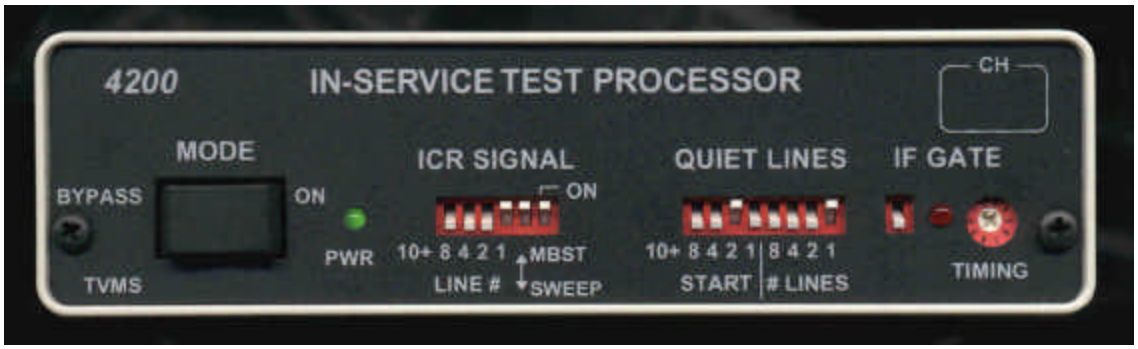


Model 4200

In-Service Test Processor

OPERATING INSTRUCTIONS

&

CALIBRATION PROCEDURE

Television Measurement Services

34405 SW Larkins Mill Rd

Hillsboro, OR 97123-9043

Tel: (503) 628-3764

e-mail: manuals@tvms.net

www.tvms.net

INTRODUCTION

Thank you for selecting the TVMS model 4200 In-Service Test Processor. The 4200 is designed to simplify cable system tests by providing appropriate test conditions for in-service CTB, CSO, carrier to noise ratio (C/N) and In-Channel Response (ICR) testing. 4200s can essentially eliminate subscriber disruptions during proof-of-performance testing. Also, with a little ingenuity, proofs can be conducted without a person in the headend to switch signals, etc. Except for CTB tests, the 4200 can be left in service continuously. Or, it can be "switched off" by placing it in the BYPASS mode.

In-Channel Response Test Signal

The 4200 provides two different signals for in-channel response tests: Multiburst and Line-Rate Sweep. The 4200's in-channel response test signals cover the complete FCC proof-of-performance frequency range (500 kHz below to 3.75 MHz above the visual carrier frequency). The in-channel response test signal can be inserted on any scan line between lines 10 and 25.

Quiet Line Insertion

If you have been using test equipment that performs C/N and/or CSO measurements during quiet lines in the vertical blanking interval, you've probably had situations in which the test instrument indicated that no quiet line was found. Or, perhaps noise on the incoming signal dominated your system noise, causing inaccurate readings. The 4200 can insert up to 15 quiet lines in the vertical blanking interval — ensuring consistent, accurate measurements.

In-Service CTB Tests

In a manner similar to blanking the video signal for in-service C/N and CSO tests, the 4200 can blank the visual IF signal for in-service CTB tests. This provides time during which analyzers with gated measurement capabilities can perform tests at the visual carrier frequency without affecting the picture displayed on television sets. There will necessarily be some sound buzz during in-service CTB tests. The magnitude of the buzz is mostly determined by the subscriber's television set or the set-top box. The duration is determined by the spectrum analyzer being used and the preferences of the person running the tests.

Refer to the section on In-Service CTB tests for more information regarding the characteristics and trade-offs involved with this technique.

Equipment requirements:

For gated CTB tests, you must have a spectrum analyzer with gated measurement capabilities. That includes the HP 8591C with Option 107, Tektronix 2715 and the Avantron AT2000R. You must also have modulators with a video and/or composite IF loops. The IF loops should have at least 65 dB isolation. Most modulators meet that criteria.

Model 4200 Specifications Summary

Characteristics	Performance Requirements	Supplemental Information
Video Specifications		
Gain	1.0 ± 1%	Reference: White bar, FCC composite test signal.
Frequency Response	± 1% to 4.2 MHz ± 3% to 4.2 MHz	Bypass Mode ON Mode
Signal to Noise ratio	> 70 dB	5MHz bandwidth, unweighted.
Signal to Noise ratio, quiet line	> 70 dB	5MHz bandwidth, unweighted.
Spurious Signals	> 45 dB down, >10MHz	Relative to 100 IRE.
Multiburst Frequencies	500 kHz, 1.25 MHz, 2 MHz, 3 MHz, 3.75 MHz.	1 cycle at 100 kHz provided for setting depth of modulation.
Line Sweep	97.6 kHz to 4.375 MHz	97.6 kHz steps
Multiburst/Sweep Amplitude	100 IRE ± 2%	May be internally adjusted to a lower level if desired.
Multiburst/Sweep Flatness	± 0.25 dB	As measured with a spectrum analyzer adjusted for 100 kHz or 300 kHz resolution bandwidth.
Multiburst/Sweep insertion range	Any single line, from 10 to 25	Both fields
Quiet line insertion range	From 0 (off) to 15 lines starting on any line from line 10 through line 25.	Both fields. No insertion beyond line 25.
IF Gate Specifications		
Input level	40 ± 6 dBmV	
Gain	0 ± 0.5 dB	At 45.75 MHz
Frequency Response	± 0.25 dB	42.0 to 46.25 MHz
Switch isolation	≥ 80 dB at 45.75 MHz	
Remote control	Ground closures to enable the IF gate and to switch the IF signal OFF/ON.	The IF gate can be adjusted for the odd field or both fields.
General Specifications		
DC Input Voltage	8 to 11 VDC. 3 W max.	Power module provided.
Dimensions (H, W, D)		1.5H, 5.5W, 4.5D (inches)
Temperature range, operating	40° to 120° F	
Optional accessories	Rack adapter Heavy duty power module	Mount 3 4200s in 1 rack unit. Powers 3 4200s.

INSTALLATION

The 4200 must be installed in the video signal path at a point where the signal is not scrambled. Typically this means connecting the 4200.....

- at the output of the satellite receiver for digital feeds or for analog feeds that are in the clear
- at the output of the descrambler (e.g. at the VideoCipher® output) for scrambled satellite feeds
- at the output of a demodulator for off-air signals, or
- at the input to the modulator for locally originated programs.

Because it must synchronize to a baseband video signal, the 4200 cannot be used with channel processors.

For in-service CTB tests, the video IF or composite IF signal from the modulator must be passed through the 4200. IF gating cannot be used with modulators that don't have IF ports. Further, both video and the IF signal must be connected — connecting the IF signal without video being connected will not work.

Mounting

The 4200 can be placed in the back of the equipment rack by simply placing it on top of existing equipment. For permanent installations, up to three 4200s can be mounted in the optional rack adapter. In either case, switch the MODE control to the BYPASS position, place the 4200(s) where desired, then plug in the power connector. The PWR indicator will illuminate indicating power is present. As long as the 4200 is in the BYPASS mode, or if power is removed, it passes the signals directly from the IN connectors to the OUT connectors with no processing.

Video Connections

Connect the 4200 in series with the unscrambled video signal:

Make certain the 4200's MODE switch is in the BYPASS position. Connect the video output from the descrambler, demodulator, or other video source to the VIDEO IN connector at the rear of the 4200. Connect a cable from the 4200's VIDEO OUT connector to where the video signal was originally connected. Use a picture monitor to be certain the channel is operating normally.

IF Connections

For in-service CTB tests you need to connect the 4200's IF ports in series with the visual or composite IF signals from the modulator. Connect the IF output from the modulator to the IF IN connector on the 4200 and connect the 4200's IF OUT connector to the IF input on the modulator.

When the IF gate is enabled — either via the front panel IF GATE switch or the remote connector, the IF GATE LED will flash indicating that the IF gate is operating.

Remote Control Connections

The IF switch in the 4200 can be controlled from the front panel or, via the REMOTE connector on the rear panel. Three pins are provided: GND, GATE, & SWITCH.

While the GATE pin is shorted to GND, the IF gate will be enabled and the IF signal will function according to the switch settings as described below under "In-Service CTB Tests".

As long as the SWITCH pin is shorted to GND, the IF signal will be turned off. This allows the visual carrier to be removed for out-of-service tests.

Interconnecting power supplies.

If a power supply of adequate rating is used, more than one 4200 may be powered by a single supply.

Use a 9V regulated power supply that is capable of providing at least 265 ma. per 4200. So, for two 4200s, you need at least 530 ma., for three 4200s at least 0.8 amps, etc. Connect the power supply to one 4200 9VDC IN connector; use a separate cable to connect the 9V Out connectors together. Size 20 or 22 hookup wire is a good choice for three 4200's and typical run lengths.

SET-UP INSTRUCTIONS

The 4200 was designed to work with spectrum analyzers that have gated measurement capabilities. If your analyzer doesn't have gating capabilities, you may want to use a TVMS model 4100 rather than the model 4200 for in-service testing.

Selecting lines for ICR and C/N tests

To insert the ICR test signal or quiet lines, the 4200 must delete existing test signals or data on the selected lines. You may want to avoid insertion of test signals on lines containing data that your subscribers may use or on lines that contain calibration signals (such as the ghost cancellation reference signal).

If you have test equipment that allows you to view individual scan lines during the Vertical Blanking Interval, it is a simple matter to view the VBI of the channel to be tested and select lines that have no signals or, lacking any "quiet lines", signals that can be removed without affecting subscribers. Usually you will want to avoid using lines 19 or 21 because they often contain the ghost cancellation reference signal and closed captioning data respectively. Lacking definite knowledge of the vertical blanking interval, you can usually use lines 10 through 13 without affecting subscribers. A call to the program provider may also provide information about vertical blanking interval signals.

Setting the 4200's ICR SIGNAL and QUIET LINE switches

Most of the functions of the ICR SIGNAL and QUIET LINE switches are binary coded. Binary coding provides sixteen different selections with only four switches. It's easy to use binary coding once you are familiar with the basic idea. For example:

Notice that under the ICR SIGNAL label, the four left-most switches are labeled "10+ 8 4 2 1". This means that, to insert the multiburst test signal on line 15, for example, you would move the switches above the 4 and 1 to their "up" position. This represents 15 because "10 + 4 + 1" = 15.

For line 16 the "4 " and "2" switches would be up and the "8" and "1" switches would be down (10 + 4 + 2 = 16). The In-Channel Response test signal can be inserted on any line between lines 10 and 25. Their binary codes are:

Line #	8	4	2	1
10	low	low	low	low
11	low	low	low	high
12	low	low	high	low
13	low	low	high	high
14	low	high	low	low
15	low	high	low	high
16	low	high	high	low
17	low	high	high	high
18	high	low	low	low
19	high	low	low	high
20	high	low	high	low
21	high	low	high	high
22	high	high	low	low
23	high	high	low	high
24	high	high	high	low
25	high	high	high	high

For the quiet line inserter, the first quiet line needs to be specified in addition to the number of consecutive lines to be forced "quiet" (any

existing noise, data, or signals deleted). The first quiet line is set, using the switches above "START", in the same manner as specifying the ICR SIGNAL line number.

To insert a single quiet line set the "1" switch above # LINES high and the "2, 4 and 8" switches low. For two quiet lines, set the "2" switch high and the others low, for three lines set "1" and "2" high, etc. You may insert between 0 (no quiet lines inserted) and 15 quiet lines. No quiet lines may be inserted above line 25.

If a quiet line is inserted on the same line as multiburst, the multiburst signal will be disabled.

SELECTING THE TEST SIGNAL FOR ICR TESTS

The 4200 provides a choice between two signals for In-Channel Response tests:

1. Multiburst with frequency packets of 500 kHz, 1.25 MHz, 2 MHz, 3 MHz and 3.75 MHz.

2. Frequency Sweep from 97.6 kHz to 4.375 MHz.

There are several trade-offs between the two signals:

- Although the sweep signal appears to provide a continuous frequency sweep, it actually consists of a complex combination of many discrete frequencies. When viewed with a spectrum analyzer at 100 or 300 kHz resolution bandwidth (RBW) the resulting trace is “smooth”, generating the illusion that very narrow peaks or valleys in the response can be measured. In fact, the ability to resolve peaks and valleys is limited by the RBW filter in the analyzer and may be much less accurate than expected.

- The width (duration) of multiburst packets may determine the amplitude as displayed on a spectrum analyzer – especially at 100 kHz or less RBW. Wider (longer duration) packets will typically yield higher amplitude displays. The *absolute* magnitude of the displayed packets is much less important than their *relative* amplitudes.

- If peaks or valleys occur near a multiburst frequency, you may get a more accurate reading using a multiburst than a sweep signal.

- When using a sweep signal for in-channel response tests, you must be careful to measure over the entire FCC specified bandwidth – and no more. If you use the multiburst test signal provided by the 4200, the frequency limits are automatically displayed (500 kHz below and 3.75 MHz above the visual carrier frequency).

- The multiburst test signal generated by some test signal generators is not flat when displayed on a spectrum analyzer – especially at 100 kHz RBW. The 4200’s multiburst is flat within +/- 0.25 dB – even at 100 kHz RBW.

Normally, the 4200’s multiburst test signal should be used for in-channel response testing with the Tek 2715. Either multiburst or sweep can be used with the Avantron AT2000R or HP 8591C. The sweep signal may be preferred if you use an HP 8591C opt 107 analyzer.

The type of ICR test signal is determined by the position of the MBST/SWEEP switch. The selected signal is enabled when the right-most ICR SIGNAL switch is in the ON (up) position.

IN-SERVICE CTB TESTS

Overview

In-service CTB tests are essentially identical to in-service C/N and CSO tests. A period of time is provided during which the analyzer can take a sample without the visual carrier being present. For in-service C/N or CSO tests, the 4200 provides the necessary quiet line(s) for the test. This is accomplished by gating off any video signals (noise, data, VITS, or live video) while the analyzer takes its samples. For in-service CTB tests, the visual carrier, rather than the video signal, is gated off at the necessary time. The visual or composite IF loop is used to gate the visual carrier off and on. Timing of the 4200's IF gate can be adjusted via the front-panel TIMING control to optimize performance for a given spectrum analyzer.

Sound buzz. When the visual carrier, aural carrier, or both are removed, nearly all television sets will exhibit sound buzz. This occurs because most sets (and set-top boxes) use inter-carrier sound systems. Within the set, the visual and aural carriers are mixed together to produce the 4.5 MHz sound IF signal. If either carrier is missing, the 4.5 MHz difference signal will disappear, causing the buzz. This can also happen if the video modulation depth is set too high (at very high modulation levels the RF signal becomes so small that the 4.5 MHz aural IF amplifiers do not produce sufficient limiting to prevent buzz).

Its mostly the design and construction of television sets and set-top boxes that determines the magnitude of the sound buzz. For most sets, the buzz is low level and may not even be noticed by viewers. For others, the buzz is much more evident, but typical program sound can be heard through it. Gated CTB tests should be performed as quickly as possible to minimize the duration of the buzz.

Adjusting the IF GATE TIMING control

The IF GATE TIMING control sets the width (duration) of the IF gate to meet the requirements of the analyzer being used. It also provides selection of either both or just odd video fields. Once the IF GATE TIMING switch is set to the desired position, it will only need readjustment if a different spectrum analyzer is used or if it is desired to change the field selection.

The switch positions correspond to the following:

Sw. Pos.	Field	Gate duration	Notes:
0	Both	53 uS	AT2000R
1	Both	70 uS	**8591C**, 2715
2	Both	83 uS	8591C, 2715
3	Odd	53 uS	**AT2000R**
4	Odd	70 uS	8591C, 2715
5	Odd	83 uS	8591C, 2715
6	Odd	70 uS	Line 25 only. AT2000R, 8591C, 2715
7	Odd	83 uS	Line 25 only. AT2000R, 8591C, **2715**
8			Reserved for future use
9			Reserved for future use

Suggested settings for the HP 8591C/107, Avantron AT2000R and Tek 2715 are displayed in bold type. Other settings may be selected after considering the following:

Fields:

- Either both fields or just the odd field may be selected and will work with any of the listed analyzers.
- The level of the sound buzz will be slightly less when using one field.
- The Tek and Avantron analyzers always use one field when doing gated measurements. Therefore, one field is the logical choice for them.
- The HP analyzer can be set to use either both fields or one field. Using both fields

cuts the amount of time required to complete the test in half (relative to using one field) but the intensity of the sound buzz is slightly greater. Usually, faster and slightly louder is the preferred mode.

Gate duration:

- Shorter gate duration yields lower levels of sound buzz. However, if the gate duration is too short, dynamic range will be reduced. The Resolution Bandwidth Filters in the analyzers determine the minimum duration.
- The Avantron analyzer works with 53 uS gate duration.
- The HP and Tek analyzers require longer duration.
- Either 70 uS or 83 uS gate duration can be used with the HP and Tek analyzers. The longer gate causes slightly more sound buzz but provides a little more dynamic range for the measurement. For typical FCC proof of performance field tests, there will be little or no difference in the test results.

Setting up the analyzer for In-Service CTB tests

HP8591C option 107
For the 8591C, Down Loadable Programs (DLPs) must be transferred to the analyzer. The necessary files, a program to transfer them, and instructions are included with the 4200 In-Service Test Processor. Refer to the README.TXT file that is included on the diskettes for installation details.

Avantron AT2000R
For the AT2000R, Avantron has provided software that includes gated CTB measurements as part of the normal menu selections. If your analyzer does not have this feature, contact Avantron for more information.

Tek 2715
For in-service CTB measurements with the 2715, the CSO, rather than CTB, menu selection is used. To ensure that the desired line numbers will be used for the gated tests, a new channel table should be created as follows:

- Open the Tek channel table editor software.
- Select "Yes" in the "Use Quiet" column for each test channel.
- Enter the desired line number in the "Quiet Line" box for each test channel.
- If desired, set up the line number for In-Channel Response tests at this time.
- Save the new channel table under a new file name (File/Save As/*Filename*).
- Transfer the new channel table to the 2715 (Transfer/To/…).

USING THE 4200 TO MAKE MEASUREMENTS

In channel response

- Set the ICR SIGNAL LINE # switch to the desired line.
- Position the MBST/SWEEP switch up for multiburst, or down for sweep.
- Enable the multiburst or sweep signal by switching the right-most switch to the ON position.
- Set the MODE switch to ON.

The 4200 will insert a high level multiburst or sweep signal on the line specified. Adjust your test instrument to make the in-service measurement on the selected line. You may need to adjust your test instrument to use the same multiburst frequencies as the 4200. If so, set it to -.5 MHz, .5 MHz, 1.25 MHz, 2 MHz, 3 MHz and 3.75 MHz. Perform the test as instructed in your test equipment user's manual.

Note: Due to the shape of the resolution bandwidth (RBW) filters in some spectrum analyzers, such as the Hewlett Packard 8591C, the 500kHz packets may not be visible using 300kHz RBW. In that case, use a narrower filter — such as 100kHz.

To use multiburst with the 8591C opt 107, the following key sequence can be used, starting with the CHAN MEAS softkeys:

Enter channel #; Main; 3 of 3

IN-CHNL FRQ RSP; VITS TEST; (Enter line number that matches 4200 setting); FLD BOTH; Select Test Sig; MULTIBURST; Prev Menu; Continue; BW (down arrow for 100 kHz RBW); (wait for scan to finish); MODE; MODE.

Position Marker 1 and Marker 2 to the maximum and minimum levels on the test signal.

To use the 4200's sweep signal with the 8591C, select GCR as the test signal.

Carrier to Noise Ratio

- Set the QUIET LINES START switches to the line on which you want the quiet lines to start.
- Set the QUIET LINES # LINES switches to the number of sequential quiet lines you wish to use. More lines may produce quicker and/or more accurate results with the 2715 when it automatically selects quiet lines. To avoid deleting the ICR test signal, be certain the quiet line settings don't overlap the ICR SIGNAL line number. Also, be careful that you don't delete needed data, such as decoding data or closed captioning.
- If not already in place, set the MODE switch to ON.

The 4200 will delete any signals on the selected line(s). If necessary, adjust your test instrument to make measurements on the selected line(s).

In-Service CTB & CSO Tests

Here are procedures that will help you get started with Gated CTB tests. A listing of all the capabilities for each of the analyzers is impractical. However, you may want to start with these and experiment from there.

HP 8591C option 107:

- Install the DLPs as described in the README.TXT file that is included with the diskettes.
- Here are the steps starting from pre-setting the analyzer. You can skip the first 4 steps if the analyzer is already set up for gated measurements and Channel Meas has been selected.

1. PRESET
2. CABLE TV ANALYZER
3. Setup, GATING YES, PAUSE YES, Prev Menu
4. CHANNEL MEAS
5. Enter channel number
6. Main, 2 of 3
7. CSO/CTB
8. Enter line # to match 4200 setting
9. Continue (after a sweep, you can measure CSO or other coherent disturbances before enabling 4200).
10. Gated CTB
11. Enable the 4200's IF Gate in the Headend, Continue
12. Wait for one or more sweeps, read the beat level
13. Disable the IF Gate in the Headend

Hint: most 8591C users read the beat level after the first sweep. For most measurements, that is probably adequate. However, improved accuracy can be obtained by letting the analyzer average over several sweeps or by using the ZOOM & MEASURE soft key.

Avantron AT2000R:

You must have the appropriate firmware version installed in the AT2000R for Gated CTB measurements. When in place, the test method follows the same procedure as for non-gated CTB tests. Here's the basic sequence:

1. Press MENU button
2. Select C/N, CSO, CTB
3. Select SINGLE for just CTB tests
4. Select CTB
5. Select Gated

6. If necessary, change the test line number to match the 4200 setup

7. Enable the 4200 in the Headend

8. MEASURE

Tektronix 2715:

- Select the channel table created in the ***Setting up the analyzer for In-Service CTB tests*** above, (CATV/APPL,CATV Measurements Setup, Channel Table, …).
- Tune to the channel to be tested.
- Go to the CSO menu screen and enable IN-SERVICE, then select SET UP CSO.
- Select AUTO, then SET UP TEST FREQUENCIES.
- Set one of the TEST FREQUENCIES to 0 MHz Offset for the CTB test. You may also set offset frequencies for CSO tests by entering additional test frequencies of -1.25 MHz, -750 kHz, +750 kHz and +1.25 MHz. Keep in mind that the gate (and, therefore sound buzz) will be enabled for the duration of the test. You may want to run CSO tests separately from CTB to minimize the duration of the sound buzz.
- Back through the menus until the CSO menu is reached.
- Press 0 to run the test. When instructed to turn off the carrier, enable the 4200's IF gate in the headend.

Hints:

When performing gated measurements on quiet lines, the 2715 checks to confirm that the line really was quiet after the test is completed. If the quiet line is provided by gating off the visual carrier — as the 4200 does for in-service CTB tests, the 2715 will display "QUIET LINE NOT VERIFIED" and display the test results with "10" in front of the actual data, eg "1062.3". Assuming that you have the 2715 and 4200 are set to use the same line, you can ignore the message. It happens because the algorithm in the 2715 doesn't interpret carrier off as "quiet". The message doesn't occur if you use lines outside of the vertical blanking interval.

The 2715 can sometimes mis-trigger during gated CTB tests. If you see this occurring, select a different line number. Typically, line 25 works well. If occasional mis-triggers occur, the test result will be slightly worse than the actual beat level.

TESTS ON SCRAMBLED CHANNELS

C/N, CSO and ICR tests can easily be conducted on scrambled channels by running the tests at the output of the set-top converter. For most systems in the United States, all of these tests are required at the output of the converter as of January, 2000.

Scrambling systems can cause inaccurate measurement results due to differences in signal processing during the vertical blanking interval as compared to processing during active video. Consequently, it may be necessary to insert the ICR test signal and/or quiet lines during active video.

For some systems, lines 22 and 23 can be used. For other systems, lines 22 and 23 are used for processing within the converter — in that case, use lines 24 and 25.

Most consumer television sets overscan enough in the vertical dimension that the ICR test signal or quiet line, on line 24 or 25, is not visible. Regardless, it's best to put the ICR test signal on the lower line number to minimize the possibility of it being visible. For example, if using lines 24 and 25, put the ICR test signal on 24 and the quiet line on 25.

IN CASE OF DIFFICULTY

In most cases, problems using the 4200 are caused by improper installation. Be certain to install the 4200 as described in the INSTALLATION section above. Refer to the "HOW IT WORKS" section below for more information regarding the 4200's operation.

The picture is OK when the 4200 is in the BYPASS mode but disappears when the 4200 is in the ON mode. The connections to the Video In and Video Out ports on the 4200 may be reversed. Be certain that there is unscrambled video connected to the Video In connector.

The picture randomly flashes when the 4200 is in operation. This can be caused by erratic or very noisy video signals. Try using another channel, if the problem remains with known good video signals, the 4200 may need serviced.

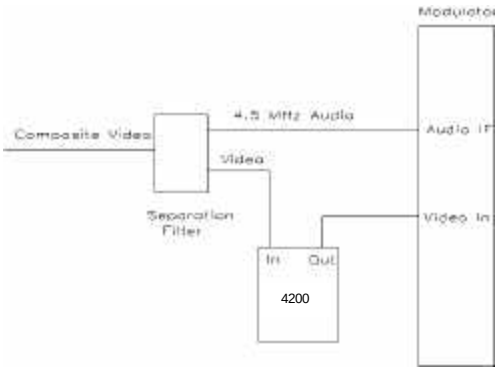
In channel response test results do not agree with measurements made using a test signal generator. Be certain that your test equipment is adjusted to perform the test on the same frequencies as provided by the 4200 or the test signal generator. The 4200 uses 500 kHz, 1.25 MHz, 2 MHz, 3 MHz, and 3.75 MHz for multiburst. Unless the test signal generator was specifically designed for cable television tests, it probably uses different frequencies. Also, use your spectrum analyzer to check the flatness of the test signal generator — some multiburst and sweep test signals appear flat on an oscilloscope but do not appear flat on a spectrum analyzer. Finally, the multiburst signal generated by some VITS inserters may not work properly with gated measurements. The 4200 was specifically designed to avoid this problem.

Sound buzz occurs when using the 4200. There are three potential causes of sound buzz when using the 4200.

There will necessarily be sound buzz when using the gated CTB measurement technique — see the section on In-Service CTB tests above. Also overdriving the modulator or, when using composite video, blanking the aural carrier will cause sound buzz.

If you are not using composite video (4.5 MHz aural carrier combined with the video input) audio buzz is likely caused by overdriving the modulator. The 4200 inserts a 100 IRE ICR test signal. If the program video level is less than the standard 1Vp-p (140 IRE), the inserted signal may cause clipping and/or overmodulation. Make certain the program video level applied to the modulator is 1Vp-p.

If you are applying composite video (video with a 4.5 MHz audio subcarrier) to the modulator, the 4200 will blank both the video and the audio resulting in sound buzz. In that case, a filter to separate the video and audio signals should be installed in front of the 4200. Connect the filter's video output to the 4200, connect its 4.5 MHz audio signal to the modulator's 4.5 MHz audio IF input port.



The dynamic range is limited when using Gated CTB tests. The 4200 removes the visual carrier by gating off the visual IF signal. Although the 4200 has over 80 dB of isolation, the modulator may have substantially less. Therefore, leakage between the modulator's IF OUT and IF IN connectors may limit the measurement range. Check the modulator by measuring the visual carrier, then disconnect the cable on the visual IF loop and measuring it again. The difference is an indication of the amount of isolation provided by the modulator. The actual amount of isolation may be a few dB different if the modulator has AGC circuits.

Also, the performance of the gating circuits and resolution bandwidth filters in the analyzer may limit dynamic range.

If the IF gate duration is too short, dynamic range will be reduced. Refer to *"Adjusting the IF GATE TIMING Control"* above for information about setting of the TIMING control on the 4200's front panel.

Typical dynamic range for gated CTB tests is over 70 dB. That's more than adequate for FCC proof of performance tests and most system tests. However, if you need the absolute maximum dynamic range for your CTB measurements, you may need to use disruptive test methods.

HOW IT WORKS

The 4200 uses synchronization information on the incoming video signal to determine when to insert the ICR test signal, quiet line(s), or to enable the IF gating function. To work properly, there must be standard NTSC synchronization pulses on the signal applied to the 4200's Video Input connector. *The 4200 will not function with scrambled video signals*. When the line number of the incoming video signal matches the ICR test signal line number or the quiet line number settings on the 4200's front panel, appropriate circuitry inside the 4200 is enabled to provide the desired test conditions.

When the IF gate is enabled, the IF signal will be gated off starting shortly after the sync pulse of the line indicated by the START switches portion of the QUIET LINES controls. The duration of the gate and which field(s) are used is determined by the IF GATE TIMING switch setting as described above.

If power is removed, or if the MODE switch is placed in the BYPASS position, relays inside the 4200 bypass the internal circuitry, bridging the VIDEO IN and VIDEO OUT connectors and the IF IN and IF OUT connectors.

CALIBRATION PROCEDURE

Only qualified technical personnel should use this section. The person performing the procedure should be familiar with NTSC video signals and general measurement procedures using oscilloscopes and spectrum analyzers.

Equipment required:

General purpose oscilloscope meeting the following specifications:

- At least 5 MHz bandwidth
- Ability to trigger on video signals
- Two vertical channels
- Ability to subtract the two vertical channel signals (CH1-CH2)

Spectrum analyzer meeting the following minimum requirements:

- Tunable to 2.7 MHz
- Resolution bandwidths of 30 kHz, 100 kHz and 300 kHz.

NTSC test signal generator

Precision 75Ω terminator.

Calibration of the 4200 consists of four sections:

1. Video Gain adjustments: Sets the gain of the 4200 to unity.
2. Internal timing adjustments: Adjusts the timing parameters to work properly with NTSC video.
3. ICR Test Signal level adjustment: Adjusts the level of the Multiburst and Sweep signals.

4. IF gate gain adjustment: Sets the gain of the 4200's IF loop to unity.

Refer to the circuit board drawing at the end of this section for adjustment locations.

1: Video Gain adjustments

- Apply a standard NTSC composite video signal to the video input connect. It is most convenient to use a test signal generator and a test signal, such as FCC composite, that includes a 100 IRE bar. However, if a generator is not available, a "live" signal can be used.
- Terminate the Video Out connector with a precision 75Ω terminator.
- Set both traces for 0.2 Volts/div and horizontal deflection for 10 uS/div. Connect both oscilloscope probes to the video input lead at the back of the Video In connector. Adjust the 'scope to trigger on the horizontal sync pulse and to subtract the two signals. If necessary, adjust the gain of one of the channels for a null in the display at low frequencies such as at sync tip. Ignore transients and subcarrier signals.
- Move one of the probes to the Video Output connector.
- Adjust R15 for a null at low frequencies.

2: Timing adjustments

- Apply an NTSC composite video signal to the Video In connection on the back of the 4200.
- Connect a scope probe to pin 2 of U5. Trigger on the falling edge of the waveform; use 1 µS/div sweep rate. Adjust R14 for a negative pulse width of 8µS.
- Connect one scope to U5 pin 13; trigger on the negative going edge. Attach the other probe to the video input lead at the back of the Video In connector.
- Adjust R13 for 1.2 µS between the negative edge at U5 pin 13 and the half amplitude point of the leading edge of the sync pulse at the video input connector.

3: ICR Test Signal Level Adjustment

- Apply an NTSC composite test signal to the VIDEO IN connector. Use a signal that does not have Vertical Interval Test Signals (VITS). Connect a precision 75Ω terminator to the Video Out connector.
- Attach a scope probe to the VIDEO OUT connector. Adjust the scope for 0.2 V/div vertical deflection scale, 10 uS/div horizontal rate, and triggered by the sync pulse. Place the 4200 in the ON mode and enable the ICR test signal. Any line number between 10 and 25 can be used. The ICR Test Signal will be visible "in the background" of the display.

  Alternatively, adjust the scope to trigger at the vertical scan rate of the signal and use a delaying time base to view the test signal during the vertical blanking interval.

- Adjust R33 such that the initial pulse of the test signal is 714 mV p-p (100 IRE). A convenient method for this is to use a test signal that includes a 100 IRE white bar, then set the 4200's ICR Signal line number to line 20 and adjust the test signal amplitude to match the white bar amplitude.

4: IF Gate Gain Adjustment

- The IF Gate gain control is accessible through the small hold in the shield of the IF Gate board.
- Apply a video signal to the 4200 Video Input connector. Connect the Video IF signal from a modulator to the 4200's IF Input connector. Connect the 4200 IF Out to the spectrum analyzer. Do not connect a video signal to the modulator's video input.
- Adjust the analyzer for 45.75 MHz center frequency, 300kHz resolution bandwidth, 1MHz total span, peak display mode, 1 or 2

dB/div and the Reference to display a signal similar to the one below:

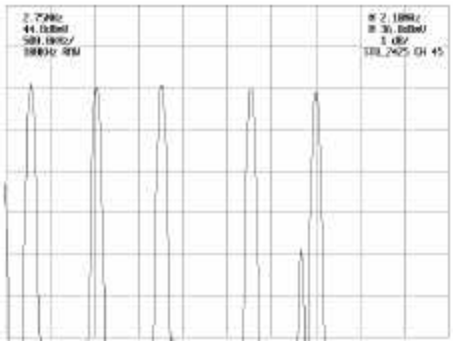
- Adjust the IF Gate gain control until there is no change in the peak signal level as the IF gate is enabled and disabled from the front panel of the 4200.

Verifying ICR Test Signal Flatness

The performance of the 4200's ICR test signal can be verified by measuring its flatness using a spectrum analyzer.

An analyzer with a 75 Ohm input impedance to below 500 kHz or an appropriate matching pad must be used.

Adjust the analyzer for a center frequency of 2.5 MHz, 100 kHz resolution bandwidth, 5 MHz total span, and 1 or 2 dB per division vertical display. Adjust the analyzer's sweep rate and reference level to obtain a display similar to the one show below. Measure the difference between the maximum and minimum multiburst packets. The difference should be less than 0.5dB (this is ± 0.25 dB).

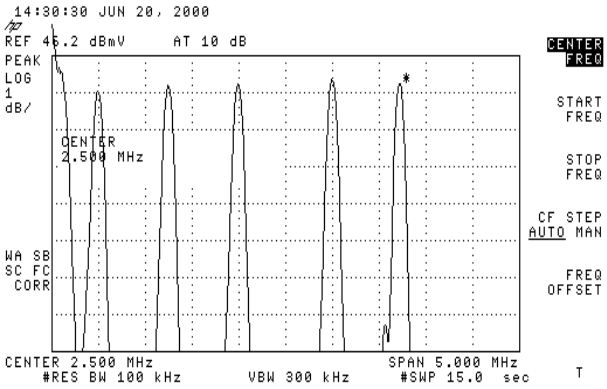


2715

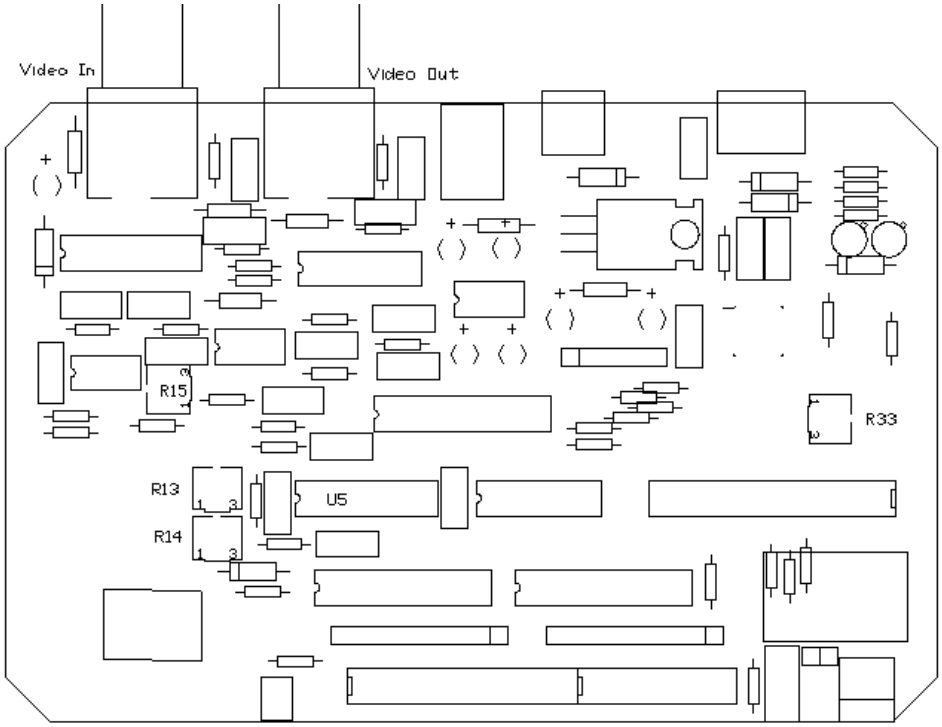
Note: the 8591C is specified down to 1MHz. It rolls off approximately 0.25 dB at 500kHz. Characterize the analyzer using a known flat signal generator before using it to verify the 4200 flatness.

Pictures from the 2715 and 8591C are shown below.

Notice that the 8591C display is "rolled off at the low end " slightly. For accurate results, you must compensate for the "roll-off".



8591C



Adjustment Locations

WARRANTY

Television Measurement Services (TVMS) warrants that this product will be free from defects in materials and workmanship for a period of one (1) year from the date of delivery. If the product proves defective during this warranty period, TVMS, at its option will either repair the defective product without charge, or will provide a replacement in exchange for the defective product.

In order to obtain service under this warranty, Customer must notify TVMS of the defect before the expiration of the warranty period and make suitable arrangements for service. Customer shall be responsible for packaging and shipping the product to the service location designated by TVMS with shipping charges prepaid. TVMS will pay for the return of the product to location from which it was shipped.

This warranty shall not apply to any defect, failure or damage caused by improper use or improper or inadequate maintenance and care. TVMS shall not be obligated to furnish service under this warranty a) to repair damage resulting from attempts by personnel other than TVMS representatives to repair or service the product; b) to repair damage resulting from improper use; c) to service a product that has been modified or integrated with other products when the effect of such modification or integration increases the time or difficulty of servicing the product.

THIS WARRANTY IS GIVEN BY TVMS WITH RESPECT TO THE PRODUCT IN LIEU OF ANY OTHER WARRANTIES, EXPRESS OR IMPLIED. TVMS AND ITS VENDORS DISCLAIM ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. TVMS' RESPONSIBILITY TO REPAIR OR REPLACE DEFECTIVE PRODUCTS IS THE SOLE AND EXCLUSIVE REMEDY PROVIDED TO THE CUSTOMER FOR BREACH OF THIS WARRANTY. TVMS AND ITS VENDORS WILL NOT BE LIABLE FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES IRRESPECTIVE OF WHETHER TVMS OR THE VENDOR HAS ADVANCE NOTICE OF THE POSSIBILITY OF SUCH DAMAGES.