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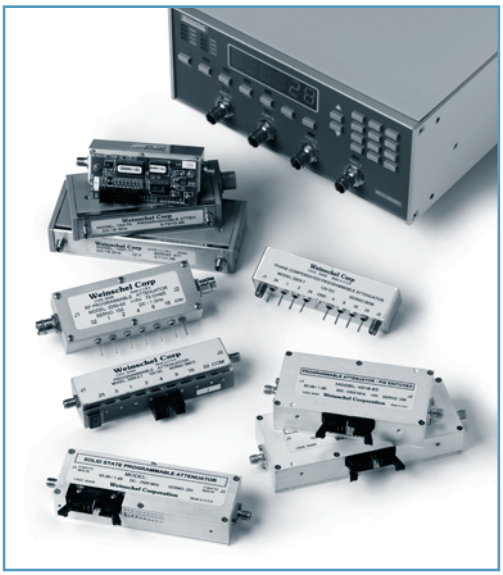
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# Programmable Attenuators & Attenuator/Switch Controllers



- Widest Selection of Attenuation Ranges & Steps Sizes
- ***Express*** shipment available on select models.
- Built-In TTL\CMOS Interface Driver Circuitry available.
- High Quality Construction & Connectors
- Special Configurations Available Upon Request
  - Custom Cell/Step Size Configurations
  - Higher Frequencies

## General Information

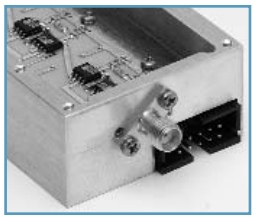
In this section of the catalog, each Programmable Attenuator is outlined utilizing individual data sheets containing product features, specifications, and outline drawings. These data sheets are preceded by a quick reference guide to help you select the Programmable Attenuator(s) that fits your needs. The page number for each Programmable Attenuator data sheet is given in the quick reference guide.

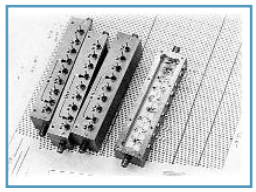
This section includes all available accessories for the Aeroflex / Weinschel programmable attenuators such as our Model 8210A Attenuator / Switch Controller, product specific driver boards, and our programmable attenuators with our built-in microprocessor-based drivers. Also Included in this section are Aeroflex / Weinschel's wide variety of programmable attenuator units which includes the 8310, 8311 and 8312 series. Other subsystem solutions can be located in the Subsystem and Accessories section (pg 129).

**NOTE:** ***EXPRESS*** Shipment available via **www.sicklesonline.com** or 800-542-4457. Check with distributor for current product stocking quantities.














Revision Date: 12/15/04

## Relay Switched Programmable Attenuators, Basic Models . . . DC-3 GHz

| Model Number | Frequency Range (GHz) | Attenuation Range (dB) | Step Size (dB) | Insertion Loss, Max. (dB) | Maximum SWR | Connector Type | Average Power (Watts) | Peak Power (Watts) | Page No. | |
|---|---|---|---|---|---|---|---|---|---|---|
| ☆ 3200-1 | dc-2.0 | 0-127 | 1 | 4.75 | 1.25-1.35* | SMA | 1 | 50 | 87 |  |
| ☆ 3200-2 | | 0-63.75 | 0.25 | 4.75 | 1.25-1.35* | | | | | |
| ☆ 3201-1 | | 0-31 | 1 | 3.75 | 1.25 | | | | | |
| ☆ 3201-2 | | 0-120 | 10 | 3.75 | 1.25 | | | | | |
| 3205-1 | | 0-70 | 10 | 3.30 | 1.25 | | | | | |
| 3205-2 | | 0-55 | 5 | 3.30 | 1.25 | | | | | |
| 3205-3 | | 0-1.5 | 0.1 | 3.30 | 1.25 | | | | | |
| ☆ 3206-1 | | 0-63 | 1 | 4.00 | 1.25 | | | | | |
| 3209-1 | | 0-64.5 | 0.1 | 6.70 | 1.35 | | | | | |
| ☆ 3200-1E | dc-3.0 | 0-127 | 1 | 4.90 | 1.25-1.40* | SMA | 1 | 50 | 87 | |
| ☆ 3200-2E | | 0-63.75 | 0.25 | 4.90 | 1.25-1.40* | | | | | |
| 3201-1E | | 0-31 | 1 | 3.40 | 1.25-1.40* | | | | | |
| 3205-3E | | 0-1.5 | 0.1 | 3.40 | 1.25-1.40* | | | | | |
| 3206-1E | | 0-63 | 1 | 3.70 | 1.25-1.35* | | | | | |
| 3209-1E | | 0-64.5 | 0.1 | 5.50 | 1.35-1.45* | | | | | |
| 3250-63 (75 Ω) | dc-1.0 | 0-63 | 1 | 4.75 | 1.20-1.30* | BNC | 1 | 50 | 96 |  |
| 3406-55 | dc-6.0 | 0-55 | 1 | 3.80 | 130 | SMA | 1 | 50 | 100 |  |
| 3408-55.75 | | 0-55.75 | 0.25 | 5.00 | | | | | | |
| 3408-103 *(New)* | | 0-103 | 1 | | | | | | | |

## Relay Switched Programmable Attenuators, with built-in Microprocessor-Base Driver . . . DC-3 GHz (For use with Aeroflex / Weinschel 8210A Controller)

| Model Number | Frequency Range (GHz) | Attenuation Range (dB) | Step Size (dB) | Insertion Loss, Max. (dB) | Maximum SWR | Connector Type | Average Power (Watts) | Peak Power (Watts) | Page No. | |
|---|---|---|---|---|---|---|---|---|---|---|
| ☆ 3200T-1 | dc-2.0 | 0-127 | 1 | 4.75 | 1.25-1.35* | SMA | 1 | 50 | 93 |  |
| 3200T-2 | | 0-63.75 | 0.25 | 4.75 | 1.25-1.35* | | | | | |
| 3201T-1 | | 0-31 | 1 | 3.75 | 1.25 | | | | | |
| 3201T-2 | | 0-120 | 10 | 3.75 | 1.25 | | | | | |
| 3201T-4 | | 0-1.2 | 0.1 | 3.30 | 1.25 | | | | | |
| 3205T-1 | | 0-70 | 10 | 3.30 | 1.25 | | | | | |
| 3205T-2 | | 0-55 | 5 | 3.30 | 1.25 | | | | | |
| 3205T-3 | | 0-1.5 | 0.1 | 3.30 | 1.25 | | | | | |
| ☆ 3206T-1 | | 0-63 | 1 | 4.00 | 1.25 | | | | | |
| 3209T-1 | | 0-64.5 | 0.1 | 6.70 | 1.35 | | | | | |
| 3200T-1E | dc-3.0 | 0-127 | 1 | 4.90 | 1.20-1.40* | SMA | 1 | 50 | 93 | |
| 3200T-2E | | 0-63.75 | 0.25 | 4.90 | 1.20-1.40* | | | | | |
| 3201T-1E | | 0-31 | 1 | 3.40 | 1.20-1.40* | | | | | |
| 3205T-3E | | 0-1.5 | 0.1 | 3.40 | 1.20-1.40* | | | | | |
| 3206T-1E | | 0-63 | 1 | 3.70 | 1.25-1.35* | | | | | |
| 3209T-1E | | 0-64.5 | 0.1 | 5.50 | 1.35-1.45* | | | | | |
| ☆ 3250T-63 (75 Ω) | dc-1.0 | 0-63 | 1 | 4.75 | 1.20-1.30* | BNC | 1 | 50 | 96 |  |

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# Programmable Attenuators

## Relay Switched Programmable Attenuators, with built-in Microprocessor-Based Driver . . . dc - 26.5 GHz (For use with Aeroflex / Weinschel 8210A Controller)

| Model Number | Frequency Range (GHz) | Attenuation Range (dB) | Step Size (dB) | Insertion Loss, Max. (dB) | Maximum SWR | Connector Type | Average Power (Watts) | Peak Power (Watts) | Page No. |
|---|---|---|---|---|---|---|---|---|---|
| ☆ 150T-11 | dc-18.0 | 0-11 | 1 | 2.2 | 1.50-1.90* | 3.5mm | 1 | 100 | 102 |
| ☆ 150T-15 | | 0-15 | 1 | 2.2 | 1.50-1.90* | | | | |
| ☆ 150T-31 | | 0-31 | 1 | 2.6 | 1.50-1.90* | | | | |
| ☆ 150T-62 | | 0-62 | 2 | 2.6 | 1.50-1.90* | | | | |
| ☆ 150T-70 | | 0-70 | 10 | 2.6 | 1.35-1.70* | | | | |
| ☆ 150T-75 | | 0-75 | 5 | 2.2 | 1.50-1.90* | | | | |
| ☆ 150T-110 | | 0-110 | 10 | 2.2 | 1.50-1.90* | | | | |
| 151T-11 | dc-4.0 | 0-11 | 1 | 0.9 | 1.50 | 3.5mm | 1 | 100 | 102 |
| 151T-15 | | 0-15 | 1 | 0.9 | 1.50 | | | | |
| 151T-31 | | 0-31 | 1 | 0.9 | 1.50 | | | | |
| 151T-62 | | 0-62 | 2 | 1.1 | 1.50 | | | | |
| 151T-70 | | 0-70 | 10 | 0.7 | 1.35 | | | | |
| 151T-75 | | 0-75 | 5 | 0.9 | 1.50 | | | | |
| ☆ 151T-110 | | 0-110 | 10 | 0.9 | 1.50 | | | | |
| ☆ 152T-55 | dc-26.5 | 0-55 | 5 | 2.98 | 1.40-1.80* | 3.5mm | 1 | 100 | 102 |
| 152T-70 | | 0-70 | 10 | 2.98 | 1.40-1.80* | | | | |
| 152AT-70 | | 0-70 | 10 | 2.98 | 1.40-1.80* | | | | |
| 152T-90 | | 0-90 | 10 | 2.98 | 1.40-1.80* | | | | |



## Relay Switched Programmable Attenuators, Basic Models . . . dc - 26.5 GHz

| Model Number | Frequency Range (GHz) | Attenuation Range (dB) | Step Size (dB) | Insertion Loss, Max. (dB) | Maximum SWR | Connector Type | Average Power (Watts) | Peak Power (Watts) | Page No. |
|---|---|---|---|---|---|---|---|---|---|
| ☆ 150-11 | dc-18.0 | 0-11 | 1 | 2.2 | 1.50-1.90* | 3.5mm | 1 | 100 | 106 |
| 150-15 | | 0-15 | 1 | 2.2 | 1.50-1.90* | | | | |
| 150-31 | | 0-31 | 1 | 2.6 | 1.50-1.90* | | | | |
| ☆ 150-70 | | 0-70 | 10 | 2.6 | 1.35-1.70* | | | | |
| ☆ 150-75 | | 0-75 | 5 | 2.2 | 1.50-1.90* | | | | |
| 150-110 | | 0-110 | 10 | 2.2 | 1.50-1.90* | | | | |
| ☆ 151-11 | dc-4.0 | 0-11 | 1 | 0.9 | 1.50 | 3.5mm | 1 | 100 | 106 |
| ☆ 152-90 | dc-26.5 | 0-90 | 10 | 2.98 | 1.40-1.80* | 3.5mm | 1 | 100 | 106 |



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## SOLID-STATE PROGRAMMABLES . . . to 3 GHz

| Model Number | Frequency Range (GHz) | Attenuation Range (dB) | Step Size (dB) | Insertion Loss, Max. (dB) | Maximum SWR | Average Power | Connector Type | Page No. | |
|---|---|---|---|---|---|---|---|---|---|
| ☆ 4216-63<br>4218-63.75<br>☆ 4218-127 | 0.8-2.3 | 0-63<br>0-63.75<br>0-127 | 1<br>0.25<br>1 | 3.40<br>4.90<br>4.90 | 150<br>150<br>150 | +28 dBm | SMA | 111 |  |
| 4226-63<br>4228-63.75<br>4228-103<br>*(New)* | 0.8-3.0<br>0.8-2.5<br>0.8-3.0 | 0-63<br>0-63.75<br>0-103 | 1<br>0.25<br>1 | 3.75<br>4.50<br>5.50 | 1.50<br>1.50<br>1.50 | +28 dBm | SMA | 113 |  |
| 4238-63.75<br>☆ 4238-103<br>*(New)* | | 0-63.75<br>103 | 0.25<br>1 | 9.00<br>9.00 | 1.60 | +30 dBm | SMA | 115 |  |
| 4246-63<br>4248-63.75<br>4248-103<br>*(New)* | 10 MHz-2.5 | 0-63<br>0-63.75<br>103/1 | 1<br>0.25 | 10.00<br>13.00<br>13.00 | 2.00 | +36 dBm | SMA | 117 |  |

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# Programmable Attenuators

## ATTENUATOR UNITS & CONTROLLERS. . . dc to 26.5 GHz, 100 Watts



### Programmable/Switch Controllers:

(pg 126-128)

The Model 8210A Attenuator / Switch Controller provides a flexible, low cost solution for the control and operation of electromechanical switches and programmable step attenuators using standard communication interfaces. The 8210A represents a new concept in device control applications for bench test and subsystem designs.

- Designed to interface with Aeroflex / Weinschel's line of programmable attenuators (3200T & 150T) and other electromechanical devices.
- Simplifies your bench test setups and subsystem design.



- Available in two standard communication interfaces:
  - Model 8210A-1:GPIB/IEEE-488 (HS-488 ready)
  - Model 8210A-2:RS-232, RS-422, RS-485

Each model contains similar capabilities and provides switch-selectable parameters to tailor the interface's operation.

### 100 W Hot-Switchable High Power Attenuator Unit:

(pages 123-125)



- Available in 0-15 dB or 0-31 dB Configurations
- DC to 13 GHz Operation
- Power Handling up to 100 Watts average
- High Accuracy & repeatability
- IEEE-488 & Standard Serial Interfaces
- Relative vs. Nominal attenuation step function.
- Bus Controlled Programmable Attenuator Units

### Programmable Attenuator Units for Rack or Bench Use:

(Pages 119-122)



Aeroflex / Weinschel's 8310 & 8311 Series Programmable Attenuator Units represent Aeroflex / Weinschel's newest concept in programmable attenuation for bench test and subsystem applications.

Standard 8310 Series designs house and control various Aeroflex / Weinschel Programmable Attenuator Models (3200T, 150T, and 4200 Series via front panel controls or standard communications interfaces including GPIB (IEEE-488) and RS-232/RS-422/RS485. The standard units combine the features of the Aeroflex / Weinschel 8210A Device Controller with a front panel user interface to form a flexible, easy to use solution.

Most 8310 Series are single channel configurations where RF signal is routed through either the front or rear mounted Ports A & B but can be configured for up to four channels of attenuation, RF switching, or other functions and other features such as:

- Multi-Channel attenuation paths (up to 4 input/ outputs).
- Relative vs. Nominal attenuation step function.
- Wide choice of Frequency & Attenuation Ranges.
  - dc to 1, 2, 3, 18 & 26.5 GHz
  - up to 127 dB
  - Solid-State (GaAs FET & PIN)
  - Relay Switched
  - 50 & 75 Ω Configurations
- High Accuracy & Repeatability.
- Easily mounted into racks or cabinets designed per EIA RS-310 or MIL-STD-189.





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# *Frequently Asked Questions about Programmable Attenuators....*

### What are the applications of Aeroflex / Weinschel programmable attenuators?

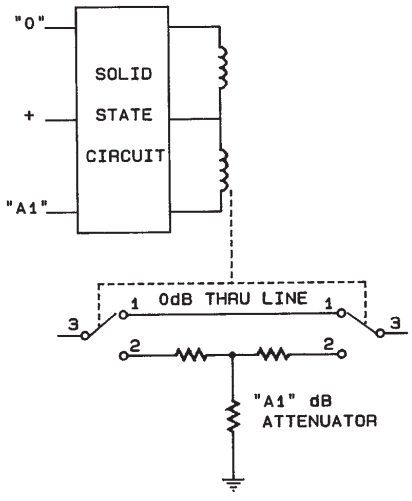
Aeroflex / Weinschel's programmable attenuators are used to control the power of radio frequency and microwave signals. Applications include control of input power to signal measuring systems, control of output power from signal generating systems, adjustment power for BIT error rate testing, controlling losses in a signal path and simulating the signal fading of a microwave communication system....to name just a few.

### How do they work?

Aeroflex / Weinschel's programmable attenuators consist of a series of attenuation pads (cells) that are selectively inserted into the signal path via a control signal. An example is a series of cells such as 1, 2, 4, 8 and 16 dB arranged in a binary sequence. Such an attenuator is called a binary attenuator. Combinations of cells are switched "on" to provide attenuation steps from 0 dB to 31 dB. Another example is a unit having cell values of 10, 20 and 40 dB which will provide 10 dB steps between 0 dB and 70 dB.

### How are the attenuators switched?

The basic structure of a programmable attenuator is shown below. There are several ways the attenuator pads are switched in and out of the RF path. Aeroflex / Weinschel's 3200 series uses TO-5 can relay switches. These are useful up to 2.0 GHz and higher. Aeroflex / Weinschel's 150 series operate up to 26.5 GHz and utilize reed switches housed within a precision machined cavity.




Aeroflex / Weinschel also manufactures programmable attenuators using solid state switching that offers faster switching speeds but their frequency range is more limited than mechanical step attenuators. Whereas mechanically switched attenuators operate from DC to their maximum frequency, solid state attenuators have a lower frequency limit. Solid state attenuators also have lower isolation between control and through path.

### How fast do the attenuators switch?

Switching speed of mechanically switched attenuators is typically between 6 and 35 msec. This is the maximum time between the application of the switching command to the cell and the cessation of contact bounce. This time is a function of switch structure and size.

### What is a latching and non-latching attenuator?



Non-latching is also called momentary or fail-safe. For the non-latching type, the attenuator is switched to the attenuation "on" position only so long as control power is applied to the switch. As soon as power is removed the switch reverts to it passive state or fail-safe state...usually the zero dB state. In latching attenuators each cell stays in the last setting even if power is removed. Latching attenuators have two control lines. One control line causes the attenuator to switch to the "attenuation on" setting while the other control line causes the attenuator to switch to the zero dB setting. There is normally a permanent magnet that holds the switch stable in either position.

Each version has its advantages and disadvantages. The non-latching switch requires constant power to the solenoid when in the "on" position. On the other hand the latching version requires greater switch current to overcome it's permanent magnet.

### How are the attenuators controlled?

The Model 3200 Series non-latching attenuators require only one 12 volt control line per cell. The direction of control current is not important. The Series 3220 latching versions require two control lines per cell and the direction of the current is important.

The Model 150 Series is a latching version using one positive 5 volt or 24 volt common return line and two grounding control lines.

In order for switching to be guaranteed the voltage between common and control must be held within specified limits. Power supply regulation must be kept within range even while heavy switching current is being drawn. Any cable voltage drops must be added to the minimum control voltage to obtain the required power supply voltage at the attenuator.

Aeroflex / Weinschel's programmable attenuators, such as the Model 3200T and 150T Series feature on-board TTL drivers. TTL driver boards are also available for the Model 150 Series attenuators.



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### What is the switch life of these programmable attenuators?

Specified life for mechanical switches is normally in the range of 1 to 10 million switching. This specification is per switch, independent of the other switches in the attenuator. For the Model 150 series attenuators the specification is 5 million cycles, i.e. one cycle is the switch moving in both directions. These specifications are based on the mechanical life of the switch, however, other factors have an impact on attenuator life. High power operation can have an adverse effect on the switch contact surfaces. This can reduce the overall life of the switch by causing the attenuator performance to go outside it's specification.

### What is monotonicity?

A programmable step attenuator is considered monotonic if it's attenuation always increases when it is commanded to increase. This applies on a per frequency basis. For instance the 20 dB setting at 1 GHz will always be less than the 21 dB setting at 1 GHz. This does not necessarily mean that the 20 dB setting at 1 GHz will always be less than the 21 dB setting 18 GHz. Monotonicity is influenced by the SWR of the individual attenuator cells as the cells are combined to form an attenuation value. It is also influenced by the summation of individual cell attenuation tolerances as the cells are combined.

### What is the difference between insertion loss and incremental attenuation?

Programmable attenuators have insertion loss and also incremental attenuation. Insertion loss is the loss through the attenuator when all cells are switched to zero dB. It is the residual loss of the device itself. Insertion loss usually increases with frequency reaching several dB at the higher frequencies and generally has very flat frequency response. Incremental attenuation is the attenuation values of the attenuators cells relative to the insertion loss. Since insertion loss is always present, the performance of a programmable attenuator is always given as incremental attenuation relative to insertion loss. Insertion loss is considered part of the fixed performance of the system path in which the programmable attenuator is located.

### What is the advantages of Attenuators with built-in driver circuitry?

These attenuators feature an internal microcontroller-based driver that provides a TTL-level digital interface for control of the attenuator relays (Figure 1). This card simplifies operation and interfacing requirements, while at the same time providing for greatly enhanced flexibility over past designs. User-selectable modes of operation include both parallel and serial bus. The parallel mode provides a simple, one-bit per relay on/off control with internal pullups for use primarily in single attenuator applications. This mode allows the attenuator to be controlled via a variety of methods, such as a TTL-level digital output port, or mechanical toggle switches. The serial mode provides a two-wire serial bus structure and protocol for connecting a number of devices to a single host control interface, suitable for use in larger system and sub-system applications. The built-in driver™ contains non-volatile configuration memory that is used to hold a wide variety of attenuator and driver-dependent parameters, including serial number, attenuator cell dB values, relay configurations, and switching requirements, which are all accessible via the digital interface. This frees the system designer from such low-level details, allowing faster integration. In either operational mode, the microcontroller enters an idle condition during periods of inactivity, turning off all on-board clocks, reducing EMI concerns, and lowering power consumption. On-board regulation for the digital circuitry allows the programmable attenuator to operate from a single input supply voltage.

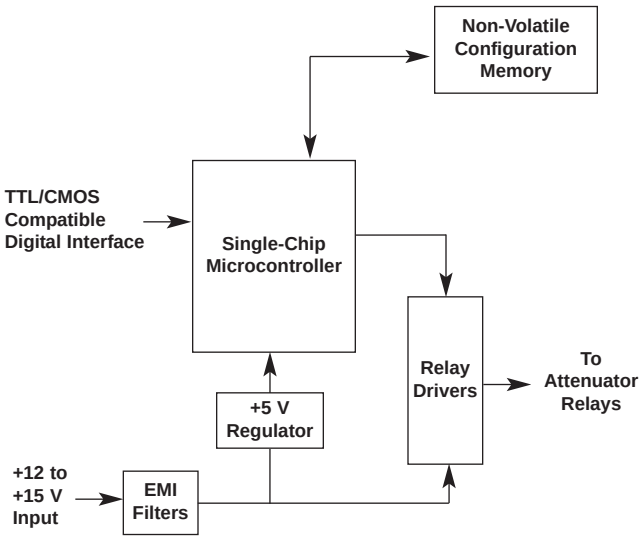



*Figure 1. Digital Driver Circuitry*

### How can I control the Attenuators with built-in drivers?

The communications interface (Model 8210A) provides a flexible, low cost solution for the operation of programmable step attenuators and other electromechanical devices under computer control. Designed to interface to Aeroflex / Weinschel's line of programmable attenuators built-in intelligent drivers, the Model 8210A represents a new concept in device control applications for bench test and subsystem designs. The 8210A communications interface provides a high-level interface from various industry standard communications interfaces, including IEEE-488 and RS232 /RS422/RS485, to the programmable attenuators serial Driver Interface Bus.



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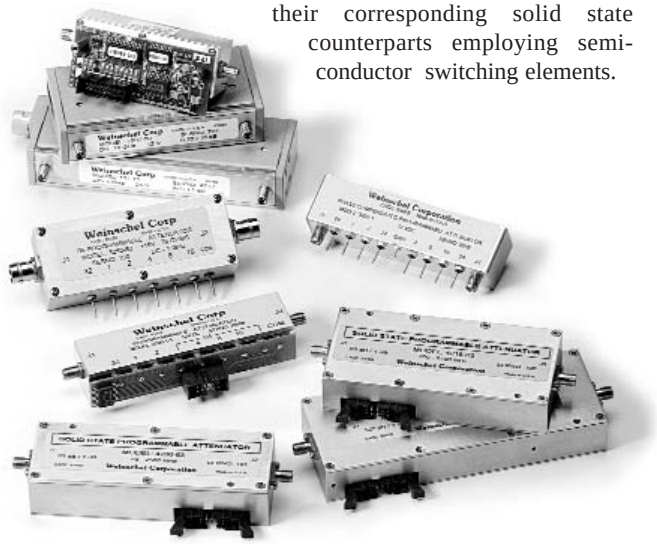
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## *Intermodulation Distortion in Programmable Attenuators....*

**Weinschel** has been a major supplier of programmable attenuators to the RF industry for over 25 years. Historically the most demanding specifications for these components have been low insertion loss and SWR, combined with a reasonable life expectancy of several million switching cycles. This was usually adequate for RF instruments like spectrum analyzers and signal generators, wherein the attenuator bandwidth rather than the switching speed was of prime concern. To achieve wide bandwidths the programmable attenuators were mostly of electromechanical design and the linearity of these passive components was not only assumed but never questioned by any customer. Intermodulation distortion discussions and problems were usually limited to components such as amplifiers, mixers and filters.

In recent years, however, wireless communication systems employing complex digital modulation schemes, increased channel capacity, high transmit power and extremely low receiver sensitivity have put into question the linearity of passive components. Even very low level multi-tone intermodulation products generated by attenuators can seriously degrade the efficiency of a system/ instrument if these products fall within the user passband. For two closely spaced tones at frequencies f1 and f2, the third order IM products at 2f1 - f2 and 2f2 - f1 , are the most harmful distortion products. They are harmful because they are located close to f1 and f2 and virtually impossible to filter out. In today's base stations the multicarrier power amplifier (MCPA) is replacing banks of single-channel amplifiers and their corresponding power combining network. MCPAs have the capability of carrying a number of modulation schemes simultaneously and can also employ schemes such as dynamic-channel-allocation (DCA) to use the allocated frequency spectrum more efficiently. The in-band intermodulation distortion (IMD) performance of these amplifiers is extremely critical and needs to be measured using low distortion programmable multi-tone generators whose IMD performance must be quite superior. This is discussed in the two case studies cited here.

Electromechanical programmable attenuators obviously provide a far superior IMD performance than their corresponding solid state counterparts employing semiconductor switching elements.



However, their slow switch speed, in the order of milliseconds, and short switch life in the order of 5-10 million cycles make them unattractive in some applications like cell phone testing and other ATE systems. Solid State programmable attenuators do overcome these two problems and are therefore included here for IMD performance comparison. It is not the intent of this brief article to go into the theory of intermodulation distortion. The goal here is to provide some good basic IMD test data for a variety of commercial programmable attenuators and let the end user select the most appropriate type for his application.

### Measurement System and Parameters...

All test data presented here was generated using a commercially available Passive IM Analyzer, Summitek Model SI-800A which provides a fully integrated system for characterizing distortion produced by cables, attenuators and other passive devices. Although the system is capable of measuring both, through and reflected IM3, IM5, IM7 and IM9, the focus here is only on through IM for the most troublesome third order product, IM3. To carry out a meaningful comparison between different attenuators all measurements were carried out using two equal amplitude input tones at 869 MHz (f1) and 891 MHz(f2) , the IM3 frequency being 847 MHz (2f1-f2). Input carrier power was stepped in increments of 1 dB from -7dBm to +27dBm. All external adapters and cables were carefully selected to maintain the system's residual IM level of around -120 dBm. Although the system permitted receiver measurements between -70 to -120 dBm we restricted all measurements between -85 to -110 dBm by using a calibrated low IM coupler and attenuators at the output port of the DUT. One must be aware that the accuracy of such small signal measurements can easily be off by 2 to 3 dB so restricting the measurement dynamic range helps reduce the receiver non-linearity error. Measurements were done over several days to ensure stability and repeatability.

### Distortion Comparison for Basic Types of Programmable Attenuators...

The programmable attenuators discussed here are the switched type with a discrete number of `cells'. Switching between the zero and attenuate state on each cell is achieved by a DPDT switch configuration. The cell values are usually in a binary sequence. For example a 6 cell/6 bit unit could have 1, 2, 4, 8, 16 and 32 dB sections providing a 63 dB dynamic range in 1dB increments. Four basic families of programmable attenuators are compared, each family being identified by the switch element used to achieve the transfer from zero to attenuate state.

For the purposes of distortion comparison it was deemed necessary to select units with similar electrical length and/or programmability. Both the electromechanical units, TO5 relay and edge-line type, had an electrical length of about 20 cms. The two solid state units had 6 cell programmability yielding 63 dB in 1 dB step size. All IM3 vs Pin measurements were done with the attenuators programmed to be in their characteristic zero insertion loss state. The zero state was selected because it generated the highest IM3 levels. The graph below shows the



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obvious compromise in IMD performance for the two solid state types. It is worth noting that the IM3 vs Pin slope is not exactly 3:1 as would be the case in a perfect third order device. The theoretical two tone third order intercept point, IP3, commonly used as a figure of merit for comparing linearity is shown in the following table at two different input power levels. The input IP3 is derived from the following relation:

$$\text{Input IP3} = \frac{3(\text{Pin}-\alpha)-\text{IM3}}{2} + \alpha$$

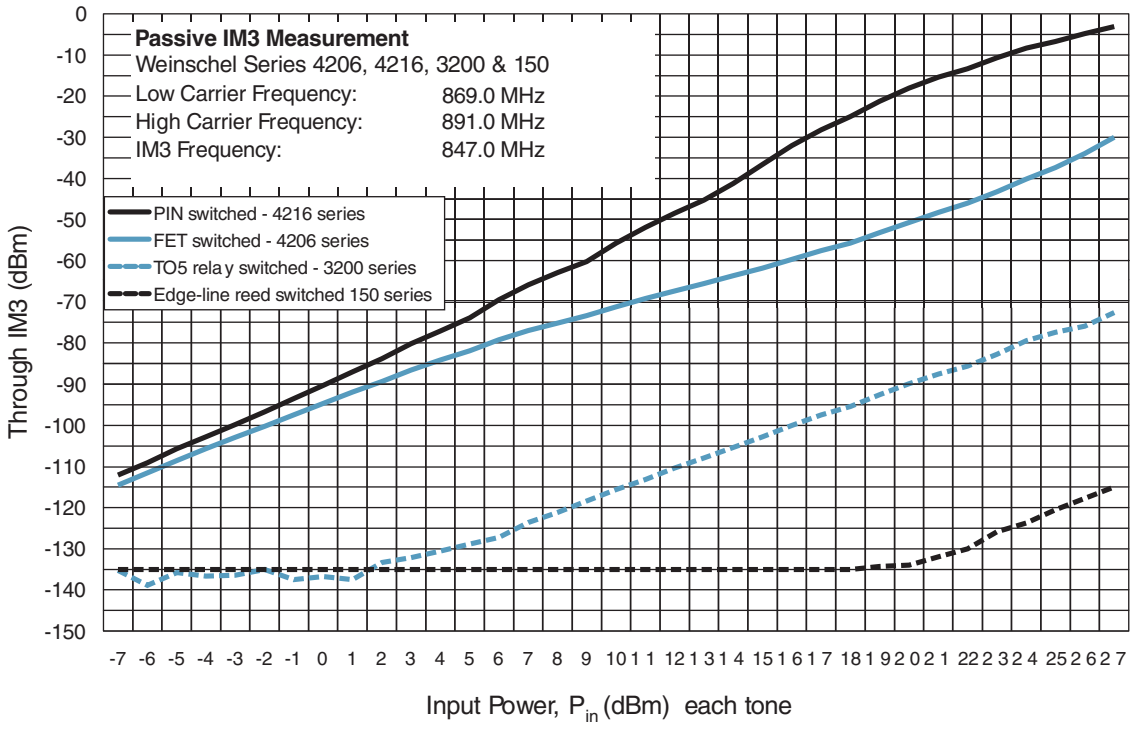
where $\alpha$ = zero insertion loss of each unit @ 847 MHz, the IM3 frequency. IM3 and Pin are selected from Table 1.

**TABLE 1. SPECIFICATION COMPARISONS:**

| Parameter | Attenuator Type | | | |
|---|---|---|---|---|
| | PIN | FET | Relay | Edge-Line |
| IP3 @ 10 dBm | 42.0 dBm | 48.0 dBm | 72 dBm | 98 dBm* |
| IP3 @ 24dBm | 39.0 dBm | 53.5 dBm | 75 dBm | 98 dBm |
| I. Loss | 2.0 dB | 5.0 dB | 1.5 dB | 0 dB |
| Switching Time | 2 µsec | 2 µsec | 5 msec | 20 msec |
| Switch Life | ∞ | ∞ | 10 million | 5 million |
| Frequency (GHz) | 0.8-2.3 | 0.01-2.5 | dc-3 | dc-26.5 |

* NOTE: Although the actual IM3 was not measurable the curve for the edge-line unit is linear and predictable unlike the two curves for the solid state attenuators. If we were to extrapolate this curve we would get the same IP3 figure of +98dBm as expected.

**IM3 Performance of Electromechanical & Solid State Programmable Attenuators**





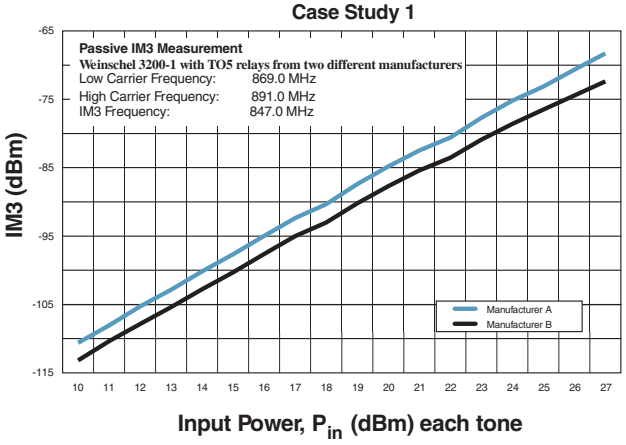

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## Case Study 1

Company A offers its IMD series Phase Aligned 8 tone generators to test intermodulation distortion in multi-carrier power amplifiers. The output level of these generators is accurately controlled using a Weinschel TO5 relay based programmable attenuator offering over 60 dB dynamic range. Eight +13 dBm carriers are input to the attenuator. In MCPAs with feedforward correction, in-band IMD levels could be as low as -75 dBc so Company A wanted at least -85 dBc at the output of their generator. The first problem was that Weinschel could not simulate the exact test conditions. This was readily resolved by establishing a good co-relation between our two tone IM3 measurement and Company A's 8 tone test. Having employed the best plating techniques and using good low IM connector design the attenuator was still short of the required IMD spec. The final improvement was achieved by extensive testing on relays from three different manufacturers. Figure 2 shows IM3 plots of the two best performers. Manufacturer B consistently provided a 4 to 5 dB improvement at the two tone level at Pin of +22 dBm and higher. This corresponded to an acceptable output distortion level for the Company A generator.

**Input Power vs. Through IM3 Level**
**Case Study 1**

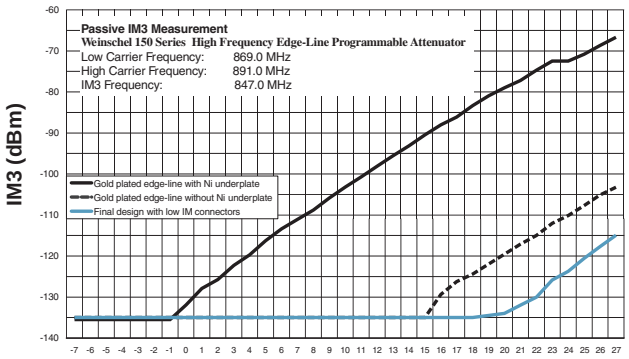



**Input Power, $P_{in}$ (dBm) each tone**

## Case Study 2

Company B manufactures ultra low distortion multi-tone signal generators. Their units offer up to 160 channels from 5 MHz through 1 GHz. Each carrier can be leveled as high as +10 dBm. One of their most stringent requirements is a cross modulation test. The Company B generator specification is -100 dB below the sideband of a 100% amplitude modulated carrier, which is -110 dBc. The actual components used in the critical path had to measure -120 dBc or better. Their generator needed an ultra linear attenuator to provide a programmed output level in 0.5 dB increments. Relay based units were tested and found to be unacceptable. The high performance edge-line attenuators were expected to solve the problem but at first they too fell short, but mainly in their zero attenuation state, which generates maximum distortion. Prior to supplying these units to Company B no customer had asked for a distortion specification on these supposedly passive attenuators. Environmental performance had warranted the use of nickel underplate on the edge lines. This was disclosed to the customer and suspected to be the prime cause of high IMD levels. Since the unit was going to be mounted in a benign environment, elimination of the nickel underplate was not thought to be a problem. Figure 3 demonstrates the tremendous reduction in IM3 levels upon elimination of the nickel underplate-a significant 40 dB! A further 10-15 dB improvement was achieved by redesigning the connectors to reduce their passive IMD. The IM improvement in these connectors would have served no purpose prior to the elimination of nickel. This is because the main source of distortion lay behind the connector back plane, along the edge transmission line, which had a far greater electrical length than the two connectors.

**Input Power vs. Through IM3 Level**
**Case Study 2**




**Input Power, $P_{in}$ (dBm) each Tone**

## Conclusion

Abundant intermodulation test data for four families of programmable attenuators has been presented in an easy format, together with their other key performance features. This should enable instrument and system designers to select the most suitable type for their application.

The two case studies have also demonstrated that an OEM component supplier cannot possibly simulate the different distortion test scenarios of every customer. Such tests would be extremely varied, complex and cost prohibitive. The IM analyzer used at Weinschel was indeed a narrow band instrument and one might be concerned about the unit's performance at other frequencies. This is a legitimate concern for the solid state types, in which the distortion mechanism is a strong function of the operating frequency. For the broadband electromechanical types this is not a major issue. However, with a meaningful two tone intermodulation measurement it is quite possible to get an excellent correlation with the customer's test conditions and thereby come up with a corresponding specification under the two tone test. It is helpful though, to be able to replicate the total power level that the unit would be subjected to in the field.

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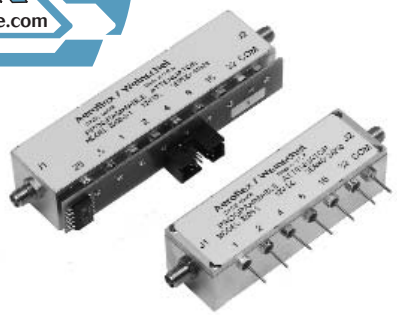
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AEROFLEX WEINSCHEL

# Model 3200 Series
# Model 3200 (E Series)
# Programmable Attenuators
## with optional TTL Interface

dc to 2.0 GHz
dc t0 3.0 GHz
1 Watt

EXPRESS
www.sicklesonline.com
800-542-4457



## Features

- **Widest Selection of Attenuation Ranges & Step Sizes**
- **Available *Express* Models:** 3200-1, 3200-1E-2
  3200-2, 3200-2E-2
  3201-1, 3201-2
  3206-1

  Other models may be available for Express delivery.
- **High Quality Construction & Connectors**
- **Special Configurations Available Upon Request**
  - Custom Cell/Step Size Configurations
  - 3.0 GHz and Higher Frequencies

## Description

The 3200 Series Programmable Step Attenuators are designed for use in automatic test equipment and OEM systems operating in the dc to 3 GHz frequency range. This series is available in many standard attenuation ranges and cell configurations. Custom designed configurations are available upon request. Each cell contains a double-pole, double-throw relay that provides a zero path or attenuated path for the RF signal.

Microstrip circuitry and special compensation techniques produce flat attenuation versus frequency characteristics. The microstrip construction, using thick-film circuit elements, ensures product uniformity. To minimize RF leakage, the 3200 Series Attenuators are provided with gold-plated contact areas and feedthrough filters at each control terminal.

## Specifications

**NOMINAL IMPEDANCE:** 50 Ω

**FREQUENCY RANGE:**

dc to 2.0 GHz: 3200-1, 3200-2, 3201-1, 3201-2, 3205-1, 3205-2, 3205-3, 3206-1, 3209-1

dc to 3.0 GHz: 3200-1E, 3200-2E, 3201-1E, 3205-3E, 3206-1E, 3209-1E

**CELL CONFIGURATIONS:**

| Model Number | NO. Cells | Attenuation Range/Steps (dB) | Cell Increments (dB) |
|---|---|---|---|
| 3200-1<br>3200-1E | 8 | 127/1 | 1, 2, 4, 8, 16, 32, 64* |
| 3200-2<br>3200-2E | 8 | 63.75/0.25 | 0.25, 0.5, 1, 2, 4, 8, 16, 32 |
| 3201-1<br>3201-1E | 5 | 31/1 | 1, 2, 4, 8, 16 |
| 3201-2 | 5 | 120/10 | 10, 20, 30, 60** |
| 3205-1 | 4 | 70/10 | 10, 20, 20, 20 |
| 3205-2 | 4 | 55/5 | 5, 10, 20, 20 |
| 3205-3<br>3205-3E | 4 | 1.5/0.1 | 0.1, 0.2, 0.4, 0.8 |
| 3206-1<br>3206-1E | 6 | 63/1 | 1, 2, 4, 8, 16, 32 |
| 3209-1<br>3209-1E | 10 | 64.5/0.1 | 0.1, 0.2, 0.4, 0.8, 1, 2, 4, 8, 16, 32 |

*64 dB cell comprised of two 32 dB cells
*60 dB cell comprised of two 30 dB cells

**MAXIMUM SWR:**

| Freq Range (GHz) | 3200-1<br>3200-2 | 3200-1E<br>3200-2E<br>3201-1E<br>3205-3E | 3201-X<br>3205-X<br>3206-X | 3206-1E | 3209-1 | 3209-1E |
|---|---|---|---|---|---|---|
| dc - 0.2 | 1.30 | 1.25 | 1.30 | 1.25 | 1.35 | 1.35 |
| 0.2 - 1 | 1.25 | 1.25 | 1.25 | 1.25 | 1.35 | 1.35 |
| 1 - 2 | 1.35 | 1.25 | 1.35 | 1.25 | 1.35 | 1.35 |
| 2 - 3 | - - - | 1.40 | - - - | 1.35 | - - - | 1.45 |

**INCREMENTAL ATTENUATION ACCURACY:**

| Frequency Range (GHz) | Accuracy |
|---|---|
| dc - 0.5 | ± 0.2 dB or 0.5% |
| 0.5 - 1 | ± 0.2 dB or 1.0% |
| 1 -3 | ± 0.3 dB or 2.0% |

**MONOTONICITY:** dc to 3.0 GHz

**INCREMENTAL TEMPERATURE COEFFICIENT:**

30 and 32 dB Cells: 0.00005 dB/dB/°C
All other cells: 0.00002 dB/dB/°C

**POWER RATING:** 1 watt average to 25°C ambient temperature, derated linearly to 0.25 watt @ 71°C. 50 watts peak (5 µsec pulse width; 1% duty cycle)



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## Specifications - Con't

**MAXIMUM INSERTION LOSS (dB):**

| Frequency Range (GHz) | 3200-1 3200-2 | 3200-1E 3200-2E | 3201-1 3201-2 | 3205-X | 3201-1E | 3205-3E | 3206-1 | 3206-1E | 3209-1 | 3209-1E |
|---|---|---|---|---|---|---|---|---|---|---|
| dc - 0.5 | 2.80 | 2.20 | 1.80 | 1.80 | 1.50 | 1.25 | 2.00 | 1.50 | 3.50 | 3.00 |
| 0.5 - 1.0 | 3.50 | 3.00 | 2.40 | 2.30 | 1.80 | 1.75 | 2.70 | 2.00 | 4.50 | 3.50 |
| 1.0 - 1.5 | 4.25 | 3.20 | 3.00 | 2.80 | 2.25 | 2.25 | 3.30 | 2.50 | 5.60 | 4.00 |
| 1.5 - 2.0 | 4.75 | 3.70 | 3.75 | 3.30 | 2.50 | 2.50 | 4.00 | 2.80 | 6.70 | 4.50 |
| 2.0-3.0 | - - - | 4.90 | - - - | - - - | 3.40 | 3.40 | - - - | 3.70 | - - - | 5.50 |

**POWER COEFFICIENT:** <0.005 dB/dB/watt

**RATED SWITCH LIFE:** 5 million cycles operations per cell @ 0 dBm

**SWITCHING TIME:** 6 msec. maximum at nominal rated voltage

**RELEASE TIME:** 3 msec maximum

**CYCLING RATE:** 5 Hz maximum per relay

**OPERATING VOLTAGE**: +12V (+ 16V maximum; +10V minimum)

**OPERATING CURRENT:**

2 GHz Models: 14 mA typical per cell @ +12V

3 GHz Models: 30 mA typical per cell @ +12V

**TEMPERATURE RANGE (Operating):** -55°C to +71°C

**TEST DATA:** Test data is available at additional cost.

**CONNECTORS:** SMA female connectors per MIL-STD-348 interface dimensions - mate nondestructively with MIL-C-39012 connectors.

**CONTROL TERMINALS:** 0.040 inch. (1 mm) diameter solderable leads. May be used with PC board sockets/ receptacles.

**CONSTRUCTION:**

| | |
|---|---|
| Housing: | Aluminum |
| Connectors: | Stainless steel body and beryllium copper contacts. |
| Control terminals: | Brass/Copper, Silver plated |

**WEIGHT (Typical):**

| | |
|---|---|
| 3200-1, 3200-2, 3200-1E & 3200-2E: | 117 g (4.1 oz) |
| 3201-1 & 3201-1E: | 89 g (3.1 oz) |
| 3201-2: | 96 g (3.4 oz) |
| 3205-1, 3205-2, 3205-3, 3205-3E: | 77 g (2.7 oz) |
| 3206-1, 3206-1E: | 99 g (3.5 oz) |
| 3209-1, 3209-1E: | 159 g (5.6 oz) |

**MODEL NUMBER DESCRIPTION:**

**Example, DC-2 GHz models:**

| | |
|---|---|
| 320X-Y | For a basic 2 GHz model* |
| 320X-Y-1 | Add -1 for TTL driver board with a 10 pin ribbon cable connector. |
| 320X-Y-2 | Add -2 for TTL driver board with a 15 pin D type connector. |

**Example, DC-3 GHz models:**

Add E as in:

| | |
|---|---|
| 320X-YE | For a basic 3 GHz model* |
| 320X-YE-1 | Add -1 for a TTL driver board with a 10 pin ribbon cable connector |
| 320X-YE-2 | Add -2 for a TTL driver board with a 15 pin D connector |

* Use the Cell Configuration table to determine X and Y for available attenuation ranges.

## CONTROL CONFIGURATION:

**Standard Unit:** One terminal is connected to case ground and the remaining terminals are provided for activation of individual cells. Attenuation is fail-safe to "0" setting in the absence of a control voltage. Application of a voltage (+) to a particular cell causes it to switch to the attenuate position.

**Units with TTL Option:** Units with this option are supplied with a very low profile connectorized TTL interface board mounted directly to the control terminals. This TTL interface option is available with either a 10 pin ribbon cable connector or a 15 pin "D" connector (**limited models**), refer to list below. Each type is supplied with a mating connector. Refer to Physical Dimensions for mating connector pin/wiring details. Two wires are specified for supply voltage and ground. The remaining wires will accept TTL control signals to activate or de-activate a particular attenuation cell. A TTL high will energize a cell to the high attenuation state, whereas a TTL low will maintain a cell in its zero attenuation state.

To order 3200 Series Attenuators with this option add -1 to basic model number for ribbon cable connector and -2 for the "D" connector. Example: Model 3201-1 with a TTL interface board would be 3201-1-1. Mating connector is provided. To order a TTL Driver board separately for an existing 3200 Series Attenuator, use the following:

| Basic Model No. | TTL BD Kit Part No. 10 Pin Ribbon | TTL BD Part No. 15 Pin "D" CONN |
|---|---|---|
| 3200-1, 3200-1E | 101-1781 | 101-1798-000** |
| 3200-2, 3200-2E | 101-1781 | 101-1798-000** |
| 3201-1, 3201-2E | 101-1780 | 101-1798-001** |
| 3201-2 | 101-1780 | 101-1798-001** |
| 3205-1 | 101-1780 | 101-1798-001** |
| 3205-2 | 101-1780 | 101-1798-001** |
| 3205-3, 3205-3E | 101-1780 | 101-1798-001** |
| 3206-1, 3206-3E | 101-1780 | N/A |
| 3209-1, 3209-1E | 101-1804-000* | N/A |

* 14 pin ribbon connector.

** 3 FT TTL Interface Cable Part No. 101-1805 supplied with unit.

Note: Control is non-latching and requires a continuous control signal for the period of time in which attenuation is required.



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## TTL DRIVER SPECIFICATIONS:

**INTERFACE CONNECTOR:** Option -1(Models 3200, 3201, 3205 and 3206): 10 pin .025 square post header on .1 center, mates with Amp connector 746285-1 or equivalent. Option -1 (3209): 14 pin .025 square post header on .1 center, mates with Amp connector 746285-2 or equivalent. Option -2: 15 pin D Socket Connector, mates with Cannon connector DA-15S or equivalent.

**INPUT VOLTAGE:** $V_{IN}$ High= +2.0V minimum
+5.0V typical
Vcc maximum
$V_{IN}$ Low = 0 minimum
0.8 maximum

**INPUT CURRENT:** $I_{IN}$ ($V_{IN}$=2.4 V) = 55 µA
$I_{IN}$ ($V_{IN}$=3.85 V) = 280 µA

**SUPPLY CURRENT (Digital Section):** $I_{CC}$=25.0 mA maximum

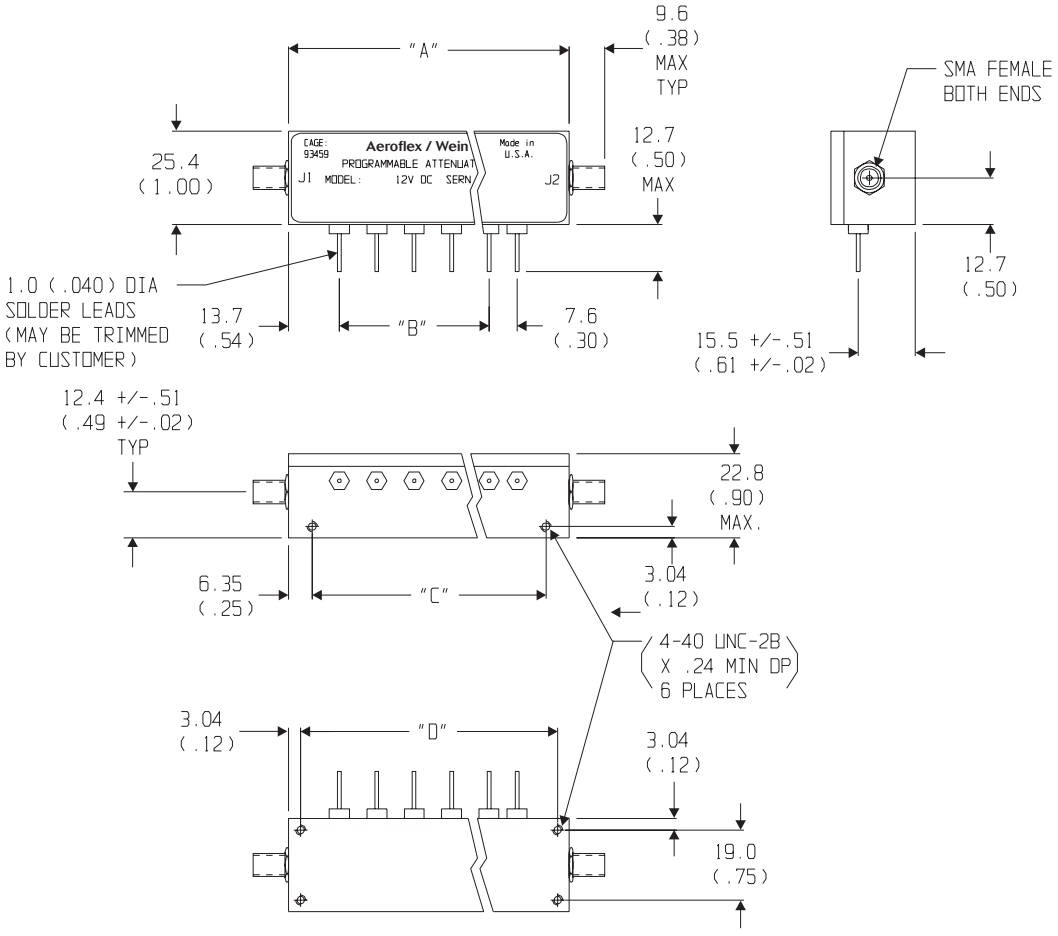
**SUPPLY CURRENT (per cell continuos):** $I_{CC}$=25.0 mA maximum for 2 GHz models and 30 mA per cell for 3 GHz models.

**SUPPLY VOLTAGE:** $V_{CC}$=+12.0 to +15V

**TEMPERATURE RANGE (Operating):** -40°C to +70°C

**MODELS WITH BUILT-IN DRIVERS:** Most 3200s are available with an intelligent interface\driver cards. These are designed to interface with our 8210A Series Controllers which greatly simplifies computer control applications. Refer to Model 3200T and 3201T data sheet for more information.

## PHYSICAL DIMENSIONS:




| Model No. | No. Cells | A | B | C | D |
|---|---|---|---|---|---|
| 3200-X | 8 | 101.6 (4.0 | 7 EQ SPCS @ 10.16 (.40) = 71.1 (2.80) | 88.9 (3.50) | 95.2 (3.75) |
| 3201-X | 5/4 | 76.2 (3.00) | 4 EQ SPCS @ 10.16 (.40) = 40.64 (1.60) | 63.5 (2.50) | 69.8 (2.75) |
| 3205-X | 4 | 58.9 (2.32) | 3 EQ SPCS @ 10.16 (.40) = 30.5 (1.20) | 46.2 (1.82) | 52.6 (2.07) |
| 3206-X | 6 | 81. 3±0.5 (3.20±0.02 | 5 EQ SPCS @ 10.16 (.40) = 50.8 (2.00) | 68.6 (2.70) | 75.18 (2.96) |

NOTE: All dimensions are given in mm (inches) and are maximum, unless otherwise specified.

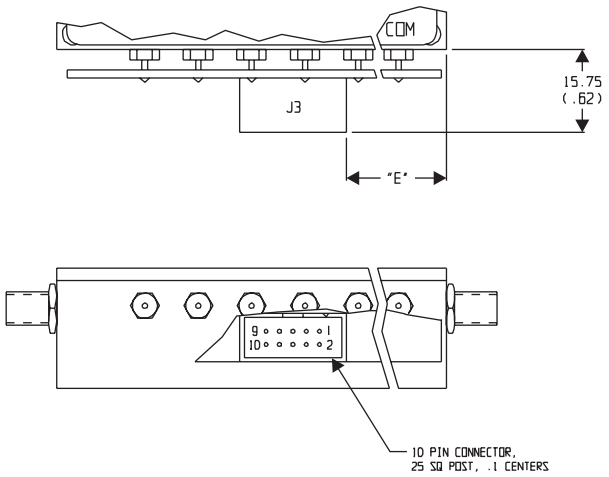


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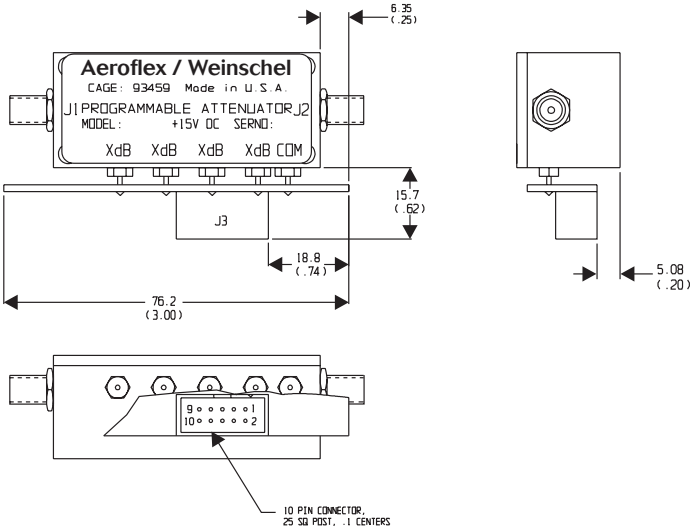
## PHYSICAL DIMENSIONS:

***TTL OPTION -1 (3200, 3201, 3206):***




| Model No. | E |
|---|---|
| 3200-X-1 | 37.8 (1.49) |
| 3201-X-1 | 18.8 (0.74) |
| 3206-X-1 | 18.8 (0.74) |

***TTL OPTION -1 (3205):***




**Control Connector J3 Pin Locations:**

| TTL Conn PIN No. (J3) | 3200-1-1 dB (Cell) | 3200-2-1 dB (Cell) | 3201-1-1 dB (Cell ) | 3201-2-1 dB (Cell) | 3205-1-1 dB (Cell) | 3205-2-1 dB (Cell) | 3205-3-1 dB (Cell ) | 3206-1-1 dB (Cell) |
|---|---|---|---|---|---|---|---|---|
| 1 | 32 | 0.25 | NC | NC | NC | NC | NC | NC |
| 2 | 1 | 0.5 | NC | NC | NC | NC | NC | NC |
| 3 | 2 | 1 | 1 | 30 | NC | NC | NC | 1 |
| 4 | 32* | 2 | 2 | 10 | 10 | 5 | 0.1 | 2 |
| 5 | 4 | 4 | 4 | 30** | 20 | 10 | 0.2 | 4 |
| 6 | 8 | 8 | 8 | 20 | 20 | 20 | 0.4 | 8 |
| 7 | 16 | 16 | 16 | 30** | 20 | 20 | 0.8 | 16 |
| 8 | 32* | 32 | NC | NC | NC | NC | NC | 32 |
| 9 | COM | COM | COM | COM | COM | COM | COM | COM |
| 10 | +Vcc | +Vcc | +Vcc | +Vcc | + Vcc | + Vcc | +Vcc | + Vcc |

*64 dB cell comprised of two 32 dB cells
**60 dB cell comprised of two 30 dB cells
NC = Not Connected

NOTE: All dimensions are given in mm (inches) and are maximum, unless otherwise specified.

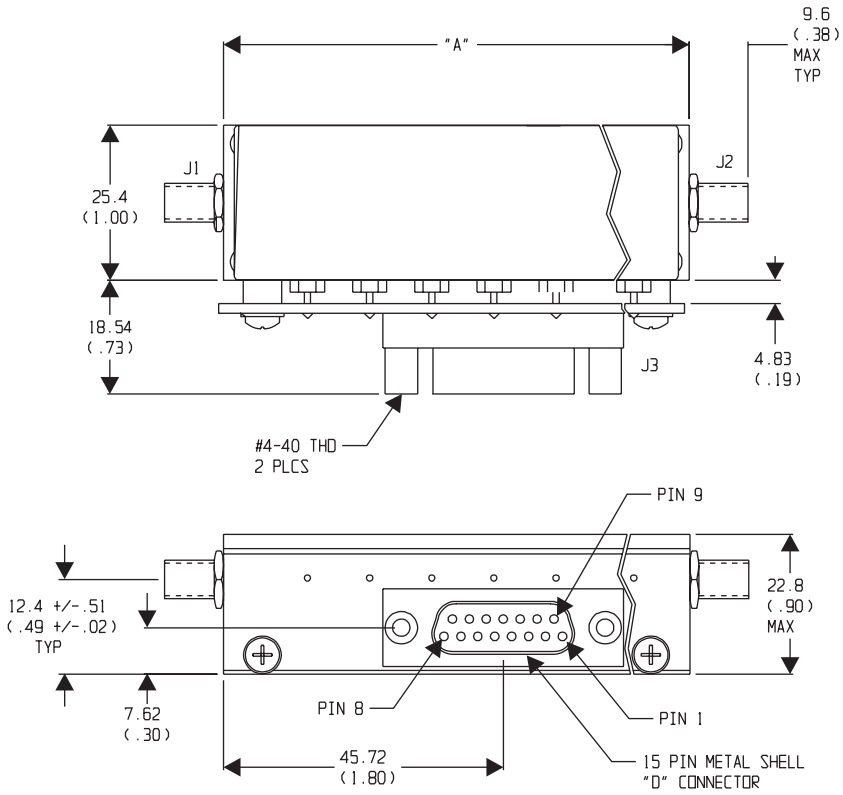


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## PHYSICAL DIMENSIONS:

***TTL Driver Option -2 (3200, 3201, 3205):***




| Model No. | A |
|---|---|
| 3200-X-2 | 101.6 (4.00) |
| 3201-X-2 | 76.2 (3.00) |
| 3205-X-2 | 76.2 (3.00) |

**Control Connector J3 Pin Locations:**

| "D" Conn PIN No. (J3) | 3200-1-2 dB (Cell) | 3200-2-2 dB (Cell) | 3201-1-2 dB (Cell ) | 3201-2-2 dB (Cell) | 3205-1-2 dB (Cell) | 3205-2-2 dB (Cell) | 3205-3-2 dB (Cell) | Cable (P/N 101-1805) Color Code |
|---|---|---|---|---|---|---|---|---|
| 1 | 32 | 32 | NC | NC | NC | NC | NC | BRN |
| 2 | 16 | 16 | NC | NC | NC | NC | NC | YEL |
| 3 | 8 | 8 | NC | NC | NC | NC | NC | GRN |
| 4 | 4 | 4 | 16 | 30** | 20 | 20 | 0.8 | LT BLU |
| 5 | 32 | 0.25 | 1 | 30** | NC | NC | NC | VIO |
| 6 | 1 | 0.5 | 2 | 10 | 10 | 5 | 0.1 | GRY |
| 7 | 2 | 1 | 4 | 30 | 20 | 10 | 0.2 | WHT |
| 8 | 32* | 2 | 8 | 20 | 20 | 20 | 0.4 | WHT/BLK |
| 9 | NC | NC | NC | NC | NC | NC | NC | RED |
| 10 | GND | GND | GND | GND | GND | GND | GND | BLK |
| 11 | NC | NC | NC | NC | NC | NC | NC | - - - |
| 12 | NC | NC | NC | NC | NC | NC | NC | - - - |
| 13 | NC | NC | NC | NC | NC | NC | NC | - - - |
| 14 | NC | NC | NC | NC | NC | NC | NC | - - - |
| 15 | +Vcc | +Vcc | +Vcc | +Vcc | +Vcc | +Vcc | +Vcc | ORN |

*64 dB cell comprised of two 32 dB cells
**60 dB cell comprised of two 30 dB cells
NC = Not Connected

NOTE: All dimensions are given in mm (inches) and are maximum, unless otherwise specified.

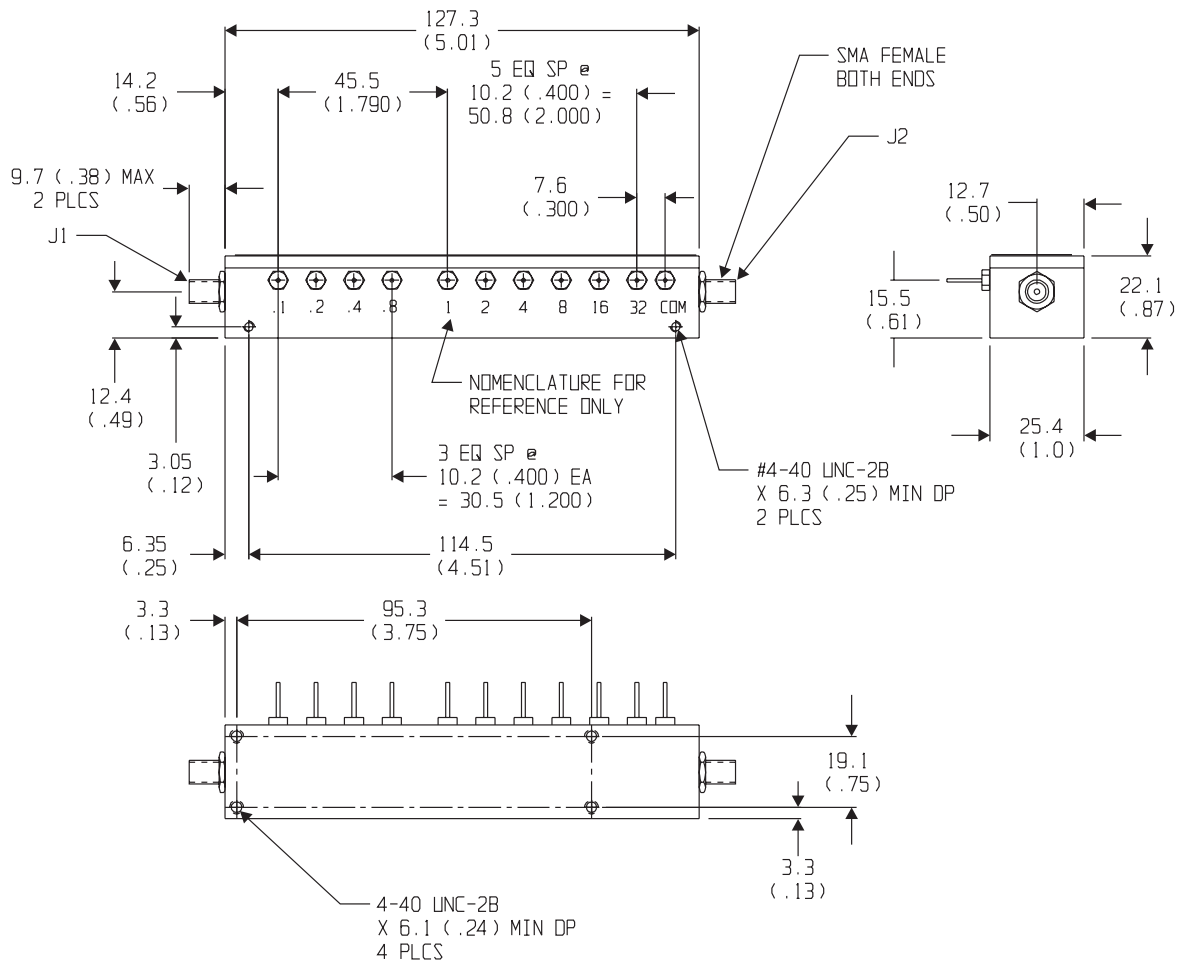


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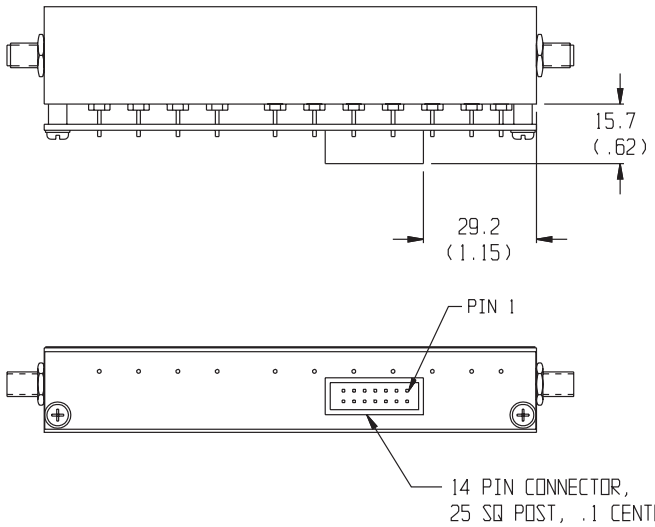
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## PHYSICAL DIMENSIONS:

***Model 3209-1:***




***Model 3209-1-1 (TTL Option -1):***




| CONN | SIGNAL DES |
|---|---|
| J3-14 | GND |
| J3-13 | +12V |
| J3-12 | N/A |
| J3-11 | N/A |
| J3-10 | 32dB |
| J3-9 | 16dB |
| J3-8 | 8dB |
| J3-7 | 4dB |
| J3-6 | 2dB |
| J3-5 | 1dB |
| J3-4 | .8dB |
| J3-3 | .4dB |
| J3-2 | .2dB |
| J3-1 | .1dB |

NOTE: All dimensions are given in mm (inches) and are maximum, unless otherwise specified.



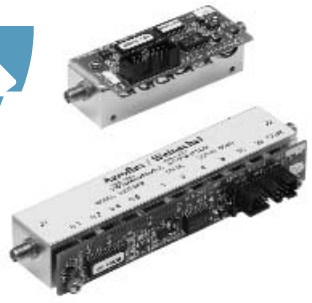
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# Model 3200T — dc to 2.0 GHz
# Model 3200T (E Series) — dc to 3.0 GHz
# Programmable Attenuators — 1 Watt
## with built-in Microprocessor-Based Driver

*For Use with Weinschel 8210A Controller*

www.sicklesonline.com
800-542-4457



## Features

- **Widest Selection of Attenuation Ranges & Steps Sizes**
- **Available *Express* Models:** 3200T-1, 3206T-1

  Other models may be available for Express delivery.
- **Built-In TTL\CMOS Interface Driver Circuitry**
- **High Quality Construction and Connectors**
- **Special Configurations Available Upon Request**
  - Custom Cell/Step Size Configurations
  - 3.0 GHz and Higher Frequencies

## Description

This line of intelligent programmable step attenuators with a built-in digital interface are designed to simplify the control and integration of these devices into subsystem and bench applications. This series of Programmable Step Attenuators is designed for use in automatic test equipment and OEM systems operating in the dc to 3 GHz frequency range. These models are available in many standard attenuation ranges and cell configurations. Each cell contains a double-pole, double-throw relay that provides a minimum loss or attenuated path for the RF signal.

Microstrip circuitry and special compensation techniques produce flat attenuation versus frequency characteristics. The microstrip construction, using thick-film circuit elements, ensures product uniformity. To minimize RF leakage, the 3200T Series Attenuators are provided with gold-plated contact areas and feedthrough filters at each control terminal.

## Specifications

**NOMINAL IMPEDANCE:** 50 Ω

**FREQUENCY RANGE:**

dc to 2.0 GHz: 3200T-1, 3200T-2, 3201T-1, 3201T-2, 3205T-1, 3205T-2, 3205T-3, 3206T-1, 3209T-1

dc to 3.0 GHz: 3200T-1E, 3200T-2E, 3201T-1E, 3205T-3E, 3206T-1E, 3209T-1E

**CELL CONFIGURATIONS:**

| Model Number | NO. Cells | Attenuation Range/Steps (dB) | Cell Increments (dB) |
|---|---|---|---|
| 3200T-1<br>3200T-1E | 8 | 127/1 | 1, 2, 4, 8, 16, 32, 64* |
| 3200T-2<br>3200T-2E | 8 | 63.75/0.25 | 0.25, 0.5, 1, 2, 4, 8, 16, 32 |
| 3201T-1<br>3201T-1E | 5 | 31/1 | 1, 2, 4, 8, 16 |
| 3201T-2 | 5 | 120/10 | 10, 20, 30, 60** |
| 3205T-1 | 4 | 70/10 | 10, 20, 20, 20 |
| 3205T-2 | 4 | 55/5 | 5, 10, 20, 20 |
| 3205T-3<br>3205T-3E | 4 | 1.5/0.1 | 0.1, 0.2, 0.4, 0.8 |
| 3206T-1<br>3206T-1E | 6 | 63/1 | 1, 2, 4, 8, 16, 32 |
| 3209T-1<br>3209T-1E | 10 | 64.5/0.1 | 0.1, 0.2, 0.4, 0.8, 1, 2, 4, 8, 16, 32 |

*64 dB cell comprised of two 32 dB cells
**60 dB cell comprised of two 30 dB cells

**MAXIMUM SWR:**

| Freq Range (GHz) | 3200T-1<br>3200T-2 | 3200T-1E<br>3200T-2E | 3201T-X<br>3205T-X<br>3206T-X | 3201T-1E<br>3205T-3E<br>3206T-1E | 3209T-1 | 3209T-1E |
|---|---|---|---|---|---|---|
| dc - 0.2 | 1.30 | 1.25 | 1.30 | 1.25 | 1.35 | 1.35 |
| 0.2 - 1 | 1.25 | 1.25 | 1.25 | 1.25 | 1.35 | 1.35 |
| 1 - 2 | 1.35 | 1.25 | 1.35 | 1.25 | 1.35 | 1.35 |
| 2 - 3 | - - - | 1.40 | - - - | 1.35 | - - - | 1.45 |

**INCREMENTAL ATTENUATION ACCURACY:**

| Frequency Range (GHz) | Accuracy |
|---|---|
| dc - 0.5 | ± 0.2 dB or 0.5% |
| 0.5 - 1 | ± 0.2 dB or 1.0% |
| 1 -3 | ± 0.3 dB or 2.0% |

**MONOTONICITY:** dc to 3.0 GHz

**INCREMENTAL TEMPERATURE COEFFICIENT:**

30 and 32 dB Cells: 0.00005 dB/dB/°C
All other cells: 0.00002 dB/dB/°C



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## Specifications - Con't

**MAXIMUM INSERTION LOSS (dB):**

| Frequency Range (GHz) | 3200T-1 3200T-2 | 3200T-1E 3200T-2E | 3201-1 3201-2 | 3205T-X | 3201T-1E 3205T-3E | 3206T-1 | 3206T-1E | 3209T-1 | 3209T-1E |
|---|---|---|---|---|---|---|---|---|---|
| dc - 0.5 | 2.80 | 2.00 | 1.80 | 1.80 | 1.25 | 2.00 | 1.50 | 3.50 | 3.00 |
| 0.5 - 1.0 | 3.50 | 2.70 | 2.40 | 2.30 | 1.75 | 2.70 | 2.00 | 4.50 | 3.50 |
| 1.0 - 1.5 | 4.25 | 3.00 | 3.00 | 2.80 | 2.25 | 3.30 | 2.50 | 5.60 | 4.00 |
| 1.5 - 2.0 | 4.75 | 3.50 | 3.75 | 3.30 | 2.50 | 4.00 | 2.80 | 6.70 | 4.50 |
| 2.0-3.0 | - - - | 4.30 | - - - | - - - | 3.40 | - - - | 3.70 | - - - | 5.50 |

**POWER RATING:** 1 watt average to 25°C ambient temperature, derated linearly to 0.25 watt @ 71°C. 50 watts peak (5 µsec pulse width; 1% duty cycle)

**POWER COEFFICIENT:** < 0.005 dB/dB/watt

**RATED SWITCH LIFE:** 5 million cycles operations per cell @ 0 dBm

**CYCLING RATE:** 5 Hz maximum per relay

**DRIVER INTERFACE:**

Input Supply Voltage: +12.0 to +15. V
Control Signals: TTL/CMOS compatible
Interface Modes: parallel / serial
DC Characteristics (at 25 °C):

| Parameter | | Specification |
|---|---|---|
| $V_{IL}$ | Low-level input V: | -0.5V min, 0.8V max |
| $V_{IH}$ | High-level input V: | 2.0V min, 5.25V max |
| $I_{PU}$ | Pullup current | 50 µA min, 400 µA max |
| $V_{IN}$ | Supply Voltage: | +12.0 to +15.0V |
| $I_{IN}$ | Supply current: (digital section) | 25 mA |
| $I_{CELL}$ | Supply current: (per cell) continuous | 15 mA (2 GHz Units) 30 mA (3 GHz Units) |

**TEMPERATURE RANGE (Operating):** -20°C to +70°C

**TEST DATA:** Test data is available at additional cost.

**CONNECTORS:** SMA female connectors per MIL-STD-348 interface dimensions - mate nondestructively with MIL-C-39012 connectors.

**INTERFACE CONNECTOR:** 14 pin .025 square post header on .1 center. Mates with Amp connector 746285-2 or equivalent.

**CONSTRUCTION:**

Housing: Aluminum
Connectors: Stainless steel body and beryllium copper contacts.

**WEIGHT:**

| | |
|---|---|
| 3200T-X | 165 g (8.4 oz) |
| 3201T-X | 132 g (7.3 oz) |
| 3205T-X | 132 g (7.3 oz) |
| 3206T-X | 132 g (7.3 oz) |
| 3209T-X | 218 g (9.7 oz) |

## ACCESSORIES

**Programmable Attenuator/Switch Controller:** The Model 8210A Programmable Attenuator/Switch Controller provides a flexible, low cost solution for the operation of programmable step attenuators and other electromechanical devices under computer control. Designed to interface to Aeroflex / Weinschel's intelligent programmable attenuators, the 8210A represents a new concept in device control applications for bench test and subsystem designs. The 8210A provides a high-level interface from various industry standard communications interfaces, including IEEE-488 and RS232/RS422/RS485, to the programmable attenuator's serial Driver Interface Bus.

## CONTROL CONFIGURATION

These programmable attenuators feature an internal microcontroller-based driver that provides a TTL-level digital interface for control of the attenuator relays. This card simplifies operation and interfacing requirements, while at the same time providing for greatly enhanced flexibility over past designs. User-selectable modes of operation include both parallel and serial bus. The parallel mode provides a simple, one-bit per relay on/off control with internal pullups for use primarily in single attenuator applications. This mode allows the attenuator to be controlled via a variety of methods, such as a TTL-level digital output port, or mechanical toggle switches. The device bus provides a two-wire serial bus structure and protocol for connecting a number of devices to a single host control interface, suitable for use in larger system and sub-system applications. The digital interface contains non-volatile configuration memory that is used to hold a wide variety of attenuator and driver-dependent parameters, including serial number, attenuator cell dB values, relay configurations, and switching requirements, which are all accessible via the digital interface.

In either operational mode, the microcontroller enters an idle condition during periods of inactivity, turning off all on-board clocks, reducing EMI concerns, and lowering power consumption. On-board regulation for the digital circuitry allows the attenuator to operate from a single input supply voltage.

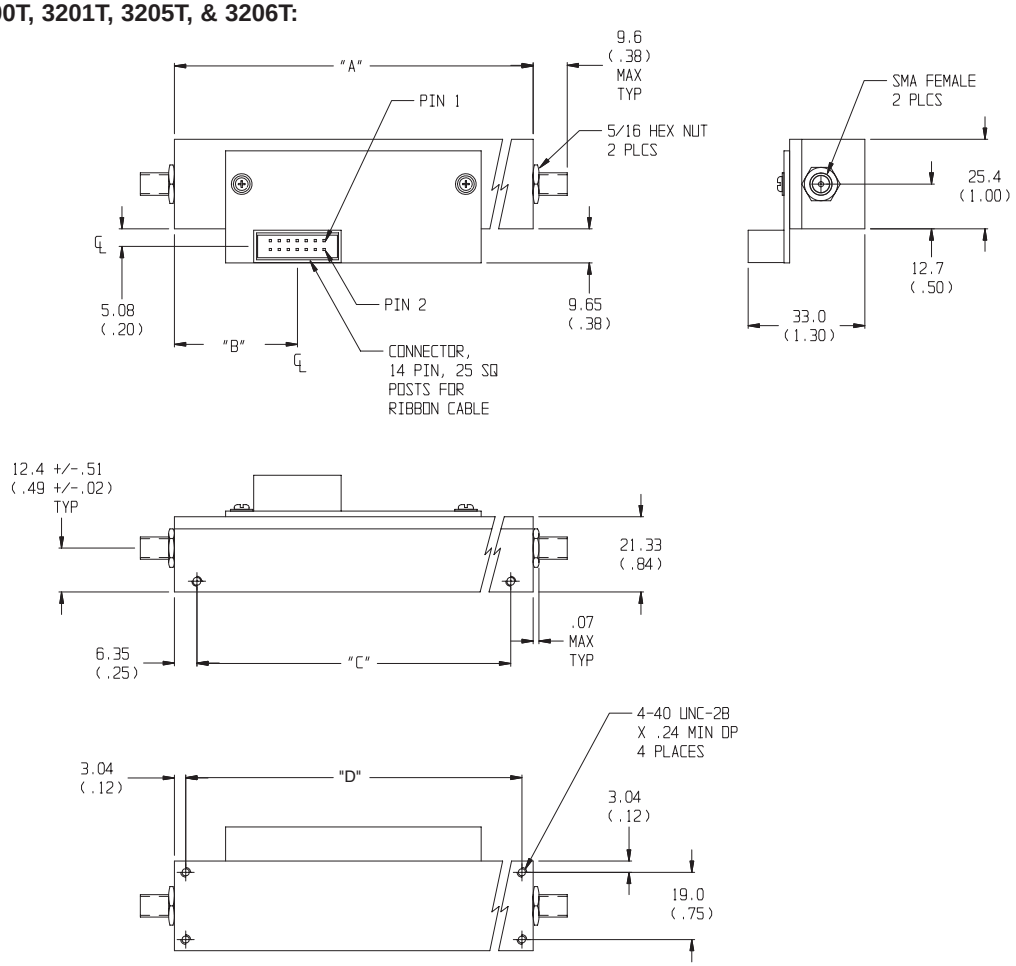


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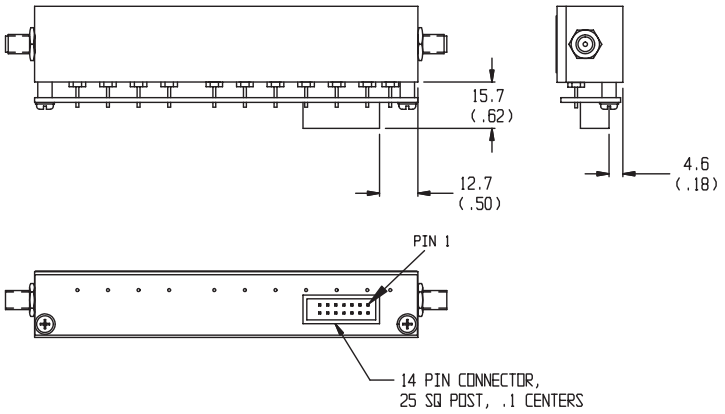
## PHYSICAL DIMENSIONS:

**Model 3200T, 3201T, 3205T, & 3206T:**




| Model No. | No. Cells | A | B | C | D |
|---|---|---|---|---|---|
| 3200T-X | 8 | 101.6 (4.0) | 34.8 (1.37) | 88.9 (3.50) | 95.2 (3.75) |
| 3201T-X | 5/4 | 76.2 (3.00) | 22.1 (0.87) | 63.5 (2.50) | 69.8 (2.75) |
| 3205T-X | 4 | 72.4 (2.85) | 20.3 (0.80) | 46.2 (1.82) | 52.6 (2.07) |
| 3206T-X | 6 | 81. 3±0.5 (3.20±0.02 | 24.0 (0.98) | 68.6 (2.70) | 75.18 (2.96) |

***Model 3209T:***




| CONN | SIGNAL DES |
|---|---|
| J3-14 | N/A |
| J3-13 | N/A |
| J3-12 | N/A |
| J3-11 | N/A |
| J3-10 | N/A |
| J3-9 | N/A |
| J3-8 | N/A |
| J3-7 | N/A |
| J3-6 | N/A |
| J3-5 | N/A |
| J3-4 | GND |
| J3-3 | GND |
| J3-2 | +V |
| J3-1 | +V |

SMARTSTEP SYSTEM ONLY
NO PARALLEL MODE OPERATION

NOTE: All dimensions are given in mm (inches) and are maximum, unless otherwise specified.



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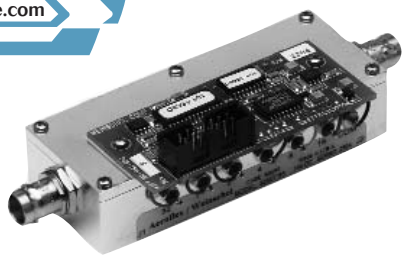
# Model 3250 & 3250T Programmable Attenuators

## with optional TTL Interface

## dc to 1.0 GHz
## 1 Watt
## 75 Ω

*T Series for use with Weinschel 8210A Controller*

EXPRESS
www.sicklesonline.com
800-542-4457



## Features

- **Cost Effective design for Wireless/Cellular Applications**
- **Available *Express* Models:** 3250T-63
  Other models may be available for Express delivery.
- **Optional Built-in Interface**
- **Custom Configurations including bus controlled attenuator subsystems**

## Specifications

**NOMINAL IMPEDANCE:** 75 Ω
**FREQUENCY RANGE:** dc to 1.0 GHz:

**MAXIMUM SWR:**

| Frequency Range (GHz) | SWR |
|---|---|
| dc - 0.5 | 1.60 |
| 0.5 - 1.0 | 1.40 |

**CELL CONFIGURATIONS:**

| Model Number | NO. Cells | Attenuation Range/Steps (dB) | Cell Increments (dB) |
|---|---|---|---|
| 3250-63 | 6 | 63/1 | 1, 2, 4, 8, 16, 32 |

**INCREMENTAL ATTENUATION ACCURACY:**

| Frequency Range (GHz) | Accuracy |
|---|---|
| dc - 0.5 | ± 0.3 dB or 2.0% |
| 0.5 - 1.0 | ± 0.4 dB or 2.0% |

**MAXIMUM CHARACTERISTIC ZERO LOSS (dB):**

| Frequency Range (GHz) | Loss (dB) |
|---|---|
| dc - 0.5 | 2.25 |
| 0.5 - 1.0 | 5.00 |

**RATED SWITCH LIFE:** 5 million operations per cell (typ)
**SWITCHING TIME**: 8 msec. maximum @ nominal rated voltage.
**CYCLING RATE:** 5 Hz maximum
**OPERATING VOLTAGE:** +11V to +16V
+12V to +17V (TTL opt -1)
**OPERATING CURRENT:** 16 mA maximum per cell
**TEMPERATURE RANGE (Operating):** -40 to +70°C
**POWER RATING:** 1 watt average, 50 watts peak (5 µsec pulse width; 1% duty cycle)
**CONNECTORS:** BNC female connectors per MIL-STD-348 interface dimensions - mate nondestructively with MIL-C-39012 connectors.

**CONTROL TERMINALS:** 0.040 inch. (1 mm) diameter solderable leads
**CONSTRUCTION:**
Housing: Aluminum
Connectors: Nickel plated brass body and beryllium copper contacts.
**WEIGHT:** 3250 140 g (4.5 oz)
3250T 189 g (4.9 oz)

## ACCESSORIES

**Programmable Attenuator/Switch Controller:** The Model 8210A Programmable Attenuator/Switch Controller provides a flexible, low cost solution for the operation of programmable step attenuators and other electromechanical devices under computer control. Designed to interface to Aeroflex / Weinschel's intelligent programmable attenuators, the 8210A represents a new concept in device control applications for bench test and subsystem designs. The 8210A provides a high-level interface from various industry standard communications interfaces, including IEEE-488 and RS232/RS422/RS485, to the programmable attenuator's serial Driver Interface Bus.



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## CONTROL CONFIGURATION:

**Standard Unit:** One terminal is connected to case ground and the remaining terminals are provided for activation of individual cells. Attenuation is fail-safe to "0" setting in the absence of a control voltage. Application of a voltage (+) to a particular cell causes it to switch to the attenuate position.

**Units with TTL Option:** Units with this options are supplied with a very low profile connectorized TTL interface board mounted directly to the control terminals. This TTL interface option is available with a 10 pin ribbon cable connector and is supplied with a mating connector. Refer to Physical Dimensions for mating connector pin/wiring details. Two wires are specified for supply voltage and ground. The remaining wires will accept TTL control signals to activate or de-activate a particular attenuation cell. A TTL high will energize a cell to the high attenuation state, whereas a TTL low will maintain a cell in its zero attenuation state.

To order 3250 Series Attenuators with this option add -1 to basic model number for ribbon cable connector. Example: Model 3250-63 with a TTL interface would be 3250-63-1.

Note: Control is non-latching and requires a continuous control signal for the period of time in which attenuation is required.

***TTL DRIVER SPECIFICATIONS:***

**INTERFACE CONNECTOR:** Option -1: 10 pin .025 square post header on .1 center, mates with Amp connector 746285-1 or equivalent

**INPUT VOLTAGE:** $V_{IN}$ High= +2.0V minimum
+5.0V typical
Vcc maximum
$V_{IN}$ Low = 0 minimum
0.8 maximum

**INPUT CURRENT:** $I_{IN}$ ($V_{IN}$=2.4 V) = 55 µA
$I_{IN}$ ($V_{IN}$=3.85 V) = 280 µA

**SUPPLY CURRENT:** $I_{CC}$=25 mA maximum per cell

**SUPPLY VOLTAGE:** $V_{CC}$=+12.0 to +15 V

**TEMPERATURE RANGE (Operating):** -40 to +70 °C

**Units with driver Circuitry (Figure 1):** Model 3250T-63 features an internal microcontroller-based driver that provides a TTL-level digital interface for control of the attenuator relays. This card simplifies operation and interfacing requirements, while at the same time providing for greatly enhanced flexibility over past designs. User-selectable modes of operation include both parallel and serial bus. The parallel mode provides a simple, one-bit per relay on/off control with internal pullups for use primarily in single attenuator applications. This mode allows the attenuator to be controlled via a variety of methods, such as a TTL-level digital output port, or mechanical toggle switches. The built-in driver bus provides a two-wire serial bus structure and protocol for connecting a number of devices to a single host control interface, suitable for use in larger system and subsystem applications. This programmable attenuator contains non-volatile configuration memory that is used to hold a wide variety of attenuator and driver-dependent parameters, including serial number, attenuator cell dB values, relay configurations, and switching requirements, which are all accessible via the digital interface.

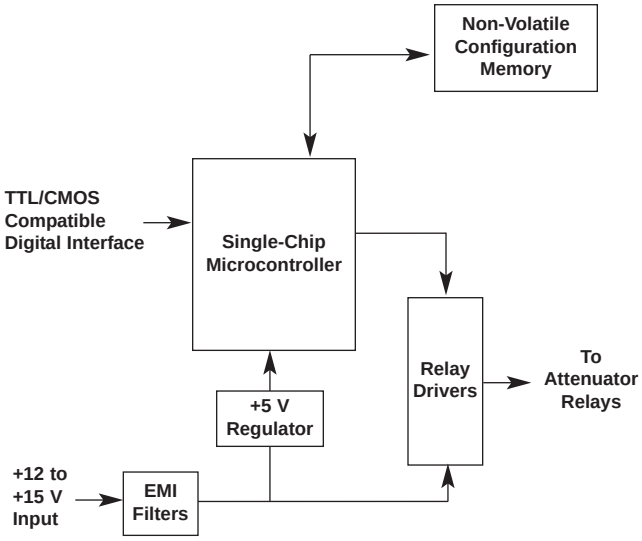



*Figure 1. Built-In Driver Circuitry*

**Digital Driver Interface Specifications:**

| | |
|---|---|
| **Input Supply Voltage:** | +12.0 to +15.0V |
| **Control Signals:** | TTL/CMOS compatible |
| **Interface Modes:** | parallel/ $I^2C$ serial |

**DC Characteristics (at 25°C):**

**Digital Interface:**

| Parameter | | Specification |
|---|---|---|
| $VI_L$ | Low Level input: | -0.5 min, 0.8V max |
| $V_{IH}$ | High Level input: | 2.0 min, 5.25V max |
| $I_{PU}$ | Pullup Current | 50 µA min, 400 µA max |

**Power Supply:**

| | | |
|---|---|---|
| $V_{IN}$ | Supply Voltage: | +12.0 to +15.0V |
| $I_{IN}$ | Supply current: | 25 mA |
| $I_{CELL}$ | Supply Current: | 150 mA (per cell, switching) |

**TEMPERATURE:** -20° to +70°C operating
-55° to +85°C nonoperating

**INTERFACE CONNECTOR:** 14 pin .025 square post header on .1 center. Mates with Amp connector 746285-2 or equivalent (one mating connector included with each unit).

**MODEL NUMBER DESCRIPTION:**

**Example:**

**3250* - XX - X**

- 3250* — Basic Model Number
- XX — Attenuation Value (dB)
- X — TTL Option (Add -1)

Example: 3250-63-1

*Add T to Basic Model Number when ordering Digital Control Circuitry.

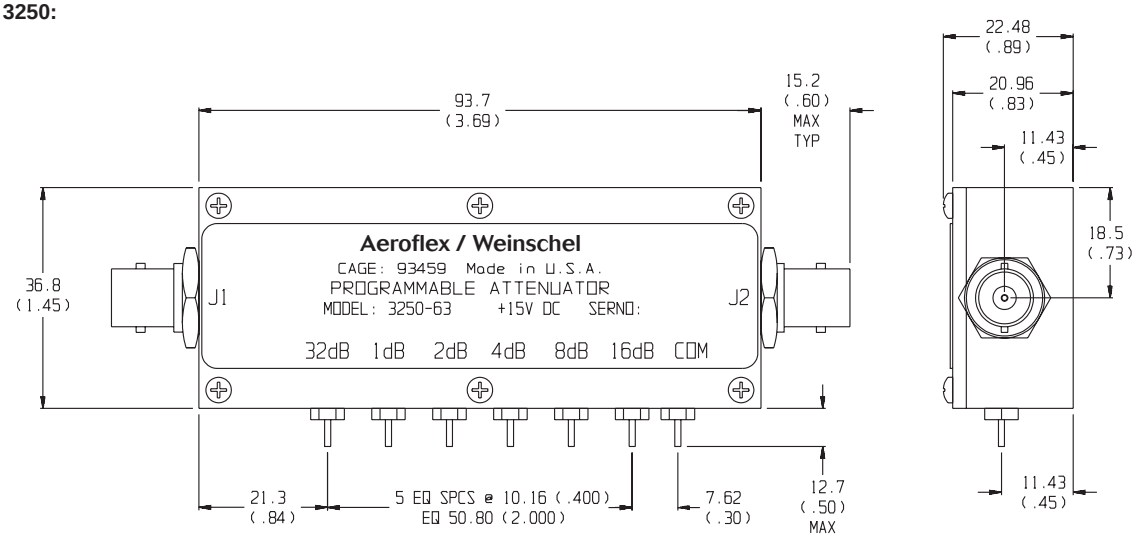


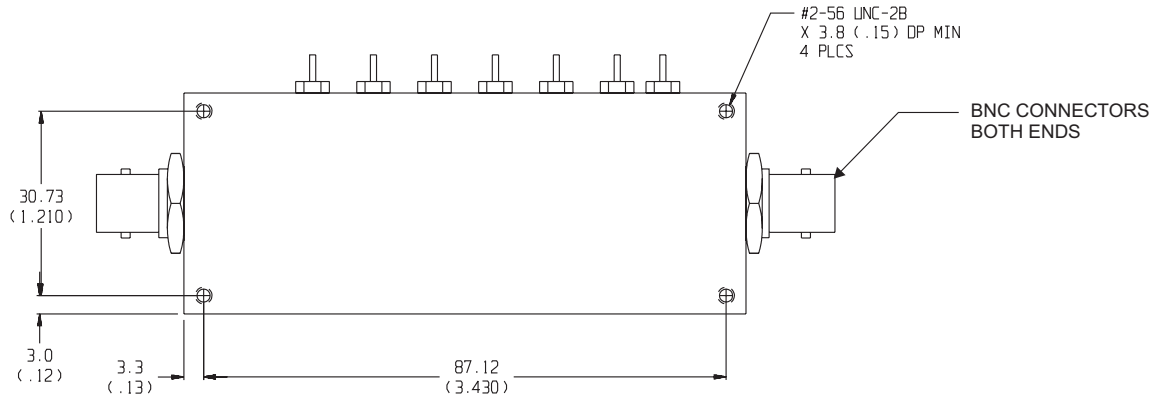
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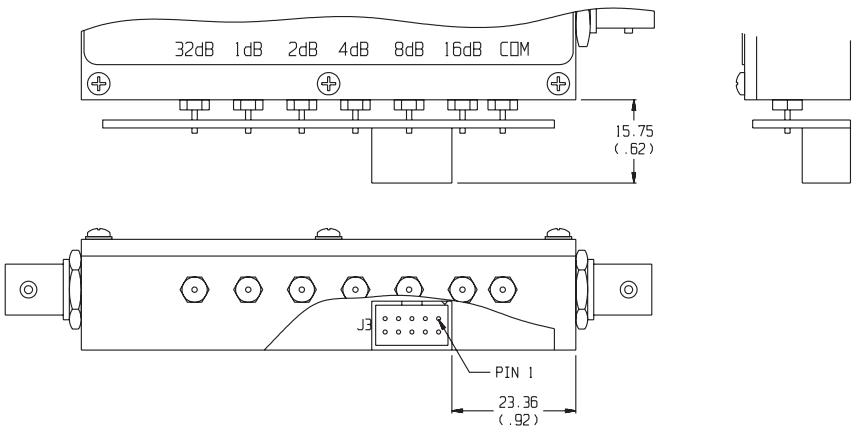
## PHYSICAL DIMENSIONS:

**Model 3250:**




**Model 3250 w/TTL Option -1:**




**Control Connector J3 Pin Locations:**

| TTL Conn PIN No. (J3) | 3250-63-1 dB (Cell) |
|---|---|
| 1 | NC |
| 2 | NC |
| 3 | 32 |
| 4 | 1 |
| 5 | 2 |
| 6 | 4 |
| 7 | 8 |
| 8 | 16 |
| 9 | COM |
| 10 | +Vcc |

NC = Not Connected

NOTE: All dimensions are given in mm (inches) and are maximum, unless otherwise specified.

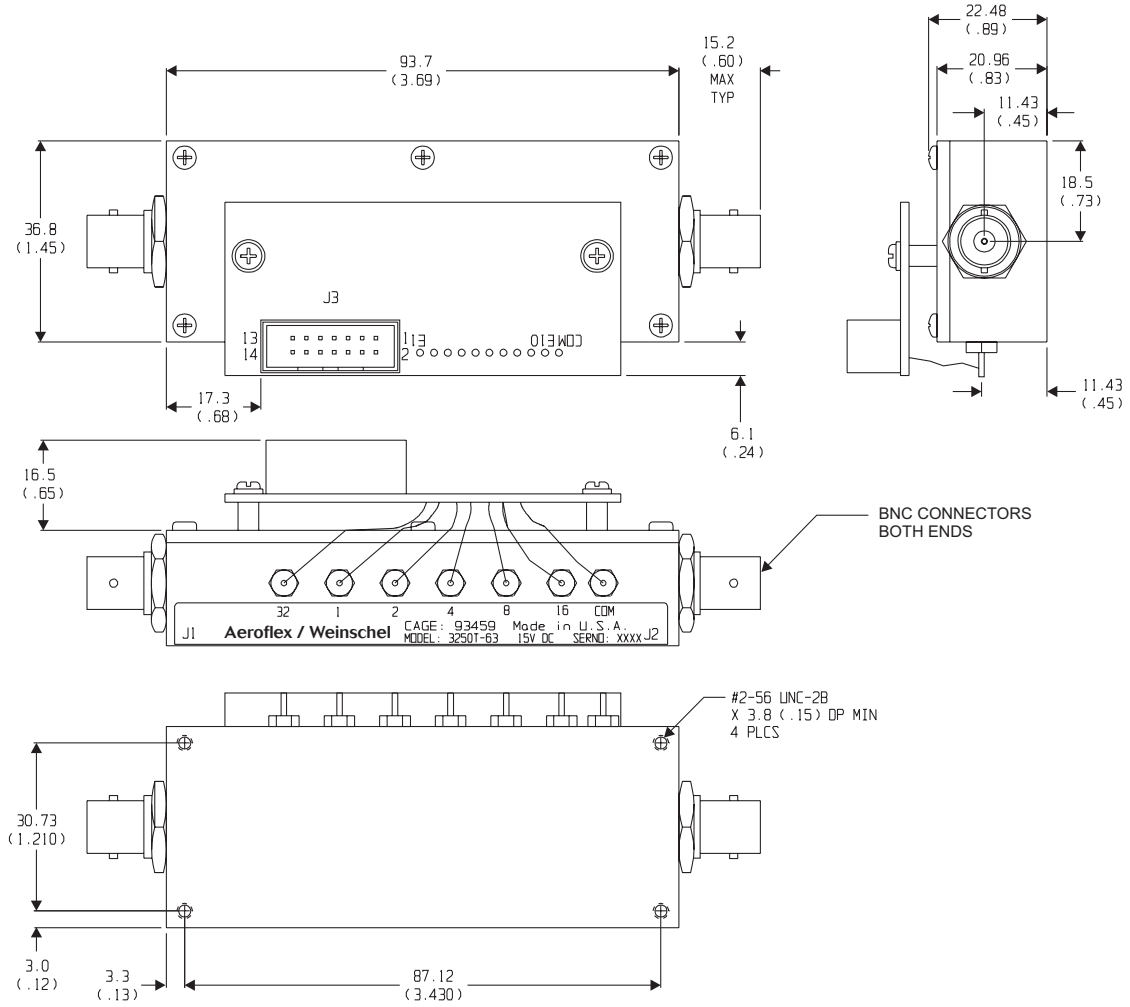


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## PHYSICAL DIMENSIONS:

**Model 3250T:**




NOTE: All dimensions are given in mm (inches) and are maximum, unless otherwise specified.



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Revision Date: 12/15/04

# Models 3406 & 3408 Programmable Attenuators

# dc to 6.0 GHz 1 Watt

*Ideal for Wireless/Test Applications*

NEW




Preliminary

## Features

- **Higher Frequency range to 6 GHz.**
- **Wide Selection of Attenuation Ranges & Step Sizes**
  - 0 to 55 dB in 1 dB steps
  - 0 to 103 dB in 1 dB steps
  - 0 to 55.75 in 0.25 dB steps
- **High Quality Construction & Connectors**
- **Special Configurations Available Upon Request**

## Description

The 3400 Series Programmable Step Attenuators are designed for use in automatic test equipment and OEM systems operating in the dc to 6 GHz frequency range. This series is available in many standard attenuation ranges and cell configurations. Custom designed configurations are available upon request. Each cell contains a double-pole, double-throw relay that provides a zero path or attenuated path for the RF signal.

Microstrip circuitry and special compensation techniques produce flat attenuation versus frequency characteristics. The microstrip construction, using thin-film circuit elements, ensures product uniformity. To minimize RF leakage, the 3400 Series Attenuators are provided with gold-plated contact areas and feedthrough filters at each control terminal.

## Specifications

**NOMINAL IMPEDANCE:** 50 Ω
**FREQUENCY RANGE:** dc to 6.0 GHz

**MAXIMUM SWR:**

| Frequency Range (GHz) | SWR |
|---|---|
| dc - 3 | 1.30 |
| 3 - 6 | 1.45 |

**CELL CONFIGURATIONS:**

| Model Number | NO. Cells | Attenuation Range/Steps (dB) | Cell Increments (dB) |
|---|---|---|---|
| 3406-55 | 6 | 55/1 | 1, 2, 4, 8, 16, 24 |
| 3408-55.75 | 8 | 55.75/0.25 | 0.25, 0.5, 1, 2, 4, 8, 16, 24 |
| 3408-103 | 8 | 103/1 | 1, 2, 4, 8, 16, 24, 48* |

*48 dB cell comprised of two 24 dB cells

**INCREMENTAL ATTENUATION ACCURACY:**

| Frequency Range (GHz) | Accuracy |
|---|---|
| dc - 3 | +0.3 dB or 2% whichever is greater |
| 3 - 6 | +0.4 dB or 3% whichever is greater |

**MAXIMUM INSERTION LOSS (dB):**

| Frequency Range (GHz) | 3206-55 | 3408-55.75 3408-103 |
|---|---|---|
| dc - 3 | 2.60 | 3.40 |
| 3 - 6 | 3.80 | 5.00 |

**MONOTONICITY:** dc to 6.0 GHz
**INCREMENTAL TEMPERATURE COEFFICIENT:**

**POWER RATING:** 1 watt average to 25°C ambient temperature, derated linearly to 0.25 watt @ 70°C. 50 watts peak (5 µsec pulse width; 1% duty cycle)

**POWER COEFFICIENT:** <0.005 dB/dB/watt

**RATED SWITCH LIFE:** 5 million cycles operations per cell @ 0 dBm

**SWITCHING TIME:** 6 msec. maximum at nominal rated voltage

**RELEASE TIME:** 5 msec maximum

**CYCLING RATE:** 5 Hz maximum per relay

**OPERATING VOLTAGE**: +12V (+13V maximum; +9V minimum)

**OPERATING CURRENT:** 17 mA typical per cell @ +12V

**TEMPERATURE RANGE (Operating):** -30°C to +70°C

**TEST DATA:** Test data is available at additional cost.



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AEROFLEX WEINSCHEL

Preliminary

## Specifications - Con't

**CONNECTORS:** SMA female connectors per MIL-STD-348 interface dimensions - mate nondestructively with MIL-C-39012 connectors.

**CONTROL TERMINALS:** 0.040 inch. (1 mm) diameter solderable leads. May be used with PC board sockets/ receptacles.

**CONSTRUCTION:**

| | |
|---|---|
| Housing: | Aluminum |
| Connectors: | Stainless steel body and beryllium copper contacts. |
| Control terminals: | Brass/Copper, Silver plated |

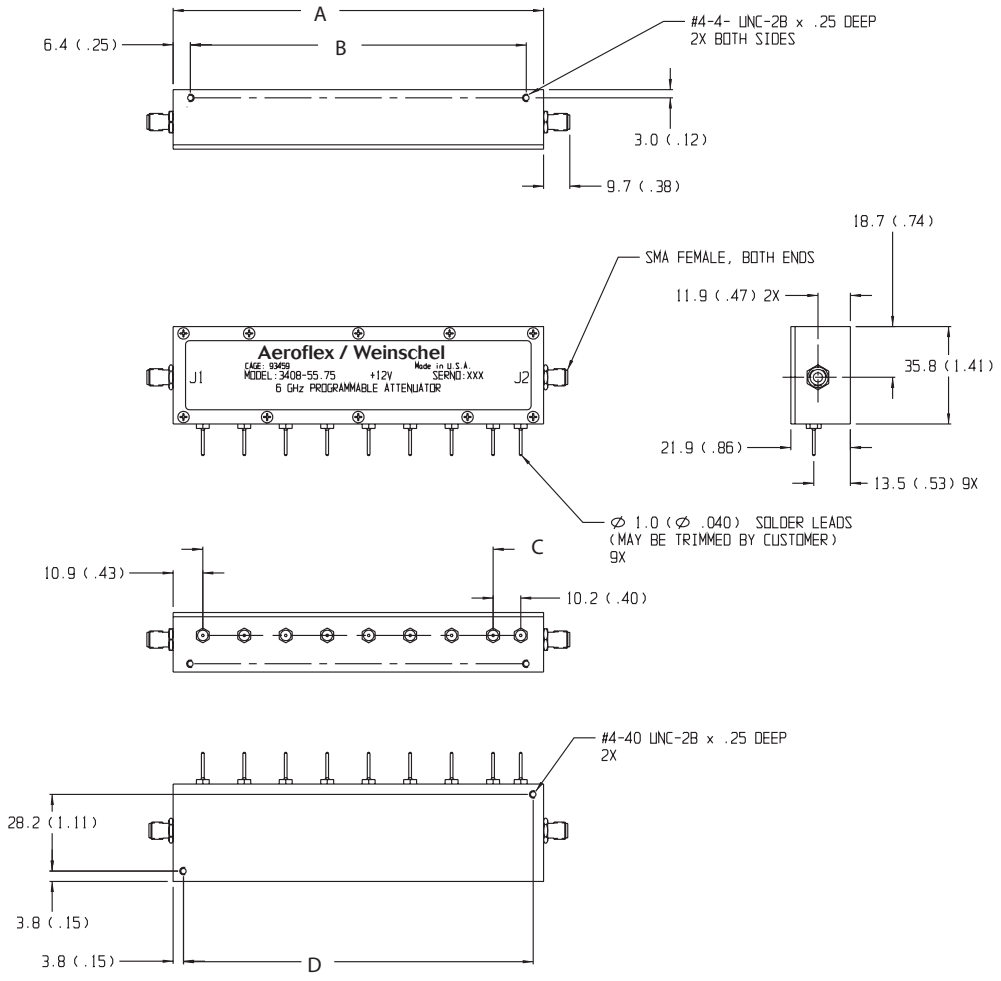
**WEIGHT (Typical):** 3406-X: 99 g (3.5 oz)
3408-X: 135 g (4.8 oz)

## CONTROL CONFIGURATION:

One terminal is connected to case ground and the remaining terminals are provided for activation of individual cells. Attenuation is fail-safe to "0" setting in the absence of a control voltage. Application of a voltage (+) to a particular cell causes it to switch to the attenuate position.

Note: Control is non-latching and requires a continuous control signal for the period of time in which attenuation is required.

## PHYSICAL DIMENSIONS:




| Model No. | No. Cells | A | B | C | D |
|---|---|---|---|---|---|
| 3408-X | 8 | 136.1 (5.36) | 123.4 (4.86) | 7 EQ SPCS @ 10.16 (.40) = 71.1 (2.80) | 128.5 (5.06) |
| 3406-X | 6 | 105.7 (3.66) | 93.0 (3.66) | 5 EQ SPCS @ 10.16 (.40) = 50.8 (2.00) | 98.0 (3.86) |

NOTE: All dimensions are given in mm (inches) and are nominal, unless otherwise specified.



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# Model 150T dc to 18.0 GHz
# Model 151T dc to 4.0 GHz
# Model 152T dc to 26.5 GHz
# Relay Switched Programmable Attenuators, with built-in Microprocessor-Based Driver

## *For Use with Weinschel 8210A Controller*

EXPRESS
www.sicklesonline.com
800-542-4457



## Description

Aeroflex / Weinschel's line of intelligent programmable step attenuators with a built-in TTL interface (Figure 1). These models are designed to simplify the control and integration of these devices into subsystem and bench applications. These intelligent attenuators offer the same long reliable operation with exceptional accuracy and repeatability as with our other 150 Series Programmable Attenuators. They provide programmable adjustments of RF signal levels in precise steps of 1 dB, 5 dB, 10 dB, or with custom steps available. Each attenuator consists of a cascaded assembly of switched attenuator cells and a internal TTL interface.

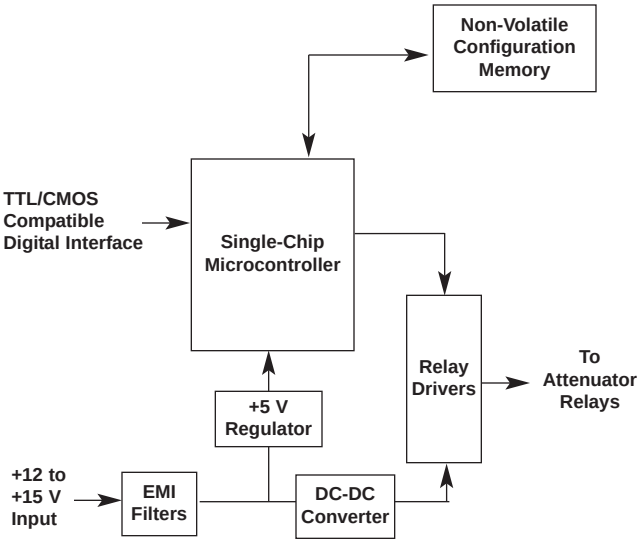



*Figure 1. Built-In Driver Circuitry*

The attenuator elements located in the attenuator cell are created by a thin-film process which provides exceptional long-term stability, low power and temperature coefficients. This series of step attenuators uses a reed switching structure that provides rapid switching together with low insertion loss.

**BUILT-IN DRIVER CIRCUITRY:** These programmable attenuators feature an internal microcontroller-based driver that provides a TTL-level digital interface for control of the attenuator relays. This card simplifies operation and interfacing requirements, while at the same time providing for greatly enhanced flexibility over past designs. User-selectable modes of operation include both parallel and serial bus. The parallel mode provides a simple, one-bit per relay on/off control with internal pullups for use primarily in single attenuator applications. This mode allows the attenuator to be controlled via a variety of methods, such as a TTL-level digital output port, or mechanical toggle switches. The device bus provides a two-wire serial bus structure and protocol for connecting a number of devices to a single host control interface, suitable for use in larger system and subsystem applications. The driver interface contains non-volatile configuration memory that is used to hold a wide variety of attenuator and driver-dependent parameters, including serial number, attenuator cell dB values, relay configurations, and switching requirements, which are all accessible via the digital interface. This frees the system designer from such low-level details, allowing faster integration. In either operational mode, the microcontroller enters an idle condition during periods of inactivity, turning off all on-board clocks, reducing EMI concerns, and lowering power consumption. On-board regulation for the digital circuitry allows the programmable attenuator to operate from a single input supply voltage.

**Other features include:**

- Wide Variety of Frequency & Attenuation Ranges
- Broadband Frequency Coverage
- High Accuracy and Repeatability
- Long Life, 5 Million Cycles Per Cell
- Common 14 pin Interface Connector
- Custom Attenuation Ranges

***For additional information on the 150 Series, visit our website @ www.aeroflex-weinschel.com/programmables.htm***



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# Programmable Attenuators

## Specifications

**NOMINAL IMPEDANCE:** 50 Ω

**FREQUENCY RANGE:** Model 151T: dc to 4 GHz
Model 150T: dc to 18 GHz
Model 152T: dc to 26.5 GHz

**CELL CONFIGURATIONS:**

| Cell | 11 | 15 | 31 | 55 | 62 | 70 | 70 | 75 | 90 | 110 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 5 | 2 | 10 | 10 | 5 | 10 | 10 |
| 2 | 4 | 8 | 16 | 10 | 32 | 20 | 40 | 40 | 30 | 40 |
| 3 | 2 | 2 | 2 | 20 | 16 | 20 | 20 | 20 | 20 | 20 |
| 4 | 4 | 4 | 8 | 20 | 4 | 20 | -- | 10 | 30 | 40 |
| 5 | -- | -- | 4 | -- | 8 | -- | -- | -- | -- | -- |

**DRIVER INTERFACE:**

**Input Supply Voltage:** +12.0 to +15.0V

**Control Signals:** TTL/CMOS compatible

**Interface Modes:** parallel / serial

**DC Characteristics (at 25 °C):**

**Digital Interface:**

| Parameter | | Specification |
|---|---|---|
| $V_{IL}$ | Low Level input: | -0.5 min, 0.8V max |
| $V_{IH}$ | High Level input: | 2.0 min, 5.25V max |
| $I_{PU}$ | Pullup Current | 50 µA min, 400 µA max |

**Power Supply:**

| | | |
|---|---|---|
| $V_{IN}$ | Supply Voltage: | +12.0 to +15.0V |
| $I_{IN}$ | Supply current: | 25 mA |
| $I_{CELL}$ | Supply Current: | 150 mA (per cell, switching) |

**POWER RATING:** 1 watt average, 100 watts peak (10 µsec pulse width; 5% duty cycle)

**TEMPERATURE:** -20° to +70°C operating
-55° to +85°C nonoperating

**TEMPERATURE COEFFICIENT:** <0.0001 dB/dB/C

**POWER SENSITIVITY:** <0.001 dB/dB/ Watt

**RATED SWITCH LIFE:** 5 million cycles per cell

**RF INPUT CONNECTORS:** Rugged female 3.5 mm which mate nondestructively with SMA male connectors per MIL-STD-39012.

**INTERFACE CONNECTOR:** 14 pin .025 square post header on .1 center. Mates with Amp connector 746285-2 or equivalent (one mating connector included with each unit).

**SWITCHING TIME:** 20 msec (includes settling time)

**CYCLING RATE:** 4 Hz max per relay

**CONTROL PULSE WIDTH:** 20 msec (minimum)

**REPEATABILITY:** ±0.01 typical to 18 GHz
±0.05 dB typical to 26.5 GHz

**VIBRATION*:** MIL-STD-202F, Method 204D Cond B

**ALTITUDE*:** MIL-STD-202F, Method 105C Cond B, 50,000 Ft.

**SHOCK*:** MIL-STD -202F, Method 213B Cond B, except 10G, 6 msec

**HUMIDITY*:** MIL-STD-202F, Method 103B, Cond. B (96 Hrs. @ 95%, RH).

**MAXIMUM SWR (50 Ω Characteristic Impedance):**

| APPLICABLE MODELS | Frequency (GHz) dc-4 | 4-18 | 18-26.5 |
|---|---|---|---|
| 151T-11, 151T-15, 151T-31, 151-62T, 151T-75, 151T-110 | 1.50 | - - - | - - - |
| 150T-11, 150T-15, 150T-31 150T-62, 150T-75, 150T-110 | 1.50 | 1.90 | - - - |
| 151T-70 (3 cell) | 1.35 | - - - | - - - |
| 150T-70 (3 cell) | 1.35 | 1.70 | - - - |
| 152AT-70 (3 cell) | 1.40 | 1.70 | 1.80 |
| 152T-55, 152T-70, 152T-90 | 1.40 | 1.60 | 1.90 |

**MAXIMUM INSERTION LOSS (dB):**

| APPLICABLE MODELS | Frequency (GHz) dc-4 | 4-18 | 18-26.5 |
|---|---|---|---|
| 151T-11, 151T-15, 151T-75, 151T-110 | 0.90 | - - - | - - - |
| 150T-11, 150T-15, 150T-75, 150T-110 | 0.90 | 2.20 | - - |
| 151T-31, 151T-62 (5 cell) | 1.10 | ---- | ---- |
| 150T-31, 150T-62 (5 cell) | 1.10 | 2.60* | ---- |
| 151T-70 (3 cell) | 0.70 | - - - | - - - |
| 150T-70 (3 cell) | 0.70 | 1.60 | - - - |
| 152AT-70 (3 cell) | 0.90 | 2.00 | 2.98 |
| 152T-55, 152T-70, 152T-90 | 0.90 | 2.00 | 2.98 |

*4-12.4 is 1.80, 12.4-18 is 2.60

**WEIGHT:** 5 Cell 350 g (12 oz)
4 Cell 290 g (9.0 oz)
3 Cell 230 g (8.0 oz)

## ACCESSORIES

**Programmable Attenuator/Switch Controller:** The Model 8210A Programmable Attenuator/Switch Controller provides a flexible, low cost solution for the operation of programmable step attenuators and other electromechanical devices under computer control. Designed to interface to Aeroflex / Weinschel's intelligent programmable attenuators, the 8210A represents a new concept in device control applications for bench test and subsystem designs. The 8210A provides a high-level interface from various industry standard communications interfaces, including IEEE-488 and RS232/RS422/RS485, to the programmable attenuator's serial Driver Interface Bus.

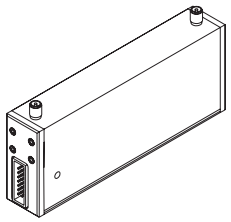
**OPTIONAL TEST Data:** Test Data is available at an additional cost for all programmable step attenuator models. Standard test Data can be provided in 250 MHz steps for all dc-4 GHz models and in 500 MHz steps for dc-18 and dc-26.5 GHz models.



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## ATTENUATION ACCURACY (+dB with respect to 0 dB reference):



**Model 150T/151T/152T-11 & 150T/151T/152T-15:**

| Frequency | Attenuation Setting (dB) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Range (GHz) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| dc-4 | 0.2 | 0.2 | 0.3 | 0.3 | 0.3 | 0.3 | 0.4 | 0.4 | 0.4 | 0.4 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| 4-12.4 | 0.3 | 0.3 | 0.4 | 0.4 | 0.5 | 0.5 | 0.6 | 0.6 | 0.6 | 0.6 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |
| 12.4-18 | 0.5 | 0.6 | 0.6 | 0.6 | 0.6 | 0.7 | 0.7 | 0.7 | 0.7 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |
| 18-26.5 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 0.9 | 0.9 | 1.0 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |

**Model 150T/151T-75:**

| Frequency | Attenuation Setting (dB) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Range (GHz) | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 | 75 |
| dc-4 | 0.2 | 0.2 | 0.4 | 0.4 | 0.5 | 0.5 | 0.7 | 0.7 | 0.9 | 0.9 | 1.1 | 1.1 | 1.2 | 1.2 | 1.4 |
| 4-12.4 | 0.3 | 0.3 | 0.6 | 0.6 | 0.9 | 0.9 | 1.2 | 1.2 | 1.5 | 1.5 | 1.8 | 1.8 | 2.1 | 2.1 | 2.1 |
| 12.4-18 | 0.4 | 0.4 | 0.8 | 0.8 | 1.2 | 1.2 | 1.6 | 1.6 | 2.0 | 2.0 | 2.4 | 2.4 | 2.8 | 2.8 | 2.8 |

**Model 150T/151T-31:**

| Frequency | Attenuation Setting (dB) | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Range (GHz) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| dc-4 | 0.2 | 0.2 | 0.3 | 0.3 | 0.3 | 0.3 | 0.4 | 0.4 | 0.5 | 0.4 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| 4-12.4 | 0.3 | 0.3 | 0.4 | 0.4 | 0.5 | 0.5 | 0.6 | 0.6 | 0.7 | 0.6 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |
| 12.4-18 | 0.5 | 0.5 | 0.6 | 0.6 | 0.6 | 0.6 | 0.7 | 0.7 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |

| Frequency | Attenuation Setting (dB) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Range (GHz) | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
| dc-4 | 0.5 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.8 | 0.8 |
| 4-12.4 | 0.8 | 0.8 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 1.1 | 1.0 | 1.0 | 1.0 | 1.0 | 1.1 | 1.1 |
| 12.4-18 | 0.9 | 0.9 | 1.0 | 1.0 | 1.0 | 1.0 | 1.1 | 1.1 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.3 | 1.3 |

**Model 150T/151T-62:**

| Frequency | Attenuation Setting (dB) | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Range (GHz) | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 |
| dc-4 | 0.3 | 0.3 | 0.3 | 0.4 | 0.4 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.6 | 0.6 |
| 4-12.4 | 0.4 | 0.4 | 0.4 | 0.5 | 0.5 | 0.6 | 0.6 | 0.6 | 0.7 | 0.7 | 0.7 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |
| 12.4-18 | 0.5 | 0.5 | 0.5 | 0.6 | 0.6 | 0.6 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 1.0 | 1.0 | 1.0 | 1.2 | 1.2 |

| Frequency | Attenuation Setting (dB) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Range (GHz) | 34 | 36 | 38 | 40 | 42 | 44 | 46 | 48 | 50 | 52 | 54 | 56 | 58 | 60 | 62 |
| dc-4 | 0.6 | 0.6 | 0.7 | 0.7 | 0.7 | 0.8 | 0.8 | 0.8 | 0.9 | 0.9 | 0.9 | 1.0 | 1.0 | 1.0 | 1.2 |
| 4-12.4 | 1.0 | 1.0 | 1.1 | 1.1 | 1.3 | 1.4 | 1.4 | 1.4 | 1.5 | 1.6 | 1.6 | 1.6 | 1.8 | 1.8 | 1.8 |
| 12.4-18 | 1.4 | 1.4 | 1.6 | 1.6 | 1.8 | 1.8 | 2.0 | 2.0 | 2.0 | 2.2 | 2.2 | 2.2 | 2.4 | 2.4 | 2.4 |

**Model 150T/151T-70, 150T/151T-110, 152AT-70:**

| Frequency | Attenuation Setting (dB) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Range (GHz) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 |
| dc-4 | 0.2 | 0.3 | 0.5 | 0.7 | 0.9 | 1.0 | 1.2 | 1.4 | 1.6 | 1.7 | 1.9 |
| 4-12.4 | 0.4 | 0.7 | 0.9 | 1.2 | 1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0 | 3.0 |
| 12.4-18 | 0.4 | 0.8 | 1.2 | 1.6 | 2.0 | 2.4 | 2.8 | 3.2 | 3.6 | 4.0 | 4.0 |
| 18-26.5 | 0.6 | 0.7 | 0.9 | 1.5 | 1.6 | 2.2 | 2.9 | --- | --- | --- | --- |

**Model 152T-55:**

| Frequency | Attenuation Setting (dB) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Range (GHz) | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 |
| dc-4 | 0.2 | 0.3 | 0.4 | 0.4 | 0.4 | 0.6 | 0.6 | 0.7 | 0.7 | 0.8 | 1.0 |
| 4-12.4 | 0.3 | 0.4 | 0.5 | 0.5 | 0.5 | 0.7 | 0.8 | 0.9 | 0.9 | 1.0 | 1.3 |
| 12.4-18 | 0.4 | 0.4 | 0.5 | 0.5 | 0.5 | 0.8 | 1.0 | 1.1 | 1.1 | 1.2 | 1.6 |
| 18-26.5 | 0.5 | 0.5 | 0.6 | 0.6 | 0.6 | 0.9 | 1.2 | 1.4 | 1.4 | 1.5 | 2.0 |

**Model 152T-70, 152T-90:**

| Frequency | Attenuation Setting (dB) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Range (GHz) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 |
| dc-4 | 0.3 | 0.5 | 0.6 | 0.7 | 0.8 | 1.0 | 1.1 | 1.1 | 1.2 |
| 4-12.4 | 0.4 | 0.5 | 0.7 | 0.9 | 1.0 | 1.3 | 1.5 | 1.6 | 1.7 |
| 12.4-18 | 0.5 | 0.6 | 0.8 | 1.1 | 1.2 | 1.4 | 1.7 | 1.8 | 2.1 |
| 18-26.5 | 0.5 | 0.6 | 0.9 | 1.4 | 1.5 | 1.8 | 2.3 | 2.4 | 2.8 |

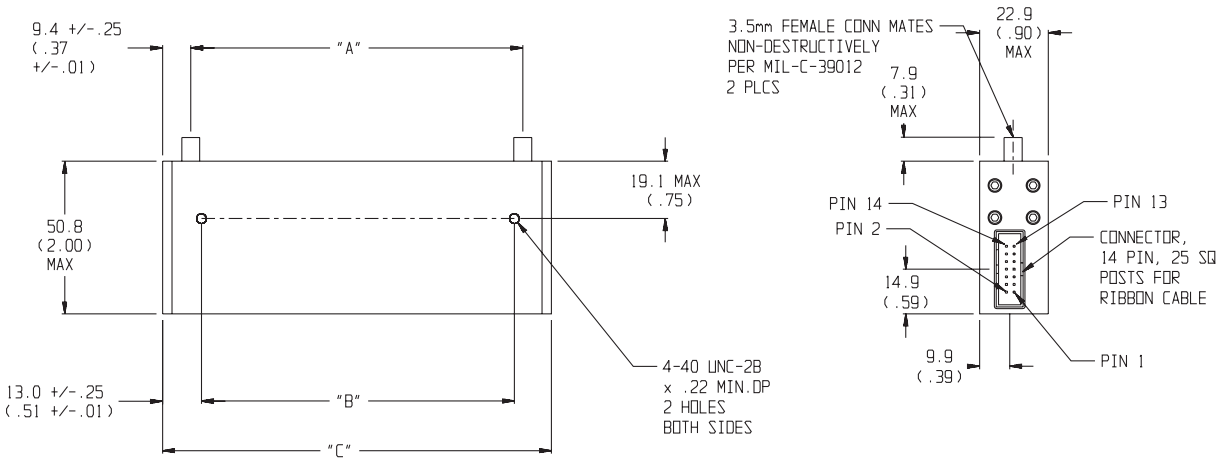


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## PHYSICAL DIMENSIONS:

**Models 150T, 151T, & 152T:**




| DIM | A | B | C |
|---|---|---|---|
| 3 cell | 83.3 (3.28) | 76.2 (3.0) | 101.6 (4.00) |
| 4 cell | 110.7 (4.36) | 103.6 (4.08) | 129.2 (5.09) |
| 5 cell | 136.1 (5.36) | 129.1 (5.08) | 154.4 (6.08) |

NOTE: All dimensions are given in mm (inches) and are maximum, unless otherwise specified.

## 150T Series Ordering Guide...

| Frequency Range | NO. Cells | Attenuator Range/Step Size | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 11/1 dB | 15/1 dB | 31/1 dB | 55/5 dB | 62/2 dB | 70/10 dB | 75/5 dB | 90/10 dB | 110/10 dB |
| dc-4 GHz | 4<br>3<br>5 | 151T-11 | 151T-15 | <br><br>151T-31 | N/A | <br><br>151T-62 | <br>151T-70 | 151T-75 | N/A | ☆151T-110 |
| dc-18 GHz | 4<br>3<br>5 | ☆150T-11 | ☆150T-15 | <br><br>☆150T-31 | N/A | <br><br>☆150T-62 | <br>☆150T-70 | ☆150T-75 | N/A | ☆150T-110 |
| dc-26.5 GHz | 4<br>3 | N/A | NA | N/A | 152T-55☆ | NA | 152T-70<br>152AT-70 | N/A | 152T-90 | 152T-110 |

☆ ***EXPRESS*** Shipment available via **www.sicklesonline.com** or 800-542-4457.
Other models may be available for Express delivery.



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Revision Date: 12/15/04

# Model 150 dc to 18.0 GHz
# Model 151 dc to 4.0 GHz
# Model 152 dc to 26.5 GHz
# Relay Switched Programmable Attenuators

EXPRESS
www.sicklesonline.com
800-542-4457



## Description

The Model 150, 151 and 152 Programmable Step Attenuators represent the widest variety of programmable attenuators available. This attenuator design is the result of an extensive development program and offers long reliable operation with exceptional accuracy and repeatability. These attenuators can provide programmable adjustments of RF signal levels in precise steps of 1 dB, 5 dB, 10 dB, or with custom steps available. Each attenuator consists of a cascaded assembly of switched attenuator cells (Figure 1). The attenuator elements located in the attenuator cell are created by a thin-film process which provides exceptional long-term stability, low power and temperature coefficients. This series uses a reed switching structure that provides rapid switching together with low insertion loss.

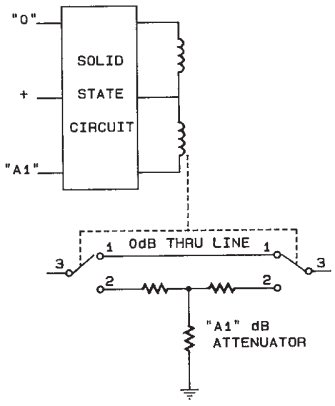



*Figure 1. Cell Schematic*

Other features include:

- Broadband Frequency Coverage
- High Accuracy and Repeatability
- Long Life, 5 Million Cycles Per Cell
- 3, 4, and 5 Cell Configurations

**PROGRAMMABILITY:** In each programmable step Attenuator, solenoids are used to switch the internal resistor card of each cell into and out of the circuit. The switching is activated by the application of a negative control voltage to the desired pin located in the control connector. Once the cell is switched, the solenoid is magnetically latched into position and is able to withstand extreme shock and vibration. Internal circuitry is included to interrupt the coil current after switching is complete. This reduces power dissipation even if power is continuously applied. The switching time for each cell is rated at 20 msec maximum which includes the contact settling time.

**BROADBAND ACCURACY & LOW SWR:** The use of Aeroflex / Weinschel's proprietary thin-film resistor process provides these programmable step attenuators with a high degree of accuracy and the lowest possible SWR uncertainty (refer to specifications for actual values). This thin film process permits the construction of circuits which are truly distributed and without stray reactances, even at the higher microwave frequencies.

**RELIABILITY:** Each programmable step attenuator is composed of 3 to 5 (4 in most models) cells. As with all mechanical designs, usable life becomes a primary concern to the user. With this in mind Aeroflex / Weinschel backs all these attenuators with a rated switch life of 5 million operations per cell. Standardized testing is also performed on each programmable step attenuator over its operating frequency range by a computer controlled Aeroflex / Weinschel Attenuation Measurement System which is traceable to NIST standards.

**ENVIRONMENTAL:** These Model 150 Programmable Step Attenuators have undergone an extensive environmental qualification program and have been subjected to temperature, shock, vibration, and humidity conditions per MIL-STD-202F. These programmable step attenuators operate within these specifications at an ambient temperature of -20° to +75°C. Operating beyond these limits will adversely affect the accuracy and could damage the internal circuitry.

***For additional information on the 150 Series, visit our website @ www.aeroflex-weinschel.com/programmables.htm***



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Revision Date: 12/15/04

## 150 Series Cell Configurations...

| ATTN Value | Cells No. | Cell 1 | | Cell 2 | | Cell 3 | | Cell 4 | | Cell 5 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Bypass | ATTN Element | Bypass | ATTN Element | Bypass | ATTN Element | Bypass | ATTN Element | Bypass | ATTN Element |
| 11 dB | 4 | 0 dB | 1 dB | 0 dB | 4 dB | 0 dB | 2 dB | 0 dB | 4 dB | - - - | - - - |
| 15 dB | 4 | 0 dB | 1 dB | 0 dB | 8 dB | 0 dB | 2 dB | 0 dB | 4 dB | - - - | - - - |
| 31 dB | 5 | 0 dB | 1 dB | 0 dB | 8 dB | 0 dB | 2 dB | 0 dB | 16 dB | 0 dB | 4 dB |
| 55 dB | 4 | 0 dB | 5 dB | 0 dB | 10 dB | 0 dB | 20 dB | 0 dB | 20 dB | - - - | - - - |
| 70 dB | 4 | 0 dB | 10 dB | 0 dB | 20 dB | 0 dB | 20 dB | 0 dB | 20 dB | - - - | - - - |
| | 3 | 0 dB | 10 dB | 0 dB | 40 dB | 0 dB | 20 dB | - - - | - - - | - - - | - - - |
| 75 dB | 4 | 0 dB | 5 dB | 0 dB | 40 dB | 0 dB | 20 dB | 0 dB | 10 dB | - - - | - - - |
| 90 dB | 4 | 0 dB | 10 dB | 0 dB | 30 dB | 0 dB | 20 dB | 0 dB | 30 dB | - - - | - - - |
| 110 dB | 4 | 0 dB | 10 dB | 0 dB | 40 dB | 0 dB | 20 dB | 0 dB | 40 dB | - - - | - - - |
| Conn PIN # | Round | 5 | 6 | 9 | 10 | 7 | 8 | 11 | 12 | 3 | 4 |
| | Ribbon | 13 | 2 | 3 | 9 | 11 | 5 | 4 | 10 | 8 | 7 |
| Wire Color | Round 3/4 Cell | Violet | Yellow | Orange | Blue | Black | Green | Brown | White | - - - | - - - |
| | Round | Black | White | Green | Orange | Blue | WHT/BLK | RED/BLK | GRN/BLK | ORN/BLK | BLU/BLK |
| | 5 Cell Ribbon | Orange | Yellow | Blue | Brown | Purple | Black | Gray | White | Orange | yellow |

Table provides standard attenuation ranges, increments, and cell configurations for all Aeroflex / Weinschel Programmable Step Attenuators (Models 150, 151, 152, & 152A)

## Specifications

**NOMINAL IMPEDANCE:** 50 Ω

**FREQUENCY RANGE:** Model 151: dc to 4 GHz
Model 150: dc to 18 GHz
Model 152: dc to 26.5 GHz

**OPERATIONAL VOLTAGE:** + 24V Nominal (+20V minimum to +30V maximum) or +5V Nominal (+4V minimum* to +7V maximum)

*Minimum operating voltage derated to +4.25 V @ 55°C and further derated to +4.5 V @ 75°C

**POWER RATING:** 1 watt average, 100 watts peak (10 µsec pulse width; 5% duty cycle)

**TEMPERATURE:** -20° to +75°C operating
-55° to +85°C nonoperating

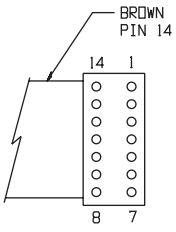
**TEMPERATURE COEFFICIENT:** < 0.0001 dB/dB/°C

**POWER SENSITIVITY:** < 0.001 dB/dB/ Watt

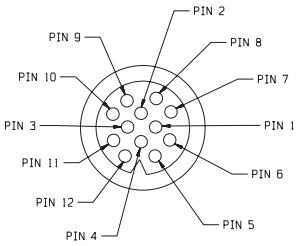
**RATED SWITCH LIFE:** 5 million cycles per cell

**RF INPUT CONNECTORS:** Rugged female 3.5 mm connectors which mate nondestructively with SMA male connectors per MIL-STD-39012.

**CONTROL CONNECTOR:** 12 pin Viking TNP12-101 connector with 5' cable or 14 conductor 16" ribbon cable with connector (shown below):




*Ribbon Cable Models*




*Round (Viking)Cable Models*

**SWITCHING TIME:** 20 msec (includes settling time)

**CYCLING RATE:** 4 Hz max per relay

**CONTROL PULSE WIDTH:** 20 msec (minimum)

**SWITCHING CURRENT:** 125 mA @ +24V per cell
300 mA @ +5V per cell

**REPEATABILITY:** ±0.01 typical to 18 GHz
±0.05 dB typical to 26.5 GHz

**VIBRATION:** MIL-STD-202F, Method 204D Cond B

**ALTITUDE:** MIL-STD-202F, Method 105C Cond B, 50,000 Ft.

**SHOCK:** MIL-STD -202F, Method 213B Cond B, except 10G, 6 msec

**HUMIDITY:** MIL-STD-202F, Method 103B, Cond. B (96 Hrs. @ 95%, RH)

**EMC:** Radiated interference is within the requirements of MIL-STD-461 method RE02, VDE 0871 and CISPR Publication II.

**WEIGHT:** 5 Cell 350 g (12 oz)
4 Cell 290 g (9.0 oz)
3 Cell 230 g (8.0 oz)

### VOLTAGE/CONNECTOR OPTIONS:

| VOLTAGE | MODEL(S) |
|---|---|
| + 24 V with Viking Connector | 150-XX, 151-XX, 152-XX, 152A-XX |
| + 24 V with Ribbon Cable | 150-XX-1, 151-XX-1, 152-XX-1 152A-XX-1 |
| + 5 V with Viking Connector | 150-XX-2, 151-XX-2, 152-XX-2 152A-XX-2 |
| + 5 V with Ribbon Cable | 150-XX-3, 151-XX-3, 152-XX-3 152A-XX-3 |



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Revision Date: 12/15/04

## MAXIMUM SWR (50 Ω Characteristic Impedance):

| APPLICABLE MODELS | Frequency (GHz) dc-4 | 4-18 | 18-26.5 |
|---|---|---|---|
| 151-11, 151-15, 151-31, 151-75, 151-110 | 1.50 | - - - | - - - |
| 150-11, 150-15, 150-31, 150-75, 150-110 | 1.50 | 1.90 | - - - |
| 151-70 (3 cell) | 1.35 | - - - | - - - |
| 150-70 (3 cell) | 1.35 | 1.70 | - - - |
| 152A-70 (3 cell) | 1.40 | 1.70 | 1.80 |
| 152-55, 152-70, 152-90 | 1.40 | 1.60 | 1.90 |

## MAXIMUM INSERTION LOSS (dB):

| APPLICABLE MODELS | Frequency (GHz) dc-4 | 4-18 | 18-26.5 |
|---|---|---|---|
| 151-11, 151-15, 151-75, 151-110 | 0.90 | - - - | - - - |
| 150-11, 150-15, 150-75, 150-110 | 0.90 | 2.20 | - - - |
| 151-31 (5 cell) | 1.10 | - - - | - - - |
| 150-31 (5 cell) | 1.10 | 2.60* | - - - |
| 151-70 (3 cell) | 0.70 | - - - | - - - |
| 150-70 (3 cell) | 0.70 | 1.60 | - - - |
| 152A-70 (3 cell) | 0.90 | 2.00 | 2.98 |
| 152-55, 152-70, 152-90 | 0.90 | 2.00 | 2.98 |

*4-12.4 is 1.80, 12.4-18 is 2.60

## ATTENUATION ACCURACY (±dB with respect to 0 dB reference):

**Model 150/151/152-11 & 150/151/152-15:**

| Frequency Range (GHz) | Attenuation Setting (dB) 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| dc-4 | 0.2 | 0.2 | 0.3 | 0.3 | 0.3 | 0.3 | 0.4 | 0.4 | 0.4 | 0.4 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| 4-12.4 | 0.3 | 0.3 | 0.4 | 0.4 | 0.5 | 0.5 | 0.6 | 0.6 | 0.6 | 0.6 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |
| 12.4-18 | 0.5 | 0.6 | 0.6 | 0.6 | 0.6 | 0.7 | 0.7 | 0.7 | 0.7 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |
| 18-26.5 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 0.9 | 0.9 | 1.0 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |

**Model 150/151-75:**

| Frequency Range (GHz) | Attenuation Setting (dB) 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 | 75 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| dc-4 | 0.2 | 0.2 | 0.4 | 0.4 | 0.5 | 0.5 | 0.7 | 0.7 | 0.9 | 0.9 | 1.1 | 1.1 | 1.2 | 1.2 | 1.4 |
| 4-12.4 | 0.3 | 0.3 | 0.6 | 0.6 | 0.9 | 0.9 | 1.2 | 1.2 | 1.5 | 1.5 | 1.8 | 1.8 | 2.1 | 2.1 | 2.1 |
| 12.4-18 | 0.4 | 0.4 | 0.8 | 0.8 | 1.2 | 1.2 | 1.6 | 1.6 | 2.0 | 2.0 | 2.4 | 2.4 | 2.8 | 2.8 | 2.8 |

**Model 150/151-31:**

| Frequency Range (GHz) | Attenuation Setting (dB) 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| dc-4 | 0.2 | 0.2 | 0.3 | 0.3 | 0.3 | 0.3 | 0.4 | 0.4 | 0.5 | 0.4 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| 4-12.4 | 0.3 | 0.3 | 0.4 | 0.4 | 0.5 | 0.5 | 0.6 | 0.6 | 0.7 | 0.6 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |
| 12.4-18 | 0.5 | 0.5 | 0.6 | 0.6 | 0.6 | 0.6 | 0.7 | 0.7 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |

| Frequency Rang (GHz) | Attenuation Setting (dB) 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| dc-4 | 0.5 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.8 | 0.8 |
| 4-12.4 | 0.8 | 0.8 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 1.1 | 1.0 | 1.0 | 1.0 | 1.0 | 1.1 | 1.1 |
| 12.4-18 | 0.9 | 0.9 | 1.0 | 1.0 | 1.0 | 1.0 | 1.1 | 1.1 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.3 | 1.3 |

**Model 150/151-62:**

| Frequency Range (GHz) | Attenuation Setting (dB) 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| dc-4 | 0.3 | 0.3 | 0.3 | 0.4 | 0.4 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.6 | 0.6 |
| 4-12.4 | 0.4 | 0.4 | 0.4 | 0.5 | 0.5 | 0.6 | 0.6 | 0.6 | 0.7 | 0.7 | 0.7 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |
| 12.4-18 | 0.5 | 0.5 | 0.5 | 0.6 | 0.6 | 0.6 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 1.0 | 1.0 | 1.0 | 1.2 | 1.2 |

| Frequency Range (GHz) | Attenuation Setting (dB) 34 | 36 | 38 | 40 | 42 | 44 | 46 | 48 | 50 | 52 | 54 | 56 | 58 | 60 | 62 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| dc-4 | 0.6 | 0.6 | 0.7 | 0.7 | 0.7 | 0.8 | 0.8 | 0.8 | 0.9 | 0.9 | 0.9 | 1.0 | 1.0 | 1.0 | 1.2 |
| 4-12.4 | 1.0 | 1.0 | 1.1 | 1.1 | 1.3 | 1.4 | 1.4 | 1.4 | 1.5 | 1.6 | 1.6 | 1.6 | 1.8 | 1.8 | 1.8 |
| 12.4-18 | 1.4 | 1.4 | 1.6 | 1.6 | 1.8 | 1.8 | 2.0 | 2.0 | 2.0 | 2.2 | 2.2 | 2.2 | 2.4 | 2.4 | 2.4 |

**Model 150/151-70, 150/151-110, 152A-70:**

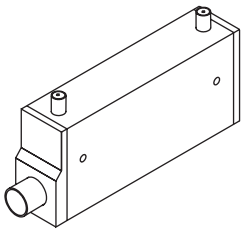
| Frequency Range (GHz) | Attenuation Setting (dB) 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| dc-4 | 0.2 | 0.3 | 0.5 | 0.7 | 0.9 | 1.0 | 1.2 | 1.4 | 1.6 | 1.7 | 1.9 |
| 4-12.4 | 0.4 | 0.7 | 0.9 | 1.2 | 1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0 | 3.0 |
| 12.4-18 | 0.4 | 0.8 | 1.2 | 1.6 | 2.0 | 2.4 | 2.8 | 3.2 | 3.6 | 4.0 | 4.0 |
| 18-26.5 | 0.6 | 0.7 | 0.9 | 1.5 | 1.6 | 2.2 | 2.9 | --- | --- | --- | --- |

**Model 152-55:**

| Frequency Range (GHz) | Attenuation Setting (dB) 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| dc-4 | 0.2 | 0.3 | 0.4 | 0.4 | 0.4 | 0.6 | 0.6 | 0.7 | 0.7 | 0.8 | 1.0 |
| 4-12.4 | 0.3 | 0.4 | 0.5 | 0.5 | 0.5 | 0.7 | 0.8 | 0.9 | 0.9 | 1.0 | 1.3 |
| 12.4-18 | 0.4 | 0.4 | 0.5 | 0.5 | 0.5 | 0.8 | 1.0 | 1.1 | 1.1 | 1.2 | 1.6 |
| 18-26.5 | 0.5 | 0.5 | 0.6 | 0.6 | 0.6 | 0.9 | 1.2 | 1.4 | 1.4 | 1.5 | 2.0 |

**Model 152-70 & 152-90:**

| Frequency Range (GHz) | Attenuation Setting (dB) 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 |
|---|---|---|---|---|---|---|---|---|---|
| dc-4 | 0.3 | 0.5 | 0.6 | 0.7 | 0.8 | 1.0 | 1.1 | 1.1 | 1.2 |
| 4-12.4 | 0.4 | 0.5 | 0.7 | 0.9 | 1.0 | 1.3 | 1.5 | 1.6 | 1.7 |
| 12.4-18 | 0.5 | 0.6 | 0.8 | 1.1 | 1.2 | 1.4 | 1.7 | 1.8 | 2.1 |
| 18-26.5 | 0.5 | 0.6 | 0.9 | 1.4 | 1.5 | 1.8 | 2.3 | 2.4 | 2.8 |



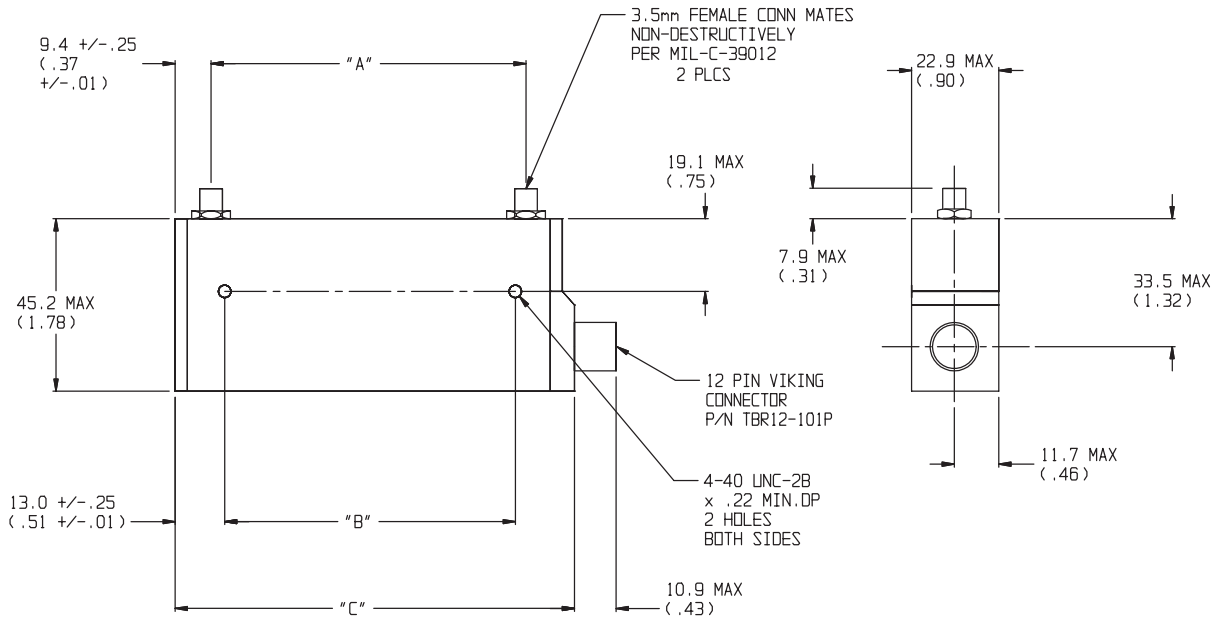


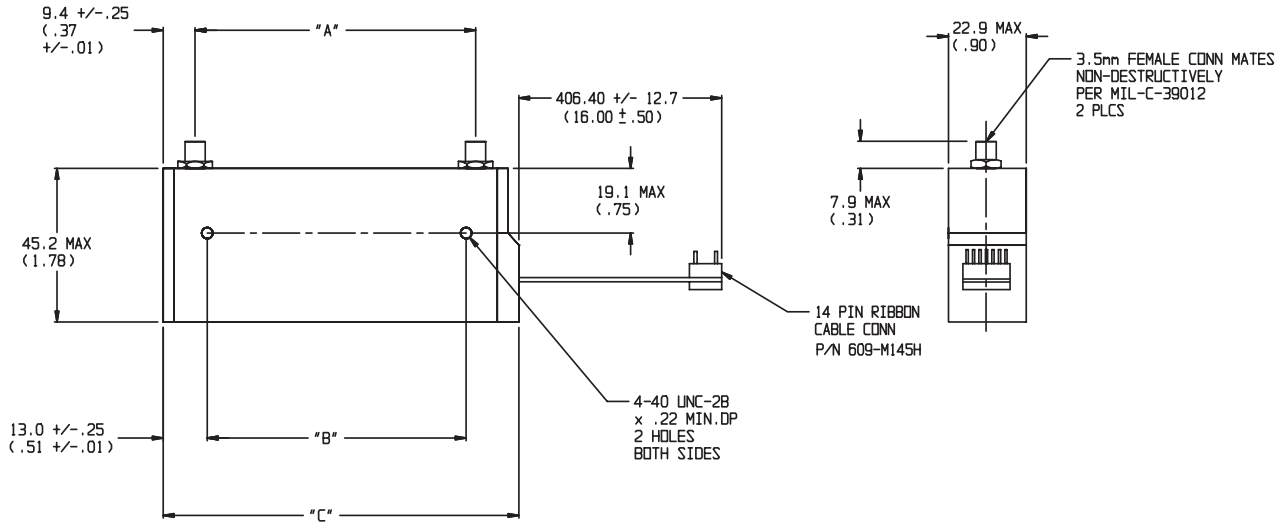
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Revision Date: 12/15/04

## PHYSICAL DIMENSIONS:

**Models 150, 151, & 152:**




| DIM | A | B | C |
|---|---|---|---|
| 3 cell | 82.3 (3.28) | 76.2 (3.0) | 104.6 (4.12) |
| 4 cell | 110.7 (4.36) | 103.7 (4.08) | 133.6 (5.25) |
| 5 cell | 136.1 (5.36) | 129.1 (5.08) | 159.5 (6.28) |

NOTE: All dimensions are given in mm (inches) and are maximum, unless otherwise specified.



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## 150 Series Ordering Guide...

| Frequency Range/ Voltage/Connector | NO. Cells | Attenuator Range/Step Size | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 11/1 dB | 15/1 dB | 55/5 dB | 31/1 dB | 70/10 dB | 75/5 dB | 90/10 dB | 110/10 dB |
| dc-4 GHz/+24 V/ Viking Connector | 4<br>3<br>5 | ☆ 151-11 | NA | N/A | <br><br>N/A | <br>N/A | N/A | N/A | N/A |
| dc-18 GHz/+24 V/ Viking Connector | 4<br>3<br>5 | ☆ 150-11 | 150-15 | N/A | <br><br>N/A | <br>☆ 150-70 | 150-75 | N/A | N/A |
| dc-26.5 GHz/+24 V/ Viking Connector | 4<br>3 | N/A | N/A | 152-55 | | N/A | N/A | 152-90 | N/A |
| dc-4 GHz/+24 V/ Ribbon Cable | 4<br>3<br>5 | 151-11-1 | NA | N/A | <br><br>N/A | <br>N/A | N/A | N/A | N/A |
| dc-18 GHz/+24 V/ Ribbon Cable | 4<br>3<br>5 | 150-11-1 | 150-15-1 | N/A | <br><br>150-31-1 | <br>☆ 150-70-1 | N/A | N/A | 150-110-1 |
| dc-26.5 GHz/+24 V/ Ribbon Cable | 4<br>3 | N/A | N/A | N/A | N/A | N/A | N/A | 152-90-1 | N/A |
| dc-4 GHz/+5 V/ Viking Connector | 4<br>3<br>5 | 151-11-2 | N/A | N/A | <br><br>N/A | <br>N/A | N/A | N/A | N/A |
| dc-18 GHz/+5 V/ Viking Connector | 4<br>3<br>5 | 150-11-2 | 150-15-2 | N/A | <br><br>N/A | <br>150-70-2 | 150-75-2 | N/A | N/A |
| dc-26.5 GHz/+5 V/ Viking Connector | 4<br>3 | N/A | N/A | N/A | N/A | <br>N/A | N/A | 152-90-2 | N/A |
| dc-4 GHz/+5 V/ Ribbon Cable | 4<br>3<br>5 | 151-11-3 | N/A | N/A | N/A | <br>N/A | N/A | N/A | N/A |
| dc-18 GHz/+5 V/ Ribbon Cable | 4<br>3<br>5 | NA | 150-15-3 | N/A | <br><br>N/A | <br>150-70-3 | ☆ 150-75-3 | N/A | NA |
| dc-26.5 GHz/+5 V/ Ribbon Cable | 4<br>3 | N/A | N/A | N/A | N/A | <br>N/A | N/A | ☆ 152-90-3 | N/A |

☆ ***EXPRESS*** Shipment available via www.sicklesonline.com or 800-542-4457.
Other models may be available for Express delivery.

N/A = Not Available

## ACCESSORIES

**OPTIONAL TEST Data:** Test Data is available at an additional cost for all programmable step attenuator models. Standard test Data can be provided in 250 MHz steps for all dc-4 GHz models and in 500 MHz steps for dc-18 and dc-26.5 GHz models. The measurements are traceable to NIST Standards.

**MODELS WITH BUILT-IN TTL/CMOS INTERFACE\ DRIVER CIRCUIT:** Aeroflex / Weinschel offers versions of the 150 series with built-in TTL/CMOS interfaces. This generation of intelligent attenuators will greatly simplify as well as provide an economical solution to 150 series driver problems. Refer to Model 150T, 151T, and 152T data sheet for more information.



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Revision Date: 12/15/04

# Models 4216 & 4218 — 0.8 to 2.3 GHz
# Pin Switched Programmable Attenuators — 1 Watt

## *Low Insertion Loss, Fast Switching*

EXPRESS
www.sicklesonline.com
800-542-4457



## Features

Ideal for use in Wireless/Cellular, RF Simulation/Emulation, & Communication Test Applications.

- **Available in 6 and 8 Cell Configurations -**
  127 dB/1 dB steps
  63 dB/1 dB steps
  63.75/0.25 dB steps
- **Available *Express* Models:** 4216-63
  4218-63.75
  Other models may be available for Express delivery.
- **High accuracy & fast switching speed**
- **Built-in TTL Driver Circuitry**
- **Special Configurations Available Upon Request.**
  - Custom Cell/Step Size & Frequency Bands

## Specifications

**NOMINAL IMPEDANCE:** 50 Ω
**FREQUENCY RANGE:** 0.8 to 2.3 GHz

**MAXIMUM SWR:**

| Frequency Range (GHz) | SWR |
|---|---|
| 0.8 - 2.3 | 1.50 |

**CELL CONFIGURATIONS:**

| Model Number | NO. Cells | Attenuation Range/Steps (dB) | Cell Increments (dB) |
|---|---|---|---|
| 4218-127 | 8 | 127/1 | 1, 2, 4, 8, 16, 32, 64 |
| 4218-63.75 | 8 | 63.75/0.25 | 0.25, 0.5, 1, 2, 4, 8, 16, 32 |
| 4216-63 | 6 | 63/1 | 1, 2,4, 8, 16, 32 |

**INCREMENTAL ATTENUATION ACCURACY:**

| Frequency Range (GHz) | Accuracy |
|---|---|
| 0.8 - 2.3 | ± 0.4 dB or 2.0% |

**INSERTION LOSS, Nominal (dB):**

| Frequency Range (GHz) | 4218-X | 4216-63 |
|---|---|---|
| 0.8 - 1.0 | 3.00 | 2.10 |
| 1.0 - 2.3 | 4.90 | 3.40 |

**MONOTONICITY:** 0.8 to 2.3 GHz
**3rd ORDER INTERMODULATION (IM3):** -55 dBm typical, measured with two +10 dBm tones @ 869 MHz (f1) and 894 MHz (f2), the IM3 frequency being 847 MHz (2f1-f2).

$$IP3 \text{ (input)} = +41.5 \text{ dBm}$$

The input IP3 is derived from the following relationship:

$$IP3 = \frac{3(Pin-\alpha)-IM3}{2} + \alpha$$

where $\alpha$ = the insertion loss (dB) at the IM3 frequency;
Pin=single tone input power (dBm).

**POWER RATING:** +24 dBm operating
+30 dBm (1 dB compression point)
**SWITCHING TIME:** 2 µsec. maximum
**OPERATING VOLTAGE:** +5 V ± 5% @ 160 mA for 6 cell/ 200 mA for 8 cell typical
**TEMPERATURE RANGE (Operating):** 0°C to +70°C
**TEMPERATURE COEFFICIENT:** < 0.002 dB/dB/°C
**CONNECTORS:** SMA female connectors - mate nondestructively with MIL-C-39012 connectors.

**CONTROL CONNECTOR:** AMP-Latch 10 pin ribbon cable connector mates with AMP P/N 746285-1 (supplied with each unit)

**WEIGHT:** 4216-X 175 g (6.1 oz)
4218-X 215 g (7.5 oz)

**CONTROL CONFIGURATION:** Units are supplied with a built-in TTL interface. Each unit is supplied with a mating 10 pin connector (Amp 746285-1). Refer to Physical Dimensions for mating connector pin/wiring details. Two wires are specified for supply voltage and ground. The remaining wires will accept TTL control signals to activate or de-activate a particular attenuation cell. A TTL high will energize a cell to the high attenuation state, whereas a TTL low will maintain a cell in its zero attenuation state.

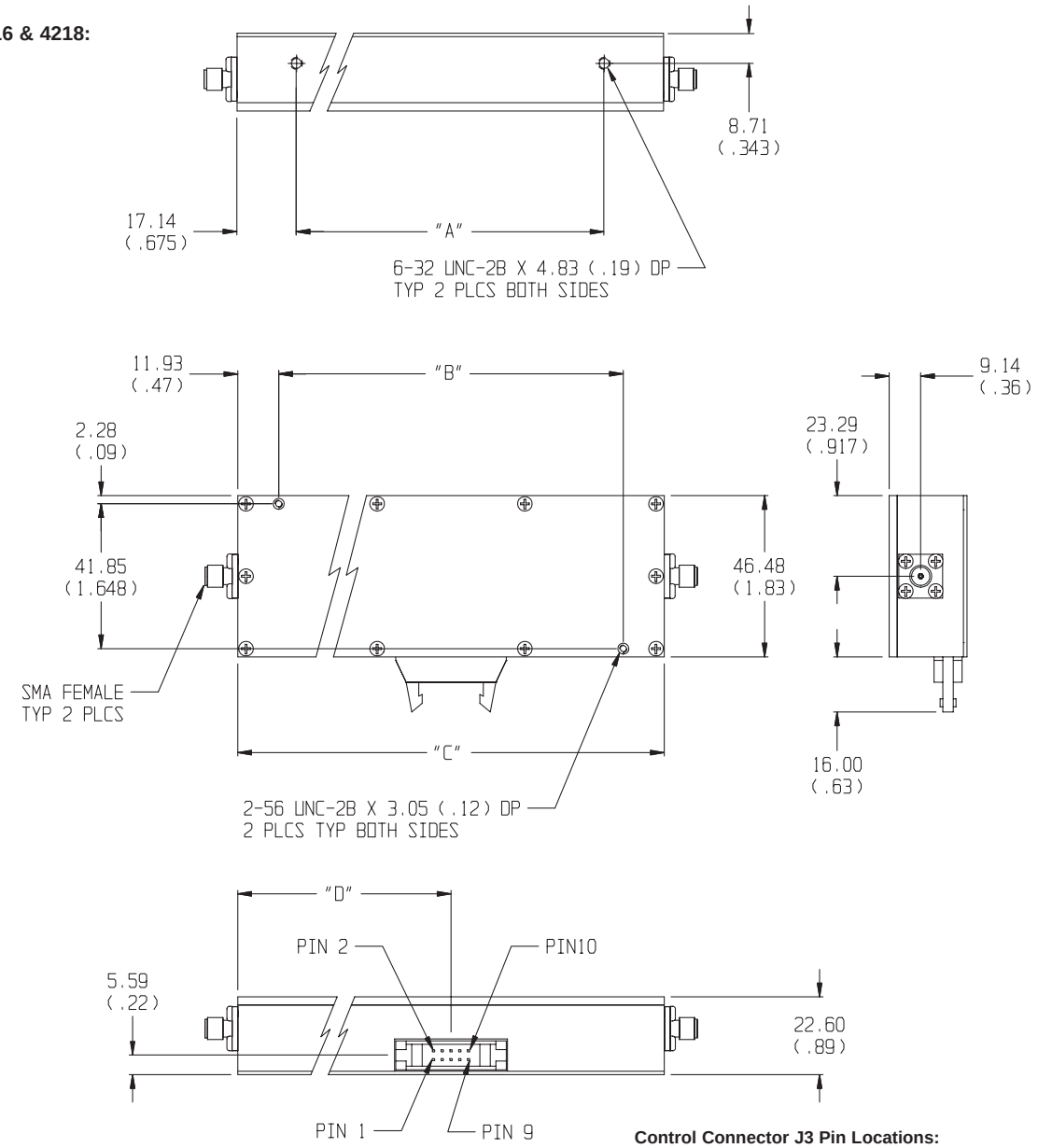


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Revision Date: 12/15/04

## PHYSICAL DIMENSIONS:

**Models 4216 & 4218:**




| Model No. | A | B | C | D |
|---|---|---|---|---|
| 4216-X | 63.50 (2.50) | 71.12 (2.80) | 94.74 (3.73) | 47.49 (1.87) |
| 4218-X | 88.90 (3.50) | 99.56 (3.92) | 123.19 (4.85) | 61.72 (2.43) |

NOTE: All dimensions are given in mm (inches) and are maximum, unless otherwise specified.

**Control Connector J3 Pin Locations:**

| TTL Conn PIN No. (J3) | 4216-63 dB (Cell) | 4218-63.75 dB (Cell) | 4218-127 dB (Cell ) |
|---|---|---|---|
| 1 | 1 | 0.25 | 1 |
| 2 | 2 | 0.50 | 2 |
| 3 | 4 | 1 | 4 |
| 4 | 8 | 2 | 8 |
| 5 | 16 | 4 | 16 |
| 6 | 32 | 8 | 32 |
| 7 | NC | 16 | 32* |
| 8 | NC | 32 | 32* |
| 9 | +5V | +5V | +5V |
| 10 | COM | COM | COM |

NC = Not Connected
*Pins 7 and 8 combined to create 64 dB cell.

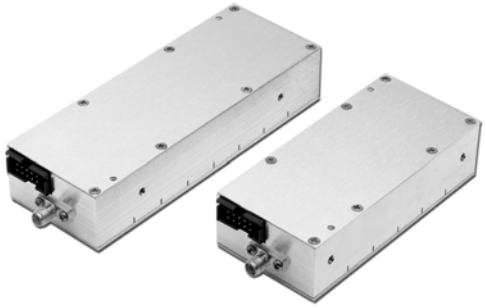


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Revision Date: 12/15/04

# Models 4226 & 4228 0.8 to 2.5/3.0 GHz
# Pin Switched Programmable Attenuators 1 Watt

## *Low Insertion Loss, Fast Switching*



## Features

Ideal for use in Wireless/Cellular, RF Simulation/Emulation, & Communication Test Applications.

- **Available in 6 and 8 Cell Configurations -**
  103 dB/1 dB steps
  63 dB/1 dB steps
  63.75/0.25 dB steps
- **High accuracy & fast switching speed**
- **Built-in TTL Driver Circuitry**
- **Special Configurations Available Upon Request.**
  - Custom Cell/Step Size & Frequency Bands

## Specifications

**NOMINAL IMPEDANCE:** 50 Ω

**FREQUENCY RANGE:**

| | |
|---|---|
| 4226-63: | 0.8 to 3.0 GHz |
| 4228-63.75: | 0.8 to 2.5 GHz |
| 4228-103: | 0.8 to 3.0 GHz |

**MAXIMUM SWR:**

| Frequency Range (GHz) | SWR |
|---|---|
| 0.8 - 3.0 (2.5) | 1.50 |

**CELL CONFIGURATIONS:**

| Model Number | NO. Cells | Attenuation Range/Steps (dB) | Cell Increments (dB) |
|---|---|---|---|
| 4228-103 | 8 | 103/1 | 1, 2, 4, 8, 16, 24, 48 |
| 4228-63.75 | 8 | 63.75/0.25 | 0.25, 0.5, 1, 2, 4, 8, 16, 32 |
| 4226-63 | 6 | 63/1 | 1, 2, 4, 8, 16, 32 |

**INCREMENTAL ATTENUATION ACCURACY:**

| CELL | 0.25 | 0.50 | 1 | 2 | 4 | 8 | 16 | 24 | 32 | 48 |
|---|---|---|---|---|---|---|---|---|---|---|
| dB | ±0.1 | ±0.15 | ±0.2 | ±0.2 | ±0.2 | ±0.2 | ±0.3 | ±0.4 | ±0.6 | ±0.8 |

**INSERTION LOSS, Maximum (dB):**

| Frequency (GHz) | 4226-63 | 4228-63.75 | 4228-103 |
|---|---|---|---|
| 0.8 - 3.0 (2.5) | 3.75 | 4.50 | 5.50 |

**MONOTONICITY:** 4226-63 & 4228-103: 0.8 to 3.0 GHz
4228-63.75: 0.8 to 2.5 GHz

**3rd ORDER INTERMODULATION (IM3):** -55 dBm typical, measured with two +10 dBm tones @ 869 MHz (f1) and 891 MHz (f2), the IM3 frequency being 847 MHz (2f1-f2).

$IP3$ (input) = +41 dBm

The input IP3 is derived from the following relationship:

$$IP3 = \frac{3(Pin-\alpha)-IM3}{2} + \alpha$$

where $\alpha$ = the insertion loss (dB) at the IM3 frequency;
Pin=single tone input power (dBm).

**POWER RATING:** +24 dBm operating
+30 dBm (1 dB compression point)

**SWITCHING TIME:** 2 µsec. maximum

**OPERATING VOLTAGE:** +5 V ± 5% @ 160 mA for 6 cell/ 200 mA for 8 cell typical

**TEMPERATURE RANGE (Operating):** 0°C to +70°C

**TEMPERATURE COEFFICIENT:** < 0.002 dB/dB/°C

**CONNECTORS:** SMA female connectors - mate nondestructively with MIL-C-39012 connectors.

**CONTROL CONNECTOR:** AMP-Latch 10 pin ribbon cable connector mates with AMP P/N 746285-1 (supplied with each unit)

**WEIGHT:** 4226-X 160 g (5.7 oz)
4228-X 210 g (7.4 oz)

**CONTROL CONFIGURATION:** Units are supplied with a built-in TTL interface. Each unit is supplied with a mating 10 pin connector (Amp 746285-1). Refer to Physical Dimensions for mating connector pin/wiring details. Two wires are specified for supply voltage and ground. The remaining wires will accept TTL control signals to activate or de-activate a particular attenuation cell. A TTL high will energize a cell to the high attenuation state, whereas a TTL low will maintain a cell in its zero attenuation state.

**DRIVER SPECIFICATIONS:**

| | | minimum | maximum |
|---|---|---|---|
| $V_{IH}$ | Input High Level | 2.0 V | 5.3 V |
| $V_{IL}$ | Input Low Level | -0.3 V | 0.8 V |
| $I_{PU}$ | Input Pull-up Current | 500 µA Typical | |

Note: Inputs have 10K pull-up resistors.

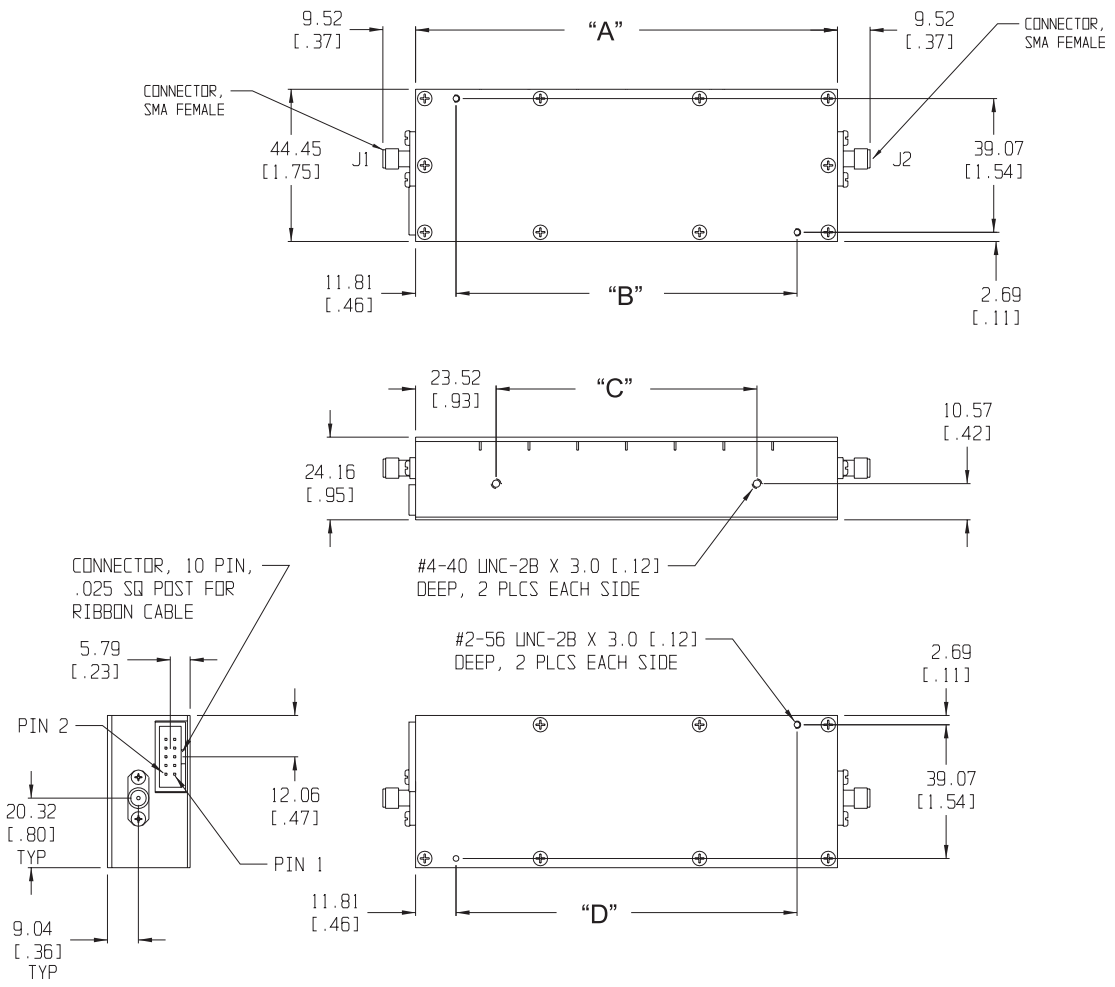


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Revision Date: 12/15/04

## PHYSICAL DIMENSIONS:

**Models 4226 & 4228:**




| Model No. | A | B | C | D |
|---|---|---|---|---|
| 4226-X | 94.79 (3.73) | 71.15 (2.80) | 76.20 (3.00) | 71.15 (2.80) |
| 4228-X | 123.24 (4.85) | 99.59 (4.85) | 76.20 (3.00) | 99.59 (4.85) |

NOTE: All dimensions are given in mm (inches) and are maximum, unless otherwise specified.

**Control Connector J3 Pin Locations:**

| TTL Conn PIN No. (J3) | 4226-63 dB (Cell) | 4228-63.75 dB (Cell) | 4228-103 dB (Cell ) |
|---|---|---|---|
| 1 | 1 | 0.25 | 1 |
| 2 | 2 | 0.50 | 2 |
| 3 | 4 | 1 | 4 |
| 4 | 8 | 2 | 8 |
| 5 | 16 | 4 | 16 |
| 6 | 32 | 8 | 24 |
| 7 | NC | 16 | 48 |
| 8 | NC | 32 | NC* |
| 9 | +5V | +5V | +5V |
| 10 | COM | COM | COM |

NC = Not Connected

* For Factory use only.



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Revision Date: 12/15/04

# Model 4238
# GaAs Switched Programmable Attenuator

## 10 MHz to 2.5 GHz
## 1 Watt

NEW

*Low Insertion Loss, High IP3*

EXPRESS
www.sicklesonline.com
800-542-4457



## Features

Ideal for use in Wireless/Cellular, RF Simulation/Emulation, & Communication Test Applications.

- **Broadband Performance -** 10 MHz to 2.5 GHz usable dc to 10 MHz with reduced specifications
- **Available *Express* Models:** 4238-103
  Other models may be available for Express delivery.
- **High IP3 and High Power Rating**
  - Utilizes MESFET Switching
- **Flexible DC Voltage (+5 to +15 V)**
- **Low DC Power Consumption** - Ideal for portable battery powered equipment.
- **Custom Configurations including bus controlled attenuator subsystems**

## Specifications

**NOMINAL IMPEDANCE:** 50 Ω
**FREQUENCY RANGE:** 10 MHz to 2.5 GHz

**MAXIMUM SWR:**

| Frequency Range (GHz) | SWR |
|---|---|
| 0.01 - 0.20 | 1.60 |
| 0.20 - 2.5 | 1.40 |

**CELL CONFIGURATIONS:**

| Model Number | NO. Cells | Attenuation Range/Steps (dB) | Cell Increments (dB) |
|---|---|---|---|
| 4238-63.75 | 8 | 63.75/0.25 | 0.25, 0.5, 1, 2, 4, 8, 16, 32 |
| 4238-103 | 8 | 103/1 | 1, 2, 4, 8, 16, 24, 48 |

**INCREMENTAL ATTENUATION ACCURACY:**

| CELL | 0.25 | 0.50 | 1 | 2 | 4 | 8 | 16 | 24 | 32 | 48 |
|---|---|---|---|---|---|---|---|---|---|---|
| dB | ±0.15 | ±0.15 | ±0.2 | ±0.2 | ±0.2 | ±0.2 | ±0.3 | ±0.4 | ±0.6 | ±0.8 |

**INSERTION LOSS, Maximum (dB):**

| Frequency Range (GHz) | 4238-X |
|---|---|
| 0.01 - 1.0 | 6.50 |
| 1.0 - 2.0 | 8.00 |
| 2.0 - 2.5 | 9.00 |

**MONOTONICITY:** 10 MHz to 2.5 GHz

**3rd ORDER INTERMODULATION (IM3):** -60 dBm typical, measured with two +27 dBm tones @ 869 MHz (f1) and 894 MHz (f2), the IM3 frequency being 847 MHz (2fl-f2).

$IP3$ (input) = +65 dBm

The input IP3 is derived from the following relationship:

$$IP3 = \frac{3(Pin-\alpha)-IM3}{2} + \alpha$$

where $\alpha$ = the insertion loss (dB) at the IM3 frequency;
Pin=single tone input power (dBm).

**INPUT POWER RATING:** +30 dBm

**SWITCHING TIME:** 5 µsec. maximum

**OPERATING VOLTAGE:** + 5 to +15 V

**OPERATING CURRENT:** 25 mA typical

**TEMPERATURE RANGE (Operating):** 0°C to +70°C

**TEMPERATURE COEFFICIENT:** <0.002/dB/dB/°C

**CONNECTORS:** SMA female connectors - mate nondestructively with MIL-C-39012 connectors.

**CONTROL CONNECTOR:** AMP-Latch 10 pin ribbon cable connector mates with AMP P/N 746285-1 (supplied with each unit)

**WEIGHT:** 4238-X 150 g (5.3 oz)

**CONTROL CONFIGURATION:** Units are supplied with a built-in TTL interface. Each unit is supplied with a mating 10 pin connector (Amp 746285-1). Refer to Physical Dimensions for mating connector pin/wiring details. Two wires are specified for supply voltage and ground. The remaining wires will accept TTL control signals to activate or de-activate a particular attenuation cell. A TTL high will energize a cell to the high attenuation state, whereas a TTL low will maintain a cell in its zero attenuation state.

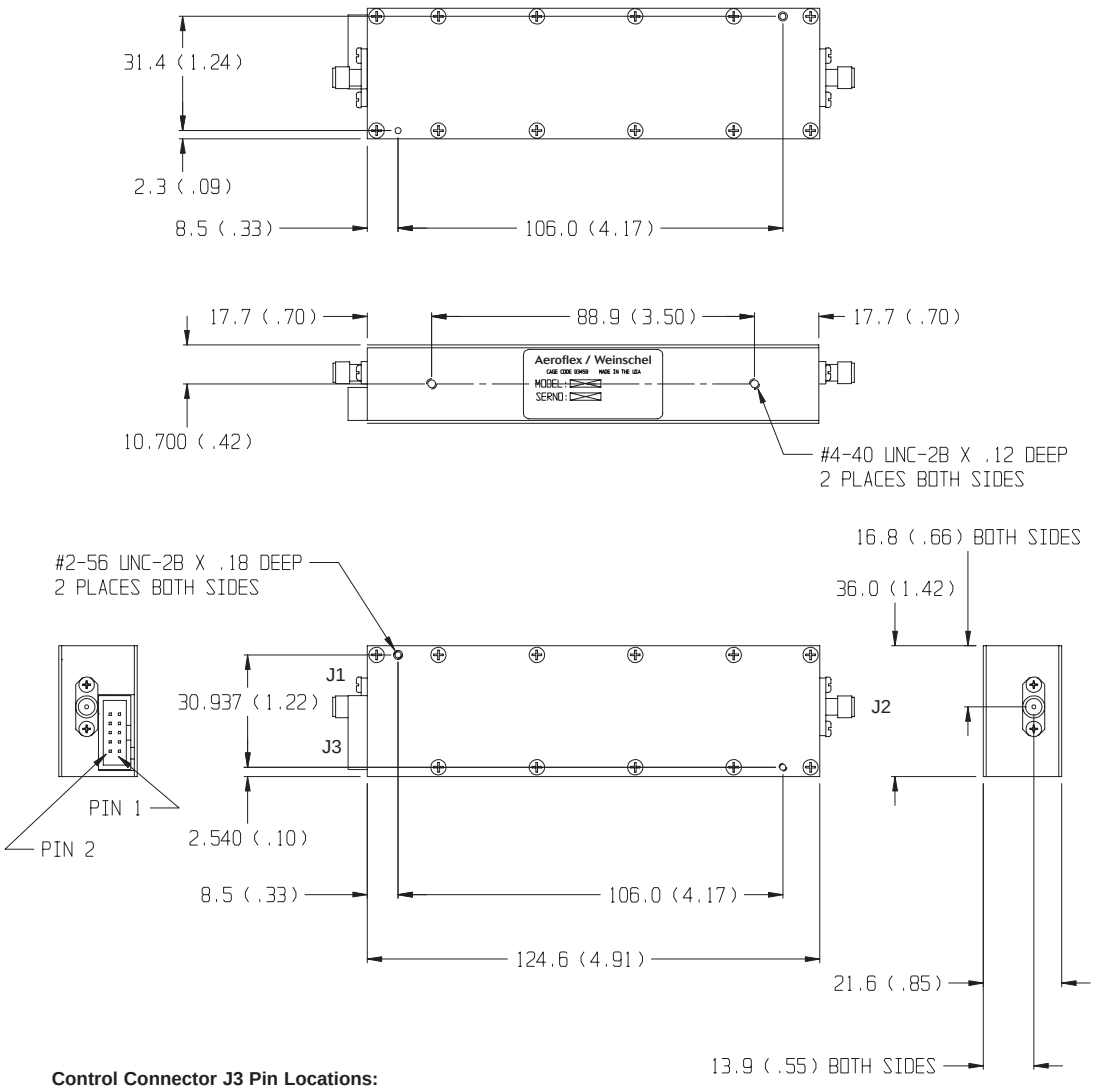


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Revision Date: 12/15/04

## PHYSICAL DIMENSIONS:

**Model 4238:**




**Control Connector J3 Pin Locations:**

| TTL Conn PIN No. (J3) | 4238-103 dB (Cell) | 4238-63.75 dB (Cell) |
|---|---|---|
| 1 | 1 | 0.25 |
| 2 | 2 | 0.50 |
| 3 | 4 | 1 |
| 4 | 8 | 2 |
| 5 | 16 | 4 |
| 6 | 24 | 8 |
| 7 | 48 | 16 |
| 8 | NC* | 32 |
| 9 | +5 to 15V | +5 to 15V |
| 10 | COM | COM |

NC = Not Connected
* For Factory use only.

NOTE: All dimensions are given in mm (inches) and are maximum, unless otherwise specified.



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Revision Date: 12/15/04

AEROFLEX WEINSCHEL

# Models 4246 & 4248 Phase Compensated GaAs Switched Programmable Attenuator

# 10 MHz to 2.5 GHz 4 Watts

NEW

***Low Insertion Loss, High IP3***



## Features

Ideal for use in Wireless/Cellular, RF simulation/Emulation, & Communication Test Applications.

- **Broadband Performance -** 10 MHz to 2.5 GHz
- **High IP3 and High Power Rating**
  - Utilizes MESFET Switching
- **Flexible DC Voltage (+5 to +15 V)**
- **Low DC Power Consumption** - Ideal for portable battery powered equipment.
- **Custom Configurations including bus controlled attenuator subsystems**

## Specifications

**NOMINAL IMPEDANCE:** 50 Ω
**FREQUENCY RANGE:** 10 MHz to 2.5 GHz

**MAXIMUM SWR:**

| Frequency Range | SWR |
|---|---|
| 10 - 100 MHz | 2.00 |
| 100 MHz - 200 MHz | 1.60 |
| 200 MHz - 2.5 GHz | 1.40 |

**CELL CONFIGURATIONS:**

| Model Number | NO. Cells | Attenuation Range/Steps (dB) | Cell Increments (dB) |
|---|---|---|---|
| 4248-63 | 6 | 63/1 | 1, 2, 4, 8, 16, 32 |
| 4248-63.75 | 8 | 63.75/0.25 | 0.25, 0.50, 1, 2, 4, 8 16, 32 |
| 4348-103 | 8 | 103/1 | 1, 2, 4, 8, 16, 24, 48* |

*48 dB cell comprised of two 24 dB cells

**INSERTION LOSS, Maximum (dB):**

| Frequency Range | 4246 | 4248 |
|---|---|---|
| 10 MHz - 1 GHz | 8.0 | 10.5 |
| 1 - 2 GHz | 9.0 | 12.0 |
| 2 - 2.5 GHz | 10.0 | 13.0 |

**INCREMENTAL ATTENUATION ACCURACY:**

| CELL | 0.25 | 0.50 | 1 | 2 | 4 | 8 | 16 | 24 | 32 | 48 |
|---|---|---|---|---|---|---|---|---|---|---|
| dB | ±0.15 | ±0.15 | ±0.2 | ±0.2 | ±0.2 | ±0.2 | ±0.3 | ±0.4 | ±0.6 | ±0.8 |

**MONOTONICITY:** 10 MHz to 2.5 GHz

**3rd ORDER INTERMODULATION (IM3):** -43 dBm typical, measured with two +27 dBm tones @ 869 MHz (f1) and 894 MHz (f2), the IM3 frequency being 844 MHz (2f1-f2).

*IP3* (input) = +58 dBm

The input IP3 is derived from the following relationship:

$$IP3 = \frac{3(Pin-\alpha)-IM3}{2} + \alpha$$

where $\alpha$ = the insertion loss (dB) at the IM3 frequency;
Pin=single tone input power (dBm).

**POWER RATING:** 4 Watts maximum

**SWITCHING TIME:** 5 µsec. maximum

**OPERATING VOLTAGE:** + 5 V to +15V

**OPERATING CURRENT:** 25 mA typical

**INCREMENTAL RELATIVE PHASE:**

±5° between 0 and.25, 1, 2, 4, 8, 16 dB
±10° between 0 and 32, 48 dB

**TEMPERATURE RANGE (Operating):** 0°C to +70°C

**TEMPERATURE COEFFICIENT:** <0.002/dB/dB/°C

**CONNECTORS:** SMA female connectors - mate nondestructively with MIL-C-39012 connectors.

**CONTROL CONNECTOR:** AMP-Latch 10 pin ribbon cable connector mates with AMP P/N 746285-1 (supplied with each unit)

**CONSTRUCTION:**

Housing: Aluminum
Connectors: Stainless steel body and beryllium copper contacts.

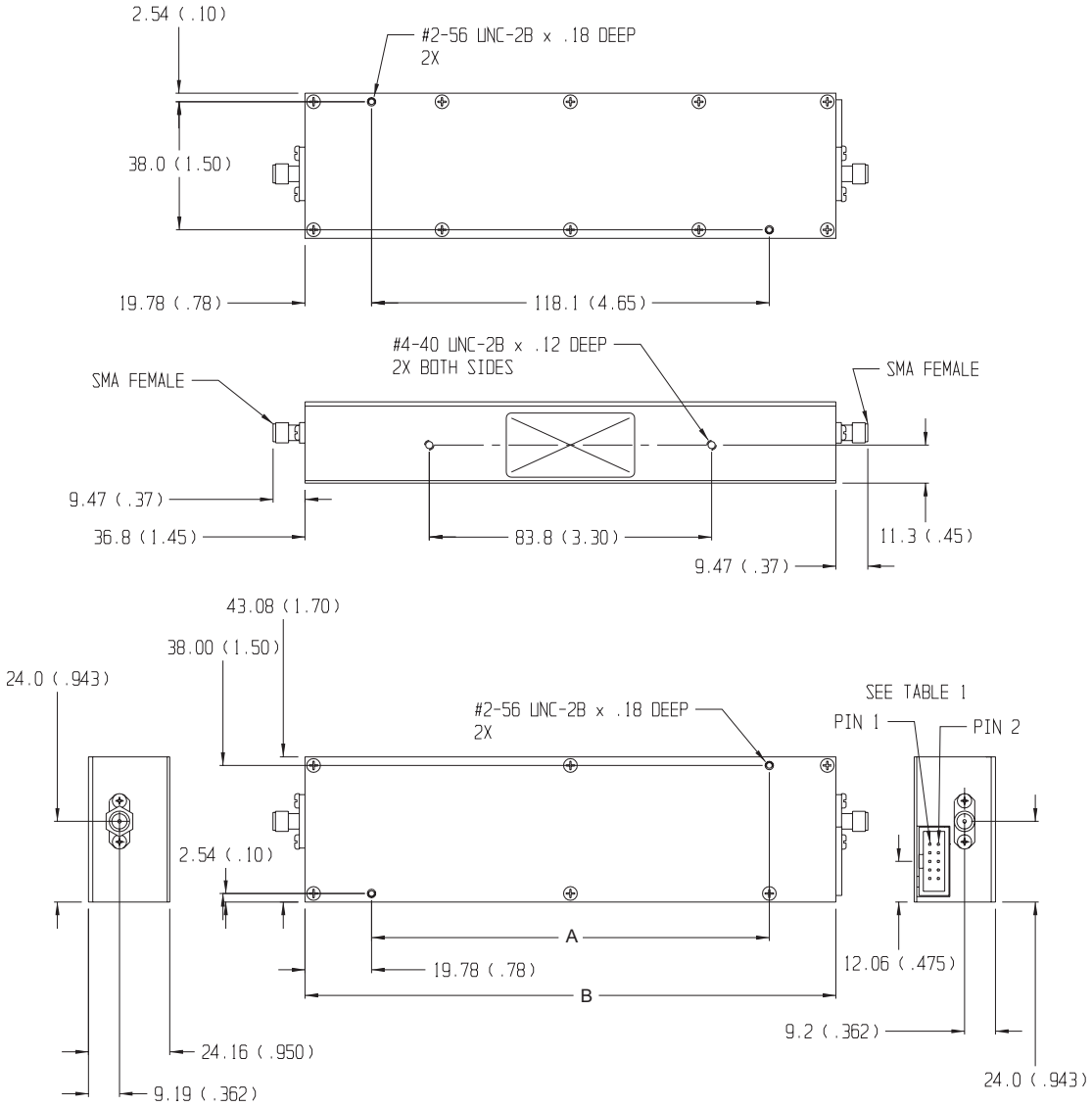
**WEIGHT:** Model 4246: 227 g (8.0 oz)
Model 4248: 300 g (10.6 oz)



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Revision Date: 12/15/04

## PHYSICAL DIMENSIONS:




**Control Connector J3 Pin Locations:**

| TTL Conn PIN No. (J3) | 4238-63 dB (Cell) | 4240-63.75 dB (Cell) | 4208-103 dB (Cell) |
|---|---|---|---|
| 1 | 1 | 0.25 | 1 |
| 2 | 2 | 0.50 | 2 |
| 3 | 4 | 1 | 4 |
| 4 | 16 | 2 | 8 |
| 5 | 32 | 4 | 16 |
| 6 | 8 | 8 | 24 |
| 7 | NC | 16 | 48 |
| 8 | NC* | 32 | NC* |
| 9 | +5 Vdc | +5 Vdc | +5 Vdc |
| 10 | COM | COM | COM |

NC = Not Connected
* For Factory use only.

| Model No. | A | B |
|---|---|---|
| 4246-X | 82.50 (3.25) | 122.50 (4.81) |
| 4248-X | 118.10 (4.65) | 157.7 (6.21) |

NOTE: All dimensions are given in mm (inches) and are maximum, unless otherwise specified.

**CONTROL CONFIGURATION:** Units are supplied with a built-in TTL interface. Each unit is supplied with a mating 10 pin connector (Amp 746285-1). Refer to Physical Dimensions for mating connector pin/wiring details. Two wires are specified for supply voltage and ground. The remaining wires will accept TTL control signals to activate or de-activate a particular attenuation cell. A TTL high will energize a cell to the high attenuation state, whereas a TTL low will maintain a cell in its zero attenuation state.



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Revision Date: 12/15/04

# Models 8310 & 8311
# Programmable Attenuator Units

IEEE-488

RS232\RS422/RS485

CE

## *A New Concept in Programmable Attenuation!*



## Features

- Provides a flexible, easy to program, low cost solution for your bench test/calibration setups and subsystem applications.
- Multi-Channel attenuation paths (up to 4 input/outputs for 8310 & up to 6 input/outputs for 8311)
- Relative vs. Nominal attenuation step function.
- Wide choice of Frequency & Attenuation Ranges.
  - dc to 1, 2, 3, 18 & 26.5 GHz
  - up to 127 dB
  - Solid-State (GaAs FET *& PIN)
  - Relay Switched
- 75 Ω Configurations
- Accuracy & Repeatability.
- Designed to interface with Aeroflex / Weinschel's line of digitally controlled programmable attenuators and other electromechanical devices.
- Designed to interface with industry standard communication interfaces:

  - GPIB/IEEE-488 (HS-488 ready)
  - RS-232, RS-422, RS-485

- **Rack Configurable:** The Model 8310 or 8311 can be rack mounted either as a single unit using Rack Mounting Kit (P/N 193-8033) or two Model 8310's can be mounted together using Rack Mounting Kit (P/N 193-8033-1). These kits fit into any rack or cabinet that is designed per EIA RS-310 or MIL-STD-189.

## Description

Aeroflex / Weinschel's 8310 and 8311Series Programmable Attenuator Units represent a new concept in programmable attenuation for bench test and subsystem applications. Standard 8310 Series designs house and control various Aeroflex / Weinschel Programmable Attenuator Models (3200T, 150T, and 4200 Series) via front panel controls or standard communications interfaces including GPIB (IEEE-488) and RS-232/RS-422 /RS485. This series combines the features of the Aeroflex / Weinschel 8210A Device Controller with a front panel user interface to form a flexible, easy to use solution.

Most 8310 Series are single channel configurations where RF signal is routed through either the front or rear mounted Ports A & B but can be configured for up to four channels of attenuation, RF switching, amplification or other functions. Multiple programmable attenuators can be used inconjuction with other coaxial devices such as switches, power combiners, directional couplers, and filters creating single or multichannel subsystems.



*6 Channel 19" Rack Size Versions*

## Applications

Applications for the 8310 and 8311 Series range from providing control of a single Programmable Attenuator in a bench test/lab environment using a PC and a terminal emulator, to complex system applications where the 8310/8311 Series are employed to control many devices to create custom/ semi-custom subsystems to reduce overall design cost. Aeroflex / Weinschel can provide a variety of custom designed driver interfaces for various devices, such as RF switches, relays, pin attenuators, motorized step attenuators, displays, and other devices, as well as complete subsystem design and integration services. Contact us with your specialized needs.

***For additional information on the Model 8310, visit our website @ www.aeroflex-weinschel.com/8310.htm***



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Revision Date: 12/15/04

## Specifications

| SPECIFICATION | DESCRIPTION | |
|---|---|---|
| **Input Power Requirements** | ac | 100 to 240 Vac, 50/60 Hz, 50 Watts |
| **Environmental** | Operating Temperature<br>Storage Temperature:<br>Humidity:<br>Altitude: | 0 to +50°C<br>67° to +167 °F (-55° to +75°C)<br>96%<br>40,000' (12,192M) |
| **IEEE-488 Bus** | Connector:<br>Protocols:<br>Indicators: | 24-pin per IEEE-488.1<br>per IEEE-488.2<br>Remote (RMT), Listen (LSN), Talk (TLK), SRQ (SRQ) |
| **RS-232 Bus** | Connector:<br>Signals:<br>Baud Rates:<br>Data Bits:<br>Handshaking:<br>Parity:<br>Indicators: | 9-pin male D<br>TXD, RXD, RTS, CTS, DTR, GND<br>2400, 9600, 19200, and 38400<br>8<br>None, RTS/CTS, XON/XOFF<br>None, Odd, Even<br>Tx (Transmit) and Rx (Receive) |
| **RS-422 BUS(3)**<br>**RS-485 Bus(4)** | Connector:<br>Signals:<br>Baud Rates:<br>Data Bits:<br>Handshaking:<br>Parity:<br>Indicators: | 9-pin male D<br>TXD+, TDX-, RXD+, RTX-, RTS+, RTS-, CTS+, CTS-, and signal GND<br>2400, 9600, 19200, and 38400<br>8<br>None, RTS/CTS, XON/XOFF<br>None, Odd, Even<br>Tx (Transmit) and Rx (Receive) |
| **RF Characteristics(5)** | See ordering guide (pg 120 through 122) | |

1. GPIB/IEEE-488 model allows user-selectable addresses.
2. RS-232 can be used with standard PC serial port for short and medium distances (up to approximately 50 ft).
3. RS-422, designed for very long distance communications (4000 ft) and & optimized as a single node protocol, typically with one device connected to a single port.
4. RS-485, designed for very long distance communications (4000 ft) & optimized for multi-drop connections that can used to create a low cost network.
5. Refer to Individual data sheet for detailed specifications on internal programmables.

## Ordering Guide...8310 Series with 4200 Programmables

| Model No | Attenuation Value (dB) | Frequency Range (GHz) | Insertion Loss (maximum) | SWR (Maximum) | No of Channels | Attenuator Model No.* | Connector Type | Conn Location |
|---|---|---|---|---|---|---|---|---|
| 8310-136-F | 63.75/0.25 | 0.8-2.5 | 6.0 | 1.6 | 1 | 4228-63.75 | N/F | Front |
| 8310-136-R | 63.75/0.25 | 0.8-2.5 | 6.0 | 1.6 | 1 | 4228-63.75 | N/F | Rear |
| 8310-136-2-F | 63.75/0.25 | 0.8-2.5 | 6.0 | 1.6 | 2 | 4228-63.75 | N/F | Front |
| 8310-136-2-R | 63.75/0.25 | 0.8-2.5 | 6.0 | 1.6 | 2 | 4228-63.75 | N/F | Rear |
| 8310-137-F | 63/1 | 0.8-3.0 | 4.7 | 1.6 | 1 | 4226-63 | N/F | Front |
| 8310-137-R | 63/1 | 0.8-3.0 | 4.7 | 1.6 | 1 | 4226-63 | N/F | Rear |
| 8310-137-2-F | 63/1 | 0.8-3.0 | 4.7 | 1.6 | 2 | 4226-63 | N/F | Front |
| 8310-137-2-R | 63/1 | 0.8-3.0 | 4.7 | 1.6 | 2 | 4226-63 | N/F | Rear |
| 8310-138-F | 103/1 | 0.8-3.0 | 6.0 | 1.6 | 1 | 4228-103 | N/F | Front |
| 8310-138-R | 103/1 | 0.8-3.0 | 6.0 | 1.6 | 1 | 4228-103 | N/F | Rear |
| 8310-138-2-F | 103/1 | 0.8-3.0 | 6.0 | 1.6 | 2 | 4228-103 | N/F | Front |
| 8310-138-2-R | 103/1 | 0.8-3.0 | 6.0 | 1.6 | 2 | 4228-103 | N/F | Rear |
| 8310-138-3-T | 103/1 | 0.8-3.0 | 6.0 | 1.6 | 3 | 4228-103 | N/F | Front/Rear |
| 8310-138-4-T | 103/1 | 0.8-3.0 | 6.0 | 1.6 | 4 | 4228-103 | N/F | Front/Rear |



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Revision Date: 12/15/04

# Programmable Attenuators

## Ordering Guide...8310 Series with 3200 Programmables

| Model No | Attenuation Value (dB) | Frequency Range (GHz) | Insertion Loss (maximum) | SWR (Maximum) | No of Channels | Attenuator Model No.* | Connector Type | Conn Location |
|---|---|---|---|---|---|---|---|---|
| 8310-1-F | 63/1 | dc-1.0 (75Ω) | 6.0 dB | 1.6 | 1 | 3250T-63 | BNC/F | Front |
| 8310-1-R | 63/1 | dc-1.0 (75Ω) | 6.0 dB | 1.6 | 1 | 3250T-63 | BNC/F | Rear |
| 8310-1-2-F | 63/1 | dc-1.0 (75Ω) | 6.0 dB | 1.6 | 2 | 3250T-63 | BNC/F | Front |
| 8310-1-2-R | 63/1 | dc-1.0 (75Ω) | 6.0 dB | 1.6 | 2 | 3250T-63 | BNC/F | Rear |
| 8310-1-3-T | 63/1 | dc-1.0 (75Ω) | 6.0 dB | 1.6 | 1 | 3250T-63 | BNC/F | Front to Rear |
| 8310-2-F | 63/1 | dc-1.0 (75Ω) | 6.75 dB | 2.0 | 1 | 3250T-63 | F/F | Front |
| 8310-2-R | 63/1 | dc-1.0 (75Ω) | 6.75 dB | 2.0 | 1 | 3250T-63 | F/F | Rear |
| 8310-2-2-F | 63/1 | dc-1.0 (75Ω) | 6.75 dB | 2.0 | 2 | 3250T-63 | F/F | Front |
| 8310-2-2-R | 63/1 | dc-1.0 (75Ω) | 6.75 dB | 2.0 | 2 | 3250T-63 | F/F | Rear |
| 8310-35-F | 127/1 | dc-2.0 | 6.0 dB | 1.4 | 1 | 3200T-1 | N/F | Front |
| 8310-35-F-E | 127/1 | dc-3.0 | 6.0 dB | 1.4 | 1 | 3200T-1E | N/F | Front |
| 8310-35-R | 127/1 | dc-2.0 | 6.0 dB | 1.4 | 1 | 3200T-1 | N/F | Rear |
| 8310-35-R-E | 127/1 | dc-3.0 | 6.0 dB | 1.4 | 1 | 3200T-1E | N/F | Rear |
| 8310-35-2-F | 127/1 | dc-2.0 | 6.0 dB | 1.4 | 2 | 3200T-1 | N/F | Front |
| 8310-35-2-R | 127/1 | dc-2.0 | 6.0 dB | 1.4 | 2 | 3200T-1 | N/F | Rear |
| 8310-35-3-T | 127/1 | dc-2.0 | 6.0 dB | 1.4 | 3 | 3200T-1 | N/F | Front to Rear |
| 8310-35-4-T | 127/1 | dc-2.0 | 6.0 dB | 1.4 | 4 | 3200T-1 | N/F | Front to Rear |
| 8310-35-4-T-E | 127/1 | dc-3.0 | 6.0 dB | 1.4 | 4 | 3200T-1E | N/F | Front to Rear |
| 8310-36-F | 64.5/0.1 | dc-2.0 | 8.0 dB | 1.4 | 1 | 3209T-1 | N/F | Front |
| 8310-36-R | 64.5/0.1 | dc-2.0 | 8.0 dB | 1.4 | 1 | 3209T-1 | N/F | Rear |
| 8310-36-2-F | 64.5/0.1 | dc-2.0 | 8.0 dB | 1.4 | 2 | 3209T-1 | N/F | Front |
| 8310-36-2-R | 64.5/0.1 | dc-2.0 | 8.0 dB | 1.4 | 2 | 3209T-1 | N/F | Rear |
| 8310-36-3-T | 64.5/0.1 | dc-2.0 | 8.0 dB | 1.4 | 3 | 3209T-1 | N/F | Front to Rear |
| 8310-37-F | 63.75/0.25 | dc-2.0 | 6.0 dB | 1.4 | 1 | 3200T-2 | N/F | Front |
| 8310-37-R | 63.75/0.25 | dc-2.0 | 6.0 dB | 1.4 | 1 | 3200T-2 | N/F | Rear |
| 8310-37-2-F | 63.75/0.25 | dc-2.0 | 6.0 dB | 1.4 | 2 | 3200T-2 | N/F | Front |
| 8310-37-2-R | 63.75/0.25 | dc-2.0 | 6.0 dB | 1.4 | 2 | 3200T-2 | N/F | Rear |
| 8310-37-3-T | 63.75/0.25 | dc-2.0 | 6.0 dB | 1.4 | 3 | 3200T-2 | N/F | Front to Rear |
| 8310-37-4-T | 63.75/0.25 | dc-2.0 | 6.0 dB | 1.4 | 4 | 3200T-2 | N/F | Front to Rear |
| 8310-38-F | 63/1 | dc-2.0 | 5.25 dB | 1.4 | 1 | 3206T-1 | N/F | Front |
| 8310-38-F-E | 63/1 | dc-3.0 | 5.25 dB | 1.4 | 1 | 3206T-1E | N/F | Front |
| 8310-38-R | 63/1 | dc-2.0 | 5.25 dB | 1.4 | 1 | 3206T-1 | N/F | Rear |
| 8310-38-2-F | 63/1 | dc-2.0 | 5.25 dB | 1.4 | 2 | 3206T-1 | N/F | Front |
| 8310-38-2-R | 63/1 | dc-2.0 | 5.25 dB | 1.4 | 2 | 3206T-1 | N/F | Rear |
| 8310-38-3-T | 63/1 | dc-2.0 | 5.25 dB | 1.4 | 3 | 3206T-1 | N/F | Front to Rear |
| 8310-38-4-T | 63/1 | dc-2.0 | 5.25 dB | 1.4 | 4 | 3206T-1 | N/F | Front to Rear |

## Ordering Guide...8310 Series with 150 Programmables

| Model No | Attenuation Value (dB) | Frequency Range (GHz) | Insertion Loss (maximum) | SWR (Maximum) | No of Channels | Attenuator Model No.* | Connector Type | Conn Location |
|---|---|---|---|---|---|---|---|---|
| 8310-201-F | 70/10 | dc-18.0 | 3.25 dB | 1.75 | 1 | 150T-70 | SMA/F | Front |
| 8310-201-R | 70/10 | dc-18.0 | 3.25 dB | 1.75 | 1 | 150T-70 | SMA/F | Rear |
| 8310-201-2-F | 70/10 | dc-18.0 | 3.25 dB | 1.75 | 2 | 150T-70 | SMA/F | Front |
| 8310-201-2-R | 70/10 | dc-18.0 | 3.25 dB | 1.75 | 2 | 150T-70 | SMA/F | Rear |
| 8310-202-F | 121/1 | dc-18.0 | 5.25 dB | 1.95 | 1 | 150T-11+150T-110 | SMA/F | Front |
| 8310-202-R | 121/1 | dc-18.0 | 5.25 dB | 1.95 | 1 | 150T-11+150T-110 | SMA/F | Rear |
| 8310-204-F | 62/2 | dc-18.0 | 3.70 dB | 1.95 | 1 | 150T-62 | SMA/F | Front |
| 8310-204-R | 62/2 | dc-18.0 | 3.70 dB | 1.95 | 1 | 150T-62 | SMA/F | Rear |
| 8310-204-2-F | 62/2 | dc-18.0 | 3.70 dB | 1.95 | 2 | 150T-62 | SMA/F | Front |
| 8310-204-2-R | 62/2 | dc-18.0 | 3.70 dB | 1.95 | 2 | 150T-62 | SMA/F | Rear |

*Refer to Individual data sheet for detailed specifications on internal programmables.



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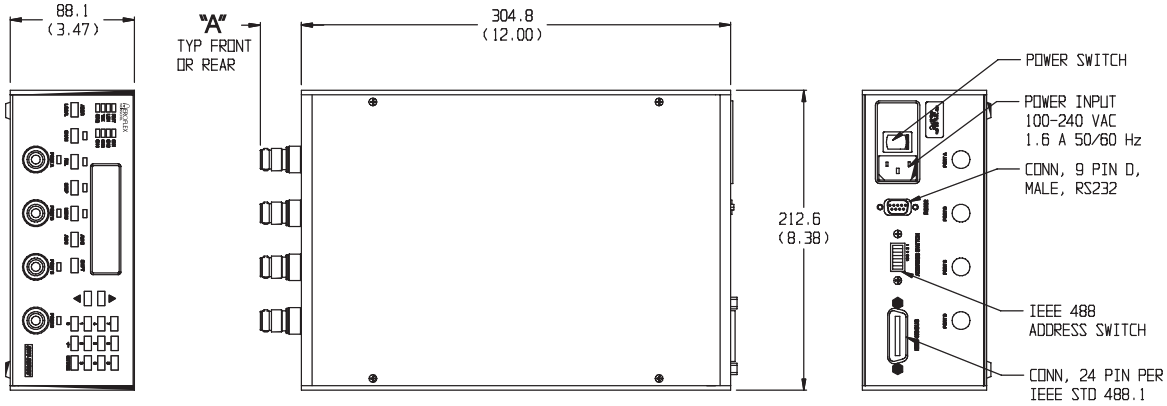
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## Ordering Guide...8311 Series....New!

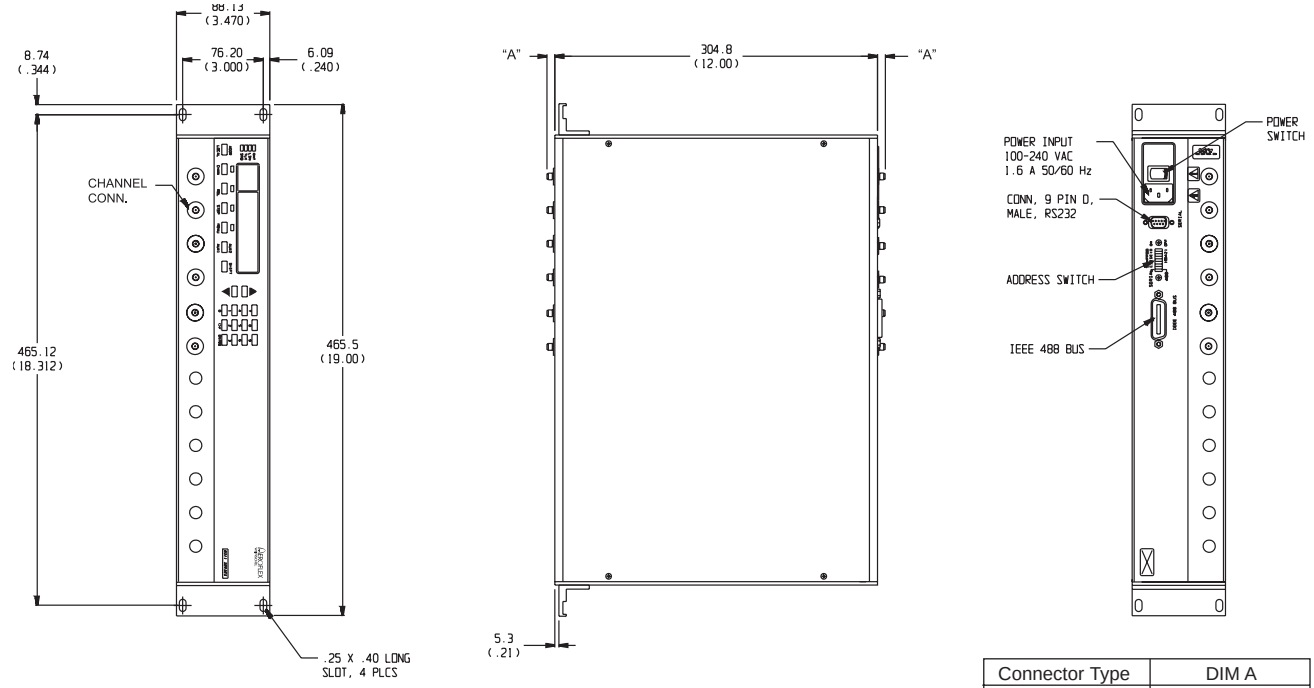
| Model No | Attenuation Value (dB) | Frequency Range (GHz) | Insertion Loss (maximum) | SWR (Maximum) | No of Channels | Attenuator Model No.* | Connector Type | Conn Location |
|---|---|---|---|---|---|---|---|---|
| 8311-1-6-F | 63/1 | dc-1.0 (75Ω) | 6.00 dB | 1.60 | 6 | 3250T-63 | BNC/F | Front |
| 8311-38-6-F | 63/1 | dc-2.0 | 5.25 dB | 1.40 | 6 | 3206T-1 | N/F | Front-Rear |
| 8311-38-12-T | 63/1 | dc-2.0 | 5.25 dB | 1.40 | 12 | 3206T-1 | N/F | Front |
| 8311-137-6-F | 63/1 | 0.8-3.0 | 4.70 dB | 1.60 | 6 | 4226-63 | N/F | Front |
| 8311-202-2-F | 121/1 | dc-18.0 | 5.25 dB | 1.95 | 2 | 150T-11+150T-110 | SMA/F | Front |
| 8311-202-3-F | 121/1 | dc-18.0 | 5.25 dB | 1.95 | 3 | 150T-11+150T-110 | SMA/F | Front |
| 8311-204-6-F | 62/2 | dc-18.0 | 3.70 dB | 1.95 | 6 | 150T-62 | SMA/F | Front |

## Physical Dimensions

### 8310 Series:




### 8311 Series:




| Connector Type | DIM A |
|---|---|
| N | 29.2 (1.15) |
| SMA | 8.6 (0.34) |
| BNC | 18.8 (0.74) |
| F | 9.65 (0.38) |

NOTE:

1. All dimensions are given in mm (inches) and are maximum, unless otherwise specified.
2. Connector location (Front/Rear) may vary depending on Model ordered.



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# Model 8312
# High Power Programmable Attenuator

IEEE-488

RS232\RS422

## *100 Watt Hot Switching Capability*



## Description

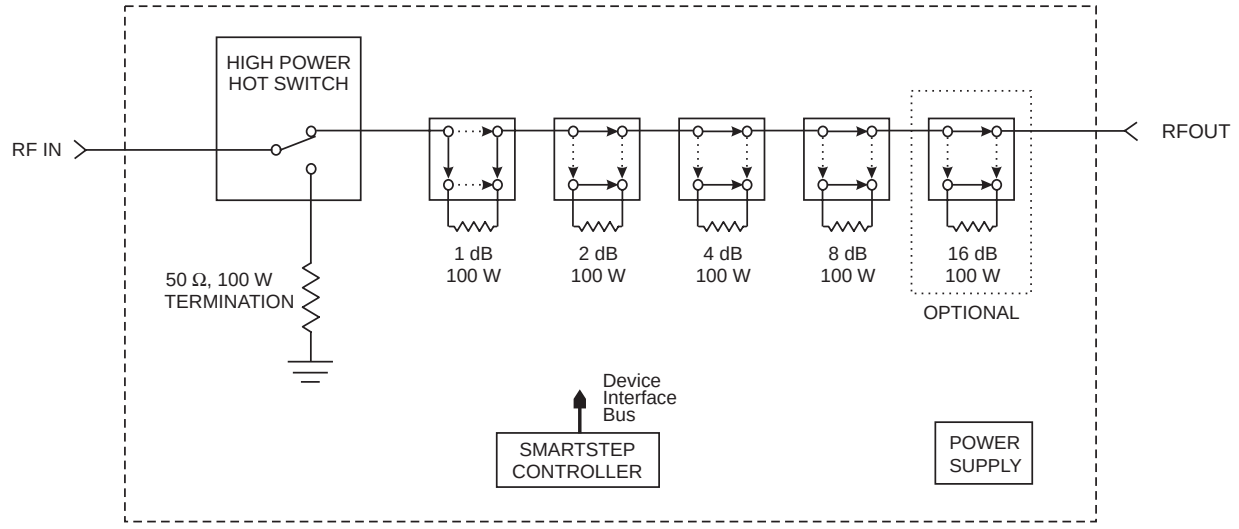
Aeroflex / Weinschel's design approach uses a highly adaptable platform that allows configuration of the step attenuator to the customers requirements. When the controller requests a new attenuation level the input switch terminates the input signal into a 50 Ohm load. (See Figure 1) This input switch is **hot switchable at 100 Watts** of input power. This will remove the high power signal from the main signal path. With no signal connected to the attenuator path the controller then commands the series of relays to configure the attenuator for the requested attenuation value. Then the input switch re-connects the input signal to the attenuator path. The system can be operated with either a remote controller (IEEE-488 or RS-232) or through front panel control.

## Features

- Available in 0-15 dB or 0-31 dB Configurations.
- Provides a flexible, easy to program, low cost solution for your bench test/calibration setups and subsystem applications.
- Relative vs. Nominal attenuation step function.
- DC to 13.0 GHz Operation.
- High Accuracy & Repeatability.
- Power Handling up to 100 Watts average
- Designed to interface with industry standard communication interfaces:

  - GPIB/IEEE-488 (HS-488 ready)
  - RS-232, RS-422

- Built-in monitoring for switching input power into the load in case of fan failure.
- **Rack Configurable:** A Rack Mounting Kit is included for easily mounting the Model 8312 into any rack or cabinet that is designed per EIA RS-310 or MIL-STD-189.




Note: If power failure should occur, the unit will remain in the last selected attenuation state.

*Figure 1. Model 8312 Block Diagram*

***For additional information on the Model 8312, visit our website @ www.aeroflex-weinschel.com/8312.htm***



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## Specifications

| SPECIFICATION | DESCRIPTION | | |
|---|---|---|---|
| **Input Power Requirements** | AC | 100 to 240 Vac, 50/60 Hz, 50 Watts | |
| **Environmental** | Operating Temperature | 0 to +50°C | |
| | Storage Temperature: | 67° to +167 °F (-55° to +75°C) | |
| | Humidity: | 96% | |
| | Altitude: | 40,000' (12,192M) | |
| **IEEE-488 Bus** | Connector: | 24-pin per IEEE-488.1 | |
| | Protocols: | per IEEE-488.2 | |
| | Indicators: | Remote (RMT), Listen (LSN), Talk (TLK), SRQ (SRQ) | |
| **RS-232 Bus** | Connector: | 9-pin male D | |
| | Signals: | TXD, RXD, RTS, CTS, DTR, GND | |
| | Baud Rates: | 2400, 9600, 19200, and 38400 | |
| | Data Bits: | 8 | |
| | Handshaking: | None, RTS/CTS, XON/XOFF | |
| | Parity: | None, Odd, Even | |
| | Indicators: | Tx (Transmit) and Rx (Receive) | |
| **RS-422 BUS(3)** | Connector: | 9-pin male D | |
| | Signals: | TXD+, TDX-, RXD+, RTX-, RTS+, RTS-, CTS+, CTS-, and signal GND | |
| | Baud Rates: | 2400, 9600, 19200, and 38400 | |
| | Data Bits: | 8 | |
| | Handshaking: | None, RTS/CTS, XON/XOFF | |
| | Parity: | None, Odd, Even | |
| | Indicators: | Tx (Transmit) and Rx (Receive) | |
| **RF Characteristics(4)** | Connectors: | Type N, Female | |
| | Frequency Range: | dc - 13 GHz | |
| | Impedance: | 50 Ω | |
| | SWR: | 50 MHz - 5 GHz: | 1.60 (Maximum) |
| | | 5 GHz - 13 GHz: | 1.95 (Typical) |
| | Attenuation Range: | 15 dB/1 dB steps (8312-15-F) | |
| | | 31 dB/1 dB steps (8312031-F) | |
| | RF Power Rating: | 50 MHz - 5 GHz: | 100 Watts (Maximum) |
| | | 5 GHz - 13 GHz: | 50 Watts (Maximum) |
| | Attenuation Settings: | 100, 000 selections (minimum) | |
| | Attenuation Update Rate: | 1 second (Typical) | |
| | Incremental Accuracy: | Frequency | 1-15 dB / 16-31 dB |
| | | 50 MHz - 3 GHz: | ±0.5 dB / ±0.8 dB |
| | | 3 GHz - 5 GHz: | ±0.5 dB / ±0.8 dB |
| | | 5 GHz - 13 GHz: | ±2.0 dB / ±3.0 dB |
| | Insertion Loss (dB): | Frequency Range | 8312-15-F / 8312-31-F |
| | | 50 MHz - 3 GHz: | 3.0 / 3.5 |
| | | 3 GHz - 5 GHz: | 4.0 / 4.5 |
| | | 5 GHz - 13 GHz: | 7.0 / 8.0 |

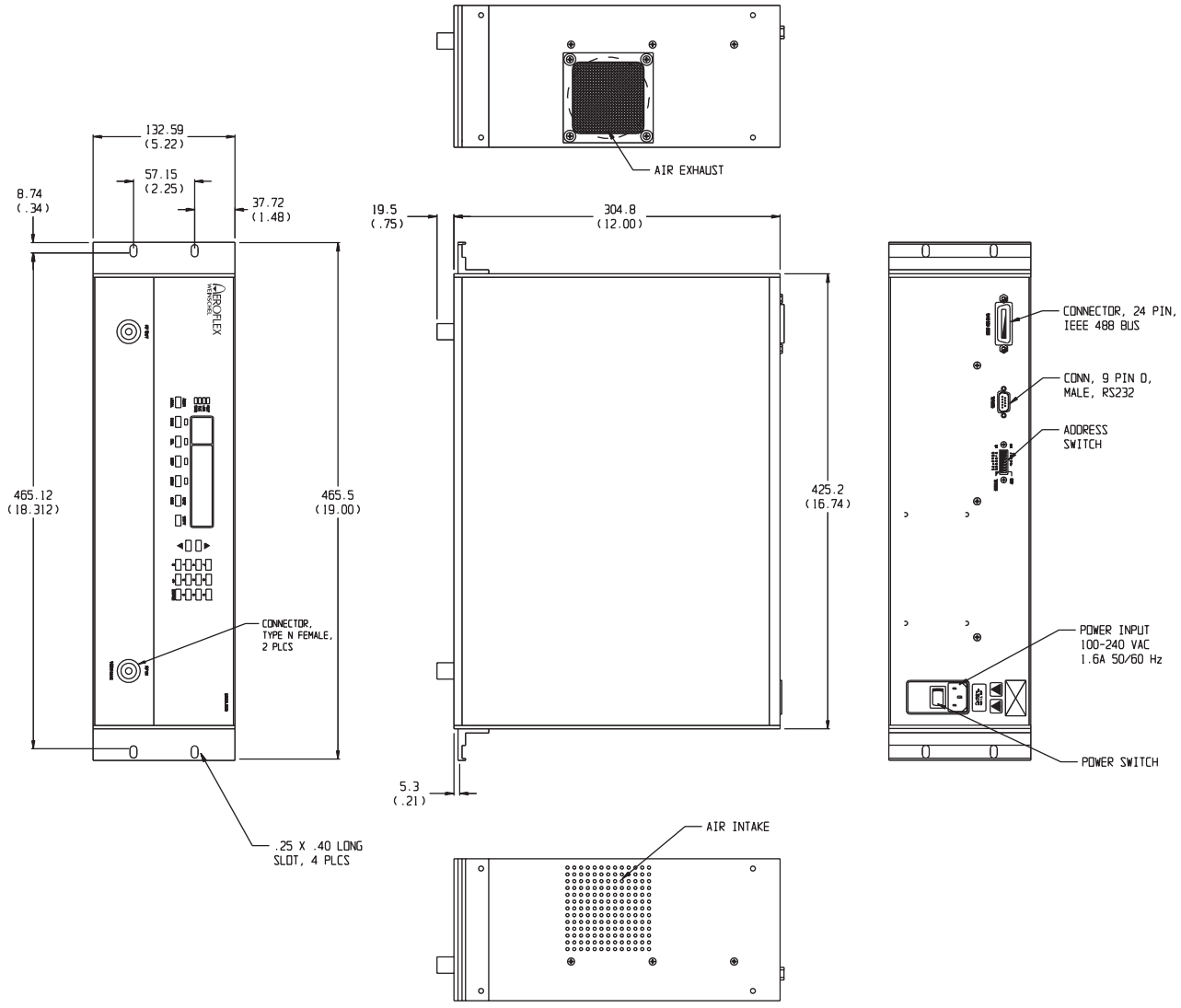
1. GPIB/IEEE-488 model allows user-selectable addresses.
2. RS-232 can be used with standard PC serial port for short and medium distances (up to approximately 50 ft).
3. RS-422, designed for very long distance communications (4000 ft) and & optimized as a single node protocol, typically with one device connected to a single port.
4. Refer to Individual data sheet for detailed specifications on internal programmables.



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## Physical Dimensions




NOTE: All dimensions are given in mm (inches) and are maximum, unless otherwise specified.

**MODEL NUMBER DESCRIPTION:**

**Example:**

**8312 - XX - F**

- **8312** — Basic Model Number
- **XX** — Attenuation Value (dB)*
- **F** — Connector Location: F = Front (Only)

* Available in 0-15 dB and 0-31 dB configurations only!



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# Model 8210A
# Programmable Attenuator/Switch Controller

IEEE-488

RS232\RS422/RS485

## *A Logical Interface for Switchable Devices!*

www.sicklesonline.com
800-542-4457



## Features

- Provides a flexible, powerful, low cost solution for bus control of programmable step attenuators and other switchable devices under computer control.
- Designed to interface with Aeroflex / Weinschel's line of intelligent programmable attenuators and other electromechanical devices.
- Simplifies your bench test setups and subsystem design.
- Available in two standard communication interfaces:
  - Model 8210A-1: GPIB/IEEE-488 (HS-488 ready)
  - Model 8210A-2: RS-232, RS-422, RS-485

## Description

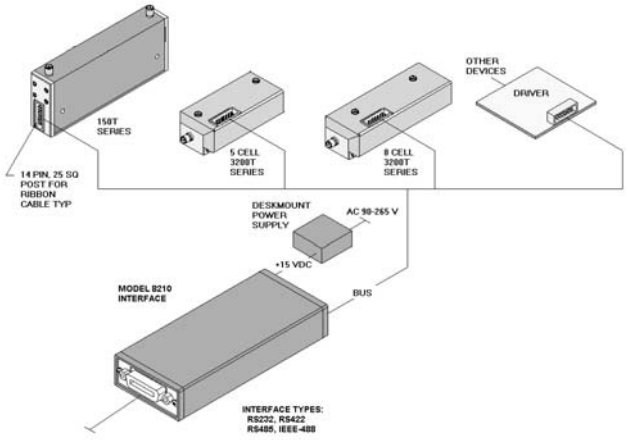
Model 8210A represents a new concept in device control applications and provides a high level interface from various industry standard communications interfaces to the serial Driver Interface Bus.

The Device Interface Bus (DIB) is a system for connecting a number of relatively low-speed I/O devices to a host, providing a simple, uniform and inexpensive way to control a variety of devices via a single port. The DIB is based on the two-wire serial bus and several software protocol layers that allow the Model 8210A to address up to 125 peripheral devices with serial data rates of up to 100 KHz. The DIB may also be used to supply DC power to the devices, resulting in a simple, low-cost interconnection system.

This Programmable attenuator/switch controller is available in two models, each providing a different type of communications interface to suit user configuration requirements. Each model contains similar capabilities, and provides switch-selectable parameters to the interfaces' operation.

## Applications

Applications for the 8210A range from providing control of a single Programmable Attenuator in a bench test/lab environment using a PC and a terminal emulator, to complex system applications where the 8210A is employed to control many devices to create custom/semi-custom subsystems to reduce overall design cost. Aeroflex / Weinschel can provide a variety of custom designed driver interfaces for various devices, such as RF switches, relays, PIN attenuators, displays and other devices, as well as complete subsystem design and integration services. Contact us with your specialized needs.




Typical Capacity: **Control a subsystem consisting of 32 individual 8-cell programmable attenuators plus 16 DPDT switches.**

## Accessories:

| PART NUMBER | DESCRIPTION |
|---|---|
| 001-378 | Deskmount Power Supply, +15 V 95-250 Vac, 47-63 Hz ac input |
| 193-8013 | Interconnect Cable |
| 193-8012 | Attenuator Mounting Kit: This kit includes all hardware to allow the user to mount one attenuator onto the Model 8210A |

***For additional information on the Model 8210A, visit our website @ www.aeroflex-weinschel.com/8210A.htm***



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## Specifications

| SPECIFICATION | DESCRIPTION | |
|---|---|---|
| **DC Input** | Connector: | 2.5mm barrel style |
| | Requirements: | +12 to +15 Vdc @ 250 mA |
| **Driver Interface** | Connector: | 14-pin 0.025" square post header @ 0.1" centers. Mates with AMP 746285-2 or equivalent. |
| | Signals : | SDA serial data<br>SDC serial clock<br>VDC DC supply voltage<br>GND ground |
| | VDC Output Current: | 2 A maximum |
| | Maximum Cable Length: | 10 Meters (1000 pF maximum capacitance) |
| | Data Transfer Rate: | 100 KHz |
| **Environmental** | Operating Temperature: | 0 to +50°C |
| | Storage Temperature: | -55° to +75°C (67° to +167°F) |
| | Humidity: | 95% |
| | Altitude: | 40,000' (12,192M) |
| **IEEE-488 Bus(1)** | Connector: | 24-pin per IEEE-488.1 |
| | Protocols: | per IEEE-488.2 |
| | Indicators: | Remote, Listen |
| **RS-232 Bus(2)** | Connector: | 9-pin male D |
| | Signals: | TXD, RXD, RTS, CTS, DTR, GND |
| | Baud Rates: | 2400, 9600, and 19200, 38400 |
| | Data Bits: | 8 |
| | Handshaking: | None, RTS/CTS, XON/XOFF |
| | Parity: | None, Odd, Even |
| | Indicators: | Tx (Transmit) and Rx (Receive Active) |
| **RS-422 Bus(3) & RS-485 Bus(4)** | Connector: | 9-pin male D(Model 8210-2) |
| | Signals: | TXD+, TDX-, RXD+, RTX-, RTS+, RTS-, CTS+, CTS-, & signal GND |
| | Baud Rates: | 2400, 9600, and 19200, 38400 |
| | Data Bits: | 8 |
| | Handshaking: | None, RTS/CTS, XON/XOFF |
| | Parity: | None, Odd, Even |
| | Indicators: | Tx (Transmit) and Rx (Receive Active) |

Notes:

1. GPIB/IEEE-488 model allows user-selectable addresses.
2. RS-232 can be used with standard PC serial port for short and medium distances (up to approximately 50 ft).
3. RS-422, designed for very long distance communications (4000 ft) & optimized as a single node protocol, typically with one device connected to a single port.
4. RS-485, designed for very long distance communications (4000 ft) & optimized for multi-drop connections that can used to create a low cost network.

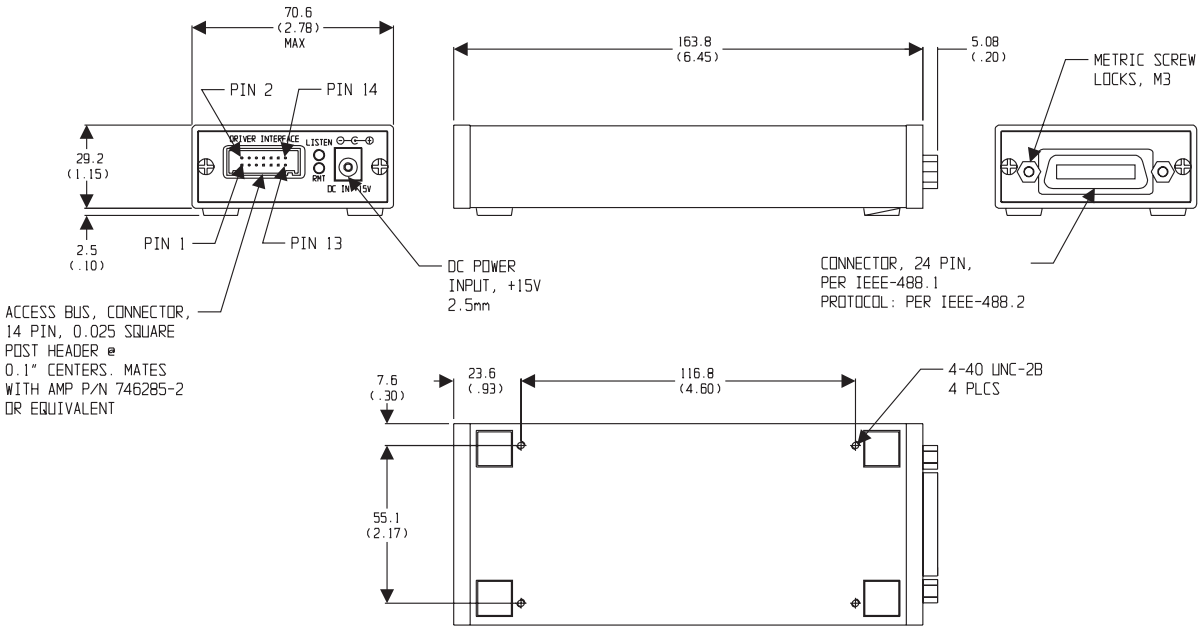


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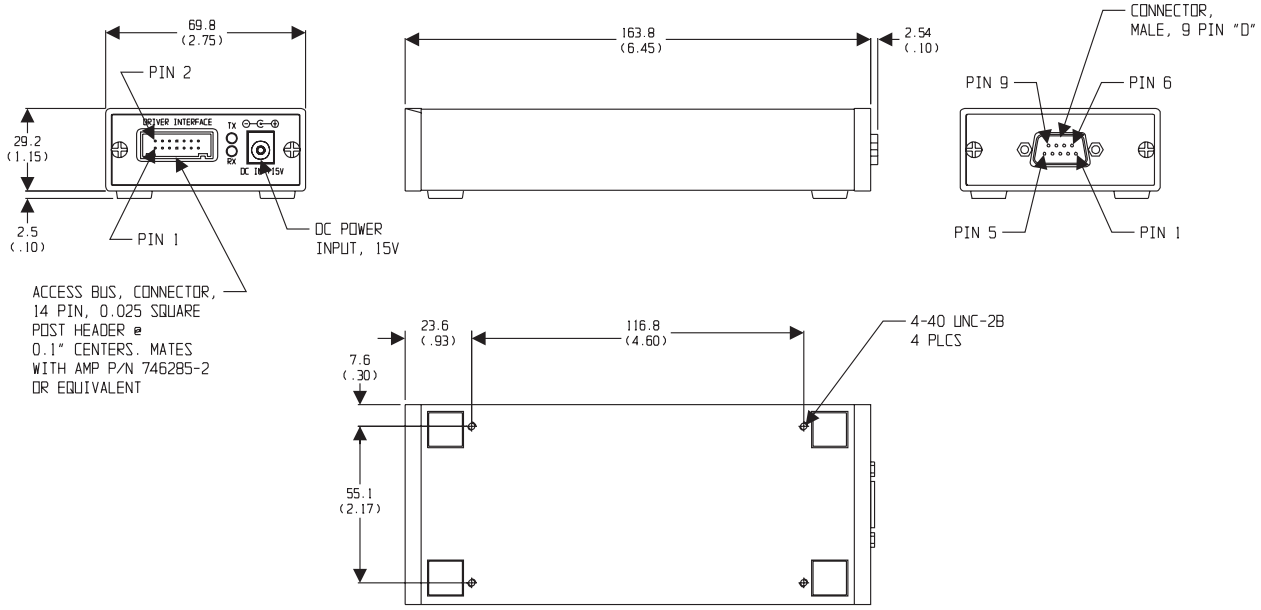
Revision Date: 12/15/04

## Physical Dimensions

**Model 8210A-1 (IEEE-488):**




**Model 8210A-2 (RS-232/RS-422/RS-485):**




NOTE: All dimensions are given in mm (inches) and are maximum, unless otherwise specified.



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