OPTOELECTRONICS
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OPTOELECTRONICS

OWNER'S MANUAL

HANDI-COUNTER™ SERIES
3000, 2810, 2600H & 2600HA

Your *OPTOELECTRONICS* 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

The 3000, 2600H, 2810 & 2600HA are advanced handheld frequency counters incorporating many unique functions that are usually found only on laboratory bench models.

These counters are designed for virtually every measurement application from near DC through Microwave including measuring RF transmission frequencies at the maximum possible distance.

The 3000 does all of this and is also the world's first Handheld Multifunction Counter Timer with Period, Time Interval, and Ratio measurement capability.

FEATURES:

- 10 Digit LCD Display with Gate, Function, and Input Annunciators.
- Direct count (1Hz resolution in 1 sec) to over 200 MHz.
- 16 segment RF signal strength bargraph displays input signal level. Ensures reliable counting, proven effective in locating concealed transmitters. (2600H & 3000 only)
- High Accuracy, 1ppm 10 MHz Crystal Time Base is standard with optional 0.2 ppm TCXO available.
- More usable sensitivity than any other counter for efficient antenna pick up measurements.
- Hold button locks detected frequency on display.
- Four push-button selectable Gate times.
- NiCad battery pack and AC-Charger/Adapter included.
- Extruded aluminum case.

3000 FEATURES:

- In addition to Frequency, Direct and Prescale, functions include: Period, Ratio, Time Interval and Average.
- Single-Shot Time Interval 100 ns, .1 ns averaged.
- Two input channels: High Impedance and 50 ohm inputs. (Also 2810.)

SPECIFICATIONS

INPUT

	INPUT "B" (3000 & 2810 only)	INPUT "A"
Range:	10Hz to 50MHz	1MHz to 2.4GHz
Typ. Max. Freq. @ 25°C	80MHz	3GHz
Input Impedance:	1 MEGOHM, 30pF	50 OHM vswr < 2:1
Input Coupling:	AC	AC
Connector Type:	Female BNC	Female BNC
Maximum Input Voltage:	100V rms	+ 15dBm

⚠ CAUTION

Damage may occur to the counter if the Maximum Power Input is exceeded. Damage occuring from input overload is not covered by your warranty. See warranty for details. Never direct couple a transmitter output to the counter input. When using an antenna, always hold the counter at least several feet away from transmitter's outputting 5 watts or more. Transmitter's outputting over 10 watts should be read from even greater distances.

Sensitivity:	<10mV 10Hz-20MHz <20mV to 50MHz	<1mV 10-200MHz <5mV to 2GHz, <10mV to 2.4GHz

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)
200MHz Direct Count	.0l	100	200.000 0
(230MHz typical	.1	10	200.000 00
"A" or "B" input)	1	1	200.000 000
	10	.1	200.000 000 0
800MHz Prescaled by 4	.04	100	800.000 0
(920MHz typical	.4	10	800.000 00
"A" Input)	4	1	800.000 000
3000MHz Prescaled by 16	.16	100	3000.000 0
("A" input)	1.6	10	3000.000 00
	16	1	3000.000 000

SPECIFICATIONS CONTINUED

RF SIGNAL STRENGTH BARGRAPH (3000 & 2600H only)		
16, 3dB Segments, driven by signal into input "A". Sensitivity varies with zero and full scale adjustments.		
FREQUENCY	**SEGMENT #1 THRESHOLD**	**# SEGMENTS ON WITH** OdBm input.
27 MHz	-40dBm	16
150 MHz	-40dBm	16
450 MHz	-33dBm	12
850 MHz	-10dBm	6

ADDITIONAL 3000 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 Adjust: through front panel
Option: TCXO 30 - Precision ± 2ppm 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 battery pack voltage falls below 4.75V +/-.25V. (3000 & 2600H only)

Annunciators: (Not used in all models) Frequency, Period, Time Interval, Ratio, Average, MHz, nS, mS. Low Batt, Prescale, Gate times and Intervals/Periods Averaged.

Size: 5.3" high x 3.9" wide x 1.4" deep. Weight: 15 oz.

Cabinet: Extruded aluminum, black paint finish.

Power: 110VAC, 60Hz to 9VDC, 300-500mA (nominal), center-positive, AC-Charger/Adapter. Approximately 2+ hours operation from single internal NiCad Battery pack in the 3000. The 2600HA power consumption is 20% less with proportionately longer battery discharge cycle. Optional second pack for extended operation. 16 hour recharge from AC-Charger/Adapter.

OPERATOR CONTROLS

PWR:
On: Counter is powered "ON". Internal NiCad batteries 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.
AC-Chg: Counter is powered "OFF". NiCad batteries will be charged at the maximum permissible rate when unit is connected to external wall plug adapter.

RANGE:
200MHz: 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. (Note: The term "prescaled" means that the frequency of the input is reduced by an integer value before being counted. Prescaling is a means by which the range can be extended.)

800MHz/3000MHz: Selects between the 10MHz to 800MHz prescale range and the 100MHz to 3000MHz prescale range. This switch is active only if the 200MHz switch is in the down position.

HOLD: Display hold. Causes the most recent information displayed on the LCD display to be held until the switch is returned to it's 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 it's normal (OFF) position to enable the LCD display. This switch parallels the Gate push-button and will cause the gate selected to increment to the next higher selection every time the Hold is activated and returned to normal. Holding down any of the three push-button switch controls (one in the 2600H) will cause the LCD display to hold until the button is released.

GATE: Momentary push-button selects measurement sample period . Continuing to depress the Gate push-button will step the counter through the available gate measurement periods. The time between measurement periods (housekeeping interval) is 40 milliseconds.

In Direct Frequency Mode, Gate times of .01, .1, 1 and 10 seconds are selected by depressing the button 1, 2, 3, or 4 times. The gate selected is indicated in the LCD display.

When Prescale, 800MHz switch positions are selected, the gate times become .04, .4, and 4 seconds (there is no 40 second gate). The gate selected is indicated by the LCD display. 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.

OPERATOR CONTROLS CONTINUED

Selecting Prescale, 3000MHz 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.

(3000 only) Period and Time Interval Average are selected by depressing the "GATE" button. The number of periods or intervals averaged will be displayed by the LCD. Depressing the Gate switch once will cause the LCD to indicate 10 periods/intervals averaged and the word Average will appear in the display. Time units appropriate to the measurement will also be displayed. Further depressing the Gate button will cause 100 or 1000 periods/intervals to be averaged. The number of significant digits displayed increases by one each time the number of periods/intervals averaged increases.

Depressing the Gate button when the Ratio function is selected increases the number of digits to the right side of the decimal point. The gate indication and count resolution will change as follows: .01-5 digits; 0.1-6 digits; 1.0-7 digits; 10-8 digits.

(3000 & 2810 only)
INPUT A/B: Momentary push-button selects the counter input and amplifier from which signals are to be counted. (See specifications for A & B input characteristics.)

(3000 only)
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 goes 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.

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.

BARGRAPH OPERATION (3000 & 2600H only):
Function: Sixteen segment relative signal strength bargraph. Each segment approximates a 3 dB signal increment. See specifications for typical absolute calibration values.

Zero Adjust: Screwdriver adjust for bargraph zero segment calibration. Use slotted screw driver with care to prevent damaging the plastic adjustment pot. This control can be used to offset background signal level for applications such as security sweeps.

Full Scale Adjust: Internal adjustment, potentiometer R2, is factory set for 0dBm at 150 MHz.

Operation: The bargraph will respond to signal levels at the "A" 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 800MHz/3000MHz switches. If the bargraph indicates sufficient signal level but the counter is not locked on to anything then check these switches.

INDICATORS
LCD Display: 10, .25 inch high LCD digits indicate frequency. The decimal is automatically placed in the correct position and the units are displayed. Leading zeros to the left of the decimal point are blanked. LCD annunciators display the function selected, the gate or measurement period selected, the input selected, prescale selected, the relative signal strength of the "A" input, and low battery condition. There may be some unused annunciators in the display.

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 operating then the main counter integrated circuit is active and the time base circuitry (system clock) is functional.

RECHARGEABLE BATTERY OPERATION

The counter can operate several hours from fully charged internal NiCad batteries when the "PWR" switch is in the "BATT" or "ON" position. The batteries are charged when the unit is powered by the AC-Charger/Adapter and the "PWR" switch is in the "AC-CHG" position. 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 AC- Charger/Adapter. If the optional NiCad 30 battery pack is installed the recharge time will be the same because as both battery packs are charged in parallel. 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 several years, however, it is recommended that the counter be checked inside after the first year of operation for any sign of battery leakage or corrosion. Replace all batteries if any visible damage is observed.

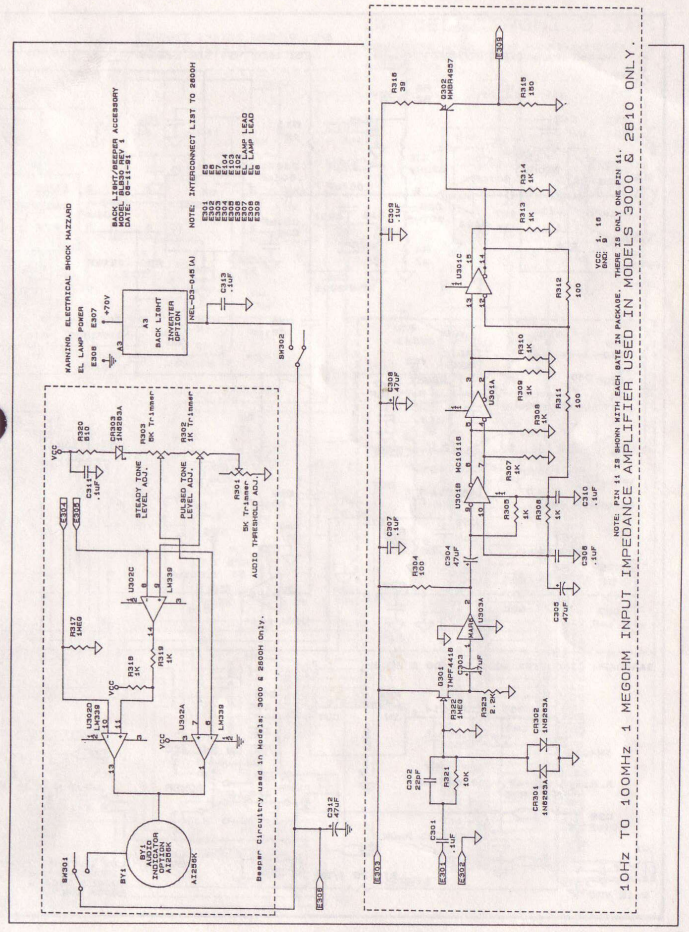
To inspect the NiCad battery packs it is necessary to open the cabinet. This is accomplished by removing two machine screws from each end of the cabinet and removing the top cover. Take care not to pinch any of the battery wires. Excessive currents could flow damaging the batteries.

CAUTION

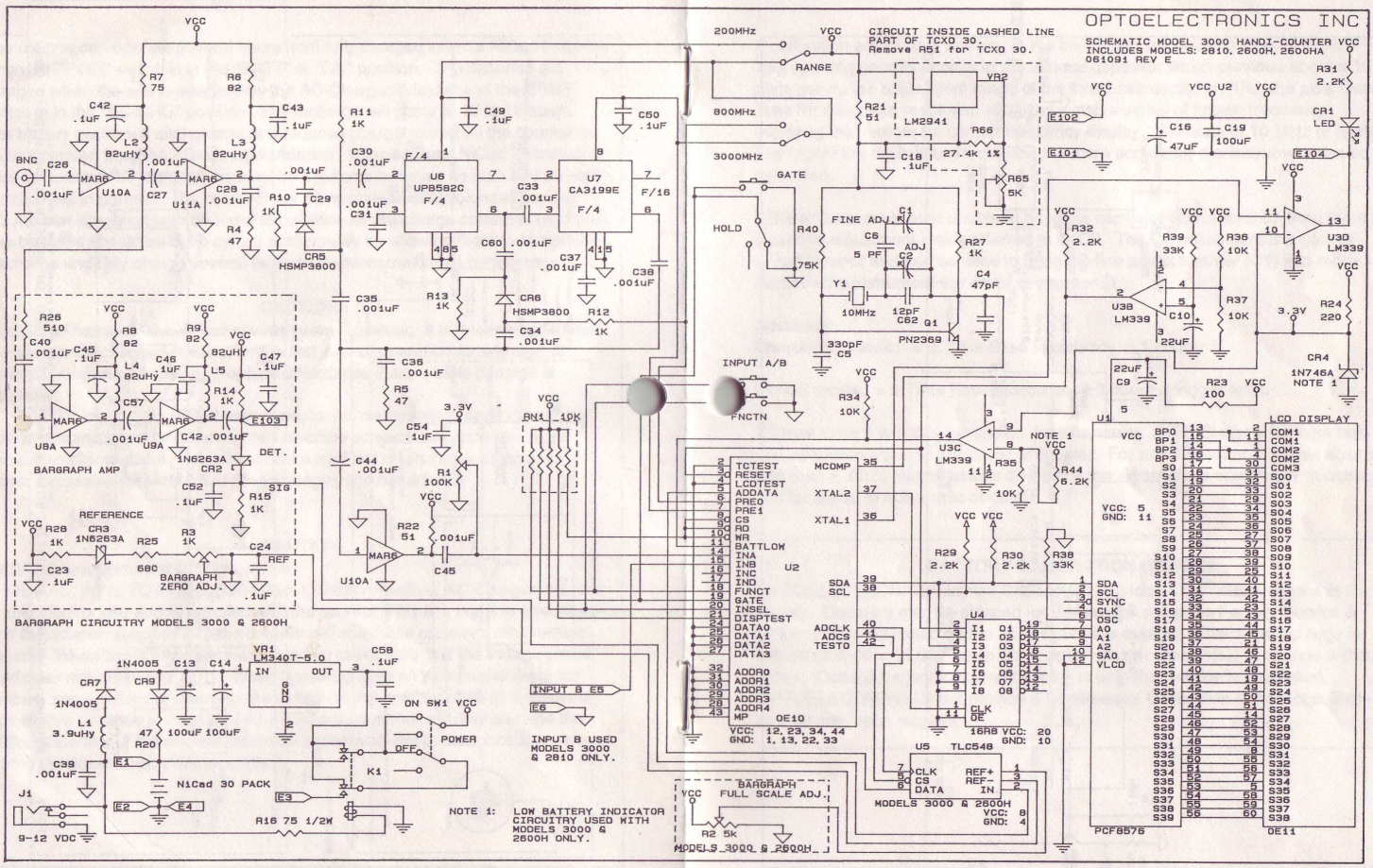
110V AC and External DC Operation

A 110V AC, 60Hz TO 9V DC, 300-500mA, Center-Positive, AC-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.

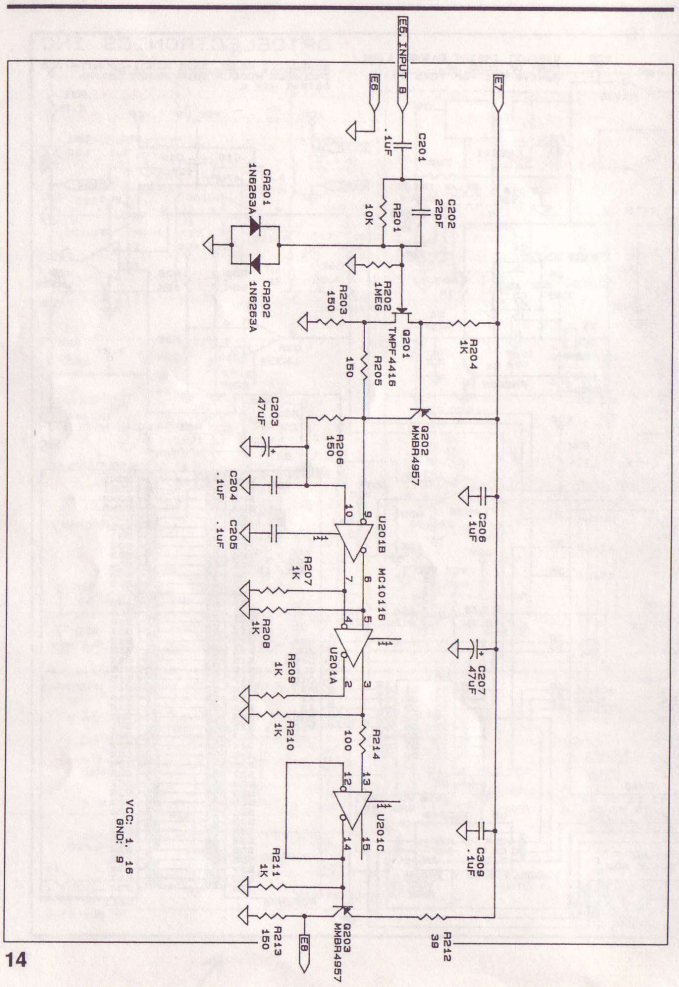
SCHEMATIC



SCHEMATIC


OPTOELECTRONICS INC
SCHEMATIC MODEL 3000 HANDI-COUNTER VCC
INCLUDES MODELS: 2810, 2600H, 2600HA
061091 REV E
CIRCUIT INSIDE DASHED LINE
PART OF TCXO 30.
Remove R51 for TCXO 30.
200MHz
800MHz
3000MHz
RANGE
GATE
HOLD
INPUT A/B
FNCTN
BARGRAPH AMP
REFERENCE
BARGRAPH CIRCUITRY MODELS 3000 & 2600H
BARGRAPH ZERO ADJ.
BARGRAPH FULL SCALE ADJ.
MODELS 3000 & 2600H
INPUT B USED MODELS 3000 & 2810 ONLY.
INPUT B E5
E6
NOTE 1:
LOW BATTERY INDICATOR CIRCUITRY USED WITH MODELS 3000 & 2600H ONLY.
NiCad 30 PACK
9-12 VDC
ON SW1 VCC
POWER
OFF
K1
LCD DISPLAY
PCF8576
16R8
TLC548
LM2941
LM339
LM340T-5.0
UP8582C
CA3199E
ICM7216E
PN2369
1N6263A
1N4005
1N746A
HSMP3800
MODELS 3000 & 2600H
VCC: 12, 23, 34, 44
GND: 1, 13, 22, 33
VCC: 5
GND: 11
VCC: 20
GND: 10
VCC: 8
GND: 4

SCHEMATIC



CALIBRATION

A calibration adjustment opening in the instrument top cover is labeled "CAL". 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.

If this adjustment is ever unable to bring the oscillator into calibration then there is a second adjustment inside referred to as C2. The C2 adjustment is a coarse adjust trimmer and can be used to bring the fine adjust trimmer (C1) into range. Remove the instrument top cover to access C2.

Accuracy:
Frequency mode: = ± Time Base Inaccuracy ± 1 count

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

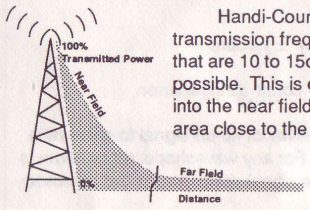
Trigger Error: is < .3% per period for sine waves of 40 dB signal to noise ratio and amplitude equal to sensitivity of counter. For any waveshape, trigger error is less than ± .0025 microseconds divided by the signal slope in volts per microsecond for signal to noise ratio of 40 dB.

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.

USING THE COUNTER

Low-cost Handi-Counters™ (Handheld Frequency Counters) such as the *OPTOELECTRONICS'* Models 3000, 2600H 2810 & 2600HA 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 *OPTOELECTRONICS'* Handi-Counters™ have sensitivity specified to 10 millivolts. The 3000, 2600HA, 2810 & 2600HA use 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 *OPTOELECTRONIC* Handi-Counters™ one of the worlds most sensitive frequency counters at any price!



Handi-Counters™ are unique in their ability to find RF transmission frequencies. Immediate response to frequencies that are 10 to 15db greater than the background RF level is possible. This is done by simply moving the Hand-Counter™ into the near field of the radio transmitter. The near field is the area close to the antenna where the field strength is high but falling off rapidly as distance increases. This is compared with the far field where the field strength is low but remains fairly constant over great distances. Handi-Counters™ work well at relatively close distances and can measure a transmission frequency rapidly without having to tune through the RF spectrum.

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. *OPTOELECTRONICS* 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 of 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.

PARTS LIST CONTINUED

BLB30 BACK LIGHT BEEPER OPTION

Item	Qty	Reference	Part
1	1	A3	NEL-D3-045(A)
2	1	BY1	AI256K
3	3	CR301,CR302,CR303	1N6263A
4	7	C301,C306,C307,C309-311,C313	.1UF
5	1	C302	22PF
6	5	C303,C304,C305,C308,C312	47UF
7	1	Q301	TMPF4416
8	1	Q302	MMBR4957
9	2	R301,R303	5K TRIMMER
10	1	R302	1K TRIMMER
11	3	R304,R311,R312	100
12	10	R305-310,R313,R314,R318,R319	1K
13	1	R315	150
14	1	R316	39
15	2	R317,R322	1MEG
16	1	R320	510
17	1	R321	10K
18	1	R323	2.2K
19	2	SW301,SW302	SW SPDT
20	1	U303	MAR6
21	1	U301	MC10116
22	1	U302	LM339

PRODUCT WARRANTY

OPTOELECTRONICS, INC. warrants its products and accessories for one (1) year against defects in materials and workmanship to the original purchaser. Products returned for warranty service will be repaired or replaced at *OPTOELECTRONICS'* option.

Specifically excluded are any products returned under this warranty that, upon examination, have been modified, had unauthorized repairs attempted, have suffered damage to the input circuitry from the application of an excessive input signal, have suffered damage to the charging circuitry or internal batteries from application of excessive voltage or show other evidence of misuse or abuse. *OPTOELECTRONICS* reserves sole right to make this determination.

No other warranties are expressed or implied, including but not limited to, the implied warranties of merchantability and fitness for a particular purpose. ***OPTOELECTRONICS, INC.*** is not liable for consequential damages.

PARTS LIST

Item	Qty	Reference	Part
1	1	BT1	NiCad 30 BATTERY
2	1	CR1	LED, RED, T1
3	2	CR2,CR3	1N6263A
4	1	CR4	1N746A
5	2	CR5,CR6	HSMP3800
6	2	CR7,CR9	1N4005
7	2	C1,C2	CAP VAR, 2-7pF NPO
8	1	C4	47PF
9	1	C5	330PF
10	1	C6	5 PF
11	2	C9,C10	22UF
12	2	C13,C14	100UF
13	1	C16	47UF 6.3V
14	13	C18,23-24,42-43,45-47,49-50,52,54,58	.1UF
15	1	C19	100UF 16V
16	19	C26-31, C33-40,C42,C44,C45,C57,C60	.001UF
17	1	C62	12PF
18	1	J1	9-12 VDC
19	1	J2	BNC
20	1	K1	RELAY DPDT, 5V
21	1	LCD DISPLAY	OE11
22	1	L1	3.9UHY
23	4	L2,L3,L4,L5	82UHY
24	1	Q1	PN2369
25	1	RN1	10K
26	4	R34,R35,R36,R37	10K
27	1	R1	100K
28	1	R2	5K
29	9	R3,R10-15,R27,R28	1K
30	3	R4,R5,R20	47
31	3	R6,R8,R9	82
32	1	R7	75
33	1	R16	75 1/2W
34	2	R21,R22	51
35	1	R23	100
36	1	R24	220
37	1	R25	680

Item	Qty	Reference	Part
38	1	R26	510
39	4	R29,R30,R31,R32	2.2K
40	2	R38,R39	33K
41	1	R40	75K
42	1	R44	6.2K
43	1	R65	5K
44	1	R66	27.4K 1%
45	1	SW1	SW DPDT
46	3	SW2,SW3,SW4	SW SPDT
47	3	SW5,S6,S7	SW PUSHBUTTON
48	1	U1	PCF8576
49	1	U2	OE10
50	1	U3	LM339
51	1	U4	16R8
52	1	U5	TLC548
53	1	U6	UPB582C
54	1	U7	CA3199E
55	4	U8,U9,U10,U11	MAR6(MSA0685)
56	1	VR1	LM340T-5.0
57	1	Y1	10MHZ

HZA 1 MEGOHM IMPEDANCE 10Hz-40MHz AMP USED IN 3000 & 2810

Item	Quantity	Reference	Part
1	2	CR201,CR202	1N6263A
2	5	C201,C204,C205,C206,C309	.1UF
3	1	C202	22PF
4	2	C203,C207	47UF
5	1	Q201	TMPF4416
6	2	Q202,Q203	MMBR4957
7	1	R201	10K
8	1	R202	1MEG
9	4	R203,R205,R206,R213	150
10	6	R204,R207,R208,R209-211	1K
11	1	R212	39
12	1	R214	100
13	1	U201	MC10116