

INSTRUCTION AND OPERATING MANUAL  
FOR

TYPE BFM210  
SELECTIVE MEASURING INSTRUMENT

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## TYPE BFM210 SELECTIVE MEASURING INSTRUMENT

## Introduction

The type BFM210 Selective Measuring Instrument was developed at the instigation and to the specifications of Messrs. L.M. Ericsson A.B., Stockholm, Sweden, as a part of a specially selective measuring equipment for use in the terminal stations of a coaxial cable carrier telephone system.

The design of the instrument provides for making measurements of the level of test signals situated in a frequency band equivalent to that of a supergroup, i.e. in the band 312-552 kc/s (the actual frequency range of the instrument is slightly wider than this, viz. 310-560 kc/s).

The measuring equipment of which the instrument forms part is based on a method of maintenance testing allowing all the high frequency circuits of the carrier telephone system to be tested without taking more than one channel out of traffic at a time. The method is as follows: A steady 800 c/s signal is applied to a channel removed from traffic. With the measuring equipment it is then possible to measure the level of the resulting frequency, whether the measurements are carried out in the supergroup bay or in the line group bay.

Measurements in the supergroup bay are carried out directly by means of the type BFM210 Selective Measuring Instrument.

At measurements in the line group bay the test signal is demodulated to the frequency range 312-552 kc/s by means of an arrangement similar to that used for the line group translation and then measured on the type BFM210 Selective Measuring Instrument.

## SECTION I

### GENERAL DESCRIPTION

#### 1-2 OPERATING PRINCIPLE

The operating principle of the type BFM210 Selective Measuring Instrument is that of a superheterodyne receiver.

Between the input terminals and the mixer stage a band-pass filter for the range 304-560 kc/s is inserted for rejecting the image frequencies.

In the mixer stage the test signal is converted into an intermediate frequency of 240 kc/s by means of a ring modulator in which the signal is modulated with the output from a tunable local oscillator covering the frequency range 550-800 kc/s.

The IF is extracted from the mixer by means of a crystal filter providing sufficient selectivity for the measurements on carrier telephone systems for which the instrument is designed.

The IF is amplified in a negative feedback amplifier and the level of the signal output from the amplifier is measured by means of a rectifier actuating the level meter on the front panel of the instrument.

By means of a push-button switch the meter can be connected to another rectifier circuit monitoring the local oscillator input to the ring modulator.

Any variations in total amplification can be compensated for by means of an amplification adjustment control.

Power for the filament and anode circuits is supplied through a multi-contact connector from an external power supply.

The drawing No. 814-A2 appended to the operating instructions shows the circuit diagram of the type BFM210 Selective Measuring Instrument.

#### 1-2 BAND-PASS FILTER, MODULATOR AND CRYSTAL FILTER

The band-pass filter for 304-560 kc/s, the ring modulator and the IF crystal filter for 240 kc/s are supplied by Messrs. L.M. Ericsson A.B.

These circuits are concentrated in two units, one of which contains the band-pass filter and the other the ring modulator and crystal filter.

In the circuit diagram No. 814-A2 the two units are only schematically shown. However, further details on the design and construction are given in the drawings No. 704308 and 704311.

In the circuit diagram No. 814-A2 a third unit following the crystal filter is indicated. This represents a blind filter-frame which is available for the insertion of an extra filter in cases where the selectivity of the crystal filter is not sufficient.

### 1-3 LOCAL OSCILLATOR

The circuit associated with the tube No. 4 in the circuit diagram No. 814-A2 is the local oscillator. The oscillator tank circuit is tunable by means of the variable capacitor VK41 (pos. F3 in the diagram) in the frequency range 550-800 kc/s. The fixed part of the tuning capacitor is a composition of several small capacitors with different temperature coefficients to ensure the high degree of frequency stability required. The anode and screen-grid voltages for the oscillator tube are electronically stabilized by means of the voltage stabilizer, tube No. 5. This stabilization also contributes to the frequency stability of the oscillator.

The tuning capacitor VK41 is coupled to the main tuning dial which is calibrated in telephone channel ranges (not in true frequencies) as shown in drawing No. 940-A3 appended to the operating instructions. The setting of the main tuning dial is accomplished by a friction drive knob which is provided with a small handle for fast rotation.

The output from the local oscillator is drawn across a single loop winding of the transformer  $L_1$ , pos. E4. The input supplied to the modulator is controlled by means of a crystal-diode rectifier, pos. D5, OA51, which is coupled as a peak-reading voltmeter across the modulator terminals. The meter can be switched into this voltmeter circuit by means of the push-button switch, pos. E12, TFA6010A.

### 1-4 IF AMPLIFIER

The intermediate frequency amplifier is a three-tube negative feedback amplifier consisting of the tubes No. 1-3 and the circuits associated here-

with. The degree of negative feedback can be varied by means of the control, pos. C8,  $50\Omega$ . Hence, all variations in total amplification of the instrument can be compensated for by setting this control. The amplification adjustment control is furnished with a knob on the front panel of the instrument. The knob can be locked to fix the proper position of the control.

In conjunction with the anode circuit of the last tube in the amplifier a rectifier circuit has been arranged for measuring the output. The rectifier is of the mean-value type using two crystal-diode rectifiers and two large capacitors. The d-c output from the rectifier circuit actuates the meter on the front panel. The meter is calibrated in Nepers from  $-2$  to  $+0.5$  or in db from  $-15$  to  $+5$  and is also furnished with a red mark indicating the proper level of local signal input to the modulator when the meter is switched by means of the push-button switch, pos. E12.

## SECTION II

### OPERATING INSTRUCTIONS

#### 2-1 CONNECTION

The type BFM210 Selective Measuring Instrument is designed for connection to an external power supply supplying 180 volts d-c for the anode circuits and 6.3 volts a-c for the filaments.

Before connecting to the power supply, make sure that the voltages are correct.

Allow a few minutes of warm-up before making measurements.

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

All controls are located on the front panel.

##### (a) Frequency control

The main tuning dial is calibrated to show the ranges of the channels in a supergroup instead of the true frequencies. The supergroup range from 312 to 552 kc/s is divided in 5 subranges by means of heavy black marks indicating the limits of the 5 primary groups forming the supergroup. The primary-group ranges are numbered 1-5 so that primary group No. 1 starts at 312 kc/s. Each primary-group range is divided in 12 subranges by means of small black marks indicating the limits of the 12 channels forming the primary group. The channel ranges are for each primary-group range numbered 1-12 so that channel No. 1 in primary group No. 1 starts at 312 kc/s.

In each channel range a red mark indicates the resulting frequency of a 800 c/s signal applied to the channel.

A series of green marks (at the frequencies 330, 342, 354, 366, 378, 390, 402, 414, 426, 438, 450, 462, 474, 486, 498, 510, 522, 534, 546 and 558 kc/s) indicates the resulting frequencies of the carrier frequencies 54, 66, 78 and 90 kc/s used for the translation of 4 basic groups into a primary group.

A series of blue marks (at the frequencies 420, 468 and 516 kc/s) indicates carrier frequencies used for the translation of primary groups

into a supergroup (two more carrier frequencies are used for this translation viz. 564 and 612 kc/s, but these are outside the frequency range of the instrument).

For details on tuning dial calibration, see drawing No. 940-A3 appended to the operating instructions.

The main tuning dial is set by means of a friction drive knob provided with a small handle for fast rotation.

(b) Amplification adjustment control

The total amplification of the instrument is adjusted with the amplification adjustment control which controls the magnitude of negative feedback in the intermediate frequency amplifier. When the correct setting of this control is obtained (giving deflection to the zero mark on the meter for the proper voltage across the input terminals, the position of the knob is fixed by means of the locking device.

(c) Local oscillator control

The input level of the local signal to the modulator can be checked by operating the push-button switch. By this means the meter is switched into the monitoring circuit of the local oscillator.

The correct level corresponding to the deflection to the red mark of the meter can be set with the oscillator level control.

(d) Terminals

The lower one of the two coaxial connectors on the front panel provides the input of the instrument.

The upper one provides the signal output from the equipment of which the instrument forms part.

In general these two coaxial connectors are connected with a U-link.

The multi-contact connector inside the cover provides for connection to the power supply.

### SECTION III MAINTENANCE

#### 3-1 GENERAL

The type BFM210 Selective Measuring Instrument is a delicate instrument. Therefore any repair should be made only by skilled persons provided with sufficient equipment to ensure that the repair is properly made.

When handling and operating the instrument with care, its useful life will be prolonged, and trouble will be reduced to a minimum. The instrument should be protected from dust, moisture, and extreme temperatures, and it is advisable from time to time to inspect it for dust, dirt and corrosion.

#### 3-2 REMOVING THE DUST COVER

The dust cover is easily removed when pulled forward.

#### 3-3 TUBE REPLACEMENT

In general the tubes need not be replaced until they cause some kind of trouble. The troubles which are generally due to faulty tubes are: insufficient local oscillator amplitude, amplification instability, etc.

All tubes can be readily replaced when the dust cover of the instrument has been removed.

Tubes with average characteristics can be used for any replacement.

#### 3-4 OPERATING VOLTAGES OF THE INSTRUMENT

The voltages listed below can be used as references when servicing the instrument. 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

	from	d - c volts
tube No. 1	pin No. 2-7	2.0
	6	103
	5	150
	1	0.4
tube No. 2	pin No. 2-7	2.0
	6	110
	5	140
	1	0
tube No. 3	pin No. 2-7	2.3
	6	112
	5	108
	1	0
tube No. 4	pin No. 1	-16 - -17
tube No. 5	pin No. 1-3-5	85

SECTION IV  
SPECIFICATIONS

Frequency range:

310-560 kc/s

Frequency dial calibration:

Black calibration marks indicate frequency limits of channel ranges in a supergroup. In each channel range a red mark indicates the resulting frequency of an 800 c/s signal applied to the channel. Green and blue marks indicate resulting and true frequencies, respectively, of the different carrier frequencies used for the frequency translations.

Level meter calibration:

The meter is calibrated in Nepers from  $-2$  to  $+0.5$  or in db from  $-15$  to  $+5$ . A red mark indicates proper value of local signal level, when the meter is switched into the local signal monitoring circuit.

Sensitivity:

A signal level of  $-6.5$  Nepers or, when calibrated in db, of  $-60$  db across the input terminals gives meter deflection to the zero mark. ( $0$  Neper =  $0$  db =  $0.775$  volt). The sensitivity of the instrument can be readjusted by means of the amplification adjustment control ( $\pm 0.5$  N or  $\pm 5$  db).

Input impedance:

Approx. 75 ohms

Selectivity:

Image rejection better than 40 db.

The IF filter characteristic is flat within 0.05 db on the range  $240 \pm 100$  c/s.

Signals that deviate more than 1 kc from the signal frequency are attenuated by more than 20 db.

## Accuracy:

The over-all accuracy is within  $\pm 0.5$  db

## Vacuum tubes:

4 type 6 AK5 or 403B or EF95

1 type 85A2

## Supply voltages and currents:

The following voltages and currents are required for the operation of the instrument:

6.3 volts a-c, 0.7 amp  
180 " d-c, 26 milliamps

## Construction:

The instrument is designed for 19-inch relay rack mounting (wall mounting). Front panel, back panel, and detachable dust cover finished in baked aluminum enamel.

## Dimensions:

483 x 310 x 235 mm<sup>3</sup> over-all

## Weight:

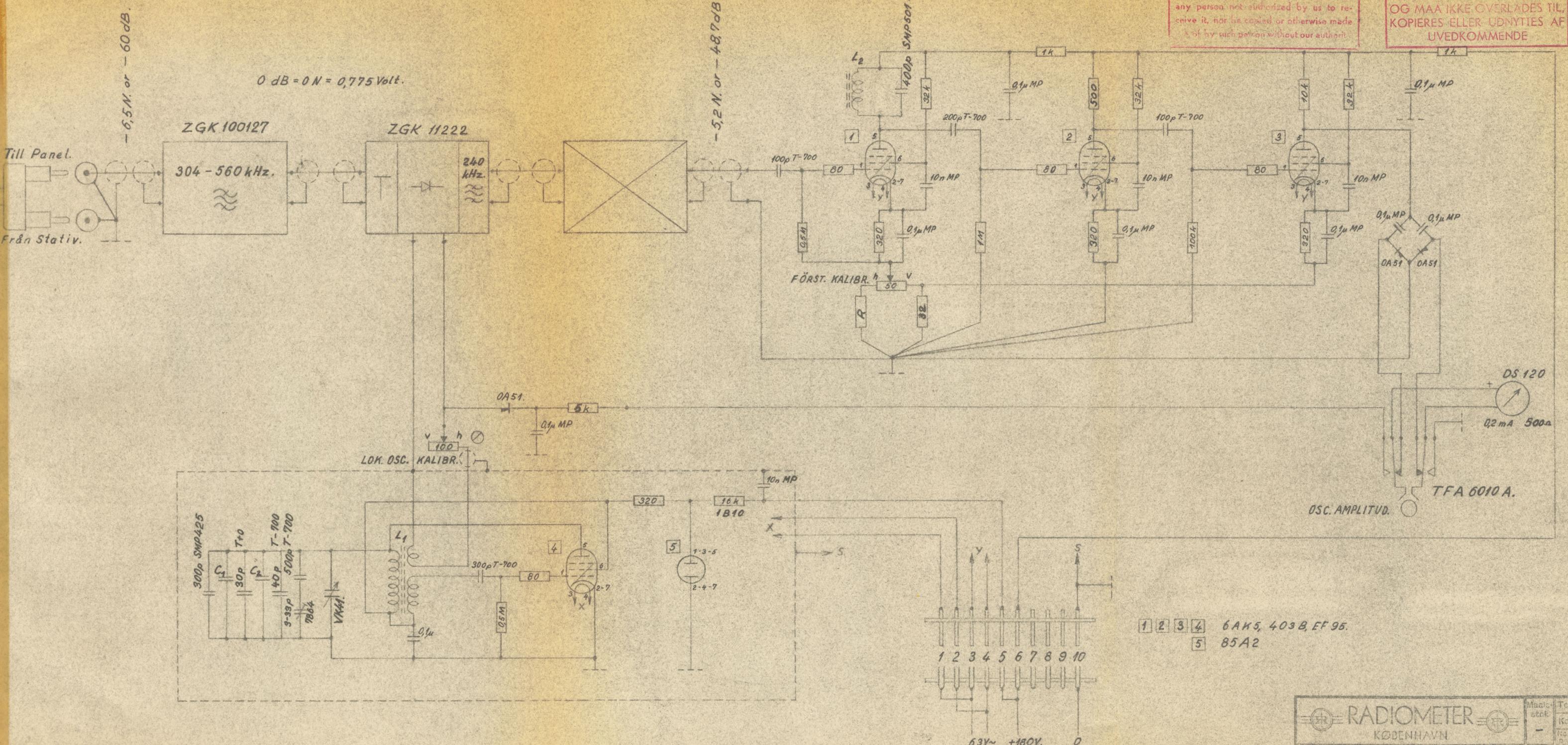
18.6 kilos

**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.

DENNE TEGNING TILHØRER  
**RADIOMETER**  
KØBENHAVN

OG MAA IKKE OVERLADES TIL, KOPIERES ELLER UDNYTTES AF LIVEDKOMMENDE



Till Panel.  
Från Stativ.

0 dB = 0 N = 0,775 Volt.

-5,2 N. or -48,7 dB.

DS 120  
0,2 mA 500 μA  
TFA 6010 A.  
OSC. AMPLITUD.

- 1 2 3 4 6AK5, 403B, EF 95.
- 5 85A2

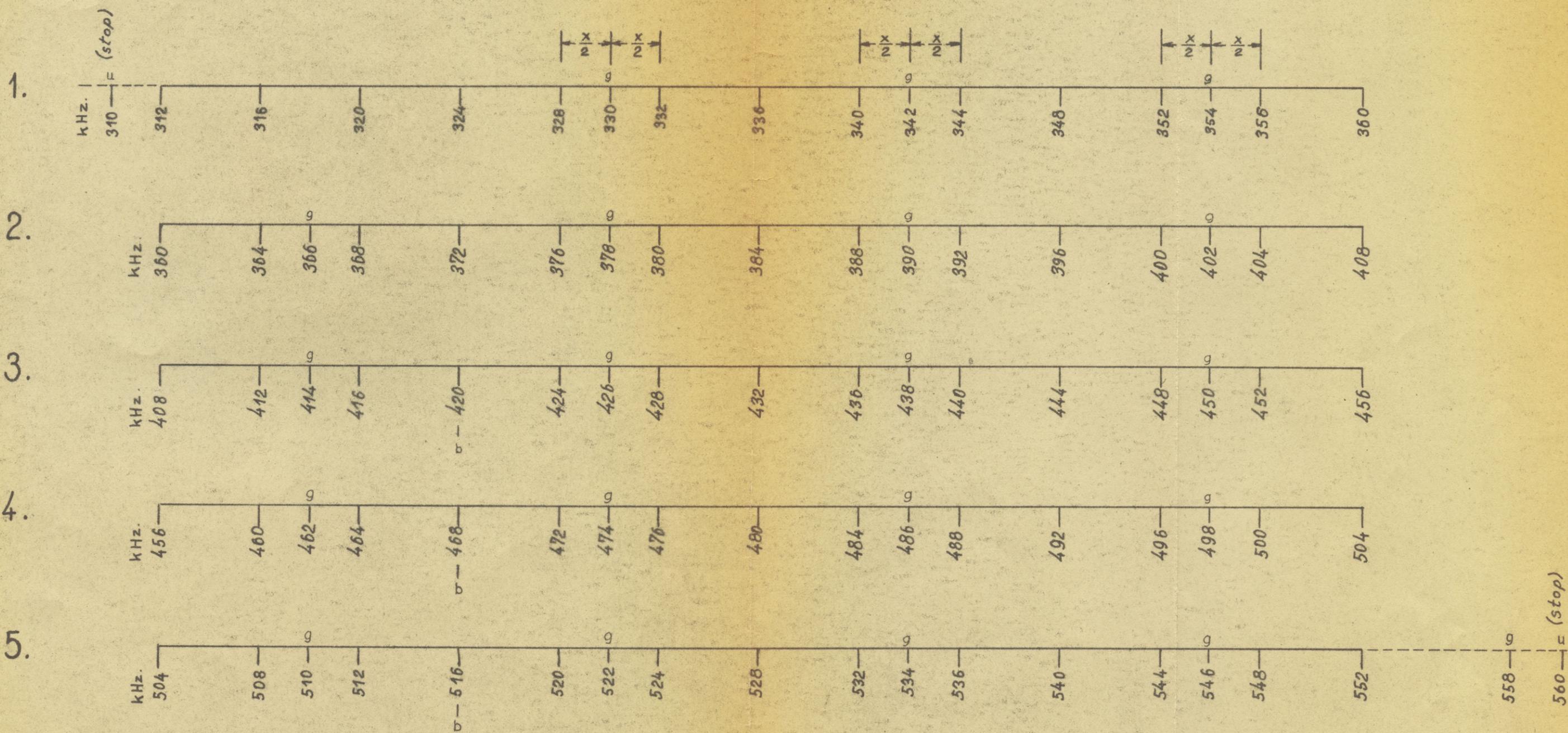
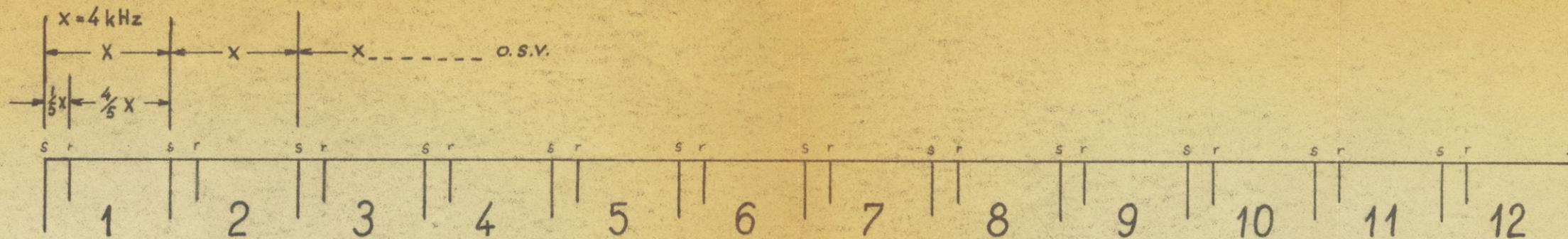
**RADIOMETER**  
KØBENHAVN

Maal: HM 1/4-55  
Konf: FH 10/4-55

Erstatet af:  
**814 - A2**

Erstatet af:

**Selektivt Måleinstrument**  
Type BFM210b. N/B  
Strømskema.



Farvemarkering:  
 s = sort  
 r = rød  
 g = grøn  
 b = blå  
 u = uden farve

se også tegn.nr. -A3.

RADIOMETER KØBENHAVN		Maal. Tegn. AM 14/3 55
Selektivt måleinstrument Type BFM 210. Skalaopskrift.		Erstatter: 940 - A3
Rt. Nr.	fr. Fab. Nr.	Dato
Rt. af	Konf.	Norm.
Erstatt. af:		