AFM1c
AM-FM
Modulation
Meter

OPERATING INSTRUCTIONS

RADIOMETER
COPENHAGEN

AFM1c
AM-FM
Modulation
Meter

OPERATING INSTRUCTIONS

RADIOMETER
COPENHAGEN

Table of Contents

	page
SECTION A - INTRODUCTION	A1
SECTION B - SPECIFICATIONS	B1
SECTION C - GENERAL DESCRIPTION	C1
1. General	C1
2. Controls, Dials, Meter, and Terminals	C1
SECTION D - OPERATING INSTRUCTIONS	D1
1. Connecting the Instrument	D1
2. Measuring Amplitude Modulation Percentage (AM%)	D1
3. Measuring Frequency Deviation (FM kHz)	D2
4. Using an External Oscillator	D2
5. Using an Internal Crystal-Controlled Oscillator	D3
SECTION E - CIRCUIT DESCRIPTION	E1
1. The RF Input Circuit	E1
2. The Tuner	E1
3. IF Filter and RF Level	E1
4. IF Amplifier	E1
5. AM Detector	E2
6. FM Detector	E2
7. AF Amplifier	E3
8. AF Detector	E3
9. Power Supply	E3
SECTION F - MAINTENANCE	F1
1. General	F1
2. Removing the Instrument from the Cabinet	F1
3. Tube Replacement	F1
4. Adjustments	F2
SECTION G - APPENDIX	G1
1. Modification for Internal Crystal-Controlled Oscillator	G1
2. Operating Voltages	G2
SECTION H - PARTS LIST	H1

Section A. Introduction

AM-FM MODULATION METER
Type AFM1

Fig.1. The AM-FM Modulation Meter, type AFM1

The AM-FM Modulation Meter, type AFM1, meets a demand for accurate measurement of the modulation percentage of amplitude-modulated signals, and of the peak deviation of frequency-modulated signals. It is a unique feature of this instrument that both types of modulation can be measured accurately.

The basic carrier-frequency range is from 3 to 320 MHz, where less than 10 millivolts are required for operation, but the Modulation Meter can be used to over 1000 MHz on harmonics.

The measuring range is very wide. Readings can be made from 0.1% to 100% on AM and from ±100 Hz to ±300 kHz on FM. The range can be extended further downwards with an external indicator, such as a vacuum-tube voltmeter. With 1 dB drop-off at 30 Hz and 25 kHz, the Modulation Meter can be used to check the performance of high-fidelity systems. The instrument has been designed so that it is possible to measure amplitude-modulation on frequency-modulated signals, and vice versa.

The Modulation Meter has provision for a crystal-controlled local or external oscillator, which reduces the spurious FM to about ±10 Hz - a convenience when measuring residual FM in oscillators.

The intermediate-frequency and audio-frequency signals can be supplied to external monitors from terminals on the front panel.

Section B. Specifications

FREQUENCY RANGE

3 to 320 MHz.

Operation to over 1000 MHz is possible on harmonics. The following data are valid at frequencies up to 320 MHz, but most of them apply equally well at higher frequencies.

INPUT LEVEL

Minimum: 10 millivolts, usually about 5 mV.

Maximum: 1 volt on AM for a 100% modulated signal to avoid distortion. Higher levels permitted for signals with less than 100% modulation.

10 volts on FM.

To obtain minimum residual readings, the input level must be 20 dB above the minimum level.

INPUT IMPEDANCE

75 Ω nominal (for type AFM1S1, 50 Ω)

AMPLITUDE MODULATION

Ranges: 3,10,30, and 100% AM full scale.

Measurement of positive and negative peaks of modulation.

Accuracy: 3% of full scale to over 95% modulation.

Frequency response: 30 Hz to 25 kHz within ±1 dB.

Residual reading: Less than 0.1% AM.

Distortion: Less than 0.5% to 95% AM.

FREQUENCY MODULATION

Ranges:	±3, ±10, ±30, ±100, and ±300 kHz deviation full scale.
	Measurement of positive and negative peaks of deviation.
Accuracy:	3% of full scale.
Frequency response:	30 Hz to 25 kHz within ± 1 dB.
Residual reading:	Varies from about 10 Hz at low carrier frequencies to about 60 Hz at high frequencies.
Distortion:	Less than 0.5% up to ±300 kHz.

AF OUTPUT

Audio-frequency signal (AM or FM) of 1 volt open-circuit at full scale from a source of 1.6 kΩ.
The frequency response is within ±1 dB in the range 30 Hz to 25 kHz.

IF OUTPUT

1 MHz intermediate-frequency signal of approximately 0.5 volt open-circuit at full scale from a source of 250 Ω.

TERMINALS

RF input to BNC coaxial sockets, type UG-290/U.

IF and AF output from standard 4 mm banana jacks.

POWER SUPPLY

Voltages:	110, 115, 127, 200, 220, 240 volts.
Line frequencies:	50 to 60 Hz.
Consumption:	80 watts.

TUBE COMPLEMENT

2 EAA91 (6AL5)	1 EC81 (6R4)
2 ECC81 (12AT7)	1 ECC82 (12AU7)
1 ECC88 (6DJ8)	1 EF80 (6BX6)
2 EF86 (6267)	4 EF91 (6AM6)
2 85A2 (5651)	1 150B2
1 6AL5	

MOUNTING AND FINISH

Steel cabinet finished in grey enamel.

DIMENSIONS AND WEIGHT

Height:	290 mm (11 1/2 inches)
Width:	565 mm (22 1/2 inches)
Depth:	270 mm (10 1/2 inches)
Weight:	20 kilos net (44 lbs.)

ACCESSORIES SUPPLIED

1 coaxial cable, 75 Ω (50 Ω for type AFM1S1), type 6D6 (6E6), with BNC plugs, type UG-88.

1 power cord, code 615-300.

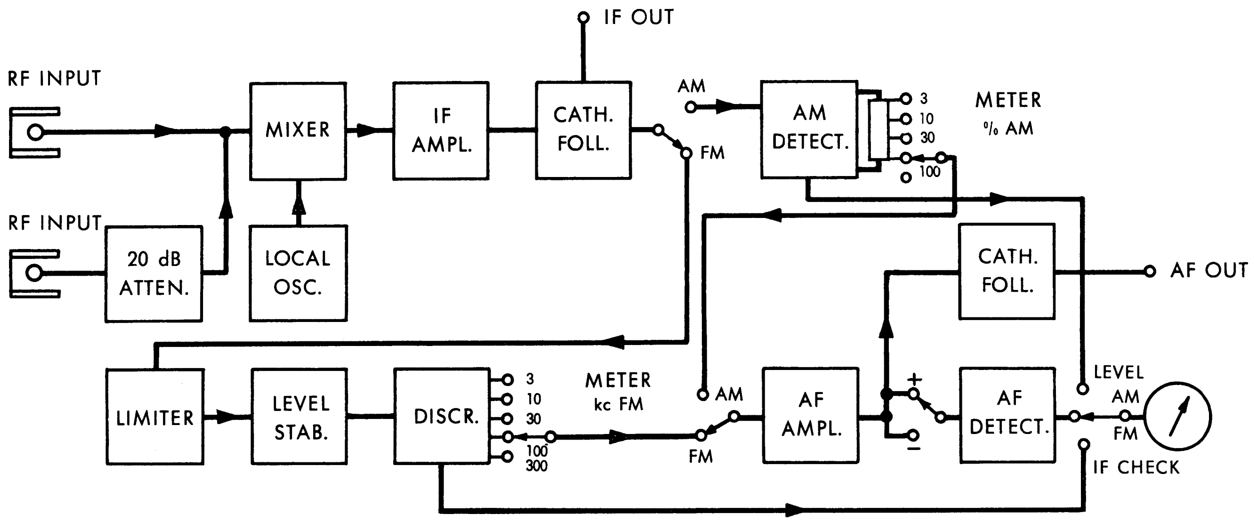

Fig. 2. Simplified block diagram of the AM-FM Modulation Meter, type AFM1

Section C. General Description

GENERAL

The Modulation Meter is a high-quality instrument designed for stable and dependable operation. It consists of the same basic elements as a radio receiver: Mixer, IF amplifier, AM and FM detectors, and AF amplifier - plus a meter for accurate indication of the modulation data. (See the simplified block diagram, Fig.2.) Input signals to one of the two 75 Ω coaxial sockets are either fed directly to a diode mixer - low input levels - or through an attenuator - high input levels. The mixer has been designed for high linearity to avoid distortion of amplitude-modulated signals. It is coupled to the local oscillator, which covers the frequency range from 3.5 to 320 MHz in seven bands. If the mixer is operated on oscillator harmonics, measurements can be made to over 1000 MHz.

The four-stage intermediate-frequency (IF) amplifier has a center frequency of 1 MHz and is essentially flat over a 400 kHz band, flatness being essential for making accurate measurements of AM on frequency-modulated signals. The IF signal is fed either to the AM unit or to the FM unit, but it is also available from terminals on the front panel. The AM detector has two uses: first, its dc output is used to standardize the IF signal level; secondly, it demodulates the IF signal and applies it to a divider network which is controlled by the meter switch (3 - 10 - 30 - 100 - 300).

The FM unit has three limiter stages - for the suppression of AM in a frequency-modulated signal - followed by a level stabilizer stage and a discriminator. Influence from power-line fluctuations and temperature is eliminated by the level stabilizer stage, which together with the low-distortion counter-type discriminator contributes to the performance of this unit.

Either the AM or the FM signal is taken to a three-stage audio-amplifier with strong negative feedback, which is followed by a peak-detector and a meter. Depending on the position of the polarity switch, the positive or the negative peak of modulation is measured.

The AF signal, which is available from terminals on the front panel, can be used for measurement of distortion or it can be applied to external monitors with desired characteristics, such as an oscilloscope or a vacuum-tube voltmeter. Loading of the AF output does not interfere with the internal measurement.

CONTROLS, DIALS, METER, AND TERMINALS

As can be seen on Fig.3, all controls are located on the front panel.

1) Power switch (OFF) and pilot lamp

Located at the lower right on the front panel.

Pilot lamp: 6.3 V, 0.3 amp.

2) RANGE knob

Selects the desired frequency range.

3) TUNING knob and frequency dial

The frequency dial is set to the signal frequency ±1 MHz.

4) FUNCTION SELECTOR switch

In position:

LEVEL - the signal is picked out and standardized to the appropriate level.

IF CHECK - the exact frequency of the converted signal is measured.

AM - amplitude modulation percentage is measured.

FM - deviation of frequency modulation is measured.

5) RF LEVEL knob

With the FUNCTION SELECTOR in position LEVEL, the attenuator marked RF LEVEL is used for standardizing the intermediate-frequency signal for full deflection on the meter.

6) METER switch

Selects the measuring range:

AM: 3 - 10 - 30 - 100%
FM: 3 - 10 - 30 - 100 - 300 kHz.

7) MODULATION PEAK switch

Selects the positive or the negative peak of the detected audio-frequency signal.

8) IF SENSITIVITY switch

Inserts 20 dB attenuation in the IF amplifier.

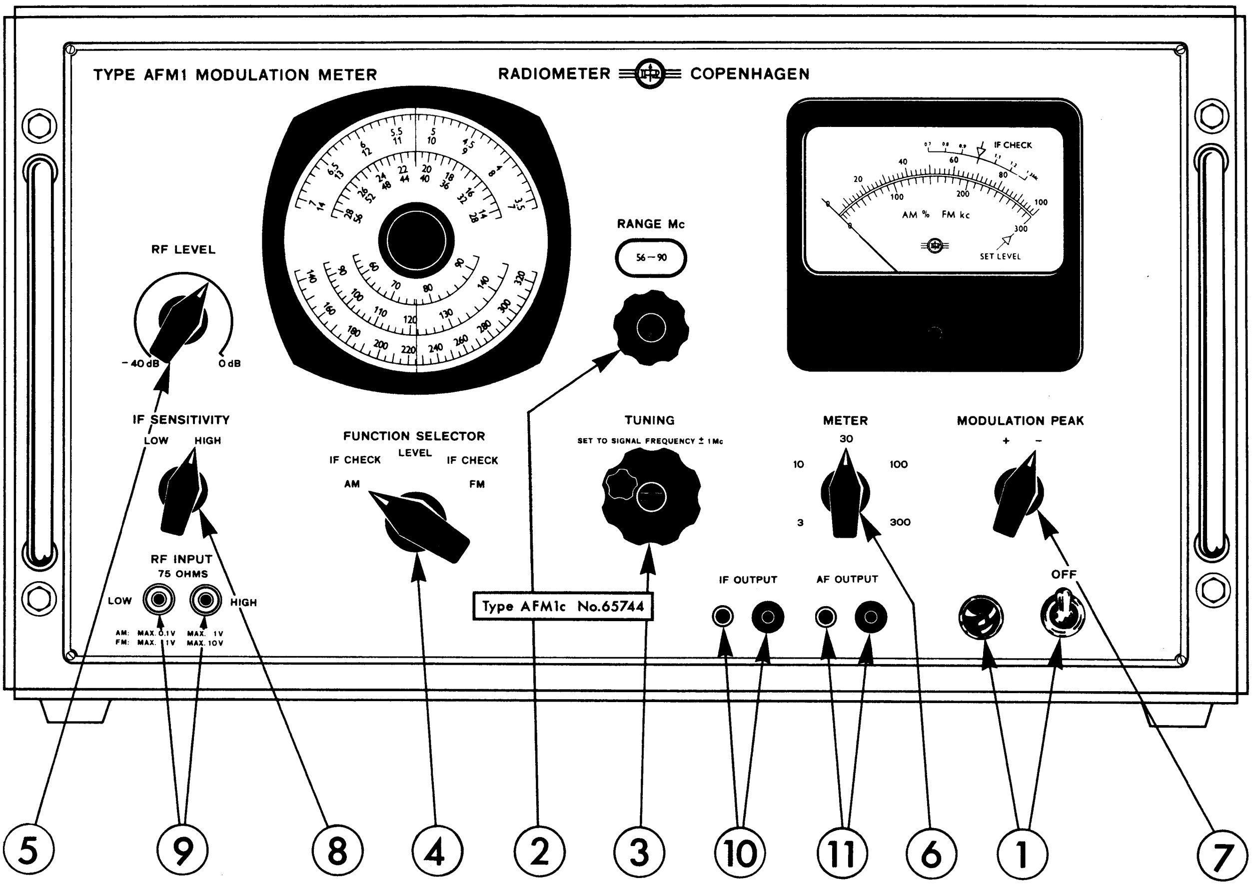

Fig.3. Front plate of the AM-FM Modulation Meter, type AFM1

9) RF INPUT connectors

Two type BNC connectors are located at the lower left on the front panel.

The left one, LOW, is used for input voltages up to

100 mV for AM
1 volt for FM

On the right-hand connector, HIGH, the input voltage must not exceed

1 volt for AM
10 volts for FM

10) IF OUTPUT terminals

The IF signal for external monitoring can be drawn from two banana jacks. Loading of the IF OUTPUT does not affect the internal measurement.

11) AF OUTPUT terminals

The detected audio-frequency signal for external monitoring can be drawn from two banana jacks. Loading of the AF OUTPUT does not affect the internal measurement.

12) Meter

As can be seen on Fig.4. the meter is provided with three scales. The two lower scales indicate full scale readings for 3, 10, 30 and 100% AM and ±3, ±10, ±30, ±100 and ±300 kHz FM deviation. The upper scale or IF scale is calibrated from 0.7 to 1.3 MHz and is used to indicate a detuning from the 1 MHz IF-frequency.

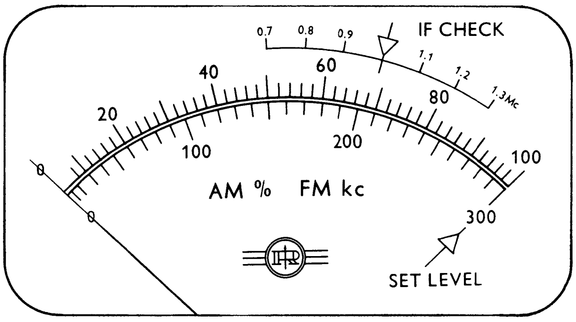

Fig.4. The meter of the AM-FM Modulation Meter, type AFM1

13) Power input terminals

Located at the back of the cabinet. Should be connected to the power line with the power cord, type 12G19-1.5, that is supplied with the instrument.

Section D. Operating Instructions

CONNECTING THE INSTRUMENT

Before connecting the instrument to the power line, make sure that the line voltage selector, S6, is set to the voltage of the power line. The voltage selector is always set to 220 volts when the instrument leaves the factory.

To change to another voltage, loosen the center screw on the voltage selector and set the selector to the desired voltage. The selector is accessible at the back of the cabinet. If the voltage is changed, it may also be necessary to change the fuse.

At 200, 220, and 240 volts, a 0.5 A slow-blow fuse should be used, and at 110, 115, and 127 volts, a 1 A slow-blow fuse should be used.

Allow two minutes for warm-up, and the instrument is ready for use.

MEASURING AMPLITUDE MODULATION PERCENTAGE (AM%)

Modulation percentage of AM signals

1) Connect the instrument under test to one of the RF INPUT terminals according to the directions printed on the front panel.

2) Set the RANGE knob to the desired frequency range.

3) Set the FUNCTION SELECTOR to position LEVEL.

4) Set the TUNING knob so that the frequency dial indicates the signal frequency ±1 MHz and then tune to maximum deflection.

5) Set the RF LEVEL knob to full-scale deflection (SET LEVEL mark).

6) Turn the FUNCTION SELECTOR to position IF CHECK.

7) Make a fine adjustment with the TUNING knob so that the meter reads 1.0 MHz on the IF CHECK scale.

8) Set the FUNCTION SELECTOR again to position LEVEL.

9) Set the RF LEVEL knob to full-scale deflection (SET LEVEL mark).

10) Set the FUNCTION SELECTOR to position AM.

11) Set the METER switch to the proper range.

12) Read the modulation percentage. Make sure that the reading is the same for MODULATION PEAK + and -: a difference indicates distortion on the modulating envelope.

Residual AM on FM signals

Proceed as described above. To obtain minimum residual reading caused by the instrument itself, set IF SENSITIVITY to LOW, if the signal level permits. If resolution somewhat better than that corresponding to the 3% AM range is wanted, a vacuum-tube voltmeter may be connected to the AF OUTPUT terminals. The external meter will read 1 volt for full deflection of the internal meter, i.e. with the METER switch set to 3, the modulation percentage read on the vacuum-tube voltmeter is 0.003% per mV.

The minimum residual AM reading caused by the instrument itself can be estimated as follows:

1) Apply a CW signal and set the FUNCTION SELECTOR to LEVEL.

2) Rotate the TUNING knob back and forth so that the intermediate frequency is changed over the range 1.0 MHz - Δ f to 1.0 MHz + Δf, where Δf is the deviation of the frequency-modulated signal whose residual AM is to be measured. (Check the frequency change with the IF CHECK scale.)

3) Read the peak-to-peak value of the change of the LEVEL reading.

The Minimum residual AM is approx. half of this percentage change.

MEASURING FREQUENCY DEVIATION (FM kHz)

Frequency deviation of FM signals

1) Connect the instrument under test to one of the RF INPUT terminals according to the directions printed on the front panel.

2) Set the RANGE knob to the desired frequency range.

3) Set the FUNCTION SELECTOR to position LEVEL.

4) Set the TUNING knob so that the frequency dial indicates the signal frequency ±1 MHz, and then tune to maximum meter deflection.

5) Rotate the RF LEVEL knob to full scale deflection (not critical).

6) Set the FUNCTION SELECTOR to position IF CHECK.

7) Make a fine adjustment with the TUNING knob so that the meter reads 1.0 MHz on the IF CHECK scale.

8) Set the FUNCTION SELECTOR to position FM.

9) Set the METER switch to the proper range.

10) Read the deviation of the frequency modulation. A difference in reading of MODULATION PEAK + and - indicates distortion.

Residual FM on CW signals and slightly modulated AM signals

Proceed as described immediately above. To obtain minimum res'dual reading caused by the instrument itself, set IF SENSITIVITY to LOW, if the signal level permits. Because of the very effective limiter in the FM detector, the residual FM caused by amplitude modulation is quite low. At the modulation percentage of 50%, the residual FM at low carrier frequencies is about 35 Hz at modulation frequency 1 kHz, and 100 Hz at 10 kHz.

If resolution somewhat better than that corresponding to the 3-kHz range is wanted, a vacuum-tube voltmeter can be connected to the AF OUTPUT terminals. The external meter will read 1 volt for full deflection of the internal meter, i.e. with the METER switch set to 3, the deviation read on the vacuum-tube voltmeter will be 3 Hz per mV.

USING AN EXTERNAL OSCILLATOR

The residual FM of the local oscillator is approximately 60 Hz at high oscillator frequencies, but decreases to 10 Hz at low frequencies. Therefore, when measuring residual FM on a signal with a residual FM of less than approximately 100 Hz, a considerable error will result.

In such a case, it is recommended that an external, crystal-controlled generator be used for injection voltage. This generator, supplying approximately 1 volt, is connected to the RF INPUT-LOW terminal, and the RANGE switch is set to EXT. OSC.

The signal under measurement is applied to the RF INPUT-HIGH terminal, or - if the level is too low - to the terminal LOW, in parallel with the external generator.

If necessary, the signal can be passed through some kind of terminating and/or separating device.

The frequency of the external generator must be the signal frequency ±1 MHz or a subharmonic of this frequency.

USING AN INTERNAL CRYSTAL-CONTROLLED OSCILLATOR

If only one crystal-controlled oscillator frequency is necessary and it is to be used quite often, it may be an advantage to modify the print board which corresponds to position EXT. OSC. in order to incorporate a piezoelectric crystal and an RF transformer. If the Modulation Meter is altered in this way no additional instrument is required to obtain a crystal-controlled injection signal.

See SECTION G for details of the construction of this unit.

*

Section E. Circuit Description

THE RF INPUT CIRCUIT

Between the RF INPUT connectors J1 (LOW) and J2 (HIGH), a 20-dB (approx.) resistive attenuator is inserted to allow a higher input level without overloading the mixer. The input impedance is 75 Ω, and mainly determined by R4.

THE TUNER

The local oscillator consists of a triode, V1, in a Colpitts circuit. The oscillator is tuned with the variable capacitor C8. The tuning coils and trimmers are located in a coil turret actuated by the RANGE knob.

A loop coupling to the tuning coil injects the oscillator signal in series with the input circuit and the diode mixer CR1.

In the ranges 3.5 - 7, 7 - 14, and 14 - 28, 28 - 56 MHz, the oscillator frequency is 3.5 - 7 and 14 - 28 MHz, respectively.

In the three high ranges, the pulling between the signal and the oscillator would be too severe, if the 1st harmonic of the oscillator frequency were used. Therefore, in these ranges, the oscillator operates on half the indicated frequencies.

With the RANGE switch in position EXT. OSC., the local oscillator is disconnected, and an external generator, supplying approximately 1 volt, must be connected to the RF INPUT terminal LOW, J1, to supply an injection voltage to the mixer circuit.

The signal to be measured is applied to the RF INPUT terminal HIGH, J2.

This arrangement is particularly useful when low residual FM is measured on oscillators, because it permits the use of an FM-free, crystal-controlled oscillator signal instead of the signal from the local oscillator, which inevitably has some residual FM.

IF FILTER AND RF LEVEL

From the mixer diode, the intermediate frequency of 1 MHz passes through a lowpass filter, which rejects all other mixing products.

The filter is terminated in a continuously variable attenuator, RF LEVEL, used to standardize the IF signal level.

IF AMPLIFIER

The IF AMPLIFIER contains three staggertuned pentode amplifiers, V2 - V3 - V4, and a cathode follower, V5.

The plate circuit of tube V2 is tuned to 0.8 MHz, and tube V3 and tube V4 are tuned to 1.2 and 1.0 MHz. The resulting IF response is flat within 0.2 dB from 0.8 to 1.2 MHz.

Between the 1st and 2nd stage, a capacitive attenuator, IF SENSITIVITY, can be inserted providing approx. 20 dB attenuation. If the signal level permits, this attenuator should be inserted (IF SENSITIVITY in position LOW) to eliminate the noise from the front end of the instrument.

From the cathode-follower V5, the IF signal is fed to the terminals J3 and J4, IF OUTPUT, for external monitoring purposes. When the IF level is standardized, the output voltage is approximately 0.5 volt rms from a source impedance of approximately 250 Ω.

AM DETECTOR

The AM detector, containing a thermionic diode, V15, is continuously coupled to the cathode follower output of the IF amplifier.

With the FUNCTION SELECTOR in position LEVEL, the dc output current from the detector is passed through the meter, M1, so that the IF level is indicated.

When the FUNCTION SELECTOR is in position AM, the detector current passes through the precision divider R89 - R90. Depending on the METER switch setting, a certain fraction of the audio-frequency voltage developed over the divider is fed to the AF amplifier through the FUNCTION switch S3.

With the FUNCTION SELECTOR in position IF CHECK or FM, a positive dc voltage is introduced on the cathode of the detector diode. When the IF signal exceeds this voltage, the detector current developes a negative dc voltage, which is used as supplementary grid bias for the 1st IF amplifier tube, V2, thus providing for automatic gain control.

FM DETECTOR

Limiter

With the FUNCTION SELECTOR in position IF CHECK or FM, the IF signal is fed from the cathode follower, V5, to the FM detector, whose first part is a limiter containing a double triode, V6, and two pentodes, V7 and V8.

The AM suppression is adjusted with the potentiometer R46, LIMITER BIAS.

Level stabilizer

The level stabilizer consists of a duodiode, V10, and a voltage reference tube, V9. The stabilizer converts the limited IF signal to square waves ("boxes") with a constant amplitude of approximately 85 volts.

Discriminator

The discriminator is a counter type, consisting of a capacitor, C54 - C55, a duodiode, V11, and loading networks, which are selected with the METER switch.

Through the left diode, the square-wave pulses charge the capacitor, C54 - C55, to the above mentioned voltage. When the square-wave voltage drops to zero, almost the whole charge of the little capacitor C54 - C55 is transferred to the much greater capacitors in the loading circuits, through the right-hand diode of V11 and the silicon semiconductors CR7 - CR8.

In this way the charge and, hence, the voltage of the capacitor in the loading circuit are proportional to the number of square waves per second, i.e. to the frequency.

When the FUNCTION SELECTOR is in position FM, the discriminator is loaded by an RC network, chosen with the METER switch. When an FM signal is applied, an AF signal is developed over the RC network with an amplitude proportional to the deviation. This AF signal is fed to the AF amplifier.

The indication of the deviation is adjusted with the trimmer capacitor C55, FM ADJUST.

With the FUNCTION SELECTOR in position IF CHECK, the discriminator current passes through the meter, M1, thus measuring the intermediate frequency directly, from 0.7 to 1.3 MHz. This circuit is adjusted with the potentiometer R66, IF CHECK ADJUST,

AF AMPLIFIER

The AF amplifier contains two cascaded pentode stages, V16 and V17, and two cathode followers, the double triode V18. A strong negative, overall feedback stabilizes the amplification and reduces the distortion.

To prevent the meter needle from jerking when the METER switch is turned, the switch wafer S4 (1) grounds the capacitor C71 in the inter-positions of the METER switch while the capacitor is being charged to the changed dc voltage over the detector load.

In the input circuit, an active RC filter attenuates the IF signal to avoid overloading of the AF amplifier. The second pentode amplifier feeds two cathode followers, the left one supplying the feedback circuit and the AF OUTPUT terminals. The amplification of the AF amplifier is calibrated to the proper value with the potentiometer R102 in the feedback circuit. The AF OUTPUT voltage is adjusted with the potentiometer R115 to 1.0 volt emf for full-scale deflection (M1).

The right-hand cathode follower supplies the AF DETECTOR.

AF DETECTOR

The silicon semiconductor diode CR5 operates as a peak-voltage rectifier. The rectifier current is measured with the meter M1, when the FUNCTION SELECTOR is in position AM or FM.

With the MODULATION PEAK switch, the polarity of the diode and the meter is reversed, making it possible to detect a difference between the amplitude of the positive and negative modulation peak, such a difference indicating even-order harmonic distortion.

Because the output impedance of the cathode follower changes a little when the MODULATION PEAK switch is operated, a correcting network, consisting of the silicon diode CR4, the resistor R122, and the potentiometer R123, is introduced to ensure that the meter reads the same value for the positive and negative modulation peak, when a distortion-free signal is applied.

The silicon diode CR6 protects the meter against overloading.

POWER SUPPLY

The instrument can be supplied from the following nom'nal line voltages: 110 - 115 - 127 - 200 - 220 - 240 volts. The slow-blow fuse F1 protects the line transformer in case of short-circuit. All filament voltages are unregulated.

The dc plate and screen supply consists of two bridge-coupled selenium rectifiers, CR2 and CR3, connected in parallel, LC filters, L17 - L19 and C62 - C63, and, when necessary, some means of electronic regulation.

The local oscillator and the screens of two IF amplifier stages are supplied from a voltage-stabilizing tube, V12. To prevent power-line fluctuations from affecting the meter reading, the AF amplifier and the screen grid of the last limiter stage in the FM detector are fed from a regulated power supply, consisting of the voltage reference tube V14 and the double triode V13. The output voltage is set to 200 volts with the potentiometer R82. The less critical voltages are unregulated.

The electronic regulation of all critical voltages permits the instrument to be operated on line voltages differing by ±10% from the nominal value.

Section F. Maintenance

GENERAL

The Modulation Meter is designed to withstand some rough treatment, but careful handling and proper operation result in a long life and high reliability.

Such repairs as are necessary should only be performed by skilled personnel provided with the proper equipment to ensure that the repair is correctly made.

REMOVING THE INSTRUMENT FROM THE CABINET

Remove the power cord and place the Modulation Meter with its front panel upwards. Remove the 4 fixing screws at the corners of the front panel and the 3 screws in the bottom of the cabinet. The instrument can now be lifted out of the cabinet.

TUBE REPLACEMENT

In general, the tubes of the instrument should not be replaced unless they cause some kind of trouble.

V1 - V2 - V3 - V4 - V5 - V10 - V11 - V12

These tubes can be replaced without any adjustments and without compromising the properties of the instrument.

V6 - V7 - V8

Replacement of the tubes of the limiter in the FM detector may necessitate an adjustment of the AM suppression.

V9

Generally, the voltage reference tube of the discriminator will never need replacement, but if, for some extraordinary reason, it must be replaced, the FM ADJUST must be adjusted for correct indication of deviation.

V13 - V14

When replacing the tubes in the regulated power supply, the dc output voltage should be checked.

V15

If utmost accuracy is desired, replacement of the AM detector diode will involve an adjustment of the AM percentage indication.

V16 - V17

Replacement of the amplifier tubes of the AF amplifier may make it necessary to adjust the sensitivity of the amplifier and possibly the voltage across the AF OUTPUT terminals.

V18

Replacing the cathode-follower tube may cause a difference between the indication of the positive and negative modulation peaks of an undistorted signal.

Correction is made with the potentiometer R123.

A change in the AF amplification caused by replacement of this tube is adjusted with the potentiometer R102.

If replacement gives rise to a change in the AF OUTPUT voltage, proceed as described below.

ADJUSTMENTS

General

Adjustments should only be made when absolutely necessary, and only by skilled personnel provided with high-precision measuring equipment.

Output voltage of regulated power supply

The output voltage is measured between ground and pin 3 (cathode) of tube V13 and should be set to 200 volts with the potentiometer R82.

Modulation peak

Set the FUNCTION SELECTOR to position AM and the METER switch to range 300.

Supply a 1 kHz voltage, approximately 7 mV rms, from a low-distortion audio-frequency generator to the AF CHECK terminals on the print board of the AF unit.

Adjust the potentiometer R123, so that the same meter deflection is obtained no matter whether the MODULATION PEAK switch is in position + or -.

Ampl. Adjust (AF amplification)

Make sure that the adjustment described immediately above has been made.

Set the FUNCTION SELECTOR to position AM and the METER switch to range 300.

Supply a 1 kHz voltage, 7.40 mV rms, from a low-distortion audio-frequency generator, to the AF CHECK terminals on the print board of the AF unit.

Adjust potentiometer R102, so that the meter gives full deflections.

AF output

Make sure that the adjustments described above have been made.

Set the FUNCTION SELECTOR to position AM and the METER switch to range 300.

Supply a 1 kHz voltage, 7.40 mV rms from a low-distortion audio-frequency generator, to the AF CHECK terminals on the print board of the AF unit, so that full-scale deflection is obtained.

Connect a vacuum-tube voltmeter to the AF OUTPUT terminals.

Adjust the potentiometer R115, so that the vacuum-tube voltmeter reads 1.0 volt rms.

AM Adjust

Use a signal generator which supplies a carrier frequency of 1 MHz modulated with a 1 kHz audio-frequency to an accurately known modulation percentage, preferably 30%, with a very low distortion (less than 0.5%). Connect this generator to one of the RF INPUT terminals.

Set the FUNCTION SELECTOR to position LEVEL and adjust the signal generator output voltage and/or the controls IF SENSITIVITY and RF LEVEL, so that the meter gives full deflection. If the signal level permits, the IF SENSITIVITY switch should be in position LOW.

Set the FUNCTION SELECTOR to position AM and the METER switch to the proper range, preferably 30.

Set the potentiometer R88, so that the meter reads the known modulation percentage.

Limiter Bias

Use a signal generator which supplies a carrier frequency of 1 MHz modulated with a 1 kHz audio-frequency to a modulation percentage of approx. 50% and with a very low residual frequency modulation. Connect this generator to one of the RF INPUT terminals.

Set the IF SENSITIVITY switch to position LOW and the FUNCTION SELECTOR to position LEVEL, and adjust the signal generator output voltage and/or the control RF LEVEL so that the meter gives full deflection.

Set the FUNCTION SELECTOR to position FM and the METER switch to range 3, and then connect a vacuum-tube voltmeter to the AF OUTPUT terminals.

Now adjust the potentiometer R46, so that the vacuum-tube voltmeter gives minimum deflection.

FM Adjust

Use an FM signal generator that is tuned to a, preferably, not too high carrier frequency and modulated to an accurately known deviation, preferably 30 kHz. Connect the generator to the proper RF INPUT terminal.

Set the IF SENSITIVITY switch to position LOW, the FUNCTION SELECTOR to position LEVEL, and the RANGE switch to the proper range. Now pick out the signal by turning the TUNING knob until the meter gives maximum deflection.

Make sure that the resulting intermediate frequency is close to 1.0 MHz. Either use a frequency meter (such as a counter) or proceed as follows:

Disconnect the FM signal generator and connect a 1.0 MHz CW source.

With the FUNCTION SELECTOR in position LEVEL, set RF LEVEL so that the meter gives full deflection.

Set the FUNCTION SELECTOR in position IF CHECK and read the meter.

Now, reconnect the FM signal generator, set the FUNCTION SELECTOR to position LEVEL, and turn the RF LEVEL knob until the meter gives full deflection.

Then turn the selector to IF CHECK.

Make a fine adjustment with the TUNING knob, so that the meter reads the same value as in item (3).

Set the METER switch to the proper range (preferably 30), and the FUNCTION SELECTOR to position FM, and adjust the trimmer C55 (avoid hand capacity), so that the meter reads the known deviation.

To check the deviation of the FM signal generator which is used for the calibration described above, the Crosby method ("vanishing carrier method") is useful. This method is based on the fact that the carrier frequency disappears at discrete values of the modulation index.

The modulation index B is defined as the ratio of the frequency deviation ΔF to the modulating frequency f, thus,

$$B = \frac{\Delta F}{f}$$

and consequently the frequency deviation

$$\Delta F = B \cdot f$$

The carrier will be zero at the following modulation indices:

2.404	1st zero
5.520	2nd "
8.653	3rd "
11.791	4th "
14.930	5th "
18.071	6th "
21.212	7th "

etc.

A selective communication receiver tuned to the output frequency of the signal generator can be used to determine the point at which the carrier disappears.

For instance, if the modulating frequency is 30 kHz/11.791 = 2.554 kHz, and a frequency deviation of 30 kHz is desired, the modulating voltage should be increased until the 4th zero occurs.

IF Check Adjust

Make sure that the adjustment described immediately above has been made.

Connect a 1.0 MHz CW source to the RF INPUT.

With the FUNCTION SELECTOR in position LEVEL, set RF LEVEL, so that the meter gives full deflection.

Set the FUNCTION SELECTOR to position IF CHECK and readjust the potentiometer R66, so that the meter reads 1.0 MHz on the IF CHECK scale.

*

Section G. Appendix

MODIFICATION FOR INTERNAL CRYSTAL-CONTROLLED OSCILLATOR

General

Remove the empty board in the coil turret that corresponds to position EXT.OSC. of the RANGE knob and remove the connection between the two contact pins.

Mount a piezoelectric crystal X and an RF transformer T on the board as shown in the diagram, Fig. 5.

Reinsert the board in the coil turret.

When using this unit, set the RANGE knob to EXT.OSC. and turn the TUNING knob to the extreme right.

Crystal X:

The resonance frequency should be between 3 - 20 MHz.

The resonance frequency must be equal to the frequency of the signal to be examined ±1 MHz or equal to a subharmonic of this frequency.

RF transformer T:

To obtain a tight coupling between the two windings, a ferrite core should be used. The number of turns should be found by the "cut-and-try" method. The ratio between the primary and secondary winding should be approx. 2:1, the best value being determined by experiment.

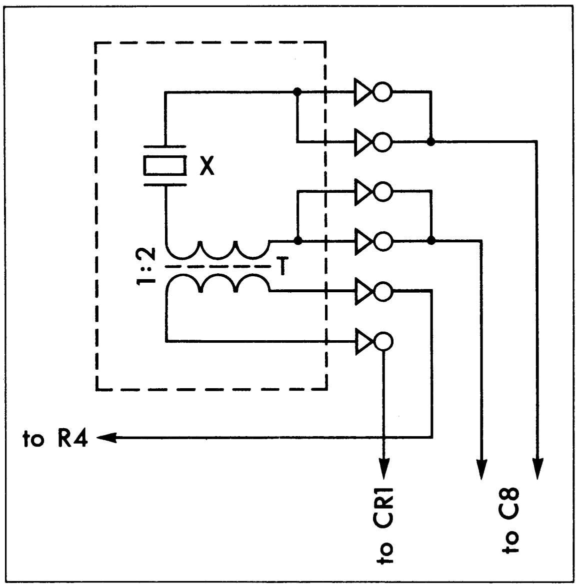

Fig.5. Crystal circuit used for alteration of the Modulation Meter, type AFM1, when one crystal-controlled oscillator frequency is necessary.

OPERATING VOLTAGES

Voltages referred to chassis.

POWER SUPPLY:

Point	A	280 V
"	B	300 V
"	C	150 V
"	D	200 V

Tube	Pin	Voltage
V1	1	-3 V
	8	110 V
V2	2+6	1.1V
	5	100 V
	7	130 V
V3	2+6	1.1V
	5	120 V
	7	130 V
V4	2+6	1.8V
	5	220 V
	7	220 V
V5	1+6	280 V
	3+8	75 V
V6	1	280 V
	2	55 V
	3+8	57 V
	6	260 V
	7	55 V
V7	2	2.7V
	5	240 V
	7	230 V

Tube	Pin	Voltage
V8	1+3+9+6	2.5V
	7	200 V
	8	190 V
V9	1	83 V
V12	1	150 V
V13	1	300 V
	2+6	198 V
	3	200 V
	7	80 V
	8	84 V
V14	1	84 V
V16	1	60 V
	2+3+7	1.5V
	6	85 V
V17	1	70 V
	2+3+7	1.7V
	6	60 V
V18	1+6	200 V
	3	55 V
	8	60 V

The instrument consumes 360 mA at 220 V.

Section H. Parts List

In the following parts list a group code prefix number is used. To facilitate the use of this code, the different types of parts and their corresponding group code prefix are listed below:

Standard resistors	100- to 139-
Precision resistors	140- to 152-
Non-linear resistors	160-
UHF resistors	170- to 172-
Carbon potentiometers	180- to 185-
Wire-wound potentiometers	190- to 195-
Mica capacitors	200- to 208-
Ceramic capacitors	210- to 214-
Paper capacitors	220- to 222-
Metal-paper capacitors	224- to 229-
Plastic Capacitors	240- to 245-
Electrolytic capacitors	260- to 267-
Variable capacitors	280- to 286-
Special tubes	310-
Rectifiers	340- to 341-
Diodes	350-
Transistors	360-
Integrated circuits	364-
Lamps, batteries, fuses	400- to 486-
Switches	500- to 580-
Coils, coil material and transformers	700- to 785-

As we are continually improving our instruments, it is important, when ordering spare parts, that you include the following information:

The code number and description of the part.

The circuit reference from the wiring diagram.

The complete type designation of your instrument.

The serial number of your instrument.

Please note that the position of any part can easily be found by referring to the last column of the parts list. This indicates on which figure the part can be located.

+Indicates special parts made by Radiometer.

CAPACITORS

Designation	Type	Value	Code No.	Shown in Fig.
C1	trimmer	2.5-20 pF	285-503	
C2	trimmer	2.5-20 pF	285-503	
C3	trimmer	2.5-20 pF	285-503	
C4	ceramic	15 pF 400 V	210-215	
C5	trimmer	2.5-20 pF	285-503	
C6	ceramic	22 pF 400 V	211-222	
C7	trimmer	2.5-20 pF	285-503	
C8	variable	80 pF	280-015	
C9	ceramic	47 pF 5%	210-247	
C10	ceramic	100 pF 5%	211 310	
C11	lead through	10 nF -20 +50% 500 V	214-009	
C12	lead through	10 nF -20 +50% 500 V	214-009	
C13	lead through	10 nF -20 +50% 500 V	214-009	
C14	ceramic	150 pF 5% 400 V	211-315	
C15	polyester	47 nF 10% 400 V	240-547	
C16	ceramic	68 pF 5% 400 V	211-268	
C17	ceramic	200 pF 5% 400 V	211-320	
C18	ceramic	47 pF 5% 400 V	211-247	
C19	ceramic	200 pF 5% 400 V	211-320	
C20	ceramic	150 pF 5% 400 V	211-315	
C21	ceramic	470 pF 20% 400 V	212-347	6
C22	polyester	0.27 μF 10% 400 V	240-627	6
C23	polyester	47 nF 10% 400 V	240-547	6
C24	polyester	47 nF 10% 400 V	240-547	6
C25	polyester	47 nF 10% 400 V	240-547	6
C26	ceramic	2.2 nF 20% 400 V	212-422	6
C27	ceramic	22 pF 5%	210-222	6
C28	ceramic	200 pF 5%	211-320	6
C29	trimmer	2.5-20 pF	285-503	6
C30	polyester	47 nF 10% 400 V	240-547	6
C31	ceramic	10 pF 10% 400 V	211-210	6

C32	polyester	47 nF 10% 400 V	240-547	6
C33	ceramic	2.2 nF 20% 400 V	212-422	6
C34	polyester	47 nF 10% 400 V	240-547	6
C35	ceramic	10 pF 10% 400 V	211-210	6
C36	ceramic	2.2 nF 10% 400 V	212-422	6
C37	polystyrene	500 pF 5% 500 V	243-008	6
C38	polyester	47 nF 10% 400 V	240-547	6
C39	polystyrene	4.7 nF 2% 63 V	243-021	6
C40	polystyrene	4.7 nF 2% 63 V	243-021	6
C41	polyester	47 nF 10% 400 V	240-547	6
C42	polyester	47 nF 10% 400 V	240-547	6
C43	polyester	47 nF 10% 400 V	240-547	6
C44	polyester	47 nF 10% 400 V	240-547	6
C45	ceramic	39 pF 5% 400 V	211 239	7
C46	polystyrene	500 pF 5% 500 V	243-008	7
C47	ceramic	15 pF 5% 400 V	210-215	7
C48	polyester	47 nF 10% 400 V	240-547	7
C49	ceramic	22 pF 5%	210-222	7
C50	polyester	47 nF 10% 400 V	240-547	7
C51	polyester	47 nF 10% 400 V	240-547	7
C52	polyester	10 nF 10% 400 V	240-510	7
C53	metal	4 μF 10% 250 V	2[illegible]5-003	7
C54	ceramic	15 pF 5%	210-215	7
C55	trimmer	$\Delta C = 6.4$ pF	285-508	7
C56	polystyrol	500 pF 5% 500 V	243-008	11
C57	polyester	47 nF 10% 400 V	240-547	10
C58	polyester	22 nF 10% 400 V	240-522	11
C59	polyester	10 nF 10% 400 V	240-510	11
C60	polyester	2.2 nF 10% 400 V	240-422	11
C61	polystyrol	500 pF 10% 400 V	243-008	11
C62	electrolytic	2 x 22 μF 450/500 V	261-018	
C63	electrolytic	2 x 22 μF 450/500 V	261-018	
C64	polyester	47 nF 10% 400 V	240-547	8
C65	polyester	47 nF 10% 400 V	240-547	8
C66	electrolytic	4 μF 250/275 V	260-018	8

C67	polyester	47 nF 10% 400 V	240-547	8
C68	polyester	47 nF 10% 400 V	240-547	8
C69	ceramic	47 pF 5%	210-247	8
C70	polyester	47 nF 5% 400 V	240-547	10
C71	polyester	47 nF 5% 400 V	240-547	9
C72	ceramic	300 pF 5% 400 V	211-330	9
C73	ceramic	150 pF 5% 400 V	211-315	9
C74	electrolytic	4 μF 250/275 V	260-018	9
C75	polyester	0.27 μF 10% 400 V	240-627	9
C76	electrolytic	47 μF 12/15 V	260-003	9
C77	ceramic	68 pF 5%	211-268	9
C78	polyester	0.1 μF 10% 400 V	240-610	9
C79	polyester	47 nF 10% 400 V	240-547	9
C80	electrolytic	47 μF 12/15 V	260-003	9
C81	ceramic	15 pF 5%	210-215	9
C82	polyester	15 nF 10% 400 V	240-515	9
C83	polyester	1 nF 10% 400 V	240-410	9
C84	polyester	1 μF 10% 125 V	240-002	9
C85	polyester	6.8 μF 10% 100 V	241-013	9
C86	polyester	2.2 nF 10% 400 V	240-422	9
C87	polyester	1 μF 10% 125 V	240-002	
C88	ceramic	matched	210-	
C89	ceramic	10 nF -20 +50%	212-751	
C90	ceramic	3.3 pF -20 +50%	210-133	

DIODES AND RECTIFIERS

Designation	Type		Code No.	Shown in Fig.
CR1	diode	OA90	350-011	
CR2	rectifier	B300C120	340-010	
CR3	rectifier	B300C120	340-010	
CR4	diode	OA81	350-009	12
CR5	diode	BAX16	350-023	12
CR6	diode	BAX16	350-023	10
CR7	diode	BAX16	350-023	7
CR8	diode	BAX16	350-023	7

FUSE

Designation	Type	Value	Code No.
F1	fuse	500 mA (220 V), slow blow	450-017

LAMP

Designation	Type	Value	Code No.
I1	lamp	6.3 V 0.3 A	400-004

TERMINALS

Designation	Type	Code No.	Shown in Fig.
J1	coaxial socket, BNC UG-290/U, RF INPUT	800-102	
J2	caoxial socket, BNC UG-290/U, RF INPUT	800-102	
J3	phone jack, black, IF OUTPUT	803-210	
J4	phone jack, black, IF OUTPUT	803-240	
J5	test jack, FM ADJUST	060-503	7
J6	test jack, FM ADJUST	060-503	7
J7	line supply, socket	802-103	
J8	test jack, AM CHECK	060-503	8
J9	test jack, AM CHECK	060-503	8
J10	test jack, AF CHECK	060-503	9
J11	test jack, AF CHECK	060-503	9
J12	phone jack, black, AF OUTPUT	803-240	
J13	phone jack, black, AF OUTPUT	803-210	

INDUCTORS

Designation	Type	Value	Code No.	Shown in Fig.
xL1	osc. coil	3.5-7 MHz and 7-14 MHz	1581-A4	

xL2	osc. coil	14-28 MHz and 28-56 MHz	5682-A4	
xL3	osc. coil	56-90 MHz	5683-A4	
xL4	osc. coil	90-140 MHz	5684-A4	
xL5	osc. coil	140-320 MHz	5685-A4	
L6	ferroxcube tube	2/4.1 ϕ x 30	704-302	
L7	ferroxcube tube	2/4.1 ϕ x 30	704-302	
xL8	filter coil	100 μH	5686-A4	
xL9	filter coil	100 μH	6452-A4	
xL10	filter coil	32 μH	6268-A4	
xL11	IF coil	1.3 mH	6269-A4	6
xL12	IF coil	0.56 mH	6270-A4	6
xL13	IF coil	0.93 mH	6271-A4	6
xL14	choke		6272-A4	6
xL15	choke		6272-A4	6
xL16	coil	1.5 mH	6273-A4	7
L17	choke	25 mH, 65 mA, 250 Ω	760-020	
L18	choke	25 mH, 65 mA, 250 Ω	760-020	
L19	choke	9 H 75 mA, 230 Ω	760-017	
xL20	coil	1.5 mH	6274-A4	8
L21	ferrite	2.2/4.4 ϕ x 2.5	704-311	
L22	ferrite	2.2/4.4 ϕ x 2.5	704-311	

METER

Designation	Type	Code No.
xM1	meter with scale	482-094

RESISTORS

Designation	Type	Value	Code No.	Shown in Fig.
R1	carbon film	82 Ω 5% 1 W	101-282	
R2	carbon film	680 Ω 5% 0.5 W	100-368	
R3	carbon film	10 Ω 5% 0.5 W	100-210	
R4	metal film	75 Ω 1% 0.5 W	140-001	

R5	carbon film	100 kΩ 5% 0.5 W	100-610	
R6	wire-wound	3 Ω 0.5 W	120-130	
R7	carbon film	10 Ω 5% 0.5 W	100-210	
R8	carbon film	4.7 kΩ 5% 0.5 W	100-447	
R9	carbon film	470 Ω 5% 0.5 W	100-347	
R10	carbon film	470 Ω 5% 0.5 W	100-347	
R11	carbon film	adapted for R14 0.5 W		
R12	carbon film	12 Ω 5% 0.5 W	100-212	
R13	carbon film	12 Ω 5% 0.5 W	100-212	
R14	carbon potm.	1 kΩ (adapted with R11 to 600 Ω ±5%)	180-113	
R15	carbon film	820 kΩ 5% 0.5 W	100-682	6
R16	carbon film	180 Ω 5% 0.5 W	100-318	
R17	carbon film	1 MΩ 5% 0.5 W	100-710	6
R18	carbon film	10 kΩ 5% 0.5 W	100-510	6
R19	carbon film	150 Ω 5% 0.5 W	100-315	6
R20	carbon film	12 kΩ 5% 0.5 W	100-512	6
R21	carbon film	220 kΩ 5% 0.5 W	100-622	6
R22	carbon film	39 kΩ 5% 0.5 W	100-539	6
R23	carbon film	5.6 kΩ 5% 0.5 W	100-456	6
R24	carbon film	390 kΩ 5% 0.5 W	100-639	6
R25	carbon film	330 kΩ 5% 0.5 W	100-633	6
R26	carbon film	180 Ω 5% 0.5 W	100-318	6
R27	carbon film	150 Ω 5% 0.5 W	100-315	6
R28	carbon film	33 kΩ 5% 0.5 W	100-533	6
R29	carbon film	factory adjusted 0.5 W		6
R30	carbon film	5.6 kΩ 5% 0.5 W	100-456	6
R31	carbon film	12 kΩ 5% 0.5 W	100-512	6
R32	carbon film	150 Ω 5% 0.5 W	100-315	6
R33	carbon film	150 Ω 5% 0.5 W	100-315	6
R34	carbon film	15 kΩ 5% 0.5 W	100-515	6
R35	carbon film	factory adjusted 0.5 W		6
R36	carbon film	5.6 kΩ 5% 2 W	109-001	6
R37	carbon film	560 Ω 5% 0.5 W	100-356	6
R38	carbon film	470 Ω 5% 0.5 W	100-347	6

R39	carbon film	3.9 kΩ 5% 2 W	109-020	6
R40	carbon film	68 Ω 5% 0.5 W	100-268	6
R41	carbon film	100 kΩ 5% 0.5 W	100-610	6
R42	carbon film	1 kΩ 5% 0.5 W	100-410	6
R43	carbon film	1 kΩ 5% 0.5 W	100-410	6
R44	carbon film	1 kΩ 5% 0.5 W	100-410	6
R45	carbon film	220 kΩ 5% 0.5 W	100-622	7
R46	carbon potm.	25 kΩ lin. 0.2 W	181-102	7
R47	carbon film	39 kΩ 5% 0.5 W	100-539	7
R48	carbon film	33 kΩ 5% 0.5 W	100-533	7
R49	carbon film	5.6 kΩ 5% 1 W	101-456	7
R50	carbon film	560 Ω 5% 0.5 W	100-356	7
R51	carbon film	4.7 kΩ 5% 0.5 W	100-447	7
R52	carbon film	15 kΩ 5% 0.5 W	100-515	7
R53	carbon film	220 kΩ 5% 0.5 W	100-622	7
R54	carbon film	47 kΩ 5% 0.5 W	100-547	7
R55	carbon film	180 kΩ 5% 0.5 W	100-618	7
R56	carbon film	33 kΩ 5% 0.5 W	100-533	7
R57	carbon film	6.8 kΩ 5% 1 W	101-468	7
R58	carbon film	330 Ω 5% 0.5 W	100-333	7
R59	carbon film	180 kΩ 5% 0.5 W	100-618	7
R60	carbon film	3.3 kΩ 5% 0.5 W	100-433	7
R61	carbon film	6.8 kΩ 5% 1 W	101-468	7
R62	carbon film	180 Ω 5% 0.5 W	100-318	7
R63	carbon film	150 kΩ 5% 0.5 W	100-615	7
R64	carbon film	100 kΩ 5% 0.5 W	100-610	7
R65	metal film	25.38 Ω 5% 0.125 W	140-006	11
R66	carbon potm.	1 kΩ lin. 0.2 W	181-100	10
R67	carbon film	180 Ω 5% 0.5 W	100-318	10
R68	metal film	21.81 Ω 5% 0.125 W	140-002	11
R69	metal film	66.95 Ω 5% 0.125 W	140-003	11
R70	metal film	241.1 Ω 5% 0.125 W	140-004	11
R71	metal film	932.4 Ω 5% 0. 25 W	140-005	
R72	wire-wound	10 Ω 5% 1 W	121-210	
R74	wire-wound	5 kΩ 5% 6 W	131-450	

R75	carbon film	33 kΩ 5% 0.5 W	100-533	8
R76	carbon film	2.7 MΩ 5% 0.5 W	100-727	8
R77	carbon film	47 kΩ 5% 0.5 W	100-547	8
R78	carbon film	1 kΩ 5% 0.5 W	100-410	8
R79	carbon film	100 kΩ 5% 0.5 W	100-610	8
R80	carbon film	1 kΩ 5% 0.5 W	100-410	8
R81	carbon film	120 kΩ 5% 0.5 W	100-612	8
R82	carbon potm.	10 kΩ lin. 0.2 W	181-101	8
R83	carbon film	68 kΩ 5% 0.5 W	100-568	8
R84	carbon film	12 kΩ 5% 0.5 W	100-512	8
R85	carbon film	270 kΩ 5% 0.5 W	100-627	8
R86	carbon film	56 kΩ 5% 0.5 W	100-556	8
R87	carbon film	5.6 kΩ 5% 0.5 W	100-456	11
R88	carbon potm.	10 kΩ lin. 0.2 W	181-101	11
xR89A	wire-wound	1442 Ω 0.2%	1975-A5	11
xR89B	wire-wound	412 Ω 0.2%	1976-A5	11
xR90A	wire-wound	1442 Ω 0.2%	1977-A5	11
xR90B	wire-wound	61.8 Ω 0.2%	1978-A5	11
R91	carbon film	100 kΩ 5% 0.5 W	100-610	11
R92	carbon film	10 kΩ 5% 0.5 W	100-510	9
R93	carbon film	22 kΩ 5% 0.5 W	100-522	9
R94	carbon film	1 MΩ 5% 0.5 W	100-710	9
R95	carbon film	82 Ω 5% 0.5 W	100-282	9
R96	carbon film	2.2 kΩ 5% 0.5 W	100-422	9
R97	carbon film	1 MΩ 5% 0.5 W	100-710	9
R98	carbon film	150 kΩ 5% 0.5 W	100-615	9
R99	carbon film	47 kΩ 5% 0.5 W	100-547	9
R100	carbon film	2.2 MΩ 5% 0.5 W	100-722	9
R101	carbon film	2.2 kΩ 5% 0.5 W	100-422	9
R102	carbon potm.	25 kΩ lin. 0.2 W	181-102	9
R103	carbon film	82 kΩ 5% 0.5 W	100-582	9
R104	carbon film	180 kΩ 5% 0.5 W	100-618	9
R105	carbon film	1 MΩ 5% 0.5 W	100-710	9
R106	carbon film	220 kΩ 5% 0.5 W	100-622	9
R107	carbon film	4.7 MΩ 5% 0.5 W	100-747	9

R108	carbon film	220 kΩ 5% 0.5 W	100-622	9
R109	carbon film	1 kΩ 5% 0.5 W	100-410	9
R110	carbon film	2.2 MΩ 5% 0.5 W	100-722	9
R111	carbon film	3.3 kΩ 5% 0.5 W	100-433	9
R112	carbon film	18 kΩ 5% 0.5 W	100-518	9
R113	carbon film	1.2 kΩ 5% 0.5 W	100-4 2	
R114	carbon film	10 kΩ 5% 0.5 W	100-510	9
R115	carbon potm.	1 kΩ lin. 0.2 W	180-004	
R116	carbon film	10 kΩ 5% 0.5 W	100-510	9
R117	carbon film	2.2 MΩ 5% 0.5 W	100-722	9
R118	carbon film	820 Ω 5% 0.5 W	100-382	9
R119	carbon film	1 kΩ 5% 0.5 W	100-410	9
R120	carbon film	276 Ω 5% 0.5 W	100-527	12
R121	carbon film	226 Ω 5% 0.5 W	100-522	12
R122	carbon film	1.5 kΩ 5% 0.5 W	100-415	12
R123	carbon potm.	10 kΩ lin. 0.2 W	181-101	12
R124	carbon film	1 kΩ 5% 0.5 W	100-4 0	10
RT1	thermistor	E20-14 Ω 1.5 W	160-005	

SWITCHES

Designation	Type	Code No.
xS1	coil switch	
xS2	switch IF SENSITIVITY	550-789
xS3	switch FUNCTION SELECTOR	550-788
xS4	switch METER	550-786
S5	main switch	500-101
S6	voltage selector	460-010
xS7	switch MODULATION PEAK	550-787

TRANSFORMER

Designation	Type	Code No.
xT1	power transformer	770-503

TUBES

Designation	Type	Code No.	Shown in Fig
V1	tube EC81	300-017	
V2	tube EF91	300-065	6
V3	tube EF91	300-065	6
V4	tube EF91	300-065	6
V5	tube ECC81	300-020	6
V6	tube ECC81	300-020	7
V7	tube EF91	300-065	7
V8	tube EF80	300-035	7
V9	tube 85A2	310-005	7
V10	tube EAA91	300-013	7
V11	tube EAA91	300-013	7
V12	tube 150B2	310-009	
V13	tube ECC88	300-024	8
V14	tube 85A2	310-005	8
V15	tube 6AL5	300-064	8
V16	tube EF86	300-036	9
V17	tube EF86	300-036	9
V18	tube ECC82	300-021	9

CABLES

Designation	Type	Code No.
W1	coaxial cable, K19M, 0.37 m	600-005
W2	coaxial cable, K19M, 0.56 m	600-005
W3	coaxial cable, K 9M, 0.21 m	600-005
W4	coaxial cable, RG17U, 0.44 m	600-008
W5	coaxial cable, K19M, 0.48 m	600-005
W6	coaxial cable, K19M, 0.36 m	600-005
W7	coaxial cable, K19M, 0.16 m	600-005
W8	coaxial cable, K19M, 0.4 m	600-005
W9	coaxial cable, RG174U, 0.45 m	600-008

W10	coaxial cable, RG174U, 0.3 m	600-008
W11	coaxial cable, RG174U, 0.34 m	600-008
W12	coaxial cable, RG174U, 0.29 m	600-008
W13	coaxial cable, RG174U, 0.28 m	600-008
W14	coaxial cable, RG174U, 0.22 m	600-008
W15	coaxial cable, RG174U, 0.31 m	600-008
W16	coaxial cable, RG174U, 0.51 m	600-008
W17	coaxial cable, RG174U, 0.[illegible]3 m	600-008
W18	coaxial cable, RG174U, 0.[illegible]2 m	600-008
W19	coaxial cable, RG174U, 0.37 m	600-008
W20	coaxial cable, RG174U, 0.63 m	600-008

MISCELLANEOUS

	Type	Code No.
x	knob N30	850-230
x	knob with handle N40	850-241
x	arrow knob 36 mm	852-001
x	arrow knob 48 mm	8[illegible]2-002
x	rubber foot	855-002
	scale cord 0 9 ϕ 0.95 m	867-901
x	front plate	973-002

AFM1/S1 (RF INPUT 50 Ω)

RESISTORS

Designation	Type	Value	Code No.
R1	carbon film	56 Ω 5% 1 W	[illegible]01 256
R2	carbon film	470 Ω 5% 0.5 W	100-347
R3	metal film	4 Ω 5% 0 5 W	140-022
R4	metal film	50 Ω 1% 0.5 W	140-355

CABLE

W1	coaxial cable	50 Ω RG58A/U [illegible] 37 m	600-007

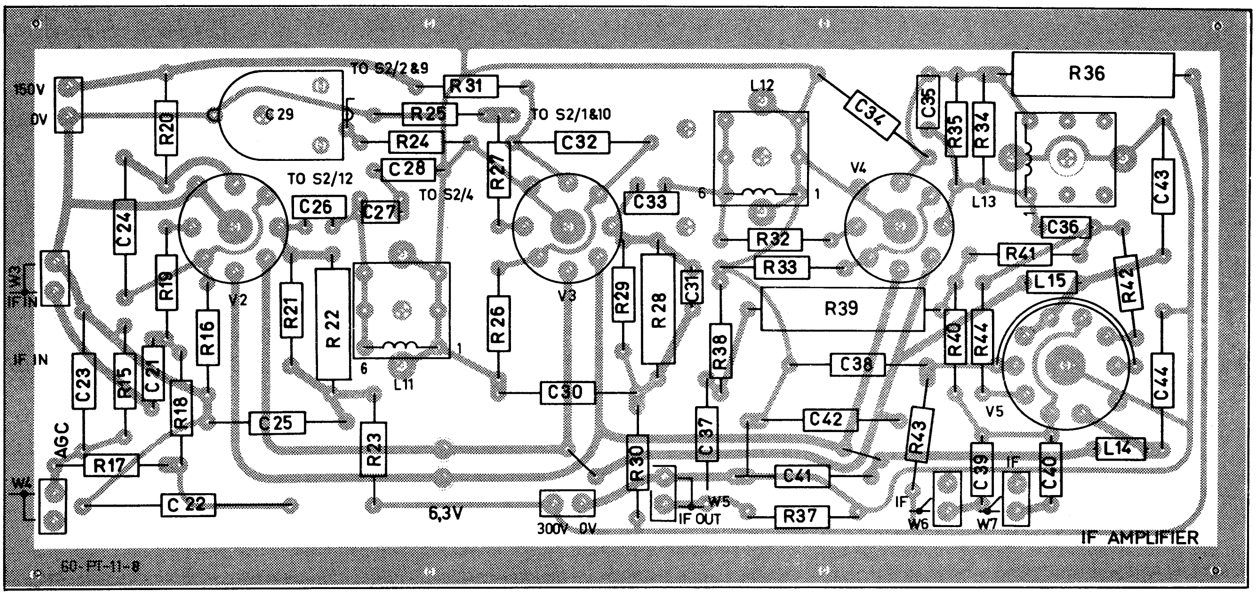

Fig.6.

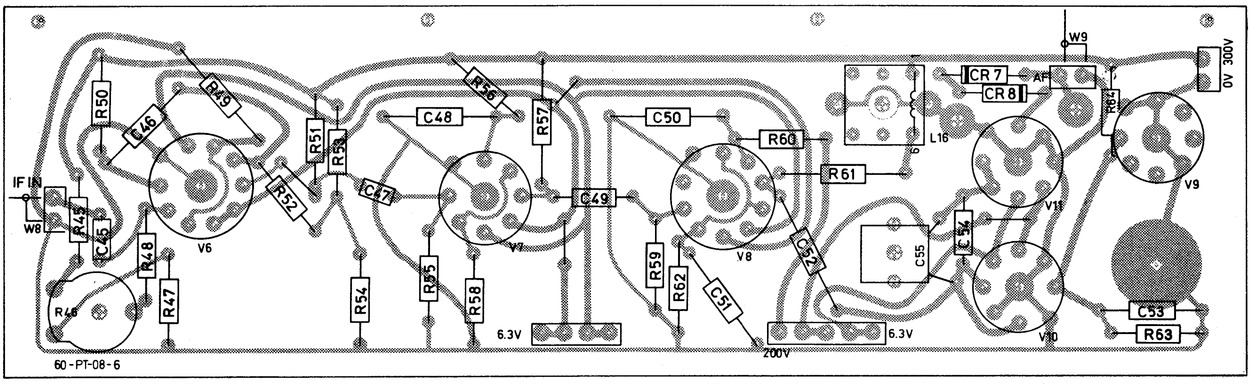

Fig.7.

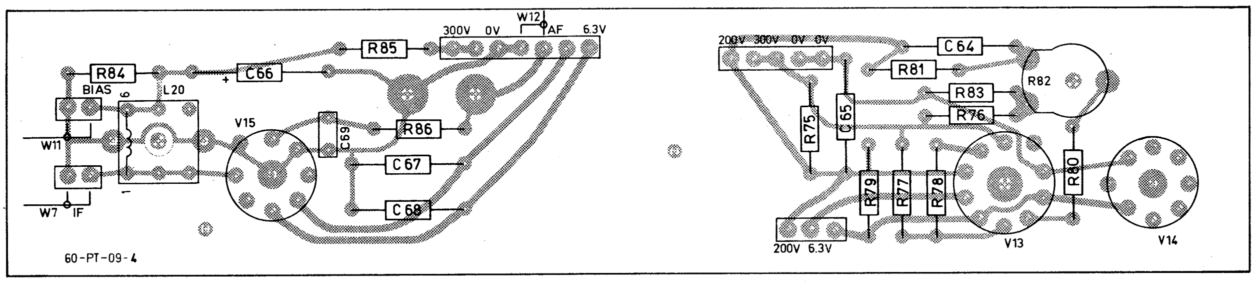

Fig.8.

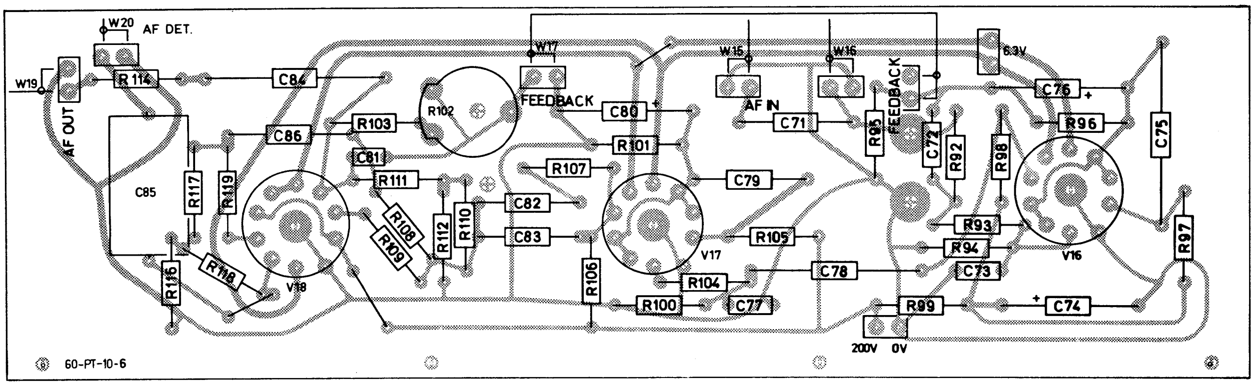

Fig.9.

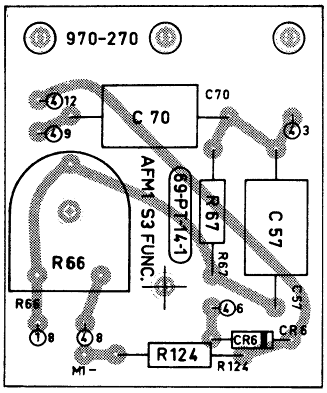

Fig.10.

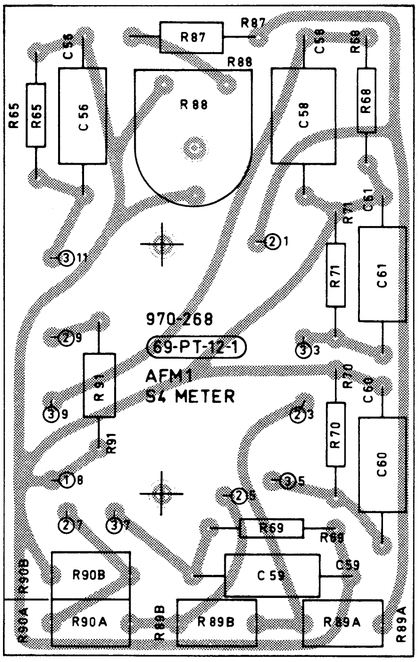

Fig.11

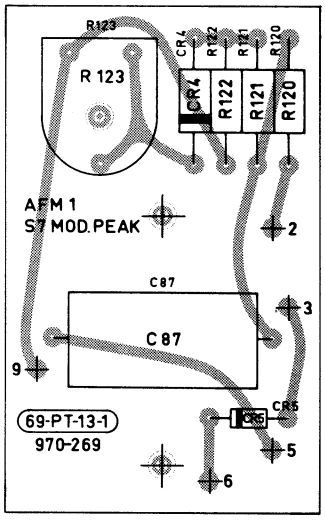

Fig.12

TUNER
IF FILTER
IF AMPLIFIER
V1 EC81
V2 EF91
V3 EF91
V4 EF91
V5 ECC81
V6 ECC81
V7 EF91
V8 EF80
V9 85A2
V10 EAA91
V11 EAA91
RANGE
TUNING
IF SENSITIVITY
RF LEVEL
RF INPUT
LOW J1
HIGH J2
FM ADJUST
LIMITER BIAS
FM CHECK
IF CHECK ADJUST
IF OUTPUT
METER
FUNCTION SELECTOR
RADIOMETER COPENHAGEN
This drawing must not be passed on to any person not authorized by us to receive it, nor be copied or otherwise made use of by such person without our authority
AF CHECK
AM CHECK
AM ADJUST
AMPL. ADJUST
AF OUTPUT
MODULATION PEAK
AF DETECTOR
AC FUSE: 0.5A for 200-220-240V
1A for 110-115-127V
SWITCHES
(SHOWN IN EXTREME CCW POSITIONS)
(LISTED FROM CCW TO CW POSITIONS)
S1 RANGE
a 3.5-7Mc, 7-14Mc
b 14-28Mc 28-56Mc
c 56-90Mc
d 90-140Mc
e 140-320Mc
f Ext Osc.
S2 IF SENSITIVITY
LOW
HIGH
S3 FUNCTION SELECTOR
AM
IF CHECK
LEVEL
IF CHECK
FM
S4 METER
3
10
30
100
300
S5 ON-OFF
S6 VOLTAGE SELECTOR
S7 MODULATION PEAK
+PEAK
-PEAK
CAPACITORS
1pF = 1μμF
1nF = 1000 μμF
RESISTORS
FINAL VALUE SELECTED
FINAL VALUE FACTORY ADJUSTED
V12 150B2
V13 ECC88
V14 85A2
POWER SUPPLY
V15 6AL5
AM DETECTOR
V16 EF86
V17 EF86
V18 ECC82
AF AMPLIFIER
5 155575 14.1.70
4 143070 12.3.69 SHM
3 131171 28-5-68 LTJ
2 124388 1-12-67 PAB
1 110286 7-10-66 BS
RADIOMETER COPENHAGEN
72 EMDRUPVEJ NV
MODULATION METER
TYPE AFM 1c
From no. 104470 to no.
1152-A1