

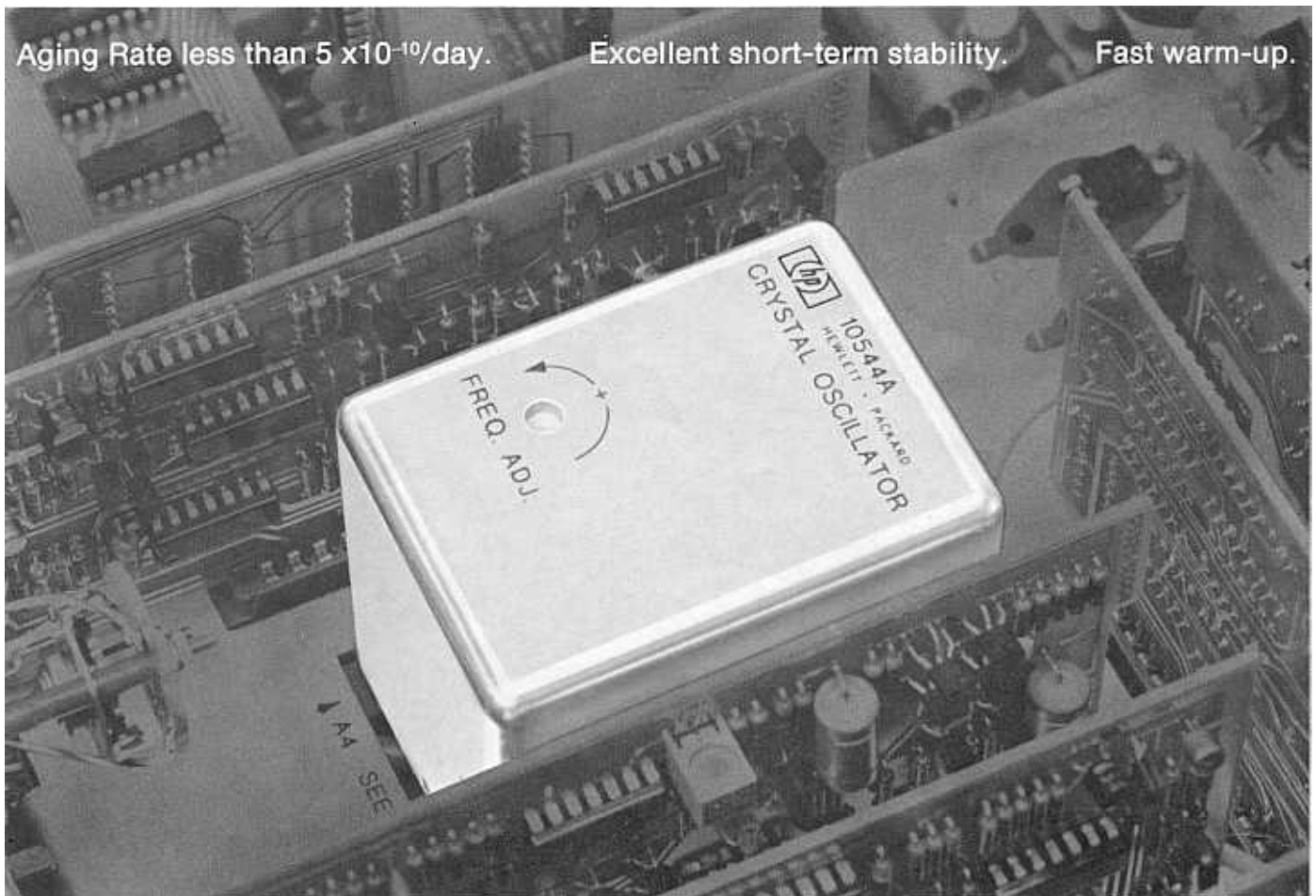
# 10544A 10 MHz CRYSTAL OSCILLATOR

TECHNICAL DATA 1 OCTOBER 72

Aging Rate less than  $5 \times 10^{-10}$ /day.

Excellent short-term stability.

Fast warm-up.



The HP Model 10544A Quartz Crystal Oscillator is an extremely stable, compact, low power, source of 10 MHz. Fast warm-up and low aging are important for both instrument and systems applications. This is achieved using a new crystal design ruggedly mounted in a cold-welded enclosure. The crystal, along with the oscillator, buffer amplifier, and oven control circuits are all mounted inside a thermally insulated oven.

Model 10544A is designed to mate with standard 15-pin printed circuit board connectors which permit direct connections and eliminates the need for separate sockets and interwiring. The 1000-Ohm output impedance satisfies most solid-state input requirements.

Its unique design features, plus production efficiencies enable HP to offer, inexpensively in the 10544A, the better than  $5 \times 10^{-10}$ /day aging formerly available only in expensive laboratory type oscillators. With this low aging rate of less than  $1.5 \times 10^{-7}$ /year the manufacturer of communication and test equipment can offer his customers a real cost saving by reducing the frequency of

calibration necessary to stay within FCC accuracy requirements.

The 10544A is ideally suited for use in communication and navigation systems, synthesizers, time-code generators, counters, and spectrum analyzers. The 10 MHz output frequency is a convenient starting point since it is easily divided or multiplied.

A screwdriver adjustment through the top of the oven enclosure permits frequency adjustment over a range of  $4 \times 10^{-6}$  (40 Hz), yet the control is sensitive enough to allow adjustment to better than  $1 \times 10^{-9}$  (0.01 Hz). Frequency can also be controlled electronically over a 1 Hz range with an externally applied voltage.

To permit optimum performance and use of available voltages, the power inputs for the oscillator/amplifier, oven controller and oven circuits are available separately. However, with a simple external IC regulator a single voltage regulated to 10 percent may be used.

## SPECIFICATIONS

**FREQUENCY:** 10 MHz.<sup>(1)</sup>

**AGING RATE:**  $<5 \times 10^{-10}$ /day after 24-hour warm-up.<sup>(2)</sup>  
and  $<1.5 \times 10^{-7}$ /year.

**SHORT TERM STABILITY:**

1 x 10<sup>-11</sup>/1 s Avg. time.  
1 x 10<sup>-11</sup>/10 s Avg. time.  
2 x 10<sup>-11</sup>/100 s Avg. time.

► **TEMPERATURE COEFFICIENT:**  $<1 \times 10^{-8}$  frequency change over a -55°C to 71°C temperature range.  
 $<3 \times 10^{-9}$  over 0 to 71°C range.

**LOAD:**  $<5 \times 10^{-10}$  frequency change for 250 Ohm load change

**WARMUP:** Within  $5 \times 10^{-9}$  of final value 15 minutes after turn-on, at 25°C (3)

► **INPUT VOLTAGES/VOLTAGE COEFFICIENTS:**

Input Circuit	Required Voltage	Required Current/Power	Voltage Coefficients	
			Voltage Change	Frequency Change
Oscillator/Amplifier	10.6-11.7 Vdc Noise $<100 \mu\text{V}$	15 mA	} 1%	$<5 \times 10^{-10}$
Oven Controller	10.6-11.7 Vdc	5 mA		
Oven	15-30 Vdc	Turn-on load is 50-Ohms. Power drops to 2½W at 25°C after 15 minutes.	10%	$<1 \times 10^{-10}$ <sup>(4)</sup>

NOTE: See Input Voltages section for details concerning use of common power supplies.

► **ADJUSTMENT:**

**Coarse Frequency Range:**  $>\pm 2 \times 10^{-6}$  from 10 MHz with 18-turn control.

**Electronic Frequency Control (EFC):**  $\geq 1 \times 10^{-7}$ , control range -5 Vdc to +5 Vdc.

**CONNECTORS:**

Printed circuit - Mates with CINCH 250-15-30-261 (HP 1251-0159) or equivalent.

**OUTPUT 10 MHz:**

**Voltage:** 1V rms  $\pm 20\%$  into 1000 Ohms from ac coupled (.01  $\mu\text{F}$ ) emitter-follower.

**Harmonic Distortion:** Down more than 25 dB from rated output.

**Nonharmonic Components:** Down more than 80 dB from rated output.

**Signal-to-Single-Sideband Phase-Noise Ratio:** (1 Hz Measurement Bandwidth):

Offset from

10 MHz (Hz)	Ratio (dB)
10	115
100	120
1,000	125
10,000	130

► **ENVIRONMENTAL:**

Temperature, operating -55°C to +71°C.  
Temperature, storage -55°C to +75°C.

**Altitude:** 50,000 feet (15,2 km).

**Humidity:** 95% RH at 40°C.

**Vibration:** 0.01" peak-to-peak, 10 to 55 Hz.

**WARRANTY:**

Hewlett-Packard warrants the 10544A 10 MHz Oscillator against defects in materials and workmanship for a period of 1 year from the date of delivery. The oscillator will be repaired or replaced at the factory at no charge during the warranty period.

**SIZE:**

2-3/4" x 2-1/32" x 2-7/16" (13.6 cu. in.), (6.985 x 5.159 x 6.191 cm) (see Figure 1).

**WEIGHT:**

11 oz (0.31 kg).

(1) 5 MHz available on special order.

(2) For oscillator off-time less than 24 hours.

(3) Final value is defined as frequency 24 hours after turn-on.

(4) A 10% voltage change will cause a frequency change of  $<5 \times 10^{-9}$  for  $<2$  min.

► INDICATES CHANGES FROM PRIOR SPECIFICATIONS

## INSTALLATION:

The 10544A 10 MHz Oscillator may be mounted into a 15-pin printed-circuit connector in any convenient position. The oscillator is secured with 6-32 machine screws and lock washers using the two threaded mounting studs on its base (see Figure 1).

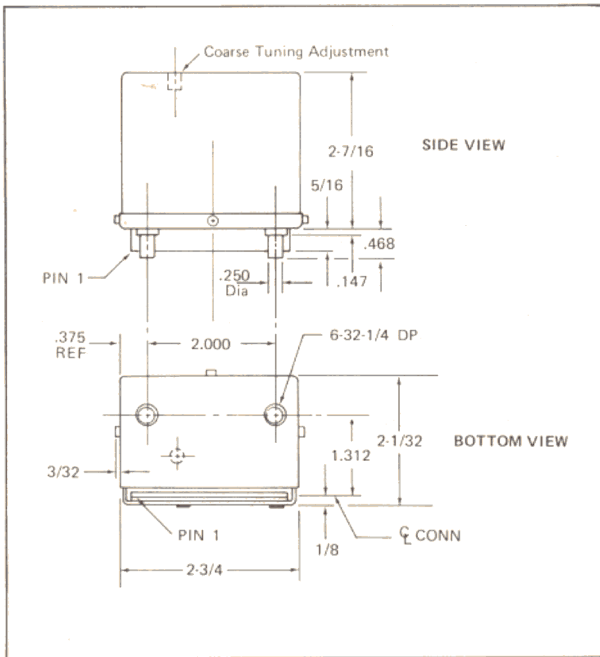


FIGURE 1  
Outline Drawing

## CONNECTIONS:

Power and signal connections are made through a 15-pin printed-circuit connector, such as CINCH 250-15-30-261 (HP Part No. 1251-0159). Connections are shown in Figure 2 and listed in Table A.

Table A

Pin 1:	10 MHz Output.
Pin 2:	Ground
Pin 3:	+10.6 to 11.7 Vdc. Oscillator/Amplifier Input (15 mA nominal).
Pin 4:	Oscillator/Amplifier and 10 MHz Signal Ground.
Pin 5:	EFC Ground (tied internally to pin 4).*
Pin 6:	EFC Input (Control range -5 to +5 Vdc).*
Pin 7:	NC
Pin 8:	+10.6 to 11.7 Vdc. Oven Controller Input (5 mA nominal).
Pin 9:	Oven Controller Negative.
Pin 10:	NC
Pin 11:	Oven Monitor
Pin 12:	NC
Pin 13:	NC
Pin 14:	+15 to 30 Vdc. Oven Power Input. (Turn-on load is 50-Ohms. Power drops to 2½W at 25°C after 15 minutes).
Pin 15:	Oven Power Negative.

\*Connect Pin 5 to Pin 6 if external EFC control is not used.

## INPUT VOLTAGES:

The oscillator-amplifier and the oven controller (pins 3 and 8) may be connected to the same 10.6 to 11.7 Vdc source. However, to isolate controller switching-transients from the oscillator, the following LC circuit is recommended:

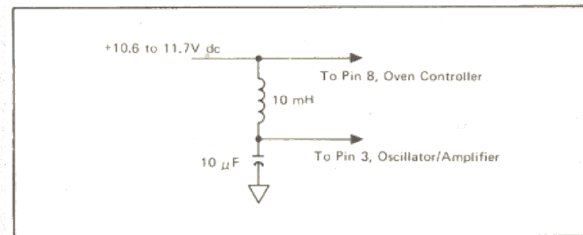


FIGURE 3  
Decoupling Filter

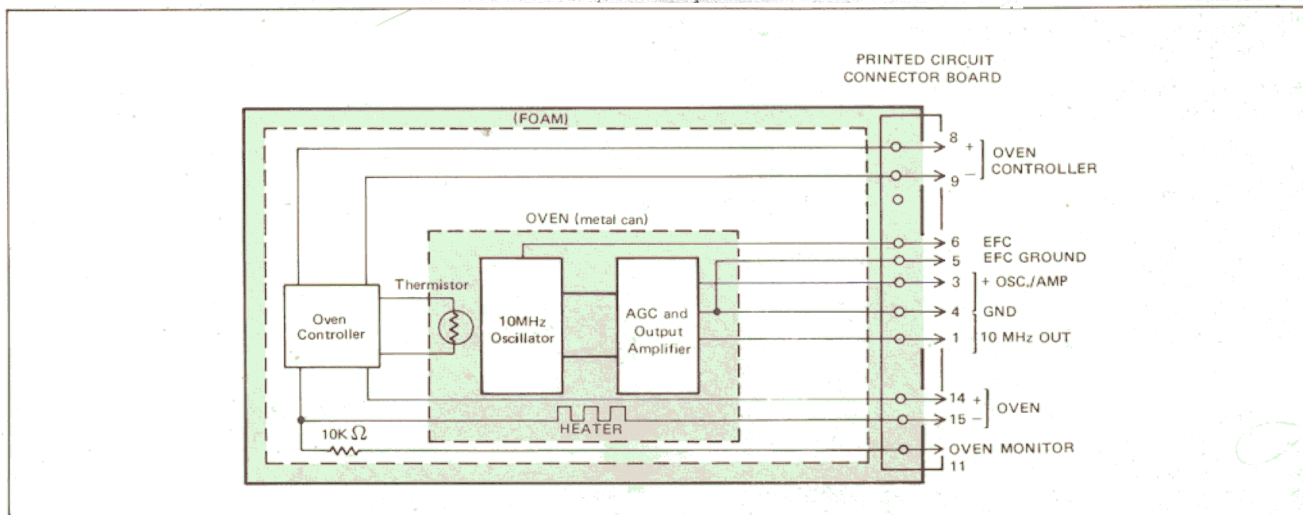


FIGURE 2  
Block Diagram

## OVEN MONITOR:

An output signal is available at pin 11 which indicates the temperature condition of the oscillator oven. The signal voltage level depends on the value of oven supply voltage at pins 14 and 15.

Duty-cycle of the signal at pin 11 depends on the oven temperature; long duty-cycle at turn-on and short duty-cycle at operating temperature. The corresponding dc voltage monitored with a high-impedance voltmeter is; maximum voltage level when the oven is cold (at turn-on) and minimum voltage level when the oven is at operating temperature.

## OPERATION:

Connect the oscillator through a 15-pin printed-circuit connector. Allow a 24-hour warm-up time for stabilization before adjusting frequency.

## FREQUENCY ADJUSTMENT:

Oscillator frequency may be adjusted within a range of  $4 \times 10^{-6}$  (40 Hz) by using the 18-turn screwdriver adjustment located on the top of the oscillator case. Fine frequency adjustments may be made within a range of  $\geq 1 \times 10^{-7}$  using -5 to +5 volts dc as a tuning source.

A simple method of frequency adjustment is the "oscilloscope drift" method. The oscillator frequency may be adjusted against a reference or "house" standard and drift can be monitored.

Methods for measuring frequency are described in Section III of HP Application Note 52. For minimum distortion the oscillator output should be terminated with a 1000-Ohm load.

## Aging and Stability Measurement:

Refer to HP Application Note 116 and Computing Counter Applications Library for information on methods of making precise aging and short-term stability measurements of the Model 10544A Oscillator.

## Operational Tests

Apply the proper input voltages and allow the output frequency to stabilize for 24-hours. Adjust the output frequency to 10 MHz as described under FREQUENCY ADJUSTMENT and check the output voltage with an RF Voltmeter or calibrated oscilloscope. Be sure to terminate the output with a 1000-Ohm load. If the out-

put voltage or frequency is not within specification, check the input voltages and determine that the regulation and noise are within specification. If the input power or current are substantially different from those shown in Table A, return the oscillator to HP for repair. The oven input power should decrease within a few minutes after turn-on as the oven temperature stabilizes. Continued full input power indicates a malfunction of the oven controller and will damage the oscillator by overheating.

## SERVICE:

The 10544A is designed for factory repair and field repair should not be attempted. Repairs are handled promptly on an exchange basis through the nearest HP Sales and Service Office.

## VOLTAGE SOURCES:

Since the Oscillator/Amplifier and EFC circuits are not tied internally to the Oven Controller and Oven circuits, the voltage to supply the oven may have either a positive or negative ground or be a combination of sources to give the required 15 to 30 Vdc. The positive Oven voltage must be at least two volts above the positive Oven Controller voltage.

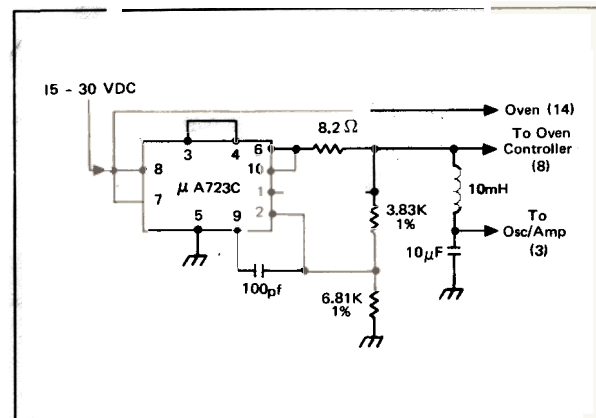


FIGURE 4

Voltage Regulator using Fairchild  $\mu$ A723C,  
(HP Part No. 1820-0196) TO5 Configuration

A source of +15 to +30 Vdc with 10 percent regulation may be used as a power source if a simple IC regulator is used. A suggested circuit is shown in Figure 4.