Programmable Attenuators

MCE
WEINSCHEL

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.

Also covered in this section are the available accessories for the MCE / Weinschel programmable attenuators such as product specific driver boards, and our SmartStep programmables. Refer to our SmartStep Components and Subsystems section for more programmable attenuator accessories such as the Model 8210A SmartStep Interface and our new series of programmable attenuator units and subsystem solutions.

RELAY SWITCHED PROGRAMMABLES...dc-2/3 GHz

Model Number	Connector Type	Frequency Range (GHz)	Incremental Attenuation Range (dB)	Insertion Loss (dB)	Average Power (Watts)	Peak Power (Watts)	Maximum SWR	Page No.	
3200-1	SMA	dc-2.0	0-127/1	2.80-4.75*	1	50	1.25-1.30*	135	
3200-2			0-63.75/0.25						
3201-1			0-31/1	1.80-3.75*			1.25		
3201-2			0-120/10						
3205-1			0-70/10	1.80-3.30*					
3205-2			0-55/5						
3205-3			0-1.5/0.1						
3206-1			0-63/1	2.00-4.00*					
3209-1			0-64.5/0.1	3.50-6.70*			1.35		
3200-1E	SMA	dc-3.0	0-127/1	2.00-4.30*	1	50	1.20-1.40*		
3200-2E			0-63.75/0.25						
3201-1E			0-31/1	1.25-3.40*			1.20-1.25		
3205-3E			0-1.5/0.1						
3206-1E			0-63/1	1.50-3.70*					
3209-1E			0-64.5/0.1	3.00-5.50*			1.35-1.45*		
3200T-1	SMA	dc-2.0	0-127/1	2.80-4.75*	1	50	1.25-1.30*	141	
3200T-2			0-63.75/0.25						
3201T-1			0-31/1	1.80-3.75*			1.25		
3201T-2			0-120/10						
3201T-4			0-1.2/0.1	1.80-3.30*					
3205T-1			0-70/10						
3205T-2			0-55/5						
3205T-3			0-1.5/0.1						
3206T-1			0-63/1	2.00-4.00*					
3209T-1			0-64.5/0.1	3.50-6.70			1.35		
3200T-1E	SMA	dc-3.0	0-127/1	2.00-4.30*	1	50	1.20-1.40*		
3200T-2E			0-63.75/0.25						
3201T-1E			0-31/1	1.25-3.40*			1.20-1.25		
3205T-3E			0-1.5/0.1						
3206T-1E			0-63/1	1.50-3.70*					
3209T-1E			0-64.5/0.1	3.00-5.50*			1.35-1.45*		
3250-63 3250T-63 (75 Ω)	BNC	dc-1.0	0-63/1	2.25-4.75*	1	50	1.20-1.30*	144	

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RELAY SWITCHED PROGRAMMABLES...dc-4/18/26.5 GHz

Model Number	Connector Type	Frequency Range (GHz)	Incremental Attenuation Range (dB)	Insertion Loss (dB)	Average Power (Watts)	Peak Power (Watts)	Maximum SWR	Page No.	
150-11	3.5mm	dc-18.0	0-11/1	0.9-2.2*	1	100	1.50-1.90*	152	
150-15			0-15/1	0.9-2.2*			1.50-1.90*		
150-31			0-31/1	1.1-2.6*			1.50-1.90*		
150-62			0-62/2	1.1-2.6*			1.50-1.90*		
150-70			0-70/10	0.7-2.6*			1.35-1.70*		
150-75			0-75/5	0.9-2.2*			1.50-1.90*		
150-110			0-110/10	0.9-2.2*			1.50-1.90*		
151-11	3.5mm	dc-4.0	0-11/1	0.9	1	100	1.50		
151-15			0-15/1	0.9			1.50		
151-31			0-31-1	1.1			1.50		
151-62			0-62/2	1.1			1.50		
151-70			0-70/10	0.7			1.35		
151-75			0-75/5	0.9			1.50		
151-110			0-110/10	0.9			1.50		
152-55	3.5mm	dc-26.5	0-55/5	0.9-2.98*	1	100	1.40-1.80*		
152-70			0-70/10	0.9-2.98*			1.40-1.80*		
152A-70			0-70/10	0.9-2.98*			1.40-1.80*		
152-90			0-90/10	0.9-2.98*			1.40-1.80*		
150T-11	3.5mm	dc-18.0	0-11/1	0.9-2.2*	1	100	1.50-1.90*	157	
150T-15			0-15/1	0.9-2.2*			1.50-1.90*		
150T-31			0-31/1	1.1-2.6*			1.50-1.90*		
150T-62			0-62/2	1.1-2.6*			1.50-1.90*		
150T-70			0-70/10	0.7-2.6*			1.35-1.70*		
150T-75			0-75/5	0.9-2.2*			1.50-1.90*		
150T-110			0-110/10	0.9-2.2*			1.50-1.90*		
151T-11	3.5mm	dc-4.0	0-11/1	0.9	1	100	1.50		
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	3.5mm	dc-26.5	0-55/5	0.9-2.98*	1	100	1.40-1.80*		
152T-70			0-70/10	0.9-2.98*			1.40-1.80*		
152AT-70			0-70/10	0.9-2.98*			1.40-1.80*		
152T-90			0-90/10	0.9-2.98*			1.40-1.80*		

SOLID-STATE PROGRAMMABLES...to 2.5 GHz

Model Number	Connector Type	Frequency Range (GHz)	Incremental Attenuation Range (dB)	Insertion Loss (dB)	Average Power (Watts)	Maximum SWR	Page No.	
4206-63 4208-63.75	SMA	0.01-2.5	0-63/1 0-63.75/0.25	7.00-10.00* 8.50-13.00*	2/4**	1.40-150*	148	
4216-63 4218-63.75 4218-127	SMA	0.8-2.3	0-63/1 0-63.75/0.25 0-127/1	2.10-4.90*	+28 dBm	1.50	150	

*Varies with frequency.
**Unidirectional

Frequently Asked Questions about Programmable Attenuators....

What are the applications of Weinschel programmable attenuators?

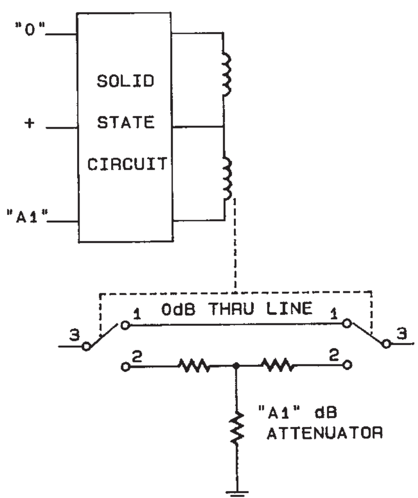
Weinschel's programmable attenuators are used to control the power of radio frequency and microwave signals. Applications include control of input power to signal measuring systems, control of output power from signal generating systems, adjustment power for BIT error rate testing, controlling losses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

How do they work?

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. Weinschel's 3200 series uses TO-5 can relay switches. These are useful up to 2.0 GHz and higher. Weinschel's 150 series operate up to 26.5 GHz and utilize reed switches housed within a precision machined cavity.



Future versions of Weinschel programmable attenuators will use solid state switching. They will have fast switching speeds but their frequency range is more limited than mechanical step attenuators. Whereas mechanically switched attenuators operate from DC to their maximum frequency, solid state attenuators have a lower frequency limit. Solid state attenuators also have lower isolation between control and through path.

How fast do the attenuators switch?

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

What is a latching and non-latching attenuator?

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

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

How are the attenuators controlled?

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

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.

Weinschel's programmable attenuators, such as the Model 3200 and new SmartStep Series feature on-board TTL drivers. TTL driver boards are also available for the Model 150 Series attenuators.

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What is the switch life of these programmable attenuators?

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

What is monotonicity?

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

What is the difference between insertion loss and incremental attenuation?

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

What is the advantages of SmartStep Attenuators?

The SmartStep™ 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 I^2C 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 I^2C 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 SmartStep™ contains non-volatile configuration memory that is used to hold a wide variety of attenuator and driver-dependant parameters, including serial number, attenuator cell dB values, relay configurations, and switching requirements, which are all accessible via the I^2C 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 SmartStep™ to operate from a single input supply voltage.

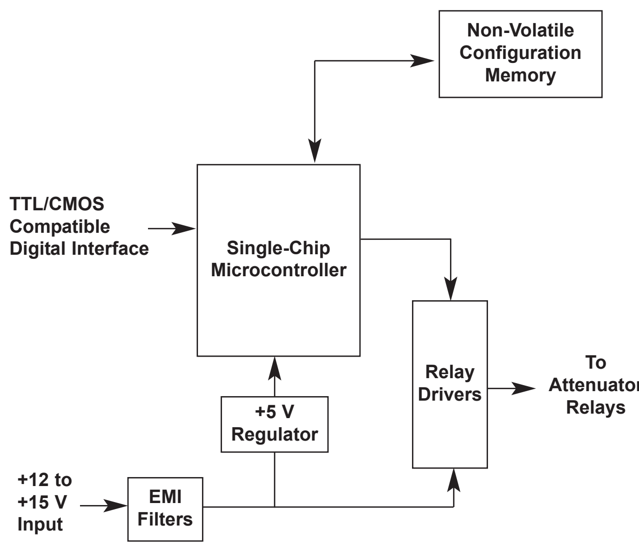


Figure 1. SmartStep Driver Circuitry

How can I control the SmartStep Attenuators?

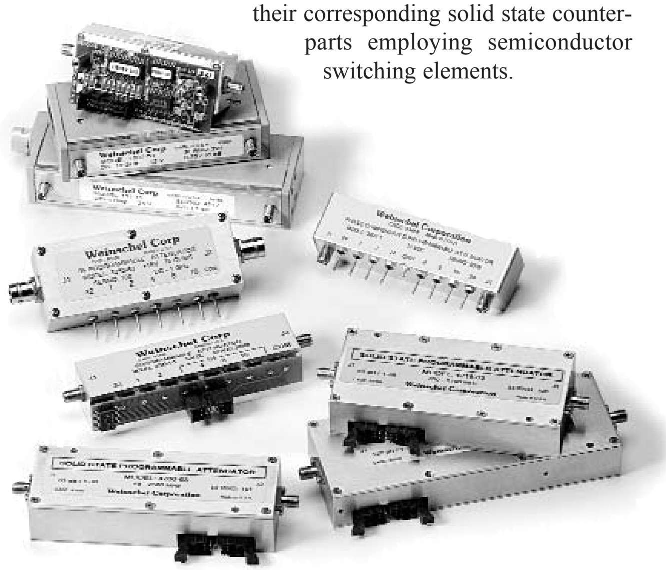
The communications interface (Model 8210A) provides a flexible, low cost solution for the operation of programmable step attenuators and other electromechanical devices under computer control. Designed to interface to Weinschel's new line of SmartStep™ programmable attenuators, the Model 8210A represents 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 SmartStep's serial Driver Interface Bus.

Intermodulation Distortion in Programmable Attenuators....

Weinschel Corporation 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:

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

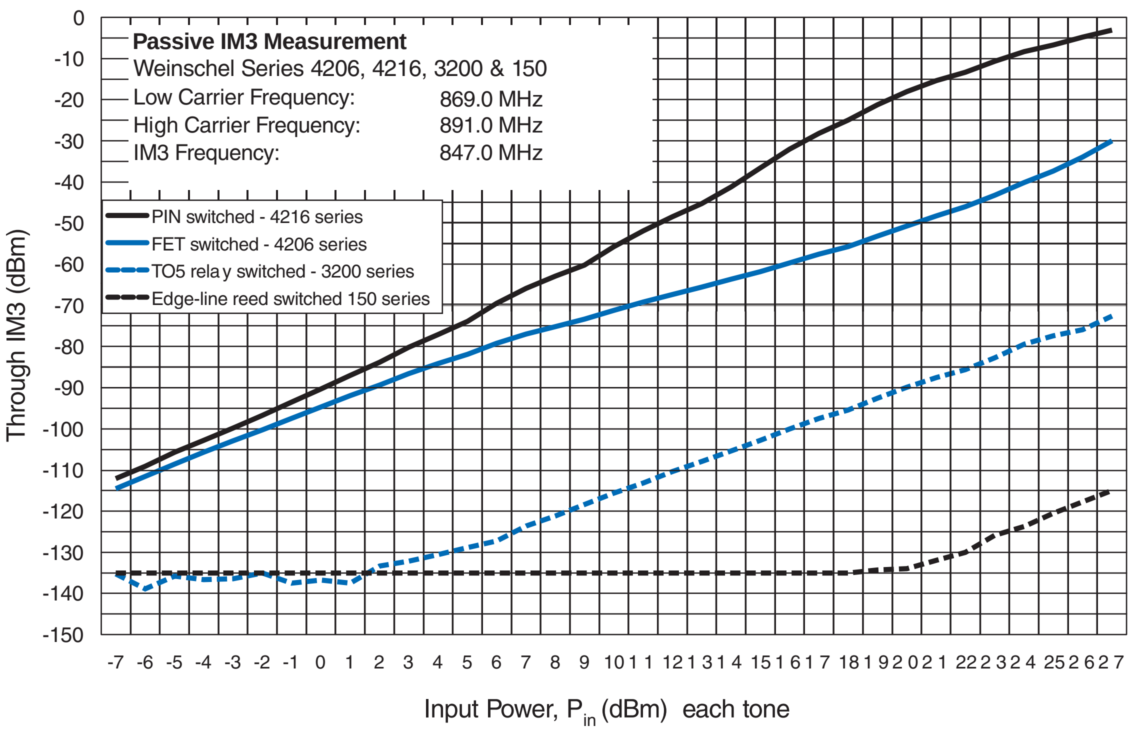
where α = zero insertion loss of each unit @ 847 MHz, the IM3 frequency. IM3 and Pin are selected from Table 1.

TABLE 1. SPECIFICATION COMPARISONS:

	Attenuator Type			
Parameter	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)	0.1-2.5	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.

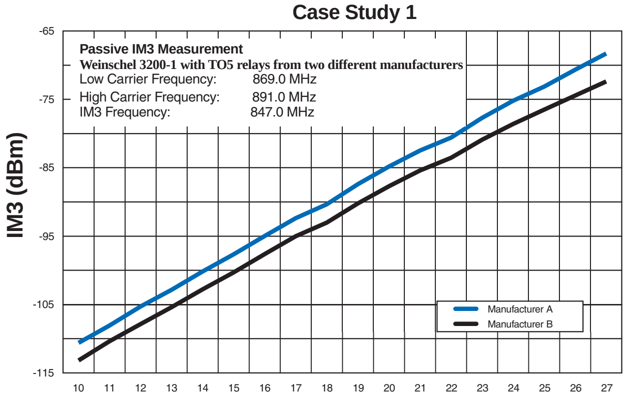
IM3 Performance of Electromechanical & Solid State Programmable Attenuators



Case Study 1

RDL, Inc. 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 RDL 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 corelation between our two tone IM3 measurement and RDL'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 +22dBm and higher. This corresponded to an acceptable output distortion level for the RDL generator.

Input Power vs. Through IM3 Level
Case Study 1

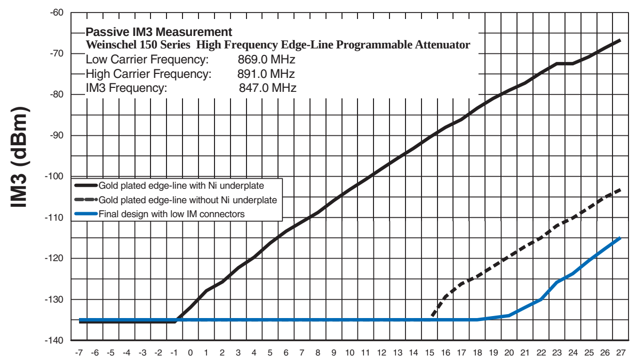


Input Power, P_{in} (dBm) each tone

Case Study 2

Matrix Test Equipment, Inc. 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 Matrix 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 Matrix 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



InputPower, P_{in} (dBm) each Tone

Conclusion

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

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

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Model 3200, 3201, 3205, 3206 & 3209 Programmable Attenuators

dc to 2.0/3.0 GHz
1 Watt

Wide Selection of Attenuation Ranges & Steps

Features

- **Widest Selection of Attenuation Ranges and Step Sizes**
- **High Quality Construction and 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 standard TO-5 type 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-X 3205-X 3206-X	3201-1E 3205-3E 3206-1E	3209-1	3209-1E
dc - 0.2	1.30	1.20	1.25	1.20	1.35	1.35
0.2 - 2	1.25	1.20	1.25	1.20	1.35	1.35
2 - 3	- - -	1.40	- - -	1.30	- - -	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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4/30/02

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	2.00	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

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

CALIBRATION: 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:

3200-X* - X

Basic Model Number

TTL Option (Add -1 or -2)
Example: 3200-1-1

*Refer to Cell Configuration table for available attenuation ranges and step sizes. Add E for 3 GHz designs, check table for available models.

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	101-1780	101-1798-000**
3200-2, 3200-2E	101-1780	101-1798-000**
3201-1, 3201-2E	101-1781	101-1798-001**
3201-2	101-1781	101-1798-001**
3205-1	101-1781	101-1798-001**
3205-2	101-1781	101-1798-001**
3205-3, 3205-3E	101-1781	101-1798-001**
3206-1, 3206-3E	101-1781	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

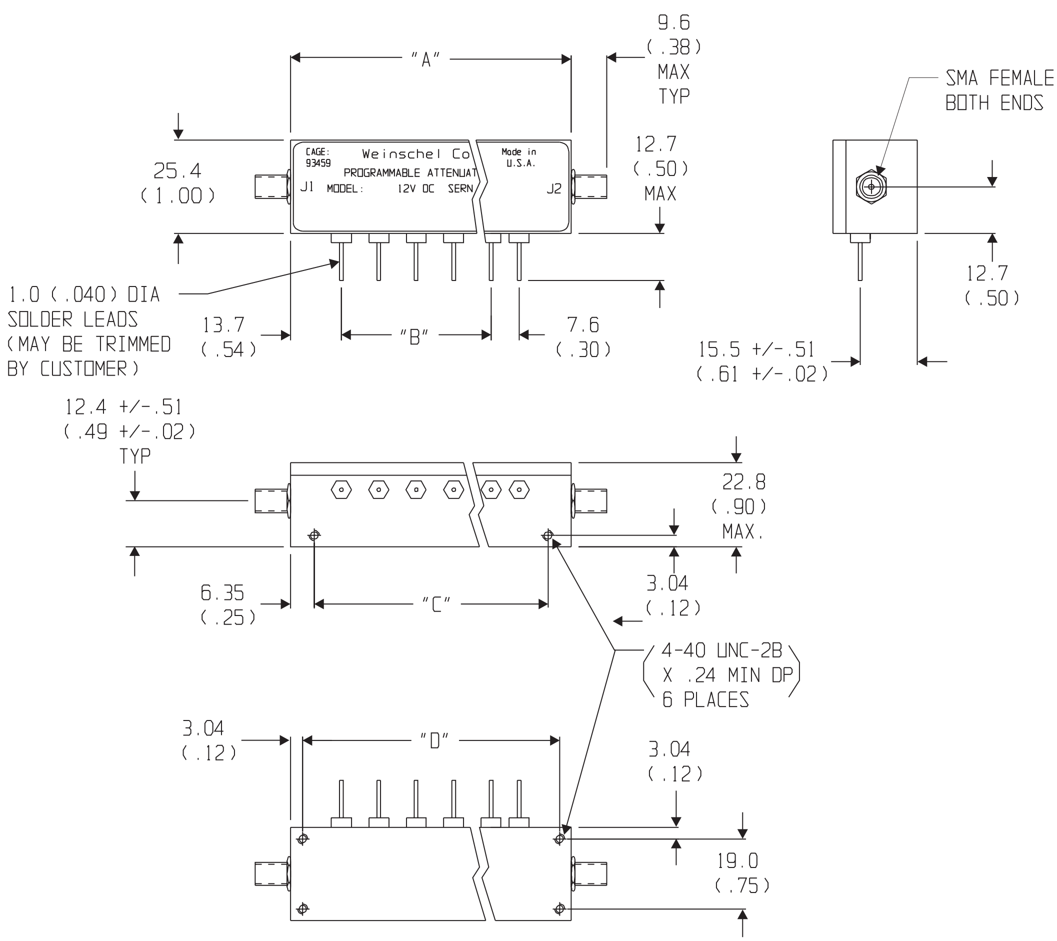
SUPPLY CURRENT (per cell continous): I_{CC}=25.0 mA maximum for 2 GHz models and 30 mA per cell for 3 GHz models.

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

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

NEW SMARTSTEP DRIVER MODELS: Most 3200s are available with a SmartStep interface\driver cards. These are designed to interface with our 8210A Series SmartStep Controllers which greatly simplifies computer control applications. Refer to Model 3200T and 3201T data sheet for more information.

PHYSICAL DIMENSIONS:



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

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

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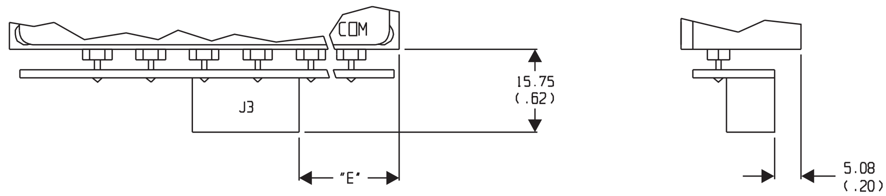
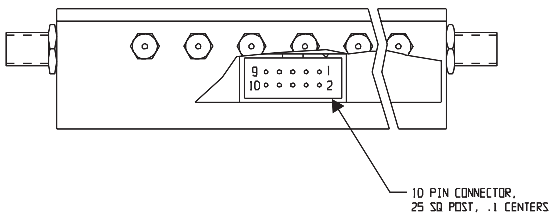
PHYSICAL DIMENSIONS:

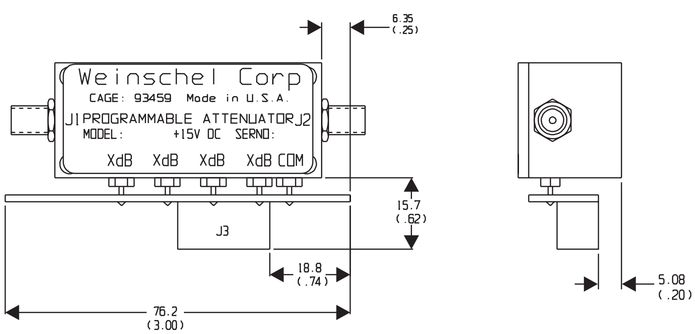
TTL OPTION -1 (3200, 3201, 3206):

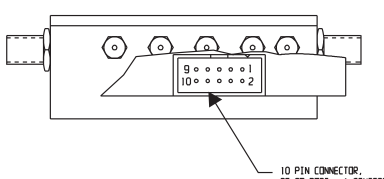




Model No.	E
3200-X-1	37.8 (1.49)
3201-X-1	18.8 (0.74)
3206-X-1	18.8 (0.74)

TTL OPTION -1 (3205):





Control Connector J3 Pin Locations:

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

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

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

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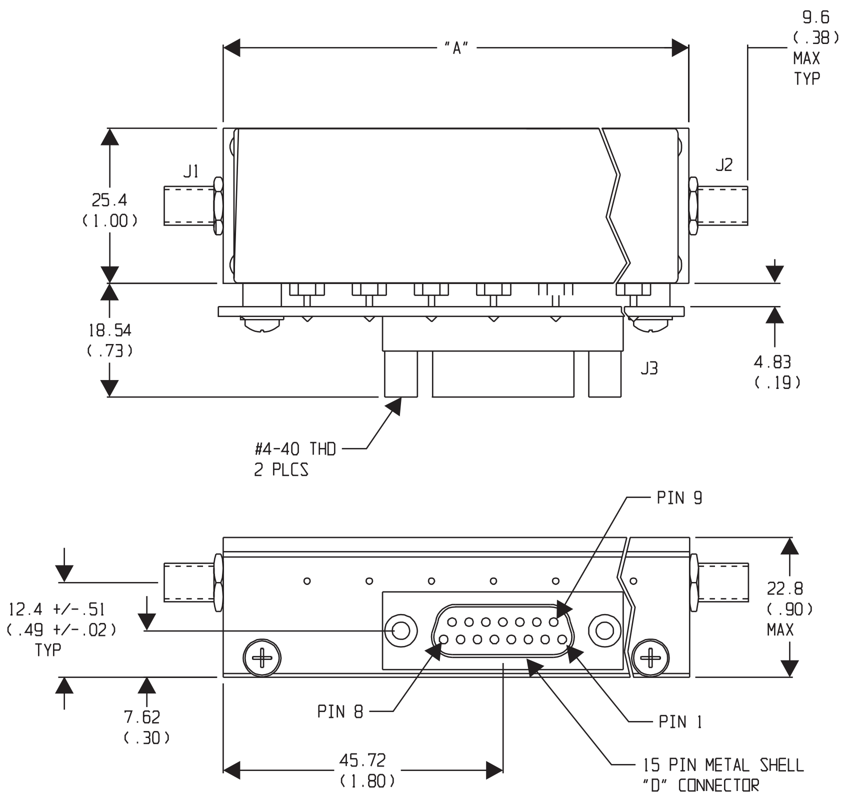
PHYSICAL DIMENSIONS:

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



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

Control Connector J3 Pin Locations:

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

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

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

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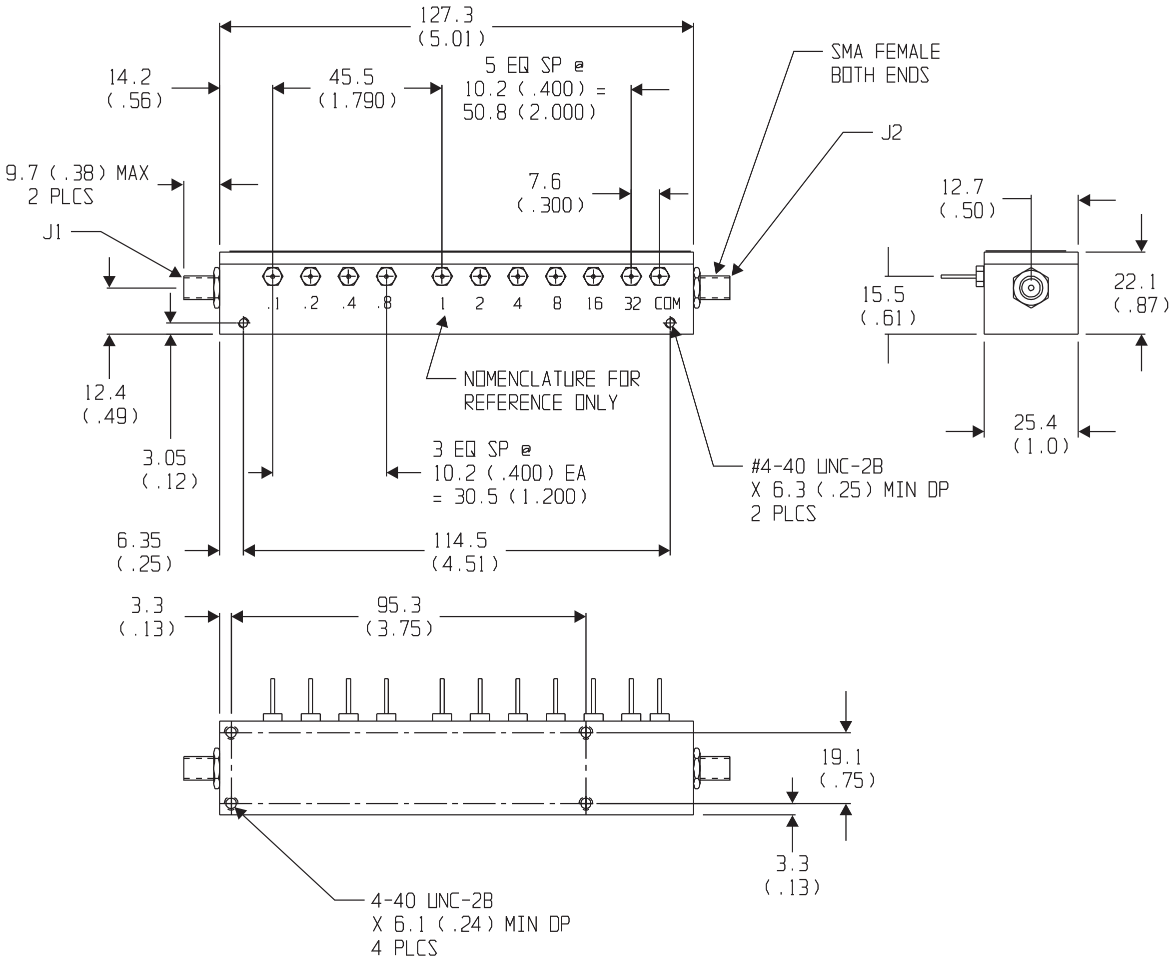
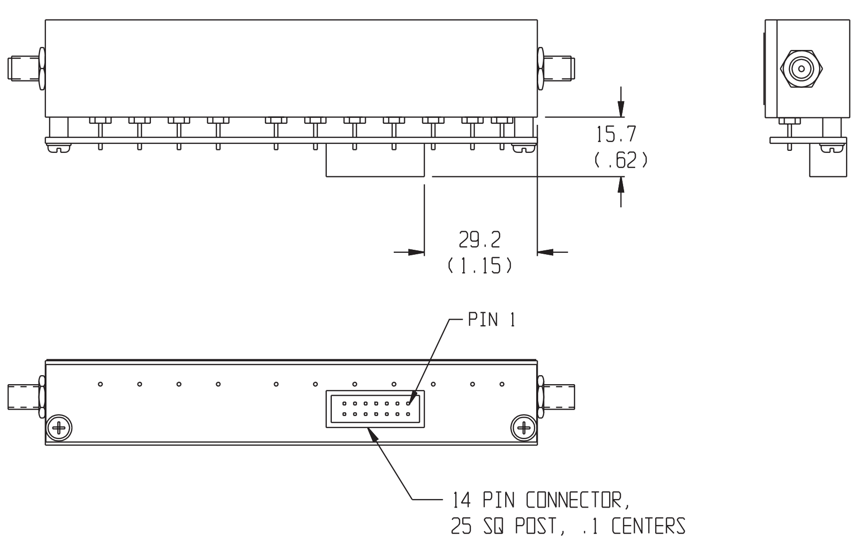
PHYSICAL DIMENSIONS:

Model 3209-1:



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



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

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

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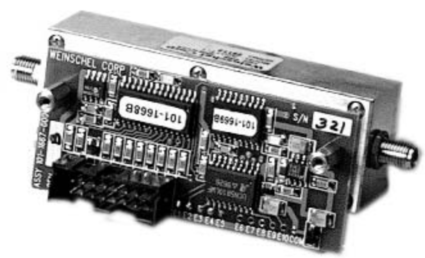
Model 3200T, 3201T, 3205T, 3206T, 3209T SmartStep™ Programmable Attenuators

dc to 2.0/3.0 GHz
1 Watt

Greatly Simplifies OEM & System Design!



Features

- **Widest Selection of Attenuation Ranges and Steps Sizes**
- **Built-In TTL\CMOS Interface\ SmartStep Driver Circuitry**
- **High Quality Construction and Connectors**
- **Special Configurations Available Upon Request**
  - Custom Cell/Step Size Configurations
  - 3.0 GHz and Higher Frequencies

Description

Weinschel Corporation *SmartStep™* 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 2 GHz frequency range. These models are available in many standard attenuation ranges and cell configurations. Each cell contains a standard TO-5 type 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	1.20	1.25	1.20	1.35	1.35
0.2 - 2	1.25	1.20	1.25	1.20	1.35	1.35
2 - 3	- - -	1.40	- - -	1.30	- - -	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/ I^2C 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 mA min, 400 mA max
V_{IN}	Supply Voltage:	+12.0 to +15.0V
I_{IN}	Supply current: (digital section)	25 µA
I_{CELL}	Supply current: (per cell) continuous	15 mA

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

CALIBRATION: 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

SmartStep Interface: The Model 8210A SmartStep Interface provides a flexible, low cost solution for the operation of programmable step attenuators and other electromechanical devices under computer control. Designed to interface to Weinschel's new line of SmartStep 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 SmartStep's serial Driver Interface Bus.

CONTROL CONFIGURATION:

The SmartStep 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 flexability over past designs. User-selectable modes of operation include both parallel and serial I^2C 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 I^2C 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 SmartStep contains non-volatile configuration memory that is used to hold a wide variety of attenuator and driver-dependant parameters, including serial number, attenuator cell dB values, relay configurations, and switching requirements, which are all accessable via the I^2C 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 SmartStep to operate from a single input supply voltage.

4/30/02
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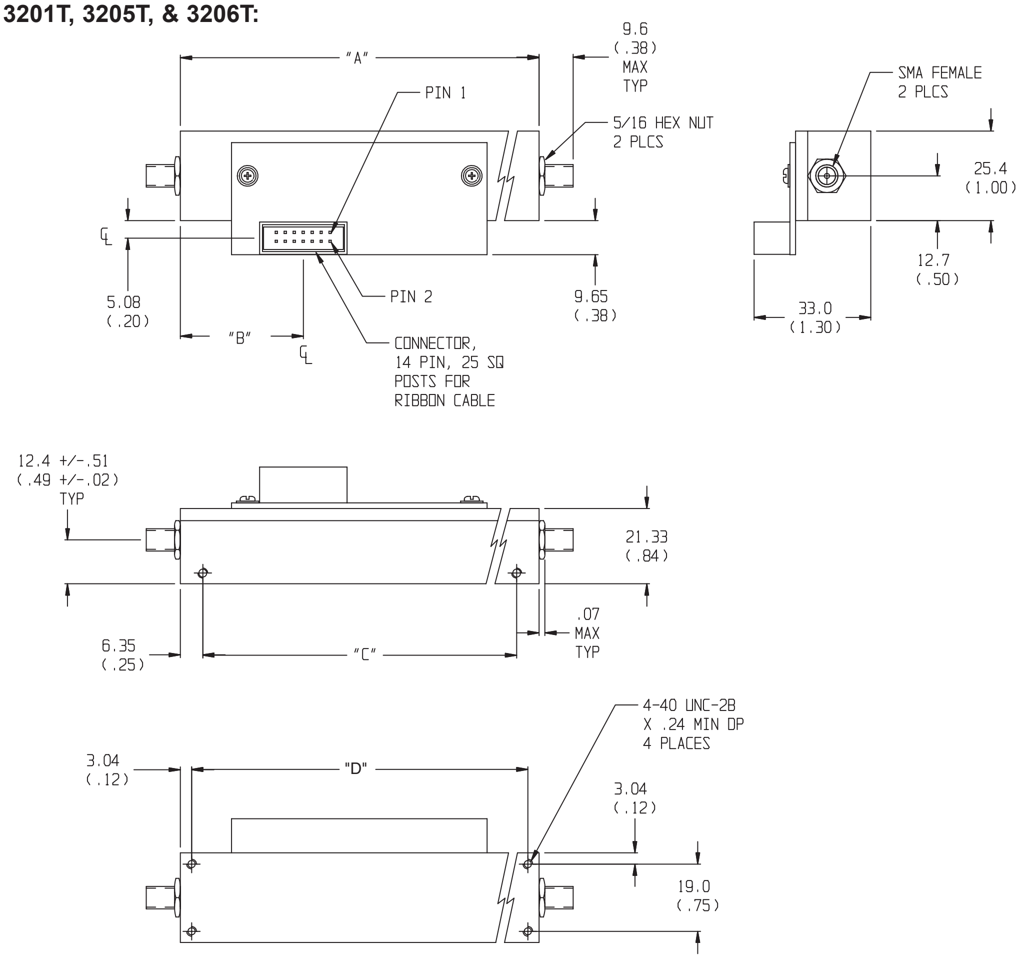
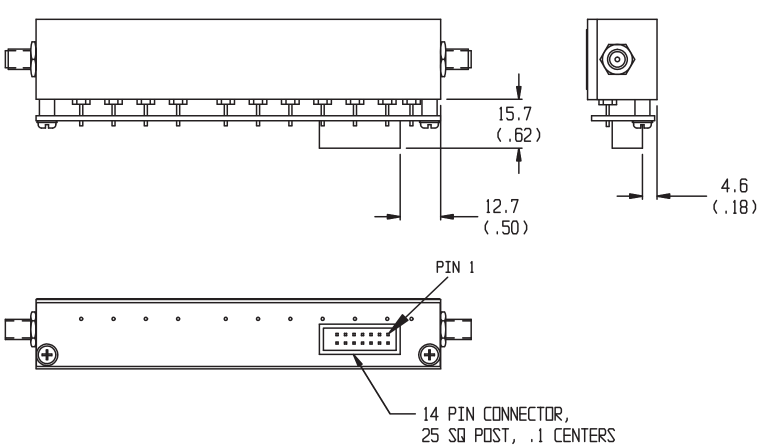
PHYSICAL DIMENSIONS:

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



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

Model 3209T:



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

SMARTSTEP SYSTEM ONLY
NO PARALLEL MODE OPERATION

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

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MCE WEINSCHEL

Model 3250 & 3250T RF Programmable Attenuators

dc to 1.0 GHz 1 Watt/75 Ω

Ideal for Wireless/Cellular Modem Applications.

Features

- **Cost Effective design for Wireless/Cellular Applications**
- **Optional TTL or SmartStep 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	1.20
0.5 - 1.0	1.30

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	4.75

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

SmartStep Interface: The Model 8210A SmartStep Interface provides a flexible, low cost solution for the operation of programmable step attenuators and other electromechanical devices under computer control. Designed to interface to Weinschel's new line of SmartStep 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 SmartStep'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 SmartStep driver Circuitry (Figure 1): The SmartStep 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 I^2C 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 I^2C 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 SmartStep contains non-volatile configuration memory that is used to hold a

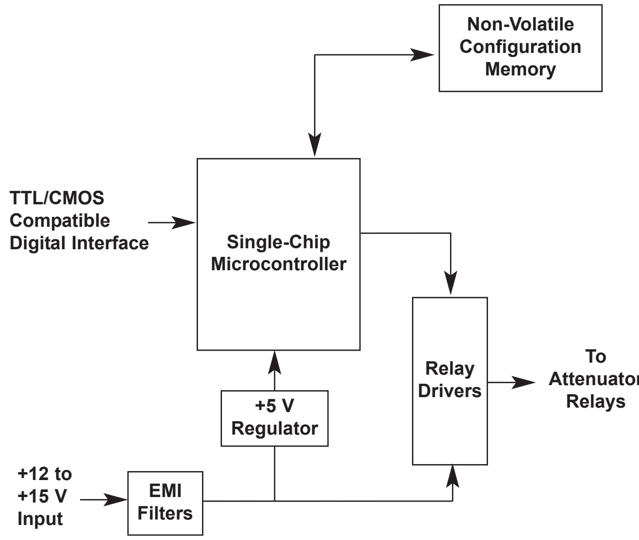

Figure 1. SmartStep Driver Circuitry

wide variety of attenuator and driver-dependant parameters, including serial number, attenuator cell dB values, relay configurations, and switching requirements, which are all accessable via the I^2C interface.

SmartStep 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
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)

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

Basic Model Number	Attenuation Value (dB)	TTL Option (Add -1) Example: 3250-63-1

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

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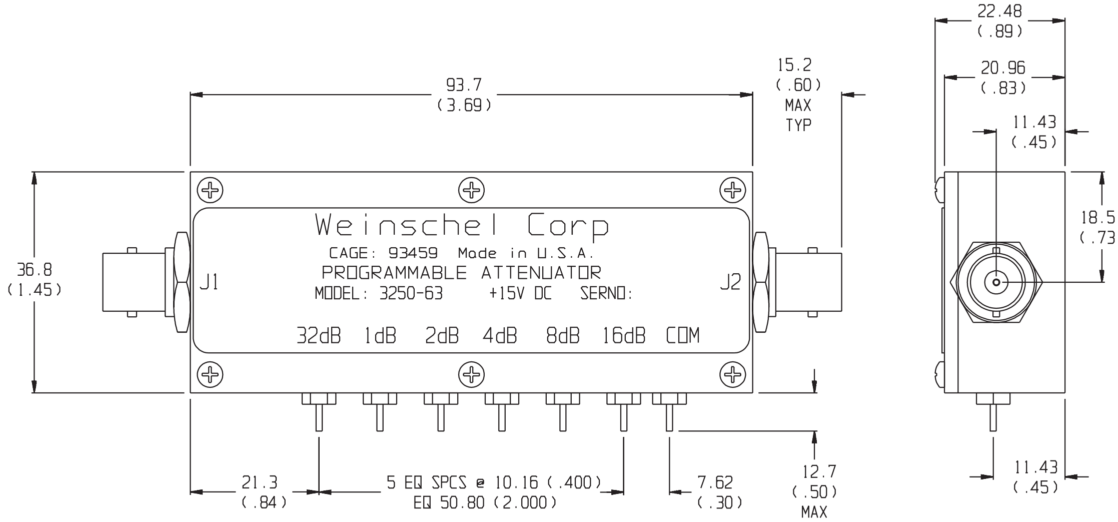
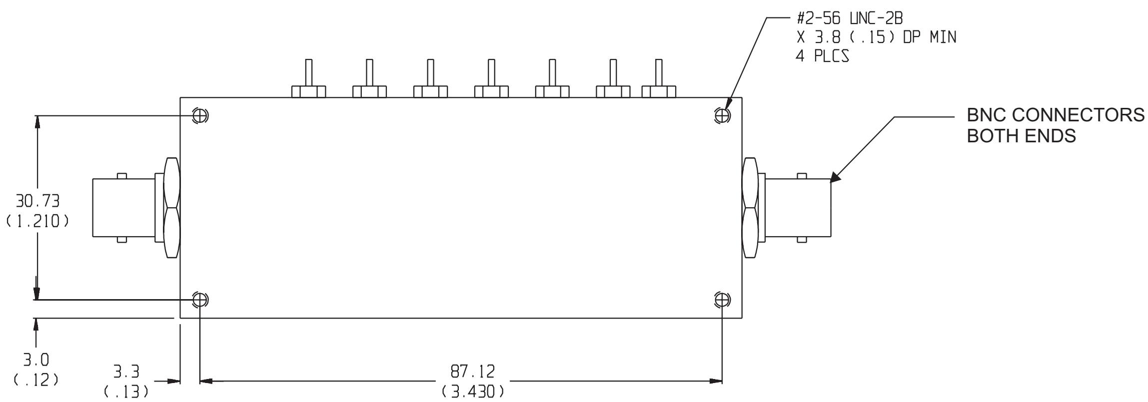
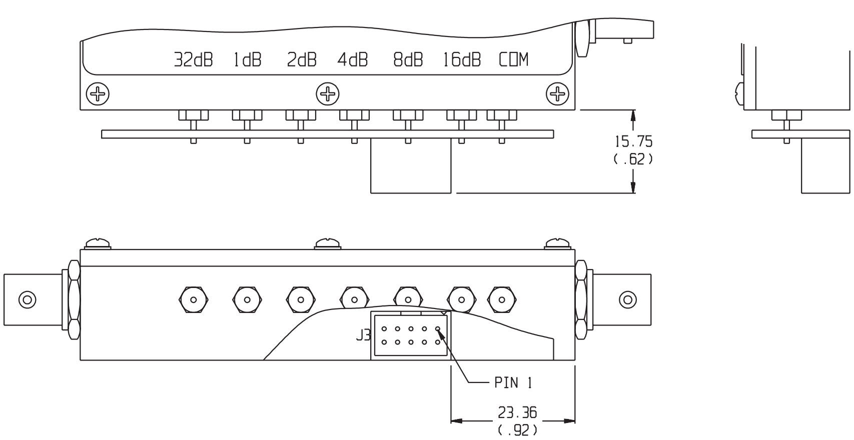
PHYSICAL DIMENSIONS:

Model 3250:





Model 3250 w/TTL Option -1:



Control Connector J3 Pin Locations:

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

NC = Not Connected

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

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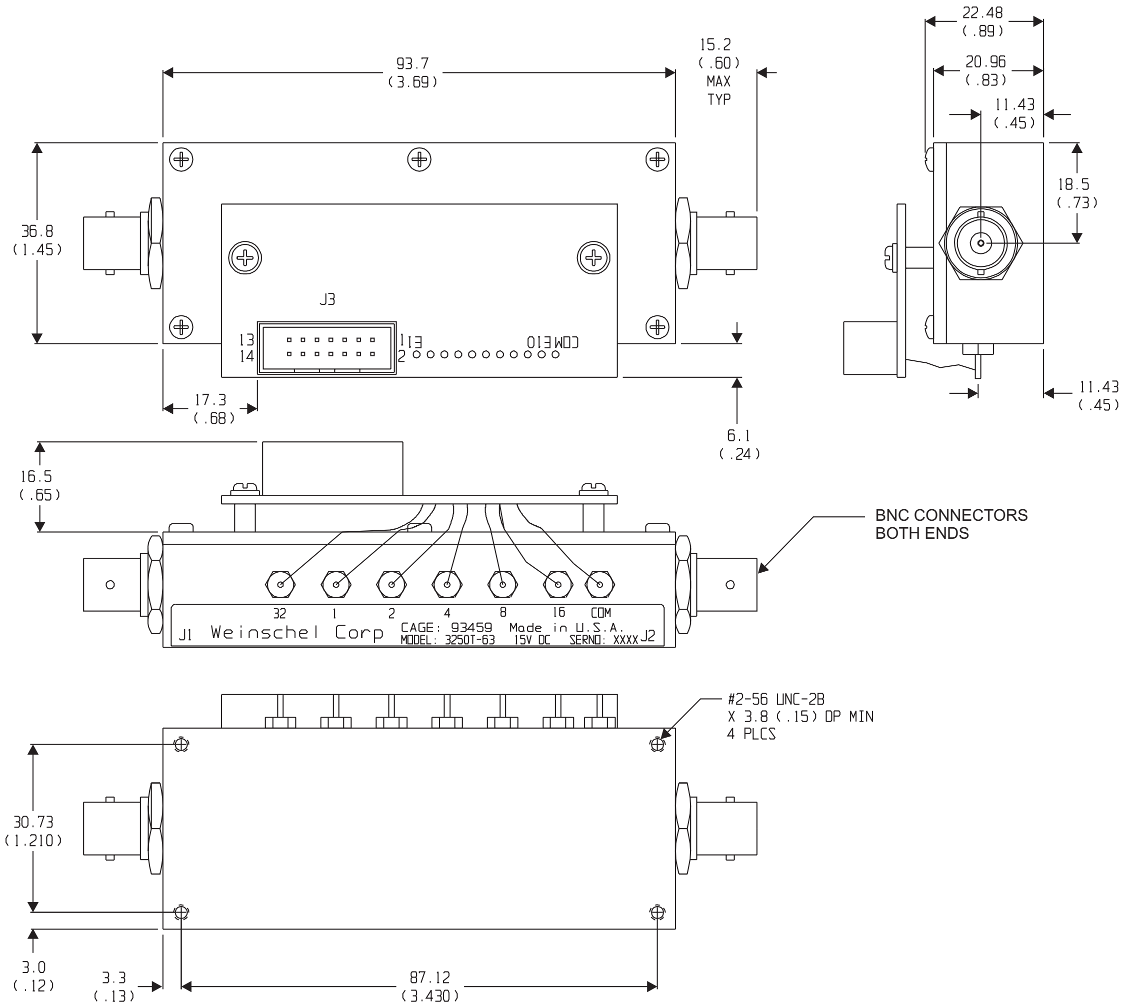
PHYSICAL DIMENSIONS:

Model 3250T:



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

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MCE WEINSCHEL

Model 4206 & 4208 High Power Solid-State Programmable Attenuators

10 MHz to 2.5 GHz *2 Watts

High IP3

Features

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

- **Broadband Performance -** 10 MHz to 2.5 GHz usable dc to 10 MHz with reducded 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 - 0.07	1.60
0.07 - 2.5	1.40

CELL CONFIGURATIONS:

Model Number	NO. Cells	Attenuation Range/Steps (dB)	Cell Increments (dB)
4208-63.75	8	63.75/0.25	0.25, 0.5, 1, 2, 4, 8, 16, 32
4206-63	6	63/1	1, 2,4, 8, 16, 32

INCREMENTAL ATTENUATION ACCURACY:

Frequency Range (GHz)	Accuracy
0.01 - 2.5	± 0.4 dB or 2.0%

INSERTION LOSS, Maximum (dB):

Frequency Range (GHz)	4208-63.75	4206-63
0.01 - 1.0	8.50	7.00
1.0 - 2.0	11.50	9.00
2.0 - 2.5	13.00	10.00

MONOTONICITY: 10 MHz to 2.5 GHz
3rd ORDER INTERMODULATION (IM3): -30 dBm typical, measured with two +27 dBm tones @ 869 MHz (f1) and 894 MHz (f2), the IM3 frequeny being 847 MHz (2fl-f2).

IP3 (input) = +53 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 (Undirectional):**

Model	J1	J2
4206-XX	4 Watts MAX IN (+36 dBm)	2 Watts MAX IN (+33 dBm)
4208-XX	2 Watts MAX IN (+33 dBm)	4 Watts MAX IN (+36 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: 4206-X 160 g (5.6 oz)
4208-X 220 g (7.7 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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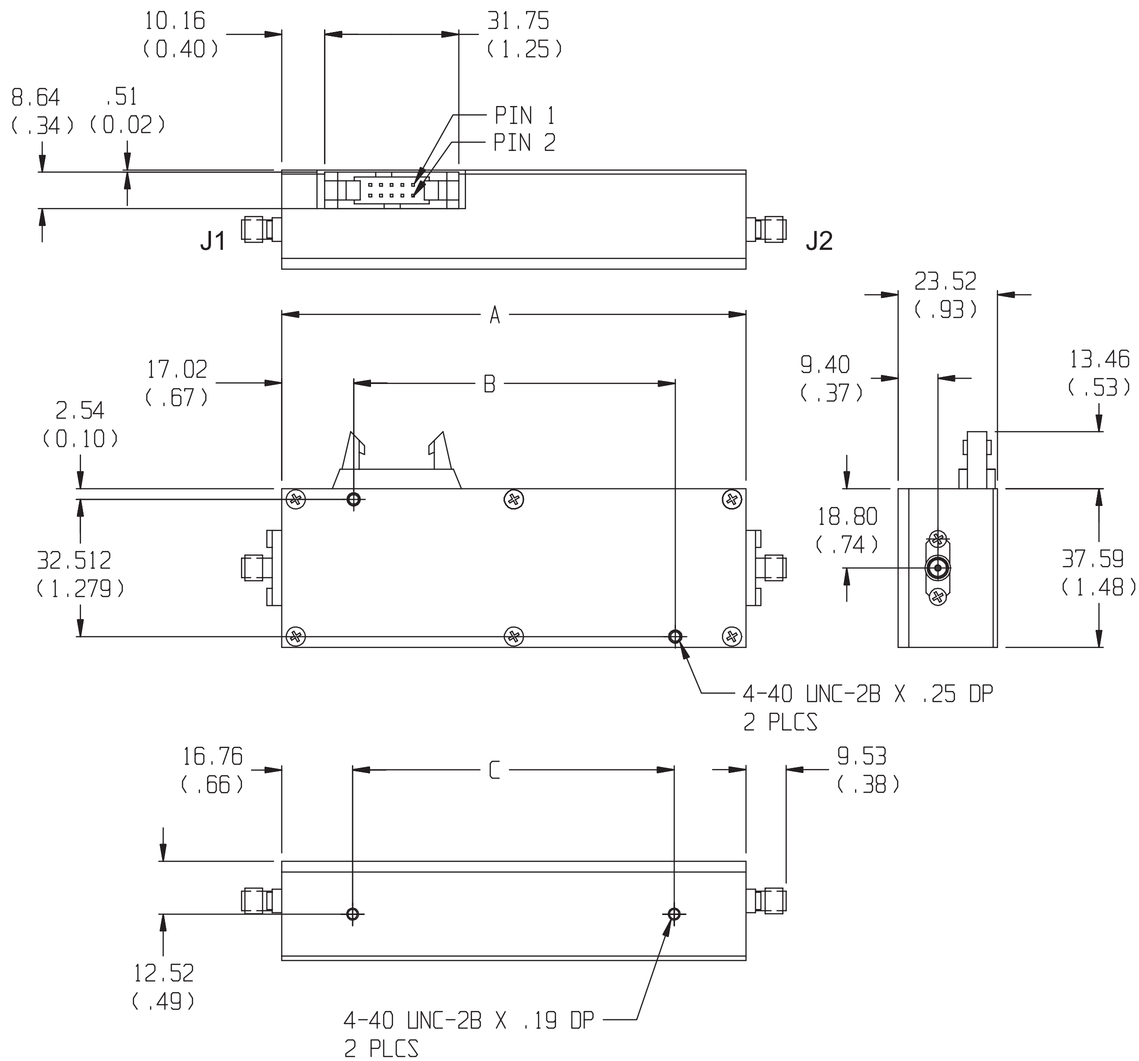
PHYSICAL DIMENSIONS:

Models 4206 & 4208:



Model No.	A	B	C
4206-X	09.0 (4.33)	96.5 (3.80)	76.2 (3.00)
4208-X	143.5 (5.65)	110.2 (4.34)	110.2 (4.34)

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

Control Connector J3 Pin Locations:

TTL Conn PIN No. (J3)	4206-63 dB (Cell)	4208-63.75 dB (Cell)
1	1	0.25
2	2	0.50
3	4	1
4	8	2
5	16	4
6	32	8
7	NC	16
8	NC	32
9	+5 to 15V	+5 to 15V
10	COM	COM

NC = Not Connected

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MCE WEINSCHEL

Model 4216 & 4218 Pin Switched Programmable Attenuators

0.8 to 2.3 GHz

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

(P) Preliminary design, specifications subject to change.

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 frequeny being 847 MHz (2f1-f2).

IP3 (input) = +41.5 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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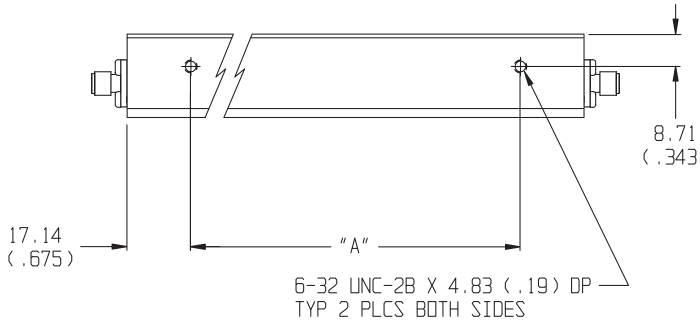
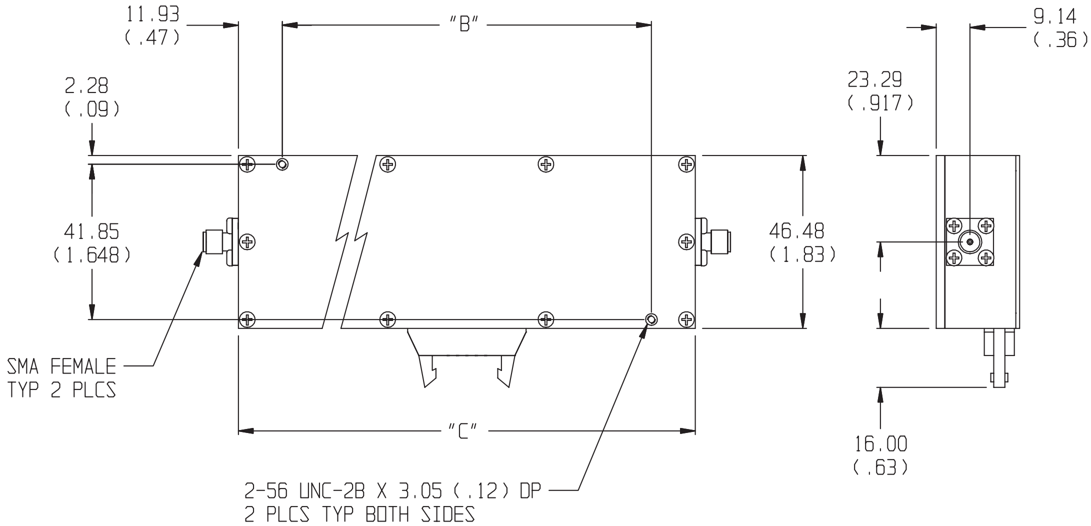
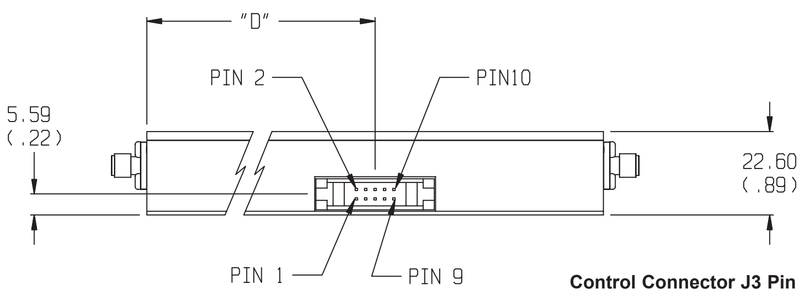
PHYSICAL DIMENSIONS:

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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MCE WEINSCHEL

Model 4238 GaAs Switched Programmable Attenuators

10 MHz to 2.5 GHz
1 Watt

Low Insertion Loss, High IP3

Features

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

- **Broadband Performance -** 10 MHz to 2.5 GHz usable dc to 10 MHz with reducded 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 - 0.20	1.60
0.20 - 2.5	1.40

CELL CONFIGURATIONS:

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

INCREMENTAL ATTENUATION ACCURACY:

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

INSERTION LOSS, Maximum (dB):

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

MONOTONICITY: 10 MHz to 2.5 GHz
3rd ORDER INTERMODULATION (IM3): -60 dBm typical, measured with two +27 dBm tones @ 869 MHz (f1) and 894 MHz (f2), the IM3 frequeny being 847 MHz (2fl-f2).

IP3 (input) = +65 dBm

The input IP3 is derived from the following relationship:

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

where 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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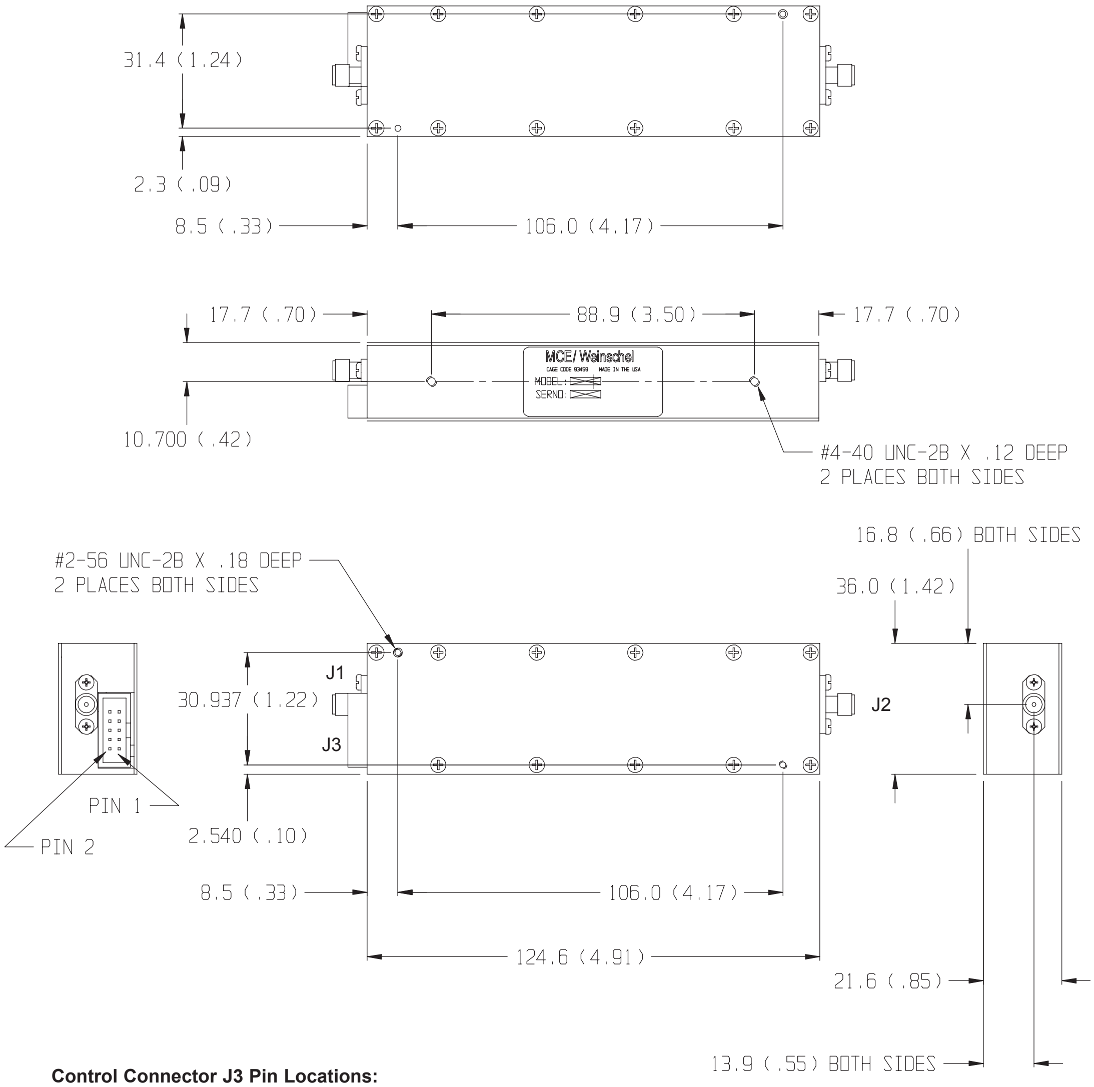
PHYSICAL DIMENSIONS:

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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Model 4226 & 4228
Pin Switched Programmable Attenuators

0.8 to 3.0 GHz

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 frequeny being 847 MHz (2f1-f2).

$$IP3\text{ (input)} = +41\text{ dBm}$$

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:
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 SPECFICATIONS:

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

Note: Inputs have 10K pull-up resistors.

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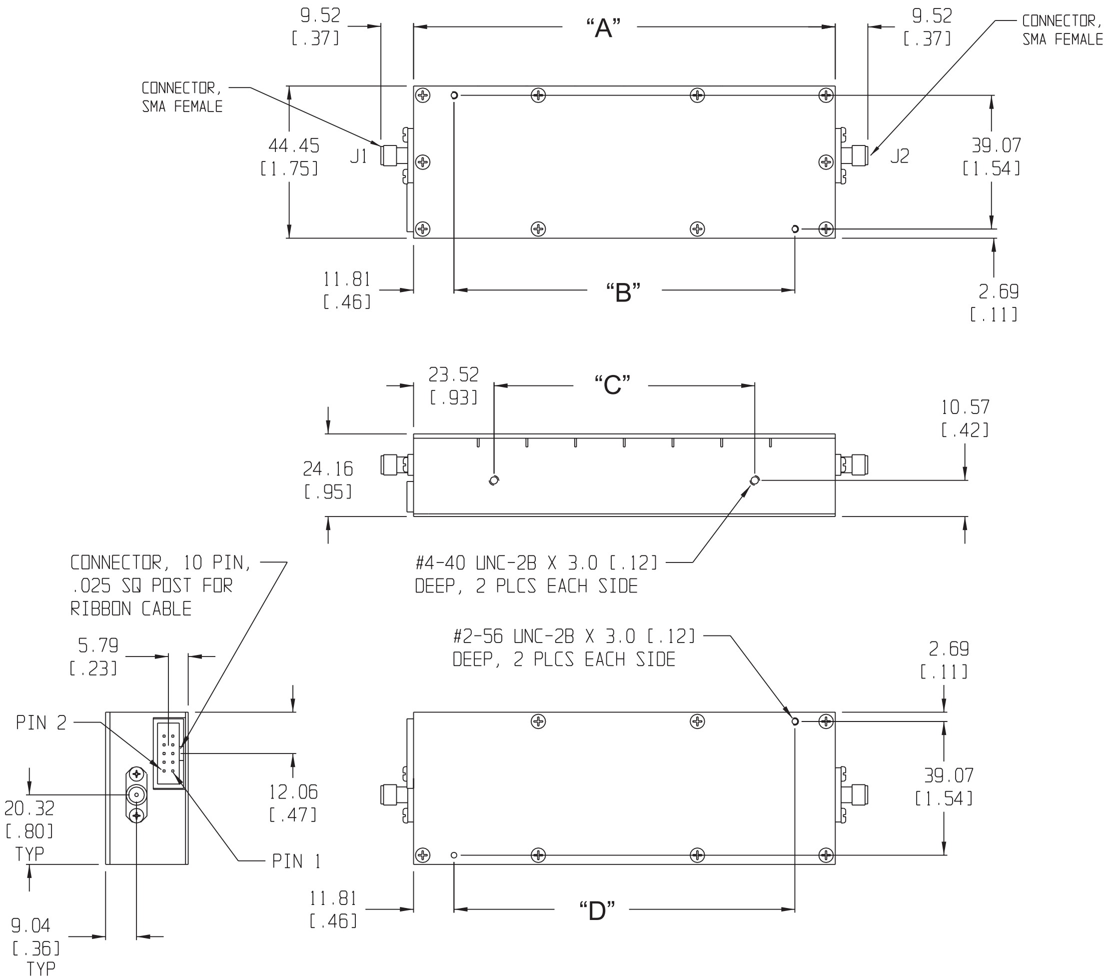
PHYSICAL DIMENSIONS:

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.

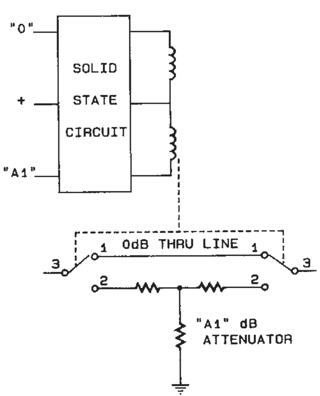
MCE WEINSCHEL

Model 150 — dc to 18.0 GHz
Model 151 — dc to 4.0 GHz
Model 152 — dc to 26.5 GHz
Programmable Step Attenuators

For OEM & System Use

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 of uses a reed switching structure that provides rapid switching together with low insertion loss. Other features include:



Figue 1. Cell Schematic

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

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

BROADBAND ACCURACY & LOW SWR: The use of Weinschel Corporation'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 Weinschel Corporation 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 Weinschel Corporation 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.weinschel.com/programmable.htm

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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
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	- - -	- - -
62 dB	5	0 dB	2 dB	0 dB	32 dB	0 dB	4 dB	0 dB	16 dB	0 dB	8 dB
70 dB	4	0 dB	10 dB	0 dB	20 dB	0 dB	20 dB	0 dB	20 dB	- - -	- - -
	3	0 dB	10 dB	0 dB	40 dB	0 dB	20 dB	- - -	- - -	- - -	- - -
75 dB	4	0 dB	5 dB	0 dB	40 dB	0 dB	20 dB	0 dB	10 dB	- - -	- - -
90 dB	4	0 dB	10 dB	0 dB	30 dB	0 dB	20 dB	0 dB	30 dB	- - -	- - -
110 dB	4	0 dB	10 dB	0 dB	40 dB	0 dB	20 dB	0 dB	40 dB	- - -	- - -
Conn PIN #	Round	5	6	9	10	7	8	11	12	3	4
	Ribbon	13	2	3	9	11	5	4	10	8	7
Wire Color	Round 3/4 Cell	Violet	Yellow	Orange	Blue	Black	Green	Brown	White	- - -	- - -
	Round 5 Cell	Black	White	Green	Orange	Blue	WHT/BLK	RED/BLK	GRN/BLK	ORN/BLK	BLU/BLK
	Ribbon	Orange	Yellow	Blue	Brown	Purple	Black	Gray	White	Orange	yellow

Table provides standard attenuation ranges, increments, and cell configurations for all Weinschel Corporation 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

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

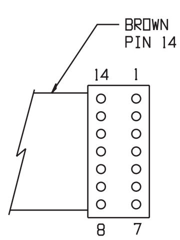
TEMPERATURE COEFFICIENT: < 0.0001 dB/dB/°C

POWER SENSITIVITY: < 0.001 dB/dB/ Watt

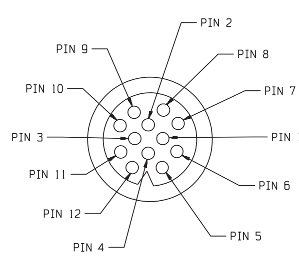
RATED SWITCH LIFE: 5 million cycles per cell

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 3' cable or 14 conductor 16" ribbon cable with connector (shown below):



Ribbon Cable Models



Round (Viking) Cable Models

SWITCHING SPEED: 20 msec (includes settling time)

CONTROL PULSE WIDTH: 20 msec (minimum)

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

REPEATABILITY: $\pm$0.01 typical to 18 GHz
$\pm$0.05 dB typical to 26.5 GHz

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

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

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

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

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

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

VOLTAGE/CONNECTOR OPTIONS:

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

MAXIMUM SWR (50 Ω Characteristic Impedance):

APPLICABLE MODELS	Frequency (GHz) dc-4	4-18	18-26.5
151-11, 151-15, 151-31, 151-62, 151-75, 151-110	1.50	- - -	- - -
150-11, 150-15, 150-31, 150-62, 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	1.80

MAXIMUM INSERTION LOSS (dB):

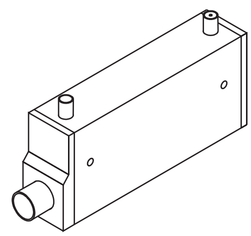
APPLICABLE MODELS	Frequency (GHz) dc-4	4-18	18-26.5
151-11, 151-15, 151-75, 151-110	0.90	- - -	- - -
150-11, 150-15, 150-75, 150-110	0.90	2.20	- - -
151-31, 151-62 (5 cell)	1.10	- - -	- - -
150-31, 150-62 (5 cell)	1.10	2.60*	- - -
151-70 (3 cell)	0.70	- - -	- - -
150-70 (3 cell)	0.70	1.60	- - -
152A-70 (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.

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

Model 150/151-62:

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

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

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

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

Model 152-55:

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

Model 152-70 & 152-90:

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

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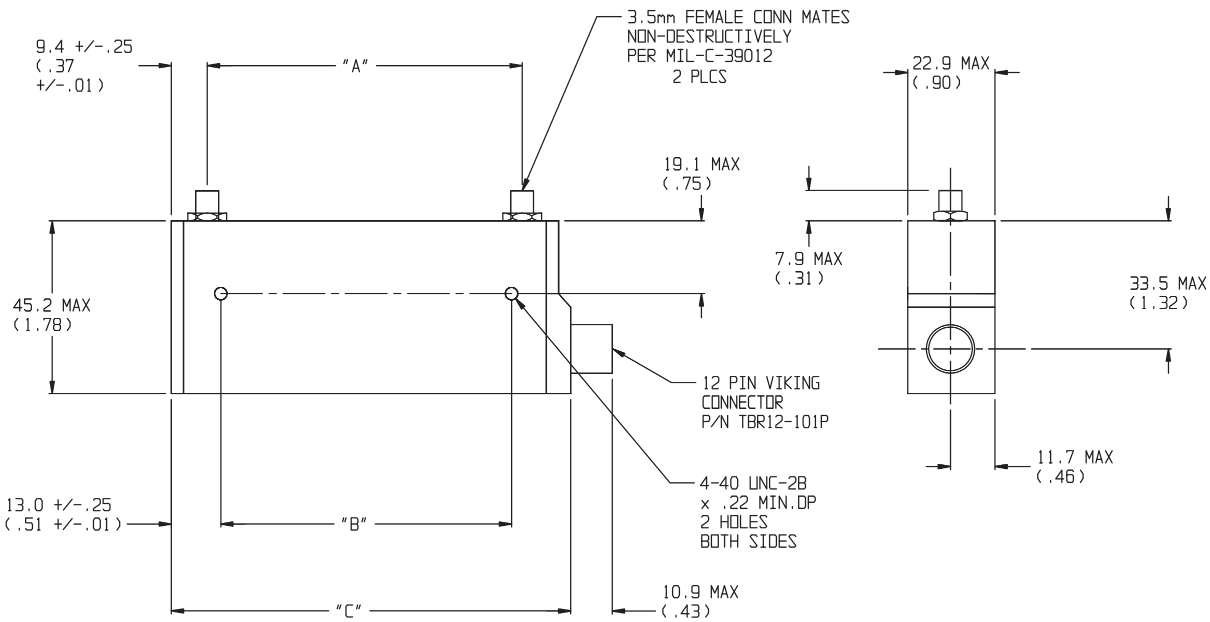
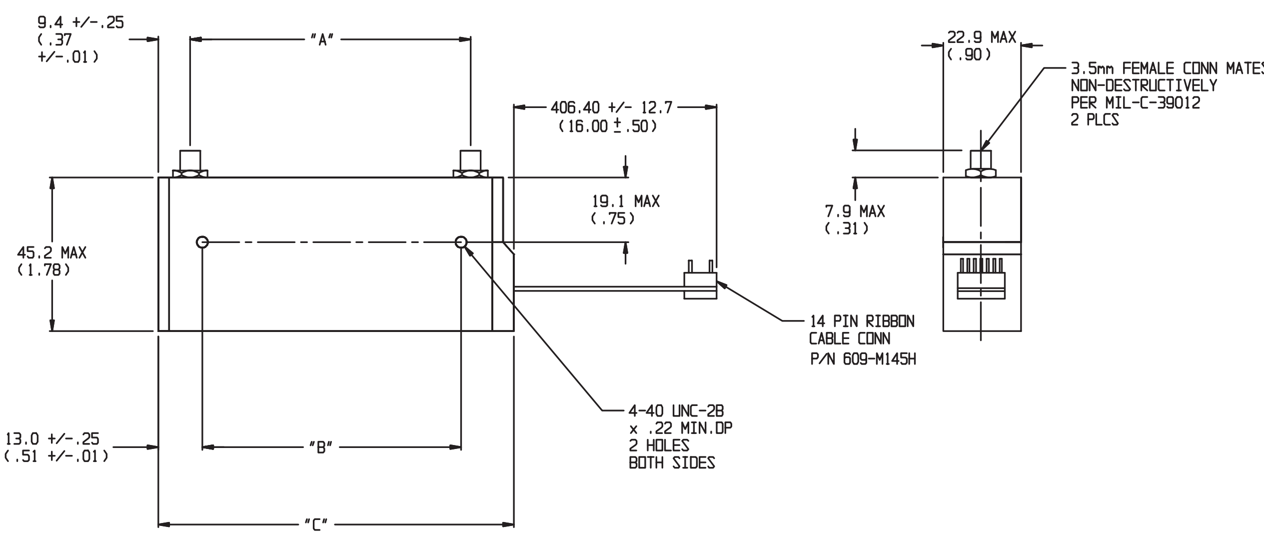
PHYSICAL DIMENSIONS:

Models 150, 151, & 152:





DIM	A	B	C
3 cell	82.6 (3.25)	76.2 (3.0)	104.6 (4.12)
4 cell	110.7 (4.36)	103.6 (4.06)	133.6 (5.25)
5 cell	136.9 (5.39)	129.8 (5.11)	159.5 (6.28)

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

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150 Series Ordering Guide...

Frequency Range/ Voltage/Connector	NO. Cells	Attenuator Range/Step Size								
		11/1 dB	15/1 dB	55/5 dB	31/1 dB	62/2 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	151-15	N/A	151-31	151-62	151-70	151-75	N/A	151-110
dc-18 GHz/+24 V/ Viking Connector	4 3 5	150-11	150-15	N/A	150-31	150-62	150-70	150-75	N/A	150-110
dc-26.5 GHz/+24 V/ Viking Connector	4 3	N/A	N/A	152-55		NA	152-70 152A-70-2	N/A	152-90	N/A
dc-4 GHz/+24 V/ Ribbon Cable	4 3 5	151-11-1	151-15-1	N/A	151-31-1	151-62-1	151-75-1 151-70-1	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	150-62-1	150-70-1	150-75-1	N/A	150-110-1
dc-26.5 GHz/+24 V/ Ribbon Cable	4 3	152-11-1	152-15-1	152-55-1	N/A	N/A	152-70-1 152A-70-1	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	151-70-2	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	N/A	N/A	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	152-70-2 152A-70-2	N/A	152-90-2	N/A
dc-4 GHz/+5 V/ Ribbon Cable	4 3 5	151-11-3	151-15-3	N/A	N/A	N/A	151-75-3 151-70-3	N/A	151-110-3	
dc-18 GHz/+5 V/ Ribbon Cable	4 3 5	150-11-3	150-15-3	N/A	N/A	N/A	150-70-3	150-75-1	N/A	150-110-3
dc-26.5 GHz/+5 V/ Ribbon Cable	4 3	N/A	N/A	N/A	N/A	N/A	152-70-3 152A-70-3	N/A	152-90-3	N/A

ACCESSORIES

OPTIONAL CALIBRATION DATA: Calibration Data is available at an additional cost for all programmable step attenuator models. This calibration data is generated using a computer controlled Weinschel Attenuation Measurement System. Standard calibration data can be provided in 250 MHz steps for all dc-4 GHz models and in 500 MHz steps for dc-18 and dc-26.5 GHz models. The measurements are traceable to NIST Standards.

MODELS WITH BUILT-IN TTL/CMOS INTERFACE\ DRIVER CIRCUIT: Weinschel Corporation now offers new versions of the 150 series with built-in TTL/CMOS interfaces. This new 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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Model 150T
Model 151T
Model 152T
SmartStep™ Programmable Attenuators

dc to 18.0 GHz
dc to 4.0 GHz
dc to 26.5 GHz

Greatly Simplifies OEM & System Design!

Description

Weinschel Corporation introduces a new generation 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. 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.

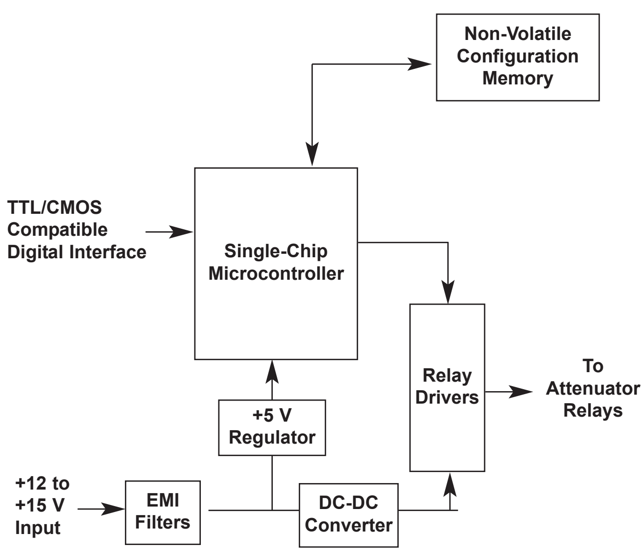

Figure 1. SmartStep Driver Circuitry

BUILT-IN SMARTSTEP DRIVER CIRCUITRY: These SmartStep 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 I^2C 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 I^2C 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 SmartStep contains non-volatile configuration memory that is used to hold a wide variety of attenuator and driver-dependant parameters, including serial number, attenuator cell dB values, relay configurations, and switching requirements, which are all accessable via the I^2C 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 SmartStep 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.weinschel.com/programmable.htm

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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	8	10	32	20	40	40	30	40
3	2	2	2	20	16	20	20	20	20	20
4	4	4	16	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/ I^2C 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

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 SPEED: 20 msec (includes settling time)

CONTROL PULSE WIDTH: 20 msec (minimum)

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

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

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

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

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

MAXIMUM SWR (50 Ω Characteristic Impedance):

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

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	- - -	- - -
151T-70 (3 cell)	0.70	1.60	- - -
152AT-70 (3 cell)	0.90	2.00	2.98
152T-55, 152T-70, 152T-90	0.90	2.00	2.98

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

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

ACCESSORIES

SmartStep* Interface:** The Model 8210A ***SmartStep Interface provides a flexible, low cost solution for the operation of programmable step attenuators and other electromechanical devices under computer control. Designed to interface to Weinschel's new line of **SmartStep** 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 ***SmartStep***'s serial Driver Interface Bus.

OPTIONAL CALIBRATION DATA: Calibration Data is available at an additional cost for all programmable step attenuator models. This calibration data is generated using a computer controlled Weinschel Attenuation Measurement System. Standard calibration data can be provided in 250 MHz steps for all dc-4 GHz models and in 500 MHz steps for dc-18 and dc-26.5 GHz models. The measurements are traceable to NIST Standards.

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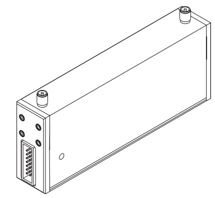
ATTENUATION ACCURACY (+dB with respect to 0 dB reference):



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.

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

Model 150T/151T-62:

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

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

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

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

Model 152T-55:

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

Model 152T-70, 152T-90:

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

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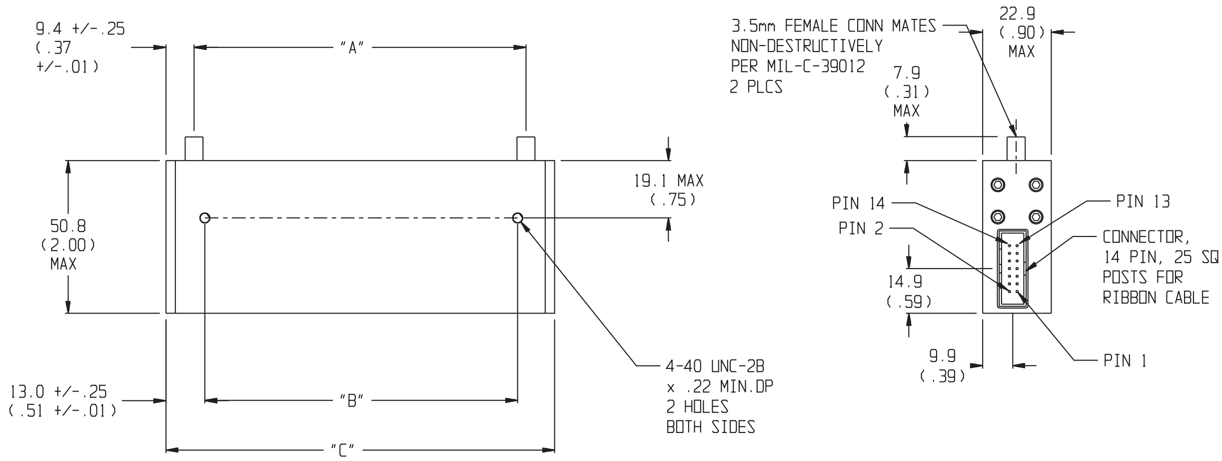
PHYSICAL DIMENSIONS:

Models 150T, 151T, & 152T:



DIM	A	B	C
3 cell	83.0 (3.27)	76.2 (3.0)	101.6 (4.00)
4 cell	110.7 (4.36)	103.6 (4.06)	129.2 (5.09)
5 cell	136.9 (5.39)	129.8 (5.11)	156.2 (6.15)

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

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