



# 9581 SST R4

## OPERATION MANUAL



## **COMPANY PROFILE**

Trilithic, Inc. was founded in 1986 as an engineering and assembly company providing customized communications and routing systems for business and government applications. As business expanded, Trilithic broadened its offerings by acquiring components manufacturer Cir-Q-tel and instruments manufacturer Texscan, adding broadband solutions to the product line.

Today, Trilithic is comprised of three major divisions, Broadband/CATV Instruments & Systems, Wireless & RF Microwave Components, and Field Technical Products. The Instruments Division specializes in the design and manufacturing of portable RF and digital test equipment and integrated test systems performing in a wide range of Broadband and LAN applications. The Wireless division provides components and custom solutions for companies specializing in cellular, military and other wireless applications. The Field Technical Products Division is a leading supplier of government-mandated Emergency Alert Systems used by Broadband service providers. An industry leader providing telecommunications solutions for major broadband and wireless markets around the world,

Trilithic is dedicated to providing quality products, services and communications solutions meeting or exceeding our customers' expectations. Today, from our worldwide headquarters in Indianapolis Indiana, we provide over 1500 measurement products and communications components to thousands of customers around the world.

## **TWO YEAR WARRANTY**

Trilithic, Inc. warrants that each part of this product will be free from defects in materials and workmanship, under normal use, operating conditions and service for a period of two (2) years from date of delivery. Trilithic, Inc.'s obligation under this Warranty shall be limited, at Trilithic, Inc.'s sole option, to replacing the product, or to replacing or reporting any defective part, F.O.B. Indianapolis, Indiana; provided that the Buyer shall give Trilithic, Inc. written notice.

Batteries are not included or covered by this Warranty.

The remedy set forth herein shall be the only remedy available to the Buyer under this Warranty and in no event shall Trilithic, Inc. be liable for incidental or consequential damages for any alleged breach of this Warranty. This Warranty shall not apply to any part of the product which, without fault of Trilithic, Inc., has been subject to alteration, failure caused by a part not supplied by Trilithic, Inc., accident, fire or other casualty, negligence or misuse, or to any cause whatsoever other than as a result of a defect. Except for the warranty and exclusions set forth above, and the warranties, if any, available to the Buyer from those who supply Trilithic, Inc., there are no warranties, expressed or implied (including without limitation, any implied warranties of merchantability of fitness), with respect to the condition of the product or its suitability for any use intended for it by the Buyer or by the purchaser from the Buyer.

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# GENERAL INFORMATION



## Introduction

Any CATV operator who maintains a two-way CATV distribution system knows that many factors can affect the performance of that system. Cumulative noise, signal ingress, incorrect gain or bad flatness all conspire to harm the return path which can lead to loss of service and customer complaints.

You have taken an excellent step toward alleviating the problems of your return path with your purchase of this **9581R4 Return Path Maintenance System**. Trilithic's 9581R4 is the next generation of the 9581. It is designed to monitor all of the troublesome parameters in a single, simple to use system. The 9581R4 is part of Trilithic's **Guardian II Return Alignment System** which includes the 9581R4 SST, 9580 SSR, 860 DSP, RSVP Installer Return Test Units and Isometer (for more information, refer to the operating manuals for the 9580 SSR, 860 DSP, RSVP and Isometer).

The 9581R4 differs from the 9581 in several ways:

- Nominally twice as fast ingress capture capability.
- Addition of many new security features and functional enhancements.

The 9581R4 is designed with two forward telemetry transmitters which makes it appear as two 9580 SSTs. This ensures that the unit is compatible with the earlier versions of the 9580 system. The setup parameters for nominal level, coupler value and detector mode are common for the SSTs. Test frequency, link frequency, and gain/tilt frequencies are treated independently for each SST.

It is more than just a return alignment system, however. The system also monitors the total performance of the return path by evaluating ingress and return noise. In any of the 9581R4's Modes of operation, you can catch the transient events. In the SSTs FAST Mode, the scan rate is doubled so that you can catch smaller duration transients. PEAK HOLD enables the Unit to display the highest ingress points in NORM or FAST Modes. This makes the SST a powerful tool for capturing transient ingress. The AVERAGING feature is included and can be used to reduce the noise floor displayed on the SST when measuring CW or common path. The digitizer for the 9581R4 handles 42 MHz in a single band and 65 MHz in two bands.

The 9581R4 SST is also equipped with **TraffiControl**. This feature enables the 9581R4 SST to measure and plot the ingress spectra of bands occupied by return traffic. TraffiControl automatically filters all the "desired" signals from scanned return spectra so that only the ingress spectrum remains.

The basic 9581R4 system consists of two types of equipment:

- SST Headend Unit (contains two SSTs in one enclosure)
- 860 DSP(i) with SSR or RSVP option, or SSR Field Unit

A system may include more hardware including additional 860 DSP(i) with SSR or RSVP options, SSR Field Units, RSVP Installer Return Test Units and a variety of headend options.

## SST Headend Unit

The SST Headend Unit is compact; occupying only 3.5" of rack space. It is easy to set up and operate. A single SST Headend Unit can support up to twelve SSR Field Units at a time with no loss of operating speed.

When it is equipped with two optional Test Point Managers (TPM8), the SST analyzes sweep and ingress signals from up to sixteen separate test points individually. It sends the appropriate ingress spectrum and sweep data to each SSR Field Unit to which it is connected.

Even when it is not supporting the SSR Field Units, the SST can function as a monitor for return path quality. In attended headends, the personnel can observe noise and ingress patterns using the SST's built-in LCD display panel as an aid to trouble-shooting. Unattended locations can be monitored since the SST, when equipped with the Communications Manager option (ECM), can send ingress and sweep measurement data via Ethernet or fiber to a PC located in a central office (see *INGRESS MANAGER 3.X OPERATION MANUAL* for more information).

## Equipment

The 9581R4 Return Path Maintenance System comes with the following standard items:

- SST Headend Unit (2 units in one enclosure)
- Operation Manual: 9581R4 SST (1)
- ~~SST Configure Software CD (1)~~

In addition to the standard equipment, you can also purchase the following:

- Additional SST Headend Units
- 860 DSP Field Units (Carrying Bags included)
- SSR Field Units (Carrying Bags included)
- RSVP Installer Return Test Units
- Communications Manager option (ECM)
- SNMP Agent option
- Test Point Manager option - equips SST so that it can monitor up to 8 individual Headend test points - each 9581SST can handle two TPMs for a total of 16 test points
- Replacement NiCad battery pack (SSR Field Unit)
- Replacement Power Cube (SSR Field Unit)

# OPTIMIZING THE RETURN PATH



## Introduction

Before you begin using your 9581R4 system, let's review the theory behind return path alignment and maintenance. To provide complex interactive services on cable, operators must ensure that they provide a reliable return path or customers won't have access to pay services, which will result in a loss of business. The high power transmissions from CB, ham radio and shortwave operators in the 5 to 30 MHz range, as well as other RF noise generating devices, present a threat to the return path as they can enter the cable system and interfere with upstream traffic. Additionally, the ever present signals from AM broadcast can enter the cable system and increase the power loading on the return laser to problematic levels.

As the return paths converge on their way to the headend or node, they act as interference concentrators. The various sources of ingress tend to add together and these independent sources of noise can merge to form a single strong ingress where the branches converge.

Since return path problems get worse as the branches converge, the best place to measure return path performance is at the headend; just before the upstream data is recovered. Return path performance monitored at the headend needs to be available to the technician in the field for alignment and troubleshooting. The 9581R4 system simplifies this process as follows:

The SST Headend Unit measures the system ingress as well as the test signals from the SSR Field Unit(s) and then transmits the results as data back to the SSR Field Unit(s), thus enabling the field technician to align the system and trouble shoot ingress problems from anywhere in the system.

## Return Path Performance Parameters

Reliable upstream performance depends upon:

- Proper Gain and Tilt
- Adequate signal-to-ingress ratio

It is important to balance Gain and Tilt in order to get the optimum performance from your system. Refer to Figure 1 Balance Gain and Tilt.

## SIGNAL-TO-NOISE RATIO

Gain in a particular branch, if set either high or low, can adversely affect the signal-to-noise ratio in some part or the entire return path.

If set low, signals on this branch could be "swamped" by the noise of other branches.

If set high, noise on this branch might be amplified enough to interfere with signals on other branches.

To minimize noise-induced communications errors, upstream data systems use robust modulation schemes like Quadrature Phase Shift Keying (QPSK), which typically operates at a data rate of 1.544 Mbps. However, even when using QPSK as the modulation format, your return system must provide a signal-to-noise ratio of at least 10 dB, as measured in a 1 MHz bandwidth around the data carrier center frequency to provide a marginally adequate Bit Error Rate (BER) of 10E-5

Incorrect gain settings, in some or all of the return paths, degrade the signal-to-noise ratio and increase the BER of the return path system.

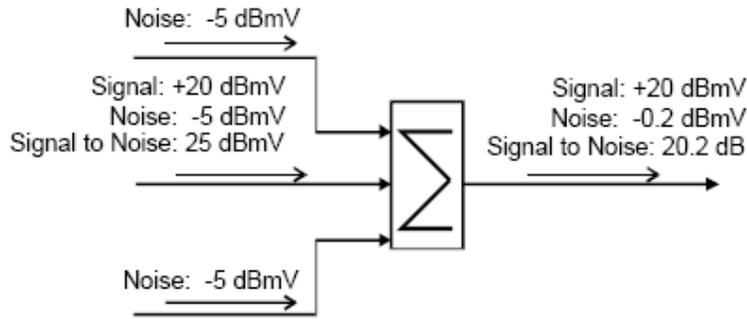
## SIGNAL-TO-INGRESS RATIO

When using QPSK, the sum of all ingressing signals lying within the data signal bandwidth (approximately 1 MHz for the data signal as discussed in *SIGNAL TO NOISE RATIO* above) should be at least 20 dB below

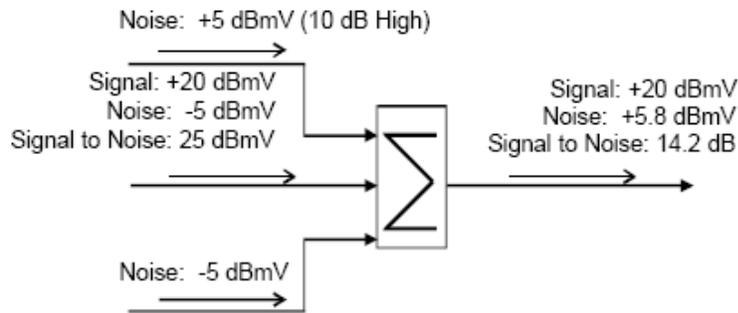
the level of the data signal. As the sum of ingress signals exceeds this level, the BER performance of the return path system is degraded. If ingress levels approach  $-10$  dBc, communication may be seriously degraded.

## A Balanced System

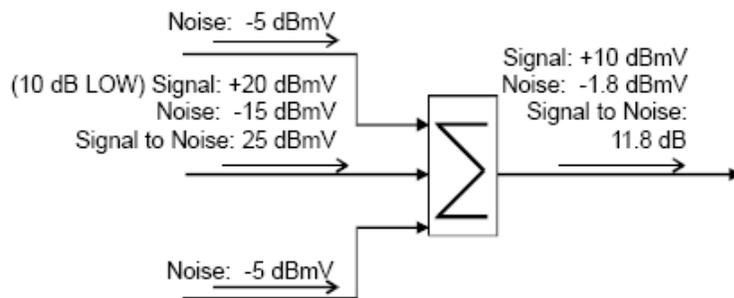
When the system is balanced, a signal on one branch is degraded equally by noise on ALL branches to the same node.



If, however, the gain of one path is set HIGHER than the others, its noise could disrupt traffic on ALL other paths.



If the gain of one path is set LOWER than the others, its signals are disrupted by the noise of ALL other paths.



**Figure 1 Balance Gain and Tilt**

# **ABOUT YOUR 9581SST R4**



## **9581R4 System Overview**

Your 9581R4 Return Path Maintenance System is a single test system that enables you to deal with all aspects of return path upkeep; including both ingress control and system balancing. At the core of the system is the SST Unit, a 0.3 to 65 MHz digitizing spectrum analyzer, which is installed at the headend of your cable system.

The SST Headend Unit monitors all signals arriving at the headend, including reverse signal “traffic”, noise, ingress and test carriers from the SSR Field Unit(s).

A single SST Unit can monitor up to sixteen separate headend test points simultaneously which enables you to analyze the condition of each. The SST analyzes test signals and the return spectra separately. It packages measurement results into a data stream that it transmits to the 860 DSP(i) or SSR Field Unit(s).

The 860's and SSR's are addressed individually (A - F) which allows six of these units to be in operation on each TPM-8 at any one time. Each of these Field Units transmits up to eight test carriers at user-settable frequencies. The SST measures these test carriers to compute the gain and tilt of the return path. The 860s and SSRs can store up to 24 sweep displays which can be reviewed at a later time or uploaded to a PC.

During system testing, the SST sorts out the test carrier measurements for each field piece and tags the data with the individual addresses (A – F) so that each field piece displays the appropriate information. When the field piece receives its data, it displays the response of the return path as either a line graph or as numeric values for gain and tilt. Ingress and noise data are presented as a spectrum analyzer display. For more information, refer to the manual that came with your particular field piece.

## **Theory of Application**

The 9581R4 test system can be used to:

- Balance the return path
- Measure the return path's ingress and noise

## **BALANCING THE RETURN PATH**

In the basic test architecture, test signals are injected upstream by the field piece. The SST measures these signals automatically at the headend. Then, the measurement data is transmitted back to the field piece for display.

In order to balance the return path of your system, you need to consider several alignment objectives. You need to set the fiber return path link to the system's design specifications. You must also set each line amplifier so that it will compensate for the gain and tilt of the cable and passives to the next amplifier.

The 860 and SSR have two types of displays, which will accommodate amplifier adjustment differences:

- Eight-carrier line graph for amplifiers that require screwdriver adjustments.
- Calculated gain and tilt values for amplifiers that use pads and equalizers.

## **MEASURING INGRESS AND NOISE**

In the basic test architecture, the SST Headend Unit's spectrum analyzer measures the incoming ingress and noise. It then transmits this measurement data to the field pieces. The field pieces display the ingress data as a spectrum pattern.

**REMINDER:** If your 9581 is equipped with the Test Point Manager option, you can analyze sixteen return paths individually.

When you are analyzing the return path, you need to determine if the return frequencies carrying “traffic” have an adequate signal/ ingress ratio. To do this, you must first calculate the effective ingress power.

For narrow band ingress, such as CB or shortwave, measure the ingress power directly.

For broadband ingress, such as interference from machinery, treat the ingress as noise and correct for video or data bandwidth. In the formulas below, Measured Power (MP) equals the reading from the 9581 and IP equals the effective Ingress Power.

- compute the effective noise in a 4 MHz video bandwidth, take the reading from the 9581R4 and add 10.3 dB.  $IP = MP + 10.3 \text{ dB}$
- compute the effective noise for data bandwidth, take the reading from the 9581R4 and add 10 times the log (data BW divided by .375MHz).
- $IP = MP + 10 \times \log (\text{data BW} / .375 \text{ MHz})$
- maintain good picture quality, video signals require narrow band ingress to be between – 40 to 60 dBc, depending on the offset from the video carrier and broadband ingress to be at least – 40 dBc.

Quadrature Phase Shift Keying (QPSK) should have an effective ingress power of – 20 dBc for either type of ingress for a Bit Error Rate (BER) of approximately  $1 \times 10^{-6}$ .

**HOT TIP**

*When the SST is setup according to this manual, it reserves about 15 dB of its amplitude measurement range to prevent the digitizer from being overloaded by powerful ingress transients. 10 dB of this “guard band” is visible as the top division on the SST’s spectrum display with an additional 5 dB above that. Experience has indicated that 15 dB is much more margin than is needed in all but the “dirtiest” systems. Up to 10 dB of the “guard band” can be reassigned to extend the SST’s measurement dynamic range. For more information, see Extending the Measurement Range on page. 27*

# INSTALLING THE 9581R4



## Introduction

You are now familiar with the theory behind return path alignment and maintenance so you can jump right in, turn on your 9581R4 system and start optimizing that ole' return path. Before you can install your 9581R4, you need to make decisions regarding carrier frequencies, device security, and IP connectivity...you get the picture. The information in this chapter will assist you in making those pre-installation determinations and will show you how to install your SST Headend Unit. For information regarding the field pieces, refer to the particular field pieces manual.

The 9581R4 SST uses a 3-conductor power supply cord which is rated at 1 A or greater. The cord should have an IEC320 connector that is the type approved as suitable for the application and acceptable to the regulatory authorities in the country where the unit is used.

The unit is identified with two IEC symbol labels. The back panel contains the symbol for alternating current (AC). The protective conductor terminal symbol label is inside the unit (see the section on unit *SPECIFICATIONS*).

## SST Headend Unit Installation

You need to make several decisions concerning the location of the 9581R4 as well as the placement and levels of the reverse test carrier and forward data carrier before you install your SST Headend Unit.

The 9581R4 SST is designed to be rack-mounted so that it provides easy access to the power cord. Consideration should be given to ensure that the location provides a reliable protective earth connection, proper ventilation, and a stable environment.

**WARNING:** Use the equipment in the manner for which it has been designed in order to ensure proper operation.

The levels vary from one cable system to another depending on the characteristics of the signals already on your system. Several of the following decisions **REQUIRE** information concerning your system's design.

## REVERSE TEST CARRIERS

You may choose up to eight reverse test carrier frequencies. Before making your selection, you should consider the following:

- Return band edges – usually the *highest* and *lowest* frequency test carriers will be near the return band edges (i.e. at 6 MHz and at 65 MHz).
- Problem frequencies – a test carrier might be placed at a frequency in the return pass band where problems may occur due to the particular models of passives (taps, power inserters, etc.), which are being used in the system. For instance, some 750 and 1000 MHz passives have significant roll off below 10 MHz. In this case, you might want to place test carriers around 5 and 10 MHz so that you can average the compensation for low-end roll off.
- Selected frequencies – you must avoid occupied bands of frequencies such as those carrying data or video. If you are using multiple Field Units, you need to provide the following clear bandwidth **ABOVE** the frequency of each test signal.

$$\text{Clear frequency BW} = (\text{number of Field Units} - 1) \times 100 \text{ kHz}$$

However, if you plan to use the RSVP Installer Return Tester, you should set up one (or more) of the SST test frequencies close to the active frequency(ies) which will be used by the subscriber's

equipment. Since the RSVP acts like a Unit F 860 or SSR, place the test carrier frequency which is to be used by the RSVP at least 500 kHz below the band edge of the active return frequency.

- The desired return signal output level is determined by the headend design.

This desired return output level **MUST** be established to set up the SST Headend Unit successfully. Consult the design documentation for your headend or calculate it based on the modem level requirements and the headend architecture to determine the correct figure.

- The actual return signal level arriving at the SST Headend Unit's INPUT port(s) must be equal to, or greater than, - 10 dBmV for accurate measurements over the full dynamic range of the SST. Include coupling losses and any inline pads in your calculation.

**NOTE:** For signal-to-noise considerations, it is necessary that all fiber receivers sharing the same headend data modem have the same output level. For this reason, the SST expects to see the same return level at each return test point.

Levels before adjustment will differ due to the varying length of fiber to the node. One of the objectives for using the 9581R4 is to balance receivers to the same output level; either through built-in adjustments or by inserting external padding, depending on the receiver's design.

## FORWARD DATA CARRIER

You also need to define the characteristics for the forward data carrier. First, select a forward data carrier frequency.

- The carrier center frequency may be set below Channel 2 (50 – 53.75 MHz); in the Channel 4 – 5 gap (74 MHz band); or 80 – 92 MHz depending on the data carrier option installed. The frequency you select must be clear of other “traffic” for 200 kHz above and below the data carrier.

## INSTALLATION PROCEDURE

Now that you have your system levels and frequencies determined, you are ready to install the your SST at the headend. Refer to Figure 2 SST Headend Unit Rear Panel View for the locations of the connections on the SST's rear panel.

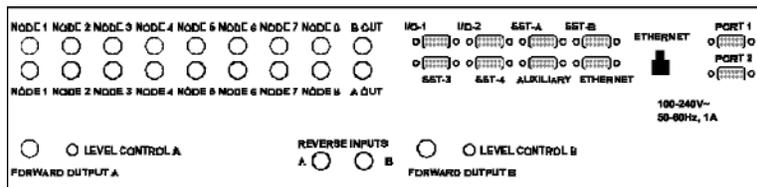
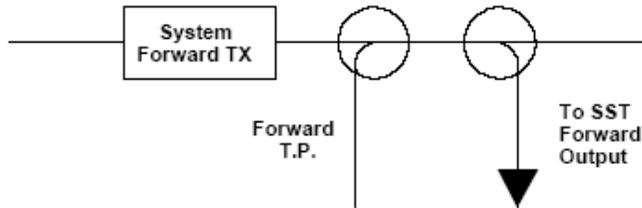


Figure 2 SST Headend Unit Rear Panel View

### Forward Connections

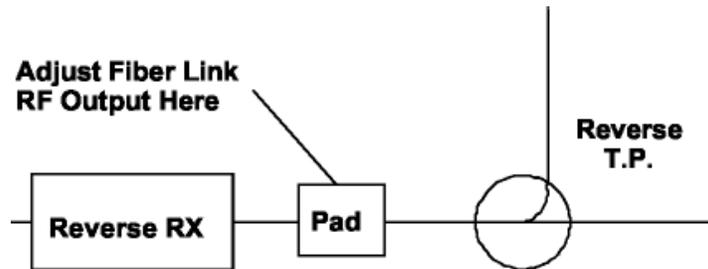
For forward connections, you need to provide a forward signal injection point. If necessary, install a 6 dB to 20 dB coupler before the forward test point. Make sure that it is inserted in the proper direction.



**REMINDER:** The injection point must be BEFORE the Headend's forward output test point.

### Reverse Connections

For reverse connections, you need to install test point couplers, in the range of 6 dB to 20 dB, at the outputs of the reverse path's fiber receiver outputs.



**REMINDER:** Note the coupler loss value. You will need to enter this data in the SST Headend Unit during the set up procedure. See the section on device

### SST WITH TWO INPUT PORTS

If your SST Headend Unit has only two input ports, you may connect several test points simultaneously by summing them in an RF combiner. The noise from the combination will increase proportionately to the number of inputs that are combined.

### SST WITH TEST POINT MANAGER OPTION

If your SST Headend Unit contains the Test Point Manager option, you can connect up to eight or sixteen test points individually to the SST Headend Unit's sixteen input ports.

**NOTE:** The value of coupling loss in the path between all fiber receiver outputs and inputs to the Test Point Manager MUST be the same for all sixteen test points.

For example, if a 12 dB coupler is used at one test point and a 6 dB coupler is used at another, you must insert an additional 6 dB pad between the coupler's tap port and the SST Headend Unit's input port.



# SETTING UP THE 9581SST R4



## Introduction

Okay, you have installed the 9581R4 SST, you're all ready to power up and start using everything. Well, almost. Before you can operate the system, you need to perform several basic setup steps for both the SST and Field Units.

The 9581R4 contains two SST units (A and B) in a single enclosure. The two sets of eight banks each support six 860 DSP(i) or SSR Field Units for a total of twelve. Since the 9581R4 contains two FSK transmitters, there is separate telemetry for the SST A and SST B.

## 9581R4 SST Onscreen Help

The 9581R4 SST provides help, which is displayed onscreen. To access the help feature at any time, press the ? (HELP) button.



This displays contact information for Trilithic Inc. support personnel.

To exit the HELP screen, press the **SELECT** button.



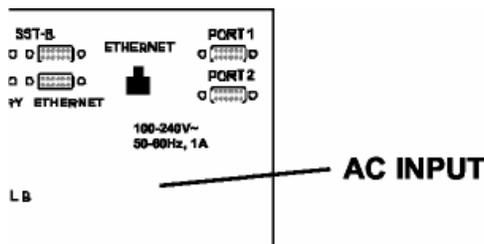
## Power Up

Now you are ready to power up your SST.

**NOTE:** Make sure that the **FORWARD OUTPUT** of the SST is disconnected.

Connect the AC Power to the **AC INPUT** on the rear panel of the SST. Then plug the power cord into an outlet.

When you INTRO used.



turn the Unit ON, the SST will power up in the screen and then display the last test mode

When you turn the Unit ON, the SST will power up in the INTRO screen and then display the last test mode used.



## Set Up

Now that the SST Headend Unit is connected and has power, you need to program its nonvolatile memory with several pieces of information:

- Return Sweep Frequencies
- Desired Return Level at the Headend
- Test Point Coupling Value
- Data Link Frequencies
- Security information
- IP connectivity information
- Data Link Levels (set on rear panel)

To enter this data, you will need to install and run the SST configure software included with your SST while connected to the serial port of the SST. The SST is now designed for remote administration as the primary method for changing device settings. The front screen of the SST is only designed to provide the user with a VIEW of the setup information of the device and a local spectrum analyzer like function as well. Pressing the SETUP button on the front panel will show the user a menu with the following option types and respective option contents:

- Network settings
  - MAC address
  - IP address
  - Subnet Mask
  - Gateway address
  - Primary DNS address
  - Secondary DNS address
- Return Path Carrier Settings (SELECT will change pages)
  - A and B side Carriers
  - A and B side Gain/Tilt markers
- Nominal Return Path Level and Tap Value
  - Nominal Input Level
  - Tap Value Used
- Forward Data Link Frequencies
  - A and B side Forward Data Carriers
- Field Piece Ingress Detector Mode
  - Ingress detector mode currently sent to the field pieces
- Display ONLY Ingress Settings
  - Peak Hold Setting
    - ON/OFF is selected on the front panel here using the UP or DOWN arrows.
  - Reference Level Setting
    - Enter the reference level for the top of the screen here

- Amplitude Scaling
  - Enter the choice for vertical scale here
- Frequency Band
  - Select the frequency band or bands to show on the screen here. The Low Band extends from 375Khz to 42Mhz, and the High Band extends from 42Mhz to 65Mhz. Selecting Both Bands shows the composite spectrum on the screen from 375Khz to 65Mhz.
- Speaker Preferences
  - Key Press Beeps
    - ON/OFF is selected on the front panel here using the UP or DOWN arrows.
  - Low Limit Violation Beeps
    - ON/OFF is selected on the front panel here using the UP or DOWN arrows.
  - Threshold Violation Beeps
    - ON/OFF is selected on the front panel here using the UP or DOWN arrows.
  - SST Shutdown Beeps
    - ON/OFF is selected on the front panel here using the UP or DOWN arrows.
- Display Contrast Adjustment
  - Use the UP or DOWN arrows until the screen is viewable.

If a menu does not have an EXIT selection visible, using the SELECT key to choose the option will select the option and EXIT as well.

The Speaker Preferences, and Display Ingress settings can ONLY be set from the front panel of the SST as well as the display contrast adjustment, which will always be the default entry point on this menu.

**NOTE:** If after you press Setup you cannot see the screen since contrast adjustment is the default setting, press Select and then the down or up arrows as appropriate until the screen is visible.

You can select any of the other settings to view the setup information of the particular SST. If you need to change any of these other settings you must use SST Configure. See the SST Configure Manual for more detail.

## LINK LEVEL

Use the **LEVEL CONTROLS** (for SST A and SST B) on the rear panel to set the data link level between 0 and 10 dB below system video carrier levels when measured at the **FORWARD OUTPUT** connection on the unit (see Figure 4 below). Connect the 9581R4 to the forward path injection point and repeat the adjustment while monitoring the level at the headend output test point.

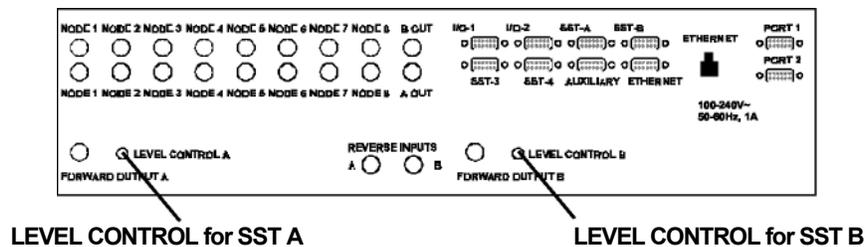


Figure 4. SST Headend Unit Rear Panel View.

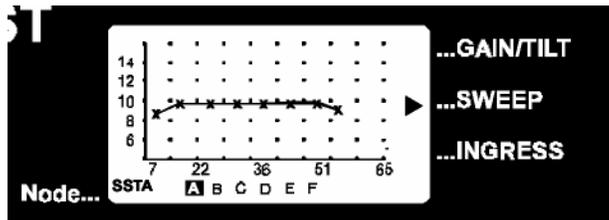


## Introduction

Okay, you have reviewed the theory behind return path alignment and maintenance, installed and “prepped” your 9581R4 SST and Field Units, and set up the 9581R4 SST according to the procedures in Chapter 5 and the SST Configure Manual. Now you’re ready to start using your 9581R4 system. In this chapter, you will learn how to perform basic operations. See Chapter 7 for information on system test and alignment procedures.

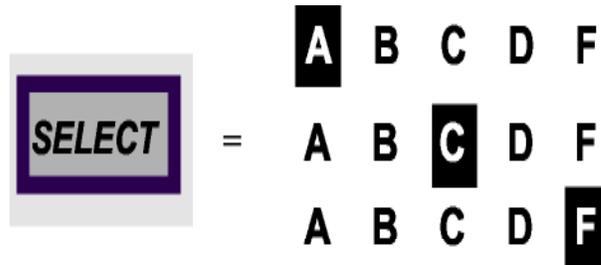
## Sweep Mode

To select SWEEP Mode, use the arrow keys to select **SWEEP**.

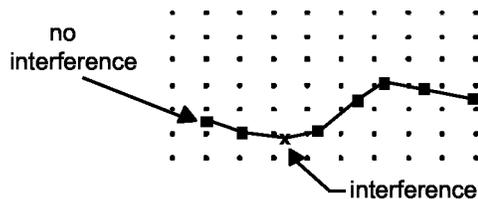


The Unit shows the sweep response for the SSR Field Units, defaulting to the last SSR Unit selected.

To view the response of a different SSR Field Unit, use the **SELECT** button to move from A through F until the desired Unit is highlighted.

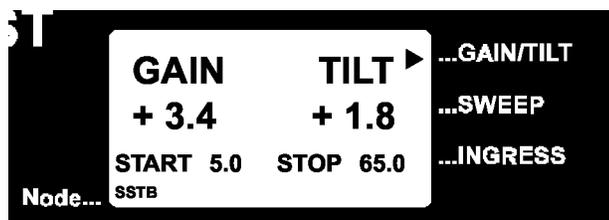


**NOTE:** When the SST Headend Unit detects interference at the sweep carrier frequency which is less than 20 dB below the sweep carrier level, it will warn you by placing an “X” at that data point instead of the bar “-” which is normally used.



## Gain/Tilt Mode

To select GAIN/TILT Mode, use the arrow keys to select **GAIN/ TILT**.



The gain and tilt are displayed in numeric format along with the two sweep carrier frequencies, which are used to compute the gain/tilt data. The display shows the gain and tilt for the Unit last selected in SWEEP Mode.

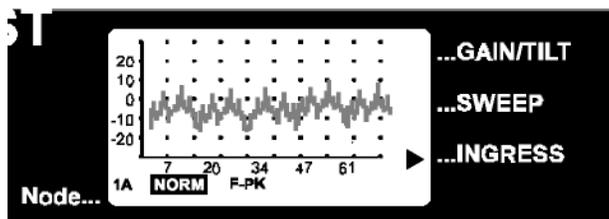
Gain represents the difference between the desired level, which has been programmed into the SST Headend Unit, and the actual return level found at the STOP frequency.

Tilt represents the STOP level minus the START level. The gain and tilt displayed by the 9581R4 represents the Field Unit, which is currently selected under the SWEEP Mode.

**REMINDER:** The START and STOP frequencies are selected by the "\*" in the RX FREQS SETUP Menu.

## Spectrum Mode

The SPECTRUM Mode provides a handy way to monitor noise and ingress. To enter SPECTRUM Mode, use the arrow keys to select **INGRESS**.



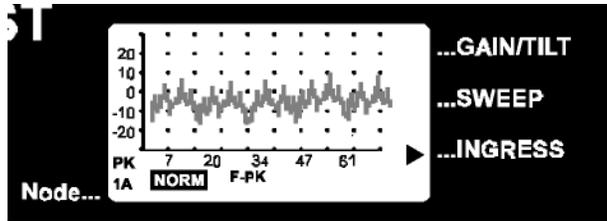
**NOTE:** You can use the **SELECT** button to cycle between the Peak, Average, and Traffic detector Modes.

If your 9581R4 is equipped with the test point manager, the test point (node) being displayed appears in the lower left corner along with the SST unit (1A, 8B, etc). Each SST supports eight nodes. In the above sample display, NODE 1 of SST A is displayed as "1A" in the lower left corner by **NODE**.

**NOTE:** If you are using the optional Test Point Manager, press the **NODE** button to cycle through the 8 nodes of SST A. Continue to press **NODE** to proceed to SST B and its eight nodes.

When you wish to look at a specific input channel, press **NODE** until the desired input test point appears next to **INGRESS**.

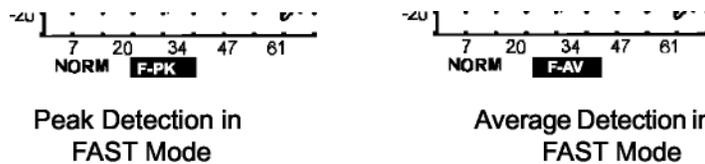
**NOTE:** If you have PEAK HOLD enabled, "PK" appears above the NODE number in the lower left of the display. PEAK HOLD is reset whenever the node is changed or the mode is cycled to FAST.



## Fast Spectrum Mode

To enter FAST SPECTRUM Mode, use SST Configure to change the device operating mode. The unit's display will look similar to the spectrum when it is in NORM Mode.

The word FAST at the bottom of the display changes to reflect the current detector selection on the screen only, remember that all detector modes are active all of the time in the 9581R4.



**NOTE:** If you are using the optional Test Point Manager, press the **NODE** button to cycle through the 8 nodes of SST A. Continue to press **NODE** to proceed to SST B and its eight nodes.

**NOTE:** You can NOT select the SWEEP or GAIN/TILT Modes while you are in FAST SPECTRUM Mode.

When you wish to look at a specific input channel, press **NODE** until the desired input test point appears next to **INGRESS**.

**NOTE:** If you have PEAK HOLD enabled, "PK" appears above the NODE number in the lower left of the display. PEAK HOLD is reset whenever the node is changed.

**REMINDER:** Your SST does not support SWEEP Mode when it is in FAST Mode. SSR Field Units with firmware version 2.00 or greater will be able to display ingress data when the SST is in FAST Mode. However, all sweeping and gain balancing activities will be halted until the SST returns to the NORM Mode. SSR's with firmware version older than 2.00 will not display ingress data when the SST is in FAST Mode. If this causes problems, contact Trilithic to have your SSR upgraded.

## Remote Mode

You may access your 9581 via a PC.

**NOTE:** In order to use this feature, you must have the COMM MANAGER (ECM) option equipped in your 9581R4.

When used in the REMOTE Mode, your 9581R4 becomes a powerful status monitoring tool when used with **Ingress Manager and/or Viewer II** software. All of the displays that appear on the unit are also available remotely. Your SST Headend unit continues to operate normally when it is under the control of a remote operator.

**REMINDER:** The REMOTE Mode is only available when you have a Communications Manager (ECM). In this case, you can access data via an Ethernet communications link and control your 9581R4.



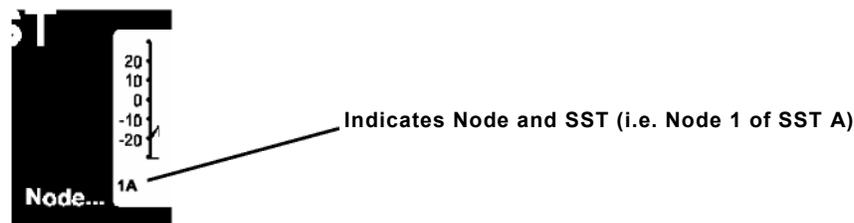
## Introduction

The first step in developing a successful alignment and maintenance strategy for the return path depends on understanding what constitutes a properly operating system. If you have not already done so, review Chapter 5 for the data regarding your system parameters so that you will have the following information handy:

- Proper levels at the headend
- Proper injection points for the node and each type of amplifier in the system
- Proper injection level for each device in the return system including coupling and test probe losses

You may also wish to review Chapters 4 and 6 for the proper installation and basic operation of your 9581R4 system as well as your field pieces operation manual.

Alignment of the reverse should begin at the headend. Use the SST to monitor the ingress for each return path that you will be aligning (refer to Spectrum Mode).



**REMINDER:** When you are reading the ingress, the 9581R4 displays the node and the SST (A or B) it is reading. In the example above, NODE 1 of SST A is being read so **1A** appears next to the word “Node” on the front panel. To cycle through SST A nodes 1 - 8 and then proceed to SST B and its 8 nodes, press the **Node** button.

For the 9581R4 system to achieve sweep accuracies better than  $\pm 1$  dB (and your return data system to function properly), ingress must be at least 20 dB below the expected return levels. If the SST is set properly, this will be 30 dB down from full scale on the ingress display. Carefully inspect the spectrum around each test carrier frequency. If ingress is excessive, take one of the following steps to reduce it:

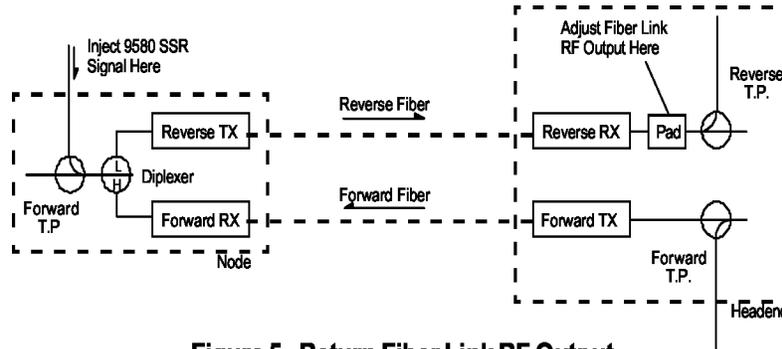
- If you are combining several return paths, try disconnecting some to reduce total ingress.
- If your system has no active carriers, turn down the gain or remove the pads in the reverse amplifiers.
- Temporarily pick a higher operating level for the SST and SSR.
- Find and fix the major ingress problems. Remember, you can use your 9581R4 system to help you troubleshoot the ingress while in the field.

If ingress exceeds  $-20$  dB relative to the desired return level, the 9581R4 sweep display will show an “X” rather than the usual frequency marker (bar). This is another indication that there is an ingress problem, which needs to be tracked down.

## Adjusting the Fiber Link

Adjustment of the fiber link will require two technicians since the fiber receiver output must be adjusted with the SSR connected to the node (see Figure 5 below).

**NOTE:** This could be achieved with one technician but it would involve a lot of back and forth runs to the headend and the node.



**Figure 5. Return Fiber Link RF Output.**

To adjust the fiber path properly, consult the manufacturer's data sheets to determine how to set gain in the fiber receiver. You may also want to measure the optical power at the receiver input to make sure that it meets recommended levels prior to starting alignment. Inject the 9581R4 test signals at the system design level into the node test point.

If your fiber receiver uses pads to set the gain, use the **GAIN/TILT** display on the SST to determine the correct pad to use in the fiber receiver. The SST will show a maximum gain error of  $\pm 9.9$  dB. If the initial gain is off by more than  $\pm 9.9$  dB, it may be necessary to zero in on the correct pad by changing the pad value until the reading is on scale. Then you can select a pad accordingly to set the gain as close as possible to 0.0 dB. When finished, switch to the **SWEEP** display to observe the sweep response.

If your fiber receiver has a screw driver adjustment, use the **SWEEP** display and adjust the receiver's gain so that the sweep response is positioned on the center graticule of the **SWEEP** display.

### **HOT TIP**

***Be sure to select the proper Unit ID on the SST SWEEP display. Remember, this also effects which Field Piece's data is displayed in the GAIN/TILT display.***

**NOTE:** Some fiber nodes have a gain adjustment in the node, which must be set first (i.e. Texscan's FLAMETHROWER™). Consult the manufacturer for the proper procedure for making this adjustment prior to setting the fiber receiver's gain.

If you cannot get a display, try the following:

- Be sure that the SSR is receiving the data carrier as evidenced by the cursor pointing to **CAR DET** (carrier detect) on the SSR's display.
- Make sure that the injection test point you are using is pointing the correct way (i.e. TOWARD the headend).

- Make sure that the fiber transmitter and receiver are functioning properly and that the proper light level is reaching the headend.
- Increase or decrease the Field Piece's TX level in 5 dB increments until the response is on screen. Note the difference that is necessary for the output setting and adjust the gain accordingly. Now you can return your Field Piece to the proper output level and fine tune the gain setting.

## Adjusting Amplifiers

When an amplifier is balanced properly, its gain and tilt will virtually cancel the loss and tilt of everything in the upstream path between the amplifier and the next amplifier upstream (see Figure 6 below)

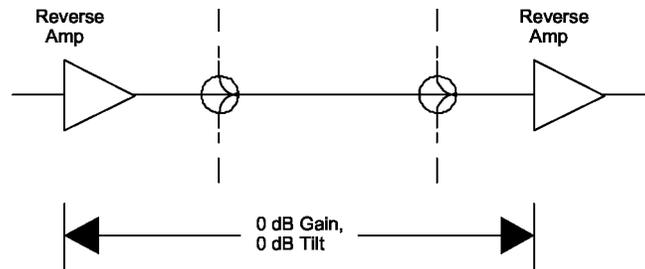


Figure 6. Balanced Amplifier.

With the node adjusted properly, proceed to the first amplifier from the node. Set your Field Piece's TX level to the proper injection level for the amplifier. Connect it to the amplifier's input test point(s).

**REMINDER:** Don't forget to allow for test point or coupling losses.

For amplifiers with fixed pads and equalizers, use the **GAIN/TILT** display. The 9581R4 will show a maximum gain error of  $\pm 9.9$  dB. If the initial gain is off by more than  $\pm 9.9$  dB, it may be necessary to zero in on the correct pad by changing the pad value until the reading is on scale. Then you can install the equalizer to compensate for tilt. Once the tilt is corrected, fine tune the pad value to give an overall gain of 0.0 dB. Now, you can switch to the **SWEEP** display to observe the sweep response.

If your amplifier has screw driver gain and tilt adjustments, you need to use the **SWEEP** display and adjust the amplifier's gain controls so that the sweep response is positioned in the display. Adjust the amplifier's tilt for a flat response. Then you can fine tune the gain adjustment to position the sweep response on the center graticule of the display. You can switch to the **GAIN/TILT** display to confirm your settings numerically.

If you do not get a display, try the following:

- Be sure that the field piece is receiving the data carrier as evidenced by the cursor pointing to **CAR DET** (carrier detect) on the field piece's display.
- Make sure that the injection test point you are using is pointing the correct way (i.e. TOWARD the headend).
- Increase or decrease the field piece's TX level in 5 dB increments until the response is on screen. Note the difference that is necessary for the output setting and adjust the gain accordingly. Now you can return your SSR to the proper output level and fine tune the gain setting.

Proceed to the next amplifier and repeat the process until ALL of your amplifiers are aligned. Make sure that you adjust the field piece's TX level if necessary when you are changing amplifier types.

## Ingress

Ingress along the return path can cause serious disruptions to a subscriber's cable service. This makes regular monitoring of ingress an essential part of a sound return maintenance strategy. The 9581R4 was designed to provide you with a simple solution to reverse monitoring.

When you are using the 9581R4 to monitor ingress, there are configuration trade-offs that you need to consider. The most important of these concerns the number of return paths connected to a single input on the SST. Combining your returns may economize on your hardware but it can make it far more difficult to localize on the source of ingress.

If you equip your 9581R4 with Test Point Managers, you will be able to monitor 8 or 16 independent return test points. This can reduce the need to combine returns.

If ingress control is a "must", as it is in the case of telephony or commercial data carrying, consider using more than one SST so that each return can be monitored separately.

You can also automate your ingress monitoring task by using **Ingress ManageR and Viewer II**, the 9581R4's Remote Monitoring Software, with a PC. When ingress problems do occur, you can:

- Determine along which return path the ingress is coming. If necessary, disconnect the combined returns one at a time until you locate the "bad" one.
- Read and record ingress levels at several frequencies.
- Go to the node (first amplifier in an all coax system) and read the ingress at the node's return input using an SLM.

**CAUTION:** Be careful to choose a test point that is looking downstream and NOT toward the headend (see Figure 7 below).

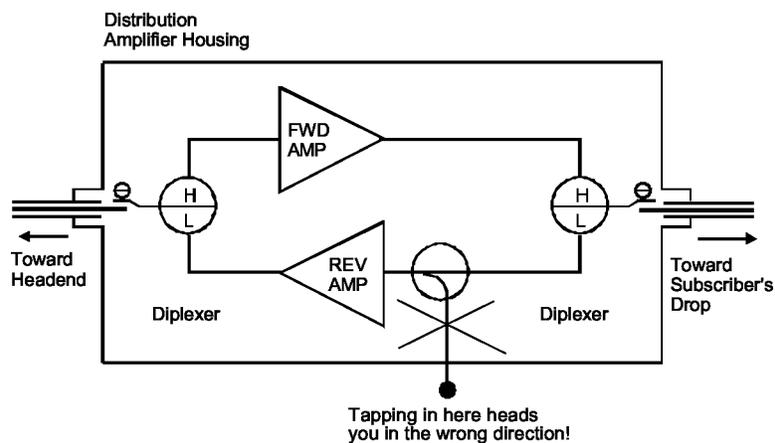


Figure 7. Incorrect Test Point Selection.

Compare this ingress to the levels you saw at the headend. If the levels are still about the same, divide the number of amplifiers in each leg in half and test at that point. Continue to divide the amplifier spans in half until you locate the amplifier farthest from the node that still has the ingress problem.

Once you have localized the ingress, you can troubleshoot the hardware and the drops of the target amplifier. When you think that you may have located the difficulty, connect the field piece to the system and verify that the problem is fixed by observing the ingress pattern.

Many ingress problems are transient in nature. For example, ingress from a CB radio will only be present when the radio is keyed on and the vehicle it is in is physically close to a leaky section of cable plant. These transient events will be on the order of 1 or 2 seconds.

Other events in the subscriber's house, such as electrical transients from turning on motors in appliances, can be much shorter in duration. The SST allows you to capture these transient events by combining the use of FAST Mode and PEAK HOLD Mode.

In FAST Mode, the SST analyzes each node at rates up to 80 Hz. This enables you to capture transients in the millisecond range.

When PEAK HOLD Mode is enabled, these transients stay in the screen until you reset the system.

**REMINDER:** The sweeping procedure is not supported when the SST is in FAST Mode.

An effective strategy for you may be to balance a node with the SST in NORMAL Mode. After you have obtained a balance, let the SST analyze the node in FAST Mode for a long duration (i.e. 24 hours) to verify that transient ingress is not a problem.

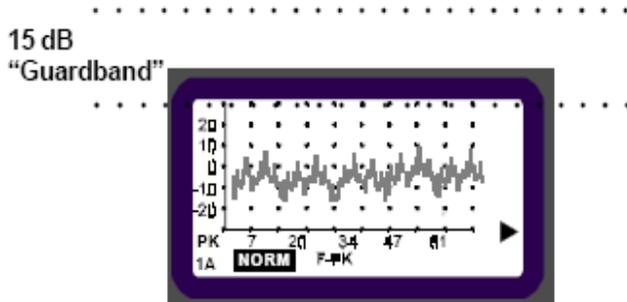


## Interoperability

SSRs that have firmware version 2.00 or higher, are equipped with major new features that were not included in earlier firmware versions. While the firmware upgrades have been designed in such a way that the older and newer units will interoperate, you need to be aware that some of the more recent functions may not operate if you are using an earlier version of the 9580 SSR with the 9581R4 SST. Also, SSRs with firmware versions less than 4.00 have firmware and hardware limitations so that they can be used only to 42 MHz.

## Extending the Measurement Range

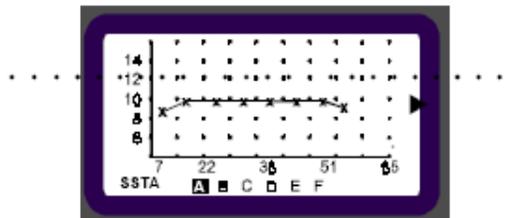
When the SST is setup according to this manual, it reserves about 15 dB of its amplitude measurement range to prevent the digitizer from being overloaded by powerful ingress transients. 10 dB of this “guard band” is visible as the top division on the SST’s spectrum display with an additional 5 dB above that.



Experience has indicated that 15 dB is much more margin than is needed in all but the “dirtiest” systems. Up to 10 dB of the “guard band” can be reassigned to extend the SST’s measurement dynamic range. You can reassign the offset via a simple variation of the normal SST set up procedure. You will also need to adjust the field pieces.

## RECONFIGURE SST FOR GREATER RANGE

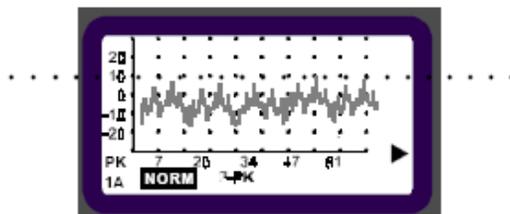
The SST evaluates system performance against a user-settable “reference level”. This is the “nominal” RF amplitude expected from a return fiber receiver when a test signal of the proper amplitude is injected into a return amplifier in the field. The SST automatically sets whatever reference level you choose to the middle of the display when it is in SWEEP Mode.



It also sets the level 10 dB BELOW the top of the display when in SPECTRUM Mode.

## Increase Sensitivity and Range

To increase the sensitivity and range of the SST in SPECTRUM Mode, simply set the reference to a LOWER level. This enables the SST to “borrow” some of the operating “guard band”. In most systems, as much as 10 dB can be added to the SST’s operating range.



For example, suppose that the nominal return system reference level should be 20 dBmV. Setting the SST for a reference level of 10 dBmV recalibrates the SPECTRUM Mode display so that the 20 dBmV line is now at the TOP of the display rather than 10 dB below. The lowest level that can be observed now decreases to -20 dBmV. This increase in the SST’s measurement sensitivity is equal to the amount of the offset.

## EFFECT OF OFFSET ON SSR AND 860 UNITS

The reference settings for the SST’s SWEEP and SPECTRUM Modes are linked. This means that offsetting the SPECTRUM Mode’s reference level will also offset the reference for the SWEEP Mode by the same amount. To keep the field piece’s “normal” sweep output from being TOO large, you simply need to reduce the field piece’s sweep output level by the same offset amount.

**NOTE:** Regardless of the offset amount, the SPECTRUM display will read correctly.

## EFFECT OF OFFSET ON RSVP UNITS

The RSVP measures the “launch level” from the subscriber’s house and the carrier/noise ratio of the path back to the hub. If the SST’s reference level is offset, the RSVP will report launch level and carrier/noise readings that are reduced by the amount of the offset. Measurements can be made by simply reducing the RSVP’s launch level and C/N PASS/FAIL settings by the value of the offset.

Problems may occur when testing through low-value taps since the SST may instruct the RSVP to operate below its minimum output, 30 dBmV.

**NOTE:** The RSVP<sup>2</sup> has an extended range that enables you to test the return “launch level” through a wider range of tap and splitter values without using an external pad. The RSVP<sup>2</sup> has sufficient range to be connected directly to taps as low as 7dB; even in systems operating at reduced return levels or to services with as much as 35dB isolation, operating at normal levels. For more information, refer to the *RSVP<sup>2</sup> Operating Manual*.

This causes the RSVP to display a “FAIL” message and show a launch level below 30 dBmV. If this happens, you can insert a **return step attenuator pad** (such as an ARCOM RSA-xx) in line with the test jumper. This raises the RSVP’s launch level to within its operating range. You then retest the launch level and subtract the pad value from the measurement.

For example:

- At a house where the launch level is nominally 40 dBmV, offsetting the SST by 5 dB causes the RSVP to report a launch level of 35 dBmV.

- At a house whose carrier/noise ratio is nominally 35 dB, offsetting the SST by 5 dB causes the RSVP to report a C/N of 30 dB.
- This particular distribution system is designed to require a launch level of no more than 50 dBmV. Offsetting the SST's reference level by 5 dB reduces the maximum acceptable level to 45 dBmV.
- At a house connected through a low-value tap, the RSVP reports a "FAIL" and shows a level reading of less than
- 30 dBmV. Insert an RSA-10 pad between the test jumper and the RSVP. Retest. The RSVP now gives a "PASS" reading. Subtract the value of the pad (in this example, 10 dB) from the displayed reading.



# SPECIFICATIONS



Frequency	0.3 – 65 MHz
Input Level Range (return test carriers)	+ 25 to – 10dBmV for full 50dB dynamic range in Spectrum Mode
Return Inputs	2 standard, 16 with two each Test Point Managers
Field Units Supported	Up to 6 simultaneously per TPM
Sweep Mode	5 – 65 MHz with 0.25dB resolution
Sweep Mode Resolution BW	25 kHz effective
Input Level Accuracy	± 0.35dB
Spectrum Display	50dB dynamic range with 1dB measurement resolution
Spectrum Dispersion	Norm (0.375 – 65)
Resolution BW	375 kHz
Sweep Rate	40 Hz/node in NORM; 120 Hz/node in FAST
Data Carrier TX Frequency	Standard: 80 - 92 MHz Optional: 50 to 53.75 and 70.00 to 75.75 MHz
Data Carrier TX Level	+23 to + 45dBmV continuously adjustable 45 dBmV @ 92 MHz, 55 dBmV @ 80 MHz
Data Carrier Spurious	– 60dBc
Modulation	FSK with 38.4 kbps data rate
Data Carrier BW	150 kHz at – 20dBc, 475 kHz at –60dBc
Remote Access	Via Ethernet for all displays (with appropriate Communications Manager)
Display	64 x 128 pixel graphic LCD w/backlight
Power Cord	3-conductor rated at 1A with IEC320 connector
Power Requirement	100-240~ (alternating current), 50-60Hz, 1A
Protective Conductor Terminal Label	

## SST 9581 SPECIFICATIONS (Continued)

Operating Temperature

10 - 50°C

Dimensions

3.5" x 17" x 12.3"

10lbs (4.5kg) with all options



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