

## AFM2 MODULATIONS METER

### SPECIAL FEATURES

High sensitivity, 3 mV  
 Full-scale deflection for 3% AM and  $\pm 3$  kHz FM in most sensitive range  
 Measures telemetric FM signals up to 200 kHz  
 Accepts stereo signals (channel separation  $> 46$  dB)  
 Powered AGC  
 Two IF bandwidths:  $\pm 25$  kHz and  $\pm 400$  kHz  
 Incorporates 4 deemphasis networks, 4 low-pass AF filters and a band-pass filter to ensure optimal conditions for a wide range of applications

### APPLICATIONS

Measurements of AM, FM or FM stereo on generators, transmitters, etc.  
 Measurements of residual AM or FM  
 Measurements of AM on FM or FM on AM  
 Can be used in conjunction with modulation distortion measurements  
 Use as station monitor

### GENERAL

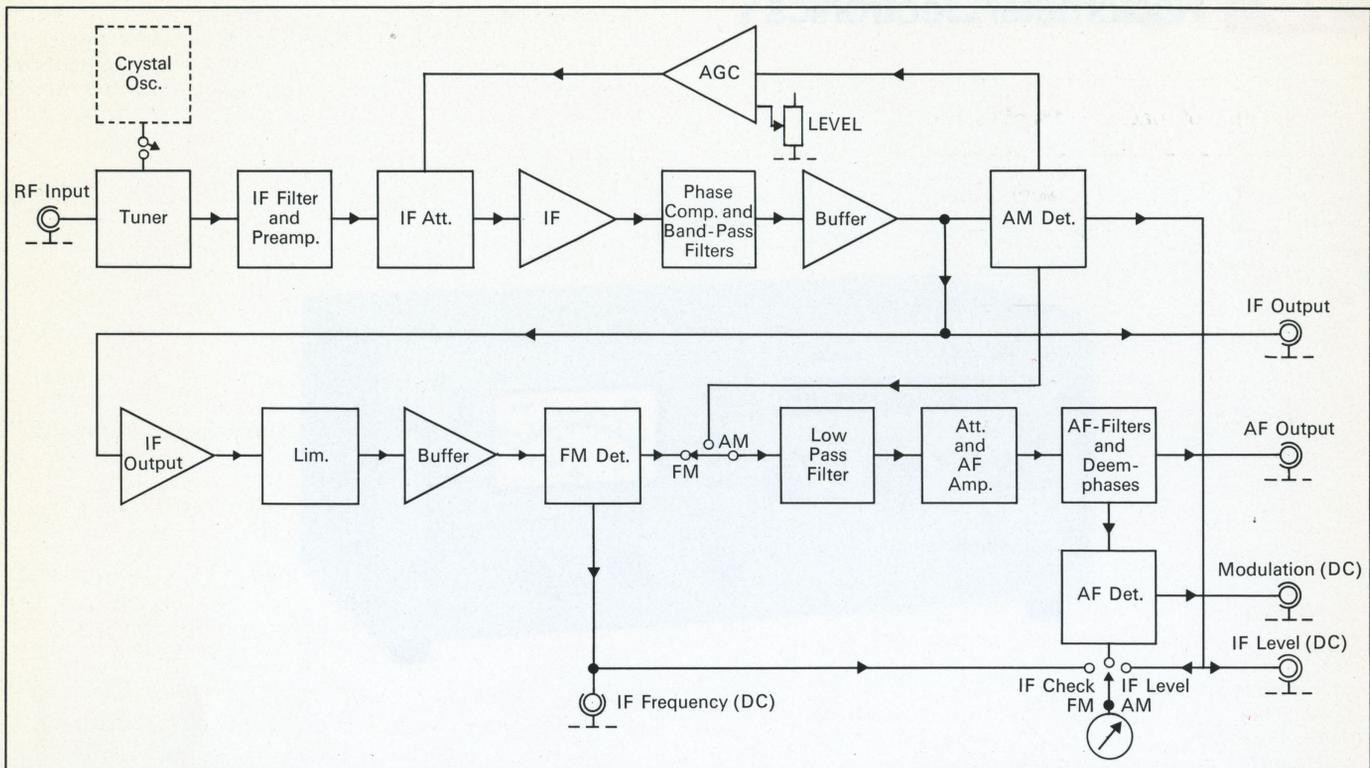
The AFM2 Modulation Meter is a solid-state, line- or battery-operated precision instrument for accurate measurements of the modulation depth of AM signals and the peak deviation of FM signals in the carrier frequency range of 5 to 1002 MHz. It is designed to accept telemetric signals up to a modulation frequency of 200 kHz and features a channel separation of  $> 46$  dB on stereo signals. The indicating meter has a full-scale deflection for 3, 10, 30 and 100% AM and  $\pm 3$ ,  $\pm 10$ ,  $\pm 30$ ,  $\pm 100$  and  $\pm 300$  kHz FM (peak value). Due to the very small amount of intrinsic residual modulation, it is possible to measure residual FM and AM in oscillators, spurious AM on FM signals, etc. Accurate measurements on distorted signals can be made easier by means of a switch that enables the positive and negative peak values to be measured separately.

The input signal level necessary for maximum accuracy is 3 mV in the carrier frequency range from 5 to 200 MHz, 20 mV in the range 200 to 600 MHz, and 30 mV in the range 600 to 1002 MHz. The maximum operating input voltage is 10 V. Besides a manual level control, the Modulation Meter features an automatic level control with a regulating range of 40 dB. To increase the versatility of the Modulation Meter for measurements on narrow band equipment, the IF has two bandwidths of  $\pm 25$  kHz and  $\pm 400$  kHz. In the AF section a FILTER/DEEMPHASIS switch provides the selection of three deemphasis networks of 50, 75 and 750  $\mu$ s together with a network providing a constant decrease of the AF output of 6 dB/octave (ref. 1 kHz), four low-pass filter circuits with frequency roll-offs at 3, 15, 75 and 200 kHz and an AF band-pass filter with 3 dB points at 50 Hz and 15 kHz.

A Crystal Oscillator Plug-in Unit (code 900-252) is available for the reduction of residual FM; a convenience when measuring very low FM deviations.

### DESCRIPTION

The RF signal is fed to the tuner, which consists of a very linear mixer of the balanced type. The mixer is coupled either to the local oscillator (8 ranges) or to an optional 900-252 Crystal Oscillator Unit, which provides for operation at up to four frequencies. The 2 MHz IF from the mixer is fed to an IF filter with two bandwidths of  $\pm 25$  kHz and  $\pm 400$  kHz, and to an IF attenuator with an insertion loss of up to 40 dB, controlled by an AGC amplifier. The AGC amplifier gain can also be controlled manually by means of the LEVEL potentiometer. Further gain is provided by a subsequent IF amplifier before the signal is passed to either a phase compensator or a band-pass filter followed by a buffer amplifier. The IF signal is then fed either to the AM detector or to the FM detector. The AM detector is an amplifier with a mean-value detector in the feedback loop, which ensures a very linear response. The AM detector has two outputs, one to the AF output connector and the other to the AF detector and the meter circuit. When switched to FM, the IF is fed via an additional IF amplifier to the limiter. The limiter transforms the



signal into a square wave form which is then passed via a buffer amplifier to the FM detector. The FM detector consists of a monostable multivibrator and an output amplifier. The square wave IF signal from the limiter triggers the multivibrator and provides output pulses of constant width. The pulses are then fed to the output amplifier of the FM detector which includes a regulating loop. This loop keeps the value of the peak-to-peak output voltage constant. Hence, as the amplitude and the width of the pulses are constant, the mean value of the output signal will vary according to the number of pulses per second. This is made use of in the IF CHECK setting of the FUNCTION switch, where the output pulses are used to ensure a high degree of accuracy when tuning to the signal frequency. From the AM and FM detectors the signal is then fed to a low-pass filter which features excellent phase-linearity, a requirement necessary when handling stereo information without deteriorating the channel separation. The low-pass filter is followed by a precision attenuator providing four steps of 10 dB which form the four settings of the METER RANGE selector. An AF amplifier follows and passes the signal to either a set of AF filters or a set of deemphasis networks selected by means of the FILTER/DEEMPHASIS switch. The output from the filters and networks is fed via a further AF amplifier to the AF detector. At this point the signal is also passed to the AF OUTPUT connector which offers an impedance of 600  $\Omega$ . 1 V (peak value) at this output corresponds to full-scale deflection of the meter. The AC/DC switch associated with the AF OUTPUT connector switches in a capacitor in the AC position to provide a non-galvanic connection, should this be required. The last stage is the AF detector which feeds the meter circuit and provides a DC output whose value is the true peak value of any AF signal present. The AF detector has two time constants which give the meter either a fast or a slow response.

## SPECIFICATIONS

### FREQUENCY RANGE OF INPUT SIGNAL

5-1002 MHz in eight ranges.

### CALIBRATION ACCURACY

3%

### CRYSTAL OPERATION

A 900-252 Crystal Oscillator Unit (option) accepts four switch-selected crystals, ensures low residual FM.

### INPUT LEVEL

One BNC input connector, connected to a 3-step input attenuator (up to 40 dB insertion loss), provides the AFM2 Modulation Meter with an input sensitivity range of 3 mV to 10 V.

Carrier frequency range	5-200 MHz	200-600 MHz	600-1000 MHz
Sensitivity without input attenuators	3-100 mV	20-100 mV	30-100 mV

**Max. safe input level:** 10 V

**Input level for residual FM and AM measurements:**

Min. 10 mV within the frequency range 5 to 600 MHz, and 20 mV from 600-1002 MHz.

### LEVEL SETTING

**Manual level setting:**

Continuous within a range of min. 40 dB.

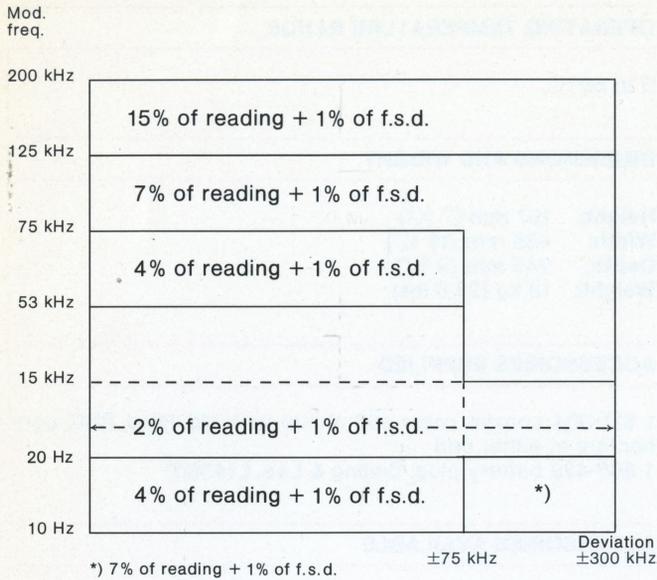


Fig. 1. Accuracy of frequency deviation measurements.

**Automatic level setting:**

The AGC holds the IF gain level within 0.5% for a 40 dB change in input level within the specified input sensitivity. Manual fine adjustment of the AGC is possible.

**INPUT IMPEDANCE**

50 ohms nominal

**FM MODULATION**

**Deviation ranges:**

±3, ±10, ±30, ±100, and ±300 kHz f.s.d. (peak deviation). Positive and negative deviation peaks can be measured separately.

**Accuracy and Distortion:** See Figs. 1 and 2.

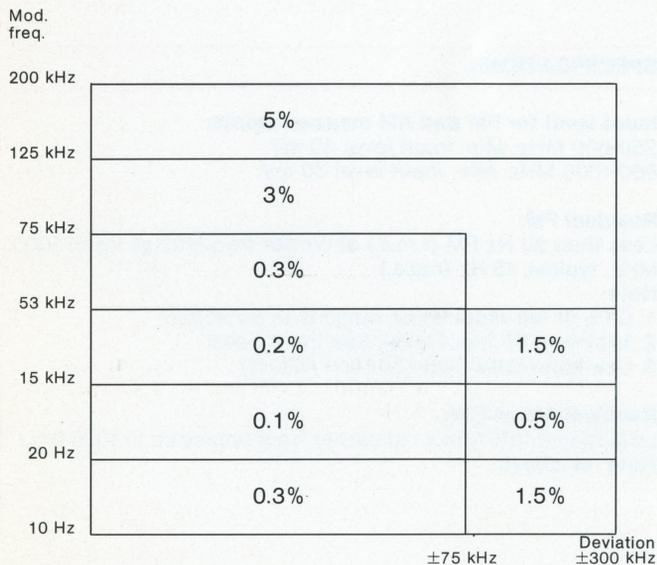


Fig. 2. Distortion on frequency deviation measurements.

**Channel-separation of FM stereo signals:**

For an FM stereo signal (FCC- and EBU stereo systems), the inherent channel-separation at modulation frequencies within 40 Hz - 15 kHz is greater than 46 dB, when measured at the AF output.

**AF output and meter response:**

Within 40 Hz - 53 kHz, the frequency response of the meter is within +0.25% and -1.5%.

**Residual FM:**

Less than 25 Hz FM (r.m.s.) within the frequency range 5-250 MHz, typically 10 Hz (r.m.s.).  
Less than 100 Hz FM (r.m.s.) up to 1002 MHz, typically 50 Hz FM (r.m.s.).

**Note:**

When measuring residual FM, the three following points must be observed:

1. 0.1% of full modulation range is to be added
2. Minimum RF input level: See Input Level
3. Use band-pass filter (50 Hz - 15 kHz)

**FM due to AM:**

Additional residual FM error due to AM is typically less than 50 Hz (r.m.s.) at 50% AM. With band-pass filter (50 Hz-15 kHz), and Crystal Oscillator Unit.

**Deemphases:**

50, 75 and 750 μs, switchable and 6 dB/oct. (ref. 1 kHz)

**AM MODULATION**

**Modulation depth range:**

3, 10, 30, and 100% AM f.s.d.

Positive and negative modulation peaks can be measured separately.

**Accuracy and AM distortion:** See Figs. 3 and 4.

**Residual AM at CW:**

Less than 0.03% AM (r.m.s.) at carrier frequencies up to 200MHz  
Less than 0.1% AM (r.m.s.) at carrier frequencies up to 500 MHz  
Less than 0.3% AM (r.m.s.) at carrier frequencies up to 1002 MHz

**Note:**

When measuring residual AM at CW, two points must be observed:

See under Residual FM above.

**AM due to FM:**

Additional AM error is less than 0.6% AM (r.m.s.) at ±50 kHz deviation

**AF output (AM):**

**Manual settings:**

The frequency response is within ±0.5% in the range 20 Hz-15 kHz

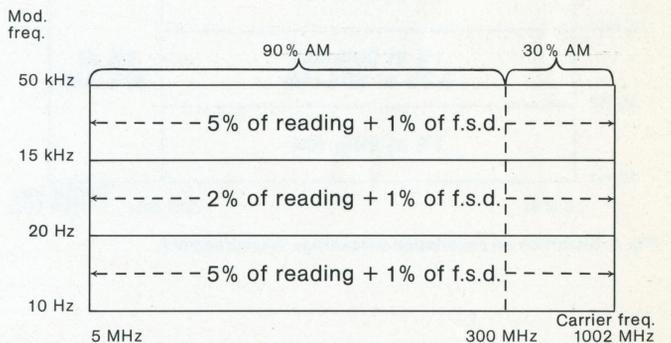


Fig. 3. Accuracy of modulation percentage measurements.

## INTERMEDIATE FREQUENCY SECTION

**Frequency:** 2 MHz

**Bandwidths:**

Approx.  $\pm 400$  kHz/3 dB and  $\pm 25$  kHz/3 dB, switch-selected

**IF check:**

The meter has a separate scale to facilitate correct tuning (IF = 2 MHz). Scale calibration: 0,  $\pm 100$ ,  $\pm 200$ , and  $\pm 300$  kHz

**IF output:**

2 MHz IF signal of 0.2 V EMF from 50 ohms source (BNC) at correct frequency tuning and full-scale deflection on meter.

**dc outputs (Jacks):**

IF level: dc voltage of 1 V EMF from 600 ohms source at deflection to LEVEL mark.

IF frequency: dc voltage of 1 V EMF from 600 ohms source at deflection to IF CHECK mark (50 mV/100 kHz).

## AUDIO FREQUENCY CHANNEL

**Bandwidths:**

Four switchable low-pass filters, 3 kHz, 15 kHz, 75 kHz, and 200 kHz, for use when measuring FM deviation and AM modulation. One band-pass filter, 50 Hz – 15 kHz (3 dB), for use when measuring residual AM and FM, etc.

**AF output (UHF connector):**

AF signal of 1 V EMF (peak value) at full-scale deflection. Bandwidths as specified above. A switch provides for ac- or dc-coupling.

**ac-coupling:** Output impedance: 600 ohms in series with 10  $\mu$ F

**dc-coupling:** Output impedance: 600 ohms

**dc-output (Jack):**

Modulation: dc voltage of 1 V EMF in 600 ohms source at full-scale deflection.

## POWER SUPPLY

**ac line:** 110 and 220 V,  $\pm 10\%$ , 48-65 Hz

**Consumption:** Approx. 20 VA. The power cord is fixed.

**dc-sources:** 0 to + (18 to 25 V) and 0 to - (18 to 25 V)

**Current drain:** Approx. 350 mA from either source.

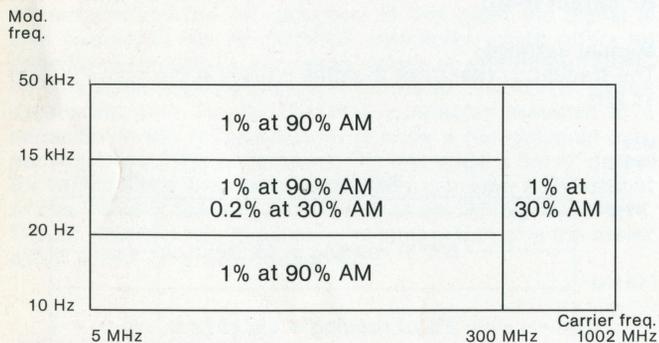


Fig. 4. Distortion on modulation percentage measurements.

Data subject to change without notice.

## OPERATING TEMPERATURE RANGE

0 to 50° C

## DIMENSIONS AND WEIGHT

**Height:** 197 mm (7  $\frac{3}{4}$ "")  
**Width:** 485 mm (19  $\frac{1}{8}$ "")  
**Depth:** 245 mm (9  $\frac{5}{8}$ "")  
**Weight:** 13 kg (28.6 lbs)

## ACCESSORIES SUPPLIED

1 617-004 coaxial cable (50 ohms) with UG-88/U BNC connectors at either end  
1 805-429 battery plug, Belling & Lee, L1436/P

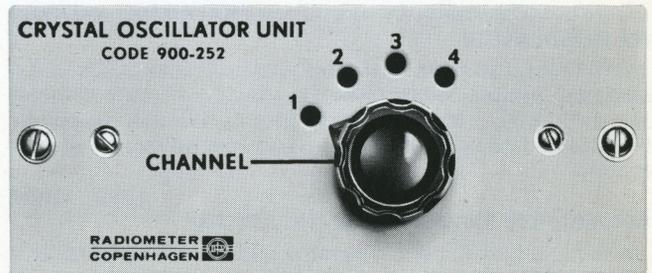
## ACCESSORIES AVAILABLE

900-252 Crystal Oscillator Unit  
1 884-002 set of dust covers (top plate and bottom plate) for use when rack mounted  
617-003 Coaxial Cable with UHF plugs

## CRYSTAL OSCILLATOR UNIT

### GENERAL

The plug-in 900-252 Crystal Oscillator Unit is intended for use within the frequency range 67-1000 MHz to achieve low residual FM. It is supplied without crystals, but has sockets for four crystals.



### SPECIFICATIONS

**Input level for FM and AM measurements:**

250-600 MHz: Min. input level 20 mV.  
600-1000 MHz: Min. input level 30 mV.

**Residual FM:**

Less than 20 Hz FM (r.m.s.) at carrier frequencies up to 1000 MHz, typical, 15 Hz (r.m.s.)

**Note:**

- 0.1% of full modulation range is to be added
- Minimum RF input level: See Input Level
- Use band-pass filter (50 Hz – 15 kHz)

**Residual AM at CW:**

Less than 0.15% (r.m.s.) at carrier frequencies up to 1000 MHz.

**Note:** as above