

Forward Sweep and Balance

Application Note 1



**Cable Networks
Application:**
Using Acterna's
family of SDA
Sweep for
forward sweep
and balance.

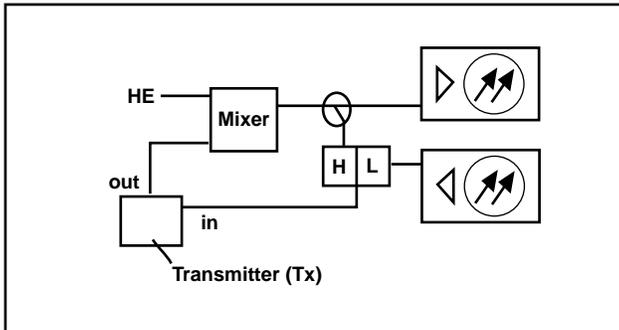


Step-by-Step Headend Set-up

Set-up of Forward Sweep (see diagram below)

A diplex filter is used to combine reverse signals into the rack mount unit instead of a splitter or DC-12 because of isolation issues, and the return fiber receiver is more than likely 5-200 MHz. This could cause jitter on the forward sweep if not set-up properly. Because the Stealth transmitter must see itself, be careful with what is in this "loop", such as launch amps, filters, etc; it could cause problems.

Note: Be sure input levels are between 4 and 12 dBmV. The recommended is 6 dBmV \pm 2. If levels are too high, channels may be enabled that aren't even there. Levels too low will leave channels disabled that otherwise should be there. The Stealth Headend Transmitter (Tx) and Multiple User Reverse Receiver (Rx) recommended input for reverse RF is 0 dBmV \pm 2. It may work between \pm 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: The newest Stealth field meter replaced many of the menus with icons. The "Set-up" button has been replaced with a "Configure" mode, which can be accessed through the "Navigator" mode, or by pressing "func" (green key) and the number 3 key. Channel plans and files names are limited to 15 characters.

The Tip Box

It's faster to build a channel plan using StealthWare. Version 6 is the latest.

1. "Video 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 Tx or StealthWare.
 - 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"
 - Enable or disable channels appropriately
 - Enter tilt channels, sweep channels and/or scrambled channels
 - Enter the type of channel (Single, TV, Dual, Digital, QAM Digital Stream, Sweep Insertion Point)

The Tip Box

When making labels, the up and down diamond keys can be used to access special symbols (i.e., "@", "\$", etc.).

To get to a certain channel quicker than scrolling, go to the "Level" mode, type in the channel number, then go back to "Edit Channel Plan" or press func. 4.

Note: "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 new QAM option; 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, there will be no sweep points made.

Build Sweep Points (Configure; Channel Plan; Build Sweep Points)

This is an option on the Tx only. Sweep insertion points are for vacant bandwidth and channels which are disabled to allow sweeping of the entire spectrum. The default is ch. 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 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.

Note: Ensure that no sweep insertion points are built within 6 MHz of either side of the ALC frequency. This could cause problems with the ALC circuitry in certain amplifiers.

Sweep Transmitter (Configure; Sweep Transmitter)

"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. The wrong mode selection will create erroneous readings.

"Forward Telemetry Frequency" must be in the 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 Tx, 52 MHz on the Rx, and 53 MHz on the PathTrak HSM.

Note: If diplex filters in the actives have a sharp roll-off, it may be wise 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 taken into account.

"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 20-50 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 14-16 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.

Note: 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 14-16 dB below the closest visual carrier. This can be seen 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" means that the sweep display will include all audio carriers; if you chose 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" is not applicable for forward sweeping.

"Reverse Sweep Plans" is not applicable for forward sweeping.

Copying Channel Plans

Ensure the sweep receiver is connected to the Tx by means of the 9 pin, RS-232 connector on the back of the receiver and the front of the Tx. This cable is supplied by Acterna and has a specific pin configure (refer to manual for cable pin configuration). Also be sure that the baud is identical on both pieces of equipment.

Note: The headend unit's channel plan does not have to be downloaded to the field unit to achieve sweep. Only the telemetry has to be the same. The channel plan in the field unit doesn't affect the sweep, only the other measurement modes like "level", "tilt", "scan", etc.

Note: If a channel plan is made on an older field meter and copied to the Tx, the Tx will freeze up and must be shut off to reset. One way around this is to transfer the channel plan to Stealthware then from a computer to the Tx. You can copy channel plans from field unit to field unit or from the Tx to a field unit.

On the receiver, select (Configure; Channel Plan; Copy Remote Plan) and enter the forward plan for the system you are working on. The Tx then downloads the plan you have built, but "sweep points" don't show up in the hand-held channel plan unless it has the portable transmitter option installed.

Field Unit Settings

Select (Configure; Measurement) and insert all the required information (Temperature Units, Signal Level Units, Fundamental Hum Frequency, Scan Rate, etc.).

Note: Select "func" and "7" to enter the Test Point compensation. You can also access the Test Point compensation through the Navigator screen on the newest unit. There is a toggle button to select forward or reverse Test Point compensation.

On the receiver, select (Configure; Sweep Receiver) and set the forward sweep telemetry frequency to be the same as the Tx. Set for the sweep mode intended to be used. Depending on the options installed in the field unit, these modes are as follows: "Sweepless", "Stealth", "SDA Compatible", "Loopback Sweep", "Transmit", and "Transmit (SDA compatible)". Normally we would select "Stealth" or "SDA Compatible".

Before You Leave the Headend

Be sure the Tx is in the sweep mode.

When at the headend, 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 receiver by using the left and right diamond keys or selecting the following sequence: (Configure; Sweep Receiver; Sweep Direction).

The Tip Box

The "Tilt" mode is simple and makes selecting EQs very easy.

A forward sweep reference can also be taken at this time. Press "func" and "6" and enter a name for your reference. Some systems may want to use this reference for tap output responses.

Note: Be careful with 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.

Forward Balancing and Sweeping

First, balance the signal levels at the node using your "Tilt" and "Level" modes at the bandedge frequencies. Press "Sweep" and verify all is well. Press the right diamond key for forward sweeping.

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: It's good to compare "apples" to "apples". Don't change things like in-line pads and test leads once a reference has been stored. Store a new reference otherwise.

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.

The Tip Box

The "Tilt Compensation" mode of the field unit makes it easy to get a true peak-to-valley no matter what 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 won't work.

Note: The "max/min" 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 unit 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 (Stealth unit must have digital option installed to monitor digital levels), which could slow down the sweep update time depending on the total number of digital and scrambled channels. The newest unit with the SDA Compatible mode utilizes 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 you have the luxury (make sure you terminate the spigots). It's an easy way to isolate the system.
- Verify for good test leads, connectors, F-81 barrels, etc.
- Use an in-line pad on your test lead to see if the standing wave goes away. If so, there is a reflection 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 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. Watch out 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. We sometimes lose communication on input test points because of the 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. Make sure test point compensation is 0.
- Verify test equipment connections, amplifier continuity, active gain, and that no terminators are installed. Just use the "level" mode to see if actual channels are present. If so, then there must be continuity.
- Verify the instrument is sweeping in the correct direction. Press the right diamond key and look in the upper right corner of the field unit display.
- Press "Sweep" on the Tx. (Sometimes it's the little things that kill.)

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 Tx to verify.

- Use the correct sweep mode. The wrong mode could lead to problems.
- If input levels are too high, this could cause extreme intermodulation distortions, which could affect the associated sweep points.
- 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 new SDA units, but not in the SDA Compatible mode.

Faster Forward Sweep

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

- Disable the Reverse Sweep and Live Headend Ingress View if present (Configure; Sweep Transmitter.)
- Don't sweep the video frequency of a scrambled channel. Leave it enabled, but don't use it as a sweep point. Insert another channel at the audio frequency, change the type to "single channel" instead of "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 guardband of digital channels. 1 or 1.1 MHz below the analog channels seems to be the "sweet spot". 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.

Note: This new plan doesn't have to be loaded or enabled in the field unit for sweep to be achieved.

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

Frequency Response Identification

- Low End Roll-Off or Instability
 - Usually caused by loose seizure screws, bad EQs/CSs, diplex filters, or dirty fiber connections.
- Standing Waves
 - 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. They can even be created between the test point and test equipment. If you use the formula $492 * V_p / f$, it will tell you the "ballpark" distance in feet to the fault. V_p 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 testpoints.

- Suck-Outs
 - Caused by grounding issues or multiple impedance mismatches at perfect intervals. Sometime this also manifests itself as spikes because of signals adding in-phase. Spikes are also caused by oscillations and ingress.
- High End Roll-Off
 - Associated with bad accessories, water, cracked sheath, or amplifier bandedge roll-off.

Other Applications

Using the portable receiver transmitter for Forward Activation. Acterna's portable Stealth Sweep transmitter and receiver can be utilized to perform the following:

- Balancing inactive plant; One could insert the receiver transmitter into the node where the optical receiver usually inserts. 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 is assuming that the next amplifier will be running the same tilt and output levels as the node. Otherwise, offset accordingly.
- Single amp bench alignment; When in the Loopback Sweep mode, the portable sweep transmitter/receiver reads its own signals. One could use it to see 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 around 500. Be sure to store a reference of your test leads before sweeping the device.

Tips & Hints

1. Because the Stealth 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 field unit 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 Tx frequency, attenuation, and turn the Tx on.

Note: *You must leave the field unit in this mode for the Tx to stay active. The cable must be attached to the "OPT" port on the field unit.*

3. If headend channel levels change, a new reference will NOT be required because the Tx will automatically compensate. It can't compensate for continuously fluctuating levels though.
4. The sweep file overlay is a nice feature to view an existing stored file and see the actual sweep trace overlaid. Select (Configure; Sweep Receiver, Sweep File Overlay) and turn it on. You can even upload an old file from Stealthware into the field unit to do an overlay.
5. Select "Func" & "i" for instrument information such as calibration date, serial number, options installed, etc.

6. The field unit 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 & stop freq., tilt compensation, etc. To print this altered trace, hit "Func" & "Print". (Use the printer serial cable supplied by Acterna.)
8. The de-facto standard is 2 dB/div for sweeping and 5 or 10 dB/div for spectrum analyzer viewing.
9. The new SDA unit has added a CW Loopback mode that is accessed through the Navigator screen. Consult Acterna for a list of other new features.
10. You can change the start and stop frequencies in the sweep mode of the field unit, which makes it easier to move your markers around.
11. Type in the frequency and hit "enter" to make a marker jump to that frequency.
12. Use "Zoom" to zoom in between the markers.
13. If you don't know the frequency of a certain channel, use the level mode. Type in the channel number, hit the "Channel" key, then hit the "Freq" key.
14. The Tx 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 Rx transmits the total noise in the headend also, but with a resolution based off the return channel plan resolution.
15. You can sweep without downloading the channel plan, but other measurement modes won't operate correctly, such as the "Tilt" mode. You must assure the same telemetry frequency.
16. The unit sweeps 4 times before a reference can be taken.
17. The number of sweep points is limited to 500, but inserting too many will make the refresh of the sweep display slower and take up more memory for storage of files. The sweep update time is dependent on the set-up.
18. "Show Horizontal Markers" (Configure, Sweep Receiver) is a nice feature to view the maximum peak and lowest valley between the vertical markers.

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