ERAVANT

FORMERLY SAGE MILLIMETER

VNA FREQUENCY EXTENDERS

COMPATIBILITY SUPPLEMENT: ROHDE & SCHWARZ ZNA SERIES

CONTENTS

1. INTRODUCTION

The STO series of frequency extenders for Vector Network Analyzers (VNAs) are compatible with many possible configurations of Rohde & Schwarz instruments. This setup guide is applicable to ZNA models that include a four-port test set. Instructions for two-port ZNA models may be obtained by contacting support@eravant.com.

Available frequency extender models cover full waveguide bands from 50 to 330 GHz. A pair of Transmit/Receive (TX/RX) extenders provides full two-port, two-path measurement capability (S11, S12, S21 and S22). A single TX/RX extender can only measure S11.

Each TX/RX frequency extender provides one waveguide test port (Fig. 1.1). A frequency multiplier in the extender converts the Radio Frequency (RF) stimulus signal provided by the VNA to a higher frequency. A directional coupler samples the incident signal applied to the Device Under Test (DUT). Another directional coupler samples the reflected signal. The sampled signals are fed to a pair of internal mixers that convert the Reference and Measured signals to the Intermediate Frequency (IF) of the VNA. A Local Oscillator (LO) signal from the VNA is also multiplied by the frequency extender and applied to the down-converting mixers.

An optional level-setting attenuator controls the test signal power level. An optional amplifier increases the maximum test signal power. Both options are recommended, as they provide maximum versatility for a wide range of measurement applications.

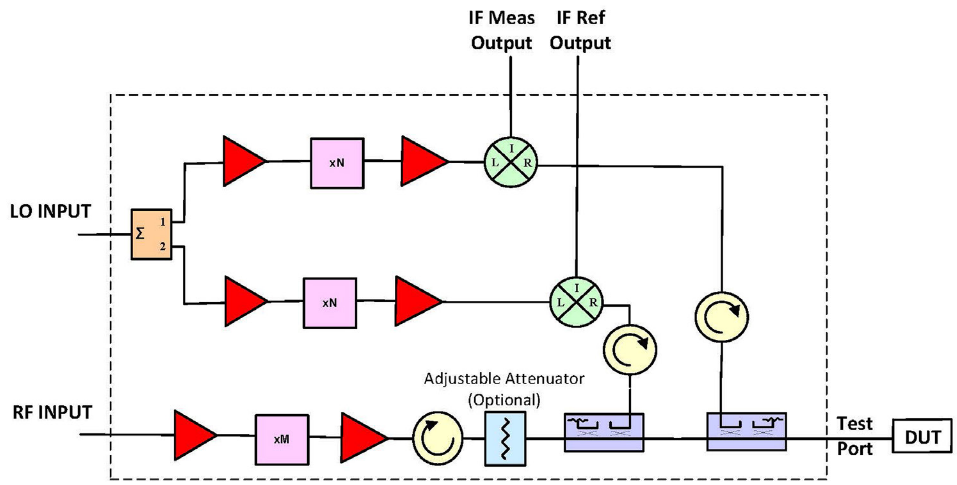

Fig. 1.1 – A single TX/RX frequency extender uses frequency multipliers to generate mm-wave test signals from lower frequency RF and LO signals provided by the VNA. Directional couplers sample the Reference and Measured signals. A pair of mixers down-convert the sampled signals to the IF of the VNA.

2. ZNA NETWORK ANALYZER COMPATIBILITY

Rohde & Schwarz ZNA series network analyzers must include two or more independent signal sources to operate one or more STO frequency extenders.

A properly configured two-port ZNA may be used with a pair of TX/RX STO frequency extenders. In such cases, the two-port ZNA must include hardware option ZNA-B8 (mmWave Converter LO) as well as ZNA-B26 (Direct IF Access). An RF power splitter is required to split the LO signal between two TX/RX frequency extenders. The IF signals generated by each frequency extender are applied to rear-panel connectors on the ZNA.

For a ZNA with either two or four ports, software option ZNA-K8 (Control of Frequency Converters) is required. If a four-port ZNA is used, hardware option ZNAxx-B16 (Direct Source and Receiver Access) provides front-panel connections to the Reference and Measured receiver channels for each port.

The following setup instructions are applicable to four-port ZNA models that have four independent signal sources, along with options ZNA-K8 and ZNAxx-B16.

Fig. 2.1 – The STO series of VNA frequency extenders work with certain configurations of Rohde & Schwarz ZNA series VNAs. Four test ports allow front-panel connections between the VNA and two TX/RX frequency extenders.

3. ELECTRICAL CONNECTIONS

A set of eight phase-stable coaxial cables are necessary to connect two TX/RX frequency extenders to a ZNA network analyzer (Fig. 3.1).

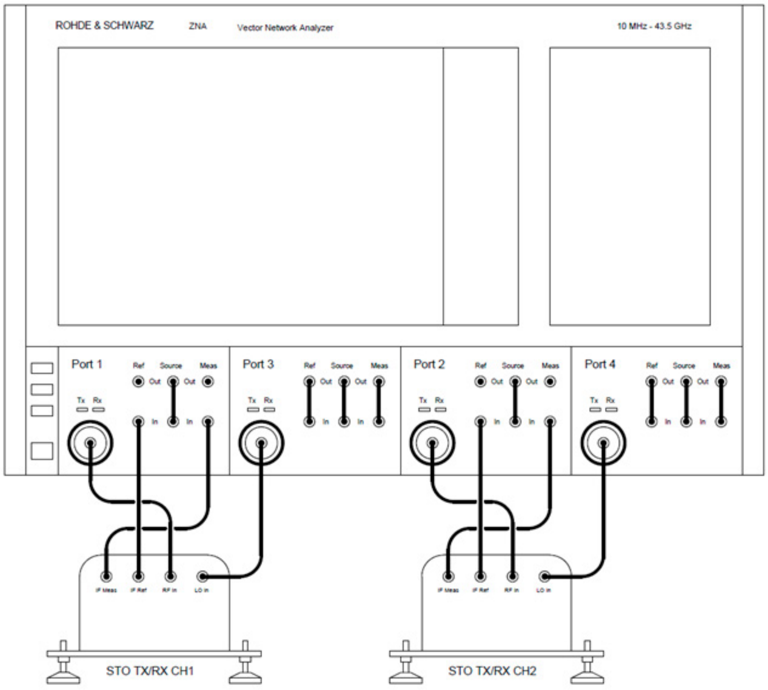

Fig. 3.1 – Each TX/RX frequency extender requires instrumentation-grade coaxial cables to carry the RF and LO signals to the extender, as well as the IF signals fed back to the VNA.

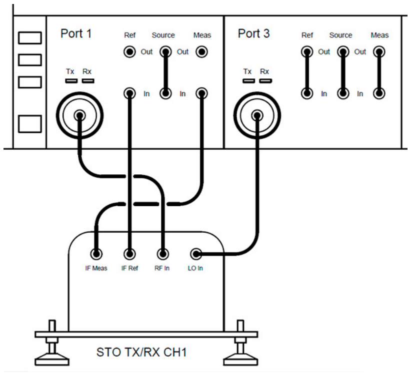

Fig. 3.2 – A single TX/RX frequency extender obtains an LO signal from Port 3 of the ZNA.

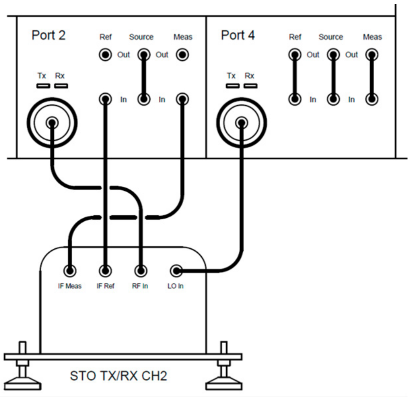

Fig. 3.3 – A second TX/RX extender obtains an LO signal from Port 4 of the ZNA. It is also possible to split the LO signal from Port 3 and apply it to both frequency extenders.

4. INSTRUMENT SETUP

The following instructions were developed using a Rohde & Schwarz Model ZNA network analyzer with four test ports. Different ZNA models or different firmware versions may have slightly different procedures or displays.

Rohde & Schwarz ZNA network analyzers are pre-loaded by the manufacturer with configurations for various types of frequency converters. To select an existing configuration, or to create a new Frequency Converter Type corresponding to an STO frequency extender, press the [Setup] key in the System key group. Select the "Frequency Converter" tab in the Setup key group, then select the "Frequency Converter ..." tab to open the Converter Configuration dialog (Fig. 4.1).

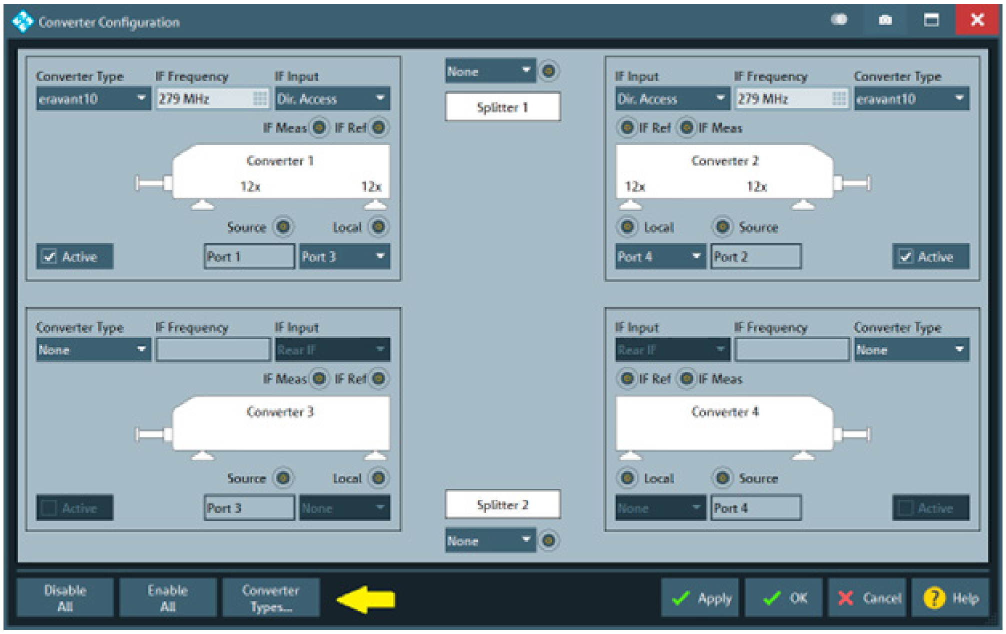

Fig. 4.1 – Select "Converter Types..." to edit an existing converter type or create a new one.

Press the "Converter Types.." button near the bottom edge of the Converter Configuration dialog to display a list of stored converters. Press the "Add" button to create a new Converter Type (Fig. 4.2).

Fig. 4.2 – The "Converter Types" dialog captures the operating parameters of frequency converters.

To add a new converter type, press the "Add" key. The dialog will present the user with default parameter values which may be edited. All pre-loaded configurations are read-only. Alternatively, an existing converter type may be copied by pressing the "Copy" key. Enter the new converter name in the "Type" data field. Follow the specifications provided with the STO frequency extender to enter the Start and Stop frequencies for the Converter Port, as well as the connector type (the standard waveguide size for the frequency extender).

Enter the multiplication factors and nominal power levels for the Source and Local Oscillator signals that are provided by the ZNA. In most cases the default value of 279 MHz for the IF signal is acceptable.

The parameter "Converter Max Power" defines the maximum tolerable input power at the RF Input port of the frequency converter. This value should be equal to or less than the maximum allowable RF power level for the STO frequency extender.

Return to the "Converter Configuration" dialog and select the new converter type for Converter 1. Port 1 on the ZNA is automatically assigned as the RF Source port. Select Port 3 as the Local Oscillator source. For the IF Input, select "Dir. Access" to specify the front-panel connectors.

If the same model STO frequency extender is used for Channel 2, select the same Converter Type for Converter 2 in the “Converter Configuration” dialog. Port 2 on the ZNA is automatically assigned as the RF Source port. Select Port 4 as the Local Oscillator source. For the IF Input, select “Dir. Access” to specify the front-panel connectors.

For the “Splitter 1” data field, select “None”. For Converter 3 and Converter 4, select “None” for the “Converter Type” data fields (Fig. 4.3).

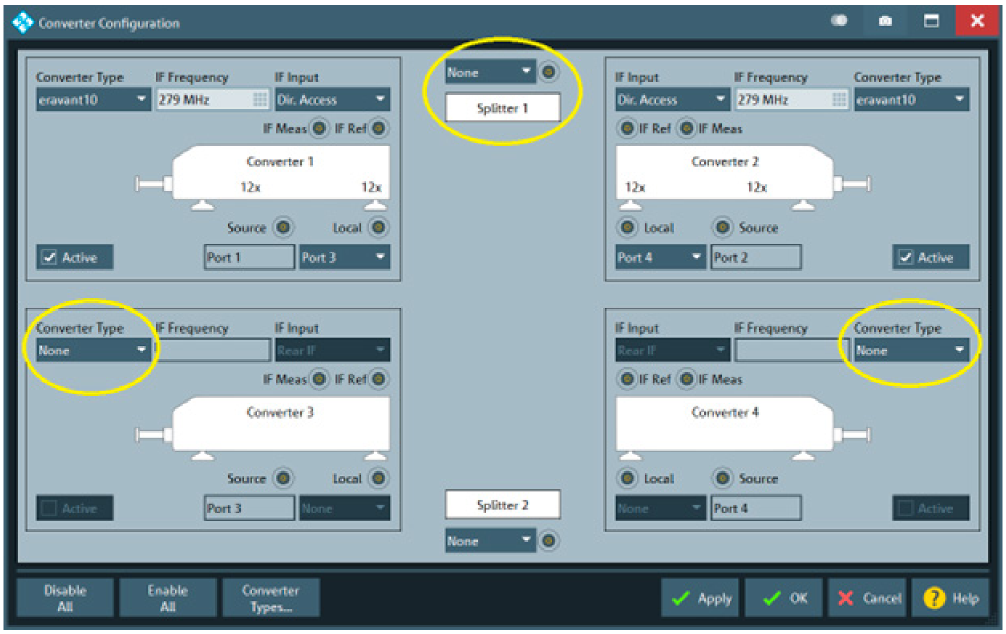

Fig. 4.3 – When two STO frequency extenders are connected to the front panel of a four-port ZNA, Converter 3 and Converter 4 are disabled by selecting “None” as the Converter Type. The “Splitter 1” data field should indicate “None”.

Additional Settings: Power Level Control

The STO series of frequency extenders are designed to operate with a narrow range of signal power levels applied to the RF and LO input ports. As a result, the leveling functions included with the ZNA for frequency converters should not be used.

To ensure that the ZNA leveling functions are disabled, press the [Setup] key in the System key group. Select the “Frequency Converter” tab in the Setup key group, then select the “Leveling Dataset ...” tab to open the “Leveling Datasets” dialog. Ensure that Power Control is turned off for all ports (Fig. 4.4).

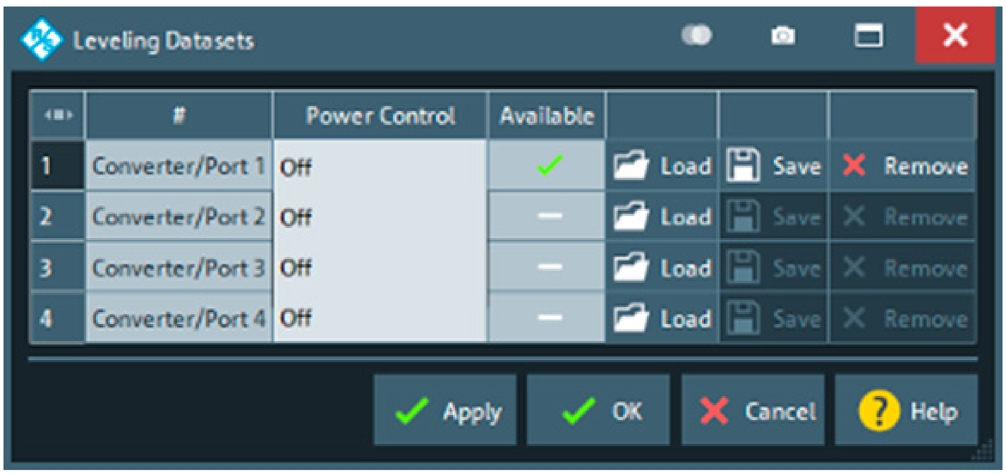

Fig. 4.4 – Level control should be disabled for all converters and ports.

5. SYSTEM TESTS

The following instructions are guidelines for testing individual TX/RX frequency extenders.

Short-Circuit Termination

Terminate the waveguide test port with a short-circuit flange. The Short termination reflects all of the test signal power back to the source and maximizes the Measured IF signal returned to the ZNA.

System Power

Apply power to the ZNA before powering the frequency extender. This ensures that the instrument has sufficient time to configure itself to operate correctly with the frequency extender attached. The user should verify that the instrument is correctly configured before applying power to the frequency extender.

Uncalibrated S11 or S22 Traces

Configure the ZNA to display S11 (or S22) over the entire waveguide band. Display the uncalibrated S11 magnitude trace at 10 dB per division. The displayed trace should be continuous and not vary by more than ±10 dB across the waveguide band. Unusual features in the uncalibrated S11 trace may indicate loose connections, damaged cables, or a configuration error.

Save the displayed trace to memory. Combine the saved trace with the currently displayed (active) S11 trace. Flex the coaxial cables and observe any differences between the active and saved traces. Amplitude variations should be less than ±0.1 dB. If greater changes are observed, the coaxial cables may be damaged or they may be of insufficient quality.

Remove the short-circuit waveguide termination and replace it with a matched load. The active S11 trace should drop by more than 10 dB across the entire frequency band.

Remove the saved S11 trace from the display.

One-Port Calibration

Perform a one-port calibration following the ZNA user instructions. A basic Open-Short-Match (OSM) or Short-Open-Load (SOL) calibration is sufficient. When calibrating a VNA with waveguide calibration standards, the "Open" standard is usually taken to be a quarter-wave offset shim combined with a short-circuit flush termination.

After completing the one-port calibration, connect a short-circuit flush termination to the frequency extender test port. The displayed magnitude of S11 should be approximately 0 dB, and the displayed phase should be approximately 180 degrees across the entire frequency band.

6. WORKING WITH TWO TX/RX FREQUENCY EXTENDERS

A pair of TX/RX frequency extenders provides full two-port measurement capability. After both TX/RX frequency extenders have been installed and tested, ZNA operation is essentially the same as when no frequency extenders are installed. Exceptions may include the range of calibration methods that can be used. Some measurement modes, such as gain compression or intermodulation, may not be possible or may require careful interpretation of the test results.

With most passive components, the frequency response does not depend on the test signal power level. For other devices, such as amplifiers, modulators, and some passive components, control of the test signal power may be essential. If return loss measurements are not required, the test signal power level may be reduced by placing an attenuator between the frequency extender and the DUT. However, this approach obscures the input match of the DUT and may not yield satisfactory test results.

Alternatively, the frequency extender connected to the input of the DUT may be equipped with a level-setting attenuator to control the test signal power level. This attenuator is positioned between the RF frequency multiplier and the directional couplers. The attenuator adjusts the test signal power level without affecting the ratio between the Reference and Measured signals, thus preserving the system's ability to measure the DUT's input return loss.

The level-setting attenuator includes a micrometer head that enables precise and repeatable adjustments. Its numerical reading does not directly indicate the attenuation level. The attenuator is typically adjusted or calibrated using a waveguide power detector, or by monitoring signal levels at various points in the test system.

7. TECHNICAL SUPPORT

Eravant's team of highly qualified engineers and technicians provides comprehensive and dedicated technical support to ensure all aspects of product performance and customer satisfaction. For any questions, comments or concerns, please contact Technical Support:

Phone: 424-757-0168
Email: support@eravant.com

Additional Compatibility Guides can be found by scanning the QR code.

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For more information on Eravant's products, applications, or services, please visit: www.eravant.com
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