

**ENERGY**  
**COMMUNICATIONS SERVICE ADJUNCT**  
**PREINSTALLATION AND PLANNING INFORMATION**  
**AND SYSTEM DESCRIPTION**

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**NOTICE**

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## 1. GENERAL

**1.01** This section describes the Energy Communication Service Adjunct (ECSA) System and provides information and instructions for planning a new ECSA installation or for planning growth and rearrangement to an existing system. The ECSA is an electronic system that uses a stored program control to conserve energy by performing diagnostics and controlling energy functions.

**1.02** The reasons for reissuing this section are listed below. Revision arrows have been omitted because of complete reorganization and extensive changes.

- (a) To provide current system information
- (b) To incorporate preinstallation and planning information
- (c) To add remote application capability information
- (d) To add binary feedback information.

**1.03** *Warning: This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of Federal Communication Commission (FCC) Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct interference.*

**1.04** *DANGER: Hazardous foreign voltages may exist on leads extended to customer.*

**1.05** The ECSA system provides the energy communications service for host communications systems. Therefore, it is specifically designed for controlling and monitoring the energy consumed by customer equipment. It performs this function by using

control signals originating from information stored in the system processor. The signals are transmitted via a dry contact closure. The closure is extended to the low-voltage circuits which control the power-consuming equipment. Sensing the contact closure and operating the energy load controls is also the responsibility of the ECSA.

**1.06** The ECSA system provides monitoring circuits for connection to power meters or customer-provided equipment to determine power consumption and demand. The power meters provide pulses at a rate which is proportional to the power usage. The ECSA system counts the pulses in a given time period and calculates the electrical consumption and demand. The information can be used to study the peak and low patterns, and to actually control the demand by using load shedding in which loads are turned off or cycled at a lower rate on a priority basis.

**1.07** The ECSA system has the capability of controlling up to a maximum of 1008 individual loads. The maximum of 512 groups may be utilized to further control the individual loads. When the system has fewer than 512 individual loads, the number of load groups can equal the number of loads, but the number of load groups may be less than the number of loads. Block diagrams of the ECSA are shown in Fig. 1 and 2.

**1.08** The ECSA system has the capability of binary feedback. Binary feedback provides the customer with the ability to monitor the response of one or more loads on the system. A load can have only one sense point tied to it. A system can provide a maximum of 384 sense points.

**1.09** The ECSA has the capability to provide remote applications. Remote applications can be configured for on-premises or off-premises service. The MASTER REMOTE UNIT (MRU) is used in the remote location. As shown in Fig. 2, an LC601 control board is located in the carrier and communicates with the remote interface board (HN18) located in the MRU. The HN18 signals the remote load control board (AGW1) containing the load relays to turn them on or off, or communicates with the remote sense point board (AGW2) which contains information from the sense points identifying the equipment being sensed as being on or off.

**1.10** The ECSA optionally provides an interface power relay and common power supply. This

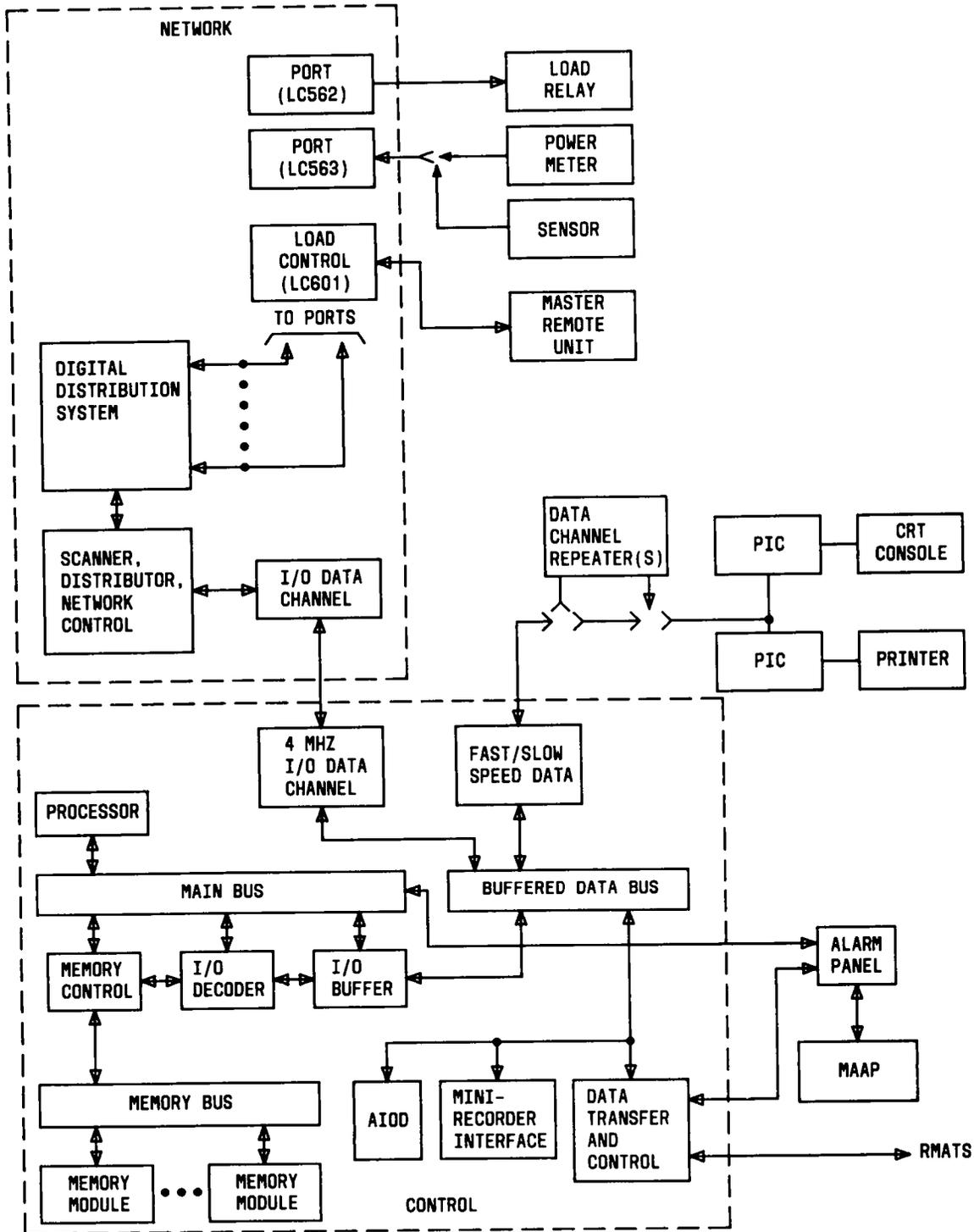


Fig. 1 — Energy Communications Service Adjunct — Block Diagram

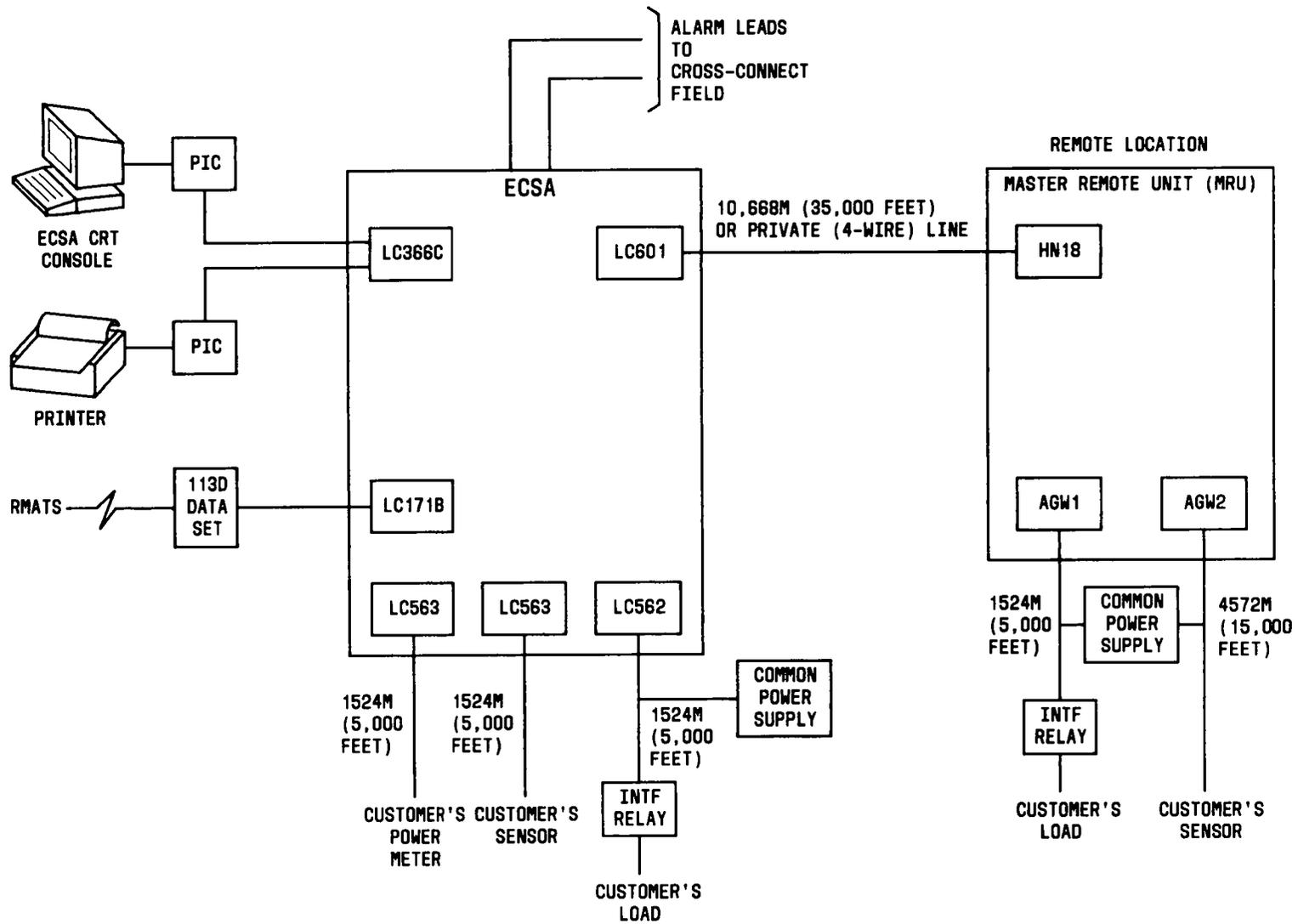


Fig. 2—Basic Block Diagram of an ECSA

option allows the telephone company to provide the **low-voltage** power relay circuits close to the customer loads. The customer's building staff provides the **high-voltage** connections to the power relay contacts.

**1.11** The generic program for the ECSA is based on a modified Feature Package (FP) 11, Issue 1.0, with the generic wording option. All programs not required for energy have been deleted and status and translation functions have been reduced to minimal size. There is no call processing capability nor any peripherals used beyond that required for the operation of the ECSA.

**1.12** Customer-provided equipment that may be controlled by an ECSA system includes heating, ventilating, and air-conditioning equipment; indoor or outdoor lighting; electric signs, etc.

**1.13** Worksheets for apparatus and/or equipment interconnections are provided (see Part 12) for installation information. Appropriate worksheets should be arranged in the same sequence in which the work is to be performed. Worksheets for energy load and power meter interface cross-connections are not provided in this section. Those worksheets may be obtained and reproduced from the customer ordering document.

**1.14** A Mechanized Ordering Form (E-8190) may be used for ordering complete new systems. (This form cannot be used for ordering additions to existing systems, or for ordering individual items.)

**1.15** It is recommended that fill-in tables (worksheets) and diagrams provided in this section be reproduced locally, as required, and the originals kept with the section for future use. Copies of the required tables (worksheets) and diagrams should be completed before the actual work begins on customer premises. Copies should be provided at the customer location, along with any other installation information, for use during the installation of the system. After the installation is completed, copies of these documents should be stored on customer premises for future reference.



***A worksheet should be completed for each feature and the data arranged in the sequence in which the work is to be performed. Where the sequence is critical, it may be desir-***

***able to complete one worksheet per feature even though this requires more than one copy of worksheet per Maintenance and Administration Panel (MAAP) PROC.***

**1.16** Last-minute customer orders may require that changes to load assignments, load groupings, and other familiar customer-furnished data be modified at the time of installation.

**1.17** Items such as power equipment, connector cables, etc, may be shipped ahead of the cabinets to facilitate the installation. The following items should be available at the customer location before the actual installation begins:

- System cabinets and energy console
- AC power installation
- Connector cables
- Termination field materials
- Power receptacle(s)
- Preinstallation worksheets completed for local minor additions or rearrangements
- Tools
- Factory computer-generated lists (shipped with the system).

**1.18** The 554 Division of Bell System Practices covers the DIMENSION PBX product line and is structured so that related information is in the same layers as follows:

- Section 554-000-000 is an index of all issue 1s or later sections.
- Layer 554-010-XXX contains sections common to more than one DIMENSION PBX system. It covers consoles, auxiliary circuits, Customer Administration Center System (CACS), Customer Administration Panel (CAP), DIMENSION PBX Electronic Custom Telephone Service (ECTS), Remote Maintenance, Administration, and Traffic System (RMATS), Station Message Detail Recording (SMDR), and Automatic Voice Network (AUTOVON).

- Layers 554-101-XXX and 554-102-XXX pertain to the DIMENSION 100 and 400 PBX systems.
- Layer 554-105-XXX pertains to the DIMENSION 600 PBX system.
- Layer 554-106-XXX pertains to the Energy Communication Service Adjunct (ECSA).
- Layer 554-111-XXX pertains to the DIMENSION 2000 and Custom PBX systems.
- Layer 554-191-XXX contains feature documents.
- How-to-operate instructions for the ECSA are contained in 999-200-XXX sections.

**1.19** The 554-1XX-XXX sections contain system description, engineering planning, and general software description of a tutorial nature. The task oriented practices (TOP) for each system are numbered in the appropriate layers for each PBX system. Maintenance support is provided in a series of sections prepared for major system elements such as scanner/distributor, processor, etc. These maintenance sections are intended to convey operational theory to provide a background for troubleshooting complex problems. Section 554-105-115 contains descriptions and procedures for all field X-ray tests. This section is based on the drawings listed in Part 11. If this section is to be used with equipment or apparatus reflecting later issue(s) of the drawing(s), reference should be made to the schematic drawings (SDs) and circuit descriptions (CDs) to determine the extent of the changes and the manner in which the section may be affected.

## 2. DESCRIPTION

**2.01** The ECSA is an electronic system that uses stored program control for energy processing and system diagnostics. The ECSA is available in either a 1- or 2-cabinet system (Fig. 3). The 1-cabinet system contains one control/energy carrier and one energy carrier permitting 784 loads in the system. The 2-cabinet system contains the same carriers as the 1-carrier system with one additional energy carrier permitting 1008 loads and 384 binary feedback points in the system.

**2.02** Functional operation of all portions of the ECSA is under the control of the processor

(Fig. 1). The processor controls all system activities by executing instructions read from the main program memory. A high-level instruction is read from the random access memory (RAM), and the processor executes a series of microinstructions in response to the high-level instruction. The processor communicates with the system via the main system bus and dedicated input/output (I/O) channels. Upon direct commands from the processor, the scanner/distributor scans for changes in port status associated with power meter interfaces. Figure 4 is a functional block diagram of the ECSA.

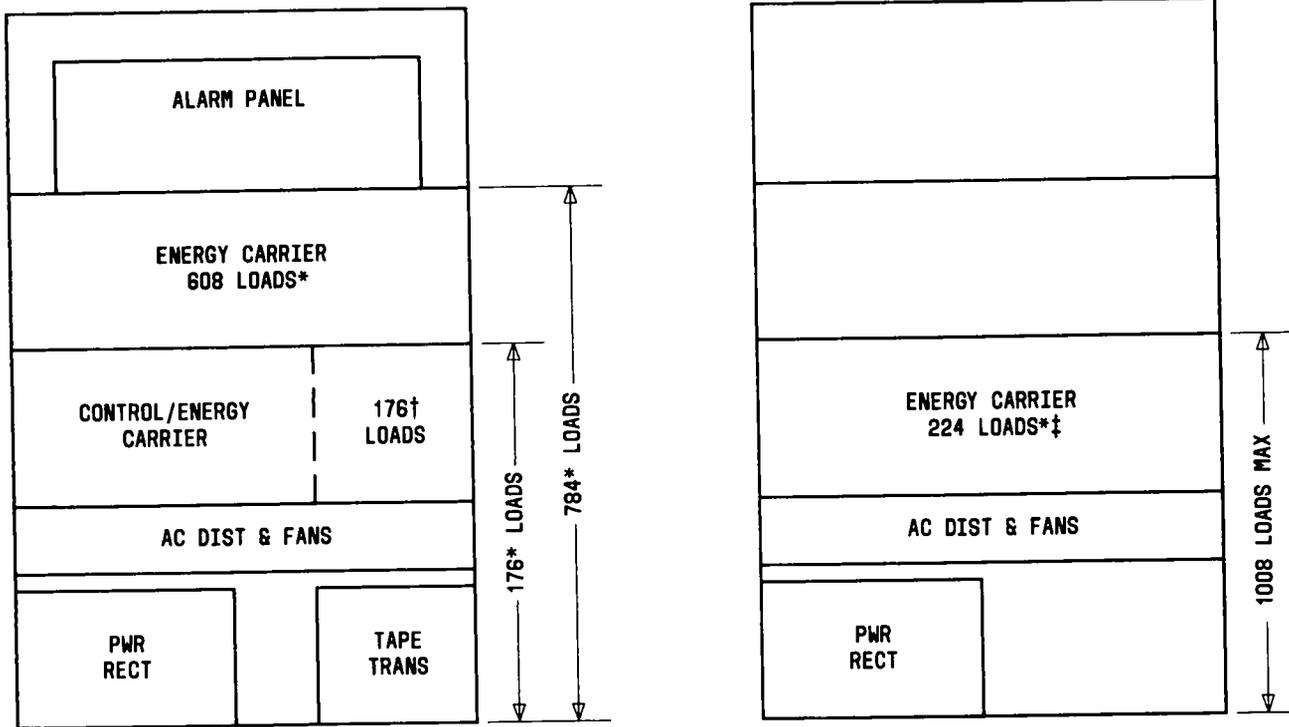
**2.03** The energy processing operations, features, and controlling generic program of the system are contained in RAM. A tape cartridge contains generic and translation data. Translation on the tape cartridge is updated by the craft person using the MAAP; however, the Remote Maintenance, Administration, and Traffic System (RMATS) can also update translations. A copy of the generic program and translation data is in RAM.

**2.04** Basic translation data (including standard features) is identical for all ECSA adjunct systems when shipped. The translations are stored on the tape cartridge and accompany each shipped system. The translations may be customized by the craft person via the Maintenance and Administration Panel (MAAP). Features that are allowed but are inaccessible due to hardware and memory size requirements may be administered by the craft person if the necessary hardware and memory are provided. The craft person or RMATS records the translations on the tape cartridge stored with the system cabinet.

**2.05** The system parameters and capacities of the ECSA are listed in Table A. The number of load interfaces, power meter interfaces, and binary feedback interfaces, along with remote controller interfaces served by a particular system, is set at specific values for either model available. The load capacity of the ECSA is a function of both hardware and software and is shown in Fig. 3.

**2.06** The ECSA is offered in two configurations (Table B). Configurations are based on memory size, load and sense point capacity, and loads and/or sense points equipped. Each configuration is equipped with a set number of loads or sense points and a cartridge tape with translations for the loads or sense points that are equipped. Two tapes are shipped with each configuration; one is a spare.

**2.07** If additional loads or sense points are required, circuit packs LC562 or LC563 will be



**BASIC CABINET J53135A-1**

\* A MAXIMUM OF 384 SENSE POINTS CAN BE PROVIDED PER SYSTEM USING LC563 CIRCUIT PACKS.

† IF POWER METER INTERFACE BOARD, LC563, IS NOT REQUIRED, 16 ADDITIONAL LOADS ARE AVAILABLE.

‡ IF POWER METER INTERFACE BOARD, LC563, IS REQUIRED, ONLY 208 LOADS CAN BE PROVIDED IN THIS CARRIER.

**AUXILIARY CABINET J53135A-1**

**Fig. 3—Single- or Dual-Cabinet System**

shipped loose to meet the need. Translations for these additional loads must be added at the job site.

### 3. HOW TO USE THE SECTION

**3.01** When planning a new installation, the material in Parts 5 through 7 should be reviewed to ensure that all requirements for power, protection, miscellaneous components, floor plan, etc, have been given adequate consideration.

**3.02** System changes may be required after the system is installed and accepted. When planning changes, obtain complete, current, and accurate system records then provide new fill-in worksheets showing each change.



*A circuit pack is normally replaced with a circuit pack having either the same or later letter suffix as printed on the carrier label. That is, an LC30 cannot be used if the label specifies LC30B. An LC30B, C, or later letter-suffixed circuit pack is a suitable replacement.*

**3.03** Refer to Parts 5 through 7 and consider all necessary areas such as cabling, additional equipment, additional power and/or grounding, etc, that are required to provide the changes.

**3.04** The fill-in interconnection tables (worksheets) (Part 12) should be reproduced and completed as required.

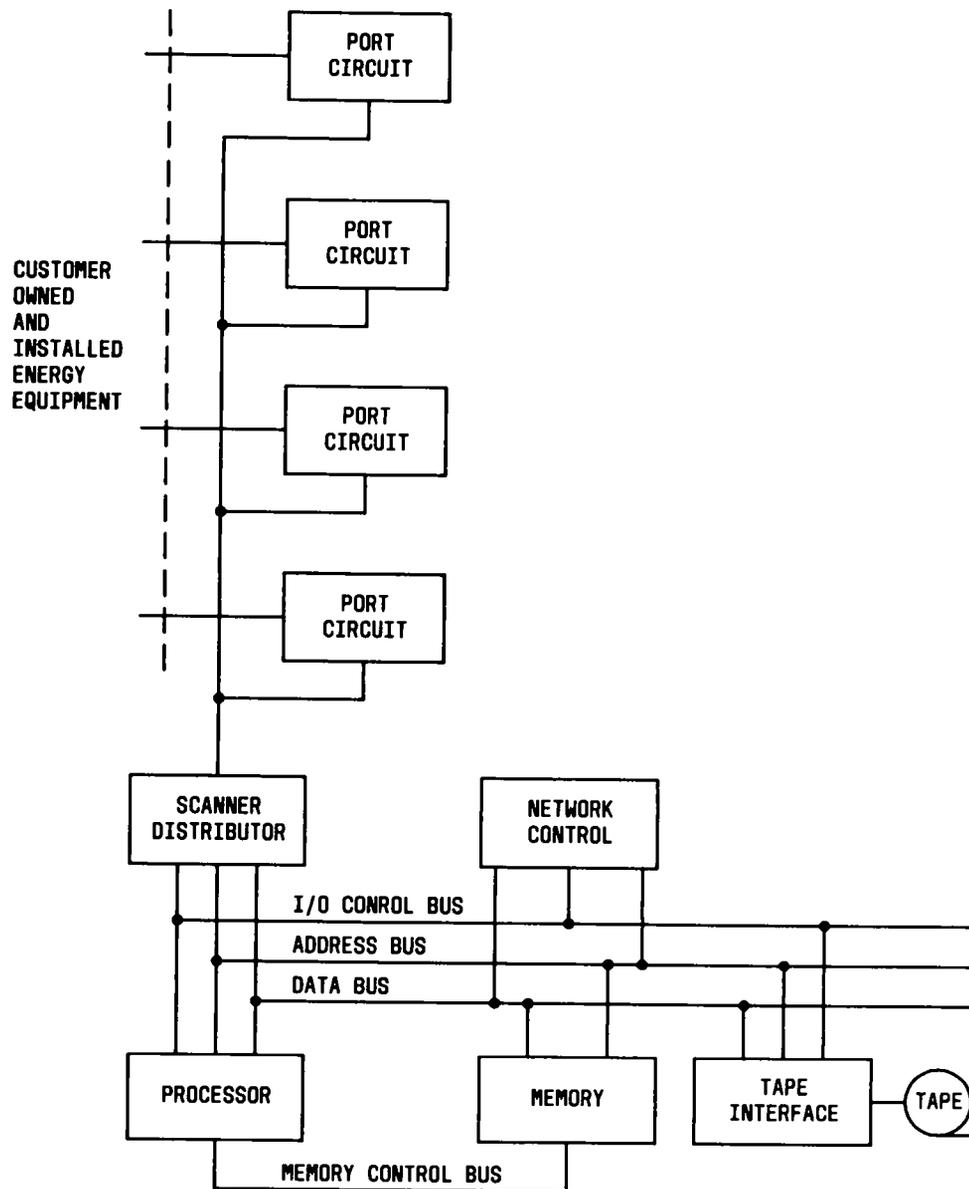


Fig. 4 Energy Control—Functional Block Diagram

#### 4. FEATURES AND SERVICES

4.01 The ECSA is designed to control energy-consuming devices within the customer premises. The ECSA allows a customer to establish equipment operation schedules in order to control total energy consumption. The scheduling software is part of the resident operating system of the ECSA.

4.02 The individual energy loads and power meter monitoring circuit pack locations are initially

translated and defined within the system program tape. The binary feedback circuit pack and remote controller circuit pack translations are accomplished by using the MAAP. Changes, such as additions, deletions, or reassignments, may be accomplished by use of the MAAP. These circuit pack translations yield corresponding load numbers which are entered into scheduling routines via the ECSA console.

4.03 Once the energy loads are defined and the ECSA equipment is installed, the system is

TABLE A

## ENERGY COMMUNICATIONS SERVICE ADJUNCT PARAMETERS

ITEM		MAXIMUM PER MEMORY CONFIGURATION	
		B	C
SYSTEM	MODULES	1	1
	CABINETS	1	2
	LOW-SPEED DATA CHANNELS*	8	8
	PERIPHERAL INTERFACE CIRCUITS†	4	4
	POWER METER INTERFACES	16	16
	CARRIERS	2	3
	MEMORY Circuit Packs (64K WORD Each)	3	4
	Quantity of Memory Words Required	192K	256K
PERIPHERAL EQUIPMENT	PIC'S†	4	4
	JOURNAL PRINTERS	3	3
	ECSA CRT DISPLAY	1	1
	ECSA INDIVIDUAL LOADS	400	1008
	ECSA LOAD GROUPS	400	512
REMOTE EQUIPMENT	REMOTE CONTROLLER	12	22
	MASTER REMOTE UNIT	12	22
	REMOTE LOAD CONTROL BOARD	12	22
	REMOTE INTERFACE BOARD	96	176
	REMOTE SENSE POINT BOARD	48	48
	BINARY FEEDBACK (SENSE POINT)	384	384

\* Low-speed data channels serve ECSA peripheral interface circuit (PIC's) devices.

† PICs are used with the journal printers and energy CRT.

ready to accept additional instructions, via the CRT, required to provide the following primary functions of the system:

- (a) Individual load cycling function (ILCF)
- (b) Peak demand shedding function (PDSF)
- (c) Energy consumption and demand monitoring (ECDM).

**4.04** The three functions permit the ECSA system to be tailored for a particular customer. The tailoring is accomplished via an ECSA console

(Fig. 5 and 6). The ECSA console displays specific forms [on its cathode ray tube (CRT)] which permit parameters governing the system performance to be defined and entered. Changes to the parameters in the forms displayed on the console may be made to enhance the system performance as well as to cover customer equipment changes or rearrangements.

**4.05** Control of the three functions is established and monitored via the ECSA console. The console operator has the capability of assigning each energy load to the cycling and shedding functions, and the power meter interfaces to the consumption

TABLE B

SYSTEM CONFIGURATIONS

LOAD ARRANGEMENTS				EQUIPMENT PROVIDED								
LOADS EQUIPPED (NOTE 1)	LOAD CAPACITY	REMOTE LOCATIONS CAPACITY	MEMORY SIZE	64K MEMORY LC346	LOAD INTERFACE LC562 (NOTE 2)	NETWORK BUFFER LC561	POWER METER INTERFACE LC563	REMOTE CONTROLLER LC601	CABINET J53135AA	CONTROL/ENERGY CARRIER J53135AA	ENERGY CARRIER J53135AB	POWER SUPPLY J87432D OR J87460D
32	176	12	B	2	2	1	2	12	1	1	—	1
					4							
					8							
	400	22	C	3	12	3		22	2	2	2	
	784				26							
	1008				50							6

**Notes:**

1. Tape translations are provided for all loads equipped with each system configuration. Additional translations must be performed by RMATS or MAAP.
2. Quantity shown is provided by system configuration. Additional LC562s will be provided as required when the desired loads exceed the loads equipped.

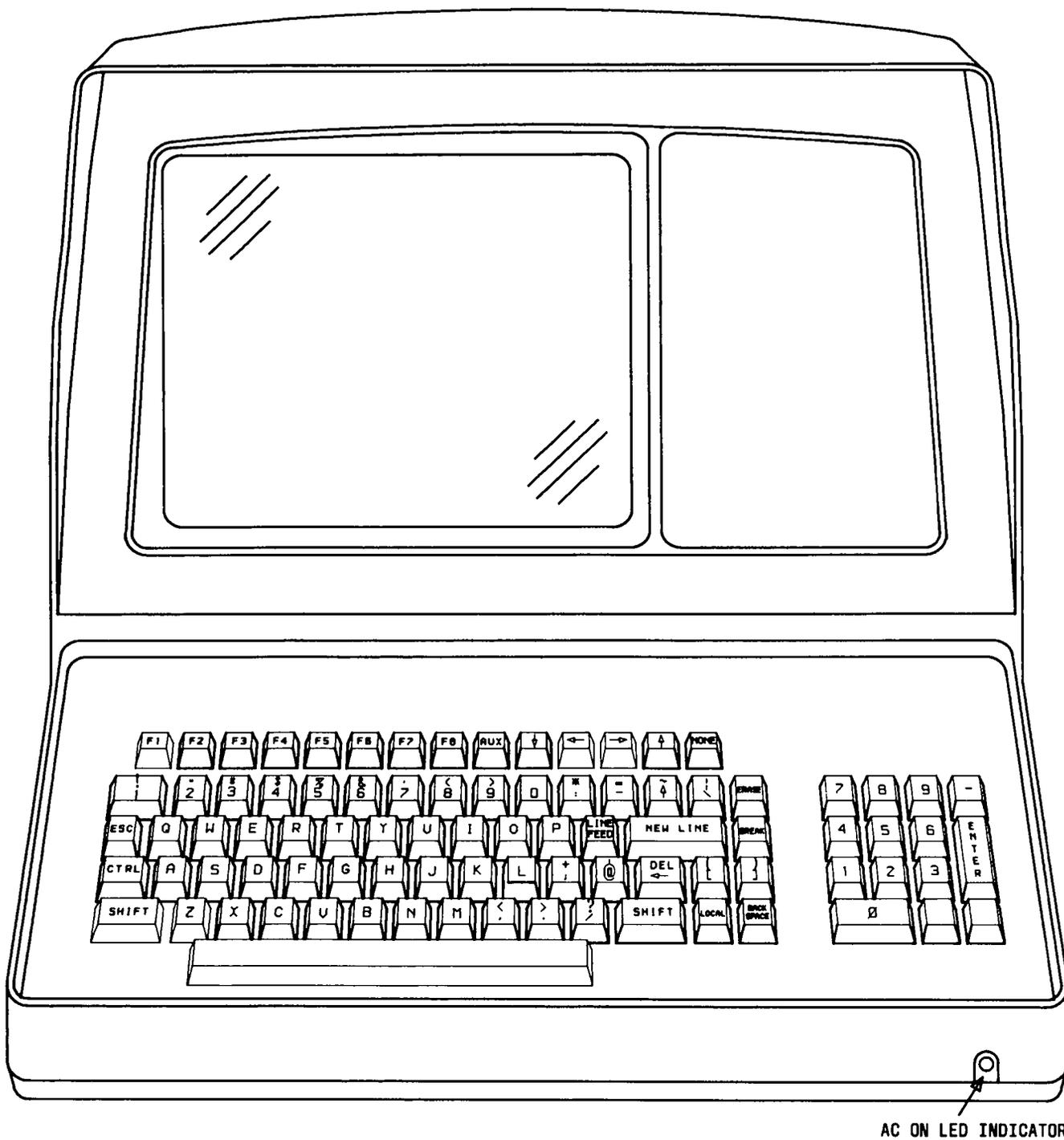
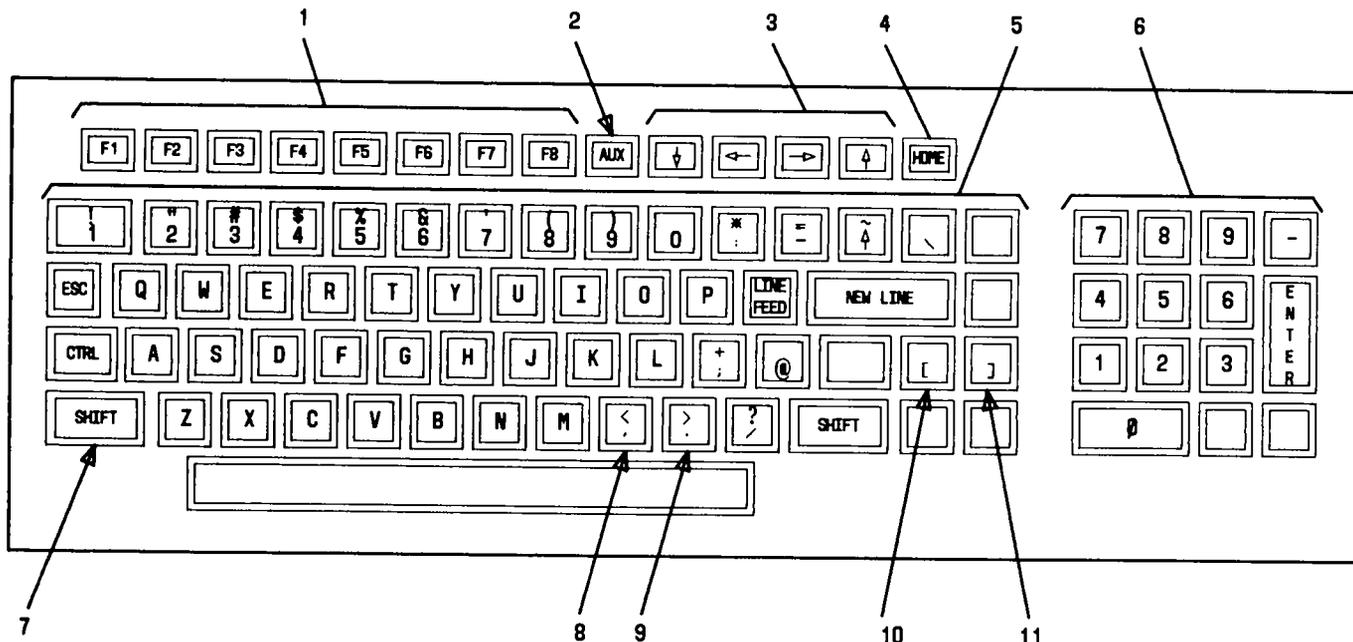


Fig. 5—ECSA Console



1. THESE KEYS ARE FUNCTION KEYS FOR CONTROLLING THE CRT DISPLAYS
2. THE AUXILIARY KEY - THIS KEY IS NOT USED
3. THESE ARE THE CURSOR CONTROL KEYS
4. THIS IS THE HOME KEY - IT MOVES THE CURSOR TO THE FIRST CHARACTER POSITION OF THE SECURITY CODE FIELD
5. THE MAJOR KEYBOARD KEYS
6. THE PAD - THE NUMBERS ARE DUPLICATED ON THE KEYBOARD
7. SHIFT KEY - WHEN PRESSED SIMULTANEOUSLY WITH ANY KEY F2 THROUGH F8, ALLOWS YOU TO JUMP DIRECTLY FROM ONE PARAMETER DISPLAY TO ANOTHER.
8. THIS KEY (NO SHIFT REQUIRED) MOVES THE CURSOR TO THE LEFT AND UPWARD TO THE BEGINNING OF THE PREVIOUS DATA FIELD.
9. THIS KEY (NO SHIFT REQUIRED) MOVES THE CURSOR TO THE RIGHT AND DOWNWARD TO THE NEXT DATA FIELD.
10. THIS KEY (LONG TAB BACKWARD) MOVES THE CURSOR BACKWARD TO THE FIRST DATA FIELD OF THE PREVIOUS LINE.
11. THIS KEY (LONG TAB FORWARD) MOVES THE CURSOR FORWARD TO THE NEXT DATA FIELD OF THE NEXT LINE.

Fig. 6—Keyboard of the ECSA Console

and demand monitoring function. The console permits ease of load assignments and provides screen displays to monitor the functions.

**4.06** Various system status reports can be monitored via the console displays to determine system performance. Hard copies of the reports can be obtained via the system printers (Fig. 7). Some reports are made on demand while others are automatically printed at specified time intervals.

#### INDIVIDUAL LOAD CYCLING FUNCTION

**4.07** Individual control signals can be sent to customer-designated devices so that the customer may enable/disable (turn ON/OFF), or cycle the device as scheduled for each day of the week, plus an additional day for holidays (8-day clock). Each day's schedule is started at midnight (00) and can be changed progressively up to five times during the day. The last change scheduled each day controls the device until the midnight starting point of the next day.

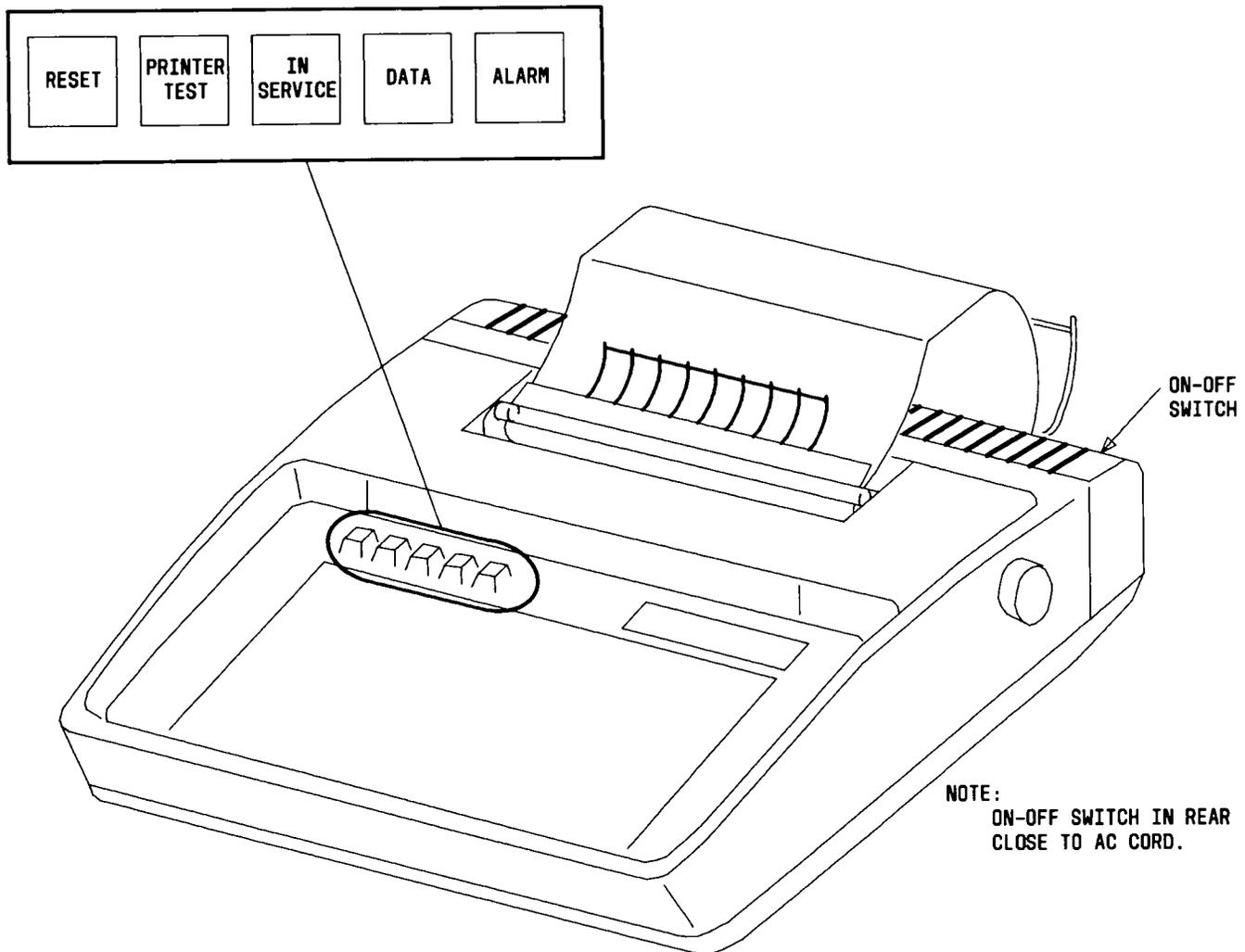


Fig. 7—ECSA Printer

#### PEAK DEMAND SHEDDING FUNCTION

**4.08** Control signals can be scheduled so that the customer may increase the off-cycle time or disable devices sharing monitored electrical meters at a particular level of energy usage and priority predetermined by the customer. This function requires a Bell System power meter interface connection block for every monitored power meter. Pulses generated by the power meter are converted into signal messages which are sent to the ECSA. These signal messages are the basis for establishing the energy consumed. Any resulting load shedding is based upon a customer-determined threshold level of power demand being approached. When the power demand subsides, the devices are enabled (turned ON) in reverse priority order. Changes to the threshold and

priorities are customer-alterable via the CRT console. The PDSF schedule takes control of loads from the ILCF when energy demand approaches the predetermined peak value.

#### ENERGY CONSUMPTION AND DEMAND MONITORING

**4.09** The ECSA provides the capability of monitoring 16 power meters. A power meter interface monitors each electrical power meter serving loads connected to the system. Impulses generated (indirectly) by the power meter are converted into signal messages that are used by the ECSA to compute the energy consumption (killowatt-hours) indicated by each meter. A similar method is provided when monitoring gas or water meter circuits.

**4.10** Monitoring the system is done by using the system status display and base procedure. This provides an up-to-the-minute report of the loads the ECSA has off, the highest load group shed, and the demand and consumption of electricity. The power meter inputs to the ECSA are totalled and used to compute the following information and update the display each minute:

- Total consumption since last date and time cleared
- Highest demand since last date and time cleared
- Current demand during the last demand interval
- Individual meter current demand during the last demand interval of 5, 15, or 30 minutes.

The display also includes the following:

- Date—time (last minute update)
- Peak demand target level (entered on F5 screen)
- Highest load group now shed (all lower numbers also shed)
- Total number of loads now off (loads with off status)
- History of demand and highest load group shed (time, recorded every 5 minutes for 50 minutes; demand, current demand recorded every 5 minutes; highest group shed, recorded every 5 minutes).

**4.11** The kilowatt-hours (kWh) per pulse designation on the SYSTEM PARAMETERS screen may or may not be applicable because all power meters are reported, including meters that are being used for measurements other than electrical consumption.

**4.12** Reports that contain the daily consumption can be requested by the operator. This report will be added to the existing DAILY STATUS REPORT.

**4.13** Translations for load feedback, and power meters can be administered via the Maintenance and Administration Panel (MAAP) and by the Remote Maintenance, Administration, and Traffic System (RMATS).

nance and Administration Panel (MAAP) and by the Remote Maintenance, Administration, and Traffic System (RMATS).

#### ENERGY CONTROL ALARM PRINTING

**4.14** While using the ECSA alarm display, the ECSA operator has the ability to page through the alarms; print all alarms and clear any particular alarm without having to clear all alarms, or clear all alarms. While using the alarm procedure, or the printer parameters and reports procedure, the operator has the ability to print out a list of the current alarms.

**4.15** An automatic printing of the ECSA alarms occurs when the number of alarms in memory reaches 35. The total number of alarms allowed in memory is 42, so automatic printing when 35 alarms are logged gives the system a buffer in case the printer is busy and more alarms are recorded before the original 35 can be printed. The alarms are deleted from memory only after a successful print of the alarms has been made. Even if there is a printer failure, the process to delete the alarms will wait for a message verifying that the print has been completed. The ECSA can provide extended alarms. This can be done with either, or both, audible or visual alarms. Once the alarm is acknowledged, it must be turned off manually.

**4.16** A fail-safe condition for individual loads can be provided optionally by the ECSA. The customer will have the ability to change the fail-safe condition using the CRT and entering an "ON" or "OFF" in the designated field on the "Individual Load Cycling and Peak Demand Shedding screen.

**4.17** The base procedure also provides a blinking alarm message with an audible beep at the bottom of the screen when an alarm is detected and entered in storage. The base procedure is displayed continually until another procedure is called using the function keys as they are listed near the bottom of the screen. If a screen other than the base screen is left idle for 5 to 6 minutes, it will time out and return to the base procedure. The function keys associated with the base procedure are as follows:

- **F1—EC Alarms Display:** (Alarms are displayed when alarm message is on the bottom of the screen or NO ALARMS message when F1 is pressed.) This will display the printer

alarms. These alarms indicate printer either out of paper or turned off, printer PIC failed or backed up, or LC366 failed, and printer out of service.

- **F2—System Parameters:** Entries change the security code, system date and time, demand interval (display only), active status of power meter alarms, kWh/pulse for power meters, holiday dates schedule, and active status of the ECSA feature.
- **F3—Binary Feedback (Sense) Points Display:** The ECSA will scan each feedback point once every 100 msec. The current state of all feedback points will be displayed when requested from the ECSA console. The alarm values are 0, 1, and 2. The value 0 means that no alarming will be done for that given sense point. The value 1 means an alarm conditions will be indicated by an asterisk on the screen (in the row for the sense point). A 2 will cause the asterisk to appear and also log an EC alarm.
- **F4—Individual Load Scheduling Parameters:** After the load is installed in the ECSA and connected to the normally open circuit, the 8-day schedule is the first entry made at the console: Monday (M) through Sunday (S) and Holiday (H) with six times for each day. Each time has space for a normal and shed cycle pattern assignment. The cycling patterns are preprogrammed in the system and include on time (enable), off time (disable), and 22 other (cycling) patterns that progress from on to off. When the schedule is complete in this procedure, the normal cycling pattern for the present day and time will control the load. The load must be entered in a group to activate shedding which is the next entry.
- **F5—Peak Demand Load Shedding Group Parameters:** This procedure is used to form load groups. The objective of the load group is to make loads available for shedding during periods of high usage (demand). The entry in this procedure includes the load number and the consumption rate. The system computes and displays the total shed estimate for all loads entered in each group. The maximum level (peak demand target) of

usage determined reasonable for the system is entered in this procedure. When this level is approached, the system responds by shedding loads according to the priority set by the load group number. The loads in the shed load group are controlled by the shed cycling pattern scheduled for the present day and time. When usage falls below maximum level, control of loads is restored to normal cycling in reverse order of load group priority. The electrical usage, status of system control, safety (dead) bandwidth, reaction minutes, predictor interval and predictor improvements are provided through the system status display.

- **F6—Load Override Parameters:** Entries change the active status of system "ON OVERRIDE" and entries for load numbers under an "ON OVERRIDE" active or "OFF OVERRIDE" active list.
- **F7—Load Status Display:** Entries designate the loads and display their status on the screen or print on the demand printer.
- **F8—Printer Parameters and Reports:** Entries assign demand report and periodic report printer, and time each daily status and periodic status report is printed—also provides the capability to print seven demand reports, and print and clear total demand and consumption.

#### REMOTE APPLICATIONS

- 4.18** The ECSA provides for on- or off-premises service via the Master Remote Unit (MRU). When on-premises remote service is required, up to a maximum of 64 loads and/or sense points per MRU may be controlled over one pair of wires to a distance of 668m (35,000 feet) maximum. Off-premises service requires a 2-wire or a private (4-wire) line circuit, which still controls a maximum of 64 loads.
- 4.19** The ECSA contains a remote controller circuit pack that provides control data to the remote interface board in the MRU. The remote interface board signals the remote load control board relays to the on or off status designated by the ECSA. This board also sends maintenance signals from the MRU back to the ECSA. The ECSA and RMATS will control and monitor the remote loads or sense points in the same manner as any other load or sense point.

**4.20** The MRU can control as few as 8 loads or sense points and as many as 64 loads in increments of 8. A maximum of 13 MRUs can be provided with a B memory, 1-cabinet ECSA, and 22 MRUs with a C memory, 2-cabinet ECSA.

**4.21** The ECSA remote premises capability requires that the following parts be added to the ECSA equipment:

(a) A control board, LC601, mounted in slots 1/2 or 9/10 of a segment (replaces LC562 circuit pack in slot 1/2 or 9/10 and the next 3 consecutive slots in an ECSA carrier, 3/4, 5/6, 7/8, or 11/12, 13/14, 15/16, remain empty).

(b) An MRU mounted at a remote location which contains:

- A remote master interface board, HN18 (converses with the LC601 for information to control the AGW1 relays and to return maintenance test results).

- Up to eight remote load control boards, AGW1 (each AGW1 controls the loads assigned to a slot number 1 to 8, or 9 to 16, in the ECSA carrier).

- Up to eight remote sense point boards, AGW2 (each AGW2 controls the sense points assigned to a slot number 1 to 8, or 9 to 16, in the ECSA carrier).

- When remote load control boards (AGW1) and sense point boards (AGW2) are required in the same MRU, only four of each circuit may be used for a total of eight.

- A power supply for the HN18, AGW1, and AGW2 boards (within the MRU mounting).

(c) A remote cross-connect field used as the load control contact interface from the MRU (point of connection for the interface power relays).

#### **INTERFACE POWER RELAY AND COMMON POWER SUPPLY**

**4.22** An optional interface power relay and common power supply are available from the interface cross-connect field to the proximity of the controlling power circuits of the load being con-

trolled. With this option, the customer's building staff and engineering consultants can establish the high-voltage circuit connections to the interface power relay contacts. The interface power relay contact specifications are as follows:

- Single pole double throw (SPDT)
- 10 amps at 120 or 240 Vac
- 10 amps at 28 Vdc resistive load
- 1/3 horsepower at 120 Vac motor load
- 1/2 horsepower at 240 Vac motor load
- Silver alloy gold flashed.

**4.23** Consideration of limits for each control relay connected is as follows:

#### **TYPICAL VOLTAGE APPLICATION**

Power	Open Circuit Voltage	Closed Circuit Current
25 VA	130 volts	0.19 amperes
25 VA	50 volts	0.5 amperes
25 VA	25 volts	1.0 amperes
12 VA	12 volts	1.0 amperes
6 VA	6 volts	1.0 amperes

**4.24** The minimum resistance in a circuit (including relay) using 50 volts or lower will usually be met by the relay coil resistance. One relay which meets these typical specifications for remote applications is shown below:

Magnecraft Electric Co., Chicago, Ill.

Code No. W 88 CPX-13

Coil Resistance 2500 Ohms

Contact - Single Pole, Single Throw (make, break)

Operate - Minimum Power, 125 milliwatts (0.125 watts)

Continuous Operation - Maximum Power, 3 watts.

**MISCELLANEOUS****A. Automatic Individual Load Number Assignment**

**4.25** The numbering scheme for the individual load numbers is not administrable. A module number, carrier number, segment number, slot number, circuit number, and port number are inputted. From these inputs, an individual load number is automatically calculated and displayed. Load numbers are generated in blocks of 16. Each load board will have a block of 16 continuous load numbers assigned.

**B. Contact Interface Implementation**

**4.26** ***DANGER: Hazardous voltages may accidentally be applied to the ECSA via LC562 contact interface leads (normally dry contacts) which are made available to the customer for the switching of load control relays.*** The LC562 provides a dry (no voltage provided) make contact. The LC562 controls the loads. When the load relay operates, the load is ON, and when the load relay releases, the load is OFF. A "Fail-Safe" condition "ON" provides an opposite reaction (load relay releases).

**UNINTERRUPTIBLE POWER SERVICE (UPS)**

**4.27** This is an optional feature which provides operating power for the ECSA during commercial ac power interruptions. When such an interruption occurs, the UPS provides the required power (holdover) from batteries which have been charged during normal commercial power operation. The UPS is available in a "nominal holdover" configuration in which battery power can be supplied in terms of minutes and supports cabinet equipment which performs energy functions.

**4.28** Nominal holdover provides power for ECSA cabinets for relatively short commercial power interruptions. This allows all energy functions to continue without interruption for approximately 5 minutes. Nominal holdover has been designed primarily for those customers who provide supplemental power sources, such as engine-alternators, that can be expected to take over local power loads within seconds or at most a few minutes. For customers without such backup arrangements, a nominal holdover prevents loss of ECSA service for perhaps 95 percent of all power interruptions, depending on local experience. The duration of the power holdover is

dependent on the load on the cabinet power supply. Commercial power failures on systems not equipped with UPS are discussed in paragraph 8.03.

**HARDWARE LIMITATIONS**

**4.29** The maximum number of relay contacts is limited to the number of LC562 circuit packs provided (16 circuits per circuit pack). Each LC562 circuit pack is capable of interfacing with 16 individual loads (one per LC562 circuit). Maximum limit of the relay contact is 25 VA.

**4.30** The maximum number of LC563 circuit packs, when sense point are not required, is limited to two: one for power meter interfaces and one for maintenance (ie, testing the LC562's). With sense points provided, a maximum of 24 more LC563 circuit packs can be provided.

**4.31** The maximum number of power meter interfaces is limited to 16. There are 16 circuits per LC563 circuit pack [used as an interface between ECSA and the power meter(s)]. The maximum relay contact rate for the LC563 circuit pack is 400 pulses per minute. The minimum pulse rate for the power meter interface is 20 pulses per minute. The maximum loop length (resistance) to the relay is 1500 ohms.

**4.32** Each system is limited to one ECSA console. The operating temperature range for this console is 0 to 50 degrees C.

**4.33** Each system is limited to eight data channels. One is used for the ECSA console and three data channels may be used for printers. The other four are reserved for future possible enhancements.

**4.34** The distance the ECSA console and printer(s) can be from the ECSA is limited to 1524 meters (5000 feet). Also, the distance the ECSA can be from the host PBX is limited to 1524 meters (5000 feet).

**4.35** For further information on hardware limitations, refer to Feature Document 554-191-262.

**5. INSTALLATION CONSIDERATIONS****PHYSICAL ARRANGEMENTS**

**5.01** The ECSA system equipment is housed in either one or two cabinets measuring approxi-

mately 1244 mm (49 inches) high by 800 mm (31-1/2 inches) wide by 610 mm (24 inches) deep (Fig. 8, and 9). The cabinets fit through standard door openings (2134 mm by 914 mm [7 feet by 3 feet]) crated and mounted on a 178-mm (7-inch) high dolly. Each cabinet consists of a basic framework with welded half-side panels. The rear panel is screw-mounted to the cabinet. A wraparound cover assembly completely encloses the front half of the cabinet. The front cover is secured to the cabinet with five flip-latch fasteners. Depending on customer requirements, one or two carriers mount on the framework of each cabinet. The cabinets are shipped equipped from the factory, and are provided with rollers for ease of installation and maintenance.

**Note:** Only eight screws attach the rear cover to the cabinet when it is shipped from the factory. Remove the remaining screws (18) from plastic bag taped to the cover. Use screws to secure cover to cabinet before system installation is complete.

**5.02** The ECSA may consist of a 1- or 2-cabinet system. The single- (basic-) cabinet system or the first cabinet of a 2-cabinet system always requires a control/energy carrier (J53135AA) (Fig. 8). When the individual energy loads or sense points exceed 176, an energy carrier (J53135AB) (Fig. 8) must also be provided in the first or single cabinet (J53135A). The energy carrier provides the interfaces for 608 additional loads or sense points.

**5.03** A second cabinet (J53135A) with a single energy carrier (Fig. 9) is required when the individual loads or sense points exceed 784. The energy carrier in the second cabinet is equipped to interface only 224 individual loads. Additional loads in the carrier would exceed the 1008 maximum of a 2-cabinet system. This energy carrier can be equipped to interface 384 sense points, provided none are in the first cabinet. The system maximum is 384 sense points.

## CABINETS

### A. Basic Cabinet

**5.04** The basic cabinet J53135A (Fig. 8) houses the following equipment:

- **J53135AA Control/Energy Carrier (Fig. 10):** This carrier provides slots for processor control, extended I/O, scanner/

distributor, network control, buffers, data channels time-of-day clock, memory, alarm panel, load interface, power meter interface/indication of load control/binary feedback interface, remote control board, and RMATS/tape interface circuit packs.

- **J53135AB Energy Carrier (Fig. 11):** This carrier provides slots for scanner/distributor, network control, buffers, load interface, power meter interface/binary feedback interface and remote control board circuit packs.
- **J53135JA AC Power Distribution and Fan Assembly:** This unit provides ac power to the power supply and houses the fan assembly.
- **J53135DA Control and Alarm Panel Assembly (Fig. 12), Wiring and Equipment:** This panel provides alarms, fault indicators, and controls used in determining system status or performing system microdiagnostics.
- **ED-1E364-70 GR 3 Thermal Assembly:** This unit contains the thermal sensors that control the fans for the cabinet in case of an overtemperature condition.

### B. Auxiliary Cabinet

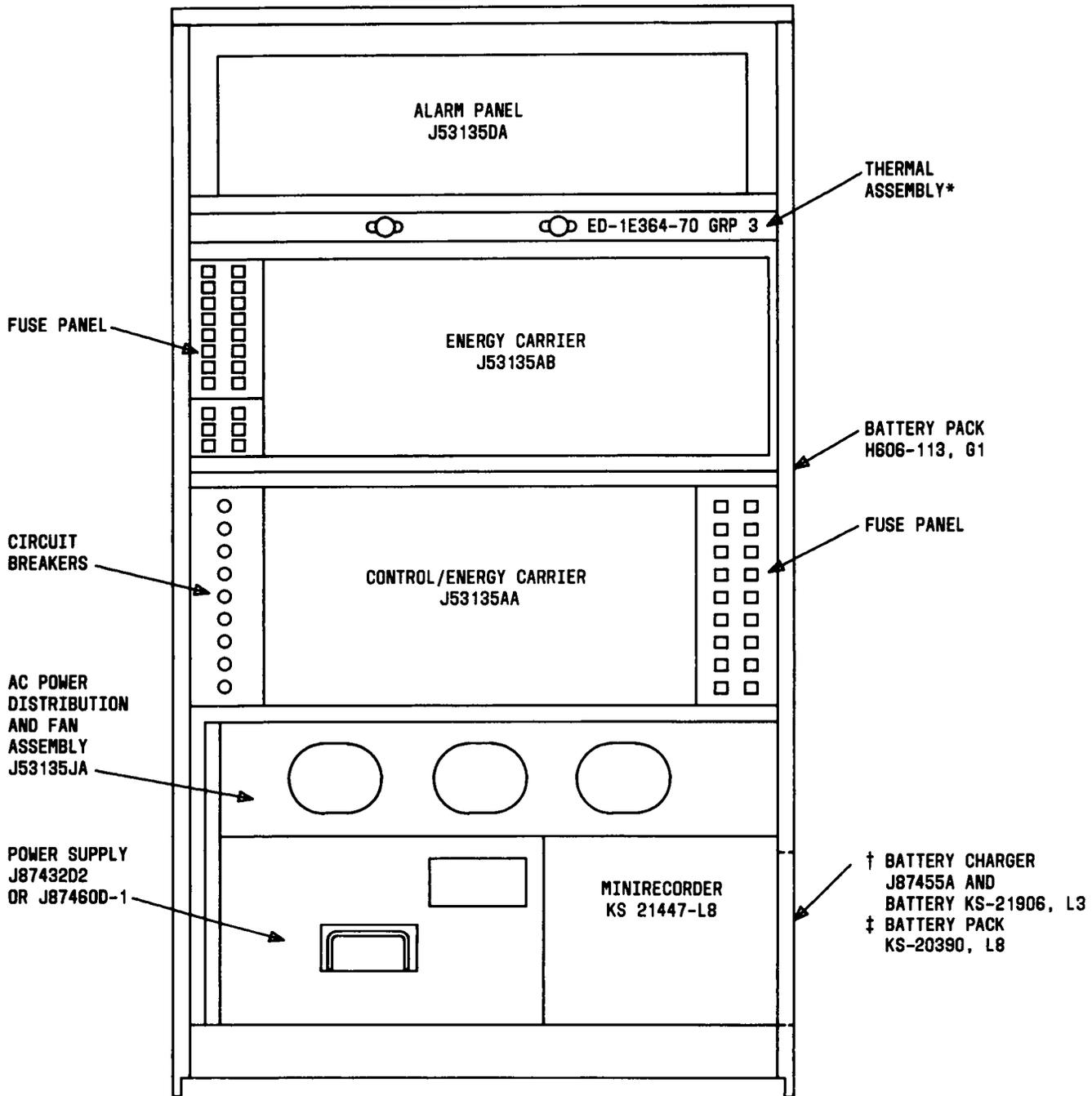
**5.05** The auxiliary cabinet (Fig. 9) is also a J53135A cabinet, which has the same dimensions as the basic cabinet. The physical design is identical and all equipment except the control/energy carrier J53135AA may be installed in this auxiliary cabinet.

## CABINET-MOUNTED EQUIPMENT

### A. Carriers

**5.06** Carriers designed to hold the circuit packs are 241 mm (9-1/2 inches) in height and mount on 622 mm (24-1/2 inch) mounting centers. A backplane wiring panel provides the circuit pack interconnections. A fuse panel or circuit breaker panel is provided at the left or right of the carrier, and a connector bracket is provided, depending on the needs of the carrier. All loose wiring and cabling from the backplane to the circuit breakers, fuses and connectors are furnished with the carrier unit.

**5.07** Circuit pack slots, or positions are numbered from left to right. The circuit packs are in-

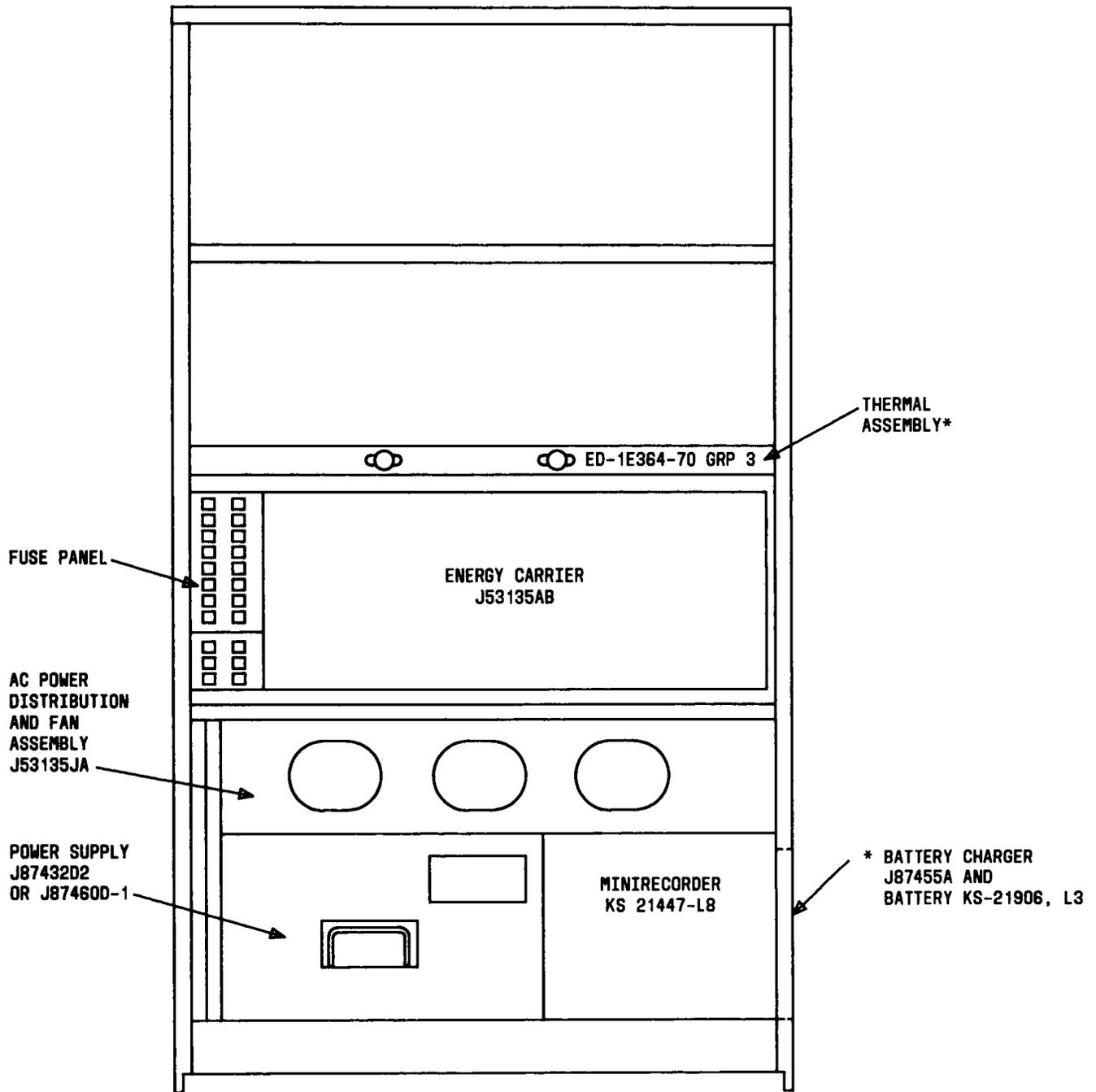


\* WHEN ONLY CONTROL/ENERGY CARRIER IS PROVIDED, THE THERMAL ASSEMBLY WILL BE MOUNTED DIRECTLY ABOVE THE CARRIER.

† REQUIRED WITH POWER SUPPLY J87460D-1 TO PROVIDE NOMINAL HOLDOVER.

‡ REQUIRED WITH POWER SUPPLY J87432D.

Fig. 8—Basic Equipment Cabinet J53135A

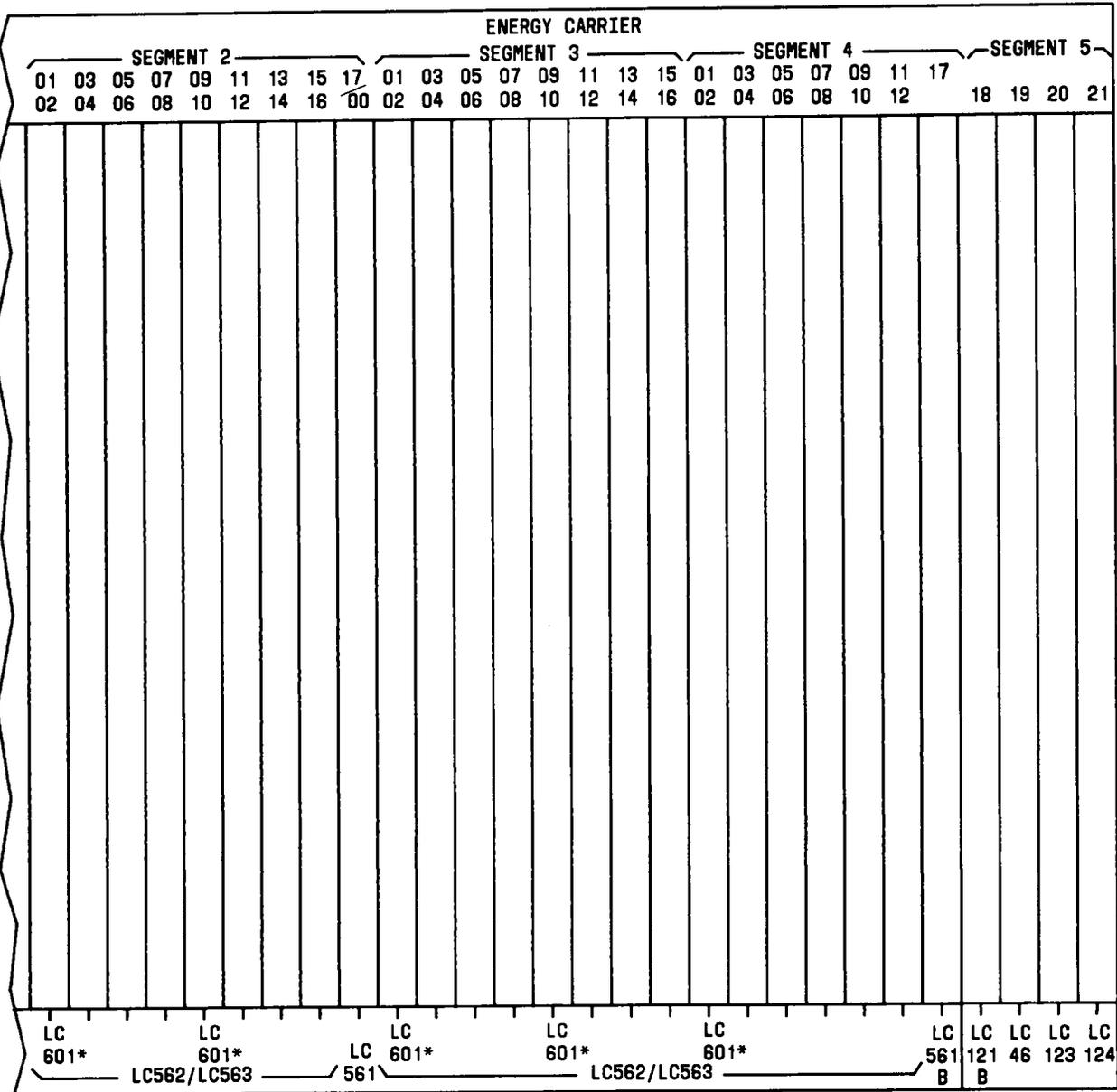


\* REQUIRED WITH POWER SUPPLY J874600-1 TO PROVIDE NOMINAL HOLDOVER

Fig. 9—Auxiliary Cabinet J53135A







\* WHEN LC601 IS REQUIRED, THE NEXT THREE SLOTS TO THE RIGHT WILL BE DEDICATED TO THE LC601.

Fig. 11—Energy Carrier J53135AB (Sheet 2 of 2)

the system processor, maintenance, memory, and control. The control portion contains RAM and associated control circuits, the processor, alarm control, I/O buffers, I/O channels, and real-time clock. The energy portion contains load and power meter interfaces, network clock, scanner distributor, I/O subchannels, network buffers, and maintenance board. Table C provides a listing of circuit packs and slot positions for the J53135AA carrier.

5.10 The control/energy carrier contains one full segment and one partial segment for individual loads or sense points. Individual loads or sense points, or power meter interfaces are contained in slots 3 through 16. Slots 1 and 2 are dedicated for the load maintenance board (LC563). The LC561 network buffer is shared between two segments and must set between the segments which share it. Therefore,

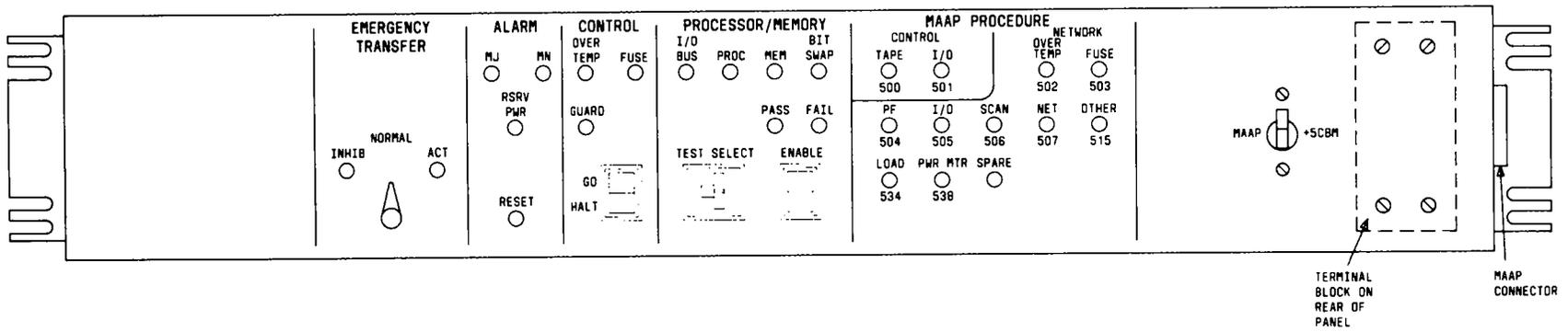


Fig. 12—Control and Alarm Panel J53135DA

TABLE C

## CONTROL/ENERGY CARRIER CONFIGURATION - J53135AA

CIRCUIT PACK		NO OF CKTS PER CP	MAX CP PER CARR	SLOT POSITION IN																									
				CONTROL CARRIER SEGMENT 0																									
TYPE	CODE			00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
TAPE TRANSPORT INTERFACE A	LC29B	1	1															X											
TAPE TRANSPORT INTERFACE B	LC30C	1	1																X										
SCANNER/DISTRIBUTOR	LC46	1	1																										
NETWORK CLOCK	LC121B	1	1																										
NETWORK I/O SUBCHANNEL INTERFACE	LC123	1	1																										
NETWORK I/O DATA CIRCUIT	LC124	1	1																										
4 MHZ CHANNEL CONTROL	LC130	1	1																								X		
4 MHZ SUBCHANNEL CIRCUIT	LC131	16	1																										X
I/O MEMORY CONTROL	LC133B	1	1													X													
I/O BUFFER AND TERMINATIONS	LC134B	1	1														X												
RAM BUS TERMINATION	LC135C	1	1	X																									
RAM DATA CONTROL	LC136	1	1							X																			
TIME-OF-DAY CLOCK	LC144	1	1																				X						
ALARM CIRCUIT	LC147	1	1									X																	
DATA CONTROL	LC171B	1	1																			X							
I/O DATA TRANSFER	LC172B	1	1																		X								
RAM (64K WORD)	LC346	1	5	X	X	X	X	X																					
DUAL SPEED SERIAL DATA CHANNEL	LC366C	4	2																					X	X				
RAM ADDRESS AND TIMING CONTROL	LC454	1	1								X																		
201CC PROCESSOR	LC455	1	1										X	X															
NETWORK BUFFER	LC561	1	1																										
LOAD INTERFACE	LC562*	16	12																										
PWR MTR INTF/INDIC OF LOAD CONTROL†	LC563*	16	13																										
SENSE POINT INTERFACE	LC563	16	12																										
REMOTE CONTROLLER	LC601‡	64	2																										

\* SEGMENT 0 AND 1 MAY CONTAIN LC562 OR LC563 AS SHOWN.

‡ FOR REMOTE APPLICATIONS.

† ONLY ONE LC563 CIRCUIT PACK PER SYSTEM (SEC-0 SLOT 01/02).



slots 0 and 17 are reserved for the LC561 and share one physical board. For even numbered segments, the LC561 is in slot 17, and for odd numbered segments, the LC561 is in slot 0.

**5.11** The first physical slot of segment zero of the control/energy carrier is reserved for the LC563 to be used for maintenance testing. The next physical slot contains LC563 for the power meter interfaces on the system shipped. This 02/03 slot can be changed in the field to contain an LC562 for individual loads or an LC563 for sense point interfaces.

**5.12** On the control/energy carrier the circuit breaker panel is on the left panel and the fuse panel is on the right panel. These are shown in Fig. 10.

#### **J53135AB Energy Carrier**

**5.13** The J53135AB energy carrier (Fig. 11) contains load interface, power meter interface, sense point interfaces and control part of the carrier. The control part of the carrier includes buffers, data channel, and alarm circuits. Table D provides a listing of circuit packs and slot positions for the J53135AB carrier.

**5.14** The energy carrier contains four full segments and one partial segment for individual loads or sense points. Individual loads or power meter interfaces are contained in slots 1 through 16. The LC561 network buffer is shared between two segments and must set between the segments which share it. Therefore, slots 0 and 17 are reserved for LC561 and share one physical board. For even numbered segments, the LC561 is in slot 17 and for odd numbered segments, the LC561 is in slot 0. Slot 17 in segment 4 must always be furnished with an LC561 for maintenance purposes.

**5.15** The energy carrier has a fuse panel on the left panel as shown in Fig. 11.

#### **B. J53135JA AC Power Distribution and Fan Assembly**

**5.16** The fan assembly mounting is always provided and is mounted in the lower portion of the basic or auxiliary equipment cabinet.

#### **C. J53135DA Control and Alarm Panel Assembly**

**5.17** The control and alarm panel (Fig. 12) provides alarm, fault indicators, and controls used in

determining system status or performing system microdiagnostics, including RMATS.

#### **D. J53135KA Equipment Control Unit**

**5.18** The equipment control unit (Fig. 13) provides box and relay for low-control voltage to high-voltage interface. This relay interface is provided optionally with load control in the basic ECSA package and load control and sensor control with remote applications.

#### **E. J53135K Common Power Supply**

**5.19** The common power supply (Fig. 14) provides -24 Vdc power to the relay interfaces. One power supply has the capability to power up to 216 interface relays. Each power supply has three fused circuits, allowing 72 relay interfaces to be supplied from each fused supply.

#### **LOADING**

**5.20** The individual energy loads are provided by LC562 circuit packs (16 loads per board). Each circuit pack requires a physical carrier slot which represents two electrical slots. The paired electrical slots are identified by an odd number followed by the next highest even number (ie, slots 3 and 4, 9 and 10, or 15 and 16). Refer to Table E for maximum load arrangements per each system carrier.

**5.21** The ECSA is offered in the two system configurations outlined in Table B. Each configuration is arranged with a set number of loads or sense points based on memory size, load or sense point capacity, and loads or sense points equipped. In some cases, the total loads required for a particular installation will not match the system configuration load arrangements.

**5.22** When the required loads for a certain system have been determined, compare the load number with the quantity shown in the LOADS EQUIPPED column in Table B. Select the load or sense point, power meter or remote location capacity, and memory configuration required. This represents the system configuration to be ordered.

**5.23** The additional LC562, LC563, and LC601 circuit packs required to bring the system up to the desired capacity will be added at the factory. The units will ship installed in the proper carrier slots.



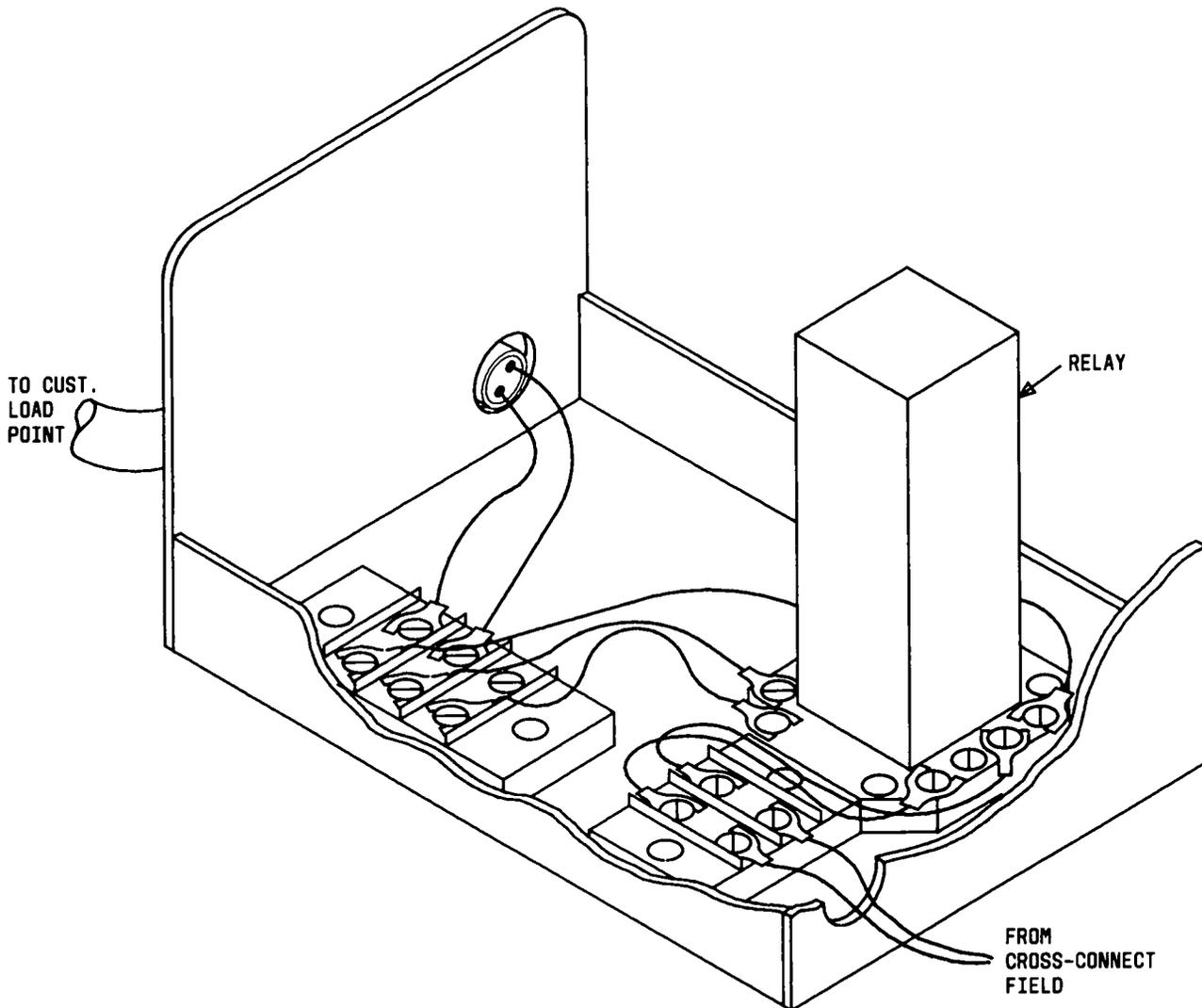


Fig. 13—Equipment Control Unit (Interface Relay)

The total number of LC561 circuit packs required in a given configuration is supplied in the basic system.

**5.24** Use MAAP or RMATS to add the translations. Translations for the additional loads must be added during installation. The original tape includes only the translations for the circuits equipped with the ordered configuration.

**Note:** An LC561 must always be provided in slot 17, segment 4, of each energy carrier.

**5.25** Table F shows the coded equipment that may be used to provide an ECSA system installa-

tion. The quantities necessary will depend upon customer system configuration.

**5.26** The individual sense points for binary feedback are provided by LC563 circuit packs (16 sense points per board). Binary feedback provides the customer with the ability to monitor the response of one or more loads on the system. The load does not have to be controlled by the ECSA. A load can have only one sense point tied to it.

**5.27** The customer can be provided with up to 384 sense points. The limit of 384 sense points applies to both memory configurations and will not af-

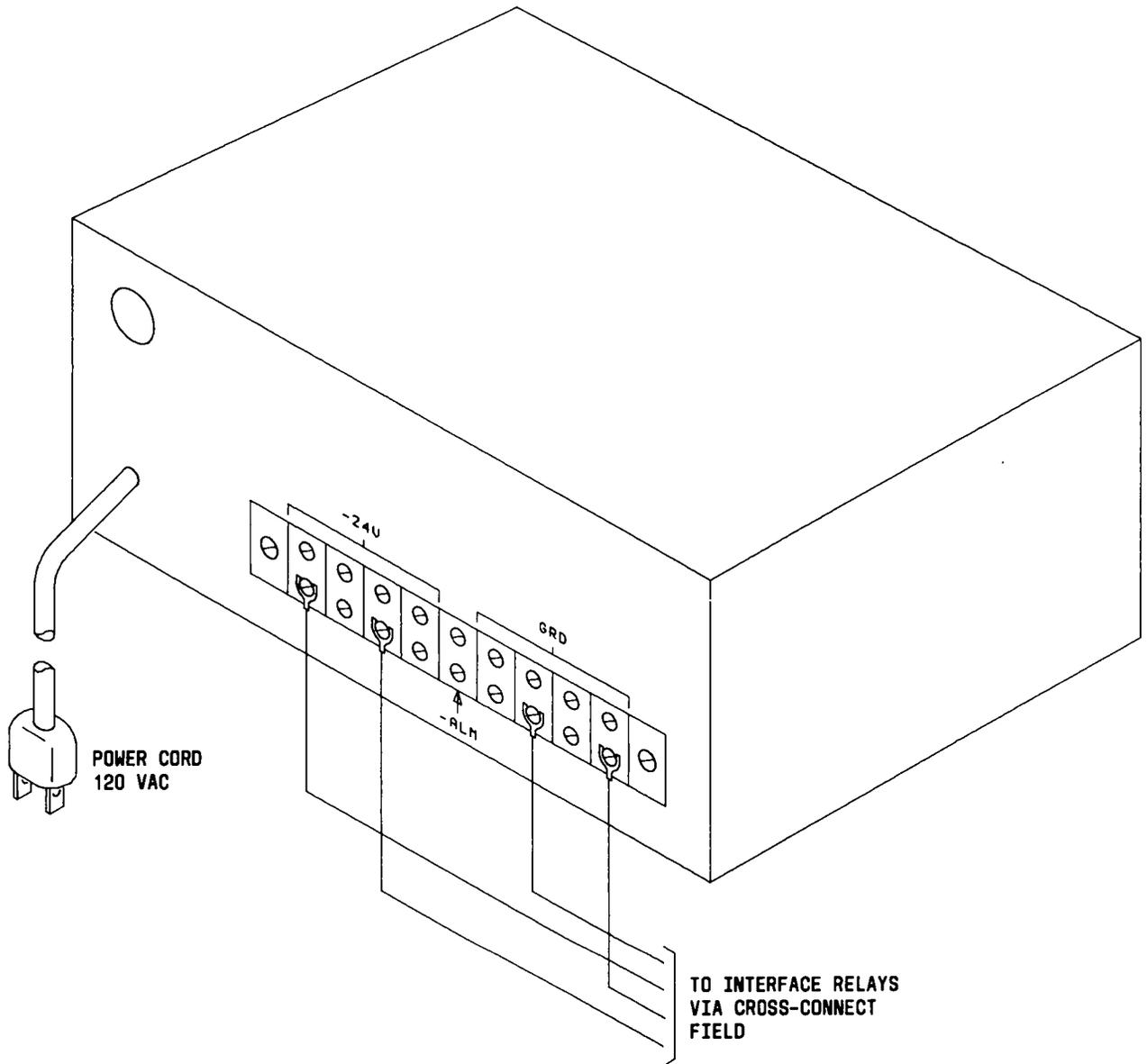


Fig. 14—Common Power Supply

fect the number of loads allowed on either one. Twenty-four LC563s are required to provide the maximum limit of 384 sense points.

**5.28** The customer's power meter and/or sensor equipment as well as the interface relay can be located up to a maximum of 1524m (5000 feet) using 24 gauge wire, or 914m (3000 feet) using 26 gauge wire, from the ECSA cabinet.

#### REMOTE APPLICATION

**5.29** The LC601 remote controller circuit pack plugs into the J53135AA control/energy carrier (Fig. 10) or the J53135AB energy carrier (Fig. 9) of the ECSA. Each LC601 can control a combined maximum total of 64 remote loads and sense points. One LC601 is required to support each Master Remote Unit (MRU) used for remote load control and sensing. When used in the J53135AA control/energy carrier, the LC601 may be placed in segment 0, slot

TABLE E

## ECSA CARRIER LOAD AND SENSE POINT ARRANGEMENTS

MAXIMUM LOADS	MAXIMUM LOADS PER CARRIER	MAXIMUM SENSE POINTS PER CARRIER	CARRIERS REQUIRED	CABINETS REQUIRED
176	176	176	One control/energy	1
784	176	176	One control/energy	1
	608	384	One energy	
1008	176	384	One control/energy	2
	608		One energy	
	224		One energy*	

\* Second cabinet required for this carrier.

09/10 or segment 1, slot 01/02. In the J53135AB energy carrier the LC601 may be placed in slots 01/02 and 09/10 of any segment. However, when placed in segment 4 slot 09/10, it is limited to controlling 32 loads or sense points instead of the usual 64. When LC601 is inserted into a carrier, the next three slots to the right are restricted from use.

**5.30** Included in the LC601 is the hardware to provide the 300-baud full duplex data channel required to interface to the MRU. The wire pair for the 300-baud channel is brought out to the cross-connect field in the standard carrier cabling. The LC601 is registered to meet FCC Part 68 private line registrations regulations.

**5.31** The ECSA remote application equipment is housed in the MRU cabinet. This cabinet measures 89 mm (3.5 inches) high by 292 mm (11.5 inches) wide by 279 mm (11 inches) long (Fig. 15 and 16). The MRU cabinet **must be mounted horizontally** (shelf, desk, cabinet) due to the mercury relays used in the remote interface board.

**5.32** The MRU can provide control for 64 loads or sense points. Additional loads or sense points will require an additional MRU.

#### Master Remote Unit Cabinet

**5.33** The MRU cabinet J53135QA (Fig. 15 and 16) houses the following equipment:

- HN18 Remote Interface Board
- AGW1 Remote Load Control Board
- AGW2 Remote Sense Point Board
- Power Chassis Assembly [ED-1E455(-)].

**5.34** The connection for the 300-baud data channel from the associated LC601 (located at the ECSA common equipment) is made to the MRU through a standard modular telephone plug (located on front panel of MRU). Connections from the MRU to the cross-connect field for the loads and sense points are made with three standard plug-ended, 25-pair cables. These three cables plug into connectors BC01, BC02, and BC03 located in the rear of the MRU. The MRU also requires a standard 120 Vac outlet capable of delivering .25 amps to be within 2.75m (9 feet) of the cabinet.

**5.35** The HN18 remote interface board contains the receiver/transmitter circuitry for the 300-baud data link. The connectors to interface to the AGW1 board, AGW2 boards, and cross-connect field are located on the HN18. A combined sum of eight AGW1 and AGW2 boards may be plugged into the HN18. This must be done in groups of two due to software reserving blocks of 16 load or sense point numbers. The MRU is registered to meet FCC Part 68 private line registration regulations.

**5.36** The AGW1 remote load control board contains the circuitry for eight normally open

**TABLE F**  
**ECSA SYSTEM EQUIPMENT**

CODE	EQUIPMENT	
J53135A	List 1	Framework, assembly, wiring, and equipment for one 3-carrier, basic, small cabinet.
	List 2	Equipment required in addition to List 1 to provide one minirecorder (KS-21447, List 8).
	List 3	Equipment required in addition to List 1 to provide one power supply (non-UPS) (J87432D-2).
	List 4	Equipment required in addition to List 1 to provide one power supply (UPS) (J87460D-1).
	List 5	Equipment required in addition to Lists 1 and 4 to provide nominal holdover battery (KS-21906, List 3) and charger (J87455A-1, List 1).
	List 6	Equipment required in addition to List 1 to provide one battery pack assembly (H606-113, G-1) and hardware for time of day clock.
	List 7	Equipment required in addition to List 4 to provide extended holdover.
J53135AA	List 1	Assembly, wiring, and equipment for one control/energy carrier.
	List 2	Apparatus required in addition to List 1 to provide: <ul style="list-style-type: none"> <li>• Processor, control, and interface circuits (LC135C, LC136, LC454, LC147, LC455B, LC133B, LC134B, LC29B, LC30C)</li> <li>• 64K memory (LC346)</li> <li>• Time of day clock (LC144)</li> <li>• Four data channel circuits (LC366C)</li> <li>• Four MHz channel control (LC130)</li> <li>• Four MHz sub-channel control (LC131)</li> <li>• One network buffer circuit (LC46, LC121B, LC123, LC124, LC561)</li> <li>• One power monitor and feedback circuit (LC563).</li> </ul>
	List 3	Apparatus required in addition to List 1 to provide one 64K memory circuit Pack-3 List 3 max. (LC346).
	List 5	Apparatus required in addition to List 1 to provide one data control circuit pack for RMATS (LC171B, LC172B).
	List 6	Apparatus required in addition to List 1 to provide one data channel circuit pack (four circuits) (LC366C).
	List 7	Apparatus required in addition to List 1 to provide one power monitor and feedback circuit pack-1 List 7 max. (LC563).
	List 8	Apparatus required in addition to List 1 to provide one energy load control circuit pack-12 List 8 max. (LC562).
List 9	Apparatus required in addition to List 1 to provide one remote controller circuit pack-2 List 9 max. (LC601).	

load relays with contact ratings of 25 VA. In the event of power loss or loss of the data channel to the MRU, the relays in the AGW1 will return to the open state.

**5.37** The AGW2 remote sense point board permits the interface to eight binary sense points using a -24 Vdc source to detect contact closures. One common power supply is required at each MRU equipped with AGW2 boards to provide the -24 volt source. Each sense point being monitored by the AGW2 must be within 4,572m (15,000 feet), using 24-gauge wire, of its MRU.

**5.38** An Equipment Control Unit containing one interface power relay (Fig. 13) may be used either on premise or off premise to provide the low control voltage to high voltage interface. The interface relay unit includes an enclosure with removable cover, an octal base relay socket, low-voltage screw terminal, high-voltage screw terminal strip, and a sealed octal base plug-in relay. The relay is current sensitive and requires 7.2 milliamps to operate with a maximum continuous 3-watt coil rating. The contacts are SPDT and rated at 120V 10 amps. The interface relay must be located within 1524m (5000 feet) using 24 gauge wire, or 914m (3000 feet) using 26 gauge wire, from its associated MRU or LC562 circuit pack.

**TABLE F (Cont'd)**  
**ECSA SYSTEM EQUIPMENT**

CODE	EQUIPMENT
J53135AB	List 1 Assembly, wiring, and equipment for one energy carrier.
	List 2 Apparatus required in addition to List 1 to provide one network buffer circuit (LC46, LC121B, LC123, LC124, LC561).
	List 3 Apparatus required in addition to List 1 to provide one buffer circuit-2 List 3 max. (LC561).
	List 4 Apparatus required in addition to List 1 to provide one energy load control circuit-38 List 4 max. (LC562).
	List 5 Apparatus required in addition to List 1 to provide one power monitor and feedback circuit (LC563).
	List 6 Apparatus required in addition to List 1 to provide one remote controller circuit pack-5 List 6 max. (LC601).
J53135DA-1	Assembly, wiring, and equipment for one control and alarm panel (unduplicated).
J53135JA	List 1 Assembly, wiring, and equipment for one ac power distribution unit (non-UPS).
	List 2 Assembly, wiring, and equipment for one ac power distribution unit (UPS).
	List 3 Wiring and equipment required in addition to List 1 or 2 to provide fans when required.
	List 4 Wiring and equipment required in addition to List 1 or 2 to provide fusing for minirecorder and emergency transfer panel.
J53135K	List 1 Equipment and wiring for one power unit.
J53135KA	List 1 Equipment and wiring for one equipment control unit.
	List 2 Equipment required in addition to List 1 to provide a magnecraft relay W88CPX-13.
J53135QA	List 1 Assembly wiring and equipment for one master remote unit.
	List 2 Apparatus required in addition to List 1 to provide interface relay circuit pack-8 List 2 max. (AGW1).
	List 3 Apparatus required in addition to List 1 to provide binary sense point circuit pack-8 List 3 max. (AGW2).
J53135TA	List 1 One blank tape cartridge for ECSA.

**5.39** The common power supply (Fig. 14) is rated at 24Vdc 2.4 amps and requires a standard 120 Vac receptacle capable of delivering 2.5 amps. The unit is equipped with a 6-foot cord. Each common power supply may be used with a total of 216 interface relays and sense points. This supply is required when the interface power relays or the AGW2 boards at an MRU are used.

## ENVIRONMENTAL REQUIREMENTS

### A. Atmospheric and Temperature

**5.40** Extreme conditions of temperature and humidity may have damaging effects on system equipment. Exposure to extreme temperature and/or humidity may degrade energy service, not only at the time of exposure but also when a normal environ-

ment is restored. Temperature is measured by an ordinary thermometer at a location 1524 mm (5 feet) above the floor and 381 mm (15 inches) in front of a system cabinet. Table G outlines the equipment room environmental requirements for the system. The humidity design range chart (Fig. 17) is provided to indicate the safe ranges for the equipment. The use of the chart requires a hygrometer to measure wet and dry bulb temperatures and a psychrometric table to determine the relative humidity from the difference in the two measurements.

**5.41** The requirements presented in Table G represent the extreme limits of the equipment operating ranges. These requirements should not be construed as being desirable working conditions for minimum maintenance. Installation in undesirable areas (eg, areas outside the temperature range of

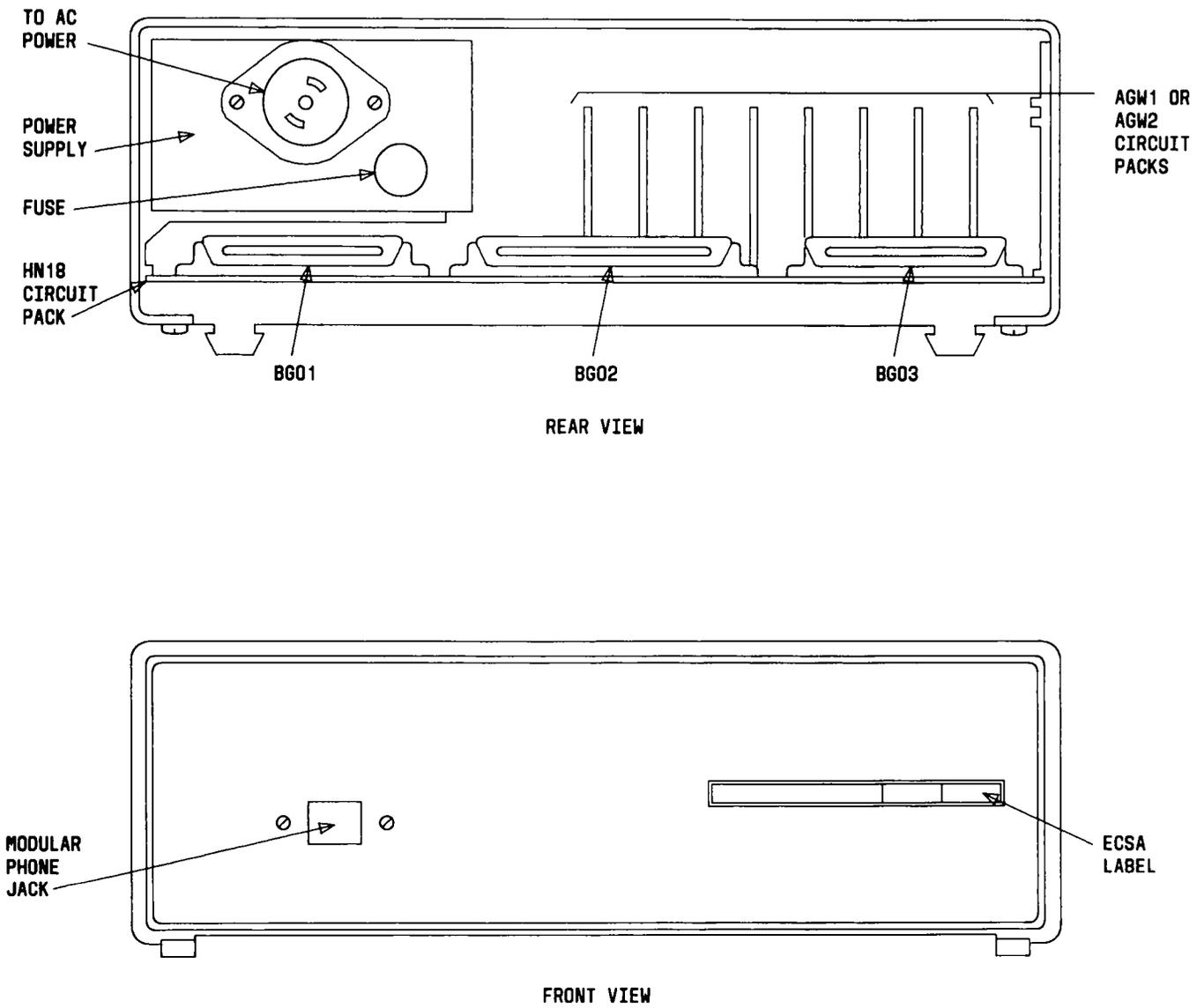


Fig. 15—Master Remote Cabinet, Front and Rear Views

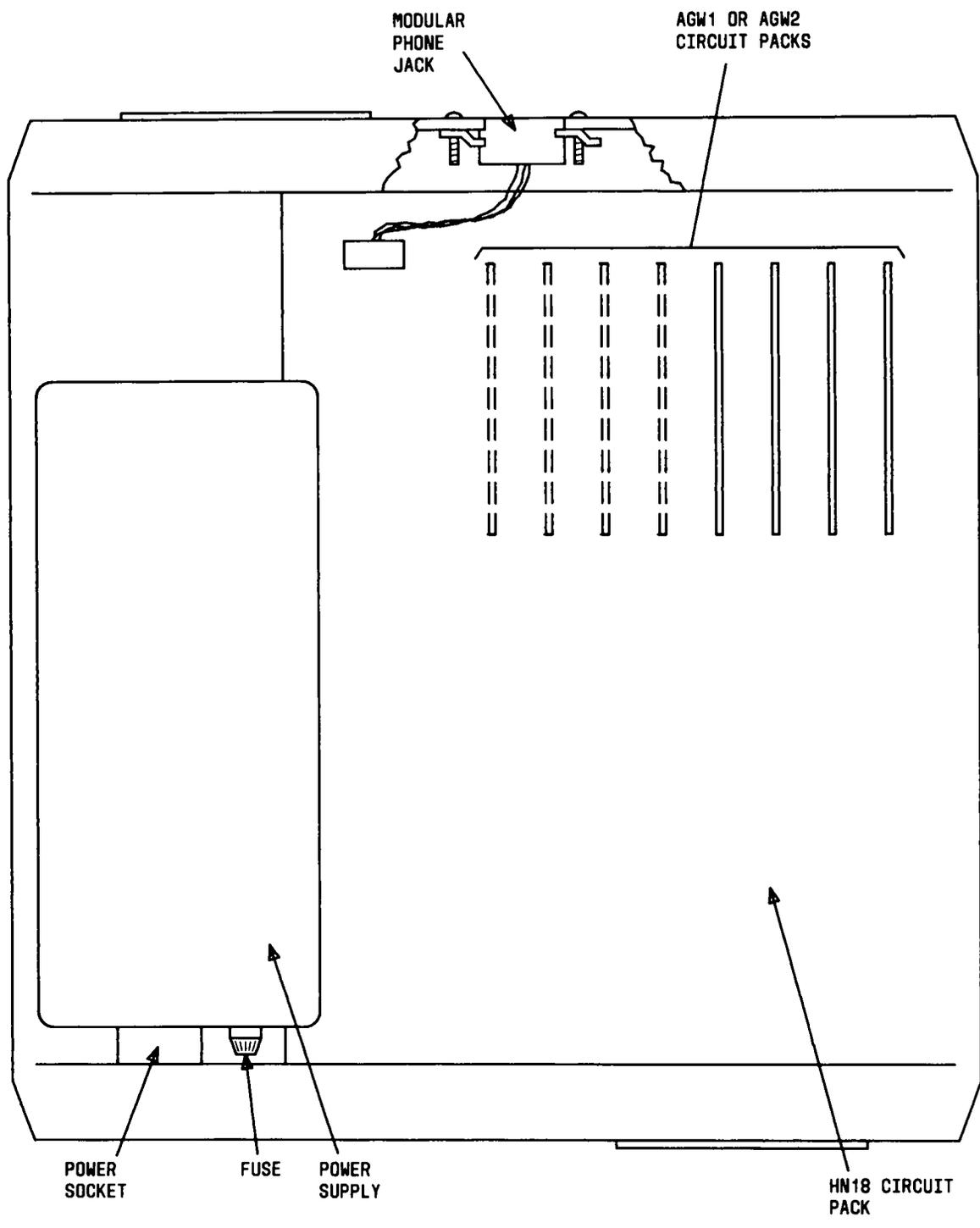


Fig. 16—Master Remote Cabinet, Top View

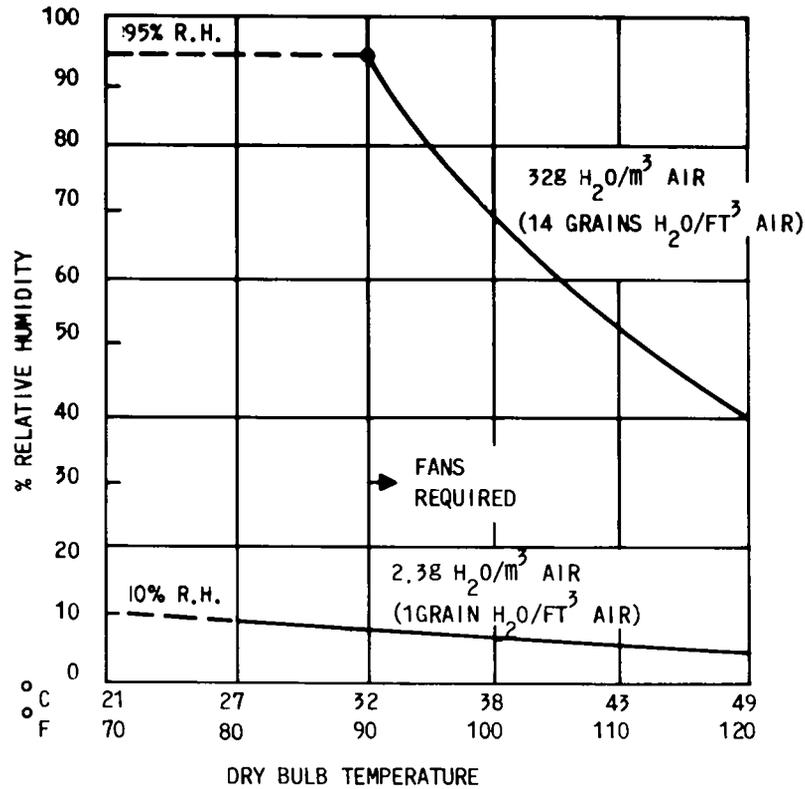


Fig. 17—Humidity Design Range

4.5°C to 35°C [40°F to 95°F] and outside the relative humidity range of 20 to 60 percent) will cause degradation of service and reduce system life.

5.42 The permissible extremes for storage and transportation environments are 66°C (150°F) with a minimum relative humidity of 15 percent and

TABLE G  
ENVIRONMENTAL REQUIREMENTS

SYSTEM	ROOM AMBIENT (DRY BULB) TEMPERAURE °C (°F)		PERMISSIBLE RANGE HUMIDITY (%)	
	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM
Without Fans	0 (32)	27 (80)	10	95
	0 (32)	29 (85)	8	95
	9 (32)	32 (90)	7	95
With Fans	0 (32)	35 (95)	6	80
	0 (32)	39 (100)	5	70
	0 (32)	41 (105)	4	60
	0 (32)	43 (110)	4	55
	0 (32)	46 (115)	3	45
	0 (32)	49 (120)	3	40

a low temperature of  $-40^{\circ}\text{C}$  ( $-40^{\circ}\text{F}$ ) with the humidity uncontrolled. Large temperature excursions, shock, and vibration affect the tape cartridge and can cause read/write errors when operation begins. The tape cartridge should not be inserted in the transport during shipment, but should be placed in a dust-free container such as a sealed plastic wrapper.

**5.43** The equipment should be installed in an air-conditioned area whenever possible. Fans are required in each cabinet whenever:

- (a) The equipment area is not air-conditioned and the ambient temperature can exceed  $32^{\circ}\text{C}$  ( $90^{\circ}\text{F}$ ).
- (b) Filters are used.

**5.44** Environments which are not recommended for installation because of potential temperature problems include:

- (a) Rooms in which a major heat source (eg, boiler room, furnace room, manufacturing areas using hot processes) can affect the room ambient temperature significantly.
- (b) Areas in which the ambient temperatures can become excessive. Such areas include:
  - (1) Unventilated rooms with less than 4.6 square meters (50 square feet) of floor space.
  - (2) Unventilated rooms with two or more exterior walls which are frequently exposed to high temperatures.

**5.45** Total power dissipation of system cabinets may be used to determine air-conditioning requirements when space is allocated. The maximum power dissipation per each energy cabinet is approximately 500 watts. This power dissipation is sufficient to heat a small room above the maximum operating temperature of the equipment if air-conditioning or ventilation is not provided. The equipment engineer should analyze the room ventilation and/or air-conditioning system and ensure that requirements for each installation site are met.

## B. Filters

**5.46** The use of filters in the equipment is determined by the environment. The environment

can be divided into the following air contamination classifications:

- **Heavy Industrial:** Space in which industrial processes or construction work act as sources of excessive dust or lint. This environment is not recommended as an installation site. However, if it is necessary to install a system in this environment, filters will be required on each cabinet.
- **Average Industrial:** Nonmanufacturing space in industrial areas. Filters must be used on each cabinet installed in this environment.
- **Average Residential:** Storage or office space which has heavy traffic or which is adjacent to building exits and entrances. In this environment, if the system is equipped with fans, filters are required on each cabinet.
- **Relatively Clean Room:** Interior rooms in office space with little or no traffic. Filters are never required in this environment.

**5.47** The ECSA equipment is primarily solid-state electronics. However, this equipment is susceptible to adverse effects from certain contaminants. Copy machines have been identified as a potential source of contaminants which can leave deposits on, erode, and insulate open contact relays. It is recommended that relay equipment be located away from equipment which exhibits this type of contaminant emission. In severely contaminated industrial environments, other ECSA equipment may be affected. Gold fingers and connector interfaces could chemically deteriorate through the corrosive effects of gases on particle surfaces. Environments containing high concentrations of corrosive gases, such as sulfur or chlorine, should not be used as installation sites. The performance of the minirecorder may be affected if high concentrations of metallic contaminants are present. These can interfere with magnetic tape read or write operations. Dust, paper fiber, or carbon particles can also affect the tape transport operation. Industrial areas suitable for prolonged human activity (without safety protection) are not considered to be severely contaminated and can be used as installation locations.

**5.48** Filters require periodic replacement when they become contaminated. The replacement

interval will vary from a few weeks to a year or more, depending upon local conditions. Under average conditions, filter life can be expected to be in excess of 6 months. It is the responsibility of the telephone company to conduct periodic filter inspections to ensure replacement when deemed necessary. Filters should be inspected (preferably in conjunction with service orders) at intervals to be determined by the nature of the environment.

### C. Transportation

#### In Transit

- 5.49** The system should always be shipped packaged in the Western Electric-provided crates.
- 5.50** The packing material used for shipping cabinets from Western Electric is adequate for upright or lay-down (on-side) shipment. However, upright shipment is preferred. If on-side shipment is used, installation personnel should carefully raise the cabinets to an upright position before unpacking.
- 5.51** The basic system cabinet is fully loaded and ready for operation, with the exception of cabling, when shipped. This includes all maintenance books and manuals to be kept inside the door. This does not include the spacer assembly and floorplate which are shipped in a separate crate.
- 5.52** The preferred modes of transportation are, in order of preference, truck, rail, and air. Air transportation is known to subject the equipment to severe handling shocks. Rail transportation is less severe, but railroad car coupling shocks can be severely stressing on the system.

#### Handling on Site

- 5.53** It is preferable (when possible) that the system remain packaged in its crate until it is in the room in which it is to be located.
- 5.54** Forklifts and dollies are acceptable means of handling the crated system on customer premises. The pallet portion of the crate has been designed for these methods of handling.
- 5.55** Care should be taken to avoid dropping the system (either crated or uncrated) from any height. Under no circumstances should the system be allowed to drop from a height greater than 203 mm (8 inches) packaged or 25 mm (1 inch) unpackaged.

### D. Structural

#### Floor Loading

- 5.56** The minimum requirement found in any commercial floor loading codes is 23 kilograms per 0.09 square meter (50 pounds per square foot). The maximum weight of the ECSA (2-carrier) cabinet is about 225 kilograms (500 pounds). Thus, a free maintenance area of at least .93 square meters (10 square feet) per cabinet must be provided on a floor which is rated at 23 kilograms per 0.09 square meter (50 pounds per square foot).
- 5.57** The average floor load is found by summing the weights of all equipment over a particular floor area and dividing the total weight by that area. The area includes aisles and open areas associated with the cabinets. The average floor load must not exceed the rated floor loading of the building.

#### Stability and Movement

- 5.58** When earthquake or disaster bracing is required by law, or when local telephone company engineers feel that it is necessary, such bracing can be provided. Areas in the continental United States in which study for the need for bracing may be desirable are shown in Fig. 18. The ECSA can be braced by bolting the cabinets directly to the floor. Four insulating bolts and washers and four spacer assemblies are used in holes provided in the baseplate of the cabinet for this purpose. When the cabinet is bolted to the floor, maintenance access space must be provided behind the cabinet.
- 5.59** Whenever maintenance access space cannot be allocated behind the cabinets, an alternate method (for earthquake bracing) is recommended. This method requires the use of ED-1E362-70 to adapt the cabinets for rail mounting. This alternate method bolts a floor rail assembly ED-1E362-70, Group 4, to the floor and uses cabinet assembly J58879C, List 22. A restraining cable is furnished to be slipped into appropriate slots on the rail and rear of cabinet.
- 5.60** When the system is installed on any rough floor or carpeting, the floorplate and rollaway assembly will be placed on the floor surface and the

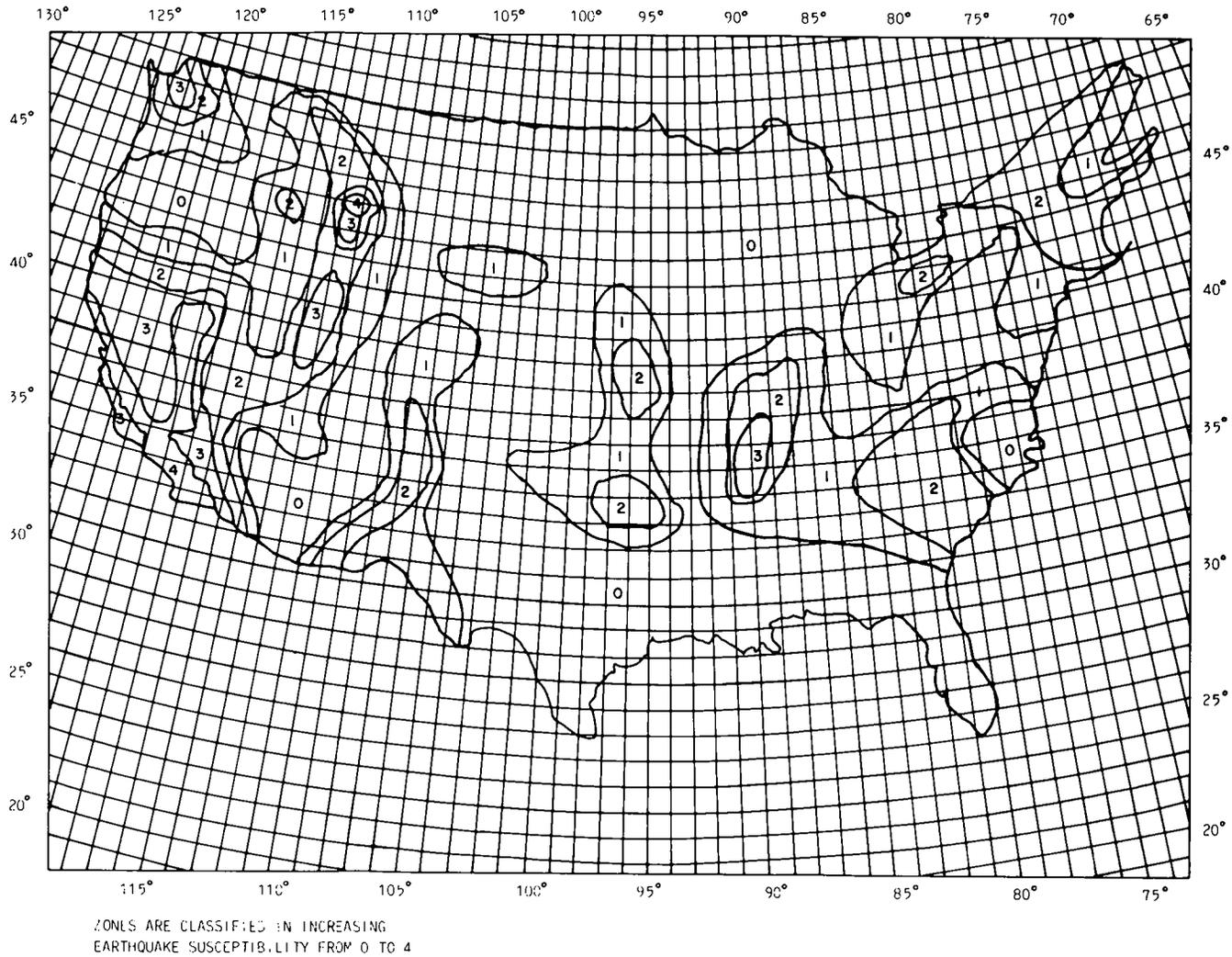


Fig. 18—Earthquake Environment (USA)

cabinet on the plate assembly. This protects the customer's floor surface and aids maintenance personnel in moving the cabinet on its casters when necessary to gain access.

**5.61** Care should be taken in moving the cabinet across deep pile carpets in order to prevent tipping. The cabinet casters have been placed so as to allow adequate force (about 45 kilograms [100 pounds]) to get the cabinet moving on thick carpeting. Also, the placement of the casters allows a moderately rapid movement, about 610 mm per second (2 feet per second), of the cabinet without risk of tipping when a bump or irregularity in the floor is encountered. Movement faster than 610 mm per second (2 feet per second), however, should be considered dangerous with regard to cabinet tipping.

#### E. Electrical Fields

**5.62** Power lines (feeders) dedicated to the ECSA should be used. Separate branch circuits may be sufficient to serve this purpose.

**5.63** Electromagnetic fields may cause noise to be introduced into the ECSA. Care should be taken to avoid placing the system near powerful radio or television transmitters. In these cases, the field strength must be measured using a standard field strength meter such as the electric field sensor, Model EFS-1, manufactured by Instruments for Industry, Inc., or a tunable R70 meter from Electro-Metrics Company. If the reading (number obtained) is greater than unity, interference into the PBX is likely.

**5.64** Properly measured field strength values of less than 0.05 volt per meter from a radio station antenna will not likely cause a problem. For measured values between 0.05 and 1.0, corrective measures may or may not be necessary. Generally, amplitude modulation (AM) radio stations are more likely to cause interference than frequency modulation (FM) stations (such as television). A building may also provide considerable shielding effect, reducing the interfering capability of the radiating station. Other possibly interfering radiators include industrial radio frequency (RF) heating equipment and welders.

**5.65** The ECSA may be subject to noise interference from motors (greater than one-fourth horsepower) having commutators if they are located in the same room or in a room adjacent to the ECSA. Small tools with universal motors are generally not a problem if operated on separate power circuits. Motors without commutators, whether synchronous or asynchronous, generally do not cause interference into the system.



***In order to preclude electrostatic noise in the system, the frame shall be well grounded as discussed in this section. Maintenance personnel should attach authorized wrist grounding strap before working on the system or handling circuit packs to remove electrostatic charge from themselves and avoid damaging the circuit boards.***

#### **F. Acoustics**

**5.66** The system should be located in an acoustic environment which allows maintenance personnel to hear tones through a standard headset while performing necessary tests.

**5.67** The noise levels which do not permit sound to be heard over the standard headset are about the same or greater than those specified in the Occupational Safety and Health Act (OSHA). This is normally 90 dB. Therefore, the OSHA requirements for sound satisfy the environmental requirements for the system, and these must be met wherever the machine is placed. Refer to current OSHA requirements for acceptable levels.

#### **G. Lighting**

**5.68** The light intensity level around the system cabinet should be sufficient to conform with

OSHA standards to provide a comfortable amount of light for maintenance personnel to do the repair tasks required. To obtain accurate footcandle measurement, measure level in center aisle, 1524 mm (5 feet) above the floor, aiming meter upward. Light measurements can be made with a WESTON\* Footcandle Meter, Model 614.

**5.69** The lighting configuration in the system area should meet OSHA standards for minimum required lighting to allow maintenance personnel to perform their tasks. The light intensity level should be adequate from any of the directions necessary, ie, from the front or back of the cabinet.



***Standard 48-Vdc lights used by some maintenance personnel for lighting are not to be powered by the system 48-volt taps, either in the power supply or backplanes.***

#### **H. Insects and Rodents**

**5.70** The ECSA cabinets are designed to seal off internal areas from insects and rodents. For this reason, the provided panels and doors should be in place at all times, particularly when such pests are known to exist in a particular location.

#### **FEDERAL COMMUNICATIONS COMMISSION (FCC) REQUIREMENTS**

**5.71** The ECSA adjunct has as registration label affixed on the control carrier in the basic cabinet.

**5.72** To comply with FCC technical requirements, the ECSA equipment cabinet(s) is designed to meet FCC Part 15 requirements. A screen is provided within the cabinet to prevent signals from radiating from the system, and to prevent outside signals from interfering with system operations.

**5.73** Another FCC requirements is that all cabling leaving the ECSA cabinets be shielded. The cabling shield should be extended for a minimum distance of 30 cable-feet. The 30-foot minimum also includes cabling going to the cross-connect field.

#### **POWER**

**5.74** Prepare a sketch of the proposed installation similar to Fig. 19 to show the desired place-

\*Registered trademark of Weston Instruments, Inc.

ment of the cabinets, cross-connect field, and the location of the customer-provided load center and power receptacles.

**5.75** The commercial power provided to the system should be capable of providing each cabinet with 120-Vac 20-ampere service. This service is adequate for any fully equipped system cabinet. Each 20-ampere circuit should be protected by a 20-ampere thermal magnetic circuit breaker (ITE QP1-B020 typical, or approved equivalent).

**5.76** The 2-cabinet installation shown in Fig. 19 could be powered from a 3-wire, single-phase, 240-Vac 60-ampere feeder. However, there is no phase restriction between cabinets. Therefore, the 120-Vac 20-ampere circuit required for each cabinet could be derived from either 2-phase or 3-phase mains.



***In order to maintain system integrity, a dedicated power feeder should be used. In lieu of this, separate branch circuits from a dedicated***

***load center are sufficient to meet minimum requirements.***

**5.77** The ECSA is equipped with two types of power supplies. The first type, J87432D, is provided for nonreserve service, and the second, J87460D, is provided for Uninterruptible Power Service (UPS). The same type supply must be provided for each cabinet.

**5.78** The ECSA power supplies, or rectifiers, are capable of operating under a wide range of frequency or input voltage conditions, provided both conditions do not occur simultaneously. The operating ranges are 99V to 129V if the variation from 60 Hz is not greater than  $\pm 0.3$  Hz, or 105V to 129V if the variation from 60 Hz is not greater than  $\pm 3.0$  Hz.

**5.79** The ac distribution required for a typical ECSA system consisting of two cabinets is shown in Fig. 20. A block diagram of a nonreserve power distribution is shown in Fig. 21. The telephone company engineer must arrange with the customer and an electrical contractor for the installation and wiring of an approved load center equipped with

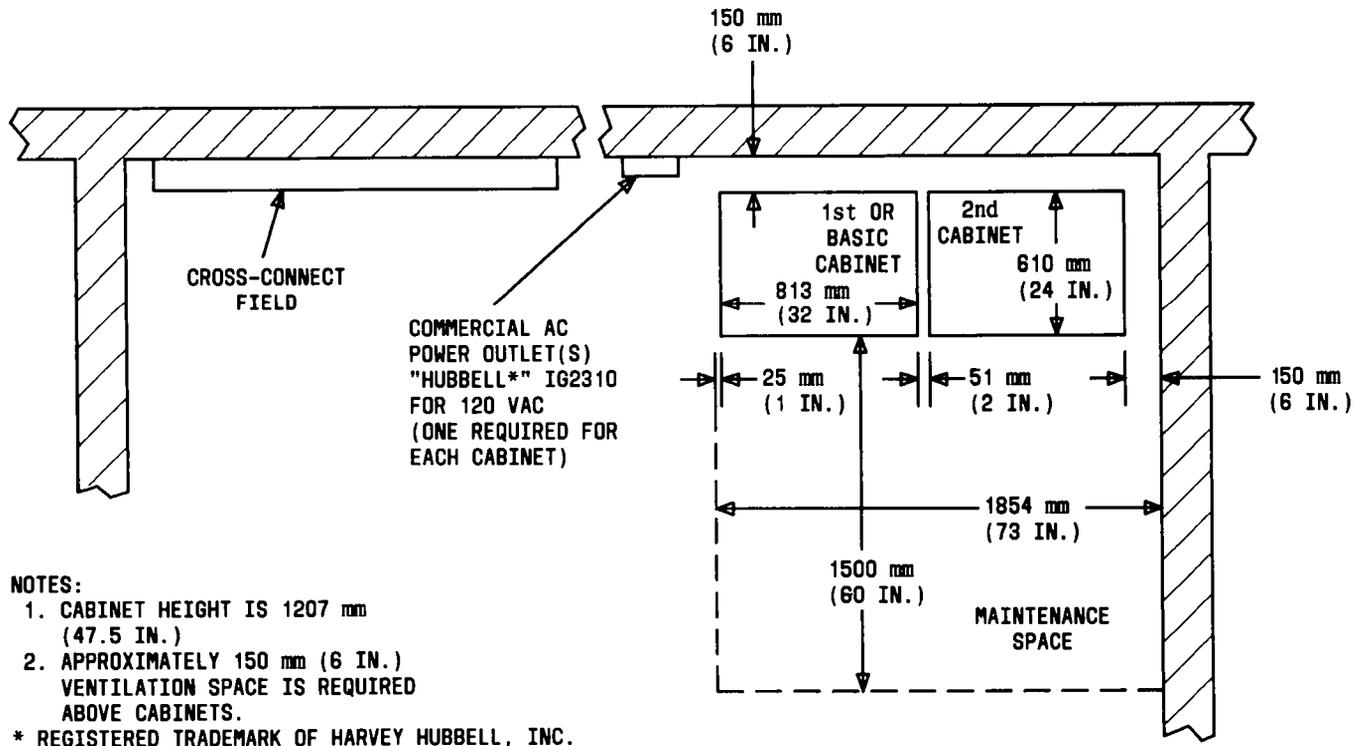


Fig. 19—ECSA Minimum Floor Space Requirements—2-Cabinet System

thermal magnetic circuit breakers, branch circuit wiring, and a wall-mounted receptacle for each cabinet. One circuit breaker and one receptacle are required per cabinet. In all cases, ac wiring and equipment must comply with local codes.

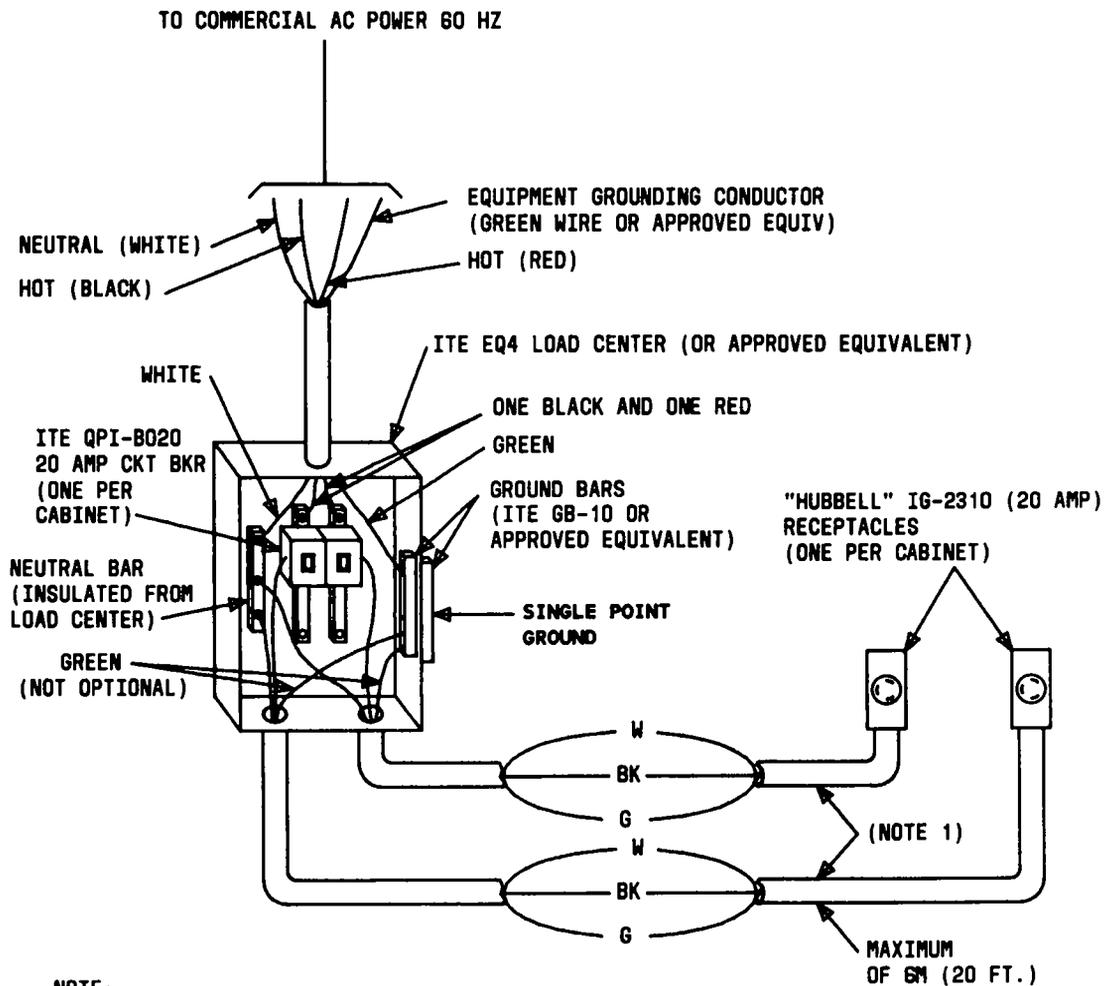


*The load center (ITE EQ4, or approved equivalent), ground bars (ITE GB-10), and HUBBELL (IG-2310) receptacles should be installed by the customer prior to start of ECSA installation.*

**Load Center**

**5.80** The customer-provided load center (circuit panel ITE EQ4, or approved equivalent) of appropriate current rating shall be equipped with 20-ampere, single-pole thermal magnetic circuit breakers (ITE QP1-B020 typical, or approved equivalent). Each circuit breaker is to protect one associated wall-mounted receptacle. A circuit breaker and receptacle shall be provided to accommodate each cabinet (Fig. 20).

**5.81** A 2-piece ground bar (ITE GB-10 typical, or approved equivalent) will be provided locally. The ground bar (Fig. 22) should be installed accord-



NOTE:  
1. AC POWER WIRING MAY BE RUN IN ONE CONDUIT.

Fig. 20—Typical Load Center and Ground Bars

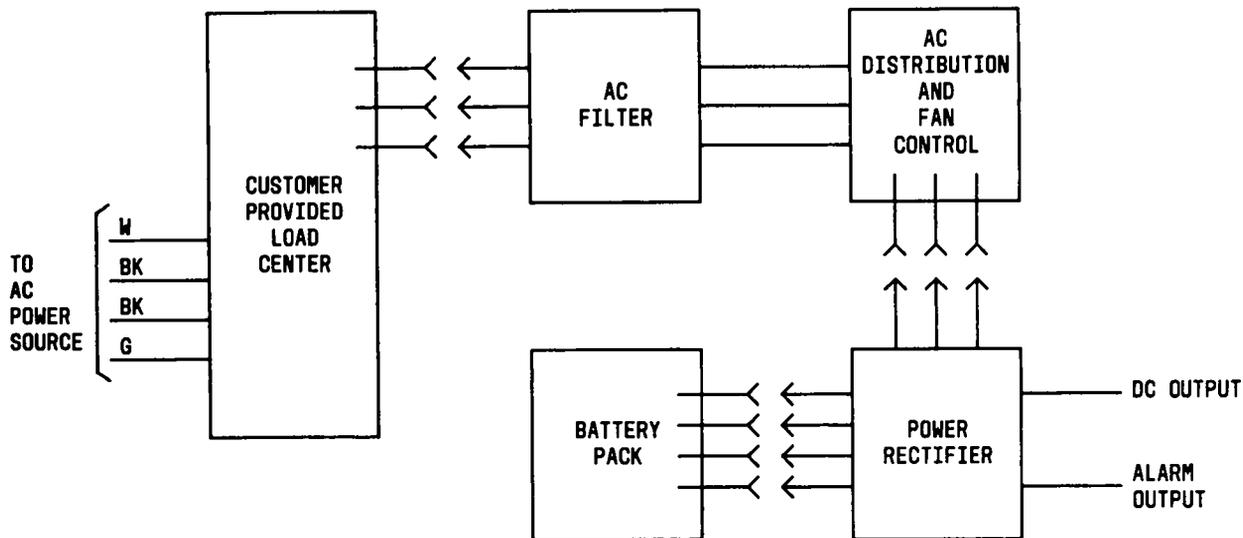


Fig. 21 — Nonreserve Power Distribution—Block Diagram

ing to details given later in this Part under the heading **GROUNDING**.

**5.82** The National Electrical Code and most local codes require that the load center be grounded through an "equipment grounding conductor" which can be one, or a combination, of the following:

- (1) A separate corrosion-resistant conductor (green wire)
- (2) Rigid metal conduit
- (3) Electrical metallic tubing.

The presence of a separate green wire (between the load center and the ac service entrance), when provided in addition to the approved metallic conduit, contributes negligibly to the protection of the PBX against lightning surges. A separate green wire conductor is therefore not specified as an installation requirement but is recommended, if practical, in order to provide a more reliable equipment grounding conductor.

#### Power Receptacles

**5.83** One HUBBELL twist-lock power receptacle, Cat. No. IG-2310, may be ordered to be shipped

with each cabinet for the power outlet installation. It may also be purchased locally by the telephone company, if desired. A power outlet must be provided behind each cabinet.

**5.84** The ac wiring between the load center and wall-mounted receptacle should be kept as short as practical and should not exceed 6096 mm (20 feet) in length. A separate neutral wire (white) shall be run from the load center neutral bar (this is not the single-point ground) to each receptacle. The cabinet circuits shall be distributed evenly as possible over the feeder circuit.



*The conduit, or other metallic enclosure, shall not be used to replace the green wire ground between the load center and the HUBBELL receptacles. A separate equipment ground wire (green wire) is required between the load center and each receptacle.*

**5.85** Since the equipment ground for the wall-mounted ac receptacles should be connected through the green conductor only, receptacles that are designed to obtain equipment ground through the conduit (when mounted in a metallic junction box) should not be used in the ECSA installation. The HUBBELL IG-2310 (insulated ground) receptacle has its ground terminal insulated from its mounting hardware and has been specified for this purpose.

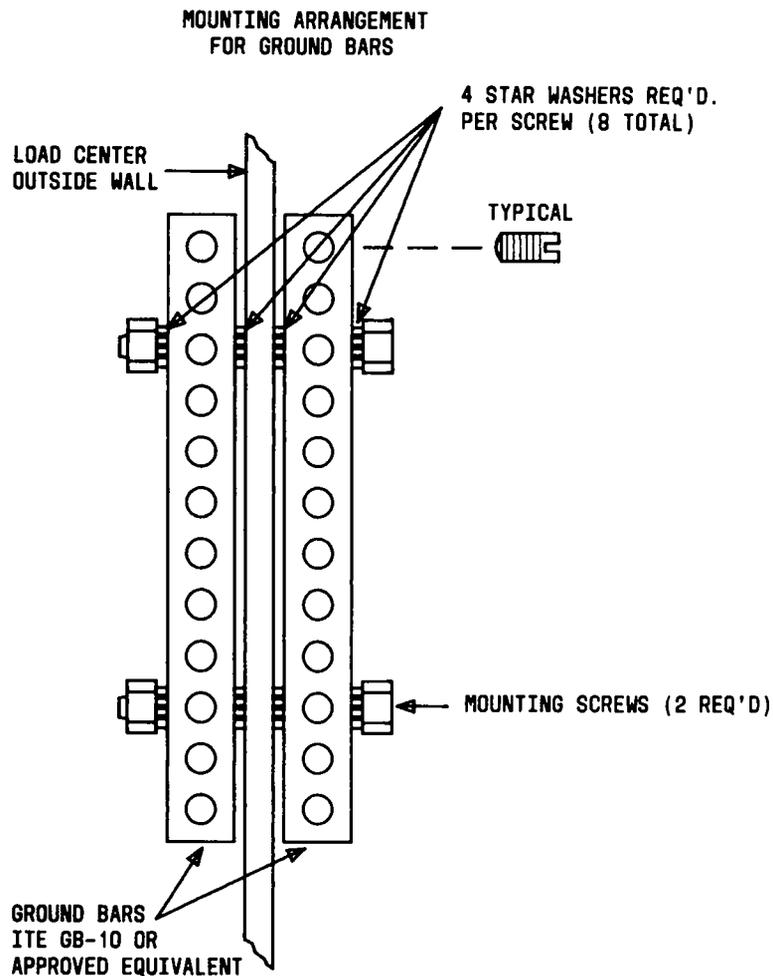


Fig. 22—Ground Bar for Load Center

**ECSA AC Current Drain**

*The values given here for current drain should not be used either for design purposes or for specifying the electrical service required for the ECSA.*

**5.86** The values calculated from the information that follows are typical current drains (in amperes) at 120 Vac 60 Hz. These values should only be used to estimate the electrical power consumption of a given system at a given time since current drain varies with voltage, frequency, traffic, etc.

**5.87** The ac current drain for the ECSA system is the sum of the current in both cabinets. The current drain for a single cabinet depends on the

number of carriers and other equipment in the cabinet. The equivalent -48V current drain for the carriers and other equipment is shown in Table H and can be used to determine the total current drain in a cabinet.

**STANDARD MEMORY HOLDOVER**

**5.88** A standard non-reserve power arrangement provides approximately 90 seconds of memory holdover during a power failure. A rechargeable battery pack KS20390, List 8 provides the backup power.

**5.89** If power is not restored to the system within 90 seconds, information pertaining to energy loads, power meter interfaces, and other stored data could be lost. When some form of backup power is available, the 90-second period should be sufficient

TABLE H

## TOTAL CURRENT DRAIN

CARRIER EQUIPMENT	J87460D RECTIFIER EQUIVALENT -48V DRAIN
Control/Energy Carrier J53135AA	8 Amperes
Energy Carrier J53135AB	5 Amperes
Minirecorder, MAAP, and Alarm Panel	0.64 Amperes

time for the backup system to come on-line and begin powering the ECSA.

## GROUNDING

**5.90** Grounding for the ECSA cabinets is provided by a system single-point ground. The single-point ground is a sandwiched ground bar arrangement (Fig. 22) mounted on the side of the load center (Fig. 20 and 23). The load center (of appropriate current rating) should be installed by an approved electrical contractor in accordance with the National Electrical Code and local codes.

**5.91** The ground bars (two ground bars) shall be mounted back-to-back on the side of the load center. They are to be held together by two screws in a sandwiched arrangement, with one part inside the load center cabinet and the other part outside. Star washers (which dig into the metal surface) shall be used between screwheads and ground bar, between nuts and ground bar, and between each ground bar and load center wall (two places per screw). These star washers are used to ensure a reliable electrical bond between the ground bar and load center. The part of the ground bar (single-point ground) inside the load center shall be used to terminate the green wire ground (equipment grounds). The neutral (circuit ground) shall not terminate on the single-point ground.

**5.92** The part of the ground bar on the outside wall of the load center shall be used by the ECSA

installer for grounding the system. All of the following connections must be made to the single-point ground:

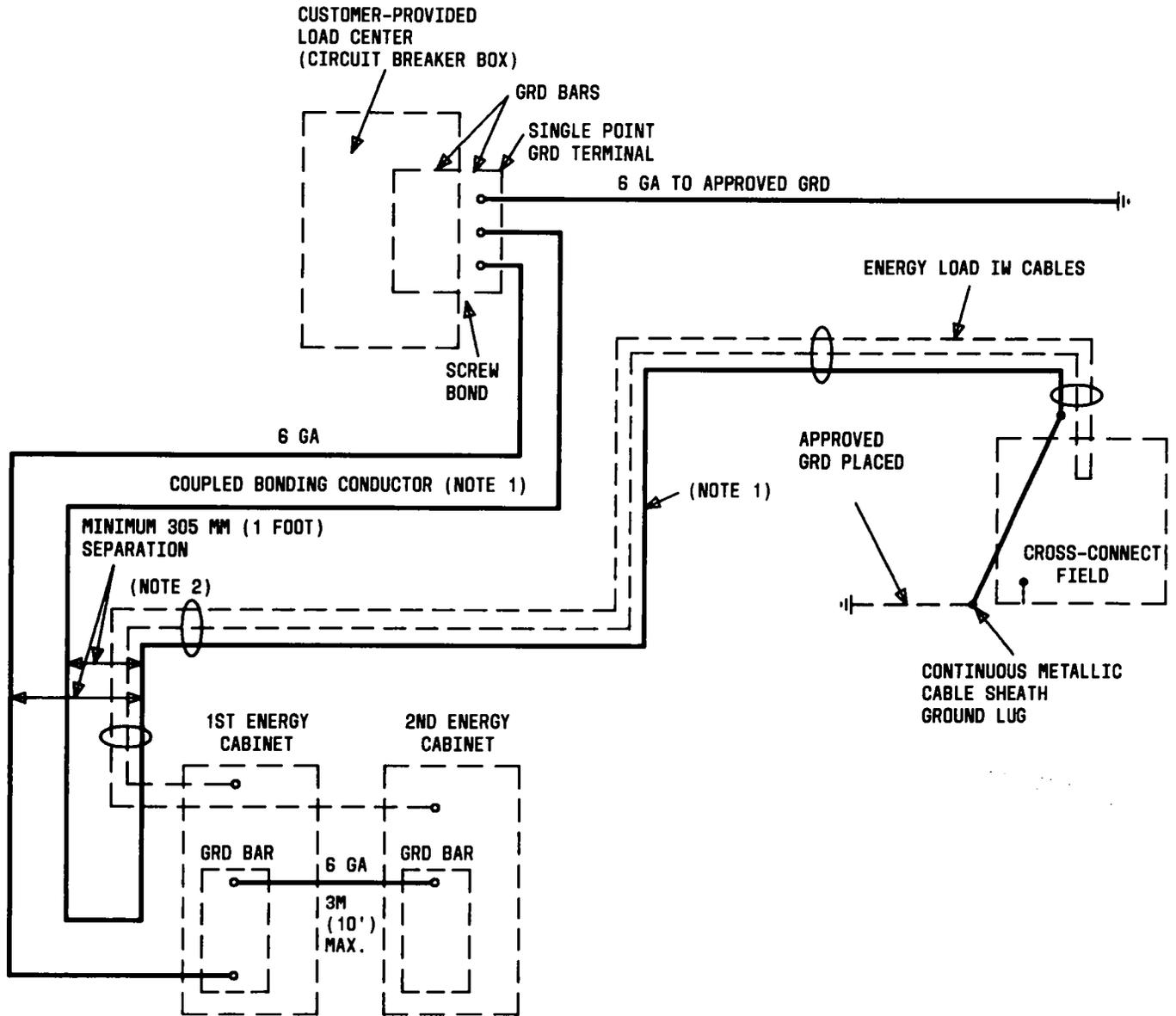
- (a) A No. 6 AWG conductor to one of the following approved ground sources:
  - A metallic cold water pipe (at least 12.7 mm [1/2 inch] diameter) that is electrically continuous through the water meter and extends at least 3048 mm (10 feet) in earth.
  - The steel frame of a steel frame building which is electrically connected to the water pipe and the power source ground.
  - The power source ground. This is the electrode to which the neutral wire of the electrical power service (entering the building) is grounded.
- (b) A No. 6 AWG conductor to the ground bar in basic or first cabinet.
- (c) A coupled bonding conductor connecting the single-point ground to the approved floor ground in a high-rise building or to an approved ground connection.

**Note:** Construction personnel, installing riser cables or other cables in the building, have the responsibility to provide the coupled bonding conductor up to the closet or cross-connect field, and the ECSA installers have the responsibility to extend the conductor to the single-point ground.



**Ground isolation:** Care should be exercised when implementing the grounding scheme. To preserve the integrity of the single-point ground arrangement, verify that neither the cabinet nor any framework on the ECSA side of the customer-provided load center is connected to (or may be moved to inadvertently come in contact with) ground at a place other than at the single-point ground.

**5.93** The single-point ground (bar), mounted on the side of the load center, shall be tagged with Form E-3013B. This form requests that the telephone company repair service be notified if connections are loose or if they must be removed.



**NOTES:**

1. COUPLED BONDING CONDUCTOR IS:
  - CONTINUOUS CABLE SHEATH
  - 6 GOOD CABLE PAIRS
  - 10 GA WIRE.
2. CABLE TIES SHOULD LASH ALL ENERGY LOADS IW CABLES (FROM THE CABINETS TO THE CROSS-CONNECT FIELD) TO THE COUPLED BONDING CONDUCTOR.

**Fig. 23—Grounding and Bonding Diagram for ECSA**

**5.94** The protector ground terminal shall be connected to an approved ground source closest to the protector. The first choice for approved ground is to the nearest point on the power service ground system. This may be the power service ground wire, grounding electrode, or the service entrance conduit.

**5.95** Alternate choices for an approved ground are a metallic water pipe or building steel **which are bonded to the power service ground**. The alternate choices should be used when located closer than the power service ground, because it is important to keep the protector ground wire as short as possible.

**Note:** Refer to Section 876-300-100 for details on approved grounds.

**5.96** When a data set is used with the ECSA system, the circuit ground of the data set must be isolated from the data set frame by opening the appropriate (screw) switch. For example, when the 113D data set is used for remote maintenance, administration, and traffic system (RMATS), apply option P (no common ground). Option P opens screw switch S1 in the data set. This isolation is necessary to ensure that lightning surges on the data set green wire ground are not transmitted to the ECSA.

## PROTECTION

### Electrical Protection

**5.97** Whenever the ECSA is installed in an environment where it may be exposed to lightning surges or to ac power voltages (either by direct contact or by induction), refer to Section 876-300-100 to determine the exposure status of the installation and for detailed protection requirements.



### **TO MINIMIZE LIGHTNING SURGES AT THE PBX:**

- **Always ground and bond ECSA in the prescribed manner.**
- **Verify that the cold water pipe system is bonded to the ac power service entrance ground.**
- **Verify that the metallic shield of the building entrance cable is grounded**

**and also bonded to the protector ground terminal.**

### Coupled Bonding Conductor

**5.98** The coupled bonding conductor provides an electrical connection between the ECSA single-point ground and an approved ground connection. This connection is needed to reduce the difference in (electrical) potential that can appear between energy load leads and the system ground as a result of lightning surges.

**5.99** For methods of providing the coupled bonding conductor in high-rise and in low, wide buildings, see Section 876-300-100.

**5.100** Figure 23 is an illustration of the grounding and bonding conductors to be placed by installation personnel.

### UNINTERRUPTIBLE POWER SERVICE (UPS)

**5.101** Uninterruptible Power Service is available for use with the ECSA systems (Fig. 24). The UPS provides power holdover to the ECSA cabinets for short-term power disruptions. Whenever a commercial power failure occurs, the battery (part of the UPS unit) assumes the ECSA load until the commercial power is restored or until the battery voltage drops to a predetermined level. The low voltage cutoff (about 42 volts) is provided to prevent battery damage. The ECSA system operations stop when the voltage cutoff is reached. When the commercial ac power is restored, the battery will fully charge in about 24 hours. The UPS arrangements are defined as **nominal holdover and extended holdover**.

**5.102** The **UPS nominal holdover** arrangement is completely self-contained and is installed in ECSA cabinets in place of normal power supply units. During a power interruption, the nominal holdover equipment provides electrical power through a UPS rectifier/converter power supply. The power originates from a UPS battery pack which has been charged from commercial power by a UPS battery charger. The batteries provide approximately 48V at 5 ampere-hours (Ah). This permits the nominal holdover period to be around 5 minutes under a full load condition. Additional connecting details for UPS nominal holdover is shown in Fig. 25. The UPS nominal holdover equipment is listed as follows:

- One J87460D rectifier/converter power supply

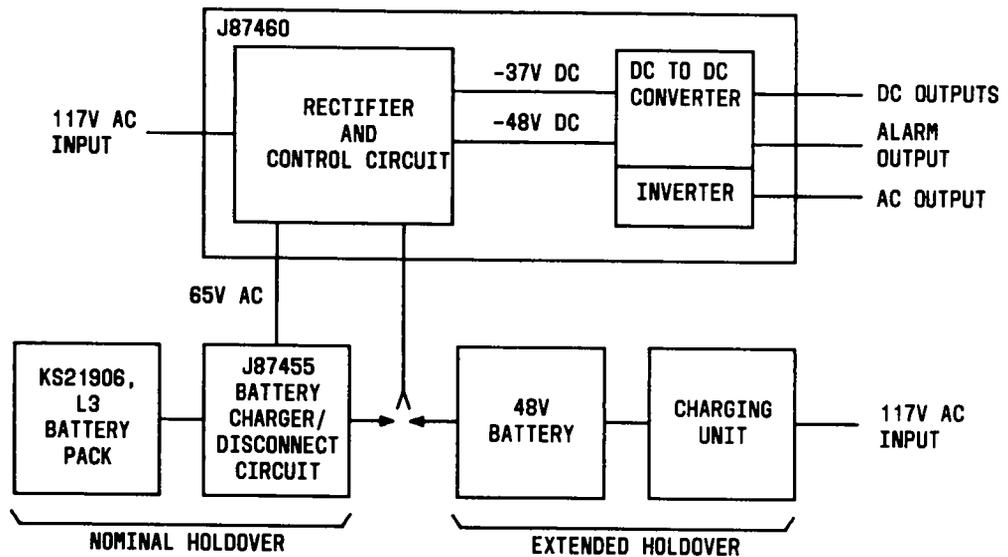


Fig. 24—Uninterruptible Power Service—Block Diagram

- One J87455A battery charger and disconnect circuit (installed in cabinet with UPS power supply)
- One KS-21906, L3, battery pack (installed in cabinet with UPS power supply)
- One J53135JA-1, L2 ac power distribution and fan assembly.

**5.103** The UPS nominal holdover provides power only for the ECSA cabinets. The service does not provide power for any auxiliary devices.

**5.104** The *UPS extended holdover* arrangement increases the holdover period to approximately 8 hours. The extended holdover service uses a separately housed battery plant and charging unit such as a 105E power plant. The UPS extended holdover equipment is listed as follows and is illustrated in Fig. 26:

- One customer-provided load center (or panel board ITE EQ6 typical, or approved equivalent) equipped with circuit breakers
- One 105E power plant or approved equivalent, equipped with rectifiers
- One J87460D rectifier/converter power supply
- One J53135JA-1, L2 ac power distribution and fan assembly.

**5.105** The -48 volts is to be supplied to the ECSA cabinet(s) by the reserve power plant discharge circuit through a filter in the power supply. The filter output terminals are already connected to the proper power distribution terminals and require no modification. With J87460D reserve power rectifiers, lead -48RSV (A, B) is connected to the corresponding internal filter input terminal on the rectifier designated as terminal 1 on TB1. The associated ground lead GRD RSV (A, B) is connected to the corresponding cabinet ground block.

**5.106** The load center must be equipped with the ITE QP1-B020 thermal-magnetic circuit breaker for each rectifier in the 105E plant.

**5.107** The steady state input current values for various ECSA units (120 Vac 60 Hz) are:

- One 105E power plant rectifier = 8A (Fig. 26 shows four rectifiers connected)
- One (fully loaded) system cabinet 00 = 8A
- One (fully loaded) system cabinet 01 = 5A.

**5.108** The various 105E power plant options required to be implemented are:

- Wired for negative battery
- Without CEMF cell

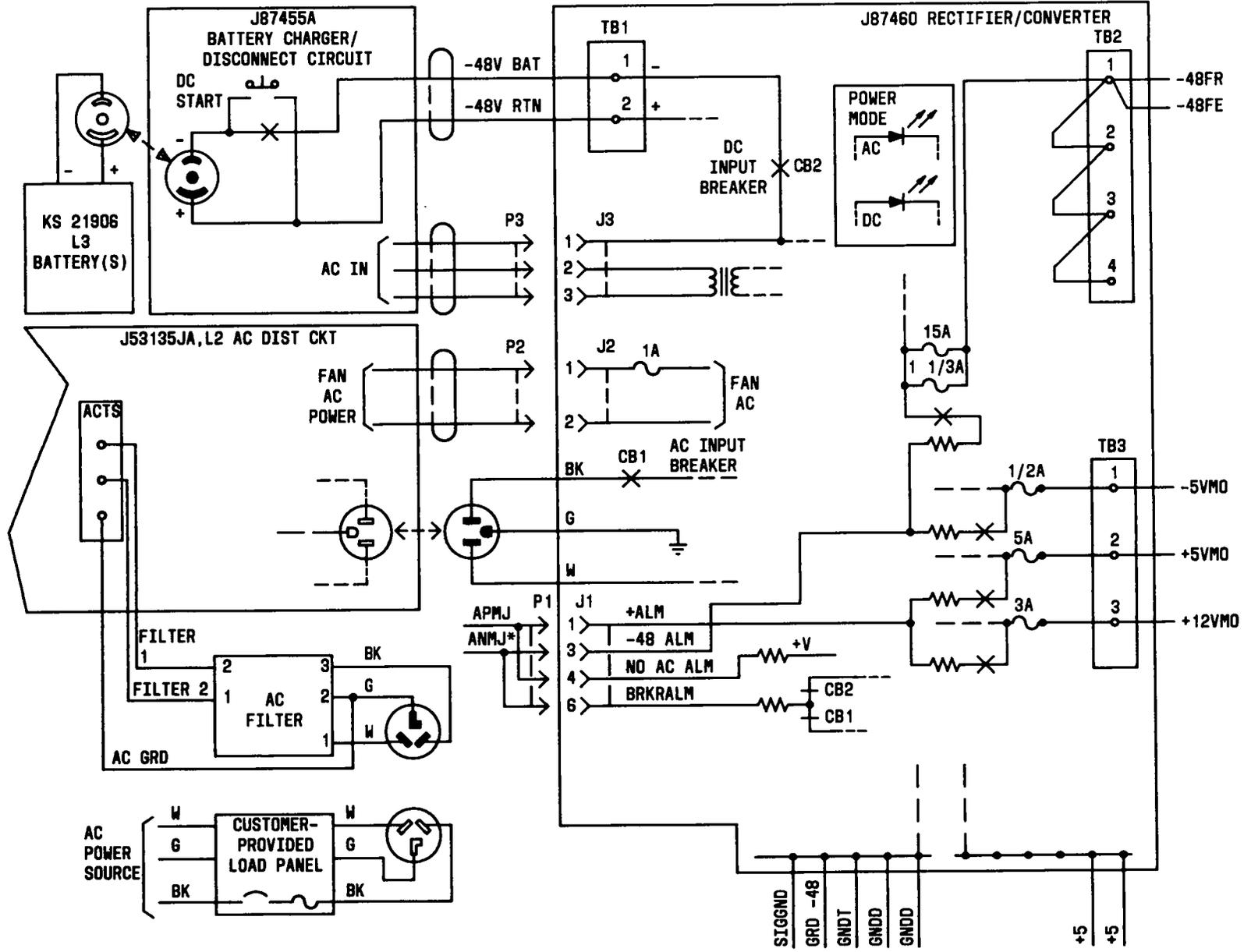


Fig. 25—Uninterruptible Power Service—Nominal Holdover

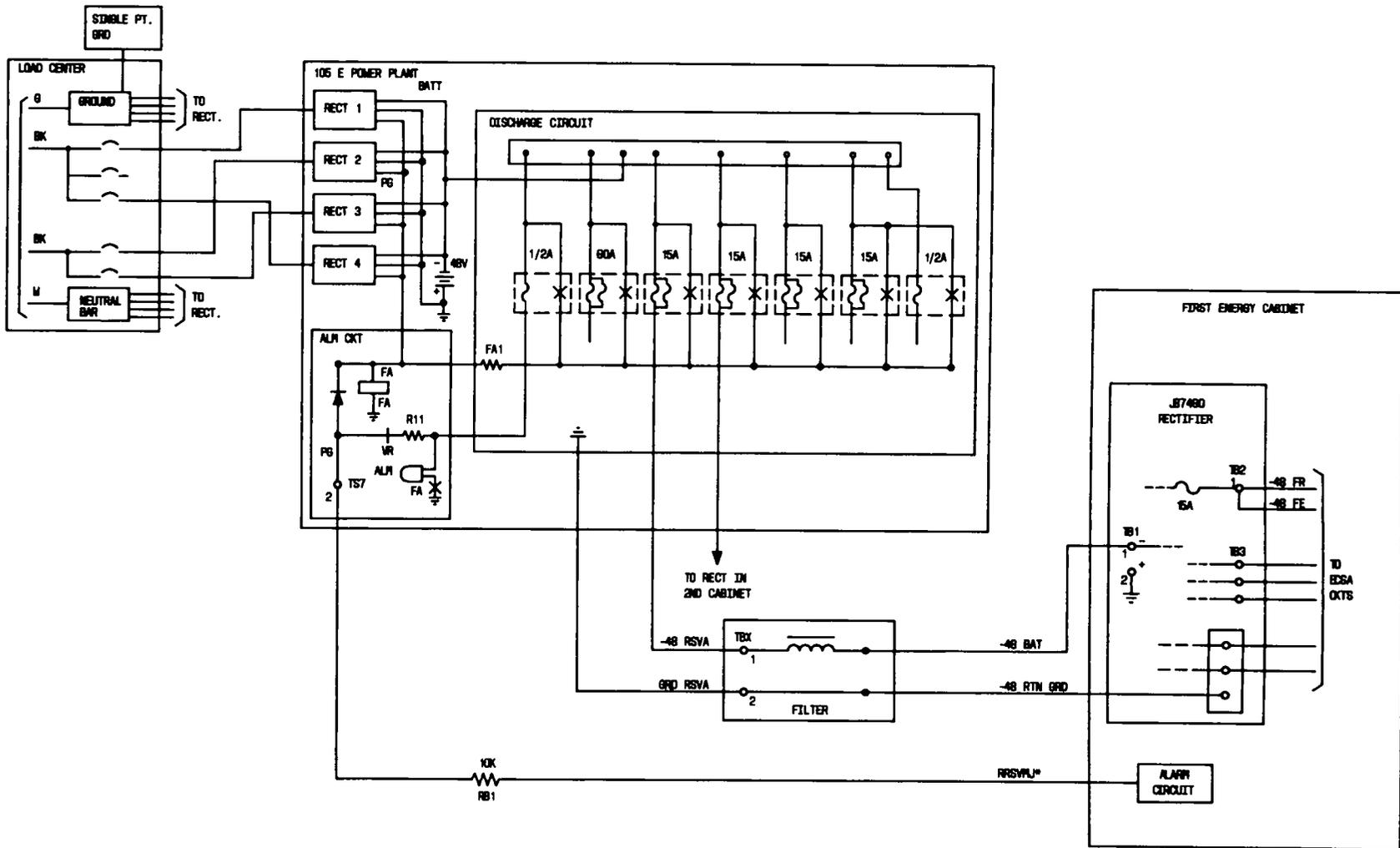


Fig. 26—Uninterruptible Power Service—Extended Holdover

- With alarm circuit
- With battery on PG lead to provide combined fuse and low-voltage alarm on a single lead
- With rectifier PG lead multiplied to originating discharge circuit FA1 alarm lead
- Without separation of discharge fuse alarms and control fuse alarms
- For normal continuous loads
- Discharge ground insulated from framework
- With the rectifier wired for negative output (120 Vac 60 Hz); ie, "+" terminal tied to battery discharge ground.

5.109 The -48 Vdc drains (in amperes) used for calculating reserve power elements are shown in Table H. Unit drain for voltages is expressed in terms of the -48V direct current from the battery plant required to generate them. Only one equivalent -48 Vdc drain is listed per carrier (corresponding to a fully equipped carrier) since this value remains essentially constant.

**Note:** The number of 100 ampere-hour battery strings can be determined from the idle

and busy-hour battery drains calculated by following standard power engineering procedures. The number of 11- to 15-ampere rectifiers provided as part of the 105E power plant should be such that they can carry the full system load and also be able to replenish the batteries in the desired time interval.

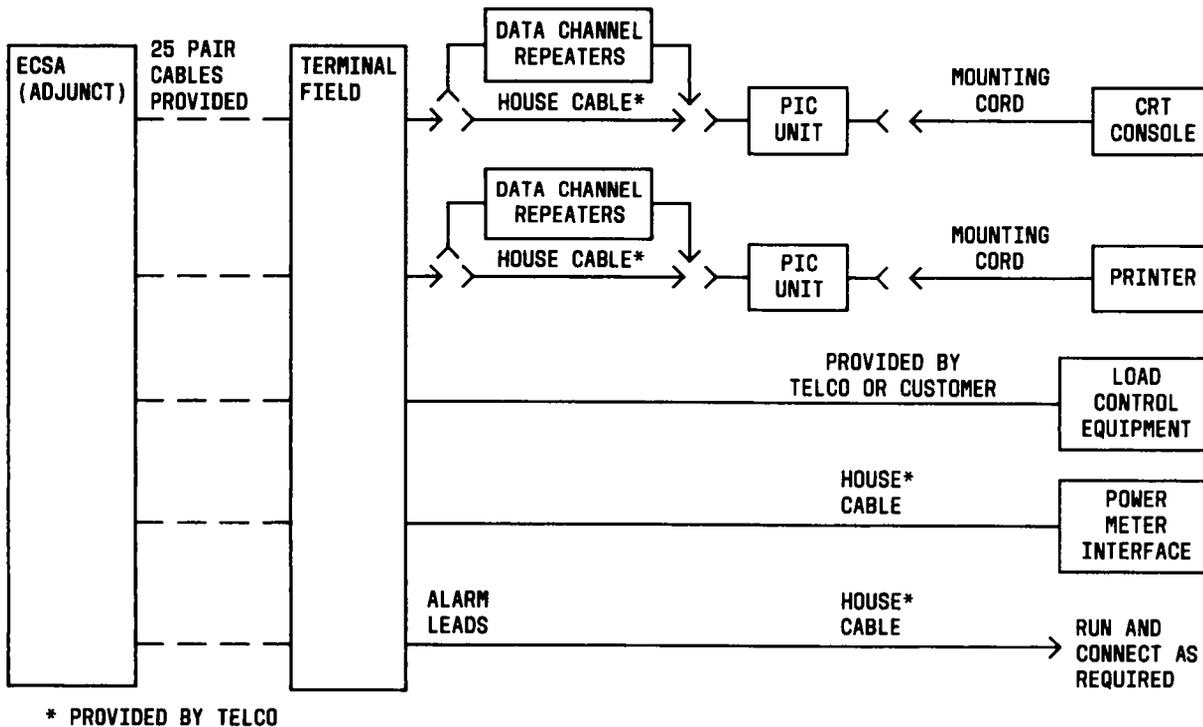
**CABLING**

5.110 Circuits in the ECSA cabinets are connected to the loads, console(s), etc, via connector cables using KS-type plugs (Fig. 27). The cables are then cut down on the cross-connect field. They may be ordered via the Mechanized Ordering Form (E-8190). Some special cables (shielded types) are used for high-frequency data channels and carrier-to-carrier cabling.

5.111 Each cable from the ECSA cabinets has a lead pulled out of the cable sheath with a spade lug crimped on the end. This spade lug must be connected to the ground terminal on the cabinet frame. This is to comply with FCC Part 68 registration regulations.



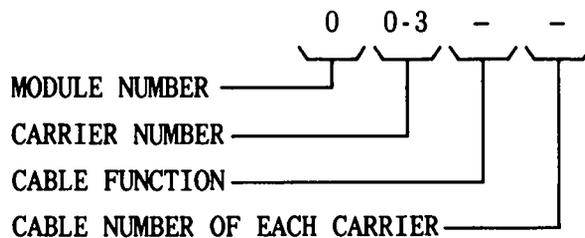
**Do not remove spare coaxial terminals in the KS-19820 connectors.**



\* PROVIDED BY TELCO

Fig. 27—Cabling From the ECSA to Peripheral Equipment via Cross-Connect Field

5.112 The A25-D type cables should be specified for connections from the cabinet to the cross-connect field. Connectors for the cables and carriers are designated by module number, carrier number, cable function, and cable number as follows:



An example designation may be 01EB03 which indicates module 0, carrier 1, energy carrier, and the third cable from the carrier.

(a) **Carrier Number:** Assigned sequentially for each carrier in the system (Fig. 8 and 9). The ECSA may contain the following carriers:

- (1) Control/energy carrier (J53135AA)—One required for each system.
- (2) Energy carrier (J53135AB)—Maximum of one allowed per each cabinet.

(b) **Cable Function:** Circuit designations on the backplanes associated with the cables and connectors are as follows:

- (1) AP—Alarm panel
- (2) BA, BB, BC, BHS, BRM, BX—Control/energy carrier
- (3) EB, GA, MC—Energy carrier

(c) **Cable Plan:** The cable plan for the cross-connect field is shown in Fig. 28:

- (1) AP7 on alarm panel
- (2) BB02 through BB07 on control/energy carrier
- (3) BX01 on control/energy carrier
- (4) EB01 through EB26 on energy carrier.

5.113 Circuits in the MRU cabinet are connected to the MRU cross-connect field via connector cables BG01, BG02, and BG03 (Fig. 29). The circuits

are extended via cross-connects to the loads or sensors. The MRU circuits are wired from the ECSA through the cross-connect field to the modular telephone jack on the MRU.

## CROSS-CONNECTIONS

### A. Cross-Connect Fields

5.114 **DANGER: Hazardous foreign voltage may exist on leads extending to customer load control circuitry and power meters via the cross-connect field.** Three typical layouts for an ECSA system cross-connect field are shown in Fig. 30. The layout selected will depend on the number of energy loads, power meter, or sense points associated with the system. These three layouts can be associated with the MRU cross-connect field.

5.115 Colored 183-type backboards are used on the cross-connect field to identify the type circuits to be terminated at the various positions. The recommended 66-type connecting blocks are identified with the system cables which terminate on the blocks. Backboard color and type of circuits terminated are as follows:

BACKBOARD COLOR	CIRCUITS OR EQUIPMENT TERMINATED
Blue (183B1)	Energy load, meter circuits, or sense points
Yellow (183B5)	ECSA load circuit

5.116 White 196A backboards, having stand-off type distribution rings, are used to separate the field into upper and lower sections and are intended for use when wiring and cross-connecting the various connecting blocks.

### B. Cross-Connect Field Enclosures

5.117 The cross-connect field enclosure assembly (Fig. 31) may be required to satisfy FCC registration requirements. It is available in two sizes as follows:

- (a) 432 mm (17 inches) wide, 686 mm (27 inches) high, and 229 mm (9 inches) deep. The 686-mm (27-inch) high assembly is used to cover one standard 432- by 508-mm (17- by 20-inch) backboard and one 196A distribution ring. This size can be expanded horizontally and vertically as required.

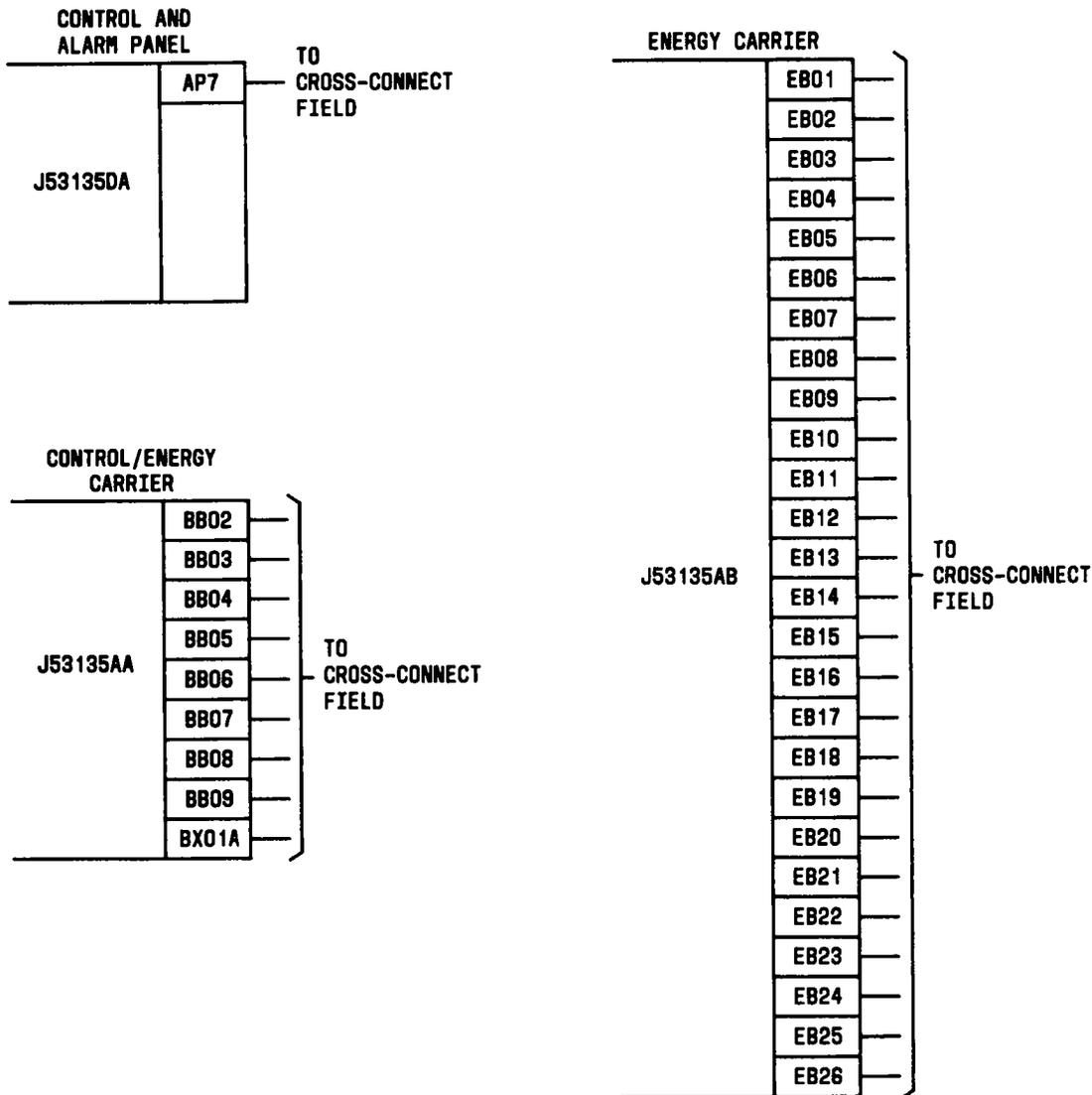


Fig. 28—Cabling Plan to Cross-Connect Field

(b) 432 mm (17 inches) wide, 1372 mm (54 inches) high, and 229 mm (9 inches) deep. The 1372-mm (54-inch) high assembly is used to cover two standard 432- by 508-mm (17- by 20-inch) backboards and two 196A distribution rings. This size can be expanded horizontally as required.

**5.118** The cross-connect field enclosures may be multiplied horizontally as needed. The top and side panels will accommodate the additional

depth of the 19-mm (3/4-inch) backboard on which the frame assembly is mounted. If the frame assembly is mounted directly on the wall (without the wooden backboard), group 4 assembly method (ED-1E322 -71, -72) of the door panel should be used. This compensates for the added depth due to the absence of the backboard.

**5.119** Mount the cross-connect field enclosure assembly with the top approximately even with the top of the cabinets.

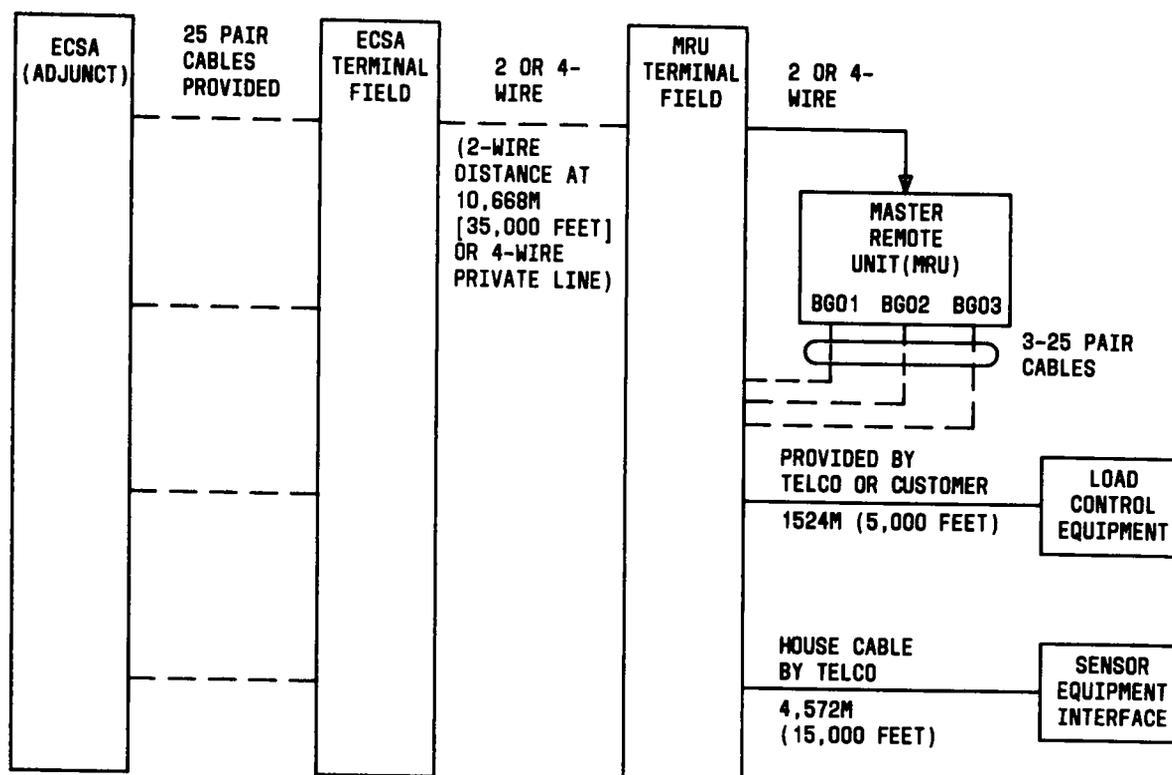


Fig. 29—Master Remote Unit Cabling to Cross-Connect Field Extended to Loads And Sensors

5.120 The installation of a 1372-mm (54-inch) high cross-connect field enclosure (ED-1E322-71) to be mounted *on a wooden backboard* requires the following:

- One GR1 (group), consisting of basic enclosure with door, brackets, and hardware
- Two GR2 (groups), each consisting of one side panel and hardware
- Two GR3 (groups), each consisting of one top/bottom panel and hardware.

When more than one enclosure is used (joined), GR2 side panels are required only at the ends.

5.121 The installation of a 1372-mm (54-inch) high cross-connect field enclosure (ED-1E322-71) to be mounted *flush on the wall* requires the following:

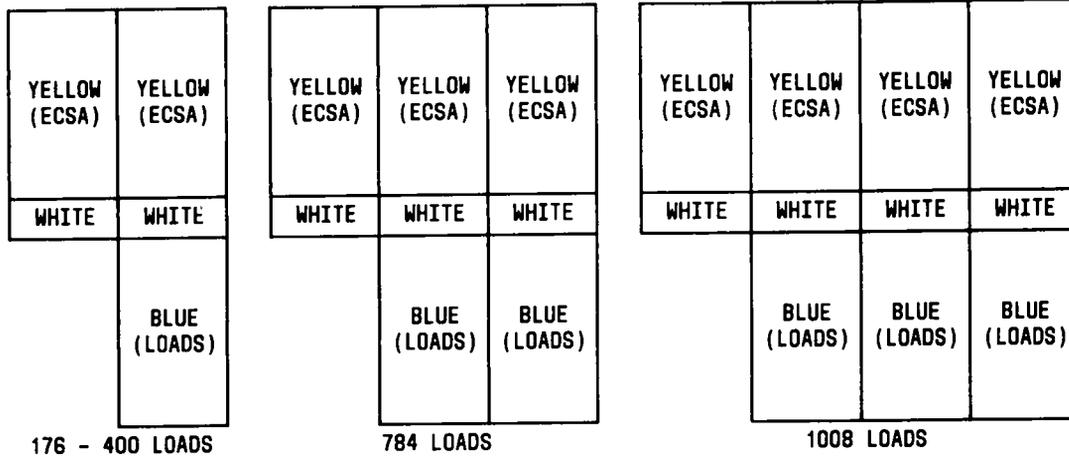
- One GR4 (group), consisting of basic enclosure with door, brackets, and hardware

- Two GR2 (groups), each consisting of one side panel and hardware
- Two GR3 (groups), each consisting of one top/bottom panel and hardware.

When more than one enclosure is used (joined), GR2 side panels are required only at the ends.

5.122 The installation of a 686-mm (27-inch) high cross-connect field enclosure (ED-1E322-72) to be mounted *on a wooden backboard* requires the following:

- One GR1 (group), consisting of the basic enclosure with door, brackets, and hardware
- Two GR2 (groups), each consisting of one side panel and hardware
- Two GR3 (groups), each consisting of a top/bottom panel with hardware.



<u>BACKBOARD COLOR</u>	<u>CIRCUITS OR EQUIPMENT TERMINATED</u>
YELLOW	ADJUNCT PORT CIRCUITS
BLUE	CUSTOMER LOAD OR METER CIRCUITS
WHITE	CROSS-CONNECTING WIRE

Fig. 30—Typical ECSA Cross-Connect Fields

When more than one enclosure is used (joined), GR2 side panels are required only at the ends.

5.123 The installation of a 686-mm (27-inch) high cross-connect field enclosure (ED-1E322-72) to be mounted *flush on the wall* requires the following:

- One GR4 (group), consisting of a basic enclosure with door, brackets, and hardware
- Two GR2 (groups), each consisting of one side panel and hardware
- Two GR3 (groups), each consisting of one top/bottom panel and hardware.

When more than one enclosure is used (joined), GR2 side panels are required only at the ends.

5.124 The cross-connect field enclosures are designed to be located on customer premises and may house the following apparatus:

- 183-type backboards
- 184-type backboards
- 187B1 backboards

- 196A backboards.

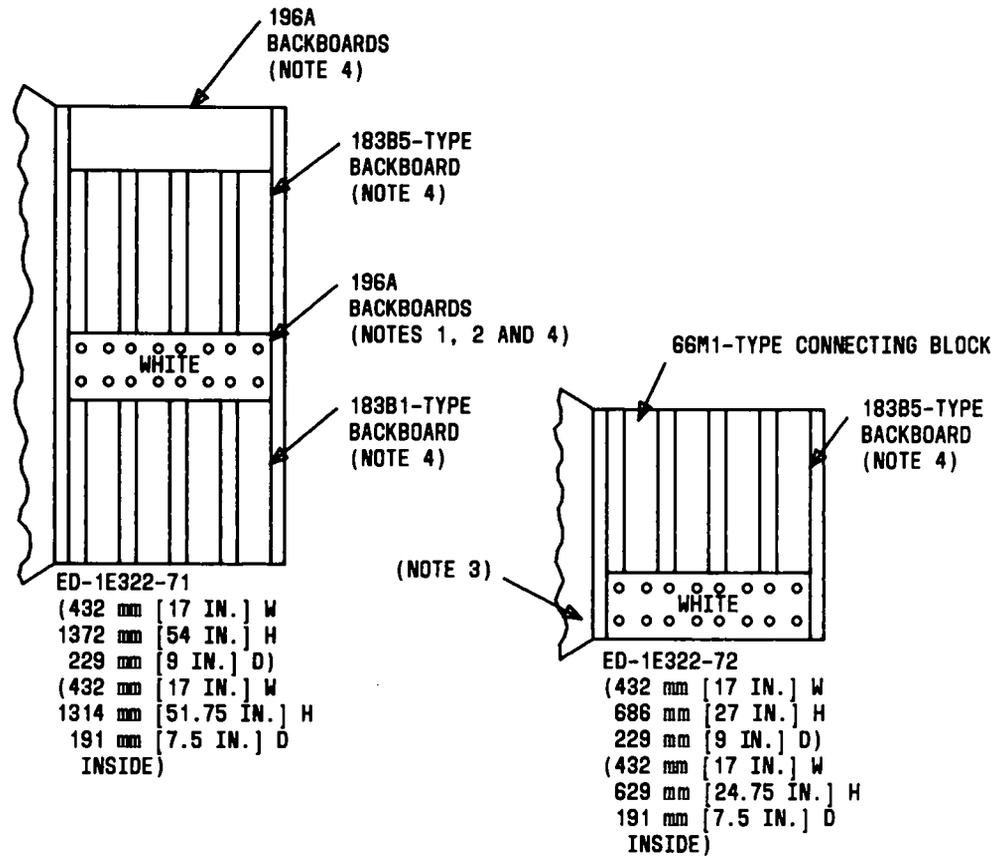
Backboard ordering information is shown in Table I.

**C. Cross-Connect Tables**

5.125 Computer-generated cross-connect tables are delivered from the factory prior to delivery of the system. These tables should be completed and provided for installer use at the time of installation. Worksheets (similar to the cross-connect tables) for apparatus and/or equipment interconnections are located at the end of this section for use when planning the system initial configuration. Worksheets should include cross-connections from the alarm panel and the control/energy and energy carriers, and interconnections for apparatus associated with each feature. The worksheets should be retained for office records.

**D. Energy Load and Power Meter Interface Cross-Connections**

**Note:** Two electrical slots are required for a single circuit pack, and each carrier connector provides cross-connections for three electrical slots or one and one-half circuits packs. For ex-



CODE (NOTE 4)	BACKBOARD COLOR	CIRCUITS OR EQUIPMENT TERMINATED
A	WHITE	CROSS-CONNECT
B1	BLUE	CUSTOMER LOAD OR METER CIRCUITS
B5	YELLOW	ADJUNCT PORT CIRCUITS

**NOTES:**

- PLYWOOD BACKBOARD MOUNTS FOR ALL SIZES (OPTIONAL).
- BACKBOARD ARRANGEMENTS ARE FLEXIBLE. REFER TO 518-010-101 TYPICAL LAYOUTS.
- CABLING IN THROUGH KNOCKOUTS IN SIDE AND BOTTOM.
- "A" SIZE = 216 mm X 508 mm (8.5" X 20"). "B" SIZE 432 mm X 508 mm (17" X 20").

**Fig. 31 — Cross-Connect Field Enclosure**

ample, connector BB02 (Table J) provides leads for board in paired-slots 3 and 4, and half of board in paired-slots 5 and 6. Connector BB03 provides leads for other half of board in slots 5 and 6 as well as board in slots 7 and 8.

**5.126** Energy load, power meter interface, sense point interface, and remote control board interface cross-connections from the control/energy carrier are shown in Table J. The first 16 circuits to

the cross-connect field, via the BB02 connector, are shown extended from power meter interfaces. This indicates that the LC563 circuit pack (one per system for power meter interfaces) is installed in slots 3 and 4 of the first segment (0 segment) of the control/energy carrier. The circuit pack ships in this position with each initial system configuration. However, the LC563 unit may be installed in any one of slots 3 through 16, segment 0, slots 1 through 10, segment 1, or any energy load slot in an energy carrier. The re-

**TABLE I**  
**BACKBOARD DESIGNATIONS**

TYPE	COLOR	SIZE IN MILLIMETERS (INCHES)	ORDERING CODE
183A5	Yellow	216 (8.5) X 508 (20)	101986446
183B1	Blue	432 (17) X 508 (20)	101412989
183B5	Yellow	432 (17) X 508 (20)	101986453
196A	White	432 (17) X 117 (4.6)	102581089
187B1	White	432 (17) X 168 (6.6)	101937944

maining slots are filled with LC562 or LC601 circuit packs as required. When the LC563 is not required, an LC562 may be installed to provide interfaces for 16 additional energy loads.

**5.127** The energy load cross-connections from an energy carrier are shown in Table K. Only connectors EB01 through EB10 are required for a second energy carrier when provided. The second energy carrier needs only to be partially equipped in order to reach maximum system configuration.

**5.128** The lead designations for the energy load, power meter interfaces, sense points interface, or to the MRU shown in Table J and K contain either three or four numerals. The first and last digits represent the segment and circuit numbers respectively. The one or two center digits represent the slot number. Examples are:

- (1) MR043 = Power meter interface associated with 0 segment, 4th slot, and the 3rd circuit
- (2) CID1127 = Energy load interface associated with 1st segment, 12th slot, and the 7th circuit.

**5.129** Tables L and M are filled-in examples of the cross-connect worksheets for the power meter interfaces, sense point interfaces, and energy loads respectively. Worksheets should provide the following information for each load, sense point interface, or power meter interface equipped:

- Equipment location (carrier, segment, slot, etc)
- Circuit number
- Power meter interface or energy load number

- Lead designations
- Connector designations
- Color code of the connector cable
- Connector block designation and terminal number in the yellow field
- Terminal number to which the cross-connection is made in the blue field.

**5.130** Figure 32 shows energy loads, power meters and sensors connected through the cross-connect field to the energy and control/energy carriers, and the MRU(s). The distance between the ECSA system and the customer load control is dependant on the coil resistance and operating voltage of the customer control relay, the interconnecting wire gauge, and the supply voltage. The distance is unlimited as long as the load control relay operates properly. The maximum suggested distances for load, sensor, power meters, and MRUs are shown in Fig. 2.

#### **E. Control Lead Cross-Connections**

**5.131** The control input/output (I/O) leads are extended to the cross-connect field via the BX01 connector on the control/energy carrier. The control leads are extended over the low-speed data channels provided by the LC366C circuit packs. The assignment of I/O leads to a particular device is not restricted by software or hardware.

**5.132** The control I/O cross-connections are shown in Table N. Eight data channels, 04 through 11, are provided. An additional low-speed data chan-

**TABLE J**  
**CONTROL/ENERGY CARRIER CROSS-CONNECTIONS**

A25D CONNECTOR CABLES FROM CONTROL/ENERGY CARRIER CONNECTORS								AT YELLOW BACKBOARD	
LEAD DESIGNATIONS FOR LC562, LC563, OR LC601 (NOTE)								CUT LEADS DOWN ON	
BB02	SEG/SLOT	BB03	SEG/SLOT	BB04	SEG/SLOT	BB05	SEG/SLOT	LEAD COLOR	CONN BLK TERMINALS
MR030	0/3	CIG060	0/6	CIG090	0/9	CIG0120	0/12	W-BL	1
M030		CID060		CID090		CID0120		BL-W	2
MR031		CIG061		CIG091		CIG0121		W-O	3
M031		CID061		CID091		CID0121		O-W	4
MR032		CIG062		CIG092		CIG0122		W-G	5
M032		CID062		CID092		CID0122		G-W	6
MR033		CIG063		CIG093		CIG0123		W-BR	7
M033		CID063		CID093		CID0123		BR-W	8
MR034		CIG064		CIG094		CIG0124		W-S	9
M034		CID064		CID094		CID0124		S-W	10
MR035		CIG065		CIG095		CIG0125		R-BL	11
M035		CID065		CID095		CID0125		BL-R	12
MR036		CIG066		CIG096		CIG0126		R-O	13
M036		CID066		CID096		CID0126		O-R	14
MR037		CIG067		CIG097		CIG0127		R-G	15
M037		CID067		CID097		CID0127		G-R	16
MR040	0/4	CIG070	0/7	CIG0100	0/10	CIG0130	0/13	R-BR	17
M040		CID070		CID0100		CID0130		BR-R	18
MR041		CIG071		CIG0101		CIG0131		R-S	19
M041		CID071		CID0101		CID0131		S-R	20
MR042		CIG072		CIG0102		CIG0132		BK-BL	21
M042		CID072		CID0102		CID0132		BL-BK	22
MR043		CIG073		CIG0103		CIG0133		BK-O	23
M043		CID073		CID0103		CID0133		O-BK	24
MR044		CIG074		CIG0104		CIG0134		BK-G	25
M044		CID074		CID0104		CID0134		G-BK	26
MR045		CIG075		CIG0105		CIG0135		BK-BR	27
M045		CID075		CID0105		CID0135		BR-BK	28
MR046		CIG076		CIG0106		CIG0136		BK-S	29
M046		CID076		CID0106		CID0136		S-BK	30
MR047		CIG077		CIG0107		CIG0137		Y-BL	31
M047		CID077		CID0107		CID0137		BL-Y	32
CIG050	0/5	CIG080	0/8	CIG0110	0/11	CIG0140	0/14	Y-O	33
CID050		CID080		CID0110		CID0140		O-Y	34
CIG051		CIG081		CIG0111		CIG0141		Y-G	35
CID051		CID081		CID0111		CID0141		G-Y	36
CIG052		CIG082		CIG0112		CIG0142		Y-BR	37
CID052		CID082		CID0112		CID0142		BR-Y	38
CIG053		CIG083		CIG0113		CIG0143		Y-S	39
CID053		CID083		CID0113		CID0143		S-Y	40
CIG054		CIG084		CIG0114		CIG0144		V-BL	41
CID054		CID084		CID0114		CID0144		BL-V	42
CIG055		CIG085		CIG0115		CIG0145		V-O	43
CID055		CID085		CID0115		CID0145		O-V	44
CIG056		CIG086		CIG0116		CIG0146		V-G	45
CID056		CID086		CID0116		CID0146		G-V	46
CIG057		CIG087		CIG0117		CIG0147		V-BR	47
CID057		CID087		CID0117		CID0147		BR-V	48
								V-S	49
								S-V	50

SEE NOTE AT END OF TABLE.

**TABLE J (Contd)**  
**CONTROL/ENERGY CARRIER CROSS-CONNECTIONS**

A25D CONNECTOR CABLES FROM CONTROL/ENERGY CARRIER CONNECTORS								AT YELLOW BACKBOARD	
LEAD DESIGNATIONS FOR LC562, LC563, OR LC601 (NOTE)								CUT LEADS DOWN ON	
BB06	SEG/SLOT	BB07	SEG/SLOT	BB08	SEG/SLOT	BB09	SEG/SLOT	LEAD COLOR	CONN BLK TERMINALS
CIG0150		CIG120		CIG150		CIG180		W-BL	1
CID0150		CID120		CID150		CID180		BL-W	2
CIG0151		CIG121		CIG151		CIG181		W-O	3
CID0151		CID121		CID151		CID181		O-W	4
CIG0152		CIG122		CIG152		CIG182		W-G	5
CID0152		CID122		CID152		CID182		G-W	6
CIG0153		CIG123		CIG153		CIG183		W-BR	7
CID0153	0/15	CID123	1/2	CID153	1/5	CID183	1/8	BR-W	8
CIG0154		CIG124		CIG154		CIG184		W-S	9
CID0154		CID124		CID154		CID184		S-W	10
CIG0155		CIG125		CIG155		CIG185		R-BL	11
CID0155		CID125		CID155		CID185		BL-R	12
CIG0156		CIG126		CIG156		CIG186		R-O	13
CID0156		CID126		CID156		CID186		O-R	14
CIG0157		CIG127		CIG157		CIG187		R-G	15
CID0157		CID127		CID157		CID187		G-R	16
CIG0160		CIG130		CIG160		CIG190		R-BR	17
CID0160		CID130		CID160		CID190		BR-R	18
CIG0161		CIG131		CIG161		CIG191		R-S	19
CID0161		CID131		CID161		CID191		S-R	20
CIG0162		CIG132		CIG162		CIG192		BK-BL	21
CID0162		CID132		CID162		CID192		BL-BK	22
CIG0163		CIG133		CIG163		CIG193		BK-O	23
CID0163		CID133		CID163		CID193		O-BK	24
CIG0164	0/16	CIG134	1/3	CIG164	1/6	CIG194	1/9	BK-G	25
CID0164		CID134		CID164		CID194		G-BK	26
CIG0165		CIG135		CIG165		CIG195		BK-BR	27
CID0165		CID135		CID165		CID195		BR-BK	28
CIG0166		CIG136		CIG166		CIG196		BK-S	29
CID0166		CID136		CID166		CID196		S-BK	30
CIG0167		CIG137		CIG167		CIG197		Y-BL	31
CID0167		CID137		CID167		CID197		BL-Y	32
CIG110		CIG140		CIG170		CIG1100		Y-O	33
CID110		CID140		CID170		CID1100		O-Y	34
CIG111		CIG141		CIG171		CIG1101		Y-G	35
CID111		CID141		CID171		CID1101		G-Y	36
CIG112		CIG142		CIG172		CIG1102		Y-BR	37
CID112		CID142		CID172		CID1102		BR-Y	38
CIG113		CIG143		CIG173		CIG1103		Y-S	39
CID113		CID143		CID173		CID1103		S-Y	40
CIG114	1/1	CIG144	1/4	CIG174	1/7	CIG1104	1/10	V-BL	41
CID114		CID144		CID174		CID1104		BL-V	42
CIG115		CIG145		CIG175		CIG1105		V-O	43
CID115		CID145		CID175		CID1105		O-V	44
CIG116		CIG146		CIG176		CIG1106		V-G	45
CID116		CID146		CID176		CID1106		G-V	46
CIG117		CIG147		CIG177		CIG1107		V-BR	47
CID117		CID147		CID177		CID1107		BR-V	48
								V-S	49
								S-V	50

NOTE: LEAD DESIGNATIONS SHOWN ARE FOR LC562 EXCEPT MR AND M LEADS IN SLOTS 3 AND 4, SEGMENT 0.  
 THESE LEADS ARE FOR LC563 AND MAY BE SUBSTITUTED FOR CIG AND CID, RESPECTIVELY, WHEN  
 INSTALLED IN ANY OTHER SLOT SHOWN.

**TABLE K  
ENERGY CARRIER CROSS-CONNECTIONS**

A25D CONNECTOR CABLES FROM ENERGY CARRIER CONNECTORS								AT YELLOW BACKBOARD	
LEAD DESIGNATIONS FOR LC562, LC563, OR LC601 (NOTE)								CUT LEADS DOWN ON	
_ _EB01	SEG/SLOT	_ _EB02	SEG/SLOT	_ _EB03	SEG/SLOT	_ _EB04	SEG/SLOT	LEAD COLOR	CONN BLK TERMINALS
MR010		CIG040		CIG070		CIG0100		W-BL	1
MO10		CID040		CID070		CID0100		BL-W	2
MR011		CIG041		CIG071		CIG0101		W-O	3
MO11		CID041		CID071		CID0101		O-W	4
MR012		CIG042		CIG072		CIG0102		W-G	5
MO12		CID042		CID072		CID0102		G-W	6
MR013		CIG043		CIG073		CIG0103		W-BR	7
MO13	0/1	CID043	0/4	CID073	0/7	CID0103	0/10	BR-W	8
MR014		CIG044		CIG074		CIG0104		W-S	9
MO14		CID044		CID074		CID0104		S-W	10
MR015		CIG045		CIG075		CIG0105		R-BL	11
MO15		CID045		CID075		CID0105		BL-R	12
MR016		CIG046		CIG076		CIG0106		R-O	13
MO16		CID046		CID076		CID0106		O-R	14
MR017		CIG047		CIG077		CIG0107		R-G	15
MO17		CID047		CID077		CID0107		G-R	16
MR020		CIG050		CIG080		CIG0110		R-BR	17
MO20		CID050		CID080		CID0110		BR-R	18
MR021		CIG051		CIG081		CIG0111		R-S	19
MO21		CID051		CID081		CID0111		S-R	20
MR022		CIG052		CIG082		CIG0112		BK-BL	21
MO22		CID052		CID082		CID0112		BL-BK	22
MR023		CIG053		CIG083		CIG0113		BK-O	23
MO23		CID053		CID083		CID0113		O-BK	24
MR024	0/2	CIG054	0/5	CIG084	0/8	CIG0114	0/11	BK-G	25
MO24		CID054		CID084		CID0114		G-BK	26
MR025		CIG055		CIG085		CIG0115		BK-BR	27
MO25		CID055		CID085		CID0115		BR-BK	28
MR026		CIG056		CIG086		CIG0116		BK-S	29
MO26		CID056		CID086		CID0116		S-BK	30
MR027		CIG057		CIG087		CIG0117		Y-BL	31
MO27		CID057		CID087		CID0117		BL-Y	32
CIG030		CIG060		CIG090		CIG0120		Y-O	33
CID030		CID060		CID090		CID0120		O-Y	34
CIG031		CIG061		CIG091		CIG0121		Y-G	35
CID031		CID061		CID091		CID0121		G-Y	36
CIG032		CIG062		CIG092		CIG0122		Y-BR	37
CID032		CID062		CID092		CID0122		BR-Y	38
CIG033		CIG063		CIG093		CIG0123		Y-S	39
CID033		CID063		CID093		CID0123		S-Y	40
CIG034	0/3	CIG064	0/6	CIG094	0/9	CIG0124	0/12	V-BL	41
CID034		CID064		CID094		CID0124		BL-V	42
CIG035		CIG065		CIG095		CIG0125		V-O	43
CID035		CID065		CID095		CID0125		O-V	44
CIG036		CIG066		CIG096		CIG0126		V-G	45
CID036		CID066		CID096		CID0126		G-V	46
CIG037		CIG067		CIG097		CIG0127		V-BR	47
CID037		CID067		CID097		CID0127		BR-V	48
								V-S	49
								S-V	50

SEE NOTE AT END OF TABLE.

**TABLE K (Contd)**  
**ENERGY CARRIER CROSS-CONNECTIONS**

A25D CONNECTOR CABLES FROM ENERGY CARRIER CONNECTORS								AT YELLOW BACKBOARD	
LEAD DESIGNATIONS FOR LC562, LC563, OR LC601 (NOTE)								CUT LEADS DOWN ON	
_ _EB05	SEG/SLOT	_ _EB06	SEG/SLOT	_ _EB07	SEG/SLOT	_ _EB08	SEG/SLOT	LEAD COLOR	CONN BLK TERMINALS
CIG0130		CIG0160		CIG130		CIG160		W-BL	1
CID0130		CID0160		CID130		CID160		BL-W	2
CIG0131		CIG0161		CIG131		CIG161		W-O	3
CID0131		CID0161		CID131		CID161		O-W	4
CIG0132		CIG0162		CIG132		CIG162		W-G	5
CID0132		CID0162		CID132		CID162		G-W	6
CIG0133		CIG0163		CIG133		CIG163		W-BR	7
CID0133	0/13	CID0163	0/16	CID133	1/3	CID163	1/6	BR-W	8
CIG0134		CIG0164		CIG134		CIG164		W-S	9
CID0134		CID0164		CID134		CID164		S-W	10
CIG0135		CIG0165		CIG135		CIG165		R-BL	11
CID0135		CID0165		CID135		CID165		BL-R	12
CIG0136		CIG0166		CIG136		CIG166		R-O	13
CID0136		CID0166		CID136		CID166		O-R	14
CIG0137		CIG0167		CIG137		CIG167		R-G	15
CID0137		CID0167		CID137		CID167		G-R	16
CIG0140		CIG110		CIG140		CIG170		R-BR	17
CID0140		CID110		CID140		CID170		BR-R	18
CIG0141		CIG111		CIG141		CIG171		R-S	19
CID0141		CID111		CID141		CID171		S-R	20
CIG0142		CIG112		CIG142		CIG172		BK-BL	21
CID0142		CID112		CID142		CID172		BL-BK	22
CIG0143		CIG113		CIG143		CIG173		BK-O	23
CID0143		CID113		CID143		CID173		O-BK	24
CIG0144	0/14	CIG114	1/1	CIG144	1/4	CIG174	1/7	BK-G	25
CID0144		CID114		CID144		CID174		G-BK	26
CIG0145		CIG115		CIG145		CIG175		BK-BR	27
CID0145		CID115		CID145		CID175		BR-BK	28
CIG0146		CIG116		CIG146		CIG176		BK-S	29
CID0146		CID116		CID146		CID176		S-BK	30
CIG0147		CIG117		CIG147		CIG177		Y-BL	31
CID0147		CID117		CID147		CID177		BL-Y	32
CIG0150		CIG120		CIG150		CIG180		Y-O	33
CID0150		CID120		CID150		CID180		O-Y	34
CIG0151		CIG121		CIG151		CIG181		Y-G	35
CID0151		CID121		CID151		CID181		G-Y	36
CIG0152		CIG122		CIG152		CIG182		Y-BR	37
CID0152		CID122		CID152		CID182		BR-Y	38
CIG0153		CIG123		CIG153		CIG183		Y-S	39
CID0153		CID123		CID153		CID183		S-Y	40
CIG0154	0/15	CIG124	1/2	CIG154	1/5	CIG184	1/8	V-BL	41
CID0154		CID124		CID154		CID184		BL-V	42
CIG0155		CIG125		CIG155		CIG185		V-O	43
CID0155		CID125		CID155		CID185		O-V	44
CIG0156		CIG126		CIG156		CIG186		V-G	45
CID0156		CID126		CID156		CID186		G-V	46
CIG0157		CIG127		CIG157		CIG187		V-BR	47
CID0157		CID127		CID157		CID187		BR-V	48
								V-S	49
								S-V	50

SEE NOTE AT END OF TABLE.

**TABLE K (Contd)**  
**ENERGY CARRIER CROSS-CONNECTIONS**

A25D CONNECTOR CABLES FROM ENERGY CARRIER CONNECTORS								AT YELLOW BACKBOARD	
LEAD DESIGNATIONS FOR LC562, LC563, OR LC601 (NOTE)								CUT LEADS DOWN ON	
--_EB09	SEG/SLOT	--_EB10	SEG/SLOT	--_EB11	SEG/SLOT	--_EB12	SEG/SLOT	LEAD COLOR	CONN BLK TERMINALS
CIG190		CIG1120		CIG1150		CIG220		W-BL	1
CID190		CID1120		CID1150		CID220		BL-W	2
CIG191		CIG1121		CIG1151		CIG221		W-O	3
CID191		CID1121		CID1151		CID221		O-W	4
CIG192		CIG1122		CIG1152		CIG222		W-G	5
CID192		CID1122		CID1152		CID222		G-W	6
CIG193	1/9	CIG1123	1/12	CIG1153	1/15	CIG223	2/2	W-BR	7
CID193		CID1123		CID1153		CID223		BR-W	8
CIG194		CIG1124		CIG1154		CIG224		W-S	9
CID194		CID1124		CID1154		CID224		S-W	10
CIG195		CIG1125		CIG1155		CIG225		R-BL	11
CID195		CID1125		CID1155		CID225		BL-R	12
CIG196		CIG1126		CIG1156		CIG226		R-O	13
CID196		CID1126		CID1156		CID226		O-R	14
CIG197		CIG1127		CIG1157		CIG227		R-G	15
CID197		CID1127		CID1157		CID227		G-R	16
CIG1100		CIG1130		CIG1160		CIG230		R-BR	17
CID1100		CID1130		CID1160		CID230		BR-R	18
CIG1101		CIG1131		CIG1161		CIG231		R-S	19
CID1101		CID1131		CID1161		CID231		S-R	20
CIG1102		CIG1132		CIG1162		CIG232		BK-BL	21
CID1102		CID1132		CID1162		CID232		BL-BK	22
CIG1103		CIG1133		CIG1163		CIG233		BK-O	23
CID1103		CID1133		CID1163		CID233		O-BK	24
CIG1104	1/10	CIG1134	1/13	CIG1164	1/16	CIG234	2/3	BK-G	25
CID1104		CID1134		CID1164		CID234		G-BK	26
CIG1105		CIG1135		CIG1165		CIG235		BK-BR	27
CID1105		CID1135		CID1165		CID235		BR-BK	28
CIG1106		CIG1136		CIG1166		CIG236		BK-S	29
CID1106		CID1136		CID1166		CID236		S-BK	30
CIG1107		CIG1137		CIG1167		CIG237		Y-BL	31
CID1107		CID1137		CID1167		CID237		BL-Y	32
CIG1110		CIG1140		CIG210		CIG240		Y-O	33
CID1110		CID1140		CID210		CID240		O-Y	34
CIG1111		CIG1141		CIG211		CIG241		Y-G	35
CID1111		CID1141		CID211		CID241		G-Y	36
CIG1112		CIG1142		CIG212		CIG242		Y-BR	37
CID1112		CID1142		CID212		CID242		BR-Y	38
CIG1113		CIG1143		CIG213		CIG243		Y-S	39
CID1113		CID1143		CID213		CID243		S-Y	40
CIG1114	1/11	CIG1144	1/14	CIG214	2/1	CIG244	2/4	V-BL	41
CID1114		CID1144		CID214		CID244		BL-V	42
CIG1115		CIG1145		CIG215		CIG245		V-O	43
CID1115		CID1145		CID215		CID245		O-V	44
CIG1116		CIG1146		CIG216		CIG246		V-G	45
CID1116		CID1146		CID216		CID246		G-V	46
CIG1117		CIG1147		CIG217		CIG247		V-BR	47
CID1117		CID1147		CID217		CID247		BR-V	48
								V-S	49
								S-V	50

SEE NOTE AT END OF TABLE.

**TABLE K (Contd)**  
**ENERGY CARRIER CROSS-CONNECTIONS**

A25D CONNECTOR CABLES FROM ENERGY CARRIER CONNECTORS								AT YELLOW BACKBOARD	
LEAD DESIGNATIONS FOR LC562, LC563, OR LC601 (NOTE)								CUT LEADS DOWN ON	
_ _EB13	SEG/SLOT	_ _EB14	SEG/SLOT	_ _EB15	SEG/SLOT	_ _EB16	SEG/SLOT	LEAD COLOR	CONN BLK TERMINALS
CIG250		CIG280		CIG2110		CIG2140		W-BL	1
CID250		CID280		CID2110		CID2140		BL-W	2
CIG251		CIG281		CIG2111		CIG2141		W-O	3
CID251		CID281		CID2111		CID2141		O-W	4
CIG252		CIG282		CIG2112		CIG2142		W-G	5
CID252		CID282		CID2112		CID2142		G-W	6
CIG253		CIG283		CIG2113		CIG2143		W-BR	7
CID253	2/5	CID283	2/8	CID2113	2/11	CID2143	2/14	BR-W	8
CIG254		CIG284		CIG2114		CIG2144		W-S	9
CID254		CID284		CID2114		CID2144		S-W	10
CIG255		CIG285		CIG2115		CIG2145		R-BL	11
CID255		CID285		CID2115		CID2145		BL-R	12
CIG256		CIG286		CIG2116		CIG2146		R-O	13
CID256		CID286		CID2116		CID2146		O-R	14
CIG257		CIG287		CIG2117		CIG2147		R-G	15
CID257		CID287		CID2117		CID2147		G-R	16
CIG260		CIG290		CIG2120		CIG2150		R-BR	17
CID260		CID290		CID2120		CID2150		BR-R	18
CIG261		CIG291		CIG2121		CIG2151		R-S	19
CID261		CID291		CID2121		CID2151		S-R	20
CIG262		CIG292		CIG2122		CIG2152		BK-BL	21
CID262		CID292		CID2122		CID2152		BL-BK	22
CIG263		CIG293		CIG2123		CIG2153		BK-O	23
CID263		CID293		CID2123		CID2153		O-BK	24
CIG264	2/6	CIG294	2/9	CIG2124	2/12	CIG2154	2/15	BK-G	25
CID264		CID294		CID2124		CID2154		G-BK	26
CIG265		CIG295		CIG2125		CIG2155		BK-BR	27
CID265		CID295		CID2125		CID2155		BR-BK	28
CIG266		CIG296		CIG2126		CIG2156		BK-S	29
CID266		CID296		CID2126		CID2156		S-BK	30
CIG267		CIG297		CIG2127		CIG2157		Y-BL	31
CID267		CID297		CID2127		CID2157		BL-Y	32
CIG270		CIG2100		CIG2130		CIG2160		Y-O	33
CID270		CID2100		CID2130		CID2160		O-Y	34
CIG271		CIG2101		CIG2131		CIG2161		Y-G	35
CID271		CID2101		CID2131		CID2161		G-Y	36
CIG272		CIG2102		CIG2132		CIG2162		Y-BR	37
CID272		CID2102		CID2132		CID2162		BR-Y	38
CIG273		CIG2103		CIG2133		CIG2163		Y-S	39
CID273		CID2103		CID2133		CID2163		S-Y	40
CIG274	2/7	CIG2104	2/10	CIG2134	2/13	CIG2164	2/16	V-BL	41
CID274		CID2104		CID2134		CID2164		BL-V	42
CIG275		CIG2105		CIG2135		CIG2165		V-O	43
CID275		CID2105		CID2135		CID2165		O-V	44
CIG276		CIG2106		CIG2136		CIG2166		V-G	45
CID276		CID2106		CID2136		CID2166		G-V	46
CIG277		CIG2107		CIG2137		CIG2167		V-BR	47
CID277		CID2107		CID2137		CID2167		BR-V	48
								V-S	49
								S-V	50

SEE NOTE AT END OF TABLE.

TABLE K (Contd)  
ENERGY CARRIER CROSS-CONNECTIONS

A25D CONNECTOR CABLES FROM ENERGY CARRIER CONNECTORS								AT YELLOW BACKBOARD	
LEAD DESIGNATIONS FOR LC562, LC563, OR LC601 (NOTE)								CUT LEADS DOWN ON	
_ _EB17	SEG/SLOT	_ _EB18	SEG/SLOT	_ _EB19	SEG/SLOT	_ _EB20	SEG/SLOT	LEAD COLOR	CONN BLK TERMINALS
CIG310		CIG340		CIG370		CIG3100		W-BL	1
CID310		CID340		CID370		CID3100		BL-W	2
CIG311		CIG341		CIG371		CIG3101		W-O	3
CID311		CID341		CID371		CID3101		O-W	4
CIG312		CIG342		CIG372		CIG3102		W-G	5
CID312		CID342		CID372		CID3102		G-W	6
CIG313		CIG343		CIG373		CIG3103		W-BR	7
CID313	3/1	CID343	3/4	CID373	3/7	CID3103	3/10	BR-W	8
CIG314		CIG344		CIG374		CIG3104		W-S	9
CID314		CID344		CID374		CID3104		S-W	10
CIG315		CIG345		CIG375		CIG3105		R-BL	11
CID315		CID345		CID375		CID3105		BL-R	12
CIG316		CIG346		CIG376		CIG3106		R-O	13
CID316		CID346		CID376		CID3106		O-R	14
CIG317		CIG347		CIG377		CIG3107		R-G	15
CID317		CID347		CID377		CID3107		G-R	16
CIG320		CIG350		CIG380		CIG3110		R-BR	17
CID320		CID350		CID380		CID3110		BR-R	18
CIG321		CIG351		CIG381		CIG3111		R-S	19
CID321		CID351		CID381		CID3111		S-R	20
CIG322		CIG352		CIG382		CIG3112		BK-BL	21
CID322		CID352		CID382		CID3112		BL-BK	22
CIG323		CIG353		CIG383		CIG3113		BK-O	23
CID323		CID353		CID383		CID3113		O-BK	24
CIG324	3/2	CIG354	3/5	CIG384	3/8	CIG3114	3/11	BK-G	25
CID324		CID354		CID384		CID3114		G-BK	26
CIG325		CIG355		CIG385		CIG3115		BK-BR	27
CID325		CID355		CID385		CID3115		BR-BK	28
CIG326		CIG356		CIG386		CIG3116		BK-S	29
CID326		CID356		CID386		CID3116		S-BK	30
CIG327		CIG357		CIG387		CIG3117		Y-BL	31
CID327		CID357		CID387		CID3117		BL-Y	32
CIG330		CIG360		CIG390		CIG3120		Y-O	33
CID330		CID360		CID390		CID3120		O-Y	34
CIG331		CIG361		CIG391		CIG3121		Y-G	35
CID331		CID361		CID391		CID3121		G-Y	36
CIG332		CIG362		CIG392		CIG3122		Y-BR	37
CID332		CID362		CID392		CID3122		BR-Y	38
CIG333		CIG363		CIG393		CIG3123		Y-S	39
CID333		CID363		CID393		CID3123		S-Y	40
CIG334	3/3	CIG364	3/6	CIG394	3/9	CIG3124	3/12	V-BL	41
CID334		CID364		CID394		CID3124		BL-V	42
CIG335		CIG365		CIG395		CIG3125		V-O	43
CID335		CID365		CID395		CID3125		O-V	44
CIG336		CIG366		CIG396		CIG3126		V-G	45
CID336		CID366		CID396		CID3126		G-V	46
CIG337		CIG367		CIG397		CIG3127		V-BR	47
CID337		CID367		CID397		CID3127		BR-V	48
								V-S	49
								S-V	50

SEE NOTE AT END OF TABLE.

**TABLE K (Contd)**  
**ENERGY CARRIER CROSS-CONNECTIONS**

A25D CONNECTOR CABLES FROM ENERGY CARRIER CONNECTORS								AT YELLOW BACKBOARD	
LEAD DESIGNATIONS FOR LC562, LC563, OR LC601 (NOTE)								CUT LEADS DOWN ON	
_ _EB21	SEG/SLOT	_ _EB22	SEG/SLOT	_ _EB23	SEG/SLOT	_ _EB24	SEG/SLOT	LEAD COLOR	CONN BLK TERMINALS
CIG3130		CIG3160		CIG430		CIG460		W-BL	1
CID3130		CID3160		CID430		CID460		BL-W	2
CIG3131		CIG3161		CIG431		CIG461		W-O	3
CID3131		CID3161		CID431		CID461		O-W	4
CIG3132		CIG3162		CIG432		CIG462		W-G	5
CID3132		CID3162		CID432		CID462		G-W	6
CIG3133		CIG3163		CIG433		CIG463		W-BR	7
CID3133	3/13	CID3163	3/16	CID433	4/3	CID463	4/6	BR-W	8
CIG3134		CIG3164		CIG434		CIG464		W-S	9
CID3134		CID3164		CID434		CID464		S-W	10
CIG3135		CIG3165		CIG435		CIG465		R-BL	11
CID3135		CID3165		CID435		CID465		BL-R	12
CIG3136		CIG3166		CIG436		CIG466		R-O	13
CID3136		CID3166		CID436		CID466		O-R	14
CIG3137		CIG3167		CIG437		CIG467		R-G	15
CID3137		CID3167		CID437		CID467		G-R	16
CIG3140		CIG410		CIG440		CIG470		R-BR	17
CID3140		CID410		CID440		CID470		BR-R	18
CIG3141		CIG411		CIG441		CIG471		R-S	19
CID3141		CID411		CID441		CID471		S-R	20
CIG3142		CIG412		CIG442		CIG472		BK-BL	21
CID3142		CID412		CID442		CID472		BL-BK	22
CIG3143		CIG413		CIG443		CIG473		BK-O	23
CID3143		CID413		CID443		CID473		O-BK	24
CIG3144		CIG414		CIG444		CIG474		BK-G	25
CID3144	3/14	CID414	4/1	CID444	4/4	CID474	4/7	G-BK	26
CIG3145		CIG415		CIG445		CIG475		BK-BR	27
CID3145		CID415		CID445		CID475		BR-BK	28
CIG3146		CIG416		CIG446		CIG476		BK-S	29
CID3146		CID416		CID446		CID476		S-BK	30
CIG3147		CIG417		CIG447		CIG477		Y-BL	31
CID3147		CID417		CID447		CID477		BL-Y	32
CIG3150		CIG420		CIG450		CIG480		Y-O	33
CID3150		CID420		CID450		CID480		O-Y	34
CIG3151		CIG421		CIG451		CIG481		Y-G	35
CID3151		CID421		CID451		CID481		G-Y	36
CIG3152		CIG422		CIG452		CIG482		Y-BR	37
CID3152		CID422		CID452		CID482		BR-Y	38
CIG3153		CIG423		CIG453		CIG483		Y-S	39
CID3153		CID423		CID453		CID483		S-Y	40
CIG3154		CIG424		CIG454		CIG484		V-BL	41
CID3154	3/15	CID424	4/2	CID454	4/5	CID484	4/8	BL-V	42
CIG3155		CIG425		CIG455		CIG485		V-O	43
CID3155		CID425		CID455		CID485		O-V	44
CIG3156		CIG426		CIG456		CIG486		V-G	45
CID3156		CID426		CID456		CID486		G-V	46
CIG3157		CIG427		CIG457		CIG487		V-BR	47
CID3157		CID427		CID457		CID487		BR-V	48
								V-S	49
								S-V	50

SEE NOTE AT END OF TABLE.

TABLE K (Contd)  
ENERGY CARRIER CROSS-CONNECTIONS

A25D CONNECTOR CABLES FROM ENERGY CARRIER CONNECTORS							AT YELLOW BACKBOARD	
LEAD DESIGNATIONS FOR LC562, LC563, OR LC6D1 (NOTE)							CUT LEADS DOWN ON	
_ _EB25	SEG/SLOT	_ _EB26	SEG/SLOT				LEAD COLOR	CONN BLK TERMINALS
CIG490		CIG4120					W-BL	1
CID490		CID4120					BL-W	2
CIG491		CIG4121					W-O	3
CID491		CID4121					O-W	4
CIG492		CIG4122					W-G	5
CID492		CID4122					G-W	6
CIG493		CIG4123					W-BR	7
CID493	4/9	CID4123	4/12				BR-W	8
CIG494		CIG4124					W-S	9
CID494		CID4124					S-W	10
CIG495		CIG4125					R-BL	11
CID495		CID4125					BL-R	12
CIG496		CIG4126					R-O	13
CID496		CID4126					O-R	14
CIG497		CIG4127					R-G	15
CID497		CID4127					G-R	16
CIG4100							R-BR	17
CID4100							BR-R	18
CIG4101							R-S	19
CID4101							S-R	20
CIG4102							BK-BL	21
CID4102							BL-BK	22
CIG4103							BK-O	23
CID4103							O-BK	24
CIG4104	4/10						BK-G	25
CID4104							G-BK	26
CIG4105							BK-BR	27
CID4105							BR-BK	28
CIG4106							BK-S	29
CID4106							S-BK	30
CIG4107							Y-BL	31
CID4107							BL-Y	32
CIG4110							Y-O	33
CID4110							O-Y	34
CIG4111							Y-G	35
CID4111							G-Y	36
CIG4112							Y-BR	37
CID4112							BR-Y	38
CIG4113							Y-S	39
CID4113							S-Y	40
CIG4114	4/11						V-BL	41
CID4114							BL-V	42
CIG4115							V-O	43
CID4115							O-V	44
CIG4116							V-G	45
CID4116							G-V	46
CIG4117							V-BR	47
CID4117							BR-V	48
							V-S	49
							S-V	50

NOTE: LEAD DESIGNATIONS SHOWN ARE FOR LC562 EXCEPT FOR MR AND M LEADS IN SLOTS 1 AND 2, SEGMENT 0. THESE LEADS ARE FOR LC563 AND MAY BE SUBSTITUTED FOR CIG AND CID, RESPECTIVELY, WHEN INSTALLED IN ANY OTHER SLOT SHOWN.

**TABLE L  
A FILLED-IN EXAMPLE OF A CONTROL/ENERGY  
CARRIER CROSS-CONNECT WORKSHEET**

CONTROL/ENERGY CARRIER 0 CONNECTOR 00BB02					CONN CABLE COLOR CODE	CROSS-CONNECT	
SEGMENT NO.	SLOT NO.	CIRCUIT NO.	POWER METER, SENSE POINT, OR ENERGY LOAD NO.	LEAD DESIG		FROM	TO
						00BB02 CONN BLK (YELLOW)	CONN BLK (BLUE)
0	3	0	1	MR	W-BL	1	BLK 2-1
				M	BL-W	2	2
		1	2	MR	W-O	3	3
				M	O-W	4	4
		2	3	MR	W-G	5	5
				M	G-W	6	6
		3	4	MR	W-BR	7	7
				M	BR-W	8	8
		4	5	MR	W-S	9	9
				M	S-W	10	10
		5	6	MR	R-BL	11	11
				M	BL-R	12	12
		6	7	MR	R-O	13	13
				M	O-R	14	14
		7	8	MR	R-G	15	15
				M	G-R	16	16
	4	0	9	MR	R-BR	17	17
				M	BR-R	18	18
		1	10	MR	R-S	19	19
				M	S-R	20	20
		2	11	MR	BK-BL	21	21
				M	BL-BK	22	22
		3	12	MR	BK-O	23	23
				M	O-BK	24	24
		4	13	MR	BK-G	25	25
				M	G-BK	26	26
		5	14	MR	BK-BR	27	27
				M	BR-BK	28	28
		6	15	MR	BK-S	29	29
				M	S-BK	30	30
		7	16	MR	Y-BL	31	31
				M	BL-Y	32	32

**TABLE M**  
**A FILLED-IN EXAMPLE OF A ENERGY**  
**CARRIER CROSS-CONNECT WORKSHEET**

ENERGY CARRIER 1 CONNECTOR 01EB01					CONN CABLE COLOR CODE	CROSS-CONNECT	
SEGMENT NO.	SLOT NO.	CIRCUIT NO.	POWER METER, SENSE POINT, OR ENERGY LOAD NO.	LEAD DESIG		FROM	TO
						01EB01 CONN BLK (YELLOW)	CONN BLK (BLUE)
0	1	0	0177	CIG	W-BL	1	BLK 8-17
				CID	BL-W	2	18
		1	0178	CIG	W-O	3	19
				CID	O-W	4	20
		2	0179	CIG	W-G	5	21
				CID	G-W	6	22
		3	0180	CIG	W-BR	7	23
				CID	BR-W	8	24
		4	0181	CIG	W-S	9	25
				CID	S-W	10	26
		5	0182	CIG	R-BL	11	27
				CID	BL-R	12	28
		6	0183	CIG	R-O	13	29
				CID	O-R	14	30
	7	0184	CIG	R-G	15	31	
			CID	G-R	16	32	
	2	0	0185	CIG	R-BR	17	33
				CID	BR-R	18	34
		1	0186	CIG	R-S	19	35
				CID	S-R	20	36
		2	0187	CIG	BK-BL	21	37
				CID	BL-BK	22	38
		3	0188	CIG	BK-O	23	39
				CID	O-BK	24	40
		4	0189	CIG	BK-G	25	41
				CID	G-BK	26	42
		5	0190	CIG	BK-BR	27	43
				CID	BR-BK	28	44
		6	0191	CIG	BK-S	29	45
				CID	S-BK	30	46
	7	0192	CIG	Y-BL	31	47	
			CID	BL-Y	32	48	

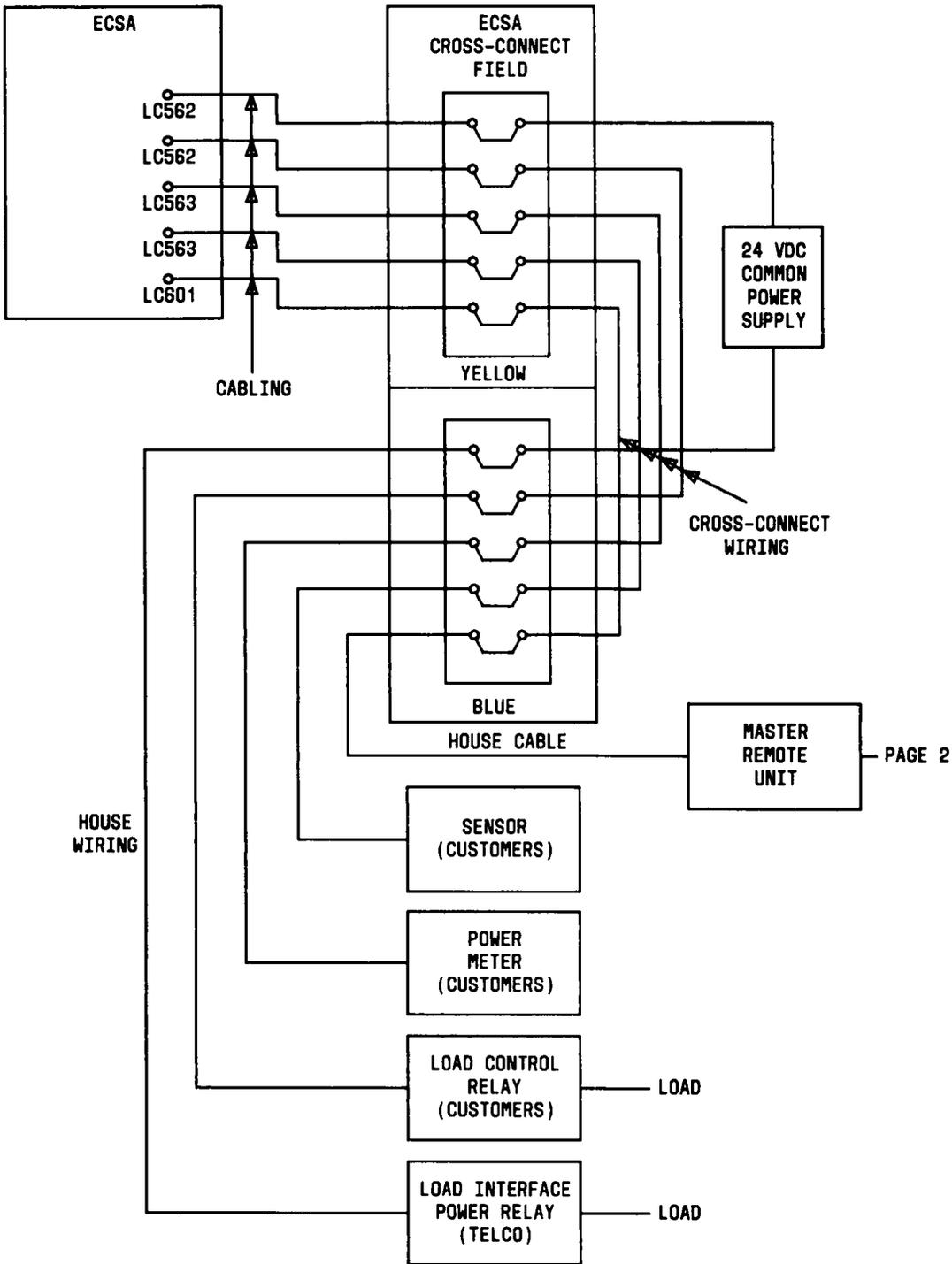


Fig. 32—Load Sensor, and Power Meter Control to Carriers or Master Remote Unit Through Cross-Connect Field (Sheet 1 of 2)

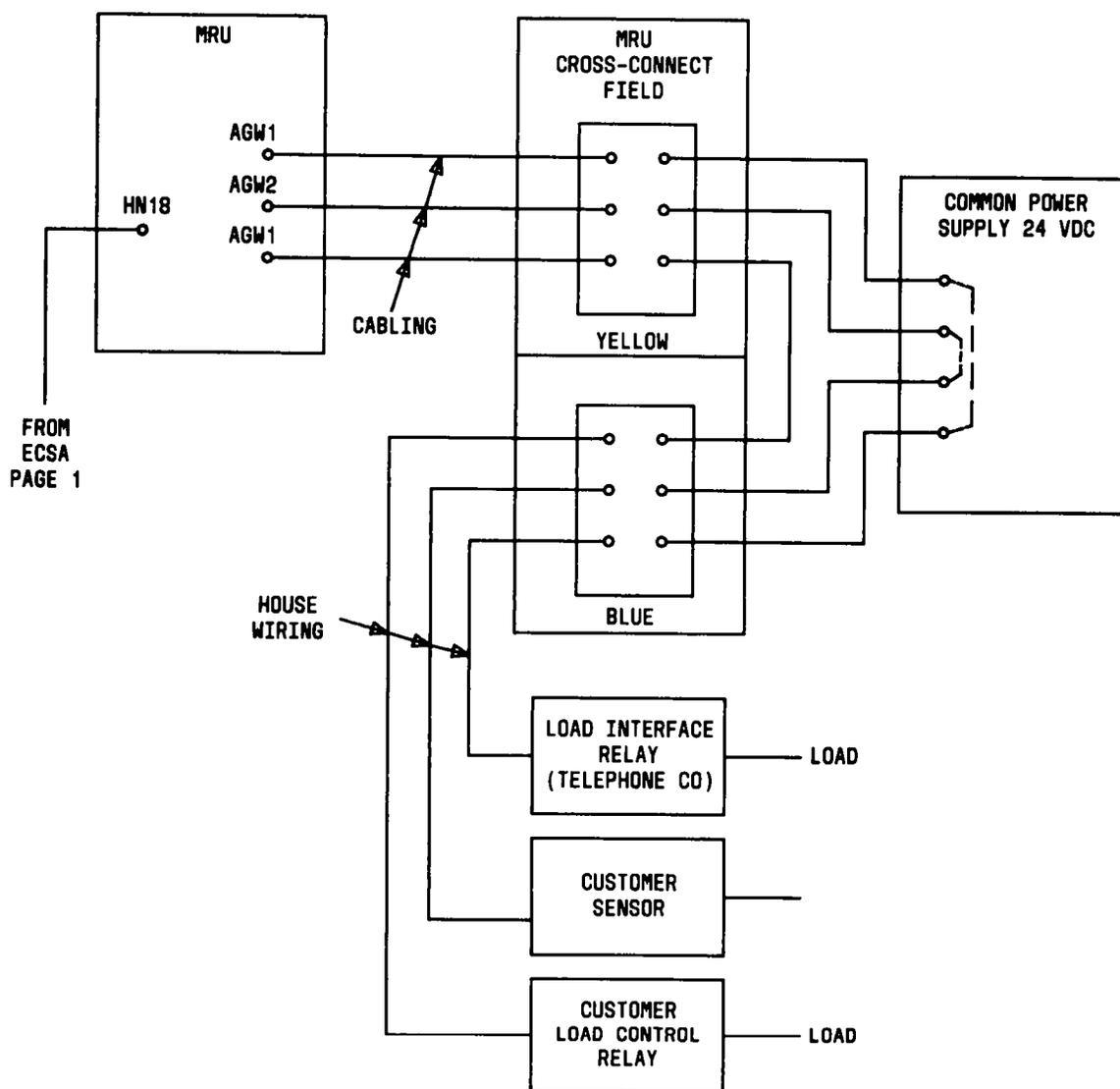


Fig. 32—Load, Sensor, and Power Meter Control to Carriers or Master Remote Unit Through Cross-Connect Field (Sheet 2 of 2)

nel (02) is available (control carrier, segment 0, slot 18) when an LB171B circuit pack is installed in slot 18. The data channel is wired to both the BX01 terminals and the BX07 connector. **Do not** connect to both channel connections at the same time.

#### F. Master Remote Unit Cross-Connections

5.133 Energy load, and sense point (binary feedback) interface cross-connections from the MRU are shown in Fig. 32. Connectors BG01, BG02, and BG03 are required to bring the load and sense

point lead from the MRU to the cross-connect field. Each MRU can contain eight AGW-1, or AGW-2, or any configuration of AGW-1 or AGW-2 circuit packs.

5.134 The lead designations for the energy load and sense point interfaces shown in Table O contain three or four numerals. The first and last digits represent the segment and circuit numbers respectively. The one or two center digits represent the slot number. These numbers represent the segment, slot number, and circuit at the control/energy or en-

TABLE N

## CONTROL I/O DATA CHANNEL CROSS-CONNECTIONS

A25D CONNECTOR CABLE FROM CONTROL/ENERGY CARRIER CONNECTOR			AT YELLOW BACKBOARD		
LEAD DESIGNATIONS FOR LC366B			CUT LEADS DOWN ON		
BX01A	DATA CHANNEL	SLOT	LEAD COLOR	CONN BLK TERMINALS	
IOXB00 IOXA00 IORB00 IORA00	04	20/21B	W-BL	1	
			BL-W	2	
			W-O	3	
			O-W	4	
	IOXB00 IOXA00 IORB00 IORA00			W-G	5
				G-W	6
				W-BR	7
				BR-W	8
				W-S	9
				S-W	10
				R-BL	11
				BL-R	12
IOXB00 IOXA00 IORB00 IORA00	05	20/21B	R-O	13	
			O-R	14	
			R-G	15	
			G-R	16	
IOXB00 IOXA00 IORB00 IORA00 IOXB00 IOXA00 IORB00 IORA00	08	22/23B	R-BR	17	
			BR-R	18	
			R-S	19	
			S-R	20	
	09		BK-BL	21	
			BL-BK	22	
			BK-O	23	
			O-BK	24	
IOXB00* IOXA00* IORB00* IORA00*	02	18B	BK-G	25	
			G-BK	26	
			BK-BR	27	
			BR-BK	28	
IOXB00 IOXA00 IORB00 IORA00 IOXB00 IOXA00 IORB00 IORA00	10	22/23B	BK-S	29	
			S-BK	30	
			Y-BL	31	
			BL-Y	32	
	06		Y-O	33	
			O-Y	34	
			Y-G	35	
			G-Y	36	
11	Y-BR	37			
	BR-Y	38			
	Y-S	39			
	S-Y	40			
IOXB00 IOXA00 IORB00 IORA00 IOXB00 IOXA00 IORB00 IORA00	06	20/21B	V-BL	41	
			BL-V	42	
			V-O	43	
			O-V	44	
	07		V-G	45	
			G-V	46	
			V-BR	47	
			BR-V	48	
		V-S	49		
		S-V	50		

\*THESE LEADS ARE ALSO CONNECTED TO BX07A. ONLY ONE SET OF LEADS SHOULD BE USED AT ONE TIME.

ergy carrier at the ECSA extended to the MRU. Examples are:

- (1) CID043 = Energy load interface associated with 0 segment, 4th slot, and the 3rd circuit
- (2) CID1127 = Sense point interface associated with 1st segment, 12th slot, and the 7th circuit.

**5.135** Table P is a filled-in example of the cross-connect worksheet for the sense point interfaces and energy loads. Worksheets should provide the following information for each load or sense point interface equipped:

- Equipment location (carrier, segment, slot, etc)
- Circuit number
- Sense point interface or energy load number
- Lead designations
- Connector designations
- Color code of the connector cable
- Connector block designation and terminal number in the yellow field
- Terminal number to which the cross-connection is made in the blue field.

#### **G. Common Power Supply Cross-Connections**

**5.136** The common power supply provides  $-24$  Vdc to the load relay interfaces, extended from the LC562 circuit pack or from the remote AGW1 circuit pack. It provides  $-24$  Vdc to the remote customer sense-points also. The connections will be made to the applicable load or sense point leads at the respective cross-connect fields. The battery lead will be connected toward the interface relay, or sense point and the ground lead shall be connect toward the contact on the circuit pack. The connections will be made at the applicable cross-connect fields. Typical connections are shown in Fig. 33.

#### **H. Alarm and Control Lead Cross-Connections**

**5.137** Alarm and control leads are extended to the cross-connect field via the AP7 cable connec-

tor. The control and alarm panel cross-connections are shown in Table Q. The alarm leads (AMJ\* and AMN\*) can be extended to remote alarm circuitry.

### **6. EQUIPMENT ASSOCIATED WITH FEATURES**

**6.01** Additional hardware and/or equipment is required to implement certain features or optional features available with the ECSA system. The optional features are described as follows:

- Data channel repeater
- Peripheral interface circuit (J58882 GA)
- Remote Maintenance, Administration, and Traffic System (RMATS).

#### **DATA CHANNEL REPEATER**

**6.02** The data channel repeater is a self-contained unit that provides range extension and/or lightning protection for the low-speed data channels. It is connected in series with the data channel to repeat data pulses and to provide isolation between input and output pairs.

**6.03** The repeater detects and reconstructs incoming modified biphas (bipolar) data pulses to eliminate any pulse attenuation or distortion as well as to increase data channel range.

**6.04** The repeater circuit is designed to operate in unexposed environments without additional protection and in exposed environments with standard 3-mil carbon block protection.

**6.05** Typical applications for the data channel repeater are the ECSA CRT console and system printers via the peripheral interface circuit unit.

#### **A. Housing and Mounting**

**6.06** The repeater circuitry is housed in a modified key service unit (Fig. 34) with a capacity for two data channel repeater circuits.

**6.07** The unit is designed to be wall-mounted near a 120V 60-Hz outlet. Power cords are available in 610-, 1220-, 1830-, or 3660-mm (2-, 4-, 6-, and 12-foot) lengths (J58879KC, Lists A, B, C, and D, respectively).

**TABLE O**  
**MASTER REMOTE UNIT CROSS-CONNECTIONS**

A25D CONNECTOR CABLES FROM MASTER REMOTE UNIT CONNECTORS						AT YELLOW BACKBOARD	
LEAD DESIGNATIONS FOR AGW1 OR AGW2 CIRCUIT PACKS						CUT LEADS DOWN ON	
--_BG01	SEG/SLOT	--_BG02	SEG/SLOT	--_BG03	SEG/SLOT	LEAD COLOR	CONN BLK TERMINALS
CIG		CIG		CIG		W-BL	1
CID		CID		CID		BL-W	2
CIG		CIG		CIG		W-O	3
CID		CID		CID		O-W	4
CIG		CIG		CIG		W-G	5
CID		CID		CID		G-W	6
CIG		CIG		CIG		W-BR	7
CID		CID		CID		BR-W	8
CIG		CIG		CIG		W-S	9
CID		CID		CID		S-W	10
CIG		CIG		CIG		R-BL	11
CID		CID		CID		BL-R	12
CIG		CIG		CIG		R-O	13
CID		CID		CID		O-R	14
CIG		CIG		CIG		R-G	15
CID		CID		CID		G-R	16
CIG		CIG		CIG		R-BR	17
CID		CID		CID		BR-R	18
CIG		CIG		CIG		R-S	19
CID		CID		CID		S-R	20
CIG		CIG		CIG		BK-BL	21
CID		CID		CID		BL-BK	22
CIG		CIG		CIG		BK-O	23
CID		CID		CID		O-BK	24
CIG		CIG		CIG		BK-G	25
CID		CID		CID		G-BK	26
CIG		CIG		CIG		BK-BR	27
CID		CID		CID		BR-BK	28
CIG		CIG		CIG		BK-S	29
CID		CID		CID		S-BK	30
CIG		CIG		CIG		Y-BL	31
CID		CID		CID		BL-Y	32
CIG		CIG		CIG		Y-O	33
CID		CID		CID		O-Y	34
CIG		CIG		CIG		Y-G	35
CID		CID		CID		G-Y	36
CIG		CIG		CIG		Y-BR	37
CID		CID		CID		BR-Y	38
CIG		CIG		CIG		Y-S	39
CID		CID		CID		S-Y	40
CIG		CIG		CIG		V-BL	41
CID		CID		CID		BL-V	42
CIG		CIG		CIG		V-O	43
CID		CID		CID		O-V	44
CIG		CIG		CIG		V-G	45
CID		CID		CID		G-V	46
CIG		CIG		CIG		V-BR	47
CID		CID		CID		BR-V	48
						V-S	49
						S-V	50

TABLE P

## A FILLED-IN EXAMPLE OF THE MASTER REMOTE UNIT CROSS-CONNECT WORK-SHEET

ENERGY CARRIER 1 CONNECTOR 01EB01					CONN CABLE COLOR CODE	CROSS-CONNECT	
SEGMENT NO.	SLOT NO.	CIRCUIT NO.	SENSE POINT, INTERFACE OR ENERGY LOAD NO.	LEAD DESIG		FROM	TO
						CONN BLK (YELLOW)	CONN BLK (BLUE)
0	1	0	0177	CIG	W-BL	1	BLK 8-17
				CID	BL-W	2	18
		1	0178	CIG	W-O	3	19
				CID	O-W	4	20
		2	0179	CIG	W-G	5	21
				CID	G-W	6	22
		3	0180	CIG	W-BR	7	23
				CID	BR-W	8	24
		4	0181	CIG	W-S	9	25
				CID	S-W	10	26
		5	0182	CIG	R-BL	11	27
				CID	BL-R	12	28
		6	0183	CIG	R-O	13	29
				CID	O-R	14	30
	7	0184	CIG	R-G	15	31	
			CID	G-R	16	32	
	2	0	0185	CIG	R-BR	17	33
				CID	BR-R	18	34
		1	0186	CIG	R-S	19	35
				CID	S-R	20	36
		2	0187	CIG	BK-BL	21	37
				CID	BL-BK	22	38
		3	0188	CIG	BK-O	23	39
				CID	O-BK	24	40
		4	0189	CIG	BK-G	25	41
				CID	G-BK	26	42
		5	0190	CIG	BK-BR	27	43
				CID	BR-BK	28	44
6		0191	CIG	BK-S	29	45	
			CID	S-BK	30	46	
7	0192	CIG	Y-BL	31	47		
		CID	BL-Y	32	48		

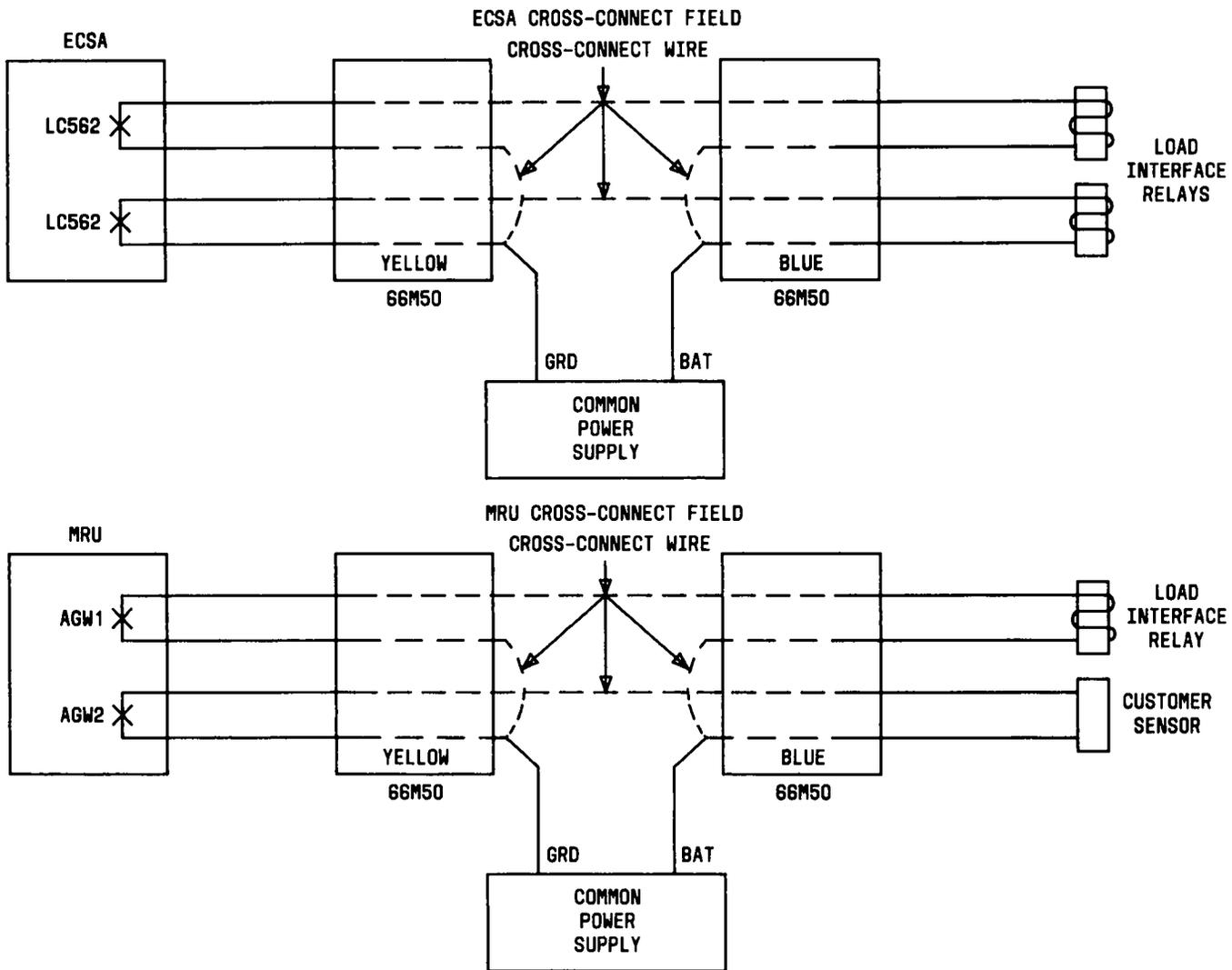


Fig. 33—Typical Power Connections From Common Power Supply

## B. Range Extension and Lightning Protection

**6.08 A single-channel repeater with range extension** (Fig. 35) consists of the following equipment:

- One J58879KC, List 1, assembly, wiring, and equipment, including a 28D2 power supply unit
- One J58879KC, List 2, rectifier and timing reference circuit card (AE-49)
- Two J58879KC, List 3, unidirectional re-

peater circuit cards (AE-48) for each repeater.

A maximum of four repeaters can be cascaded (Fig. 36) for the purpose of extending the distance between the ECSA and peripheral to 3353m (11,000 feet).

**6.09 A dual channel repeater with range extension** (Fig. 37) consists of the following equipment:

- One J58879KC, List 1, assembly, wiring, and equipment, including a 28D2 power supply unit

**TABLE Q**  
**CONTROL AND ALARM PANEL CROSS-CONNECTIONS**

A25D CONNECTOR CABLE FROM CONTROL AND ALARM PANEL CONNECTOR	AT YELLOW BACKBOARD	
AP7	CUT LEADS DOWN ON	
LEAD DESIGNATIONS	LEAD COLOR	CONN BLK TERMINALS
MJR	W-BL	1
MJ	BL-W	2
MNR	W-O	3
MN	O-W	4
	W-G	5
AMJ*	G-W	6
	W-BR	7
AMN*	BR-W	8
	W-S	9
	S-W	10
	R-BL	11
	BL-R	12
	R-O	13
	O-R	14
	R-G	15
	G-R	16
	R-BR	17
ARSVPR*	BR-R	18
	R-S	19
	S-R	20
	BK-BL	21
	BL-BK	22
	BK-O	23
	O-BK	24
	BK-G	25
	G-BK	26
	BK-BR	27
	BR-BK	28
	BK-S	29
	S-BK	30
	Y-BL	31
	BL-Y	32
	Y-O	33
	O-Y	34
	Y-G	35
	G-Y	36
	Y-BR	37
	BR-Y	38
	Y-S	39
	S-Y	40
	V-BL	41
	BL-V	42
GRDD	V-O	43
-48PX	O-V	44
GRDD	V-G	45
-48PX	G-V	46
GRDD	V-BR	47
-48PX	BR-V	48
GRDD	V-S	49
-48PX	S-V	50

TO REMOVE  
ALARM  
CIRCUITRY  
(IF REQUIRED)

\* THIS LEAD IS ACTIVE IN LOW STATE

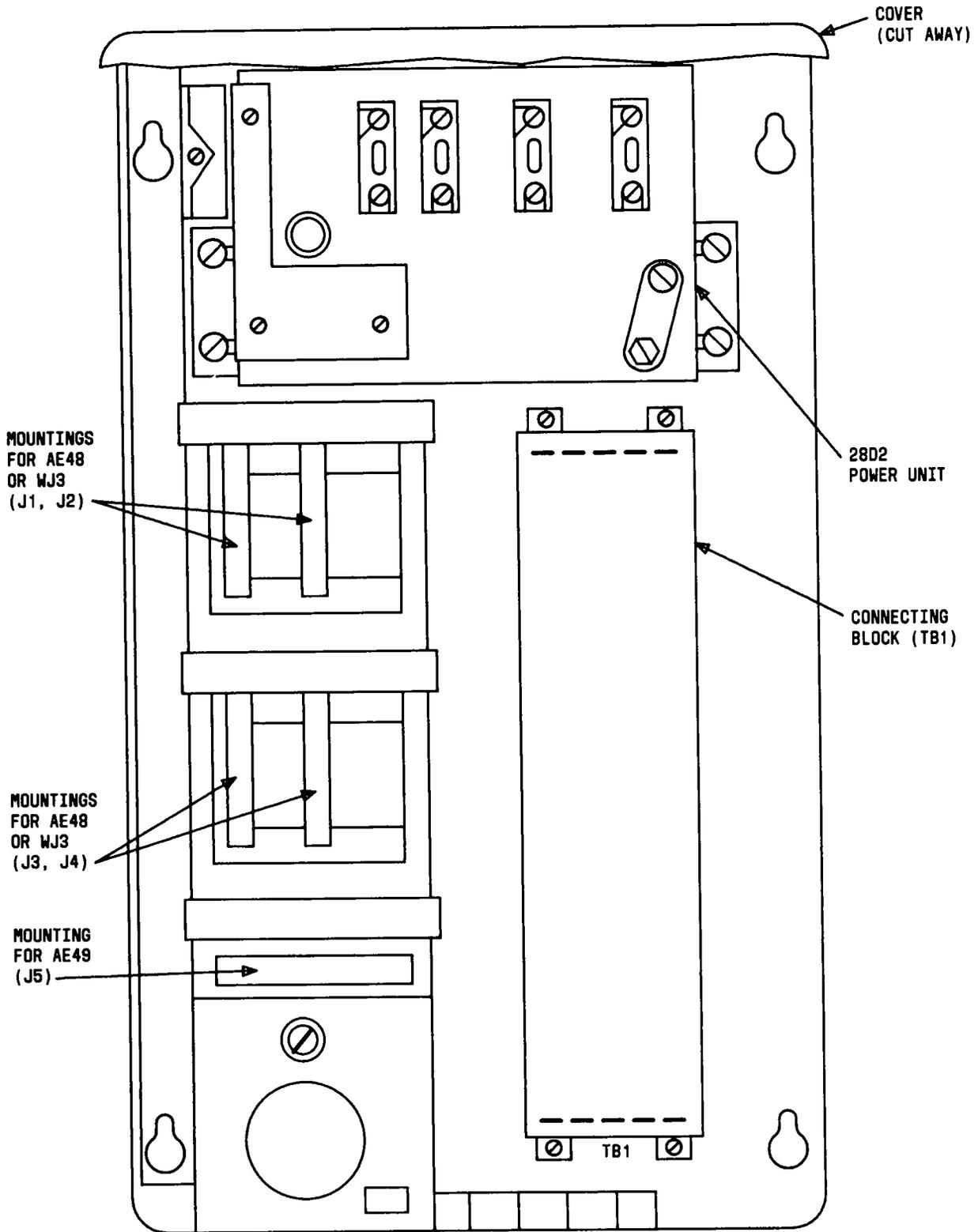
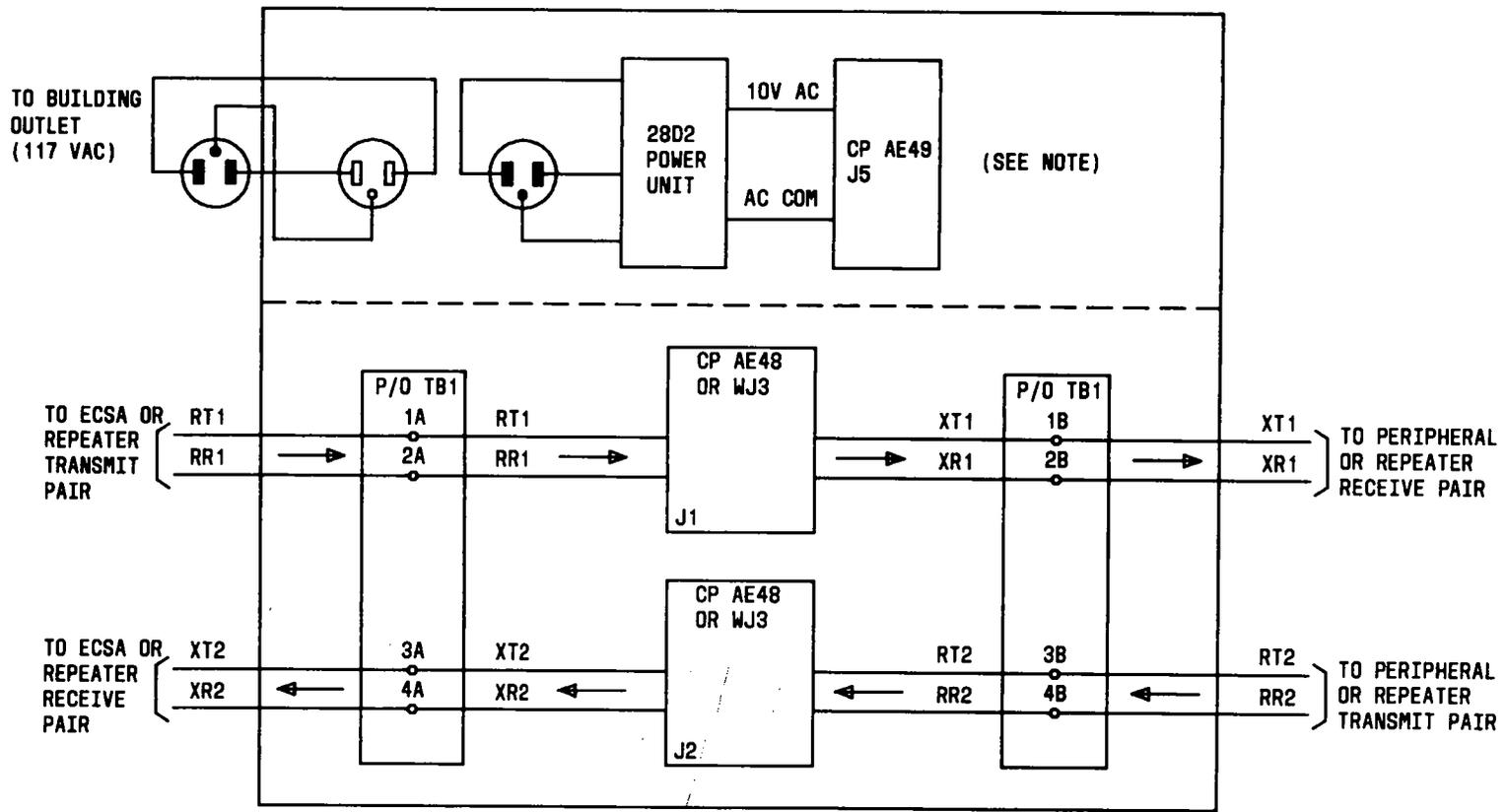
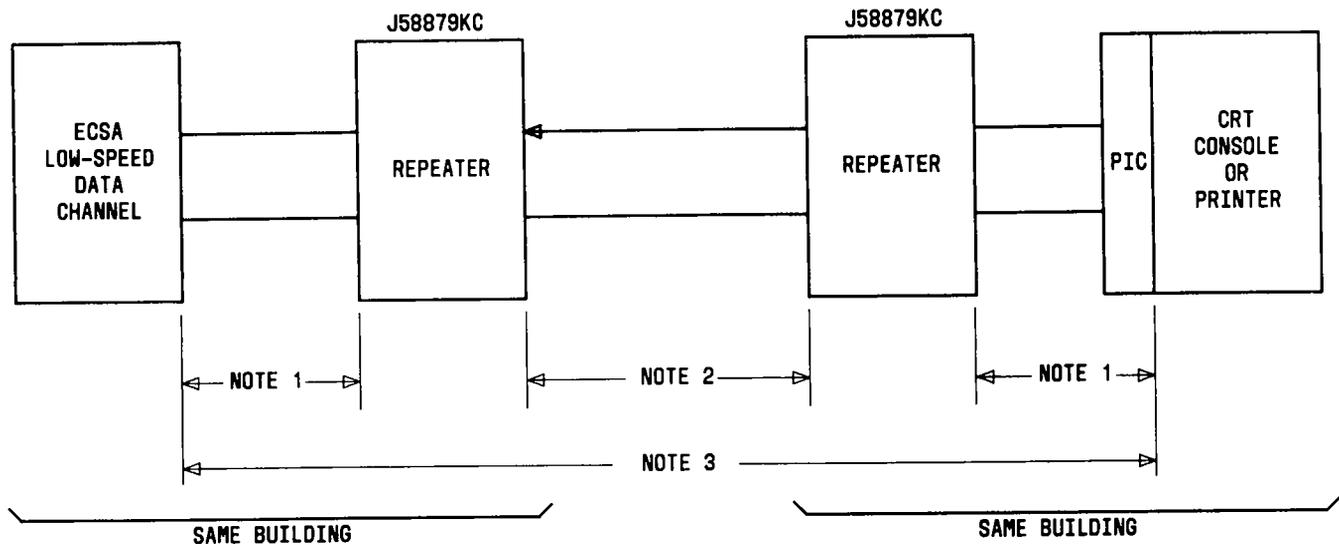


Fig. 34—Data Channel Repeater (J58879KC)



NOTE:  
THE POWER SUPPLY UNIT AND CP AE49 ARE NOT REQUIRED WHEN THE WJ3 CIRCUIT IS USED.

Fig. 35—Single-Channel Repeater With Range Extension (AE-48) or Without Range Extension (WJ-3)



## NOTES:

1. MAXIMUM DISTANCE BETWEEN ECSA AND REPEATER OR REPEATER AND PERIPHERAL IS 300 m (1000 FEET).
2. MAXIMUM DISTANCE BETWEEN REPEATERS IS 900 m (3000 FEET). UP TO FOUR REPEATERS CAN BE USED IN SERIES.
3. MAXIMUM DISTANCE BETWEEN ECSA AND PERIPHERAL WITH RANGE EXTENSION IS 3350 m (11,000 FEET) USING FOUR DATA CHANNEL REPEATERS.

Fig. 36—Data Channel Repeater

- One J58879KC, List 2, rectifier and timing reference circuit card (AE-49)
  - Four J558879KC, List 3, unidirectional repeater circuit cards (AE-48) for each repeater.
- 6.10 When the data channel repeater is used for **lightning protection only** (Fig. 35 and 37), the equipment required is as follows:
- Two (single-channel) or four (dual-channel) J58879KC, List 4, data link, buffer circuit card (WJ3)
  - One J58879KC, List 5, assembly, wiring, and equipment, excluding the 28D2 power supply unit.
- C. Installation
- 6.11 The repeater connections and a typical application are discussed in the following paragraphs.

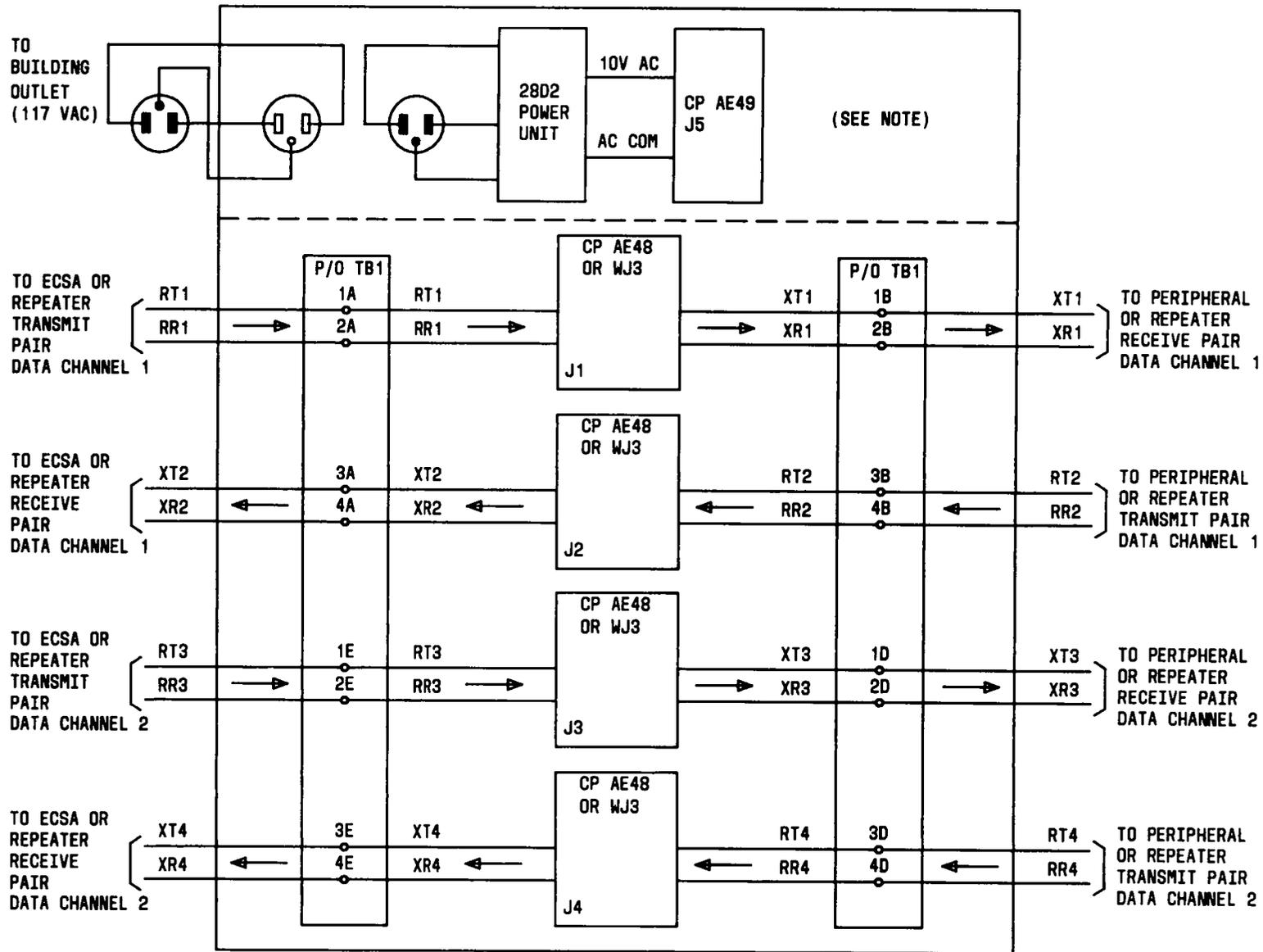
6.12 A block diagram of a single-channel repeater with and without range extension with some internal wiring is shown in Fig. 35. The required connections consist of data pair terminations to connecting block TB1.

6.13 When operating in the ECSA to peripheral data direction, the repeater input pair is connected to terminals 1A and 2A of TB1. The output pair appears on terminals 1B and 2B.

6.14 When operating in the peripheral to ECSA data direction, the repeater input pair is connected to terminals 3B and 4B. The output pair is tied to terminals 3A and 4A.

6.15 The tip leads of the data pairs are connected to the odd-numbered terminals, and the ring leads of the data pairs are tied to even-numbered terminals.

6.16 The equipment required for a dual channel repeater to an off-premises peripheral is shown in Fig. 38. The connections for the two data channels are provided in Fig. 37. The channel 1 con-



NOTE:  
THE POWER SUPPLY UNIT AND CP AE49 ARE NOT REQUIRED WHEN THE WJ3 CIRCUIT CARD IS USED.

Fig. 37—Dual-Channel Repeaters With Range Extension (AE-48) or Without Range Extension (WJ-3)

nections are identical to the single repeater channel connections. The channel 2 repeater circuit cards in J3 and J4 are used in conjunction with rows D and E of terminal block 1.

**D. Data Range**

**6.17** The use of data channel repeaters can extend the maximum distance between the ECSA and the peripheral unit to 3350m (11,000 feet) as follows:

- 305m (1000 feet) between the PBX and one repeater
- 914m (3000 feet) between the first and second repeater
- 914m (3000 feet) between the second and third repeater
- 914m (3000 feet) between the third and fourth repeater

- 305m (1000 feet) between the fourth repeater and the peripheral unit.

**6.18** Table R is to be used in providing cross-connection information on the data channel repeater and cascaded repeater connections from a control/energy carrier. Connections from a repeater to a second repeater or to a peripheral device are given in fill-in Table S.

**6.19** Data link range is a function of cable attenuation and receiver sensitivity. The repeater-to-repeater range is 914m (3000 feet) for No. 24 AWG cable. The ECSA-to-repeater and repeater-to-peripheral data link range is limited to 305m (1000 feet) by receiver sensitivity.

**6.20** The data range is limited by the cable attenuation and round trip propagation delay and may not exceed 3353m (11,000 feet) from the ECSA to the peripheral unit, regardless of cable wire gauge.

**6.21** The range for one direction of a data link may be estimated by the following formula.

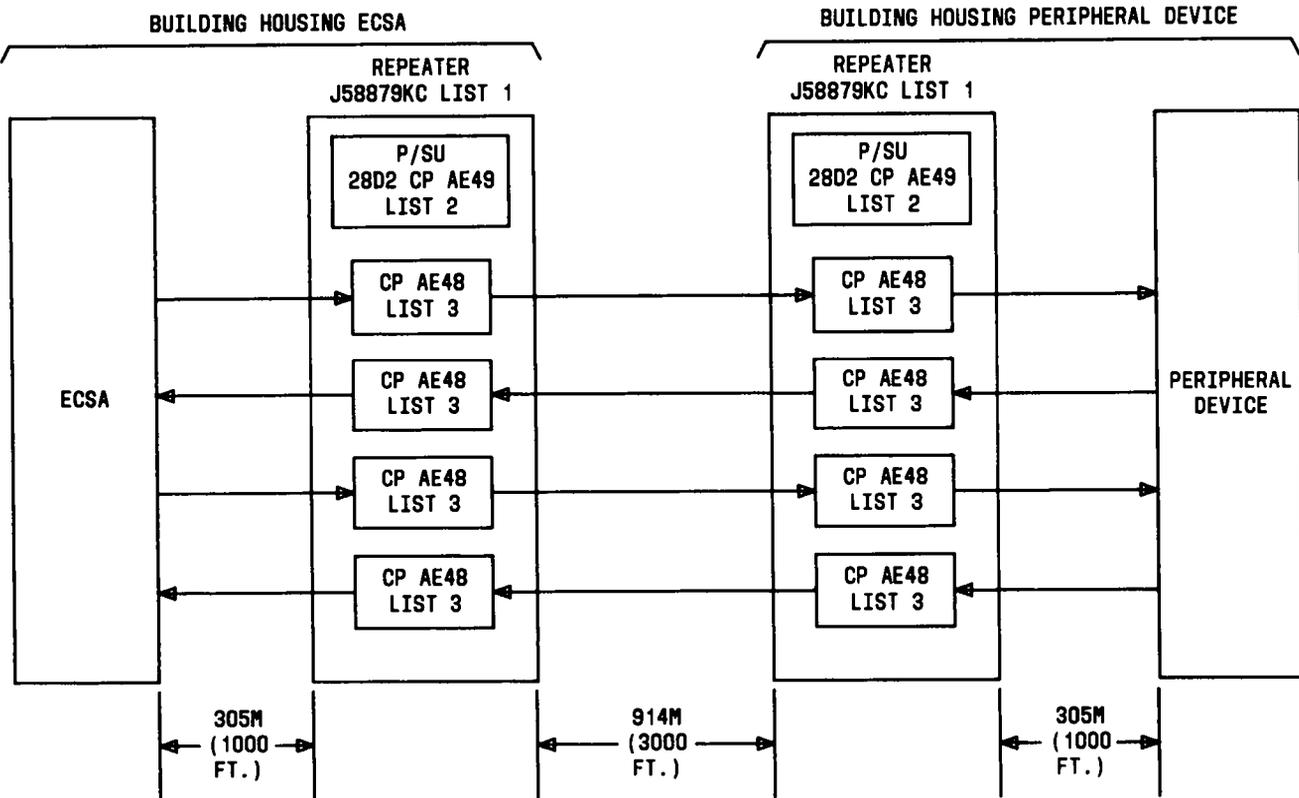


Fig. 38—Dual-Channel Repeaters for Off-Premises Use

TABLE R

DATA CHANNEL REPEATER FROM CONTROL/ENERGY CARRIER CROSS-  
CONNECTIONS

MODULE 0 CARRIER 0 SEGMENT 0				CONN CABLE COLOR CODE	CROSS-CONNECT		REPEATER TERMINALS				
CONN. NO.	CP SLOT NO.	CKT NO.	LEAD DESIGNATION		CONN BLOCK	CONN BLOCK					
BX01A	20/21B	0	IOXB0004	W-BL	1						
			IOXA0004	BL-W	2						
			IORB0004	W-O	3						
			IORA0004	O-W	4						
					W-G	5					
					G-W	6					
					W-BR	7					
					BR-W	8					
					W-S	9					
					S-W	10					
					R-BL	11					
					BL-R	12					
				20/21B	1		IOXB0005	R-O	13		
							IOXA0005	O-R	14		
	IORB0005	R-G	15								
	IORA0005	G-R	16								
	22/23B	0		IOXB0008	R-BR	17					
				IOXA0008	BR-R	18					
				IORB0008	R-S	19					
				IORA0008	S-R	20					
		1			IOXB0009	BK-BL	21				
					IOXA0009	BL-BK	22				
					IORB0009	BK-O	23				
					IORA0009	O-BK	24				
					BK-G	25					
					G-BK	26					
					BK-BR	27					
					BR-BK	28					
	18B	0		IOXB0002*	BK-S	29					
				IOXA0002*	S-BK	30					
				IORB0002*	Y-BL	31					
				IORA0002*	BL-Y	32					
	22/23B	2		IOXB0010	Y-O	33					
				IOXA0010	O-Y	34					
				IORB0010	Y-G	35					
				IORA0010	G-Y	36					
		3			IOXB0011	Y-BR	37				
					IOXA0011	BR-Y	38				
					IORB0011	Y-S	39				
					IORA0011	S-Y	40				
	20/21B	2		IOXB0006	V-BL	41					
				IOXA0006	BL-V	42					
				IORB0006	V-O	43					
				IORA0006	O-V	44					
		3			IOXB0007	V-G	45				
					IOXA0007	G-V	46				
					IORB0007	V-BR	47				
					IORA0007	BR-V	48				
					V-S	49					
					S-V	50					

\* THESE LEADS ARE ALSO CONNECTED TO BX07 - ONLY ONE SET OF LEADS SHOULD BE USED AT ONE TIME.

TABLE S

**CONNECTIONS FOR A DATA CHANNEL REPEATER FROM REPEATER TO REPEATER  
OR REPEATER TO PERIPHERAL DEVICE**

MOD 0 CARR 0 SEG 0		PBX LEADS FROM BX01A	1ST REPEATER		2ND, 3RD, OR 4TH REPEATER		LEAD DESIG	PERIPH TERM.
			TO PBX	TO SUCCEEDING REPEATER OR PERIPHERAL	TO PRECEDING REPEATER	TO SUCCEEDING REPEATER OR PERIPHERAL		
			TB1 TERM. NO.	TB1 TERM. NO.	TB1 TERM. NO.	TB1 TERM. NO.		
SLOT	CIRCUIT							
	0/2	IOXA_ _ _ _	1A	1B	1A	1B	XT1	
		IOXB_ _ _ _	2A	2B	2A	2B	XR1	
		IORA_ _ _ _	3A	3B	3A	3B	RT2	
		IORB_ _ _ _	4A	4B	4A	4B	RR2	
	1/3	IOXA_ _ _ _	1E	5B	1E	5B	XT3	
		IOXB_ _ _ _	2E	6B	2E	6B	XR3	
		IORA_ _ _ _	3E	7B	3E	7B	RT4	
		IORB_ _ _ _	4E	8B	4E	8B	RR4	

$$R = \frac{20 \text{ LOG}_{10} \left( \frac{XL}{RS} \right)}{\alpha (\text{dB/UNIT LENGTH})}$$

Where:

XL = Transmit level of sender

RS = Receive sensitivity of receiver

$\alpha$  = Cable attenuation

Both directions must be measured to determine the data link range.

**6.22** The transmit level is the magnitude of the transmitted biphasic pulse; for the repeater, XL = 5 volts.

**6.23** The receiver sensitivity is the minimum magnitude of biphasic pulse required by the receiver circuit for detection; for the repeater, RS = 0.7 volt. For other circuits, the sensitivity depends upon the circuit pack code and vintage.

**6.24** The cable attenuation is a function of the cable type and temperature; for No. 24 AWG,  $\alpha = 5.5$  dB per 305m (1000 feet).

**6.25** The previously mentioned values can be substituted into the following range formula:

$$R = \frac{20 \text{ LOG}_{10} \frac{5.0}{0.7}}{5.5/305\text{m (1000 FEET)}} = 947\text{M (3105 FEET)}$$



*The cable attenuation formula may be applied to individual cable runs between units. However, the total cable distance between the ECSA and the peripheral device **MUST NOT exceed 3353m (11,000 feet).***

#### E. Propagation Delay

**6.26** The maximum data range is limited in software by the time allowed for a data channel response. The maximum response time permitted by software is 160  $\mu\text{s}$ , allowing four repeaters to be cas-

caded for a maximum range of 3353m (11,000 feet) using 24 AWG wire. Range extension increases the data response due to repeater delay and cable propagation.

**6.27** Each unidirectional repeater circuit (AE-48) has a  $2.4 \mu\text{s}$  delay. In an application employing two repeaters, a total of four repeater circuits are inserted in the loop for a total delay of  $9.6 \mu\text{s}$ .

**6.28** Cable delay is approximately  $1.7 \mu\text{s}$  per 305m (1000 feet). For example, when a 1524m (5,000-foot) maximum range is used, the total cable length is 3048m (10,000 feet) resulting in a cable delay of  $17 \mu\text{s}$ .

**6.29** In an application where four repeaters are used, a total of eight circuits are inserted in the loop for a total delay of  $19.2 \mu\text{s}$ .

**6.30** Additional elements in the data response time are:

- Time required to shift out the data ( $92 \mu\text{s}$ )
- Time required by the peripheral to respond to each bit ( $2 \mu\text{s}$ )
- Time for the ECSA receiver to respond ( $1 \mu\text{s}$ ).

**6.31** The above application (employing four repeater circuits and a range of 1524 meters [5000 feet]) requires the software to allow  $122 \mu\text{s}$  for a data channel response.

#### PERIPHERAL INTERFACE CIRCUIT (PIC)

**6.32** The PIC is a stand-alone unit containing a controller which converts bipolar ECSA signals into an Electronic Industries Association (EIA) RS232C format which can drive an input/output peripheral device. The unit also contains a power supply, a 25-pin EIA serial data connectors (SX02), and an interface circuit. The PIC is required with the ECSA to provide a communication link between the LC366C circuit pack in the ECSA and the CRT console and/or the system printers. One PIC is required for each peripheral device.

**6.33** The unit is mounted in a data set housing and requires the associated cord assemblies as shown in Fig. 39. The main terminal connections for SX02 and SR01 are provided in Table T. Table U is a

fill-in worksheet to be used to provide connections to a PIC unit.

#### REMOTE MAINTENANCE, ADMINISTRATION, AND TRAFFIC SYSTEM (RMATS-1)

**6.34** Remote access to the logic and memory of ECSA systems is provided by RMATS-1. This capability allows certain maintenance and administrative routines to be performed remotely.

**6.35** Various studies and structures may be flexibly administered in the ECSA and automatically polled by the RMATS-1 central facility (Fig. 40).

**6.36** In order to function with the RMATS-1 central facility, the ECSA must be equipped with an LC171B (with slow-speed option), an LC172B circuit pack, and one low-speed automatic answering data set. An optional telephone set may be used if voice communication over the data link is required. The LC171B and LC172B circuit packs must be installed in control carrier, segment 0, slots 18 and 17, respectively. A dual in-line package (DIP) base containing strap wires is inserted into the DIP socket on LC171B to allow selection of data control rate (300 or 1200 baud) for data transmission.

**6.37** The RMATS-1 interface equipment required for an ECSA system includes the following:

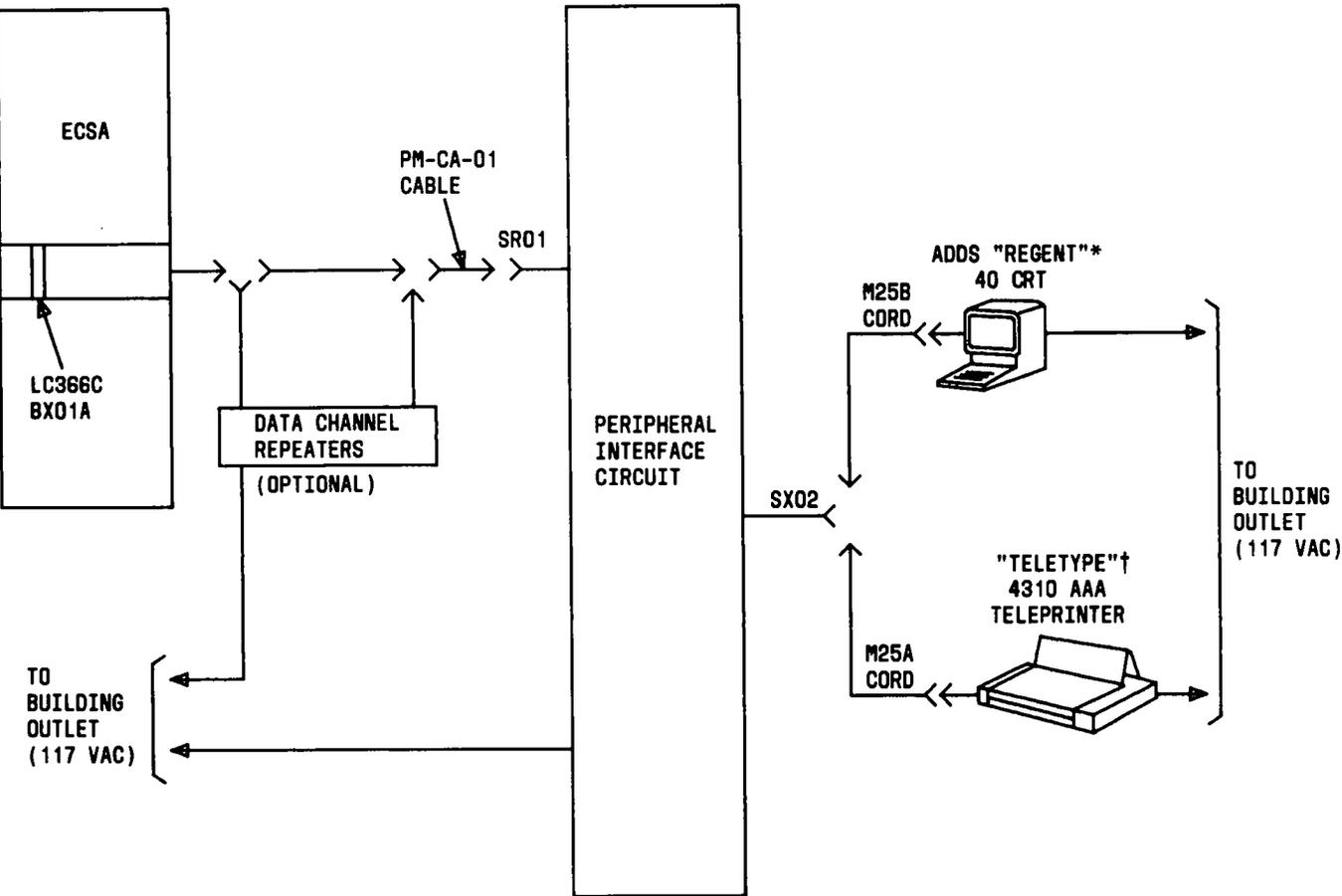
- One 113D or 113DR data set
- One 47-type data set mounting
- One LC171B circuit pack
- One LC172B circuit pack.

**6.38** The data set and data mounting should be located no more than 46 cable meters (150 cable feet) from the ECSA. The location should permit connection of the interface cable to the processor as well as 120-Vac 60-Hz power to the data set. Interface equipment for RMATS is shown in Fig. 41. For additional RMATS information, refer to Section 554-010-130.

#### 7. CIRCUIT PACKS AND OPTIONS



*In order to preclude electrostatic noise in the system, the frame shall be well grounded. Always attach authorized wrist grounding strap before working on system or handling circuit packs.*



\* REGISTERED TRADEMARK OF APPLIED DIGITAL DATA SYSTEMS CORP.  
 † REGISTERED TRADEMARK OF TELETYPE CORP.

Fig. 39—Peripheral Interface Circuit (PIC) and Typical Connections

**7.01** Circuit packs are 203 mm by 292 mm (8 by 11-1/2 inches). Each pack is equipped with an identification faceplate containing a color-coded label. The circuit packs have been separated according to function to simplify maintenance and repair. In addition, the circuit pack faceplates have test points to allow interrogation of internal circuit states for fault diagnosis.

**7.02** Circuit packs contain the circuits for the system and plug into connectors on associated carriers. Every circuit can be addressed by a 5-digit number which tells its location by segment-slot-circuit-port. For example, circuit number 02-16-0-4

indicates the circuit located in segment 02, slot 16, circuit number 0, port 4.

**7.03** The ECSA is shipped complete with circuit packs installed. However, engineering an ECSA installation requires knowledge of the circuit pack locations in the equipment cabinets (Fig. 8 and 9).

**7.04** Plug-in printed wiring boards contain the circuitry to control operation of the ECSA system. Special marking is used to designate circuit pack vintages which must be chosen for installation in specific systems. This marking is a lettered suffix forming a part of the circuit pack code number. When a circuit pack code specified includes a lettered suffix,

TABLE T  
PERIPHERAL CONNECTORS SR01 AND SX02

CONNECTOR	PIN	LEAD DESIG	DESTINATION
SR01 (CONN BURNDY SMS6R-1)	1	IOXB	BX01 (LC366B)
	2	IOXA	
	3	IORB	
	4	IORA	
SX02	1		"TELETYPE" 4310 AAA TELEPRINTER, OR ADDS "REGENT" 40 CATHODE RAY TUBE
	2	RXD	
	3	TXD	
	4		
	5	DTR	
	6	DTR	
	7	SIG GRD	
	8	DSR	
	20	DSR	

TABLE U  
PERIPHERAL INTERFACE CIRCUIT CONNECTIONS

SLOT_ _ LC366B CKT NO.	LEAD DESIG	OOBX01A CONN BLK TERM.	PIC CONN CABLE	
			COLOR CODE	LEAD DESIG
	IOX800_ _		W-BL	IOXB
	IOXA00_ _		BL-W	IOXA
	IOR800_ _		W-O	IORB
	IORA00_ _		O-W	IORA

only that circuit pack code (or a later version indicated by a higher lettered suffix) should be used.



**An LC366 circuit pack should NOT be used if an LC366B circuit pack is specified, but an LC366C can be used if either an LC366C or LC366B circuit pack is specified.**

**7.05** Standard circuit packs are required for normal system operation. Optional strappings or other circuit packs may be required to implement additional features. Other strappings, working limits, etc, are provided for the following units to assist in system planning:

- Data control circuit (LC171B)
- Data transfer circuit (LC172B)

- Digital network buffer circuit (LC561)
- Dual-speed serial data channel (LC366C)
- Energy load control circuit (LC562)
- I/O and memory control (LC133 and LC133B)
- Network clock (LC121B)
- Power monitor and feedback circuit (LC563)
- Time-of-day clock (LC144).

**A. Data Control Circuit (LC171B)**

**7.06** Circuit pack LC171B is used in conjunction with the RMATS. Each circuit pack contains

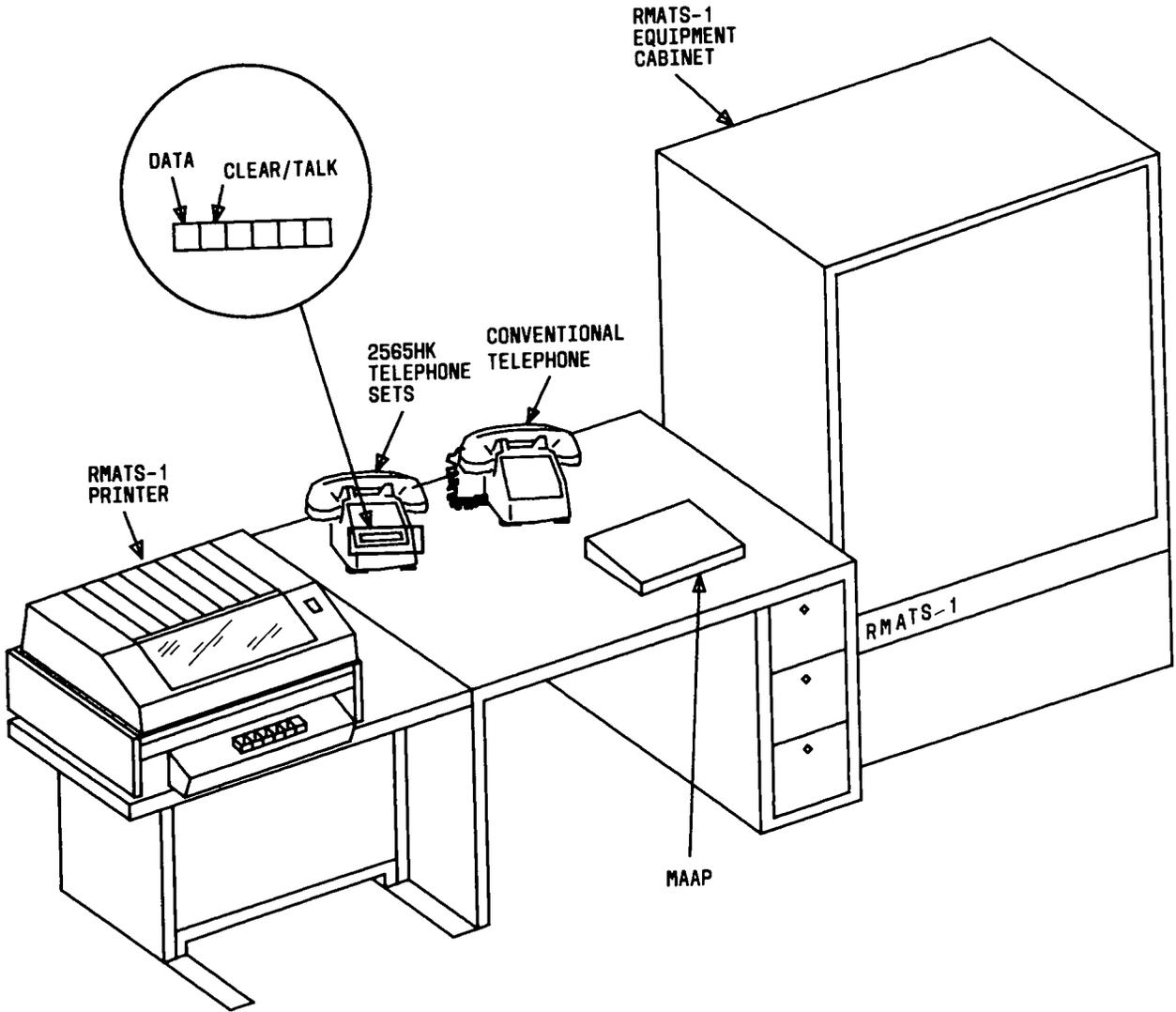


Fig. 40—RMATS-1 Equipment

two circuits, 0 and 1, and is installed in the control carrier, segment 0, slot 31. One circuit (1) of the LC171B circuit pack connects to the external data set which communicates with the RMATS. The second circuit (0) is a typical high-speed link which functions similarly to an LC366C channel. The LC171B circuit pack with speed control option blocks is shown in Fig. 42.

**B. Data Transfer Circuit (LC172B)**

**7.07** Circuit pack LC172B is required for RMATS in conjunction with LC171B. This circuit provides a data channel between the ECSA processor and the MAAP. The circuit pack (Fig. 43) contains an

option block to be set for option G, required for the ECSA system.

**C. Digital Network Buffer Circuit (LC561)**

**7.08** The LC561 provides control, and board and port decoders for the energy load circuits. The circuit pack provides the signaling for two electrical carriers or two segments. One LC561 is required for each control/energy carrier, and two or three are required in each energy carrier. One of the LC561s required for the energy carrier must always be installed in slot 17 of segment 4. The unit provides maintenance control for the network control circuit packs in slots 18 through 21 as well as control for any

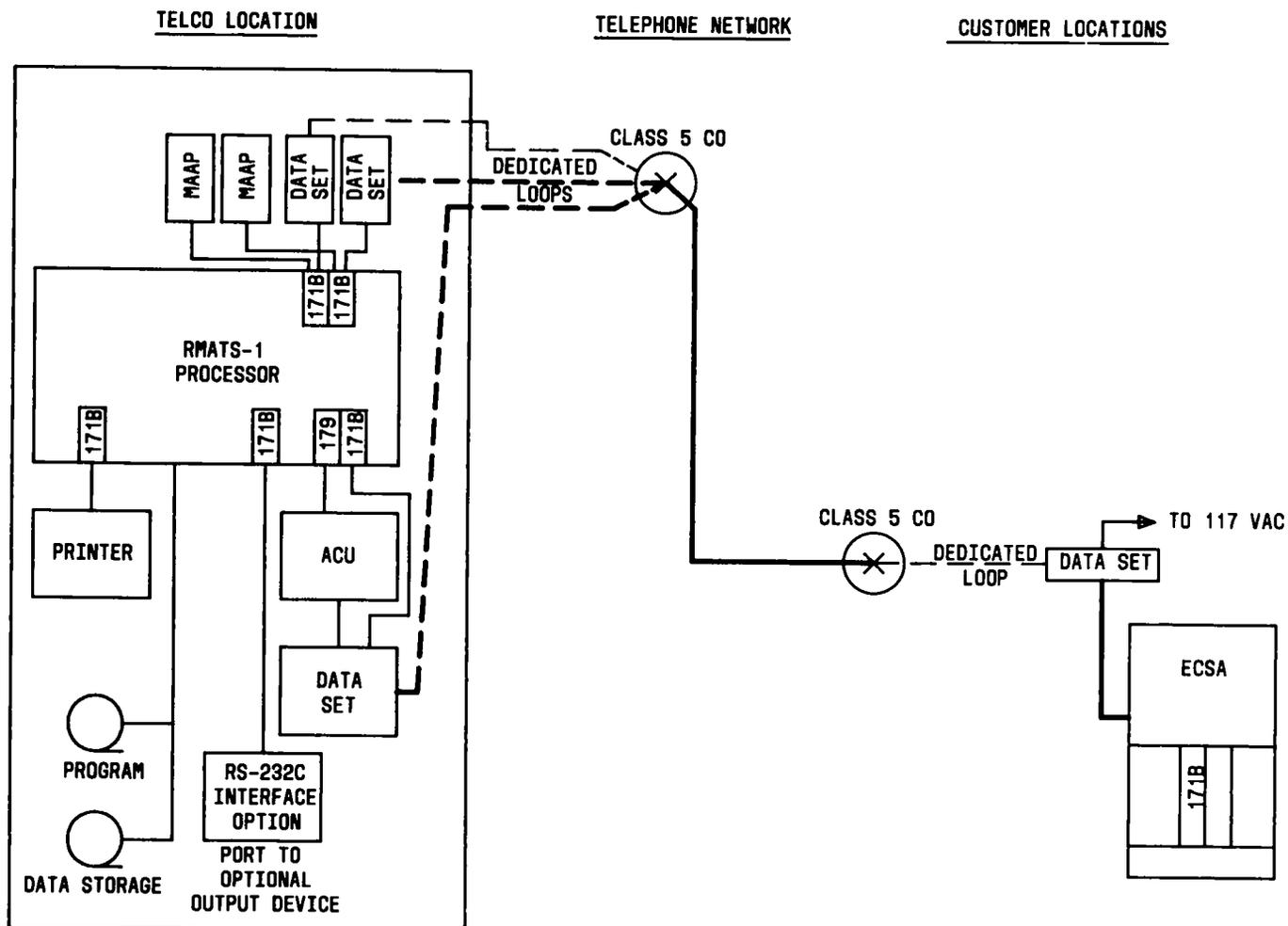


Fig. 41 — RMATS-1 Functional Block Diagram

LC562 load interface that may be installed in segment 4.

#### D. Dual-Speed Serial Data Channel (LC366C)

7.09 Circuit pack LC366C contains four input/output serial data channels. One channel (circuit 0) is a dual-speed (185 or 833 kilobits per second) channel. The three remaining channels can be used only for low-speed (185 kilobits per second) operation. Each LC366C circuit pack provides four data channels for use in the control/energy carrier. These channels are used for connection to the system console and printers. The circuit pack is installed in the control carrier, segment 0, slots 20/21 and 22/23. The low-speed/high-speed option for circuit 0 is selected

via DIP socket J2 (Fig. 44). Dual in-line package socket J1 is used to select the type of system in which the LC366C is installed (eg, ECSA system).

#### E. Energy Load Control Circuit (LC562)

7.10 **DANGER: Hazardous voltages may accidentally be applied to the ECSA system via the LC562 energy load interface leads which extend to the customer through the cross-connect field for connection to load control circuitry.** The LC562 provides contacts for controlling customer energy loads. Each unit has 16 contact circuits. Up to eight circuit packs may be installed in each segment of an energy carrier.

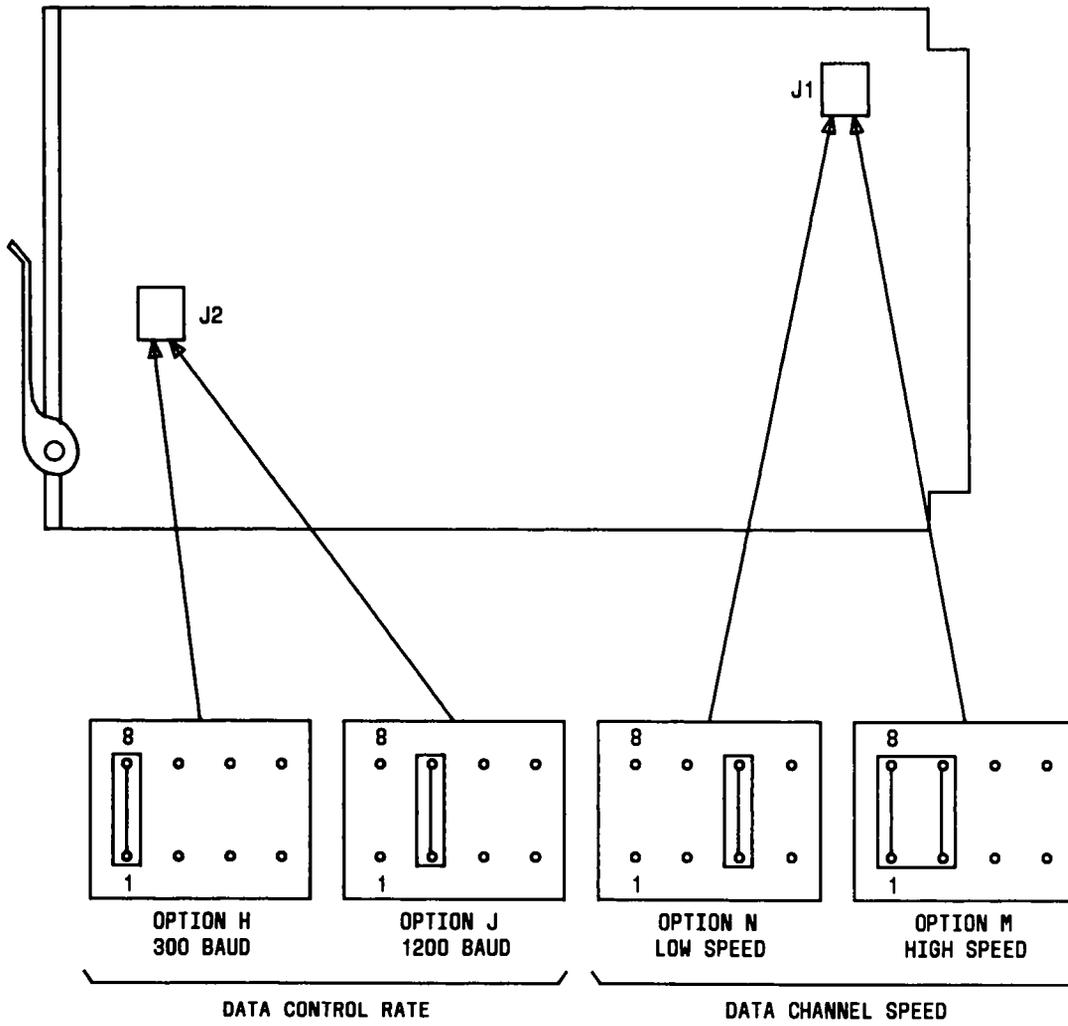
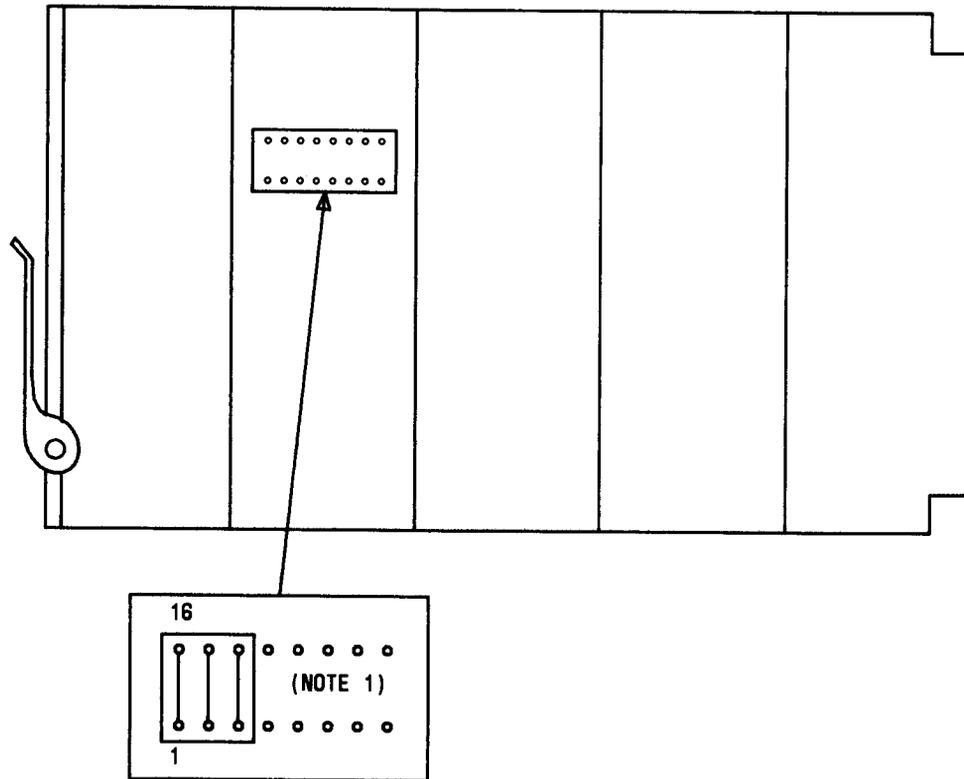


Fig. 42—LC171B Circuit Pack Options



NOTE:  
1. BLOCK SET FOR OPTION G (REQUIRED FOR ECSA SYSTEM)

Fig. 43—LC172B Circuit Pack Showing Shorting Block Set for Option G

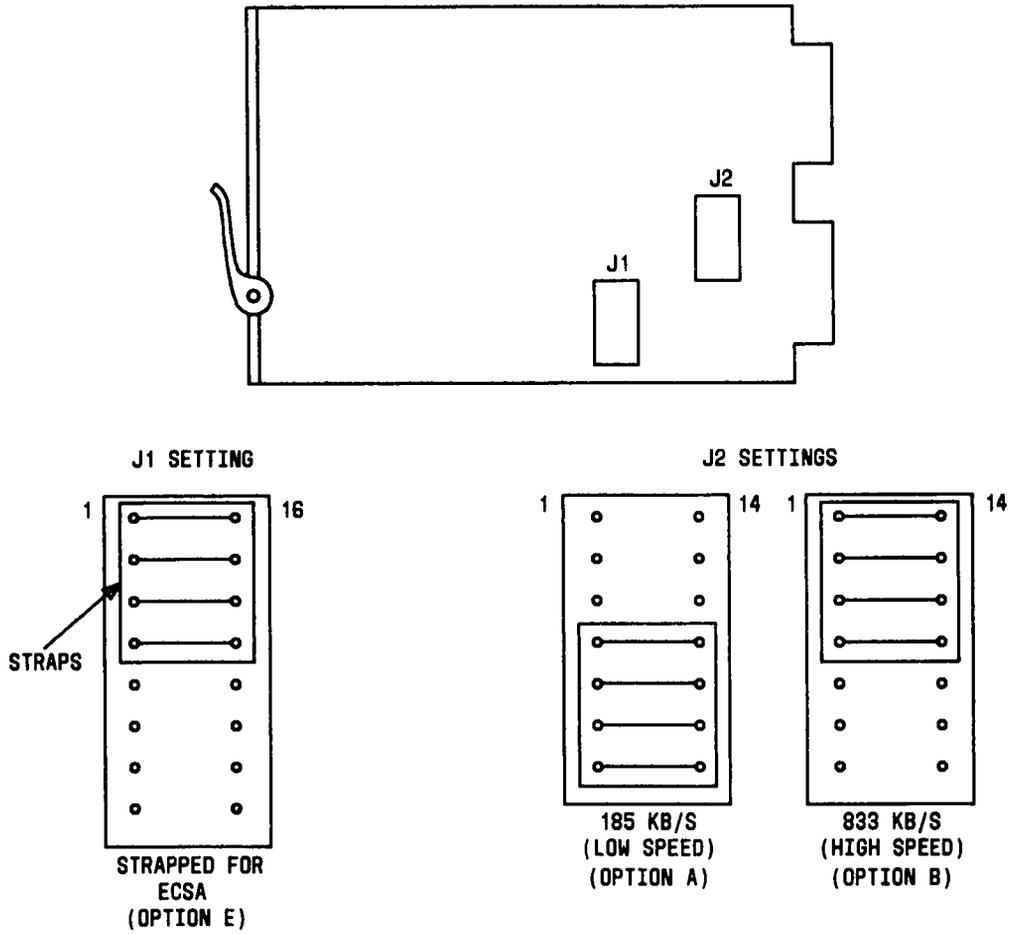


Fig. 44—LC366C Circuit Pack Options



*The working limits for the contacts on the LC562 should not be exceeded.*

- 7.11 The working limits of the circuit pack contacts are as follows:

<u>MAXIMUM DC VOLTAGE</u>	<u>MAXIMUM DC CURRENT</u>	<u>MAXIMUM POWER</u>
130V	1A	25 VA

- 7.12 Power is calculated as the open circuit voltage across contacts times the closed circuit current through the contacts. Typical examples for energy load circuits are as follows:

<u>DC VOLTAGE</u>	<u>DC CURRENT</u>	<u>POWER</u>
130V	0.19A	25 VA
50V	0.5A	25 VA
25V	1A	25 VA
12A	1A	12 VA
6A	1A	6 VA

- 7.13 The range limitations between the ECSA system and the customer load control relay may be calculated (when using 26-gauge wire) as follows with *RC* equal to the relay coil resistance in ohms, *VO* equal to relay operating voltage in volts, and *VS* equal to supply voltage in volts:

$$\text{DISTANCE (FEET)} = 12.19 \times RC \times (VS/VO - 1)$$

#### F. I/O and Memory Control Circuits (LC133B)

- 7.14 The I/O and memory decoder circuit pack, LC133B, contains a movable shorting block in a dual in-line package which provides options for the memory pack size used in the random access memory. The block shall be set to option W as shown in Fig. 45 (64K memory boards).

#### G. Network Clock Circuit (LC121B)

- 7.15 The network clock circuit pack (LC121B) provides all functional timing for the ECSA system. One LC121B is required for each energy carrier in slot 18.
- 7.16 The circuit pack contains a switchable circuit which must be positioned as shown in Fig. 46.

#### H. Power Monitor and Feedback Circuit (LC563)

- 7.17 The LC563 detects pulse signals from power meters or other pulse-type circuits. A maximum of 400 pulses per minute can be detected. The circuit pack contains 16 pulse detecting circuits. Only one circuit pack per system is used to interface power meters. This circuit pack may be installed in any energy load slot in the control/energy and energy carriers.

- 7.18 In addition, a second LC563 is provided for maintenance use to test the LC562 circuit packs. Slots 1 and 2 of segment 0 in the control/energy carrier is reserved for the LC563 used for testing. A set of special cables (groups 601, 602, and 603) are provided to connect between the LC563 (carrier connector BB01) and the connector(s) associated with the LC562 under test.

#### I. Time-of-Day Clock Circuit (LC144)

- 7.19 This common-control circuit pack provides an improved hardware clock recommended for billing accuracy. It is installed in slot 19, segment 0 of the control carrier. The H-606-113, G1 battery pack provides power for the LC144 in the event of commercial power failure.

- 7.20 A numerical listing and a brief description of the ECSA circuit packs follow:

- **LC29B—Tape Transport Interface A:** The LC29B contains the interface circuits between the processor, data bus, and tape transport interface B (LC30C). One LC29B is required per system.
- **LC30C—Tape Transport Interface B:** The LC30C controls the operation of the tape transport. One LC30C is required per system.
- **LC46—Scanner/Distributor:** The LC46 interrogates the port circuits and reports status to the processor. In addition, it distributes control data to port circuits. It is also used in conjunction with the network control during network tasks and decodes carrier addresses, buffer boards, and port address bits to the LC561. One LC46 is required in the control/energy carrier and one for each energy carrier.
- **LC121B—Network Clock:** The LC121B provides a 25-ms clock for the LC561 circuit

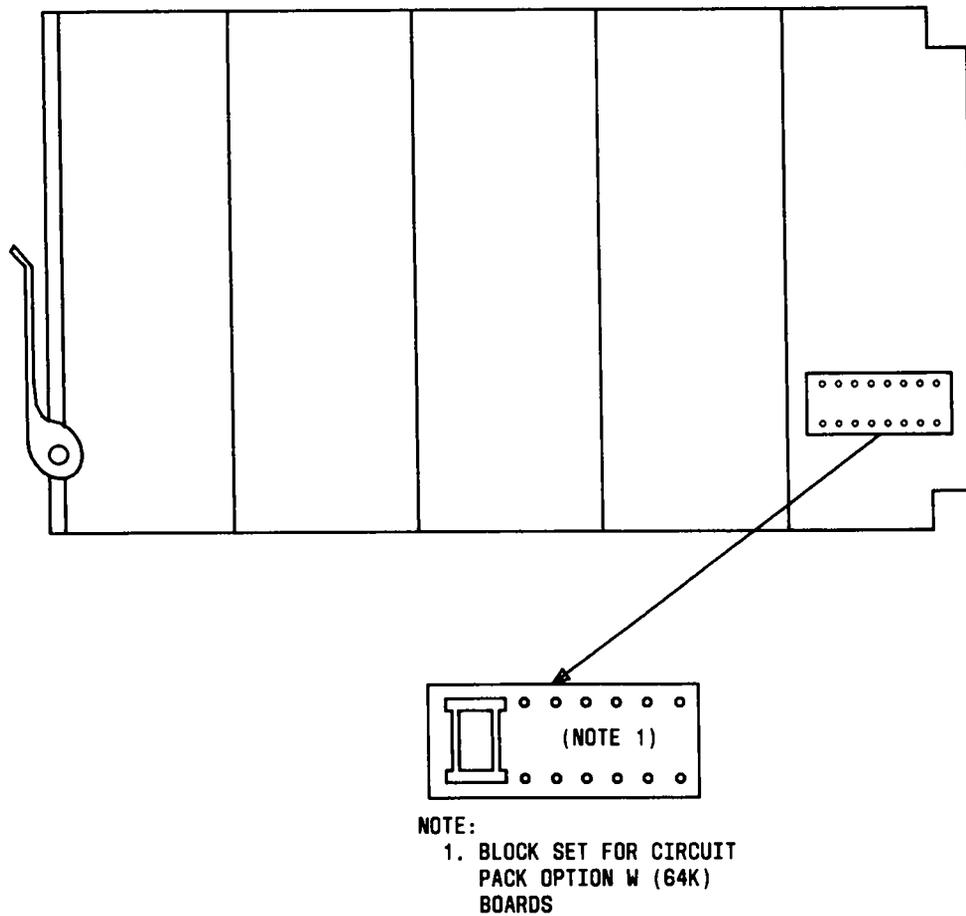


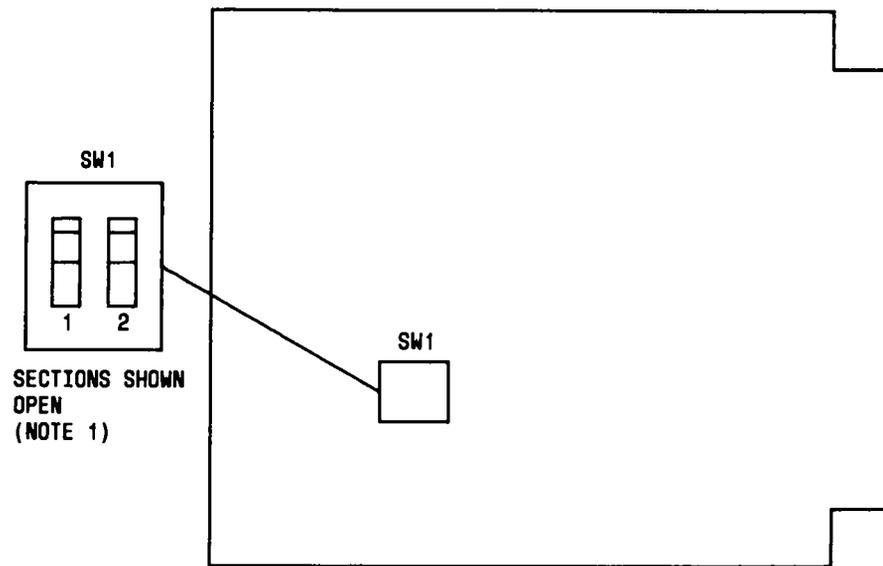
Fig. 45—LC133B Circuit Pack Showing Shorting Block Set for Option W

pack. One LC121B is required per each control/energy carrier and energy carrier.

- **LC123—Network I/O Subchannel Interface:** The LC123 receives and transmits data in a serial format from the common control subchannels. It provides a dedicated data channel between the processor and each network cabinet. One LC123 is required in the control/energy carrier and in each energy carrier.
- **LC124—Network Input/Output Data Circuit:** The LC124 receives serial data from the LC123 and converts the data to a parallel format to be used by the scanner/distributor and network control. Information is passed through it from the processor, providing instructions to the scanner/distributor and

network control. One LC124 is required in the control/energy carrier and in each energy carrier.

- **LC130—4-MHz Channel Control:** The LC130 controls information passed from the processor to the LC131. One LC130 is required per system.
- **LC131—4-MHz Subchannel Circuits:** This data channel allows the processor to execute commands using the scanner/distributor and network control. Each LC131 provides 16 subchannels. One LC131 is required per system.
- **LC133B—Input/Output and Memory Decode Control:** The LC133B circuit pack provides processor control of data passed

**NOTE:**

1. SECTION 2 OF SWITCH MUST ALWAYS BE IN OPEN POSITION. SECTION 1 IS A SPARE AND MAY BE PLACED IN EITHER POSITION.

**Fig. 46—LC121B Circuit Pack Switch Location and Options**

from memory to the input/output buffer (LC134). This circuit pack should be obtained for the 64K memory. One LC133B is required in the control/energy carrier.

- **LC134B—Input/Output Buffer and Terminations:** The LC134B provides the interface between the main data bus and peripheral control circuits. It also provides terminating resistors on data and address bus leads to reduce oscillations. It has been modified to correct noise problems which may occur during circuit pack testing. One LC134B is required in the control/energy carrier.
- **LC135/135C—RAM Bus Termination:** The LC135 provides terminations for the memory address, data, and control buses. One LC135 is required in the control/energy carrier.
- **LC136—RAM Data Control:** The LC136 functions as a memory data buffer and a bit-swap circuit. One LC136 is required in the control/energy carrier.
- **LC144—Time-of-Day Clock:** The LC144 provides time-of-day data—seconds, minutes, hours, and days (0-999)—to the adjunct software for record-keeping purposes. One LC144 is required in the control/energy carrier.
- **LC147—Alarm Circuit:** The LC147 interfaces with the processor, alarm panel, fuse and breaker alarm bus, and overtemperature sensors. One LC147 is required in the control/energy carrier.
- **LC171B—Data Control:** The LC171B circuit pack contains two data channels. Channel 0 provides dual-speed (serial data channel) operation similar to the LC34B and LC366B circuit packs. The dual speeds are selectable, 833 kilobits per second for fast speed and 185 kilobits per second for slow speed. Channel 1 also has dual-speed options (300 baud and 1200 baud). The 300-baud option is for use with RMATS-1. An LC171B circuit pack is required with the RMATS-1 system. The 1200-baud option is for use with a high-speed printer, and a printer cutoff

lead is provided from the LC171B. One LC171B is required in the control/energy carrier.

- **LC172B—Data Transfer:** The LC172B provides an I/O data channel between the processor and MAAP. One LC172B is required in the control/energy carrier when the ECSA is associated with the RMATS-1 system.
- **LC346B—RAM (64K Word):** The LC346B circuit pack provides 64K words of main memory per circuit pack. Two or three LC346s are required in the control/energy carrier.
- **LC366B—Dual Speed Serial Data Channel:** The LC366B provides one dual-speed data channel which can be optioned for either slow speed (185 kilobits per second) or fast speed (833 kilobits per second) and three fixed slow-speed data channels. The data channels convert and transmit data bits synchronously between the processor and peripheral unit(s). One or two LC366Bs are required in the control/energy carrier.
- **LC366C—Dual Speed Serial Data Channel:** The LC366C performs the same functions as the LC366B, but is designed to permit a permanently enabling data channel so that the MAAP can communicate with the off-line processor in a duplicated machine; allow SMDR to operate correctly; and improve the timing performance.
- **LC454—RAM Address and Timing Control:** The LC454 provides refresh and other timing signals required to maintain and control the read/write memory. One LC454 is required in the control/energy carrier.
- **LC455—201CC Processor:** The LC455 is a microprogrammable processor made up of two separate printed circuit boards (LC140 and LC141B) mounted together and connected through two special interboard connectors. It controls data flow between the main memory and I/O devices via a 1-way address bus and a 2-way data bus. The LC455 performs arithmetic and logic operations on this data. It also provides logic to generate system interrupts and bootstrap loading of the main memory. The read only memory (ROM) stores the microcontrol programs, generates signals for the processor and clock generator, and controls decoding circuits for the generation of timing and control signals for the processor. Circuit pack LC455 combines the functions of circuit packs LC142 (extended microstore) and LC143 (processor) into a single circuit pack. One LC455 is required in the control/energy carrier.
- **LC561—Network Buffer:** This circuit pack has the density to handle two segments. One LC561 is required in the control/energy carrier and two to three in each energy carrier.
- **LC562—Load Interface:** This is a double density circuit pack having 16 circuits, each supplying contacts for use on controlling customer loads. These are required in both the control/energy and the energy carrier.
- **LC563—Power Meter Interface:** This circuit pack is a double-density board supplying 16 circuits for power meter interface and binary feedback interface or for indication of load control when testing the operation of circuits on an LC562 circuit pack. One LC563 is required in the control/energy carrier for testing, and a second LC563 can be located in the control/energy carrier or the energy carrier power for meter interface. Other LC563s can be located in the control/energy or the energy carrier for binary feedback interfaces as required.
- **LC601—Control Board:** The LC601 acts as a buffer circuit to the master remote unit (MRU) keeping it transparent to the processor and carrier. The control board may only be used in slots 1/2 or 9/10 of a segment. Once installed in one of these slots (1/2) the next three consecutive slots (3/4, 5/6, 7/8) must remain empty. Two control boards can be placed in the control/energy carrier. Thirteen is the maximum number of control boards for a 3-carrier ECSA configuration. The control board transmits at a 300-baud rate and the output signal strength is 0 dbm. One LC601 is required per MRU. The circuit

pack contains a switchable circuit which must be positioned as shown in Fig. 47.

- **HN18—Remote Interface Board:** The HN18 is located in the MRU. It accepts the signal generated by the control board and in turn signals the load relays to the proper condition. This board sends maintenance signals back to the control board located in the carrier at a 300-baud rate. One HN18 is required per MRU.
- **AGW1—Remote Load Control Board:** The AGW1 is located in the MRU and provides a make (normally open) dry contact rated at 25VA. The AGW1 contains eight load relays. A maximum of eight AGW1s can be located in each MRU.
- **AGW2—Remote Sense Point Board:** The AGW2 is located in the MRU and per-

mits interface to eight binary sense points using a -24 volt source to detect contact closures. Each sense point being monitored must be within 1524m (5000 feet) of the MRU.

**8. DESCRIPTION OF OPERATION**

**GENERAL INFORMATION**

**8.01** Energy communications is under the control of the processor. The processor determines the status of the load and peripheral circuits. It reacts to changes of states by executing instructions which are read from the software program stored in the main memory. Each system has a tape which contains energy processing routines (generic program) and translations. When the system is loaded the generic and translation are copied to the random access memory (RAM).

**8.02** The ECSA is controlled from an energy console only. The ability to change the system

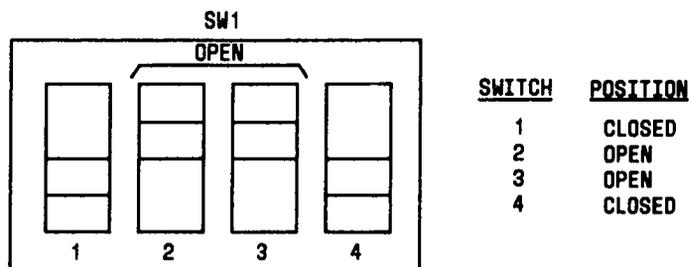
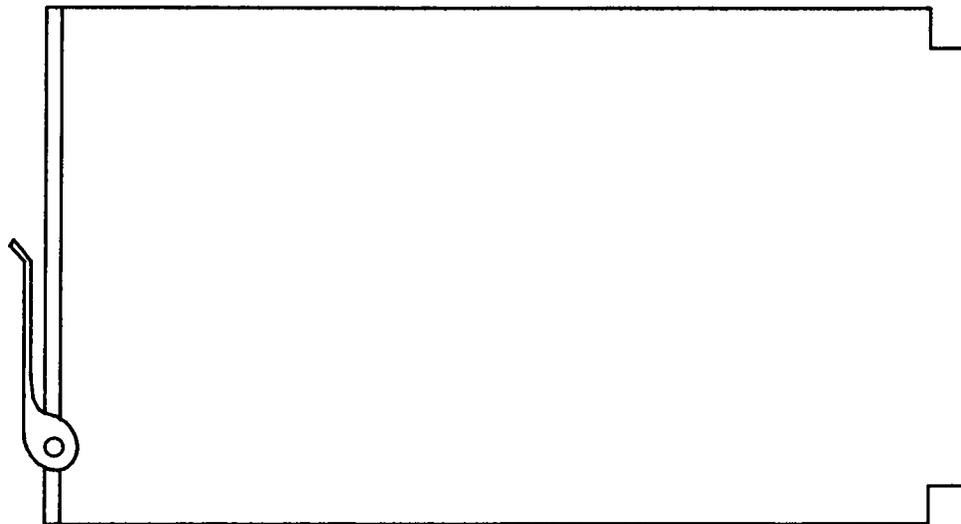


Fig. 47—LC601 Circuit Pack Switch Location and Options

time and date is made from the MAAP, through RMATS or from the system parameter on the ECSA console.

**8.03** When a system is installed, initialization (manual) is required which results in transferring all required data from the tape to the electronic memory. The RAM is called upon continually by the processor during energy processing. The tape cartridge remains in the system, is periodically exercised, and is used for certain maintenance and traffic routines. The tape is automatically called upon for system reinitialization after a power failure of more than 90 seconds. System initialization will be required as a direct result of power failure or parity errors which will activate memory load. This consists of writing the on-line information from the tape into the high-level memory. Stable (relays latched) energy loads are not affected when this occurs. The next phase will require the INIT program to gain control of the ECSA system through the microprogram and restart the system. The following problems will cause reinitialization procedures:

- (a) **Long Power Failure (memory contents lost):** This occurs after about 90 seconds of power outage. Memory contents are restored from the tape. The INIT program clears status memory and puts all peripheral units in the idle state. All energy controls are placed in a disabled/off state until reload of tape is complete, then are put in their proper state.
- (b) **Short Power Failure (memory contents remain intact):** This is a power outage of less than 90 seconds. The INIT program reschedules energy processing tasks and immediately refreshes status for all loads. However, loads are not really affected.
- (c) **Software Errors:** When bad memory parity, illegal program branches, illegal memory writes, or other software problems occur, the INIT program will abort the energy load, or the maintenance task being processed when the error was detected, and energy load processing tasks will be rescheduled.
- (d) **Persistent Software Errors:** When five software errors occur in less than 2 minutes, the INIT program clears all status memory, constructs energy records for all energy loads based on information in the network port circuit, and

reschedules energy processing tasks. A **sixth** software error within 2 minutes will cause memory to be reloaded from the tape, after which the INIT program follows the same action described for the five software errors. A **seventh** software error within 2 minutes will cause the processor to stop.

- (e) **Manual Initialization:** Moving the control rocker switch on the alarm panel to HALT and back to GO causes the INIT program to react as though there had been a short power failure. Activating microdiagnostic 9 will cause memory to be loaded from tape after which the INIT program follows the same action described above for the five software errors.

#### ENERGY PROCESSING

- 8.04** The processor monitors the power meters by issuing commands to the scanner to clock the status of the energy.
- 8.05** Energy processing under control of a stored program permits most of the intelligence to reside in the memory and very little to be provided in the fixed logic circuits. The fixed logic circuits, ports, etc, can be kept simple and low in cost. The power meter circuits only need to condition incoming signals for the scanner.

#### SCANNER/DISTRIBUTOR AND NETWORK CONTROL (Fig. 48)

- 8.06** The processor communicates with the port circuits via the scanner/distributor. When the processor issues a distribution command over the address, data, and control buses, the scanner/distributor decodes an address, designates the port equipment number, and selects the appropriate load. The processor periodically addresses ports via the scanner/distributor and searches for a change of status. Present status of the addressed ports is decoded, updated, and returned to the processor via the data bus. The scanner/distributor scans power meter interface circuits for status.
- 8.07** The scanner/distributor receives the address of the port or ports to be scanned from the processor via the address bus. The address can contain as many as 11 bits. Bits 0 and 1 represent port-select. Bits 2 through 5 determine electrical slot-select. Bits 6 through 9 are segment-select. Bit 10 is used as an additional port-select bit when more than

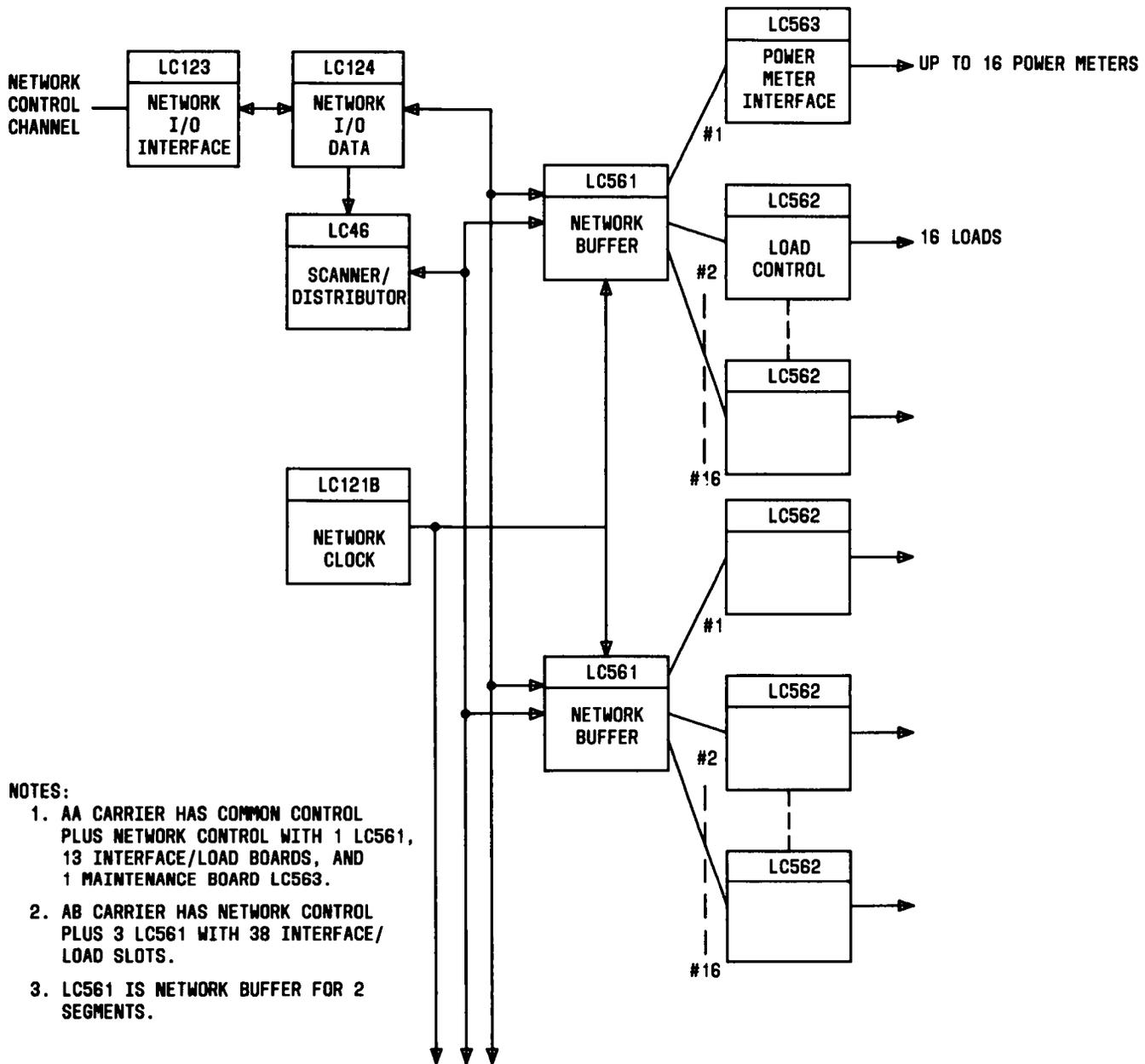


Fig. 48—Block Diagram of Network Control

four port addresses per board position are required. The carrier address is decoded and enables the corresponding carrier buffer circuit pack. Buffer circuit packs and segments have a direct relationship; eg, buffer number 2 is located in and electronically associated with units mounted in segment number 2. The 4-bit board address is decoded into 1 of 16 slots by

segments buffers. The 2-bit port address is decoded into 1 of 4 ports on the selected circuit pack.

**8.08** Once the carrier has been selected and enabled, the scanner/distributor sequentially selects the addressed slot and three adjacent ones and returns four status bits for each of four slots.

## A. Control Logic

**8.09** The processor is a 16-bit microprogrammed general-purpose computer. It performs the common control functions by executing a program stored in the random access memory (RAM). The processor communicates with other circuits via the 16-bit unidirectional address bus, bidirectional data bus, and 6-bit memory control bus. All internal data movement and manipulation is accomplished by operating on the 16-bit word in 4-bit segments.

## B. Memory and Memory Control (Fig. 49)

**8.10** System memory is comprised of two circuit packs in the control/energy carrier. The LC346 is a 64K RAM circuit, where the customer translations reside, and generic programs. The customer translations and generic programs are loaded from the tape cartridge onto the LC346. The LC454 circuit pack is the RAM address and timing control.

**8.11** The processor communicates with the memory by providing the address of the desired word on the address bus and issuing a read command. When the desired word is accessed, the memory control signals the processor that access of the desired word is complete.

**8.12** To write a word into the memory, the processor places an address on the address bus, the data word to be written on the data bus, then issues a write command. After the data word has been written into the proper memory location, the memory control signals the processor that the write function has been completed. The memory control contains a refresh timing circuit and a refresh address counter, with the control of memory allocated to either the processor request mode or the memory refresh mode.

**8.13** Once an energy communication service is installed and initialized, the tape remains functionally inactive until a power failure requires that the tape be reloaded or until customer translations must be changed. At approximately 23-hour intervals, the run tape procedure is executed and the tape is retensioned on the cartridge.

## 9. AUXILIARY CIRCUITS

**9.01** The processor interface circuits consist of the tape interface, data channels, extended I/O, and the MAAP. The LC366C data channel circuit

packs are used in the control/energy carrier. Each LC366C provides four data channels, and the LC171B and LC172B have two data channels for the tape interface and RMATS. When the LC171B and LC172B circuit packs are used for high-speed data transmission and reception, the circuit receives parallel data from the I/O bus and converts it to serial data for transmission to various types of peripheral equipment. Returning serial data is received and stored in a register. The position of a shorting plug determines whether the circuit is used for fast- or slow-speed data.

**9.02** The extended I/O circuit pack LC133B is in the control/energy carrier where it decodes data from the I/O address bus and distributes enable signals to the I/O circuits. The I/O circuit pack interfaces the processor I/O command leads, performs gating and timing functions for the extended I/O circuits, and provides separate command leads (such as read or write) to data links, the MAAP, and cathode ray tube (CRT) console via the peripheral interface circuit (PIC).

## 10. MAINTENANCE

### A. General Information

**10.01** The maintenance philosophy includes specific objectives and long-term goals to establish a practical maintenance plan. Design and development considerations include desired customer features with high reliability and ease of maintainability. The circuits are packaged on replaceable circuit packs. The components on a circuit pack are not replaceable in the field. The long-term goals (based on full usage of the provided maintenance aids) are as follows:



***In order to preclude electrostatic noise in the system, the frame shall be well grounded. Always attach authorized wrist grounding strap before working on system or handling circuit packs.***

- (a) Isolation of at least 95 percent of all troubles encountered by craft personnel
- (b) Isolation and repair time—an average of 1/2 hour after arrival on premises
- (c) Correction of 90 percent of circuit pack failures by the first circuit pack replacement.

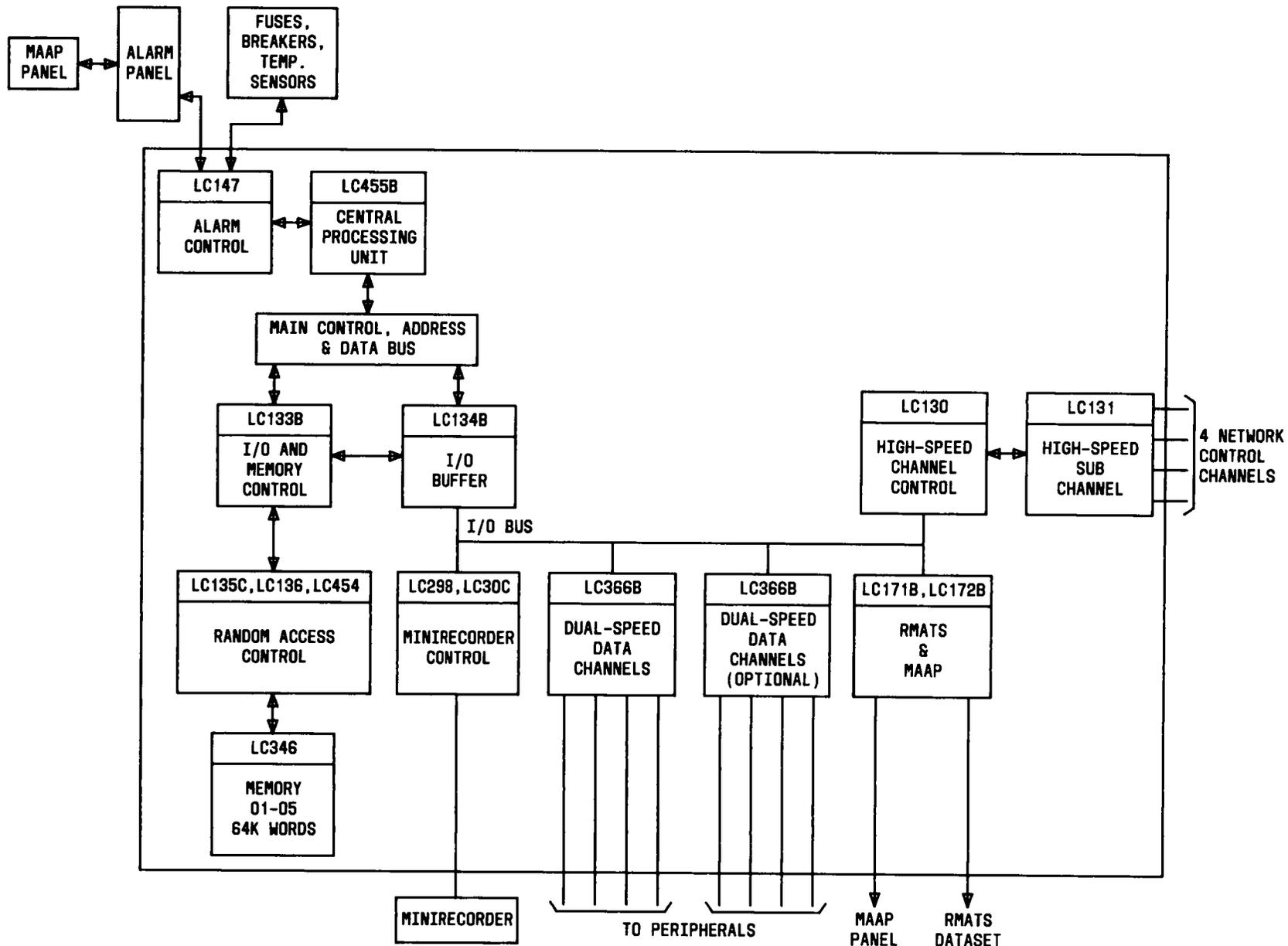


Fig. 49—Block Diagram of Common Control Segment

The ability of fault isolation to a single replaceable circuit pack minimizes replacement requirements and costs. It is estimated that less than 5 percent of the problems will be either software associated or more complex multiple faults. The isolation of such faults requires personnel with a high level of system knowledge and training. Automatic fault detection, fault reporting, and fault isolation aids are provided to support this maintenance plan. The maintenance plan calls for using these aids to isolate faults rather than replacing circuit packs as a fault isolating method.

## B. Alarms

**10.02** A major or minor alarm is generated when a fault condition is detected by software or hardware. The alarms are indicated by LEDs on the alarm panel and at the host communications system.

**10.03** A major alarm generally indicates a failure which removes a significant number of ports from service. A minor alarm generally indicates a failure which affects a limited number of ports. A major or minor alarm is always indicated by one or more fault indicator lights which help to isolate a fault to a specific function which has failed.

## C. Fault Indicators

**10.04** Software and maintenance circuitry constantly monitor critical functions. When a fault condition is detected, a major or minor alarm is generated, and one or more fault indicators light on the alarm panel.

**10.05** The alarms and fault indicators are designed to provide a quick index to specific maintenance procedures to restore the system to an operating condition.

## D. Maintenance Aids

**10.06** Certain maintenance aids are built into the system. These maintenance aids and associated functions are as follows:

- (a) **Maintenance and Administration Panel (MAAP) (Fig. 50):** This unit provides the basic craft interface with the system. It is used for diagnostic troubleshooting and for entry of translation and/or patch information. Loads, trunks, power meter interfaces, etc, may be individually selected and tested from this panel.

(b) **Alarm Circuit Panel:** This panel contains the major and minor alarm indicators, fault indicators, and controls used for system trouble analysis (performing diagnostic tests on the processor and memory). System initialization can also be accomplished from this panel.

(c) **Other Troubleshooting Aids:** These aids include indicating-type fuses, and test points on circuit packs.

## E. Maintenance Tools and Test Sets

**10.07** The following tools and test sets are recommended for maintenance:

- **Digital Multimeter (KS-20599, List 4):** Used for measurement of system voltages requiring greater accuracy and protection than the standard volt-ohm-milliammeter (KS-14510) can provide.
- **Carrying Cases (KS-21539, L1):** Used for protection and shipment of magnetic tapes and circuit packs.
- **Logic Probe (KS-22003, L1):** Used to detect absence or presence of system timing pulses. The logic probe can be ordered with the system.
- **X-Ray Program Tape (LC569):** Used for internal testing and troubleshooting.
- **Tape Control Unit.**
- **Load Board Loop-Around Cables ( ):** Used for testing load boards.
- **Wrist Grounding Strap CP401 or Equivalent:** Used to ground an individual who handles circuit packs to protect the circuit pack against static charges.

## F. Maintenance Philosophy

**10.08** Maintenance testing can be performed at an RMATS central facility to evaluate a trouble report prior to dispatching a repair person to the customer location. Refer to Section 554-010-130 for more information on RMATS. Trouble reports may indicate that an alarm exists, accompanied by a customer complaint. After analyzing the report, the mainte-

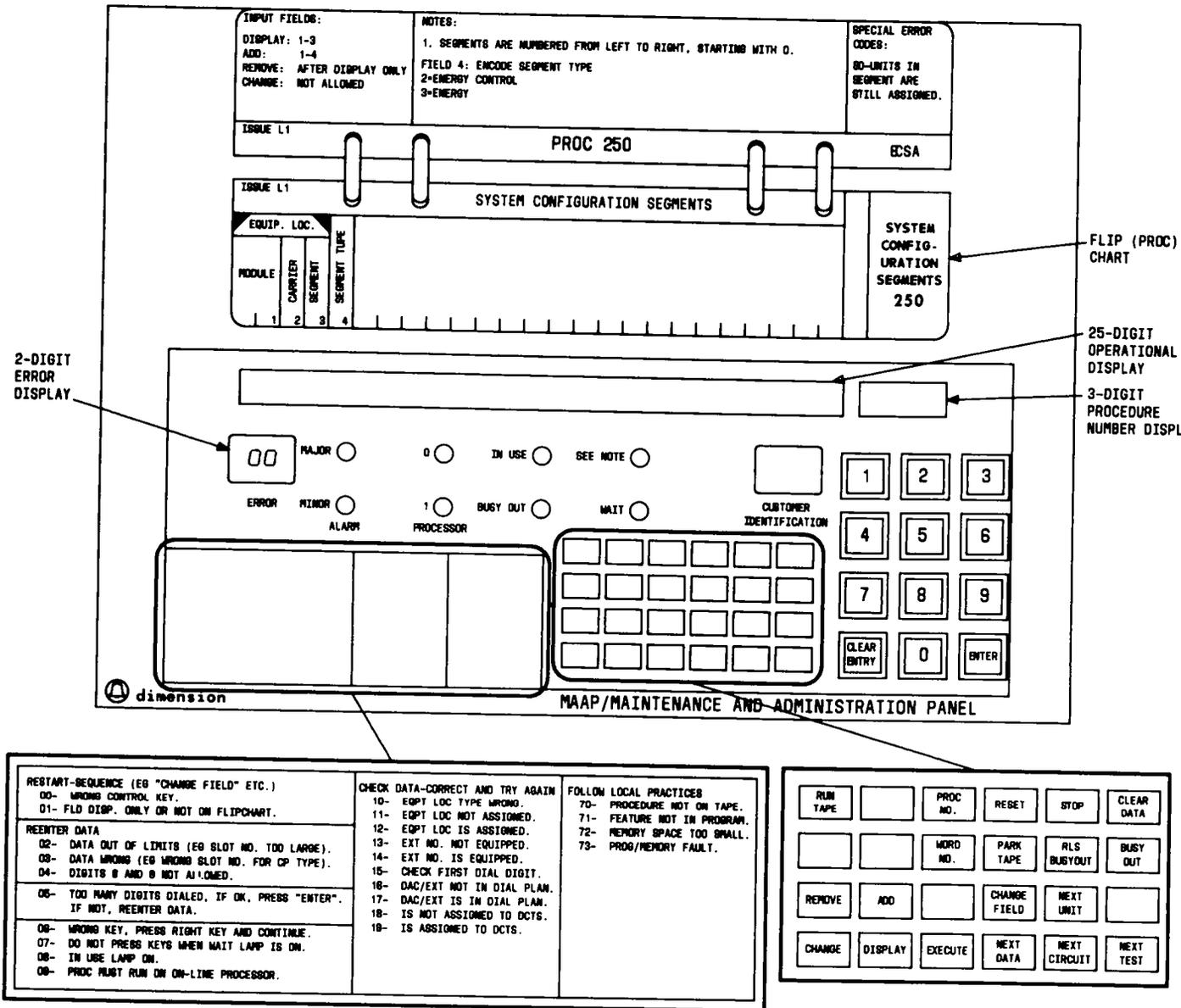


Fig. 50—Maintenance and Administration Panel

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nance personnel follow routine procedures established for restoring the system to operational status as follows:

- (1) Verify trouble report with CRT console attendant.
- (2) Observe the fault indicators and follow alarm procedures until all indicators and alarms are cleared.
- (3) Make tests with console and CRT.
- (4) Follow nonalarm troubleshooting procedures until all nonalarm troubles are cleared.

Certain indications may require the use of one of several maintenance displays or programmed diagnostic procedures via the MAAP. The results of these diagnostic procedures are displayed on the MAAP. Corrective action is usually simple circuit pack replacement. However, circuit pack replacement is never used as a trial-and-error method. Should use of the MAAP fail to isolate the problem, the logic probe provides an additional means of locating faults.

**G. X-Ray Program Package**

**10.09** The X-ray is a tape consisting of a series of computer programs used to exercise the system. Programs are run at the time of installation prior to any other system tests. After initialization, the X-rays run continuously unless a system failure is detected. If this occurs, a fault indication is given. No special hardware or test equipment is required but loop-around testing is recommended. For further information regarding X-ray, refer to Section 554-101-115.

**11. REFERENCES**

**11.01** The following *sections* are associated with the ECSA and, when available, may be used for additional information:

SECTION	TITLE
461-130-100	Backboards—Identification and Installation
554-000-000	DIMENSION PBX Numerical Index (refer to this index for TOP Documents)

SECTION	TITLE
554-000-100	DIMENSION PBX Miscellaneous Documentation Index (refer to this index for Administration and Maintenance Manuals)
554-010-101	DIMENSION Type PBXs—Input/Output, Interface, and Auxiliary Circuits—Maintenance Support Information
554-010-102	Peripheral Interface Circuit
554-010-130	DIMENSION PBX—Remote Maintenance, Administration, and Traffic System (RMATS-1)—Description and Operation
554-106-100	Energy Communication Service Adjunct—System Description
554-101-100	DIMENSION PBX—Feature Document Reference Guide
809-002-100	PBX Equipment Space Requirements
876-300-100	Electrical Protection—Station and PBX

**11.02** The following *schematic diagrams (SDs)* and associated *circuit descriptions (CDs)* are applicable and may be referred to when required:

SD-1E460-01	PBX System CSS201 Data Channel Repeater (Issue 3D)
SD-1E467-01	Peripheral Interface Circuit (Issue 6D)
SD-1E482-01	Maintenance and Administration Panel—(MAAP)—(Issue 6D)
SD-1E483-01	AC Distribution, Fan Assembly and Frequency Generator Circuit (Issue 18B)
SD-1E499-01	Energy Communications Service Adjunct (Issue W1F)
SD-97736-01	KS-21447 Minirecorder (Issue 2B)

**11.03** The following *J-drawings* are associated with the PBX and may be referred to for additional information:

J53135A-1	Basic Small Cabinet (Issue 1W7)
J53135AA-1	Control/Energy Carrier (Issue 1W9)
J53135AB-1	Energy Carrier (Issue 1W6)
J53135DA-1	Control and Alarm Panel (Issue 1W6)
J53135JA-1	AC Power Distribution, Fan Assembly, and Mini-Recorder (Issue 1W)
J53135TA	Stored Program Memory (Issue 1W2)
J53135K	Power Unit for ECU (LD12)
J53135KA	Equipment Control Unit (LD13)

J53135QA	Master Remote Unit (LD13)
J58882DC-1	MAAP (Issue 10W)

**11.04** The following *equipment drawings (EDs)* are associated with the PBX and may be referred to for additional information:

SECTION	TITLE
ED-1E301-01	Environmental Requirements (Issue 6)
ED-1E432	Three-Carrier Capacity Cabinet Assembly (Issue 1W)
ED-1E433	Three-Carrier Cabinet Front Cover Assembly (Issue 1W)
ED-1E446	Cabling Information (Issue 1W2)