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Section 1
GENERAL DESCRIPTION

1-1. Outline of the Tracking Scope

The TR 4110/ TR 4110M Tracking Scope Mainframe and the TR 4114/4114T/ 4114H/4114HT RF Section constitute a tracking scope capable of measuring radio frequencies within the range from 50 Hz to 120 MHz with 10 Hz resolution. The input sensitivity is -135 dBm.

The TR 4110/ TR 4110M tracking scope mainframe is composed of an IF section and a CRT display section. The CRT display screen has dynamic range of 80 dB. The LED displays located on the left of the screen anounce the reference level and the setting values of the DISPERSION/DIV. and BAND WIDTH switches on the RF section, to facilitate reading of the measuring conditions.

The TR 4114 series plug-in unit is an RF section to be inserted into the TR 4110/ TR 4110M mainframe. A tracking generator is incorporated in the TR 4114T/ TR 4114HT to permit visual checking of frequency response characteristics. The input impedance of the TR 4114/ TR 4114T is 50 Ω, an that of the TR 4114H/ TR 4114HT is 1 MΩ, 20 pF. The TR 4114 series plug in unit is provided with an automatic band width setting feature that automatically sets the scan time and band width at the optimum values when the DISPERSION/DIV. switch is set at optional position. Thus complex operations are eliminated and prompt measurement is possible. The TR 4114 series plug in unit allows a wide range of purity, spurious and noise measurements since the spectrum purity of the plug in unit itself is excellent.

The TR 4110M is identical to the TR 4110 in basic design, but differs in having a storage tube for the CRT display. The storage tube is of halftone type.

Section 2
SPECIFICATIONS

2-1. TR-4114/4114T/4114H/4114HT Specifications

Frequency response characteristics

Frequency measuring range:
50 Hz to 120 MHz

Scan width:

PER DIVISION	From 50 Hz/div. to 20 MHz/div. in a 1, 2, 5 sequence (DISPERSION/ DIV. switch.)
FULL	0 to 120 MHz
ZERO	The X axis on the CRT screen assumes the time axis.

Selection of PER DIV, FULL, or ZERO mode with the SWEEP MODE switch; continuously variable by more than ±50 kHz or ±500 Hz with the FINE TUNE control.

Frequency accuracy

Center frequency accuracy:
The LED indicates the display center frequency within 1 MHz;
Within 100 kHz with use of the incorporated COMB generator;
Within 10 Hz when a frequency counter is connected to the TR-4114T/ TR-4114HT plug-in units.

Scan width accuracy:
Within ±5%

Resolution

Band width:
10 Hz to 300 kHz in a 1, 3 sequence by the BAND WIDTH switch.

Band width accuracy:
±25% (for 3 dB down point)

Band width selectivity:
60dB/3dB IF band width ratio 1:15 (10 Hz to 300 kHz)
Approx. 60 dB, 50 Hz or more away from carrier signal with 10 Hz band width.

Stability

Frequency stability (one hour after power on):
After stabilization:
3 Hz p-p/0.1 sec, 50 Hz/min
Before stabilization:
1 kHz p-p/0.1 sec, 5 kHz/min

Noise sideband (at ±23°C ±10°C):
Average noise level when the VIDEO FILTER switch is set at 10 Hz. (See Table above.)

Amplitude accuracy

Frequency response:
1.5 dB p-p (50 Hz to 120 MHz)

Switching between band width accuracy:
±1 dB (10 Hz to 300 kHz) (at 23°C ±10°C)

Scale selection:
Switching between logarithmic and linear scales.

LOG. scale:
10 dB/division, 5 dB/division, 2 dB/division, 1 dB/division set on the dB/DIV. switch.

LOG display accuracy:
±0.5 dB or less/ 10 dB
±1.5 dB or less/ 70 dB

STABILIZER	Band width	Difference from Center freq.	Noise level
OFF	1 kHz	50 kHz	-95 dB below
OFF	1 kHz	20 kHz	-90 dB below
OFF	300 kHz	10 kHz	-85 dB below
ON	100 kHz	5 kHz	-85 dB below
ON	100 kHz	2 kHz	-84 dB below

Dynamic range
Gain compression:
1 dB or less for -10 dBm input.
Spurious response:
-80 dB below for -40 dBm input (for 15 MHz or higher frequency); -70 dB below for -40 dBm input (for frequency lower than 15 MHz).
Residual response:
-100 dBm (for no input, input attenuation below is 0 dB)

Calibration output
Level:
-20 dBm ±0.5 dB
Frequency:
10 MHz ±1 KHz, 1 MHz COMB signal included.
Connector:
BNC type

Input characteristics
Minimum average noise level:
-135 dBm or less
Maximum input level:

TR 4114/T	TR 4114H/HT
+20 dBm DC ±10 V	5 Vrms. (RF ATT. 0dB) 30 Vrms (RF ATT. 20 dB or more) ±100 V DC

Input impedance:
TR 4114/4114T ... Approx. 50 Ω (VSWR 1.3 or less for RF ATT. setting at 10 dB)
TR 4114H/4114HT ... 1 MΩ, approx. 20 pF
Input attenuator:
TR 4114/4114T ... 0dB to 40 dB in a 10 dB sequence
TR 4114H/4114HT ... 0 dB to 50 dB in a 10 dB sequence
Error within ±0.5 dB in both of above types of attenuator
Connector:
BNC type

Tracking generator section (for TR 4114T/4114HT only)
Frequency characteristics:
30 kHz to 120 MHz
1 dB p-p (with the ALC. set at ON)
50 Hz to 30 kHz
1 dB p-p (with the ALC. set at OFF)
Output level:
Less than -40 dBm to +10 dBm
Output attenuator:
0 dB to -40 dB in a 10 dB sequence and OFF; continuously variable from 0 dB to 10 dB or more.
Output impedance:
Approx. 50 Ω
Stability:
Same as the spectrum analyzer section
ALC (Automatic Level Control):
Response for 30 kHz or higher frequency
TG mode:
TUNED AMP ... Selects and amplifies signals of -70 dB or more and S/N ratio 10 dB or more, then generates the signal.
NOR. (Normal) ... Output of the signal synchronized with the frequency axis on the CRT screen

General specifications
Ambient temperature (for operation):
0°C to +40°C
Power consumption:
Approx. 20W
Weight:
Approx. 7 kg
Dimensions:
Approx. 181.5(W) x 117.5(H) x 469 (D) (mm)

2-2. TR 4110/TR 4110M Specifications

Amplitude characteristics
Reference level indication:
-60 dBm to +40 dBm in a 10 dBm sequence; indication in dB μ is optional
IF gain:
0 dB to 60 dB in a 10 dB sequence;
0 dB to 12 dB in a 1 dB sequence;
continuously variable by more than ±1.5 dB by means of the VARI. control.
Reference level indication accuracy:
±0.5 dB
Display level accuracy:
±0.5 dB/10 dB, ±1.5 dB/70 dB

Level stability:
0.1 dB/°C (for IF band width of 300 kHz)
Warning indication:
LED indicator
Video filter:
Selectable from 10 Hz, 100 Hz, 10 kHz and OFF.

Scan characteristics

Scan mode:
Selectable from the SINGLE, EXT., INT., and MANUAL modes.
Scan trigger:
Selectable from the AUTO, LINE, EXT., and VIDEO modes, only when the SCAN MODE switch is set at INT.

Scan time characteristics

Scan time;
20 μs/division to 10 sec/division; in a 1, 2, 5 sequence.
Scan time accuracy:
±15%
Scanning indication:
LED indicator

Output characteristics

X axis output:
Output impedance Approx. 1 kΩ
Output level ±5 V
Y axis output:
Output impedance Approx. 5 kΩ
Output level 3 V p-p for full scale
Z axis output:
Output level TTL level blanking at low level

CRT characteristics

Dynamic range:
80 dB
CRT:
TR-4110
Post deflection acceleration type tube.
P7 persistence
400 ms
Screen space
10 cm x 8 cm (10 divisions x 8 divisions)
TR-4110M
Half-tone type storage tube, acceleration voltage 7.5 kV, P31 phosphor; screen space 9.5 cm x 7.6 cm (10 division x 8 divisions)

General specifications

Ambient temperature (for operation):
0 °C to 40 °C
Power supply:
100 VAC ±10%, 50/60 Hz; approx. 140 VA (TR-4114 series included); selectable from 115, 200 and 230 VAC by tap changing.
Dimensions:
Approx. 425(W) x 175(H) x 472(D) (mm)
Weight:
Approx. 20 kg
In addition to the above features, the TR-4110M is operable in any of the following four display modes:

NORMAL:
Use as a non-storage tube
PERSISTENCE:
Variable range MIN ... 500 ms
MAX ... 15 sec
Hold ..... 120 sec
STORE:
MIN ..... 1 min
MAX ..... 1 hour
ERASE:
Available in the PERSISTENCE mode; approx. 1 sec
Warm-up time;
Approx. 1 min.

2-3. TR 4114 Series Accessories

	TR 4114	TR 4114T	TR 4114H	TR 4114HT
Input cable (MI-02)	1	2	1	2
Slow blow fuse (See note)	2	2	2	2
Hexagonal wrench (3 mm, 4 mm)	1 each	1 each	1 each	1 each
TR 1622 50 Ω terminator	0	0	1	1
Instruction manual (for TR 4110 series tracking scope)	1	1	1	1

Note: Fuse value
AC 100 V, AC 115 V ... 2A slow-blow (EAWK-2A)
AC 200 V, AC 230 V ... 1A slow-blow (EAWK-1A)

Section 3
OPERATING PROCEDURE

3-1. Inspection

The TR-4110/4110M mainframe and TR-4114 series plug-in unit are separately packed. On receiving the mainframe and plug-in unit, unpack and inspect them for damage during shipment and loosening of controls and other fittings.

If damage is found or any plug-in unit or mainframe does not operate in conformity with the specifications, contact an agency or the Takeda Riken Industry.

3-2. Preparations and Precautions before Use

(1) Power voltage
The standard AC power voltage required for the instrument is 200 VAC ±10%. The power voltage is set at the specified voltage before the shipment. The power voltage to be supplied is designated under the power connector on the rear panel. No other power voltage can be used.

(2) Power cable
The power cable connected to the mainframe consists of an MP-20 cable and an adapter (KPR-13 (black)).

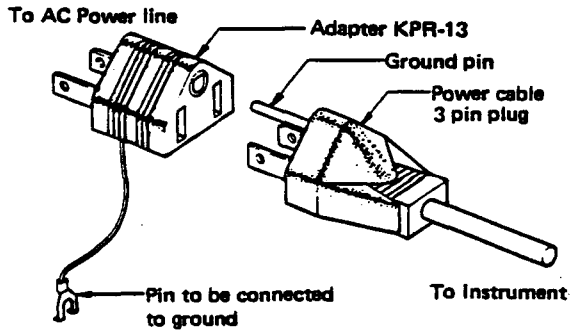


Fig. 3-1 Power cable

The plug attached to the power cable has three pins. The round pin in the upper center is for ground connection.
When using an adapter to connect the cable to the AC outlet, connect the external ground to the ground lead of the adapter or the ground terminal provided on the rear panel of the TR-4110/4110M mainframe.

(3) Confirm that the POWER switch is set to OFF before connecting the power cable.

(4) Protect the instrument against excessive impacts since the TR-4114 series RF section and the TR-4110/4110M mainframe are interconnected via a connector and the TR-4110/ 4110M mainframe houses a CRT.

(5) Locate the instrument so as to facilitate ventilation since the instrument draws in air through the slit on its side and blows it out via the fan provided on the rear panel for cooling.

(6) Warm-up time
The instrument starts operation approximately 10 sec. after the POWER switch is turned on. However, it takes approximately one hour of warm-up to ensure stable operation of the complete circuit.

(7) Storage
When you are not going to use the instrument, pack it in a vinyl sack or a corrugated cardboard box and store it in a place of low humidity protected from the direct sunlight. The allowable storage temperature range is from -20 °C to +70 °C.

3-3. Interconnection of the TR-4110/ 4110M and TR-4114 Series Plug-in Units.

After unpacking the TR-4110/4110M mainframe and the TR-4114 series plug-in unit, which are separately packed, insert the TR-4114 series plug-in unit into the TR-4110/4110M mainframe.

Confirm that the POWER switch is set to OFF before inserting the plug-in unit. Refer to Fig. 3-2 when reading the following description of the insertion procedure.

(1) Pull the lock lever on the TR 4110/4110M mainframe until it is perpendicular to the front panel.
(2) Carefully insert the TR 4114 series plug-in unit backwards into the TR 4110/4110M mainframe.
(3) Pushing the front panel of the TR 4114 series plug-in unit, fully insert the plug-in unit. The lock lever is restored to its previous position after the insertion operation.
(4) Push the lock lever under the TR 4114 series plug-in unit and lock it.
To draw out the TR 4114 series plug-in unit, lift and pull the lock lever. The plug-in unit can then be withdrawn.
After completely inserting the plug-in unit, adjust the CRT display in accordance with section 5-2.

3-4. Fittings on Panel

Figure 3-3 shows the front panel of the TR 4110 and TR 4110M mainframes with the TR 4114T plug-in unit inserted in the respective mainframes,

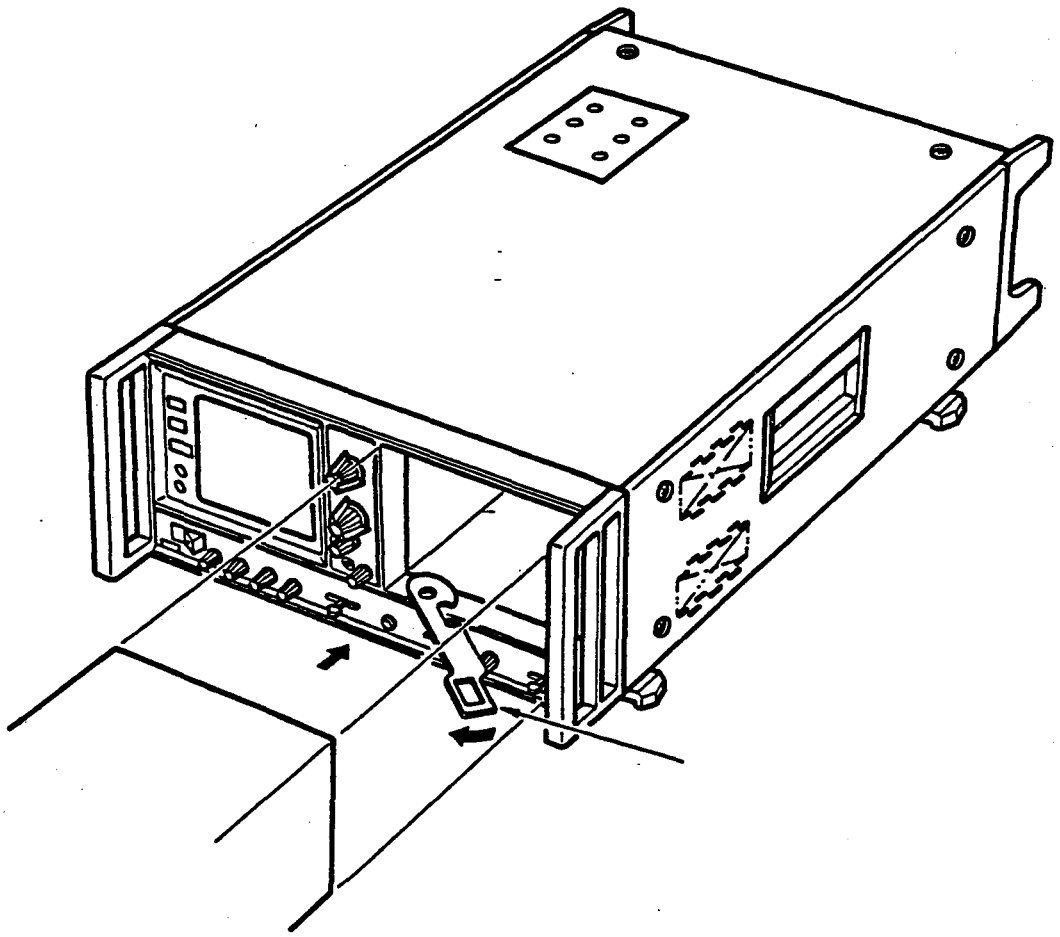


Fig. 3-2 Interconnection of the TR 4110/4110M and TR 4114 series modules

and the rear panel of the TR 4110/4110M module. This figure is valid also for the combination of the TR 4114/4114H/4114HT plug-in unit and the TR-4110 mainframe, or the combination of the TR 4114/4114H/4114HT and the TR 4110M.

-- Front Panel --

(1) POWER switch
Setting the POWER switch at ON supplies power to the instrument, and puts the instrument into operation after approximately 10 sec. Setting this switch at OFF immediately turns the power off.

(2) FOCUS control
Focuses the bright line on the CRT screen.
Operating the INTENSITY control may defocus the bright line. Consequently, refocus by means of the FOCUS control.

(3) INTENSITY control
Adjust the intensity of the spectrum on the CRT screen. Turning the control clockwise intensifies the spectrum. It may defocus the spectrum.

CAUTION
Excessive intensity may burn the fluorescent screen of the CRT.

(4) GRASS CLIPPER control
Erases the noise (grass) at the bottom of the CRT screen up to the desired height, to improve the spectrum readability.
This control is used to balance the intensity in case of taking a photograph (using the TR 1651).

(5) SCALE ILLUM. control (for TR 4110 only)
Illuminates the scale on the CRT screen and adjusts the intensity of illumination.

(6) SCAN TRIGGER switch
Sets the scanning trigger mode when the SCAN MODE switch is set at INT.
When the VIDEO mode is selected, scanning is triggered by a signal within the range from 100 Hz to 100 kHz on the CRT screen, as in the case of an oscilloscope. (The signal amplitude must reach at least the second mark on the scale.)
When the EXT. mode is selected, scanning is triggered by a TTL level signal applied to pin 5 of the OUTPUT connector on the rear panel.
When the LINE mode is selected, scanning is triggered by the AC power frequency. This mode permits recognition of induced noise from the AC power supply, etc.
When the AUTO mode is selected, scanning is automatically repeated with the timing set in the instrument

(7) SCAN MODE switch
Selects the scan mode.
When the SINGLE mode is selected, pressing the pushbutton switch on the left of the SCAN MODE switch initiates a scanning cycle. The scan time is determined by the scan time set in the instrument.
When the EXT mode is selected, applying a signal of -5 V to +5 V to the SCAN INPUT/OUTPUT connector on the rear panel initiates scanning.
When the MANUAL mode is selected, the MARKER POSITION/MANUAL SWEEP control on the right of the SCAN MODE switch can be used for manual sweep.
When the INT. mode is selected, scanning is performed by the scan generator incorporated in the instrument. The SCAN TRIGGER switch is effective only when the SCAN MODE switch is set at INT.

(8) MARKER POSITION/MANUAL SWEEP control
When an external frequency counter is connected to this instrument, a marker spot appears in spectrum on the CRT screen as though caused by intensity modulation. Turning this control moves the marker spot. The frequency of the marker spot is

indicated on the frequency counter.
When the SCAN MODE switch is set at MANUAL, turning this control permits manual sweep.

(9) VIDEO FILTER switch
Selects the cut-off frequency for the CRT driver in the instrument. When high level noise affects the spectrum, setting this switch will integrate the noise and improve the spectrum readability.

(10) SWEEP MODE switch
Selects the sweep mode for the X axis (also known as the horizontal axis or frequency axis) on the CRT screen.
When the FULL mode is selected, a scanning cycle sweeps from 0 to 200 MHz. The frequency indicated by the FREQUENCY indicator is displayed in the form of a V-shaped marker on the base line.
When the PER DIV. mode is selected, the frequency scale on the CRT screen is determined according to the setting of the DISPERSION/DIV. switch, and the FREQUENCY indicator shows the center frequency on the CRT screen.
When the ZERO mode is selected, frequency scanning is not performed, and the frequency is fixed at the value set with the TUNING control. The X axis represents the time axis set with the SCAN TIME/DIV. switch. Thus the instrument operates just like an ordinary selective levelmeter.

(11) LOG./LIN. switch
Selects the scale for the Y axis on the CRT screen.
When this switch is set at LOG., the Y axis represents the logarithmic scale, and when it is set at LIN., the Y axis represents the linear scale. The gain per scale division can be increased with the dB/DIV. switch.

(12) dB/DIV. switch
Sets the gain per scale division of the Y axis on the CRT screen.
When the LOG./LIN. switch is set at LOG., setting this switch at 1, 2, 5 or 10 selects 1 dB/division, 2 dB/division, 5 dB/division or 10 dB/division respectively. When the LOG./LIN. switch is set at LIN., setting this switch at 1, 2, 5 or 10 multiplies the linear gain value per division by ten, five, two and one respectively.

(13) STABILIZER switch
When the SWEEP MODE switch is set at PER DIV. or ZERO and the DISPERSION/DIV. switch is set at a value lower than 20 kHz, setting this switch at ON automatically stabilizes operation. For stabilization, the first local oscillator is phase-locked by a 1 MHz crystal oscillator.
Accordingly, when the DISPERSION/DIV. switch is set at a value lower than 20 kHz, the FINE TUNE control must be used to move the spectrum.
When the STABILIZER switch is set at OFF, the first local oscillator is not phase-locked.
Therefore, the TUNING control is effective for the DISPERSION/DIV. switch setting up to 10 kHz, and the sideband noise is low.

(14) INPUT connector
Input connector of RF signal. The input impedance is approximately 50 Ω and the maximum input level is +20 dBm, ±10 V DC for the TR 4114/4114T, while the input impedance is 1 MΩ with approximately 20 pF, and the maximum input level is 30 Vrms, ±100V DC for the TR 4114H/ 4114HT.

(15) CAL. OUT. connector
Gives the output of the referrence oscillator in the module. This signal is used for calibration of the level and frequency.
The output frequency is 10 MHz and the output level is -20 dBm.
A 1 MHz COMB signal generator is incorporated to facilitate calibration of the X axis.

(16) RF ATT. switch
Attenuates the input signal level. This switch is used when the input signal level is too high. The maximum input level of the

TR-4114/4114T is +20 dBm, ±10 VDC regardless of the setting of the RF ATT. switch.
The maximum input level of the TR-4114H/4114HT is 5 Vrms (with the RF ATT. set at 0 dB) or 30 Vrms (with the RF ATT. set at over 20 dB), ±100 VDC.

(17) ZERO ADJ. control
Adjusts the FREQUENCY indicator to "□□□". This control is used when the zero frequency spectrum is set at the center of the CRT screen by means of the TUNING control.

(18) FINE TUNE controls
The two FINE TUNE controls permit fine adjustment of the frequency.
The ±50 kHz control varies the frequency within the range of ±50 kHz (100 kHz), and is used with the DISPERSION/DIV. switch set at 20 kHz or less. The ±500 Hz control varies the frequency within the range of +500 Hz (1 kHz), and is used with the DISPERSION/DIV. switch set at 200 Hz or less.

(19) TUNING control
Sets the center frequency (the frequency at the CENTER mark of the X axis) on the CRT screen.
The FREQUENCY indicator indicates the center frequency displayed on the CRT screen.
When the STABILIZER switch is set at OFF, this control is effective for DISPERSION/DIV. switch settings up to 10 kHz.

(20) DISPERSION/DIV. switch
Sets the frequency scan width per scale division of the X axis on the CRT screen. The scan width can be set within the range from 0.05 kHz to 20 MHz. The switch provides selection of a value in a 1, 2, 5 sequence.

(21) BAND WIDTH switch
Varies the IF band width which determines the resolution of this module. Narrowing the IF band width lowers the noise level and improves the frequency resolution, but causes response lag. If the response lag causes an error in the level, the WARNING lamp lights up. In this case set the SCAN TIME/DIV. or DISPERSION/ DIV. switch so as to extinguish the WARNING lamp.
When this switch is set at AUTO, setting the DISPERSION/DIV. and VIDEO FILTER switches automatically sets the scan time/division and band width.

(22) TG. LEVEL switch (for TR-4114T/4114HT only)
Attenuates the tracking generator output.

(23) LEVEL VARI. control (for TR-4114T/4114HT only)
Continuousely changes the output level of the tracking generator (T.G.) with combination to the T.G. LEVEL switch described above.
When this control is turned clockwise up to the maximum (CAL.), the output level equals the value set by the TG. LEVEL switch. As the switch is turned counterclockwise from the CAL. positon, the T.G. output level decreases. When set to fully counterclockwise, the T.G. output level decreases approximately 10 dB.
When turned fully counterclockwise with a little bit stronger force, the control is switched and set to the OFF. When set to OFF, the T.G. output level is cut off completely. When the tracking generater is not used, it is advisable to set this control to OFF so that more sensitive measurement is possible.

(24) TG. FREQ. control (for TR-4114T/4114HT only)
Permits fine adjustment of the frequency output from the tracking generator.
When the BAND WIDTH switch is rotated clockwise to make the IF band width narrow and the tracking generator output frequency is not exactly equal to the frequency of the spectrum analyzer, the signal level on the CRT screen declines. Thus this control must be used to prevent the level from declining.

Fine adjustment with this control is unnecessary when the BAND WIDTH switch is set at over 300 Hz, but is necessary when this switch is set within the range from 10 Hz to 100 Hz.

(25) TG OUT. connector (for TR4114T/4114HT only)
Tracking generator output connector. No DC voltage must be output since the DC voltage would not be cut at this connector.

(26) ALC. switch (for TR4114T/4114HT only)
Stabilizes the tracking generator level. This switch should be set at OFF for frequencies lower than 30 kHz since the ALC. cannot respond to such frequencies.

(27) TG MODE switch (for TR4114T/4114HT only)
When this switch is set at NOR., the tracking generator functions and emits the signal in synchronism with the frequency displayed on the CRT screen from the TG OUT. connector.
When this switch is set at TUNED AMP., the signal connected to the INPUT connector is selected, amplified and emitted from the TG OUT. connector.
When this switch is set at TUNED AMP., the tracking generator operates as a selective amplifier.

(28) PROBE POWER connector (for TR4114/4114T only)
Supplies power when the active probe is used. The ±15V power voltage and ground are supplied.

(29) SCAN TIME/DIV. switch
Sets the scan time per scale division of the X axis on the CRT screen. The scan time can be set within the range from 20 [s to 10 sec, being selected from among values in a 1, 2, 5 sequence.
Manual switching is prevented when the BAND WIDTH switch on the RF section is set at AUTO.

(30) IF GAIN 10 dB step switch
Selects IF stage gain between 0 dB to 60 dB in 10-dB increment.
Operating this switch varies the reference level and the REFERENCE LEVEL indicator changes by 10 dB steps.

(31) IF GAIN 1 dB step switch
Selects IF stage gain between 0 dB to 12 dB in 1-dB increment.
REFERENCE LEVEL indication LEDs do not change by this switch.

(32) VARI. control
Continuously varies the gain in the IF stage by ±1.5 dB. When this control is turned counterclockwise to the CAL. position, the control is turned off.

(33) CAL. control
If level calibration using the CAL. OUT. signal cannot be done by setting the VARIABLE control at CAL., this control is used.

(34) CRT display
The TR4110 has a CRT display with screen area of 10 cm x 8 cm. The CRT has P7 phospher for persistence of approximately 400 ms.
The TR4110M has a CRT display with a variable persistence storage type CRT (P31 phosphor) which gives a clear, stable trace even for repeated scanning at a low speed.

(35) DISPERSION/DIV. indicator
LED indicator to indicate the value set with the DISPERSION/DIV. switch.

(36) BAND WIDTH indicator
LED indicator to indicate the value set with the BAND WIDTH switch.

(37) REFERENCE LEVEL indicator
LED indicator to indicate the reference level of the CRT screen in terms of the absolute level. The indication is according to the setting of the RF ATT. and IF GAIN 10 dB step switches.
The indication ranges from -60 dBm to +40 dBm for the TR4114/4114T, and from -60 dBm to +50 dBm for the TR4114H/4114HT.

(38) WARNING lamp
Lights up to give warning when there is a level error in the spectrum displayed on the CRT screen.
When this lamp is lit, set any one of the SCAN TIME/DIV., VIDEO

FILTER, DISPERSION/DIV. and BAND WIDTH switches again to extinguish it.

(39) SCANNING lamp
Lights to indicate scanning.

(40) Display Mode switches (for TR-4110M only)

-- Rear Panel --

(41) X AXIS connector
Gives the X axis signal as output on the CRT screen. The output level is approximately ±5 V and the output impedance is approximately 1 kΩ.

(42) Y AXIS connector
Gives the Y axis signal as output on the CRT screen. The output level is 3 V p-p for full scale, and the output impedance is approximately 10 kΩ.

(43) Z AXIS connector
Emits the blanking signal. The output level is the TTL level which is low during blanking. The output impedance is approximately 5 kΩ.

(44) SCAN INPUT/OUTPUT connector
When the SCAN MODE switch on the front panel is set at EXT., an external voltage of -5 V to +5 V applied to this connector causes scanning. When the SCAN MODE switch is set at a position other than EXT., the internal scanning signal is emitted from this connector. Consequently, this connector can be used for monitoring. The output impedance is approximately 1 kΩ. The load connected to this output affects the CRT display since this output is directly connected to the CRT driver circuit. Therefore, the input impedance of the load connected to this output should be as high as possible.

(45) Y INPUT and OUTPUT connectors The OUTPUT connector gives the 0 V to +4.5 V output signal from the LOG. amplifier within the module.
The INPUT connector is connected to the input of the CRT driver circuit. Usually the INPUT and OUTPUT connectors must be interconneted with a cable.

(46) X INPUT and OUTPUT connectors
The OUTPUT connectors gives the X axis signal. Usually the INPUT and OUTPUT connectors must be interconnected with a cable.

(47) Ground terminal
Terminal to connect the ground. When attaching a two-pin adapter to the power cable, connect the ground to the ground lead of the adapter or this terminal.

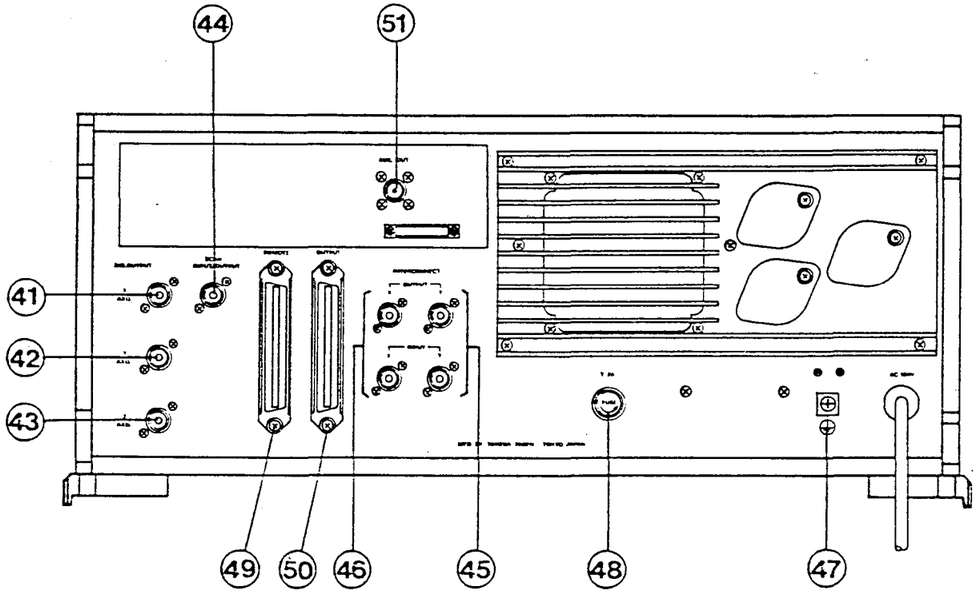
(48) FUSE
Fuse for power line. The 2 A slow-blow fuses are used for the 100 V AC and 115 VAC power voltages, and the 1A slow-blow fuses are used for the 200 VAC and 230 VAC power voltages.

(49) REMOTE connector (option)
Connector to connect the remote control signal.

(50) OUTPUT connector
If the instrument is to be used in synchronism with a frequency counter manufactured by the Takeda Riken Industry, this connector must be connected to the DATA OUT. or TRACKING SCOPE COUNT. connector on the frequency counter by a cable provided exclusively for this purpose.

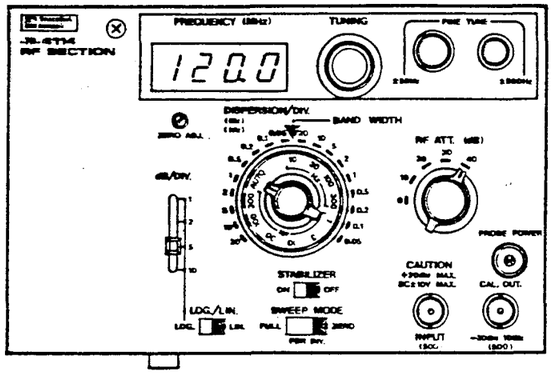
(51) AUX. OUT. connector (for TR-4114T/4114HT only)
When the TR-4114T/4114HT is incorporated, the AUX. OUT. connector gives the same signal as output from the TG. OUT. connector on the front panel. This connector is used for connection to a frequency counter or other device.

TR 4110/4114T Front Panel

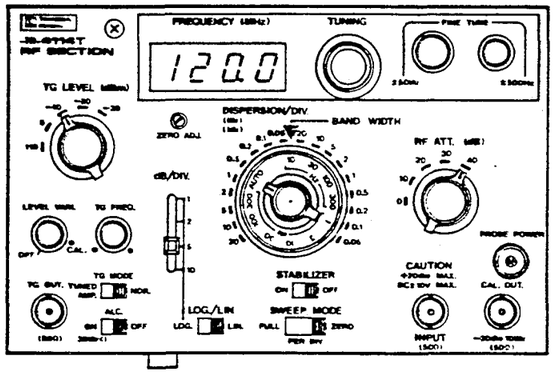


TR 4110/4110M Rear Panel

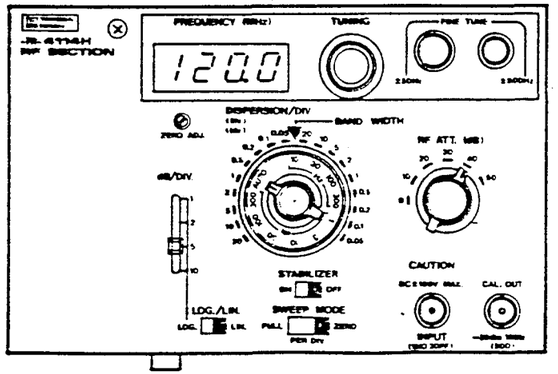
Fig. 3-3 Panel Description



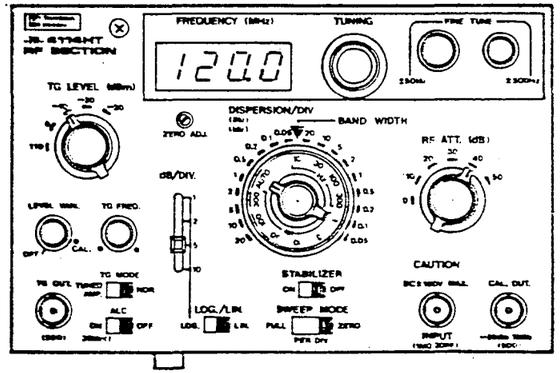
TR 4114



TR 4114T



TR 4114H



TR 4114HT

3-5. Basic Operating Procedure

The basic operating procedure for use of this module is discussed hereunder. The description given here will also be helpful in checking to confirm normal operation of the module.

Apply the following procedure in the indicated sequence, referring to Fig. 3-8.

(1) Confirm that the POWER switch is set at OFF and connect the power cable.

(2) Set the switches and controls on the front panel as follows:

SCAN TIME/DIV.	20 ms
SCAN TRIGGER	AUTO
SCAN MODE	INT.
VIDEO FILTER	OFF
INTENSITY	Center position
FOCUS	Center position
GRASS CLIPPER	Fully counter-clockwise
SCALE ILLUM.	Fully counter-clockwise (for TR-4110 only)
IF GAIN 10 dB step	0 dB
IF GAIN 1 dB step	0 dB
VARIABLE	CAL.
TUNING	Fully counter-clockwise
FINE TUNE	Center position (both)
BAND WIDTH	300 kHz
DISPERSION/DIV.	20 MHz
LOG./LIN.	LOG.
STABILIZER	ON
SWEEP MODE	PER DIV.
dB/DIV.	10
RF ATT.	0 dB
LEVEL VARI.	OFF

(3) Set the POWER switch at ON.
The SCANNING lamp on the left of the CRT screen will start flashing, the DISPERSION/DIV. indicator will show 20 MHz, the BAND WIDTH indicator will show 300 kHz, and the REFERENCE LEVEL indicator will show 00 dB.
A bright line appears on the CRT screen after approximately 10 sec.

(4) If a bright line is not observed on the CRT screen, enhance the intensity by turning the INTENSITY control clockwise. When the bright line is too bright, turn the INTENSITY control counter-clockwise to obtain the appropriate intensity.

> **CAUTION**
> Excessive intensity may burn the fluorescent screen of the CRT.

(5) If the bright line is defocused, turn the FOCUS control until a clear line is obtained (for TR-4110 only).

(6) If the noise (grass) at the bottom of the CRT screen is so bright that the signal spectrum cannot be observed clearly, turn the GRASS CLIPPER control clockwise to erase the grass.
The GRASS CLIPPER control can also be used to balance the intensity in case of taking a photograph.

(7) To make the scale on the CRT screen clear, turn the SCALE ILLUM. control clockwise (for TR-4110 only).

(8) Set the SCAN MODE switch as follows: Set the SCAN MODE switch at MANUAL in order to move the bright spot on the CRT screen by turning the MANUAL SWEEP control situated on the right of this switch.
Set this switch at SINGLE to perform a single scanning cycle by pressing the pushbutton switch situated on the left of this switch. This mode is effective for recording using an X-Y recorder or taking a photograph.
Set this switch at INT. for scanning in the mode set by means of the SCAN TRIGGER switch.
Set this switch at EXT. for scanning using a signal of -5 V to +5 V applied to the SCAN INPUT/OUTPUT connector on the rear panel.
This switch is usually set at INT.

(9) Set the SCAN TRIGGER switch as follows:
This switch is effective only when the SCAN MODE switch is set at INT.
Set this switch at AUTO for automatic repetition of scanning with the timing set within the module.
Set this switch at LINE to trigger scanning by the AC power frequency.
This mode is appropriate for recognizing a noise from the power line.
Set this switch at EXT. to trigger scanning by applying a low TTL level signal to pin 5 of the OUTPUT connector on the rear panel during blanking.
Set this switch at VIDEO to trigger scanning by a signal within the range from 100 Hz to 100 kHz of which the amplitude reaches the two divisions of the Y axis on the CRT screen, as in the case of an oscilloscope. (This mode is appropriate for observing a demodulated wave displayed on the CRT screen when an AM or FM signal is demodulated with the SWEEP MODE set at ZERO.)
This switch is usually set at AUTO.

(10) Set the FREQUENCY indicator to show 00.0 MHz by turning the TUNING control.

(11) Set the DISPERSION/DIV. switch at 10 MHz.
The zero frequency spectrum now appears around the center of the CRT screen.
Set the peak of the zero frequency spectrum at the CENTER mark on the X axis by turning the TUNING control.

(12) If the FREQUENCY indicator does not show 00.0 MHz, set it at 00.0 MHz by turning the ZERO ADJ. control.

(13) Interconnect the CAL. OUT. connector and the INPUT connector with the attached cable (MI-02). In the case of the TR-4114H/4114HT, insert a 50 Ω terminator (TR-1622) into the INPUT connector before connecting the cable.
Then the spectrum shown in Fig. 3-4 appears on the CRT screen.

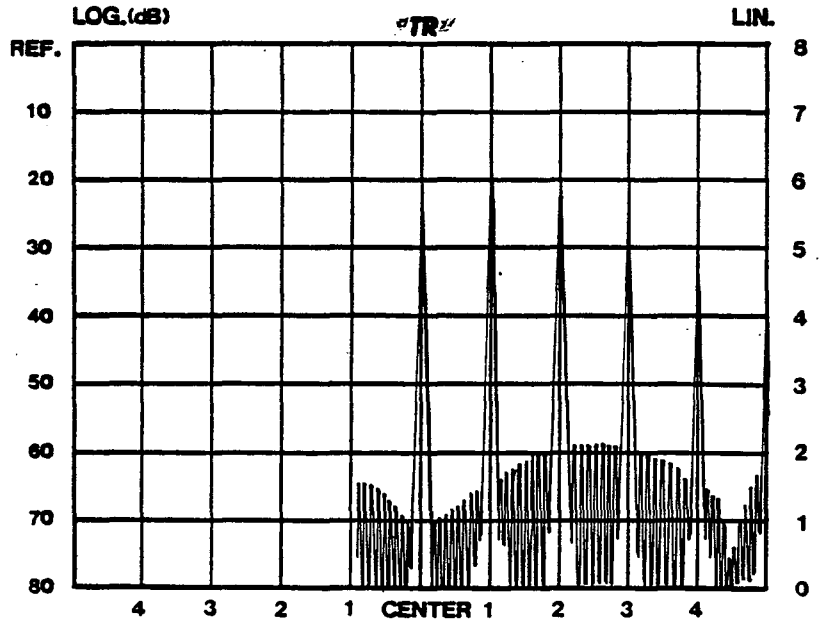


Fig. 3-4 CAL. OUT. signal spectrum

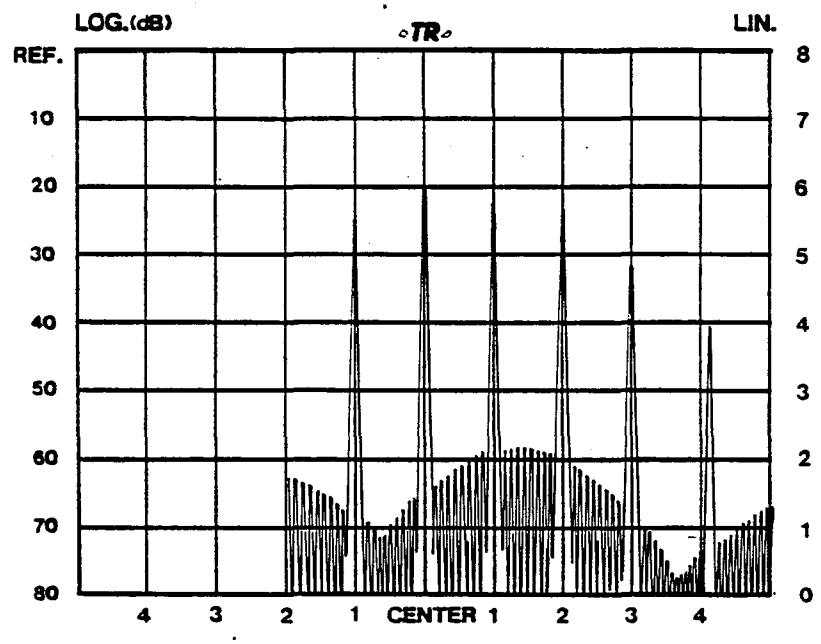


Fig. 3-5 10 MHz CAL. signal spectrum

The spectrum appearing one division to the right of the zero frequency spectrum represents the 10 MHz CAL. signal.

(14) Set the 10 MHz spectrum at the CENTER mark by turning the TUNING control clockwise. (See Fig. 3-5)

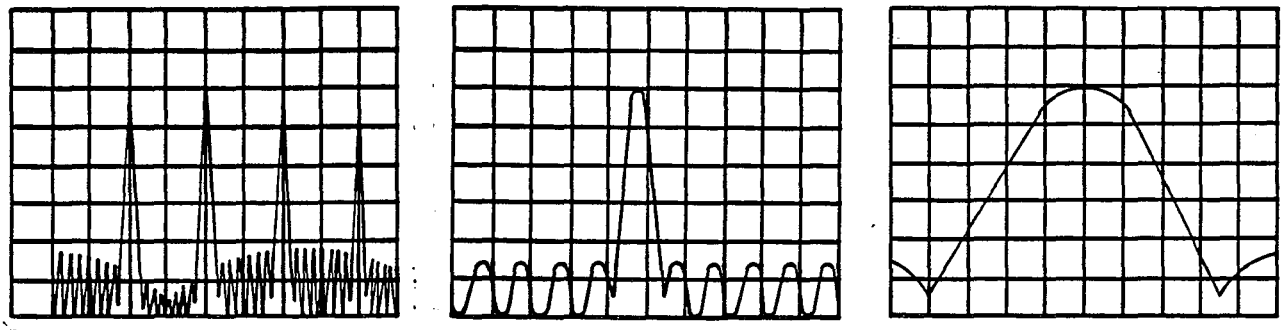
(15) Confirm that the level of the 10 MHz spectrum is -20 dBm (i.e. the peak of the spectrum is located at mark 20 on the Y axis).
If the level of this spectrum is not -20 dBm, adjust it with the CAL. control.

(16) Set the RF ATT. switch at 10 dB, 20 dB, etc., the level of the 10 MHz spectrum thus being lowered in 10 dB decrements.
The dynamic range differs with the input signal level. Set the level most appropriate for measurement using the RF ATT. switch.

CAUTION

The maximum input level of TR 4114/4114T is +20 dBm, ±10 VDC regardless of the setting of the RF ATT. switch, and the maximum input level of the TR 4114H/4114HT is 5 Vrms (with RFATT. set at 0 dB) or 30 Vrms (with RF ATT. set at more than 20 dB), ±100 VDC. This value must not be exceeded.

(17) Use the IF GAIN 10 dB step, 1 dB step switches when the signal level of the spectrum to be observed is low. Turning these switches clockwise lowers the reference level of the display and the spectrum is incresed. The REFERENCE LEVEL indications changes by the settings of the 10 dB step switch.



5 MHz 1 MHz 200 kHz

Fig. 3-6 Spectrum widening

When the IF GAIN is increased, the noise level also increases. In this case, narrow the band width by the BAND WIDTH switch to lower the noise level.

(18) Set the IF GAIN 10 dB step and 1 dB step switches to 0 dB respectively.

(19) The VARI. control is used to the fine tuning of the IF gain from -1.5dB to +1.5dB. When turned clockwise from the CAL position, the control is switches on, and the IF gain changes continuousely from -1.5dB to +1.5dB.

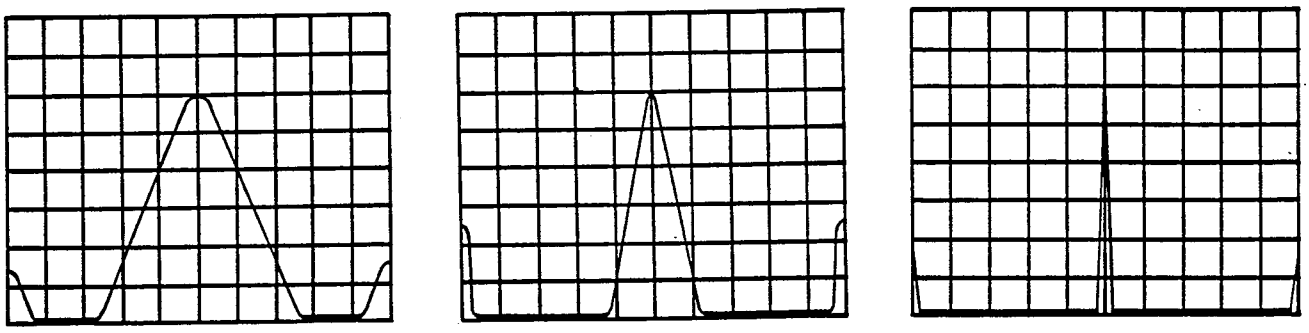
(20) The level of a spectrum can be continuously varied by more than 10 dB by means of the VARIABLE control. The level difference between two spectrums can easily be read by setting the peak of one of the spectrums at a certain mark on the scale.
Set this control to CAL. when reading the absolute level of a measured signal.

(21) To widen the spectrum, rotate the DISPERSION/DIV. switch clockwise.
Adopt the following procedure when changing the value from 0.05 MHz to 20 kHz:
Set the DISPERSION/DIV. switch at 0.05 MHz and bring the signal spectrum on the CRT screen to the CENTER mark. Then rotate the switch to 20 kHz.
When the DISPERSION/DIV. switch is set at a value under 20 kHz, use the FINE TUNE ±50 kHz control to move the spectrum, and when the said switch is set at a value under 200 Hz, use the FINE TUNE ±500 Hz control.
If spectrum widening control is performed when the SWEEP MODE switch is set at PER DIV., the spectrum is widened on both sides from the CENTER mark.

(22) When widening the signal spectrum, narrow the band width by means of the BAND WIDTH switch to improve the spectrum readability. With the band width narrowed, the spectrum is narrowed and the resolution is improved. Thus the desired spectrum can be separated from noise or other spectrums.

(23) If the WARNING lamp lights up during narrowing of the resolution band width, rotate the SCAN TIME/DIV. switch counterclockwise until the lamp is extinguished.
When the WARNING lamp lights up in general, it is necessary to reset the SCAN TIME/DIV. switch or one or more of the DISPERSION/ DIV., BAND WIDTH and VIDEO FILTER switches.

(24) If the BAND WIDTH switch is set at AUTO, the band width and scan time per division are automatically set with the setting of the VIDEO FILTER and DISPERSION/DIV. switches. In this situation manual setting of the BAND WIDTH or SCAN TIME/DIV. switch has no effect, and the module operates on the values automatically set.
Table 3-1 lists the band width and scan time per division automatically set with setting of the



100 kHz 10 kHz 3 kHz

Fig. 3-7 Band width control

DISPERSION/DIV. and VIDEO FILTER switches.

(25) When the SWEEP MODE switch is set at FULL, scanning takes place with the dispersion per division set at 20 MHz. Then part of the base line on the CRT screen falls forms a V shape to represent a marker. The marker shows the frequency indicated by the FRE- QUENCY indicator. Bring the spectrum to be measured to the marker by turning the TUNING control and set the SWEEP MODE switch at PER. DIV.; the spectrum to be measured then comes to the center of the CRT screen.

(26) The Y axis scale can be enlarged by using the LOG./LIN. and dB/DIV. switches. The scale is expanded with reference to the REF. level on the CRT screen.

When the LOG./LIN. switch is set at LOG., each designation of the dB/DIV. switch represents the level per scale division.

When the LOG./LIN. switch is set at LIN., the height of the spectrum on the CRT screen varies linearly in relation to the base line. In this mode, operating the dB/DIV. switch multiplies the linear gain per division. Setting this switch at 10 multiplies the linear gain per division by one, setting at 5 by two, setting at 2 by five and setting at 1 by ten. When the switch is set at 1, the scale represents approximately 0.1 dB per division. When the REFERENCE LEVEL indication displays "0 dBm" and the dB/DIV. switch is set to 10, a spectrum of -10 dBm level does not change its magnitude when the LOG./LIN. switch is set from LOG. to LIN. The spectrum peak is as high as scale mark 7 in the latter case, this spectrum level is identified as 70 mV. A spectrum of peak level -16 dBm decreases when the LOG./ LIN. switch is set from LOG. to LIN. Since the decreased peak level is as high as 3.5 of the LIN. scale, the spectrum level is identified as 35 mV.

The above two examples are of the REFERENCE LEVEL indication 0 dBm. In other cases, refer to Table 3-1 REF. level voltage per scale division.

When the dB/DIV. switch is set at 10, the voltage represented per scale division varies in the following way: if the reference level is 0 dBm, the voltage per scale division is approximately 10 mV, if the reference level is -20 dBm, the voltage per scale division is approximately 1 mV, and so on.

(27) When the STABILIZER switch is set at OFF, automatic stabilization does not take place; however, the TUNING control can be used to move the spectrum with the DISPERSION/DIV. switch set as low as 10 kHz, the sideband noise being low in this mode.

(28) NORMAL display mode (for TR 4110M only)
This mode is used at a high scanning speed or in general conditions. Excessive intensity must be avoided since storing operation is performed within the CRT display.

(29) PERSISTENCE display mode (for TR 4110M only)
This mode is used at a low scanning speed.

(30) PERSISTENCE control (for TR 4110M only)
When the display mode is set at PERSISTENCE, turning this switch clockwise increases the persistence time.
When the PERSISTENCE switch is set at MIN, the persistence time is approximately 500 ms, and when it is set at MAX (position A), the persistence time is 15 sec. (The persistence time differs according to the INTENSITY.)
The control can be switched from position A to position B. When it is set in position B, the persistence time is over 120 sec.
If signals are repeatedly applied with this control set in position B, the spectrum becomes blurred.
Set this control in the position B for a single scanning or observation of a sharp spectrum.

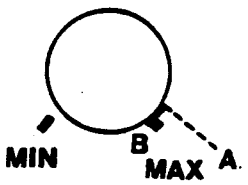


Table 3-1

VIDEO FILTER / DISPERSION/DIV.	OFF		10 kHz		100 Hz		10 Hz	
	BAND WIDTH	SCAN TIME/DIV.	BAND WIDTH	SCAN TIME/DIV.	BAND WIDTH	SCAN TIME/DIV.	BAND WIDTH	SCAN TIME/DIV.
20 MHz	300 kHz	20 ms	300 kHz	20 ms	300 kHz	1 s	300 kHz	10 s
10 MHz	300 kHz	20 ms	300 kHz	20 ms	300 kHz	500 ms	300 kHz	5 s
5 MHz	100 kHz	20 ms	100 kHz	20 ms	100 kHz	500 ms	100 kHz	5 s
2 MHz	100 kHz	20 ms	100 kHz	20 ms	100 kHz	500 ms	100 kHz	5 s
1 MHz	30 kHz	20 ms	30 kHz	20 ms	30 kHz	500 ms	30 kHz	5 s
0.5 MHz	10 kHz	20 ms	10 kHz	50 ms	10 kHz	500 ms	10 kHz	5 s
0.2 MHz	10 kHz	20 ms	10 kHz	50 ms	10 kHz	200 ms	10 kHz	2 s
0.1 MHz	3 kHz	20 ms	3 kHz	50 ms	3 kHz	500 ms	3 kHz	5 s
0.05 MHz	3 kHz	20 ms	3 kHz	20 ms	3 kHz	200 ms	3 kHz	2 s
20 kHz	1 kHz	50 ms	1 kHz	200 ms	1 kHz	500 ms	1 kHz	5 s
10 kHz	1 kHz	50 ms	1 kHz	50 ms	1 kHz	200 ms	1 kHz	2 s
5 kHz	300 Hz	100 ms	300 Hz	200 ms	300 Hz	500 ms	300 Hz	5 s
2 kHz	300 Hz	100 ms	300 Hz	100 ms	300 Hz	200 ms	300 Hz	2 s
1 kHz	100 Hz	500 ms	100 Hz	500 ms	100 Hz	500 ms	100 Hz	2 s
0.5 kHz	30 Hz	2 s	30 Hz	2 s	30 Hz	2 s	30 Hz	10 s
0.2 kHz	30 Hz	2 s	30 Hz	2 s	30 Hz	2 s	30 Hz	10 s
0.1 kHz	10 Hz	2 s	10 Hz	2 s	10 Hz	5 s	10 Hz	10 s
0.05 kHz	10 Hz	2 s	10 Hz	2 s	10 Hz	5 s	10 Hz	10 s

(31) STORE display mode (for TR-4110M only)
When this mode is selected, the waveform applied in the PERSISTENCE mode is stored.

(32) STORE TIME control (for TR-4110M only)
When the display mode is set at STORE, turning this control clockwise lengthens the store time but the waveform becomes vague.
When the STORE TIME control is set at MIN, the spectrum becomes blurred in approximately 60 sec. When taking a photograph, it is advisable to set this control at MAX and return it to MIN immediately before pressing the shutter.

(33) ERASE (for TR-4110M only)
This switch is used to erase the spectrum on the CRT screen.
This switch is effective only in the PERSISTENCE mode.
It takes approximately 1 second for a single erase operation.

3-6. Notices concerning Use of the TR-4110M Module

(1) Set the INTENSITY control at MIN (by turning it fully counterclockwise), set the DISPLAY MODE switch at PERSISTENCE, and set the PERSISTENCE control at MIN (by turning it fully counterclockwise), before turning the power on.

(2) Turn the power on in accordance with 1) above. The screen now lights up in green. After 1 second, press the ERASE switch once or twice. Adjust the INTENSITY control so that the bright line is not blurred. (Blurring, if not corrected, may cause deterioration of the CRT.)

(3) Set the DISPLAY MODE switch at NORMAL as indicated above. In this condition the intensity is decreased.
Do not raise the intensity since this may cause deterioration of the CRT.

(4) Storing takes place even in the NORMAL Mode. Therefore, when changing the DISPLAY MODE to PERSISTENCE, press the ERASE switch two or more times.

(5) When enhancing the intensity to observe a sharp spectrum, erase the especially bright grass around the base line by means of the GRASS CLIPPER control.

(6) If no waveform is being observed, set the INTENSITY control at MIN (by turning it fully counterclockwise).

3-7. Measurement of Frequencies from 50 Hz to 120 MHz

This section describes operating procedures for analyzing signal spectrums and measuring levels and frequency bands of spurious frequency, etc.

Adopt the following procedure, referring to Fig. 3-9.

(1) Set the POWER switch at ON.

(2) Connect the signal to be measured to the INPUT connector.
The input impedance of the TR-4114/4114T is approximately 50 Ω (with VSWR of 1,3 or less) and that of the TR-4114H/4114HT is 1 MΩ with approximately 20 pF.

(3) Set the RF ATT. switch according to the level of the measured signal.
The maximum input level of the TR-4114/4114T is +20 dBm, ±10 VDC, and that of the TR-4114T/4114HT is 5 Vrms (with RF ATT. set at 0 dB) or 30 Vrms (with the RF ATT. set at over 20 dB), ±100 VDC. The input level must not exceed the above levels.

(4) Set the BAND WIDTH switch at AUTO. and the subsequent operation will be easy.
Set the BAND WIDTH switch to separate the spectrum from neighboring noise or other spectrums.

(5) Set the STABILIZER switch at ON.

(6) Set the LOG./LIN. switch at LOG. and the dB/DIV. switch at 10.

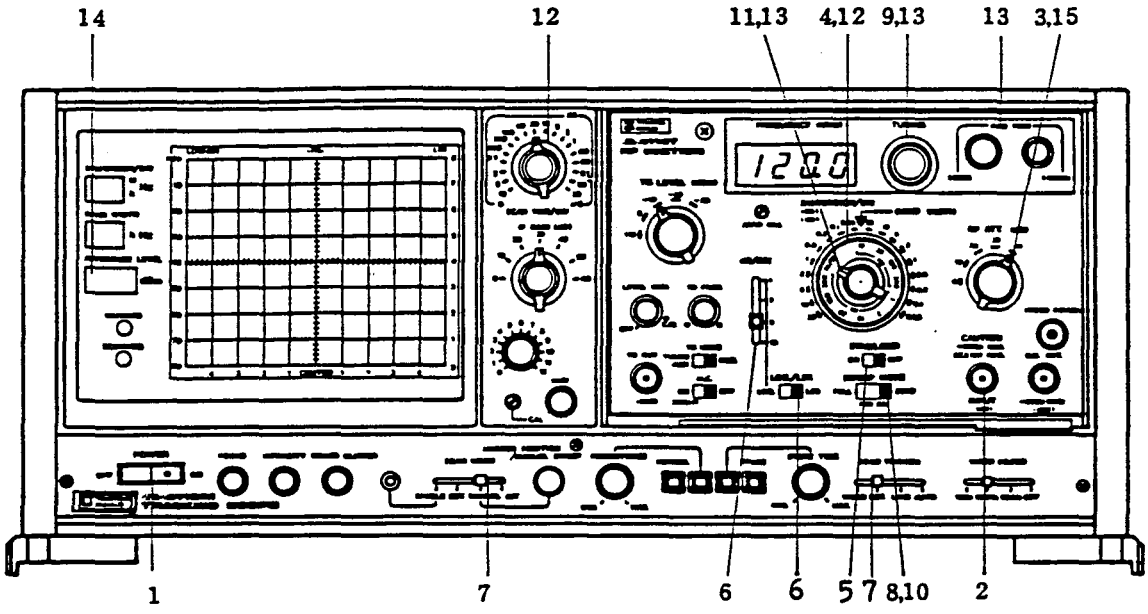


Fig. 3-9 Operating procedure for measurement of frequencies from 50 Hz to 120 MHz

(7) Set the SCAN MODE switch at INT and the SCAN TRIGGER switch at AUTO.

(8) Set the SWEEP MODE switch at FULL. Then scanning begins with zero frequency spectrum and proceeds from left to right on the screen. The dispersion per scale division is 20 MHz.

(9) Bring the spectrum to be measured to the marker by turning the TURNING control.

(10) Set the SWEEP MODE control at PER DIV. and bring the spectrum to be measured to the CENTER mark on the CRT screen.

(11) Set the X axis scale with the DISPERSION/DIV. switch.
The frequency of the spectrum displayed in the center of the screen is indicated by the FREQUENCY (MHz) indicator. Neighboring frequencies are scanned and displayed on both sides of this spectrum.
The value set on the DISPERSION/DIV. switch is the frequency band width per scale division.

(12) To improve the resolution of the desired spectrum, release the BAND WIDTH switch from the desired spectrum, release the BAND WIDTH switch from the AUTO mode and narrow the band width. Use this switch when separating the desired spectrum from neighboring noise or other spectrums. Operate this switch and the DISPERSION/DIV. switch to put the spectrum in the best condition for observation.
If the band width is set excessively narrow, the module can no longer respond and the WARNING lamp lights up. In this case turn the SCAN TIME/DIV. switch counterclockwise to lower the scanning speed.

(13) When setting the DISPERSION/DIV. switch at less than 20 kHz, firstly bring the spectrum to the center of the CRT screen by turning the TURNING control.
After setting the DISPERSION/DIV. switch at less than 20 kHz, use the FINE TUNE switch to bring the spectrum to the center of the CRT screen.

(14) The absolute signal level can be obtained from the value of the

REF. level on the CRT screen, which is indicated by the REFERENCE LEVEL indicator.
Insert the attached TR-1622 50 Ω terminator into the input connector of the TR-4114H/ 4114HT, of which the input impedance is 1 MΩ, 20 pF. Figure 3-10. shows an example of a signal spectrum. The spectrum peak goes up to scale mark 20.
Assuming that the REFERENCE LEVEL indicator shows the value of -30 dBm, the absolute level of this spectrum is -50 dBm (if the dB/DIV. switch is set at 10; however this spectrum assumes another level if the dB/DIV. switch is set at another value).
For the TR-4114H/4114HT, voltage measurement (dBV, dBμ) is preferable to power measurement (dBm) since the input impedance is high.

Note: 0 dBμ = 1 μV
0 dBV = 1 V

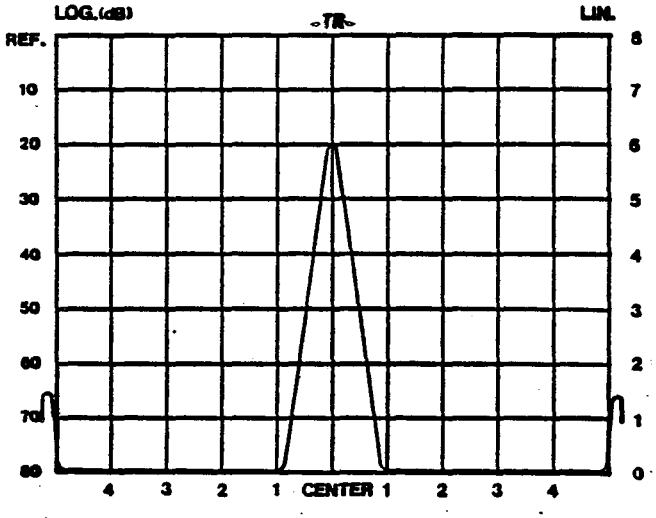


Fig. 3-10 Spectrum level reading

A dBm level is converted into a dBV level by adding -13, and converted into a dBμ level by adding 107. (See Table 3-3. dBm/50 Ω, dBm/75 Ω, Vrms, W/50 Ω, dBμ, dBV conversion table.)
An absolute level of -50 dBm is converted into dBμ and dBV levels as follows:
-50 + -13 = -63 (dBV)
-50 + 107 = 57 (dBμ)
A dBμ indicator is available as an option. This indicator is used for measurement of electric field strength, etc.
When the LOG./LIN. switch is set at LIN., the REF. level is 0 dBm, and the dB/DIV. switch is set at 10, each scale division represents approximately 10 mV. For example, the level of the spectrum shown in Fig. 3-10. is approximately 60 mVrms since its peak reaches scale mark 20 and this mark is the sixth division counted from the base line.
Table 3-2. lists the voltage per scale division for each reference level.

Table 3-2.

REF. level	Voltage per scale division	
+20 dBm	Approximately	100 mV
+10 dBm	Approximately	30 mV
0 dBm	Approximately	10 mV
-10 dBm	Approximately	3 mV
-20 dBm	Approximately	1 mV
-30 dBm	Approximately	0.3 mV
-40 dBm	Approximately	0.1 mV
-50 dBm	Approximately	30 μV
-60 dBm	Approximately	10 μV

Conditions; LOG./LIN. ..... LIN.
dB/DIV. 10

(15) If an input signal at a high level is applied with the RF ATT. switch set at 0 dB, the input mixer is saturated and therefore the level indication is not correct.
When the fundamental wave is observed, the saturation level is 1 dB for the input level of -10 dBm (70 mV), and over 1 dB for the input level of 0 dBm.

To prevent input mixer saturation caused by the fundamental wave, the RF ATT. switch must be set to satisfy the following expression:

(Measured signal level) - (RF ATT. setting value) $\leq$ -20 dBm (or 87 dBμ, 33 dBV)

When the second or third order harmonic is observed, error occurs at lower levels. When the fundamental wave level is -30 dBm, the input mixer causes distortion of -70 dB. Each time the fundamental wave is lowered by 10 dB, the second order harmonic level is lowered by 20 dB, and the third order harmonic level by 30 dB. Thus the dynamic range with no distortion can be widened by attenuating the input level. (See Fig. 3-11.) To check the affection of distortion caused by the input mixser, change the value on the RF ATT. switch by 10 dB. In this case, if the levels of the fundamental wave, the second order harmonic and the third order harmonic are all varied by 10 dB, it is considered that no error is caused by the distortion.

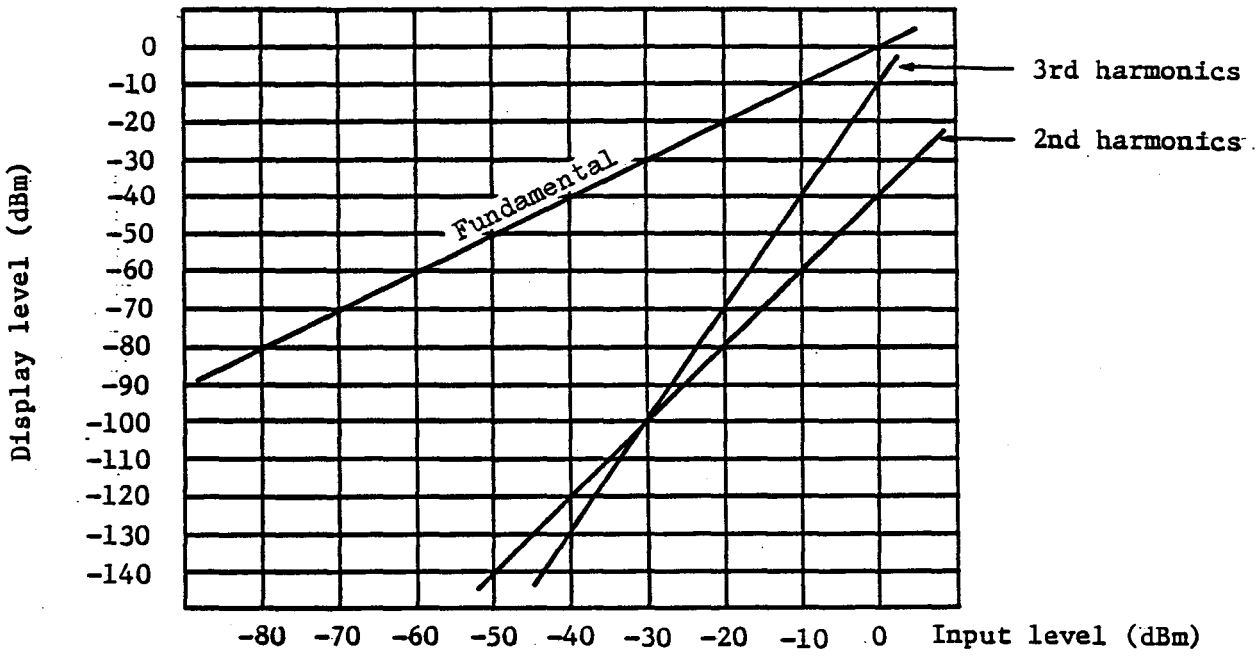
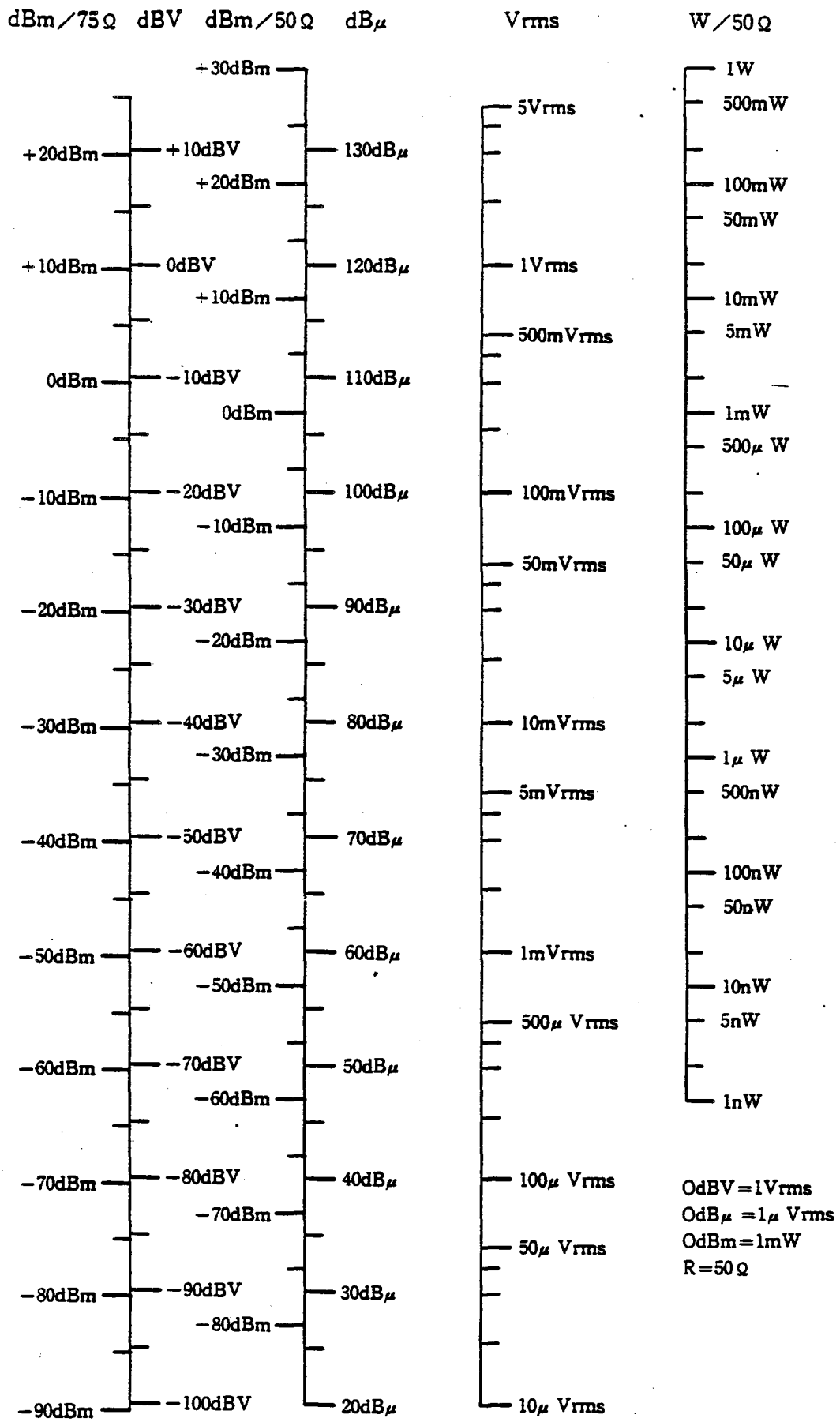


Fig. 3-11 Fundamental wave and the 2nd and 3rd order harmonic distortion

Table 3-3 dBm/50 Ω, dBm/75 Ω, Vrms, W/50 Ω, dBμ, dBV conversion table



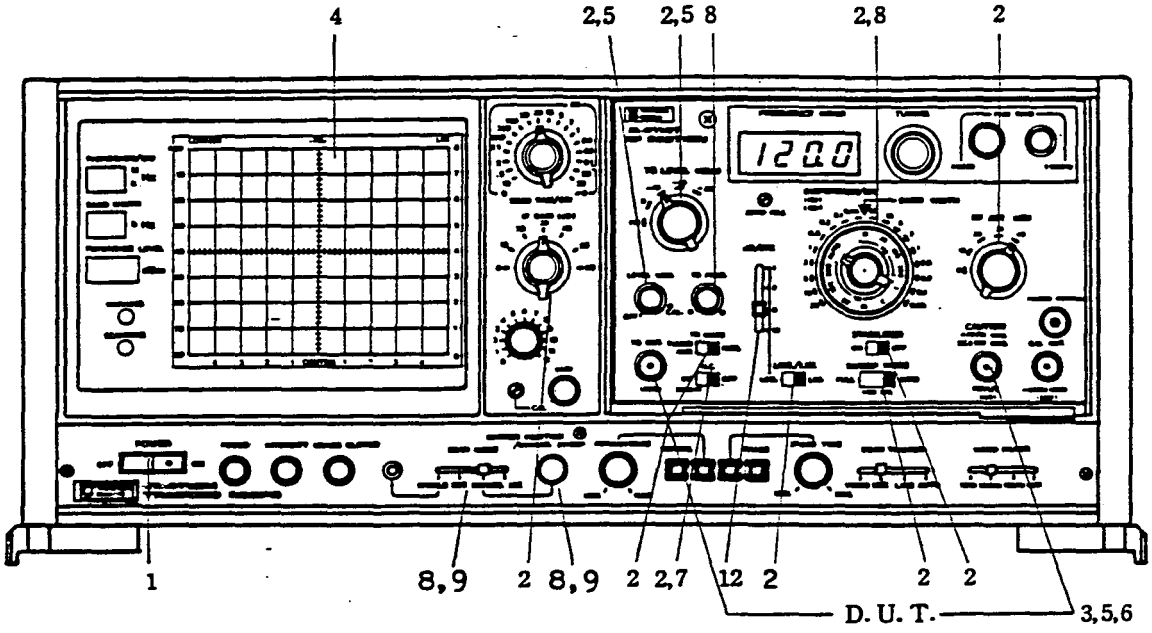


Fig. 3-12 Operating procedure for the -TR-4114T/4114HT

3-8. Operating Procedure for Tracking Generator (Operating Procedure for the TR-4114T/4114HT Inserted in the TR-4110/4110M)

This section describes the operating procedure for the RF section TR-4114T/4114HT incorporating a tracking generator.

(1) Set the POWER switch at ON.
(2) Set the switches as follows:

DISPERSION/DIV.	20 MHz
BAND WIDTH	300 kHz
LOG./LIN.	LOG.
dB/DIV.	10
STABILIZER	ON
SWEEP MODE	FULL
RF ATT.	30
IF GAIN 10 dB step	10
IF GAIN 1 dB step	0
TG LEVEL	+10 dBm
LEVEL VARI.	CAL.
TG MODE	NOR.
ALGC	ON

(3) Interconnect the TG OUT. connector and the INPUT connector with a cable.
For the TR-4114HT, insert a TR-1622 terminator into the INPUT connector before connecting the cable. The TG OUT. output level is approximately +10 dBm.
(4) The CRT display presents the frequency characteristic without load.
(5) Connect the TG OUT. connector to the input of the DUT with a cable. The maximum output level at the TG OUT. is +10 dBm. Set this out-put at the optimum level for input to the DUT by adjusting the TG LEVEL switch and the LEVEL VARI. control. The output impedance at the TG OUT. is approximately 50 Ω.
(6) Connect the output of the DUT to the INPUT connector with a cable. The input impedance of the TR-4114HT is 1 MΩ, 20 pF; therefore terminate the input according to the measuring impedance of the DUT.
(7) Set the ALC switch according to the frequency band for measuring. When the frequency band for measuring is 30 kHz or less, set the ALC switch at OFF, and when the frequency band for measuring is over 30 kHz, set this switch at ON. This switch can be set at OFF

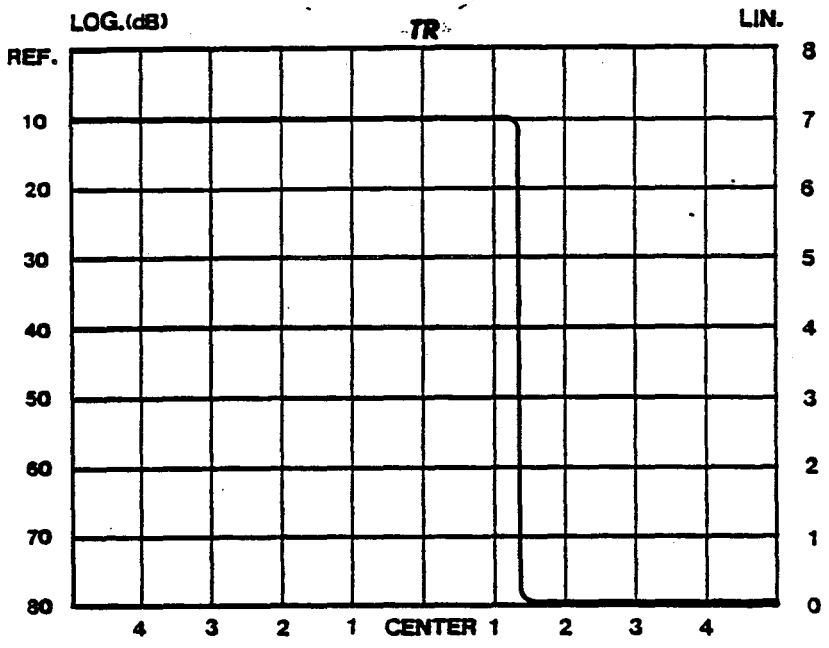


Fig. 3-13 Tracking generator output frequency characteristic without load

for a frequency over 30 kHz, but the frequency response of the tracking generator is lowered.

(8) Narrowing the band width with the BAND WIDTH switch lowers the noise level, the dynamic range for measurement thus being widened.
Note that setting the BAND WIDTH switch at less than 100 Hz causes tracking error (deviation of the tuning frequency of the spectrum analyzer from the tracking generator output frequency), which will result in level error.
In this case, set the level on the CRT screen at the maximum by means of the TG FREQ. control. When the scanning speed is low, set the SCAN MODE switch at MANUAL, set the bright spot at the desired position by means of the MARKER POSITION/MANUAL SWEEP control, and then set the level at the maximum by means of the TG FREQ. control.

(9) The AUX. OUT. connector on the rear panel of the TR-4114T/4114HT gives the same signal as the output from the TG OUT. connector. If a frequency counter is connected to the AUX. OUT. connector and the SCAN MODE switch is set at MANUAL, the frequency counter indicates the frequency of the bright spot.
If the TG MODE switch is set at TUNED AMP., the tracking generator operates as a selective amplifier. Therefore, if the bright spot is set at a certain signal within the spectrum displayed on the CRT screen by turning the MANUAL control, the frequency counter indicates the frequency of the specified signal together with its accuracy. In this measurement, the S/N ratio of the signal to be measured must be over 10 dB.
(Note: Set the ALC. switch at OFF when setting the TG MODE at TUNED AMP.)
If the OUTPUT connector on the

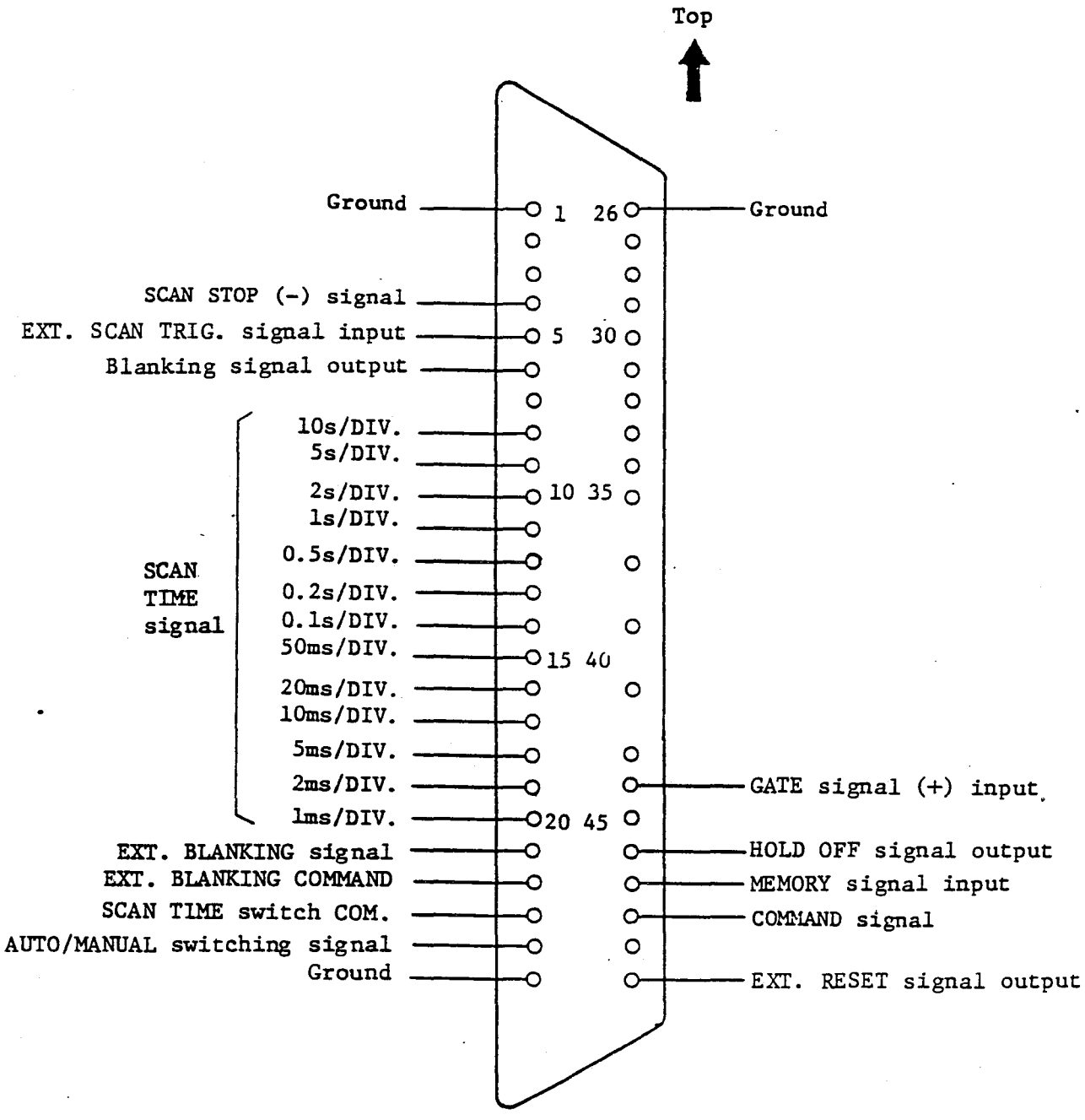
rear panel of the TR-4110/4110M is connected to the SPA CONTROL connector on the TR-5120 series frequency counter or the DATA OUT. connector on the TR-5501G/ 5502G series frequency counter (both manufactured by the Takeda Riken Industry) with a connector specified in the NOTE, an intensity-modulated marker appears. This marker is moved by turning the MANUAL SWEEP control. Thus the frequency at a point designated by the marker is indicated on the frequency counter.

Note: The following cables (supplied separately) should be used for connection to a frequency counter:

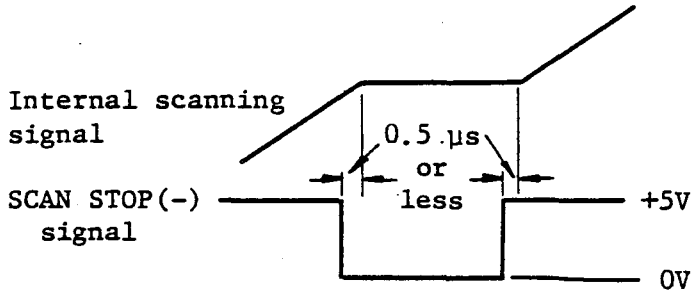
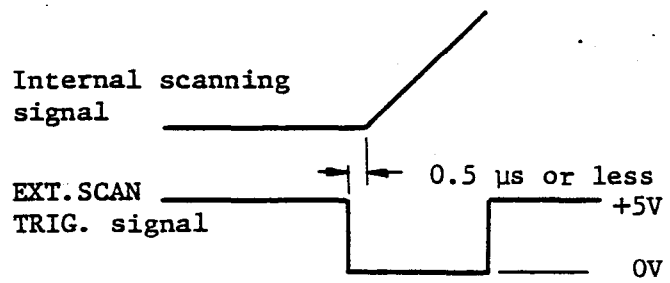
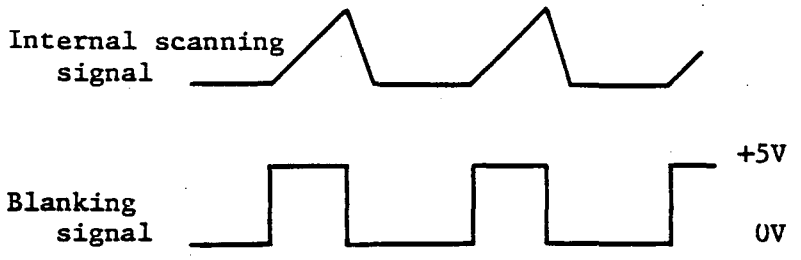
For TR-5120 series frequency counter MC-18

For TR-5501G/5502G series frequency counter .. MC-31A

3-9. OUTPUT Connector on TR-4110/ 4110M



The connector used is Amphenol 57-40500.
Use Amphenol connector 57-30500 for connection.
No signal should be applied to pins 21 to 24, as they are used when the remote control option is attached.

Pin No.	Signal name	Description
1, 25, 26,	Ground	0V
4	SCAN STOP (-) signal	A negative pulse at TTL level, if applied to this pin, stops scanning of the module for the duration of the said negative pulse. If scanning was stopped by a signal output from pin 44, 46, 47, 48, or 50, 0 V at the TTL level is output. 
5	EXT. SCAN TRIG. signal (input)	If a negative pulse at the TTL level is applied to this pin with the SCAN TRIGGER switch on the front panel set to EXT., scanning is triggered. 
6	Blanking signal (output)	Negative blanking signals at TTL level are emitted from this pin. The signal level is low in the scan return time. 
8 - 20	SCAN TIME signal (output)	When the SCAN TIME switch on the front panel is set within the range from 1 ms to 10 sec, only the pin corresponding to the set value is at 0 V at TTL level, all the other pins being at +5 V.

Pin No.	Signal name	Signal
44	GATE signal (Input)	The timing and level of the GATE signal are shown in the timing chart (Fig. 3-14) when the cable MC-18 is used.
46	HOLD OFF signal (Output)	The timing and level of the HOLD OFF signal are shown in the timing chart (Fig. 3-14) when the cable MC-18 is used.
47	MEMORY signal (Input)	The timing and level of the MEMORY signal are shown in the timing chart (Fig. 3-14) when the cable MC-31 is used.
48	COMMAND signal (Input)	Sweeping stops if a SCAN STOP signal is output when pin 48 is set to 0 V at the TTL level.
50	EXT. RESET signal (Output)	The timing and level of the EXT. RESET signal are shown in the timing chart (Fig. 3-14) when the cable MC-31 is used.

The timing chart is shown in Fig. 3-14.

An HOLD OFF or EXT. RESET signal is output to each pin by the comparator in the TR 4110/M and a SCAN STOP signal is also output.
If a COMMAND signal at pin 48 is 0 V, sweeping stops by the SCAN STOP signal.

A gate at the counter opens by the HOLD OFF or EXT. RESET signal and the SCAN STOP signal ends by a MEMORY or GATE signal when the gate was closed, then sweeping starts again.

The HOLD OFF signal (pin 46) and GATE signal(pin 44) use optional cable MC-18 and the EXT. RESET signal (pin 50) and MEMORY signal (pin 47) use the optional cable MC-31.

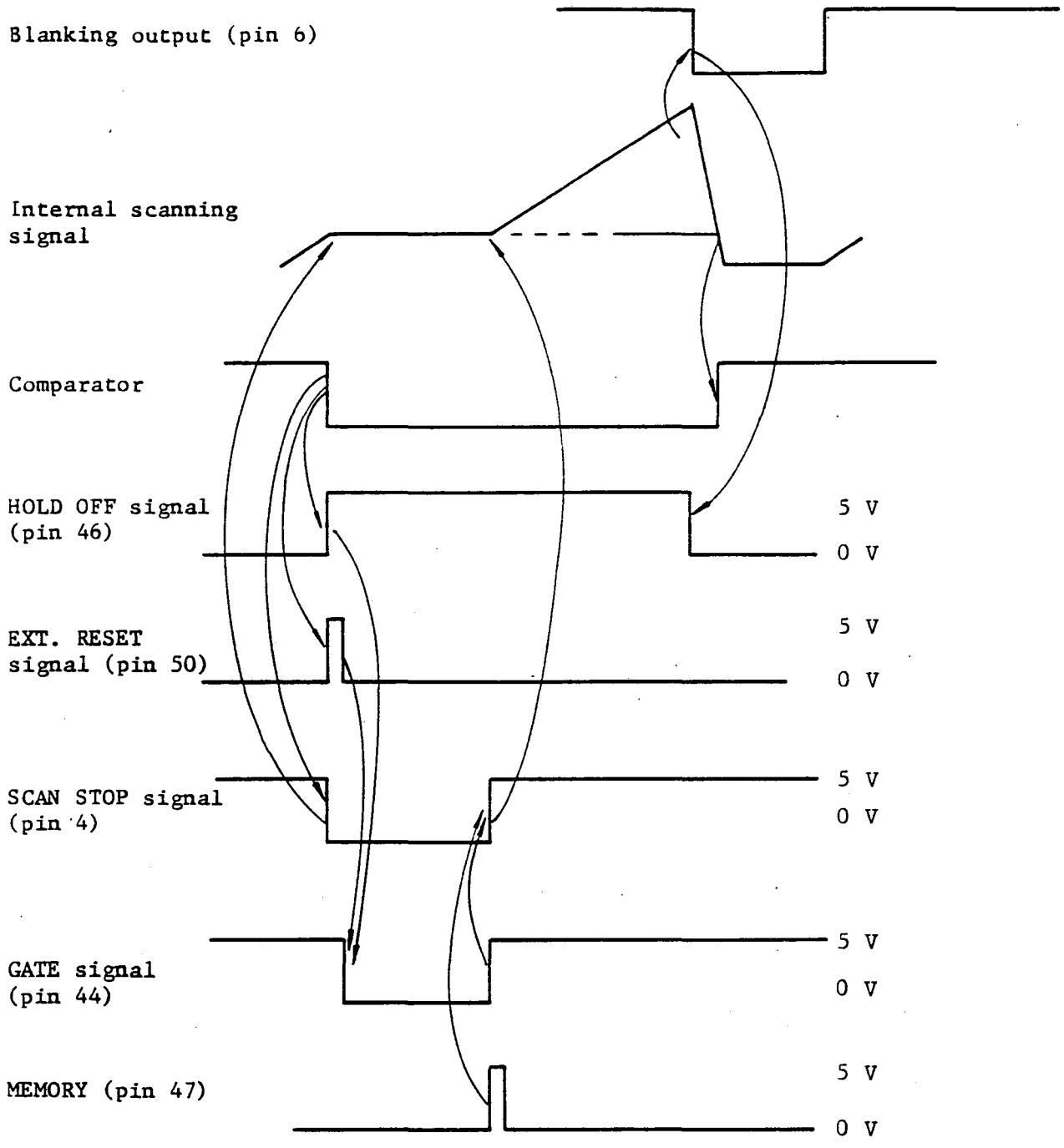


Fig. 3-14 Timing chart

Section 4
PRINCIPLES OF OPERATION

4-1. Outline

This chapter discusses the basic operations of the TR-4110 mainframe and TR-4114 series RF section.
Figure 4-1 shows a schematic block diagram of the tracking scope.

4-2. Principles of Operation

The signal to be tested (input signal) is applied to the INPUT connector, and led to the initial-stage mixer via the DC cutter and the RF attenuator. The RF attenuator can attenuate the input level by 0 dB to 40 dB (or 50 dB in the TR-4114H/4114HT) in 10 dB increments.

The initial-stage mixer combines the signal to be tested with the signal output from the initial-stage local oscillator. The initial-stage mixer is a double-balanced mixer which can perform balanced operation both for the signal to be tested and for that from the initial-stage local oscillator. Thus the distortion caused by the input mixer is low and the dynamic range for measurement is wide.

The initial-stage local oscillator divides frequency of the signal sent from the YIG-tuned oscillator by twelve to obtain 187 MHz to 307 MHz signals. The frequency generated by the 1st local oscillator is varied by means of the TUNING control, and the scan width is controlled by means of the DISPERSION/DIV. switch. If the DISPERSION/DIV. switch is set at less than 20 kHz and the STABILIZER switch is set at ON, the 1st local oscillator is phase-locked and stabilized. In this condition, the frequency is varied by adjusting the frequency output from the second-stage local oscillator by means of the FINE TUNE control.

The output from the 1st mixer is sent to the second mixer via the 187.7 MHz band-pass filter.
The second mixer combines the 187.7 MHz signal with the 157.7 MHz signal output from the second-stage local oscillator to generate the 30 MHz IF signal.

If the STABILIZER switch is set at ON and the DISPERSION/DIV. switch is set at less than 20 kHz, the scanning signal is applied not to the 1st local oscillator but to the second local oscillator. In this condition, the signal frequency is varied by means of the FINE TUNE switch.

The 30 MHz IF signal is sent to the TR-4110 via the band-pass filter and applied to the mixer.
This mixer combines the 30 MHz IF signal with the signal generated by the 33.3 MHz crystal oscillator to obtain the 3.3 MHz IF signal.

The purpose of the above-mentioned frequency conversion through multiple stages is to prevent spurious signals from occurring within the frequency band under measurement and obtain high resolution for a wide scanning range.

The 3.3 MHz IF signal is applied to the band-pass filter. The band width of this filter can be varied from 10 Hz to 300 kHz by means of the BAND WIDTH switch. This filter is composed of an LC filter and a crystal filter. Signals in the frequency band from 10 Hz to 300 kHz pass through the LC filter, and the signals with the frequency band from 3 kHz to 10 kHz pass through the crystal filter. The gain in this filter is variable from 0 dB to 60 dB with the IF GAIN switch.

The IF signal which passes through the band-pass filter is applied to the logarithmic amplifier for amplitude indication in decibels. The dynamic range of this logarithmic amplifier is 80 dB. The logarithmic amplifier includes not only an amplifier for amplitude indication in decibels but also the one for amplitude indication in linear level. The output of the

logarithmic amplifier is applied to the CRT driver for level display on the CRT screen. The CRT driver also receives the signal sent from the lamp signal (scanning signal) generator. The dB/DIV. switch varies the gain of the amplifier in the CRT driver to increase the level displayed on the CRT screen.

The CRT display has a dynamic range of 80 dB.

The tracking generator incorporated in the TR-4114T/4114HT operates as follows:

The 33.3 MHz Local signal from the TR-4110/M and 3.33 MHz signal from the chrystal oscillator in the tracking generator are mixed to make a 30 MHz signal. This signal passes through the 30 MHz bandpass filter and then mixed with 157 MHz signal from the second local oscillator to be converted to a 187 MHz signal. This 187 MHz signal passes through the band pass filter and then mixed with 187 to 307 MHz signal to be converted to 0 to 120 MHz signal.

The signal thus obtained is synchronized to the signal received by the spectrum analyzer.

When the TG MODE is set at "TUNED", the 33.3 MHz signal from the TR-4110/M is mixed with the 3.33 MHz signals from the Log. Amp of the tracking scope, instead of the 3.33 MHz signals from the christal oscillator. Thus the signal obtained has the same frequency as the signal to be tested, which is applied to the INPUT connector.

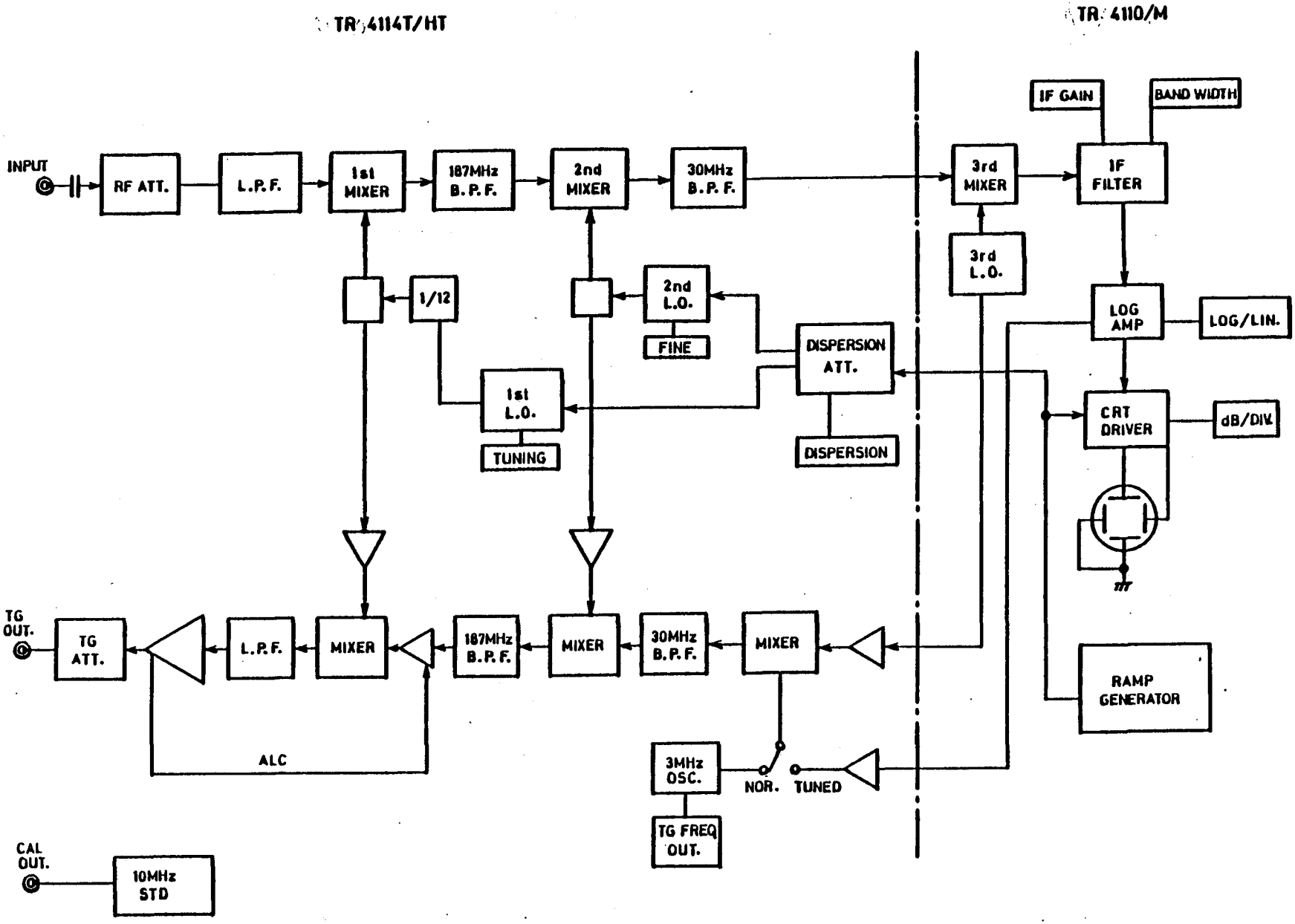


Fig. 4-1 Schematic block diagram

Section 5
MAINTENANCE

5-1. Outline

This chapter describes the CRT display adjustment and the CRT filter cleaning procedures.

5-2. CRT Display Adjustment

This section concerns the zero frequency spectrum centering control, the horizontal centering and gain control and the vertical centering and gain control, and describes use of the ASTIG. and TRACE ALIGN. adjusters.

Follow the adjustment procedures indicated herein in case of changing the RF section (TR 4114/4114T/4114H/4114HT), when using the tracking scope after a long period of disuse (more than three months), or at any time when the need arises.

After completing adjustment in accordance with the procedures indicated herein, follow the basic operating procedure indicated in 3.6.

The adjusters are situated on the top cover near the rear side (see Fig. 5-1). Use a 3 mm screw driver for the adjustment.

(1) Zero frequency spectrum centering control

If the zero frequency spectrum does not appear in the center of the CRT screen (at scale mark CENTER) then the FREQUENCY indicator is set at "□□□ MHz" by turning the TUNING control, set the spectrum at the center by turning the ZERO ADJ. adjuster on the front panel.

In the above adjustment, keep the SWEEP MODE switch at PER DIV.

(2) H. POSI.

Changing the DISPERSION/DIV. switch setting may cause deviation of the position of the spectrum displayed in the center of the CRT screen. In such case correct the position by means of the H. POSI. adjuster following the procedure indicated in the table below:

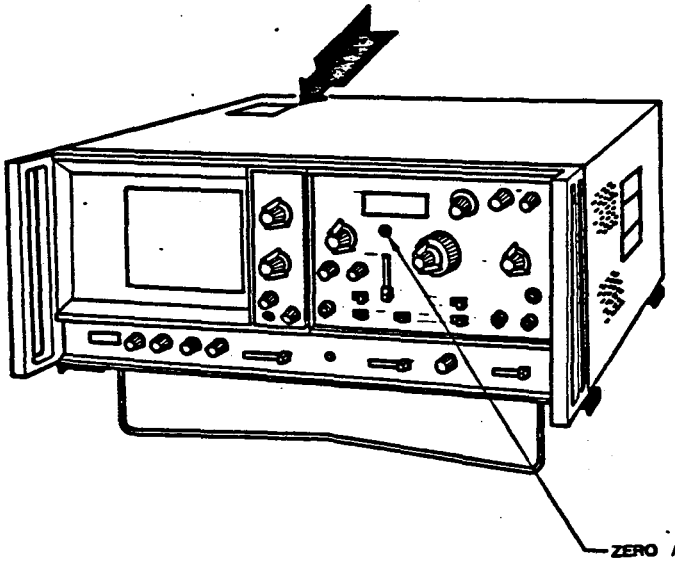
(3) H. GAIN

If the frequency of the spectrum displayed on the CRT screen deviates from the X axis scale marks, adjust it by means of the H. GAIN adjuster according to the procedure indicated in the table below:

(4) V. POSI. and V. GAIN

Adjust the linearity of the y axis on the CRT screen using a DC voltage generator of 0 to 5 V.

Follow the adjustment procedure indicated in the table below:



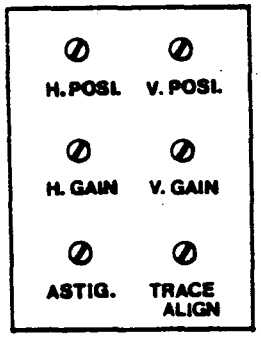
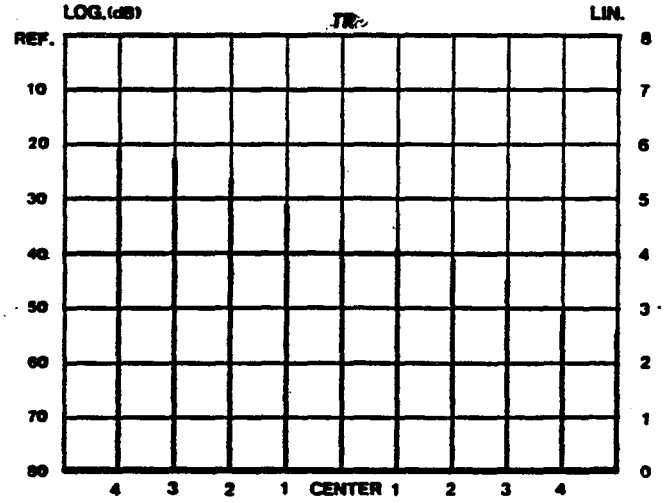


Fig. 5-1 Adjusters for the CRT Display

H. POSI. adjustment procedure

Step	Operation
1	Set the BAND WIDTH switch at 100 kHz and the DISPERSION/DIV. switch at 0.05 MHz.
2	Set the peak of the zero frequency spectrum at the center of the CRT screen (at the CENTER mark) by means of the TUNING and FINE TUNE controls.
3	Change the DISPERSION/DIV. switch setting from 0.05 MHz to 5 MHz. This may cause the peak of the spectrum to deviate from the center of the screen. If this occurs, return the peak position to the center by means of the H. POSI. adjuster.

H. GAIN adjustment procedure

Step	Operation
1	Set the BAND WIDTH switch at 300 kHz and the DISPERSION/DIV. switch at 10 MHz.
2	Interconnect the INPUT connector and the CAL. OUT. connector with a cable.
3	Set the zero frequency spectrum at the left side of the CRT screen by means of the TUNING control.
4	Make sure that the spectrum of the 10 MHz signal and its harmonics coincide with the scale marks on the CRT screen. 
5	If the frequencies deviate, adjust them by means of the H. GAIN adjuster. The frequencies vary in relation to the value in the center of the CRT screen; therefore, adjust the spectrums on both sides of the center spectrum.

V. POSI. and V. GAIN adjustment procedure

Step	Operation
1	Disconnect the cable from the VERTICAL INPUT and OUTPUT connectors on the rear panel.
2	Connect the INPUT connector to the output terminal of an external DC voltage generator with a BNC bananatip cable.
3	Set the output voltage of the DC voltage generator at +2.50 V. Bring the bright line on the CRT screen to the center (at the LOG scale mark 40) by means of the V. POSI. adjuster.
4	Vary the output voltage of the DC voltage generator by 0.5 V at a time, and check that the bright line moves by a scale division with each 0.5 V variation of the output voltage. If the bright line does not move by exactly a scale division, adjust the movement distance by means of the V. GAIN adjuster. The gain varies in relation to the center level on the CRT screen (at LOG. scale mark 40).
5	After completion of the adjustment, interconnect the VERTICAL INPUT and OUTPUT connectors on the rear panel with a cable.

(5) ASTIG. (ASTIGmatism)
The ASTIG. adjuster permits overall focusing of the image on the CRT screen.
Use this adjuster together with the FOCUS control for optimal focusing of the spectrum.

(6) TRACE ALIGN.
If the bright line on the CRT screen inclines as affected by the earth magnetism or magnetism device, correct the line with the TRACE ALIGN. adjuster.
Adjust the bright line until it is parallel to the X axis scale on the CRT screen.

5-3. Cleaning the Filter Panel on the CRT Display

During long use, dust accumulates on the inner side of the filter panel on the CRT display. This section describes the procedure for cleaning the filter panel.

Adopt the following procedure referring to Fig. 5-2.

(1) Attach a piece of adhesive tape to the center of the filter panel. The appropriate tape length is about 2 cm.

(2) Hold the upper end of the tape and lift the filter up. The filter thus comes out of the lower groove. Pull the tape and remove the filter.
Note: When removing the filter, take care not to damage the frame of the CRT display.

(3) Wipe the inner side of the filter and the CRT screen with a soft cloth (a cloth coated silicon oil, etc.).
Note: Wipe the filter and CRT screen as gently as possible to avoid generation of static electricity.

(4) After the cleaning, reinstall the filter following in reverse order the procedure described in (2) above.

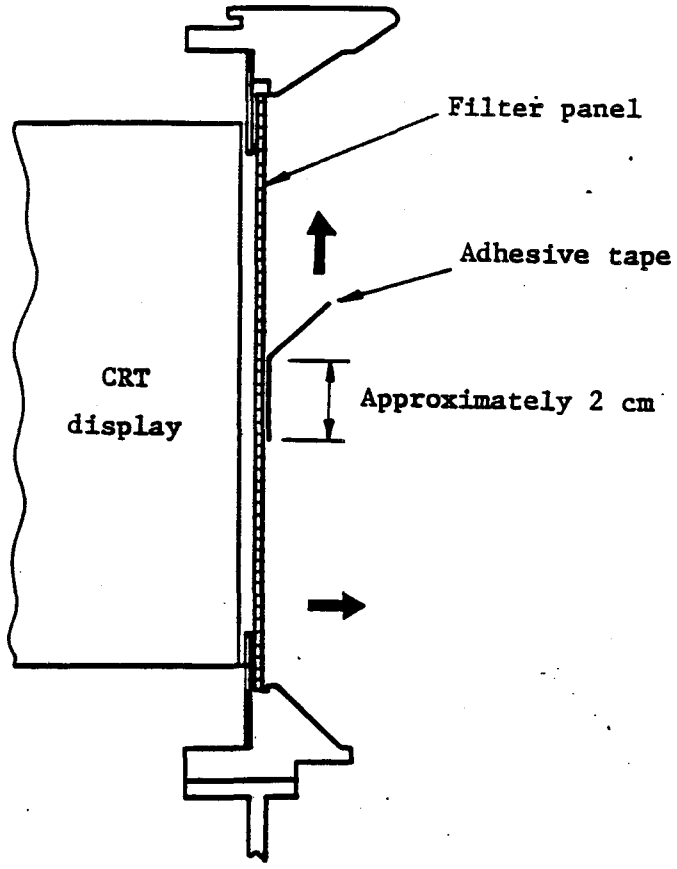


Fig. 5-2 Filter panel removing procedure (cross-sectional view)