

4314A/B

Digital Igniter Tester

Instruction and Maintenance Manual



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SECTION I — GENERAL INFORMATION

1.1 DESCRIPTION

The Valhalla Scientific Series 4314 Digital Igniter Testers are available with various input range combinations. Otherwise, all Model 4314's are identical. Subsequent discussion applies to all Model 4314's unless specific exceptions are noted.

The Valhalla Scientific Model 4314 Digital Igniter Tester is designed specifically to test the igniters used to detonate charges in explosive bolts and similar remote release devices. This tester was designed with one major objective: to make it absolutely failsafe.

1.2 FAIL-SAFE OPERATION

The Model 4314 Digital Igniter Tester incorporates internal protective circuits which render it incapable of delivering excessive voltage or current to the igniter under test. A detailed description of the fail-safe circuits is contained in paragraphs 4-6 and 4-8. The meter was pre-tested at the factory where component failure was simulated to duplicate a failed mode. The resulting fail-safe current levels were recorded and supplied as part of the original calibration information. As

a further precaution, the possibility of an external common-mode voltage delivering unwanted power to the igniter is eliminated by operating the Model 4314 from an internal battery pack. Thus, it is totally isolated from the AC power line. An external line-powered charger is included with the Model 4314 for recharging the battery pack.

1.3 ACCESSORIES

The Valhalla Scientific Model 4314 is shipped from the factory with a rechargeable nickel cadmium battery pack, an external charger and an instruction manual. The batteries are packed separately in the same shipping container with the 4314. Observe polarity marks on the bottom of the battery holder when installing batteries. Although batteries are shipped from the factory fully charged, some recharging might be necessary to insure a fully charged condition.

1.4 OPTIONAL EQUIPMENT

There are several optional equipment items available for the Series 4314 Digital Igniter Testers which are listed in Table 1-1.

Table 1-1. Optional Equipment Items.

Option "BCD-MX"	Data Outputs
Option "CC4"	Meter and Accessory Carrying Case
Option "HDB"	Spare Battery Pack
Option "JAWS"	Heavy Duty Kelvin Clips
Option "KCS"	Kelvin Clip Set
Option "K"	Kelvin Clip Cable Set (with KCS)
Option "KK"	Kelvin Cable Set (with JAWS)
Option "MP-1"	Kelvin Micro Probes
Option "MP-2"	Kelvin Mini Probes
Option "R4"	Rack Mount Adapter

SECTION II — INSTALLATION

2.1 INTRODUCTION

This section outlines the procedure for inspecting and installing Valhalla Scientific Series 4314 Digital Igniter Testers.

2.2 INITIAL INSPECTION

Before accepting the instrument from the shipper, inspect the shipping container for signs of external damage. If any damage is noted, either before or after acceptance, advise the carrier immediately.

Unpack the instrument and keep the shipping container until the instrument has been inspected for shipping damage. If damage is evident, contact the carrier and Valhalla Scientific for authorization to return the instrument to Valhalla Scientific for repairs.

If the container is damaged, but the instrument appears to be intact, perform the calibration procedure outlined in Section V to be sure that the instrument has incurred no hidden damage.

2.3 POWER REQUIREMENTS

The Valhalla Scientific Model 4314 is supplied with a self-contained rechargeable nickel cadmium battery pack and an external charger. Although the battery pack is charged prior to shipment it is desirable to refresh the charge before using the instrument.

2.4 BATTERY PACK CHARGING

To refresh the battery pack before initial use, connect the AC power input of the charger to a 115-volt AC power outlet. Charge for eight to sixteen hours.

The normal operating time between battery pack recharges is eight hours of continuous duty. It is recommended that the Model 4314 battery pack be recharged overnight when not in use to insure that it is ready when needed. Sixteen hours of recharge time is required after eight hours of continuous use.

2.5 INSTALLATION

The Model 4314 draws little power and generates virtually no heat. Consequently, it will function properly in any area where the ambient temperature does not exceed its specified temperature range.

2.6 BCD-MX CONNECTIONS

The BCD-MX Option provides BCD outputs for operation of external. An instrument equipped with this option has a rear-panel mounted connector with pin assignments as listed in Table 2-1. All outputs are positive, active high logic capable of driving one TTL load. The BCD data is valid when the STROBE signal is high.

Table 2-1. BCD-MX Connector Pin Assignments.

Pin Nos.	Function
1, 6, 11, 16	1 BIT
2, 7, 12, 17	2 BIT
3, 8, 13, 18	4 BIT
4, 9, 14, 19	8 BIT
21	10,000 COUNT
22, 23, 24, 50	GND
29	10 ⁰ STROBE
30	10 ¹ STROBE
31	10 ² STROBE
32	10 ³ STROBE
5, 26, 33	+5V

SECTION III — OPERATION

3.1 INTRODUCTION

This section of the manual contains complete operating instructions for the Series 4314 Digital Igniter Testers. Included is a description of the front panel controls and their functions.

3.2 FRONT PANEL

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 igniter and AC Power Ground is, therefore, eliminated. The operator need not be concerned if the AC Power Charging Adapter is plugged in while measuring igniter resistance.

3.3 RANGES

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

3.4 IGNITER RESISTANCE MEASUREMENTS

With the charger disconnected and the input cable connected to the Model 4314, connect the Kelvin clips to the igniter. Depress the desired RANGE switch pushbutton. Depress the POWER pushbutton. Observe the reading on the digital display. A blinking display indicates the resistance to be measured exceeds the full scale range selected. Select a higher range if this occurs.

SECTION IV — THEORY OF OPERATION

4.1 INTRODUCTION

The Valhalla Scientific Model 4314 Digital Igniter Tester is shown in block diagram form in Figure 4-1. It consists of an analog-to-digital (A/D) converter and an ohms-to-DC converter. Its output is a DC voltage precisely proportional to the igniter resistance. This precise DC voltage is converted from analog to digital form by the A/D converter and displayed as a resistance value.

The Model 4314 uses solid state semiconductors exclusively, and C-MOS circuits extensively, the latter minimizing power requirements and making battery pack operation practical.

4.2 CIRCUIT DESCRIPTION

The circuit descriptions which follow are referenced to the block diagram of Figure 4-1 and the schematic diagram of Figure 5-5.

4.3 A/D CONVERTER

The Model 4314 incorporates a three-step integrator to convert the ohms-to-DC converter output from analog to digital form (see Figure 4-1). The initial step, or 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 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 during the period when the ohms-to-DC converter output is being integrated.

With capacitor C21 charged to offset any zero error present, the second step of the

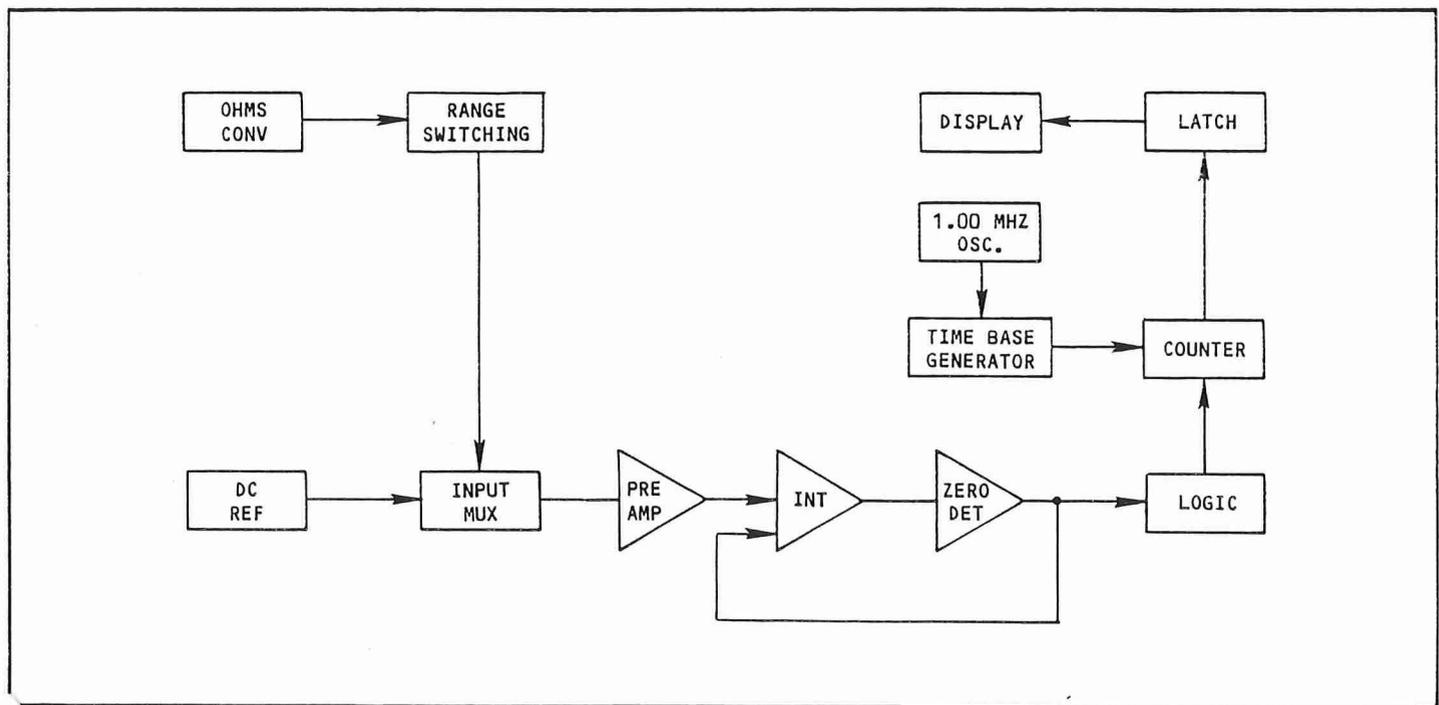


Figure 4-1. Block Diagram of Digital Igniter Tester.

4.6 CONSTANT CURRENT SOURCE

The constant current source comprises two sections of IC15, IC17, Q8, DS6 and associated components. The input to the constant current source is approximately +1.05 volts, developed at IC15-1 and coupled to IC15-13 through R58 and R59.

The heart of the constant current source, and the major factor that makes the Model 4314 absolutely failsafe, is the voltage-to-current converter, which incorporates a transconductance amplifier (U.S. Patent No. 4,091,333). A simplified schematic of this unique circuit is shown in Figure 4-3. The first amplifier, IC15-12, -13 and -14 is an inverter, and its output is applied to IC15-9. The amplifier comprised of IC15-8, -9 and -10 has unity gain due to the feedback through R74. Its output is applied to the inverting input at IC17-3. The output

of IC17-6 provides feedback to the non-inverting input at 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.

4.7 TRANSCONDUCTANCE AMPLIFIER OPERATION

Assume that terminals I_{hi} and I_{lo} of Figure 4-3 are shorted, and 1 volt is applied to the transconductance amplifier so that I_{hi} is positive. To equalize the inputs at IC17-2 and IC17-3, IC15-8 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 at IC17-8 must be at +1 volt. Since the output at IC15-8 must be zero, the drop across R74 is 0.5 volt, making the inverting input 0.5 volt. The drops across R73, R76 and

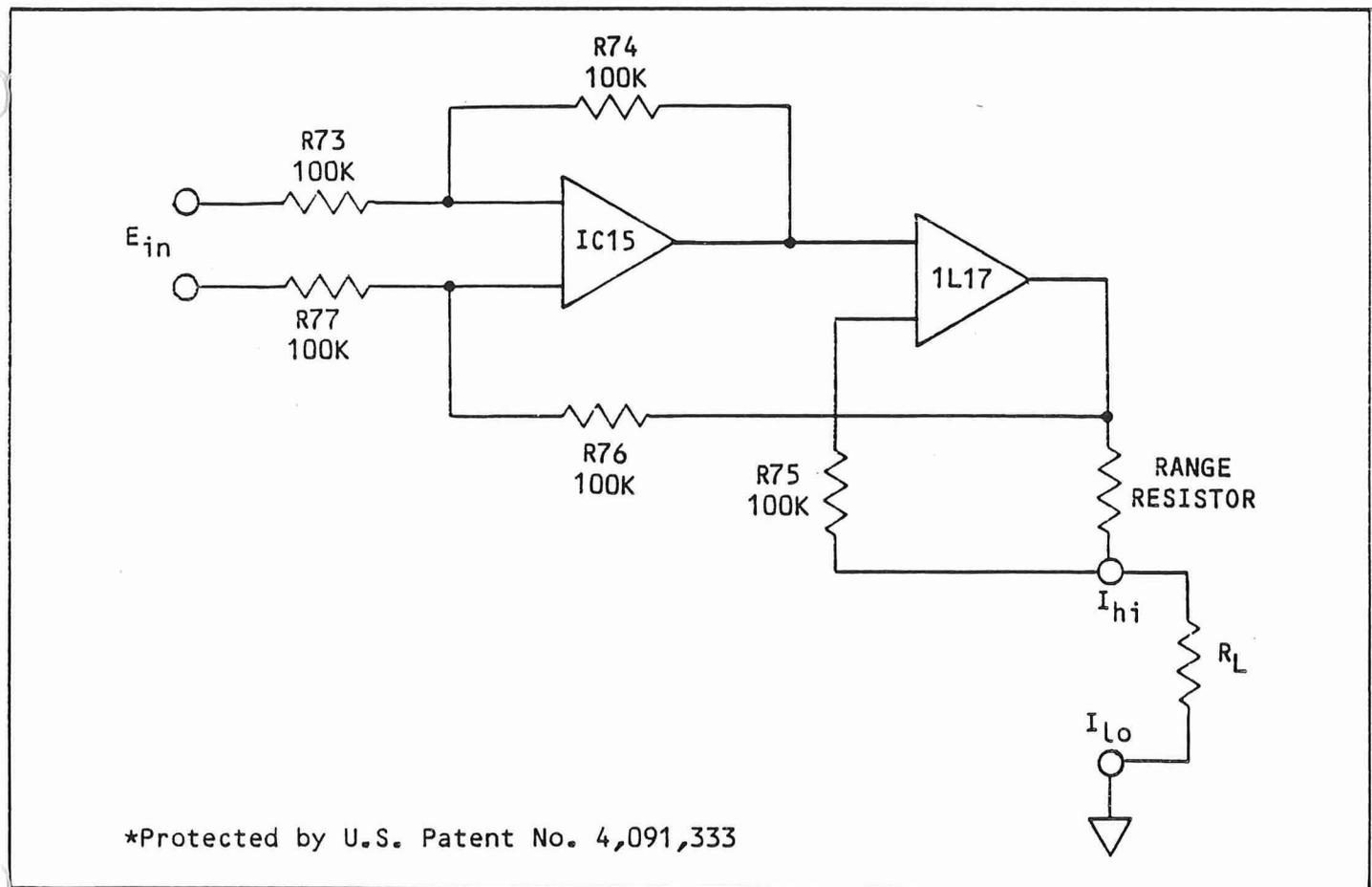


Figure 4-3. Simplified Diagram, Transconductance Amplifier.

SECTION V — MAINTENANCE

5.1 INTRODUCTION

This section of the manual contains maintenance information for the Valhalla Scientific Series 4314 Digital Ingiter Testers. It includes a list of required test equipment and a calibration procedure.

5.2 REQUIRED TEST EQUIPMENT

The following items of test equipment are required for calibration of the tester.

Precision Resistors

0.1 ohm $\pm 0.01\%$ Accuracy

100 ohms $\pm 0.005\%$ Accuracy

5.3 CALIBRATION PROCEDURE

The following procedure should be performed on a routine basis to insure that the instrument remains in calibration. It should also be performed after repair or replacement of any accuracy-determining component. Allow five minutes warmup time after instrument turn-on before beginning the calibration procedure.

5.3.1 ZERO CALIBRATION

1. Select the 100 OHMS range. Connect the Kelvin clips of the input cables to a shorting bar.
2. Adjust R3 to its end stop closest to the front panel. Adjust R60 for a 0000 reading on the panel display.

5.3.2 RANGE CALIBRATION

1. Select the 100 OHMS range. Connect the Kelvin clips to the 0.1 ohm precision resistor. Adjust R3 for a 0010 reading on the panel display.

2. Connect the Kelvin clips to the 100 ohm precision resistor. Adjust R69 for a display value of fullscale ± 2 digits.
3. Check and verify calibration of the remaining ranges of the instrument to the specifications listed in front of this manual.

5.4 TROUBLESHOOTING

Apparent difficulties are often due to misinterpretation of the specifications or to noise pickup at the instrument input. Be sure the instrument is truly malfunctioning before attempting repairs.

When attempting to repair a complex instrument, localize the malfunction to the greatest possible extent before beginning the actual process of troubleshooting individual components. For example, if a malfunction is not on one range, check performance on the other ranges to determine whether the malfunction is common to all. This approach saves time and eliminates needless component changes.

Figure 5-1 functionally describes the gates used in the Model 4314. All logic used in the Model 4314 is positive "1" state.

5.4.1 POWER SUPPLIES

The +5 volts supply is derived directly from the battery pack. The battery pack voltage will vary from 4.5 to 6.4 volts, depending on battery condition. The -5 volts supply is obtained from a regulated DC/DC converter comprised of Q11, Q12, T1 and IC22. The -10 volts supply is obtained at the junction of CR19 and CR20.

SECTION VI — PARTS LISTS

6.1 GENERAL

The parts lists of this section are reproductions of factory parts lists. The designators are those of the diagrams in Section V. When ordering replacement parts, provide the reference designator, manufacturer's part number, manufacturer's

name and Valhalla part number if contained in the parts list. The manufacturer is identified in the parts list by a federal stock number. A list of manufacturer's federal stock codes is provided as an appendix to this manual for identification of manufacturer's.

		PARTS LIST			UNIT ASSY "DC"		MÓDEL 4314		DWG NÓ 4314-400		REV G
#	REF DES	VALHALLA PART NO	DESCRIPTION	CODE IDENT	MFG PART NO	QTY.				REMARKS	
						I	N	I	N		
1	B1-4	5-10117	Battery H.D. Nicad	Gould	3.5AH	4					
2	Q17	3-10010	Transistor	07263	2N4402	1					
3	C1-2,8,34	2-10009	Cap Cerm .001uf	56289	5GAD10	4					
4	C4	2-10002	Cap Cerm 500pf	56289	5GAT50	1					
5	C5, 6	2-10010	Cap Cerm 39pf	56289	5GAQ39	2					
6	C7,25,33,35 41, 20	2-30001	Cap Tan 10uf 25V	05397	T360B106M025AS	6					
7	C36,10-13, 3	2-10000	Cap Cerm .005uf	56289	5GAD50	6					
8	C21	2-50000	Cap Poly .22uf	27556	PA2A224	1					
9	C22	2-10005	Cap Cerm 50pf	56289	5GAQ50	1					
10	C23	2-10004	Cap Cerm .02uf	56289	5GAS20	1					
11	C26, 27	2-10007	Cap Cerm 330 pf	56289	5GAT33	2					
12	C32	2-30003	Cap Tan 47uf 10V	05397	T360B476M010AS	1					
13	C44	2-40004	Cap Elect 2200uf	30039	16T2200	1					
14	CR2,12-16,19 20, 29, 30	3-20000	Diode	07263	IN4001	6					
	CR18,3-6, 9	3-20002	Diode, Rect	07263	1N4148	10					
15	CR17	3-20041	Diode Zener	02763	IN821 (825)	1					
16	DS1	5-01020	LED 1 Display	28480	QDSP-3789,Bin "B"	1					
17	DS2-5	5-01010	LED 0-9 Display	28480	5082-7650C	4					
18	DS6	5-01005	LED, Red		5082-4480 (HLMP 1000)	1					
19	F1	5-04001	Fuse Slo-Blo	75915	2A	1					
20	IC1	3-30022	IC Level Shifter	86684	CD4054AE	1					

NOTES :

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PARTS LIST

UNIT ASSY "DC"

MODEL
4314DWG NO
4314-400REV
G

#	REF DES	VALHALLA PART NO	DESCRIPTION	CODE IDENT	MFG PART NO	QTY.				REMARKS
						I	N	I	N	
44	R5, 25-27,75 106	1-01081	Res Fxd 100 K 1/4W 5%	81349	RC07GF104J	6				
45	R8	1-01120	Res Fxd 12 M 1/4W 5%	81349	RC07GF126J	1				
46	R9	1-01119	Res Fxd 10 M 1/4W 5%	81349	RC07GF106J	1				
47	R18	1-01067	Res Fxd 24K 1/4W 5%	81349	RC07GF243J	1				
48	R19	1-01021	Res Fxd 100 1/4W 5%	81349	RC07GF101J	1				
49	R58, 104		Factory Select							
50	R22	1-10038	Res Fxd 90.9K .1%	81349	RN60C9092B	1				
51	R23, 69	1-50000	Res Var 100 20%	71450	X201R101	2				
52	R24, 59, 62, 66 68, 70, 71	1-10037	Res Fxd 10K .1%	81349	RN60C1002B	7				
52	R28, 105,110	1-01061	Res Fxd 10K 1/4W 5%	81349	RC07GF103J	3				
53	R29	1-10039	Res Fxd 274K 1%	81349	RN60C2743F	1				
54	R30	1-01080	Res Fxd 91K 1/4W 5%	81349	RC07GF913J	1				
55	R49	1-01018	Res Fxd 75 ohm 1/4W 5%	81349	RC07GF750J	1				
56	R73,74,76,77	1-10049	Res Fxd 100K .1%	81349	RN60C1003B	4				
57	R109, 54	1-01128	Res Fxd 1000M	81349	RC07GF108J	2				
58	R50, 55	1-01045	Res Fxd 2K 1/4W 5%	81349	RC07GF202J	2				
59	R51	1-01041	Res Fxd 1K 1/4W 5%	81349	RC07GF102J	1				
60	R52	1-01065	Res Fxd 20K 1/4W 5%	81349	RC07GF203J	1				
61	R53	1-01051	Res Fxd 3.9K	81349	RC07GF392J	1				
62	R56, 113, 121	1-01007	Res Fxd 10 1/4W 5%	81349	RC07GF100J	3				
63	R57	1-01097	Res Fxd 750K 1/4W 5%	81349	RC07GF754J	1				

NOTES :

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Valhalla Scientific Inc.		PARTS LIST			UNIT ASSY "DC"		MODEL		DWG NO		REV
					4314		4314-400		G		
#	REF DES	VALHALLA PART NO	DESCRIPTION	CODE IDENT	MFG PART NO	QTY.				REMARKS	
						I	N	I	N		
88		4-10529	4314A front panel, screened Valhalla		4314-100	1					
89		5-10198	1/8" spacer	Smith	8880	4					
90		5-10199	Fibre Washer	Smith	2161	4					
91			#4 x 1/2 lg. Self tapping screw			4					
92		4-10130	Chassis	PacTec	CH-250 Beige	1					
93		5-10521	Fuse Holder Panel Mounting	Little	Fuse 342004A	1					
94		4-10235	Rear Panel		4440-214	1					
95		5-10278	Dress Nut	C & K	7099	1					
96		5-10277	Silver Button	71590	B426	6					
97		5-10019	Cable Tie 4" x 1/8"	Panduit	WRN-4	20					
98			Wire:								
99			22 AWG, Orn		10 in.	1					
100			22 AWG, Blue		27 in.	1					
101			22 AWG, Black		33 in.	1					
102			22 AWG, White		4 in.	1					
103			22 AWG, Red		10 in.	1					
104			22 AWG, Buss		1 in.	1					
105			22 AWG, Purple		7 in.	1					
106											
107			14 AWG, Buss		3 in.	1					
108		5-10239	Velcro, Hook 8"	Un. Textile	VN06330HK 8"	1					
109		5-10240	Velcro Loop 8"	Un. Textile	VN06330LP 8"	1					

NOTES: *For unit assembly use 440-400 sheet 7 *For Main P. C. B. Assy. See 4314-600
 *For Display PC Board see 4440-601-2 #For Wiring Info see DC 4314-051

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 Valhalla Scientific Inc.	PARTS LIST	MOD FOR MX	MODEL 4314 with BCD/MX	DWG NO 4314-401	REV A
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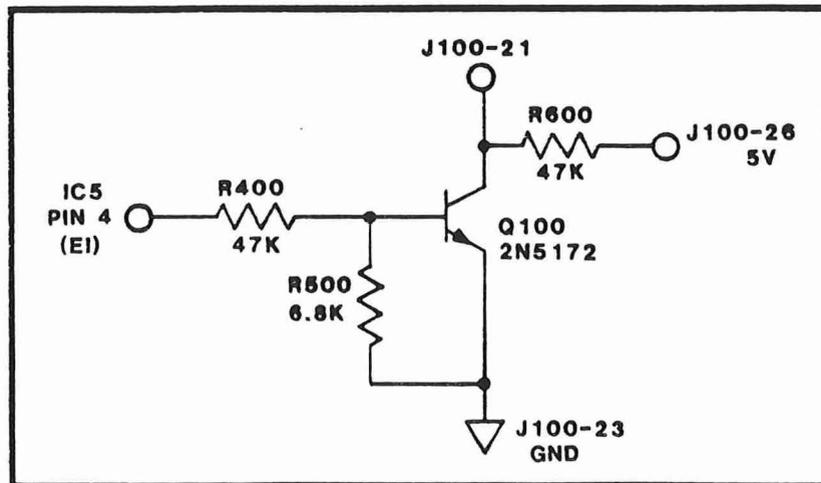
#	REF DES	VALHALLA PART NO	DESCRIPTION	CODE IDENT	MFG PART NO					REMARKS
						I	N	I	N	
		F.G.	STD 4314A	53504		1				
	DELETE:									
		4-10236	REAR PANEL	53504	4440-215	1				
	ADD:									
	Q100	3-10003	TRANS.		2N5172	1				
	R400,R600	1-01073	RES 47K 1/4W	81349	RC07GF473J	2				
	R500	1-01057	RES 6.8K 1/4W	81349	RC07GF682J	1				
	J100	5-10012	CONN BCD 50 PIN F		57-40500	1				
			REAR PANEL MX	53504	4440-218	1				
			SCREW, PHIL PAN CAD		2-56x3/8	2				
			WASHER, STAR		#2	2				
			NUT, HEX		2-56	2				
			WIRE:							
			22 BLK		88"	1				
			22 BUSS		12"	1				

NOTES:

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(ALL 10° THRU 10³ OUTPUTS ARE MULTIPLEXED)

4314		50 PIN CONNECTOR (J100)	DATA
IC7	Pin 23	1,6,11,16	1
IC7	Pin 24	2,7,12,17	2
IC7	Pin 1	3,8,13,18	4
IC7	Pin 2	4,9,14,19	8
IC7	Pin 8	29	10° STROBE
IC7	Pin 6	30	10 ¹ STROBE
IC7	Pin 9	31	10 ² STROBE
IC7	Pin 7	32	10 ³ STROBE
IC7	Pin 16	23,22,24,50	GND
R600		5,26,33	+5V



BCD-MX

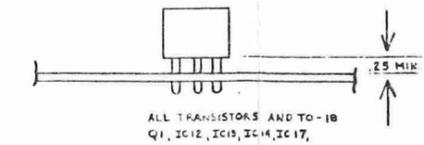
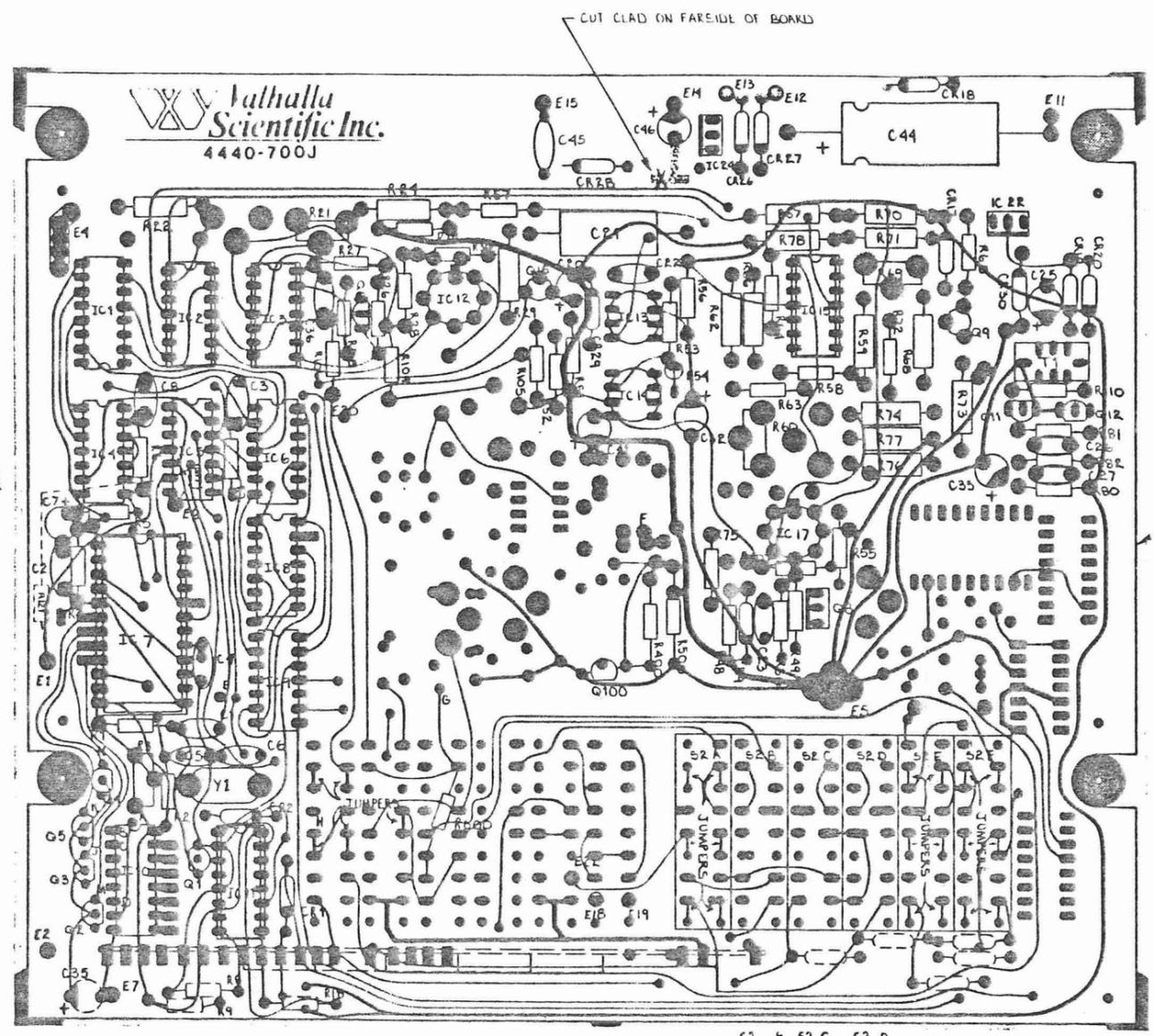
Federal Supply Codes for Manufacturers

00656 Aerovox Corp. New Bedford, Massachusetts	04713 Motorola Inc. Phoenix, Arizona	08261 Spectra Strip Corp. Garden Grove, California	12697 Clarostat Mfg. Co. Dover, New Hampshire
00686 Film Capacitors, Inc. Passaic, New Jersey	04946 Standard Wire & Cable Los Angeles, California	08530 Reliance Mica Corp. Brooklyn, New York	12969 Unitrode Corp. Watertown, Massachusetts
00779 AMP Inc. Harrisburg, Pennsylvania	05276 Pomona Electronics Co., Inc. Pomona, California	08806 General Electric Co. Cleveland, Ohio	13103 Thermalloy Co., Inc. Dallas, Texas
00853 Sangamo Electric Company Pickens, South Carolina	05277 Westinghouse Electric Corp. Youngwood, Pennsylvania	09026 Babcock Electronics Corp. Costa Mesa, California	13327 Solitron Devices Inc. Tappan, New York
01121 Allen-Bradley Co. Milwaukee, Wisconsin	05397 Kemet, Union Carbide Corp. New York, New York	09214 G. E. Co. Semi-Conductor Auburn, New York	13454 Texas Crystals River Grove, Illinois
01255 Litton Industries, Inc. Beverly Hills, California	05574 Viking Industries Chatsworth, California	09353 C and K Components Watertown, Massachusetts	13511 Amphenol Cadre Div. Los Gatos, California
01281 TRW Electronic Comp. Semiconductor Operations Lawndale, California	05820 Wakefield Engineering Inc. Wakefield, Massachusetts	09922 Burndy Corp. Norwalk, Connecticut	13606 Use 56289 Sprague Electric Co. Concord, New Hampshire
01295 Texas Instruments, Inc. Dallas, Texas	06001 General Electric Co. Columbia, South Carolina	09969 Dale Electronics Inc. Yankton, S. Dakota	14099 Semtech Corp. Newbury Park, California
01686 RCL Electronics Inc. Manchester, New Hampshire	06383 Panduit Corp. Tinley Park, Illinois	11236 CTS of Berne Berne, Indiana	14655 Cornell-Dublier Electronics Newark, New Jersey
02114 Ferroxcube Corp. Saugerties, New York	06473 Bunker Ramo Corp. Chatsworth, California	11403 Best Products Co. Chicago, Illinois	14752 Electro Cube Inc. San Gabriel, California
02131 General Instrument Corp. Westwood, Maine	06555 Beede Electrical Instrument Co. Penacook, New Hampshire	11503 Keystone Columbia Inc. Warren, Michigan	14936 General Instrument Corp. Hicksville, New York
02799 Aero Capacitors, Inc. Chatsworth, California	06743 Clevite Corp. Cleveland, Ohio	11532 Teledyne Relays Hawthorne, California	15801 Fenwal Electronics Inc. Framingham, Massachusetts
03508 General Electric Co. Syracuse, New York	07088 Kelvin Electric Company Van Nuys, California	11711 General Instrument Corp. Hicksville, New York	15818 Teledyne Semiconductors Mountain View, California
03797 Genisco Technology Corp. Compton, California	07256 Silicon Transistor Corp. Chelmsford, Massachusetts	12014 Chicago Rivet & Machine Co. Bellwood, Illinois	15849 Useco Inc. Van Nuys, California
03877 Transistron Electronic Corp. Wakefield, Massachusetts	07263 Fairchild Semiconductor Mountain View, California	12060 Diodes, Inc. Chatsworth, California	15898 International Business Machines Corp. Essex Junction, Vermont
03911 Clairex Corp. Mt. Vernon, New York	07344 Bircher Co., Inc. Rochester, New York	12136 Philadelphia Handle Co. Camden, New Jersey	16332 Replaced by 28478
04009 Arrow Hart Inc. Hartford, Connecticut	07597 Burndy Corp. Rochester, New York	12405 Hysol Corporation El Monte, California	16473 Cambridge Scientific Ind. Cambridge, Maryland
04217 Essex International Inc. Anaheim, California	07716 I R C Incorporated Burlington, Iowa	12406 Elpac, Incorporated Fullerton, California	16758 Delco Electronics Kokomo, Indiana
04222 AVX Corp. Myrtle Beach, Florida	07910 Teledyne Semiconductor Hawthorne, California	12615 U.S. Terminals Inc. Cincinnati, Ohio	17856 Siliconix, Inc. Santa Clara, California
04423 Telonic Industries Laguna Beach, California	08065 Accurate Rubber and Plastics Co. San Diego, California	12617 Hamlin Inc. Lake Mills, Wisconsin	18324 Signetics Corp. Sunnyvale, California

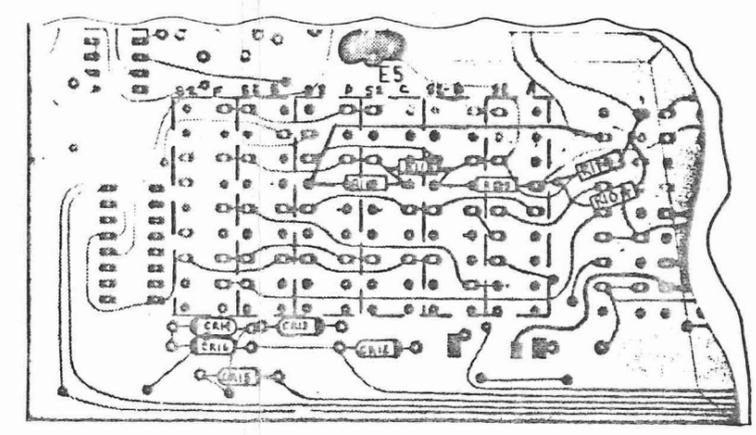
Federal Supply Codes for Manufacturers (cont.)

81095 Triad Transformer Corp. Venice, California	89730 G.E. Co Newark, New Jersey	95348 Gordo's Corp Bloomfield, New Jersey
81312 Winchester Electronics Div. of Litton Industries Inc. Oakville, Connecticut	90201 Mallory Capacitor Co. Indianapolis, Indiana	95712 Bendix Corp. Franklin, Indiana
81483 International Rectifier Corp. Los Angeles, California	56365 Square D Co. Chicago, Illinois	97913 Industrial Electronic Hardware Corp. New York, New York
81741 Chicago Lock Co. Chicago, Illinois	90303 Mallory Battery Co. Tarrytown, New York	97945 Penwalt Corp. SS White Industrial Products Div. Piscataway, New Jersey
82389 Switchcraft Inc. Chicago, Illinois	91094 Essex International Inc. Newmarket, New Hampshire	98278 Malco A. Microdot Co., Inc. Connector & Cable Div. Pasadena, California
82877 Rotron Inc. Woodstock, New York	91293 Johanson Mfg. Co. Boonton, New Jersey	98291 Sealectro Corp. Mamaroneck, New York
82879 ITT Royal Electric Div. Pawtucket, Rhode Island	91506 Augat Inc. Attleboro, Massachusetts	98388 Royal Industries Products Div. San Diego, California
83003 Varo Inc. Garland, Texas	91637 Dale Electronics Inc. Columbus, Nebraska	98978 IERC Burbank, California
83298 Bendix Corp. Eatontown, New Jersey	91662 Elco Corp. Willow Grove, Pennsylvania	99120 Plastic Capacitors, Inc. Chicago, Illinois
83330 Herman H. Smith, Inc. Brooklyn, New York	71468 Gremar Mfg. Co., Inc. ITT Cannon/Gremar Santa Ana, California	99217 Bell Industries Elect. Burbank, California
83594 Burroughs Corp. Plainfield, New Jersey	91802 Industrial Devices, Inc. Edgewater, New Jersey	99392 STM Oakland, California
83740 Union Carbide Corp. New York, New York	91833 Keystone Electronics Corp. New York, New York	99515 ITT Jennings Monrovia Plant Monrovia, California
84171 Arco Electronics Great Neck, New York	91929 Honeywell Inc. Micro Switch Div. Freeport, Illinois	99779 Use 29587 Bunker-Ramo Corp. Landsdowne, Pennsylvania
84411 TRW Electronic Components Ogallala, Nebraska	92194 Alpha Wire Corp. Elizabeth, New Jersey	99942 Centrelab Semiconductor El Monte, California
84613 Fuse Indicator Corp. Rockville, Maryland	93332 Sylvania Electric Products Woburn, Massachusetts	
84682 Essex International Inc. Peabody, Massachusetts	94988 Wagner Electric Corp. Tung-Sol Div. Newark, New Jersey	
86684 Radio Corp. of America Harrison, New Jersey	95146 Alco Electronic Products Inc. Lawrence, Massachusetts	
88219 Gould Inc. Trenton, New Jersey	95275 Vitramon Inc. Bridgeport, Connecticut	
88245 Litton Systems Inc. Useco Div. Van Nuys, California	95303 RCA Corp Receiving Tube Div. Cincinnati, Ohio	
88419 Cornell-Dubilier Electronic Div. Fuquay-Varian, North Carolina		

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
616	K	ADDED R121 + Q17	DPM 3-21-85	EM

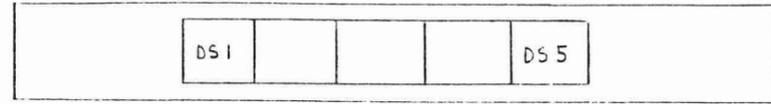


P.C.B. 4440-700J



VIEW FROM BOTTOM OF P.C.B.
(CLAD SHOWN IF NEAR SIDE)

NOTE:
Q17 AND R121 MOUNT ON THE FAR SIDE OF THE BOARD.
MOUNT R121 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.



SHOWN IS PC BOARD ASSEMBLY 4314B-700
(CLAD SHOWN IS FAR SIDE)

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

MATERIAL	DRAWN	ME	4/84	Valhalla Scientific Inc. SAN DIEGO, CALIFORNIA
	CHECKED	EM	5/85	
	APPR.	EM	7/85	
FINISH				4314A ASSEMBLY
	SCALE	NONE	CODE IDENT NO.	53504
			SIZE	D
			DRAWING NO.	4314-600
			REV.	K
	SHEET	1	OF	1

NOTES: