TESTING, REPLACING, HANDLING, STORING, AND SHIPPING CIRCUIT PACKS AND SEMICONDUCTOR DEVICES

CONTENTS PAGE

1. GENERAL

1.01 This section provides description and definitions of circuit packs for various electromechanical systems and electronic-type switching systems. Instructions are also provided for handling, storing, shipping, testing, and repairing circuit packs and semiconductor devices.

1.02 This section is reissued to add information pertaining to KS-21487 blister paks, KS-21040 carrying case, and to update circuit pack information. Since this reissue covers a general revision, arrows ordinarily used to indicate changes have been omitted. This reissue does not affect the Equipment Test List.

1.03 This section contains many precautions with which all personnel involved with semiconductor devices and circuit packs should become thoroughly familiar. This will reduce the probability of damage to these devices during periods of testing, replacing, and handling.

1.04 Normally the only semiconductor devices tested in the field are those not mounted on plug-in circuit packs.

2. APPARATUS

2.01 KS-14510 L1 volt-ohm-milliammeter (VOM) or equivalent.

2.02 Testing cord (2W49A) consisting of testing cord W2FU, equipped with a 360A and B tool on the red and black conductors, respectively, at the testing end, and two KS-14530 connectors at the meter end. The W2FU cord includes a 0.47

μF capacitor and a 446F diode encased in a plastic shell. This cord is intended for use with KS-14510 L1 meter.

2.03 Testing cord (2W49B) consisting of W2FU cord, equipped with a 360A and B tool on the red and black conductors, respectively, at the tool end, and two H. H. Smith 255 banana plugs at the meter end. The W2FU cord includes a 0.47 μF capacitor and a 446F diode encased in a plastic shell. This cord is intended for use with Simpson 260- and 270-type VOM or Triplett 630-type VOM.

2.04 Two KS-6278 connecting clips or tools as specified in the appropriate section in Division 069 for making connections when testing diodes.

3. DEFINITION AND DESCRIPTION

SEMICONDUCTOR COMPONENTS

3.01 The material used in the fabrication of semiconductor devices is a solid, deriving the term solid-state devices. Semiconductors operate at low supply voltages, have low power dissipation, and have long operating life.

3.02 The active region of a miniature electron tube is approximately a million times that of a typical switching transistor. The gold wires which connect the input leads to the active region inside the transistor case can be as small as 0.0004-inch diameter or 1/4 the size of a human hair. An appreciation of the size of the internal parts of a semiconductor device is important in understanding why these devices are easily damaged by heat and shock. With these small active regions, cleanliness around the region is very important. Maintaining this cleanliness is closely controlled during manufacture but is dependent on the glass seal between the leads and the case once the device is assembled. This glass seal must never become cracked if the device is to provide reliable operation.

3.03 Diodes have a low resistance to current flow in one direction and a relatively high resistance to current flow in the reverse direction. Individual types of diodes are constructed with various voltage and current limits, dependent on size, type of materials, and design characteristics. Exceeding the voltage and current limits of the diode, even momentarily, usually results in permanent damage to the device.

3.04 Varistors are electrical resistors whose resistance depends on the applied voltage. The value of resistance varies inversely with variations of applied voltage. Permanent damage may result by exceeding the voltage and current limits.

3.05 The leads of a 3-element transistor are designated emitter, base, and collector and compare to the cathode, grid, and plate of the electron tube (Fig. 1). The polarity of the bias voltage is critical as reversal of polarity of bias voltages result in excessive current which can cause permanent damage to the transistor.

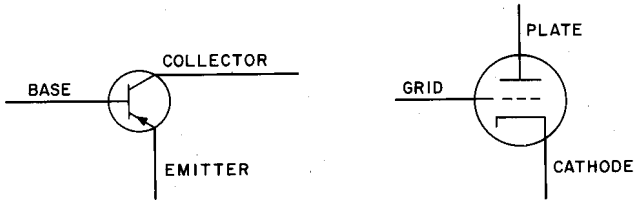


Fig. 1—Comparison of Transistor and Vacuum Tube

3.06 A circuit pack is defined as a replaceable plug-in unit consisting of semiconductors, capacitors, resistors, and other electronic components assembled into specific circuit configurations on a printed wiring board.

3.07 Circuit packs are coded alphanumerically (eg, A1, A2, etc, or P1, P2, etc). The packs vary in size from 3 to 8 inches high, from 3 1/2 to 8 inches long, and mount on from 0.4- to 3-inch centers. A typical circuit pack is shown in Fig. 2.

3.08 Each circuit pack contains all or part of the following. (See Fig. 3, 4, 5, and 6.)

(a) Code number (eg, A6) superimposed or stamped on the pack.

(b) Data and location of manufacture (eg, 8H69—a pack manufactured at Hawthorne in August 1969).

(c) Series number of the original manufacture and any subsequent changes (eg, 1-3 means that design changes 1, 2, and 3 have all been incorporated; 1.3 or 1/3 means that only changes

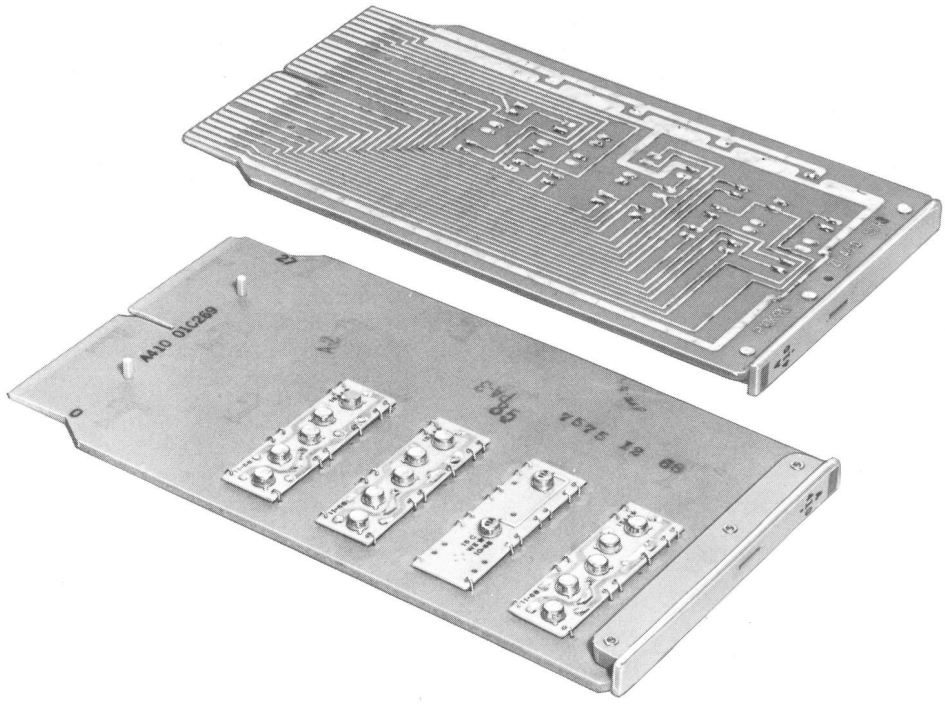


Fig. 2—Typical Circuit Packs

per series 1 and 3 have been included in the pack). The latest series number required by a particular system for a circuit pack is shown on a functional schematic drawing for that system.

(d) Colored strip (red, yellow, or blue).

3.09 There are several types of faceplates (front part of circuit pack) used on the various circuit packs. Some switching systems have used two types of faceplates with corresponding designation strips. The older vintage faceplate and designation strip, now rated Manufacture Discontinued, use an inserted designation card (typical shown in Fig. 3 and 5). The later style faceplate and designation strip use molded plastic; the color code and alphanumeric apparatus code are hot stamped into the plastic (typical shown in Fig. 4 and 6). However, some systems do not use a faceplate. In these cases, a card ejector is permanently affixed to the circuit pack. The circuit pack code is stamped on the ejector.

3.10 The circuit packs referred to in this section can be classified into two general categories; namely, functional-type circuit packs and component-type circuit packs. Functional circuit packs will contain logic circuit elements, such as gates, flip-flops, and/or nonlogic circuit elements, such as oscillators, timers, etc. Component-type circuit packs are essentially mounting facilities for diodes, resistors, capacitors, etc. It is possible for a circuit pack to include the characteristics of both categories.

3.11 Circuit packs should be tested in the field only when the testing requirements and specifications are given in the appropriate schematic drawing or BSP. Transistors should not be tested as separate components, only as part of circuit packs, except when specific instructions are given regarding a particular circuit and observing the necessary precautions for testing of circuit packs.

4. HANDLING

GENERAL PRECAUTIONS

4.01 Semiconductor devices are physically constructed to withstand limited mechanical shocks of mishandling, such as drops and jolts of a normal nature. They are not indestructible, however, and excessive shocks may shorten their life expectancy

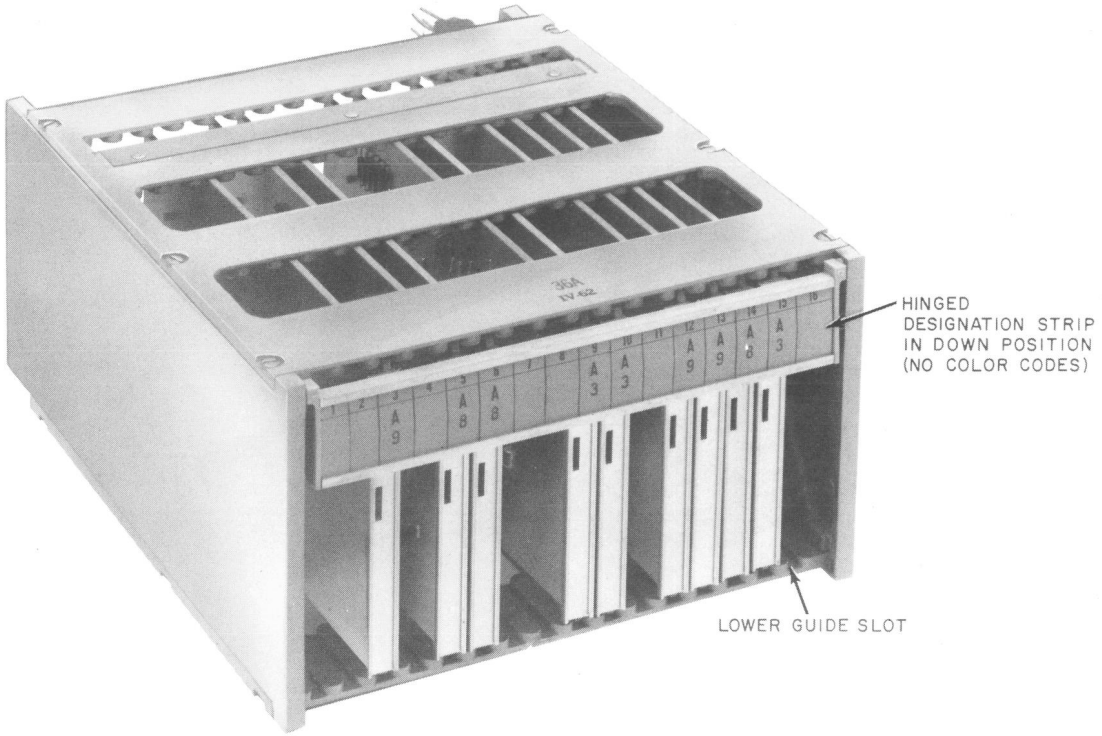


Fig. 3—Apparatus Mounting With Hinged Designation Strip in Normal Position

and change their electrical characteristics. If any damage is noted, such as cracked glass seals or dents and nicks in the case, the transistor should be replaced.

4.02 In the event a semiconductor device or a circuit pack is dropped from the workbench, or equivalent height, an inspection and test should be made at this time to determine possible damage. Testing of the circuit pack may be accomplished by inserting the pack into a working system with the system in an "off-line" state. An item that tests defective should not be installed or returned to stock but returned to a service or repair center in accordance with local procedures.

4.03 Semiconductor devices and circuits in general are sensitive to static charges. A static charge of several thousand volts can be produced by walking on nonconductive floors, low humidity condition, and wearing of certain types of clothing materials. These static charges can be effectively dissipated before handling semiconductor devices by touching a grounded metal object such as a metal frame.

4.04 Integrated circuit packs and thin film circuits are usually more susceptible to mechanical shock than conventional circuit packs due to their multiplicity of components and construction. Thin film circuits are not encapsulated and care must be exercised to avoid damage to these units. A minute scratch can result in serious circuit damage.

4.05 Damage may also result from dirt and other contaminants that abrade the gold contacts and cause premature wear of the circuit packs. Once the gold plating has worn off or been scratched, an insulating film will form on the exposed copper of the printed circuit board. This film will cause electrical noise in the circuit and, if undisturbed for a long time, could open the circuit. A great deal of the contamination and dirt can come from personnel mishandling the gold-plated contacts. By allowing them to come into contact with floor dirt or abrasives or even dirty hands, these contacts can be destroyed.

4.06 The main cause of mechanical damage in handling circuit packs are as follows:

(a) Dropping on bench or floor

Fig. 4—Molded Circuit Faceplate and Front of Apparatus Mounting With Hinged Description Strip in Normal Position

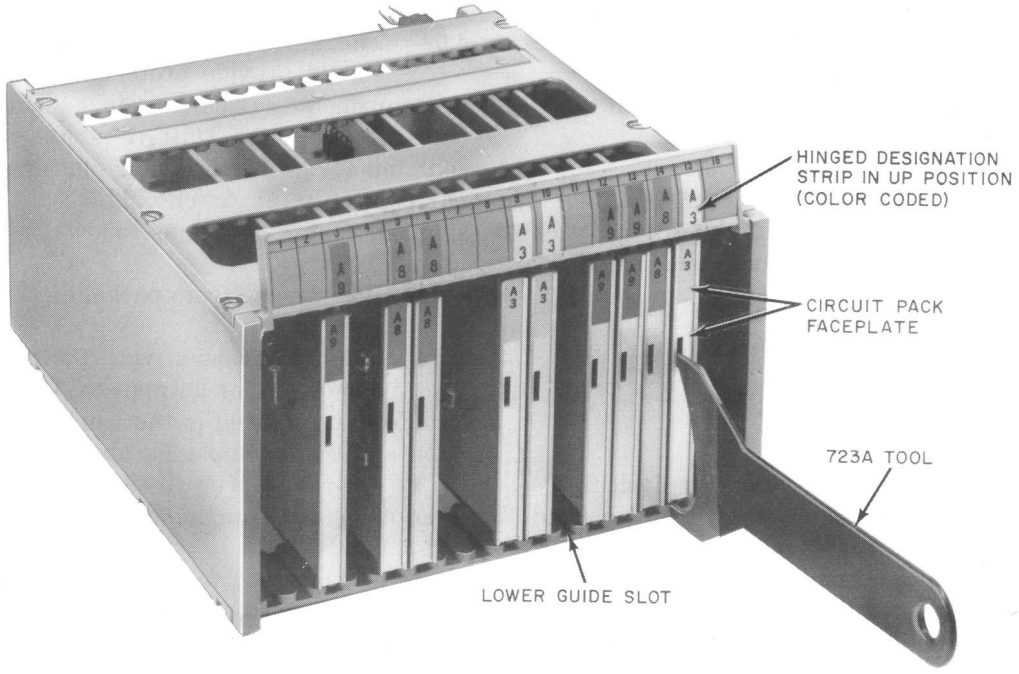


Fig. 5—Apparatus Mounting With Hinged Designation Strip in Raised Position

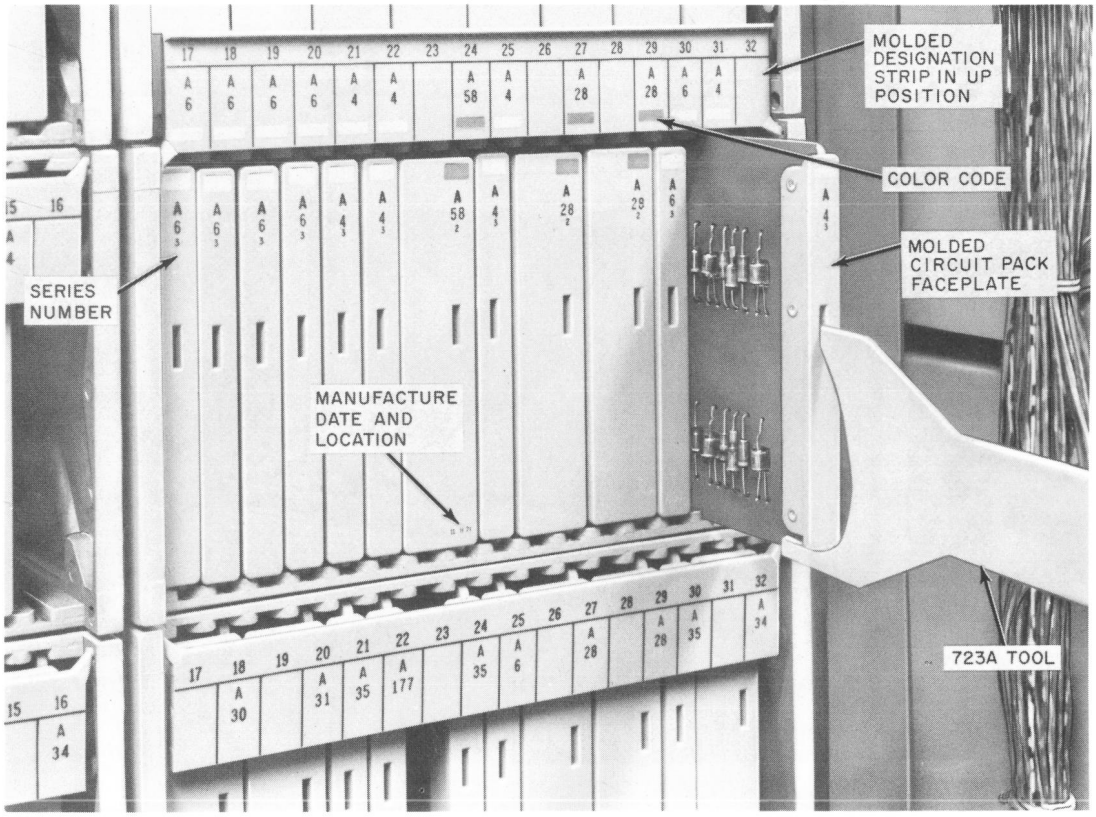


Fig. 6—Molded Circuit Pack Faceplate and Front of Apparatus Mounting With Hinged Designation Strip in Raised Position

(b) Stacking pack on or against each other

(c) Applying direct pressure to components

(d) Failure to protect connector contacts

(e) Touching connector contacts contaminates gold plating and causes poor connections.

SHIPPING

General

4.07 Circuit packs and semiconductor devices are very fragile and must be carefully packed to prevent damage in shipment. When possible, the replacement unit shipping carton should be used to return the defective unit. If approved-type cartons are not available, any standard shipping carton will suffice, providing each unit is tightly enclosed with wadding or crushed paper and that the shipping carton is completely filled.

4.08 The shipping container for circuit packs should provide protection for the pack and its components. This container should protect the contact finish so that it is not scratched or contaminated with particular matter or substances, such as sulphur or chlorides. Two suggested shipping containers are as follows.

(1) Polystyrene foam package.

(2) Chipboard carton (with the circuit pack in a blister pak or an approved polyethylene bag before it is placed in the chipboard carton). The outer package must be able to meet the shock and vibration requirements as specified in Equipment Design Standards Specification X74500, 3.3.2 and 3.3.3.

4.09 A carrying case KS-21040 (Fig. 7) is available for transporting circuit packs between regional centers and central offices. The circuit pack must be in a blister pak before being placed into the case; however, the blister paks themselves should

not be used as shipping containers. The carrying case may also be used as a storage container when necessary.

UNPACKING

4.10 Proper care should be exercised when opening a shipping container to avoid damage to its contents. Unnecessary handling of semiconductor devices or circuit packs should be avoided. Packs should be handled either by edges or the faceplate to avoid scratching the gold-plated contacts or deforming the components and leads.

STORING

General

4.11 Semiconductor and circuit packs should be stored in protective cartons when possible. Shipping cartons including transparent plastic cases will serve to protect circuit packs from dirt, dust, or damage.

Caution: Many shipping cartons including those made of plastic or foam material are flammable, and if used for storage of these components, should be kept in a metal cabinet.

4.12 Semiconductors and circuit packs should not be dumped into cartons and bins since mechanical shock may shorten the life expectancy of semiconductor components. If protective cartons are not available, each device or circuit pack should be isolated to prevent the possibility of mechanical shock.

4.13 Circuit packs, after being unpacked from the shipping carton, should be stored in a suitable storage facility. The facility may be an especially designed frame, such as the one used in No. 2 Electronic Switching System (ESS) offices (Fig. 8), a steel cabinet (ED-1A229-10) equipped with a wooden storage rack as used in No. 1A and No. 4 ESS offices, or any facility which protects the pack from mechanical damage, dust, or dirt during storage.

4.14 Circuit packs must be protected by a blister pak (KS-19382, KS-21487, or etc) during all phases of storage (except when located in the No. 2 ESS or similar storage frame), or remain sealed in the styrofoam-type case in which the circuit pack was shipped. Unnecessary handling of circuit packs should be avoided.

4.15 Circuit packs should be stored in a manner which readily exposes the code on the pack or code marking on the storage container. This permits storing the packs in numerical order for quick identification and inventory checks.

4.16 The following damage may occur when circuit packs are improperly stored:

(a) Accumulation of dirt or dust on gold-plated contacts

(b) Scratching of gold-plated contact surfaces

(c) Defacing of printed wiring surface area

(d) Deformation of circuit board components

(e) Warping of circuit board.

5. TESTING

GENERAL PRECAUTIONS

5.01 The only semiconductor devices to be tested in the field are those not mounted on plug-in circuit packs. No tests are to be made on semiconductors or components used in plug-in circuit packs except when specified along with detailed procedures in the schematic drawing or a BSP covering the system in which the circuit pack is used. In-circuit tests may be made on diodes and varistors wired into nonplug-in type circuits, such as relay rack mounted circuits.

5.02 If an in-circuit test is to be made on diodes, one of two procedures should be followed. If the diode is used in the configuration shown in Fig. 9 (shunting a relay coil), test procedure 1 (5.08) should be carried out. If the diode is arranged in any other circuit configuration, test procedure 2 (5.09) should be followed.

5.03 Consideration must be given to ambient temperature when testing semiconductor circuits. The equipment is designed to operate within specified temperature ranges, and any variation beyond temperature limits specified for the equipment under test could give indications which result from temperature variations rather than equipment failures.

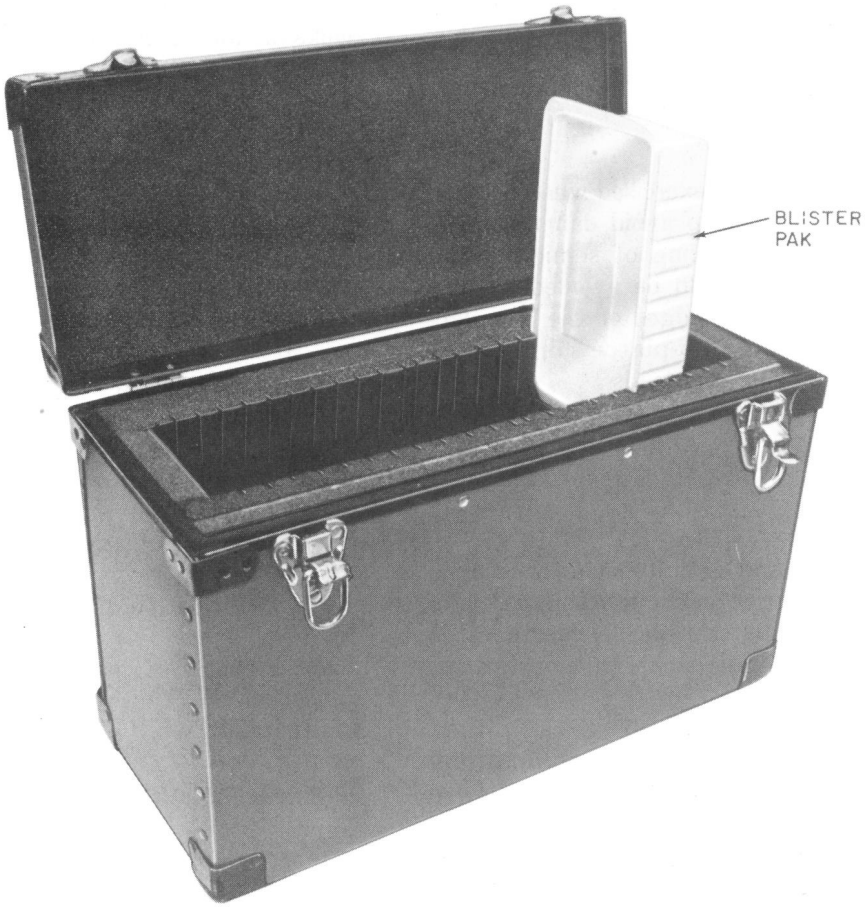


Fig. 7—KS-21040 Carrying Case

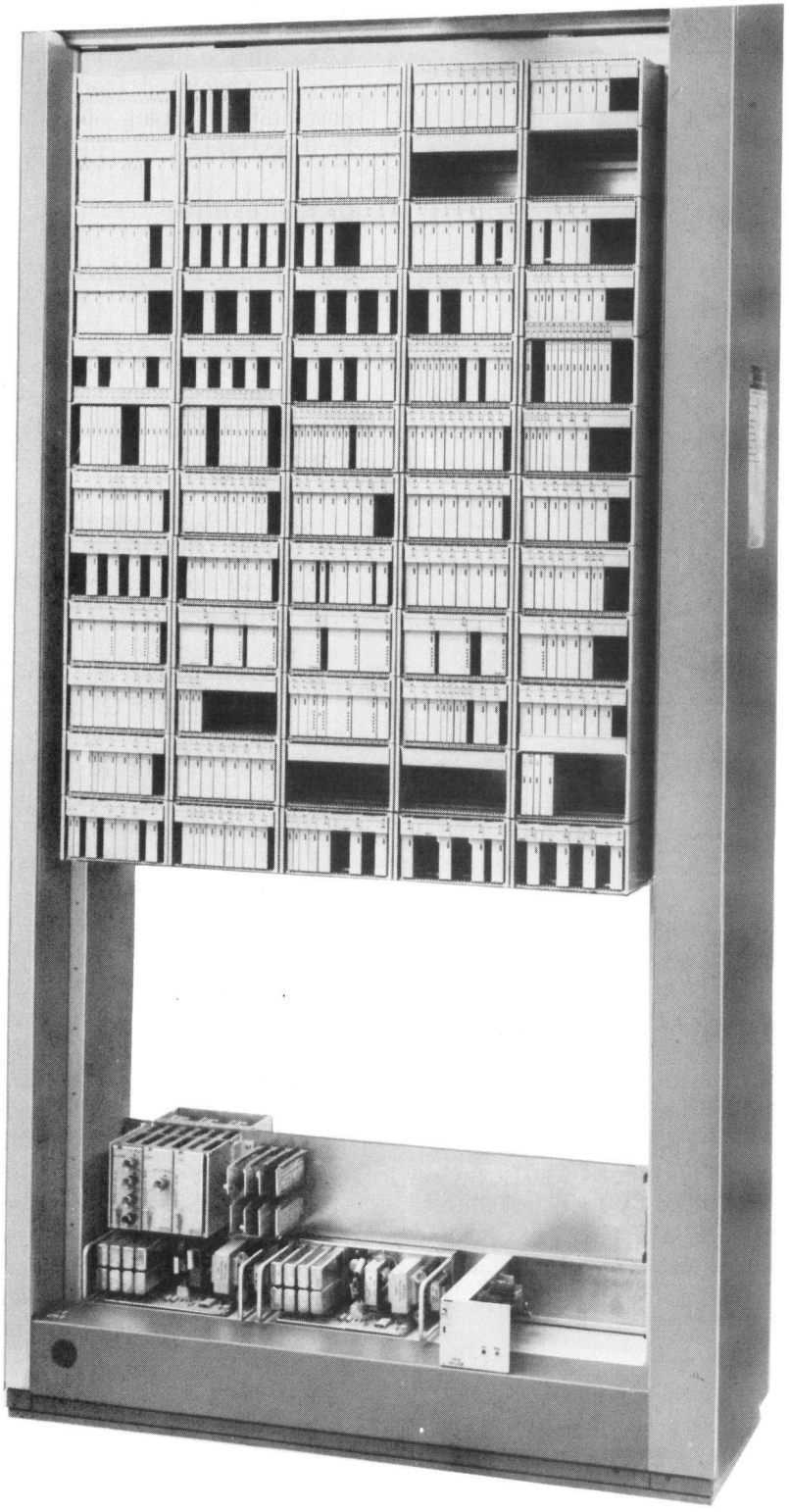


Fig. 8—Circuit Pack Storage Frame

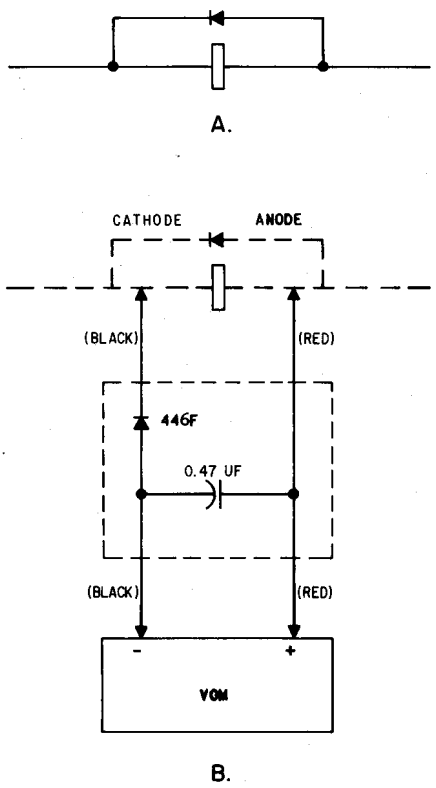


Fig. 9—Diode Test Hookup Procedure 1

5.04 For making voltage measurements of circuits containing semiconductor devices, a voltmeter, such as the KS-14510 meter with sensitivity of 20,000 ohms-per-volt or higher, should be used.

5.05 For making continuity tests of circuits containing semiconductor devices, when removed from adjacent circuitry or with power off, the R × 1000 range of the KS-14510 meter may be used. Unless specified by test procedures, tone buzzers, test receivers, and test picks should not be used for testing circuit packs and semiconductor circuits.

5.06 Probe input capacitances may become charged at one point in a live circuit, and at the next point of application, discharge destructive energy through a semiconductor. Shorting of probes between readings will eliminate this problem.

COMPONENT TESTING

5.07 In the event the component under test must be isolated from surrounding circuitry, the possibility of doing so by blocking a relay should be investigated.

DIODE TESTING

5.08 ***Test Procedure 1***

(a) This test procedure should be used to test diodes which are not mounted on plug-in packages and which are arranged in the circuit configuration shown in Fig. 9, A (a diode shunting a relay coil).

(b) The test connection is shown in Fig. 9, B. The equipment needed consists of one KS-14510 meter, or equivalent, and testing cords listed in Part 2.

(c) De-energize the relay in parallel with the diode under test.

(d) Connect the KS-14510 meter (60 Vdc scale) across the relay coil in parallel with the diode under test in the configuration shown in Fig. 9, B observing the polarities indicated.

(e) Electrically operate and release the relay. CARE MUST BE TAKEN NOT TO AFFECT EQUIPMENT IN USE WHEN OPERATING THE RELAY. The meter should read near zero. ***If the meter reads the battery voltage instead of near zero while the relay is operated, reverse the test leads at the relay coil.***

(f) Using successively lower voltage scales on the KS-14510 meter, electrically operate and release the relay until a satisfactory reading on the meter is obtained. A satisfactory reading is obtained when a transient movement or steady reading of the meter is noted when the relay is released.

(g) If the diode is good, the transient movement or steady meter reading should be less than the value corresponding to the diode types listed in Table A.

TABLE A

DIODE	READING
400-Type	5 volts
420-Type	2 volts
425-Type	2 volts
426-Type	2 volts
All Other	1 volt

(h) If the reading is greater than that in Table A, the diode is defective and should be replaced.

5.09 ***Test Procedure 2***

(a) This test procedure should be used to test diodes which are not mounted on plug-in packages and which are ***not*** arranged in the circuit arrangement shown in Fig. 9, A.

(b) An attempt should be made to isolate the diode from external circuitry. This can usually be performed by blocking relay contacts; however, if it ***cannot,*** consult the circuit requirements table of SD for detail test requirements for the diode under test.

(c) The P-N junction of diodes can be verified by using the KS-14510 meter and standard test leads supplied with the meter. This test determines if the junction is opened or shorted and in some instances shows junctions that have excessive leakage. The ohmmeter test can determine only if the device is open or shorted and cannot give quantitative information or marginal conditions.

(d) Only the R $\times$ 1000 range of the KS-14510 meter should be used since this range provides the lowest possible current, 75 μA through a dead short.

(e) Since the ohmmeter circuit of the KS-14510 meter contains an internal battery, the polarity of the ohmmeter is opposite that of the voltmeter circuit. The polarity used for voltage measurements is stamped on the case of the KS-14510 meter. The following instructions take this into account.

(f) Connect the meter leads to the diode as shown in Fig. 10 for the reverse or high resistance check. The meter should read in the high portion of the scale.

(g) Reverse the meter leads to the diode as shown in Fig. 10 for the forward or low resistance check. The meter should read 10 or lower on the low end of the resistance scale. (This is a scale reading, not an ohm reading.)

Note: Generally, a defective diode will show a high reading in both directions (open diode) or a low reading in both directions (shorted diode). This is the most common sign of a defective P-N junction.

(h) The ohmmeter test for 400-type point contact germanimum diodes is not entirely complete. Reference should be made to Section 032-160-701 covering the requirements of the 400-type diodes using the KS-12054 test set.

CIRCUIT PACK TESTING

5.10 Testing of circuit packs will be performed only when specific testing procedures are available, such as the SD drawing or BSP. Circuit packs can be tested by use of the test points on the pack, adjacent to the pack, a circuit pack test set when available, or card extender. Card extenders are designed to allow testing at designating test points, not for gaining access to card components.

5.11 Power should be turned off before inserting or removing plug-in circuit packs from equipment racks. Refer to the appropriate BSP covering taking equipment out of service. Replacement with power on will be made only when testing requirements so state. Refer to the BSP covering the testing of the particular unit.

6. INSERTING AND REMOVING CIRCUIT PACKS

6.01 The 36A and B apparatus mountings are typical units used by various switching systems for installing circuit packs. The mountings are equipped with a hinged designation strip for displaying circuit pack information, such as code number, color code, system mounting position number, etc.

6.02 Figures 3 and 4 show designation strips in the down or normal position. When the designation strip is raised, as shown in Fig. 5 and 6, both the color code and alphanumerical code of

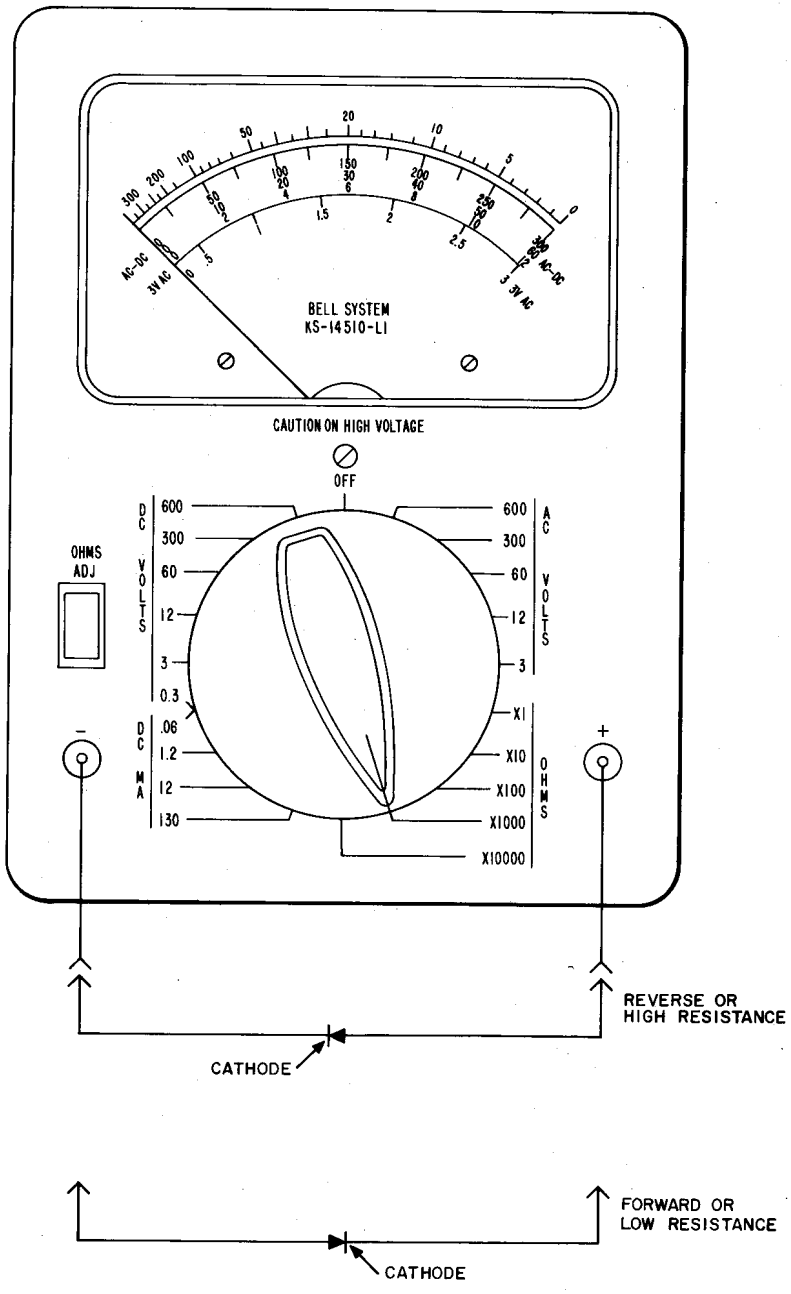


Fig. 10—Diode Test Procedure 2

the circuit pack must match those of the designation strip. Circuit packs of different codes are physically, but not electrically, interchangeable within each code type (such as A or P types). The color codes also define broad classes of circuits. The circuits in the yellow category are almost exclusively low-level logic NAND gates. Circuit packs within this group, if interchanged, will not cause damage to the system. The circuits in the blue category are mostly low-level logic gates but of a higher power level than the yellow category circuits. Circuit packs in this category, if interchanged, usually will not cause damage to either the circuit packs involved or others associated with them in the system.

Caution: Damage can result if a red circuit pack is inserted in a position that does not have both the same color and

alphanumerical code. Likewise, a white circuit pack, which consists mainly of transistor resistor logic (TRL) circuits, should not be interchanged with any other color-coded pack as damage could result in both the circuit pack and equipment.

6.03 The contact surfaces of the circuit pack should be examined carefully before insertion into the apparatus mounting. A low-power magnifying glass is suggested for this inspection. The gold finish must be continuous over the entire contact surface. Scratches or other finish imperfections which expose the base metal are potential sources of trouble. The contact surface must also be clean and free from accumulations of dirt or other foreign materials. A circuit pack extender or a circuit pack board having damaged terminal connector contact surfaces must not be used, since these contacts may permanently damage the mating connector contacts.

6.04 When a circuit pack is replaced for any reason, inspect the mating connector for missing gold contacts, bent springs, or any other defect before reinserting the circuit pack.

6.05 In some systems, before inserting or removing a circuit pack, ***power must be removed*** from the circuit (not necessarily the frame). This may be necessary for the following two reasons.

(1) If electrical connection is disturbed while power is applied, it is possible for an electrical arc (even a very small one) to puncture the gold terminal plating.

(2) Some types of circuit packs contain components which could be damaged if the pack is installed or removed while power is connected.

6.06 To remove power from a circuit or frame:

- ***For No. 1 ESS,*** refer to Section 231-105-302 for 2-wire offices or Section 231-405-302 for 4-wire offices.
- ***For No. 2 ESS,*** refer to Section B of the appropriate Trouble-Locating Manual (TLM).
- ***For No. 4 ESS,*** refer to TOP 234-151-002.
- ***For TSPS,*** refer to Section 250-125-301.
- ***For AIS,*** refer to Section 250-414-301.

6.07 When inserting a circuit pack in an apparatus mounting, care must be exercised to align the board in the associated upper and lower guide slots directly under its code on the designation card. The board must be fully engaged with the connector to insure proper electrical connections to all terminals. A secondary, although important, factor is that the designation strip is likely to be broken if an attempt is made to lower it when a circuit pack is not fully engaged.

6.08 To remove a circuit pack from an apparatus mounting, the hinged designation strip must be raised. When required, use a 723A, B, or similar-type extracting tool to remove the pack. Insert hook of tool into slot on faceplate with foot of tool resting on lower edge of the apparatus mounting (Fig. 5 and 6). The circuit pack is pried free of the connector with a downward motion on the extracting tool. When freed of the connector, pull pack out by hand to avoid dropping.

Note: The designation strip is likely to be broken if an attempt is made to remove a circuit pack without raising the designation strip.

6.09 When an adapter (extender) is used to test a circuit pack on the frame, it will project the circuit pack approximately 11 inches beyond the frame; therefore, all possible precautions should be taken to avoid injury to personnel and equipment.

7. REPLACEMENT

GENERAL PROCEDURES

7.01 The only semiconductor devices to be replaced in the field are diodes and varistors not located on circuit packs. No replacement of individual components mounted on circuit packs should be made. The circuit pack should be replaced, and the defective pack handled in accordance with local instructions.

7.02 When a failure is encountered, replace the unit. If the new unit fails, then the cause of failure of the device or circuit pack should be determined before another replacement is made. Common causes of failure are as follows:

(a) Improper test procedures

(b) Failure of one or more associated devices

(c) Abnormal variation of circuit parameters, such as supply or signal voltage, ambient temperature, etc

(d) Internal failure of the device.

SEMICONDUCTOR DEVICES

7.03 Observe all lead designations and polarities before replacing semiconductors.

7.04 For soldering, the KS-16346 soldering copper, as described in the appropriate section in Division 074, is recommended. The junction to be soldered should be heated and soldered quickly without excessive heat. This will help reduce the transfer of heat through leads to a semiconductor. The use of a clamp-on type heat sink or B long-nose pliers for clamping the lead between the junction to be soldered and the semiconductor is required. To avoid subjecting the device to excessive current, the soldering copper should be checked to ensure that the tip is not shorted or grounded. Oxide on leads necessitate special cleaning before soldering. Handling of leads should be kept to a minimum, as residue from body oils is likely to cause soldering difficulties.

7.05 To cut semiconductor leads, a tool, such as electrician scissors, that cuts with a shearing action should be used. Diagonal cutters, when used to cut semiconductor leads, can create a shock wave along the lead sufficient to damage or destroy the internal crystal. After a semiconductor is soldered to terminals, the excess lead length may be cut off using a pair of diagonals.

7.06 Particular care should be exercised in bending leads to prevent rupturing the glass seal. The tip of a pair of B long-nose pliers should be used to hold the lead between the bending point and the body of the semiconductor. Bends should not be made closer than 1/16 inch from the surface of the glass seal or the body of the device. Excessive bending of leads should be avoided to protect soundness of seals and prevent breaking or weakening of the leads.

7.07 To guard against possible damage to semiconductor devices, the hand-operated KS-16363 wire-wrap tool is the authorized tool for use when making wrapped connections with a semiconductor lead or when connecting leads or terminals which are connected to semiconductor circuits. Leave enough slack in the lead being connected to keep the wire-wrap tool from exerting tension on the lead which might damage the seal.

CIRCUIT PACKS

A. Locating and Replacing Faulty Circuit Packs

Note: The procedures listed herein for locating and replacing faulty circuit packs are patterned after procedures recommended for No. 1 and No. 2 ESS. The requirements for other systems may vary as well as references to certain maintenance and/or testing manuals. However, the procedures outlined will apply in general to most other systems.

General Methods Available

7.08 Indications of a circuit pack failure may occur as one or as any combination of the following.

- A primary or secondary trouble (TBL) lamp lights on the alarm, display, and control panel.
- A major or minor audible alarm sounds.
- A maintenance teletypewriter (TTY) diagnostic failure message is printed out.

The maintenance TTY message is printed out as a result of a fault diagnosis. The diagnostic printout consists of ***trouble numbers (TNs)*** that should indicate the circuit pack possibility causing the trouble. TNs may also be obtained from a specially requested diagnosis.

7.09 There are three basic methods that may be used to find the faulty circuit pack(s). These methods are as follows.

(1) Matching TNs printed out in TTY output message with TNs listed in the TLM. These TNs may be obtained from a regular diagnosis (automatic or requested) or from specially requested phase and cell results.

(2) Requesting raw data using a diagnosis input TTY message. Raw data method requires the use of PKs, SDs, and CDs used in conjunction with VOM, oscilloscope, and various pieces of

test equipment to aid in locating the faulty circuit pack. This method should be used only if the first method fails to provide results.

(3) Off-line operations provide a means to isolate specific units in the system (such as standby central control, program store, call store bus, etc) to allow the use of special testing programs. This method should be used only if the first and second methods fail to resolve the problem.

Matching Printout TNs With TLM Listed TNs

7.10 The matching of TNs printed out in a TTY output message with the TNs listed in the TLM is the most common method of locating faulty circuit packs. Associated with the TN found in the TLM is a list of circuit pack numbers that could possibly be faulty.

7.11 A sequential list of possible faulty circuit packs, called the ***replacement list,*** should be made as they are looked up in the TLM. Circuit pack testing should begin with the first circuit pack on this list.

7.12 The recommended procedure for locating and replacing faulty circuit packs is to replace one circuit pack at a time starting at the top of the replacement list. Before each circuit pack is changed, the frame (or circuit) power must be removed. The frame or circuit power, in some systems, may be removed via TTY request (refer to TLM). Then the power to the circuit pack can be removed by operating the frame control POWER OFF key associated with the pack. When power is restored to the frame, a system diagnostic occurs. The disgnostic should be requested via manual TTY input message for some systems.

7.13 If a circuit pack has been replaced and the frame still remains out of service, the faulty circuit pack has not been located. A failing diagnosis having the same failure pattern as the previous diagnostic printout requires changing the next suspected faulty circuit pack on the replacement list. Changing circuit packs in this manner should continue until the faulty circuit pack is found, or until a different failure pattern is printed out when frame power is restored, or when the TN printed out is not found in the TLM. A failure pattern that differs from the previous failure pattern printed out requires reevaluation of the failure and possible reordering of the replacement list.

Note: If the failure pattern changes when a circuit pack has been replaced, the probable cause for this change of pattern could be that the spare circuit pack was bad. A second spare should be tried in this position before proceeding to establish a new replacement list.

7.14 To locate a faulty circuit pack by this method, use the flowchart procedure given in Fig. 11.

7.15 Any circuit packs that are found to be bad should be listed on the ***reserve circuit pack list*** along with the failure locations. These circuit packs require retesting in the failing positions after the frame has been restored to service.

Retesting Reserve Circuit Packs

7.16 The retesting of circuit packs listed on the reserve circuit pack list is done to make certain circuit packs retained in the ESS office (those not sent to the repair center) are good. Each possible faulty circuit pack should be reinserted into the frame location where that circuit pack failure occurred. If the circuit pack fails the system diagnostic tests again, it should be sent to the repair center. If the circuit pack passes the diagnostic tests, then it should be used in the frame or should be kept as a good spare.

7.17 To retest circuit packs listed on the reserve circuit pack list, use the flowchart procedure given in Fig. 12.

Precautions and Repairs

7.18 The contacts of circuit packs are plated with hard gold selected for its wear resistance. These contacts may be lubricated with a wax (KS-19416 L2 lubricant), but dust can still adhere to this wax even though it is hard. For this reason, it is necessary to keep circuit packs in protective covering until used as indicated in 4.13. If dust, dirt, or other foreign material is present on the contacts, it may be removed with the use of trichloroethane pertroleum spirits (KS-7860 or equivalent) and a lint-free cloth (KS-2423 or equivalent). After cleaning, the contacts should be rewaxed.

Caution: Exercise extreme care to prevent solvents from touching the acryloid finish

on the circuit pack. Do not use an abrasive to clean the contacts. Even the softest eraser is an abrasive and can remove gold contact finish, contaminate contact surfaces with solid residue rubbed off from the eraser, and can remove the lubricant on the contacts.

7.19 Circuit pack troubles can be classified as mechanical, electrical, or a combination of the two. Before a suspect pack is sent to the authorized repair center, it should be inspected for minor faults that can sometimes be readily detected and repaired on the job. These include:

(a) Short circuits caused by solder deposits, stray pieces of wire, or other foreign material.

(b) Dirty contacts.

A low-power magnifying glass is suggested as an aid when inspecting a circuit pack. Although the simpler types of troubles can be found by inspection, packs with more complicated troubles require special tools and techniques and should be sent to the repair center.

Caution: Avoid the use of a high-wattage soldering iron when minor circuit pack repairs are necessary; printed wiring damage or board damage may result.

7.20 When sending circuit packs to the repair center, foam casings and sufficiently padded corrugated shipping containers (see Part 4) should be used to avoid damage occurring to contacts, components, and leads, and to diminish excessive vibration, moisture, and temperature.

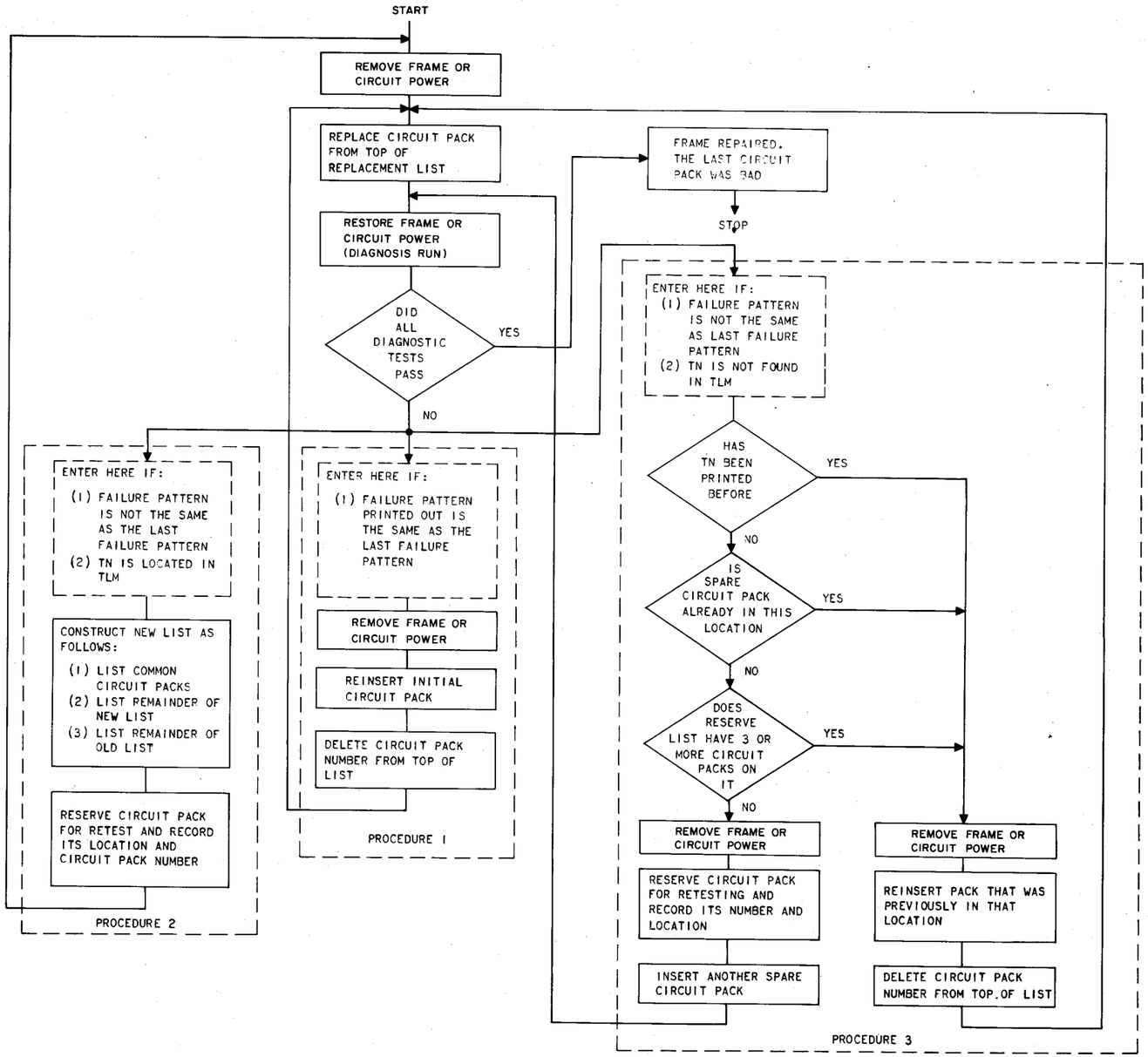


Fig. 11—Procedure for Replacing Faulty Circuit Packs

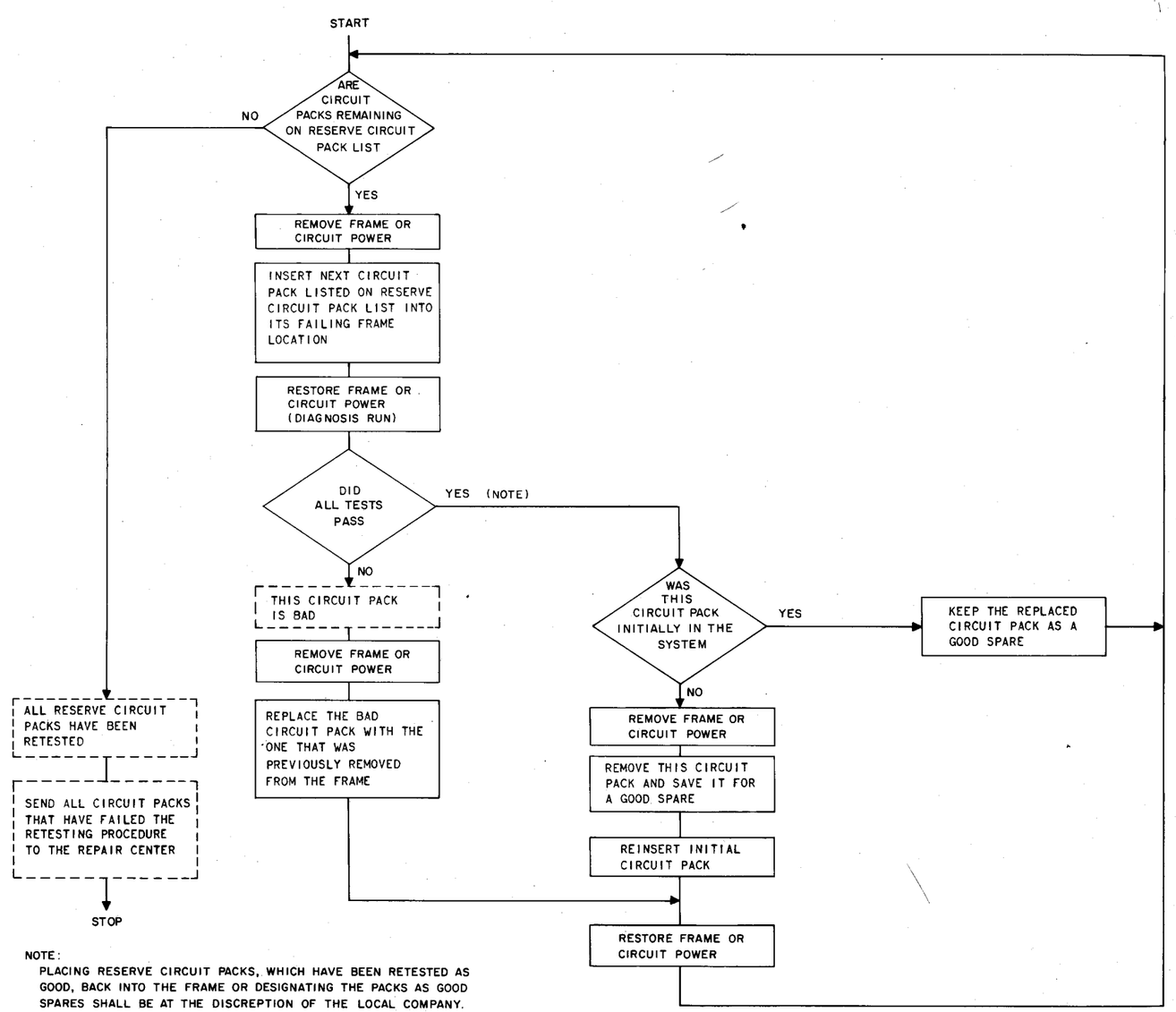


Fig. 12—Procedure for Retesting Reserve Circuit Packs

7.21 Faulty circuit packs being sent to the repair center for the first time do not need a trouble identifying tag attached; the standard shipping forms are required. However, if a repaired circuit pack still checks bad under normal operating conditions, a trouble identifying tag should be attached before returning the pack to the repair center. An example of a tag is shown in Fig. 13. The following information should be placed on the tag:

(a) Central office identification

(b) Date

(c) Apparatus type and code

(d) Location of circuit pack in frame when circuit pack was found bad; for example:

CC	0	—8	—17
↑	↑	↑	↑
UNIT	BAY	HMP	SLOT

(e) Trouble. Trouble information should be entered that will aid the repair center (such as intermittent, burnout, damaged connector, failing TN, etc).

7.22 An alternate method of tagging circuit packs is available, the ***pink tag routine.*** The pink tag routine provides a streamlined procedure for handling circuit packs found defective within 1 year after:

(a) Date of manufacture

(b) Date of repair, if repaired previously under the pink tag procedure.

This procedure obviates the large volume of paper work that would otherwise be required if the engineering complaint procedure were to be applied to circuit packs less than a year old. Refer to the appropriate section in Division 010 for complete procedures and coverages of the pink tag routine.

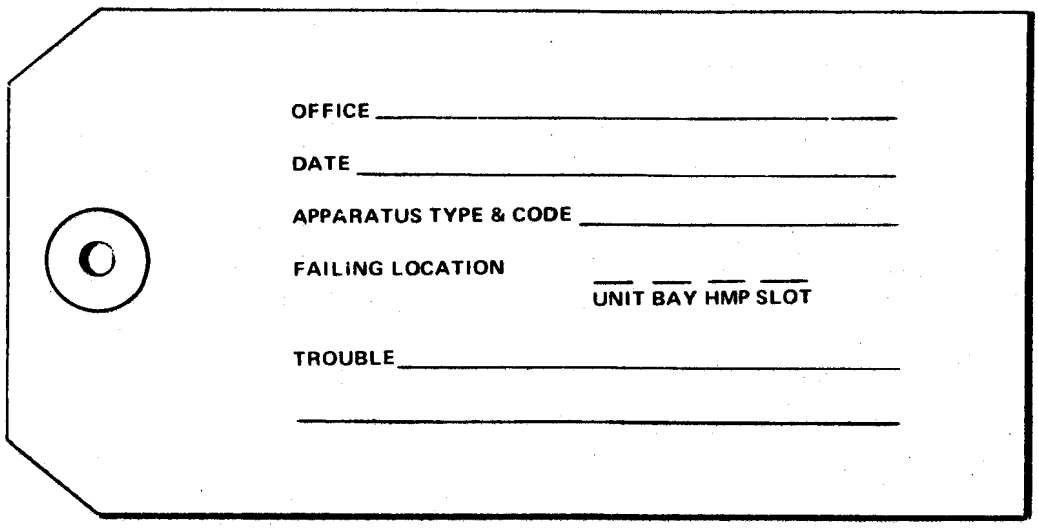
7.23 For ESS applications, a 112A apparatus blank or test pack must be inserted in unoccupied positions where a 905 connector is located on the frames. These packs are furnished to protect the gold contact surfaces of the 905 connectors.

B. Special Precautions for ESS Scanner Circuit Packs

7.24 Scanner circuit packs A37, A49, and A52 require special attention when being removed from or being placed into service. The recommended procedures for removing these circuit packs are as follows.

7.25 ***Core Matrix (A37):*** Only one of the two scanner controllers can be taken out of service at any time. This is accomplished by the system when it has been requested to do so via the TTY. (Refer to IM 2H200.) Once a controller has been removed from service, power to it can be removed by operating the appropriate frame control OFF-0 or OFF-1 key. (Refer to TLM.) A request should be made to the system to remove the associated network controller before the key is operated. The appropriate out-of-service lamp will light when the system quarantines the network controller. Perform strapping procedures as follows.

(1) Operate the frame control OFF-0 or OFF-1 key associated with the faulty package. This removes power from the circuit pack and also permits the system to determine that the controller is out of service.



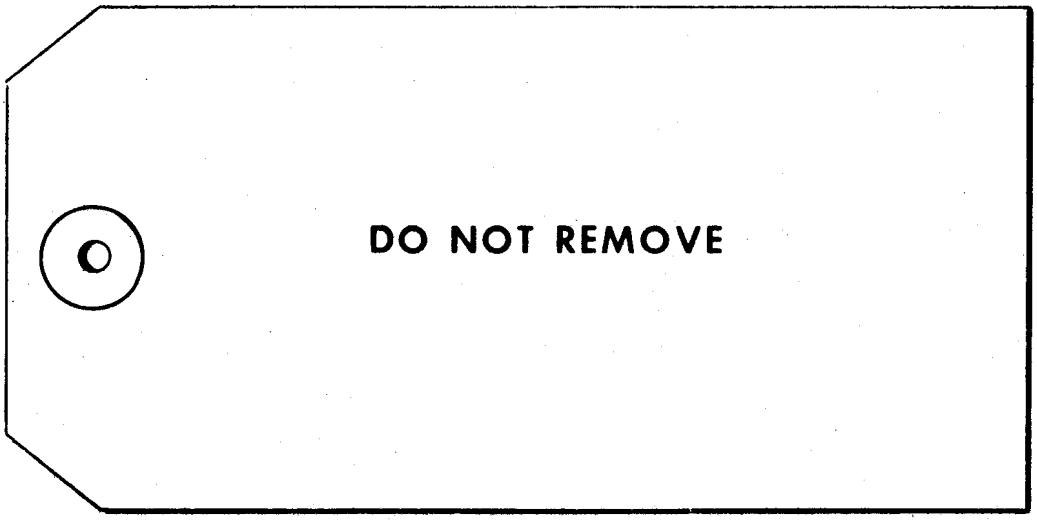


Fig. 13—Example of Circuit Pack Identification Tag

(2) Provide shorting straps on the output terminals to assure continuity between the active core matrix (A37) and the ferrod matrix. Also provide a shorting strap on the bias terminals so that the bias relay does not release when the faulty circuit pack is removed. Strapping is done in the following order:

Terminal	To	Terminal
A0		A1
A2		A3
A4		A5
A6		A7
A20		A21
A22		A23
A24		A25
A26		A27
B0		B1
B2		B3
B4		B5
B6		B7
B20		B21
B22		B23
B24		B25
B26		B27
A19		B19

(3) Replace circuit pack.

(4) Remove shorting straps in the reverse order specified in Step (2).

(5) Operate the FRAME CONTROL NOR key, and request the system to restore to service the appropriate controller.

Note: Whenever a request has been made to take a controller out of service, it remains out of service until a request has been made to the system via the TTY to restore it to service.

7.26 ***Test Transformer (A49):*** To replace a test transformer (A49), strapping must be performed beforehand to prevent introducing an open circuit into eight readout lamps when the circuit pack is removed. Since the circuit pack is common to both controllers, neither has to be taken out of service. Connect straps as follows at the connector of the circuit pack involved:

Terminal	To	Terminal
1		2
3		4
5		6
7		8
9		10
11		15
16		17
18		19
24		26

After the faulty package has been replaced, the shorting straps must be removed.

7.27 ***ASW-S Transformer (A52):*** To replace an ASW-S transformer pack (A52), strapping must be performed beforehand to prevent introducing an open circuit into eight interrogate loops when the circuit pack is removed. Since the circuit pack is common to both controllers, neither has to be taken out of service.

Immediately before the strapping is performed, strap terminal 3 to terminal 5 on each of the two ASW-S amplifier circuits (A148). This forces the scanner to return ASW-S pulses for all input addresses. Connect straps as follows at the connector of the circuit pack involved:

Terminal	To	Terminal
19		27
18		26
17		25
16		24
15		23
11		22
10		21
9		20

All straps must be removed after the faulty package has been replaced. If the straps on the A148 are not removed, scanner failures will be masked since the ASW-S circuit is being forced to give ASW pulses for all addresses.