Tektronix

492 & 492P
Spectrum Analyzers
Operator Handbook

070-2729-01

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OPERATORS SAFETY SUMMARY

The general safety information in this part of the summary is for both operating and servicing personnel. Specific warnings and cautions will be found throughout the manual where they apply, but may not appear in this summary.

TERMS

In This Manual

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

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

As Marked on Equipment

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

DANGER indicates a personal injury hazard immediately accessible as one reads the marking.

SYMBOLS

In This Manual

This symbol indicates where applicable cautionary or other information is to be found.

As Marked on Equipment

DANGER — High voltage.

Protective ground (earth) terminal.

ATTENTION — refer to manual.

Power Source

This product is intended to operate from a power source that will not apply more than 250 volts rms between the supply conductors or between either supply conductor and ground. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

Grounding the Product

This product is grounded through the grounding conductor of the power cord. To avoid electrical shock, plug the power cord into a properly wired receptacle before connecting to the product input or output terminals. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

Danger From Loss of Ground

Upon loss of the protective-ground connection, all accessible conductive parts (including knobs and controls that may appear to be insulating) can render an electric shock.

Use the Proper Power Cord

Use only the power cord and connector specified for your product.

Use only a power cord that is in good condition.

Refer cord and connector changes to qualified service personnel.

Use the Proper Fuse

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

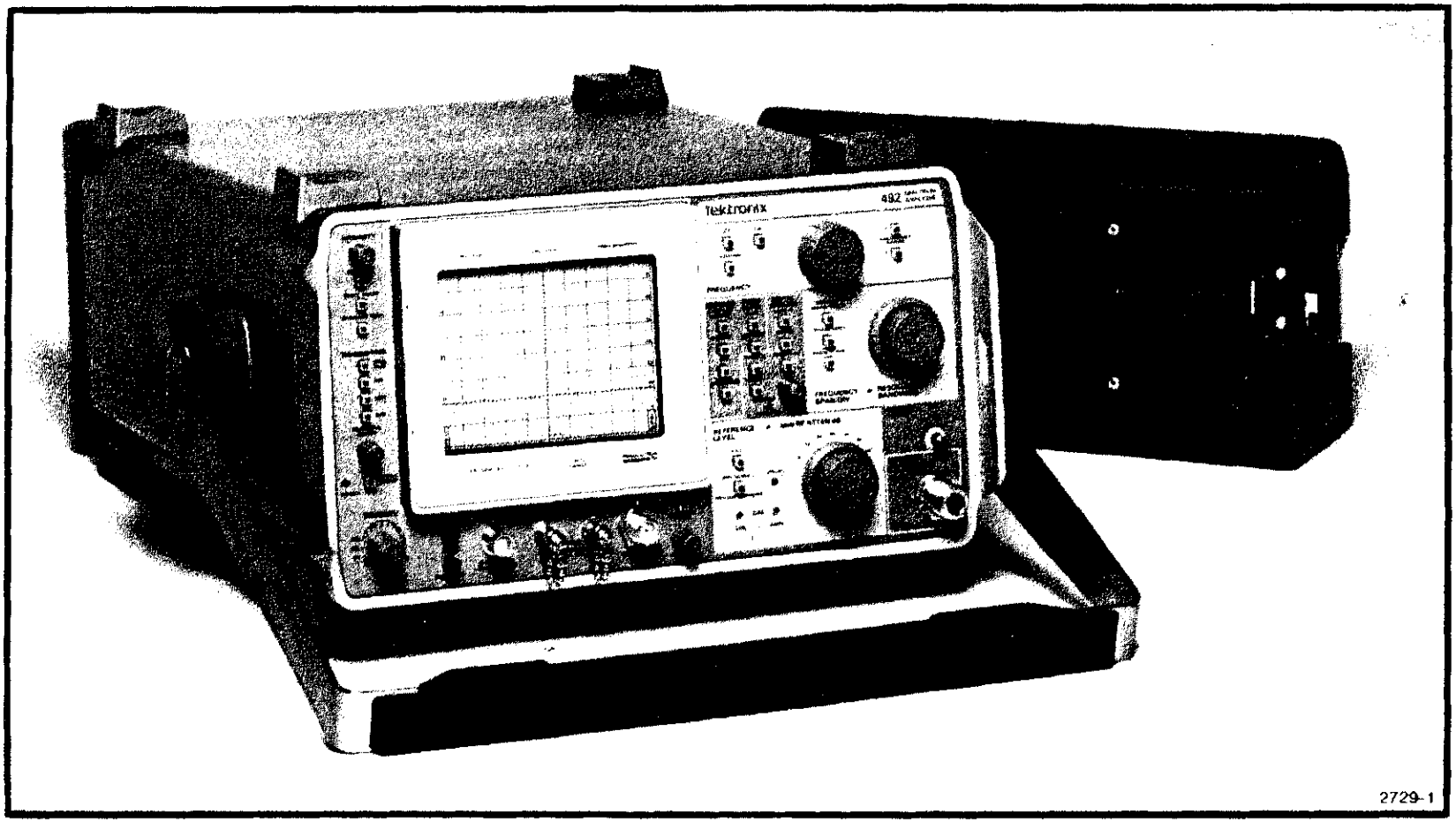
Refer fuse replacement to qualified service personnel.

Do Not Operate in Explosive Atmospheres

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

Do Not Remove Covers or Panels

To avoid personal injury, do not remove the product covers or panels. Do not operate the product without the covers and panels properly installed.



The 492/492P Spectrum Analyzer.

SECTION 1
GENERAL INFORMATION AND SPECIFICATION SUMMARY

PRODUCT DESCRIPTION

The 492/492P Spectrum Analyzer is a high performance, compact, portable spectrum analyzer that displays absolute amplitude and frequency information of signals within the frequency spectrum of 50 kHz to 21 GHz with the internal coaxial mixer, and up to 60 GHz with optional external TEKTRONIX High Performance Waveguide Mixers. The 8.4 X 10.2 cm crt face reads out all major display parameters.

The 492P adds remote control capability to the features of the 492. The front-panel controls (except those intended for local use, such as INTENSITY and POSITION controls) can be remotely operated through the GPIB port allowing the 492P to be used with a variety of systems and controllers. This operation is described in detail in the Programmer's manual.

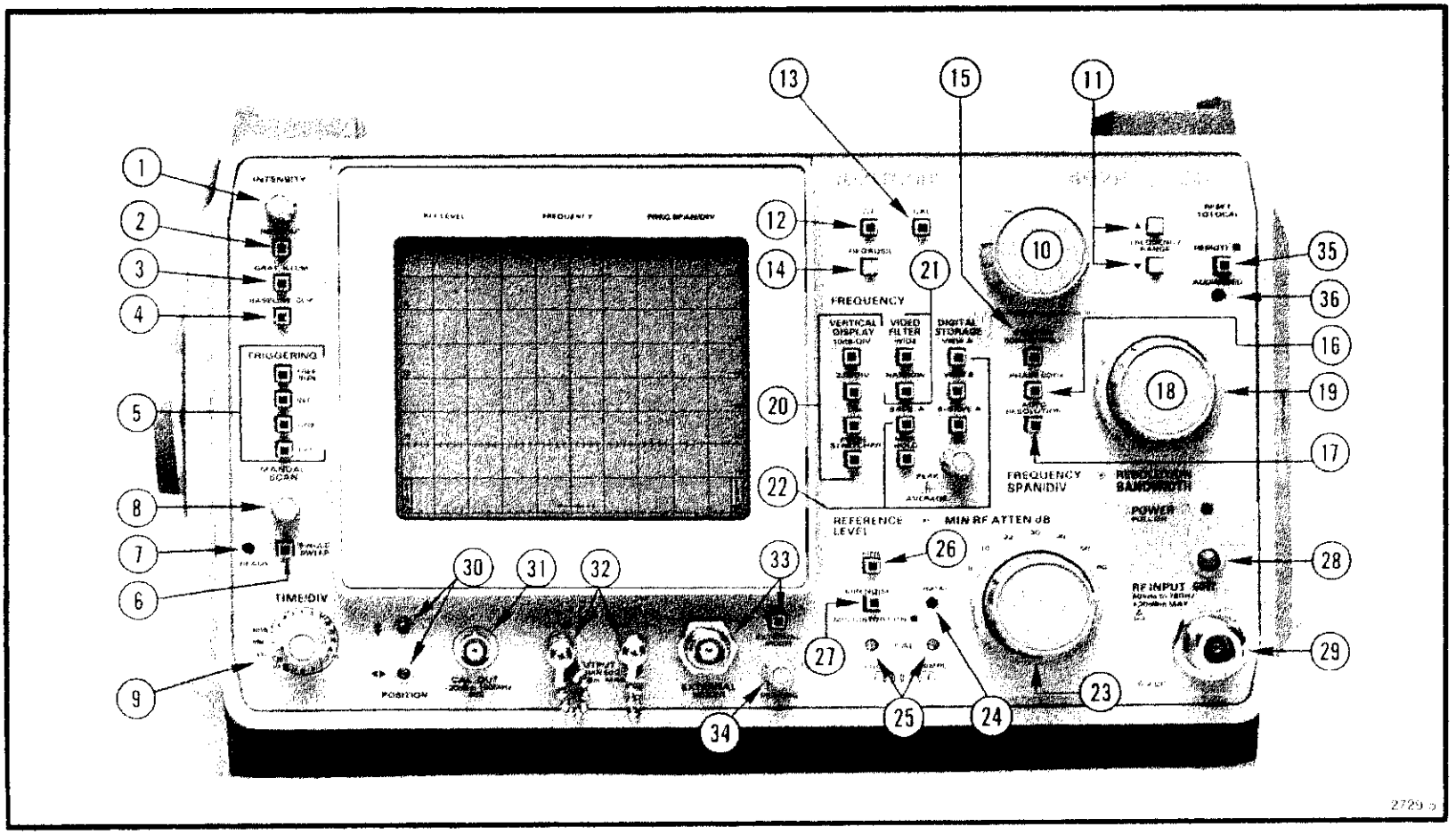


Fig. 2-1. Front-panel selectors, controls, and connectors.

(8) **MANUAL SCAN.** When the TIME/DIV selector is in the MNL position, this control will manually scan the spectrum.

(9) **TIME/DIV.** Selects sweep rates from 5 s/div to 20 μs/div in 5-2-1 sequence. This switch also selects AUTO, EXT, and MNL modes.

AUTO (automatic)—In this position the sweep rate is selected by the microcomputer to maintain a calibrated display for any FREQ SPAN/DIV, RESOLUTION BANDWIDTH, and VIDEO FILTER combination.

EXT (external input)—This position connects the rear-panel EXT IN HORIZ/TRIG connector to the horizontal sweep circuit. A voltage ramp of 0 to +10 V will sweep 10 divisions of the horizontal (x) axis.

MNL (manual)—In this position the horizontal axis can be swept with the MANUAL SCAN control.

(10) **FREQUENCY.** Tunes the center frequency. Tune rate is proportional to the selected FREQ SPAN/DIV. Any given signal moves across the display at a constant rate for all spans. In MAX span, the tuning range depends on the band; for example, in Band 2 (1.7—5.5 GHz) the frequency dot will not tune to the extreme left edge of the graticule, or in Band 6 (15—21 GHz) the dot will tune only to the right of center.

(11) **FREQUENCY RANGE** (band). These two push buttons shift the center frequency range up or down. Frequency range of the band is displayed by the crt readout.

(12) **ΔF.** A convenience for measuring frequency difference between signals. When selected, the frequency readout goes to zero. It will then read out the deviation from this reference as the FREQUENCY is tuned.

(13) **CAL.** When activated, the frequency readout can be calibrated to center frequency by adjusting the FREQUENCY control for the correct reading. When calibrated, deactivate the CAL mode.

(14) **DEGAUSS.** When the DEGAUSS button is pressed, current through the tuning coils of the YIG oscillator (1st LO) is reduced to zero to minimize hysteresis effects. This enhances center frequency and display amplitude accuracy. DEGAUSS does not function when the FREQ SPAN/DIV is less than 1 MHz/Div. Degauss the tuning coils after a significant frequency change and before calibrating the center frequency readout.

(15) **IDENTIFY 500 kHz ONLY.** Signal identify feature is functional only when the FREQ SPAN/DIV is 500 kHz. When activated (button lit), true signals will change amplitude each sweep; images and spurious response signals will shift horizontally or

off screen. To ensure that the signal is changing amplitude every sweep, decrease the sweep rate so each sweep can be analyzed; or, if the instrument has digital storage, activate SAVE A, VIEW B.

When the true signal is centered under the dot marker after degauss, the FREQUENCY readout is the signal frequency (within specification). Degauss by pressing DEGAUSS at a FREQ SPAN/DIV setting of 1 MHz or 2 MHz.

(16) **PHASELOCK (Option 03).** The 1st LO is locked to a stable internal reference and the 2nd LO swept to reduce residual FM in narrow spans; the button lights when phase lock is active. In narrow spans, phase lock can be turned off or back on by pressing the button. Spans for which the microcomputer automatically selects phase lock are:

Band	Span/Div
1, 2, 3	50 kHz and below
4	100 kHz and below
5 and above	200 kHz and below

(17) **AUTO RESOLUTION.** This is a push button that activates automatic bandwidth selection for the selected FREQ SPAN/DIV, TIME/DIV, and VIDEO FILTER. An internal microcomputer selects bandwidth to maintain a calibrated display. When the TIME/DIV is in AUTO mode, resolution bandwidth becomes a function of the FREQ SPAN/DIV selection.

(18) **FREQUENCY SPAN/DIV.** This is a continuous detented control that selects frequency span/div. Span/div is indicated by the crt readout. Range of the span/div selection depends on the frequency band and options. Table 2-1 lists the range for the various bands and options. Selection is a 5-10-20 sequence plus MAX span and 0 Hz span positions.

When MAX span is selected, the span displays the full band. Sweep beyond the band is clamped to the baseline. A dot marker near the top of the screen indicates the position on the span of the crt frequency readout. This dot and frequency point will be center screen when the FREQ SPAN/DIV is reduced below MAX span position. When zero span is selected, Time/Div is read out instead of Span/Div.

Table 2-1

SPAN/DIV RANGES VERSUS BAND AND OPTION

Band	Narrow Span/Div		Wide Span/Div
	Standard	Option 03	All Instruments
1—3 (0—7.1 GHz)	5 kHz	500 Hz	200 MHz
4—5 (5.4—21 GHz)	10 kHz	500 Hz	500 MHz
6 (18—26 GHz)	20 kHz	500 Hz	1 GHz
7—8 (26—60 GHz)	50 kHz	500 Hz	2 GHz
9 (60—90 GHz)	100 kHz	500 Hz	2 GHz
10 (90—140 GHz)	100 kHz	500 Hz	5 GHz
11 (140—220 GHz)	100 kHz	500 Hz	10 GHz

(19) **RESOLUTION BANDWIDTH.** This is also a continuous detented control that selects resolution bandwidth. Bandwidth is indicated by crt readout. Range of selection is 1 kHz to 1 MHz in decade steps. An additional resolution bandwidth of 100 Hz, when Option 03 is installed, is provided. Changing the resolution bandwidth with this control deactivates AUTO RESOLUTION.

(20) **VERTICAL DISPLAY.** These four push buttons select the display mode. The crt readout indicates scale factor.

10 dB/DIV—When activated, the dynamic range of the display is a calibrated 80 dB with each major graticule representing 10 dB.

2 dB/DIV—Increases resolution so that each major graticule division represents 2 dB.

LIN—Selects a linear display between zero volts (bottom graticule line) and the reference level (top graticule line) scaled in volts/division. See REFERENCE LEVEL.

PULSE STRETCHER—Increases the fall time of pulse signals so very narrow pulses in a line spectrum display can be seen. The effect is most apparent for discrete signals analyzed at resolution bandwidths that are narrow compared to the span; PULSE STRETCHER may be necessary for digital storage of such signals, especially if they are averaged.

(21) **VIDEO FILTER.** One of two (NARROW and WIDE) filters can be activated to reduce the video bandwidth and reduce high-frequency components for display noise averaging. The NARROW filter is approximately 1/300th of the selected resolution bandwidth; the WIDE filter is approximately 1/30th the bandwidth. Activating either filter cancels or deactivates the other filter. Press the push button to switch the filters off.

(22) **DIGITAL STORAGE (Option 02).** Five push buttons and one control operate the digital storage functions. With none of the push buttons activated, the 492/492P display is not stored.

VIEW A, VIEW B—When either or both of these push buttons are selected, the push button illuminates and the contents of memory A and/or memory B are displayed. With SAVE A mode off, all memory locations are displayed and updated continuously. Data in A memory are interlaced with data from B memory.

SAVE A—When activated, this mode holds data in A memory and inhibits further updating. With SAVE A and VIEW A active, data in A memory are displayed but not updated, serving as a reference to compare contents of B memory.

B−SAVE A—When activated, the differential (arithmetic difference) of data in B memory and the saved data in A memory is displayed. SAVE A mode is activated and SAVE A button illuminated. The zero difference point is nominally set at the middle graticule line with positive differences displayed above this line and negative differences below. (The zero difference position on screen is internally switch selectable.)

MAX HOLD—When activated, the digital storage memory retains the maximum signal amplitude at each memory location. This permits visual monitoring of signal frequency and amplitude at each memory location over an indefinite period of time. This feature is used to measure drift, stability, and record peak amplitudes.

PEAK/AVERAGE—This control selects the amplitude at which the vertical display is either peak detected or averaged. Video signals above the level set by the control (shown by a horizontal line or cursor) are peak detected and stored; video signals below the cursor are digitally averaged and stored. See Digital Storage in General Operating Information, Section 3.

(23) **MIN RF ATTEN dB and REFERENCE LEVEL.** These two concentric controls select the minimum RF attenuation (in dB) between the RF INPUT and the first mixer and the display reference level respectively.

REFERENCE LEVEL.— This is a continuous control that requests the microcomputer to change the reference level one step for each time the control is moved one detent. The normal steps are 10 dB in the 10 dB/DIV vertical display mode and 1 dB in the 2 dB/DIV mode. When the vertical display is changed to LIN, the reference level remains the same, then switches in dB steps equivalent to a full-scale volts display (8 divisions X volts/division). The normal volts/division steps are in a 5-2-1 sequence. See FINE for the fine reference level steps.

MIN RF ATTEN dB.— selects the lowest value of attenuation allowed; actual RF attenuation is set by the microcomputer according to the algorithm selected by the MIN NOISE/MIN DISTORTION button. If RF attenuation is increased [illegible] MIN RF ATTEN, the microcomputer automatically changes IF gain to maintain the current reference level.

(24) **UNCAL.** This indicator lights when the displayed amplitude is no longer calibrated (e.g. [illegible] a sweep rate that is not compatible with the frequency span/div and resolution bandwidth).

(25) **LOG and AMPL CAL.** These adjustments calibrate the dynamic range of the display. LOG calibrates the logarithmic gain in dB/div, and the AMPL calibrates the reference level of the top graticule line at the top of the screen.

(26) **FINE.** When activated, REF LEVEL switches in 1 dB increments for the 10 dB/DIV display mode, and 0.25 dB for the 2 dB/DIV display mode. In the 2 dB/DIV display mode, FINE activates ΔA mode.

Vertical Display Mode	FINE Increment
10 dB/DIV	1 dB
2 dB/DIV	0.25 dB (ΔA mode)[a]
LIN	Voltage equivalent to 1 dB

[a]For ΔA mode description see Delta A Mode under General Operating Information later in this section.

(27) **MIN NOISE/MIN DISTORTION.** One of two algorithms is selected to control attenuator and IF gain. MIN NOISE (button illuminated) reduces the noise level by reducing attenuation 10 dB and reducing IF gain 10 dB. MIN DISTORTION reduces IM distortion due to input mixer overload. To observe any change, the RF ATTEN displayed by the crt readout must be 10 dB higher than that set by the MIN RF ATTEN selector.

In MIN DISTORTION mode (button not illuminated) distortion is minimum.

(28) **POWER.** Pull-type switch that switches the main power supply on.

(29) ⚠ **RF INPUT.** A 50 Ω coaxial input connector for signals 21 GHz or below. The maximum, nondestructive input signal level to the input mixer is +13 dBm or 30 mW. Signals above −18 dBm may cause signal compression.

CAUTION

The maximum rating of the RF attenuator is +30 dBm (1 W average, 75 W peak, pulse width ≤ 1 μs, with a duty cycle that does not exceed 0.001). Burn-out occurs above 1 W.

If MIN NOISE is activated and RF ATTEN is 60 dB, the +30 dBm rating could be exceeded. If the input signal level is increased for a full-screen display, the input level will be +40 dBm. Reduce high-level signals with external attenuators. Use external attenuators and the MIN RF ATTEN to reduce the level into the 1st mixer to −18 dBm or less. Input voltage to the input mixer must not contain any dc component. Refer to Signal Application in General Operating Instructions, Section 3.

(30) **POSITION** ◄► ▲▼ . These controls position the display on the horizontal and vertical axes.

(31) **CAL OUT** (Calibrator output). The source of a calibrated −20 dBm (±0.3 dB) 100 MHz (±1.7 kHz) signal, and a comb of frequency markers 100 MHz apart. The calibrated 100 MHz marker is used as a reference for calibrating reference level and log scale. The comb of 100 MHz markers is used to check span and frequency readout accuracy.

(32) **OUTPUT 1st and 2nd LO.** These connectors provide access to the output of the respective local oscillators. The connectors must be terminated into 50 Ω when they are not connected to some external device.

(33) **EXT MIXER.** When the EXT MIXER button is activated, bias is provided out the EXT MIXER port for

external waveguide mixers. The IF output from the external mixer is then applied through the EXT MIXER port to the 2nd converter. External mixer connection and operation is described in General Operating Information, Section 3.

CAUTION

Do not exceed mixer input limits. Refer to the external mixer operating instructions in General Operating Information, Section 3.

(34) **PEAKING.** This control varies mixer bias for external mixers in the EXT MIXER mode. If the 492/492P has a preselector (Option 01), the control also adjusts the preselector filter tracking for the 1.7 to 21 GHz frequency range (Bands 2—5). In both cases it is adjusted for maximum signal amplitude. Refer to external mixer operation for more detailed instructions.

(35) **RESET TO LOCAL—(492P Only).** This button is lit when the 492P is under the remote control of a GPIB controller. Pressing this button restores local control and updates the GPIB primary address. In TALK ONLY mode, this button sends a waveform and the control settings onto the GPIB bus.

(36) **ADDRESSED—(492P Only).** Lights when the 492P is addressed to listen or talk.

Refer to the GPIB Controls, Indictors, and Connectors in General Operating Information, Section 3, for more detailed information.

Rear Panel (Fig. 2-2)

(1) **PROBE POWER.** The PROBE POWER connector on the rear panel of this instrument provides operating power for active probes such as TEKTRONIX P6056 or P6021 Probes. It is not recommended that this or the other rear-panel connectors be used as a power source for applications other than the compatible probes or other accessories specifically designed for use with this source.

(2) **EXT IN HORIZ/TRIG.** Dc coupled input for horizontal drive voltages and ac coupled for trigger signal. A 0 to +10 V ramp produces full sweep. A 1.0 to 50 V peak signal is required for trigger (0.1 μs minimum pulse width), 15 Hz to 1 MHz. Selection as to HORIZ or TRIG mode depends on front-panel TRIGGERING and TIME/DIV selections.

(3) **MARKER/VIDEO (B053575 and up) or EXT PRESELECTOR (B053574 and below):** MARKER/VIDEO interfaces the 492/492P with a TV Sideband Adapter, such as Tektronix 1405, so a

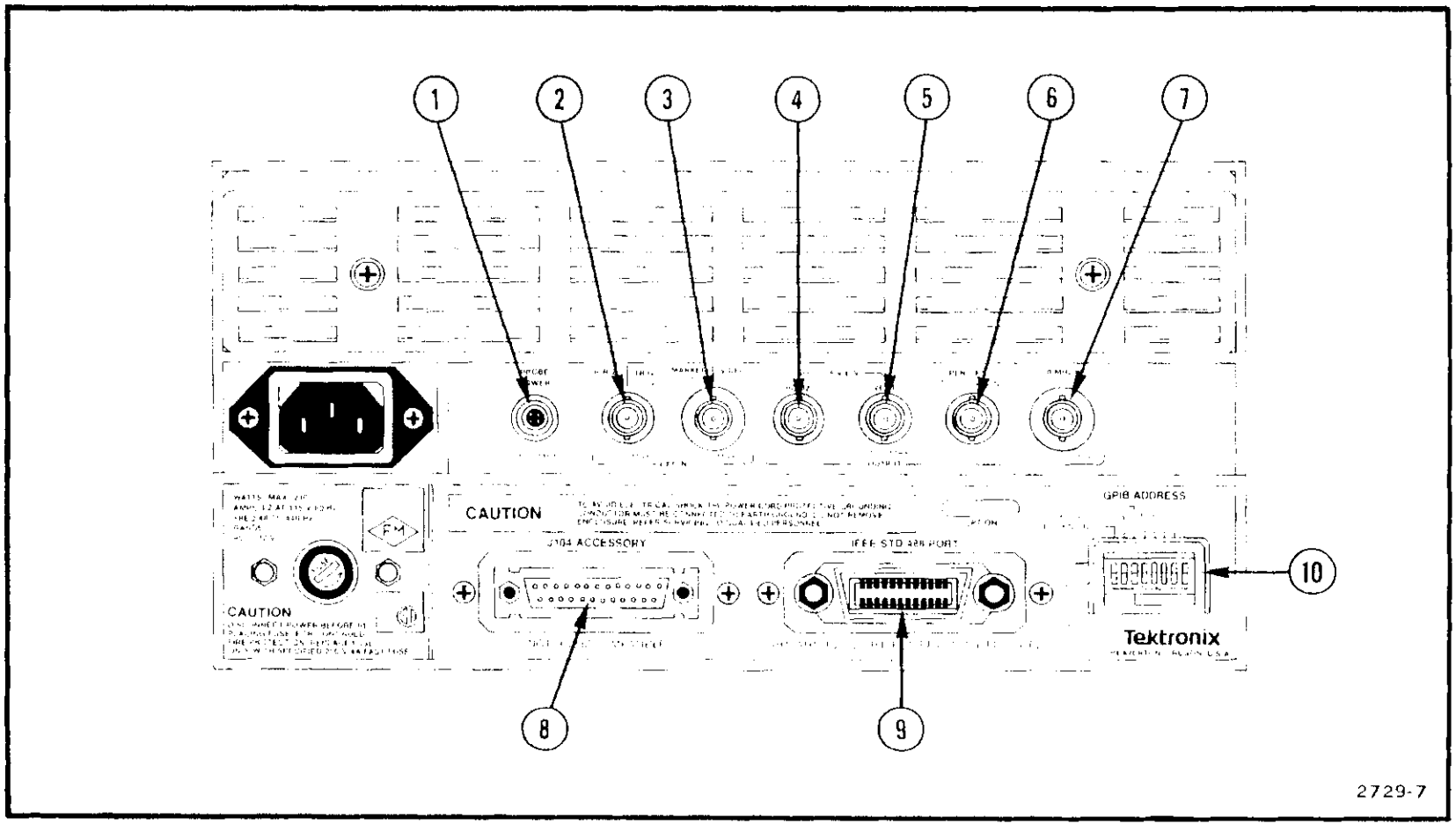


Fig. 2-2. Rear-panel connectors.

marker from the adapter is displayed on the internal video. External video applied to this connector will also be displayed if pin 1 of the ACCESSORIES connector is grounded.

EXT PRESELECTOR provides a variable voltage (approximately −0.2 V to +10 V) that is proportional to center frequency, for preselector bands of Option 01 instruments, to drive an external preselector.

In OPTION 42 instruments, this port is relabeled and provides 110 MHz IF output with a bandwidth greater than 5 MHz. External video signals used for calibration may be injected into the PEN LIFT connector. See (6) PEN LIFT. This port is not compatible with a TV Sideband Adapter.

(4) **HORIZ** (output). Source of a signal that is 0.5 V for each division of display.

(5) **VERT** (output). Source of a video signal that is 0.5 V for each division of display above or below the centerline. If the signal is used to drive a chart recorder, digital storage should be off. If the signal drives a slave monitor and PEN LIFT is used for blanking, the screen will blank during retrace time.

(6) **PEN LIFT.** TTL compatible, nominal +5 V provided to lift the pen of a chart recorder.

In OPTION 42 instruments this port may also be used for inputting external video, if pin 1 of the ACCESSORIES connector is grounded.

CAUTION

High level signals (such as a line voltage) previously injected into the VIDEO/MARKER connector may cause damage to the output amplifier if injected into the 110 MHz output.

(7) **10 MHz IF** (+20 dBm max). Access to the 10 MHz IF signal. Output level is approximately −10 dBm with a full-screen signal at −30 dBm reference level, maximum output is +20 dBm.

(8) **J104 ACCESSORY.** For instruments B053575 and up, this connector provides bi-directional access to the 492P instrument bus. It is not RS-232 compatable. TTL logic 0, applied to pin 1, will select External Video which connects video signals, applied to the rear panel MARKER/VIDEO connector, to the video path ahead of the video filters. Pins 2 and 3 provide the output and return lines to drive an external preselector for instruments that have Option 01.

For instruments B053574 and below, this connector has no application.

(9) **GPIB Connector—(492P Only).** This interfaces the 492P with a GPIB bus. Connect the GPIB cable after the instrument is switched on to avoid interference on the bus.

(10) **GPIB Address—(492P Only).** These switches set the primary GPIB address of the 492P and select the TALK or LISTEN operating mode. Address 31 (11111) logically disconnects the 492P from the bus; address 0 (00000) is reserved for 4050-Series controllers.

492P Controls and Connectors

Refer to GPIB Controls, Indicators and Connectors in General Operating Information, Section 3 for more detailed information.

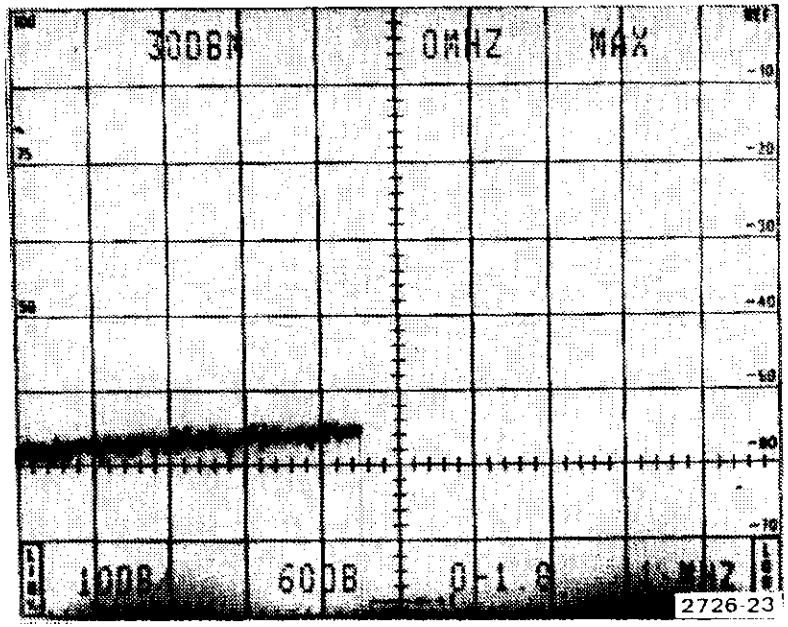


Fig. 2-3. Crt readout for power-up state.

FIRMWARE VERSION AND ERROR MESSAGE READOUT

Firmware Version

During initial turn-on or power-up cycle, the firmware version in the instrument will flash on screen for approximately two seconds. The Replaceable Electrical Parts list in the 492/492P Service manual, Vol. 2 lists the ROMs used for each version.

Error Message Readout

The 492/492P features error message readout. These messages (numbers) flash on screen when the address and data from the microcomputer fails to complete an operational routine. These error numbers and their meaning are as follows:

Error #	Meaning
57	Tune routine failed
58	Failed to phaselock
59	Lost phaselock
60	Failed to recenter frequency when phase lock canceled or when switching to an unlocked span/div setting. (Phase lock occurs for 50 kHz or less in Bands 1 through 3, 100 kHz or less for Band 4, and 200 kHz or less for Bands 5 and above.)

TURN ON PROCEDURE AND PREPARATION FOR USE

The following procedure initiates a display and calibrates center frequency readout, display reference level, and dynamic range.

1. Initial Turn On

a. Connect the 492/492P power cord to an appropriate power source (see power requirements in the Specification portion of Section 1) and switch POWER on. Allow three to four minutes for the instrument to warm up and stabilize before proceeding. Note that the crt readout is functioning (see Fig. 2-3).

When POWER is switched on (power up), the operating functions and modes of the 492/492P initialize to the following "power up" state.

Vertical Display	10 dB/DIV
FREQUENCY	0.0 MHz
REF LEVEL	+30 dBm
RF ATTENuation	60 dB
FREQUENCY RANGE	0.0—4.2 GHz (0.0—1.8 GHz with Option 01)
AUTO RESOLUTION	On
RESOLUTION BANDWIDTH	1 MHz
FREQ SPAN/DIV	MAX
TRIGGERING	FREE RUN
READOUT	On
Digital Storage (Option 02)	VIEW A/VIEW B on
All other push buttons	Inactive or off

b. Apply the CAL OUT to the RF INPUT by connecting a 50 Ω coaxial cable between the CAL OUT connector and the RF INPUT.

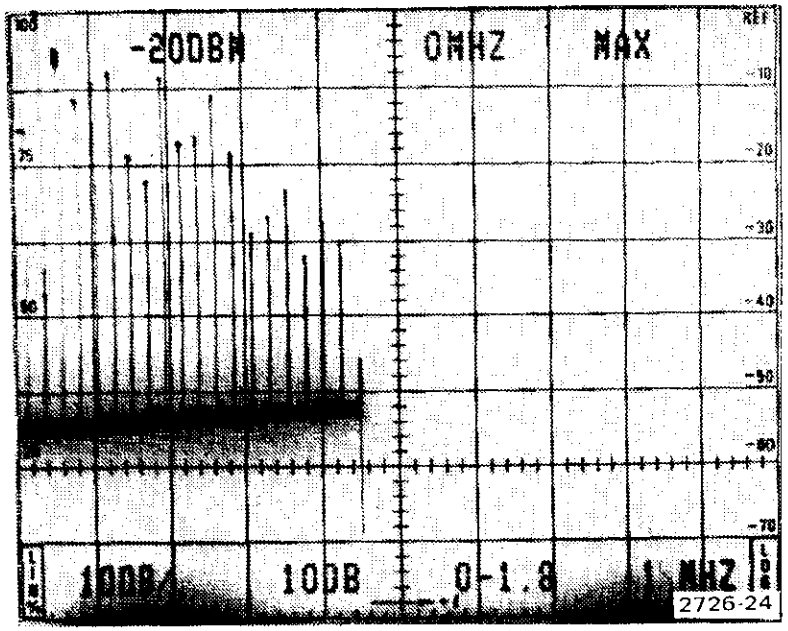


Fig. 2-4. Typical display of calibrator markers in MAX SPAN position.

c. Set MIN RF ATTEN to 0 dB and the PEAK/AVERAGE control fully counterclockwise. Set the TIME/DIV to AUTO, the REF LEVEL to -20 dBm, and adjust the INTENSITY for a display with the desired brightness. Note that the RF ATTEN readout is now 10 dB.

d. In the MAX frequency span mode, a dot marker in the upper portion of the screen indicates the location on the display to which the 492/492P center frequency is tuned. With a frequency readout of 0.0 MHz, it will be in the upper left portion of the screen. Adjust the center FREQUENCY control and note the dot marker move across the display.

e. Note the comb of 100 MHz markers at the left side of the display (see Fig. 2-4). Tune the dot marker to a position above the first 100 MHz marker.

f. Change the FREQ SPAN/DIV to 100 MHz. Note that the dot marker is now centered horizontally and the 100 MHz signal is at or near center screen.

g. Position the dot marker to the graticule centerline with the horizontal (◄►) POSITION control. Adjust the center FREQUENCY control to tune the signal over the dot marker.

h. Press the 2 dB/DIV Vertical Display button; then position the baseline of the display to the bottom graticule line with the vertical (▲▼) POSITION control.

2. Calibrate Center Frequency Readout

a. Change the Vertical Display to 10 dB/DIV. If the instrument has phase lock, ensure that PHASE LOCK is deactivated or the FREQ SPAN/DIV is above 50 kHz (recommend setting of 10 MHz).

b. Tune FREQUENCY to place the 100 MHz calibrator signal over the center-span dot marker. Reduce FREQ SPAN/DIV to 1 MHz, press the DEGAUSS button, and fine-tune center frequency.

NOTE

Degauss function is inoperative when the FREQ SPAN/DIV is less than 1 MHz.

c. Press the CAL button to activate the calibration function (button illuminated); then, adjust the FREQUENCY tuning control for a readout of 100 MHz. Press the CAL button to deactivate the CAL mode and increase FREQ SPAN/DIV to 20 MHz.

d. Check—center frequency accuracy at other multiples of the 100 MHz calibrator signal. Approach each check point from the low-frequency side and degauss the tuning coils of the oscillator as each check point is approached. Readout should be within +(5 MHz + 20% span/div).

e. Return the frequency to 100 MHz.

3. Calibrate Reference Level and Dynamic Range

a. With the 100 MHz calibrator signal tuned to center screen and the REF LEVEL at −20 dBm, set the FREQ SPAN/DIV to 20 kHz, as indicated by the crt readout.

b. Alternately switch Vertical Display from 10 dB/DIV to 2 dB/DIV and adjust AMPL CAL so the peak amplitude of the signal is the same for each logarithmic display mode.

c. With the Vertical Display mode at 10 dB/DIV, set the top of the calibrator signal to the top graticule line, with the LOG CAL adjustment, so the top graticule line is a calibrated −20 dBm.

d. Check—the display log scale over 50 dB of dynamic range by switching REF LEVEL in 10 dB steps from 20 dBm to +30 dBm and noting that the display amplitude decreases 10 dB or one division per step.

As the analyzer sweep rate is increased, a critical rate is reached where both sensitivity and resolution are degraded. Therefore, sweep time for a calibrated display is dependent on resolution bandwidth and the frequency span.

In spans other than MAX SPAN, frequency span is symmetrical about the center frequency. In MAX SPAN the display represents the full frequency range of the selected band. A frequency dot above the display indicates the location on the spectrum of the FREQUENCY readout. The frequency span used depends on the application. Wide spans are normally used to monitor a frequency spectrum for spurious signals, check harmonic content, etc. Narrow spans are used to identify the characteristics around a particular signal, such as modulation side bands, bandwidth, power line related distortion, etc. When wide spans are used, sweep rate on non-store displays is usually increased to eliminate flicker. This requires wider resolution bandwidths. Narrow spans, used to observe signal phenomena, usually call for narrow resolution bandwidths and, therefore, slow sweep speeds.

The 492/492P features microcomputer circuitry that selects sweep rate and resolution bandwidth to correlate with the selected frequency span. When both TIME/DIV and RESOLUTION BANDWIDTH are in the AUTO mode, the display is calibrated for each FREQ SPAN/DIV selection. The AUTO position of the TIME/DIV selector [illegible] sweep speed to the analyzer span/div and resolution bandwidth. The AUTO mode of the RESOLUTION BANDWIDTH optimizes bandwidth for the selected FREQ SPAN/DIV and TIME/DIV settings unless either is outside the [illegible] correction. When this occurs, the UNCAL indicator lights and a > symbol prefixes the REF LEVEL readout on the crt display.

When analyzing pulse signals, a wider bandwidth than that provided by AUTO is usually desired. The resolution bandwidth should be on the order of 1/10 the side lobe frequency width, or the reciprocal of the pulse width, in order to ensure adequate resolution. The RESOLUTION BANDWIDTH is usually set for optimum main lobe detail after the sweep rate has been selected.

USING THE PEAKING CONTROL

The PEAKING control adjusts bias for the EXT MIXER port and the preselector tracking for the instruments with Option 01. It is adjusted for maximum conversion or maximum signal amplitude. This control has a marked affect on performance when operating in the higher frequency ranges. Mixer peaking, when Option 01 is installed, must be adjusted before relative amplitude and sensitivity measurements are made, when operating above Band 1 (1.8 GHz).

Frequency response and flatness are also affected; therefore, after any significant frequency change, it is good practice to degauss, then adjust PEAKING for maximum signal amplitude. Degauss with FREQ SPAN/DIV of 2 MHz or 1 MHz.

USING THE SIGNAL IDENTIFIER

Conversion in the 1st mixer generates many spurious responses. This is due to the multiple harmonics of the local oscillator converting input signals to an intermediate frequency within the bandpass of the IF. This is especially true for the basic 492/492P (without the Option 01 preselector) and when the waveguide mixers are used.

PHASELOCK OPERATION

Phase lock is activated for the narrower spans (see description under Controls, Indicators, and Connectors) to lock the 1st LO to a stable reference. If phase lock mode is active and PHASE LOCK button is pressed to deactivate phase lock, the signal may shift position and in narrow spans it may shift off screen.

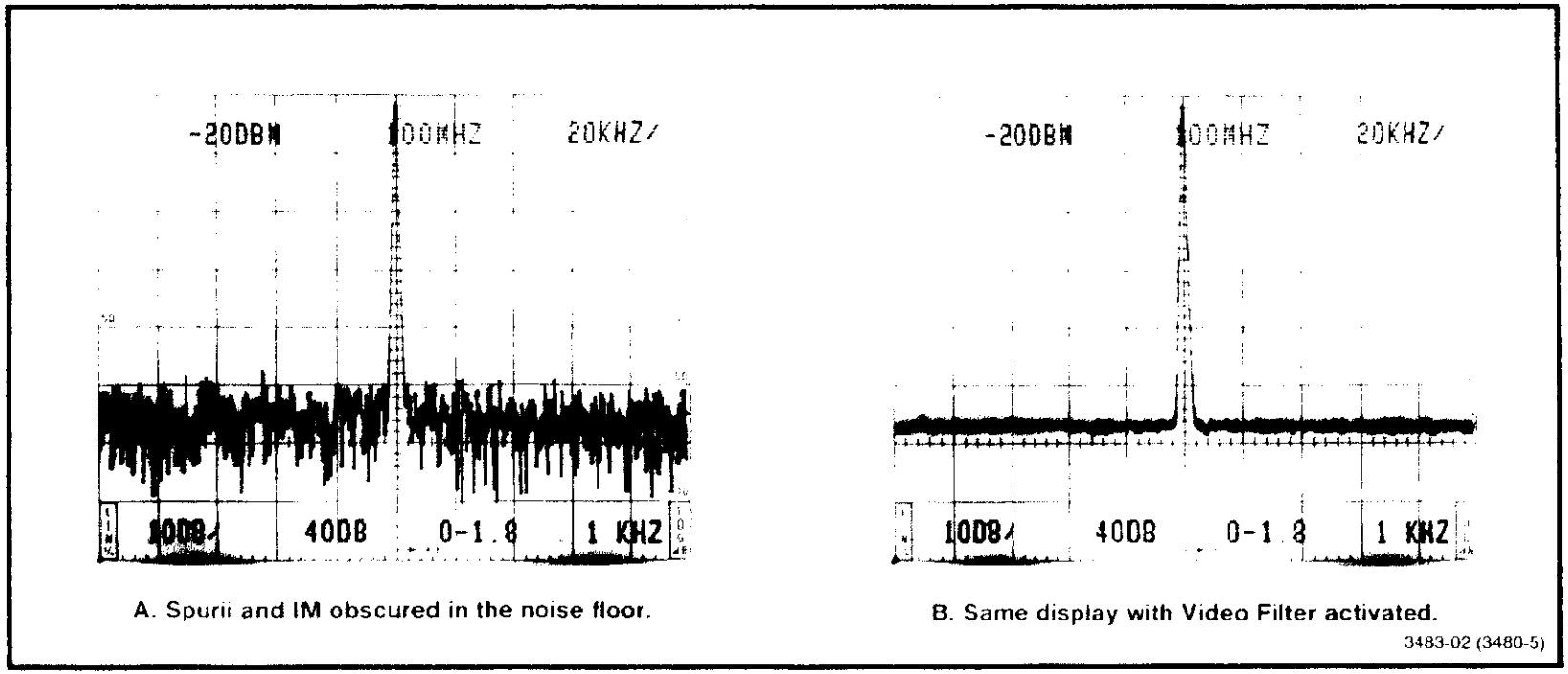
USING THE VIDEO FILTER

The video filter restricts the video bandwidth so that noise or beat signals are reduced (see Fig. 3-4). When signals are closely spaced, the filter may be useful to reduce modulation between two signals so they can be more easily analyzed. The filters can also be used to average the envelope of pulsed RF spectra that has a relatively high prf (pulse repetition frequency); however, because the filter is basically an integrating circuit, selecting a Video Filter when measuring low prf spectra produces poor results.

The WIDE filter reduces the bandwidth to approximately 1/30th the selected resolution bandwidth; the NARROW filter approximately 1/300th. Using the filter may require a reduction in the sweep rate to maintain a calibrated display. The UNCAL indicator will light if the sweep speed is too fast for video filtering.

TIME DOMAIN OPERATION

When the FREQ SPAN/DIV is reduced to zero, the analyzer functions as a tunable receiver to display time domain characteristics within the capabilities of the resolution bandwidth. The TIME/DIV selector can now be used to analyze such characteristics as modulation pattern, pulse repetition rates, etc.



A. Spurii and IM obscured in the noise floor.

B. Same display with Video Filter activated.

3483-02 (3480-5)

Fig. 3-4. Integrating the display with the Video Filter.

TRIGGERING THE DISPLAY

Triggering is usually FREE RUN for spectrum displays; however, it may be desirable or necessary to trigger the display when the event is time related to some source or when the frequency span has been reduced to zero for time domain analysis. In the FREE RUN mode, the sweep will not synchronize with any input signal.

The sweep can be triggered internally from the vertical or video signal, at the line frequency rate of the power supply, or from an external signal applied to the EXT IN HORIZ/TRIG jack on the back panel. The amplitude of trigger signal required to trigger the sweep is two (2.0) divisions or more, for internal triggering, and 1.0 V to a maximum of 50 V (dc + peak ac) for external triggering.

Trigger source is selected by activating one of the triggering push buttons. In addition to the four trigger source selections, SINGLE SWEEP mode can be selected. The sweep will run once after the circuit has been armed and trigger signal arrives. The READY indicator lights when the circuit is armed and waiting for a trigger signal, and remains lit until the sweep has run. Pushing the SINGLE SWEEP button once activates SINGLE SWEEP mode; pushing it again arms the trigger circuit so it is ready for a trigger signal.

SWEEPING THE DISPLAY

Horizontal sweep for the display is either internal or from an external sweep source. Sweep rate and source are selected by the TIME/DIV switch. When the TIME/DIV switch is in the AUTO position, the sweep rate is controlled by the internal microcomputer.

When the TIME/DIV switch is in the EXT position, a signal source of 0 to +10 volts, applied to the EXT IN HORIZ/TRIG connector, will sweep the crt beam the full 10 division graticule span. The input is dc coupled and sensitivity is 1 V/div. External input impedance is approximately 10 kΩ.

The beam can be positioned by the MANUAL SCAN control when the TIME/DIV is in the MNL position (see Manual Scan of the Spectrum that follows).

MANUAL SCAN OF THE SPECTRUM

Manual scan is used to examine a particular point or portion of a display, such as one of the null points of a frequency modulation spectrum or where a slow sweep of the full span would take unnecessarily long. When the TIME/DIV control is set in the MNL position, the display may be swept with the MANUAL SCAN control. The sweep scan is usually first calibrated in one of the timed sweep positions. Note that with a wide span/div and/or a narrow resolution bandwidth setting, it is possible to scan too rapidly to achieve an accurate display. Also, digital storage can give unpredictable results when used with the MNL SCAN mode. Digital storage is updated only when scanning toward the right.

REFERENCE LEVEL, RF ATTENUATION, AND VERTICAL DISPLAY

A change in the REF LEVEL control requests the microcomputer to change the display reference level—the amplitude represented by the top of the crt graticule. The microcomputer selects the gain distribution (IF gain and input RF attenuation) for the new reference level according to the setting of the FINE, Vertical Display mode, MIN RF ATTEN, and MIN NOISE/MIN DISTORTION selectors.

The amount of attenuation between the RF INPUT and the first mixer, set by the microcomputer, is based on the reference level requested and the mode of the MIN RF ATTEN and MIN NOISE/MIN DISTORTION selectors. The microcomputer assumes the MIN RF ATTEN selection is the minimum attenuation required for the expected signal levels. It does not reduce RF attenuation below this value. It also selects the best ratio of RF attenuation and IF gain according to the MIN NOISE/MIN DISTORTION mode (see description that follows). As MIN RF ATTEN is increased, the lower limit reference level is raised an equal amount. At 0 dB minimum attenuation, the lower limit reference level is 123 dBm. At 10 dBm minimum attenuation, the reference level goes to −113 dBm, etc.

The reference level increments depend on the Vertical Display mode and FINE selector mode. Reference level steps for the log displays are 10 dB and 1 dB with FINE off, and 1 dB and 0.25 dB with FINE activated (0.25 dB steps apply to the ΔA mode). For LIN displays with FINE off, the microcomputer selects the reference level, which is the equivalent of an 8-division signal, where the bottom of the crt graticule is zero volt and the top of the crt graticule is eight times the vertical display factor. The display factor changes in a 1-2-5 volts/division sequence. For LIN displays with FINE on, the reference level changes in 1 dB steps and the scale factor is 1/8 the voltage equivalent of the reference level.

DELTA A MODE

To select this mode, activate 2 dB/DIV and FINE; the REF LEVEL readout becomes *0.00 dB and the REFERENCE LEVEL steps in 0.25 dB increments.

The ΔA mode is useful for measuring relative amplitude differences of signals more accurately. This is because the gain distribution (IF gain and RF attenuation) is not changed when ΔA mode is activated. The REF LEVEL is changed by shifting the log amplifier offset. The measurement range of the ΔA mode is at least from 10 dB above to 40 dB below the reference level established when the mode was activat-

ed; however, the overall instrument display characteristic of −123 dBm to +30 dBm cannot be exceeded. The asterisk in the REF LEVEL readout remains until the ΔA mode gain distribution is changed.

The ΔA mode is canceled when either FINE or 2 dB/DIV are deactivated, or a selector that could change gain distribution (MIN RF ATTEN or MIN NOISE) is changed. The analyzer also deactivates ΔA mode when EXT MIXER or an external mixer frequency range is selected.

Signals with large differences in amplitude that are within the ΔA range can be compared without the distortion usually introduced when signals are driven off-screen. Signals shifted off-screen by changes in the ΔA reference level are not overdriving the input because the attenuator and IF gain are not changed; thus the mixers do not see any change in signal levels due to the ΔA reference level changes.

To measure amplitude level differences of two signals:

1) select ΔA mode by activating 2 dB/DIV and FINE;

2) using the REF LEVEL control, set the larger amplitude signal to a graticule line;

3) press the FINE push button twice to deactivate and reactivate the ΔA mode;

4) using the REF LEVEL control, set the lower amplitude signal to the same graticule line established in part 2;

5) the REF LEVEL readout displays amplitude level difference in dB.

MIN NOISE/MIN DISTORTION

This push button selects one of two algorithms that control attenuator and IF gain settings. MIN NOISE minimizes noise level while MIN DISTORTION minimizes input mixer overload. To observe any change when MIN NOISE is activated, the RF ATTEN crt readout must be 10 dB higher than that set by the MIN RF ATTEN selector.

CAUTION

With MIN NOISE activated and 60 dB of MIN RF ATTEN, the REF LEVEL can be set to +40 dBm. The front end of the 492/492P is specified at +30 dBm maximum. Do not increase input signal level to full screen with a REF LEVEL of +40 dBm because this will exceed the attenuator rating. Dc input is limited to zero (0) volt.

DIGITAL STORAGE (Option 02)

Digital storage provides a smooth (flicker free) display. Two complete sweeps can be stored. One of these can be saved and then compared to subsequent updated information. A MAX HOLD feature updates the stored data in memory when the new input is of higher amplitude, thus allowing monitoring and graphic plotting of display changes with time. Vertical information can be divided by a cursor, or horizontal line, that is positioned with the PEAK/AVERAGE control. Above the cursor, video information is peak detected and displayed; below the cursor, signal averaging occurs. The average (number of samples) is a function of sweep speed. The slower the sweep, the greater the number of samples averaged. This feature suppresses noise in that portion below the cursor and allows full peak detection of vertical data above the cursor. An intensified spot on the cursor indicates the horizontal position at which memory is being updated.

When digital storage is used, an additional quantization error of 0.5% of full screen must be added to the amplitude performance characteristics (i.e., frequency response, sensitivity, etc.).

Digital storage memory is functionally divided into two sections—A and B. Data can be stored in A or B or in both. There are 512 horizontal locations in A and 512 horizontal locations in B. When both are displayed, the origin of B is shifted such that the A and B coordinates are interlaced to provide 1024 display increments. Data in memory is continually updated with each sweep so the display, when viewing A or B, is always current.

When SAVE A function is activated, data in A memory is held in storage and only B memory is updated. This inhibition takes place whether A is displayed or not. This mode captures an event or waveform for comparison with a subsequent event displayed by VIEW B mode. In this mode all of A memory is displayed, then all of B, each by a separate sweep.

When B – SAVE A is activated, the contents of data in B memory minus the contents saved in A are displayed. This provides the comparison of the two events by presenting the algebraic difference of the two displays. This convenient mode can be used to align filters or other devices when tuning for a null. The reference waveform is stored in A and the unknown in B. If the device under test is active, the B waveform may be larger than the refrence which results in a shift in the zero reference line. The position of the zero reference can be selected with an 8-bit digital switch. The reference level is normally set mid-screen so positive and negative quantities can be observed. Qualified service per-

sonnel can position the reference anywhere within the graticule window.

MAX HOLD causes the digital memory to be updated only if the new input is of higher magnitude than the former (B memory only if SAVE A is active). This allows monitoring of signals that may change with time and provides a graphic record of amplitude/frequency excursions.

Signal averaging is useful for suppressing noise. The number of samples averaged per digitized slot (increment) is a function of the spectrum analyzer sweep rate. The slower the sweep speed, the more samples averaged per resolution bandwidth. Resolution bandwidth also affects the amplitude difference between peak detected and average levels of cw signals. When the resolution bandwidth is less than 1/30th the span/division (e.g., 100 kHz or less with 5 MHz span/div) there will be significant difference between peak and average amplitude levels of cw signals. The peak value will be the true value, the average value will be in error, especially if only A or B is displayed. It is best to run digital storage with both A and B interlaced when using narrow resolution bandwidth with wide frequency spans.

To analyze signal amplitude level, set the cursor at least 1/4 division below the signal peak. To average noise, set the cursor at least 1/4 division above the noise level.

Waveguide Mixers and External Diplexer

Introduction

Two types of waveguide mixers are avaliable: lower cost, general purpose mixers that cover the microwave bands, and TEKTRONIX High Performance Waveguide Mixers that cover both microwave and millimeter-wave frequency bands. The 18 to 26.5 GHz and 26.5 to 40 GHz frequency ranges are considered microwave bands; above 40 GHz are millimeter-wave bands. Improved frequency response and sensitivity characteristics for the High Performance Waveguide Mixers (see Specification section of the 492/492P Operators manual) makes them a better choice for critical measurements in the microwave bands, whereas the General Purpose Waveguide Mixers can be used for initial measurements or as backup units for the high performance mixers.

Typical broadband frequency response for the High Performance Waveguide Mixers is ± 3 dB to 60 GHz. The mixers are optimized for flatness over each waveguide band.

Both the High Performance and General Purpose waveguide mixers have field replaceable diodes. The millimeter-wave mixers are not field repairable and must be returned to Tektronix, Inc. for repair.

Reference Level for Waveguide Mixers

Reference Level readout changes from −30 dBm for Band 8 (40—60 GHz) and lower to 10 dBm for Bands 9 and 10 (60—140 GHz) and to 0 dBm for Band 11 (140—220 GHz).

Handling

CAUTION

To prevent damage to the waveguide mixers, read the following instructions fully and carefully before installing or using the mixers.

Handle the waveguide mixers with care. The mixer diode is sensitive to static discharges and excessive rf energy. The maximum input level to all waveguide mixers is +10 dBm or 10 mW cw rf (see specifications in the Waveguide manual). Bias polarity for Tektronix Waveguide mixers is negative-going. Check bias requirements of non-Tektronix mixers before connecting them to the 492/492P Spectrum Analyzer.

Ensure that the shorting cap is installed when the mixer is not in use, and install the flange cover on the mixer before returning it to the storage box. The mixer diode can also be destroyed by mechanical vibration or shock.

Do not use an ohmmeter to test or check the mixer diode. The voltage across the test leads of many ohmmeters is capable of destroying the diode.

Use care to avoid scratching the flange surface; these can degrade the performance.

Installation

The waveguide mixer is connected in the rf system of the analyzer as shown in Fig. 3-5. Physically the mixer is bolted to a waveguide flange at or near the rf signal source. A flexible cable is used to connect the mixer to the external Diplexer. Since the capacitance of the cable is capable of storing enough energy to destroy the mixer diode, connect the cable first to the EXT MIXER port of the Diplexer to discharge it before connecting to the mixer. For best performance use the recommended cable, do not extend its length. The Diplexer assembly includes a sma-to-tnc adapter and a shaped semi-rigid coaxial cable. Cable length is not critical; therefore, the semi-rigid cable can be replaced with different length cable.

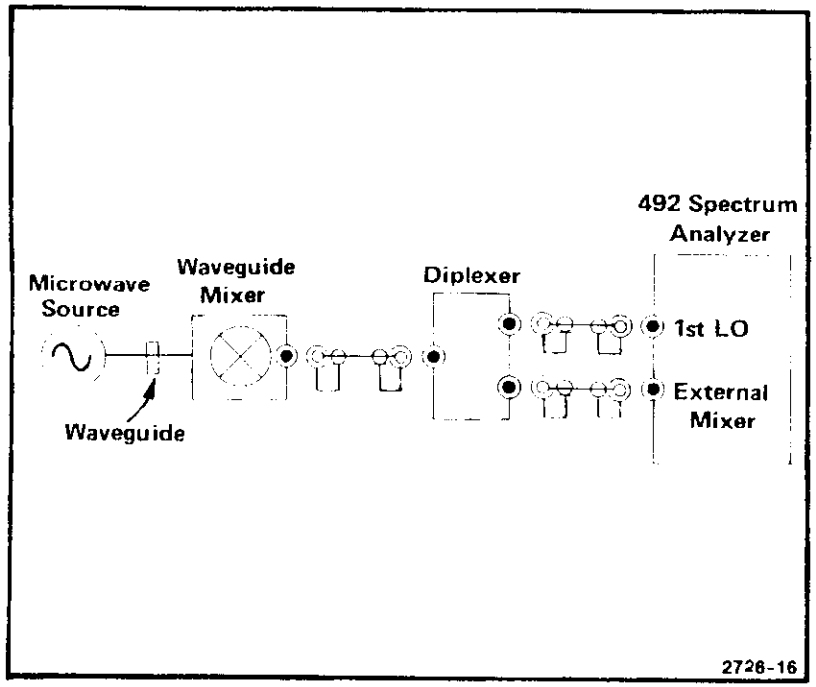


Fig. 3-5. External (Waveguide) mixer installation.

When installing the mixer, make sure the flange surfaces are clean and free of scratches. Be sure to install and tighten all flange screws. This care will minimize input vswr and provide optimum frequency response.

Never apply more than +10 dBm of continuous rf energy to the input of the waveguide mixer port. The waveguide mixers saturate at −20 dBm (typical); therefore, little is gained with inputs above this level. If the input level is unknown, use the general purpose mixer or appropriate waveguide attenuator and RF power meter to test the input level.

The mixers require +7 dBm (min) to +15 dBm (max), typically +10 dBm, of LO signal with a variable bias from −2.0 V to +1.0 V through a current limiting resistor, to meet sensitivity and frequency response characteristics.

CAUTION

The Tektronix mixers are designed to use with Tektronix spectrum analyzers. The mixer diode may be damaged if the unit is connected to an analyzer with a different bias supply.

Activate the EXT MIXER push button and adjust PEAKING for maximum response amplitude. The PEAKING control adjustment will produce more than one maximum through its range. Adjust for the maximum peak.

CAUTION

When EXT MIXER is activated or the FREQUENCY RANGE is in the waveguide bands (18 GHz and above), the internal RF attenuator is bypassed. The MIN RF ATTEN control is inactive and the REF LEVEL cannot be set to a value less than −30 dBm.

Operation

When using the waveguide mixers, many spurious responses will be displayed. A typical MAX SPAN display, generated by a −30 dBm signal at 40 GHz, is shown in Fig. 3-6. The true response must be identified before any analyses can be made.

If the approximate frequency of the signal is known, select the FREQUENCY RANGE (band) and adjust FREQUENCY for the correct readout; then open the display with the SPAN/DIV selector and adjust FREQUENCY so the desired signal is at center screen. Adjust PEAKING over its range for maximum response; then reduce SPAN/DIV to 500 kHz so IDENTIFIER feature can be used to verify that the signal is a true response.

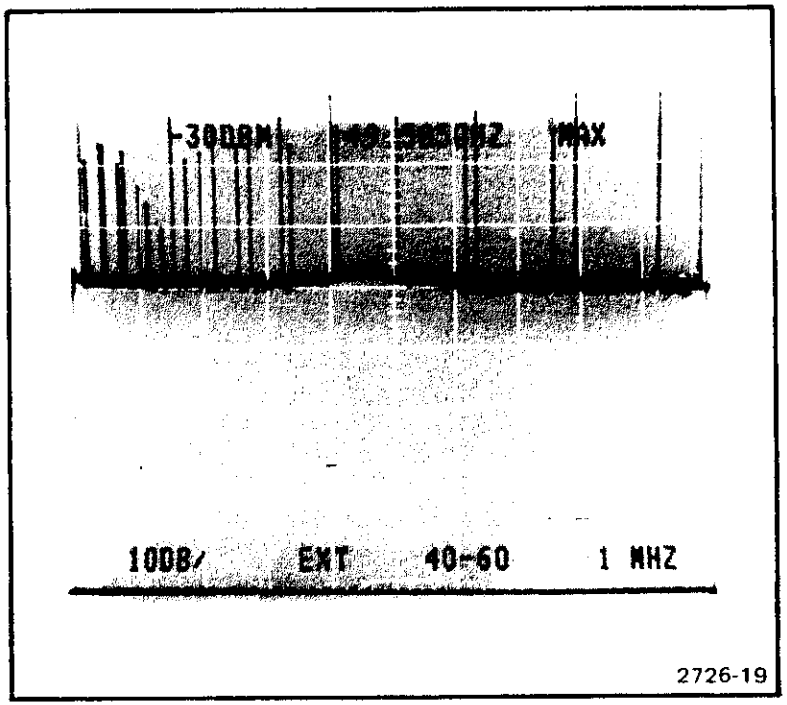
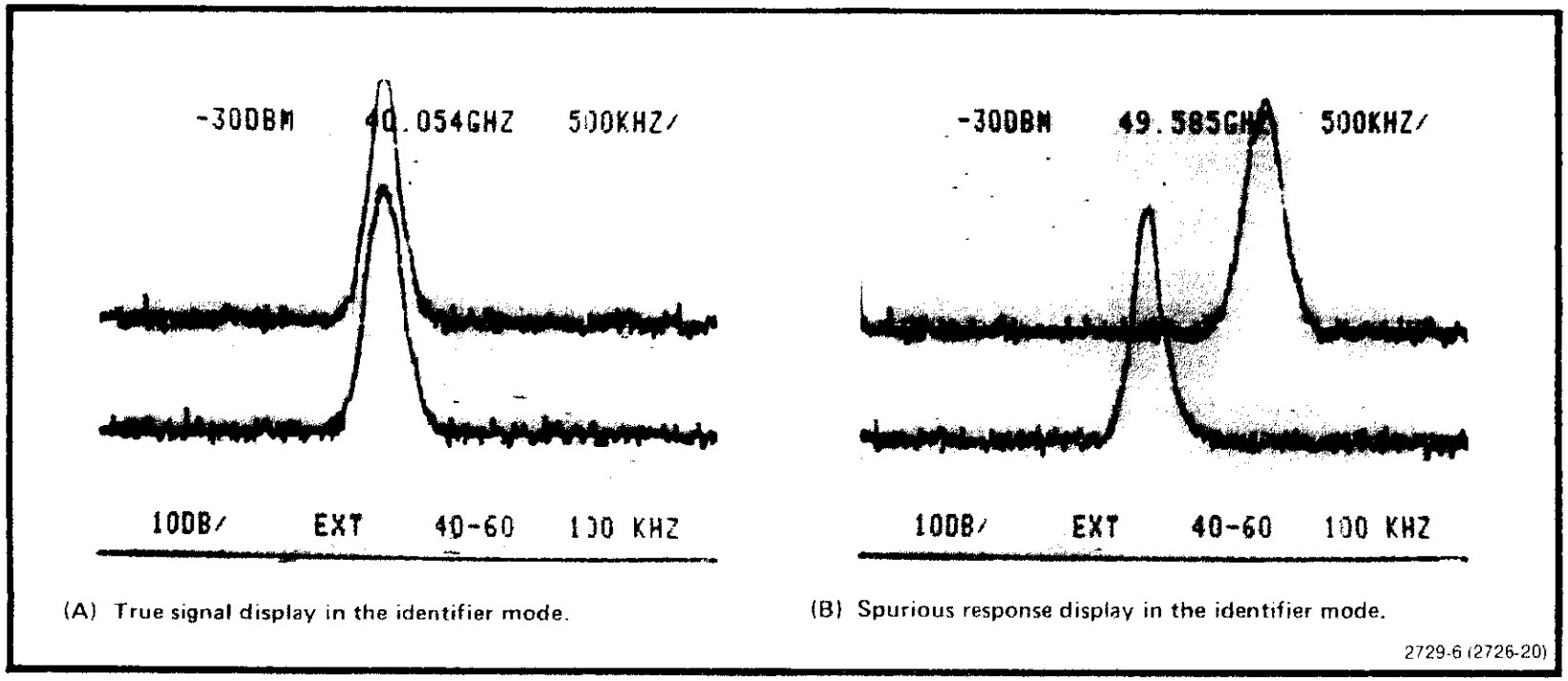


Fig. 3-6. Typical display generated by a signal into the waveguide mixer.

When the IDENTIFIER mode is active, the display will alternately sweep between two levels (approximately two

divisions as shown in Fig. 3-7). If the displayed signal is a true response, there will be no horizontal offset between the two displays. If the signal is a spurious response, there will be a significant horizontal offset between the two displays (off screen in some cases). As the harmonic conversion number (n) increases, for the higher bands, the offset may be small. The accuracy of the center frequency readout is also a function of this conversion number; therefore, a cavity (resonant) wavemeter is recommended to aid in determining frequency. This is especially apparent in the millimeter-wave bands where the conversion number (n) is 10 or higher. The wavemeter dip, when it is tuned to the input frequency, can be easily seen on a power meter connected into the signal path; otherwise, use the 2 dB/DIV



(A) True signal display in the identifier mode.

(B) Spurious response display in the identifier mode.

2729-6 (2726-20)

Fig. 3-7. Identifier mode displays.

display mode and adjust the wavemeter for a dip indication of the responses.

The PEAKING control serves to adjust the tracking of the preselector (Option 01 instruments) for the coax bands and to adjust extenal mixer bias for the External Mixers in the waveguide bands. Adjust the PEAKING for maximum response through its range. (There are usually several peaks over the range of adjustment; adjust for the maximum peak.) After any change in input signal frequency, readjust PEAKING to maintain sensitivity and frequency response characteristics.

Analyzing Signals

The following are operational precautions to observe when analyzing displays.

1. If the analyzer has digital storage, ensure that the cursor is at the bottom of the display or screen for peak detection. On wide spans, digital storage averaging can obscure signals in the noise.

2. Use AUTO RESOLUTION with care when measuring absolute amplitude level. Always use a bandwidth wider than the incidental FM level of the signal source.

3. The reference level is calibrated to compensate for the nominal conversion loss of the waveguide mixers in each waveguide band. Slight variations between mixers result in an amplitude accuracy of approximately ±6 dB (or more) the ±3 dB frequency response of each mixer. The absolute power level accuracy of each waveguide mixer/spectrum analyzer system can be calibrated to within 3 dB by adjusting the front panel AMPL CAL so the display amplitude of a known level external input signal to the mixer is correct.

492P GPIB CONTROLS, INDICATORS, AND CONNECTORS

The 492P adds remote control to the features of the 492. Remote control is accomplished by a controller connected to the 492P through the General Purpose Interface Bus (GPIB—IEEE Std 488). The following is a description of the controls, indicators, and connectors that are unique to the 492P.

For a description of programming techniques for the 492P, refer to the 492P Programmer's manual.

Front Panel (Figs. 3-8 and 3-9)

RESET TO LOCAL (REMOTE). This button is lighted when the GPIB controller takes remote control of the analyzer. While the 492P is under remote control, its other front-panel controls are not active, but indicators still reflect the current state of front-panel functions.

This button is not lighted when the operator has local control. While the analyzer is under local control, it does not execute GPIB messages that would conflict with front-panel controls or change the waveforms in digital storage.

Pressing this button restores local control unless the controller prevents this with the local lockout message. Programmable functions do not change when switching from remote to local control except as necessary to match the settings of the front-panel controls for TIME/DIV, MIN RF ATTEN, and PEAK/AVERGE.

The internal 492P microcomputer flashes the firmware version number and GPIB address on the crt when the button is pressed. This also causes the microcomputer to update the GPIB primary address if the GPIB ADDRESS switches have been changed.

This button has another function in talk-only mode. See the Talk/Listen Only Operation information later in this section.

When the 492P is executing a message that includes the REPEAT command, the REPEAT loop can only be aborted by DCL and then only if the loop contains a WAIT command. Pressing RESET TO LOCAL does not abort the loop, but only causes execution errors to be reported if the loop contains front-panel commands.

Beginning with version 1.2 firmware, pressing RESET TO LOCAL while a message including the REPEAT command is executing, limits message execution to 256 times if the message contains WAIT. A SIGSWP command preceding WAIT in the message is ignored after the RESET TO LOCAL button is pressed, so the REPEAT loop completes quickly.

ADDRESSED. Lights when analyzer is addressed to listen or talk.

GPIB Function Readout. A single character appears in the crt readout when the 492P is talking, listening, or requesting service. The character appears in the position shown in Fig. 3-9, but only while the 492P is addressed to talk or listen or is asserting SRQ.

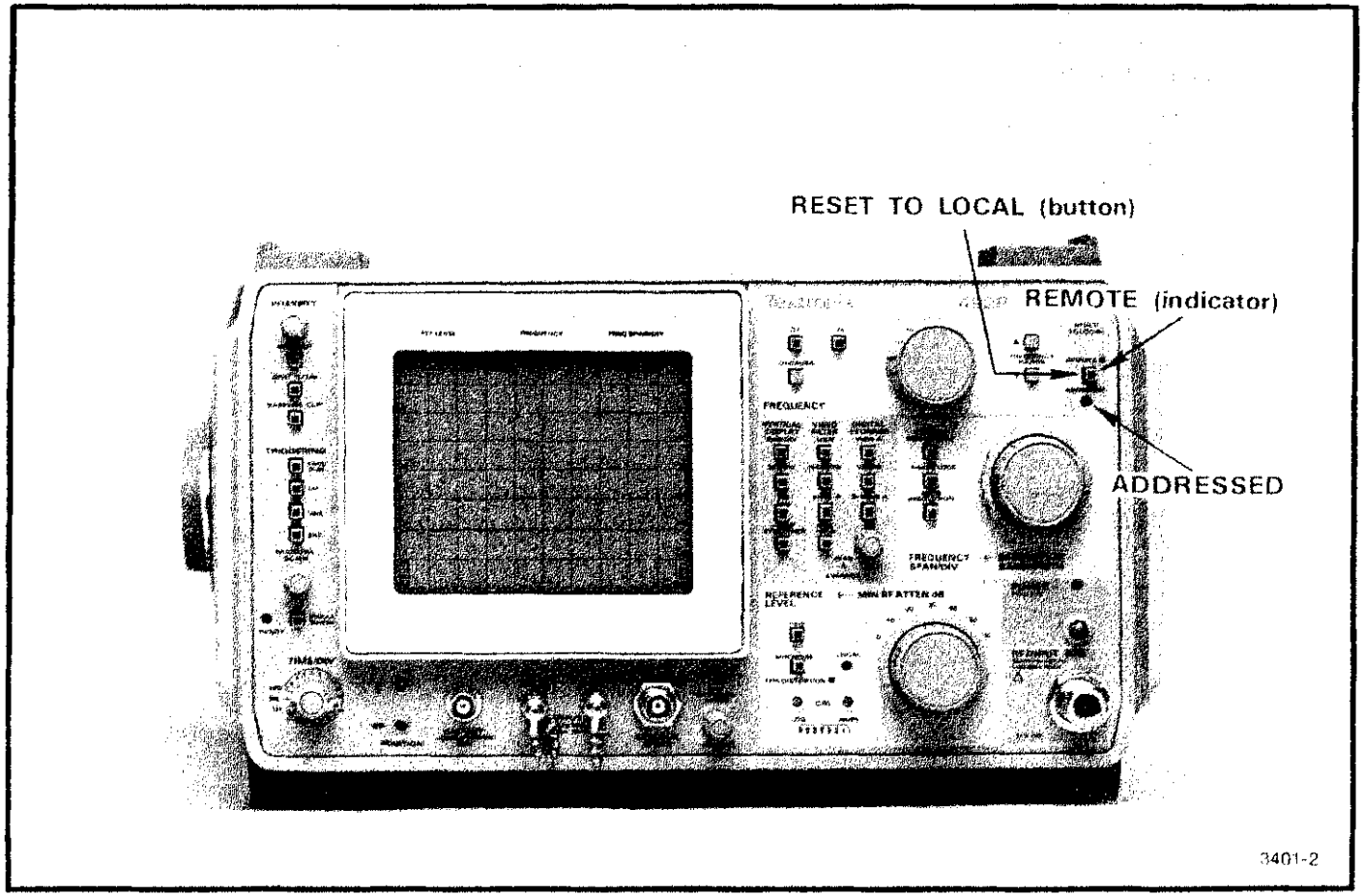


Fig. 3-8. GPIB control and indicators on the front panel.

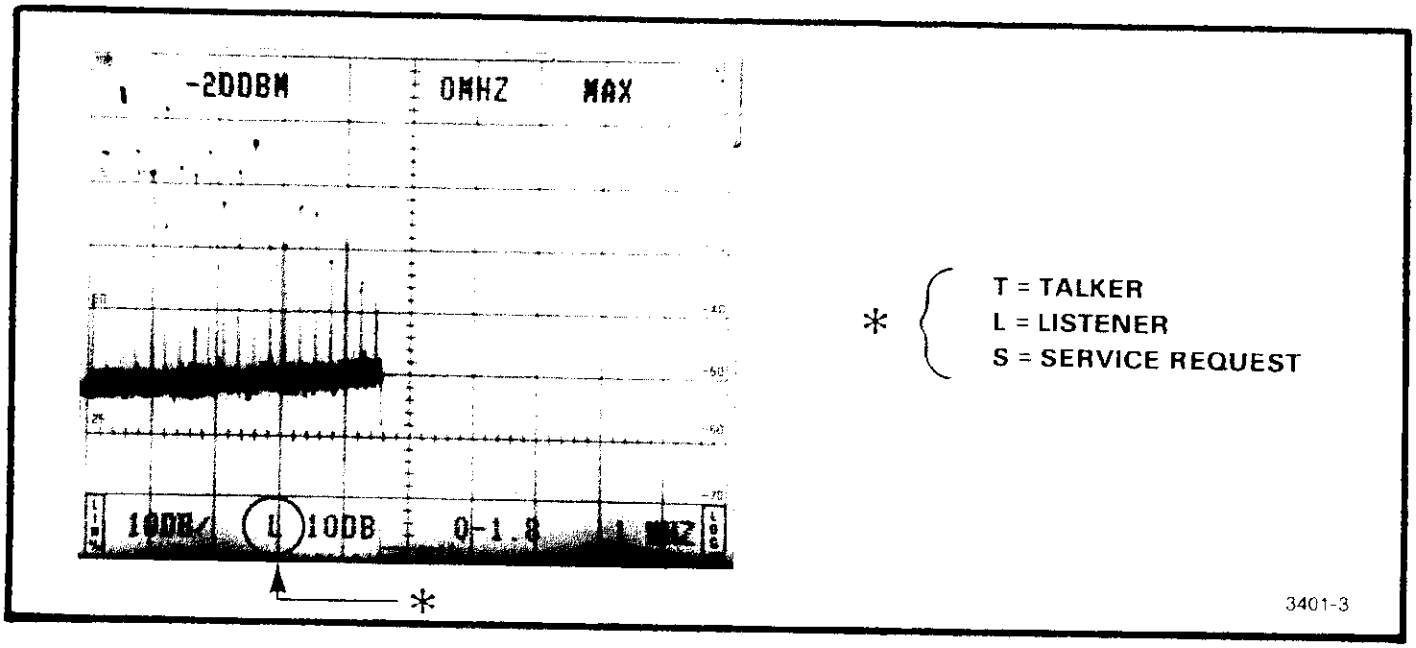


Fig. 3-9. Status of GPIB functions indicated when active.

Rear Panel (Figs. 3-10 and 3-11)

Setting the GPIB ADDRESS Switches. Switches on the rear panel set the value of the lower five bits of the instrument's GPIB addresses. The value of these switches is called the instrument's primary address. Details of how the switches are used in remote control are found in the Programmer's manual.

Set the switches as desired, but don't use 0 with 4050-Series controllers—they reserve this address for themselves. Selecting a primary address of 31 logically removes the 492P from the bus; it does not respond to any GPIB address, but remains both unlistened and untalked. Remember, if you change these switches after the 492P is already powered-up, you must press RESET TO LOCAL to

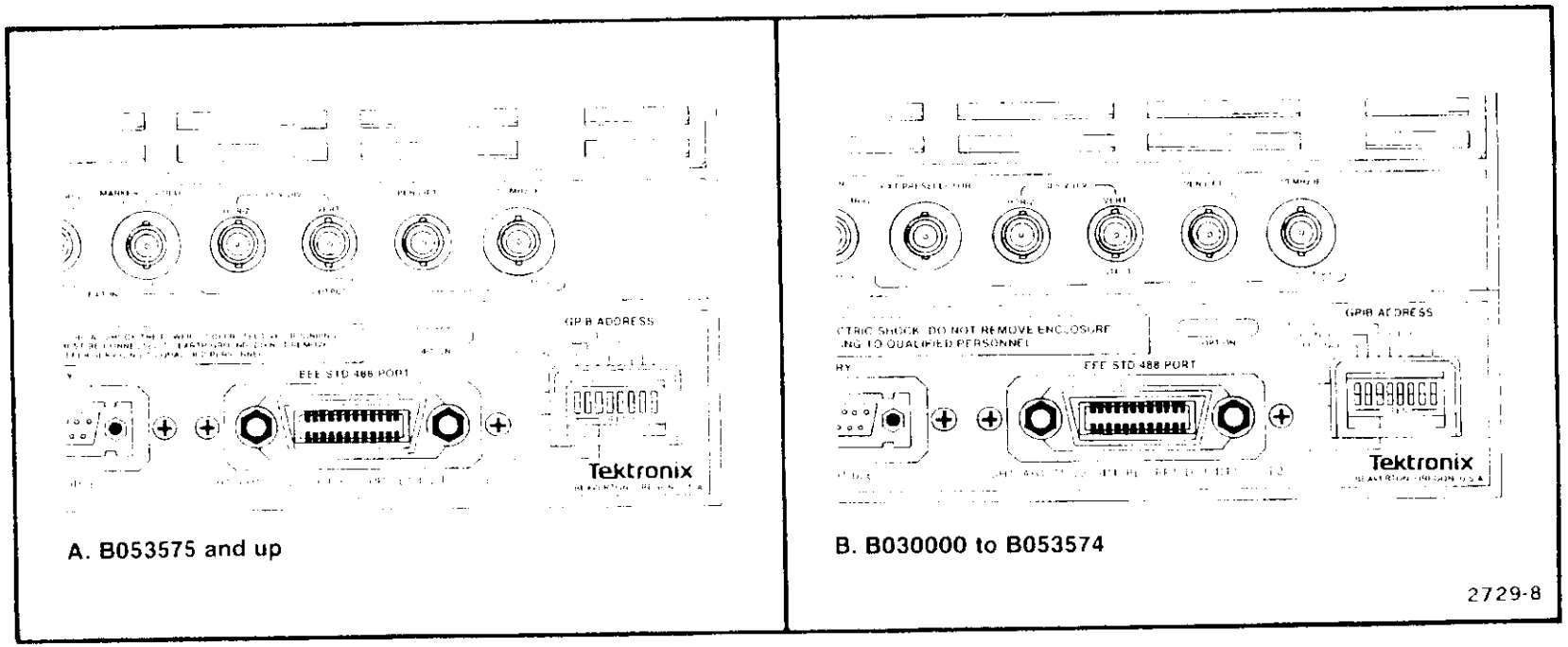


Fig. 3-10. The 492P GPIB port on the rear panel.

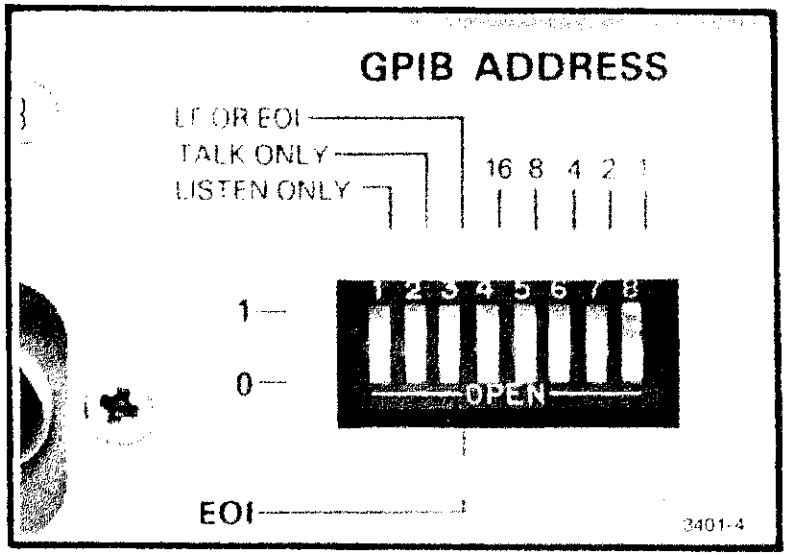


Fig. 3-11. GPIB address, LF, EOI, TALK-ONLY and LISTEN-ONLY switches.

cause the microcomputer to update the primary address.

492P TALK/LISTEN-ONLY Operation

The 492P can be operated as a talker only or a listener only on the GPIB under local control. A simple system requires only the 492P and a talker or listener. Such a system using the 4924 Digital Cartridge Tape Drive is shown in Fig. 3-12.

This system can be used to save spectrum measurements for later display on the 492P or analysis by a controller. This system can also be used to save and restore analyzer control settings.

TALK ONLY, LISTEN ONLY Switches. The 492P switches for talk-only and listen-only operation are part of the GPIB ADDRESS switch bank (Figs. 3-10 and 3-11). Set either or both switches—an extension of the IEEE 488 standard allows you to enable both talk-only and listen-only operation. If 492P power is already on, press RESET TO LOCAL to cause a change in these switches to take effect.

Set the LF OR EOI switch to EOI for use with Tektronix equipment. The switches marked 1, 2, 4, 8, and 16 may be set to any combination except all ones (decimal 31), which logically disconnects the 492P from the bus.

The MODE CONTROL switches on the 4924 rear panel must be set as a pair to operate with the 492P. Set SW1 to On and SW2 to Off (same as for operating with the 4051) or set both switches to the same position (both SW1 and SW2 On or Off).

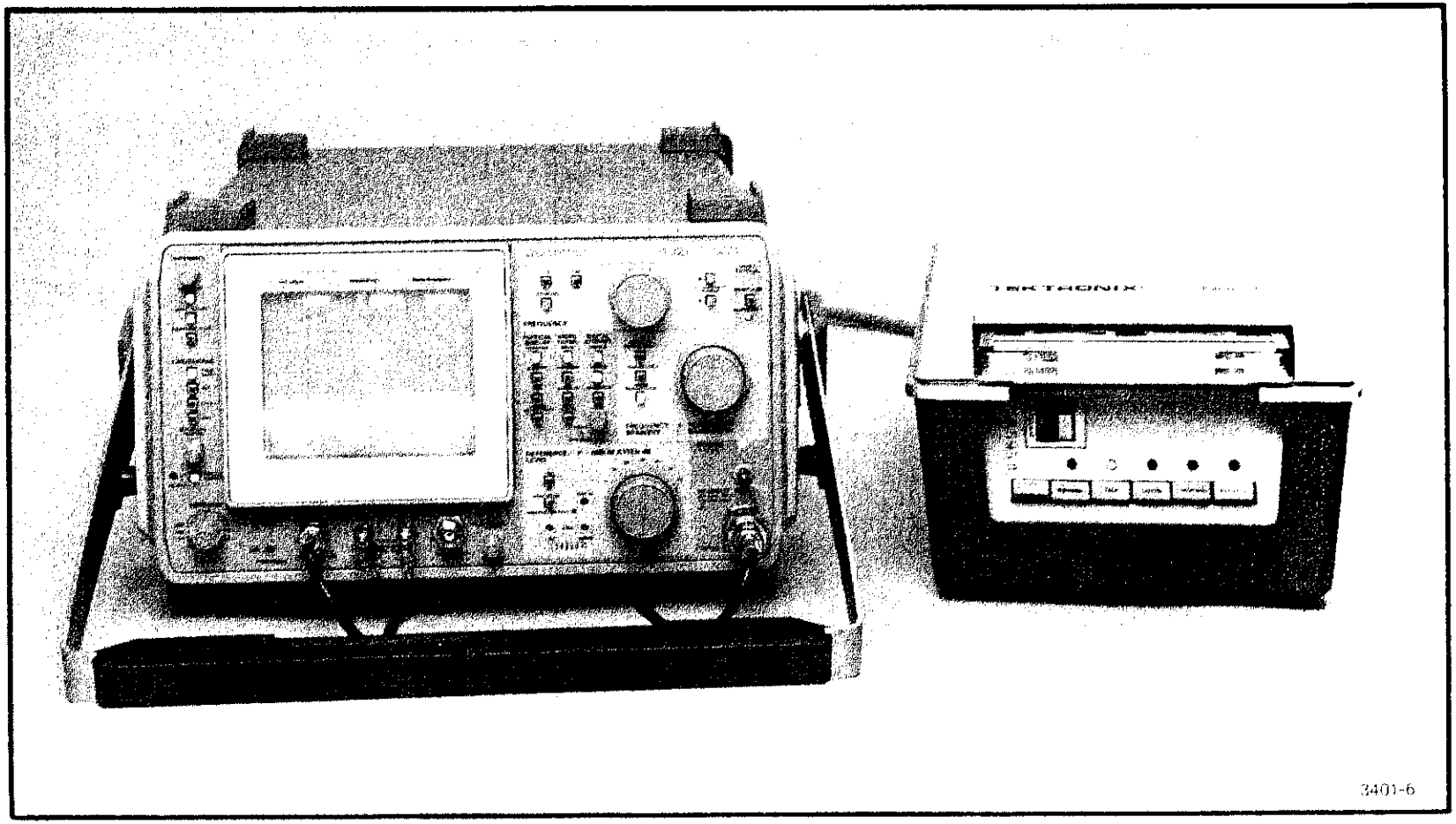


Fig. 3-12. The TEKTRONIX 4924 Digital Cartridge Tape Drive and 492P Programmable Spectrum Analyzer in a TALK/LISTEN-ONLY system.

Data Logging

With the TALK ONLY switch set, you can write spectrum data onto a tape in the 4924 using the controls shown in Fig. 3-13.

1. Insert a marked tape in the 4924. The tape must be previously marked for the size and number of files you expect to record (see the 492P Programmer's manual for tape marking).

2. Connect the 4924 and 492P with a GPIB cable after both are powered up.

3. Set the 4924 ON LINE switch out (off line).

4. Rewind the tape.

5. Press FORWARD to advance to file 1. Press FORWARD again, as desired, to reach a file further into the tape.

6. To save the current control settings and waveform in digital storage, press LISTEN on the 4924 and RESET TO LOCAL on the 492P.

Pressing the RESET TO LOCAL button causes the analyzer to transmit instrument settings and a waveform. The message is formatted so that when it is played back to the analyzer, it restores the settings and display. The message is a combination of the responses to the SET and CURVE queries.

If SAVE A is Off, A and B are transmitted as a full waveform (A and B memories are merged for 1000 points).

If SAVE A is On, A and B are transmitted as separate waveforms (500 points each).

The analyzer transmits waveform data as ASCII-coded decimal numbers unless changed by the ENCDG argument in a WMPRE command. You'll find the full CURVE? response syntax diagram in Section 5 of the 492P Programmer's manual. See Section 7 of the Programmer's manual for the full SET? response syntax program.

NOTE

If an internal switch is changed, the analyzer reports only control settings when RESET TO LOCAL is pressed. Refer questions about setting this internal switch to qualified service personnel.

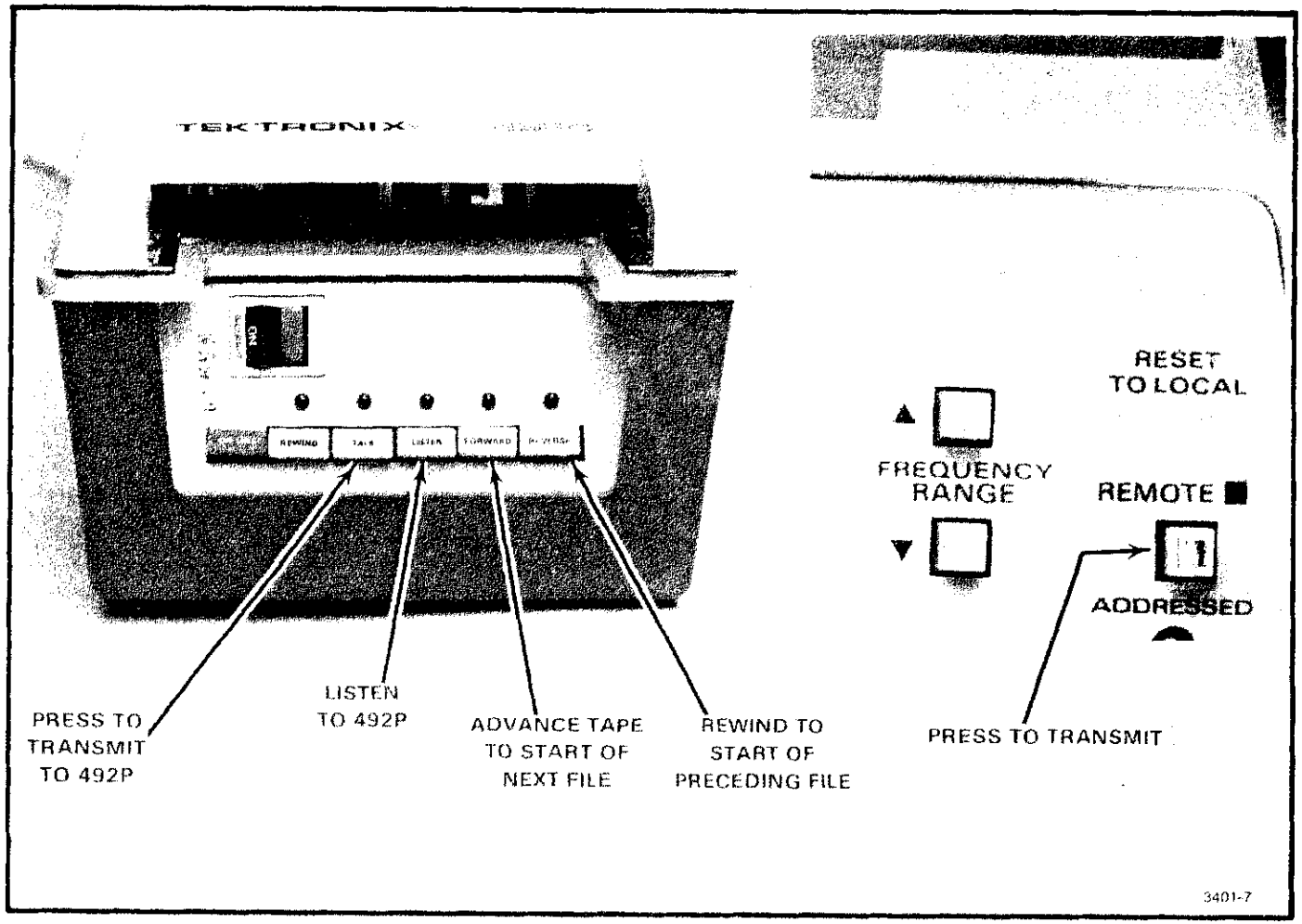


Fig. 3-13. Controls on the 4924 and 492P used for TALK/LISTEN-ONLY data transfers.

The 4924 keeps listening (or talking if TALK is pressed) until the message transfers end—there is no reset switch except for POWER. The 492P, once it starts talking, keeps talking until finished. It also cannot be interrupted except by turning off the power. (This is true only if the 492P begins transmitting—if there is no listener, it flashes a message to the operator and returns to local control.)

7. To move to the next file, press FORWARD. To move to the previous file, press REVERSE. To move to the beginning of the same file, press REVERSE, then FORWARD.

Restoring Control Settings and Display

With the LISTEN ONLY switch set, the 492P buffers and executes device-dependent messages (except for interrupt control commands EOS and RQS). Since the remote-local state diagram in the IEEE 488 standard does not cover the listen-only mode, we have chosen to implement this mode so the 492P goes to remote state after buffering a message. This makes listen-only mode consistent with the nonlisten-only mode, which requires that the 492P be under remote control to execute commands that change front-panel settings or waveform data in digital storage.

To restore control settings and a display previously recorded:

a) find the file on the tape using FORWARD or REVERSE on the 4924;

b) press TALK. The 492P goes to remote to execute the message and then returns to local control.

Listen-only mode can be used for a comparison test. Settings and a waveform previously recorded with SAVE A on can be played back to the analyzer. The analyzer automatically sets up to make the same measurement (turning on SAVE A), and saves the comparison waveform in A memory. If B−SAVE A is selected, the operator can compare the current spectrum data being acquired in B memory to the saved waveform in A memory.

Connecting to a System

The 492P can be connected directly to a GPIB system with the cable supplied with the instrument. The GPIB port is shown in Fig. 3-10. To avoid interference on the bus, connect the 492P after turning on power or while the controller on the bus is turned off.

492/492P OPERATIONAL PRECAUTIONS

1. Measurements Outside the Specified Frequency and Tuning Range versus Span of the Display. Signal level or frequency measurements of signals outside the specified frequency range of the band are not reliable.

The total span of the display for some bands exceeds the frequency range; for example, the display extends below the 1.7 GHz lower limit of Band 2 and below the 15 GHz limit of Band 5 (15—21 GHz). The center frequency tuning range and the frequency indicating dot correspond to the specified frequency range of the band. Because of this difference, it can be confusing when the frequency dot fails to tune across a full MAX span display, or a displayed signal outside the frequency range of the band will not tune to center screen. This occurs in Bands 1 and 2 of Option 01 instruments and in Band 5 (15—21 GHz) of all instruments.

The frequency range for external mixer bands is commensurate with the frequency range of the waveguide mixers. The span of the displays, however, for these external mixer bands, is much wider. Band 6 (18—26.5 GHz) for example, displays at least a 15—39 GHz span.

2. Signal FM. Check to see if the PHASE LOCK switch is activated before deciding that the displayed signal is FM'ing or the spectrum analyzer is malfunctioning.

3. Correct Trigger Mode. The triggering mode is usually in FREE RUN. In pulsed RF applications, a triggered display is required to measure between pulse repetition lines for determining the pulse repetition rate.

Since INTernal triggering requires one or more divisions of signal amplitude, tune the center frequency so a reasonably sized signal is located at the sweep start before changing the trigger source from FREE RUN to INT.

4. Level of Pulsed Signals. The spectrum for a pulsed signal is spread out. Consequently, the height of the crt response is less for a pulsed signal than for a cw signal of the same peak amplitude. This loss in display height means, in effect, a loss in sensitivity. The amount of loss can be computed from:

$$\text{voltage loss} = (t_0 B)^{-1}$$ where

t_0 = pulse

B = resolution bandwidth

The spectrum analyzer self-generated noise power increase is proportional to bandwidth. Pulsed RF voltage level is also proportional. Since power is proportional to voltage squared, a wider bandwidth gives better sensitivity and greater dynamic range for pulsed RF inputs.

When in doubt about signal level overdrive problems, reduce the signal level by inserting RF attenuation, the repeat the measurement. If the two agree, the measurement is correct; if not, the input mixer stage is probably overdriven.

An important consideration for pulsed RF measurements is the peak signal level at the mixer. It is greater by $(t_0B)^{-1}$ than the peak level displayed on the crt. Taking the sensitivity loss into account is the ony sure way of ascertaining that the mixer peak power input for linear operation is not exceeded.

5. Level of Continuous Wave Signals. Similar problems can occur when analyzing cw signals at relatively narrow span widths. The large cw signal may not appear on screen because its frequency is outside the set span width. The mixer nevertheless is saturated and will compress signals.

6. Excessive Input Signal Level. Too much input power will destroy the front end mixer or attenuator. Replacement mixers and attenuators are costly. When working with high power signals, use couplers or other devices to reduce the signal down to acceptable levels. Once the signal is down below the rating of the RF attenuator, prevent possible mixer damage by starting with the MIN RF ATTEN fully on then reduce attenuation if needed.

7. No Crt Trace. The BASELINE CLIP is used to reduce the intensity of the baseline. If Triggering, Intensity, Vertical Position, etc., all seem to be in order and there is no crt trace, check the BASELINE CLIP state.

8. Digital Storage Effects on Signal Analyses. When operating with digital storage, the frequency base is divided into storage slots. For peak displays (above the PEAK/AVERAGE cursor) the display point in each slot corresponds to the maximum sampled value of the signal. Samples are taken at approximately 9 μs intervals. When sweeping at one second per division, this is about 1000 samples per slot. For average displays (below the cursor) the values of all samples per slot are summed and divided by the number of samples to compute the display point for each slot. Each display point is interconnected to create a smooth display. When A or B are displayed independently, only half of the slots are interconnected. The following are a few pitfalls that can occur.

For wide spans and relatively narrow resolution bandwidth (50 or more resolutions per division), the resolution bandwidth equals a digital storage slot. If that slot is in A memory and only B memory is displayed, that point of the signal will not be displayed and an erroneous level would result. SAVE A will display the correct value because an algorithm chooses the larger of adjacent display points to store in A memory.

If the PEAK/AVERAGE cursor is set above the signal level, the average value for each digital slot will be displayed. With narrow resolution andwidth compared to the slot width, the average value of the resolution response shape will be displayed, which has nothing to do with signal amplitude.

To avoid the above pitfalls, it is best to run digital storage with A and B interlaced. Do not set the PEAK/AVERAGE cursor to average a cw signal. It is best to set the cursor about 1/4 division above the signal to be averaged and about 1/2 division below the signal to be analyzed.

None of these restrictions apply when the resolution bandwidth is wide compared to a digital storage slot (e.g., 50 MHz/div with 1 MHz resolution).

9. Stored Display Averaged in Wide Spans. When operating in wide spans, with digital storage, low level signals will be averged with the noise and lost if the PEAK/AVERAGE cursor is above the display. Turn the control fully counterclockwise for peak detection when operating with wide spans.

10. Cold Storage or Power-Interrupt Initialization. After storage below the operating temperature range (see Environmental Characteristics in the 492/492P Operators manual), the microcomputer may not power up correctly. If so, allow the instrument to warm up for at least 15 minutes and reinitialize the microcomputer; turn power off for five seconds, then turn it back on. Repeat, if necessary. It may also be necesary to reinitialize the microcomputer after a power interruption.