User Manual

Tektronix

WFM601
Serial Digital Component Monitor

070-8471-00

Please check for change information at the rear of this manual.

This document supports software versions 1.0 through 1.3.

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WARRANTY

Tektronix warrants that this product, that it manufactures and sells, will be free from defects in materials and workmanship for a period of three (3) years from the date of shipment. If any such product proves defective during this warranty period, Tektronix, at its option, either will repair the defective product without charge for parts and labor, or will provide a replacement in exchange for the defective product.

In order to obtain service under this warranty, Customer must notify Tektronix of the defect before the expiration of the warranty period and make suitable arrangements for the performance of service. Customer shall be responsible for packaging and shipping the defective product to the service center designated by Tektronix, with shipping charges prepaid. Tektronix shall pay for the return of the product to Customer if the shipment is to a location within the country in which the Tektronix service center is located. Customer shall be responsible for paying all shipping charges, duties, taxes, and any other charges for products returned to any other locations.

This warranty shall not apply to any defect, failure or damage caused by improper use or improper or inadequate maintenance and care. Tektronix shall not be obligated to furnish service under this warranty a) to repair damage resulting from attempts by personnel other than Tektronix representatives to install, repair or service the product; b) to repair damage resulting from improper use or connection to incompatible equipment; or 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 TEKTRONIX WITH RESPECT TO THIS PRODUCT IN LIEU OF ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED. TEKTRONIX AND ITS VENDORS DISCLAIM ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. TEKTRONIX' RESPONSIBILITY TO REPAIR OR REPLACE DEFECTIVE PRODUCTS IS THE SOLE AND EXCLUSIVE REMEDY PROVIDED TO THE CUSTOMER FOR BREACH OF THIS WARRANTY. TEKTRONIX AND ITS VENDORS WILL NOT BE LIABLE FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES IRRESPECTIVE OF WHETHER TEKTRONIX OR THE VENDOR HAS ADVANCE NOTICE OF THE POSSIBILITY OF SUCH DAMAGES.

German Postal Information

Certificate of the Manufacturer/Importer

We hereby certify that the WFM601 Serial Component Monitor and all factory-installed options complies with the RF Interference Suppression requirements of Postal Regulation Vfg. 243/1991, Amended per Vfg. 46/1992

The German Postal Service was notified that the equipment is being marketed.

The German Postal Service has the right to re-test the series and to verify that it complies.

TEKTRONIX

Bescheinigung des Herstellers/Importeurs

Hiermit wird bescheinigt, daß der/die/das WFM601 Serial Component Monitor und alle fabrikinstallierten Optionen in Übereinstimmung mit den Bestimmungen der Amtsblatt-Verfügung Vfg. 243/1991 und Zusatzverfügung 46/1992 funkentstört sind.

Der Deutschen Bundespost wurde das Inverkehrbringen dieses Gerätes angezeigt und die Berechtigung zur Überprüfung der Serie auf Einhalten der Bestimmungen eingeräumt.

TEKTRONIX

NOTICE to the user/operator:

The German Postal Service requires that Systems assembled by the operator/user of this instrument must also comply with Postal Regulation, Vfg. 243/1991, Par. 2, Sect. 1.

HINWEIS für den Benutzer/Betreiber:

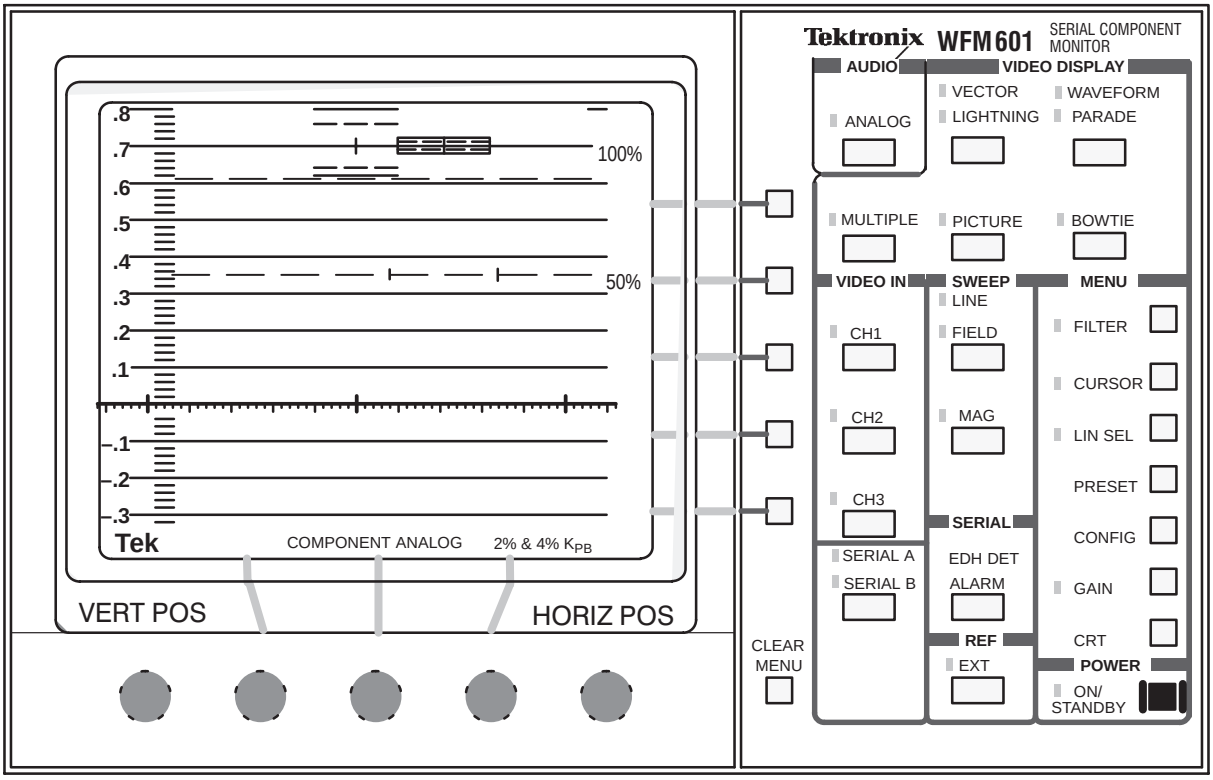
Die vom Betreiber zusammengestellte Anlage, innerhalb derer dieses Gerät eingesetzt wird, muß ebenfalls den Voraussetzungen nach Par. 2, Ziff. 1 der Vfg. 243/1991, genügen.

NOTICE to the user/operator:

The German Postal Service requires that this equipment, when used in a test setup, may only be operated if the requirements of Postal Regulation, Vfg. 243/1991, Par. 2, Sect. 1.8.1 are complied with.

HINWEIS für den Benutzer/Betreiber:

Dieses Gerät darf in Meßaufbauten nur betreiben werden, wenn die Voraussetzungen des Par. 2, Ziff. 1. 8.1 der Vfg. 243/1991 eingehalten werden.



WFM601 Serial Digital Component Monitor

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Safety Summary

Please take a moment to review these safety precautions. They are provided for your protection and to prevent damage to the monitor. This safety information applies to all operators.

Symbols and Terms

These two terms appear in manuals:

CAUTION. statements identify conditions or practices that could result in damage to the equipment or other property.

WARNING. statements identify conditions or practices that could result in personal injury or loss of life.

These two terms appear on equipment:

- *CAUTION* indicates a personal injury hazard not immediately accessible as one reads the marking or a hazard to property including the equipment itself.
- *DANGER* indicates a personal injury hazard immediately accessible as one reads the marking.

This symbol appears in manuals:

Static-Sensitive Devices

These symbols appear on equipment:

DANGER
High Voltage

Protective ground
(earth) terminal

ATTENTION
Refer to
manual

Specific Precautions

Power Source

This product is intended to operate from a power source that will not apply more than 250 V_{rms} between the supply conductors or between either supply conductor and ground. A protective ground connection, through the grounding conductor in the power cord, is essential for safe system operation.

Grounding the Product

This monitor is grounded through the power cord. To avoid electric shock, plug the power cord into a properly wired receptacle where earth ground has been verified by a qualified service person. Do this before making connections to the input or output terminals of the monitor.

Without the protective ground connection, all parts of the monitor are potential shock hazards. This includes knobs and controls that may appear to be insulators.

Use the Proper Power Cord

Use only the power cord and connector specified for your product. Use only a power cord that is in good condition.

Use the Proper Fuse

To avoid fire hazard, use only the fuse specified in the parts list for your product, matched by type, voltage rating, and current rating.

Do Not Operate Without a Cabinet

To avoid personal injury, do not operate the monitor unless it is properly installed in a cabinet or rack adapter, such as those listed in the Accessories Section. When power is supplied to the monitor, line voltage will be present in the instrument, even when the POWER switch is set to STANDBY.

Do Not Operate in Explosive Atmospheres

To avoid explosion, do not operate this product in an explosive atmosphere unless it has been specifically certified for such operation.

Do Not Service Alone

Do not perform internal service or adjustment of this product unless another person capable of rendering first aid and resuscitation is present.

Preface

This manual is a guide for operators of the WFM601 monitors, and contains instructions for daily use.

Please complete and mail the “Business Reply Card” at the front of this manual to receive a service manual when it becomes available.

Manual Overview

Getting Started provides the material needed to place the instrument in service. It contains ”Product Description”, ”Installation”, and ”Functional Check”.

Operation Basics provides information needed for dailly operation. It has ”At a Glance”, which describes the controls and connectors, and a ”Functional Overview”, which discusses the menus.

Reference contains the basic measurements, gain calibration, and a discussion of ”Measurement Theory.”

Appendix A provides instrument specifications, both electrical and mechanical.

Appendix B describes remote control interfaces.

Appendix C covers routine service procedures, such as replacing fuses and graticule light bulbs.

Appendix D describes the software version used in this instrument.

The appendixes are followed by a glossary of specialized terms and an index.

Getting Started

Product Description

The WFM 601 is capable of measuring and monitoring 4–2–2 component serial digital. It incorporates a straight through (non–filtered) display or a differentiated step filter. The assignable cursors, along with the crt readout can be used for time, and voltage measurements. The system of menus and crt readout simplifies the configuration of this monitor for measurement or monitoring of signal characteristics.

The following list composes the feature set for the WFM 601:

Features

- GBR or Y P_R P_B display format.
- Any or all of channels 1, 2, or 3 displayed.
- Parade or Overlay display.
- Flat or Diff'd Step filtering.
- X1, X5, X10, and Variable display gain.
- X25 Magnified sweep.
- 1 and 2 Line or Field sweep.
- Bar Cursors; amplitude, time, or amplitude + time, +marker.
- Line Select with readout; 1 line or 15 line, all fields or 1 of 2 fields.
- Picture Monitor Out with bright up (Y or G channel only).
- Vector Display; fixed or variable gain, 75% or 100% bars, SMPTE/EBU N10.
- Lightning or Diamond display; vertical gain (same as waveform), horizontal gain fixed, magnified, or variable, 75% or 100% bars, SMPTE/EBU N10.
- Electronic graticules for Lightning, Diamond, Vector, and Audio Displays.
- Displays audio input from Remote Connector as a lissajous pattern.
- Monitor Output; GBR or Y P_R P_B (follows A/B switching). gamut error bright up.
- EDH: (Follows A/B switching) LED for presence and an alarm, rear panel TTL low through Remote Connector.
- Reclocked Serial Component Digital output following A/B switching.

- Video Reference: Internal Serial Component signal (follows A/B switching), External Composite.

Description Of Features

Menu

A notable feature of this monitor is the menu-assisted operation. An expanded feature set is possible through the use of menus and multi-use controls and buttons. When the operator selects a menu item, such as Voltage and or Timing Cursors, Variable Gain, or Line Select, an on-screen label shows the current function of the controls.

Many instrument configurations that required moving internal jumpers in older instruments are made through an on-screen menu in the WFM601. The operator can also recall up to 10 front-panel setups through the Recall menu; 9 recalls are user-programmable and 1 is factory-programmed. The Filter menu provides the means to select the Differentiated Step Filter in addition to flat.

CRT

The monitors have a bright, post-accelerated CRT with lighted internal graticule. The parallax-free internal graticule structure contains targets and markings for both the vector and waveform functions.

The bright CRT allows use in high ambient light conditions, such as those encountered in field production applications.

Calibrator

Vertical and horizontal instrument gain can be set using the calibrator signal. The 1 Volt calibrator signal is available in 100 kHz rate.

More Information

- Standard and optional accessories are listed in the Accessories section, which follows the list of options.
- Instrument options are listed on the next page.
- A complete listing of instrument specifications begins on Appendix page A-1.

Options

Power cord options are the only options currently available. Field upgrade kits listed in this section can also be used with these the WFM601. monitor.

Power Cord Options

Any of the following power cord options can be ordered for the WFM601. If no power cord option is specified, instruments are shipped with a North American 125 V power cord and one replacement fuse.

Unless otherwise specified, power cords for use in North America are UL listed and CSA certified. Cords for use in areas other than North America are approved by at least one test house acceptable in the country to which the product is shipped.

Option A1. Power, Universal Europe, 220 V/16 A (Locking Power Cord)

Option A2. Power, United Kingdom, 240 V/15 A (Power Cord)

Option A3. Power, Australia, 240 V/10 A (Power Cord)

Option A4. Power, North America, 250V/10 A (Power Cord)

Option A5. Power, Swiss, 240 V/6 A (Power Cord)

Accessories

Standard Accessories

These accessories are provided for this product:

1 Manual, user: WFM601 (070–8471–00)

1 Manual, service: WFM601 (070–8876–00)

1 Cable assembly, power: United States and Japan only (161–0216–XX)

1 Cable assembly, power: all other countries (161–0066–XX)

2 75Ω End–line Terminations, 26 dB to 300 MHz (011–0163–00)

1 Fuse, cartridge: 3AG, 2A, 250V, fast–blow (159–0021–00)

4 Light bulbs: graticule scale (150–0168–00).

4 Air filters: fan (378–0335–00).

This accessory is installed on the product:

1 CRT filter: smoke gray (378–0258–00)

Optional Accessories

Camera, C9 Option 20

Viewing Hood (016–0475–00)

Front-Panel Cover (200–3897–01)

Field Upgrade Kits

1700F00 Plain Cabinet — This plain metal half-rack size cabinet is painted silver-gray. Ventilating holes in top, bottom, and sides of the cabinet allow heat generated within the instrument to dissipate.

1700F02 Carrying Case — This portable cabinet is similar to the 1700F00, but has feet, carrying handle, flipstand, and front cover.

1700F05 Side-by-Side Rack Adapter — The 1700F05 allows the user to mount two half-rack width instruments in a standard 19–inch rack.

1700F06 Blank Panel — If only one section of a 1700F05 is used, the 1700F06 Blank Panel can be inserted in the unused section to improve appearance and air flow.

1700F07 Utility Drawer — When only one side of a 1700F05 is used, this utility drawer can be installed in the unused section to provide storage. The drawer opens and closes freely, unless latched for transport.

Ordering — These items can be ordered with the monitor, or purchased through a Tektronix field office or distributor. When ordering, include both the name and number of the Field Upgrade Kits.

Installation

Packaging

At installation time, save the shipping carton and packing materials (including anti-static bag) in case it becomes necessary to ship the instrument to a Tektronix Service Center for service or repair.

Repackaging for Shipment

If it becomes necessary to ship the instrument to a Tektronix Service Center for service or repair, follow these instructions for repackaging:

1. Attach a tag to the instrument showing: the owner, complete address and phone number of someone at your firm who can be contacted, the instrument serial number and a description of the required service.
2. Repackage the instrument in the original packaging materials. If the original packaging materials are not available, follow these directions:
   a. Obtain a carton of corrugated cardboard having inside dimensions six or more inches greater than the dimensions of the instrument. Use a shipping carton that has a test strength of at least 275 pounds.
   b. Surround the instrument with a protective bag (anti-static preferred). For instruments which are not in a cabinet, wrap a cardboard piece around the bagged instrument to protect components.
   c. Pack dunnage or urethane foam between the instrument and the carton. If using Styrofoam kernels, overfill the box and compress by closing the lid. There should be three inches of tightly packed cushioning on all sides of the instrument.
3. Seal the carton with shipping tape, industrial stapler, or both.

Packaged Accessories

The following accessory items are included with these monitors:

- User Manual with Service Manual request card.
- Power Cord
- Replacement Fuse Cartridge (1)
- Replacement Graticule Light Bulbs (4)
- Replacement Air Filters for Fan (4)
- 75Ω End–line Terminations, 26 dB to 300 MHz (2)

Mechanical Installation

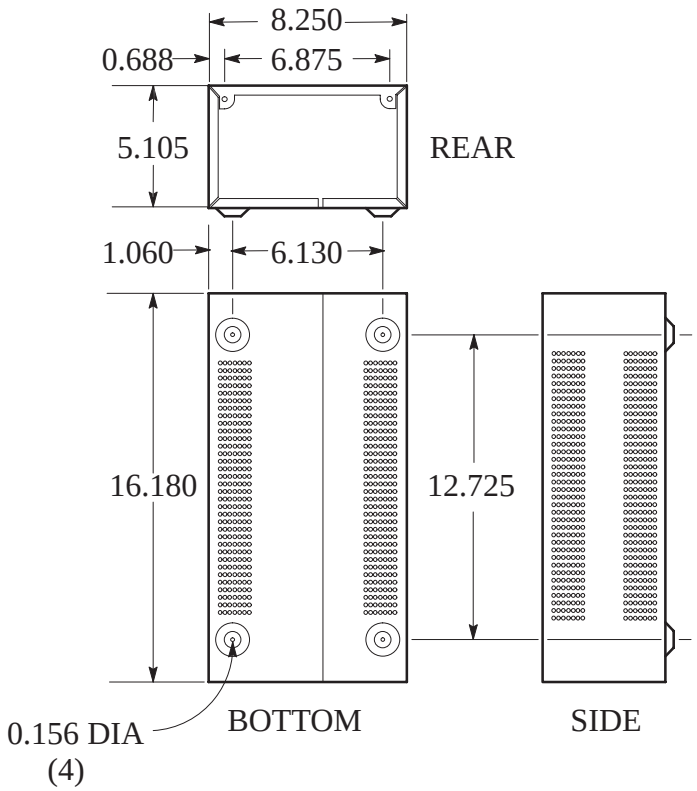

Figure 1-1: Dimensions of the 1700F00 plain cabinet.

Cabinets The cabinets available for this instrument not only provide necessary shielding, and protection against accidental electrical shock, but also provide internal circuitry with protection against build up of dust. A supply of filtered, cooling

air is provided from the rear panel and exits through the cabinet vent holes. Operation in air flow restricted environments may lead to excessive heat build up.

All qualification testing for the WFM 601 was performed in a 1700F00 cabinet. To guarantee compliance with specifications, the instrument should be operated in a cabinet. The plain cabinet, 1700F00, is shown in Figure 1-1.

The optional 1700F00 cabinet is the basic element for all of the cabinets that fit this instrument. The 1700F02 Portable carrying case is an enhanced version of this cabinet, as is the 1700F04 side-by-side rack mount assembly. All of these cabinets are available from Tektronix. If you need one of these cabinets, contact your nearest Tektronix field office or representative for assistance in ordering.

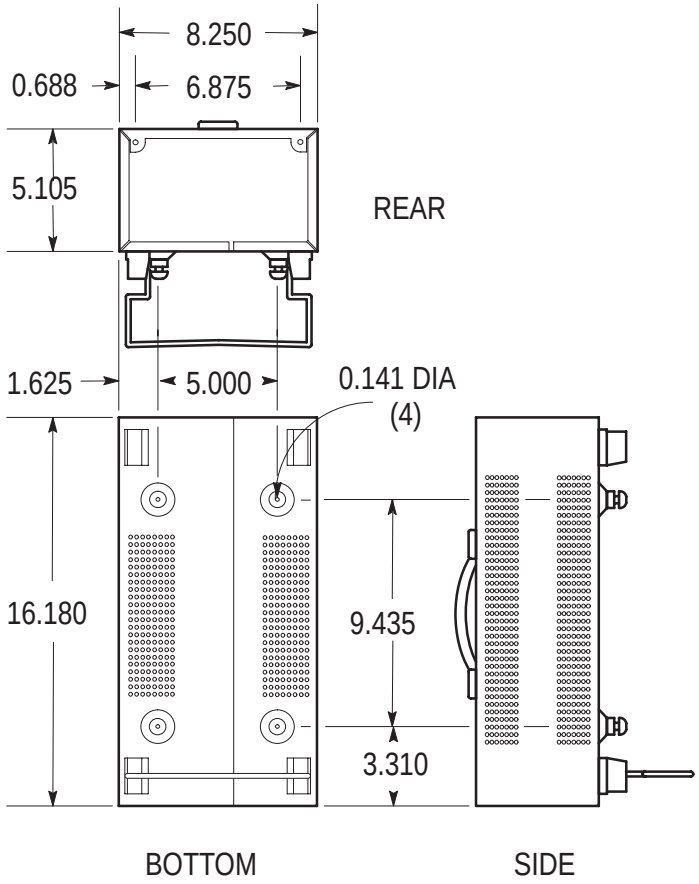

Figure 1-2: 1700F02 portable cabinet.

The portable cabinet, 1700F02, is shown in Figure 1-2. The 1700F02 has a handle, four feet, a flip-up stand. The mounting hole sizes and spacing are different from those of the 1700F00.

All of the 1700-Series metal cabinets, which are available from Tektronix as Optional Accessories, provide the proper electrical environment for the instrument. They supply adequate shielding, minimize handling damage, and reduce dust accumulation within the instrument.

Cabinetizing

Do not attempt to carry a cabinetized instrument without installing the mounting screws. Without the mounting screws there is nothing to hold the instrument in the cabinet if it is tipped forward.

The instrument is secured to the cabinet by two 6-32 Pozidrive® screws, located in the upper corners of the rear panel. See Figure 1-3.

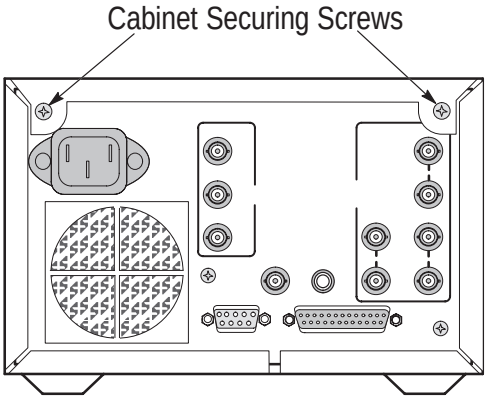

Figure 1-3: Rear view of the instrument, showing the securing screws.

Rack Adapter

The optional 1700F05 side-by-side rack adapter, shown in Figure 1-4, consists of two attached cabinets. It can be used to mount the WFM601 and another half-rack width instrument, such as an analog component monitor (Tektronix WFM300A or 1760–Series), in a standard 19-inch rack.

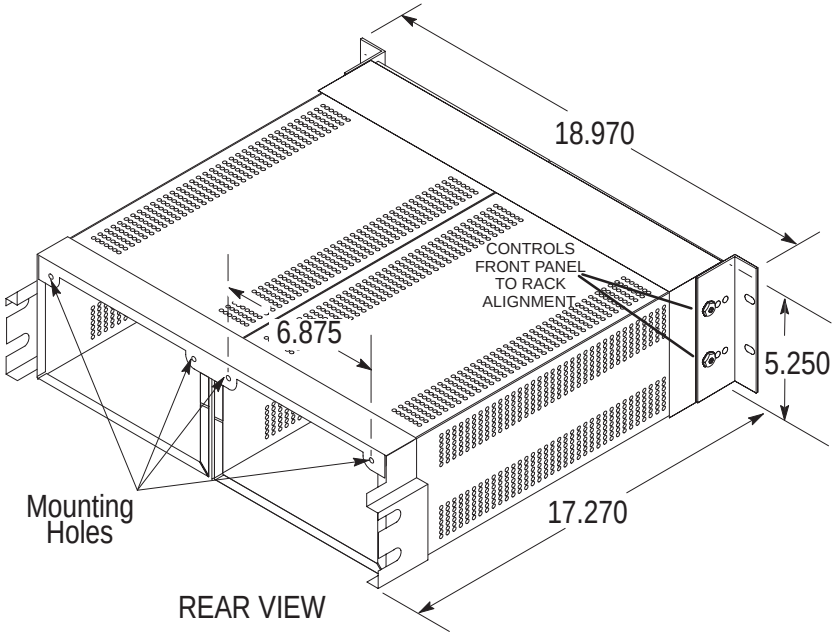

Figure 1-4: The 1700F05 side-by-side rack adaptor.

The rack adapter is adjustable, so the WFM 601 can be more closely aligned with other equipment in the rack. See Figure 1-4.

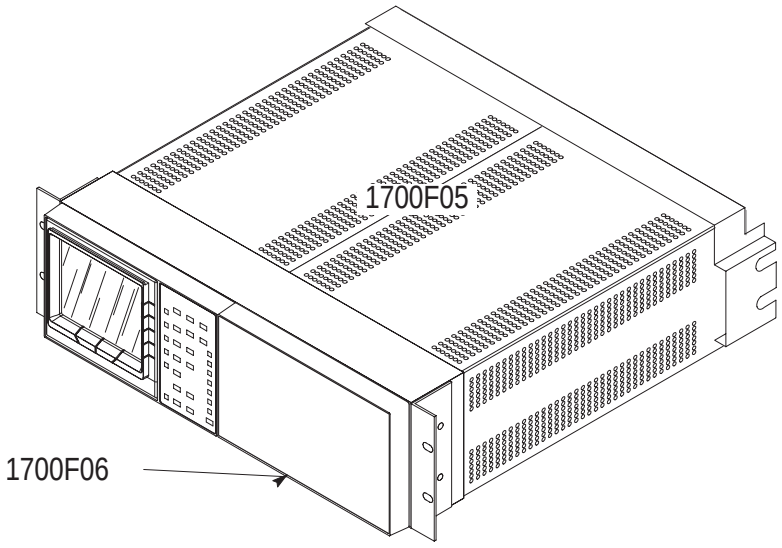

Figure 1-5: Instrument in a 1700F05 with a blank front-panel (1700F06).

If only one side of the rack adapter is used, a 1700F06 Blank Panel can be inserted in the unused section. See Figure 1-5. The rack adapter and panel are available through your local Tektronix field office or representative.

When only one instrument is mounted in the side-by-side adaptor an accessory drawer (1700F07) can be installed in the blank side of the cabinet. See Figure 1-6.

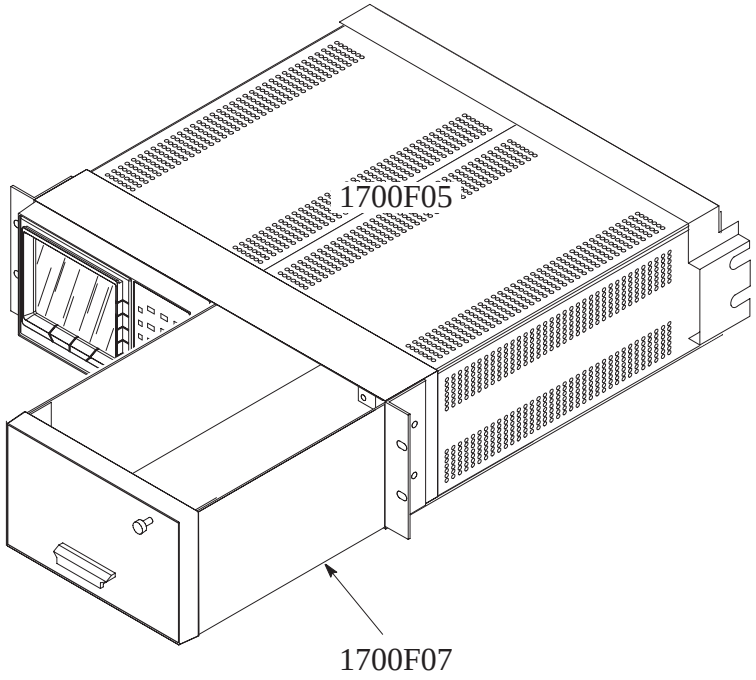

Figure 1-6: A 1700F05 rack mounting cabinet with a 1700F07 utility drawer.

Custom Installation

For applications such as consoles the instrument can be mounted with front molding flush or protruding from the console. In both cases, allow approximately 3 inches of rear clearance for BNC and power-cord connections.

To mount the WFM601 safely, attach it to a shelf strong enough to hold its weight. Install the mounting screws through the four 0.156-inch diameter holes in the bottom of the 1700F00 cabinet. See Figure 1-7.

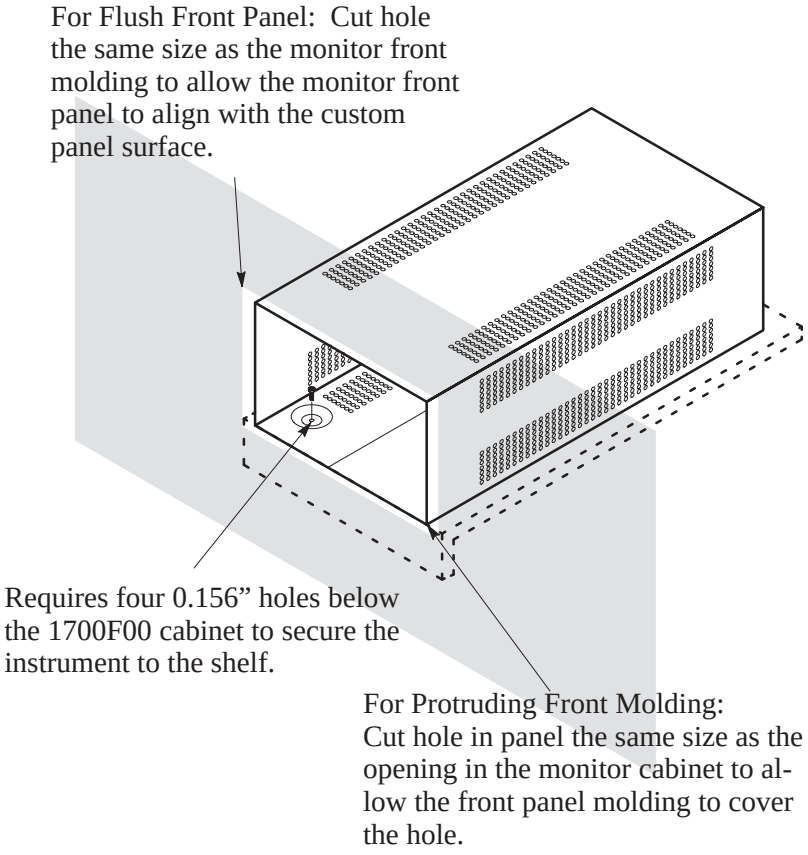

Figure 1-7: Considerations for custom installation of an instrument.

Electrical Installation

Power Source

These monitors are designed to operate from a single-phase power source having one of its current-carrying conductors at or near earth ground (the neutral conductor). Only the line conductor is fused for over-current protection. Systems that have both current-carrying conductors live with respect to ground (such as phase-to-phase on multiphase systems) are not recommended as power sources. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

WARNING. *When power is supplied, line voltage will be present in the instrument, even if the POWER switch is set to STANDBY.*

Mains Frequency and Voltage Range

The WFM601 monitors operate at 50 and 60 Hz, over the range of 90–250 Volts, without operator adjustment.

Remote Connector

The rear-panel REMOTE connector is a 25-pin, D-type connector. It provides the input for, stereo L and R audio. TTL signal or ground closure to designated pins are the enables. Eight front-panel setups can also be stored and recalled through the Remote connector. See Appendix B.

RS232 Connector

The rear-panel RS232 connector is a 9-pin subminiature D-type connector that provides a serial interface for remote control. The RS232 pin assignments are given in Appendix B.

Operational Changes

No operational modifications are made to this monitor through internal jumper settings.

Functional Check

The following procedure is provided to aid in obtaining a display on the WFM 601 Serial Digital Component Waveform/Vector Monitor. It is designed for operator familiarization and as a check of basic instrument operation. Only instrument functions, not measurement quantities or specifications, are checked in this procedure. Therefore, a minimum amount of test equipment is required.

WARNING. *Be sure that the cabinet is installed on the instrument to avoid personal injury.*

All checks are made with the cabinet installed. The cabinet, an optional accessory, must be installed on the instrument to avoid personal injury, maintain proper environment for the instrument, keep dust out, and provide proper EMI shielding.

NOTE*. Unless otherwise noted, the waveforms shown in this procedure are representations of actual displays on the WFM601.*

If performing the Operator's Familiarization Procedure reveals improper operation or instrument malfunction, first check the operation of the associated equipment. If it is operating normally but the WFM601 is not, then refer the instrument to qualified service personnel for repair or adjustment.

When a complete check of the instrument performance to specification is desired, refer qualified service personnel.

This Operator's Checkout Procedure requires a source of serial digital component video and composite sync signals. The TEKTRONIX TSG-422 Option 1S Component Test Signal Generator with Serial Digital output was used in preparing this procedure.

Required Equipment

The following equipment is required to perform this procedure:

1. **Digital Component Television Signal Generator to provide:**
   Colorbar, Luminance Staircase, and Component Timing signal.

   For example: Tektronix TSG-442 Digital Component Generator, Option 1S (Serial Digital output).

2. **Audio Signal Generator**

For example: A Tektronix SG505 Option 02 Oscillator installed in a Tektronix TM500 Series Power Module.

In addition, an adaptor for the 25-pin miniature D-type connector will be needed to access the analog audio input. See equipment list in Section 6 (Performance Verification) for details.

3. **Coaxial Cables**
   4 — 42-inch 75Ω RG59U (Tektronix Part No. 012-0159-00)

4. **75Ω Terminators**
   3 — End-line (Tektronix Part No. 011-0102-00)
   1 — Feed through (Tektronix Part No. 011-0103-02)

Initial Equipment Connections

- Connect the WFM601 to an appropriate AC power source.
- Connect the component serial digital signal to SER A and terminate the other side of the loop-through with a 75Ω terminator.

  This procedure does not check at the Monitor Out, but if there is a GBR or $Y–P_B–P_R$ digital color monitor available, it can be hooked up to check these outputs.

Procedure

1. **Initialize the Front-Panel Controls**

   The Tektronix WFM601 Serial Component Monitor is shipped with an internal preset which sets the front-panel controls to a factory-defined setting. To reset the front-panel controls to the factory presets, enter the MENU by pressing the PRESET button. Select the FACTORY setting by turning the front-panel bezel knob under the list of presets until FACTORY is highlighted. Press the bezel button adjacent to RECALL. The PRESET MENU is automatically exited, and the front-panel control settings are set to the factory preset. This preset automatically selects the line rate (625 or 525) and the 2:1 format. Note that upper right hand corner of the CRT displays the format and scan rate with a readout preceded by an Ⓐ (scan rate automatically selected.) Check that the instrument is now in the WAVEFORM display mode with the luminance portion of the Color Bar signal displayed at a line sweep of 10 µs/Div.

2. Display Control

Adjust the VERT and HORIZ POS controls to center the signal display. The CRT menu allows the operator to adjust the instrument CRT display. Enter the menu by pressing the CRT button. The knobs under the crt now control the focus, scale illumination, and display intensity of the signal. Adjust the controls to the desired viewing levels. See Figure 1-8.

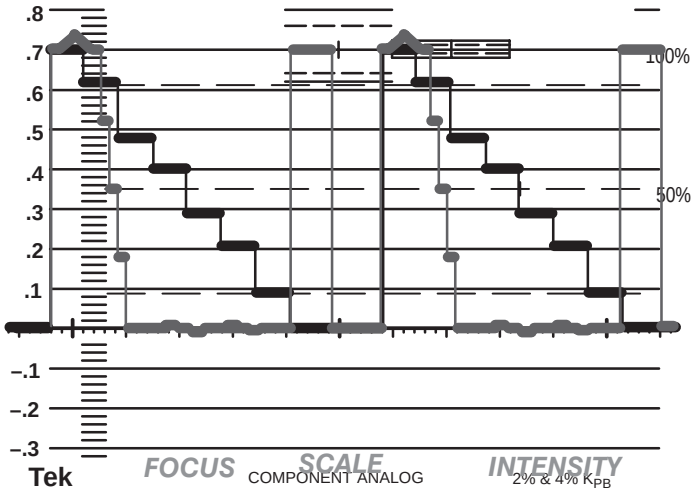

Figure 1-8: Channel 1 of the SMPTE color bar signal on the WFM601.

Press the top front-panel bezel button to select READOUT. One of the front-panel control knobs now controls the readout intensity. Adjust the control to the desired level.

***NOTE**. READOUT INTENSITY controls the intensity of the menus that are used to select and setup instrument operation. Be sure to set this level at a comfortable, yet visible setting. If the readout intensity is accidently turned too low to see, consult MENUS in Section 2 Operating Basics for the recovery procedure.*

Press the top front-panel bezel button again to select TRACE. One of the front-panel control knobs now controls the trace rotation. Adjust the control for a level signal baseline parallel to the graticule 0 line.

Press the bottom front-panel bezel button to turn on RO TEST. Note that a cross mark is now displayed at the center of the 0.7 volt line, directly under the target mark.

Exit the CRT menu by pressing either the CLEAR MENU or the CRT button. The changes made while the menu was displayed remain in effect, but the readout test mark disappears.

3. Parade Display

The WFM601 can display the signals on any of the components of the rear-panel INPUT channels simultaneously in a parade mode. To display the INPUT signals in a paraded display, press the PARADE button. Check that he PARADE indicator lights.

Press the CH 2 button and check that both the CH 1 (luminance) signal and the CH 2 (P_B) signal are displayed. See Figure 1-9.

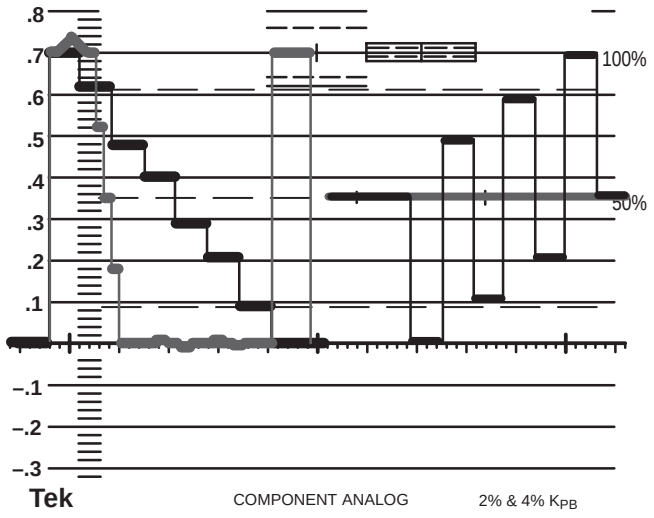

Figure 1-9: Parade display of Y and P_B.

Press the CH 3 button and check that the CH 1 (luminance) signal, the CH 2 (P_B), and the CH 3 (P_R) signals are displayed. See Figure 1-10.

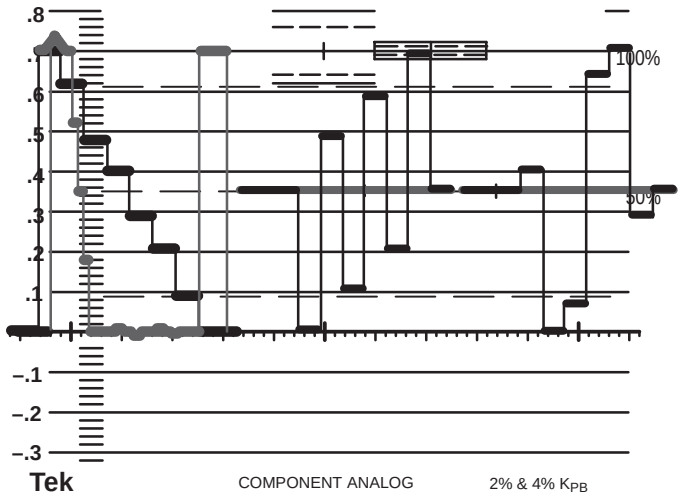

Figure 1-10: Parade display of Y, P_B, and P_R.

4. RGB Screen Display

There is a choice to display color difference signals or RGB. The choice is accessed through the instruments configure menu.

Push the CONFIG button to enter the configure menu. Push the button adjacent to the menu selection for WFM AS to select RGB.

Push the LIN SEL button and select 15H from the line select menu. Push the CLEAR MENU button to remove the line select menu. Use the LINE SEL control (center assignable control) to get a display similar to the one shown in Figure 1-11.

Push the LIN SEL button twice to exit the line select operating mode. Push the CONFIG button and select YPBPR for WFM AS. Push the CLEAR MENU button.

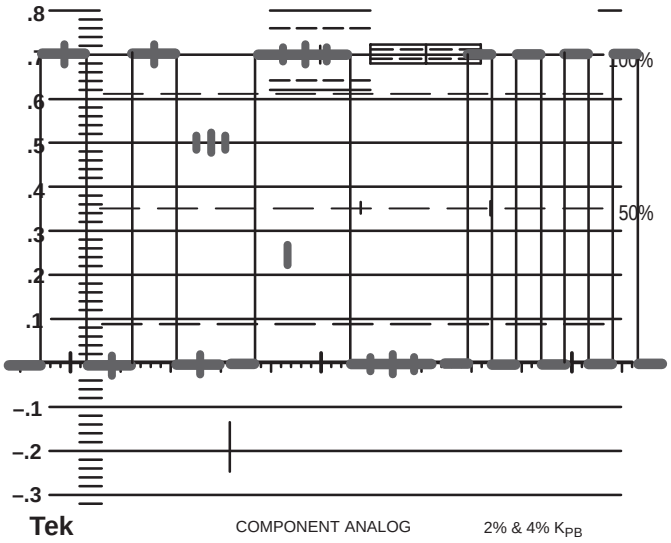

Figure 1-11: WFM601 on screen RGB display.

5. Check Gain

The WFM601 has an internal calibration signal which can be used to check the vertical and horizontal calibration. To display the calibration signal, press the CONFIG button to enter the configure menu. Select CALIBRATE by turning the front-panel control knob under the list of configuration categories until CALIBRATE is highlighted. Press the top front-panel bezel button to select CAL SIG ON.

Select WAVEFORM VIDEO DISPLAY.

The CALIBRATOR signal should now be displayed. Position the signal as in Figure 1-12.

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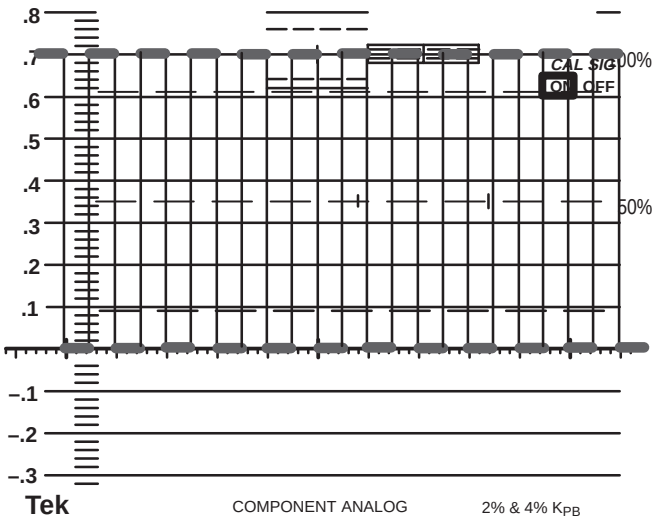

Figure 1-12: WFM601 calibrator display. Note that the amplitude is 700 mV.

6. Auto Gain Calibrate

The WFM601 has an auto horizontal and vertical gain calibration. Push the appropriate bezel button returns the gain to its last calibrated level. To access GAIN CAL push the bottom front panel bezel button and observe that the cursor box now surrounds the ON readout.

The other two assignable bezel controls are now labeled V CAL and H CAL. Rotate both controls enough to see that the horizontal and vertical gains have changed noticeably and that two new labels have appeared next to the bezel buttons. They are RESET V CAL and RESET H CAL. See Figure 1-13.

Push the RESET V CAL button and note that the vertical amplitude returns to 700 mV and that the RESET V CAL label disappears.

Push the RESET H CAL and note that the horizontal gain returns to one cycle per division and the RESET H CAL label disappears. Exit the configure menu by pressing the CONFIG button. The calibrator signal is automatically turned off.

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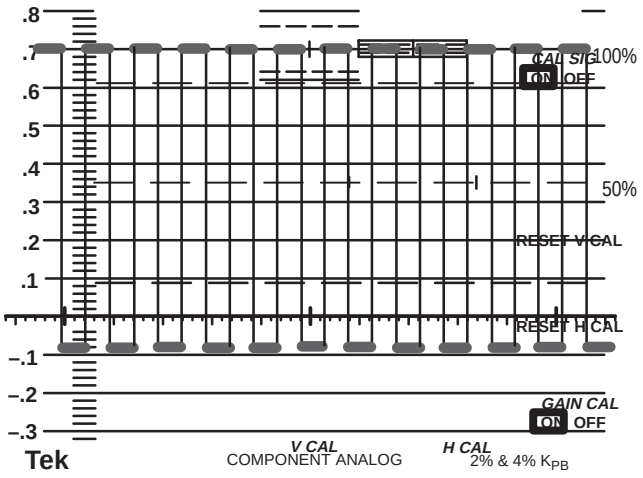

Figure 1-13: Calibrator signal, Gain Cal on, and both gains misadjusted.

7. Gain Control

There are three calibrated gain settings available (X1, X5, and X10), as well as an independent VARIABLE GAIN control.

Turn off CH 2 and CH 3. Press the GAIN button to enter the gain menu. Press the front-panel bezel button corresponding to X5. Check that X5 is highlighted and that the display is immediately amplified. Press the bezel button corresponding to X10. Check that X10 is highlighted and that the display is immediately amplified again.

Press the front-panel bezel button adjacent to the VARIABLE ON/OFF menu selection. Check that ON is highlighted and that one of the front-panel assignable controls is identified as the VAR GAIN control. Adjust the control to the minimum gain setting. The entire signal should now be visible on the crt. Set the WFM VAR GAIN control to the maximum setting and see that by adjusting the VERT POS control, any portion of the signal can be displayed on the crt.

Return the gain to the normal by pressing the GAIN button to exit the gain menu. The next time the gain menu is entered, the settings will be the same as they were left this time (variable X10 gain). Adjust the VERT POS control to place the signal on the baseline.

8. Sweep Timing

The LINE/FIELD button cycles the waveform sweep rate through 1 LINE (5 µs/div), 2 LINE (10 µs/div), 1 FIELD, and 2 FIELD. The MAG button provides additional line sweep rates of 200 ns/div and 1 µs/div. The FIELD sweeps magnified by approximately 25X.

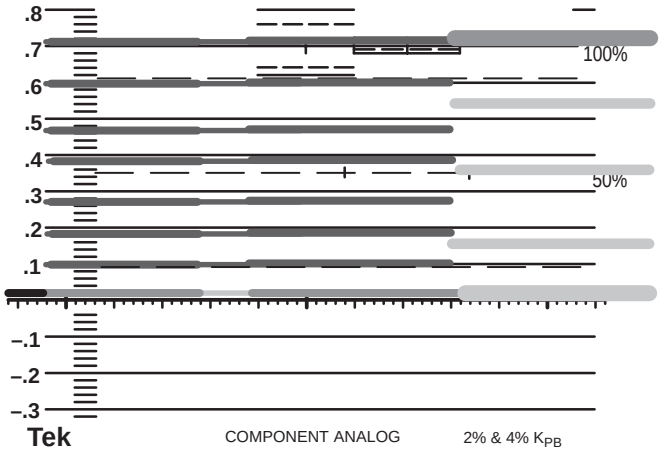

Figure 1-14: One field display of CH 1 (Y) signal.

Press the LINE/FIELD button. Check that the FIELD indicator lights and that the display changes to 1 FIELD. See Figure 1-14. Press the LINE/FIELD button again. Check that the display changes to 2 FIELD. See 1-15. Press the LINE/FIELD button twice to return to the 2 LINE (10 µs/Div) display.

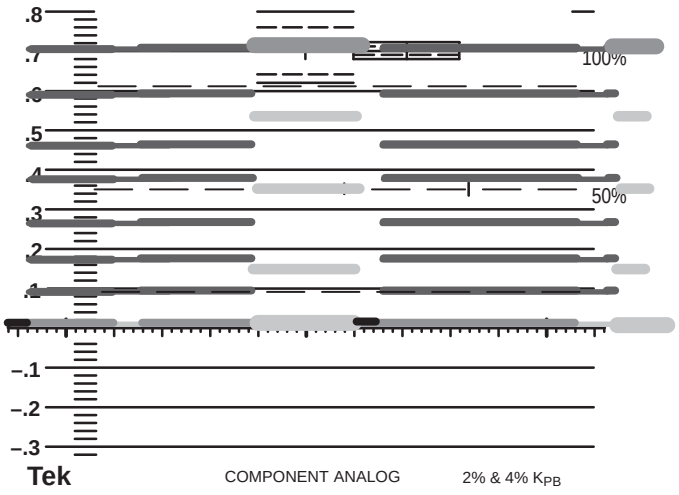

Figure 1-15: Two field display of CH 1 (Y) signal.

Check that the readout shows 10 µs/DIV. Horizontally center the display and then press the MAG button. Check that the MAG indicator lights and that the display changes to 1 µs/Div with a portion of the blanking level, between 700 mV vertical excursions is visible. See Figure 1-16. Press the MAG button again to return to 10 µs/Div sweep.

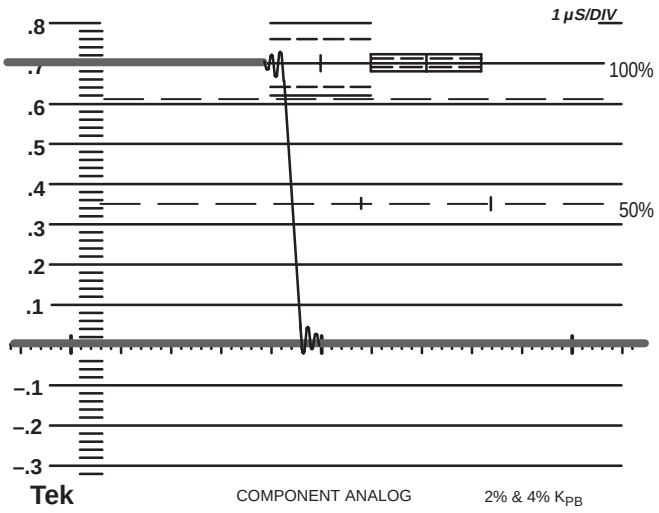

Figure 1-16: Two Line Magnified Display.

9. Flat or Differentiated Filter Selection

The WFM601 offers a selection of either unfiltered display (FLAT) or differentiate step filter for the waveform display. The normal display is unfiltered. Press the FILTER button to enter the filter menu. Check that FLAT is highlighted.

Change the digital input signal to the five–step luminance staircase signal.

Press the front-panel bezel button adjacent to DIFF and see that the label is highlighted by the cursor box.

Check that there is a display similar to Figure 1-17. Push the bezel button adjacent to FLAT and see that it is highlighted and the five-step staircase luminance staircase is again displayed.

Push the FILTER button to turn off the FILTER menu and return to the unfiltered staircase display.

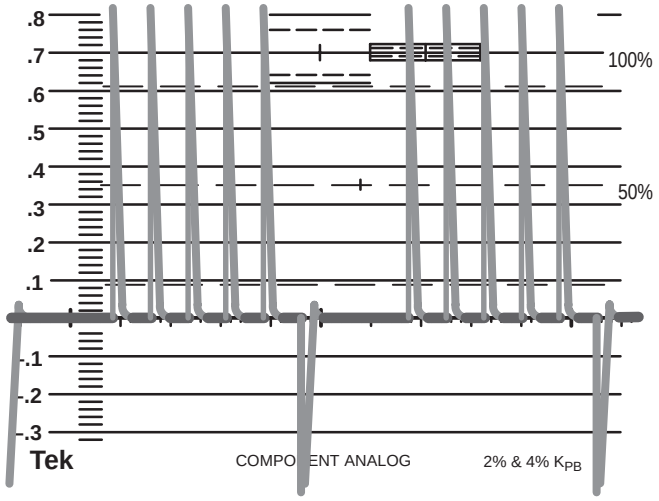

Figure 1-17: A two–line differentiated step display.

10. Line Select

The WFM601 can display one line out of two fields, one line in both fields or up to 15 continuous lines in either or both fields. Display can be 1 line, 2 lines, 1 field, or 2 fields.

Change the digital generator signal to colorbars.

Press the LIN SEL button to enter the line select menu. Push the bezel button adjacent to the FIELD selection to highlight ALL. Turn the front-panel control knob assigned to LINE SEL until the readout, in the upper left corner of the CRT, displays ALL 150. Note that there is no NEXT FIELD label. In the 2 LINE display, the left display is line 150 and the right display is line 151. Press the bezel button adjacent to ALL/1 OF 2 to highlight 1 OF 2. Note that the NEXT FIELD label appears.

Press the LINE/FIELD button twice to select 2 FIELD sweep. If the readout is displaying F2:, push the button adjacent to NEXT FIELD and check that the readout now reads F1:150. Note the intensified portion of the display is in the first field. See Figure 1-18.

Press the bezel button next to the NEXT FIELD selection and note that the readout in the upper left corner of the CRT changes from F1 to F2 and that the location of the intensified line corresponds to the readout whenever this button is pressed.

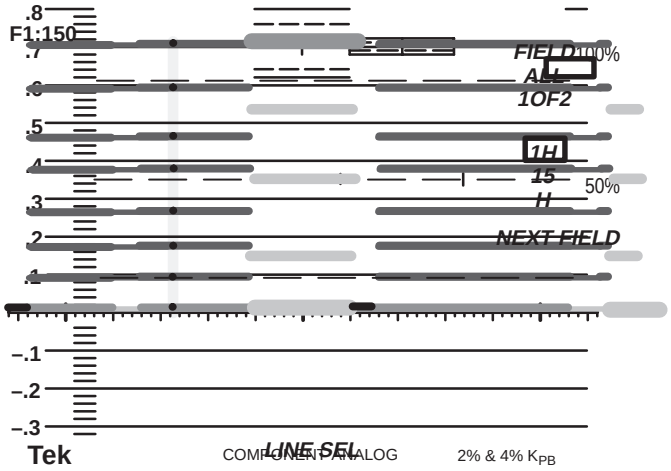

Figure 1-18: Two field line select display with line number 150 selected.

Press the front-panel bezel button adjacent to 1H/15H. Check that 15H is highlighted and that the intensified portion of each field increases in width. See Figure 1-19. Note that the line select readout now reads F1:150/164.

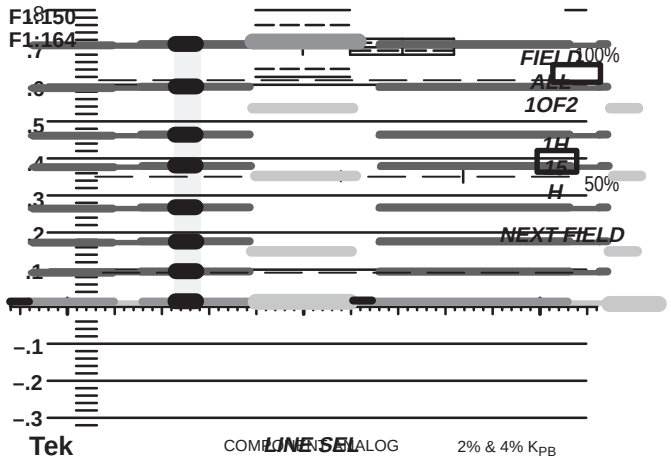

Figure 1-19: Line select, 15-line display; lines150-164 displayed.

Note that only the first field has the intensified zone, and that there is a NEXT FIELD menu selection. Press the front-panel bezel button adjacent to NEXT FIELD. Note that the intensified zone has moved to the second field display and that the readout now reads F2 :150/ F2:164 for 525/2:1, or F2:463/F2:477 for 625/2:1.

Line select is available for the WAVEFORM, VECTOR, PICTURE and LIGHTNING displays. When line select is used in the MULTIPLE display mode, the displays appear in the following order: WAVEFORM, VECTOR.

Return to the normal 2 FIELD display by pressing the LIN SEL button to exit the line select menu. The next time the line select menu is entered, the settings will be just as they were left this time. Press the LINE/FIELD button to select the 2 LINE (10 μs/Div) sweep.

11. Vector Display

The WFM601 vector display uses an electronic graticule. Amplification of the vertical and horizontal axes for both the signal and the graticule are the same, which eliminates errors due to crt geometry anomalies.

Press the VECTOR/LIGHTNING button to switch the monitor to the vectorscope display mode. The display should look similar to Figure 1-20.

Press the CONFIG button to enter the configuration menu. Rotate the menu selection control until FORMAT is high lighted. Press the bezel button adjacent to the COLOR BARS label to change from 100% to 75%. Note that the color bar vector dots are no longer in the target boxes.

Press the bezel button again and note that the dots and the targets are again aligned. Press the CONFIG button again to exit the configure menu.

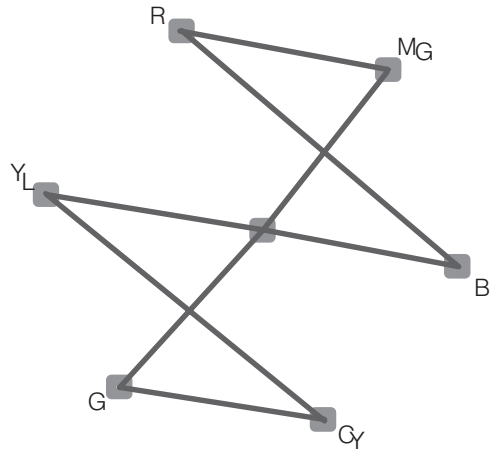

Figure 1-20: Vector color bar display with electronic graticule.

12. Picture Monitor Display

The PICTURE display mode allows the operator to verify the signal source. Press the PICTURE button to select monochrome display. Check that the display changes to a picture monitor display of the Color Bar signal. See Figure 1-21.

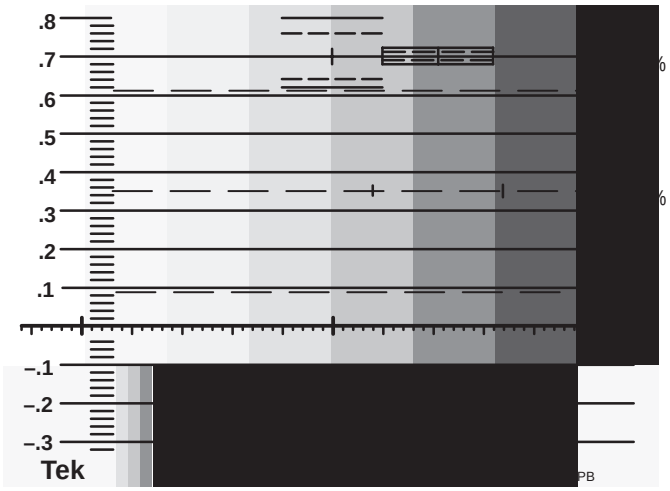

Figure 1-21: Picture monitor display of the SMPTE color bar signal.

13. Audio Display

The AUDIO display mode displays any phase error as an opening in a lissajous waveform. Connect the X/Y audio signal to the rear-panel REMOTE connector. See the equipment list at the start of this procedure for audio generator and and adaptor information. See pages 1-4 and 1–5 for remote connector pin assignments and the operational description.

Press the AUDIO button to select AUDIO. The AUDIO indicator lights and the display changes to the lissajous waveform. See Figure 1-22.

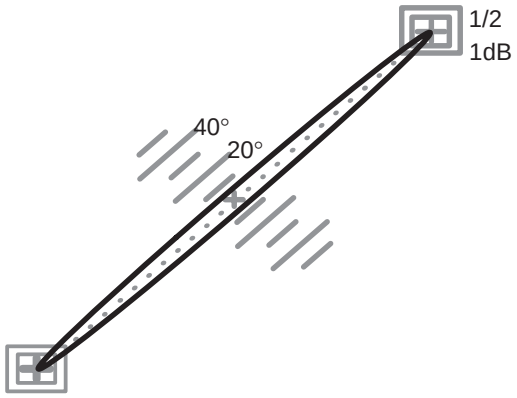

Figure 1-22: Audio display with small phase error.

14. Lightning Display

The LIGHTNING display mode displays either a LIGHTNING or DIAMOND component waveform as chosen from the configuration menu. The DIAMOND display evaluates the RGB signal for gamut limit violations and color errors due to gamma correctors. The LIGHTNING display serves a similar purpose for color difference signals.

Press the VECTOR/LIGHTNING button to select LIGHTNING. Check that the LIGHTNING indicator lights and that the display changes to the LIGHTNING display. See Figure 1-23.

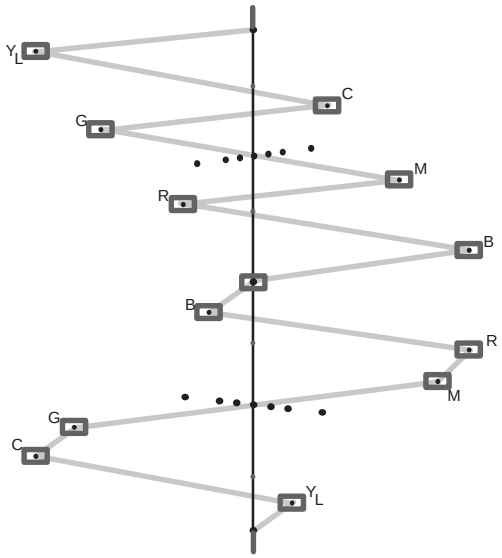

Figure 1-23: Lightning display of the component color difference signals.

15. Diamond Display

Press the CONFIG button to enter the configuration menu. Press the front-panel bezel button corresponding to LIGHTNING/DIAMOND DISPLAY. Check that DIAMOND is highlighted and the display changes to the DIAMOND display. See Figure 1-24.

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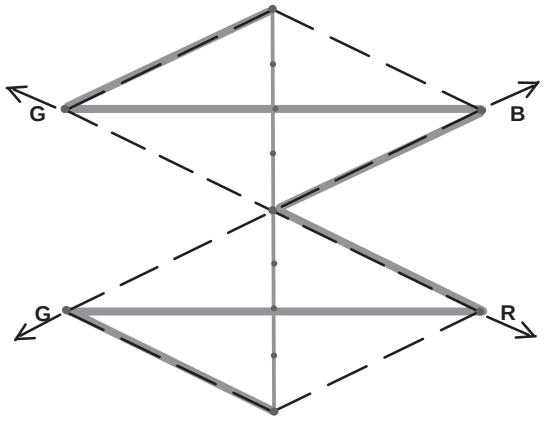

Figure 1-24: Diamond display.

Exit the configure menu by either pushing CONFIG or CLEAR MENU.

16. Bowtie Display

The BOWTIE display provides a two-line display of component signals: line one displays CH 1 minus CH 2 and line two showing CH 1 minus CH 3.

Select the timing signal from the Digital Component Generator. Make sure it is the low frequency (500 kHz) signal with markers.

Press the BOWTIE VIDEO DISPLAY button. Check that the BOWTIE indicator lights and the display changes to the BOWTIE display. See Figure 1-25.

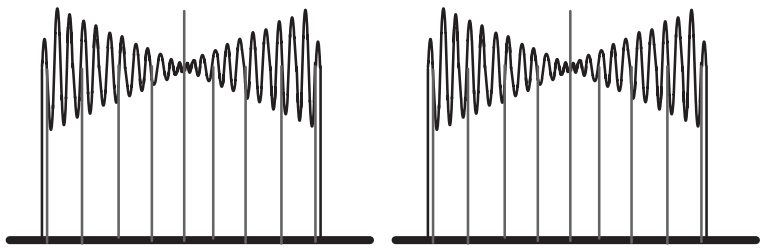

Figure 1-25: The bowtie display.

Operating Basics

At A Glance

The following is an overview of the front panel controls and rear panel connectors for the WFM 601 Serial Component Monitor.

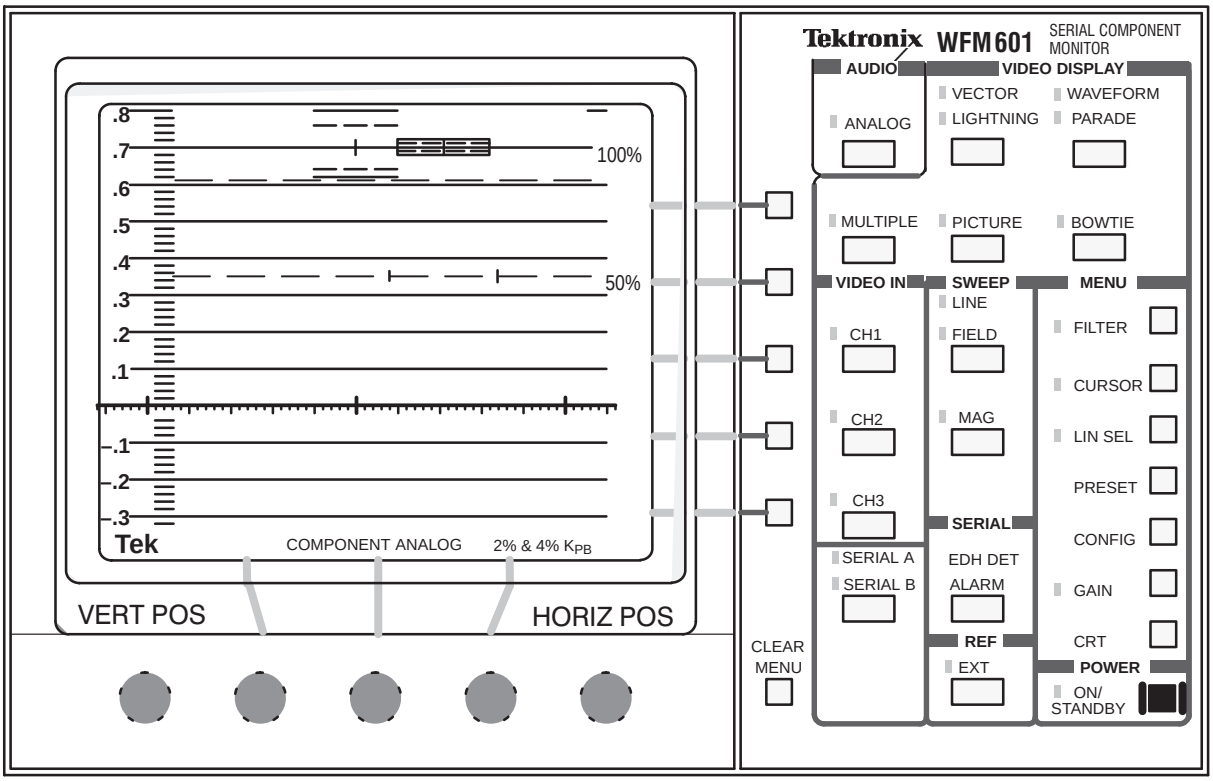

Figure 2-1: Front panel for the WFM 601 Serial Component Monitor.

Front Panel Controls and Indicators

Front panel controls operate in conjunction with crt readout. The central three controls, located beneath the crt, are assigned by front panel switching. See Figure 2-1. For example, one of the controls is the line selector for Line Select displays and becomes a cursor control when Cursors are used. Intensity, focus, scale illumination, trace rotation, and readout intensity are accessed through the CRT Menu. In all cases the outside left control is the Vertical Position and the outside right is the Horizontal Position, as designated on the CRT bezel.

Switches to the immediate right of the crt work in conjunction with crt readout. They are assigned by the Menu switching. The assigned switches either scroll through a list of two or more items or turn on or off a function.

Once there is no further need of the menu, pressing the CLEAR MENU switch clears the crt menu readout.

Indicators

All switches, except the assignable switches to the immediate right of the crt, Clear Menu, and the Menus (for preset, configuration, and crt) have indicators that light up (along with the associated function name).

Two front-panel indicators show the characteristics of the incoming video. When the serial input signal has the Error Detection and Handling (EDH) signal imbedded in it the EDH Detection label is illuminated. When an error occurs the ALARM label is illuminated. The error conditions that light this indicator can be setup in the Configure menu.

EDH DET — The incoming serial digital signal has SMPTE RP165 specified EDH signal.

ALARM — Lights when a serial video format error occurs, the serial signal is lost, or a color gamut error has occurred.

POWER — Push button switch that changes between standby and operational modes.

Display Switching

VIDEO DISPLAY — Five push button switches the display.

WAVEFORM — Selects a waveform overlay display.

PARADE — Displays the selected inputs in a multi–line parade.

VECTOR — Selects the vector display.

LIGHTNING — Selects Lightning or Diamond display as selected through the configure menu.

PICTURE — Selects the monochrome picture monitor mode.

BOWTIE — Selects the Bowtie display.

MULTIPLE — Allows simultaneous display of waveform or parade + vector, waveform or parade + lightning or diamond, waveform or parade + audio.

AUDIO — Displays an XY plot of stereo audio channel phasing from the rear panel REMOTE connector.

VIDEO IN — Turns on or off CH 1, CH 2, or CH 3 or any combination. At least one channel will always remain on.

SERIAL A / SERIAL B – Selects the signal from one of the two rear–panel bnc inputs for display.

SWEEP — Selects the waveform monitor sweep rate.

LINE / FIELD — Toggles through four sweep rates (1–Line (5 µs/division), 2–Line (10 µs/division), 1–Field, and 2–Field)..

MAG — Turns on the horizontal sweep magnifier.

1 µs/division in 2 line sweep rate.

500 ns/division in 1 line sweep rate.

25X magnification for 1– and 2–field sweep rates.

REFERENCE (REF) — Selects either internal serial digital or external composite video input for the instruments reference.

MENU — Serves dual purpose. Four menus (Filter, Cursor, Lin Sel, and Gain) control operational settings. They are identified by LED indicators that are lit when the function is selected. Clearing the menu, by using the CLEAR MENU, blanks the menu readout, but continues to display the control function labels. When the menu is turned off the enabled functions are turned off. When the menu is again selected the previous enabled selections automatically reappear.

Only the menu readout for the last function selected will be displayed, even though more than one menu is selected.

The Preset, Config, and CRT menus either select a stored front panel setting (PRESET) or set up the monitor (CONFIG and CRT). The selections made when these menus are displayed remain, even when the menu is turned off.

More information about the menu selections follows.

CLEAR MENU — Turns off menu readout without affecting any of the menu selections.

Rear Panel Connectors

Power Connector

This instrument is intended to operate from a single-phase power source with one current−carrying conductor at or near earth-ground (the neutral conductor). Only the line conductor is fused for over-current protection. Mains frequency is 50 or 60 Hz. Operating voltage range is continuous from 90 to 250 Vac.

WARNING. *Do not connect power to the WFM601 if it is not enclosed in a prescribed cabinet. Dangerous potentials are present on the Power circuit board.*

Loop–Through Inputs

Rear panel connectors are shown in Figure 2-2.

SER A — Passive loop-through serial digital component input, compensated for 75Ω.

SER B — Passive loop–through serial digital component input compensated for 75Ω.

EXT REF — Loop-through synchronization input (compensated for 75Ω), selected by the front-panel REF switch. The input signal may be black burst, or composite video.

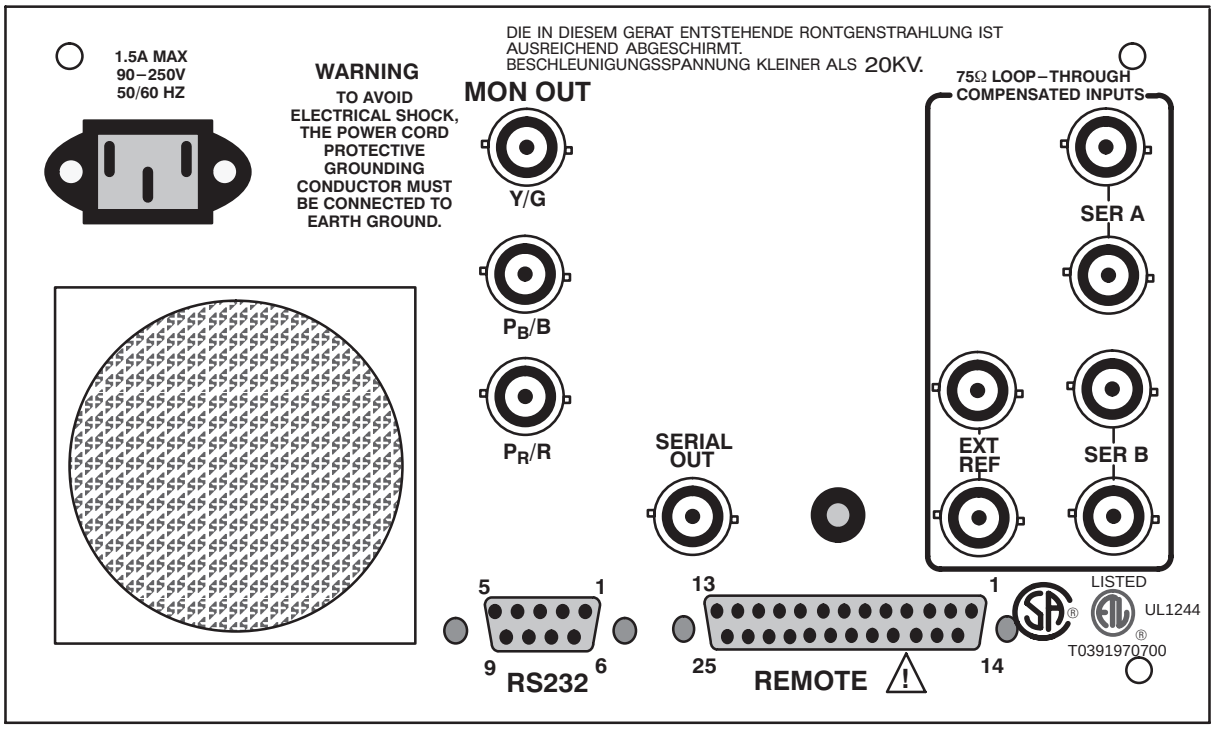

Figure 2-2: Rear panel for the WFM601 Monitor.

Outputs

MON OUT (Y/G – P_B/B – P_R/R) —Three 75Ω outputs that are designed to drive a component picture monitor. Invalid signals cause a blinking bright-up of the monitor display. This gamut error bright–up signal is present on the Y (or G) and can be turned off by menu selection.

Multi–pin Connectors

RS232 — A 9-pin subminiature D-type connector that provides a serial interface for calibration.

REMOTE — A 25-pin subminiature D-type connector that provides limited remote control functions, an alarm output, and analog audio input.

Functional Overview

The ***Functional Overview*** describes instrument functions in greater detail than ***At A Glance.*** Menu operation follows. Detailed Measurement procedures are given in ***Making Measurements,*** beginning on page 4-1.

Display Modes

- **WAVEFORM**
- **VECTOR**
- **AUDIO**
- **LIGHTNING** and **DIAMOND**
- **BOWTIE**
- **PICTURE**
- **MULTIPLE** displays

Waveform

The waveform monitor portion of the instrument provides a voltage-versus-time display of the video signal. The selected input can be displayed in one or two line, or one or two field sweeps. In Line Select mode, identified lines of any field can be selected and displayed. Time and Voltage cursors can be activated and positioned for reference or measurement.

Vector

The vector mode presents an XY plot of demodulated chrominance phase and amplitude. The angle represents chrominance phase and the distance from the center represents chrominance amplitude.

Audio

Audio amplitude and phase is monitored using a calibrated X/Y Lissajous display. The operator can verify that the program audio will be properly reproduced on both monaural and stereo receivers. Correct phasing between two audio channels is quickly verified by the direction of the display.

Lightning

The front-panel LIGHTNING button is used to select either the Lightning display or the Diamond display. For select which one to display, go to the Configure, Format menu and select either Lightning or Diamond. Push the Clear Menu to clear the menu readout.

Selecting Lightning mode forces the instrument to three channel display of either Serial A or Serial B Input.

The Diamond display evaluates the GBR signal for gamut limit violations and color errors due to gamma correctors. Signals which are inside the electronic diamond graticule are within gamut limit. For signals outside the diamond, the graticule is labeled with G, B, and R to determine the color problem area.

Bowtie

In BOWTIE mode, the display is forced to a two line or field sweep of Channel 1, 2, and 3 of the selected Serial Input. The left half of the display shows Channel-1 minus Channel-2 and the right half shows Channel-1 minus Channel-3. If the timing between channels is matched, the centers of the bowties will be centered and not skewed. If Channel-2 is delayed with respect to Channel-1, the skew moves to the right. If Channel-2 is advanced with respect to Channel-1, the skew moves to the left.

Picture

The PICTURE mode allows the operator to verify the signal source. In Picture-mode with Line Select on, a bright-up marker identifies the selected line in the picture.

Multiple

When Multiple display is selected, Waveform or Parade can be displayed at the same time as Vector or Lightning (or Diamond).

When exiting Multiple display, the instrument will return to the previous display settings. When multiple is re-selected, the previous Multiple display settings will be restored.

Displaying a Signal

Inputs

Either of the two rear panel serial loop through inputs can be displayed. In the Waveform display mode, multiple channels (CH-1, CH-2, & CH-3) selected the display is overlayed. Only one serial digital conponent signal can be displayed at a time.

Parade

Selecting PARADE displays up to 3 channels in sucession, The LINE/FIELD button offers only two choices: one line and one field.

Overlay

OVERLAY superimposes the selected input channels. The LINE/FIELD button remains a four-way toggle, providing one line, two line, one field, and two field displays.

Sweep

Sweep buttons are used to select the waveform sweep rate. LINE/FIELD toggles through four sweep rate selections: one line, two line, one field, and two field. In PARADE mode, the LINE/FIELD button becomes a two-way switch, toggling between line and field.

The MAG button is used with LINE/FIELD to provide horizontal magnification of each rate as follows:

One line magnified = 200 ns/division

Two line magnified = 1 µs/division

One field or two field magnified = approximately X20 magnification.

Using the Menus

The operation of the WFM601 is under microprocessor control, which provides it with more flexibility. Operating selections that once were made by jumper changes, Digital In-line–Package (DIP) switches, or multi–position front panel switches can now be made with assignable controls and momentary push button contact switches. To do this the instrument has a set of front-panel selectable MENU switches that call up crt readout menus which operate in conjunction with 5 bezel switches and 3 controls directly beneath the crt. See Figure 2-3.

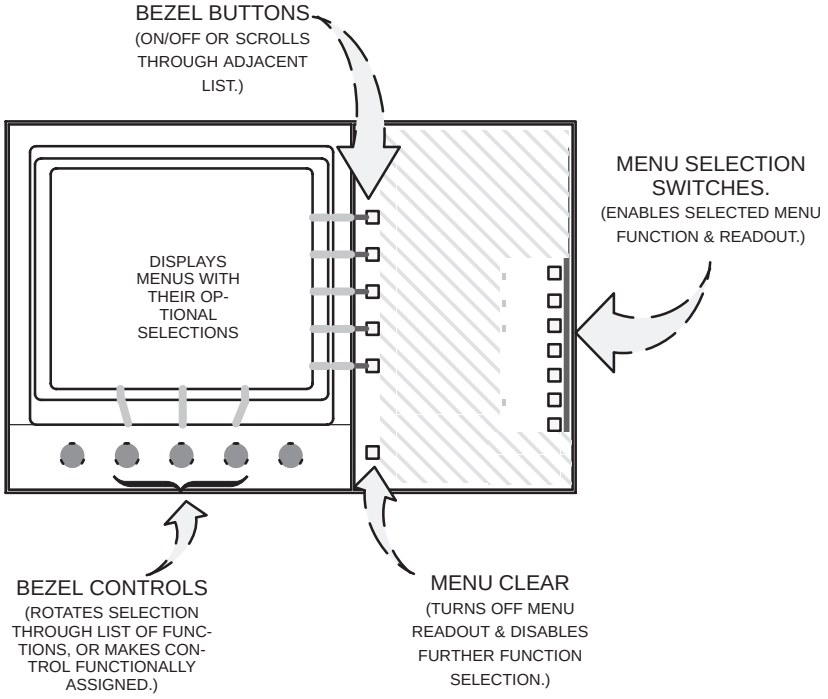

Figure 2-4: Elements of the WFM601 menu driven selections.

Enabled menu selections are surrounded by a rectangle to indicate that they are active.

Pressing the CLEAR MENU switch turns off the menu readout while leaving the functions that were set up by that menu.

Pressing a menu switch when its menu is displayed turns off both the menu readout and in the case of Line Select, Cursor, and Gain disables the function. Filter returns to flat, even if Diff is selected. When selecting Line Select, Cursor, Filter, or Gain the last settings are returned. For example, if X5 and variable were the last gain selections pushing the GAIN MENU will turn on X5 gain and variable gain (variable gain level also returns to the setting previously set up).

Filter Menu

This menu provides only two selections FLAT (unfiltered) and the DIFF (differentiated steps filter). Turning off the FILTER always returns to the unfiltered (FLAT) position. If DIFF is selected when the menu is turned off, selecting the function again returns to DIFF.

Pressing CLEAR MENU turns off the filter selection readout.

Cursor Menu

The Cursor menu allows the operator to chose Voltage Cursors, Time Cursors, Markers, or both Voltage and Time Cursors. With Voltage, or Time cursors the three controls below the crt are assigned to control cursor 1, cursor 2 and cursor tracking. The difference in the settings of cursor 1 and cursor 2, when voltage or time is selected is reported with crt readout as Δ V or Δ T. In the both mode (V+T) a CONTROL selection allows the three controls to be used with either the voltage or time cursors.

Markers operate in the vertical direction only. There are three markers identified by the type of dashed lines:

Mark 1 is the longest dash.

Mark 2 is double dash.

Mark 3 is the shortest dash.

The markers have no readout associated with them.

CLEAR MENU removes the readout associated with the cursor selection, but the cursors, difference readout (voltage or time) and control assignments remain active and on screen. To restore the menu readout, push the CURSOR menu button again. To turn off the cursors, push the CURSOR menu button when the menu readout is displayed. (Two pushes of the CURSOR button, if the menu readout is not displayed.)

Line Select Menu

The Line Select menu provides a means of displaying a specified portion of the signal. In the field rate sweeps one line out of one of field 1 or field 2, or the same line in both fields can be displayed as a bright up of the display. A readout in the upper left corner identifies the line. If 15H is selected the intensified portion of the sweep increases in size and the read out now gives a range of lines (Field plus starting and ending line).

In the line rate sweeps the display will be one or two lines long and will display the selected line first. In 15H mode the display will consist of 15 lines overlaid. Again the readout will be a range of lines.

The NEXT FIELD selection comes up when 1 OF 2 FIELD is selected and allows the operator to toggle between fields 1 and 2.

A special condition exists when PARADE or WAVEFORM overlaid mode display is selected. The first line in the display corresponds with the readout and the first line of the three displayed. The second is the from the next line and finally the last third of the display is from the third line in the sequence. See Figure 2-5.

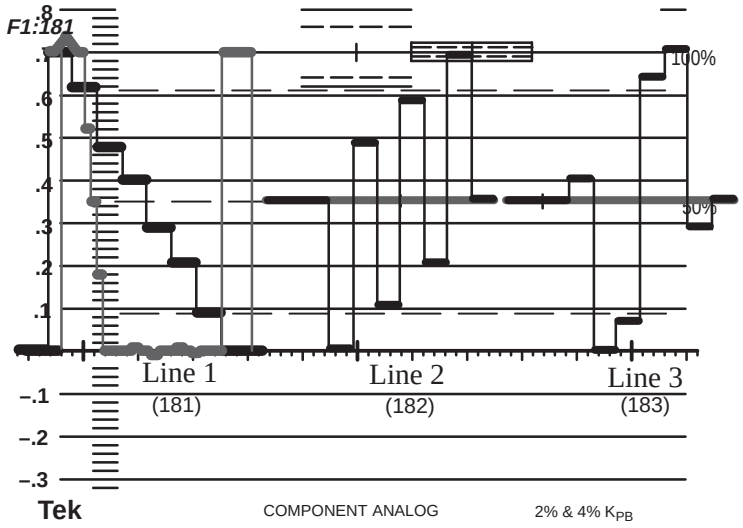

Figure 2-5: Parade display of $Y–P_B–P_R$ shown in line select.

CLEAR MENU removes the readout associated with the line selection, but the line number readout and Line Sel control assignment remain active and on screen. To restore the menu readout, push the LINE SEL menu button again. To turn off the function push the LINE SEL menu button when the menu readout is displayed. (Two pushes of the LINE SEL button if the menu readout is not displayed.)

Preset t Menu

The Preset menu makes it possible to recall a preset measurement from a list of 10 possible front panel setups, Nine of these front panel set ups can be used for storage of front panel setups. The remaining one is factory programmed to to assist in the calibration of the instrument.

Once a front panel has been set up, to make a measurement, those settings can be named and stored in one of nine available memory locations for future recall.

When the PRESET menu button is pushed a list of the 10 presets appears over the 2nd knob below the crt. Rotating this knob moves the highlight box up or down the list. Once the desired preset location is selected, one of four actions can be taken:

RECALL – Sets the front panel to the stored settings previously loaded into that memory location.

STORE – Wipes out the currently stored settings, in the selected memory location, and replaces them with the current front panel settings.

RENAME – Calls up a set of alpha–numeric characters, plus a limited set of symbols. In the rename sub menu the two controls to the right of the preset scroll that are assigned and the Factory selection disappears. One control is used to select the location (within the current name) where you wish to change a letter or character. The second scrolls through a list of characters to select the naming choice. The blank space is located immediately following the letter Z. Once the correct location and letter (number or character) are selected, pressing the ACCEPT button locks the selection. When renaming is complete, pressing the RETURN button brings back the original menu.

RECOVER – Returns to the previously selected choice. (Assume that Preset 1 was the previous choice and Preset 8 has now been selected but not recalled. Pushing RECOVER returns to Preset 1.)

To restore the Preset menu, push the PRESET menu button again. To turn off the function Recall a Preset, press RECOVER, press CLEAR MENU, or press the PRESET menu button.

Configure Menu

There are six separate sub menus included in the Configure Menu: Format, Serial Alarm, Serial Utility, Gamut, Offset and Calibrate. Access to these menus is through the list above the second crt control. The Configure menus are overlaid on the currently selected display mode, even though they may have no effect on that particular display.

In addition to the functions enabled by the CONFIG MENU, the software version number and coprocessor version number are found on the CALIBRATE sub menu.

FORMAT This menu controls a number of items affecting the crt and monitor out displays. Enter it by selecting CONFIG MENU and scroll to the FORMAT entry with the designated bezel control.

STANDARD – Provides three options: 525 line scan rate 2:1 format, 625 line scan rate 2:1 format, or Automatic recognition of incoming scan rate and format. The selected standard or the automatic selection is indicated at the upper left corner of the CRT. If the selection is automatic recognition of the incoming signal, an Ⓐ precedes the standard label. Normally the instrument should be operated in the automatic recognition mode.

COLOR BARS – Scales the vector, and lightning signal amplitudes to be read on the graticule. Readout is provided to identify whether the signal is 100% or 75% amplitude color bars.

DISPLAY – Provides a choice of either Lightning or Diamond display when LIGHTNING is selected.

WFM AS – Selects between RGB and $Y–P_B–P_R$ for the display format for the crt display in WAVEFORM and PARADE modes.

MON OUT AS – Selects between GBR or $Y–P_B–P_R$ for the rear panel Monitor Output format.

SER ALARM This menu controls whether the front panel ALARM indicator lights when any of the following Error Detection and Handling (EDH) conditions occur. Alarms are turned on or off by the push of the adjacent bezel push button. When the alarms are turned, on these conditions will turn on the front-panel alarm indicator.

MISSING VID – Video is missing from the incoming signal, or there is no incoming signal.

FULL FIELD CRC ERROR – The transmitted cyclical redundancy checksum (CRC) does not match the actual CRC for the last video field.

ACTIVE PIC CRC ERROR – The transmitted CRC does not match the actual CRC for the last active picture region

EDH FLAGS – Full field or active picture CRC errors, or hardware errors have been detected and flagged upstream.

EDH Error Reporting - Whenever there is a need to determine what error has occurred, it is possible to access an error status readout. This readout is brought up by pushing the front panel SERIAL push button. The status of the alarms plus the number of errored seconds in any of the four reporting categories (Full Field CRC Errors, Active Picture CRC Errors, EDH Flags Set, and Gamut Limit) is reported. Table 2–1 approximates the CRT EDH error report form.

Table 2–1: EDH CRT error reporting.

SERIAL ITEM	STATUS	ALARM LEDS
SERIAL VIDEO	PRESENT/MISSING	ENABLED/DISABLED
EDH ANC DATA	PRESENT/MISSING	
FF CRC ERR SEC	0	ENABLED/DISABLED
AP CRC ERR SEC	0	ENABLED/DISABLED
EDH FLAGS ERR SEC	0	ENABLED/DISABLED
GAMUT ERR SEC	0	ENABLED/DISABLED

RESET ERR - If there are errored second reports a reset readout appears above the display on the CRT face. Counters for the errored seconds status are reset to 0 when the bezel push button next to the CRT readout label is pushed.

SERIAL UTILITY Strips off or passes the horizontal interval from End of Active Video (EAV) to Start of Active Video (SAV), including the EAV and SAV pulses in pass mode. In most cases, the parade or waveform display will be cleaner without these pulses. Figure 2-6 shows the EAV/SAV pulses on a parade display.

PASS – In the pass mode, all of the horizontal interval along with the pulses is passed. The horizontal interval can be monitored on the waveform display, but the monitor output (MON OUT) remains blanked. In addition, the horizontal blanking encroaches on the digital active picture area, but leaves the entire analog active picture area unblanked for the monitor output.

STRIP – In the strip mode the entire digital active picture area is passed through to the monitor output. Any ancillary data in the horizontal interval is also visible as video. Normally the horizontal interval is digitally blanked; EAV and SAV, and all video and ancillary data between them is replaced with digital data values that represent blanking levels.

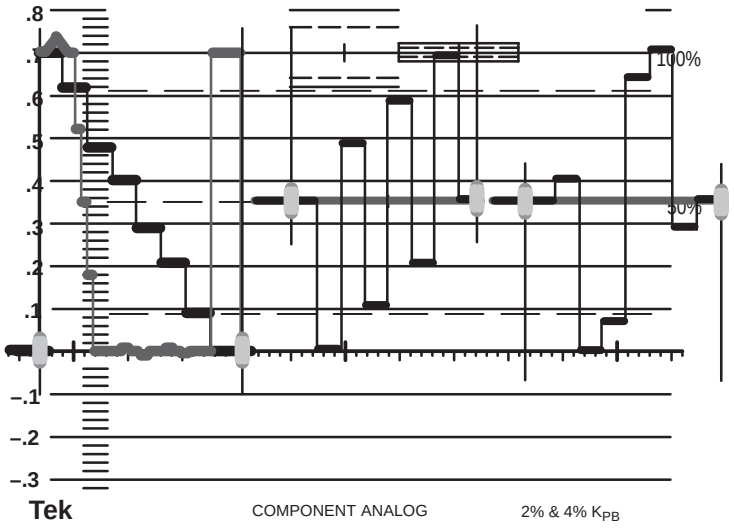

Figure 2-6: Parade display with EAV/SAV turned on.

GAMUT Provides the means to turn on or off the gamut error alarm. This sub menu has only two bezel switch options. Gamut limit alarm status and error report are part of the EDH CRT error report see Table 2–1.

MONITOR OUT – Alarm/off enables or disables blinking on monitor out to indicate the presence of gamut errors.

PANEL LED – Alarm/off enables or disables blinking of the WFM601 front panel ALARM led to indicate the presence of gamut errors.

OFFSET Changes the location of the baseline for P_B and P_R to either 350 mV or 0 mV. Two toggle selections are on the CRT readout menu one for each color difference signal. Figure 2-7 shows P_B and P_R at 0 offset.

CALIBRATE Provides an accurate calibration signal and the means to set up both horizontal and vertical gains. Selections for the Calibrate menu are only present when the instrument is operating in the WAVEFORM or PARADE display modes.

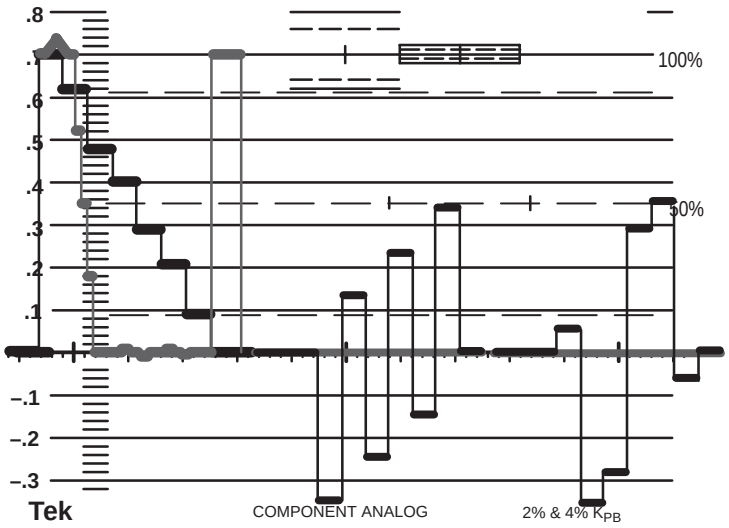

Figure 2-7: Parade display with the P_B and the P_R with 0 offset.

CAL SIG – Turns on or off the calibrator signal. Calibrator signal is synchronized in order to provide an accurate 100 kHz horizontal timing standard.

GAIN CAL – Enables or disables the V CAL and H CAL controls. If the current calibration is misadjusted, readout adjacent to two of the bezel buttons assigns them to reset the calibration. Pushing the reset v or h cal returns the corresponding gain to original calibrated setting. When the original calibration is restored, the reset readout and the function of the buttons goes away.

READOUT – On/off turns the readout off to enable the calibrator waveform to be viewed without extraneous detail. Pushing the same bezel button, when readout is off, brings back the menu. Readout automatically returns when exiting the CALIBRATE mode.

Software Version Number – The lower right corner of the crt has the version number for the software loaded in this instrument. If in doubt of the software level, check this menu.

CLEAR MENU removes the readout associated with the Configure selections. To restore the menu readout, push the CONFIG menu button again. To turn off the configure menus, either push the CONFIG menu, or the CLEAR MENU button when the menu readout is displayed.

Gain Menu

The Gain menu allows a change to the vertical gain for the Waveform, Parade, and Bowtie displays. Variable gain for the Vector display changes both horizontal and vertical gain equally. Lightning and Diamond displays have both horizontal and vertical variable gain. X1, X5, and X10 gain are fixed levels and selected by the bezel buttons adjacent to the gain selection. Variable gain is also selected by bezel button push.

CLEAR MENU turns off all of the menu readout, except the VAR GAIN label (If turned on). Variable gain remains active as long as the front panel GAIN indicator is lit.

When GAIN is pressed to turn it off, Variable gain is returned to the calibrated setting and the vertical gain returns to X1.

CRT Menu

There are five functions that can be controlled from this menu; Focus, Scale, Intensity, Readout Intensity, and Trace Rotation. Functions are assigned to the three assignable controls from the menu readout adjacent to the top bezel button.

Readout intensity can be turned below the minimum viewing level, which makes all CRT menus disappear. If this happens, there is a method to recover. Press the CRT Menu button and note that the menu does come up, at a reduced intensity. Pushing the top CRT bezel button once moves the cursor to the READOUT and again reduces the intensity; however, the control next to the HORIZ POS is now the readout intensity control and turning it clockwise increases the readout intensity.

Pressing either the CLEAR MENU or the CRT menu button exits the menus.

Remote Operation

The 25-pin rear-panel REMOTE connector is a subminiature D-type connector. It accepts the input for Left and Right audio. For remote controlled functions like preset/recall a TTL low or ground closure is the enabling level.

The user can store and recall up to eight front-panel setups through the remote. Remote connector pin assignments and an operational description are in Appendix B.

Using Presets through the Remote

The WFM601 has 10 presets capable of storing front-panel setups. Presets one through eight are accessible through the rear-panel REMOTE connector. A TTL low or ground closure on one of the PRESET pins selects the front-panel setup stored at that preset location.

When STORE (pin 25) is grounded along with one of the preset pins, the current front-panel setup is stored at the selected preset location.

Reference

Making A Measurement

Making a measurement contains WFM601 graticule descriptions, followed by specific measurement procedures.

This monitor uses an internal graticule, which combines waveform and vector markings. The internal graticule scales are on the same plane as the CRT phosphor, eliminating parallax errors. Graticule illumination can be adjusted through the CRT menu to provide optimum brightness for viewing or photographing displays.

Internal Etched Waveform Graticule

This is the graticule that is permanently etched on the crt faceplate glass. It has controlled illumination, which varies between off and a level sufficient to make measurements in the presence of normal room light.

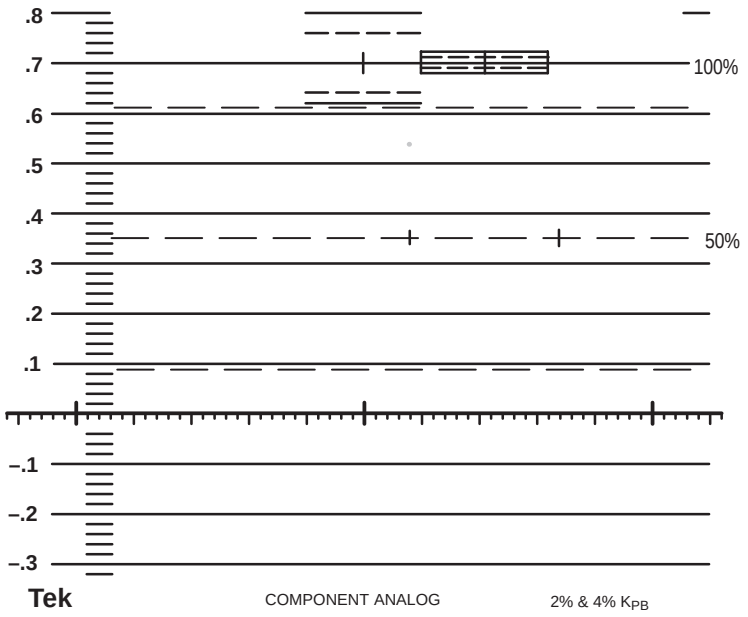

Figure 3-1: WFM601 waveform measurement graticule.

Vertical Scale This graticule scale facilitates Waveform, and Parade measurements. See Figure 3-1. The scale is marked in millivolts (mV) and extends from

–300 mV to +800 mV in 100 mV increments. Each major division is divided into 5 minor divisions which equal 20 mV each.

There are three dashed lines on the graticule. The line at 50% amplitude is the center line for the color difference signals. The lines at 90 mV and 610 mV correspond to the peak excursions for 75% amplitude color difference signals. 100% amplitude color difference signals extend from the baseline (0V) to 700 mV, centered on the 50% graticule line.

K–Factor line–time distortion is measured from the largest deviation of the bar top (tilt or rounding) within the structure located just right of center, on the 700 mV line. The structure is designed to ignore the first and last 1 μs of the bar where short–time distortions (ringing, overshoot, undershoot, etc.) occur. The solid outer box equals a 4% K factor, while the dashed line inner box equals a 2% K factor. For signals with a bar half–amplitude duration that exceeds 18 μs, measure the bar top in increments by positioning the bar to the left or right from the leading or trailing edge.

2T pulse–to–bar measurements are made using the solid and dashed lines located to the left of K Factor box. These lines are scaled according to the following formula:

$$\frac{1}{(1-4K)} \quad \text{and} \quad \frac{1}{(1+4K)}$$

Where:

K = 0.02 for 2% K Factor (using the dashed lines)

K = 0.04 for 4% K Factor (using the solid lines)

The VERTICAL X5 GAIN increases the resolution to 0.4% and 0.8%.

Horizontal Scale. The horizontal reference line is also referred to as the reference line, base line, 0% line, 0 mV, zero line, blanking level, and black level. The reference line is 12 major divisions long with main marks at the 1st, 6th, and 11th divisions for timing and linearity measurements within the center ten divisions on the scale. When the sweep button is set to 1 line, each major division represents 5 microseconds (μs), minor divisions equal 1 μs; when set to 2 line sweep, each major division represents 10 μs, minor divisions equal 2 μs.

The horizontal reference line is also referred to as the reference line, base line, 0% line, 0 mV, zero line, blanking level, and black level. The reference line is 12 major divisions long with main marks at the 1st, 6th, and 11th divisions for timing and linearity measurements within the center ten divisions on the scale. When the sweep button is set to 1 line, each major division represents 5 microseconds (μs), minor divisions equal 1 μs; when set to 2 line sweep, each major division represents 10 μs, minor divisions equal 2 μs.

When the sweep is magnified the scale on the baseline equals 1µs per major division and 200 ns per minor division in 2 line sweep, and 500 ns per major division and 100 ns per division for 1 line sweep.

Electronic Graticules

There are three measurement specific electronic graticules available. Lightning and vector graticules are available with the signal amplitude scaled to the graticule for 100% and 75% amplitudes. The scaling factor is selected from the CONFIGURE MENU, with CRT readout to indicate the signal amplitude. In addition, there is the audio graticule, which is not affected by the color bar amplitude selections.

Vector Graticule

The polar display permits measurements of hue in terms of the relative phase of the chrominance signal. Amplitude of chrominance is the displacement from center (radial dimension of amplitude) towards the color point which corresponds to 75% (or 100%) amplitude for the color being measured.

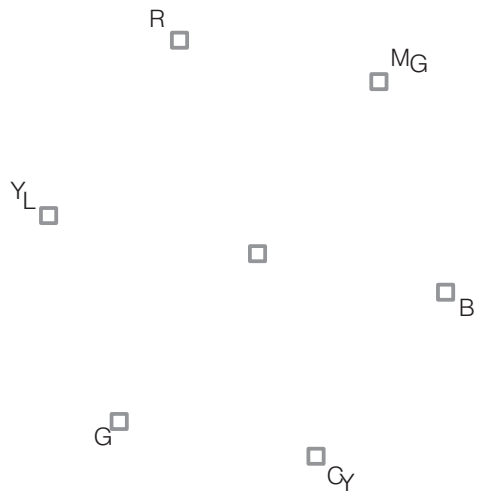

Figure 3-2: WFM601 vectorscope graticule.

On the WFM601 electronic component vectorscope graticule, each chrominance vector terminates in a target See Figure 3-2. The dimension of each target box equals 2% of the 700 mV, or ±14 mV.

Lightning Graticule

Figure 3-3 shows the graticule that appears when the WFM 601 is operating in the Lightning mode. This graticule matches the format of the display when component signals are applied to the instrument. The graticule targets indicate a tolerance of ±14 mV. The closely–spaced small dots provide a guide for checking transitions. These dots are spaced 40 ns apart while the dots that are spaced further apart represent 80 ns.

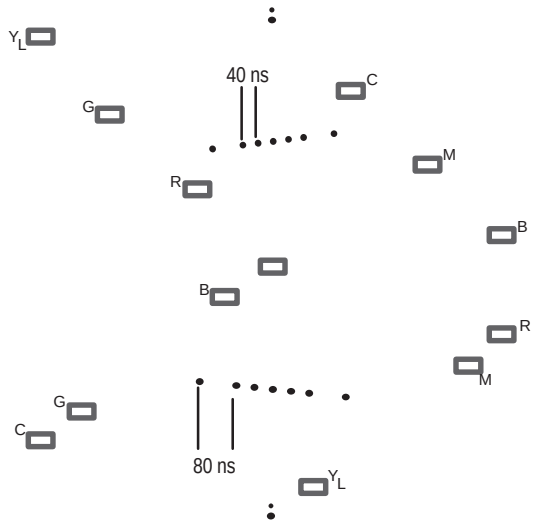

Figure 3-3: Electronic graticule used for evaluating the Lightning display.

Diamond Graticule

The Diamond graticule is not intended as a measurement graticule, rather it is intended to convey that the RGB signal is either within or outside valid gamut limits. Signals contained within the diamonds are within gamut limits. The two identical diamonds are used to convey amplitude errors. Errors in green amplitude affect both diamonds equally, while blue amplitude errors affect only the top diamond and red errors affect only the bottom diamond. See Figure 3-4.

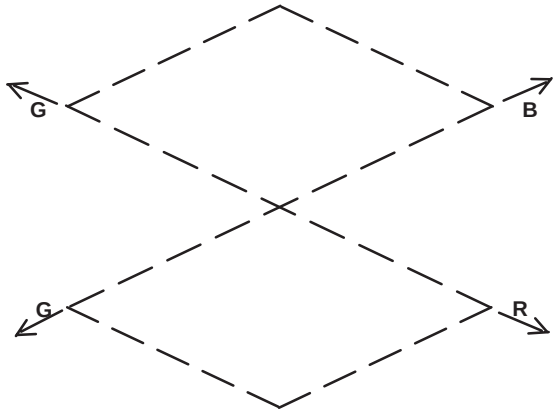

Figure 3-4: Graticule for the diamond display.

Analog Audio Measurement Graticule

Any oscilloscope, including a vectorscope, that has identical X and Y amplifiers can be used to make accurate stereo audio phase measurements. When identical signals of equal amplitude are input, the resultant display will be a lissajous pattern, whose opening is relative to the phase error between the signals. If there is no phase error between signals, the display will be a 45° diagonal line. See Figure 3-5. When the signals are not equal in phase, the pattern will have its axis on the diagonal but be displayed as an ellipse. As long as the amplitude of the signals remains the same, the amount of opening in the ellipse (up to 90°) is a relative measure of the phase difference. At 90° the display is a circle; errors greater than 90° cause the axis to rotate by 90°.

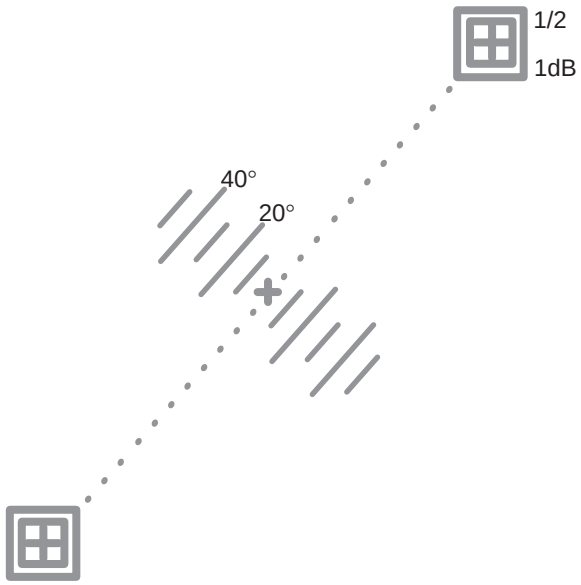

Figure 3-5: Electronic graticule for measurement of stereo audio phase.

The electronic graticule for the WFM601 has scales for measurement of stereo audio phase. The dashed diagonal line is the measurement axis for errors less than 90°, it is terminated in amplitude targets that correspond to the length of X and Y axes. The boxes, surrounding the crosshairs, are equal to amplitude errors of 1/2 and 1 dB, respectively.

The Y axis has markings, in 10° increments, for measurement of phase error.

Calibration

Instrument gain may require readjustment for special monitoring applications. To prevent erroneous measurements, gain should be adjusted only by qualified personnel; however, normal instrument calibration, performance verification, and service maintenance are covered in the service manual, whichis a separate volume. A method to return the horizontal and vertical gain to their last calibrated level is built into the instrument.

Adjusting Instrument Gain

Instrument gain can be reset through the CONFIG—CALIBRATE menu.

Resetting Vertical Gain

1. To reset the vertical gain, select WAVEFORM display mode and push the CONFIG menu button. Select CALIBRATE, then CAL SIG ON and GAIN CAL ON.
   a. Use the VERT POS control to place the calibrator signal between the 0 and approximately the 0.7 graticule lines. (Probably will be extactly 700 mV.).
   b. If the RESET V CAL readout is on, push the adjacent bezel button.
   c. Pushing RESET V CAL reinstates the established at the last calibration.
   d. Check to see that calibrator signal is now displayed as exactly 700 mV.

Resetting Horizontal Gain

1. To set horizontal gain, push the CONFIG menu button. Select CALIBRATE, then CAL SIG ON. Select GAIN CAL ON.
   a. In 1 LINE SWEEP (5 µs/div) there should be one-half cycle per major graticule division; in 2 LINE SWEEP (10 µs/div)there should be one full cycle per major division.
   b. If the RESET H CAL readout is on, push the adjacent bezel button.
   c. Pushing RESET H CAL reinstates the gain setting established at the last calibration.
   d. Check to see that there is one half cycle/division (1–line sweep) or one cycle/division (2–line sweep).

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Measurement Theory

The purpose of any test equipment is to locate and identify abnormal operation. The role of the WFM601 is no different. It is designed to work in a relatively new technology, and to do so it incorporates some displays that are not in common use. Two of these component measurement tools, lightning and diamond, are variations of the commonly used vector display. This instrument also provides a bowtie timing display mode to evaluate interchannel timing.

Vector Display

The vectorscope and its XY Cartesian display has long been a staple of the television industry. In its more familiar configuration it presents a display of the two color difference signals (R–Y & B–Y in NTSC, or U & V in PAL) that are decoded from the composite video signals. In the composite world a sample of subcarrier (burst) is supplied with each line of video to synchronize the decoding of the coloring information contained in the color subcarrier. This provides a display where it is possible to measure color phase errors (angular displacement) and color signal amplitude errors (radial displacement). The system is based on the accuracy of the color burst(s), which are placed at the correct phase and then any variance in the color bar vectors is measured by the mislocation of the dots from the appropriate targets. Figure 3-6 shows how the decoded color difference signals draw the vector display commonly used throughout the television industry.

Note that color burst is not shown in Figure 3-6. It would normally be shown at 180° on the B–Y axis for NTSC or +&– 45° from the negative U axis for PAL. Although this measurement technique originated with composite video signals, there is a great deal of information about the component signals that can be derived from vector displays. Not only can the encoder accuracy for both phase and amplitude be checked, but some rough approximations about the relative timing delays between the color difference signals can be made.

In the composite domain the transitions between the vector tips display timing differences. But, because these timing differences include the delay in the decoder output filtering they are largely ignored, unless they become too gross. In the component domain there is no decoding required and therefore useful information can be derived from the color bar transitions. These variations in timing between the two color difference signals show up as looping or bowing of the transitions. Theoretically, it would be possible to measure the amount of bowing and convert the results to a delay value, but there are better methods available. If the transition looping appears to be too much, use the lightning display to determine the full amount of delay.

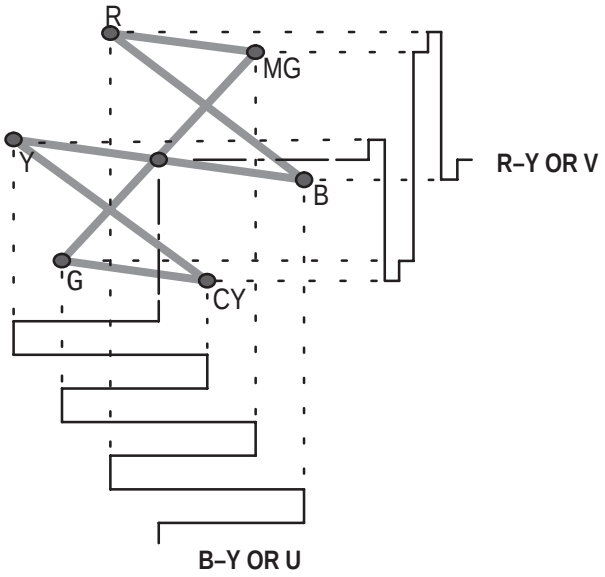


Figure 3-6: Vector display relationship of the R–Y (V) and B–Y (U).

The electronic graticule for the WFM601 provides vector targets that are ±2% of B–Y and R–Y amplitudes. This differs from composite vectorscope targets, which are sectors indicating a polar, magnitude and phase error. These are the errors most often caused by the coding, transmission and decoding of the composite signal. In a component format, utilizing R–Y and B–Y the errors are most likely to be in amplitude and timing. The most obvious short coming of using the color vector display is that there is no convenient method of relating the color difference signals to the luminance signal, which is the third element of the component signal necessary for determining color saturation.

Lightning Display

In order to overcome the shortcomings of not being able to plot the color difference signals against the luminance signal, the lightning display was created. The three signals are back porch clamped and identically low pass filtered to provide a common point and identical delay through the system. Next the color difference signals are line alternated and the luminance signal inverted on alternate lines.

The B–Y (P_B) signal is applied concurrently with the positive luminance signal (Y); the R–Y (P_R) signal is then applied with the inverted luminance signal. This provides a display that compares B–Y to Y on the top half of the display and R–Y to –Y on the lower half of the display. See Figure 3-7.

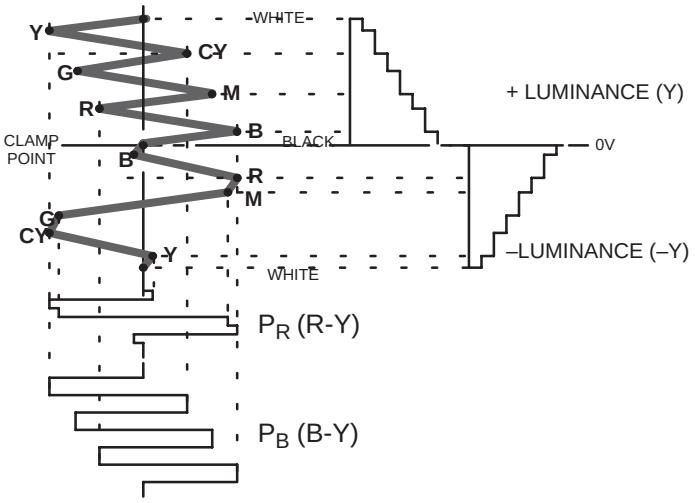


Figure 3-7: Construction of the lightning waveform.

Valuable gain and timing information is recoverable when a graticule is added to this display. By using an electronic graticule the effects of crt nonlinearity are eliminated. The information that we can obtain from this display is color difference signal accuracy (horizontal displacement of either half of the display), luminance gain (vertical displacement between the black and white levels), timing delay between either color difference signal and luminance (bending of the green/magenta transitions). Figure 3-8 shows the graticule and the measurement targets and timing delay scales.

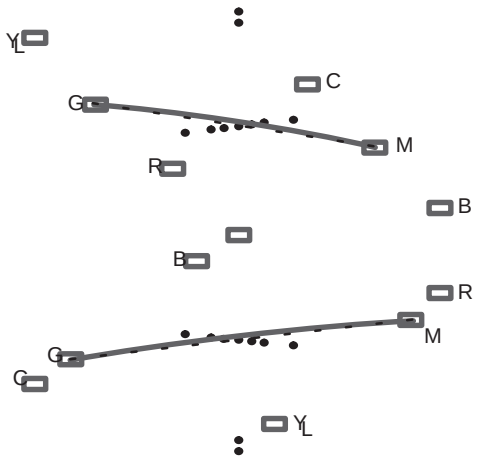


Figure 3-8: The lightning graticule demonstrating interchannel timing errors.

Luminance Gain – The vertical axis above and below the center box is the luminance signal. The lower half is inverted. The luminance gain is correct when the center dot (clamped black level) is centered in the target box and the end of positive and negative excursions end at the top and bottom of the graticule. Perfect monochrome signals appear as a thin vertical line. Any deviation or bending off the center line indicates a color tinting away from the monochrome setup of the display monitor. Luminance gain alone can be measured more accurately in either the waveform or parade display modes of the monitor.

Interchannel Timing – The scale between the green and magenta targets is used to check interchannel timing (CH-2 to CH-1 and CH-3 to CH-1) or signal delay. If the color difference signal is not coincident with luminance, the transitions between color dots will bend. The amount of this bending represents the relative signal delay between luminance and the color difference signal. The upper half of the display measures the P_B-to-Y timing, while the bottom half measures the P_R-to-Y Timing. If the transition bends in toward black, the color difference signal is delayed with respect to luminance and if it bends out toward white, the color difference signal leading the luminance.

P_R and P_B Gain – The horizontal deflection of the top half of the display is an indication of the P_B gain and the lower half indicates the P_R gain. If the color bar signal dots are within the horizontal dimensions of the appropriate graticule targets, the P_B and P_R gains are within 2% of the correct amplitude.

***NOTE**. Since the vertical dimension of the graticule target boxes indicate a 2% luminance gain error and the horizontal dimension a 2% color difference gain error, each color bar can be evaluated for encoding accuracy with these limits. Peak-to-peak gain can be evaluated with the parade display mode, but only the lightning display shows the relative level or coding accuracy of Y, P_B, and P_R for each of the eight primary colors.*

Diamond Display

The diamond display is a simplified vector display for the GBR (RGB) format. Like the lightning display, it is an alternating line display. The first half of the display is made up of B+G on the vertical axis and B–G on the horizontal axis. The second half of the display is made up of inverted R+G on the vertical axis and R–G on the horizontal axis. The resulting display is the vertices of two diamonds which form the RGB gamut limits. See Figure 3-9.

The graticule used with this display has no targets or specified tolerances. It consists of dotted lines that scribe the two diamonds, which defines the color gamut. Any signal outside the gamut limits, scribed by the graticule, may not be reproducible by a color monitor, or is subject to clipping. This robust system of

gamut limits is an accurate method of determining whether the gamut limit violation will cause a serious picture degradation.

Monochrome signals appear as a vertical line. Nonlinear component processing, such as from a gamma corrector that destroys white balance, will cause the vertical axis to deviate. B–G errors will affect the top diamond and R–G errors will affect the lower diamond.

As with the lightning display, any bending of the transitions indicates timing delays. When a color bar signal is applied, the vertical axis becomes an indicator of delay errors. B to G timing errors affect only the upper diamond while R to G timing errors affect only the lower diamond.

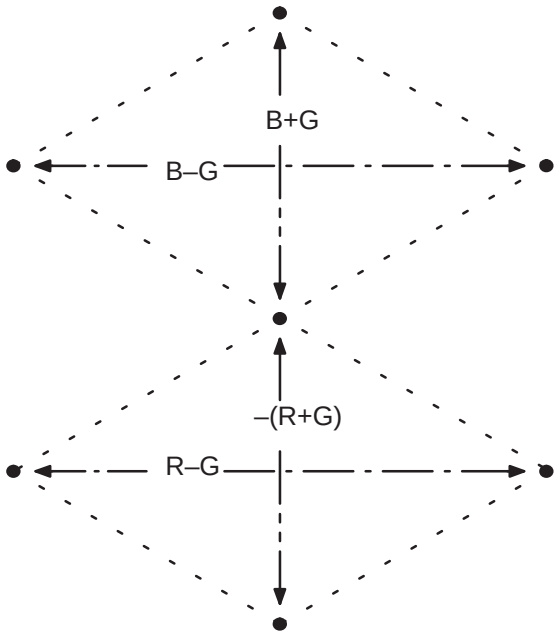


Figure 3-9: Construction of the Diamond GBR display.

Bowtie Display

The bowtie display provides a means of making a quick evaluation of relative amplitudes and timing through the three channels. A special test signal is required for this display. The Tektronix TSG-422, Option 1S provides this type of signal and a set of time marks to aid in signal evaluation. The signal is a 500 kHz sinewave on channel 1 (luminance) and 502 kHz sinewave on channels 2 and 3 (color difference signals). The display is made up of two separate waveforms. See Figure 3-10. The first waveform compares channel 1 to channel 2. The second waveform compares channel 1 to channel 3. The

generator provides a center marker, which should correspond with the null point if interchannel timing is correct. The time markers are from the generator and are 20 ns apart.

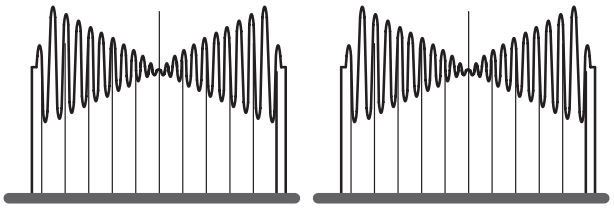


Figure 3-10: Typical bowtie display as seen on the Tektronix WFM601.

The bowtie test signal and display method provides better resolution and is easier to use than the waveform or lightning display when with color bar test signal to make relative channel timing measurements. Changes in location of the null indicate a difference in the relative timing. If the null shifts two full time markers, the relative timing error between channels would be 40 ns. The direction that the null is offset identifies the signal that is delayed. If the null is to the left of the center marker, luminance is delayed. Both signals will show the delay to luminance; color difference signals are to the right of the center marker. When either of the nulls is shifted to the right, that color difference signal is delayed when compared to luminance channel timing.

In addition to measuring the interchannel timing differences, the bowtie measurement provides a method of determining whether the relative channel gain is correct. If the gains are not equal, the null point will not be a complete null; instead it will increase in amplitude. If the gain error is in channel 1, both halves of the display will not produce a “good” null. If channel 2 gain is off, the first waveform will not null all the way down, but the second one will. If the gain is off for channel 3, the left waveform will be normal and the right one will not null as far.

Appendices

Appendix A: Specification

The items listed in the following tables describe the performance of the WFM601 Serial Digital Component Monitor. Performance Requirements are generally quantitative and can be tested by the Performance Verification Procedure, contained in the Service Manual.

Reference information (RI) is valuable data pertaining to the operation and measurement capabilities of this instrument. Only a few of the items listed in this category are testable in the Performance Verification Procedure.

Performance Conditions – The Requirements listed in the electrical specification portion of these specifications apply over an ambient temperature range of 0° C to +40° C. The rated accuracies are valid when the instrument is calibrated at an ambient temperature range of +20° C to +30° C, after a warm–up time of 20 minutes. Test equipment used to verify Performance Requirements must be calibrated and working within the limits specified under the Equipment Required list.

These instruments are intended to operate from an ac power source that will not apply more than 250 V rms between the supply conductors or either supply conductor and ground. A protective ground connection by way of the grounding conductor is essential for safe operation.

Environmental specifications are listed toward the back of the following tables. In addition a list of appropriate safety and electrom magnetic interference (EMI) standards also can be found there.

Table A-1: Waveform Vertical Deflection

Deflection Factor	***REQ:*** For Digital Input: 700 mV digital input = 700 mV ± 2% screen display any magnifier setting. ***REF:*** Any one of the 3 channels. ***REF:*** RGB on screen accuracy ± 3%
Variable Gain Range	***REF:*** 0.2X to 1.4X
Frequency Response	***REQ:*** Luminance Channel (Y), to 5.0 MHz ≤ 2% Color Difference Channels (P_B & P_R) to 2.5 MHz ≤ 2% ***REF:*** Typically ≤ 1% to 5.75 MHz luminance (Y) channel and ≤ 1% to 2.75 MHz for the color difference (P_B or P_R) channel.
Transient Response	***REF:*** Preshoot ≤ 1% ***REF:*** Overshoot ≤ 1% ***REF:*** Ringing ≤ 1% ***REF:*** Pulse To Bar Ratio 0.99:1 to 1.01:1
Offscreen Recovery	***REF:*** 1% variation in baseline of a 5 MHz modulated pulse when positioned anywhere on screen. ***REF:*** X1, X5, or X10 with any variable gain setting.
Voltage Cursor Accuracy	***REQ:*** ± 0.5%
Differentiated Step Filter	***REF:*** Amplitude of pulses ≤ 5% variation.
Field Rate Tilt	***REF:*** ≤ 1%
Line Rate Tilt	***REF:*** ≤ 1%

Table A-2: Serial Digital Interface (Serial A & Serial B)

Format	***REF:*** 270 Mbit/s component. Complies with SMPTE 259M & CCIR 656.
Input Type	***REF:*** Passive loop–through 75Ω compensated.
Input Level	***REF:*** 800 mV peak–to–peak ± 10%. ***REF:*** Input voltages outside this range may cause reduced receiver performance.
Return Loss	***REQ:*** ≥ 25 dB 1–270 MHz. Channels on or off, power on. ≥ 15 dB 1 –270 MHz, Power turned off.
Insertion Loss	***REQ:*** ≤ 1.5%
Transmission Bandwidth	***REQ:*** 50 kHz – 300 MHz ± 1.0 dB. ***REF:*** –3 dB at not less than 500 MHz.
Loop–Through Isolation	***REF:*** ≥ 50 dB to 300 MHz.
Serial Receiver Equalization Range	***REQ:*** Proper operation with up to 17 dB loss at 135 MHz using coaxial cable having $1/\sqrt{F}$ loss characteristics. 800 mV launch amplitude. ***REF:*** Nominally 175 meters of Beldon 8281 coaxial cable.

Table A-3: Serial Video Output (Follows Serial A/B Channel Selection)

Format	***REF:*** 270 Mbit/s component. Complies with SMPTE 259M & CCIR 656.
Output Level	***REQ:*** 800 mV peak–to–peak ± 10%. ***REF:*** Internal jumper can change output to 740 mV peak–to–peak ± 10%.
Return Loss	***REQ:*** ≥ 15 dB 1–270 MHz.

Table A-4: Serial Video Diagnostics (EDH)

Video Error Detection	***REF:***	Type: Active picture and full field. Field rate resolution. Uses CRC check word system. System is known as EDH (Error Detection and Handling) in industry literature.
	REF:	Complies with SMPTE RP 165.
	REF:	Front panel EDH DET lamp.
	REF:	Sets error flag output through rear panel REMOTE connector.
Alarm	***REF:***	Warns that a serial signal video error has occurred. Detected Errors: 1. Video Missing. 2. FF CRC error. 3. AP CRC error. 4. Any ESP flag set.
	REF:	Front panel ALARM lamp.
	REF:	Sets error flag output through rear panel REMOTE connector.

Table A-5: External Reference

Input	***REF:***	Analog composite video, or black burst.
Maximum Operating Input Voltage	***REF:***	–1.8V to +2.2V, dc plus peak ac.
Absolute Maximum Input Voltage	***REF:***	–8.5V to +8.5V, dc plus peak ac.
DC Input Impedance	***REF:***	≥ 20 kΩ.
Return Loss	***REQ:***	≥ 40 dB to 6 MHz.
	REF:	Typically ≥ 46 dB to 6 MHz; ≥ 40 dB to 10 MHz.

Table A-6: Waveform Horizontal Deflection

Sweep	***REQ:***	Synchronization: Internal: Proper horizontal and vertical synchronization with a component digital signal conforming to CCIR Rec. 601 and SMPTE 125M. External: Proper horizontal and vertical synchronization with a composite sync signal of approximate line and field rate.
	REF:	Sweep Length: ≈12 divisions.
	REF:	Sweep freeruns without input.
Sweep Timing Accuracy	***REQ:***	1 Line: 5 µs/division ±1%. 2 Line: 10 µs/division ±1%.
	REF:	1 Field: Displays 1 full field, including field rate sync. 2 Field: Displays 2 full fields and the field rate sync between them.
Sweep Linearity	***REQ:***	±1%.
Magnified Sweep Accuracy	***REQ:***	1 Line: 0.2 µs/division ±1%. 2 Line: 1.0 µs/division ±1%.
Magnified Sweep Linearity	***REQ:***	±1%.
Timing Cursors	***REQ:***	Accuracy: ±0.1%.
	REF:	≤ ±0.5% at 25°C
Horizontal Position Range	***REQ:***	Any portion of the synchronized sweep can be positioned on screen in all sweep modes.

Table A-7: Calibrator

Waveform Squarewave	***REQ:***	Amplitude: 0.700V ±1%
	REQ:	Frequency: 100 kHz ±0.1%
	REF:	Crystal controlled outputs a 10 µs squarewave that can be used for adjusting horizontal gain of the instrument.

Table A-8: Analog Audio Mode

Input	***REF:***	DC coupled, differential input.
Input Impedance	***REF:***	20 kΩ.
Full Scale Selection	***REF:***	0, 4, 8, & 12 dBu full scale. Menu selectable.
Full Scale Accuracy	***REQ:***	± 0.5 dB
Maximum Input Voltage	***REF:***	*± 8 V peak.*
Bandwidth	***REQ:***	–3 dB ≥ 500 kHz.
X & Y Input Phase Matching	***REQ:***	≤ 1°

Table A-9: Component Vector Mode

Vertical Bandwidth	***REF:***	≥ 1.0 MHz.
Horizontal to Vertical Bandwidth Matching	***REQ:***	≤ 2° at 500 kHz and 2 MHz.
Vertical Gain Accuracy	***REQ:***	± 1%.
Horizontal Gain Accuracy	***REQ:***	± 1%
Display to Graticule Registration	***REQ:***	≤ 0.25 box with the color bar black display dot centered in target.
Electronic Graticule Shape	***REF:***	No visible gaps or tails at corners of target boxes.
Vector Display	***REF:***	P_B is displayed on horizontal axis and P_R is displayed on vertical axis.

Table A-10: Lightning Mode

Vertical Gain Accuracy	***REQ:***	± 2%
Electronic Graticule Display	***REF:***	Y is displayed vertically. P_B is displayed horizontally on top half of display. P_R is displayed horizontally on bottom half of display.

Table A-11: Bowtie Mode

Common Mode Rejection Ratio	***REF:***	≥ 34 dB at 2.5 MHz.
Accuracy	***REF:***	± 3%
Interchannel Timing Match	***REQ:***	± 2.0 ns.

Table A-12: Picture Monitor Outputs

Input Format	***REF:***	EBU/N10.
Active Video Accuracy	***REQ:*** ***REF:***	700 mV ± 3% Typically <1%
Sync Amplitude Accuracy	***REF:***	300 mV ± 10%
Monitor Output Impedance	***REF:***	Nominally 75Ω. Back porch clamped to 0V.

Table A-13: Power Source

Electrical Rating	***REQ:***	90 –250V, 50/60 Hz, 1.5A maximum.
	REF:	Continuous range from 90 to 250V ac.
Supply Type	***REF:***	Single Phase
Supply Connection	***REF:***	Detachable cord set
Power Consumption	***REF:***	<110 VA (70 watts).

Table A-14: CRT Display

CRT Viewing Area	***REF:***	80 X 100 mm. Horizontal: 12.5 divisions. Vertical: 1.19V.
Accelerating Potential	***REF:***	Nominally 13.75 kV.
Trace Rotation Range	***REQ:***	Greater that + & – 1° from horizontal.
	REF:	Total adjustment range is typically ≥8°.
Graticule	***REF:***	Internal with variable illumination.

Table A-15: Environmental Characteristics

Operating Temperature	***REQ:***	0° to 40°C (+32° to 122°F)
Storage Temperature	***REQ:***	–40° to 75°C (–40° to 158°F)
Operating Altitude	***REQ:***	To 15,000 feet (4572 meters).
	REF:	(IEC 1010–1 compliant to 2000 meters)
Storage Altitude	***REQ:***	To 50,000 feet (15,240 meters).
Vibration	***REQ:***	5 minutes at 5 – 15 Hz with 0.060 inch displacement. 5 minutes at 15 – 25 Hz with 0.040 inch displacement. 5 minutes at 25 – 55 Hz with 0.020 inch displacement. Military Specification: Mil–T–28800D, Paragraph 1.2.2, Class 3
Mechanical Shock	***REQ:***	Non Operating: 50 g's 1/2 sine, 11 ms duration 3 shocks per surface (18 total).
Transportation	***REQ:***	Qualified under NSTA Test Procedure 1A, Category II (24 inch drop).
Equipment Type	***REF:***	Measurement
Equipment Class	***REF:***	IEC 1010–1, Annex H, Class I
Installation Category	***REQ:***	Indoor use only IEC 1010–1 (Category 2)
Pollution Degree	***REQ:***	IEC 1010–1 Level 2 operating environment
Humidity	***REQ:***	Will operate at 95% relative humidity for up to five days.
	REF:	Do not operate with visible moisture on the circuit boards.

Table A-16: Certification

Category	Standard
Safety	Designed to meet or exceed: UL1244 Factory Mutual 3820 CSA Standard 231 IEC 1010–1 (for operation up to 2000 meters)
EMI	**Designed to meet or exceed:** FCC EMI Compatibility (FCC Rules Part 15, Subpart J, Class A) VDE 0871.5 (Class B) Instrument must be installed in a cabinet equal to the shielding provided by Tektronix F00 or F02 cabinets to qualify for EMI certification.

Table A-17: Physical Characteristics

Dimensions		
	REQ:	Height: 5 1/4 inches (133.4 millimeters) Width: 8 1/2 inches (215.9 millimeters) Depth: 18 1/8 inches (460.4 millimeters)
Weight	***REQ:***	Net: 8 pounds (3.8 kilograms) Shipping: 15.7 pounds (7.2 kilograms) *approximate.*

Appendix B: Multipin Connectors

REMOTE Connector

The rear-panel REMOTE connector is a 25-pin, D-type connector that is the remote control interface, and analog audio input.

Remote functions, which provide switching and recalling of stored front-panel setups from a remote location, are enabled by ground closures (TTL lows). Functions with "overbars" indicate an active low state. Eight of the menu selectable front-panel RECALL SETUPs can be called up remotely. Pin assignments for the REMOTE connector are shown in Figure B-1 and discussed in Table B-1.

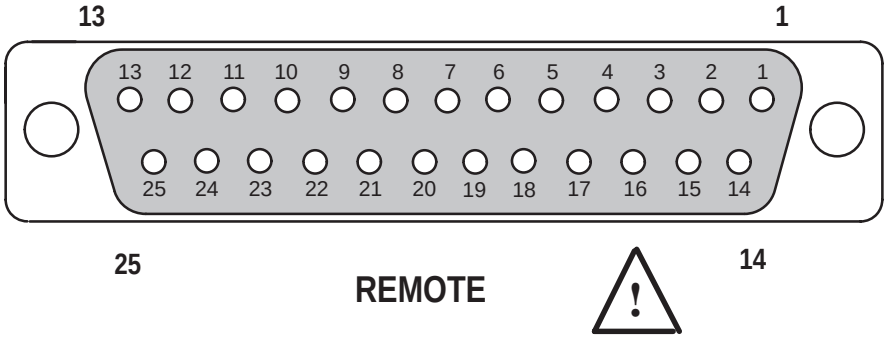


Figure B-1: Rear view of the rear-panel REMOTE connector.

Table B-1: Remote Connector Pin Assignments and Functions

Pin	Name	Function/Description
1	Not used.	
2	Ground	
3	Not used.	
4	External Blanking Input.	Low= Blank
5	Ground	
6	Ground	
7	Ground	
8	+Y Audio (Left)	Max. Input ±8 V peak. (Measured to Chassis Ground.)

Table B-1: (Cont.) Remote Connector Pin Assignments and Functions

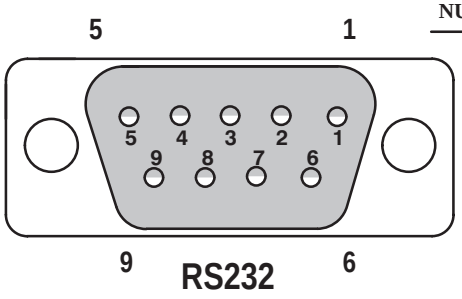
Pin	Name	Function/Description
9	–Y Audio (Left)	Max. Input ±8 V peak. (Measured to Chassis Ground.)
10	+X Audio (Right)	Max. Input ±8 V peak. (Measured to Chassis Ground.)
11	–X Audio (Right)	Max. Input ±8 V peak. (Measured to Chassis Ground.)
12–13	Unused	
13	Unused	
14	Ground	
15	Output 1	Reserved for future applications.
16	Serial Video Alarm	Goes low when the front panel ALARM indicator lights.
17	$\overline{\text{PRESET 1}}$	Ground (TTL low) Recalls the stored front panel setup from this location, or selects the Preset 1 memory location to store the current front panel settings.
18	$\overline{\text{PRESET 2}}$	Ground (TTL low) Recalls the stored front panel setup from this location, or selects the Preset 2 memory location to store the current front panel settings.
19	$\overline{\text{PRESET 3}}$	Ground (TTL low) Recalls the stored front panel setup from this location, or selects the Preset 3 memory location to store the current front panel settings.
20	$\overline{\text{PRESET 4}}$	Ground (TTL low) Recalls the stored front panel setup from this location, or selects the Preset 4 memory location to store the current front panel settings.
21	$\overline{\text{PRESET 5}}$	Ground (TTL low) Recalls the stored front panel setup from this location, or selects the Preset 5 memory location to store the current front panel settings.
22	$\overline{\text{PRESET 6}}$	Ground (TTL low) Recalls the stored front panel setup from this location, or selects the Preset 6 memory location to store the current front panel settings.
23	$\overline{\text{PRESET 7}}$	Ground (TTL low) Recalls the stored front panel setup from this location, or selects the Preset 7 memory location to store the current front panel settings.

Table B-1: (Cont.) Remote Connector Pin Assignments and Functions

Pin	Name	Function/Description
24	$\overline{\text{PRESET 8}}$	Ground (TTL low) Recalls the stored front panel setup from this location, or selects the Preset 8 memory location to store the current front panel settings.
25	$\overline{\text{STORE}}$	Ground (TTL low) Grounding $\overline{\text{STORE}}$ enables storage of instrument settings. When $\overline{\text{STORE}}$ is low, and one of the $\overline{\text{PRESET}}$s is grounded the current front panel setup will be stored in that Preset memory location.

RS232 Connector

The RS232 connector is a 9–pin D–type connector that is provided as the calibration interface. See Figure B-2. The WFM601 is intended to be calibrated with a Personal Computer (PC). See Section 6 for more information.



PIN NUMBER	DATA CONNECTION
1.	**DCD** (RECEIVED LINE SIGNAL DETECTOR
2.	**RXD** (RECEIVED DATA)
3.	**TXD (**TRANSMITTED DATA)
4.	**DTR** (DTE READY)
5.	**SIGNAL GROUND**
6.	**DCR** (DCE READY)
7.	**RTS** (REQUEST TO SEND)
8.	**CTS** (CLEAR TO SEND)
9.	**NOT CONNECTED**

Figure B-2: Rear view of the rear-panel REMOTE connector.

Appendix C: User Service

These instructions are primarily for user and preventive maintenance. If the instrument does not function properly, it should be referred to qualified service personnel or returned to Tektronix for service.

Cleaning or Replacing the Fan Filter

To ensure adequate air flow, it is essential to clean or replace the rear-panel fan filter regularly. The interval between filter cleaning or replacement is determined by the operating environment.

To remove the filter, take out the two screws that fasten the housing to the rear panel.

Remove the filter and wash it in a mild detergent and water solution. Place cleaned and dried filter (or new filter) in the housing and replace housing over the fan. Replace and tighten the two screws (8 in lbs).

Fuse Replacement

The line fuse for this instrument is located inside the cabinet, under a protective shield. Replacement of this fuse should only be undertaken by a qualified service technician, following the instructions in the WFM601 Service Manual.

Graticule Light Replacement

Replacement Bulbs

Replacement bulbs are supplied with this instrument as Standard Accessories. Additional bulbs can be purchased from Tektronix or from local electronics distribution sources.

Required Equipment

NOTE. *For graticule light removal and replacement, tweezers with curved, serrated tips are recommended. For example, Miltex PL312,6-100 (equivalent to PL312) or PL317 (longer than PL312).*

Procedure

1. Remove the five knobs below the CRT.
2. Insert a small, straight-blade screwdriver into the recessed area on either the right or left side of the panel. Pry gently until the panel snaps out of the front-panel frame. See Figure C-1 for panel and recess location.

CAUTION. *Needle-nosed pliers are not recommended.*

3. To remove a bulb, position the tweezer tips on the thin, flat portion of the bulb (close to the plastic socket). Carefully pull the bulb straight out.
4. To install a new bulb, hold it with the tweezers as described in step 3, position it in front of the socket, and push the bulb until it snaps in place.
5. Replace the panel below the CRT, and press on both the right and left sides of the panel until it snaps into place.
6. Replace the five knobs below the CRT and tighten the set screws.

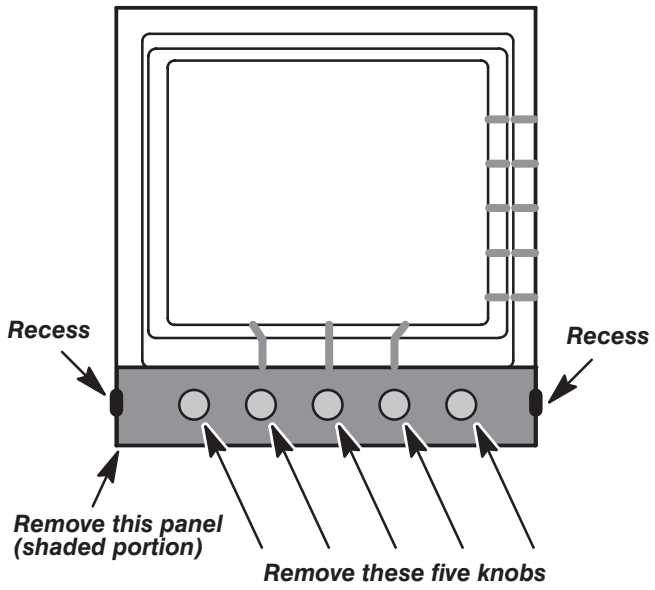


Figure C-1: Graticule light replacement.

Cleaning

The instrument should be cleaned often enough to prevent dust and dirt from accumulating. Dirt acts as a thermal insulator, preventing effective heat dissipation, and can also provide high-resistance electrical leakage paths between conductors or components in a humid environment.

CAUTION. *Do not allow water to get inside any enclosed assembly or component. Do not clean any plastic materials with benzene, toluene, xylene, acetone, or similar compounds, because they may damage the plastic.*

Exterior

Clean the dust from the outside of the instrument with a soft, clean cloth or small brush. A brush is especially useful for removing dust from around the selector buttons, knobs, and connectors. Hardened dirt can be removed using a soft cloth dampened with a mild detergent and water solution. Abrasive cleaners should not be used.

CRT

Clean the light filter and CRT face with a soft, lint-free cloth dampened in denatured alcohol. Abrasive cleaners should not be used.

Interior

Interior cleaning and maintenance should be performed by qualified service personnel only. Instructions for interior maintenance are provided in the WFM601 Service manual.

CAUTION. *A 2% RMA flux content solder is recommended for making repairs in this instrument. Cleaning of rosin residue is not recommended. Most cleaning solvents tend to reactivate the rosin and spread it under components where it may cause corrosion under humid conditions. The rosin residue, if left alone, does not exhibit these corrosive properties.*

Replacing the CRT Filter

A smoke-gray filter is installed over the face of the CRT. The filter part number is given on page A–4. If the filter becomes damaged, it can be replaced in the following manner:

1. Remove the five knobs below the CRT.
2. Insert a small, straight-blade screwdriver into the recessed area on either the right or left side of the panel. Pry gently until the panel snaps out of the front-panel frame. See Figure C-1 for panel and recess location.
3. Remove the two Torx® screws that fasten the bezel to the instrument.
4. Grasping the bottom of the bezel, pull out and upward to remove the bezel from the instrument. (There are two hinges at the top of the bezel that hold it in place; once the bezel is at an approximate 45° angle with the front panel, they will disengage.)
5. Remove the damaged filter and snap the new filter into place on the back side of the bezel. Position the ridged side of the filter towards the CRT to eliminate unwanted visual effects on the CRT face.
6. Replace the bezel and bezel screws. Tighten screws (8 in lbs).
7. Replace the panel below the CRT, and press on both the right and left sides of the panel until it snaps into place.
8. Replace the five knobs below the CRT and tighten the set screws.

Appendix D: Software Version

Table D–1 details software releases. If a new release occurs after this manual is printed, a revised Table D–1 will be shipped with the manual.

Table D-1. Software Releases

Version	Date	Serial No.	Comments
1.0	APR 1993	None Shipped	Original software.
1.1	May 1993	None Shipped	Pilot software.
1.2	June 1993	B010101 - B010105	First Output
1.3	June 1993	B010106	Corrected audio readout power up reset problem.

Determining Software Version

The software version number for this instrument is displayed on the Calibrate sub menu of the Configure Menu. The version number is located in the lower right corner of the CRT display. In addition, a second number is also displayed which identifies the Coprocessor code.

Glossary and Index

Glossary

AC Coupled A connection which removes the constant voltage (DC component) on which the signal (AC component) is riding. Usually implemented by passing the signal through a capacitor.

APL (Average Picture Level.) The average signal level (with respect to blanking) during active picture time, expressed as a percentage of the difference between the blanking and reference white levels.

Back Porch The portion of the video signal which lies between the trailing edge of the horizontal sync pulse and the start of the active picture time. Burst is located on back porch.

Bandwitdth The range of frequencies over which signal amplitude remains constant (within some limit) as it is passed through a system.

Baseband Refers to the composite video signal as it exists before modulating the picture carrier. Composite video distributed throughout a studio and used for recording is at baseband.

Black Burst (NTSC) Also called ”color black,” black burst is a composite video signal consisting of all horizontal and vertical synchronization information, burst, and usually setup. Typically used as the house reference synchronization signal in television facilities.

Black Burst (PAL) Also called ”color black,” black burst is a composite video signal consisting of all horizontal and vertical synchronization information and burst. Typically used as the house reference synchronization signal in television facilities.

Blanking Level Refers to the 0 IRE level for NTSC systems (0.3 volt level, with respect to sync tip, for PAL systems) which exists before and after horizontal sync and during the vertical interval.

Bowtie Bowtie display. A display used to assess relative timing and gain through a three channel component system.

Breezeway The portion of the video signal which lies between the trailing edge of the horizontal sync pulse and the start of burst. Breezeway is part of back porch.

Broad Pulses Another name for the vertical synchronizing pulses in the center of the vertical interval. These pulses are long enough to be distinguished from all others, and are the part of the signal actually detected by vertical sync separators.

Bruch Blanking (PAL) A 4–field burst blanking sequence employed in PAL signals to ensure that burst phase is the same at the end of each vertical interval.

Burst (NTSC) A small reference packet of the subcarrier sine wave, typically 8 or 9 cycles, which is sent on every line of video. Since the carrier is suppressed, this phase and frequency reference is required for synchronous demodulation of the color information in the receiver.

Burst (PAL) A small reference packet of the subcarrier sine wave sent during the horizontal blanking interval on every line of video. Since the carrier is suppressed, this phase and frequency reference is required for synchronous demodulation of the color difference signals in the receiver.

B–Y (NTSC) One of the color difference signals used in the NTSC system, obtained by subtracting luminance from the blue camera signal. This is the signal which drives the horizontal axis of a vectorscope.

B–Y (PAL) One of the color difference signals used in the PAL system, obtained by subtracting luminance (Y) from the blue camera signal (B).

Chrominance Chrominance refers to the color information in a television picture. Chrominance can be further broken down into two properties of color: hue and saturation.

Chrominance Signal The high–frequency portion of the video signal which is obtained by quadrature amplitude modulation of a 3.58 MHz (NTSC) or 4.43 MHz (PAL) subcarrier with R–Y and B–Y information.

Color Black See Black Burst.

Color Difference Signals Signals used by color television systems to convey color information in such a way that the signals go to zero when there is no color in the picture. R–Y, B–Y, I, and Q are all color difference signals for the NTSC system; U and V are color difference signals for the PAL system. Component system color difference signal is Y, P_B, P_R as specified by SMPTE and CCIR standards.

Color Gamut The area between minimum and maximum reproducible limits for elements of the color difference or RGB signals.

Component Video Video which exists in the form of three separate signals, all of which are required in order to completely specify the color picture. For example, R, G, and B; or Y, R–Y, and B–Y.

Composite Video A single video signal containing all of the necessary information to reproduce a color picture. Created by adding quadrature amplitude modulated R–Y and B–Y to the luminance signal for NTSC systems or U and V to the luminance signal for PAL systems.

CW Continuous Wave. Refers to a separate subcarrier sine wave used for synchronization of chrominance information.

dB (Decibel) A decibel is a logarithmic unit used to describe signal ratios. For voltages, dB = 20 Log_{10} (V_1/V_2).

DC-Coupled A connection configured so that both the signal (AC component) and the constant voltage on which it is riding (DC component) are passed through.

DC Restorer A circuit used in picture monitors and waveform monitors to clamp one point of the waveform to a fixed DC level.

Demodulator In general, this term refers to any device which recovers the original signal after it has modulated a high–frequency carrier. In television it may refer to:
(1) An instrument, such as a TEKTRONIX 1450, which takes video in its transmitted form (modulated onto the picture carrier) and converts it to baseband.

(2) The circuits which recover R–Y and B–Y for NTSC systems or U and V for PAL systems from the composite signal.

Diamond Diamond display. A simplified vector display for RGB signals that defines the valid gamut limits in the form of two diamonds.

Distortion If a sine wave of a single frequency is put into a system, and harmonic content at multiples of that frequency appears at the output, there is harmonic distortion present in the system. Harmonic distortion is caused by non–linearities in the system.

Equalizer The pulses which occur before and after the broad pulses in the vertical interval.

Envelope Detection A demodulation process in which the shape of the RF envelope is sensed. This is the process used by a diode detector.

Field In interlaced scan systems, the information for one picture is divided up into two fields. Each field contains one half of the lines required to produce the entire picture. Adjacent lines in the picture are in alternate fields.

Frequency Modulation (FM) is the process by which the frequency of a carrier signal is varied in proportion to the signal of interest. In both the NTSC and PAL television systems, audio information is transmitted using FM.

Frame A frame (sometimes called a ”picture”) contains all the information required for a complete picture. For interlaced scan systems, there are two fields in a frame.

Front Porch The portion of the video signal between the end of active picture time and the leading edge of horizontal sync.

Gamma (NTSC) Since picture monitors have a non–linear relationship between the input voltage and brightness, the signal must be correspondingly predistorted. Gamma correction is always done at the source (camera) in television systems: the R, G, and B signals are converted to $R^{1}/_{V}$, $G^{1}/_{V}$, and $B^{1}/_{V}$. Values of about 2.2 are typically used for gamma.

Gamma (PAL) Since picture monitors have a non–linear relationship between the input voltage and brightness, the signal must be correspondingly predistorted. Gamma correction is always done at the source (camera) in television systems: the R, G, and B signals are converted to $R^{1}/_{V}$, $G^{1}/_{V}$, and $B^{1}/_{V}$. Values for gamma range from 2.2 to 2.8.

Gamut See Color Gamut.

GBR The same signals as RGB, but rearranged in sequence to correspond with SMPTE specification.

Gen Lock The process of locking both sync and burst of one signal to sync and burst of another, making the two signals completely synchronous.

Graticule The scale which is used to quantify the information on a waveform monitor or vectorscope display. Graticules may either be screened onto the faceplate of the CRT itself (internal graticule), or onto a piece of glass or plastic which fits in front of the CRT (external graticule). They can also be electronically generated.

Horizontal Blanking Horizontal blanking is the entire time between the end of the active picture time of one line and the beginning of active picture time of the next line. It extends from the start of front porch to the end of back porch.

Horizontal Sync Horizontal sync is the –40 IRE pulse in NTSC systems (–300 mV pulse for PAL systems) occurring at the beginning of each line. This pulse signals the picture monitor to go back to the left side of the screen and trace another horizontal line of picture information.

Hue Hue is the property of color which allows us to distinguish between colors such as red, yellow, purple, etc.

Hum Hum refers to the undesirable coupling of the 60 Hz power sine wave for NTSC systems (50 Hz power sine wave in PAL systems) into other electrical signals.

ITS (PAL) Insertion Test Signal. A test signal which is inserted in one line of the vertical interval to facilitate in–service testing.

IRE (NTSC) A unit equal to 1/140 of the peak–to–peak amplitude of the video signal, which is typically 1 volt. The 0 IRE point is at blanking level, with sync tip at –40 IRE and white extending to +100 IRE. IRE stands for Institute of Radio Engineers, the organization which defined the unit.

Lightning Lightning display. A display, for use with SMPTE specified color difference signal (Y, P_B, P_R), that plots the two color difference signals against luminance to create a display similar in appearance to a lightning bolt.

Linear Distortion Refers to distortions which are independent of signal amplitude.

Luminance The signal which represents brightness, or the amount of light in the picture. This is the only signal required for black and white pictures, and for color systems it is obtained as a weighted sum (Y = 0.3R + 0.59G + 0.11B) of the R, G, and B signals.

Modulated (NTSC) When referring to television test signals, this term implies that chrominance information is present. (For example, a modulated staircase has subcarrier on each step.)

Modulated (PAL) When referring to television test signals, this term implies that chrominance information is present. (For example, a modulated ramp has subcarrier on each step.)

Modulation A process which allows signal information to be moved to other frequencies in order to facilitate transmission or frequency–domain multiplexing. See **AM** and **FM** for details.

Non–Linear Distortion Refers to distortions which are amplitude–dependent.

NTSC National Television System Committee. The organization which developed the television standard currently in use in the United States, Canada, and Japan. Now generally used to refer to that standard.

PAL Phase Alternate Line. Refers to one of the television systems used in Europe and many other parts of the world. The phase of one of the color difference signals alternates from line to line to help cancel out phase errors.

Quadrature AM A process which allows two different signals to modulate a single carrier frequency. The two signals of interest Amplitude Modulate carrier signals which are the same frequency but differ in phase by 90 degrees (hence the Quadrature notation). The two resultant signals can be added together, and both signals recovered at the other end, if they are also demodulated 90 degrees apart.

Quadrature Distortion Distortion resulting from the asymmetry of sidebands used in vestigial sideband television transmission. Quadrature distortion appears when envelope detection is used, but can be eliminated by using a synchronous demodulator.

RF Radio Frequency. In television applications, RF generally refers to the television signal after the picture carrier modulation process

RGB Red, Green, and Blue. Also referred to as GBR. The three primary colors used in color television's additive color reproduction system. These are the three color signals generated by the camera and used by the picture monitor to produce a picture.

R–Y One of the color difference signals is obtained by subtracting luminance (Y) from the red camera signal.

Saturation The property of color which relates to the amount of white light in the color. Highly saturated colors are vivid, while less saturated colors have more white mixed in and, therefore, appear pastel. For example, red is highly saturated, while pink is the same hue, but much less saturated.

In signal terms, saturation is determined by the ratio between luminance level and chrominance amplitude. It should be noted that a vectorscope does not display saturation; the length of the vectors represents chrominance amplitude. In order to verify that the saturation of the colors in a color bar signal is correct, you must check luminance amplitudes with a waveform monitor in addition to observing the vectors.

SCH The timing relationship between the horizontal sync pulses and the zero crossings of the reference subcarrier (burst).

Setup In NTSC systems, video black is typically 7.5 IRE above the blanking level. This 7.5 IRE level is referred to as the black setup level, or simply as setup.

Subcarrier The modulation sidebands of the color subcarrier contain the R–Y (V) and B–Y (U) information. For NTSC, subcarrier frequency is 3.579545 MHz. For PAL, subcarrier frequency is 4,433,618.75 Hz.

Synchronous Detection A demodulation process in which the original signal is recovered by multiplying the modulated signal with the output of a synchronous oscillator locked to the carrier.

Termination In order to accurately send a signal through a transmission line, there must be an impedance at the end which matches the impedance of the source and of the line itself. Amplitude errors and reflections will otherwise result. Video is a 75 Ω system, so a 75 Ω terminator must be put at the end of the signal path.

Time Code, Longitudinal (LTC) LTC is an 80-bit signal with information which makes it possible to accurately identify an individual frame. The LTC signal is typically recorded on an audio channel.

Time Code, Vertical (VITC) VITC is a signal in the vertical interval of video, which makes it possible to accurately identify an individual field.

U The B–Y signal after a weighting factor of 0.493 has been applied. The weighting is necessary to reduce peak modulation in the composite signal.

Unmodulated When used to describe television test signals, this term refers to pulses and pedestals which do not have high–frequency chrominance information added to them.

V The R–Y signal after a weighting factor of 0.877 has been applied. The weighting is necessary to reduce peak modulation in the composite signal.

Vectorscope A specialized oscilloscope which demodulates the video signal and presents a display of R–Y versus B–Y in NTSC systems (or V versus U in PAL systems). The angle and magnitude of the displayed vectors are respectively related to hue and saturation.

Vertical Interval The synchronizing information which appears between fields and signals the picture monitor to go back to the top of the screen to begin another vertical scan.

Waveform Monitor A specialized oscilloscope that plots voltage versus time to evaluate television signals.

Y Abbreviation for luminance.

Zero Carrier Reference A pulse in the vertical interval which is produced by the demodulator to provide a reference for evaluating depth of modulation.

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