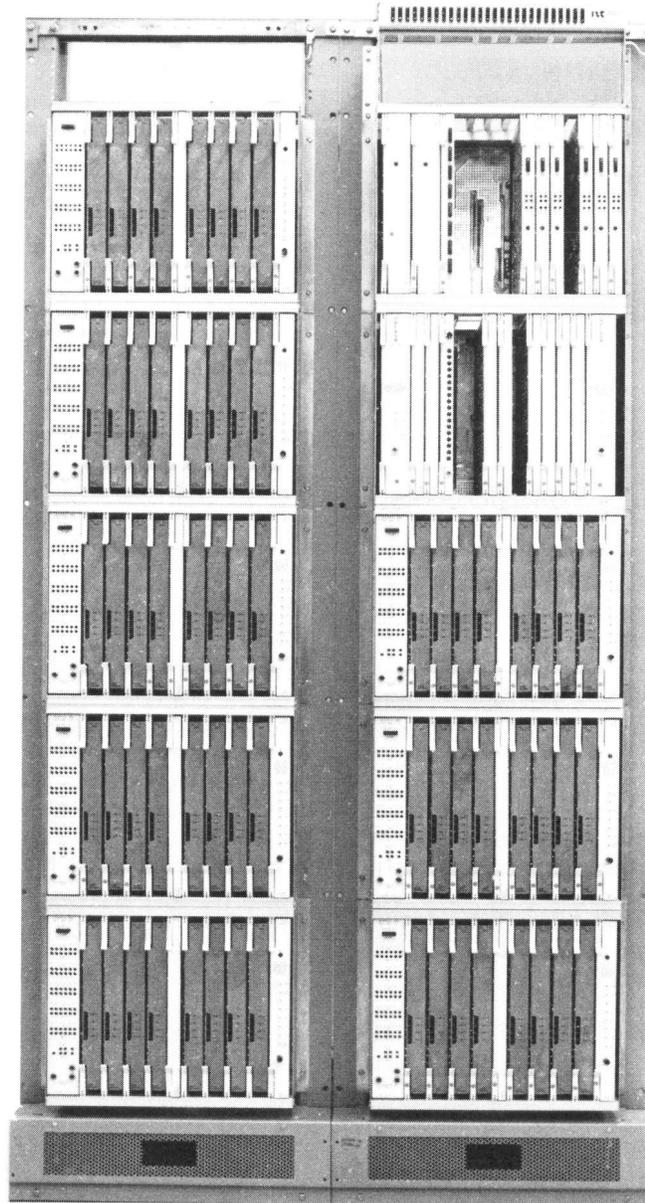


DMS-1* DIGITAL MULTIPLEX SYSTEM

REMOTE CONCENTRATOR TERMINAL

DESCRIPTION



363-020

* DMS-1 is a trademark of Northern Telecom Limited

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1. GENERAL

1.01 This section describes the Remote Concentrator Terminal (RCT) which is used to connect subscriber lines, at remote locations, to the DMS-1 Digital Multiplex System.

1.02 *Reason for Reissue:* to add new and revised information. Because this is a general revision, the changes are not marked.

1.03 The DMS-1 system can have up to four RCT. The number of RCT in each system depends on the number and location of the subscribers to be served. A maximum of 256 subscriber lines are served by the DMS-1. All 256 subscriber lines can be served by one RCT (lumped mode), or be distributed through up to four RCT (distributed mode).

1.04 Transmission between the RCT and the Control Concentrator Terminal (CCT), is through 1.544 Mb/s (DS1) digital lines. In each RCT, the voice signals and supervisory information transmitted from the CCT on the digital lines are extracted and decoded for connection to the individual subscriber lines. Similarly, return voice signals and supervisory information from the subscriber lines connected to the RCT are converted to digital format and inserted in the appropriate time slots for transmission on digital lines to the CCT.

1.05 The RCT is located either in a hut or in its own cabinet (Fig. 2).

2. PHYSICAL DESCRIPTION

BAY AND CABINET DESCRIPTION

A. Hut-Installed Bay

2.01 The RCT is available in steel or aluminum bays. Bay sizes are 7 foot (2135 mm), 8 foot (2440 mm), 9 foot (2745 mm), 11 foot 6 inch (3507 mm), and 11 foot 8 inch (3558 mm) for hut installation. Two bays are required (excluding the DMS-1 power bay) for a fully equipped RCT (256 subscriber lines). An initial bay contains the common equipment and up to three line shelves (96 lines). An extension bay contains up to five line shelves (160 lines). Figure 1 shows the layouts of fully equipped RCT bays. Initial bays with four line shelves (128 lines) on 9-foot frames, and six shelves (192 lines) on 11.5-foot frames are also available.

2.02 Line shelves can be added to a partially equipped RCT, when required, by mounting them on the initial or extension bay.

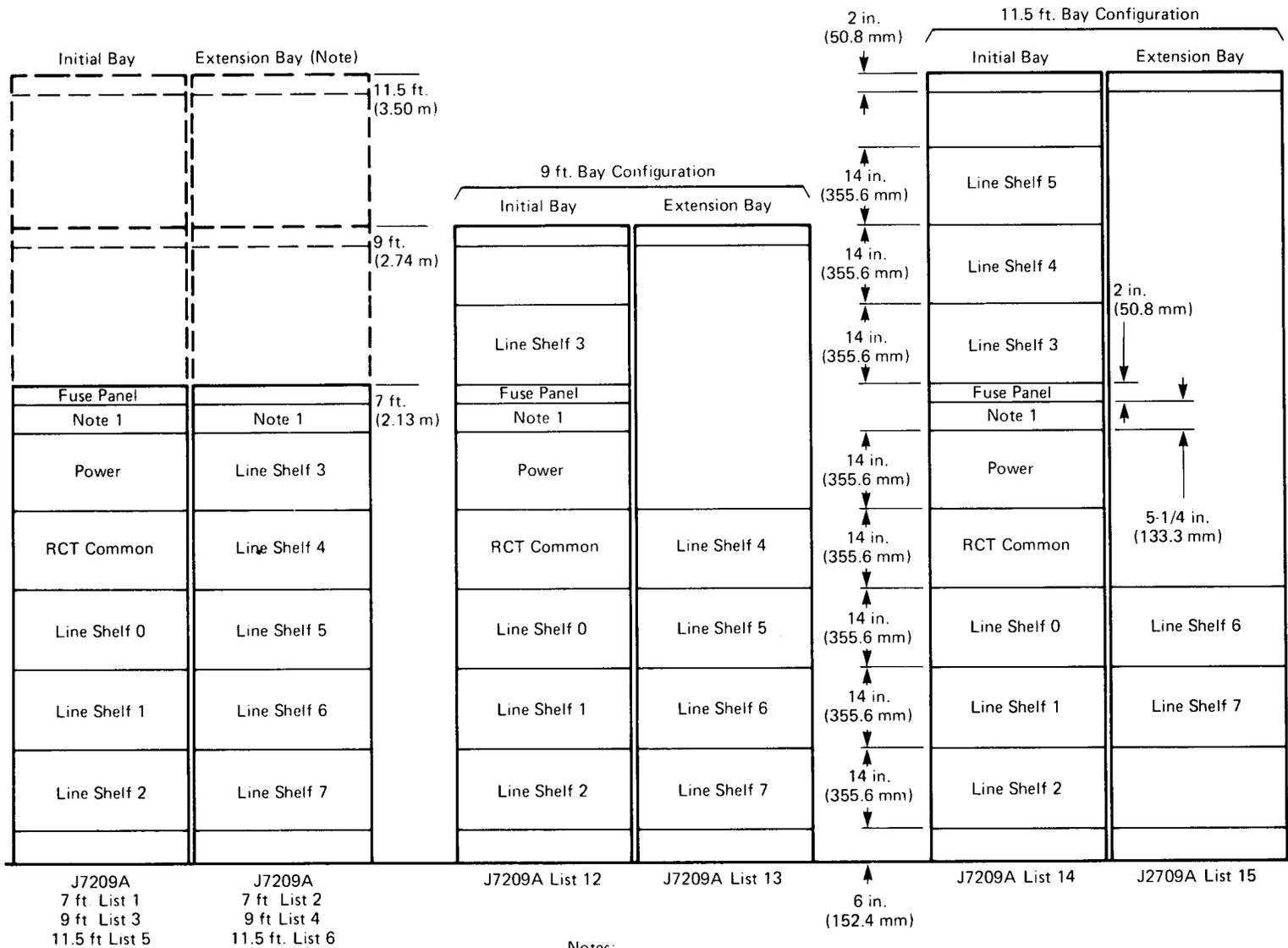
2.03 The fuse panel is installed above the other shelves on the initial bay. At the bottom of the initial and extension bays, panels with 115-V utility outlets are available as an option.

B. Cabinet-Mounted RCT

2.04 RCT cabinets provide a controlled working environment for the electronics and miscellaneous hardware required to service up to 128 subscriber lines. A single RCT cabinet is suitable for packaging the electronics, batteries, and cross-connect facilities required to service from 32 through a maximum of 128 subscriber lines. A second cabinet can be located at the same site back-to-back or side-by-side to the first cabinet to expand service to 256 lines.

The initial RCT cabinet (Fig. 3) is equipped with:

- a power shelf and a common-equipment shelf
- up to four line shelves
- order wire and fault-locate shelf
- fuse and alarm panel and a rectifier shelf
- protection and cross-connection facilities for up to 200 pairs
- heaters and thermostat
- temperature and door alarms.



Notes:

1. This space reserved for either an Order-wire and Fault-locate shelf, or a Star Protection shelf.
2. Extension bay can be either on the right side or left side of the initial bay.

Fig. 1(a) – RCT Bay Layout for Hut Installation – Steel-Duct Types

Notes:

1. This space reserved for either an Order-wire and Fault-locate shelf, or a Star Protection shelf.
2. Extension bay can be either on the right side or left side of the initial bay.

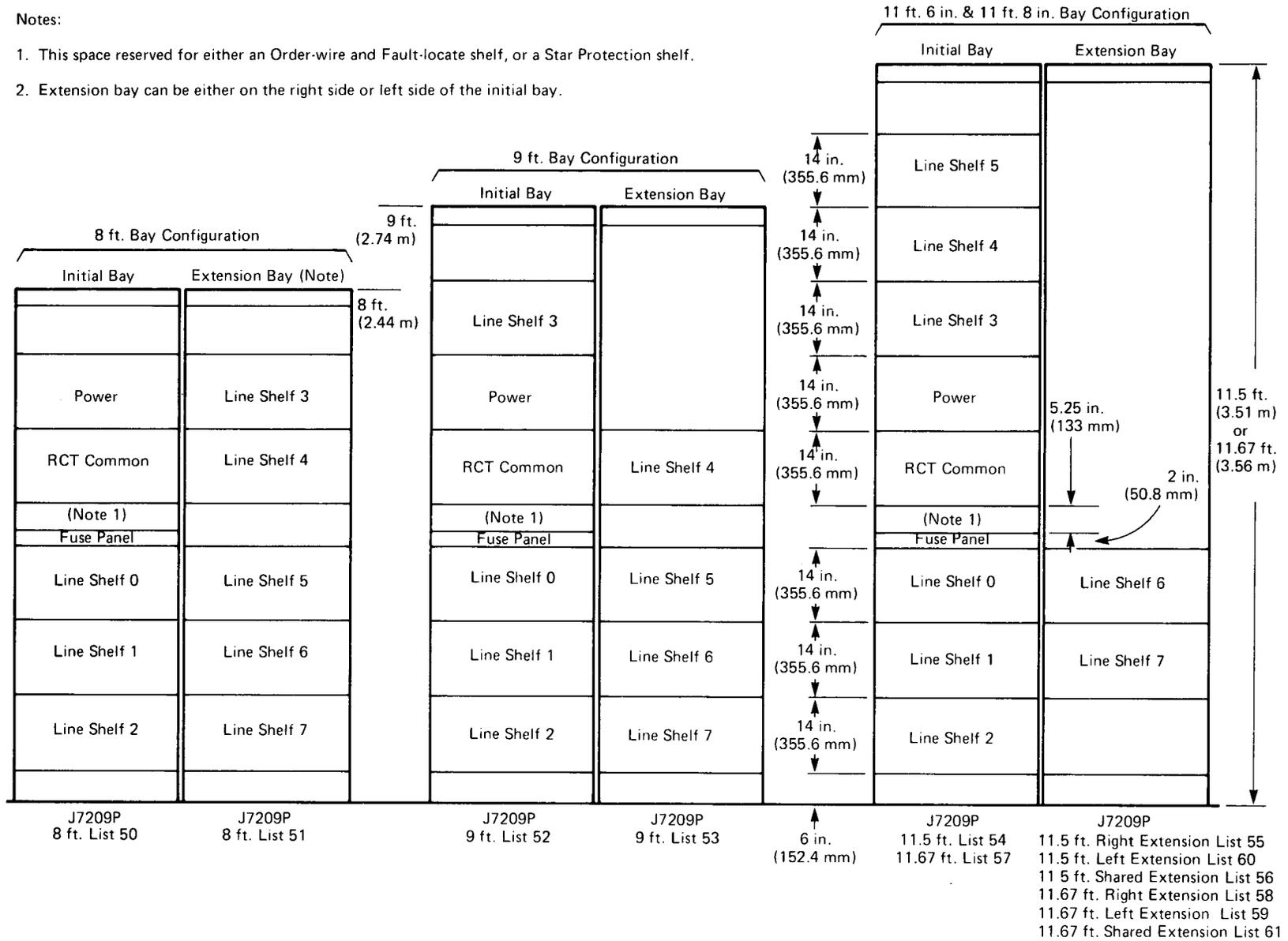
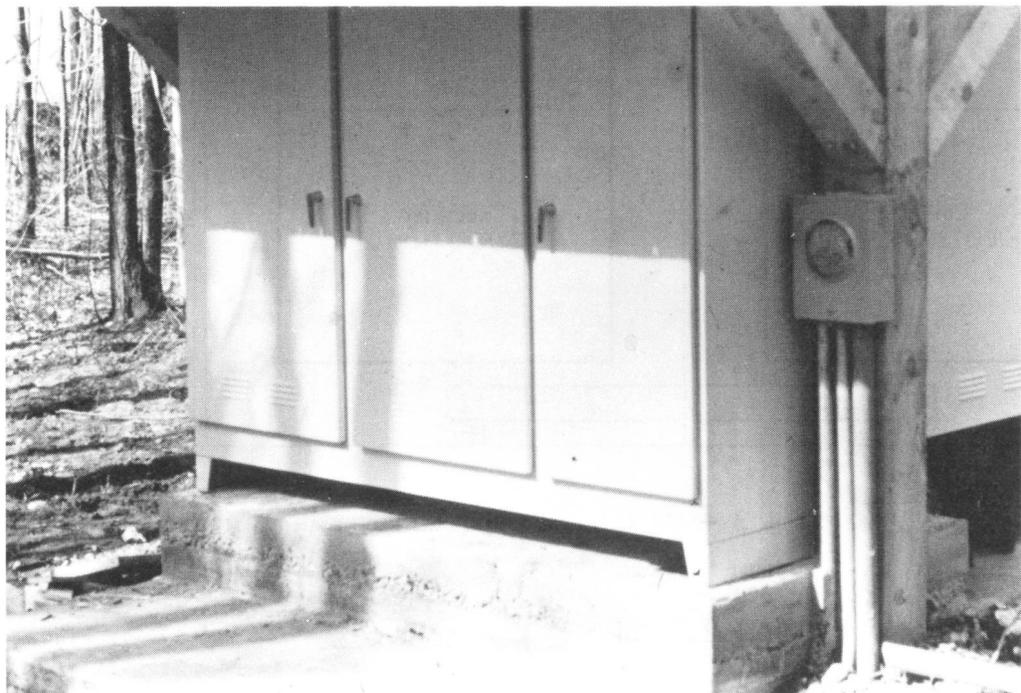
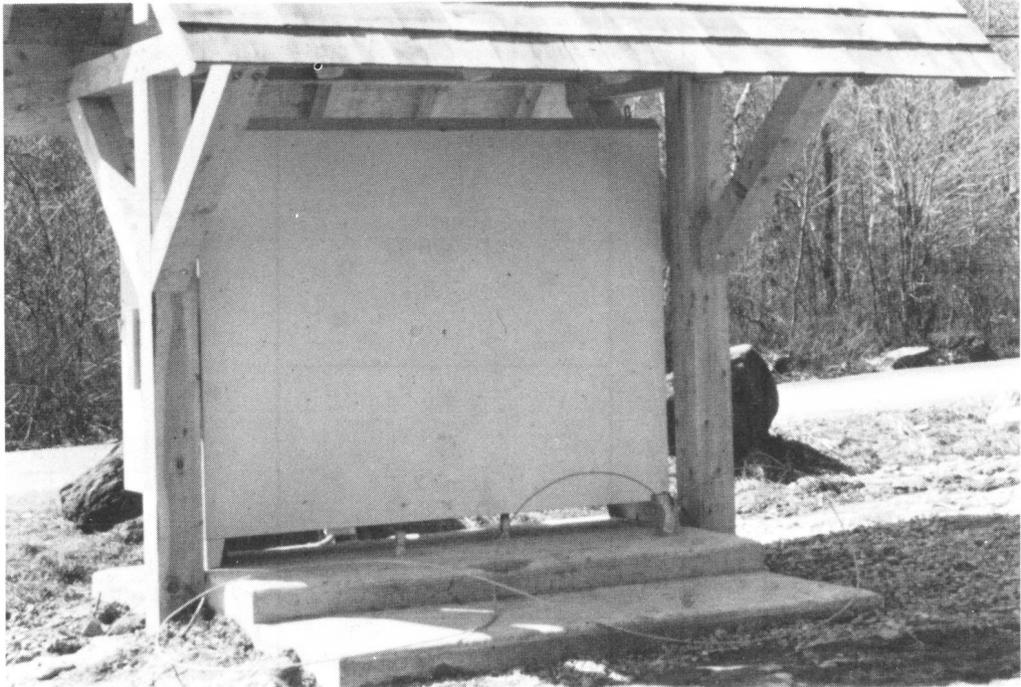


Fig. 1(b) – RCT Bay Layout for Hut Installation – Aluminum-Channel Types



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Fig. 2 — RCT Cabinet Mounting

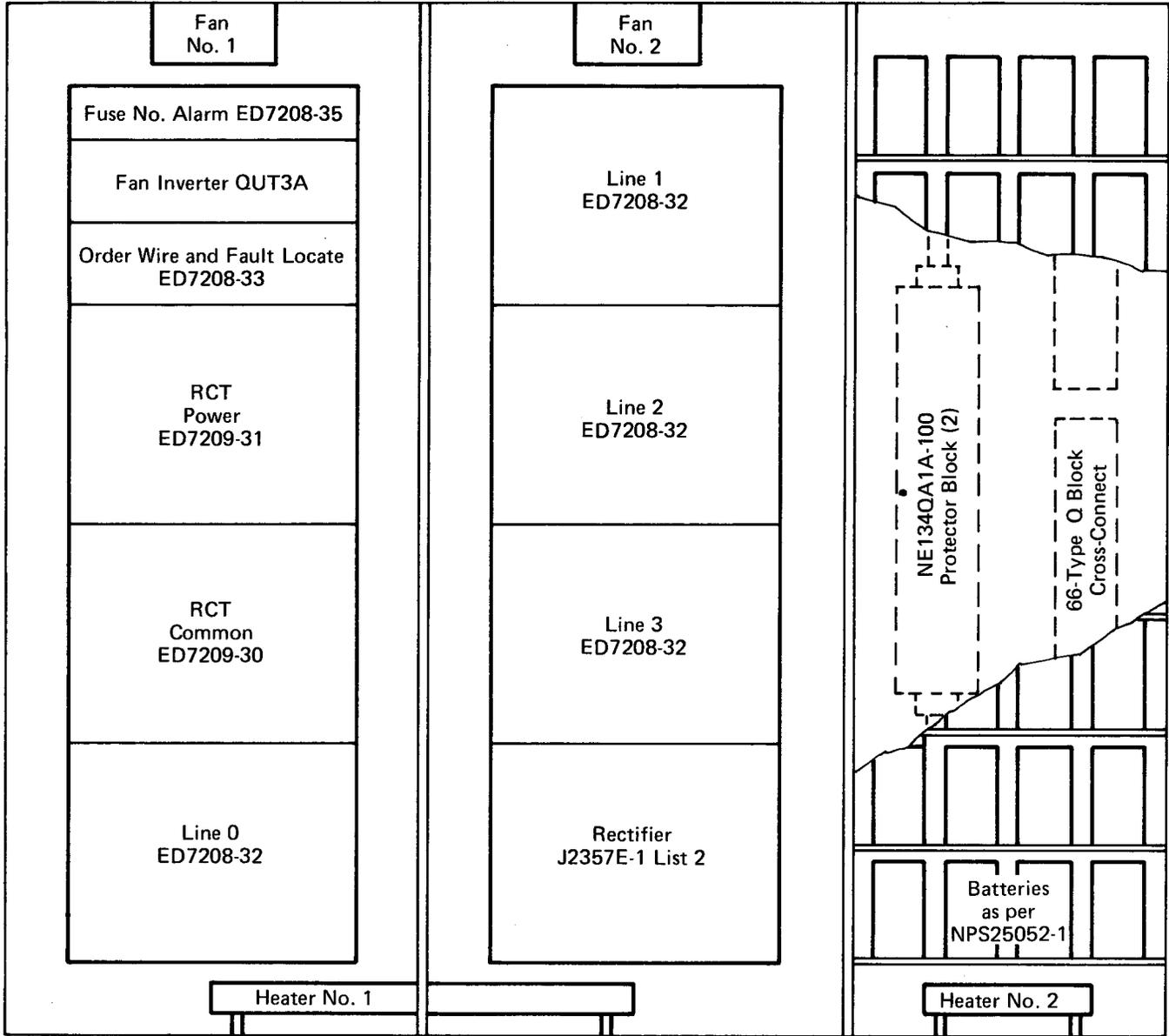


Fig. 3 – RCT Initial Cabinet Equipment, Layout

2.05 The RCT cabinet is designed for mounting on a concrete pad or pedestal. The cabinet is made of sheet steel and measures approximately 72 inches (1828 mm) high, 90 inches (2286 mm) wide, and 20 inches (508 mm) deep. The three cabinet doors are sealed to provide a weathertight environment for internal components. The cabinet is sufficiently strong to withstand shock, vibration, wind, snow, and ice loading. Ventilation openings are provided in the roof and doors, and are protected with filters against dust, snow, and insects. A false roof is used to decrease sun-loading effects and to cover the roof vents.

2.06 Within the initial cabinet, behind the left-hand and center doors, are mounting arrangements for seven 14-inch high and two 6-inch high equipment shelves on a standard 19-inch frame (Fig. 3). The mounting frames are hinged for both front and rear access to the shelves. Rear-mounted connectorized intercabling allows the installation or removal of shelves for maintenance and service expansion. Connector blocks, protection blocks, and battery trays are located behind the right-hand door. The battery trays can accommodate a maximum of thirty-two, 12-V, 20-A-hour, gelled-electrolyte batteries.

2.07 The initial cabinet is equipped with thermostatically controlled fans and heaters which control the inside temperature for maximum equipment reliability, regardless of outside weather conditions.

2.08 The number of subscriber lines served at one location can be expanded to 256 by either installing a second initial cabinet (with common equipment and power) or an extension cabinet. The extension cabinet is identical in size and shape to the initial cabinet. The extension cabinet is equipped with:

- up to four line shelves
- protection and cross-connection facilities for up to 200 pairs
- heaters and thermostat
- temperature and door alarms.

Wiring between the initial and extension cabinets passes through an interconnecting duct on the rear wall.

TERMINAL DESCRIPTION

A. RCT Shelf Description

2.09 There are four types of shelves, plus a fuse panel in an RCT. All are 17.5 inches wide for mounting in standard 19-inch racks. The height and depth of the different shelves and the fuse panel are:

| SHELF | HEIGHT | DEPTH |
|---------------------------------------------|-----------------------|-----------------------|
| common shelf power shelf line shelves | 14 inch (355 mm) | 15 inch (380 mm) |
| order-wire and fault-locate shelf | 5.25 inch (135 mm) | 13.5 inch (343 mm) |
| fuse panel | 2 inch (51 mm) | 13.5 inch (343 mm) |

(a) one digital line fails: by switching to the protection DS1 line if protection-switching is installed; or by subscribers being reassigned by the CCT from channels on the failed line to idle channels on the other working DS1 line (up to the 24-channel capacity);

(b) one common power converter fails: by maintaining operation on the other digroup powered by the other power converter;

(c) one line power converter fails: service is lost to the 32 lines on the failed shelf but continues to the other seven line shelves;

(d) DS1 lines to one arm at a star-configured system fail: by bypassing the failed arm, provided the star switch option is installed at the CCT.

2.10 The common shelf, power shelf, and line shelves are constructed of two steel sideplates. Two aluminum extrusions at the top and two at the bottom, support nylon guides for the circuit packs and a Printed Circuit Board (PCB) backplane (Fig. 4). The order-wire and fault-locate shelf, with the exception of wire-wrapped connectors instead of a PCB backplane, is of similar construction.

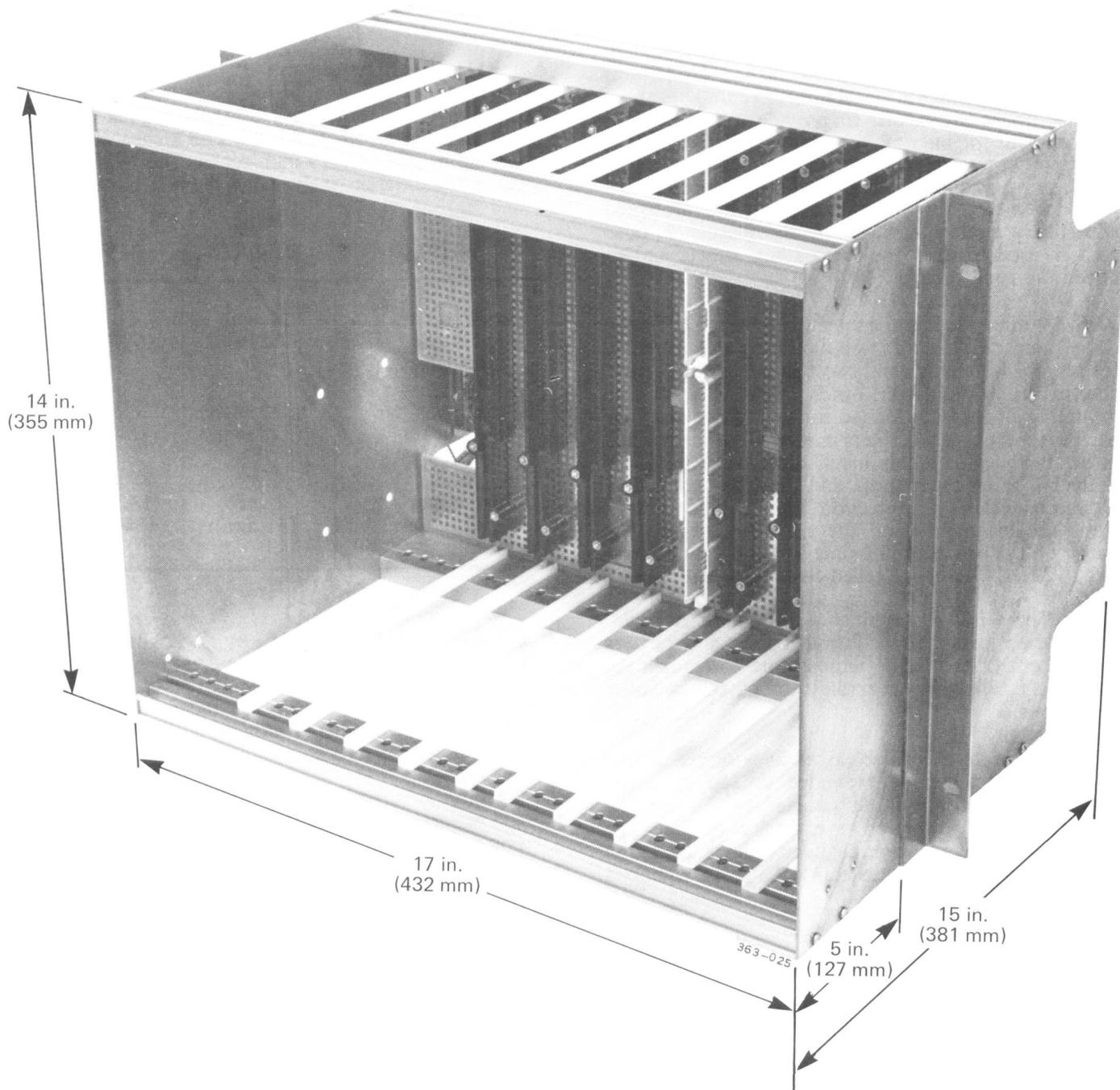


Fig. 4 — Typical Shelf Construction

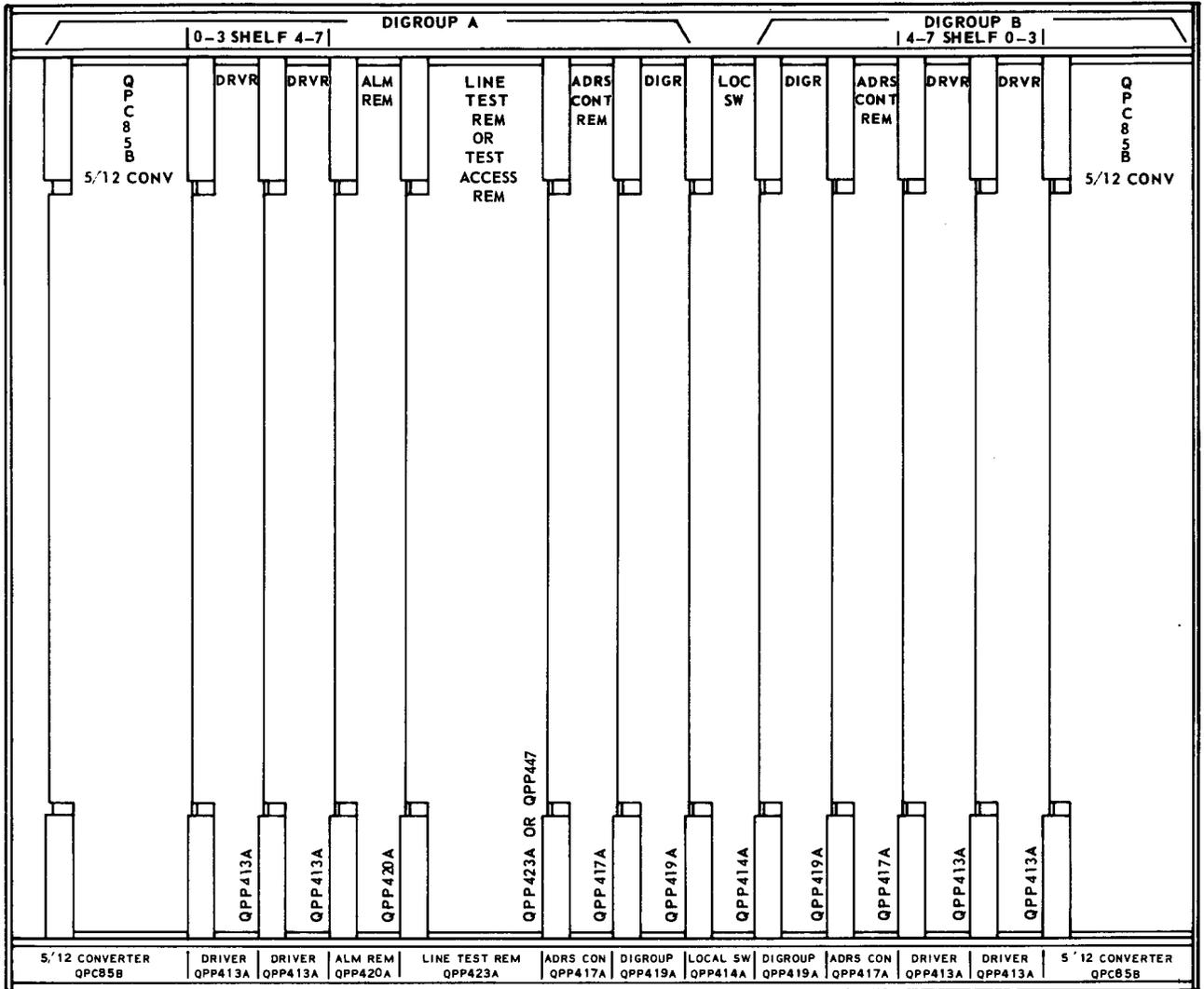


Fig. 5 – Common Shelf Layout

2.11 Contact pins are swaged and soldered into the backplane and mate with the connectors on the circuit pack. The contact pins are protected and aligned by plastic shrouds bolted to the PCB backplane. The shrouds also align the circuit pack connector for proper mating. Printed paths on the backplane interconnect the contact pins.

2.12 Interconnections between the shelves are made by connectorized cables which plug into connectors mounted and soldered onto the backplane.

2.13 *Common Shelf (Fig. 5)*. There is one common shelf in the RCT. The common shelf contains all of the digroup-associated transmission circuit packs, plus two common power converters, the alarm-remote, and the line test circuit packs.

2.14 *Power Shelf (Fig. 6)*. There are two versions of the power shelf. One version is equipped with a power backplane for use with lines that operate with ac/dc ringing only. The second version is equipped with an FSR backplane for use with lines that operate with ac/dc, FSR, or superimposed ringing. Details on the application of the two versions are available in drawing J7209A-1, Engineering Note 65. Both versions of the shelf contain ring generator and ring distribution circuit packs as well as repeaters and protection switching circuits. In addition, the FSR backplane versions contain QPP430 or QPP435 circuit packs for FSR or superimposed ringing. Up to six repeaters can be plugged into the power shelf in an intermediate RCT equipped with two working and one protection digital lines. The ac/dc ringing transformer is mounted on the left sideplate of the power shelf within the shelf. For superimposed ringing, an additional ringing transformer is mounted on the right sideplate. The ring generator PCB is cut out to clear the transformer.

2.15 *Line Shelf (Fig. 7)*. The line shelf contains the following line-associated circuit packs and apparatus:

- up to eight line circuit packs
- buffer circuit pack
- line power converter
- jackfield (optional).

There are eight line shelves in a fully equipped RCT.

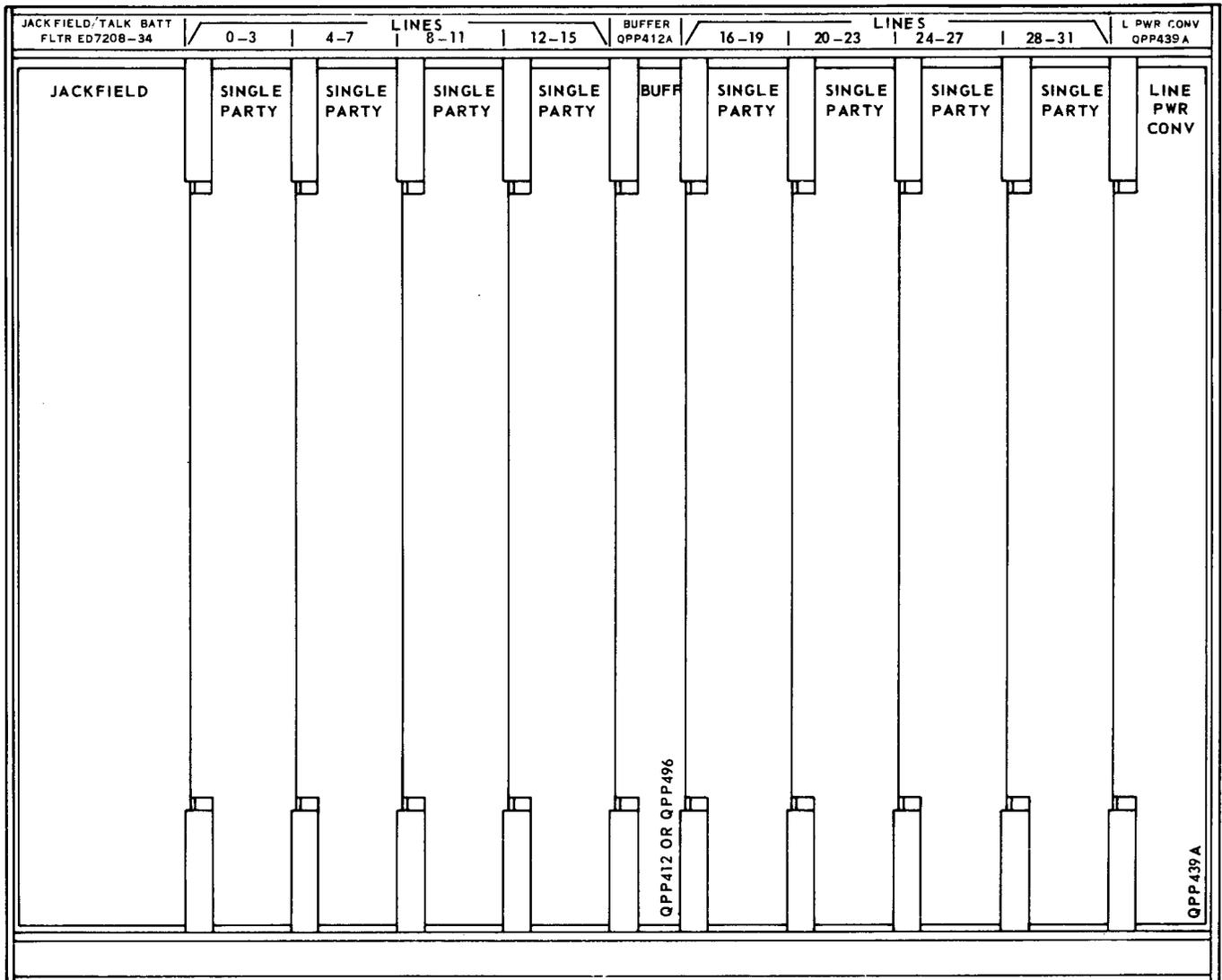
2.16 *Order-Wire and Fault-Locate Shelf*. The order-wire and fault-locate shelf contains circuit packs for termination and access to the order-wire and fault-locate pairs of the LD-1 line. See 363-2011-103 for a detailed description.

2.17 *Fuse Panel (Fig. 8)*. The fuse panel is used for the distribution of power to each of the circuit pack shelves.

B. Circuit Pack Description

2.18 The RCT circuit packs (Fig. 9) are 12.5 inches (318 mm) high, and 10 inches (254 mm) deep. Each circuit pack is equipped with a rear-mounted PCB connector and a faceplate. The PCB connector mates with the pins swaged and soldered to the shelf PCB backplane to provide signal paths. The faceplates are used to mount controls, indicators, and test points.

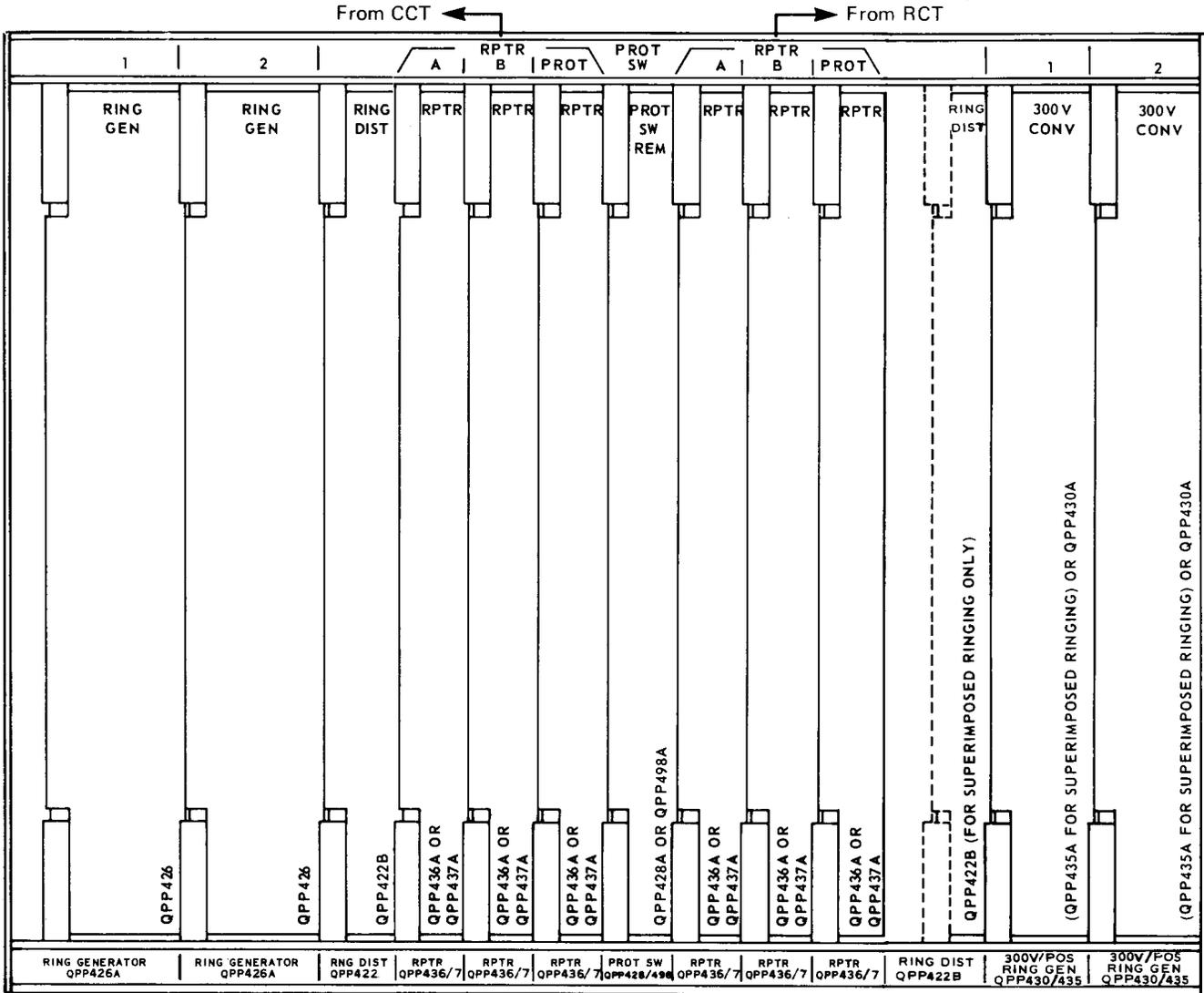
2.19 The circuit packs are held in position by nylon guides on the shelf and are secured by latches on the faceplate. Each circuit pack is keyed to prevent insertion of the circuit pack into the wrong slot on the shelf.



- Notes:
1. Line cards can be any required types but must obey the restrictions of 363-2011-150, Table D, Note 2.
 2. Line shelf is shown equipped with QPP412A BUFF. A separate designation strip is supplied when QPP496 BUFF is installed.
 3. Jackfields are available with line and equipment drop jacks with grounded sleeves, or line drop monitor jacks with isolated sleeves.

(a) AC/DC Ringing – Power Backplane

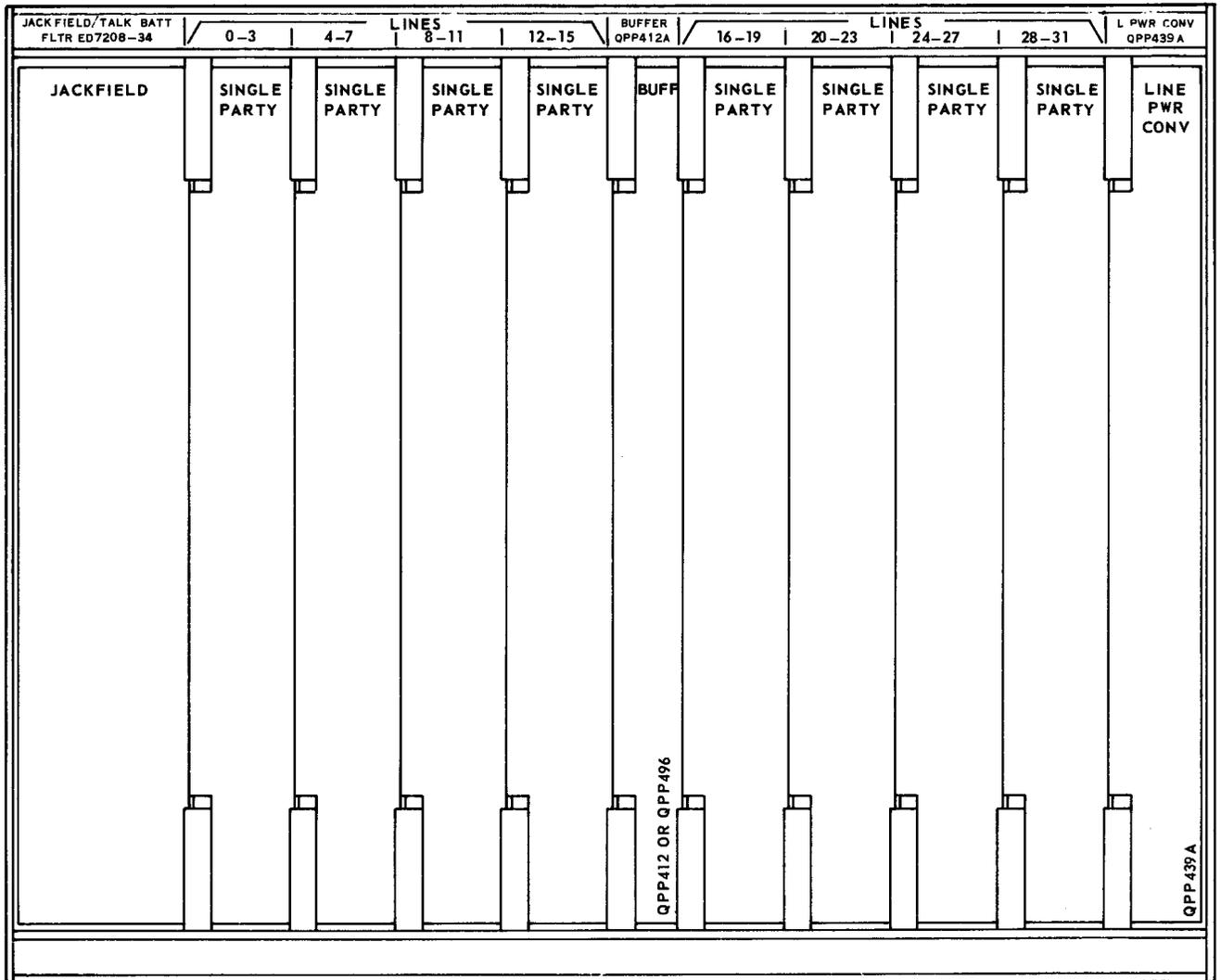
Fig. 6 – Power Shelf Layout



Note: Layout is for a Shelf Fully-Equipped with Both AC/DC and Frequency-Selective Ringing Supplies.

(b) AD/DC, Frequency-Selective, and Superimposed Ringing – FSR Backplane

Fig. 6 – Power Shelf Layout



- Notes:
1. Line cards can be any required types but must obey the restrictions of 363-2011-150, Table D, Note 2.
 2. Line shelf is shown equipped with QPP412A BUFF. A separate designation strip is supplied when QPP496 BUFF is installed.
 3. Jackfields are available with line and equipment drop jacks with grounded sleeves, or line drop monitor jacks with isolated sleeves.

Fig. 7 – Line Shelf Layout

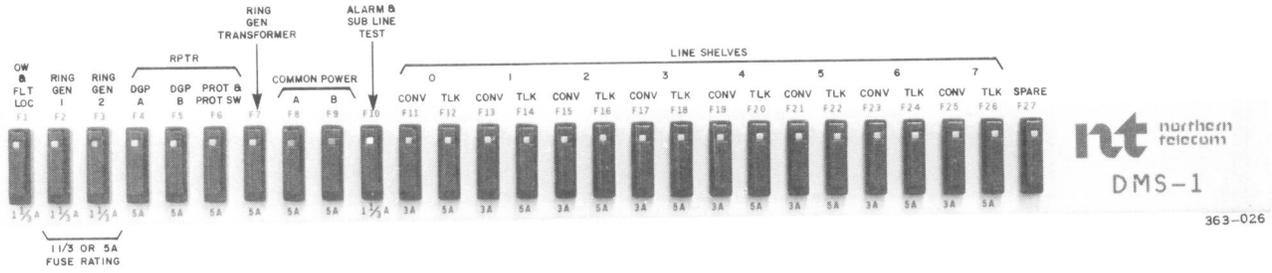


Fig. 8 — Fuse Panel Layout

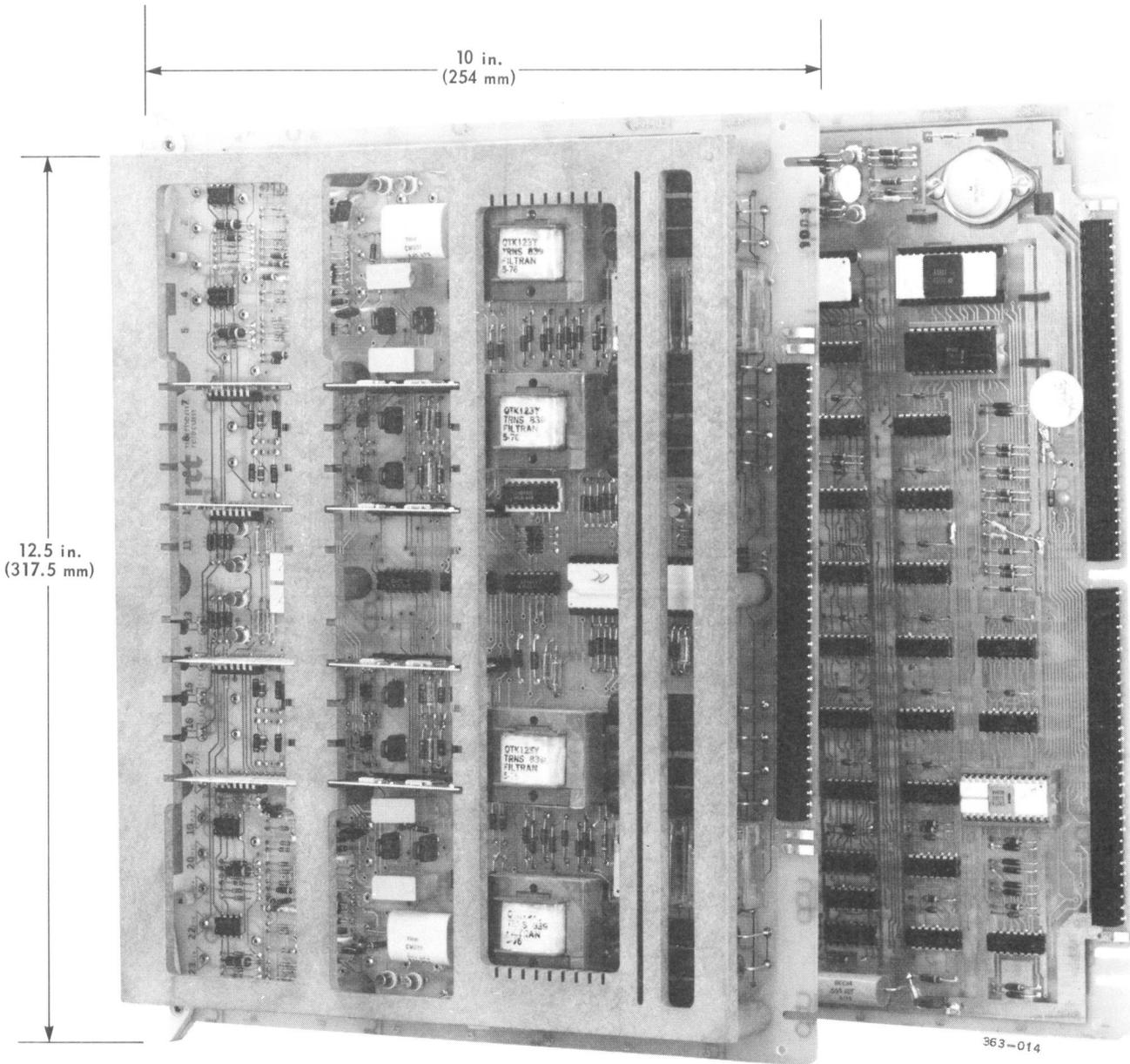


Fig. 9 — Typical Circuit Pack Dimensions

3. FUNCTIONAL DESCRIPTION

A. Block Diagram (Fig. 10)

3.01 The block diagram of the RCT is divided into four main functional areas:

- (1) transmission block
- (2) peripheral block
- (3) digital line termination block
- (4) power block.

Transmission Block

3.02 The transmission block in the RCT is subdivided into two groups of circuits:

- (1) *Line Associated Circuit Packs*. Line and buffer circuit packs which convert voice signals on the subscriber lines to and from the digital bit streams.
- (2) *Digroup Associated Circuit Packs*. For each working DS1 line, one set consisting of a driver, address control remote, digroup, and local switch circuit packs.

Peripheral Block

3.03 The circuit packs in the peripheral block:

- (a) monitor and transmit alarm conditions, and
- (b) carry out line tests and maintenance operations.

Digital Line Termination Block

3.04 The circuit packs of the digital line termination block are the interface between the RCT and the DS1 line. The circuits also provide protection switching to a protection line on either a 1-for-1 or 1-for-2 basis.

Power Block

3.05 The power block provides all necessary voltages to the electronic circuits. Power is supplied from the office -48 V battery supply; or from a 115/230-V, 60-Hz supply through a rectifier and backup battery circuit. Ring generators provide

ac/dc ringing power; 300-V converters power the frequency-selective ringing circuits; positive ring generators supplement the ac/dc ring generators for superimposed ringing.

B. Signal Path — Transmission and Control (Fig. 11 and 12)

3.06 The incoming PCM signal from the CCT or the preceding RCT is first processed as follows:

- (a) the PCM signal is converted to a unipolar bit stream;
- (b) in the digroup circuit packs, clock and frame timing are extracted and the RCT circuits are synchronized to the framing pattern;
- (c) in the address control circuit pack, the B-words (control codes) are extracted from the bit stream; a B-word for a new channel assignment is error-checked and then stored in the appropriate memory.

3.07 The digital bit stream is fanned out through the driver and buffer circuits and passed on each of the eight receive PCM buses to the 32 line circuits on each of the eight line shelves. At the same time, at the start of each assigned time slot, an enabling signal is generated in the address control-remote circuits and steered through the appropriate driver and buffer circuits to the line circuit assigned to the time slot.

3.08 In the line circuit the digital signals are decoded into voice and supervisory signals and passed to the subscriber over the subscriber line. Return voice and supervisory signals from the subscriber line are encoded into the now vacant time slot and passed on the line-shelf transmit PCM bus through the buffer. From the buffer, the signals are steered through either the digroup A or B driver to the address control remote circuits. In the address control remote circuits, the PCM signals are recombined with control codes for return to the CCT through the digroup, protection-switch, and repeater circuits.

C. Signal Path — Local-Link (Fig. 13)

3.09 When the CCT determines that two subscribers served by one RCT can be connected together, the channel assignments on the local-link digital path are written into the memories of the local switch circuit pack (see 363-2011-100 and 363-2011-101 for details on control codes and local link detection).

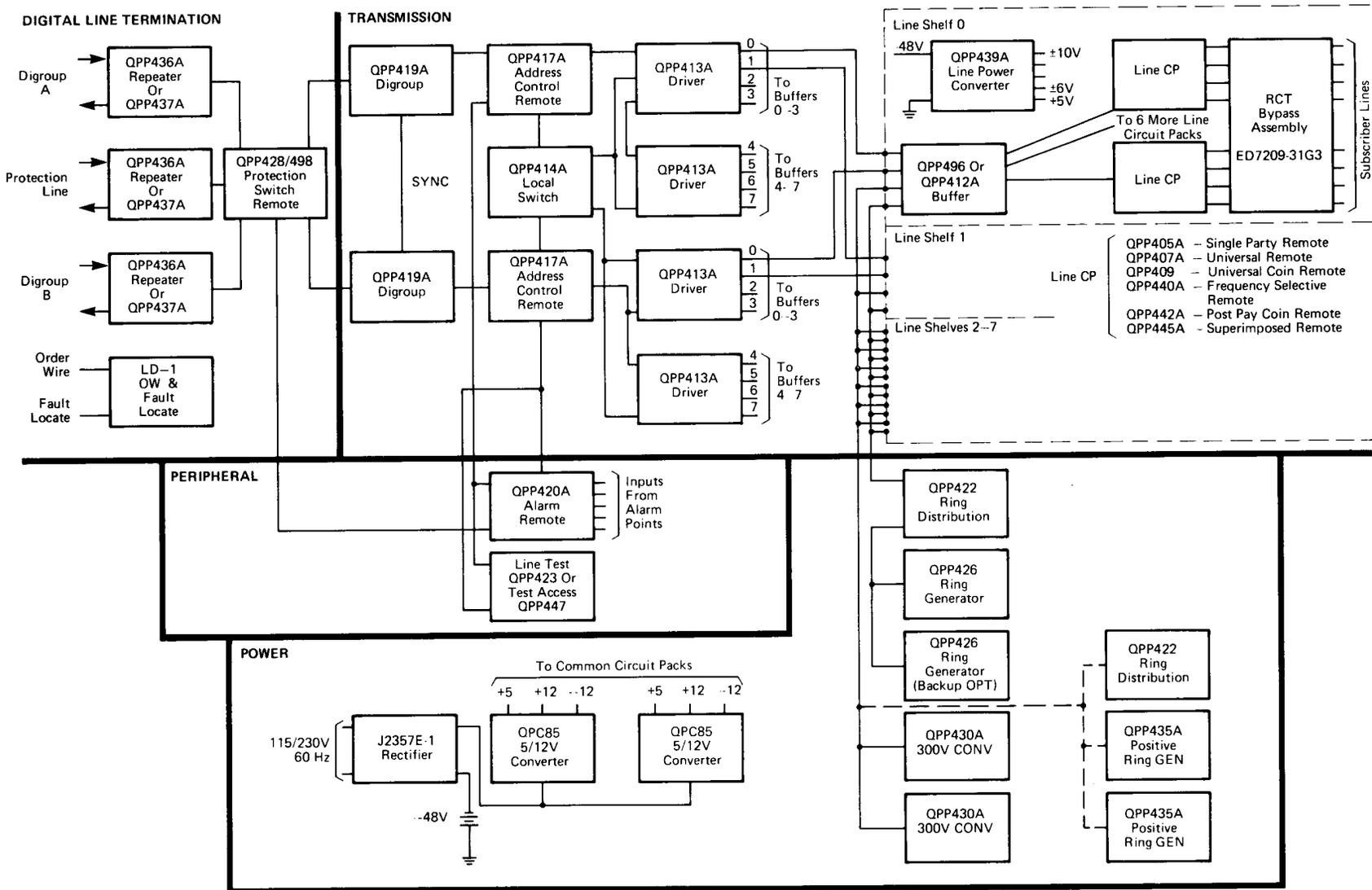


Fig. 10 - RCT Block Diagram

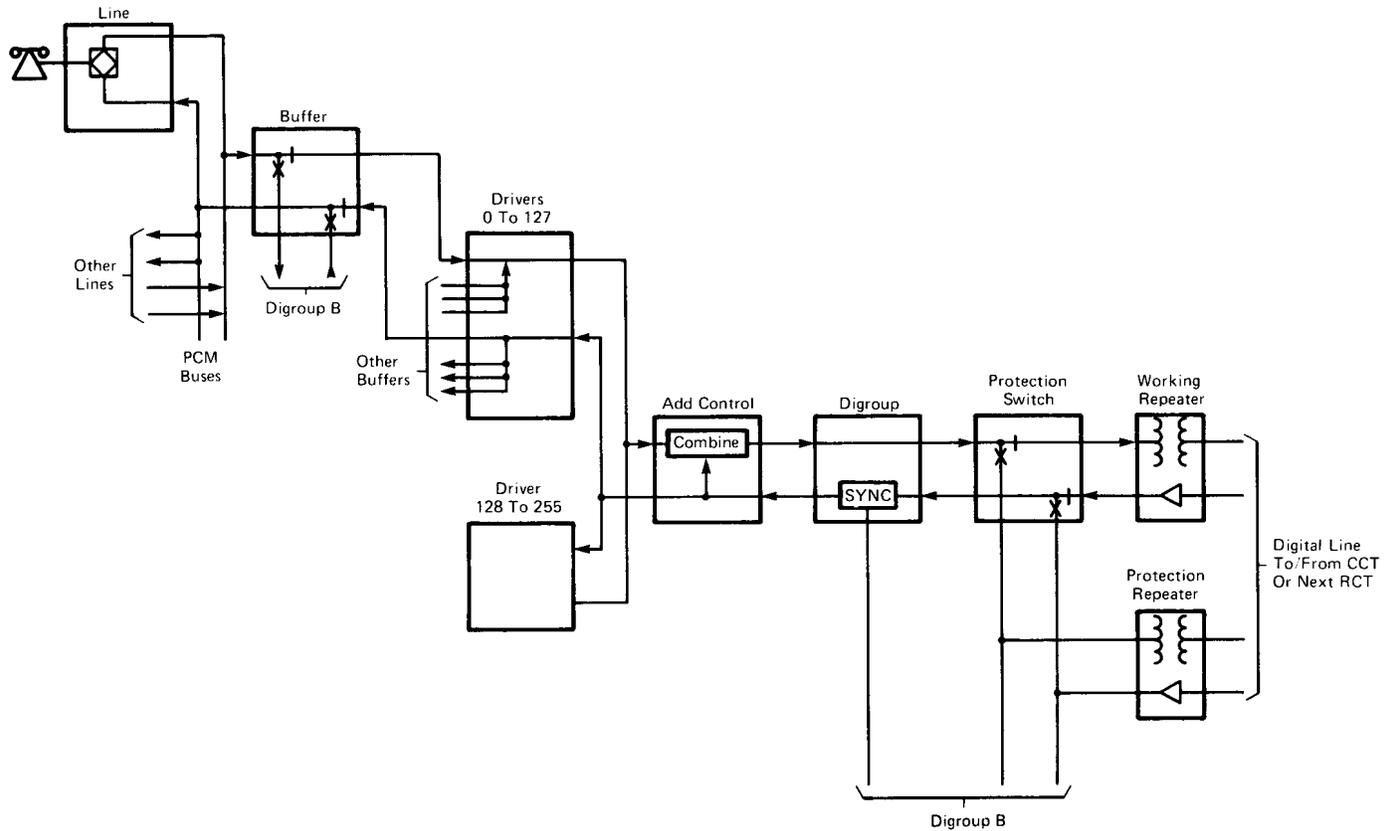


Fig. 11 - RCT Transmission Path

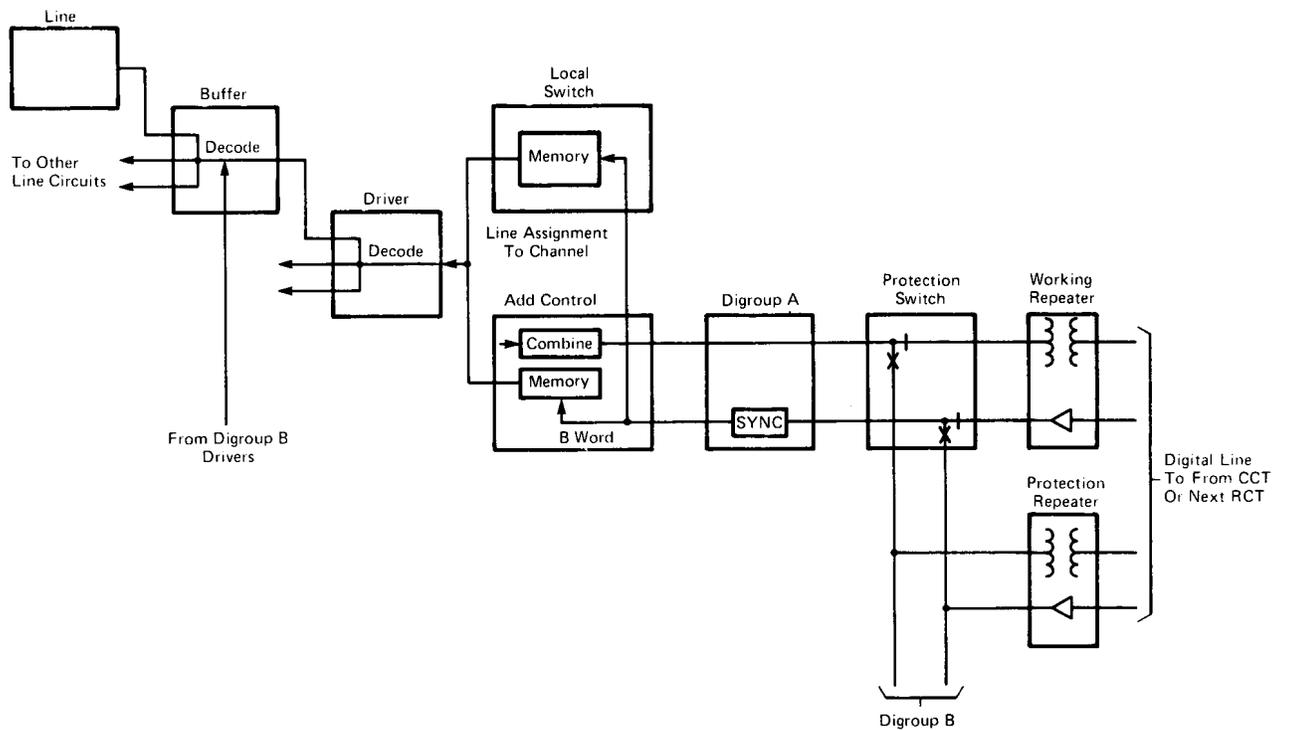


Fig. 12 - RCT Control Path

3.10 The operation of the drivers, buffers, and line circuits for a local link transmission is similar to that described in 3.06 through 3.08 for a remote (CCT/RCT) transmission, except that the PCM signal, instead of being steered through the address control-remote circuits by the driver, is steered through the local link circuits. In the local link circuits both subscribers are assigned to a local link channel, thus freeing the PCM channel.

D. Power

3.11 The RCT equipment is powered:

- (a) from the office 48-V battery supply, or
- (b) from the J2357E rectifier (Fig. 14) and backup battery supply through the fuse panel.

3.12 Voltages for common circuit packs are provided by two power converters. One power converter powers the circuit packs associated with digroup A and the peripheral packs; the other converter powers digroup B associated circuit packs.

3.13 One line power converter is required on each line shelf. The line-shelf converters are separately fused on the fuse panel.

E. Reliability

3.14 The RCT is able to survive failures and continue to provide service when:

- (a) one digital line fails: by switching to the protection DS1 line if protection-switching is installed; or by subscribers being reassigned by the CCT from channels on the failed line to idle channels on the other working DS1 line (up to the 24-channel capacity);
- (b) one common power converter fails: by maintaining operation on the other digroup powered by the other power converter;
- (c) one line power converter fails: service is lost to the 32 lines on the failed shelf but continues to the other seven line shelves;
- (d) DS1 lines to one arm at a star-configured system fail: by bypassing the failed arm, provided the star switch option is installed at the CCT.

F. Maintainability

3.15 The RCT is equipped with both automatic and manual circuits for detecting both system and circuit pack failure, and for indicating the location and type of failure.

- (a) *Alarms.* Many of the circuit packs are monitored continuously; alarms are generated if a failure occurs. The alarm is displayed, and the applicable major or minor office alarm is operated.
- (b) *Audit-Memory.* Channel idle/busy memory locations are automatically scanned and compared to the system controller master memory. Faults are exercised by special write/read routines. If memory has failed, an alarm is generated, and type and location of the fault is indicated on the alarm circuit pack.
- (c) *Audit-Line.* All line circuits at both CCT and RCT are automatically exercised by operating the supervisory detectors. Single faults are localized to one line circuit pack; multiple faults are analyzed to determine whether the trouble is due to a buffer or driver failure. Backup circuits are also exercised by switching line circuit scan steering between the digroup A and B transmission blocks. Failures are alarmed and indicated on the alarm-office circuit pack at the CCT.
- (d) Manual system testing and fault location is carried out through the test circuit packs. (See 363-2011-101, QPP424 Line Test-Office and QPP425 System Test.)

4. CIRCUIT PACK FUNCTIONS

A. Transmission Block

General

4.01 The transmission block is subdivided as follows:

- (a) line-associated circuit packs:
 - QPP405 Single-Party, Remote
 - QPP407 Universal, Remote
 - QPP409 Universal Coin, Remote

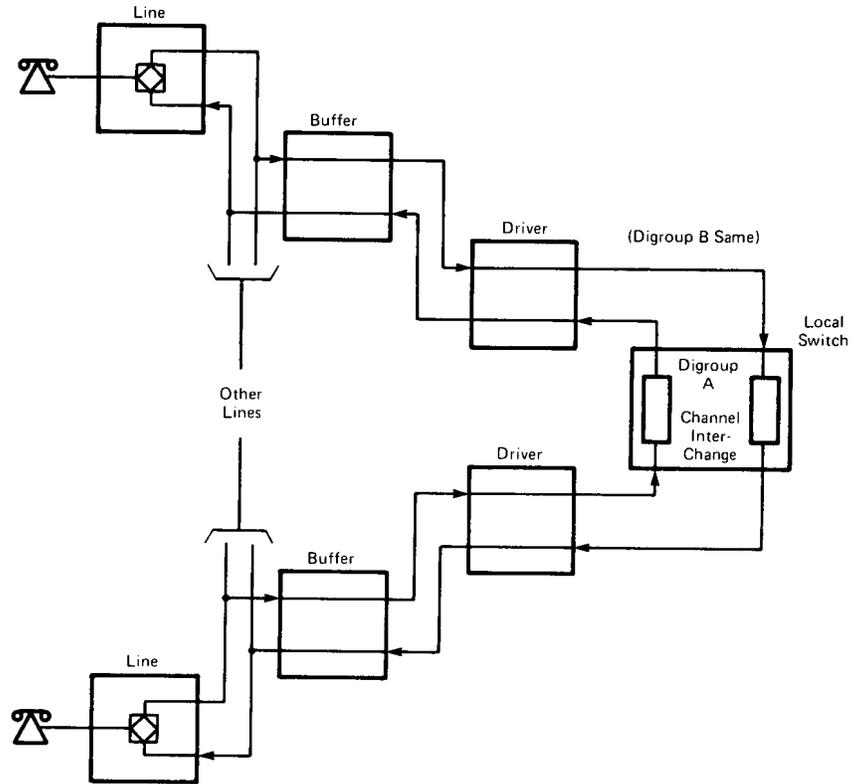


Fig. 13 -- RCT Local Link Path

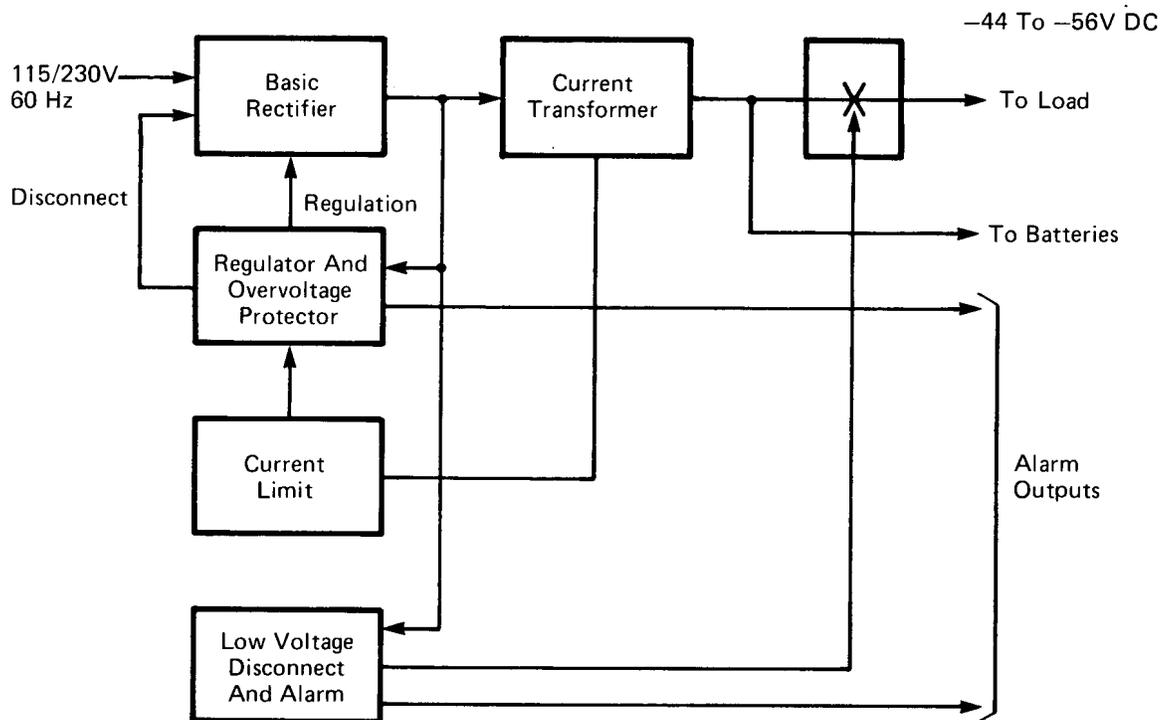


Fig. 14 -- J2357E Rectifier Block Diagram

- QPP412 or QPP496 Buffer
- QPP442 Post Pay Coin, Remote
- QPP445 Superimposed Ringing, Remote.

(b) digroup-associated circuit packs:

- QPP413 Driver
- QPP414 Local Switch
- QPP418 Address Control-Remote
- QPP419 Digroup.

Any line-associated circuit pack except the QPP412 buffer can be plugged into any line circuit pack position on the line shelves.

QPP405 Single-Party, Remote (Fig. 15)

4.02 Features of the QPP405 circuit packs are:

- (a) four subscriber lines per circuit pack
- (b) four LED indicators, one per line, to show when the subscriber lines are busy.

4.03 Functions of the QPP405 circuit packs are:

- (a) to connect the ringing generator or line-test circuit to the subscriber lines (ring/test relay); the ring trip detector creates a local ring trip when a subscriber line goes off-hook;
- (b) to detect off-hook and supervisory conditions (off-hook detector) on the subscriber lines;
- (c) to transform the 2-wire subscriber line into a 4-wire path to separate/combine transmit and receive signals (hybrid transformer);

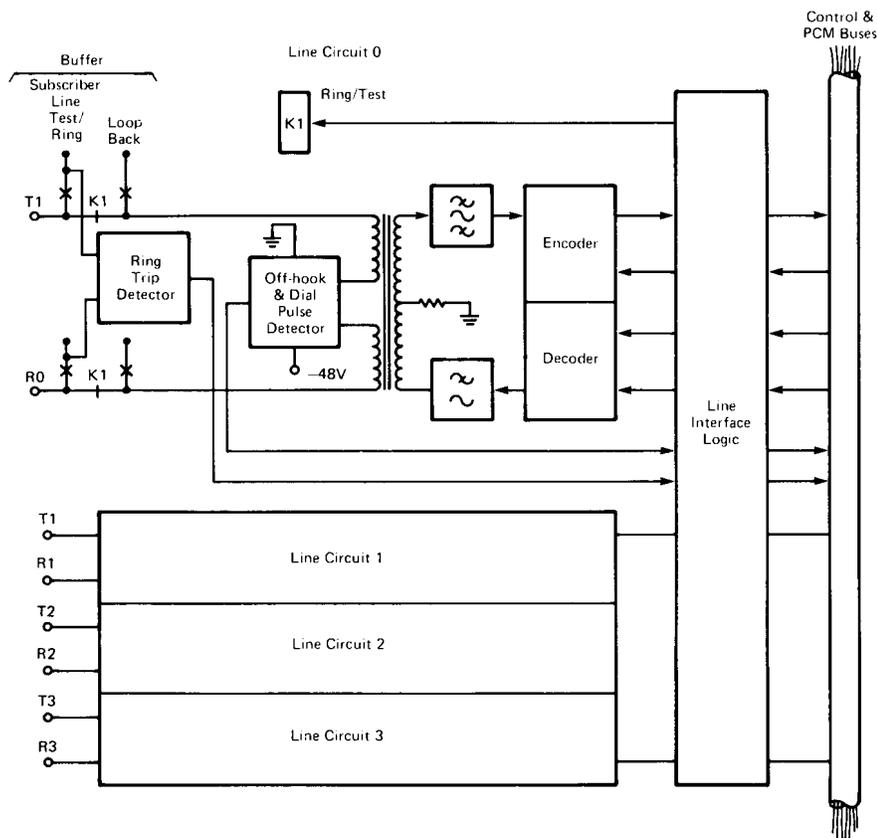


Fig. 15 — QPP405 Single-Party Remote, Block Diagram

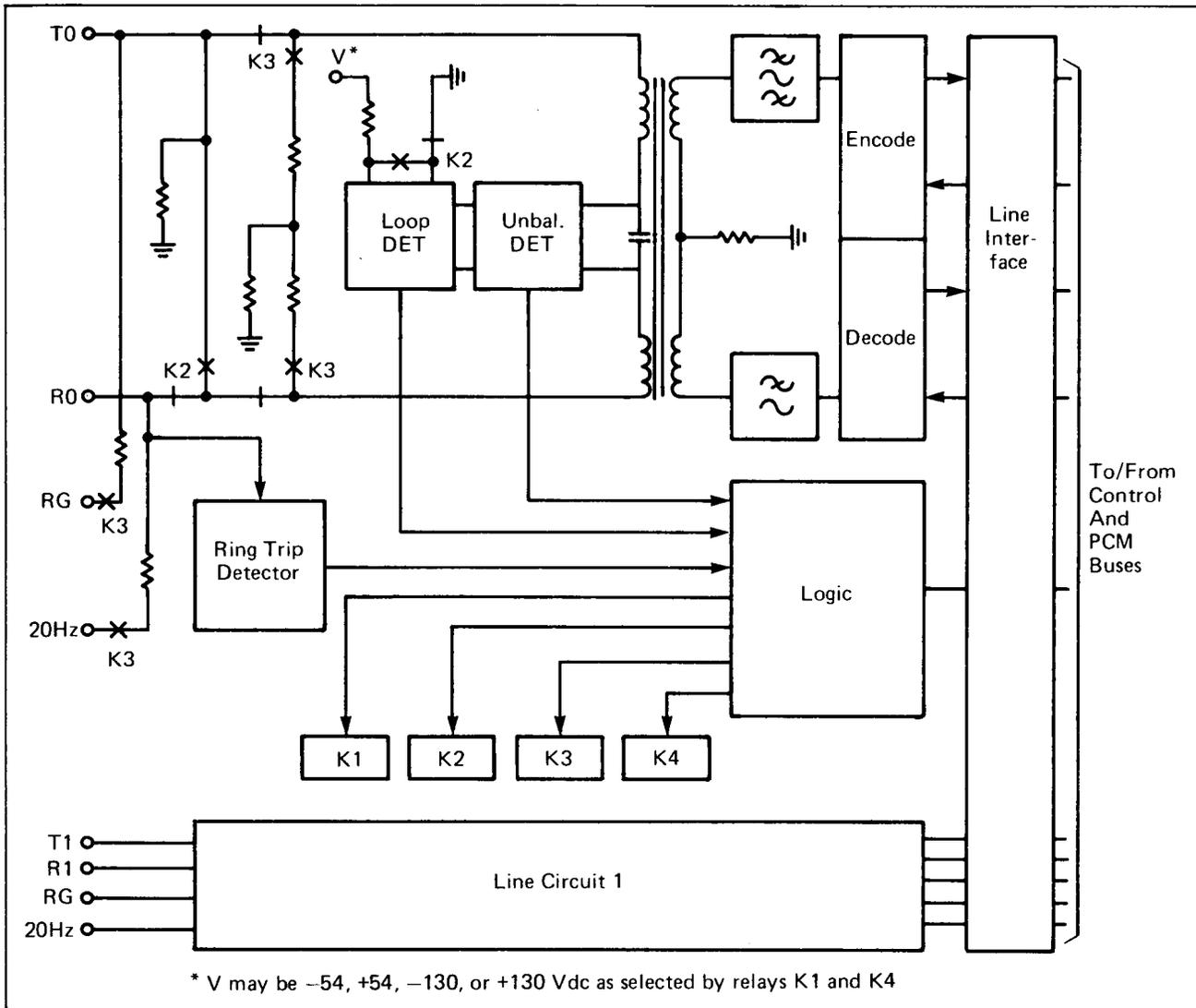


Fig. 17 — QPP409 Universal-Coin Remote — Block Diagram

4.07 Functions of the QPP409 circuit pack are:

- (a) to connect the ring generator or line-test circuit to the coin lines (ring/test relay); the ring-trip detector creates a local ring trip when a coin line goes off-hook;
- (b) to connect appropriate voltages (± 48 or ± 130 V) to the coin line on command from the CCT;
- (c) to connect coin-return signals without a command from CCT;
- (d) to generate +48 and ± 130 V internally;
- (e) to detect on-hook/off-hook and dial pulse signals and send them to the CCT;

- (f) to detect presence or absence of coin ground on the coin line and send the information to the CCT;
- (g) to transform 2-wire subscriber lines to 4-wire paths to separate transmit and combine receive signals (hybrid transformer);
- (h) to band-limit the transmit analog signal to the 0.3 to 3.2 kHz range (20 dB, 60 Hz rejection) and convert it to an 8-bit per sample PCM signal for connection to the transmit PCM bus (transmit filter and encoder);
- (i) to convert 8-bit PCM signals from the receive PCM bus to analog, and band-limit the analog signal to 3.2 kHz (decoder and receive filter);

(j) to synchronize the codec-enable and PCM signals from the buffer before connection to the codec (line interface circuit);

(k) to operate the ring/test relay, on command from the CCT, to connect the 2-wire vf port to the loopback circuit on the same QPP409 card.

(a) chops the 300-V dc from the 300-V converter at a rate synchronous with the ringing signal received through the decoder;

(b) applies the chopped voltage to the subscriber lines with the same connections (tip/ring, tip/ground, or ring/ground) as the switching equipment applies to the CCT line circuit.

QPP440 Frequency Selective – Remote

4.08 Features of the QPP440 circuit packs are:

(a) four subscriber lines per circuit pack; providing service for single-party, two-party with ANI, and multiparty circuits;

(b) one LED per line to show when the lines are busy.

4.09 Functions of the QPP440 circuit packs are the same as those for the QPP407 Universal Remote (4.05). In addition, the QPP440;

QPP442 Post-Pay Coin Remote (Fig. 18)

4.10 Features of the QPP442 circuit packs are:

(a) two line circuits per circuit pack

(b) one LED indicator per line to show when the line is busy.

4.11 Functions of the QPP442 circuit packs are the same as those for the QPP405 Single-Party Remote circuit pack (4.02). In addition, the QPP442:

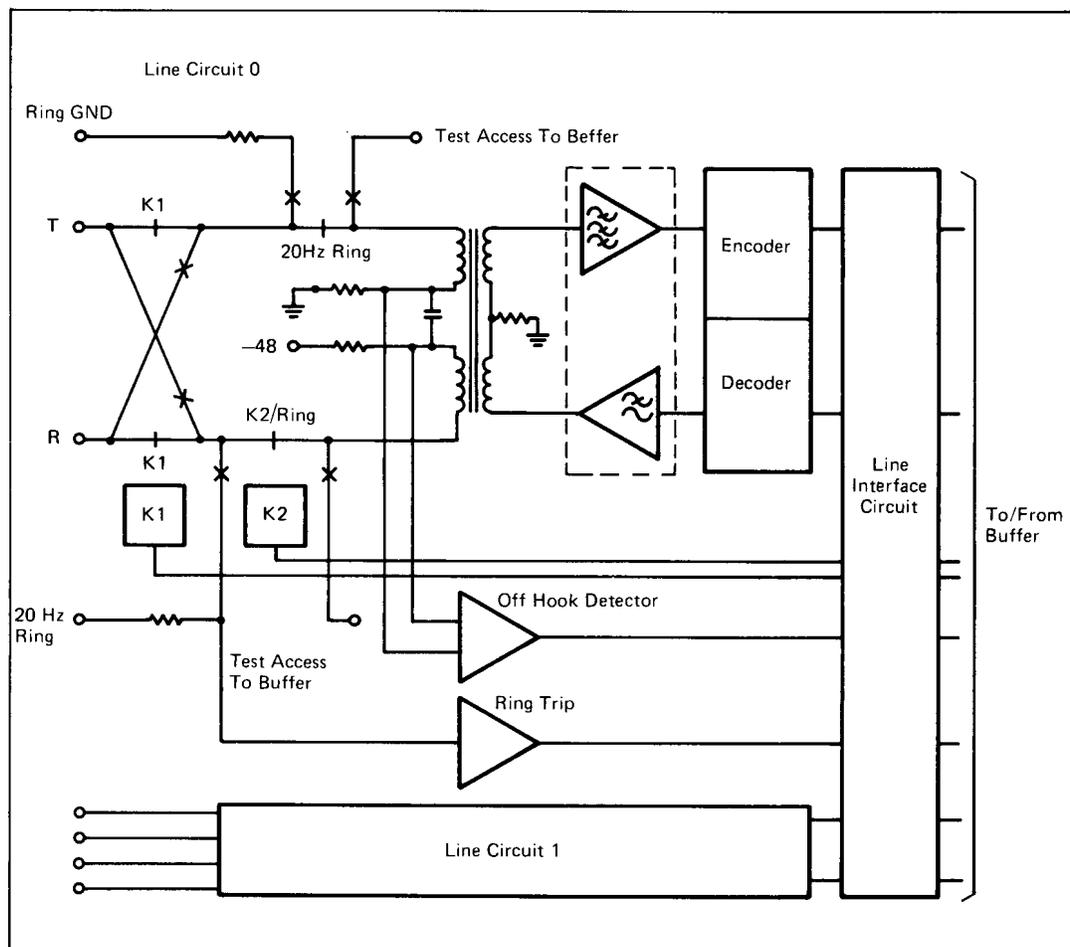


Fig. 18 – QPP442 Post Pay Coin Remote

- (a) on reception of A bits, reverses the battery connection to tip and ring (battery on tip and ground on ring) to disconnect the microphone, and inhibit the digitone pad;
- (b) on reception of SD1 and SD3, connects ringing to the subscriber line.

QPP445 Superimposed-Remote

4.12 Features of the QPP445 circuit packs are:

- (a) four subscriber lines per circuit pack; providing service for single-party, 2-party with ANI, and multiparty circuits;
- (b) one LED per line to show when the lines are busy.

4.13 Functions of the QPP445 are the same as those of the QPP407 Universal Remote (4.05). In addition, the QPP445 decodes the polarity of the dc voltage received through the decoder and applies a corresponding ring voltage of either the standard -20 Hz from the ring generator output, or +20 Hz from the positive ring generator to the subscriber lines. Connection of ringing to the subscriber lines is the same as the switching equipment applies to the CCT line circuits; i.e., tip-ring, tip-ground, or ring-ground.

QPP412 or QPP496 Buffer (Fig. 19)

4.14 Functions of the QPP412 and QPP496 circuit packs are:

RECEIVE PATH:

- (a) to buffer and fan-out all of the control and data leads between the driver and the line circuit pack;
- (b) to decode address signals from the drivers to pass card-enable signals to the correct line circuit pack;
- (c) to accept control and data signals from either the driver associated with digital line A, or the driver associated with digital line B, depending on which digroup and channel is assigned to the line;
- (d) QPP496 only: to demodulate ringing information (ringing applied to tip or ring side) from the CCT and forward necessary control signals to the QPP407, QPP440 and QPP445 to apply ringing to the correct side (T or R), updated every 1.5 ms.

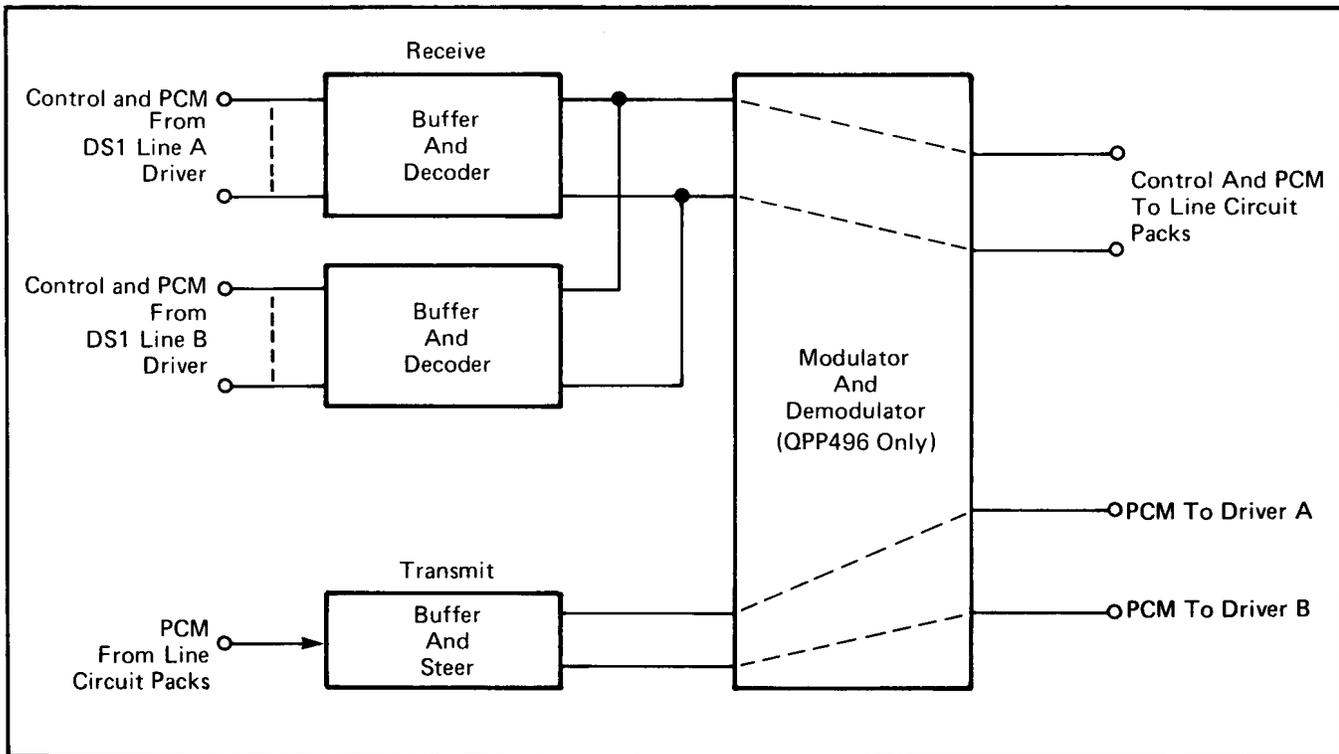


Fig. 19 – QPP412 and QPP496 Buffer – Block Diagram

TRANSMIT PATH:

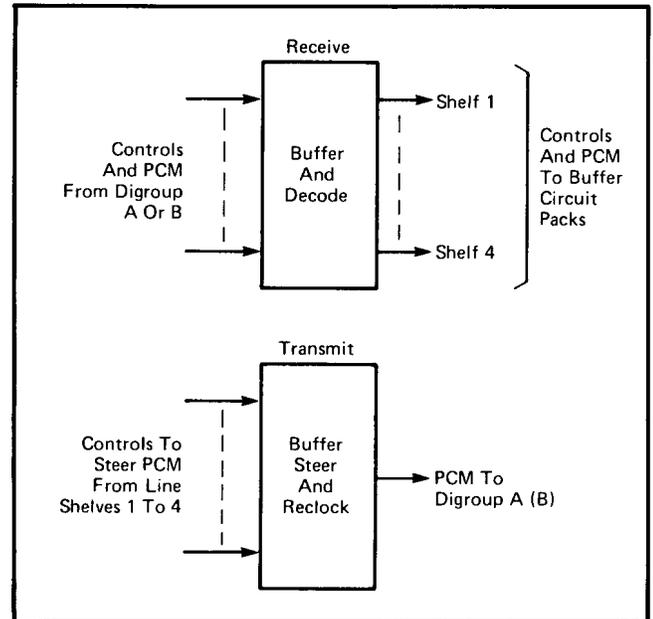
- (e) to buffer and collect the message outputs from the line circuit packs and indicate either the status of the lines during a line scan, or the type of line during an identification scan;
- (f) to buffer and steer the PCM signal to either the digroup A or the digroup B drivers;
- (g) to disconnect the ring generator and connect the line-test circuit to the ringing bus on command from the CCT;
- (h) to terminate the loopback bus in a resistance network to produce a 9-dB hybrid loss, and operate the off-hook and ANI detectors in the line circuit pack;
- (i) On QPP496 only: to generate a modulating signal that causes the QPP407, QPP440 and QPP445 circuit pack to pass ANI information (tip or ring party off-hook) to the CCT, updated every 1.5 ms.

QPP413 Driver (Fig. 20)**4.15 QPP413 circuit packs are required as follows:**

- (a) one per digroup for up to 128 lines;
- (b) two per digroup for 129 through 256 lines.

4.16 Functions of the QPP413-type circuit packs are:

- (a) to fan-out controls, addresses, frame pulses, clocks, strobes, and data to four buffers;
- (b) in the transmit direction, to route the 8 bits of each channel in the PCM streams from four line shelves onto either local or remote buses, depending on whether the channel is assigned to the local link or the digital line;
- (c) in the receive direction, to select address and PCM data bits from the local or remote buses;
- (d) to combine the message output signals from four line shelves onto the message output bus, for indicating either the status of the line during a line scan or the type of line during an identification scan;

**Fig. 20 – QPP413 Driver, Block Diagram**

- (e) to inhibit digroup frame pulse, clock, strobe, control, address, and data when not selected from that digroup (digroup control select).

QPP414 Local Switch (Fig. 21)**4.17 Features of the QPP414 circuit packs are:**

- (a) two local memories (24 words each) to store line numbers assigned to each local link channel;
- (b) a delay line to switch data signals in time between adjacent channels (i.e., channel n and channel n+1), by delaying the PCM signal in one direction by the equivalent of one time slot; and in the other direction by the equivalent of 23 time slots plus one frame bit.

- 4.18 The function of the QPP414 is to provide local link facilities for the subscriber lines connected to the RCT. There are two identical circuits on the circuit pack (one for each digroup) to ensure that failure of one switch does not stop all local call traffic.

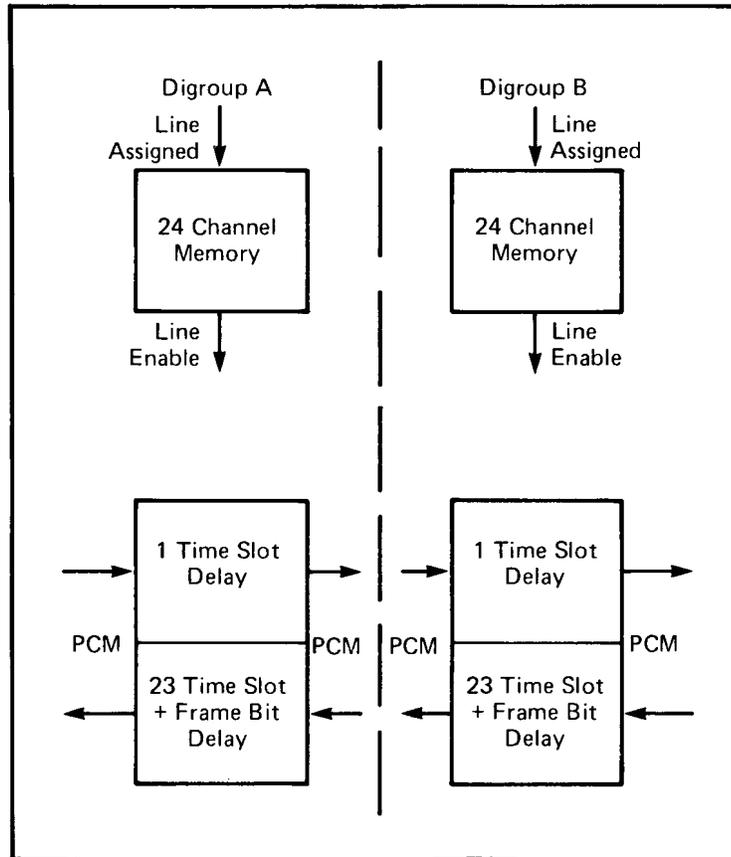


Fig. 21 — QPP414 Local Switch, Block Diagram

QPP417 Address Control Remote (Fig. 22)

4.19 One QPP417 is required for each digroup. The circuit pack interfaces between the digroup circuit pack and the driver, local switch, alarm remote, and the line test circuit packs.

4.20 Functions of the QPP417 circuit packs are:

- (a) to store a B-word as it is received and to error-check pairs of successively received B-words for differences; this prevents operating on a B-word if the successively received pairs of words are not identical;
- (b) to decode each operation code (first 8 bits of the B-word) as it is received, and steer the last 16 bits to the correct memory or register;
- (c) in a connection memory, to store the line number assigned to each digroup channel;
- (d) in auxiliary memory, to store the busy-idle bit from the operation code for each DS1 channel, and store the multiparty Signal Distributing (SD) bits;

- (e) in a B-word encoder, to read the contents of the address memory or register when commanded by the CCT, and encode the information into the B-word to return it to the CCT;

- (f) to bypass the unassigned information bits through the RCT without steering them to any line circuit; or to combine the through and bypassed PCM bit streams and insert the B-word;

- (g) to identify which line shelves are equipped in the RCT. The switches on a module of eight switches corresponding to the shelves equipped must be operated before the circuit pack is installed;

- (h) to steer the control bits to operate the vf loopback relays to the buffer and subscriber line test equipment to the line test circuit pack (test register);

- (i) to steer the control bits to operate the RCT loopback, bypass, and protection-switch relays, to the protection-switch, remote circuit pack.

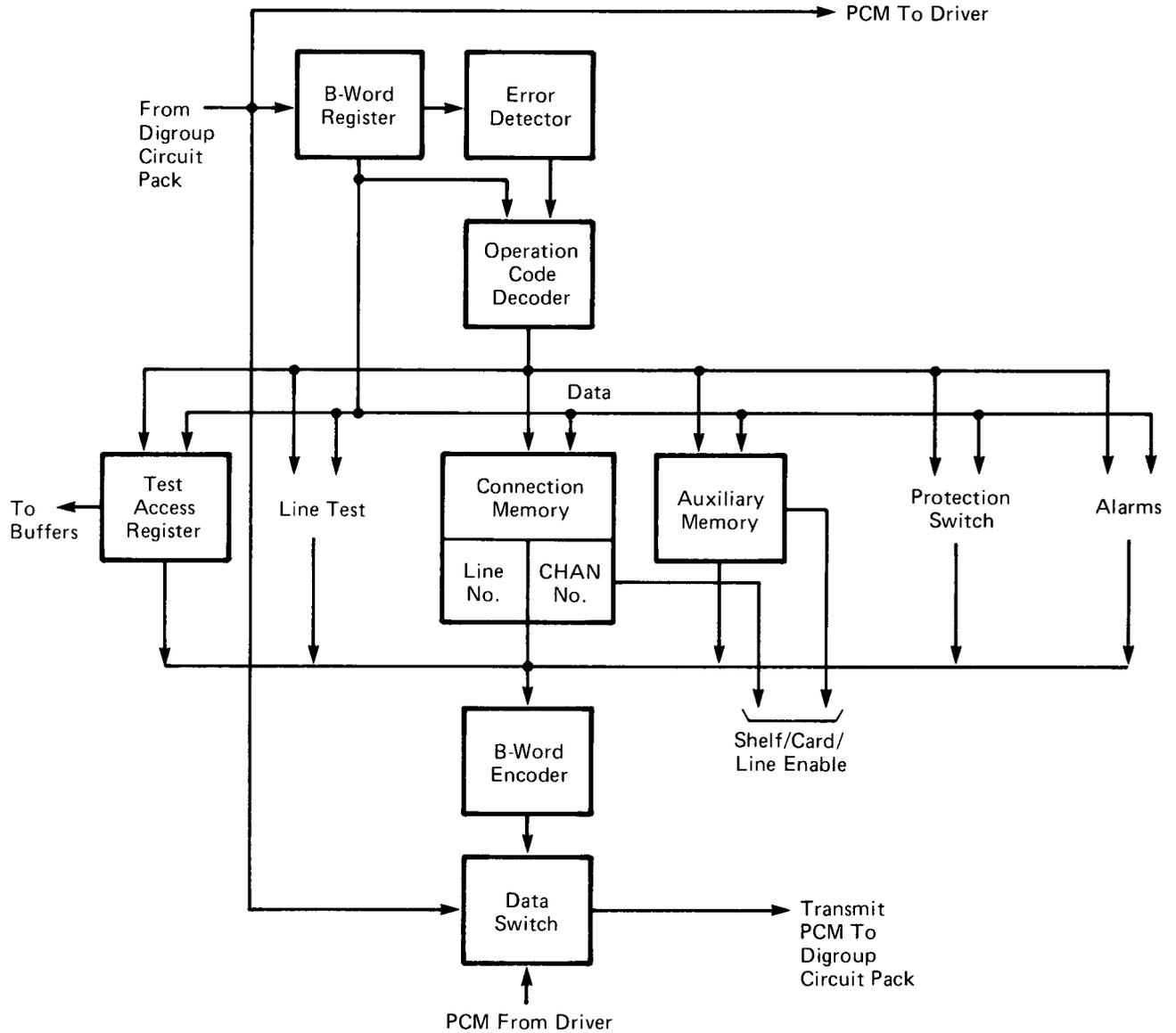


Fig. 22 — QPP417 Address Control Remote, Block Diagram

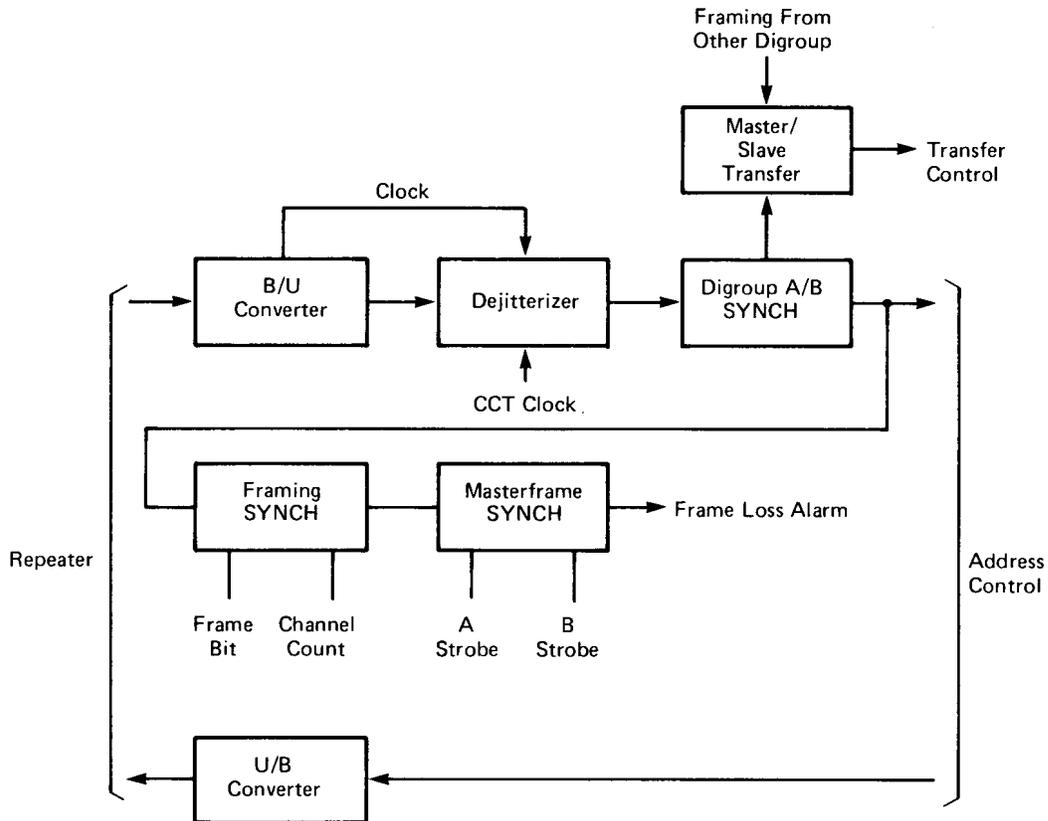


Fig. 23 — QPP419 Digroup, Block Diagram

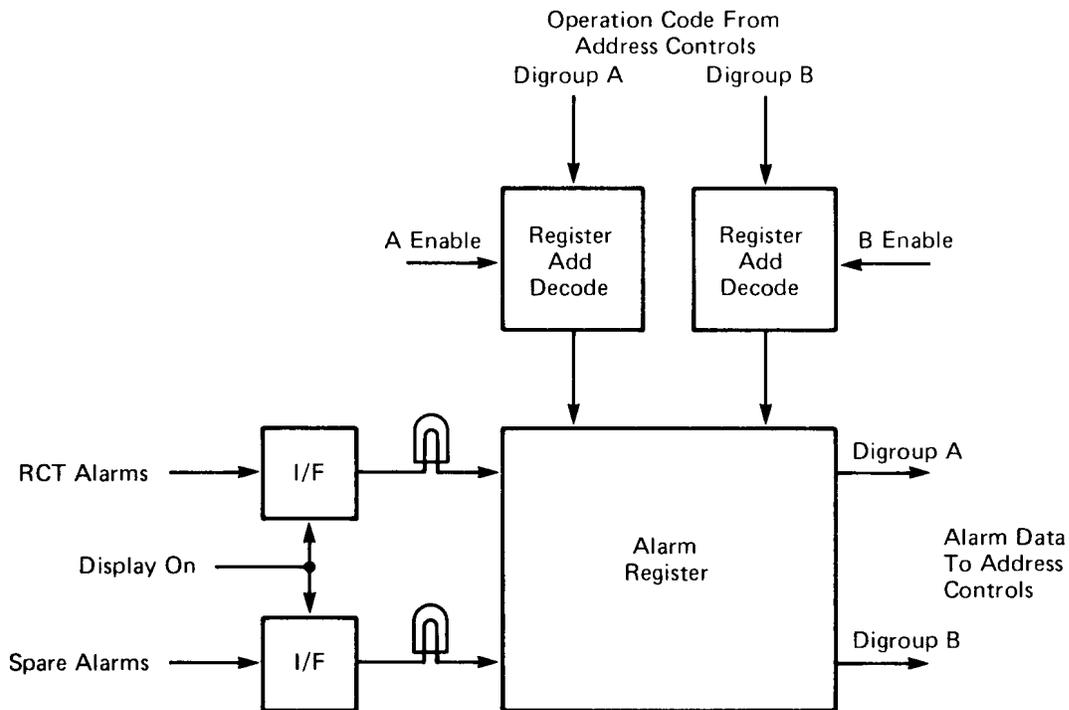


Fig. 24 — QPP420 Alarm Remote, Block Diagram

QPP419 Digroup (Fig. 23)

4.21 One QPP419 circuit pack is required for each digroup for the following functions:

- (a) to convert the unipolar signal from the address control circuit pack to bipolar format for transmission on the digital line;
- (b) to convert the bipolar signal from the digital line into a unipolar signal and extract the clock signal;
- (c) to synchronize the received signal to the framing pattern and extract the frame pulse and B-word.

B. Peripheral Block

4.22 The peripheral block (Fig. 10) consists of the following:

- QPP420 Alarm Remote
 QPP423 Line Test – Remote
 QPP447 Test Access – Remote
 ED7209-31, G3 Remote Bypass Assembly.

QPP420 Alarm Remote (Fig. 24)

4.23 The QPP420 circuit pack interfaces between the alarm detection circuits and the QPP417 address control remote circuit packs. Fourteen RCT and four spare alarms are provided (see Table A and Fig. 24).

4.24 Functions of the QPP420 circuit packs are:

- (a) to convert the alarm inputs (Table A) into control data word format (interface unit);
- (b) to transfer the contents of the alarm registers to the QPP417 circuit pack for encoding into the B-words on command from the CCT; the CCT command can be received by either digroup QPP417 circuit pack and decoded by the register address decoding circuit;
- (c) to display the RCT alarms on the faceplate LED when the DISPLAY ON switch is operated;
- (d) to switch the power source to the other common power converter if one common power converter fails. This action maintains alarm supervision if one of the converters fails.

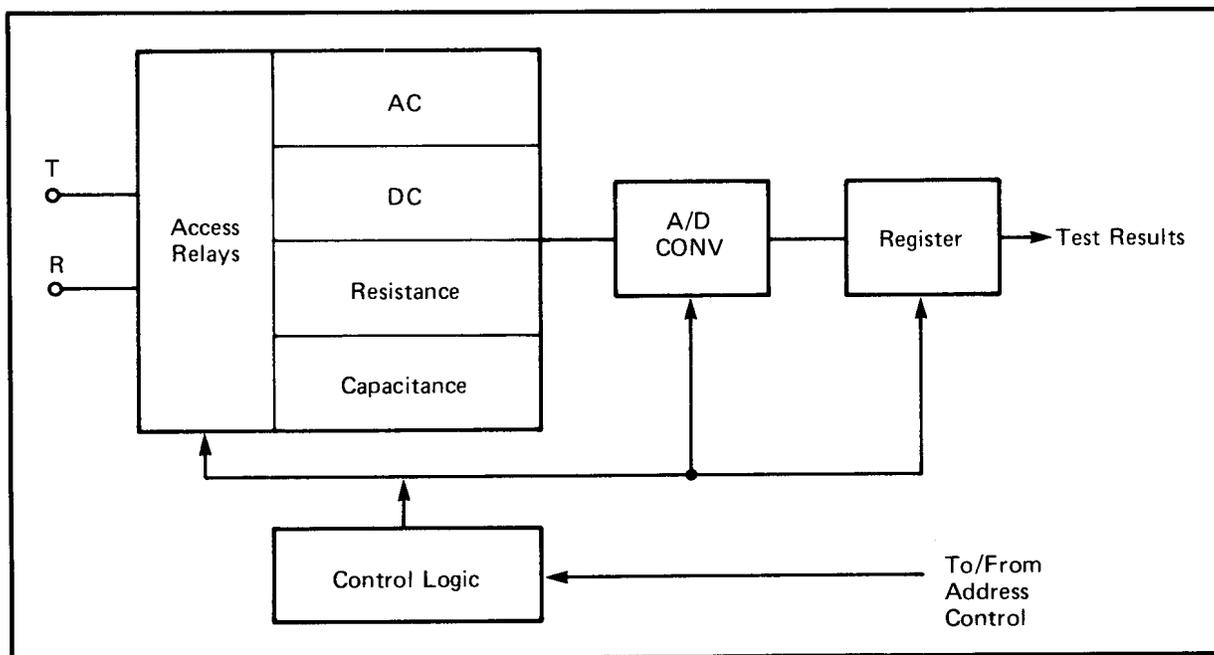


Fig. 25 — QPP423 Line Test Remote

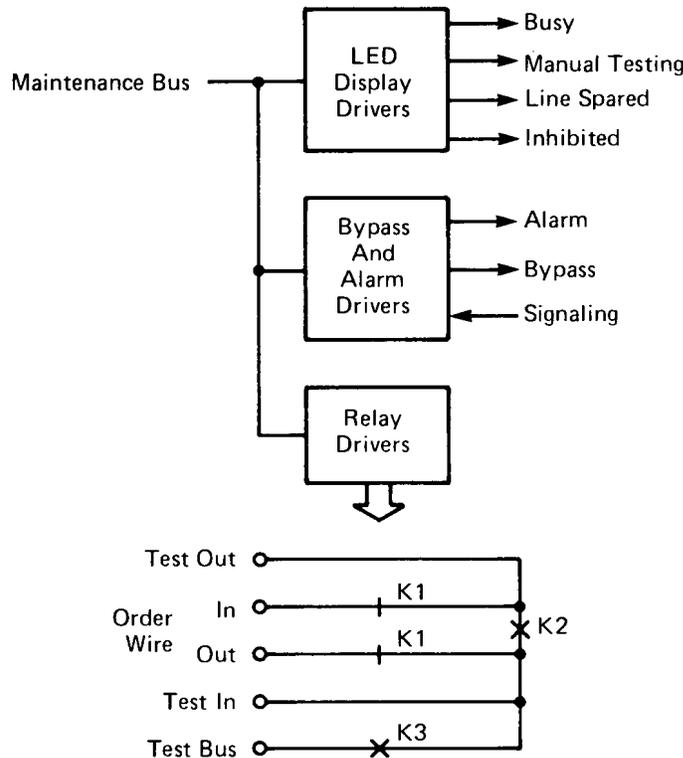


Fig. 26 — QPP447 Test Access Remote — Block Diagram

QPP423 Line Test Remote (Fig. 25)

4.25 The QPP423 circuit pack contains circuits for measuring and registering conditions on the subscriber lines as follows:

- (a) foreign ac voltage; tip-ground and ring-ground;
- (b) foreign dc voltage; tip-ground and ring-ground;
- (c) leak resistance; tip-ground, ring-ground, and tip-ring;
- (d) capacitance; tip-ground, ring-ground, and tip-ring.

4.26 The QPP423 circuit pack functions as follows:

- (a) When a test is initiated from the QPP424 circuit pack at the CCT, the system controller generates test commands to operate the ring/test relays on the RCT buffer and line circuit packs; this connects the QPP423 through the line shelf ring bus to the subscriber line to be tested.

- (b) When the start-test command is received, measurements are made, in the sequence listed in 4.25, to detect potentially damaging voltages before they are applied to sensitive circuits.

- (c) The measurement results are converted from analog to digital (binary) form and stored in the test registers.

- (d) The test registers are read by the system controller through the B-word control.

- (e) When a command is received to repeat the measurement of one parameter, that test is repeated and the new results stored in the applicable register.

QPP447 Test-Access Remote (Fig. 26)

4.27 The QPP447 circuit pack, together with the Remote Bypass Assemblies, ED7209-31, G3, on each RCT line shelf, are part of the subscriber line test extension system which provides metallic test access from the office test desk directly to the subscriber lines. When a test is initiated from the test desk, or from the QPP448 at the CCT, the RCT

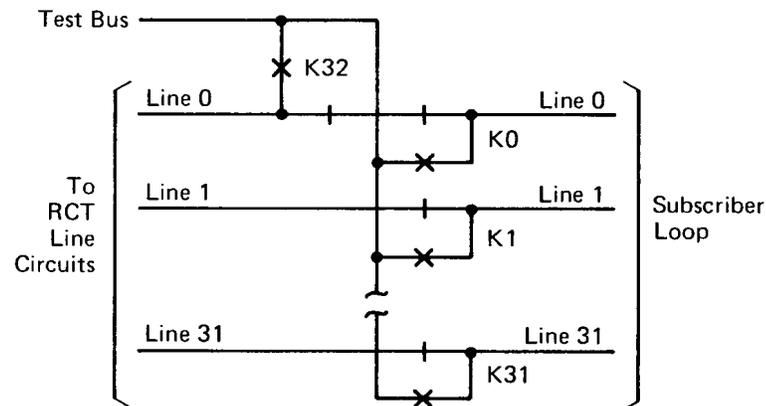
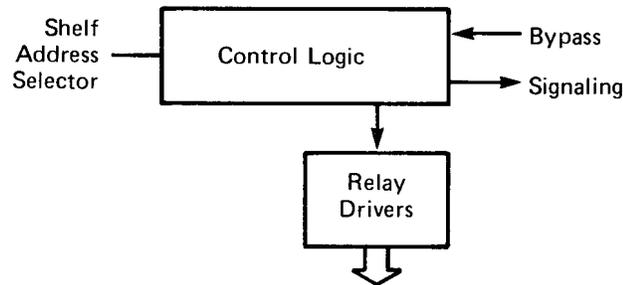


Fig. 27 — ED7209-31, G3 Remote Bypass Assembly — Block Diagram

circuits control and implement the transfer of a subscriber line to the LD-1 order wire or a separate metallic test pair which bypasses the RCT and CCT terminals.

4.28 Functions of the QPP447 circuit pack are:

- (a) to provide faceplate indications of the status of the test access system;
- (b) to provide logic and driver circuits for communication with the remote bypass circuits ED7209-31, G3, on the line shelves;
- (c) to provide relay switching for the following:
 - disconnecting the LD-1 order-wire terminal from the test pair;
 - disconnecting downstream RCT;
 - connecting the test bus at the RCT to the test pair.
- (d) to provide interface circuits to the RCT maintenance bus for signaling alarm and status conditions both locally and to the CCT.

ED7209-31, G3 Remote Bypass Assembly (Fig. 27)

4.29 Functions of the Remote Bypass Assembly, ED7209-31, G3, on each RCT line shelf are:

- (a) to provide relay switching on each line circuit to transfer a line circuit to the test bus;
- (b) to provide a relay for switching the line circuit at the line 0 position on the shelf to the test bus;
- (c) to receive and decode bypass commands from the QPP447, and operate the applicable relays to switch the addressed line to the test bus.

C. Digital Line Interface Block

4.30 The digital line interface block consists of the following circuit packs:

| | |
|--------|--------------------------|
| QPP428 | Protection Switch Remote |
| QPP436 | Repeater |

QPP437 Repeater/Line Power

QPP498 1-For-N Protection Switch – Remote.

QPP428 Protection Switch Remote (Fig. 28)

4.31 The QPP428 circuit pack is used only in conjunction with QPP436 or QPP437 repeaters. The functions of the QPP428 circuit packs are as follows:

- (a) to monitor the signals from the combined violation-rate and level detector in the repeaters and determine the conditions of the working and the spare digital lines (digital line detector logic circuit);
- (b) to delay the initiation of a protection switch for 40 ms after a failure indication is received to prevent operation from short transients (switch driver logic);
- (c) to transfer traffic automatically from a failed working line to the protection line when the working line fails. The transfer is on both the receive end of the incoming lines and the transmit end of the outgoing lines;
- (d) to steer control signals from the CCT to the protection switch remote circuit pack through the address control remote circuit pack; the control signals are decoded by the control decode logic;
- (e) restore the traffic to the working line after the line monitor has indicated that the line is good for more than 10 seconds;
- (f) to bypass the digital line signal around the RCT, on both of the digital lines, if the RCT fails (bypass switch); the bypass relays for both lines are operated automatically if both +5 V outputs from the 5/12-V converters fail;
- (g) to loop both digital lines back to the return lines at the output of the RCT on command from the CCT (loopback switch); when the signal at the CCT on both return digital lines fails, the CCT automatically generates a loopback command to loopback the next to last RCT (the last RCT is always looped back). If the signal is not restored within 0.25 seconds, the CCT generates a command to loopback the next closer RCT, and continues until signals are restored or loopback has been attempted at all RCT. The automatic loopback also operates if all outgoing and return repeaters indicate signal failure, in order

to restore power to a power-feed-through digital line. The loopback can be initiated manually from switches on the protection switch office circuit pack at the CCT.

QPP498 1-For-N Protection Switch Remote

4.32 The QPP498 circuit pack provides 1-for-n protection switching at an RCT sharing a protection line with the RCT of other systems. The QPP498 functions are similar to those of the QPP428 (4.31) with the following exceptions:

- (a) three interlock lines are provided to interface with colocated RCT sharing the same protection line;
- (b) the break introduced into the transmit line section following operation of the protection switch is extended from 80 ms (4.31[c]) to 320 ms;
- (c) the QPP498 can interface with LD-1 or similar line terminal repeaters as well as with the QPP436 and QPP437 DMS-1 terminal repeaters.

Fail-Safe Remote Assembly (P0577078)

4.33 The fail-safe assembly is an optional feature for use with either QPP428 or QPP498 circuit packs. Its purpose is to prevent failure of the system if the QPP428 or QPP498 is removed from its shelf position. The assembly comprises a set of relays and drivers, and is connected between the digital signal inputs and outputs of the QPP428 or QPP498. If the QPP428 or QPP498 is removed, the relay contacts on the fail-safe assembly close to complete the digital signal paths for digroups A and B, and so prevent system failure. The assembly is mounted on the backplane of Common Shelf 2.

QPP436 and QPP437 Office Repeater (Fig. 29)

4.34 Because QRY6A and QRY7A LD-1 office repeaters do not fit into DMS-1 equipment shelves, the repeaters are repackaged as QPP437 and QPP436 repeaters respectively. The QPP436 and QPP437 are used to terminate LD-1 digital lines, or lines with LD-1 characteristics and features, directly on the CCT. Functionally, the QPP436 and QPP437 are identical to the QRY7A and QRY6A. For detailed circuit descriptions, refer to 368-2101-101.

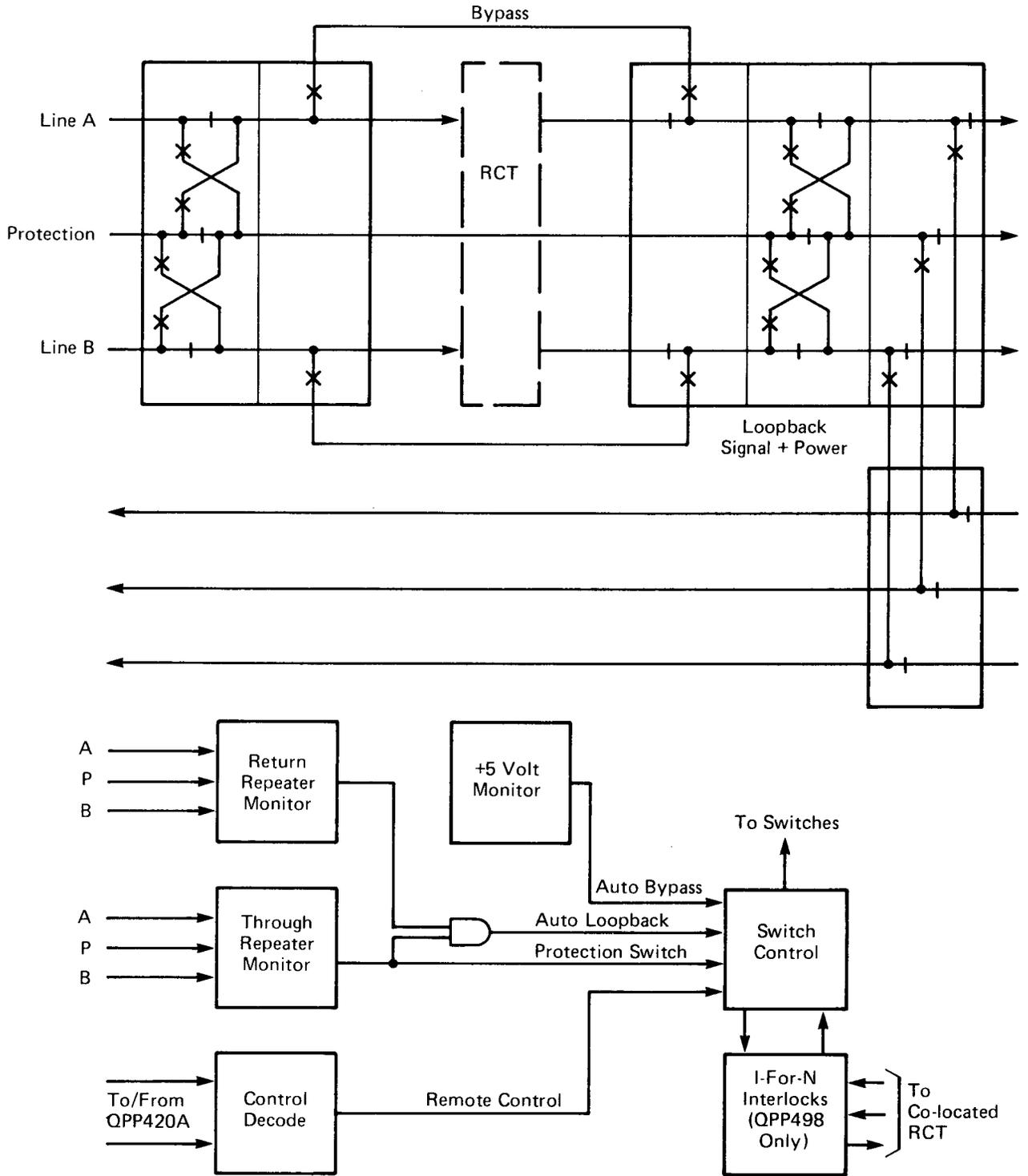


Fig. 28 – QPP428/QPP498 Protection-Switch Remote – Block Diagram

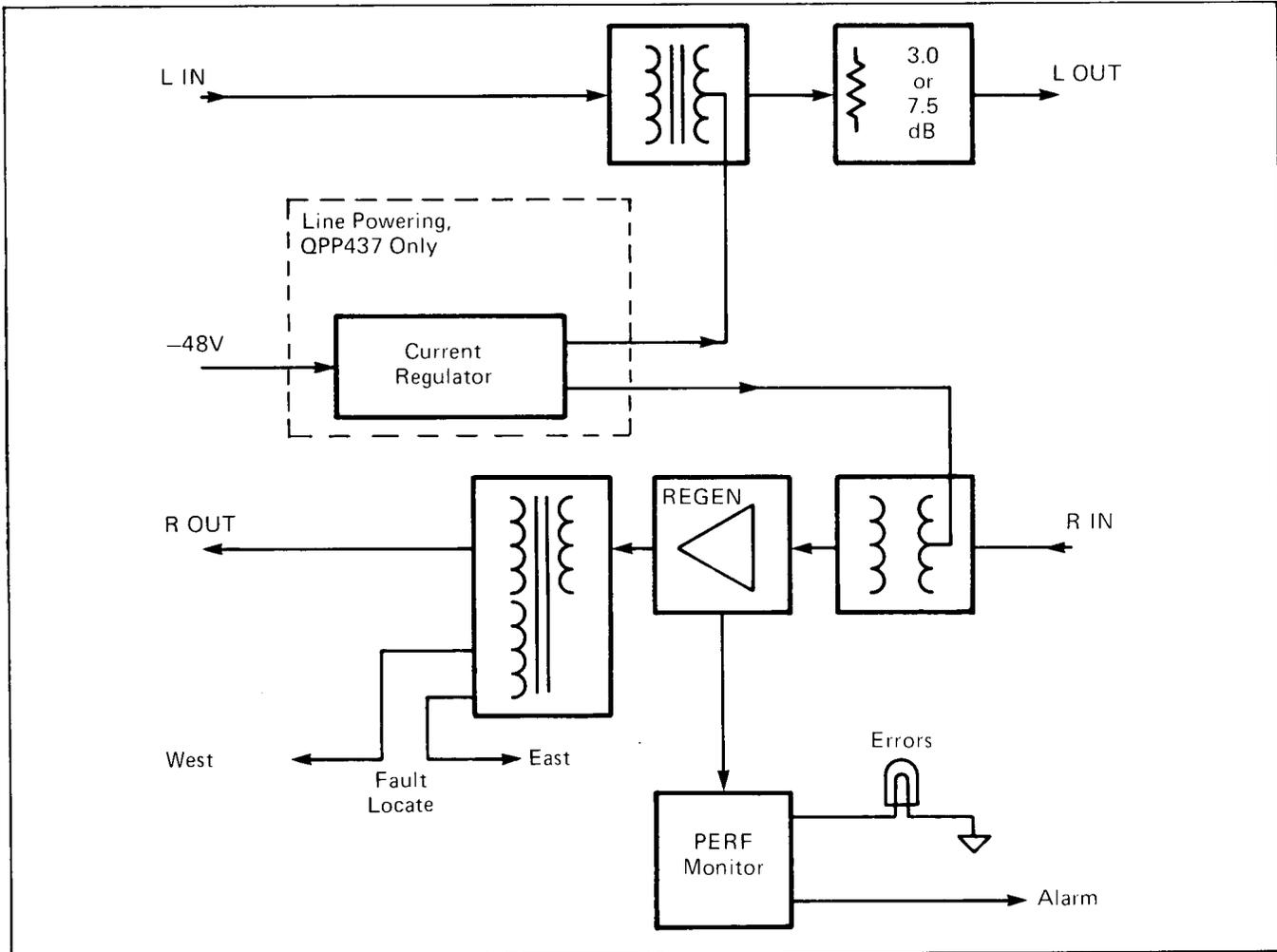


Fig. 29 — Repeater

4.35 The QPP436 and QPP437 functions are similar except that the QPP437, like the QRY6A, includes a current regulator and coupling circuits for powering the LD-1 line repeaters (or equivalents). The QPP437 is used when line-powering from the RCT is required; the QPP436 is used when line-powering from the RCT is not required. The functions of the repeaters are:

- (a) to reshape, retime, and regenerate the input signal from the DS1 line, and produce standard level signals at the RCT inputs;
- (b) to monitor the signals from the digital line for loss of signal and for violations of the bipolar format; and produce alarms when the alarm thresholds are exceeded;
- (c) to couple the DS1 signal output of the RCT to the digital line through a transformer for isolation and pads for loss adjustment;
- (d) in the QPP437 only, to provide a regulated 100-mA dc current, at up to +130 and -130 V for powering the DS1 line repeaters.

D. Power Block

4.36 The power block (Fig. 10) consists of the following:

| | |
|--------|--------------------------|
| QPC85 | 5/12-V Converter |
| QPP439 | Line Power Converter |
| QPP426 | Ring Generator |
| QPP422 | Ring Distribution |
| QPP430 | 300-V Converter |
| QPP435 | Positive Ring Generator. |

QPC85 5/12-V Converter

4.37 One QPC85 converter is required for each digroup for the following functions:

- (a) to provide +5, +12 and -12 V power for the digroup logic circuits;
- (b) to limit output current to prevent damage to the circuits.

QPP439 Line Power Converter

4.38 One QPP439 circuit pack is required for each line shelf (eight for a fully equipped RCT) and has the following functions:

- (a) to convert the 48-V supply to +6, -6, +10, -10, and +5 V for powering the line circuit packs and the buffer;
- (b) to ensure that the supply voltages are applied to the line circuit packs in the correct order to prevent codec latchup;
- (c) to sense loss of any output voltage, or loss of frame or clock signals for more than 4 seconds, and disconnect power from the line circuit packs;
- (d) to restart if the fault condition has been removed, AND either a restart pulse has been received from the system controller or the RESET button on the faceplate has been pressed;
- (e) to indicate an alarm condition for power converter shutdown; alarms are indicated by alarm outputs and by an LED. The LED is mounted on the faceplate.

QPP426 Ring Generator

4.39 The QPP426 circuit pack, together with an external ringing transformer, is used to supply single-frequency ringing power to the subscriber lines. One ring generator can ring up to 20 ringers at one time, all on zero-length loops. A backup ring generator can be installed to switch to the ringing transformer if the primary ring generator fails. 20-Hz ringing is provided by the QPP426A, 25 Hz by the QPP426B; and 30 Hz by the QPP426C. The ring generator circuit pack contains:

- (a) an oscillator and Class AB amplifier to generate a 20, 25 or 30 Hz, 40-V peak-to-peak sine wave with a continuous rms power output of 20 watts. The 86-V rms ringing tone required for subscriber lines is obtained from the external ringing transformer driven by the ring generator;
- (b) a ring synchronizer to generate a ring-synchronization pulse for connection or disconnection of the ring voltage on the subscriber line at the point, on the ring waveform, of minimum voltage and current;

(c) a monitor and alarm circuit to produce an alarm on loss of ring voltage or ring-synchronization pulse. It also operates the transfer circuit to connect an optional backup ring generator to the external ringing transformer. The alarm is indicated by an LED mounted on the faceplate.

QPP422 Ring Distribution

4.40 The QPP422 circuit pack provides:

- (a) fuses on each of the single-frequency ringing supplies to the eight line shelves (8 QFF-type, 1-1/3 ampere fuses);
- (b) an alarm output to the QPP420 alarm remote circuit pack if any of the fuses blow.

QPP430 300-V Converter

4.41 The QPP430 converter provides the source of ringing voltage for the frequency selective line circuit packs. An optional backup QPP430 may be connected in parallel with the initial converter. The converter outputs are connected through relay contacts to prevent internal shorts from short-circuiting the ringing voltage bus.

4.42 The QPP430 converter functions as follows:

- (a) converts the 48-V dc supply to 300 V dc chopped at ringing frequencies in each frequency-selective line circuit connected to the subscriber lines;
- (b) limits the output current to 300 mA;
- (c) generates an alarm signal for low-voltage output;

(d) clamps the output voltage to ground if the voltage rises above 350 V; the circuit automatically resets when the external voltage is removed.

QPP435 Positive Ring Generator

4.43 The QPP435, in conjunction with an external positive-ringing transformer, provides 20 Hz ringing voltage superimposed on +54 Vdc to supply +20 Hz ringing to "superimposed" subscriber lines. A backup QPP435 can be installed to switch to the ringing transformer if the operating ring generator fails. One QPP435 can ring a maximum of 21 ringers at one time, all on zero-length loops. The 20 Hz ringing is distributed to the line shelves through a second QPP422B ring distribution circuit pack.

4.44 Functions of the QPP435 circuit pack are:

- (a) generates a 20-Hz, 40-V peak-to-peak sine wave output of 20-watts power capacity. The 20 Hz generator operates synchronously with the QPP426 circuit pack. The 90 V rms ringing voltage required for superimposed ringing is obtained from the external ringing transformer driven by the QPP435;
- (b) converts the -48 V dc supply to +54 V dc in a dc-to-dc converter;
- (c) generates an alarm signal and operates a front-panel LED to show failure of the ring generator or power converter outputs;
- (d) disconnects both the ring generator and power converter from the ringing transformer when the QPP435 fails, and signals the backup QPP435 to connect to the transformer;

**TABLE A
ALARMS**

| DESIGNATION | SOURCE | DESCRIPTION |
|-------------|----------------------------------|--------------------------------------------------------------------------------------------------------|
| DFA | A DIGR circuit pack | Loss of frame synchronization in digroup A. |
| DFB | B DIGR circuit pack | Loss of frame synchronization in digroup B. |
| LFA | A RPTR circuit pack | Signal loss or high bipolar violation rate on line A (Note 1). |
| LFB | B RPTR circuit pack | Signal loss or high bipolar violation rate on line B (Note 1). |
| LFP | Protection Repeater circuit pack | Signal loss or high bipolar violation rate on protection line (Note 1). |
| LPF | Line Power Converter | Power converter shutdown. |
| RMJ | Ring Generator | Loss of ringing voltage or synchronization. Ground or excessive load on ringing bus (Major); (Note 2). |
| RMN | Ring Generator | Failure of one of the two ring generators (Minor). |
| CPF | 5/12 V-Converter | Loss of output voltage. |
| AC | Rectifier | Loss of ac supply or over voltage shutdown. |
| BAT | Rectifier | Battery voltage below 47 V. |
| TEM | Thermostats | Temperature over 50°C or below 0°C. |
| DOOR | Switch on door (cabinet or hut) | Door open. |
| FUSE | Fuse | Blown fuse. |
| SPARE(4) | (Customer choice) | (Note 1). |

Notes:

1. Since these indications are connected to the PCB backplane, DMS-1 repeaters are required to generate these alarms. The spare alarms may be used provided that the external repeaters provide alarm outputs with a contact to ground.
2. The alarm for ground or excessive load on the ringing bus is available only when the QPP430B ringing generator is used.