HEWLETT PACKARD

The Best Value in High Performance Crystal Oscillators

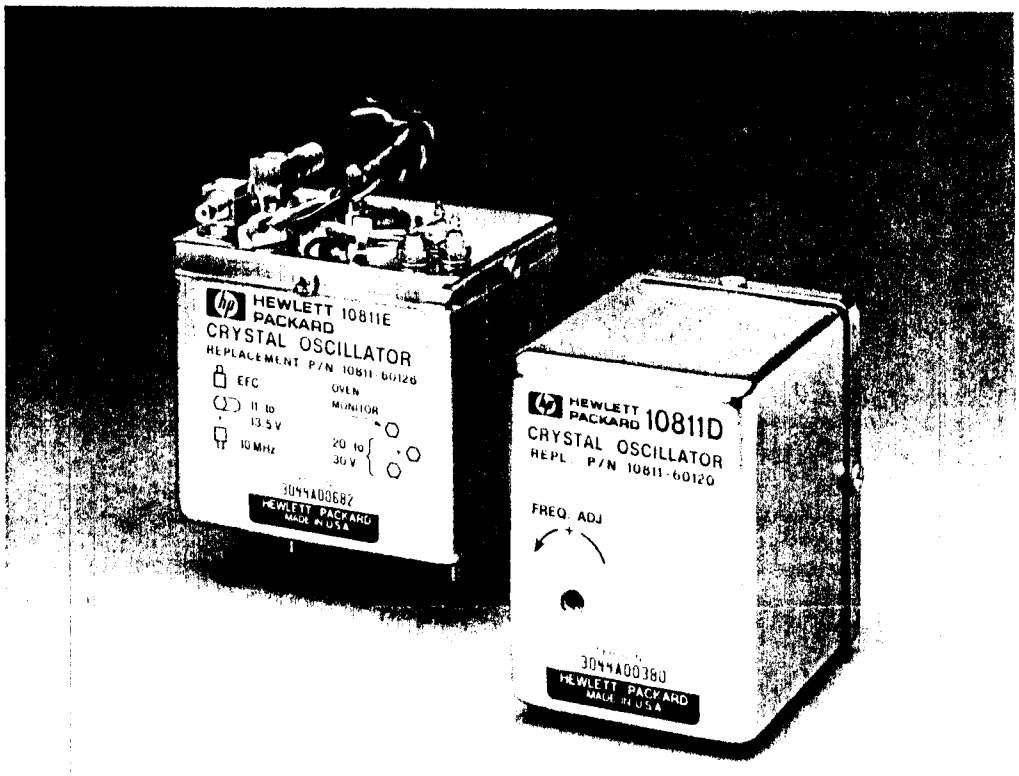
HP 10811D/10811E Crystal Oscillators

The HP 10811D and HP 10811E Crystal Oscillators are oven-controlled, high-performance component oscillators for use in OEM equipment and in a wide variety of communication, navigation, and instrumentation applications. You get the best value in oscillators for these reasons:

- low aging rate means lower maintenance costs
- fast warm-up time reduces downtime - typically six minutes
- low power consumption provides longer backup battery life
- low phase noise
- high reliability results in low cost of ownership
- you get all the above at a competitive price

HP quality and attention to every design and manufacturing detail are evident throughout the HP 10811D/E. For example, the oscillators' oven power control transistors, themselves, are the source of oven heat. This simplified design gives you greater reliability.

The HP 10811D/E replace the HP 10811A/B in most applications.



Proven performance and reliability in the HP 10811D/E continue to give you the highest value in crystal oscillators.

OPERATING NOTE

HP MODELS 10811D and 10811E
QUARTZ OVEN OSCILLATORS

DESCRIPTION:

The HP models 10811D and E are extremely stable, compact 10 MHz quartz oscillators. These oscillators feature low aging rate, low phase noise, extremely good short-term frequency stability, and very low power consumption. Oscillator connections are described below, while *Table 1* on the following page shows input requirements and output signals.

CONNECTIONS:

10811D. Connections to the 10811D are made through a 15-pin circuit board connector (such as the CINCH 250-15-30-210, HP part number 1251-0160). See *Figure 1* for pin 1 location, and *Table 1* for input/output locations and signal characteristics.

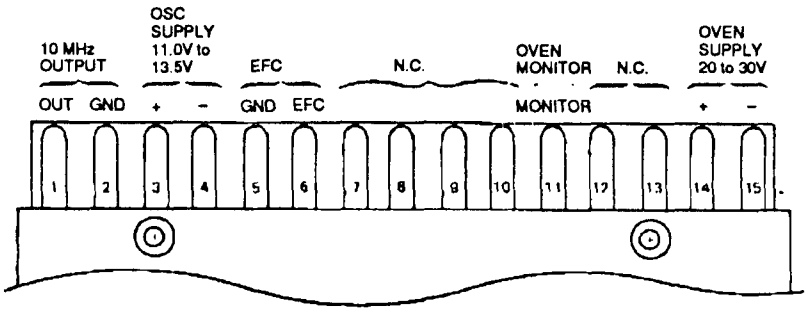
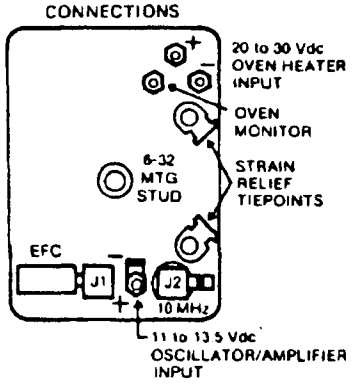


Figure 1. 10811D input/output pins.

10811E. Power and signal connections are made to the 10811E as described in *Table 1*. The 10811E uses two SMB connectors and a 5-pin connector which is wired to the filtered power inputs and oven monitor output. See *Figure 2* for pin location. SMB miniature connectors are used for the 10MHz output and EFC (Electronic Frequency Control) input. The SMB connectors mate to Cablewave Systems, Inc. #700156 or equivalent. The 5-pin connector can mate either with a straight pin connector HP P/N 1251-6868 (Amp P/N 102202-2), or a right-angle connector HP P/N 1251-6794 (Amp P/N 102203-2).



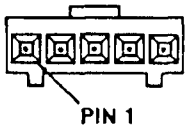


Figure 2a. Detail of 5-pin connector.

Figure 2. 10811E input/output connector locations.

MOUNTING:

Figure 3 shows the mechanical mounting dimensions of the 10811D/E Oscillators for use in custom installation. All quartz oscillators are sensitive to shock, vibration, radiation fields, and ambient temperature changes. Therefore, to obtain the best performance from your 10811D/E, these factors should be taken into consideration. To optimize performance:

1. The 10811D/E should be mounted in an area that has a minimum amount of vibration or shock acceleration. In addition, the 10811D/E should be mounted so that the vibrational forces act along the "minimum G sensitivity" axis shown in *Figure 3*.
2. The 10811D/E should be mounted as far as possible from transformers or fan motors that radiate electromagnetic fields.
3. The 10811D/E should be mounted away from the main system airflow in order to isolate it as much as possible from ambient temperature changes.
4. The three mounting studs on the 10811E are internally threaded for 4-40 screws to a depth of 1/4 inch. These mounting studs may be used with vibration isolators such as HP P/N 1520-0094 (LORD #J2924-2-1).

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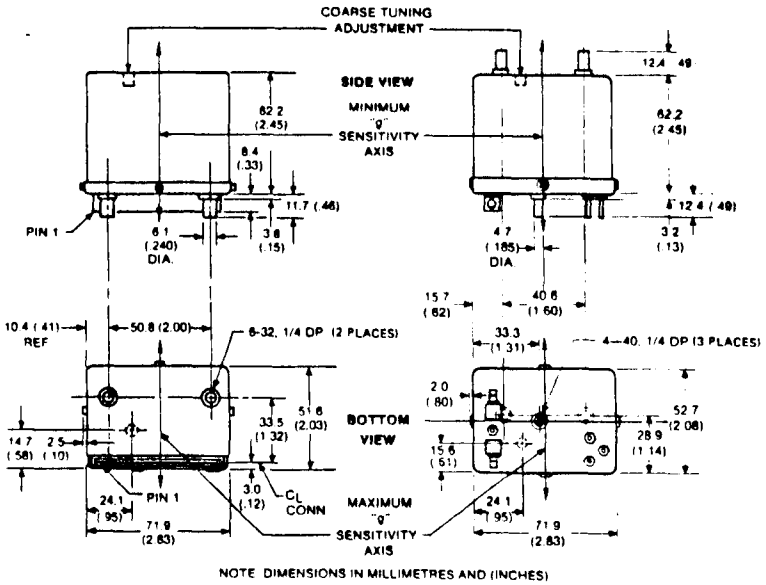


Figure 3. 10811D/E mechanical mounting dimensions.

FREQUENCY ADJUSTMENT: Coarse frequency adjustment is made through the top of the oscillator case via 18-turn control. This control opening is clearly marked on the oscillator with a label indicating the location and the direction of increasing frequency.

CAUTIONS

1. ***Always use an insulated slot-type tool (such as the Johanson #8777) when making frequency adjustments. The adjustment capacitor is connected electrically into the oscillator circuit. Shorting the adjustment capacitor to the case by using a metal tool could cause circuit damage.***
2. ***DO NOT FORCE THE FREQUENCY ADJUSTMENT CONTROL TO THE LIMITS OF ITS RANGE. DOING SO WILL DAMAGE THE CONTROL.***

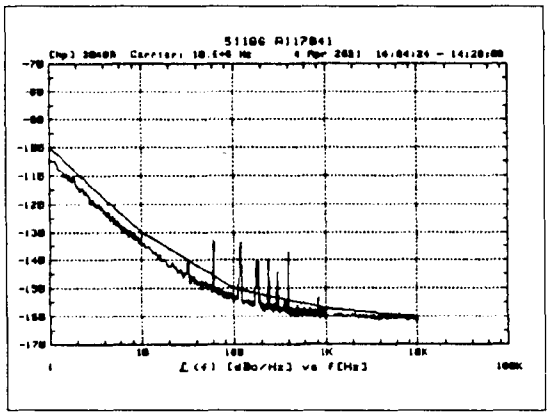
The coarse frequency adjustment has a minimum range of ± 10Hz ($\pm 1\times10^{-6}$). The 10811D/E Opt 100 has a minimum range of ± 8Hz ($\pm 8\times10^{-7}$). A fine tuning control can be made by connecting an adjustable source of +5 to –5 V dc to the EFC input. Since noise on this input directly affects the output frequency, it is essential that the voltage source be very quiet. Use the oscillator/amplifier input voltage as a reference.

SERVICE: The 10811D and 10811E oscillators are not field repairable. Should a failure occur, a replacement unit must be ordered. To find the part number for the replacement oscillator, look on the 10811D/E label. This part number will differ according to option. For example, the replacement part number for the standard 10811D is 10811-60120, for the 10811D option 001 the part number is 10811-60121.

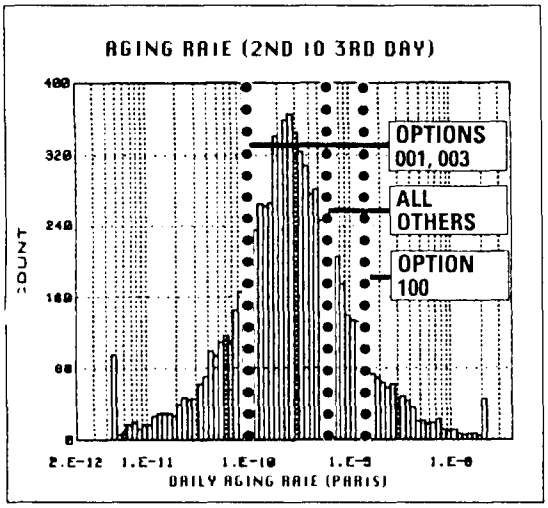
WARRANTY: The 10811D and 10811E are warranted against defects in materials and workmanship for a period of 90 days. Should a failure occur during this period, Hewlett-Packard will repair or replace the oscillator at no charge. Contact your nearest HP Sales and Service Office for assistance.

Table 1. 10811D/E Connections.

OUTPUT/INPUT	10811D Pin #*	10811E Pin #*	CHARACTERISTICS
10 MHz Output (10.23 MHz for 10811D/E Opt. 023)	1,2	SMB	10811D: Pin 1: .55 V rms into 50Ω. Pin 2: 10 MHz return (connected to case). 10811E: SMB center conductor — same as pin 1, Shield same as pin 2.
Oscillator/ Amplifier	3(+) 4(–)	1(+) 2(–)	11 to 13.5 V dc low noise (<100 µV ripple and noise) 40 mA maximum.
Case Common	4	2	Connected to oscillator case, 10 MHz return, EFC return, and oscillator/ amplifier (–) input
Electronic Frequency Control (EFC)	5,6	SMB	Pin 5: common (connected to case). Pin 6 or center conductor: –5 to +5 V dc. Connect to case common if not used. Use shorting connector on 10811E.
Oven Monitor	11	3	Voltage is high (approximately equal to oven supply) at turn on. Steady state approximately 3.5 V dc.
Oven Heater	14, 15	4, 5	10811D: Pin 14 (+), Pin 15 (–) 10811E: Pin 4 (–), pin 5 (+) Input is 20 to 30 V dc. Turn-on load: 42Ω minimum. Steady state power 2 Watts @ 25° C.
*Pins not listed are not connected. SMB = miniature coax connector.			



Phase noise plot



Aging rate histogram

Low Oscillator Phase Noise Means Low System Phase Noise

The graph on the left shows a typical HP 10811D/E noise floor and power line spur plot. As local oscillator frequencies for communication and navigation receivers go higher, low phase noise becomes a much more important oscillator characteristic. Many of these applications require multiplication of base frequency to useable local oscillator frequencies.

Extensive Analysis in Manufacturing Ensures Your Oscillator Will Meet or Exceed Spec

The histogram on the left plots aging rates measured during a recent HP 10811D/E manufacturing cycle. Many other histograms are generated so that phase noise, short-term stability, temperature and other specifications are continuously monitored. HP quality and reliability translates to reduced downtime for you.

Low Acceleration Sensitivity

Both vibration and gravity acceleration can cause frequency shifts larger than those caused by aging or temperature. The maximum frequency shift is less than $\pm 4 \times 10^{-9}$ for any reorientation of the HP 10811D/E. Typically, the acceleration frequency shift along the most sensitive axis of rotation is $< 5 \times 10^{-10}$ for 2 g turnover.

Gravitational and vibrational stress can be minimized by mounting the oscillator so that the stress will be along the minimum g sensitivity axis (see "Dimensions" below).

Differences Between the "D" and "E"

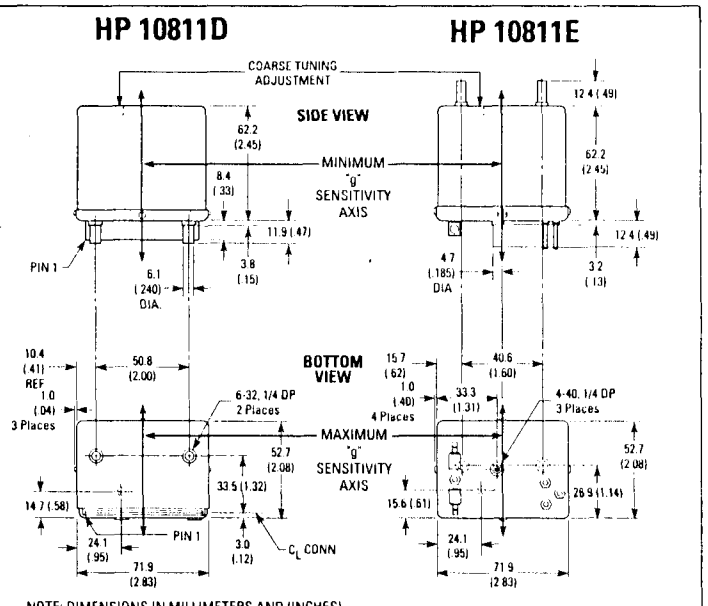
The difference between the HP 10811D and HP 10811E is in the method of making electrical connections. The "D" uses a printed circuit connector board. The "E" uses filter feed-thru terminals for the power connections, oven monitor and SMB snap-on type rf connectors for the 10 MHz output and EFC input.

Mechanically the "D" has two internally-threaded mounting studs on the bottom cover. The "E" has one stud on its bottom cover and two on the top, so vibration isolators, such as the LORD #J2924-2-1 (HP P/N 1520-0094) can further isolate the "E" from shock or vibration.

PIN CONNECTIONS

1 10 MHz OUT
2 10 MHz RETURN*
3 +] OSC/AMP
4 –] POWER (11 to 13.5 Vdc)*
5 EFC GROUND*
6 EFC INPUT
7 NC
8 NC
9 NC
10 NC
11 OVEN MONITOR
12 NC
13 NC
14 +] OVEN
15 –] POWER (20 to 30 Vdc)

*Pins 2, 4, and 5 are conted together



NOTE: DIMENSIONS IN MILLIMETERS AND (INCHES)

Dimensions

HP 10811D/E Specifications*

Averaging Time (seconds) τ	Stability (parts) $\sigma_y\tau$	Offset from Signal (Hz) Frequency	Phase Noise (dBc) Relative Power	
Standard and all options except Option 100			Std, Opt 001	Opt 002,003
0.001	$<1.5\times10^{-10}$	1	<–100	<–103
0.01	$<1.5\times10^{-11}$	10	<–130	<–133
0.1	$<5\times10^{-12}$	100	<–150	<–153
1	$<5\times10^{-12}$ (see opt note A)	1,000	<–157 (see opt note B)	<–162
10	$<5\times10^{-12}$	10,000	<–160	<–162
100	$<1\times10^{-11}$			
1,000 (typical)	$<1\times10^{-11}$			

Frequency Stability

Long Term (Aging Rate): $<5\times10^{-10}$/day after 24 hour warm-up. See Notes 1 and 2, and Option Note C.

Continuous Operation: $<1\times10^{-7}$ per year. (Typical 1×10^{-8} per year after 1 year.) See Option Note D.

Short Term: refer to tables above.

Warm-up: $<5\times10^{-9}$ of final value** 10 minutes after turn-on. See Notes 1 and 3, and Option Note E.

Environmental Sensitivity:

Temperature: $<4.5\times10^{-9}$ from 0°C to +71°C. See Option Note F.

Operating Range: 0°C to +71°C.

Storage Range: –55°C to +85°C.

Load: $<5\times10^{-10}$ for ±10% change in 50 Ω load. $<5\times10^{-10}$ for ±25% change in 1K Ω load.

Oscillator Power Supply: $<2\times10^{-10}$ for a 1% change in oscillator supply voltage. See Option Note G.

Ripple: <–90 dBc spurs from 10 mV rms ripple on oscillator supply voltage at 100 Hz.

Oven Power Supply: $<2.5\times10^{-10}$ for 10% change in oven supply voltage ($<1\times10^{-10}$ typical) See Option Note G.

Gravitational Field: $<4\times10^{-9}$ for 2g static shift (turn-over). See Option Note H.

Magnetic Field: <–90 dBc sidebands due to 0.1 mT (1 Gauss) rms at 100 Hz. See Option Note H.

Humidity (typical): 1×10^{-9} for 95% RH @ 40°C.

Shock (survival): 30 g, 11 ms, 1/2 sinewave.

Altitude (typical): $<2\times10^{-9}$ for 0 to 50,000 ft.

Adjustment

Coarse Frequency Range: $>\pm1\times10^{-6}$ (±10 Hz) with 18-turn control. See Option Note I.

Electronic Frequency Control (EFC): $\geq 1\times10^{-7}$ (1 Hz) total, control range –5 Vdc to +5 Vdc. See Option Note J.

Power Requirements

Oscillator Circuit: +11.0 to +13.5 Vdc. I= <40mA (30mA typical). Ripple < 100μV rms.

Oven Circuit: 20 to 30 Vdc; Ripple <30 mV rms. Turn-on load is 42 Ω minimum.

Steady-state power drops to a typical value of 2.0W at 25°C in still air with 20 Vdc applied.

(Specifications cont. on back page)

Notes:

1. For oscillator off-time less than 24 hours and aging rate was $<5\times10^{-10}$ per day before turnoff.
2. If off-time is greater than 24 hours, specified aging rate will be met in less than 30 days (typically 3 days).
3. With >20 Vdc on oven, at 25°C ambient.

Option Notes:

A. Option 100 $<5\times10^{-11}$ @ 1 second only
B. Option 100 <–155 dBc @ 1000 Hz only
C. Option 001, 003, $<1\times10^{-10}$; Option 100, 1.5×10^{-9}
D. Option 001, 003, $<3.6\times10^{-8}$ per year; Option 100 (5.5×10^{-7} per year)
E. Option 100 $<6\times10^{-9}$
F. Option 100 $<7\times10^{-9}$ from 0°C to +71°C
G. Option 100 $<1\times10^{-8}$
H. Option 100 not specified
I. Option 100 > $\pm8\times10^{-7}$
J. Opt 100 not specified
K. Opt 100 .5V (typical) into 50 Ω

* Specifications describe the oscillator's warranted perfomance. Supplemental characteristics are intended to provide information useful in applying the oscillator by giving TYPICAL or NOMINAL, but non-warranted performance parameters. Definition of terms is provided at the end of the specification section. See "NBS-Monograph 140" for measurement definitions.

**Final frequency value is the oscillator frequency 24 hours after turn-on.

Specifications (continued)

Connectors

HP 10811D: mates with CINCH 250-15-30-210 (HP# 1251-0160) or equivalent (not supplied).

HP 10811E: solder terminals and SMB Snap-on connectors. Mates with Cablewave Systems, Inc. #700156 or equivalent (not supplied).

Output

Frequency: 10.000000 MHz.

Voltage: 0.55V ±50 mV rms into 50Ω. 1V rms ±200mV into 1KΩ. See Option Note K (previous page).

Harmonic Distortion: >25 dB down from output.

Spurious Phase Modulation: < –100 dBc with respect to output (discrete sidebands 10 Hz to 25 kHz).

General

Size: See "Dimensions" drawing inside.
Weight: 0.31 kg (11 oz.)

Ordering Information:

HP 10811D Standard	$ 1050
HP 10811E Standard	$ 1200

Options	**Add:**
001 (Lower Aging Rate)	$ 500
002 (Lower Phase Noise)	$ 750
003 (001 plus 002)	$ 2500
100 (Reduced Specs)	$ –200

Consult HP Sales Office for quantity discounts.

Requests for special connectors, mounting, and for special frequencies within 500 kHz will be considered. Contact your local HP Sales Office for details about S01-59991A.

Warranty

Hewlett-Packard warrants the HP 10811D/E Oscillators against defects in materials and workmanship for a period of 90 days from date of shipment. The oscillators will be repaired or replaced at no charge during the warranty period.

United States: Hewlett-Packard Company, 4 Choke Cherry Road, Rockville, MD 20850, Tel. (301) 670-4300. Hewlett-Packard Company, 5201 Tollview Drive, Rolling Meadows, IL 60008, Tel. (708) 255-9800. Hewlett-Packard Company, 5161 Lankershim Boulevard, No. Hollywood, CA 91601, Tel. (818) 505-5600. Hewlett-Packard Company, 2015 South Park Place, Atlanta, GA 30339, Tel. (404) 955-1500. **Canada:** Hewlett-Packard Ltd. 6877 Goreway Drive, Mississauga, Ontario L4V 1M8, Tel. (416) 678-9430. **Europe:** Hewlett-Packard S.A., Marcom Operations Europe, P.O. Box 529, 1180 Amstelveen, The Netherlands, Tel. (31) 20 547 9999. **Japan:** Yokogawa-Hewlett-Packard Ltd., 15-7 Nishi Shinjuku 4 Chome, Shinjuku-ku, Tokyo, Japan, (03) 5371 1315. **Latin America:** Latin American Region Headquarters, Monte Pelvoux No. 11, Lomas de Chapultepec, 11000 Mexico, D.F., Tel. (525) 202 0155. **Australia/New Zealand:** Hewlett-Packard Australia Ltd., 31-41 Joseph Street, Blackburn, Victoria 3130, Australia (A.C.N. 004 394 763), Tel. (03) 895 2895. **Far East:** Hewlett-Packard Asia Ltd., 22/F Bond Centre, West Tower, 89 Queensway, Central, Hong Kong, Tel. (852) 848 7777.

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Prices and Data Subject to Change
May 1991

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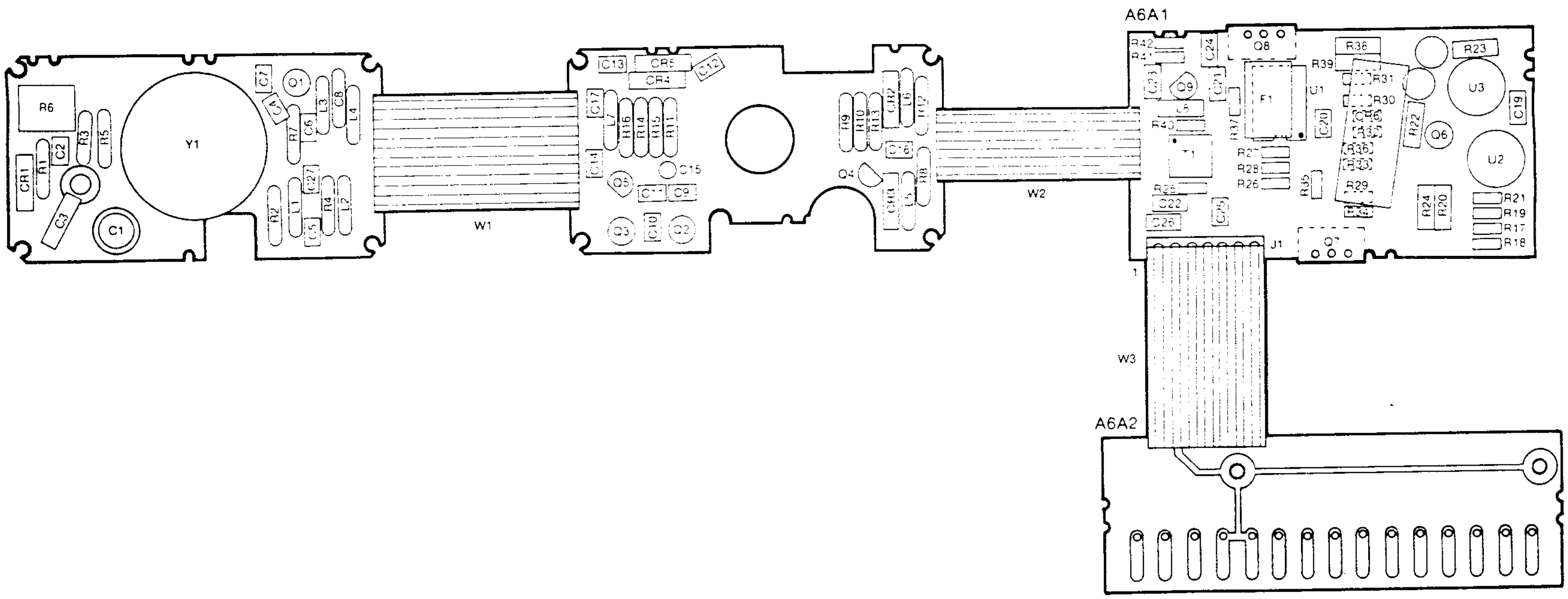
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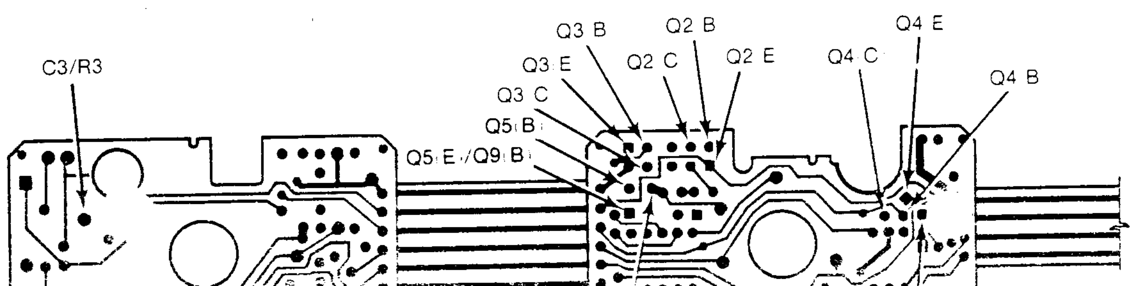
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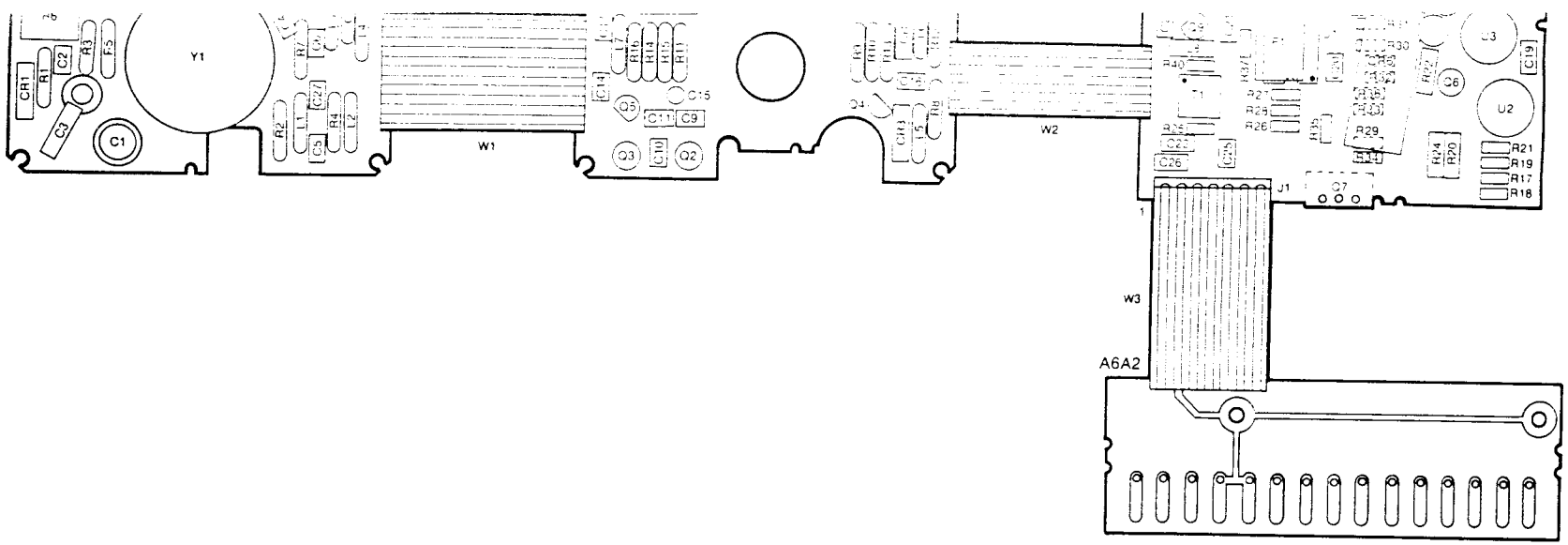
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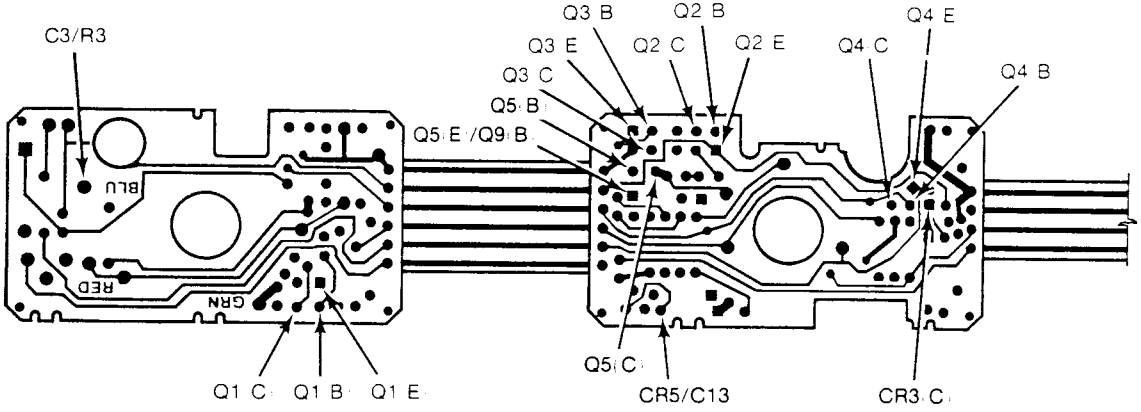
C3/R3
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Q3 E
Q2 C
Q2 E
Q4 C
Q3 C
Q4 B
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BLU
RED
GRN
Q1 C
Q1 B
Q1 E
Q5 C
CR5/C13
CR3 C

SPECIFICATIONS SHEET
FOR SPECIAL OPTION
K74-59991A
QUARTZ CRYSTAL OSCILLATOR

INTRODUCTION

This special is an HP 10811-60111 Quartz Crystal Oscillator with the following specifications.

TIME DOMAIN

AVERAGING TIME	STABILITY
1 second only	1×10^{-11}

LONG TERM
(Aging Rate)

A. $< 5 \times 10^{-10}$ per day after 24 hour warmup when:

1. Oscillator off-time was less than 24 hours.

2. Oscillator aging rate was $< 5 \times 10^{-10}$ per day prior to turn-off.

B. $< 5 \times 10^{-10}$ per day in less than 30 days of continous operation for off-time greater than 24 hours.

C. $< 1 \times 10^{-7}$ per year for continous operation.

TEMPERATURE

Frequency change less than 7×10^{-9} for temperature change of 0 to 71 degrees C.

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