

# TM 11-6625-493-15

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

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## DS, GS, AND DEPOT MAINTENANCE MANUAL

# FREQUENCY COMPARATOR CM-77A/USM

This copy is a reprint which includes current pages from Changes 1 through 4.

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HEADQUARTERS, DEPARTMENT OF THE ARMY

SEPTEMBER 1964

TECHNICAL MANUAL )  
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NO. 11-6625-493-15 )

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Washington, D.C. 29 September 1964

**DS, GS, and Depot Maintenance Manual  
Frequency Comparator CM-77A/USM**

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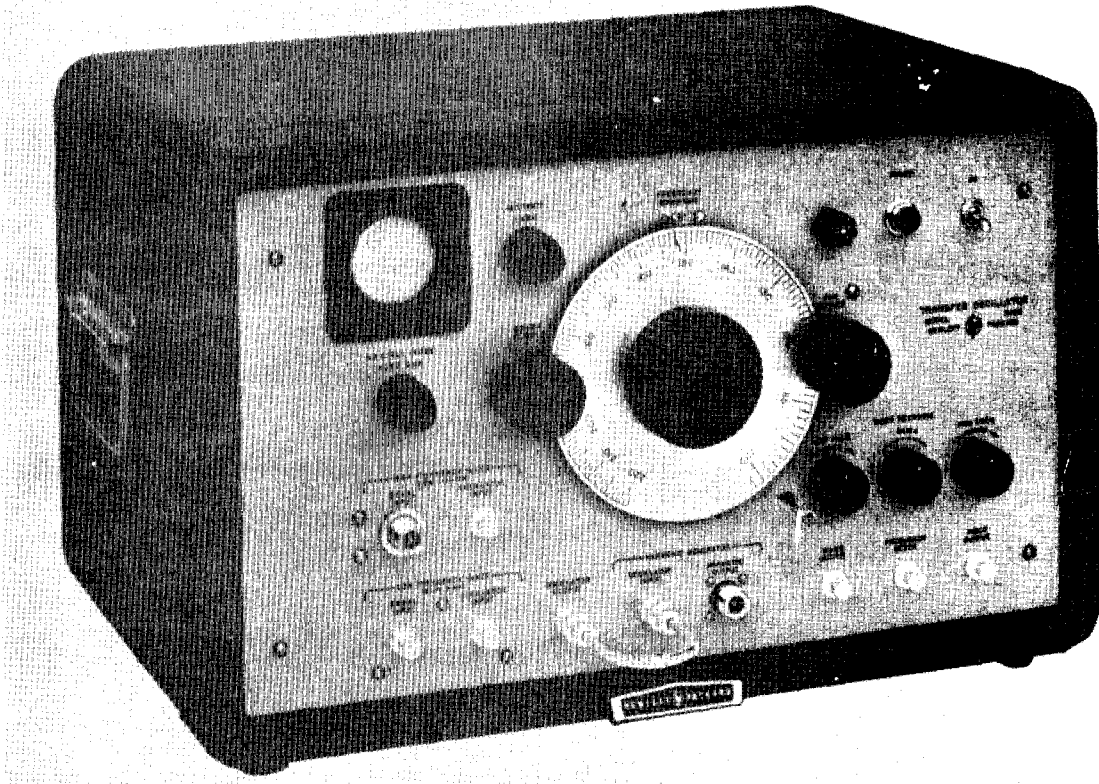


Figure 1-1. Model 540B, Front View

## FOREWORD

Throughout this manual, reference is made to Model 540B Transfer oscillator which is a commercial designation and is identical with Frequency comparator CM-77A/USM. This is a first-edition manual containing preliminary and unreviewed information compiled by the manufacturer of the equipment. Judicious caution should be exercised in using the information in this manual until it is replaced by a revised edition.

## Index of Equipment Publications

Refer to the latest issue of DA Pam 31C-4 to determine whether there are new editions, changes, or additional publications pertaining to the equipment. Department of the Army Pamphlet No. 310-4 is an index of current technical manuals, technical bulletins, supply manuals, supply bulletins, lubrication orders, and modification work orders available through publications supply channels. The index lists the individual parts (-10, -20, -35P, etc) and the latest changes to and revisions of each equipment publication.

## Forms and Records

Reports of Maintenance and Unsatisfactory Equipment. Use equipment forms and records in accordance with instructions in TM 38-750.

Report of Damaged or Improper Shipment. Fill out and forward DD Form 6 (Report of Damaged or Improper Shipment) as prescribed in AR 700-58 (Army), NAVSANDA Publication 378 (Navy), and AFR 71-4 (Air Force).

Reporting of Equipment Manual Improvements. The direct reporting, by the individual user, of errors, omissions, and recommendations for improving this equipment manual is authorized and encouraged. DA Form 2028 will be used for reporting these improvements. This form may be completed by using pencil, pen, or typewriter. DA Form 2028 will be completed in triplicate and forwarded by the individual using the manual. The original and one copy will be forwarded direct to: Commanding General, U. S. Army Electronics Command, ATTN: AMSEL-MR-(NMP)-MA, Fort Monmouth, New Jersey 07703.

## SECTION I

### GENERAL INFORMATION

#### 1-1. INTRODUCTION.

1-2. **PURPOSE AND USE.** The Hewlett - Packard Model 540B Transfer Oscillator is an electronic frequency-measuring instrument which, extends the frequency measurement range of the Hewlett - Packard 524 and 5243 series of electronic frequency counters into the microwave region. The transfer oscillator - frequency counter combination measure frequencies up to 12.4 gigacycles (gc), or with an external mixer, up to 18 gc, with near-counter accuracy. The Model 540B can also be used without a frequency counter to measure frequency below 4 gc within about  $\pm 1/2\%$ .

1-3. The method used in the Model 540B Transfer Oscillator to determine frequency is to zero-beat the unknown input signal with a harmonic of an extremely-stable signal generated in the 540B, and to measure the 540B fundamental frequency on a counter. Multiplying the counter readout by the number of the harmonic causing the zero-beat gives the input signal frequency. The harmonic number is determined either from previous knowledge of the input frequency or by computation. The zero-beat is displayed on the 540B internal oscilloscope. Typical difference-frequency displays obtained are shown in figures 3-4 and 3-5.

1-4. The visual display of the difference frequency between two signals permits reading microwave carrier frequencies to very close tolerance while the signal is being amplitude- or frequency-modulated, or when it contains troublesome amounts of noise. It also permits measuring the incidental frequency modulation in amplitude-modulated carriers, the residual frequency modulation in cw signals and the center frequency and limits of deviation in frequency-modulated signals. When the 540B is used in conjunction with an external oscilloscope, the carrier frequency of rf pulses can also be measured to high accuracy. Typical beat-frequency displays of pulse-modulated carriers are shown in figures 3-10 and 3-11.

1-5. **ACCURACY OF MEASUREMENT.** The stability of the transfer oscillator and the precision with which it can be adjusted are sufficient that the high accuracy and resolution of the electronic counters used for readout are utilized over the entire frequency range. Accuracies up to 1 part per million may be expected with cw signals that are very stable and noise-free. Few radio-frequency (rf) signals are stable enough to be measured with such accuracy. Thus, the instability of the signal being measured is usually the greatest accuracy-limiting factor.

1-6. When measuring pulsed signals, accuracy depends to some extent on pulse length because measurement can take place only during the pulse. Typical accuracy obtainable when measuring a stable, pulsed

carrier of 1000 mc is approximately 3 parts per million for a 10-microsecond pulse duration and 10 parts per million for a 2.5-microsecond pulse.

1-7. **DESCRIPTION OF EQUIPMENT.** The transfer oscillator is a single-unit, cabinet-mounted instrument. The electronic circuitry has four main groups which can be interconnected by front panel jumpers for a variety of measurement applications. The four groups are shown in the block diagram in figure 1-2, and listed below:

a. **Oscillator Section.** An internal oscillator generates a frequency from 100 to 220 mc, which is continuously adjustable by front panel controls. This frequency is applied to frequency mixers and to an external frequency counter for accurate frequency indication.

b. **Frequency Mixers.** There are two mixers, a low frequency mixer for input signals from about 10 mc to 5 gc and a high frequency mixer for input signals from 1 gc to 12.4 gc. The oscillator output is connected to the proper mixer through a front panel jumper. The mixer generates harmonics of the oscillator signal which beat with the input signal and produce low-frequency beat signals which constitute the mixer output.

c. **Amplifier-Oscilloscope Section** The amplifier amplifies the mixer output to display the beat frequency on the built-in oscilloscope. The amplified mixer output is also available for display on an external oscilloscope. With the mixer output being displayed on the oscilloscope, the frequency of the oscillator can be adjusted until one of its harmonics produces a zero-beat indication. The zero-beat indication on the oscilloscope differs in shape as different types of signals having varying amounts of modulation or noise are measured.

d. **Harmonic Generator.** This separate harmonic generator section may be used to produce higher-order harmonics of the oscillator frequency for external amplification and use.

1-8. **ACCESSORIES FURNISHED.** The Model 540B Transfer Oscillator includes as part of the equipment a 6-inch coaxial cable jumper with type BNC connectors for use in programming connections between the jacks on the front panel, and a 4-foot coaxial cable with type BNC connectors for connecting the transfer oscillator to the electronic counter.

#### 1-9. DIFFERENCES IN INSTRUMENTS.

1-10. This manual applies directly to 540B Transfer Oscillators having the serial-number prefix 234. The manual with the following changes also applies to 540B Transfer Oscillators having serial-prefix numbers 128, 046, 015, 008, and the earlier prefix 129 for serials between 101 and 597.