

RADIOMETER

Type MSK1 a
CONVERTER

Electrical
measuring instruments for
industrial and scientific work



Type MSK1 a
C O N V E R T E R

I N D E X

Introduction	data sheet	15901x
Description	" "	15901x
Specifications	" "	15901x

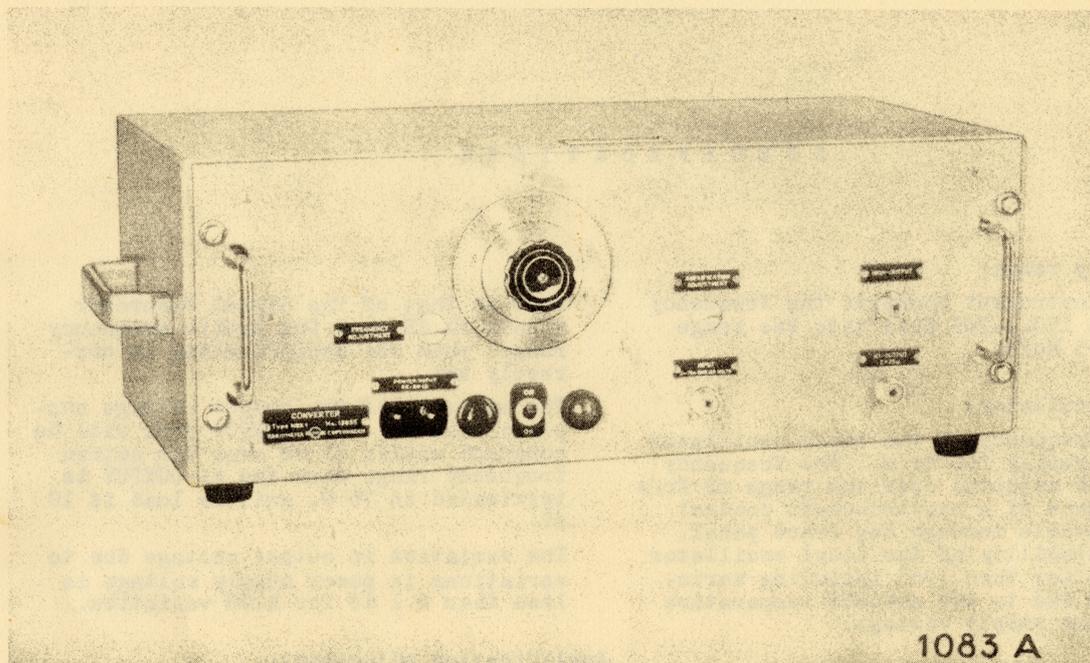
<u>Section I - Operating Principle</u>	page
(1) The oscillator	1
(2) The mixer	1
(3) The wide-band amplifier	2
(4) The power supply	2

Section II - Operating Instructions

(1) Connection	3
(2) Operating controls, dials, and terminals	3
(3) Step-by-step operation	5

Section III - Maintenance

(1) General	5
(2) Removing the instrument from the cabinet	6
(3) Tube replacement	6
(4) Operating voltages and currents of the Converter	6
(5) Fuses	8



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CONVERTER Type MSK1

(provisional data sheet)

INTRODUCTION

The type MSK1 Converter converts the frequency range 150-205 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 connection with any other VHF Signal Generator including the 150-205 Mc/s range and having an output impedance of 75 Ω .

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 up to the present time Signal Generators providing FM signals over the entire frequency range have not been available.

DESCRIPTION

The Converter includes a local oscillator operating at 150 Mc/s and tunable over a small range, a mixer stage in which the input signal from the Signal Generator beats with the local oscillator output to produce a difference frequency, a wide-band amplifier, flat from 0.1-55 Mc/s, an output stage and an electronically regulated power supply.

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

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

The input jacks fitting a coaxial connector terminates the input cable in 75 Ω .

Two output jacks are available at 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.

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SPECIFICATIONS

Frequency range:

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

same as that of the Signal Generator within ± 1 dB over the entire frequency range, when the amplification is correctly set.

Local oscillator:

The frequency of the local oscillator is normally 150 Mc/s. The frequency can be adjusted over the range ± 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 variations due to the ambient temperature and the supply voltage.

The accuracy of the output voltage supplied from the HIGH-OUTPUT jack will be constant within ± 1 dB over the entire frequency range when the xl-OUTPUT is terminated in 75Ω , and the load is 10 pF.

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

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 through zero to +350 kc/s.

Amplification adjustment:

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

Input:

The input jack fits a coaxial connector type UHF (PL259). The input impedance is 75Ω . The input voltage should not exceed 0.5 volt.

Distortion:

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

Output:

The Converter is provided with two output jacks fitting the coaxial connector type UHF (PL259).

A level equal to the input level can be drawn from the output jack marked xl-OUTPUT. The output impedance of this jack is 75Ω .

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

With the xl-OUTPUT jack terminated in 75Ω the HIGH-OUTPUT level in a 10 pF load will be approximately 6.3 times the input level.

Power supply:

110 or 220 volts, 50-60 c/s.
Consumption: 32 watts

Tubes:

2 ECC81
2 EF95
1 EF80
1 85A2

Over-all dimensions:

Height: 200 mm
Width: 565 mm
Depth: 290 mm

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

Accuracy of output voltage:

The accuracy of the output voltage supplied from the xl OUTPUT jack is the

Net weight:

12.4 kilos

Data subject to change without notice

Type MSK1
C O N V E R T E R

Section I
Operating Principle

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

(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 ± 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.

(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 100Ω 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.

(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 preceding 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.

(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

(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) 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 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).

The Converter is provided with two output jacks fitting the coaxial connector type UHF (PL259).

A level equal to the input level can be drawn from the output jack marked xl-OUTPUT. The output impedance of this jack is 75Ω .

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

With the xl-OUTPUT jack terminated in 75Ω 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.

(3) Step-by-step operation

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

Section III

M a i n t e n a n c e

(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.

(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) 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.

(4) Operating voltages and currents of the Converter

The voltages and currents listed on the next page can be used as references 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).

Voltage measurements

(all voltages measured to chassis)

	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. 1	150	
	2	3.5	
	5	177	
tube No. 2	pin No. 1	150	
	2	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~
" " " " 110 volt line voltage	430 mA~
Average d-c current in control coil of choke SR ₁	12 mA~

(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).

