

# INSTALLATION & OPERATING INSTRUCTIONS

## Models 150, 151, & 152 Programmable Step 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  
1996, 2002, 2004

## GENERAL

This manual provides general installation instructions and wiring data to be used as an aid in installing a Aeroflex / Weinschel 150 Series Programmable Step Attenuator into any system or application. Also included are specifications and other technical data to help in the installation and operation of the 150 Series Programmable Attenuator.

This series of Programmable Step Attenuators represents the widest range of programmable attenuators available. The attenuator design is a result of an extensive development program to ensure that they offer long reliable operation with exceptional accuracy. These attenuators provide programmable adjustments of RF signal levels in very precise steps of 1 dB, 5 dB, 10 dB, or higher if required. Each attenuator consists of a cascaded assembly of switched attenuator cells (Figure 1). This series of Programmable Step Attenuators uses a switching structure that provides rapid switching.

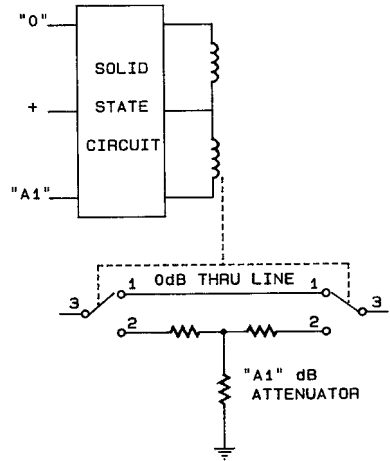


Figure 1. Cell Schematic

**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.



**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  $-20^{\circ}$  to  $+75^{\circ}\text{C}$ . Operating beyond these limits will adversely affect the accuracy and could damage the internal circuitry.

**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.

## CELL CONFIGURATION

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

*Table 1. Series 150 Cell Configurations*

ATTN Value	No. Cells	CELL 1		CELL 2		CELL 3		CELL 4		CELL 5	
		Bypass	ATTN Element	Bypass	ATTN Element	Bypass	ATTN Element	Bypass	ATTN Element	Bypass	ATTN Element
11 dB	4	0 dB	1 dB	0 dB	4 dB	0 dB	2 dB	0 dB	4 dB	---	---
15 dB	4	0 dB	1 dB	0 dB	8 dB	0 dB	2 dB	0 dB	4 dB	---	---
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	16 dB	0 dB	4 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	---	---

## INSTALLATION

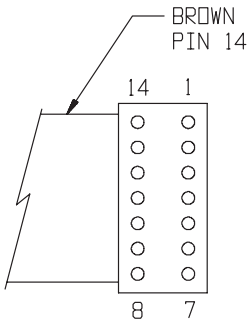
**MOUNTING:** Each Programmable Step Attenuator is supplied with two mounting screws (P/N MS35335-57). These screws will fit any of the mounting holes (4-40 UNC-2B x 0.22 MIN DP) located on either side of the attenuator.

**RF CABLE INSTALLATION:** Care should be taken to prevent strain on the interconnecting cables, since damage here may not always be apparent. Check the attaching RF cables and the 3.5mm 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.

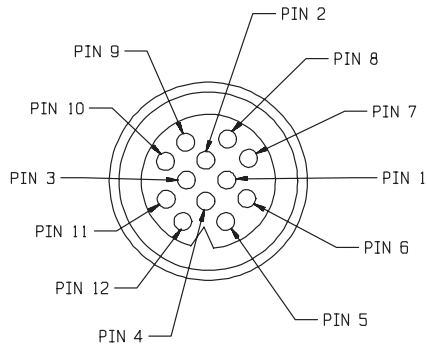
**CONTROL CONNECTOR WIRING:** Table 2 provides the necessary wiring data to connect the attenuator to the appropriate driver circuitry. This table covers both types of attenuator cables. Figure 2 is also provided to show the location of each-control connector pin.

*Table 2. Control Connector Wiring*

Control Signal/ Voltage	Ribbon Cable Pin/Color	Round (Viking) Cable Pin/Color
Cell 1    Bypass ATTN	13/orange 2/yellow	5/violet 6/yellow
Cell 2    Bypass ATTN	3/blue 9/brown	9/orange 10/blue
Cell 3    Bypass ATTN	11/purple 5/black	7/black 8/green
Cell 4    Bypass ATTN	4/gray 10/white	11/brown 12/white
Cell 5    Bypass ATTN	8/orange 7/yellow	3/pink 4/tan
+24 or +5 V	6/red	1/red



Ribbon Cable Models



Round (VIKING) Cable Models

Figure 2. Control Connector Pin Locations

## SPECIFICATIONS

**NOMINAL IMPEDANCE:** 50  $\Omega$

**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 TKP12-101 connector with 5' cable or 14 conductor 16" ribbon cable with connector (Figure 2)

**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

**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  $\Omega$  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 ( $\pm$ dB with respect to 0 dB reference):

Model 150/151-11 &amp; 150/151-15:

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

Model 150/151-75:

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 150/151-31:

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

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

Model 150/151-62:

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

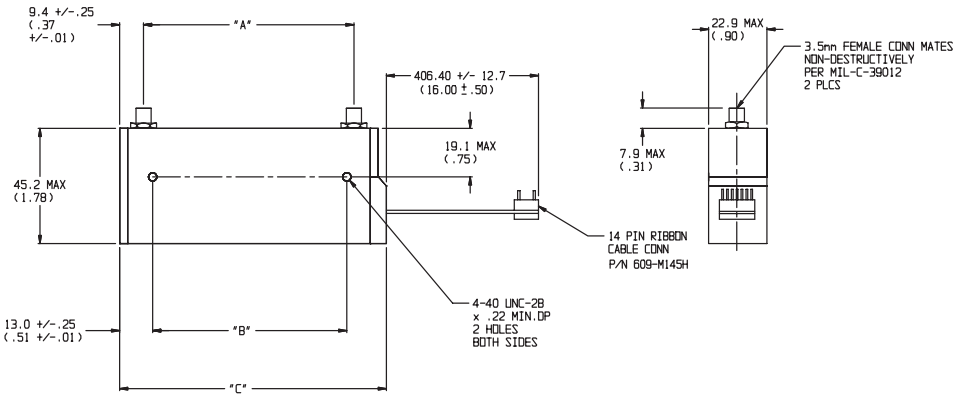
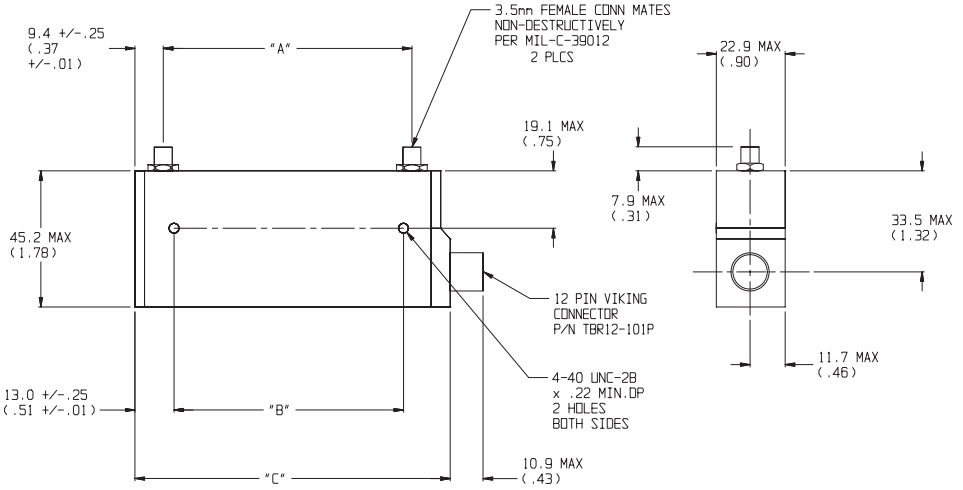
Model 152-55:

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 152-70 &amp; 152-90:

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

**PHYSICAL DIMENSIONS:**



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.



## **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 Aeroflex / 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 Aeroflex / Weinschel products, contact the Sales Department at Aeroflex / Weinschel, Inc..

## 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.

## Aeroflex / Weinschel Warranty

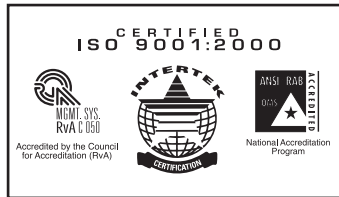
**PRODUCTS:** Aeroflex / Weinschel warrants each product it manufactures to be free from defects in material and workmanship under normal use and service anywhere in the world. Aeroflex / Weinschel's only obligation under this Warranty is to repair or replace, at its plant, any product or part thereof 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, Inc.'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 Quality System Certified to:



Certification No. 94-289E



5305 Spectrum Drive, Frederick, Maryland 21703-7362  
TEL: (301) 846-9222, 800-638-2048, FAX: (301) 846-9116  
Web: [www.aeroflex-weinschel.com](http://www.aeroflex-weinschel.com), e-mail: [sales@aeroflex-weinschel.com](mailto:sales@aeroflex-weinschel.com)