PHILIPS

RF signal generator

PM 5326

9452 053 26001

Instruction manual

9499 520 08002

790501/2/01–03

PHILIPS

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Instruction manual
Gerätehandbuch
Mode d'emploi et d'entretien

RF signal generator
HF Signal-Generator
Générateur des signaux de H.F.

PM 5326

9452 053 26001

PHILIPS

9499 520 08002

790501/2/01-03

Please note

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

Bitte beachten

Bei Schriftwechsel über dieses Gerät wird gebeten, die Typennummer und die Gerätenummer anzugeben. Diese befinden sich auf dem Typenschild an der Rückseite des Gerätes.

Noter s. v. p.

Dans votre correspondance et dans vos réclamations se rapportant à cet appareil, veuillez toujours indiquer le numéro de type et le numéro de série qui sont marqués sur la plaquette de caractéristiques.

Important

As the instrument is an electrical apparatus, it may be operated only by trained personnel. Maintenance and repairs may also be carried out only by qualified personnel.

Wichtig

Da das Gerät ein elektrisches Betriebsmittel ist, darf die Bedienung nur durch eingewiesenes Personal erfolgen. Wartung und Reparatur dürfen nur von geschultem, fach- und sachkundigem Personal durchgeführt werden.

Important

Comme l'instrument est un équipement électrique, le service doit être assuré par du personnel qualifié. De même, l'entretien et les réparations sont à confier aux personnes suffisement qualifiés.

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1. GENERAL

1.1. INTRODUCTION

The RF signal generator PM 5326 is an instrument of high accuracy. The precise specifications and easy to operate controls make this device suitable for service workshops and education as well as development laboratories. The variety of applications includes telecommunication, radio and television problems.

Based on the phase-locked-loop (PLL) principle the RF carrier is very stable and easy to be set. The frequency is electronically counted (MOS technique) with X-tal reference and 5-digit LED-displayed. So faults in setting and reading which are characteristic for common generators with circular or linear scales are eliminated.

The amplitude of the carrier frequency able to be wobbulated is precise stabilized throughout the whole frequency ranges.

Radiation of the internal generated frequencies possibly escaping the case or the mains cable is utmost reduced by the separate cast RF housing within the instrument. So reliable use of the high attenuation can be made.

The instrument includes a separate swept frequency oscillator (wobbulator), the ranges of which are optimal suited for the common AM/IF, FM/IF, TV/IF and VHF range as well. The wobbulator is overmore used as frequency modulator for the FM/IF and VHF ranges. Together with the wobbulating ranges the center frequency, the width and marker distance of the spectrum is automatically switched over. When a wobbulating range is chosen, the X-tal controlled adjustable reference carrier frequency is used as "travelling marker" for pointing out the response in the band-pass.

The wobbulated or frequency modulated signal is then amplitude stabilised, defined attenuated and fed to the RF output.

The multi-variable applications are pre-determined in the extensive push-button array which in conjunction with the further controls, sockets and the display are all arranged at the frontpanel. The text plate is multi-coloured so indicating the different functions for operating convenience.

The overall electrical and mechanical concept reduces the time for set-up, measurement and evaluation.

1.2. TECHNICAL DATA

General information:

On delivery from the factory, the instrument complies with the safety regulations of measuring and control equipment. The information and warnings contained in this instruction manual must be followed by the user to ensure safe operation and to maintain the instrument in a safe condition.

- Only data with indicated tolerances or limits are guaranteed; data without tolerances are given only for guidance.
- All specifications will be met after a warm-up time of 30 min. when keeping the instrument in a constant mounting position.
- Inaccuracies (absolute or in %) relate to the indicated reference value.

SPECIFICATIONS

1.2.1. RF Generator

Frequency range	0,1 – 125 MHz
Ranges	0,1 – 0,25 MHz 0,25 – 0,5 MHz 0,5 – 1 MHz 1 – 2,5 MHz 2,5 – 5 MHz 5 – 10 MHz 10 – 25 MHz 25 – 50 MHz 50 – 125 MHz
Frequency display	5-digit LED display, red, 11 mm high; 3 decimal points; 2 LEDs for dimension kHz, MHz
Error of the display	$< 10^{-4}$ typical, ±1 digit
Temperature coefficient of the display	$\pm 5 \times 10^{-6}/^{o}C$ at 23 °C ±20 °C
Temperature coeffiecient of the frequency	$< 10^{-5}/^{o}C$

1.2.2. RF Sweep generator

Ranges	.4/.5 MHz 10/11 MHz 36/41 MHz 75/110 MHz
wave form	semi-rectangular

1.2.3. RF output

for all RF ranges and all sweep ranges

Connection:	BNC connector RF OUT
Impedance:	75 Ω
max. output voltage:	50 mV into 75 Ω
Frequency response:	< ± 2 dB (1 dB typ.) for all RF ranges

Attenuator

> 100 dB total
0 – 80 dB continous
3 dB, 40 dB calibrated

1.2.4. Modulation

Modulation modes	see also table in chapter 3.2.
unmodulated	all RF ranges and all sweep ranges
amplitude-modulated, AM	all RF ranges and all sweep ranges
frequency-modulated, FM	sweep ranges 10/11 and 75/110 MHz
Frequency response	< 2 dB in .4/.5 and 10/11 MHz ranges < 0.2 dB in 36/41 and 75/110 MHz ranges
Modulating output MOD OUT	1 kHz sine, 2 V resp. external modulating signal at MOD IN

Amplitude modulation

unmodulated	all RF ranges and all sweep ranges	
AM, internal	all RF ranges and all sweep ranges	
	Modulation frequency:	1 kHz sine
	Modulation depth:	30 %
AM, external	Modulation depth:	0 – 100 %
	Modulation coefficient:	200 mV/10 % AM
	3 dB band width:	20 Hz – 20 kHz
	Input impedance:	> 10 k Ω

Frequency modulation — 10/11 and 75 /110 MHz ranges

FM, internal	Modulation frequency:	1 kHz sine
	Sweep (Δ f):	22,5 kHz
FM, external	Modulation signal:	20 Hz – 60 kHz (3 dB)
	Sweep (Δ f):	0 – 75 kHz
	Modulation coefficient:	200 mV/±7,5 kHz
	3 dB band width:	20 Hz – 60 kHz
	Input impedance:	>10 k Ω

1.2.5. Wobbulation

Ranges, wobbulation width	Range	Width (Δ 2 f)
	.4/.5 MHz	0 – 50 kHz
	10/11 MHz	0 – >1 MHz
	36/41 MHz	0 – 10 MHz
	75/110 MHz	0 – 1 MHz
Frequency response	< 0,2 dB in .4/.5 and 10/11 MHz ranges	
Wobble frequency, triangle	3 – 30 Hz, blanking during fly-back	
– Linearity error	< 5 %	
Wobble frequency, sine-wave	50/60 Hz line frequency, phase variable	
Center frequency	adjustable within the full ranges	
Wobbulating output SWEEP OUT		
– Signal	triangle	sine-wave
– Frequency	3 – 30 Hz	50/60 Hz line frequency
– Amplitude	2,5 – 10,5 Vpp	2,5 – 10,5 Vpp
– Impedance	1 k Ω	1 k Ω

1.2.6.	**Marker generator**	prepared by one of the RF SWEEP RANGE buttons (indicator-LED MARKER is illuminated); switched in by button MARKER OFF/ON
	variable frequency markers	from RF generator, adjusted frequency on the display
	fixed frequencies for adjustable frequency marker spectrum	Range / Marker distance .4/.5 MHz — 10 kHz 10/11 MHz — 100 kHz 36/41 MHz — 1 MHz 75/110 MHz — 100 kHz
	Marker	Marker mixing, superposition; (birdy-marker)
	Amplitude	2 Vpp
	Output	2 loop-through BNC connectors
	Impedance	> 500 k Ω

1.2.7. Counter

	PM 5326:	PM 5326 X:
Frequency range	1 – 999.99 kHz	1 kHz – 99.999 MHz
Input voltage	50 mV – 50 V	30 mV – 50 V
Input impedance	1 MΩ	1 MΩ

1.2.8. Power supply AC mains

Reference value	230 V
Nominal values	115 V/230 V selectable by solder links
Frequency range	48 – 63 Hz
Power consumption	18 W

1.2.9. Environmental conditions

Ambient temperature

Reference value	+ 23 °C ± 1 °C
Nominal working range	+ 5 °C ... +40 °C
Safe operation temperature range	–15 °C ... +55 °C
Limits for storage and transit	–40 °C ... +70 °C

Relative humidity

Reference range	45 ... 75 %
Nominal working range	20 ... 80 %

Air pressure

Reference value	1013 mbar (≙ 760 mm Hg)
Nominal working range	800 ... 1066 mbar (up to 2200 m height)

Air speed

Reference value	0 ... 0.2 m/s
Nominal working range	0 ... 0.5 m/s
Operating position	normally upright on feet or with handle fold down
Warm-up time	30 min.

1.2.10. Cabinet

Protection type (see DIN 40 050)	IP 20
Protection class (see IEC 348)	class 1, protective conductor
Overall dimensions	
– height	140 mm
– width	310 mm
– depth	330 mm
Weight	approx. 6.5 kg

1.3. ACCESSORIES

1.3.1. Standard

Instruction manual
Fuse ~~250~~ 125 mA delayed 125 mA 230V 250 mA 110V
PM 9537 Coax cable with impedance transformer 75 Ω/300 Ω

1.3.2. Optional

PM 9075 Coax cable BNC – BNC 75 Ω
PM 9072 Coax cable BNC → two 4 mm plugs

1.4. OPERATING PRINCIPLE (FIG. 1)

1.4.1. RF circuitry, amplitude modulation

The RF Generator produces the high frequency. The RF FREQUENCY RANGE push-button array allows selecting the desired range, while the continuous control FREQUENCY SETTING determines the exact frequency.
Via Switching Stage and Amplifier 1 the RF frequency is fed to the Amplitude Modulator passing eihter unmodulated or amplitude-modulated by the internal 1 kHz Oscillator or by extern MOD IN low frequency due to the selected push-buttons MODULATION.
The amplitude of the RF frequency is stabilized in the control circuit Amplitude with automatic gain control AGC in the feedback path.
The Output Amplifier can be interacted by the Output blanking stage: when sweeping with the internal triangle the RF-signal is blanked during fly-back.
The RF ATTENUATION sets the output continuously from 0 to –80 dB, but the RF attenuator overmore has two fixed stages of –3 dB and –40 dB.

1.4.2. Sweep section and frequency modulation

The LF Sweep Generator produces and modulates high frequencies for the sweep ranges .4/.5, 10/11, 36/41, 75/110 MHz, selected by push-buttons RF SWEEP RANGE. The waveform is semi-rectangular.
The carrier for the frequency modulation and the center frequency for the wobbulating ranges respectively are set in Frequency Selection, activated by RF SWEEP RANGE just mentioned and coarse and fine adjusted by the double continuous control RF CENTER.
Pressed button AM/FM activates frequency modulation of the ranges 10/11 or 75/110 MHz with 1 kHz internal or with external signal via MOD IN input socket.
If one of the RF SWEEP RANGE buttons is pressed, the frequency modulated or wobbulated high frequency is fed via the Switching Stage to the main RF output path.
Due to the different frequency ranges the maximum sweep width is adapted by RF SWEEP RANGE. Control RF WIDTH reduces the width.
The sweeping or wobbulating signal and the signal for X-deflexion of an indicator or oscilloscope at the MOD/SWEEP OUT socket can be switched off by push-button SWEEP OFF/ON. In this case the modulating signal is available at the output.

1.4.3. Frequency marker

The Marker Mixer superimposes the frequency of the RF Generator to the swept frequency of the RF Sweep Generator. The low frequency beat is filtered in the Band-pass Filter Amplifier 3 and fed to the OUT-Y-IN socket for the Y-channel of an indicator (oscilloscope). Each frequency of the RF Generator can be used for frequency marker, i. e. "travelling marker".
Pulling the button MARKER AMPL generates fixed markers with many harmonics. The fundamental wave of the fixed marker is selected by RF SWEEP RANGE. So a marker spectrum with suited distance due to the sweep range is generated.
When using triangular sweep mode the square wave output of the LF Sweep Generator blanks the frequency markers in the Marker blanking during fly-back.

1.4.4. Display circuitry

The frequency of the RF-Generator is divided depending on the selected frequency range and fed to the Counter Decoder Driver which is controlled by the Time Base. The Time base, i. e. one measuring period for the counter, is changed by the chosen frequency range. The stage of the counter at the end of one measuring period represents the frequency which is multiplex-displayed on the 5-digit display.
Push-button COUNTER EXT enables the display circuitry working as normal counter. Amplifier 5 feeds the signal at the COUNTER IN socket directly to the counter, decoder and driver.

1.4.5. Power supply

The power supply provides the stabilized DC voltages of +5 V, +12 V, –12 V and +27 V, and the sinusoidal wobbulating voltage.

2. INSTALLATION

2.1. SAFETY REGULATIONS

Upon delivery, the instrument complies with the required safety regulations. To maintain this condition and to ensure safe operation, it is recommended to follow the instructions below.

2.1.1. Before connecting

Mains voltage

Check whether the instrument is adapted to the nominal mains voltage.

Protection

This instrument is protected according to class I (protective earth) of the IEC 348 or VDE 0411. The mains cable provides earth connection. Outside specially protected rooms, the mains plug must be connected only to sockets with earthed contact.

It is not allowed to interrupt the earth connection inside or outside the instrument.

2.1.2. Maintenance and repair

Failure and excessive stress

If the instrument is suspected of being unsafe, take it out of operation permanently.

This is the case when the instrument

- shows physical damage
- does not function anymore
- is stressed beyond the tolerable limits (e. g. during storage and transportation)

Dismantling the instrument

When removing covers or other parts by means or tools, live parts or terminals could be exposed. Before opening the instrument, disconnect it from all power sources.

If the open live instrument needs calibration, maintenance or a repair, it must be performed only by trained personnel being aware of the risks. After disconnection from all power sources, the capacitors in the instrument may remain charged for some seconds, observe the circuit diagrams.

Fuses

Only use the specified fuses.

Repair, Replacing parts

Repairs must be made by trained personnel. Ensure that the construction of the instrument is not altered to the detriment of safety. Above all, leakage paths, air gaps and insulation layers must not be reduced.

When replacing, use only original parts. Other spare parts are only acceptable when the safety precautions for the instrument are not impaired.

2.2. MOUNTING

The instrument may be used in any desired position. With the handle fold down, the instrument may be used in sloping position; for this purpose press the buttons A of the handle (Fig. 2). Do not position the instrument on any surface which produces or radiates heat, or in direct sunlight.

2.3. EARTHING

Before switching on, the instrument must be earthed in conformity with the local safety regulations. The mains cable fixed to the instrument includes a protective conductor, which is connected to the earth contacts of the plug. Thus, when connected to an earthed mains socket, the cabinet of the instrument is consequently connected to the protective earth.

WARNING: Connect the mains cable plug only to a socket with protective earth contacts. This protection must not be made ineffective, e. g. by using an extension cable without earth protection!

The circuit earth potential applied to the external contacts of BNC sockets is connected to the cabinet. The external contacts of the BNC sockets must not be used to connect a protective conductor.

2.4. DISMANTLING THE INSTRUMENT

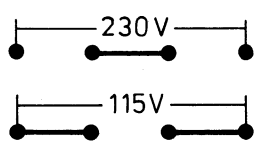
- Unplug the mains connector
- Fold up the handle to the top. For this push the buttons A (Fig. 2)
- Loosen the central screw at the rear
- Remove the lead-through of the mains cable from the cabinet
- Dismantle the cabinet

2.5. MAINS CONNECTION

The instrument must be connected only to an AC supply. On delivery the instrument is set to 230 V. Before mains connection, ensure that the local mains voltage ranges within the set mains voltage range indicated on the plate at the rear of the instrument.

If the instrument is to be used on 115 V supply, proceed as follows:

- Unplug the mains connector
- Dismantle the instrument, see 2.4.
- Resolder links on the mains transformer in accordance with the stick-on connection diagram. See also below.



- Insert the supplied fuse 250 mA delayed into the fuse holder instead of the one built-in
- Change the mains voltage plate at the rear of the instrument in accordance with the mains voltage selected. This plate for 115 V is inserted into a plastic cover
- Close the instrument

Mains connection must be made in accordance with the local safety regulations. This implies that the instrument is connected to mains socket with protective earth contact (see para. 2.3.).

3. OPERATING INSTRUCTIONS

3.1. CONTROLS AND SOCKETS (FIG. 2)

3.1.1. Frequency

Legend	Position	Function
RF FREQUENCY RANGE .1 – ... – 125 MHz	801.2 to 801.10	pushbuttons for selecting the frequency range
FREQUENCY SETTING		knob for continuous frequency adjustment
RF ATTENUATION 0/30/40 dB		rotary switch for setting the fixed attenuation
RF ATTENUATION 0 – 80 dB		knob for continuous attenuation adjustment
RF OUT	810	BNC output socket for RF signal
Display kHz, MHz		5-digit LED frequency display; 2 LEDs for dimension

3.1.2. Modulation

Legend	Position	Function	
MODULATION	802	pushbuttons; change-over contacts	
		not pressed	
			pressed
OFF/ON	802.1	unmodulated	modulated
AM/FM	802.2	amplitude-modulated	frequency-modulated
INT/EXT	802.3	internal	external
MOD IN	816	BNC input socket for external modulation voltage	
MOD/SWEEP OUT	815	BNC output socket for modulation signal	
SWEEP RF CENTER	603	dual-knob (coarse, fine) for continuous carrier adjustment	

3.1.3. Sweep

Legend	Position	Function	
		pushbuttons; change-over contacts	
		not pressed	
			pressed
RF SWEEP RANGE	802		
.4/.5 MHz	802.7		AM – IF
10/11 MHz	802.8	frequency mod. prepared	FM – IF
36/41 MHz	802.9		TV – IF
75/110 MHz	802.10	frequency mod. prepared	FM (band 2)
SWEEP OFF/ON	802.5		wobbling
SWEEP ^ ~	802.6	triangular wobbling	wobbling at line frequency

Legend	Position	Function
SWEEP RF CENTER	603	dual-knob (coarse, fine) for continuous adjustment of the centre frequency of the wobbling range
SWEEP RF WIDTH	604	knob for continuous adjustment of the wobbling width
SWEEP LF FREQUENCY PHASE	601	knob for continuous frequency adjustment on triangular wobbling or phase adjustment on wobbling at line frequency
SWEEP LF AMPLITUDE	602	knob for continuous adjustment of the wobbling voltage
SWEEP OUT	815	BNC output socket for the wobble signal

3.1.4. Frequency markers

MARKER OFF/ON	802.4	pushbutton for operation with frequency markers
MARKER		LED for operation with markers
MARKER AMPL	605	knob for continuous adjustment of marker amplitude
PULL FOR FIXED MARKERS	605	pull switch for adding fixed frequencies
IN–Y–OUT	813, 814	2 BNC sockets: – output socket for marker signal – mixing device for superposition of test object output signal with marker signal

3.1.5. Counter

COUNTER EXT	801.1	commutator for frequency counter mode
COUNTER IN	812	BNC counter input socket

3.1.6. 1 kHz sine-wave generator

MOD/SWEEP OUT	815	BNC output socket for 1 kHz sine wave

3.1.7. Triangle generator

SWEEP OUT	815	BNC output socket for triangle signal of sweep generator
LF AMPLITUDE	602	knob for continuous amplitude adjustment

3.1.8. Power supply

POWER ON o ● OFF	851	mains switch: white dot for ON position

3.2. OPERATION AND APPLICATION

Mode of operation — Betriebsarten — Mode d'operation

pushbutton / range MHz	counted and displayed	MODULATION			WOBBULATION		MARKER GENER.	
		OFF • / ON	AM • / FM o	INT • / EXT	var. mark.	var. mark. spectrum	frequency	carrier frequency
							OFF • / ON	AMPL • / PULL
.1 – .25	•	•	•	•				
.25 – .5	•	•	•	•			•	•
.5 – 1	•	•	•	•				
1 – 2.5	•	•	•	•				
2.5 – 5	•	•	•	•				
5 – 10	•	•	•	•			•	•
10 – 25	•	•	•	•			•	•
25 – 50	•	•	•	•			•	•
50 – 125	•	•	•	•			•	•
								marker distance
.4/.5		•	•	•	•	•		10 kHz
10/11		•	• o	•	•	•		100 kHz
36/41		•	•	•	•	•		1MHz
75/110		•	• o	•	•	•		100 kHz
1 – 999.99 kHz	COUNT. EXT.							
	Fig. 7	3	4	4	5	6	5	6

3.2.1. RF signal generator, unmodulated

All push-buttons are off except the concerning one of the RF FREQUENCY RANGE (fig. 3). The figure only contains the controls, function blocks, inputs and outputs which take active part of the applications.

3.2.2. RF signal generator, amplitude modulated

As 3.2.1., button MODULATION OFF/ON pressed. The set carrier is modulated by 1 kHz to 30 % depth.

As 3.2.2., button MODULATION IN/EXT pressed. The set carrier is modulated by the NF voltage fed in via MOD IN. At socket MOD OUT the external modulating voltage is available.

3.2.3. RF signal generator, frequency modulated

All push-buttons are off except the concerning one of the RF SWEEP RANGE 10/11 or 75/110 and the buttons for modulation OFF/ON and AM/FM (fig. 4). The carrier, fixed or to be set , is frequency modulated by 1 kHz.

As 3.2.3. and button MODULATION IN/EXT pressed. The set carrier is frequency modulated by the NF voltage, fed in via MOD IN. At the socket MOD OUT the NF voltage is available.

Note!
Adjustment of the carrier frequency see fig. 4

3.2.4. Wobbulator with variable frequency marker

All push-buttons are off except the concerning one of the RF SWEEP RANGE, SWEEP OFF/ON and MARKER OFF/ON (fig. 5). It is swept about the center frequency, which is chosen by button RF SWEEP RANGE and set by RF CENTER. The sweep width is pre-determined due to the range and can be varied by control RF WIDTH.

The sweep frequency of the ⋀LF signal is set by LF FREQUENCY. During fly-back the output amplifier and marker mixer are blanked. During sweep the marked band-pass can be seen on an indicator. The altitude of the marker is set by the MARKER AMPL control.

As in the first chapter 3.2.4. In addition button SWEEP⋀/∼pressed. It is wobbulated at line frequency (sine). The output and the marker signal are <u>not</u> blanked during fly-back. Sweep and fly-back curves are identically covered by the PHASE control. The X-channel of the indicator is fed in via SWEEP OUT output. The scale-factor is set by LF AMPLITUDE; see 3.3.6.3.

3.2.5. Wobbulator with travelling marker and coupled marker spectrum

According to 3.3.4. with additionally pulled turn-knob MARKER ÅMPL. (fig. 6)

3.2.6. Frequency counter

All push-buttons off except COUNTER EXT (fig. 7).

3.2.6.1. In this mode of operation the center frequency of the RF sweep generator can directly be measured in range .4/.5 and adjusted by means of button CENTER. For this connect the sockets RF OUT and COUNTER IN and push the button .4/.5.

3.2.7. 1 kHz sine-wave generator

All push-buttons off except MODULATION OFF/ON; the signal is fed to the MOD/SWEEP OUT socket (fig. 7).

3.2.8. Triangle generator

All push-buttons off except SWEEP OFF/ON and one of the buttons RF SWEEP RANGE. The frequency is set by LF FREQUENCY, the amplitude by LF AMPLITUDE. The signal is available at SWEEP OUT (fig. 7).

3.3. APPLICATION EXAMPLES

3.3.1. General measuring principle

Due to the fact that the output voltage is accurate and stable over a large range, gain and sensitivity can be conveniently measured. It is possible to apply the method of "continuous signal supply" by keeping the output level constant, or the method of "signal tracing". The choice depends mainly on the importance either of the non-reactive signal supply or of the signal decoupling with low detuning. The first method is subject to matching problems, the second to detuning phenomena.

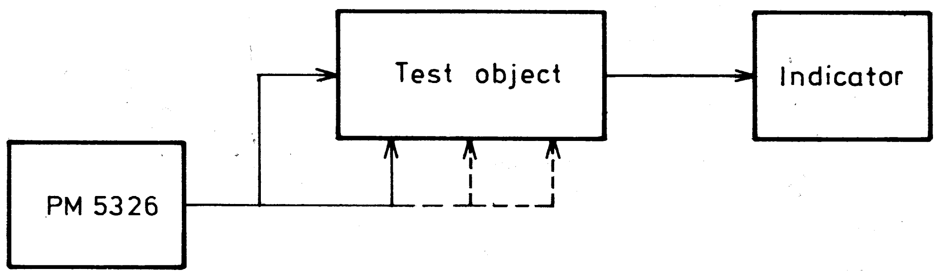


Fig. 3.3-1 Continuous signal supply

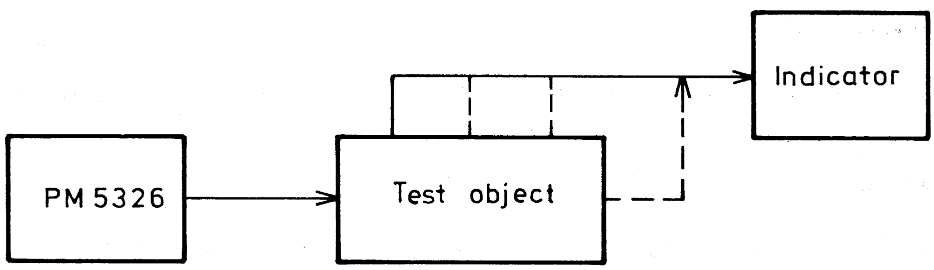


Fig. 3.3-2 Signal tracing

Usually the transmission characteristic of a selective test object is measured statically, i.e. point by point.

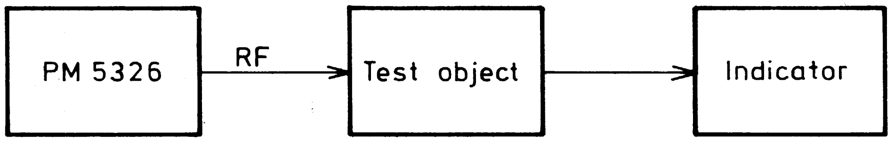


Fig. 3.3-3 Static measuring method

The static method gives very reliable results, but takes much time. As mostly only the shape must be determined and not the absolute values of the transmission characteristic, the dynamic method (wobbling) is generally preferred.

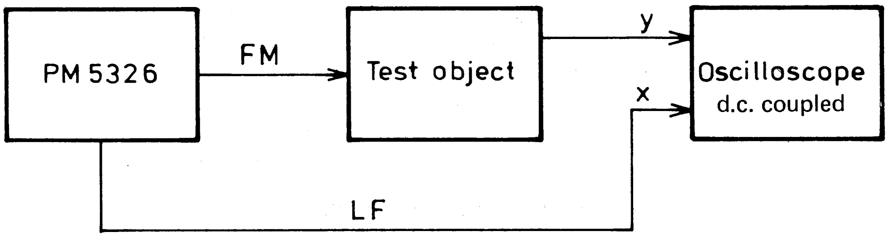


Fig. 3.3-4 Dynamic measuring method

3.3.2. Mains connection, general

Connect the RF-generator PM 5326 according to para. 2.5. of the Instruction Manual. The test object should be connected to mains via an isolating transformer. Only one test object may be connected to this transformer at the same time. When measuring all-mains receivers or TV sets, an isolating transformer must be used. Correctly connect the chassis of the test object to earth. Avoid double earthing of the test setup.

3.3.3. Connection of RF generator

It is recommended to observe always the checking and adjusting procedures given by the manufacturer of the test object (see fig. 3.3-20).

The test object may be connected to the RF generator via the cables mentioned below. These cables are optional:

PM 9072: cable BNC – 4mm plugs

PM 9075: cable BNC – BNC

In the FM range, the impedance transformer PM 9537 adapts the output impedance of the generator to the input impedance of the test object; 75Ω /300Ω .

In the AM range, a dummy aerial according to fig. 3.3-5 may be used to simulate the impedance of an AM aerial.

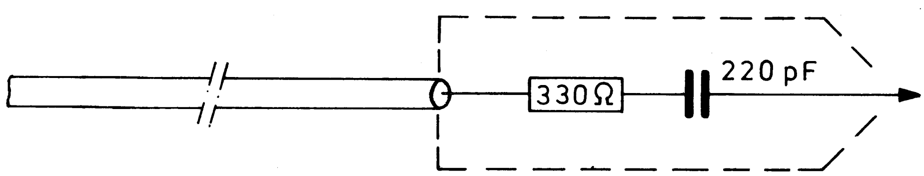


Fig. 3.3-5 Dummy aerial for AM range

Due to the low input impedance of a modern AM receiver, an isolating capacitor of 30 nF must be connected to its IF input. This capacitor must be mounted directly at the end of the cable, as with the PM 9072, for example.

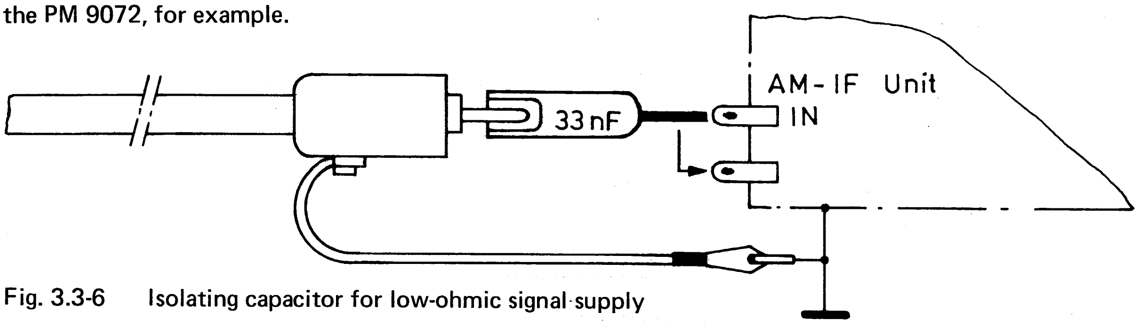


Fig. 3.3-6 Isolating capacitor for low-ohmic signal supply

Unit	via C	Δf	f_{wob}
AM–IF	33 nF	20 kHz	50 Hz
FM–IF	10 nF	200 kHz	50 Hz
FM–Tuner	direct	200 kHz	50 Hz
Selectivity	direct	200 kHz	10 Hz /\

For defined signal decoupling with low detuning and damping, a probe with damped resonant circuit can be used as attenuator. The coil of this circuit is tapped at the ratio of 10/1, thus transforming the resonant voltage downward during signal decoupling. The L/C ratio must be optimized for AM-IF and FM-IF with particular regard to coil losses.

For application in the AM-IF range, for example, the capacitive detuning is eliminated by means of the trimmer and by tapping the medium and high-ohmic potentials of the test object.

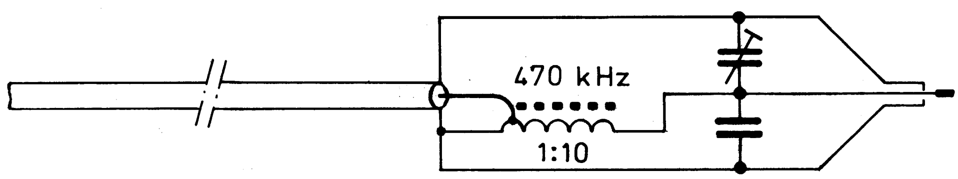


Fig. 3.3-7 Probe with selective voltage divider

3.3.4. Automatic gain control AGC of test object

To prevent incorrect measurements, it is necessary to test the efficiency and set-in level of AGC of the test object. Measuring results obtained at too high levels without suppression of AGC, are subject to considerable errors. This applies to wobbling, as well as to static methods.

It is common practice to adequately fix the sliding DC voltage of AGC to a constant DC voltage from a low-ohmic source. This can be achieved by an adjustable DC supply (e. g. PE 1535 or PE 1537), if the controlling DC voltage of the test object is related only to the chassis without being isolated. In case of conductive hum-pickup, it is recommended to use a dry battery or an accumulator and to tap the voltage by means of a potentiometer connected in parallel to the battery. The output of such a potentiometer circuit becomes more low-ohmic with moderate battery load, if the potentiometer is followed by a transistor ermitter-follower stage.

The connection point and the voltage level to be set are given in the checking and adjusting procedures of the test object. Receivers with suppressed (delayed) control set-in point produce acceptable measuring values, when working below the set-in point during measurement, so that the control is not effective.

3.3.5. Type and connection of indicator

The following indicators can be used: multi-purpose instruments, calibrated signal tracers, selective µV- or mV-meters, broadband voltmeters, oscilloscopes, wobble indicators and x/y recorders.

3.3.5.1. Connection to LF output

With supply of modulated signals, it is possible to connect indicators to LF outputs. The loudspeakers are replaced by resistors. Adjust the operating controls: volume to medium level, bass control to maximum, treble control to maximum, bandwidth to narrow.
With several LF channels, connect the indicator to the bass channel.

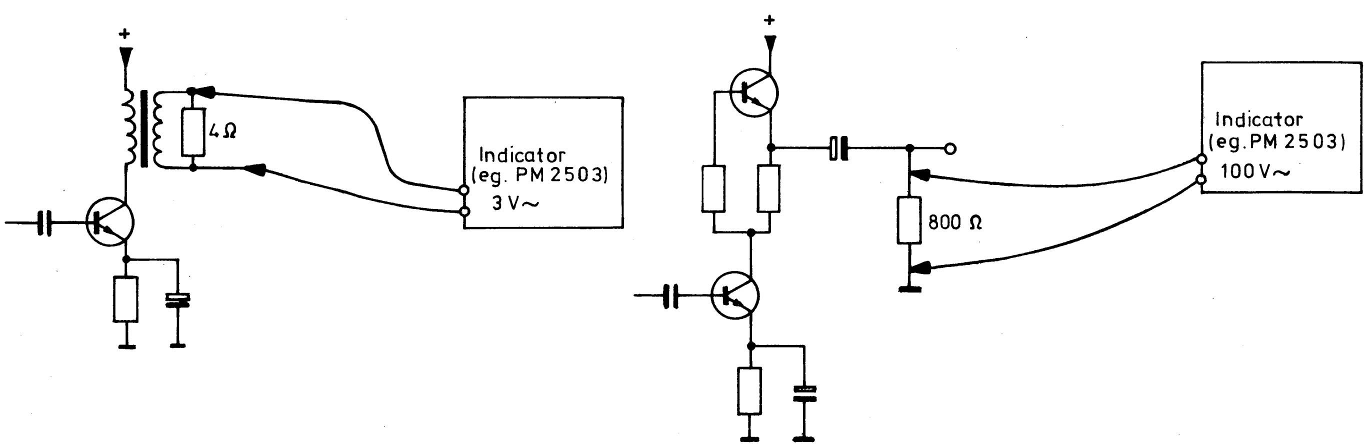


Fig. 3.3-8 Connecting indicator to LF output

3.3.5.2. Multi-purpose instruments

can be used as indicators of rectified currents of demodulators in AM and FM receivers and as limiters with FM receivers and TV sets.

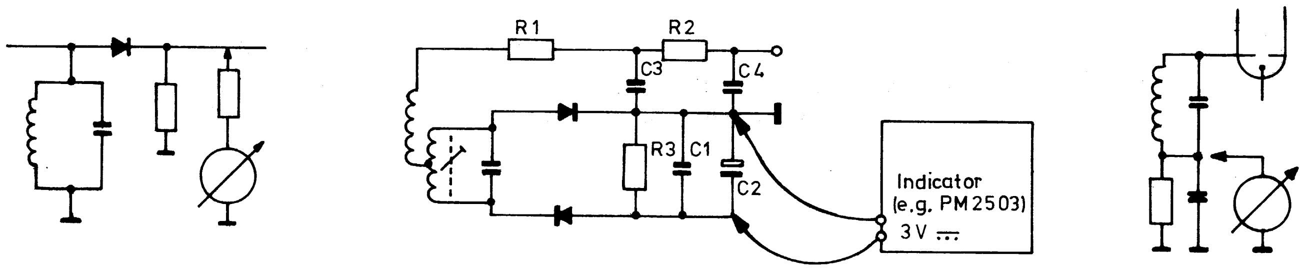


Fig. 3.3-9 Connection to AM, FM demodulators or FM limiter

3.3.5.3. For determining the gain of the IF stage

in AM receivers, the HF signal must be decoupled. This can be achieved by means of a voltage divider probe (ratio of 10 : 1, for example) with low detuning and damping. The resonant circuit probe, described before, is also suited.

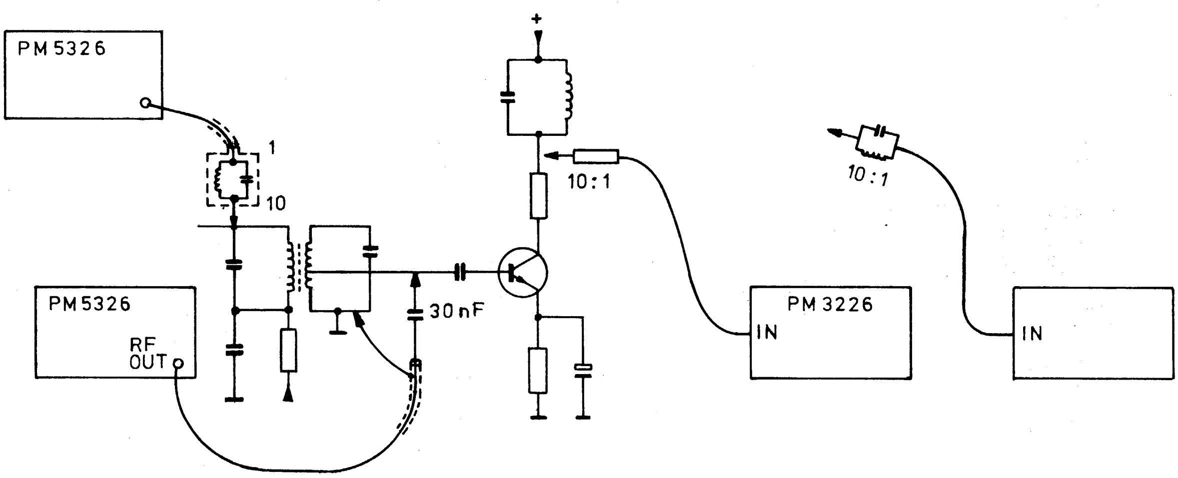


Fig. 3.3-10 Determination of gain of an AM stage

3.3.5.4. Adjusting overcritical coupled band filters

The mostly overcritical coupled band filters in the FM-IF amplifier must be damped and adjusted alternately. The connection wires of the damping resistor should be as short as possible.

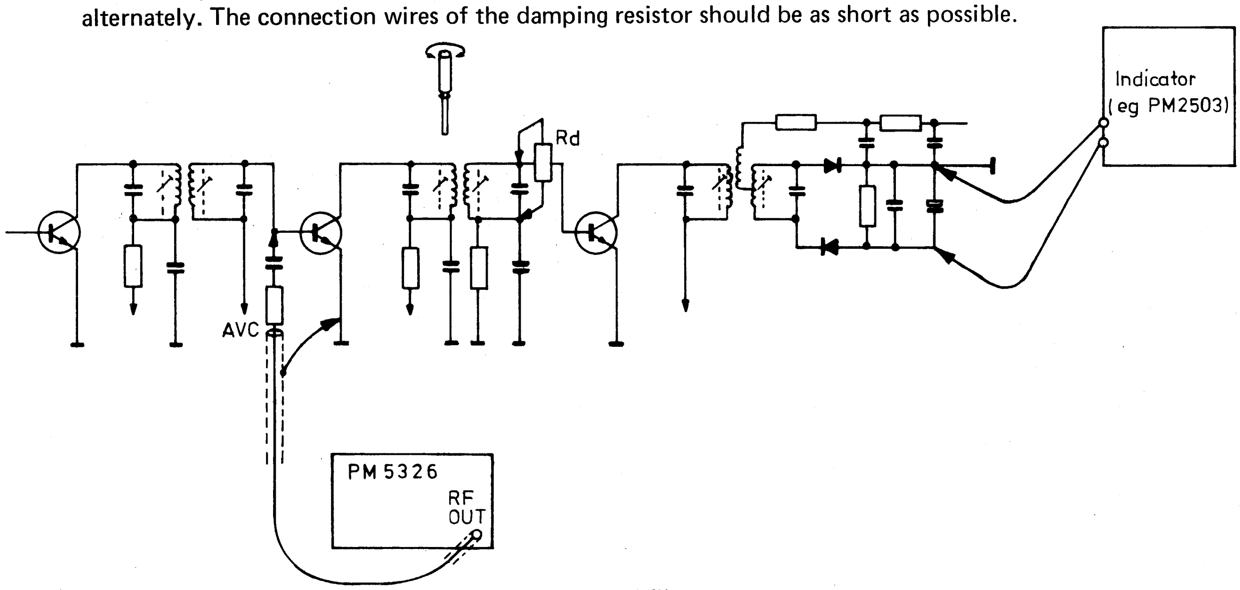


Fig. 3.3-11 Adjusting overcritical coupled IF band filters

Repeat the adjustment of a band filter several times.

3.3.5.5. Symmetry of a ratio detector

The S-shaped demodulator characteristic (fig. 3.3-17) should be linear and symmetric to the zero-axis crossing with normal control. For determining the symmetry, it is convenient to adjust the ratio detector in amplitude limitation. The rectified voltage at the limiter capacitor C2 is halved in the vol-age divider and is symmetrical with refence to the LF demodulator output (fig. 3.3-12). For recording the s-shaped demodulator characteristic, supply the signal to the base of the last IF stage.

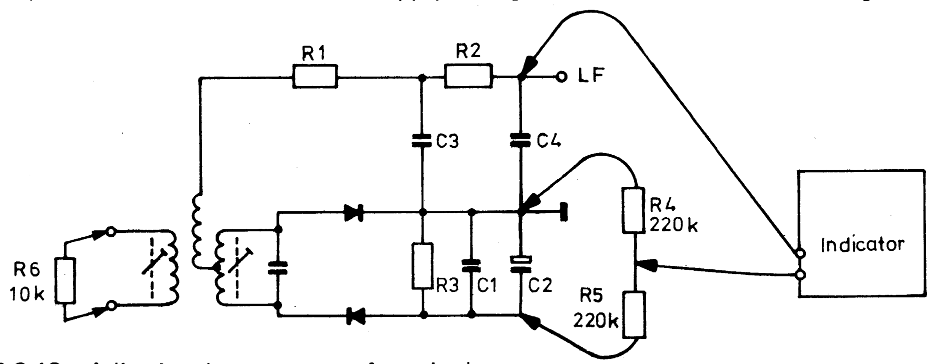


Fig. 3.3-12 Adjusting the symmetry of a ratio detector

3.3.6. Examples of wobbling

3.3.6.1. Test setup for checking and adjusting an FM receiver

see fig. 3.3-13. Examples of oscillograms are shown in figs. 5 and 6. The centre frequency in the FM-IF range can be adjusted by means of control RF CENTER with reference to the frequency of the RF generator. An example is given in fig. 4, at the top.

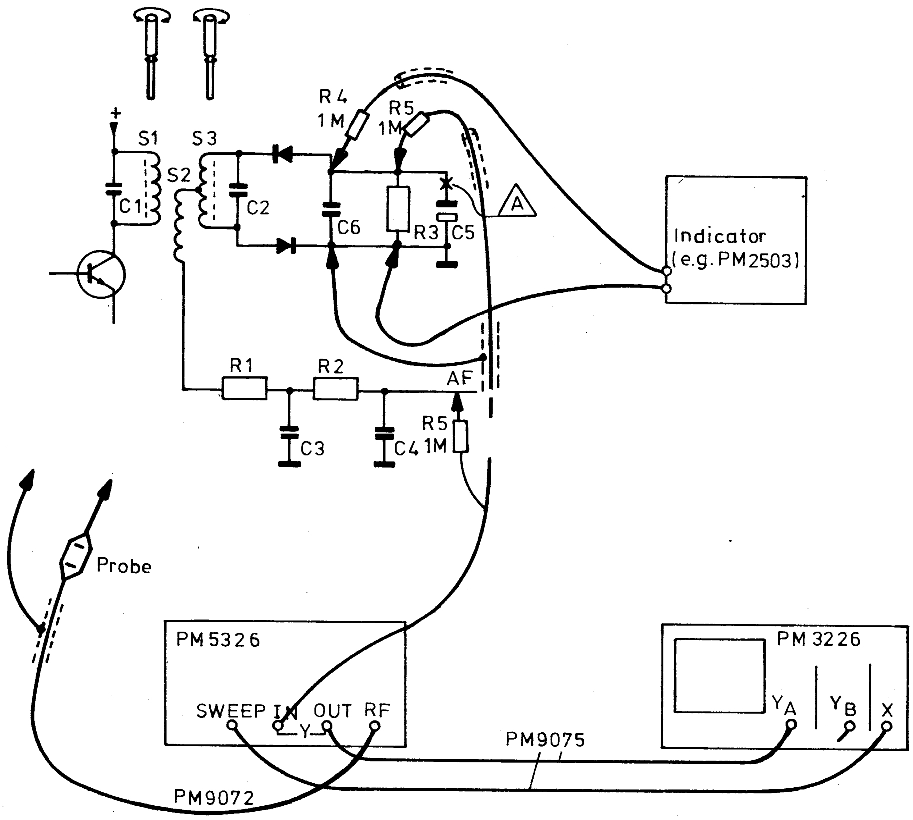


Fig. 3.3-13 Wobbulator setup

With actuated button SWEEP OFF/ON, the RF sweep generator is wobbled about the centre frequency at a frequency deviation adjustable by means of control WIDTH. The display width is set by using control LF AMPLITUDE. For adjusting the wobbulating frequency with /\– mode, use control LF FREQUENCY. The same control (PHASE) is used for phase shifting with ∿-mode, when button /\/∿ is actuated.

3.3.6.2. Wobbled signals

The wobbled frequency-modulated HF signal with large amplitude (e. g. fig. 4, at the bottom) is supplied to the low-ohmic input of the test object, ideally without reaction. Typical test objects are: AM, FM and TV-IF amplifiers and VHF channel selectors matching to the frequency ranges and the mean frequency deviation of the RF sweep generator. The signals are supplied, for instance, to the low-ohmic base connections of the IF stage. So-called capacitive test probes have been proved good for valved mixer and IF stages, which transfer the wobbled signals to the anodes of the valves without reaction.

The signal is semi-rectangular due to the decoupling at the sweep oscillator; this does not mean any disadvantage, as the important information of an FM signal is inherent in the zero-crossings of the signal. The wave form is not so important, as the amplitude is mostly limited by the IF amplifier.
The portion of the harmonic waves is considerable, especially of the uneven harmonics. This is not inconvenient, as the selective measuring or wobbled object itself extensively suppresses the harmonics.
Instead of the fundamental wave it is possible to operate with the harmonics; but it must be taken into account, that the frequency width increases with the ordinal number of the harmonic. In special cases the harmonics can considerably be reduced by inserting a low-pass filter between output socket and measuring cable, especially valuable for applications according to chapters 3.3.6.7 and 3.3.6.8.

3.3.6.3. **The X-channels of wobble indicators,**

oscilloscopes, special wobble displays or X - Y high-speed recorders must be DC-coupled. Otherwise, linearity errors occur in X-direction, particularly with slow wobbulating frequencies.

Finite lower limit frequencies in the Y-channel cause pulse droops due to suppression of the DC components. In this way, an error is simulated, which is actually not present. The upper limit frequency of the Y-channel has less effect, as the Y-signal is decoupled after the demodulator and is therefore at low frequency. The oscillograms show that the leading and trailing edges are not very steep.

The non-linearity of an X-channel with finite lower limit frequency is reducible, when wobbled with sine-waves at mains frequency.

As the edges of the wobbling sine-signal are not linear, wobbling must be symmetric to the zero-axis crossing to obtain a deflection synchronous and in phase with the sinusoidal frequency variation. This is the case, when the sweep-flyback is made coincident by means of control PHASE.

3.3.6.4. **AGC of wobbled object**

For suppression of AGC of the wobbled object, see para. 3.3.4. The DC supplies PE 1535 or PE 1537 are suited for this purpose.

3.3.6.5. **Frequency marks**

For marking a frequency of the transmission characteristics, the frequencies RF and RF sweep are mixed and the modulationproduct is selected by means of a narrow-band LF amplifier. The frequency marks are produced by amplitude modulation, fig. 3.3-14.

This frequency mark is adjustable over the transmission characteristic by varying the frequency of the RF generator, fig. 3.3-14 and fig. 5.

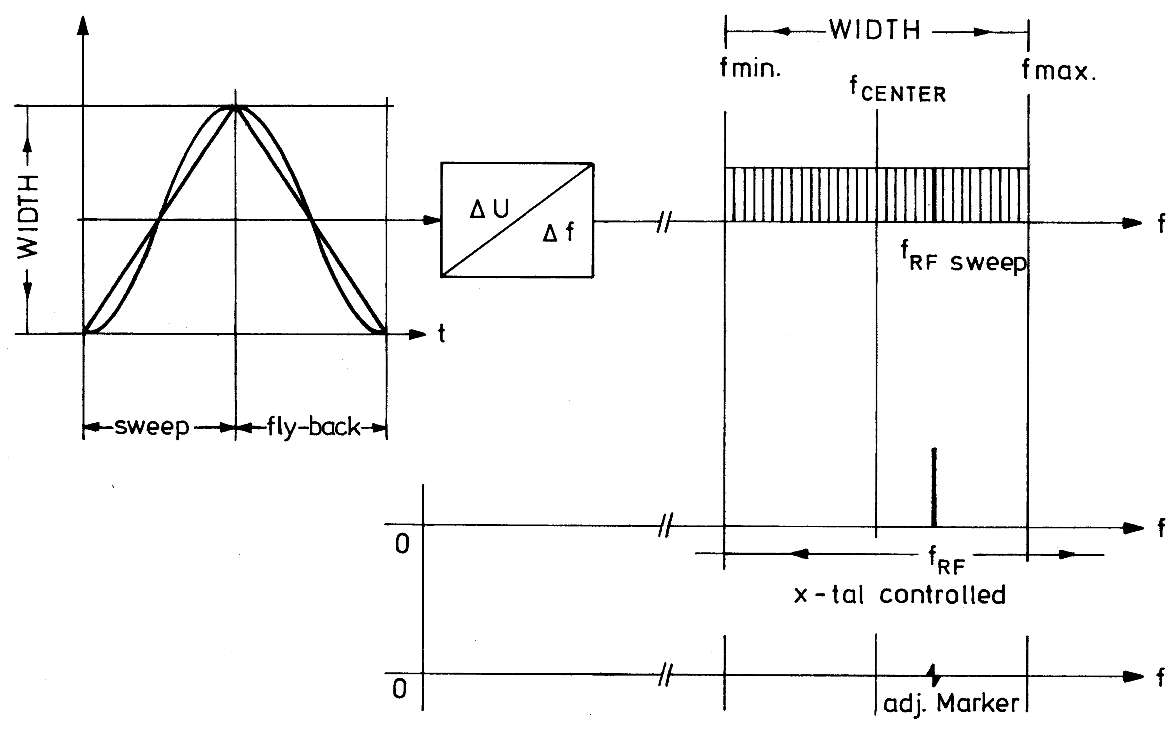


Fig. 3.3-14 Adjustable frequency marks

The frequency mark signal is available at the BNC connector IN-Y-OUT to be superimposed to the Y-signal. The output signal of the test object is active at the Y-input of the wobble indicator via the loop-through IN-Y-OUT and produces a frequency mark at the required point of the transmission characteristics, fig. 3.3-16.

The frequency mark can be displayed separately or in addition via the second channel of a wobble indicator, fig. 3.3-17 (LH-side).

The adjustable frequency mark spectrum is used for rough determination of the linearity and bandwidth of the test object. Fig. 3.3-15 shows the composition of the frequency mark spectrum

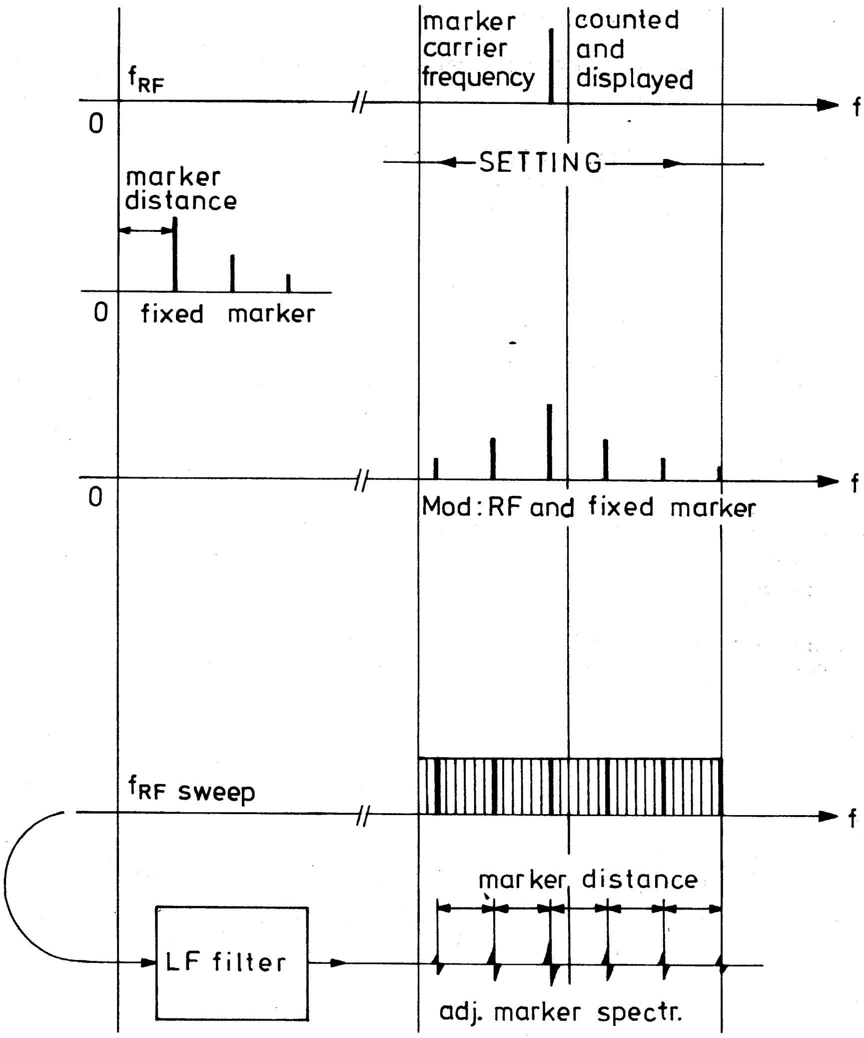


Fig. 3.3-15 Adjustable spectrum of frequency marks

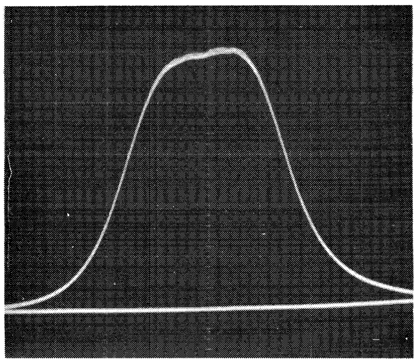
The main mark has the largest amplitude; it marks the frequency indicated by the counter. When operating the FREQUENCY control, the main mark is displaced and the side marks of the spectrum are shifted equidistantly. This allows the frequency marks to be brought into coincidence with the frame of the display unit (fig. 3.3-17).

3.3.6.6. Table of adjustments, example.

Fig. 3.3-21 shows a table of adjustments for a test object, given as an example. It recommends to wobble the AM-IF at 50 Hz with a deviation of 20 kHz. Due to the finite settling time of the IF-amplifier, it is recommended to use low sweep frequencies.

Such low deflections (from 3 Hz) correspond to the resolving power of the Human's eye and, therefore the observer perceives a dashed transmission curve. When connected, it corresponds approximately to the true line. The FM-IF should be wobbled at 50 Hz with a deviation of 200 kHz; the same applies here as above.

With low frequency deviations, occurring on wobbling in the AM range, for example, the frequency marks are relatively large and apparently non-defined. It is, however, recommended to fix the bright point in the middle of each frequency mark, which is due to the phase jump with equal wobble and mark frequency, fig. 3.3-16.



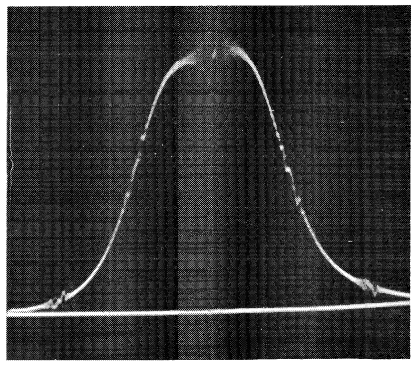
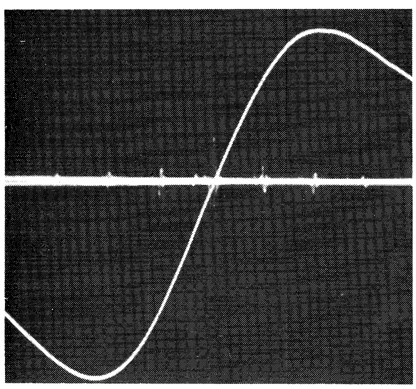


Fig. 3.3-16
Non-marked and marked AM-IF transmission characteristics



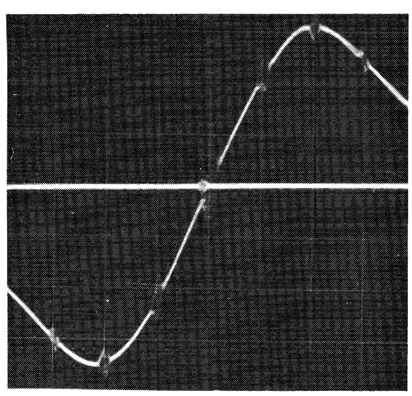


Fig. 3.3-17
Frequency marks of the zero line and/or transmission characteristics, with reference to frame

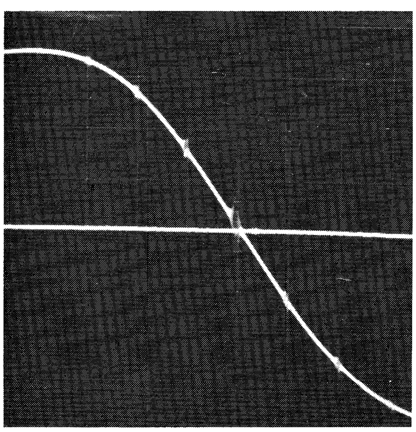


Fig. 3.3-18 Spectrum of frequency marks (with reference to frame) of a coincidence demodulator (quadrature)

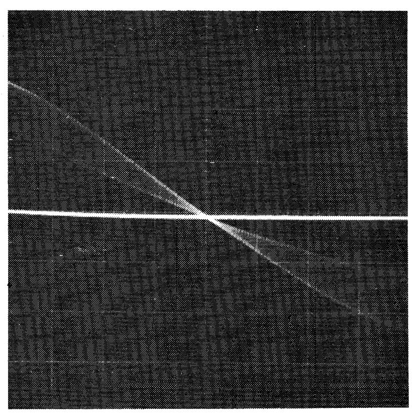


Fig. 3.3-19 Amplitude modulation when wobbling with insufficient amplitude limitation of test object

3.3.6.7. S-characteristic of an FM demodulator

The quality of the reception depends considerably on the zero-axis crossing, symmetry and linearity of the S-characteristic of an FM demodulator. Fig. 3.3-17 shows the properly adjusted S-characteristic of a ratio detector with frequency marks and an oscillogram with frequency marks on the zero line.

These frequency marks considerably facilitate the adjustment and evaluation of the demodulator characteristic, particularly when the marks are spaced at the same distance as the reference frame.

For adjusting the S-characteristic, supply the wobbled RF signal to the base of the last FM-IF transistor stage, so that the IF amplifier cannot reduce the bandwidth.

3.3.6.8. S-characteristic of a coincidence demodulator

Fig. 3.3-18 shows the transmission characteristic of an IF quadrature demodulator (coincidence demodulator). It can be realized by an IC with high amplification and strict limitation of the main IF signal a. o. The main channel selection acts as a filter between the FM tuner and the IF quadrature demodulator.

A parallel resonant circuit can be used as phase shifter, furnishing a phase-shifted voltage component with high-ohmic IF signal control, which is proportional to the frequency variation. For the centre frequency, the phase shift is 90^{o}.

For demodulation, the main signal is multiplied by the phase-shifted voltage in a multiplier. The plotted geometric sums give the transmission characteristic.

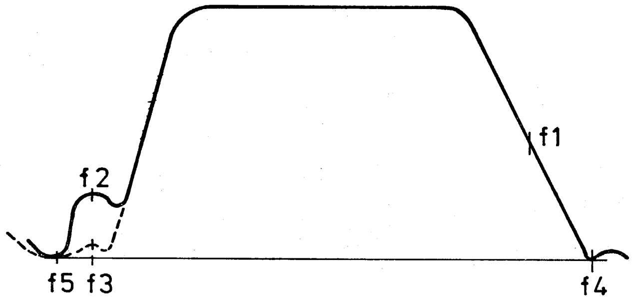
3.3.6.9. Amplitude limitation

For checking the amplitude limitation of the test object, the wobbled RF signal is additionally amplitude-modulated with button MODULATION OFF/ON depressed.

Set attenuator to position 40 dB and reduce the RF signal by means of potentiometer 0 – 80 dB just until the superposition of the 1 kHz signal over the S-characteristic becomes visible. Then turn the attenuator switch to position 3 dB or 0 dB; with correct amplitude limitation, the superposition of the S-characteristic should be completely suppressed. When increasing the signal, take care that the set-in point of the AGC is not exceeded, otherwise additional limitation could be the result, see para. 3.3.4 and fig. 3.3-19.

3.3.7. IF transmission characteristic of a TV set

Fig. 3.3-20 shows the ideal IF transmission characteristic of a TV set. Due to the residual time band modulation in the transmitter, the lower frequencies (from 0 to 1.25 MHz) are doubled in the receiver during demodulation and must be reduced by a factor 2 at point f_1 of the Nyquist slope.



$$A_{f1} = \frac{A_f}{2}$$

$$A_{f2} = \frac{A_f}{12 \div 20}$$

$$A_{f3} = \frac{A_f}{200}$$

$$A_{f4} = A_{f5} = \frac{A_f}{800}$$

Fig. 3.3-20 Ideal transmission characteristic of a TV set

The amplitude of the waveform at f_2 should be 12 to 20 times smaller than the max. amplitude of the vision. With parallel sound mode, the amplitude is reduced 20 times at point f_3. The suppression factor of the adjacent picture f_5 and the adjacent sound f_4 should be 800 at least. Refer to manufacturer's documentation for exact alignment procedure.

To determine the adequate damping of the critical points of the transmission characteristic, e. g. f_2, f_3, f_4 and f_5 in fig. 3.3-20, the point-by-point method is recommended.

For tracing the transmission characteristic, use the wobble range 36/41.

SK Wave range	→	◇		*			
MW 517-1622 kHz	/00/28/50: 452 kHz /15 : 470 kHz /19/59 : 460 kHz ΔF 20 kHz (50 Hz) via 33 nF	◇A ◇B	C401 min. cap.	[K]	[L] [H] [K]	↕ ◇2 [1]	
LW 148.5-262.5 kHz	147 kHz	◇K	C401 max. cap.		[C]	↕	◇1 V max.~
MW 517-1622 kHz	1635 kHz		C401 min. cap.		C584		
SW 7.03-21.97 MHz	6.95 MHz	◇J	C401 max. cap.		[B]		
	22.2 MHz		C401 min. cap.		C573		
LW 148.5-262.5 kHz	156 kHz	◇K	∅ Tune in		S407c.d	↕	◇1 V max.~
MW 517-1622 kHz	550 kHz				S407a,b		
	1500 kHz				C563		
SW 7.03-21.97 MHz	7.5 MHz	◇J			[A]		
	21 MHz				C555		
SW (49 m) 5.91-6.24 MHz	6.1 MHz				[P]		
	5.89 MHz		C401 max. cap.		C578		
FM 87.5-104 MHz	[2] 10.7 MHz ΔF 200 kHz (50 Hz) via 5 nF	◇C	S310 min. ind.	[C][N]	[E]	◇3	
		◇D			[D]	[1]	
		◇J			[M] [N]	[3]	
					[G]	◇4 [4]	
FM 87.5-104 MHz	108 MHz	◇J	S310 min. ind.		C331	↕	◇1
	96 MHz		∅ tune in		S310,312		V max.~

*Turn the mentioned coils fully outwards.

[1] Adjust for maximum height and symmetry.
[2] Open bridge ▽, damp S526c with 1,5 kΩ
[3] Close bridge ▽
[4] Adjust for maximum slope and symmetry of the "S"-curve.

[1] Ajuster sur hauteur et symétrie maximales.
[2] Ouvrir le pontet ▽. Amortir S526c avec 1,5 kΩ
[3] Fermer le pontet ▽.
[4] Ajuster sur Raideur et symétrie maximales de la courbe en "S".

[1] Justiere auf maximale Höhe und Symmetrie.
[2] Öffne Brücke ▽. Dämpfe S526c mit 1,5 kΩ.
[3] Schliesse Brücke ▽.
[4] Justiere auf maximale Steilheit und Symmetrie der "S"-Kurve.

Fig. 3.3-21
Table of adjustments, example of an FM/AM-receiver
Abgleichtabelle, Beispiel eines FM/AM-Empfängers
Table de réglage, exemple d'un récepteur FM/AM
(PHILIPS RH 702)