V9054 VXI Spectrum Analyzer Technical Manual

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V9054 Spectrum Analyzer Overview

Introduction

The V9054 Spectrum Analyzer from Morrow Technologies now gives VXIbus integrators access to a full-functioned 1.6 GHz spectrum analyzer. In addition to being the first VXI spectrum analyzer, the V9054 also provides a combination of innovative hardware and software features that further benefits spectrum analyzer applications.

First, unlike traditional spectrum analyzers, the V9054 maintains precise frequency accuracy at all points in a sweep . This is accomplished with fully synthesized tuning which locks the synthesizer to the reference oscillator at each point in a sweep. Since the instrument sweeps by making many small steps, every point returned by the instrument will be as accurate in frequency as the reference oscillator.

Next, the V9054 has virtually no limit on the number of points that can be returned from a sweep. Instead of just a few hundred points that are available from a traditional analyzer, the V9054 has the capability to deliver tens of thousands of points from one sweep. Thus, instead of searching for signals with a wide sweep and then making narrow sweeps to resolve details, the V9054 can capture the details in one wideband sweep. An added benefit is that each of the points in the sweep has precise frequency accuracy.

Nonlinear sweeps are another unique capability provided in the V9054. Users can download the instrument with a table of frequency points which allows it to jump directly to frequencies of interest. For instance, when testing the harmonic content of a signal, the V9054 can be set up to jump only to the frequencies of the harmonics and avoid a slow wideband sweep. Using this feature in automated test systems can dramatically reduce the time it takes to perform tests. Also, this directed search capability can be very beneficial in spectrum surveillance applications. In many VXI applications the V9054 may also be suitable for performing the functions of multiple instruments. For instance, in a communications test set the V9054 could serve as a spectrum analyzer, power meter, frequency counter, and a modulation meter.

Hardware

The V9054 is composed of four main sections: a synthesizer, RF chain, video processor, and a digital controller. The RF chain uses triple conversion to convert the input signal to a final I.F.. frequency of 10.7 MHz. The first mixer is preceded by a fixed low pass preselection filter and a 0 to 60 dB stepped attenuator. High quality mixers and filters are used throughout the RF chain, as well as low noise amplifiers. The resulting circuit provides a noise floor of less than -120 dBm, a third order intercept of 5 dBm, and a third order dynamic range of greater than 80 dB over the 1600 MHz input frequency range.

The third I.F.. is further processed by resolution bandwidth filters. The RBW filters are implemented as 4-pole synchronous filters to minimize settling time as the engine sweeps. The bandwidth of the filters ranges from 300 Hz to 3 MHz.
The synthesizer produces the three local oscillator signals for the RF chain. Each of the local oscillators is locked to a precise TCXO (or optional OCXO) 10 MHz reference oscillator. The second and third local oscillators are fixed in frequency while the first local oscillator provides all the tuning for the instrument.

The first local oscillator has a main phase-locked loop that combines the outputs of three sub-loops and a direct digital synthesizer. The multi-loop design provides a wide band, low phase noise synthesizer which settles in approximately 100 microseconds and has a 1 Hz step resolution.

The video processor includes the log detector, linear detector, video bandwidth filters, and a high speed, 12 bit analog-to-digital converter. In addition to digitizing the amplitude of the detected signal, the converter can also be used to directly digitize the third I.F.. signal.

The digital controller has two microprocessors and two digital signal processors to communicate with the VXI bus and control the other sections of the instrument. One microprocessor interprets the commands from the VXI bus. The other microprocessor and a digital signal processor control the internal functions of the V9054, including control of the synthesizer and calibration. The second digital signal processor is available to perform various DSP algorithms such as FFTs and digital filtering. User-defined algorithms can be downloaded into this processor.

The V9054 is packaged as a two slot "C" size VXI module. A machined housing and innovative shielding and grounding techniques are used to achieve sufficient isolation between both the instrument's own internal modules, and between the instrument and other VXI modules.

Calibration

The V9054 is calibrated at over 12,000 different combinations of input frequency, reference level, RBW, VBW, etc. These calibration points are maintained in nonvolatile memory and are used by the instrument to accurately adjust the amplitude of the points returned in a sweep. This extensive amplitude correction technique is possible because the frequency is precisely known at every point in a sweep. Thus for every frequency step in a sweep the instrument looks up the

nearest calibration point and makes an amplitude correction.

Software

An integral part of any VXI instrument is the software. The V9054 provides a powerful array of software tools for spectrum analysis and application development. While the greatest number of tools exist for the Microsoft Windows environment, strong support is available for DOS and UNIX systems as well.

Many VXI applications are highly specialized and tend to require custom features. Thus, system integrators often face some degree of programming for VXI instruments. To meet these needs, the V9054 provides a number of software options for creating custom applications. The first of these is the V9054 C Programming Library. This C language application programming interface (API) provides complete control of the V9054 hardware to any C program.

This same API is also available as a Windows dynamic link library (DLL). This allows Windows programmers to control the V9054 from C/C++, Visual Basic, or any other DLL-capable Windows application. Virtually any application can be designed using this library, regardless of size or complexity. In addition, Morrow Technologies will provide LabWindows/CVI and LabView instrument drivers. This makes the V9054 even easier to integrate with other VXI test instruments.

The V9054 C Library Function Tree

The C Library function outline is shown below as a "tree" of functions and their descriptions grouped with respect to the operations they perform. This is the set of functions available in the Morrow Technologies V9054 C Library and provides complete control of the V9054 hardware and all of its capabilities.

Function Operational Description	Function Name:
Configuration Functions	
Hardware Configuration	
Set Interrupt Code	SetIntrCode
Read Interrupt Code	RdIntrCode
Set IRQ Number	SetIrqNum
Read IRQ Number	RdIrqNum
Set Address Port Number	SetPortNum
Read Address Port Number	RdPortNum
Attenuation Functions	
Set Attenuator Value	SetAttenuatr
Read Attenuator Setting	RdAttenuatr
Set Input Reference Level	SetRefLevel
Read the Input Reference Level	RdRefLevel
Detector Mode Functions	
Set Linear Detector	SetDetectLin
Set Log Detector	SetDetectLog
Set 3rd IF Detector	SetDetect3IF
Read Detector Mode	RdDetect
Trigger Mode Functions	
Set Trigger Mode	SetTrigMode

Read Trigger Mode	RdTrigMode
Set Trigger Frequency	SetTrigFreq
Read Trigger Frequency	RdTrigFreq
Set Trigger Threshold	SetTrigThrsh
Read Trigger Threshold	RdTrigThrsh
Cell Mode, Dwell Time Functions	
Set Auto Cell	SetAutoCell
Read Auto Cell	RdAutoCell
Set Cell Mode	SetCellMode
Read Cell Mode	RdCellMode
Read Cell Point Frequency	RdCellPtFreq
Set Number of Cells	SetNumCells
Read Number of Cells	RdNumCells
Set Sweep Code	SetSweepCode
Read Sweep Point Frequency	RdSwpPtFreq
Frequency Hop Functions	
Set Hop Table Count	SetHopTabCnt
Read Hop Table Count	RdHopTabCnt
Resolution Bandwidth Functions	
Calculate RBW Code	CalcRBWCode
Set RBW	SetRBW
Read RBW	RdRBW
Set RBW Mode	SetRBWmode
Get RBW Wide	GetRBWwide
Video Bandwidth Functions	
Calculate VBW Code	CalcVBWCode
Set VBW	SetVBW
Read VBW	RdVBW
Set VBW Mode	SetVBWmode
Get VBW Wide	GetVBWwide
Set Filter Ratio	SetFiltRatio
Read Filter Ratio	RdFiltRatio
Sweep Functions	
Set Start Frequency	SetStartFreq
Read Start Frequency	RdStartFreq
Set Stop Frequency	SetStopFreq
Read Stop Frequency	RdStopFreq
Step Size Mode	StepSizeMode
Set Default Points	SetDefltPts
Read Default Points	RdDefltPts
Set Number of Sweep Points	SetNumSwpPts
Read Number of Sweep Points	RdNumSwpPts
Set Step Size	SetStepSize
Read Step Size	RdStepSize
Sweep Time Functions	
Sweep Time Mode	SwpTimeMode
Set Sweep Time	SetSwpTime
Read Sweep Time	RdSwpTime
Override Settling Time`	OverrideSetTime
Read Settling Time	RdSettleTime
Set Dwell Time	SetDwellTime
Read Dwell Time	RdDwellTime
Default Settling Time VBW	DefltSetTimeVBW
Default Settling Time RBW	DefltSetTimeRBW
Zero Span Functions	
Set Zero Span Sample Count	SetZSamplCnt
Read Zero Span Sample Count	RdZSamplCnt
Set Zero Span Sample Rate	SetZSamplRate
Read Zero Span Sample Rate	RdZSamplRate
Set Zero Span Frequency	SetZspanFreq
Read Zero Span Frequency	RdZspanFreq
Action/Status Functions	
Action Functions	
Initialize Engine	InitEngine

Break Sweep	BreakSweep
Start Sweep	StartSweep
Start Frequency Hop	StartFreqHop
Start Zero Span	StartZspan
Load Frequency Hop Table	LoadHopTable
Shut Down Engine	ShutdownEngine
Status Functions	
Is Calibrated	IsCalibrated
Is Sweeping	IsSweeping
Check For Min/Max Mode	CheckForMinMax
Check for Frequency Data Mode	CheckForFreqpts
Data Functions	
Acquisition Functions	
Get Spectrum Data	GetSpectrumData
Get Trace Data Only	GetTraceData
Get Trace Data with Frequency	GetTraceWithFreq
Get Min and Max Data Points	GetMinMaxData
Get Min, Max and Freq data	GetMinMaxWithFreq
Data Conversion Functions	
Get dBm for Amplitude	GetDbmForAmpl
Get nano Volts for Amplitude	GetnVForAmpl
Get nano Volts for dBm	GetnVForDbm
Data Analysis Functions	
Find High Peak	FindHighPeak
Find Next Peak	FindNextPeak
Find Point at Sweep Frequency	FindPtAtSwpFreq
Utility Functions	
Initialize Instrument Data	InitInstrData
Reset Engine	ResetEngine
Re Couple (Engine calibration)	Recouple
Delay Operations	DelayOps
Copy 9052 Structure	Copy9052Struct
Close	Close

V9054 Hardware Orientation

Hardware Installation

1. Insure that the power to the chassis is off.

2. Set the logical address of the V9054 before placing it into your VXI chassis. You will find a red bank of slide switches at the rear of the spectrum analyzer for this purpose. All V9054s are shipped with all these switches in the OFF position which produces a logical address of 255. An address of 255 is a special case which indicates that the resource manager software will assign a logical address to the device. If you do not want the address assigned automatically, set the switches to a binary value other than 255 or 0. The 0 address is the other special case in that the chassis controller reserves address 0 for itself.

3. Now, hold the spectrum analyzer with the face toward you and with the product label lettering oriented upwards. The blue Morrow Technologies ejector handle should now be at the top front of the spectrum analyzer.

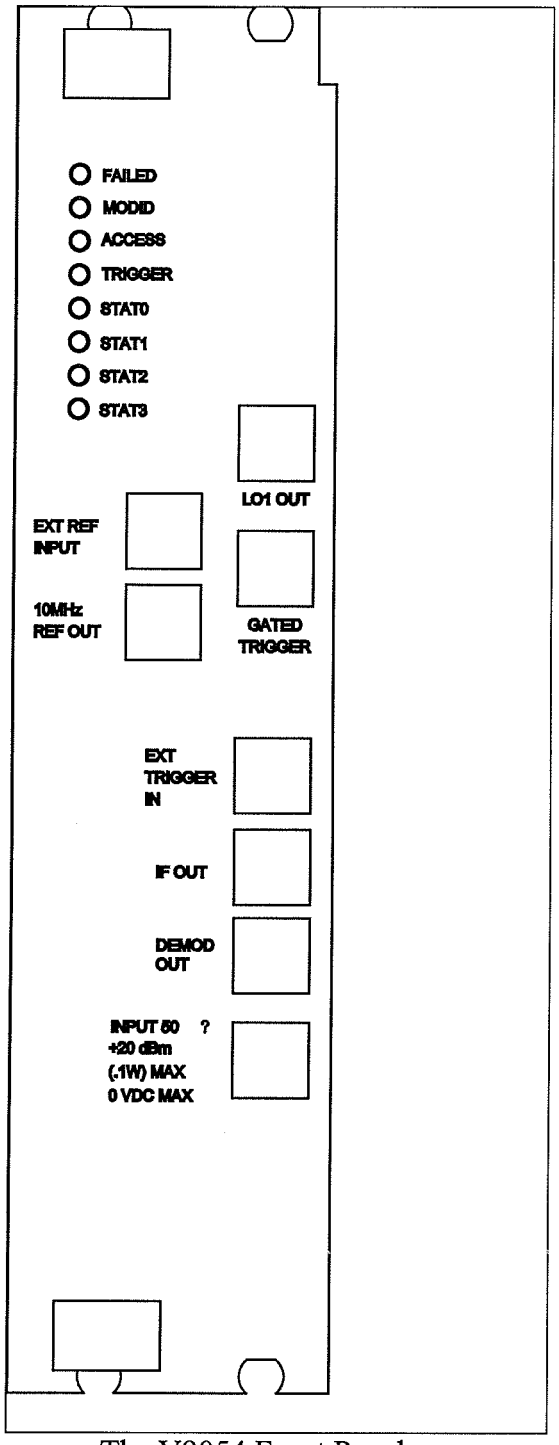
4. Select a pair of adjacent slots in the VXI chassis for the spectrum analyzer to occupy. Note the controller requires that it be inserted into the leftmost slot numbered 0. Obviously you should avoid placing the V9054 in the 0 slot. You will notice that each slot has an upper and lower guide rail in which there is a groove. You must insert the spectrum analyzer such that the green circuit board, visible from the top and bottom of the V9054, fits into the upper and lower grooves. Only with the circuit board in both the upper and lower grooves will the connectors on the rear of the spectrum analyzer fit into the connectors on the chassis back plane properly.

5. Slide the unit carefully along its guide rails to the back of the chassis. A slight amount of pressure may be necessary to insert the connectors at the back of the unit into the chassis. If excessive force is required, check to see that you are properly on the guide rails. Applying undue pressure to a misaligned connector could cause damage to the V9054. When the unit is secured in the chassis, the ejector handles should click into place.

Power Up

When the chassis is first powered up, the top LED on the V9054 should light for a short time and then turn off. At this point, only the fourth LED, "Trigger", should be lit. If the LEDs are not in this state after a couple of seconds, perform the following corrective actions.

Turn the chassis power off.
Insure proper insertion of all devices.
Power the chassis back up. If the problem persists, contact Morrow Technologies technical support for help.



The V9054 Front Panel

The V9054 front panel has 3 main features: 8 LED indicators; 8 SMA type input/output connectors; and 2 ejectors, shown at the left top and bottom corners. These interface features are described in detail below.

Removing the V9054

To remove the spectrum analyzer, push the top ejector knob toward the top the chassis, and push

the bottom knob toward the bottom of the chassis. To clarify, place a finger on the bottom of the top knob, and place another finger on the top of the bottom knob. Now push the ejector knobs away from each other. Finally, slide the unit along the guide rails until it is free of the chassis.

V9054 External Connectors

To operate your spectrum analyzer you will need to use at least one of the connectors which project from the spectrum analyzer through the back of your PC or the front of your VXI chassis. Figure 1 below identifies the V9054 external connectors and figure 2 identifies the V9054 external connectors.

Note: *optional ports include L.O. 1 Input, Tracking Generator Output, and Gated Trigger Output*

Of the ten possible connectors only the RF Input connector must be used to operate the spectrum analyzer. The L.O. 1 output connector should be terminated in a 50 Ohm impedance.

To operate the spectrum analyzer, you must connect a signal to the RF Input connector. Use of any of the other input or output connectors is optional. Below is a brief functional description for each connector.

L.O. 1 Out

This signal is produced by the first local oscillator synthesizer. It is required for the optional tracking generator. The frequency of this signal is equal to the input frequency in MHz plus 2050 MHz. The level is typically +6 dBm. During the normal instrument operation this connector must have a 50 Ohm terminator installed.

External Reference Input

Use this input when you wish to use a 10 MHz high precision reference other than the internal reference. The external reference should be a sine wave with a level of 0 to +4 dBm.

10 MHz Reference Output

You may use this sine wave output signal to drive the external reference inputs of any other devices in the system. The standard OCXO (oven controlled) reference oscillator has an accuracy of $5x10^{-7}$, and the optional TCXO (temperature controlled) reference has an accuracy of $5x10^{-8}$.

External Trigger In

Using this TTL level input allows the spectrum analyzer to start collecting data when the logic of the External Trigger reaches some pre-defined logical state. For example, the V9054 can be setup to start collecting data when the External Trigger In signal goes high, or the sweep may be setup to collect data when the trigger signal is low. This trigger may also be set for rising or falling edge sensitivity.

3rd I F Out

This output reflects the input signal at the intermediate frequency 10.7 MHz.

Demod Out

The demodulation output is produced by the log and linear detectors. The output signal from the detector is first processed by the VBW filter before reaching this connector. The DEMOD OUT level is 0 to +1 Volt full scale.

RF Input

This is the only required connection when measuring a signal. Without an input signal the collected data reflects only the spectrum analyzer's internal noise floor.

Input Signal Limitations

- DO NOT apply more than +20 dBm to the input connector because this will damage your spectrum analyzer.
- DO NOT connect a DC power source to the input connector because this will damage your spectrum analyzer.
- DO use input signal sources with 50Ω characteristic impedances to obtain the most accurate readings.

V9054 Spectrum Analyzer LEDs

The V9054 Spectrum Analyzer is equipped with eight LED's to indicate the status of the spectrum analyzer. Next to each LED on the face plate of the V9054, each LED's function is labeled. What follows here is a discription of each LED based on its label name.

Name	Description
FAILED	This LED is linked directly to the SysFail* line on the VXI bus. If this LED is on, the entire VXI bus needs to be reset; usually the 0 Slot Controller has a reset button to accomplish this. You, also, may notice the Failed light flash after reset or power on; this is a result of the VXI defined hard reset-power on procedure.
MODID	Connected to a VXI bus line that is used only during setup by the Resource Manager, this LED should be off at all times except during a short period during logical address configuration (you may, in fact, not even see it flash.)
ACCESS	This LED is extremely useful for diagnostics during programming. This LED will light when data is read or written to the VXI registers present on the Spectrum Analyzer. Following the communications protocols listed in the **Programmer's Guide to the SA9054 Spectrum Analyzer** the Access LED may remain on for long periods of time if the V9054 is not responding. This is due to the host software continually polling the specturm analyzer for a successful error code.
TRIGGER	This LED currently is unused, and it is on at all times.
STAT0-STAT3	These LED's are unused, and they are off at all times

A Brief V9054 Operations Guide

This guide presents an introduction to how the V9054 conducts spectrum analysis. The V9054 has much in common with most spectrum analyzers on the market, but there is also much which is unique. Having an understanding of how the V9054 operates will help you make measurements and take advantage of strengths of its design.

The V9054 is a super-heterodyne spectrum analyzer. This means that the instrument examines frequencies by mixing the input signal with a signal from an internal oscillator. This oscillator is referred to as the first local oscillator (L.O.) and the V9054 generates it in a unique manner. Most spectrum analyzers utilize a free sweeping oscillator (VCO or YIG) which is phase locked at its start frequency or perhaps its center frequency. The V9054's synthesizer instead takes discrete frequency steps, and is phase locked at each of those steps. This allows the V9054 to step directly to any frequency within its bandwidth and it locks that frequency to its internal reference in 120 us. The fast step time and design of the V9054's synthesizer allows the V9054 to hop directly forward or backward to frequencies of interest.

Warm-Up Time

You need to let the spectrum analyzer warm-up before use. After powering up at room temperature the V9054 will be operational in less than five minutes and will meet all specifications within fifteen minutes. This time allows the V9054's components to reach each their individual operating temperatures. In particular the reference oscillator needs to be heated to a specific temperature before it will output the correct frequency. If you attempt to use the spectrum analyzer before this oscillator has reached its operating temperature you may observe your signal "jumping" in frequency and amplitude. This is normal. If you observe the signal while the spectrum analyzer warms up you will see the signal stabilize over a short period time. When the signal becomes stable the oscillator has reached its operating temperature, but if fifteen minutes have not yet elapsed the amplitude and frequency reported may be slightly out of specification due to instability in the temperatures of the components as a whole. Thus, before taking any new measurements it is best to measure a signal of known frequency and amplitude. In this way you can verify that the spectrum analyzer is reporting correct values. However, you may be sure that after fifteen minutes have elapsed that the spectrum analyzer is reporting correct values without bothering to verify with a known signal. The amount of warm up time does vary with the ambient temperature. Particularly if the temperature is colder than normal you will observe that more warm-up time is required.

Sweeping

The primary function of a spectrum analyzer is to measure the signal amplitude in the frequency domain. The frequency range examined is determined by the output of the first L.O. that, as already mentioned, is normally generated from a ramped or swept frequency source. Thus the process of examining a frequency range is often referred to as "sweeping" the frequency spectrum. Although, the V9054 executes a "sweep" by taking many finely tuned, discrete frequency steps, the speed of the V9054's synthesizer results in sweep times very similar to the

traditional method. However, the V9054 achieves far greater frequency accuracy, and has the added ability to execute nonlinear frequency scans.

As the paragraph above states, the V9054 takes many frequency steps to examine a frequency range. The number of steps taken depends on the desired search range, and the desired resolution of the resultant spectral data. The width of frequency range under examination is known as the current span of the instrument. Thus if the V9054 is currently examining the frequency spectrum ranging from 88 MHz to 108 MHz (the FM band) the span would be 20 MHz. The number of synthesizer steps the V9054 will take to examine a 20 MHz span depends on the selected RBW filter and would be between 20 steps (for a 3 MHz RBW) and 200,000 steps (for a 300 Hz RBW.)

Filters

After determining the range of your sweep, you will want to choose settings for the two types of filters available. The choices you make will affect the appearance of your signal, and the amount of time each sweep requires. The two filters you may set are the Resolution Bandwidth Filter, RBW, and the Video Bandwidth Filter, VBW.

RBW

You may choose to let Giselle select the RBW for you automatically or, you may choose from one of 5 RBWs that are designated 300 Hz, 3 KHz, 30 KHz, 300 KHz, and 3 MHz. Each filter is specified by a frequency that is called the filter's bandwidth. RBWs with smaller bandwidth's are called narrow or slow RBWs, and similarly filters with larger bandwidths are called wide or fast.

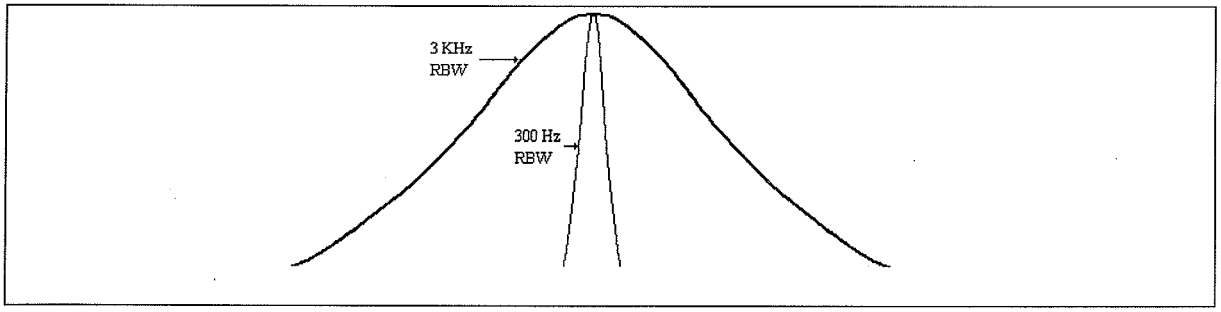


Figure 1 - This image contrasts the appearance of the same signal viewed with different RBW filters.

Each name offers a different perspective on the effects of a particular filter on your sweep. For example, the 300 Hz RBW will produce a narrower trace of your signal than the 3 KHz RBW, and the 300 Hz RBW will also produce a slower sweep than the 3 KHz RBW (if effects of the VBW are ignored, see below.) Below is an example of how the same signal would look if it were swept using the 300 Hz filter and the 3 KHz filter.

As you can see the chosen RBW has a profound effect on the appearance of the signal. Choosing the next highest RBW (10x the current RBW bandwidth) will cause the apparent width of the signal to increase about 10 fold. More than just a matter of appearance, however, the width of the signal determines how well two signals with similar frequencies are separated (if at all) on the display. That is, the narrower the RBW the more noticeable the separation of two signals; Figure 2 below illustrates this point.

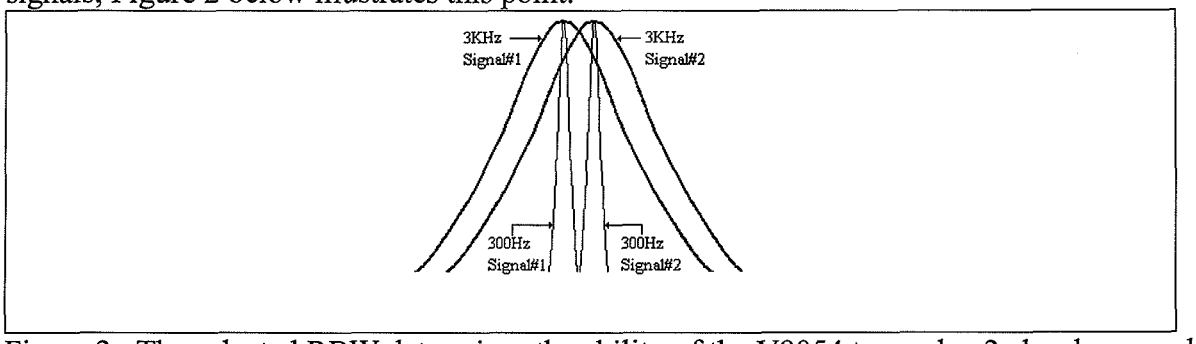


Figure 2. The selected RBW determines the ability of the V9054 to resolve 2 closely spaced signals.

It would be difficult to distinguish the two signals using the 3 KHz RBW, however the two signals when viewed using the 300 Hz RBW are completely separated. This effect is called resolution, and it gives the RBW its name (Resolution Bandwidth Filter). Two signals are said to be resolved if using a particular filter it is possible to tell that there are two signals present. If in the above example the 30 KHz RBW had been used instead of the 3 KHz RBW, the two signals would have appeared to be a single signal and thus would have been unresolved. The bandwidth of a filter tells you the minimum width of any signal on the display, so to view two signals of equal amplitude whose center frequencies are *f* Hz apart you can not use a RBW with a bandwidth less than *f* Hz. For instance, if you would like to view two signals whose center frequencies you know to be 50 KHz apart, you would not be able to use any filter larger 50 KHz because the signals would not be resolved.

The RBW helps to determine the time it takes for a sweep to complete. Narrow RBWs take longer at each frequency in the sweep to obtain a stable amplitude reading, and thus narrow RBWs cause slower sweeps. The time spent at each frequency is called the RBW's settling time. A full explanation of sweep time including the effects of the RBW, VBW, and synthesizer is offered in the section Sweep Speed below. RBWs with more narrow bandwidths require more time to settle than those with comparatively wide bandwidths..

VBW

The Video Bandwidth Filter is used to reduce or eliminate noise on your signal. The seven VBWs (3 Hz, 30 Hz, 300 Hz, 3 KHz, 30 KHz, 300 KHz, 3 MHz) offered by the V9054 are, also, designated by bandwidth. You may choose any one of these filters, or unlike RBWs you may choose to use no VBW filter at all. Using the correct VBW, will allow you to clarify your signal

or even see a signal you otherwise would not have been able to see because it was masked by noise. Below is a diagram displaying a sweep of the same signal using two different VBWs.

Typically the VBW will be controlled automatically by the software using the ratio of VBW/RBW size. Setting the VBW/RBW ratio manually allows you to maintain a fixed relationship between the filters even when you alter the RBW setting.

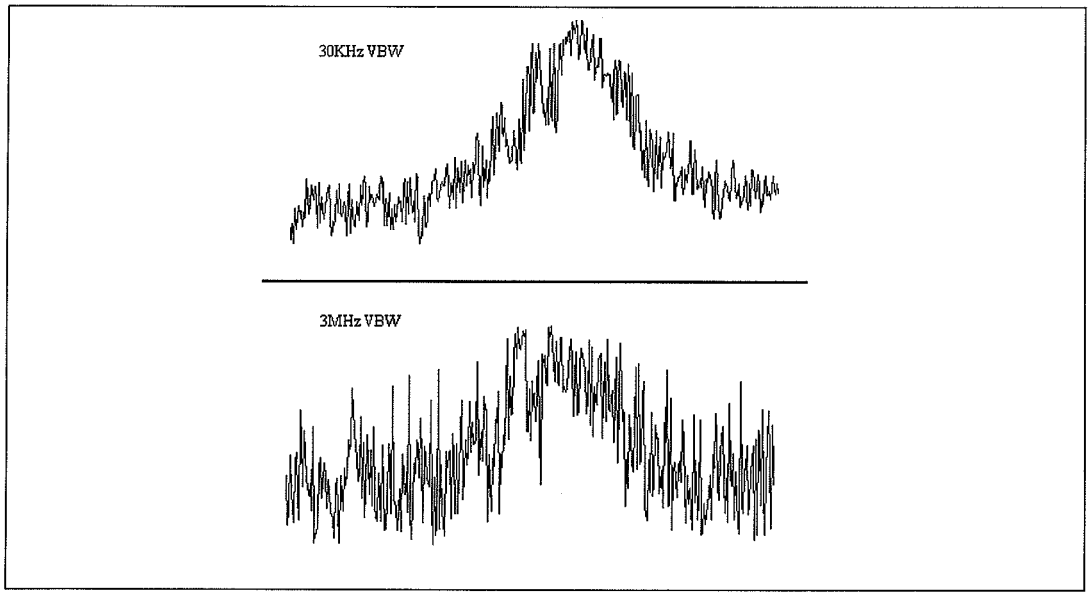


Figure 3. Using different VBW filters to smooth displayed noise

Sweep Time

The time for the spectrum analyzer to analyze each frequency point from the first to the last frequency is called the sweep time, and it is directly affected by three factors, RBW, VBW, and synthesizer settling times. The effects of the RBW and VBW settling times will be discussed together in the Filters section below because together they determine the second part of the total time required by the spectrum analyzer at each frequency. The first part of the total time is the synthesizer settling time.

Synthesizer

The V9054 uses three Phase Locked Loops (PLLs) and direct digital synthesis to tune the V9054 to a particular frequency. The components of the PLLs require a certain amount of time to lock at a new frequency. This time is called the synthesizer settling time and is approximately 120 microseconds (us.) Using this method to tune to a frequency can under certain circumstances lead to sweep times that differ from traditional spectrum

analyzers, but it also lets the V9054 accurately determine the frequency at which a given reading will be performed and to collect points down to 1 Hz resolution.

Filters

The RBW and VBW filters determine the second delay required at each point. That is at each frequency, each filter requires a certain time, settling time, before it can be trusted to return accurate data. Both filters may settle simultaneously, so the sweep is delayed only by the settling time of the slowest filter. For example if the RBW being used has a longer settling time than the VBW being used, it is only necessary to wait for the RBW to settle since the VBW will be settled before the RBW has finished settling. The settling time of a filter is indirectly proportional to the bandwidth of the filter. Thus, the 30 KHz RBW requires 1/10th the settling time of the 3 KHz RBW, and although the 300 KHz VBW would require 1/10th more time to settle than the 30 KHz VBW, it is not true to say that the 300 KHz VBW would require 1/10th more time than the 30 KHz RBW. Athough the relationship between two RBWs or the relationship between two VBWs can be determined by simply evaluating the ratio of the bandwidths of the two filters, the same can not be said when evaluating RBWs to VBWs. The ratio of RBW to VBW times can be determined, from the filter settling data in Appendix A if desired, but it is usually sufficient to know that for RBWs and VBWs of equal bandwidth the RBW will require more settling time.

To summarize, given a particular filter combination, the spectrum analyzer will require a settling time at each frequency equal to the synthesizer settling time plus the largest settling time between the current VBW and RBW. Thus if the 3 KHz RBW and the 3 KHz VBW are being used, you know that the spectrum analyzer will require the synthesizer settling time plus the settling time of the 3 KHz RBW because between RBWs and VBWs of equal size the RBW requires the most settling time. If exact settling times are needed they can be found in the specifications chapter..

Delay Time & Return Data

The V9054 allows the user to specify that the spectrum analyzer dwell for a certain period of time at each point after the spectrum analyzer settles. During the dwell time the spectrum

analyzer tracks the minimum and maximum points at that frequency. When the dwell time is set to a non zero value, the V9054 may be instructed to return the minimum, maximum, or both the minimum and maximum values for each point.

Detectors

Based on the nature of your signal you will select either the log detector or the linear detector. As their names imply, the log detector returns data on a logarithmic scale, and the linear detector returns data on some linear scale.

Attenuation

Attenuation reduces the level of the signal entering the V9054. Without the ability to attenuate a signal, the V9054 could only examine signals in the range of -120 dBm to -40 dBm, but with attenuation this range becomes -120 dBm to +20 dBm. Attenuation accomplishes this by shifting the range of the range of the spectrum analyzer, so the difference between the high and low ends of the range will always be 80 dBm. Thus, if 25 dB of attenuation is used the measurable signal levels will be -95 dBm to -15 dBm. The V9054 can add from 0 to 60 dB of attenuation in 1 dB increments for any sweep.

VXI Bus Programming

VXI Programming Libraries

VXI software standards define the set of VXI Library commands available to the user for low level communication with instrument hardware in a VXI chassis. A subset of these commands is used by the Morrow Technologies V9054 C Library to implement the V9054 interface through an MXI host computer or embedded zero-slot computer interface. National Instruments NI-VXI software library is a package which implements the input/output functions which "glue'" the V9054 C Library interface to the standard VXI command set and bus architecture . This NI-VXI software is loaded at run time when the function InitVXIlibrary() is called. The NI- VXI software also includes the utility programs VXIINIT.EXE and RESMAN.EXE referred to in this document. The Hewlett Packard HP SICL software library fills a similar role.

Operation

The VXI architecture is based on a Master/Slave principle. The master is called the zero-slot controller because it goes into the left most slot of the chassis that is slot number zero. Before accessing VXI instruments, a program generally called the resource manager (RESMAN.EXE) must be run on the zero-slot controller. Some zero-slot controllers require that an additional initialization program (VXIINIT.EXE) be run before executing the resource manager. The resource manager's job is to locate connected devices, collect various data from the devices, determine or assign the logical address of each device, and finally initialize each device. Some devices will be configured to use a specific logical address while others will be configured such that the resource manager assigns a specific logical address. Those devices that allow the resource manager to configure their logical address are called dynamically configured devices. During the assignment of logical addresses, the "MODID" LED of each device (if it has one) will flash. After assigning the logical address, the resource manager sends commands to each device to prepare it for normal operations which will cause the access light of each device to flash as it receives commands.

V9054 Register Values

The Morrow Technologies V9054 is a Message Based VXI servant device. Some of its VXI registers are initialized by hardware on power-up while other registers are initialized by boot code in the V9054 static memory. Still other registers are neither used nor initialized and will contain unknown values. For each register below there is a list of values which that register may hold while the device is operating normally. Additionally, some text is given to describe the conditions under which the values appear.

When first powered up all of the V9054's registers other than 0x0A and 0x40 will be in an unknown state. 0x0A's power-up value is 0x4980, and 0x40's power-up value is 0x2901. The initialization code then sets each of the registers to one of the values listed in the table below. After the initialization code has run, the value of registers 0x00, 0x02, 0x08, and 0x40 will not change. Any registers not listed in the table below should be considered to be in an unknown state at all times.

Register	Valid Values
0x00	0xBECE
0x02	0x0100
0x04	This LED is extremely useful for diagnostics during programming. This LED will light when data is read or written to the VXI registers present on the Spectrum Analyzer. Following the communications protocols listed in the **Programmer's Guide to the V9054 Spectrum Analyzer** the Access LED may remain on for long periods of time if the V9054 is not responding. This is due to the host software continually polling the specturm analyzer for a successful error code.
0x08	0xFFFF
0x0A	0x4180, 0x4380, 0x4580, 0x4780, 0x4980, 0x4B80, 0x4D80, 0x4F80
0x40	0x29F1, 0x2901

NOTES: The value of register 0x0A is determined by the word serial protocol. For example, when the device is not in an error state, ready to receive data, and has no data to send the value of the register will be 0x4B80.

- The value of register 0x04 is determined by the state of the V9054's internal data buffer.
- Register 0x40 will contain 0x2901 only after a reset but before the initialization code has completed. This state can be expected to exist for at most a few microseconds.

Elementary VXI Programming

The V9054 C Library is normally used to handle all low level details of operating the V9054. The spectrum analyzer's Get Software Version Number command will serve as simple example of how to communicate with VXI devices. This command will also verify that the spectrum analyzer is receiving and responding to commands. If you have already installed the V9054 C Library, you can use its functions to verify the instrument. The example below demonstrates direct communication with the V9054 in case you have not yet installed the library.

Retrieving the version number from the V9054 requires using the Word Serial Protocol to send three commands to the spectrum analyzer and verify each command's response. The commands being sent to the spectrum analyzer will be Abort Normal Operations (value 0xC8FF), Begin Normal Operations (value 0xFCFF), and Get Version Number (value 0x7C00.)

□Using the C library word serial command for your platform send 0xC8FF to the spectrum analyzer and retrieve the command's response. For HP SICL the command is "ivxiws" and for NI-VXI the command is "wscmd"; see the documentation on the library for your platform concerning the format and usage of the command.
□A response to step 1 of 0xFFFE indicates success.
□Send 0xFCFF to the spectrum analyzer just as 0xC8FF in step 1.
□Success is indicated when the lower 8 bits of the upper byte of the response (bits 8-0xB) are set.
□Send 0x7C00 to the spectrum analyzer just as 0xC8FF in step 1.
□The response to step 5 is the version number currently being used by the processor in the V9054 assigned to processing VXI commands (1 of 4 processors.) The lower 4 bits of the returned number indicate the minor version number of the software, and the upper 12 bits reflect the major version number. As of this writing the current version is 1.4, so you should have received a response of 0x0014 from the spectrum analyzer.

Low Level Hardware Programming

Scope

This section only applies to programmers attempting to port the V9054 C Library to a new architecture. The functions and operations described here are contained within the V9054 C Library and involve converting higher level user function calls from the User Function Tree to lower level VXI Library command sequences which are compatible with the requirements of the V9054 processor interface. The V9054 C Library has a set of functions which do this for the National Instruments MXI or embedded VXI interfaces that are hidden from the user unless the V9054 C Library source code is purchased. These functions must be changed to accommodate other architectures while maintaining V9054 processor communication requirements.

Outline

I. The Processors
II. The V9054 VXI User Defined Commands
III. Features and Operation
IV. Brief VXI Word Serial Protocol and Register Tutorial

I. The Processors

The V9054 VXI Spectrum Analyzer (hereafter simply "the V9054") has two CPUs on board. The first processor (designation P1) controls data collection, and the second processor (P2) provides the VXI interface. Two processors were used to simplify the design process. Since a single processor spectrum analyzer had already been designed for the PC Bus (the V9052), when the V9054 was designed a second processor was added in part to be used as an interface mechanism. That is, the second processor was to interpret VXI commands and interpret what needs to be sent to the first processor which retains its PC Bus architecture.

II. The VXI Commands

Standard Commands

The V9054 VXI Spectrum Analyzer conforms to all the requirements of a VXI Word Serial (WS) Device; in addition to those standard WS commands the device also has 4 user defined commands. The operation of each of the user defined commands is explained below.

User Defined Commands

The V9054 VXI Spectrum Analyzer has seven user defined commands as of January 27, 1995. These seven commands are used to inform P2 to perform some spectrum analyzer specific function. Three of the seven functions are used to interface with P1 which is responsible for data collection. Another user defined command is used to determine the software version running on P2 and to enable an enhanced mode of operation, and the next command is used to reset the spectrum analyzer through software. The last 2 commands are used to program the Flash RAM used in P2. The list below shows the command number with its #define name used in the C library to abstract the command number into a name. A brief description of the operation of each command is also given (for further explanation see the description of the standard operational process.)

Command#	Program Definition and Functional Description
0x0008	***VXI_SETUPFLASH*** - This command is executed before command *0x0009* to setup the flash programming process. If this command is not executed or if both commands are not executed with the same parameters the flash will not be programmed when command *0x0009* is executed.
0x0009	***VXI_PROGFLASH*** - This command is executed after command *0x0008*. This command, unlike, command *0x0008* is followed by the actual data in the Intel Hex format that you desire to program into the flash. The code currently running in P2 has the ability to recognize invalid program code but only after the programming process is complete. Thus, one should be careful when loading code into the processor to avoid accidentally sending the wrong file. The processor has a backup in flash which is non-erasable, however, and it will use this until proper code is reloaded. The non-eraseable code is loaded at the factory however, and depending on the age of the spectrum analyzer may lack features of newer code.
0x7B00	***VXI_RESETENG*** - Simply put this command will reset both processors. However, all VXI setup information will be lost, thus you will need to run the Resource Manager after executing this command.
0x7C00	***VXI_GETVERSION*** - This command causes P2 to return the version # of the software it is currently executing in DataLow, and it unlocks a special mode of operation called DataLow Fill Mode (DLFM) which is explained later. The format of the 16 bit version number should be interpreted as follows: bits 0-3 : minor version # bits 4-15: major version #

Command#	Program Definition and Functional Description
0x7D00	***VXI_ENGINEDATA*** - When this command is placed into DataLow P2 fetches a word of sweep data from (if nothing is

available, junk is fetched) the internal FIFO buffer and places it into DataLow.

0x7E00 ***VXI_GETSTATUS*** - This command causes P2 to read both the FIFO status and the status of P1 and return the result in DataLow. The FIFO status is an indication of how much data is waiting to be read from the FIFO. The status of P1 changes to 00 if anything has been sent to P1 and stays 00 until P1 receives a full command. P1 will then put a status value into this register indicating either success or the nature of the error. See *SA_DEFIN.H* and *INTRFACE.C* for a list of both the FIFO and P1 status values.

0x7F00 ***VXI_ENGINECMD*** - This command when placed into DataLow causes P2 to send the next word placed into DataLow to P1.

III. Features and Operation

Error Codes

Code (hex)	Error Description
0x00 -	processor has not issued an error code
0x01 -	success/Acknowlege
0x02 -	no main code loaded (not valid on P2)
0x03 -	no DSP code loaded (not valid on P2)
0x04 -	no Calibration tables loaded (not valid on P2)
0x05 -	error while trying to erase flash
0x06 -	error while trying to program memory word
0x07 -	invalid # of bytes received from hex file
0x08 -	invalid checksum from hex file
0x09 -	first char in hex file line not a colon
0x13 -	bad first parameter (block code in this case)
0x14 -	bad second parameter (erase code in this case)

Normal Data Transfer

Data to and from Processor #2

Data is transferred to and from P2 using the VXI DataLow and Response Registers (see section IV.) via the Word Serial Protocol (also described in section IV.)

_____Data to Processor #1

As in section III.B.1 above the DataLow and Response registers are used to transfer data, but additionally, the VXI User Defined Command *0x7F00* must be used. Following the Word Serial Protocol, the value *0x7F00* is placed into DataLow. After that value has been received by the spectrum analyzer the value being sent to P1 is placed into DataLow. If a response from P1 is desired, one should wait until DataLow is empty and then use the VXI User Defined command *0x7E00* which will return the status of P1 in DataLow. It will be noted here that some commands (particularly the flash programming commands) may take extremely long times to execute. The commands that are used in the course of normal operation (P1 command numbers 0-7) are quick, and one can expect a response to be available after a few microseconds.

_____Data from Processor #1

It is absolutely essential that before one attempts to read data from P1 using this method that one first checks to see that data is available to be read, for regardless of whether data is available something will be returned. Two methods are available for determining if data is available from P1.

_____The VXI User Defined Command.

P2's *0x7E00* command returns both P1 error code and the Data FIFO's fill level. Bits 8-11 in the word returned in DataLow contain the FIFO fill level. Bit 8, however, will be 0 if no data is available and set to 1 if anything is available (see *SA_DEFIN.H* for a complete description of the FIFO fill level bits.)

_____The User Defined bits of the Status Register.

P2 continually monitors the status of the FIFO and places the four FIFO fill level bits in bits 4-7 of the VXI Status Register (offset 4 in the register bank.) Reading this register is much faster than using the User Defined Command *0x7E00*. However, the disadvantage to using this method is that the status may not reflect the actual FIFO status because P2 does other things in the same loop with updating the status; the status lag should not be more than 2 microseconds, if no command is sent to P2 while waiting for a status change.

Once one has established that data is available, the VXI User Defined Command *0x7D00* is used to tell P2 to grab a word from the data FIFO and place it into DataLow. The process is quick and only a catastrophic failure will prevent something from appearing in DataLow within 8 microseconds.

High Speed Data Transfer

Called DataLow Fill Mode or DLFM, when this mode is active, P2 will place any available data into DataLow. Additionally P2 will respond to any command it to which it would normally respond without losing any data.

_____Entering DLFM

- Set Bit#9 in the Status Register

  Begin Checking Bit#8 in the Status Register, when this bit is Set the request to enter DLFM has been acknowledged.

  If this is the first time that DLFM has been turned on, 2 additional steps are needed.

  1. Send the VXI command Begin Normal Operations. (see the VXI specification for the format and responses of this command.) According to the VXI specification a device may not source data into its registers or respond to User Defined commands until the device has successfully executed this command. However, the Resource Manager normally will send the BNO command to all devices when it is executed. If a redundant BNO command is executed, the response to the command will indicate that is the case.

  2. Send the GetVersion user defined command (code *0x7C00*) this command will source the version number into DataLow (you may discard it if you like,) and this command Unlocks Data Low Fill Mode. This is done to prevent automatic entry into DLFM after the Begin Normal Operations command if the status of the bits in the Status Register happen to be high after power on or reset.

DLFM is now on. Simply check to see if data is available using one of the methods described in the Normal Data Transfer, Data from Processor #1 section before reading DataLow. This will ensure that data in DataLow is in fact data from P1 rather than a response from a previous command that was left in DataLow. DLFM and the status retrieval method described in III.B.3.b together provide an efficient method to retrieve data from very fast sweeps.

_____Exiting DLFM

Clear Bit#9 in the Status Register

Wait for Bit#8 in that same register to be cleared by P2
DLFM is now off, turning it back on at this stage involves only III.C.1.a and III.C.1.b unless the spectrum analyzer is turned off and reset.

Initialization

Operations required to properly initialize the V9054 include the following:

Bit#9 in the Status Register should be set or cleared to turn DLFM (see III.C) on or off as

desired. After Bit#9 is in the desired state, the Status Register's Bit#8 should match Bit#9 within 3 microseconds. Bit#9 functions only as a mechanism to send a request to the V9054 to change the current operational mode while Bit#8 reflects the actual mode under which the spectrum analyzer operating.

The VXI Begin Normal Operations (BNO) command should be sent. NOTE: this device is incapable of being a VXI commander device, thus the BNO command sent to the V9054 should reflect this (see appendix E in the VXI specification).

. The user defined command *0x7C00* should be sent to the V9054. This command will unlock DLFM if it was requested in step 1 above, and this command will return the current version number of the software executing on P2. It should be verified that the version number is correct (currently 1.1 as of 2-1-95.) The reason for this is that the code in the Boot Block will have a version number different from the version number of the Main Code Block if new software has been loaded, and if the version number is not that of the Main Code Block, features may not be available.

IV. VXI Word Serial Protocol and Device Tutorial

For those unacquainted with VXI Word Serial Devices, a brief description of the essential concepts and hardware follows.

The Registers

Each VXI device has a set of internal 16 bit registers used for data transfer and device identification. How these registers appear on the host computer is implementation specific, but whether the devices are I/O mapped or memory mapped the registers will always hold the same relation to each other. Below, each register will be given a name and an offset from the address base, thus, offset 4 (the status register) is the third register (offset 0 is the first register, offset 2 the second, offset 4 the third.) Four registers are necessary for the normal operation of the V9054 (though more are necessary for the setup process.)

Status Register - offset 0x04 - bits of interest in this register are:

Bits#4-7 Data FIFO Fill Level Bits. The exact meaning of these bits is described in *SA_DEFIN.H*, and they are described in general in section III.B.3.a.

Bit#8 DLFM acknowledge bit (set and cleared by P2) in response to Bit#9 below

Bit#9 DLFM request bit(set and cleared by host to turn DLFM on and off

Response Register - offset 0x0A - this register controls handshaking and error

notification for Word Serial Protocol.

Bit#9 Called WriteReady, this bit is high when P2 is ready to receive a command or data.

Bit#10 Called ReadReady, this bit is high when a datum has been placed into DataLow (offset 0x0E). This datum could either be a response from a command which was just placed into DataLow (offset 0x0E) or it could be data from P1 if DLFM is active.

Bit#11 Called the ERR* bit, this bit represents in negative logic (that's what the * indicates) that an error has occurred. Thus, if ERR* = 1 no error has occurred, and conversely if ERR* = 0 an error has occurred. The nature of the error can be retrieved using the VXI Get Protocol Error command (see appendix E in the VXI specification for details.)

DataLow Register

Offset 0x0E - this register is bi-directional. That is, if the P2 places a datum in DataLow and before reading that datum the host writes a command to DataLow the data will not be lost because DataLow is actually 2 registers. One of the registers is readable by P2 and writeable by the host while the other register is readable by the host and writable by P2. Reading and writing to DataLow affects the bits in the Response Register (offset 0x0A) in the following manners.

Host Read from DataLow	=>	ReadReady = 0
Host Write to DataLow	=>	WriteReady = 0
P2 Write to DataLow	=>	ReadReady = 1 & WriteReady = 1

Word Serial Protocol

The foundations for word serial protocol are laid out with the hardware described above. To use Word Serial Protocol a device must contain both a Response Register and a DataLow Register.

Transferring from the host

When transferring a word from the host to the Word Serial Device, the WriteReady and ERR* bits are checked. If both bits are high, the value may be placed into DataLow for the WS Device, and the host may be assured that the device has received the word when WriteReady is high and/or ERR* is low. If ERR* is high and WriteReady is high then the it can be assumed that the command was received and executed successfully. If ERR* is low an error has occurred and the Read Protocol Error command (see Appendix E in the VXI specification) must be used to determine the nature of the error. If a suitable period of time elapses WriteReady remains low and ERR* remains high one can only assume the device has Failed.

Transferring to the host

Receiving data from the device is only possible if ReadReady is high. If ReadReady is high, simply read from offset 0x0E. Host Obligations are as follows:

> The host should never cause the device to source data into DataLow when ReadReady is high. This condition is called a Multiple Query Error and it will cause the ERR* bit to drop low.
>
> All VXI commands have a state dependency. The state is based on if the device is operating after a Begin Normal Operations command, End Normal Operations Command, Abort Normal Operations Command, or a reset. If the BNO command has been successfully executed by the device and none of the other commands or conditions have occurred the device is said to be in the Normal Operations Substate. Typically if the device is not in the Normal Operations Substate it will be in the Configure Substate. The VXI specification gives a detailed explanation of this and a list of each command's state dependency. It is the host's duty to know the state of each of the devices attached to it, and to issue only those commands which are valid for the devices current state.

Device Obligations

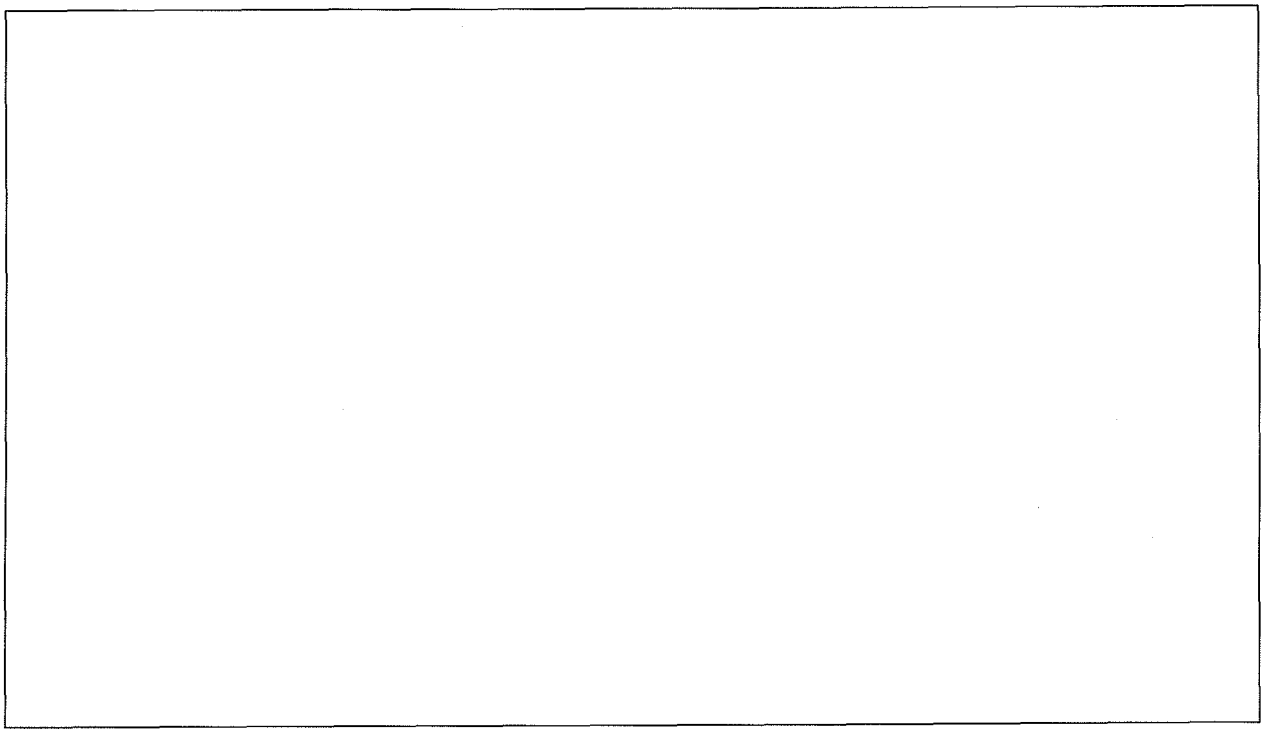
The device may not source a datum into DataLow unless the host has issued a command directing the device to do so though a single command is permitted to source more than one datum. The important point here is that both the host and device agree on when data should cease to be sourced into DataLow.

V9054 Specifications

Filter Settling Times

(in microseconds)

Filter Size	Settling Time RBW	Settling Time VBW
3 Hz	-NA-	250,000
30 Hz	-NA-	25,000
300 Hz	6,000	2,500
3 KHz	600	250
30 KHz	60	25
300 KHz	6	2.5
3 MHz	0.6	0.25



Phase Noise Plot

9052 PHASE NOISE LIMITS

(dBc / Hz vs. offset frequency)

V9054 VXI SPECTRUM ANALYZER SPECIFICATIONS

September 1995

FREQUENCY RELATED	
FREQuency RANGE	100 KHz - 1.6 GHz
READOUT ACCURACY (Start, stop, center, marker)	±(C. F. x 5x10 $^{-7}$ + RBW Accuracy + 1025 Hz) Option 002 : ± (C. F. x 5x10^{-8} + RBW Accuracy + 103 Hz)
READOUT RESOLUTION	1 Hz
REF. FREQUENCY temperature STABILITY	5x10^{-7} Option 002: 5x10^{-8}
REF. FREQUENCY aging	±1 x 10^{-6} Option 002: ± 0.2 PPM
Frequency Stability (Hz) (Residual FM)	3 KHz RBW: < 100Hz P-P in 100 mS
FREQuency STABILITY short term	2x10^{-9} per 100 mS Option 002: 3 x 10^{-10} per 100 mS
PHASE NOISE	< 87 dBc/Hz @ > 30 KHz Offset
Frequency Span Accuracy	± (Stop Frequency x 5x10 $^{-7}$ + RBW Accuracy + 1025 Hz) Option 002: ± (Stop Frequency x 5x10 $^{-8}$ + RBW Accuracy + 103 Hz)
Resolution Bandwidth Range	300 Hz - 3 MHz
RBW Accuracy	20% of RBW except 300 Hz: ±100Hz
RBW Selectivity 60dB / 3dB	15:1, 4 Section Synchronous Filter
VIDEO BANDWIDTH RANGE	3 Hz - 3 MHz
AMPLITUDE RELATED	
REFERENCE LEVEL RANGE	-120 dBm to +20 dBm
Max. Safe Input Power (CW)	+20 dBm
CRT Display Range (LOG)	1 to 10 dB / div
Absolute Level Accuracy	< ±0.5 dB (-20 dBm input, 100 MHz, -20 dBm reference, 300 Hz RBW, 300 Hz VBW)
Frequency Response accuracy (ref. to Absolute Level Point)	±1.0 dB (<1.35 GHz) ±1.5 dB (≥1.35 GHz)
Log Maximum Cumulative Error	±1.5 dB (0 to -70 dB from reference level)
RBW Switching Uncertainty	±0.5 dB
INPUT ATTENUATOR RANGE	0 to 60 dB in 1 dB steps
Dynamic Range COMPRESSION TO NOISE	110 dB @ 300 Hz RBW
Dynamic Range SIGNAL TO 3r d order INTERMOD	>80 dB @ 300 Hz RBW
Viewable On Screen	80 dB
RESIDUAL RESPonses	< -90 dBm with input terminated, 0 dB attenuation.
3rd Order Intermodulation Distortion	< -70 dBc for two - 30 dBm signals @ mixer
3rd Order Intercept	+5 dBm
Gain Compression (1 dB)	@Mixer Level = -10 dBm
Displayed Avg. Noise Level	< -120 dBm (>2 MHz, 300 Hz RBW, 3 Hz VBW, 0 dB attenuation, input terminated)
TIME RELATED CHARACTERISTICS	

Synthesizer Step Time	< 120 µS
SWEEP TIME RANGE (FREQ DISP.)	3.5 mS / Division minimum (auto mode)
SWEEP TIME RANGE (TIME DISP.)	35 µS / Division minimum
SWEEP TIME ACCURACY	Sweep Time x Reference Accuracy
MARKER TIME MEAS. ACCURACY	Time x Reference Accuracy
DELTA MARKER TIME MEAS. ACCURACY	Time x Reference Accuracy
SWEEP TRIGGER MODES	Single, Continuous, External, Video Level
DIGITIZing RATE	$1x10^6$ Samples/sec. (Max) w/ 50 MHz sample & hold
EXTERNAL INPUT CHARACTERISTICS	
RF Input	50 Ω, SMA female
VSWR	< 1.5:1 typical. (< 1.5 GHz, ≥10 dB input attenuation)
L.O. Emission	< 80 dBm (10 dB input attenuation)
Ext. Reference Input Frequency	10 MHz
External Trigger Input	TTL
External Output Characteristics	
1st L.O. Output Level	+6 dBm
VIDEO OUTPUT	0 to +1 Volt Full Scale
3rD I.F. OUTPUT	10.7 MHz @ 0 dBm typical.
GENERAL SPECIFICATIONS	
POWER REQUIREMENT (Maximum)	6.0 amps @ +5 volts 0.4 amps @ -5.2volts 1.50 amps @ +12 volts 1.0 amps @ +24 volts 0.5 amps @ -24 volts (OCXO option only)
WEIGHT	9 lbs
ENVIRONMENTAL CHARACTERISTICS	0 - 50 °C (chassis), Non-condensing
Chassis	VXI "C" size, double wide
VXI Instrument Type	Message-based
Points per Sweep	Typically 350 to 10,000
Directed Search Mode	Sweep with frequency hop table supplied by user

September 1995

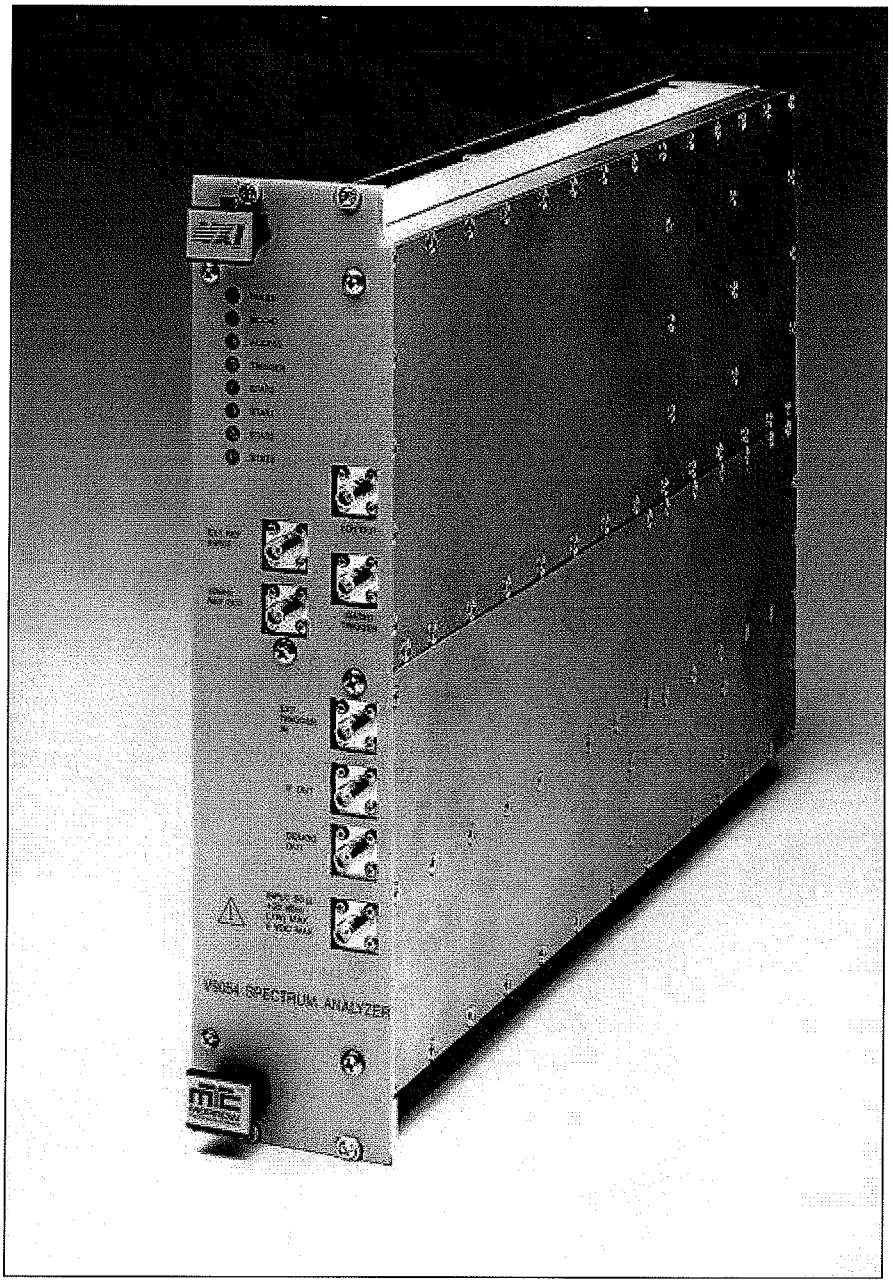
V9054SPC

V9054 Functional Block Diagrams

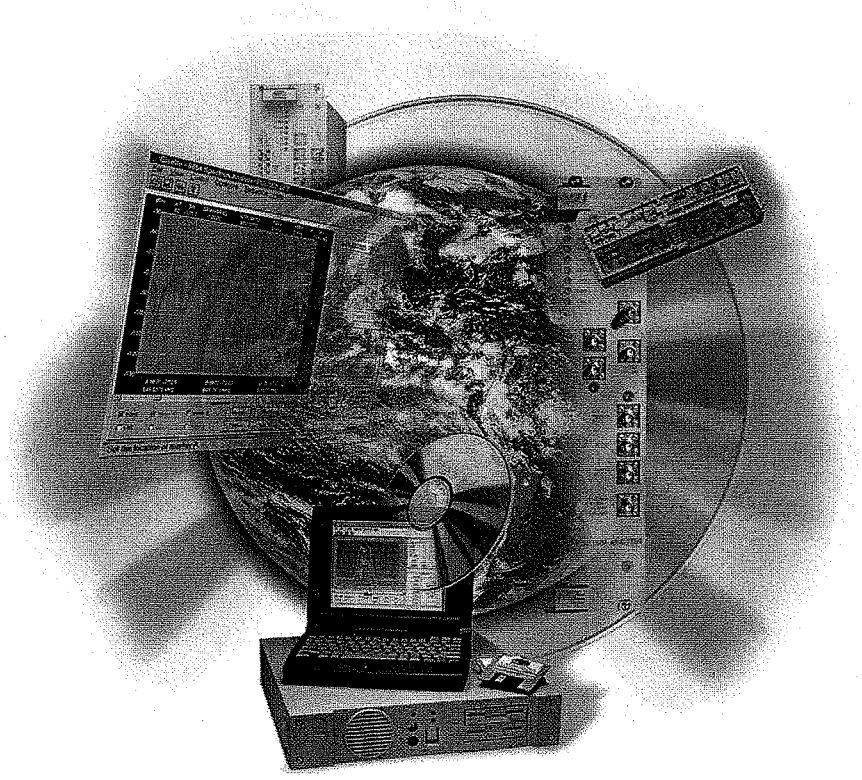
Receiver Chain Block Diagram

Resolution BandWidth Filters / Log Detector Block Diagram

Synthesizer Block Diagram



Spectrum Analyzer User Guide



MORROW™ TECHNOLOGIES

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Document Number: 2002-036

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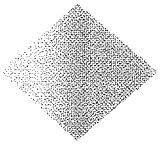
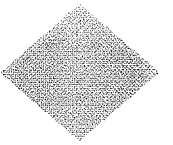



List of Figures

CHAPTER

1

INSTALLING SPECTRUM ANALYZER SOFTWARE

Installation Instructions for Front Panel

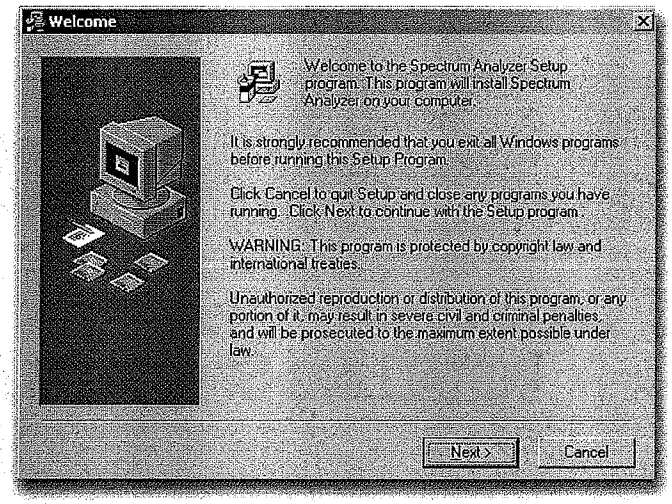
Use the following instructions to install your Spectrum Analyzer software.

1. Remove all older versions of Spectrum Analyzer software from your system. Begin by clicking **Start>Settings>Control Panel>Add/Remove Programs**. Select and remove any Spectrum Analyzer software from the list of programs.
2. Exit all Windows Programs, and place the installation CD in your CD Drive.

NOTE: If you do not have a CD ROM drive in your system, you can take the installation CD to a system with a CD ROM drive, then download the program from the Diskettes directory to individual diskettes.

3. Open Windows Explorer, and click your CD drive. The name of the Morrow Technologies product–**MTC Spectrum** displays next to this drive.
4. In the right navigation pane, double click Setup.exe. The Installation Wizard launches followed by the Welcome screen.

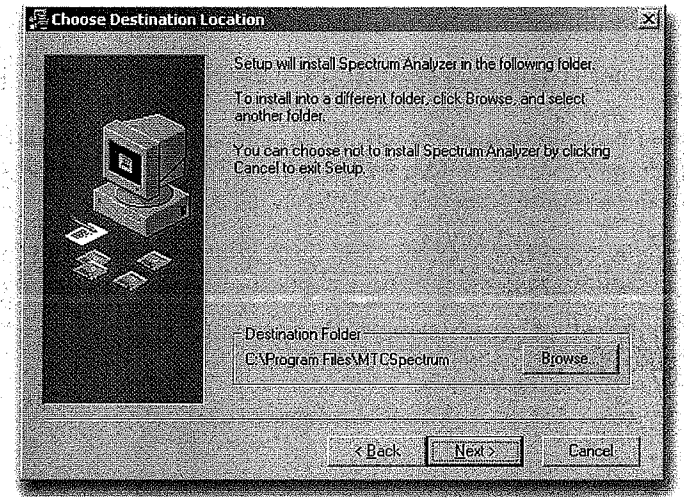
Figure 1.1 *Welcome Screen*



5. If you have already exited all Windows programs, click **Next**. The Choose Destination Location screen displays.

NOTE: If you have not exited all Windows programs, click **Cancel** and please do so before proceeding with this installation.

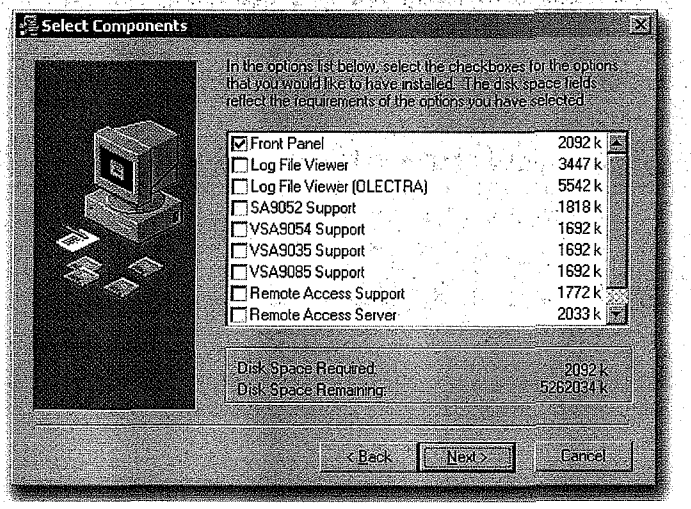
Figure 1.2 *Choose Destination Location Screen*



6. If you want to change the Destination Folder, you can click **Browse** to locate another directory, or click **Next** to install the program in the default

directory C:\Program Files\MTC Spectrum. The Select Components screen displays.

Figure 1.3 *Select Components Screen*



7. From the Select Components screen, a check mark displays next to Front Panel by default. You can deselect this option if you choose not to install Front Panel.

The information below provides a brief description of all component options.

Component	Description
Front Panel	User interface software used to display Spectrum Analysis results on your PC.
Log File Viewer	Configures the Data Logger component and displays logged data traces in 3D graphic format to your PC.
Log File Viewer (OLECTRA)	Same as above, but an older version that uses OLECTRA graphic controls to achieve the 3D graphic format to your PC.
SA 9052 Support	Interface support for communicating with an SA9052 Spectrum Analyzer. This Spectrum Analyzer is used in the P9116.
VSA 9054 Support	Interface support for communicating with a VSA 9054 Spectrum Analyzer.
VSA 9035 Support	Interface support for communicating with a VSA 9035 Spectrum Analyzer.
VSA 9085 Support	Interface support for communicating with a VSA 9085 Spectrum Analyzer.
Remote Access Support	Interface support for communicating with a Spectrum Analyzer located in a remote server such as a P9116.

Component	Description
Remote Access Server	Server support for Spectrum Analyzers.
Data Logger	Server support for Spectrum Analyzers. Collects and logs Spectrum Analyzer data for display using one of the log viewer options.

The information below provides a brief description of various configuration choices.

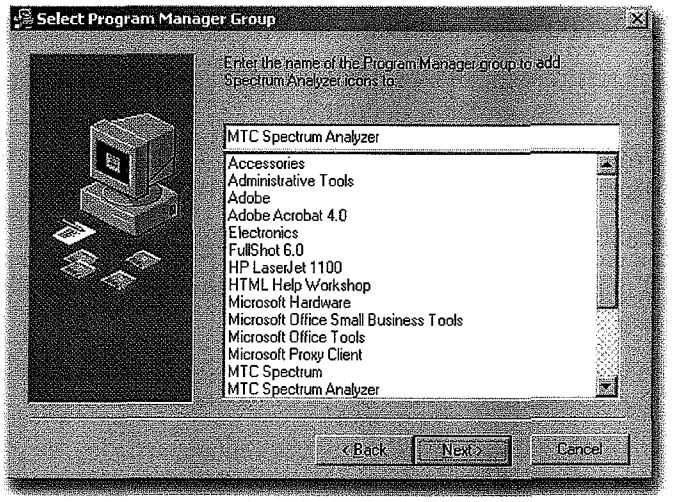
For a typical Remote Client System select the following components:
Front Panel
Log File Viewer
Remote Access Support

For a typical server system using a 9116 select the following components:
Front Panel
SA 9052 Support
Remote Access Server
Data Logger

For a bench top Spectrum Analyzer using a 9116 select the following components:
Front Panel
SA 9052

8. After making your component selections, click **Next**. The Select Program Manager Group screen displays.

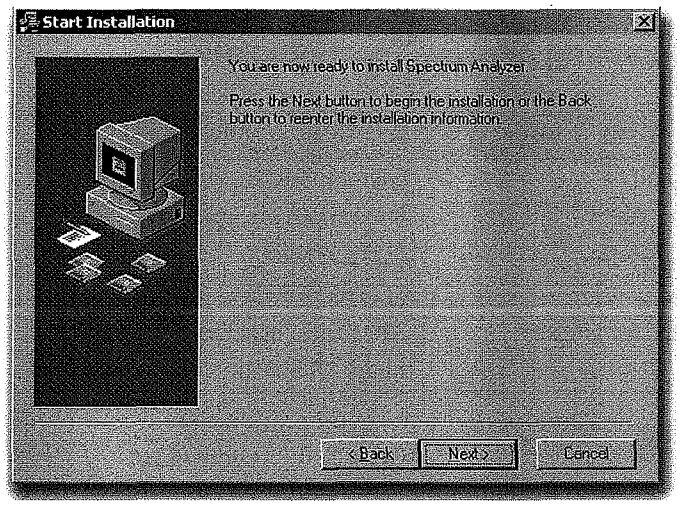
Figure 1.4 *Select Program Manager Group Screen*



9. The default group is MTC Spectrum Analyzer, which appears when you click **Start>Programs>MTC Spectrum Analyzer**. Keep this default unless you absolutely must change your Program Manager Group.

10. Click **Next**. The Start Installation screen displays.

Figure 1.5 *Start Installation Screen*



11. Click **Next** to begin the installation.

Uninstalling Front Panel

To uninstall Front Panel from your PC:

1. Close Front Panel by selecting **Panel>Exit**, or clicking the Close button in the right corner of the title bar.
2. From the Start Menu, select **Settings>Control Panel**. The Control Panel displays.
3. Double-click the **Add/Remove Programs** button.
4. If necessary, click the **Change or Remove Programs** button in the left pane.
5. Scroll through the Currently installed programs list box until Front Panel is highlighted.
6. Click the **Change or Remove** button as needed.
7. Follow the on-screen prompts.

Using the Program Resources

In addition to the Front Panel User's Guide and the online Help system, you can access Technical Support via E-mail from the Morrow Technologies Corporation Web site and by regular mail. See below.

Contacting Morrow Technologies

Contact Type	Address or Number
E-mail	techsupport@morrow.com
Web site	www.morrowcorp.com
Telephone	(727) 531-4000
Fax	(727) 531-4026
Standard US Mail	2300 Tall Pines Drive Largo, Fl 33771

Getting Help

Using the Help File

Once you have Front Panel installed, you can use the online Help system at any time. To start online Help, select **Help>Help Topics** from the Menu Bar, or press the **<F1>** key.

Context Sensitive Help Topics

You can access context sensitive help topics by clicking the Help  button on the toolbar, and clicking a menu item, toolbar button, or program feature. You gain access to help for active dialog boxes by pressing **<F1>** when a dialog box is displayed. By highlighting a menu item or toolbar item and pressing **<F1>**, help displays information on the highlighted item.

CHAPTER

2

ABOUT FRONT PANEL

Tour of the Front Panel Interface

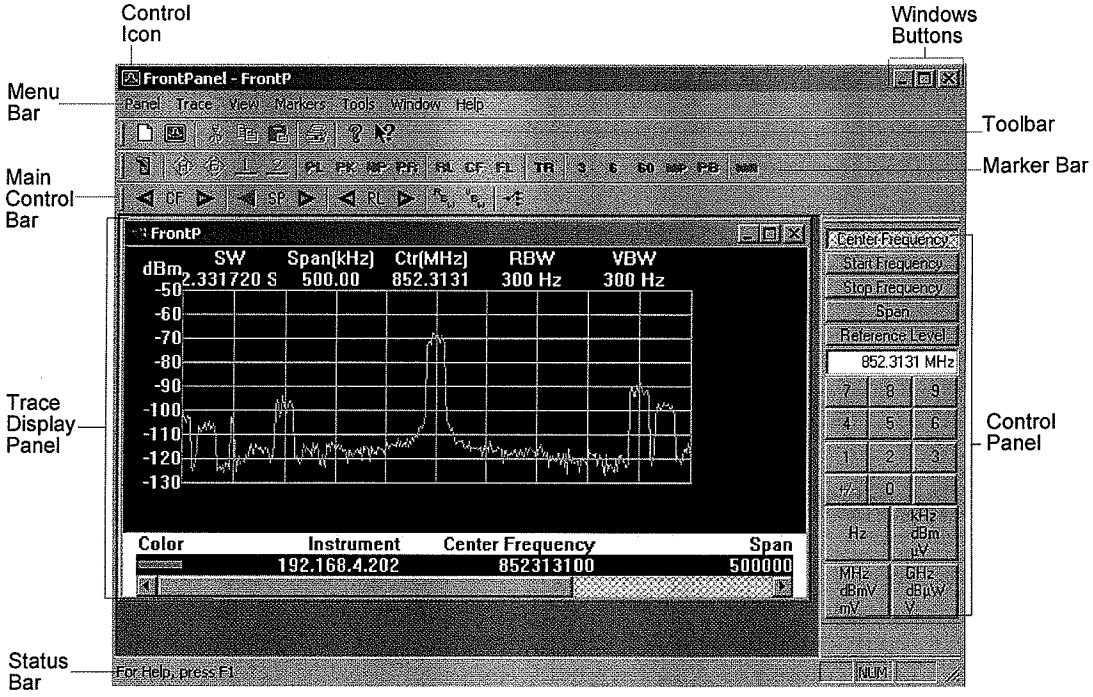
When you start Front Panel for the first time, the New Spectrum Analyzer dialog box displays over the Add Trace dialog box. From the New Spectrum Analyzer dialog box, you can assign a name to your Spectrum Analyzer in the **Local Name For Analyzer** field, and select Local or Remote Location. For detailed instructions, see "Before starting Front Panel" on page 3-1.

When you open Front Panel, you start a blank Workspace area. You add a Trace Display Panel using Panel on the Menu Bar, and begin by using the Add Trace dialog box. For more information, see "Displaying Front Panel" on page 3-1.

You can display, hide, minimize, or move most toolbars around on the screen as needed. Figure 2.1 illustrates the main workspace for Front Panel with an active trace display panel shown. This illustration provides a mini map of the most frequently used functions in Front Panel.

The remaining sections of this chapter provide information about Front Panel and Windows features. Subsequent chapters provide information on the use of these features.

Figure 2.1 *Front Panel Screen with Active Trace Display Panel*



About the Front Panel Features

Menu Bar

The Menu Bar displays two views, Start Up when you first open Front Panel, and Active after a Trace Display Panel is displayed. Different menu items display depending on whether you are starting Front Panel, or adding a Trace Display Panel. Menu items that appear in gray are disabled.

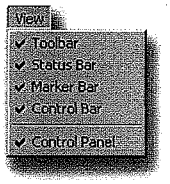
Figure 2.2 *Start Up Menu Bar*

Figure 2.3 *Active Menu Bar*

View Menu

The View Menu is used to turn Front Panel features on and off. The default setting is on, and indicated by the checkmark next to each menu item. By selecting each item in the menu list you turn that feature off and its check mark disappears. To turn the feature on again, click View on the Menu Bar and select the feature. The checkmark reappears and the feature is active again on Front Panel.

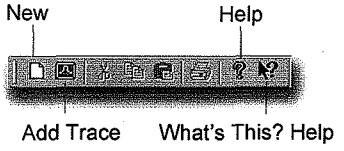
Figure 2.4 *View Menu*



Toolbar

The Toolbar displays buttons that when pressed, apply standard Windows and frequently used functions in Front Panel. Click any toolbar button to activate its function. Buttons displayed in light gray are disabled.

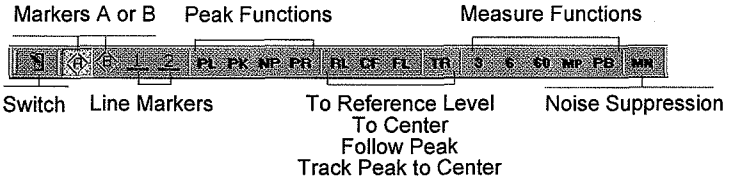
Figure 2.5 *Toolbar*



Marker Bar

The Marker Bar accesses many of the same functions used from the pull down menus. The icon buttons provide easier access to these functions. Click any marker bar button to activate its function. Buttons displayed in light gray are disabled.

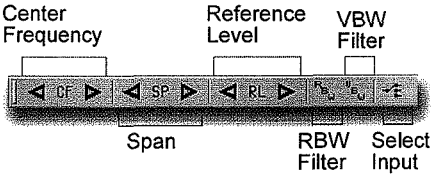
Figure 2.6 *Marker Bar*



Main Control Bar

The Main Control Bar provides adjustment options that help you to refine a trace. You can use these buttons in lieu of the Control Panel to adjust Center Frequency, Span, Reference Level, RBW, VBW, and Select Input.

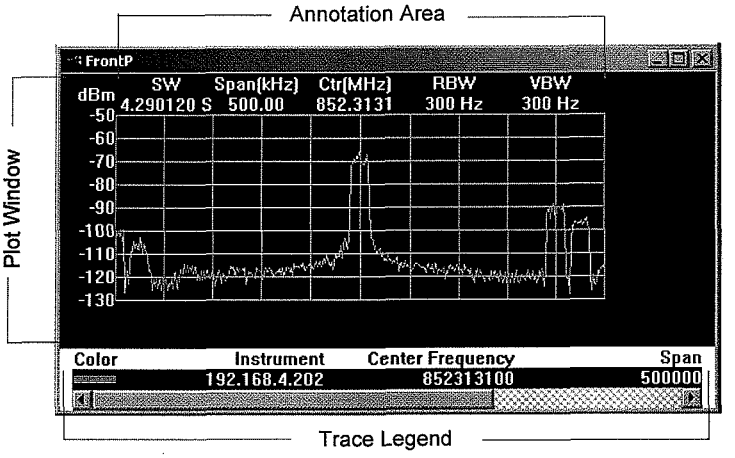
Figure 2.7 *Main Control Bar*



Trace Display Panel

The Trace Display Panel includes the Plot Window, the Annotation Area, and the Trace Legend. All spectrum sweeps are traced in the Plot Window. The Annotation Area displays current instrument settings, and reflects changes to settings when made. The Trace Legend displays a list of information on a single trace or on multiple traces.

Figure 2.8 *Trace Display Panel*



Understanding Sweep Time

Sweep Time is based on the current filter settings and the sweep span. Sweep Time (SW) displays in the upper left corner of the Trace Display Panel between dBm and Span.

Figure 2.9 *Sweep Time Between dBm and Span*

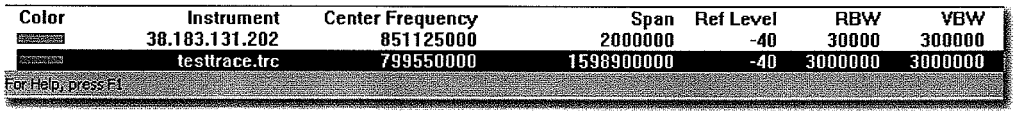
NOTE: Limitations in connection bandwidth and workstation performance can cause discrepancies between sweep time observed on a trace, and sweep time reported in the annotation area of Front Panel.

Trace Legend

With Trace Legend, you can view or select multiple traces displayed in the list box. For example, from the Toolbar, click the **Add Trace** button. The Add trace dialog box displays. Click the **Change** button, and select yellow from the basic color box, choose **OK**.

The Trace Legend adds the second trace below the first trace and displays various instrument settings. You can highlight any trace in the legend with one click. Double click on any highlighted trace to launch the Configure dialog box.

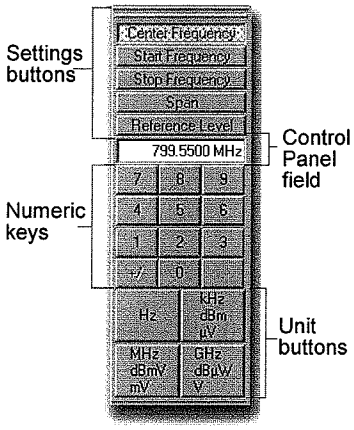
Figure 2.10 *Trace Legend with Multiple Traces*



Control Panel

You can enter and change parameter values with the Control Panel, and view the changes in the Trace Display Panel. You can set Center Frequency, Start Frequency, Stop Frequency, Span, and Reference Level from the group of buttons at the top. Use the numeric keys to enter numbers in the control panel field. Use the unit button to select Hz, kHz, MHz, or GHz.

Figure 2.11 *Control Panel*



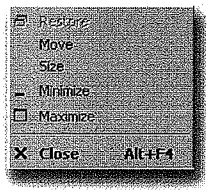
About the Windows Features

Control Icon and Menu

The Control icon located on the left side of the title bar allows you to gain access to the Control menu. You can also double-click this icon to close Front Panel.

The Control Menu provides access to commands you can use to resize or reposition Front Panel. Click the Control icon to open this menu.

Figure 2.12 *Control Menu*



Title Bar

The Front Panel title bar contains the Control icon, the title of the application, the name of the active window, and the standard Windows buttons.

The Trace Display Panel, and all dialog boxes also have title bars. The active Trace Display Panel, or Dialog box displays the title of the panel or box.

Double-clicking the program's title bar enlarges the window to full screen. Double-clicking the Trace Display Panel's title bar enlarges it to fit the workspace.

Figure 2.13 *Front Panel Title Bar*

Windows Buttons

The standard Windows Buttons in the right corner of the title bar are used to manipulate the size of the Front Panel window as follows below.

Minimize		Reduces the size of the window, and places it on the task bar.
Maximize		Increases the size of the window to fill the screen.
Restore		Return the window to its last position, and displays only if you activate the Minimize or Maximize function.
Close		Closes the window and exits the program.

You can control the Windows Buttons located on the right corner of a Trace Display Panel in the same way.

Workspace

The Workspace is the area where you display, add, and edit traces in Trace Display Panels. See Figure 2.1 on page 2-2 for a mini map of the Workspace area. From the Window Menu, you can display multiple trace display panels in a variety of ways as follows.

Figure 2.14 *Cascade*

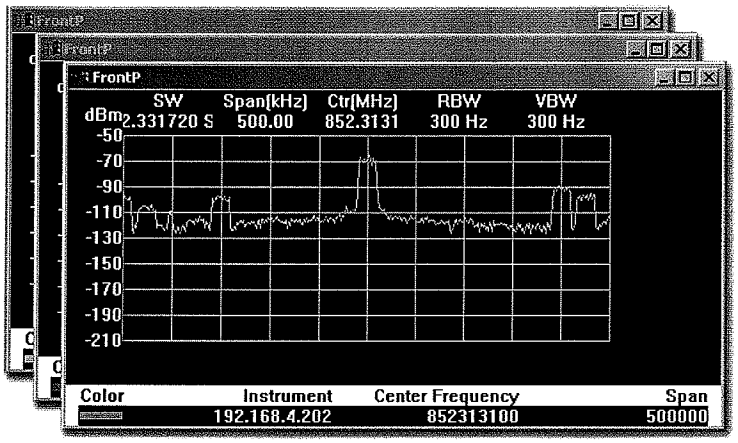


Figure 2.15 *Tile Horizontal*

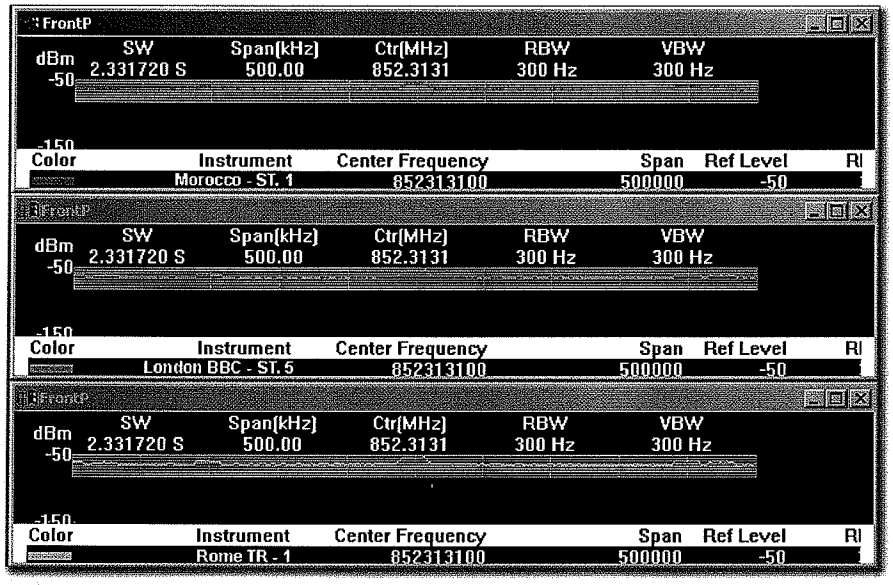
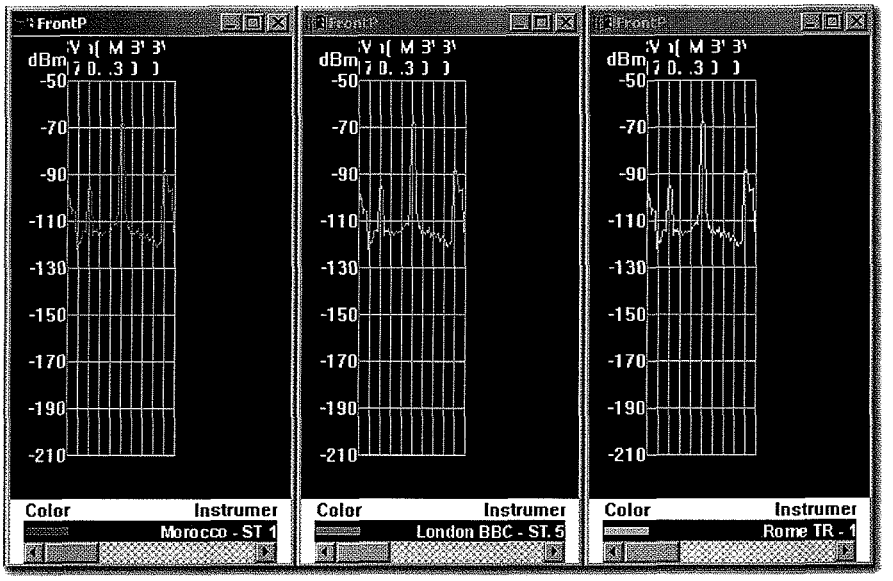


Figure 2.16 *Tile Vertical*



Status Bar

The Status Bar is located at the bottom edge of the Front Panel window and displays details about button functions. You can hover over most buttons on the Front Panel window and the status bar lists a description for each button.

Figure 2.17 *Status Bar*

CHAPTER

3

GETTING STARTED

Initial Set Up

Before starting Front Panel

If you are operating in a network environment, then you must establish network communications between your workstation and the spectrum analyzer server. Please see your network administrator for assistance.

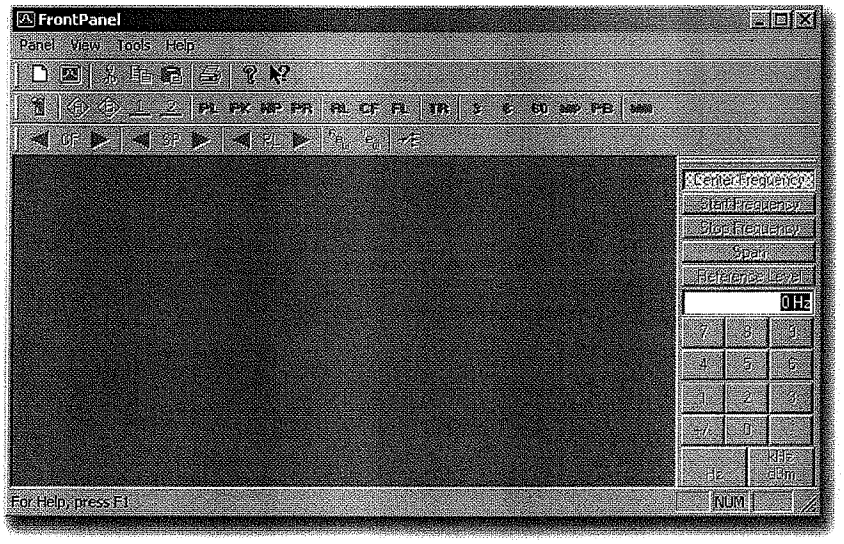
Displaying Front Panel

Follow these instructions to display Front Panel.

NOTE: The instructions below provide information on gaining access to Front Panel from the Windows Start Menu. However, you can also start Front Panel from Windows Explorer, or My Computer, then navigate to the MTC Spectrum directory, and double click **MTCFP.EXE** to start the application.

1. From the Windows Start Menu, select **Programs>MTC Spectrum>Front Panel**. The Front Panel screen displays.

Figure 3.1 *Front Panel screen*



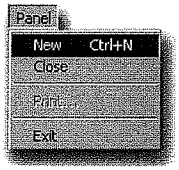
2. From the Menu Bar, select **Panel**.
3. Select **New**. The New Spectrum Analyzer dialog box displays.

NOTE: For first time access and to assist with configuration, the New Spectrum Analyzer dialog box displays over the Add Trace dialog box.

Using the New Spectrum Analyzer dialog box

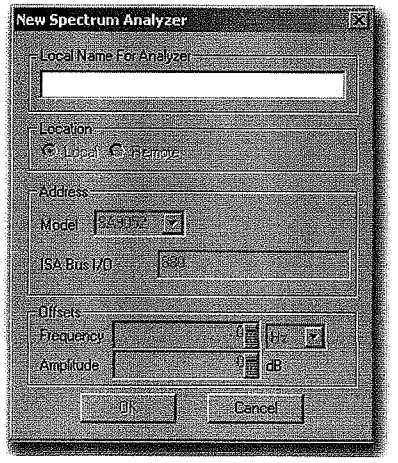
The first time you access Front Panel the New Spectrum Analyzer dialog box is displayed, and from here you can configure the system. You can enter a specific name for a new spectrum analyzer, for example TX Site One. You can also select Local or Remote location, enter address information, and apply Frequency and Amplitude Offsets. You access this dialog box by selecting **Panel>New** from the menu bar.

Figure 3.2 *Panel>New Menu*



NOTE: You can also access this dialog box by selecting **Panel>New** from the menu bar, and clicking the New button on the Add Trace dialog box.

Figure 3.3 *New Spectrum Analyzer dialog box*



4. In the Local Name for Analyzer field enter a familiar name. For example, TX Site One.

Local Location

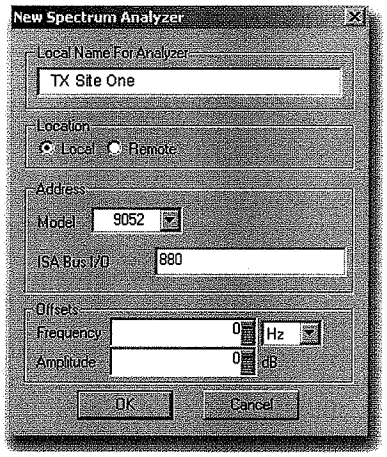
Once you enter a local name for the Spectrum Analyzer, default settings are activated. You can establish stand-alone access for the Spectrum Analyzer by completing the following steps.

1. From Address, click the drop down arrow next to Model, and select the model number for your instrument.

NOTE: If you have a model 9116, select 9052.

2. Enter the ISA Bus I/O number. The default number is 880.

Figure 3.4 *New Spectrum Analyzer dialog box for Local Location*



3. Set the Frequency and Amplitude Offsets.
4. Click **OK**.

NOTE: Before selecting OK confirm the connection to the remote analyzer.

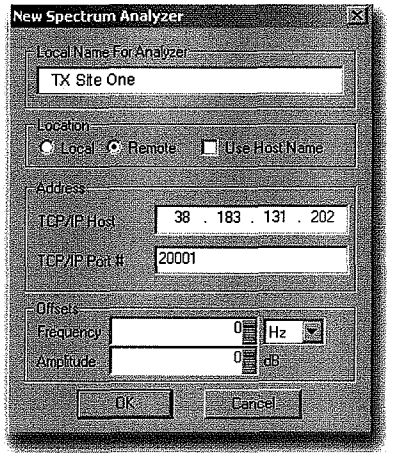
Remote Location

You can set up your Spectrum Analyzer to accept data from remote locations by using the New Spectrum Analyzer dialog box. After you enter a name for a new spectrum analyzer use the following instruction for Remote Location set up.

1. From Location, select **Remote**.
2. From Address, enter your host number in the **TCP/IP** Host field.

NOTE: To enter a preferred TCP/IP Host name, click the Use Host Name check box, and enter your Host name in the TCP/IP Host field. For example, TX1.mycompany.com.

Figure 3.5 *New Spectrum Analyzer dialog box for Remote Location*



3. The TCP/IP Port # can be changed. See your system administator.
4. Set the Frequency and Amplitude Offsets.
5. Click **OK**.

Setting Offsets

You can apply Offsets for a Spectrum Analyzer from the New Spectrum Analyzer dialog box. You can gain access to Offsets whether your instrument is set for local or remote location. Use the following instructions to set Offsets.

1. From Offsets, click the calculator icon next to the Frequency field. The built in calculator displays.
2. Enter the Offset number by clicking the appropriate keys on the built in calculator.

TIP: You can also use your numeric keypad to enter the Offset number.

3. Click the drop down arrow next to the units field.
4. Select the appropriate unit. Choices include Hz, kHz, MHz, and GHz.
5. Click the calculator icon next to the Amplitude field. The built in calculator displays.
6. Repeat Step 2, and click **OK**.

Exiting Front Panel

To exit Front panel use any of the following methods.

- Click the close button in the right corner of the title bar
- From the Menu Bar, select **Panel>Exit**
- Double-click the Front Panel icon in the left corner of the title bar
- Select **Exit** from the Control icon menu
- Press **<Alt>** + **<F4>**

CHAPTER

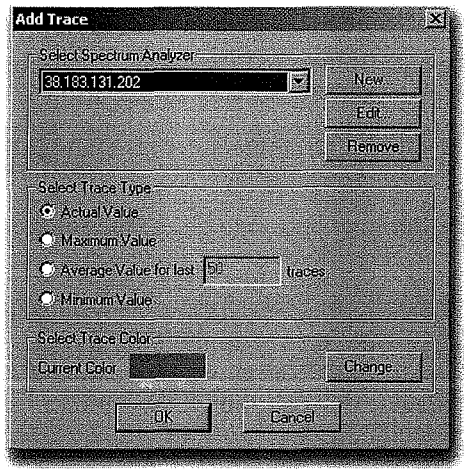
4

CREATING A NEW TRACE

Adding a Trace to a Trace Display Panel

You begin creating a new trace by using the Add Trace dialog box, and then adding a Trace Display Panel to the Front Panel workspace.

Figure 4.1 *Add Trace dialog box*

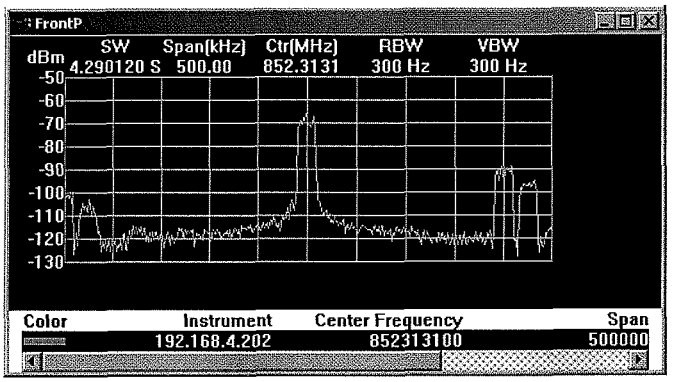


To gain access to the Add Trace dialog box you can:

- Use the Menu Bar and select **Panel>New**
- Use the New icon on the Menu Bar
- Press Ctrl + N

The Add Trace dialog box displays. You use this dialog box to set up a trace. Once you set parameters and click **OK**, the Trace Display Panel appears on the workspace.

Figure 4.2 *Trace Display Panel*



Using the Add Trace dialog box

When you activate the Add Trace dialog box you can select configured spectrum analyzers from the Select Spectrum Analyzer drop down box. You can also:

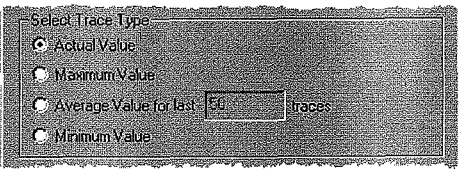
- Choose the New Button to gain access to the New Spectrum Analyzer dialog box
- Choose the Edit button to gain access to the Edit Spectrum Analyzer dialog box
- Choose the Remove button to delete the selected analyzer in the Select Spectrum Analyzer field
- Choose settings from Select Trace Type, and change the trace color by using Select Trace Color.

NOTE: The New Spectrum Analyzer dialog box and the Edit Spectrum Analyzer dialog box function identically. For more information, see "Using the New Spectrum Analyzer dialog box" on page 3-2.

Selecting Trace Type

There are four option buttons available in the Select Trace Type section of the Add Trace dialog box. You make your selection based on the data you want to receive on each trace.

Figure 4.3 *Selecting Trace Type segment of Add Trace dialog box*



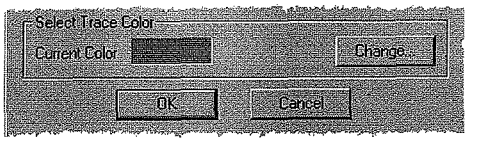
From each option you can select:

- Actual Value - This is the default setting, and displays the actual trace value data
- Maximum Value - Tracks and displays the maximum data value at each frequency
- Average Value for last [50] traces - Tracks and displays an average of the amplitude at each frequency
- Minimum Value - Tracks and displays the minimum data value at each frequency

Selecting Trace Color

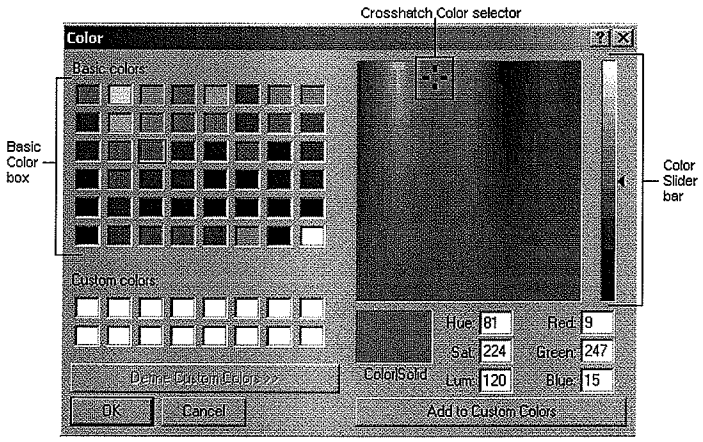
From the Add Trace dialog box, you can change the trace display color with Select Trace Color. The default color is bright green and is displayed in the Current Color field. Use the following instructions to change the trace color.

Figure 4.4 *Select Trace Color Segment of Add Trace dialog box*



1. Click the **Change** button.
2. The standard Windows color selection palette displays.

Figure 4.5



3. From the Basic Color box, select your preferred color.

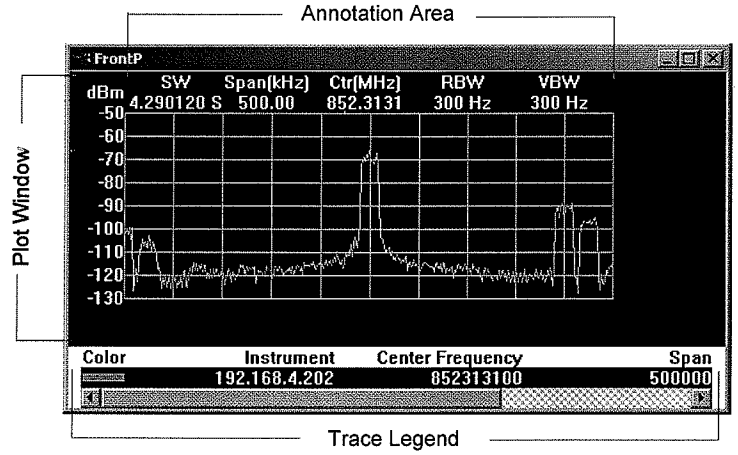
NOTE: You can also create your own custom color using the custom color section of this dialog box.

4. Click **OK**. The new color displays in the Current color field on the Add Trace dialog box.

Viewing the Trace Display Panel

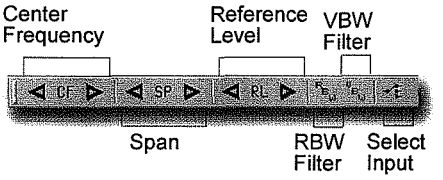
Once you click OK on the Add Trace dialog box the Trace Display Panel appears in the Front Panel workspace.

Figure 4.6 *Trace Display Panel*



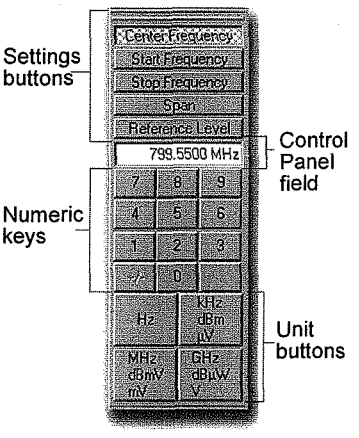
When a Trace Display Panel displays, you gain access to data from settings made during the initial setup process. You can make changes to settings as needed by using the Main Control Bar. For detailed instructions on using the Main Control Bar, see "Setting Sweep Parameters" on page 6-1.

Figure 4.7 *Main Control Bar*



You can also make changes to settings by using the Control Panel. For detailed instructions on using the Control Panel, see "To set Center Frequency" on page 6-1.

Figure 4.8 *Control Panel*



Working with Traces

Adding a Trace

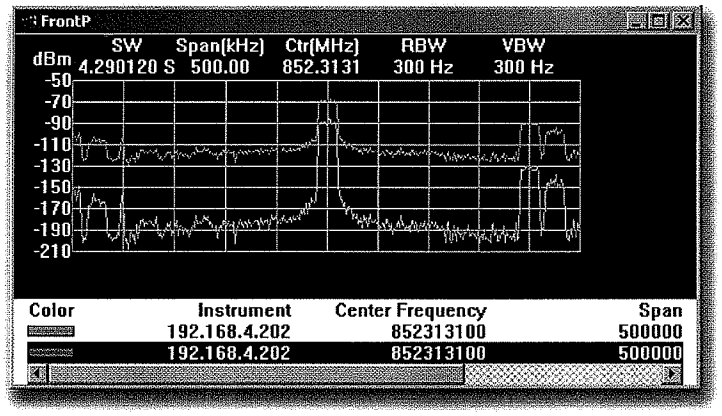
When you add a new trace to the active Trace Display Panel, the add trace dialogbox displays. You can set display parameters by selecting options in Trace Type, see Selecting Trace Type above. You can also change the Trace Color, see Selecting Trace Color above.There are two ways you can add a new trace to an active Trace Display Panel. To add a new trace you can:

- Use the Menu Bar and select **Trace>Add**
- Use the Add Trace icon on the Menu Bar

Creating Multiple Traces

Selections made in the add trace dialog box determine how each trace displays. You can create up to four traces at a time. Follow these instructions to create multiple traces.

Figure 4.9 *Trace Display Panel with Multiple Traces*



1. Click **Panel>New**. The Add Trace dialog box displays with the default Actual Value option button selected.
2. Click **OK**. The Trace Display Panel displays with a trace representing Actual Value.
3. Click **Trace>Add** to add another trace.
4. From the Add Trace dialog box, click the Maximum Value option button.

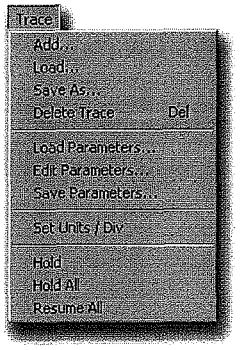
NOTE: For viewing ease and trace distinction, it is recommended that you change the color of each added trace. To change the trace color, see "Selecting Trace Color" on page 4-3.

5. Click **OK**. The new trace appears in the Trace Display Panel.
6. Repeat Steps 3, 4, and 5 twice to display traces for Average Value for last [50] traces, and Minimum Value trace types.

Using the Trace Menu

You use the Trace Menu for a variety of functions.

Figure 4.10 *Trace Menu*



You can:

- Add or delete traces
- Save traces, then load them on a Trace Display Panel
- Load saved parameters
- Edit parameters using the Configure dialog box
- Create and save measurement parameters to analyze at a later time
- Set Units Per Division
- Suspend the trace(s) using Hold or Hold All
- Continue trace activity using the Resume trace function

Deleting Traces

You can delete a trace on a Trace Display Panel from the Trace Menu. To delete a trace:

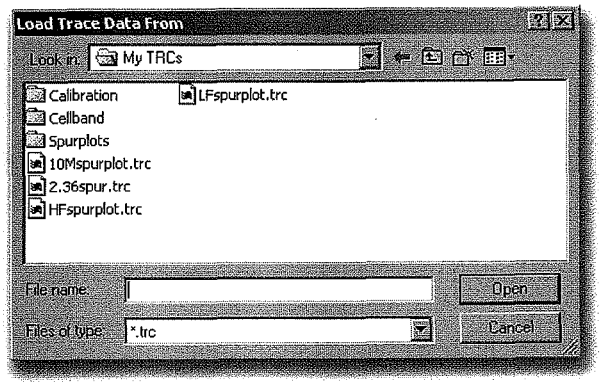
1. From the trace legend, highlight the trace you want to delete.
2. From the Trace Menu, select **Delete Trace**.
3. The trace is cleared from the trace display panel.

Loading Saved Traces

You can insert saved trace files (.trc) on an active Trace display Panel using the Trace Menu. Follow these instructions to load saved traces.

1. From the Trace Menu, select **Load**.
2. The Load Trace Data From dialog box displays.

Figure 4.11 *The Load Trace Data From dialog box*



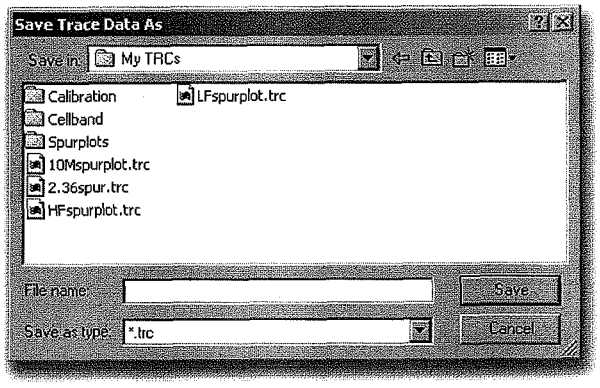
3. Select a saved trace (.trc files) from a directory of your choice.
4. Click **Open**.The loaded trace remains fixed, while the active trace continues scanning. The saved trace file and settings appear in the Trace Legend section at the bottom of the Trace Display Panel (see Figure 4-2). Saved traces are obtained by using **Trace>Save As**. For more information, see Saving Traces.

Saving Traces

You can create a trace file (.trc) and save it in a directory of your choice. Follow these instructions to create and save traces.

1. From the Trace Menu, select **Save As**.
2. The Save Trace Data As dialog box displays.

Figure 4.12 *The Save Trace Data As dialog box*



3. Navigate to a directory of your choice.
4. In the File Name field, name the file and add a .trc extension.
5. Click **Save** to save the file.

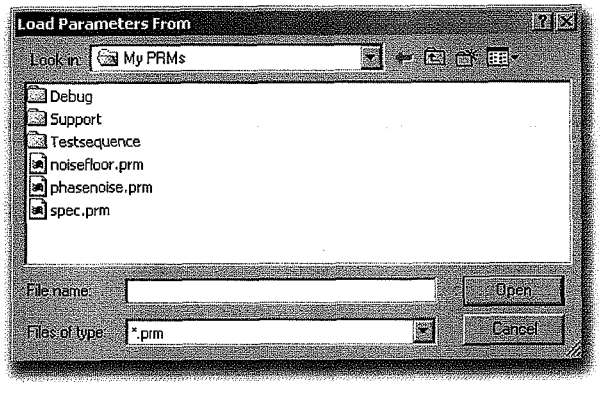
To load a trace on an active Trace Display Panel use **Trace>Load**. For more information, see "Loading Saved Traces" on page 4-8.

Loading Parameters

You can load measurement parameters that you saved using the Save Parameters As dialog box. To load parameters:

1. From the Trace Menu, select **Load Parameters**. The Load Parameter From dialog box displays.

Figure 4.13 *Load Parameters From dialog box*



2. Navigate to the saved parameter file of your choice.

3. Select the saved parameter file, and click **Open**. The saved parameter file displays on the Trace Display Panel.

Editing Parameters

From the Trace Menu, you can access the Configure dialog box and edit parameters. To edit parameters:

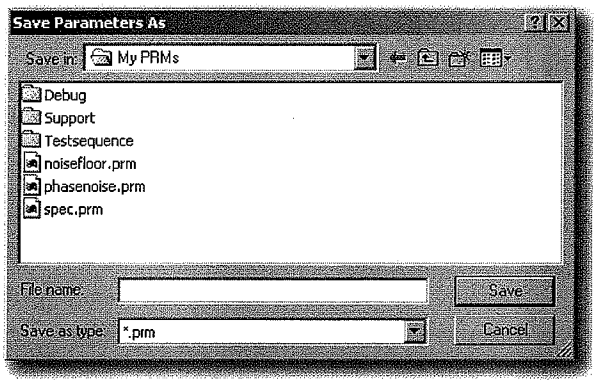
1. From the Trace Menu, select **Edit Parameters**. The Configure dialog box displays. See, "Using Configure" on page 8-1
2. Select the desired tab and set the new parameters.

Saving Parameters

You can create and save measurement parameters to use at a later time. To save measurement parameters:

1. From the trace menu, select **Save Parameters**. The Save Parameters As dialog box displays.

Figure 4.14 *Save Parameters As dialog box*



NOTE: From the navigation area, you can select a directory of choice and save your parameters.

2. In the File Name field, enter the name of the file. For example, test.prm.
3. Click **Save** to save the file.

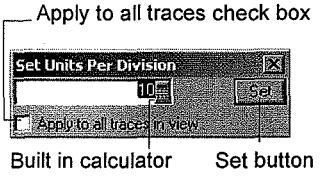
Set Units Per Division

You can select Set Units Per Division to zoom in to a trace without changing the frequency range. Follow these instructions to Set Units Per Division.

1. From the Trace Menu, select **Set Units / Div**.

2. The Set Units Per Division dialog box displays.

Figure 4.15 *The Set Units / Div dialog box*



3. Click the built in calculator and select the number of units for each grid cell.
4. For multiple traces, click **Apply to all traces in view** check box.
5. Click **Set**.

Results

The following illustrations show the difference between 20 and 30 Units per Division.

Figure 4.16 *At 20 dBm*

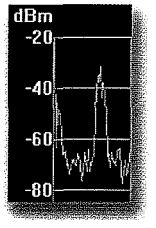
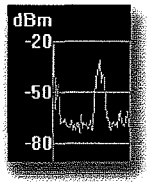


Figure 4.17 *At 30 dBm*

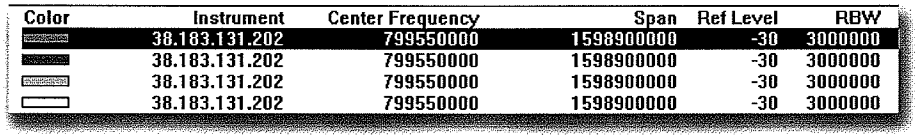


Hold/Resume

You can use Hold/Resume to hold a trace in a current state on a Trace Display Panel. All other traces continuously update while the spectrum analyzer is sweeping, but the held trace remains unchanged until Resume is selected. Follow these instructions to use Hold/Resume.

1. From the Trace Legend, click to highlight the trace you want to hold.

Figure 4.18 *Trace Legend with Multiple Traces*



Color	Instrument	Center Frequency	Span	Ref Level	RBW
	38.183.131.202	799550000	1598900000	-30	3000000
	38.183.131.202	799550000	1598900000	-30	3000000
	38.183.131.202	799550000	1598900000	-30	3000000
	38.183.131.202	799550000	1598900000	-30	3000000

2. From the Trace Menu, select **Hold**.The highlighted trace freezes, and Hold switches to Resume on the Trace menu.
3. To continue a trace, select **Resume**.

Hold All/Resume All

You can use Hold All/Resume All to freeze one or more traces simultaneously on a Trace Display Panel. Follow these instructions to use Hold All/Resume All.

1. From the Trace Menu, select **Hold All**. The trace(s) freezes on the Trace Display Panel.
2. To continue the sweep of a trace(s), select **Resume All** from the Trace Menu.

CHAPTER

5

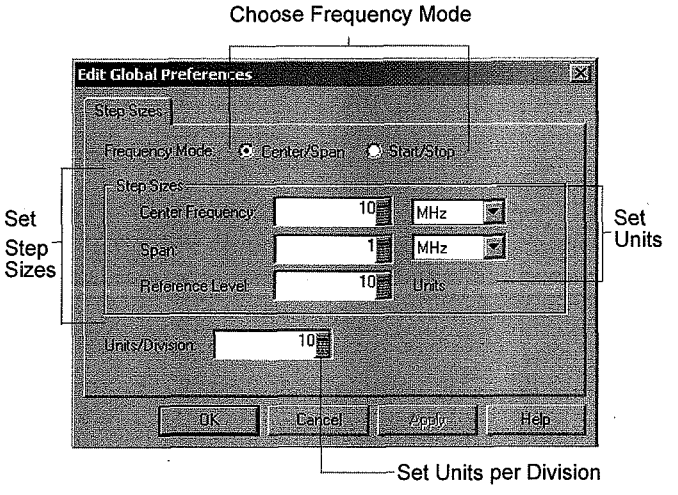
USING TOOLS

Editing Global Preferences

From the Tools Menu, you gain access to the Edit Global Preferences dialog box. Follow these instructions to Edit Global Preferences.

1. From the Tools Menu, select **Tools>Preferences**. The Edit Global Preferences dialog box displays.

Figure 5.1 *Edit Global Preferences dialog box*



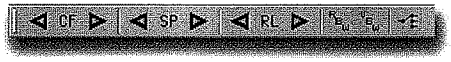
2. From the Frequency Mode, choose **Center/Span** or **Start/Stop**.

3. From the Step Sizes section, you can set steps by clicking the built in calculator , then enter the number of increments.

TIP: You can also click any field in this section and enter numbers using the keypad on your keyboard.

NOTE: These step sizes affect the active Trace Display Panel. To view the results, click **OK** after you enter numbers, then click the blue arrows next to the CF, SP, or RL buttons on the Main Control Bar.

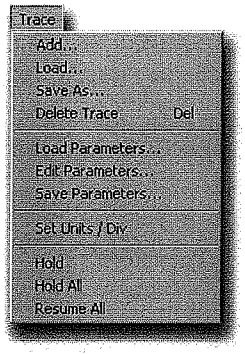
Figure 5.2 *Main Control Bar*



4. Click the drop down arrows next to the Units field to set units. Choices include Hz, KHz, MHz, GHz.
5. To set units per division for future traces use the Units/Division section. See the **NOTE** below.

NOTE: To change Units Per Division for the active Trace Display Panel use Trace>Set Units/Division from the Menu Bar.

Figure 5.3 *Menu Bar*



CHAPTER

6

SETTING SWEEP PARAMETERS

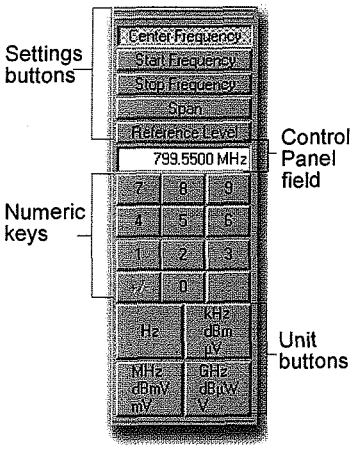
Setting Center Frequency

You can set the Center Frequency and Span on the Spectrum Analyzer from the Control Panel. Follow these instructions to accomplish this task.

To set Center Frequency

1. From the top of the Control Panel, press the Center Frequency button.

Figure 6.1 *Control Panel*



2. From the numeric keypad, enter the center frequency number you want to analyze. The numbers you select display in the Control Panel field.

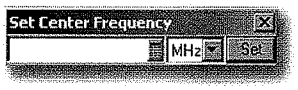
TIP: You can click in the Control Panel field and enter numbers using the numeric keypad on your keyboard.

3. From the Unit buttons, click the desired unit. Choices include, Hz, kHz, MHz, and GHz.

To set Center Frequency using the Main Control Bar

1. Click the CF button on the Main Control Bar.
2. The Set Center Frequency dialog box displays.

Figure 6.2 *Set Center Frequency*



3. Click the built in calculator and enter a new Center Frequency.
4. Click the drop down arrow next to the unit field and adjust as needed.
5. Click **Set** to set the new Center Frequency.

NOTE: Once set, you can increase or decrease the Center Frequency by an increment of one using the blue arrows ◀ ▶ to the right and left of the CF button.

Setting Span

To set Span using the Control Panel

1. From the top of the Control Panel, press the Span button.
2. From the numeric keypad, enter the number of the Span you want to analyze. The numbers you select display in the Control Panel field.

TIP: You can click in the Control Panel field and enter numbers using the numeric keypad on your keyboard.

3. From the Unit buttons, click the desired unit. Choice include Hz, kHz, MHz, and GHz.

To set Span using the Main Control Bar

1. Click the SP button on the Main Control Bar.
2. The Set Frequency Span dialog box displays.

Figure 6.3 *Set Frequency Span*

3. Click the built in calculator and enter a new Frequency Span.
4. Click the drop down arrow next to the unit field and adjust as needed.
5. Click **Set** to set the new Frequency Span.

NOTE: Once set, you can increase or decrease the Span by an increment of one using the blue arrows to the right and left of the **SP** button.

Setting Start/Stop Frequency

To set Start Frequency

You can set the Start/Stop Frequency on the spectrum analyzer from the Control Panel. Follow these instructions to accomplish this task.

1. From the top of the Control Panel, press the Start Frequency button.
2. From the numeric keypad, enter the first number of the frequency you want to analyze. The numbers you select display in the Control Panel field.

TIP: You can click in the Control Panel field and enter numbers using the numeric keypad on your keyboard.

3. From the Unit button, click the desired unit. Choices include Hz, kHz, MHz, and GHz.

To set Stop Frequency

1. From the top of the Control panel, press the Stop Frequency button.
2. From the numeric keypad, enter the last number of the frequency you want to analyze. The numbers you select display in the Control Panel field.

TIP: You can click in the Control Panel field and enter numbers using the numeric keypad on your keyboard.

3. From the Unit button, click the desired unit. Choices include Hz, kHz, MHz, and GHz.

Setting the Reference Level

You can set the Reference Level on the Spectrum Analyzer from the Control Panel. Follow these instructions to accomplish this task.

To set the Reference Level

1. From the top of the Control Panel, press the Reference Level button.
2. From the numeric keypad, enter the Reference Level you want to view. The numbers you select display in the Control Panel field.

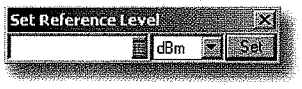
TIP: You can click in the Control Panel field and enter numbers using the numeric keypad on your keyboard.

3. From the Unit buttons, click the desired unit. Choices include, Hz, kHz, MHz, and GHz.

To set Reference Level using the Main Control Bar

1. Click the RL button on the Main Control Bar.
2. The Set Reference Level dialog box displays.

Figure 6.4 *Set Reference Level*



3. Click the built in calculator and enter a new Reference Level.
4. Click the drop down arrow next to the unit field and adjust as needed.
5. Click **Set** to set the new Reference Level.

NOTE: Once set, you can increase or decrease the Reference Level by an increment of 10 using the blue arrows to the right and left of the RL button.

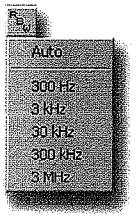
Setting RBW and VBW

You can set the Resolution Bandwidth Filter (RBW) and the Video Bandwidth Filter (VBW) from the Main Control Bar. Follow these instructions to accomplish this task.

To set the RBW

1. From the Main Control Bar, press the RBW button. The RBW drop down menu displays.

Figure 6.5 *RBW drop down menu*

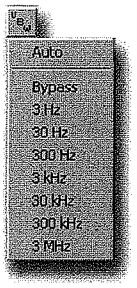


2. Select the appropriate Resolution Bandwidth Filter from this list.

To set the VBW

1. From the Main Control Bar, press the VBW button. The VBW drop down menu displays.

Figure 6.6 *VBW drop down menu*



2. Select the appropriate Video Bandwidth Filter from this list.

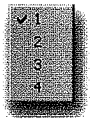
Using Select Input

You choose Select Input if your server is configured for multiple inputs. Follow these instructions to accomplish this task.

To set Select Input

1. Click the Select Input button on the Main Control Bar.
2. The Select Input drop down menu displays.

Figure 6.7 *Select Input drop down menu*



3. Select from 1 to 4 to gain access to each input.

CHAPTER

7

WORKING WITH MARKERS

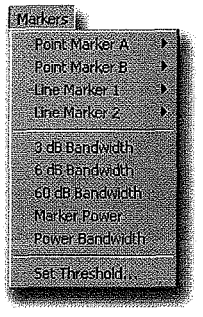
Activating a Point Marker

Point Markers affect the active trace display panel on top. Follow these instructions to activate a Point Marker.

To activate a Point Marker

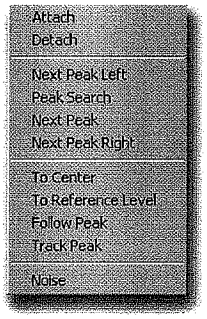
1. Click **Markers** on the Menu Bar. The Marker pull down menu displays.

Figure 7.1 *Marker Pull Down Menu*



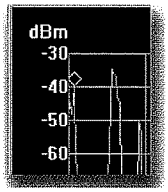
2. Point to **Point Marker A** or **Point Marker B**. The Marker pull down secondary menu displays to the right.

Figure 7.2 *Marker Pull Down Secondary Menu*



3. Click **Attach**. A diamond peak Marker displays in the active trace display panel on the left.

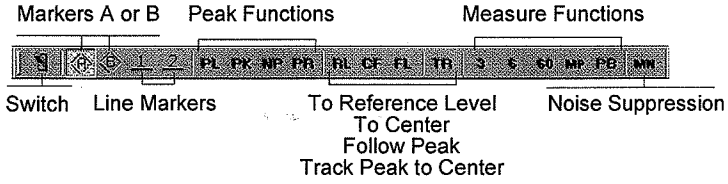
Figure 7.3 *Diamond Peak Marker*



From the Marker Bar

You can also attach a Point Marker using the Marker Bar. Follow these instructions to accomplish this task.

Figure 7.4 *Marker Bar*



1. From the Marker Bar, click the Switch button. The Marker drop down box displays.

Figure 7.5 *Switch button and Marker drop down box*

2. Select **Point Marker A** or **Point Marker B**.
3. A diamond peak Marker displays on the left of the trace display panel, and the button or button is highlighted on the Marker Bar.

NOTE: You can remove a marker by selecting Point Marker A or B again from the Switch>Marker drop down box.

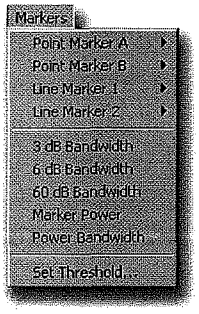
Activating a Line Marker

Line Markers affect the active trace display panel on top of the workspace. Follow these instructions to activate a Line Marker.

To activate a Line Marker

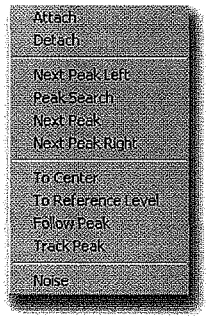
1. Click **Markers** on the Menu Bar. The Marker pull down menu displays.

Figure 7.6 *Marker Pull Down Menu*



2. Point to **Line Marker 1** or **Line Marker 2**. The Marker pull down menu displays to the right.

Figure 7.7 *Marker Secondary Pull Down Menu*



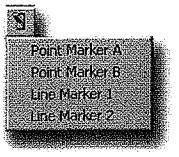
3. Click **Attach**. A solid horizontal line Marker displays when you select Line Marker 1. A dashed horizontal line Marker displays when you select Line Marker 2.

From the Marker Bar

You can also attach a Line Marker using the Marker Bar. Follow these instructions to accomplish this task.

1. From the Marker Bar, click the Switch button. The Marker drop down box displays.

Figure 7.8 *Switch and Marker Drop Down box*



2. Select **Line Marker 1** or **Line Marker 2**.
3. A solid horizontal line displays when you select Line Marker 1. A dashed horizontal line displays when you select Line Marker 2.

NOTE: You can remove a line marker by selecting Line Marker 1 or 2 again from the Switch>Marker drop down box.

Using Point and Line Markers

There are several ways you can manage Markers on the trace display panel.

You can:

- Drag and Drop the Marker(s) directly on the Trace Display Panel
- Use the Marker Bar
- Use the Menu Bar

Drag and Drop For Point or Line Markers

1. Click the Point or Line Marker with the left mouse button.
2. Hold the left mouse button down and drag the Marker to the desired peak.
3. Release the mouse button, and the Marker anchors to the desired peak.

Use the Marker Bar

After activating a Point Marker you must press the  , or  button to start other functions on the Marker Bar.

From the Marker Bar you can click the:

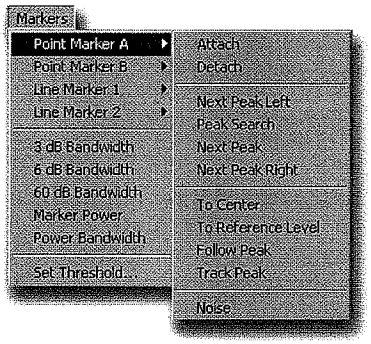
-  button to move a Marker left to the next peak.
-  button to move a Marker to the highest level in a sweep.
-  button to move a Marker to the next highest peak.
-  button to move a Marker right to the next peak.
-  button to set the reference level to the Marker amplitude.
-  button to set center frequency to the Marker frequency.
-  button to set the instrument to Follow a signal. Follow automatically maintains the Marker on a moving peak.
-  button to set the instrument to Track a signal. Track automatically adjusts the center frequency to maintain the selected peak at the center of the screen.
-  button to move Point Markers 3 dB lower than the current peak.
-  button to move Point Markers 6 dB lower than the current peak.
-  button to move Point Markers 60 dB lower than the current peak.
-  button to compute the power between Point Markers A and B. The Mkr Pwr computation displays to the right of the grid on the Trace Display Panel.

- PB button to compute 99% of the power bandwidth between Point Markers A and B. The Pwr BW computation displays to the right of the grid on the Trace Display Panel.
- MN button to activate Marker Noise Mode. By using Marker Noise the Marker readout is normalized to a 1 dB bandwidth, specifically units of dBm/Hz. An "N" displays at the bottom of the trace display panel indicating activated Marker Noise.

Use the Menu Bar

From the Menu Bar point to **Markers>Point Marker A or B**. The secondary menu displays and you can:

Figure 7.9 *Markers Full Menu*



- Add or remove Markers by selecting **Attach** or **Detach**
- Move a Marker left to the next peak by selecting **Next Peak Left**
- Move a Marker to the highest level in a sweep by selecting **Peak Search**
- Move a Marker to the next highest peak by selecting **Next Peak**
- Move a Marker right to the next peak by selecting **Next Peak Right**
- Make the center frequency equal to a Point Marker frequency by selecting **To Center**
- Set the reference level to the Marker amplitude by selecting **To Reference Level**
- Set the instrument to follow a signal by selecting **Follow Peak**
- Set the instrument to track a signal by selecting **Track Peak**
- Set the instrument to activate noise suppression by selecting **Noise**

Use the Marker Bar for Line Markers

After activating a Line Marker, you must press the 1, or 2 button to start other functions on the Marker Bar.

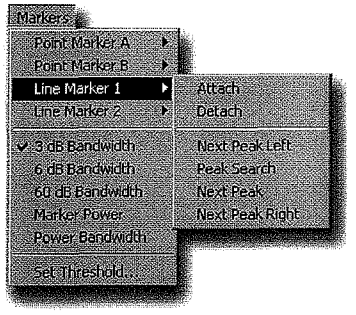
From the Marker Bar you can click the:

- PL button to move a Marker left to the next peak.
- PK button to move a Marker to the highest level in a sweep.
- NP button to move a Marker to the next highest peak.
- PR button to move a Marker right to the next peak.

Use the Menu Bar for Line Markers

From the Line Marker Menu Bar you can:

Figure 7.10 *Line Markers Full Menu*



- Attach or detach Markers by selecting **Attach** or **Detach**
- Move a Marker left to the next peak by selecting **Next Peak Left**
- Move a Marker to the highest level in a sweep by selecting **Peak Search**
- Move a Marker to the next highest peak by selecting **Next Peak**
- Move a Marker right to the next peak by selecting **Next Peak Right**

Working with Measure Functions

Using Bandwidth Markers

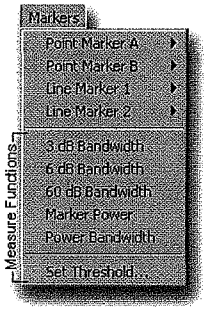
From the Markers menu, you can select 3 dB, 6 dB, or 60 dB bandwidth markers. Point Markers are placed on each side of the current frequency at 3, 6,

or 60 dB lower than the current peak. Follow these instructions to activate bandwidth markers.

To activate Bandwidth Markers

1. From the Markers menu measure functions segment, point to **3 dB**, **6 dB**, or **60 dB** Bandwidth.

Figure 7.11 *Measure Functions segment of Markers Menu*



2. Point Markers are displayed on a sweep at frequencies lower than the current peak.
3. To disable Bandwidth Markers select **Markers>Point MarkerA>Detach**, then **Markers>Point Marker B>Detach**.

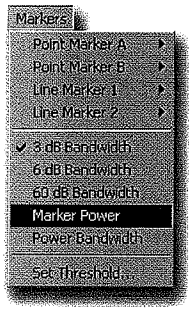
Using Marker Power

You can use Marker Power to compute the power between Point Markers A and B of a 3 dB, 6 dB, or 60 dB Bandwidth measurement. Follow these instructions to activate Marker Power.

To activate Marker Power

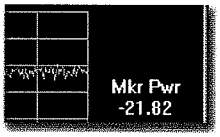
1. From the Markers menu measure functions segment, choose **3 dB**, **6 dB**, or **60 dB** Bandwidth. (See Figure 7.11).
2. Select the Markers menu again and point to **Marker Power**.

Figure 7.12 *Markers Menu>Marker Power*



3. The Mkr Pwr computation displays to the right of the grid on the Trace Display Panel.

Figure 7.13 *Mkr Pwr Computation*



4. Point to and select **Marker Power** again to disable Marker Power.

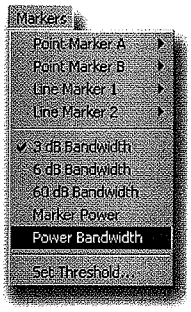
Using Power Bandwidth

You can use Power Bandwidth to compute the occupied bandwidth between Point Markers A and B of a 3 dB, 6 dB, or 60 dB Bandwidth measurement. Follow these instructions to activate Power Bandwidth.

To activate Power Bandwidth

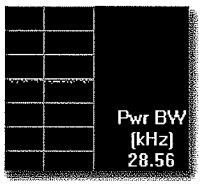
1. From the Markers menu measure functions segment, choose **3 dB**, **6dB**, or **60 dB** Bandwidth. (See Figure 7.11).
2. Select the Markers menu again and point to **Power Bandwidth**.

Figure 7.14



3. The Pwr BW computation displays to the right of the grid on the Trace Display Panel.

Figure 7.15 *Pwr BW Computation*



4. Point to and select **Power Bandwidth** again to disable Power Bandwidth.

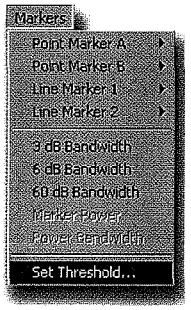
Setting Threshold

You can limit your Point Markers to values above the instrument's noise floor by selecting Set Threshold from the Markers menu. Follow these instructions to activate Set Threshold.

To activate Set Threshold

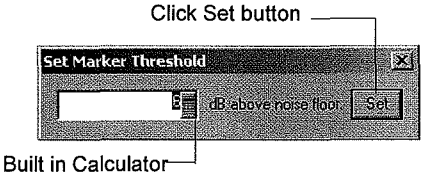
1. Activate a Point Marker, or select a measure function. For more information, see "Activating a Point Marker" on page 7-1.
2. From the Markers menu, choose **Set Threshold**.

Figure 7.16 *Markers>Set Threshold*



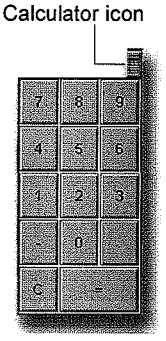
3. The Set Marker Threshold dialog box displays.

Figure 7.17 *Set Marker Threshold dialog box*



4. Click the calculator icon. The built in calculator displays.

Figure 7.18 *Calculator*



5. Enter the Marker Threshold number by clicking the appropriate keys on the calculator.

NOTE: The default setting is 6 dB.

6. Click the **Set** button.

NOTE: To view the Threshold you've set, use the peak left (**PL**) or peak right (**PR**) buttons on the Marker Bar to move the Marker on the trace until it stops.

CHAPTER

8

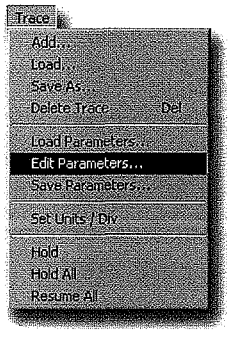
USING CONFIGURE

Accessing Configure

From the Configure dialog box you have a variety of adjustment capabilities for each trace. Five separate tabs provide adjustment options for the following functions: Frequency, Amplitude, Filters, Trigger, and Custom. You can access the Configure dialog box from the Menu Bar. Follow these instructions to complete this task.

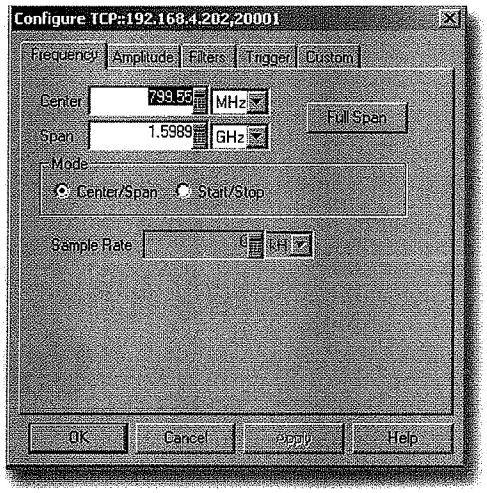
1. From the Menu Bar, click **Trace>Edit Parameters**.

Figure 8.1 *Trace drop down menu*



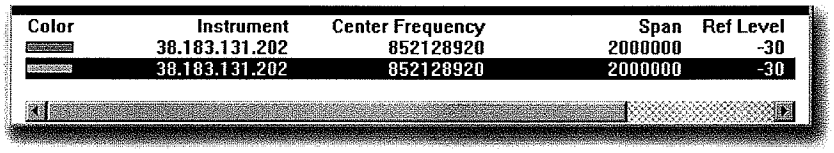
2. The Configure dialog box displays. Click each tab to view all available options and make changes as needed.

Figure 8.2 *Configure dialog box*



You can also access the Configure dialog box by double clicking any highlighted trace on the Trace Legend.

Figure 8.3 *Trace Legend with Multiple Trace*

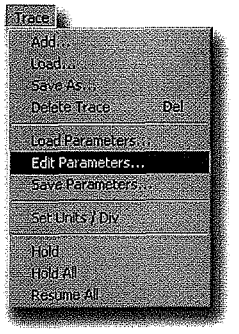


Configuring Frequency

From the Frequency tab, you can change the current frequency by selecting the option button for Center/Span or Start/Stop Mode. Follow these instructions to complete this task.

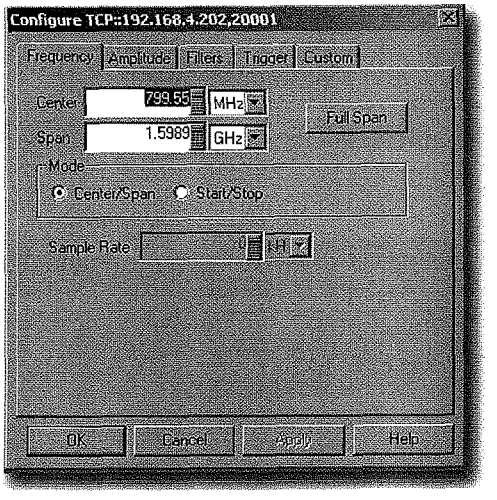
1. From the Menu Bar, click **Trace>Edit Parameters**.

Figure 8.4



2. The Configure dialog box displays.

Figure 8.5 *Configure dialog box*



3. From the Frequency tab, click the built in calculator and enter a new frequency.
4. Click the equal sign to set the new frequency.
5. Click the pull down arrow and select the appropriate unit from the drop down list.
6. Click **Apply**, and then click **OK**.
7. To select Full Span, click the Full Span button.

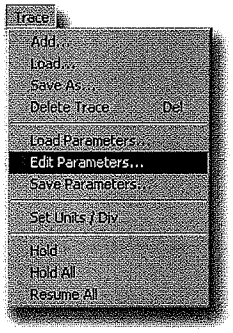
NOTE: You can gain access to the Configure dialog box by double clicking a highlighted trace on the Trace Legend.

Configuring Amplitude

From the Amplitude tab, you can set the Log or Linear Detector, set the Reference Level and Unit, or establish Data Collection Parameters. Follow these instructions to accomplish this task.

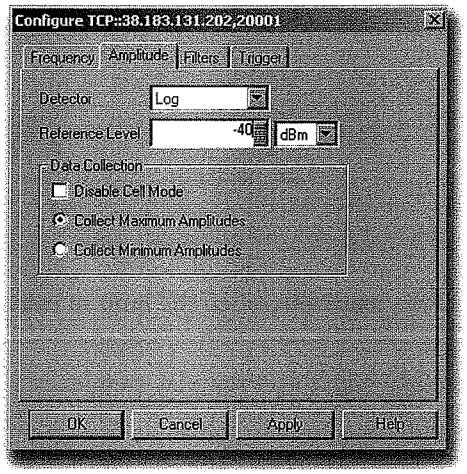
1. From the Menu Bar, click **Trace>Edit Parameters**.

Figure 8.6



2. The Configure dialog box displays.Click the Amplitude tab.

Figure 8.7



3. From the Detector pull down arrow, select Log or Linear.

Figure 8.8 *Log Detector selected*

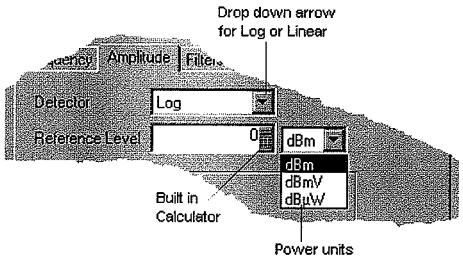
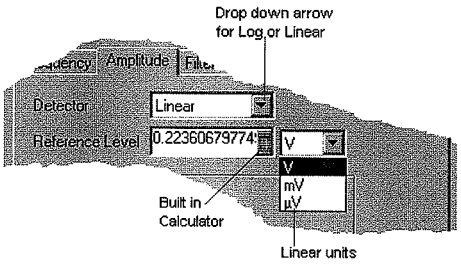
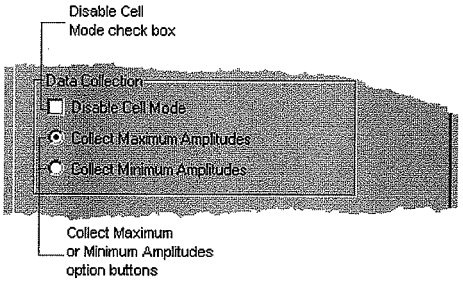


Figure 8.9 *Linear Detector selected*



4. Click the built in calculator and enter the Reference Level for the Log or Linear Detector.
5. Click the equal sign to set the Reference Level.
6. Click the pull down arrow and select the appropriate unit from the drop down list.
7. From Data Collection, select the option button for Maximum or Minimum Amplitudes, or disable these settings by clicking the Disable Cell Mode check box.

Figure 8.10 *Data Collection segment of Amplitude Tab*



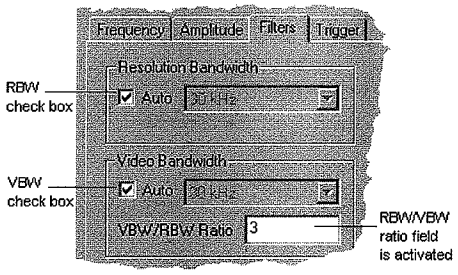
8. Click **Apply**, and click **OK**.

NOTE: You can gain access to the Configure dialog box by double clicking a highlighted trace on the Trace Legend.

Configuring Filters

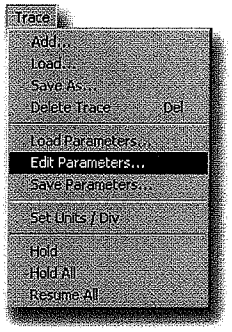
From the Filters tab, you can configure the system to automatically set the RBW and VBW filters. Follow these instructions to complete this task.

Figure 8.11 *RBW/VBW filters tab*



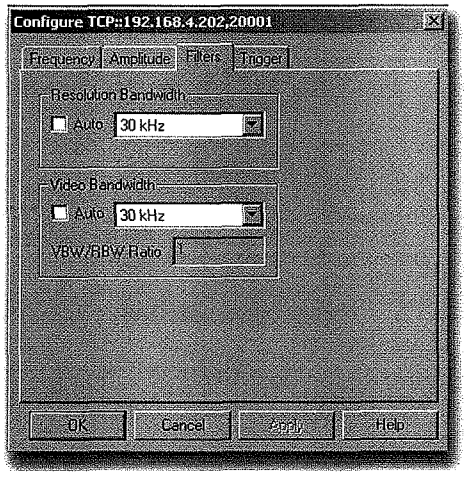
1. From the Menu Bar, click **Trace>Edit Parameters**.

Figure 8.12



2. The Configure dialog box displays. Click the Filters tab.

Figure 8.13



3. Click the check box next to Auto in the Resolution Bandwidth box.
4. Click the check box next to Auto in the Video Bandwidth box.This action disables the units field and enables the RBW/VBW Ratio field.
5. Set the RBW/VBW Ratio by clicking in the field and entering a number from your numeric keypad.
6. Click **Apply**, and then click **.**

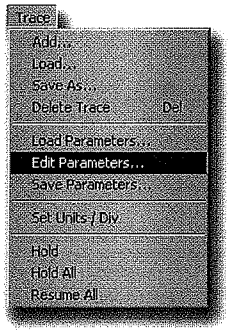
NOTE: You can gain access to the Configure dialog box by double clicking a highlighted trace on the Trace Legend.

Configuring Trigger

From the Trigger tab, you can configure the system to control how sweeps begin and proceed. Follow these instructions to complete this task.

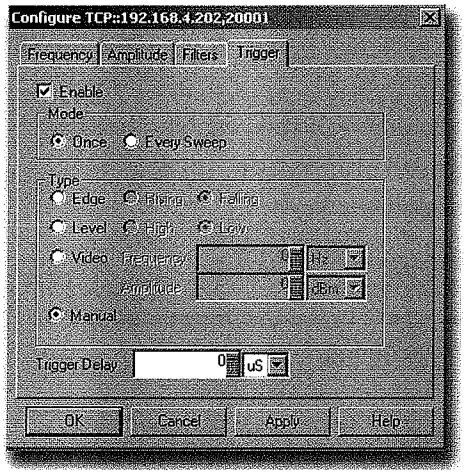
1. From the Menu Bar, click **Trace>Edit Parameters**.

Figure 8.14



2. The Configure dialog box displays. Click the Trigger tab.

Figure 8.15



3. Click the check box next to Enable, and then select the appropriate option button for Mode or Type.
4. From Mode, click the Once, or Every Sweep option button.
5. From Type, you can select Edge>Rising or Edge>Falling by selecting the appropriate option button.
6. From Type, you can select Level>High or Level>Low by selecting the appropriate option button.
7. From Type, select the Video option button, and set the Frequency, Amplitude, units, and dBm by using the built in calculator and drop down list.

8. From Type, you can select the Manual option button to disable all other functions in Type.
9. From Trigger Delay, you can use the built in calculator to set the amount of time for the delay, and use the drop down list to select the seconds.

NOTE: You can gain access to the Configure dialog box by double clicking a highlighted trace on the Trace Legend.

Glossary

A

Active Menu Bar — Displays after a new Trace Display Panel is displayed in the Front Panel Workspace.

Actual Value — A trace type that displays the actual trace value data.

Add Trace — Dialog box used to add extra traces to a Trace Display Panel.

Annotation Area — A section of the Trace Display Panel that displays current instrument settings and reflects changes to settings when made.

Attach — Command used to attach a Point or Line Marker to a Trace Display Panel.

Average Value — A trace type that tracks and displays an average of the amplitude at each frequency.

B

Basic Color Box — Use to change the color of traces added to a Trace Display Panel. You gain access to the Basic Color Box from the Add Trace dialog box.

C

Center Frequency — The frequency that exists in the center of a sweep.

Color Selection Palette — Use to change the color of additional traces, and accessed through the Add Trace dialog box. Contains standard Windows colors.

Configure — Dialog box used to configure the specturm analyzer. With this dialog box you can configure frequency, reference level, filters, trigger, and custom.

Control Panel — The group of control buttons located on the right side of the workspace. Use to enter and change parameter values.

D

Data Collection Parameters — Use to set parameters for collection of minimum or maximum amplitude readings, or disable cell mode. You can gain access from the Configure dialog box, Amplitude tab.

E

Edit Global Preferences — Use to set step sizes globally for Center Frequency, Span, Reference Level, and Units per Division.

Edit Parameters Use to change parameter settings. When you access Edit Parameters from the Trace Menu, the Configure dialog box displays.

Edit Spectrum Analyzer Use to edit information about the spectrum analyzer. You can gain access from the Add Trace dialog box, Edit. button.

F

Filters Use to automaticaly configure the RBW and VBW filters. You can gain access fromt the Configure dialog box, Filters tab.

Front Panel Morrow Technologies latest innovation in Spectrum Analysis software.

Full Span Use to display the entire span of the Spectrum Analyzer. You can gain access from the Trace Menu>Edit Parameters>Frequency tab, and click the Full Span button.

L

Line Marker Use to activate a solid or dashed horizontal line on the Trace Display Panel. You gain access from the Markers Menu.

Linear Detector Returns Data on a linear scale.

Load Parameters Use to load measurement parameter files you saved using the Save Parameters As dialog box. You can gain access from the Trace Menu.

Log Detector Returns data on a logarithmic scale.

M

Maximum Value Tracks and displays the maximum data value at each frequency. You can gain access from the Add Trace dialog box.

Minimum Value Tracks and displays the minimum data value at each frequency. You can gain access from the Add Trace dialog box.

N

New Spectrum Analyzer Dialog box. Use to set up a new spectrum analyzer. You can gain access from the Add Trace dialog box by clicking the New button after the system is configured.

P

Point Marker

Use to activate a diamond peak marker on the Trace Display Panel. You can gain access from the Markers Menu.

R

RBW

Resolution Bandwidth Filter. A bandwidth dependent filter used to resolve individual signals. The narrower the RBW the more noticeable the separation of two signals.

S

Set Units Per Division

Trace Menu item used to establish the amplitude units represented by each grid cell on a Trace Display Panel.

Span

The width of the frequency range being examined.

Start Frequency

The first frequency setting in a sweep. You can establish this setting from the Control Panel.

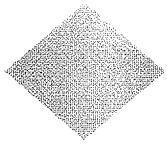
Stop Frequency

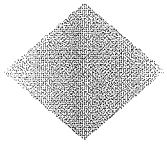
The last frequency setting in a sweep. You can establish this setting from the Control Panel.

V

VBW

Video Bandwidth Filter. Used to reduce or eliminate noise of the signal.





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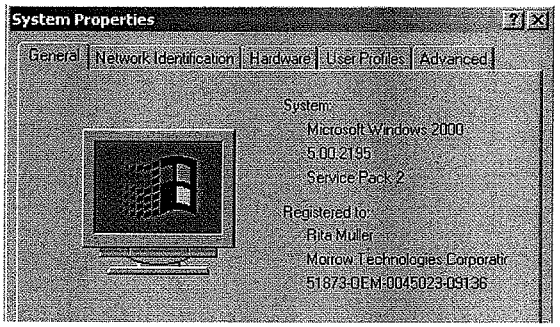
Welcome to Switch Support

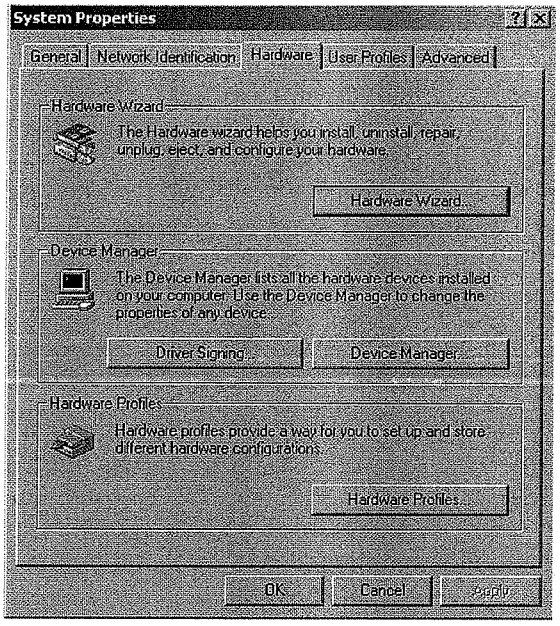
1 Configuring the Parallel Port Through the Device Manager

For use with models 9052 and 9116 server configurations. Use the following instructions to configure the parallel port using the Windows Device Manager. Screen shots taken from Windows 2000.

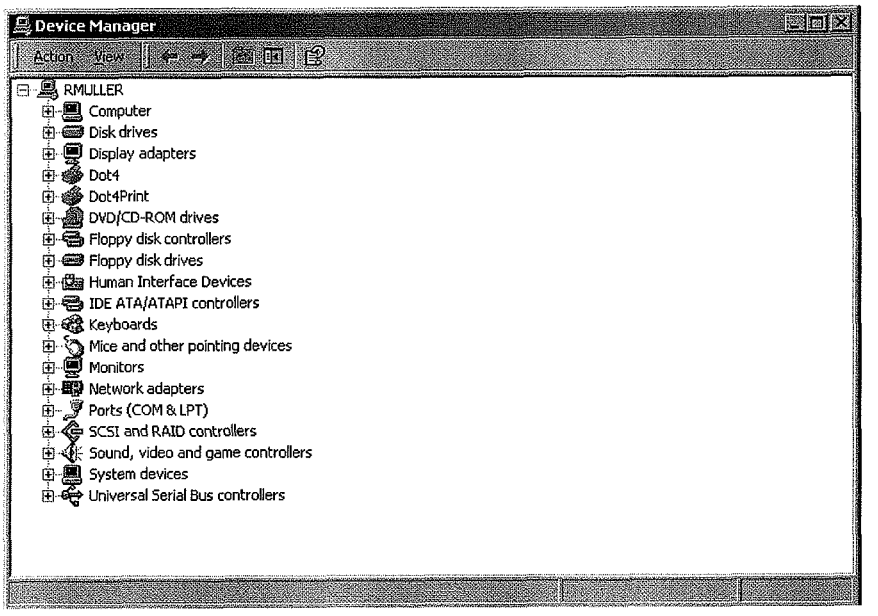
1. From the desktop, right-click My Computer and choose Properties. The System Properties dialog box displays.



2. From the System Properties dialog box choose the Hardware tab.



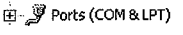
3. From the Hardware tab, choose the Device Manager button. The Device Manager dialog box displays.



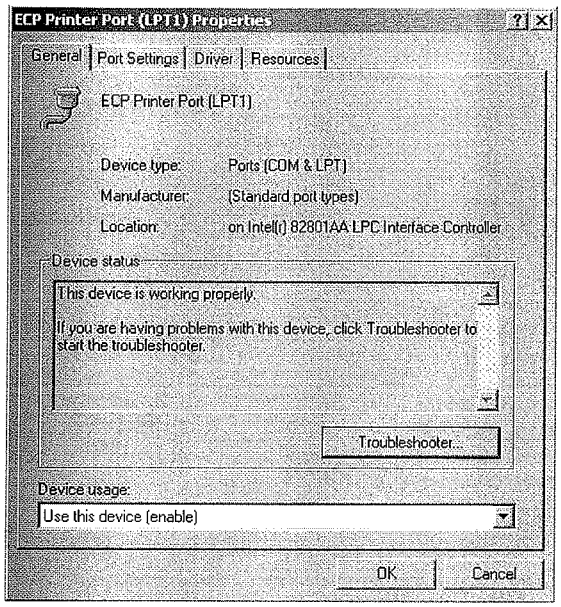
2 Setting The Port

You can set the port using the Device Manager dialog.

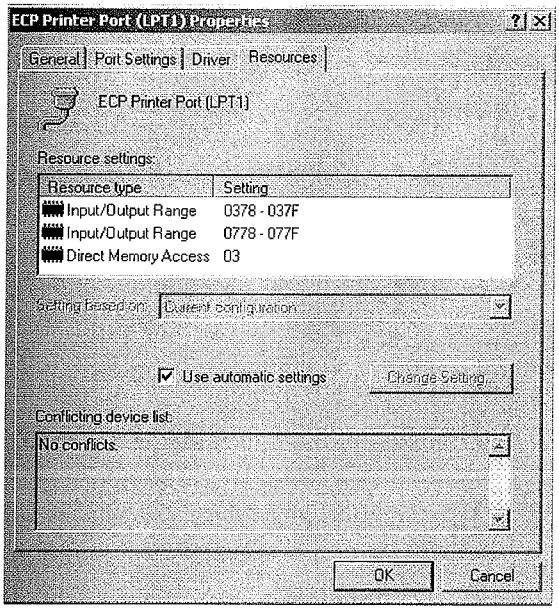
1. From the Device Manager dialog box, click the plus sign next to Ports.



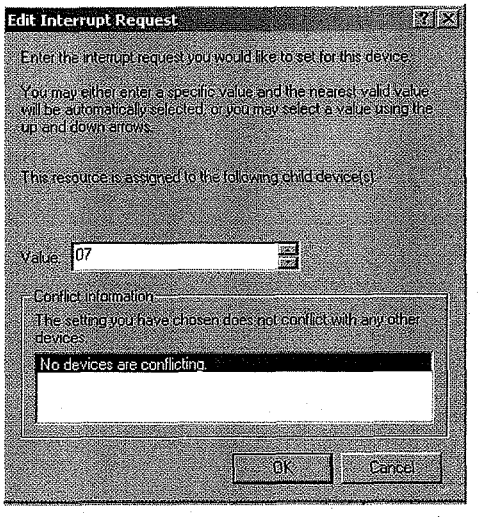
2. From the drop down list, double-click Printer Port (LPT1). The ECP Printer Port Properties dialog box displays.



3. From the ECP Printer Port Properties dialog box, click the Resources tab.



4. From the Use automatic settings check box, click to remove the check mark. This action activates the Setting based on field, and the Change Setting button.
5. Click the drop down arrow and choose Basic Configuration 0001 from the list.
6. From the Resource settings field, click Interrupt Request.
7. Click the Change Settings button. The Edit Interrupt Request dialog box displays.



8. Click the up arrow to change the Value to 07.
9. Click OK.

1 Installing Switch Support

Follow these instructions to setup the instrument with correct switch support.

Renaming the Current Service File

1. Install the Front Panel software. For more information see, the Spectrum Analyzer Installation Guide. The default folder created is C:\Program Files\MTCSpectrum.
2. Navigate to C:\Program Files\MTCSpectrum.
3. Double-click the MTCSpectrum folder to open.
4. Choose the MTCISASvc.exe file, right-click and choose Rename.
5. Rename this file MTCISASvcNoswitch.

Creating the New Service File with Coax Switch Capability

1. From the Front Panel installation CD, select the MTCISASvc4p.exe file.
2. Choose Edit>Copy.
3. From Windows Explorer, open the MTCSpectrum folder.
4. Choose Edit>Paste.
5. Right-click the MTCISASvc4p.exe file and choose Rename.
6. Rename this file to MTCISASvc.exe
7. Delete the MTCISASvcNoswitch file.
8. Restart the computer.