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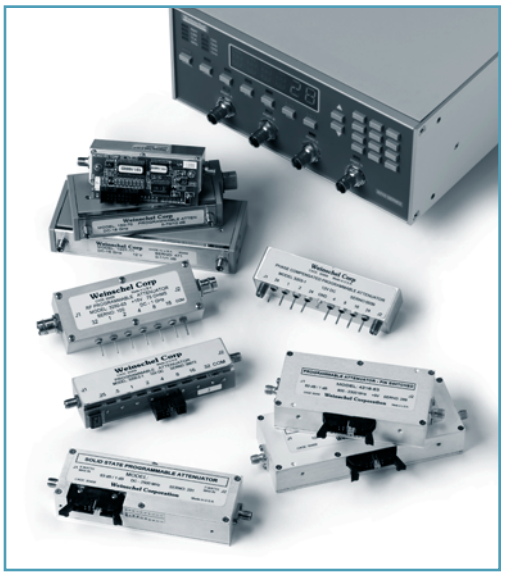
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Programmable Attenuators & Attenuator/Switch Controllers

AEROFLEX
A passion for performance.



- 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

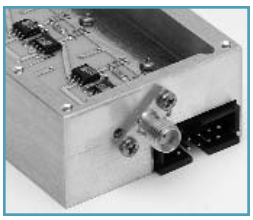
In this section of the catalog, each Programmable Attenuator is outlined utilizing individual data sheets containing product features, specifications, and outline drawings. These data sheets are preceded by a quick reference guide to help you select the Programmable Attenuator(s) that fits your needs.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

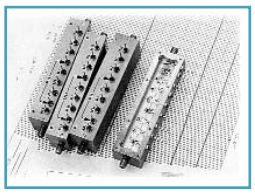
This section includes all available accessories for the Aeroflex / Weinschel programmable attenuators such as our Model 8210A Attenuator / Switch Controller, product specific driver boards, and our programmable attenuators with our built-in microprocessor-based drivers. Also Included in this section 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 135).

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











6 GHz Designs

AEROFLEX
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Revision Date: 3-1-07

AEROFLEX WEINSCHEL

Programmable Attenuators

Relay Switched Programmable Attenuators, Basic Models . . . DC-6 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	89	
☆ 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	89	
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	98	
3406-55	dc-6.0	0-55	1	3.80	130	SMA	1	50	102	
3408-55.75		0-55.75	0.25	5.00						
3408-103		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	95	
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	95	
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	98	
3406T-55	dc-6.0	0-55	1	3.80	130	SMA	1	50	106	
3408T-55.75		0-55.75	0.25	5.00						
3408T-103 *(New)*		0-103	1							

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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	108
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	108
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	1.40-1.90*	3.5mm	1	100	108
152T-70		0-70	10	2.98	1.40-1.90*				
152AT-70		0-70	10	2.98	1.40-1.90*				
152T-75		0-75	5	2.98	1.40-1.90*				
152T-90		0-90	10	2.98	1.40-1.90*				



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	112
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	112
152-90	dc-26.5	0-90	10	2.98	1.40-1.80*	3.5mm	1	100	112



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SOLID-STATE PROGRAMMABLES . . . to 3 GHz

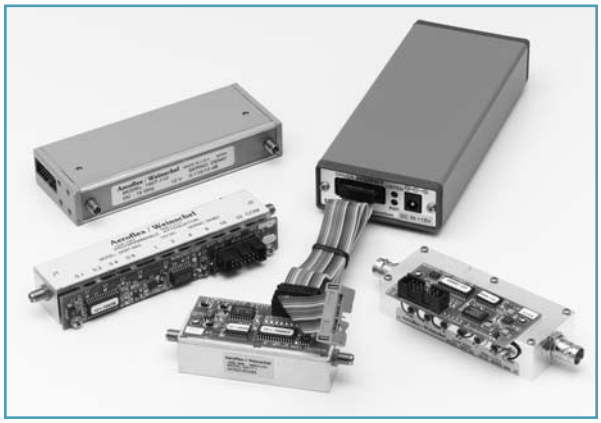
Model Number	Frequency Range (GHz)	Attenuation Range (dB)	Step Size (dB)	Insertion Loss, Max. (dB)	Maximum SWR	Average Power	Connector Type	Page No.	
4216-63 4218-63.75 4218-127	0.8-2.3	0-63 0-63.75 0-127	1 0.25 1	3.40 4.90 4.90	150 150 150	+28 dBm	SMA	117	
4226-63 4228-63.75 4228-103	0.8-3.0 0.8-2.5 0.8-3.0	0-63 0-63.75 0-103	1 0.25 1	3.75 4.50 5.50	1.50 1.50 1.50	+28 dBm	SMA	119	
4238-63.75 4238-103		0-63.75 103	0.25 1	9.00 9.00	1.60	+30 dBm	SMA	121	
4246-63 4248-63.75 4248-103	10 MHz-2.5	0-63 0-63.75 103/1	1 0.25	10.00 13.00 13.00	2.00	+36 dBm	SMA	123	

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Programmable Attenuators

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



Programmable/Switch Controllers:

(pg 132-134)

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 129-131)



- 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 125-128)



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?

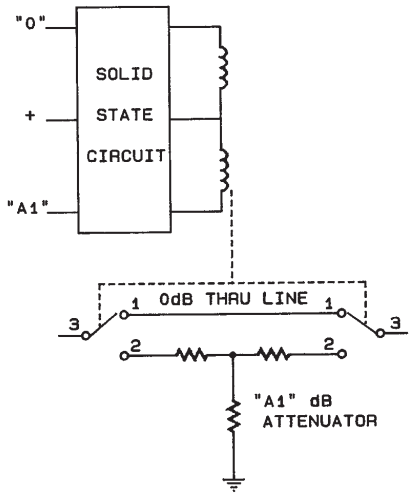
Aeroflex / Weinschel's programmable attenuators are used to control the power of radio frequency and microwave signals. Applications include control of input power to signal measuring systems, control of output power from signal generating systems, adjustment power for BIT error rate testing, controlling 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 and 3400 Series non-latching attenuators require only one 12 volt control line per cell. The direction of control current is not 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, 3400T and 150T Series feature on-board TTL drivers. TTL driver boards are also available for most models.

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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.

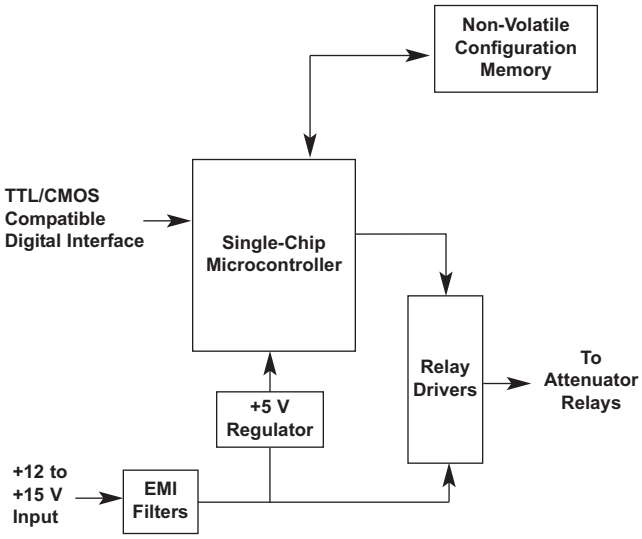


Figure 1. Digital Driver Circuitry

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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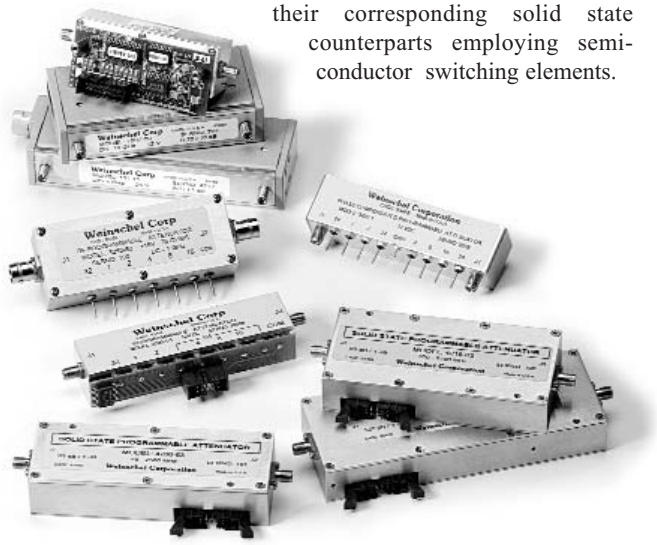
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Intermodulation Distortion in Programmable Attenuators....

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:

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

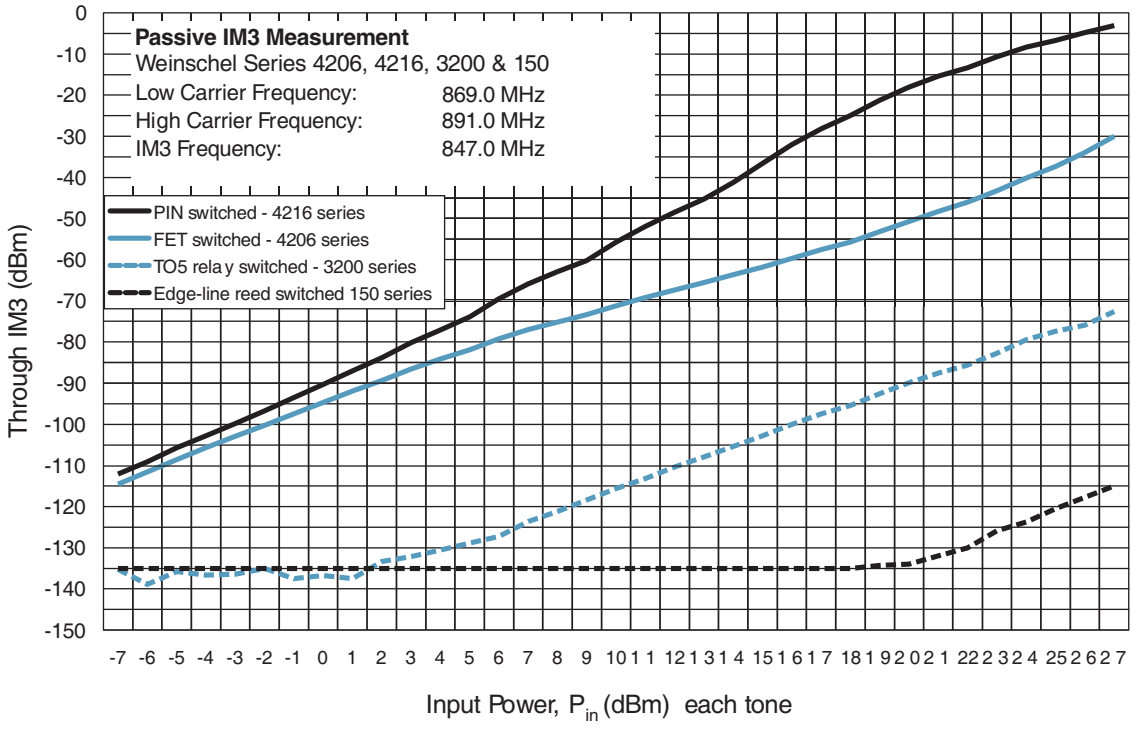
where α = zero insertion loss of each unit @ 847 MHz, the IM3 frequency. IM3 and Pin are selected from Table 1.

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



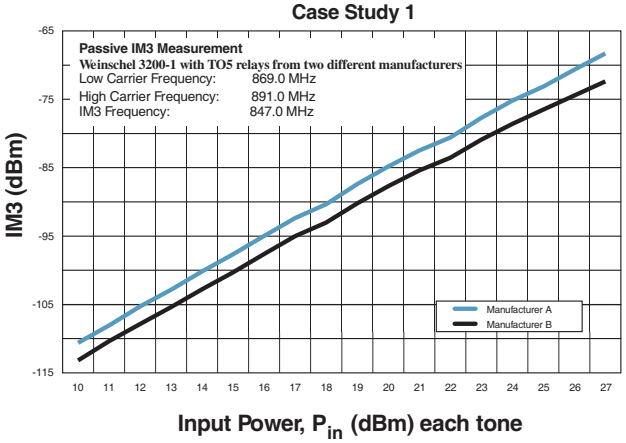
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Case Study 1

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.

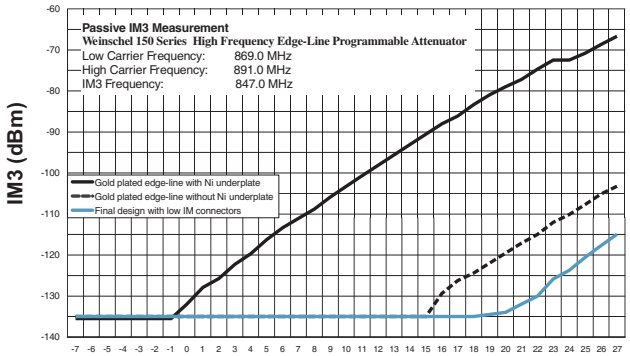
Input Power vs. Through IM3 Level
Case Study 1



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



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.

Author: Jimmy Dholoo, VP Engineering @ Aeroflex / Weinschel

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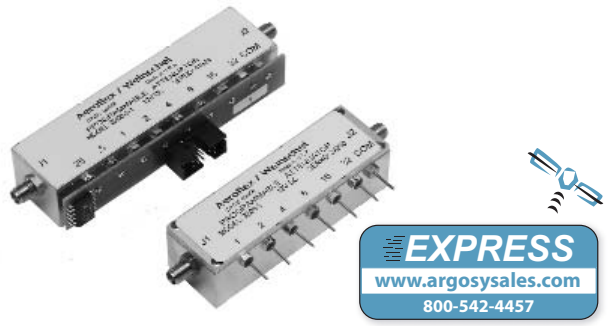
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AEROFLEX WEINSCHEL

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



Features

- **Widest Selection of Attenuation Ranges & Step Sizes**
- **Available *Express* Models:** 3200-1, 3200-1E-2
  3200-2
  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 3200-1E	8	127/1	1, 2, 4, 8, 16, 32, 64*
3200-2 3200-2E	8	63.75/0.25	0.25, 0.5, 1, 2, 4, 8, 16, 32
3201-1 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 3205-3E	4	1.5/0.1	0.1, 0.2, 0.4, 0.8
3206-1 3206-1E	6	63/1	1, 2, 4, 8, 16, 32
3209-1 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 3200-2	3200-1E 3200-2E 3201-1E 3205-3E	3201-X 3205-X 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

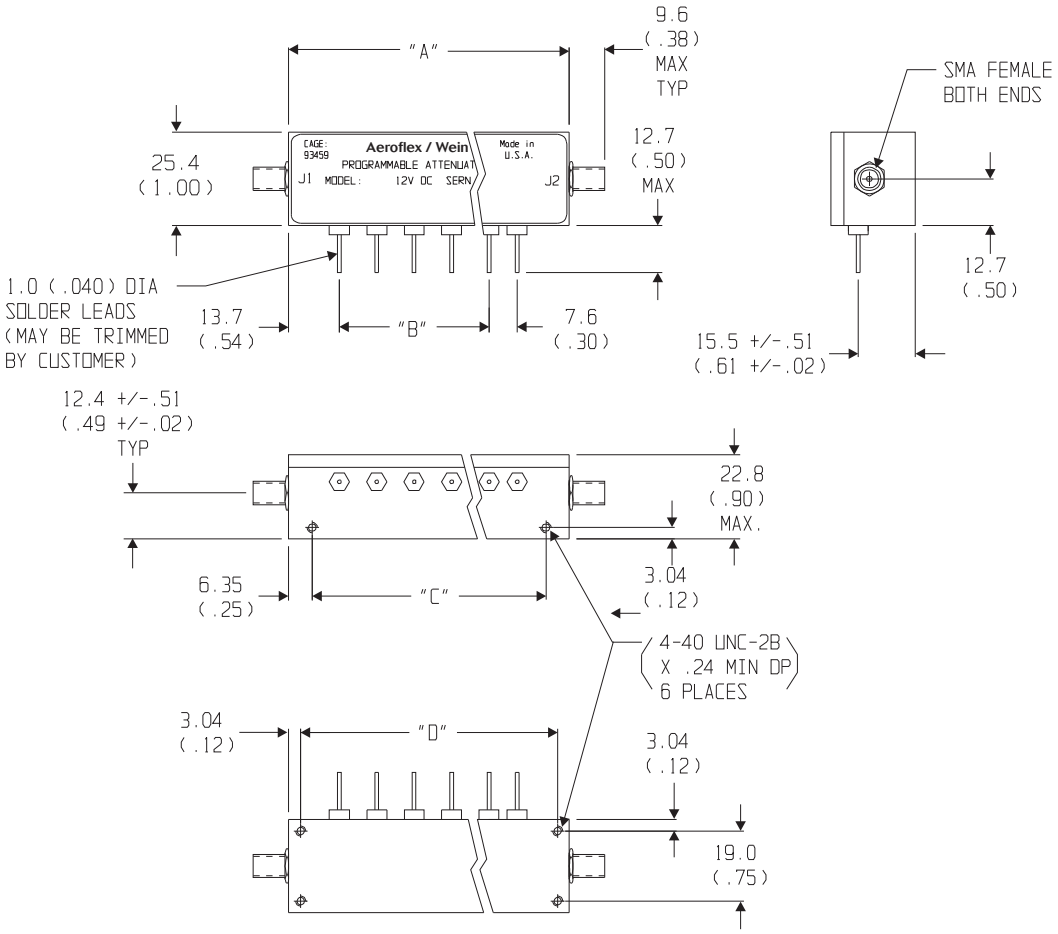
SUPPLY CURRENT (per cell continuos): I_{CC}=25.0 mA maximum for 2 GHz models and 30 mA per cell for 3 GHz models.

SUPPLY VOLTAGE: Vcc=+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)

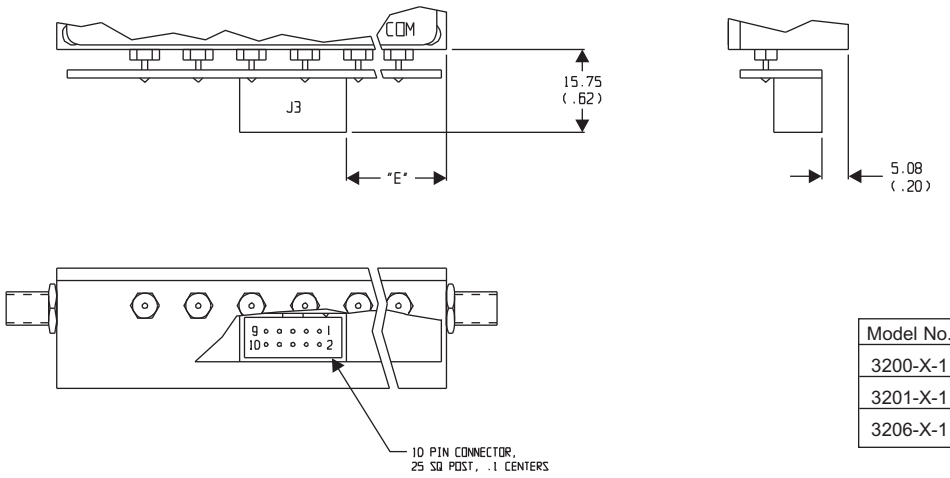
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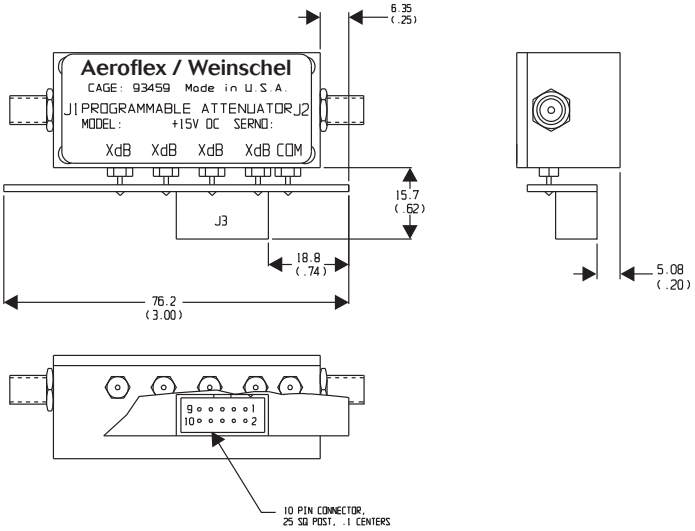
PHYSICAL DIMENSIONS:

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

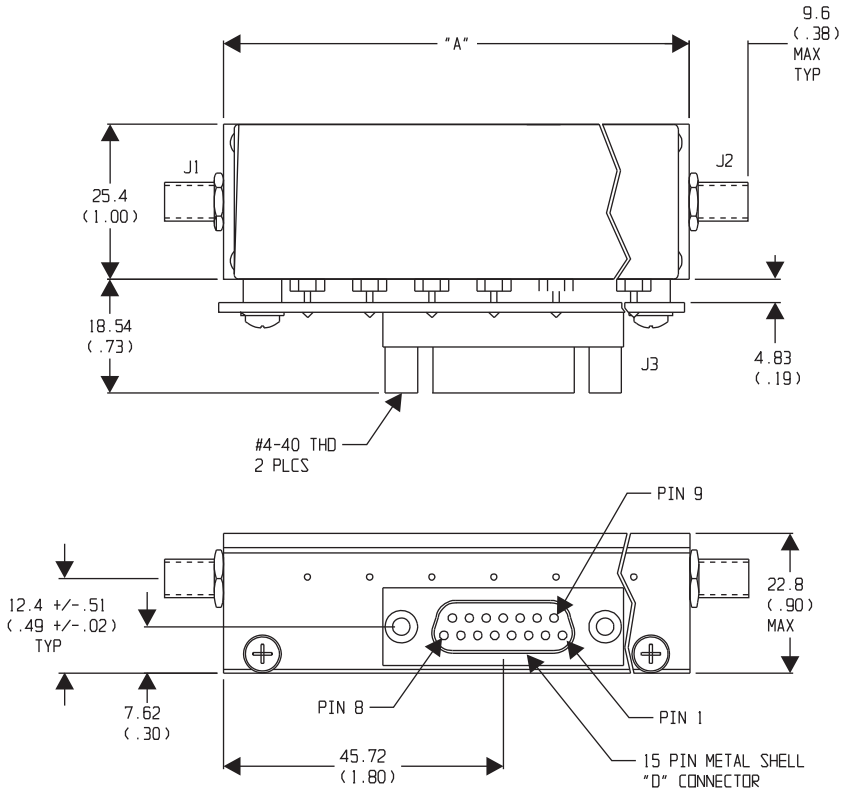
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PHYSICAL DIMENSIONS:

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

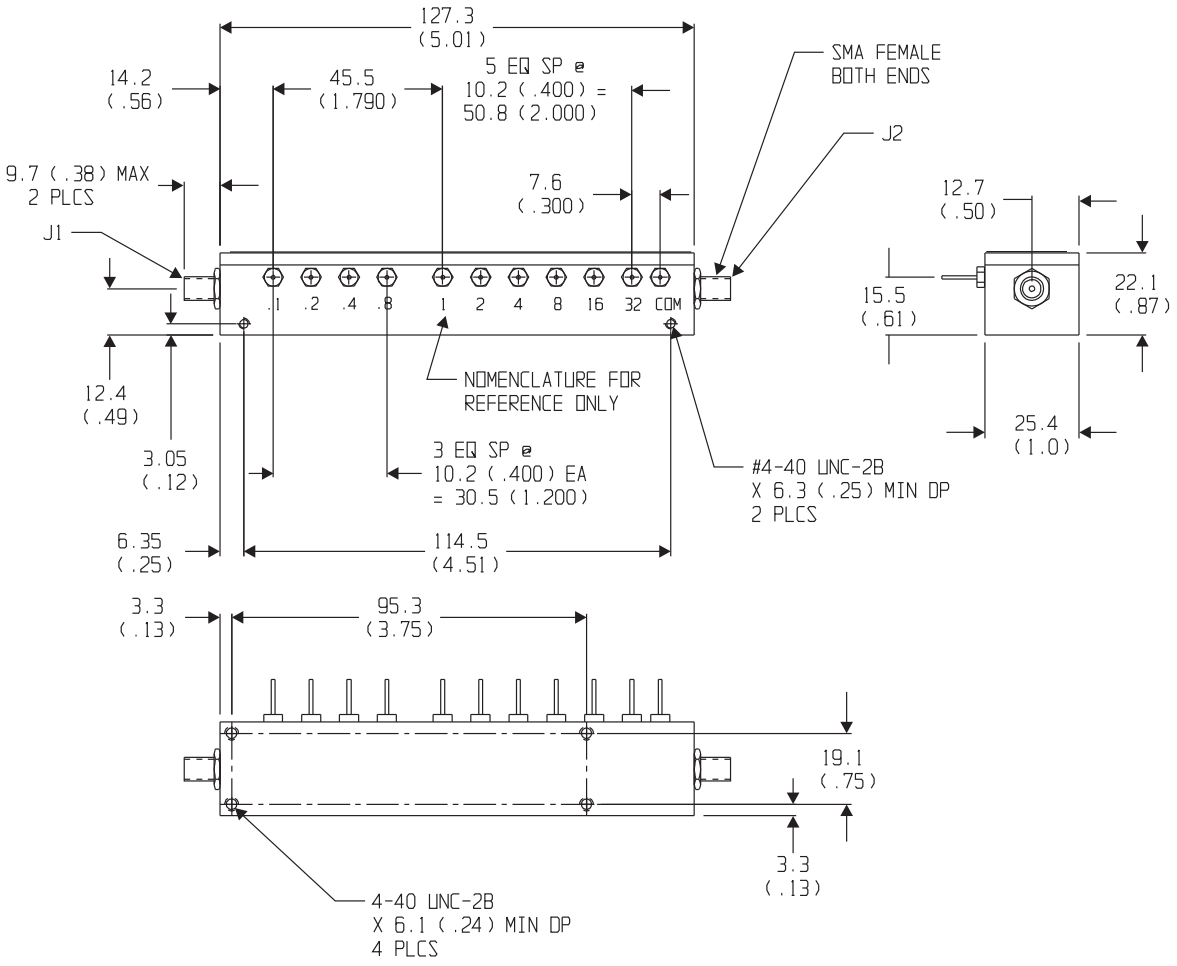
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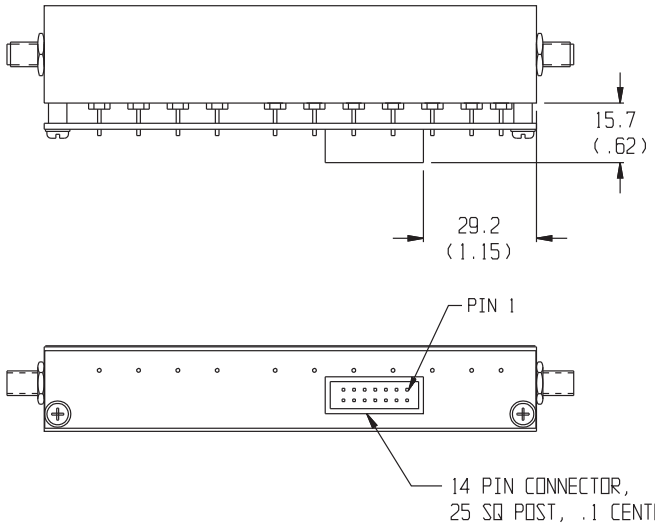
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PHYSICAL DIMENSIONS:

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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Revision Date: 3-1-07

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

For Use with Weinschel 8210A Controller



Features

- **Widest Selection of Attenuation Ranges & Steps Sizes**
- **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 3200T-1E	8	127/1	1, 2, 4, 8, 16, 32, 64*
3200T-2 3200T-2E	8	63.75/0.25	0.25, 0.5, 1, 2, 4, 8, 16, 32
3201T-1 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 3205T-3E	4	1.5/0.1	0.1, 0.2, 0.4, 0.8
3206T-1 3206T-1E	6	63/1	1, 2, 4, 8, 16, 32
3209T-1 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 3200T-2	3200T-1E 3200T-2E	3201T-X 3205T-X 3206T-X	3201T-1E 3205T-3E 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:	15 mA (2 GHz Units)
	(per cell) continuous	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.

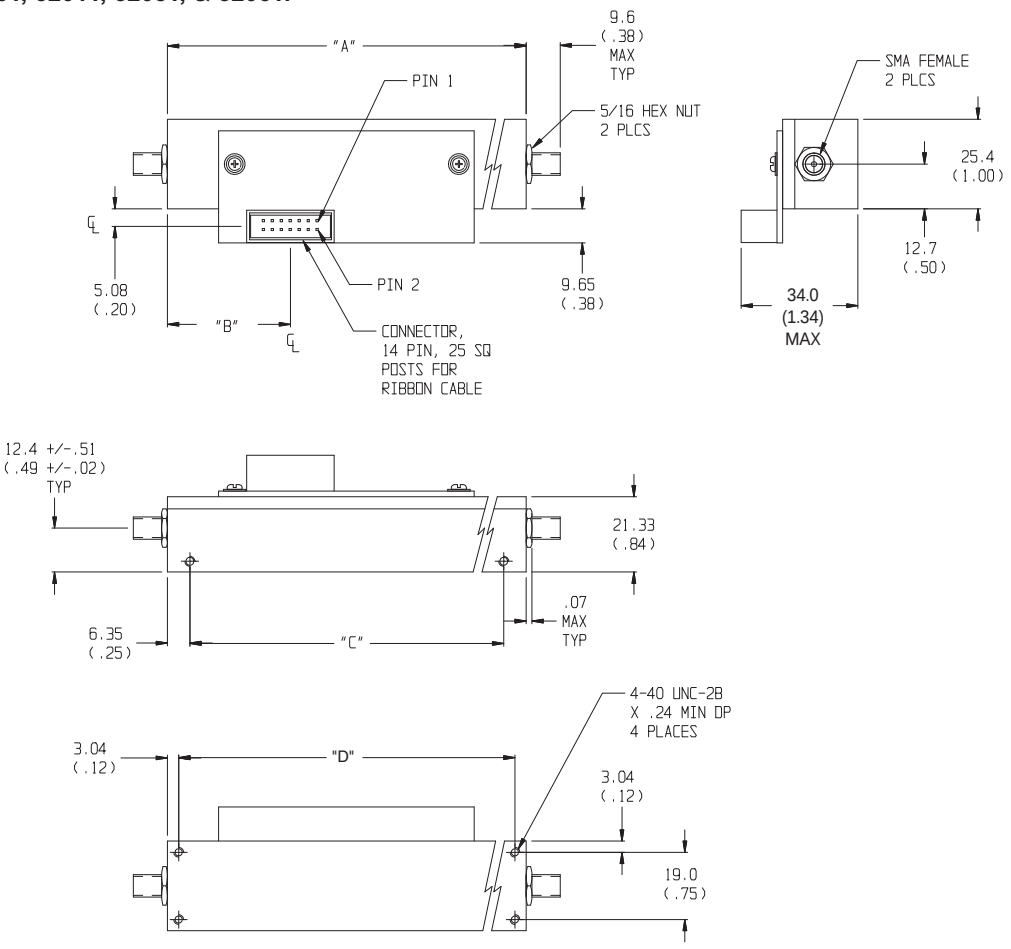
In either operational mode, the microcontroller enters an idle condition during periods of inactivity, turning off all on-board clocks, reducing EMI concerns, and lowering power consumption. On-board regulation for the digital circuitry allows the attenuator to operate from a single input supply voltage.

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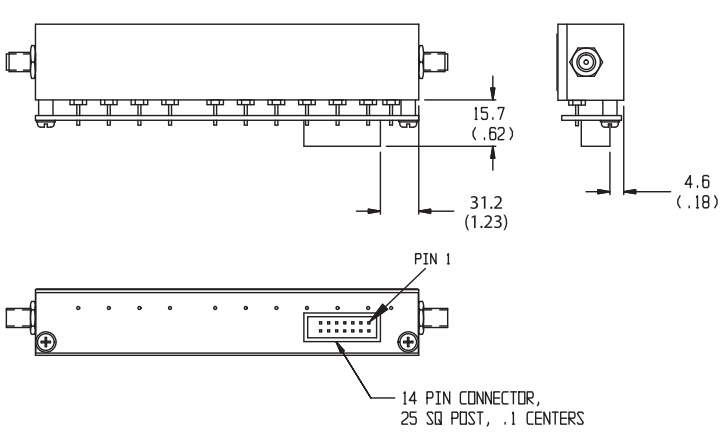
PHYSICAL DIMENSIONS:

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



Model No.	No. Cells	A	B	C	D
3200T-X	8	101.6 (4.0)	31.8 (1.25)	88.9 (3.50)	95.2 (3.75)
3201T-X	5/4	76.2 (3.00)	19.1 (0.75)	63.5 (2.50)	69.8 (2.75)
3205T-X	4	72.4 (2.85)	19.1 (0.75)	46.2 (1.82)	52.6 (2.07)
3206T-X	6	81. 3±0.5 (3.20±0.02	21.46 (0.85)	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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Revision Date: 3-1-07

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



Features

- **Cost Effective design for Wireless/Cellular Applications.**
- **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.

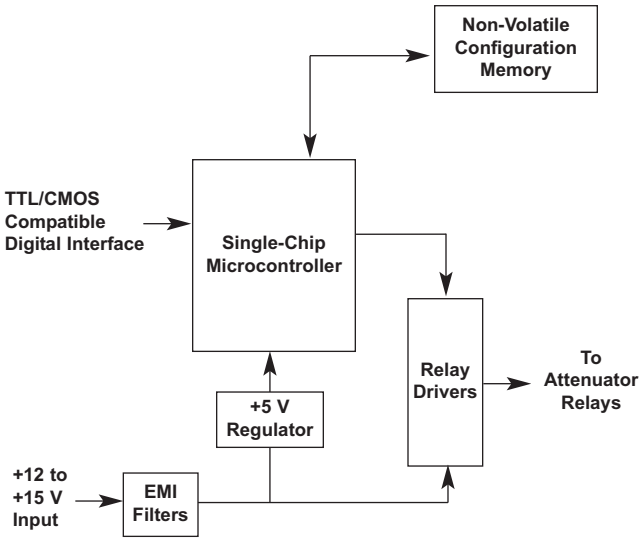


Figure 1. Built-In Driver Circuitry

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

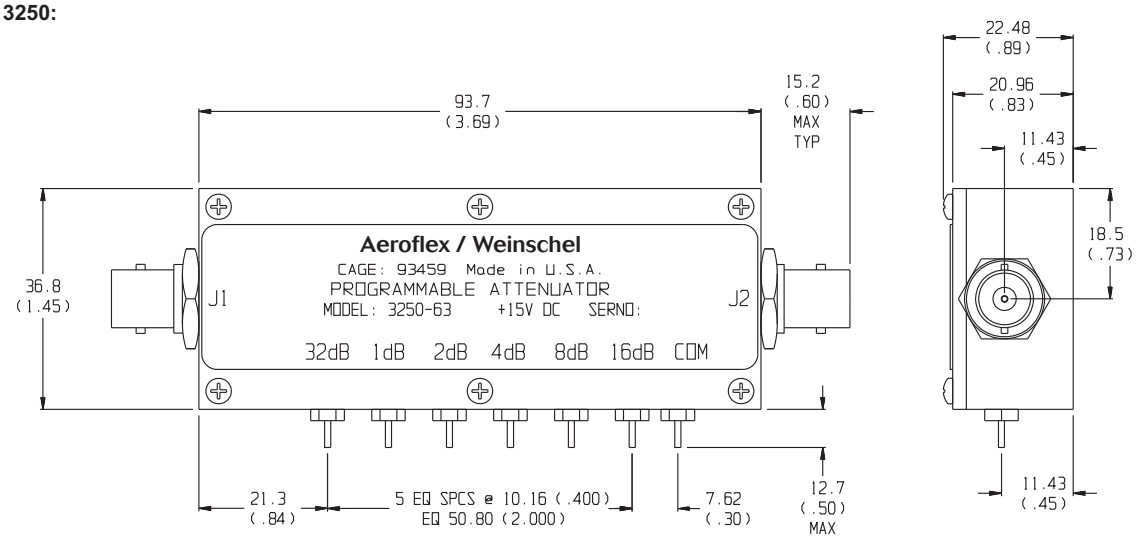
*Add T to Basic Model Number when ordering Digital Control Circuitry.

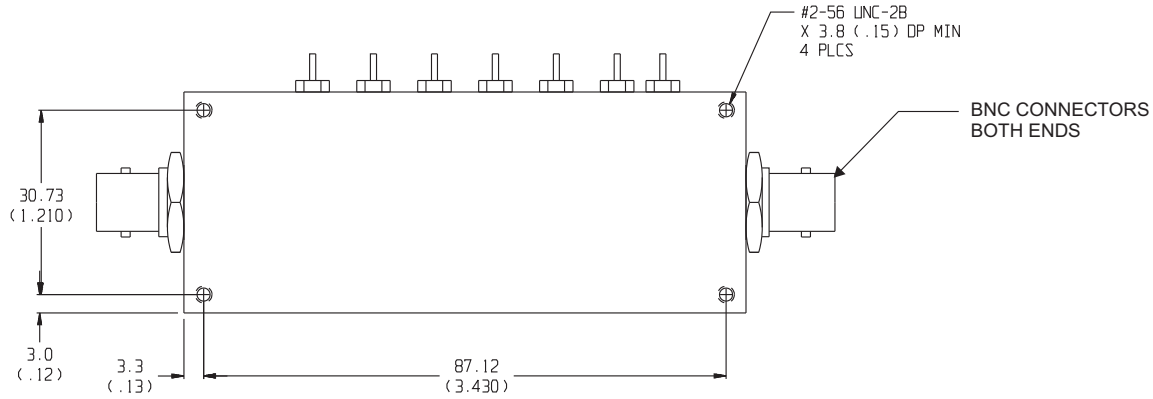
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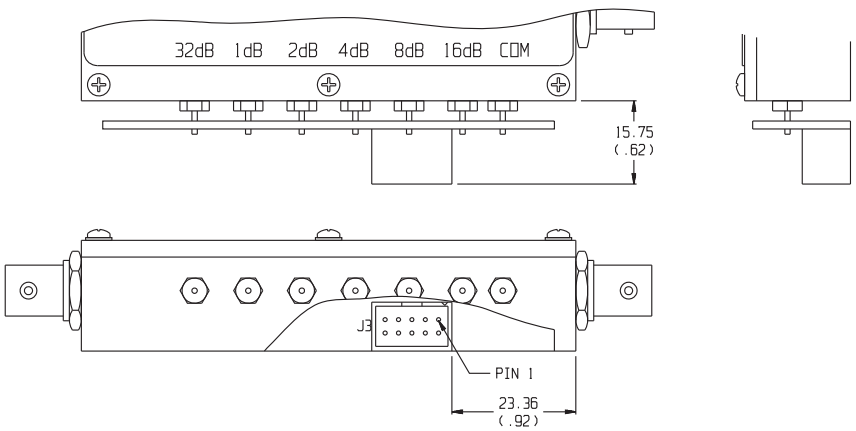
PHYSICAL DIMENSIONS:

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

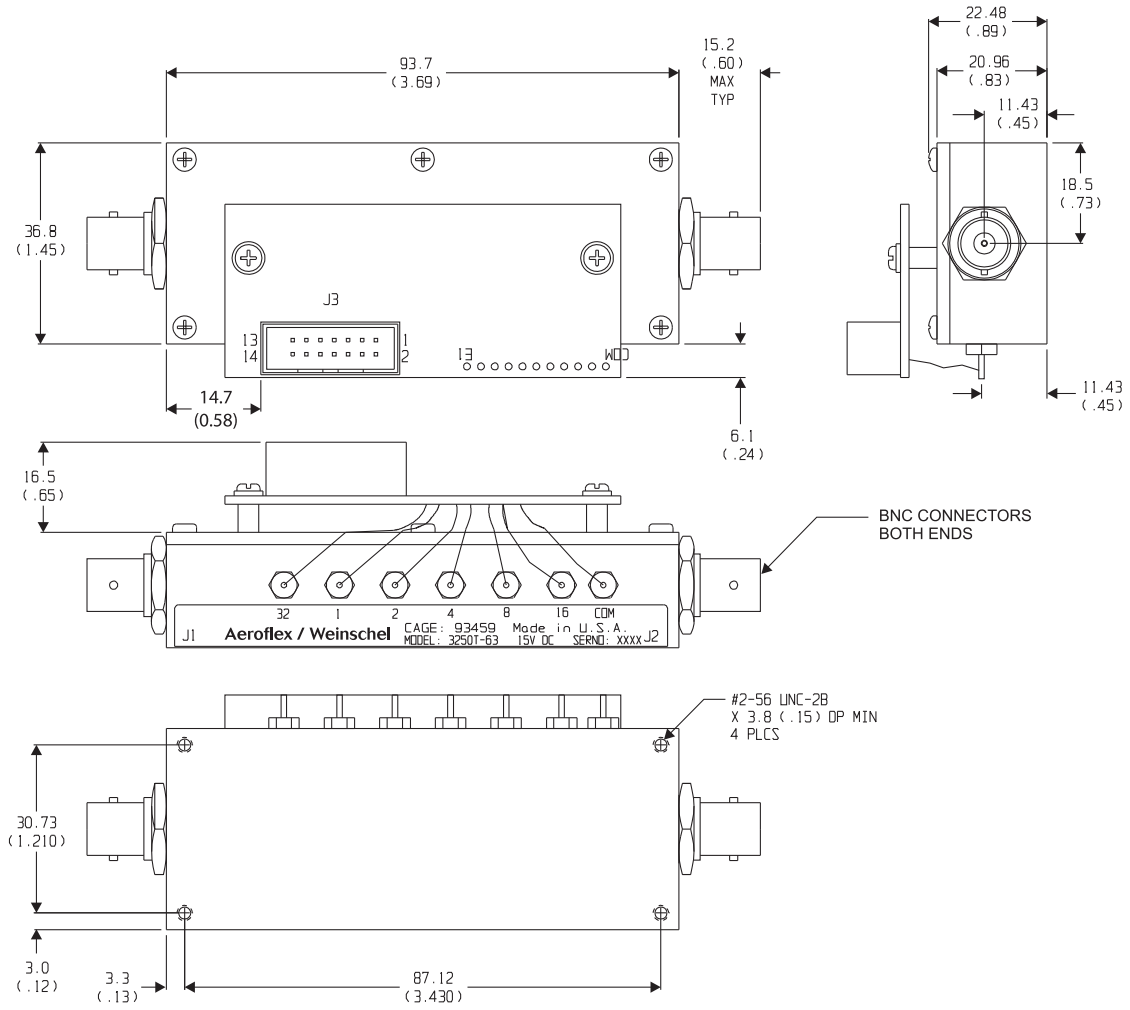
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PHYSICAL DIMENSIONS:

Model 3250T:



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

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Revision Date: 3-1-07

Models 3406 & 3408 Programmable Attenuators

dc to 6.0 GHz 1 Watt

Ideal for Wireless/Test Applications

NEW



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
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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Revision Date: 3-1-07

SPECIFICATIONS - Con't

CONNECTORS: SMA female connectors per MIL-STD-348 interface dimensions - mate nondestructively with MIL-C-39012 connectors. eads. May be used with PC board sockets/ receptacles.

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:

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 3400 Series Attenuators with this option add -1 to basic model number for ribbon cable connector. Example: Model 3406-63 with a TTL interface would be 3406-63-1.

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

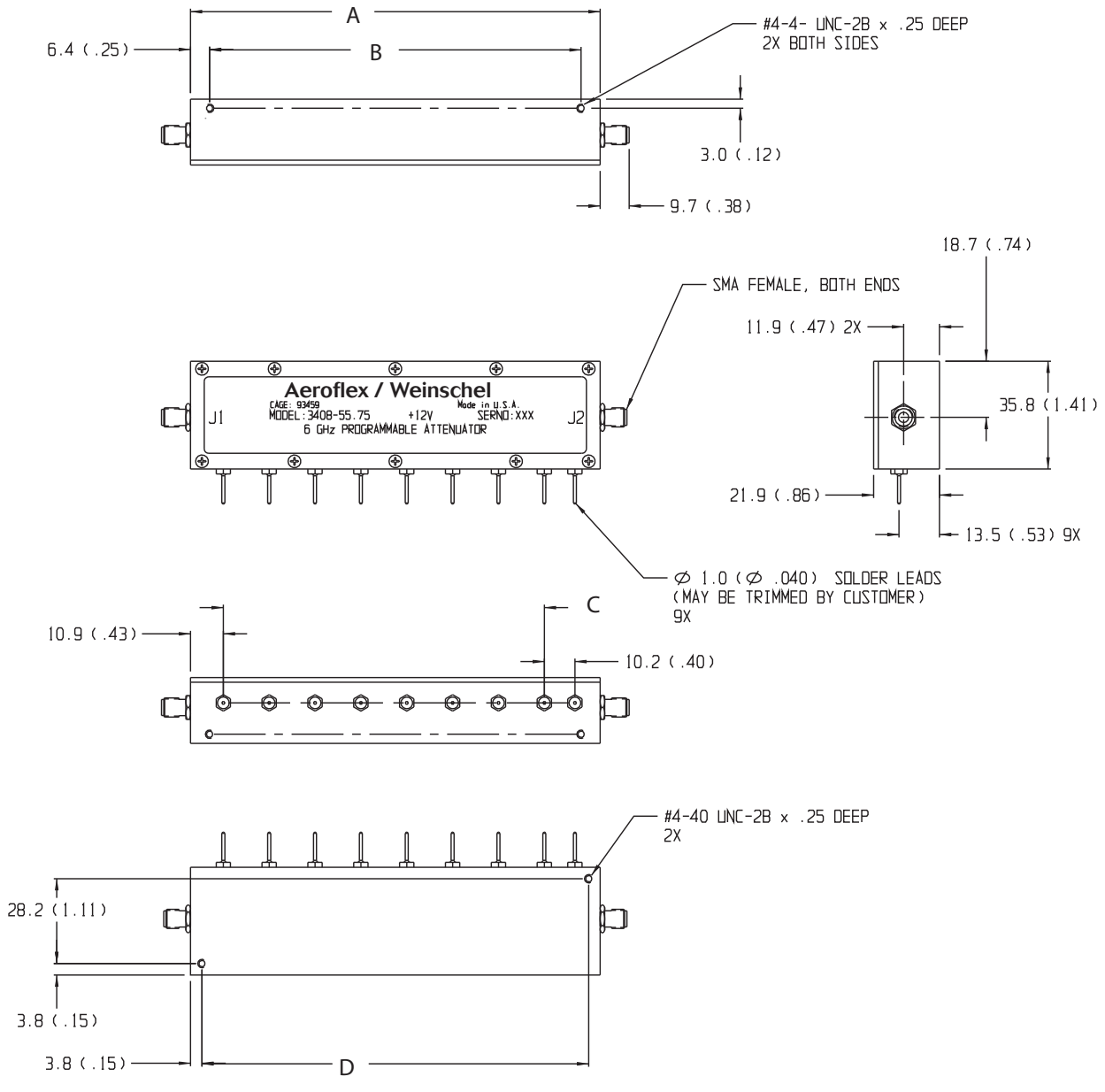
SUPPLY VOLTAGE: V_{CC}=+12.0 to +15 V

MODELS WITH BUILT-IN DRIVERS: Most 3400s 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 3406T and 3408T data sheet for more information.

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Revision Date: 3-1-07

PHYSICAL DIMENSIONS:



Model No.	No. Cells	A	B	C	D
3408-X	8	136.1 (5.36)	123.4 (4.86)	7 EQ SPCS @ 15.20 (.60) = 106.7 (4.20)	128.5 (5.06)
3406-X	6	105.7 (3.66)	93.0 (3.66)	5 EQ SPCS @ 15.20 (.60) =76.0 (3.00)	98.0 (3.86)

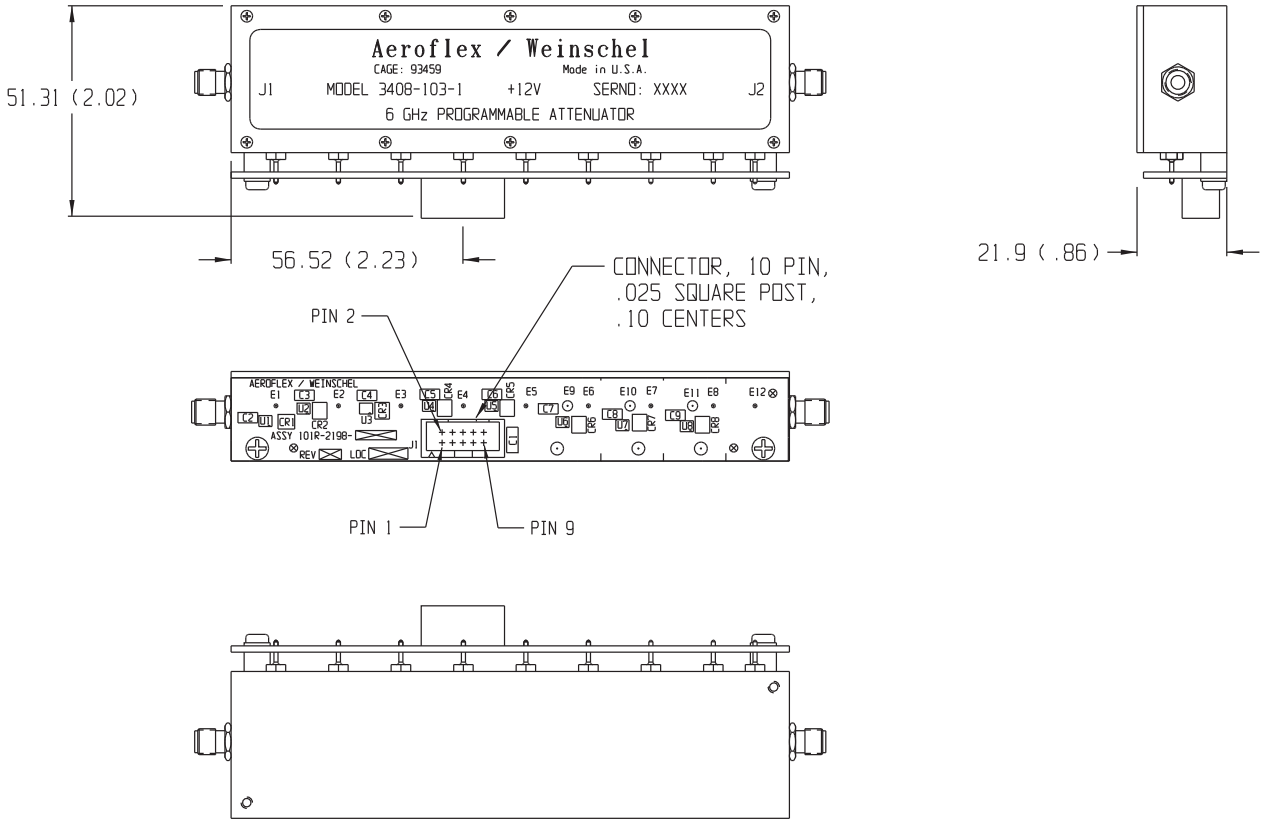
NOTE: All dimensions are given in mm (inches) and are nominal, unless otherwise specified.

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PHYSICAL DIMENSIONS:

TTL OPTION -1 (3406 & 3408)



Control Connector J3 Pin Locations:

TTL Conn PIN No. (J3)	3408-103-1 dB (Cell)	3408-55.75-1 dB (Cell)	3406-55-1 dB (Cell)
1	24*	0.25	1
2	24	0.5	2
3	1	1	4
4	2	2	8
5	4	4	16
6	8	8	24
7	16	16	NC
8	24*	24	NC
9	+Vcc	+Vcc	+Vcc
10	COM	COM	COM

* 48 dB cell comprised of two 24 dB cells
NC = Not Connected

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

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Models 3406T & 3408T Programmable Attenuators

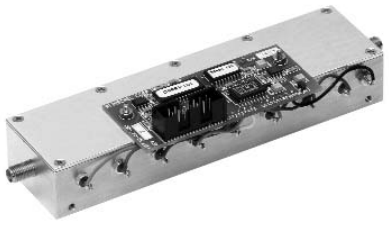
with built-in Microprocessor-Based Driver

dc to 6.0 GHz

1 Watt

NEW

For Use with Weinschel 8210A Controller



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**
- **Built-In TTL\CMOS Interface Driver Circuitry**
- **Special Configurations Available Upon Request**

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 6 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 3400T 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)
3406T-55	6	55/1	1, 2, 4, 8, 16, 24
3408T-55.75	8	55.75/0.25	0.25, 0.5, 1, 2, 4, 8, 16, 24
3408T-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

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

SWITCHING SPEED: 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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Specifications - Con't

DRIVER INTERFACE:

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:	16.6 mA @ 12V

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

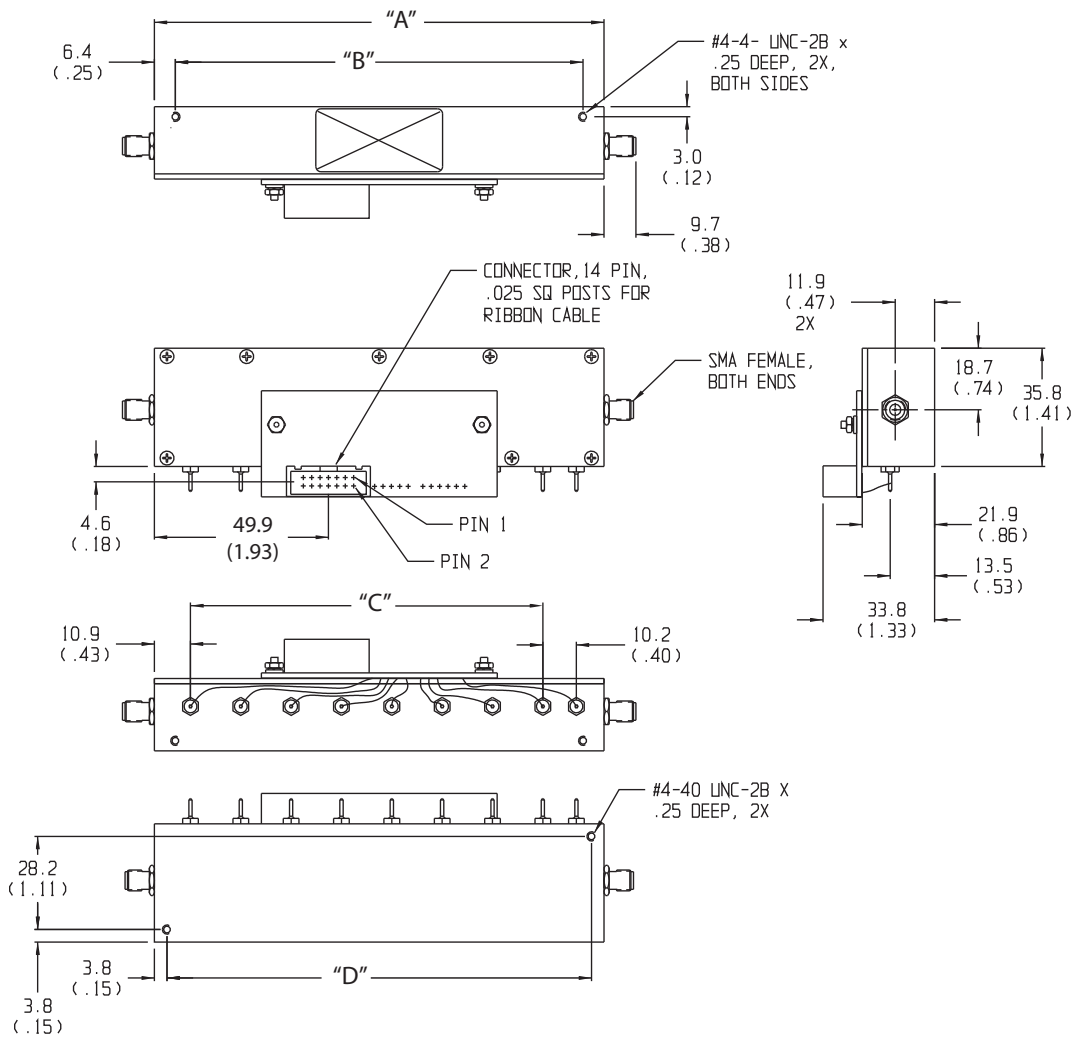
INTERFACE CONNECTOR: 14 pin .025 square post header on .1 center. Mates with Amp connector 746285-2 or equivalent.

CONSTRUCTION:

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

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

PHYSICAL DIMENSIONS:



Model No.	No. Cells	A	B	C	D
3408T-X	8	136.1 (5.36)	123.4 (4.86)	7 EQ SPCS @ 15.20 (.60) = 106.7 (4.20)	128.5 (5.06)
3406T-X	6	105.7 (3.66)	93.0 (3.66)	5 EQ SPCS @ 15.20 (.60) =76.0 (3.00)	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

SmartStep® Relay Switched Programmable Attenuators, with built-in Microprocessor-Based Driver

For Use with Weinschel 8210A Controller



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.

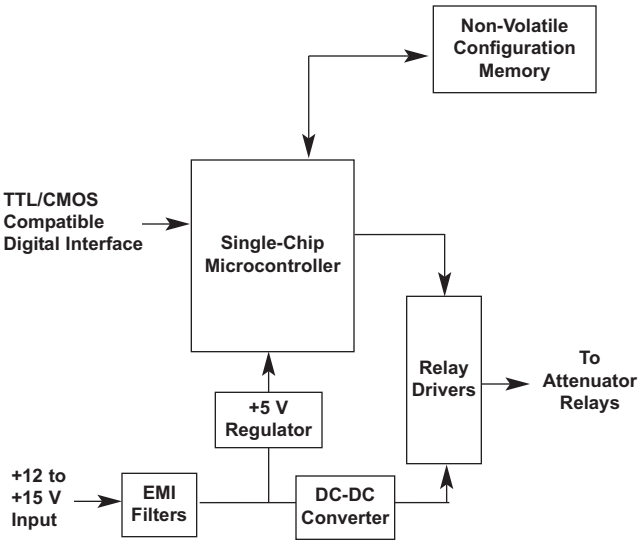


Figure 1. Built-In Driver Circuitry

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 (5 µsec pulse width; 0.5% 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: ±0.1 dB typical per cell

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)	1.40	- - -	- - -
150T-70 (3 cell)	1.40	1.60	- - -
152AT-70 (3 cell)	1.40	1.60	1.90
152T-55, 152T-70, 152-75, 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-75, 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

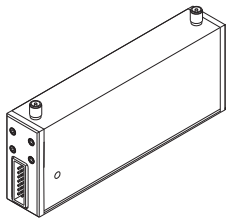
Programmable Attenuator/Switch Controller: The Model 8210A Programmable Attenuator/Switch Controller provides a flexible, low cost solution for the operation of programmable step attenuators and other electromechanical devices under computer control. Designed to interface to Aeroflex / Weinschel's intelligent 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/152T-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
18 - 26.5	0.5	0.5	0.9	0.9	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-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:

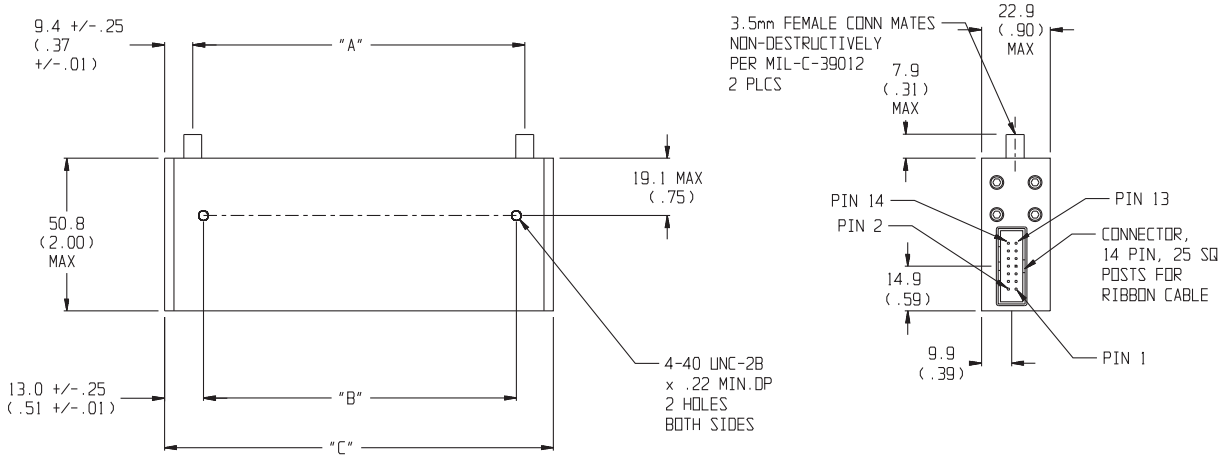
Frequency	Attenuation Setting (dB)								
Range (GHz)	10	20	30	40	50	60	70	80	90
dc-4	0.3	0.5	0.6	0.7	0.8	1.0	1.1	1.1	1.2
4-12.4	0.4	0.5	0.7	0.9	1.0	1.3	1.5	1.6	1.7
12.4-18	0.5	0.6	0.8	1.1	1.2	1.4	1.7	1.8	2.1
18-26.5	0.5	0.6	0.9	1.4	1.5	1.8	2.3	2.4	2.8

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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 3 5	151T-11	151T-15	 151T-31	N/A	 151T-62	 151T-70	151T-75	N/A	151T-110
dc-18 GHz	4 3 5	150T-11	150T-15	 150T-31	N/A	 150T-62	 150T-70	150T-75	N/A	150T-110
dc-26.5 GHz	4 3	N/A	NA	N/A	152T-55	NA	152T-70 152AT-70	152T-75	152T-90	N/A

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Revision Date: 9-14-07

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



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.

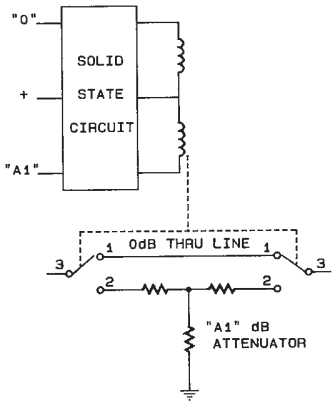


Figure 1. Cell Schematic

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. 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: 10-1-07

150 Series Cell Configurations...

ATTN Value	Cells No.	Cell 1 Bypass	Cell 1 ATTN Element	Cell 2 Bypass	Cell 2 ATTN Element	Cell 3 Bypass	Cell 3 ATTN Element	Cell 4 Bypass	Cell 4 ATTN Element	Cell 5 Bypass	Cell 5 ATTN Element	Power +Vdc
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	- - -	- - -	
Round Conn.	PIN #	5	6	9	10	7	8	11	12	3	4	1
3 & 4 Cell	Wire	Violet	Yellow	Orange	Blue	Black	Green	Brown	White	- - -	- - -	Red
5 Cell	Color	Black	White	Green	Orange	Blue	WHT/BLK	RED/BLK	GRN/BLK	ORN/BLK	BLU/BLK	Red
Ribbon Cable Conn.	PIN#	13	2	3	9	11	5	4	10	8	7	6
	Wire Color	Orange	Yellow	Blue	Brown	Purple	Black	Gray	White	Orange	yellow	Red

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 (5 µsec pulse width; 0.5% duty cycle)

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

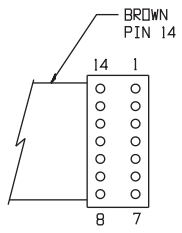
TEMPERATURE COEFFICIENT: < 0.0001 dB/dB/°C

POWER SENSITIVITY: < 0.001 dB/dB/ Watt

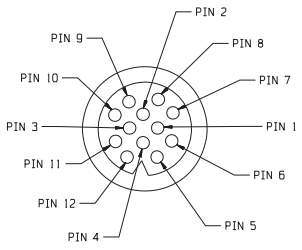
RATED SWITCH LIFE: 5 million cycles per cell

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: ±0.1 dB typical per cell

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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AEROFLEX WEINSCHEL

Programmable Attenuators

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

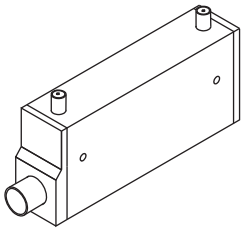
ATTENUATION ACCURACY (±dB with respect to 0 dB reference):

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 150/151-70, 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:

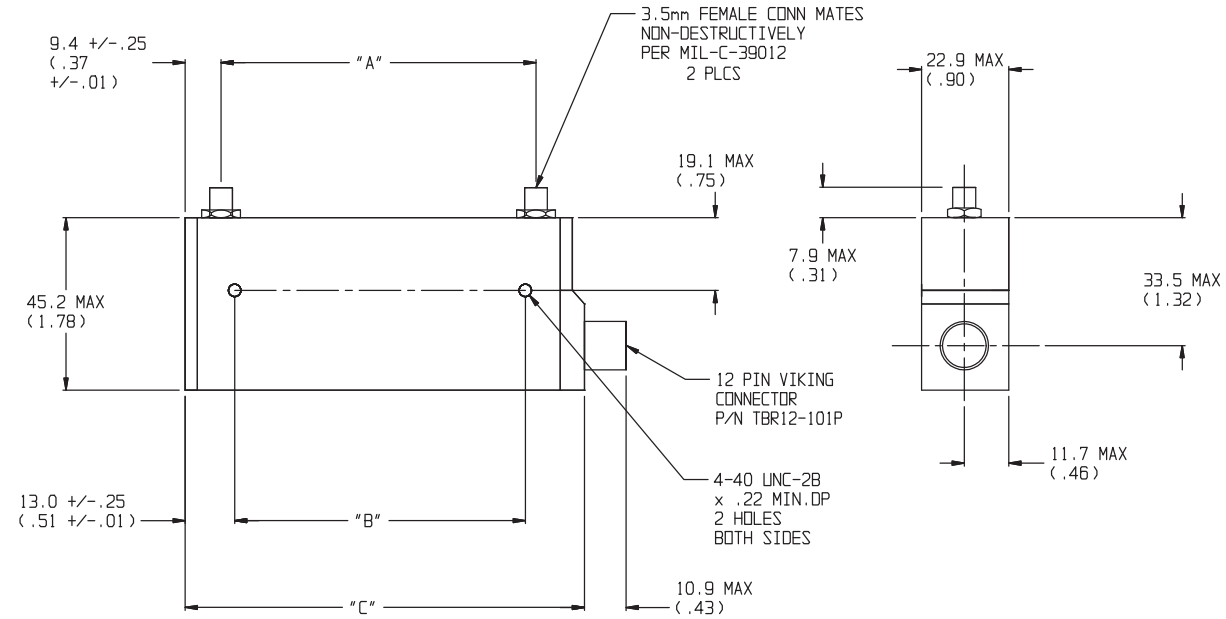
Frequency Range (GHz)	Attenuation Setting (dB) 10	20	30	40	50	60	70	80	90
dc-4	0.3	0.5	0.6	0.7	0.8	1.0	1.1	1.1	1.2
4-12.4	0.4	0.5	0.7	0.9	1.0	1.3	1.5	1.6	1.7
12.4-18	0.5	0.6	0.8	1.1	1.2	1.4	1.7	1.8	2.1
18-26.5	0.5	0.6	0.9	1.4	1.5	1.8	2.3	2.4	2.8

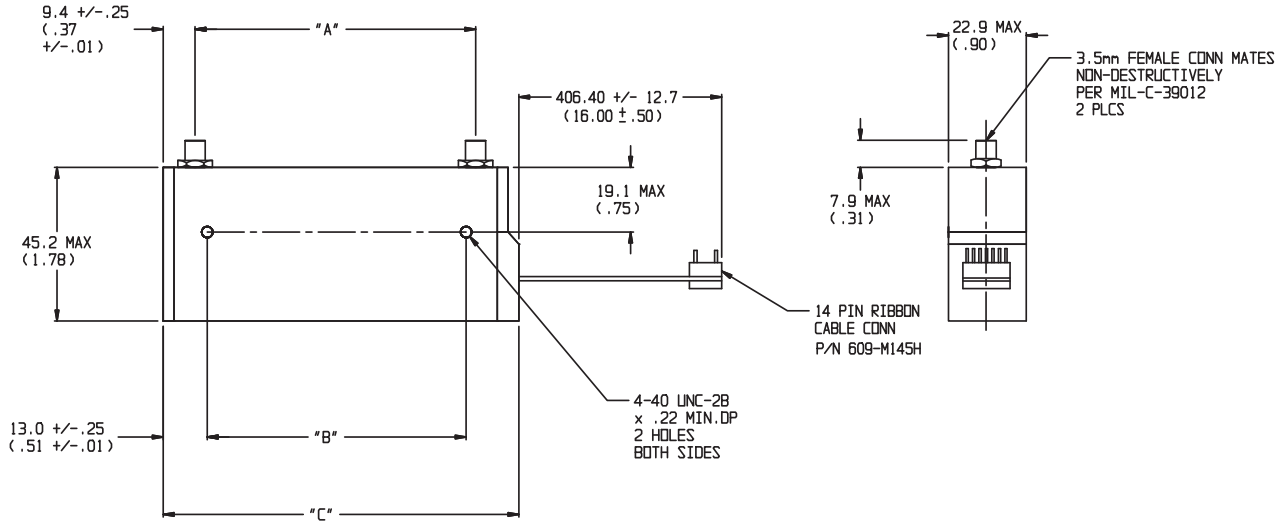
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PHYSICAL DIMENSIONS:

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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Revision Date: 10-1-07

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 3 5	151-11	NA	N/A	151-31	N/A	151-75	N/A	151-110
dc-18 GHz/+24 V/ Viking Connector	4 3 5	150-11	150-15	N/A	150-31	150-70	150-75	N/A	150-110
dc-26.5 GHz/+24 V/ Viking Connector	4 3	N/A	N/A	152-55		N/A	N/A	152-90	N/A
dc-4 GHz/+24 V/ Ribbon Cable	4 3 5	151-11-1	NA	N/A	151-31-1	N/A	151-75-1	N/A	151-110-1
dc-18 GHz/+24 V/ Ribbon Cable	4 3 5	150-11-1	150-15-1	N/A	150-31-1	150-70-1	N/A	N/A	150-110-1
dc-26.5 GHz/+24 V/ Ribbon Cable	4 3	N/A	N/A	152-55-1	N/A	N/A	N/A	152-90-1	N/A
dc-4 GHz/+5 V/ Viking Connector	4 3 5	151-11-2	151-15-2	N/A	151-31-2	N/A	151-75-2	N/A	151-110-2
dc-18 GHz/+5 V/ Viking Connector	4 3 5	150-11-2	150-15-2	N/A	150-31-2	150-70-2	150-75-2	N/A	150-110-2
dc-26.5 GHz/+5 V/ Viking Connector	4 3	N/A	N/A	152-55-2	N/A	N/A	N/A	152-90-2	N/A
dc-4 GHz/+5 V/ Ribbon Cable	4 3 5	151-11-3	N/A	N/A	151-31-3	N/A	N/A	N/A	N/A
dc-18 GHz/+5 V/ Ribbon Cable	4 3 5	150-11-3	150-15-3	N/A	150-31-3	150-70-3	150-75-3	N/A	150-110-3
dc-26.5 GHz/+5 V/ Ribbon Cable	4 3	N/A	N/A	152-55-3	N/A	N/A	N/A	152-90-3	N/A

N/A = Not Available

ACCESSORIES

OPTIONAL TEST Data: Test Data is available at an additional cost for all programmable step attenuators models. Standard test date is sweep measurements which magitude and VSWR for each primary cell'.

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: 10-1-07

Models 4216 & 4218 — 0.8 to 2.3 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 -**
  127 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: 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 α = 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)

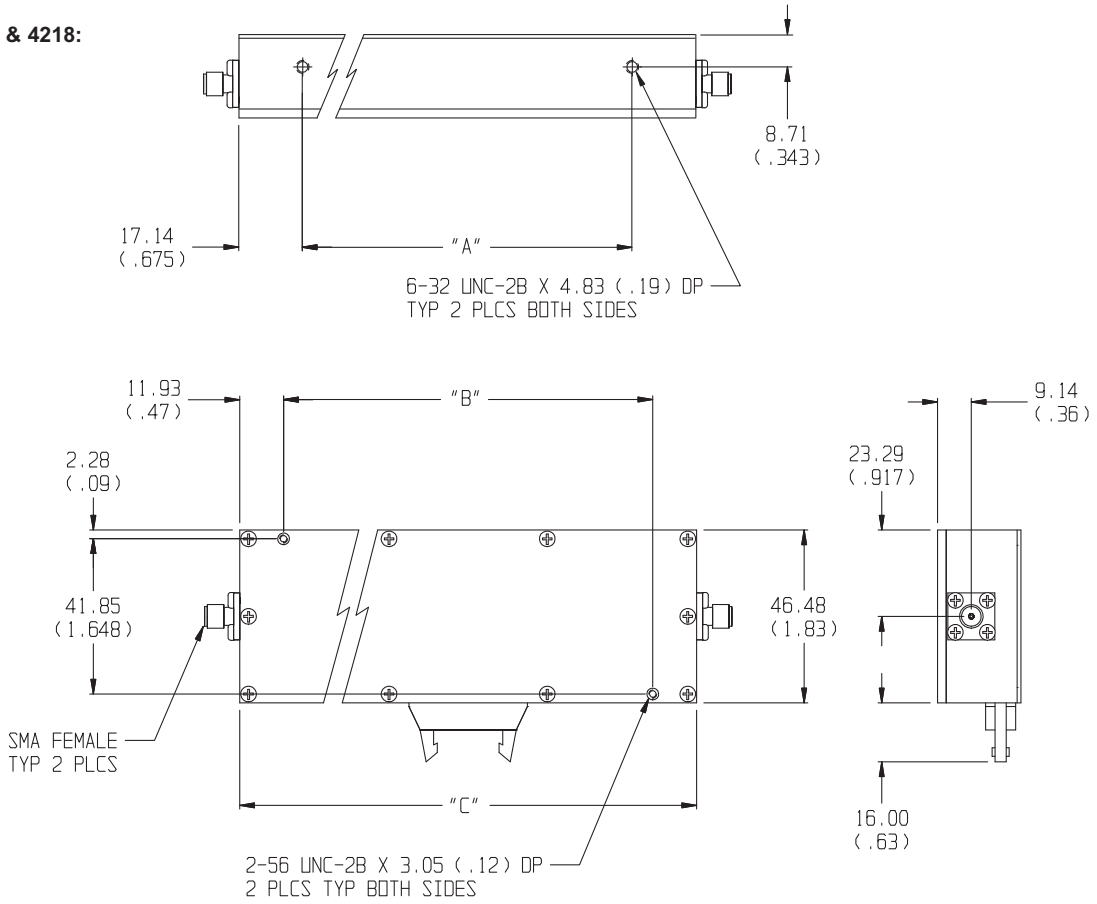
CONTROL CONFIGURATION: Units are supplied with a built-in TTL interface. Each unit is supplied with a mating 10 pin connector (Amp 746285-1). Refer to Physical Dimensions for mating connector pin/wiring details. Two wires are specified for supply voltage and ground. The remaining wires will accept TTL 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: 3-1-07

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: 3-1-07

AEROFLEX WEINSCHEL

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 α = 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	

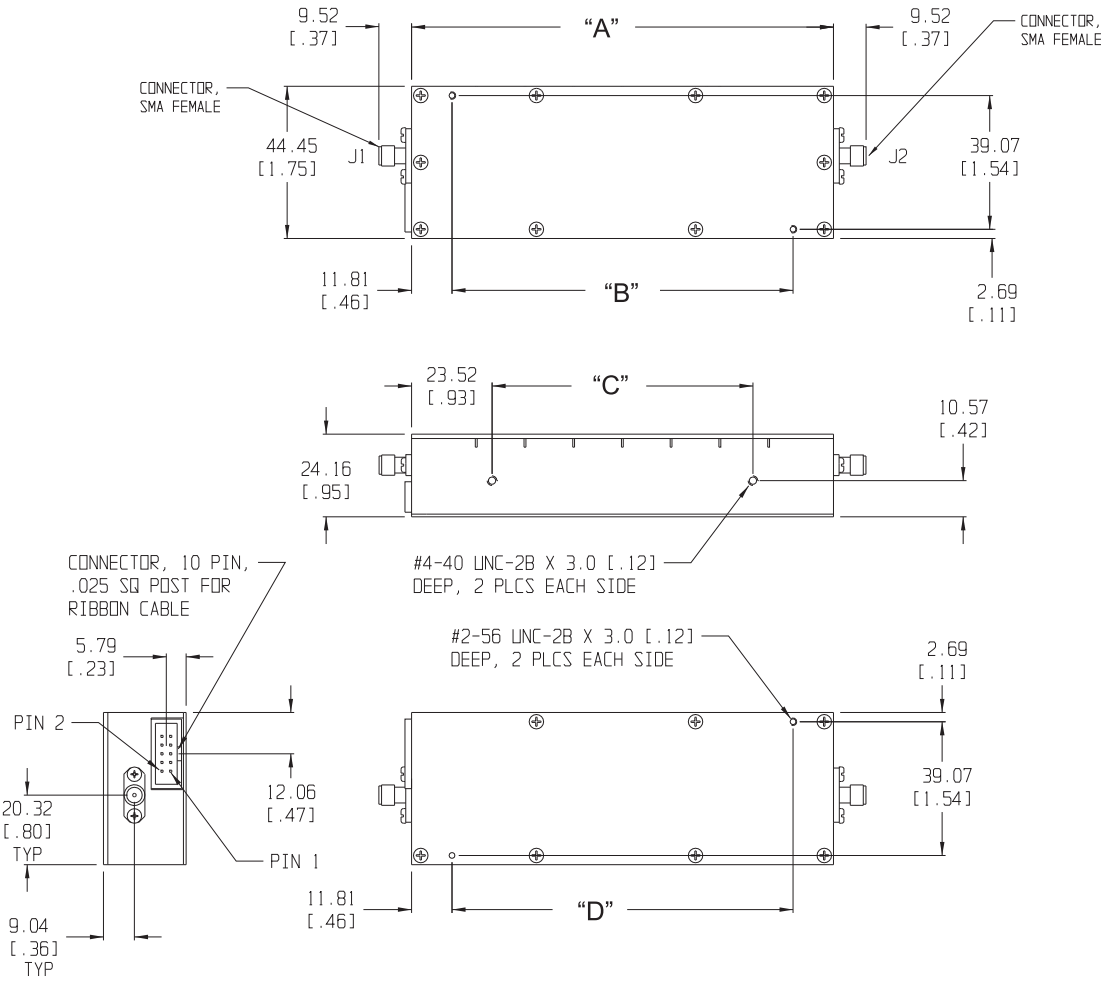
Note: Inputs have 10K pull-up resistors.

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Revision Date: 3-1-07

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: 3-1-07

Model 4238
GaAs Switched Programmable Attenuator

10 MHz to 2.5 GHz
1 Watt

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 usable dc to 10 MHz with reduced specifications
- **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 - 0.25	1.75
0.25 - 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 (2f1-f2).

$$IP3 \text{ (input)} = +65 \text{ dBm}$$

The input IP3 is derived from the following relationship:

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

where α = 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)

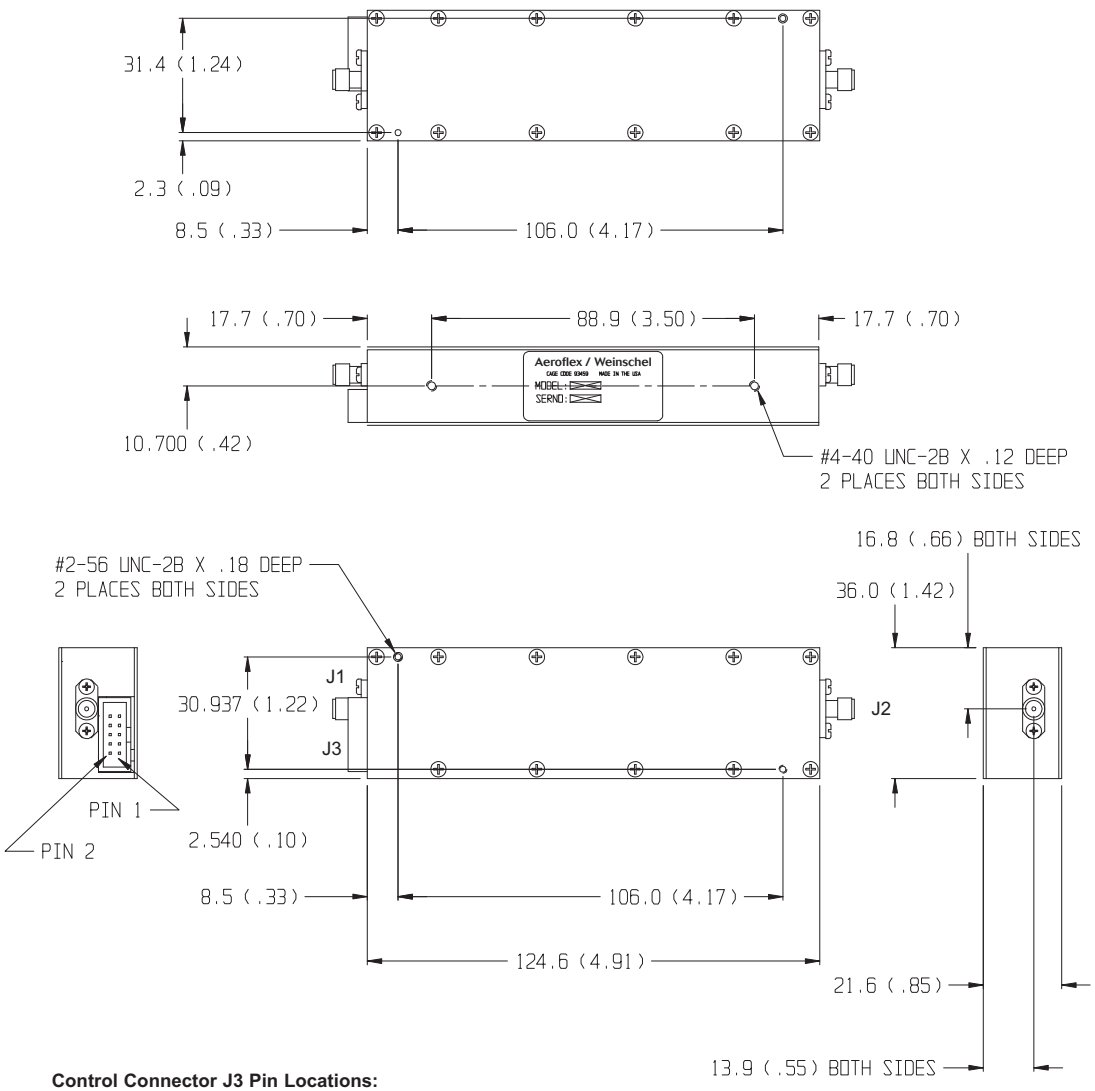
CONTROL CONFIGURATION: Units are supplied with a built-in TTL interface. Each unit is supplied with a mating 10 pin connector (Amp 746285-1). Refer to Physical Dimensions for mating connector pin/wiring details. Two wires are specified for supply voltage and ground. The remaining wires will accept TTL 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: 8-28-07

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: 8-28-07

Models 4246 & 4248 Phase Compensated GaAs Switched Programmable Attenuator

10 MHz to 2.5 GHz 4 Watts

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)
4246-63	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
4248-103	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).

$$IP3 \text{ (input)} = +58 \text{ dBm}$$

The input IP3 is derived from the following relationship:

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

where α = 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:

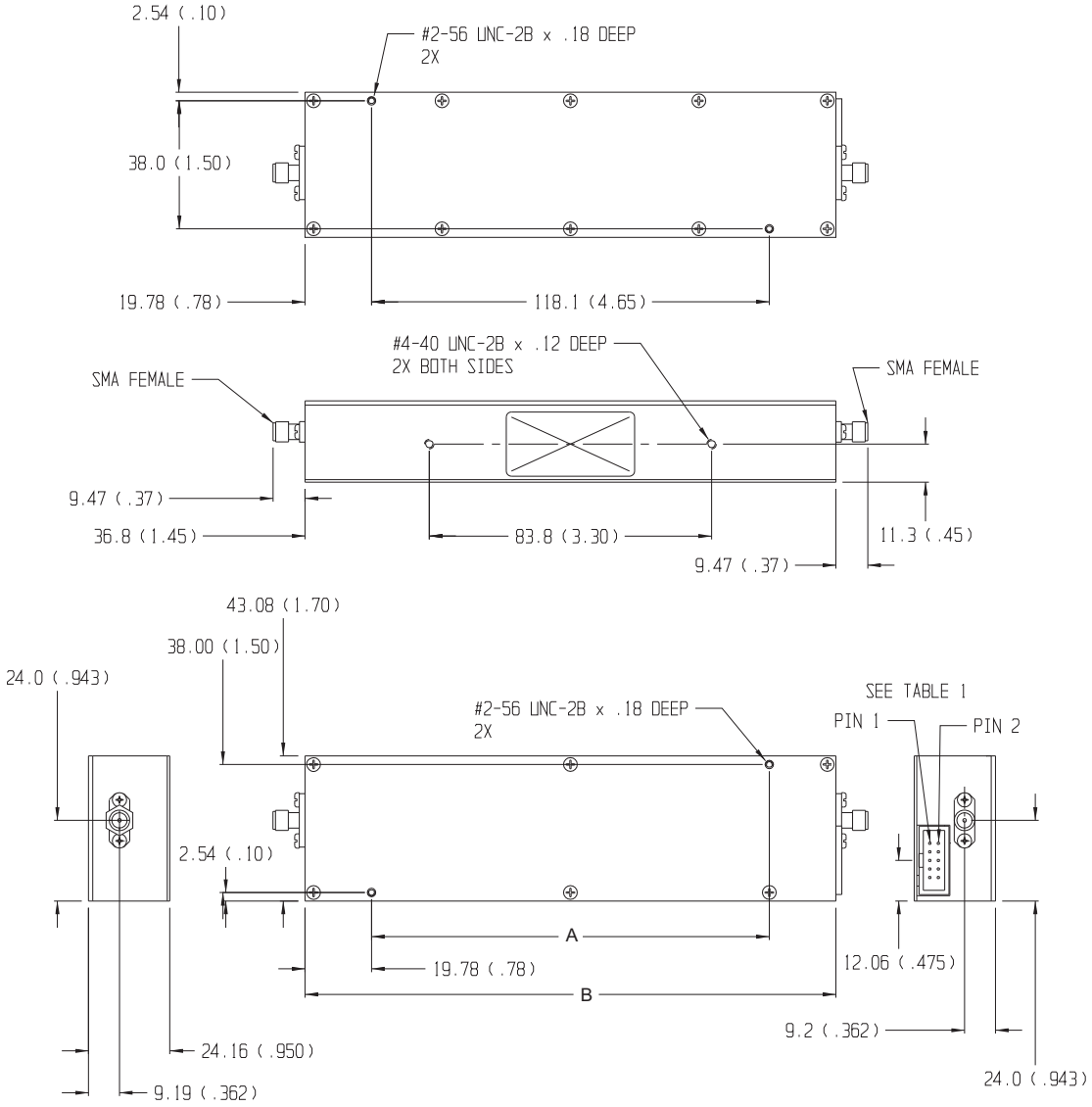
Housing:	Aluminum
Connectors:	Stainless steel body and beryllium copper contacts.

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

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Revision Date: 3-1-07

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: 3-1-07

Models 8310 & 8311
SmartStep® 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, 6 & 18 GHz
  - NEW dc to 6 GHz Models
  - 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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web: www.aeroflex-weinschel.com • email: sales@aeroflex-weinschel.com

Revision Date: 5-15-07

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) **RS-485 Bus(4)**	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(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: 5-31-07

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
8310-352-1-F	103/1	dc-6.0	6.00 dB	1.55	1	3408T-103	N/F	Front
8310-352-1-R	103/1	dc-6.0	6.00 dB	1.55	1	3408T-103	N/F	Rear
8310-352-2-F	103/1	dc-6.0	6.00 dB	1.55	2	3408T-103	N/F	Front
8310-352-2-R	103/1	dc-6.0	6.00 dB	1.55	2	3408T-103	N/F	Rear
8310-352-3-T	103/1	dc-6.0	6.00 dB	1.55	3	3408T-103	N/F	Front to Rear
8310-352-4-T	103/1	dc-6.0	6.00 dB	1.55	4	3408T-103	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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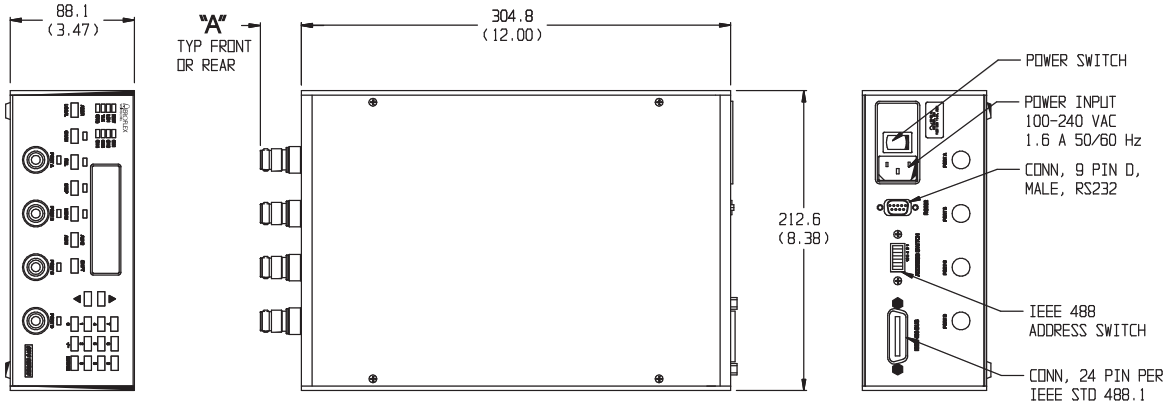
Revision Date: 5-31-07

Ordering Guide...8311 Series!

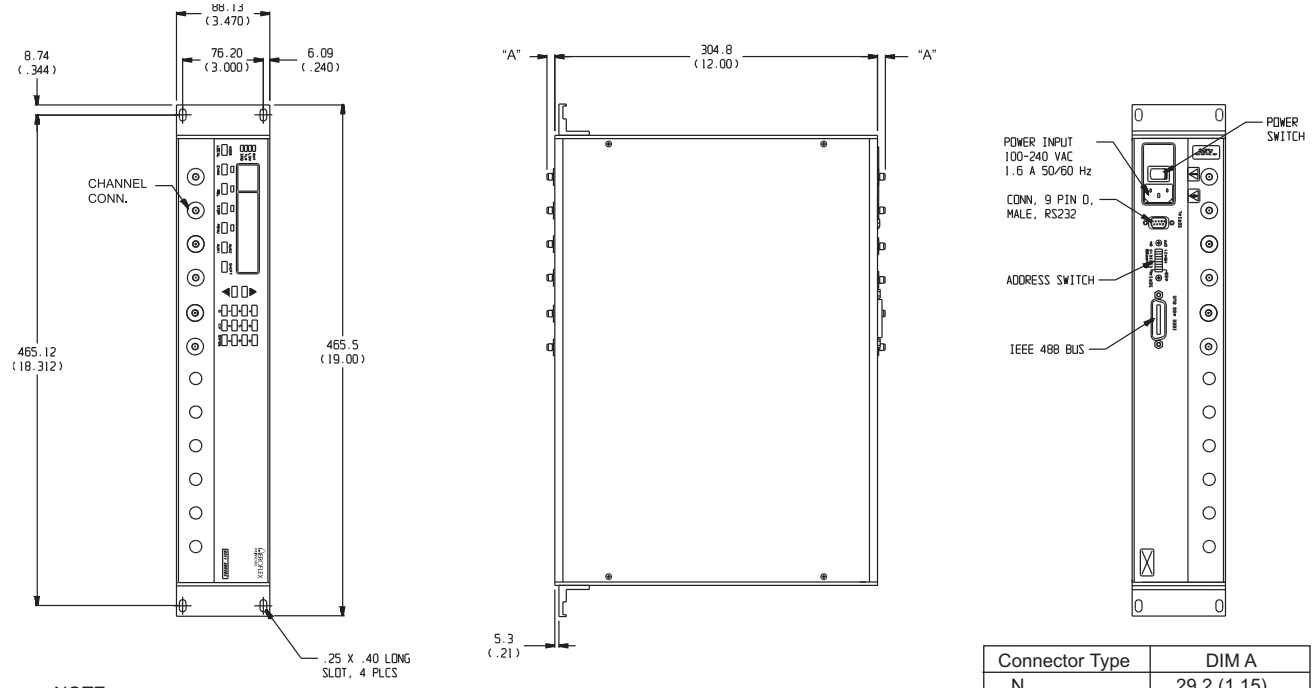
Model No	Attenuation Value (dB)	Frequency Range (GHz)	Insertion Loss (maximum)	SWR (Maximum)	No of Channels	Attenuator Model No.*	Connector Type	Conn Location
8311-1-6-F	63/1	dc-1.0 (75Ω)	6.00 dB	1.60	6	3250T-63	BNC/F	Front
8311-38-6-F	63/1	dc-2.0	5.25 dB	1.40	6	3206T-1	N/F	Front
8311-38-12-T	63/1	dc-2.0	5.25 dB	1.40	12	3206T-1	N/F	Front-Rear
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
8311-352-6-F	103/1	dc-6.0	6.00 dB	1.55	6	3408T-103	N/F	Front
8311-352-9-T	103/1	dc-6.0	6.00 dB	1.55	9	3408T-103	N/F	Front-Rear

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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Revision Date: 5-31-07

Model 8312
High Power Programmable Attenuator

IEEE-488

RS232\RS422

100 Watt Hot Switching Capability



Description

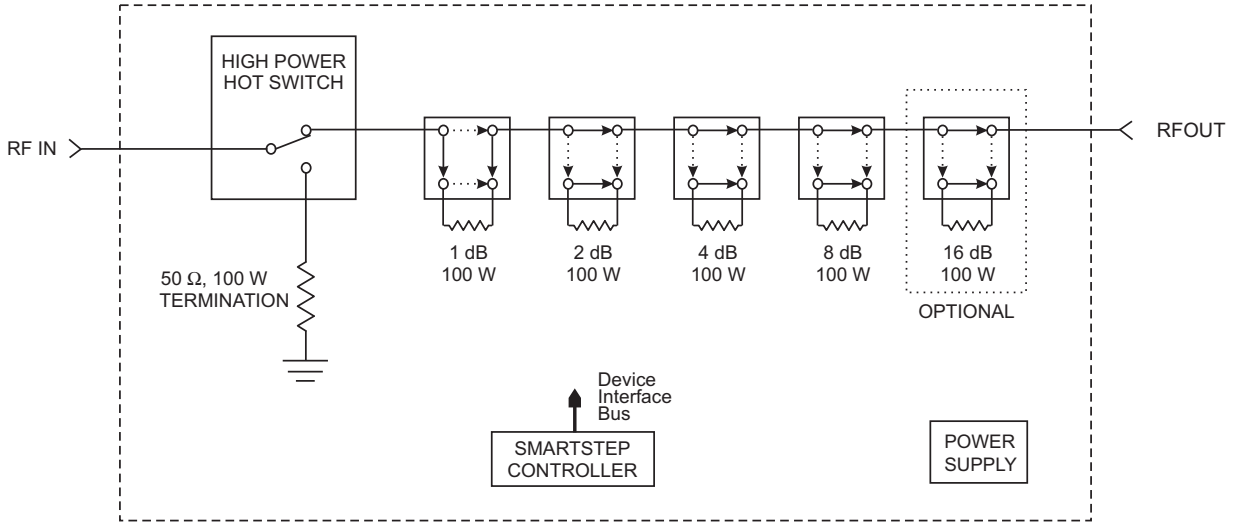
Aeroflex / Weinschel's design approach uses a highly adaptable platform that allows configuration of the step attenuator to the customers requirements. When the controller requests a new attenuation level the input switch terminates the input signal into a 50 Ohm load. (See Figure 1) This input switch 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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Revision Date: 9-14-07

Specifications

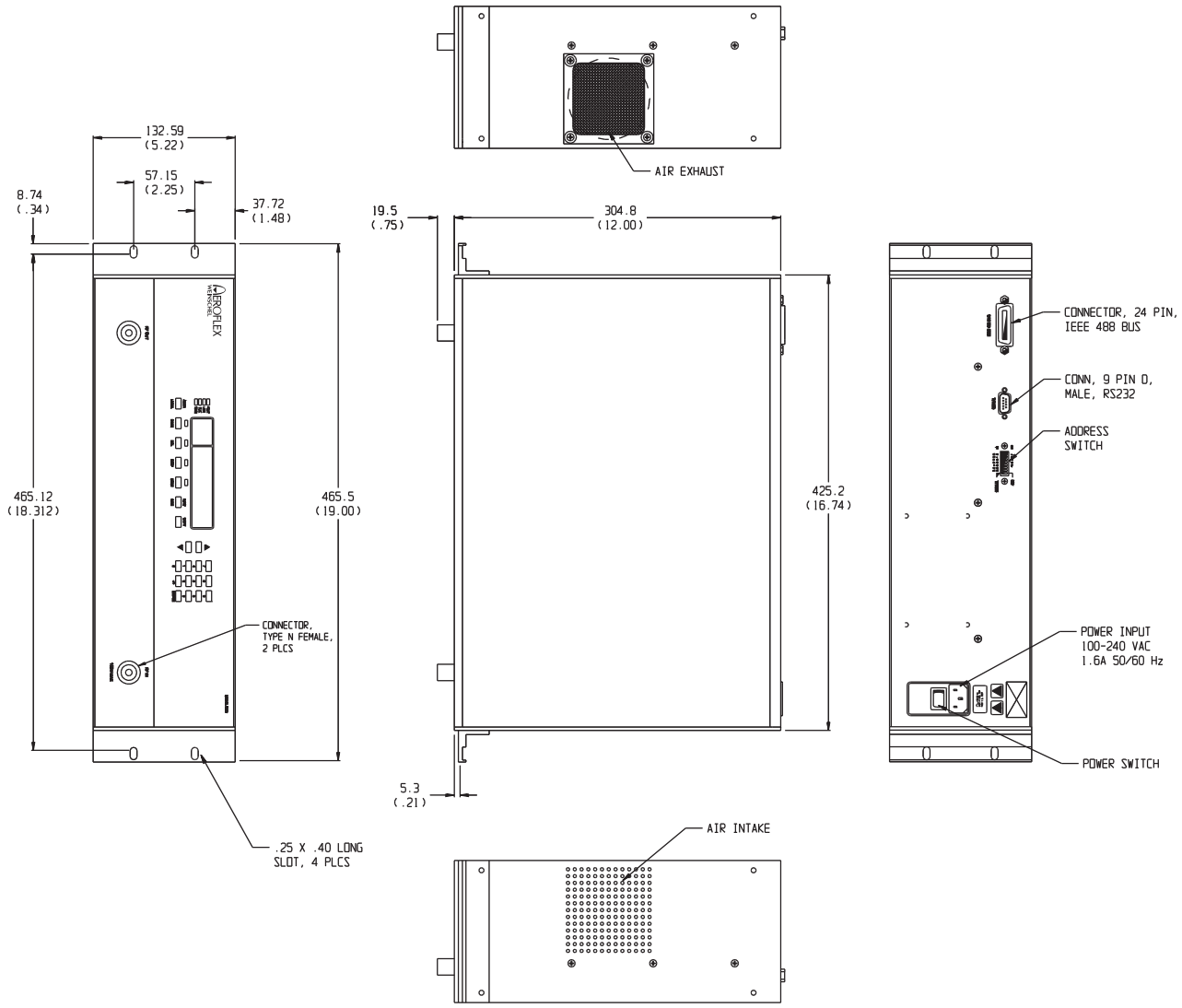
SPECIFICATION	DESCRIPTION
Input Power Requirements	AC 100 to 240 Vac, 50/60 Hz, 50 Watts
Environmental	Operating Temperature 0 to +50°C Storage Temperature: 67° to +167 °F (-55° to +75°C) Humidity: 96% Altitude: 40,000' (12,192M)
IEEE-488 Bus	Connector: 24-pin per IEEE-488.1 Protocols: per IEEE-488.2 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: 2.30 (Maximun) 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: ±0.6 dB / ±0.8 dB 3 GHz - 5 GHz: ±0.6 dB / ±0.8 dB 5 GHz - 13 GHz: ±2.5 dB / ±3.0 dB Insertion Loss (dB): Frequency Range / 8312-15-X / 8312-31-X 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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Revision Date: 9-14-07

Physical Dimensions



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

MODEL NUMBER DESCRIPTION:

Example:

8312 - XX - X

Basic Model Number	Attenuation Value (dB)*	Connector Location F = Front R = Rear

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

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Revision Date: 9-14-07

Model 8210A
Programmable Attenuator/Switch Controller

IEEE-488

RS232\RS422/RS485

A Logical Interface for Switchable Devices!



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

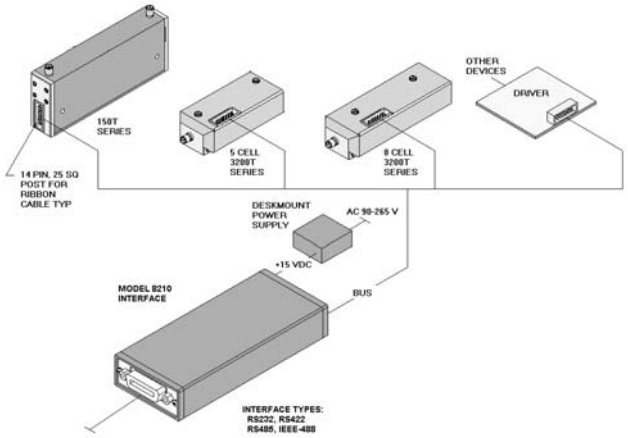
Model 8210A represents a new concept in device control applications and provides a high level interface from various industry standard communications interfaces to the serial Driver Interface Bus.

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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Revision Date: 3-1-07

Specifications

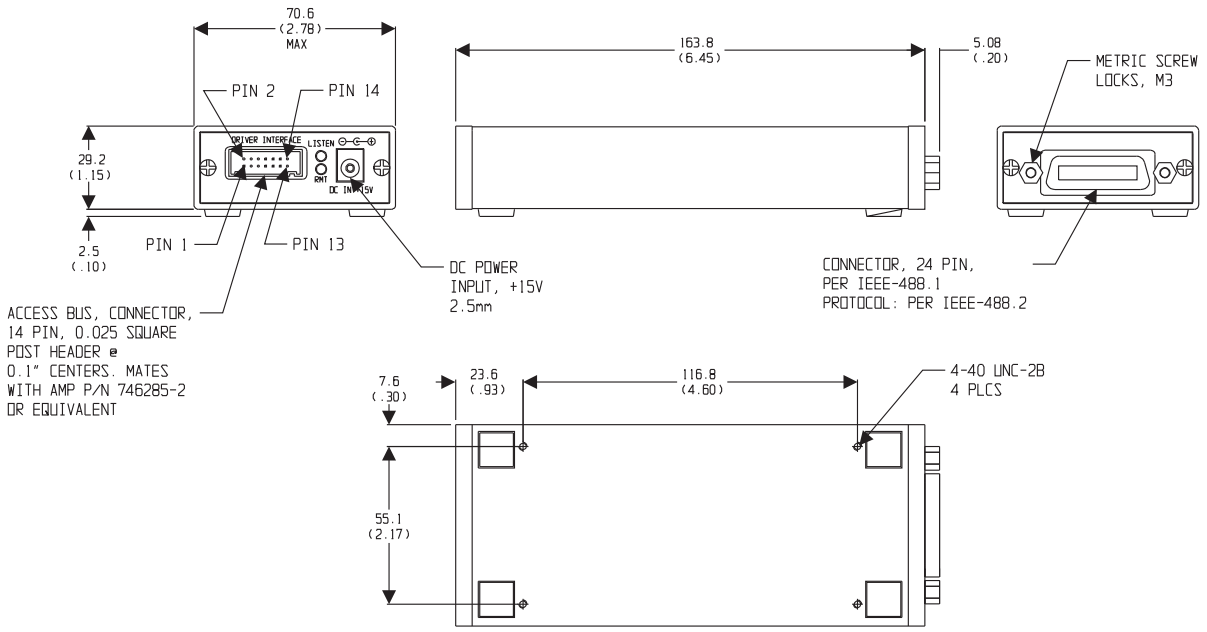
SPECIFICATION	DESCRIPTION	
DC Input	Connector:	2.5mm barrel style
	Requirements:	+12 to +15 Vdc @ 250 mA
Driver Interface	Connector:	14-pin 0.025" square post header @ 0.1" centers. Mates with AMP 746285-2 or equivalent.
	Signals :	SDA serial data SDC serial clock VDC DC supply voltage GND ground
	VDC 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.

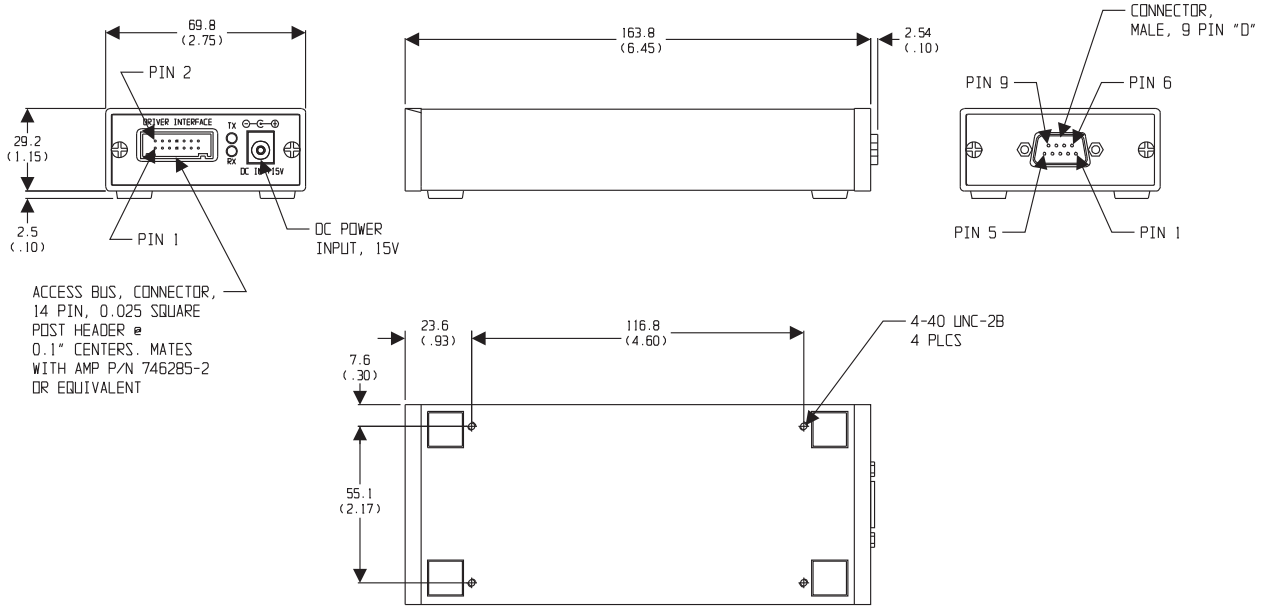
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Physical Dimensions

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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