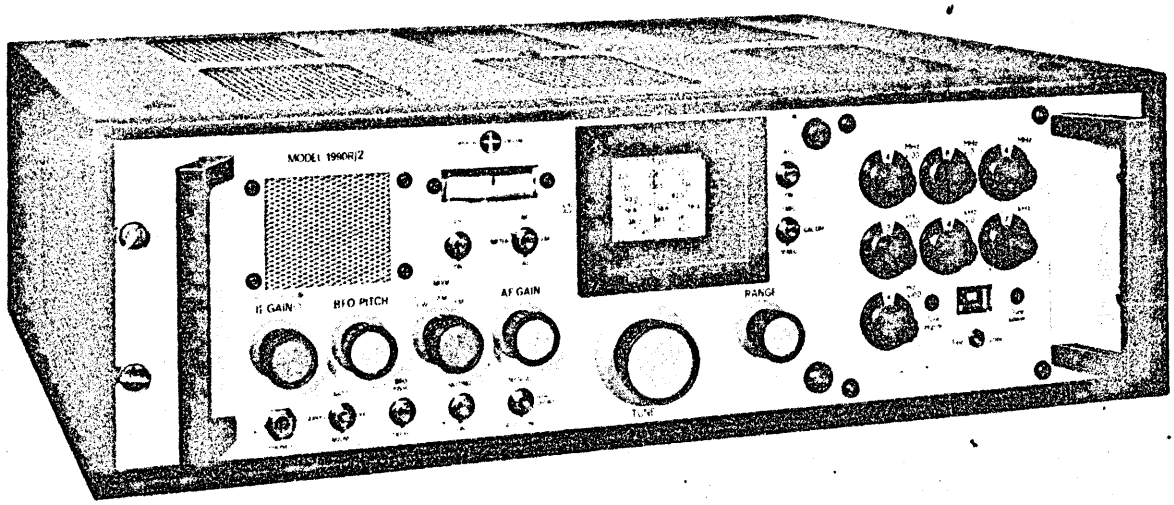
NEW ZEALAND POST OFFICE

ENGINEER-IN-CHIEF'S OFFICE
POST OFFICE HEADQUARTERS
WELLINGTON

Eddystone

DIGITAL SYNCHRONISER For MODEL 1990R SERIES

SYNCHRONISER



MODEL 1990R/2-S FITTED WITH SYNCHRONISER

Manufactured in England by Marconi Instruments Limited for

EDDYSTONE RADIO LIMITED
MEMBER OF MARCONI COMMUNICATION SYSTEMS LIMITED
ALVECHURCH ROAD, BIRMINGHAM B31 3PP
Telephone: 021-475 2231 Telex: 337081

ISSUE NUMBER 1 JULY 1976

PRINTED IN ENGLAND

INTRODUCTION

General

This manual provides comprehensive instructions for the servicing and maintenance of the frequency synchroniser as used in the Model 1990R suffix "S" receivers. Operating instructions are included in the 1990R receiver handbook, and brief notes are given here for the sake of completeness.

Guarantee

The synchroniser is covered under the same guarantee as the receiver.

Servicing

Spares for user servicing can be supplied and helpful advice will be given freely when required. Any enquiries relating to service matters should be directed to the "Sales and Service Dept." at our usual address.

Should major servicing become necessary, where it has been established that the fault lies in the synchroniser and not in the main part of the receiver, then the synchroniser only may be returned to Eddystone Radio. In other cases the receiver and synchroniser should be returned as a complete unit. The serial number of both receiver and synchroniser should be quoted in all communications and care should be taken to ensure that the equipment is well protected against possible damage during transit.

Section 1

OPERATION

These notes are included for the sake of completeness only. Full details of operating procedures are given in the Model 1990R Receiver Manual.

Controls

TUNING CONTROL SWITCHES

Seven switches allow the receiver frequency to be set, to increments of 100Hz.

TUNE-LOCK SWITCH

In the TUNE position the receiver can be tuned normally. In the LOCK position the Variable Frequency Oscillator in the receiver is locked to the synchroniser.

Tuning

Two methods of operation will be described:—

When the signal frequency is known precisely:

(a) Adjust the tuning control switches so that an exact readout of the signal frequency is obtained.

(b) Tune the receiver to the signal frequency. The direction in which the tuning must go is indicated by the two lamps TUNE HIGHER or TUNE LOWER. The lamps will flash alternately when the setting is correct.

(c) The TUNE/LOCK switch should now be set to LOCK. The receiver is now locked to the frequency set by the synchroniser.

When the signal frequency is not known precisely:

(a) Tune the receiver to the desired signal using the TUNE control.

(b) Set the tuning control switches on the synchroniser to give the same frequency read-out as the receiver tuning scale. Slight adjustment of the least significant knob may be necessary to make the indicator lamps flash alternately. The maximum setting accuracy which may be achieved is ±100Hz.

(c) The TUNE/LOCK switch may now be set to LOCK. The receiver is now locked to the frequency set by the synchroniser.

(d) If the receiver goes off tune when this is done it is an indication that the synchroniser is not set exactly to the signal frequency and more exact adjustment is required. The meter situated between the tuning lamps gives an indication of the degree of synchronism between the receiver and the synchroniser. With the switch in the LOCK position the pointer will rest at centre scale if the two frequencies are identical.

Use of the synchroniser is recommended when using narrow bandwidth filters in the receiver.

If for any reason the receiver is required for use when neither a crystal unit nor a synchroniser is available, this is possible when a dummy unit is used. Details are given in Appendix C.

Section 2

TECHNICAL DATA & CIRCUIT DESCRIPTION

TECHNICAL DATA

General Specification

(To be read in conjunction with Model 1990R Receiver Specification).

Frequency Coverage

25–500MHz in increments of 100Hz.

Frequency Setting Accuracy

±100Hz.

Frequency Stability

5 parts in 10^8/degree C over the range -10^{o}C to $+50^{o}$C.

Dimensions and Weight

Panel: 108 x 127mm (4¼in. x 5in.)
Weight: 2.27kg (5lb).

Power Supplies

All power supplies are derived from the parent receiver.

CIRCUIT DESCRIPTION

This description should be read in conjunction with the circuit diagrams found at the rear of this manual, and with the description of the parent receiver. The upper frequency limit is 235MHz for Model 1990R/1 receivers and 500MHz for Model 1990R/2 receivers.

The major part of the following information is reproduced by kind permission of Marconi Instruments Limited, St. Albans, Herts.

Solid state circuits are employed throughout to ensure long term reliability and the design provides for easy access to all components for servicing.

If desired, the receiver can be used independently by setting the TUNE-LOCK switch to TUNE.

PRINCIPLE OF OPERATION

When the synchroniser is used to lock the frequency of the 1990R as shown in the block diagram Fig. 2.1 the configuration is that of a phase locked frequency synthesizer.

Output from the crystal reference oscillator at a frequency f_r is passed to a series of fixed ratio dividers to produce a reference frequency f_r/m which is applied to one input of a phase detector.

The RF output signal from the VFO at a frequency f_o is passed to a series of variable ratio dividers to produce a signal frequency f_o/n which is applied to the second input of the phase detector.

When the frequency of the oscillator is set so that f_o/n is correctly related to f_r/m the control signal from the phase detector will be held constant.

If the frequency of the variable frequency oscillator drifts, the two frequencies will not be correctly related, causing the AFC signal from the phase detector to change in a manner such that the frequency of the receiver will be corrected.

Output from the variable frequency oscillators can be between 46MHz and 522MHz and it is first necessary to amplify this signal before prescaling it by a factor of 20 to ensure that it never exceeds the frequency handling capability of the variable ratio divider. When the variable ratio divider is set to display the desired frequency by the switches on the front panel of the synchroniser it has a ratio such that when the receiver is tuned to the set frequency, its output is a train of 5Hz pulses. This signal is passed to a sample and hold type phase detector where it is compared with a 50Hz ramp waveform obtained by dividing and shaping the output of an internal 5MHz crystal controlled oscillator. If the receiver frequency is not precisely that set by the synchroniser a correcting voltage will be produced by the phase detector. This voltage is applied to the synchroniser amplifier circuit where it is converted to the correct phase and level for application to the AFC circuits in the receiver. Correct locking is indicated by the "IN LOCK" meter.

TUNING

When the TUNE-LOCK switch is in the TUNE position, the synchroniser circuit is employed to some extent as a frequency counter. The variable ratio divider then operates to provide 50Hz pulses and these are used as gating signals for a counter consisting of three decade dividers and a flip flop, whose clock frequency is obtained from the standard divider chain and is 50kHz, see Fig. 2.2. When the frequency entering the synchroniser is higher than that displayed by the dials the gating signal will be at a p.r.f. greater than 50Hz so the counter will be re-set before 1000 pulses have been counted and consequently the final flip-flop will change state. The flip-flop drives a monostable circuit which produces outputs to drive the L.E.D. frequency finding indicators. When operating as described, the TUNE LOWER indicator will be lit. When the frequency entering the synchroniser is lower than that set by the switches the flip-flop will change state at regular intervals, this drives the monostable permanently into its triggered state causing the TUNE HIGHER indicator to be lit.

Variable Ratio Dividers and Offset Detector

The local oscillator signal from the receiver is divided by the variable ratio divider to give an output frequency of 5Hz for comparison with the crystal standard in the phase detector. The variable ratio divider is complicated by the necessity to display on the frequency selection knobs the signal frequency which differs from the local oscillator frequency by the amount of the receiver I.F., and it is further complicated because the local oscillator may be above or below the signal frequency depending on the range selected.

The counter counts from a number set by the switches to a higher number set by the offset detector. The first number is the 9's complement of the signal frequency, i.e. (999 999 9) – (signal frequency), and the second number is (counters all full) ± (receiver I.F.), i.e. (999 999 9) ± (021 400 0). In the case of the local oscillator being above the signal frequency the second number is 1 021 399 9 which means that the last stage of the counters can be a simple divide-by-two stage, IC16. The rest of the counting chain consists of presettable divide-by-ten counters, the presetting (in BCD form) is done by the frequency selection switches which are wired so that the 9's complement is set automatically. BCD outputs from the counters are fed into the offset detector. This is programmed by a logic signal derived from the range switch, to recognise either 1 021 399 9 (high offset) or 978 599 9 (low offset), when it produces an output.

Notice that each counting stage resets as it becomes full, a feature which considerably increases the speed of operation. A further increase in speed is needed in the TUNE mode when a more rapid response of the TUNE lamps is desirable. This is done by bypassing one of the decade stages, when the output pulse frequency to the phase detector becomes 50Hz.

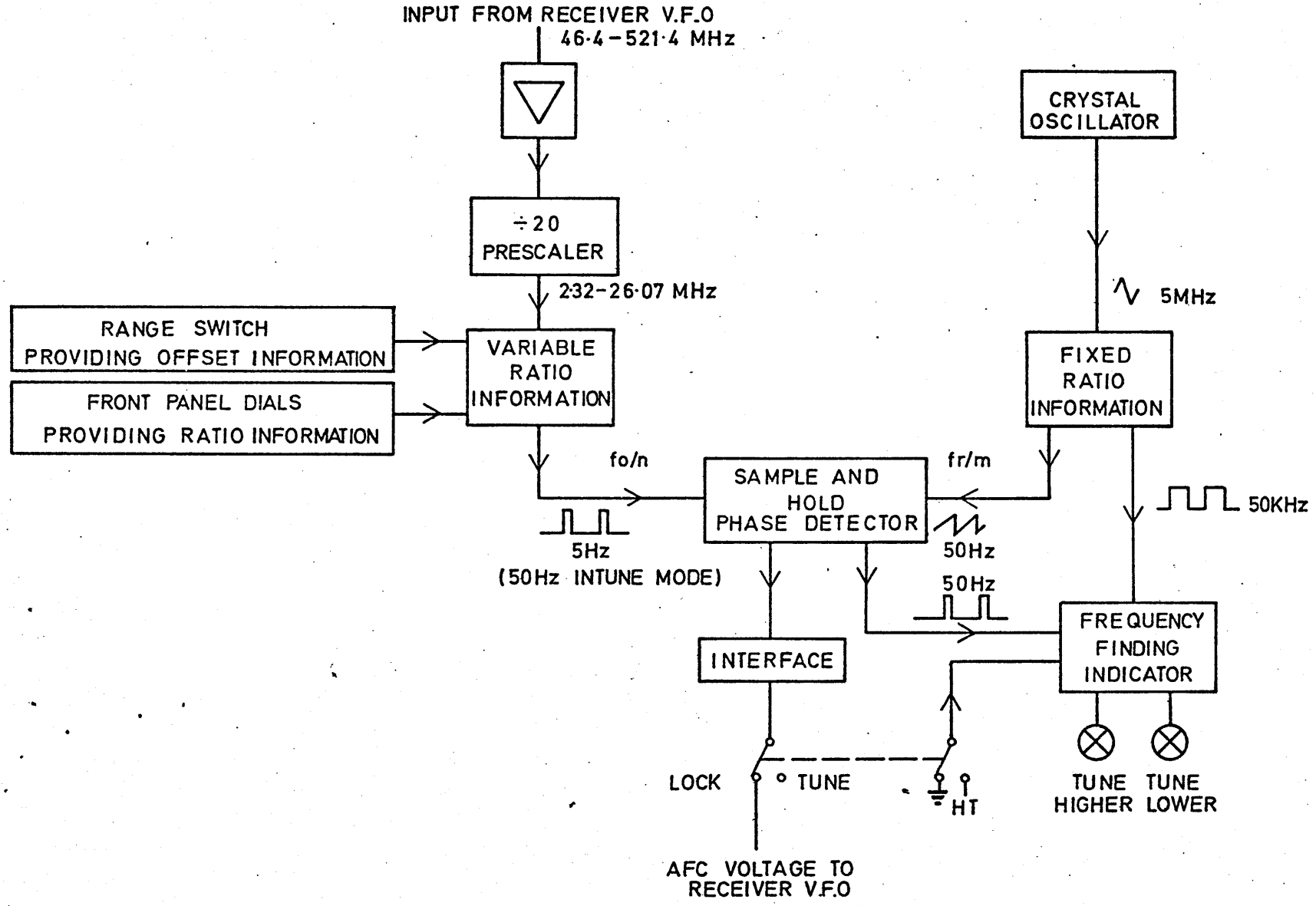
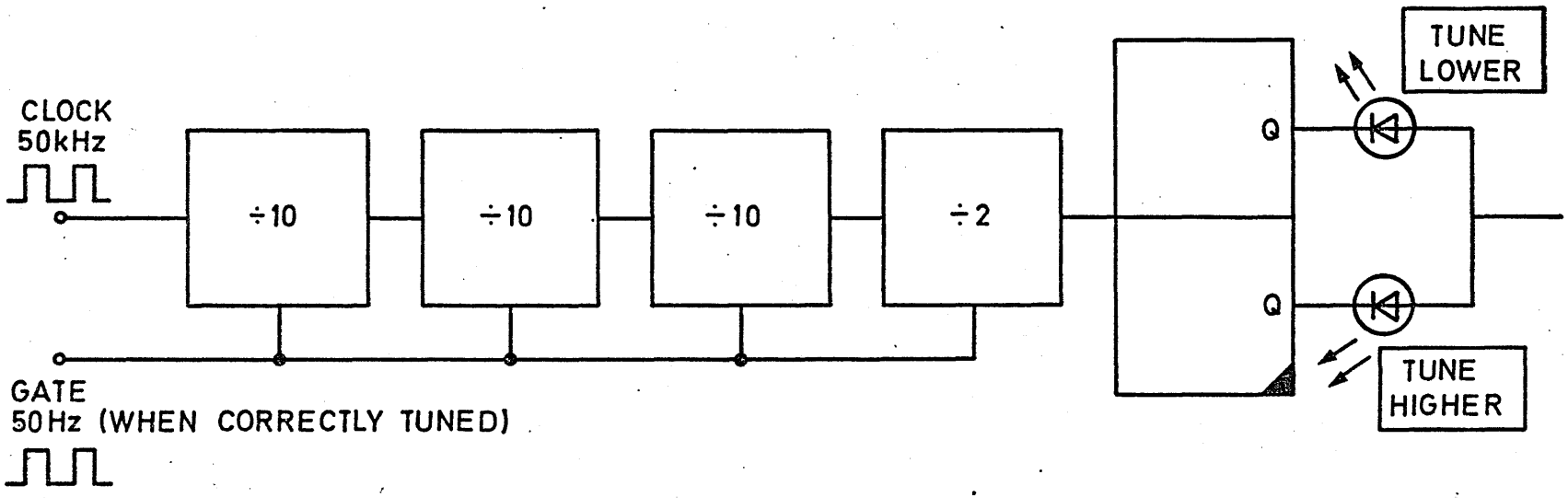


FIG. 2.1. FUNCTIONAL DIAGRAM



: FIG. 2.2. FREQUENCY FINDING INDICATOR FUNCTIONAL DIAGRAM