

MODEL UTC8030
Universal Frequency Counter
User Information
And Service Manual



Your OEI Frequency Counter has been designed to give years of trouble-free service. This manual contains important information on it's use and care. Please take a few moments to familiarize yourself with the contents prior to using your counter.



Where this symbol appears on the counter, it means:

"SEE EXPLANATION IN MANUAL"

"CAUTION" The use of this word in this manual is reserved for conditions or actions that may damage your counter.

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Features of the UTC 8030

The UTC8030 is a full-featured Universal Counter-Timer in a compact, Bench/Portable design. Capable of frequency measurements from near D.C. to over 3GHz, the UTC8030 is suited for virtually every application.

Outfitted with the optional rechargeable NiCad battery pack and antenna, it's compact size and ultra-high sensitivity make it perfect for "off-the-air" measurements and FREQUENCY FINDING in the field at maximum distances.

Compare These Features

- Full Function: Frequency, Direct and Prescale, Period, Period Average, Time Interval, Time Interval Average, Ratio.
- Wide Frequency Range: <10Hz to >2.4GHz (1Hz to 3GHz - typical).
- Extremely High Sensitivity: <1mV 10MHz to 500MHz, <10mV to 2.4GHz (< .1mV 10-100MHz, < .2mV below 200MHz - typical).
- High Resolution: 1Hz in 1 Second to over 200MHz, 1Hz in 4 Seconds to over 600MHz, 10Hz in 1.6 Seconds to over 2.4GHz.
- High Accuracy: Timebase Accuracy +/- 1ppm 20-40°C TCXO - Standard Precision Sealed TCXO +/- .1ppm 20-40°C - Optional.
- 10 Digit LCD Display with Gate, Function, and Input Annunciators.
- 16 Segment Signal Strength Bargraph displays input signal level. Ensures reliable counting, proven effective in locating concealed transmitters.
- Two Input Channels: High Impedance and 50 ohm inputs.
- Adjustable Trigger Level, Input "B".
- Trigger Variable/Auto Select, Input "B".
- Switched, Low-Pass Input Filter, Input "B".
- Switched, 20 dB Input Attenuator, Input "B".
- Hold Button locks detected frequency on display.
- External Clock Input/Output with LED Indicator.
- Zero/Fullscale Bargraph Adjust.
- Four Pushbutton Selectable Gate Times with LED Indicator.
- Probe Power Jack (powers AP-8015-B pre-amp).
- Compact Aluminum Cabinet: 3.5"H x 7.3"W x 6.8"D With non mar feet and swing down tilt bale for bench operation. Textured polycarbonate/aluminum laminate front and rear panels.

SPECIFICATIONS

INPUT

	INPUT "B"	INPUT "A"
Range:	10Hz to 100MHz	11MHz to 2.4GHz
Typ. Max. Freq. @ 25°C	150MHz	3GHz
Input Impedance:	1 MEGOHM, 30pF	50 OHM vswr < 2:1
Input Coupling:	AC	AC
Sensitivity:	<10mV 10Hz-20MHz <20mV to 40MHz	<1mV 10-200MHz <10mV to 2.4GHz
Maximum Input Voltage:	100V rms	+ 15dBm
Connector Type:	Female BNC	Female BNC

FREQUENCY MODE

Least Significant digit displayed (LSD) as a Function of Gate Time and Range

RANGE	GATE TIME (in seconds)	LSD (Hz)	SAMPLE DISPLAY (MHz)
150MHz Direct Count	.01	100	150.000 0
(230MHz typical	.1	10	150.000 00
"A" or "B" input)	1	1	150.000 000
	10	.1	150.000 000 0
600MHz Prescaled by 4	.04	100	600.000 0
(900MHz typical	.4	10	600.000 00
"A" Input)	4	1	600.000 000
2400MHz Prescaled by 16	.16	100	2400.000 0
(3GHz typical "A" input)	1.6	10	2400.000 00
	16	1	2400.000 000

SIGNAL STRENGTH BARGRAPH

16, 3dB Segments, driven by signal into input "A". or "B".
Sensitivity varies with zero and full scale adjustments.
(Input "A" Typical)

FREQUENCY	SEGMENT #1	# SEGMENTS ON WITH THRESHOLD	OdBm INPUT
27 MHz	-40dBm	16	
150 MHz	-40dBm	16	
450 MHz	-33dBm	12	
850 MHz	-10dBm	6	

ADDITIONAL UTC8030 FUNCTIONS

Time Interval (TI) Mode: "A" Start "B" Stop. Minimum pulse width is 200 ns. Triggers on rising edge.
Period/TI Max Resolution: Single Shot - 100 ns. Averaged .1 ns Max Display: 999 999 999.9 us
Period/TI Average: Averages 10, 100, or 1000 measurements for increased resolution.
Ratio Mode: "A": "B", "B" input limited to 10MHz max..

Time Base: 10MHz Stability: +/-1ppm 20-40°C Aging: 1 ppm/yr Calibration Adjustment: Through rear panel
Option: TCXO 90 - Precision +/- .1ppm 20 to 40°C temperature compensated crystal oscillator.

Display: 10 Digit (120 segment) .25" Liquid Crystal Display. Decimal at MHz position.

Time Between Measurement Periods: 40 ms - Gate Light LED illuminates between measurement periods.

Low Battery Indicator: "Low Batt" displayed when optional battery pack voltage falls below 4.75V +/- .25V.

Annunciators: Frequency, Period, Time Interval, Ratio, Average, MHz, nS, mS. Low Batt, Prescale, Gate times and Intervals/Periods Averaged.

Size: 3.5" high x 7.3" wide x 6.8" deep. Weight: 30 oz. **Cabinet:** Aluminum, black paint finish with tilt bale.

Power: 9VDC, 500MA using 110VAC 60Hz wall plug adapter. 2+ hours operation with optional NiCad Battery pack
16 Hour recharge from A.C. charger/adapter.

Warranty: One year parts and labor, not including batteries. See warranty statement for details.

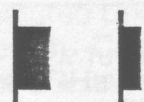
Quality manufactured in the United States of America.

CONTROL

OPERATION

DISPLAY

POWER



Off

On

FREQUENCY

0.01

0.0000^A MHz

INPUT

A/B



Momentary
Push-Button

FREQUENCY

0.01

0.0000^B MHz

FUNCTION



Momentary
Push-Button
Press Once
For Period

PERIOD

1.0

0.0^A μ S

FUNCTION



Press Again
For Time Interval

INTERVAL

1.0

0.0^A μ S

FUNCTION



Press Again
For Ratio

RATIO

0.01

0.00000^A

FUNTION



Press Again
To Return to Frequency

FREQUENCY

0.01

0.0000^A MHz

FUNCTION

COMMENTS

Counter is powered "ON". Internal NiCad batteries (if installed) will supply circuit power except when unit is connected to external wall plug adapter. When operating from the wall plug adapter, the batteries will charge at a reduced rate that depends upon functions selected, and the frequency being counted.

Counter is powered "OFF". NiCad batteries will be charged at the maximum permissible rate when unit is connected to external wall plug adapter.

INPUT A/B: Momentary push-button selects the counter input and amplifier from which signals are to be counted.

Check Specifications section for Input characteristics of the "A" and "B" Inputs.

FUNCTION: Push-button switch selects Measurement function. Depressing the switch will successively select Frequency, Period, Interval (Time Interval), and Ratio functions. These functions are defined as follows:

Frequency: Number of electrical cycles the input signal go through in one second. Unit of measurement is MHz.

Period: Time required for the input signal to go through one complete cycle. Functionally the reciprocal of frequency.

Unit of measurement is microseconds or nanoseconds in the period average mode.

Period does not work with Prescale Function. Use Period for greater measurement resolution at frequencies below 1KHz.

Time Interval: Elapsed time between two electrical pulses. With the "A" input selected, a pulse (minimum 200 nano Seconds width) applied to the "A" input starts the measurement and a pulse (same minimum) applied to the "B" input stops the measurement. The positive (leading) edge is used for starting and stopping for maximum noise immunity.

Ratio: The ratio of two frequencies, a measurement that has no units. With the "A" input selected, the ratio of frequencies of signals applied to the "A" and "B" inputs, with the "B" input being the denominator.

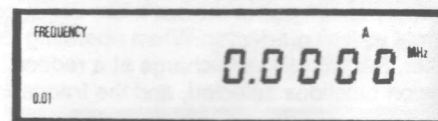
CONTROL

OPERATION

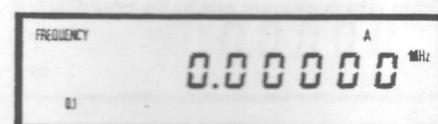
DISPLAY



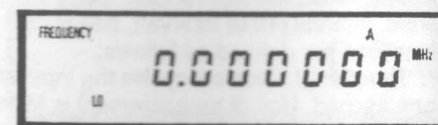
Momentary
Push-Button



Press Once
To Go From 0.01 Second
To 0.1 Second Gate Period



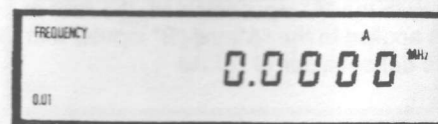
Press Again
To Go From 0.1 Second
To 1.0 Second Gate Period



Press Again
To Go From 1.0 Second
To 10 Second Gate Period



Press Again
To Return To
0.01 Second Gate Period



FUNCTION

COMMENTS

Momentary push-button selects measurement sample period.

Frequency Function Selected Ratio Function has similar display with Ratio annunciator on and Units annunciator blanked

CONTROL

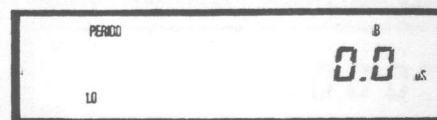
OPERATION

DISPLAY

MEAS
TIME



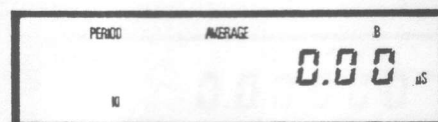
Momentary
Push-Button



MEAS
TIME



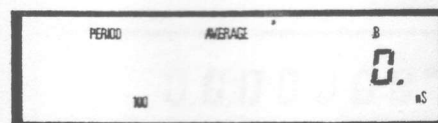
Press Once
To Go From 1
To 10 Cycles Averaged



MEAS
TIME



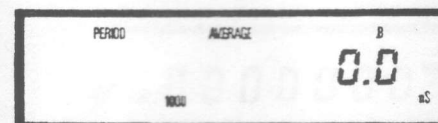
Press Again
To Go From 10
To 100 Cycles Averaged



MEAS
TIME



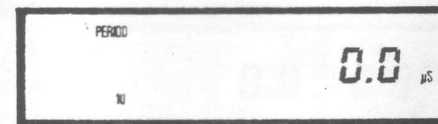
Press Again
To Go From 100
To 1000 Cycles Averaged



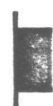
MEAS
TIME



Press Again To
Return to Single
Measurement Cycle



HOLD



OFF



ON

FUNCTION

COMMENTS

Display indicates the number of cycles averaged.

Period or Time Interval Function selected and Prescale/Direct Switch is in Direct position.

Hold: Display hold. Causes the most recent information displayed on the LCD display to be held until the switch is returned to its normal (OFF) position. If the counter powers up with the LCD display blank then check to see if the Hold switch was left on. Return the switch to its normal (OFF) position to enable the LCD display. This switch parallels the MEAS Time push-button and will cause the Time selected to increment to the next higher selection every time the Hold is activated and returned to normal. Holding down any of the three momentary push-button switch controls will cause the LCD display to hold until the button is released.

CONTROL**OPERATION****DISPLAY****PRESCALE****DIRECT****Direct Prescale****10MHz-
2.4GHz****10MHz-
600MHz****600MHz 2.4GHz****ZERO FS****BARGRAPH**

Zero Adjust: Screw driver adjust for bargraph zero segment calibration. This control can be used to offset background signal level for applications such as security sweeps.

Full Scale Adjust: Is factory set for 0dBm a 150MHz, Input "A".

BARGRAPH**A****B****A****GATE**

Gate: Red LED lamp is illuminated during the interval between measurement periods and remains off during the measurement interval. A second function of the Gate light is diagnostic, if it is operation then the main counter integrated circuit is active and the time base circuitry (system clock) is functional.

FUNCTION

COMMENTS

DIRECT/PRESCALE: Selects the direct count (non-prescaled) range or prescaled ranges. Check specifications for minimum and maximum frequency ranges permissible with the direct and prescaled ranges.

600MHz/2400MHz: Selects between the 10Hz to 600MHz prescale range and the 100MHz to 2400MHz prescale range. This switch is active only if the Direct/Prescale switch is in the Prescale position.

When Prescale, 600MHz switch positions are selected, the gate times become .04, .4 and 4 seconds (there is no 40 second gate). The LCD gate indication must be multiplied by 4 for the actual time in seconds. The indicated frequency count is automatically adjusted for the prescale factor of 4.

Selecting Prescale, 2400MHz switch positions changes the actual gate times to .16, 1.6 and 16 seconds. The prescale factor is 16 and the LCD gate display must be multiplied by 16 for the actual gate time in seconds. The indicated frequency count is automatically adjusted for the prescale factor of 16.

Sixteen segment relative signal strength bargraph. Each segment approximates a 3 dB signal increment. See specifications for typical absolute calibration values.

The bargraph will respond to signal levels at the "A" or "B" Input. The bargraph takes one measurement period to respond to a change in input signal level. Use fastest gate time when making relative signal level measurements. The bargraph detector is not perfectly linear with frequency. Calibrated measurements are therefore not possible. Generally, if there are at least a couple of segments visible then there is sufficient signal level available for a reliable measurement. The Bargraph will respond independent of the positions of the Direct/Prescale and 600MHz/2400MHz switches. If the bargraph indicates sufficient signal level but the counter is not locked on to anything then check these switches.

CONTROL

OPERATION



EXT REF
INPUT
10MHz TTL

Connect an external 10 MHz frequency source to the BNC connector on the rear panel.



EXT REF

-20dB



ATTN 0dB



OUT



IN

Attenuates signals applied to B input. Reduces sensitivity to prevent false triggering caused by noise and interference. Will also reduce signal level to B input Bargraph amplifier.

LP
FILTER



OUT



OUT



IN

Low Pass Filter works on input B where it attenuates signals with frequencies greater than 50MHz.

Filter Attenuation: 20dB at 200kHz.

VAR



AUTO



AUTO



VAR

The Auto Trigger Level is 0 Volts. This is good for symmetrical signals like sine waves. Variable trigger moves the trigger points above or below 0 volts and is useful for counting noisy signals or non-symmetrical signals.

TRIGGER



Trigger Level Input "B". Control is operated by rotating. The Var/Auto Switch must be in the IN position for this control to work. Works on "B" input only.

FUNCTION

COMMENTS

The Frequency Counter automatically detects if a suitable signal is connected to the EXT REF Input connector. More precise measurements are possible using a precision external timebase as the reference. A suitable signal source must be TTL compatible. The front panel EXT REF indicator will illuminate when an external source is being used.

The internal TCXO timebase 10MHz signal is available from the EXT REF connector on the rear. The amplitude of this signal is approximately .5v. This signal is not capable of driving TTL loads but can be used to calibrate other instruments with amplified inputs such as oscilloscopes or frequency counters.

The LP Filter eliminates the Counter's RF sensitivity that can cause problems when trying to make low frequency or audio measurements. Always recommended when making measurements below 50kHz.

CONTROL

OPERATION



**PROBE
POWER**

Accessory Power Outlet for Probe
or Amplifier.

5VDC 50MA max.

**LCD
BACK
LIGHT
(OPTIONAL)**

HOLD



On

**MEAS
TIME**



**Momentarily
Depress Once**

Comes ON with Instrument Power up. To turn OFF
Engage "HOLD" switch. Slowly depress "MEAS TIME"
once. Slowly depress again to turn on or, recycle the
"POWER". Turn off "HOLD" switch.

**AUDIBLE
SIGNAL
LEVER
INDICATOR**

HOLD



On

FUNCTION



**Momentarily
Depress Once**

Inactive with Instrument Power Up. To turn ON engage
"HOLD" switch. Slowly depress "FUNCTION" once.
Depress again to turn OFF. Turn off "HOLD" switch.

OPTIONAL RECHARGEABLE BATTERY OPERATION

The counter can operate several hours (4 hours typical) from fully charged internal NiCad batteries. The "LOW BATT" Indicator in the LCD display will come on when there is only a few minutes of operation remaining. The batteries are charged automatically when the unit is powered by the AC90 Charger/Adapter. Full recharge will occur in 12 to 16 hours. The battery packs will also charge at a reduced charge rate while the counter is being operated from the AC90 Charger/Adapter. The counter may be operated over prolonged periods by AC Adapter operation with no harm to batteries as the charge current is regulated. The batteries should be deep cycled occasionally by allowing them to completely discharge and fully charge several times to maintain maximum battery capacity.

CAUTION

The NiCad batteries should last over several years, however, it is recommended that the counter be checked inside periodically for any sign of battery leakage or corrosion. Replace all batteries if any visible damage is observed.

To inspect the NiCad battery packs it is necessary to open the cabinet. This is accomplished by removing two machine screws from each side of the cabinet and removing the top cover. Take care not to pinch any of the battery wires. Excessive currents could flow damaging the batteries.

CAUTION

110V AC and External DC Operation

A 110V AC, 60Hz TO 9V DC, 500mA, Center-Positive, AC90 Charger/Adapter is specified for use and is supplied with the counter. This is a nominal specification and the adapter supplied with the counter will match the counter's requirement exactly. When using external power supplies make sure that the voltage under load does not exceed 12 VDC. When operating from an automotive electrical system, some means of reducing the voltage to the counter must be employed. Automotive voltages in excess of 13.8VDC are common and may damage the NiCad batteries. If the counter becomes excessively hot to the touch then remove it from the power supply immediately.

CALIBRATION

A calibration adjustment opening in the rear of the instrument is labeled "TCXO ADJ". This opening permits access to the trimmer capacitor which provides about a 10 parts per million adjustment range of the time base oscillator. Use the slow Gate Time for maximum resolution and read a stable signal of known frequency adjusting the trimmer for correct frequency display. Calibrate at 10 MHz or higher. The higher the calibration frequency, the more accurately the instrument can be calibrated.

Operate the unit for a minimum of 1 hour prior to calibrating. Do not remove top cover before or during Calibration. Accurate TCXO (Temperature Compensated Crystal Oscillator) operation requires that the counter be at thermal equilibrium with its environment.

Accuracy:

Frequency mode: = \pm Time Base Inaccuracy ± 1 count

Period mode: = \pm Time Base Inaccuracy ± 1 count \pm trigger error.

Trigger Error: is $< .3\%$ per period for sine waves of 40 dB signal to noise ratio and amplitude equal to sensitivity of counter. For any waveshape, trigger error is less than $\pm .0025$ microseconds divided by the signal slope in volts per microsecond for signal to noise ratio of 40 dB.

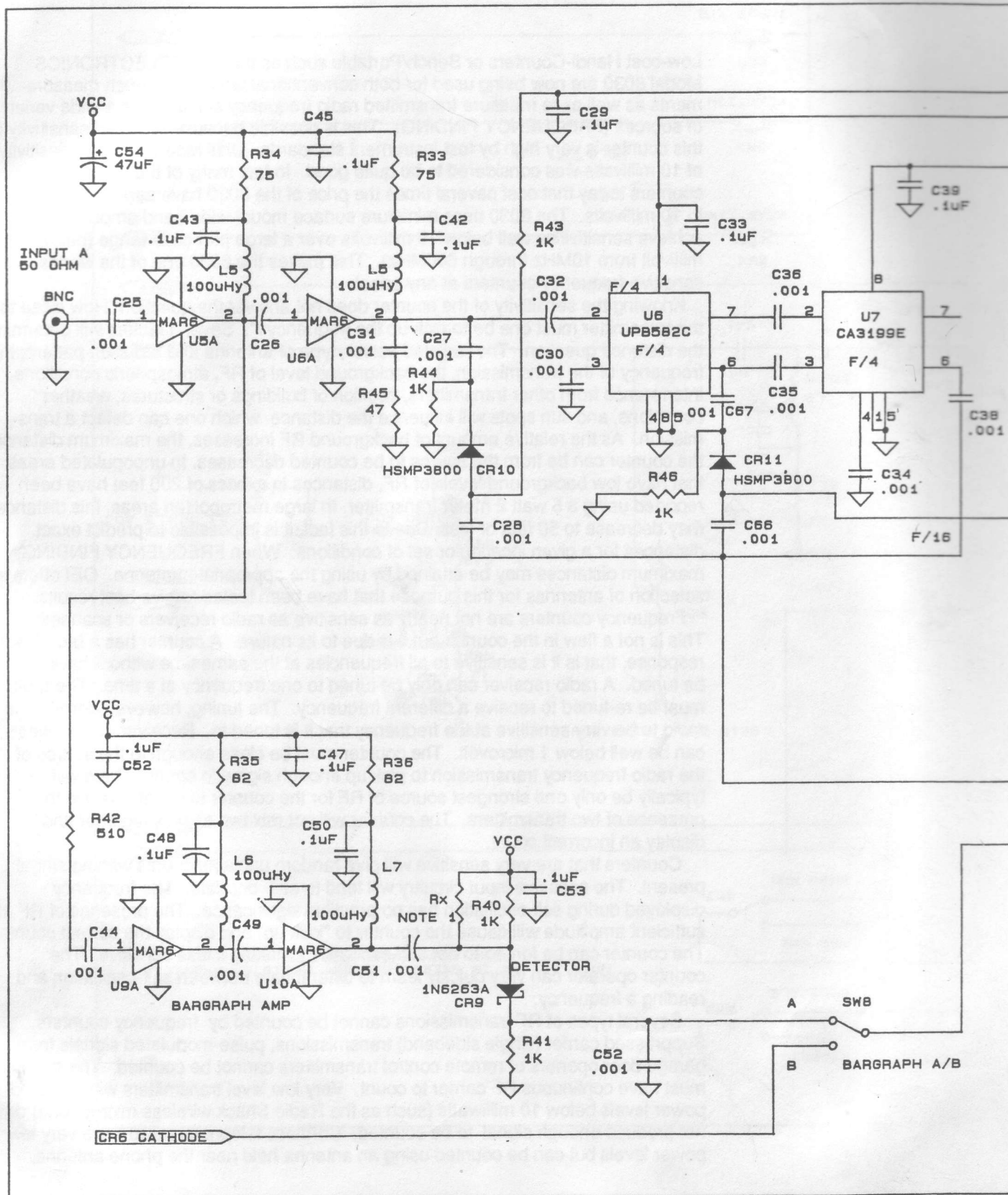
FACTORY CALIBRATION SERVICE

OPTOELECTRONICS' Service Department provides a calibration service at the factory. Counters may be shipped for this service using the Factory Service & Return Policy explained on the last page of this manual. The current charge is \$40.00 (\$35.00 + \$5.00 Return Shipping). This price is subject to change without notice. Consult factory for current pricing at time this service is requested.

OPTOELECTRONICS will provide a Certificate of Calibration at time of calibration service, upon request.

SCHEMATIC

MAIN BOARD, HIGH FREQUENCY AMPLIFIER AND PRESCALER



USING THE COUNTER

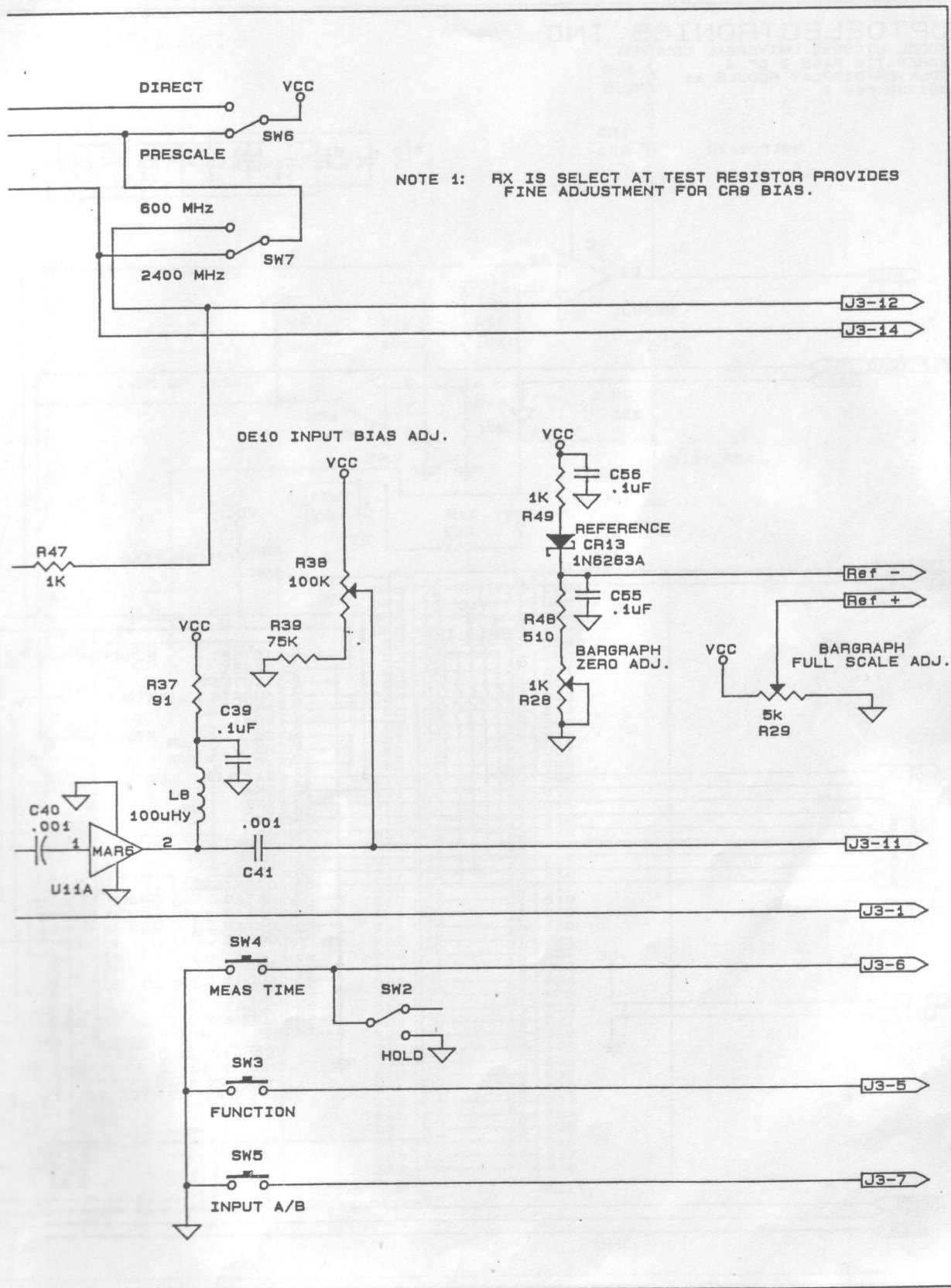
Low-cost Handi-Counters or Bench/Portable such as the OPTOELECTRONICS Model 8030 are now being used for both conventional laboratory bench measurements as well as to measure transmitted radio frequency signals from a wide variety of sources (FREQUENCY FINDING). This is possible because the input sensitivity of this counter is very high by test instrument standards. Until recently, input sensitivity of 10 millivolts was considered to be quite good. In fact many of the lab quality counters today that cost several times the price of the 8030 have sensitivity specified to 10 millivolts. The 8030 uses miniature surface mount wide band amplifier ICs to achieve sensitivities well below 10 millivolts over a large part of its range (below 1 millivolt from 10MHz through 600MHz). This makes the 8030 one of the worlds most sensitive frequency counters at any price!

Knowing the sensitivity of the counter does not answer the question "How close to the transmitter must one be to pick up the frequency?". Several factors will determine the distance question. The radiated power, type of antenna and radiation pattern, the frequency of the transmission, the background level of RF, atmospheric conditions, interference from other transmitters, position of buildings or structures, weather conditions, and sun spots will influence the distance which one can detect a transmission. As the relative amount of background RF increases, the maximum distance the counter can be from the source to be counted decreases. In unpopulated areas that have low background levels of RF, distances in excess of 200 feet have been reported using a 5 watt 2 meter transmitter. In large metropolitan areas, this distance may decrease to 50 feet or less. Due to this fact, it is impossible to predict exact distances for a given location or set of conditions. When FREQUENCY FINDING, maximum distances may be attained by using the appropriate antenna. OEI offers a selection of antennas for this purpose that have been tested to give best results.

Frequency counters are not nearly as sensitive as radio receivers or scanners. This is not a flaw in the counter but it is due to its nature. A counter has a broadband response, that is it is sensitive to all frequencies at the same time without having to be tuned. A radio receiver can only be tuned to one frequency at a time. The radio must be re-tuned to receive a different frequency. The tuning, however, permits the radio to be very sensitive at the frequency that it is tuned to. Receiver sensitivities can be well below 1 microvolt. The counter must be close enough to the source of the radio frequency transmission to pick up enough signal to count. There will typically be only one strongest source of RF for the counter to count, even in the presence of two transmitters. The counter will not mix two signals together and display an incorrect count.

Counters that are very sensitive will give random unstable counts with no signal present. The sensitive input circuitry will tend to self-oscillate. The frequency displayed during self-oscillation has no practical significance. The presence of RF at sufficient amplitude will cause the counter to "lock up" and display the correct count. The counter can be forced to not self-oscillate by making it less sensitive. The counter operator can very quickly learn to differentiate between self-oscillation and reading a frequency.

Several types of RF transmissions cannot be counted by frequency counters. Suppressed carrier (single sideband) transmissions, pulse-modulated signals from garage door openers or remote control transmitters cannot be counted. The counter must have continuous RF carrier to count. Very low level transmitters with radiated power levels below 10 milliwatts (such as the Radio Shack wireless microphone) do not produce enough signal to be counted. Cordless telephones also have very low power levels but can be counted using an antenna held near the phone antenna.



SCHEMATIC

COUNTER/DISPLAY MODULE A1

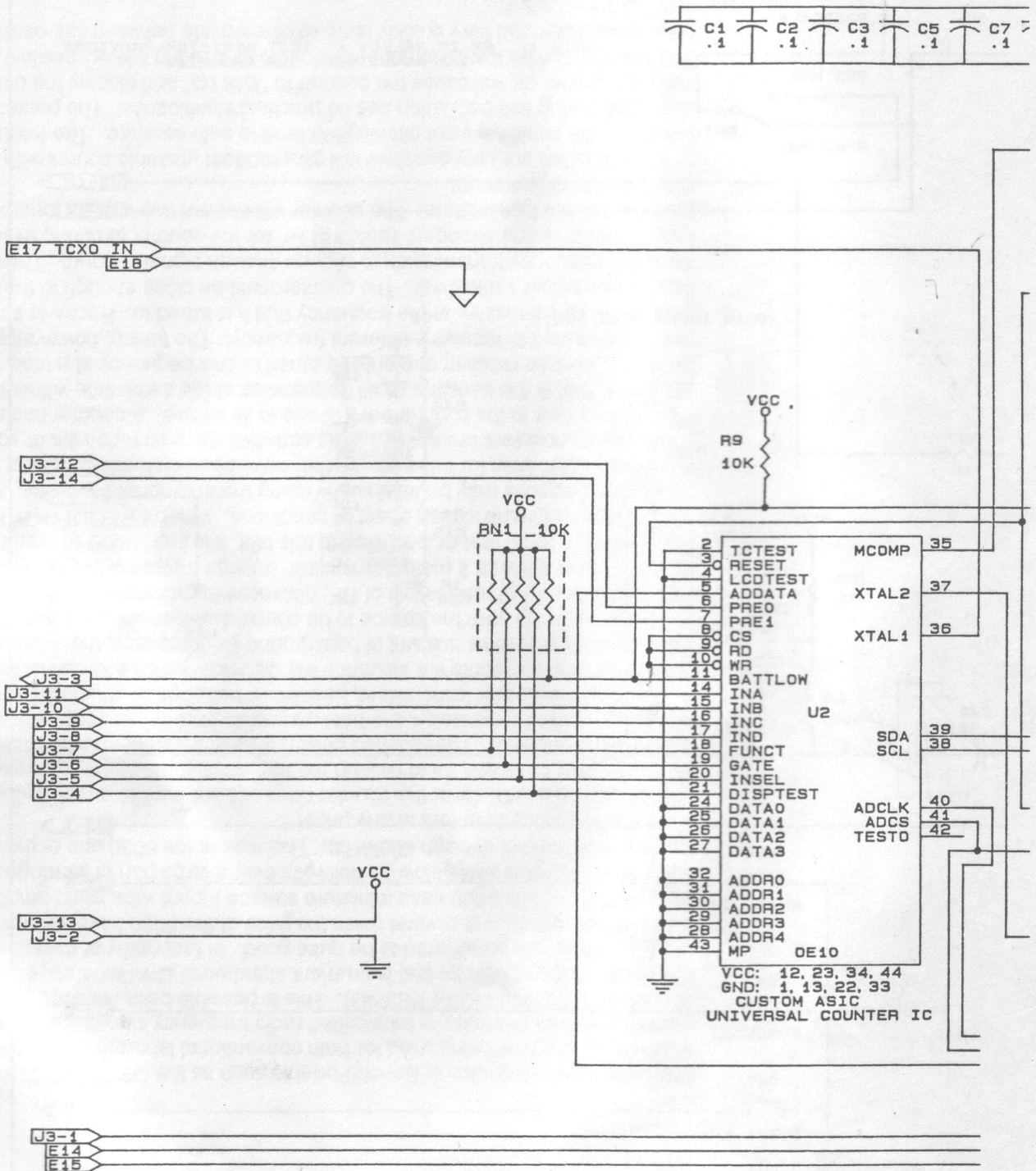
OPTOELECTRONICS INC.

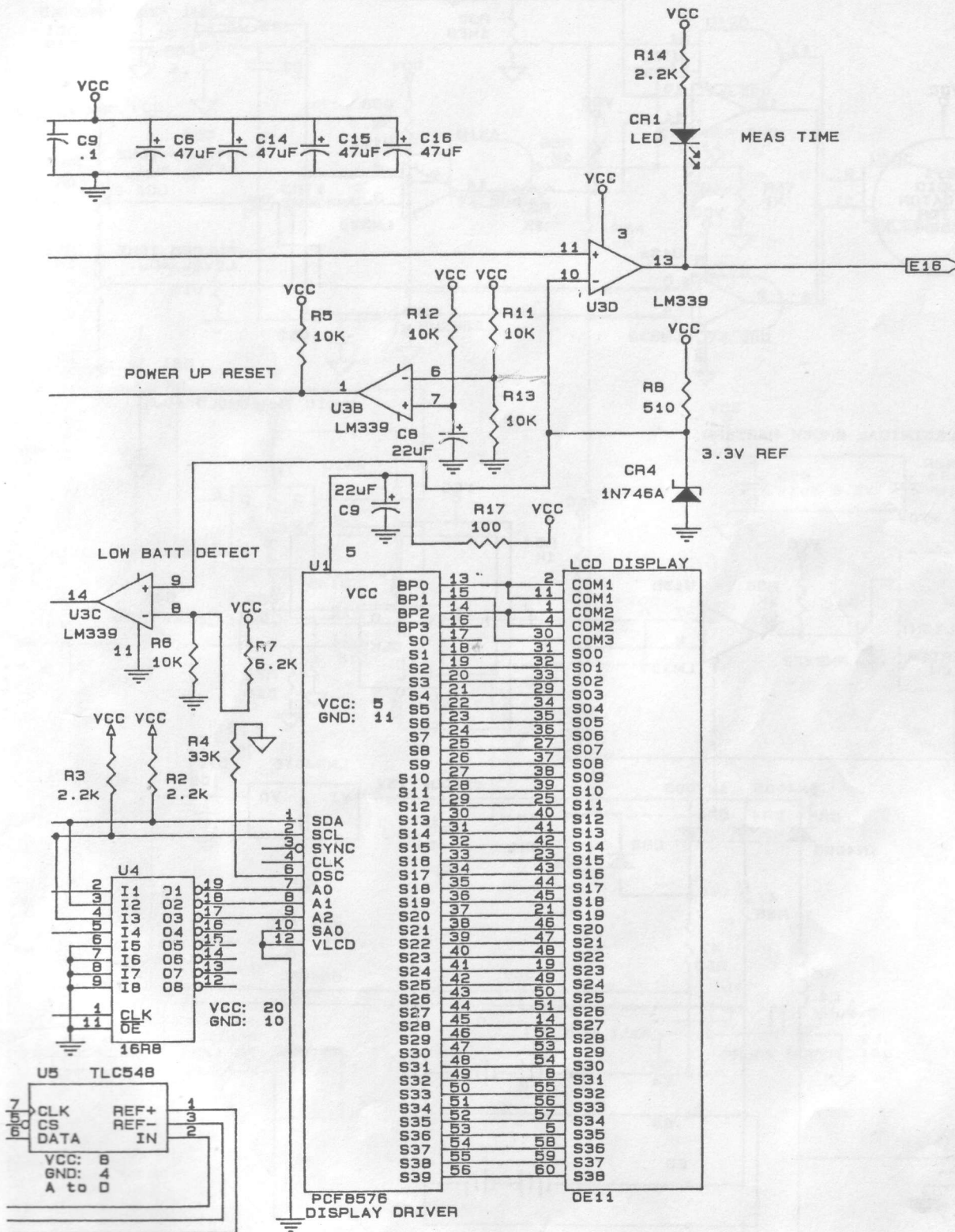
MODEL UTC8030 UNIVERSAL COUNTER

SCHEMATIC PAGE 2 OF 4

COUNTER/DISPLAY MODULE A1

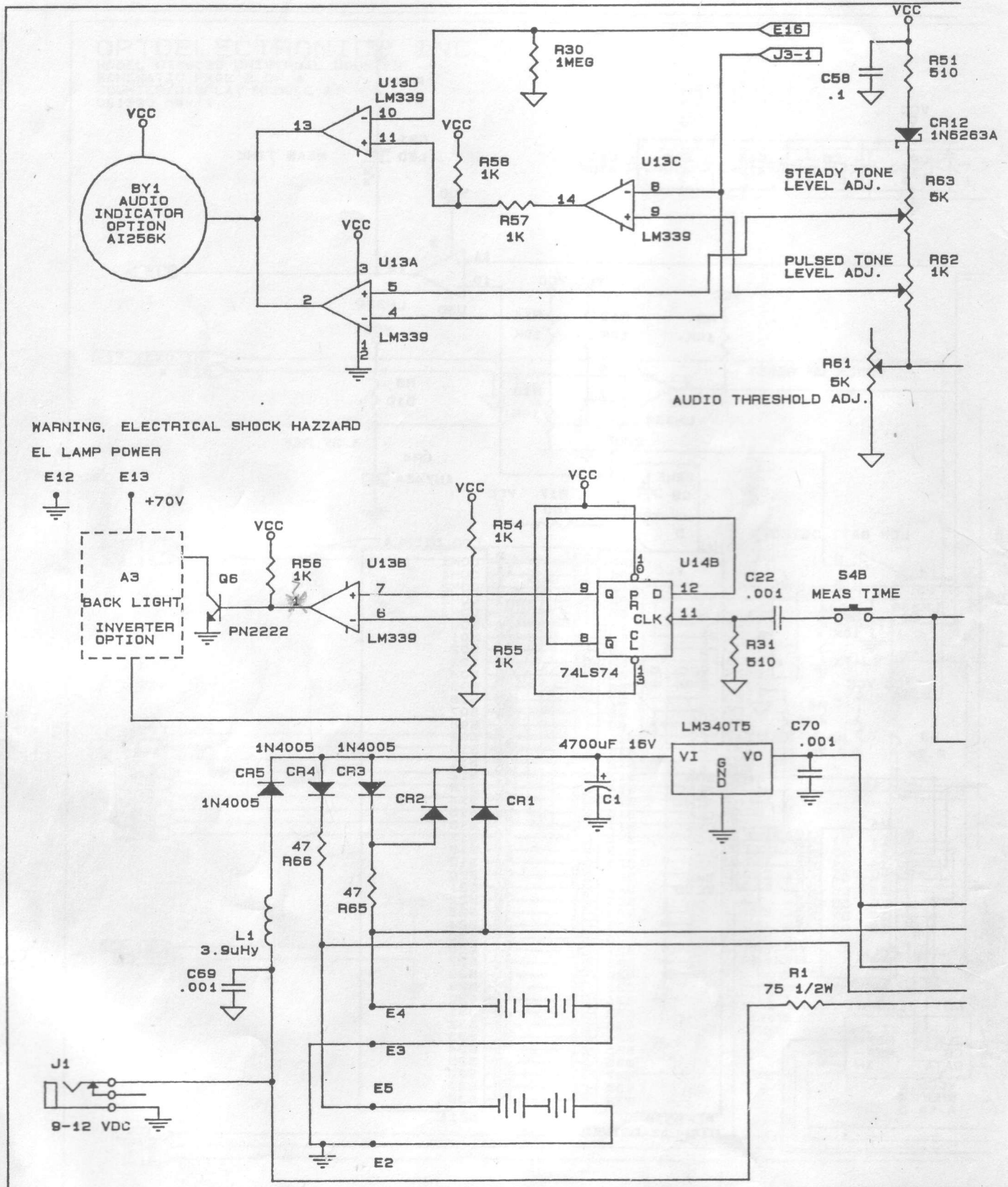
091390 rev 1

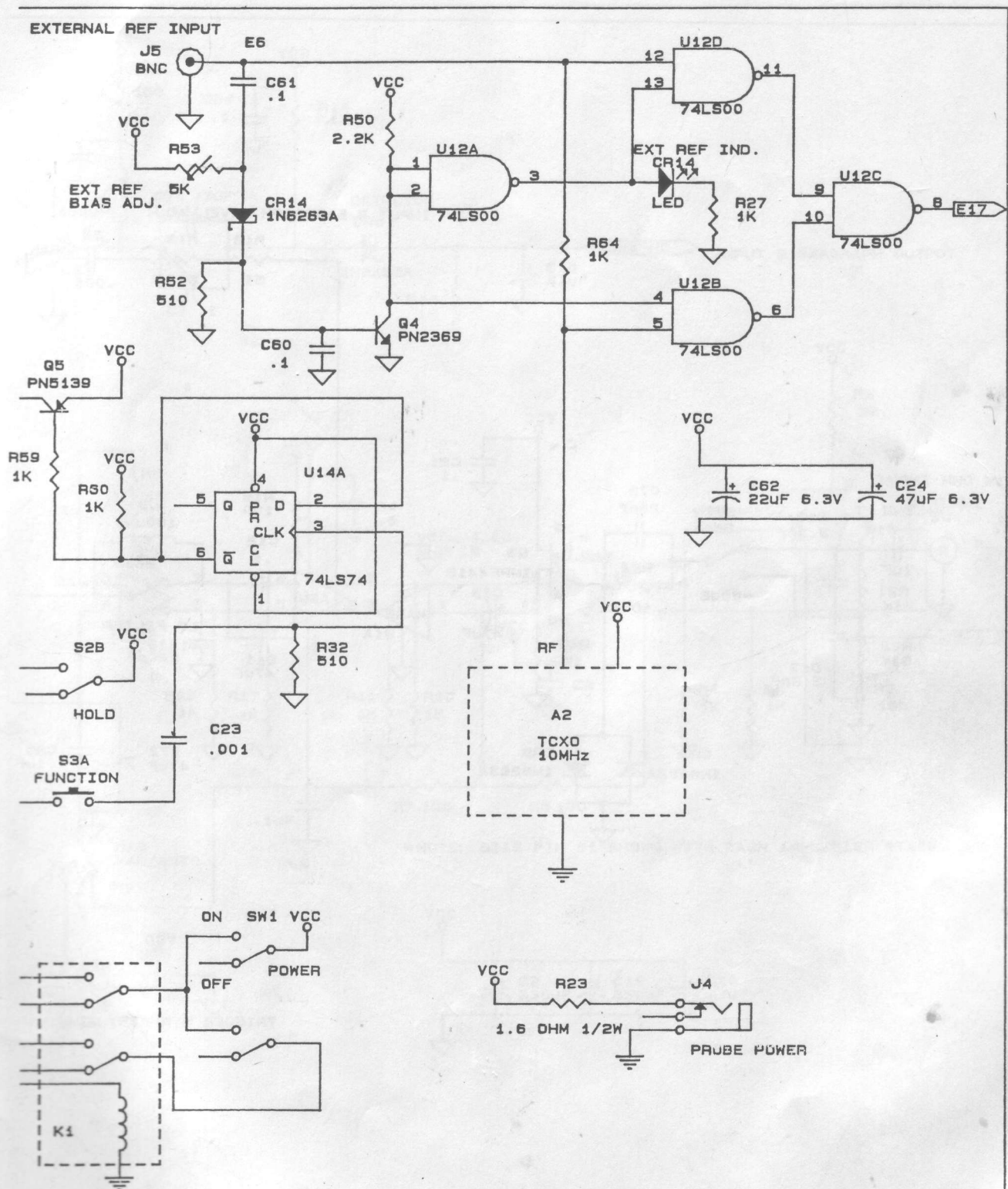




SCHEMATIC

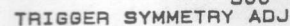
MAIN BOARD CIRCUITRY

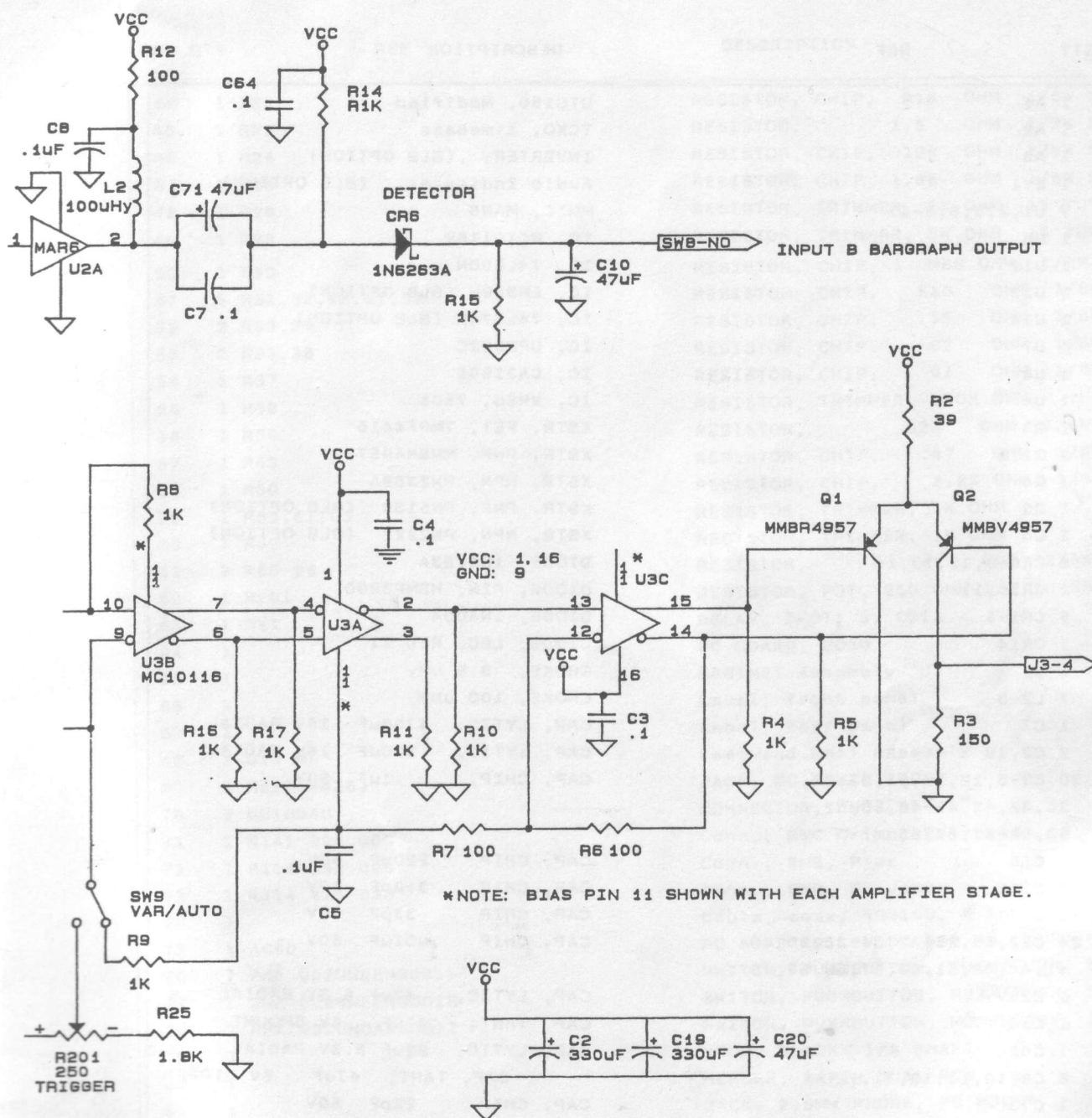




POWER SUPPLY, TCXO, NiCad BATTERY OPTION
OPTIONAL AUDIO INDICATOR AND BACKLIGHT CIRCUITRY

INPUT B AMPLIFIER AND BARGRAPH DETECTOR





PARTS LIST

LINE	QTY	REF	DESCRIPTION
1	1	A1	UTC150, Modified
2	1	A2	TCXO, timebase
3	1	A3	INVERTER, ,(BLB OPTION)
4	1	BY1	Audio Indicator, (BLB OPTION)
5	7	U1,2,5,6,9-11	MMIC, MAR6
6	1	U3	IC, MC10116P
7	1	U12	IC, 74LS00N
8	1	U13	IC, LM339N (BLB OPTION)
9	1	U14	IC, 74LS74N (BLB OPTION)
10	1	U7	IC, UPB582C
11	1	U8	IC, CA3199E
12	1	U4	IC, VREG, 7805
13	1	Q3	XSTR, FET, TMPF4416
14	2	Q1,2	XSTR, PNP, MMBR4957L
15	1	Q4	XSTR, NPN, PN2369A
16	1	Q5	XSTR, PNP, PN5139 (BLB OPTION)
17	1	Q6	XSTR, NPN, PN2222 (BLB OPTION)
18	6	CR6-9,12,13,14	DIODE, 1N6263A
19	2	CR10,11	DIODE, PIN, HSMP3800
20	5	CR1-5	DIODE, 1N4004
21	1	CR14	DIODE, LED, RED T1
22	1	L1	CHOKE, 3.9 uHy
23	7	L2-8	CHOKE, 100 uHy
24	1	C1	CAP, LYTIC, 4700uF 16V RADIAL
25	2	C2,19	CAP, LYTIC, 330uF 16V RADIAL
26	30	C3-8,12,18,21,33,37, 39,42,43,45-48,50,52, 53,55-61,64,65	CAP, CHIP, .1uF 50V
27	1	C15	CAP, CHIP 220pF 50V
28	1	C16	CAP, CHIP 3.3pF 50V
29	1	C17	CAP, CHIP 33pF 50V
30	24	C22,23,25-32,34-36,38,40, 41,44,49,51,66,67,68,69,70	CAP, CHIP .001uF 50V
31	1	C24	CAP, LYTIC, 47uF 6.3V RADIAL
32	1	C54	CAP, TANT, 47uF 6V SMOUNT
33	1	C62	CAP, LYTIC, 22uF 6.3V RADIAL
34	6	C9,10,11,13,71,72	CAP, TANT, 47uF 6V DIPPED
35	1	C73	CAP, CHIP 22pF 50V
36	1	R1	RESISTOR, 75 OHM 1/2W 5%
37	1	R2	RESISTOR, CHIP, 39 OHM 1/8W 5%
38	1	R3	RESISTOR, CHIP, 150 OHM 1/8W 5%
39	28	R4,5,8-11,14-17,20,27, 40-44,46,47,49,54-60,64	RESISTOR, CHIP, 1K OHM 1/8W 5%
40	4	R6,7,12,19	RESISTOR, CHIP, 100 OHM 1/8W 5%
41	2	R13, 26	RESISTOR, TRIMMER, 500 OHM
42	1	R18	RESISTOR, 51 OHM 1/8W 5%
43	1	R21	RESISTOR, CHIP, 910K OHM 1/8W 5%

LINE	QTY	REF	DESCRIPTION
44	1	R22	RESISTOR, CHIP, 91K OHM 1/8W 5%
45	1	R23	RESISTOR, 1.6 OHM 1/2W 5%
46	1	R24	RESISTOR, CHIP, 10K OHM 1/8W 5%
47	1	R25	RESISTOR, CHIP, 1.8K OHM 1/8W 5%
48	1	R28	RESISTOR, TRIMMER, 1K OHM 15 TURN
49	1	R29	RESISTOR, TRIMMER, 5K OHM 15 TURN
50	1	R30	RESISTOR, CHIP, 1 MEG OHM, 1/8W 5%
51	5	R31,32,48,51,52	RESISTOR, CHIP, 510 OHM 1/8W 5%
52	2	R33,34	RESISTOR, CHIP, 75 OHM 1/8W 5%
53	2	R35,36	RESISTOR, CHIP, 82 OHM, 1/8W 5%
54	1	R37	RESISTOR, CHIP, 91 OHM 1/8W 5%
55	1	R38	RESISTOR, TRIMMER, 100K OHM
56	1	R39	RESISTOR, 33K OHM 1/8W 5%
57	1	R45	RESISTOR, CHIP, 47 OHM 1/8W 5%
58	1	R50	RESISTOR, CHIP, 2.2K OHM 1/8W 5%
59	1	R53,61,63	RESISTOR, TRIMMER, .5K OHM
60	1	R62	RESISTOR, TRIMMER, 1K OHM
61	2	R65-66	RESISTOR, 47 OHM 1/4W 5%
62	1	R201	RESISTOR, POT, 250 OHM 1/8 in SHAFT
63	1	RY1	RELAY, DPDT, 5V COIL
64	1		PC BOARD, 8030
65	1		CABINET Assembly
66	1		Label, front panel
67	1		Label, rear panel
68	1	O1B MP	Feet and Bail Assembly
69	1	ME171-4263	JACK, DC POWER INPUT
70	2	UG1094U	CONNECTOR, BNC
71	1	R141 306 000	Conn., BNC Crimp, Bulkhead
72	1	R114 082 020	Conn., SMB, Plug
73	1	R114 426 020	Conn., SMB, PC Jack
74	1		Cable, coax, RG316U, 6 in lngth
75	1	AC90	AC ADAPTER, 9V DC 500 ma
76	7	PHA 002UNEENG001I	SWITCH, PUSHBUTTON, PUSH/PUSH, IVORY
77	1	PHA 0024NEENG001R	SWITCH, PUSHBUTTON, PUSH/PUSH, RED
78	3	PHA 002UNOANG001I	SWITCH, PUSHBUTTON, MOMENTARY, IVORY
79	1		KNOB, BLACK, 1/8 SHAFT
80	1		HEADER, 14PIN DUAL ROW
81	1		JACK, 2.5MM PHONE, PC MOUNT

INTERNAL ADJUSTMENTS

Circuit Reference	Function	Comments
R19	Input B signal level input to Bargraph.	Use to balance offset between input A and B Bargraph amplitudes.
R26	Trigger Center Control.	Apply 100mV 1Khz sinewave to input B and check for 50% duty cycle at U3 pin 15 with trigger control centered.
R38	Counter Input Bias.	Adjust so that counter triggers on 150 MHz signal of less than 500 micro volts amplitude. Note: at maximum sensitivity, counter will self-oscillate with input shorted.
R53	Ext Ref Bias Adj.	Bias adjustment for external reference detection circuit. Adjust for clean switch over when external 10MHz TTL compatible clock signal is applied.
R61	Audible indicator Threshold	Set full counter clockwise. Make final setting after adjusting R62 and R63 to move threshold.
R62	Pulsating Tone Set Level	Set with 150MHz, -20 dBm signal into input A.
R63	Steady Tone Set Level	Set with 150MHz, 0 dBm signal into input A.