Sweep Equipment Application and Configuration

This application note is organized into two primary sections after the Overview of Sweep introduction. The Forward Sweep section beginning on page 3 includes configuration detail, Tips and Field Meter Settings chart followed by Reverse Sweep with similar aids starting on page 13.

Application

Forward and Reverse Sweep and Balance using JDSU Stealth Sweep™ technology incorporated in SDA network equipment and SDA-5000 and DSAM-6000 field meters.

Summary of Equipment

DSAM-6000 and SDA-5000 field meters with Stealth Sweep technology options enabled can perform either forward, reverse or both sweep operations, depending on options installed and configurations at the meter and at the headend SDA network units.

SDA-5500 Stealth Sweep Transceiver is located in the headend or hub site. It transmits sweep points on the forward path and/or uses broadcast program carriers, either analog or digital, as reference points, thus minimizing the use of active sweep points. If so configured, it can also manage a single field meter for sweeping the return from a field location.

SDA-5510 Return Sweep Manager is located in the headend or hub site. It is strictly used for managing multiple field meters for simultaneous return sweep operations. Up to 10 meters can sweep the return at the same time.

Note: This application note describes the setup and configuration of SDA equipment manufactured as of 2001. Equipment prior to year 2001 has minor user interface differences. Most prominent is the Function key. Prior to 2001 the Function key was green instead of blue.

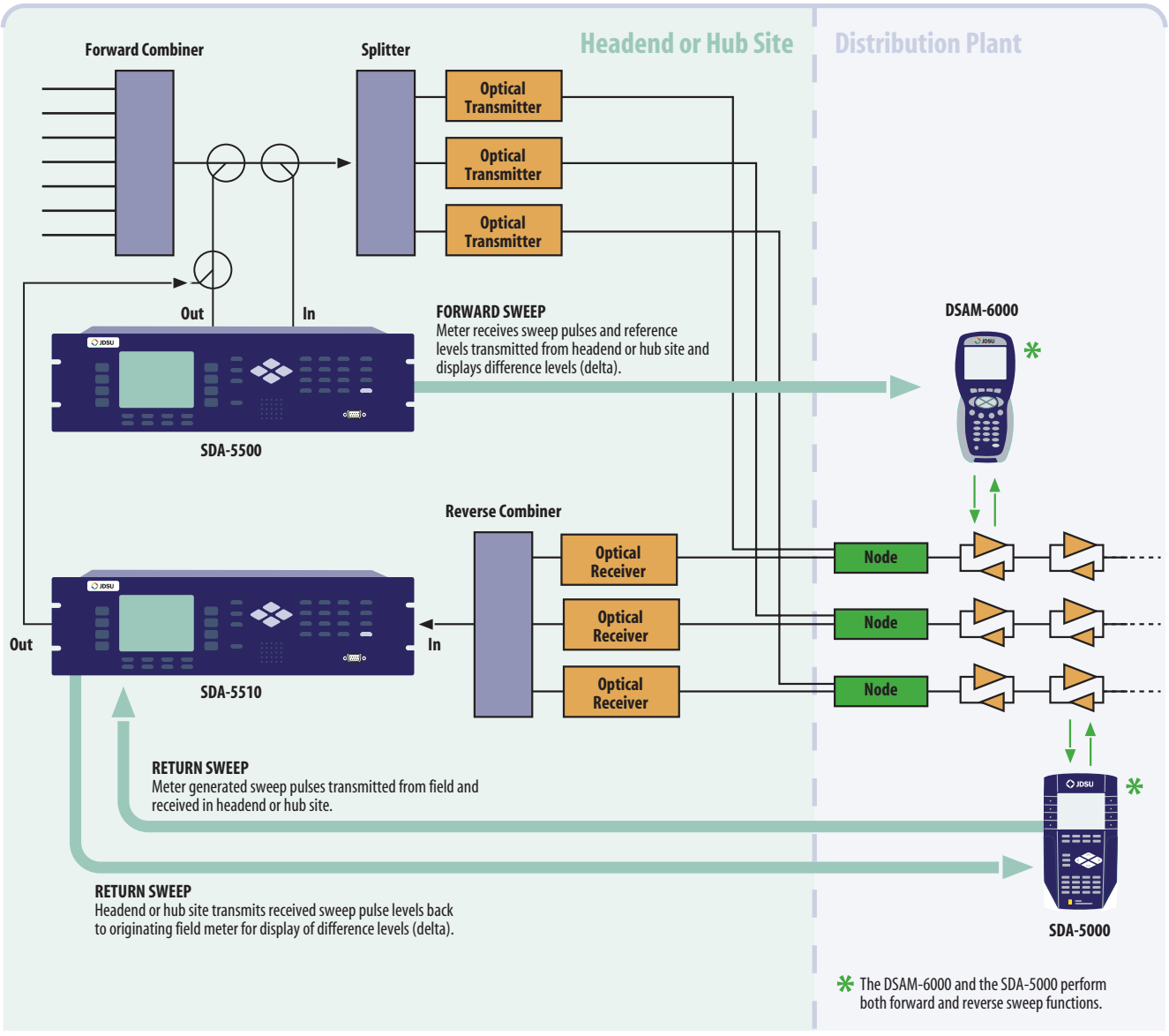
Overview of Sweep

The DSAM-6000 and SDA-5000 field meters sweep display shows the difference (delta) in level from the headend to the field meter or vice versa. The goal is to measure the frequency response of the cable system distribution network. This is done by injecting active sweep points (momentary narrow test carriers) over a range of frequencies at the input of the hybrid fiber coax (HFC) distribution system. The level of each sweep point is measured at both the input and the output of the system. At the receiving end (output), the two values are compared and the difference is displayed on the field meter, thereby emphasizing any deviation caused by the network. As an alternative to active test sweep points injected around a channel, the actual broadcast video carrier can be used as a reference carrier for that frequency. An optimized sweep plan will include both active sweep points, representing unused frequency bands within the network's spectrum, as well as reference carriers. This exclusive Stealth Sweep™ technology is patented by JDSU and minimizes any possibility of service interference.

Both directions of the network can be swept. Forward sweep is accomplished with the SDA-5500 Stealth Sweep Transceiver and measurement system in the headend or hub site. It transmits and measures active sweep points as well as measures reference carriers. Multiple DSAM-6000 or SDA-5000 field meters can be used at the same time with a common SDA-5500. Typically the headend technician or network engineer is responsible for an accurate forward sweep plan within the SDA-5500 transceiver.

Reverse sweep is accomplished in a similar manner except that only active sweep points are transmitted and measured by the field meter and the SDA-5500 receives and measures the sweep points at the headend or hub site. Only a single field user at a time can perform reverse sweep with the SDA-5500. Larger networks typically will use a SDA-5510 Stealth Reverse Sweep Manager to handle only reverse sweep for multiple field users and configure the SDA-5500 for only forward sweep requirements.

Network Sweeping

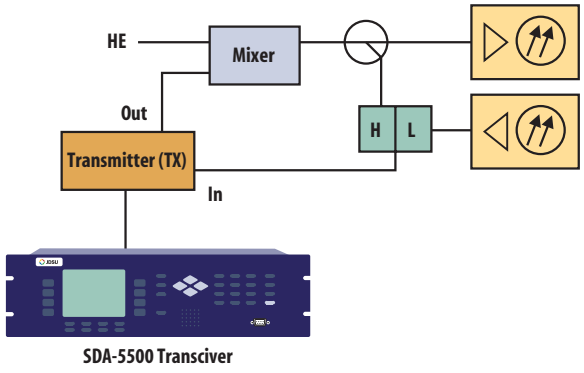


Forward Sweep

Step-by-Step Headend Set-up for Forward Sweep (see diagram below)

A diplex filter is used to combine reverse signals into the rack mounted SDA-5500 instead of a splitter or DC-12 due to isolation issues. Also the return fiber receiver is likely to be 5-200 MHz. This could cause jitter on the forward sweep if not set-up properly. Because the SDA Stealth Sweep Transceiver must see itself, be mindful of what is in this "sample loop," such as launch amps, filters, etc; it could cause problems.

Note: Be sure input levels are between 4 and 12 dBmV. The recommended level is 6 dBmV ±2. If levels are too high, channels may be enabled that are present. Levels too low will leave channels disabled that otherwise should be present. The recommended input for reverse RF into the SDA-5500 Transceiver and SDA-5510 Return Sweep Manager is 0 dBmV ±2. It may work between ±10 dBmV, but it depends on the aggregate noise floor.



Build Channel Plan (Configure > Channel Plan)

If a channel plan has already been made, choose it from the list under Select Channel Plan.

Note: Configure mode can be accessed through the Navigator mode, or by pressing the green function key followed by the number 3 key. Channel plans and files names are limited to 15 characters.

1. Signal Type
   NTSC for North America, PAL or SECAM for Europe
2. Build Channel Plan
   The forward channel plan should be set up on the SDA-5500 or StealthWare PC software.
   a. Enter Plan Name
   b. Type of Plan (NCTA is common in North America, but could be HRC or IRC)
   c. Stop Frequency (be sure to press enter then ok)
3. Edit Channel Parameters
   a. Enable or disable channels appropriately. Default channel type will be analog TV.
   b. Enter tilt channels, sweep channels and/or scrambled channels
   c. Enter the type of channel
      (Single, TV, Dual, Digital, QAM Digital Stream, or Sweep Insertion Point)

Tips

When making labels, the up and down diamond keys may be used to access special symbols (i.e., @, $, etc.). To get to a certain channel more quickly than scrolling, go to the Level mode, type in the channel number, then go back to Edit Channel Plan or press the green function key followed by the number 4 key. TV is for regular, analog television signals; Single designation is used for continuous wave (CW) carriers; Dual is for NICAM not Secondary Audio Programming (SAP); QAM Digital Stream is for 64 or 256-QAM carrier designation for the QAM option on SDA field meters; and Digital is for regular digital "haystacks" regardless of modulation type. Do not delete unused channels until sweep points are made. If all disabled channels are deleted, no sweep points will be made.

Build Sweep Points on SDA-5500 (Configure > Channel Plan > Build Sweep Points)

This is an option on the SDA-5500 only. Sweep insertion points are for vacant bandwidth and channels which are disabled to allow sweeping of the entire spectrum. The default is channel 2 to 1 GHz for the sweep, but sweep points can be inserted anywhere between 5 MHz and 1 GHz. Sweep insertion points are not automatically inserted in the FM band. You must do this manually if required. Build insertion points for disabled channels; 2 points per channel slot is the default, 3 is the max, 1 is sufficient in most cases. Sweep points are approximately 2.8 ms in duration and approximately 100 kHz wide. Ensure that no sweep insertion points are built within 6 MHz of either side of the AGC frequency as this may cause problems with the AGC circuitry in certain amplifiers.

SDA-5500 Sweep Transmitter (Configure > Sweep Transceiver)

Sweep Mode must be in the appropriate mode to allow proper operation. The Transmit mode is the older Stealth Sweep, whereas the new Transmit (SDA Compatible) mode is for the faster sweep refresh with digital and scrambled carriers present. SDA Compatible mode is the only mode compatible with DSAM-6000 field meters. If DSAM-6000 is to be used on existing networks that already have SDA products, both in the headend and in the field, all equipment must be upgraded to SDA Compatible capability. The wrong mode selection will create erroneous readings.

Forward Telemetry Frequency must be in a vacant spectrum and at least 500 kHz from any other carrier. It must also be within the bandwidth of the downstream spectrum. This is an FSK carrier and approximately 500 kHz wide. The factory default is 51 MHz on the SDA-5500 transmitter, 52 MHz on the receiver, and 53 MHz on the PathTrak™ HSM (a common JDSU element also typically located with the SDA sweep gear).

Note: If diplex filters in the actives have a sharp roll-off, it is advisable to move the telemetry to a frequency that is more reliable. The location and level of the telemetry may cause its second harmonic to interfere with existing channels if not optimally adjusted.

Forward Telemetry Level determines the level of the telemetry signal. This should be set 10 dB below the video reference level. The telemetry level is adjustable from 20 to 50 dBmV in 2 dB increments. The max is 50 dBmV; however, some older units may have a max of only 40 dBmV. Forward Sweep Insertion Level is the level at which sweep insertion points will be inserted; 40 or 50 dBmV is the max. Sweep points should be 14 to 16 dB below the video reference level. Sweep points fall on the video and/or audio frequency of unused channels by default, but can be moved.

Initially set the Telemetry and Sweep Insertion levels to the minimum of 20 dBmV each. Change the sweep insertion level until the sweep insertion points are 14 to 16 dB below the closest visual carrier. This may be viewed on the display when the sweep is activated. Once the sweep is set correctly, change the telemetry level to 4 dB above the Sweep Insertion level. Include Audio Carriers indicates that the

sweep display will include all audio carriers; if you choose no, the sweep will be faster but will display less resolution. Enable Reverse Sweep allows reverse sweep to operate. If disabled, the forward sweep will be faster. Enable Live Headend Ingress View allows reverse noise to be transmitted on the forward telemetry. If disabled, the forward sweep will be faster. Reverse Telemetry Frequency and Reverse Sweep Plans are not applicable for forward sweeping.

Copying Channel Plans

Ensure that the SDA-5000 field meter is connected to the SDA-5500 transceiver by means of the 9 pin, RS-232 connector, on the back of the field meter and the front of the transceiver. This cable is supplied with the SDA-5500 transceiver by JDSU and has a specific pin configuration. Also be sure that the baud rate is identical on both pieces of equipment.

Note: The headend unit channel plan does not have to be downloaded to the field meter to achieve sweep. Only the telemetry has to be the same. The channel plan in the field meter does not affect the sweep, only the other measurement modes such as level, tilt, scan, etc.

If a channel plan is made on an older field meter and copied to the transceiver, the transceiver will freeze and must be powered off to reset. A way to avoid this situation is to transfer the channel plan to Stealthware then from a computer to the transceiver. You may copy channel plans from SDA field meter to SDA field meter or from the transceiver to an SDA field meter. DSAM is not able to communicate to either SDA transceivers or field meters. On the SDA field meter, select (Configure> Channel Plan> Copy Remote Plan) and enter the forward plan for the system you are working on. The transceiver then downloads the plan you have built, but sweep points do not show up in the hand-held channel plan unless the portable transmitter option (SDA only)is installed.

For importing plans to DSAM, transfer Stealthware plan to FDM\TPP and then deploy to DSAM meters. Stealthware plan must have been created in V7.0 or later to be able to import.

Field Meter Settings, Forward Sweep

To Configure:	For SDA-5000 Meter	For DSAM-6000 Meter
Global settings Such as Temperature Units, Signal Level Units, Fundamental Hum Frequency, Scan Rate, etc	Blue function key followed by 7 or enter Configure by Navigator (Nav) key then select Global.	Enter Configure by Configure key. Select Global > General > Regional Preferences.
Sweep Mode If DSAM-6000 is to be used on existing networks that already have SDA products, both in the headend and in the field, all equipment must be upgraded to SDA Compatible capability. The wrong mode selection will create erroneous readings.	Depending upon the options installed in the field unit, the modes available are: - Sweepless - Stealth - Stealth (SDA Compatible) - Loopback - Transmit - Transmit (SDA Compatible) Normally select Stealth or Stealth (SDA Compatible).	DSAM is "SDA compatible" only. No selection is required.
Forward Sweep Telemetry Set the forward sweep telemetry frequency to be the same as the SDA 5500 transceiver.	Blue function key followed by 7 or enter Configure by Navigator (Nav) key then select Sweep > Forward Telemetry Freq (5500)	While in the Sweep Mode, select Settings softkey > Telemetry Frequency… Or enter Configure by Configure key > Chan Plan > Downstream Plans. Highlight the plan for network to be swept. Select Plan softkey > Telemetry… Select SDA-5500 Telemetry Frequency. All DSAM telemetry settings are saved in specific channel plan file.
Sweep Tilt Compensation	Enter compensation value while in the Sweep mode by selecting Tilt icon located at the lower right side of screen. Enter value then press Enter.	While in the Sweep Mode, select Settings softkey > Sweep Tilt and Limit… Or enter Configure by Configure key > Sweep Settings
Sweep Limit	SDA sweep limit is compensated for the effect of numerous amps in cascade (by the formula n/10 +x), common in early CATV distribution systems. Two values need to be entered; a limit variable (x) provided by network engineer and an amp number (n) that represents how deep the amplifier is down the network from the node amp. To enter x enter Configure by Navigator (Nav) key or blue Function key followed by 7 key. Select Sweep > Sweep Limit Variable. Enter amp number while in the Sweep mode by selecting Limit icon located on right side of screen.	While in the Sweep Mode, select Settings softkey > Sweep Tilt and Limit… Or enter Configure by Configure key > Sweep Settings.
Test Point Compensation (TPC)	Blue Function key followed by 7 key or Nav key > Files and Configure > Testpoint. Use toggle button to select forward or reverse TPC.	Blue Function key followed by the 4 key or Configure key > Measure > Test Point Compensation.

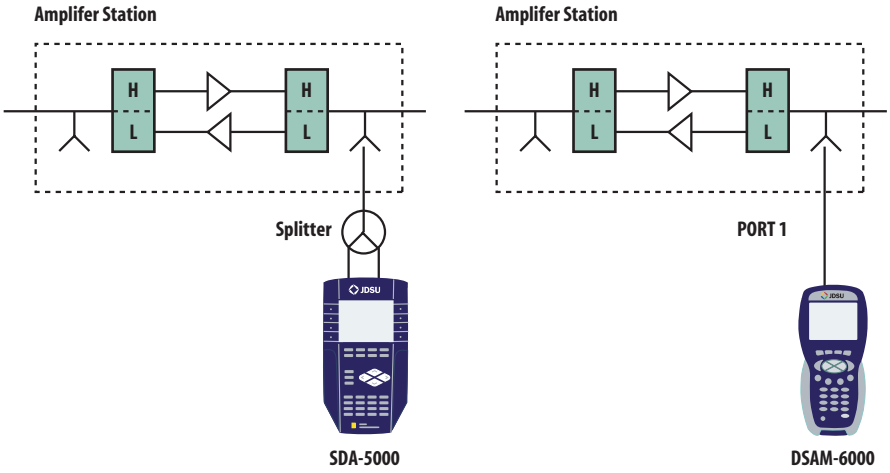
Before Leaving the Headend

Ensure that the SDA-5500 transceiver is in the Sweep mode. Ensure that your forward tilt channels are working correctly by pressing the Tilt key. Then check the sweep. The sweep direction can be changed on the SDA-5000 field meter by using the left and right diamond keys. For DSAM, the sweep direction can be changed while in the Sweep mode by selecting the third soft key under the display. This key toggles between the two sweep directions. A forward sweep reference can also be taken at this time. On the SDA, press the blue Function key followed by the 6 key and enter a name for your reference. On the DSAM, press the File soft key and select Save Reference.

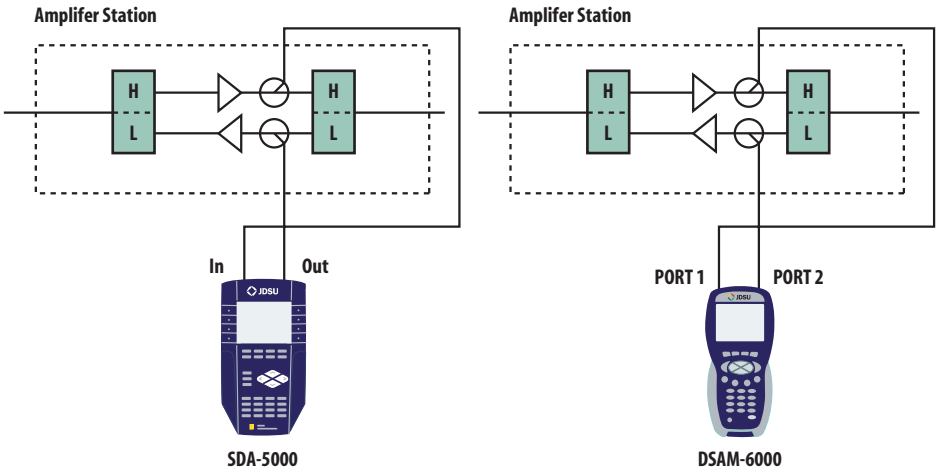
Note: Take care with the forward fiber optic transmitters in the headend. The test point may be aligned for the input to the "box" or the actual input to the laser diode. This could give a faulty reference.

Port Configurations Based on Equipment Test Point Types

Before performing any sweep operation it is imperative to configure the ports of the sweep meter correctly, otherwise erroneous results will occur including the potential introduction of standing waves which will not be a response of the network under test, but rather reflections of a poor test setup. Appropriate set-up depends on the type of test point on the equipment under test and the type of meter used. On systems with bi-directional test points (forward and reverse signals both present on the same test point), a "summing" network using a splitter is used on the SDA-5000 to enable reception of forward telemetry and sweep, as well as inject reverse telemetry and sweep. For the DSAM-6000, a configuration is made in Configure > Sweep Settings; and a single jumper cable is connected between the test point and port 1 on the meter. See figures below:



Systems with directional test points are preferred. A directional coupler is incorporated on the amplifier under test. Both the SDA and the DSAM are connected the same way. Two jumper cables are used, one for the forward sweep and another for reverse sweep.



Forward Balancing and Sweeping

First, balance the signal levels at the node amplifier using your Tilt and Level modes at the band edge frequencies. Make appropriate adjustments before proceeding further. For SDA, press Sweep and verify all parameters are correct. Press the right diamond key for forward sweeping. For DSAM Sweep mode, press Measure > Sweep > Forward Sweep. Build your reference using the same procedures you used to build the reference at the headend. Store a reference for each leg of the node that has actives attached.

Note: Do not change in-line pads, test leads, or other RF path elements once a reference has been stored. Otherwise store a new reference

Proceed to the next active in line. Use a directional test point on the active for forward balancing and sweeping. Most forward balancing is based on unity gain at the output. If the design slope is different than the node design slope, use tilt compensation.

Tips

The Tilt Compensation mode of the field meter makes it easy to get a true max/min (peak-to-valley) regardless of the tilt of the reference. The highest tilt channel programmed in your channel plan is the most affected point, and the lower tilt channel would be the pivot point. If no tilt channels have been enabled, tilt compensation will not work.

Note: The Min/Max displays the peak-to-valley between the markers. The delta displays the difference in level and frequency at the markers.

In forward sweep, the field meter has a max input of approximately 20 dBmV/ch for a fully loaded system. This is usually not a problem on the high loss test points, but could be an issue when connecting directly to a seizure screw. The default option is to dwell on all carriers which could slow down the sweep update time depending on the total number of digital and scrambled channels. The SDA and DSAM with the SDA Compatible mode utilize a different algorithm to speed this up by 5 times.

Common Forward Sweep Problems

Standing Waves

– Use a directional test point if available. Standing waves could still occur if a mismatch is severe and close enough.

– Read from a tap. Some lower value taps may still give reflections depending on port-to-port isolation and port-to-output isolation.

– Use a plug-in test point not a probe. Probes will always be bi-directional unless they are in series with the circuit and a directional coupler is used.

– Install a terminating tap (4 port 8 or 8 port 11) if possible (make sure you terminate the spigots). This is an easy way to isolate the system.

– Verify good test leads, connectors, F-81 barrels, etc. Use an in-line pad on your test lead to determine whether the standing wave goes away. If it disappears, a reflection is being created between the field unit and test point.

Spikes

– Keep the resolution to approximately 6 MHz for forward sweep. This lowers the probability of inadvertent, overlapping sweep points and transients. A sweep point every 6 MHz is sufficient in most situations for forward sweeping. It also creates a faster sweep update and less memory is required for each stored trace.

– Verify proper set-up, levels, channel types, no overlapping sweep and actual channels, etc.

– Avoid common problem areas such as strong off-air broadcasts (analog and digital) and certain FM channels.

No Communication

– Verify the appropriate telemetry; keep it high and located in the passband. Look for sharp diplex filter roll-off and old 550 MHz passives in a 750 MHz system. The minimum level for telemetry is approximately -15 dBmV, and the max is approximately +12 dBmV.

– Sometimes communication will be lost on input test points due to lack of gain from the active and/or the test point loss. Use the spectrum mode with Max Hold on to verify the existence of the telemetry and the level. Make sure test point compensation is 0 or off.

– Verify test equipment connections, amplifier continuity, active gain, and that no terminators are installed. Use the Level mode to determine whether actual channels are present. If there are channels present, then there must be continuity.

– Verify that the instrument is sweeping in the correct direction. Check upper label in display for Forward Stealth (for SDA) or Forward Sweep (for DSAM).

– Have headend personnel verify that the SDA-5500 is in sweep mode (have headend personnel press Sweep on the transceiver).

Bad Response

– Verify accessories are operating correctly such as cable, push-ons, older summation networks (DDC-20), pads, etc.

– Low sweep points may get confused with the noise floor especially after going through more actives with their associated noise figures. This could cause the "grassy" effect on the sweep display. Increase the sweep insertion level on the SDA-5500 Stealth Sweep Transceiver to verify.

– Use the correct Sweep mode. Selecting the wrong mode can lead to problems.

– If input levels are too high, this may cause extreme intermodulation distortions, which can affect the associated sweep points.

– Firmware versions must be the same on the transceivers and field meters. Older Stealth units with firmware versions 8.5 and 9.3 are not compatible and will yield inaccurate sweep measurement results. Version 9.3 will work with the new SDA units, but not in the SDA Compatible mode.

– DSAM sweep will function only with SDA Compatible mode selected on the transceiver.

Faster Forward Sweep

Note: These are suggestions only and discretion must be used.

– Disable the Reverse Sweep and Live Headend Ingress view if present (Configure > Sweep Transmitter).

– Do not sweep the video frequency of a scrambled channel. Leave it enabled, but do not use it as a sweep point. Insert another channel at the audio frequency, change the type to Single Channel rather than Scramble, and use it as a sweep point. This assumes the audio is stable.

– Disable all audio readings; only use single insertion points (Configure > Sweep Transmitter).

– Place sweep points in the lower sideband of analog channels, especially sync suppressed scrambled channels, and in the guard band of digital channels. 1 or 1.1 MHz below the analog channels is the setting most likely to yield the best results. Dwell times are set at 4 ms for a standard channel, 2.8 ms for a sweep point, and 158 ms for a scrambled or digital channel.

– Use the SDA Compatible mode to speed up the dwell time on digital and scrambled channels and still remain non-intrusive.

Note: This new plan does not have to be loaded or enabled in the field unit for sweep to be achieved.

Frequency Response Identification

Low End Roll-Off or Instability

These problems usually are caused by loose seizure screws, bad EQs/CSs, diplex filters, or dirty fiber connections. Standing Waves may be created from reflections from impedance mismatches. This is seen when viewing a sweep display from a resistive/bi-directional test point. Directional test points have enough isolation to block the reflected wave (depending on the severity) from adding in and out of phase with the main wave, which creates the standing wave appearance. Additionally, they can be created between the test point and test equipment. The formula 492*Vp/f, will yield an approximate distance in feet to the fault. Vp is the velocity of propagation of the cable and is typically .87 for most foam dielectric, hard-line cable. Using this formula, "f" is the separation in MHz between two peaks on the sweep display; 492 is derived by the speed of light, which is 984 Mft/s and the fact that the reflection is 180 degrees out of phase for 984/2 = 492. This also could be a reflection between the test point and test equipment, especially on 20 dB test points.

Suck-Outs

This situation is caused by grounding issues or multiple impedance mismatches at perfect intervals. Sometime this also manifests itself as spikes due to signals adding in-phase. Spikes also are caused by oscillations and ingress.

High End Roll-Off

This is associated with bad accessories, water, cracked cable sheath, or amplifier bandedge roll-off.

Other Applications

Using the optional portable receiver/transmitter, SDA-5000 only:

Balance the inactive plant by placing the transmitter into the node where the optical receiver is usually inserted. Store a reference at the Node output. Proceed to the next active in cascade and balance back to the same reference line and telemetry level, which was achieved at the node. This assumes that the next amplifier will be running the same tilt and output levels as the node. Otherwise, offset accordingly.

Perform a single amp bench alignment by selecting the Loopback Sweep mode, SDA-5000 only:

The portable sweep transmitter/receiver reads its own signals. It may be used to determine the frequency response and gain of a single amplifier. Set up a channel plan with sweep points every 2 MHz for good resolution. The total number of points is limited to approximately 500. Remember to store a reference of your test leads before sweeping the device.

Tips

1. Because the Stealth Sweep™ technology default set-up uses the actual channels for sweep, and inserts sweep points where there are no active carriers, there is no interference to the TV picture.
2. The SDA-5000 field meter is capable of a frequency agile, CW carrier at 50 dBmV (40 dBmV for the older version). Select (Configure > Diagnostics > Transmitter Diagnostics), set the transmit frequency, attenuation, and turn on the transmitter.

   Note: You must leave the field meter in this mode for the transmitter to stay active. The cable must be attached to the OPT port on the SDA-5000.

3. If headend channel levels change, a new reference will NOT be required because the transmitter will automatically compensate. However, it cannot compensate for continuously fluctuating levels.

4. The sweep file overlay feature on the SDA-5000 can be used to view an existing stored file and see the actual sweep trace overlaid. Select (Configure > Sweep Receiver > Sweep File Overlay) to turn it on. Additionally, an old file from Stealthware may be uploaded into the field meter to do an overlay.
5. Select green Function key and i key for instrument information such as calibration date, serial number, options installed, etc.
6. The field meter is DC blocking to 200V peak-to-peak. This equates to approximately 100 VAC.
7. Once a trace is stored, you can alter the dB/div, start and stop frequency, tilt compensation, etc. To print this altered trace, press the blue Function key and select Print (SDA-5000 only). Use the printer serial cable available from JDSU.
8. The de-facto standard is 2 dB/div for sweeping and 5 or 10 dB/div for spectrum analyzer viewing.
9. The SDA unit has a CW Loopback mode that is accessed through the Navigator screen. Consult JDSU for a list of other features.
10. You may change the start and stop frequencies in the Sweep mode of the SDA-5000 field unit, which makes it easier to move your markers around within a narrower spectrum view. The DSAM-6000 uses the markers to identify the desired spectrum view, then selecting View > Zoom uses the markers to specify the narrower spectrum view.
11. Type in the frequency and press Enter to make a marker jump to that frequency.
12. If you do not know the frequency of a certain channel, use the Level mode. Type in the channel number, press the Channel key then press the Freq key.
13. The SDA-5500 Stealth Sweep Transceiver will transmit/broadcast the ingress from all the return amplifiers connected to it back to the field unit. This will be transmitted on the forward telemetry with 280 kHz of resolution. Return continuity is not needed for this reception. The noise mode on the SDA-5510 Return Sweep Manager transmits the total noise in the headend also, but with a resolution based off the return channel plan resolution.
14. You can sweep without downloading the channel plan, but other measurement modes will not operate correctly such as the Tilt mode. You must assure the same telemetry frequency.
15. The unit must sweep 4 times before a reference can be taken.
16. The number of sweep points is limited to 500. Inserting too many will make the refresh of the sweep display slower and requires more memory for file storage. The sweep update time is dependent on the set-up.
17. The Show Horizontal Markers (Configure > Sweep Receiver on the SDA-5000) feature is helpful for viewing the maximum peak and lowest valley between the vertical markers.

Reverse Sweep

Step-by-Step Headend Set-up for Reverse Sweep

If both forward and reverse sweep are being installed in the system, you will find that the material presented in the forward sweep sections also applies to the proper installation of the reverse sweep components. Please read the forward sweep sections even if forward sweep will not be included in the system you will be using.

Following are specific instructions and tips for the reverse sweep components only.

SDA-5510 Return Sweep Manager (Configure > Sweep)

For the field meters to communicate with the SDA-5500 (with reverse sweep enabled) or the SDA-5510, the reverse sweep option must be installed on the meter. Check the information screen on the meter for the options included.

Forward Telemetry Level determines the level of the telemetry signal transmitted to the field meters SDA-5000 and DSAM-6000. It should be set 10 dB below the video reference level. The telemetry level is adjustable from 20 to 50 dBmV in 2 dB increments. The max is 50 dBmV; however, some older units may have a max of only 40 dBmV. The telemetry must be in a vacant spectrum and at least 500 kHz from any other carrier. It also must be within the bandwidth of the downstream spectrum. This is an FSK carrier and approximately 500 kHz wide.

Note: If diplex filters in the actives have a sharp roll-off, it is suggested to move the telemetry to a frequency that is more reliable. The location and level of the telemetry can cause its second harmonic to interfere with existing channels if not optimally adjusted.

Enable Reverse Sweep allows reverse sweep to operate in the SDA-5500 Transceiver. If disabled, the forward sweep will be faster but reverse sweep will be inoperable.

Enable Live Headend Ingress View allows reverse noise to be transmitted on the forward telemetry. If disabled, the forward sweep will be faster.

Reverse Telemetry Frequency is set up on the SDA-5500 or SDA-5510 and not on the field unit.

Note: Be sure to select a reliable frequency void of interference in the most stable part of the passband, not in the roll-off or below 15 MHz.

Reverse Channel Plans are built and/or edited for the upstream direction. The reverse channel plan must be set-up on the unit that is to receive the sweep points from the upstream receiver (SDA-5500 or SDA-5510). It will be communicated automatically to the field unit via the forward telemetry. Notice this menu is found under Set-up > Sweep Transmitter > Reverse Channel Plans.

Field Meter Settings, Reverse Sweep

To Configure:	For SDA-5000 Meter	For DSAM-6000 Meter
Global settings Such as Temperature Units, Signal Level Units, Fundamental Hum Frequency, Scan Rate, etc	Blue Function key followed by 7 or enter Configure by Navigator (Nav) key then select Global.	Enter Configure by Configure key. Select Global > General > Regional Preferences.
Sweep Mode If DSAM-6000 is to be used on existing networks that already have SDA products, both in the headend and in the field, all equipment must be upgraded to "SDA Compatible" capability. The wrong mode selection will create erroneous readings.	Depending on the options installed in the field unit, the modes available are: - Sweepless - Stealth - Stealth (SDA Compatible) - Loopback - Transmit - Transmit (SDA Compatible) Normally select Stealth or Stealth (SDA Compatible).	DSAM is "SDA compatible" only. No selection is required.
Forward Telemetry Set the forward telemetry frequency used for reverse sweep to be the same frequency as the SDA 5500 transceiver (with reverse sweep enabled) or as the SDA-5510, whichever is used for reverse sweep management.	Blue Function key followed by 7 or enter Configure by Navigator (Nav) key then select Sweep > Forward Telemetry Freq (5510)	While in the Sweep Mode, select Settings softkey > Telemetry Frequency… Or enter Configure by Configure key > Chan Plan > Downstream Plans. Highlight the plan for network to be swept. Select Plan softkey > Telemetry… Select SDA-5510 Telemetry Frequency. All DSAM telemetry settings are saved in specific channel plan file.
Sweep Tilt Compensation	Enter compensation value while in the Sweep mode by selecting Tilt icon located at the lower right side of screen. Enter value then press Enter.	While in the Sweep Mode, select Settings softkey > Sweep Tilt and Limit… Or enter Configure by Configure key > Sweep Settings
Sweep Limit		
Test Point Compensation (TPC)	Blue Function key followed by 7 key or Nav key > Files and Configure > Testpoint. Use toggle button to select forward or reverse TPC.	Blue Function key followed by the 4 key or Configure key > Measure > Test Point Compensation.

Before Leaving the Headend

On the field receiver, DSAM-6000 or SDA-5000, set the forward sweep telemetry frequency to be the same as the SDA-5500 and/or SDA-5510. Set for the Sweep mode intended to be used. See Field Meter Settings chart above for details.

Set the reverse sweep insertion and telemetry levels as close to the system specifications as possible, taking into consideration insertion losses.

Note: Sweep and telemetry levels >15 dB above the recommended input could cause return laser clipping and erroneous balancing and sweep traces. This depends upon the type of laser and return hybrids used.

Put in Single User mode if using the SDA-5500 Stealth Sweep Transceiver for reverse sweeping, or in Multiple User mode if using the SDA-5510 Reverse Sweep Manager. Be sure the Transceiver is in the Sweep mode and the reverse is enabled.

Reverse Balancing and Sweeping

First, balance the forward path and press Sweep to verify all is well, then proceed with reverse. Check the sweep in both directions. The sweep direction can be changed on the SDA-5000 field meter by using the left and right diamond keys. For DSAM, the sweep direction can be changed while in the Sweep mode by selecting the third soft key under the display. This key toggles between the two sweep directions.

A reverse sweep reference can also be taken at this time. On the SDA Press blue Function key followed by the 6 key and enter a name for your reference. On the DSAM press the File soft key and select Save Reference. Take a reference at each leg if warranted.

Note: The NS-6 or DDC-20 is necessary for SDA firmware version 8.5 or earlier. A summation network for return path sweeping is not necessary for versions 9.x or later. There must be a place to inject the sweep, which will make its way to the transmitter or receiver. Record the reverse telemetry level, recommended reverse input, and test point loss. See Port Configurations Based On Equipment Test Point Types earlier in this document for more details for correct connections to the test point.

If you use the amplifier's internal directional test point it must be an injection test point. You may be able to sweep in reverse using the forward test point if it is on the outside of the diplex filter. Otherwise, bi-directional test points can be used, but may give misleading displays because of standing waves. Use a tap if possible. You must use a splitter or diplex filter when using the same TP for injection and reading.

Note: Turn off the automatic level control (ALC), sometimes referred to as the automatic gain control (AGC), in the reverse rack mount receiver if present. Also turn off the ALC in any LAN return amplifiers. Each ALC sensitivity will have to be adjusted after balancing is completed.

Note:Max/min displays the peak-to-valley between the markers. The delta displays the difference in level and frequency at the markers.

Proceed to the first amplifier from the node and reverse sweep and balance to a flat line using an EQ. Use the corresponding node reference for the leg being balanced. Use a pad to achieve a telemetry level X dB higher than what was documented when the reference was stored. X = (A-B) where A = the recommended reverse input of the active where the reference was taken + test point loss + accessory losses + Summation Network loss. B = the recommended reverse input of the amplifier being balanced + test point loss + accessory losses + Summation Network loss. Only losses in the reverse injection path are considered.

Note: The recommended injection level is dependent upon whether you are balancing constant inputs to the port or hybrid, and where the actual injection point is located. Many systems balance constant inputs to the port and take into account extra accessory losses such as internal "feedermakers" and input pads if warranted. The reasoning behind constant inputs to the port vs. hybrid is beyond the scope of this application note.

The reference line on the display should also be X dB. Look at marker levels on the field meter display to verify. Ref on the sweep display is the middle graticule line, not the actual sweep level.

Note: The sweep trace displayed on the field meter will change if someone in the headend changes the test point compensation on the SDA-5500 or SDA-5510. This also affects the Reverse Alignment mode on the field meter.

Others may use test point compensation and change the injected telemetry level to account for different test points, different recommended injection levels, and extra accessories. They then balance to a 0 dB reference line and the same telemetry reading as was achieved at the reference.

Note: The SDA unit works slightly differently. The reverse test probe value adds to the telemetry and sweep values to give the actual output of the field unit. It also has a Reverse Alignment mode (accessed through the Navigator mode). The markers give actual received levels in the headend as if using 2 CW carriers with a Raw sweep behind it. This is not available on DSAM.

An Alternative Method

Consider that you have a node with 20 dB test points and a recommended injection of 15 dBmV, and a trunk amp with 25 dB TPs and recommended injection of 17 dBmV. The Bridger amp with 20 dB TPs has a recommended injection of 12 because you are inserting at the hybrid, balancing constant inputs of 17 dBmV to the port, and the internal loss from the test point to the hybrid is 5 dB. There is also an LE with a 26 dB tap for injection and a recommended injection of 17 dBmV. After adding all the numbers and the extra loss of 3.5 dB from the summation network (splitter) used in reverse balancing, the total generator output would be:

Node = 20+15+3.5 = 38.5

Trunk = 25+17+3.5 = 45.5

Bridger = 20+12+3.5 = 35.5

LE = 26+17+3.5 = 46.5

Note: The value for the summation network, 3.5 dB, is not required for DSAM if the ports are properly configured as discussed in Port Configurations Based on Equipment Test Point Types earlier in this document.

Find the highest number and set the Sweep and Telemetry close to this. For instance, the highest number is 46.5 so they are set for 46 dBmV. Store a reference at the node with an 8 dB in-line pad installed. This will automatically knock down the sweep and telemetry level without having to change the generator output and the associated problems with doing that (explained later). Store a reference and record the telemetry. Go to the trunk amp and install an in-line 1 pad, and reverse balance to the same reference and telemetry. Go to the bridger amp and install an 11 dB in-line pad. Balance to the same telemetry and reference. Go to the LE and disconnect the in-line pad. Balance back to the same reference of 0 and telemetry that was recorded when the reference was stored. The one caveat to this is the inconsistency with in-line pads. Here, one more variable is added to the equation.

Considerations

There are several considerations when changing the sweep and telemetry levels on the field unit for different balancing scenarios. This may influence your balancing method.

1. Changing the sweep insertion level on the field unit does not change where the sweep is displayed. The display you see is gain or loss, not the headend unit received. If you increase the sweep insertion level on the field unit, the sweep trace will not increase on the display.
2. Changing test point compensation changes where the sweep is displayed on the screen.
3. Changing the telemetry insertion may not have a 1 for 1 effect, and it is only in 2 dB increments.
4. Will all technicians change the level correctly?

Note: Because this is a sweep, ingress can affect the outcome. It may be advantageous to terminate all reverse port pads or keep all amplifiers terminated until activation.

Common Return Sweep Problems

Standing Waves

– Use a directional, injection test point if available. Standing waves could still occur if a mismatch is close and severe enough.

– Inject into a tap. Some lower value taps may still give reflections depending on port-to-port isolation and port-to-output isolation.

– Use a plug-in test point, not a probe. Probes always will be bi-directional unless they are in series with the circuit and a directional coupler is used.

– Keep all proceeding actives terminated for return sweeping. Do not pre-stuff the reverse pad and EQ. The noise funneling may hamper your ability to sweep properly. A high value pad or terminator is recommended.

– Terminate all low value tap ports. Even an un-terminated splitter in a subscriber's house a few thousand feet away can cause standing waves. Coax attenuation at the lower frequencies is slight, which allows the reflected wave to make it back without much loss.

– Install a terminating tap (4 port 8 or 8 port 11) if possible. It is an easy way to isolate the system.

– Verify that test leads, connectors, F-81 barrels, etc. are good. Use an in-line pad to determine whether the standing wave goes away. If it disappears, a reflection is being created between the field unit and test point.

Spikes

– Keep the resolution to approximately 1 MHz for reverse sweep. This lowers the probability of inadvertent, overlapping sweep points and transients. A sweep point every 1 MHz is sufficient in most situations for reverse sweeping. It also creates a faster sweep update and less memory required for each stored trace.

– Verify proper set-up, levels, no overlapping sweep, and actual channels, etc.

– Avoid common problem areas (strong off-air shortwave, ham, and CB at 27 MHz)

No Communication

- Check forward sweep to confirm communication path between the transmitters and field unit.
- Set to Single User for SDA-5500 Stealth Sweep Transceiver return sweeping and Multiple User for SDA-5510 Return Sweep Manager return sweeping.
- Collisions with other technicians conducting reverse sweeps on the same SDA-5500 Transceiver may be the source of trouble. Use a dedicated SDA-5510 Return Sweep Manager if warranted.
- Verify the appropriate telemetry; keep it high and located in the passband. Look for sharp diplex filter roll-off and old 550 MHz passives in a 750 MHz system. The minimum level for forward telemetry is approximately -15 dBmV, but can also overload with greater than approximately +12 dBmV. Communication also can be lost on input test points due to lack of gain from the active and the test point loss. Use the spectrum mode with Max Hold on to verify the existence of the telemetry and the level. Ensure test point compensation is 0.
- Check return path continuity. Verify test equipment connections, amplifier continuity, active gain, and that no terminators are installed. Look at the noise floor level on the reverse input and compare with the reverse output. It should be higher by the amount of gain of the amplifier, but not necessarily. The noise reading could be affected by the test equipment noise floor. It may be warranted to inject a carrier and read the output to verify continuity. Choose CW Loopback mode if using an SDA-5000 with reverse option to verify continuity and gain. Use Diagnostics to send a CW carrier to the headend. Have personnel in the headend use the SDA-5500 Level mode to read the reverse carrier level. Return to Sweep mode when finished.
- Reverse telemetry must have >20 dB S/N. To calculate the S/N for the reverse, find the telemetry level at the headend read on the field unit while sweeping, activate the Noise mode (SDA-5000 only) and move the marker to the same frequency. Record the difference.

  Note: The number of node returns is limited for the Stealth reverse set-up because the reverse telemetry signal must have > 20dB S/N. It is advisable to combine less than 40 nodes into the headend unit. This may also influence where the telemetry is placed. Avoid 5-15 MHz due to the inherent noisy nature of this passband and the upper band because of diplex filter rolloff. Also avoid 27 MHz due to CB ingress as well as any multiple of 6 MHz due common path distortions (CPD).

- Verify the instrument is sweeping in the correct direction. Check upper label in display for Rev Stealth (for SDA) or Reverse Sweep (for DSAM).
- Have headend personnel verify the SDA-5500/SDA-5510 is in Sweep mode (This is accomplished by pressing “Sweep” on the front of the unit).
- Firmware versions must be the same on the transmitters and receivers. Older Stealth units with firmware versions 8.5 and 9.3 are not compatible and will yield inaccurate sweep measurement results. Version 9.3 will work with the SDA units, but not in the SDA Compatible mode. DSAM is SDA compatible only.

Bad Response

– Verify accessories are operating correctly such as cable, push-ons, older summation networks (DDC-20), pads, etc.

– Low sweep points may get confused with the noise floor, especially from the total noise funneling. This could cause the "grassy" effect on the sweep display. Increase the sweep insertion level on the field unit to verify.

– Use the correct Sweep mode. The wrong mode may lead to problems.

– High forward levels into the meter can cause severe intermodulation that can affect the reverse sweep.

Faster Reverse Sweep

– Make a mock forward sweep plan on the SDA-5500 Transceiver with only 1 sweep point. By sweeping the forward faster, the reverse will also be faster, but forward sweep will not be usable.

– Use an SDA-5510 Reverse Sweep Manager for up to 10 concurrent sweepers. This will decrease the probability of collisions with other sweepers off the same device. It also eliminates the chance of forward level overload.

Frequency Response Identification

– Refer to the Forward Sweep section of this application note.

Other Applications

Using the optional portable receiver/transmitter, SDA-5000, only:

– Segmented sweeping: Moving the transmitter out in the field to sweep and balance certain spans or legs of a cable plant.

– Active gain, frequency verification, or single amp bench alignment; When in the Loopback mode, the portable sweep transmitter/receiver reads its own signals. Technicians may use it to evaluate the frequency response and gain of a single amplifier. Set up a channel plan with sweep points every 1 MHz for good resolution. The total number of points is limited to approximately 500.

– Segmented Noise mode for troubleshooting: Rather than getting the aggregate noise from many receivers being combined in the headend, use the portable transmitter in the field for better segmentation of the aggregate noise. A PathTrak™ system can be installed for remote analyzing and performance archiving of the return spectrum as received in the headend or hub site. Contact JDSU for more information.

Tips

1. The SDA-5000 field meter is capable of a frequency agile, CW carrier at 50 dBmV (40 dBmV for the older version). Select (Configure > Diagnostics > Transmitter Diagnostics) and set the transmit frequency, attenuation, and turn on the transmitter.

   Note: Leave the field meter in this mode for the transmitter to stay active. The cable must be attached to the OPT port on the SDA-5000.

2. The field meter is DC blocking to 200V peak-to-peak. This equates to approximately 100 VAC.
3. Once a trace is stored, you can alter the dB/div, start and stop freq., tilt compensation, etc. To print this altered trace, press the blue Function key select Print (SDA-5000 only). Use the printer serial cable available from JDSU.
4. The sweep file overlay is a feature on the SDA-5000 to view an existing stored file and see the actual sweep trace overlaid. Select Configure > Sweep Receiver > Sweep File Overlay and turn the feature on. You can also upload an old file from Stealthware into the field unit to do an overlay. This feature is not available on DSAM.
5. The standard is 2 dB/div for sweeping and 5 or 10 dB/div for spectrum analyzer viewing.
6. Select the green Function key and i key for instrument information such as calibration date, serial number, options installed, etc.
7. The SDA-5500 Stealth Sweep Transceiver will transmit/broadcast the ingress from all the return amplifiers connected to it back to the field unit. This will be transmitted on the forward telemetry with 280 kHz of resolution. Return continuity is not needed for this reception. The Noise mode on the SDA-5510 Return Sweep Manager transmits the total noise in the headend also, but with a resolution based on the return channel plan resolution.
8. You may change the start and stop frequencies in the Sweep mode of the SDA-5000 field unit, which makes it easier to move your markers around within a narrower spectrum view. The DSAM-6000 uses the markers to identify the desired spectrum view, then selecting View > Zoom uses the markers to specify the narrower spectrum view.
9. Type in the frequency and press Enter to make a marker jump to that frequency.
10. The unit must sweep 4 times before a reference can be taken.
11. The SDA-5500 and the SDA-5510 not only displays the noise received, but can also be used to determine which technician is reverse sweeping.
12. The number of sweep points is limited to 500. Inserting too many will make the refresh of the sweep display slower and requires more memory for file storage. The sweep update time is dependent on the set-up.

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