CHAPTER 2

GENERAL MAINTENANCE INSTRUCTIONS

2.1 GENERAL INFORMATION

This chapter provides the maintenance technician with general information concerning the 580 Computing System. The Computing Components manual of this series (EAI Publication Number 00 800.2057-0) provides a specific maintenance guide for each individual tray.

The technician is referred to the following: (a) Reference Handbook for patching procedures of the various computational components (EAI Publication Number 00 800.2055-0); and Applications Reference Library Bulletins available through the EAI Advertising Department, West Long Branch, New Jersey.

2.2 PREVENTIVE MAINTENANCE

The primary goal of preventive maintenance is to minimize downtime. This is accomplished by a systematic check of the equipment to detect any decline in performance. Detailed and carefully maintained records and malfunction reports should be kept. These records (if carefully analyzed) will provide information to evaluate a given maintenance program. This permits the maintenance technician to establish an efficient program for his particular installation.

The preventive maintenance routines are divided into two groups. These groups are frequent (daily to weekly) checks, and infrequent (semi-annual) checks.

2.2.1 Daily to Weekly Checks

1. The computing and maintenance areas should be kept clean. Dirt and loose or foreign objects can cause malfunctions. Recorders and plotters should be covered when not in use.

2. All power supplies should be checked for nominal magnitude.

3. All operational amplifiers should be checked and balanced when necessary.

4. The reference supplies should be checked for 10 volts nominal magnitude, ripple, and noise.

5. Check the DVM unloading amplifier balance and unloading adjustment after sufficient warm-up (1/2 hour).

6. Check RDAC amplifier balance.

7. All recording equipment should be checked for ink and paper supply as well as for general operating conditions and calibration.

8. The readout functions should be checked for operation.

9. Make certain that all equipment necessary for scheduled operation is available and in operating condition.

2.2.2 Semi-Annual Checks

1. Complete all daily checks.

2. Check slaving capabilities.

3. Check all amplifiers for offset and load current.

4. Perform a dynamic check on all multipliers, and function generators.

5. Check DVM display lamp operation.

6. Check the display oscilloscope for overall operating condition.

7. Check potentiometers for automatic and manual setting.

8. Check the following:
   - All air filters.
   - Accuracy of all resistors.
   - Accuracy of integrators.
   - Comparator sensitivity and operation.
   - All trunks for continuity.

9. Service plotting equipment and check recorder frequency response.

10. Check DVM calibration.

EAI maintains a highly trained and skilled Service Engineering staff that is available to a customer on two terms: either resident or temporary basis. The suggested preventive maintenance routines are based on the experience of this staff in both EAI Computation Centers and customer installations throughout the world.

2.3 SERVICE TECHNIQUES

The following suggestions and techniques are given to aid maintenance personnel who are not yet familiar with the servicing of transistorized equipment.

2.3.1 Etched-Circuit Board Soldering

The techniques and precautions employed while soldering any electronic equipment apply to etched-circuit boards; however, several additional factors should also be considered.

Wire leads or components fastened to the board by their leads may be replaced in the following manner:

1. If a component (IC can, transistor, etc.) is to be replaced, remove it with a pair of "flush cutters" by clipping the leads as high, and as close to the "can" as possible (Figure 2.1). Remaining now are only the wire leads.

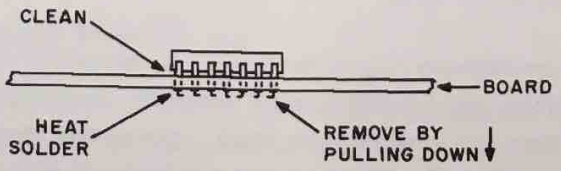

Figure 2.1. Removal of Flat Pack

2. Grip the lead to be removed with a pair of long nosed pliers. While applying pressure to the lead, touch a well-tinned, small (40-watts or less) soldering iron to the fillet. If the lead does not slip out easily, remove the soldering iron and insure that the correct fillet is being heated.

3. Clear the excess solder from the hole by briefly touching it with the iron and then carefully pushing it out with a soldering aid (CG Electronics Number 9093). For plate-through holes, a vacuum type soldering iron is recommended. In most cases, a hollow point soldering iron with a manually operated vacuum bulb (ENDICO, Model 300 pencil de-soldering iron) is sufficient.

4. Bend the leads on the new components or jumper to fit the board connections, and insert the component without cutting the leads.

5. With the component held in place, touch the iron to the lead allowing solder to run down the lead and form a fillet. As soon as fillet is formed, remove the iron. It is not necessary to completely fill the hole with solder as some components (transistors, diodes, etc.) are easily damaged by excessive heat.

6. When all leads have been soldered, cut the lead off as close to the board as possible (flush cutters). Carefully scrape off excess flux and solder from the board with a soldering aid.

Removal of the components is much easier if special soldering iron tips such as the Ungar Electric Tool Number 856 (5/8 inch diameter cup) and Number 858 (bar) are used. These tips are used for component *removal* only, and permit all leads to be freed together.

If the above procedures are followed, no trouble with the etched conductor itself should be encountered. If, however, a conductor becomes cracked it may be repaired by carefully soldering a tinned piece of bus wire over it. Again, extreme care should be taken not to overheat the strip and cause it to separate from the board.

2.3.2 Transistor Servicing

Most transistors are mechanically rugged, but they can be damaged by excessive heat. If it becomes necessary to solder near a socket mounted transistor, the transistor should be removed to prevent damage. When it is soldered to the board, extreme care should be taken to prevent overheating. Always use a small, well tinned soldering iron, and work as quickly as possible.

Transistors and diodes soldered directly to the board should be removed only when there is strong reason to believe they are defective. When soldering transistors or diodes, a heat sink should be used on each lead as it is soldered. Two common methods of heat-protection for these components are (1) holding the lead with a pair of long-nose pliers or (2) by clipping an alligator clip (the jaws filled with solder) on the lead.

Power transistors are often mounted on metal chassis plates, which function as heat sinks, to dissipate the heat generated during normal operation. The metal case of a power transistor is usually the collector and operates at a relatively high voltage. Because of this, power transistors must be electrically insulated from the heat sink but still allow heat transfer to the sink. A

common method of accomplishing this is by using a mica, anodized aluminum, or fiberglass washer with silicon grease. The washer provides electrical insulation and the silicon grease increases the heat conduction. When replacing the power transistor, use only a single washer and coat both sides with silicon grease; Dow Corning Number 340 Compound, EAI 00 942.0025-0 (or equivalent). As a final precaution before applying power to the unit, check the resistance between the body of the transistor and the heat sink to ensure that no short or high resistance leakage patch exists between these points.

Diodes, electrolytic capacitors, and the transistors themselves used in transistor circuits are frequently damaged by voltage overlaod. Transistors should never be removed or inserted with power applied, and special care must be taken in the selection and use of test equipment. Signal generators commonly used in servicing vacuum tube circuits are often capable of producing enough output to overload and permanently damage the diodes, electrolytic capacitors, and transistors of the type used in transistor circuits. Always start with the minimum output signal and slowly increase it to the desired level.

The meter used for continuity and resistance checks must be carefully chosen. Some ohmmeters use batteries with a higher voltage rating than the transistors and capacitors being checked, and can destroy them. A meter with a 1-1/2 volt battery is recommended. In order to prevent damage to the small electrolytic capacitors it is essential to determine the polarity of the ohmmeter leads. This may be accomplished with another meter set to a low dc scale.

2.3.3 Transistor Troubleshooting

As with any other type of electronic circuit, the first step in troubleshooting transistor circuits is a visual inspection for charred, discolored, or leaky components; broken, shorted, or loose connections; heavily tarnished or broken connectors; and physical damage to the board itself. The next step is to replace any relays, ovens, or choppers, which are socket mounted on the board, with units known to be good. This is done not only because it is fairly easy, but also because each contains mechanical moving parts which may fail due to normal wear. If the trouble is not located by either of these steps, the board may be dynamically tested by applying all supply voltages and a signal input and then checking voltages and signals on the board until the trouble is isolated. If dynamic testing is impossible due to the lack of suitable test equipment, or availability of "down time" on the equipment in which it is used, the trouble can usually be located through resistance and continuity checks.

Refer to the schematic when making resistance checks to be sure that meter polarity is correct for any electrolytic capacitors in the circuit and that parallel dc paths are not affecting the readings. When the board is removed many components are naturally isolated by the plug or pin

connections. Others are effectively isolated by capacitors in series with them. When it becomes necessary to unsolder and lift one end of a component from the board to isolate it for resistance checks, resistors should be chosen whenever possible. Resistors are least likely to be damaged by heat. In many cases, by carefully selecting the correct lead to disconnect, several components may be isolated at one time.

It is not usually necessary to risk overheating a transistor by unsoldering it to make resistance checks. For example, lifting one end of the collector load resistor and one end of the emitter resistor would effectively isolate the transistor in a normal transistor amplifier stage.

Once a transistor is isolated, it may be checked using the following procedures:

1. Set the ohmmeter to a high range and connect it between the base and the collector leads; reverse the leads and note which connection caused the higher reader. This is the reverse-bias direction.

2. Connect the ohmmeter to reverse-bias the transistor and note the reading. Short the base to the emitter. The reading should decrease. Remove the short.

3. Move the lead on the base to the emitter and note the reading. Reconnect the short, the reading should increase.

This test will indicate a turned-out transistor but not a weak or high-leakage transistor. If a transistor is still suspected, and no other troubles are found, substitute one known to be good.

2.4 TROUBLESHOOTING

This paragraph describes some of the convenient troubleshooting aids provided in the 580 System and outlines a few basic procedures for the technician who is not thoroughly familiar with the system.

CAUTION

When replacing trays refrain from ramming or forcing mating connectors together. A slight misalignment (or inadvertently placing the tray in the wrong slot) can cause connector blocks to crack if subjected to undue force.

First, ensure that primary power is applied and that all cables are properly connected. Actual ac hookup is dependent upon site requirements; the technician should have an accurate diagram of the ac hookup at time of system installation.

If the programmer reports a malfunction during a problem run, the technician should request a copy of the programmer's computer diagram, amplifier and attenuator assignment sheets, etc. The technician should be familiar with both Analog and Digital programming symbols and various programming notations in order to obtain maximum information from the data.

Because the console is a completely self-contained computer, disconnection of the peripheral gear will locate the faults in either the console or the peripheral equipment. Once the major component is located, maintenance information concerning that unit may be found in the respective handbook, and/or chapter within the 580 Maintenance manuals. Refer to the index and list of associated manuals at the front of this manual.

The DVM, display unit, and monitoring oscilloscope are also very useful in troubleshooting. When a particular tray is suspect, interchange it with an identical unused tray and, if the trouble clears, the fault is isolated to the replaced tray. If the trouble remains, the patching is probably in error. If an unused tray is not available, switch position with an identical unit that is in use and check to see if the malfunction follows the tray.

Another method is to remove the patching from the suspected unit and patch in its place, an identical unit. If the trouble is cleared, repatch the original unit back into the problem to ascertain that some unnoticed patching error was not rectified in the change.

2.5 MAINTENANCE EQUIPMENT

In the 580 Computing System, most components are mounted on plug-in cards and/or trays. This allows rapid replacement of a defective unit with a spare unit. The interruption to computation is brief; actual repair of the defective unit can then be made at the convenience of the technician. With this concept, it is necessary to maintain a supply of spares. The use of spares, on a regular rotational schedule, allows regular computer components to go through preventive maintenance with little or no computer down-time. A recommended spares list may be purchased from EAI to suit a specific customer installation. An extraction tool (EAI 00 777.0239-0) for removal of the plug-in trays behind the patch panel is available from EAI.