1405 NTSC TELEVISION SIDEBAND ADAPTER

GENERAL INFORMATION

1.1 DESCRIPTION

The 1405 NTSC Television Sideband Adapter is an accessory instrument which is used with a spectrum analyzer, such as the 7L12, 7L13 or 7L14, to analyze the video output of a television transmitter. The 1405 generates a composite video signal, the "picture" portion of which is a constant-amplitude sinusoidal signal that sweeps continuously and periodically between 0 and 15 MHz. This signal is applied as modulation to a television transmitter. The transmitter output is displayed on the spectrum analyzer, and appears as the transmitter's response curve. The 1405/spectrum analyzer combination will display the frequency response characteristics of RF and IF circuits for transmitters with carrier frequencies up to 1 GHz. Video circuits (zero frequency offset) can also be analyzed.

The swept portion of the 1405 output signal is produced by mixing the 1405 local oscillator with the 7L12 or 7L13 first local oscillator. The first local oscillator produces a sweeping signal whose frequency limit depends upon the input frequency (tuned to the transmitter frequency), and the FREQ SPAN/DIV setting of the spectrum analyzer. Sync and blanking signals are combined with the sweep to form the composite output signal. The internal sync signal can be switched off for sinusoidal sweep only, or when external blanking is used. External blanking allows either full-field or single-line operation, a feature useful for in-service testing.

The output amplitude of the cw portion of the composite video signal can be varied from 0 to 100 IRE in 10-IRE steps. The average picture level (APL) can also be varied from 0 to 100 in 10-IRE steps. Three adjustable, preset APLs are provided, and can be selected for rapid checks. If a combination of cw amplitude and APL exceeds tv transmitter modulation limits, internal logic will clamp the APL to 50 IRE and light an UNCAL indicator as a caution.

Five marker frequencies related to tv transmission standards are provided; a sixth marker oscillator is available for a user-provided crystal. The intensity and width of the displayed z-axis markers are adjustable.

A television transmitter's aural fm deviation can be checked with the 1405, using the 10.396 kHz signal output. This signal, applied to a transmitter's aural input at the amplitude that produces the first carrier null, corresponds to ±25 kHz of frequency deviation, or 100% modulation.

1.2 ELECTRICAL SPECIFICATIONS

The following electrical specifications apply to the 1405 and the 1405/7L12, 7L13 or 7L14 combination. They are applicable over the environmental specification limits for the 1405 and 7000-Series mainframes.

Transmitter Frequency (Frequency Offset)

Range: Will tune and provide a swept video output for a 7L12, 7L13 or 7L14 center frequency range of 0 to 1 GHz.

FREQUENCY Dial Accuracy: When properly tuned to transmitter frequency, dial reading is within 20 MHz.

Fine Tuning Range: From ±0.5 MHz to ±1.25 MHz, depending upon transmitter frequency setting.

Tuned Frequency Drift: Less than 1 MHz per hour after a 30-minute warm-up.

Local Oscillator Input

Requires ±5 dBm to ±10 dBm for a constant output level. The frequency is 2095 MHz to 3095 MHz. (This level and frequency is provided by the 1st LO OUTPUT on the 7L12 above SN B160000 or with LO Output Mod, or the 7L13.)

Output Signal Level

Amplitude (sync off): 100 IRE equals 0.714 V P-P when terminated in 75 Ω.

Output Impedance: 75 Ω ±1% at 100 IRE and ±2% from 0 to 90 IRE.

Output Signal Level (cont)

Step Variable: 0 to 100 IRE in 10-IRE steps.

Accuracy (at 200 kHz): ±1 IRE at 100 IRE; ±2 IRE from 10 IRE to 90 IRE.

Amplitude at 0 IRE setting (relative to 100 IRE): 0.1 MHz to 5 MHz, greater than 40 dB down; 5 MHz to 10 MHz, greater than 33 dB down; 10 MHz to 15 MHz, greater than 30 dB down.

CW Output Amplitude: No change in relative level between cw and line rate blanking. Single-line cw amplitude within 0.2 dB of the cw level.

CW Only: 0.6 V to 1.3 V P-P when terminated in 75 Q. Reference line on variable at about 1 V P-P.

Output Level During Blanking: 0 V ±0.01 V at 0 IRE; 0 V ±0.04 Vat 100 IRE from 0 to 1 MHz; 0 V ±0.02 Vat 100 IRE above 1 MHz.

CW Output Harmonics: 2nd harmonic content dependent upon spectrum analyzer 1st LO OUTPUT. 3rd harmonic content down 40 dB from 0.1 MHz to 5 MHz; down 35 dB from 5 MHz to 10 MHz.

Video Monitor

Same as Output Signal Level within 5%.

Flatness

1405: Within ±0.1 dB from 100 kHz to 10 MHz; within ±0.2 dB from 10 MHz to 15 MHz; and within ±0.4 dB from 50 kHz to 20 MHz.

1405 plus 7L12, 7L13 or 7L14: TRANSMITTER FREQUENCY greater than 20 MHz: Within ±0.2 dB from 100 kHz to 10 MHz, increasing to ±0.3dB at 15 MHz. Within ±0.5 dB from 50 kHz to 20 MHz.

TRANSMITTER FREQUENCY 0 to 20 MHz: Within ±0.5 dB from 100 kHz to 15 MHz.

System Span

7L12, equal to or greater than 200 kHz per division. 7L13 and 7L14, equal to or greater than 100 kHz per division.

Video Frequency Range

15-0-15 MHz, with 1405 TRANSMITTER FREQUENCY controls properly set.

Average Picture Level (APL)

Variable: 0 to 100 IRE in 10-IRE steps.

Accuracy: ±2 IRE.

Three preset levels: PRESET A, 0 to 50 IRE; PRESET B, 25 IRE to 75 IRE; PRESET C, 50 IRE to 100 IRE:

Horizontal Sync and Blanking Duration

Within NTSC limits (no vertical interval is provided). Transition time is 0.24 us ±10%, from 10% to 90% points.

External Blanking Modes

A. 0 V turns cw on, greater than —5 V turns cw off. DC coupled (e.g., composite blanking).

B. TTL pulse from > +2.5 V to 0 V turns cw on (e.g., 1480 line strobe). Minimum pulse length, 50 us.

Markers and Z-Axis Output

Marker Frequencies, NTSC version: 0.75 MHz, 1.25 MHz, 3.58 MHz (color subcarrier), 4.18 MHz and 4.75 MHz.

Accuracy: ±0.01% of frequency selected (crystal con-trolled). Additional marker oscillator accepts user-supplied crystals.[1]

External Marker Input: Accepts 0.2 MHz to 10 MHz, 1 V P-P nominal.

Internal Marker Output: Marker crystal frequencies, nominal output level 0.75 V P-P or greater.

'Crystal Requirements: Maximum frequency 10 MHz, Series resonant, R_s less than 1000 Ω, Q greater than 5000, case, HC-6/U or HC-25/U.

Z-Axis Output Amplitude: Up to about +10 V and -3 V into 500Ω. Minus voltage intensifies trace to provide markers (variable with INTEN control); dark zone identifies middle of marker. About +10 V (fixed) blanks trace during blanking interval.

Aural Output

Output Frequency: 10.396 kHz, +0.01% (crystal con-trolled).

CW Output Amplitude: Variable up to at least +12 dBm into 600 Ω (about 10 V P-P).

Harmonics down 45 dB or more.

1.3 ENVIRONMENTAL SPECIFICATIONS

Operating Temperature Range: 0°C to +50°C. Non-operating Temperature Range: -40°C to +75°C. Operating Altitude Range: to 15,000 feet. Non-operating Altitude Range: to 50,000 feet.

1.4 STANDARD AND OPTIONAL ACCESSORIES

Refer to Section 7, Accessories page for accessories.

Consult General Catalog for other accessories, such as cables, attenuators, and adaptors, that are available.

1.5 POWER INPUT REQUIREMENTS

25 VA maximum, 48-440 Hz

Voltage range and fuse are as follows.

Line Selector	**Voltage Range**	Fuse
100	90-110 V	0.3 A slow
120	108-132 V	0.3 A slow
220	198-242 V	0.15 A slow
240	216-250 V	0.15 A slow

Continued fire hazard protection requires 250 V slow blow fuse with listed current rating.

OPERATION

2.1 INTRODUCTION

The Performance Check can be used: (1) to check the operating status of the 1405; (2) as an incoming inspection procedure; (3) to familiarize the user with the basic operation of the 1405.

The Controls and Connectors section gives a detailed description of the effect of each control and the use of each connector. It is also intended to aid in discovering alternate or additional ways to use the 1405.

Since the 1405 is designed to be used with a TEKTRONIX 7L12, 7L13 or 7L14 Spectrum Analyzer Plug-In installed in a 7000-Series Oscilloscope mainframe, the General Operating Information and Applications sections assume their presence, and that the user is familiar with their operation.

This equipment has a 3-wire power cord with a 3-contact plug for connection to the power source and to protective ground. The plug protective-ground contact connects (through the cord protective-grounding conductor) to the accessible metal parts of the equipment. For electric-shock protection, insert this plug into a socket outlet that has a securely grounded protective-ground contact.

For confirmation that the socket-outlet ground contact is securely grounded, refer to qualified service personnel.

2.2 PERFORMANCE CHECK

The following procedure can be used to perform an operational check or incoming inspection. It does not test the 1405 to specifications.

2.2.1 Equipment Required

7L12, 7L13, or 7L14 Spectrum Analyzer in mainframe. Test oscilloscope (to check aural output amplitude and frequency only). Appropriate cables as indicated (1405 standard accessories).

2.2.2 Procedure

1. Connect the cable with SMA connectors between the spectrum analyzer 1st LO and the 1405 LO IN. Connect a cable with BNC connectors between the 1405 VIDEO OUT and the spectrum analyzer RF IN. Connect a second cable with BNC connectors between the 1405 Z-AXIS OUT and the spectrum analyzer mainframe EXT Z-AXIS IN. Turn instruments on and allow them to warm up.

2. Set the spectrum analyzer controls as follows:

FREQ	0
REFERENCE LEVEL	OdB
LOG 10dB/DIV	Pushed in
MODE	P-P AUTO
SOURCE	FREE RUN
TIME/DIV	2 ms/DIV
FREQ SPAN/DIV	5 MHz
RESOLUTION	300 kHz

3. Set up the 1405 controls as follows:

TRANSMITTER FREQUENCY	0
AMPLITUDE	100
APL	0
SYNC	OFF
MARKER INTEN	OFF

4. Adjust the spectrum analyzer controls as necessary to position the zero spike to the left edge of the display. Adjust the 1405 frequency controls as necessary to produce maximum upward deflection of the display, then switch the spectrum analyzer RESOLUTION control to 30 kHz and repeat the above adjustments. The flat portion of the display depicts the pass band of the 1405.

5. Turn all markers on (push in), set the MARKER INTEN and WIDTH controls to midrange, and set the spectrum analyzer SPAN/DIV control to 0.5 MHz. It may be necessary to readjust the frequency controls slightly. Intensified markers will be displayed; it may also be necessary to adjust the MARKER INTEN, WIDTH, and oscilloscope INTENSITY controls.

6. Turn the MARKER INTEN control to OFF, reset the FREQ SPAN/DIV control to 5 MHz and the RESOLUTION control to 300 kHz, set the TIME/DIV control to 0.2 ms/DIV, and the SOURCE control to INT. Set the SYNC control to ON; the display should be similar to that in step 4, with the addition of negative-going spikes (sync pulses).

7. Connect a cable from the 10.396 kHz OUT to the test oscilloscope vertical input. With the aural AMPLITUDE control set fully clockwise, the test oscilloscope should display a sine wave of about 10 V P-P amplitude and about 10.4 kHz frequency (with the TIME/DIV control at 0.1 ms/DIV, ten cycles in about 9.6 divisions).

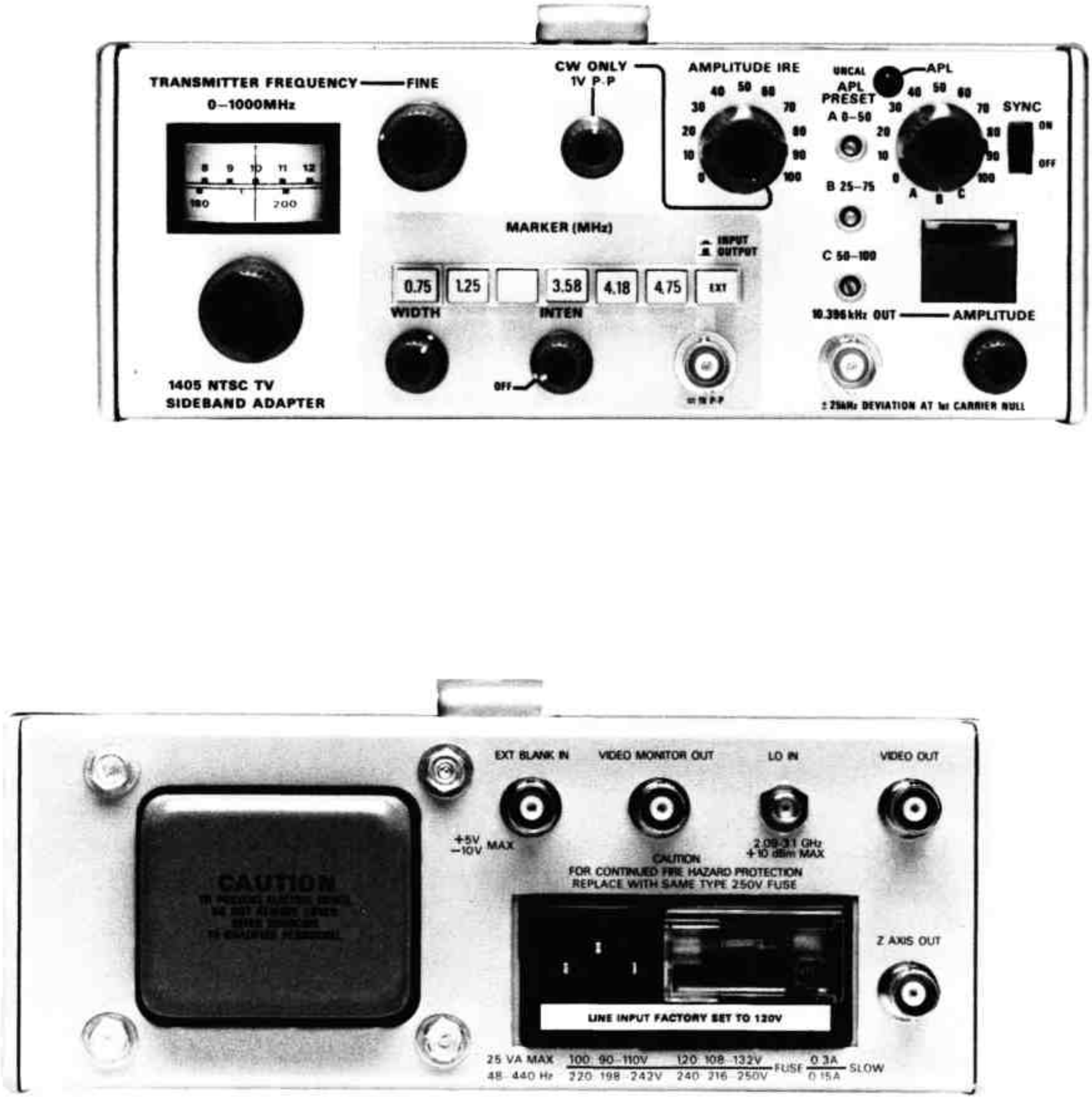

Fig. 2-1. 1405 front and rear panel.

2.3 FRONT-PANEL CONTROLS AND CONNECTORS

TRANSMITTER FREQUENCY

Positions a dial scale marked in 20 MHz increments (0 to 1000) and tv channels from 2 to 83, and tunes the 1405 local oscillator to offset the spectrum analyzer first local oscillator frequency. The correct setting occurs when the 1405 and spectrum analyzer are both tuned to the transmitter frequency. At this setting, the 1405 local oscillator frequency equals the 7L12 or 7L13 first local oscillator center frequency.

FINE (tuning)

Tunes the local oscillator over a range of 1 MHz or more.

AMPLITUDE

Sets the cw amplitude of the 1405 output signal, from 0 to 100 IRE units, in steps of 10 IRE, or to a VARIABLE position.

CW ONLY

Varies the cw between about 0.6 V and 1.3 V P-P, when the AMPLITUDE is in the CW ONLY position. A front-panel index mark shows the nominal 1 V position. The sync and APL are disabled; SYNC ON or external blanking will gate the cw as in normal operation (although the sync will not be present).

APL

Sets the average picture level (APL) from 0 to 100 IRE in steps of 10 IRE.

APL PRESET A, B, C

Three adjustable ranges for setting APL to a preset level: A can be preset from 0 to 50 IRE; B can be preset from 25 to 75 IRE; C can be preset from 50 to 100 IRE.

APL UNCAL

Warns operator when combinations of amplitude and APL exceed transmitter modulation limits (limits are 120 IRE and -40 IRE). The pedestal latches at about 50 IRE when the indicator is lighted.

SYNC ON/OFF

Disables internal horizontal sync rate generator, allowing continuous cw signal when set to OFF. With sync OFF, cw and pedestal (APL) may be externally blanked or strobed on.

MARKERS

Selects frequency markers (which appear as intensified portions of the sweep) as follows: 0.75 MHz, 1.25 MHz, 3.58 (3.579545) MHz, 4.18 MHz, 4.75 MHz, user-supplied crystal frequency, external marker input or internal marker output (see below).

WIDTH: Controls width (in frequency) of marker pulses.

INTEN: Controls intensity of markers pulses. In the detent position, the marker oscillators and mixer are switched off.

INPUT/OUTPUT: When the pushbutton is pushed in, the BNC connector can be used for adding an external marker signal. External markers should be between 0.2 MHz and 10 MHz, at a nominal level of 1 V peak to peak.

When the pushbutton is in the out position (push to release), the internal marker oscillator signals are available at the BNC connector, at a nominal level of 0.75 V peak to peak.

10.396 kHz OUT

Signal output for carrier null method of fm deviation measurement.

10.396 kHz AMPLITUDE

Variable control for output amplitude.

POWER

Turns the ac power to the instrument on and off. Green button lights to indicate when power is applied.

2 4 REAR PANEL CONNECTORS

LO IN (local oscillator input) Three millimeter (SMA) input which must be connected tothe7L12or7L13 1st LO.

VIDEO OUT The composite video output of the instrument. Source impedance is 75 Ω.

EXT BLANK IN Input for external blanking signal.

Z AXIS OUT Signal to 7000-Series Z-axis input.

VIDEO MONITOR Composite video output for the oscilloscope 1 MΩ input.

Rear panel also includes the ac power connector and provisions for universal ac voltage selection. Consult the Electrical Parts List for correct fuse value.

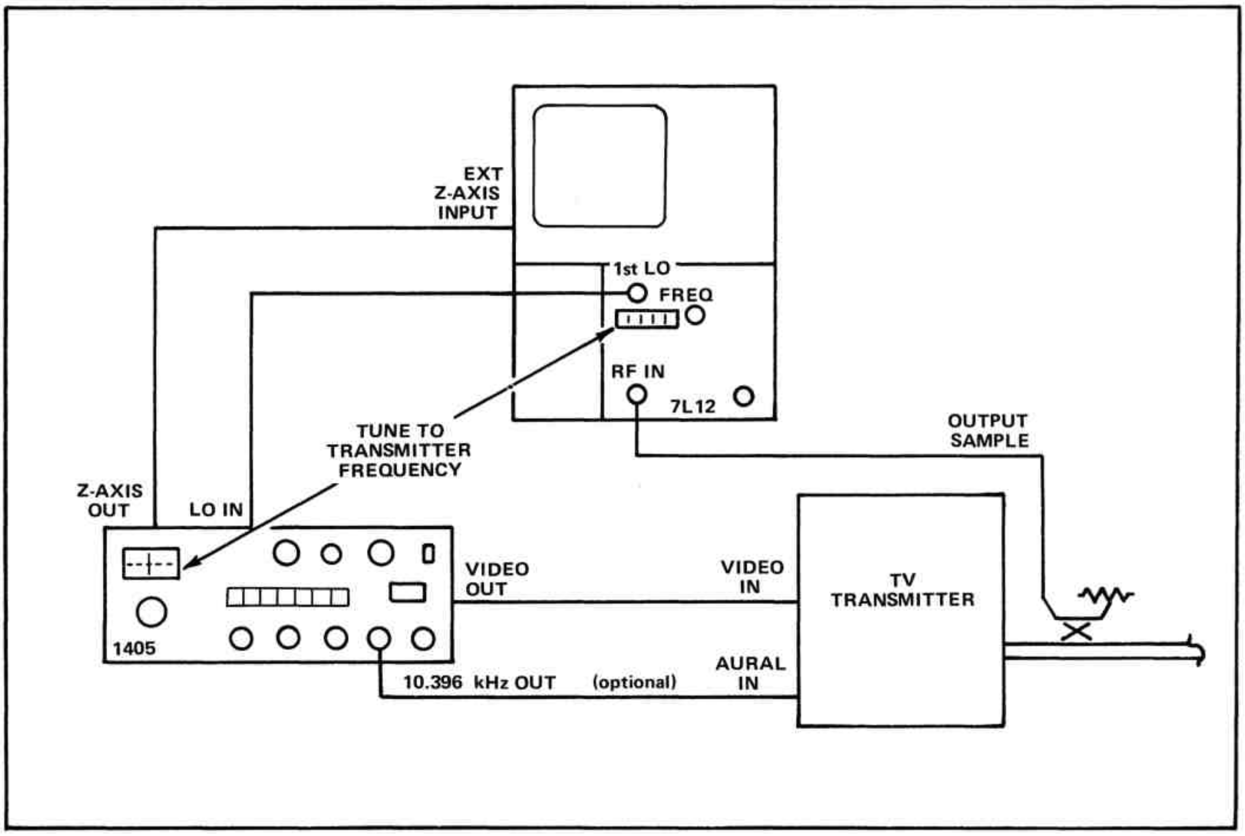

Fig. 2-2. Basic interconnections for general operation.

2.5 GENERAL OPERATING INFORMATION

2.5.1 Initial Connections

The basic interconnections required for general operation are shown in Fig. 2-2, and are described below.

a. If desired, secure the 1405 to the top of the oscilloscope mainframe, using the accessory hold-down strap provided (Tektronix Part No. 346-0144-00).

b. Connect the spectrum analyzer 1st LO to the 1405 LO IN, using the cable provided (Tektronix Part No. 012-0649-00).

c. Connect the 1405 Z-AXIS OUT to the oscilloscope mainframe EXT Z-AXIS IN, using the cable provided (Tektronix Part No. 012-0057-01).

d. Connect the 1405 VIDEO OUT to the video input of the tv transmitter or circuit under test, using the cable provided (Tektronix Part No. 012-0057-01) or any other convenient cable.

e. Connect a sample of the output of the tv transmitter or circuit under test to the RF IN of the spectrum analyzer, using an appropriate cable and coupler to avoid exceeding the maximum input power level of +30 dBm.

CAUTION

Use care to keep the power level into the spectrum analyzer low; an off-screen signal can damage the spectrum analyzer. External attenuators should be used if the internal attenuator will not reduce the signal sufficiently.

f. If you desire to check the transmitter's aural circuitry, connect the 1405 10.396 kHz OUT (NTSC) to the transmitter's aural input. Check that the AMPLITUDE control is initially set fully counterclockwise.

2 5 2 Calibrating the 1405 Television Sideband Adapter Frequency Dial Readout to the 496 or 492 Series Spectrum Analyzers

The 1405 frequency readout can be calibrated to the 496 or 492 series spectrum analyzers by offsetting the dial to compensate for the difference between the 1 st LO frequencies between the 7L12/7L13/7L14 and the 496/492 analyzers. The procedures is as follows:

1. Remove the bottom panel from the 1405 to expose the frequency drive shaft and couplers between the oscillator assembly and the tuning control mechanism. Center the FINE tune potentiometer (5 turns from either extreme position).

2. Connect the 1405 to the 496 or 492 Spectrum Analyzer as directed for the 7L12, 7L13 or 7L14 and illustrated in Fig. 2-2.

3. Tune the spectrum analyzer frequency to center the transmitter visual signal on the display and note its frequency.

4. Now tune the 1405 FREQUENCY so the center of the display coincides with the transmitter frequency.

5. Loosen the Allen set-screw in the coupler, between the tuning shaft and the oscillator assembly, then while holding the oscillator tuning shaft with one hand, adjust the FREQUENCY control until the dial reads the same as the transmitter frequency. Re-tighten the set-screw.

6. Replace the bottom panel for the 1405.

2.5.3 Initial Set-Up for TV Transmitter

The following control settings assume the set-up described above was accomplished, and that the circuit under test is a TV transmitter. For other types of circuits, refer to Applications, Section 2.6.

Oscilloscope Mainframe
(as necessary to obtain display.)

Spectrum Analyzer

MODE	NORM
SOURCE	FREE RUN
FREQUENCY	To transmitter output frequency
TIME/DIV	1 ms or slower
FREQ SPAN/DIV	2 MHz
REFERENCE LEVEL	As appropriate for incoming signal

1405

TRANSMITTER FREQUENCY	To transmitter output frequency; same as spectrum analyzer.
AMPLITUDE and APL	As appropriate to produce desired signal. Ascertain that the APL UNCAL indicator is off.
SYNC	Set to ON to add blanking and internally-generated sync pulses; set to OFF for cw output or when external blanking is used.

MARKERS

Turn INTEN fully ccw to OFF position.

POWER ON

The above set-up, possibly with minor adjustments, should result in a display of the output of the tv transmitter when modulated by the 1405. The display should appear similar to Fig. 2-4.

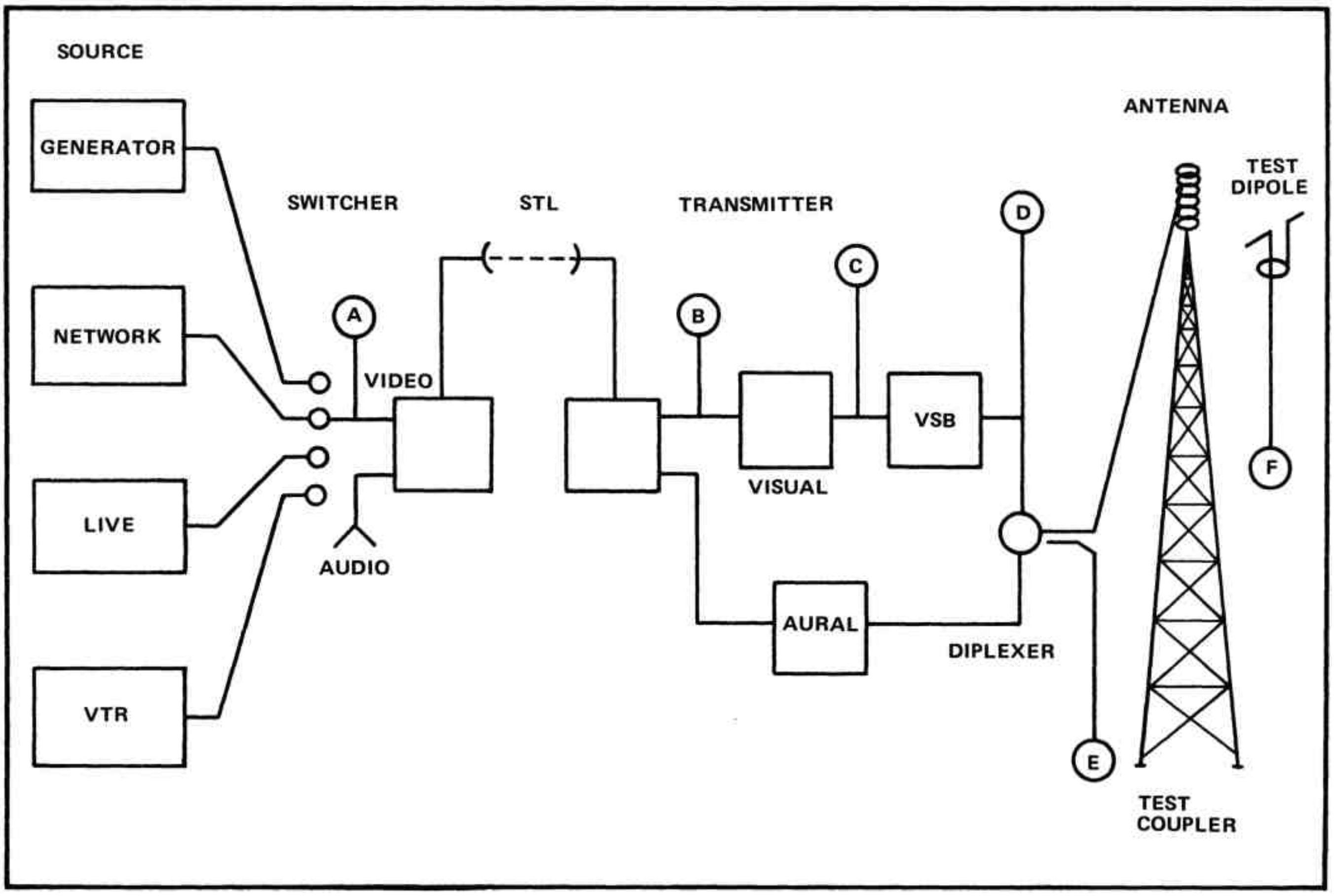

Fig. 2-3. Typical station layout showing test points.

2 6 APPLICATIONS

2.6.1 General Sideband Analysis

Many possibilities exist for performing sideband analysis. For transmitter tuning, refer to Fig. 2-3, set up the 1405 (see procedure below), and connect it directly to the transmitter input (B). Connect the input of the spectrum analyzer to the output of the vestigial sideband filter (D). Other intermediate points can also be observed, such as the transmitter IF, the transmitter output before the vestigial sideband filter (C), after the diplexer (E), or off-the-air using a dipole (F).

Many parameters can change significantly when the aural and visual transmitters are combined in the diplexer. Tests should be performed both at a test point after the diplexer, and off-the-air to verify the condition of the signals as actually received by the customer.

Once the transmitter has been correctly set up, you may wish to move the sideband analyzer system to the studio (A) so that, by using a test antenna, the entire loop including the microwave link and transmitting antenna can be verified.

Procedure

1. Calibrate the 7L12, 7L13, or 7L14 Spectrum Analyzer as described in its instruction manual.

2. Connect the 1405 Sideband Analyzer to the 7L12 or 7L13. Temporarily connect a BNC to BNC jumper from the output of the 1405 to the input of the spectrum analyzer.

3. Tune both units to zero and verify that the 1405 is producing a flat response curve from 0 MHz to at least 15 MHz (refer to Fig. 2-4).

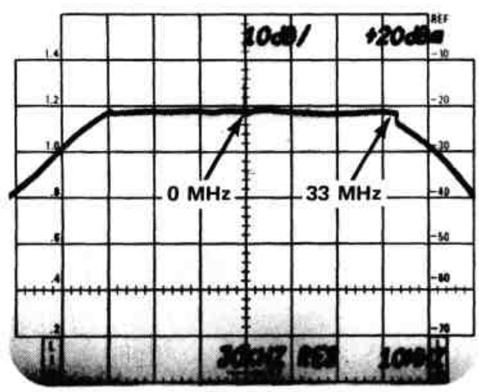

Fig. 2-4. Sideband analyzer response at baseband.

4. Make sure that the internal SYNC on the 1405 is switched ON, and connect the 1405 VIDEO OUT to the transmitter input (B). Generally this can be accomplished through the video patch panel. See note for special cases and international standards.

NOTE

For transmitters where the supplied sync rate will not work, or for transmitters that must see vertical or full NTSC sync, the 1405 Sideband Analyzer cw signal can be added to a test signal generator as described in Section 2.6.3 and shown in Fig. 2-11. In this mode the 1405 internal sync is switched off. Although not necessary, blanking can be supplied to the1405 to interrupt the swept signal during the sync interval. When the 1405 signal is added to composite sync as shown in Fig. 2-11, the transmitter input gain control may have to be increased to make up combining losses of 50%.

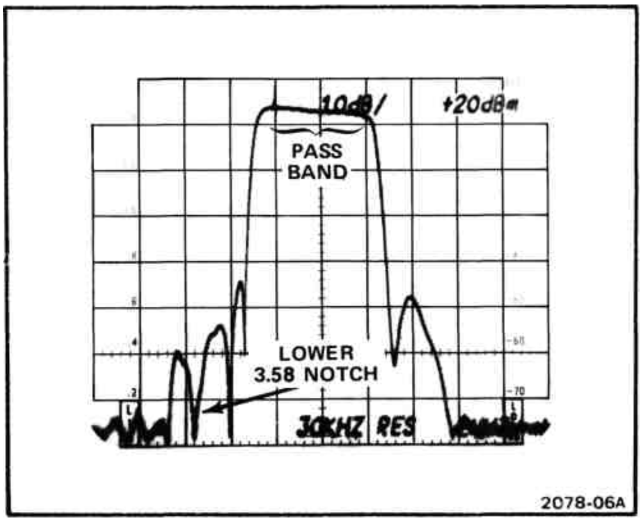

Fig. 2-5. Transmitter response at **2 MHz/Div and** 10 **dB/Div**

5. Connect the spectrum analyzer to an rf test point after the vestigial sideband filter.

CAUTION

Use care to keep the power level into the spectrum analyzer low; an off-screen signal can damage the spectrum analyzer. External attenuators should be used if the internal attenuator will not reduce the signal sufficiently.

6. With the spectrum analyzer in the 10 dB/DIV mode and its FREQ SPAN/DIV control set to 5 MHz/DIV, adjust the FREQ control until the station carrier is centered on the screen.

7. With the spectrum analyzer RESOLUTION control set to 0.3 MHz, adjust the 1405 TRANSMITTER FREQUENCY control until the display floor on the spectrum analyzer suddenly rises to indicate the response shape of the tv transmitter. Then reduce the SPAN/DIV control on the spectrum analyzer to 2 or 1 MHz/DIV, reduce RESOLUTION control to 30 kHz, and adjust the 1405 FINE control for maximum rise on the display. A properly adjusted transmitter will appear similar to Fig. 2-5.

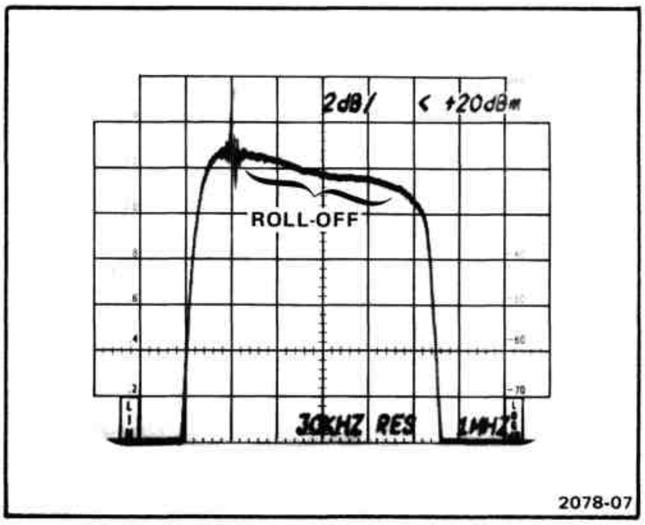

Fig. 2-6. Transmitter response at 2 dB/Div (note response rolloff of about 2 dB).

8. Set the spectrum analyzer mode to 2 dB/DIV and verify the display flatness from -0.75 MHz to +4.2 MHz. The display should be similar to Fig.2-6. Intensity markers can be used by connecting a cable from the Z-AXIS OUT of the 1405 to the Z-AXIS IN of the spectrum analyzer mainframe.

2.62 **In-Service Sideband Analysis Using Low-Level Technique**

The low level sweep is attractive because of its simplicity and real time adjustment capabilities. The sweeping signal is combined directly with the tv picture signal using a resistive combiner so that the sweeping signal is down 30 to 40 dB (or more) below the picture information. Because of the low signal level and repetition rates, interference from in-service testing by this technique is only perceptible to the trained observer. The average customer will not detect the sweeping signals superimposed on the tv signal.

The intentional addition of the swept signal to the picture information might be interpreted as illegal [FCC Rules and Regulations, Vol. Ill, §73.682(a21)] especially since no information is permitted on sync information. However, part a16 of the same section states that carrier-to-noise and other effects can be up to 5%. This is equivalent to 8 IRE units. We recommend that the sweeping signal be inserted with 2 or 3 IRE units, well within the tolerance of this rule.

This in-service technique can be used from the studio, to verify not only the transmitter, but also the studio-transmitter link, processors, and antenna performance.

Procedure

1. Prepare a test point where the swept signal can be inserted. This can be a simple T as shown in Fig. 2-7 (supplied with the 1405). Make sure that the internal sync on the 1405 is switched OFF, APL is set to 0, and the AMPL control is set to 101 RE. *Amplitude settings between Wand 20 (equivalent to 1 and 2 IRE through the insertion T) will give the most satisfactory results with minimum picture impairment.*

2. Connect the spectrum analyzer to an rf test point and carefully tune in the picture carrier at 10 dB/DIV, 1 or 2 MHz/DIV and 30 kHz resolution.

3. Connect the 1405 to the test point, and while watching an off-air color monitor to ensure that there is no interference, tune the TRANSMITTER FREQUENCY control until the baseline raises. It should be possible to use the FINE control to tune for maximum upward deflection of the display.

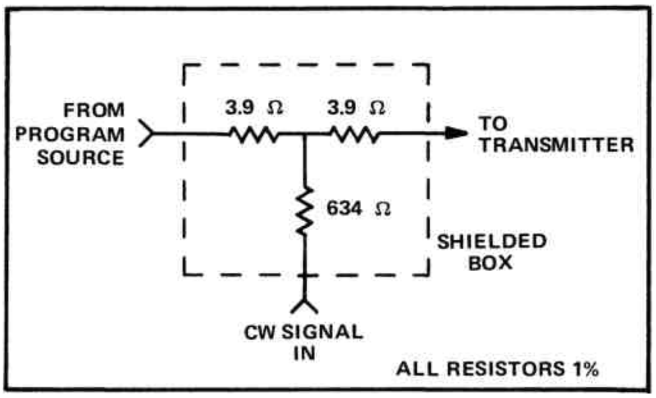

Fig. 2-7. Insertion "T" for in-service low level testing.

4. By using the video filters on the spectrum analyzer it should be possible to obtain a display similar to Fig. 2-8.

5. Approximately 10 dB more range and finer resolution can be obtained with 3 kHz resolution (see Fig. 2-9). The fine tuning control will be more critical and tend to drift unless both instruments are completely warmed up.

6. The 2 dB/DIV mode can also be used to check the flatness (see Fig. 2-10).

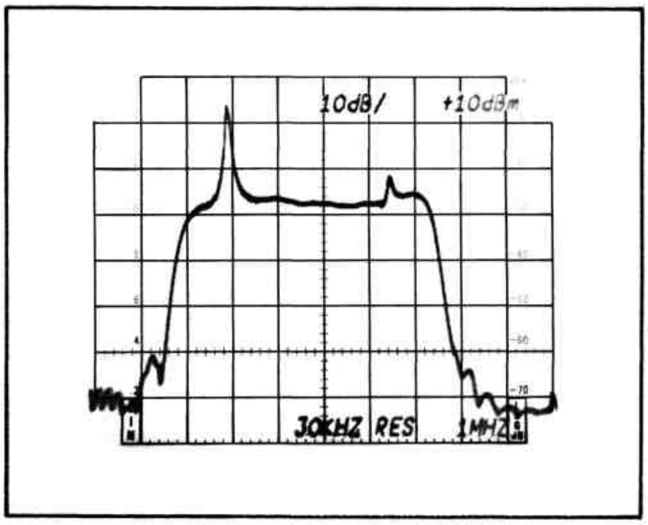

Fig. 2-8. In-service low level sideband

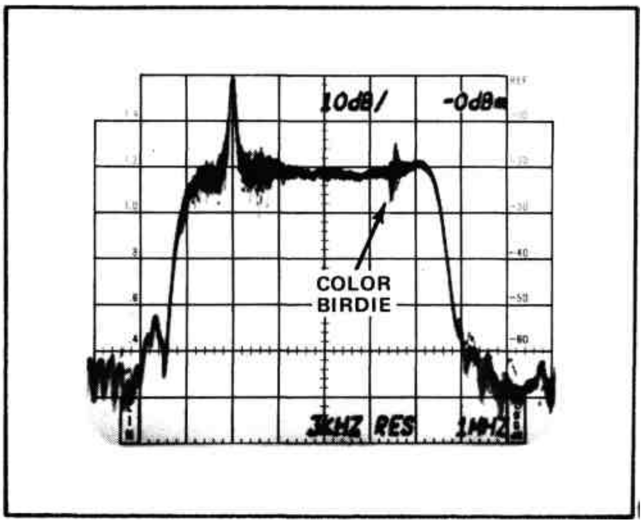

Fig. 2-9. Low level sideband response using 3 kHz resolution bandwidth.

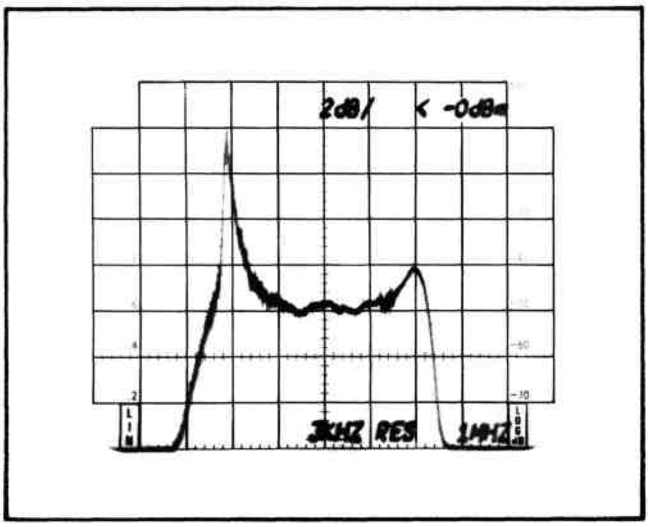

Fig. 2-10. Low level sideband response at 2 dB/Div.

2.6.3 **In-Service Sideband Analysis Using the Vertical Interval**

This technique inserts the swept signal on one line in the vertical interval. It has the advantage that it can be used continuously with no picture interference and with very fine resolution and accuracy; however, a storage oscilloscope is required to recover the swept display. Also, the display is not real time; up to thirty seconds is required after an adjustment to visually verify the result.

A number of lines in the VITS area can be used for the sweeping signal [FCC Rules and Regulations, Vol. Ill §73.682(a16)]. Line 18, field 2 is sometimes available, and line 20, both fields is also often empty.

The theory of this technique should be understood before attempting to use the procedure. Different VITS insertion devices can be used other than those shown in the procedure, provided that the same keying can be accomplished.

The spectrum analyzer will receive all the normal picture information; however, the z-axis (intensity) is only turned on during the single line sweep.

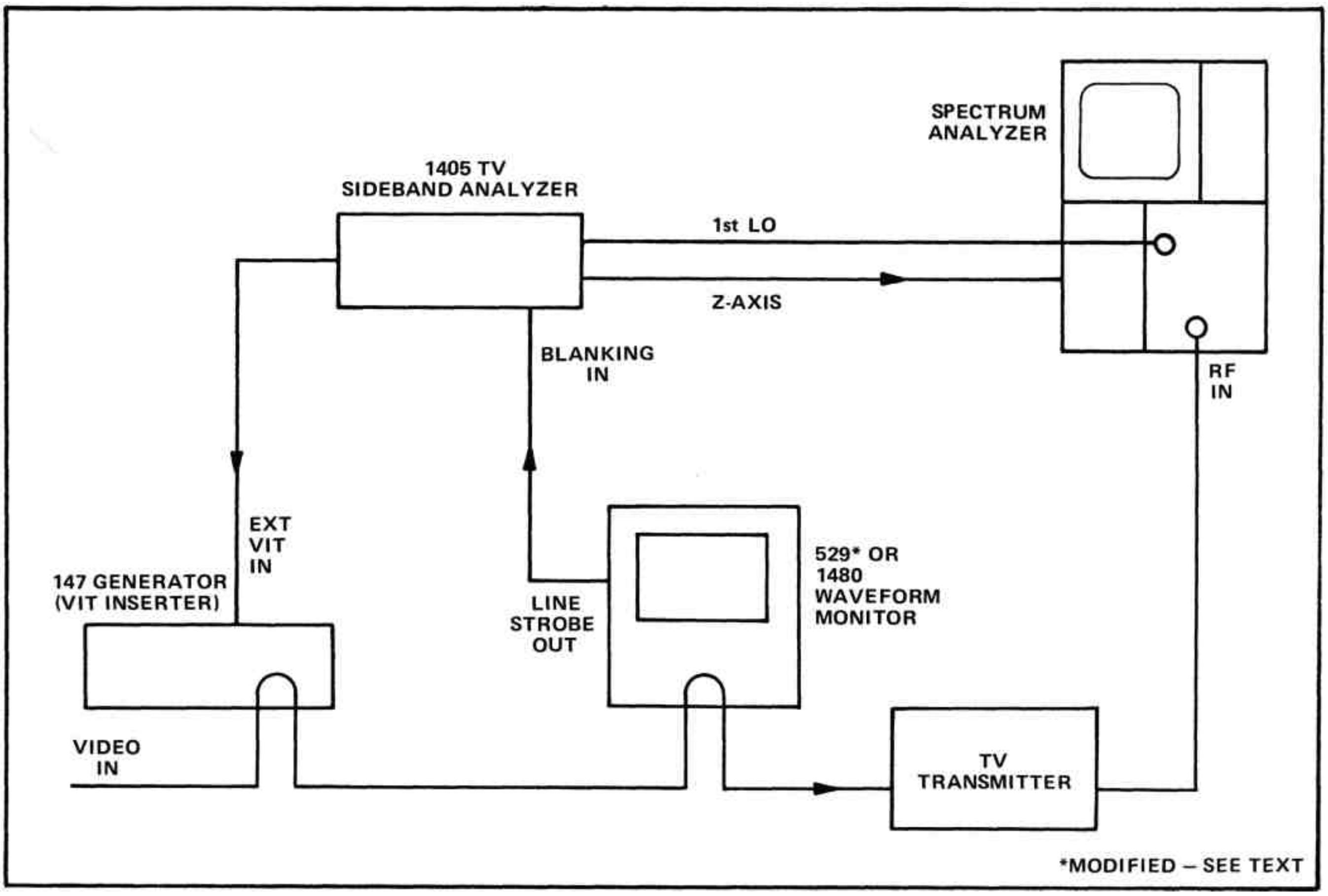

Fig. 2-11. Sideband analyzer connections for VITS insertion.

Procedure

1. Set up the equipment as shown in Fig. 2-11. Good results can be obtained without the 1480 Waveform Monitor if the intensity on the spectrum analyzer is carefully set. A 529 Waveform Monitor can be substituted for the 1480, using the video output. However, the 529 must be modified by disconnecting one end of R198.

2. Verify with the 1480 (or another waveform monitor) that the sweep signal is inserted on the correct line, and the APL and AMPLITUDE controls work correctly (see Fig. 2-12).

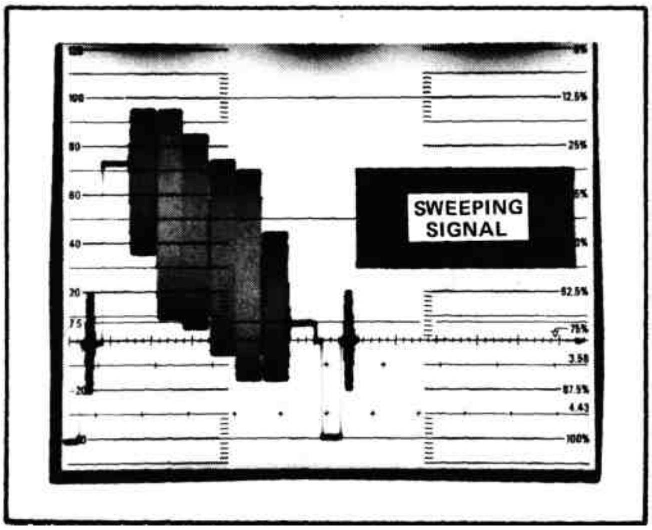

Fig. 2-12. Waveform monitor display of VITS interval including sideband envelope.

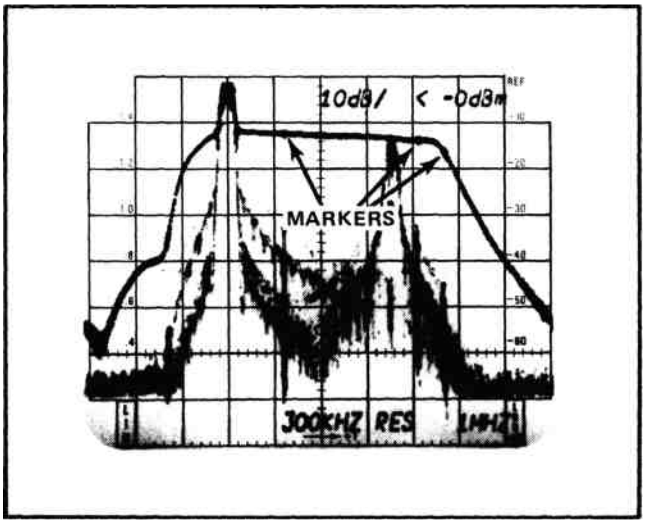

Fig. 2-13. Sideband response using VITS insertion.

3. The spectrum analyzer should be tuned to the picture carrier with 1 MHz/DIV, 300 kHz resolution, and 10dB/DIV.

4. Using the storage mode on the spectrum analyzer and a slow sweep speed (approximately 0.5 s/DIV), carefully tune the 1405 for maximum upward deflection of the response curve (see Fig. 2-13).

5. This procedure can be used at the studio location, by using a suitable antenna to receive the rf for the spectrum analyzer. On long studio-transmitter links some delay will occur, and can be compensated for with the FINE tuning control on the 1405. The intensity markers work normally with this technique.

2.6.4 **Swept Differential Gain Measurements on the Television Transmitter**

A variety of methods exist at baseband for making differential gain measurements. However, the following technique uses the rf swept signal of the sideband analyzer. This makes it possible to check gain changes with frequency across the passband of the transmitter.

The tv transmitter, being a very high powered am transmitter, often tends to exhibit an inferior differential gain characteristic. A "linearizer" function is generally included to correct most of the gain effects; however, effects related to frequency remain. The procedure which follows shows a typical transmitter characteristic with (Fig. 2-14) and without (Fig. 2-15) the "linearizer" function. Although most of the gain slewing with input APL is controlled, the effects relative to frequency remain.

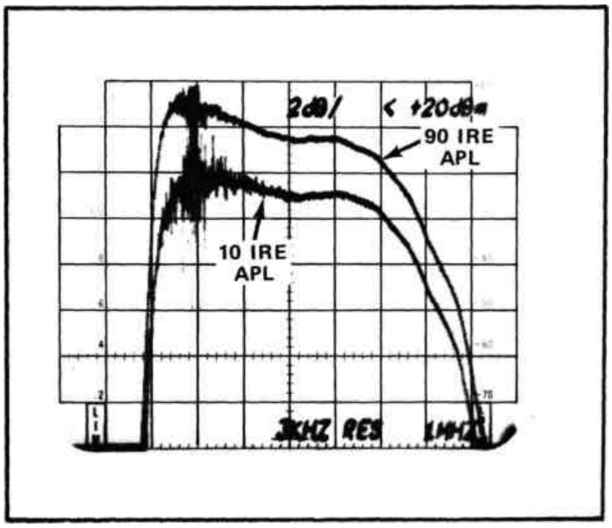

Fig. 2-14. Transmitter variations with 10 and 90 IRE test sweeps.

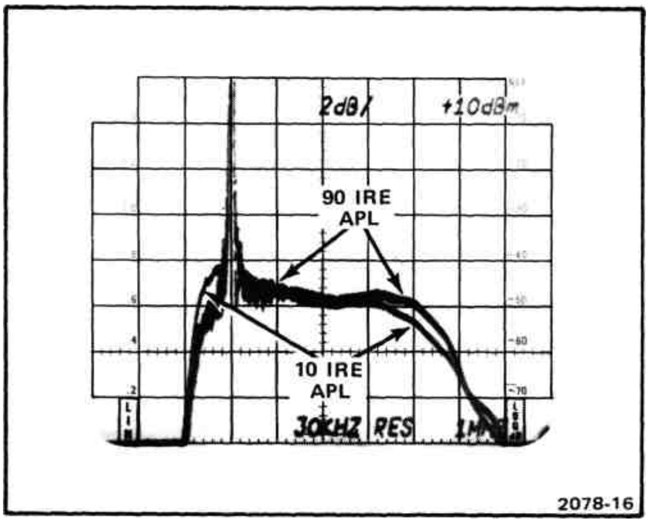

Fig. 2-15. Transmitter differential gain display for 20% amplitude 10 and 90 IRE test sweeps.

Procedure

1. Set up the sideband analyzer and spectrum analyzer for normal out-of-service testing (see Section 2.6.1).

2. With all processing defeated and the transmitter "linearizer" OFF, sweep the transmitter using a 20 IRE AMPLITUDE signal with an APL of 10 and 90 IRE. A display similar to Fig. 2-14 will be typical. You may wish to do a series of sweeps from 10 to 90 IRE to determine how the transmitter responds at intermediate levels.

3. With the "linearizer" or other processing equipment on, repeat the sweep tests for levels of 10 and 90 IRE. The display in Fig. 2-15 is typical. Note the response changes with APL.

2.6.5 **Aural Modulation Monitor Calibration**

NOTE

This section applies to NTSC instruments only. For 1405 Option 1, refer to Options and Modifications, Section ***4.***

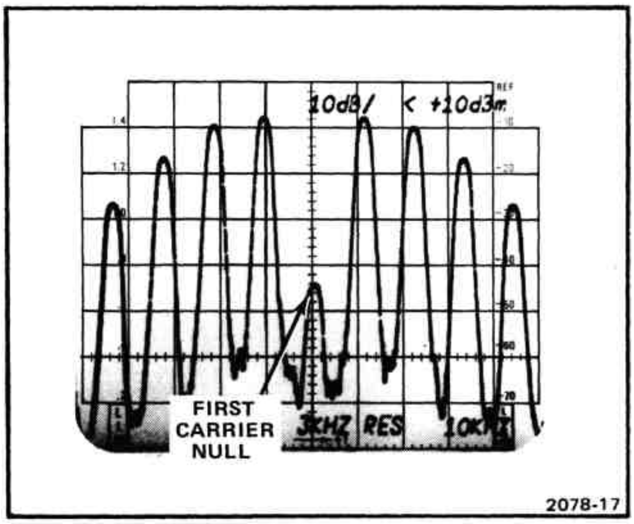

Fig. 2-16. Bessel null technique of determining 100% modulation.

The 1405/spectrum analyzer system provides a very accurate method of calibrating the aural modulation monitor, using the Bessel Null technique. With this technique, a specific frequency (10.396 kHz for 25 kHz deviation) will cause a distinctive and undisputable carrier null at 100% modulation (see Fig. 2-16).

Procedure

1. Connect the spectrum analyzer to sample the output of the aural transmitter, and connect the 10.396 kHz OUT from the 1405 to the input of the aural transmitter.

2. Advance the 10.396 kHz AMPLITUDE control until the first carrier null occurs (see Fig. 2-16). At the first carrier null, the transmitter is being modulated 100% and the fm frequency deviation is 25 kHz.

3. Adjust the modulation monitor to indicate 100% modulation.

OPTIONS

4.1 OPTION 01

4.1.1 Description

The 1405 Option 01 is used with PAL television systems. Features and operation are the same as the NTSC instrument except that the sync rate, blanking time, marker frequencies, and aural oscillator frequency are different as required by the PAL system (see Specifications, Section 4.1.2).

The 1405 Option 01 differs mechanically from the 1405 in that the front panel reflects the changes noted below, and the dial tape does not include the US television channel numbers.

NOTE

Option 01 instruments are connected for a nominal power line voltage of 240 V. Refer to Section 3.4.3 to change the nominal line voltage.

4.1.2 Specifications

Except as noted below, all specifications for the 1405 also apply to the Option 01.

Horizontal Sync and Blanking Duration

Blanking Time: 12.05 *μs* ±0.25 μs, internally adjustable. Sync Rate: 64 us ±1.5 us, internally adjustable. Sync Pulse Length: 4.7 /μs ±0.25 /μs. Front Porch: 1.55 μs ±0.25 μs.

Markers and Z-Axis Output

Marker Frequencies: 0.75 MHz, 1.25 MHz, 1.75 MHz, 2.25 MHz, 4.43 MHz, 5.0 MHz, 5.5 MHz, 5.75 MHz, 6.25 MHz. Some crystals are installed and all may be relocated as explained in Marker Crystal Installation, Section 4.1.3, below.

Aural Output

Output Frequency: 9.058 kHz ±0.01%

(crystal con-trolled).

See Operation, Section 4.1.4.

4.1.3 Marker Crystal Installation

Because of the various international standards, the 1405 Option 1 is shipped with the marker crystals installed as indicated in Table 4-1. The remaining crystals are shipped with the unit. Any combination of crystals may be installed; Table 4-1 lists those desirable for the different systems.

To install or change the crystals, remove the bottom cover (refer to Service Information, section 3) and plug the crystals in the sockets indicated in Table 4-1. Crystal circuit numbers are printed on the circuit board. Change the pushbutton caps as appropriate by pulling them straight out, and pushing on the new caps.

TABLE 4-1
Marker Crystals (Frequencies in MHz)

	Installed when shipped	Frequencies Used in			Installed in this unit (write in)
		System B	System G	System I	
Y560	0.75	0.75	0.75	1.25	
Y580	1.25	1.25	2.25	1.75	
Y600	2.25				
Y620	4.43	4.43	4.43	4.43	
Y640	5.0	5.0	5.0	5.5	
Y670	5.75	5.75	5.75	6.25	

4.1.4 Operation

Aural Modulation Monitor Calibration—The basic technique is the same as described in the manual EXCEPT that the output frequency is **9.058 kHz,** and the level should be adjusted for the **second** carrier null, for frequency modulation limits of **±50 kHz.**