9581 SST R5
Return Path Analyzer

Operation Manual

think ahead.

TRILITHIC

Trilithic Company Profile

Trilithic is a privately held manufacturer founded in 1986 as an engineering and assembly company that built and designed customer-directed products for telecommunications, military, and industrial customers. From its modest beginnings as a two-man engineering team, Trilithic grew over the years and broadened its offerings of RF and microwave components by adding broadband solutions to its product line. This was accomplished with the acquisition of components manufacturer Cir-Q-Tel and instruments manufacturer Texscan.

Today, Trilithic is an industry leader providing telecommunications solutions for major broadband, RF, and microwave markets around the world. As an ISO 9000:2001 certified company with over 40 years of collective expertise in engineering and custom assembly, Trilithic is dedicated to providing quality products, services, and communications solutions that exceed customer expectations.

Trilithic is comprised of five major divisions:

- **Broadband Instruments and Systems**
  Offers test, analysis, and quality management solutions for the major cable television systems worldwide.
- **Telecom Solutions**
  Offers affordable, easy-to-use instruments for testing and measurement of Telecom networks.
- **RF Microwave Components**
  Provides components and custom subsystems for companies specializing in cellular, military, and other wireless applications.
- **Emergency Alert Systems**
  Leading supplier of government-mandated emergency alert systems used by broadcast TV, cable TV, IPTV, DBS, and radio stations.
- **XFTP**
  Offers a specialty line of field technical products for cable operators and technicians, as well as a line of products for installing electronics in the home of the future.

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Chapter 1

General Information

Helpful Website

The following website contains general information which may be of interest to you:

http://www.trilithic.com

Trilithic's website contains product specifications and information, tips, release information, marketing information, Frequently Asked Questions (FAQs), bulletins and other technical information. You can also check this website for product updates.

Where to Get Technical Support

Trilithic technical support is available Monday through Friday from 8:00 AM to 5:00 PM EST. Callers in North America can dial 317-895-3600 or 800-344-2412 (toll free). International callers should dial 317-895-3600 or fax questions to 317-895-3613. You can also email technical support at *techsupport@trilithic.com*.

For quicker support response when calling or sending e-mail, please provide the following information:

- Your name and your company name.
- The technical point of contact (name, phone number, e-mail).
- Product name, model number, and serial number.
- A detailed description of the problem you are having, including any error or information messages.

How this Manual is Organized

This manual is divided into the following chapters:

- Chapter 1, “General Information” provides Trilithic contact information and describes how this operation manual is structured.
- Chapter 2, “Introduction” explains what the 9581 SST R5 does and provides an overview of the physical features of the device.
- Chapter 3, “Optimizing the Return Path” provides an overview of how to provide a reliable return path in order to optimize the system’s performance.
- Chapter 4, “Installation” provides installation instructions for the 9581 SST R5 and explains the use of the front display screen.
- Chapter 5, “Operation” provides instructions on how to use the 9581 SST R5 to balance the return path in order to optimize the system’s performance.
- Chapter 6, “Appendix” provides detailed technical specifications and warranty information.

Conventions Used in this Manual

This manual has several standard conventions for presenting information.

- Connections, menus, menu options, and user-entered text and commands appear in **bold**.
- Section names, web and e-mail addresses appear in *italics*.

A <u>WARNING</u> alerts you to any condition that could cause personal injury.

A <u>CAUTION</u> alerts you to any condition that could cause a mechanical failure or potential loss of data.

A <u>NOTE</u> is information that will be of assistance to you related to the current step or procedure.

Precautions

A strong electromagnetic field may affect the accuracy of the 9581 SST measurements.

Exposure of data cables to a field with high-voltage and fast transient signals may cause measurement errors in the 9581 SST.

A shielded CAT-5 cable is recommended for Ethernet connection.

Do not use the 9581 SST in any manner not recommended by the manufacturer.

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Chapter 2
Introduction

This chapter:

- Describes the purpose of the 9581 SST R5
- Lists the features of the 9581 SST R5

System Overview

The 9581 SST R5 Return Path Maintenance System is a single test system that enables management of all aspects of return path upkeep; including both ingress control and system balancing. At the core of the system is the 9581 SST R5 Return Path Analyzer, a 4.125 to 85.5 MHz digitizing spectrum analyzer which is installed at the headend of the cable system.

The 9581 SST R5 monitors all signals arriving at the headend, including reverse signal “traffic”, noise, ingress and test carriers from the 860 DSP or 860 DSPi field analyzer(s).

A single 9581 SST R5 can monitor up to sixteen separate headend test points simultaneously, allowing analysis of the condition of each test point. The 9581 SST R5 analyzes test signals and the return spectra separately and packages measurement results into a data stream that it transmits to the 860 DSP or 860 DSPi.

Each 860 DSP or 860 DSPi are addressed individually (A - F) which allows six field analyzers to be in operation at any one time. Each field analyzer transmits up to eight test carriers at user-settable frequencies. The 9581 SST R5 measures these test carriers to compute the gain and tilt of the return path. The 860 DSP and 860 DSPi can store up to 24 sweep displays which can be reviewed at a later time or uploaded to a PC.

During system testing, the 9581 SST R5 sorts out the test carrier measurements for each field analyzer and tags the data with the individual addresses (A – F) so that each field analyzer displays the appropriate information. When the field analyzer 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 860 DSP and 860 DSPi Operation Manual.

Application

The 9581 SST Return Path Maintenance 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 860 DSP or 860 DSPi field analyzer. The 9581 SST R5 measures these signals automatically at the headend. The measurement data is transmitted back to the field analyzer for display.

To balance the return path of the system, several alignment objectives must be considered. The fiber return path link must be set to the system's design specifications. Additionally, each line amplifier must be set so that it will compensate for the gain and tilt of the cable and passives to the next amplifier.

The 860 DSP and 860 DSPi 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 spectrum analyzer of the 9581 SST R5 return path analyzer measures the incoming ingress and noise. It then transmits this measurement data to the 860 DSP or 860 DSPi field analyzers. The field analyzers display the ingress data as a spectrum pattern.

While analyzing the return path, it must be determined if the return frequencies carrying the "traffic" have an adequate signal-to-noise ratio. To calculate the signal-to-noise ratio, the effective ingress power must be calculated first. 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 SST R5 and IP equals the effective ingress power.

- Compute the effective noise in a 4 MHz video bandwidth; take the reading from the 9581 SST R5 and add 10.3 dB. **IP = MP + 10.3 dB**
- Compute the effective noise for data bandwidth, take the reading from the 9581 SST R5 and add 10 times the log (data BW divided by .375 MHz). **IP = MP + 10 x log (data BW/.375 MHz)**
- Maintain good picture quality, video signals require narrow band ingress to be between -40 and +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 x 10E-6.

When the 9581 SST R5 is setup according to this manual, it reserves about 15 dB of amplitude measurement range to prevent the digitizer from being overloaded by powerful ingress transients. 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 measurement dynamic range of the 9581 SST R5. For more information, see **Chapter 5: Operation**, Extending the Measurement Range.

Return Path Maintenance

Cable television operators who maintain a two-way cable television distribution system knows that many factors can affect the performance of the 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.

The 9581 SST R5 is component of the next generation of the 9581 Return Path Maintenance System. The 9581 SST R5 monitors all of the troublesome parameters in a single, simple to use system. The 9581 SST R5 is a component of Trilithic's Guardian II Return Alignment System which includes the 9581 SST R5 and 860 DSP or 860 DSPi with SSR or RSVP option. For additional information on each of the components in the Guardian II Return Alignment System, refer to the operation manual for each of the components.

The 9581 SST R5 differs from the 9581 SST R4 in several ways:

- The telemetry signal resides on a single transmitter which can be placed anywhere between 50 MHz and 1 GHz
- The bandwidth has been increased to 85.5 MHz
- There is no live display on the 9581 SST R5

The 9581 SST R5 Return Path Maintenance System is more than just a return alignment system. It also monitors the total performance of the return path by evaluating ingress and return noise. In any operation mode of the 9581 SST R5, transient events can be captured. In the Fast mode of the 9581 SST R5, the scan rate is tripled so smaller-duration transients can be captured. The Peak Hold mode enables the 9581 SST R5 to display the highest ingress points in Norm or Fast modes. This makes the 9581 SST R5 a powerful tool for capturing transient ingress. The Averaging feature is included and can be used to reduce the noise floor displayed when measuring CW or common path. The digitizer for the 9581 SST R5 handles 85.5 MHz in two bands.

The 9581 SST R5 is also equipped with TraffiControl. This feature enables the 9581 SST R5 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.

9581 SST Headend Analyzer

The 9581 SST R5 headend analyzer is compact; occupying only 3.5" (2U) of rack space, and is easily set up and operated. A single 9581 SST R5 headend analyzer can support up to six 860 DSP or 860 DSPi field analyzers at a time with no loss of operating speed.

The 9581 SST analyzes sweep and ingress signals on sixteen separate test points individually. It sends the appropriate ingress spectrum and sweep data to each 860 DSP or 860 DSPi field analyzer to which it is connected.

Even when the 9581 SST R5 is not supporting the 860 DSP or 860 DSPi field analzyers, the 9581 SST R5 can function as a monitor for return path quality. Unattended locations can be monitored since the 9581 SST R5 can send ingress and sweep measurement data to a PC located in a central office (refer to the Viewer II Operation Manual for more information).

Included Equipment

The 9581 SST R5 Return Path Analyzer includes the following items:

- 9581 SST R5 Return Path Analyzer
- Power Cable
- SST Configure Software on CD
- Operation Manual on CD

Optional Equipment

The following optional items are also available:

- Additional 9581 SST R5 headend analyzers
- 860 DSP or DSPi field analyzer

A Guided Tour of Your 9581 SST R5

Front View

Power Button

Press this button to enable or disable operation of the instrument. To turn off the instrument, remove the power cable.

Select Button

Press this button to select a menu or edit a configuration parameter.

Down Arrow Button

Press this button to scroll down through the configuration menus and to perform downward adjustments of configuration parameters.

Up Arrow Button

Press this button to scroll up through the configuration menus and to perform upward adjustments of configuration parameters.

Info button

Press this button to view the hardware and software version numbers of the instrument.

Test button

Press this button to view the internal temperature, date, and time of the instrument.

Setup Button

This button is not used.

Node Button

This button is not used.

Display Screen

The display screen is used to display configuration and setup parameters.

Internal Speaker

The internal speaker will sound a “beep” each time a button is pressed.

Back View

A. **FORWARD OUTPUT** - This is the output connection that the 9581 SST R5 transmits measurement results back to the 860 DSPi on a downstream telemetry signal.

B. **TEST POINT INPUTS** - These are the test point input connections that the 9581 SST R5 uses to analyze data from a test point in the headend or field.

C. **ETHERNET** - This connection is used for web based setup and upgrades.

D. **100-240 V** - AC power input connection

E. **PORT-1** & **PORT-2** - (For Future Use)

Chapter 3

Optimizing the Return Path

Introduction

To provide complex interactive services on cable, operators must ensure that they provide a reliable return path or customers will not have access to pay services. The high power transmissions from citizens' band (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, 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 are amplified as the branches converge, the best location within the system 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 9581 SST R5 Return Path Maintainance system simplifies this process as follows:

The 9581 SST R5 Return Path Analyzer measures the system ingress as well as the test signals from the 860 DSP and 860 DSPi field analyzer(s) and then transmits the results as data back to the 860 DSP or 860 DSPi field anayzer(s), thus enabling the field technician to align the system and troubleshoot ingress problems from anywhere in the system.

Return Path Perfomance Parameters

Reliable upstream performance depends upon:

- Proper gain and tilt banance
- Adequate signal-to-ingress ratio

It is important to balance gain and tilt in order to optimize the system's performance. Refer to *A Balanced System* later in this chapter for instruction in balancing gain and tilt.

Signal-to-Noise Ratio

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

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

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

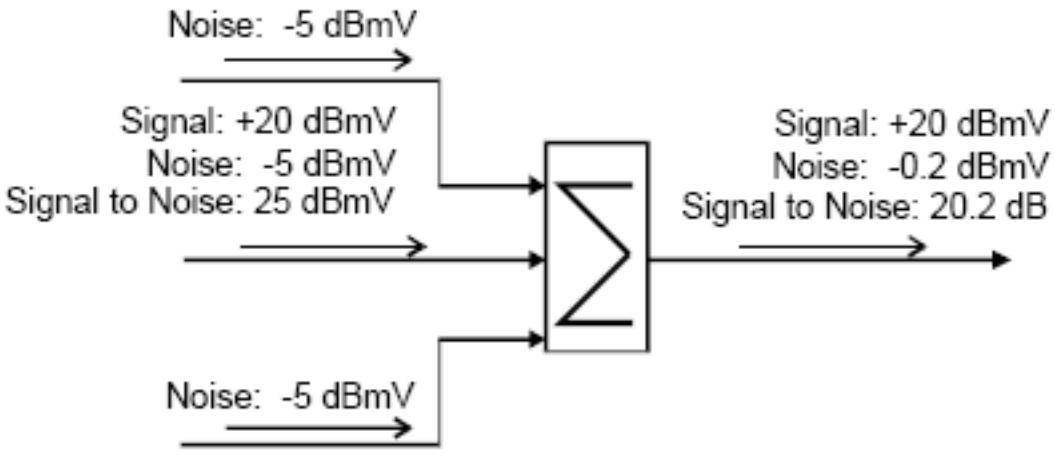
To minimize noise-induced communication errors, upstream data systems use robust modulation schemes like quadrature phase shift keying (QPSK), which typically operates at a data rate of 1.544 Mbps. Even when using QPSK as the modulation format, the return system must provide a signal-tonoise ratio of 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

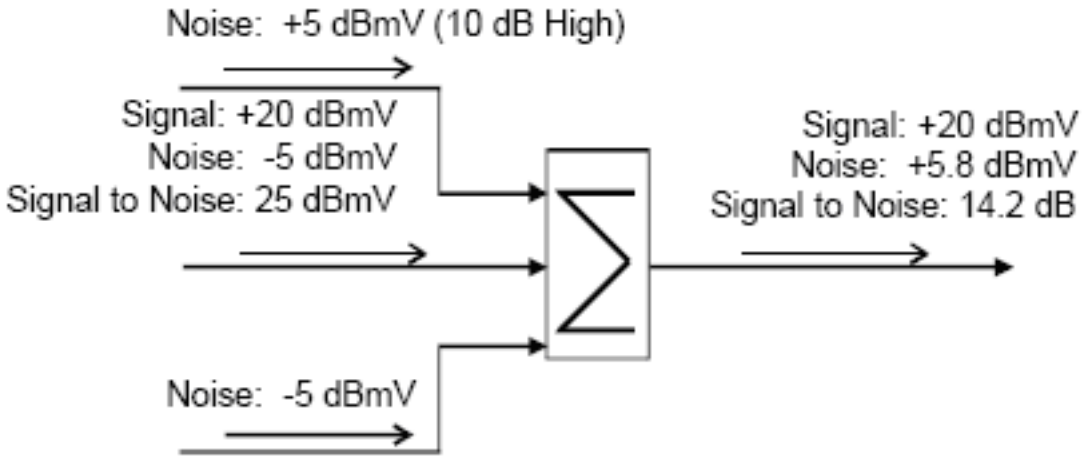
When using QPSK, the sum of all ingressing signals lying within the data signal bandwidth (approximately 1 MHz for the data signal as discussed in *SIGNAL TO NOISE RATIO* above) should be at least 20 dB below the level of the data signal. As the sum of ingressing signals exceeds this level, the BER performance of the return path system is degraded. If ingress levels approach – 10 dBc, communication may be seriously degraded.

A Balanced System

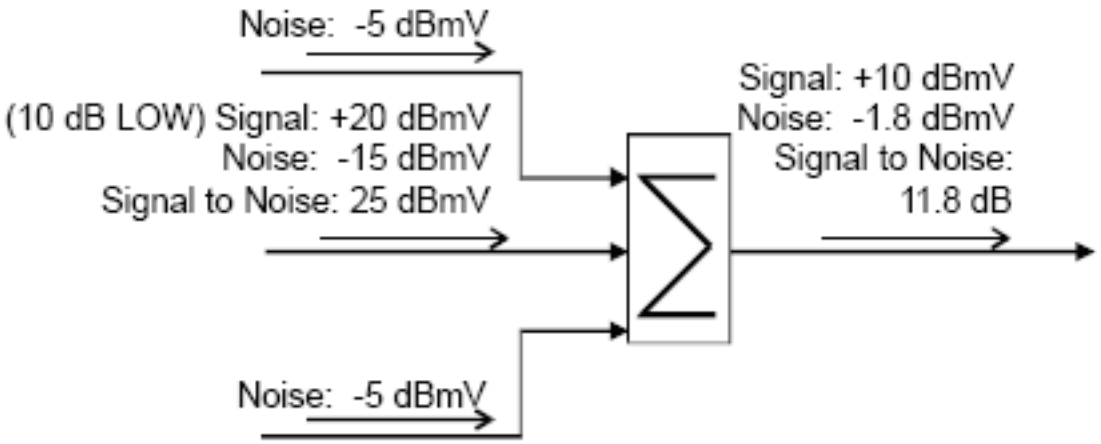
When the system is balanced, a signal on one branch is degraded equally by noise on *all* branches to the same node.



If the gain of one path is set *higher* than the other paths, 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.



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Chapter 4
Installation

Overview

Before the 9581 SST R5 can be installed, the carrier frequencies, device security, and IP connectivity must be set up. The information in this chapter will assist in making pre-installation determinations and provide instruction in installing the 9581 SST R5 Return Path Analyzer. For additional information regarding the operation of the referenced 860 DSP or 860 DSPi Field Analyzer, refer to the 860 DSP and 860 DSPi Operation Manual.

Pre-Installation Considerations

Several decisions must be made concerning the location of the 9581 SST R5 as well as the placement and levels of the reverse test carrier and forward data carrier before installing the 9581 SST R5 Return Path Analyzer.

The 9581 SST R5 is designed to be rack-mounted so that it will provide 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.

Do not use the 9581 SST R5 in any manner not recommended by the manufacturer.

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

Reverse Test Carriers

As many as eight reverse test carrier frequencies may be selected. Before selecting the reverse test carriers, the following should be considered:

- Return band edges - Typically the highest and lowest frequency test carriers will be near the return band edges (i.e. at 6 MHz and at 85 MHz).
- Problem frequencies - A test carrier may 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, it is suggested that test carriers be placed around 5 and 10 MHz to average the compensation for low-end roll-off.

- Selected frequencies - Occupied frequency bands such as those carrying data or video must be avoided. If multiple 860 DSP or 860 DSPi field analyzers are in use, the following clear bandwidth *ABOVE* the frequency of each test signal must be provided.

  Clear frequency BW = (number of field analyzers - 1) x 100 kHz

- The desired return signal output level is determined by the headend design. This desired return output level *MUST* be established to set up the 9581 SST R5 Return Path Analyzer successfully. Consult the design documentation for the 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 INPUT port(s) of the 9581 SST R5 must be equal to, or greater than, -10 dBmV for accurate measurements over the full dynamic range of the 9581 SST R5. Include coupling losses and any inline pads in your calculation.

  Levels before adjustment will differ due to the varying length of fiber to the node. One of the objectives for using the 9581 SST R5 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.


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 9581 SST R5 expects to see the same return level at each return test point.

Forward Data Carrier

The characteristics of the forward data carrier must be defined. Select a forward data carrier frequency.

- The selected frequency must be clear of other "traffic" for 400 kHz above and below the data carrier.

Installing the 9581 SST R5

The following section explains the procedure used to physically install the 9581 SST R5. In order to properly setup the 9581 SST R5 the following steps must be completed in this order. Do not skip any steps.

NOTE

DO NOT plug in the 9581 SST R5's power cord until instructed below.

1. Mount the 9581 SST R5 in a standard rack using four retaining screws.

CAUTION

Make sure the fan intake holes on the left of the 9581 SST R5 and the fan exhaust holes on the right of the 9581 SST R5 remain unblocked.

2. Plug the 9581 SST R5's power cord into the **100-240 VAC** Power Connection and then into an AC power source. When power is supplied to 9581 SST R5, the screen on the front of the 9581 SST R5 is illuminated.

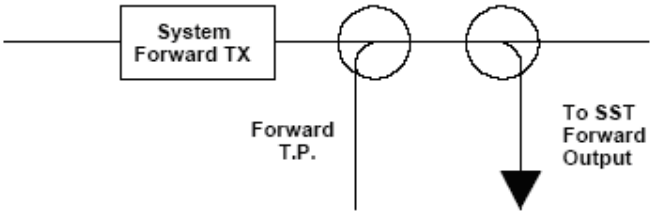
NOTE

If the display screen is not illuminated upon connecting power to the 9581 SST R5, call Trilithic Application Support at 1-800-344-2412 for assistance.

3. Now that the system levels and frequencies have been determined, the 9581 SST headend analyzer can now be installed in the headend. Refer to **Chapter 2: Introduction**, A Guided Tour of Your 9581 SST R5, *Back View* for more information on the connections located on the rear panel of the 9581 SST R5.

Forward Connections

For forward connections, a forward signal injection point must be provided. If necessary, install a 6 dB to 20 dB coupler before the forward test point. Ensure that the coupler is installed in the proper orientiation.

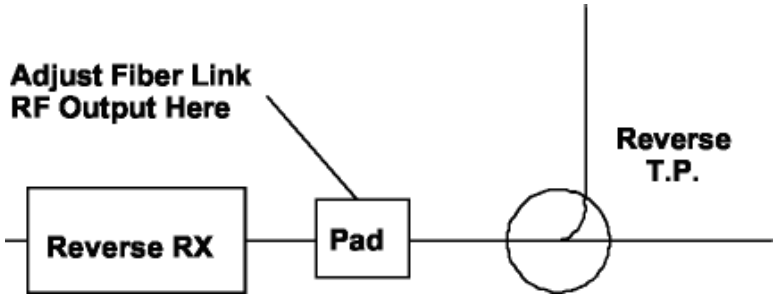


NOTE

The injection point must be before the headend's forward output test point.

Reverse Connections

For reverse connections, test point couplers must be installed (in the range of 6 to 20 dB) at the outputs of the reverse path's fiber receiver outputs.



NOTE

Take note of the coupler loss value, this data will be entered in the 9581 SST R5 during the setup procedure.

Display Screen Overview

The front panel display screen on the 9581 SST R5 provides a view of the setup information of the analyzer.

When the 9581 SST R5 is powered on, the splash screen shown to the right will appear momentarily.

Instrument Information

Instrument Time, Date, & Internal Temperature

From any menu, press the Test button to display the current time, date, & internal temperature of the instrument.

The time and date of the unit are set at the factory and are not adjustable at this time. The time is set to Greenwich Mean Time (GMT).

In this example the internal temperature is designated as “XX”, the date is designated as “MM/DD/YYYY”, and the time is displayed in a 24 hour format as “HHMM”.

To exit this screen and return to the previous menu, press the **Select** button.

Firmware & Software Version Numbers

From any menu, press the ? button to display the current firmware & software version numbers and Trilithic contact information.

To exit this screen and return to the the previous menu, press the **Select** button.

Setup Menu Navigation

After the splash screen disappears, the SETUP MENU will appear as shown to the right.

Use the ↑ or ↓ buttons to highlight the desired setup parameter and then press the **Select** button to view/edit the selected parameter.

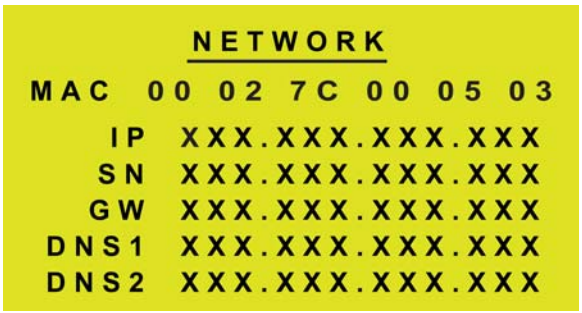
NOTE

The Speaker and Contrast settings can be adjusted from the Setup Menu, all other settings are for reference only and can be adjusted using the included SST Configure Software.

Viewing the Network Settings

To view the Network settings, perform the following steps:

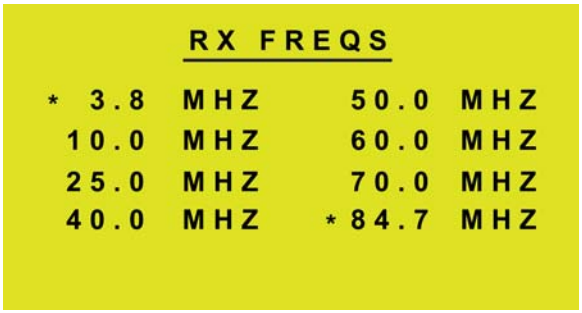
1. From the SETUP MENU, highlight **NETWORK** and then press the **Select** button to display the NETWORK menu.
2. The MAC address and current network settings will be displayed.
3. Use the **Select** button to return to the SETUP MENU.



Viewing the RX Frequency Settings

To view the RX Frequency settings, perform the following steps:

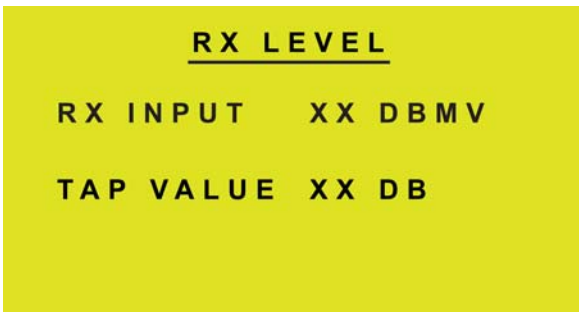
1. From the SETUP MENU, highlight **RX FREQ** and then press the **Select** button to display the RX FREQ menu.
2. The available RX Frequencies will be displayed. The active RX Frequencies are indicated by an asterisk (*) to the left of the frequency.
3. Use the **Select** button to return to the SETUP MENU.



Viewing the RX Level Settings

To view the RX Level settings, perform the following steps:

1. From the SETUP MENU, highlight **RX LEVEL** and then press the **Select** button to display the RX LEVEL menu.
2. The current RX Input Level and Tap Value will be displayed.
3. Use the **Select** button to return to the SETUP MENU.



Viewing the Link Frequency Settings

To view the Link Frequency settings, perform the following steps:

1. From the SETUP MENU, highlight **LINK FREQ** and then press the **Select** button to display the LINK FREQUENCY menu.
2. The current Link Frequency and TX Attenuator Level will be displayed.
3. Use the **Select** button to return to the SETUP MENU.

Viewing the Remote Detection Type Settings

To view the Remote Detection Type settings, perform the following steps:

1. From the SETUP MENU, highlight **REMOTE DET** and then press the **Select** button to display the REMOTE DET menu.
2. The current remote detection type will be displayed.
3. Use the **Select** button to return to the SETUP MENU.

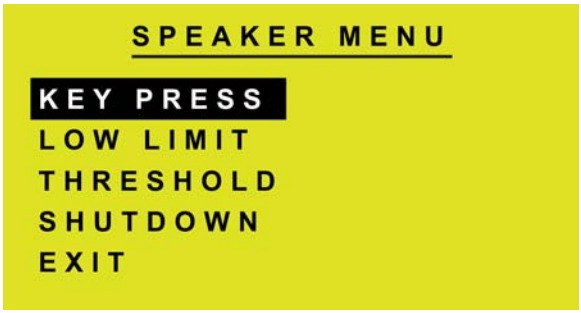
Adjusting the Speaker Settings

To edit the Speaker settings, perform the following steps:

1. From the SETUP MENU, highlight **SPEAKER** and then press the **Select** button to display the SPEAKER MENU menu.

2. Use the ↑ or ↓ buttons to highlight the desired speaker setting and then press the **Select** button to edit the selected parameter.

3. Use the ↑ or ↓ buttons to highlight ON or OFF and then press the **Select** button to accept the changes.



4. Once you have adjusted the desired speaker settings, Use the ↑ or ↓ buttons to highlight EXIT and then press the **Select** button to return to the SETUP MENU.

KEY PRESS

LOW ALARM

THRESHOLD ALARM

SHUTDOWN

Adjusting the Display Screen Contrast Settings

To edit the Display Screen Contrast settings, perform the following steps:

1. From the SETUP MENU, highlight **CNTRST ADJ** and then press the **Select** button to display the CONTRAST ADJUST menu.
2. Use the ↑ button to make the screen darker and the ↓ button to make the screen lighter.
3. Use the **Select** button to return to the SETUP MENU.

NOTE

After pressing the Setup button, if the display screen is not visible because the screen contrast is at the default setting, press the Select button then the Up or Down arrow buttons as appropriate until the screen is visible.

Chapter 5
Operation

Overview

The first step in developing a successful alignment and maintenance strategy for the return path depends on understanding what constitutes a properly operating system. Refer to ***Chapter 4: Optimizing the Return Path*** and ***Chapter 5: Setting up the 9581 SST*** for instruction in collecitng the following system parameters:

- 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

Setting up the 9581 SST R5

Now that the 9581 SST R5 Return Path Analyzer is powered on, the following parameters must be entered into the non-volatile memory:

- Return Sweep Frequencies
- Desired Return Level at the Headend
- Test Point Coupling Value
- Data Link Frequencies and Attenuator Value
- Data Link Levels
- Security Information
- IP Connectivity Information

To configure the 9581 SST R5, you must use the included SST Configure software. The only method for changing device settings on the 9581 SST is via remote administration, using the SST Configure program.

Initial configuration of the 9581 SST R5 must be completed using a serial connection between the 9581 SST R5 and the host computer on which the SST Configure software is installed.

For more information about the initial setup proceedure of the 9581 SST R5 using the SST Configure software, see the SST Configure Operation Manual.

Now that the 9581 SST R5 Return Path Analyzer has been installed and set up as instructed in the SST Configure software Operation Manual and the 860 DSP or DSPi Field Analyzers are set up, the 9581 SST R5 is ready to be deployed.

Remote Operation

The 9581 SST R5 Return Path Analyzer can be accessed and controlled via a PC and the Viewer II program. When used in the Remote mode, the 9581 SST R5 becomes a status monitoring tool when used with the Viewer II program. The 9581 SST R5 will continue to operate normally when it is under the control of a remote operating program.

Return Path Alignment

The alignment procedure for the reverse path should be initiated at the headend. The 9581 SST R5 Return Path Analyzer will be used to monitor the ingress for each return path that will be aligned.

For the 9581 SST R5 to achieve sweep accuracies greater than ±1 dB (and for the return data system to function properly), ingress must be at least 20 dB below the expected return levels. If the SST 9581 R5 is properly configured, the ingress level will be 30 dB below full-scale on the ingress display. Carefully inspect the spectrum around each test carrier frequency; if ingress is excessive, perform one of the following procedures to reduce the ingress:

- If several return paths have been combined, try disconnecting some return paths to reduce total ingress
- If the 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 9581 SST R5 and 860 DSP or 860 DSPi
- Locate and repair major ingress problems. The 9581 SST R5 can be used to troubleshoot ingress from in the field

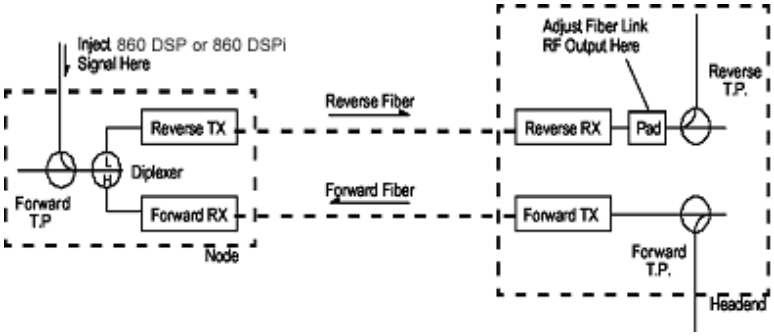
If ingress exceeds -20 dB relative to the desired return level, the 860 DSP or 860 DSPi sweep display will display an “X” rather than the usual frequency marker (bar). The “X” display is an indication that there is an ingress problem, which must be located and repaired.

Adjusting the Fiber Link

Adjustment of the fiber link will require two technicians since the fiber receiver output must be adjusted with the 860 DSP or 860 DSPi connected to the node as shown in the following figure.

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.



To adjust the fiber path properly, consult the manufacturer's datasheets to determine how to set gain in the fiber receiver. It is suggested that the optical power at the receiver input be measured to ensure that it meets the recommended levels prior to starting alignment. Inject the 9581 SST R5 test signals at the system design level into the node test point.

If the fiber receiver uses pads to set the gain, use the Gain/Tilt display on the 860 DSP or 860 DSPi Field Analyzer to determine the correct pad to use in the fiber receiver. The 860 DSP or 860 DSPi will show a maximum gain error of ±9.9 dB. If the initial gain is off by more than ±9.9 dB, it may be necessary to zero in on the correct pad by changing the pad value until the reading falls within the scale. A pad can then be selected accordingly in order 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 the fiber receiver has a screwdriver 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.

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.

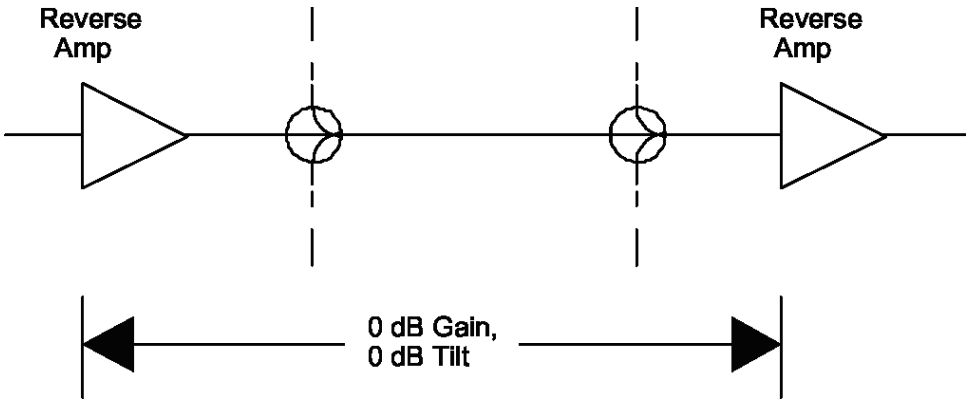
If a sweep response cannot be displayed on the scale's range, attempt the following procedures:

- Ensure that the injection test point is pointing the correct direction (toward the headend)
- Ensure that the fiber transmitter and receiver are functioning properly and that the proper light level is reaching the headend
- Increase or decrease the 860 DSP or 860 DSPi field analyzer's TX level in 5 dB increments until the sweep response is displayed on the screen

Note the difference that is necessary for the output setting and adjust the gain accordingly. The 860 DSP or 860 DSPi can now be returned to the proper output level and the gain setting can be fine-tuned.

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 as shown in the following figure.



With the node adjusted properly, proceed to the first amplifier from the node. Set the TX level of the 860 DSP or 860 DSPi to the proper injection level for the amplifier. Connect it to the amplifier's input test point(s).

NOTE

When setting the injection level, allow for test point or coupling losses.

For amplifiers with fixed pads and equalizers, use the Gain/Tilt display. The 9581 SST R5 will display a maximum gain error of ±9.9 dB. If the initial gain is off by more than ±9.9 dB, it may be necessary to zero in on the correct pad by changing the pad value until the reading falls within the scale. The equalizer can then be installed to compensate for tilt. Once the tilt is corrected, fine tune the pad value to give an overall gain of 0.0 dB. Now the Sweep display can be used to observe the sweep response.

If the amplifier has screwdriver gain and tilt adjustments, use the Sweep display and adjust the amplifier's gain so that the sweep response falls within the display. Adjust the amplifier's tilt for a flat response, then fine-tune the gain adjustment to position the sweep response on the center graticule of the display. Switch to the Gain/Tilt display to confirm the settings numerically.

If a sweep response cannot be displayed on the scale's range, attempt the following procedures:

- Ensure that the 860 DSP or 860 DSPi is receiving the data carrier as evidenced by the cursor pointing to Car Det (carrier detect) on the display of the 860 DSP or 860 DSPi
- Ensure that the injection test point is pointing the correct direction (toward the headend)
- Increase or decrease the TX level of the 860 DSP or 860 DSPi in 5 dB increments until the sweep response is displayed on the screen

Note the difference that is necessary for the output setting and adjust the gain accordingly. The 860 DSP or 860 DSPi can now be returned to the proper output level and the gain setting can be fine-tuned.

Proceed to the next amplifier and repeat the process until all of the amplifiers have been aligned. Ensure that the TX level of each 860 DSP or 860 DSPi has been adjusted, if necessary, when 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 9581 SST R5 was designed to provide a simple solution for reverse monitoring.

When using the 9581 SST R5 to monitor ingress, there are configuration trade-offs that must be considered. The most important of these concerns are the number of return paths connected to a single input on the 9581 SST R5. Combining multiple returns may economize on hardware but it complicate localizing the source of system ingress.

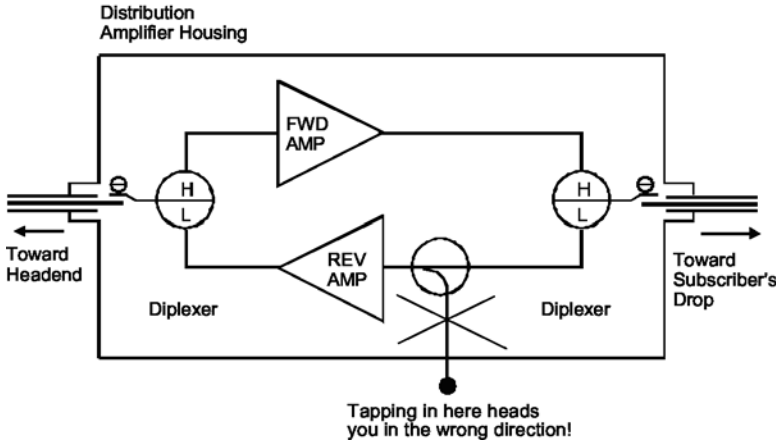
If ingress control is a necessity for system maintenance, as it is in the case of telephony or commercial data transfer, consider using more than one 9581 SST R5 so that each return can be monitored separately.

Ingress monitoring can be automated by using the Ingress ManageR and Viewer II (the 9581 SST's remote monitoring software), with a PC. When ingress problems do occur, the software allows the following operations:

- The return path which is experiencing ingress can be determined and isolated. Disconnect the combined return paths one at a time until the path affected by ingress is isolated.
- Read and record ingress levels at several frequencies.
- Go to the node (first amplifier in an all-coaxial system) and read the ingress at the node's return input using an SLM.

CAUTION

Ensure that a downstream-looking test point is selected; not one that is looking toward the headend.



Compare the ingress measured at the node to the levels measured 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 the amplifier farthest from the node that still has the ingress problem is located.

Once the ingress has been localized, the hardware and the drops of the target amplifier can be troubleshot. When the ingress source has been pinpointed, connect the 860 DSP or 860 DSPi field analzyer to the system and verify that the ingress problem has been remedied 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 in which the radio is installed is nearby the ingress point within the cable plant. Transient events will be on the order of 1 or 2 seconds.

Other events in the subscriber's house, such as electrical transients from alternating-current motors in electrical appliances, can be much shorter in duration. The 9581 SST R5 is sensitive enough to capture these short-duration transient events by combining Fast mode and Peak Hold mode. In Fast mode, the 9581 SST R5 analyzes each node at rates up to 120 Hz. This allows the capture of transients in the millisecond range. In Peak Hold mode, these transients remain displayed on the screen until the system has been reset.

The 9581 SST R5 does not support Sweep mode while operating in Fast mode. All sweeping and gain balancing functions will be halted until the 9581 SST R5 returns to Norm mode.

An effective strategy for balancing a node is to use the 9581 SST R5 in Normal mode. After obtaining a balance, allow the 9581 SST R5 to analyze the node in Fast mode for approximately 24 hours to verify that transient ingress is not a problem.

Extending the Measurement Range

When the 9581 SST R5 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.

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 measurement dynamic range of the 9581 SST R5. You can reassign the offset via a simple variation of the normal 9581 SST R5 set up procedure. You will also need to adjust the offset of the 860 DSP or 860 DSPi.

Reconfigure the 9581 SST R5 for Greater Range

The 9581 SST R5 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 ampli-tude is injected into a return amplifier in the field.

Increase Sensitivity and Range

The 9581 SST R5 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.

Effect of the Offset on the 860 DSP and 860 DSPi

The reference settings for the SWEEP and SPECTRUM Modes of the 9581 SST R5 are linked. This means that offsetting the reference level of the SPECTRUM Mode will also offset the reference for the SWEEP Mode by the same amount. To keep the 860 DSP or 860 DSPi “normal” sweep output from being too large, you simply need to reduce the sweep output level of the 860 DSP or 860 DSPi by the same offset amount.


NOTE

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

Chapter 6
Appendix

Specifications

Frequency Range	4.125 to 85.5 MHz
Input Level Range	+25 to -10 dBmV for full 50 dB dynamic range in Spectrum Mode
Return Inputs	16 standard
Field Units Supported	Up to six (6) simultaneously
Sweep Mode	5 to 85 MHz with 0.25 dB resolution
Sweep Mode Resolution Bandwidth	25 kHz effective
Input Level Accuracy	±0.35 dB
Resolution Bandwidth	375 kHz
Sweep Rate	40 Hz per node in NORM, 120 Hz per node in FAST
Data Carrier TX Frequency	50 MHz to 1 GHz
Data Carrier TX Level	45 dBmV ± 6 dB in 0.5 dB steps
Data Carrier Spurious	-60 dBc
Modulation	FSK with 75 kbps data rate
Data Carrier Bandwidth	700 kHz at -60 dBc
Remote Access	Via Ethernet for all displays
Display	64 x 128 pixel graphic LCD with backlight
Power Cord	3-Conductor rated at 1 A with IEC320 connector
Power Requirements	100 to 240 AC, 50 to 60 Hz, 1 A
Protective Conductor Terminal Label	16 standard
Operating Temperature	10 to 50 °C
Dimensions	3.5” x 17” x 12.3”
Weight	10 lbs (4 kg)

Warranty Information

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) year 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 repairing 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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