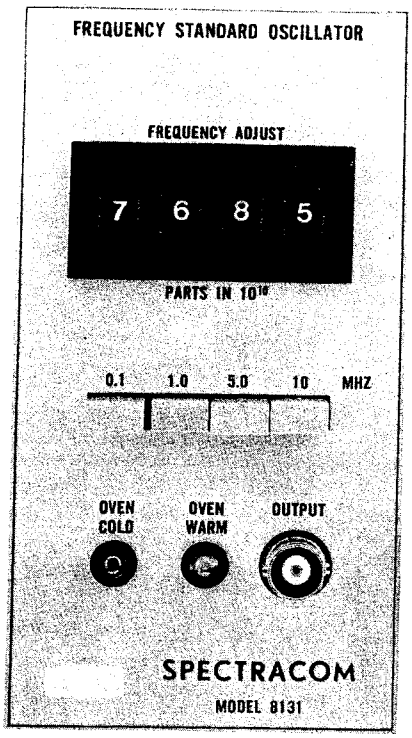
SPECTRACOM CORPORATION

FREQUENCY STANDARD OSCILLATOR MODEL 8131



- **HIGH STABILITY**
- **FAST WARM-UP**
- **FITS TEKTRONIX TM-500**
- **ADJUSTMENT RESOLUTION 1 x 10^{-10}**
- **OUTPUTS AT 10, 5, 1, 0.1 MHz**
- **REAR OUTPUTS FEED THROUGH MAINFRAME TO ADJACENT TEKTRONIX COUNTERS.**

SPECIFICATIONS

FREQENCY STANDARD OUTPUTS

Front Panel: 0.1, 1.0, 5.0 or 10 MHz, front panel selectable, TTL compatible (fan out, 2 max.) 3.4 v rectangular positive pulses, into 93 ohms minimum resistive load. Will drive 50 ohms with reduced amplitude.

Rear Connector to Main Frame: 1.0 or 10 MHz TTL signal for use as external time base by Tektronix TM-500 counters. Internal switch selects 1 or 10 MHz. Two outputs for mainframe jumpering to two separate counters.

FREQUENCY STANDARD STABILITY

Aging Rate: 3×10^{-9}/day typical after 1 day on.
2.5×10^{-9}/ day max after 30 days on.
1×10^{-9}/day typical after 30 days on.
5×10^{-10}/day typical after 120 days on.

Short Term Stability: 2×10^{-10} rms over 10 successive 10-second counts.

Temperature: $\pm 7 \times 10^{-9}$ over the range of 0 - 55° C

Output Load: $\pm 1.0 \times 10^{-11}$ for any load change.

Supply Voltage: $\pm 2.5 \times {}^{-10}$ max. for ±10% voltage change.

Warm-Up at 25° C: Within $\pm 1 \times 10^{-7}$ in 10 minutes, $\pm 2 \times 10^{-8}$ in 20 minutes, referenced to frequency after 24 hours operating from cold start.

FREQUENCY ADJUSTMENTS

Fine: Front panel control with $\pm 5 \times 10^{-7}$ range, and 1×10^{-10} resolution. Typically compensates for 3 years aging.

Coarse: Internal piston capacitor accessible at side of oven. Range $\pm 2.0 \times 10^{-6}$ minimum (10 years min.), resolution $\pm 2 \times 10^{-8}$.

POWER SOURCE

TM-500 Mainframe: Plugs into any TM-500 Mainframe. No special connections required.

Stand-by Battery Supply: Rear connector terminals for mainframe connection to adjacent Model 8132 Battery Power Supply which keeps oscillator and oven only running during AC power interruptions. Batteries are float-charged from mainframe when power is on, voltage and current limited and temperature compensated. Model 8132 Plug-in keeps oscillator and oven running for approximately 10 hours while main power is off.

OPERATING ENVIRONMENT & MECHANICAL

Ambient Temperature: 0 - 60° C.
Power Source: TM-500 Mainframe
Panel Connector: BNC
Panel Lamps: Go/No-Go lamps show 20-minute warm-up period starting when power is turned on, corresponding to frequency accuracy of $\pm 2 \times 10^{-8}$.

Specifications are subject to change without notice.

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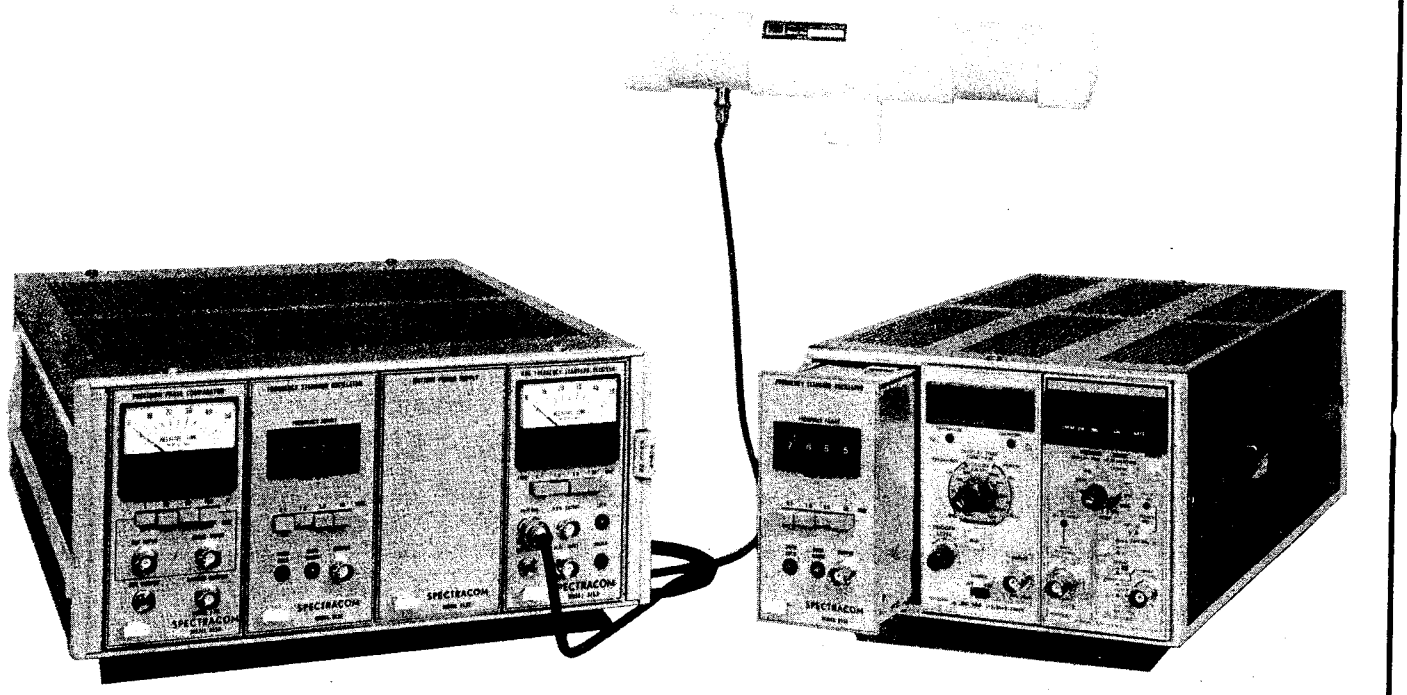
APPLICATION NOTES

LABORATORY COMPARISON STANDARD

As a secondary frequency standard the 8131 provides accurate, stable, low-noise standard frequencies for calibration of other frequency measuring and generating instruments. Frequency counters may be calibrated by counting the 8131 output, and adjusting the counter's internal clock oscillator until the counter readout exactly matches the specified 8131 output frequency. Or, the counter may use the 8131 output as its own frequency standard by feeding it into the external standard input usually found on the rear panel of the counter. Frequency sources, oscillators, standards, time bases, generators, and synthesizers may be compared to the 8131 output frequency using the Spectracom Model 8150 Phase Comparator. The 8150, shown at the left in the photograph below, performs very precise frequency comparisons with real-time resolution approaching 1 x 10^{-9}. Long-term resolution approaches 1 x 10^{-14}.

EXTERNAL COUNTER TIME BASE

If the 8131 is used as a counter time base, the counter then has the same accuracy as the 8131, plus or minus one count. Most standalone frequency counters have an external time base input jack on their rear panels. If the front panel output from the 8131 is fed into this jack at the appropriate frequency, the counter accuracy is improved to that of the 8131. Tektronix frequency counters can use the 8131 as an external time base if an appropriate jumper is added to the mainframe rear interface connectors. At least two counters in the same mainframe as the 8131 may be operated in this manner using the 8131 as their common time base. Counter accuracies of the order of 1 x 10^{-9} can be achieved. The photo below shows two Tektronix counters in a TM-503 using the 8131 as their common time base.



PORTABLE USE WITH BATTERY SUPPLY

To prevent warm-up and retrace problems if power fails, the 8131 may be used in conjunction with the Model 8132 Battery Power Supply. If an appropriate jumper is added to the mainframe, the battery power supply, when plugged in next to the 8131, will be float-charged when line power is applied to the equipment. Should line power fail or if the mainframe power switch is turned off, the oscillator and oven circuitry in the 8131 will remain operating for up to 10 hours. This eliminates waiting for the oscillator to warm up after power is restored. The Model 8132 Battery Power Supply working in tandem with the 8131 Oscillator is float-charged with a voltage limited and temperature compensated circuit for maximum battery life. During power-off periods, only the oscillator circuitry and its oven remain operable, thus conserving battery power. When power is restored, the oscillator is operable with no warm-up period required, as long as the batteries have not become completely discharged during power-off periods.

COMPLETE FREQUENCY CALIBRATION SYSTEM

The above photo shows a TM-504 Mainframe with four Spectracom plug-ins, constituting a complete frequency calibration system. On the right, the Model 8163 WWVB Receiver with its antenna provides constant monitoring capability allowing the user to compare the 8131 output frequency with the Bureau of Standards at all times. When the system is moved to another location, perhaps away from the antenna installation, the 8131 oscillator remains warm during travel due to the 8132 Battery Power Supply installed in the same mainframe. At the remote site, frequency calibration may be performed, after plugging in the equipment, using the Model 8150 Precision Phase Comparator to compare oscillators and time bases with the Model 8131 output frequency. When the calibrations at the remote site are complete, the unit is again turned off and carried back to its original site where, after power is restored, the 8163 WWVB Receiver is again used to monitor the frequency output of the oscillator. Thus, this system provides fixed-station or portable frequency calibrations at multiple sites.

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OPERATING INSTRUCTIONS

for

MODEL 8131 OSCILLATOR

INSTALLATION: Oscillator plug-in may be powered from any Tektronix TM-500 series Mainframe. Be sure that the unit is plugged firmly into its connector at the rear of the Mainframe so that the edge connector makes good contact with the oscillator circuit board. Be sure that the Mainframe power switch is turned off until after the plug-in is firmly in place.

FRONT PANEL FUNCTIONS:

Output Connector: This BNC connector provides either 0.1, 1.0, 5.0, or 10 MHz as set with front panel push button switch.

Oven Cold/Warm Lamps: When power is first applied to the oscillator plug-in, the red lamp will indicate warm-up is in progress. After approximately 19-20 minutes have passed, the red light will go off and the green light will come on, indicating sufficient warm-up time for the oscillator to be within $\pm 2 \times 10^{-8}$ of its final frequency.

Push Button Selector Switch: Selects front panel output frequency as above.

Digital Frequency Adjustment: This digital potentiometer, similar to a set of thumbwheel selector switches, is used for precision adjustments of the oscillator output frequency. The digital readout is calibrated in parts in 10^{10}, with the right hand digit providing adjustment steps with this resolution. Adjustments of this digital control are typically made after comparison of the output frequency with a primary frequency standard such as station WWVB. This signal can be received using the Spectracom Model 8163 WWVB Receiver/Comparator, or similar instrument. If the oscillator output frequency is found to be off, appropriate adjustment upward or downward is made using this front panel digital control.

USING THE FRONT PANEL OUTPUT: When the appropriate output frequency has been chosen using the front panel push button switches, it may be used as a frequency standard signal. A typical application might be to measure this frequency with the counter that you wish to calibrate, noting the error with which the counter counts 1.0 MHz. The internal clock oscillator in the counter may then be adjusted so that the counter reads exactly 1.000 000 MHz. This adjustment should not be made until the counter has been warmed up for at least an hour, and preferably more. Refer to the counter instruction manual for detailed procedures.

The oscillator aging rate is typically 3×10^{-9} per day after 24 hours of warm up. Thus, the accuracy of the oscillator at some known time period after calibration can be estimated by knowing this aging rate.

Caution should be used when long lengths of coaxial cable are used to feed this signal to the load. Because the output is a TTL square wave from a line driver output, 93-ohm terminated cable should be used for long runs where wave form must be preserved. 50-ohm terminated cable may also be used with reasonable success, especially at the lower frequencies.

Termination impedance is less critical for a 1 MHz output than for a 10 MHz output.

CONNECTION TO TEKTRONIX FREQUENCY COUNTERS: The oscillator output signal may be used as the time base for Tektronix counters that are plugged into the same Mainframe. Two parallel outputs are provided from the rear interface connector to the Mainframe for this purpose, allowing operation of up to 2 Tektronix counters to use the same oscillator as their external time base. To do this, make the following connections in the TM-500 Mainframe and in the counter:

NOTE: The following instructions assume that one single counter will be operated from the oscillator plug-in. If a second counter interface is required, the same instructions should be followed taking the output from the oscillator pin 14B.

NOTE: Switch S1 on the oscillator's printed circuit board must be set for either 1.0 or 10 MHz to choose the external clock frequency from which the counter will operate. All of the Tektronix counters listed below will operate using a 1.0 MHz external clock frequency. The DC-508 may also be set to accept a 10 MHz external clock frequency as stated below.

DC-501: Connect 8131 pin 14A to DC-501 pin 14A.
Connect 8131 pin 17A to DC-501 pin 17A.
Install coaxial jumper in DC-501 from pin 14A (shield to 17A) to U209-14. Remove U200 (U201 if Option 1 instrument.)

DC-502: Same as DC-501.

DC-503: Connect 8131 pin 14A to DC-503 pin 14A.
Connect 8131 pin 17A to DC-503 pin 17A.
Place DC-503 internal jumper P250 in EXT position.
Replace DC-503 R251 with a wire jumper (does not affect normal counter operation).

DC-504: Connect 8131 pin 14A to DC-504 pin 14A.
Connect 8131 pin 17A to DC-504 pin 17A.
Place the DC-504 Int/Ext switch in the EXT position and connect the printed circuit pads marked EO with a coaxial jumper.

DC-505: Connect 8131 pin 14A to DC-505 pin 14A.
Connect 8131 pin 17A to DC-505 pin 17A.
Place the Ext Clock switch of the DC-505 in the EXT position.
Replace DC-505 R897 with a wire jumper (does not affect normal counter operation).

DC-508: Connect 8131 pin 14A to DC-508 pin 14A.
Connect 8131 pin 17A to DC-508 pin 17A.
Set the counter internal jumper to the EXT position.
If a 1.0 MHz external clock frequency is chosen in the 8131, set the counter internal selection jumper J1290 in the 1.0 MHz position. If 10 MHz is used, this jumper must be connected between pins 4 and 5 for 10 MHz operation.

DC-509/5009

DC 5010

OPERATION WITH BATTERY PLUG-IN: This oscillator may be operated with a Spectracom Model 8132 Battery Power Supply. This plug-in power supply has its batteries float-charged from the oscillator power supply when appropriate jumpering is done in the Mainframe. If the power is then removed from the Mainframe, the battery pack will keep the oscillator and its oven operating for up to 10 hours. Oscillator output stages are not left on during battery operation in order to preserve battery charge. Thus, to use the oscillator output frequencies the Mainframe must be plugged into an operating power line again.

Mainframe jumpering required to use this battery power supply consists of a connection from pin 16B to pin 16B in the appropriate Mainframe slots. Use wire size at least as large as #20 AWG. See battery power supply instructions for more details.

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ALIGNMENT PROCEDURE FOR MODEL 8131 OSCILLATOR

Regulator Adjustments

1. Preset controls as follows: (if alignment has been previously performed, controls may be left as is.):

   Set R17 to center of range
   Set R13 to center of range

2. Connect the negative lead of a DVM to the chassis. Connect the positive lead to TP1 (brown test point) and select the +200 volt full scale range.

3. Apply power to the unit and adjust R17 for 21.0 volts.

4. Move the positive DVM lead to TP2 (red test point). Adjust R13 for a DVM reading of +27.6 volts at +25°C ambient. The set voltage should be changed by -0.05 volts per degree C for room temperatures other than +25°C. The following table gives the voltage to set for various ambient temperatures.

Temperature	Set Volts
17°C	28.00V
18°C	27.95V
19°C	17.90V
20°C	27.85V
21°C	27.80V
22°C	27.75V
23°C	27.70V
24°C	27.65V
25°C	27.60V
26°C	27.55V
27°C	27.50V
28°C	27.45V
29°C	27.40V
30°C	27.35V

5. Apply glyptol or torque seal to R13 and R17.

6. Temporarily disconnect the positive lead of the DVM, and set the DVM for a full scale range of +2.0 amperes. Temporarily reconnect the positive DVM lead to TP2. A reading of 900 $\pm$ 100 milliamperes should be obtained.

7. Disconnect the DVM.

Oscillator Alignment

1. Use an oscilloscope to check the output signal levels and approximate frequencies.

   A. With front panel push button switch set as shown below, observe front panel output pulses of 2.5 V peak-to-peak minimum. Pulse period must be approximately as shown below.

Frequency Selector Switch Setting	Pulse Period
0.1 MHz	10.0 microseconds
1.0 MHz	1.0 microseconds
5.0 MHz	0.2 microseconds
10 MHz	0.1 microseconds

   B. Repeat the above amplitude and frequency measurements at pins 14A and 14B of the Mainframe connector for 1.0 MHz and 10 MHz only, switching the switch S1 on the printed circuit board to the appropriate frequency for each measurement.

2. Using a wrist watch or timer with 1-second resolution, check the operation of the red and green timer lights. Turn off the power to the Mainframe and wait for at least 10 seconds. Using the watch or timer, check the length of time that the panel lamps take to change from red to green after the power is turned on. (If this alignment has not been performed before, R_t will be in place on the circuit board and the time for the lamps to switch from red to green will be 13 $\pm$ 1 seconds. After this reading is obtained, use a pair of wire cutters to remove R_t from the circuit board.) After R_t has been removed, the time for the lamps to switch from red to green will be 19 $\pm$ 2 minutes.

3. Allow the oscillator to operate with uninterrupted oven and oscillator power for at least 24 hours before performing the following steps.

4. Set the front panel fine frequency control to 9999. Select 10 MHz front panel output frequency and connect a frequency counter with an accuracy of at least 1×10^{-8} and resolution of at least 0.1 Hz.

5. For all new oscillators, and older oscillators exhibiting upward frequency aging, adjust the oscillator coarse frequency control (accessible through the top of the oscillator can) for a frequency of 10,000.0025 KHz. Older oscillators known to be aging downward should be coarse adjusted for a frequency of 10,000.0050 KHz.

   NOTE: Use a metal tipped non-metallic tuning tool for this coarse adjustment, and replace the coarse adjustment sealing screw as soon as possible after adjustment to avoid thermal disruption of the oscillator.

   The coarse frequency adjustment has a nominal sensitivity of 10 Hz/turn at 10 MHz, with clockwise rotation decreasing the frequency

6. Set the front panel fine frequency control to 0000 and adjust R26 for a frequency exactly 10.0 Hz (.0100 KHz) below that obtained in Step 5. Clockwise rotation of R26 decreases the oscillator frequency. Do not glyptol R26.

7. Set the front panel fine frequency control to 5000 and adjust R23 for a frequency exactly 5.0 Hz (.0050 KHz) below that obtained in Step 5. Glyptol R23.

8. Set the front panel fine frequency control to obtain a frequency counter reading of <u>exactly</u> 10 MHz, then calibrate to any greater degree of precision desired using a WWVB receiver or other suitable means.

> NOTE: R26 is a tracking control, and should be tuned exactly the same amount in the same direction as any future adjustments of the oscillator <u>coarse</u> frequency control, unless a complete oscillator realignment is performed.

9. After completing the above steps, continue monitoring the accuracy of the output frequency for several more hours until satisfactory accuracy and stability are verified. Then turn the oscillator off for at least 24 hours.

10. After the oscillator has cooled for at least 24 hours, final verification of frequency accuracy and warm up time will be obtained during the next 24 hours of test time. Turn the oscillator power on, and verify that the following accuracies are obtained:

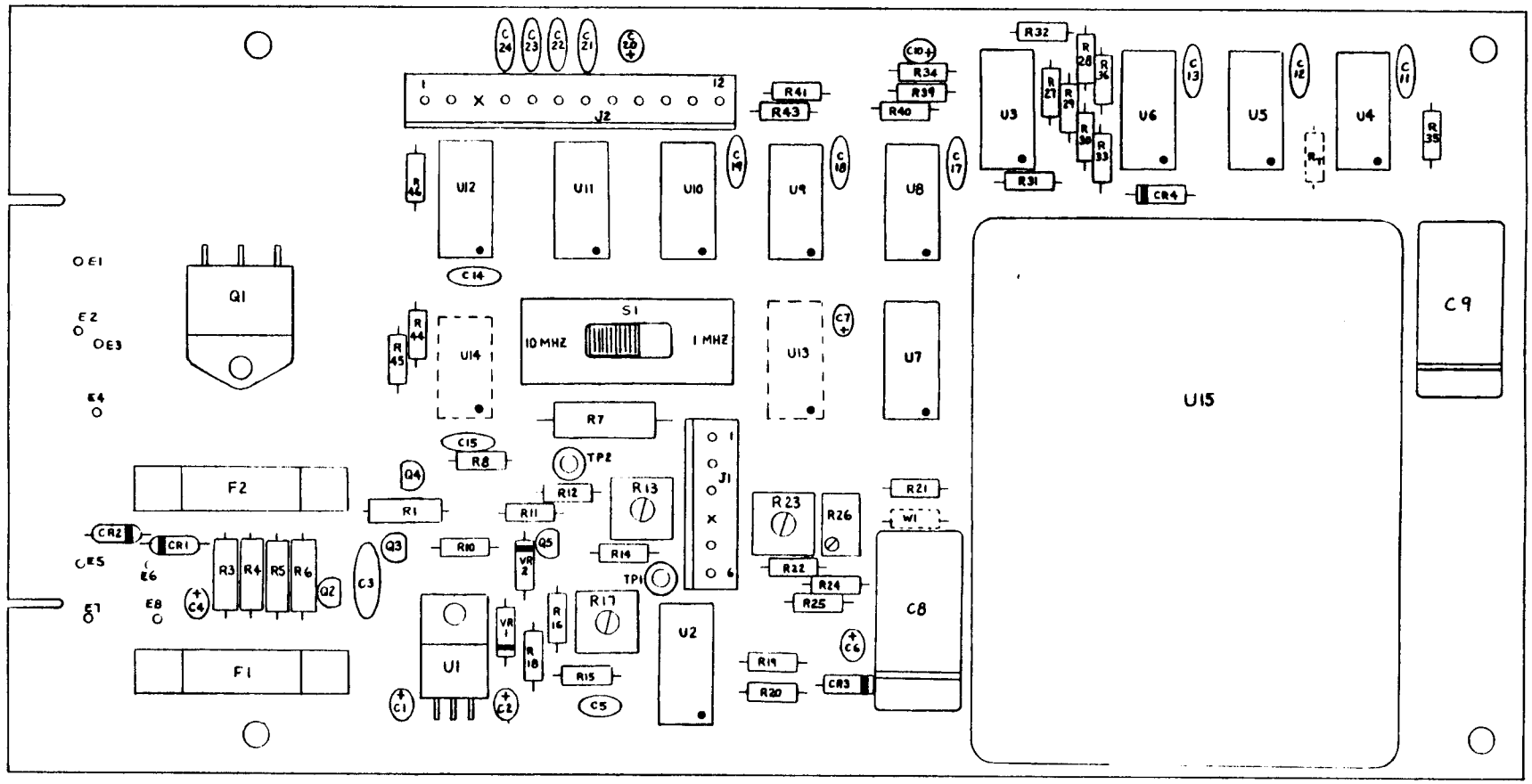
    Within $\pm$ 1 x 10^{-7} in ten minutes.
    Within $\pm$ 2 x 10^{-8} in twenty minutes.

<u>Final Button-up and Inspection</u>

1. Verify that the following items are satisfactory:

   a. Torque seal on potentiometers.
   b. Cap screws replaced on oscillator.
   c. R_t removed from circuit board.
   d. Internal switch S1 set at 1.0 MHz unless otherwise instructed.
   e. Replace side covers.

2. This completes this oscillator test procedure.



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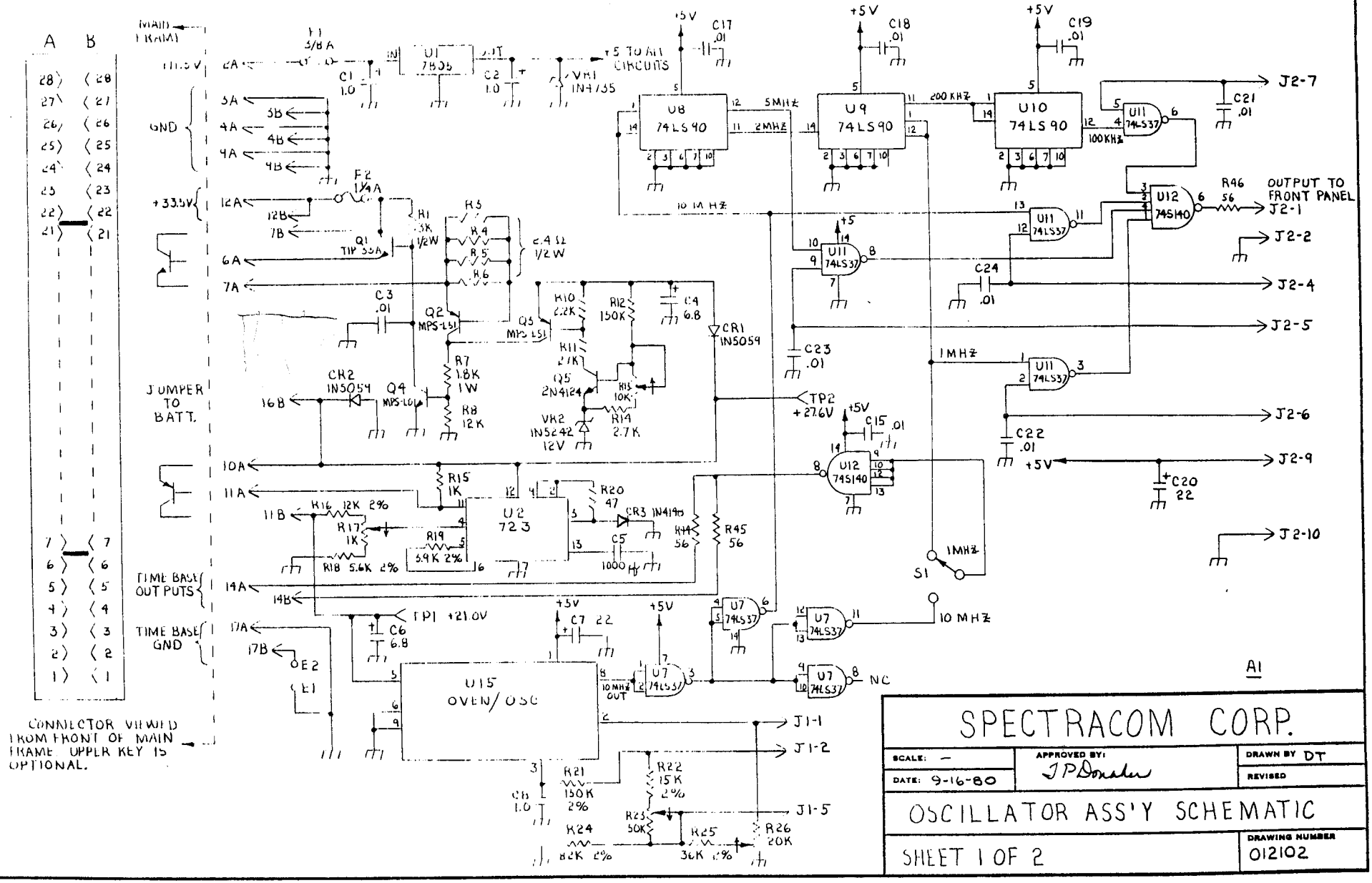

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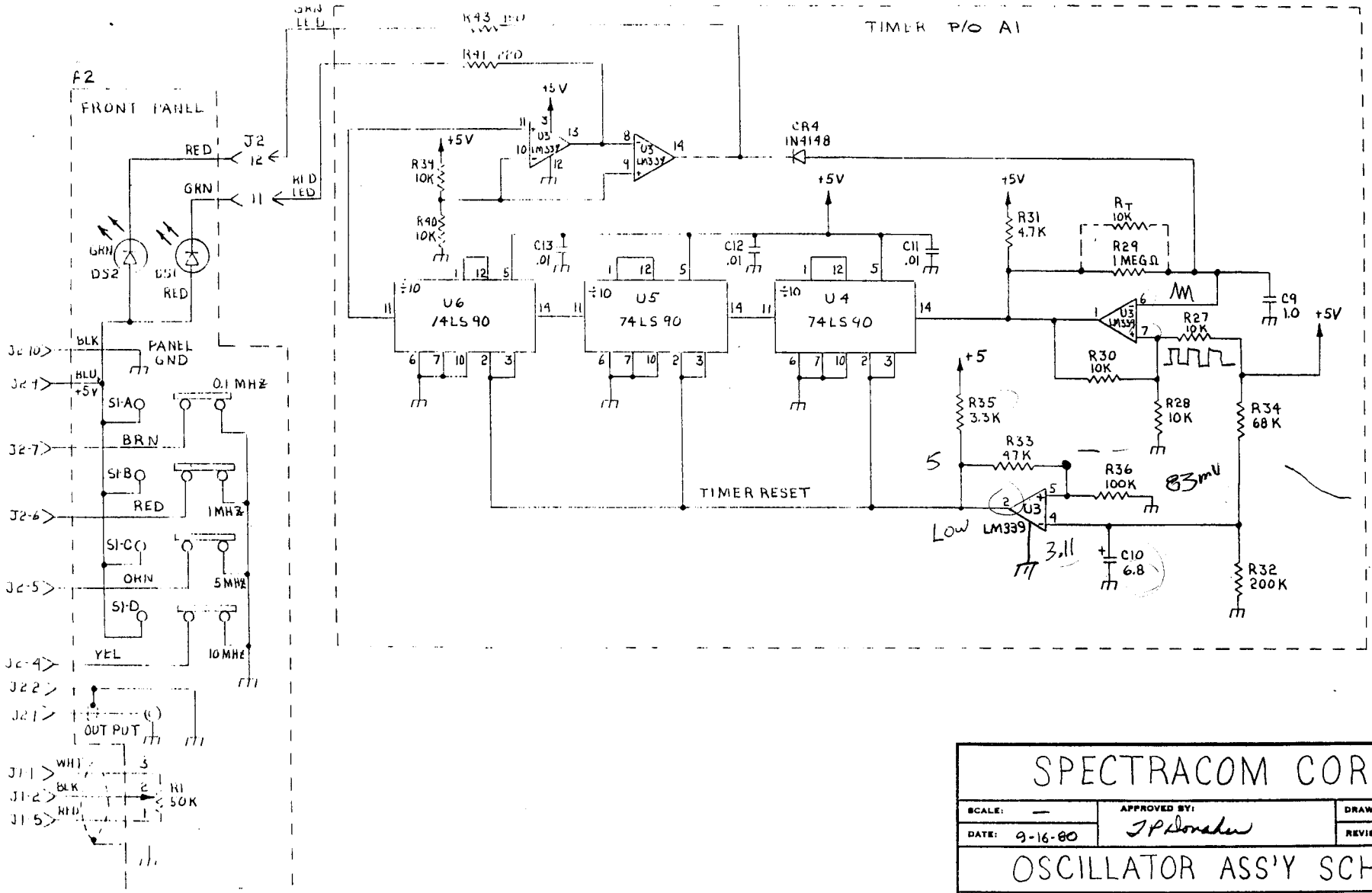

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WARRANTY

Spectracom Corporation warrants to the original purchaser each new instrument to be free from defects in material and workmanship for a period of one year after shipment. Repair or replacement, at our option, will be made when our examination indicates that defects are due to workmanship or materials. Electron tubes, batteries, fuses, and lamps that have given normal service are excluded from warranty coverage. All warranty returns must first be authorized in writing by the factory.

This warranty does not apply to any of our products which have been repaired or altered by persons not authorized by Spectracom Corp. or not in accordance with instructions furnished by us. If the instrument is defective as a result of misuse, improper repair, or abnormal conditions or operations, or if any serial number or seal has been removed or altered, the warranty is void and repairs will be billed at cost.

This warranty is in lieu of all other obligations or liabilities expressed or implied and Spectracom Corp. neither assumes nor authorizes any person to assume for them, any other liability in connection with sales of its products.

REPAIR AND MAINTENANCE

Instruments should be returned only upon prior written authorization from Spectracom Corp. or its authorized sales and service representative. Warranty repair will be made upon written request. Please provide the following information in order to enable us to serve you efficiently:

1. Model Number and type
2. Serial Number
3. Description of trouble
4. Conditions and hours of use

Upon receipt of this information our service department will send you service data or shipping instructions. Transportation to the factory is to be prepaid by purchaser.

For assistance contact your nearest Spectracom sales representative.

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MODEL 8132 BATTERY POWER SUPPLY

TM-500 Main Frame Jumpering: To use the 8132 with the Model 8131 Oscillator plug-in, jumper pins 16B to pin 16B in the Mainframe connectors where the two units will be used. This allows the battery to be float-charged by the 8131 whenever the Mainframe power is on. If the power line fails or if the Mainframe power switch is turned off, the oscillator and oven will operate from the battery for up to 8 hours. Oscillator output stages are not operated by the battery.

Operating Considerations: Battery life is normally 4-6 years or over 100 discharge cycles to 50% capacity. Do not leave battery in a discharged state for long periods or the life will be reduced.

W A R N I N G

This battery will furnish very high currents into short circuits! Accidental shorts can be dangerous and must be avoided. Never place the 8132 where tools, wires, or any metal might short circuit the terminals.

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TO SPECTRACOM CORPORATION:

Please send the final instruction manual for the Model 8131 to the following address as soon as it is available. The name shown below is the person who will be responsible for the equipment maintenance:

Name:

Mailing Address:

Equipment Serial No.

Signature _____ _____Date_____