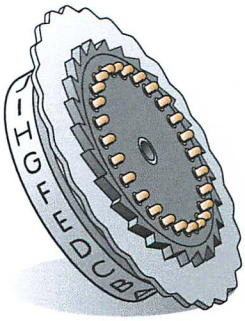
EC Mark I

Part A - Operational Manual

March 1956 (est.)

Project Easy Chair



P A R T A

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C O N T E N T S

OPERATIONAL MANUAL

PART A

OPERATIONAL MANUAL.

A technical description of the system components together with circuit diagrams and constructional details is given in Part B, Technical Manual.

1. Brief description of the system.

The system consists of a transmitter, a receiver, two antennas and a passive element (designated P.E.). (See Fig. 1).

In the transmitter high-frequency power is generated with a fixed frequency of 976,5 mc/sec. at a level adjustable between 2 and 40 watts.

The P.E. can, according to the operational requirements, be situated at a certain distance from the base-station.

In free space the maximum permitted distance between P.E. and base-station is about 70 meters (77 yards). This range will be reduced by obstacles or walls etc. in or near the propagation path between transmitter and P.E. The nature of the obstacles determines the ultimate range.

The frequency chosen is such that the compromise between wall losses and antenna gain in consistence with allowable dimensions is optimum.

The transmitted power activates the P.E. in such a way that acoustical signals received by the P.E. are modulated on the R.F. power which is reflected by the P.E.

The reflected and modulated power of the P.E. is received by the receiver antenna and fed to the receiver, where it is detected. After detection the audio signal is amplified and fed to a loudspeaker and a pair of output jacks. A fraction of the transmitted power will reach the receiver directly due to reflection on surrounding objects and the coupling between antennas. This overcoupled power stimulates the detection in such a way that the sensitivity increases. The process involved is frequently called homodyne- or synchronous detection. The overcoupled (and unmodulated) power acts as "local oscillator" for the detector.

Too much overcoupling results in excessive noise or may eventually damage the crystal; an insufficient amount of overcoupling results in a decrease of sensitivity.
The right amount of overcoupling can easily be established by adjusting the position of the receiver antenna, relative to the transmitter antenna. (See also section 6).
The signal to noise ratio can be improved by further adjustment of the receiver antenna relative to the transmitter antenna.
Optimum signal to noise ratio is reached when the (amplitude modulated) signal from the P.E. is in phase with the overcoupled (non-modulated) signal.

N.B. From what is said above it is clear that each shift in position of the passive element may involve a shift in position of the receiving antenna to obtain the right phase between received signal and overcoupled signal.
Also a shift in transmitted frequency (e.g. due to warming-up) may involve a shift in position of the receiving antenna.

2. Contents of suitcases.

a. Transmitter suitcase:

Transmitter
Four radiating elements
Two radiating element supports
Field strength monitor
Two passive element antennas
Sheet-reflector
Sponge rubber sheet

b. Receiver suitcase:

Receiver
Four antenna feet
Two antenna center supports
Extension power line cord
Two power line cords
Three-way plug
Two R.F. coaxial cables
Pair of headphones
Telephone jack adaptor
Transmitter tuning rod
Passive element audio amplifier with separate microphone, connecting cord and adaptor cord
Passive element audio amplifier with integrated microphone and connecting cord
Sponge rubber sheet
Operational manual
Technical manual
Fuses

3. Setting up the base-installation.

The setting up of the base-installation can be accomplished in a few minutes. The following method is recommended:

a. Assembly of the antennas: (See Fig. 2)
   1. Take out the black sheet reflector from the receiver suitcase and attach an antenna center support to it.
   2. Slide an antenna foot to each end of the antenna center support.
   3. Erect the sheet reflector on a table or other suitable object whereby the narrow ends of the slots in the sheet should point upwards.
   4. Take out a radiating element support and connect two different marked (green and yellow) radiating elements to the ends.
      It is of no importance which elements are used for the transmitter or the receiver antenna, or which mark is on top or bottom of an antenna.
      The connectors are normal "General Radio" connectors. The connections must be tight to avoid contact trouble.
      When equallymarked elements are used the antenna will not radiate properly.
   5. Fit this assembly (one support and two elements) on one of the sheet-reflectors and fasten it to the sheet-reflector by pulling the knobs on the radiation supports backwards and turning the short bars 90 degrees.
   6. Make the other antenna complete in the same way.

b. Take out the transmitter and place it less than two meters from one antenna.
   The transmitter is locked to the supporting chassis in the suitcase with "omni"-fastners, which can be unlocked by turning them 90 degrees.

c. Take out the receiver and place it less than two meters from the other antenna.
   The receiver is locked to the supporting chassis in the same way as the transmitter.

To reduce microphony when operating the loudspeaker, transmitter and receiver must be seperated a suitable distance, and placed on the sponge rubber sheets provided.

d. Connect the transmitter with one antenna, and the receiver with the other one, with the coaxial cables provided.
The coaxial panel-connectors on transmitter and receiver are located at the back.
The connection to the antenna is made by leading the cable through the center hole in the sheet-reflector and connecting it to the center connector of the radiating element support.

Make all connections tight.
Do not bend the cables too sharply.
Avoid sideway pull on the plugs due to the stiffness of the cable.

e. Connect transmitter and receiver to the mains.
The mains plugs for transmitter and receiver are situated at the backs of transmitter and receiver.
Make sure that the mains voltage switch, situated under the mains plugs, is in the correct position (either 110 or 220 volts).
Before connecting the mains cables, check if the switches on the transmitter and receiver are in the "off"- position.

When the transmitter is used with a 110 V mains supply, it is recommended to exchange the 2 Amp fuse for one of 3 or 4 Amps.

4. Operation of the transmitter.

Make sure that the mains switch (110 - 220 volts) is in the right position.
Switch on the filaments to warm up for two (2) minutes.
Before switching on the high tension, check if the power is adjusted for minimum. This can be done by turning the knob marked "OUTPUT" fully counterclockwise.
Check if the antennas are not looking into each other and are separated by a reasonable distance.
After the two minutes warming-up time switch on the high tension with the switch marked "H.T.".
Check if the meter reading on the receiver is not excessive. By shifting the position of the receiver antenna relative to the transmitter antenna a position can be found where the meter reading is half scale or less.
Increase of power can be obtained by turning the knob marked "OUTPUT" clockwise.
When switching off the transmitter, H.T. must be switched off first.
The transmitter has two stages: an oscillator stage and an amplifier stage.
The performance and tuning of the transmitter can be checked with the three-position switch and the meter. Whenever retuning should be necessary, the following procedure is recommended:

The "FIL" and "H.T." switches are switched on as described before, with the output control in counter-clockwise position. (Minimum power).
Adjust the three-position switch in position 1, in which case the meter is indicating the oscillator output power. Use the tuning rod provided to adjust the oscillator grid tuning circuit, which can be reached through a hole in the lefthand side of the top cover. The tuning element has a nut which fits in the tuning rod.
For optimum performance first tune for maximum meter reading and then advance the nut clockwise for 1/8 of a turn.

Adjust the three-position switch in position 3, in which case the meter indicates the output of the amplifier stage.
Advance the output control for about 1/4 of a turn clockwise and use the tuning rod again to adjust the output circuit, which can be reached through a hole on the righthand side of the top cover, for maximum meter reading.
Finally adjust the three-position switch in position 2, in which case the meter indicates the anode current of the amplifier.(f.s.= 200 mA). Check that the anode current can be adjusted over a range of about 40 - 130 mA by adjustment of the "output" control.
Tuning should be performed after at least a quarter of an hour warming-up time. The output of the transmitter should be connected to the antenna and care should be taken not to overload the receiver crystal (if necessary, disconnect the receiver antenna).

5. Operation of the receiver.

Check if the mains switch is in the right position.
Adjust the volume for minimum by turning the knob marked "volume" fully to the left.
Switch on the receiver.
The meter in the front panel indicates the crystal current.(See section 4).
The two-position switch at the right side selects the audio bandwidth. In the position "LOW" the bandwidth ranges from 400 - 4000 c/s. In the position "HIGH" the bandwidth ranges from 400 - 7000 c/s.
Under the loudspeaker two output jacks are provided. The righthand jack disconnects the loudspeaker.
The crystal holder is situated above the meter.
For replacement of the crystal, unscrew the cap.

When the system is operative the volume control can be advanced as required, but care should be taken for audio feedback to the transmitter when the internal speaker is used.

6. Operational procedure of the system.

Set up the base station. (See section 3).
Direct the antennae to the P.E. or the future position of the P.E.
Direct the transmitter beam at the P.E. along a path with as few obstacles as possible.
Put into operation the transmitter and the receiver according to the instructions laid down in sections 4 and 5.
Adjust the receiver antenna till the crystal-current meter reads half-scale or less and minimum "HUM" is audible.
Install the P.E. (See section 7).
When the P.E. is installed adjust the receiver antenna for optimum signal to noise ratio or optimum signal to hum ratio.

7. Installation of the P.E.

Two types of P.E.'s are supplied.
Type one consists of three units: antenna with detector, audio amplifier and microphone.
Type two consists of two units: antenna with detector and an integgrated unit of audio amplifier and microphone.
Connecting wires provided with miniature connectors are supplied for interconnecting the parts.
The wires provided with connectors carrying a RED dot are to be used for interconnecting antenna and audio amplifier. The connections have to be made in such a way that the dots coincide.
The microphone cord has to be connected to the pair of receptacles marked with a BLUE dot, the blue dot indicating the "live" side of the input.
If a screened microphone wire is used, the center conductor should be connected to the live side of the input.
For mounting purposes the dipoles, made of insulated wire, can be bent slightly without noticeable decrease in performance.

The polarization chosen for the system is horizontal because the interference, caused by moving persons, is less than with vertical polarization.
Therefore, when installing the P.E., care must be taken that the dipole of the P.E. is mounted horizontally and at the same time perpendicularly to the direction to the transmitter.
It is not necessary that the P.E. is mounted exactly horizontally and perpendicularly to the direction to the transmitter. When there is sufficient power some deviation can be allowed.
The influence of the objects, surrounding the P.E., on the fieldstrength may be very large.
An aid to the installing of the P.E. is the fieldstrength monitor which is also provided and which consists of a dipole and a meter.
With the aid of the fieldstrength monitor the fieldstrength on the positions which are considered convenient for mounting the P.E. can be compared and the best one chosen.

Care should be taken, when monitoring the field-strength, that the P.E. is kept away from the fieldstrength monitor, due to the interaction of P.E, and fieldstrength monitor.
Hold the dipole of the fieldstrength monitor preferably in the center.
For proper performance the meter readings should be at least 15. When the meter reading is less, the transmitter power must be increased and/or the transmitting antenna redirected.
With a meter reading of 50 optimum results can be expected.
When the meter is over full scale, over-modulation may occur. In that case the transmitter power has to be decreased and/or the transmitter antenna turned away.

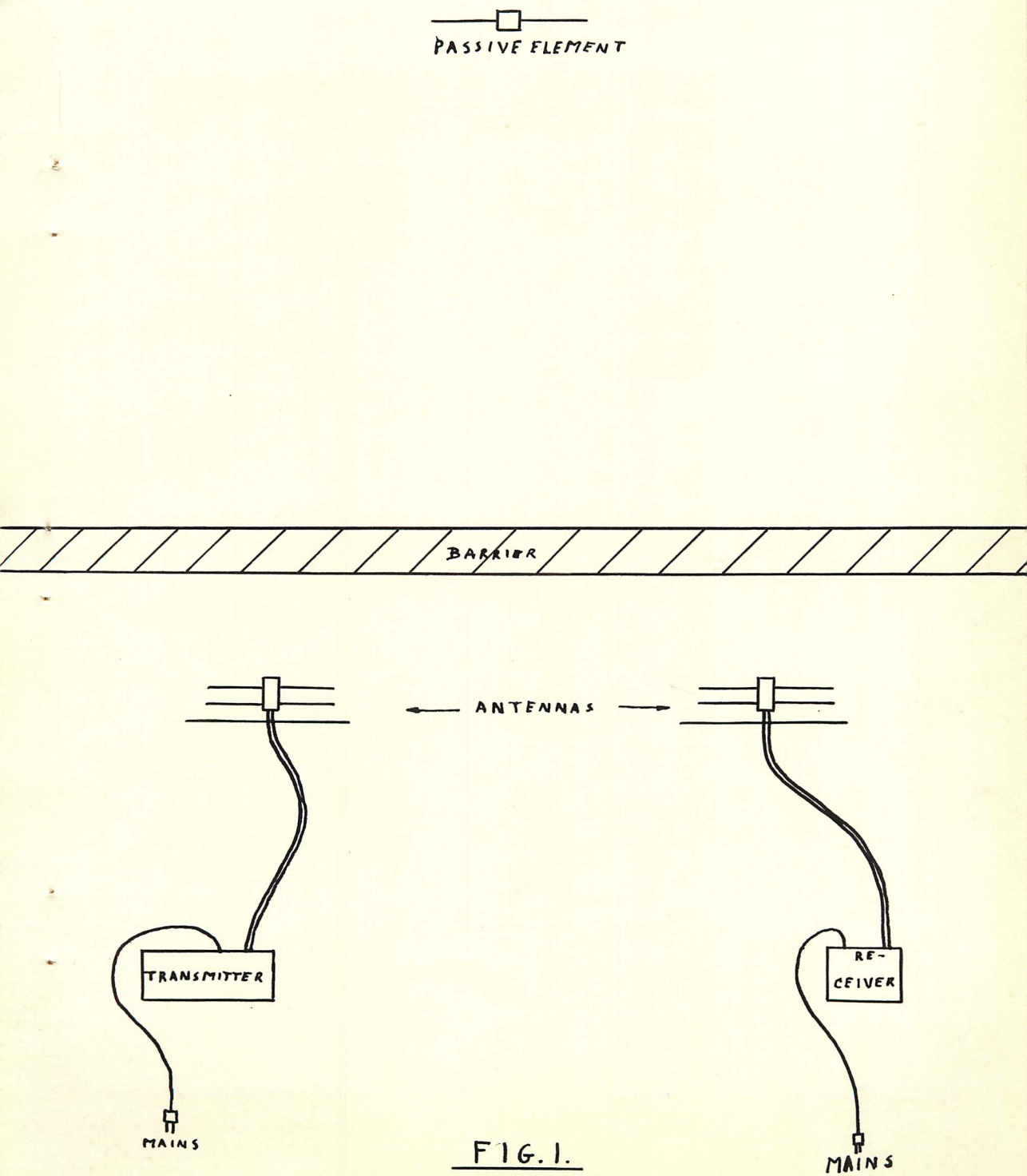
PASSIVE ELEMENT
BARRIER
ANTENNAS
TRANSMITTER
MAINS
RE-
CEIVER
MAINS

FIG. 1.

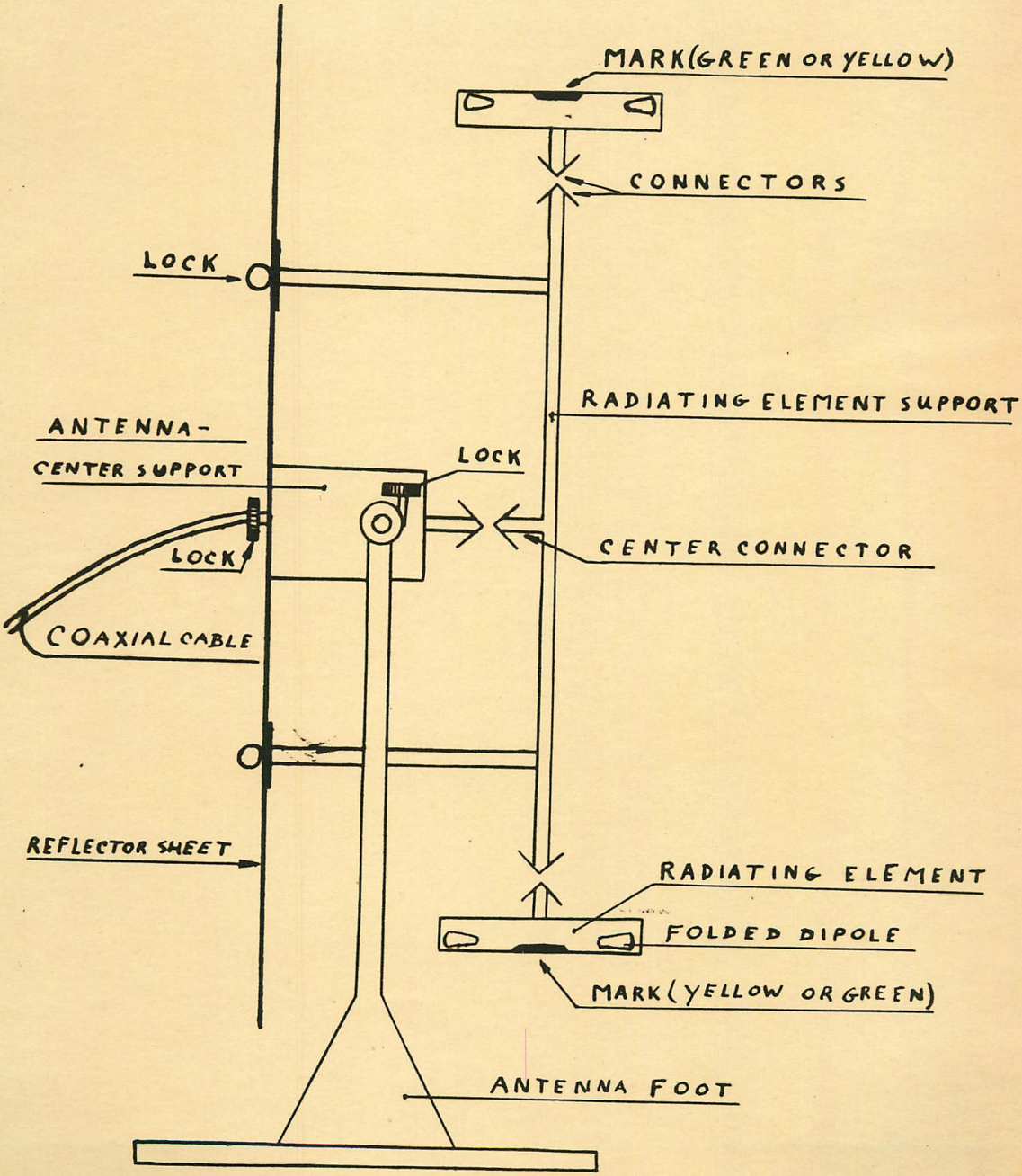
MARK(GREEN OR YELLOW)
CONNECTORS
LOCK
RADIATING ELEMENT SUPPORT
ANTENNA-
CENTER SUPPORT
LOCK
LOCK
CENTER CONNECTOR
COAXIAL CABLE
REFLECTOR SHEET
RADIATING ELEMENT
FOLDED DIPOLE
MARK(YELLOW OR GREEN)
ANTENNA FOOT

FIG 2