

INSTALLATION & OPERATING INSTRUCTIONS

Models 150T, 151T, & 152T SmartStep™ Programmable Attenuators



This documentation may not be reproduced in any form, for any purpose unless authorized in writing by Aeroflex / Weinschel, Inc.



© **Aeroflex / Weinschel, Inc.**
Frederick, Maryland
1997, 2001, 2004

GENERAL

This manual provides general installation instructions and wiring data to be used as an aid in installing the Aeroflex / Weinschel Model 150T, 151T and 152T Series SmartStep™ Programmable Attenuators into any sub-system or application. Also included are specifications and other technical data to help in the installation and operation of your 150T Series Programmable Attenuator.



Each attenuator consists of a cascaded assembly of switched attenuator cells (Figure 1) 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.

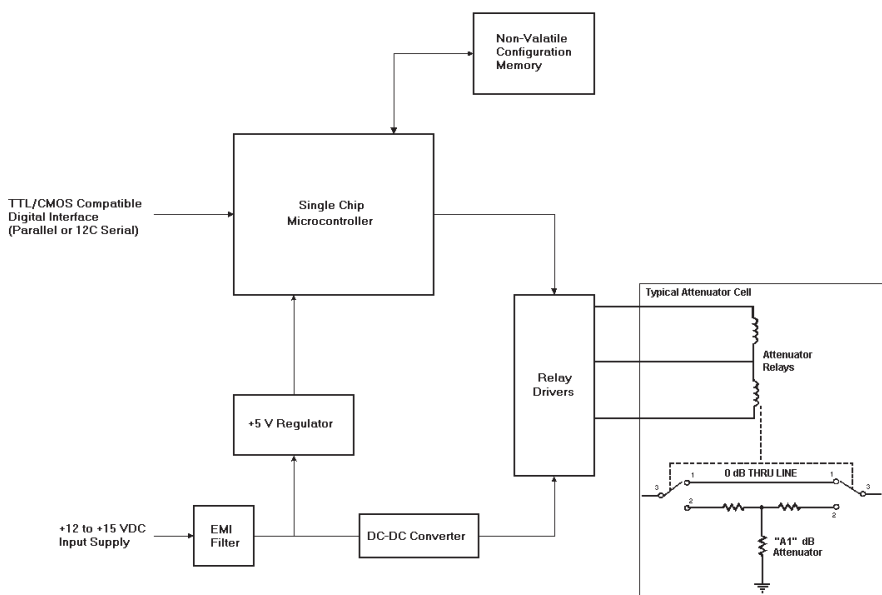


Figure 1. SmartStep Driver Circuitry

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 I²C 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 I²C 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 I²C 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.

CELL CONFIGURATION

The table below list all the standard attenuation ranges and cell configurations for Weinschel 150T Series Smartstep Programmable Attenuators (Models 150T, 151T, 152T). Note the dash number is the attenuation value of your attenuator.

Model No.	Cell No.	Range/ Step Size	Data Bit-Cell Value (dB)							
			D7	D6	D5	D4	D3	D2	D1	D0
15XT-11	4	0-11/1					4	2	4	1
15XT-15	4	0-15/1					4	2	8	1
15XT-31	5	0-31/1				4	16	2	8	1
15XT-55	4	0-55/5					20	20	10	5
15XT-62	5	0-62/2				8	16	4	32	2
15XT-70*	3	0-70/10						20	40	10
152T-70	4	0-70/10					20	20	20	20
15XT-75	4	0-75/5					10	20	40	5
15XT-90	4	0-90/10					30	20	30	10
15XT-110	4	0-110/10					40	20	40	10

* Model 152AT-70 also!

INSTALLATION

MOUNTING: Each Programmable Step Attenuator is supplied with two mounting screws (P/N MS35335-57). These screws will fit any of the mounting holes (4-40 UNC-2B x 0.22 MIN DP) located on either side of the attenuator.

RF CABLE INSTALLATION: Care should be taken to prevent strain on the inter-connecting cables, since damage here may not always be apparent. Check the attaching RF cables and the SMA connectors for signs of cracked insulation and/or bent or worn pins prior to connection. Tests show that connectors must be clean for accuracy and stability. This requires an inspection and cleaning of each connector immediately before use. When cleaning precautions are observed regularly, connectors can maintain their stability for over several thousand connection cycles. Weinschel recommends a torque value of 7 to 10 inch pounds when connecting any RF cable to the attenuator's RF connectors.

DEVICE INTERFACE BUS (DIB) CONNECTOR WIRING: Figure 2 shows the connectors contact pin numbering scheme and the signal designator for signal present at each contact pin.

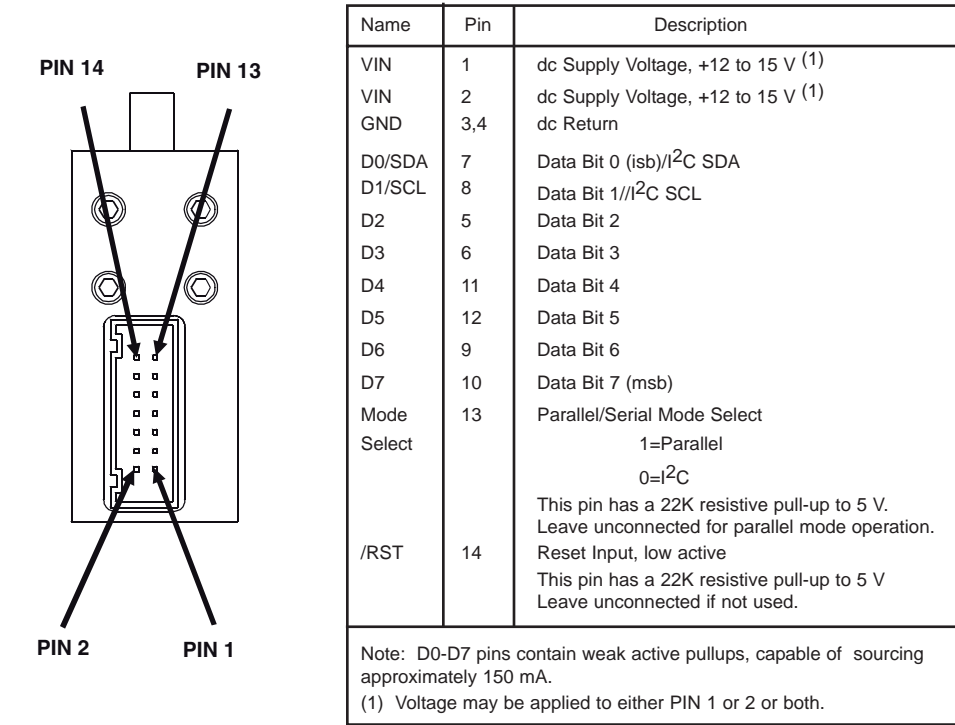


Figure 2. DIB Connector Wiring

PARALLEL MODE OPERATION:

In the parallel mode of operation, the Smartstep attenuator accepts TTL-level parallel data on the D0-D7 input data lines. Each data line controls a separate attenuation cell, where a logic 1 input (TTL high) engages the attenuation cell, and a logic 0 input (TTL low) bypasses the cell, providing a through path. The data lines have a weak active pull-up to +5V, and therefore if the pin is left unconnected (or floating), will engage the attenuation cell. The on-board microcontroller debounces the data lines and generates the proper timing and control sequence for operation of the relays. The data line inputs are not latched, and must be driven with a constant level to keep the desired attenuation setting.

I²C MODE OPERATION:

In the I²C serial mode of operation, the Smartstep attenuator communicates over a two-wire serial bus to the Weinschel Model 8210 Smartstep Interface. The bus uses a clock (SCL) and data (SDA) line to send and receive programming and configuration information. The messages sent over the bus use the software protocol as defined in the ACCESS.bus™ V2.2 specification (Base Protocol) with Weinschel-specific extensions to support the control of step attenuators (StepAttn Protocol). These protocols and operating instructions can be located in the Model 8210 instruction manual (IM-288). The ACCESS.bus™ messages have the following format:

Byte#	D7	D6	D5	D4	D3	D2	D1	D0	Description
1	D7	D6	D5	D4	D3	D2	D1	0	Destination address
2	S7	S6	S5	S4	S3	S2	S1	0	Source address
3	P	L6	L5	L4	L3	L2	L1	L0	Protocol flag & Msg Length
4									msg body- 0 to 127 bytes
Length+4	X7	X6	X5	X4	X3	X2	X1	X0	Checksum

For an indepth discussion of the hardware and software operation, refer to the ACCESS.bus™ specification.

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

DRIVER INTERFACE:

Input Supply Voltage: +12.0 to +15.0V
Control Signals: TTL/CMOS compatible
Interface Modes: parallel/ I²C serial

DC Characteristics (at 25 °C):

Digital Interface:

<u>Parameter</u>	<u>Specification</u>
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 μ A min, 400 μ A 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:** \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).

MAXIMUM SWR (50 Ω Characteristic Impedance):

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

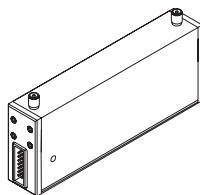
MAXIMUM INSERTION LOSS (dB):

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-62 (5 cell)	1.10	----	----
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-11, 152T-15, 152T-55, 152T-70, 152T-90	0.90	2.00	2.98

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

Specification (con't):

ATTENUATION ACCURACY (dB with respect to 0 dB):



Model 150T/151T-11/152T-11 & 150T/151T-15/152T-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 155T-11:

Frequency Range GHz	Attenuation Setting (dB)										
	1	2	3	4	5	6	7	8	9	10	11
dc-3	0.2	0.2	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.5
3-8	0.3	0.3	0.4	0.4	0.5	0.5	0.6	0.6	0.6	0.6	0.7

Model 150T/151T-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	0.6	0.9	0.9	1.2	1.2	1.5	1.5	1.8	1.8	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-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
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
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
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

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

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	---	---	---	---

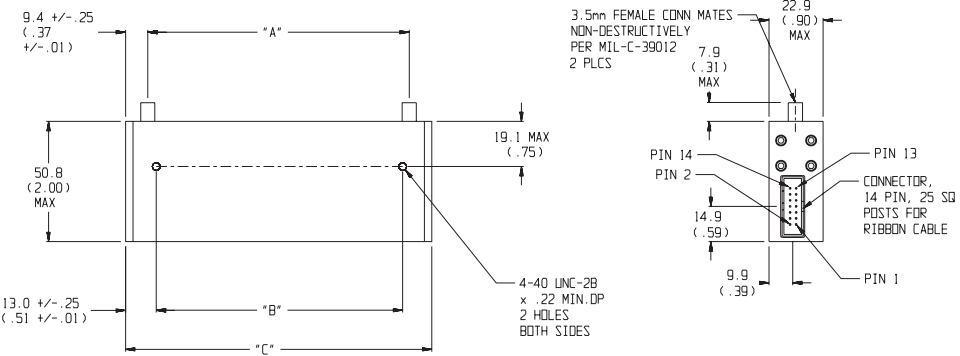
Model 152T-55:

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 152T-70 & 152T-0:

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

PHYSICAL DIMENSIONS:



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.

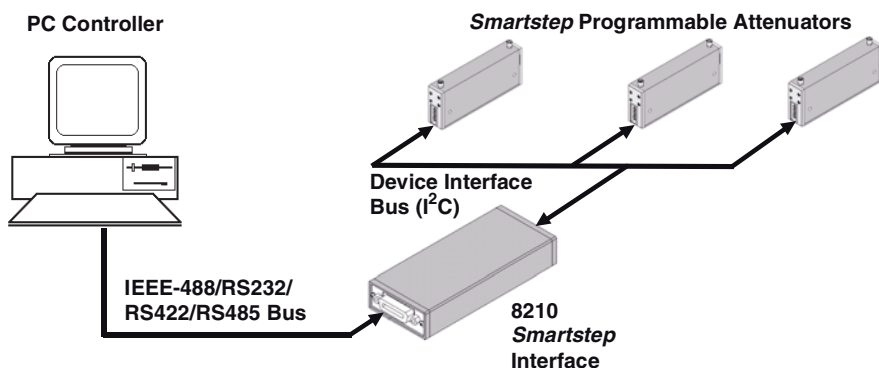
CONTACTING Aeroflex / Weinschel

In the event you're having difficulty or believe that the components are defective, please contact Weinschel immediately. An apparent malfunction may be corrected over the phone by contacting the Customer Service Department at Weinschel. DO NOT send the product back to the factory without prior authorization (RMA number). When it is necessary to return an item, state the symptoms or problems, catalog and type number of the attenuator, and date of original purchase. Also write the company name, your name, and phone number on an index card. Then attach the card to the attenuator to be returned.

For more information or any questions about your Programmable Step Attenuators and/or other Weinschel products, contact the Sales Department at Aeroflex / Weinschel.

ACCESSORIES

Model 8210 Smartstep Interface: The Model 8210 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 8210 represents a new concept in device control applications for bench test and subsystem designs. The 8210 provides a high-level interface from various industry standard communications interfaces, including IEEE-488/RS232/RS422/RS485, to the Smartstep's serial Device Interface Bus. Typical Setup shown below:



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.

Other 150T SmartStep Programmable...

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

N/A=No Standard Model Available.

Aeroflex / Weinschel Warranty

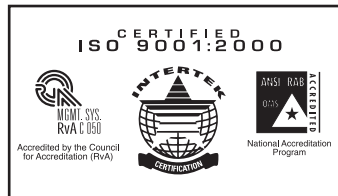
PRODUCTS: Aeroflex / Weinschel warrants each product it manufactures to be free from defects in material and workmanship under normal use and service anywhere in the world. Aeroflex / Weinschel's only obligation under this Warranty is to repair or replace, at its plant, any product or part thereof that is returned with transportation charges prepaid to Aeroflex / Weinschel by the original purchaser within ONE YEAR from the date of shipment.

The foregoing Warranty does not apply to, and in Aeroflex / Weinschel's sole opinion, products that have been subject to improper or inadequate maintenance, unauthorized modifications, misuse, or operation outside the environmental specifications for the product.

SOFTWARE PRODUCTS: Aeroflex / Weinschel software products are supplied without representation or Warranty of any kind. Aeroflex / Weinschel, therefore, assumes no responsibility and will not accept liability (consequential or otherwise) arising from the use of program materials, disk, or tape.

The Warranty period is controlled by the Warranty document furnished with each product and begins on the date of shipment. All Warranty returns must be authorized by Aeroflex / Weinschel prior to their return.

Aeroflex / Weinschel's Quality System Certified to:



Certificate No. 289e



5305 Spectrum Drive, Frederick, Maryland 21703-7362

TEL: (301) 846-9222, 800-638-2048, FAX: (301) 846-9116

Web: www.aerofle-weinschel.com, e-mail: sales@aeroflex-weinschel.com