

# PHILIPS



## AUTOMATIC FREQUENCY CONVERTER PM 6634

9446 066 34..1

DIAMOND

## Contents

<b>GENERAL</b>	5
I. Introduction	5
II. Technical data	6
III. Accessories	8
IV. Block diagram description	9
<b>DIRECTIONS FOR USE</b>	10
V. Input and output connectors, switches	10
VI. Operation	11

## List of figures

Fig. III-1	Coaxial cable 50 $\Omega$	8
Fig. III-2	Interconnection cable for service purposes	8
Fig. III-3	Rear panel for plug-in connection, PM 9663	8
Fig. III-4	19" cabinet provided with rear panel PM 9664	8
Fig. IV-1	Block diagram	9
Fig. V-1	Front view	10
Fig. V-2	Rear view	10
Fig. VI-1	Graph showing dBm versus mW versus V <sub>r.m.s.</sub> into 50 $\Omega$	11
Fig. VI-2	Presetting the comb line frequency in the PRESET-AUTO mode	12
Fig. VI-3	Presetting the comb line frequency in the PRESET (manual) mode	14

### IMPORTANT

In correspondence concerning this instrument, please quote the type number and serial number as given on the type plate at the rear of the instrument.

# GENERAL

## I. Introduction

The heterodyne YIG tuned frequency converter PM 6634 forms together with basic counter PM 6640 or PM 6645 a fully-automatic microwave-frequency counter for C.W. frequency measurements from 810 MHz to 12.6 GHz at an input sensitivity of  $-7$  dBm to  $+10$  dBm.

The measuring result is direct and unambiguously displayed in GHz on the read-out of the basic counter, with automatic decimal-point positioning. This auto microwave-counter combination offers a unique feature viz. the choice of operating modes:

fully automatic (AUTO), semi-automatic (PRESET-AUTO) or manual (PRESET).

In the auto mode the frequency to be measured is automatically traced by scanning through the whole frequency range.

The semi-automatic and preset modes permit unambiguous measurement of signals containing more than one frequency or FM signals with a frequency swing up to 100 MHz.

The accuracy of the basic counter is maintained over the entire frequency range because the counter's internal time base is used as a reference source.

## II. Technical data

Properties, expressed in numerical values with statement of tolerances are guaranteed. Numerical values without tolerances are intended for information purposes only and indicate the properties of an average instrument.

### INPUT SPECIFICATIONS

Frequency range	810 MHz ... 12.6 GHz
Sensitivity	-7 dBm (100 mV <sub>r.m.s.</sub> ) ... +10 dBm (700 mV <sub>r.m.s.</sub> )
Overload	+20 dBm (2.2 V <sub>r.m.s.</sub> ) maximum
Impedance	50 Ohm nominal
Coupling	A.C.
Connector	Precision type N (female)

### OUTPUT SPECIFICATIONS

	To be coupled to INPUT of the basic counter
Frequency	10 MHz ... 220 MHz (difference frequency)
Voltage	100 mV <sub>r.m.s.</sub> into 50 Ohm
Connectors	BNC (female)
Accuracy	Maintains counter accuracy

### GENERAL SPECIFICATIONS

Display	Direct read out on the counter with correct decimal point positioning with measurement unit indication in GHz.
Resolution	With PM 6640 and PM 6645 the gate time is 10 ms, giving a resolution of 100 Hz.
Measuring modes	<ol style="list-style-type: none"> <li>1. AUTO In this mode the frequency range is scanned automatically, starting at the lower end, until the signal is detected. The signal is displayed direct on the basic counter.</li> <li>2. PRESET (AUTO) This mode is similar to 1, except that the scanning starts at a preset frequency.</li> <li>3. PRESET In this mode the converter is manually tuned in 200 MHz steps.</li> </ol>
Acquisition time	In the modes AUTO and PRESET-AUTO, the scanning time is about 100 ms/GHz. Once locked, up to 75 readings/sec can be made. In the PRESET mode the mixing frequency is locked in 20 ms, after which up to 75 readings/sec can be made.
Remote reset	PM 6634 can be reset at rear panel connector REMOTE INPUT of the basic counter (PM 6640 or PM 6645).
Power supply	From the basic counter via plug in rear panel PM 9664.

Temperature range	
Operating within specifications	0 °C ... +45 °C
Operating	-10 °C ... +55 °C
Storage	-40 °C ... +70 °C
Dimensions	2/6 Plug-in module fitting into 19" cabinet PM 9716A
	Height 132 mm
	Depth 397 mm
	Width 139 mm
Weight	3.5 kg

### III. Accessories

#### Standard accessories (included in the delivery)

- 1 manual
- 1 coaxial cable, 50  $\Omega$ , 200 mm,  
(service code no. 5322 320 10009)
- 1 Allen wrench

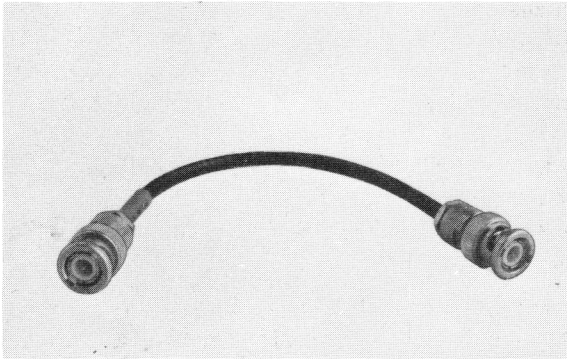


Fig. III-1. Coaxial cable 50  $\Omega$

#### Optional accessories (to be ordered separately)

- Interconnection cable for service purposes  
(service code no. 5322 321 24109)
- Rear panel for plug-in connection, PM 9664

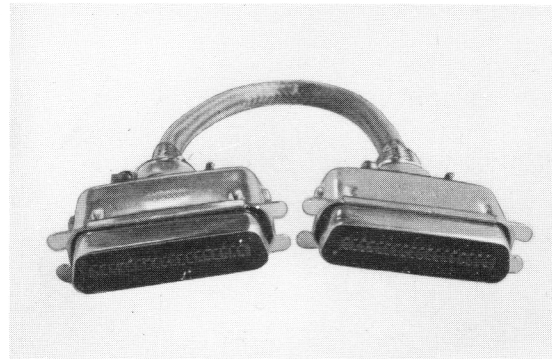


Fig. III-2. Interconnection cable for service purposes

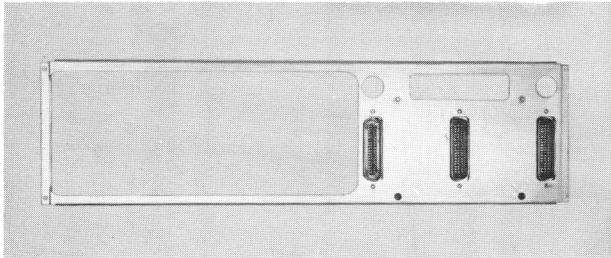


Fig. III-3. Rear panel for plug-in connection, PM 9663

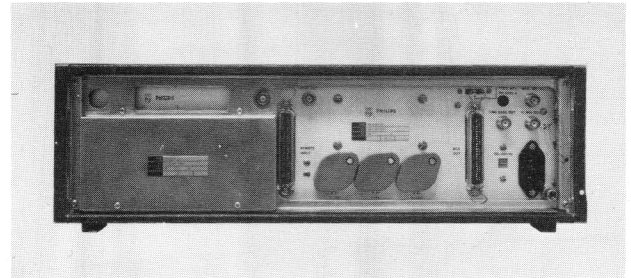


Fig. III-4. 19" cabinet provided with rear panel PM 9664

## IV. Block diagram description

The 10 MHz reference frequency derived from the counter is applied to a phase lock circuit in which the fifth harmonic of the reference is phase-locked to the 50 MHz oscillator frequency. Thus, the converter maintains the accuracy and stability of the counter's time base.

The 50 MHz frequency is multiplied four times to 200 MHz and next applied to a power amplifier. This stage drives the comb generator that produces a comb of harmonics from 0.8 GHz to 12.6 GHz with a 200 MHz interval between each comb line.

These comb lines are continuously applied to the yttrium-iron-garnet (YIG) filter, being a magnetically tuned high-Q resonator device.

The mixer produces two signals. First, a d.c. signal with a level proportional to the power of the input RF signal, and second, a heterodyned signal whose frequency is the difference between the input RF signal frequency and the comb line frequency to which the YIG filter is tuned.

The d.c. signal is picked-off at the input of the pre-amplifier as a logical "1" and coupled to the YIG control circuits via the video control circuits. This starts a BCD counter whose output is converted into a staircase voltage by the digital to analogue converter. The YIG driver, in turn, produces a current proportional to the staircase voltage. This current continuously tunes the YIG filter until the frequency of the heterodyned output signal of

the mixer falls within the range of 10 MHz to 220 MHz corresponding to the passband of the tuned pre-amplifier. Then the video control circuits provides a stop signal to the BCD counter in the YIG control circuit. The YIG filter will now be tuned to the comb line frequency next below the input frequency. The decade counters on the D/A converter will be locked and feed their instantaneous states as signals presetting the three most significant digits of the basic counter. The YIG-control circuits provides a gating signal to the video amplifier which then will be opened. The heterodyned signal from the mixer can pass the pre-amplifier and the video amplifier to the counter. Here the frequency of the heterodyned signal is added to the preset frequency so that the complete result is presented on the counter's display.

In the PRESET (manual) mode, the decade counters in the D/A converter will be locked to a state dictated by the setting of thumbwheel switch FREQUENCY PRESET, S1. The preset frequency should be lower than the RF input signal frequency but so high that the difference frequency ( $f_{RF} - f_{comb}$ ) of the mixer output is within the frequency range 10 MHz ... 220 MHz of the pre-amplifier.

When switching over from PRESET to AUTO, the YIG filter is again continuously tuned, starting from the preset frequency.

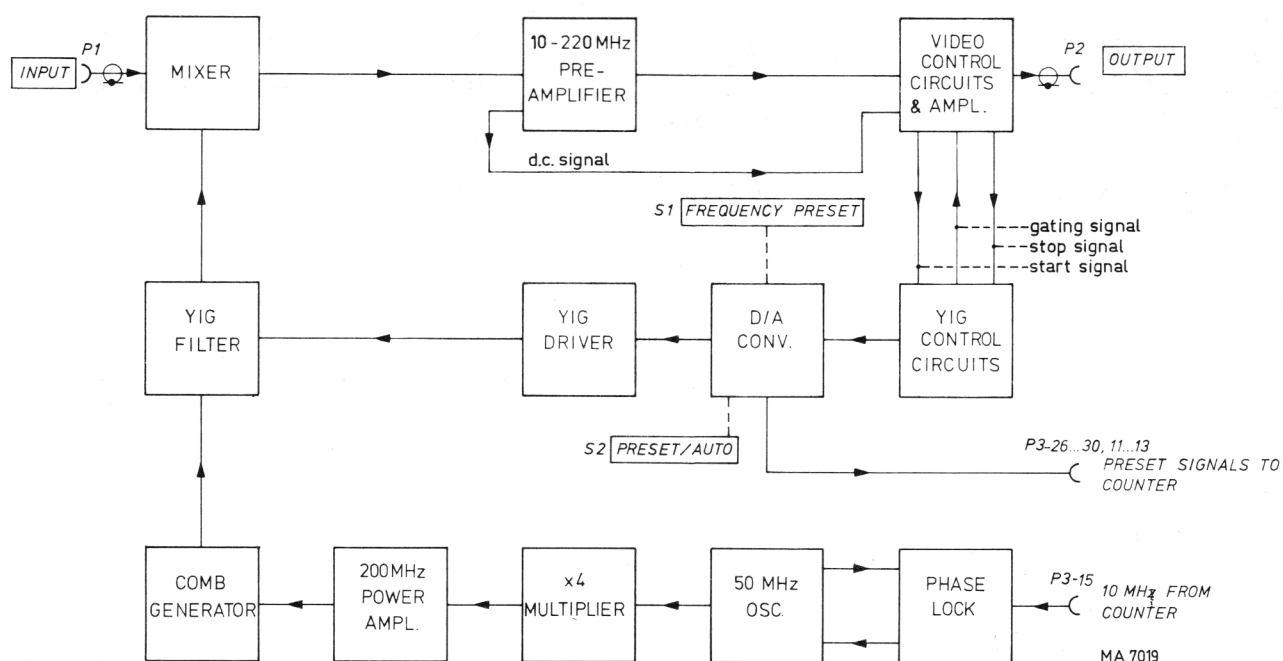


Fig. IV-1. Block diagram

## DIRECTIONS FOR USE

### V. Input and output connectors, switches

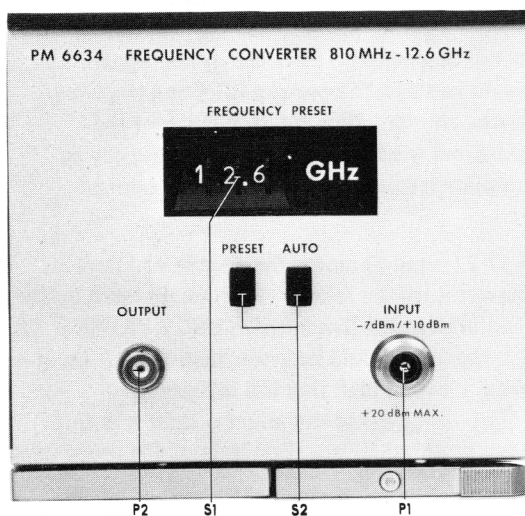


Fig. V-1. Front view

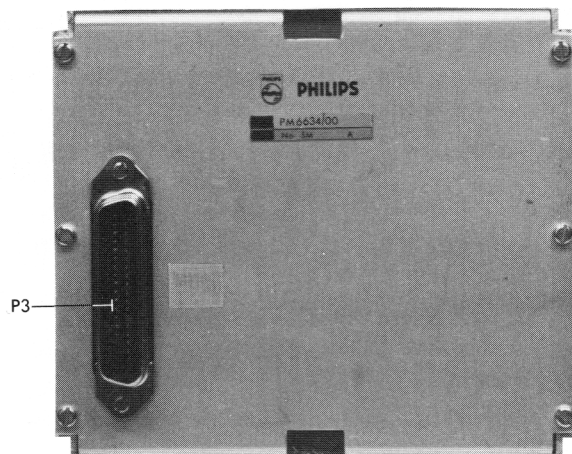
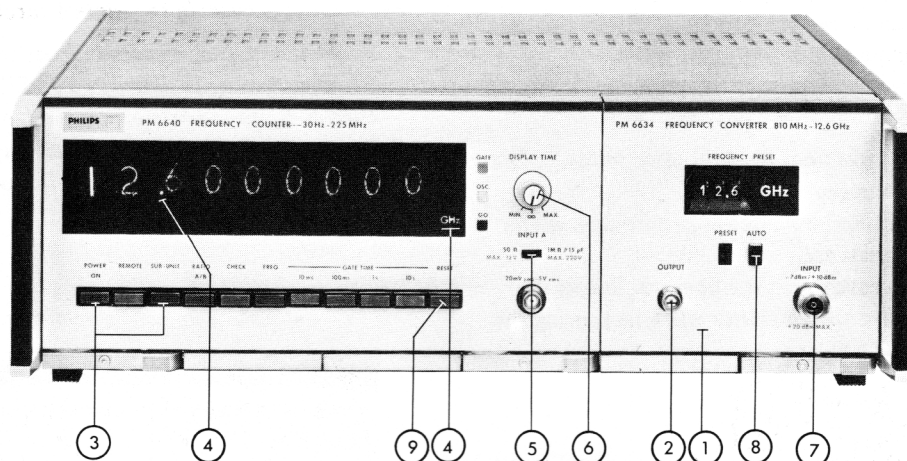


Fig. V-2. Rear view

Socket or switch	Designation	Purpose
P1	INPUT	Input socket for signal to be measured.
P2	OUTPUT	Output signal to counter.
P3		Connector for power supply and 10 MHz reference signal from counter. Output for signals presetting the three most significant digits of the counter display.
S1	FREQUENCY PRESET	Selector for presetting the comb line frequency in steps of 200 MHz. In the preset mode, selection of the comb line frequency next below the frequency to be measured.
S2	AUTO/PRESET	Selection of AUTOMATIC or PRESET operating modes. The AUTO button is only releasing the PRESET button, so when none of the buttons is depressed, the converter operates in the AUTO mode.

## VI. Operation



### Note:

Bear in mind that the possibility of erroneous measurements due to harmonics, spurious signals etc. is inherent in the basic concept of the heterodyne converter (both in the manually tuned and in the YIG tuned types).

When the counter/converter combination is used for C.W. calibration the frequency is always roughly known. Therefore, we recommend always to use the PRESET mode in these cases; this can be easily and quickly done by the thumb wheel switches.

The PRESET mode prevents erroneous readings due to spectral impurity.

If you want to scan the frequency range for the presence of signals, e.g. harmonics of a certain frequency, you can conveniently use the time saving AUTO or PRESET-AUTO mode.

Irrespective of which gate time button is pressed, the gate time of the counters PM 6640 or PM 6645 is permanently 10 ms when combined with the PM 6634.

### A. Preliminary steps

1. Install the PM 6634 in the cabinet.
2. Connect the converter OUTPUT to the counter INPUT A with the 50  $\Omega$  coaxial cable.
3. Depress buttons POWER ON and SUB-UNIT.
4. Check that the unit annunciator shows GHz and that the decimal point in the third indicator tube from left is illuminated.
5. Set switch IMPEDANCE to 50  $\Omega$ .
6. Set control DISPLAY TIME to a suitable position. Preset, if desired the display time range to FAST or NORMAL with internal switch S414 (see operating manual of PM 6640 or PM 6645).

7. Apply the signal to be measured to the PM 6634 INPUT via a 50  $\Omega$  coaxial cable. The input level should be between  $-7$  dBm (100 mV<sub>r.m.s.</sub> in 50  $\Omega$ ) and  $+10$  dBm (700 mV<sub>r.m.s.</sub> in 50  $\Omega$ ).

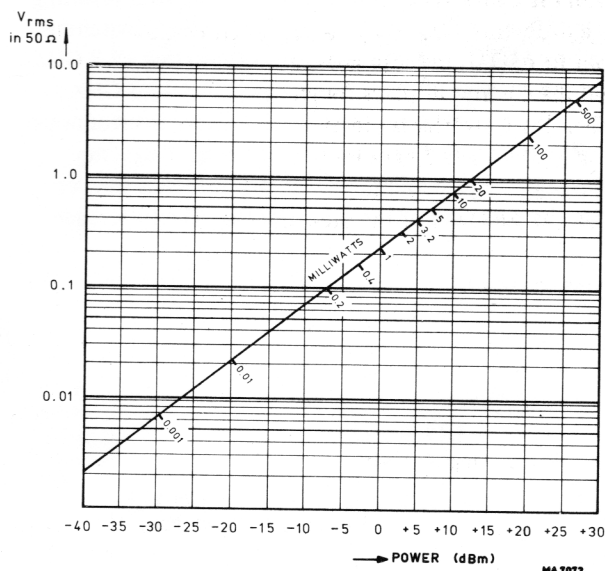


Fig. VI-1. Graph showing dBm versus mW versus  $V_{r.m.s.}$  into 50  $\Omega$

### B. AUTOMATIC mode

Set counter according to points 1 through 7.

8. Press the AUTO button and read the measured frequency on the counter's display.
9. When the RESET button on the basic counter is depressed, both the counter and the converter are reset to zero. When the button is released, the scanning starts again beginning at 810 MHz.

### C. PRESET-AUTO mode

In many applications more than one frequency with sufficient amplitude may be present in the range 0.8 to 12.6 GHz. When, in that case, the converter is used in the AUTO mode, the filter scan will stop at the first (lowest) frequency and the other frequencies are not measured. Therefore, a PRESET/AUTO mode is incorporated so that a certain frequency can be preset, from where scanning of the YIG-filter starts. Consequently, frequencies lower than the preset frequency are not measured.

Bear in mind that erroneous displays are obtained when a wrong preset frequency is selected.

False counting is caused by harmonics produced in the mixer, spurious signals etc.

Therefore, it is necessary that the operator knows the signal which is fed to the converter when he is using the PRESET/AUTO MODE.

#### Examples

##### Measuring a signal containing three frequencies (Fig. VI-2)

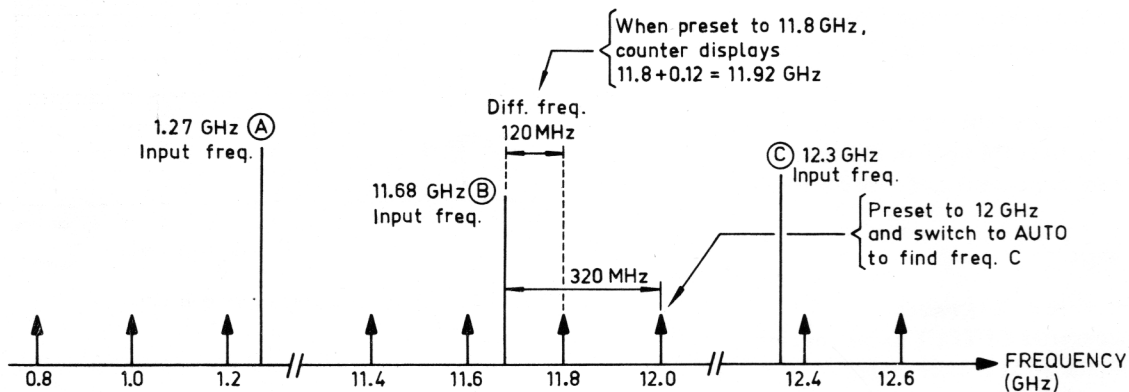
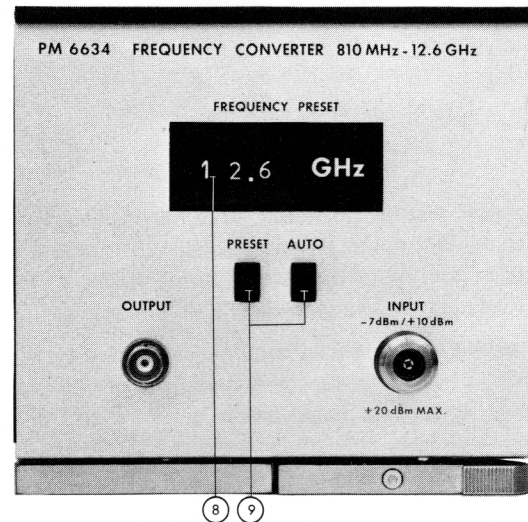
An r.f. signal containing the frequencies A, B and C is fed to the converter. If one wants to measure frequency C, the converter should be preset to such a frequency, that the difference between  $f_{\text{PRESET}} - f_B$  is greater than the passband of the pre-amplifier ( $> 220$  MHz). In this case, the converter should be preset to 12 GHz resulting in a difference frequency of 320 MHz. When switching over to AUTO, the scan goes on to comb line 12.2 GHz and the counter displays frequency C, i.e. 12.3 GHz. When the converter is preset to 11.8 GHz, an erroneous display is obtained because the difference frequency ( $f_{\text{PRESET}} - f_B$ ) amounts to 120 MHz which is smaller than the passband of the pre-amplifier. The difference

frequency is added to the preset value in the counter, thus giving a display of  $11.8 + 0.12 = 11.92$  GHz.

The distance between frequencies A (1.27 GHz) and C (12.3 GHz) in this example is so large that harmonics of frequency A will hardly be strong enough to interfere, but one should always reckon with the possibility.

Set counter according to points 1 through 7 above (VI-A).

8. Preset the desired comb line frequency with thumb wheel switch FREQUENCY PRESET. Be sure that the correct comb line frequency is selected.
9. Depress the PRESET button, subsequently the AUTO button and read the measured frequency on the counter's display.



MA 7073

Fig. VI-2. Presetting the comb line frequency in the PRESET/AUTO mode.

In the AUTO mode the YIG filter scan stops at 1.2 GHz and signal A is detected.

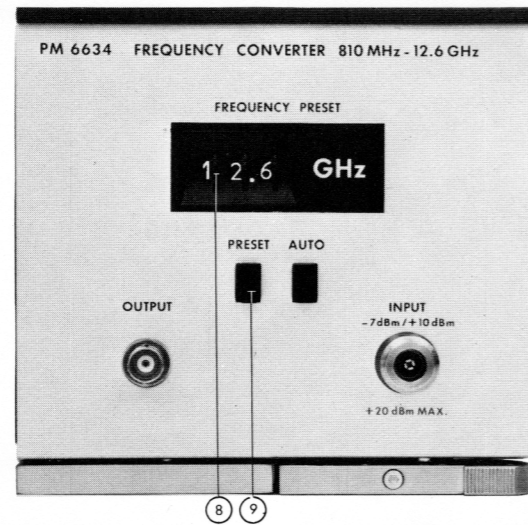
For automatic tracing of a signal having a frequency higher than signal B, the comb line should be preset to 12 GHz. In this example only signal C will thus be detected.

**D. PRESET mode**

Set counter according to points 1 through 7 (VI-A).

8. Preset the comb line frequency next below the frequency to be measured with the thumb wheel switch FREQUENCY PRESET.
9. Depress the PRESET button and read the measured frequency on the counter's display. If no response is obtained, try next higher comb line frequency.

**Note:** In some cases more than one response can be obtained, as shown in the following examples.



INPUT FREQUENCY GHz	FREQUENCY PRESET GHz	COUNTER DISPLAY GHz	DIFF. FREQ. MHz	
8.610 (Fig. VI-3a)	8.4 (A)	08.6100000	210	First response
	8.6 (B)	08.6100000	10	Second response
	8.8 (C)	08.9900000	190	Third response. Counter shows wrong value because the YIG filter is tuned to a comb line above the input frequency.
11.720 (Fig. VI-3b)	11.4 (A)	00.0000000	320	No response because the difference frequency is greater than the 10 - 220 MHz passband of the pre-amplifier
	11.6 (B)	11.7200000	120	First response
	11.8 (C)	11.8800000	80	Second response. Counter shows wrong value because the YIG filter is tuned to the comb line next above the input frequency.
5.402 (Fig. VI-3c)	5.2 (A)	05.4020000	202	First response.
	5.4 (B)	00.0000000	2	No response because the difference frequency is less than the 10 - 220 MHz passband of the pre-amplifier.
	5.6 (C)	05.7980000	198	Second response. Counter shows wrong value because the YIG filter is tuned to a comb line above the input frequency.

Fig. VI-3a. Presetting to 8.4 GHz, 8.6 GHz and 8.8 GHz at an input frequency of 8.610 GHz

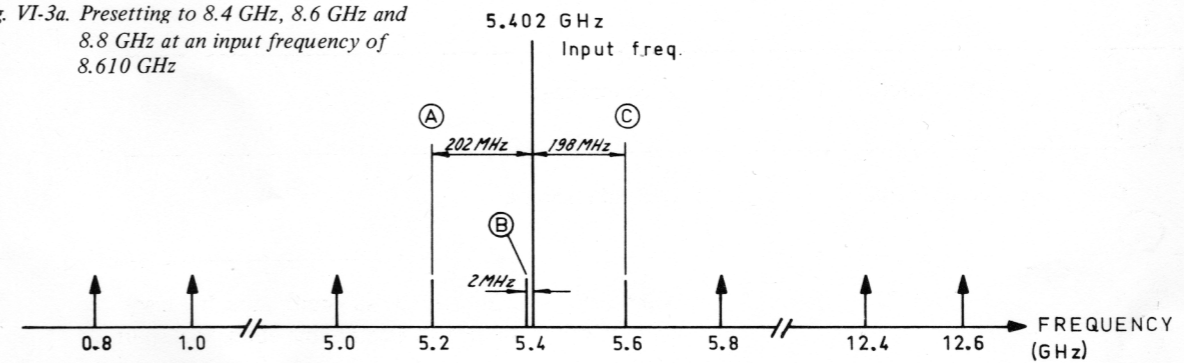


Fig. VI-3b. Presetting to 11.4 GHz, 11.6 GHz and 11.8 GHz at an input frequency of 11.720 GHz

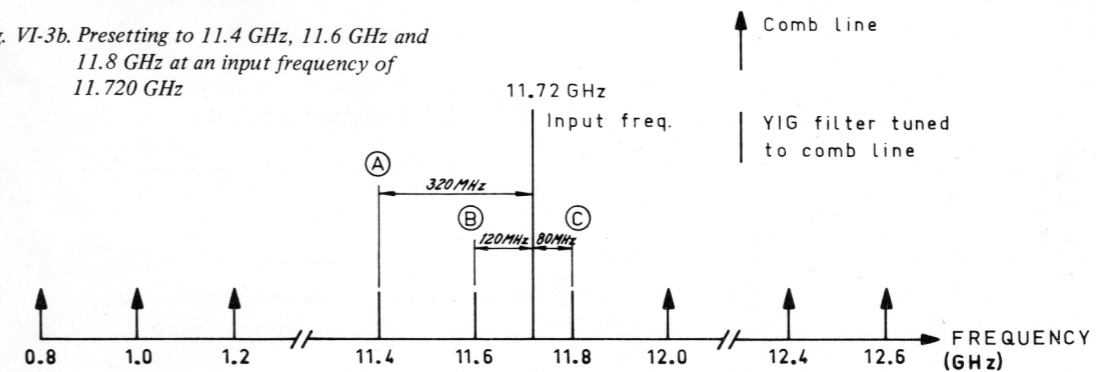


Fig. VI-3c. Presetting to 5.2 GHz, 5.4 GHz and 5.6 GHz at an input frequency of 5.402 GHz

