | N/A |
| Operating Temperature | 0.01 - 21.0 GHz | - | -0 | - | 50 | °C |
| Storage Temperature | - | - | -55 | - | 105 | °C |

Notes:

1. Referenced to insertion loss @ 0 dB. % = % of attenuator setting. i.e. 25 dB setting @ 15 GHz = $\pm(0.75 + 0.025 * 25) = \pm 1.375$ dB accuracy.
2. Two-tone input power = 14 dBm per tone, $\Delta f = 1$ MHz, all attenuation states.
3. RF Input and RF output are DC blocked, Input and output are NOT bidirectional.
4. SPI and USB communication times are excluded. Measured @ RF, 10%/90%.

Option D: Level Flatness Correction—User Initiated

| Parameter | Frequency Range | Condition | Min. | Typ. | Max. | Units |
|--------------------------------|-----------------|--------------|------|-------------|------|-------|
| Operating Frequency | - | - | 0.01 | 0.01 - 26.5 | 21.0 | GHz |
| Calibration Range ¹ | 0.01 - 21.0 GHz | 0.5 dB Steps | 0 | - | 31.5 | dB |
| Added Insertion Loss | .01 - 8 GHz | | - | 1.6 | 1.8 | |
| | 8 - 15 GHz | @ 0 dB | - | 2.1 | 2.3 | dB |
| | 15 - 21.0 GHz | | - | 2.7 | 2.9 | |

See MLAT general specifications for all other product specs.

Notes:

1. Before calibration, all attenuation and calibration settings should be set to 0.0 dB.

Option D description:

This option adds a user initiated level flatness correction that is stored in nonvolatile memory. The frequency range, and step size can be defined, in MHz, and stored in nonvolatile memory. FA = start frequency, FB = end frequency, and FC = correction frequency increment (i.e. FA2000, FB8000, FC50). The source Cal level point SCL command, "SCL0.0" stores, in memory the RF output level that you would like to calibrate at. (i.e. 0.0 dBm). Note: The RF output of the attenuator, with all attenuation and correction set to minimum, must be greater than the SCL level setting, across the FA to FB range. Setting your signal source to FA, then measuring the RF output power of the attenuator, send (decrement) the LC command (LC-0.5) until the measured RF output reaches the desired "SCL" level, ± 0.5 dB. Send the SC0 command to store the first calibration point (i.e. last LC setting sent LC-2.5 = 2000 MHz @ 0.0 dBm) into Cal memory location 0 (which would now read back as -2.5). Now increment the signal source frequency by FC (50 MHz), repeat the LC routine until SCL is reached, send SC1 command to store 2050 MHz @ 0.0 dBm. Repeat until FB is reached. The correction mode can be enabled / disabled via the C1 / C0 commands. With calibration complete, enable correction "C1". Send the signal source to 2000 MHz. Send the attenuator the frequency command F2000. The attenuator will pull the 2000 MHz correction data from nonvolatile memory, and set the RF output to be 0.0 dBm, ± 0.5 dB. You can now set the attenuator, attenuation level to any setting in the attenuators range (i.e. L-45.5). The RF level accuracy will be relative to the 0.0 dB Cal point insertion loss (-45.5 dBm, ± 0.5 dB). If you set the signal source frequency to a new frequency, set the attenuator frequency to the same number, and the attenuator will output the frequency / level corrected attenuation level setting. You can read the calibration table starting at memory location 500 (FA) to 2000 (FB). Read memory command = R500, 0 data = no correction, valid correction = a negative number between 0 and -31.5 , in 0.5 increments. Please note: There are only 1500 memory locations to store data, for a full frequency range calibration, keep $FC \geq 25.0$ MHz. If your signal source has abrupt RF power frequency band changes, select an FC increment that will match the frequency band changes. If the signal source is substituted, a new calibration run will be required.

Option E:

| Parameter | Frequency Range | Condition | Min. | Typ. | Max. | Units |
|------------------------------|-----------------|-----------|------|-------------|------|-------|
| Operating Frequency | - | - | 0.01 | 0.01 - 23.0 | 22 | GHz |
| Gain | | | 10 | 15 | | dB |
| Noise Figure | | | | 2.5 | 6 | dB |
| P1 dB | | | 14 | 17 | | dB |
| Psat | | | 19 | 21 | | dBm |
| IP3 | | | | 26 | | dBm |
| Additional Module Current | | | | 200 | 225 | mA |
| Gain Temperature Coefficient | | | | 0.008 | | dB/°C |
| NF Temperature Coefficient | | | | 0.009 | | dB/°C |

See MLAT general specifications for all other product specs.

Notes:

1. Insertion loss of the optioned attenuator must be subtracted for correct gain numbers.
2. This option is available with options A and D.

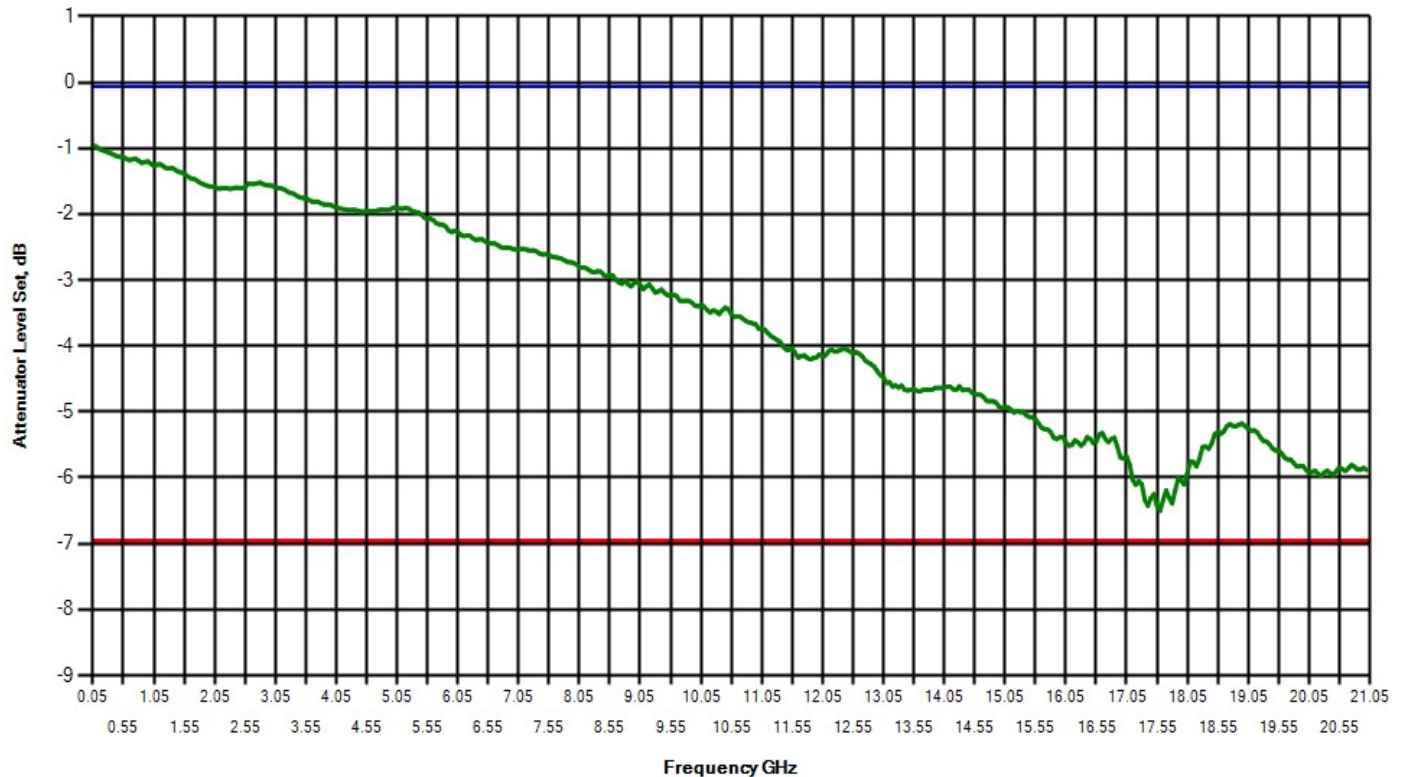
Option E description:

This option adds an internal 10.0 to 22.0 GHz GaAs MMIC RF amplifier to the attenuators RF output port. This will eliminate the insertion loss associated with the attenuators RF path. This will lead to some gain from the attenuator, at the expense of frequency range, noise figure, harmonics, and increased power consumption.

Typical Performance Curves:

Insertion Loss vs Frequency @ Attenuation Setting Test, Calibration N/A, Attenuator Level Setting = 0.0, MLAT-1000A SN: 0005, 6/19/2020 8:40:20 AM

Pass

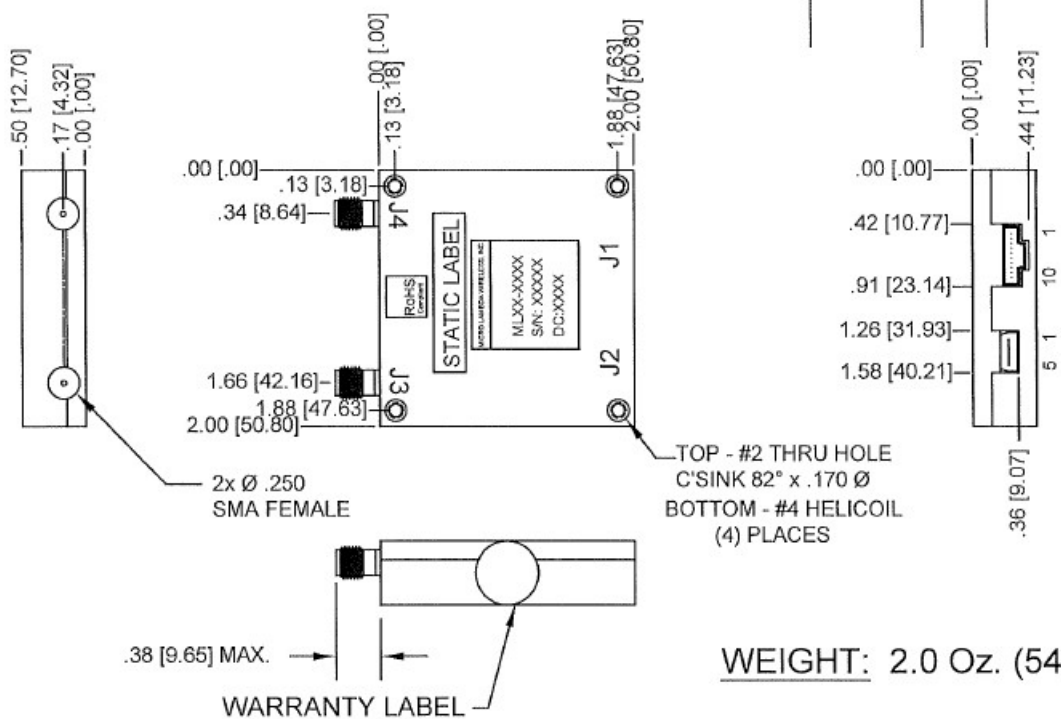


MLAT Attenuator Range Test
MLAT-1000A SN: 0005
Calibration = N/A
6/19/2020 10:11:39 AM

| | | | | | | | | | |
|---------|-----|-----|------|------|------|------|------|------|------|
| 50.0 | 0.0 | 4.9 | 9.9 | 14.8 | 19.7 | 24.7 | 29.6 | 31.0 | Pass |
| 1000.0 | 0.0 | 5.0 | 10.0 | 14.9 | 19.9 | 24.8 | 29.8 | 31.2 | Pass |
| 1500.0 | 0.0 | 5.0 | 10.0 | 14.9 | 19.9 | 24.8 | 29.8 | 31.2 | Pass |
| 2000.0 | 0.0 | 5.0 | 10.0 | 14.9 | 19.9 | 24.8 | 29.8 | 31.2 | Pass |
| 2500.0 | 0.0 | 5.0 | 10.0 | 14.9 | 19.9 | 24.8 | 29.8 | 31.2 | Pass |
| 3000.0 | 0.0 | 5.0 | 10.1 | 15.0 | 20.0 | 25.0 | 30.0 | 31.4 | Pass |
| 3500.0 | 0.0 | 5.0 | 10.0 | 14.9 | 19.9 | 24.9 | 29.9 | 31.3 | Pass |
| 4000.0 | 0.0 | 4.9 | 9.9 | 14.8 | 19.8 | 24.8 | 29.8 | 31.2 | Pass |
| 4500.0 | 0.0 | 4.9 | 9.9 | 14.8 | 19.8 | 24.8 | 29.8 | 31.2 | Pass |
| 5000.0 | 0.0 | 4.9 | 10.0 | 14.9 | 19.9 | 24.9 | 29.9 | 31.4 | Pass |
| 5500.0 | 0.0 | 5.0 | 10.0 | 14.9 | 20.0 | 24.9 | 30.0 | 31.4 | Pass |
| 6000.0 | 0.0 | 4.8 | 9.8 | 14.8 | 19.8 | 24.8 | 29.8 | 31.2 | Pass |
| 6500.0 | 0.0 | 4.9 | 9.9 | 14.8 | 19.8 | 24.7 | 29.8 | 31.2 | Pass |
| 7000.0 | 0.0 | 4.9 | 9.9 | 14.8 | 19.8 | 24.8 | 29.9 | 31.4 | Pass |
| 7500.0 | 0.0 | 4.9 | 9.9 | 14.8 | 19.8 | 24.8 | 30.0 | 31.4 | Pass |
| 8000.0 | 0.0 | 4.9 | 9.9 | 14.8 | 19.9 | 24.9 | 30.0 | 31.4 | Pass |
| 8500.0 | 0.0 | 4.9 | 9.9 | 14.8 | 19.8 | 24.8 | 30.0 | 31.4 | Pass |
| 9000.0 | 0.0 | 4.9 | 10.0 | 14.9 | 20.0 | 25.0 | 30.1 | 31.5 | Pass |
| 9500.0 | 0.0 | 4.9 | 9.9 | 14.8 | 19.9 | 24.9 | 30.0 | 31.4 | Pass |
| 10000.0 | 0.0 | 4.9 | 9.9 | 14.8 | 19.9 | 24.9 | 30.0 | 31.4 | Pass |
| 10500.0 | 0.0 | 4.9 | 9.9 | 14.8 | 19.9 | 24.9 | 30.0 | 31.4 | Pass |
| 11000.0 | 0.0 | 4.9 | 9.9 | 14.8 | 19.9 | 24.9 | 30.0 | 31.4 | Pass |
| 11500.0 | 0.0 | 4.8 | 9.8 | 14.6 | 19.7 | 24.7 | 29.8 | 31.2 | Pass |
| 12000.0 | 0.0 | 4.8 | 9.8 | 14.6 | 19.7 | 24.7 | 29.8 | 31.2 | Pass |
| 12500.0 | 0.0 | 4.9 | 10.0 | 14.9 | 20.0 | 24.9 | 30.1 | 31.4 | Pass |
| 13000.0 | 0.0 | 4.9 | 9.9 | 14.9 | 20.0 | 24.9 | 30.1 | 31.5 | Pass |
| 13500.0 | 0.0 | 4.8 | 9.8 | 14.7 | 19.8 | 24.7 | 29.9 | 31.3 | Pass |
| 14000.0 | 0.0 | 4.9 | 10.0 | 14.9 | 20.0 | 25.0 | 30.2 | 31.7 | Pass |
| 14500.0 | 0.0 | 4.9 | 10.0 | 14.9 | 20.0 | 25.0 | 30.3 | 31.7 | Pass |
| 15000.0 | 0.0 | 4.9 | 10.0 | 14.9 | 20.0 | 25.0 | 30.2 | 31.6 | Pass |
| 15500.0 | 0.0 | 4.9 | 9.9 | 14.8 | 19.9 | 24.8 | 30.0 | 31.4 | Pass |
| 16000.0 | 0.0 | 4.8 | 9.7 | 14.6 | 19.6 | 24.6 | 29.7 | 31.1 | Pass |
| 16500.0 | 0.0 | 4.9 | 9.8 | 14.7 | 19.7 | 24.7 | 29.8 | 31.1 | Pass |
| 17000.0 | 0.0 | 4.7 | 9.5 | 14.4 | 19.4 | 24.2 | 29.4 | 30.7 | Pass |
| 17500.0 | 0.0 | 4.5 | 9.4 | 14.1 | 19.1 | 23.9 | 29.0 | 30.3 | Pass |
| 18000.0 | 0.0 | 4.6 | 9.7 | 14.4 | 19.4 | 24.2 | 29.3 | 30.6 | Pass |
| 18500.0 | 0.0 | 5.0 | 10.2 | 15.0 | 20.1 | 24.9 | 30.0 | 31.3 | Pass |
| 19000.0 | 0.0 | 4.9 | 10.0 | 14.9 | 19.9 | 24.8 | 29.9 | 31.2 | Pass |
| 19500.0 | 0.0 | 4.9 | 10.0 | 14.8 | 19.9 | 24.8 | 29.9 | 31.2 | Pass |
| 20000.0 | 0.0 | 4.8 | 10.0 | 14.8 | 19.8 | 24.7 | 29.8 | 31.1 | Pass |
| 20500.0 | 0.0 | 4.8 | 10.0 | 14.7 | 19.8 | 24.6 | 29.7 | 31.0 | Pass |
| 21000.0 | 0.0 | 4.8 | 9.9 | 14.7 | 19.8 | 24.6 | 29.8 | 31.1 | Pass |

6/19/2020 10:32:16 AM
Number of failures = 0
Test Status = Pass

| REV | DESCRIPTIONS | DATE | APP'D | NOTES |
|--------|--|-----------------------|-------|-------|
| - A | PRELIMINARY DRAWING # INITIAL RELEASE | 11/21/19 8/18/2020 | DS | |



J1
POWER / SPI INTERFACE

| PIN | FUNCTION |
|-----|------------------------|
| 1 | MOSI - DATA IN |
| 2 | MISO - DATA OUT |
| 3 | CLOCK - SERIAL CLOCK |
| 4 | SS - SLAVE SELECT (*) |
| 5 | GROUND - LOGIC |
| 6 | N/C |
| 7 | N/C |
| 8 | N/C |
| 9 | + 5V (IF NO USB CONN.) |
| 10 | GROUND |

J2
USB INTERFACE (MICRO-B)

| PIN | FUNCTION |
|-----|------------|
| 1 | + V (+ 5V) |
| 2 | D - |
| 3 | D + |
| 4 | GROUND |
| 5 | GROUND |

J3: RF INPUT, SMA FEMALE
J4: RF OUTPUT, SMA FEMALE

NOTES:

- J1 MALE: MOLEX# 5015681007
- J1 MATES WITH FEMALE: MOLEX# 5013301000
- CRIMP PIN: MOLEX#5013340000
- J1 POWER SUPPLY INPUTS NOT REQUIRED FOR USB OPERATION.
- SMA ENGAGE/DISENGAGE TORQUE: 2 INCH-POUNDS MAX.
- SMA MATING TORQUE (ROTATIONAL): 8 INCH POUNDS MAX.
- SMA CONTACT RETENTION: 6 LBS. MIN. AXIAL FORCE ON MATING END. 4 IN-OZ MIN. RADIAL TORQUE.
- (*) ACTIVE LOW

| | |
|---|--------------|
| UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCE ARE: FRACTIONS DECIMALS ANGLES XX + .02 [52] XX - .010 [254] | CONTRACT NO. |
| APPROVALS | DATE |
| DRAWN: N. NGUYEN | 02/03/2021 |
| CHECKED: DS | 2/3/21 |
| ISSUED | |
| WATERWL: ALUMINUM | |
| FINISH: NICKEL | |
| DO NOT SCALE DRAWING | |



MICRO LAMBDA WIRELESS, INC.

MLAT ATTENUATOR 2" X 2" X 0.5"

| | | | |
|------|------------------|-----------------------------|----------|
| SIZE | CAGE No ORN63 | DWG. No. 99 - 0221 - 001 | REV A |
|------|------------------|-----------------------------|----------|