
SECTION 10

Hardware Reference

Replacing Batteries

The E-600 is powered by three "C" cells, which are located in a compartment on the bottom of the instrument. Replacing the batteries involves simply loosening the single screw which secures the battery door, removing the old batteries (if present) and inserting three new cells. The positive terminal of each battery holder is marked both by a red terminal ring and by a "+" mark stamped on the bottom of the holder. It is recommended that the instrument be switched to "OFF" before changing batteries.

Although rechargeable or low cost zinc-carbon batteries may be used in this instrument, alkaline batteries are recommended for longest battery life. All batteries in a set must be of the same type and at the same charge level; do not mix different types or new and partially discharged cells.

Disassembly and Re-Assembly

The following sequence should be followed to disassemble an E-600; reverse the procedure to re-assemble:

1. Power the instrument off, open the battery door and remove the batteries.
2. Remove the lower end plate (including the handle assembly) using a 9/64 Allen key. Slide the circuit boards out just far enough to disconnect the switch and audio connectors.
3. Remove the front end plate and slide the circuit boards out through the front of the case. Note that the end plate is attached to the upper circuit board by two connector harnesses; avoid excessive flexing of the solder connections where these harnesses connect to the board.
4. The two circuit boards may be separated by pulling them apart. Do not lose the floating header strip which connects the boards together.

- Caution: When re-assembling the instrument, insure that the wires leading from the upper circuit board to the front end plate connectors fit inside the cutouts along the edges of the board and are not pinched or cut as the board slides into the case.
- Caution: These boards contain numerous CMOS components which may be damaged by static discharge. Disassemble the instrument only when necessary, and then only at an anti-static work station.
- Caution: When re-assembling, do not permit the mylar ribbon cable from the handle control switches to become pinched or folded between the endplate and case. Sharp folds will destroy the silver traces which are painted onto the mylar.
- Caution: Do not permit the wire harness connected to the mode control rotary switch and response time selector switch to snag the pins of J7 when removing the boards from the case. These pins are very small and easily broken.

Circuit Description

Power for the E-600 is provided by three "C" batteries, which may vary from 1.5 Volts to below 1.0 Volts each during their useful life. To obtain maximum efficiency over this voltage range, a DC-DC inverter is implemented by IC A102 and its associated components on the battery board. The output of this circuit is approximately 5.7 Volts, which is then regulated down to 5.0 V by A101. Because the main function selector switch has a grounded common terminal, the negative side of the battery stack is switched rather than the positive voltage.

The instrument is controlled by a conventional microprocessor circuit based on the Dallas Semiconductor 80C320 processor chip. In addition to parallel I/O ports which interface to the instrument's panel controls, the processor bus also includes a 4-wire RS-232 serial interface (A18), non-volatile EEPROM for parameter storage (A1), a 10-bit A/D converter which measures battery voltage (A3), and a quad D/A converter (A22) which controls the high voltage power supply and two detection thresholds.

32K Bytes of RAM is provided (A16), both as working memory for the processor and for logging of measurement results. This chip is installed in a "Smart" socket which contains a lithium battery for data retention when the instrument is powered off and a real-time clock/calendar chip used to timestamp logged data. The processor's crystal frequency of 2.4576 MHz is divided down by a 14-stage ripple counter (A23) to obtain both a 150 Hz clock interrupt input and the two audio frequencies used for particle 'clicks.'

Three logic-level signals are present in the "Smart" probe connector; two of these sense the type of probe connected, while the third is a bi-directional serial data line connecting the microprocessor to the probe's memory. These three signals

are protected against static discharges or the possibility of an arc from the high voltage supply. All of these signals are buffered by a Schmidt trigger (A2).

All of the instrument's analog circuitry is located on a custom hybrid circuit (A5) which includes a two-stage amplifier, two threshold comparators, pulse shapers, and the feedback loop which regulates the high voltage power supply. This supply is located on the battery PCB. Its output is connected to the main board via a banana plug.

Calibration of the high voltage supply may be accomplished by adjusting a potentiometer (R8) until the output (measured at C109 or the banana plug) agrees with the indicated probe voltage. A ground reference is available on un-masked traces along both edges of each circuit board. It is strongly recommended that 1250 volts be used as a calibration point since most other nominal voltages cannot be attained due to roundoff errors.

Schematic

The accompanying diagrams include schematics and component placement diagrams for both of the E-600 circuit boards. Note that A5, the custom hybrid circuit module which contains virtually all of the analog components, is a non-repairable component and is simply shown as a block on the schematic.

Parts List

The following tables list the electronic components used in the E-600 and should contain sufficient information for obtaining replacement parts. Unless otherwise specified, specific manufacturers and part numbers listed may be considered examples only and not restrictions against using equivalent components with the same characteristics from other vendors. When ordering parts from Eberline, specify the model and serial numbers of the instrument and reference designator(s) and/or descriptions of the parts required. Eberline will automatically substitute equivalent parts if the original source is no longer available.

Main PC Board

Reference Designation	Part Name	Part Description	Eberline Part Number
(None)	Circuit Board	Main PCBA	YP11581003
C3,5,7,10,11,13-18,22-34	Capacitor	0.1 uF, 50V, CW20C104K	CPCE104P3N
C4	Capacitor	1000 uF, 100V	CPCE102P3P
C21	Capacitor	,22 pF, 200V, 22pF, 200V, 10%	CPCE220P3R
C20	Capacitor	33 pF, 100V, 10%, 20%	CPCE330P3P
C2	Capacitor	220 pF, 3KV, 10%, DD30-221	CPCE221P3Y
C6,8,9,12,19,35,36	Capacitor	10 uF, 16 V, Tantalum, 20%	PTA100M4X
R5,7,10	Resistor	100 Ohm, 5%, 1/4W	RECC101B22
R11,13,15	Resistor	1K Ohm, 5%, 1/4W	RECC102B22
R17	Resistor	2.2K Ohm, 5% 1/4 W	RECC222B22
R4,6,9	Resistor	4.7K Ohm, 5%	RECC472B22
R16,18,19	Resistor	10K Ohm, 5%, 1/4W	RECC103B22
R3	Resistor	1M Ohm, 5%, 1/4W	RECC105B22
RPK1,2	Resistor	9 x 10K Ohm Pin 1 Common	REAR103B21
R8	Pot	100K Ohm	PTCE104B83
CR4,6	Diode	Switching, 1N4148	CRSI1N4148
CR1,2,3,5	Diode	Zener, 4.7V, 1N5230B	CRZR1N5230
Q1,2,3,5	Transistor	FET	TRMN2N7000
XA1,3	IC Socket	8-Pin DIP, C93-08-02	SOIC308
XA2,4,7,8	IC Socket	14-Pin DIP, 93-14-02	SOIC114
XA17,23	IC Socket	16-Pin DIP, 93-16-02	SOIC116
XA18	IC Socket	18-Pin DIP, C931802	SOIC118
XA14,19-22	IC Socket	20-Pin DIP, #C932002	SOIC120

Reference Designation	Part Name	Part Description	Eberline Part Number
XA15,16	IC Socket	28-Pin DIP, #C932802	SOIC128
XA13	IC Socket	40-Pin DIP, C93-40-02	SOIC140
A7,8	IC	Quad NAND, 74HC00	ICHCA00
A2,4	IC	Hex Schmidt	ICHCA14
A17	IC	3-to-8 Decode	ICCM4HC138
A14,19,20	IC	Octal Buffer #74HC373	ICHCA74373
A21	IC	Octal D-Latch 74HC374	ICHCA74374
A23	IC	4060B, 14STG, BINCNTR,	ICCMA4060B
A5	Hybrid	Modified MDB	VEBD14A
A9	IC	5-V Regulator LP2950CZ	ICAVA2950C
A3	IC	A/D Convert.CHNL/10 BIT	ICCM1091
A1	IC	EEPROM	ICCM93C66
A13	IC	Micro-Processor/8 BIT	ICCM80C320
A15	IC	EPROM	ICCM27C512R
A16	IC	RAM, 32K X 8	ICCM43C256
A22	IC	Quad D/A	ICCMMAX506
A18	IC	RS-232	ICXXMAX242
J1	Connector	2 x 5 Recept.	COMR1610
J3	Connector	7-Pin Header	COMR1007
J4	Connector	10-Pin Thru-Board Recept.	COMR1510
J5	Connector	8-Pin Header	COMR1008
J7	Connector	5-Pin Header	COMR1505
J8	Connector	5-Pin Header	COMR1005

Reference Designation	Part Name	Part Description	Eberline Part Number
J2	Connector Assembly	Smart Probe Harness	YP11579050
J6	Connector Assembly	Serial Data Harness	YP11581050
X1	Crystal	2.4576 MHz	CYOS21
(None)	Display	LCD	OPDS33
(None)	Spacer	4-40 x 1/2"	SPHN4408
(None)	Connector	Banana Jack	COMI14
XXA16	IC Socket	"Smart" Watch	ICXX26

Battery Board

Reference Designation	Part Name	Part Description	Eberline Part Number
(None)	Circuit Board	Battery PCBA	YP11581005
BT101,102, 103	Battery Holder	Single "C" Cell Holder	BTBH20
BT101,102, 103	Polarity Marker	Red Plastic	BTBH13
P4	Connector	10-Pin Thru-Board Recept.	COMR1510
A101	IC	Low-Drop +5V Voltage Regulator	ICAV4941
A102	IC	DC-DC Converter	ICAV1111
XA102	Socket	8-Pin DIP	SOIC308
L101	Inductor	100 uH Choke	INF15
T101	Xfmr.	High Voltage	TFHV5
CR101-103	Rectifier	VA25	CRSIVA0025
CR104	Diode	Schottky	CRSC1N5817
Q101	Transistor	Silicon	TRSP2N4234
C104	Capacitor	.001 uF, 3KV	CPCE102P3Y
C105-107	Capacitor	.01 uF, 3KV	CPCE103P4Y
C109	Capacitor	.047 uF, 4KV	CPPF503PXY
C103	Capacitor	.01 uF, 80V	CPPF103P3O
C102	Capacitor	.27 uF, 50V	CPCE274P4N
C101,110	Capacitor	10 uF, 16V Tantalum	CPTA100M4X
C108,111	Capacitor	33 uF, 25V Tantalum	CPTA330M3J
C112	Capacitor	.1 uF, 50V	CPCE104P3N

R104	Resistor	100 Ohm, 5%	RECC101B22
R101	Resistor	270 Ohm, 5%	RECC271B22
R106	Resistor	93.1 K Ohm, 1%	RECE933B12
R105	Resistor	332 K Ohm, 1%	RECE334B12
R102,103	Resistor	10 M Ohm, 5%	RECC106B22
(None)	Connector	Banana Plug	COMI13

Miscellaneous

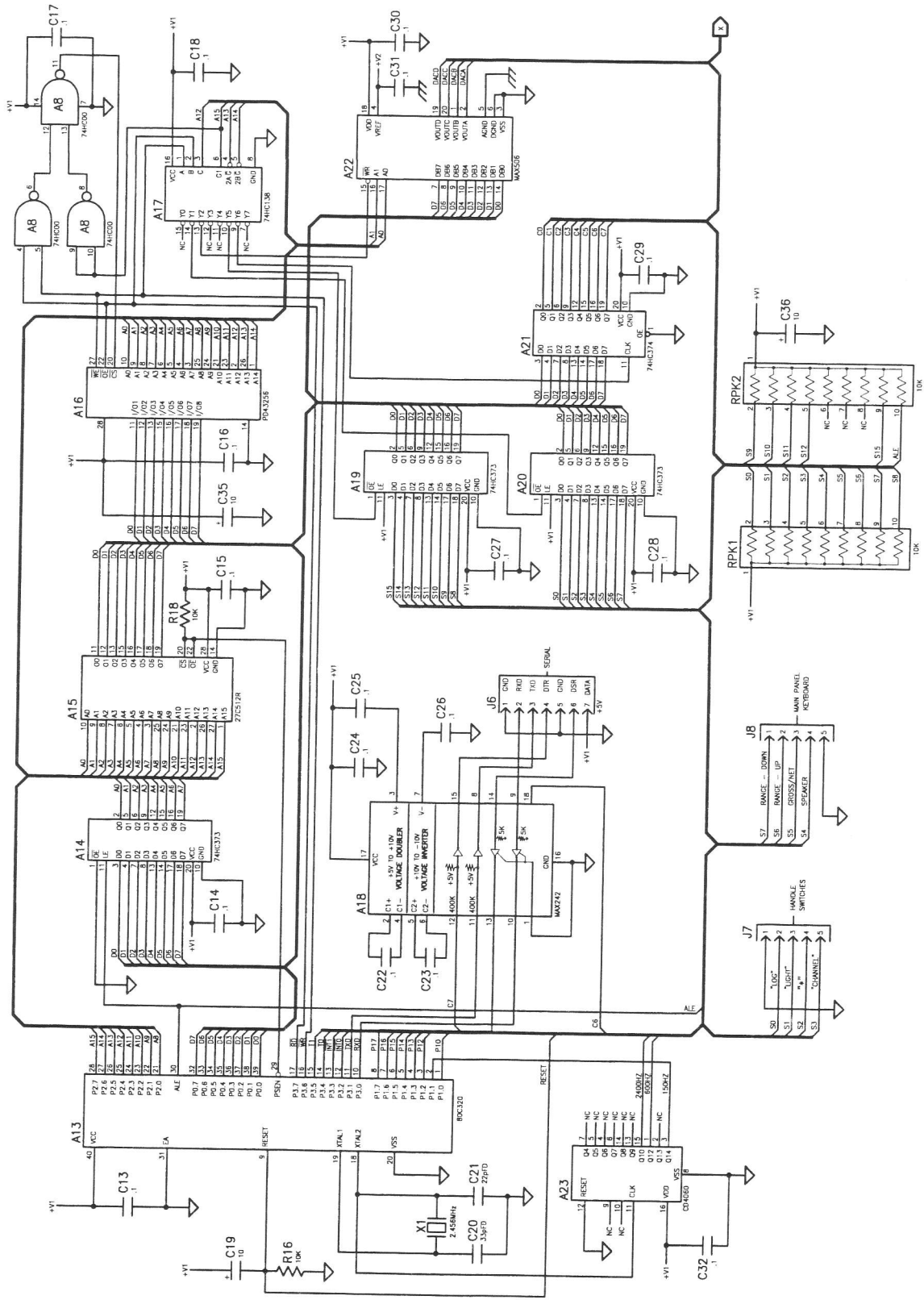
Reference Designation	Part Name	Part Description	Eberline Part Number
(None)	Switch	Rotary Encoder	SWRO59
(None)	Switch	SPDT Toggle	SWTO40
(None)	Switch Boot	Miniature Toggle	SWHD22
(None)	Knob	Encoder	HDKN30
(None)	Adapter	Knob Shaft	HDKN41
(None)	Speaker	1" Sealed	ADSP4
(None)	Connector	Headphone	COAF26
(None)	Gasket	Front Plate	ZP11581025
(None)	Gasket	Rear Plate	ZP11581026
(None)	Gasket	Battery Door	ZP11581030
(None)	Connector	10 X 0.1" Double Ended Header	COMR1710

SECTION 11

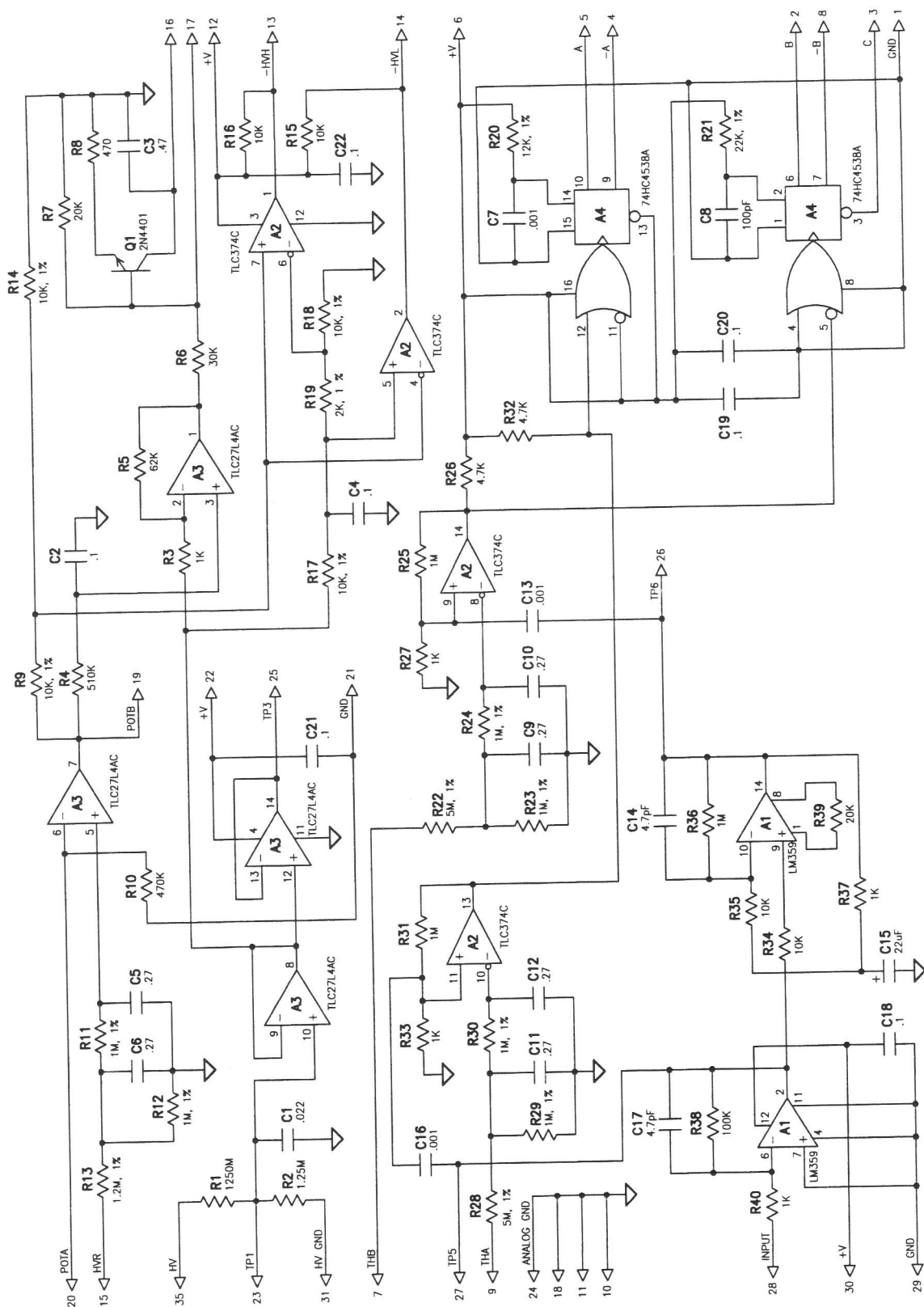
Diagrams

The following schematic and assembly diagrams are included for repair and troubleshooting purposes. Component reference designators refer to the parts lists in the previous section of this manual.

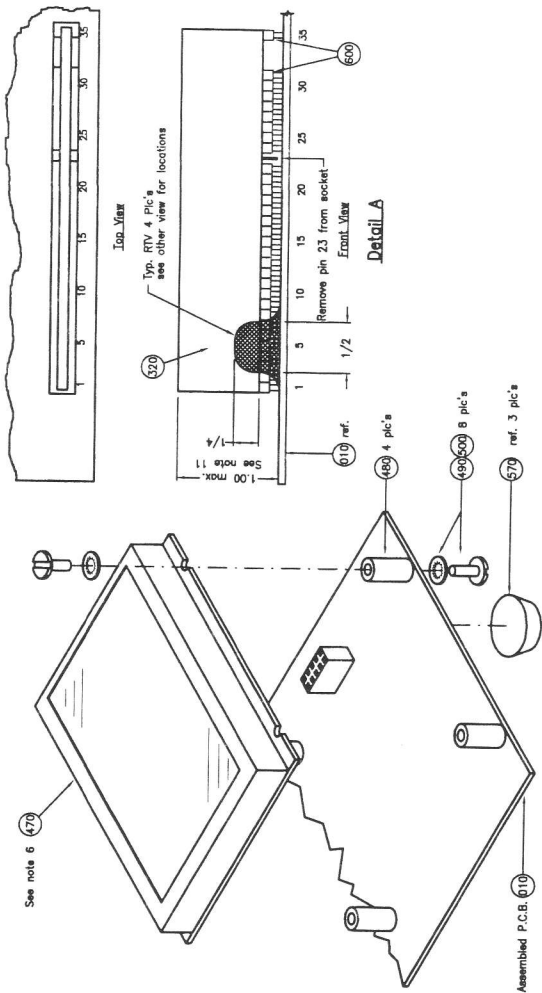
Main P.C. Board Schematic	Drawing # 11581-D01
Hybrid Schematic	Drawing # 11543-D08
Main P.C. Board Component Assembly	Drawing # 11581-D04
Battery P.C. Board Schematic	Drawing # 11581-D02
Battery P.C. Board Component Assembly	Drawing # 11581-D06
Overall Interconnect Diagram	Drawing # 11581-D76
Case Assembly	Drawing # 11581-D07
Endplate Assembly	Drawing # 11581-D08
Battery Door Assembly	Drawing # 11581-C09
E-600 Overall Assembly	Drawing # 11581-D55



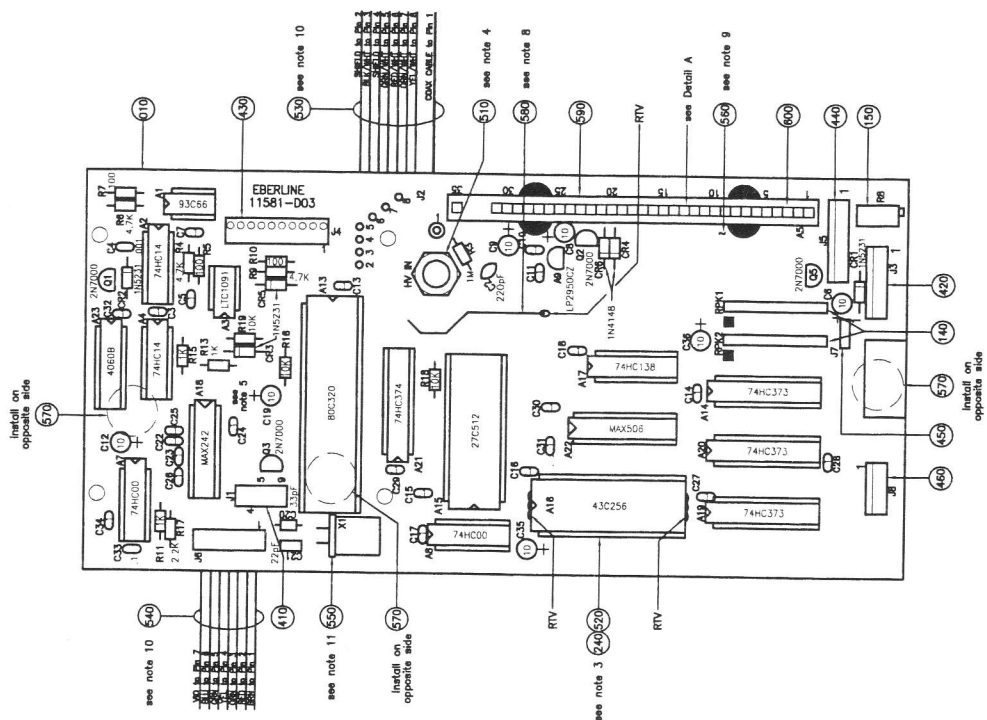
Main PCBoard Schematic, E-600, 11581-D01b sheet 2 of 2

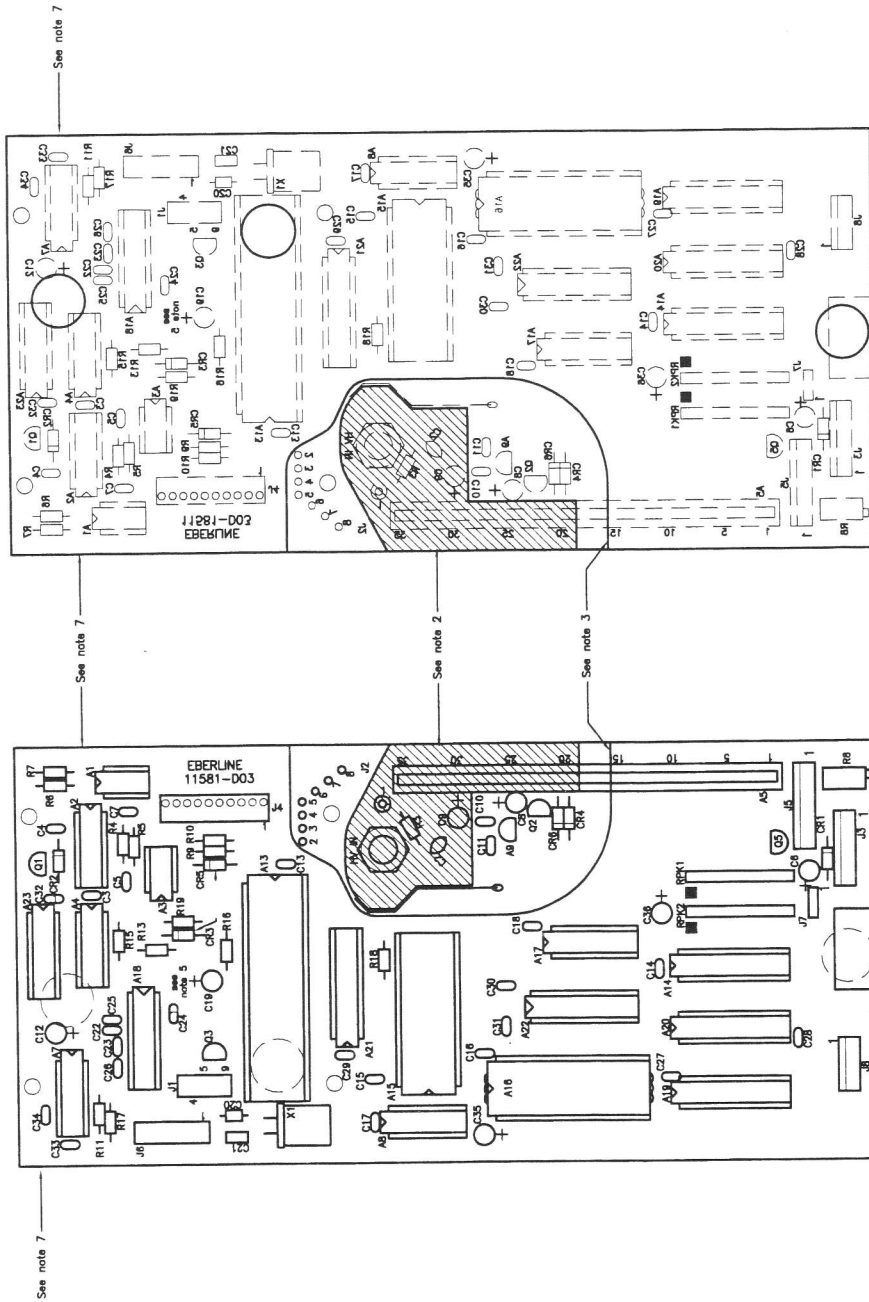


Modular Detector Hybrid, Schematic, 11543-D08B

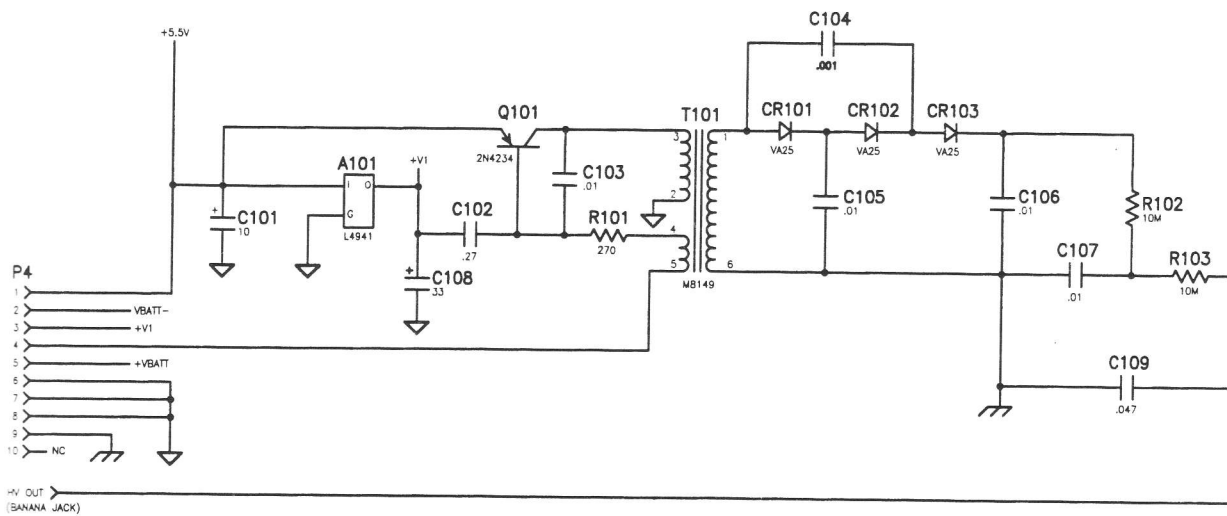
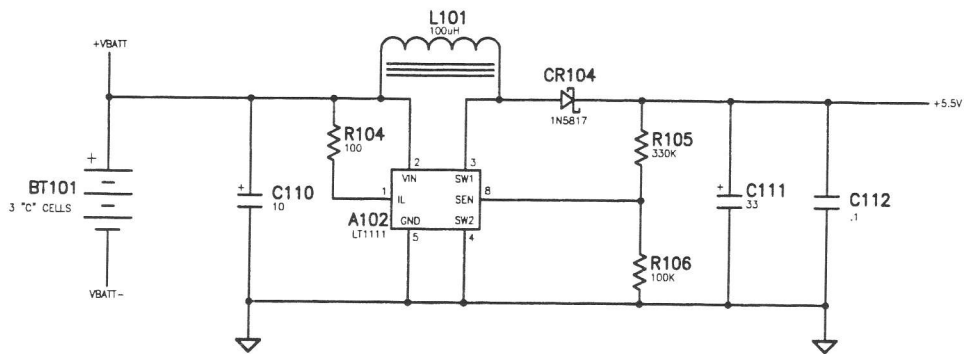


- NOTES:**
1. Encircled numbers refer to line item numbers on B.O.M. YP11581003.
 2. Solder all discrete components and I.C. sockets into P.C. board first.
 3. Install Smart Watch Socket, item 520, into I.C. socket at location A16; use a small amount of RTV to attach the Smart Watch Socket, prevent RTV from clogging pins. Use Dow Corning clear RTV #732 here and in following steps. Clean all RTV areas with alcohol before applying.
 4. Install the Banana Jack, item 510, from the opposite side.
 5. Insert all I.C.'s into I.C. sockets.
 6. The Display, item 470, is to be mounted to Main P.C. board after all other components have been installed. Be sure to follow the "Caution" note that accompany this Display; note that the Display can only be mounted one way.
 7. Resistor values are 1/4 watt, 5% unless noted otherwise.
 8. Solder Noise Shield, item 580, directly to P.C. board trace, at right angle to board, in location shown. Use RTV to secure lower (unsoldered) end of shield.
 9. Apply a 1/4" tall bead of RTV four places on Hybrid AS, item 320, to prevent lead flexing; approximate location shown. DO NOT apply until after TEST operation.
 10. Solder wires from items 530 and 540 to solder side of P.C. board, in location shown. Apply approximately 1/8" of RTV around solder joints with cables held perpendicular to PCB. RTV mound can "lean" toward center of PCB, not toward edge.
 11. Use a small amount of RTV or foam tape to secure the Crystal, item 550, to P.C. board. Mount crystal parallel to PCB.
 12. Maximum height with item 320 fully inserted.





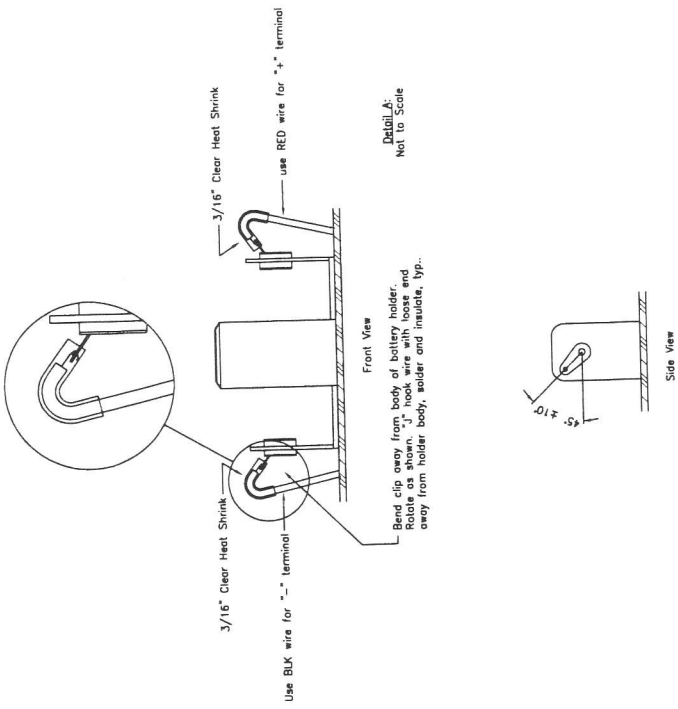
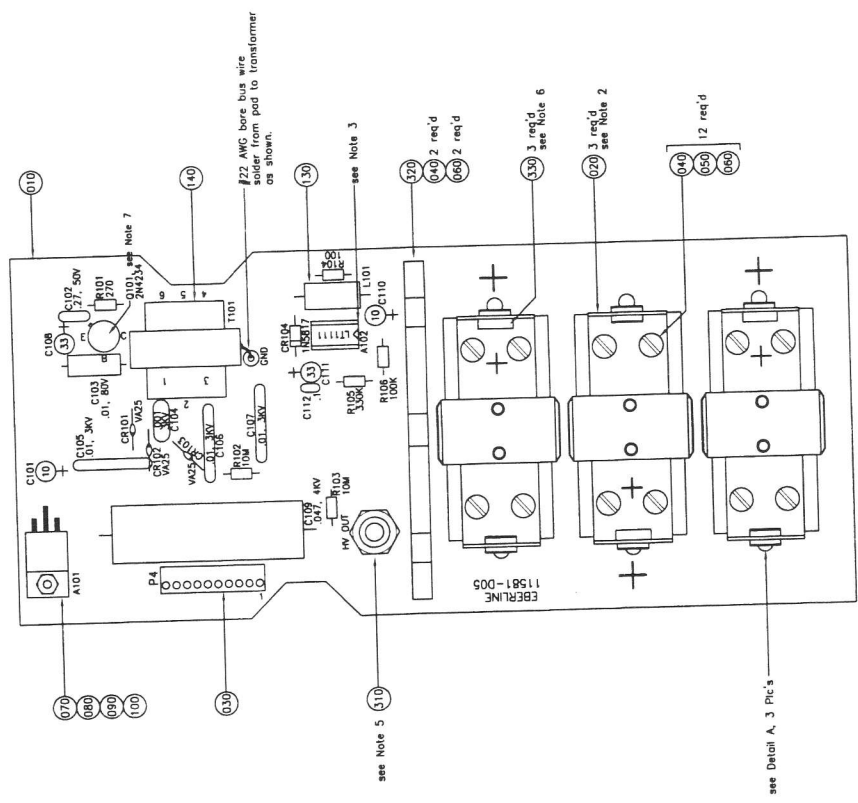
- Instructions for Application of Conformal Coating**
1. Mask or plug both ends of "HY IN" banana jack. Mask or remove liquid crystal display.
 2. Apply a heavy coat of conformal coating in area designated by hatching.
 3. Overpray may extend to second outline boundary.
 4. No overpray permitted on J4 (Either side) or socketed ICs (Component side).
 5. Conformal coating to be Loc-Tite "Shodureure" type AR or equivalent. May be applied by either spraying or brushing.
 6. After TEST operation, apply conformal coating to be Loc-Tite "Shodureure" type AR or equivalent over A5 socket and pins up to A5's coating.
 7. Mask metallized board edges to prevent any solder build-up.



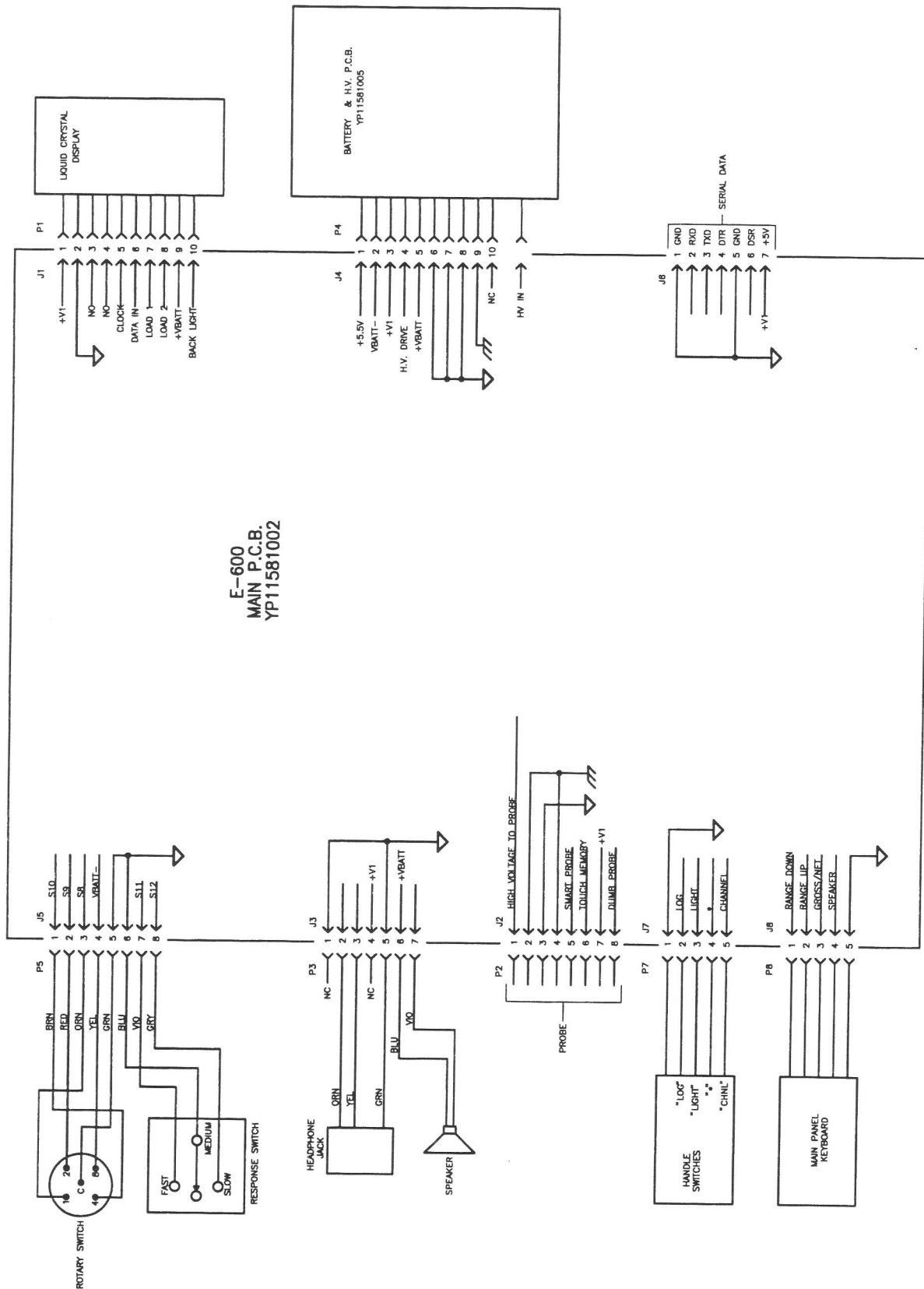
Battery PCBoard Schematic, E-600, 11581-D02a

NOTES:

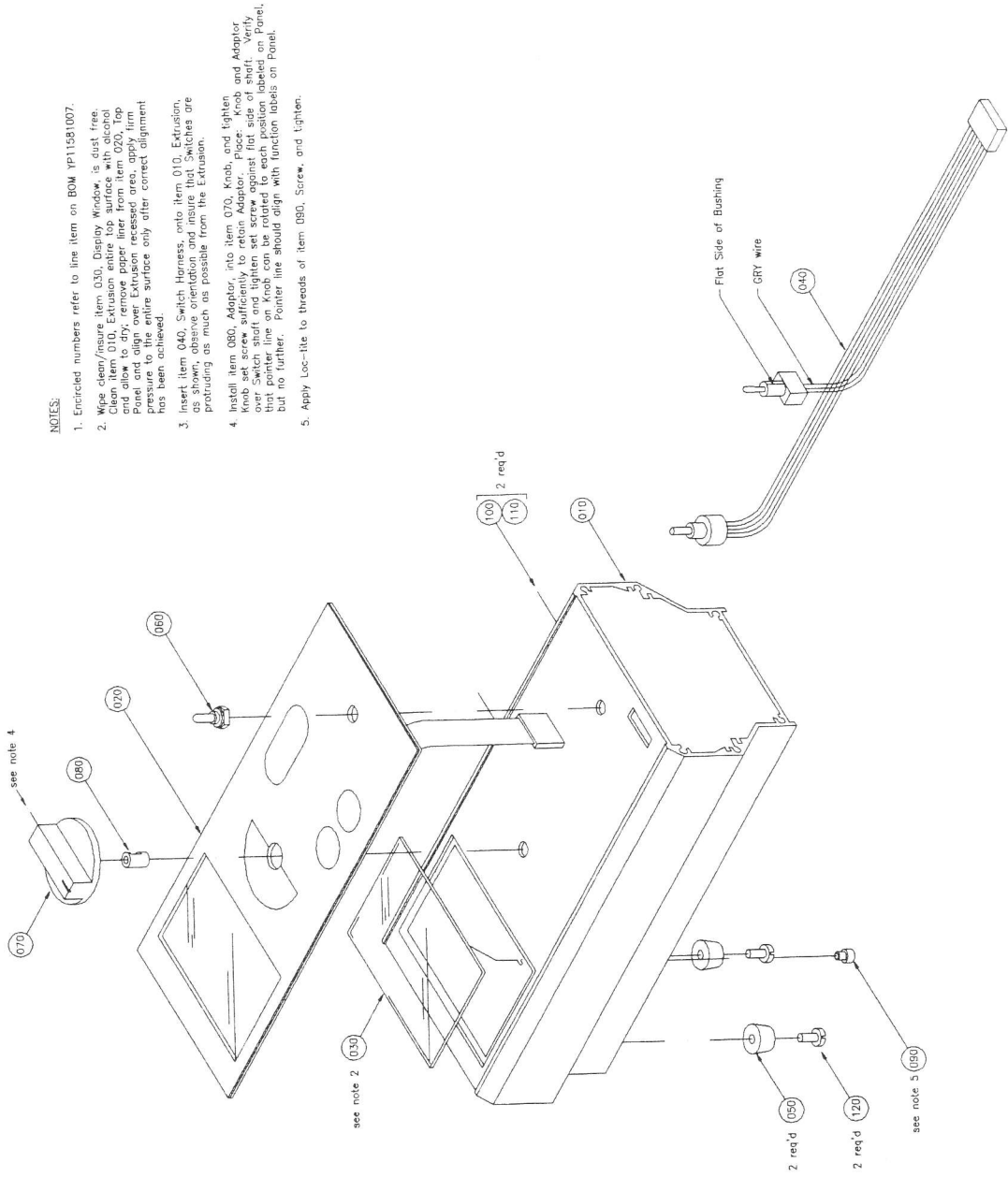
1. Encircled numbers refer to line item numbers on B.O.M. YP11581005.
2. Observe correct orientation of Battery Holders (Item 020).
3. I.C. A102 is inserted into an I.C. socket after all other components have been soldered to the P.C. Board.
4. Resistors are 1/4 watt, 5% tolerance. Capacitor values are in microfarads.
5. Mount "Banana" Plug (Item 310) from solder side.
6. The red Caps (Item 330) shall be placed on the "+" (positive) end of each battery holder as shown. These caps are pushed on over the round terminal.
7. Apply heat shrink tubing over Q101.



Detail A:
Not to Scale

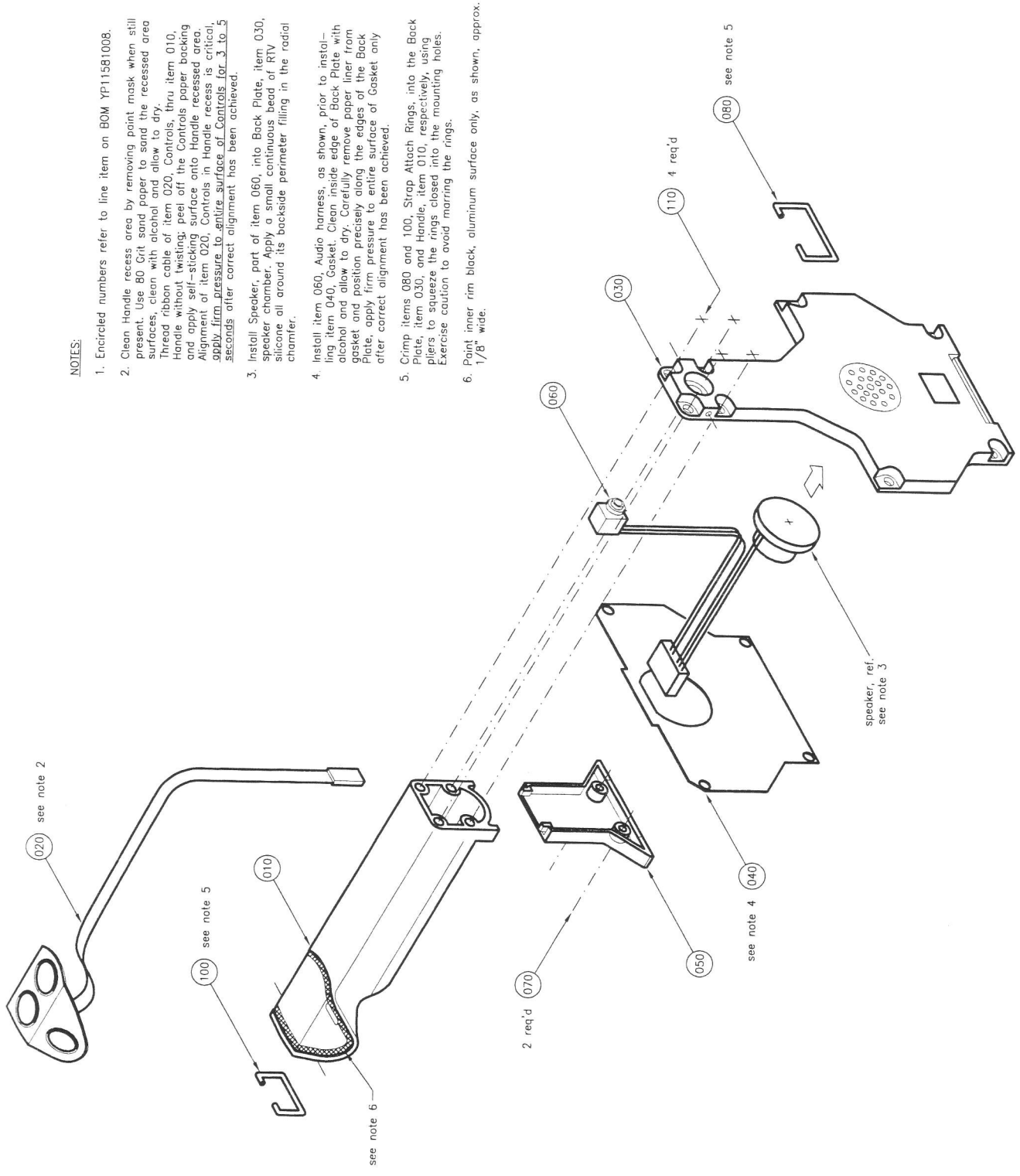


Overall Interconnect Diagram, 11581-D76



NOTES:

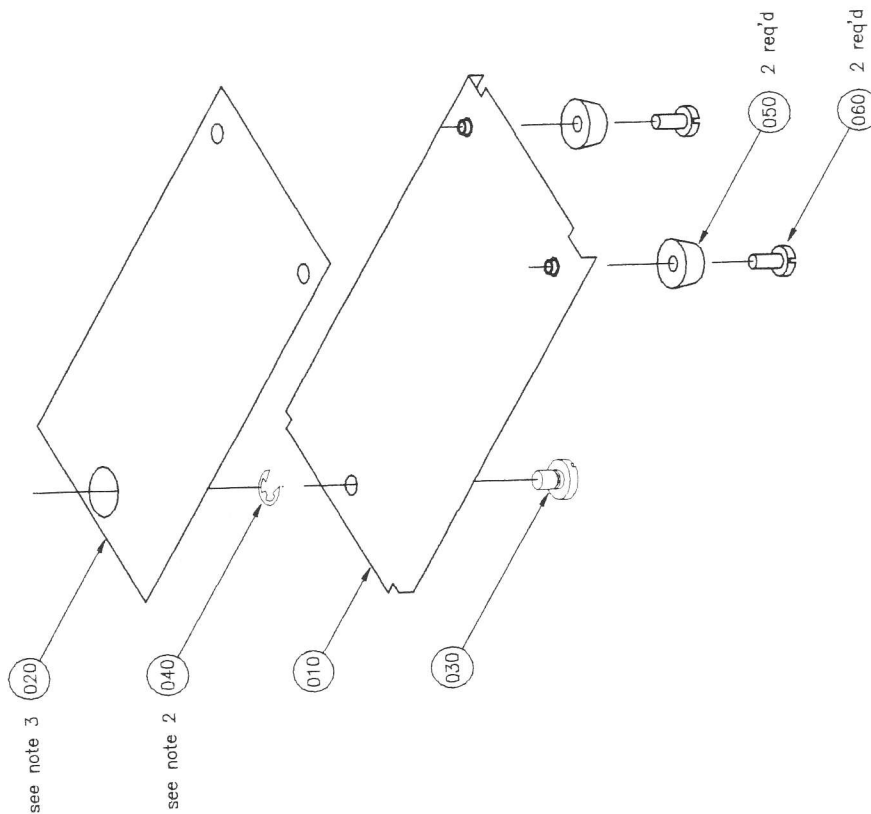
1. Encircled numbers refer to line item on BOM YP11581007.
2. Wipe clean/insure item 030, Display Window, is dust free. Clean item 010, Extrusion entire top surface with alcohol and allow to dry, remove paper from top surface. On top Panel and single entire surface only after correct alignment has been achieved.
3. Insert item 040, Switch Harness, onto item 010, Extrusion, (S) side of extrusion and insure that Switches are protruding as much as possible from the Extrusion.
4. Install item 080, Adaptor, into item 070, Knob, and tighten Knob set screw sufficiently to retain adaptor. Insert Knob and Adaptor over Switch Harness and tighten set screw against flat side of shaft. Verify that the set screw on Knob can be rotated to each position labeled on Panel, but no further. Pointer line should align with function labels on Panel.
5. Apply Loc-Rite to threads of item 080, Screw, and tighten.



NOTES:

1. Encircled numbers refer to line item on BOM YP11581008.
2. Clean Handle recess area by removing point mask when still present. Use 80 Grit sand paper to sand the recessed area surfaces, clean with alcohol and allow to dry. Thread ribbon cable of item 020, Controls, thru item 010, Handle without twisting, peel off the Controls paper backing and apply self-sticking surface onto Handle recessed area. Alignment of item 020, Controls in Handle recess is critical, apply firm pressure to entire surface of Controls for 3 to 5 seconds after correct alignment has been achieved.
3. Install Speaker, part of item 060, into Back Plate, item 030, speaker chamber. Apply a small continuous bead of RTV silicone all around its backside perimeter filling in the radial chamfer.
4. Install item 060, Audio harness, as shown, prior to installing item 040, Gasket. Clean inside edge of Back Plate with alcohol and allow to dry. Carefully remove paper liner from gasket and position, precisely along the edges of the Back Plate, apply firm pressure to entire surface of Gasket only after correct alignment has been achieved.
5. Crimp items 080 and 100, Strap Attach Rings, into the Back Plate, item 030, and Handle, item 010, respectively, using pliers to squeeze the rings closed into the mounting holes. Exercise caution to avoid marring the rings.
6. Paint inner rim block, aluminum surface only, as shown, approx. 1/8" wide.

Endplate Assembly, E-600, 11581-D08C

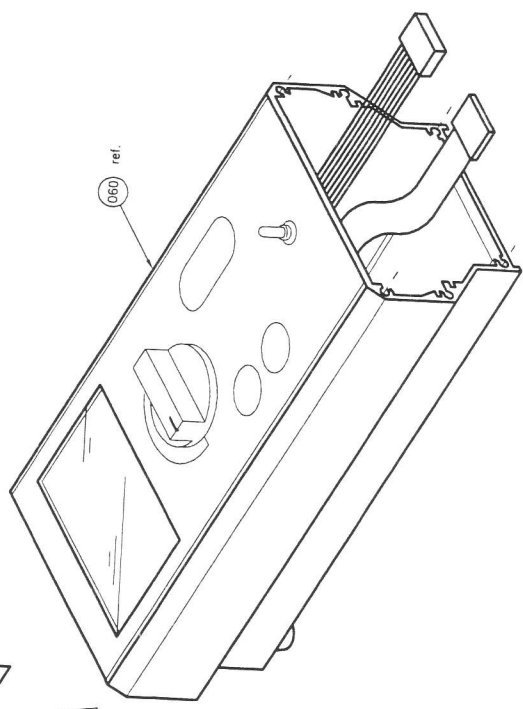
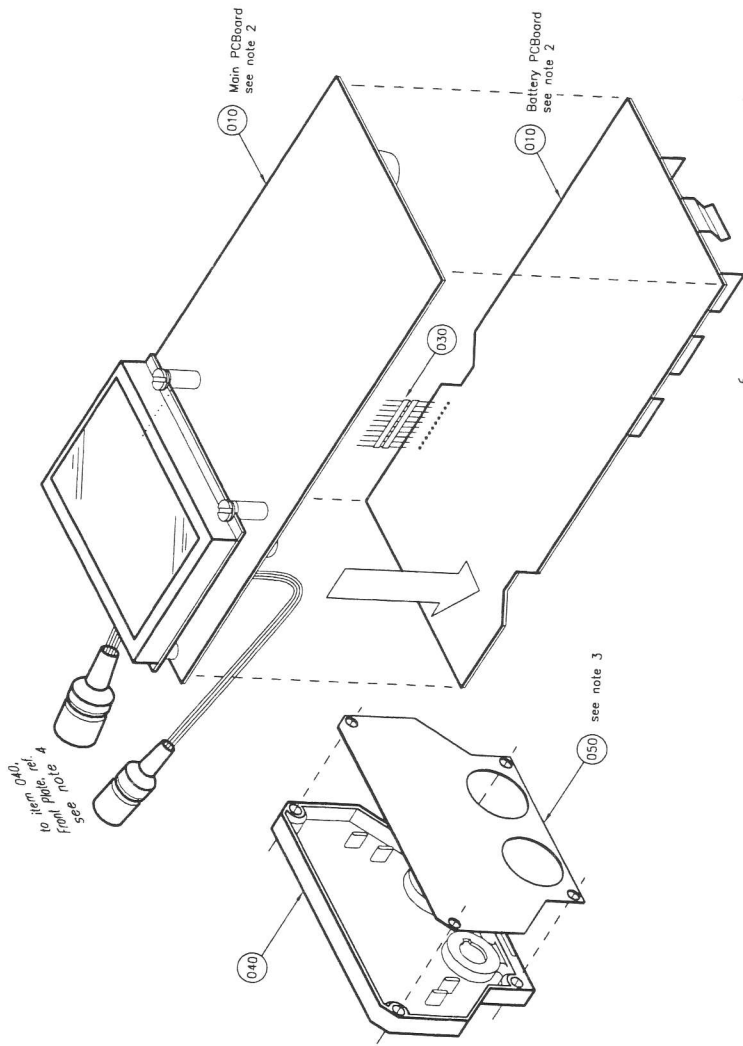


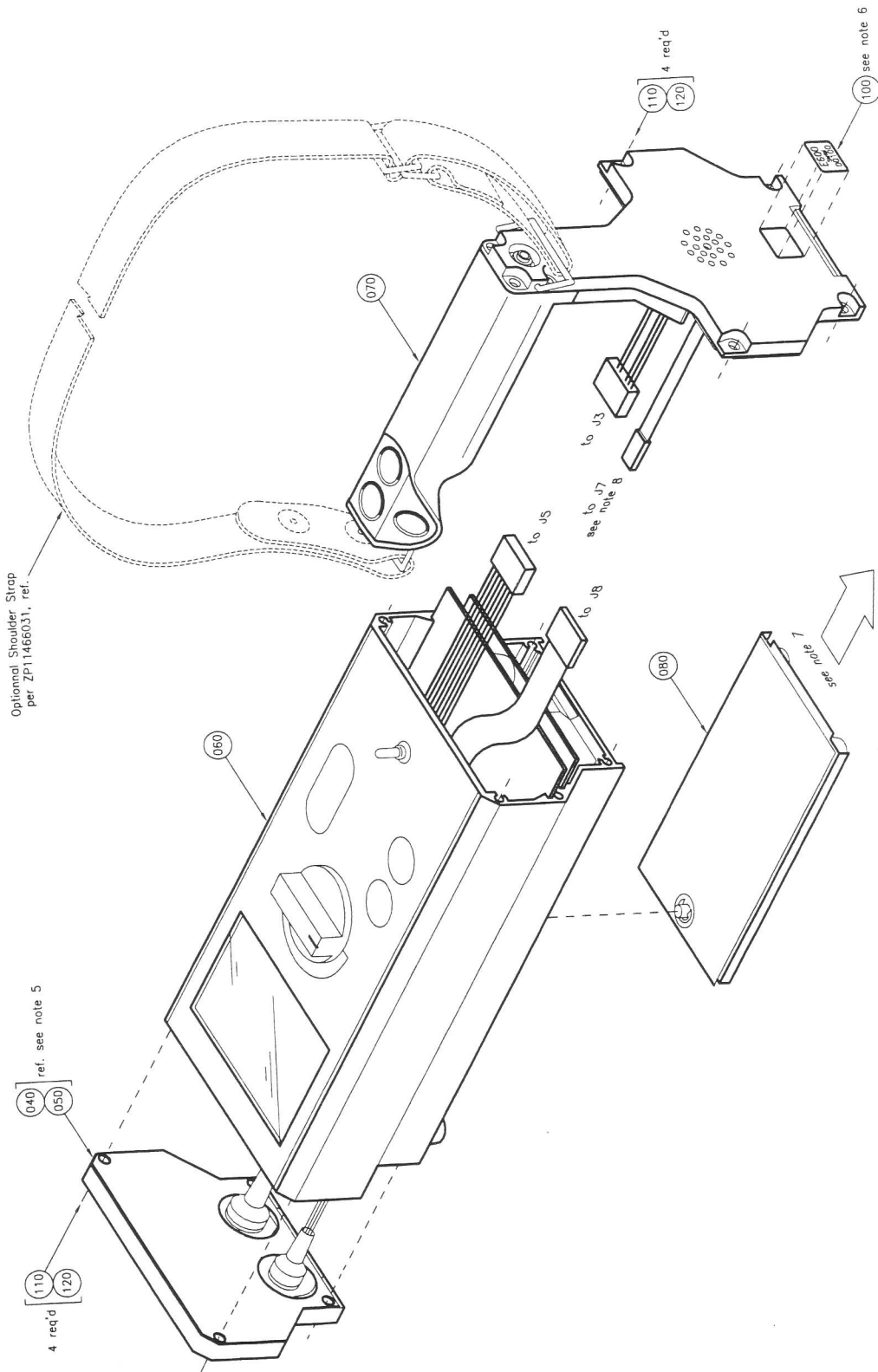
NOTES:

1. Encircled numbers refer to line item on BOM YP11581009.
2. Install item 040, Retainer Ring, onto item 030, Screw, securing both items to Battery Cover.
3. Battery Cover surface mating with item 020, Gasket, is to be cleaned with alcohol and allowed to dry prior to Gasket installation. Remove paper liner from Gasket and align along all edges of Cover prior to applying pressure.

NOTES:

1. Encircled numbers refer to line items on BOM E600-Basic.
2. Insert item 030, Double Ended Header, into Main PCBoard, item 010, and again into item 010, Battery PCBoard, as shown; wires from Main PCB going down on each side of Battery PCB cutouts.
3. Clean inside edges of Front Plate, item 040, with alcohol, allow to dry. Carefully remove paper liner off Gasket, item 050, and position precisely along the edges of the Front Plate, apply firm pressure to entire surface of Gasket only after correct alignment has been achieved.
4. Install both Connector Bodies of Main PCBoard, item 010, into Front Plate using C clips provided with connectors.
5. Carefully insert PCBoard Assembly, items 010 through 050, into guide channel of item 060, Case, making sure that wires are passing thru Battery PCBoard properly and that they are not pinched against the Case walls. Push the PC Boards thru the Case until connectors are accessible at opposite end. Connect J3, J5, J7 and J8 then reposition PCBoards flush with Case and secure Front and Rear End Plates assemblies.
6. Clean small recess area of item 070, Endplate Assembly, with alcohol and allow to dry. Remove paper liner off of item 100, Serial Label and position into recessed area. Apply firm pressure to entire surface only after correct alignment has been achieved.
7. Install item 080, Battery Cover Assembly, by first inserting it with tab feature into mating slot in End Plate, item 070, until bottomed in slot. Press firmly against extrusion bottom surface and tighten, fastening screw snugly.
8. When attaching item 070, Endplate Assembly to item 060, Case do not pinch mylar tail from handle switches between Endplate and Case extrusion; pointed traces on mylar will be destroyed if tail is folded.





E-600 Accessories

Probe Cables

Cables for Eberline smart probes: These cables have Eberline's proprietary probe connectors on both ends and must be used with smart probes to permit retrieval of parameters stored in probe memory.

36 inch Smart-Smart	Order # E600OPT12
60 inch Smart-Smart	Order # E600OPT13

Cables for use with conventional probes: Cables in this group adapt probes with the indicated connector type to the E-600's smart probe connector. Note that the same cable may be used to adapt smart probes for use with instruments which have conventional connectors.

36 inch BNC-Smart	Order # E600OPT8
60 inch BNC-Smart	Order # E600OPT9
36 inch MHV-Smart	Order # E600OPT10
60 inch MHV-Smart	Order # E600OPT11
36 inch CP-1-Smart	Order # E600OPT14
60 inch CP-1-Smart	Order # E600OPT15

Probe Brackets

These bracket assemblies provide a convenient means of attaching probes to the instrument for easy carrying and to prevent damage to the probe.

For probe type AC-3 also fits SHP-340, SHP-350	Order # E600OPT1
For probe type SPA-3	Order # E600OPT2
For probe type SPA-8	Order # E600OPT3
For SHP-330, SHP360 also fits (S)HP-270, -290, -190A, etc.	Order # E600OPT4
For probe type HP-100B	Order # E600OPT5

Other Accessories

Software: Two versions of the E-600 Interface Program, as described in this manual. Additional documentation is provided with this software. Runs on an IBM® PC compatible computer running Microsoft Windows®. Requires an E-600 data cable for connection to the instrument.

Basic interface program	Order # E600OPT7
With Rad Mapping capability	Order # E600OPT17
E-600 data cable	Order # E600OPT20

Barcode pistol: Permits automatic entry of measurement location or sample identifier numbers from barcode labels.

Barcode pistol	Order # E600OPT6
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Carrying case: Black hard case to protect the E-600 during transport.

Carry case	Order # E600OPT18
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Headset: Lightweight stereo headset with 3.5 mm plug.

Headset	Order # E600OPT16
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Carrying strap: Black nylon shoulder strap.

Carry strap	Order # E600OPT19
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Smart Probes

Probes in this group contain parameter memories and require cables with the Eberline smart probe connector.

SHP-270	Energy compensated GM detector, 0-3 R/Hr
SHP-290	Energy compensated GM detector, 0-100 R/Hr
SHP-330	Sealed gas proportional survey/frisking probe
SHP-350	Alpha/Beta scintillator survey/frisking probe, rectangular
SHP-360	Pancake GM survey/frisking probe
SABP-100	Alpha/Beta scintillator survey/frisking probe, square

Additional smart probes are currently under development; contact Eberline Sales for availability and prices.

Conventional Probes

As described in this manual, conventional probes may be used by entering their operating parameters into the instrument's internal memory. Appropriate cables to adapt from BNC, MHV or CP-1 probe connectors to the E-600 are listed above.

HP-100 series	100 cm ² Gas flow proportional (MHV)
HP-190A	End window GM detector (BNC)
HP-210 series	Pancake GM detectors (BNC)
HP-220A	Shielded/directional GM detector (BNC)
HP-270	Energy compensated GM detector, 0-3 R/Hr (BNC)
HP-280	Neutron sphere, 3 inch diameter (MHV)
HP-290	Energy compensated GM detector, 0-100 R/Hr (BNC)
HP-360	Pancake GM detector (BNC)
HP-320	Sealed gas proportional (MHV)
NRD-1	Neutron sphere, 9 inch diameter (MHV)
AC-3-7, AC-3-8	Alpha scintillators (CP-1)
ABP-100	Alpha/Beta scintillator (MHV) 100 cm ² dual-phosphor plastic scintillator element
LEG-1	Low energy Gamma scintillator (CP-1) 1" diameter x 0.04" thick NaI crystal
PG-2	Low energy Gamma/X-Ray scintillator (CP-1) 2" diameter x 0.08" thick NaI crystal
SPA-1A	Alpha scintillator for particulate and swipe samples (MHV) 1" diameter zinc sulfide detector element
SPA-3	High sensitivity Gamma scintillator (CP-1) 2" diameter x 2" thick NaI crystal
SPA-6	Medium sensitivity Gamma scintillator (MHV) 2" diameter x 2.4" thick plastic element
SPA-8	Gamma scintillator (MHV) 1" diameter x 1" thick NaI crystal
SPA-9	Gamma scintillator for Iodine (MHV) 2" diameter x 0.5" thick NaI crystal