

Forward Sweep and Balance

Application Note 1



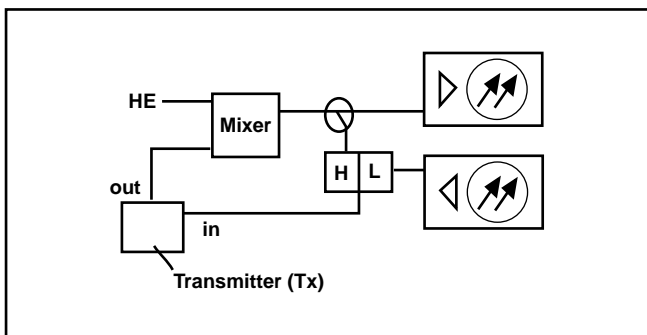
CATV Application:
Using WVG's
family of
StealthSweep for
forward sweep
and balance.

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 ± 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 ± 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: 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 4.1 with service kit 6 is the latest.

1. "Video Signal Type"
NTSC for North America, PAL 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")
 - d. "Enter Tilt Channels" (yes)
3. "Edit Channel Parameters"
 - Enable or disable channels appropriately
 - Enter tilt channels, sweep channels and/or scrambled channels
 - Enter the type of channel
(CW = Single, TV, Dual, Digital, Sweep Insertion Point)

Tx=Stealth Headend Transmitter
Rx=Multiple User Reverse Receiver

The Tip Box

When making labels, the up and down diamond keys can be used to access special symbols.

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".

Note: 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, 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)

"Forward Telemetry Frequency" must be in the vacant spectrum and at least 500 kHz from any other carrier; must also be within the bandwidth of the downstream spectrum. The factory default is 51 MHz on the Tx and 52 MHz on the Rx.

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.

"Forward Telemetry Level" determines the level of the telemetry signal (FSK). 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 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. Once the sweep is set correctly, change the Telemetry level to 4 dB above the Sweep Insertion level.

"Include Audio Carriers" means that the references 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 WWG and has a specific pin configure (refer to manual for cable pin configure). Also be sure that the Baud rate is identical on both pieces of equipment.

Note: The headend unit's channel plan does not have to be downloaded to the Stealth field unit to achieve sweep. Only the telemetry has to be the same. The channel plan affects the other measurement modes.

Note: If a channel plan is made on the StealthTrak field meter and copied to the Tx, the Tx will freeze up and must be shut off to reset. Only copy channel plans from field unit to field unit or Tx to 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.

On the receiver, select (Configure; Sweep Receiver) and set the forward sweep telemetry frequency to be the same as the Tx. Set for "Stealth" sweep mode instead of "Sweepless".

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. There is a toggle button to select forward or reverse Test Point compensation.

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).

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.

The Tip Box

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

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 (Sweep; Tilt; Tilt On/Off).

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.

256-QAM is a more complex modulation scheme and requires a higher C/N than 64-QAM. It also doesn't have as much guardband. The default option is to dwell on the carrier (Stealth unit must have digital option installed), which could slow down the sweep update time depending on the total number of carriers.

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. It's an easy way to isolate the system.
- Verify test leads, connectors, F-81 barrels, etc. Use an in-line pad 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.
- Verify proper set-up, levels, channel types, no overlapping sweep and actual channels, etc.
- Avoid common problem areas such as strong off-air broadcasts 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.)
- Firmware versions must be the same on the transmitters and receivers. Stealth firmware version 9.3 is the latest. StealthTrak version 1.2 is the latest and fully compatible with version 9.3. Stealth firmware versions 8.5 and 9.3 are not compatible and will yield inaccurate sweep measurement results.

Bad Response

- Verify accessories are operating correctly such as cable, push-ons, 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 "Stealth" sweep instead of "Sweepless" sweep. 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.

Faster Forward Sweep

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

- Disable the Reverse Sweep and Ingress Broadcast 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. 1.1 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.
- This new plan doesn't have to be loaded or enabled in the field unit for sweep to be achieved.

Frequency Response Identification

- Low End Roll-Off
 - Usually caused by loose seizure screws, bad EQs/CSs, or diplex filters.
- 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 $492 \cdot V_p / f$, 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 distance 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 $984/2 = 492$.

- 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.
- High End Roll-Off
 - Associated with bad accessories, water, or amplifier bandedge roll-off.

Other Applications

Using the portable receiver transmitter for Forward Activation.

WWG's portable StealthSweep transmitter and receiver can be utilized to perform the following:

- Segmented sweeping; Moving the transmitter out in the field to sweep certain spans or legs of a cable plant.
- 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 transmitter mode, the portable sweep transmitter/receiver reads its own signals just like the headend transmitter when sweeping. One could use it to see the frequency response and gain of a single amplifier. Set-up a channel plan with sweep points every 250 kHz for better resolution.

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.

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 WWG.)
8. The de-facto standard is 2 dB/div for sweeping and 10 dB/div for spectrum analyzer viewing.
9. Version 9.3 firmware has added a few features worth mentioning. There is a hard key for Test Point Compensation (func. 7) a hard key to Select Previous Screen (func. 1) and Password Protection. Also, the spectrum analyzer is faster and has variable dwell times (only in the latest generation of Stealth and 4040D meters).
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. The sweep update time is dependent on the set-up.
18. "Show Horizontal Markers" (Configure, Sweep Receiver) is a nice feature to view the max peak and valley between the vertical markers.

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