

# INSTRUCTION MANUAL

Type MSK1  
CONVERTER



## RADIOMETER

ELECTRONIC MEASURING INSTRUMENTS  
FOR SCIENTIFIC AND INDUSTRIAL USE

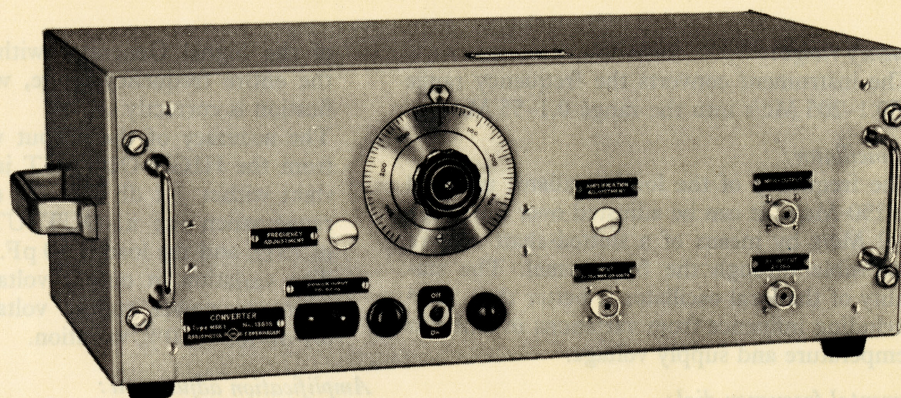


INSTRUCTION AND OPERATING MANUAL  
FOR

Type MSK1  
CONVERTER

These instructions apply  
to model MSK1a only





1083 B

## Converter type MSK 1

### Introduction:

The type MSK1 Converter converts the frequency range 150.1–205 Mc/s from a Signal Generator into the range 0.1–55 Mc/s.

The Radiometer Standard Signal Generator type MS24 provides FM and AM signals in the range 54 to 216 Mc/s and the Converter type MSK1 is especially designed to provide a continuous extension of the frequency range of this Signal Generator down to 0.1 Mc/s without changing the signal level or the modulation characteristics, thus giving complete FM and AM coverage from 0.1 Mc/s to 216 Mc/s.

The Converter can, however, be used in conjunction with any other VHF Signal Generator including the 150–205 Mc/s range and having an output impedance of 75  $\Omega$ .

With the Converter connected to a Signal Generator all the usual tests, such as stage gain, band width, sensitivity and distortion, can be carried out in the frequency range 0.1–55 Mc/s which is particularly important since this range covers the intermediate frequency of almost all receivers and also includes many communications and broadcasting services, some of these using FM, and until now Signal Generators providing FM signals over the entire frequency range have not been available.

### Description:

The Converter includes a local oscillator, a mixer stage, a wide-band amplifier, an output stage and an electronically regulated power supply.

The local oscillator operates at 150 Mc/s and is tunable over a small range. The input signal from the Signal Generator beats with the local oscillator output to produce a difference frequency. The frequency response of the wide-band amplifier is flat from 0.1 to 55 Mc/s.

The frequency stability of the local oscillator is very high. The frequency can be adjusted over the range  $\pm 2$  Mc/s by means of a slotted-shaft control which is accessible through the front panel and permits adjustment to zero beat with the Signal Generator set to read 150 Mc/s.

Small changes in the converted frequency can be made by rotating an incremental frequency dial which is direct reading in kc/s from  $-350$  kc/s through zero to  $+350$  kc/s.

The input jacks which will receive a coaxial connector terminate the input cable in 75  $\Omega$ .

Two output jacks are available on the front panel. One of these jacks supplies a level equal to the input level. The other supplies a somewhat higher voltage.

The Converter does not introduce any FM-distortion. An AM-signal, however, will be distorted when the input level is very high. At low input levels the AM-distortion will be negligible.



## SPECIFICATIONS

*Frequency range:*

The instrument converts the frequency range 150.1–205 Mc/s into the range 0.1–55 Mc/s.

*Local oscillator:*

The frequency of the local oscillator is tuned to 150 Mc/s. It can be adjusted over the range  $\pm 2$  Mc/s by means of a slotted-shaft control accessible through the front panel. The stability of the local oscillator is better than  $10^{-4}$  including influence from variations in ambient temperature and supply voltage.

*Incremental frequency dial:*

Small changes in converted frequency can be had by rotating a frequency dial which is direct reading in kc/s from  $-350$  kc/s through zero to  $+350$  kc/s.

*Input:*

The input jack will receive a coaxial UHF connector type PL259. The input impedance is  $75 \Omega$ . The input voltage should not exceed 0.5 volt.

*Output:*

The Converter is provided with two output jacks which will take the UHF coaxial connector type PL259.

A level equal to the input level can be drawn from the output jack marked x1-OUTPUT. The output impedance of this jack is  $75 \Omega$ .

A level somewhat higher than the input level can be drawn from the output jack marked HIGH-OUTPUT.

The HIGH-OUTPUT level depends on the load or on the x1-OUTPUT jack. With this jack terminated in  $75 \Omega$  the HIGH-OUTPUT level in a  $10 \text{ pF}$  load will be approximately 6.3 times the input level.

*Accuracy of output voltage:*

The accuracy of the output voltage supplied from the x1-OUTPUT jack is the same as that

of the Signal Generator within  $\pm 1$  db over the entire frequency range, when the amplification is correctly set.

The accuracy of the output voltage supplied from the HIGH-OUTPUT jack will be constant within  $\pm 1$  db over the entire frequency range when the x1-OUTPUT is terminated in  $75 \Omega$ , and the load is  $10 \text{ pF}$ .

The variation in output voltage due to variations in power supply voltage is less than 0.1 db for  $\pm 10\%$  variation.

*Amplification adjustment:*

The total amplification of the Converter can be adjusted by means of a slotted-shaft control, accessible through the front panel.

*Distortion:*

The Converter does not introduce any FM-distortion. At input levels below 0.1 volt the AM-distortion will be negligible.

*Power supply:*

110 or 220 volts, 50–60 c/s.

Consumption: 32 watts.

*Tubes:*

2 ECC81.

2 EF95.

1 EF80.

1 85A2.

*Extra accessory:*

20 db pad type FDL1.

*Over-all dimensions:*

Height: 200 mm.

Width: 565 mm.

Depth: 290 mm.

(Width and depth same as for Radiometer Standard Signal Generator, type MS24).

*Net weight:*

12.4 kilos.

Data subject to change without notice.





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## SECTION I

### OPERATING PRINCIPLE

The drawing No. 660-A2 appended to the operating instructions shows the complete circuit diagram of the Converter.

#### 1-1 THE OSCILLATOR

One half of the tube No. 1 (see complete circuit diagram) is operated as a Colpitts oscillator with grounded cathode.

The major part of the tuning capacity is fixed.

The operating frequency of the oscillator is normally 150 Mc/s. However, it can be adjusted over the range  $\pm 2$  Mc/s by means of the split-stator condenser  $C_2$  (position B2). This condenser is provided with a slotted shaft, which is accessible through the front panel.

Very small changes in the frequency of the oscillator, and consequently in the converted frequency, can be had by means of the condenser  $C_1$  (position B1).

This condenser is operated from the front panel by means of a dial which is direct reading in kc/s from -350 through zero to +350 kc/s.

The coil  $L_2$  (position C1) provides for coupling the local signal to the grid of the mixer stage.

#### 1-2 THE MIXER

The other half of the tube No. 1 is operated as an additive mixer with signal input to the cathode and local signal input to the grid.

From the input jack the signal is fed to the mixer via a coaxial cable.

With a cathode resistor of 100 $\Omega$  the input of the mixer is approximately equal to the characteristic impedance of the input cable.

The coupling network between the mixer stage and the first stage of the



wide-band amplifier is of the well known four-terminal type for compensating the high-frequency response.

### 1-3 THE WIDE-BAND AMPLIFIER

The tubes No. 2, 3 and 4 and the associated circuits are operated as a wide-band amplifier.

The interstage coupling networks are all of the four-terminal type mentioned in the preceeding paragraph.

Adjustment of the amplification takes place by adjustment of the cathode bias resistors  $P_2$  and  $P_3$  of the tubes No. 2 and 3. One of these controls, the resistor  $P_3$ , is accessible through the front panel.

The last stage is provided with two output circuits, one being in connection with the cathode giving a low impedance output, and the other being in connection with the anode giving a somewhat higher output voltage, however with a correspondingly higher output impedance.

### 1-4 THE POWER SUPPLY

The power supply is unconventional because both the voltage for the anode current supply and the voltage for the filament current supply are electronically regulated.

The regulating circuit incorporates a reactor in series with the power transformer. The voltage drop across this reactor is controlled by a d-c magnetizing current.

The output voltage of the principal rectifier circuit (position F4) is compared with a reference voltage, i.e. the voltage drop across the glow-discharge tube No. 6.

The difference between these voltages is amplified in a two-stage d-c amplifier (tube No. 5). The output current from the amplifier is led through the control coil of the reactor.

The power supply incorporates an auxiliary rectifier circuit (position E4) that supplies the anode current to the output stage of the d-c amplifier.

By means of an input voltage selector the power line voltage can be set to 220 volts or 110 volts.



## SECTION II

### OPERATING INSTRUCTIONS

#### 2-1 CONNECTION

Before connecting the instrument to the power line, make sure that the line voltage selector is set to the correct voltage. The voltage selector is accessible when the cover plate at the back of the cabinet is removed.

Before the instrument leaves the factory, the voltage selector is set to 220 volts.

The instrument is switched on with the power switch ON-OFF and allowed to warm up for a few minutes.

#### 2-2 OPERATING CONTROLS, DIALS AND TERMINALS

All the controls required for the operation of the instrument are located on the front panel.

##### (a) Frequency controls

The incremental frequency dial is calibrated directly in kilocycles from -350 through zero to +350.

When the plug button marked FREQUENCY ADJUSTMENT is removed, a slotted control shaft is accessible for adjusting the local oscillator frequency to zero beat with the signal from a signal generator set to read 150 Mc/s and connected to the input jack.

The zero beat is determined by means of a pair of head phones connected to the HIGH OUTPUT jack.

##### (b) Amplification control

Any change in amplification can be reset by removing the plug button marked AMPLIFICATION ADJUSTMENT and by rotating the slotted shaft control until correct output is obtained.

The output voltage can be measured with a suitable vacuum-tube voltmeter (ensure that the converted frequency is within the frequency range of the vacuum-tube voltmeter).



(c) Terminals

The POWER INPUT terminal provides for connecting to the power line by means of a type C12H13-1.5 power cord which is supplied with the instrument.

The input terminal fits a coaxial connector type UHF (PL259).

A level equal to the input level can be drawn from the output jack marked x1-OUTPUT. The output impedance of this jack is  $75\Omega$ .

A level somewhat higher than the input level, depending on the load, can be drawn from the output jack marked HIGH-OUTPUT.

With the x1-OUTPUT jack terminated in  $75\Omega$  the HIGH-OUTPUT level in a 10 pF load will be approximately 6.3 times the input level.

In order to obtain a better signal-noise ratio at the receiver input when measuring sensitivity on high-sensitive receivers it is advisable to insert a fixed attenuator of 20 db or more between the Converter and the receiver.

## 2-3 STEP-BY-STEP OPERATION

- (1) Determine the line voltage on which the instrument is to operate.  
Set the line voltage selector to the proper value.
- (2) Connect the instrument to the power line, switch it on, and allow it to warm up for five minutes or more.
- (3) Connect the input terminal to the signal generator output and set the generator to read 150 Mc/s.
- (4) Set the incremental frequency dial to 0 kc/s and ascertain the local oscillator zero beat with the signal generator output by means of headphones connected to the HIGH OUTPUT terminal.
- (5) If necessary, adjust the local oscillator frequency by operating the slotted shaft control marked FREQUENCY ADJUSTMENT.
- (6) Set the Signal Generator to read a frequency equal to the desired output frequency from the Converter plus 150 Mc/s.



### SECTION III

#### MAINTENANCE

##### 3-1 GENERAL

The type MSK1 Converter is carefully aligned at the factory, so any attempts to improve the accuracy should generally not be made.

Such repairs as may become necessary should be made by skilled personnel only, provided with sufficient equipment to ensure that the repair is properly made.

When transporting, handling and operating the instrument with care, its useful life will be prolonged, and trouble will be reduced to a minimum.

When the instrument is not in use, the power switch should be turned off. The instrument should be protected from dust, moisture and extreme temperatures. It is advisable from time to time to inspect the exterior for dust, dirt and corrosion.

##### 3-2 REMOVING THE INSTRUMENT FROM THE CABINET

The instrument can be removed from the cabinet when the four fixing screws along the edge of the front panel have been removed.

##### 3-3 TUBE REPLACEMENT

In general the tubes of the type MSK1 Converter require no replacement, until they cause some kind of trouble.

The troubles which are generally due to faulty tubes are: insufficient output, faulty local oscillator output, incorrect anode and filament voltages, etc.

All tubes can be readily replaced when the instrument is removed from the cabinet.

Tubes with average characteristics can be used for any replacement.



## 3-4 OPERATING VOLTAGES AND CURRENTS OF THE CONVERTER

The voltages and currents listed below can be used as reference when servicing the Converter. These values are mean values from a series of measurements, and deviations up to 20% may usually be neglected. The voltmeter should have a negligible consumption (vacuum-tube voltmeter). All voltages are measured to chassis.

## VOLTAGE MEASUREMENTS

from		d - c volts	a - c volts
"x"			6.3
"y"		180	
tube No. 5	pin No. 1	405	
	3	181	
	6	179	
	8	85	
tube No. 4	pin No. 1	1.8	
	7	170	
	8	140	
tube No. 3	pin No. 6	150	
	2-7	3.5	
	5	177	
tube No. 2	pin No. 6	150	
	2-7	3.5	
	5	177	
tube No. 1	pin No. 1	170	
	2	-2.2	
	3	0.5	
	6	180	
	7	-9	

## CURRENT MEASUREMENTS

Total primary consumption at 220 volt line voltage	225 mA $\sim$
" " " " 110 " " "	430 mA $\sim$
Average d-c current in control coil of choke SR <sub>1</sub>	12 mA $\sim$

## 3-5 FUSES

The fuse mounted on the front panel is the power line fuse. A 1-amp fuse should be used.

The fuses that protect the two rectifiers incorporated in the power supply are mounted on the instrument chassis and are accessible when the instrument has been removed from the cabinet (see circuit diagram for fuse values).



