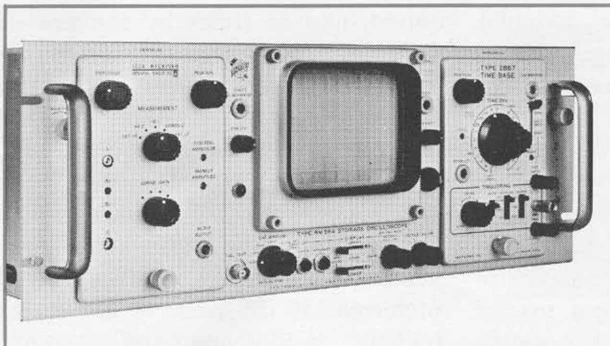


The Type 1124 Receiver.

A RECEIVER FOR PRECISE TIME CALIBRATIONS

A common method of establishing accurate local time is to drive a local clock with a frequency standard, checking the absolute accuracy regularly against standard time signals broadcast by various agencies throughout the world. An elegant variation of this technique involves the use of primary time standards flown to the local site for periodic calibrations. The "flying-clock" method, though obviously expensive, offers the greater accuracy, since it eliminates the uncertainties of radio transmissions. However, once the clock flies away, there exists the problem of maintaining time until it flies in again. For this purpose, as well as for the many applications that require accurate timekeeping but that do not justify flying clocks, the use of broadcast time signals is the answer.

A time-comparison system using broadcast signals typically takes the form shown in Figure 1. General Radio has for years made two of the components used in such a system: standard-frequency oscillators and Syncronometer® digital time comparators (clocks). We now offer the rest of the system, a receiver designed specifically for time standardization with the GR Syncronometer, with a built-in oscilloscope for automatic visual comparison of the received signals against those from the local clock.

The General Radio time standard included in Figure 1 operates as follows: The 100-kHz output from the 1115-C Standard-Frequency Oscillator is fed to the Syncronometer, which translates the zero crossings into a pulse train and thence into a one-pulse-per-second master tick. These ticks are accumulated in six digital counting circuits, and the totals are presented as digital time-of-day infor-

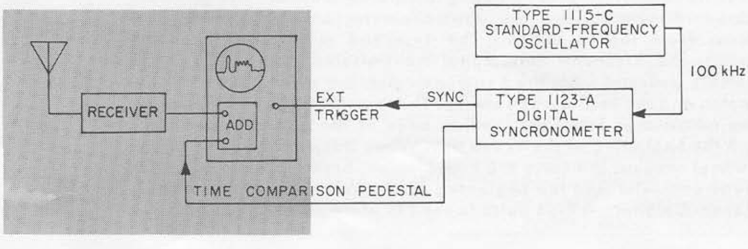


Figure 1. The components of a time-calibration system. Functions in shaded area are performed by the new 1124 receiver. (Antenna is included for Loran-C.)

mation (hours, minutes, and seconds) on the Syncronometer front panel.

To calibrate the system in terms of off-the-air time signals, one need only compare the one-second master tick with a one-second time signal broadcast by one of several agencies offering such services. Then, with both local and broadcast time signals on the oscilloscope, synchronizing the local master tick with the received signal is a simple matter of adjusting a few thumbwheels and pushing a button on the Syncronometer.

This procedure, which sounds simple in the telling, is complicated by the vagaries of radio propagation, by the high degree of precision usually required, and at times by the practical difficulties of integrating and interconnecting several instruments into an efficient system. A stable, sensitive receiver is obviously required. It is unreasonable to expect a general-coverage receiver to have optimum performance at a few selected frequencies, and a special-purpose receiver is usually preferred. If the receiver has its own built-in oscilloscope, the system is greatly simplified.

The new GR receiver (Type 1124) is specially designed for dependable, consistent reception and faithful display of time signals on six fixed frequencies. These are the 2.5-, 5.0-, and 10.0-MHz frequencies of WWV, two CHU fre-

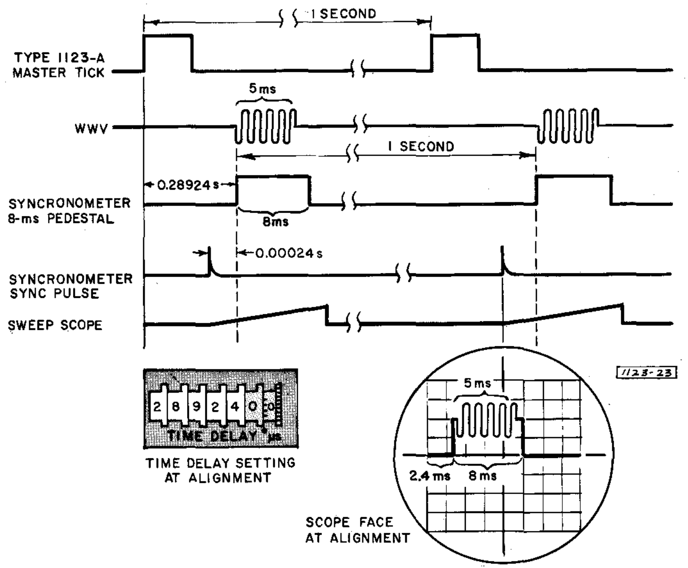
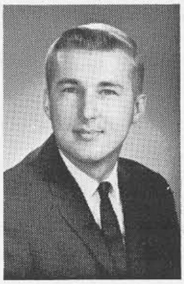


Figure 2. Syncronometrics: Above timing diagrams illustrate the principle of time standardization using the Syncronometer and off-the-air time transmissions. From top to bottom: The 1-second master tick from the Syncronometer; the 1-second time-signal transmissions from WWV; the 8-ms adjustable pedestal from the Syncronometer, the sync pulse from the Syncronometer, and the oscilloscope sweep. The thumbwheels on the Syncronometer are adjusted to bring the leading edge of the pedestal into coincidence with the beginning of the WWV tick. When this adjustment is made, the thumbwheel readout indicates the time interval between the master tick from the Syncronometer and the beginning of the WWV tick. With higher-precision Loran-C signals, a 1-μs pulse is used in place of the 8-ms pedestal.

quencies (3.33 and 7.335 MHz), and 100 kHz for Loran-C transmissions. An "external" mode permits use of signals from other sources (such as, for instance, flying clocks).

The five high-frequency circuits are all fixed-tuned with crystal-controlled local oscillators, and all are mounted on plug-in etched boards. The two used most frequently are left in the receiver and selected by a front-panel switch. Usable input sensitivity for the high frequencies is greater than 3 μV, and agc circuits hold the receiver output within 3 dB over an input-signal range of 10 μV to 100 mV. A 3-MHz crystal i-f filter and three tuned rf stages provide image and i-f rejection of more than 80 dB, with all other spurious responses at least 70 dB down. Low distortion of the modulating waveform, even with 90% modulation, ensures faithful pulse reproduction. There is an audio output monitor, isolated from the display to prevent loading.

The Loran-C receiver is a fixed-tuned amplifier with 100-kHz center frequency and a bandwidth of about 20 kHz (needed to preserve the Loran pulse waveshape). Its 50-ohm input impedance matches the impedance of the loop antenna supplied. Input sensitivity is 3 μV for a signal-to-noise ratio of 2 or greater. An important feature is a pair of notch filters for rejection of unwanted signals near 100 kHz. These filters tune from 80 to 95 kHz and from 105 to 125 kHz and have greater than 40-dB rejection. A gain control with a 60-dB range supplements the oscilloscope gain control for Loran-C presentations.



Dale O. Fisher joined General Radio in 1964, after receiving his BSEE degree from Northeastern University. A development engineer in GR's Frequency and Time Measurement Group, Mr. Fisher has specialized in the design of digital time comparators and related equipment. He is now completing work toward his MS degree from Massachusetts Institute of Technology.

Visual display is by means of a built-in Tektronix RM564 Storage Oscilloscope. The storage mode is especially useful in this application, since it will average out time variations due to unstable propagation characteristics and will increase the signal-to-noise ratio, since the random noise is stored less frequently than is the desired signal. The Tektronix TYPE 2B67 Time Base provides up to 1-μs/cm display for accurate Loran-C comparisons and allows single-pulse triggering for photographic records.

It is expected that the new receiver will be widely used for its Loran-C capability. Those interested in learning more about the use of Loran-C in precision frequency and time measurements are invited to ask for our recently published monograph on the subject. The 12-page booklet, No. 2 in GR's *Frequency/Time Notebook* series, is available free on request.

— D. O. FISHER

SPECIFICATIONS

HIGH-FREQUENCY RECEIVERS

Rf Frequencies: 2.5, 3.33, 5.0, 7.335, and 10 MHz. Any two are selected by a front-panel switch.

Sensitivity: Better than 3 μV.

Input Impedance: Approx 50 Ω.

Max Input Signal: > 100 mV.

Bandwidth: I-f 3-dB bandwidth approx 3 kHz; 3.0 MHz center frequency of i-f amplifier and crystal filter.

Automatic Gain Control: Receiver output is within 3 dB for signal change of 10 μV to 100 mV.

Image and I-F Rejection: >80 dB; all other spurious responses at least 70 dB down.

LORAN-C RECEIVER

Center Frequency: 100 kHz; 3-dB bandwidth approx 20 kHz.

Sensitivity: 3 μV for S/N>2.

Input Impedance: Approx 50 Ω.

Max Input Signal: >100 mV.

Gain Control: 4 fixed steps, 60-dB total range.

Notch Filters: Two, front-panel screwdriver-control, 80 to 95 kHz and 105 to 125 kHz (other ranges with internal-capacitor change). Rejection >40 dB; 6-dB bandwidth <3 kHz.

EXTERNAL INPUT Intended for comparing other timing signals with the GR 1123 comparator.

Sensitivity: Approx 0.5 V for full-screen deflection.

GENERAL

Front-Panel Controls: Amplitude (20-dB range), vertical position, input-channel selector, gain; screwdriver controls: notch-filter tuning (2), 1123 pedestal amplitude, and 1123 marker amplitude.

Connections: Front panel: audio output, approx 1 V, for monitoring hf receiver. Rear panel (BNC connectors): Loran antenna, hf antenna, ext-signal input, and pedestal, sync, and marker pulses from 1123.

Power Required: 105 to 125 or 210 to 250 V, 50 to 60 Hz, 240 W.

Accessories Supplied: Storage-oscilloscope accessories, shielded-cable set, 1124-P1 Antenna.

Mounting: 19-inch rack-mount.

Dimensions (width x height x depth): 19 x 7 x 18½ in. (485 x 180 x 470 mm).

Weight: Net, 42 lb (19.5 kg); shipping, c 70 lb (32 kg).

1124-P1 Antenna

Center Frequency: 100 kHz.

Bandwidth: Approx 20 kHz at 3-dB points, with 50-Ω load.

Dimensions (width x height x depth); 58 x 86 x 3¾ in. (1480 x 2200 x 96 mm).

Catalog Number	*Description*	*Price in USA*
1124-9701	**1124 Receiver**	**$3250.00**

GR1125

PARALLEL-STORAGE UNIT FOR THE SYNCRONOMETER

In the *Experimenter* article introducing the Type 1123 Syncronometer® digital time comparator,[1] we said, "No commercial equipment presently available can accept time readings as fast as the comparator can supply them. Required is a parallel-entry storage register with a capacity of 11 four-bit binary words. The register must accept and store the data from the clock in a time well under 5 microseconds." We can now drop the other shoe, by announcing the availability of the Type 1125 Parallel-Storage Unit.

The Syncronometer, it may be recalled, is essentially a precise accumulator of time in 10-microsecond increments. Feeding such fast-changing data to auxiliary data-handling equipment presents an obvious problem: Most such equipment (printers, tape punches, etc)

[1] D. O. Fisher, R. W. Frank, "A New Approach to Precision Time Measurements," *General Radio Experimenter*, February-March 1965.