Agilent Technologies Z5623A-K01

User's and Service Guide

Gain Compression Test Set

Agilent Technologies

Manufacturing Part Number: Z5623-90040
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Safety Notes

The following safety notes are used throughout this document. Familiarize yourself with each of these notes and its meaning before performing any of the procedures in this document.

WARNING	**Warning denotes a hazard. It calls attention to a procedure which, if not correctly performed or adhered to, could result in injury or loss of life. Do not proceed beyond a warning note until the indicated conditions are fully understood and met.**

CAUTION	Caution denotes a hazard. It calls attention to a procedure that, if not correctly performed or adhered to, could result in damage to or destruction of the instrument. Do not proceed beyond a caution sign until the indicated conditions are fully understood and met.

Definitions

All specifications and characteristics apply within the operating temperature range of 0 to 55 °C and after a 90 minute warm-up period, unless otherwise stated.

Specification (spec): Represents warranted performance of a calibrated instrument. Specifications include guardbands to account for the expected statistical performance distribution, measurement uncertainties, and changes in performance due to environmental conditions.

Characteristic (char): A performance parameter that the product is expected to meet before it leaves the factory, but is not verified in the field and is not warranted. A characteristic includes the same guardbands as a specification.

Typical (typ): Expected performance of an average unit which does not include guardbands. It is not covered by the product warranty.

Nominal (nom): A general, descriptive term that does not imply a level of performance. It is not covered by the product warranty.

Calibration: The process of measuring known standards to characterize a network analyzer's systematic (repeatable) errors.

Corrected (residual): Indicates performance after error correction (calibration). It is determined by the quality of calibration standards and how well “known” they are, plus system repeatability, stability, and noise.

Uncorrected (raw): Indicates instrument performance without error correction. The uncorrected performance affects the stability of a calibration.

Standard: When referring to the analyzer, this includes no options unless noted otherwise.

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Description

The Agilent Z5623A-K01 gain compression Test Set is designed for use with PNA performance test software. This document guides you through the steps necessary to correctly and safely install the gain compression Test Set.

The Test Set provides the ability to test gain compression on the microwave PNA Network Analyzers. The Test Set is controlled by using an external GPIB controller.

Verifying the Shipment

To verify the contents shipped with your product, refer to the “Box Content List” included with the shipment.

Inspect the shipping container. If the container or packing material is damaged, it should be kept until the contents of the shipment have been checked mechanically and electrically. If there is physical damage refer to “Contacting Agilent” on page 38. Keep the damaged shipping materials (if any) for inspection by the carrier and an Agilent Technologies representative.

Table 1 Content List

Description	Agilent Part Number	Qty
Power Cord	Figure 12 on page 18	1
Front Handle Kit	5063-9226	1
Rack Mount Kit	5063-9232	1
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Electrical and Environmental Requirements

The line power module on your Test Set is an autoranging input. It is designed to be used with an ac power source with a nominal voltage of 115 V or 230 V.

Ensure that the available ac power source meets the following requirements:

- 100/120 V 30 Watts
- 220/240 V 40 Watts
- 50/60 Hz

CAUTION This product has an autoranging line voltage input. Be sure the supply voltage is within the specified range. If the ac line voltage does not fall within these ranges, an autotransformer that provides third wire continuity to earth ground should be used.

Table 2 Operating Environment

Temperature	
Operation	0 °C to 55 °C (32 °F to 131 °F)
Storage	–40 °C to +70 °C (–104 °F to +158 °F)
Measurement Calibration	20 °C to 26 °C (68 °F to 79 °F)
Performance Verification	Temperature must be within 1 °C (1.8 °F) of the temperature at which the measurement calibration was performed.
Pressure Altitude (Operation or Storage)	0 to 3,000 meters (~ 10,000 feet)

WARNING **This product is designed for use in Installation Category II and Pollution Degree 2.**

Verify that the power cable is not damaged, and that the power source outlet provides a protective earth ground contact. Note that Figure 3 on page 5 depicts only one type of power source outlet. Refer to Figure 12 on page 18 to see the different types of power cord plugs that can be used with your Test Set.

Table 3 Cabinet Dimensions

Item	Measurement/ Weight
Height	17.8 cm (7.02 in)
Width	42.5 cm (16.75 in)
Depth	50 cm (19.7 in)
Weight	9 kg (19.85 lb)
Shipping Weight	20 kg (44.10 lb)

Figure 1 Physical Dimensions

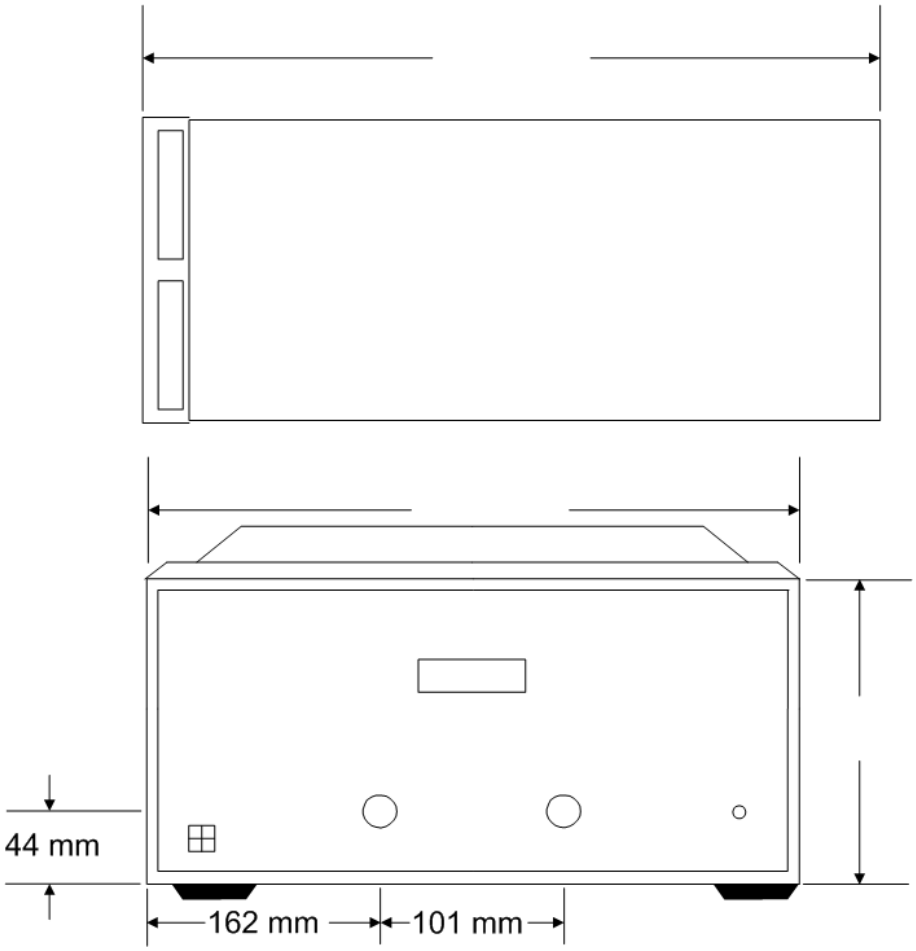
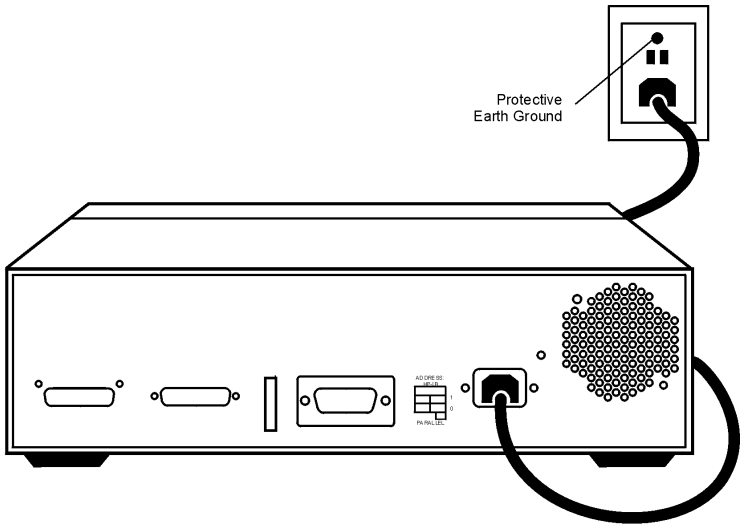


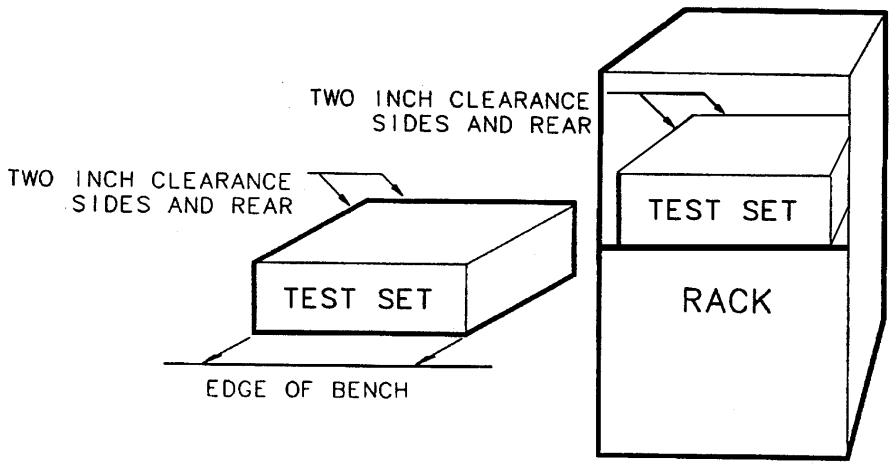
Figure 2 Protective Earth Ground



Ventilation Requirements: When installing the instrument in a cabinet, the convection into and out of the instrument must not be restricted. The ambient temperature (outside the cabinet) must be less than the maximum operating temperature of the instrument by 4 °C for every 100 watts dissipated in the cabinet. If the total power dissipated in the cabinet is greater than 800 watts, forced convection must be used.

WARNING **This is a Safety Class I product (provided with a protective earthing ground incorporated in the power cord). The mains plug shall be inserted only into a socket outlet provided with a protective earth contact. Any interruption of the protective conductor, inside or outside the instrument, is likely to make the instrument dangerous. Intentional interruption is prohibited.**

Figure 3 Ventilation Clearance Requirements



Performance Characteristics

Table 4 Z5623A-K01 Performance Characteristics

Parameter Range	Characteristics
Frequency Range	45 MHz to 50.0 GHz
Gain (all Atten's = 0 dB):	
45 MHz to 10.0 GHz	≥ +5 dB
10.0 to 30.0 GHz	≥ +9 dB
30.0 to 40.0 GHz	≥ +10 dB
40.0 to 45.0 GHz	≥ +15 dB
45.0 to 50.0 GHz	≥ +18 dB
Output Match (Output Atten = 0 dB):	
45 MHz to 35.0 GHz	≤-10 dB
35.0 to 50.0 GHz	≤-9 dB
Input Power Damage Level	>+20 dBm (±10 Vdc_{max})

Connecting and Turning on the Test Set

The Z5623A-K01 is designed to be placed below the PNA microwave network analyzer.

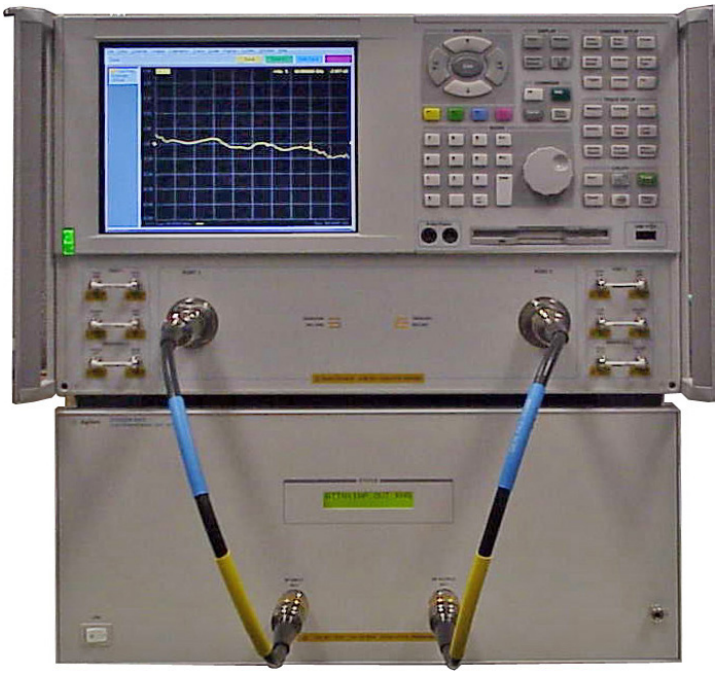
1. Connect the Test Set to the PNA, using two 2.4 mm 50 Ω jumper cables as shown in Figure 4.
2. Install a GPIB cable (Agilent part number 10833D) from the rear panel on the Test Set to the rear panel of the PNA. After the proper rear panel connections have been made, turn on the Test Set using the front panel line switch. The front panel line switch disconnects the mains circuits from the mains supply after the EMI filters and before other parts of the instrument.

NOTE For accurate, repeatable measurement, allow the Test Set warm up for at least 30 minutes. For the most stable and accurate measurements leave the Test Set turned on at all times.

Table 5 Cable Orientation E8364A

Description	Agilent Part Number	Network Analyzer Connections
RF Input	85133-60002 or 85133-60016	Port 1
RF Output	85133-60002 or 85133-60016	Port 2

Figure 4 System Setup

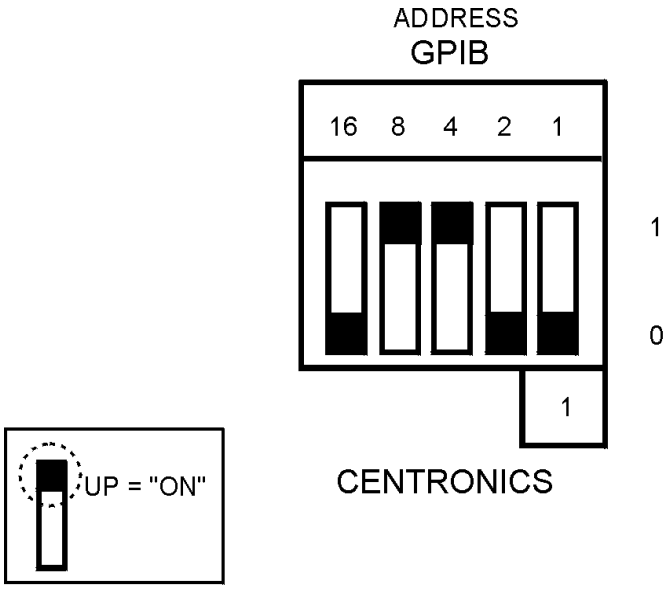


Setting the Test Set Address Switch

The Test Set is shipped with the GPIB address set to 12 as shown in Figure 5. Refer to "Controlling the Test Sets and Making Measurements" on page 9.

To set the GPIB address, set all five switches so that the sum of the switches in the "ON" (or 1) position equal the desired address. In the example below, the two switches in the "ON" position are 8 and 4, thus the GPIB address of 12.

Figure 5 Address Switch



Controlling the Test Sets and Making Measurements

The Agilent Z5623A-K01 is a “slave” instrument. A controller must be used to control the Test Set. There is one way in which the Test Set can be controlled.

- The controller can control the Test Set using GPIB commands via the GPIB connector.

Computer Control

Address the Z5623A-K01 Test Set directly over GPIB, using a controller to write directly to the Test Set's GPIB port. The following example assumes that the address of the Test Set is 12.

```
OUTPUT 712;"<command>"
```

Table 6 Recommended Test Set Commands

Connection Path	GPIB Command	Display Result[1]	Explanatory Remarks
Range Atten = 0dB	`rng0`	RNG → □□0	These are "A" display command forms. Each command updates all three digits of the display. Because all three digits are changed for each command, when changing from an "B" display command form to a "A" display command form, the display will be correct after the first command written. Refer to “Display Examples” on page 11 for more details.
Range Atten = 10dB	`rng10`	RNG → □10	
Range Atten = 20dB	`rng20`	RNG → □20	
Range Atten = 30dB	`rng30`	RNG → □30	
Range Atten = 40dB	`rng40`	RNG → □40	
Range Atten = 50dB	`rng50`	RNG → □50	
Range Atten = 60dB	`rng60`	RNG → □60	
Input Atten = 0dB	`inp0`	INP → □□0	
Input Atten = 10dB	`inp10`	INP → □10	
Input Atten = 20dB	`inp20`	INP → □20	
Input Atten = 30dB	`inp30`	INP → □30	
Input Atten = 40dB	`inp40`	INP → □40	
Input Atten = 50dB	`inp50`	INP → □50	
Input Atten = 60dB	`inp60`	INP → □60	
Output Atten = 0dB	`out0`	OUT → □□0	
Output Atten = 10dB	`out10`	OUT → □10	
Output Atten = 20dB	`out20`	OUT → □20	
Output Atten = 30dB	`out30`	OUT → □30	
Output Atten = 40dB	`out40`	OUT → □40	
Output Atten = 50dB	`out50`	OUT → □50	
Output Atten = 60dB	`out60`	OUT → □60	

Table 6 Recommended Test Set Commands (Continued)

Connection Path	GPIB Command	Display Result[1]	Explanatory Remarks
Clears line 2 of Disp	`disp_clr`		
Display Test Set Rev.	`disp_rev`		Same as "idn."
Reset	`*rst`	100 100 100	Same display at Power Up
Serial Number	`sn?`	(no drwgs)	Serial number returned over GPIB.
Display Test Set ID (no GPIB response)	`idn?`		There is no response over the GPIB, just on the Test Set display.

1. □ = blank

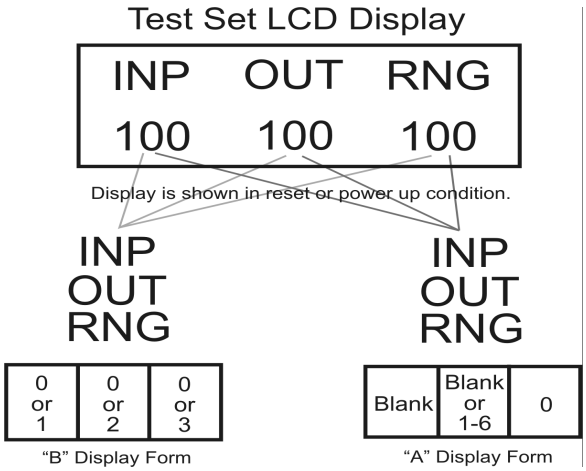
Table 7 Alternate Test Set Commands

Connection Path	GPIB Command	Display Result[1]	Explanatory Remarks
Range Atten 10dB In	`rng_s10in`	RNG → 1xx	These are "B" display command forms. Each command updates only one digit of the display. Because only one digit is changed for each command, when changing from a "A" display command form to an "B" display command form, the display may not be correct until all three digits have been written. Refer to "Display Examples" on page 11 for more details.
Range Atten 10dB Out	`rng_s10out`	RNG → 0xx	
Range Atten 20dB In	`rng_s20in`	RNG → x2x	
Range Atten 20dB Out	`rng_s20out`	RNG → x0x	
Range Atten 30dB In	`rng_s30in`	RNG → xx3	
Range Atten 30dB Out	`rng_s30out`	RNG → xx0	
Input Atten 10dB In	`inp_s10in`	INP → 1xx	
Input Atten 10dB Out	`inp_s10out`	INP → 0xx	
Input Atten 20dB In	`inp_s20in`	INP → x2x	
Input Atten 20dB Out	`inp_s20out`	INP → x0x	
Input Atten 30dB In	`inp_s30in`	INP → xx3	
Input Atten 30dB Out	`inp_s30out`	INP → xx0	
Output Atten 10dB In	`out_s10in`	OUT → 1xx	
Output Atten 10dB Out	`out_s10out`	OUT → 0xx	
Output Atten 20dB In	`out_s20in`	OUT → x2x	
Output Atten 20dB Out	`out_s20out`	OUT → x0x	
Output Atten 30dB In	`out_s30in`	OUT → xx3	
Output Atten 30dB Out	`out_s30out`	OUT → xx0	

1. x = any visible digit

Display Examples

The commands given in Table 6 on page 9 are generally recommended because the displayed result is more intuitive.



The following table demonstrates the effects of various commands. Command sequence may affect the display result.

Display Command Form (A/B)	Command	Display		
		INP	OUT	RNG
B	`*rst` (or power on)	100	100	100
B	`rng_s10in`	100	100	100
B	`inp_s30in`	103	100	100
A	`rng0`	100	100	0
A	`inp60`	60	100	0
A	`out30`	60	30	0
B	`inp_s10in`	160	30	0
B	`inp_s30in`	163	30	0
B	`inp_s20out`	103	30	0

Serial Number Command

To identify the Test Set's serial number, send the following commands:

```
OUTPUT 712;"sn?"
ENTER 712;Sn$
DISP Sn$
```

This command will return a 10 digit serial number.

Reset Command

```
OUTPUT 712;"*rst"
```

When the Reset command (**`*rst`**) is sent, the Test Set is set to the default state, which sets the input, output, and range attenuators to 10 dB. The display will be: 100 100 100. This same condition exists for power-up.

Switch Count Commands

Refer to the Z5623A-K01 block diagram, Figure 14 on page 30 for the switch paths. To read the individual switch count, send the following command:

```
Output 712;"sw51?"
```

The example above illustrates the command for switch 51 only. This command returns a value which indicates the number of times the particular switch has been addressed and switched. To enter additional commands, refer to Table 8.

Table 8 Switch Count Commands

Switch Number	Attenuator Section	GPIB Command
S50	Range 30 dB section	sw50?
S51	Range 20 dB section	sw51?
S52	Range 1 0dB section	sw52?
S53	Output 30 dB section	sw53?
S56	Output 10 dB section	sw56?
S57	Output 20 dB section	sw57?
S75	Input 20 dB section	sw75?
S76	Input 30 dB section	sw76?
S77	Input 10 dB section	sw77?

Programming Languages

This section provides some tips on controlling the Test Set using different programming languages.

Rocky Mountain Basic (RMB) or HP Basic

To address the Test Set directly over GPIB, use a controller to write directly to the Test Set's GPIB port. The following example assumes that the address of the Test Set is 12. (Note the semi- colon ";" .)

Write Commands:

OUTPUT 712;"STRING$;" ! Output Command

Read Commands:

OUTPUT 712;"STRING$;" ! Output Command
ENTER 712;String$! Enter Command

Quick Basic or Visual Basic

If you are using Quick Basic or Visual Basic, be sure to disable EOI and EOL before sending commands to the Test Set. Including the semicolon in program commands will not ensure that these commands are disabled as would be the case in HP Basic/RMB. When using the 82335 GPIB Interface and Visual Basic, use the following commands to disable EOI and EOL, send the necessary data to the Test Set, and re-enable EOI and EOL.

Be sure to re-enable EOI and EOL before sending data to another instrument.

Write Commands:

```
info$="refl_01" 'command for reflection to port 1
length%=len(info$) 'length of command
HpibEoi(hHpib;7,0) 'disable EOI
HpibEol(hHpib;7,"",0) 'disable EOL
HpibOutputs (hHpib;712,info$,length%)) 'send command to Test Set
HpibEol(hHpib;7,chr$(13)+chr$(10),2) 're-enable EOL and set to
chr$(13)+chr$(10)
HpibEoi(hHpib;7,1,) 're-enable EOI hHpib specifies the handle returned by
HpibOpen.
```

Read Commands:

```
info$="id?" 'command for Test Set identification.
length%=len(info$) 'length of command
max.len% = 10 'max length data from id? or swxx? function.
infi$ = space$(max.len%)
pibEoi(hHpib;7,0) 'disable EOI.
HpibEol(hHpib;7,"",0) 'disable EOL
HpibOutputs (hHpib;712,info$,length%)) 'send command to Test Set.
HpibEnters(hHpib%,712,infi$,max.len%) 'get data from Test Set.
HpibEol(hHpib;7,chr$(13)+chr$(10),2) 're-enable EOL and set to
chr$(13)+chr$(10).
HpibEoi(hHpib;7,1,) 're-enable EOI hHpib specifies the handle returned by
HpibOpen.
```

NOTE For more information on the EOI and EOL commands, refer to the programming library manual supplied with the 82335 interface.

HPVEE

If you are using HPVEE, be sure to set the Direct I/O in the Advance Device Configuration so the Read Terminator and Write EOL Sequence is set to "\n". In the I/O Transaction make sure the EOL is ON.

National Instruments VISA

If you are using National Instruments VISA, be sure to set the following variables as follows:

VI_ATTR_SEND_END = VI_FALSE ' This specifies whether to assert END during the transfer of the last byte of the buffer.

VI_ATTR_TERMCHAR = 0x0A ' This is the termination character. When the termination character is read and VI_ATTR_TERMCHAR_EN is enabled during a read operation, the read operation terminates.

VI_ATTR_TERMCHAR_EN = VI_TRUE ' This is a flag that determines whether the read operation should terminate when a termination character is received.

VI_ATTR_SUPPRESS_END_EN = VI_FALSE ' Specifies whether to suppress the END bit termination. If this attribute is set to VI_TRUE, the END bit does not terminate read operations. If this attribute is set to VI_FALSE, the END bit terminates read operations.

Write Commands:

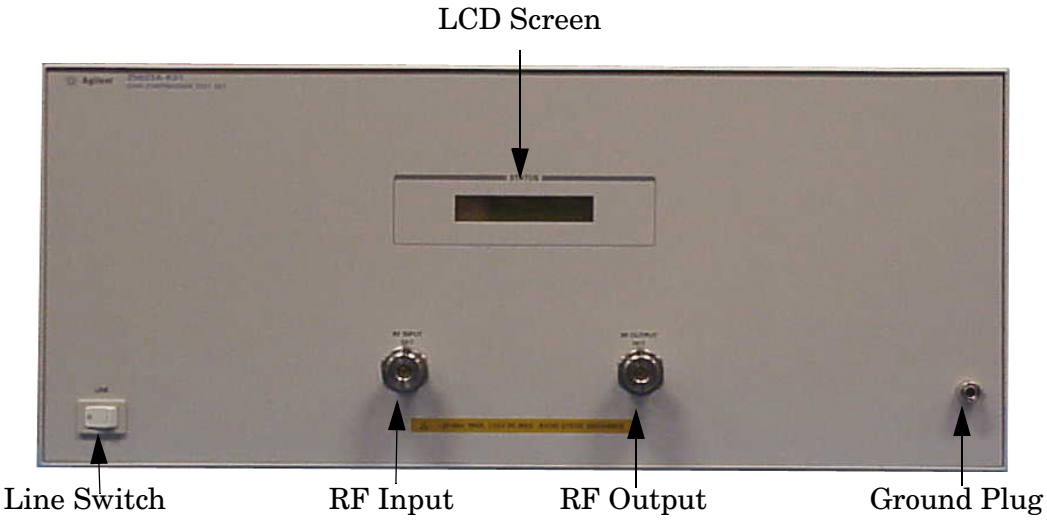
Append "\n," to all commands for example, `*rst\n`.

Read Commands:

The Test Set returns data terminated by `\r\n`.

Front and Rear Panel Features

Figure 9 Front Panel



Active LED

- When the Test Set power switch is On and is connected and addressed by a PNA, the LED is On (illuminated).
- The LED is Off (not illuminated) when the Test Set power switch is not addressed by a PNA.

Line Switch

O – Off

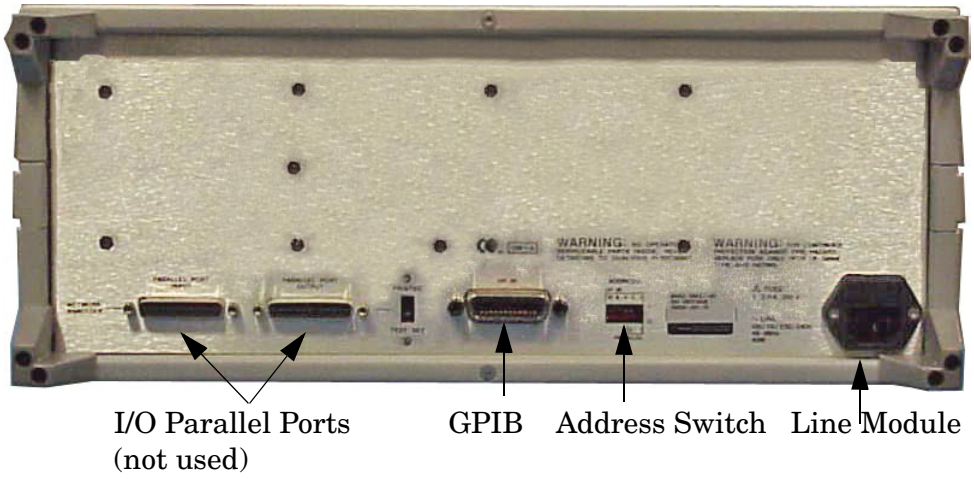
| – ON (Active LED On)

Ground Connector

The ground connector provides a convenient front panel ground connection for a standard banana plug.

CAUTION Do not input more than + 20 dBm or ± 10 Vdc to these ports, internal damage may occur.

Figure 10 Rear Panel



GPIB Controller

This connector allows the Test Set to be connected directly to a controller.

Address Switch

The address switch sets the GPIB of the Test Set. Refer to Figure 5 on page 8.

Line Module

The line module contains the power cable receptacle and the line fuse. The line module is an autoranging input and is designed to be used with an ac power source with a nominal voltage of either 115 V or 230 V.

Power Cables

The line power cable is supplied in one of several configurations, depending on the destination of the original shipment.

Each instrument is equipped with a three-wire power cable. When connected to an appropriate ac power receptacle, this cable grounds the instrument chassis. The type of power cable shipped with each instrument depends on the country of destination. See Figure 12 on page 18 for power cables part numbers, or contact “Agilent Support, Services, and Assistance” on page 38 for further information.

CAUTION Always use the three-prong ac power cord supplied with this product. Failure to ensure adequate grounding (by not using this cord) may cause damage to the product.

WARNING **This is a Safety Class I product (provided with a protective earthing ground incorporated in the power cord). The mains plug shall be inserted only into a socket outlet provided with a protective earth contact. Any interruption of the protective conductor, inside or outside the instrument, is likely to make the instrument dangerous. Intentional interruption is prohibited.**

Available Fuses

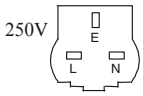
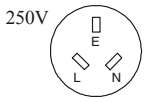
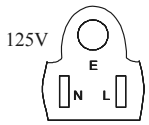
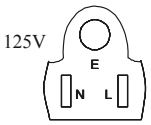
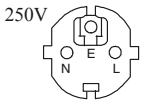
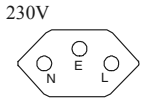
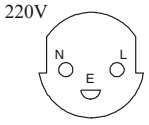
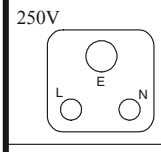
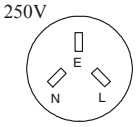
- Fuse (F 3 A/250V, 2110-0780) UL listed and CSA certified.

WARNING **For continued protection against fire hazard replace line fuse only with same type and rating. The use of other fuses or material is prohibited.**

Figure 11 Line Fuse

CAUTION Verify that the premise electrical voltage supply is within the range specified on the instrument.

Figure 12 Power Cable and Line (Mains)

Plug Type [a]	Cable Part Number	Plug [b] Description	Length cm (in.)	Cable Color	For Use in Country
	8120-8705 8120-8709	Straight BS 1363A 90˚	229 (90) 229 (90)	Mint Gray Mint Gray	Option 900 United Kingdom, Hong Kong, Cyprus, Nigeria, Singapore, Zimbabwe
	8120-1369 8120-0696	Straight AS 3112 90˚	210 (79) 200 (78)	Gray Gray	Option 901 Argentina, Australia, New Zealand, Mainland China
	8120-1378 8120-1521	Straight NEMA 5-15P 90˚	203 (80) 203 (80)	Jade Gray Jade Gray	Option 903 United States, Canada, Brazil, Colombia, Mexico,Philippines, Saudi Arabia, Taiwan
	8120-4753 8120-4754	Straight NEMA 5-15P 90˚	229 (90) 229 (90)	Gray Gray	Option 918 Japan
	8120-1689 8120-1692	Straight CEE 7/VII 90˚	200 (78) 200 (78)	Mint Gray Mint Gray	Option 902 Continental Europe, Central African Republic, United Arab Republic
	8120-2104 8120-2296	Straight SEV Type 12 90˚	200 (78) 200 (78)	Gray Gray	Option 906 Switzerland
	8120-2956 8120-2957	Straight SR 107-2-D 90˚	200 (78) 200 (78)	Gray Gray	Option 912 Denmark
	8120-4211 8120-4600	Straight IEC 83-B1 90˚	200 (78) 200 (78)	Mint Gray Mint Gray	Option 917 South Africa, India
	8120-5182 8120-5181	Straight SI 32 90˚	200 (78) 200 (78)	Jade Gray Jade Gray	Option 919 Israel

a. E =earth ground, L = line, and N = neutral.
b. Plug identifier numbers describe the plug only. The Agilent Technologies part number is for the complete cable assembly.

Service Information

This section contains information on the theory of operation, how to verify the performance of your Test Set, how to troubleshoot it if necessary, and a block diagram.

Functional Tests

Functional testing consists of measuring the gain, output match and attenuator steps. For the most accurate measurements, the Agilent E8364B 50 GHz Network Analyzer is recommended and its use is assumed in these notes. Familiarity with RF/microwave measurements is also assumed. The use of adapters may be required and their effects should be accounted within the measurements.

There are no adjustments required for the Agilent Z5623A-K01 Test Set.

Prior to January 2008 the Z5623A-K01 had hard specification, therefore a calibration certificate was available for the Test Set. The specifications have now been replaced with typical performance characteristics. The change was made because performance specifications from the Z5623A-K01 are not critical to the network analyzer gain compression test. The accuracy of the Test Set does not affect the accuracy of the test results. Therefore, only a functional test certificate is offered for the Z5623A-K01 Test Set.

Equipment Required

- Agilent E8364B 50 GHz PNA (or equivalent).
- 2 - 2.4 mm Test Port Extension Cables (85133-60002, 85133-60016 or equivalent),
- Agilent 85056A Calibration Kit or 50 GHz ECAL module.
- PC, PNA, or other source of GPIB commands to control the Test Set.

Make a photocopy of the functional test record (later in this section) to record the results of the functional tests.

Controlling the Test Set

Use the GPIB commands as defined in Table 6 on page 9 to control the three step attenuators in the Test Set.

For easier interpretation of the front panel display, use GPIB commands of the form: 6, "rng10", "out40", etc. As an example, "inp40" will set the 10 and 30 dB sections "in" and the 20 dB section "out."

The signal flow through the Test Set is as follows:

"RF INPUT" > buffer amp > INP attn > RNG attn > system amp > OUT attn > "RF OUTPUT". See Figure 14 on page 30.

The front panel display provides a number for each step attenuator, it represents information about the most recent command sent to the attenuator. The numbers may have two different formats. The format of the display depends on the type of command most recently sent to a particular attenuator. The commands recommended above provide the most easily understood display values. When the Test Set first powers up, the "100" indicates that only the 10 dB section is "in".

Refer to "Controlling the Test Sets and Making Measurements" on page 9 for examples of controlling the Test Set using various programming languages. An alternative is to use the Agilent VISA Assistant on a PC or on a PNA.

The following are notes for issuing GPIB commands to the Test Set using the Agilent VISA Assistant on the PNA. Special preparation is needed because the GPIB interface does not follow the current standard.

1. Connect the Test Set to the PNA. If the PNA has a single GPIB connector, verify the GPIB is in controller mode (via the PNA System menu). If the PNA has more than one GPIB connector, use the "Controller" connector.
2. Open the Agilent VISA Assistant.
3. Select the desired GPIB device on the left side of the VISA Assistant window.
4. Select the **Attributes** tab and double click **INSTR Resource Attributes** > **Generic INSTR Attributes.**
5. Highlight **VI_ATTR_TERMCHAR**. Change the Current Value to **0x0D**, press **Set**.
6. Highlight "**VI_ATTR_TERMCHAR_EN**" and change the Current Value to **VI_TRUE**, press **Set**.
7. Select **FORMATTED I/O** tab and enter the desired GPIB command string. Click **viPrintf** to send a "write only" command. Click **viQueryf** to send a command that requires a response.

Calibrating the PNA

When using the 85056A Calibration Kit, measure the fixed (lowband) load before the sliding load. The calibration process must use the sliding loads. If the calibration process does not prompt for sliding loads, make sure the specified cal kit is 85056A.

1. Connect a cable to each port of the PNA.
2. **Preset** the PNA.
3. Set Output Power level to **[–23 dBm]**.
4. Change the IF Bandwidth to **[1 kHz]**.
5. Perform a two port calibration using the ends of the cables as the calibration plane (Full SOLT 2-Port calibration). Verify that the **Omit Isolation** box is checked.

Step Attenuator Verification

The Test Set should be powered up for at least 30 minutes before performing this test. The PNA should be calibrated as described above.

1. Set the PNA to measure S21.
2. Set each of the three attenuators as follows:
   a. INP=30, RNG=0, OUT=0. (inp30;rng0;out0)
3. Connect the two cables from the PNA to the Test Set.
   a. Port 1 to the RF INPUT
   b. Port 2 to the RF OUTPUT
4. Verify that the 20 dB section on the RNG and OUT step attenuators is 20 (± 2.5 dB). Perform the following procedure for each attenuator:
   a. Set the attenuator to be measured to zero.
   b. Normalize the trace via **[Math/Memory]** > **[Data>>Mem]** > **[Data/Mem].** The display trace should now be at 0 dB.
   c. Set the attenuator to be checked to 20 (rng20 or out20) and then use the **[Marker Search]** function to determine the **max and min magnitudes** for the trace.
   d. Record results in Table 13 on page 26.
   e. Return the PNA trace display to default operation via **[Math/Memory]** > **[Data].**
   f. Set the attenuator that was just measured back to zero. (rng0 or out0)
5. Set each of the three attenuators as follows:
   a. INP=0, RNG=20, OUT=20. (inp0;rng20;out20)
6. Use the above procedure to verify the 10 dB section on the INP attenuator. It should be 10 (± 0.8 dB).
7. Record results in Table 13.

8. Set each of the three attenuators as follows:
   a. INP=0, RNG=20, OUT=20. (inp0;rng20;out20)
9. Normalize the trace via **[Math/Memory]** > **[Data>>Mem]** > **[Data/Mem].** The display trace should now be at **0 dB**.
10. Set the INP attenuator to **20 dB** (inp20), verify that the difference is –**10** (± 0.9 dB).
    Record results in Table 13.
11. Return the PNA trace display to default operation via **[Math/Memory]** > **[Data].**

Gain Check

The Test Set must be powered up for 30 minutes before performing this test. The PNA should be calibrated as described in "Calibrating the PNA" or re-calibrated during the gain check.

1. Set the PNA to measure S21.
2. Set each of the attenuators as follows:
   a. INP=0, RNG=0, OUT=0. (inp0;rng0;out0)
3. Connect the two cables from the PNA to the Test Set.
   a. Port 1 to the RF INPUT
   b. Port 2 to the RF OUTPUT
4. Record the minimum gain value for reach frequency range listed in Table 13 on page 26.

If the gain indicated on the S21 trace is greater than the values in the Table 13 the test has "passed".

NOTE If the gain of the Test Set is significantly greater than the "pass" values given in the table, then receiver compression in the PNA may cause the measured gain to be less than the actual gain of the Test Set. This is acceptable.

Output Match Check

The Test Set should be powered up for at least 30 minutes before performing this test. The PNA should be calibrated as described above in "Calibrating the PNA" or re-calibrated during the gain check.

1. Set each of the attenuators as follows:
   a. INP=30, RNG=0, OUT=0
2. Connect the two cables from the PNA to the Test Set.
   a. Port 1 to the RF INPUT
   b. Port 2 to the RF OUTPUT
3. Set the PNA to measure S22.
4. Measure the output match and record it in Table 13.

Attenuator Connection Check

This check confirms that the control cables for the step attenuators are properly connected. Precision RF measurements are not required.

1. Connect the two cables from the PNA to the Test Set.
   a. Port 1 to the RF INPUT
   b. Port 2 to the RF OUTPUT
2. Cycle the power on the Test Set, this sets each of the step attenuators to 10 dB. The display will read "100, 100, 100".
3. **Preset** the PNA.
4. Set the **[Start Frequency]** to **[1 GHz].**
5. Set the **[Stop Frequency]** to **[1.5 GHz]**.
6. Set the PNA to measure S21.
7. Turn on the **[Marker]** at approximately **[1.25 GHz]**.
8. Issue the **`"rng0"`** command to the Test Set to set RNG=0.
9. Set the PNA **[Power]** to **[–20 dBm]**. Note the gain as indicated by the marker value.
10. Step the output [Power Level] up on the PNA until the gain has decreased approximately 10 dB, or until the PNA reaches maximum power.
11. Issue the "out0" command to set the Test Set to OUT=0.
12. Note the gain value as **[A]**.
13. Issue the "out10" and "inp0" commands to set the Test Set to OUT=10 and INP=0.
14. Note the gain value as **[B]**.
15. For this test to pass the following conditions must be met: **[A] - [B] > 3.**

NOTE If this test does not pass, the likely cause is incorrect control signals connected to the output attenuator, see Figure 14 on page 30.

Functional Test Record

The following pages (Performance Test Record) are designed to be duplicated and used as a template.

_____ Date _____

_____ Date of Last System Calibration _____

_____ _____

Tested by_____ Customer _____

Model_____ Serial Number _____

Ambient Temperature_____°C Relative Humidity_____%

Test Equipment Used	Model Number	Trace Number	Cal Due Date
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Special Notes:

_____

_____

_____

_____

_____

Table 13 Z5623A-K01 Test Record

Test Description	Characteristics	Measured Results		Measurement Uncertainty
		MIN	**MAX**	
Attenuator Step				
Range 20 dB	20 ±2.5 dB	_____	_____	±0.3 dB
Output 20 dB	20 ±2.5 dB	_____	_____	±0.3 dB
Input 10 dB	10 ±0.8 dB	_____	_____	±0.3 dB
Input 10 dB to 20 dB	10 ±0.9 dB	_____	_____	±0.3 dB
Gain Checks				
45 MHz to 10 GHz	≥ +0.5 dB	_____		±0.3 dB
10 GHz to 30 GHz	≥ +0.9 dB	_____		±0.3 dB
30 GHz to 40 GHz	≥ +10 dB	_____		±0.3 dB
40 GHz to 45 GHz	≥ +15 dB	_____		±0.3 dB
45 GHz to 50 GHz	≥ +18 dB	_____		±0.3 dB
Output Match				
45 MHz to 35 GHz	< –10 dB		_____	±1.5 dB
35 GHz to 50 GHz	< –9 dB		_____	±1.5 dB
Atten Conn Check [A] - [B]	> 3 dB	_____		N/A

Replaceable Parts

The following table contains the list of replaceable parts for the Agilent Z5623A-K01 gain compression Test Set. If any of these parts or assemblies are replaced, you must run all performance tests to verify conformance to specifications.

NOTE Special options are built to order, long lead times may be encountered when ordering replacement parts.

Description	Agilent Part Number	Qty
Rear Panel	08720-00102	1
Window Display	08720-00110	1
AY F PNL Display	08720-60193	1
Power Supply	0950-2252	1
Tilt Stand SST; Tilt Stand	1460-1345	1
Fuse (Inch) 3A 125V	2110-0518	2
Fuse (Metric) 3A 250V	2110-0780	1
Switch-RKR	3101-3008	1
Attenuator 60 dB	33325-60006	1
Cover - FM, Top - 497.8D	5002-1047	3
Cover - FM, Bottom - 497.8D	5002-1088	1
SD C PERF W/HDL	5002-3985	1
Bulkhead Mount	5021-8752	2
Foot - FM, 1/2M	5041-9167	2
TRM-FR FR SD	5041-9173	4
Trim Strip - Top	5041-9176	2
CAP - Strap Handle-Front	5041-9186	1
CAP - Strap Handle- Rear	5041-9187	2
Stand-off - Rear Panel	5041-9188	2
Coax Assembly	5062-4567	4
2.4 Connector Assembly	5062-6621	2
Strap Handle Assembly	5063-9210	2
Buffer Amplifier	5086-7649	2

Description	Agilent Part Number	Qty
CA DC Power	70429-60144	1
Flat Ribbon Assembly	8120-8794	1
Preamplifier; 0.045-50 GHz	83051A-FG	1
CBL AY-DC PWR	87050-60021	1
Cable AY-Daughter Board, PWR	87050-60022	1
CBL AY-Interconnect	87050-60023	2
Cable Assembly, Fan	87050-60027	1
Daughter Controller Board	87050-60324	1
BD AY Interim	87050-63149	1
Cable Assembly - AC Line	N5260-60015	1
Front Panel	Z5623-00028	1
RF CBL- INPUT	Z5623-20176	1
RF CBL- BUF AMP OUT	Z5623-20177	1
RF CBL- AMP IN	Z5623-20178	1
RF CBL- AMP OUT	Z5623-20179	1
RF CBL- OUTPUT	Z5623-20180	1
RF CBL- ATTEN	Z5623-20261	1
CBL-Ribbon Atten	Z5623-60005	2
CBL AY ATTN #K01	Z5623-60039	1
Buffer AMP Bias Board Assembly	Z5623-60175	1
Programmed Flash	Z5623-80014	1
User's and Service Guide	Z5623-90040	1

NOTE Before replacing an assembly or board, inspect for obvious, easily repaired defects such as bent pins on ICs or cold solder joints.

Troubleshooting

This section contains information on troubleshooting the Test Set to the assembly level only. By following these procedures you should be able to determine whether the power supply, front panel, or main switch board need replacing. Refer to "Theory of Operation" on page 31 and "Z5623A-K01 Block Diagram" on page 30.

NOTE If you disassemble the instrument, be sure to work at an antistatic workstation and use a grounded wrist strap to prevent damage from electrostatic discharge (ESD). See "Electrostatic Discharge Protection" on page 37.

Power Supply

Turn the instrument on. Check the condition of the LCD on the front panel:

1. LCD is off: Check the main fuse located in the power supply filter at the rear of the instrument.
2. If the fuse is in working order and the LCD is still off, check the cable and connections between the main board and front panel board.
3. If the cable and connections are good and the LCD is still off, the power supply may not be supplying the necessary +24 V, +12 V, and +5 V to the main board.
4. Disconnect the dc power cable from the power supply to the main switch board and measure the voltages. They should be +24 V, +12 V, and +5 V. If not, replace the power supply.

Front Panel Board Problems

Turn the instrument On and check the following:

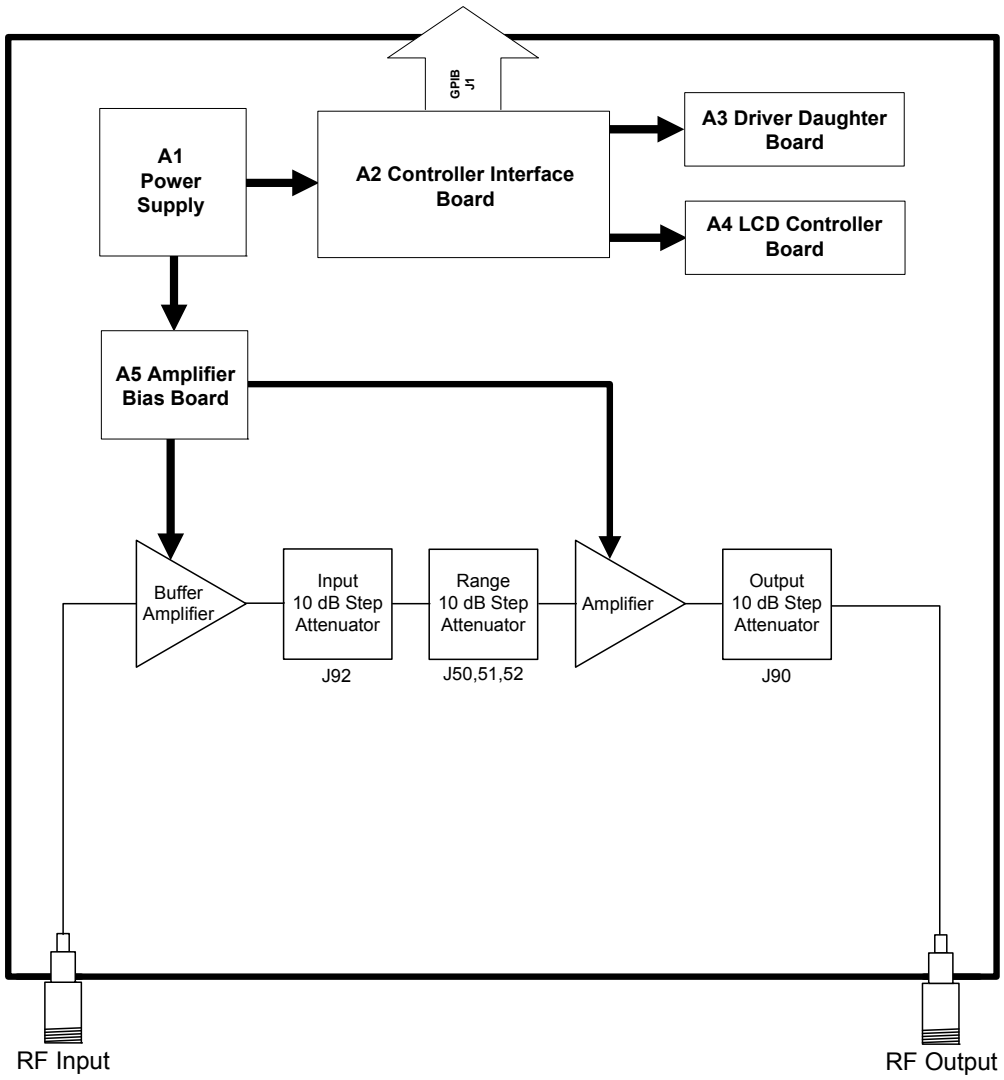
1. Check for power supply problems.
2. If the LCD has no backlight replace the LCD assembly.
3. If the LCD has backlight but no data is displayed, adjust R48 on the bottom side of the controller board. If there is still no data displayed, the problem is with the LCD assembly or the controller board. Replace.

Controller and Switch Driver Boards

Turn the instrument On. Check the condition of each switching path by issuing commands to switch each of the attenuator “in” and “out” sections. If an attenuator section is not connected check the +24 V control voltage, if the voltage is present replace the fault attenuator assembly. If the +24 V control voltage are not present, replace the switch driver board, and possibly the control board.

Refer to Figure 14 for the major components and the switching paths of the Z5623A-K01.

Figure 14 Z5623A-K01 Block Diagram



Theory of Operation

The theory of operation begins with a general description of the Agilent Z5623A - K01 gain compression Test Set. This is followed by more detailed operating theory. The operation of each group is described briefly, to the assembly level only. Detailed component level circuit theory is not provided.

System Theory

The Test Set consists of four main components: a power supply, a front panel display switch board, and a controller board. The purpose of the power supply is to provide power to both the front panel display, switch driver and the controller board. The front panel display serves to indicate the switching paths to the user. Finally, the controller and switch driver boards do the actual switching among the different attenuators.

A1 Power Supply Theory

The switching power supply provides regulated dc voltages to power all assemblies in the Test Set. A dc cable provides power to the main switch board and amplifier bias board. A connector from the main switch board to the front panel display provides dc power and control signals to the front panel. The power supply provides the following supplies: +24 V, +12 V, and +5 V.

A2 Front Panel Display Theory

The front panel display consists of an LCD. The LCD is divided into two lines. Control signals and dc power are provided by a cable connected to the controller board.

A3 Controller Board and Switch Driver board Theory

Refer to Figure 14 on page 30 for the following discussion.

The controller and switch driver boards provide the bias for the switching of the various attenuator sectors.

The Test Set consists of three (3) programmable attenuators, a buffer amplifier, and a preamplifier.

All switches are mechanical and are biased according to the necessary switching path. A user interface, through the GPIB ports, converts the necessary input signals to the control signals, which then control the switching paths.

Safety and Regulatory Information

Introduction

Review this product and related documentation to familiarize yourself with safety markings and instructions before you operate the instrument. The documentation contains information and warnings that must be followed by the user to ensure safe operation and to maintain the product in a safe condition.

Before Applying Power

Verify that the premises electrical supply is within the range of the instrument. The instrument has an autoranging power supply.

WARNING **To prevent electrical shock, disconnect the Agilent Technologies Z5623A-K01 from mains electrical supply before cleaning. Use a dry cloth or one slightly dampened with water to clean the external case parts. Do not attempt to clean internally.**

Connector Care and Cleaning

If alcohol is used to clean the connectors, the power cord to the instrument must be removed. All cleaning should take place in a well ventilated area. Allow adequate time for the fumes to disperse and moist alcohol to evaporate prior to energizing the instrument.

WARNING **Keep isopropyl alcohol away from heat, sparks, and flame. Store in a tightly closed container. It is extremely flammable. In case of fire, use alcohol foam, dry chemical, or carbon dioxide; water may be ineffective.**

Declaration of Conformity

A copy of the Declaration of Conformity is available upon request, or a copy is available on the Agilent Technologies web site at
http://regulations.corporate.agilent.com/DoC/search.htm

Statement of Compliance

This instrument has been designed and tested in accordance with CAN/CSA 22.2 No. 61010-1-04, UL Std No. 61010-1 (Second Edition), and IEC 61010-1 (Second Edition).

General Safety Considerations

Cautions

Cautions applicable to this instrument.

CAUTION	The Mains wiring and connectors shall be compatible with the connector used in the premise electrical system. Failure, to ensure adequate earth grounding by not using the correct components may cause product damage, and serious injury.

CAUTION	Always use the three prong AC power cord supplied with this product. Failure to ensure adequate earth grounding by not using this cord may cause product damage and the risk of electrical shock.

CAUTION	This product is designed for use in Installation Category II and Pollution Degree 2.

CAUTION	Ventilation Requirements: When installing the instrument in a cabinet, the convection into and out of the instrument must not be restricted. The ambient temperature (outside the cabinet) must be less than the maximum operating temperature of the instrument by 4 °C for every 100 watts dissipated in the cabinet. If the total power dissipated in the cabinet is greater than 800 watts, forced convection must be used.

Servicing

Warnings applicable to this instrument.

WARNING	**Danger of explosion if battery is incorrectly replaced. Replace only with the same or equivalent type recommended. Discard used batteries according to manufacturer's instructions.**

WARNING	**This is a Safety Class I product (provided with a protective earthing ground incorporated in the power cord). The mains plug shall be inserted only into a socket outlet provided with a protective earth contact. Any interruption of the protective conductor, inside or outside the product is likely to make the product dangerous. Intentional interruption is prohibited.**

WARNING	**These servicing instructions are for use by qualified personnel only. To avoid electrical shock, do not perform any servicing unless you are qualified to do so.**

WARNING	**The opening of covers or removal of parts is likely to expose the user to dangerous voltages. Disconnect the instrument from all voltage sources before it is opened.**

WARNING	**No operator serviceable parts inside. Refer servicing to qualified personnel.**

WARNING	**If this product is not used as specified, the protection provided by the equipment could be impaired. This product must be used in a normal condition (in which all means for protection are intact) only.**

Regulatory Information

This section contains information that is required by various government regulatory agencies.

Instrument Markings

The instruction documentation symbol. The product is marked with this symbol when it is necessary for the user to refer to the instructions in the documentation.

This symbol indicates that the instruction requires alternating current (ac) input.

This symbol indicates separate collection for electrical and electronic equipment, mandated under EU law as of August 13, 2005. All electric and electronic equipment are required to be separated from normal waste for disposal (Reference WEEE Directive, 2002/96/EC).

This symbol indicates that the power line switch is ON.

This symbol indicates that the power line switch is in the STANDBY position.

This symbol indicates that the power line switch is in the OFF position.

This symbol is used to identify a terminal which is internally connected to the product frame or chassis.

The CE mark is a registered trademark of the European Community. (If accompanied by a year, it is when the design was proven.)

The CSA mark is a registered trademark of the CSA International. This instrument complies with Canada: CSA 22.2 No. 61010-1-04.

ISM1-A

This is a symbol of an Industrial Scientific and Medical Group 1 Class A product.

ICES/NMB-001

This is a marking to indicate product compliance with the Canadian Interference-Causing Equipment Standard (ICES-001).

Direct Current.

IP 2 0

The instrument has been designed to meet the requirements of IP 2 0 for egress and operational environment.

This is a required mark signifying compliance with an EMC requirement. The C-Tick mark is a registered trademark of the Australian Spectrum Management Agency.

China RoHS regulations include requirements related to packaging, and require compliance to China standard GB18455-2001.

This symbol indicates compliance with the China RoHS regulations for paper/fiberboard packaging.

Compliance with German Noise Requirements

This is to declare that this instrument is in conformance with the German Regulation on Noise Declaration for Machines (Laermangabe nach der Maschinenlaermrerordnung-3. GSGV Deutschland).

Acoustic Noise Emission/Geraeuschemission	
LpA<70 dB	Lpa<70 dB
Operator Position	am Arbeitsplatz
Normal Operation	normaler Betrieb
per ISO 7779	nach DIN 45635 t. 19

EMC Information

Complies with European EMC Directive 2004/108/EC

- IEC/EN 61326-1
- CISPR Pub 11 Group 1, class A
- AS/NZS CISPR 11
- This ISM device complies with Canadian ICES-001.
  Cet appareil ISM est conforme a la norme NMB du Canada.

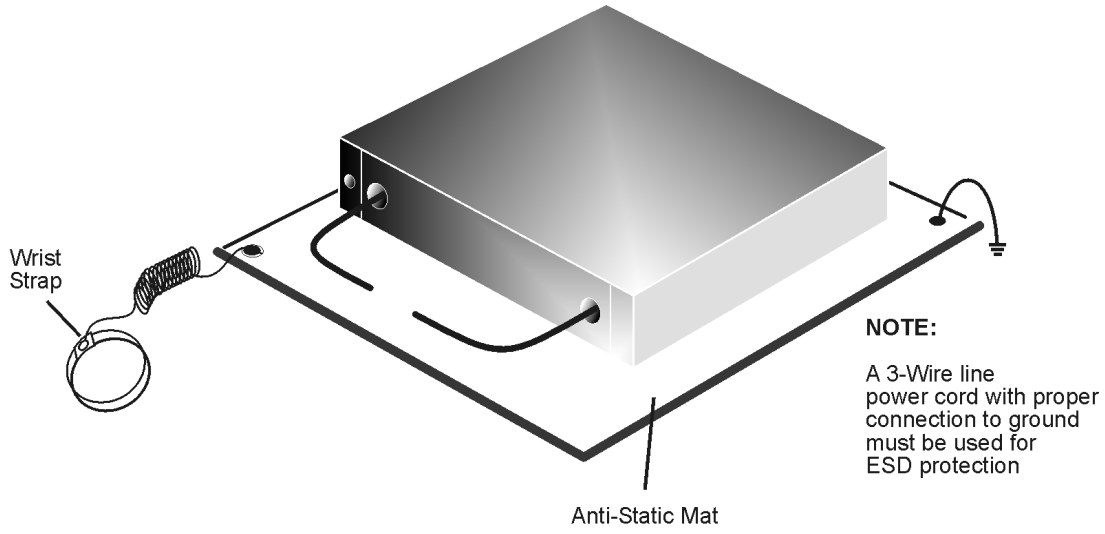
Electrostatic Discharge Protection

Protection against electrostatic discharge (ESD) is essential while removing assemblies from or connecting cables to the network analyzer. Static electricity can build up on your body and can easily damage sensitive internal circuit elements when discharged. Static discharges too small to be felt can cause permanent damage. To prevent damage to the instrument:

- *always* have a grounded, conductive table mat (9300-0797) in front of your test equipment.
- *always* wear a grounded wrist strap (9300-1367) with grounding cord (9300-0980), connected to a grounded conductive table mat, having a 1 MΩ resistor in series with it, when handling components and assemblies or when making connections.
- *always* wear a heel strap (9300-1126) when working in an area with a conductive floor. If you are uncertain about the conductivity of your floor, wear a heel strap.
- *always* ground yourself before you clean, inspect, or make a connection to a static-sensitive device or test port. You can, for example, grasp the grounded outer shell of the test port or cable connector briefly.
- *always* ground the center conductor of a test cable before making a connection to the analyzer test port or other static-sensitive device. This can be done as follows:

  1. Connect a short (from your calibration kit) to one end of the cable to short the center conductor to the outer conductor.
  2. While wearing a grounded wrist strap, grasp the outer shell of the cable connector.
  3. Connect the other end of the cable to the test port and remove the short from the cable.

Figure 6 ESD Protection Setup



Agilent Support, Services, and Assistance

Service and Support Options

The standard product warranty is a one-year return to Agilent Technologies service warranty.

NOTE There are many other repair and calibration options available from the Agilent Technologies support organization. These options cover a range of service agreements with varying response times. Contact Agilent for additional information on available service agreements for this product.

Contacting Agilent

Assistance with test and measurements needs and information or finding a local Agilent office are available on the Web at:
http://www.agilent.com/find/assist

You can also purchase accessories or documentation items on the Internet at:
http://www.agilent.com/find

If you do not have access to the Internet, contact your field engineer.

NOTE In any correspondence or telephone conversation, refer to the Agilent product by its model number and full serial number. With this information, the Agilent representative can determine the warranty status of your unit.

Shipping Your Analyzer to Agilent for Service or Repair

IMPORTANT Agilent Technologies reserves the right to reformat or replace the internal hard disk drive in your analyzer as part of its repair. This will erase all user information stored on the hard disk. It is imperative, therefore, that you make a backup copy of your critical test data located on the analyzer's hard disk before shipping it to Agilent for repair.

If you wish to send your instrument to Agilent Technologies for service or repair:

- Include a complete description of the service requested or of the failure and a description of any failed test and any error message.
- Ship the analyzer using the original or comparable antistatic packaging materials.
- Contact Agilent for instructions on where to ship your analyzer.