Distributed Antenna System (DAS) Testing Procedure

This document describes how to test the DAS Operational Integrity with a Spectrum Analyzer to take the necessary DAS Signal Strength measurements.

Note: It is more efficient to perform the DAS Testing Procedure before performing the Donor Testing Procedure.

Within a distributed antenna system, a RF is received by the donor antenna (on the roof), sent to a BDA that amplifies the power of the RF and evenly distributes the signal throughout the building through the internal antennas. The power levels at each internal antenna is dependent on the power losses from the head-end (BDA) to the antenna. These losses can accumulate across the cable length, and through couplers and splitters, but are all accounted for by the RSI Project Manager.

The DAS testing method is to ensure that the DAS system has been properly implemented, by comparing the actual signal strengths with the RSI Project Managers' expected signal strengths. At each antenna node within the system, there is an expected value of signal strength that was calculated by all the assumed losses from the head-end to the antenna. If the actual value differs significantly, RSI can start to troubleshoot where within the system something may have gone wrong. Common mistakes that would cause inconsistency would consist of kinked cable, bad connectors, incorrect orientation of couplers, or even incorrect couplers or splitters used. The reason this test is so important for the BDA system is that to ensure effective signal coverage throughout the building, the DAS needs to be implemented as closely to the design as possible. If an error (or inconsistency between implementation and the design) is found, changes can be made to guarantee effective signal strength throughout the whole building.

Sub-Procedures

1. Setting the Radio Frequency

2. Setting up the Tracking Generator (TG)

3. Testing the Portable Radio

4. Measuring the DAS Signal Strength Off-Air
   Troubleshooting Section Included

Requirements

Radio Solutions, Inc. (RSI) Test Accessory Kit:

- Rigol DSA-815 Spectrum Analyzer with Tracking Generator (TG)
- End-Type Barrel Connector
- Tait Portable Radio
- 30dB attenuator
- 20dB attenuator
- Test Cable

Additional accessories provided are not required for these testing procedures

Note: **Bold, green text** indicates a selection on the Spectrum Analyzer

1. Setting the Radio Frequency

Using the Rigol DSA-815 Spectrum Analyzer (See Figure 1.1), set the frequency on which to test the DAS array by first selecting a testing channel

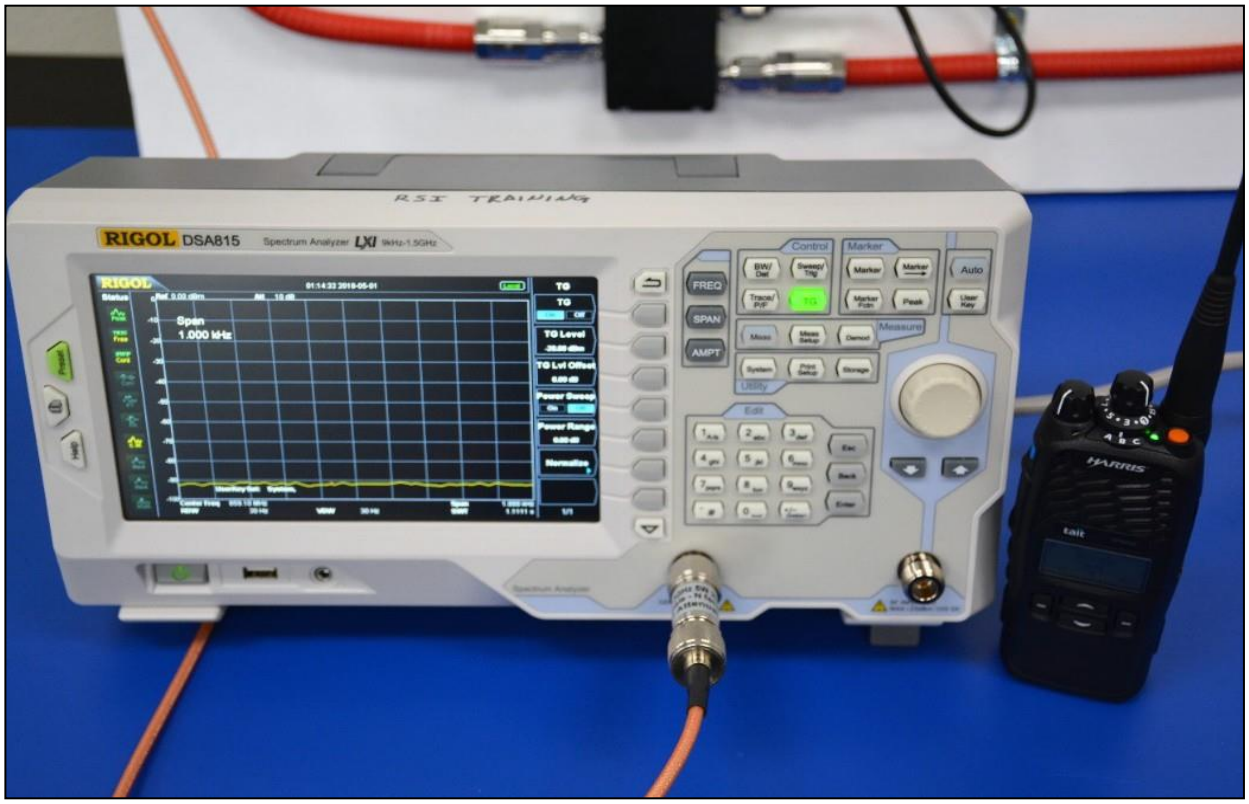
Note: During the Radio Solutions ESD Training Course, a list of testing channels was provided, regarding the Tait Programming Application (Refer to "Portable Radio Programming Procedure").

DO NOT use a local system's control channel as this will interfere with the testing procedure

Procedure:

1. Power up the Spectrum Analyzer, which will default to factory settings
2. For Calibration of the Spectrum Analyzer: **System** > Calibrate > CalNow
3. Set the Start Frequency: **FREQ** > **Center Freq** > **774.99375** > **MHz**
   (774.99375 is an itinerant frequency)
4. Set the Span Frequency: **Span > Span** > **1** > **kHz**

Figure 1.1



2. Setting up the Tracking Generator (TG)

Procedure:

1. Set the TG: **TG** > **TG Level**
2. Adjust the rotary dial to the desired level of **-20dBm**

3. Testing the Portable Radio

Once settings are confirmed, testing may now commence to ensure quality control.

Procedure:

1. Connect the 30dB attenuator to the "Gen Output", located on the Spectrum Analyzer
2. Remove the antenna from the Portable Radio and connect to the test cable between the radio and the generator (see Figure 1.2)
3. Using the Portable Radio, select the following: **Menu > Diagnostics > RSSI**
4. Using the Spectrum Analyzer, select the following: **TG > On**

The radio should now read as -50dBm (±1dBm)

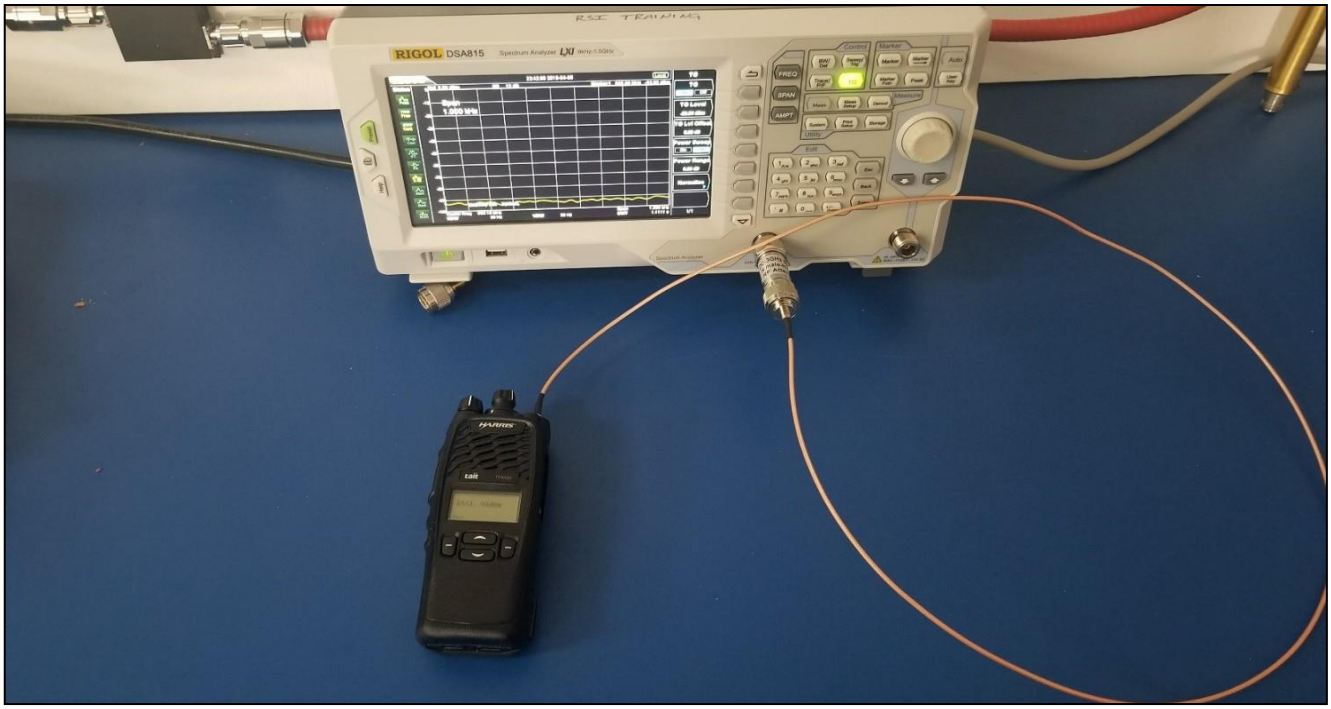


Figure 1.2

4. Measuring the DAS Signal Strength Off-Air

Use portable radio to test individual antennas within the array and coverage areas by moving the radio near antennas of DAS individually (See Figure 1.3).

Procedure:

1. **TG > Off**
2. Disconnect the test cable and place the antenna back on the radio
3. Replace the 30dB attenuator attached to the "Gen Output" on the Spectrum Analyzer with a 20dB attenuator
4. Attach the test cable to the 20dB attenuator and connect the opposite end of the test cable to the end-type barrel connector
5. Attach the end-type barrel connector to the head-end of the DAS cable (the M-connector that would normally connect to DAS port on BDA)
6. Set the TG: **TG** > **TG Level**
7. Adjust the rotary dial to the desired level of **-20dBm**
8. Turn on the TG: **TG > ON**
9. Walk around the building, stopping under each antenna location to take a reading

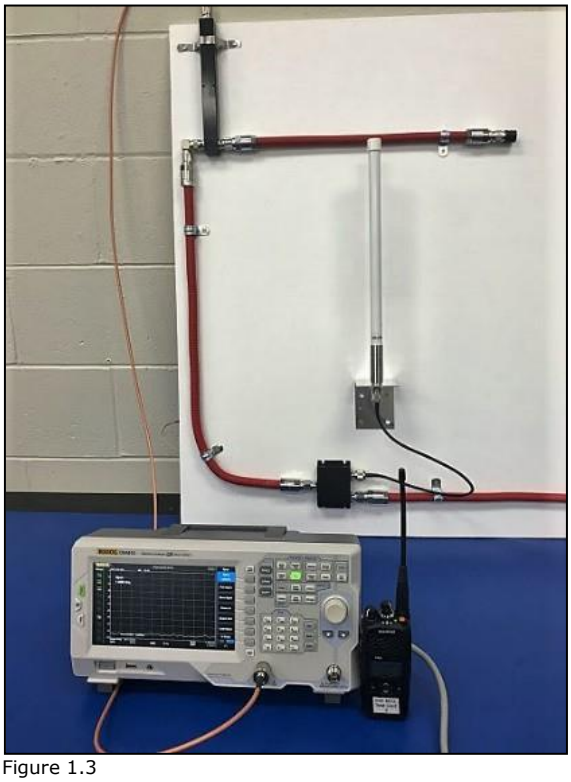


Figure 1.3

10. Populate the signal chart with the corresponding site readings and send to designated Project Manager for review:

- The display should show between -85dBm and -110dBm
- With the -40dBm of signal being generated from the signal generator, the radio will show expected values of 30-40dB free space loss near each individual antenna (at approximately three (3) feet) and 15-30 feet cable loss

Troubleshooting:

If actual results are not consistent with the expected results, ***confirm with the designated Project Manager*** to execute one of the following troubleshooting methods:

1. Adjust the attenuators[1] and TG levels[2] per Project Manager's direction only. Re-submit the new site reading results

[1] Note:
- This radio's RSSI is more accurate with signal levels about -50dBm or lower
- An attenuator on the "Gen Output" on the Spectrum Analyzer may be needed to temporarily tamp down the signal in to the radio to obtain a more accurate reading
- For example, if TG is set for -20dB and system losses are 20dB at the measurement point, add the 20dB attenuator at the DAS head end included in the test kit to obtain a reading of -60dB on the radio

-20dB signal **+** -20dB loss **+** -20dB attenuator **=** -60dB display

[2] Note:
- Dependent upon the system design (as well as the ceiling height) the TG level may be adjusted to differentiate separate antennas. Generally, the higher the ceiling, the greater the TG level required.

2. Should issue(s) persist, perform Direct Cable Connection (DCC) Testing per Project Manager's direction only.

   - The portable radio may be connected directly in to the DAS to test individual points and sections to determine if the cables, splitters, and power dividers are working properly out to that point (see Figure 1.4)

   - First, remove the antenna from the portable radio and attach portable test cable to the radio. Attach the other side of the portable test cable to the directed test point within the DAS, as per designated Project Manager

Figure 1.4