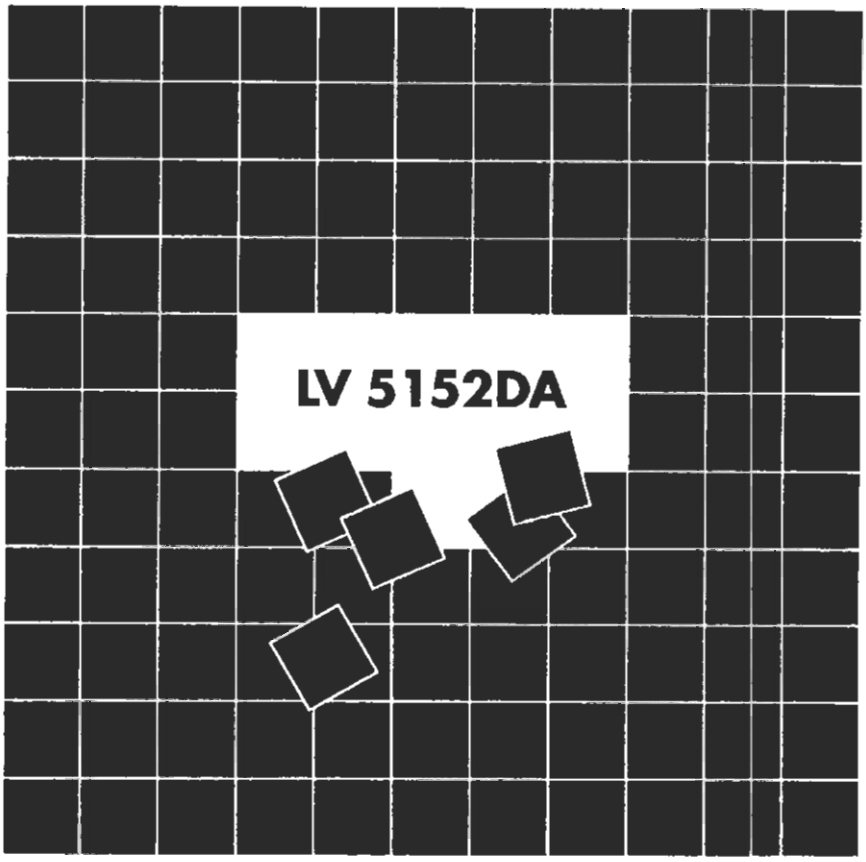
LEADER

HD DIGITAL WAVEFORM MONITOR

INSTRUCTION MANUAL



LEADER ELECTRONICS CORP.

TABLE OF CONTENTS

GENERAL SAFETY SUMMARY

To Avoid Personal Injury

It is recommended that only qualified personnel with technical knowledge use this instrument only after reading and fully understanding all functions of the instrument described this instruction manual.
This instrument is not designed and manufactured for consumers.
If you do not have enough knowledge on electricity, to avoid personal injury and prevent damage to this product, please be sure to use this product only under the supervision of an engineer who has sufficient knowledge about electronics.

Precautions on Contents

Should you find the contents in this manual and any of its technical terms confusing, please feel free to contact your local Leader agent.

Symbols and Terms

Following terms and symbols indicate necessary warnings and cautions used in this manual and on the product are there for safe operation.

<Symbol> 	The sections where this symbol is marked in this manual or instrument, if not correctly performed or practiced, could result in personal injury or cause serious danger to the instrument. Misuse could also produce unintentional movement to create an operational impediment on the instrument or other products that might be connected to it. Be sure to refer to the safety precautions in this manual to safely use the part of the instrument where the symbol is marked.
<Term> ⚠ WARNING	Warning statements identify warning conditions that if disregarded or not correctly performed or adhered to, could result in serious personal injury or even loss of life.
<Term> ⚠ CAUTION	Caution statements identify warning conditions if disregarded or not correctly performed or adhered to, could result in personal injury or damage to the instrument.

GENERAL SAFETY SUMMARY

Review the following safety precautions to avoid operator's injury and loss of life and prevent damage and deterioration to this instrument. To avoid potential hazards, use this product as specified.

WARNING

Warnings on the Cases and Panels of the Instrument

Operator should not remove any cases or panel for any reasons. If you touch inside the instrument it could result personal shock or fire hazard. Refrain from spilling any liquid on or inserting anything flammables or piece of metal into the ventilation of the instrument. Such actions could cause fire, shock, malfunction and be an accident hazard while the power is on.

Warnings on Power Line

- **Make sure to connect only to the rated power line voltage. Excess voltage may cause fire.**
  Confirm the voltage of the commercial power line before connecting the AC power cord. The power frequency of the power line should be 48 Hz to 440 Hz.

- **Warning on the Power Cord**
  Use only the optional power cord that is attached to this instrument. The use of the power cord other than that attached could cause fire hazard.
  If the attached cord is damaged stop using it and contact your local Leader agent. Should you use a damaged cord, it could cause a shock or create a fire hazard.
  When you pull out the cord be sure to hold it by plug and pull from the socket not by holding the cord wire.

Warning on Fuse

When the fuse is melted the instrument stops operation. If the fuse melted, turn off the power switch and disconnect the power plug from the socket. If you change the fuse while the cord is connected to the socket, it could cause a shock hazard. Only use the specified type and rated current and voltage fuses.
If the cause for melting fuse is unclear or if you suspect there is damage to the instrument or if you have no proper fuse at hand please contact your local Leader agent.

GENERAL SAFETY SUMMARY

WARNING

Warning on Installation Environments

- **About the Guaranteed Operating Temperature Range**
  Operate the instrument between the temperature range of 0 to 40℃. Operating the instrument at higher temperatures could cause a fire hazard.
  Rapid changes of temperatures from cold to warm can create internal moisture or condensation and could damage the instrument. If there is a possibility of moisture condensation allow the instrument to sit for 30 minutes without the power on.

- **About the Guaranteed Operating Humidity Range**
  Operating humidity range is ≤ 90 % RH.
  Do not operate the instrument with wet hands, This could cause a shock and fire hazard.

- **About the Operation in the Presence of Gasses**
  Operating the instrument in and near the presence or storage locations of flammable, explosive gasses or fumes could create an explosion and fire hazard. Do not operate the instrument anywhere near such environments.

- **Avoid Insertions**
  Do not insert metals or flammable objects or drop liquid on or into the instrument. To do so could cause fire, shock, malfunction and create a dangerous accident hazard.

Warning while Operating

While operating the instrument in smoke, fire, or a bad smell, occurs, turn off the instrument at once for it could cause a fire hazard. When such a case occurs, turn off the power switch and pull the plug of the cord from the plug socket. Contact your local Leader agent after confirming there is no fire.

Warning about Ground

The instrument has a ground terminal to avoid electric shock hazard and to protect the instrument from damage. Ensure that the product is properly grounded for safe operation.

GENERAL SAFETY SUMMARY

CAUTION

■ Caution on Input/Output Terminals

Input Terminals are rated with a maximum input. Do not supply an input over the specified rating in the standard section of the instruction manual. Also, do not supply external power to Output terminal, this could cause the instrument to malfunction.

■ Caution when Not to Using Instrument the for a Long Time

Make sure to disconnect the power cord from the socket when you do not use the instrument for a long time.

■ About the Cabinets

- **This Product has No Cabinet.**

  Please install into the optional cabinet or rack mount adaptor before use.
  Operating without cabinets may cause electric hazard, fire hazard and breakdown of the product.

Parts	Model No.
Cabinet with Handle	LR-2427
Cabinet without Handle	LR-2404
Inch Size Rack mount Adaptor	LR-2400VI-02
Metric Size Rack mount Adaptor	LR-2400V-M

- **Qualified Personnel shall install the Product to the Cabinet or Rack Mount Adaptor**

  Please pay attentions for the follows when install.
  • Off the power, then disconnect power cable and the others.
  • Be careful for the internal parts or cables not to be caught by the cabinet.

- **To protect the User, Please Stick the enclosed "WARNING" Label on the Cabinet or Rack Mount Adaptor**

Please conform to the above wamings and cautions for safe operation. There are cautions in each area of in this instruction manual, so please conform to each caution. If you have any questions about this manual, please feel free to contact your local Leader agent.

1. INTRODUCTION

Thank you for purchasing Leader's measuring instruments.
Please read this instruction manual carefully to ensure correct and safe operation.
If you have any difficulties or questions on how to use the instrument after you have read this manual, please feel free to contact your local Leader agent.

1.1 Scope of Warranty

This Leader instrument has been manufactured under the strictest quality control guidelines. Leader shall not be obligated to furnish free service during the warranty period under the following conditions.

1. Repair of malfunction or damages resulting from fire, natural calamity, or improper voltage applied by the user.
2. Repair of an instrument that has been improperly repaired, adjusted, or modified by personnel other than a factory-trained Leader representative.
3. Repair of malfunctions or damages resulting from improper use.
4. Repair of malfunctions caused by devises other than this instrument.
5. Repair of malfunctions or damages without the presentation of a proof of purchase or receipt bill for the instrument.

1.2 Operating Precautions

⚠WARNING

1.2.1 Line Voltage and Fuse

Confirm that the power line voltage is correct before connecting the power cord. The voltage range and fuse rating are indicated on the rear panel.
The instrument must be connected to the rated line voltage and line frequency of 48 Hz to 440 Hz.
When replacing the fuse, turn the power switch off and disconnect the power cord from the mains.

Voltage Range	Fuse	
	Rating	Leader Parts Number
90 to 250V	T2AL, time-lag, slow blow	436 3780 01

⚠CAUTION

1.2.2 Maximum Allowable Input Voltage

The maximum allowable input voltage to the input connectors is shown in Table below.Do not apply excessive voltage to prevent damage the instrument.
Refer to Installation Category I(IEC 1010-1, Annex J).

Input Connector	Maximum Allowable Input Voltage
SERIAL INPUT A, B	± 2 V(DC + peak AC)
ANALOG INPUT Y, P_B, P_R	± 2 V(DC + peak AC)
ANALOG EXT REF	±12V(DC + peak AC)

The maximum input voltage of "±12V(DC+peak AC)"is as shown Figure 1-1.

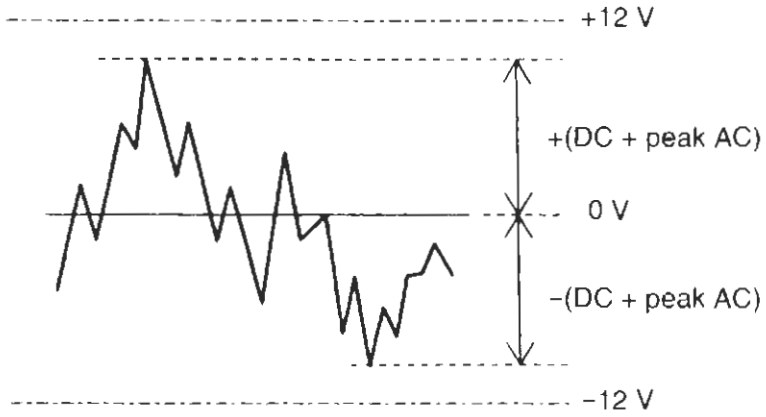


Figure 1-1

1.2.3 Installation

Do not use the instrument in the following environments.

- High temperature environments
  Do not place the instrument under direct sunlight or near a heater(e.g., stove). Do not move the instrument from cold to warm environment abruptly, it may cause condensaton.
  Operating temperature range:0 to 40 ℃

- High humidity environments
  Do not place the instrument in the high humidity environment(e.g., bathroom, near a humidor).
  Operating humidity range: ≤ 90% RH (without condensation)

- Dusty environments

- Excessive magnetic fields
  Do not place the instrument by the strong magnetic field(e.g., high-power transformer). Waveform distortion or tilt may occur.

1.2.4 CRT

Do not leave the instrument with high intensity or displaying sharp spot. The CRT screen may be burned-in or its life may reduce.
To prevent CRT damage and maintain accuracy, be careful not to expose the instrument to other forms of severe mechanical shock.

1.2.5 Last Memory and Default Setting

The last memory function retains the front panel settings immediately before turning the power off .
When the instrument is first powered on after purchase or left for longer than one month without supplying power, the stored data may be lost with the instrument assuming the default settings. Therefore, leave the instrument powered on at least eight hours to charge the backup battery.
To forcibly obtain default settings, hold down the CH2 key, then turn the power on. "PUSH ANY KEY"is displayed. Press any key.

1 2.6 Cabinet

Install the instrument in the optional cabinet for safety purpose and avoicing EMI. Refer to Section 2.4.20, "Optional Accessories"for optional cabinet.

1.2.7 Calibration

When calibration or service is required, contact your local Leader agent.

2. SPECIFICATIONS

2.1 Description

The LV 5152DA multiformat Waveform Monitor is designed to display HDTV serial digital and analog signals.
This instrument features two serial digital input systems and one analog component signal input system. In addition to the waveform monitor function, vectorscope, timing, and audio signal display functions are provided.
Digital input signal can be analyzed since transmission error monitoring equivalent cable length measurement, and digital video data dump functions are provided.
Versatile functions (e.g., 8-channel AES/EBU outputs, GAMUT error monitoring, full line selector, various settings with menu) are also provided.

2.2 Features

Applicable to multi-format
The serial digital signal conforming to BTA S-001B/002B, SMPTE 240M/260M, 274M and 296M standards can be used.

- Digital data dump function
  Since parallel digital video data can be displayed in hexadecimal format, this instrument is convenient to trace troubles.

- AES/EBU digital audio output conforming to SMPTE 276M
  Digital audio signal separated from the serial digital signal can be output.

- Digital input error monitor
  An error logger and error contents display function are provided for HD-SDI.

- Equivalent cable length measurement
  Indicates the serial digital signal level applied to the input connector as the coaxial cable (LS-5CFB) length instead of the actual level.

- Gamut error monitoring function
  Monitors incorrect level of signals converted from Y, P_B, P_R into GBR format.

- Two serial digital input systems and one output system
  Serial digital signal input systems conforming to BTA S-004B standards, active output system to reoutput the input signal.

- Analog signal input system (Y, P_B, P_R or GBR)
  This input system enables the monitoring of both analog and digital signals since the analog input is provided.

- Vectorscope function (conforms SMPTE274M, 296M)
  Display color difference signal in vector format. The analog GBR signal is converted into color difference signal with a matrix and displayed.

- Picture monitor output
  The Y, P_B, P_R or G, B, R format can be selected with D/A converted analog signal from serial digital signal.
  Analog signal is displayed via loop-through circuit.

- Conversion matrix, Y, P_B, P_R into GBR (conforms SMPTE274M, 296M)
  Simplifies signal level monitoring.

- Full-line selector mode
  Enables the selection and display of arbitrary video signal lines in each field. Since up to 15 lines can be continuously displayed, waveform is displayed with sufficient intensity.

- Measurements using cursor
  Ensures level measurement with 0.5% accuracy.

- Lissajous display for stereo audio signal
  Analog stereo audio signal can be displayed in lissajous format.

- Preset memory function
  Stores/recalls up to 10 panel settings to reduce setup time by presetting frequently used measurement conditions.
  (Up to eight items of data can be recalled by using the remote controller)

- Timing display
  Time difference and amplitude difference between channels can be monitored by using the timing display mode.

- Power Supply is the free voltage of AC 90 to 250V.

- Option
  Option 70 : Waveform display for
  NTSC Composite and Component Signal is optionary equipped
  (Factory Option)

2.3 Basic Operation Mode and Principal Functions

2.3.1 Basic Operation Mode

WFM (Waveform monitor mode)	Displays up to three channel waveforms.
VEC (Vectorscope mode)	Vector display of P_B and P_R channel input signals.
PIC (Picture monitor mode)	Monochrome display of Y/G channel input signals.
AUDIO (Audio mode)	Lissajous display of analog stereo audio signal.

2.3.2 Principal Functions

(1) Serial Digital Signal

- Data Dump Function
  Displays serial digital signal data.
- Error Analysis Function
  Displays error logger, error contents
- Equivalent Cable Length Display Function
  Displays cable length converted from the signal level.
- Format Conversion (Picture monitor output) Function
  The input Y, P_B, P_R format signals can be converted into GBR format for signal display on a picture monitor.

(2) Serial Digital/Analog Compornent Signal Measurements

Cursor Function	Voltage and time measurements (WFM only).
Full line Selector	Selects line on each field (WFM, VEC, PIC).
Timing Measurement	Measures time difference between Y/G channel and P_B/B, P_R/B channel (WFM only).
Format Converter	Converts Y, P_B, P_R format signal into GBR format.

2.4 Specifications

2.4.1 Measurement signal and Standards

Digital/Analog VIDEO Standards

	VIDEO System	Standards	
1	1920 × 1035 / 60i	BTA S-001B, 002B	
2	1920 × 1035 / 59.94i	SMPTE 240M, 260M	
3	1920 × 1080 / 60i,30sF		
4	1920 × 1080 / 59.94i,29.97sF		
5	1920 × 1080 / 50i,25sF	SMPTE 274M	
6	1920 × 1080 / 30p		
7	1920 × 1080 / 29.97p		
8	1920 × 1080 / 25p		
9	1920 × 1080 / 24p		
10	1920 × 1080 / 23.98p		
11	1920 × 1080 / 24sF		
12	1920 × 1080 / 23.98sF		
13	1980 × 720 / 60p	SMPTE 296M	
14	1980 × 720 / 59.94p		
15	※NTSC(ANLOG ONLY)	SMPTE 170M, 253M	※OPTION 70

- Serial Digital Specifications BTA S-004B, SMPTE 292M
- Ancillary Data Specifications BTA S-005B, SMPTE 291M
- Embedded Audio Specifications BTA S-006B, SMPTE 299M

2.4.2 Input System

(1) Serial Digital Input

Input Connector	75-Ω BNC, 1-connector, 2-system
Return Loss	≥15dB, 5 MHz to 742.5 MHz ≥10dB, 742.5 MHz to 1.485 GHz (for SER A/SER B, power on/off)
Impedance	75Ω, terminated
Maximum Input Voltage	±2V (DC + peak AC)
Isolation between Channels	≥50 dB, 50 kHz to 742.5 MHz

(2) Analog Input

Input Channel	CH1(Y/G), CH2(P_B/B), CH3(P_R/R), passive loopthrough, 1-system
Input Connector	75-Ω BNC
Return Loss	≥30 dB, 50 kHz to 30 MHz(both power on/off)
Impedance	75-Ω Loop-through
Maximum Input Voltage	±2 V (DC + peak AC)

(3) Analog EXT REF Input

Input Channel	EXT REF, passive Loop-through, 1-system
Input Connector	75-Ω BNC
Return Loss	≥30 dB, 50 kHz to 30 MHz (both power on/off)
Impedance	75-Ω Loop-through
Maximum Input Voltage	±12 V (DC + peak AC)

2.4.3 Output System

(1) Serial Digital Active Output

Output Signal	Reoutput selected input signal out of 2 systems
Output Impedance	75 Ω
Output Connector	BNC, 1-connector
Output Level	800 mVp-p±10%

(2) Analog Picture Monitor Output

Format	Y, P_B, P_R or G, B, R (digital input, selectable)
Frequency Response	25 Hz to 30 MHz, within ±5%
Output Impedance	75 Ω
Output Connector	BNC, 3-connector, 1-system
Amplitude	1 V±5%

(3) AES/EBU Output

Output Signal:	CH1/2, CH3/4, CH5/6, CH7/8
Output Impedance:	75 Ω
Output Connector:	BNC, 4-connector, 4-system
Amplitude:	1.0 V±10%
Sampling Frequency:	48 kHz
Quantization Accuracy:	16, 18, 20, 24 bits, selectable

The relative phase of output sound between the sound group-1 (CH1 to CH4) sound group-2 (CH5 to CH8) are not guaranteed.
The phase in the group is matched.

2.4.4 Sync (Analog input only)

Sync Amplitude	Both internal and external 0.3 Vp-p±3 dB

2.4.5 Vertical Axis

(1) Vertical Axis

Deflection Sensitivity	Within ±1%, GAIN X1
	Within ±3%, GAIN X5
Variable Range	At least 0.5 to 1.2 times (both GAIN X1 / X5)
GBR matrix on	Within ±1%, GAIN X1
Frequency Response	×1 GAIN
FLAT	Within ±1%, 25 Hz to 30 MHz
	(15 to 35℃ / 50 kHz ref., analog mode)
LOWPASS	
Attenuation	≥20 dB, at 20 MHz (50 kHz ref.)
DIF'D STEP	
Attenuation	≥20 dB, at 30 MHz (1.6 MHz ref.)
	>20 dB, at 7 MHz (1.6 MHz ref.)
Step Response	For 2T pulse, 2T bar
	Within ±1%, pulse/bar ratio
	Within ±1%, overshoot
	Within ±1%, preshoot
	Within ±1%, ringing
	Within ±1%, sag (vertical tilt)

(2) DC Restorer

Frequency Response	
Slow Mode	≤20%, attenuation at 60 Hz input
Fast Mode	≥80%, attenuation at 60 Hz input
Clamp Point	Back porch
Variable Range	0.5 µs to 2 µs, with respect to the sync pulse rising edge
Blanking Level Shift	≤1% (10 to 90% of APL variation)

(3) Horizontal Axis

Operation Mode	Overlay: Display waveforms overlaid Parade: Display waveforms side-by-side Timing: For bowtie signal* measurement *Use of bowtie has been authorized by Tektronix, Inc.
Sweep Mode	Automatic sweep
Display Method	
Line	1H, 2H, 3H
Line Magnified	1H MAG, 2H MAG, 3H MAG
Field	1V, 2V, 3V
Field Magnified	1V MAG, 2V MAG, 3V MAG
Time Base Accuracy	Within ±3% (0.1 µs/div)
Sweep Length	11.6 div±0.2 div (1080i/60i, 2H overlay mode)
Linearity	Within ±3%

2.4.6 Vectorscope Mode

Frequency Range	≥1 MHz
Amplitude Accuracy	±2% (Y, P_B, P_R input) ±2% (G, B, R input)
Variable Range	At least 0.5 to 1.2 times (both GAIN X1 / X5) (for vertical and horizontal axes)
Graticule	Illuminated graticule (select external or electronic graticule)
Sync Blanking	Blanks SYNC DOT when the SYNC is on Analog P_B, P_R Signal

2.4.7 Picture Monitor Mode

Displays picture using the Y or G signal.

2.4.8 Audio Mode

Input System	Direct coupled balanced input
Input Impedance	≥20 kΩ
Calibration Accuracy	±0.5 dB of full scale
Full Scale	0, 2, 4 dBm (menu selectable)
Maximum Input Voltage	±12 V (DC + peak AC)
Bandwidth	Within -3 dB at 20 kHz
X-Y Phase Accuracy	Within 1° at 20 kHz

2.4.9 Calibration Signal

Amplitude	1 V±0.5%
Time	Depends on SWEEP setting as follows. 1 cycle/2 div 1 cycle/10 div for 1H MAG

2.4.10 Digital Analyze Function

- Error Display

signal error is detected and displayed.

VIDEO block:	Detected with CRCC
AUDIO block:	Detected with BCH
ANC block:	Detected with checksum
Error:	LED indicates an error, CRT displays error contents.

Equivalent Cable Length Meter Function:

Compares serial digital signal level with reference signal(800 mVp-p)and displays level as the cable length.

Equivalent Cable	LS-5CFB
Indication Range	5m to 130m
Resolution	5m
Indication Accuracy	±20m

2.4.11 Gamut Error Display

LED on the front panel
Menu shows detail

• Error Detection Range	Exceeding -35 mV and 735 mV
• Detector Setting Accuracy	≤ ±5 mV

2.4.12 Line Selector

Operation Mode	WFM, VEC, PIC
Operation Field	FLD1, FLD2, ALL
Selectable Line	1 to 750, 1 to 1125

2.4.13 Line Window

Intensifies selected line

Function	Displays multiple lines continuously
Window Range	1 to 15 lines
Operation Mode	WFM, VEC, PIC
Operation Field	FLD1, FLD2, ALL

2.4.14 Preset Function

Number of Items	Up to 10 panel settings can be preset/recalled. (Up to eight items of data can be recalled by using the remote controller)
Items	All front panel controls (except INTEN, READOUT INTEN, ROTATION, FOCUS, ILLUM, POWER)

2.4.15 Remote Control

Control Signal	TTL (low active)
Control Input	D-sub, 25-pin (REMOTE), rear panel

2.4.16 Cursor Measurement

Configuration	Two horizontal cursors (REF, Δ) Two vertical cursors (REF, Δ)
Amplitude Measurement	Voltage (V or %) between the REF and Δ cursors
Measurement Range	0 - 2000.0 mV, 0 - 280.0%
Accuracy	±0.5%
Resolution	1 mV or 0.1%
Amplitude Ratio Measurement	
	When "R%" is selected from the menu, amplitude between the REF and Δ cursors with respect to the 100% REF is displayed in units of R%.
Time Measurement	Measures time between the REF and Δ currsors
Measurement Range	At least ±6 div from graticule center
Accuracy	±3%
Resolution	1/80 div
Time Ratio Measurement	When "R%" is selected from the menu, time between the REF and Δ cursors with respect to the 100% REF is displayed in units of R%.
Frequency Measurement	Frequency of one cycle between the REF and Δ cursors

2.4.17 CRT

Type	150 mm rectangular, P4 phosphor
Accelerating Potential	16.5 kV
Effective Display Area	80 x 100 mm
Graticule	Illuminated internal graticule (waveform monitor) Illuminated external graticule (vectorscope) Electronic graticule (vectorscope, audio)

2.4.18 General Specifications

Power Requirements	90 to 250 VAC, 48 to 440 Hz	
Fuse	2 A time-lag	
Power Consumption	≤100 W	
Dimensions	215 (W) x 132 (H) x 429 (D) mm	
Weight	5.5kg	
Environmental Conditions		
Operating	Temperature Range:	0 to 40°C
	Humidity Range: (without condensation)	≤ 90%
Spec-Guaranteed	Temperature Range:	10 to 35°C
	Humidity Range: (without condensation)	≤ 80%
	Indoor Use	
	Altitude up to 2,000m	
	Over voltage Category:	II
	Pollution degree:	2

2.4.19 Accessories

Illumination lamp	5
D-sub 25-pin connector	1
D-sub 25-pin connector cover	1
Screw, rack mounting, inch size	2
Cover, inlet stopper	1
Power cord	1
Instruction manual	1

2.4.20 Operation Accessories (Cabinet)

LR-2427 I-U for USA (Cabinet, with handle)
LR-2404 (Cabinet, without handle)
LR-2400 VI-02(Rack-Mount Adapter, inch size)
LR-2400 V-M (Rack-Mount Adapter, metric size)

3. PANEL DESCRIPTION

3.1 Front Panel

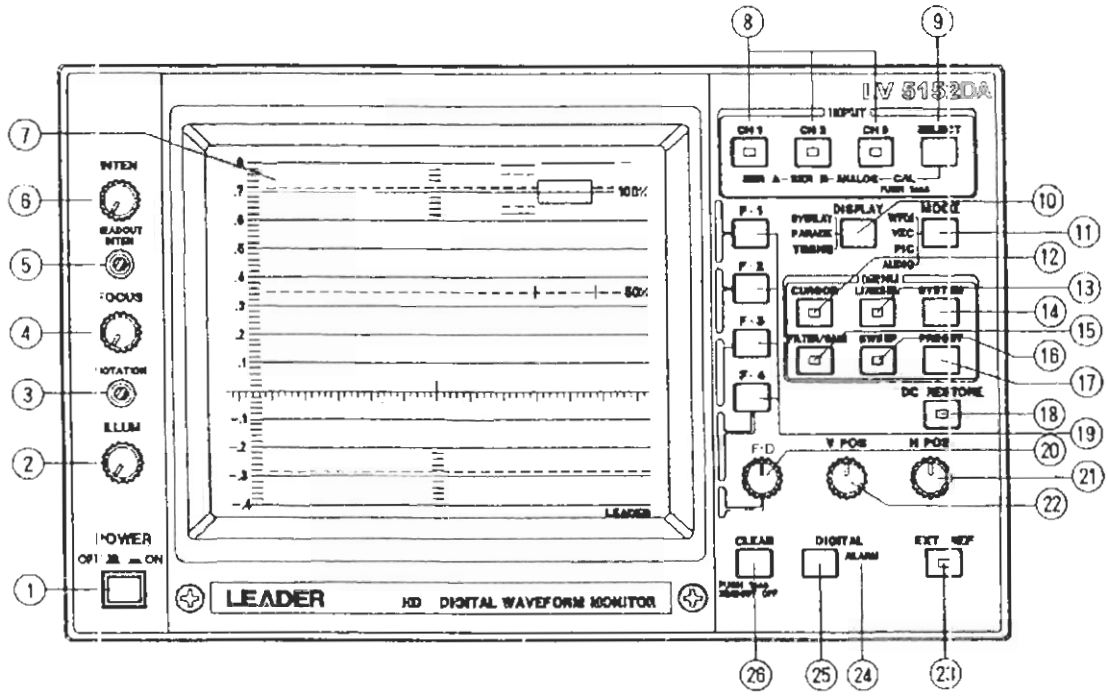


Figure 3-1

(1) POWER switch
Press to turn power on.
Release to turn power off.

(2) ILLUM control
Controls brightness of scale illumination.
Clockwise rotation increases brightness.

(3) ROTATION adjustment
Compensates for slight tilting of the trace due to terrestrial magnetism.
Parallel the trace with respect to the horizontal graticule line by using a screwdriver.

(4) FOCUS control
Adjusts waveform sharpness.

⑤ READOUT INTEN adjustment
Controls intensity of the readout characters by using a screwdriver.

⑥ INTEN control
Controls intensity of the displayed waveform.

⑦ Graticule
Refer to Section 3.3, "Graticules" for detail.

⑧ CH1, CH2, CH3, keys
Select channel to be displayed.
The channel can be selected respectively. Lighted or Lite LED indicates the selected channel is on.
All channels cannot be turned off simultaneously.

⑨ SELECT key
Selects input signal sequentially: SER A (serial digital A), SER B (serial digital B), or ANALOG.3-wire Y, P_B, P_R or G, B, R 16:9 aspect ratio.
To display the calibration signal, hold down this key for at leastr one second.

⑩ DISPLAY key
In the WFM mode, OVERLAY, PARADE, or TIMING can be selected. sequentially by pressing this key.

OVERLAY:	Displays signals in overlay mode.
PARADE:	Displays signals in parade mode.
TIMING:	The delay time and amplitude difference between signals can be measured by applying timing signal (bowtie signal) to the Y/G, Pb/B, and Pr/R connectors on the rear pane . Use of bowtie has been authorized by Tektronix, Inc.

⑪ MODE key
Selects operation mode (i.e., WFM, VEC, PIC, AUDIO) can be selected sequentially.

WFM:	Waveform monitor mode
VEC:	Vectorscope mode
PIC:	Picture monitor mode
AUDIO:	Audio monitor mode

⑫ - ⑰ MENU key group

Select the menu.

The selected menu can be operated by using the FUNCTION keys (F·1 to F·4) ⑲ and FUNCTION control ⑳.

⑫ CURSOR key

This key is only enabled in the WFM mode.

By pressing this key, the key LED lights, and the CURSOR menu and cursor are displayed.

To cancel the menu and cursor, press this key again. The key LED goes off.

⑬ LINESEL key

This key can be used in the all operation modes except the AUDIO mode.

By pressing this key, the key LED lights, and the LINE SEL menu and selected line are displayed.

To cancel the menu, press this key again. The key LED goes off.

⑭ SYSTEM key

Sets basic operation mode of this instrument.

By pressing this key, the SYSTEM menu is displayed.

To cancel the SYSTEM menu display, press this key again.

⑮ FILTER/GAIN key

The filter can only be set in the WFM mode.

The gain can be set in all modes.

By pressing this key, the key LED lights, and the FILTER/GAIN menu is displayed. The waveform is also displayed according to the current setting conditions.

Press this key again for default setting (V. GAIN X1, FILTER FLAT). The key LED goes off.

VEC Mode:	The gain can be set independent of WFM mode. The gain factor is set to X1 after canceling the menu.
PIC Mode:	The contrast can be set. The previous contrast is obtained after canceling the menu.
AUDIO Mode:	Pressing the FILTER/GAIN key displays the full scale setting menu. The setting condition is retained after exiting the menu.

⑯ SWEEP key

This key is only enabled in the WFM mode.

Pressing this key displays the sweep time setting menu.

To cancel the menu, press this key again.

⑰ PRESET key
This key is used for storing and recalling the panel setting conditions.
Pressing this key displays previous screen.

⑱ DC RESTORE key
By pressing this key, the key LED lights and the pedestal level of analog component signal is fixed.
This key fixes the pedestal level when waveform is moved by changing Average Picture Level (APL).
To cancel the mode, press this key again. The key LED goes off.
The DC restorer is always enabled when digital input is selected.

⑲ FUNCTION key (F·1, F·2, F·3, F·4)
The key function depends on the menu. The function is displayed at the right margin of the screen.

⑳ FUNCTION DIAL
The controllable function depends on the menu. The function is displayed at the right margin of the screen.

㉑ H POS control
Moves waveform horizontally.

㉒ V POS control
Moves waveform vertically.

㉓ EXT REF key
Pressing this key alternately selects the internal or external trigger source.
Lit LED indicates the external triggering.

㉔ ALARM LED
Lights if an error occurs in the digital input signal.
Select ALARM SET in the DIGITAL menu to determine whether to light the LED in error status.

㉕ DIGITAL key
Displays DIGITAL SYSTEM menu (digital signal status screen).
To cancel this mode, press this key again. The key LED goes off.

㉖ CLEAR key
Clears menu. By pressing this key when the MENU key LED (⑫, ⑬, ⑮, ⑯) lights, the menu is only cleared. The setting conditions are retained even when this key is pressed.

All readout display can be cleared when this key is held down for at least one second. If part of the waveform is obscured by readout display, this phenomenon can be eliminated.

3.2 Rear Panel

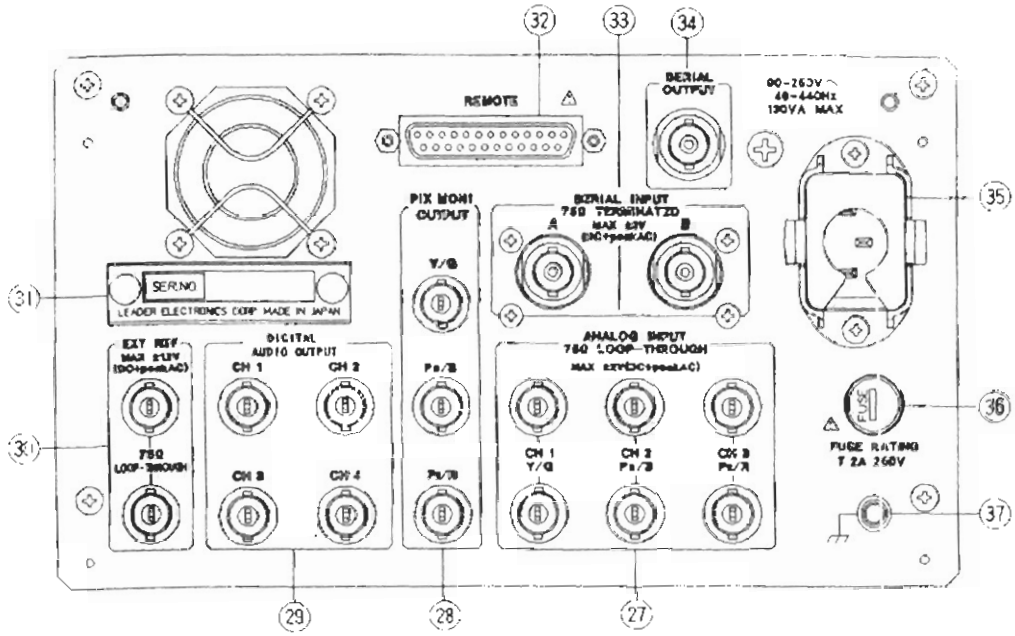


Figure 3-2

27 ANALOG INPUT connectors
Accepts analog signal either Y, P_B, P_R or GBR format.
Input configuration is loop-through.

28 PIX MONITOR OUTPUT connector
Output the signal to the picture monitor.
When serial digital signal is input, the Y, P_B, P_R or GBR output format can be selected by using the menu.

29 DIGITAL AUDIO OUTPUT
Separates audio signal embedded in the serial digital signal, and outputs in AES/EBU format.

30 EXT REF connector
Accepts external sync signal (i.e., analog composite sync signal, Y signal, G signal with sync).
Input configuration is loop-through.

31 Serial number plate
Instrument serial number. Provide this number when contacting us.

(32) REMOTE control connector
D-sub, 25-pin connector.
Pins are assigned for remote control and X-Y audio input.
Refer to Section 4.13, "REMOTE Connector" for detail.

(33) SERIAL INPUT connector
Accepts serial signal.
Two systems (A and B) are provided.

(34) SERIAL OUTPUT connector
Outputs serial digital signal.
Signal applied to the SERIAL INPUT B is retransmitted when the SER B in the SELECT key (9) is selected.
Signal applied to the SERIAL INPUT A is retransmitted when other INPUT is selected.

(35) AC inlet
Voltage range is 90 to 250 VAC, universal.

(36) Fuse
Power supply fuse. Use specified fuse when replace it.

(37) Ground terminal
This terminal is connected to the chassis, and is used for grounding.

3.3 Graticules

3.3.1 Waveform Monitor

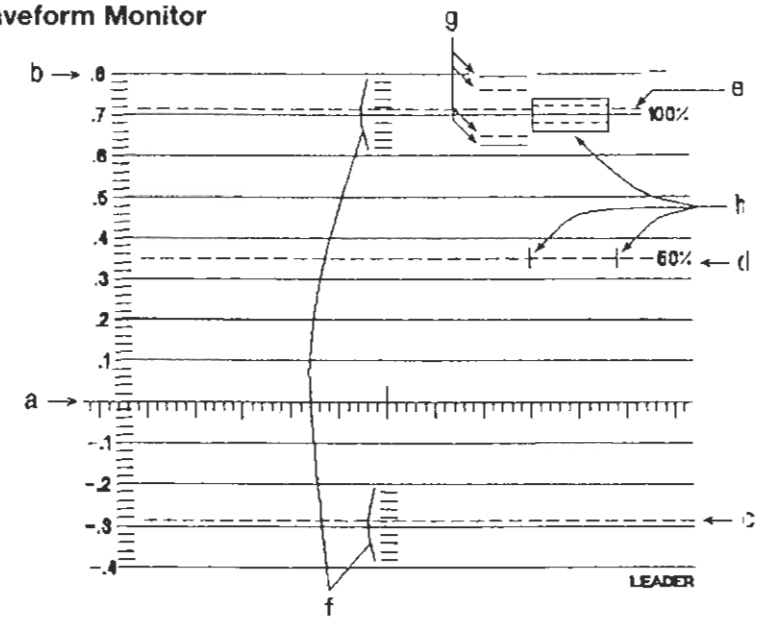


Figure 3-3

a. 0 V scale for vertical system
Divided into 12 major divisions and 5 sub divisions for horizontal system.

b. 0.1 V-step vertical scale

c. 0.286 V sub scale

d. 50% (0.35 V) scale for video signal.

e. 0.714 V sub scale

f. 0.02 V (0.1 V / 5) scales

g. K factor scales (Kpb)
Indicate pulse/bar rotio.
Kpb = 2 (broken lines)
Kpb = 4 (solid lines)

where
upper broken line = $\frac{1}{(1 + 4K)\%}$

lower broken line = $\frac{1}{(1 - 4K)\%}$

h. Line time distortion (L.D) scales
Solid lines: 4%
Broken lines: 2%
Read the slope in the box for distortion.

3.4 Vectorscope

3.4.1 External Graticule

This graticule can be used to monitor a high-definition TV signal using a method similar to that used by the NTSC system since the scale is arranged in NTSC format

· Inner Target Box	Amplitude	Converted NTSC specifications into high-definition TV specifications ±2 IRE for 58.8 IRE (green, maximum amplitude of chroma signal)
	Angle	±2.5°
· Outer Target Box	Amplitude	±20% of each color amplitude
	Angle	±10°

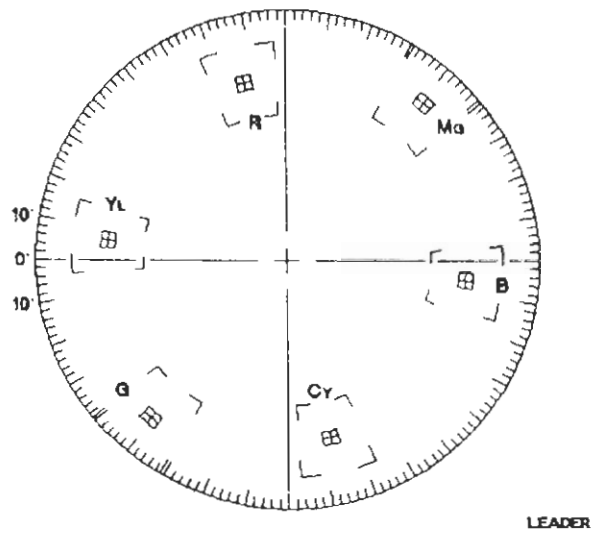


Figure 3-4

The vector scale conforming to SMPTE 274M, 296M, (720p, 1080i) standards is used. Use the electronic graticule when observing the signal conforming to SMPTE 240M (1035/60i).

3.4.2 Electronic Graticule

Two electronic vector graticules are provided and selected according to the video format.

Graticule	Video Format Setting	Conforms To
1	1080/60i, 1080/50i, 1080/30p, 1080/25p, 1080/24p, 1080/30sF, 1080/25sF 1080/24sF, 720/60p	SMPTE 274M, 296M ITU-R BT. 709-3 Part 2
2	1035/60i	SMPTE 240M

Figure 3-5 shows the electronic target boxes ⊞ and axis.

· Target Box Amplitude: ±3% of full scale (0.7 V)

· IQ Axes When 0.7 V full scale is expressed as 100%, the following axes are displayed:

I axis G = 44.559%
B = 27.865%
R = 69.120%

Q axis G = 37.056%
B = 84.085%
R = 62.417%

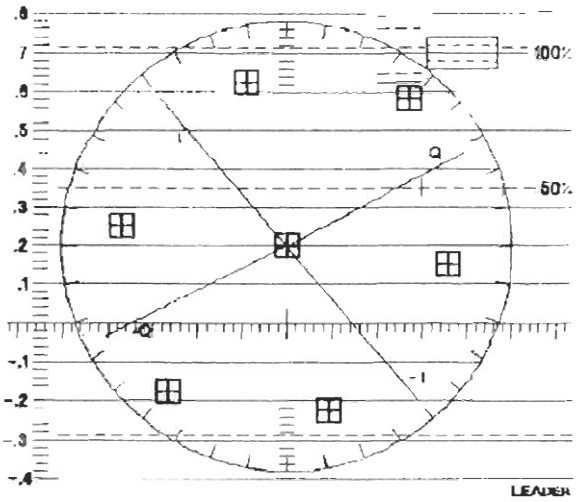


Figure 3-5

4. OPERATING PROCEDURE

4.1 Menu Operation and Structure

4.1.1 Basic Operation

The MENU key group (CURSOR ⑫, LINESEL ⑬, SYSTEM ⑭, FILTER/GAIN ⑮, SWEEP ⑯, PRESET ⑰) is used to display the menu.
To operate the menu, use the FUNCTION keys ⑲ (F·1 to F·4) and FUNCTION control ⑳ according to the menu.
Pressing the key selects on or off alternately.

The CURSOR ⑫, LINESEL ⑬, FILTER/GAIN ⑮, and SWEEP ⑯ keys equipped with LED can alternately select user setting or default setting. When the default setting is selected, the key LED goes off.

The default setting is as follows.

CURSOR	OFF
LINESEL	OFF
FILTER/GAIN	
FILTER	FLAT
GAIN	X1
GAIN VAR	OFF
SWEEP MAG	OFF

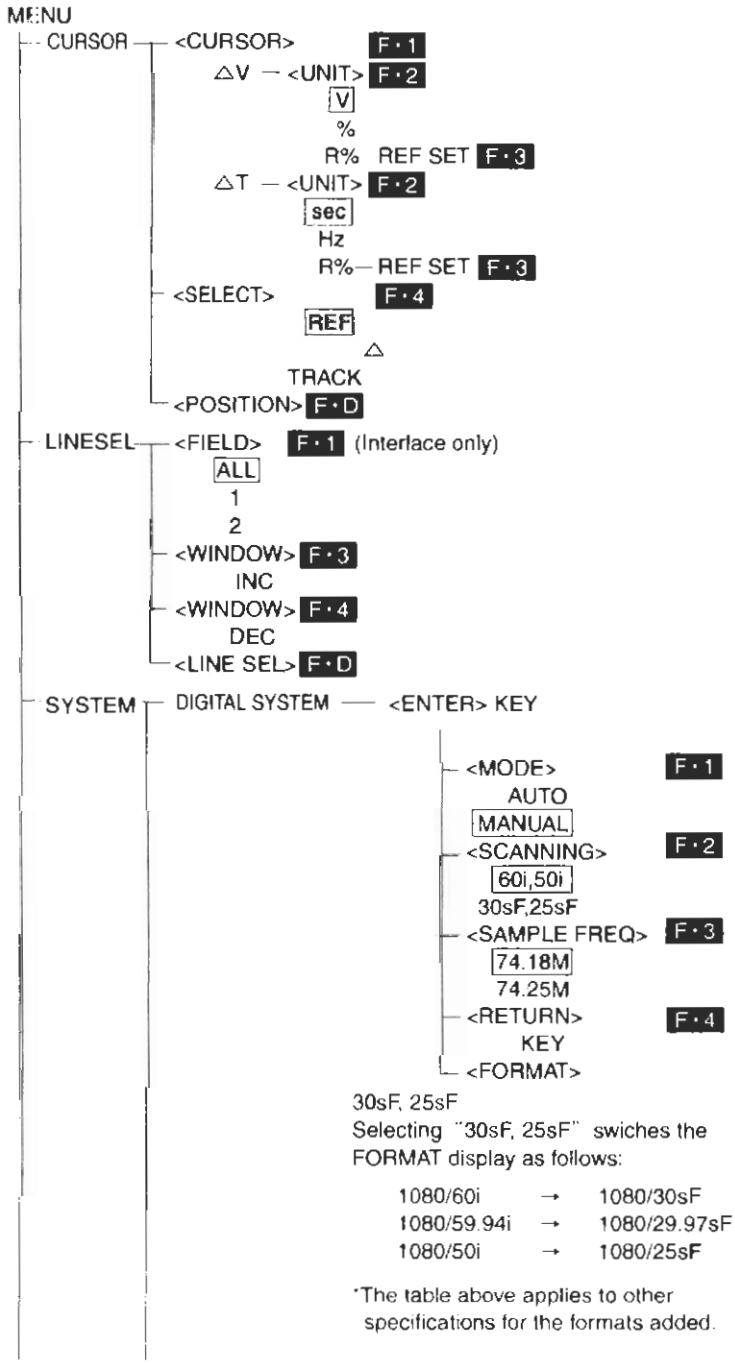
4.1.2 CLEAR Key

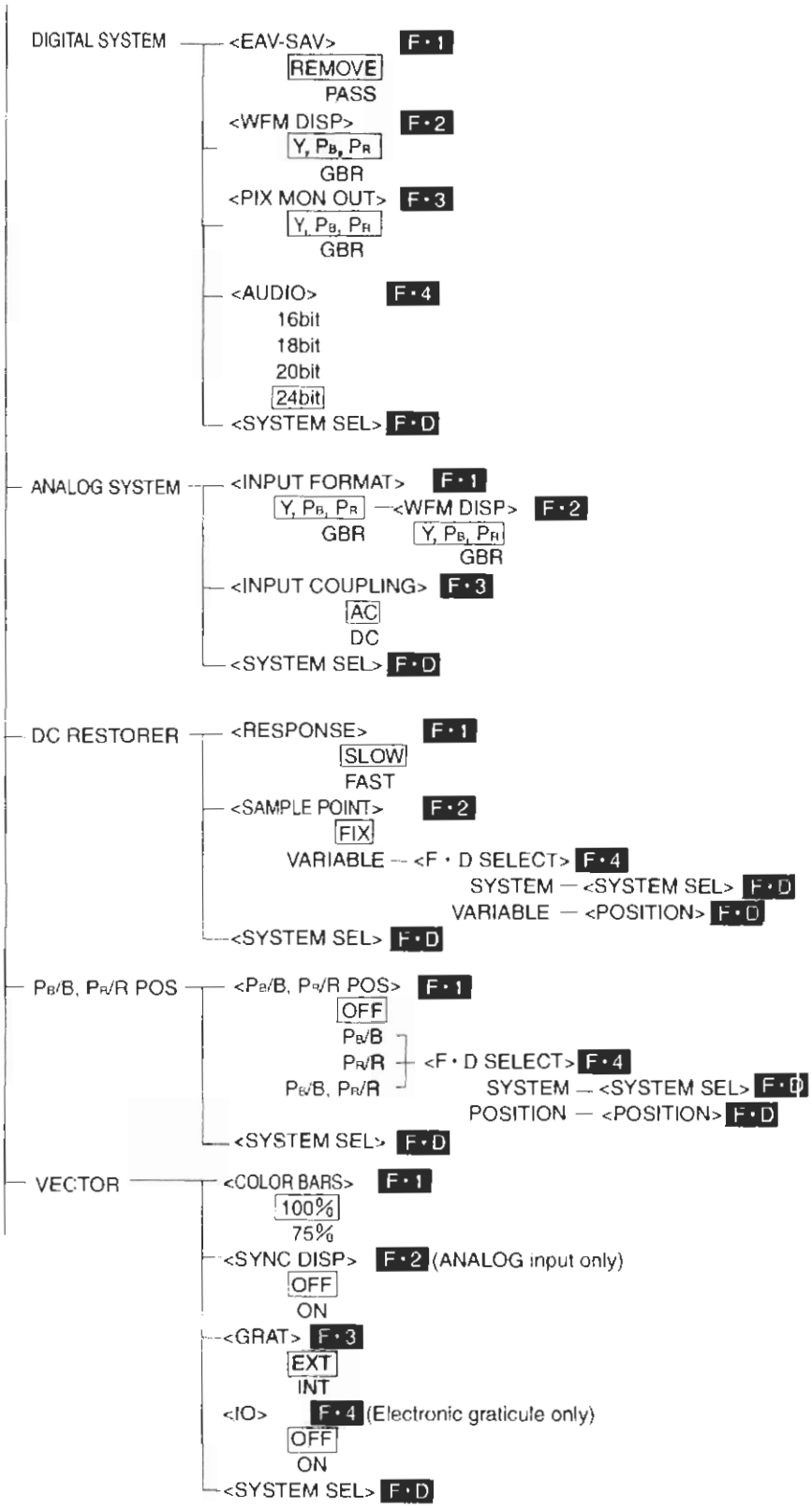
(1) Clearing the Menu
When a waveform is displayed with menu and part of the waveform is obscured by the menu, press the CLEAR key ㉖ to eliminate the menu. The menu setting condition is retained even when cleared.
To display the menu again, press the corresponding menu key in the MENU key group.

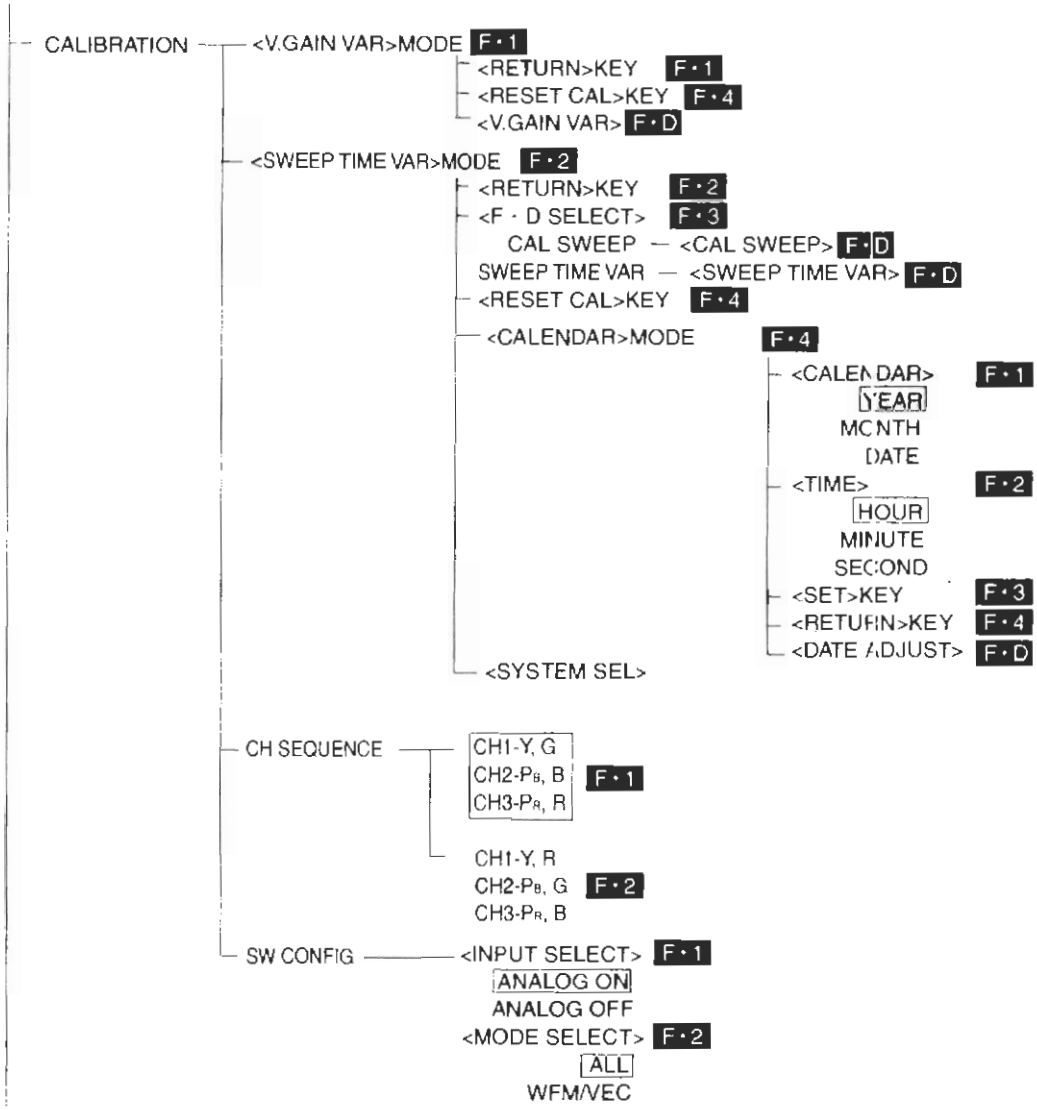
(2) Clearing All Readouts
All readouts can be cleared by holding down CLEAR key ㉖ for at least one second.
To display readouts again, press the corresponding menu key.

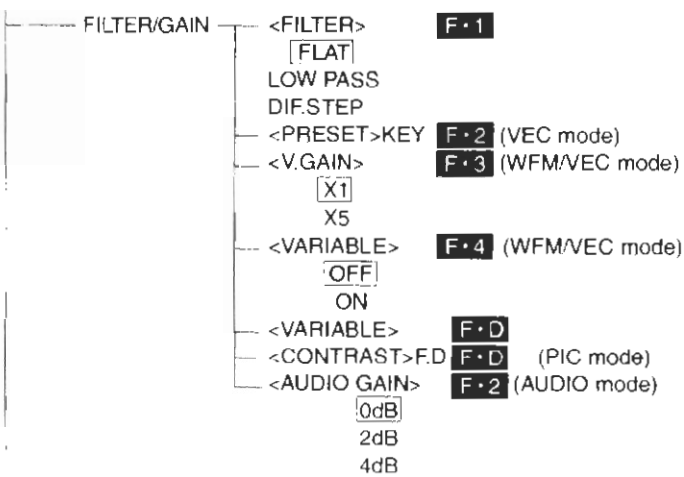
4.1.3 Menu Structure

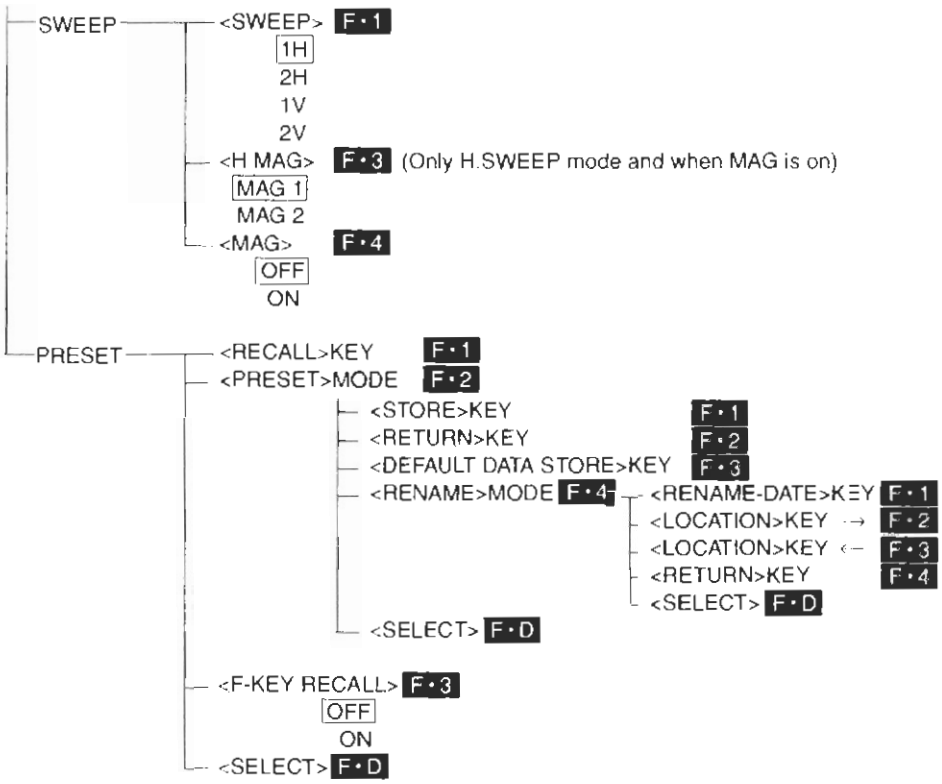
The menu, structure is shown below.
Items surrounded by [ ] are default.




DIGITAL SYSTEM
<EAV-SAV> F·1
REMOVE
PASS
<WFM DISP> F·2
Y, PB, PR
GBR
<PIX MON OUT> F·3
Y, PB, PR
GBR
<AUDIO> F·4
16bit
18bit
20bit
24bit
<SYSTEM SEL> F·D
ANALOG SYSTEM
<INPUT FORMAT> F·1
Y, PB, PR
GBR
<WFM DISP> F·2
Y, PB, PR
GBR
<INPUT COUPLING> F·3
AC
DC
<SYSTEM SEL> F·D
DC RESTORER
<RESPONSE> F·1
SLOW
FAST
<SAMPLE POINT> F·2
FIX
VARIABLE
<F · D SELECT> F·4
SYSTEM
<SYSTEM SEL> F·D
VARIABLE
<POSITION> F·D
<SYSTEM SEL> F·D
PB/B, PR/R POS
<PB/B, PR/R POS> F·1
OFF
PB/B
PR/R
PB/B, PR/R
<F · D SELECT> F·4
SYSTEM
<SYSTEM SEL> F·D
POSITION
<POSITION> F·D
<SYSTEM SEL> F·D
VECTOR
<COLOR BARS> F·1
100%
75%
<SYNC DISP> F·2 (ANALOG input only)
OFF
ON
<GRAT> F·3
EXT
INT
<IO> F·4 (Electronic graticule only)
OFF
ON
<SYSTEM SEL> F·D


CALIBRATION
<V.GAIN VAR>MODE F·1
<RETURN>KEY F·1
<RESET CAL>KEY F·4
<V.GAIN VAR> F·D
<SWEEP TIME VAR>MODE F·2
<RETURN>KEY F·2
<F · D SELECT> F·3
CAL SWEEP — <CAL SWEEP> F·D
SWEEP TIME VAR — <SWEEP TIME VAR> F·D
<RESET CAL>KEY F·4
<CALENDAR>MODE F·4
<CALENDAR> F·1
YEAR
MONTH
DATE
<TIME> F·2
HOUR
MINUTE
SECOND
<SET>KEY F·3
<RETURN>KEY F·4
<DATE ADJUST> F·D
<SYSTEM SEL>
CH SEQUENCE
CH1-Y, G
CH2-PB, B F·1
CH3-PR, R
CH1-Y, R
CH2-PB, G F·2
CH3-PR, B
SW CONFIG
<INPUT SELECT> F·1
ANALOG ON
ANALOG OFF
<MODE SELECT> F·2
ALL
WFM/VEC


FILTER/GAIN
<FILTER> F·1
FLAT
LOW PASS
DIF.STEP
<PRESET>KEY F·2 (VEC mode)
<V.GAIN> F·3 (WFM/VEC mode)
X1
X5
<VARIABLE> F·4 (WFM/VEC mode)
OFF
ON
<VARIABLE> F·D
<CONTRAST>F.D F·D (PIC mode)
<AUDIO GAIN> F·2 (AUDIO mode)
0dB
2dB
4dB


SWEEP
<SWEEP> F·1
1H
2H
1V
2V
<H MAG> F·3 (Only H.SWEEP mode and when MAG is on)
MAG 1
MAG 2
<MAG> F·4
OFF
ON
PRESET
<RECALL>KEY F·1
<PRESET>MODE F·2
<STORE>KEY F·1
<RETURN>KEY F·2
<DEFAULT DATA STORE>KEY F·3
<RENAME>MODE F·4
<RENAME-DATE>KEY F·1
<LOCATION>KEY → F·2
<LOCATION>KEY ← F·3
<RETURN>KEY F·4
<SELECT> F·D
<SELECT> F·D
<F-KEY RECALL> F·3
OFF
ON
<SELECT> F·D

4.1.4 Example of Menu Operation

Example below describes the calibration procedure for the 1V SWEEP TIME.

[SYSTEM → CALIBRATION → F·2<SWEEP TIME VAR> MODE → F·3 <F·D KNOB SELECT> CAL SWEEP → <CAL SWEEP> 1V → F·3 <F·D KNOB SELECT> SWEEP TIME VAR]

(1) Press the SYSTEM key ⑭.
The SYSTEM menu is displayed. Waveform intensity is reduced.

(2) Highlight the CALIBRATION by using the <MENU SEL> F·D KNOB.
The next hierarchical menu is displayed at the right margin of the screen.

(3) The <SWEEP TIME VAR> MODE is displayed at the F·2. Press the F·2 key.

(4) The CAL SWEEP and SWEEP TIME VAR in the <F·D KNOB SELECT> are displayed at the F·3.
Highlight the CAL SWEEP by pressing the F·3 key.
CAL SWEEP menu is displayed at the left margin of the screen.
Highlight the 1V by using the <CAL SWEEP> F·D KNOB.

(5) Select the SWEEP TIME VAR in the <F·D KNOB SELECT> by pressing the F·3 key. The calibration signal is displayed instead of the waveform.
Adjust the INTEN control ⑥ as required.
The sweep time can be adjusted by using the <SWEEP TIME VAR>F·D KNOB.

(6) To exit from the menu after calibration is completed, press the SYSTEM key or CLEAR key.

4.2 Connections

4.2.1 SERIAL INPUT Connector

The SERIAL INPUT connector on the rear panel is internally terminated with 75 Ω. Excessive input voltage can result in damage to the termination resistor. Do not apply excessive voltage.

4.2.2 ANALOG INPUT and EXT REF Connectors

The ANALOG INPUT and EXT REF Connectors on the rear panel are the loop-through configuration as shown in Figure 4-1.
Apply the signal to either connector, and terminate the other connector with a 75-Ω terminator or 75-Ω equipment.
Use a 75-Ω cable for connection.

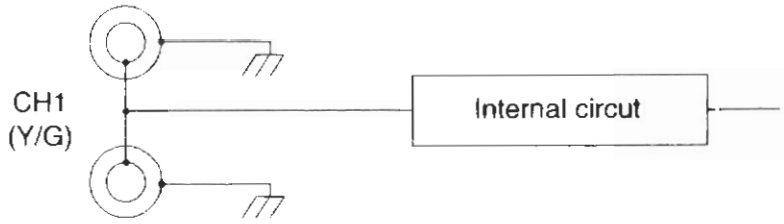


Figure 4-1 Loop-through input

4.3 Displaying the Trace

Procedure

(1) Connect the power plug to the mains.

(2) Set the FOCUS control ④ and INTEN control ⑥ to the center.

(3) Turn the POWER switch ① on.

(4) Wait for about 30 seconds until the trace appears.

(5) If the trace is tilted, adjust ROTATION ③ to make the baseline parallel to horizontal graticule line.

Note: If no trace appears, it may be positioned off screen. Rotate the H POS and V POS controls as required to display the trace.
For brightening the graticule, rotate the ILLUM control ②.
The READOUT INTEN ⑤ control is used to adjust readout intensity.

4.4 SELECT key

4.4.1 Input Signal Selection

This SELECT key ⑨ is used to select the signal (i.e., serial digital A, serial digital B, analog) applied to each input connector.

4.4.2 CAL Mode

To obtain the CAL mode, hold down SELECT key ⑨ for at least one second. The calibration signal is displayed.

The signal amplitude is 1 Vp-p; one-cycle square wave equals 2 horizontal divisions. See Figure 4-2.
When the 1H MAG is selected, one-cycle square wave equals 10 divisions. See Figure 4-3.
To exit from the CAL mode, press the SELECT key ⑨ again.

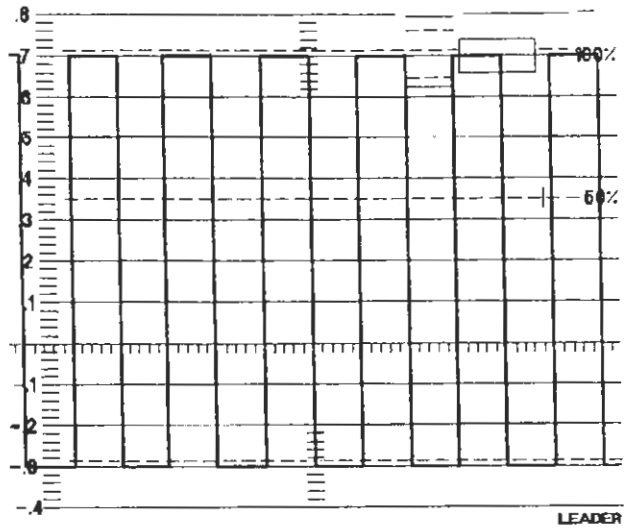


Figure 4-2 Calibration signal

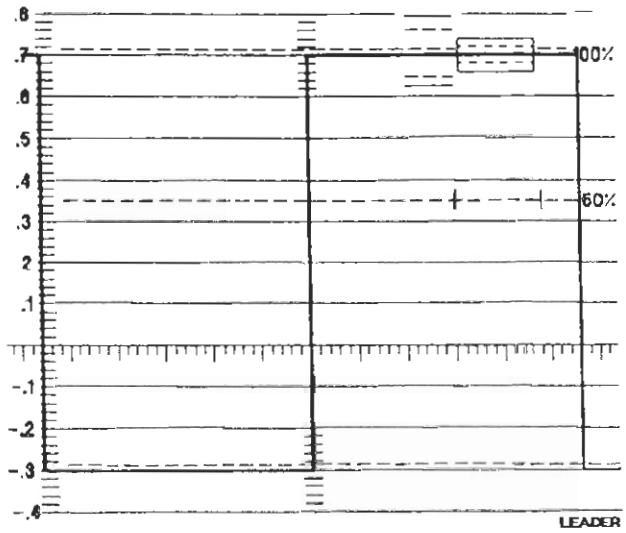


Figure 4-3 Calibration signal, 1H MAG

4.5 MODE Key

Pressing this key sequentially selects the basic operation mode (i.e., WFM, VEC, PIC, AUDIO).

4.6 Waveform Monitor Mode

Before operating the waveform monitor mode, set the system according to the signal to be measured. Refer to Section 4.11, "SYSTEM Key" for detail.

Set the following systems. Underlined items are the default settings.

- System setting for monitoring serial digital signal
  [1035/60i, 1080/60i, 1080/50i, 1080/30p, 1080/25p, 1080/24p, 1080/24sF, 720/60p]

TRS waveform display	PASS (display), REMOVE (no display)
Waveform display format	Y, P_B, P_R, GBR
Picture monitor output format	Y, P_B, P_R, GBR

- System setting for monitoring analog component signal
  [1035/60i, 1080/60i, 1080/50i, 1080/30p, 1080/25p, 1080/24p, 1080/24sF, 720/60p]

Input signal format	Y, P_B, P_R, GBR
Waveform display format	Y, P_B, P_R, GBR
Input coupiing	AC, DC

- Others

DC restorer	Sample point, response speed
P_B/B, P_R/R position	

- Channel sequence setting
  Waveform display order

4.6.1 INPUT Keys

The channel to be displayed can be selected by using the CH1, CH2, CH3 key (8). Lit LED indicates the selected channel. Refer to Section, 4.11.7 "Using CH SEQUENCE Menu" for detail.

By pressing the key again, the wavefoem and LED go off. All channels cannot be turned off, however.
The channel can only selected in WFM mode.
When selecting TIMING by DISPLAY key (10), only channel selection for TIMING DISPLAY become active.
When measuring the serial digital signal, the Y, P_B or P_R signal separated by BTA S-004B standards or converted GBR can be selected.
When measuring the analog component signal, signal applied to the selected channel (LED lights) or signal converted into GBR (color difference signal applied) can be selected.

4.6.2 DISPLAY Key

The DISPLAY key ⑩ is used to select the multichannel display mode and time difference measurement mode.

The OVERLAY, PARADE, or TIMING can be selected sequentially by pressing this key. Lit LED indicates the selected mode.

(1) Overlay Display
The waveforms are displayed in overlay mode.

(2) Parade Display
The waveforms are displayed in parade mode (side-by-side). See Figure 4-4. Waveform display order from the left is determined with the channel sequence menu.(Refer to section 4. 11. 8)

Sweep time set by using the SWEEP key ⑯ shown below.

Sweep Time	Setting
1H, 2H	1H
1V, 2V	1V

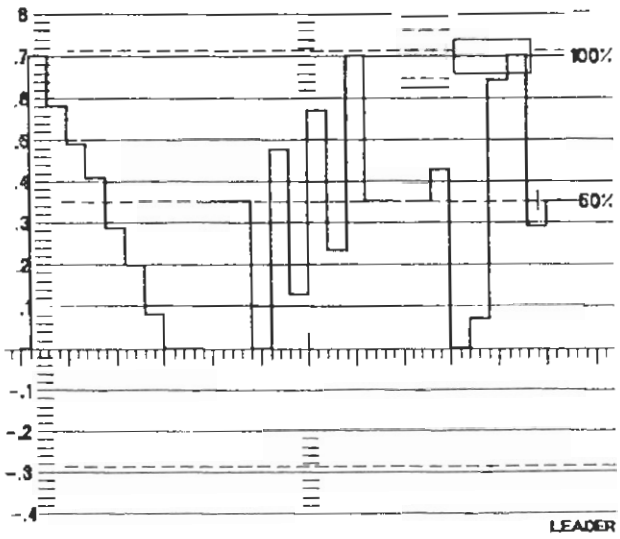


Figure 4-4 Parade display

(3) TIMING Display

This is used to measure time difference and amplitude difference between channels with respect to the CH1(Y/G) channel. Apply the bowtie signal. Two bowtie waveforms are displayed as shown in Figure 4-5. Left side waveform is CH1(Y/G) - CH2(P_B/B); right side waveform is CH1(Y/G) - CH3(P_R/R).

Vertical lines are the marker. The large markers at the center of both waveforms are the reference (no time difference).

The marker interval is 1 ns (e.g., model LT440D, Leader). Read the time difference (between the null point and center marker) using the markers. When the null point is positioned at the left of the reference marker, the P_B/B or P_R/R is advanced with respect to the Y/G, and vise versa.

When the amplitude difference exists between the channels, the null point becomes thicker.

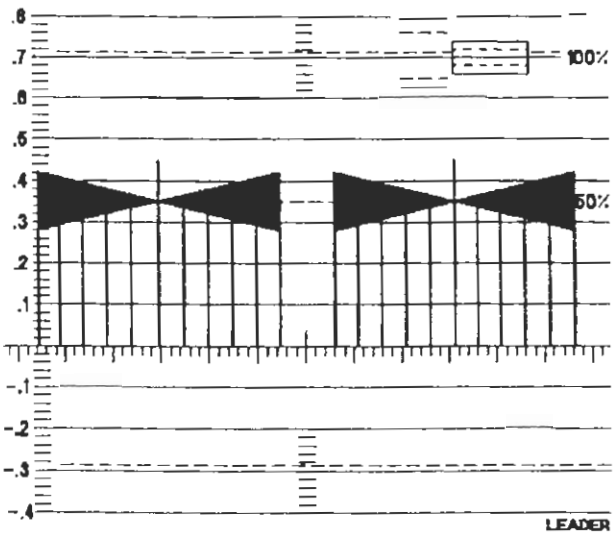


Figure 4-5 Timing display

4.6.3 SWEEP Key

The SWEEP key ⑯ is used to set the sweep time and sweep magnification. Four sweep times (i.e., 1H, 2H, 1V, 2V) can be selected and magnified.

(1) Basic Operation

The FUNCTION KEY menu can be displayed by pressing this key. The key LED lights. The current setting is retained.

F·1 key is used to set the sweep time.
F·4 key is used to set the MAG on or off.

Press the SWEEP key ⑯ again after sweep time setting is completed, or to set the sweep magnification mode off. Menu is cleared and default setting is made. The key LED goes off.

To clear the menu with magnification mode on, press the CLEAR key. Only the menu is cleared and the LED remains on.
To return to the sweep time setting mode, press the SWEEP key ⑯ again.

Key	Display	Function
F·1	<SWEEP> 1H:2H:1V:2V	Selects sweep time
F·3	<H MAG> MAG1:MAG2	Select horizontal sweep magnification
F·4	<MAG> OFF:ON	Sets sweep magnification

(2) Sweep Time Selection
[SWEEP → F·1 <SWEEP> 1H:2H:1V:2V]
The F·1 key is used to select the sweep time.
The actual sweep time displayed on the screen depends on the DISPLAY key ⑩ setting as shown below.

- OVERLAY display
  1H: Displays one-line waveform.
  2H: Displays two-line waveform.
  1V: Displays one-field waveform.
  2V: Displays two-field waveform.

- PARADE display
  1H,2H: One-line display for each waveform.
  1V,2V: One-field display for each waveform.

- TIMING display
  Displays timing measurement screen regardless of other settings.

(3) Sweep Magnification
[SWEEP → F·4 <MAG> OFF:ON]
When setting ON, a waveform will be expanded toward the time base.
When setting OFF, the waveform will be not expanded based on the sweep time which is selected by F·1 key .

(4) Switching of a ratio of horizontal sweep magnifier.
When 1H or 2H is selected from the SWEEP menu and ON is selected from the MAG menu, the H MAG is displayed at the F·3 key.
Table 4-1 shows the relationship between the format and magnification factor(i.e., MAG 1, MAG 2).

(5) Sweep Time

The relationship between the sweep mode and sweep time is shown in Tables 4-1 and 4-2. Tables below show sweep speed per division. The sweep time is marked on the 0 IRE graticule.

The 1 div correspond to one major horizontal scale.

FORMAT	MAG OFF			MAG 1			MAG 2		
	1H	2H	3H	1H	2H	3H	1H	2H	3H
1035/60i	2.5 μs	5.0 μs	7.5 μs	0.25 μs	0.5 μs	0.75 μs			
1080/60i,30sF	2.5 μs	5.0 μs	7.5 μs	0.25 μs	0.5 μs	0.75 μs			
1080/50i,25sF	3.0 μs	6.0 μs	9.0 μs	0.5 μs	1.0 μs	1.5 μs			
1080/30p	2.5 μs	5.0 μs	7.5 μs	0.25 μs	0.5 μs	0.75 μs	0.1 μs	0.2 μs	0.3 μs
1080/25p	3.0 μs	6.0 μs	9.0 μs	0.5 μs	1.0 μs	1.5 μs			
1080/24p	3.0 μs	6.0 μs	9.0 μs	0.6 μs	1.2 μs	1.8 μs			
1080/24sf	3.0 μs	6.0 μs	9.0 μs	0.6 μs	1.2 μs	1.8 μs			
720/60p	2.0 μs	4.0 μs	6.0 μs	0.25 μs	0.5 μs	0.75 μs			

Table 4-1 H.Sweep time

FORMAT	MAG OFF			MAG ON		
	1V	2V	3V	1V	2V	3V
1035/60i	1.25 ms	2.5 ms	3.75 ms	62.5 μs	125 μs	187.5 μs
1080/60i,30sF	1.25 ms	2.5 ms	3.75 ms	62.5 μs	125 μs	187.5 μs
1080/50i,25sF	1.55 ms	3.1 ms	4.65 ms	77.5 μs	155 μs	232.5 μs
1080/30p	3.0 ms	6.0 ms	9.0 ms	150 μs	300 μs	450 μs
1080/25p	3.5 ms	7.0 ms	10.5 ms	175 μs	350 μs	525 μs
1080/24p	3.5 ms	7.0 ms	10.5 ms	175 μs	350 μs	525 μs
1080/24sf	1.55 ms	3.1 ms	4.65 ms	77.5 μs	155 μs	232.5 μs
720/60p	1.25 ms	2.5 ms	3.75 ms	62.5 μs	125 μs	187.5 μs

Table 4-2 V.Sweep time

4.6.4 CURSOR Key

THE CURSOR key ⑫ is used to measure voltage and time.
The REF and Δ cursors are displayed by pressing this key for measuring the voltage and time.

The voltage, voltage ratio, time, frequency, and time ratio can be measured.
The cursor measurement is ideal for precise measurement.

(1) Basic Operation
By pressing the CURSOR key ⑫, the REF and Δ cursors, and FUNCTION KEY menu are displayed. The key LED lights.
Use the FUNCTION KEY to select the function.
Use the FUNCTION KNOB to position the cursor.

To cancel the cursor measurement mode, press the CURSOR key ⑫ again. The menu is cleared and the key LED goes off.

To clear the menu after cursor setting is completed, press the CLEAR key. The menu only is cleared and LED retains on. To return to the cursor measurement mode, press the CURSOR key ⑫ again.

Key	Display		Function
F·1	<CURSOR>	ΔV:ΔT	Selects voltage/time measurement
F·2	<UNIT>	V:%:R%	Unit for ΔV
		sec:Hz:R%	Unit for ΔT
F·3	REF SET		Reference setting in units of %
F·4	<SELECT>	REF:Δ:TRACK	Selects cursor
F·D	<VARIABLE>		Positions cursor

Note: If Ref and Δ cursors are at the same position, RATIO=INFINITE is displayed at the upper-right corner of the screen when the F 3 key is pressed.
If the ratio goes beyond 1000.00%, OVER RANGE is displayed.

(2) Voltage Measurement
[CURSOR → F·1 <CURSOR> ΔV → F·2 <UNIT> V:%]

The voltage between the cursors can be measured.
Select the unit (V or %) by pressing the F·2 key.

Position the REF and Δ cursors to the desired points on the waveform.
Refer to Step (1).
The measured value between the cursors is displayed at the upper-right corner of the screen.

When the TRACK is selected by pressing the F·4 <SELECT> key, both REF and Δ cursors can be positioned simultaneously.

When the Δ cursor is positioned below the REF cursor, a negative sign "-" is displayed.

(3) Voltage Ratio Measurement
[CURSOR → F·1 <CURSOR> ΔV → F·2 <UNIT> R%]

The voltage ratio between the reference points (100%) and desired points can be measured.
The F·3 <REF SET> key is used to set the reference points.

Position the REF and Δ cursors to the reference points on the waveform, then press the F·3 key. Refer to Step (1).
The reference value "100.00R%" is displayed.
Position the REF and Δ cursors to the desired points on the waveform.

The measured value between the cursors is displayed at the upper-right corner of the screen.

(4) Time Measurement
[CURSOR → F·1 <CURSOR> ΔT → F·2 <UNIT> sec]

The time between the cursors can be measured.

Position the REF and Δ cursors to the desired points on the waveform.
Refer to Step (1).

The measured value between the cursors is displayed at the upper-right corner of the screen.
When the Δ cursor is positioned at the left of the REF cursor, a negative sign "-" is displayed.

(5) Frequency Measurement
[CURSOR → F·1 <CURSOR> ΔT → F·2 <UNIT> Hz]

The frequency between the cursors can be measured.

Position the REF and Δ cursors to the desired points on the waveform.
Refer to Step (1).

The measured value between the cursors is displayed at the upper-right corner of the screen.

(6) Time Ratio Measurement
[CURSOR → F·1 <CURSOR> (ΔT) → F·2 <UNIT> (R%)]

The time ratio between the reference points (100%) and desired points can be measured. The F·3 <REF SET> key is used to set the reference points.

Position the REF and Δ cursors to the reference points on the waveform, then press the F·3 <REF SET> key. The reference value "100.00R%" is displayed. Refer to Step (1).

Position the REF and Δ cursors to the desired points on the waveform. The measured value between the cursors is displayed at the upper-right corner of the screen.

4.6.5 LINESEL Key

The **LINESEL** Key ⑬ is used to display an arbitrary line of a video signal. This function is ideal for monitoring such specified lines as Vertical Interval Test Signal (VITS) or Vertical Interval Reference (VIR).

With the line window function, up to 15 lines started with the specified line can be displayed.
When the 1V or 2V is selected by using the SWEEP menu, the selected line (including line window) is highlighted.

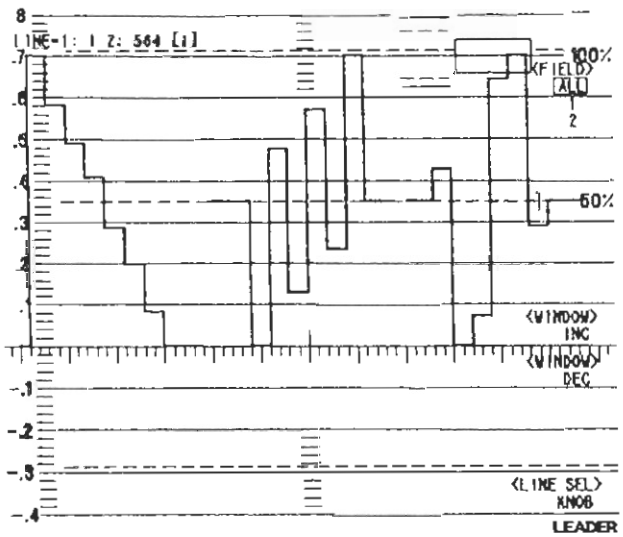


Figure 4-6 Display of lines selected

(1) Basic Operation

The line selector mode can be obtained by pressing the LINESEL key ⑬.
The FUNCTION KEY menu is displayed and the key LED Lights.
Use the FUNCTION KEY to set the function; FUNCTION KNOB to select the line.

To cancel the line selector mode, press the LINESEL key ⑬ again. The menu is cleared and the key LED goes off.

To clear the menu after line selector setting is completed, press the CLEAR key ㉖. The menu only is cleared, and LED remains on to indicate the line selector mode is in operation.
To change the field or line being set, press the LINESEL key ⑬ again and repeat the procedure.

Key	Display		Function
F·1	<FIELD>	ALL:1:2	Selects field
F·3	<WINDOW>	INC	Selects number of lines (increment)
F·4	<WINDOW>	DEC	Selects number of lines (decrement)
F·D	<LINESEL>		Selects line number

(2) Field Selection

[LINESEL → F·1 <FIELD> ALL:1:2]

The F·1 key is used to select the field in the arbitrary line.
The field is not displayed when the signal format is progressive.

ALL: Displays specified lines of fields 1 and 2 in overlay mode.
1: Displays specified lines of field 1
2: Displays specified lines of field 2

Triple parade is displayed as follows.

Example: Line number 5

(3) Specifying the Line Window
[LINESEL → F·3 <WINDOW> INC]
[LINESEL → F·4 <WINDOW> DEC]

Up to 15 lines started with the specified line can be selected.
Press the F·3 key to increase the number of lines; press the F·4 key to decrease the number of lines.

The line number displayed on the line window screen indicates the first line of the WINDOW.
When the SWEEP is set to 2H, at least 2 windows are displayed.

4.3.6 FILTER/GAIN Key-1 (GAIN)

This section describes the vertical gain selection and variable control procedures.
Two gain control functions (i.e., X5, continuous variable) are provided.
This key cannot be used in the VEC mode.

(1) Basic Operation
By pressing the FILTER/GAIN key ⑮, the latest gain setting is recalled. The menu is displayed and the key LED lights.

Use the FUNCTION KEY to turn magnification and variable modes on or off.
Use the FUNCTION DIAL for adjusting gain when the variable mode is on.

To obtain the default setting (X1, VARIABLE OFF), press the FILTER/GAIN key ⑮ again. The menu is cleared and the key LED goes off.

To clear the menu after gain setting is completed, press the CLEAR key ㉖. The menu only is cleared, and LED remains on.
To change the gain, press the FILTER/GAIN key ⑮ again and repeat the procedure.
This menu is common to the filter selection menu (refer to Section 4.6.7). To set the gain to the default setting when LOW PASS or DIF.STEP is selected, press the F·3 key to X1, and F·4 key to OFF instead of the FILTER/GAIN key ⑮.

Key	Display		Function
F·1	<FILTER>	FLAT:LOW PASS:DIF.STEP	Selects filter
F·3	<V.GAIN>	X1:X5	Selects gain
F·4	<VARIABLE>	OFF:ON	Variable on/off
F·D	<VARIABLE>		Gain variable

(2) Gain Selection
[FILTER/GAIN → F·3 <V.GAIN> X1:X5]

Gain (X1 or X5) can be selected by pressing the F·3 key.

(3) Gain Variable Mode
[FILTER/GAIN → F·4 <VARIABLE> ON → <VARIABLE> F·D]

To obtain the variable mode, select <VARIABLE> ON by pressing the F·4 key, then use the FUNCTION KNOB to set the gain. Clockwise rotation increases the gain, counter clockwise decrease the gain.
Bar displayed at the lower-right corner of the screen indicates gain (i.e., variable range, current setting status).
The variable range is as follows.
At least 0.5 to 1.2 times for both GAIN X1 and GAIN X5.

4.6.7 FILTER/GAIN Key-2 (FILTER)

This section describes operating procedure of the filter menu.
The FLAT, LOW PASS, or DIF.STEP filter can be selected. The default setting is the FLAT.

(1) Basic Operation
By pressing the FILTER/GAIN key ⑮, the waveform according to the selected filter is displayed.
The menu is displayed and the key LED lights.
Press the F·1 key to select the filter.

To obtain the default setting (FLAT), press the FILTER/GAIN key ⑮ again.
The menu is cleared and the key LED goes off.

This menu is common to the gain selection menu (refer to Section 4.6.6). To set the filter to the default setting (FLAT) when gain mode is set to X5 or VARIABLE ON, press the F·1 key instead of the FILTER/GAIN key ⑮.

To clear the menu after filter setting is completed, press the CLEAR key.
The menu is only cleared and LED remains on.
To return to the filter mode, press the FILTER/GAIN key ⑮ again.

Key	Display		Function
F·1	<FILTER>	FLAT:LOW PASS:DIF.STEP	Selects filter
F·2	<PRESET>	KEY	Gain preset in vector mode
F·3	<V.GAIN>	X1:X5	Selects gain
F·4	<VARIABLE>	OFF:ON	Gain variable on/off
F·D	<VARIABLE>		Gain variable

(2) Filter Selection

[FILTER/GAIN - F·1 <FILTER> FLAT:LOW PASS:DIF.STEP]

The following filters can be selected by using the F·1 key.

FLAT: Flat (default setting)

LOW PASS: Video signal passes the low-pass filter (≥20 dB at 20 MHz)

DIF.STEP: Video signal passes 1.6 MHz band-pass filter. Refer to Step (3).

(3) Using Differential-Step Filter

This filter is used to measure the nonlinear distortion of the luminance component.

Apply 5-step staircase signal to the equipment under test.

Differentiated waveform is displayed as shown in Figure 4-7.

Procedure

a. Select the voltage ratio measurement mode from the CURSOR menu.

b. Position the cursors to the largest pulse (reference, 100%)

c. Position the cursors to the smallest pulse.

Nonlinear distortion = (100 - A) %

where voltage ratio = A %

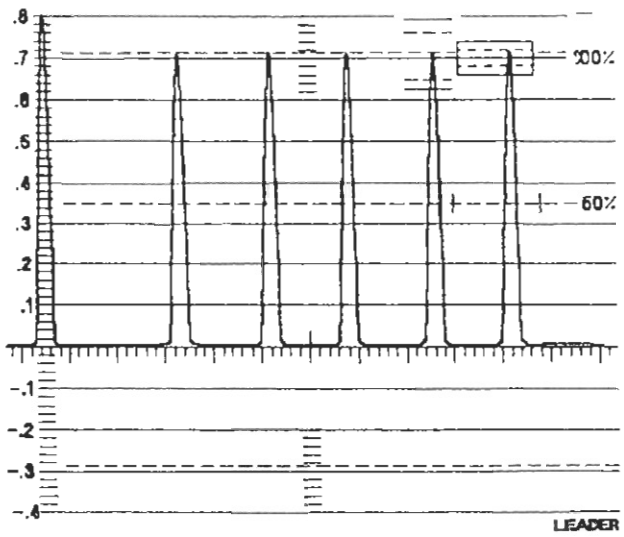


Figure 4-7 DIF.STEP display

(4) Using Gain Preset

In vector mode, pressing the FILTER/GAIN key (15) displays <PRESET> KEY at the F·2.

Pressing the F·2 key sets the IQ signals on the outer circle when NTSC SMPTE COLOR BARS is up-converted to the high definition TV signal.

Pressing the F·2 key also sets the vector gain to the preset value and displays the preset marker (▼) on the variable range indicator.
Pressing the F·2 key again returns to the CAL GAIN.
The magnification factor in preset mode is as follows:

3.79 times for COLOR BARS 100%
2.85 times for COLOR BARS 75%

4.6.8 EXT REF key

For external synchronization, input the HD sync to the EXT REF input connector on the rear panel, then press the EXT REF key. The key LED lights. Pressing the EXT REF key again returns to the internal synchronization. The key LED goes off.
The TRS timing reference signal added to the digital signal or sync signal input to the ANALOG CH1 (Y/G) connector is used for internal sychronizat on.

4.7 Vectorscope Mode

Pressing the MODE key ⑪. selects the VEC mode.
The vectorscope mode operates as a X-Y display using P_B (horizontal axis) and P_R (vertical axis) components. See Figure 4-8.
The external graticule or electronic graticule can be selected.

The GBR format analog component signal is converted into color difference signal and displayed in vector format.

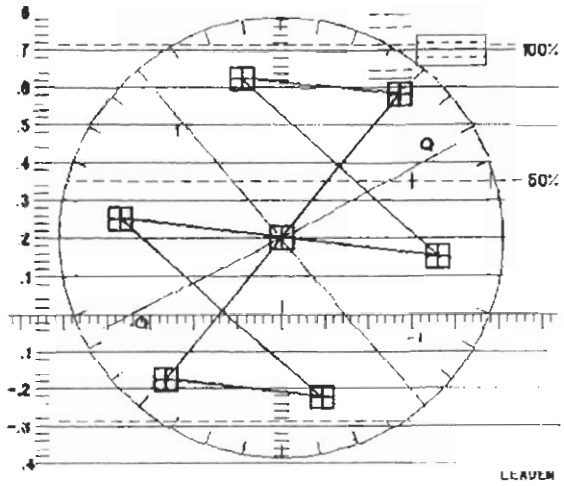


Figure 4-8 Vector display

4.7.1 System Settings

Press the SYSTEM key ⑭ to display the SYSTEM menu.
Use the SELECT KNOB to select the vectorscope mode, then set the system as described below.

(1) Basic Operation

Key	Display		Function
F·1	<COLOR BARS>	100%:75%	Selects color bar amplitude
F·2	<SYNC DISP>	OFF:ON	Sets sync on/off※
F·3	<GRAT>	EXT:INT	Selects external or electronic graticule.
F·4	<IQ>	OFF:ON	Sets IQ axis of electronic graticule.

(2) Color Bars Selection
[SYSTEM→VECTOR→F·1 <COLOR BARS> 100%:75%]

Select the 75% or 100% according to input signal amplitude by pressing the F·1 key.

(3) Sync Signal Display
[SYSTEM-F·2 <SYNC DISP> OFF:ON]

Use the F·2 key to determine whether to display the sync signal contained in the component signal.
※The sync signal is only displayed when the ANALOG input signal is selected by using the SELECT key ⑨

(4) Graticule Selection
[SYSTEM→F·3 <GRAT> INT:EXT]

EXT: External graticule
INT: Electronic graticule

(5) Setting IQ axis of Electronic Graticule
[SYSTEM→F·4 <IQ> OFF:ON]

Setting ON displays the IQ on the electronic graticule.

4.7.2 GAIN Menu

The GAIN menu (except F·1<FILTER>) is same as in waveform monitor mode.
Refer to Section 4.6.6, "FILTER/GAIN Key-1 (GAIN)" for detail.

4.7.3 LINESEL Key

This key function is same as in waveform monitor mode.
Refer to Section 4.6.5, "LINESEL Key" for detail.

4.8 Picture Monitor Mode

The video signal applied to the CH1(Y/G) connector can be displayed as a HDTV picture with 16:9 aspect ratio.

In the line selector mode, the selected line can easily be identified since the selected line is highlighted on the picture.

All line selector functions of the picture mode are same as the waveform monitor mode.

A picture contrast can be controlled by pressing the FILTER/GAIN key ⑮

Bar displayed at the lower-right corner of the screen indicates contrast (i.e., variable range, current setting status).
When the line selector mode is selected and part of the picture is obscured by readout display, the readouts can be eliminated by setting the line selector mode off.

The picture is horizontally reduced in size because the CRT aspect ratio is not 16:9.

4.9 Audio Mode

[FILTER/GAIN→F·2<AUDIO GAIN> 0dB:2dB:4dB]

The AUDIO mode displays stereo audio signal, applied from the REMOTE connector on the rear panel, in lissajous format. This mode is used to monitor an audio signal amplitude and stereo signal polarity.

The electronic graticule is displayed in this mode. See Figure 4-9.

The target boxes indicate as follows.
- Center cross "+": Reference value
- Inner target box: ±0.5 dB
- Outer target box: ±1 dB

The reference value (i.e., 0 dB, 2 dB, 4 dB) can be set by pressing the FILTER/GAIN key ⑮.

Refer to Section 4.13, "REMOTE Connector" for pin assignments.

4.9.1 Connections

The audio signal input configuration is a balanced input.
Refer to Section 4.13, "REMOTE Connector" for pin assignments.
Terminate across the Y+and Y-, and X+and X-inputs as required.

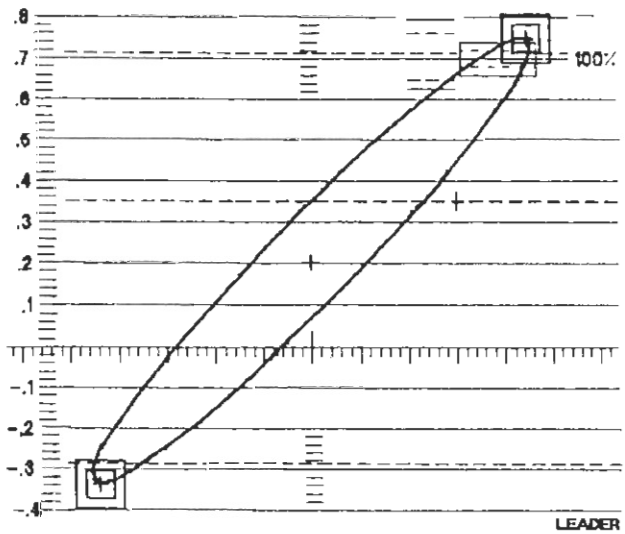


Figure 4-9 Audio mode

4.10 PRESET Key

4.10.1 Basic Operation

The RECALL menu is displayed by pressing the PRESET key (17). This menu is used to set the address to be recalled.
Use the FUNCTION control (20) to select the address, then press the F 1 key..

Key	Display		Function
F·1	<RECALL>	KEY	Recall key
F·2	<PRESET>	MODE	Preset mode
F·4	<F-KEY RECALL>	ON:OFF	Recall using F-KEY

All controls except (2) through (6) can be preset.
Up to 10 control settings can be stored.

4.10.2 Preset Mode

Pressing the F·2 key enters PRESET mode.
This mode is used for naming and renaming the preset contents.
See Figure 4-10

Key	Display		Function
F·1	<STORE>	KEY	Store key
F·2	<RETURN>	KEY	To previous hierarchy
F·3	<DEFAULT DATA STORE>	KEY	Stores default data
F·4	<RENAME>	MODE	Rename mode

Note:The current control settings can be stored.
To store further data, cancel the preset mode, set the controls, then store data.

Procedure

(1) Set the controls menus as required.
(2) Press the PRESET key (17).
(3) Press the F·2 key.
(4) Select the preset name by rotating the FUNCTION control (20).
(5) Press the F·1 key.
(6) Press the PRESET key (17) to exit the preset mode.
(7) To store other setting, repeat procedures above.

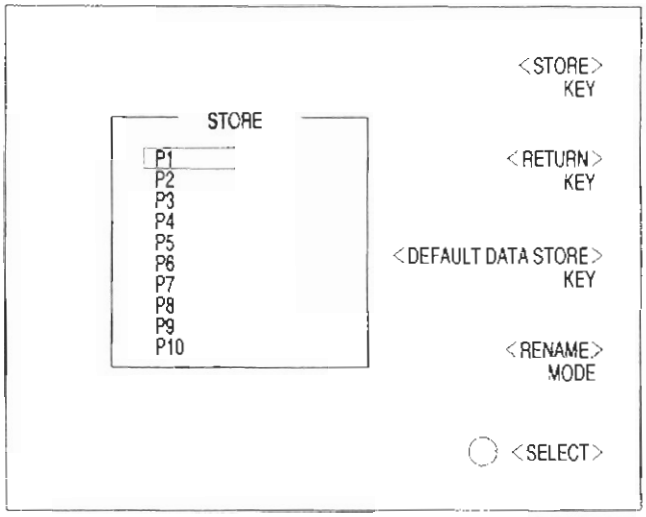


Figure 4-10 Preset mode

4.10.3 Rename Mode

A dialog box and character list are provided for renaming the address. See Figure 4-11.

F·1 key
Enters time set at CALIBRATION.
F·2, F·3 key
Locates character in the dialog box.
F·4 key
Enters name into specified address. During storing data, "COMPLETE" is displayed.

Rotate the <SELECT> F·D KNOB to select the character for naming. Up to 16 characters can be used.

Key	Display	Function
F·1	<RENAME DATE> KEY	Rename date
F·2	<LOCATION> → KEY	Selects character location
F·3	<LOCATION> ← KEY	Selects character location
F·4	<RETURN> KEY	Returns to previous hierarchy

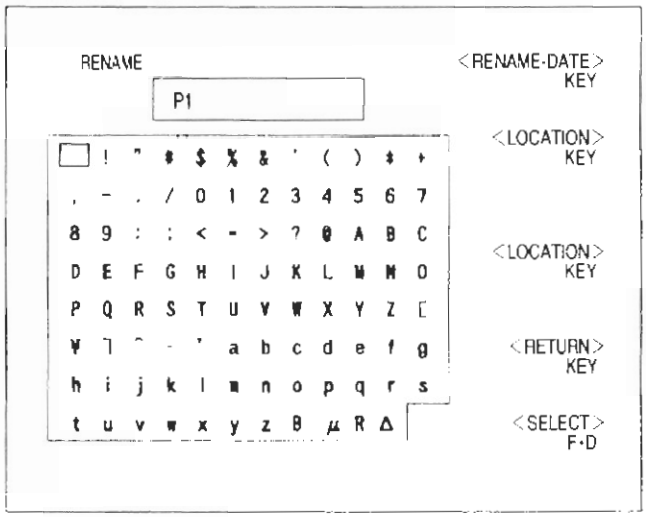


Figure 4-11 Rename mode

4.10.4 Direct Recall Mode

By setting RECALL key in the menu ON, RECALL P1 to RECALL P10 are assigned to the function keys F·1 to F·4. Pressing the function key directly recalls preset conditions.

The RECALL is only enabled when the P1 to P10 are displayed.

To select preset P1 to P10, rotate the SELECT knob.

4.11 SYSTEM Key

By pressing the SYSTEM key (14), the system menu is displayed.
See Figure 4-12.
Use the <FUNCTION> F·D KNOB to select the next hierarchy.
The menu structure is shown below.

SYSTEM
VIDEO FORMAT
DIGITAL SYSTEM
ANALOG SYSTEM
DC RESTORER
PB/B, PR/R POS
VECTOR
CALIBRATION
CH SEQUENCE
SW CONFIG

Figure 4-12 System menu

4.11.1 DIGITAL FORMAT Menu

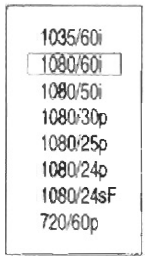
This menu is used to set the video format according to the signal to be measured.
Select VIDEO FORMAT from the SYSTEM menu, then press the F·1 ENTER key to display the format setting screen.

(1) Basic Operation

Key	Display	Function
F·1	<MODE> AUTO:MANUAL	Sets automatic format selection.
F·2	<SCANNING>60i,50i:30sF,25sF	Selecting Interlace or Segment Frame Scanning
F·3	<SAMPLE FREQ>74.18M:74.25M	Selecting clock for Embedded Audio
F·4	<RETURN> KEY	Returns to upper hierarchy.
F·D	<FORMAT>	Selects format.

(2) AUTO/MANUAL
[SYSTEM → VIDEO FORMAT → F·1 ENTER → F·1 <MODE> AUTO: MANUAL]

AUTO mode automatically selects the video format. (Serial input only) When MANUAL is selected from the VIDEO FORMAT menu, ANALOG in the INPUT group on the front panel is selected, the format selected from the INPUT FORMAT is only enabled.



(3) Selecting Interlace or Segment Frame Scanning
[SYSTEM → VIDEO FORMAT → F·1 ENTER → F·2 <SCANNING>60i : 50i : 30sF : 25sF]

This procedure is used to select the scanning system (i.e.,interlace,segment frame) on the format setting screen.
Setting 60i, 50i, selects the interlace scanning; setting 30sF,25sF selects the segment frame scanning.
The scanning system can be selected in the following formats:

1080/60i	→	1080/30sF
1080/59.94i	→	1080/29.97sF
1080/50i	→	1080/25sF

(4) Setting SAMPLE FREQ
[SYSTEM → VIDEO FORMAT → F·1 ENTER → F·3 <SAMPLE FREQ> 74.18M:74.25M]

This setting swiches the clock frequency to optimize recovery of embedded audio within the serial digital signal.
Select the frequency accordingly to match the video format input when using the DIGITAL AUDIO OUTPUT on the rear panel.
Ignore this setting when DIGITAL AUDIO OUTPUT is not used.

4.11.2 DIGITAL SYSTEM Menu

This menu is used to set the display format and picture monitor output for the digital component signal.

(1) Basic Operation

Key	Display	Function
F·1	<EAV-SAV> REMOVE:PASS	EAV-SAV display
F·2	<WFM DISP> Y ,P_B, P_R:GBR	Display format
F·3	<PIX MON OUT> Y ,P_B, P_R:GBR	Picture monitor output
F·4	<AUDIO> 16bit:18bit:20bit:24bit	Sets audio quantitative bits.
F·D	<SYSTEM SEL>	Selects menu

(2) EAV→SAV Display
[SYSTEM → DIGITAL SYSTEM → F·1 <EAV-SAV> REMOVE:PASS]

Sets the EAV-SAV (sync signal of digital signal, TRS) on or off.
REMOVE: Not display
PASS: Display

(3) Display Format
[SYSTEM → DIGITAL SYSTEM → F·2 <WFM DISP> Y, P_B, P_R:GBR]

Sets the waveform display format to Y, P_B, P_R or GBR.

(4) Picture Monitor Output
[SYSTEM → DIGITAL SYSTEM → F·3 <PIX MON OUT> Y, P_B, P_R:GBR]

Sets the picture display output format to Y, P_B, P_R or GBR.

(5) Audio
[SYSTEM→DIGITAL SYSTEM→F·4 <AUDIO> 16 bit, 18 bit, 20 bit 24 bit]

This menu is used to set quantitative bits of the embedded audio signal. The separated signal is output from the DIGITAL AUDIO OUTPUT connector on the rear panel in AES/EBU format.
The AES/EBU output will be muted if an error occurs.

4.11.3 ANALOG SYSTEM Menu

This menu is used to set the input format, display format, and input coupling for the analog component signal.

(1) Basic Operation

Key	Display	Function
F·1	<INPUT FORMAT> Y,P_B, P_R:GBR	Input format
F·2	<WFM DISP> Y,P_B, P_R:GBR	Display format
F·3	<INPUT COUPLING>	AC:DC Input coupling
F·D	<SYSTEM SEL>	Selects menu

(2) Input Format Selection

[SYSTEM → ANALOG SYSTEM → F·1 <INPUT FORMAT> Y, P_B, P_R:GBR]

Set the Y, P_B, P_R:GBR according to the input signal.

(3) Display Format Selection

[SYSTEM → ANALOG SYSTEM → F·2 <WFM DISP> Y,P_B, P_R:GBR]

Sets the waveform display format to Y, P_B, P_R or GBR.
This function is displayed when the F·1 INPUT FORMAT is set to Y, P_B, P_R format.
When GBR is selected, the signal is output in GBR format. .

(4) Input Coupling

[SYSTEM → ANALOG SYSTEM → F·4 <INPUT COUPLING> AC:DC]

Selects input coupling: AC or DC.

4.11.4 DC RESTORER Menu

This menu is used to set the response time and SAMPLE POINT (c amp point) in DC RESTORER mode.
The DC restorer is always enabled when digital input is selected.

(1) Basic Operation

Key	Display		Function
F·1	<RESPONSE>	SLOW:FAST	Response
F·2	<SAMPLE POINT >	FIX:VARIABLE	Sample point
F·4	<F·D SELECT>	SYSTEM SEL:VARIABLE SEL	Selects F·D function
F·D	<SYSTEM SEL>		Selects menu

(2) Response Setting

[SYSTEM → DC RESTORER → F·1 <RESPONSE> SLOW:FAST]

The attenuation is as follows when 60 Hz sine wave is applied as reference, 100% in DC RESTORER mode.
SLOW: ≥20%
FAST: ≤80%

(3) Sample Point
[SYSTEM → DC RESTORER → F·2 <SAMPLE POINT> FIX:VARIABLE]

Sets the DC clamp point to FIX or VARIABLE.
When the FIX is selected, the VARIABLE cannot be selected by pressing the F·4 key.

4 FUNCTION KNOB Setting
[SYSTEM → DC RESTORER → F·2 <SAMPLE POINT> VARIABLE - F·4 <F·D SELECT>]

This procedure is used to select the F·D function; selecting the menu or varying the sample point.
When the VARIABLE is selected, the <POSITION>is displayed. The sample point can be set by using the F·D.
This function is used to compensate the clamp point displacement caused by timing difference between the external sync signal and video signal in EXT REF mode.
Bar displayed at the lower-right corner of the screen indicates sample point (i.e., variable range, current setting status).
This instrument sets the DC restore level by sampling the back porch of the video signal. Therefore, when a signal (e.g., digital data) exists on the back porch, the DC restorer may malfunction.
Move the sampling point by using the DC RESTORER in the SYSTEM menu or set the DC RESTORER on the front panel off, in this case (both digital and analog inputs).

4.11.5 P_B/B, P_R/R POS Menu

This menu is used for positioning the P_B/B and P_R/R waveforms with respect to the Y/G waveform.

(1) Basic Operation

Key	Display	Function
F·1	<P_B/B, P_R/R POS>OFF:P_B/B:P_R/R:P_B/B,P_R/R	Selects signal
F·4	<F·D KNOB SELECT>MENU SEL:VARIABLE	Selects F·D KNOB function
F·D	<SYSTEM SEL:POSITION>KNOB	Selects menu,positioning

(2) Selects Signal
[SYSTEM→P_B/B,P_R/R POS → F·1<P_B/B,P_R/R POS> OFF:P_B/B:P_R/R:P_B/B,P_R/R]
This menu is used for positioning the waveform.

OFF: The waveform is positioned by the default setting.
For analog input, the position is determined by selecting the Y,P_B,P_R or GBR from the <INPUT FORMAT> in the analog system menu.
For digital input, the position is determined by selecting the Y,P_B,P_R or GBR from the <WFM DISPLAY> in the digital system menu.

P_B/B POS, P_R/R POS:
Each waveform can be positioned respectively.

P_B/B, P_R/R POS:
Both waveform can be positioned simultaneously.

(3) F·D Function Setting
[SYSTEM → P_B/B, P_R/R POS → F·4 <F·D SELECT>MENU SEL:VARIABLE]

The P_B/B or P_R/R can be positioned respectively.
When <POSITION> is displayed, the P_B/B POS, P_R/R POS, or P_B/B, P_R/R POS selected by using the F·1 key can be moved.

4.11.6 VECTOR Menu

This menu is used to set the vectorscope function according to the input signal. Refer to Section 4.7, "Vectorscope Mode" for detail.

4.11.7 CALIBRATION Menu

This menu is used to set the vertical amplitude, sweep time, and calendar.

The calibration signal (1 Vp-p±0.5%) is provided for calibrating this instrument. An external calibration signal can also be used.

This section describes calibration procedure using the internal calibration signal.

(1) Basic Operation
Select the CALIBRATION menu by pressing the SYSTEM key. The menu shown below is displayed.

Key	Display	Function
F·1	<V.GAIN VAR> MODE	Gain mode
F·2	<SWEEP TIME VAR> MODE	Sweep mode
F·4	<CALENDAR> MODE	Calendar mode
F·D	<SYSTEM>	Selects menu

(2) Gain Mode
This mode is used for calibrating the vertical sensitivity.

a. Using Gain Mode Menu

Perform Step (1).

By pressing the F·1 key, V.GAIN VAR menu is displayed.

Key	Display	Function
F·1	<RETURN> KEY	To previous hierarchy
F·4	<RESET CAL> KEY	Default setting
F·D	< V.GAIN VAR> F·D	Gain variable

b. Vertical Axis Amplitude Calibration

F·1 key

By pressing this key, the menu returns to previous hierarchy.

Hold down the INPUT SELECT key (9) for at least one second to display calibration signal.

F·4 key

By pressing this key, stored data is rewritten to the default setting.

Set COLOR BARS to 100% for VECTOR mode.

The vertical deflection factor can be varied by using the FUNCTION F·D.

Bar displayed at the-lower-right corner of the screen indicates gain (i.e., variable range, current setting status).

(3) Sweep Mode

a. Sweep Mode Operation

Perform Step (1).

By pressing the F·3 key, SWEEP TIME VAR menu and screen as shown in Figure 4-13 are displayed.

Key	Display	Function
F·2	<RETURN> KEY	To previous hierarchy
F·3	<F·D SELECT> CAL SWEEP:SWEEP TIME VAR	Select KNOB function
F·4	<RESET CAL> KEY	Default setting
F·D	<CAL SWEEP : SWEEP TIME VAR>	CAL selection : Time variable

b. Sweep Time Calibration

Calibrating four modes shown in Figure 4-13 calibrates all sweep modes. Table 4-3 shows relationship between modes.

Table 4-3

Calibration Mode	Sweep Modes Calibrated	
	OVERLAY	PARADE(No.of waveforms displayed)
1V	1V, 2V	1, 2, 3
1V MAG	1V MAG, 2V MAG	1, 2, 3(magnified)
1H	1H, 2H	1, 2, 3
1H MAG	1H MAG	1, 2, 3(magnified)

F·2 key

By pressing this key, the menu returns to previous hierarchy.

F·3 key

This key is used to select the KNOB function.
When the CAL SWEEP is selected, menu as shown in Figure 4-13 is displayed. Select the desired sweep mode.

Selecting the SWEEP TIME VAR displays CAL signal.
The sweep time can be varied by using the FUNCTION KNOB.
Bar displayed at the lower-right corner of the screen indicates sweep time (i.e., variable range, current setting status).

Adjust the SWEEP TIME VAR for a one cycle of 2 divisions display. See Figure 4-2.
When the 1H MAG is selected, adjust the SWEEP TIME VAR for a one cycle of 10 divisions display see Figure 4-3.

F·4 key

By pressing this key in the F·3 MENU SEL mode, stored data is rewritten to the default setting.

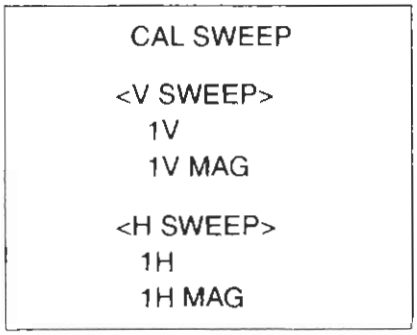


Figure 4-13 Sweep calibration selection menu

(4) Calendar Mode

This mode is used to set date and time.

a. Calendar Mode Operation

Perform Step (1).
By pressing the F·4 key, CALENDAR menu is displayed

Key	Display	Function
F·1	<CALENDAR> YEAR: MONTH:DATE	Year, month, date
F·2	<TIME> HOUR:MINUTE:SECOND	Hour, minute, second
F·3	<SET> KEY	Set key, starts settings
F·4	<RETURN> KEY	To previous hierarchy
F·D	<DATE ADJUST>	Calendar setting

b. Using the Timer

F·1 key

This key is used to select YEAR, MONTH, or DATE. Set them by using the FUNCTION DIAL ⑳. Date is displayed.

The timer supports dates in the 21st century.

F·2 key

This key is used to select HOUR, MINUTE, or SECOND. Set them by using the FUNCTION DIAL ⑳.

The time is displayed.

F·3 key

This key is used to move the SET time to NOW box.

F·4 key

By pressing the F·4 key, the menu returns to previous hierarchy.

Figure 4-14 shows an example of calendar mode. The current time is framed, and time being set is displayed underneath.

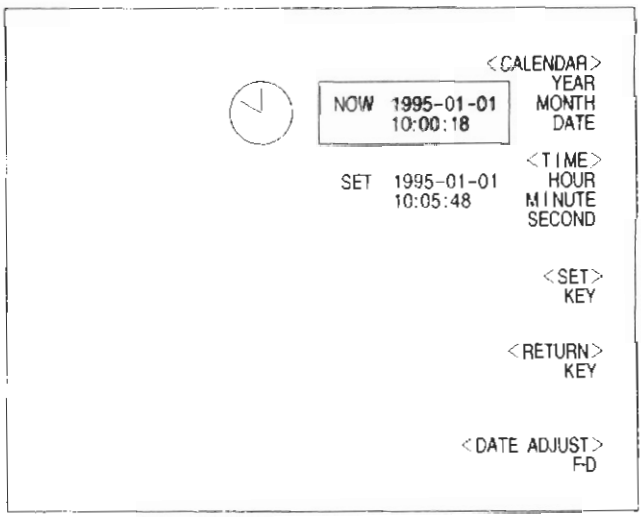


Figure 4-14 Calendar mode

4.11.8 Using CH SEQUENCE Menu

This menu is used to set waveform display format and key arrangement.

Pressing the SYSTEM key ⑭ displays the system menu.
Select the CH SEQUENCE using the SELECT KNOB.
The waveform is set as shown in the table below by using the F·1 or F·2 key.

F·1 Key	F·2 Key
CH1-Y, G	CH1-Y, R
CH2-P_B, B	CH2-P_B, G
CH3-P_R, R	CH3-P_R, B

Select the PARADE display by using the DISPLAY key ⑩ and set keys (i. e., CH1, CH2, CH3) on, the waveform is displayed in parade format in CH1, CH2, and CH3 order from the left.
For example, in GBR display mode, pressing the F·1 key displays waveforms in G, B, R order; pressing the F·2 key displays waveform in R, G, B order.

4.11.9 Using SW CONFIG Menu

Key	Display	Function
F·1	<INPUT SELECT> ANALOG ON: ANALOG OFF	Selects input.
F·2	<MODE SELECT> ALL: WFM/VECT	Selects mode.
F·D	<SYSTEM SEL>	Selects menu.

The SW CONFIG menu can be used to set the desired operating conditions.

Set the F·1 <INPUT SELECT> to ANALOG OFF when analog input is not used.
When the SELECT KEY is pressed in this condition, SERIAL A or SERIAL B is alternately selected; the ANALOG input is not selected.

Set the F·2 <MODE SELECT> to WFM/VECT when PIC or AUDIO mode is not used.
When the MODE KEY is pressed in this condition, WFM or VECT is alternately selected; the PIC and AUDIO modes are not selected.

4.12 DIGITAL Key

The DIGITAL key ㉕ is used to check the parameters of the serial digital signal. By pressing this key, the DIGITAL menu is displayed.
The waveform intensity is reduced for easier DIGITAL menu monitoring. Pressing this key again clears the DIGITAL screen.

The DIGITAL screen consists of the following three pages that can be selected by pressing the F·1 <PAGE> NEXT key.
For other settings, use the FUNCTION KEY displayed on the screen.

1/2 PAGE: This page displays an equivalent cable length measured with serial digital signal, and serial digital signal transmission error.
The subscreen displays detailed error and detailed log, and is used to set ALARM LED on/off.

2/2 PAGE: This page is used to set GAMUT error check mode on/off, and display detected results.
The subscreen displays detailed log, and is used to set A_ARM LED on/off.

4.12.1 Equivalent Cable Length and Transmission Error Display Screen(1/2 Page)

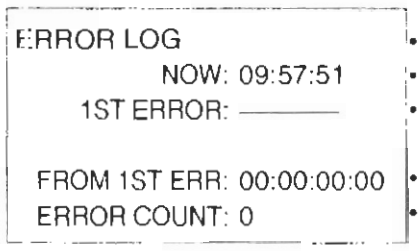
When the VIDEO FORMAT is set to AUTO, an error may not be detected correctly.
Set the VIDEO FORMAT to MANUAL when detecting an error.

(1) Screen Description

VIDEO FORMAT:1080/60i---
Video format display
The selected serial digital video format is displayed.
When AUTO is selected, serial digital video format being applied is displayed.
The display depends on the condition below.
NO SIGNAL No signal input
UNKNOWN SIGNAL Signal not judged in AUTO mode

CABLE:10 m---
Equivalent cable length display
The equivalent cable length is displayed by converting a received serial signal level into an LS-5CFB coaxial cable length. A reference 800 mV signal source is used to obtain the cable length.
When the cable length display exceeds 130 m, the signal will be muted.
The display range is as follows:

≤5 m	Less then 5 meters
5 m	5 meters
:	Cable length between 5 meters and 130 meters is displayed in 5 meters steps.
130 m	130 meters
≥130 m	Exceeds 130 meters
---	No signal



- ERROR LOG ••• Log display of error
- NOW: 09:57:51 ••• Current time
- 1ST ERROR: ———— ••• Display and retains time of first error occurrence.
- FROM 1ST ERR: 00:00:00:00 ••• Time from first error
- ERROR COUNT: 0 ••• Monitors error after previous error is reset of power is turned on.Counts number of errors per second even if multiple errors occur.

(2) Basic Operation

Key	Display	Function
F·1	<PAGE> NEXT	Select Page.
F·2	<RESET> KEY	Resets error.
F·3	<DETAILS> KEY	Displays of detailed error log.
F·4	<SETUP> KEY	Displays of detailed error setup screen

(3) ERROR DETAILS Menu
[DETAILS → F·3 <DETAILS> KEY]

The DETAILS screen is used to select the screen to display error contents or screen to display error log (displays up to 20 error occurrence blocks and times).
Use the F·3 NEXT KEY to select VIDEO, AUDIO, ANC, or LOG.

Set VIDEO FORMAT TO MANUAL TO WATCH ERROR.

a. VIDEO ERR DETAILS

The following screen is displayed. "NO ERR" is changed to 'ERR" if an ancillary error occurs.

. [VIDEO ERR DETAILS]

SAMPLE	CRCC
Y	NO ERR
C	NO ERR

b. AUDIO ERR DETAILS

The following screen is displayed. "NO ERR" is changed to "ERR" if an ancillary error occurs.

ERR DETAILS
[AUDIO ERR DETAILS]

BIT	BCH DECODE
7	NO ERR
6	NO ERR
5	NO ERR
4	NO ERR
3	NO ERR
2	NO ERR
1	NO ERR
0	NO ERR

CH	DIAG CHECK
1/2	NO ERR
3/4	NO ERR
5/6	NO ERR
7/8	NO ERR

c. ANC ERR DETAILS

The following screen is displayed. "NO ERR" is changed to "ERR" if an ancillary error occurs.

[ANC ERR DETAILS]

ANC	TRANSMISSION DC OVER FLOW	ANC DATA CHECK SUM	RECEIVE DC OVER FLOW
1	NO ERR	NO ERR	NO ERR
2	NO ERR	NO ERR	NO ERR
3	NO ERR	NO ERR	NO ERR
4	NO ERR	NO ERR	NO ERR
5	–	NO ERR	–

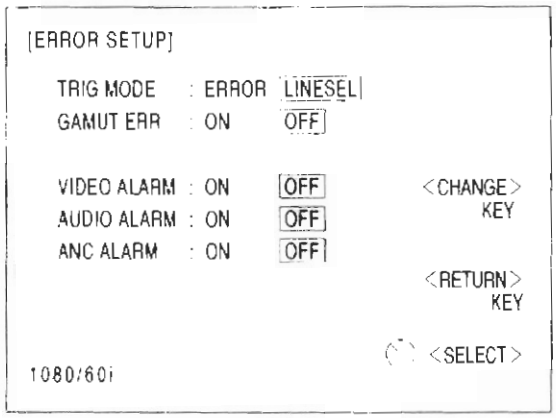
d. ERROR LOG

When ERROR LOG is selected, up to 20 blocks and error occurrence times are logged and displayed on the screen as shown in Figure below.
A built-in timer is used when logging error occurrence time.
Rotate the <SCROLL> DIAL to select the Number of error.

NO	TIME	VIDEO	AUDIO	ANC
1	15:45:49	*	-	-
2	15:50:05	-	*	-
3	16:04:25	-	-	*
4	16:43:23	*	*	*

An error occurs in VIDEO block
An error occurs in AUDIO block
An error occurs in ANC block
An error occurs in VIDEO, AUDIO, and ANC blocks
"-" indicates no error exists.
"*" indicates an error occurs.

(4) About <SETUP> KEY
[DIGITAL→F·4<SETUP>KEY
The following screen is displayed.



a. Basic Operation

Key	Display	Function
F·3	<CHANGE>KEY	Changes setting.
F·4	<RETURN>KEY	Returns to previous hierarchy.
F·D	<SELECT>	Selects setting item.

b. Description of setting Item

TRIG MODE: Selects trigger to display the error log or data display. If an error occurs on the EAV or SAV, data cannot be retained.

ERROR Detailed data is displayed on the line where CRC error occurs. Data contents are retained.

LINESEL Latest detailed error contents are displayed. Data of line selected with the line selector is displayed.

GAMUT ERR: Selects GAMUT error on/off. The GAMUT LED lights when ON is selected.

VIDEO ALARM: Sets ALARM LED on/off mode if an error occurs in the VIDEO block.

AUDIO ALARM: Sets ALARM LED on/off mode if an error occurs in the AUDIO block.

ANC ALARM: Sets ALARM LED on/off mode if an error occurs in the ANC block.

4.12.2 GAMUT Error Display Screen(2/2 Page)

The GAMUT error mode checks whether GBR format video signal level satisfies the specifications(i.e., 0V to 0.7V).

specifications

(1) Description of Screen

GAMUT ERR LOG	···Log display of GAMUT error
NOW: 09:57:51	···Current time
1ST ERROR: ————	···Display and retains time of first error occurrence.
FROM 1ST ERR: 00:00:00:00	···Time from first error
ERROR COUNT: 00000	···Monitors error after previous error is reset of power is turned on. Counts number of errors per second even if multiple errors occur.

(2)Basic Operation

Key	Display	Function
F·1	<PAGE>NEXT	Select page.
F·2	<RESET>KEY	Resets error.
F·3	<DETAILS>KEY	Displays of detailed GAMUT error og.
F·4	<SETUP>KEY	Dispalys of detailed error setup screen

(3)About <DETAILS>(Display of detailed GAMUT error)

Up to 20 GAMUT error and occurrence times are logged time stamped and displayed as shown in Figure below.

A built-in timer is used to log an error.

Pressing the F·4 RETURN key displays the previous screen.

GAMUT ERR LOG

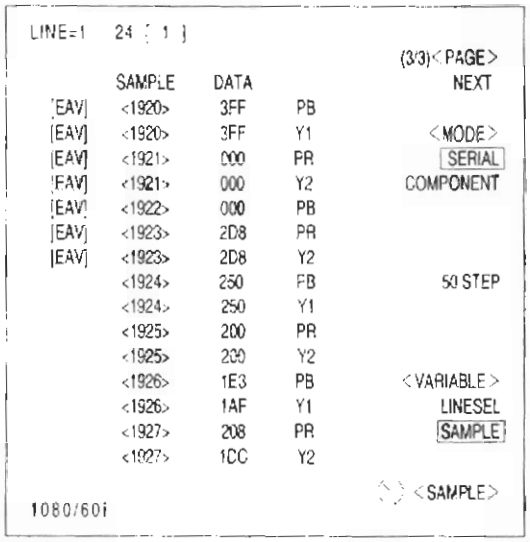
NO	TIME
1	15:45:49
2	15:50:05
3	16:04:25
4	16:43:23

· · · · · · ·Shows that an error occured at 15:45:49

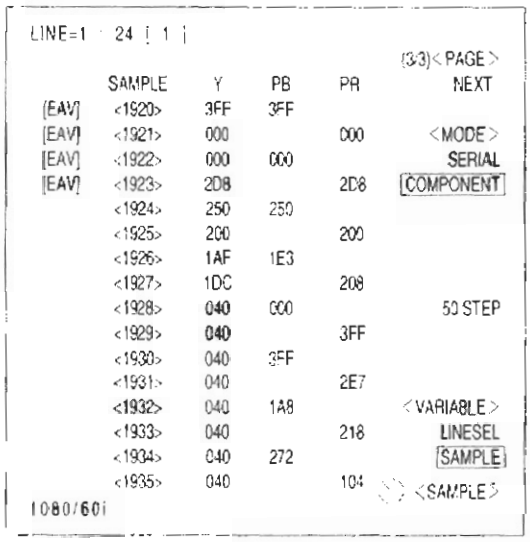
4.12.3 Data Display Screen(3/3 page)

(1) Displaying Data in Serial Format

The received serial data is displayed in order of sample number.



(2) Displaying Data in component Format



(3) Basic Operation

Key	Display	Function
F·1	<PAGE>NEXT	Selects page.
F·2	<MODE>LINE:COMPONENT	Selects data display format.
F·3	50 STEP	Increments or decrements sample number in 50 steps.
F·4	<VARIABLE>LINESET:SAMPLE	Selects function dial operation.
F·5	<LINESEL:SAMPLE>	Selects line, selects sample.

14.12.4 Error Display

(1) VIDEO Block

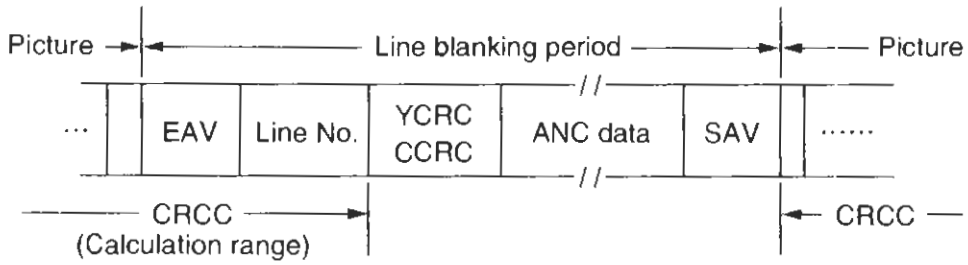
Error is detected by Cyclic Redundancy Check Code (CRCC). The CRCC signal should be added to the input signal.

The instrument compares the CRCC data signal added to the input signal and generated in this instrument, then outputs NO ERROR when both signals are the same.

Polynomial generator equation $C(X) = X^{18}+X^5+X^4+1$(initial value = 0)

Calculation range Start point: Next word of SAV on the previous line (YD0 and PbD0)

End point: Last word of line number data (LN1)



(2) AUDIO Block

ERROR can be displayed since audio data contains BCH for error correction.

Polynomial generator equation $G(X) = (X^5+X^2+1)(X+1)$

Calculation range ADF(indicates start of auxiliary data packet consisting of three words (i.e., 000h, 3FFh, 3FFh.)

〈

24 words up to UDW17 (UDW: User Data Word)

Audio data packet

ADF			DC	CLK	AES1 CH1	AES1 CH2	AES2 CH3	AES2 CH4	ECC	CS
3	1	1	1	2	4	4	4	4	Error Correction 6	1

DID: Data identification word
DBN: Data block number word
DC: Data count word
CS: Checksum word
ECC: Error correcting code

(3) ANC Block

Detects whether there is any ANC data in VIDEO data of the Y sample.
Three words (000, 000, 3FF) of the ADF are used to detect errors.

DID is used to identify the detected type of data.
DC is used to detect the number of data words.

DC: The instrument compares the memory capacities of the DC and ANC detection blocks, then outputs ERROR when DC memory capacity is larger.

CS: Checksum detected error.
The checksum is nine low-order bits of the total from DID through UDW.

Auxiliary data packet

ADF	DID	DBN	DC	UDW	CS
3	1	1	1	0-255	1

Type 1

ADF	DID	SDID	DC	UDW	CS
3	1	1	1	0-255	1

Type 2

ADF: Auxiliary data flag
DID: Data identification word
SDID: Second data identification word
DBN: Data block number word
DC: Data count word
UDW: User data word
CS: Checksum word

4.13. REMOTE Connector

4.13.1 Pin Assignments

Table below shows REMOTE connector ㉜ pin assignments.
This connector is used for both remote control and audio input.

Pin No.	Name	Description
1	NC	No connection
2	GND	Ground
3	NC	No connection
4	/EXT BLANK	External blank
5	GND	Ground
6	GND	Ground
7	GND	Ground
8	+Y	Audio input, Y(V) axis, positive polarity
9	-Y	Audio input, Y(V) axis, negative polarity
10	+X	Audio input, X(H) axis, positive polarity
11	-X	Audio input, X(H) axis, negative polarity
12	NC	No connection
13	NC	No connection
14	GND	Ground
15	NC	No connection
16	SVA	Serial video alarm output
17	/PRESET 1	Reads preset condition at falling edge.
18	/PRESET 2	Reads preset condition at falling edge.
19	/PRESET 3	Reads preset condition at falling edge.
20	/PRESET 4	Reads preset condition at falling edge.
21	/PRESET 5	Reads preset condition at falling edge.
22	/PRESET 6	Reads preset condition at falling edge.
23	/PRESET 7	Reads preset condition at falling edge.
24	/PRESET 8	Reads preset condition at falling edge.
25	/STORE	Low level for Store mode.

4.13.2 Signal Description

/EXT BLANK (Pin 4) : Reduces intensity at Low TTL input.
SVA (Pin 16): Low when ALARM LED (serial video alarm output) lights.
/STORE (Pin 25): Stores data to Low PRESET address.

5. MAINTENANCE

When calibration or service is required, contact your local Leader agent.

5 1 Illumination Lamp Replacement

Procedure

1 Remove two screws on the hood.
2 Pull the lamp housing out.
3 Remove the burned-out lamp.
4 Mount the new lamp to the pins.
5 To reinstall the parts, reverse the order of the removal steps.

Ordering Information
To obtain extra lamp, contact your local Leader agent and provide followings.

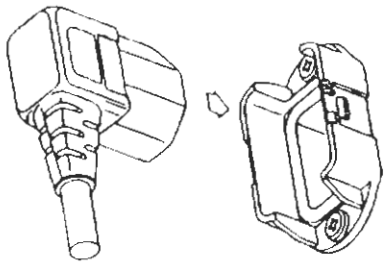
LI-2306 Lamp (5 pieces per set)

5.2 To Prevent Power Cord Disconnection

To prevent the power cord disconnection from the input, the Cover/Input stopper s supplied as an accessory. Refer to procedure below.

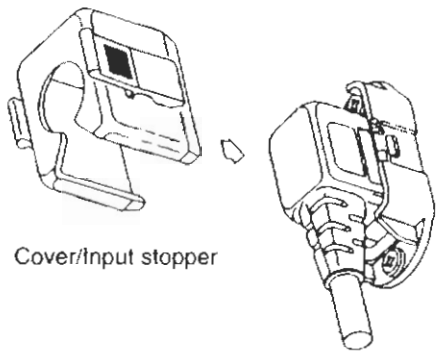
5.2.1 Connecting the Power Cord

(1) Insert the power cord connector into the AC inlet.



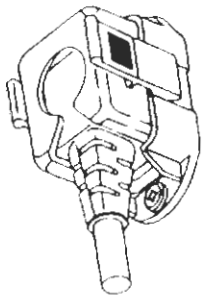
connector Base

(2) Place the Cover/Input stopper on top of the connector as shown in the Figure below.



Cover/Input stopper

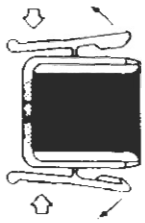
(3) Press the cover until it clicks into place.



(4) Confirm that the Cover/Input stopper is locked to the base.

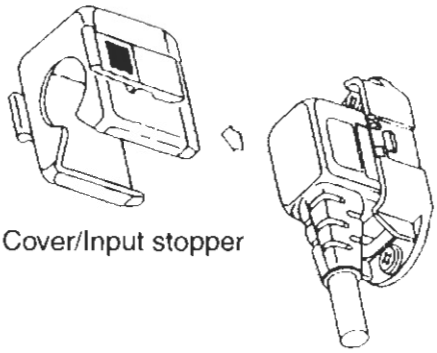
5.2.2 Disconnecting the Power Cord

(1) Press the levers on the Cover/Inlet stopper with your fingers to release.



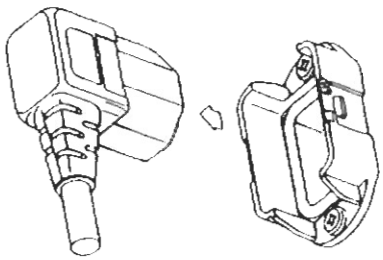
Cover/Input stopper (side view)

(2) Remove the Cover/Inlet stopper from the base.



Cover/Input stopper

(3) Disconnect the power cord connector from the AC input.



Connector Base

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