ANRITSU 2300-482
Vector Network Measurement System
Performance Verification

Software User's Guide

/inritsu

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Chapter 1
General Information

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1   Introduction

This manual supports the Anritsu B59987 VNA Performance Verification Software. This software is used with the Anritsu Vector Network Analyzers and Vector Network Measurement Systems. The manual is organized into six chapters and three appendices, as shown below.

- *General Information*—Provides an overview of the product

- *Required Equipment*—Describes the test equipment, components, hardware and software required to use this product

- *Configuring the System*—Describes how the equipment is setup and interconnected

- *Configuring the Program*—Describes how to setup the software

- *Running the Program*—Provides step-by-step instructions for running the software

- *Troubleshooting*—Contains troubleshooting suggestions and service information

- Appendix A—Contains an example of tabular test results

- *Appendix B*—Provides GPIB card and instrument settings

- *Appendix C*—Lists instrument, calibration kit, and verification kit combinations

2   Format of the Verification Software

The Performance Verification Software is offered on an IBM compatible CD-ROM.

3   Capability

This software provides information for automating measurements of the test components contained in an Anritsu Verification Kit.

It compares the measurements made on your instrument with the test component data provided in each verification kit. This will aid in determining if the measurement values are consistent with system specifications.

4   **Data Output**

The test data and results are output in the form of six files to a directory (X:\installed directory) on your computers hard drive. The default file names, depending on the type of test being performed, are:

- MIS12.DAT, 20DB12.DAT, 50DB12.DAT
- MIS13.DAT, 20DB13.DAT, 50DB13.DAT
- MIS14.DAT, 20DB14.DAT, 50DB14.DAT

NOTES

- This Performance Verification Software allows you to re-name these files using the default ".dat" extension.

- The tabular data in each file is given at discrete frequencies at 200 MHz intervals, along with separate start and stop frequencies if the start and stop frequencies do not fall on a 200 MHz spacing.

- The test results can be viewed or printed from the "Main Menu" window.

Chapter 2
Required Equipment

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Introduction

This section describes the equipment required to use the Performance Verification Software.

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Computer (System Controller)

Operating System

This software can be used with the following Operating Systems (U.S. English):

- Microsoft Windows 95/98

- Microsoft Windows NT 4.0

NOTE

This program may not function on international versions of Microsoft Windows that use double byte character sets.

Hardware

IBM-compatible computer with a 486 or faster microprocessor with a math coprocessor and a 3.5 inch floppy disk drive.

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GPIB Interface Card

Depending upon the Operating System and hardware used to perform the Verification, there are different requirements for the GPIB hardware configurations. This program has been tested with the following configurations:

- Win95: National Instruments PCMCIA for Windows 95, Versions 1.2, 1.3, 1.4, 1.5 and 1.6

- WinNT: GPIB Software for Windows NT (Intel) (NI-488.2M Software) Version 1.2, 1.3, 1.4, 1.5, and 1.6

Regardless of which GPIB hardware and software is used, the GPIB card must be configured as "GPIB0."

| 8 | **Instrument** |

You will need one of the following Anritsu vector network measurement systems with the appropriate calibration kits:

- MS4622(A/B/D) or MS4623(A/B/D) with 3750LF/R, 3751LF-1/R, or 3753LF/R

- MS4624(A/B/D) with 3750R, 3751R, or 3753R with Option 3

| 9 | **Low Frequency VNMS Coaxial Measurements** |

A Scorpion System consists of a MS462X(A/B/D) model. One-port verifications will work with any instrument. Two-port verifications require a "B" model or an "A" model with Option 6. Three-port verifications require a MS462(2/3)B model with Option 3(A/B) or Option 6 with an external source. Four-port verifications require a "D" model.

| 10 | **Verification Kit** |

You will need an Anritsu 3663LF, 3666LF, or a 3667LF Verification Kit for verifications up to 6 GHz. For verifications up to 9 GHz, you will need an Anritsu 3663R, 3666R, or a 3667R Verification Kit.

NOTE

This program will not work with the following Anritsu Verification Kits: 3663, 3666, 3667, 3668, 3669, or 3669B regardless of the data disk version. You cannot use an Anritsu type "LF" Verification Kit on an 8 or 9 GHz instrument.

| 11 | **Printer** |

A printer is not required for operation as the verification results and data are stored in four files on the computer hard disk drive. These files are saved in ASCII format for easy viewing and printing.

| 12 | **Cables** |

You will need a GPIB cable (Anritsu part number: 2100-2). For a one or two-port verification, you will need an RF Test Port Cable (Anritsu part number 3670A50-1, 3670A50-2, 3670K50-1, 3670K50-2, 3670N50-1, or 3670N50-2). For a three-port verification, you will need two cables. For a four-port verification, you will need three cables. With the large physical size of the Type N and GPC7 verification devices, a "-2" cable (2 foot) is recommended. If a verification of an AutoCal calibration is to be performed, the instrument must have Option 10 installed. Also, the Anritsu AutoCal product has its own list of cable requirements not listed here.

NOTE

The Anritsu AutoCal product must have Option 1 or 2 installed. An AutoCal unit without Option 1 might work, but it will not calibrate the instrument properly. Also, the AutoCal will only do a one- or two-port calibration. The AutoCal is not capable of performing a three-port calibration. 4-port AutoCal is not supported.

Chapter 3
Configuring the System

13   **Introduction**

This chapter describes how the various system elements are interconnected and the preliminary steps required for operation of the verification software.

14   **Hardware Interconnection**

Connect one end of the cable to the computer's GPIB port. Connect the other end of the cable to the instrument GPIB port labeled IEEE 488.2 GPIB. Do not connect the cable to the instrument GPIB port labeled Dedicated GPIB.

For a one- or two-port verification, connect a test cable to Port 2 such that a male connector is available for use. Connect a test cable or connector adapter on Port 1 such that a female connector is available for use.
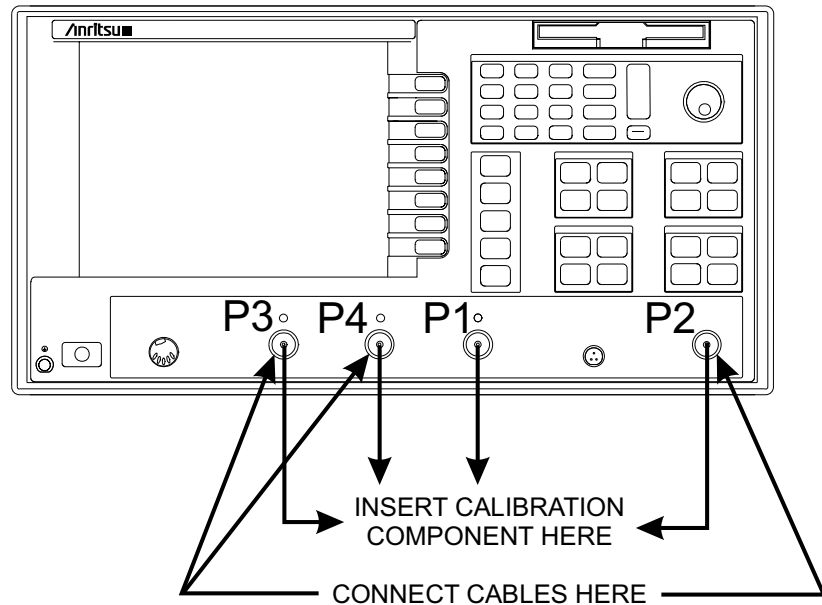
Figure 1. MS4624D Connected to DUT

15	**Performance Verification (PV) Software Installation**

CD ROM

Insert the CD-ROM into your CD-ROM Drive. The installation program should run automatically. Follow the instructions on the screen. If the installation program does not start automatically, then, using *Windows Explorer* or the *My Computer* icon, browse to the root directory of the CD-ROM. Double click the *Startup.exe* program to begin the installation process.

Floppy Disk

The program installation files, *Setup.exe, Setup.W02,* etc, in the CD-ROM's Program Directory can be copied to floppy disks for installation on PC's without CD-ROM drives. Each *Setup.** file will need to be on its own floppy disk. Label the first "Disk 1," the second "'Disk 2," etc.

Put the disk labeled "Disk 1" into the 3.5-inch high-density-floppy drive. From the Task Bar [TB], select the Start—Run command sequence and type X:\setup.exe, where X is the drive letter of the floppy drive the disk is in. Press the Enter key.

The setup program will copy the files to your PC into the directory of your choice (you will be prompted for the destination directory). Unlike previous versions, this program cannot be run from a floppy disk directly. When the setup program is completed, the program may or may not want to restart Windows, depending if there were any files in use (usually DLLs) at the time of the installation.

16	**AutoCal Hardware/Software Installation**

Follow the instructions in the AutoCal manual (or MS462XX Operation Manual) for these procedures. Refer to Figure 1 (previous page) when connecting an AutoCal module (calibration component) to the instrument for an AutoCal calibration.

If an Anritsu 36581NNF or a 36582KKF AutoCal module is to be used, there are some special considerations that have to be made in order to successfully pass the verification. These are discussed later in the "Running the Program" section. The program will also advise the operator of these considerations at the proper time.

Chapter 4
Configuring the Program

17 Introduction

This Performance Verification software runs in a Windows environment as described below. Note that the actual appearance may vary slightly in relation to the operating system being used (Windows 95 or NT 4.0).

18 Starting the Program

With the equipment and software configured as described in Chapter 3, turn on the computer and allow it to boot up to Windows.

Locate the VerifyAll.Exe icon on the desktop and double-click on it. The program launcher menu will be displayed (as shown below).
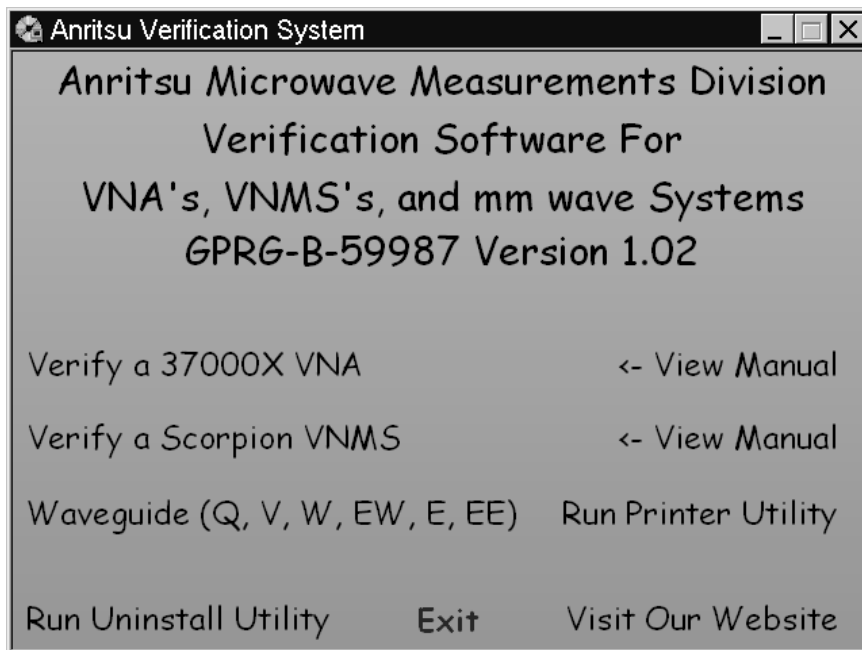
Double Click the Scorpion Verification Software icon on the desktop.

At this point you can install the 3.5-inch data disk from the Verification Kit into an available floppy drive.

The program will also display an About dialog box.

Press OK or Enter to continue.

<div style="text-align:center">**19**</div>

Program Initialization

You will be prompted to enter your name.

```
Anritsu Verification                          [×]

Please Enter Your Name [3 character Minimum]    [ OK ]

                                                [ Cancel ]


Fred
```
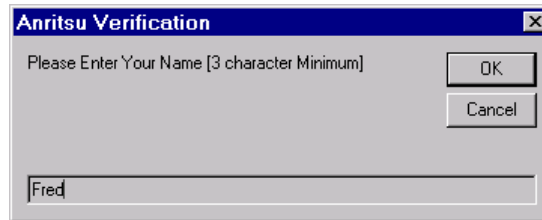
After you enter your name, the program will check for a GPIB card at the location GPIB0.

```
Press Enter to Cancel

Checking for GPIB Board  0


                     [ Cancel ]
```
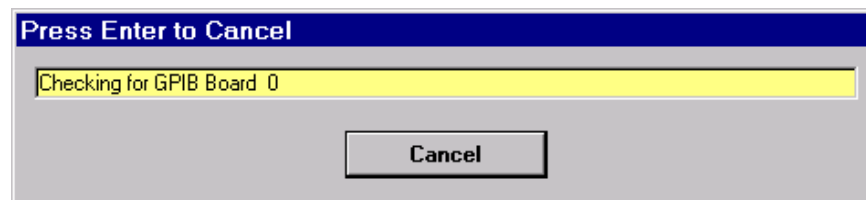
If the program finds a GPIB board at GPIB0 the program will continue. If the program does not find a GPIB board at GPIB0, or if you answer No to the dialog box below, the program will terminate. At this point you should answer Yes to this question.

```
Hi Fred                         [×]

  (×)   I found GPIB Board  0.
        Do you want to use this Board ?

        [ Yes ]    [ No ]
```
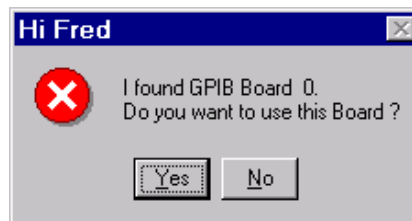
Next, the program will search the GPIB bus for an Anritsu Scorpion instrument. If the program finds any other Anritsu VNA, the program will skip those instruments without any response required from you.

```
Press Enter to Cancel

Searching GPIB Bus Address 6 for a Anritsu VNA.  Press Enter key to abort search.


                     [ Cancel ]
```
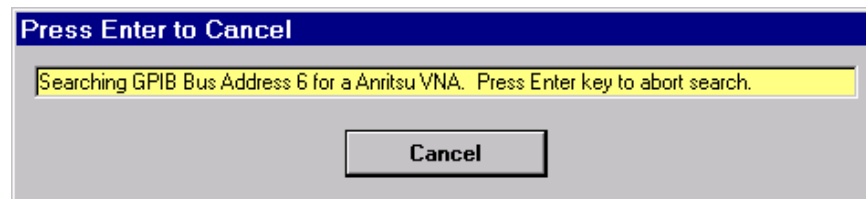
If the program finds a VNA, it will ask you for information about the VNA you want to use for the verification.
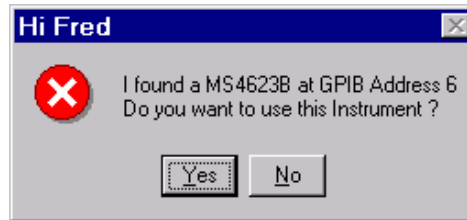
If there are multiple Scorpion instruments on the GPIB Bus, and this instrument is not the one you want to verify, then you should answer No so the program will look for another Scorpion on the GPIB bus.

If the you answer No to the above, the program will respond by searching for another instrument.

If the program did not find an instrument on the GPIB bus, the program will tell the you that it did not find one, then exit. If there is an instrument on the GPIB bus and the program did not find it, then a problem exists somewhere in the system. Check the cables to make sure they are properly connected, and check the GPIB system to verify that it is operating properly. If this does not alleviate the problem, there could be something wrong with the GPIB system or the instrument.

NOTES

In this section of the program, items that are determined by the program to be complete enough to continue to the next step will have the Frames text label change color from red to green to give you an indication to proceed.

If the next item is a text box that needs to be filled in, the program will automatically move the cursor to that text box.

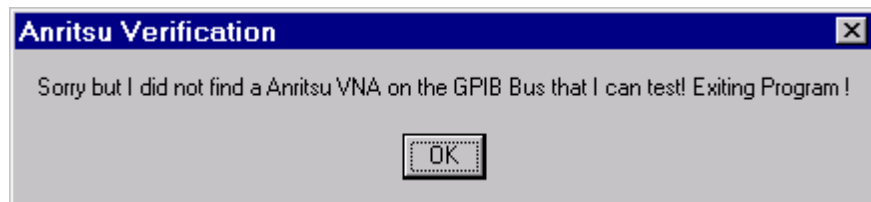If the next item is a multiple choice item, the program will enable the choice's frame box and turn the label of the box red to draw your attention to it.

After you make a selection, the program will continue in this fashion until enough information has been entered to perform a calibration. At that point, the "Calibrate VNA" button will be enabled so you can start the actual calibration of the instrument. You will have a chance to confirm the information that was input before proceeding with the calibration. Also, at any time up until the confirmation of the information input, you can go back to any stage of the setup and change items you wish to change.

Please bear in mind that changing some choices may cause some of the information to have to be re-entered. For example, if you select a different calibration kit, you will also have to choose the verification kit as well as the frequency range again since the newest selections may not be valid for the previous information that was entered.

Next, you are prompted to select a test port configuration.

Then, you will enter the information about the Calibration Kit. The calibration has a coefficients disk and it should be loaded at this point.

Select the verification kit type, enter the verification kit serial number, and select the appropriate floppy drive.
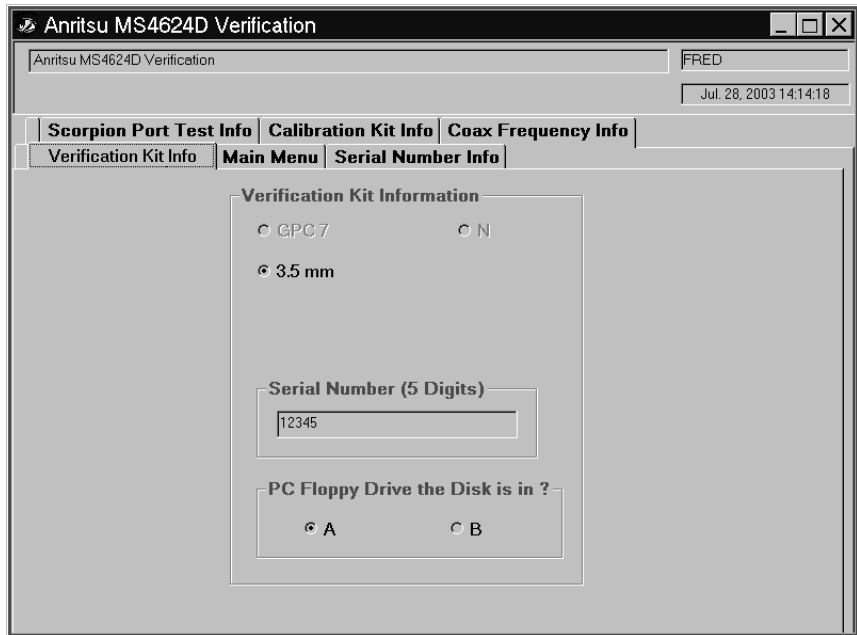
The program will tell you to insert the disk into the disk drive, then check to see if the correct disk (a Scorpion verification kit disk) is in the floppy drive.

NOTE

This program WILL NOT WORK with an older Version 1 disk because the tolerances on the Version 1 disk do not conform to the new specifications. This program will not work with a high frequency Version 2 verification kit disk from a 3663, 3666, 3667, 3668, 3669, or 3669B verification kit. Also, customers can not have their high frequency verification kits upgraded for use with a Scorpion Instrument. If there are any questions about this please contact your local Anritsu customer service center for more information.

The next item that must be entered is the frequency range for the verification to be done. Once a start and stop frequency have been selected the "Setup Calibration of VNA" button will be enabled.
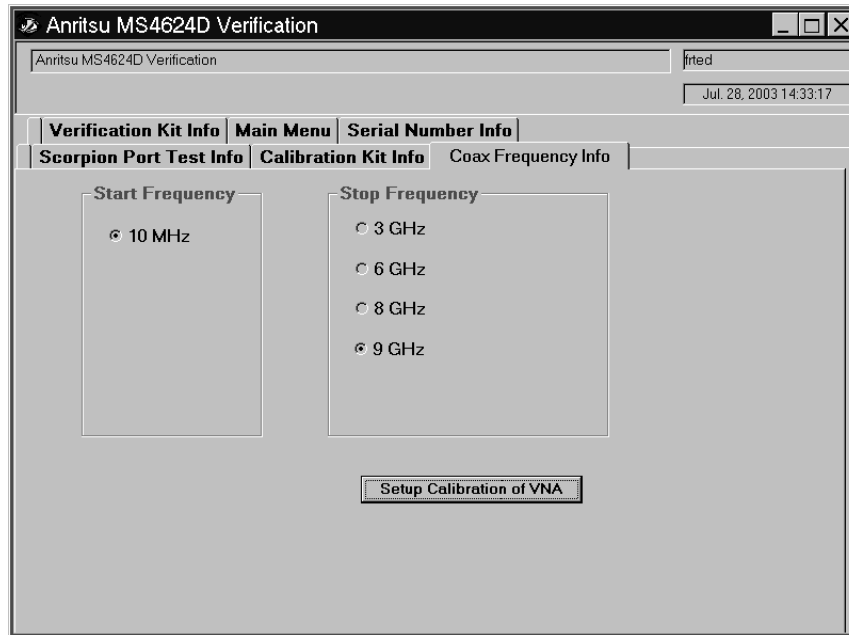
When you click "Setup Calibration of VNA," you will be asked to confirm if the information entered was correct. If you select <u>N</u>o, the program will return to the setup menus so that you can check or change items.

If you select the <u>Y</u>es option, the program will setup the VNA according to the input supplied. A dialog box similar to the one shown below will provide instructions.
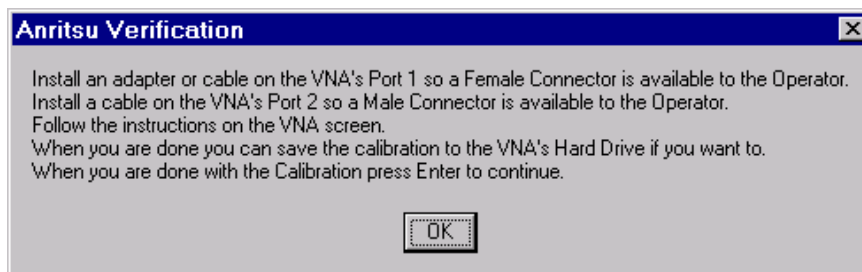
When you click the <u>OK</u> button in the "Setup Instructions" dialog box, the program will setup the VNA for running the tests on the verification devices and display the "Main Menu" shown below.
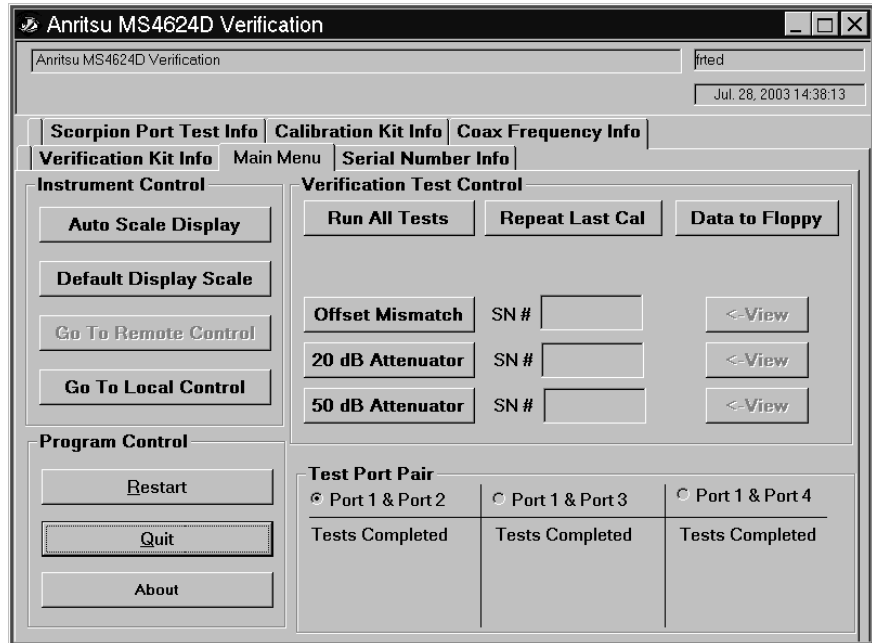
Program initialization is now complete.

Chapter 5
Running the Program

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Running the Program

Anytime the program is executing a command from the main menu, the buttons will be disabled until the currently executing command is finished. This is necessary due to the event driven nature of Windows. Also, while a command is being executed, informational messages may be displayed on the screen.
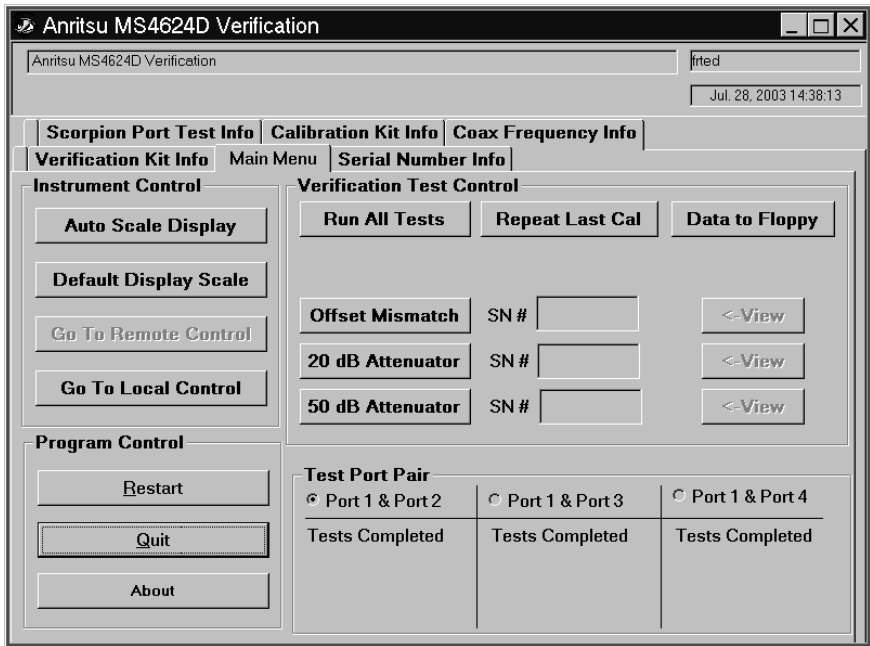
If a device passes, the serial number text will turn GREEN. If a device fails, the serial number text will turn RED. If a test for a device was canceled before pass-fail status could be established, the serial number text will be WHITE. If a device has not been tested, there will be no entry for the serial number. However, a devices serial number may be entered before testing by double clicking a device serial number text box. Also, since Port 1 and Port 2, Port 1 and Port 4, or Port 1 and Port 3 are possible to test in this case there are additional indicators (Test Port Pair) that show the status (pass or fail) of all the port-pair combinations. If a port-pair test has not been completed, this indicator will not display a pass or fail status. If a two port or a one port calibration was selected in the beginning, then the Test Port Pair selection will be disabled.

The test results, pass or fail, will be displayed in dialog boxes and in the 'Verification Test Control' frame.
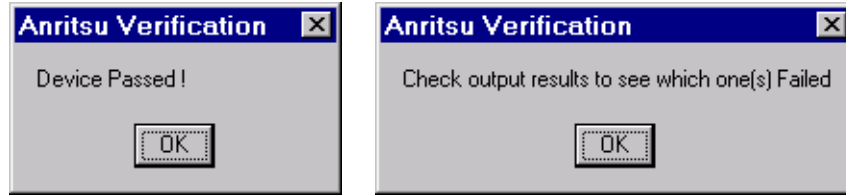
Initially, if a device failed, the program displays the number of points that failed and asks if you would like to recheck those points. If the answer is Yes, the points will be rechecked. If they now pass, the device is considered good and will be passed. In contrast, if the points cannot be resolved, the device is failed.

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Commands

The main menu consists of four frames: Program Control, Instrument Control, Verification Test Control, and Test Port Pair. Each frame contains buttons to control various program operations.
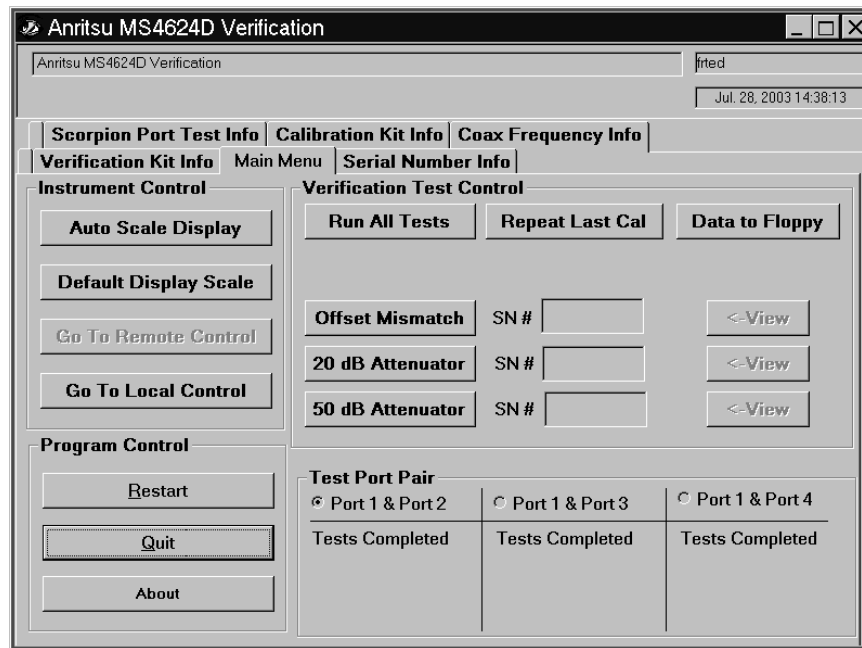
Program Control Frame

Quit

Selecting Quit will bring up a confirmation box. Selecting Yes will exit the program; selecting No will return you to the previous screen.

Reset Test/Cal

This command allows you to change the instrument to test, the frequency range, or the selected verification kit. Selecting Yes will cause the program to return to the configuration stage.

About

Displays version information, copyright, and other legal notices as well as company contact information.

Instrument Control Frame

Auto Scale Display

This command will automatically scale each channel on the Scorpion VNMS. It is the same as selecting a front panel channel button then pushing the front panel Auto Scale button for each channel.

NOTE

When the program detects the Scorpion has finished a sweep, the program will auto scale all four channels before continuing.

Default Display Scale

This command sets all four channels to a scale of 15 (dB or Unit)/Div and the reference value to 0. This will allow you to see if the device is remotely or properly connected.

Go to Remote Control

This command is only available after you have clicked the "Go to Local Control" button. When you push this button, the program takes control of the VNA and restores the VNA to the same state it was in after the instrument was calibrated.

Go to Local Control

This command allows you access to the front panel buttons while the program is running. The instrument is in "Local Lock Out" unless this button is pushed. This prevents an inadvertent front panel button actuation from affecting the proper operation of the program.

Verification Test Control Frame

Run All Tests
This command button will run all of the tests (offset mismatch, 20 dB, 50 dB) in order. You will be prompted for information as required.

Offset Mismatch
This command button will run a 20 dB offset mismatch test only, then display the results.

20 dB Attenuator
This command button will run a 20 dB attenuator test only, then display the results.

50 dB Attenuator
This command button will run a 50 dB attenuator test only, then display the results.

Data to Floppy
This command button will write the data files of the last set of tests that were run to the same floppy disk drive in which the verification kit disk is located. You will be prompted to remove and reinsert the verification kit disk at the proper times. The program will not write data to the verification kit disk even if the disk is not write protected.

Repeat Last Cal
This command button will recalibrate the Scorpion according to the CURRENT calibration. This provides a way to quickly recalibrate the Scorpion without having to reset the program parameters in case the original calibration was flawed for some reason.

View Buttons
These buttons allow you to view or print the test results without the use of an external program.

Test Port Pair
These button pairs switch between the allowed test port pairs:

- S11, S12, S21, and S22 for a two-port setup

- S11, S13, S31, and S33 for a three-port setup

- S11, S14, S41, and S44 for a four-port setup

22   **Running a Test**

This section presents the typical test scenario.

NOTE

In this section, the testing of a mismatched 20 dB offset device is used as an example. If any other device is tested, the program will respond in a similar manner, except the word "Offset Mismatch" will be replaced with "20 dB Attenuator," or "50 dB Attenuator" as appropriate.

When either the Run All Tests, Offset Mismatch, 20 dB Attenuator, or the 50 dB Attenuator command button is pushed, the program can respond in one of two ways. If no device has previously been tested, the program prompts you for the serial number of the device to be tested.
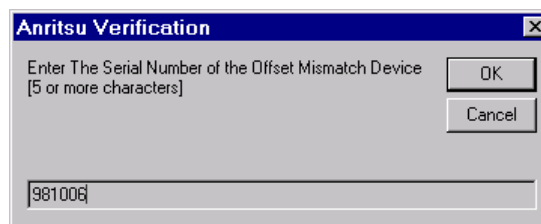
If a device has been previously tested, the program will prompt to determine if the test is to be run on the same or a different device.
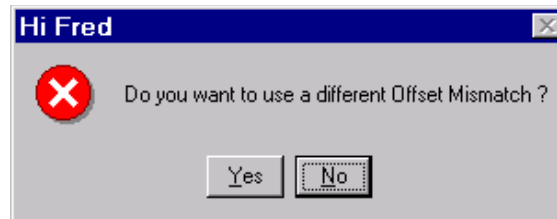
Selecting Yes will display the dialog to input the serial number for the new device (above). Selecting No will display the device's connection dialog box (below).

When you click the "OK" button, an "Abort Test" dialog box is displayed showing test progress. At this point, if you choose to abort the test, the measurement data will be discarded. The program will not stop after the first sweep, since the Scorpion will automatically do two sweeps. The Scorpion will finish the current sweep, then return to the "Main Menu."

When the test is finished, the program will get the test data from the VNA, read in the data from the verification kit disk, calculate the uncertainties, inform you if the device passed or failed, then write the measurements to the data files. If the device failed, the program will display the number of points that failed the test and prompt you to retest the specific failed points.

Please bear in mind that the larger the number of failed points, the longer it will take to recheck them. If there is a large number of failed points, then rechecking those points might be skipped; there is probably something else wrong such as bad or worn connectors or devices. After this option, the program then writes the measurements to the data files. When the program starts to save the data to a file, the program will display the following dialog box.
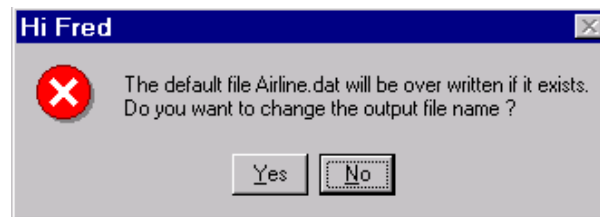
Select Yes to enter a specific filename to save the data to. Selecting No will cause the program to write the data to the default file name for the device under test. After saving the data, the program will return to the main menu

Chapter 6
Troubleshooting

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23 **Difficulty Running the Program**

If you have difficulty getting the program to run properly:

1. Check your GPIB interconnection cables and addresses.

2. Check to see that the Windows GPIB is present on the boot drive, that it is properly configured, and that it passes the National Instruments hardware and software tests.

3. This version of the verification software must be installed with the install program on the CD ROM. The program will not run if it is just copied from the CD ROM to the hard disk.

4. Ensure that, after starting-up the performance verification software, the Scorpion verification kit data disk is installed in drive A or B and that it contains the following files:

   • For a 366XLF kit:

   MIS12.S21, MIS12.S11, MIS12.S12, MIS12.S22, MIS13.S31, MIS13.S11, MIS13.S13, MIS13.S33, 20DB12.S21, 20DB12.S11, 20DB12.S12, 20DB12.S22, 20DB13.S31, 20DB13.S11, 20DB13.S13, 20DB13.S33, 50DB12.S21, 50DB12.S11, 50DB12.S12, 50DB12.S22, 50DB13.S31, 50DB13.S11, 50DB13.S13, 50DB13.S33

   • For a 366XR kit:

   MIS12.S21, MIS12.S11, MIS12.S12, MIS12.S22, MIS13.S31, MIS13R.S11, MIS13R.S13, MIS13R.S33, 20DB12R.S21, 20DB12R.S11, 20DB12R.S12, 20DB12R.S22, 20DB13R.S31, 20DB13R.S11, 20DB13R.S13, 20DB13R.S33, 50DB12R.S21, 50DB12R.S11, 50DB12R.S12, 50DB12R.S22, 50DB13R.S31, 50DB13R.S11, 50DB13R.S13, 50DB13R.S33

If, after checking the above, you are still having difficulty, contact your Anritsu customer service center and ask for the Vector Network Analyzer support engineer for further assistance.

24   **Difficulty Meeting System Specifications**

If the verification software appears to run properly but the results are not within the measurement limits associated with the verification kit:

1. Check both the verification kit and calibration kit devices for signs of physical damage. Make sure that the connectors are clean.

2. Ensure that the serial number of the verification kit data disk matches that shown on the verification kit.

3. Repeat the process with a fresh calibration. Save the results of both measurements as an aid in troubleshooting, if you require factory assistance.

4. When installing calibration devices, and when measuring verification devices, pay particular attention to proper connector alignment and torque. Torque the connector using the torque wrench supplied with the calibration kit.

If, after following the above steps, you still have difficulty, please contact Anritsu Customer Service at (408) 778-2000 (FAX: (408) 778-0239) and ask for the Vector Network Analyzer Support Engineer for further assistance.

Appendix A
GPIB Card and Instrument Settings

Following are the recommended GPIB Card and Instrument Settings

GPIB Board Settings

Primary Address = 0
Secondary Address = NONE or 0
Timeout Setting = 10 seconds

Terminate Read on EOS = no or unchecked
Set EOI with EOS on Writes = yes or checked
Type of compare on EOS = 8-bit
EOS Byte = 0Ah or decimal 10
Send EOI at end of Write = yes or checked

System Controller = yes or checked
Assert REN when SC = yes or checked
Enable Auto Serial Polling = No or unchecked
Enable CIC protocol = No or unchecked
Bus Timing = 2 μseconds
Parallel Poll Duration = Default

The following settings may vary depending on the GPIB Card type and Operating System selected.

Use this GPIB Interface = yes or checked
Board Type = your board type (PCIIA, PCI, etc.)
Base I/O Address = consult the GPIB card manual
DMA Channel = consult the GPIB card manual
Interrupt Level = consult the GPIB card manual

Instrument Settings

Primary GPIB Address = 6
Secondary GPIB Address = NONE
Timeout Setting = 10 seconds
Serial Poll Timeout = 1 second

Terminate Read on EOS = no or unchecked
Set EOI on EOS on Writes = yes or checked
Type of compare on EOS = 8-bit
EOS Byte = 0Ah or decimal 10
Send EOI at end of Write = yes or checked

Enable Repeat Addressing = no or unchecked

Appendix B
Example of Tabular Test Results

```
                    Anritsu Verification Version 1.02
Vna Model : MS4624D        Vna Serial Number : 984107
Calibration Kit Model Number : 3753R        Calibration Kit Serial Number : 107001
Verification Kit Model Number : 3663R        Verification Kit Serial Number : 907002
Date :7/11/02 4:07:50 PM        Operator : fred
50 dB Attenuator Serial Number : 907002
Port 1 and Port 4 were used for this measurement

----------------- S41 Magnitude ------------------   ----------------- S41 Phase -----------------
Freq     STD       MEAS      DIFF      UNC  Pass     STD        MEAS       DIFF       UNC  Pass
GHz      (dB)      (dB)      S-M       +/-  Fail     DEG        DEG        S-M        +/-  Fail

 .01   -49.6534  -49.5903   -.0631    .2600        -1.7153     -.9657    -.7496    1.5250
 .20   -49.6839  -49.6852    .0013    .2602       -21.1699   -21.2509     .0810    1.6200
 .40   -49.7073  -49.6630   -.0443    .2604       -41.9113   -41.8214    -.0899    1.7200
 .60   -49.7090  -49.6968   -.0122    .2607       -62.6656   -62.6106    -.0550    1.8200
 .80   -49.7103  -49.6966   -.0138    .2609       -83.4478   -83.3336    -.1143    1.9200
1.00   -49.7203  -49.7071   -.0132    .2611      -104.1648  -104.1258    -.0390    2.0200
1.20   -49.7274  -49.6958   -.0315    .2613      -124.9250  -124.8262    -.0988    2.1200
1.40   -49.7301  -49.7122   -.0179    .2615      -145.6467  -145.5915    -.0552    2.2200
1.60   -49.7327  -49.7161   -.0165    .2618      -166.5017  -166.2935    -.2082    2.3200
1.80   -49.7468  -49.7345   -.0123    .2620       172.8451   172.9440    -.0989    2.4200
2.00   -49.7508  -49.7385   -.0123    .2622       152.0522   152.2420    -.1898    2.5200
2.20   -49.7597  -49.7387   -.0210    .2624       131.2071   131.4752    -.2681    2.6200
2.40   -49.7724  -49.7528   -.0196    .2626       110.5433   110.8142    -.2709    2.7200
2.60   -49.7811  -49.7445   -.0367    .2629        89.7670    90.0584    -.2914    2.8200
2.80   -49.7913  -49.7746   -.0167    .2631        68.9942    69.4312    -.4371    2.9200
3.00   -49.8019  -49.7821   -.0198    .2633        48.2697    48.5929    -.3232    3.0200
3.20   -49.8077  -49.7840   -.0237    .2635        27.5562    27.7698    -.2136    3.1200
3.40   -49.8262  -49.7974   -.0288    .2637         6.8199     7.1449    -.3250    3.2200
3.60   -49.8358  -49.8188   -.0170    .2640       -13.9192   -13.6056    -.3136    3.3200
3.80   -49.8515  -49.8263   -.0253    .2642       -34.6284   -34.3108    -.3175    3.4200
4.00   -49.8758  -49.8255   -.0503    .2644       -55.2655   -55.0813    -.1842    3.5200
4.20   -49.8871  -49.8411   -.0460    .2646       -76.0635   -75.7527    -.3108    3.6200
4.40   -49.8922  -49.8537   -.0385    .2648       -96.8731   -96.4365    -.4366    3.7200
4.60   -49.9056  -49.8653   -.0404    .2651      -117.6715  -117.2121    -.4595    3.8200
4.80   -49.9278  -49.8875   -.0403    .2653      -138.4648  -137.9058    -.5591    3.9200
5.00   -49.9428  -49.8970   -.0458    .2655      -159.2747  -158.7855    -.4892    4.0200
5.20   -49.9507  -49.9112   -.0395    .2657       179.9772  -179.5226     .5002    4.1200
5.40   -49.9612  -49.9275   -.0337    .2659       159.2190   159.7625    -.5435    4.2200
5.60   -49.9805  -49.9585   -.0220    .2662       138.5126   139.0660    -.5533    4.3200
5.80   -49.9911  -49.9746   -.0165    .2664       117.7458   118.4145    -.6687    4.4200
6.00   -50.0048  -49.9796   -.0252    .2666        96.8166    97.5746    -.7580    4.5200
6.20   -50.0326  -50.0072   -.0255    .2668        76.2327    76.7029    -.4702    4.6200
6.40   -50.0430  -50.0031   -.0399    .2670        55.4596    55.9534    -.4938    4.7200
6.60   -50.0750  -50.0165   -.0585    .2673        34.6938    35.0794    -.3857    4.8200
6.80   -50.0810  -50.0498   -.0312    .2675        13.8855    14.3432    -.4577    4.9200
7.00   -50.1080  -50.0755   -.0325    .2677        -7.0012    -6.5187    -.4824    5.0200
7.20   -50.1324  -50.0647   -.0677    .2679       -27.9544   -27.3212    -.6332    5.1200
7.40   -50.1524  -50.0821   -.0703    .2681       -48.7482   -48.1945    -.5536    5.2200
7.60   -50.1680  -50.1297   -.0383    .2684       -69.5173   -68.9842    -.5331    5.3200
7.80   -50.1783  -50.1573   -.0210    .2686       -90.1799   -89.5543    -.6256    5.4200
8.00   -50.2154  -50.1823   -.0331    .2688      -110.7590  -110.2818    -.4772    5.5200
8.20   -50.2323  -50.2307   -.0016    .2690      -131.5512  -131.0174    -.5338    5.6200
8.40   -50.2509  -50.2068   -.0440    .2692      -152.4737  -151.7954    -.6783    5.7200
8.60   -50.2681  -50.2301   -.0380    .2695      -173.2953  -172.9139    -.3814    5.8200
8.80   -50.2796  -50.2335   -.0461    .2697       165.9641   166.4709    -.5068    5.9200
9.00   -50.2877  -50.2221   -.0656    .2699       144.8694   145.5781    -.7087    6.0200
```

Appendix C
Allowable VNA, Calibration Kit, and
Verification Kit Combinations

This set of tables is to be used as a guide in determining if you can perform verifications on an instrument with a given calibration and verification kit. There are three sets of verification kit tables and three sets of calibration kit tables. The verification kit tables cross-reference verification kits with VNA's. There is one table set for 37000 series VNA's, MS462XX VNMS's, and one table for Millimeter Wave VNA's. Each calibration kit has been assigned a Reference Code. This Reference Code is also in the verification kit tables.

One way to use the charts is to start with a verification kit chart. Pick the instrument-test set to be used in the test from the far-left column. Next pick the verification kit to be used in the test from the top row. Scan to the box where the instrument-test set and verification kit intersects. If there is a reference code for a calibration kit in that box then the combination of equipment picked can be verified. If there is not a reference code in that box then the combination of equipment picked can not be verified.

Table C-1. List of Calibration/Verification Kits and Instrument Combinations (1 of 2)

	Coax Verification Kit					
A, B, or C Models	**N (3663)**	**3.5 mm (3666)**	**GPC7 (3667)**	**K (3668)**	**V (3669)**	**V (3669B)**
37147				A3*		
37169				A3*		
37(2/3)11	A4, B1	A1, B4, B5	A2	A3, B2, B4		
37(2/3)17	A4, B1	A1, B4, B5	A2	A3, B2, B4		
37(2/3)25	A4, B1	A1, B4, B5	A2	A3, B2, B3, B6, B7		
37(2/3)47	A4, B1	A1, B4, B5	A2	A3, B2, B3, B6, B7		
37(2/3)69	A4, B1	A1, B4, B5	A2	A3, B2, B3, B6, B7		
37(2/3)77				A3	A5	A5
37(2/3)97	A4	A1	A2	A3	A5	A5

	Coax Verification Kit					
A, B*** or D Models**	**N (3663LF)**	**3.5 mm (3666LF)**	**GPC7 (3667LF)**	**3.5 mm (3666R)**	**GPC7 (3667R)**	**N (3663R)**
MS462(2/3) (to 6 GHz)	C3	C1	C2	C1	C2	C3
MS4623B/88 (8 GHz), MS462(2/3/4) (to 9 GHz)				E1	E2	E3

Table C-1. Allowable Calibration Kit - Verification Kit - Instrument Combinations (2 of 2)

	Millimeter Wave Verification Kit					
A or C Models	WR-22 (3655Q)	WR-15 (3655V)	WR-12 (3655E)	WR-12E (3655EE)	WR-10 (3655W)	WR-10E (3655WE)
37147	D1	D2	D3	D3	D4	D4
37169	D1	D2	D3	D3	D4	D4
	Coax Calibration Kit					
	3.5 mm (3650-1)	GPC7 (3651-1)	K (3652-1)	N (3653)	V (3654)	N AutoCal (36581NNF)
Reference Code	A1	A2	A3	A4	A5	B1
	Coax Calibration Kit					
	36581KKF (K Electronic AutoCal 20 GHz)	36582KKF (K Mechanical AutoCal 40 GHz)	36581KKF with 36583L	36582KKF with 36583L	36581KKF with 36583K	36582KKF with 36583K
Reference Code	B2	B3	B4	B5	B6	B7
	Coax Calibration Kit					
	3.5 mm (3750LF)	GPC7 (3751LF-1)	N (3753LF)	3.5 mm (3750R)	GPC7 (3751R)	N (3753R)
Reference Code	C1	C2	C3	E1	E2	E3
	Millimeter Wave Calibration Kit					
	WR-22 (3655Q)	WR-15 (3655V)	WR-12 (3655E)	WR-12E (3655EE)	WR-10 (3655W)	WR-10E (3655WE)
Reference Code	D1	D2	D3	D3	D4	D4

Notes: 36583L and 36583K are phase equalized insertable adapters.

* Requires the use of a SM5235 or SM5392 S-parameter test set adapter.

** "A" models are restricted to a one-path, two-port calibration.

*** Port 3 verifications are NOT SUPPORTED for "B" models with Option 6 and an external source.