# NO. 2B HARDWARE AND SUPPORTING DOCUMENTATION NO. 2B ELECTRONIC SWITCHING SYSTEMS

CONTENTS PAGE



Figures

CONTENTS PAGE



CONTENTS PAGE



## 1. GENERAL

**1.01** No. 2B hardware technology is a method of utilizing a set of common hardware and circuit devices which are manufactured and assembled using computer-aided techniques to form components of electronic switching equipment.

**1.02** No. 2B hardware makes extensive use of integrated circuits and a modular, connectorized concept of design which allows for factory testing, rapid field installation, and ease in equipment modification and repair. This type of hardware was initially developed for use with the 1A processor and No. 4 ESS. This technology has been applied in the processor portion of the No. 2B ESS.

**1.03** The smallest components of this system are the circuit packs. They are connected together to form units by one or a combination of several methods. These methods are:

- Multilayer Printed Wiring Board

- 30 Gauge Surface Wire
- Connectorized Cables

The main physical support for a unit is a mounting plate on which connectors and apparatus mountings are attached. The apparatus mountings provide support for the circuit packs and also guide them into the connectors, thus assuring proper mating. Units are assembled into a standard frame from the front by attaching the unit mounting plate to the frame mounting bars. Interconnection between units within the same frame or between units in different frames are connectorized to allow for rapid installation and repair of the electronic switching equipment.

## 2. HARDWARE DESCRIPTION

### *Circuit Packs*

**2.01** Four general types of circuit packs are used in No. 2B hardware:

- FA Ceramic Circuit Packs
- FB and FC Discrete Component Circuit Packs
- JK and JL Discrete Component Circuit Packs
- A- and S-Type Circuit Packs.

### *FA Ceramic Circuit Pack (Fig. 1)*

**2.02** The FA ceramic circuit packs are constructed from a 3.25-inch by 4-inch hybrid integrated circuit (HIC) attached to a 3.67 inch by 7.04 inch aluminum plate. Electrical connections to the HIC are implemented via a 946-type plug connector which is attached to the aluminum plate. The aluminum plate is primarily a heat sink for the HIC; the aluminum plate also provides a mechanical link to the connector during removal and installation of the circuit pack. The HIC is encapsulated with a coating of ***silicon rubber*** for protection against humidity and dust. Mechanical protection for the HIC is provided by a cover plate which attaches to the aluminum plate.

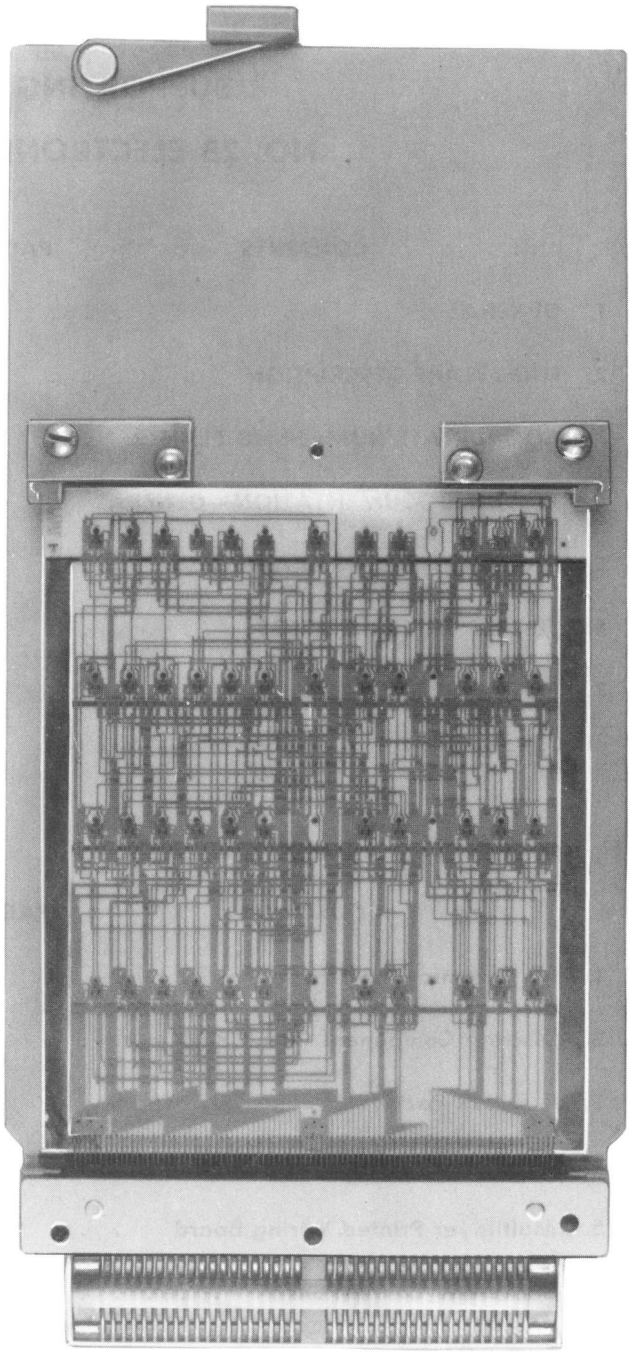


**Fig. 1—FA Ceramic Circuit Pack**

**2.03** Two basic types of FA circuit packs are constructed for 2B: FA digital and FA augmented. FA digital circuit pack HICs consist of bilevel substrate film-integrated circuits to which active logic devices (beam-leaded silicon integrated circuits) and capacitors are bonded. The HIC has a fixed format that allows a maximum of 52 silicon integrated circuits to be bonded to the substrate. The fixed format also allows for the extensive use of machine aids in the design, manufacture, and test of FA circuit packs. FA augmented circuit

pack HICs consist of bilevel substrate film integrated circuits; however, in addition to the standard devices, any approved beam-leaded active or passive devices can be bonded to the substrate and thin film resistors can also be used.

### *FB and FC Discrete Component Circuit Pack (Fig. 2)*

**2.04** FB and FC circuit packs are constructed from 0.062-inch thick epoxy-glass printed circuit boards attached to a 946-type plug connector. These circuit packs are approximately 4-inches by 7-inches in size. The difference between the two codes is in the number of pin-outs provided by plug connectors; the FB uses a 946B-type plug connector with 42 terminals and the FC uses a 946C with 82 terminals.

### *JK and JL Circuit Packs (Fig. 3)*

**2.05** JK and JL packs are similar to FB and FC packs respectively except they are 6-inches by 7-inches in size.

**2.06** Other miscellaneous circuit packs are the A- and S-types used in power converters of the 2B ESS.

### *Circuit Pack Connectors*

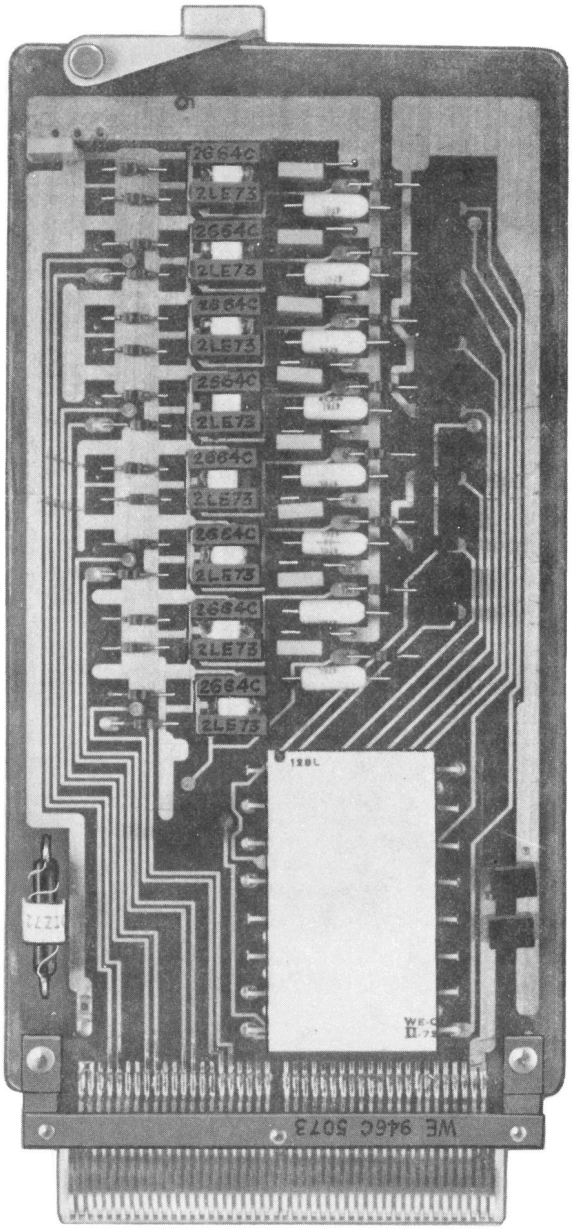
**2.07** The 946-type connectors on the circuit packs are designed to mate with 947-type receptacles. The terminals of these receptacles pass through the holes of the backplane and are soldered to it. The protruding pins of the receptacle at the rear of the backplane form the surface wiring field and pin plugs for cable connectors.

### *Circuit Pack Apparatus Mountings (Fig. 4)*

**2.08** Circuit packs are held in place on a unit by apparatus mountings which attach to the front of a mounting plate. Designation strips are attached to the top-front of the apparatus mountings to identify the circuit pack code for each mounting position.

### *Multilayer Printed Wiring Boards (Fig. 5)*

**2.09** Multilayer printed wiring boards are used to form the backplane for interconnecting the 947-type connectors. They consist of a number of (up to seven) epoxy-glass printed circuit boards laminated into a single structure forming embedded copper paths. The various layers are connected to each other by means of plated through holes




| CODE | CONNECTOR | PINOUTS |
|---|---|---|
| FB | 946B | |
| FC | 946C | 82 |

**Fig. 2—Discrete Component Circuit Pack**

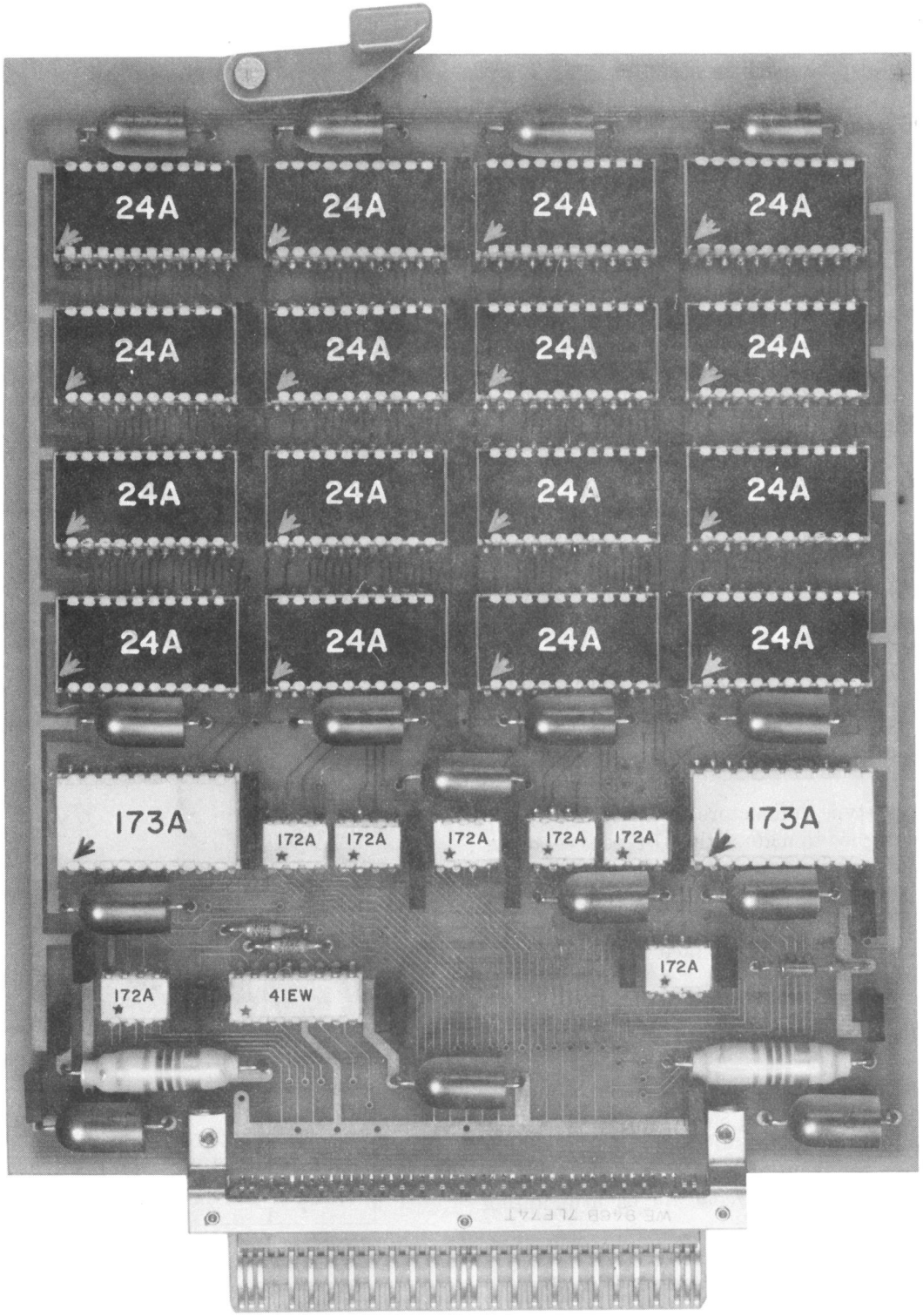



Fig. 3—JL Circuit Pack

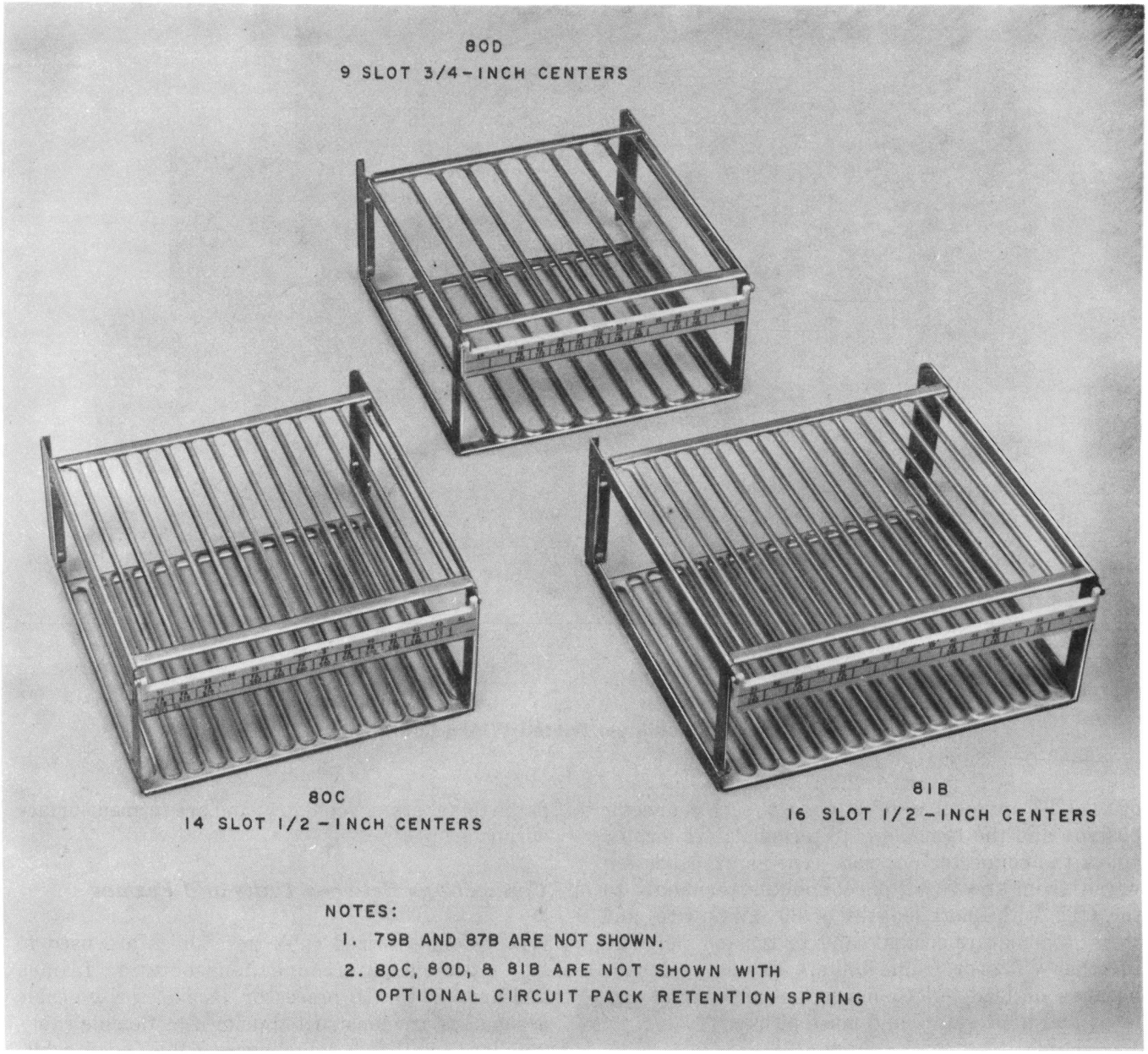



**Fig. 4—Circuit Pack Apparatus Mounting**

on one-eighth inch centers. The 947-type connector pins are inserted through these holes to form the terminal array on the rear of the multilayer board. Additional connections between circuit pack connectors may be machine wired with 30 AWG plastic insulated wire. The multilayer board is attached to the rear of a frame mounting plate to form a frame unit.

### *Coaxial Terminal Fields*

**2.10** Coaxial Terminal Fields (CTFs) on the multilayer board supplement the 947-type terminal fields by providing 32 terminals per connector position on which signal and ground (shield) leads may be terminated. Sixteen terminals

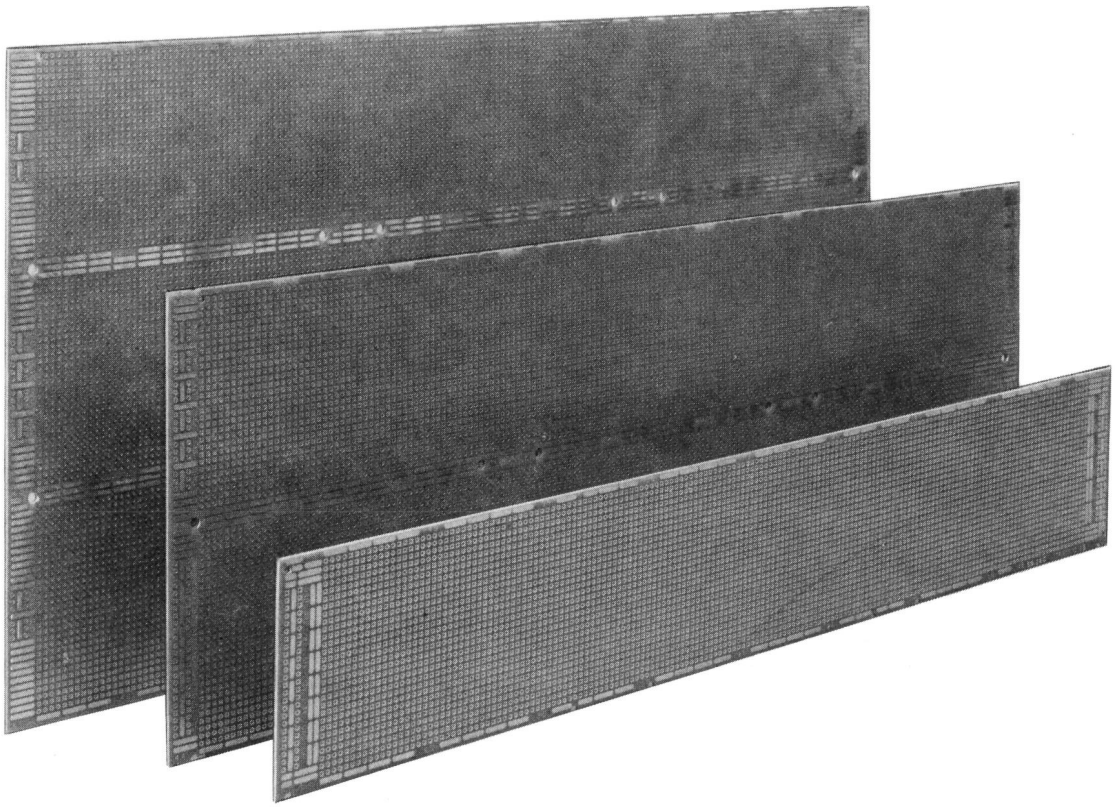


**Fig. 5—Multilayer Printed Wiring Board**

of the CTF are located directly above each connector position and the remaining 16 terminals are located below the connector position. The signal leads are wired from the 947-type connector terminals to the CTF with short lengths of 30 AWG wire, and then by miniature coaxial cable or twisted pair wire to other CTFs or frame units. This is necessary because of lead length limitations on single wire leads due to crosstalk and noise pickup.

### *Intraunit Connections*

**2.11** The majority of interconnections between circuit packs on the same unit are made by the automatic wire-wrap of plastic insulated 30 AWG wire between the terminal pins of the 947-type receptacle connectors and CTFs. Where more stringent cross-talk requirements must be met, tight-twisted pair and miniature coax are used. These wires are usually semiautomatically applied. The coax, because of the extra preparation required, costs significantly more and is used only where necessary. Signal leads implemented with solid wire and tight-twisted pair are routed in rectilinear paths (Manhattan Geometry) and are termed surface wiring.

### *Connections Between Units and Frames*

**2.12** Connectorized cable assemblies are used to provide interconnections between frames and units in the 2B processor. Connectorized cable assemblies are constructed using flat flexible cable, standard eight-pair switchboard cable, coax cable, and discrete wire to which backplane connectors (942-, 943-type) are attached. The backplane connectors are designed to plug directly onto the backplane terminals of the 947-type receptacle connectors.

**2.13** Backplane connectors are built up from either a 1-inch by 1.25-inch or a 1.25-inch by 1.50-inch printed circuit board. One or two plastic contact housings with ten contacts each are attached to the board (one to each side if there are two). Contact tabs from the terminals extend beyond the back of the contact housing and are soldered to the printed circuit board. A cable is soldered

to the appropriate electrical paths on the printed circuit board. The cable is then clamped to the circuit board with a strain relief clamp. Backplane connectors of 10 or 20 terminals are designed to mate with one quadrant of a 947C-type receptacle connector terminal field. Backplane connectors are held in place on the 947-type terminals with 82- and 83-type apparatus mountings which fit over the 947-type terminal field. These apparatus mountings provide for the alignment of the terminal pins and for guidance and locking of the backplane connector into its mating position. Figure 6 is a view of the rear of a typical backplane with various types of connectors in place.

### *Cable Types*

**2.14** Flat flexible cable is used because of its controlled electrical properties and the low cost at which it can be terminated (many wires handled at one time). The flat cable used consists of either 24- or 31-plastic insulated parallel conductors (32 AWG). These cables are usually used as 100-ohm unbalanced, transmission lines for interunit connections, an application which provides excellent cross-talk performance. Flat flexible cable can provide 8, 10, or 16 signal leads configured with alternate signal leads surrounded by multiple shield ground leads.

**2.15** Standard switchboard cable is used for balanced interunit connections. This cable is extremely low in cost, but is more costly to terminate than flat flexible cable. Therefore, it is used for long runs, runs where the required fold structure of flat flexible cable would be too complex, or where the superior performance of a twisted pair wire is needed for balanced transmission.

## 3. COORDINATE NUMBERING PLAN

### GENERAL

**3.01** The coordinate numbering plan is used to identify the locations of equipment and apparatus on units and frames. These locations are termed equipment locations (EQLs) in the frame coordinate numbering grid (Fig. 7). The EQLs consist of a frame bay identifier, a vertical position identifier, and a horizontal position identifier, as required.

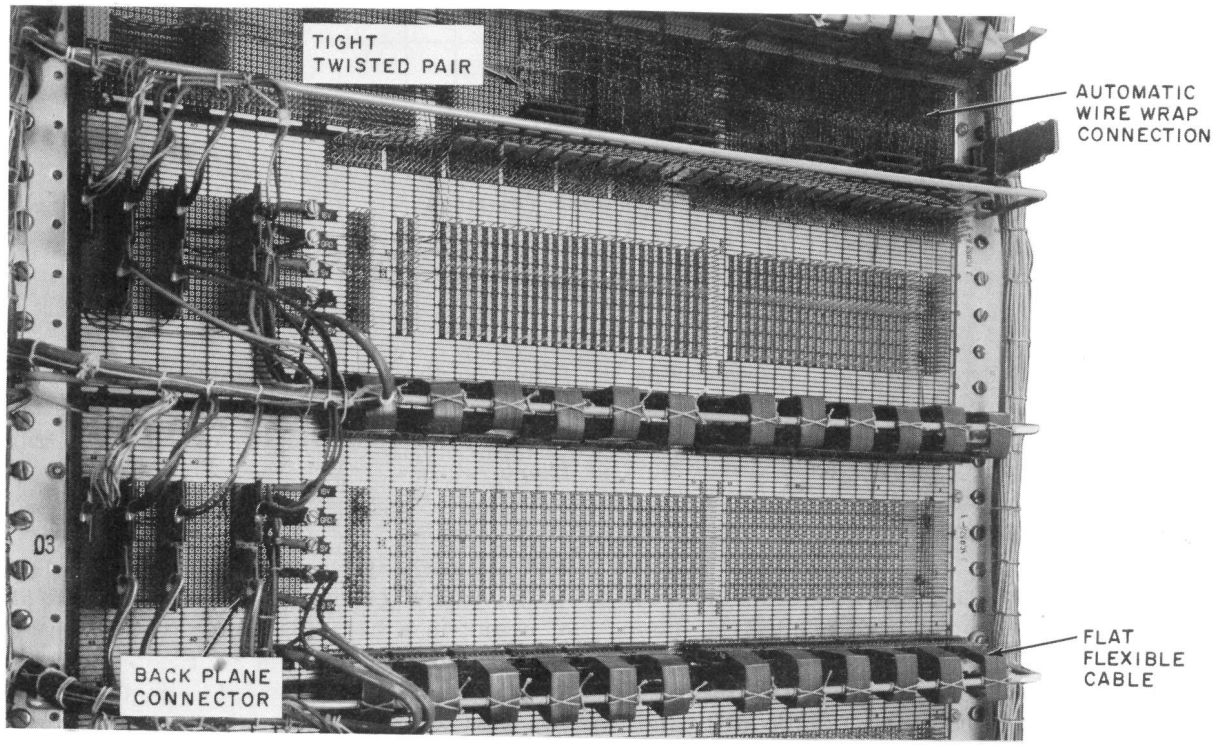



**Fig. 6—Backplane Connections**

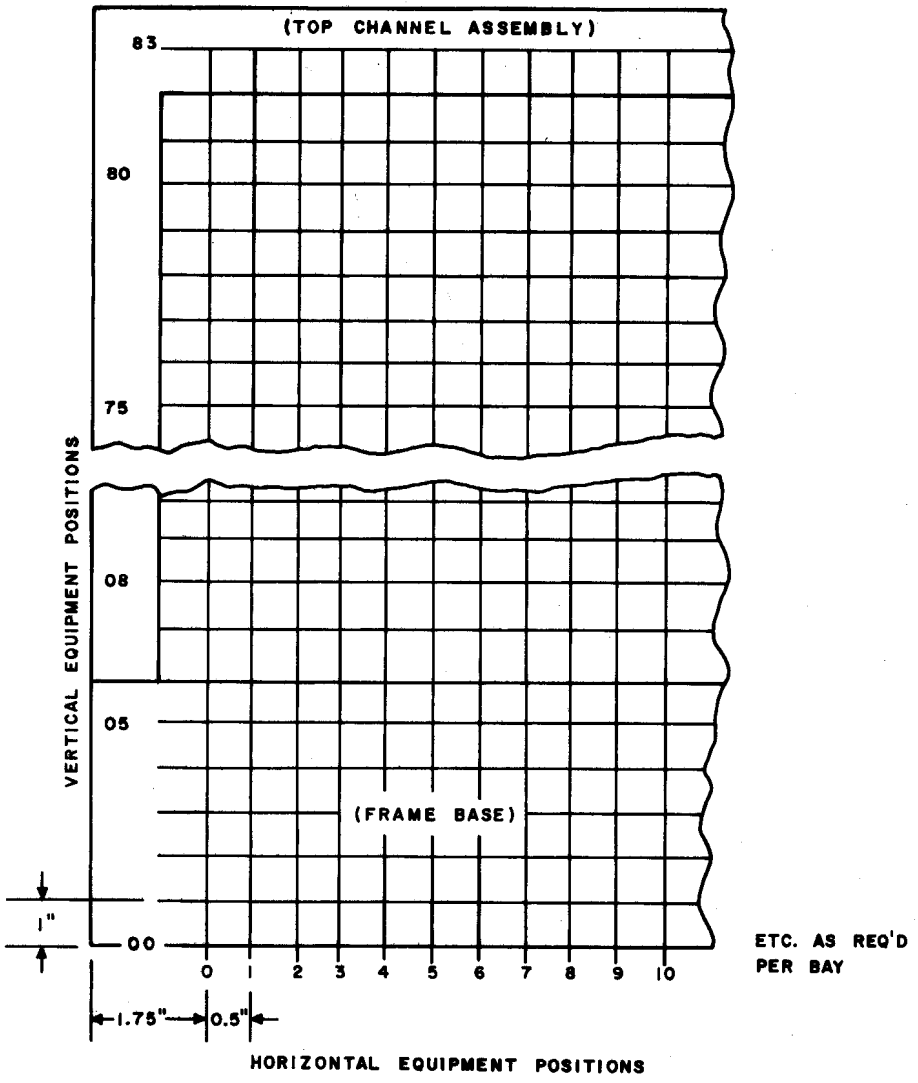



**Fig. 7—Frame Coordinates**

**3.02** EQLs are converted to *x* and *y* dimensions and combined with component terminal coordinates to generate automatic and semiautomatic wiring data.

## FRAME VERTICAL POSITIONS

**3.03** Frame vertical positions (EQLs) are numbered from 00 through 83 in 1-inch center line increments starting at the base of the frame. Vertical position numbers are stamped in the rear of a frame on the right most, middle left, and both middle left mounting bars as applicable for a single-, double-, and triple-bay frame. Vertical position numbers are stamped in the front of a frame on the left most, right side of the middle, and the right sides of both middle frame uprights as applicable for a single-, double-, and triple-bay frame.

**3.04** Units may be mounted on the frame starting at any vertical position number. The location of a unit in a bay of a frame is identified by the vertical position number of the bottom edge of the unit. When equipment is mounted between two vertical position numbers, the equipment is identified by the lower position number. The bay identifier (0, 1, or 2) precedes the vertical position number for double- and triple-bay frames.

**3.05** A unit which appears in a single ***fixed*** location on a frame will be numbered according to its relative vertical position number on the bay of the frame. If a unit appears in more than one bay of the frame, and each appearance is in the same fixed location of the bay, then the unit will be numbered as a single fixed location unit.

**3.06** A unit which appears in a ***variable*** location on any bay of a frame will be numbered relative to the unit vertical position number, position 00 being the base of the unit. Unit vertical position numbers will be stamped in the rear of the left frame mounting bar. A variable location unit will be stamped with the unit vertical position numbers every four positions beginning with 02 (02, 06, 10....).

**FRAME HORIZONTAL POSITIONS**

**3.07** Frame horizontal positions (EQLs) are numbered in 1/2-inch center line increments with position 00 beginning 1.75 inches right of the left frame bay upright. Frame bays 2 feet 2 inches wide have horizontal positions ranging from 00 to 44; 3-foot 3-inch wide bays have horizontal positions ranging from 00 to 70.

**3.08** Frame horizontal positions are subdivided for locating components (circuit packs) which are mounted on wider than 1/2-inch center lines. The suffix ***P (plus)*** is added to the horizontal equipment position number to indicate ***plus one-half of a division*** (0.25 inches) to the right of the base position number.

**EQL APPLICATION TO CIRCUIT PACK IDENTIFICATION**

**3.09** EQLs for circuit packs are based on the location of the 947-type connector with respect to unit level number. Hinged designation strips, which are attached to the circuit pack apparatus mounting, are stamped on both sides with the applicable vertical and horizontal position numbers. Also stamped on the designation strip are circuit pack type designations, the unit identifier, and functional designation. Space is provided for stamping cautions regarding circuit pack removal and replacement. Figure 8 shows a typical circuit pack designation strip.

**EQL APPLICATION TO 947-TYPE RECEPTACLE CONNECTOR AND TERMINAL PIN NUMBERING PLAN**

**3.10** The location of a 947-type receptacle connector/terminal field is identified by the nearest vertical and horizontal EQLs with respect to the center lines of the terminal pin fields. A particular pin within a terminal field is identified by combining the pin coordinates (three digits) with the vertical and horizontal EQLs of the terminal field.

**3.11** The location of a CTF (top and bottom) is identified by the nearest horizontal EQL with respect to the center line of the terminal field (same as 947-type horizontal EQL). The top CTF associated with the 947-type terminal field is identified by the 947-type terminal field vertical EQL plus one division (1-inch); the bottom CTF is identified by the 947-type terminal field vertical EQL minus one division (1-inch). A particular pin within a CTF is identified by combining the pin coordinate (two digits) with the vertical and horizontal EQLs of the CTF.

**3.12** The pin coordinate numbering plan for individual connectors is shown in Fig. 9.

**4. CIRCUIT DOCUMENTATION—GENERAL**

**4.01** This section will concentrate on describing the particular areas of circuit documentation in which new methods have been used in place of previous methods.

**4.02** The documentation methods will be described as applying to four types of schematic drawings (SDs). These will be referred to as follows:

- Functional Unit SDs
- Frame Unit SDs
- Frame SDs
- Circuit Pack Information SDs

**4.03** Functional Unit SDs: This type of SD covers circuitry capable of functioning on a stand-alone basis. The quantity of circuitry covered in these SDs may range from amounts that will occupy an entire frame or frames to smaller units occupying only a fractional part of a frame.

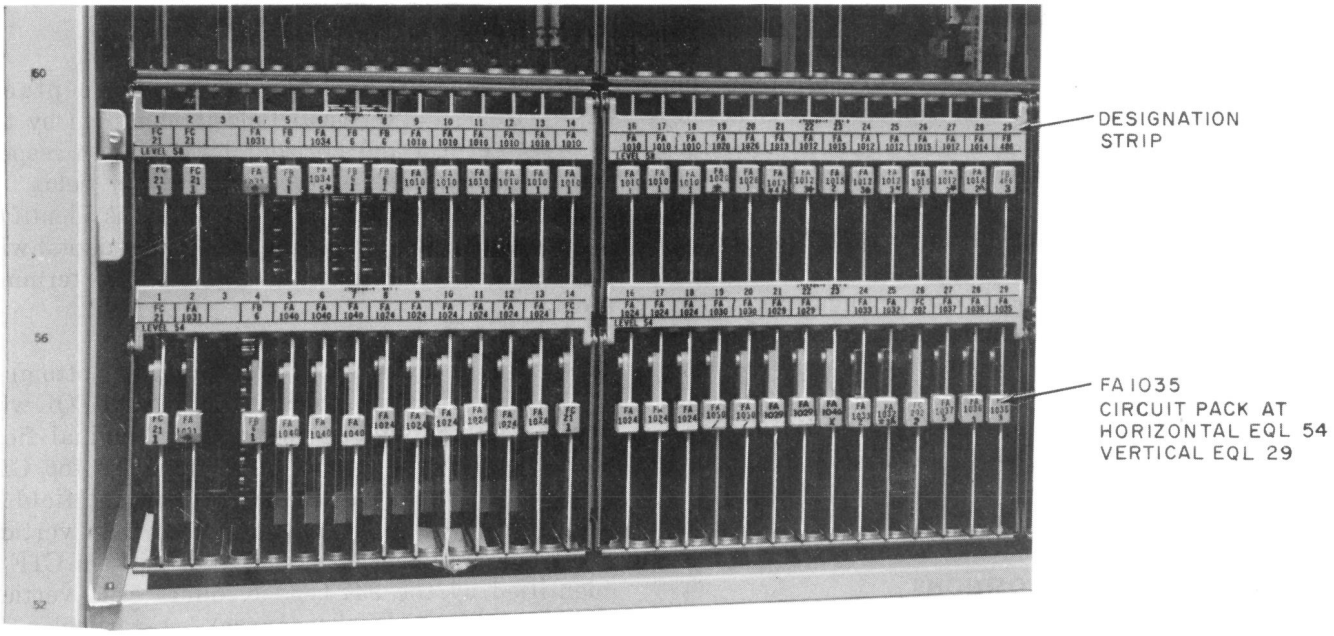



**Fig. 8—Circuit Pack Designations**

**4.04** Frame Unit SDs: These SDs cover circuits which appear more than once in a frame or have application in a number of frames. Frame unit SDs must be used in conjunction with frame SDs.

**4.05** Frame SDs: The purpose of these SDs is to document the interconnecting circuitry between the frame units of 4.04. Also shown in this type of SD are connections between frame units and nonframe unit circuit packs that are part of the circuitry covered by a frame SD.

**4.06** Circuit Pack Information SDs: There are two types of circuit pack information SDs:

(a) Circuit Pack Schematics (CPS)—These SDs document all of the circuit packs used in one system, such as the 2B processor.

(b) Circuit Module Schematics—These SDs list all of the information on circuit modules (which may be a part of a circuit pack) and information on integrated circuits.

***SD Section to Circuitry Level Relationship***

**4.07** In general, the circuitry is composed of the following four levels:

- Backplane Level
- Circuit pack Level
- Circuit Module Level, and
- Integrated Circuit Level.

The relationship of these levels to the various types of SDs and sections within the SDs is shown in Fig. 10.

**4.08** At the circuit pack level there will be separate Circuit Pack Schematic (CPS) drawings for each circuit pack used in the system. Drawing numbers will consist of a CPS prefix followed by the alphanumeric apparatus code of the individual circuit pack.

**4.09** Below the circuit pack level there will be a circuit pack information SD for the system as a whole. It will contain information on circuit modules (parts of circuit packs) in the K section. In addition, the D section of the same SD will contain information and circuit details on all

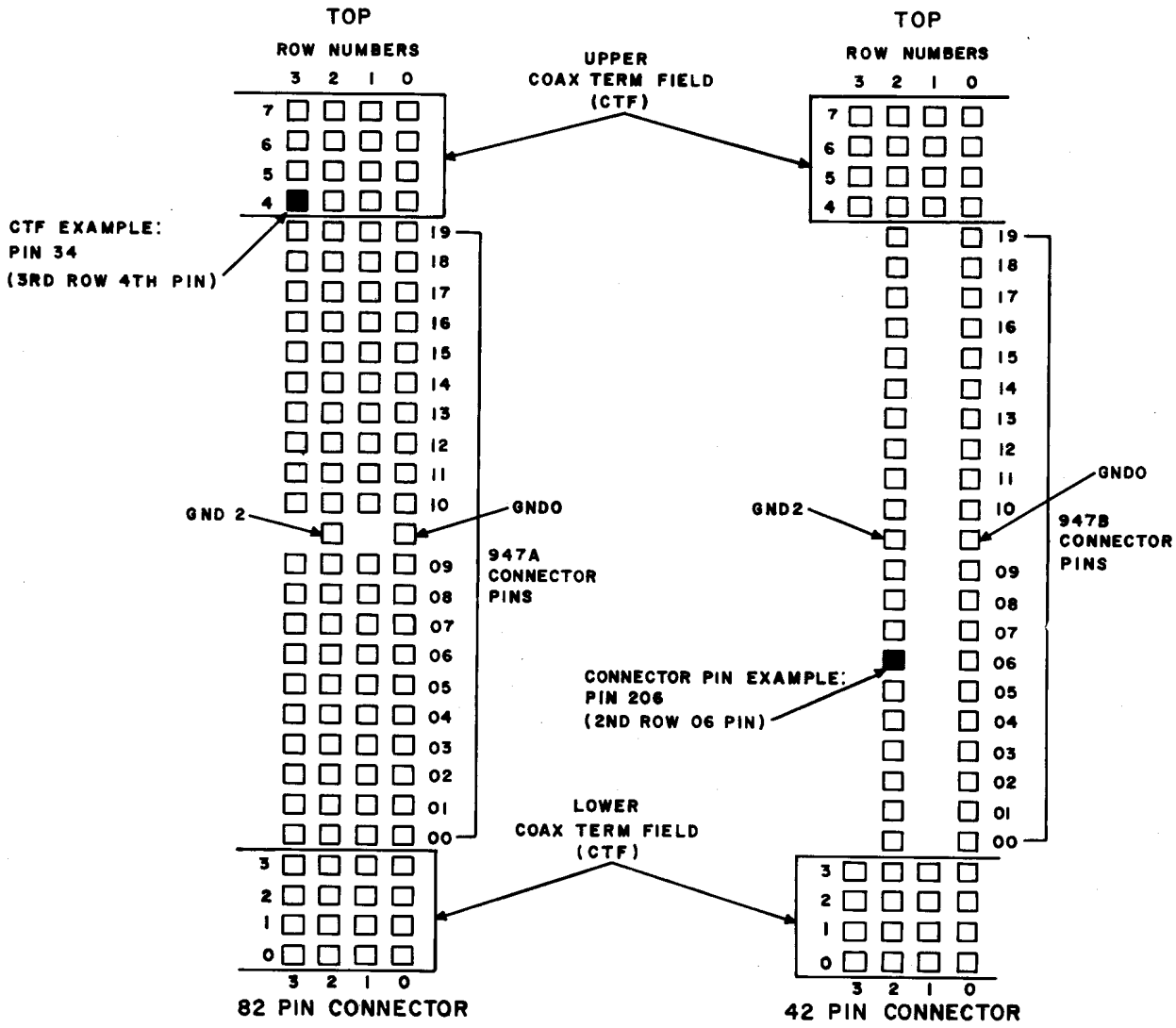



**Fig. 9—Connector Pin Numbering**

integrated circuits which are part of the circuit modules and circuit packs used in the system.

**4.10** The remainder of this section will describe the three types of SDs that document the backplane level. They are the functional unit, frame unit and frame SDs. Emphasis will be placed on the differences from the more traditional SDs.

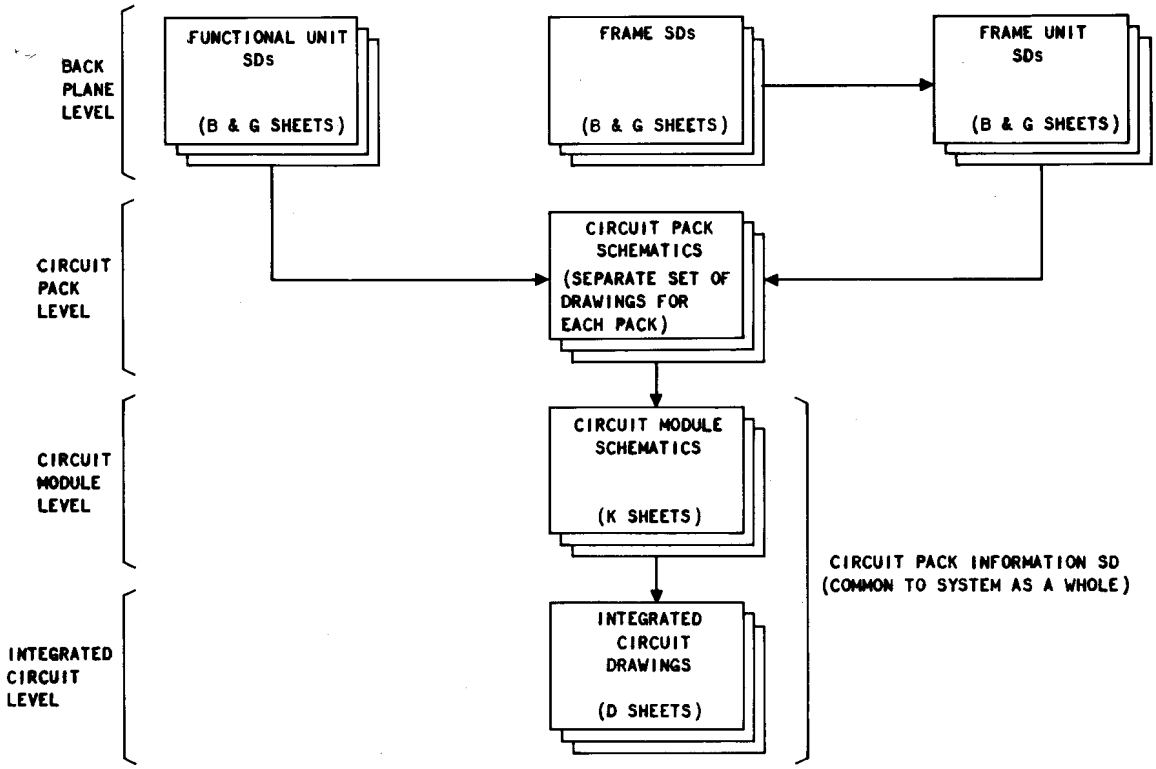



**Fig. 10—Schematic Drawing Relationship**

**4.11** The sectional breakdown of traditional SDs is as follows:

| Section Letter | Section Name |
|---|---|
| A | Drawing Indices |
| B | Functional Schematics (FSs) |
| C | Apparatus Figures |
| D | Circuit Notes and Tables |
| E | Sequence Charts |
| F | Circuit Requirements Tables |
| G | Cabling Diagrams (CADs) |
| H | Block Diagrams |
| J | Circuit Pack Schematics |
| K | Circuit Module Schematics |

**4.12** Little use of the F section is likely because of the relatively small use of relays and similar wired-in components. Also the J and K sections will be separate documents for the 2B system and will not be included in the Functional Unit, Frame Unit, and Frame SDs.

**4.13** The remaining sections can be regarded as falling into two separate categories. These are circuitry and auxiliary sections. In the auxiliary category are sections A, C, D, E, and H. These are sections whose information generally supplements or expands on information in the B & G section. The following pargraphs will describe the B & G sections of the three types of SDs.

## 5. FUNCTIONAL UNIT DRAWINGS

**5.01** The B section in a functional unit SD consists of three parts. Each part will have a two-letter suffix added to the B sheet number. The names of the parts and the suffix relationship is shown in Table A.

TABLE A

| Part Name | Suffix |
|---|---|
| Interconnection and Flow Diagrams | AA thru AY<br>BA thru BY |
| Connection List Tables | CA thru FY |
| Composite Diagrams | GA thru GY |

Interconnection and Flow Diagrams (IFDs)

**5.02** IFDs show in a general manner connections between circuit packs and other components at the backplane level. Circuit packs and portions of circuit packs are drawn as rectangles and assigned a symbol number. The backplane wiring is represented by lines drawn between rectangles. Connections off the page are designated by FS and symbol number destinations at the ends of IFD symbol lines. One line may be used to represent several connections. Each of the individual connections will be documented in the connection list table following the IFD. Signal flow is indicated on these lines with directional arrows.

**5.03** Data within a symbol in an IFD will always consist of the following six items (see Fig. 11):

(1) The symbol number used for the purpose of identifying the symbol within the IFD and for reference to other parts of the SD.

(2) The functional name or description of the circuitry.

(3) The functional mnemonic designation assigned to item 2.

(4) The plug-in location of the related circuit pack.

(5) The apparatus code of the related circuit pack.

(6) The element identifier—This item assigns a letter designation to the one or more separately identifiable circuitry subdivisions on a circuit pack, for example one of a number of identical ICs.

**5.04** Symbol/lead designations in IFDs are listed in alphanumeric order in a column headed by the word ***MNEMONIC.*** In an adjacent column headed by the word DEFINITION, the functional significance or definition of the designation is indicated.

Connections List Tables

**5.05** Specific information on individual leads in the FS which comprise the backplane wiring is obtained from the connections list tables that follow the IFDs. These tables provide the specific circuit pack terminal information not shown in the IFD. For each IFD symbol within an FS, there is a separate connection list table. The table provides near-end connection information for backplane leads terminating at specific circuit pack terminals. It also provides far-end destination documentation as to the FS and symbol number at which a lead terminates. When the destination of a lead is to another SD, the title of the SD is given in the tables. Figure 12 is an illustration of a typical connection list table.

**5.06** Each connection list table will have an overall caption containing the same information found in the IFD symbol it describes. The information in the columns fall into two categories. The columns at the left of the table are entries pertaining to the FS and are shown under the heading FS INFO. The columns at the right, with the heading CP INFO pertain to circuit pack information. Individual items in the columns are described as follows:

LEAD DESIG—The mnemonic designation of the leads as shown on the IFD symbol.

FUNC—The letters I or O are the usual entries in this column. They indicate whether a lead is essentially an input (I) or an output (O) of a circuit element. When two output leads are connected together, the letter combination OT is entered in the column. The addition of the letter T indicates that two or more gates are connected in a wired-node manner. The GRD and PWR are other entries that may appear in this column. These entries indicate that the particular leads so designated are ground and power connections of a circuit pack.

TERM—Terminal numbers of the 40- or 80-pin circuit pack connectors.

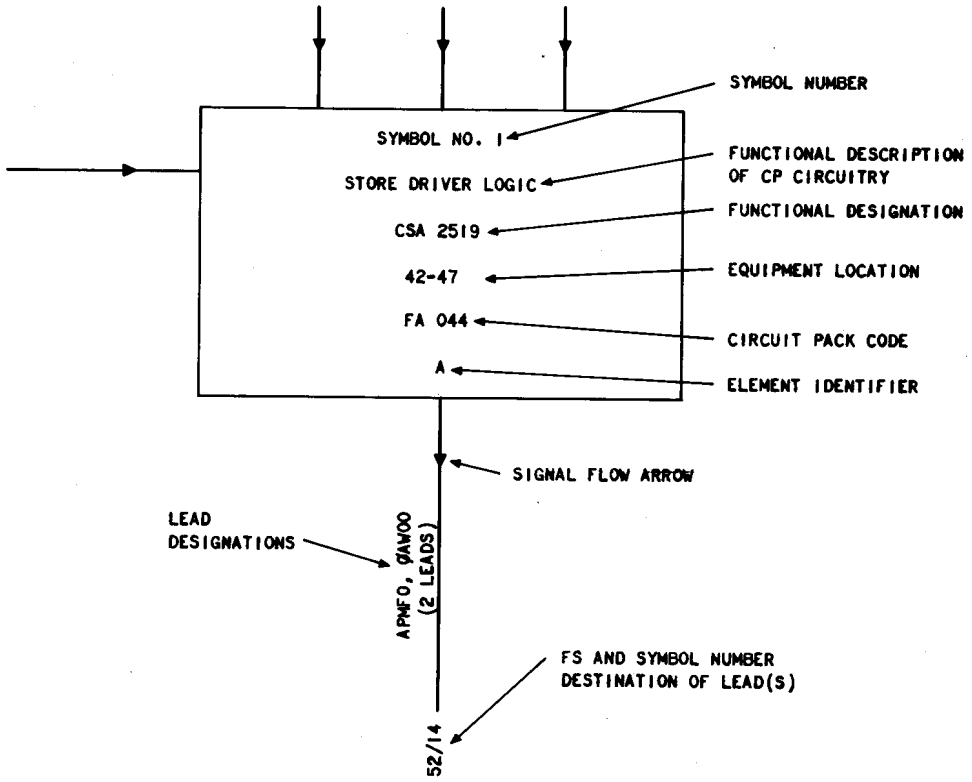



**Fig. 11—Interconnection and Flow Diagram (IFD) Symbol**

SYMBOL NO. 83

LOGIC TO MEMORY ACCESS INTERFACE

| DESIG | EQPT LOC | CODE | ELEM IDENT | OPT |
|---|---|---|---|---|
| OC22 | 10-05 | FA366 | C | |

CLT CAPTION

| FS INFO | | | | | CP INFO | |
|---|---|---|---|---|---|---|
| LEAD DESIG | FUNC | TERM. | DESTINATION | NOTE | TERM. MOD | LOC |
| HC220 | 0 | 308 | 6/24 | P/HC221 | ON | |
| HC221 | 0 | 307 | 6/24 | P/HC220 | OA | |
| OC220 | 1 | 108 | 5/7 | | I1 | |

CLT COLUMNS

**Fig. 12—Connections List Table**

DESTINATION—FS to FS destinations are shown in this column. The data is written in the format "6/24" where 6 is the FS number and 24 is the symbol number in which the lead terminates.

> ***NOTE:*** This column is used when it is necessary to refer to a sheet note or to indicate pairing with another lead (e.g., P/HC221 indicates that the lead in the LEAD DESIG column is paired with lead HC221).

TERM. MOD—Entries in this column specify the designation by which a circuit pack termination is identified in the CPS drawing. This designation may or may not be the same as in the IFD.

LOC—This is the TERM. MOD companion entry that provides sheet and sheet coordinate information that locates the lead in the CPS.

Composite Diagrams

**5.07** Composite diagrams make up the last third of the three parts of the FS drawings. Information in composite diagrams can take any of several forms such as:

- Functional Block Diagrams
- Timing Diagrams
- State Diagrams
- Truth Tables
- Boolean Expressions
- Word Descriptions
- Condensed Logic Diagrams

In general, composite drawings are theory orientated, and their main purpose is to aid in understanding circuit functions.

Cabling Diagrams (CADs)

**5.08** In functional unit SDs the G section is divided into two subsections identified with the suffixes —GA and —GB. Subsection —GA is reserved for graphical manually prepared CADs and —GB for tabular machine prepared CADs. Graphical CADs are used when intricate connecting arrangements are involved and vary in a manner not easily represented and interpreted from a tabular-type presentation. In general graphical CADs are identical to the older and traditional type drawings.

**5.09** Figure 13 is an example of part of a tabular CAD. Immediately under the CAD number (i.e., CAD 3) is the name of the circuit the CAD documents. Below this are the —FROM CONNECTION— and —TO CONNECTION— brackets which divide the listing into what may be thought of as the cable and equipment sides, respectively. Across the top of the listing are the following designators.

Beneath the —TO CONNECTION— bracket:

- DESTINATION—The circuit pack location, terminal strip, other CAD or other SD to which this CAD connects.
- LEAD DESIG—The alphanumeric designation of the lead.

Between brackets:

- METHOD—The physical type of wiring (e.g., CA 16 refers to ***CABLE*** 16, LW is loose wire, CX is coaxial cable, etc.)
- WIRE SYM—Used to indicate paired wires with the symbol P- or tight twisted pairs with the symbol TW.
- TERMINAL—Terminal number on connector terminal strip, etc.

Beneath the —FROM CONNECTION— bracket:

- LEAD DESIG—The alphanumeric designation of the lead internal to the circuit pack or SD. May be different than LEAD DESIG under —TO CONNECTION— bracket.
- TO TERMINATION—Physical location of a circuit pack connector. This column is used to show the ultimate destination of the

connection when an intermediate terminal strip or connector is used.

- TERMINAL—The terminal number of the terminal strip or connector previously discussed.

To the right of the brackets:

- OPTION—If a connection is an option, the option designation, usually a letter will be shown here.
- NOTE—Reference to any circuit notes will be shown here.

**5.10** Directly beneath these designators and preceding the listings a line enclosed by a series of dashes will specify the terminal strip or circuit pack connector documented by the CAD.

**5.11** Following this line will be one line for each terminal in the terminal strip/connector. Spare terminals will be designated SPARE or NC.

## 6. FRAME UNIT DRAWINGS

**6.01** The purpose of frame unit SDs is to document the circuitry of units which appear more than once in a frame. The format of frame unit SDs is the same as that for functional unit SDs described in 5—FUNCTIONAL UNIT DRAWINGS with some minor exceptions.

CAD 3
CPD SEQUENCER

| TO CONNECTION | | | | | FROM CONNECTION | | | | |
|---|---|---|---|---|---|---|---|---|---|
| DESTINATION | LEAD DESIG | METHOD | WIRE SYM | TERMINAL | LEAD DESIG | TO TERMINATION | TERMINAL | OPT | NOTE |
| J2, 012-09, JACK/CONN, NOTE 2 | | | | | | | | | |
| 060-14-209(J4) | AAO | CA16 | | 019 | AA | 012-14CP | 012 | X | 0001 |
| 080-12-001 | ABO | CA16 | | 018 | AB | 012-14CP | 013 | | |
| TO CAD 4 | ACO | CA16 | | 017 | AC | 012-14CP | 014 | | |
| TO CCO CKT | ADO | CA16 | PI | 016 | AD | 012-14CP | 015 | | |
| TO CCO CKT | AEO | CA16 | PI | 015 | AE | 012-14CP | 016 | | |

GRAPHICAL EQUIVALENT:

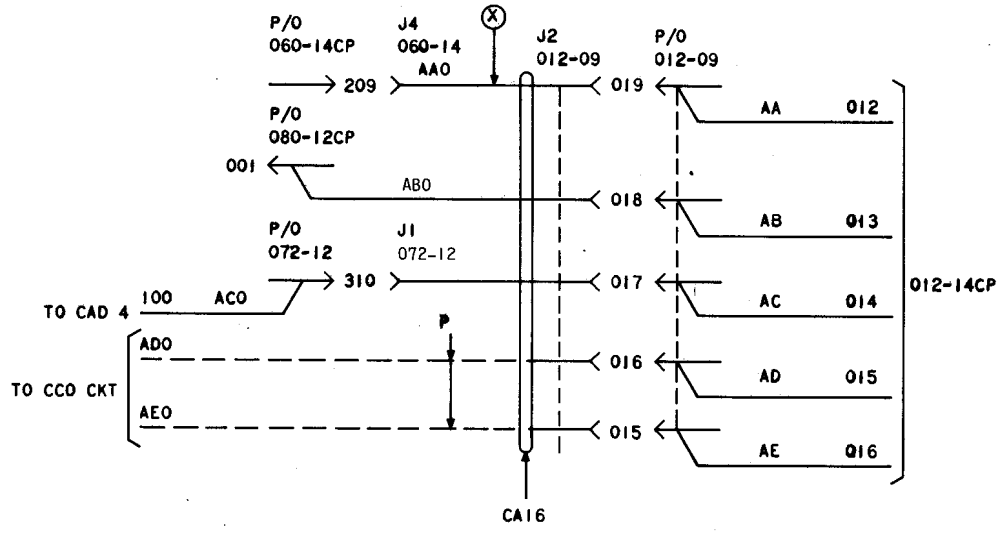



**Fig. 13—Tabular Cabling Diagrams**

**6.02** Since the units documented have multiple applications no reference is made to external circuit SD names which connect to the units. All leads which leave a unit are labeled with the statement "to connecting circuit." Frame unit SDs are always used in conjunction with frame SDs which are explained in the next section.

**6.03** In the A section of the SD a "USED ON" table will be provided. This will list all users (i.e., other SDs) of the documented circuit. Included will be user SD numbers, name of the project and Bell Labs control location. This table will be located directly above the title box on sheet A1. An example of a Used On table is shown in Fig. 14.

**6.04** The other difference in frame unit drawings is in the G section (CAD). Since no explicit external connections are defined in this type of SD, the information in the CADs will contain only the "shop" side wiring of terminal strips and/or connectors. Unlike traditional CADs where information is grouped by terminal strips, the data in frame unit CADs is formatted in a functional rather than a physical manner. The access points are arranged so as to form a functional symbol used on the next higher level SD (i.e., frame SDs). Figure 15 shows a typical functional unit symbol and contains the following information:

- Lead designation (TERM MOD)
- Function (FUNC) e.g., O = output, I = Input.
- Access Terminal
- FS Terminal
- Location of FS terminal
- Notes (reference may be made to an equipment note or sheet note which will describe anything unique about the access point.)

Intraunit CADs are provided (in addition to the type shown in Fig. 15) when terminal strips or other connecting devices which are not shown in

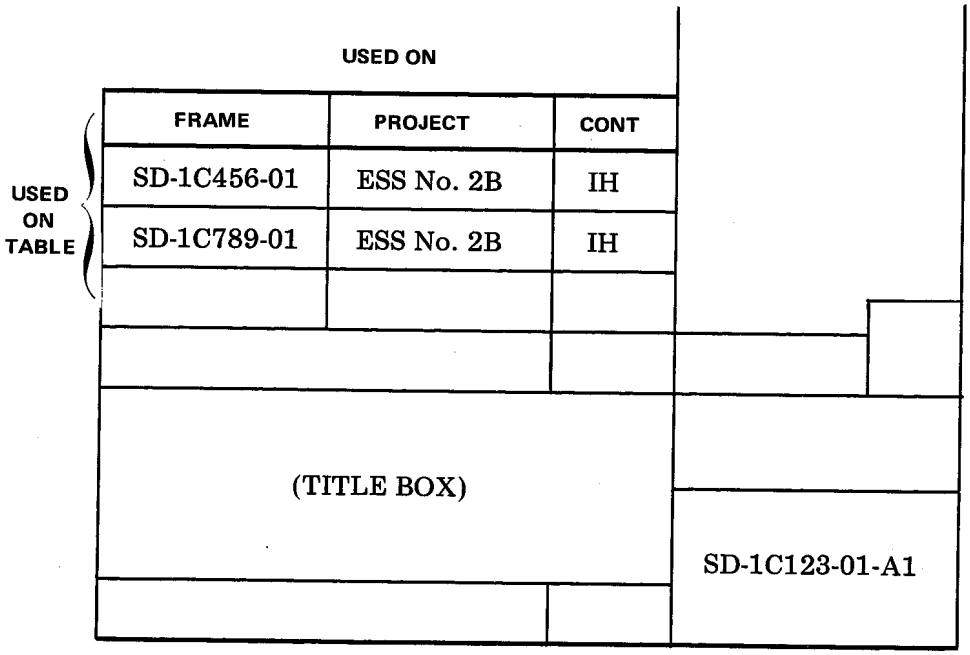



**Fig. 14—Used On Table**

the FSs are used to make internal connections within the unit.

## 7. FRAME DRAWINGS

**7.01** The purpose of a Frame SD is to document the interconnecting circuitry between the frame unit SDs described in 6—FRAME UNIT DRAWINGS. Frame SDs may also document miscellaneous frame circuitry such as power, bussing, etc. which is not shown on frame unit SDs.

**7.02** The Indexes (A Section) for frame SDs are essentially the same as those for functional unit SDs already described with the following differences:

(a) The apparatus index will include frame units. The units are listed first in the apparatus index under the heading UNIT. Circuit packs are listed next followed by all other components in alphabetical order.

(b) Frame SDs contain two lead indexes, an ***Intraframe Lead Index*** and an ***Interframe Lead Index.*** The ***Inter***frame Index equates to the conventional lead index used in all SDs while the ***Intra***frame Index is provided to correlate the lead designations on the frame unit SD with the lead designations on the frame SD.

**7.03** The B section drawings are similar to the Functional Unit SDs and are divided into the same three parts:

- Interconnection and Flow Diagrams (IFD)
- Connection List Tables
- Composite Drawings

The IFD symbol is similar to that found in functional unit SDs with the addition of the Frame Unit SD number and the J- number. An example of a Frame SD symbol is shown in Fig. 16.

**7.04** Connection list tables provide the specific unit and other component terminal information not shown in the IFDs. For each IFD symbol within an FS, there is a separate connection list

CAD 1
SYMBOL
TITLE
ELEMENT IDENTIFIER

| TERM MOD | FUNC | ACCESS TERM | FS TERM | LOC FS/SYM | NOTE |
|---|---|---|---|---|---|
| ATSP0A0 | 0 | 06-19-106 | 02-09-010 | 1/2 | |
| ATSP0B0 | 0 | 06-19-213 | 02-17-010 | 1/3 | |
| ATSP1A0 | 0 | 06-19-107 | 02-19-110 | 1/4 | |

Terminal number

Physical location of the connecting device on the unit.

**Fig. 15—Typical Functional Unit Symbol**

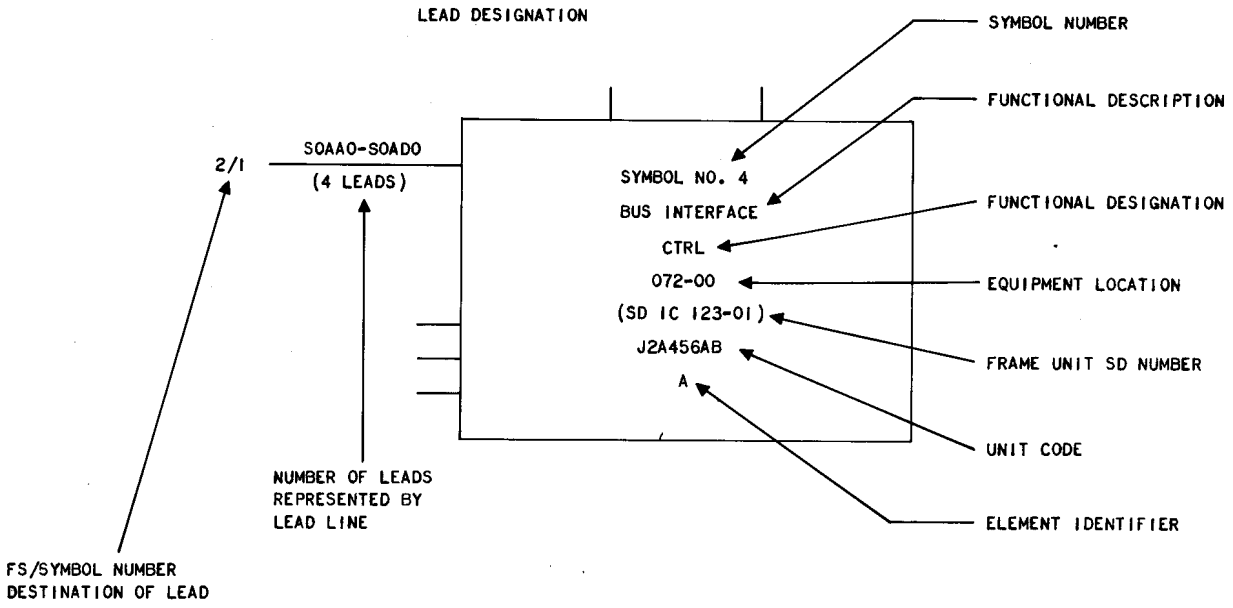



**Fig. 16—Typical Frame SD Symbol**

table. For each designated IFD lead there is a corresponding lead designation entry in a connection list table of the same symbol number. The purpose of connection list tables is to provide near-end connection information for backplane leads terminating at specific unit or other component terminals. These tables also provide the far-end documentation destination as to the FS and symbol number at which a lead terminates. When the destination of a lead is to another SD, the title of the SD- is given in the tables. An example of a frame connection list table is shown in Fig. 17.

**7.05** All leads which leave a frame (interframe wiring) are documented in the CADs of the Frame SD. Consolidating this information on Frame SDs avoids the need to show interframe wiring in CADs on individual unit SDs. Hence, a user can find all of the connections to a frame in one SD. Frame SDs also provide intraframe CADs which document cables between units on the same frame. The format of the CAD information is the same as for Functional-Unit SD CADs described in 5—FUNCTIONAL UNIT DRAWINGS.

SYMBOL NO. 5

CONTROLLER AND BUS INTERFACE

| DESIG | EQPT LOC | CODE | ELEM IDENT | OPT |
|---|---|---|---|---|
| CRTL | 068-00 | J4AXXXAB | A | |

| FRAME INFO | | | | | UNIT INFO | |
|---|---|---|---|---|---|---|
| LEAD DESIG | FUNC | TERM. | DESTINATION | NOTE | TERM MOD | LOC |
| ATS0AA0 | Ø | 02-19-100 | 2/1 | | ATSPAA0 | 17/8 |
| ATS0AB0 | Ø | 02-19-300 | 2/1 | | ATSPAB0 | 17/8 |
| ATS0AC0 | Ø | 02-19-001 | 2/1 | | ATSPAC0 | 17/8 |
| ATS0AD0 | Ø | 02-19-201 | (Z)2/1, (Y)3/2 | | ATSPAD0 | 17/8 |

OPTIONS

**Fig. 17—Typical Frame Connections List Table**