VALHALLA SCIENTIFIC, INC.

4314 SERIES
DIGITAL IGNITER TESTERS

OPERATION MANUAL

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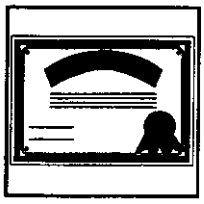
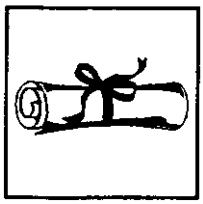
CERTIFICATION



Valhalla Scientific, Inc. certifies that this instrument was thoroughly tested and inspected and found to meet published specifications when shipped from the factory. Valhalla Scientific, Inc. further certifies that its calibration measurements are traceable to the National Institute of Standards and Technology to the extent allowed by NIST's calibration facility.

WARRANTY



The warranty period for this instrument is stated on your invoice and packing list. Please refer to these to determine appropriate warranty dates. We will repair or replace the instrument during the warranty period provided it is returned to Valhalla Scientific, Inc. freight prepaid. No other warranty is expressed or implied. We are not liable for consequential damages. Permission and a return authorization number must be obtained directly from the factory for warranty repairs. No liability will be accepted if returned without such permission. Due to continuing product refinement and due to possible parts manufacturer changes, Valhalla Scientific reserves the right to change any or all specifications without notice.

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SECTION I UNPACKING AND INSTALLATION

1-1. Introduction

The Valhalla Series 4314 Igniter Testers are widely accepted as the standard in the industry, and are designed to provide extremely safe and reliable resistance testing of explosive or volatile devices. Some of the proven uses include: fuses, squibs, igniters, explosive bolts, automobile airbag initiators and many others.

Essentially, a Model 4314 is a 4-wire ohmmeter which has been designed to use very low test currents for its measurement. Additional circuitry proprietary to Valhalla Scientific is used to ensure that test current levels do not exceed the specified "failsafe current" even in a worst-case component failure situation. The failsafe feature is tested in every instrument before shipment and the results provided to the customer on a data sheet that accompanies the unit.

The 4314 series consists of approximately 15 different versions spanning the measurement range from 1mΩ resolution to 100MΩ full scale. The most popular of these versions are listed in Table 2-1. The 4314 may have a maximum of four (4) ranges installed at any one time. Unless otherwise specified when placing the order, the Model 4314A is the standard configuration. Please check Section 7 for any addendums that may apply to special 4314 versions.

Recently added as a standard feature of the 4314 is a **battery monitoring** circuit that alerts the user if the batteries have become or will soon become unusable. Please refer to section 4-8 for more details.

1-2. Inspection

If the shipping carton is damaged, request that the carrier's agent be present when the unit is unpacked. If the instrument appears damaged, the carrier's agent should authorize repairs before the unit is returned to the factory. Even if the instrument appears undamaged, it may have suffered internal damage in transit that may not be evident until the unit is operated or tested to verify conformance with its specifications. If the unit fails to operate or fails to meet the performance specifications of Section 2, notify the carrier's agent and the nearest Valhalla Sales Office. Retain the shipping carton for the carrier's inspection. DO NOT return equipment to Valhalla Scientific or any of its sales offices prior to obtaining authorization to do so.

1-3. Power Requirements

The Model 4314 is powered by an internal rechargeable heavy-duty nickel-cadmium battery pack. The battery charge is maintained by an external AC/DC converter that plugs into a standard 115VAC receptacle. The AC adapter provides 6VDC @ 300mA.

For safety reasons, the 4314 may not be powered directly from the AC adapter. The 4314 must be turned *off* and have the adapter connected in order to charge the batteries. The battery pack may power the 4314 for up to 10 hours before requiring a recharge.

Although the batteries are fully charged prior to shipment, it may be desirable to refresh the charge for 24 hours before use. As a rule of thumb, the 4314 requires twice as much time to fully recharge as

the amount of discharge time. For example, if the instrument was used continuously for 2 hours, the AC adapter must be connected for 4 hours in order to fully restore the charge.

1-4. Installation

The Model 4314 consumes little power and generates virtually no heat. Consequently, it may be used in any area where the environment does not exceed the specifications of Table 2-2.

A rack mount adapter is available to allow installation of the 4314 in a standard 19" equipment rack. This option is designated as Option R4. When installing this instrument in a rack environment, avoid exposing the 4314 to extremes of temperature which will affect accuracy and shorten battery life-span. For installation instructions, please refer to the drawing included with the option.

SECTION II SPECIFICATIONS

Table 2-1. Partial Listing of Available 4314 Versions [1]

4314	RANGE/RESOLUTION TEST CURRENT/FAILSAFE CURRENT[2]				NOTES
A	20Ω/1mΩ	200Ω/10mΩ	2kΩ/0.1Ω	20kΩ/1Ω	Standard Version
	10mA/16mA	1mA/1.8mA	100µA/180µA	10µA/18µA	
B	--	200Ω/10mΩ	2kΩ/0.1Ω	20kΩ/1Ω	20Ω Range Deleted
	--	1mA/1.8mA	100µA/180µA	10µA/18µA	
AN	20Ω/1mΩ	200Ω/10mΩ	2MΩ/100Ω	20MΩ/1kΩ	20MΩ measurement capability
	10mA/16mA	1mA/1.8mA	0.1µA/0.18µA	10nA/18nA	
UK	20Ω/1mΩ	200Ω/10mΩ	2kΩ/0.1Ω	20kΩ/1Ω	Reduced Test & Fail Safe Currents
	5mA/8mA	0.5mA/1.8mA	50µA/180µA	5µA/18µA	
KB	20Ω/1mΩ	200Ω/10mΩ	2kΩ/0.1Ω	20kΩ/1Ω	Charger & fuseholder on front panel
	5mA/8mA	0.5mA/1.8mA	50µA/180µA	5µA/18µA	
N	200Ω/10mΩ	2kΩ/0.1Ω	2MΩ/100Ω	20MΩ/1kΩ	High Resistance, Low Currents
	1mA/1.8mA	100µA/180µA	0.1µA/0.18µA	10nA/18nA	
AP	20Ω/1mΩ	2kΩ/0.1Ω	200kΩ/10Ω	100MΩ/10kΩ	100MΩ measurement capability
	10mA/16mA	100µA/180µA	1µA/1.8µA	1nA/1.8nA	
GD	20Ω/1mΩ	20kΩ/1Ω	200kΩ/10Ω	20MΩ/1kΩ	20MΩ measurement capability
	10mA/16mA	10µA/18µA	1µA/1.8µA	10nA/18nA	
LK	20Ω/1mΩ	200Ω/10mΩ	2kΩ/0.1Ω	200kΩ/Ω	Reduced Test & Fail Safe Currents
	5mA/8mA	.5mA/1.8mA	50µA/180µA	0.5µA/1.8µA	
SPECIALS	For more models check our web site www.valhallascientific.com For special requests call 858-457-5576				

[1] If a particular version is not represented here, also refer to Section 7.

[2] Upper Limit of Fail Safe Current. Actual Fail Safe currents vary from instrument. The actual measured level is provided on the Final Calibration Data Sheet.

Table 2-2. Specifications

Accuracy: **(for 1 year @25°C ± 10°C)**

20Ω through 20000Ω ranges	±0.02% of rdg ±0.02% of rng
200KΩ range	±0.05% of rdg ±0.05% of rng
2MΩ range	±1% of rdg ±0.2% of rng
20MΩ range	±2% of rdg ±0.2% of rng
100MΩ range	±3% of rdg ±1% of rng

Temperature Coefficient

20Ω through 20KΩ ranges	±0.002% per °C (from 0°C-15°C and 35°C-50°C)
200KΩ range and above	not applicable

Temperature Range

Operating	0°C to 50°C
Storage	-10°C to 70°C

Display Type . . . . . 4½ digit Light Emitting Diodes (LED) (19999)

Overload Indication . . . . . Display flashes

Conversion Rate . . . . . Approximately 300ms

Terminal Configuration . . . . . Four-wire Kelvin

Maximum Input . . . . . 250VDC or AC_{peak} without damage

Current Source Compliance Voltage . . . . . clamped at 1.6 volts

Power . . . . . (4 "D") 1.2V rechargeable nickel-cadmium batteries

Battery Charger . . . . . provides 6VDC at 300mA nominal

Dimensions . . . . . 9½"(24cm)W x 11"(27cm)D x 3"(8cm)H

Weight . . . . . 3.5lbs(1.6kg) net; 6.5lbs(3kg) shipping

SECTION III OPTIONAL EQUIPMENT

3-1. Available Options

Listed below are the options available for use with the Model 4314 Series Digital Igniter Testers.

Option A: Battery Charger

Option "A" is an AC/DC converter that converts 115VAC line voltage to 6VDC at 300mA. One charger is provided as a standard accessory with every 4314.

Replacement Batteries

The rechargeable Nicad batteries installed in the 4314 should provide years of trouble-free operation. Replacement, however, will eventually be necessary. The 4314 uses four 1.2V cells installed in a reusable battery box. The batteries are held in place by reusable tie-wraps. When ordering replacement batteries, please specify Valhalla Stock #05-10117, quantity four (4).

Option CC4: Carrying Case

Option "CC4" is a meter and accessory carrying case with extra room for test leads, battery charger, etc.

Option R4: Rack Mount Adapter

Option "R4" is an adapter tray that allows the 4314 to be installed in a standard 19" equipment rack.

Option BCD-MX: Data Outputs

Option "BCD-MX" provides multiplexed binary-coded-decimal data outputs that may be used by various types of data acquisition equipment. Refer to section 4-7.

Model 1248: Dual-Limit Comparator

The Valhalla Model 1248 may be used in conjunction with a Model 4314 and Option BCD-MX above. The Model 1248 is a dual-limit comparator that interprets the display indications of the 4314 as either "HI", "LO" or "GO", based on a window that is set by the user. Relay contact closure is provided to trigger an alarm, batch sorter, counter or other device. The mating cable from the 4314 to the 1248 is 2½ feet in length and designated as "IDC-2".

3-2. Test Leads

Option K: 4-Wire Kelvin Lead Set

Option "K" is the recommended general purpose lead set for all Valhalla Ohmmeters. Option K is a shielded 48" lead set terminating in ½" gold plated clips.

Option MP-S: Single Probe Lead Set

Option "MP-S" is a 4-wire lead set terminated in single points. The 4-wire configuration is maintained up to the point of the probe, eliminating most cable resistance effects. Option MP-S may be used where a single probe tip is a must.

Option MP-1: Kelvin Micro-Probes

Option "MP-1" is a 48" shielded lead set terminated in spring-loaded steel tips with .05" spacing.

Option MP-2: Kelvin Mini-Probes

Option "MP-2" is a 48" shielded lead set terminated in spring-loaded steel tips with .18" spacing.

Option MP-4/MP-5: Surface Probes

These probes permit rapid, repeatable bonding testing on a variety of screened or flat surfaces. Test current is evenly distributed through the probe base while sensing is accomplished via a spring loaded center contact. The "MP-4" target area is 1" in diameter. The "MP-5" target area is .4" in diameter.

Option KK: 4-Wire Kelvin Lead Set

Option "KK" is a 48" heavy duty cable set terminated in large "jaws" that have an open span of 2".

Option C: Banana-to-Clip Cable

Option "C" is a 48" shielded cable terminated in dual alligator clips. Two cables are provided for use with Valhalla ohmmeters.

Option BBL: Banana-to-Banana Cable

Option "BBL" is a 48" shielded cable terminated in dual banana plugs at both ends.

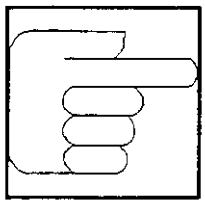
Option KCS: Kelvin Clips

Option "KCS" are the gold plated kelvin clips used on the Option "K" cable. These clips may be used when making custom cables or when repairing Option "K".

Option JAWS: Heavy-Duty Clips

Option "JAWS" are the jumper cable type clips used on the Option "KK" cable. These may be used when making custom cables or when repairing Option "KK".

SECTION IV OPERATION



4-1. General

This section of the manual contains complete operating instructions for the 4314 Series Digital Igniter Testers. A description of the front panel controls, connection instructions, and the theory behind 4-wire resistance measurement is discussed in this section.

4-2. Front Panel

» Power Switch

When the front panel power switch is placed in the OFF/CHARGE position, all power is removed from the output terminals, and the battery pack is connected to the charging circuit. When the switch is placed in the ON position, the battery pack is disconnected from the charging circuit. The possibility of a common mode voltage between the device under test and AC Power ground is therefore eliminated. The operator need not be concerned if the Battery Charging Adapter is plugged in while making resistance measurements.

» Range Switch

The Model 4314 input range is selected by depressing the desired button on a multistation interlocking pushbutton array located on the right-hand side of the front panel. The pushbutton for the lowest resistance range is nearest to the POWER switch.

4-3. Rear Panel

» Fuseholder

The fuseholder is mounted on the rear panel and contains a 2 amp in-line fuse. This fuse is designed to protect the battery pack from excessive charging currents. On Model 4314KB this fuseholder is mounted on the front panel. Replace blown fuses with the same type and rating only!

» Charging Jack

The battery charging jack is a barrel type and is located on the 4314 rear panel. The center pin of the connector is positive. The charging requirements of the internal battery pack are 6VDC @300mA. The correct charging voltage is supplied by the adapter included with the instrument. Additional adapters are available as Option "A". The charging jack is mounted on the front panel on Model 4314KB.

4-4. 4-Wire Resistance Measurement

The four-terminal configuration of the 4314 eliminates errors normally caused by test lead and contact resistances. In many applications the contact resistance can exceed the value of the load by several orders of magnitude. The 4314 bypasses this potential error source by providing two terminals of constant current and an additional two terminals for high impedance voltage measurement. The result is a fast, accurate resistance measurement of the load, independent of the resistance of the current carrying leads.

Figure 4-1 illustrates how the 4-wire principle is used to eliminate lead, wire and contact resistances as potential error sources. The internal current source inherently overcomes all series resistance (within compliance voltage limits) and delivers a precise constant current.

The internal high-impedance DVM senses the voltage drop across the load. There is negligible contact and lead resistance error created by the voltage measurement because the high input impedance of the DVM limits current flow in the voltage leads.

4-5. Connections

Connections are made to the front panel terminals using a 4-wire configuration as described in section 4-4. When using Valhalla test leads, the tabbed side of the banana jack is plugged into the **current** terminals. This ensures that the current is carried in the largest conductor and that the voltage input is shielded.

V_{HI}* *I_{HI} ←Tab

V_{LO}* *I_{LO} ←Tab

All Valhalla ohmmeters use a high impedance voltmeter as part of the resistance measurement process. This voltmeter is a highly accurate and stable 4½ digit analog-to-digital converter (A to D). Unless it is receiving a definite input signal, the output reading of this A to D is ambiguous. The display may indicate a randomly wandering number or it may indicate an overrange condition. This unpredictable display may make it seem to appear that the instrument is experiencing some sort of malfunction. It is, in fact, just a characteristic of the voltmeter circuit and should not be mistaken for a fault in the instrument.

The display indications should be ignored unless there is a definite measurement being taken. If this wandering display is not acceptable, the ohmmeter can be made to indicate an overrange condition whenever the terminals are open by using a 4-wire Kelvin type lead set or by shorting the V_{HI} and I_{HI} terminals together.

The display should indicate a stable reading when the test leads are securely attached to the device under test. If the display appears to be erroneous when connected to a load, recheck the test leads for integrity and cleanliness. If all external items appear to be functioning properly, the problem may be the ohmmeter. In this case, please contact your local Valhalla Scientific Sales Office.

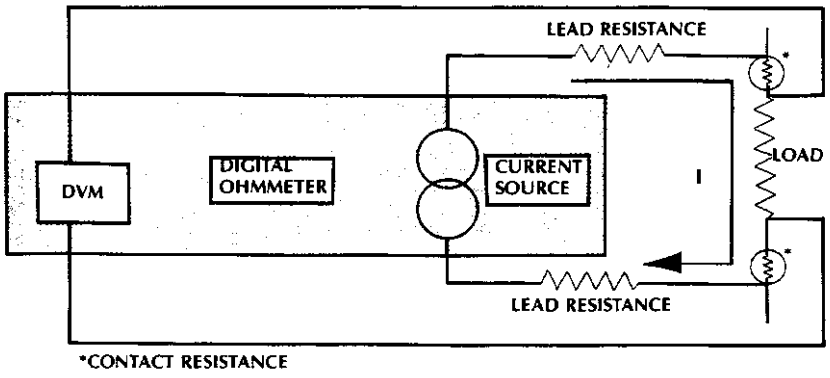


Figure 4-1. Error Sources in Resistance Measurements

4-6. Failsafe Operation

The 4314 Series Igniter Testers incorporate a proprietary current source design that renders them incapable of delivering excessive voltage or current to the device under test. The *typical* failsafe current for each range is indicated under the corresponding range switch on the 4314 front panel. Please refer to section 5-6 for a technical description of the failsafe circuitry.

Every 4314 Series Igniter Tester is thoroughly tested before it leaves the factory. These tests include a failsafe test that simulates a "worst case" failure condition. The resulting output current is recorded and provided on the data sheet included with every 4314.

As a further precaution the 4314 is isolated from the AC line whenever the POWER switch is in the ON position.

The 4314 receives its power from an internal rechargeable battery pack. The 4314 must be in the OFF/CHARGING position in order to charge the batteries.

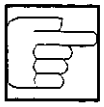
4-7. Option BCD-MX Connections

The 4314 may be equipped with an optional data output designated as Option BCD-MX. This option provides a multiplexed binary-coded-decimal output that may be interpreted by various types of data acquisition equipment. The outputs are compatible with the Valhalla Model 1248 BCD Comparator.

Table 4-1 lists the function of each pin of the rear panel connector. All outputs are TTL compatible, active-high, positive logic digital signals capable of driving one TTL load. The data is valid when the corresponding STROBE line is high (1).

Pin Numbers	Function
1, 6, 11, 16	1's Data Bit
2, 7, 12, 17	2's Data Bit
3, 8, 13, 18	4's Data Bit
4, 9, 14, 19	8's Data Bit
21	10,000 counts
29	10^0 STROBE
30	10^1 STROBE
31	10^2 STROBE
32	10^3 STROBE
22, 23, 24, 50	Common (GND)
5, 26, 33	+5VDC

Table 4-1. Option BCD-MX Connector Pin Assignments



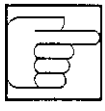
4-8. Battery Monitoring Circuitry

A standard feature of 4314's manufactured after December 3, 1993 is a circuit that monitors the output voltage of the internal battery supply. The indicator for this feature is located to the far left of the display window and is a red light bar " – ".

If this LED flashes during a measurement, this indicates that the batteries will require recharging within the next 2 hours of continuous use. Readings are still within specified accuracies at this point.

If the LED is continuously illuminated, readings should not be trusted. An overnight recharge should be performed before using the 4314 for critical testing.

☞ It is possible for the user to receive a low battery indication on a single range only (particularly the 20Ω range), while the 4314 remains well within operating limits on other ranges. **Unless the user observes a continuous low battery indication during measurement, readings are still valid.**



SECTION V THEORY OF OPERATION

5-1. General

The Valhalla Scientific Model 4314 Digital Igniter Tester is shown in block diagram form in Figure 5-1. All information disclosed in this section is proprietary and is included in order to make troubleshooting to component level possible.

The Model 4314 uses solid-state semiconductors exclusively and CMOS circuits extensively to minimize power requirements and make battery operation practical.

5-2. Troubleshooting

Malfunctions are often the result of misinterpretation of specifications or due to an incomplete understanding of the instrument. **A thorough review of the operating instructions for this instrument is recommended prior to any component replacement, etc.** Check to be sure that cables and other test equipment are in good working order before attempting to troubleshoot the 4314.

If the Model 4314 exhibits problems that cannot be eliminated by reviewing Sections 2 and 4, the following guidelines have been established to help solve the problem.

5-2-1. Localizing the Problem

The key to successful troubleshooting is to localize the problem as much as possible before trying to pin the problem down to a specific component. Certain questions should be asked such as "Does the problem occur on all ranges or on a specific range only?". The power supplies are also one of the first things that should be checked.

As it is not possible to anticipate all failure modes of the 4314, servicing personnel should become familiar with this section to gain a complete understanding of the internal workings of the Model 4314.

5-2-2. Component Replacement

If the problem has been identified as a faulty component, the accuracy of the 4314 can be maintained only if the following precautions are taken:

- Use only the specified component or its exact equivalent. Spare parts can be ordered from your nearest Valhalla Scientific Service Center or directly from the factory by referring to the Valhalla Stock Number listed in the Parts Lists section at the back of this manual.

- Use only 63/37 grade rosin core electronic grade solder with a 50W or lower maximum power soldering iron.

- When soldering, heat the terminal of the component, *not* the solder. Apply solder smoothly and evenly. Do not move the component until the solder has cooled. **Bad solder joints can cause additional problems!**

- Static sensitive parts require special handling procedures. Always treat an unknown part as if it were static sensitive.

5-3. Circuit Descriptions

The circuit descriptions which follow are referenced to Figures 5-1, 5-2, 5-3 and the schematic diagrams at the back of this manual. In the following descriptions, references to integrated circuits are given in the form "IC15-1", which refers to Integrated Circuit 15, pin 1.

5-4. Analog-to-Digital Converter

The Model 4314 incorporates a three-step analog-to-digital integration process to convert the output of the ohms-to-DC converter from analog to digital form (see Figure 5-2). Step 1, the RESTORE mode, lasts for 200 milliseconds. During this period the input to preamplifier IC12 is grounded through one section of quad-bilateral switch IC2. Sample-and-Hold switch Q15 is ON, closing the feedback loop around the integrator IC13 and zero detector IC14. This forces the zero detector output to zero, and capacitor C21 charges to the level of any offset voltage present in the preamplifier, integrator and zero detector. This charge on C21 will cancel the effect of any zero drift or offset originating in the analog section of the A/D converter.

With the capacitor C21 charged to offset any zero error present, the second step of the digitizing process begins. Q15 is switched OFF, opening the feedback loop, and the ohms-to-DC converter output is applied to the input of unity gain amplifier IC12. The output of this preamplifier is applied to the integrator input. During the 100-millisecond integration time, the integrator output rises to a level proportional to the amplitude of the input voltage. The output of the zero detector, which senses the integrator output, delivers a control voltage to the "D" input of flip-flop IC6-5.

At the end of the integration period, the input of IC12 is disconnected from the ohms-to-DC converter output, and the control signal at IC6-5 is clocked through the flip-flop to its "Q" output at IC6-1. This connects the reference voltage (E_{ref}) to the input of IC12. The polarity of E_{ref} is opposite to that of the ohms-to-DC converter output.

With E_{ref} applied to its input, preamplifier IC12 begins to charge in the opposite direction toward the negative value of E_{ref}. Time T_x (Step 3 of Figure 5-2) is the time required for the integrator voltage to decrease to zero volts, and is directly proportional to the output of the ohms-to-DC converter (E_x); that is: $E_x/E_{ref} = T_x/100$ milliseconds. Consequently, the value of E_x can be determined by measuring T_x.

The actual digitizing process is performed by IC7 counting the output of the crystal-controlled clock during Step 3. When the zero detector output passes through zero due to E_{ref} integration, the count initiated at the beginning of Step 3 is stopped, and the total is displayed on the LED readout. At the same time, the zero detector resets IC5 to begin the RESTORE mode again.

5-4-1. Reference Amplifier

The precision reference voltage required to perform Step 3 of the A/D conversion is developed by IC15. Current for the reference zener CR17 is derived from constant current source Q9. The zener voltage is sensed at IC15-3, and feedback from IC15-1 to IC15-2 sets the output at IC15-1 to approximately -1.05 volts. This voltage is applied to quad-bilateral switch IC2-1 and, during Step 3, to the voltage divider consisting of R22 through R24. Quad-bilateral switch IC3 connects -1 volt to the input of preamplifier IC12 from the arm of R23.

5-4-2. LED Display

At the completion of the A/D conversion, the count is stored in four registers of IC7. IC7 also contains an internal oscillator which is set by C4 to operate at 10 kHz. IC7 output terminals 2, 3, 23, and 24 are connected to decoder-driver IC10. These outputs are sequentially connected to the IC10 storage registers at a 10 kHz rate. Concurrently, driver transistors Q2 through Q5 are turned on in sequence. When data representing the most significant digit is available on IC10's outputs, Q5 is turned on and the decoded data appears on DS2. Data for each less significant digit appears sequentially at IC10's output as the corresponding driver transistors (Q4 through Q2) are turned on, and is displayed by DS3, DS4 and DS5. This sequence is repeated at the 10 kHz rate, and the data display consequently appears to be continuous. The MSB is enabled by IC7 through IC5 and Q17.

IC11 is a programmable oscillator that has an output of 100kHz at pin 1. Y1 is a 1MHz crystal that provides the base clock frequency for IC11. The output of IC11 is used to clock signals through the flip-flops and to sequence the display LED's.

5-5. Ohms-To-DC Converter

The ohms-to-DC converter generates a constant current which is passed through the device under test to develop the voltage measured by the A/D converter.

5-5-1. Constant Current Source

The constant current source is composed of IC15, IC17, Q8, DS6 and their associated components. The input to the constant current source is approximately +1.05 volts, developed at IC15-7 and connected to IC15-13 through R58 and R59.

The heart of the constant current source is the voltage-to-current converter, which incorporates a Transconductance Amplifier. A simplified schematic of this unique circuit is shown in Figure 5-3 and described in Section 5-5-2. The amplifier of IC15-12 is an invertor, and its output is applied to IC15-9. The amplifier of IC15-8 has unity gain due to the feedback through R74. Its output is applied to the inverting input of IC17-3. The output of IC17-6 provides feedback to the non-inverting input of IC15-10. This circuit operates to maintain the inverting input at IC17-3 and the non-inverting input at IC17-2 at the same potential.

5-5-2 Transconductance Amplifier (U.S. Patent No. 4,091,333)

Assume that terminals I_{hi} and I_{lo} of Figure 5-3 are shorted, and 1 volt is applied to E_{in} so that I_{hi} is positive. To equalize the inputs of IC17, IC15 must be driven to zero. This condition occurs only when the voltage drops across R73 and R77 are equal to the drops across R74 and R76. For these voltage drops to be equal, the output of IC17 must be at +1 volt. Since the output of IC15-8 must be zero, the drop across R74 is 0.5 volts, making the inverting input 0.5 volts. The drops across R73, R76 and R77 will also be 0.5 volts. Since the inputs to IC15 are essentially equal, its output is zero (offset by the few microvolts required to drive IC17 to +1 volt). Under these conditions the sum of the voltages across R73, R74, R76 and R77 equals the sum of E_{in} plus the output of IC17.

Consider now that the short is removed from the I_{hi} and I_{lo} terminals and a 100-ohm resistor (R_L) is connected in its place. The current through R_L increases the voltage at the input to IC15. A balanced condition will be reached when the output of IC15 is equal to the non-inverting input of IC17. Again, this condition occurs when the voltage drops across R73 and R77 are equal to the voltage drops across R74 and R76. At this time the output of IC17 is 1.1

volts. The voltage drop across the Range Resistor is 1 volt, just as it was when the output terminals were shorted. The current through R_L is 10 milliamperes, just as it was through the jumper when the output terminals were shorted.

5-6. Failsafe Design

Reference to the Model 4314 schematic will show that the output of IC17-6 is actually applied to the base of transistor Q8, which acts as a current limiter. The worst-case failure that could occur in this circuit would be a Q8 short, which would effectively connect the -5 volt supply directly across R49, CR9, the range resistor and R_L. DS6, however, acts as a 1.6 volt zener diode, limiting the voltage that can appear across these components. Even if every component in the amplifier circuit shorted, the current through the igniter could not exceed safe limits, because the -5 volt supply includes inherent limiting. Because of the design of T1, the -5 volt supply can only deliver 20 to 25 milliamperes before the DC/DC converter disengages, dropping the -5 volt output to zero. See Section 5-7.

5-7. Power Supplies

The Model 4314 is powered by a rechargeable internal battery pack and cannot be operated directly from the battery charging adapter. This is to prevent the possibility of a short to the AC line. When the POWER switch is in the OFF/CHARGING position, the batteries are connected to the rear panel charging jack to allow for recharge. When the POWER switch is in the ON position, the batteries are disconnected from the battery charger and connected to the internal circuits of the 4314.

The +5 volt supply is provided directly by the batteries. The -10 volt supply is developed by a DC/DC converter composed of Q11, Q12, T1, CR19, CR20 and their associated components. The -5 volt supply is regulated from the -10 volt supply by IC22.

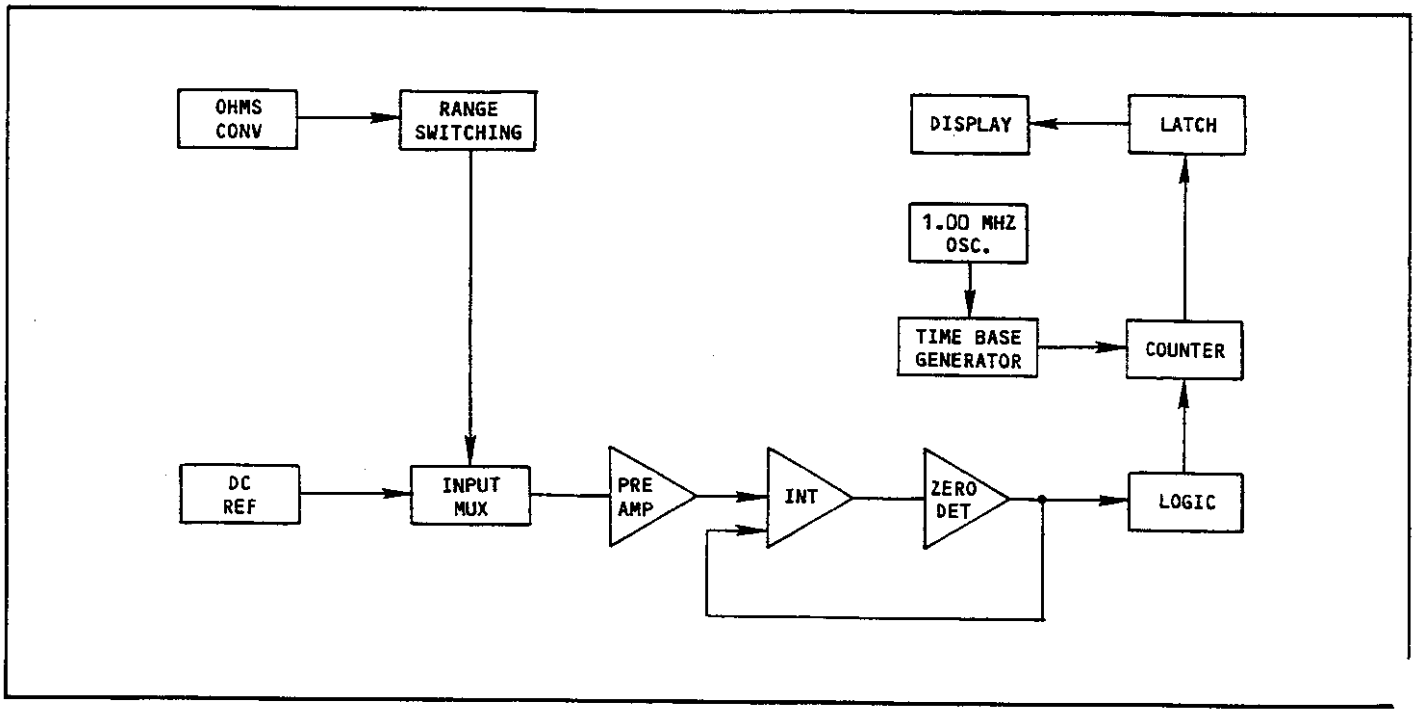


Figure 5-1. Model 4314 Block Diagram

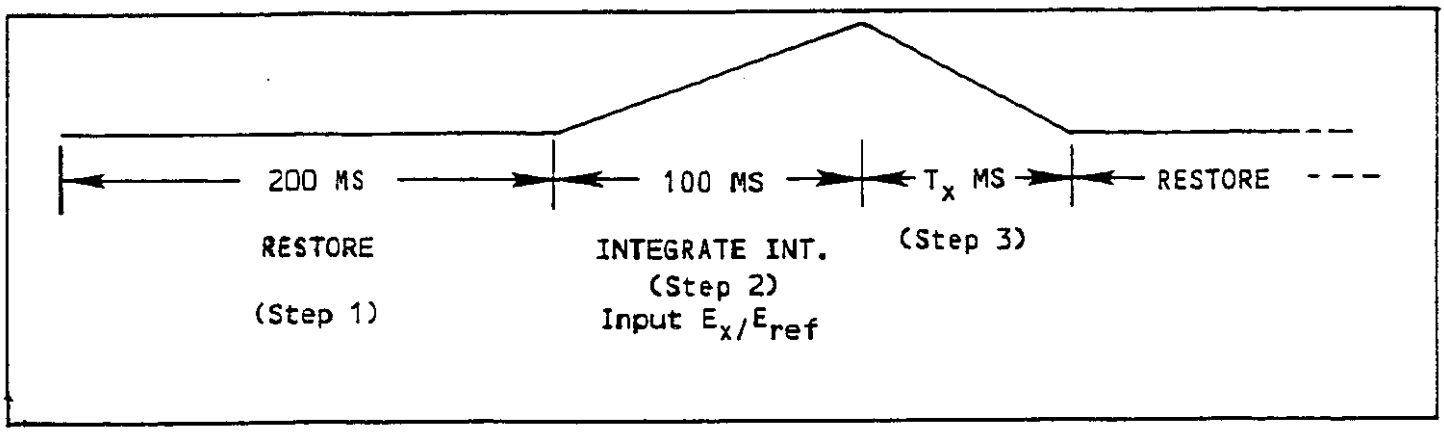


Figure 5-2. Analog-to-Digital Converter Timing Diagram

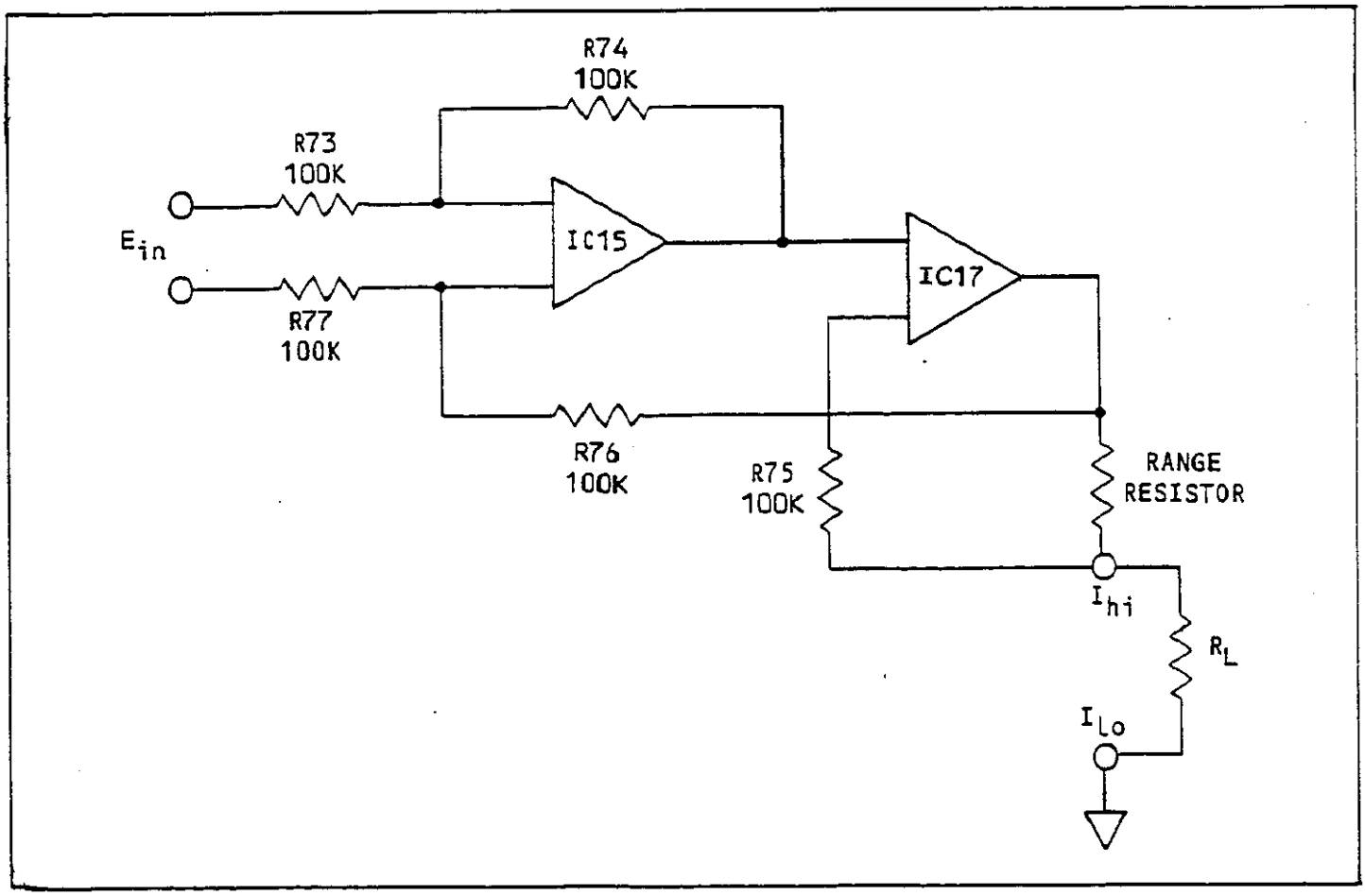


Figure 5-3. Transconductance Amplifier (Simplified)
Protected by U.S. Patent No. 4,091,333

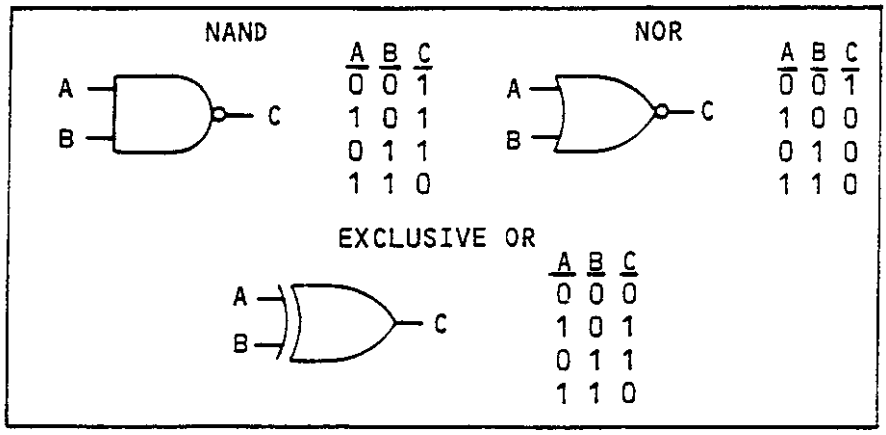


Figure 5-4. Logic Gate Truth Tables

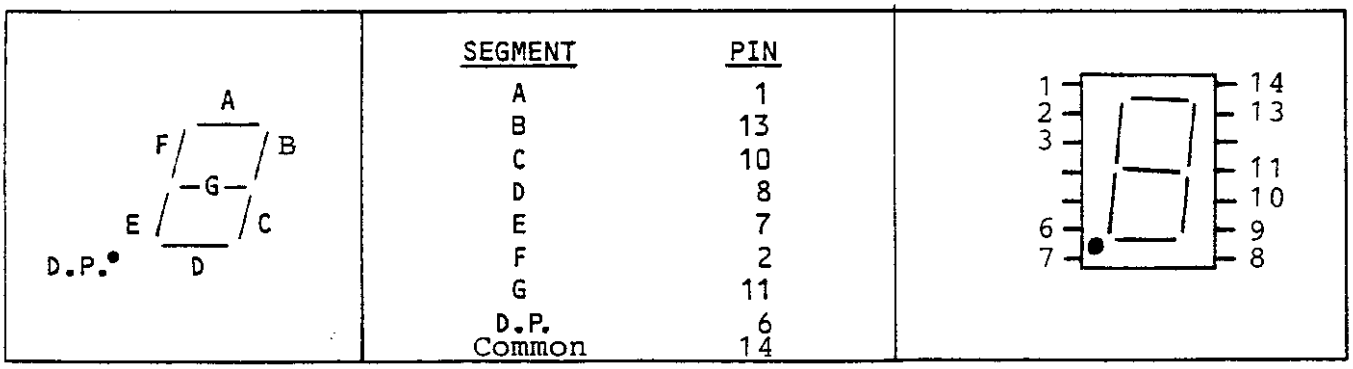
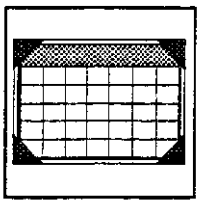


Figure 5-5. LED Display Pin Functions

SECTION VI ROUTINE MAINTENANCE



6-1. General

This section of the manual contains routine maintenance information regarding the Valhalla Scientific Model 4314 Digital Igniter Testers. Calibration should be performed on a regular basis to ensure continued instrument accuracy. The recommended calibration interval is 1 year.

6-2. Required Test Equipment

Following is a list of the standard resistors required to calibrate the Model 4314A. Calibration of Models other than the 4314A use the same basic procedure however different standard resistor values may apply.

Precision Resistors:

.1 ohm ± 0.01% Accuracy
10 ohm ± 0.005% Accuracy
100 ohms ± 0.005% Accuracy *
1000 ohms ± 0.005% Accuracy *
10000 ohms ± 0.005% Accuracy *

*The Valhalla Model 2724A may be used for 100Ω and above.

Test Leads:

4-wire lead set
(Valhalla Option "K" or "C")

6-3. Calibration Procedure

The 4314 should be calibrated with fully charged batteries and should be allowed to warm-up for a minimum of 5 minutes before beginning the procedure. The adjustments are accessed by removing the four feet screws, then lifting off the top cover only. The locations of the adjustments are shown on drawing number 4314-600 at the back of this manual.

6-3-1. Linearity Adjustment

1. Select the 200Ω range. Connect the Kelvin clips to the 0.1 ohm standard resistor.

2. Adjust potentiometer R60 for a display indication of 00.10.

6-3-2. Full Scale Adjustment

1. Select the 200Ω range. Connect the Kelvin clips to the 100 ohm standard resistor.

2. Adjust R69 for a display indication of 100.00.

3. Check all remaining ranges with the appropriate standard resistors. All ranges must be within the specifications outlined in Section 2.

6-4. Battery Replacement Instructions

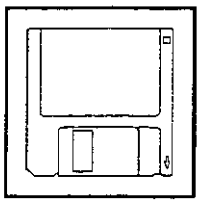
The rechargeable nicad batteries used in the 4314 are very durable and should provide years of trouble-free operation. As with all batteries, replacement will eventually be necessary. Batteries may be ordered from Valhalla Scientific as stock #05-10117, quantity: (4). The process of battery replacement is described below:

1) Remove the four feet screws and the bottom cover.
2) Undo the reusable tie-wraps by pushing down on the locking pin.
3) Remove the old batteries and replace. **Observe polarity!**
4) Secure the new batteries in place by re-tightening the tie-wraps.
5) Replace the cover and feet screws, taking care not to pinch any wires.

SECTION VII MANUAL CHANGES & ADDENDUMS

Immediately following this page may be found any notices regarding manual changes, or operating considerations for special 4314 versions. Please refer to any applicable material before attempting to operate your Model 4314.

SECTION VIII PARTS LISTS



The following parts lists are included in this manual:

4314-400	4 pages	4314A Main Board Assembly
4314-614	1 page	HCTR4010 (IC7) Replacement PCB Assembly

REF.DES.	STOCK#	QUANTITY A T N	DESCRIPTION	MANUFACTURING PURCHASING DATA
C1	02-10003	1	20pF/100V CERAMIC CAPACITOR	SPRAGUE SGAQ20
C2	02-10003	1	20pF/100V CERAMIC CAPACITOR	SPRAGUE SGAQ20
C3	02-10014	1	.1mF/50V CAPACITOR	AVX SR205E104MAA00
C4	02-10014	1	.1mF/50V CAPACITOR	AVX SR205E104MAA00
C5	02-10014	1	.1mF/50V CAPACITOR	AVX SR205E104MAA00
D1	05-01013	1	LED, GREEN, PANEL MOUNT	HP, 5082-4955
P1	05-10293	1	24 PIN ADAPTOR PLUG, .335 SP.	SAMTEC APA-624-T-N
PCB1	04-30304	1	HCTR BOARD 8/8/00	4314-714P
Q1	03-10026	1	N-CHANNEL VMOS (TO92)	VN10KM
R1	01-01041	1	1K 5% 1/4W COMP.	RC07GF102J
R2	01-01041	1	1K 5% 1/4W COMP.	RC07GF102J
R4	01-01041	1	1K 5% 1/4W COMP.	RC07GF102J
R5	01-01061	1	10K 5% 1/4W COMP.	RC07GF103J
R6	01-01068	1	27K 5% 1/4W COMP.	RC07GF273J
R7	01-01068	1	27K 5% 1/4W COMP.	RC07GF273J
U1	03-30653	1	512x32 uCNTRLLR (IC)	PIC16C54A-04/P
U1A	05-10293	1	SOCKET, dil, 18 PIN	BURNDY DILB 18P-108
U2	03-30619	1	OCTAL BUFFER/LINE DRIVER	74HC244
X1	05-02004	1	CRYSTAL, MPU, 4MHz	HC18-4MHz

REF.DES.	STOCK #	QUANTITY A	QUANTITY T	QUANTITY N	DESCRIPTION	MANUFACTURING/PURCHASING DATA	ALTERNATE
C36	02-10000	1			0.005uF 100V Ceramic Disc	SPRAGUE 56AD50	
C41	02-30001	1			10uF 25V Tantalum Bead	AVX TAP106K025SP	
C44	02-40004	1			2200uF 16V Aluminum	Illinois 228TTA016	
CR2	03-20000	1			Diode, general purpose	1N4148 or 1N914	
CR9	03-20002	1			Diode, rectifier, 1A, 50V	1N4001-1N4007	
C101	02-10007	1			330pF 1000V Ceramic disc	SPRAGUE 56AT33	
C102	02-10007	1			330pF 1000V Ceramic disc	SPRAGUE 56AT33	
C201	02-60017	1			0.1uF,63V,Mylar,5%	WIMA MKC2-0.1uF	
C202	02-60017	1			0.1uF,63V,Mylar,5%	WIMA MKC2-0.1uF	
C203	02-60017	1			0.1uF,63V,Mylar,5%	WIMA MKC2-0.1uF	
C204	02-60017	1			0.1uF,63V,Mylar,5%	WIMA MKC2-0.1uF	
C205	02-30004	1			1uF 25V Tantalum Bead	Kemet T350A105K025AS	
C206	02-60017	1			0.1uF,63V,Mylar,5%	WIMA MKC2-0.1uF	
C207	02-60017	1			0.1uF,63V,Mylar,5%	WIMA MKC2-0.1uF	
CR13	03-20000	1			Diode, general purpose	1N4148 or 1N914	
CR14	03-20000	1			Diode, general purpose	1N4148 or 1N914	
CR16	03-20000	1			Diode, general purpose	1N4148 or 1N914	
CR17	03-20041	1			Zener, reference, 6.3V, 20ppm/C, 5%	1N825	
CR18	03-20002	1			Diode, rectifier, 1A, 50V	1N4001-1N4007	
CR19	03-20000	1			Diode, general purpose	1N4148 or 1N914	
CR20	03-20000	1			Diode, general purpose	1N4148 or 1N914	
CR29	03-20000	1			Diode, general purpose	1N4148 or 1N914	
CR30	03-20000	1			Diode, general purpose	1N4148 or 1N914	
CR31	03-20000	1			Diode, general purpose	1N4148 or 1N914	
DS1	05-01020	1			LED Display, +/-1, Red	HP 5082-7656, Bin C or D only	
DS2	05-01010	1			LED Display, 7-Segment (0-9), Red	HP 5082-7650 Bin C or D only	
DS3	05-01010	1			LED Display, 7-Segment (0-9), Red	HP 5082-7650 Bin C or D only	
DS4	05-01010	1			LED Display, 7-Segment (0-9), Red	HP 5082-7650 Bin C or D only	
DS5	05-01010	1			LED Display, 7-Segment (0-9), Red	HP 5082-7650 Bin C or D only	
DS6	05-01005	1			Single LED,Red,Small	Hewlett Packard,HLMP1000	
D201	03-20006	1			Diode, low leakage	1N3595	
D202	03-20006	1			Diode, low leakage	1N3595	
D203	05-01011	1			LED,Red,Panel Mount	Micro Elec. MRB51D	
D204	03-20006	1			Diode, low leakage	1N3595	
D205	03-20006	1			Diode, low leakage	1N3595	
F1	05-04001	1			2A,Fuse	Littlefuse,312-002	
IC1	03-30022	1			LCD Display Driver (CMOS)	4054BE	
IC2	03-30023	1			Quad Analog Switch (CMOS)	4066BF (Ceramic)	
IC4	03-30024	1			Quad 2 Input NOR (CMOS)	4001BE	
IC5	03-30025	1			Quad 2 Input Exclusive OR (CMOS)	4030BE	
IC6	03-30026	1			Dual D-Type Flip Flop (CMOS)	4013BE	
IC7	30-00156	1			HCTR4010 Replacement Board Assembly	ASSY 4314-614	
IC8	03-30026	1			Dual D-Type Flip Flop (CMOS)	4013BE	
IC9	03-30027	1			Quad 2 Input NAND (CMOS)	4011BE	
IC10	03-30106	1			BCD to 7-Segment decoder/driver	74LS47N	
IC11	03-30012	1			A to D Converter Logic	Mostek MK5009	
IC12	03-30315	1			Precision JFET Op Amp	Burr Brown OPA103CM	
IC13	03-30017	1			Op-Amp,Uncompensated	LM308H	
IC14	03-30013	1			Op-Amp,General Purpose,Uncompensated	LM301AH or LM301AN	
IC15	03-30031	1			Quad Op-Amp,General Purpose	LM324N	
IC17	03-30074	1			General Purpose JFET Op-Amp,Metal Can	LF356H	

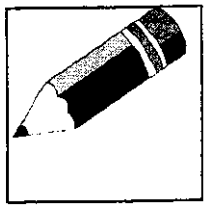
REF.DES.	STOCK #	QUANTITY A	QUANTITY T	QUANTITY N	DESCRIPTION	MANUFACTURING/PURCHASING DATA	ALTERNATE
82	04-30009	1			4440 Main Board	DWG 4440-700	
83	04-30010	1			4440 Display Board	DWG 4440-701	
87	05-10049	1			Box, battery, four D cells	Digikey BH24DL-ND	
88	04-10529	1			4314A Front Panel (screened)	DWG 4314-100 using 04-10247	
89	05-10198	4			Spacer, 1/4 dia, 1/8 lg, #4, nylon	Smith 8880	
90	05-10199	4			Washer, fib, 1/4 od, 7/64 id, 1/16 tall	Smith 2161	
91	90-04608	4			#4 x 1/2" Self-Tap Phil Pan S.S. Type AB		
92	04-10130	1			Chassis	PARTEK CH250-BRIGE ETC.	
93	05-10521	1			Fuse holder, panel mount	Littlefuse 342004	
94	04-10235	1			4440 Rear Panel (battery unit)	DWG 4440-214	
96	05-10277	4			Knob, silver	ITT 160844 (ITT internal #)	
97	05-10019	12			Cable tie, 4"x 1/8"	Panduit WRN-4	
98	80-01422	8			22AWG Wire, Yellow PVC	M16878/1-BFB-4	
99	80-01322	4			22AWG Wire, Orange PVC	M16878/1-BFB-3	
100	80-01622	24			22AWG Wire, Blue PVC	M16878/1-BFB-6	
101	80-01022	7			22AWG Wire, Black PVC	M16878/1-BFB-0	
102	80-01922	7			22AWG Wire, White PVC	M16878/1-BFB-9	
103	80-01222	26			22AWG Wire, Red PVC	M16878/1-BFB-2	
104	80-00022	14			22AWG Buss Wire	IBB-2201 AMIXTER	
105	80-01522	15			22AWG Wire, Green PVC	M16878/1-BFB-5	
106	80-01122	15			22AWG Wire, Brown PVC	M16878/1-BFB-1	
107	80-00014	5			14AWG Buss Wire	AMIXTER IBB-1401	
108	05-10325	4			Cable tie, 14"x.25" reusable	Panduit PRT-4S	
111	05-10441	2			Tie-wrap block, small	Panduit ABMM-AT	
114	70-11020	10			20awg TFE Sleeving	Atlantic TFT 20	
B1	05-10117		1		Battery, ni-cad, heavy duty, D cell	Panasonic P-400D-E15	
B2	05-10117		1		Battery, ni-cad, heavy duty, D cell	Panasonic P-400D-E15	
B3	05-10117		1		Battery, ni-cad, heavy duty, D cell	Panasonic P-400D-E15	
B4	05-10117		1		Battery, ni-cad, heavy duty, D cell	Panasonic P-400D-E15	
C1	02-60019	1			2200pF 100V Mylar	WIMA FKS2-2200P	
C2	02-10009	1			0.001uF 50V Ceramic Disc	NIC NCD102KIVX5P	
C3	02-10000	1			0.005uF 100V Ceramic Disc	SPRAGUE 56AD50	
C4	02-10002	1			500pF 100V Ceramic Disc	SPRAGUE 56AT50	
C7	02-30001	1			10uF 25V Tantalum Bead	AVX TAP106K025SP	
C8	02-10009	1			0.001uF 50V Ceramic Disc	NIC NCD102KIVX5P	
C10	02-10000	1			0.005uF 100V Ceramic Disc	SPRAGUE 56AD50	
C11	02-10000	1			0.005uF 100V Ceramic Disc	SPRAGUE 56AD50	
C12	02-10000	1			0.005uF 100V Ceramic Disc	SPRAGUE 56AD50	
C13	02-10000	1			0.005uF 100V Ceramic Disc	SPRAGUE 56AD50	
C20	02-30001	1			10uF 25V Tantalum Bead	AVX TAP106K025SP	
C21	02-50000	1			0.22uF 10% 50V Polystyrene	IMB PA2A224K	
C22	02-10005	1			50pF 500V Ceramic disc	Illinois 500BCR050K	02-20002
C23	02-60015	1			0.022uF, 100V, Mylar, 5%	WIMA MKC2-0.022uF	
C25	02-30001	1			10uF 25V Tantalum Bead	AVX TAP106K025SP	
C26	02-10007	1			330pF 1000V Ceramic disc	SPRAGUE 56AT33	
C27	02-10007	1			330pF 1000V Ceramic disc	SPRAGUE 56AT33	
C31	02-30008	1			6.8uF 10V Tantalum Bead		
C32	02-30003	1			47uF 10V Tantalum Bead	AVX TAP476M020SP	
C33	02-30001	1			10uF 25V Tantalum Bead	AVX TAP106K025SP	
C34	02-10009	1			0.001uF 50V Ceramic Disc	NIC NCD102KIVX5P	
C35	02-30001	1			10uF 25V Tantalum Bead	AVX TAP106K025SP	

REF.DES.	STOCK #	QUANTITY A	T	N	DESCRIPTION	MANUFACTURING/PURCHASING DATA	ALTERNATE
	03-30090	1			General Purpose JFET Op-Amp	LF356N or H	03-30074
IC22	03-30035	1			Regulator,-5V,0.5A,TO202 or TO220	79M05CP or LM320T-5.0	
IC25	05-02007	1			Programmable Osc.,8.3Hz-1MHz	Statek,PX01000KHzA	
IC201	03-30170	1			Low Noise, low drift Op-amp	OP07DP	
IC202	03-30487	1			Low Noise Chopper Amplifier(8 pin)	LTC1052CN8	
IC203	03-30487	1			Low Noise Chopper Amplifier(8 pin)	LTC1052CN8	
J1	05-10030	1			Banana jack, red	Pomona 1581-2	
J2	05-10030	1			Banana jack, red	Pomona 1581-2	
J3	05-10031	1			Banana jack, white	Pomona 1581-9	
J4	05-10033	1			Battery Charging Jack	Switchcraft 712A	
J5	05-10031	1			Banana jack, white	Pomona 1581-9	
Q1	03-10003	1			NPN Darlington Transistor (TO92)	2N5172	
Q2	03-10003	1			NPN Darlington Transistor (TO92)	2N5172	
Q3	03-10003	1			NPN Darlington Transistor (TO92)	2N5172	
Q4	03-10003	1			NPN Darlington Transistor (TO92)	2N5172	
Q5	03-10003	1			NPN Darlington Transistor (TO92)	2N5172	
Q8	03-10015	1			NPN Transistor (TO220)	MJE3439	
Q9	03-10000	1			N-Channel JFET	U1899E or PN4392	
Q11	03-10013	1			NPN Transistor (TO92)	2N4401	
Q12	03-10013	1			NPN Transistor (TO92)	2N4401	
Q15	03-10004	1			P-Channel JFET	P1087E (selected)	
Q17	03-10010	1			PNP Transistor (TO92)	2N4402	
R1	01-01073	1			47K 5% 1/4W Carbon Film	RC07GF473J	
R2	01-01073	1			47K 5% 1/4W Carbon Film	RC07GF473J	
R?	01-50005	1			50K Single Turn	CTS X201R503	
	01-01073	1			47K 5% 1/4W Carbon Film	RC07GF473J	
R5	01-01081	1			100K 5% 1/4W Carbon Film	RC07GF104J	
R6	01-01073	1			47K 5% 1/4W Carbon Film	RC07GF473J	
R7	01-01073	1			47K 5% 1/4W Carbon Film	RC07GF473J	
R10	01-01026	1			220 5% 1/4W Carbon Film	RC07GF221J	
R11	01-01026	1			220 5% 1/4W Carbon Film	RC07GF221J	
R12	01-01026	1			220 5% 1/4W Carbon Film	RC07GF221J	
R13	01-01026	1			220 5% 1/4W Carbon Film	RC07GF221J	
R14	01-01026	1			220 5% 1/4W Carbon Film	RC07GF221J	
R15	01-01026	1			220 5% 1/4W Carbon Film	RC07GF221J	
R16	01-01026	1			220 5% 1/4W Carbon Film	RC07GF221J	
R17	01-01026	1			220 5% 1/4W Carbon Film	RC07GF221J	
R19	01-01021	1			100 5% 1/4W Carbon Film	RC07GF101J	
R21	01-10000			1	Factory Select Resistor	RN60C???	
R22	01-10038	1			90.9K 0.1% 50ppm/C 1/4W Metal Film	RN60C9092B	
R23	01-50000	1			100 Single Turn	CTS K201R101	
R24	01-10037	1			10K 0.1% 50ppm/C 1/4W Metal Film	RN60C1002B	
R28	01-01061	1			10K 5% 1/4W Carbon Film	RC07GF103J	
R29	01-10039	1			274K 1% 50ppm/C 1/4W Metal Film	RN60C2743F	
R30	01-01080	1			91K 5% 1/4W Carbon Film	RC07GF913J	
R48	01-01073	1			47K 5% 1/4W Carbon Film	RC07GF473J	
R49	01-01018	1			75 5% 1/4W Carbon Film	RC07GF750J	
R50	01-01045	1			2K 5% 1/4W Carbon Film	RC07GF202J	
R51	01-01041	1			1K 5% 1/4W Carbon Film	RC07GF102J	
R52	01-01065	1			20K 5% 1/4W Carbon Film	RC07GF203J	
	01-01051	1			3.9K 5% 1/4W Carbon Film	RC07GF392J	

REF.DES.	STOCK #	QUANTITY A	QUANTITY T	QUANTITY N	DESCRIPTION	MANUFACTURING/PURCHASING DATA	ALTERNATE
R54	01-01128	1			1000M 5% 1/4W Carbon Film	RC07GF108J	
R55	01-01045	1			2K 5% 1/4W Carbon Film	RC07GF202J	
R56	01-01007	1			10 5% 1/4W Carbon Film	RC07GF100J	
R57	01-01086	1			220K 5% 1/4W Carbon Film	RC07GF224J	
R58	01-10000			1	Factory Select Resistor	RN60C???	
R59	01-10037	1			10K 0.1% 50ppm/C 1/4W Metal Film	RN60C1002B	
R60	01-50005	1			50K Single Turn	CTS X201R503	
R62	01-10037	1			10K 0.1% 50ppm/C 1/4W Metal Film	RN60C1002B	
R64	01-01053	1			4.7K 5% 1/4W Carbon Film	RC07GF472J	
R65	01-01028	1			270 5% 1/4W Carbon Film	RC07GF271J	
R66	01-10037	1			10K 0.1% 50ppm/C 1/4W Metal Film	RN60C1002B	
R67	01-10215	1			1.65K 1% 50ppm/C 1/4W Metal Film	RN60C1651F	
R68	01-10037	1			10K 0.1% 50ppm/C 1/4W Metal Film	RN60C1002B	
R69	01-50000	1			100 Single Turn	CTS X201R101	
R70	01-10073	1			9.76K 1% 50ppm/C 1/4W Metal Film	RN60C9761F	
R71	01-10073	1			9.76K 1% 50ppm/C 1/4W Metal Film	RN60C9761F	
R72	01-01053	1			4.7K 5% 1/4W Carbon Film	RC07GF472J	
R73	01-10049	1			100K 0.1% 50ppm/C 1/4W Metal Film	RN60C1003B	
R74	01-10049	1			100K 0.1% 50ppm/C 1/4W Metal Film	RN60C1003B	
R75	01-01081	1			100K 5% 1/4W Carbon Film	RC07GF104J	
R76	01-10049	1			100K 0.1% 50ppm/C 1/4W Metal Film	RN60C1003B	
R77	01-10049	1			100K 0.1% 50ppm/C 1/4W Metal Film	RN60C1003B	
R78	01-10215	1			1.65K 1% 50ppm/C 1/4W Metal Film	RN60C1651F	
R80	01-01004	1			4.7 5% 1/4W Carbon Film	RC07GF4R7J	
R81	01-01048	1			2.7K 5% 1/4W Carbon Film	RC07GF272J	
R82	01-01048	1			2.7K 5% 1/4W Carbon Film	RC07GF272J	
R93	01-01026	1			220 5% 1/4W Carbon Film	RC07GF221J	
R94	01-01026	1			220 5% 1/4W Carbon Film	RC07GF221J	
R95	01-01026	1			220 5% 1/4W Carbon Film	RC07GF221J	
R96	01-01026	1			220 5% 1/4W Carbon Film	RC07GF221J	
R102	01-50003	1			5K Single Turn	CTS X201R502	
R104	01-01061	1			10K 5% 1/4W Carbon Film	RC07GF103J	
R105	01-01061	1			10K 5% 1/4W Carbon Film	RC07GF103J	
R106	01-01081	1			100K 5% 1/4W Carbon Film	RC07GF104J	
R107	01-01033	1			470 5% 1/4W Carbon Film	RC07GF471J	
R112	01-01032	1			430 5% 1/4W Carbon Film	RC07GF431J	
R114	01-20013	1			100 0.05% 5ppm/C Wire Wound	Goldstar GS711-100R-.05%-5PPM	
R115	01-20004	1			900 0.05% 5ppm/C Wire Wound	Goldstar GS711-900R-.05%-5PPM	
R116	01-20005	1			9K 0.05% 5ppm/C Wire Wound	Goldstar GS711-9K-.05%-5PPM	
R117	01-20006	1			90K 0.05% 5ppm/C Wire wound	Goldstar GS711-90K-.05%-5PPM	
R120	01-10000			1	Factory Select Resistor	RN60C???	
R201	01-10178	1			10K 0.1% 25ppm/C 1/8W Metal Film	PRP 1/8W - 10K - 0.1% - 25PPM	
R202	01-10178	1			10K 0.1% 25ppm/C 1/8W Metal Film	PRP 1/8W - 10K - 0.1% - 25PPM	
R203	01-10178	1			10K 0.1% 25ppm/C 1/8W Metal Film	PRP 1/8W - 10K - 0.1% - 25PPM	
R204	01-10178	1			10K 0.1% 25ppm/C 1/8W Metal Film	PRP 1/8W - 10K - 0.1% - 25PPM	
R205	01-01081	1			100K 5% 1/4W Carbon Film	RC07GF104J	
R206	01-01041	1			1K 5% 1/4W Carbon Film	RC07GF102J	
S2	05-03005	1			Switch,6 Station,Int-Lock,6 Pole,Chrome	Centralab,ZKBC000600864+B426	
S3	05-03015	1			Toggle Switch, 2PDT	C&K,7201-7760-7062-3	
T1	04-20006	1			4440 Transformer (DC to DC Converter)	DWG 4440-010	
XIC2	05-10041	1			Socket, dil, 14 pin	Burndy 8514-01	

REF.DES.	STOCK #	QUANTITY A	T	N	DESCRIPTION	MANUFACTURING/PURCHASING DATA	ALTERNATE
	05-10406	1			Socket, DIL, 24 pin, 0.3", Gold Contacts	Amp 583640-3	
XIC11	05-10008	1			Socket, dil, 16 pin	Burndy C8516-01	
XIC15	05-10041	1			Socket, dil, 14 pin	Burndy 8514-01	

SECTION IX DRAWINGS AND SCHEMATICS



The following schematic diagrams have been included in this manual:

4314-600	1 page	4314A Main Board Assembly
4314-070	1 page	4314A Main Board Schematic
4314-614	1 page	HCTR4010 (IC7) Replacement PCB Assembly
4314-084	1 page	HCTR4010 (IC7) Replacement PCB Schematic

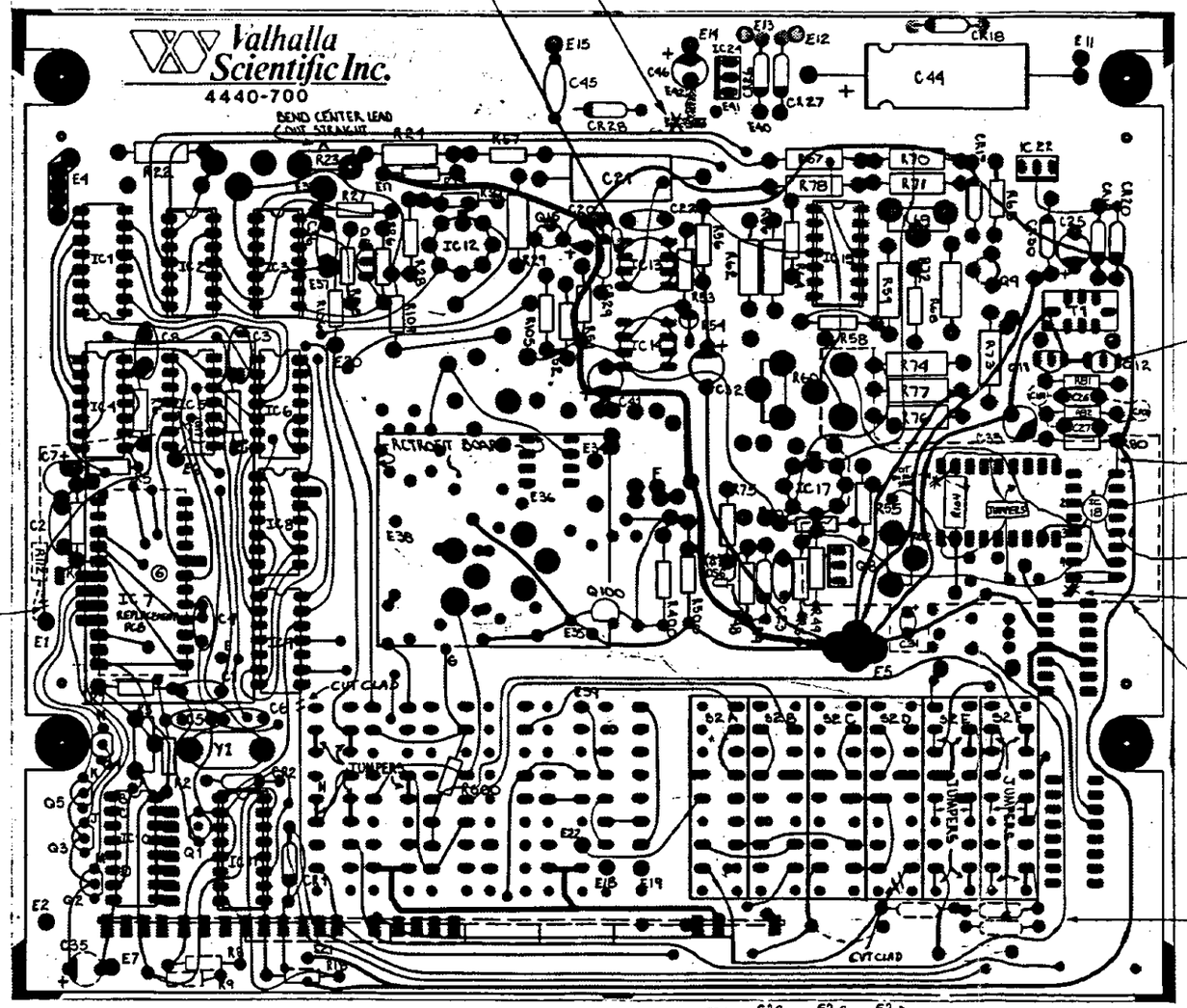
NOTES: (CONT...)

⑥ CUT SOCKET FOR IC7 IN HALF AND SOLDER FLUSH WITH PCB. INSTALL REPLACEMENT PCB (4314-64) SECURELY IN SOCKET.

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED

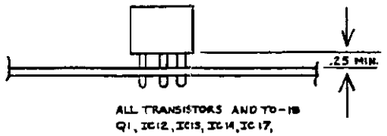
INSTALL CR31 ON SOLDER SIDE

CUT CLAD ON FARSIDE OF BOARD



NOTE:
Q17 AND R112 MOUNT ON THE FARSIDE OF THE BOARD. MOUNT R112 BETWEEN E1 AND THE COLLECTOR OF Q17. THE EMITTER OF Q17 CONNECTS TO E6. THE BASE OF Q17 CONNECTS TO PIN 4 OF IC5. SLEEVE ALL LEADS.

NOTE:
Q100, R900, R500, R600 ARE USED IN BCD-MX ONLY



SEE DETAIL "A" FOR INSTALLATION OF Q11 & Q12

JUMPER (4314-122)

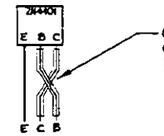
INSTALL IC18 AS SHOWN. SOLDER LEGS TO NUMBERED HOLES. CUT OFF LEGS 1, 5, AND 8. (4314-422)

JUMPER TO DS1 PIN 7 (4314-422)

CUT CLAD ON SOLDER SIDE (4314-422)

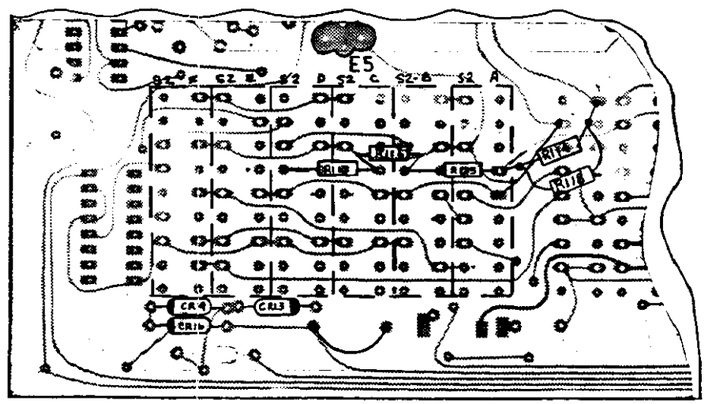
(4314-422) AREA CONTAINED IN DOTTED LINES

TRIM LEADS FOR CR27-CR36 FLUSH WITH PCB.

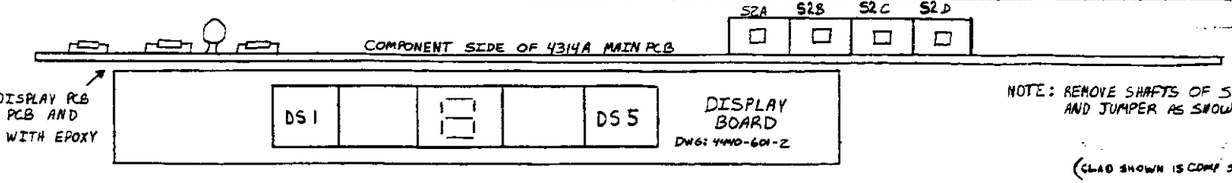


DETAIL-A

CROSS LEADS AS SHOWN WITH Q11 AND Q12. COVER WITH ITEM 23 SLEEVING.



VIEW FROM BOTTOM OF P.C.B.
(CLAD SHOWN IS SOLID STATE)



NOTE: REMOVE SHAFTS OF S2E AND S2F AND JUMPER AS SHOWN.

(CLAD SHOWN IS COMP SIDE)

CONT...

5. USE PARTS LIST 4314-400.
4. USE P.C. BOARD 4440-700
3. FOR ASSEMBLY DIAGRAM SEE 4440-400
2. FOR WIRE TAB TABLE SEE 4314-051
1. FOR SCHEMATIC SEE 4314-070

NOTES:

MATERIAL		Valhalla Scientific Inc. SAN DIEGO, CALIFORNIA
FINISH		4314A ASSEMBLY
SCALE NONE	CODE IDENT NO. 53504	SIZE D
SHEET 1 OF 1	DRAWING NO. 4314-600	REV. T

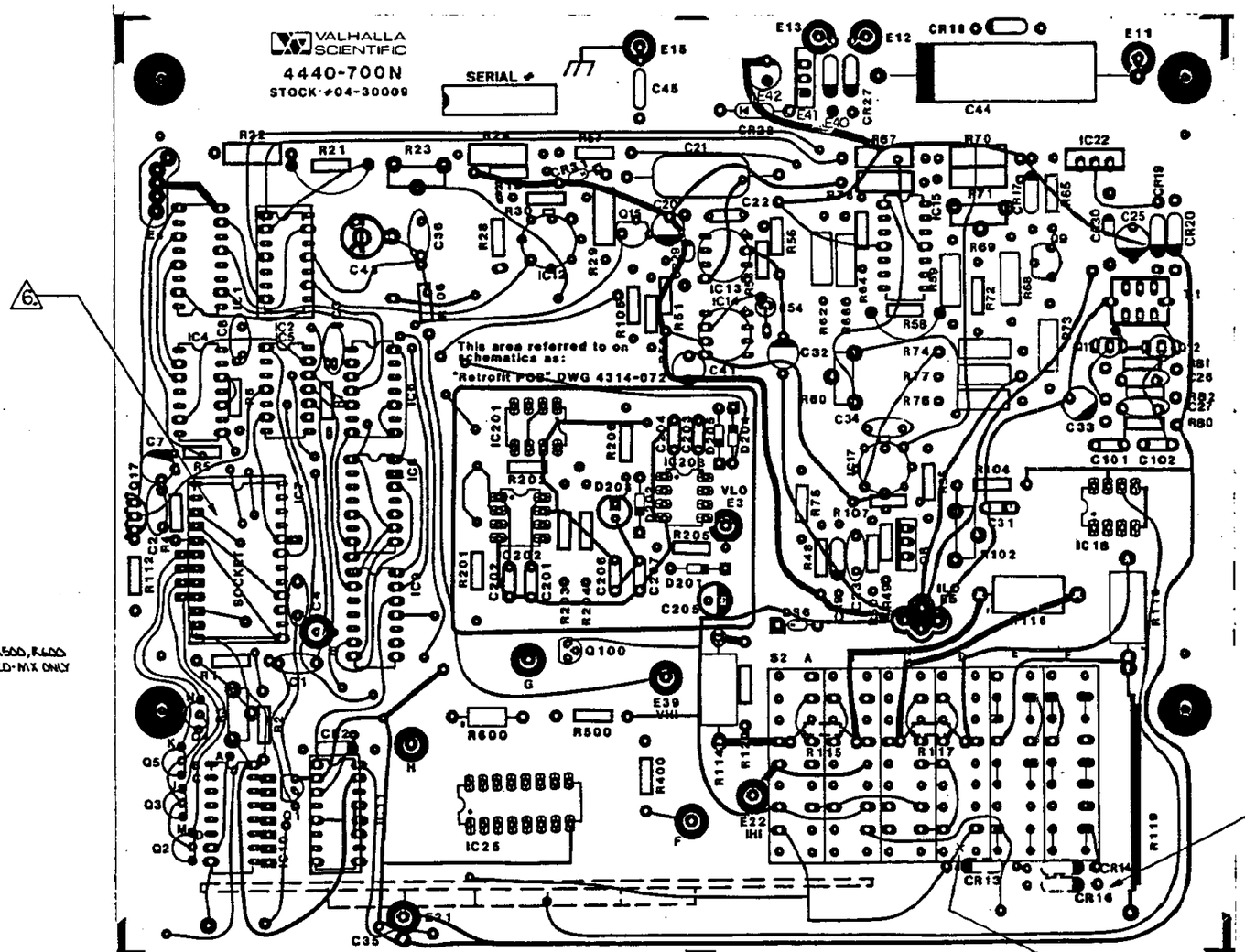
REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED

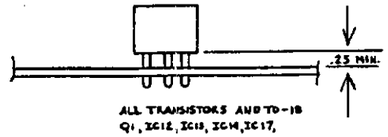
NOTES: (CONTINUED FROM BELOW)

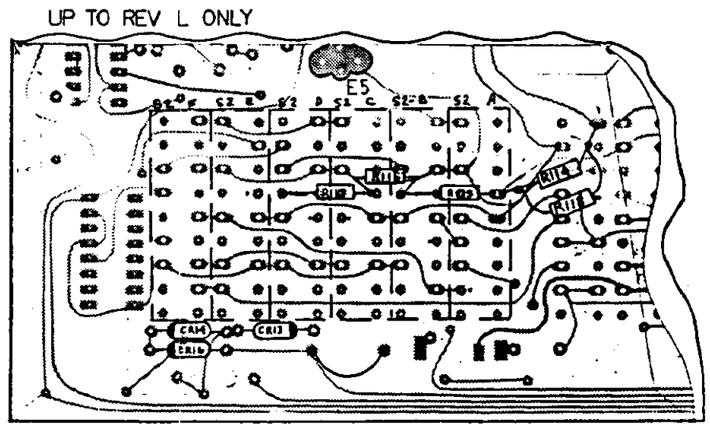
6. CUT SOCKET IN HALF AND INSTALL FLUSH WITH PCB. INSTALL ASSEMBLY 4314-614 SECURELY IN SOCKET.

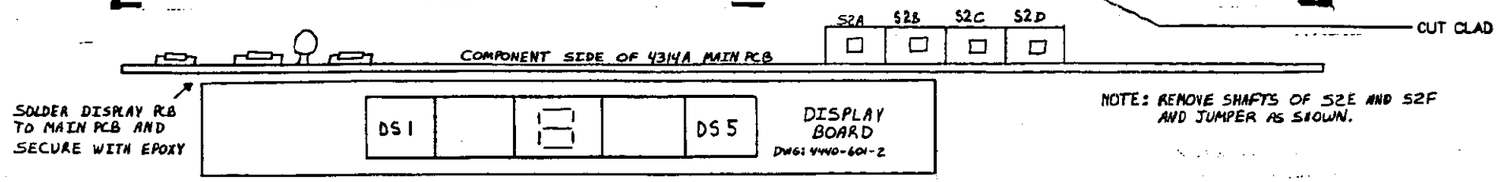
7. TRIM LEADS FLUSH AND INSULATE WITH KAPTON TAPE.

8. JUMPER R21 AND R58 WITH ITEM #104 BUSS WIRE.









NOTE: REMOVE SHAFTS OF S2E AND S2F AND JUMPER AS SHOWN.

(CLAD SHOWN IS COMPONENT SIDE)

(CONTINUED ABOVE)

5. USE PARTS LIST 4314-400.
4. USE PC BOARD 4440-700
3. FOR ASSEMBLY DIAGRAM SEE 4440-400 SHT 8
2. FOR WIRE TAB TABLE SEE 4314-051
1. FOR SCHEMATIC SEE 4314-070

NOTES:

MATERIAL

FINISH

Valhalla Scientific Inc.
SAN DIEGO, CALIFORNIA

4314 A ASSEMBLY

SCALE	CODE IDENT NO.	SIZE	DRAWING NO.	REV.
NONE	83504	D	4314-600	U

SHEET 1 OF 1

NOTES:

1) "RETRO" REFERS TO SCHEMATIC 4314-072.

REVISIONS				
ECO#	LTR	DESCRIPTION	DATE	APPROVED

+1V REF
-1V REF
TO RETRO E1
TO RETRO E2
TO RETRO E7
R106 100K
R24 10K
R23 100Ω
R22 90.9K
C36 .005µF
R28 10K
R29 274K
R30 91K
IC12
IC13
IC14
C21 .22µF
50PF
CR31
CR29
C20 10µF
Q15 P1087
R51 1K
R52 20K
R53 3.9K
R54 100K
R19 100
R57 220K
R58 F.S.
R59 10K
R60 50KΩ LINEARITY
IC15
R64 4.7K
R65 470Ω
R62 10K
R66 10K
R67 1.62K
R70 10K
R71 10K
R78 1.62K
C9 UJ379
CR17 IN825
F1 2A
INTERNAL BATTERY PACK 4.7V TO 6V
CR18
C44 2200µF
CHARGER CONNECTOR J4
POWER SWITCH S3
CHARGE ON
C41 10µF
C32 47µF
R105 10K
R56 10Ω
R68 10K
R69 100Ω
R73 100K
R74 100K
R72 4.7K
R75 100K
R76 100K
R77 100K
C23 .02µF
CR9
Q8 MTE340
R50 2K
R55 2K
R107 470Ω
R49 75Ω
C34 .001µF
R48 47K
D56
C1 2200pF
IC8 CD4013
IC6 CD4013
IC4
IC5
IC7
IC9
Q1 2N5172
R1 47K
R3 50K
R2 47K
Q17 2N4402
R112 430
R4 47K
R5 100K
C7 10µF
R6 47K
R7 47K
C2 .001µF
C3 .005µF
CB .001µF
Q2 2N5172
Q3 2N5172
Q4 2N5172
Q5 2N5172
HEX 4010 IC7
IC10
C4 500PF
C35 10µF
IC11 MK5009
1MHZ
IC25
CR2
R17 220 (7PL)
R11
R10 220
DS1 LOW BAT
DS2 "1" D.P.
DS3 "10" D.P.
DS4 "100" D.P.
DS5 "1000" D.P.
R93 220
R94 220
R95 220
R96 220
CR16 CR14
TO RETRO E3
E5
J1 VHI
J2 IHI
J3 VLO
J5 ILO
S2A
S2B
S2C
S2D
S2E
S2F
R120
R114 100Ω
R115 900Ω
R116 1K
R117 90K
CR13
20Ω
200Ω
2000Ω
20000Ω
NOT USED
NOT USED
IC22
CR19
CR20
C25 10µF
T1
E21
R81
Q11 2N4401
Q12 2N4401
C101
C102 (330pF)
C27
C33 10µF
R82 2.7K
R80 4.7K
R104 10K
R102 5K
LOW BAT
IC18 LF356
C31 6.8µF
-10V
R600 47K
R400 47K
Q100
R500 6.8K
E0
OH
OG
F
USED FOR OPTION BCD-MX

VALHALLA SCIENTIFIC		
SCALE: NONE	APPROVED BY: PJD	DRAWN BY: MLG
MODEL 4314A		REV. T
		DRAWING NUMBER 4314-070

REVISIONS			
ECO# LTR	DESCRIPTION	DATE	APPROVED

BATTERY MONITOR CIRCUITRY

"LOW BAT" (ACTIVE HIGH)

VALHALLA SCIENTIFIC

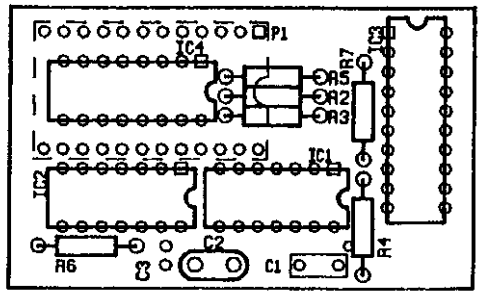
MODEL 4314A REV. S

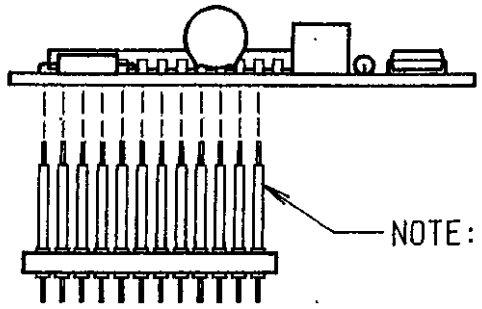
DRAWING NUMBER 4314-070

NOTES: Unless Otherwise Specified

1. SEE SEPARATE PARTS LIST.
2. BAG AND TAG WITH DRAWING NUMBER, STOCK NUMBER, AND CURRENT REVISION LETTER.

REVISIONS				
ECR#	LTR	DESCRIPTION OF CHANGE	DATE	APPROVED
	A	RELEASED PEL	2/24/94	





NOTE: INSTALL P1 ON SOLDER SIDE AS SHOWN.

TOLERANCES: X = ±30' .XX = ±.02 .XXX = ±.005	FINISH:	MATERIAL:	DRAWN BY P. LOFTUS	2/24/94
			CHECKED BY	2/25/94
			APPROVED BY	2/26/94
DEBURR AND BREAK ALL SHARP EDGES AND CORNERS				
MACHINED SURFACES ARE TO HAVE A	SCALE: 1 : 1	STOCK NO. 30-00156		

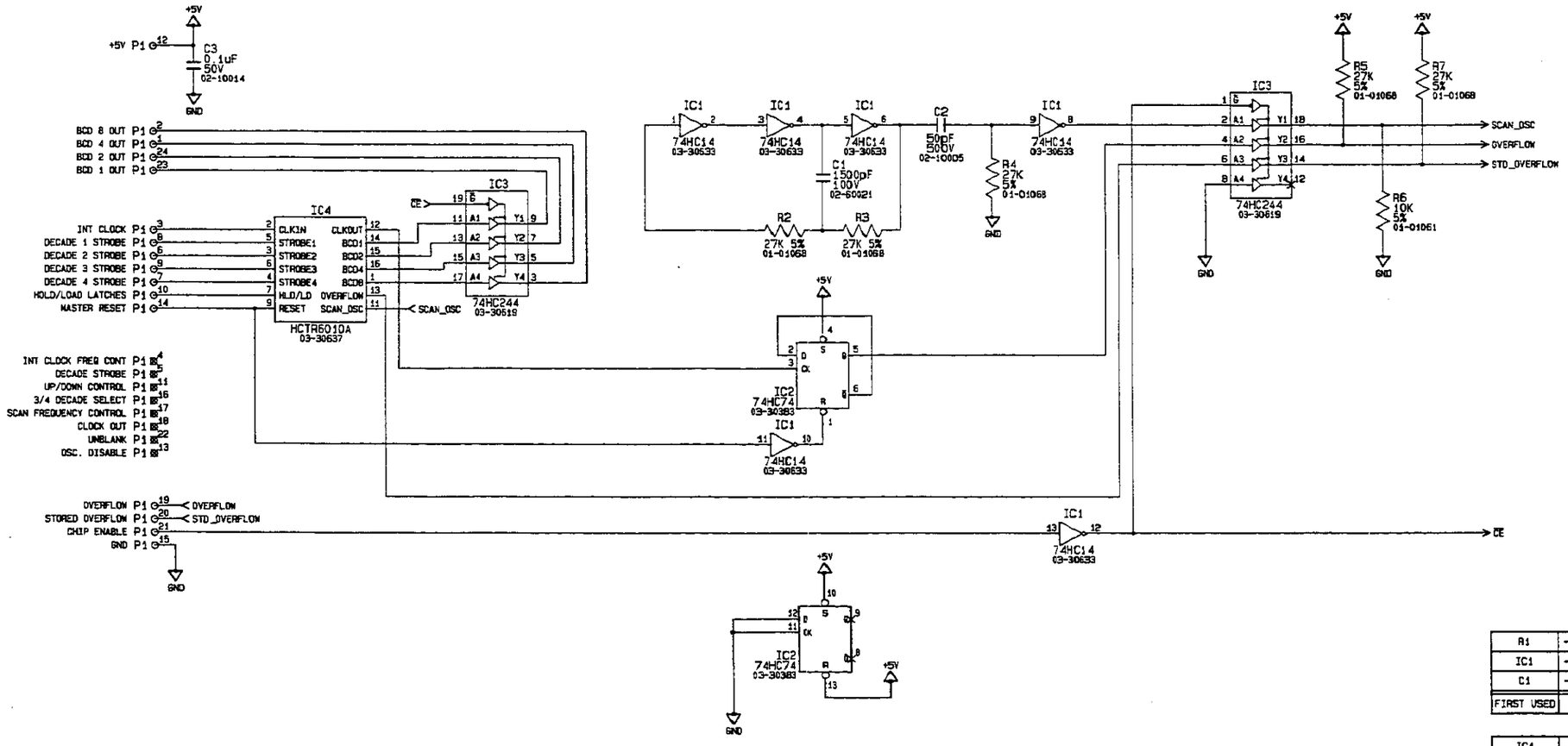
VALHALLA SCIENTIFIC
9955 MESA RIM RD. SAN DIEGO, CA 92121

TITLE: P.C.B. ASSEMBLY-- HCTR4010 REPLACEMENT BD.

SHEET 1 OF 1 | DRAWING NO. 4314-614 | REV: A

NOTES: Unless Otherwise Specified

REVISIONS				
ECR#	LTR	DESCRIPTION OF CHANGE	DATE	APPROVED
	A	PROTOTYPE PEL	2/17/94	



R1	— — — — — —		R7
IC1	— — — — — —		IC4
C1	— — — — — —		C3
FIRST USED	NOT USED		LAST USED

IC4	8	10	DIP16
IC3	20	10	DIP20
IC2	14	7	DIP14
IC1	14	7	DIP14
DEVICE	+5V	GND	PACKAGE

DRAWN BY P. LOFTUS	2/17/94	VALHALLA SCIENTIFIC
CHECKED BY	2/25/94	9855 MESA RIM RD. SAN DIEGO, CA 92121
APPROVED BY	2/25/94	

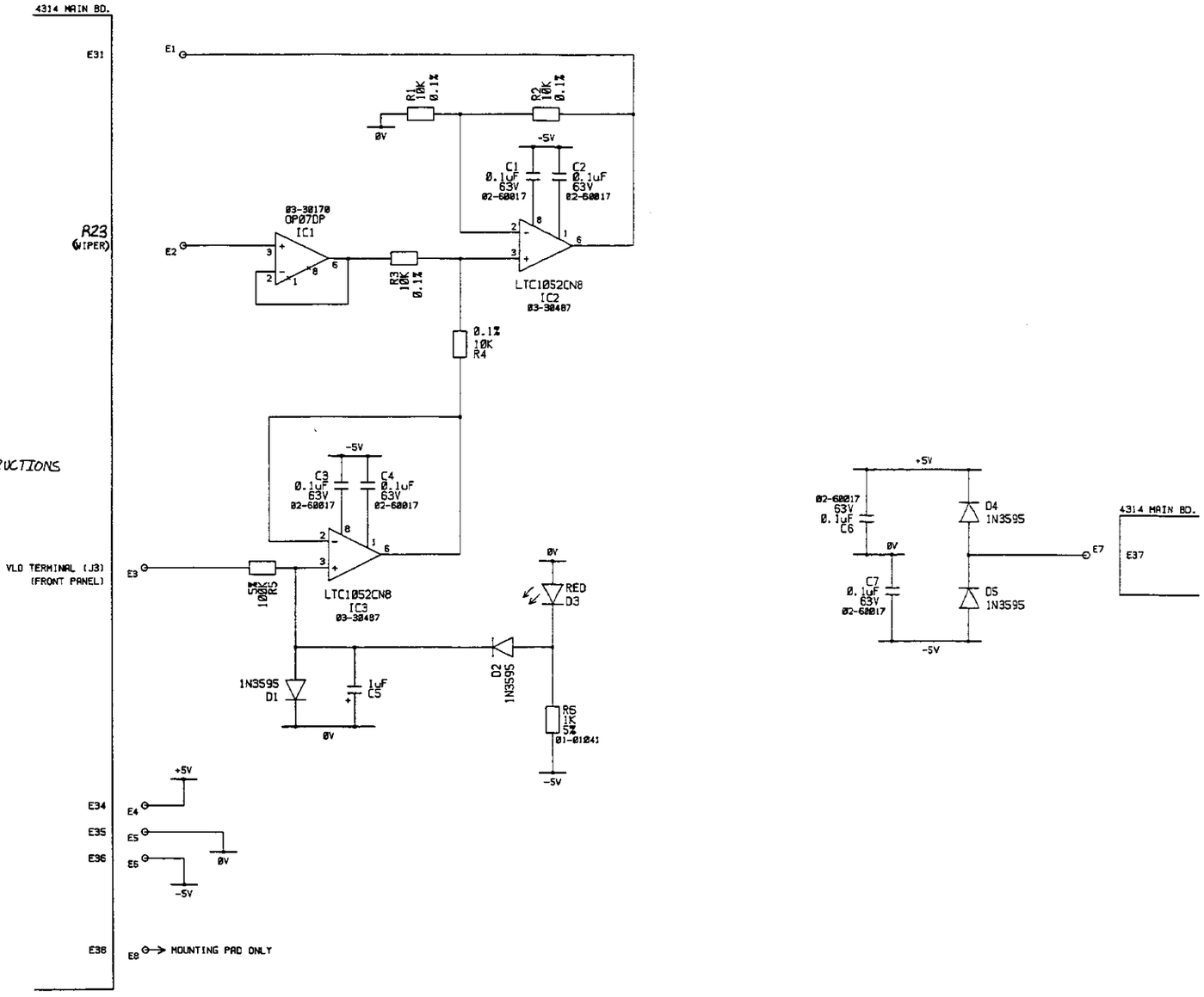
TITLE: SCHEMATIC- HCTR4010 REPLACEMENT

SHEET 1 OF 1 | DRAWING NO. 4314-084 | REV: A

REFER TO:

4314-070 FOR SCHEMATIC

4314-416 FOR ASSEMBLY INSTRUCTIONS



IC3	4	7			5
IC2	4	7			5
IC1	4	7			1.5.8
DEVICE	-5V	+5V			

VALHALLA SCIENTIFIC
9955 MESA RIM RD. SAN DIEGO, CA 92121

TITLE
RETROFIT SCHEMATIC

SHEET 1 OF 1 | DRAWING NO. 4314-072 | REV: A

NOTES: Unless otherwise specified

1. FOR INSTALLATION IN 4020, DO ONLY ITEMS MARKED WITH: ≺

REVISIONS				
ECR#	LTR	DESCRIPTION OF CHANGE	DATE	APPROVED

MODIFICATION INSTRUCTIONS

≺1. REMOVE THE FOLLOWING WIRES FROM A COMPLETED 4314:

≺ MAIN BD. E17 TO MAIN BD. E18
≺ " " E20 TO J1 (V HI TERMINAL)
≺ " " E19 TO J3 (V LO TERMINAL)

REMOVE ALL THE WIRING FROM S3 (POWER SWITCH)

≺2. CHANGE R57 FROM 01-01097 (750k)
≺ TO 01-01086 (220k)

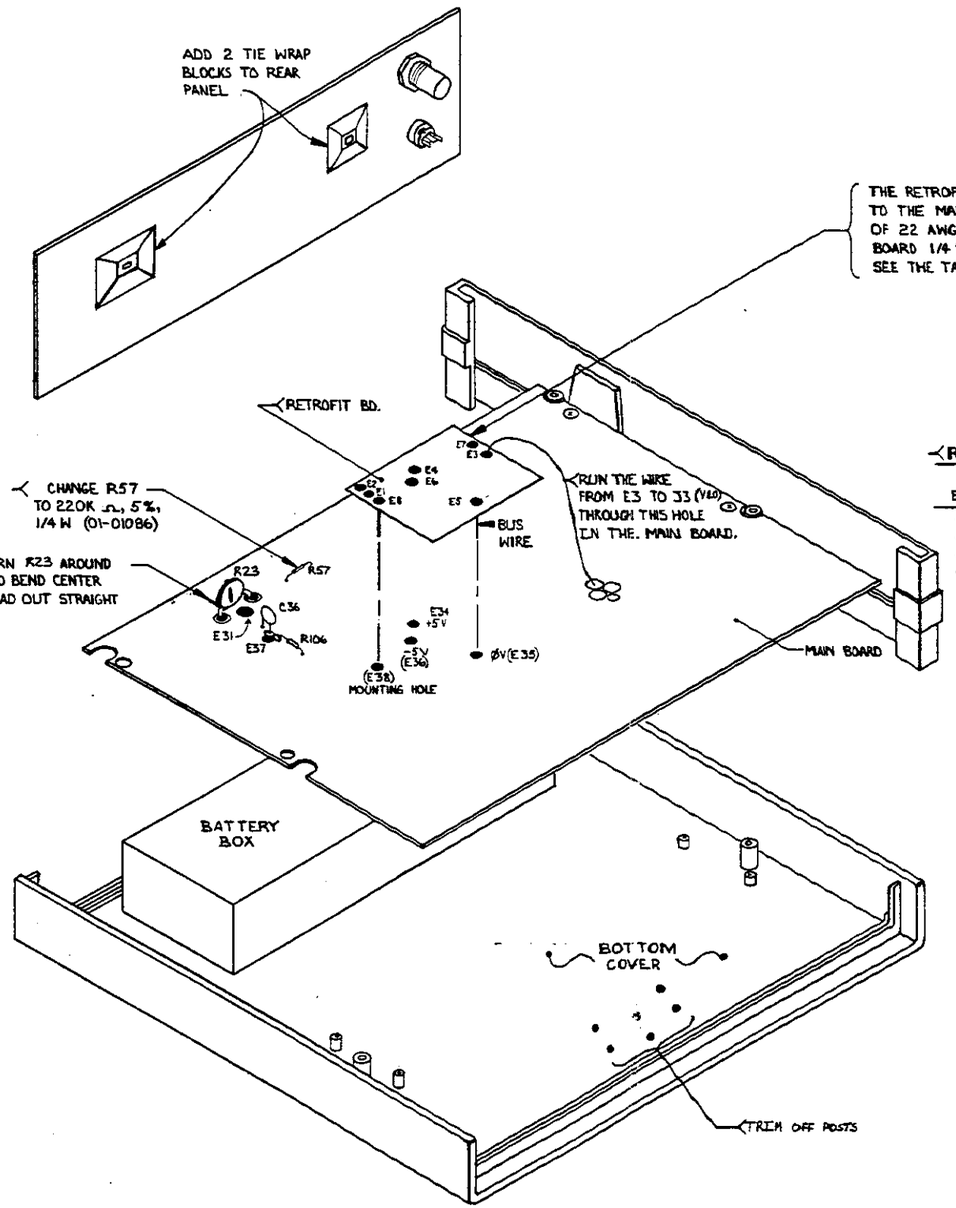
≺3. TURN R23 AROUND AND BEND CENTER LEAD OUT STRAIGHT

4. ADD TWO TIE-WRAP BLOCKS TO REAR PANEL (05-10491)

≺5. MOUNT THE RETROFIT BOARD ONTO THE THE MAIN BD. (MOUNT THE BOARD ¼" OFF THE MAIN BD.) SEE THE DIAGRAM AT RIGHT FOR MOUNTING

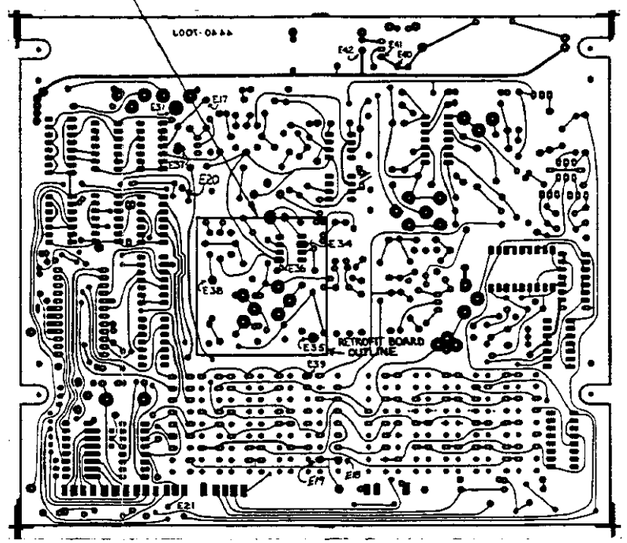
≺6. ADD THE FOLLOWING WIRES:

	FROM	TO	COLOR	AWG
≺	MAIN BD. C20 (-)	MAIN BD E17	ORN	22
≺	FRONT PANEL J1	MAIN BD E39	BLUE	22
≺	" " J3	RETRO BD. E3	WHITE	22
	" " S3-1	REAR PANEL J4-B	BROWN	22
	" " S3-2	MAIN BD. E41	RED	22
	" " S3-3	" " E21	ORN	22
	" " S3-4	" " E4	YELLOW	22
	" " S3-5	" " E42	GREEN	22
	" " S3-6	REAR PANEL J4-C	BLUE	22
≺	RETRO BD E1	MAIN BD E31	BROWN	22
≺	RETRO BD E2	R23 CENTER LEAD	RED	22
≺	RETRO BD E7	MAIN BD E37	VIOLET	22



≺RETROFIT BD. HOOK-UP

MAIN BOARD	RETROFIT BOARD
≺ E34	E4
≺ E35	E5
≺ E36	E6
≺ E38	E8



THE TRACES SHOWN IN THIS VIEW ARE THE TRACES ON THE SOLDER (BOTTOM) SIDE OF BOARD.

TOLERANCES: X° = ± 30' .XX = ± .02 .XXX = ± .005	MATERIAL:	VALHALLA SCIENTIFIC 9955 MESA RIM ROAD, SAN DIEGO, CA 92121		
DEBURR AND BREAK ALL SHARP EDGES AND CORNERS	FINISH:	TITLE: RETROFIT MODIFICATION ASSY.		
MACHINED SURFACES ARE TO HAVE A FINISH OF 63		SCALE: 3/4 =1 SHEET 1 OF 1	STOCK NO.	DRAWING NO. 4314-416 REV: D

VALHALLA SCIENTIFIC, INC.

4314 SERIES
DIGITAL IGNITER TESTERS

OPERATION MANUAL

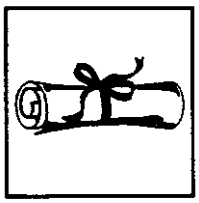
VALHALLA SCIENTIFIC

We've Moved!
Our new address is:
8318 Miramar Mall, San Diego, CA 92121
Ph. (858) 457-5576 • Fax (858) 457-0127

CERTIFICATION

Valhalla Scientific, Inc. certifies that this instrument was thoroughly tested and inspected and found to meet published specifications when shipped from the factory. Valhalla Scientific, Inc. further certifies that its calibration measurements are traceable to the National Institute of Standards and Technology to the extent allowed by NIST's calibration facility.

WARRANTY



The warranty period for this instrument is stated on your invoice and packing list. Please refer to these to determine appropriate warranty dates. We will repair or replace the instrument during the warranty period provided it is returned to Valhalla Scientific, Inc. freight prepaid. No other warranty is expressed or implied. We are not liable for consequential damages. Permission and a return authorization number must be obtained directly from the factory for warranty repairs. No liability will be accepted if returned without such permission. Due to continuing product refinement and due to possible parts manufacturer changes, Valhalla Scientific reserves the right to change any or all specifications without notice.

TABLE OF CONTENTS

SECTION V: THEORY OF OPERATION

SECTION VI: ROUTINE MAINTENANCE

SECTION VII: MANUAL CHANGES & ADDENDUMS

SECTION VIII: PARTS LISTS

SECTION IX: DRAWINGS AND SCHEMATICS

SECTION I UNPACKING AND INSTALLATION

1-1. Introduction

The Valhalla Series 4314 Igniter Testers are widely accepted as the standard in the industry, and are designed to provide extremely safe and reliable resistance testing of explosive or volatile devices. Some of the proven uses include: fuses, squibs, igniters, explosive bolts, automobile airbag initiators and many others.

Essentially, a Model 4314 is a 4-wire ohmmeter which has been designed to use very low test currents for its measurement. Additional circuitry proprietary to Valhalla Scientific is used to ensure that test current levels do not exceed the specified "failsafe current" even in a worst-case component failure situation. The failsafe feature is tested in every instrument before shipment and the results provided to the customer on a data sheet that accompanies the unit.

The 4314 series consists of approximately 15 different versions spanning the measurement range from 1mΩ resolution to 100MΩ full scale. The most popular of these versions are listed in Table 2-1. The 4314 may have a maximum of four (4) ranges installed at any one time. Unless otherwise specified when placing the order, the Model 4314A is the standard configuration. Please check Section 7 for any addendums that may apply to special 4314 versions.

Recently added as a standard feature of the 4314 is a **battery monitoring** circuit that alerts the user if the batteries have become or will soon become unusable. Please refer to section 4-8 for more details.

1-2. Inspection

If the shipping carton is damaged, request that the carrier's agent be present when the unit is unpacked. If the instrument appears damaged, the carrier's agent should authorize repairs before the unit is returned to the factory. Even if the instrument appears undamaged, it may have suffered internal damage in transit that may not be evident until the unit is operated or tested to verify conformance with its specifications. If the unit fails to operate or fails to meet the performance specifications of Section 2, notify the carrier's agent and the nearest Valhalla Sales Office. Retain the shipping carton for the carrier's inspection. DO NOT return equipment to Valhalla Scientific or any of its sales offices prior to obtaining authorization to do so.

1-3. Power Requirements

The Model 4314 is powered by an internal rechargeable heavy-duty nickel-cadmium battery pack. The battery charge is maintained by an external AC/DC converter that plugs into a standard 115VAC receptacle. The AC adapter provides 6VDC @ 300mA.

For safety reasons, the 4314 may not be powered directly from the AC adapter. The 4314 must be turned *off* and have the adapter connected in order to charge the batteries. The battery pack may power the 4314 for up to 10 hours before requiring a recharge.

Although the batteries are fully charged prior to shipment, it may be desirable to refresh the charge for 24 hours before use. As a rule of thumb, the 4314 requires twice as much time to fully recharge as

the amount of discharge time. For example, if the instrument was used continuously for 2 hours, the AC adapter must be connected for 4 hours in order to fully restore the charge.

1-4. Installation

The Model 4314 consumes little power and generates virtually no heat. Consequently, it may be used in any area where the environment does not exceed the specifications of Table 2-2.

A rack mount adapter is available to allow installation of the 4314 in a standard 19" equipment rack. This option is designated as Option R4. When installing this instrument in a rack environment, avoid exposing the 4314 to extremes of temperature which will affect accuracy and shorten battery life-span. For installation instructions, please refer to the drawing included with the option.

Table 2-1. Partial Listing of Available 4314 Versions [1]

4314	RANGE / RESOLUTION TEST CURRENT / FAILSAFE CURRENT [2]				NOTES
A	20Ω/1mΩ	200Ω/10mΩ	2000Ω/.1Ω	20000Ω/1Ω	Standard version 4314
	10mA/15mA*	1mA/1.5mA	100μA/150μA	10μA/15μA	
B	-	200Ω/10mΩ	2000Ω/.1Ω	20000Ω/1Ω	20Ω range deleted
	-	1mA/1.5mA	100μA/150μA	10μA/15μA	
AN	20Ω/1mΩ	200Ω/10mΩ	2MΩ/100Ω	20MΩ/1KΩ	20 Megohm measurement capability
	10mA/15mA*	1mA/1.5mA	.1μA/.15μA	.01μA/.015μA	
UK	20Ω/1mΩ	200Ω/10mΩ	2000Ω/.1Ω	20000Ω/1Ω	Reduced test & failsafe currents
	5mA/8mA	.5mA/1.5mA	50μA/150μA	5μA/20μA	
KB	20Ω/1mΩ	200Ω/10mΩ	2000Ω/.1Ω	20000Ω/1Ω	charging jack, fuseholder on front panel
	5mA/8mA	.5mA/1.5mA	50μA/150μA	5μA/20μA	
N	200Ω/10mΩ	2000Ω/.1Ω	2MΩ/100Ω	20MΩ/1KΩ	High resistance, low currents
	1mA/1.5mA	100μA/150μA	.1μA/.15μA	.01μA/.015μA	
AP	20Ω/1mΩ	2kΩ/.1Ω	200KΩ/10Ω	100MΩ/10KΩ	100 Megohm measurement capability
	10mA/15mA*	100μA/150μA	1μA/1.5μA	1nA/1.5nA	
GD	20Ω/1mΩ	20KΩ/1Ω	200KΩ/10Ω	20MΩ/1KΩ	20 Megohm measurement capability
	10mA/15mA*	10μA/15μA	1μA/1.5μA	.01μA/.015μA	
LK	20Ω/1mΩ	200Ω/10mΩ	2000Ω/.1Ω	200KΩ/10Ω	Reduced test & failsafe currents
	5mA/8mA	.5mA/1.5mA	50μA/150μA	.5μA/1.5μA	
A1	?	?	?	?	Any single range only (dedicated)
	?	?	?	?	

[1] If a particular version is not represented here, also refer to Section 7.

[2] Typical values. Actual fail-safe currents vary from instrument to instrument and may be ±20% from the typical value. The actual measured level is provided on the Final Calibration Data sheet.

* maximum fail-safe current level

Table 2-2. Specifications

Accuracy: (for 1 year @25°C ± 10°C)

20Ω through 20000Ω ranges	±0.02% of rdg ±0.02% of rng
200KΩ range	±0.05% of rdg ±0.05% of rng
2MΩ range	±1% of rdg ±0.2% of rng
20MΩ range	±2% of rdg ±0.2% of rng
100MΩ range	±3% of rdg ±1% of rng

Temperature Coefficient

20Ω through 20KΩ ranges	±0.002% per °C (from 0°C-15°C and 35°C-50°C)
200KΩ range and above	not applicable

Temperature Range

Operating	0°C to 50°C
Storage	-10°C to 70°C

Display Type ..... 4½ digit Light Emitting Diodes (LED) (19999)

Overload Indication ..... Display flashes

Conversion Rate ..... Approximately 300ms

Terminal Configuration ..... Four-wire Kelvin

Maximum Input ..... 250VDC or AC_{peak} without damage

Current Source Compliance Voltage ..... clamped at 1.6 volts

Power ..... (4 "D") 1.2V rechargeable nickel-cadmium batteries

Battery Charger ..... provides 6VDC at 300mA nominal

Dimensions ..... 9½"(24cm)W x 11"(27cm)D x 3"(8cm)H

Weight ..... 3.5lbs(1.6kg) net; 6.5lbs(3kg) shipping

SECTION III OPTIONAL EQUIPMENT

3-1. Available Options

Listed below are the options available for use with the Model 4314 Series Digital Igniter Testers.

Option A: Battery Charger

Option "A" is an AC/DC converter that converts 115VAC line voltage to 6VDC at 300mA. One charger is provided as a standard accessory with every 4314.

Replacement Batteries

The rechargeable Nicad batteries installed in the 4314 should provide years of trouble-free operation. Replacement, however, will eventually be necessary. The 4314 uses four 1.2V cells installed in a reusable battery box. The batteries are held in place by reusable tie-wraps. When ordering replacement batteries, please specify Valhalla Stock #05-10117, quantity four (4).

Option CC4: Carrying Case

Option "CC4" is a meter and accessory carrying case with extra room for test leads, battery charger, etc.

Option R4: Rack Mount Adapter

Option "R4" is an adapter tray that allows the 4314 to be installed in a standard 19" equipment rack.

Option BCD-MX: Data Outputs

Option "BCD-MX" provides multiplexed binary-coded-decimal data outputs that may be used by various types of data acquisition equipment. Refer to section 4-7.

Model 1248: Dual-Limit Comparator

The Valhalla Model 1248 may be used in conjunction with a Model 4314 and Option BCD-MX above. The Model 1248 is a dual-limit comparator that interprets the display indications of the 4314 as either "HI", "LO" or "GO", based on a window that is set by the user. Relay contact closure is provided to trigger an alarm, batch sorter, counter or other device. The mating cable from the 4314 to the 1248 is 2½ feet in length and designated as "IDC-2".

3-2. Test Leads

Option K: 4-Wire Kelvin Lead Set

Option "K" is the recommended general purpose lead set for all Valhalla Ohmmeters. Option K is a shielded 48" lead set terminating in ½" gold plated clips.

Option MP-S: Single Probe Lead Set

Option "MP-S" is a 4-wire lead set terminated in single points. The 4-wire configuration is maintained up to the point of the probe, eliminating most cable resistance effects. Option MP-S may be used where a single probe tip is a must.

Option MP-1: Kelvin Micro-Probes

Option "MP-1" is a 48" shielded lead set terminated in spring-loaded steel tips with .05" spacing.

Option MP-2: Kelvin Mini-Probes

Option "MP-2" is a 48" shielded lead set terminated in spring-loaded steel tips with .18" spacing.

Option MP-4/MP-5: Surface Probes

These probes permit rapid, repeatable bonding testing on a variety of screened or flat surfaces. Test current is evenly distributed through the probe base while sensing is accomplished via a spring loaded center contact. The "MP-4" target area is 1" in diameter. The "MP-5" target area is .4" in diameter.

Option KK: 4-Wire Kelvin Lead Set

Option "KK" is a 48" heavy duty cable set terminated in large "jaws" that have an open span of 2".

Option C: Banana-to-Clip Cable

Option "C" is a 48" shielded cable terminated in dual alligator clips. Two cables are provided for use with Valhalla ohmmeters.

Option BBL: Banana-to-Banana Cable

Option "BBL" is a 48" shielded cable terminated in dual banana plugs at both ends.

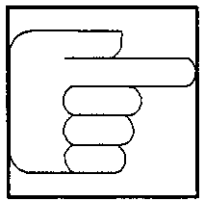
Option KCS: Kelvin Clips

Option "KCS" are the gold plated kelvin clips used on the Option "K" cable. These clips may be used when making custom cables or when repairing Option "K".

Option JAWS: Heavy-Duty Clips

Option "JAWS" are the jumper cable type clips used on the Option "KK" cable. These may be used when making custom cables or when repairing Option "KK".

SECTION IV OPERATION



4-1. General

This section of the manual contains complete operating instructions for the 4314 Series Digital Igniter Testers. A description of the front panel controls, connection instructions, and the theory behind 4-wire resistance measurement is discussed in this section.

4-2. Front Panel

» Power Switch

When the front panel power switch is placed in the OFF/CHARGE position, all power is removed from the output terminals, and the battery pack is connected to the charging circuit. When the switch is placed in the ON position, the battery pack is disconnected from the charging circuit. The possibility of a common mode voltage between the device under test and AC Power ground is therefore eliminated. The operator need not be concerned if the Battery Charging Adapter is plugged in while making resistance measurements.

» Range Switch

The Model 4314 input range is selected by depressing the desired button on a multistation interlocking pushbutton array located on the right-hand side of the front panel. The pushbutton for the lowest resistance range is nearest to the POWER switch.

4-3. Rear Panel

» Fuseholder

The fuseholder is mounted on the rear panel and contains a 2 amp in-line fuse. This fuse is designed to protect the battery pack from excessive charging currents. On Model 4314KB this fuseholder is mounted on the front panel. Replace blown fuses with the same type and rating only!

» Charging Jack

The battery charging jack is a barrel type and is located on the 4314 rear panel. The center pin of the connector is positive. The charging requirements of the internal battery pack are 6VDC @300mA. The correct charging voltage is supplied by the adapter included with the instrument. Additional adapters are available as Option "A". The charging jack is mounted on the front panel on Model 4314KB.

4-4. 4-Wire Resistance Measurement

The four-terminal configuration of the 4314 eliminates errors normally caused by test lead and contact resistances. In many applications the contact resistance can exceed the value of the load by several orders of magnitude. The 4314 bypasses this potential error source by providing two terminals of constant current and an additional two terminals for high impedance voltage measurement. The result is a fast, accurate resistance measurement of the load, independent of the resistance of the current carrying leads.

Figure 4-1 illustrates how the 4-wire principle is used to eliminate lead, wire and contact resistances as potential error sources. The internal current source inherently overcomes all series resistance (within compliance voltage limits) and delivers a precise constant current.

The internal high-impedance DVM senses the voltage drop across the load. There is negligible contact and lead resistance error created by the voltage measurement because the high input impedance of the DVM limits current flow in the voltage leads.

4-5. Connections

Connections are made to the front panel terminals using a 4-wire configuration as described in section 4-4. When using Valhalla test leads, the tabbed side of the banana jack is plugged into the **current** terminals. This ensures that the current is carried in the largest conductor and that the voltage input is shielded.

V_{HI}* *I_{HI} ←Tab

V_{LO}* *I_{LO} ←Tab

All Valhalla ohmmeters use a high impedance voltmeter as part of the resistance measurement process. This voltmeter is a highly accurate and stable 4½ digit analog-to-digital converter (A to D). Unless it is receiving a definite input signal, the output reading of this A to D is ambiguous. The display may indicate a randomly wandering number or it may indicate an overrange condition. This unpredictable display may make it seem to appear that the instrument is experiencing some sort of malfunction. It is, in fact, just a characteristic of the voltmeter circuit and should not be mistaken for a fault in the instrument.

The display indications should be ignored unless there is a definite measurement being taken. If this wandering display is not acceptable, the ohmmeter can be made to indicate an overrange condition whenever the terminals are open by using a 4-wire Kelvin type lead set or by shorting the V_{HI} and I_{HI} terminals together.

The display should indicate a stable reading when the test leads are securely attached to the device under test. If the display appears to be erroneous when connected to a load, recheck the test leads for integrity and cleanliness. If all external items appear to be functioning properly, the problem may be the ohmmeter. In this case, please contact your local Valhalla Scientific Sales Office.

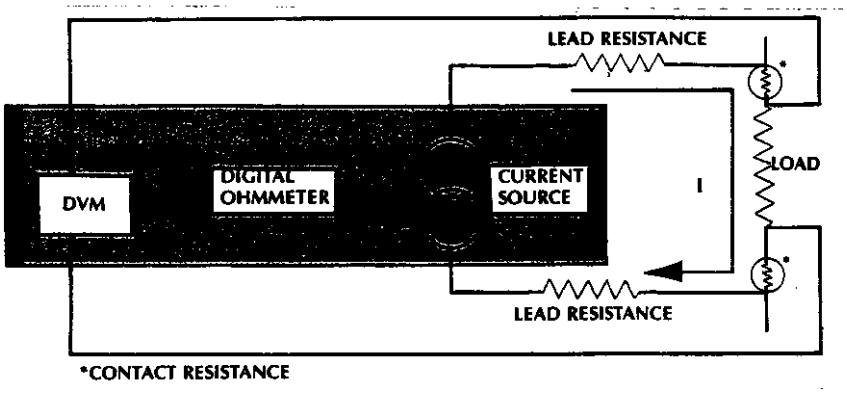


Figure 4-1. Error Sources in Resistance Measurements

4-6. Failsafe Operation

The 4314 Series Igniter Testers incorporate a proprietary current source design that renders them incapable of delivering excessive voltage or current to the device under test. The *typical* failsafe current for each range is indicated under the corresponding range switch on the 4314 front panel. Please refer to section 5-6 for a technical description of the failsafe circuitry.

Every 4314 Series Igniter Tester is thoroughly tested before it leaves the factory. These tests include a failsafe test that simulates a "worst case" failure condition. The resulting output current is recorded and provided on the data sheet included with every 4314.

As a further precaution the 4314 is isolated from the AC line whenever the POWER switch is in the ON position.

The 4314 receives its power from an internal rechargeable battery pack. The 4314 must be in the OFF/CHARGING position in order to charge the batteries.

4-7. Option BCD-MX Connections

The 4314 may be equipped with an optional data output designated as Option BCD-MX. This option provides a multiplexed binary-coded-decimal output that may be interpreted by various types of data acquisition equipment. The outputs are compatible with the Valhalla Model 1248 BCD Comparator.

Table 4-1 lists the function of each pin of the rear panel connector. All outputs are TTL compatible, active-high, positive logic digital signals capable of driving one TTL load. The data is valid when the corresponding STROBE line is high (1).

Pin Numbers	Function
1, 6, 11, 16	1's Data Bit
2, 7, 12, 17	2's Data Bit
3, 8, 13, 18	4's Data Bit
4, 9, 14, 19	8's Data Bit
21	10,000 counts
29	10^0 STROBE
30	10^1 STROBE
31	10^2 STROBE
32	10^3 STROBE
22, 23, 24, 50	Common (GND)
5, 26, 33	+5VDC

Table 4-1. Option BCD-MX Connector Pin Assignments

4-8. Battery Monitoring Circuitry

A standard feature of 4314's manufactured after December 3, 1993 is a circuit that monitors the output voltage of the internal battery supply. The indicator for this feature is located to the far left of the display window and is a red light bar " – ".

If this LED flashes during a measurement, this indicates that the batteries will require recharging within the next 2 hours of continuous use. Readings are still within specified accuracies at this point.

If the LED is continuously illuminated, readings should not be trusted. An overnight recharge should be performed before using the 4314 for critical testing.

☞ It is possible for the user to receive a low battery indication on a single range only (particularly the 20Ω range), while the 4314 remains well within operating limits on other ranges. **Unless the user observes a continuous low battery indication during measurement, readings are still valid.**

SECTION V THEORY OF OPERATION

5-1. General

The Valhalla Scientific Model 4314 Digital Igniter Tester is shown in block diagram form in Figure 5-1. All information disclosed in this section is proprietary and is included in order to make troubleshooting to component level possible.

The Model 4314 uses solid-state semiconductors exclusively and CMOS circuits extensively to minimize power requirements and make battery operation practical.

5-2. Troubleshooting

Malfunctions are often the result of misinterpretation of specifications or due to an incomplete understanding of the instrument. **A thorough review of the operating instructions for this instrument is recommended prior to any component replacement, etc.** Check to be sure that cables and other test equipment are in good working order before attempting to troubleshoot the 4314.

If the Model 4314 exhibits problems that cannot be eliminated by reviewing Sections 2 and 4, the following guidelines have been established to help solve the problem.

5-2-1. Localizing the Problem

The key to successful troubleshooting is to localize the problem as much as possible before trying to pin the problem down to a specific component. Certain questions should be asked such as "Does the problem occur on all ranges or on a specific range only?". The power supplies are also one of the first things that should be checked.

As it is not possible to anticipate all failure modes of the 4314, servicing personnel should become familiar with this section to gain a complete understanding of the internal workings of the Model 4314.

5-2-2. Component Replacement

If the problem has been identified as a faulty component, the accuracy of the 4314 can be maintained only if the following precautions are taken:

- Use only the specified component or its exact equivalent. Spare parts can be ordered from your nearest Valhalla Scientific Service Center or directly from the factory by referring to the Valhalla Stock Number listed in the Parts Lists section at the back of this manual.

- Use only 63/37 grade rosin core electronic grade solder with a 50W or lower maximum power soldering iron.

- When soldering, heat the terminal of the component, *not* the solder. Apply solder smoothly and evenly. Do not move the component until the solder has cooled. **Bad solder joints can cause additional problems!**

- Static sensitive parts require special handling procedures. Always treat an unknown part as if it were static sensitive.

5-3. Circuit Descriptions

The circuit descriptions which follow are referenced to Figures 5-1, 5-2, 5-3 and the schematic diagrams at the back of this manual. In the following descriptions, references to integrated circuits are given in the form "IC15-1", which refers to Integrated Circuit 15, pin 1.

5-4. Analog-to-Digital Converter

The Model 4314 incorporates a three-step analog-to-digital integration process to convert the output of the ohms-to-DC converter from analog to digital form (see Figure 5-2). Step 1, the RESTORE mode, lasts for 200 milliseconds. During this period the input to preamplifier IC12 is grounded through one section of quad-bilateral switch IC2. Sample-and-Hold switch Q15 is ON, closing the feedback loop around the integrator IC13 and zero detector IC14. This forces the zero detector output to zero, and capacitor C21 charges to the level of any offset voltage present in the preamplifier, integrator and zero detector. This charge on C21 will cancel the effect of any zero drift or offset originating in the analog section of the A/D converter.

With the capacitor C21 charged to offset any zero error present, the second step of the digitizing process begins. Q15 is switched OFF, opening the feedback loop, and the ohms-to-DC converter output is applied to the input of unity gain amplifier IC12. The output of this preamplifier is applied to the integrator input. During the 100-millisecond integration time, the integrator output rises to a level proportional to the amplitude of the input voltage. The output of the zero detector, which senses the integrator output, delivers a control voltage to the "D" input of flip-flop IC6-5.

At the end of the integration period, the input of IC12 is disconnected from the ohms-to-DC converter output, and the control signal at IC6-5 is clocked through the flip-flop to its "Q" output at IC6-1. This connects the reference voltage (E_{ref}) to the input of IC12. The polarity of E_{ref} is opposite to that of the ohms-to-DC converter output.

With E_{ref} applied to its input, preamplifier IC12 begins to charge in the opposite direction toward the negative value of E_{ref}. Time T_x (Step 3 of Figure 5-2) is the time required for the integrator voltage to decrease to zero volts, and is directly proportional to the output of the ohms-to-DC converter (E_x); that is: $E_x/E_{ref} = T_x/100$ milliseconds. Consequently, the value of E_x can be determined by measuring T_x.

The actual digitizing process is performed by IC7 counting the output of the crystal-controlled clock during Step 3. When the zero detector output passes through zero due to E_{ref} integration, the count initiated at the beginning of Step 3 is stopped, and the total is displayed on the LED readout. At the same time, the zero detector resets IC5 to begin the RESTORE mode again.

5-4-1. Reference Amplifier

The precision reference voltage required to perform Step 3 of the A/D conversion is developed by IC15. Current for the reference zener CR17 is derived from constant current source Q9. The zener voltage is sensed at IC15-3, and feedback from IC15-1 to IC15-2 sets the output at IC15-1 to approximately -1.05 volts. This voltage is applied to quad-bilateral switch IC2-1 and, during Step 3, to the voltage divider consisting of R22 through R24. Quad-bilateral switch IC3 connects -1 volt to the input of preamplifier IC12 from the arm of R23.

5-4-2. LED Display

At the completion of the A/D conversion, the count is stored in four registers of IC7. IC7 also contains an internal oscillator which is set by C4 to operate at 10 kHz. IC7 output terminals 2, 3, 23, and 24 are connected to decoder-driver IC10. These outputs are sequentially connected to the IC10 storage registers at a 10 kHz rate. Concurrently, driver transistors Q2 through Q5 are turned on in sequence. When data representing the most significant digit is available on IC10's outputs, Q5 is turned on and the decoded data appears on DS2. Data for each less significant digit appears sequentially at IC10's output as the corresponding driver transistors (Q4 through Q2) are turned on, and is displayed by DS3, DS4 and DS5. This sequence is repeated at the 10 kHz rate, and the data display consequently appears to be continuous. The MSB is enabled by IC7 through IC5 and Q17.

IC11 is a programmable oscillator that has an output of 100kHz at pin 1. Y1 is a 1MHz crystal that provides the base clock frequency for IC11. The output of IC11 is used to clock signals through the flip-flops and to sequence the display LED's.

5-5. Ohms-To-DC Converter

The ohms-to-DC converter generates a constant current which is passed through the device under test to develop the voltage measured by the A/D converter.

5-5-1. Constant Current Source

The constant current source is composed of IC15, IC17, Q8, DS6 and their associated components. The input to the constant current source is approximately +1.05 volts, developed at IC15-7 and connected to IC15-13 through R58 and R59.

The heart of the constant current source is the voltage-to-current converter, which incorporates a Transconductance Amplifier. A simplified schematic of this unique circuit is shown in Figure 5-3 and described in Section 5-5-2. The amplifier of IC15-12 is an invertor, and its output is applied to IC15-9. The amplifier of IC15-8 has unity gain due to the feedback through R74. Its output is applied to the inverting input of IC17-3. The output of IC17-6 provides feedback to the non-inverting input of IC15-10. This circuit operates to maintain the inverting input at IC17-3 and the non-inverting input at IC17-2 at the same potential.

5-5-2 Transconductance Amplifier (U.S. Patent No. 4,091,333)

Assume that terminals I_{hi} and I_{lo} of Figure 5-3 are shorted, and 1 volt is applied to E_{in} so that I_{hi} is positive. To equalize the inputs of IC17, IC15 must be driven to zero. This condition occurs only when the voltage drops across R73 and R77 are equal to the drops across R74 and R76. For these voltage drops to be equal, the output of IC17 must be at +1 volt. Since the output of IC15-8 must be zero, the drop across R74 is 0.5 volts, making the inverting input 0.5 volts. The drops across R73, R76 and R77 will also be 0.5 volts. Since the inputs to IC15 are essentially equal, its output is zero (offset by the few microvolts required to drive IC17 to +1 volt). Under these conditions the sum of the voltages across R73, R74, R76 and R77 equals the sum of E_{in} plus the output of IC17.

Consider now that the short is removed from the I_{hi} and I_{lo} terminals and a 100-ohm resistor (R_L) is connected in its place. The current through R_L increases the voltage at the input to IC15. A balanced condition will be reached when the output of IC15 is equal to the non-inverting input of IC17. Again, this condition occurs when the voltage drops across R73 and R77 are equal to the voltage drops across R74 and R76. At this time the output of IC17 is 1.1

volts. The voltage drop across the Range Resistor is 1 volt, just as it was when the output terminals were shorted. The current through R_L is 10 milliamperes, just as it was through the jumper when the output terminals were shorted.

5-6. Failsafe Design

Reference to the Model 4314 schematic will show that the output of IC17-6 is actually applied to the base of transistor Q8, which acts as a current limiter. The worst-case failure that could occur in this circuit would be a Q8 short, which would effectively connect the -5 volt supply directly across R49, CR9, the range resistor and R_L. DS6, however, acts as a 1.6 volt zener diode, limiting the voltage that can appear across these components. Even if every component in the amplifier circuit shorted, the current through the igniter could not exceed safe limits, because the -5 volt supply includes inherent limiting. Because of the design of T1, the -5 volt supply can only deliver 20 to 25 milliamperes before the DC/DC converter disengages, dropping the -5 volt output to zero. See Section 5-7.

5-7. Power Supplies

The Model 4314 is powered by a rechargeable internal battery pack and cannot be operated directly from the battery charging adapter. This is to prevent the possibility of a short to the AC line. When the POWER switch is in the OFF/CHARGING position, the batteries are connected to the rear panel charging jack to allow for recharge. When the POWER switch is in the ON position, the batteries are disconnected from the battery charger and connected to the internal circuits of the 4314.

The +5 volt supply is provided directly by the batteries. The -10 volt supply is developed by a DC/DC converter composed of Q11, Q12, T1, CR19, CR20 and their associated components. The -5 volt supply is regulated from the -10 volt supply by IC22.

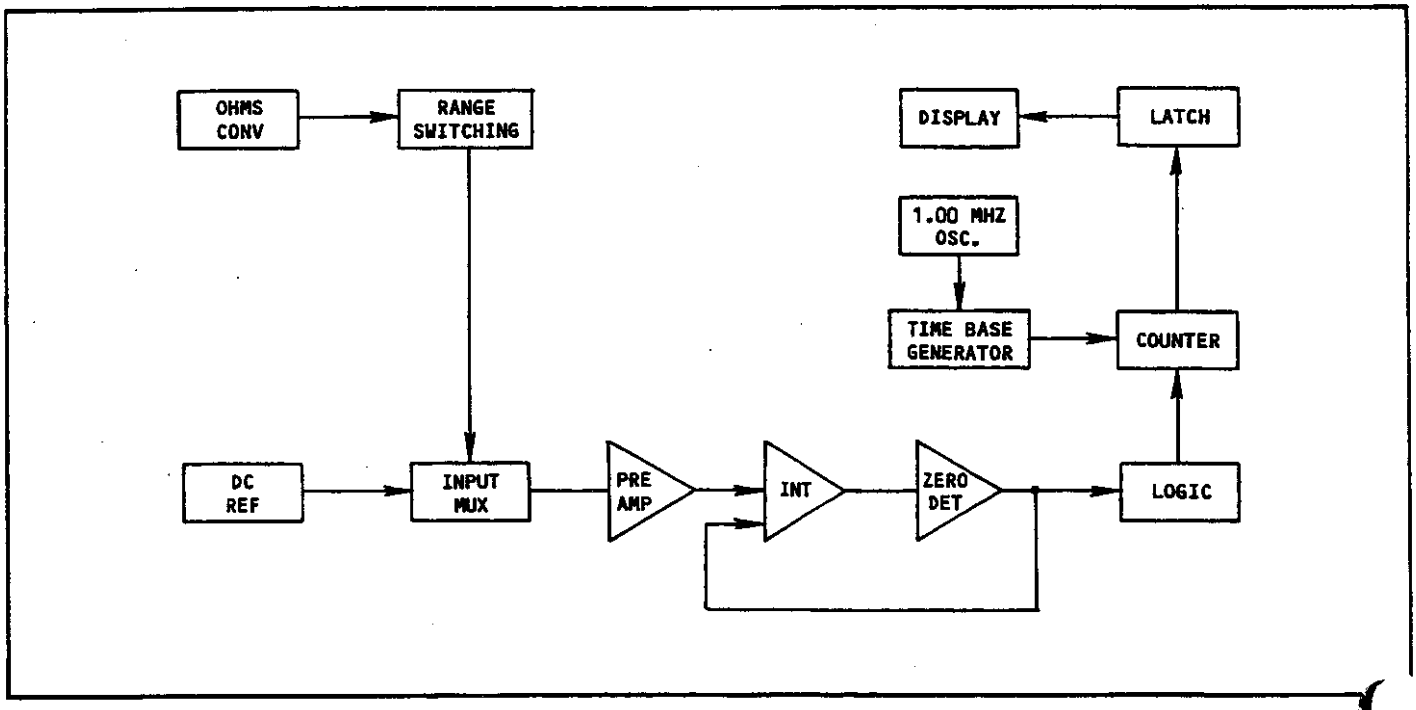


Figure 5-1. Model 4314 Block Diagram

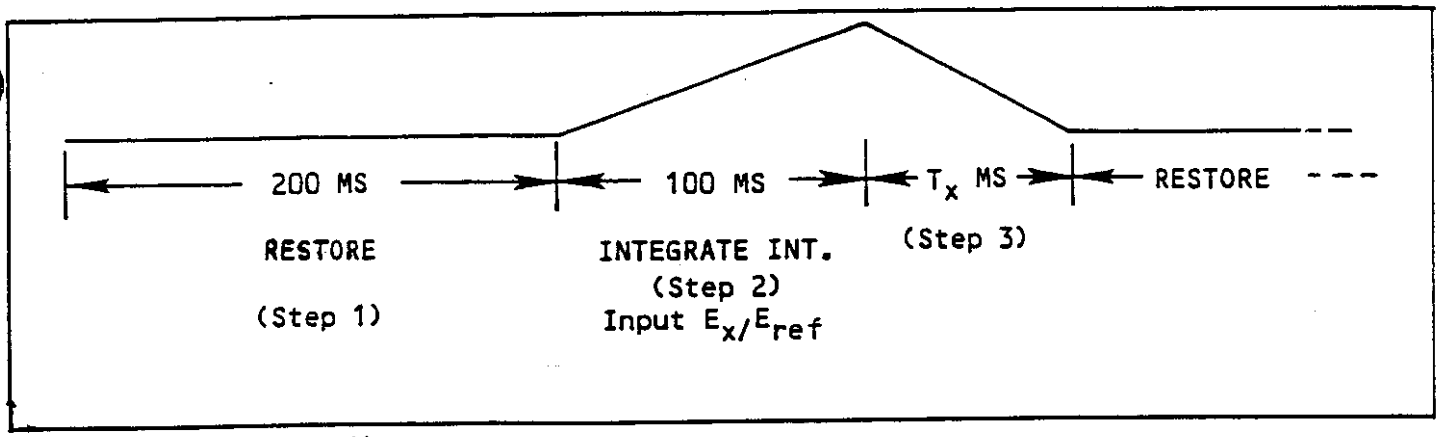


Figure 5-2. Analog-to-Digital Converter Timing Diagram

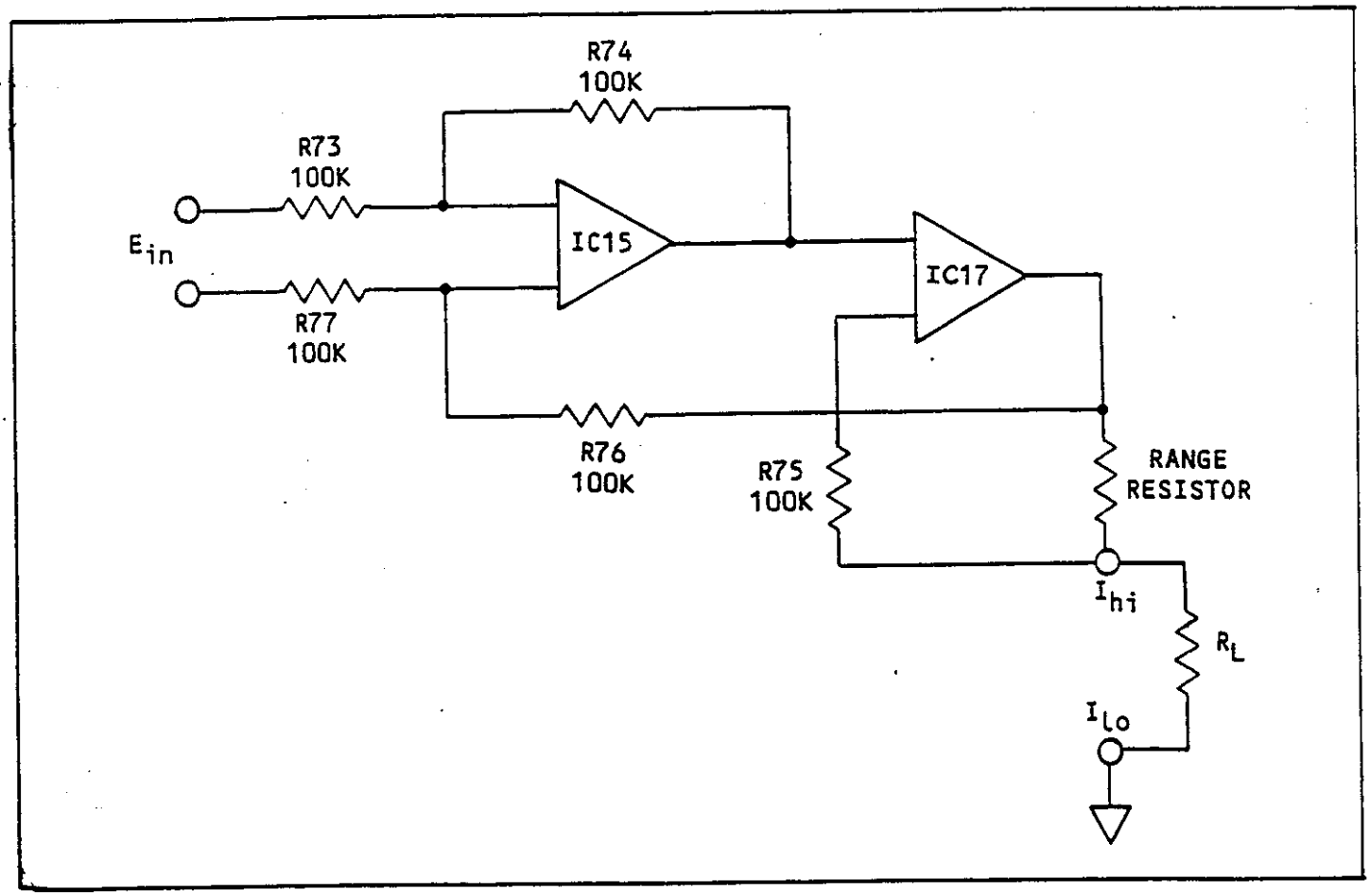


Figure 5-3. Transconductance Amplifier (Simplified)
Protected by U.S. Patent No. 4,091,333

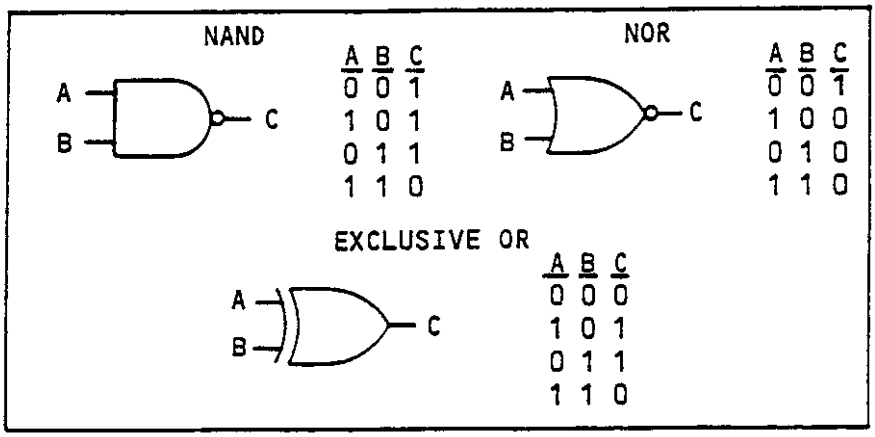


Figure 5-4. Logic Gate Truth Tables

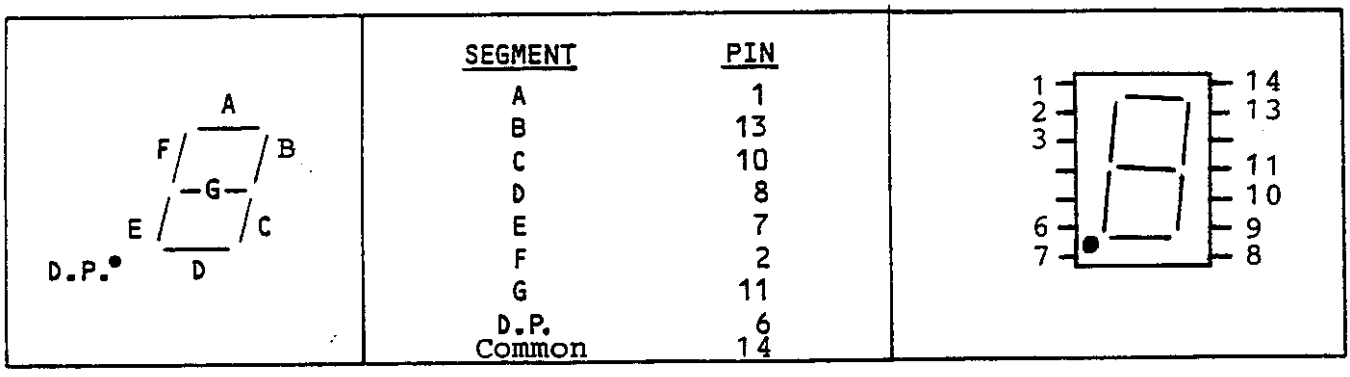
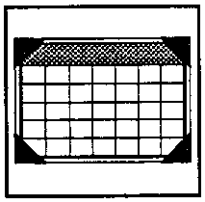


Figure 5-5. LED Display Pin Functions

SECTION VI ROUTINE MAINTENANCE



6-1. General

This section of the manual contains routine maintenance information regarding the Valhalla Scientific Model 4314 Digital Igniter Testers. Calibration should be performed on a regular basis to ensure continued instrument accuracy. The recommended calibration interval is 1 year.

6-2. Required Test Equipment

Following is a list of the standard resistors required to calibrate the Model 4314A. Calibration of Models other than the 4314A use the same basic procedure however different standard resistor values may apply.

Precision Resistors:

.1 ohm ± 0.01% Accuracy
10 ohm ± 0.005% Accuracy
100 ohms ± 0.005% Accuracy *
1000 ohms ± 0.005% Accuracy *
10000 ohms ± 0.005% Accuracy *

*The Valhalla Model 2724A may be used for 100Ω and above.

Test Leads:

4-wire lead set
(Valhalla Option "K" or "C")

6-3. Calibration Procedure

The 4314 should be calibrated with fully charged batteries and should be allowed to warm-up for a minimum of 5 minutes before beginning the procedure. The adjustments are accessed by removing the four feet screws, then lifting off the top cover only. The locations of the adjustments are shown on drawing number 4314-600 at the back of this manual.

6-3-1. Linearity Adjustment

1. Select the 200Ω range. Connect the Kelvin clips to the 0.1 ohm standard resistor.

2. Adjust potentiometer R60 for a display indication of 00.10.

6-3-2. Full Scale Adjustment

1. Select the 200Ω range. Connect the Kelvin clips to the 100 ohm standard resistor.

2. Adjust R69 for a display indication of 100.00.

3. Check all remaining ranges with the appropriate standard resistors. All ranges must be within the specifications outlined in Section 2.

6-4. Battery Replacement Instructions

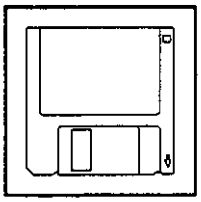
The rechargeable nicad batteries used in the 4314 are very durable and should provide years of trouble-free operation. As with all batteries, replacement will eventually be necessary. Batteries may be ordered from Valhalla Scientific as stock #05-10117, quantity: (4). The process of battery replacement is described below:

1) Remove the four feet screws and the bottom cover.
2) Undo the reusable tie-wraps by pushing down on the locking pin.
3) Remove the old batteries and replace. **Observe polarity!**
4) Secure the new batteries in place by re-tightening the tie-wraps.
5) Replace the cover and feet screws, taking care not to pinch any wires.

SECTION VII MANUAL CHANGES & ADDENDUMS

Immediately following this page may be found any notices regarding manual changes, or operating considerations for special 4314 versions. Please refer to any applicable material before attempting to operate your Model 4314.

SECTION VIII PARTS LISTS



The following parts lists are included in this manual:

4314-400	4 pages	4314A Main Board Assembly
4314-614	1 page	HCTR4010 (IC7) Replacement PCB Assembly

REF.DES.	STOCK #	QUANTITY A	QUANTITY T	QUANTITY N	DESCRIPTION	MANUFACTURING/PURCHASING DATA	ALTERNATE
C36	02-10000	1			0.005uF 100V Ceramic Disc	SPRAGUE 56AD50	
C41	02-30001	1			10uF 25V Tantalum Bead	AVX TAP106K025SP	
C44	02-40004	1			2200uF 16V Aluminum	Illinois 228TTA016	
CR2	03-20000	1			Diode, general purpose	1N4148 or 1N914	
CR9	03-20002	1			Diode, rectifier, 1A, 50V	1N4001-1N4007	
C101	02-10007	1			330pF 1000V Ceramic disc	SPRAGUE 56AT33	
C102	02-10007	1			330pF 1000V Ceramic disc	SPRAGUE 56AT33	
C201	02-60017	1			0.1uF,63V,Mylar,5%	WIMA MKC2-0.1uF	
C202	02-60017	1			0.1uF,63V,Mylar,5%	WIMA MKC2-0.1uF	
C203	02-60017	1			0.1uF,63V,Mylar,5%	WIMA MKC2-0.1uF	
C204	02-60017	1			0.1uF,63V,Mylar,5%	WIMA MKC2-0.1uF	
C205	02-30004	1			1uF 25V Tantalum Bead	Kemet T350A105K025AS	
C206	02-60017	1			0.1uF,63V,Mylar,5%	WIMA MKC2-0.1uF	
C207	02-60017	1			0.1uF,63V,Mylar,5%	WIMA MKC2-0.1uF	
CR13	03-20000	1			Diode, general purpose	1N4148 or 1N914	
CR14	03-20000	1			Diode, general purpose	1N4148 or 1N914	
CR16	03-20000	1			Diode, general purpose	1N4148 or 1N914	
CR17	03-20041	1			Zener, reference, 6.3V, 20ppm/C, 5%	1N825	
CR18	03-20002	1			Diode, rectifier, 1A, 50V	1N4001-1N4007	
CR19	03-20000	1			Diode, general purpose	1N4148 or 1N914	
CR20	03-20000	1			Diode, general purpose	1N4148 or 1N914	
CR29	03-20000	1			Diode, general purpose	1N4148 or 1N914	
CR30	03-20000	1			Diode, general purpose	1N4148 or 1N914	
CR31	03-20000	1			Diode, general purpose	1N4148 or 1N914	
DS1	05-01020	1			LED Display, +/-1, Red	HP 5082-7656, Bin C or D only	
DS2	05-01010	1			LED Display, 7-Segment (0-9), Red	HP 5082-7650 Bin C or D only	
DS3	05-01010	1			LED Display, 7-Segment (0-9), Red	HP 5082-7650 Bin C or D only	
DS4	05-01010	1			LED Display, 7-Segment (0-9), Red	HP 5082-7650 Bin C or D only	
DS5	05-01010	1			LED Display, 7-Segment (0-9), Red	HP 5082-7650 Bin C or D only	
DS6	05-01005	1			Single LED,Red,Small	Hewlett Packard,HLMP1000	
D201	03-20006	1			Diode, low leakage	1N3595	
D202	03-20006	1			Diode, low leakage	1N3595	
D203	05-01011	1			LED,Red,Panel Mount	Micro Elec. MRB51D	
D204	03-20006	1			Diode, low leakage	1N3595	
D205	03-20006	1			Diode, low leakage	1N3595	
F1	05-04001	1			2A,Fuse	Littlefuse,312-002	
IC1	03-30022	1			LCD Display Driver (CMOS)	4054BE	
IC2	03-30023	1			Quad Analog Switch (CMOS)	4066BF (Ceramic)	
IC4	03-30024	1			Quad 2 Input NOR (CMOS)	4001BE	
IC5	03-30025	1			Quad 2 Input Exclusive OR (CMOS)	4030BE	
IC6	03-30026	1			Dual D-Type Flip Flop (CMOS)	4013BE	
IC7	30-00156	1			HCTR4010 Replacement Board Assembly	ASSY 4314-614	
IC8	03-30026	1			Dual D-Type Flip Flop (CMOS)	4013BE	
IC9	03-30027	1			Quad 2 Input NAND (CMOS)	4011BE	
IC10	03-30106	1			BCD to 7-Segment decoder/driver	74LS47N	
IC11	03-30012	1			A to D Converter Logic	Mostek MK5009	
IC12	03-30315	1			Precision JFET Op Amp	Burr Brown OPA103CM	
IC13	03-30017	1			Op-Amp,Uncompensated	LM308H	
IC14	03-30013	1			Op-Amp,General Purpose,Uncompensated	LM301AH or LM301AN	
IC15	03-30031	1			Quad Op-Amp,General Purpose	LM324N	
IC17	03-30074	1			General Purpose JFET Op-Amp,Metal Can	LF356H	

REF.DES.	STOCK #	QUANTITY A	T	N	DESCRIPTION	MANUFACTURING/PURCHASING DATA	ALTERNATE
IC18	03-30090	1			General Purpose JFET Op-Amp	LF356N or H	03-30074
IC22	03-30035	1			Regulator,-5V,0.5A,TO202 or TO220	79M05CP or LM320T-5.0	
IC25	05-02007	1			Programmable Osc.,8.3Hz-1MHz	Statek,PX01000KHzA	
IC201	03-30170	1			Low Noise, low drift Op-amp	OP07DP	
IC202	03-30487	1			Low Noise Chopper Amplifier(8 pin)	LTC1052CN8	
IC203	03-30487	1			Low Noise Chopper Amplifier(8 pin)	LTC1052CN8	
J1	05-10030	1			Banana jack, red	Pomona 1581-2	
J2	05-10030	1			Banana jack, red	Pomona 1581-2	
J3	05-10031	1			Banana jack, white	Pomona 1581-9	
J4	05-10033	1			Battery Charging Jack	Switchcraft 712A	
J5	05-10031	1			Banana jack, white	Pomona 1581-9	
Q1	03-10003	1			NPN Darlington Transistor (TO92)	2N5172	
Q2	03-10003	1			NPN Darlington Transistor (TO92)	2N5172	
Q3	03-10003	1			NPN Darlington Transistor (TO92)	2N5172	
Q4	03-10003	1			NPN Darlington Transistor (TO92)	2N5172	
Q5	03-10003	1			NPN Darlington Transistor (TO92)	2N5172	
Q8	03-10015	1			NPN Transistor (TO220)	MJE3439	
Q9	03-10000	1			N-Channel JFET	U1899E or PN4392	
Q11	03-10013	1			NPN Transistor (TO92)	2N4401	
Q12	03-10013	1			NPN Transistor (TO92)	2N4401	
Q15	03-10004	1			P-Channel JFET	P1087E (selected)	
Q17	03-10010	1			PNP Transistor (TO92)	2N4402	
R1	01-01073	1			47K 5% 1/4W Carbon Film	RC07GF473J	
R2	01-01073	1			47K 5% 1/4W Carbon Film	RC07GF473J	
R3	01-50005	1			50K Single Turn	CTS X201R503	
R4	01-01073	1			47K 5% 1/4W Carbon Film	RC07GF473J	
R5	01-01081	1			100K 5% 1/4W Carbon Film	RC07GF104J	
R6	01-01073	1			47K 5% 1/4W Carbon Film	RC07GF473J	
R7	01-01073	1			47K 5% 1/4W Carbon Film	RC07GF473J	
R10	01-01026	1			220 5% 1/4W Carbon Film	RC07GF221J	
R11	01-01026	1			220 5% 1/4W Carbon Film	RC07GF221J	
R12	01-01026	1			220 5% 1/4W Carbon Film	RC07GF221J	
R13	01-01026	1			220 5% 1/4W Carbon Film	RC07GF221J	
R14	01-01026	1			220 5% 1/4W Carbon Film	RC07GF221J	
R15	01-01026	1			220 5% 1/4W Carbon Film	RC07GF221J	
R16	01-01026	1			220 5% 1/4W Carbon Film	RC07GF221J	
R17	01-01026	1			220 5% 1/4W Carbon Film	RC07GF221J	
R19	01-01021	1			100 5% 1/4W Carbon Film	RC07GF101J	
R21	01-10000		1		Factory Select Resistor	RN60C???	
R22	01-10038	1			90.9K 0.1% 50ppm/C 1/4W Metal Film	RN60C9092B	
R23	01-50000	1			100 Single Turn	CTS X201R101	
R24	01-10037	1			10K 0.1% 50ppm/C 1/4W Metal Film	RN60C1002B	
R28	01-01061	1			10K 5% 1/4W Carbon Film	RC07GF103J	
R29	01-10039	1			274K 1% 50ppm/C 1/4W Metal Film	RN60C2743F	
R30	01-01080	1			91K 5% 1/4W Carbon Film	RC07GF913J	
R48	01-01073	1			47K 5% 1/4W Carbon Film	RC07GF473J	
R49	01-01018	1			75 5% 1/4W Carbon Film	RC07GF750J	
R50	01-01045	1			2K 5% 1/4W Carbon Film	RC07GF202J	
R51	01-01041	1			1K 5% 1/4W Carbon Film	RC07GF102J	
R52	01-01065	1			20K 5% 1/4W Carbon Film	RC07GF203J	
R53	01-01051	1			3.9K 5% 1/4W Carbon Film	RC07GF392J	

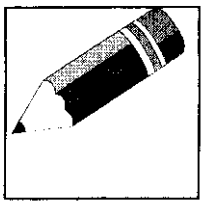
REF.DES.	STOCK #	QUANTITY A	T	N	DESCRIPTION	MANUFACTURING/PURCHASING DATA	ALTERNATE
R54	01-01128	1			1000M 5% 1/4W Carbon Film	RC07GF108J	
R55	01-01045	1			2K 5% 1/4W Carbon Film	RC07GF202J	
R56	01-01007	1			10 5% 1/4W Carbon Film	RC07GF100J	
R57	01-01086	1			220K 5% 1/4W Carbon Film	RC07GF224J	
R58	01-10000			1	Factory Select Resistor	RN60C???	
R59	01-10037	1			10K 0.1% 50ppm/C 1/4W Metal Film	RN60C1002B	
R60	01-50005	1			50K Single Turn	CTS X201R503	
R62	01-10037	1			10K 0.1% 50ppm/C 1/4W Metal Film	RN60C1002B	
R64	01-01053	1			4.7K 5% 1/4W Carbon Film	RC07GF472J	
R65	01-01028	1			270 5% 1/4W Carbon Film	RC07GF271J	
R66	01-10037	1			10K 0.1% 50ppm/C 1/4W Metal Film	RN60C1002B	
R67	01-10215	1			1.65K 1% 50ppm/C 1/4W Metal Film	RN60C1651F	
R68	01-10037	1			10K 0.1% 50ppm/C 1/4W Metal Film	RN60C1002B	
R69	01-50000	1			100 Single Turn	CTS X201R101	
R70	01-10073	1			9.76K 1% 50ppm/C 1/4W Metal Film	RN60C9761F	
R71	01-10073	1			9.76K 1% 50ppm/C 1/4W Metal Film	RN60C9761F	
R72	01-01053	1			4.7K 5% 1/4W Carbon Film	RC07GF472J	
R73	01-10049	1			100K 0.1% 50ppm/C 1/4W Metal Film	RN60C1003B	
R74	01-10049	1			100K 0.1% 50ppm/C 1/4W Metal Film	RN60C1003B	
R75	01-01081	1			100K 5% 1/4W Carbon Film	RC07GF104J	
R76	01-10049	1			100K 0.1% 50ppm/C 1/4W Metal Film	RN60C1003B	
R77	01-10049	1			100K 0.1% 50ppm/C 1/4W Metal Film	RN60C1003B	
R78	01-10215	1			1.65K 1% 50ppm/C 1/4W Metal Film	RN60C1651F	
R80	01-01004	1			4.7 5% 1/4W Carbon Film	RC07GF4R7J	
R81	01-01048	1			2.7K 5% 1/4W Carbon Film	RC07GF272J	
R82	01-01048	1			2.7K 5% 1/4W Carbon Film	RC07GF272J	
R93	01-01026	1			220 5% 1/4W Carbon Film	RC07GF221J	
R94	01-01026	1			220 5% 1/4W Carbon Film	RC07GF221J	
R95	01-01026	1			220 5% 1/4W Carbon Film	RC07GF221J	
R96	01-01026	1			220 5% 1/4W Carbon Film	RC07GF221J	
R102	01-50003	1			5K Single Turn	CTS X201R502	
R104	01-01061	1			10K 5% 1/4W Carbon Film	RC07GF103J	
R105	01-01061	1			10K 5% 1/4W Carbon Film	RC07GF103J	
R106	01-01081	1			100K 5% 1/4W Carbon Film	RC07GF104J	
R107	01-01033	1			470 5% 1/4W Carbon Film	RC07GF471J	
R112	01-01032	1			430 5% 1/4W Carbon Film	RC07GF431J	
R114	01-20013	1			100 0.05% 5ppm/C Wire Wound	Goldstar GS711-100R-.05%-5PPM	
R115	01-20004	1			900 0.05% 5ppm/C Wire Wound	Goldstar GS711-900R-.05%-5PPM	
R116	01-20005	1			9K 0.05% 5ppm/C Wire Wound	Goldstar GS711-9K-.05%-5PPM	
R117	01-20006	1			90K 0.05% 5ppm/C Wire wound	Goldstar GS711-90K-.05%-5PPM	
R120	01-10000			1	Factory Select Resistor	RN60C???	
R201	01-10178	1			10K 0.1% 25ppm/C 1/8W Metal Film	PRP 1/8W - 10K - 0.1% - 25PPM	
R202	01-10178	1			10K 0.1% 25ppm/C 1/8W Metal Film	PRP 1/8W - 10K - 0.1% - 25PPM	
R203	01-10178	1			10K 0.1% 25ppm/C 1/8W Metal Film	PRP 1/8W - 10K - 0.1% - 25PPM	
R204	01-10178	1			10K 0.1% 25ppm/C 1/8W Metal Film	PRP 1/8W - 10K - 0.1% - 25PPM	
R205	01-01081	1			100K 5% 1/4W Carbon Film	RC07GF104J	
R206	01-01041	1			1K 5% 1/4W Carbon Film	RC07GF102J	
S2	05-03005	1			Switch,6 Station,Int-Lock,6 Pole,Chrome	Centralab,ZKBC000600864+B426	
S3	05-03015	1			Toggle Switch, 2PDT	C&K,7201-7760-7062-3	
T1	04-20006	1			4440 Transformer (DC to DC Converter)	DWG 4440-010	
XIC2	05-10041	1			Socket, dil, 14 pin	Burndy 8514-01	

REF.DES.	STOCK #	QUANTITY A	T	N	DESCRIPTION	MANUFACTURING/PURCHASING DATA	ALTERNATE
XIC7	05-10406	1			Socket, DIL, 24 pin, 0.3", Gold Contacts	Amp 583640-3	
XIC11	05-10008	1			Socket, dil, 16 pin	Burndy C8516-01	
XIC15	05-10041	1			Socket, dil, 14 pin	Burndy 8514-01	

REF.DES.	STOCK #	QUANTITY A	QUANTITY T	QUANTITY N	DESCRIPTION	MANUFACTURING/PURCHASING DATA
A1	04-30293	1			HCTR4010 Replacement Board	DWG 4314-714
C1	02-60021	1			1500pF, 100V, Mylar	WIMA MKC4-1500p
C2	02-10005	1			50pF 500V Ceramic disc	Illinois 500BCR050K
C3	02-10014	1			0.1uF 50V Ceramic disc	AVX SR205E104MAA00
IC1	03-30633	1			Hex Schmitt-Trigger Inverter	74HC14N
IC2	03-30383	1			Dual D-Type flip flop (HCMOS)	74HC74N
IC3	03-30619	1			Octal Buffer and Line Driver	74HC244
IC4	03-30637	1			CMOS 4 1/2 Decade Counter	Hughes HCTR6010AP
P1	05-10990	1			24 pin Adaptor Plug, 0.335 sp.	Samtec APA-624-T-N
R2	01-01068	1			27K 5% 1/4W Carbon Film	RC07GF273J
R3	01-01068	1			27K 5% 1/4W Carbon Film	RC07GF273J
R4	01-01068	1			27K 5% 1/4W Carbon Film	RC07GF273J
R5	01-01068	1			27K 5% 1/4W Carbon Film	RC07GF273J
R6	01-01061	1			10K 5% 1/4W Carbon Film	RC07GF103J
R7	01-01068	1			27K 5% 1/4W Carbon Film	RC07GF273J

REF.DES.	STOCK #	QUANTITY A	QUANTITY T	QUANTITY N	DESCRIPTION	MANUFACTURING/PURCHASING DATA	ALTERNATE
82	04-30009	1			4440 Main Board	DWG 4440-700	
83	04-30010	1			4440 Display Board	DWG 4440-701	
87	05-10049	1			Box, battery, four D cells	Digikey BH24DL-ND	
88	04-10529	1			4314A Front Panel (screened)	DWG 4314-100 using 04-10247	
89	05-10198	4			Spacer, 1/4 dia, 1/8 lg, #4, nylon	Smith 8880	
90	05-10199	4			Washer, fib, 1/4 od, 7/64 id, 1/16 tall	Smith 2161	
91	90-04608	4			#4 x 1/2" Self-Tap Phil Pan S.S. Type AB		
92	04-10130	1			Chassis	PAKTEK CH250-BEIGE ETC.	
93	05-10521	1			Fuse holder, panel mount	Littlefuse 342004	
94	04-10235	1			4440 Rear Panel (battery unit)	DWG 4440-214	
96	05-10277	4			Knob, silver	ITT 160844 (ITT internal #)	
97	05-10019	12			Cable tie, 4"x 1/8"	Panduit WRN-4	
98	80-01422	8			22AWG Wire, Yellow PVC	M16878/1-BFE-4	
99	80-01322	4			22AWG Wire, Orange PVC	M16878/1-BFE-3	
100	80-01622	24			22AWG Wire, Blue PVC	M16878/1-BFE-6	
101	80-01022	7			22AWG Wire, Black PVC	M16878/1-BFE-0	
102	80-01922	7			22AWG Wire, White PVC	M16878/1-BFE-9	
103	80-01222	26			22AWG Wire, Red PVC	M16878/1-BFE-2	
104	80-00022	14			22AWG Buss Wire	1BB-2201 ANIXTER	
105	80-01522	15			22AWG Wire, Green PVC	M16878/1-BFE-5	
106	80-01122	15			22AWG Wire, Brown PVC	M16878/1-BFE-1	
107	80-00014	5			14AWG Buss Wire	ANIXTER 1BB-1401	
108	05-10325	4			Cable tie, 14"x.25" reusable	Panduit PRT-4S	
111	05-10441	2			Tie-wrap block, small	Panduit ABMM-AT	
114	70-11020	10			20awg TFE Sleeving	Atlantic TFT 20	
B1	05-10117		1		Battery, ni-cad, heavy duty, D cell	Panasonic P-400D-E15	
B2	05-10117		1		Battery, ni-cad, heavy duty, D cell	Panasonic P-400D-E15	
B3	05-10117		1		Battery, ni-cad, heavy duty, D cell	Panasonic P-400D-E15	
B4	05-10117		1		Battery, ni-cad, heavy duty, D cell	Panasonic P-400D-E15	
C1	02-60019	1			2200pF 100V Mylar	WIMA FKS2-2200P	
C2	02-10009	1			0.001uF 50V Ceramic Disc	NIC NCD102KIVX5P	
C3	02-10000	1			0.005uF 100V Ceramic Disc	SPRAGUE 56AD50	
C4	02-10002	1			500pF 100V Ceramic Disc	SPRAGUE 56AT50	
C7	02-30001	1			10uF 25V Tantalum Bead	AVX TAP106K025SP	
C8	02-10009	1			0.001uF 50V Ceramic Disc	NIC NCD102KIVX5P	
C10	02-10000	1			0.005uF 100V Ceramic Disc	SPRAGUE 56AD50	
C11	02-10000	1			0.005uF 100V Ceramic Disc	SPRAGUE 56AD50	
C12	02-10000	1			0.005uF 100V Ceramic Disc	SPRAGUE 56AD50	
C13	02-10000	1			0.005uF 100V Ceramic Disc	SPRAGUE 56AD50	
C20	02-30001	1			10uF 25V Tantalum Bead	AVX TAP106K025SP	
C21	02-50000	1			0.22uF 10% 50V Polystyrene	IMB PA2A224K	
C22	02-10005	1			50pF 500V Ceramic disc	Illinois 500BCR050K	02-20002
C23	02-60015	1			0.022uF, 100V, Mylar, 5%	WIMA MKC2-0.022uF	
C25	02-30001	1			10uF 25V Tantalum Bead	AVX TAP106K025SP	
C26	02-10007	1			330pF 1000V Ceramic disc	SPRAGUE 56AT33	
C27	02-10007	1			330pF 1000V Ceramic disc	SPRAGUE 56AT33	
C31	02-30008	1			6.8uF 10V Tantalum Bead		
C32	02-30003	1			47uF 10V Tantalum Bead	AVX TAP476M020SP	
C33	02-30001	1			10uF 25V Tantalum Bead	AVX TAP106K025SP	
C34	02-10009	1			0.001uF 50V Ceramic Disc	NIC NCD102KIVX5P	
C35	02-30001	1			10uF 25V Tantalum Bead	AVX TAP106K025SP	

SECTION IX DRAWINGS AND SCHEMATICS



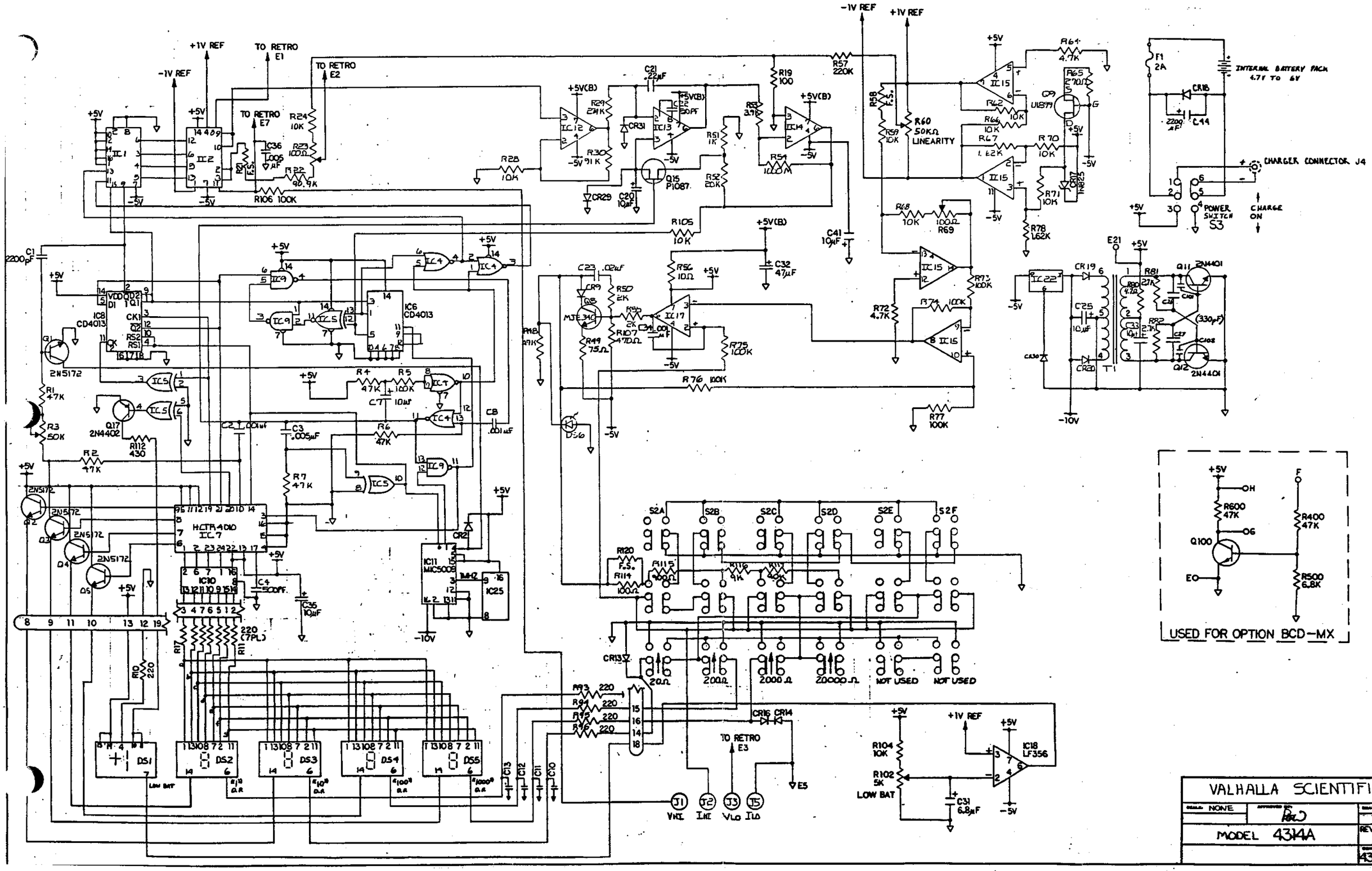
The following schematic diagrams have been included in this manual:

4314-600	1 page	4314A Main Board Assembly
4314-070	1 page	4314A Main Board Schematic
4314-614	1 page	HCTR4010 (IC7) Replacement PCB Assembly
4314-084	1 page	HCTR4010 (IC7) Replacement PCB Schematic

NOTES:

1) "RETRO" REFERS TO SCHEMATIC 4314-072.

REVISIONS			
ECO# LTR	DESCRIPTION	DATE	APPROVED



VALHALLA SCIENTIFIC

SCALE NONE	APPROVED BY [illegible]	DRAWN BY [illegible]
MODEL 4314A		REV. T
		4314-070

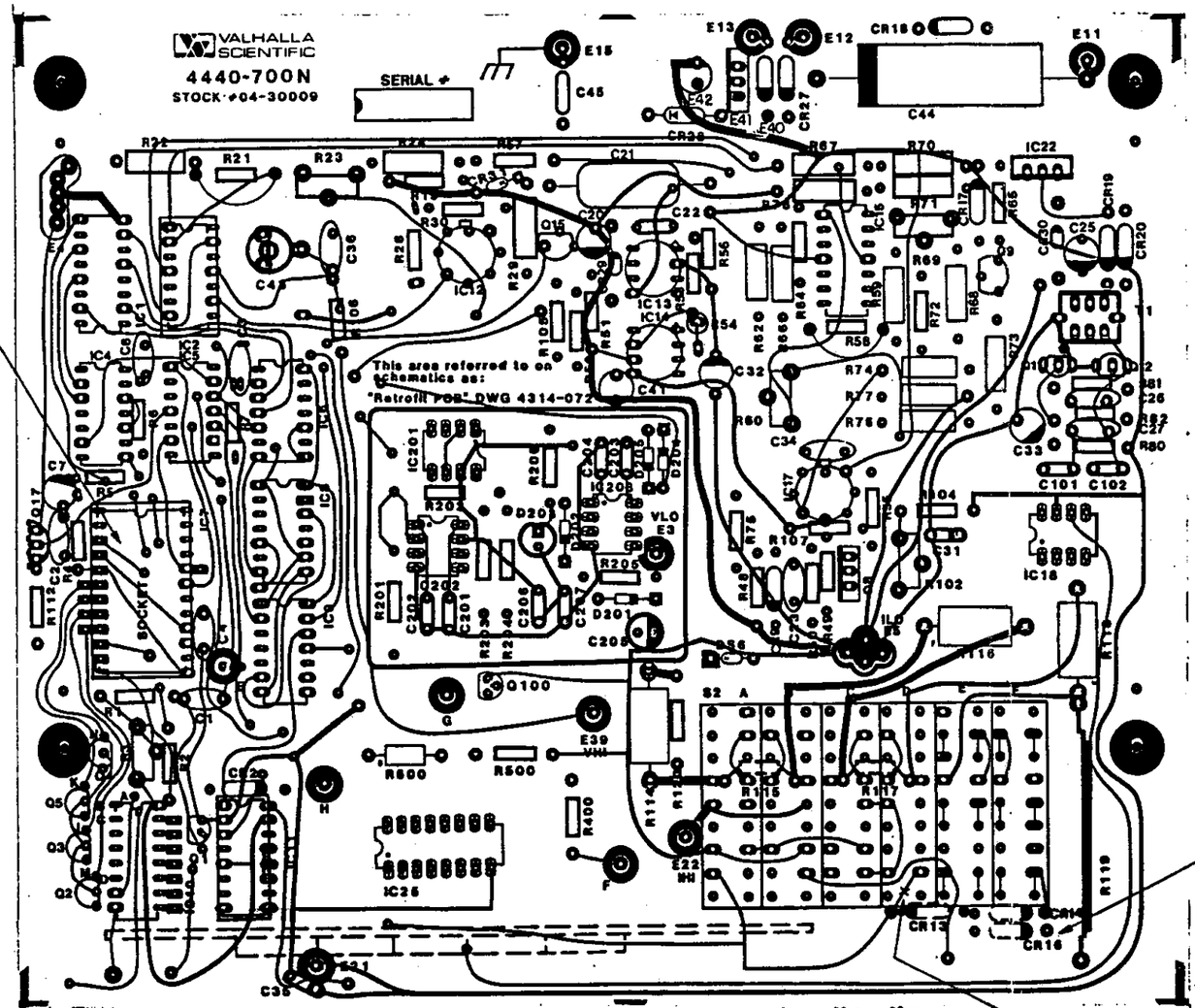
NOTES: (CONTINUED FROM BELOW)

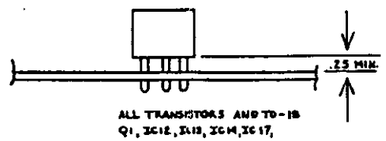
6. CUT SOCKET IN HALF AND INSTALL FLUSH WITH PCB. INSTALL ASSEMBLY 4314-614 SECURELY IN SOCKET.

7. TRIM LEADS FLUSH AND INSULATE WITH KAPTON TAPE.

8. JUMPER R21 AND R58 WITH ITEM # 104 BUSS WIRE.

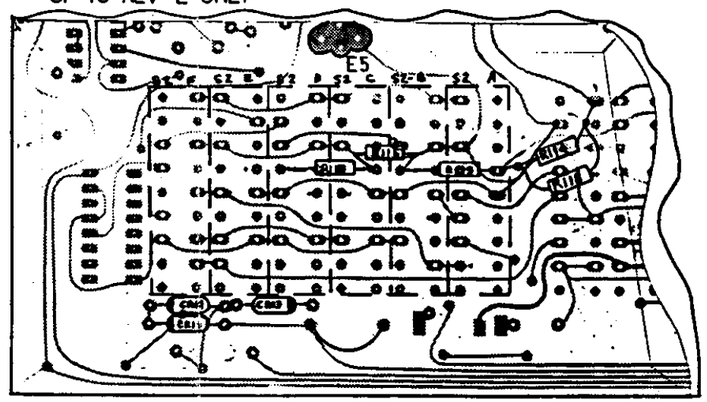
REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED





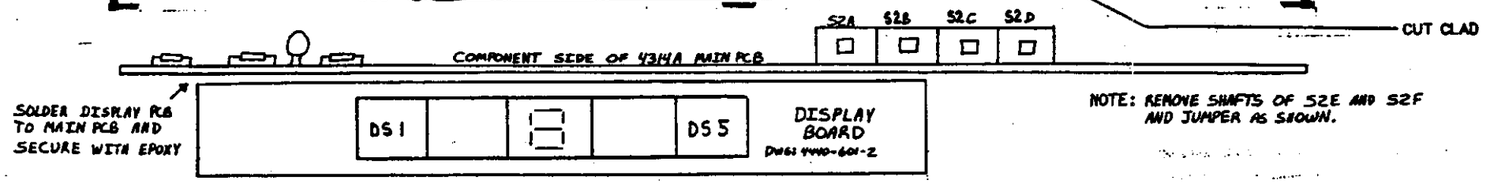
ALL TRANSISTORS AND TO-18 Q1, IC1E, IC18, IC14, IC17,

UP TO REV L ONLY



VIEW FROM BOTTOM OF P.C.B. (CLAD SHOWN IS SHADED BLUE)

NOTE: Q100, R400, R500, R600 ARE USED IN BCD-MIX ONLY



NOTE: REMOVE SHAFTS OF S2E AND S2F AND JUMPER AS SHOWN.

(CLAD SHOWN IS COMPONENT SIDE)

(CONTINUED ABOVE)

5. USE PARTS LIST 4314-400.
4. USE P.C. BOARD 4440-700
3. FOR ASSEMBLY DIAGRAM SEE 4440-400 SHT 8
2. FOR WIRE TAG TABLE SEE 4314-051
1. FOR SCHEMATIC SEE 4314-070

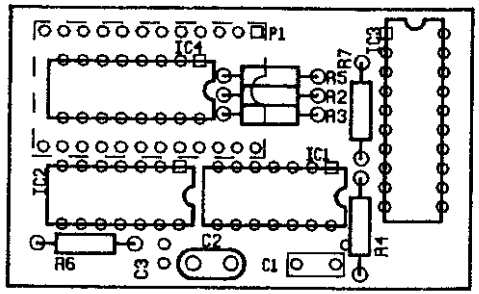
NOTES:

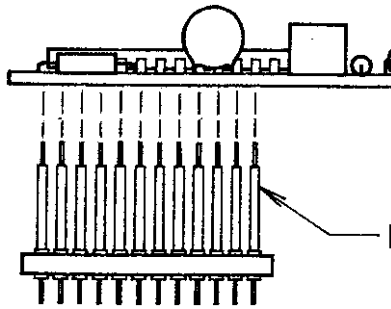
MATERIAL		Valhalla Scientific Inc. SAN DIEGO, CALIFORNIA		
FINISH		4314A ASSEMBLY		
	SCALE NONE	CODE IDENT NO. 83504	SIZE D	DRAWING NO. 4314-600
	SHEET 1 OF 1			REV. U

NOTES: Unless Otherwise Specified

1. SEE SEPARATE PARTS LIST.
2. BAG AND TAG WITH DRAWING NUMBER, STOCK NUMBER, AND CURRENT REVISION LETTER.

REVISIONS				
ECR#	LTR	DESCRIPTION OF CHANGE	DATE	APPROVED
	A	RELEASED PEL	2/24/94	





NOTE: INSTALL P1 ON SOLDER SIDE AS SHOWN.

TOLERANCES: X = ±30' .XX = ±.02 .XXX = ±.005	FINISH:	MATERIAL:	DRAWN BY P. LOFIUS	2/24/94
			CHECKED BY	2/25/94
			APPROVED BY	2/25/94
DEBURR AND BREAK ALL SHARP EDGES AND CORNERS				
MACHINED SURFACES ARE TO HAVE A FINISH OF 63	SCALE: 1 : 1	STOCK NO. 30-00156		

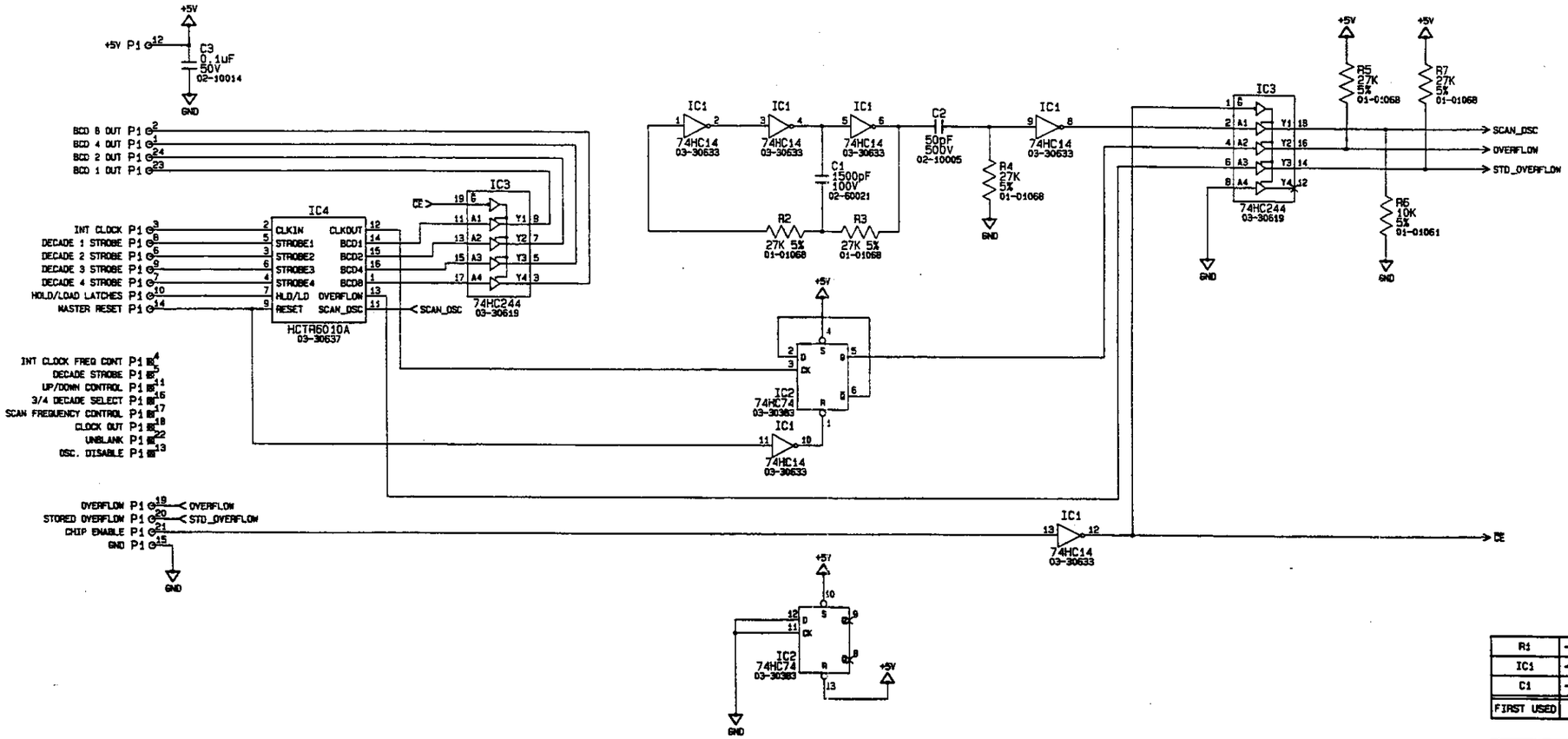
VALHALLA SCIENTIFIC
9955 MESA RIM RD. SAN DIEGO, CA 92121

TITLE: P.C.B. ASSEMBLY- HCTR4010 REPLACEMENT BD.

SHEET 1 OF 1 | DRAWING NO. 4214-614 | REV: A

NOTES: Unless Otherwise Specified

REVISIONS				
ECR#	LTR	DESCRIPTION OF CHANGE	DATE	APPROVED
	A	PROTOTYPE PEL	2/17/94	



R1	— — — — —		R7
IC1	— — — — —		IC4
C1	— — — — —		C3
FIRST USED	NOT USED		LAST USED

IC4	8	10	DIP16
IC3	20	10	DIP20
IC2	14	7	DIP14
IC1	14	7	DIP14
DEVICE	+5V	GND	PACKAGE

Drawn BY P. LOFTUS	2/17/94
CHECKED BY	2/25/94
APPROVED BY	2/25/94

VALHALLA SCIENTIFIC
9955 MESA RIM RD. SAN DIEGO, CA 92121

TITLE: SCHEMATIC- HCTR4010 REPLACEMENT

SHEET	DRAWING NO.	REV:
1 OF 1	4314-084	A