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NOTE TO THE BUILDER

The µMONITOR manuals are open to revision based on your needs. If you have suggestions for improvement or clarification, please write or call.

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Introduction

You'll find assembling your own µMONITOR is a satisfying and economical experience and will appreciate being in charge of quality control of an instrument you want to be reliable. Your kit has been checked for completeness, and all critical components have been pre-tested.

The unit is easy to assemble. High quality machined socket pins have been furnished for the integrated circuits. These socket pins are provided to reduce the possibility of overheating the integrated circuits if you haven't totally mastered the soldering technique. If your an old pro and want the utmost reliability, you **may** consider omitting the socket pins for all ICs if you have the necessary skill and are willing to put up with the extra hassle to replace an IC that goes belly up during burn-in. With the quality of socket pins used, however, we feel that the socket pins should be used without concern.

The four most important steps for a top quality µMONITOR:

1. **PAY SPECIAL ATTENTION TO SOLDERING TECHNIQUE.**
2. Observe static control procedures to the letter.
3. Take your time a few extra hours will help insure a top quality instrument.
4. Follow the instructions exactly or call or write for any clarifications if something goes wrong let it be our fault. We have made every effort to insure accuracy don't omit any parts called for, and don't install parts not called for.

Additional important hints:

- Make any corrections as noted in the CURRENT NOTES sheet packed with the kit.
- Scan the **entire** Assembly Manual before starting work on the kit. All of the directions leading up to installation of the first part are important (except DEFINITIONS).
- Before starting on the first step, read all previous sections and directions.
- Follow the assembly instructions exactly; **don't jump steps**. Some techniques in later parts of the assembly rely on instructions previously given.
- **Read the entire step before doing it** clarification or cautions may come after the description of the step.
- **Don't use just the drawings for assembly** necessary detail might be in the text.
- Double-check component identification before installing the component and before soldering it in.
- Figure on putting in about 15-20 hours for assembly, calibration and testing. But please don't hurry.
- **Watch your eyes when cutting off component leads!** Either wear protective glasses or place a finger on the lead being cut.
- When using the battery charger for testing and calibration, be **CAREFUL**. Double check all power and transducer connections and take extra care that the power leads from the battery charger aren't allowed to make contact with other leads or the case. The heavy currents available from the charger can wreck havoc with the µMONITOR components.

Tools and Materials

The only tools you'll need are found on any electronics work bench long-nose and diagonal cutting pliers, Phillips-head screw driver, and soldering equipment.

Your solder iron must have a 700-800°F element and a **small**, preferably new, iron-clad screwdriver tip. Do not use an iron with a large tip. If you look at one of the PC boards in the kit you will see that the soldering pads are close together. Ideally, the width of the tip should be 1/16" or less wide, which is just about the size of the smaller soldering pads on the PC board. If you use a larger tip it is harder to keep from re-melting previously soldered joints. If you don't have one, Weller makes a reasonably priced soldering iron. If you don't see any future use for such a solder iron, find a friend with one that you can borrow. A 25 or 30 watt pencil type solder iron is approximately equal to a 700°F controlled temperature iron.

Weller - Model WP25 or WP30 25 and 30 watt irons come with a ST-3 tip. We suggest you buy and use their smaller ST-6 tip. Sources are DigiKey (800-344-4539) and Mouser (800-346-6873). While you're at it, ask for their catalogs. They are a great source for electrical/electronic parts and tools.

Radio Shack - Less quality than the above irons, but OK. Model 64-2055 is a switchable 15-30 watt iron.

The solder included in this kit is 60% tin and 40% lead and contains rosin flux. After an assembly is completely soldered, the flux should be thoroughly cleaned from the board for inspection. It can also cause complete or intermittent connection in sockets. There should be about five feet of solder left after the two PC boards are complete. If your current solder iron tip is in bad shape, replace the tip before starting. Be sure to pay extra attention to soldering techniques explained later.

You'll need a VOM (voltmeter) during the calibration portion of the assembly to adjust the battery charging voltage and the reference voltage. A procedure is given to check the accuracy of your meter so most any reliable VOM is ok, but if a 3 1/2 or 4 1/2 digit hand-held unit can be borrowed for a few hours, it will simplify the calibration. The ohmmeter might come in handy for double-checking the value of a resistor if the colors are hard to interpret or your bifocals are a little out of date.

You'll also need:

- #0 or #1 Phillips-head screwdriver
- Small slotted-head screwdriver
- 4 inch diagonal cutters (preferably with flush cutting edge)
- 409, Fantastik or similar spray household cleaner
- Needle-nose pliers
- Xacto knife, razor blade or sharp utility knife
- Lacquer thinner (medium or fast dry) or denatured alcohol solvent for flux removal (lacquer thinner is best!)
- Thermometer to at least 65°C/150°F for burn-in testing
- Cellulose sponge for cleaning soldering iron tip
- RTV cement (silicone seal)
- Old toothbrush or acid brush for use during flux removal
- 12 volt battery charger as power supply during testing
- 3" x 8" (or larger) heavy glass for socket pin installation (or similar flat, non-heat conducting material

Packaging

As the assembly instructions progress, small drawings will help select parts from the packaging. It's recommended that you leave the parts packages intact until you need the part in the assembly. There are a few very small parts that might be lost. **DO NOT** remove the integrated circuits from their protective anti-static packaging until you've read the next section on handling CMOS integrated circuits and the instructions call for installation.

Packages:

1. Electronic parts not in sort pads & wire
2. Knobs & buttons
3. Sort pads
4. Fasteners and hardware
5. Crimp terminals for installation
6. Solder
7. Push switches
8. Preassembled display PC board
9. Integrated circuits & assemblies
10. Socket pins
11. Faceplate and faceplate parts
12. Amp transducer and parts

Some large individual parts are also packed in the µMONITOR case. The integrated circuits are packed in a static protection bag and static protection tube carriers. The display PC board assembly is packed in an anti-static bag. Do not open unit ready to install.

The sort pads contain most of the small electronic parts. Each sort pad is labeled with information that will speed identification of the parts and indicate the location that the part will be installed. The designator number (i.e. R14 or C11) indicates the part type and the location where it will be installed. These parts are **usually** in the order that they will be installed. Parts are grouped with like parts (i.e. resistors, capacitors etc.).

The column of information next to the component on the sort pad is a guide of colors (explained later) or numbers **(the marked value)** to positively identify each part. The assembly instructions will also repeat this marking to prevent mixing up parts. To save time later, now is a good time to go through the sort pads (after reading the color code chart in) and make sure each part is marked with the proper code or marking. We take pains to not make any packaging mistakes, but it is your responsibility to not trust us, and double-check that the proper part is installed in the proper place.

In addition to the part marking that is called out in the instructions, there will probably be other marks on the part. These represent lot numbers, dates, etc. A few parts are not marked and will have to be identified by description. The marking called out may also be preceded or followed by other numbers or letters. You may have to search all sides of some parts to see the marking; there is no pattern in their placement.

Handling ICs

The integrated circuits in the µMONITOR are almost all CMOS circuits that are vulnerable to static electricity, particularly when they are not yet installed in the circuit. A static discharge that can not be felt can "zap" a part. Do not open the carrier packages or handle the ICs until you are ready to install them, and then follow the assembly/installation instructions exactly. An IC exposed to a static discharge does not necessarily die at that instant. It may weaken the circuit for eventual failure however.

The integrated circuits in the sort pads are not as sensitive to static destruction but can still be ruined.

Definitions

The following are some terms that will be used throughout this assembly manual:

PC Board - Printed Circuit Board, the flat, green boards with a million holes to solder components in. There are three of them in the µMONITOR (one already assembled). These boards eliminate the rats nest of wires that were necessary years ago.

Component Side - The side of the PC board that the components are soldered to. This side is marked with white lines and numbers (designator) to help locate and identify the proper location for the components.

Solder Side - The opposite side from the component side of a PC board. This is the side where the component leads will be soldered.

IC - Integrated circuit. An electronic circuit that contains more than one and sometimes thousands of components shrunk down to microchip size. An IC is packaged in many forms but most of them in this kit are in DIPs.

DIP - Dual in-line package. A dual row of equally spaced connectors on an electronic component are characteristic. All of the ICs are DIPs that are installed in socket pins.

SIP - Single in-line package. A single row of equally spaced connectors on an electronic component.

EPROM - Electrically-programmable read only memory. This is the integrated circuit that has been programmed with the software, or program that the microprocessor will follow to operate the µMONITOR.

Designator - This is the symbol and outline in white on the PC board that helps locate the proper part in the proper place on the board.

Trimpot - A variable resistor with a screwdriver adjustment.

Soldering Tips

NOTE: This section is very important for both first time kit builders and old pros. Analysis of service records over a two year period show that of all the kits returned for repair, over 90% are due to soldering errors. All of those solder errors are missed or incomplete joints... many of which are easily seen by the naked eye. Soldering of electronic components to printed circuit boards is not a difficult task. This section is a mini-course in how to solder and what good and bad solder joints look like. The next section will deal with how to clean and INSPECT the PC boards for bad solder joints after the soldering is complete.

Soldering materials, tools, techniques and inspection could make the difference between bringing your µMONITOR up at the first shot, spending hours in troubleshooting, or even shipping a printed circuit board back for repair.

Soldering of electronic components is not difficult to master. Most soldering mistakes are due to incomplete joints (which may not cause a problem until 6 months later!).

Use a small soldering iron with a 700-800°F element and a iron-clad (no copper), screwdriver tip. For best results, use only the rosin-core solder provided with the kit. **NEVER** use acid-core solder.

The solder included in this kit has a core of rosin flux. All fluxes are corrosive. Rosin flux is corrosive when it's hot, and that is when it does its work. Hot rosin cleans metallic oxides from the joint, which enables the molecules of the solder to intermix with those of the work. When the rosin cools, its corrosive properties diminish to **almost** nothing. When the assembly is finished, it is **imperative** that the flux be thoroughly cleaned

from the PC board and joints to prevent future damage. Removal of the flux is also necessary for inspection of the joints.

While the rosin flux removes oxides during soldering, it will not remove body oils from handling. The PC boards must be cleaned before starting assembly. Also, before starting and as necessary during assembly, wash your hands to reduce body oils that can contaminate the leads of the components or the PC boards. Instructions for pre-assembly cleaning of the PC boards are in a later section.

SOLDERING - With a 700°F (apx 25-30 watt) solder iron, touch the tip of the iron with light pressure to make good heat contact to **both** the component lead and the PC board solder pad for three seconds (on the solder side of the PC board), then apply the solder to the **lead and pad** (not the iron) until about 3/16 inch (small pads... more on larger pads) of the solder melts (about 1-2 seconds) and flows down the lead and into the hole and spreads out on the pad. Leave the iron in contact with the joint for another second. Don't force-feed the solder, it should melt on contact or the joint is not getting enough heat. For components with larger leads such as switches, pre-heat 3 to 5 seconds longer before applying solder.

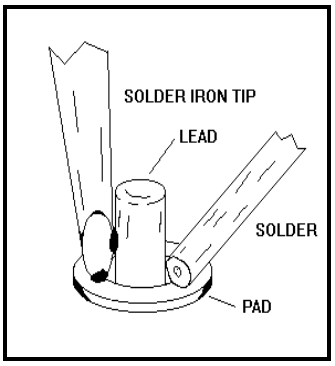


Figure 1 Soldering a component to the PC Board.

If it is the first solder joint of a series, it helps to brush the tip of the hot iron across a wet sponge (cellulose type!) to clean the tip by generating a bit of steam, and then put a small drop of solder to the tip to help make thermal contact with the component lead when the tip is applied. If you see oxides starting to build up on the tip of the iron or the heat of the iron is not getting transferred to the pad and component lead during the first three seconds, clean the tip with the sponge and apply another small drop of solder. You should be able to do about 10 to 20 joints in a series before having to clean the tip again. You can't overkill on cleaning the tip, it just adds a little more time.

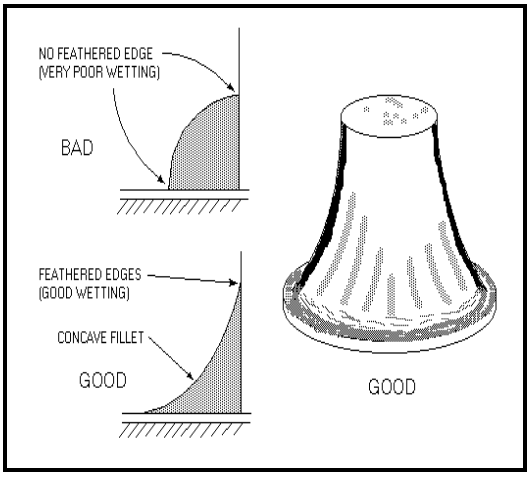


Figure 2 Good wetting is the sign of a proper solder joint.

GOOD SOLDER JOINTS - A good solder joint will look like Figure 2. It should have a shiny, smooth appearance and exhibit wetting as exemplified by a concave meniscus between the pad and the lead. A feathered edge is created by the solder to the part being joined. An appearance of adhesion of the solder to the parts is exhibited. A comparison with the poor solder joint in the figure shows a non-wetting condition that results in the solder forming a ball or bead on the surface, much as water beads form on a well waxed surface. Note there is no feathered edge apparent.

Figure 3 shows two acceptable solder joints. The less than ideal solder joint, although starting to form a ball, still has proper wetting at both the solder pad and the component lead. Note that the solder has not extended outside the diameter of the solder pad.

With the proper amount of heat and solder, some solder should wick through the PC board hole so that there is a fillet and wetting between the solder pad and the lead on the component side of the PC board. Too much solder going through the hole to the component side can cause a **short circuit** to another component lead or pad. Too little solder will leave the pad on the component side of the board flat and if you look carefully, you can probably see part of the hole in the pad. As long as the joint on the solder side of the board is a smooth fillet, you can still see the outline of the solder pad, and **some solder has wicked through to the other side**, the joint will be ok.

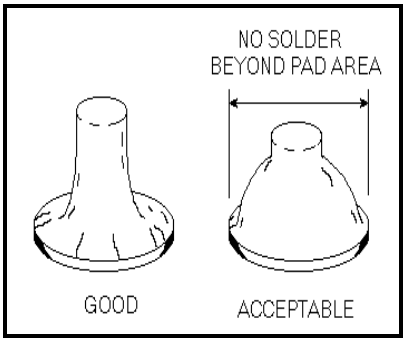


Figure 3 Two acceptable solder joints.

BAD SOLDER JOINTS - In Figure 4, the solder line of solder joint number 1 does not completely cover the solder pad. However, 80% of the pad is covered and wetting is complete and well feathered to both the solder pad and the component lead. Solder joint number 2 is acceptable but marginal. Solder is recessed into the hole about 25%, but again extends 360° around the lead and wets at least 80% of the solder pad.

Three samples of poor solder joints are shown in Error! Reference source not found.. Solder joint number 1 has less than 80% of solder wetting to the solder pad (actually, 0% in this drawing). The solder in joint number 2 does not completely encircle the component lead and wets only a small part of the solder pad. Solder joint number 3 shows the component side (opposite from where we're soldering) has only a small blob of solder extending through the PC board hole, and no wetting to either the top of the solder pad or the lead.

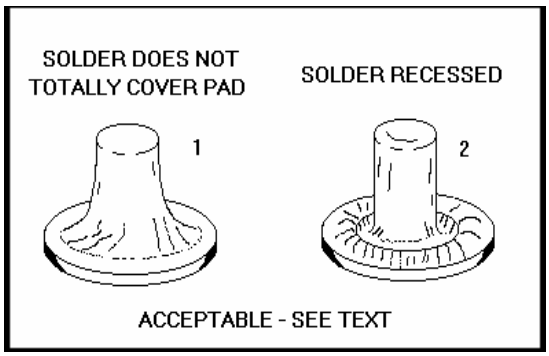


Figure 4 Two more acceptable, but less ideal solder joints.

Component leads on switches and other large parts will need more heat so preheat longer and linger longer (wow) or use an optional 800F element. These joints will also require more solder.

INSPECTION - After a PC board assembly is completed and cleaned, **close** visual inspection of solder joints using the above criteria is vital. Examination should be done with at least a five power loupe or magnifying glass. Resolder any rejects, clean the board again and inspect. If you are diligent in following the routine of clean, inspect and repair, you will eliminate the cause of most failures.

If you must remove a soldered-on component, it is worthwhile to invest a few dollars in a solder sucker to remove the solder from the hole so the component can be easily removed. Be careful not to overheat or over stress pads and ruin your board. A DIP or SIP component is harder to remove and a solder sucker is a must. If you're unsure, get some help rather than ruin your board. If the DIP or SIP component is being removed because it is bad, carefully clip all the leads on the component side of the board and then remove the leads one at a time. After the component is removed, carefully clean out the hole with a 1/32 inch drill **(absolutely no larger)** in a hand chuck.

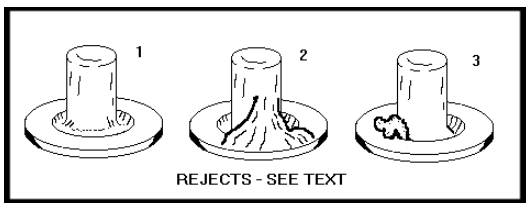


Figure 5 Three samples of rejects.

Examination of returned units indicates that most people are not preheating the joint enough before applying the solder (or applying the solder so fast the joint cools) resulting in a joint that looks more like a blob than a fillet. This leaves a poor joint with the pad and wire lead and little if any of the solder wicks through to the other side. This usual happens when you get bored soldering all those leads and start speeding up. The joints look ok while you're zipping along but are not getting enough heat or solder. Keep up a slow rhythm using the method described.

Remember these hints and you should complete your µMONITOR with a perfect soldering job.

Cleaning and Checking the PC Boards

When the soldering is completed on an assembly, the flux must be removed. This is an important step that must not be hurried. When properly cleaned, the PC board will be as clean looking as when you removed it from the package and no flux will be visible on the joints and there will be no film on the PC board, even when viewed with a strong magnifying glass.

Use either medium or fast-dry lacquer thinner for cleaning. A commercial flux remover in a spray can as sold by Radio Shack is an acceptable (but poorer) choice. Check the label to make sure that there are no oils added that would leave a film after the solvent evaporates. A half-pint of cleaner (two cans of RS spray) should handle all three boards, but don't skimp. If you have a kitchen sprayer that you can sacrifice, it works nicely to apply the lacquer thinner. Observe proper ventilation for the cleaner used. Do not allow the cleaner to remain on the assembly for more than two minutes. Also discontinue cleaning if the solvent appears to be attacking the green solder mask or the epoxy silkscreen on the PC board.

Hold the PC board at about a 45° angle with the solder side up and any switches at the highest point to keep from getting cleaner into the switches. Spray the board with cleaner (or pour if necessary) with sufficient volume to dissolve and carry away the flux. Hold the assembly vertical and spray rinse with additional cleaner so the cleaner carries off any remaining dissolved flux. Immediately dry the board with compressed air. Repeat until the solder side of the assembly is **free from flux.** Rinse the component side of the assembly and blow dry. Do a final rinse of both sides of the assembly and blow dry. You will have to alternately blow one side and then the other to evaporate any cleaner that is pushed to the other side of the board through the holes in the board. Make sure to blow under all components and inside all the little socket pins. If you do not have access to an air compressor, a hand-held hair drier will have to be substituted.

Do not quit until the PC board is thoroughly clean. If you are going to take more than two weeks to build the kit, you should clean the flux from each assembly as it is completed.

Use a good light and magnifying glass to thoroughly check all the solder connections. In addition to the criteria listed in the section on soldering, look for solder bridges (unintentional connection of two adjacent solder connections) and component lead(s) not soldered at all. If necessary, repair any bridges, solder any missed connections or solder any suspicious looking joints and clean as necessary.

With a light source behind you, hold the board as if to reflect light, like a mirror, into your eyes. Any pad that does **NOT** have a proper fillet of solder, or is unsoldered, will show up as a shiny circle. Examine those carefully, or re-solder as a precaution.

Installing Components on a PC Board

Since both hands will be busy soldering, you will need to hold the PC board with something else. There will be a component sticking out one side of the board and the component leads sticking out the other side. One way that works easily, is to use a small cardboard box or plastic parts tray to set the assembly on when installing and soldering components. When installing the components, the component leads will go down inside or outside the walls of the box. Or be creative.

Double check all component locations on the PC board before soldering them in place, it's no fun taking them back out. Some designator symbols may be hard to read because they are printed on a thru hole of the PC board. Use the assembly drawing to resolve any ambiguities. With some exceptions, all the numbered symbols are in rows that start in the upper left corner, and then increase in value to the right, and then start a new lower row until the lower right corner of the PC board is reached.

Vias are holes through the PC boards that join a trace on one side with a trace on the other side. Vias are smaller than holes that accept component leads. If a via accidentally gets filled with solder, just leave it alone.

Bend the component leads so that the **value** marking on the component is visible after installation. This will make it easier to detect incorrect locations and troubleshooting.

If you can get the component to stay in place with friction when you turn the PC board over for soldering, it will be much easier to get out if it's ever necessary to remove it. Otherwise, spread the leads slightly to keep the component in place.

Pay careful attention to legends and symbols printed on the PC board that indicates orientation of diodes and capacitors. Match the band on one end of diodes with the band on the PC board. Match the + lead of electrolytic capacitors with the + on the PC board. We normally design the PC boards so that the + on electrolytic capacitors, the bands on diodes and the number 1 pin or front of integrated circuits all face the same direction.

CAUTION: Be careful when clipping off component leads, wear eye protection or put your finger on the lead that you are cutting.

Additional hints will be given as the assembly progresses.

There are two PC board assemblies that need completion. The display driver PC board assembly has been factory assembled because of the many surface mount components. Except for the hardware and soldering of the socket pins and other connectors, each board will be completed separately. The order of assembly is as follows:

1. Make corrections to the assembly manual.

2. Clean PC boards before soldering.

3. Install socket pins on all PC boards. This will give you maximum practice with your soldering technique with parts that are relatively indestructible. Inspect work.

4. Assemble the CPU board. Inspect work.

5. Assemble the Main board. Inspect work.

6. Clean flux from boards. Check and repair all soldering, then apply power and check main power supply voltages.

7. Install integrated circuits in sockets while observing antistatic procedures.

8. Faceplate assembly.

9. Assemble complete unit. Perform initial testing of the µMONITOR.

10. High temperature operational burn-in for reliability.

11. Complete checkout.

Make Corrections to Assembly Manual

Occasionally there are corrections, clarifications or additions to the µMONITOR manuals which will be listed on a separate correction sheet contained in the kit.

__ 1. Make corrections to all manuals per the corrections sheet. Either cut and paste the corrections in the proper place or make a note at the proper place in the manual to refer to the corrections sheet when that step in the manual is reached.

Cleaning the PC Boards before Assembly

During soldering, the flux in the solder acts as a cleaner for both the part and the soldering pad on the PC board. Soldering will be easier, however, if any existing oils on the boards due to handling etc. are removed.

Spray a household cleaner similar to 409 to both sides of the two large PC boards and scrub with a brush. Rinse with plenty of HOT water and thoroughly dry with compressed air or a hair drier. After drying, and during all subsequent handling, keep your hands as clean as possible and handle the PC boards by the edges as much as possible to reduce body oils getting on solder locations before the parts are soldered.

Install Socket Pins

Continuous strip machined socket pins are provided for all IC devices in DIP packages, except for the CPU assembly which uses a dedicated 40-pin socket. This is to protect the devices from soldering heat, and to facilitate troubleshooting and repair. Socket pins may or may not be gold plated in the contact area. Recent findings have indicated that gold plated sockets for integrated circuits have no benefit over tin plated sockets unless the leads of the ICs are also gold plated.

Each group of socket pins is installed on the board at a "U" location. "U" is the component designator for integrated circuit.

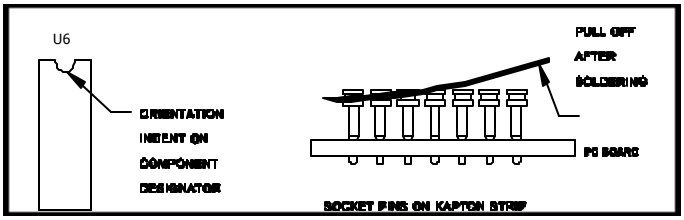


Figure 6 Component designator identification & socket pin installation**.**

The indentation on the designator orients the integrated circuit that will be installed in the socket pins later in the assembly. In each of the following steps, two strips of sockets pins will be cut to size and installed at most integrated circuit locations. Use small diagonal cutters or scissors to cut the plastic strip leaving the proper number of pins. The plastic will be removed after the socket pins are soldered.

__ 1. Set the Main PC board (the biggest one with "ASSEMBLY No 1051" in white marking) on a flat surface with the designators up.

__ 2. Cut 6 strips of 7 socket pins each and insert at three 14 pin DIP positions.
(U2,U3,U4)

Note that the IC location at U8 is not used.

Lay a flat, hard sheet of material (preferably a material like glass that is a poor heat conductor but does not melt easily) across the top of the socket pins, then carefully turn the PC board over, using the material to keep the socket pins in place. A heavy piece of flat glass or a thinner piece of glass on a hard surface works best. Lay the sandwich on a flat surface with the PC board now lying on the upside-down socket pins. If the PC board is warped, it's important to weight the board down with a hand tool or other weight so all socket pins are **flush to the PC board**.

When soldering the socket pin strips, do about every fourth pin on all the socket strips, turn the board over to see how it's going (**vertical and flush**) and then flip back over and finish the remainder. If your solder iron has a little flat spot, you can lightly push down on the end of the socket pin to apply heat. Otherwise, gently touch the

solder pad and the socket pin at the same time, press **lightly** down to hold the pin vertical and apply solder to the socket pin. If you leave the socket pin sticking up in the air on the component side of the PC board instead of flush, the pin will be more likely to break off at the small diameter.

If a socket pin needs to be straightened, be sure to heat the solder first or the pin may break.

__ 3. Solder every fourth pin, flip the board over and check that all the socket pins are vertical and flush to the PC board. If not, reheat the solder joints while pressing down on the socket pin (with something other than a bare finger) and adjust your technique.

__ 4. Solder all the remaining socket pin leads.

__ 5. Grab a corner of each plastic strip with needle nose pliers and pull the strip from the socket pins. If any of the socket pins are not in line or are not flush, reheat the solder for that individual pin and repair. **Make sure solder joints are GOOD!**

Set the CPU PC board with "ASSEMBLY No 1052" marked in white, in the same manner as the Main board so that socket pins can be installed. Note that there is no ICs installed at U15, U19 and U21.

__ 6. Cut 6 strips of 4 socket pins each and insert at three 8 pin DIP positions.
(U18,U20,U24)

__ 7. Cut 6 strips of 7 socket pins each and insert at three 14 pin DIP positions.
(U12,U13,U14)

__ 8. Cut 2 strips of 9 socket pins each and insert at one 18 pin DIP position.
(U17)

__ 9. Cut 2 strips of 10 socket pins each and insert at one 20 pin DIP position.
(U11)

__ 10. Cut 2 strips of 12 socket pins each and insert at one 24 pin DIP position.
(U23)

__ 11. Cut 2 strips of 14 socket pins each and insert at one 28 pin DIP position.
(U22)

__ 12. Invert the PC board and solder the socket pins as before.

__ 13. Locate the 40-pin socket and install at U16. Install with the #1 pin index notch in the cross-rail at the same end as the white designator line notch on the PC board. Solder two opposite corners pins, make sure that the socket is flush to the board, and solder all the remaining pins.

This completes the installation of the sockets.

CPU PC Board Bill of Materials

A bill of materials (parts) list will be given for each PC board assembly. "ITEM" is the component designator that is used in the schematic and on the PC board to locate the part. "RMI#" is the Rocky Mountain Instrument part number if a replacement is needed. "Manufacturer" and "Mfg Part Number" is additional information that would enable part replacement from other than RMI. It will also contain the quantity used for some parts.

Item#	RMI#	Description	Mfg	Mfg Part #
RESISTORS				
R71	28-0144	4.99K QW 1%	Various	RN55D4991F
R72	28-0154	100K QW 5%	"	
R73	28-0154	100K QW 5%	"	
R74	28-0154	100K QW 5%	"	
R75	28-0138	357K QW 1%	"	RN55D3573F
R76	NOT USED			
R77	NOT USED			
R78	NOT USED			
R79	NOT USED			
R80	28-0138	357K QW 1%	"	RN55D3573F
R81	28-0148	60.4K QW 1%	"	RN55D6042F
R82	28-0149	61.9K QW 1%	"	RN55D6192F
R83	28-0153	1OK QW 5%	"	
CAPACITORS				
C24	32-0107	2.2µFD 16v TANTALUM	"	
C25	32-0102	100pFD DISC/CERAMIC	"	
C26	32-0100	5pFD 50v MON/CERAMIC	"	
C27	32-0101	22pFD 50v CERAMIC DISC	AVX	SR151A220
C28	32-0105	.1µFD 50v MON/CERAMIC	Various	
C29	32-0105	.1µFD 50v MON/CERAMIC	"	
C32	32-0103	.001µFD 50v MON/CERAMIC	"	21RX510
C33	32-0105	.1µFD 50v MON/CERAMIC	Various	
C34	32-0104	.01µFD 50v MON/CERAMIC	Mouser	21RX410
C35	32-0103	.001µFD 50v MON/CERAMIC	"	21RX510
C36	32-0105	.1µFD 50v MON/CERAMIC	Various	
ICs				
U11	34-0105	A/D CONVERTER 10 BIT	National	ADC1005CCJ-1
U12	34-0107	QUAD XOR	Various	CD4070 or 74C86
U13	34-0108	QUAD AND	"	CD4081
U14	34-0109	HEX SCHMIDT TRIGGER	"	74C14 or CD40106
U15	NOT USED			
U16	14-0013	CPU ASSEMBLY	RMI	14-0013
U17	34-0104	CLOCK	Oki	M62X42
U18	14-0002	RESET ASSEMBLY	RMI	14-0002
U19	NOT USED			
U20	34-0113	DUAL OP AMP	Linear Tech	LT1013CN
U21	NOT USED			
U22	34-0103	A/D MULTIPLEXER	Analog Dev.	MUX16FP
U23	34-0102	PORT EXTENDER	NEC	uPD82C43C
U24	34-0114	ONE SHOT	Various	ICM7555IPA
SOCKETS				

	42-0007	40-PIN DIP SOCKET	Various	
	42-0035	SOCKET PINS	Qty 156	
PCB				
	48-0014	CPU PC BOARD	RMI	48-0014
MISC ELECT PARTS				
Y1	54-0006	XTAL - 11.0592MHZ	Digikey	X089

CPU PC Board Assembly

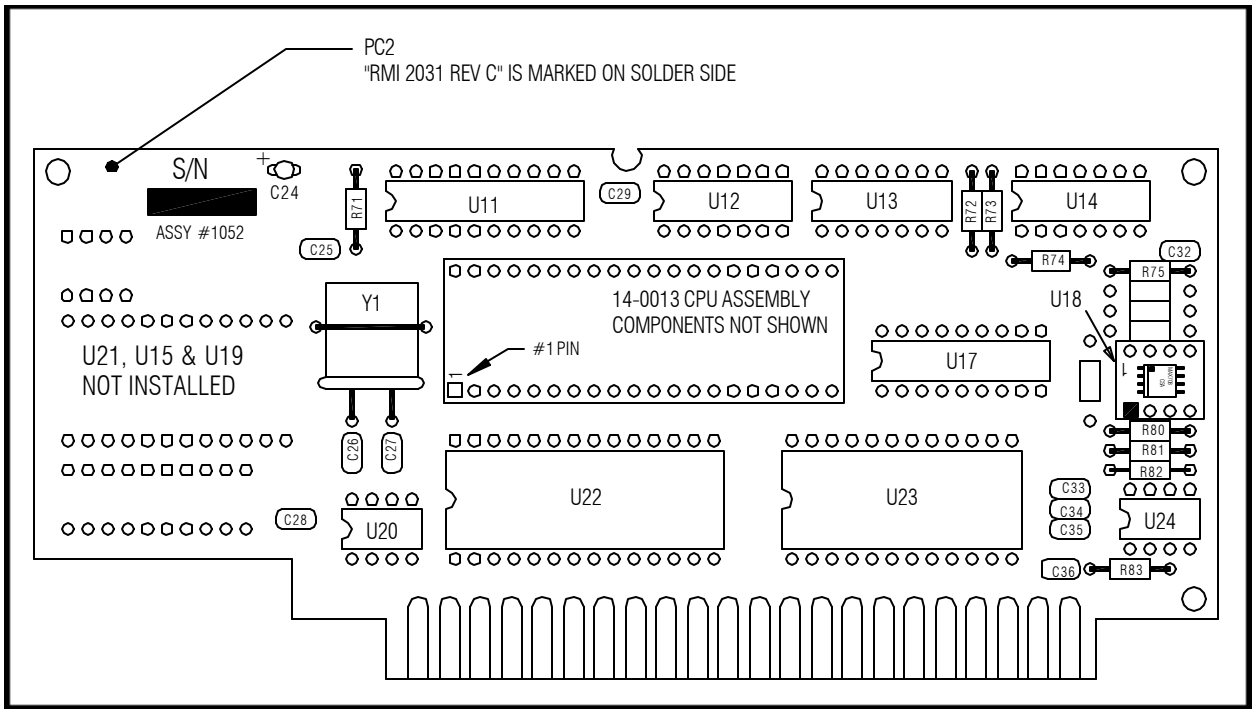


Figure 7 CPU PC board assembly. A large tear-out drawing is in Appendix D.

The leads on the horizontal mounted resistors will be bent as shown in Figure 8. Hold the resistor with one hand and bend the leads down to a 90 position with two fingers of the other hand. Push on the leads about halfway between the resistor and the end of the lead. Remember to bend the leads so the value marked on the resistor can be read after installation. Horizontal resistors should have the resistor body touching the PC board after soldering.

The resistors should remain in place with friction when the board is turned over, if not spread the leads apart slightly. Solder only one lead on each part. This lets the part cool down before the other lead is soldered and lets you take a final check to make sure the part is flush with the PC board before soldering the other lead. If everything looks ok, solder the remaining leads and then snip off the excess lead wire. The lead wire would be cut at the smallest diameter of the solder fillet where the lead wire starts.

Locate from the sort pad, bend and insert the following resistors:

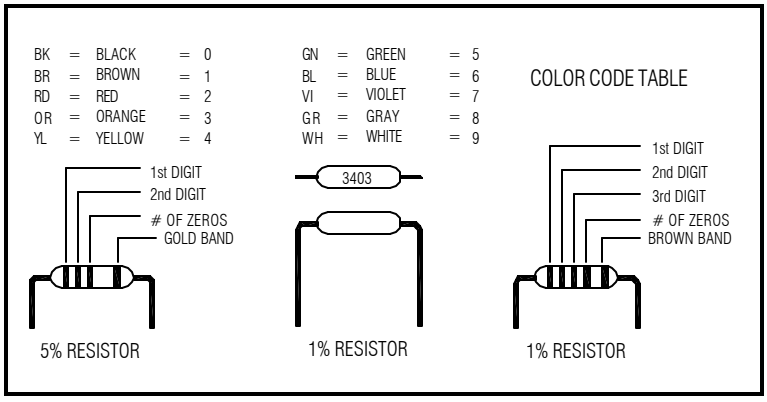


Figure 8 Various resistor markings to identify value.

__ 1. R71 - 4.99k 1% marked 4991 or YL-WH-WH-BR

__ 2. R72 - 100k 5% marked BR-BK-YL

__ 3. R73 - 100k 5% marked BR-BK-YL

__ 4. R74 - 100k 5% marked BR-BK-YL

- - - - - - - - - - - - - - - - - -

__ 5. R75 - 357k 1% marked 3573 or OR-GN-VI-OR

__ 6. R76 - Not Used

__ 7. R77 - Not Used

__ 8. R78 - Not Used

- - - - - - - - - - - - - - - - - -

__ 9. R79 - Not Used

__ 10. R80 - 357k 1% marked 3573 or OR-GN-VI-OR

__ 11. R81 - 60.4k 1% marked 6042 or BL-BK-YL-RD

__ 12. R82 - 61.9k 1% marked 6192 or BL-BR-WH-RD

- - - - - - - - - - - - - - - - - -

__ 13. R83 - 10k 5% marked BR-BK-OR

Solder and clip.

This completes installation of the resistors on the CPU board.

__ 1. Locate one 2.2µFD 16v - marked 2.2 16 or 225 16 - tantalum capacitor & install. These capacitors are polarized, which means that the lead with the "+"sign, heavy line and longer lead must go toward the "+"sign on the PC board designator. Solder and clip.
(C24)

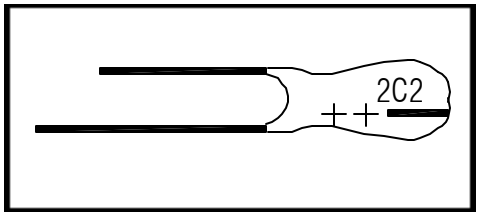


Figure 9 Tantalum capacitor.

Locate from the sort pads and/or the miscellaneous parts pack and insert the following ceramic capacitors (Figure 10). After inserting the capacitor, spread the leads slightly so the capacitor won't fall out when the PC board is turned over. Do not spread the leads so much that the capacitor is tight to the PC board–the capacitor coating that goes part way up the leads should not be down inside the hole when the part is soldered on but should be approximately 1/16 inch from the board surface.

__ 2. C25 - 100PF marked 101

__ 3. C26 - 5PF marked 5

__ 4. C27 - 22PF marked 22

__ 5. C28 - .1µFD marked 104

- - - - - - - - - - - - - - - - -

__ 6. C29 - .1µFD marked 104

__ 7. C32 - .001µFD marked 102

__ 8. C33 - .1µFD marked 104

__ 9. C34 - .01µFD marked 103

- - - - - - - - - - - - - - - - -

__ 10. C35 - .001µFD marked 102

__ 11. C36 - .1µFD marked 104

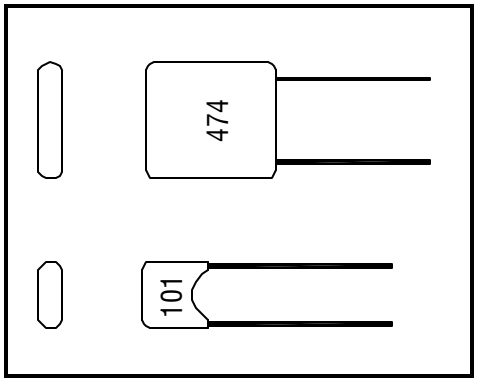


Figure 10 Ceramic capacitors. Some of them are a round shape.

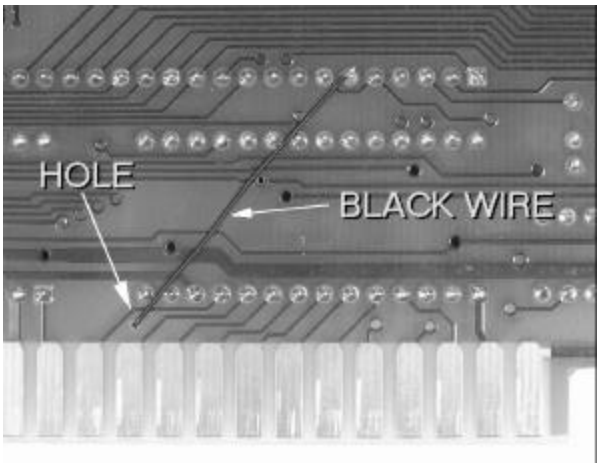
Solder and clip.

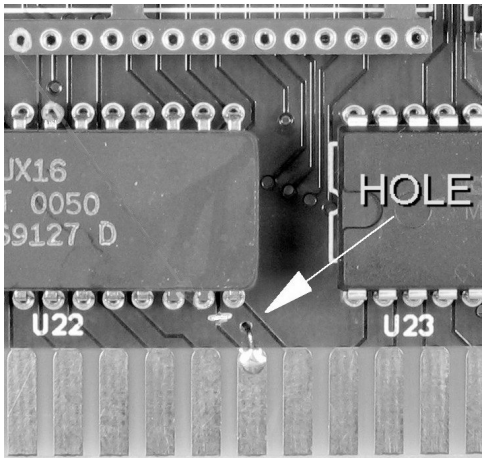
This completes the capacitor installation for the CPU board.

Locate the CPU crystal from the sort pad. This crystal determines the operating frequency of the microprocessor. It is shaped just like the Y1 designator on the PC board.

__ 1. Y1 - 11.0592mhz quartz crystal marked 11.05. Bend the leads at a 90° angle so the crystal will mount lying on its side. This component must be anchored to the PC board so that the leads are not strained. Shape a cutoff lead to fit over the crystal and through the two mounting holes at either side of the crystal. Solder one end of the mounting lead, hold the crystal flat to the PC board and solder the other end. Solder the functional leads. Clip all leads.

A jumper wire will be installed on the CPU PC board. Refer to the two photos below.





__ 1. Locate the black jumper wire. Cut the lead off one end of the wire so the bare lead is about 1/8" long. Bring this end up through the hole and bend the bare portion flat to the gold tab and solder as shown in the right-hand picture.

__ 2. Turn the PC board over and solder the other end of the black jumper as shown in the left-hand picture. Trim the end.

This completes the CPU board assembly. Clean the assembly now if there will be more than two weeks before all assemblies are complete and cleaned.

Main PC Board Bill of Materials

Item	RMI#	Description	Mfg	Mfg Part #
RESISTORS				
R1	28-0153	10K QW 5%	Various	
R2	28-0154	100K QW 5%	"	
R3	28-0134	3.01K QW 1%	"	
R4	28-0171	100K 10 PIN NETWORK	Allen Bradley	710A104
R5	28-0163	39K QW 5%	Various	
R6	28-0159	22K QW 5%	"	
R7	28-0163	39K QW 5%	"	
R8	28-0159	22K QW 5%	"	
R9	28-0168	620 QW 5%	"	
R10	28-0108	1.00K QW 1%	"	RN55D1001F
R11	30-0007	50K CERMET TRIMPOT	Bourns	RJ26FW503
R13	28-0156	12K QW 5%	Various	
R14		See C47	"	
R15	28-0142	442K QW 1%	"	RN55D4423F
R16	28-0142	442K QW 1%	"	RN55D4423F
R17	28-0133	287 QW 1%	"	RN55D2870F
R18	28-0105	4.99K QW .1%	"	RN55C4991B
R19	28-0105	4.99K QW .1%	"	RN55C4991B
R20	28-0133	287 QW 1%	"	RN55D2870F
R21	28-0121	165K QW 1%	"	RN55D1653F
R22	28-0108	1.00K QW 1%	"	RN55D1001F
R23	28-0116	130 QW 1%	"	RN55D1300F
R24	28-0126	22.1K QW 1%	"	RN55D2212F
R25	28-0126	22.1K QW 1%	"	RN55D2212F
R26	28-0118	154K QW 1%	"	RN55D1543F
R27	28-0128	2.55K QW 1%	"	RN55D2551F
R28	28-0143	4.64K QW 1%	"	RN55D4641F
R29	28-0146	5.49K QW 1%	"	RN55D5491F
R30	28-0150	6.98K QW 1%	"	RN55D6981F
R31	28-0136	3.16K QW 1%	"	RN55D3161F
R32	28-0125	2.21K QW 1%	"	RN55D2211F
R33	28-0119	158K QW 1%	"	RN55D1583F
R34	28-0137	316K QW 1%	"	RN55D3163F
R35	28-0137	316K QW 1%	"	RN55D3163F
R36	28-0112	10.0 QW 1%	"	RN55D10R0F
R37	28-0121	165K QW 1%	"	RN55D1653F
R38	28-0108	1.00K QW 1%	"	RN55D1001F
R39	28-0116	130 QW 1%	"	RN55D1300F
R40	28-0139	37.4K QW 1%	"	RN55D3742F
R41	28-0139	37.4K QW 1%	"	RN55D3742F
R42	28-0113	113K QW 1%	"	RN55D1133F
R43	28-0124	2.05K QW 1%	"	RN55D2051F
R44	28-0134	3.01K QW 1%	"	RN55D3011F
R45	28-0147	6.04K QW 1%	"	RN55D6041F
R46	28-0162	3.9K QW 5%	"	
R47	30-0004	10K CERMET TRIMPOT	Bourns	RJ26FW103

R48	NOT USED			
R49	NOT USED			
R50	30-0005	100K CERMET TRIMPOT	Aln Bradly	85W 104
R51	28-0121	165K QW 1%	Various	RN55D1653F
R52	28-0121	165K QW 1%	"	RN55D1653F
R53	28-0121	165K QW 1%	"	RN55D1653F
R54	28-0121	165K QW 1%	"	RN55D1653F
R55	28-0107	101K QW .5%	"	RN55D1013D
R56	28-0152	909K QW 1%	"	RN55D9093F
R59	28-0111	10.7K QW 1%	"	RN55D1072F
R60	28-0120	1.62K QW 1%	"	RN55D1621F
R61	28-0131	2.80K QW 1%	"	RN55D2801F
R62	28-0109	10.0K QW .1%	"	RN55C1002B
R63	28-0109	10.0K QW .1%	"	RN55C1002B
R64	28-0107	101K QW .5%	"	RN55D1013D
R65	28-0152	909K QW 1%	"	RN55D9093F
R66	30-0007	50K CERMET TRIMPOT	Bourns	RJ26FW503
R67	28-0129	255K QW 1%	Various	RN55D2553F
R68	28-0130	27.4K QW 1%	"	RN55D2742F
R69	28-0130	27.4K QW 1%	"	RN55D2742F
R70	28-0122	178K QW 1%	"	RN55D1783F
RTEST	28-0158	1.8M QW 5%	"	

CAPACITORS

C1	32-0106	.47µFD 50v MON/CERAMIC	Various	.2 LEAD SPACE
C2	32-0105	.1µFD 50v MON/CERAMIC	"	
C3	32-0107	2.2µFD 16v TANTALUM	"	
C4	32-0107	2.2µFD 16v TANTALUM	"	
C5	32-0107	2.2µFD 16v TANTALUM	"	
C6	32-0117	100µFD 25v ELCTROLYTC	Panasonic	P6239
C7	32-0109	470µFD 16v ELCTROLYTC	"	P6230
C8	32-0112	1000µFD 16v ELCTROLYTC	"	P6231
C9	32-0110	1000µFD 50v ELCTROLYTC	"	P6272
C10	NOT USED			
C11	NOT USED			
C12	32-0107	2.2µFD 16v TANTALUM	Various	
C13	32-0107	2.2µFD 16v TANTALUM	"	
C14	32-0107	2.2µFD 16v TANTALUM	"	
C15	32-0107	2.2µFD 16v TANTALUM	"	
C16	32-0107	2.2µFD 16v TANTALUM	"	
C17	32-0107	2.2µFD 16v TANTALUM	"	
C18	32-0107	2.2µFD 16v TANTALUM	"	
C19	32-0107	2.2µFD 16v TANTALUM	"	
C20	32-0107	2.2µFD 16v TANTALUM	"	
C21	32-0107	2.2µFD 16v TANTALUM	"	
C22	32-0108	100µFD 35v ELECTROLYTC	Panasonic	P6252
C23	32-0105	.1µFD 50v MONO/CERAMIC	Various	
C37	32-0107	2.2µFD 16v TANTALUM	"	
C38	32-0105	.1µFD 50v MON/CERAMIC	"	
C39	32-0105	.1µFD 50v MON/CERAMIC	"	
C40	32-0105	.1µFD 50v MON/CERAMIC	"	
C41	32-0105	.1µFD 50v MON/CERAMIC	"	
C42	32-0105	.1µFD 50v MON/CERAMIC	"	
C43	32-0105	.1µFD 50v MON/CERAMIC	"	

C44	32-0105	.1µFD 50v MON/CERAMIC	"	
C45	32-0105	.1µFD 50v MON/CERAMIC	"	
C46	32-0105	.1µFD 50v MON/CERAMIC	"	
C47	32-0107	2.2µFD 16v TANTALUM	"	installed at R14
ICS				
U2	34-0111	J THERMOCOUPLE AMP	Analog Devices	AD594AQ
U3	34-0112	K THERMOCOUPLE AMP	"	AD595AQ
U4	34-0110	QUAD OP AMP	Linear Tech	LT1014CN
U5	34-0118	5v REGULATOR	National	LM2931AZ-5.0
U6	34-0119	5v REFERENCE	"	LM336Z-5.0
U7	NOT USED			
U8	NOT USED			
U9	34-0117	BATTERY REGULATOR	National	LM2931CT
U10	34-0117	10 V REGULATOR	"	LM2931CT
TRANSISTORS				
Q1	36-0002	DARLINGTON	Various	MPSA13
Q2	36-0002	DARLINGTON	"	MPSA13
DIODES				
CR1	38-0102	4.7v ZENER DIODE	Various	1N750A
CR2	38-0102	4.7v ZENER DIODE	"	1N750A
CR3	38-0100	SILICON RECTIFIER	"	1N4002
CR4	38-0101	SCHOTTKY DIODE	"	1N5818
CR5	38-0102	4.7v ZENER DIODE	"	1N750A
CR6	38-0102	4.7v ZENER DIODE	"	1N750A
CR7	38-0102	4.7v ZENER DIODE	"	1N750A
CR8	38-0101	SCHOTKY DIODE	"	1N5818
CONNECTORS				
J1	42-0036	DISPLAY SOCKET	Samtec	SS-220-T-2
J2	42-0037	PC TAIL EDGE CONNECTOR	Molex	09-04-6221
	44-0013	1" Red Wire		
	44-0019	2" Blue Wire		
	44-0020	3" Yellow Wire		
	44-0025	1.25" Black Wire		
SOCKETS				
	42-0007	40 Pin CPU Socket	Various	
	42-0035	SOCKET PIN	Qty 42	
SWITCHES				
S1	46-0005	DUAL CONCENTRIC	Stackpole	
S2	46-0007	MOM/PB1 NOMTGTAB	Centralab	
S3	46-0007	MOM/PB1 NOMTGTAB	"	
S4	46-0007	MOM/PB1 NOMTGTAB	"	
S5	46-0006	PSH/PSH PB1 NOMTGTAB	"	
S6	46-0006	PSH/PSH PB1 NOMTGTAB	"	
S7	46-0007	MOM/PB1 NOMTGTAB	"	
PC BOARD				
	48-0013	MAIN PC BOARD	RMI	48-0013

MISC ELECTRONIC PARTS

	18-0012	HEATSINK	Avvid	5743B Qty 2
X1	NOT USED			
F1	40-0103	150ma POLY FUSE	Raychem	X017

Main PC Board Assembly

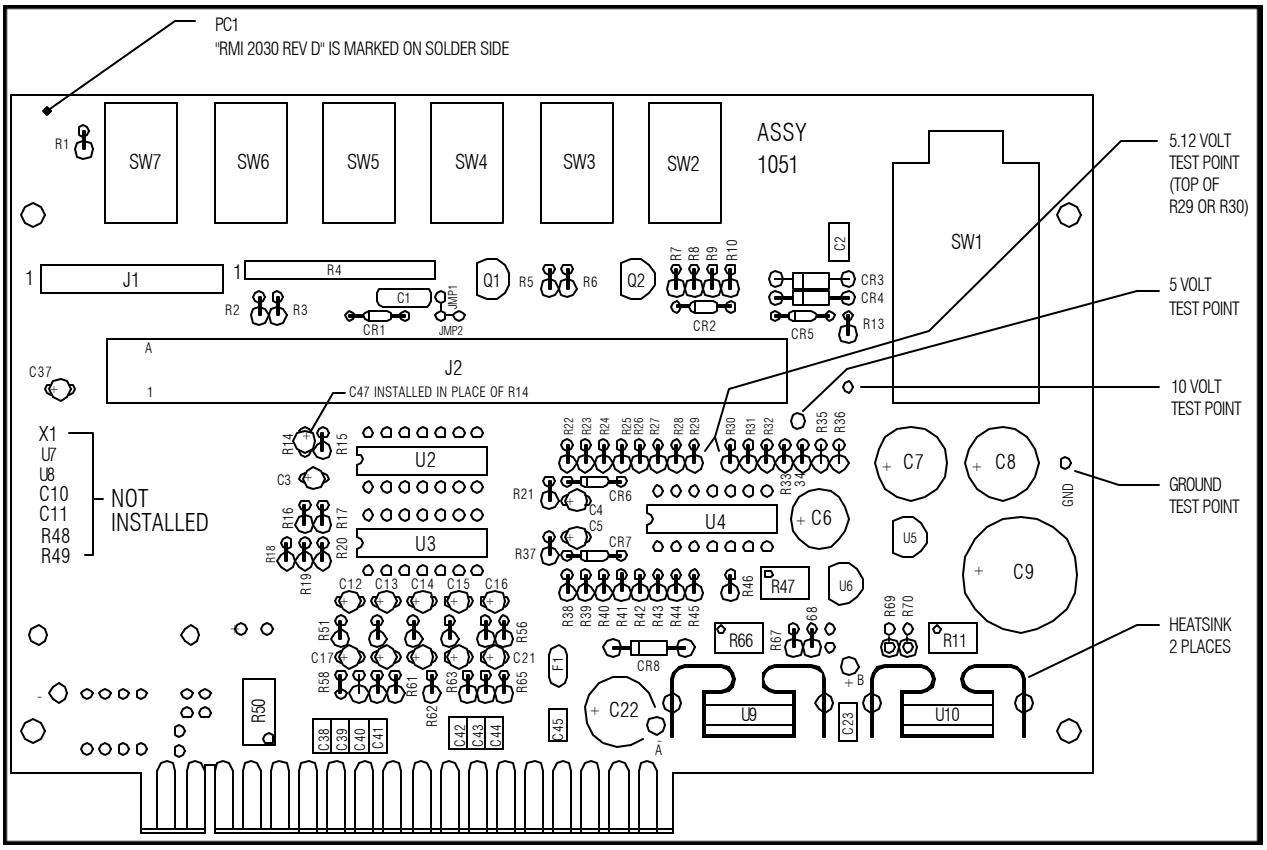


Figure 11 Main PC board assembly. A large tear-out drawing is in Appendix D.

All of the resistors on the main PC board are mounted vertically to save space. Only one lead is bent as shown in Figure 12, with leads slightly spread for friction. Hold the resistor while bending so the marking will be seen after installation. If you're fussy, all the markings should read from the top to the bottom after installation so it is easier to double check your work. Install all vertical resistors so the component body is in the hole toward the gold fingered edge connector and the bare lead is toward the top of the board.

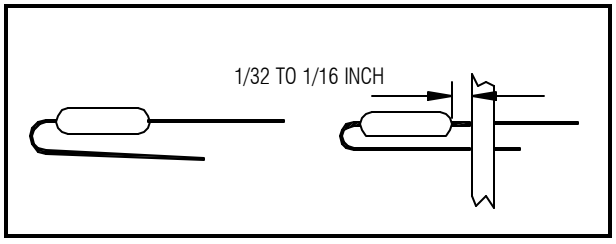


Figure 12 Vertical resistor mounting detail.

Locate from the parts pack, bend and install the following resistors:

__ 1. R1 - 10k 5% marked BR-BK-OR

__ 2. R2 - 100k 5% marked BR-BK-YL

__ 3. R3 – 3.01k 1% marked 3011 or RD-RD-OR NOTE: If a RMI supplied Hall Effect device is to be used (rare) for RPM pickup (µMONITOR can't share electronic ignition's Hall sensors) instead of magnetos or electronic ignition - install a jumper wire made from one of the cutoff leads in place of R3 and install the 3.01k resistor horizontally in place of CR1 to the right. See detail in Figure 13.

__ 4. Install a jumper wire in JMP1 position made from a cutoff lead. The lower left hole is common to both JMP1 and JMP2. See detail in Figure 13. NOTE: If a RMI Hall Effect device is going to be used, install the jumper wire in the JMP2 position.

__ 5. R5 - 39k 5% marked OR-WH-OR

__ 6. R6 - 22k 5% marked RD-RD-OR

__ 7. R7 - 39k 5% marked OR-WH-OR

__ 8. R8 - 22k 5% marked RD-RD-OR

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__ 9. R9 - 620 5% marked BL-RD-BR

__ 10. R10 - 1.00k 1% marked 1001 or BR-BK-BK-BR

__ 11. R13 - 12k 5% marked BR-RD-OR

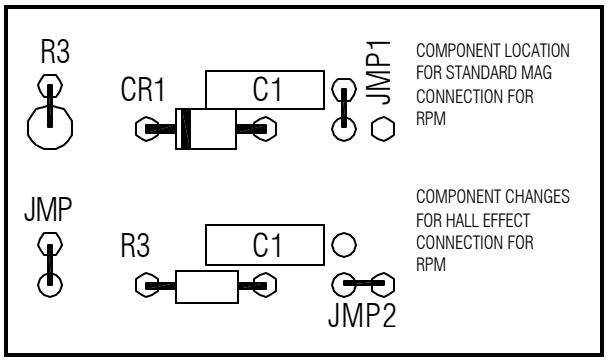


Figure 13 Changes made when using a RMI Hall Effect pickup for the tachometer. Use C1 as the reference point.

Double check your work, solder the long lead and clip, check to see that resistors are standing straight and the proper height, and solder and clip remaining leads.

__ 12. R14 – Skip for now. A capacitor will be installed here in a later step.

__ 13. R15 – 442k 1% marked 4423 or YL-YL-RD-OR

__ 14. R16 - 442k 1% marked 4423 or YL-YL-RD-OR

__ 15. R17 - 287 1% marked 2870 or RD-GR-VI-BK

- - - - - - - - - - - - - - - - -

__ 16. R18 - 4.99k .1% marked 4991

__ 17. R19 - 4.99k .1% marked 4991

__ 18. R20 - 287 1% marked 2870 or RD-GR-VI-BK

Double check your work, solder the long lead and clip, check to see that resistors are standing straight and the proper height, and solder and clip remaining leads.

__ 19. R21 - 165k 1% marked 1653 or BR-BL-GN-OR

__ 20. R22 - 1.00k 1% marked 1001 or BR-BK-BK-BR

__ 21. R23 - 130 ohm 1% marked 1300 or BR-OR-BK-BK

__ 22. R24 - 22.1k 1% marked 2212 or RD-RD-BR-RD

- - - - - - - - - - - - - - - - -

__ 23. R25 - 22.1k 1% marked 2212 or RD-RD-BR-RD

__ 24. R26 - 154k 1% marked 1543 or BR-GN-YL-OR

__ 25. R27 - 2.55k 1% marked 2551 or RD-GN-GN-BR

__ 26. R28 - 4.64k 1% marked 4641 or YL-BL-YL-BR

- - - - - - - - - - - - - - - - -

__ 27. R29 - 5.49k 1% marked 5491 or GN-YL-WH-BR

__ 28. R30 - 6.98k 1% marked 6981 or BL-WH-GR-BR

__ 29. R31 - 3.16k 1% marked 3161 or OR-BR-BL-BR

__ 30. R32 - 2.21k 1% marked 2211 or RD-RD-BR-BR

- - - - - - - - - - - - - - - - -

__ 31. R33 - 158k 1% marked 1583 or BR-GN-GR-OR

__ 32. R34 - 316k 1% marked 3163 or OR-BR-BL-OR

__ 33. R35 - 316k 1% marked 3163 or OR-BR-BL-OR

__ 34. R36 - 10.0 ohm 1% marked 10R0

Double check your work, solder the long lead and clip, check to see that resistors are standing straight and the proper height, and solder and clip remaining leads.

__ 35. R37 - 165k 1% marked 1653 or BR-BL-GN-OR

__ 36. R38 - 1.00k 1% marked 1001 or BR-BK-BK-BR

__ 37. R39 - 130 ohm 1% marked 1300 or BR-OR-BK-BK

- - - - - - - - - - - - - - - - -

__ 38. R40 - 37.4k 1% marked 3742 or OR-VI-YL-RD

__ 39. R41 - 37.4k 1% marked 3742 or OR-VI-YL-RD

__ 40. R42 - 113k 1% marked 1133 or BR-BR-OR-OR

__ 41. R43 - 2.05k 1% marked 2051 or RD-BK-GN-BR

- - - - - - - - - - - - - - - - -

__ 42. R44 - 3.01k 1% marked 3011 or OR-BK-BR-BR

__ 43. R45 - 6.04k 1% marked 6041 or BL-BK-YL-BR

__ 44. R46 - 3.9k 5% marked OR-WH-RD

Double check your work, solder the long lead and clip, check to see that resistors are standing straight and the proper height, and solder and clip remaining leads.

__ 45. R48 – Not Used.

__ 46. R49 – Not Used.

__ 47. R51 - 165k 1% marked 1653 or BR-BL-GN-OR

__ 48. R52 - 165k 1% marked 1653 or BR-BL-GN-OR (unmarked - to right of R51)

- - - - - - - - - - - - - - - - -

__ 49. R53 - 165k 1% marked 1653 or BR-BL-GN-OR (unmarked - to right of R52)

__ 50. R54 - 165k 1% marked 1653 or BR-BL-GN-OR (unmarked - to right of R53)

__ 51. R55 - 101k 1% marked 1013 or BR-BK-BR-OR (unmarked - to left of R56)

__ 52. R56 - 909k 1% marked 9093 or WH-BK-WH-OR

Double check your work, solder the long lead and clip, check to see that resistors are standing straight and the proper height, and solder and clip remaining leads.

__ 53. R58 - Install a jumper wire using a cut-off lead in place of this resistor.

__ 54. R59 - 10.7k 1% marked 1072 or BR-BK-VI-RD

__ 55. R60 - 1.62k 1% marked 1621 or BR-BL-RD-BR

- - - - - - - - - - - - - - - - -

__ 56. R61 - 2.80k 1% marked 2801 or RD-GR-BK-BR

__ 57. R62 - 10.0k 1% marked 1002 or BR-BK-BK-RD

__ 58. R63 - 10.0k 1% marked 1002 or BR-BK-BK-RD

__ 59. R64 - 101k 1% marked 1013 or BR-BK-BR-OR

- - - - - - - - - - - - - - - - -

__ 60. R65 - 909k 1% marked 9093 or WH-BK-WH-OR

__ 61. R67 - 255k 1 marked 2553 or RD-GN-GN-OR

__ 62. R68 - 27.4k 1% mark 2742 or RD-VI-YL-RD

__ 63. R69 - 27.4k 1% mark 2742 or RD-VI-YL-RD

__ 64. R70 - 178k 1% marked 1783 or BR-VI-GY-OR

Double check your work, solder the long lead and clip, check to see that resistors are standing straight and the proper height, and solder and clip remaining leads.

__ 65. R4 - 100k 10 pin resistor network, marked 100K or 104. Orient the resistor network to match the dot, "1" or the stripe marked on the part with the "1" at the end of the designator. Solder one of the center pins, check the part, then solder the remaining pins.

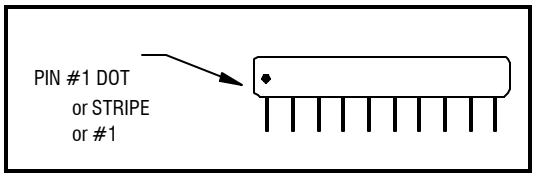


Figure 14 Resistor network in SIP package.

This completes the installation of the fixed resistors on the Main PC board.

Locate from the parts pack and install the following trimpots:

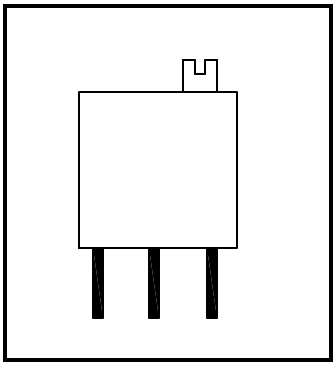


Figure 15 Trimpot. Note that there are two different size trimpots in the kit.

__ 1. R11 - 50k cermet trimpot marked 503 or 50k or 50k k (careful!... there is also a 103)

__ 2. R50 - 100k cermet trimpot marked 104 or 100k or 100k k. This is the headset audio volume control.

__ 3. R66 - 50k cermet trimpot marked 503 or 50k or 50k k

Insert the trimpots in their proper location, slightly spread the two outside leads, and solder the center lead, making sure that the trimpot is flush with the component side of the board. Straighten the two outside leads and solder. Trim the excess leads.

__ 4. R47 trimpot may be installed after the board is powered up. With this trimpot out of the circuit, your voltmeter can be checked using the marked voltage (explained later). If you have a good quality digital voltmeter, you can install R47 now - 10k cermet trimpot marked 103 or 10k or 10kk.

Solder and clip.

This completes the resistor installation on the Main Board.

Locate from miscellaneous parts pack and install the following capacitors. Unless you involve a friend and solder them one at a time or have three hands, you will probably have to spread the leads slightly to hold the part in the board when you turn it over. Do not install with the lead insulation down into the hole. It should be about 1/32 to 1/16 inch above the PC board.

__ 1. C1 - .47µFD 50v marked 474

__ 2. C2 - .1µFD 50v marked 104

__ 3. C10 – Not Used.

__ 4. C23 - .1µFD 50v marked 104

__ 5. Locate eight (8) more .1µFD 50v - marked 104 ceramic capacitors and install. These capacitors are in a line just above the gold edge connectors.
(C38,C39,C40,C41,C42,C43,C44,C45)

Double check your work, solder one lead and clip, check to see that the capacitors are the proper height, and solder and clip remaining leads.

NOTE: Any remaining .1µFD 50v ceramic capacitors are used in construction of various sensors, and will be called for in the Appendixes.

__ 6. Locate a 2.2µFD 16v - marked 2.2 16 or 225 16 - tantalum capacitor and install at C37. Tantalum capacitors are polarized, which means that the lead with the "+"signs must go toward the "+"sign on the PC board designator. Solder and clip.

__ 7. Locate thirteen more (13) 2.2µFD 16v - marked 2.2 16 or 225 16 - tantalum capacitors and install. Some of the designator "+"signs are missing where there are groups of polarized capacitors. All the tantalum "+"pads are to the left of the part. Solder and clip.

(C3,C4,C5,C12,C13,C14,C15,C16,C17,C18,C19,C20,C21)

___ 8. Locate an additional 2.2µFD capacitor as in step 7 and install at position R14. Be sure the positive terminal of the capacitor is towards J2. See Figure 12 for J2 location.
(R14)

Locate from the sort pad and install the following diodes, being sure to orient the marking band with the band on the PC board:

__ 1. CR1 - 1N750A diode marked 1N750A NOTE: This part will be omitted if a Hall Effect pickup is used on RPM.

__ 2. CR2 - 1N750A diode marked 1N750A

__ 3. CR3 - 1N4002 diode marked 1N4002

__ 4. CR4 - 1N5818 diode marked 1N5818

__ 5. CR5 - 1N750A diode marked 1N750A

__ 6. CR6 - 1N750A diode marked 1N750A

__ 7. CR7 - 1N750A diode marked 1N750A

__ 8. CR8 - 1N5818 diode marked 1N5818

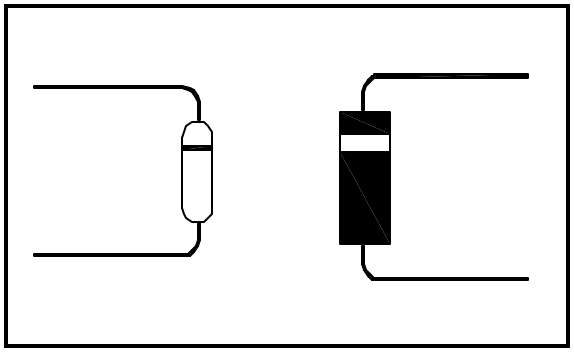


Figure 16 Two types of diode.

Double check your work, solder one lead and clip, check to see that the diodes are flush with the PC board and solder and clip remaining leads.

This completes the installation of diodes on the Main PC board.

Locate the 6 pushbutton switches in the parts pack. Four of the pushbutton switches are momentary type switches. They remain closed only as long as the pushbutton is held in. They are identified by a plastic "barrel" around the coiled shaft spring. The other two switches are push-push type that alternate closed and open on each successive push. They are identified by a lack of the "barrel". Observe the following instructions carefully to assure that the buttons will be lined up to fit through the faceplate holes later.

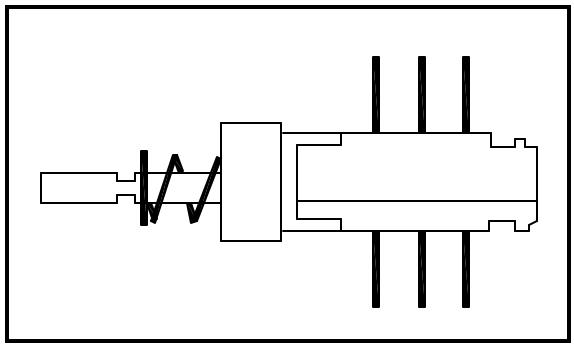


Figure 17 One of the momentary pushbutton switches with the barrel on the shaft.

__ 1. Isolate the four momentary switches with the plastic barrel around the coiled spring from the push-push switches. Notice that the solder pins stick out of both the top and bottom of the switches. On one side of the switch the solder pins have a visible flat that appears right where the solder pin enters the switch body. All of the switches will be installed with the flats next to the PC board. The flats fit tightly into the PC board holes and help hold the switch in position.

__ 2. S2 - momentary pushbutton switch. Install but don't solder.

__ 3. S3 - momentary pushbutton switch. Install but don't solder.

__ 4. S4 - momentary pushbutton switch. Install but don't solder.

__ 5. **S7** - momentary pushbutton switch. **NOTE that we skipped two spots!** Install but don't solder.

__ 6. **Make sure the switches are in the right places, they are a bugger to get out (call RMI if you do install incorrectly).** The switches must be flush with the PC board. Solder the two center leads only. (More heat will be needed for these larger parts). Make sure the switches are flush to the PC board. If not, reheat the two leads one at a time while squeezing the switch body toward the board.

CAUTION: The pins go all the way through the switch and the one you reheat gets HOT.

__ 7. Locate the two remaining push-push switches. These are also installed with the flats next to the PC board. They will have a copper colored triangular shaped flat spring on the top side.

__ 8. S5 - push-push pushbutton switch. Install with the body of the switch flush to the PC board.

__ 9. S6 - push-push pushbutton switch. Install.

__ 10. Solder the two center leads only.

__ 11. Sight down the tips of the white shafts to see that they are in line. If not, reheat the soldered leads and move. They don't have to be perfect, you'll notice that the shafts have quite a bit of play. Use the faceplate to see that there are no gross errors. If so, one of the soldered leads can be reheated and the switch shifted slightly. Once you're happy with the whole mess, solder the remaining leads and clip. If you find switches installed incorrectly... call RMI for instructions to fix.

__ 12. Clip all the leads off the top of all six switches.

__ 13. Locate the rotary switch S1 - marked by its hugeness. Remove the nut and washer and put them in your junk box. If any of the solder pins on the switch are out of alignment, bend them straight. Squeeze the switch down in place in the PC board until it is solid. The switch body and the shaft should look parallel to the PC board. Flip the PC board and solder one pin on the front row and one pin on the back row. Reheat one soldered pin at a time while squeezing down on the switch to make sure it's flush. Check the switch position and solder the remainder of the leads.

This completes the installation of switches on the main board.

__ 1. Locate J1 - 9 section connector and install with the nine "high-backed chairs" facing the switch SW7 (like sitting facing a fireplace). Solder a center lead, make sure the connector is flush to the PC board, then solder the remainder of the leads.

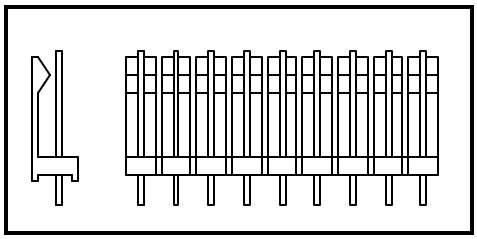


Figure 18 J1 connector for display.

__ 2. Locate J2 - the large 44 pin edge connector. Note that the connectors opposite the leads are numbered from 1 to 22 on one side of the top of the connector and A to Z (some letters are omitted) on the opposite side of the connector. Install the connector making sure that the "1" and the "A" match the markings on the designator and that it is seated firmly. The connector has standoffs on the bottom so the main body will not seat flush to the PC board. Solder two end leads, check the part, then solder the remainder and clip.

This completes the installation of the connectors on the Main Board.

__ 1. Locate from the sort pad the polyfuse marked X017 (looks similar to a ceramic capacitor). Straighten the lower part of the bends on each lead so the lead spacing will fit the holes in the PC board. The part is made by a different vendor than the original design. Solder and clip.
(F1)

Locate the four transistors/ICs from the sort pad. These will be installed without sockets. When soldering these smaller ICs, try to have a little blob of solder on the tip of your solder iron so thermal contact is made quickly. Try to not solder each lead for more than a total of 8 seconds and skip from IC to IC to allow the part to cool before soldering the next lead.

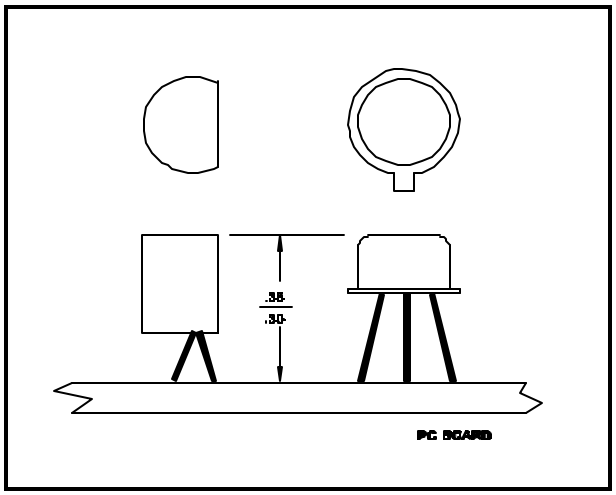


Figure 19 Two types of transistors or ICs that might be in this kit. Note mounting height.

Install the following integrated circuits and transistors insuring that the polarity flat on the IC matches the designator on the PC board.

__ 1. Q1 - NPN Darlington transistor marked MPSA13

__ 2. Q2 - NPN Darlington transistor marked MPSA13

__ 3. U5 - 5v voltage regulator marked LM2931AZ-5.0

__ 4. U6 - 5.12 voltage reference marked LM336Z-5.0

__ 5. Solder the center lead, check the part, solder the remaining leads and clip.

__ 6. Locate U9 and U10 - adjustable voltage regulators marked LM2931CT with five leads. Locate two heatsinks. Insert the heatsink leads into the PC board to check for fit. If too tight, file the leads down slightly. Push the voltage regulators into the heatsinks as shown in Figure 12, with the metal tab of the regulator against the back wall of the heatsink and the heatsink spring fingers pushing against the writing on the regulator. Wiggle the IC and the heatsink until the IC starts in under the spring arms. Push in until the top of the tab hits the little bump above the hole of the heat sink. You should be able to see part of the marking on the regulator through the vertical slot of the heatsink. The hole in the regulator tab will match up and be against the hole in the heatsink.

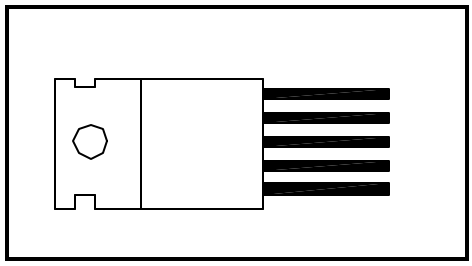


Figure 20 Voltage regulators.

__ 7. Install one of the assemblies at U9. Orient the assembly as shown in and the designator (DOUBLE CHECK--they have been installed backwards). Bend the center and outside leads slightly toward the front of the part and the other two leads slightly to the rear until they will start in the PC board holes. Rock the assembly back and forth and work the assembly down until the **heatsink** leads stick out about 1/8" on the solder side of the PC board and the distance between the board and the bottom of the heatsink is about 3/16". Use the white outline on the PC board as a guide for proper orientation. Solder the two heatsink tabs, check that the part is straight and solder the remainder of the leads. Clip the leads.

__ 8. Install another assembly at U10. Solder and clip.

This completes the installation of the non-socketed integrated circuits.

Electrolytic capacitors are polarized like the tantalums, but they usually mark the negative lead with a "–" so the opposite **long** lead is the "+"lead. They should be **installed as flush as possible** to the PC board.

__ 1. Locate a small radial electrolytic capacitor marked 100µFD 16v (or 25v). Install, observing the polarity. Solder and clip.
(C6)

__ 2. Locate and install the radial electrolytic capacitor marked 100µFD 35v, observing the polarity. Solder and clip.
(C22)

__ 3. Locate and install the radial electrolytic capacitor marked 470µFD 16v or 25v, observing the polarity. Solder and clip.
(C7)

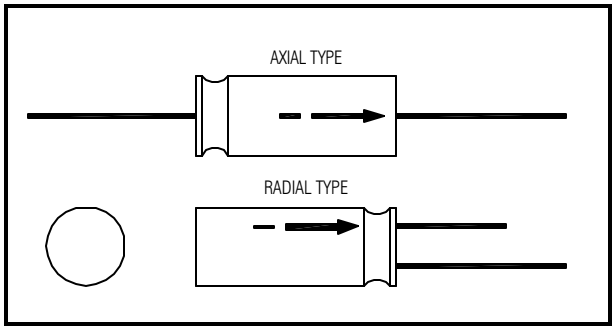


Figure 21 Two types of electrolytic capacitors. Note polarity markings.

__ 4. Locate and install the radial electrolytic capacitor marked 1000µFD 16v, observing the polarity. Solder and clip.
(C8)

__ 5. Locate and install the remaining large radial electrolytic capacitor marked 1000µFD 50v, observing the polarity. Solder and clip.

(C9)

This completes the capacitor installation on top of the Main board.

__ 1. If your voltmeter has a spring loaded hook probe of some type, you may optionally install short test point wires in the 10v, 5v and GND test points. Solder a clipped-off lead in the hole, clip on the solder side of the PC board and cut about 1/4" long on the component side.

Four additional components will be added to the solder side of the main PC board, one capacitor and three small gage wires. Also, one of the PC board traces will be cut through. These changes have been recently made and will continue until the current stock of PC boards has been used.

__ 2. Locate the thin, pre-stripped red wire. Use a small blob of solder on the tip of the iron to tack the wire to the lead sticking through the PC board as shown in Figure 22. Trim off the excess lead. Trim the end of the wire that will be tacked to the unused edge connector "T". Hold the end so that it touches the edge connector as shown and tack it with a blob of solder. Try to keep the solder blob inside the round portion of the edge connector so it won't interfere with the housing that it will eventually plug into.

__ 3. Locate a .1µFD 50v capacitor - marked 104, and install as shown in Figure 22. You may spread the leads if necessary. Tack one lead, position and solder the other lead and then re-solder the first lead if necessary.
(C46)

__ 4. Locate the thin, pre-stripped blue wire, and install as shown in Figure 22 using the same technique as the red wire.

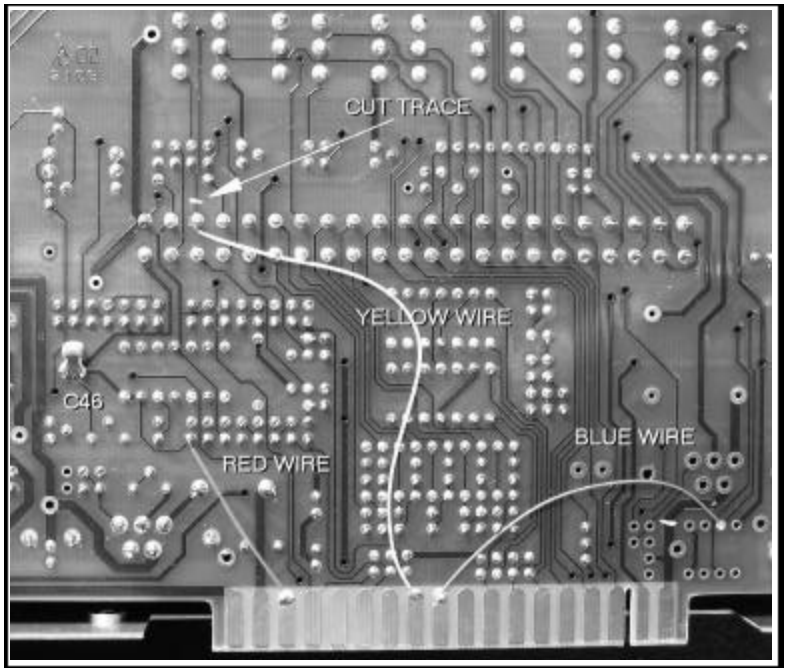


Figure 22 Installing three jumper wires, capacitor C46 and cutting a trace on the solder side of the PC board. Note how clean the PC board is.

__ 5. Locate the thin, pre-stripped yellow wire, and install as shown in Figure 22 using the same technique as the previous wires.

__ 6. Carefully cut through the trace pointed to by the arrow in Figure 22. Use an Xacto knife or a small burr in a rotary tool.

This completes the assembly of the Main board except for R47.

__ 1. Clean all the PC board assemblies. Refer to the section on page 7.

__ 2. IMPORTANT! IMPORTANT! One at a time, using a good light and magnifying glass, visually check all the solder connections on all the PC assemblies. In addition for the good/bad joint criteria outlined in the section SOLDERING TIPS look for solder bridges and component leads not soldered. If necessary, repair any "bridges", solder any missed connections, solder any suspicious looking joints and reclean as necessary.

This completes the initial inspection.

Polarizing Key Assembly

__ 1. Locate the large black connector housing. This housing holds the crimp contacts that will be attached to the wires in the aircraft. Locate and install the small white polarizing key between compartment "2" and compartment "3" of the connector as shown above. The key fits in the groove of the connector so that once it is installed, the connector will fit on the edge connector of the PC board with the key fitting into the slot in the PC board between fingers "2" and "3". Try the connector on the PC board and confirm that the numbers from 1-18 on the connector will match the fingers on the **component** side of the PC board. Set the connector aside until later.

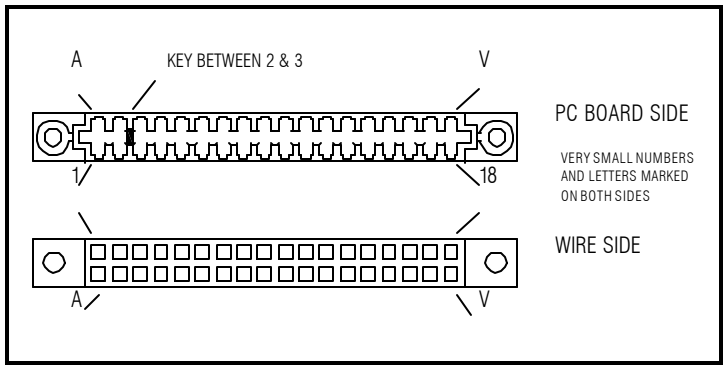


Figure 23 Wire harness connector for back of mounting tray.

Setting Up the Battery Charger

A 12 volt auto battery charger will be used to simulate the aircraft bus when the engine is running. Connections from the charger to the unit are as follows:

__ 1. Cut two wires 3 to 4 feet long (this length may be needed during burn-in) to reach from the battery charger to the unit. If your aircraft wiring has not been done yet, use 24 gage aircraft wire and cut the pieces long enough to be used later for hookup of one of the transducers.

__ 2. Locate two of the crimp terminals and attach them to the two wires as shown in the installation manual. There are 6 extra crimp terminals in the kit.

__ 3. Strip the other ends of the wires so the battery charger leads can be attached.

__ 4. Locate the large 36 pin connector housing and insert one of the wires with the attached crimp terminal into stall #17 or #18 (GROUND). Insert the other terminal into stall #V (AIRCRAFT POWER). Use the drawing in the POLARIZING KEY ASSEMBLY section or the drawing in the installation manual to help locate the proper stalls.

__ 5. Connect the wire from stall #17 or #18 to the **negative** lead of the charger. Connect the wire from stall #V to the **positive** lead of the charger. Make provision to keep the charger clamps from shorting to each other.

Initial Power Up

In this section, the battery charger will be used to power up the main PC board to check the power supply voltages. Use the assembly drawing of the Main PC board as a reference during the following steps.

__ 1. Temporarily install the small knob on the off-on-bat portion of the rotary switch using the collet wrench. The switch has three positions, off, on and battery, with the off position being the extreme counterclockwise position. Turn the switch to the off position.

__ 2. With the battery charger off, plug the edge connector to the Main PC board.

__ 3. Connect the common lead of your voltmeter to the µMONITOR GND test point.

__ 4. Set the voltmeter to read DC volts in a range to measure 5 VDC and connect the positive lead of the voltmeter to the 5v test point. Turn on the battery charger and then turn the off-on-bat switch clockwise one click to the "on" position. The voltage being measured powers the digital circuits and should read between 4.75 and 5.25 volts.

__ 5. Set the voltmeter in a range to read 10 VDC and connect the positive lead of the voltmeter to the 10v test point. The voltage being measured should read approximately 10 volts (this will be adjusted later).

If all of the above is successful and you would like to check the accuracy of your voltmeter using the factory measured voltage for the unadjusted U6 reference, measure the voltage between the two outside of the three holes where R47 will be installed. The common voltmeter lead should be placed on the right hole closest to U6. Accurately record your voltmeter reading in the table below and calculate adjusted readings as shown in the table.

A. Your voltmeter reading in volts ..... _____

B. Factory measured voltage of U6 as posted on sort pad #5 ..... _____

C. Divide step A by step B..... _____

When manual says:		Your voltmeter reads:
5.12 volts	(times step C) =	_____
10.05 volts	(times step C) =	_____
13.2 volts	(times step C) =	_____

__ 6. Turn power off, disconnect battery charger and voltmeter, locate and install trimpot R47 - marked 103 or 10k or 10k k. Solder and clip. Remove solder flux and dry.

__ 7. Remove the off-on-bat knob.

Install ICs on Main PC Board

Review the section HANDLING ICs. Lay out a large piece of aluminum foil on your workbench. Lay the three PC board assemblies on the foil. Locate the integrated circuit containers and lay them on the foil. Sit or stay in the same place during the following procedures to lessen static generation. Touch the aluminum foil before picking up any parts. The idea is to keep the static potential the same for you, the boards and the integrated circuits.

IC manufacturers are constantly changing the prefix or suffix on their part numbers. Don't worry if the marked number is slightly different than called out. There are no parts with numbers close to each other.

1. Remove the end-plug from each IC tube and slide the ICs out so their legs are standing on the aluminum foil. We try to pack ICs in order in the tubes. Leave the other assemblies in their separate bag.

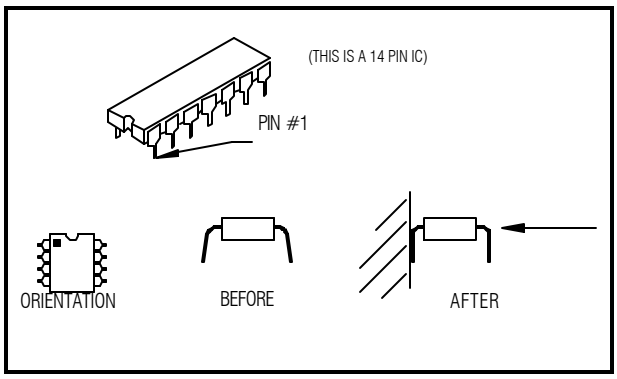


Figure 24 Forming integrated circuit leads for easy insertion into sockets.

The integrated circuits in DIP packages have the pins splayed outward to hold the IC in the PC board when a socket is not used. To ease insertion of the IC into its socket, bend the leads to point straight down as shown above by holding the body of the IC and pressing the leads against the foiled workbench top.

__ 2. Install 14 pin type J thermocouple amplifier IC - marked AD594.
(U2)

__ 3. Install 14 pin type K thermocouple amplifier IC - marked AD595.
(U3)

__ 4. Install 14 pin precision quad op amp IC - marked LT1014.
(U4)

This completes assembly of the Main PC board.

Install ICs on CPU PC Board

__ 1. Install 20 pin 10bit A/D converter IC - marked ADC1005.
(U11)

__ 2. Install 14 pin quad 2-input exclusive OR gate IC - marked CD4070 or 74C86.
(U12)

__ 3. Install 14 pin quad 2-input AND gate IC - marked CD4081.
(U13)

__ 4. Install 14 pin hex Schmidt trigger IC - marked 74C14 or 40106 or 14106 (with lead #10 cut off).
(U14)

__ 5. Install 40 pin CPU assembly from its separate package. The components are not shown in the assembly drawing for this part so use the square pad and the white, printed "1" to locate pin #1. To prevent broken pins, make sure that all the pins are aligned with the socket before pressing down.
(U16)

__ 7. Install 18 pin real time clock IC - marked M62X42.
(U17)

__ 8. Install 8 pin reset assembly - marked MAX708 (separate antistatic bag). Use CPU assembly drawing to orient.
(U18)

CAUTION: All ICs must be installed with the polarizing "indent" and/or "pin #1 dot" oriented to match the designator "indent" on the PC board. Installing an IC backwards is a common mistake. Be careful.

__ 9. Install dual precision op amp IC - marked LT1013.
(U20)

__ 10. Install 28 pin 16-channel analog multiplexer IC - marked DG506 or MUX-16.
(U22)

__ 13. Install 24 pin port extender IC - marked 82C43.
(U23)

__ 14. Install 8 pin timer IC - marked ICM7555.
(U24)

Now that the ICs are installed, a jumper must be added on the solder side of the CPU PC board under IC U14. Doing it now helps keep a socket pin from coming out.

__ 15. Use Figure 25 to locate where the jumper will be installed. Use a cut-off piece of lead or other solid wire to jumper across pin10 and pin11 of U14. After you are through, be sure that the solder pin on the unused lead (component side of PC board) has not leaned over where it is touching anything... or you may remove the unused socket pin.

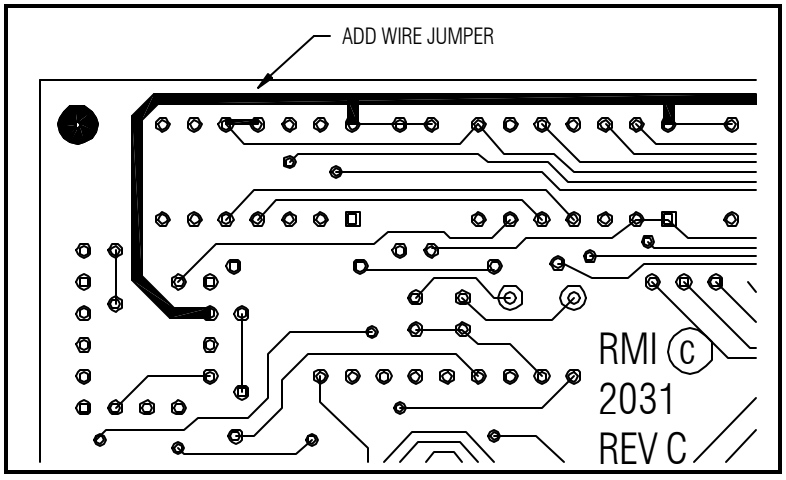


Figure 25 Adding jumper wire across U14 pin10 and pin11.

Faceplate Assembly

The front window is made from .030 inch thick plastic with one non-glare side that stops reflections from degrading the display.

__ 1. Locate the approximately 2 x 6 non-glare plastic sheet with protective film and mark out a 1.92 x 5.82 rectangle (part may already be correct size) using an Xacto or other sharp knife (the back opening of the black faceplate can be used as a guide). Cut the plastic about 1/3 of the way through and flex to snap along the score like cutting glass. Leave the protective films on both sides until ready to assemble the faceplate assembly.

The two gaskets shown in the faceplate assembly cross-section are made from the blanks of black plastic film (.010 thick) in the kit.

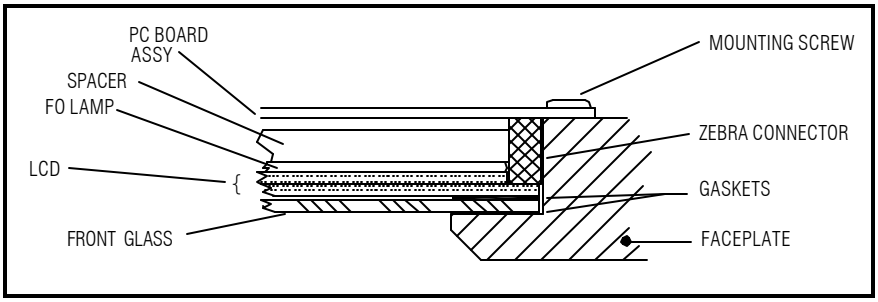


Figure 26 Cross section of faceplate assembly.

__ 2. Locate the black metal faceplate. Use the front window cutout as a pattern and remove the centers of the blanks with an Xacto or similar knife. If you're steady, you can freehand cut out the gaskets. Just leave approximately 1/8 inch all around the gasket. When the gasket is tried into the faceplate cavity, you should not be able to see the gasket from the front of the unit. If so, trim more off.

Use the cross-section assembly drawing as a guide during the following steps. Before proceeding, wash your hands to help eliminate contamination on the LCD conductive pads (they are semi-transparent and located in the "step" where the front and back glasses are joined) and the conductive rubber connectors.

__ 3. Install one of the black gaskets into the faceplate recess.

___ 4. Remove BOTH the protective films from the plastic front window (NOT the GLASS LCD DISPLAY!). The back film is about like Saran Wrap & the front is like white paper. Determine the dull non-glare side, and install with the non-glare side to the front of the µMONITOR.

__ 5. Install the remaining black gasket.

Before starting the next step, it is important to determine if the LCD display has a protective film on the front of the display. If it is not present, you may be tempted to remove the necessary polarizer film on the front of the display instead of the protective film called out in the next step. We have two different vendors for the display... and even the same vendor does not always use the same type of protective film (color & markings) from batch to batch. Basically, if the front of the LCD is very shiny (nice reflections like clean glass), then it does not have a protective film. If it a dull finish, has obvious scratches, has small trapped air bubbles or has diagonal lines, then a film is present. A film of any type will come off **EASILY**.

__ 6. There are a number of ways to determine the top and bottom of the LCD display. If you look at the front of the display at an angle in the light, you can see the digit pattern and the large digits are toward the top. Also the two black horizontal lines are displaced from center toward the bottom of the display. After you have figured out the top from the bottom, remove the protective film from the front of the LCD display if present. It is green in color and usually there are small air bubbles under it - it may be missing. The film will peel off easily, it's stuck down with an electrostatic bond rather than adhesive. Install the display.

__ 7. Locate the two "Zebra" display connectors. These are silicon rubber strips about 6 inches long, .3 inches wide and .05 inches thick. The connectors are actually a long row of alternating strips of conducting rubber and insulating rubber (thus the "Zebra" moniker). The connectors have a white insulation barrier on both of the .3 inch sides. Make sure that the two narrow surfaces are clean and install the strips, one on each long side of the display. These strips will provide separate conduction paths for each of the pads on the Display Driver PC board and the matching pad on the Liquid Crystal Display.

__ 8. Locate the fiber-optic lamp. It is about 1/16 inch thick, white color, with the light-pipe fibers coming out one end and then making a 180° turn around behind the lamp (the "tail"). All of the individual fibers are

then gathered into a round, black, plastic housing behind the lamp. Place the front of the lamp into the faceplate cavity. The lamp tail fibers should be on the side above the **[OFF/ON/BAT]** round switch hole and will match up with the end notch on the Display PC board assembly.

__ 9. Locate the cardboard spacer(s). There will either be two individual rectangles, or one large rectangle with a hole in the middle. The spacer is used to help hold up the rubber "Zebra" connectors during and after assembly. Refer to the display driver PC board assembly. Note the one component installed on the solder side of the PC board that will face toward the lamp and display after the assembly is in position. Position the hole of the large spacer, or position the two smaller spacers so that the component on the PC board will have clearance, and not be pressing into the back of the cardboard spacer(s).

__ 10. Remove from its anti-static bag, and position the Display Driver PC board assembly so that the twelve mounting holes in the PC board line up with the threaded holes in the faceplate. The PC board assembly will set up off the back faceplate surface because of the Zebra connectors. Installing the mounting screws will apply the proper amount of squeeze to the rubber connectors. The wire cable from the PC board is positioned toward the push-button holes in the faceplate. Start two of the #4-40 x 1/4 pan head screws at diagonal corners to hold the assembly in line. Start the remaining ten screws and turn until they just touch the PC board, then alternately tighten each screw about 1/2 turn until the screws have pulled the PC board assembly flush to the back of the faceplate surface. Snug all screws.

__ 11. Hold the LED so it doesn't get its leads strained, and slide the black, plastic housing on the tail of the fiber-optic lamp over the LED on the PC board assembly until it snaps into place. Position, as much as is possible, the tail fibers so they fit into the PC board notch.

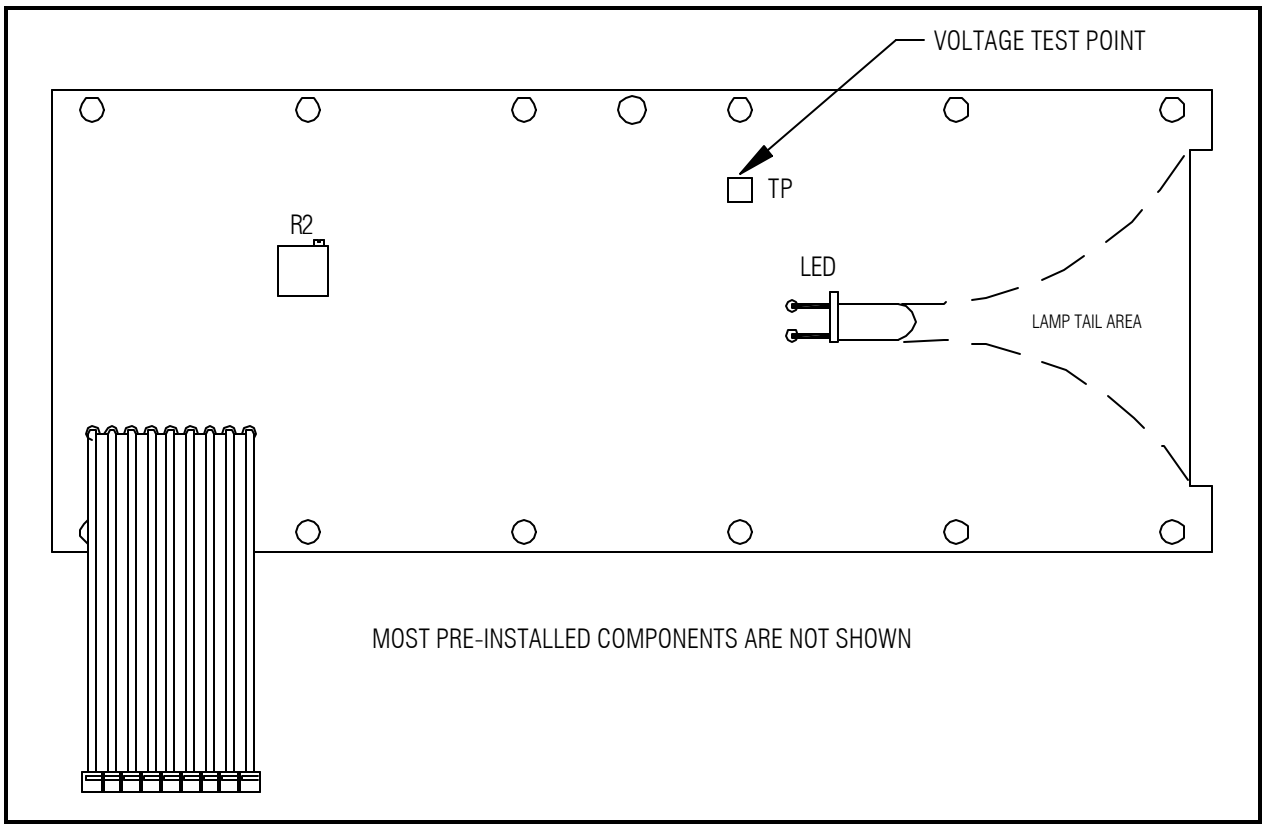


Figure 27 Display PC board assembly already assembled by RMI.

This completes the faceplate assembly.

µMonitor Bill of Materials

QTY	RMI#	DESCRIPTION	MANUFACTURER	MFG PART#
1	18-0100	Knob - selector	Selco	S110-125 BLK
1	18-0101	Knob - on/off	"	SP151-187 BLK
1	18-0102	Knob - insert	"	C111 WHITE
2	18-0103	Button - Yellow	Centralab	B-305-Y
4	18-0105	Button - Gray	"	B-305-GY
1	20-0002	Faceplate	RMI	1200
1	20-0005	Retaining screw	"	1201
1	22-0001	Non-glare glass	KSH	UVFNG 0507
2	22-0002	Display gasket	RMI	
9	22-0003	Display spacer	RMI	
1	22-0010	6 x 5-3/8 Adhesive film	"	
1	24-0007	Enclosure	"	1300B
1	24-0008	Top cover	"	1301B
1	24-0009	Bottom cover	"	1302B
1	24-0010	Mounting tray	"	1304B
18	26-0021	4-40x.25 PHMS PHLPS	Various	
15	26-0022	4-40x.187 FHMS PHLPS	"	
2	26-0023	Retaining ring	TRUARC	5103-12
2	26-0029	4-40 Hex Nut		
4	26-0025	4-40x.437 PHMS PHLPS	"	
2	34-0120	Temp Transducer	Analog Devices	AD590J
1	42-0038	Connector Housing	Molex	09-50-6185
1	42-0039	Polarizing Key	"	
40	42-0040	Crimp Terminal	"	08-05-0302
2	42-0041	Elastomer Connector	Tecknit	02-61890A
1	48-0001	Amp Transducer PC Board	RMI	2033
1	50-0003	LCD Display	"	2050
1	50-0002	Fiber-optic Lamp	"	2063
1	40-0100	12-28V Audio Transducer	L&M	KPE-650S
1	52-0009	Fuel PSI Transducer	VDO	360-043
1	52-0010	Oil PSI Transducer	"	360-430
1	52-0008	Ammeter Transducer	Micro Switch	CSLA1CE
1	14-0004	Monitor Display Assembly	RMI	

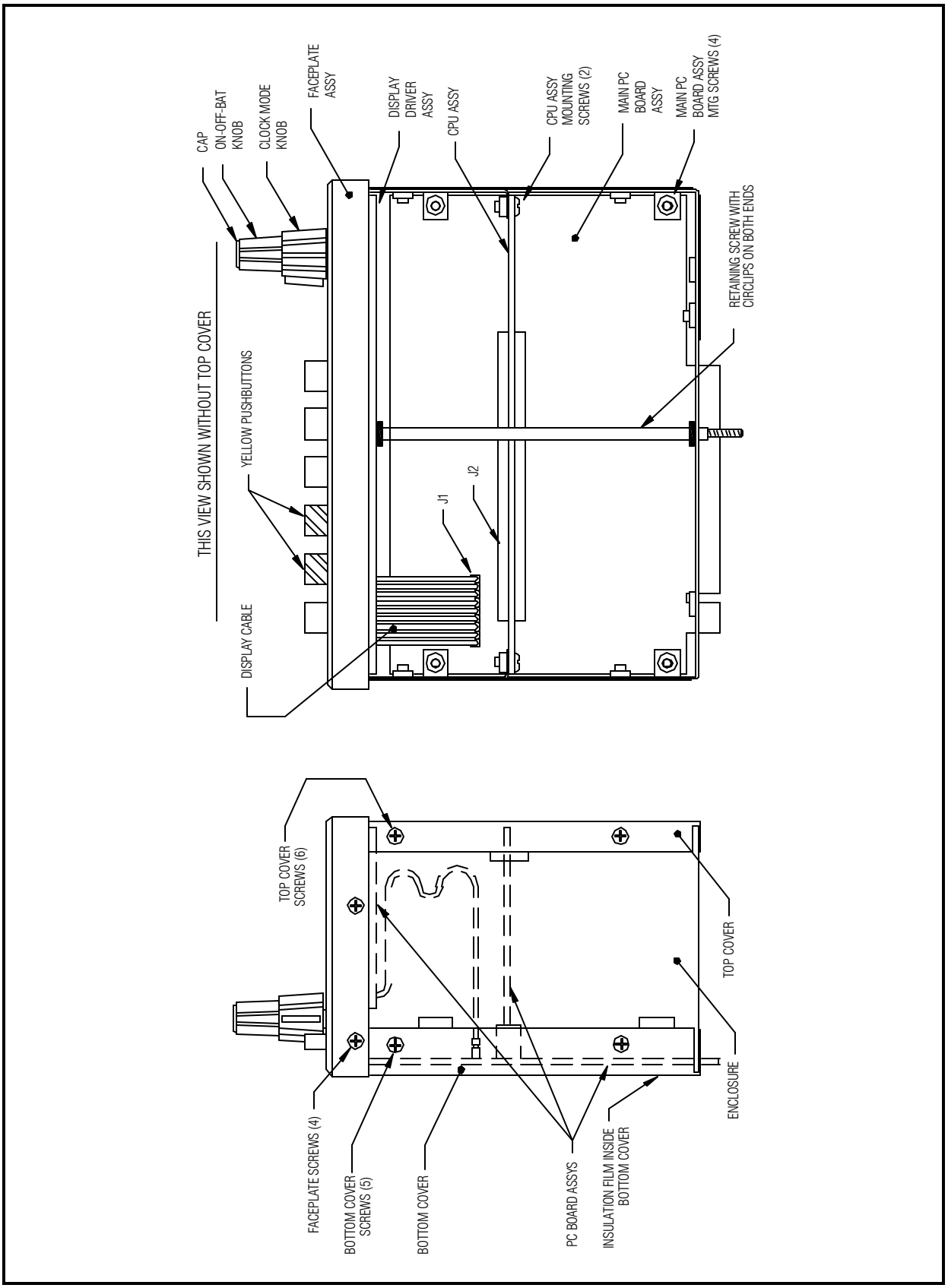


Figure 28 µMONITOR main assembly. For clarity, PC board assemblies are shown without components.

Install Push-Buttons

Install the push-buttons on the Main PC board switches as follows:

__ 1. Locate the four gray push-buttons and install them horizontally on the push-button switch shafts of the momentary switches. There may be a dimple from the molding process on one of the large surfaces. If so, install this side down for appearance.
(S2,S3,S4,S7)

__ 2. Locate the two yellow push-buttons and install them on the push-push switches.
(S5,S6)

Install PC Boards in Case

Refer to Figure 28.

__ 1. Locate the enclosure and turn it so the connector notch on the rear is facing up. Lay the Main PC board assembly on the four mounting tabs with the solder side up. Locate and install four #4-40 x 1/4 pan head screws through the PC board mounting holes into the threaded inserts of the mounting tabs of the enclosure. Turn the assembly over.

__ 2. Slide the holes in the faceplate assembly over the shaft and push-buttons of the Main PC board. The four mounting tabs on the front of the enclosure will fit into the rear of the faceplate assembly between the faceplate and the edge of the Display Driver PC board. Mount the faceplate assembly to the front of the enclosure with four #4-40 x 3/16 flathead screws.

__ 3. Plug the Display Driver connection cable into J1 on the Main PC board. Carefully fold the cable so that it does not protrude above the top edge of the enclosure.

__ 4. To install the CPU PC board assembly, slip the CPU board down behind the two mounting tabs on the top of the case, the mounting screws will install from the rear. Plug the gold fingers on the CPU board into J2 on the Main PC board. Match the two PC board mounting holes with the enclosure mounting tab holes and install two #4-40 x 1/4 pan head screws.

__ 5. Use the large end of the collet wrench from the knob package to loosen the nut on the large knob. Fully slip the large knob over the larger, outer shaft and tighten the collet nut enough that the switch can be turned. Turn the switch back and forth until the center of the five positions can be determined. Before repositioning the knob pointer, loosen the nut on the small knob (small end of wrench) and install it on the smaller outer shaft. Note the gap between the two knobs. You may need to position the large knob higher on the shaft to minimize the gap for best appearance. Reposition the large knob so the pointer is centered on the "TIMER" dot and tighten with the collet wrench. Don't leave the large knob too low to the faceplate, or it will mar the faceplate when turned.

__ 6. Install the small off-on-bat knob on the smaller shaft and tighten with the collet wrench. Rotary position is not important.

__ 7. Turn the off-on-bat knob back and forth to determine the center position. Install the white knob cap with the indicator line pointing to the "ON" position and snap into place. Save the collet wrench in case of future need.

__ 8. Put a little dab of RTV silicone seal at the tops of the three large electrolytic capacitors (C7, C8 & C9) to join them in as a group to reduce any possible vibration damage.

Related Sensor Assembly

Construction of the outside air temperature sensor/probe and the oil temperature sensor/probe are covered in the installation manual. However, since you already have the hand tools and solder iron handy, you may want to pursue these tasks now. Refer to Appendix A and B for those details also covered in the installation manual.

Unit Calibration

__ 1. Connect the battery charger to the µMONITOR. Make sure the unit is not on the foil anti-static sheet.

__ 2. Turn the off-on-bat switch to "on". The display descriptors and readings in all the sections of the display should appear. Hooray! With no transducers connected, the oil pressure, fuel pressure and carburetor temperature should indicate full scale. The remainder should read minimum scale except for EGT (may vary between 0 to 5 degrees) and manifold pressure (usually about 2.6 InHg). The amps should read -9 and start blinking after six seconds (warning/alarm condition).

In the next steps, be sure to adjust the voltmeter range switch to the best range (most sensitive) for all measurements.

The display driver voltage for the LCD was adjusted to approximately 1.9 volts during manufacturing testing. IF you wish to vary this voltage to change the contrast of the display, adjust the trimpot marked R2 on the PC board. The actual voltage can be measured by following the next step.

__ 3. Connect the common lead of the voltmeter to the GND test point. Hold the positive lead to the pad marked "TP" on the top portion of the PC board. As you turn the voltage down, some parts of digits that are supposed to be off will start appearing. Turn the voltage up until these disappear. You may want to vary the backlighting and refine the adjustment for best contrast under all conditions.

The following will adjust the 5.12 VDC reference voltage for the analog to digital converter.

__ 4. Connect the common lead of the voltmeter to the GND test point and the positive lead of the voltmeter to the top of either of R29 or R30. Adjust trimpot R47 until the voltmeter reads 5.12 VDC.

The following will adjust the 10.05 VDC voltage for the transducers.

__ 5. Leave the common lead of the voltmeter at GND and connect the positive lead of the voltmeter to the 10V test point. Adjust R11 until the voltmeter reads 10.05 VDC.

This completes the unit calibration and test until the after burn-in is complete.

Installing the Retaining Screw

__ 1. Locate the 4.8 inch long retaining screw and install it as shown in the assembly drawing with the threads to the rear of the unit. The screw can be inserted either from the front or rear of the unit and passes through the faceplate, the top of the CPU PC board and the rear of the enclosure.

The retaining rings ("C" clips) that fit into the two grooves of the retaining screw have been manufactured by a stamping process. This leaves the ring with a very sharp edge on one flat of the ring and a "rounded" edge on the other side. You may need a little magnification to see this.

2. Locate the two smaaallllll retaining ring circlips and install them in the two grooves in the retaining screw using small needle-nose pliers, with the sharp edge of the rings FACING TOWARD THE

MIDDLE of the retaining screw. This leaves the sharp edge of the ring bearing the load, reducing the chance of popping out of the groove.

Reliability Burn-in

The reliability of present day microcircuits is exceptional. But failures do occur. Over 90% of all electronic component failures occur during the first few hours of operation. Manufacturers of electronic products such as the µMONITOR subject the finished unit to varying degrees of reliability testing to eliminate weak components. Generally, the more stress given the unit (within limits), the more reliable it will be.

The major avionics manufacturers generally only subject the finished product to a 48 hour operational burn-in at elevated temperatures, and offer 2 and 3 year warranties, so it's not necessary to go crazy with reliability testing. The testing program described here will help ensure a µMONITOR with a long life.

The test program will be:

High temperature burn-in for 48 hours while operating
Diagnostics checkout and calibration
Shelf operation (optional)

To set up for the high temperature burn-in ("high" in this case will not exceed 65°C (149°F), put a 100 watt light bulb on an extension cord under a 16 x 12 x 6 inch box. Other box sizes may be used by adjusting the wattage of the light bulb or punching holes in the box. The ambient temperature should be about room temperature. Lay the bulb on a small glass oven casserole cover on a workbench or table. When the µMONITOR is placed in the box, it will be positioned at one end so that the face will be away from the bulb and toward one of the box walls when the box is placed over the whole mess. Position the box (flaps out with some weights on the flaps) over the lighted bulb and stick a meat thermometer through one side of the box so that the temperature measuring will be about two inches from the table (the use of more sophisticated thermometers is encouraged). Let the temperature stabilize (about 1/2 to 1 hour) and check the temperature. The ideal temperature would be exactly 55°C (131F).

The important point is to **NOT** exceed 65°C (149°F) at any time. The Liquid crystal display will turn totally black at 57°C (134°F) but will correct itself without harm once the temperature decreases. If the temperature is too high, switch to a 75 watt bulb or punch some holes in the box.

Don't put the µMONITOR into the box until you are sure that it won't go over 65°C (149°F).

__ 1. Connect the "aircraft bus" battery charger to the µMONITOR and turn the unit on and confirm that all is operating correctly.

__ 2. Put the µMONITOR in the box with the battery charger connected and the unit operating. For the first few hours, keep an eye on the temperature as a double check. At least every 12 hours, turn the unit off and on a few times. Once during the 48 hour process, unplug the light bulb and let everything cool off, then check that operation is good before plugging in the light bulb for the remainder of the time. Temperature changes are most likely to reveal any minimal solder joints.

__ 3. While the unit is toasting in the box, this is a good time to build the ammeter, outside air temperature and oil temperature transducer. Complete the instructions in Appendix A, B and C.

__ 4. At the end of the 48 hours, remove the unit and let it set at room temperature for about 15 minutes.

Complete Checkout

__ 1. Connect the battery charger power supply for a complete checkout of all functions.

__ 2. To connect the audio transducer, cut two wires, strip the ends and attach two of the crimp terminals to one end of each of the wires. Connect the other two ends of the wires to the screw terminals of the audio transducer. Insert the crimp terminal from the "+"lead of the audio transducer into stall #16 of the edge connector. Insert the crimp terminal from the "-"lead of the audio transducer into stall #2 of the edge connector. Make sure the AUDIO OFF pushbutton is in the out position.

__ 3. Turn the µMONITOR and the battery charger on. After six seconds, the amps alarm should trigger since there is no sensor connected. The amp reading should start blinking at the same rate as the audio transducer beeps.

__ 4. Turn the µMONITOR off. Remove the audio alarm.

__ 5. If the 600 ohm audio output will be fed into a headset, connect the headset to pins 4 and 17/18. Turn the µMONITOR on and wait for the amp alarm again. Adjust the headset audio alarm volume with trimpot R50. Remove the headset.

The following will adjust the µMONITOR battery charging voltage for the optional external backup battery (see Appendix D).

__ 6. Connect your voltmeter common lead to the GND test point and the positive lead to the banded lead of CR8. Adjust trimpot R66 until the voltmeter reads 13.2. Remove the voltmeter leads. If you are using a 12 volt battery for power, or the battery charger is not putting out sufficient voltage, you will not be able to adjust up to the 13.2 volts. If you are not installing a backup battery, this voltage is not important.

Although the backup battery feature is offered, we feel that in most cases it is not needed. If the alternator fails on the aircraft, you will have immediate warning with the µMONITOR alarm. You can then conserve the battery by shutting down non-essential, high power equipment. Because the µMONITOR draws so little current (approximately 150ma), it can be left on without significantly contributing to the battery=s demise.

__ 7. With a suitable length of jumper wire, connect the #1 special function alarm input on the edge connector to the GND test point or edge connector 17/18. Another good ground point is the negative (black wire) terminal on the battery - if connected. Turn the µMONITOR on edge if necessary. The edge connector input for special function #1 is "D" (under #4). Since the connector is in place, contact must be made to the rounded part of the edge connector finger that is not in the connector. Touch the wire to the finger, wait six seconds and observe that the special function "1" has started blinking in the center of the display.

__ 8. Test the #2 special function alarm input by touching finger #5.

__ 9. Test the #3 special function alarm input by touching finger #E.

__ 10. Recheck the 5.12 reference volt setting. Connect the common lead of the voltmeter to the GND test point and the positive lead of the voltmeter to the top of either of R29 or R30. Adjust trimpot R47 if necessary.

The remainder of the checkout is performed by reading through the µMONITOR Operation Manual and trying out each of the functions as you read about them.

__ 11. To check the nonvolatile memory, change the fuel quantity and then turn the µMONITOR off. Turn the µMONITOR back on and confirm that the new fuel quantity has been stored and recalled from memory.

Installing Covers

__ 1. Locate the bottom cover to the case. It has higher sides than the top cover and there is a notch in the back that matches the edge connector of the Main PC board. Locate the sheet of adhesive backed film from the kit. This will be installed inside the bottom cover as a protective insulator for the solder side of the Main PC board. Peel the paper off the adhesive backing and install the film to the cover.

__ 2. Install the bottom cover to the enclosure with five of the #4-40 x 3/16 flathead screws.

__ 3. Locate the top cover to the case. Slip the cover from rear to front over the retaining screw. Attach the top cover with six #4-40 x 3/16 flathead screws.

__ 4. Locate the adhesive-backed label sheet and the 3 x 4.5 inch adhesive-backed sheet of clear plastic. The clear plastic will be used as a protector for the labels as the label material has its own adhesive. Be sure that your serial number has been entered on the serial number label. Remove the backing from the clear plastic and stick it over the entire label. Cut the two labels to size leaving a little bit of white on the outside of the outlines.

__ 5. Remove the adhesive backing from the connector label, position above the edge connector and below the edge of the top cover on the back of the unit and apply.

__ 6. Remove the adhesive backing from the serial number label, position on the side of the unit midway between the top and bottom cover and apply.

Transducer Calibration

Calibration of the µMONITOR to match the individual engine transducers can be done on the bench if the transducers have not been installed in the aircraft, or on the aircraft itself. It is easier to do the temperature calibrations with the sensors out of the aircraft. The calibration steps are detailed in the µMONITOR Programming Manual.

If the calibration is done on the bench, the battery charger power supply used during assembly, a spare battery, or the optional external battery may be used to power the unit. Each transducer may be connected to the edge card connector one at a time, using the audio transducer wires that were made during assembly of the unit. Refer to the installation schematic in the µMONITOR Installation Manual for proper connection of the transducer to the edge card connector.

This completes the transducer calibration. Assemble the unit as necessary.

Shelf Testing

If you wish, you may connect the completed µMONITOR to the "aircraft bus" battery charger and run the unit outside the aircraft for additional experience in programming and operation.

Centigrade to Fahrenheit Conversion

°C to °F	°F to °C
(°C x 9/5)+32 = °F	(°F-32)/(5/9) = °C

°C =	°F
-40 =	-40
-30 =	-22
-20 =	- 4

-10 = 14

0=32	100=212	200=392	300=572	400=752	600=1112	800=1472
10=50	110=230	210=410	310=590	420=788	620=1148	820=1508
20=68	120=248	220=428	320=608	440=824	640=1184	840=1544
30=86	130=266	230=446	330=626	460=860	660=1220	860=1580
40=104	140=284	240=464	340=644	480=896	680=1256	880=1616
50=122	150=302	250=482	350=662	500=932	700=1292	900=1652
60=140	160=320	260=500	360=680	520=968	720=1328	920=1688
70=158	170=338	270=518	370=698	540=1004	740=1364	940=1724
80=176	180=356	280=536	380=716	560=1040	760=1400	960=1760
90=194	190=374	290=554	390=734	580=1076	780=1436	980=1832

* APPENDIX A *

Outside Air Temperature Probe

Figure 29 shows the AD590 temperature transducer. When handling the transducer, be sure to observe reasonable static protection precautions.

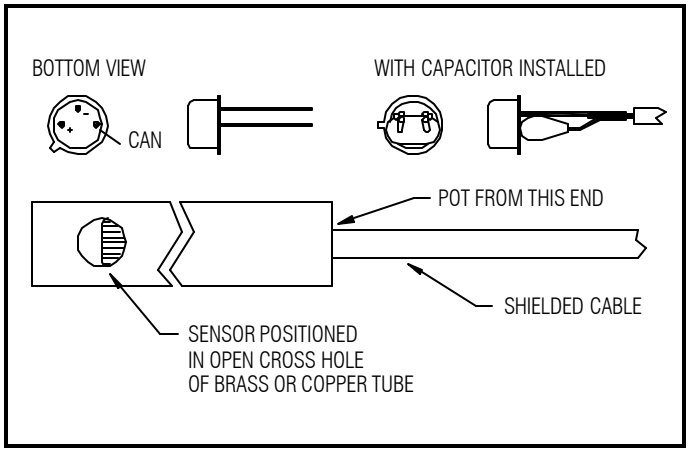


Figure 29 Outside air and oil temperature sensor details. Bottom of figure is one possible OAT probe.

Prepare one end of a proper length of twisted pair, shielded cable as follows:

__ 1. Remove the outer insulation for 1 inch (don't cut shield wires!). If the shield on the cable is a braided one, use a needle or sharp tool to unbraid the shield wires, gather about a third of the shield wires and twist them into a wire and fold it out of the way and gather the remaining shield wires and cut them completely off. If the shield on the cable is a foil type, just bend the bare drain wire (touches the foil shield) out of the way.

__ 2. Strip 3/16 inch from each of the twisted pair wires. Heat your solder iron, apply a small blob of solder to the tip and "tin" each of the bare leads. This keeps the stranded wire together and makes it easier to solder the lead to the sensor later.

__ 3. Cut two 1/2 inch pieces of the small shrink tubing and slide one over each insulated wire. You may want to wrap a temporary piece of electrical tape around the assembly to hold the shrink tubing so that they won't keep falling off during assembly and soldering.

__ 4. Cut a 1-1/2 length of the large shrink tubing and slip over the entire cable for later use.

__ 5. Locate the temperature sensor (marked AD590) and the .1µFD ceramic capacitor (marked 104) from the black anti-static box. Use the figure to identify the lead marked "CAN" and bend it about 45° out of the way. Trim the capacitor leads to about 3/8 inch long. Position and hold the capacitor as shown in the figure and then trim the "+"and "–"leads off so the ends of the sensor leads match the ends of the capacitor leads.

__ 6. Hold the capacitor and sensor in one hand so that the end of a capacitor lead and the end of a sensor lead are touching. Melt a small blob of solder on the tip of your solder iron to and temporarily solder tack the two leads together. Now that the assembly is better held together, position and solder the other capacitor and sensor lead together.

__ 7. Lightly clamp the previously prepared cable in a vise so the black and white wires are in a position to solder the sensor assembly to them.

__ 8. Overlap the "+"lead of the joined capacitor and sensor with the lighter colored wire and with your free hand apply the solder iron with a little solder on the tip to the junction. Make sure you have a good joint. Repeat with the "–"lead and the darker wire.

__ 9. Slip the two small shrink tubes down over the two completed joints and shrink into place.

__ 10. Overlap the twisted shield wire with the "CAN" lead from the sensor and trim the shield wire so the overlap will be about 1/4 inch. Solder the shield and "CAN" lead.

__ 11. Slide the large shrink tube up until it touches the back of the AD590. Shrink into place. This completes the attachment of the AD590 sensor to the wire cable.

__ 12. You may wish to test the sensor before potting and installing by cutting the cable to length and temporarily attaching the wires to the edge connector housing. Mark the lighter colored wire with a "+"to later identify the positive lead. Reverse connection of the sensor will not damage the sensor.

Since the variety of possible installation locations is so large, a specific design can not be given, but the following points are universal:

- If the metal case of the transducer itself is not exposed to the outside air, the thermal connection between the transducer and the probe material that is exposed to the air should be metal to metal with little if any insulating adhesives etc. between them.

- The mass of the probe material should be small as possible. The intent of this and the previous instruction is to minimize the time for the transducer to respond to a change in temperature.

- Use minimum solder heat when connecting the leads to the wiring harness. Cover the finished joints with shrink tubing and mark both ends of the wires with the proper polarity.

- Minimize the strain placed on the leads entering the transducer. If the transducer can be inserted into a probe far enough, pot the wires with RTV cement or similar compounds.

- Direct moisture contact between the two leads (on bare wires) will affect the accuracy of the temperature readout.

- It is OK to clip off the little polarity tab with diagonal cutters if necessary.

We would appreciate any sketches or descriptions of your design to pass on to other builders. Thanks.

* APPENDIX B *

Oil Temperature Probe

The AD590 temperature sensor used for oil temperature is the same as that used for outside air temperature.

__ 1. Repeat Appendix B through step 12.

The completed sensor/cable assembly must be potted into a proper fitting for the engine used. A "plug" of the proper thread for your engine is modified to hold the sensor. If the engine already has a different type of sensor installed, or the blank plug is not installed, you may get a blank from the engine manufacturer. It has also been reported that a common automobile oil drain plug works well. The engine manufacturer's blank is brass and the automobile type is steel. You may also use a 1/4 or 3/8 inch pipe thread plug if that will work with your engine. George Orndorf at (940) 648-0841 can provide a brass, one-piece (5/8-18 thread) housing that reaches the oil stream for $12.00 plus shipping (fits all Lycomings and Continentals).

__ 2. Determine the proper plug for your engine oil temperature connection. Drill a 15/64 (.234) diameter hole from the outside face of the plug toward the tip. Leave approximately .100 of material between the bottom of the hole and the bottom of the plug. If you have the capability of going in with an end mill to leave a flat bottom, that would be better.

__ 3. Clean the pipe plug and insert the probe assembly into the hole. Fixture the cable to hold the transducer firmly against the bottom of the brass plug and fill the cavity with RTV sealant. The transducer should not lift off the bottom. The intent is to provide maximum thermal contact between the transducer and the housing. If the plug has a flat bottom, a **light** coat of contact cement to both transducer and plug bottom will hold the transducer down while filling the cavity.

__ 4. Let the RTV set overnight.

Variations may be made on the above to suit your engine installation as long as the principle is the same.

* APPENDIX C *

Optional External Battery

The µMONITOR has a float charging circuit and connections for an external gel-cell battery that will operate the instrument for 8 to 10 hours in the event of electrical failure.

The external battery (if installed) is maintained in a float charge by the µMONITOR's internal charging circuit when the aircraft is operating. However, if the gel-cell needs to be charged on the ground, connect a battery charger directly to the µMONITOR or the aircraft (with aircraft battery disconnected) and not directly to the gel-cell. The µMONITOR must then be turned on to recharge the external battery. Direct connection of the gel-cell to a standard automobile type battery charger (even on trickle charge) will probably destroy the gel-cell.

If the µMONITOR is being operated solely on the external battery on an aircraft without an alternator or generator system, a convenient plug may be installed for easy connection of the µMONITOR to the battery charger.

Any 12 volt gel-cell with an ampere-hour rating of 1.2 or less will operate the µMONITOR. The 8 to 10 hour operation is based on a 1.2 ampere-hour rating.

Two compatible gel-cells are:

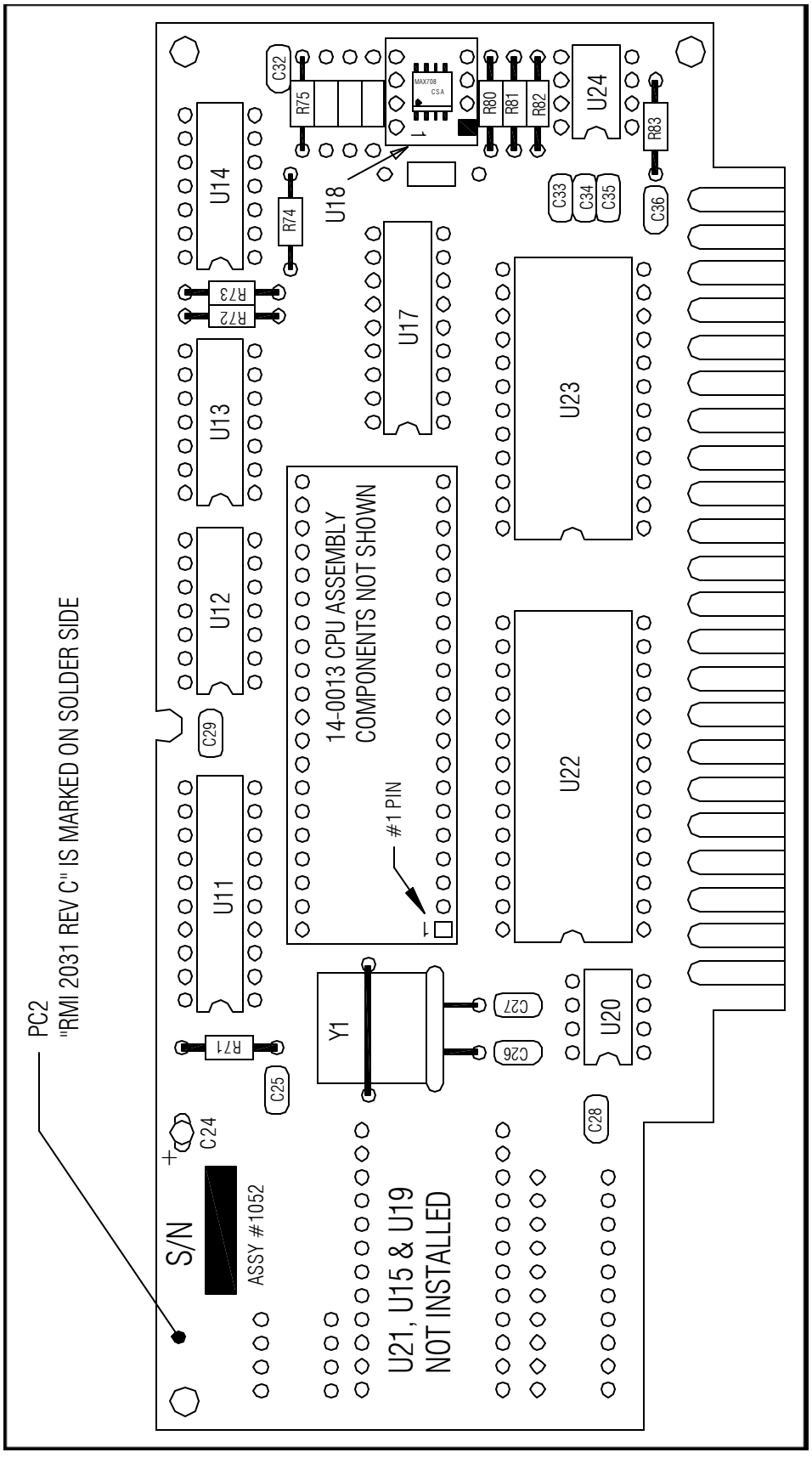
Powersonics	PS-1212
Yuasa	NP1.2-12

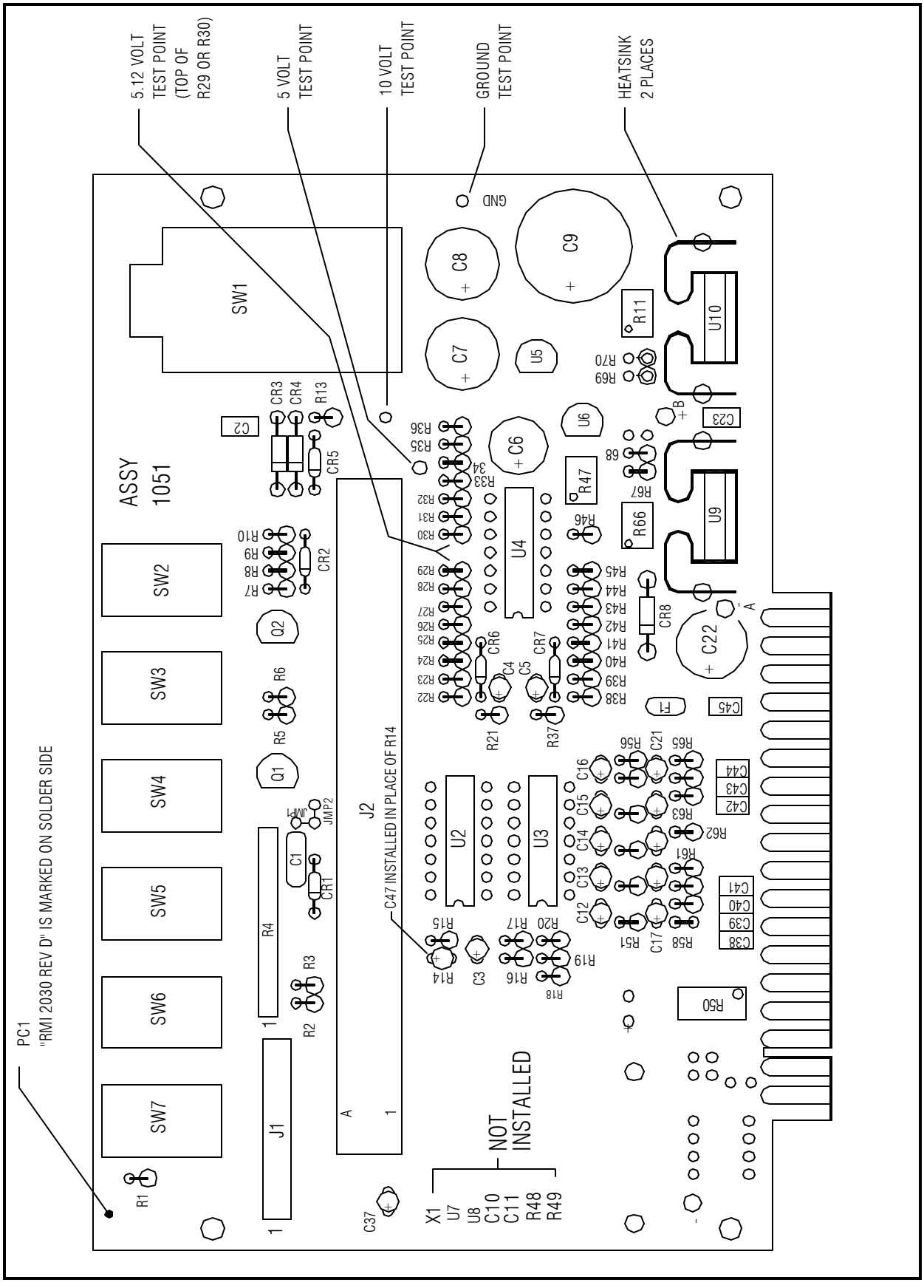
They can be found in the Yellow pages under batteries. Motorcycle dealers also handle these brands.

Two mail order sources for the Powersonic gel-cells are:

Allied Electronics	(800) 433-5700	Stock # 621-0402 Apx. $18
Mouser Electronics	(800) 346-6873	Stock # 547-PS-1212 Apx. $18

- APPENDIX D *


PC2
"RMI 2031 REV C" IS MARKED ON SOLDER SIDE
14-0013 CPU ASSEMBLY
COMPONENTS NOT SHOWN
#1 PIN
U21, U15 & U19
NOT INSTALLED
S/N
ASSY #1052
U11
U12
U13
U14
U17
U18
U20
U22
U23
U24
Y1
R71
R72
R73
R74
R75
R80
R81
R82
R83
C24
C25
C26
C27
C28
C29
C32
C33
C34
C35
C36
MAX708
CSA


5.12 VOLT TEST POINT (TOP OF R29 OR R30)
5 VOLT TEST POINT
10 VOLT TEST POINT
GROUND TEST POINT
HEATSINK 2 PLACES
PC1
"RMI 2030 REV D" IS MARKED ON SOLDER SIDE
ASSY 1051
C47 INSTALLED IN PLACE OF R14
NOT INSTALLED
X1
U7
U8
C10
C11
R48
R49
SW1
SW2
SW3
SW4
SW5
SW6
SW7
J1
J2
U2
U3
U4
U5
U6
U9
U10
C6
C7
C8
C9
C22
C23
GND