

PROVISIONAL SPECIFICATIONS FOR PORTABLE MEASURING EQUIPMENT  
FOR 4 MEGACYCLE COAXIAL CABLE CARRIER TELEPHONE SYSTEMS

1) General

The portable selective measuring equipment described below has been designed by Radiometer at the instigation of Messrs. L.M.Ericsson A-B for supervision and maintenance measurements on coaxial cable carrier telephone systems. It is designed to make possible point checks on the transmission band on the cable. Thus it can be used in all attended and unattended repeater stations along the line. The equipment allows measurements to be carried out without impairing the traffic on the cable.

2) Method

The measuring equipment is based upon measuring the levels of certain auxiliary line pilots which will be transmitted from the terminal station having frequencies in accordance with the recommendations of CCIF. These auxiliary pilots are located in the gaps between adjacent line groups. The widths of these empty  $\sqrt{8}$  kc/s <sup>bands are</sup> between all line groups except between line groups 1 and 2, and 2 and 3. All auxiliary pilots are generated by introducing 308 kc/s into the super group. Consequently their frequencies on the line will be 308, 808, 1056, 1304.....3536, 3784 kc/s. All these pilots will be transmitted at a level 9 db below that of the adjacent telephone channels. In addition to the above auxiliary pilots the measuring equipment measures the levels of the ordinary line pilots 60 kc/s and 4092 kc/s.

In general the auxiliary line pilots will not be transmitted constantly except for 308 kc/s, which also serves as a regular line pilot, but will be transmitted only when necessary.

3) Mode of operation

The enclosed block diagram shows the principal features of the equipment. The line is bridged by a high-impedance transformer forming a measuring probe. The impedance is at least 3000 ohms implying a bridging loss of max. 0.1 db. From this probe the signals are fed to the measuring instrument.

The principle of the measuring instrument is that of a superheterodyne receiver. The incoming signal is preamplified in a selective amplifier using negative feedback and mixed in a converter stage with a local signal generated by a crystal controlled oscillator having 16 different quartz crystals, which can be individually switched in and out.

The frequencies of these crystals differ 249 kc/s from those of the corresponding line pilots, i.e. they are 309, 557, 1057, 1305.....4341 kc/s.

The beat-frequency of 249 kc/s passes a 249 kc/s band-pass filter. The filter is followed by a cathode coupled amplifier stage incorporating a 10 db/step voltage divider for changing the voltage range of the instrument. After a final amplification in a three-tube-negative-feedback amplifier the amplitude of the signal is measured on a meter calibrated in db.

A second crystal controlled oscillator with a frequency of 3040 kc/s is incorporated for calibration purposes. The output of this oscillator can be standardized to a level -80 db (relative to 0.775 volts) and by connecting the probe to the calibration oscillator output the gain of the equipment can be checked. Any variation in total amplification can be compensated by adjusting the main amplification control.

4) Construction

The equipment consists of the following instruments:

- A) selective measuring instrument type BFMI10a
- B) probe " BFMI20a
- C) power supply " BFMI30a

5) Specifications

A) SELECTIVE MEASURING INSTRUMENT TYPE BFMI10a

<u>Pilot frequencies?</u>	60 kc/s	308 kc/s	808 kc/s	1056 kc/s
	1304 "	1552 "	1800 "	2048 "
	2296 "	2544 "	2792 "	3040 "
	3288 "	3536 "	3784 "	4092 "

Sensitivity?

For the instrument proper without probe -25 db to -95 db full scale (0 db corresponds to 0.775 volt)

The entire range is divided in 8 sub-ranges in steps of 10 db. The positions of the switch are so designed that the levels read apply to measurements with probe.

The indicating meter is calibrated in db from -10 db to +5 db.

Input impedance:

(75 + j0) ohms

Selectivity:

The damping of the intermediate frequency (249 kc/s) is >30 db for pilot frequencies below 1056 kilocycles. For all other pilot frequencies it is >40 db. The damping of all other unwanted frequencies is >40 db.

The LF filter curve is flat within 0.5 db in a range of +400 kilocycles to prevent frequency drift of local oscillator, etc.

Accuracy: +0.5 db

Calibration of amplification:

The instrument is provided with a built-in calibrating oscillator for the pilot frequency of 3040 kc/s with an output voltage of -80 db (output impedance  $(37.5 + j0)$  ohms). The total amplification of the instrument can be checked and readjusted, if required, by connecting the probe to the output jack of the calibrating oscillator.

Vacuum tubes: 9 type 6AK5 or 403B

Supply voltage and current requirements:

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

6.3 V , 1.6 amps  
160 V= ; 27 mA  
160 V= stab, 32 mA

In general the instrument is supplied from a type BFMI30a power supply.

Change in indication due to variations in supply voltages:

When the instrument operates in conjunction with type BFMI30a power supply the relation between supply voltage and the indication is as follows:

At operation from 220V a-c power line:

If the indication for 220V is 0 db it is  
-0.4 db at 200V and  
+0.3 db " 240V

At operation from 6V storage battery:

If the indication for 6V is 0db when measured on the built-in voltmeter it is  
-0.5 db at 5.7V and  
-0.8 db " 5.4V

Change in indication due to ambient temperature:

about -0.1 db per degree centigrade

Construction:

The instrument is mounted in a heavy grey finish steel case with detachable cover in which the type BFMI20a probe can be mounted when the instrument is being carried. The case is provided with two solid handles and with rubber feet on all four sides.

The over-all dimensions are

260 x 285 x 252 mm<sup>3</sup>

Weight:

22 kilos with type BFMI20a probe mounted in cover.

B) TYPE BFMI20a PROBE

Damping: 20 db  
 at 4 megacycles it has increased by 0.1 db  
 " 6 " " " " " " 0.2 db

Input impedance: When the measuring cable is terminated in an impedance  $Z = (75 + j0)$  ohms, the input impedance is  $Z_i > 3$  kilohms in the frequency range 60 kc/s to 4 Mc/s.

Construction: The probe fits the hand well and is made of an aluminum alloy with a black crackle-finish surface. It is provided with a coaxial plug for connection to the measuring jacks of the carrier frequency racks, and a 2 m long flexible cable with a coaxial connector for connection to a type BFMI10a selective measuring instrument. In general the probe is mounted in the cover of the type BFMI10a instrument while being carried.

Weight: Probe with cable weighs 530 grams

C) POWER SUPPLY TYPE BFMI30a

Voltages supplied: The instrument is especially designed for supplying the type BFMI10a selective measuring instrument. It contains transformers and rectifiers for

6.3 V~ for filament current supply  
 160 V= }  
 160 V= } for anode current supply

Power supply: The instrument can be supplied either from a 220V a-c power line, or from a 6V storage battery.

Consumption: When loading with the type BFMI10a instrument the primary consumption is:

200 mA at operation on 220V a-c  
 7.9 A " " " 6V d-c

Vacuum tube: 1 type 150C1K or OD3

Construction: The instrument is mounted in a heavy grey finish steel case with detachable cover in which the cables for connection to the type BFMI10 instrument, 220 volt a-c line, and 6 volt storage battery can be mounted when the instrument is being carried. The case is provided with two solid handles and rubber feet on ~~all~~ four sides.

The over-all dimensions are

220 x 285 x 535 mm<sup>3</sup>

Weight: <sup>19</sup> 22 kilos with <sup>connecting cables</sup> ~~type BFMI20a probe~~ mounted in cover

STEP-BY-STEP OPERATION OF PORTABLE SELECTIVE MEASURING  
EQUIPMENT TYPE BFM

- 1) Make equipment ready for use by connecting the type BFM110a selective measuring instrument to the type BFM120a probe and type BFM130a power supply.
- 2) Connect the type BFM130a power supply to 220 volt a-c line or to 6 volt storage battery and switch on the power. Allow for a warm-up period of a few minutes.
- 3) Connect the type BFM120a probe to CAL. SIGNAL jack. Set FREQUENCY KC/S switch to 3040 and LEVEL-RANGE-db switch to -80. Set deflection of amplitude meter to red mark by means of LOC. OSC. ADJUSTMENT knob. Press START CAL. OSC. push button, set deflection of amplitude meter to red mark by means of CAL. OSC. ADJUSTMENT knob and watch the deflection of the db-meter. If the deflections differ from 0, set to 0 by means of the AMPLIFIER ADJUSTMENT knob. Set LEVEL-RANGE-db switch to -10.
- 4) Connect the type BFM120a probe to the measuring jack. Select the signal frequency wanted by means of FREQUENCY KC/S switch. Set the amplitude meter deflection to red mark by means of LOC. OSC. ADJUSTMENT knob.  
Turn switch LEVEL-RANGE-db to the right, until an adequate deflection is obtained on the db-meter.  
Read the db-meter and add the reading to the value at which the LEVEL-RANGE-db switch has been set.