Agilent Technologies
Z5623A Option H86
User's and Service Guide

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Agilent Technologies

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Safety Notes

The following safety notes are used throughout this manual. Familiarize yourself with each of the notes and its meaning before operating this instrument. All pertinent safety notes for using this product are located in Chapter 2, “Safety and Regulatory Information,” on page 54.

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

- *Specifications* describe the performance of parameters covered by the product warranty (temperature - 0 to 55 °C, unless otherwise noted.)
- *Typical* describes additional product performance information that is not covered by the product warranty. It is performance beyond specification that 80% of the units exhibit with a 95% confidence level over the temperature range 20 to 30 °C. Typical performance does not include measurement uncertainty.
- *Nominal* values indicate expected performance, or describe product performance that is useful in the application of the product, but is not covered by the product warranty.

Contents

Z5623A H86

Description . . . 2
Content List . . . 3
General Information . . . 4
Operation Overview . . . 5
System Setup . . . 8
Controlling the Test Set . . . 11
Commands . . . 11
Typeface Key Conventions . . . 11
PNA Control . . . 12
Addressing Directly . . . 14
Parallel Port . . . 18
Direct Control . . . 20
Controlling the Switches . . . 20
Switch Indicators . . . 20
Switch Indicator Function . . . 22
Controlling the Attenuators . . . 23
Making High Power Measurements With Option H86 . . . 26
Setup . . . 26
Determining Power Levels . . . 28
Selecting Power Ranges and Attenuator Settings . . . 30
Test Set Internal Configurations . . . 35
Bypass . . . 35
High Power . . . 36
Pulse . . . 36
Pulse High Power . . . 37
Amplifier Terminate . . . 37
Specification . . . 38
Pulsed RF Pin Switch Detectors . . . 38
E8363B/E8364B RF Pin Switch Modulator . . . 38
Test Set Performance Verification . . . 40
Procedure . . . 41
Replaceable Parts . . . 51

Safety and Regulatory Information

Safety and Regulatory Information . . . 54
Introduction . . . 54
Connector Care and Cleaning . . . 54
Before Applying Power . . . 54
Shipping Instructions . . . 54
Compliance with Canadian EMC Requirements . . . 54
Compliance with German Noise Requirements . . . 55

Contents

Declaration of Conformity 55
Statement of Compliance 55
Warnings 56
Cautions 57
Instrument Markings 58
Contacting Agilent 59

Z5623A H86

Description

The Agilent Z5623AH86 is a 2 GHz to 40 GHz Forward Direction Pulse Test Set. When connected to the E8363B or E8364B PNA Series Network Analyzer with option H08 (Pulse) and H11 (IF access), pulse measurements from 2 GHz to 40 GHz can be made depending on the PNA and Band Pass filter. The Z5623AH86 can be configured in many ways. The Bypass configuration allows the user to use the E8363B or E8364B PNA Series Network Analyzer from 10 MHz to 50 GHz depending on the analyzer. This mode bypasses the test sets internal 2 GHz to 40 GHz pin modulator switch. In the pulse mode the user can configure the test set for their application needs to either make straight un-conditioned pulse measurements or permit the insertion of high power amplifiers and other signal conditioning equipment to allow high power measurements at RF levels up to 20 Watts (+43 dBm) from 10 MHz to 40 GHz and 10 Watts (+40 dBm) from 40 GHz to 50 GHz.

Control of the Agilent Z5623AH86 forward direction pulse test set can be performed either by GPIB or directly. Both methods control the port 1 internal switches and attenuator. Direct control requires the user to connect the port 1 37-pin D-sub connectors located on the rear panel. Both GPIB and direct control cannot be used simultaneously. When used in the direct control mode the test sets front panel LCD indicator may differ from the user setup.

High power configurations require that attenuators and isolators be connected to the test ports and receivers in order to protect the E8363B or E8364B PNA Series Network Analyzer. The Agilent E8363BH85 and E8364BH85 High Power Configurable PNA Series Network Analyzer when ordered with the Option H08 and H11 can be used for high power pulse measurement applications. More information on the setup and configuration of the Agilent E8363BH85 and E8364BH85 PNA Series Network Analyzer can be found in manual p/n E8364-90027 Microwave PNA Series High Power Configurable Test Set Option H85.

The instrument is shipped from the factory with jumper cables installed on the front panel in what is called the Shipped Configuration.

Two Band Pass filters are also shipped with the Test Set. The band pass filters are used externally. These Band pass filters are used to eliminate video feed from the Pin switch. The filters are banded. The low frequency band filter allows measurements between 2 to 20 GHz. The high frequency band filter allows measurements between 20 GHz and 40 GHz. See Pulse Configurations Setups.

The pulse test set can be used from 400 MHz to 2 GHz but is not specified. No band pass filter is provided. If low frequency pulse measurements are required user must supply a high pass 400 MHz filter.

If any pulse measurements are required using a frequency band that includes frequencies above and below 20 GHz, the user must supply a bandpass filter for that band or make two separate measurements.

Install the instrument so that the ON/OFF switch is readily identifiable and is easily reached by the operator. The ON/OFF switch or the detachable power cord is the instrument disconnecting device; it disconnects the mains circuit from the mains supply before other parts of the instrument. Alternatively, an externally installed switch or circuit breaker (which is readily identifiable and is easily reached by the operator) may be used as a disconnecting device.

Content List

Agilent Part Number	Description	Qty
0955-0608	µ-Wave Term 40 GHz, 1 Watt	2
1250-2330	3.5 mm M to 2.4 mm M Adapter	1
5063-9226	Kit — Front Handles	1
5063-9232	Kit — Rack Mount	1
5063-9803	RCVR Jumper	2
5063-9804	Source In Jumper	2
5063-9805	CPLR THRU Jumper	1
E8364-20059	Front Panel Jumper	3
Z5623-20519	Coaxial Cable (2.4 - 3.5 male, 5 in)	1
Z5623-60202	37-Pin D-SUB Jumper	1
Z5623-80027	2-20 GHz (highpass filter)	1
Z5623-80042	20-40 GHz (bandpass filter)	1
Z5623-90069	User's and Service Guide	1

General Information

Environmental:

Operating Temperature Range	0 to 40 °C
Operating Humidity Range	Maximum relative humidity 80% for temperatures up to 31 °C decreasing linearly to 50% relative humidity at 40 °C (unless specified otherwise).
Operating Altitude	3000 meters (9840 ft)
EMC	Meets the conducted and radiated interference and immunity requirements of IEC/EN 61326-1. Meets radiated emission requirements of CISPR Pub 11/1997 Group 1 Class A.
Indoor/Outdoor Use	Indoor Use (unless specified otherwise)
	This product is designed for use in INSTALLATION CATEGORY II and POLLUTION DEGREE 2, per IEC 61010-1 Second Edition and 664 respectively.

Power Requirements:

Frequency	50 to 60 Hz
Voltage	100/115/230/240VAC
Power	40 Watts

Weights and Dimensions:

Net Weight	9.1 kg (20 lb)
Dimensions	Height: 9 cm (3.54 in) Width: 42.5 cm (16.7 in) Depth: 50 cm (19.7 in)

Operation Overview

The Agilent Z5623AH86 Forward Direction Pulse Test Set can be configured differently for many applications. Included in this document are four typical configurations:

- Figure 1-2, “Shipped Configuration.”
- Figure 1-3, “System Setup Configuration.”
- Figure 1-4, “Pulse Configuration.”
- Figure 1-5, “High Power Pulse Configuration.”

NOTE The internal firmware of the PNA has not been modified for this test set option. The power levels indicated on the Agilent E8363B and E8364B may differ depending on the user configuration that is chosen.

Refer to the configuration diagrams for external component connections and/or operating constraints when utilizing the high power capability of the Agilent Z5623AH86 Forward Direction Pulse Test Set. External components are not supplied with this option.

When using the Agilent E8363B and E8364B Series Network Analyzer with Z5623AH86 Forward Direction Pulse Test Set in the bypass or the high power configuration, the PNA Frequency Offset mode (Option 080) and External R1 (Option 081) must be activated. This will ensure phase lock and allow R1 and R2 to receive the new reference power levels from the amplifiers. Refer to Table 1-1 on page 6.

CAUTION The Z5623AH86 is equipped with reference channel attenuators. These attenuators reduce the RF power to the PNA R1 and R2 receiver ports. The test set attenuators can be set from 0 to 60 dB in 10 dB steps. The recommended power levels to the PNA R1 and R2 receiver ports is –15 dBm. Refer to your PNA specifications to optimize power levels to the receiver ports.

The PNA Option 016, Receiver Step Attenuators, reduces the power to the A and B receivers. The A and B maximum attenuator setting is 35 dB. Power measurements to Test Ports 1 and 2 above +35 dBm will require additional attenuation. Add the appropriate amount of attenuation that will keep the coupler arm output power below –15 dBm. Refer to Table 1-1 on page 6.

CAUTION Hot Switching is not allowed with the Z5623AH86 when making high power measurements or damage to the switch will occur. Hot Switching is the condition when the internal switch or switches are set to a position for making high power measurements, and then set to another position without reducing the power. The maximum power that the switches are allowed to switch states is +20 dBm.

CAUTION Prior to powering-up the booster amplifier, it is highly recommended that the user verify the RF power levels seen by the various elements of the test setup. At high power levels a mistake could permanently damage the instrument. Refer to Table 1-1.

Table 1-1 Power Levels

Test Setup	Power Level
Maximum Z5623AH86 RF Power Levels to Access Ports:	
SOURCE IN	+20 dbm
RCVR R1 OUT	+20 dBm
CPLR THRU, CPLR IN	+43 dBm @ 10 MHz to 40 GHz
CPLR THRU, CPLR IN	+40 dBm @ 40 GHz to 50 GHz
AMP IN, AMP OUT, SOURCE OUT	+30 dBm
FILTER IN	+30 dBm (Dependent on Filter)
PULSE OUT	+20 dbm (Dependent on Filter)
AMP 1 IN TERM (J4)	+30 dBm
AMP 1 OUT TERM (J3)	+30 dbm
Maximum PNA RF Power Levels to Access and Test Ports:	
Max Recommended RF Level at A/B/R1/R2 Receivers	–15 dbm
Damage Level at A/B/R1/R2 Receivers	+15 dbm
Max Recommended RF Level at Port 1, 2 Source	+0 dBm
Damage Level to Port 1, 2 SOURCE OUT	+20 dBm
Max Level to Port 1, 2 Test Ports	+20 dBm

NOTE Refer to your PNA specifications to optimize the power levels in the receivers.

NOTE We recommend that you do NOT operate components near damage or maximum levels. The power levels should be kept at less than 3 dB, preferably 6 dB, below damage and maximum levels. Damage and Maximum levels are not necessarily the optimum level.

Figure 1-1 Maximum Power Levels

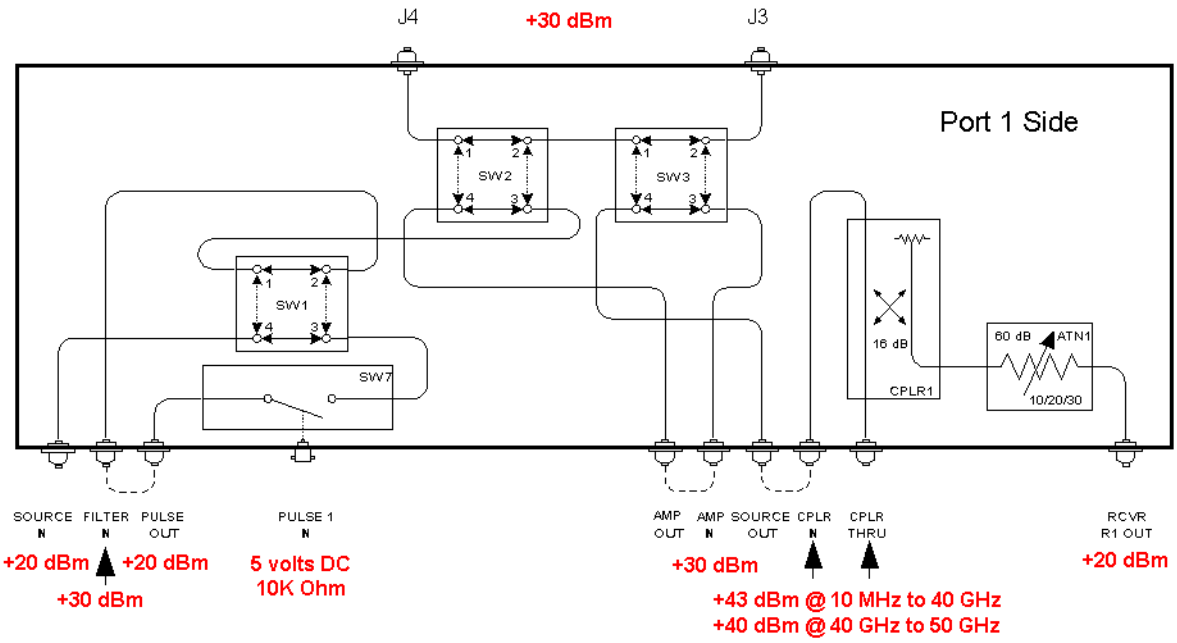
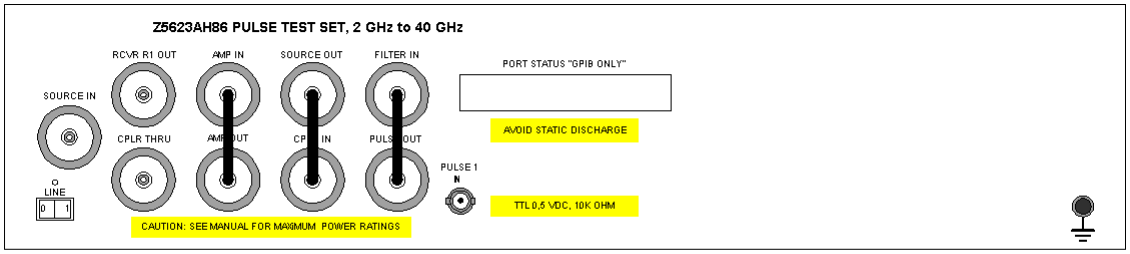


Figure 1-2 Shipped Configuration



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System Setup

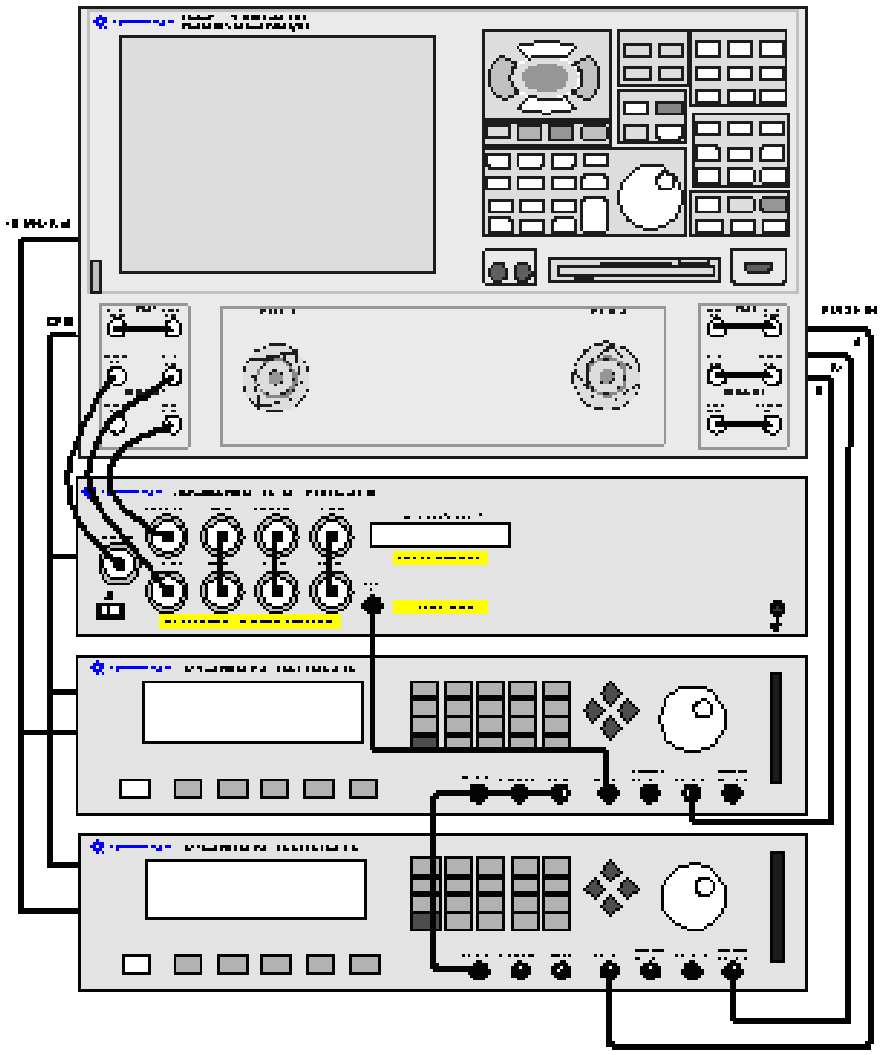
Figure 1-3 on page 9 shows the setup configuration of the Z5623AH86 Forward Direction Pulse Test Set and how it should be configured with the PNA and the Pulse Pattern Generators.

1. Connect the following RF Cables:
   - Connect RF Cable (5063-9803) from the Test Set RCVR R1 Out to the PNA RCVR R1 IN.
   - Connect RF Cable (5063-9804) from the Test Set SOURCE IN to the PNA SOURCE OUT.
   - Connect RF Cable (5063-9805) from the Test Set CPLR THRU to the PNA CPLR THRU.

NOTE The test set rear panel connections are not shown in Figure 1-3 on page 9.

2. Connect the external 50 Ω loads (0955-0608) on test sets rear panel RF Ports J3 and J4.
3. Connect the test set's 37-Pin D-SUB jumper (Z5623-60202) to port 1 on the rear panel for GPIB and parallel control.
4. Connect a GPIB cable from the PNA, Test Set and Pulse Pattern Generators. (These cables are not supplied).
5. Connect a BNC cable for the 10 MHz Reference between the PNA and the Pulse Pattern Generators. (These cables are not supplied).
6. Connect four BNC cables from each Pulse Pattern Generators Output 1 and 2 to the PNA rear panel IF Inputs. (These cables are not supplied).
7. Connect a BNC cable from the test sets PULSE 1 IN to the Pulse Pattern Generator. (These cables are not supplied).

Figure 1-3 System Setup Configuration



A high power isolator or attenuator *must* be inserted at the Source Out and CPLR IN front panel connectors to protect the internal test set modulator pin-switch and PNA solid state transfer switch (30 dB isolation recommended), or if reverse isolation of the amplifier is less than 30 dB. Maximum power into modulator pin-switch is 20 dBm for both forward and reverse directions. Optimum power level to all PNA receivers is –15 dBm. Insert or set attenuators to the receivers (A, B, R1 and R2 ports) to reduce power to receivers accordingly. Set initial instrument state to –65 dBm test port power level to reduce risk of damage when turning on the unit. Recommended sweep mode is **[STEP]**. Frequency Offset mode must be on and the R1 reference channel should be set to external.

Figure 1-4 Pulse Configuration

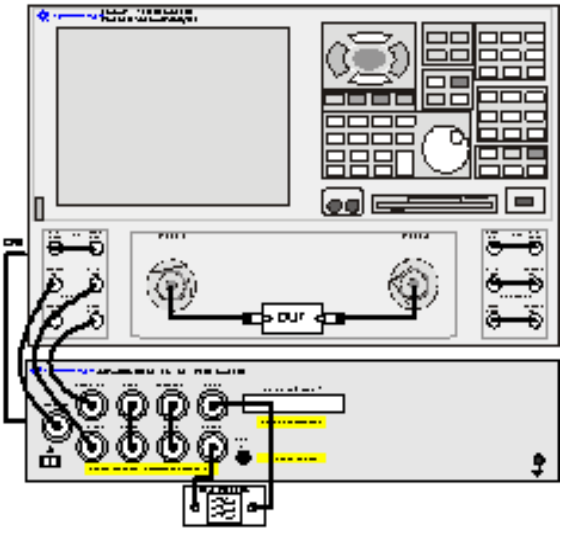
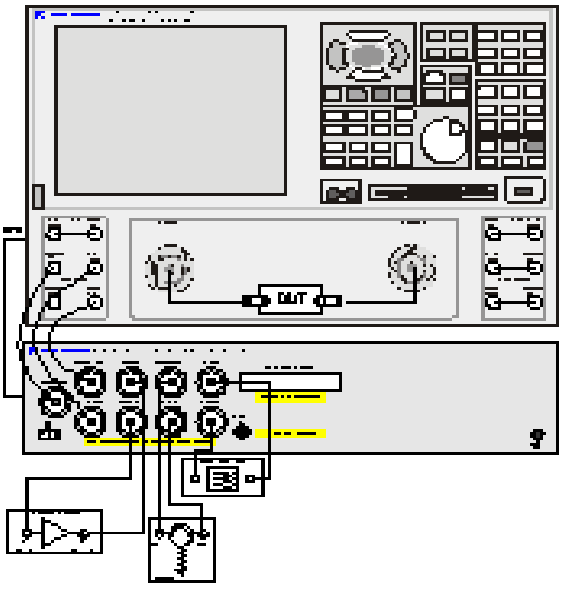


Figure 1-5 High Power Pulse Configuration



Controlling the Test Set

The Agilent Z5623AH86 is considered a “slave” instrument. A Controller must be used to control the test set. There are four ways to control the test set:

- The PNA can be used as the controller to talk to the test set over the GPIB.
- A Controller can directly talk to the test set over the GPIB.
- The Parallel port can be used to set the test set.
- Direct control access to the internal switches and attenuators via open collector lines to ground the input lines.

Commands

As mentioned before, the test set can be controlled in four ways. The first two involve the use of a separate computer. The third way uses the parallel port manually. The fourth control method uses direct access from the port 1 rear panel 37 pin D-Sub connector.

NOTE The 37 pin D-Sub jumper (Z5623-60202) must be attached to the test sets Port 1 rear panel direct access connectors to allow the GPIB and parallel port commands to work. This connector is not connected to the test set when it is shipped.

Typeface Key Conventions

The following key conventions are used throughout this document.

- **[HARDKEYS]** are labeled front panel keys.
- **SOFTKEYS** are unlabeled key whose function is indicated on the instrument display.

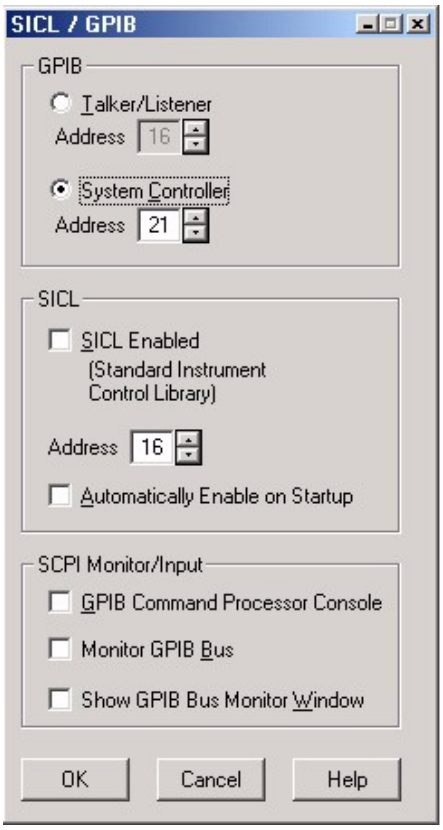
PNA Control

Write the GPIB commands from the PNA directly to the Z5623AH86 test set GPIB port located on the rear panel. The following example assumes that the address of the test set is set to 12. Be sure to use an ending semi-colon.

The PNA must first be setup as the Controller.

1. Select **System > Configure > SICL/GPIB > System Controller**. Under System, select Configure then SICL/GPIB. Once the SICL/GPIB appears in the GPIB section click on System Controller, press OK and close the window.

Figure 1-6 SICL/GPIB



2. Launch the **Measurement & Automation** icon located on the PNA desk top.
3. Expand **Devices and Interfaces**.

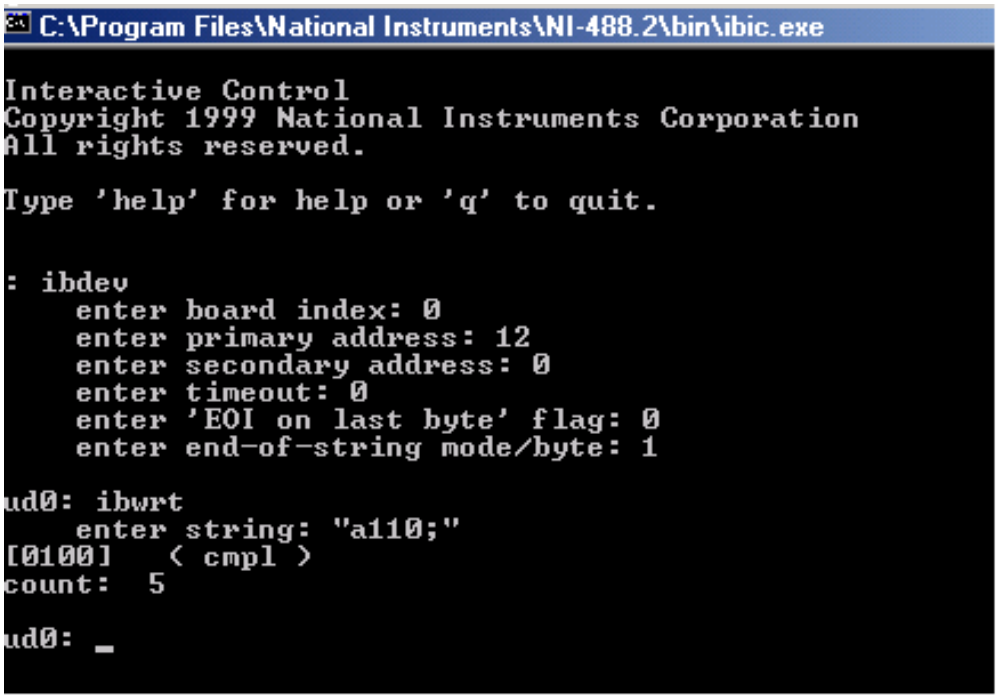
4. Right click on **GPIB0 (AT-GPIB/TNT)** and select **Interactive control**. When the new window appears at the prompt type the following:

: ibdev (This command sets up the PNA GPIB to talk to the Z5623AH86 test set)

```
enter board index: 0
enter primary address: 12
enter secondary address: 0
enter timeout: 0
enter 'EOI on last byte' flag: 0
enter end-of-string mode/byte: 1
```

`ibwrt:"command$;"` (Command$ is the string the user would get from the table)

Figure 1-7 Interactive Control



Addressing Directly

Write GPIB commands from the controller to write commands directly to the Z5623AH86 test set GPIB port located on the rear panel. The following RMB example assumes that the address of the test set is set to 712.

RMB

```
OUTPUT 712;"command$;"
```

To query and read from the Z5623AH86 test set, the user needs to send two commands. The first queries the test set for an individual switch count, and the second reads the data as a string. Be sure to use an ending semi-colon. See your manual regarding details for switching the identifier.

```
OUTPUT 712;"sw10?;"!Query test set for switch 10

ENTER 712;"Count$;" !Read switch 10 Count
```

To query and read from the Z5623AH86 test set, the user needs to send two commands. The first queries the test set for an ID, and the second reads the data in as a string. See your manual for details for "ID Identifier read" when queried.

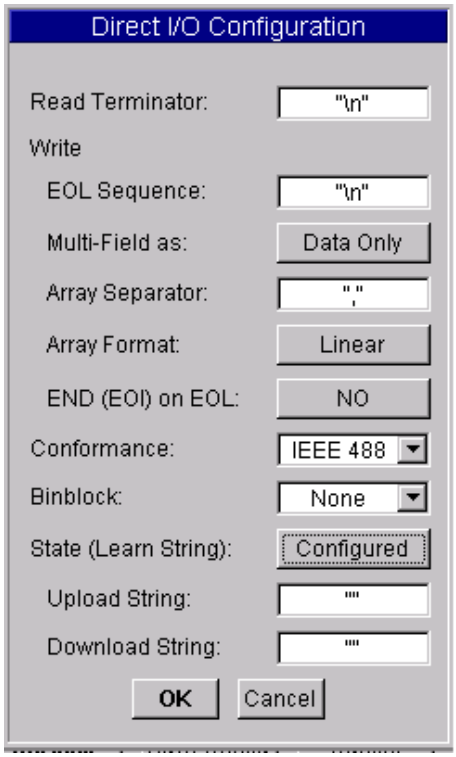
```
OUTPUT 712;"idn?;"!Query test set for ID

ENTER 712;"Name$;"!Read test set ID
```

VEE

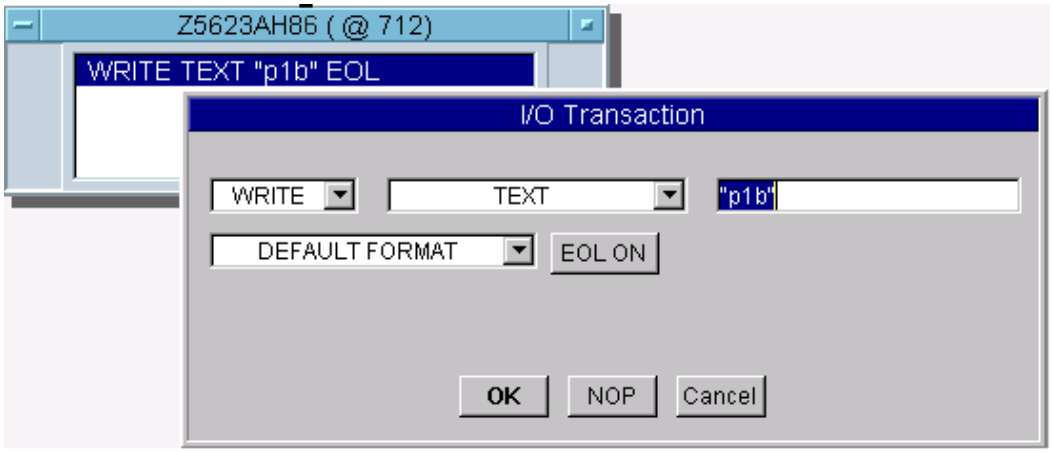
When using VEE insure the Direct I/O is set as follows. This is also the default Direct I/O settings.

Figure 1-8 Direct I\O



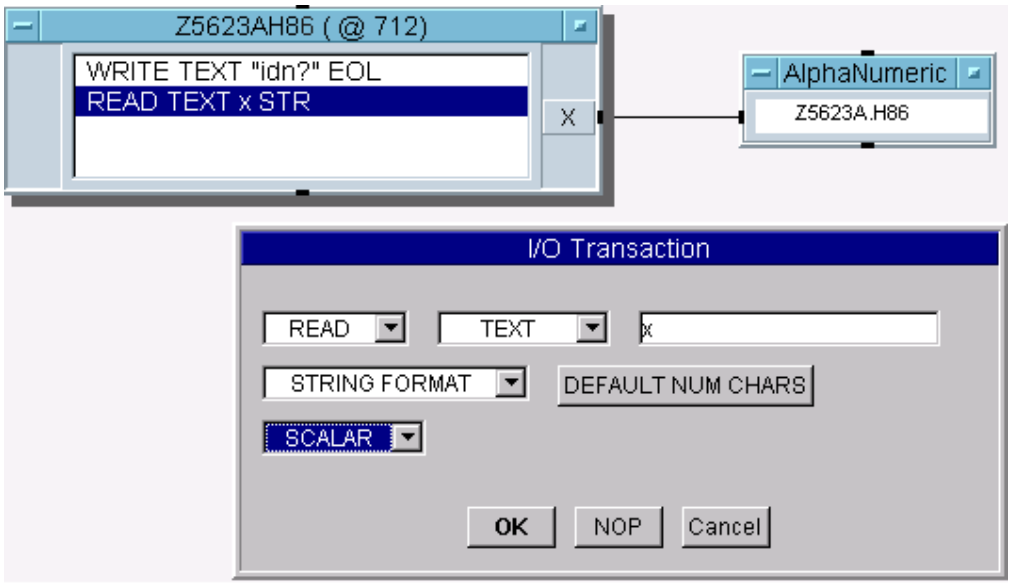
To send commands to the test set configure the I/O Transaction as follows:

Figure 1-9 I\O Transaction



Querying and read from the test set is the same for both switch count and box ID.

Figure 1-10 Query/Read



Quick 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.

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

Write Commands

```
GpibEoi(hGpib;7,0) 'disable EOI

GpibEol(hGpib;7, "",0) 'disable EOL

GpibOutputs(hGpib;712,info$,length%) 'send command to test set.

GpibEol(hGpib;7,chr$(13)+chr$(10),2) 're-enable EOL and set to
chr$(13)+chr$(10)

GpibEoi(hGpib;7,1,) 're-enable EOI where hGpib specifies the handle
returned by GpibOpen
```

Read Commands

```
info$ = "sw10?" 'query sw10 for switch count

length% = len(info$) 'length of command

max.len% =10 'max length data form idn? or swxx? function

infi$ = space$(max.len%)

GpibEoi(hGpib;7,0) 'disable EOI

GpibEol(hGpib;7, "",0) 'disable EOL

GpibOutputs(hGpib%,712,info$,length%) 'send query command to tests
set.

GpibEnters(hGpib%,712,infi$,max.len%) 'get data from tests set.

GpibEol(hGpib;7,chr$(13)+chr$(10),2) 're-enable EOL

GpibEoi(hGpib;7,1,) 're-enable EOI
```

National Instruments VISA

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

`VI_ATTR_SEND_END_ENVI = 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 ' ` This specifies whether to suppress the END bit termination. If this attribute is set to VI_TRUE, than the END bit does not terminate read operations. If this attribute is set to VI_FALSE, than the END bit terminates read operations.

Write Commands:

Append all commands with \n. For example; `*rst\n`

Read Commands:

The test set returns data terminated by \r\n. For example the query `sw10?\n` returns 00000010\r\n.

Parallel Port

The third way is used by the service center or during production to verify the port path connections. This uses the parallel port on the rear panel of the Z5623AH86. This method uses an 8722ES Network Analyzers Parallel port to control the test set. The following example assumes that the address of the network analyzer is set to 16. Be sure to use an ending semi-colon.

```
OUTPUT 716;"PARALGPIO";  (Sets the parallel port for GPIO function).
OUTPUT 716;"PARAOUT[D];  (Programs all GPIO output bits (0 to 256) at once).
```

Table 1-2 GPIB and Parallel Commands

GPIB	Description	LCD Display	Parallel	Decimal
A100	RCVR R1 Attenuator 0 dB	A00	00000000	0
A110	RCVR R1 Attenuator 10 dB	A10	00000001	1
A120	RCVR R1 Attenuator 20 dB	A20	00000010	2
A130	RCVR R1 Attenuator 30 dB	A30	00000011	3
A140	RCVR R1 Attenuator 40 dB	A40	00000100	4
A150	RCVR R1 Attenuator 50 dB	A50	00000101	5
A160	RCVR R1 Attenuator 60 dB	A60	00000110	6
P1B	Port 1 Bypass Mode	P1 Bypass Axx	00001110	14
P1HPB	Port 1 High Power Mode	P1 HP Bypass Axx	00001111	15
P1HPP	Port 1 High Power Pulse Mode	P1 HP Pulse Axx	00010000	16
P1P	Port 1 Pulse Mode	P1 Pulse Axx	00010001	17
*RST	Reset (Port 1 Bypass Mode)	P1 Bypass A00	00010110	22
Display		**Description (GPIB)**		
IDN?	Z5623A H86	Read Test Set ID		
	ERR: invalid command	Non GPIB or Parallel Command Sent		

Direct Control

The fourth method to control the test set uses the port 1, 37 pin D-Sub connector located on the rear panel. When the Z5623AH86 is shipped, the jumper (Z5623-60202) is not connected to port 1, 37 pin D-Sub connector. This will allow the user to control the internal switches and attenuators directly from the 37 pin D-Sub connector. Refer to Table 1-4 on page 24 which shows the pinout and function for port 1.

NOTE LCD indicator is only valid when the test set is used in control methods; PNA, Controller, and Parallel. Direct control does not change the LCD indicator when either the switches or attenuators are repositioned.

Controlling the Switches

Control of the internal switches directly, is provided from the 37 pin D-Sub connector and can be done in two ways.

- TTL
- Open Collector

The TTL input allows the user independent switch position control by either a low (0) or high (1). The TTL voltage is 0 or 5 Volts. Refer to Figure 1-11 on page 21. The 37 Pin D-Sub connector shows the rear panel input/output configuration for Port 1. Pins 5, 12, 22 are the TTL input pins. Pin 5 controls SW1, pin 12 controls SW3 and pin 22 controls SW2.

The Open Collector inputs allows the user to control a switch position by grounding either the A (AD) or B (BD) drive input lines for each switch. Only one of these two input lines can be grounded at any given moment. Recommended is break-before-make when the input line position changes. Refer to Figure 1-11. The 37 Pin D-Sub connector shows the rear panel input/output configuration for port 1. Pins 1, 2 control SW1, pins 8, 9 control SW3 and pins 25, 26 control SW2.

Switch Indicators

The internal switch positions can be read-only when used in the Direct Control method. A switch position can be read by either a low (0) or high (1) on the A (AI) or B (BI) indicator lines. The voltage is either 0 or 5 Volts depending on the switch position. Low (0) indicates disabled, and high (1) indicates enabled. Figure 1-11 shows the rear panel input/output configuration for port 1. Pins 3, 4 indicate SW1 position, pins 10, 11 indicate SW3 position, and pins 23, 24 indicate SW2 position. Figure 1-12 on page 21 shows how each switch is configured.

Figure 1-11 37 Pin D-Sub Connector

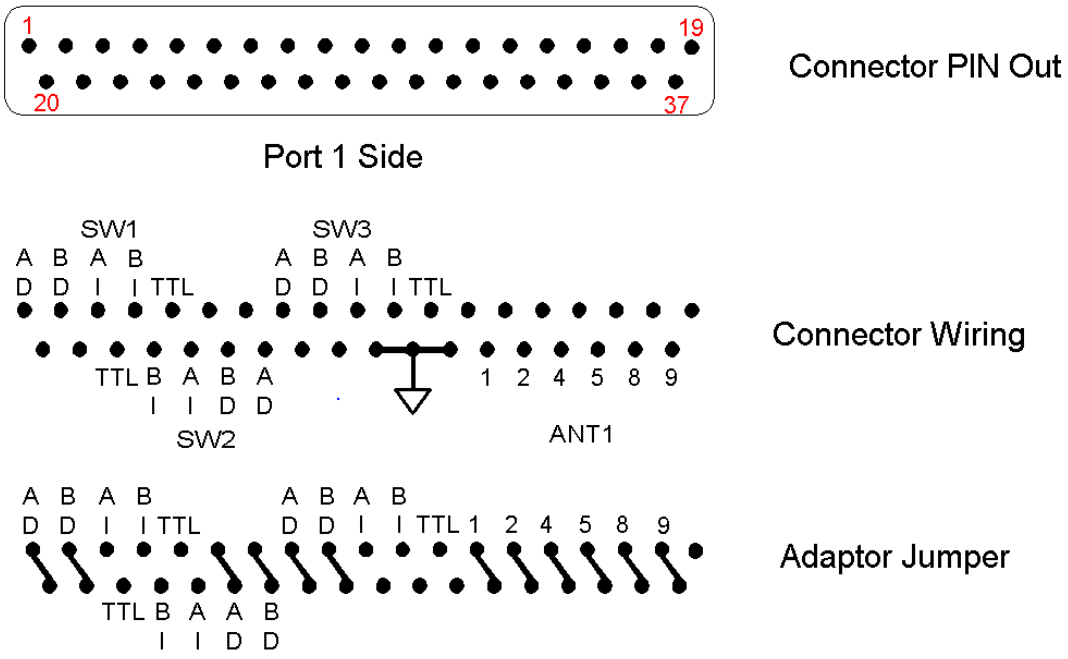
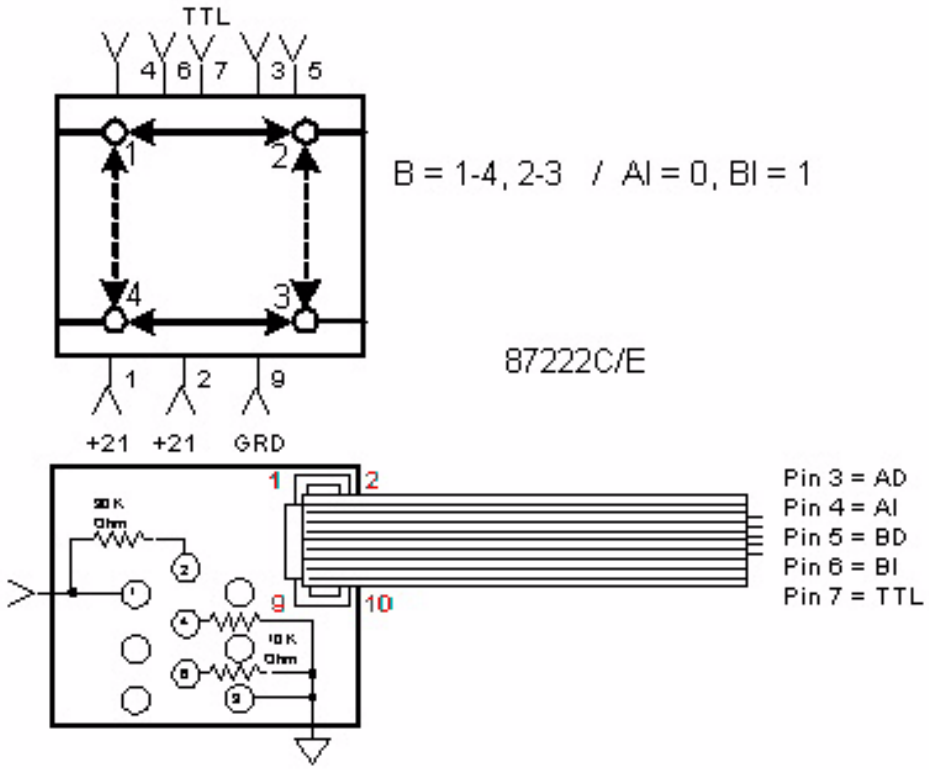


Figure 1-12 Switch Connection



Switch Indicator Function

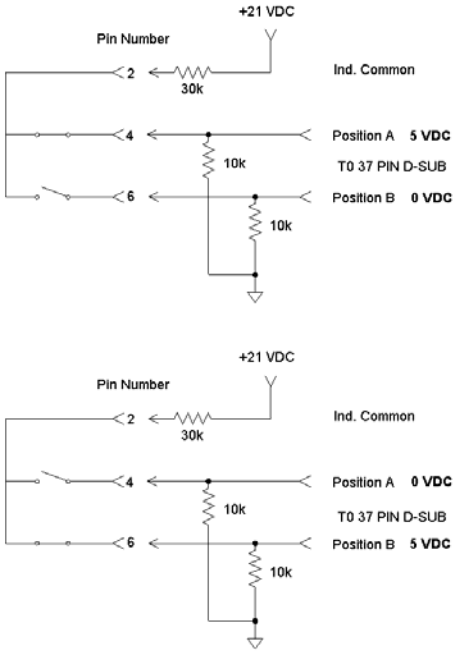
The 87222E is set to the A or B Position. Refer to Table 1-5 on page 25, Switch Indicator Voltages for Test Set Modes. When the switch is set to the A position the Indicator Common is connected, completing the A Indicator path. The 21 VDC connected to the Indicator Common is connected to ground by two resistors (30 kΩ and 10 kΩ). The Position A and B Indicators have independent 10 kΩ resistors to ground. The measured voltage from Position A Indicator to ground is approximately 5 Volts and the Position B Indicator will measure 0 Volts. When the switch is set to Position B, the Indicator common is connected. Measuring the voltage from Position B Indicator to ground will measure approximately 5 Volts and the A indicator will measure 0 Volts.

Example 1 A Indicator Position Connected

- Resistance Indicator Common in a connected path = 40 kΩ
- Resistance between the Indicator Common and Position A when connected = 30 kΩ
- Resistance between Position A and ground = 10 kΩ
- Resistance between the Indicator Common and Position B when connected = OPEN
- Resistance between Position B and ground = 10 kΩ
- I = V/R = 21 V/40 kΩ = 0.525 mA
- Voltage drop across 30 kΩ resistor: V = I×R = 0.525 mA×30 kΩ = 15.75 Volts
- Voltage drop across 10 kΩ resistor: V = I×R = 0.525 mA×10 kΩ = Position A indicator to ground = 5.25 Volts

In that the Position B switch to the Indicator Common is open, only the 10 kΩ resistor ground is connected providing a pull down on the Position B Indicator pin, effectively grounding it.

Figure 1-13 Switch Indicator Status



Controlling the Attenuators

Controlling the attenuators are identical to the Switch Open Collector control method. Figure 1-11 on page 21 shows the rear panel input/output configuration for Port 1. Pins 13-18 control the attenuator. Like the switch open collector lines, brake-before-make operation is used for the attenuator bypass or select setting changes.

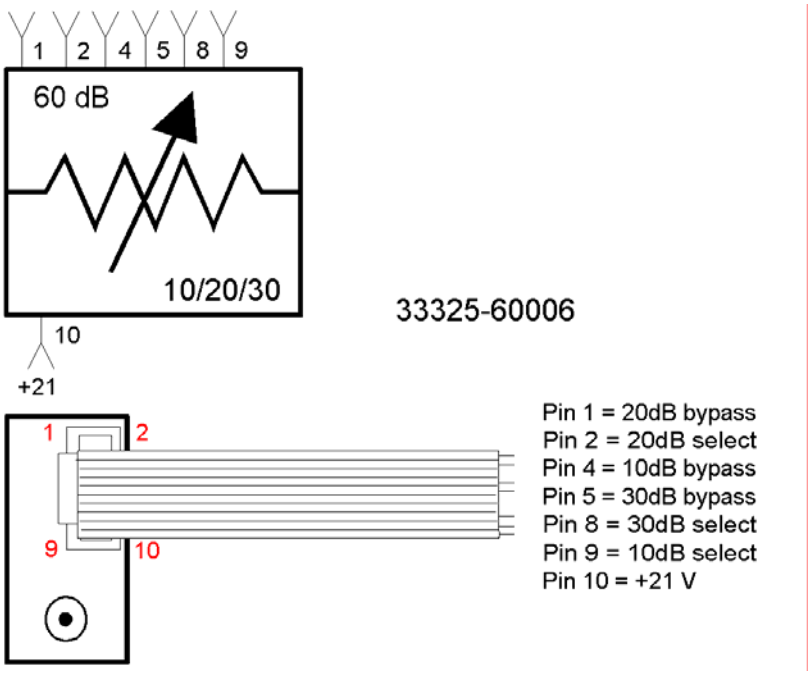
CAUTION Always break-before-make a selection when using the Open Collector control inputs for the switches and attenuators. Failure to do so can damage the internal switches or attenuators.

CAUTION Make rear panel Direct Control connections while the test set is off. Ensure that all inputs are OFF before making any connection. Turn off the test set before removing the connector jumper. Failure to do so can damage the internal switches or attenuators.

Table 1-3

Pin	Description
13	10 dB bypass
14	10 dB select
15	30 dB bypass
16	20 dB bypass
17	20 dB select
18	30 dB select

Figure 1-14 Attenuator Connection



NOTE Switches and attenuators supply voltage is supplied internally by the test set. The supply voltage is 21 Vdc.

NOTE LCD indicator is only valid when the test set is used in the following control methods; PNA, Controller, Parallel. Direct Control does not change the LCD indicator when the switches or attenuators are repositioned.

Table 1-4 Rear Panel Connection for Port 1

Pin #	Switch	Function	Port 1	Description	Switch Position	Pin Bias Switch Control
1	1&4	AD	SW1	Position A Drive	1 to 2; 3 to 4	1=gnd; 2=OPEN
2	1&4	BD	SW1	Position B Drive	1 to 4; 2 to 3	1=OPEN; 2=gnd
3	1&4	AI	SW1	Position A Indicator	A= 5 volts; B= 0 volts	
4	1&4	BI	SW1	Position A Indicator	A= 0 Volts; B= 0 volts	
5	1&4	TTL	SW1	TTL Drive	A=High; B=Low	A=5 volts; B=gnd
26	2&5	AD	SW2	Position A Drive	1 to 2; 3 to 4	1=gnd; 2=OPEN
25	2&5	BD	SW2	Position B Drive	1 to 4; 2 to 3	1=OPEN; 2=gnd
24	2&5	AI	SW2	Position A Indicator	A= 5 volts; B= 0 volts	
23	2&5	BI	SW2	Position B Indicator	A= 0 volts; B= 5 volts	
22	2&5	TTL	SW2	TTL Drive	A=High; B=Low	A=5 volts; B=gnd
8	3&6	AD	SW3	Position A Drive	1 to 2; 3 to 4	1=gnd; 2=OPEN
9	3&6	BD	SW3	Position B Drive	1 to 4; 2 to 3	1=OPEN; 2=gnd
10	3&6	AI	SW3	Position A Indicator	A= 5 volts; B= 0 volts	
11	3&6	BI	SW3	Position B Indicator	A= 0 volts; B= 5 volts	
12	3&6	TTL	SW3	TTL Drive	A=High; B=Low	A=5 volts; B=gnd
Pin #	**Attenuator**	**Function**	**Port 1**	**Description**	**Attenuator Position**	**Pin Bias Atten Control**
13	1&2	10 OUT	Atten1	10 dB Bypass	0	13=gnd; 14=OPEN
14	1&2	10 IN	Atten1	10 dB Select	10	13=OPEN; 14=gnd
15	1&2	30 OUT	Atten1	30 dB Bypass	0	15=gnd; 18=OPEN
16	1&2	20 OUT	Atten1	20 dB Bypass	0	16=gnd; 17=OPEN
17	1&2	20 IN	Atten1	20 dB Select	20	16=OPEN; 17=gnd
18	1&2	30 IN	Atten1	30 dB Select	30	15=OPEN; 18=gnd

Table 1-5 Switch Indicator Voltages for Test Set Modes

VDC	SW1		SW2		SW3	
0 VDC= Disengaged 5 VDC= Engaged						
	AI	BI	AI	BI	AI	BI
Bypass	0	5	0	5	0	5
HP Bypass	0	5	5	0	5	0
Pulse	5	0	0	5	0	5
HP Pulse	5	0	5	0	5	0

NOTE Indicator position voltages are influenced by the user's interface. High impedance, sensor, or TTL input may be used to monitor the indicator position lines.

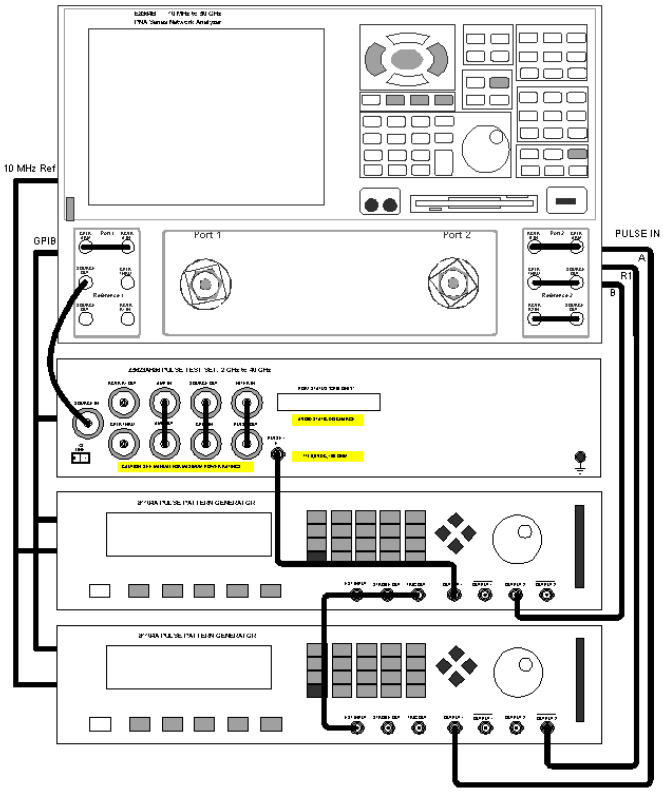
Making High Power Measurements With Option H86

The Z5623AH86 and PNA with Options 014, 016, 080, 081, and UNL or H85 can be configured to measure high power devices. This ability is useful if the required power for the device under test is greater than the analyzer can provide, or if the maximum output power from an amplifier under test exceeds safe input limits for a test set and analyzer. This section describes how to set up the analyzer to perform high power measurements.

Setup

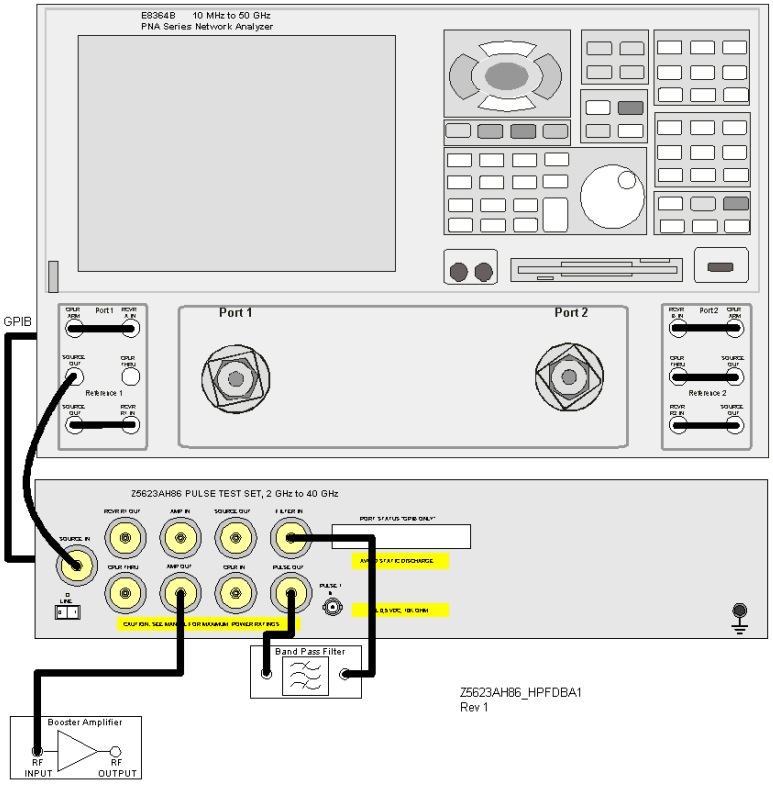
1. Turn off all of the equipment. Be sure that the jumpers between the PNA and test sets RCVR 1 and CPLR THRU are disconnected at this time. This will protect the PNA from damage.
2. Connect the PNA jumpers for Port 1 SOURCE OUT and RCVR IN connectors.
3. Connect the Z5623AH86 to the PNA, refer to Figure 1-15, “Setup Configuration.” Depending on your application set up, not all pulse pattern generators may be required as shown in this figure.

Figure 1-15 Setup Configuration



4. If the Z5623AH86 is in the Shipped mode configuration (all the jumpers are still on) remove the jumper between AMP OUT and AMP IN connectors on the front panel for Port 1. Refer to Figure 1-16, “Connect Booster Amplifier.”
5. Place two terminations on J3 and J4 on the rear panel for AMP 1 and 2.
6. Verify that the Booster Amplifier is turned off at this time.
7. Connect the Booster Amplifier RF INPUT connector to the Port 1 AMP OUT connector on the front panel of the Z5623AH86.
8. Remove the jumper on the Z5623AH86 between SOURCE OUT and CPLR IN. Place an isolator or attenuator between the SOURCE OUT and CPLR IN on the port 2 side of the PNA.

Figure 1-16 Connect Booster Amplifier



Determining Power Levels

Before continuing, save this state and set it up as the **User Preset** key. The User Preset Conditions can be found in the PNA Series Network Analyzer's help menu.

1. Press **[Menu/Dialog]** then tab to **Help**. Select **Network Analyzer Help**. Type in *User Preset*, this will describe how to setup a User Preset. The final state should be saved as the User Preset to avoid an over power condition from the factory preset.

To find the User Preset:

2. Press **[Menu/Dialog]** then tab to **System**. Scroll down to **User Preset**. Click on **User Preset Enable** and press **Save,** then **OK.** This will save the current state as **User Preset**.
3. Turn on the analyzer and decrease the power level to –20 dBm by pressing **[Menu/Dialog]** then tab to **Channel**. In the pull down menu select **Power**. Scroll to **Port Selection** enter **[–20]**. Select **Port Power Coupled** to ensure that Ports 1 and 2 power levels are the same. Uncoupled ports should be used when adjusting the S12 power level or when Port 1 has a very low power level in comparison to Port 2.

NOTE Frequency Offset mode (Option 080) and External R1 (Option 081) must be activated when using the analyzer in a high power configuration. This will ensure phase lock and allow the R1 and R2 to receive the new reference power levels from the amplifiers.

- Press **[Menu/Dialog]** then tab to **Channel.** In the pull down menu select **Frequency Offset** and turn on the **Frequency Offset Mode**. In the Offset Setting set the **Offset** to **[0]**.
- Press **[Menu/Dialog]** then tab to **Channel.** In the pull down menu select **Test Set**. Select the **External R1 Loop** in the R1 Input Path window.

4. Set the Z5623AH86 Test Set so that the external booster amplifier is in the RF path. Refer to "Controlling the Test Set" on page 11 to set the external Booster Amplifier to be engaged in the RF path.
5. Turn on the booster amplifier.
6. Measure the output power from the booster amplifier RF Output using a power meter and sensor.

NOTE Additional attenuation may have to be added between the coupler and the power meter, depending on the power used.

7. Verify the gain of the Booster Amplifier(s). For example, if the analyzer's output power level was set to –20 dBm and the output power measured from the open end of the coupler was –5 dBm, the gain of the booster amplifier would be +15 dB.

8. Verify that the power measured in the previous steps is within the acceptable limits (less than +43 dBm for the AMP IN port). The maximum power level between 40 GHz and 50 GHz is +40 dBm.
9. Turn off the booster amplifier.
10. Estimate the maximum power level that will be needed to force the DUT into compression. Acceptable limits are less than +43 dBm for the AMP IN port. The maximum power level between 40 GHz and 50 GHz is less than +40 dBm.

CAUTION Do not command the test set to engage *or* disengage the amplifier from the Port 1 RF path while the amplifier is on. This can damage the internal RF switches in the test set.

11. Verify that the Booster Amplifier is turned off.
12. Connect the Booster Amplifier RF OUTPUT connector to the Port 1 AMP IN connector on the front panel of the Z5623AH86.
13. Turn on the Booster Amplifier.
14. Using a high power meter and sensor, measure the output power from the test sets RCVR R1 port.
15. Turn off the Booster Amplifier.
16. Estimate the maximum power level that will be needed to force the DUT into compression.

Selecting Power Ranges and Attenuator Settings

1. Select a power range that will not exceed the maximum estimated power level, but will force the DUT into compression. For example, if your Booster Amplifier has a gain of +15 dB and the DUT will compress if supplied with +15 dBm, then you would adjust the analyzer's output power not to exceed 0 dBm. This can be done by setting the Attenuator Control to 10 dB by pressing **Power**, under **Attenuator Control,** uncheck **Auto** and enter **[10]** into the entry area. In the "Port Selection" area, the Port Power Coupled can be checked to ensure that Port 1 and 2 power levels are the same, or unchecked if Port 1 and 2 power level requirements are different.
2. Estimate the maximum amount of gain that could be provided by the DUT and as a result, the maximum amount of power that could be received by Test Port 2 when the DUT is in compression. For example, if a DUT with a maximum gain of +10 dB receives an input of +10 dBm, then the maximum amount of power that could be received by Test Port 2 is +20 dBm. An isolator or attenuator may be required depending on the amount of power at Test Port 2. An isolator is placed between the CPLR IN and SOURCE OUT to protect the test set and the PNA.
3. Calculate the amount of attenuation needed between the analyzer's coupler and receiver so that you do not exceed the optimum receiver power level of –15 dBm. Refer to your PNA specifications to optimize power levels to the receiver ports.

It will be necessary to take the following into consideration:

- Power measured at the test sets RCVR R1 OUT = –2 dBm.
- Estimated compression power = –2 dBm.
- The optimum PNA receiver power level = –15 dBm.

Attenuation Equations:

4. Set the internal Z5623AH86 Test Set RCVR R1 step attenuator to the value calculated below (rounding off to the highest 10 dB step). Refer to "Controlling the Test Set" on page 11 to set the Attenuator for RCVR R1 OUT path.

With the previous points in mind, the amount of attenuation can be calculated from the following equations:

$$Attenuator\ \ RCVR\ \ R1\ \ Setting\ \ = -2dBm - (-15\ \ dBm)\ \ = \ 13\ \ dBm$$

$$RCVR\ \ R1\ \ Attenuator\ \ Value = \ 20$$

5. Turn on the Booster Amplifier.
6. Measure the output power from the test sets RCVR R1 using a high power meter and sensor.
7. Verify that the power measured in the previous step is within the acceptable limits (–12 dbm at the RCVR R1 OUT).

8. Measure the output power from the test sets CPLR THRU port using a high power meter and sensor.
9. Turn off the Booster Amplifier.
10. Verify that the power measured in the previous step is within the acceptable limits (less than +43 dBm at the CPLR THRU port). The maximum power level between 40 GHz and 50 GHz is less than +40 dBm.
11. Calculate the amount of attenuation needed between the analyzer's coupler and receivers so that you do not exceed the optimum receiver power level of –15 dBm.

It will be necessary to take the following into consideration:

- Receiver A will be coupled to the analyzer RF path that could receive power reflections as high as +10 dBm.
- Receiver B will be coupled to the analyzer RF path that could receive a maximum of +20 dBm from the DUT.
- Analyzer coupler loss is –13 dB.
- The optimum receiver power level is –15 dBm.

12. Set the internal step attenuator to the value calculated below (rounding off to the highest 5 dB step). Setting the receiver attenuation will set the internal attenuation. Press **[Menu/Dialog]** then tab to **Channel**. In the pull down menu select **Power**, under **Receiver Attenuation** set Receiver A to **[10]** and Receiver B to **[20]**. Power levels greater than +35 dBm will require additional attenuation between Port 2, access ports CPLR ARM and RCVR B IN.

With the previous points in mind, the amount of attenuation can be calculated from the following equations:

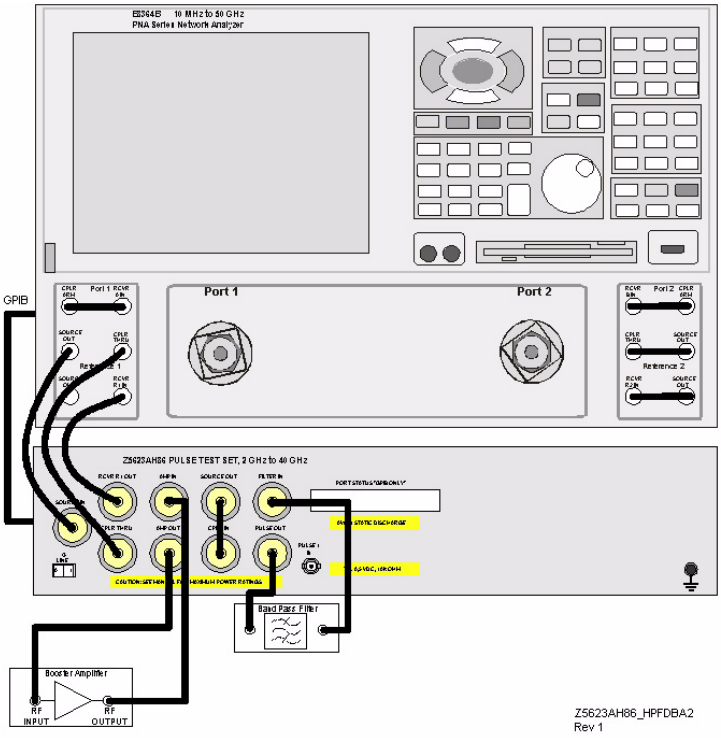
$$Reciver\ Attenuator\ A = 10\ dBm - 13\ dBm - (-15\ dBm) \qquad Attenuator\ A = 12\ dBm$$

$$Reciver\ Attenuator\ B = 20\ dBm - 13\ dBm - (-15\ dBm) \qquad Attenuator\ B = 22\ dBm$$

Additional Setup

1. Remove the PNA SOURCE OUT and the RCVR IN jumpers.
2. Insert the jumpers between the PNA and the test set RCVR RI and CPLR THRU ports.
3. Turn on the Booster Amplifier.
4. Measure the output power from test Port 1 using a high power sensor. Verify that the power level is as expected.

Figure 1-17 Connect PNA and Test Set Jumpers



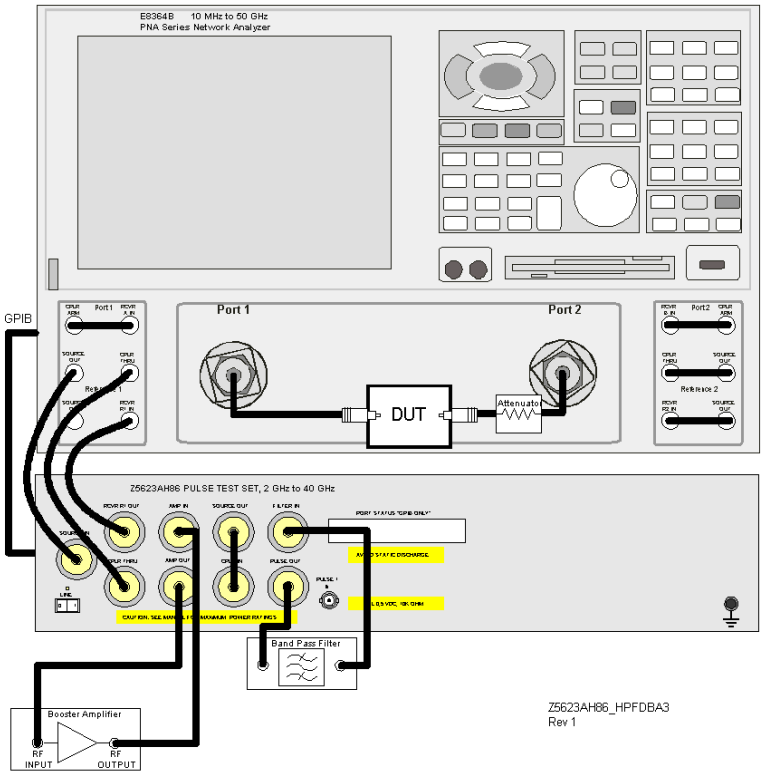
CAUTION Do *not* press Preset unless you have turned off the Booster Amplifier(s) or have saved this state and renamed it to User Preset. Pressing Preset will return the analyzer to its default power level and default internal attenuator settings. The increase in power may result in damage to the DUT or analyzer.

CAUTION High power isolators should be inserted between the SOURCE OUT and CPLR IN front panel ports on the test set if you are measuring a highly reflective device. The increase in power may result in damage to the analyzer.

Final Setup and Response Calibration

1. Verify that all of the power and attenuator settings are correct, and set to the following measurement. Press **[Menu/Dialog]** then tab to **Trace**. In the pull down menu select **Measure** then **S21**.
2. Connect the analyzers test port cables to form a thru configuration.
3. Press **[Menu/Dialog]** then tab to **Calibration**. In the pull down menu select **Calibration Wizard** and then **Unguided Calibration Use Mechanical Standards**. Select **THRU Response**. Follow the analyzers window prompts to finish the calibration.
4. Make the connection as shown in Figure 1-18.

Figure 1-18 Connecting the DUT



5. Turn on the DUT and measure the S21 gain of the amplifier under test to confirm the proper operation of the measurement test setup.

6. Continue with any other high power measurements.

NOTE Ratio measurements, such as gain, will be correctly displayed. However, the displayed absolute power levels on the analyzer will *not* be correct. To correctly interpret power levels and the gain of the booster amplifier, the attenuator setting must be taken into consideration.

If no calibration has been performed or if the instrument is in an un-calibrated state, the following must be taken into consideration when interpreting the measured data:

- The value of attenuation added to receiver A and B.
- The R channel reference level supplied from the test set.
- Protection of the internal parts for the test set and PNA.

Test Set Internal Configurations

The Z5623AH86 can be internally configured to allow the user to configure it for different application requirements. In this section we will show the test sets internal configurations.

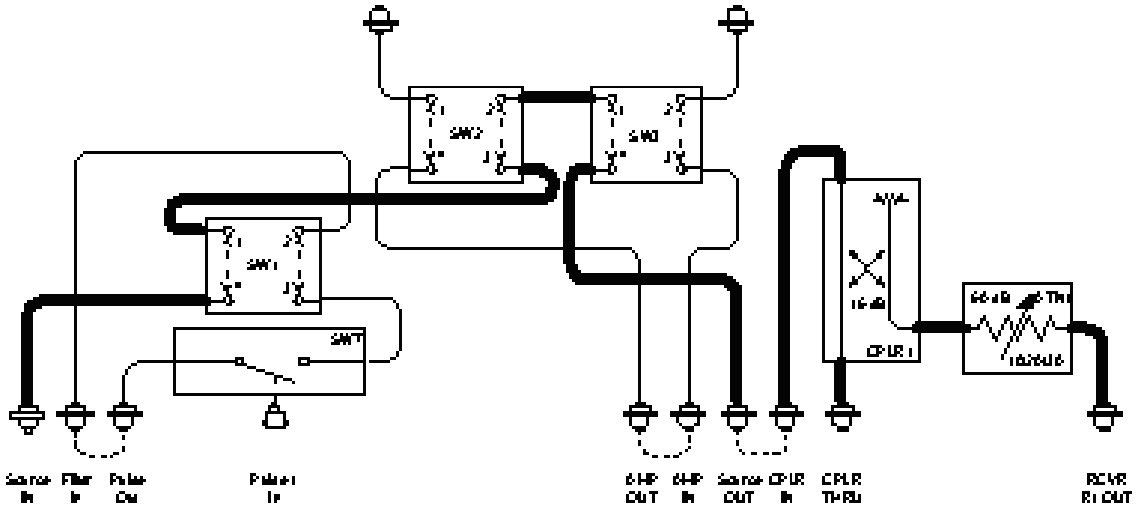
There are five basic mode configurations:

- Bypass
- High Power
- Pulse
- Pulse High Power
- Amplifier Terminate

Bypass

The bypass mode sets the Test Set's internal switches so that the SOURCE IN port thru path connects directly to the CPLR THRU port. This allows you to use the PNA in a normal operation. The test port and R1 reference power at the PNA will be reduced due to the loss of the test set.

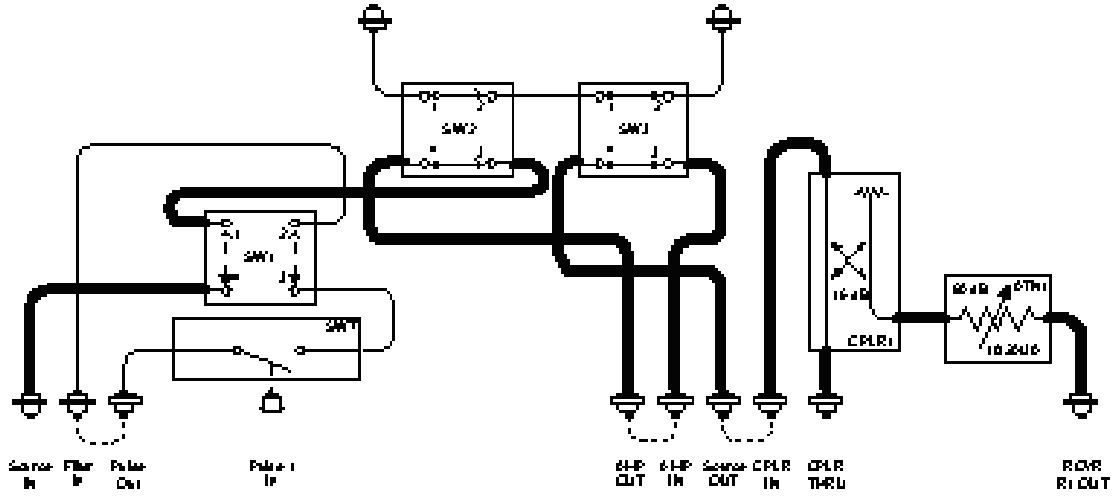
Figure 1-19 Bypass



High Power

The high power mode sets the Test Set's internal switches so that the SOURCE IN port thru path connects to the AMP OUT and AMP IN ports, and then to the CPLR THRU port. This allows the user to insert a Booster Amplifier in the RF path.

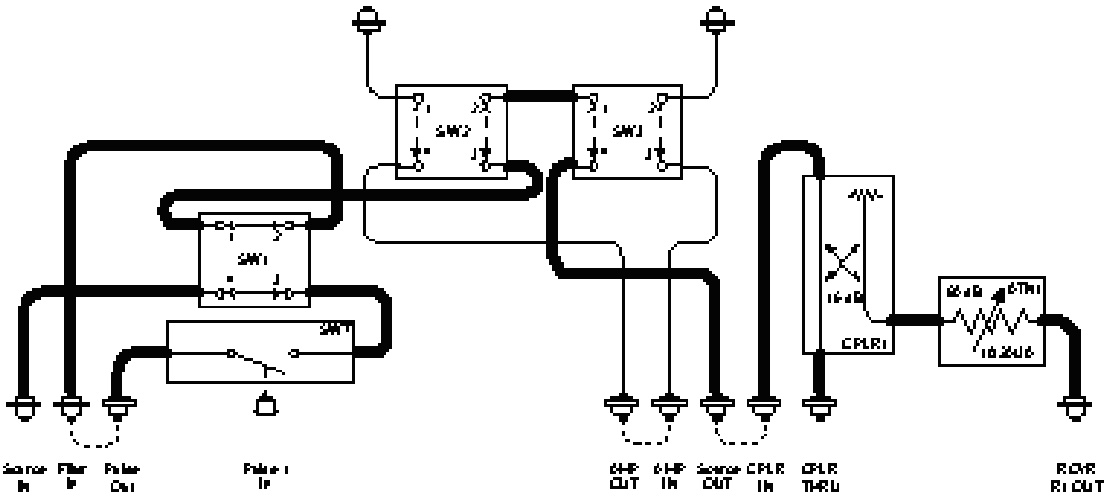
Figure 1-20 High Power



Pulse

The pulse mode sets the Test Set's internal switches so that the SOURCE IN port thru path connects to the pin switch modulator, directly to the CPLR THRU port. This allows the user to make lower power pulse measurement.

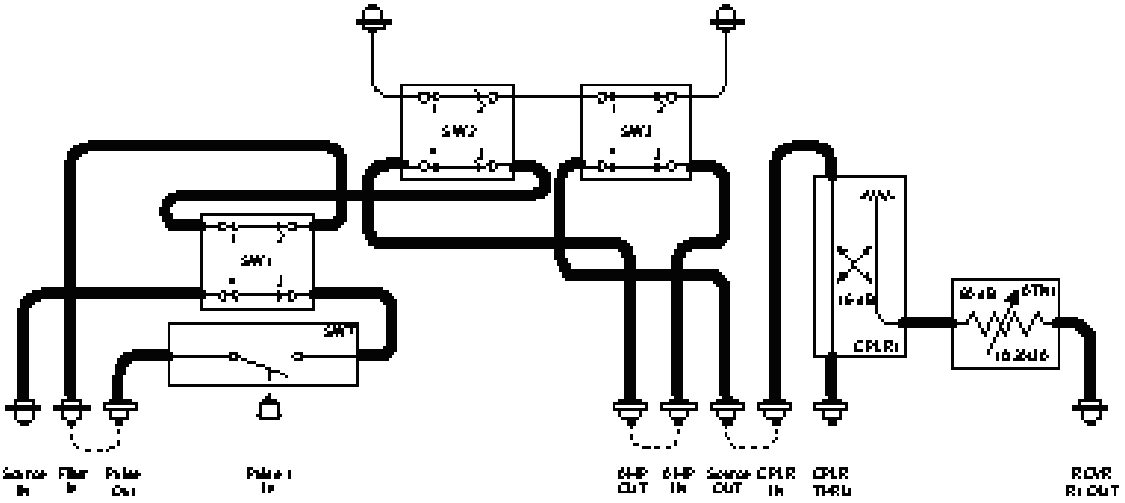
Figure 1-21 Pulse



Pulse High Power

The pulse high power mode sets the Test Set's internal switches so that the SOURCE IN port thru path connects to the pin switch modulator, then to the AMP OUT and AMP IN ports, and then to the CPLR THRU port. This allows user to insert a booster amplifier in the pulsed RF path.

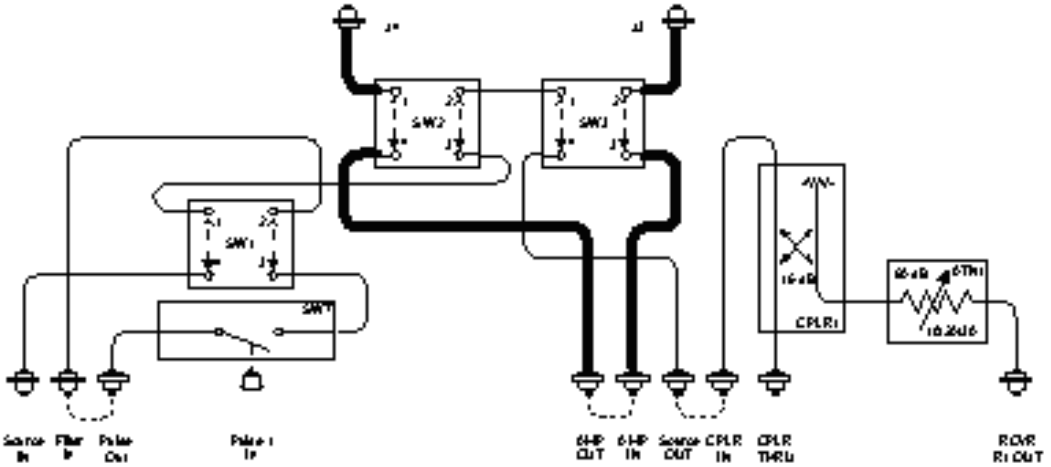
Figure 1-22 Pulse High Power



Amplifier Terminate

The terminate amplifier is set in the bypass and pulse mode. This sets the Test Set's internal switches so that the AMP IN and AMP OUT RF ports are routed to the rear panel Amp Term 1 ports. Customer furnished terminations can be connected to these ports so that you may customize your power requirements. This allows the user to terminate the Booster Amplifiers input and output.

Figure 1-23 Amplifier Termination



Specification

Specifications for the Z5623AH86 Forward Direction Pulse Test Set are nominal.

Pulsed RF Pin Switch Detectors

Transition Time: 30 nanoseconds; TYPICAL 20 nanoseconds

Rise/Fall Time (10% to 90%): 10 nanoseconds; TYPICAL 8 nanoseconds

Pulse Width (minimum): 100 nanoseconds

Trigger Level (External): 10 kΩ TTL, "0" ON, "1" OFF, TTL-low-level signal turns RF on.

Maximum Power Input: 20 dBm

On/Off Ratio: 65 dB (> 90 dB, 400 MHz to 2 GHz)

Frequency Range: 2 to 40 GHz

E8363B/E8364B RF Pin Switch Modulator

Widest Bandwidth: 10 kHz

Trigger Level (External): TTL

Trigger Width (minimum): 20 nanoseconds

Table 1-6 Nominal System Performance

Item		Unit of Measure			
Nominal system Performance (Not tested at this time)		0.01 to 8 GHz	8 to 20 GHz	20 to 40 GHz	40 to 50 GHz
Maximum Power at Port 1[a] (nominal)		–25 dBm	–30 dBm	–35 dBm	–40 dBm
Reference Power at Port 1 (nominal)		–38 dBm[b]	–43 dBm	–48 dBm	–53 dBm
Minimum Power at Port 1[c] (nominal)		–80 dBm	–80 dBm	–80 dBm	–80 dBm
System Dynamic Range[d] (bypass mode)		110 dB	100 dB	90 dB	85 dBm
System Dynamic Range[d] (pulse mode)	Pulse[e]	50 dB[f]	50 dB	50 dB	
	Non-Pulse[e]	80 dB[f]	80 dB	80 dB	

a. This maximum power measurement assumes that the PNA source attenuator is set to 0 dB and the power level is set to –17 dBm (default power level for the E8363B and E8364B).
b. Excludes frequencies below 1 GHz due to test sets RCVR Out Coupler. Frequencies below 1 GHz are nominally –3 dB at 500 MHz, –15 dB at 100MHz, and –20 dB at 50MHz from measured performance at 1 GHz.
c. This minimum power measurement is in bypass mode.
d. Forward transmission measurements. Limited by compression level and noise floor.
e. System Dynamic Range “Pulse” indicates the ON/OFF ratio of the pin switch. The Non Pulse indicates when the pin switch is ON and not used in a pulse mode application.
f. Excludes performance below 2 GHz.

Test Set Performance Verification

Equipment Required

- E8363B/E8364B Network Analyzer 10 MHz to 50 GHz or equivalent
- 85056A Calibration kit or equivalent
- 81110A with 81111A Pulse Pattern Generator
- (2) 2.4 mm RF cables (36 inch or equivalent)
- 86110A Infinium DCA Wideband Oscilloscope
- 83484A Two Channel 50 GHz Module

Procedure

To test the performance of the Z5623AH86 this document assumes that the user is familiar with the necessary equipment. The PNA USB keyboard and mouse will be necessary to enter GPIB commands and to read the trace data. Measurements can be made easier by setting up Markers with search, tracking and search domain user states for each of the frequency bands.

Using the PNA as the controller to issue commands to the Z5623AH86 Test Set can be found in "Controlling the Test Set" on page 11.

General S-Parameters are used to characterize the connection paths of the test set. Both reflection and transmission measurements are required. These measurements are made with the E8363B, 2.4 mm cal kit and RF cables. Power Output and Pulse Shape are not measured to re-verify the Z5623AH86 test set.

A Full 2-Port Slot Calibration should be performed on the PNA at the ends of the RF cables. The Isolation must not be omitted. The calibration should be performed at the following settings shown in Table 1-7.

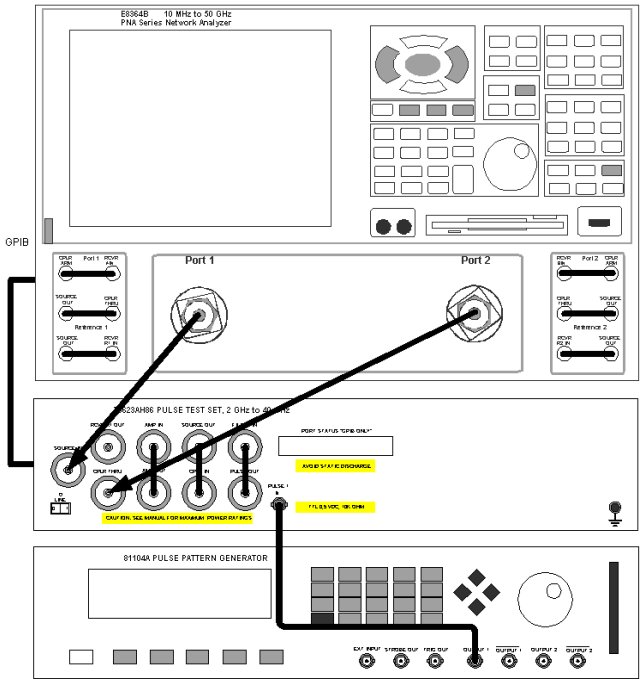
Table 1-7 Calibration Settings

Start freq	10 MHz	Stop Freq	50 GHz
Power level	–17 dbm	IF bandwidth	100 Hz
Number of points	401		

CPLR Thru S-Parameters

1. Connect the RF cables as shown in Figure 1-24, “CPLR Thru S-Parameters,” which shows the configuration for Port 1 setup. This measures the Source In to CPLR THRU S-Parameters and On/Off Ratio for Port 1. Connect Port 1 and record the data in Table 1-8 on page 49.
2. Connect a 50 Ω load to the RCVR Out Port.
3. Set the Z5623AH86 Test Set to the Bypass mode using the PNA as the controller. Measure the S-Parameters for the Source In to CPLR THRU. Record the performance data in Table 1-8.
4. Verify that the Pulse In is set to 0 Volts on the 81111A and set the impedance on the Output to 1000 Ω
5. Set the Z5623AH86 Test Set to the High Power mode using the PNA as the controller. Measure the S-Parameter for the Source In to CPLR THRU. Record the data in Table 1-8.
6. Set the Z5623AH86 Test Set to the High Power Pulse mode using the PNA as the controller. Measure the S-Parameter for the Source In to CPLR THRU. Record the data in Table 1-8 for frequencies between 20 to 40 GHz only.
7. Set the Z5623AH86 Test Set to the Pulse mode using the PNA as the controller. Measure the S-Parameter for the Source In to CPLR THRU. Record the data in Table 1-8 for frequencies between 20 to 40 GHz only.

Figure 1-24 CPLR Thru S-Parameters

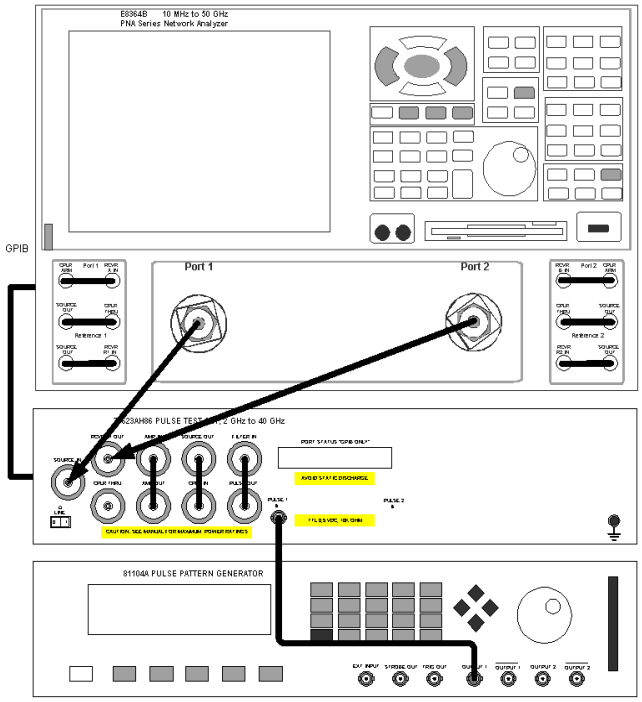


Z5623AH86 Sbar

RCVR Port S-Parameters

1. Connect the RF cables as shown in Figure 1-25, “RCVR Port S-Parameters,” which shows the configuration for Port 1 setup. This measures the Source In to REF 1 OUT S-Parameters for the Port 1. Record the data in Table 1-9 on page 49.
2. Set the Z5623AH86 Test Set to the Pulse mode using the PNA as the controller. Measure the S-Parameters for the Source In to REF OUT. Record the data in Table 1-9 for frequencies between 20 to 40 GHz only.
3. Connect a 50 Ω load to the CPLR Thru Port.
4. Verify that the Pulse In is set to 0 Volts on the 81111A and set the impedance on the Output to 1000 Ω
5. Set the Z5623AH86 Test Set to the High Pulse mode using the PNA as the controller. Measure the S-Parameter for the Source In to REF OUT. Record the data in Table 1-9.
6. Set the Z5623AH86 Test Set to the High Power mode using the PNA as the controller. Measure the S-Parameter for the Source In to REF OUT. Record the data in Table 1-9.
7. Set the Z5623AH86 Test Set to the Bypass mode using the PNA as the controller. Measure the S-Parameter for the Source In to REF OUT. Record the data in Table 1-9.

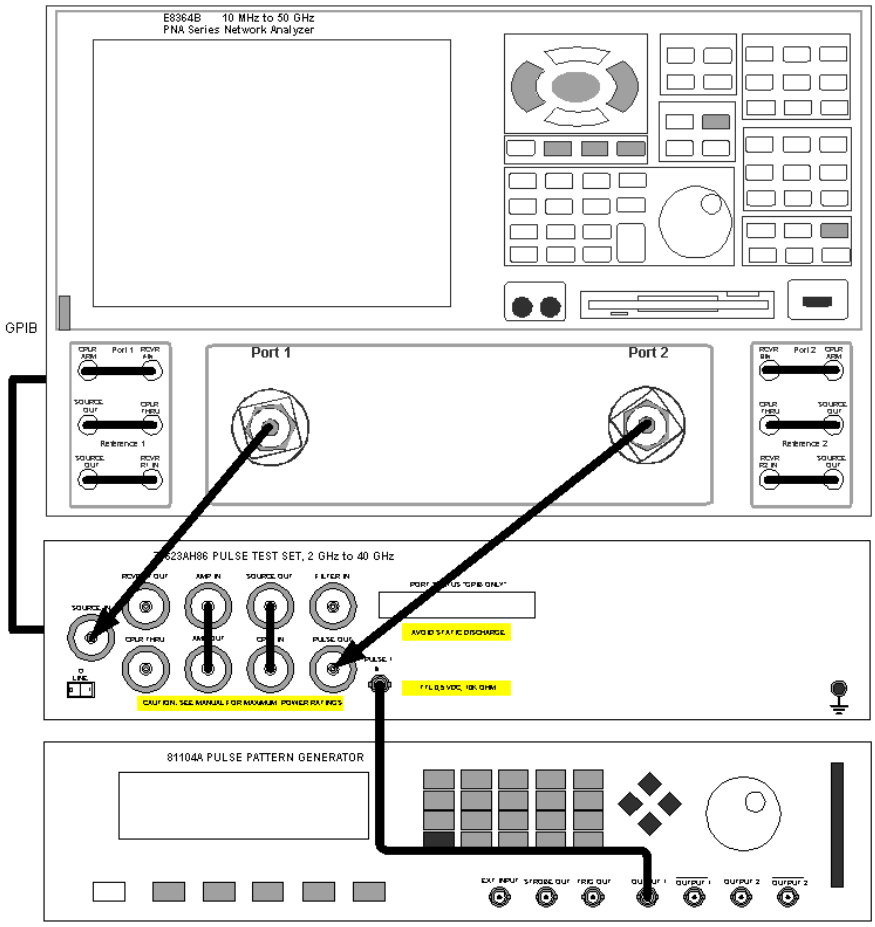
Figure 1-25 RCVR Port S-Parameters



On/Off Switch Ratio

1. Connect the RF cables as shown in Figure 1-26, “On/Off Switch Ratio,” which shows the configuration for Port 1 set up. This measures the Source In to REF 1 OUT S-Parameters and Reference Attenuators for Port 1. Record the data in Table 1-10 on page 50.
2. Verify that the Pulse In is set to 0 Volts on the 81111A and set the impedance on the Output to 1000 Ω
3. Set the Z5623AH86 Test Set to the Pulse mode using the PNA as the controller. Measure the S-Parameter for the Source In to Pulse Out. Record the data in Table 1-10.
4. Set the PNA to measure S21 only. Normalize the S21 response.
5. Set the Pulse In to 5 Volts by changing the 81111A Output to 5 Volts.
6. Measure the On/Off Ratio. Record the data in Table 1-10.

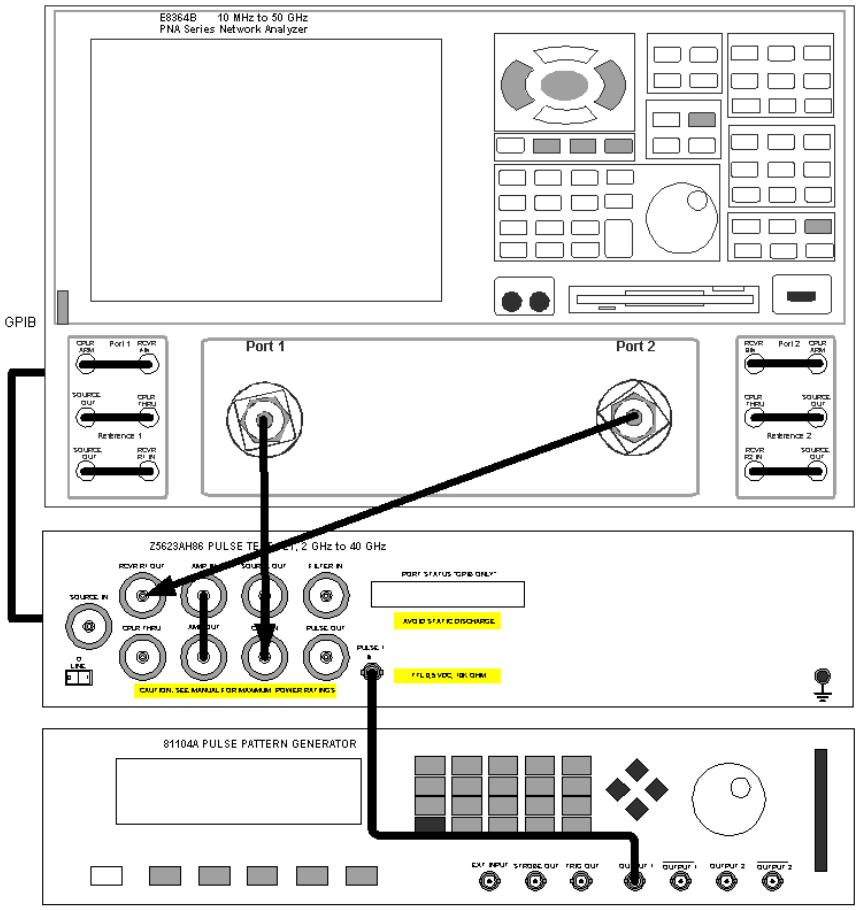
Figure 1-26 On/Off Switch Ratio



Attenuator Settings

1. Connect the RF cables as shown in Figure 1-27, “Attenuator Steps,”. This configuration measures the CPLR IN to REF 1 OUT Reference Attenuators for Port 1. Record the data in Table 1-10 on page 50.
2. Connect a 50 Ω load to the CPLR Thru Port.
3. Set the PNA to measure S21 only. Normalize the S21 response.
4. Set Marker 1 to 2 GHz. The attenuator setting is measured at 2 GHz only to test the attenuators relative attenuation for each setting. The noise floor of the PNA limits measurements when the test sets attenuator setting is greater than 40 dB. Frequencies above 6 GHz at low power levels make measurements difficult. Frequencies below 1 GHz are also difficult due to the coupler roll off.
5. Set the Z5623AH86 Test Set Reference Attenuator in 10 dB steps (10 - 60 dB) and measure the response. Record the data in Table 1-10.

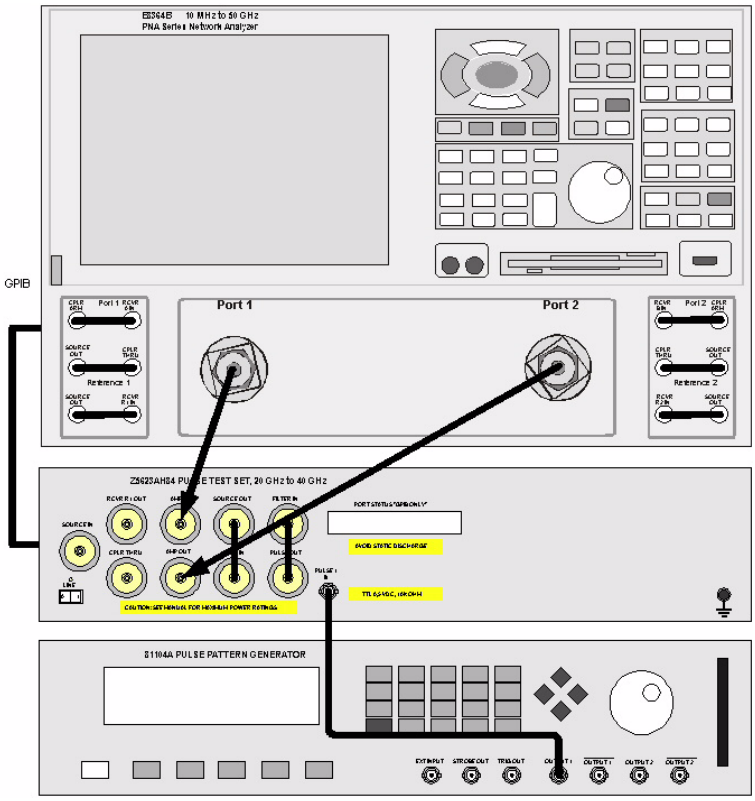
Figure 1-27 Attenuator Steps



Rear Panel Termination Test

1. Connect the 50 Ω loads to the rear panel connectors J3, and J4.
2. Set the PNA to measure S11 and S22.
3. Set the Z5623AH86 Test Set to the Bypass mode using the PNA as the controller. Measure the S-Parameter to the Amp In and Amp Out for J4 and J3. Record the data in Table 1-10 on page 50.

Figure 1-28 Rear Panel Termination

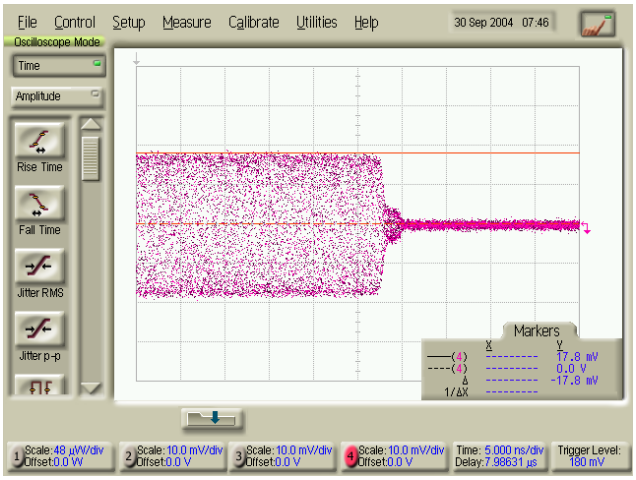


Rise and Fall Time Test

1. Connect the RF cables shown in Figure 1-31 on page 48. This configuration measures the rise and fall times of the pin switch modulators in the test set. Record the data in Table 1-10 on page 50.
2. Set the E8363/64B to **[CW mode] [Frequency] [20 GHz]**.
3. Set the E8363/64B **[Power Level] [–20 dBm]**.
4. Turn the 81110A Output 1 **On**.
5. Set the 81110A **[LEVEL] Normal** > **High 5 Volts** > **Low 0 Volts** > **50 to 1 kΩ**
6. Set the 81110A **[TRIGGER MODE]** to **Continuous** > **Pulse Signal** to **Output 1** > **Pulse Period** to **Internal Osc**.
7. Set the 81110A **[TIMING]** to **Freq 100 kHz** > **Delay 0 ns** > **Duty Cycle 90%** > **LeadEdge 2 ns** > **TrailingEdge = LeadEdge**.
8. Set the 81110A **[PATTERN]** to **Update Continuous** > **CH1** to **1**.
9. Set the 86100A for **Channel 1 On** > **Scale to 10 mv** > **Time** to **2 µs**. Position the pulse to the right edge of display.
10. Expand the **Time** scale to measure the pulse amplitude at 100 ns. You may need to reposition the pulse to keep the rising edge on the display.
11. Measure the amplitude of the Positive pulse side by setting the **solid horizontal marker** to the center of the trace 0 Volts. Set the **dash horizontal marker** to the maximum Positive Pulse amplitude. Measure the delta voltage. The following equation will allow you to calculate the 10% and 90% rise and fall time.

    10% point = delta (positive pulse) × 0.1
    90% point = delta (positive pulse) × 0.9

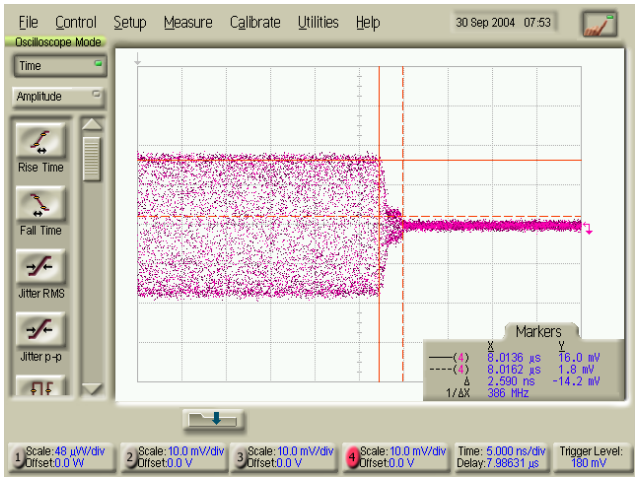
Figure 1-29 Delta Voltage



12. Set the **solid horizontal marker** to the 10% point and the **dash horizontal marker** to the 90% point.

13. Expand the **Time scale** of the oscilloscope for **5 ns**, keeping the pulses rise time in view.
14. Set the **vertical solid marker** to the 10% point and the **vertical dash marker** to 90%, and measure the rise time by reading the delta vertical Marker. Record the rise time in Table 1-10.
15. Increase the Time scale to 100 ns. Position the Marker on the pulses fall time to the right on the display and then expand the scale to 5 ns keeping the pulse fall time in view.
16. Set the **vertical solid marker** to the 90% point and the **vertical dash marker** to 10%, measure the fall time by reading the delta vertical marker. Record the fall time in Table 1-10.

Figure 1-30 Fall Time



17. Repeat Steps 9 through 16 for 30 GHz and 40 GHz by changing the CW frequency on the E8363/64B and measure the rise and fall times.

Figure 1-31 Rise and Fall Time Setup

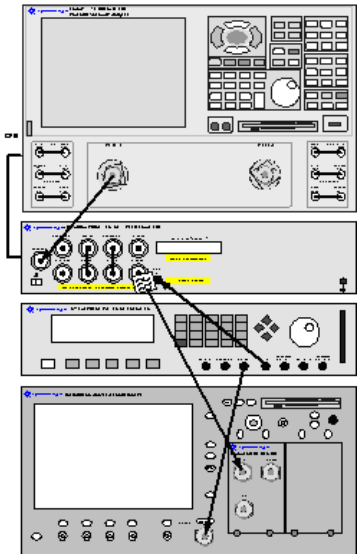


Table 1-8 Performance Data (Port 1 to CPLR THRU)

Port/Connection/Mode	2 to 8.0 GHz		8.0 to 20.0 GHz		20.0 to 40.0 GHz		40.0 to 50.0 GHz	
Port 1 SOURCE IN to CPLR THRU	Spec (dB)	Meas	Spec (dB)	Meas	Spec (dB)	Meas	Spec (dB)	Meas
Bypass								
S11, S22	18		12		11		11	
S21, S12	–6		–10		–14		–16	
High Power								
S11, S22	18		12		11		11	
S21, S12	–8		–12		–17		–20	
High Power Pulse								
S11, S22	8		6		6		n/a	n/a
S21, S12	–16		–22		–26		n/a	n/a
Pulse								
S11, S22	8		6		6		n/a	n/a
S21, S12	–16		–20		–24		n/a	n/a

Table 1-9 Performance Data (Port 1 to RCVR R1 OUT)

Port/Connection/Mode	2 to 8.0 GHz		8.0 to 20.0 GHz		20.0 to 40.0 GHz		40.0 to 50.0 GHz	
Port 1 SOURCE IN to RCVR R1 OUT[a]	Spec (dB)	Meas	Spec (dB)	Meas	Spec (dB)	Meas	Spec (dB)	Meas
Pulse								
S11, S22	8		6		6		n/a	n/a
S21, S12	–30		–35		–36		n/a	n/a
High Power Pulse								
S11, S22	8		6		6		n/a	n/a
S21, S12	–30		–40		–44		n/a	n/a
High Power								
S11, S22	18		12		11		11	
S21, S12	–23		–27		–30		–32	
Bypass								
S11, S22	18		12		11		11	
S21, S12	–21		–25		–27		–29	

a. RCVR OUT measured from 1 to 50 GHz due to internal coupler roll-off below 1 GHz. The roll-off adds –3 dB at 500 MHz, –15 dB at 100 MHz and –20 dB at 50 MHz from the measured response value at 1 GHz.

Table 1-10 Performance Data (On/Off, Attenuation, Rise and Fall)

Port/Connection/Mode	**2 to 8.0 GHz**		**8.0 to 20.0 GHz**		**20.0 to 40.0 GHz**		**40.0 to 50.0 GHz**	
On/Off Switch Ratio Normalized S21 Response	Spec (dB)	Meas	Spec (dB)	Meas	Spec (dB)	Meas	Spec (dB)	Meas
Port 1 side (90 dB, 400 MHz to 2 GHz)	70		65		60		n/a	n/a
Attenuator Setting[a] **Normalized S21 Response**	Specification ± 3.5 dB				Measured Value			
Port 1 Side								
10	10							
20	20							
30	30							
40	40							
50	50							
60	60							
Rear Panel Match	J4 (AMP IN)		J3 (AMP OUT)					
	Spec (S22 dB)	Meas	Spec (S11 dB)	Meas				
AMP IN/OUT Term Ports	8		8					
Rise and Fall Time	Rise Time Spec (ns)		Meas		Fall Time Spec (ns)		Meas	
Port 1 Side								
20 GHz	10				10			
30 GHz	10				10			
40 GHz	10				10			

a. Marker 1 data measured at 2 GHz only with 0 dB attenuation in the RCVR Out path normalized. This is a functional check only.

Replaceable Parts

Table 1-11 Replaceable Parts List

Reference Designator	Description	Agilent Part Number
	PWR-SPLY; power-110W; number of Outputs = 4	0950-2252
ATTN1	Attenuator assembly (60 dB 3-Section)	33325-60006
FP/RP RF Conn	Connector assembly (bulkhead)	5062-7243
CPLR1	Coupler (50 GHz)	5068-7658
	Daughter controller board	87050-60324
	Board assy interim	87050-63149
SW1-SW3	50 GHz transfer switch	87222-60015
	Pulse bias board assy	Z5623-63293
	Manual control interface assembly	Z5623-63364
SW7	U-Wave pin diode switch (2 to 40 GHz)	Z5623-80031
	User's and Service Guide (Option H86)	Z5623-90069

Safety and Regulatory Information

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.

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 **To prevent electrical shock, disconnect the Agilent Technologies model product from mains before cleaning. Use a dry cloth or one slightly dampended with water to clean the external case parts. Do not attempt to clean internally.**

Before Applying Power

Verify that the product is configured to match the available main power source. If this product is to be powered by autotransformer, make sure the common terminal is connected to the neutral (grounded) side of the ac power supply.

Shipping Instructions

You must always call the Agilent Technologies Instrument Support Center to initiate service before retuning your instrument to a service office. Refer to “Contacting Agilent” on page 59. Always transport or ship the instrument using the original packaging if possible. If not, comparable packaging must be used. Attach a complete description of the failure symptoms.

Compliance with Canadian EMC Requirements

This ISM device complies with Canadian ICES-001.
Cet appareil ISM est conforme a la norme NMB du Canada.

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

Declaration of Conformity

For a copy of the manufacturer's Declaration of Conformity for this apparatus, contact your local Agilent Technologies office or sales representative on page 59.

Statement of Compliance

This product has been designed and tested in accordance with IEC Publication 1010, Safety Requirements for Electronic Measuring Apparatus, and has been supplied in a safe condition. The instruction documentation contains information and warnings which must be followed by the user to ensure safe operation and to maintain the instrument in a safe condition.

Warnings

WARNING **The WARNING notice denotes a hazard. It calls attention to a procedure which if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.**

Warnings applicable to this instrument are:

WARNING **To prevent electrical shock, disconnect the Agilent Technologies model Z5623AH86 from mains before cleaning. Use a dry cloth or one slightly dampened with water to clean the external case parts. Do not attempt to clean internally.**

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.**

WARNING **For continued protection against fire hazard replace line fuse only with same type and rating:**
- **United States—F 0.5A/250V, Part Number 2110-0202**
- **Europe—F 3.15A/250V, Part Number 2110-0655**

The use of other fuses or material is prohibited.

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 dangerous voltages. Disconnect the instrument from all voltage sources while it is being opened.**

WARNING **This product is designed for use in Installation Category II and Pollution Degree 2 per IEC 61010-1: 2001.**

WARNING **No operator serviceable parts inside. Refer servicing to qualified personnel. To prevent electrical shock do not remove covers.**

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.**

Cautions

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

Cautions applicable to this instrument are:

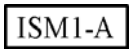
CAUTION Always use the three-prong ac power cord supplied with this instrument. Failure to ensure adequate earth grounding (by not using this cord) can cause instrument damage.

CAUTION This product is designed for use in Installation Category II and Pollution Degree 2 per IEC 61010-1:2001.

CAUTION This instrument has autoranging line voltage input; be sure the supply voltage is within the specified range.

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.

Instrument Markings

	When you see this symbol on your instrument, you should refer to the instrument's instruction manual for important information.
	This symbol indicates hazardous voltages.
	The laser radiation symbol is marked on products that have a laser output.
	This symbol indicates that the instrument requires alternating current (ac) input.
	The CE mark is a registered trademark of the European Community. If it is accompanied by a year, it indicates the year the design was proven.
	The CSA mark is a registered trademark of the Canadian Standards Association.
	This symbol indicates the product meets the Australian Standards.
	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 text indicates that the instrument is an Industrial Scientific and Medical Group 1 Class A product (CISPR 11, Clause 4).
	This symbol indicates that the power line switch is ON.
	This symbol indicates that the power line switch is OFF or in STANDBY position.
	Safety Earth Ground. This is a Safety Class I product (provided with a protective earthing terminal). An uninterruptible safety earth ground must be provided from the main power source to the product input wiring terminals, power cord, or supplied power cord set. Whenever it is likely that the protection has been impaired, the product must be made inoperative and secured against any unintended operation.

Contacting Agilent

By internet, phone, or fax, get assistance with all your test and measurement needs.

This information supersedes all prior contact information.

Online assistance: www.agilent.com/find/assist

Americas			
Brazil *(tel)* (+55) 11 3351 7012 *(fax)* (+55) 11 3351 7024	**Canada** *(tel)* +1 877 894 4414 *(fax)* +1 303 662 3369	**Mexico** *(tel)* 1 800 254 2440 *(fax)* 1 800 254 4222	**United States** *(tel)* 800 829 4444 *(alt)* (+1) 303 662 3998 *(fax)* 800 829 4433
Asia Pacific and Japan			
Australia (*tel*) 1 800 225 574 (*fax*) 1 800 681 776 (*fax*) 1 800 225 539	**China** (*tel*) 800 810 0508 (*alt*) 800 810 0510 (*fax*) 800 810 0507 (*fax*) 800 810 0362	**Hong Kong** (*tel*) 800 933 229 (*fax*) 800 900 701	**India** *(tel)* 1600 112 626 (*fax*) 1600 112 727 (*fax*) 1600 113 040
Japan (Bench) (*tel*) 0120 32 0119 (*alt*) (+81) 426 56 7799 (*fax*) 0120 01 2144	**Japan (On-Site)** (*tel*) 0120 802 363 (*alt*) (+81) 426 56 7498 (*fax*) (+81) 426 60 8953	**Singapore** (*tel*) 1 800 275 0880 (*fax*) (+65) 6755 1235 (*fax*) (+65) 6755 1214	**South Korea** (*tel*) 080 778 0011 (*fax*) 080 778 0013
Taiwan (*tel*) 0800 047 669 (*fax*) 0800 047 667 (*fax*) 886 3492 0779	**Thailand** (*tel*) 1 800 2758 5822 (*alt*) (+66) 2267 5913 (*fax*) 1 800 656 336	**Malaysia** (*tel*) 1800 880 399 (*fax*) 1800 801 054	
Europe			
Austria (*tel*) 0820 87 44 11* (*fax*) 0820 87 44 22	**Belgium** (*tel*) (+32) (0)2 404 9340 (*alt*) (+32) (0)2 404 9000 (*fax*) (+32) (0)2 404 9395	**Denmark** (*tel*) (+45) 7013 1515 (*alt*) (+45) 7013 7313 (*fax*) (+45) 7013 1555	**Finland** (*tel*) (+358) 10 855 2100 (*fax*) (+358) (0) 10 855 2923
France (*tel*) 0825 010 700* (*alt*) (+33) (0)1 6453 5623 (*fax*) 0825 010 701*	**Germany** (*tel*) 01805 24 6333* (*alt*) 01805 24 6330* (*fax*) 01805 24 6336*	**Ireland** (*tel*) (+353) (0)1 890 924 204 (*alt*) (+353) (0)1 890 924 206 (*fax*)(+353) (0)1 890 924 024	**Israel** (*tel*) (+972) 3 9288 500 (*fax*) (+972) 3 9288 501
Italy (*tel*) (+39) (0)2 9260 8484 (*fax*) (+39) (0)2 9544 1175	**Luxemburg** (*tel*) (+32) (0)2 404 9340 (*alt*) (+32) (0)2 404 9000 (*fax*) (+32) (0)2 404 9395	**Netherlands** (*tel*) (+31) (0)20 547 2111 (*alt*) (+31) (0)20 547 2000 (*fax*) (+31) (0)20 547 2190	**Russia** (*tel*) (+7) 095 797 3963 (*alt*) (+7) 095 797 3900 (*fax*) (+7) 095 797 3901
Spain (*tel*) (+34) 91 631 3300 (*alt*) (+34) 91 631 3000 (*fax*) (+34) 91 631 3301	**Sweden** (*tel*) 0200 88 22 55* (*alt*) (+46) (0)8 5064 8686 (*fax*) 020 120 2266*	**Switzerland (French)** (*tel*) 0800 80 5353 opt. 2* (*alt*) (+33) (0)1 6453 5623 (*fax*) (+41) (0)22 567 5313	**Switzerland (German)** (*tel*) 0800 80 5353 opt. 1* (*alt*) (+49) (0)7031 464 6333 (*fax*) (+41) (0)1 272 7373
Switzerland (Italian) (*tel*) 0800 80 5353 opt. 3* (*alt*) (+39) (0)2 9260 8484 (*fax*) (+41) (0)22 567 5314	**United Kingdom** (*tel*) (+44) (0)7004 666666 (*alt*) (+44) (0)7004 123123 (*fax*) (+44) (0)7004 444555		

(tel) = primary telephone number; *(alt)* = alternate telephone number; *(fax)* = FAX number; * = in country number 11/16/04