



# **9581 RSA Return SpeedSweep Analyzer**



## **OPERATION MANUAL**



**TRILITHIC**  
INNOVATIVE ENGINEERING

## 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 three major divisions:

- **Broadband Instruments & Systems**  
Offers test, analysis and quality management solutions for the major cable television systems worldwide.
- **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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# 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 8:00AM to 5:00PM EST. Callers in North America can dial 1-317-895-3600 or 1-800-344-2412 (toll free). International callers should dial 1-317-895-3600 or fax questions to 1-317-895-3613. You can also e-mail technical support at [techsupport@trilithic.com](mailto: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)
- The 9581 RSA serial number and firmware version number
- The SST Configure Software version 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” introduces what the 9581 RSA is and what it does. This chapter discusses the practical application of the 9581 RSA. Finally, this chapter will also explain the connections and LED indicators of the 9581 RSA.
- Chapter 3, “Hardware Installation” describes the steps needed to install the 9581 RSA.
- Chapter 4, “Initial Setup” describes the steps needed to perform the initial configuration of the 9581 RSA.
- Chapter 5, “Specifications” shows the technical specifications of the 9581 RSA.

## 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 email addresses appear in *italics*.



**Note:** A note is information that will be of assistance to you related to the current step or procedure.



**CAUTION:** A caution alerts you to any condition that could cause a mechanical failure or potential loss of data.



**WARNING:** A warning alerts you to any condition that could cause personal injury.

## Precautions



**WARNING:** Do not use the 9581 RSA in any manner not recommended by the manufacturer.

## What is the 9581 RSA?

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. The 9581 RSA Reverse SpeedSweep Analyzer is part of Trilithic's SpeedSweep System, and by purchasing this instrument, you have taken an excellent step toward alleviating the problems of your return path.

Trilithic's 9581 RSA is a compact return alignment system; occupying only 3.5" of rack space that provides a low entry cost solution for field unit support and enables you to deal with all aspects of return path upkeep; including both ingress control and system balancing.

At the core of the 9581 RSA is a 0.3 MHz to 65 MHz digitizing spectrum analyzer. The spectrum analyzer for the 9581 RSA handles 42 MHz in a single band and 65 MHz in two bands. The 9581 RSA measures signals arriving at the headend, including reverse signal "traffic", noise, ingress and test carriers from compatible field units.

A single 9581 RSA can monitor sweep and ingress signals of sixteen separate headend test points simultaneously which enables you to analyze the condition of each. The 9581 RSA analyzes test signals and the return spectra separately. The 9581 RSA packages the measurement results into a data stream, and then it transmits the appropriate ingress spectrum and sweep data to each field unit to which it is connected; which allows for the observation of the current ingress on the field unit.

The 9581 RSA is designed with two forward telemetry transmitters; the test frequency, link frequency, and gain/tilt frequencies are treated independently for each transmitter.

A single 9581 RSA can support the test carriers of up to twelve individually addressed field units at a time with no loss of operating speed. The 860 DSPi and the SSR are both addressed individually (A - F) which allows for six of these field units to be in operation on each forward telemetry transmitter at any one time. Each of these field units transmit up to eight test carriers at user-settable frequencies. The 9581 RSA measures these test carriers to compute the gain and tilt of the return path. The 860 DSPi and SSR 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 RSA sorts out the test carrier measurements for each field unit and tags the data with the individual addresses (A - F) so that each field piece displays the appropriate information. When the field unit receives its data, it displays the response of the return path as either a line graph or as a numeric values for gain and tilt. Ingress and noise data are presented as a spectrum analyzer display.

## Application of the 9581 RSA Reverse SpeedSweep System

The basic 9581 RSA Reverse SpeedSweep Analyzer System can be used to balance the return path and measure the return path's ingress and noise. The system may consist of the following types of equipment:

- RSA Headend Unit
- 860 DSP or 860 DSPi Multifunction Cable Analyzer (with SSR or RSVP option installed)
- SSR Field Unit
- RSVP<sup>2</sup> Installer Return Test Field Unit

### Balancing the Return Path

In the basic test architecture, test signals are injected upstream by the field unit. The 9581 RSA measures these signals automatically at the headend. Then, the measurement data is transmitted back to the field unit 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 field units 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 RSA measures the incoming ingress and noise. It then transmits this measurement data to the field units. The field units then display the ingress data as a spectrum pattern.

When you are analyzing the return path, you need to determine if the return frequencies carrying "traffic" have an adequate signal to 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 RSA and IP equals the ingress power.

- Compute the effective noise in a 4 MHz video bandwidth, take the reading from the 9581 RSA and add 10.3 dB.

$$IP = MP + 10.3 \text{ dB}$$

- Compute the effective noise for data bandwidth, take the reading from the 9581 RSA and add 10 times the log (data BW divided by 0.375 MHz).

$$IP = MP + 10 \times \log(\text{data BW} / 0.375 \text{ MHz})$$

- 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  $1 \times 10^{-6}$ .



**CAUTION:** When the 9581 RSA 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 RSA’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 RSA’s measurement dynamic range.

# Overview of the 9581 RSA

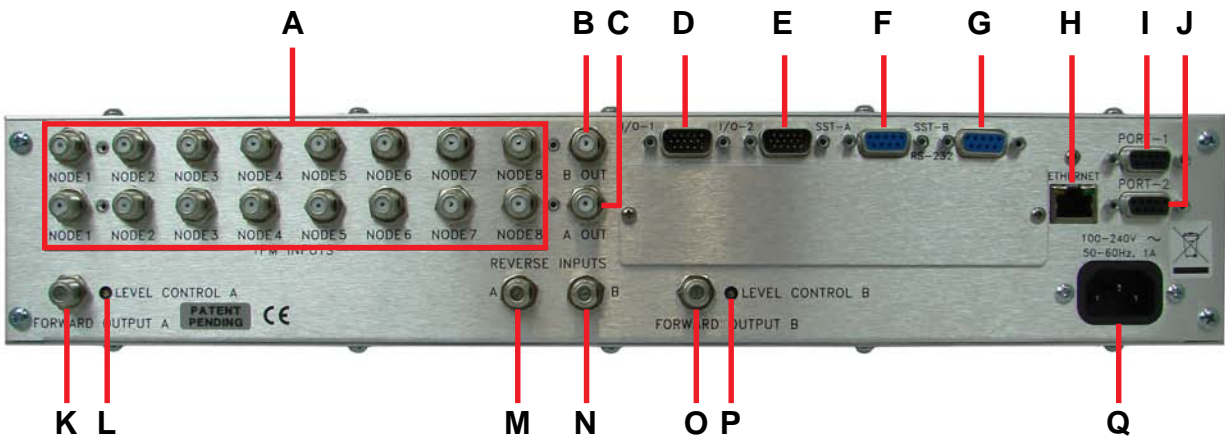
## Front Panel View



### A. Power Indicator LED (Red)

After power is applied to the 9581 RSA, this LED should light and stay lit after a short delay. This LED will blink if there is a problem with the unit, contact Trilithic Support if this LED continues to blink.

## Rear Panel View



A. **TPM INPUTS** - Up to sixteen test points can be connected to the 9581 RSA using these inputs. The top row of inputs correspond to **B OUT** and the bottom row of inputs correspond to **A OUT**. The 9581 RSA uses these inputs to measures test signals that are injected upstream into the return path of the cable system by field units.

B. **B OUT** - This output must be connected to **REVERSE INPUT B**.

C. **A OUT** - This output must be connected to **REVERSE INPUT A**.

- D. **I/O-1** - Not used, reserved for future use.
- E. **I/O-2** - Not used, reserved for future use.
- F. **SST-A** - Not used, reserved for future use.
- G. **SST-B** - Not used, reserved for future use.
- H. **ETHERNET** - Network communication connection (RJ-45).
- I. **PORT-1** - This is a straight through PC serial cable connection used for initial configuration of the 9581 RSA.
- J. **PORT-2** - This is a straight through PC serial cable connection used for initial configuration of the 9581 RSA.
- K. **FORWARD OUTPUT A** - Test signals that are received using the **TPM INPUTS** located to the left of the **A OUT** connection are automatically analyzed by the 9581 RSA. The **FORWARD OUTPUT A** connection is then used to inject this ingress and noise measurement data downstream into the forward path of the cable system for display on the field units that originated the corresponding test signals.
- L. **LEVEL CONTROL A** - This control is used to adjust the data link level between 0 and 10 dB below system video carrier levels when measured at **FORWARD OUTPUT A**.
- M. **REVERSE INPUT A** - This output must be connected to **A OUT**.
- N. **REVERSE INPUT B** - This output must be connected to **B OUT**.
- O. **FORWARD OUTPUT B** - Test signals that are received using the **TPM INPUTS** located to the left of the **B OUT** connection are automatically analyzed by the 9581 RSA. The **FORWARD OUTPUT B** connection is then used to inject this ingress and noise measurement data downstream into the forward path of the cable system for display on the field units that originated the corresponding test signals.
- P. **LEVEL CONTROL A** - This control is used to adjust the data link level between 0 and 10 dB below system video carrier levels when measured at **FORWARD OUTPUT A**.
- Q. **AC POWER INPUT** - This is a 100-240 Volt (50-60 Hz, 1 A) AC power input.

# Hardware Installation

## Overview

Before you can install your 9581 RSA, you need to make decisions regarding carrier frequencies and IP connectivity. The information in this chapter will assist you in making those pre-installation determinations and will show you how to install your 9581 RSA.

The 9581 RSA 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, for more information see [Chapter 5: Specifications](#).

## Important Things to Consider During Installation

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

### Installation Location

The 9581 RSA 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.

### Choosing Your Reverse Test Carrier Frequencies

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<sup>2</sup> Installer's Return Tester, you should set up one (or more) of the RSA test frequencies close to the active frequency(ies) which will be used by the subscriber's equipment. Since the RSVP<sup>2</sup> acts like a Unit F 860 DSPi or SSR, place the test carrier frequency which is to be used by the RSVP<sup>2</sup> at least 500 kHz below the band edge of the active return frequency.

- **Desired Return Signal Output Level** - 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 RSA 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.
- **Actual Return Signal Output Level** - The actual return signal level arriving at the 9581 RSA 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 in-line 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 9581 RSA 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 9581 RSA 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.

## Choosing Your Forward Data Carrier Frequency

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 to 53.75 MHz); in the Channel 4 to 5 gap (74 MHz band); or 80 to 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.

## Installing the 9581 RSA

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



**CAUTION: DO NOT** plug in the 9581 RSA's power cord until instructed to do so.



**CAUTION: DO NOT** connect **FORWARD OUTPUT A** or **FORWARD OUTPUT B** until instructed to do so in Chapter 4: Initial Setup.

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



**CAUTION:** Make sure the fan intake holes on the left of the 9581 RSA and the fan exhaust holes on the right of the 9581 RSA remain unblocked.



Fan Exhaust Holes

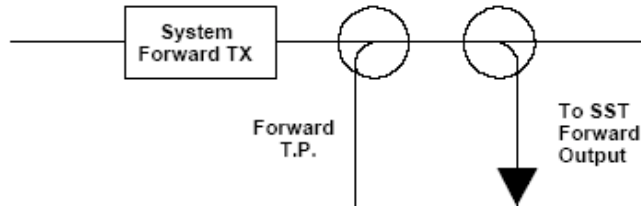


Fan Intake Holes

2. Connect the **ETHERNET** Connection of the 9581 RSA to an active Ethernet connection.
3. Connect a serial cable (9 pin to 9 pin straight through) from the **PORT-1** or **PORT-2** connection of the 9581 RSA to the serial port of a laptop or PC that is running the SST Configure Software. (This port will be used for initial configuration.)
4. Plug the 9581 RSA's power cord into the **AC POWER INPUT** and then into an AC power source. When power is supplied to 9581 RSA, the red LED on the front of the 9581 RSA should light and stay lit after a short period of time.
5. Connect the Forward and Reverse Connections as described in the following sections.

## 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.



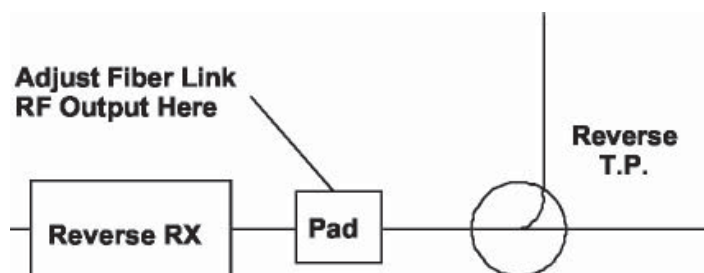
**Note:** The injection point must be **BEFORE** the Headend's forward output test point.



**CAUTION: DO NOT** connect **FORWARD OUTPUT A** or **FORWARD OUTPUT B** until instructed to do so in [Chapter 4: Initial Setup](#).

## 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.



**Note:** Record the coupler loss value. You will need to enter this number in the 9581 RSA during the set up procedure.

## Test Point Connections

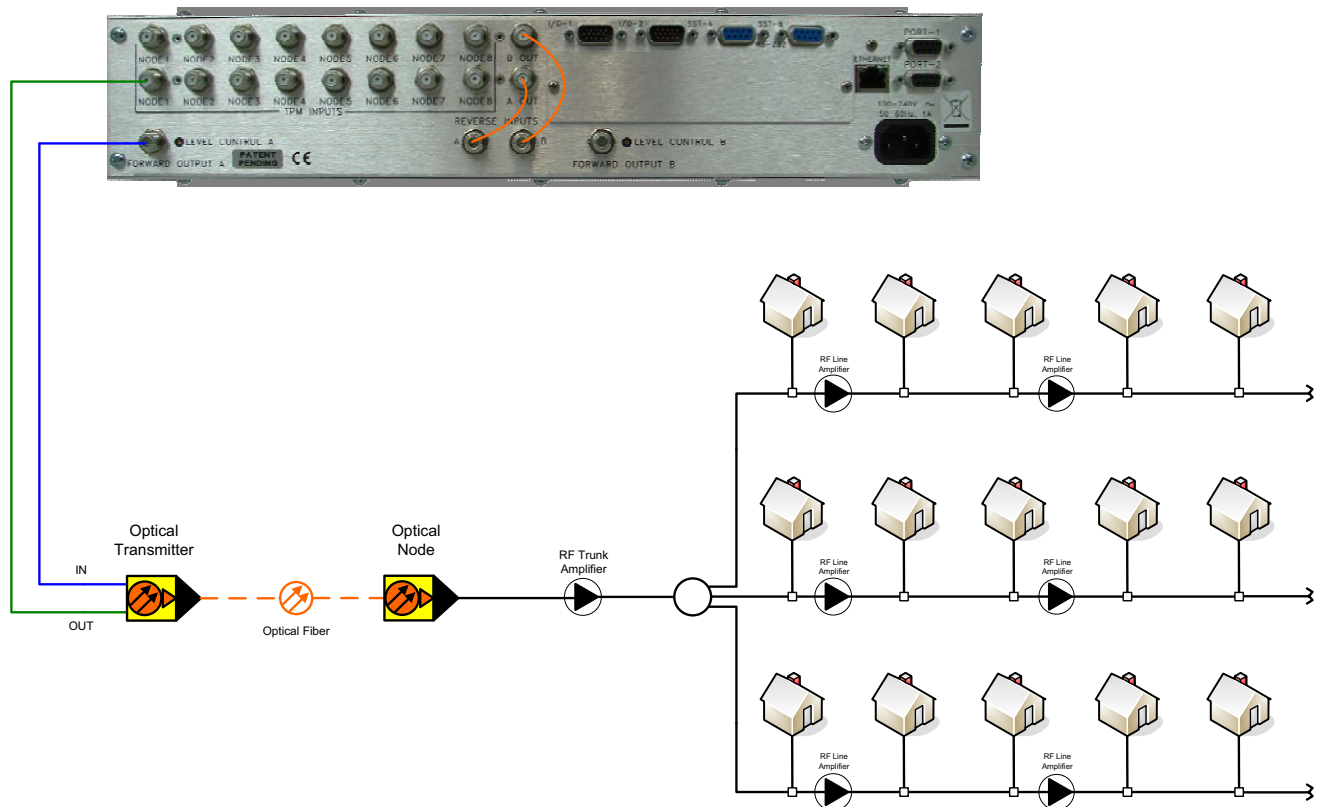
You can connect up to sixteen test points individually to the 9581 RSA sixteen input ports.



**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 9581 RSA's input port.

## Example Network Architecture Diagram



**Note:** The architecture diagram above is shown for reference only, your system installation and application may be different.

## Overview

Now that the 9581 RSA is connected and has power, you need to program the unit's 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 (adjusted manually on the rear panel)

## Using SST Configure to Configure Your 9581 RSA

To enter the data shown above, you will need to install and run the SST Configure Software included with your 9581 RSA. To perform this configuration your PC or laptop computer that is running the SST Configure Software must be connected to **PORT-1** or **PORT-2** on the rear panel of the 9581 RSA.

Once you have performed the initial configuration using **PORT-1** or **PORT-2** on the rear panel of the 9581 RSA, the 9581 RSA will be configured for remote administration as the primary method of changing device settings.


For more information on how to use the SST Configure Software to configure the 9581 RSA, see the [SST Configure Operation Manual](#).

## Link Level Adjustment

Use **LEVEL CONTROL A** and **LEVEL CONTROL B** on the rear panel of the 9581 RSA to set the data link level between 0 and 10 dB below the video carrier levels when measured at the **FORWARD OUTPUT A** and **FORWARD OUTPUT B** connections on the unit.

Connect the 9581 RSA to the forward path injection point and repeat the adjustment while monitoring the level at the headend output test point.

# Specifications

<b>Frequency:</b>	0.3 - 65 MHz
<b>Input Level Range (return test carriers):</b>	+25 to -10 dBmV for full 50 dB Dynamic Range
<b>Return Inputs:</b>	16
<b>Field Units Supported:</b>	12
<b>Sweep Mode:</b>	5 - 65 MHz with 0.25 dB Resolution
<b>Sweep Mode Resolution BW:</b>	25 kHz Effective
<b>Input Level Accuracy:</b>	±0.35 dB
<b>Spectrum Display:</b>	50 dB Dynamic Range with 1 dB Measurement Resolution
<b>Spectrum Dispersion:</b>	0.375 - 65
<b>Resolution BW:</b>	375 kHz
<b>Sweep Rate:</b>	40 Hz/Node
<b>Data Carrier TX Frequency:</b>	Standard: 50 - 53.75 MHz, 80 - 90 MHz, and 70.00 - 75.75 MHz
<b>Data Carrier TX Level:</b>	+23 to + 55 dBmV Continuously Adjustable
<b>Data Carrier Spurious:</b>	-60 dBc
<b>Modulation:</b>	FSK with 38.4 kbps Data Rate
<b>Data Carrier BW:</b>	150 kHz at -20 dBc, 475 kHz at -60 dBc
<b>Remote Access:</b>	Via Ethernet
<b>Power Cord:</b>	3-Conductor Rated at 1A with IEC320 Connector
<b>Power Requirement:</b>	100-240 V ~ (Alternating Current), 50-60 Hz, 1A
<b>Protective Conductor Terminal Label:</b>	
<b>Operating Temperature:</b>	10 - 50°C
<b>Dimensions:</b>	3.5 in. x 17 in. x 12.3 in.
<b>Weight:</b>	10 lbs (4.5 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) 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 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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