

DMS-1* DIGITAL MULTIPLEX SYSTEM CONTROL CONCENTRATOR TERMINAL DESCRIPTION

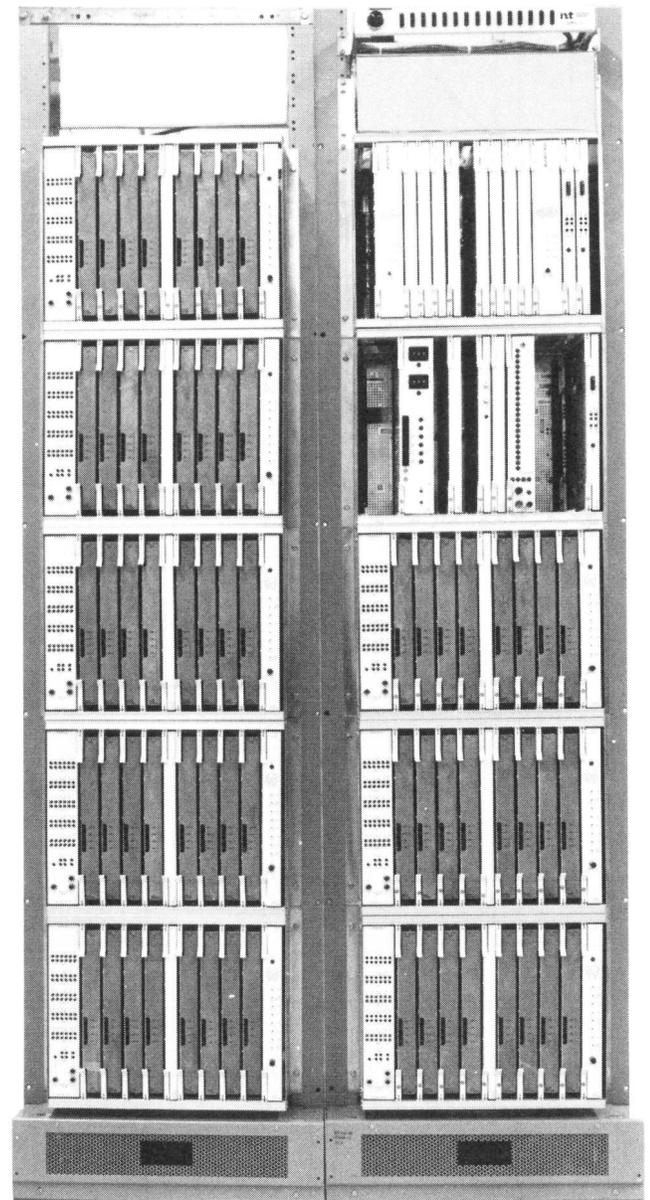
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1. GENERAL

1.01 This section describes the Control Concentrator Terminal (CCT) equipment of the DMS-1 Digital Multiplex System.

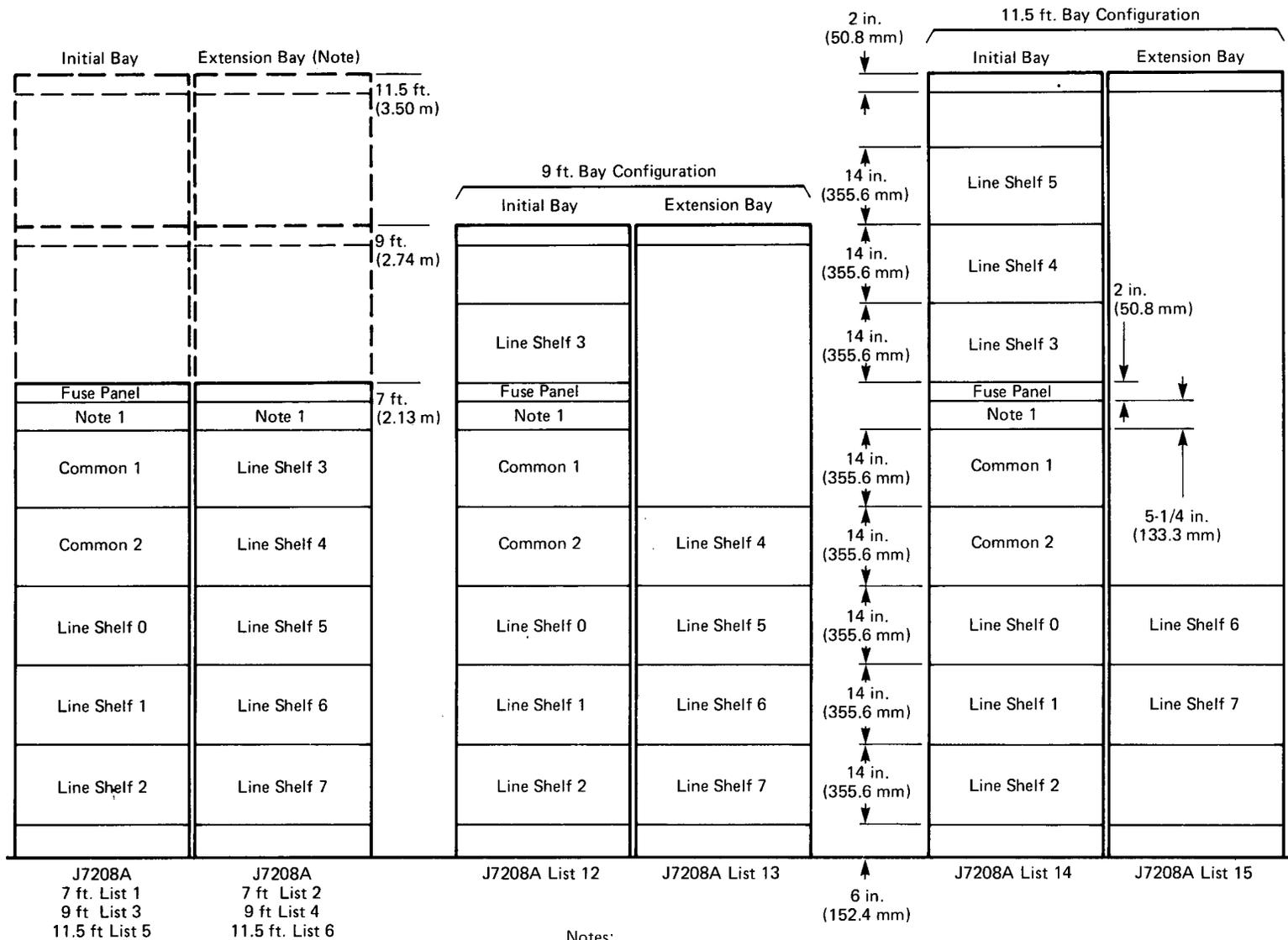
1.02 *Reason for Reissue:* to add new and revised information, and to incorporate changes previously published in Addendum 363-2011-101 issued 78 10 20.

1.03 The CCT controls the operation of the DMS-1 system. It originates the digital bit stream, framing format, and control signals through which the operations of the CCT and Remote Concentrator Terminals (RCT) are coordinated.



363-019

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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) – CCT Configurations – Steel-Duct Type Bays

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.

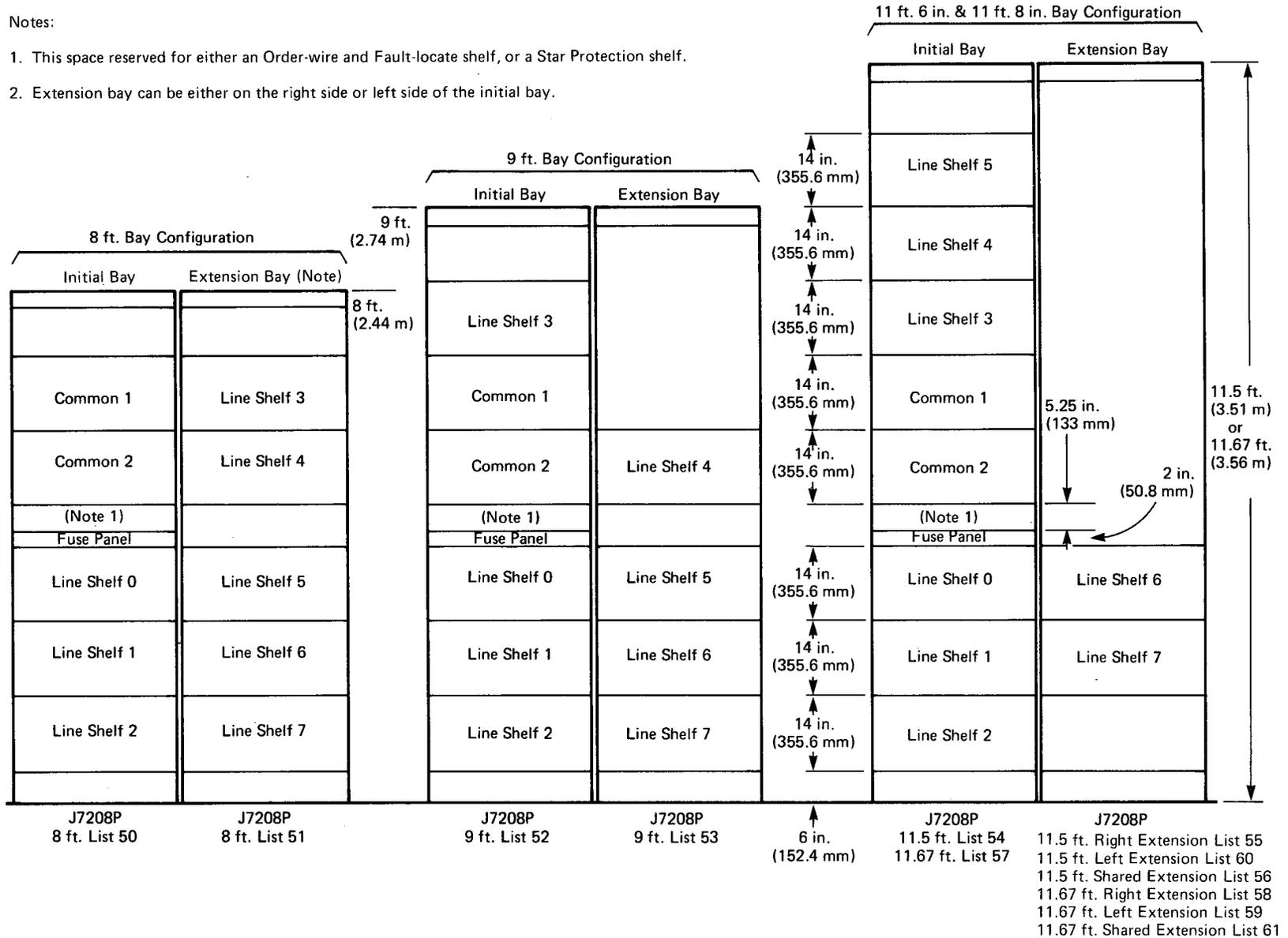


Fig. 1(b) – CCT Bay Configurations – Aluminum Channel Type Bays

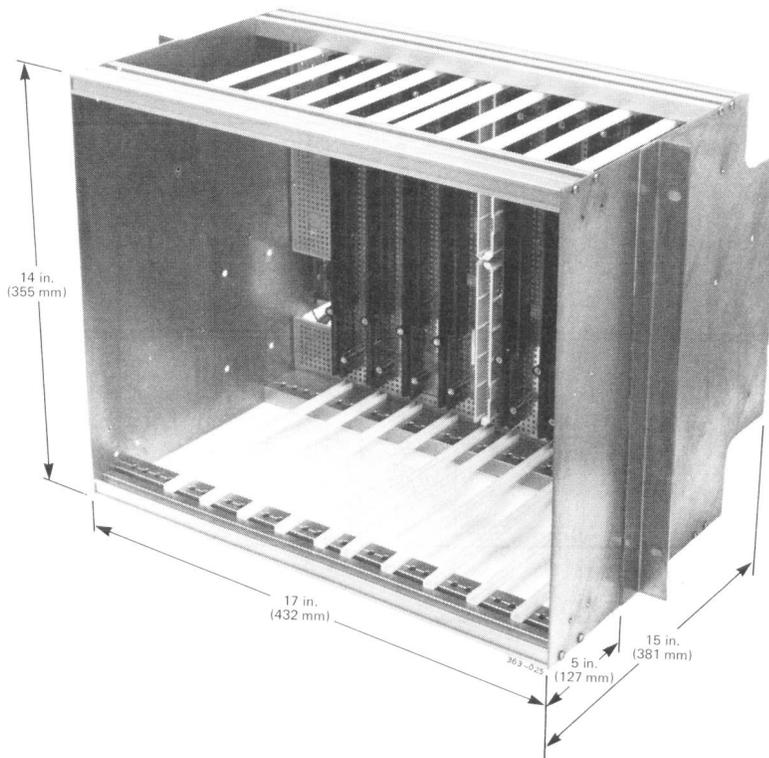


Fig. 2 — Common Equipment and Line Shelf Construction

1.04 The CCT is located in a class 5 switching office. It is cross-connected to the switching equipment by up to 256 subscriber pairs (one pair for each subscriber line served by the system).

1.05 The CCT is connected to one to four RCT by DS1 (1.544 Mb/s) digital lines.

1.06 The DMS-1 system operates over either one DS1 line (single digroup), or two DS1 lines (dual digroup); and operates with or without protection switching to a protection DS1 line on a 1-for-1, 1-for-2, or 1-for-n basis.

2. MECHANICAL DESCRIPTION

A. Bays (Fig. 1[a] and 1[b])

2.01 The CCT is available in steel or aluminum bays. Bay size 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). Two bays are needed for a fully-equipped (256-line) CCT. The Initial bays contain Common Equipment (CE) shelves; an optional order-wire and fault-locate shelf for the digital line, or an optional star switch shelf; a fuse panel; and either three (96 lines), four (128 lines), or six (192 lines) line shelves depending on the height of the bays. The extension bays contain the remaining line shelves (five, four, or two) necessary to provide up to the maximum 256 lines for a full system.

B. CCT Shelves

2.02 There are four types of shelves, plus a fuse panel in a CCT. All are 17 inches (432 mm) wide for mounting in standard 19 inch (482 mm) racks. The height and depth of the different shelves and the fuse panel are:

SHELF	HEIGHT	DEPTH
common shelf 1 common shelf 2 line shelves	14 in. (356 mm)	15 in. (381 mm)
order-wire and fault-locate shelf	5.25 in. (133 mm)	13.5 in. (343 mm)
span switch shelf	5.25 in. (133 mm)	13.7 in. (350 mm)
fuse panel	2 in. (51 mm)	13.5 in. (343 mm)

2.03 The common equipment and line shelves (Fig. 2) are constructed of two steel sideplates; two aluminum extrusions at the top and two at the bottom supporting nylon guides for the circuit packs; and a Printed Circuit Board (PCB) backplane. The order-wire and fault-locate shelf and the star protection shelf are of similar construction but with wire-wrap connectors instead of a PCB backplane. Connector pins are swagged and soldered into the backplane and mate with the connectors on the circuit packs. The pins are protected and aligned by plastic shrouds bolted to the backplane. The shrouds also align the circuit pack connector for proper mating. Printed circuits on the backplane interconnect the contact pins.

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

2.05 *Common Shelf 1 (Fig. 3)*. There is one common shelf 1 in the CCT. Common shelf 1 contains the digroup-associated transmission circuit packs plus two common power converters, local link and reorder tone circuit, and DS1 line terminal repeater units.

2.06 *Common Shelf 2 (Fig. 4)*. There is one common shelf 2 in the CCT. Common shelf 2 contains the system alarm, test, and control circuits, and the terminal repeaters for the protection DS1 lines.

2.07 *Line Shelf (Fig. 5)*. The line shelves contain the line-associated circuit packs and apparatus as follows:

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

There are up to eight line shelves in a fully-equipped CCT.

2.08 *Order-Wire and Fault-Locate Shelf (Fig. 6)*. The order-wire and fault-locate shelf contains circuit packs for termination of and access to the order-wire and fault-locate pairs of an LD-1 line. See 363-2011-103 for details.

2.09 *Star Switch Shelf (Fig. 7)*. The star switch shelf contains circuit packs to control and implement the switching of the arms of a star-configured system when a failure occurs in an arm.

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

C. Circuit Packs (Fig. 9)

2.11 The CCT circuit packs are 12.5 inches (317 mm) high and 10 inches (254 mm) deep. Width of the circuit packs ranges from 1 inch (25 mm) to 2.5 inches (63 mm). The faceplates mount the controls and indicators, and designate the circuit packs. The components are mounted on glass-epoxy PCB. Connectors mounted at the rear of the circuit packs mate with pins which are swagged and soldered into the PCB backplane. Key slots prevent a circuit pack being inserted into the wrong location on a shelf. Line circuit packs are protected by a molded plastic stiffener.

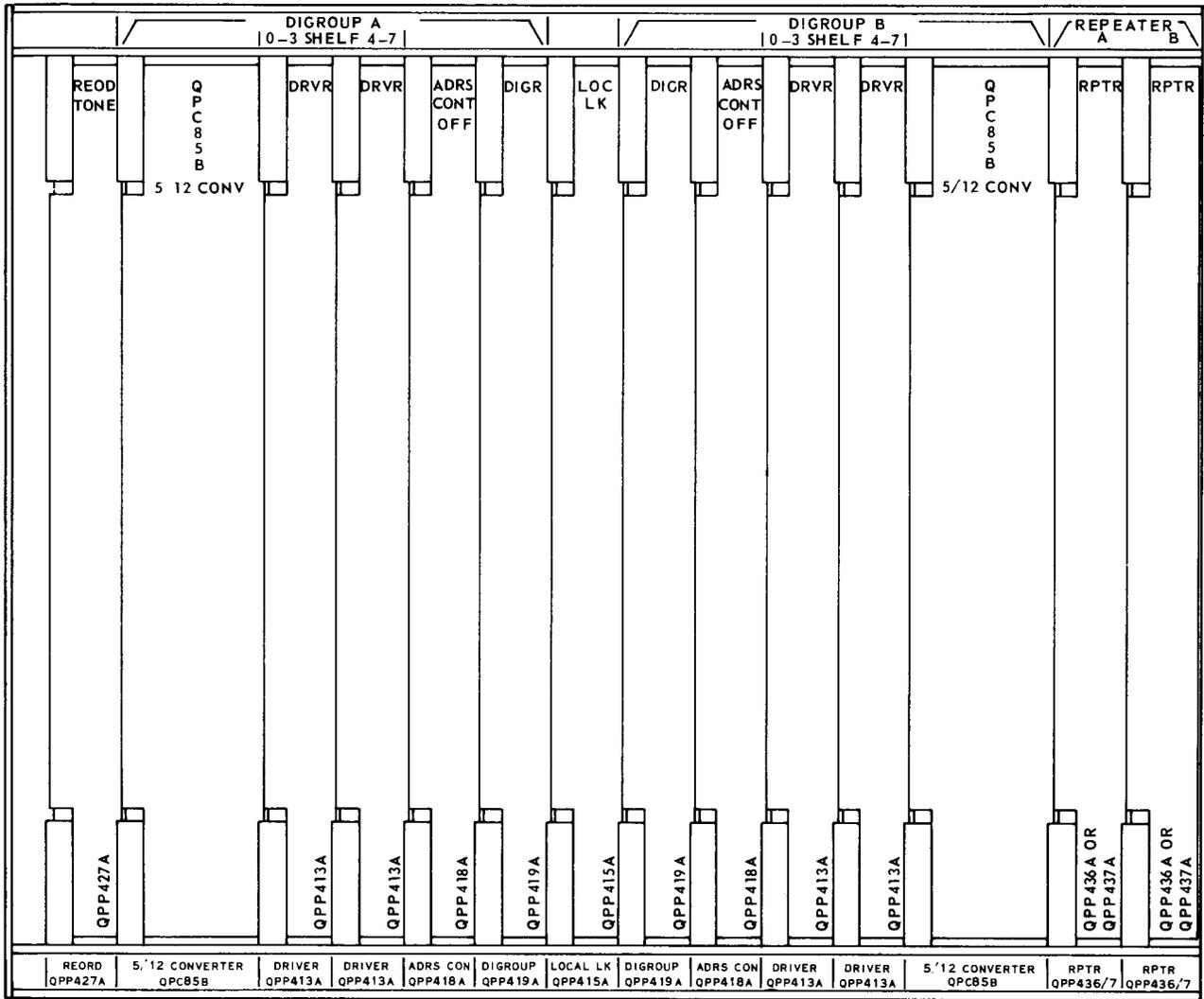
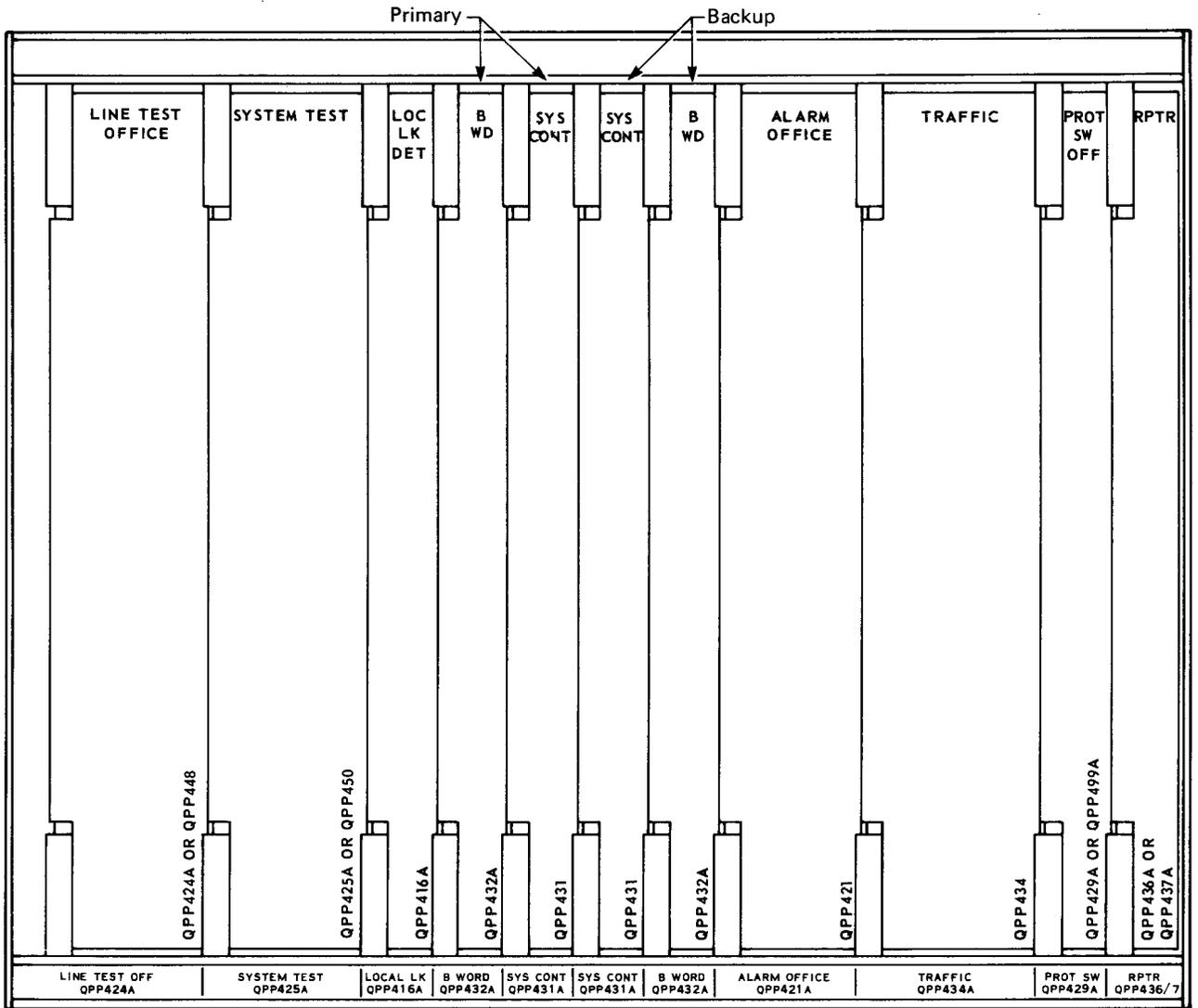
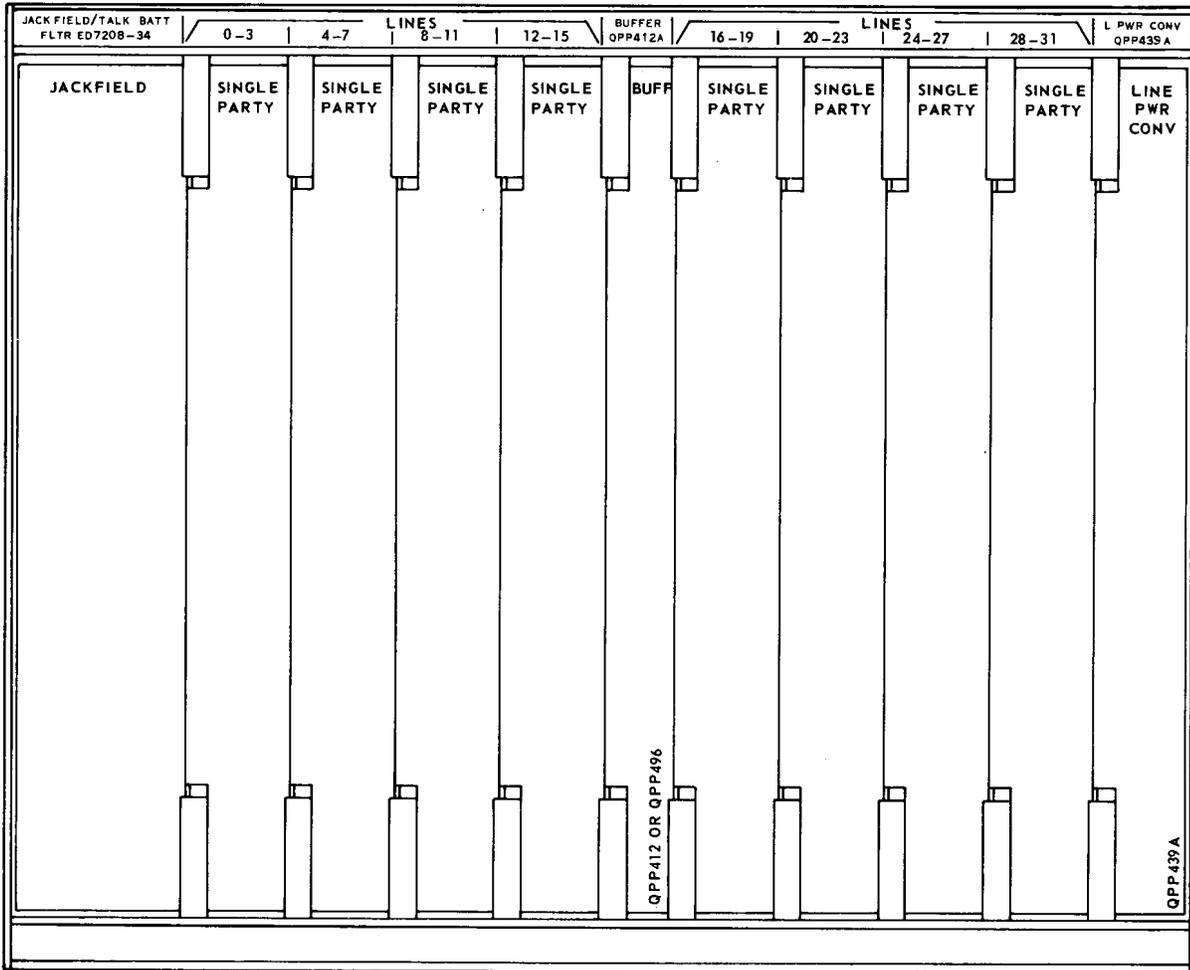


Fig. 3 - Common Shelf 1



Note: QPP448 test access office, QPP450 test control, and QPP499 1-for-N protection switch office can be used in place of the QPP424, QPP425, and QPP429.

Fig. 4 – Common Shelf 2



- 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. 5 — Line Shelf

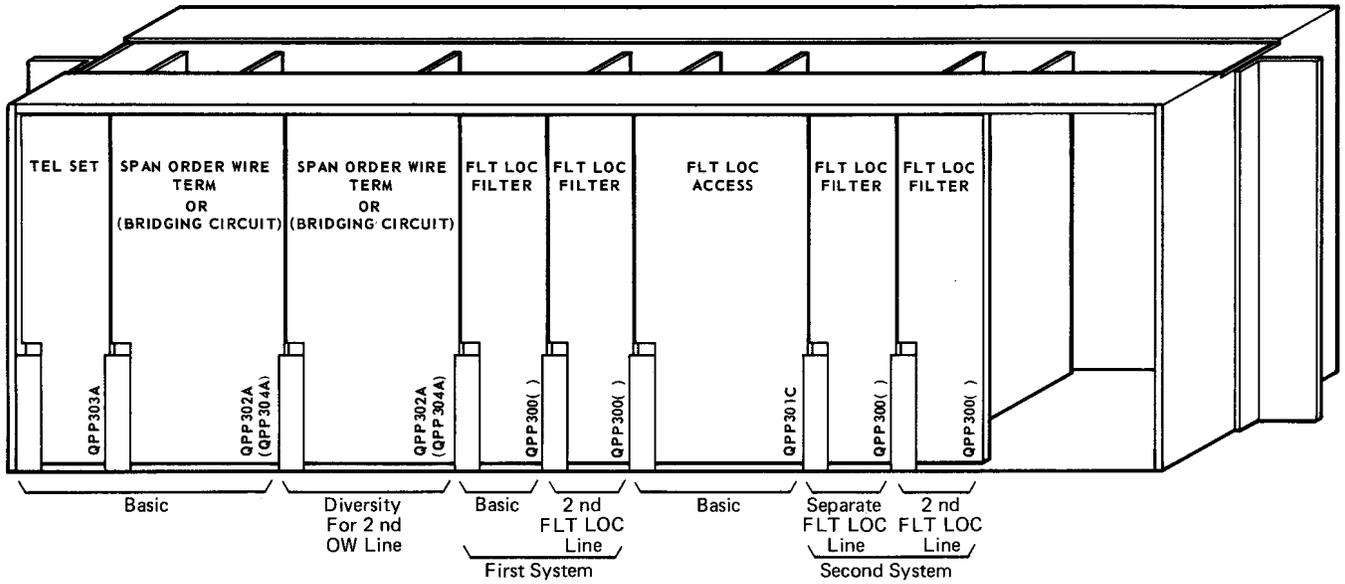


Fig. 6 – Order-Wire and Fault-Locate Shelf

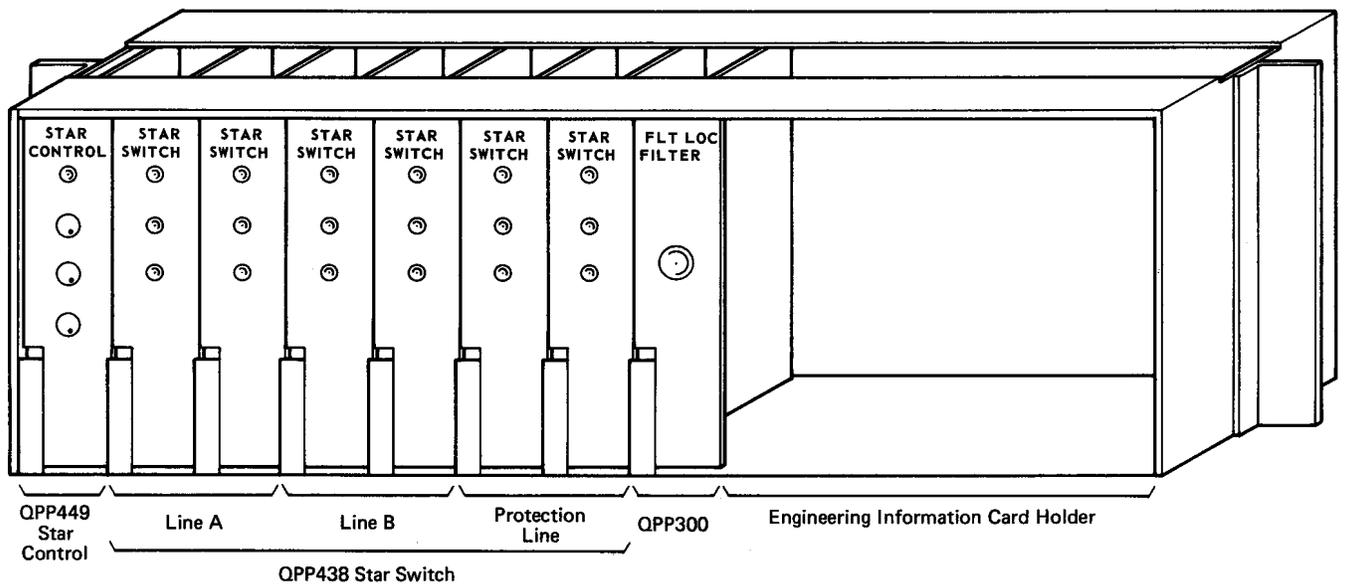


Fig. 7 – Star Switch Shelf

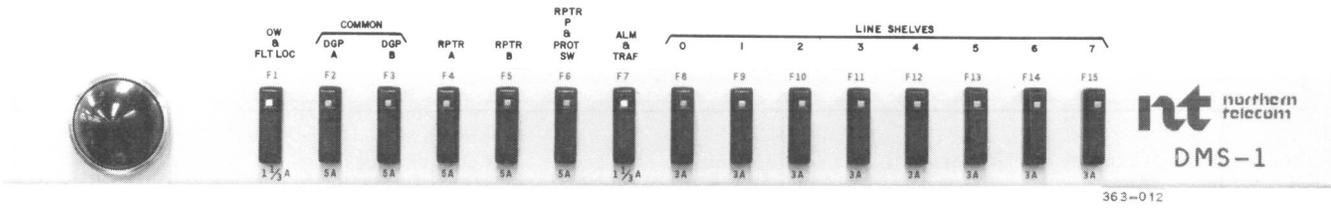


Fig. 8 – Fuse Panel

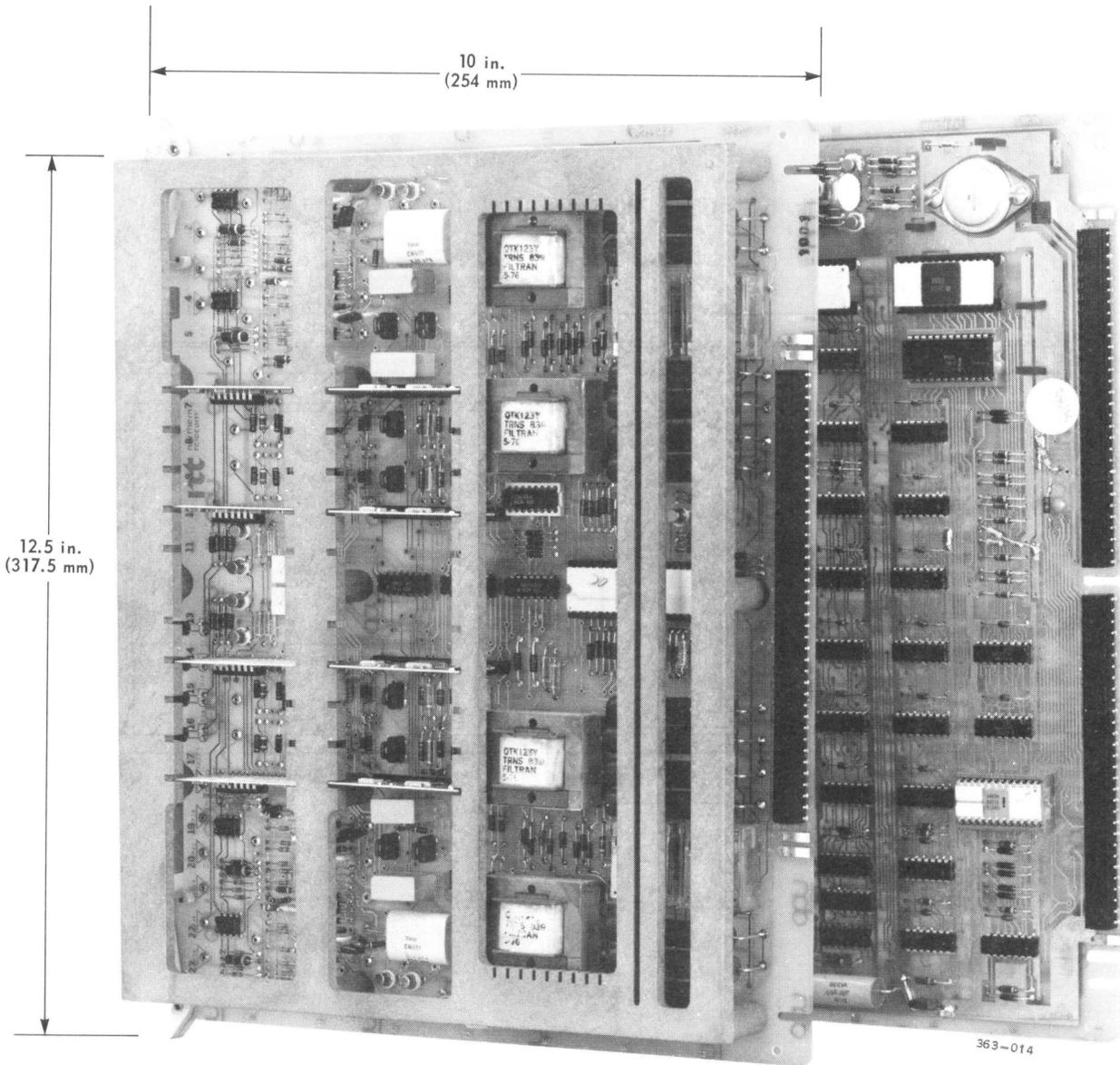


Fig. 9 – Circuit Pack Dimensions

3. FUNCTIONAL DESCRIPTION

A. Block Diagram

3.01 The block diagram of the CCT (Fig. 10) is divided into five Sections:

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

3.02 *Transmission Block.* The transmission block is further subdivided into;

- (a) *Line Associated Circuit Packs:* line and buffer circuit packs mounted on the line shelves;
- (b) *Digroup Associated Circuit Packs:* driver, address control-office, digroup, local-link detector and local-lock circuit packs on the common shelves.

3.03 *Control Block.* The control block contains the system controller and B-word circuit packs. The control block generates the control codes (B-words) through which the CCT and RCT operations are coordinated, and organizes and steers the information flow between the CCT and RCT peripheral blocks.

3.04 *Peripheral Block.* The peripheral block is the interface between the CCT and operating personnel. The block provides controls and indications of the DMS-1 system operating status.

3.05 *Digital Line Termination Block.* The digital line termination block is the interface between the DMS-1 system and the DS1 (LD-1 or equivalent) digital lines. The circuits provide protection switching to a spare digital line.

3.06 *Power Block.* The power block consists of the power distribution circuits, common power converters and line power converters.

B. Signal Path — Transmission (Fig. 11)

3.07 The transmission signal paths through the CCT are as follows:

- (1) When a request for service is identified by the system controller from the line scan, a digital channel time slot is assigned; the line number associated with the channel is then written into the address-control memory.

(2) At the start of the assigned time slot, an enabling signal (see Fig. 12) is generated in the address-control circuit and steered through the appropriate driver and buffer circuits to the line circuit requiring service.

(3) Voice and supervisory signals on the line from the switching equipment are encoded into data bits in the applicable line circuit pack, and are inserted into the assigned channel time slot on the transmit PCM bus by the enabling pulse (Fig. 12).

(4) The signals on the eight PCM buses from the eight buffers are combined in the driver circuits and steered either to the digroup A or digroup B outputs through the applicable address control, digroup, protection switch, and repeater circuit, for transmission to the RCT.

(5) Digital signals returning from the RCT are steered through the repeaters, protection switch, digroup, address control, driver, buffers, and line circuits in a similar way to the transmit signals.

(6) The digital signals from the RCT are decoded into voice and supervisory signals in the line circuits and passed to the switching equipment.

C. Signal Path — Control (Fig. 12)

3.08 The system controller communicates with the other circuit packs in the system in two modes:

- (a) with the transmission block circuit packs indirectly through the control codes and the B-word circuits;
- (b) with the peripheral circuit packs directly through data and address buses.

3.09 The flow of control signals is as follows:

(1) Control codes from the system controller are assembled into 24-bit B-words in the B-word circuits and inserted into the digital stream by the address control circuits.

(2) Control codes returned from the RCT are extracted from the digital bit stream in the digroup circuits, checked for errors in the B-word circuit, and decoded by the system controller.

(3) Indications and alarms from the RCT are passed on the data bus to the peripheral circuits (e.g., alarm, test) by the system controller.

(4) Local status information (e.g., traffic statistics, CCT alarms) is generated, or operated on, by the system controller, and then passed to the appropriate circuit.

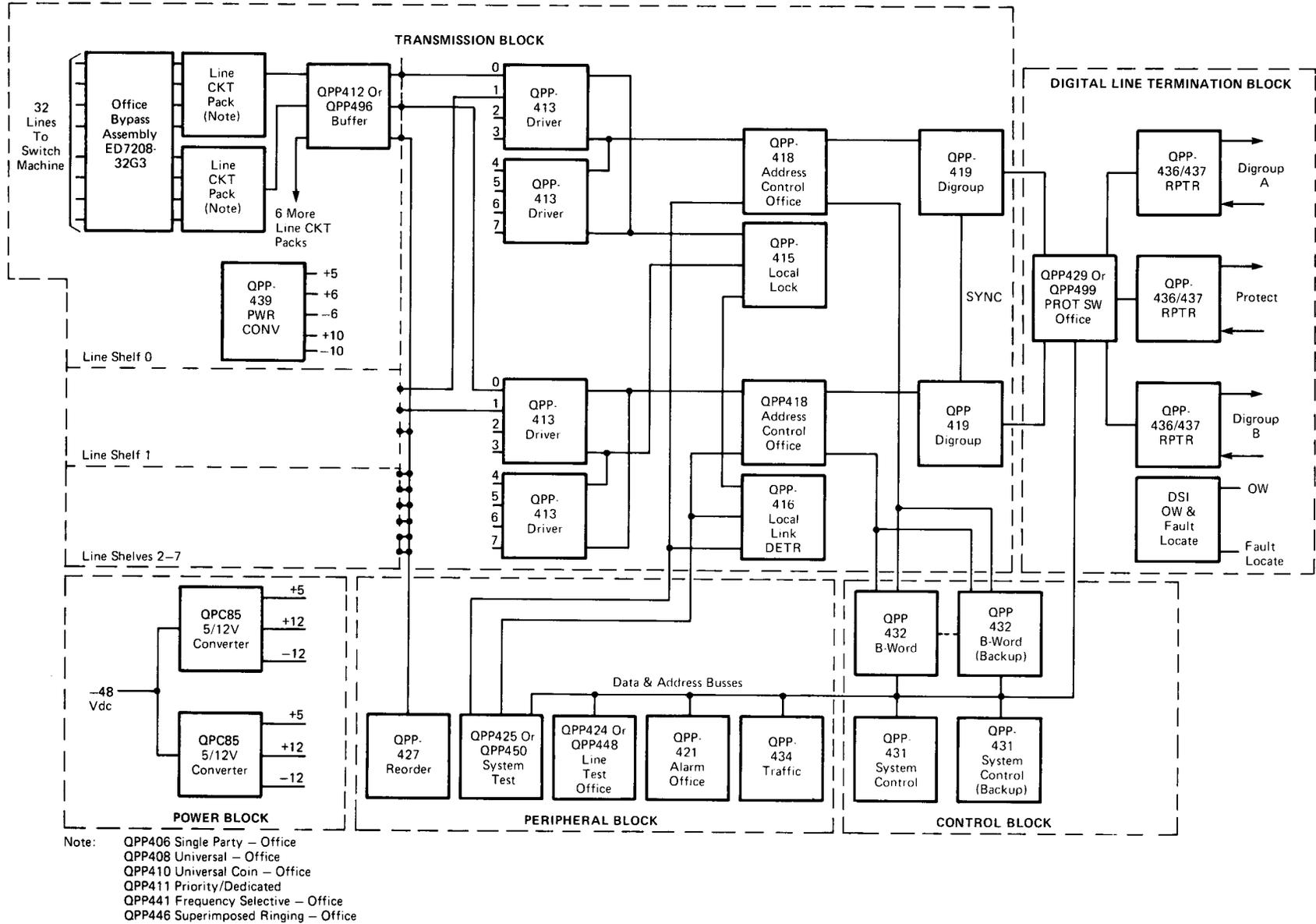


Fig. 10 - CCT Block Diagrams

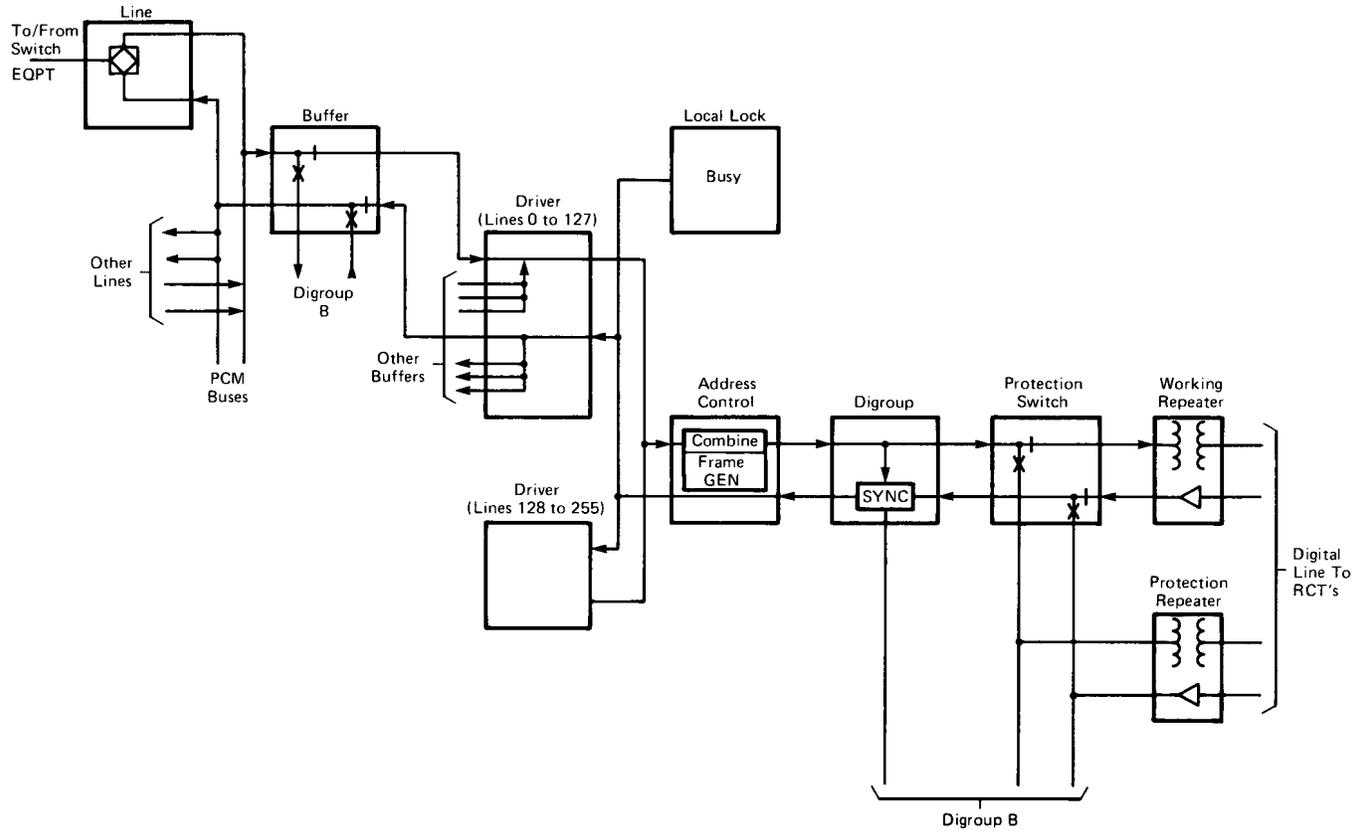


Fig. 11 – Signal Path – Transmission

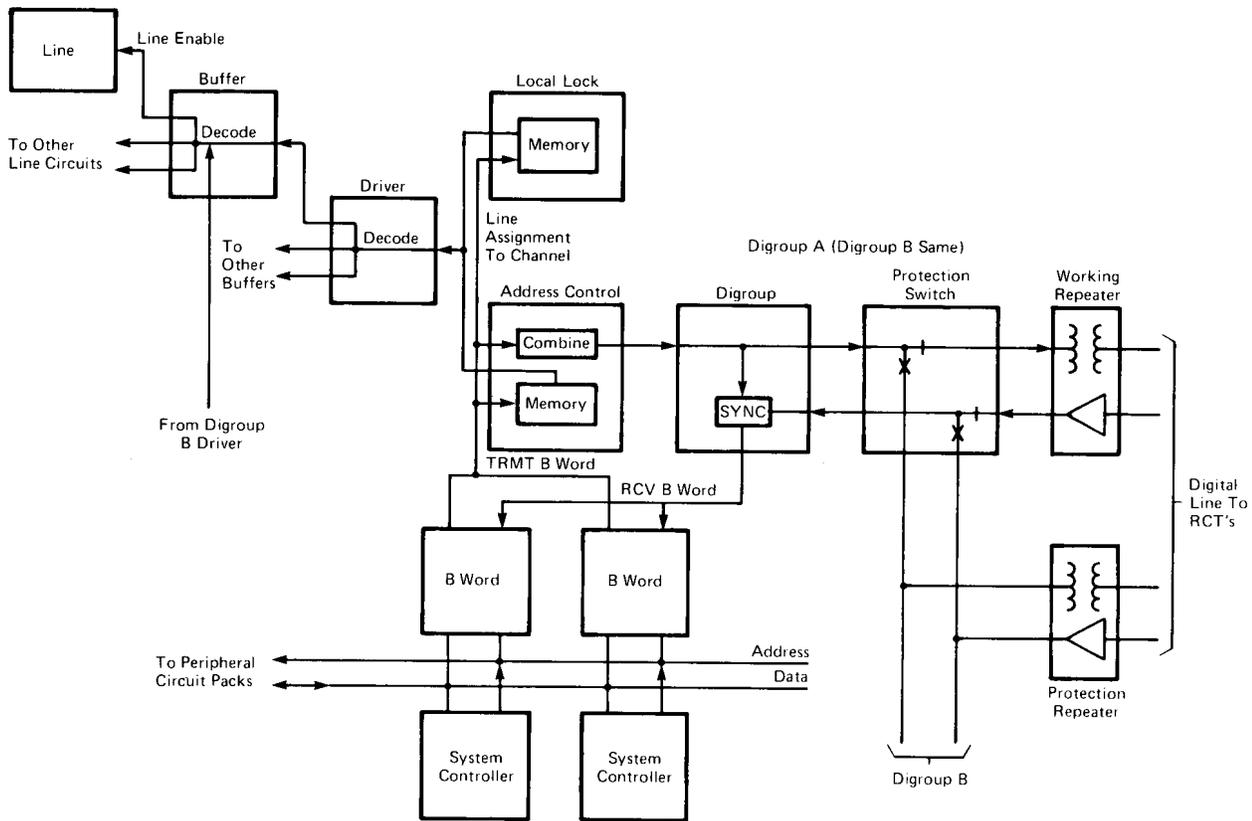


Fig. 12 — Signal Path — Control

D. Signal Path — Local Link (Fig. 13)

3.10 The flow of local-link signals in the system is as follows:

- (1) When a command is generated by the system controller to search for a possible local link, the local-link detector inserts a tone on the assigned channel in the PCM signal in the address control circuits.
- (2) The PCM signal is steered through the drivers and buffers to the line circuit assigned to the PCM channel.
- (3) The PCM signal is converted (decoded) to an analog tone by the line circuit and passed to the switching equipment.
- (4) If the line circuit is connected through the switching equipment with another line circuit on the CCT, the tone is returned and encoded into the PCM channel assigned to the second line circuit.
- (5) The local-link detector then scans all channels except the channel associated with the line requesting service, accessing them through the address control circuits on digroups A or B, as required.
- (6) If a return tone is detected, the local-link detector changes the tone frequency; then, if the change in tone is detected, the local-link detector passes the channel identification to the system controller.
- (7) When the system controller assigns a pair of local-link channels to the lines (if in the same RCT), it also assigns the same PCM channels to the two CCT line circuits in the local-lock circuit pack memories (Fig. 12).
- (8) Supervisory signals are then generated in the local-lock circuits which make the two line appearances busy at the CCT (Fig. 11). The supervisory signals are inserted onto the receive PCM buses by enabling signals steered to the appropriate line circuits as described in 3.07.

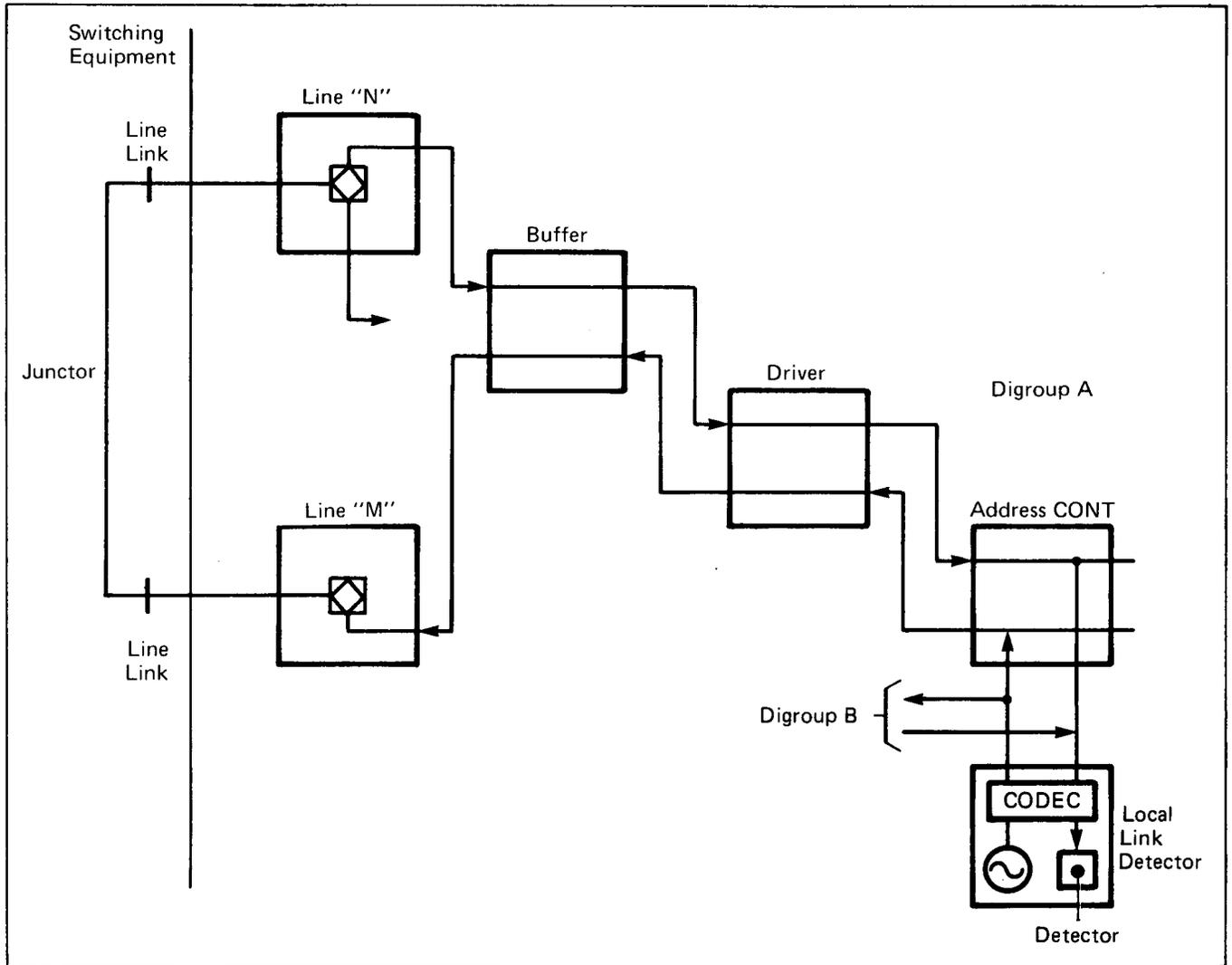


Fig. 13 — Signal Path — Local Link

E. Reorder Tone

3.11 Each line circuit is connected through a separate transmission gate to a common reorder-tone bus from the reorder tone circuit pack.

3.12 When a ringing signal is received on a line from the switching equipment, but a PCM channel cannot be assigned (all channels busy), the system controller generates an all-channels-busy pulse. The line circuit maintenance relay then

operates, bridging zener diodes across the subscriber line until the ringing is tripped, and then releases. Reorder tone is connected to the lines for 12 through 24 seconds.

F. Power

3.13 The CCT bays are powered from the office 48-V battery supply through fuses on the fuse panel.

3.14 The common circuit packs are powered by two power converters. One power converter powers the transmission, control and peripheral circuit packs required for single digroup operation. The other power converter powers the second digroup and backup control circuit packs. Critical circuit packs (alarm, protection switching) are normally powered from the digroup A power converter, but switch to the digroup B power converter if digroup A power converter fails. The QPP416 Local Link Detector and the QPP425 System Test circuit packs are powered by the power converters from line shelf 1 and line shelf 0 respectively.

3.15 One line power converter is required per line shelf. Each converter is separately fused on the fuse panel (Fig. 8).

G. Reliability

3.16 The CCT can survive failures and continue to provide service when:

- (a) *one digital line fails*: either by switching to the protection DS1 line if the system is equipped with protection switching, or by reassigning subscribers from channels on the failed DS1 line to idle channels on the other working line;
- (b) *an arm of a star-configured system fails*: by bypassing the failed arm, provided the system is equipped with the star switch option;
- (c) *one common power converter fails*: by maintaining operation on the other digroup powered by the other power converter, and reassigning subscribers as in (a);
- (d) *one system controller or B-word circuit pack fails*: by switching system operation to the backup circuit packs, if provided;
- (e) *one framing and timing generator fails*: by switching system operation to the backup generator on the other address control office circuit pack;

(f) *one line power converter fails*: service is lost to the 32 lines on the failed shelf but service continues to the other 7 line shelves;

(g) *digroup or address control fails*: by reassigning subscribers from channels on the failed digroup to the idle channels on the working digroup; calls which cannot be reassigned because of insufficiently available channels are disconnected.

H. Maintainability

3.17 The CCT is equipped with both automatic and manual circuits for detecting 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*. The channel busy/idle memories 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 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 if 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 circuit pack.

(d) Manual system testing and fault location are carried out through the system test circuit pack (see 4.31).

4. CIRCUIT PACK FUNCTIONS

A. Transmission Block

General

4.01 The transmission block is subdivided as follows:

(a) *Line-Associated Circuit Packs.*

QPP406-Type	Single-Party – Office
QPP408-Type	Universal – Office
QPP410	Universal Coin-Office
QPP411	Priority/Dedicated
QPP412	
<i>or</i>	
QPP496	Buffer
QPP441	Frequency Selective – Office
QPP443	Post Pay Coin – Office
QPP446	Superimposed – Office

(b) *Digroup-Associated Circuit Packs.*

QPP413	Driver
QPP415	Local Lock
QPP416	Local-Link Detector
QPP418	Address Control Office
QPP419	Digroup

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

4.02 The B or D version, e.g., QPP406B or QPP441D of each line circuit pack, provides for the connection of reorder tone.

QPP406-Type Single-Party – Office (Fig. 14)

4.03 Features of the QPP406 circuit packs are:

- (a) four lines per circuit pack,
- (b) one Light Emitting Diode (LED) indicator per line to show when the lines are busy.

4.04 Functions of the QPP406 circuit packs are:

- (a) to detect the presence of bridged ringing, and request a channel assignment from the control logic (ring detector);
- (b) to repeat the on-hook/off-hook and dial pulse signals from the subscriber lines to the switching equipment (hook relay, K1);
- (c) to transform the 2-wire line from the switching equipment into a 4-wire path to separate/combine transmit and receive signals (hybrid transformer)
- (d) to band-limit the transmit analog signal to 0.3 to 3.2 kHz (20 dB, 60 Hz reject) and convert it to an 8-bit-per-sample PCM signal for connection to the transmit PCM bus (transmit filter and encoder);
- (e) to convert the received 8-bit signals from the receive PCM bus to an analog signal, and band-limit the signal to 3.2 kHz (decoder and receive filter);
- (f) to synchronize the codec-enable and PCM signals from the buffer connection to the codec (line interface circuit);
- (g) on command from the control block, to open the 2-wire vf port (maintenance relay, K2);
- (h) to trip a ringing signal, and connect reorder tone on the 2-wire line to the switching equipment, when service cannot be provided to the line (e.g., all channels busy); this function is available only on the QPP406B circuit pack.

QPP408-Type Universal – Office (Fig. 15)

4.05 Features of the QPP408 circuit packs are:

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

4.06 Functions of the QPP408 circuit packs are the same as those of the QPP406 circuit pack described in 4.04(a) through (h). In addition the QPP408 unit,

- (a) senses the presence of divided (tip-to-ground, ring-to-ground) ringing voltage, and requests a channel assignment from the control logic;
- (b) provides a resistive ground path for the Automatic Number Identification (ANI) test from the switching equipment when the tip party goes off-hook.

QPP410 Universal Coin-Office (Fig. 16)

4.07 Features of the QPP410 circuit pack are:

- (a) two coin lines per circuit pack; providing service for ground start; or loop-start, ground-isolated (GI), non-GI, dial-tone-first, coin-first, prepaid, postpay, or semi-postpay;
- (b) one LED indicator per line to show when the lines are busy.

4.08 Functions of the QPP410 circuit pack are:

- (a) to detect ringing (ring-to-ground), and request a channel assignment from the control logic;
- (b) to detect coin disposal (± 130 V on tip-to-ground, or tip and ring simplex to ground), and request a channel assignment from the control logic;
- (c) to detect coin check (± 48 V tip-to-ground with ring open), and request a channel assignment from the control logic;
- (d) to repeat on-hook/off-hook and dial pulses from coin lines to the office equipment (hook relay, K2);
- (e) to repeat coin conditions from the remote to the office equipment (coin relay, K1);

(f) to transfer the 2-wire line from the switching equipment into a 4-wire path to separate/combine transmit and receive signals (hybrid transformer);

(g) to band-limit the transmit analog signal to 0.3 to 3.2 kHz (20 dB, 60 Hz reject) and convert it to an 8-bit-per-sample PCM signal for connection to the transmit PCM bus (transmit filter and encoder);

(h) to convert the received 8-bit signals from the receive PCM bus to an analog signal, and band-limit the signal to 3.2 kHz (decoder and receive filter);

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

(j) on command from the control block, to open the 2-wire v_f port (maintenance relay, K4);

(k) to trip a ringing signal, and connect reorder tone on the 2-wire line to the switching equipment when service cannot be provided to the line (e.g., all channels busy); this function is available only on the QPP410B circuit pack.

QPP411-Type Priority/Dedicated

4.09 Features of the QPP411 circuit packs are:

- (a) four lines per circuit pack,
- (b) priority/dedicated switches accessible from the front of the circuit pack,
- (c) used with QPP405 at the RCT.

4.10 Functions of the QPP411 circuit packs are the same as for the QPP406-type (4.04[a] through [h] and Fig. 14), with the addition of interface logic and four 2-position switches (one for each line) which function as follows:

(a) When a switch is placed in the priority (P) position, the associated line is assigned a PCM channel as soon as it indicates a request, even though all channels are busy.

(b) When a switch is placed in the dedicated (D) position a PCM channel is permanently assigned to the associated line but RCT on-hook/off-hook supervisory conditions are repeated at the CCT.

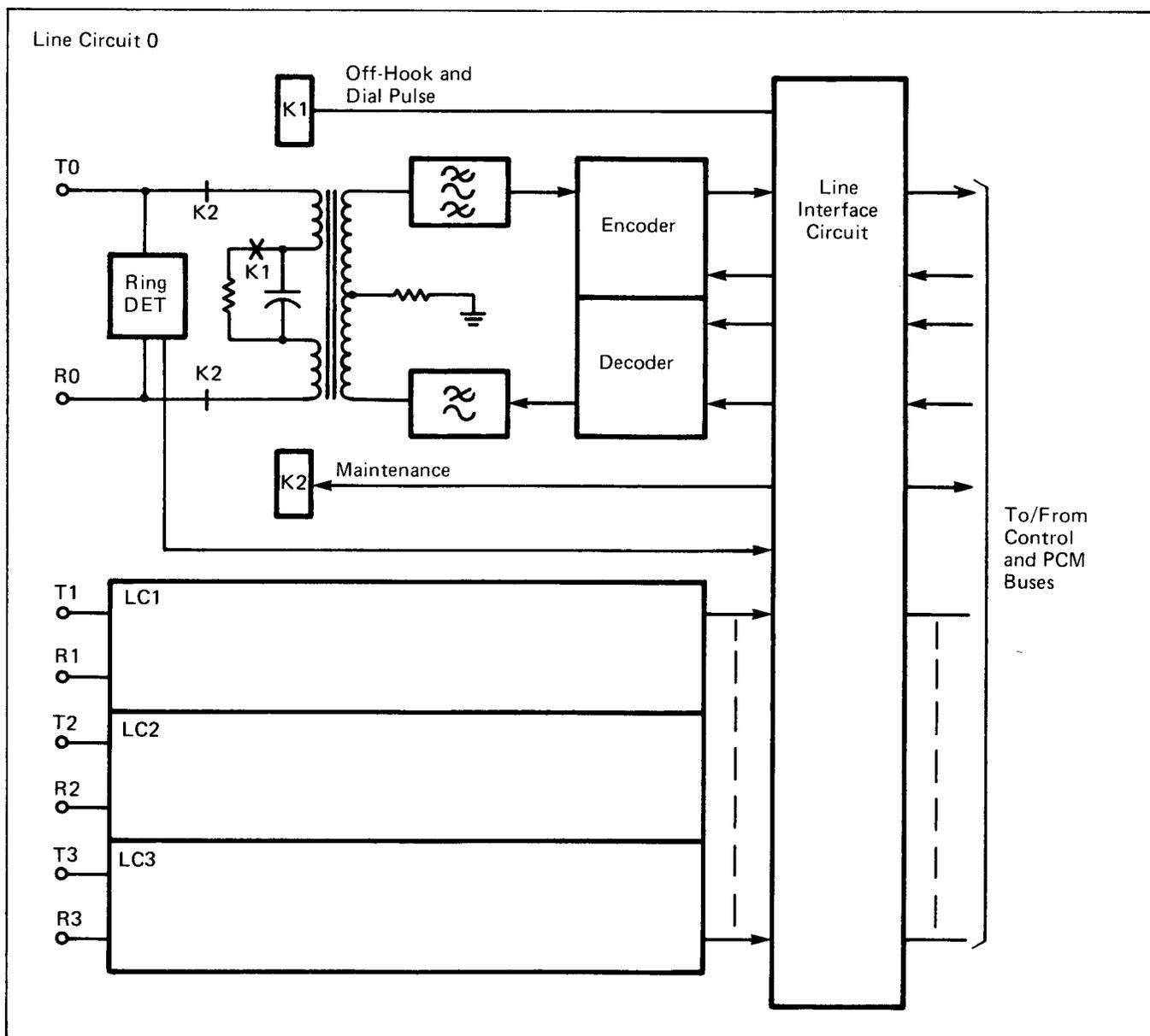


Fig. 14 - QPP406 Single Party - Office

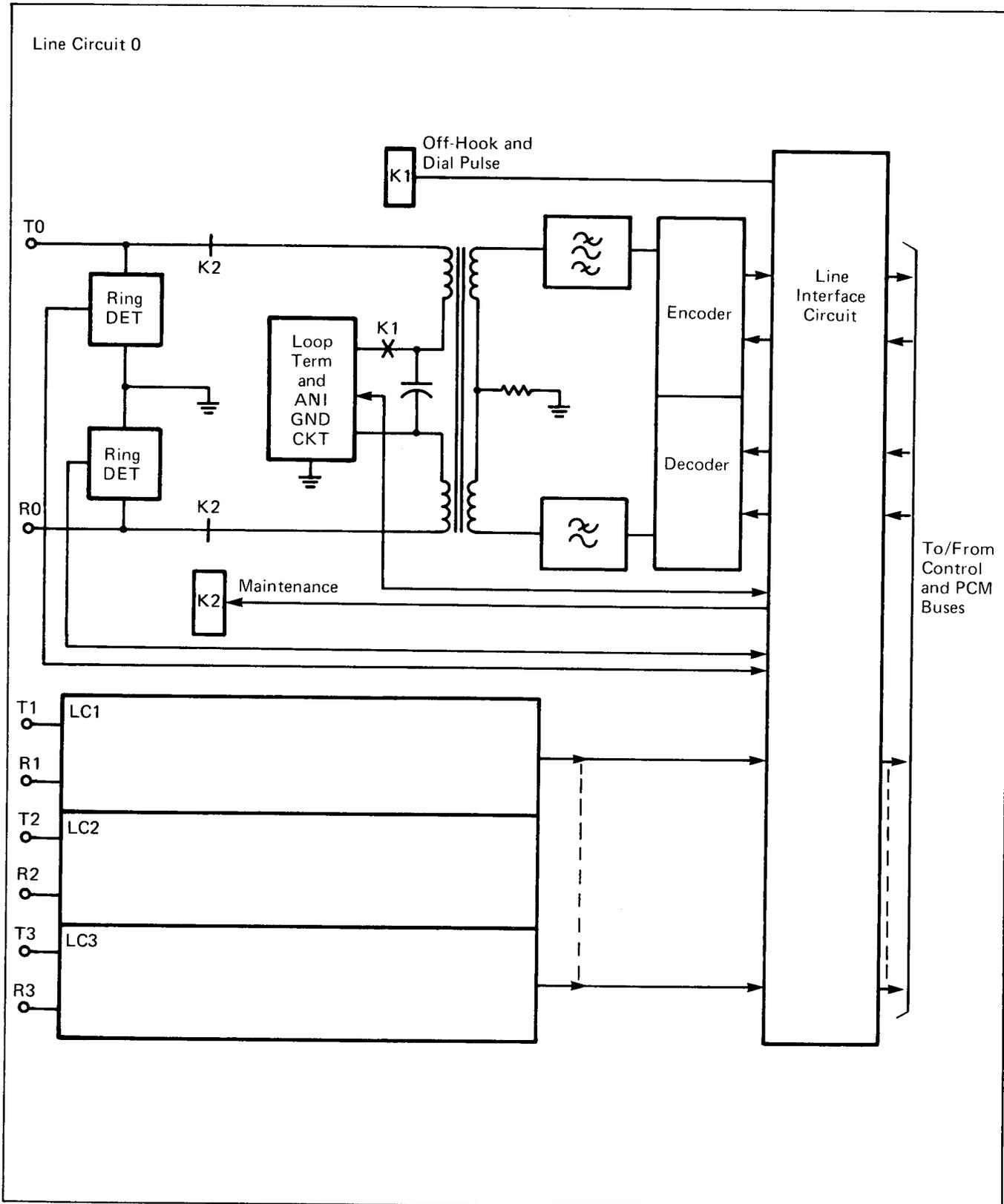


Fig. 15 — QPP408 Universal — Office

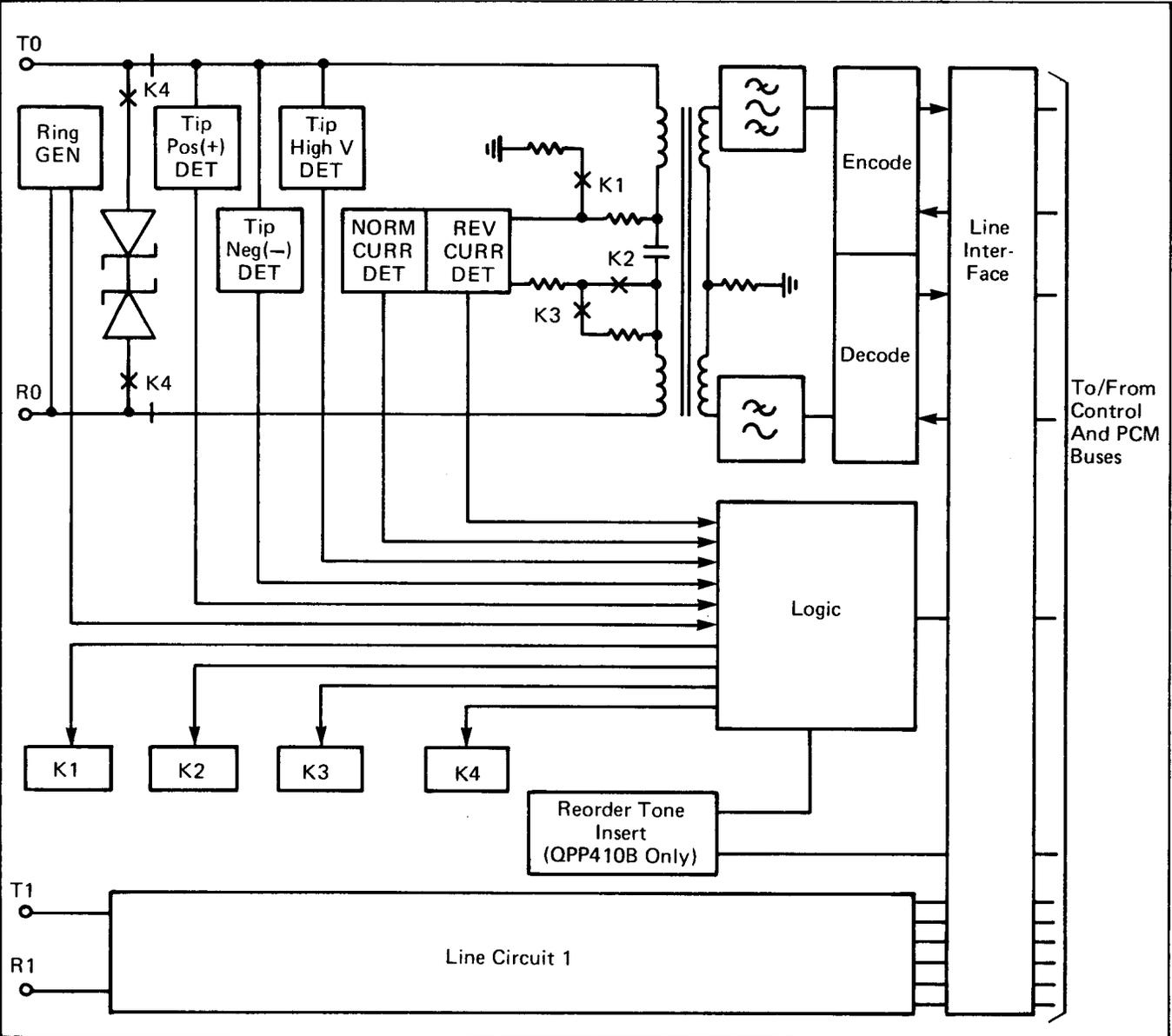


Fig. 16 - QPP410 Circuit Pack - Universal Coin-Office

QPP441 Frequency Selective – Office

4.11 Features of the QPP441 circuit packs are:

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

4.12 Functions of the QPP441 circuit packs are the same as for the QPP408 (4.06), with the addition of circuits which attenuate the ring signals (16 to 67 Hz) and switch the signal to the encoder input for transmission to the RCT.

QPP443-Type Post Pay Coin – Office (Fig. 17)

4.13 Features of the QPP443 circuit packs are:

- (a) two line circuits for each circuit pack;
- (b) one LED indicator for each line to shown when the line is off-hook;
- (c) type B circuit pack provides reorder tone when a terminating call is blocked.

4.14 Functions of the QPP443 circuit packs are the same as those for the QPP406 Single-Party-Office (4.04[a] through [h]) circuit pack with the addition of circuits to:

- (a) Detect battery reversal (battery on tip, ground on ring) from the switching equipment.
- (b) Interrogate the ring detector once per scan interval (180 ms) by the system controller using SD1. When ringing is detected, the system controller transmits ringing control signals to the RCT using SD1 and SD3 to operate the ringing relay.

QPP446-Type Superimposed Ringing – Office

4.15 Features of the QPP446 circuit pack are:

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

4.16 Functions of the QPP446 circuit pack are the same as for QPP408 circuit packs (see 4.06) with the addition of circuits to detect one of four superimposed ringing conditions (20 Hz on either positive or negative battery, and on either tip or ring conductor), and switch a unique dc voltage to the encoder input for transmission to the RCT.

QPP412 and QPP496 Buffer (Fig. 18)

4.17 Functions of the QPP412 and QPP496 circuit packs are:

RECEIVE PATH

- to buffer and fan-out all of the control and data leads between the drivers and the line circuit packs;
- to decode control signals from the drivers to pass enabling signals to the correct line circuit pack;
- 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;
- on QPP496 only, to demodulate the ANI information (tip party or ring party off-hook condition) from the RCT and apply the necessary control signals to the QPP408, QPP441 and QPP446 office line cards which serve to update ANI information to the switching equipment every 1.5 ms.

TRANSMIT PATH

- 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;
- to buffer and steer the PCM signal to the digroup A or digroup B driver;
- on QPP496 only, to generate a modulating signal which causes the QPP408, QPP441 and QPP446 line cards to update ringing information (ringing applied to tip side or ring side) to the RCT every 1.5 ms.

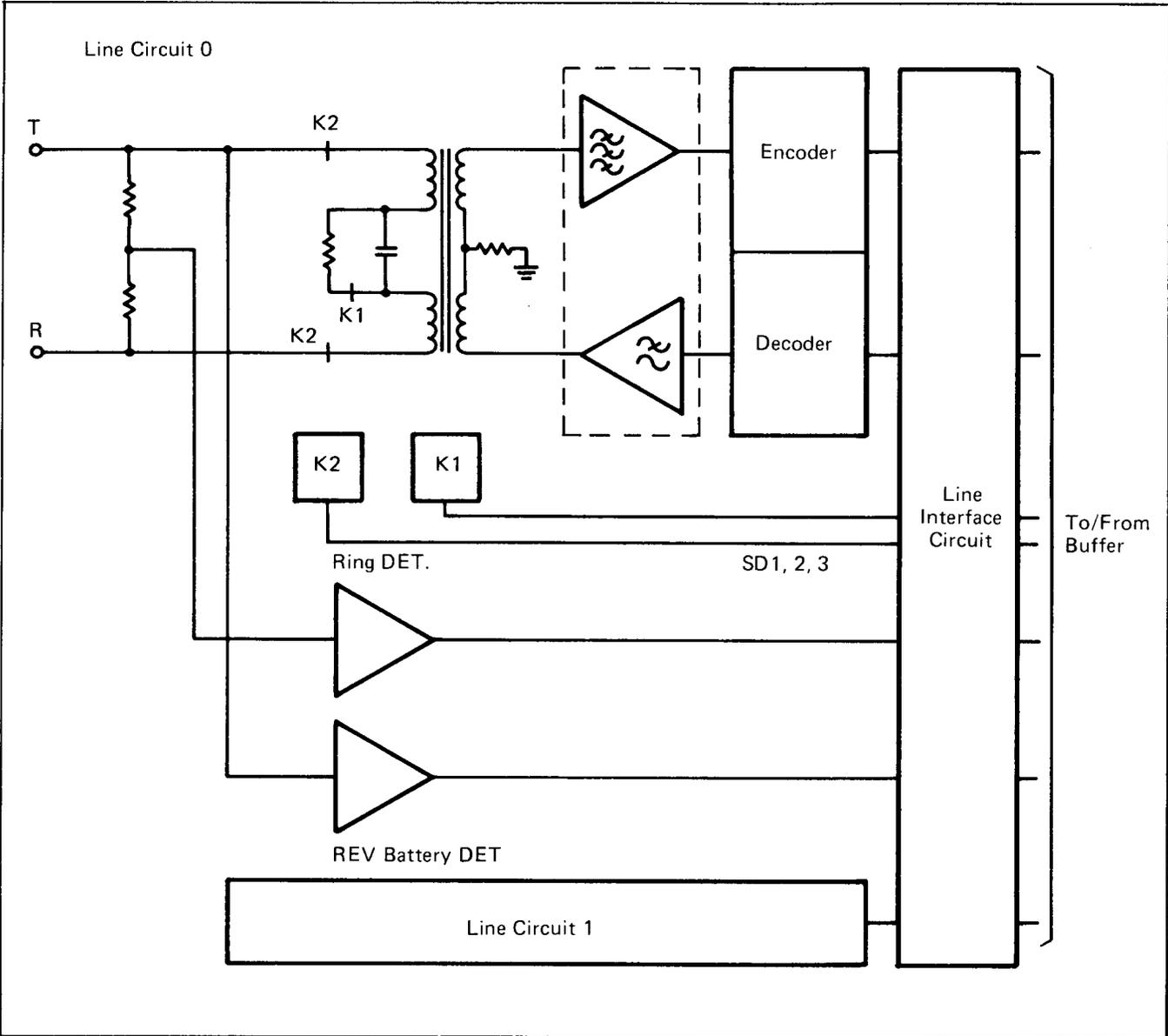


Fig. 17 – QPP443 Circuit Pack – Post Pay Coin-Office

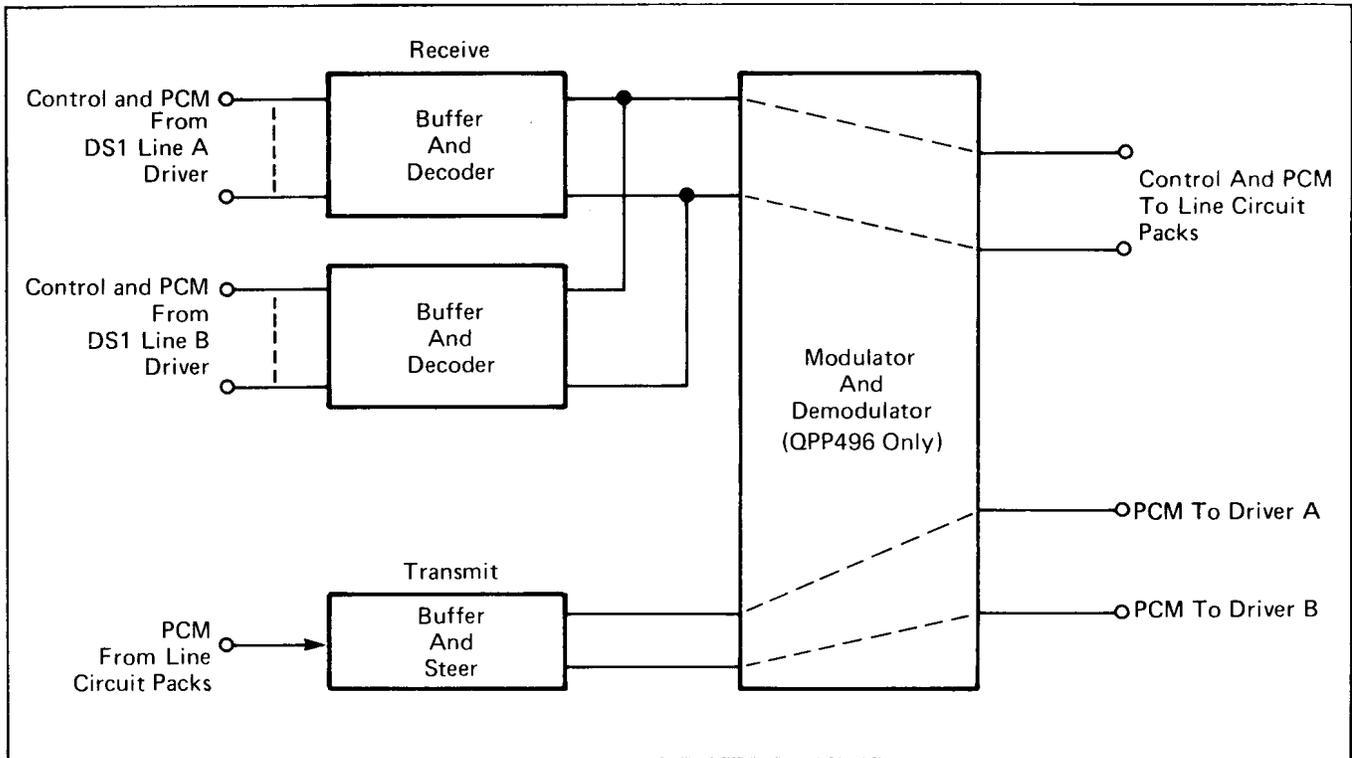


Fig. 18 – QPP412 and QPP496 Buffer

QPP413 Driver (Fig. 19)

4.18 QPP413 driver circuit packs are required as follows:

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

4.19 Functions of the QPP413 circuit packs are:

- (a) to fan-out controls, frame pulse, clock, strobes, and data to four buffers;
- (b) in the transmit direction, to route the eight 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 control 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.

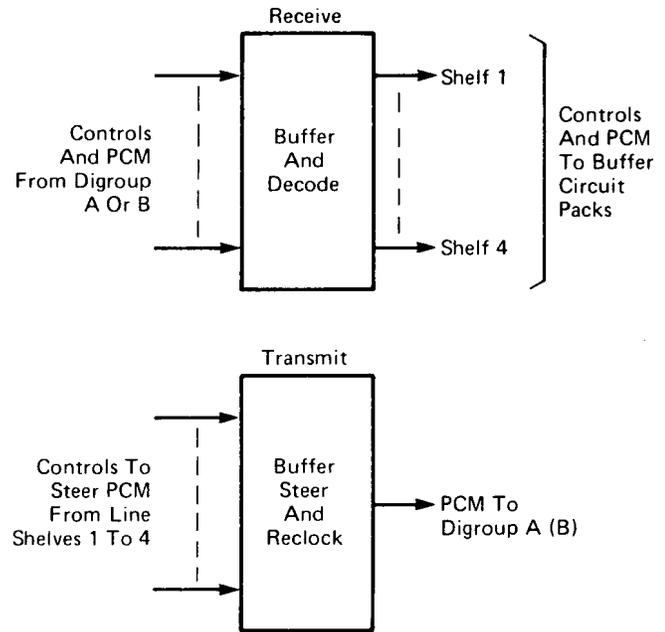


Fig. 19 – QPP413 – Driver

QPP415 Local-Lock (Fig. 20)

4.20 Functions of the QPP415 circuit packs are:

- (a) to provide local memories for both digroups;
- (b) to force the bit stream in the particular channel time slot to simulate an off-hook condition and lock the hook relay in the off-hook state, when a line number is written into the assigned channel position in the local-lock memory.

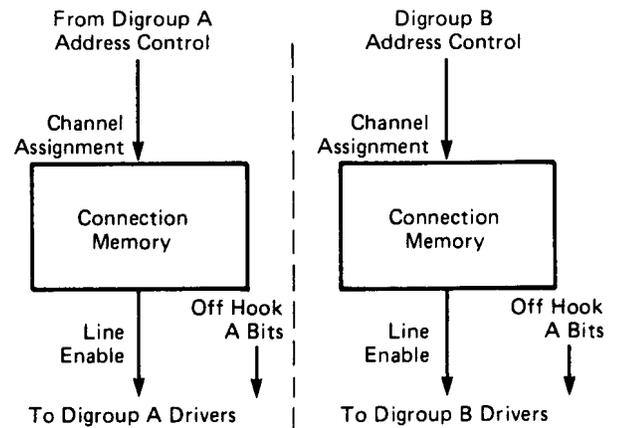


Fig. 20 – QPP415 Local Lock

SECTION 363-2011-101

QPP416 Local-Link Detector (Fig. 21)

4.21 Functions of the QPP416 circuit packs are:

- (a) to encode a vf tone from the oscillator and insert the code into the channel marked by the system controller, when an enabling and steering signal is received from the system controller;
- (b) to scan each of the transmitted channels on each digroup (through digroup selector II and the decoder) for the tone presence after a delay for ring trip and talk connection to occur in the switching equipment;
- (c) to measure the frequencies of the oscillator and of any signal on the transmitted channel, and compare the two frequencies in the counter and comparator circuit;
- (d) if the two frequencies match, to change the frequency of the oscillator and again compare the oscillator frequency with the signal on the transmit digroup bus;
- (e) if the frequencies match again, to repeat (c) and (d) and then flag the channel as a confirmed link;
- (f) the system controller checks for the presence of the flag once in each complete scan cycle and, when a flag is present, carries out the steps of 3.10.

QPP418 Address Control Office (Fig. 22)

4.22 One address control office circuit pack is required for each digroup for the following functions.

- (a) to accept B-words from the control block;
- (b) to decode the B-words and steer the data bytes to the addressed memory or registers for CCT operation;
- (c) to insert the B-words into the PCM stream for transmission to the RCT;
- (d) provide memory stores for
 - storing the line numbers assigned to each DS1 channel between the RCT and CCT (connection memory);
 - storing the status of each CCT to RCT channel (auxiliary memory, idle/busy);
 - storing the Signal Distributing (SD) control bits used for reflecting special line conditions from the RCT to the CCT, e.g., ANI test (auxiliary memory, SD);
- (e) to generate the 1.544-MHz clock from the 6.176-MHz signal from the system controller;
- (f) to generate the framing pattern, and supply frame, channel-enable, A-bits enable, and B-bits enable signals to the CCT;
- (g) under control of the system controller, to transfer control of the frame generation from the digroup A to the digroup B address control office circuit pack when the digroup A frame generator fails;
- (h) to count the number of zeros in each channel time slot; if the first six bits are zeros, insert a 1-bit into the seventh bit position to supply timing information to the repeatered line.

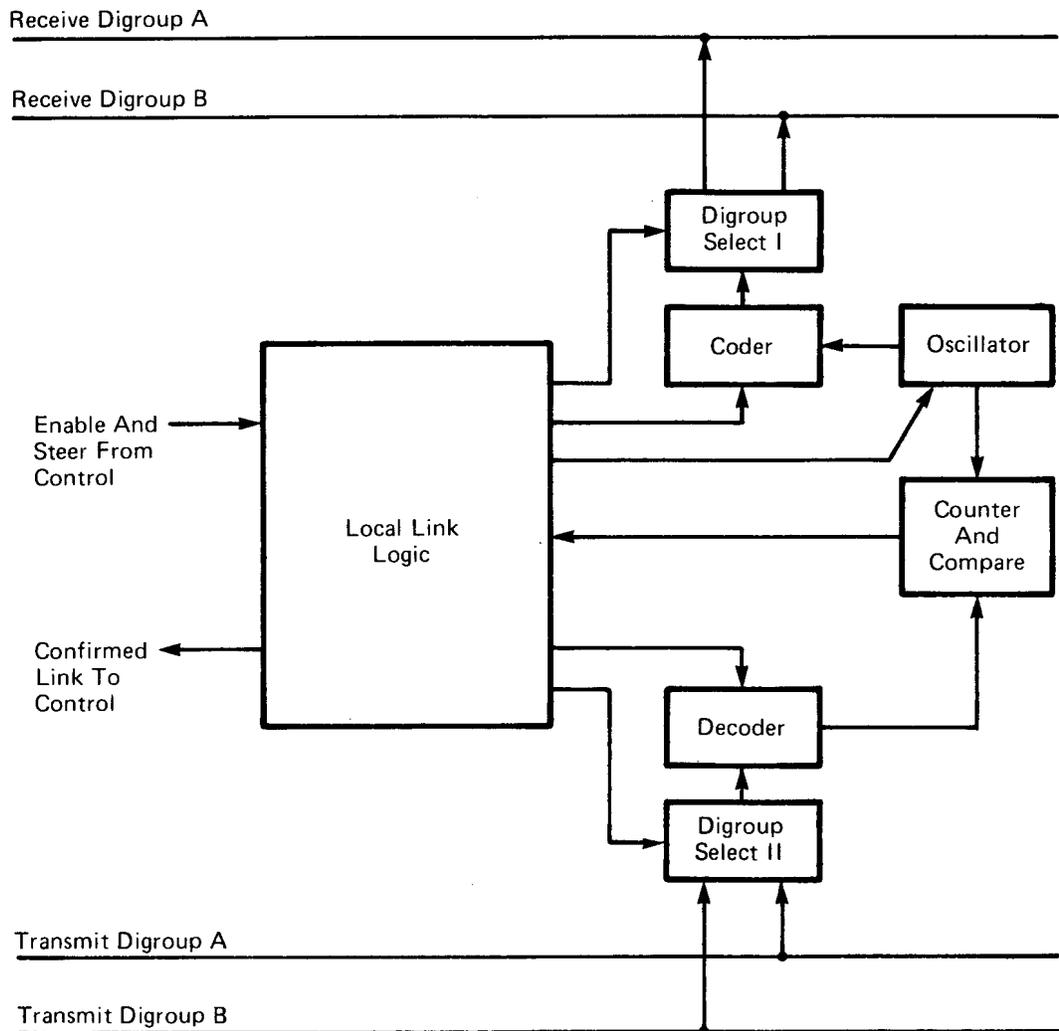


Fig. 21 – QPP416 Local-Link Detector

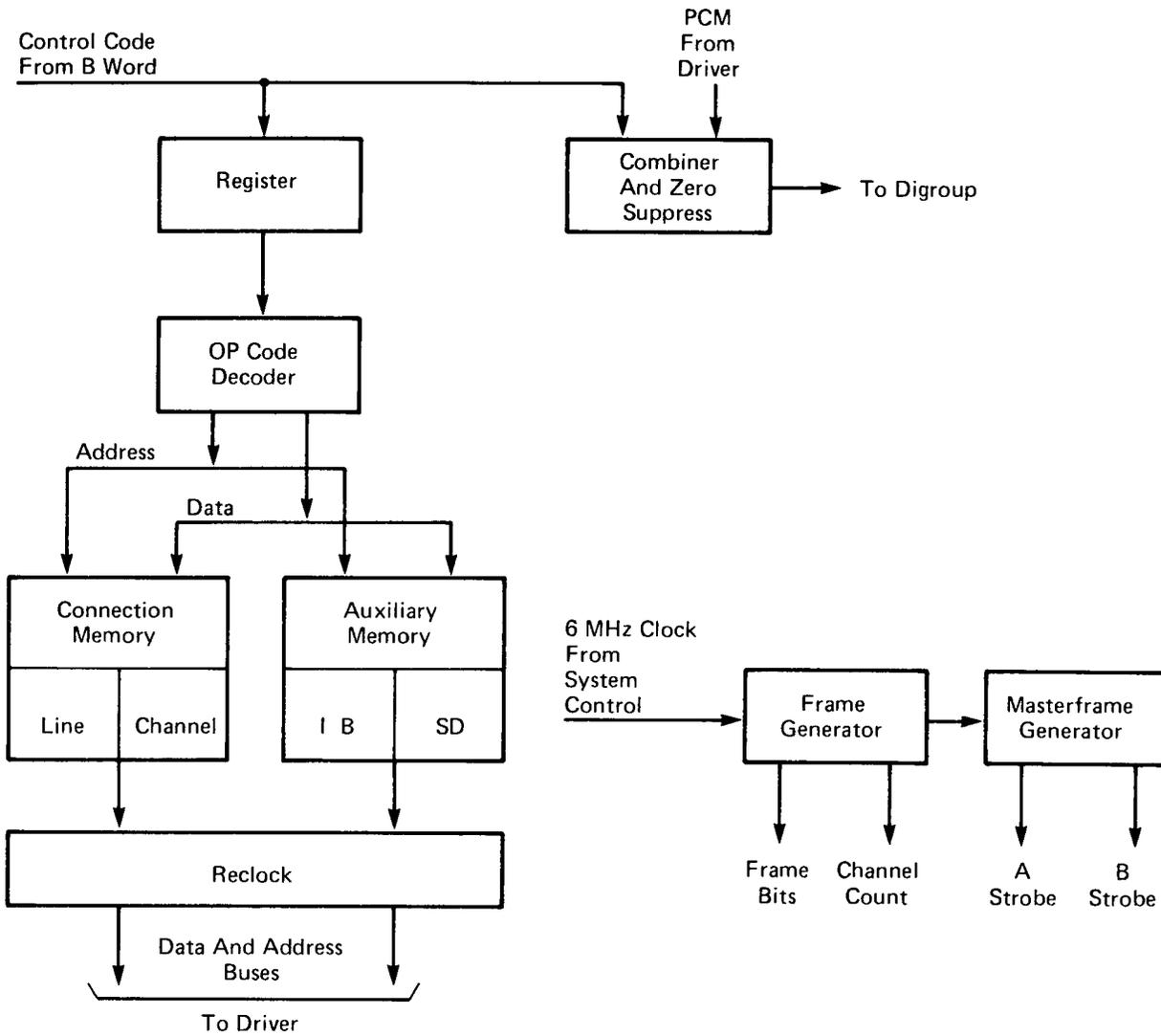


Fig. 22 – QPP418 Address Control Office

QPP419 Digroup (Fig. 23)

4.23 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; and to provide level adjustment and equalization over a 6-dB range;
- (b) to convert the bipolar signal from the digital line into a unipolar signal and extract the clock signal;
- (c) to dejitterize the received signals by clocking the signal into an elastic store with the received clock and out of the store with the CCT clock;
- (d) to synchronize the received signal to the framing pattern and extract the frame pulse and B word
- (e) to synchronize the two received digroup signals;
- (f) to generate an alarm if framing is lost, for more than 100 ms; if the framing on the master digroup is lost, transfer control of the framing outputs to the slave digroup.
- (g) to provide inputs to the QPP449 star control circuit pack (star switch option only).

B. Control Block**General**

4.24 The control circuit packs are:

- QPP431 System Controller
QPP432 B-Word

QPP431 System Controller (Fig. 24)

4.25 The QPP431 system controller circuit pack contains:

- (a) a microprocessor (Type 8080);
- (b) Erasable, Programmable, Read Only Memory (EPROM) to store the firmware programs;
- (c) Random Access Memory (RAM) to store volatile data;
- (d) clock generator, self check monitors, and bus drivers and receivers.

4.26 Functions of the QPP431 circuit packs are:

- (a) to store the following operating programs and carry out the programmed sequences outlined in 363-2011-100:
 - system initialization
 - option identification
 - line identification
 - line scan
 - trunk and local-link channel assignment
 - single-party, universal, priority/dedicated, and frequency selective line operation
 - reorder tone
 - alarms
 - system tests
 - subscriber line tests
 - traffic measurements
 - reassignment
 - line and memory audit
 - line and CE automatic fault location
 - synchronize the cutting of arms to RCT by the star control, QPP449 (with the star switch option in star configured systems only).
- (b) to store the channel assignments of all lines;
- (c) to store the identification of all lines;
- (d) to generate the control codes, assemble the 24-bit control words into three successive 8-bit bytes, and pass words to the B-word circuit pack;
- (e) to interrogate the status of the CCT maintenance controls between each complete line scan (about once every 180 ms); and, if a control is operated, to generate a control code to transmit the operation command to the RCT;
- (f) to check the results of an RCT alarm scan, as well as the CCT alarms, between each complete line scan, and pass the alarm indications to the alarm-office circuit pack;
- (g) to collate traffic statistics and output the statistics to the traffic circuit pack;

- (h) to check the operation of the microprocessor by looking for a periodic reset pulse; if the reset pulse is not found, an alarm is initiated and the backup system controller (if installed) takes over system operation;
- (i) to check the operation of the interrupt function by periodically generating an interrupt signal to which the microprocessor must reply; if the microprocessor does not reply, an alarm is initiated and the backup system controller takes over system operation;
- (j) to reset all memories and registers to the initial state by:
 - transmitting a master clear control code to the RCT
 - erasing data in all RAM when the front panel RESTART and RESTART ARM buttons are pressed simultaneously.
- (k) to carry out a check of all idle/busy memories in the complete system once every 12 seconds (one memory location for each complete scan cycle); any errors found cause a checkerboard test to be carried out for the memory location, and alarms to be initiated if a failure is found;
- (m) to restart a line power converter up to three times at 10-second intervals after a line-power fail alarm is received;
- (n) to generate the system master clock.

QPP432 B-Word (Fig. 25)

4.27 Functions of the QPP432 circuit packs are:

- (a) to assemble the three B-word bytes received from the system controller into a complete B-word for insertion into the transmitted digital streams;

- (b) to pass the B-word to the address control office circuit packs for control of the CCT and for transmission to the RCT;
- (c) to error-check the received B-words by:
 - comparing two successive received B-words per digroup from both the RCT and CCT (data bits only);
 - comparing transmitted and received B-words per digroup (operation code and address bytes);
 - comparing the received B-words from the two digroups (for line scan only);
 - comparing the returned data from a read control code against the related write-control code data sent;
- (d) to generate an interrupt to the system controller when a B-word is received and processed; and also to generate an alarm if the B-word fails one of the error checks.

C. Peripheral Block

General

4.28 The peripheral circuit packs include:

QPP421	Alarm Office
QPP424	Line Test – Office
QPP425	System Test
QPP450	Test Control
QPP427	Reorder Tone
QPP448	Test Access – Office
ED7208-32, G3	Office Bypass Assembly

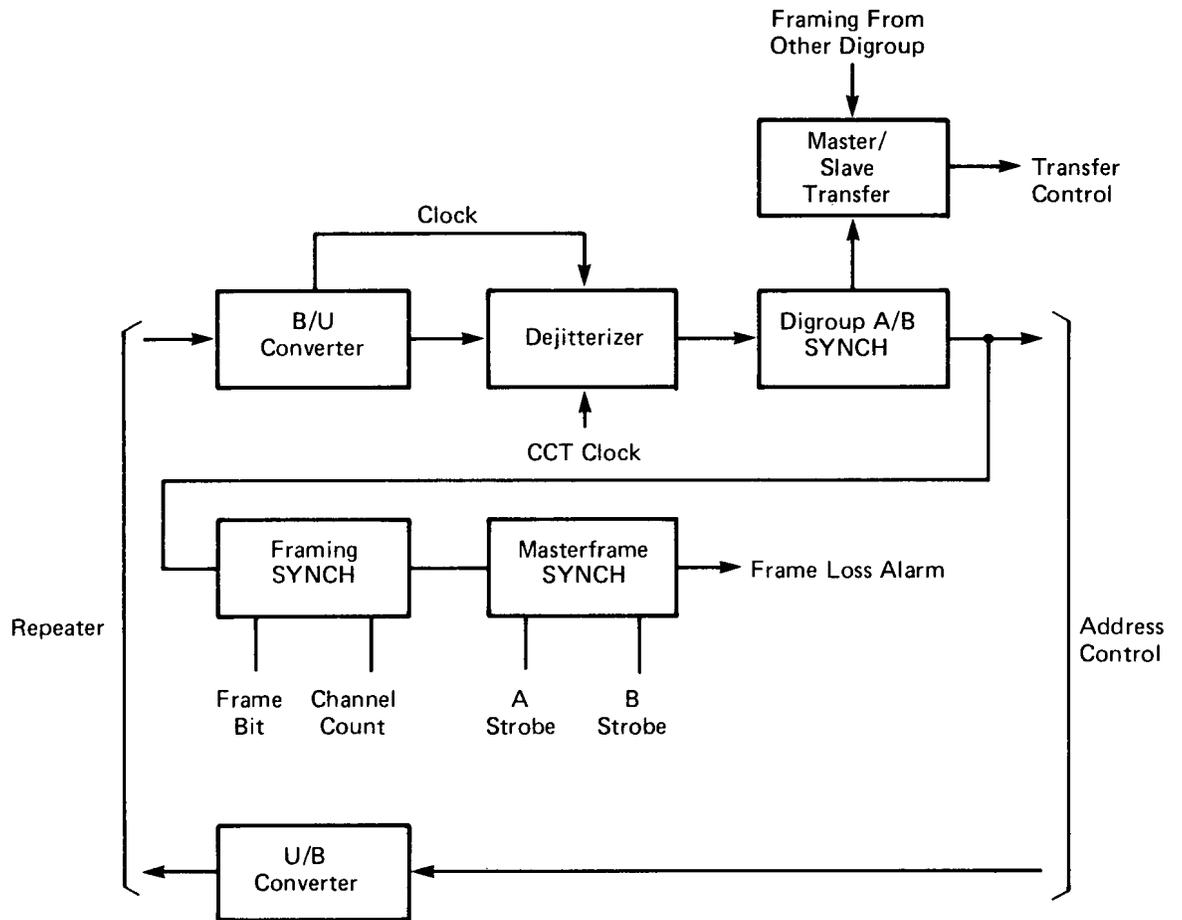


Fig. 23 – QPP419 Digroup

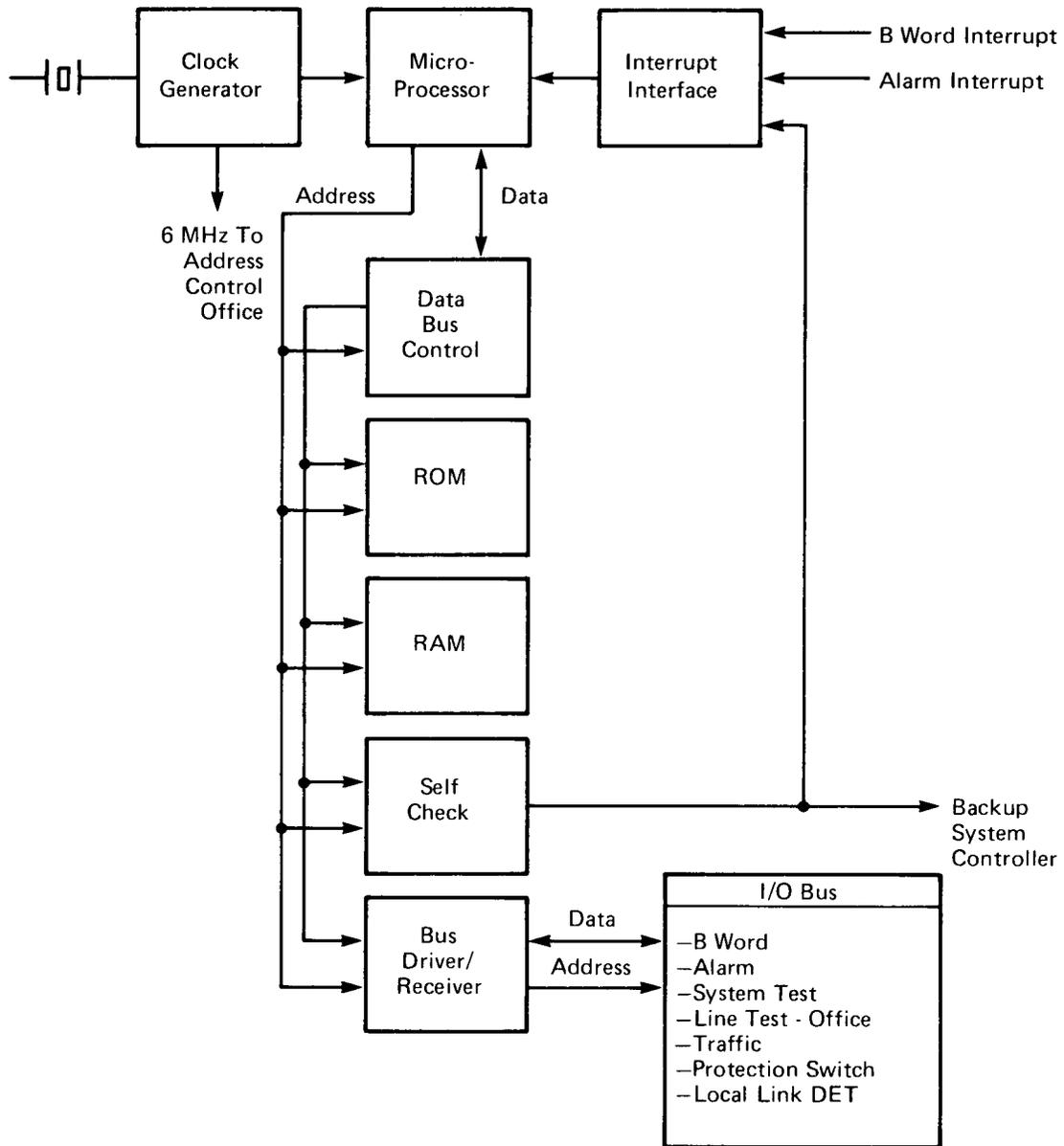


Fig. 24 – QPP431 Circuit Pack – System Controller

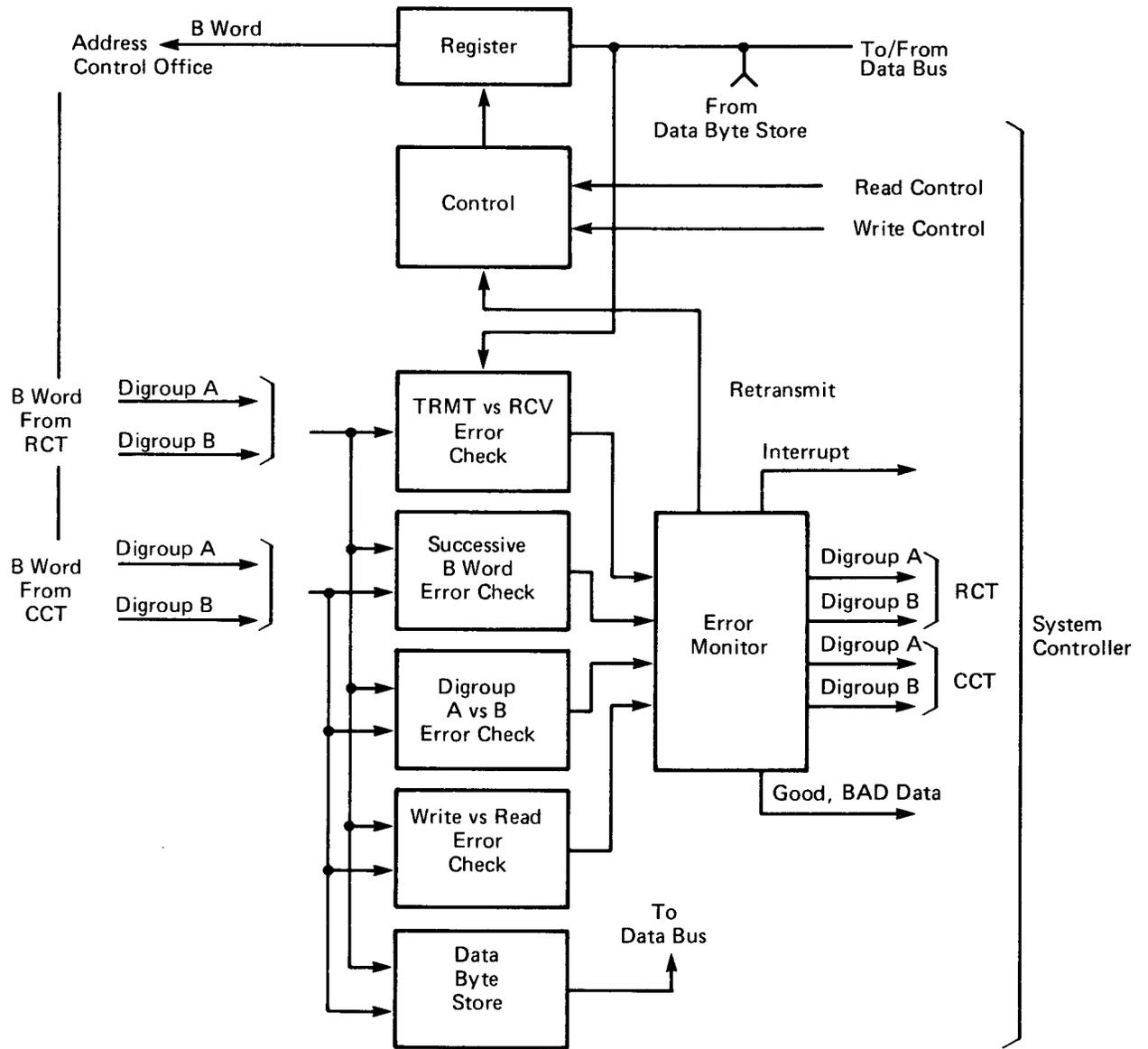


Fig. 25 — QPP432 B Word

QPP421 Alarm Office (Fig. 26)

4.29 Functions of the QPP421 circuit packs are:

- (a) to display both local CCT alarms, and alarms returned from the RCT via the B control code (Table A); four spare locations are provided for alarms from an RCT location, with provision for a front panel designation card; the location of the alarm is indicated by one LED per location (one CCT and four RCT). The location is selected by a switch and the common display then indicates the type of alarm;
- (b) to categorize the alarm into:
 - *Major Alarms*: conditions causing a service failure;
 - *Minor Alarms*: an equipment failure or out-of-limits condition which does not cause a service failure.
- (c) to provide three normally open contacts with an isolated return for major alarms, and three normally open contacts for minor alarms, for operation of the office audible and visual alarms;
- (d) to provide an ACO button to release the office alarm contacts; the alarm indication on the CCT remains until the fault has been repaired. Succeeding, different alarms reoperate the office alarms (e.g., if the first alarm was for ac power failure, and a second alarm was for RCT door open);
- (e) to allocate line shelves to different RCT in a distributed system through the settings of switches on the QPP421 circuit pack. There are four modules of eight switches each; one module for each RCT, with one switch on each module for each line shelf in the RCT.
- (f) to indicate the system configuration by one 8-position system switch (e.g., local link installed, protection switch installed).

QPP424 Line Test – Office (Fig. 27)

4.30 Functions of the QPP424 circuit pack are:

- (a) to test any of the subscriber lines for foreign ac and dc voltages, leak resistance, and capacitance; used with the Line Test – Remote (QPP423) and System Test (QPP425) circuit packs; (see Table B for test ranges and Table C for testing times).
- (b) to control the operation of the QPP423 by means of the switch settings on the QPP424 faceplate and the line address switch settings on the QPP425;
- (c) to generate control signals to the system controller for operation of the line test-remote circuit pack;
- (d) to receive measurement and status data from the line test remote circuit pack through the system controller and calculate the required display parameters;
- (e) to display selected parameter values (conditions between tip and ring, tip and ground, or ring and ground on the circuits);
- (f) to identify (by LED) the parameter being displayed, and indicate if an overload condition is indicated by the measurement;
- (g) to indicate (by LED) the testing status; that is, TESTING HALTED, or CAL CHECK FAIL;
- (h) to initiate the self-test routine for the line test remote circuit pack when the ON switch is operated;
- (i) to permit a single parameter to be selected for continuous test and display;
- (j) to halt testing if ringing occurs on the shelf under test, or if the ac or dc voltage is out of range;
- (k) to select compensation for either frequency-selective line circuit packs, or any other type of line circuit pack (option switch S2).

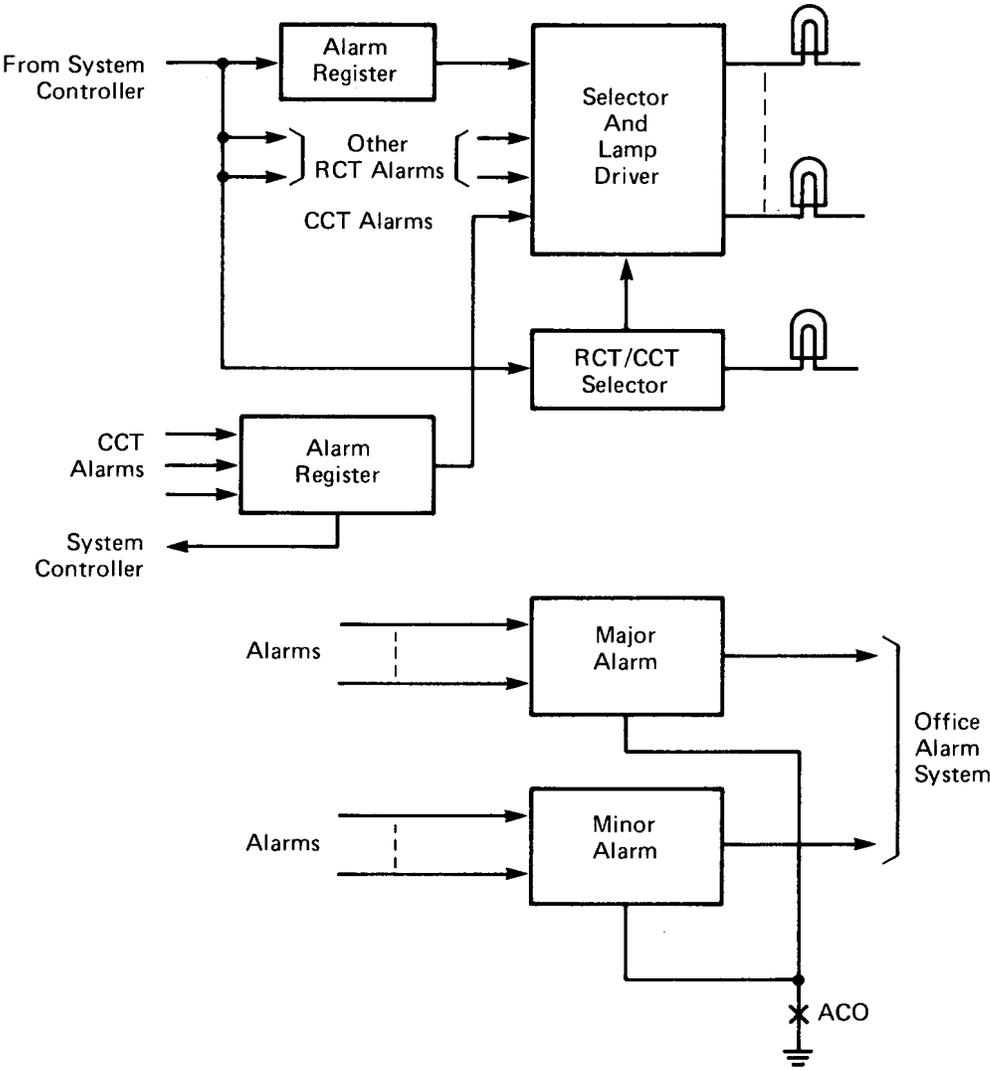


Fig. 26 – QPP421 Alarm-Office

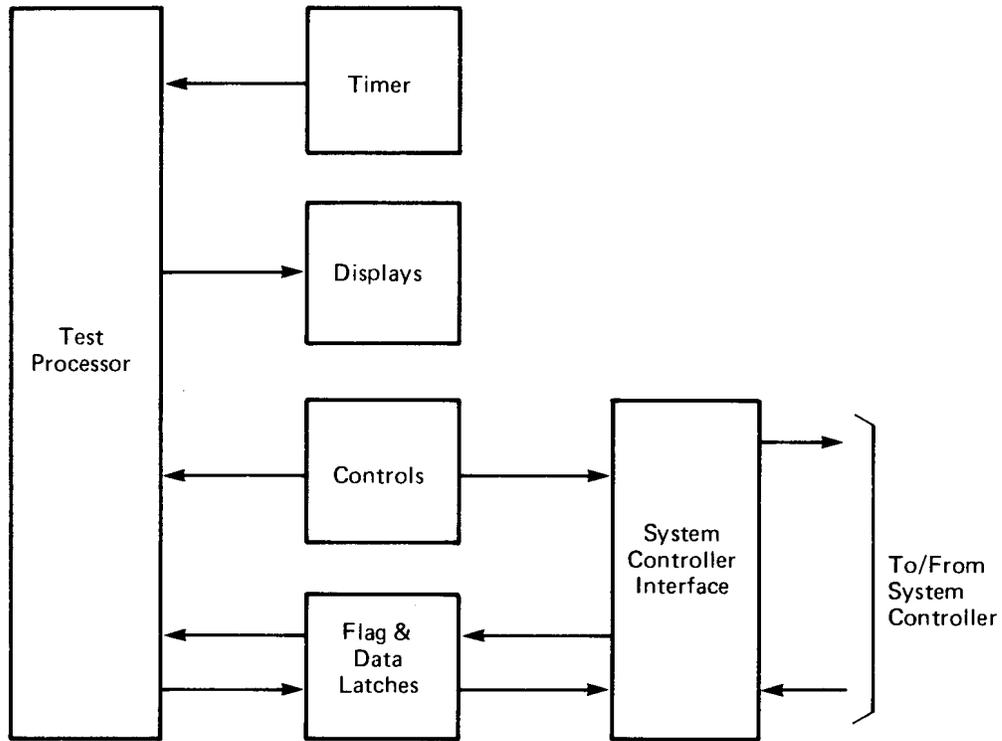


Fig. 27 - QPP424 Line Test - Office

QPP425 System Test (Fig. 28)**4.31 Functions of the QPP425 circuit packs are:**

- (a) to provide selection for testing of any line or any channel, by means of thumbwheel switches mounted on the front panel; and to provide indicators of the status of the line and channels (busy/idle) before testing is started. If tests must be carried out on busy lines or channels, the test switches override the busy conditions. If the channel selector is set to other than 00 through 23, an unoccupied channel is selected;
- (b) to provide for both manual or automatic tests of the looped-back transmission path to isolate a fault to the CCT or an RCT. A signal can be injected into a selected channel and looped back at a 2-wire port at either the RCT or CCT for level measurements; or, a built-in 800-Hz generator and high/low threshold detector can be used to indicate automatically if the path loss is within ± 2 dB of nominal. The automatic test is completed within 1 second. Jacks are also provided for inserting tone and measuring the returned signal level. One pushbutton and an indicator are provided for loopback tests of each of the RCT and CCT;
- (c) to generate a request to the system controller to operate the ring/maintenance relays on the line circuit and buffer at the RCT; this terminates the line circuit in a loopback network on the buffer and simulates an off-hook condition on the 2-wire line to test the hook detector; an additional resistor to ground tests the ANI detector; indicators on the faceplate of the circuit pack indicate the operation of the detectors; at the CCT the loopback operation also tests part of the ring detector circuit;
- (d) to assign a channel to a selected line without ringing the subscriber's telephone; this allows a test operator to listen to the subscriber's transmission path, including the RCT-to-CCT link and the subscriber's line. One pushbutton and an indicator are provided to initiate the connection;
- (e) to provide circuits so that, if a ringing signal is received on any other line on the line shelf being tested, the loopback connection is dropped, and the ringing indicator is turned on.

QPP450 Test Control (Fig. 29)**4.32 Functions of the QPP450 circuit pack are:**

- (a) to provide selection for testing any line or channel by means of thumbwheel switches on the front of the panel; and to provide indicators of the status of the lines and channels before testing is started. If tests must be made on busy lines or channels, the switches override the busy conditions. If the channel selector is set to other than 00 through 23, an unoccupied channel is selected;
- (b) to provide both manual and automatic tests of the looped-back transmission path to isolate a fault to the CCT or RCT. A signal from a built-in 800 Hz PCM generator can be injected into a channel and looped back at the 2-wire port at either the CCT or RCT; a high/low threshold detector is then used to show automatically if the path loss is within ± 2 dB of nominal. The automatic test is completed within 1 second. One pushbutton and an indicator are provided for loopback tests of each RCT and the CCT;
- (c) to generate a request to the system controller to operate the ring/maintenance relays on the line circuit and buffer at the RCT; this terminates the line circuit in a loopback network on the buffer and simulates an off-hook condition on the 2-wire line to test the hook detector; an additional resistor to ground tests the ANI detector; indicators on the faceplate indicate the operation of the detectors; at the CCT the loopback operation also tests part of the ring detector circuit;
- (d) to assign a channel to a line without ringing the subscriber's telephone; this allows a test operator to listen to the subscriber's transmission path, including the RCT-to-CCT link and the subscriber's line. One pushbutton and an indicator are provided to initiate the connection;
- (e) to provide circuits so that, if a ringing signal is received on any other line on the shelf being tested, the loopback connection is dropped, and the ringing indicator is turned on;
- (f) to provide a permanent off-hook control to direct the system controller not to assign a channel to the selected off-hook line.

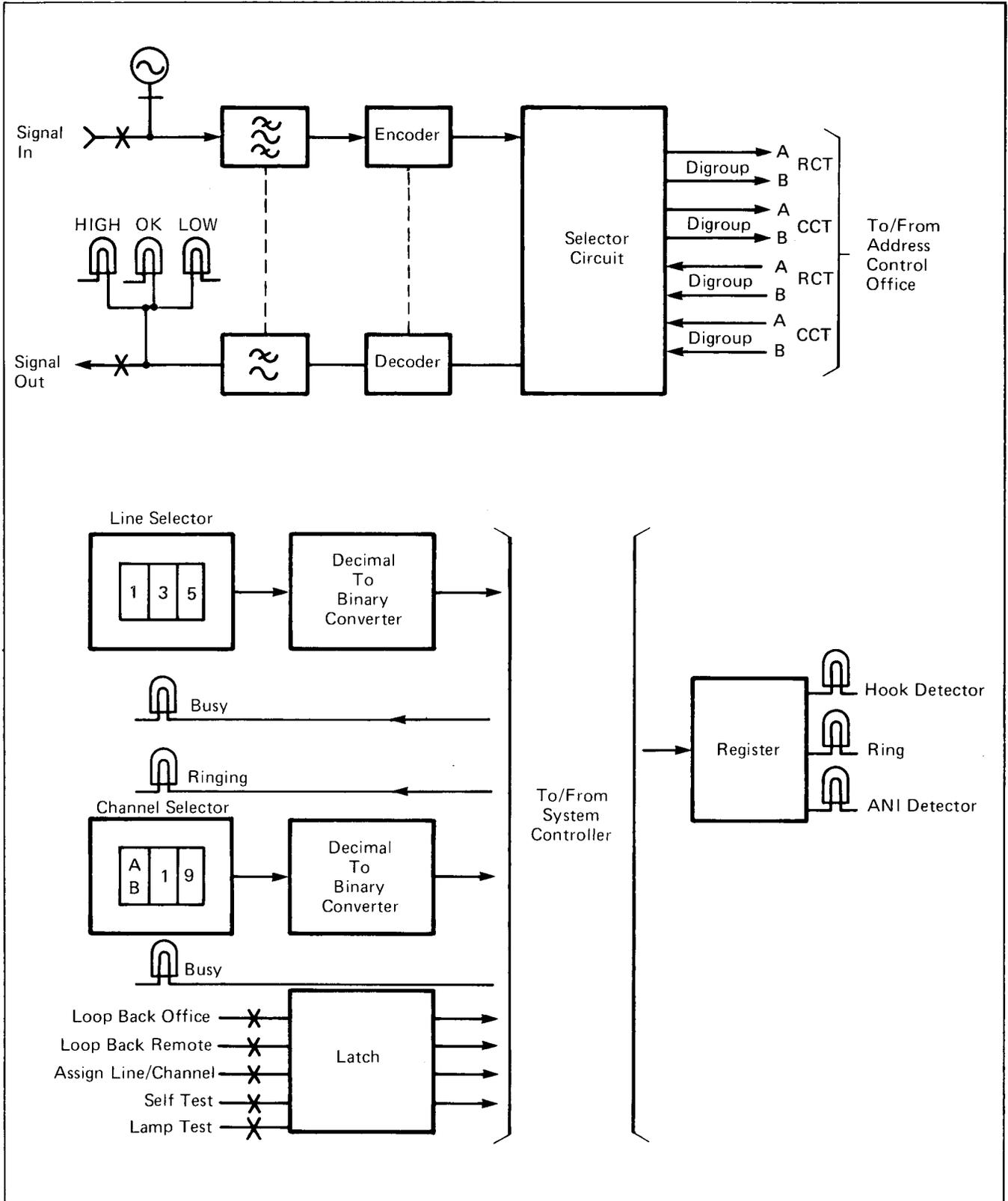


Fig. 28 - QPP425 - System Test

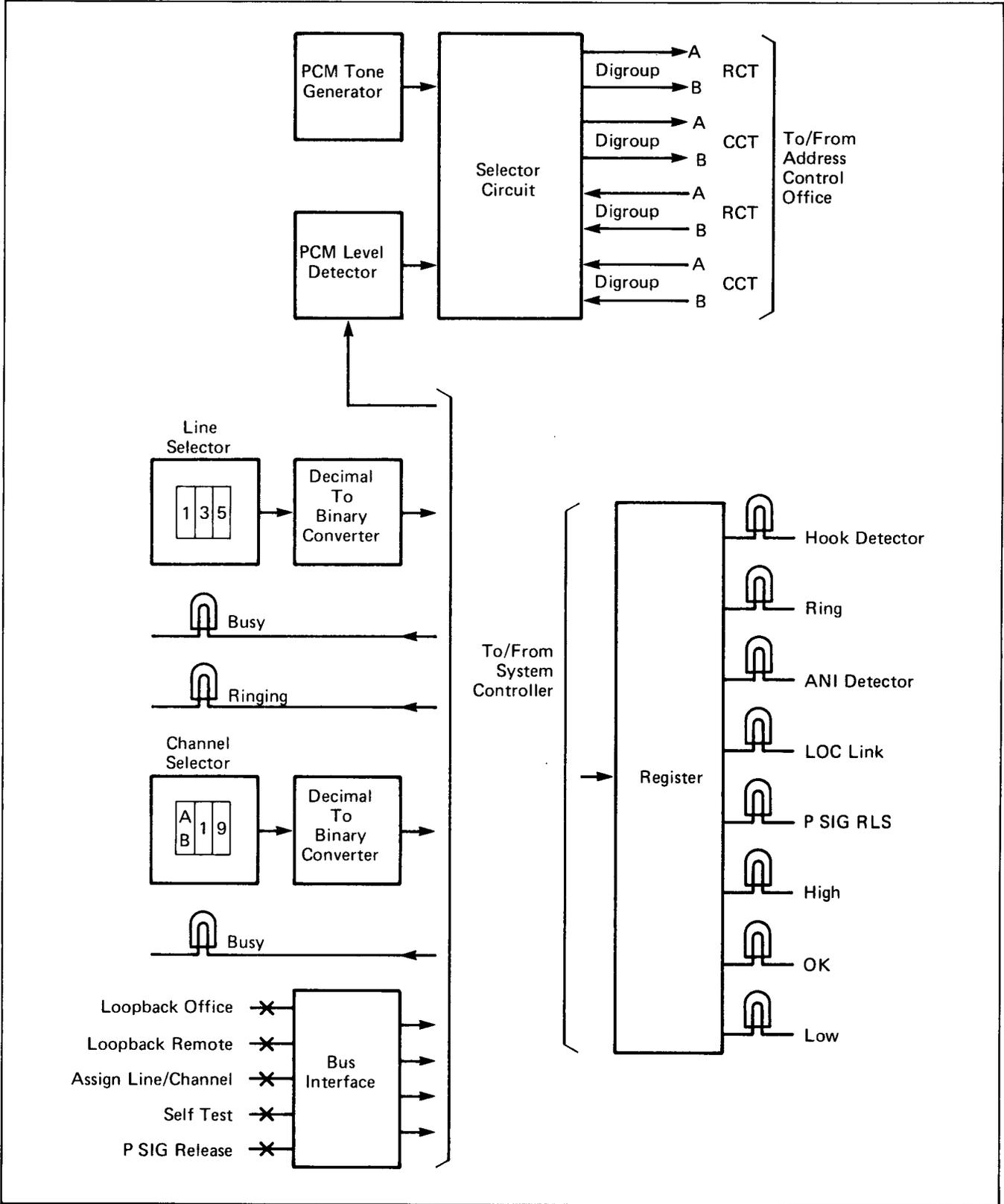


Fig. 29 - QPP450 - Test Control

QPP434 – Traffic (Fig. 30)

4.33 Functions of the QPP434 circuit packs are:

- (a) to measure separately the peg count of completed (i.e., channel assigned) originating calls and terminating calls (two 5-digit mechanical counters);
- (b) to measure total CCS, including local-link CCS (one 5-digit mechanical counter);
- (c) to measure total local-link CCS (one 5-digit mechanical counter);
- (d) to measure the high hourly CCS (including local-link CCS) and retain the maximum value until reset (one 6-digit mechanical counter);
- (e) to measure the number of all-channels-busy occurrences (one 5-digit mechanical counter);
- (f) to measure the number of terminating calls blocked (one 5-digit mechanical counter);
- (g) to measure the number of originating calls delayed for more than 3 seconds (one 5-digit mechanical counter);

- (h) to provide an output for functions (a) through (g) to operate a number 14 counter or equivalent, and to provide a contact closure of 100 ms duration to an isolated common lead for each of the functions when the respective counter is incremented by one count. The maximum counting rate is 5 counts/second.

QPP427 – Reorder Tone (Fig. 31)

4.34 The QPP427 circuit pack is needed when reorder tone return is required during all-channels-busy conditions. The central office reorder tone generator cannot be used, because ringing voltage can be connected to the reorder tone generator under some conditions.

4.35 The B versions of the line circuit packs are required when reorder tone return is provided by a QPP427.

4.36 Functions of the QPP427 circuit packs are:

- (a) to generate 480- and 620-Hz sinusoidal signals, combine the two signals, and chop the resulting signal at a 2-Hz rate (50 percent duty cycle);
- (b) to connect the output signal to the reorder tone bus at a composite level of -21 dBm; the source impedance is less than 10 ohms and can drive ten 900-ohm loads with less than 1-dB drop in level.

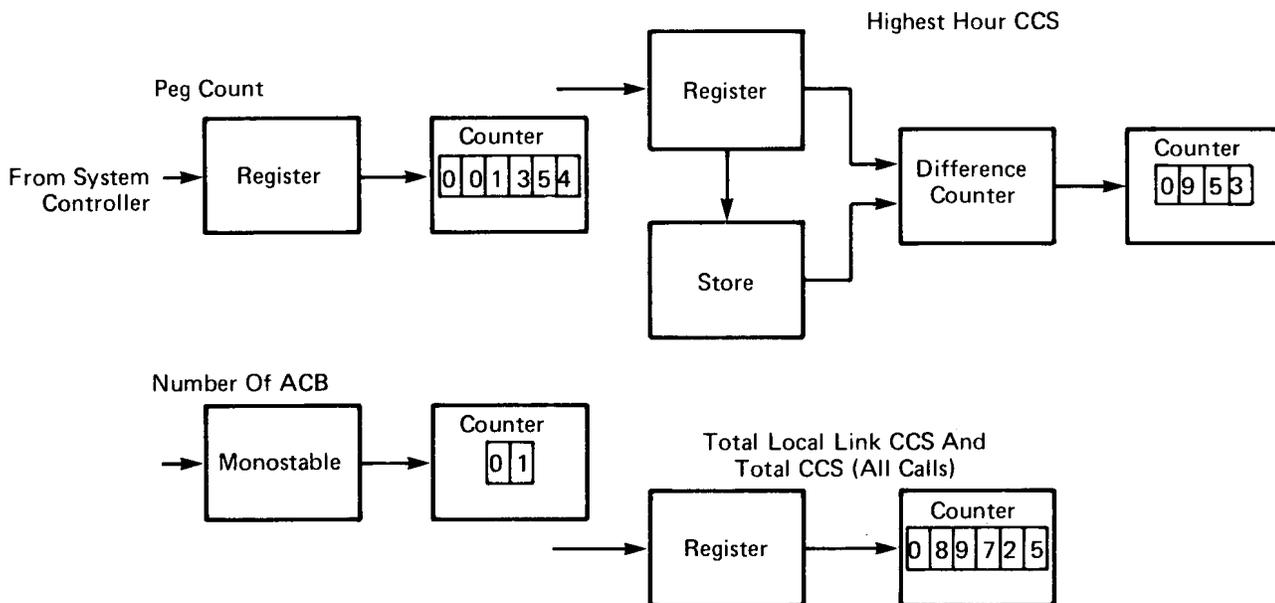


Fig. 30 – QPP434 – Traffic

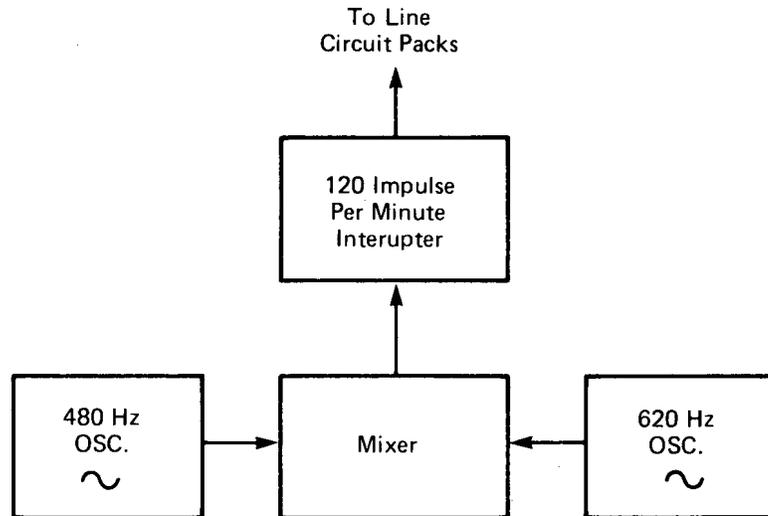


Fig. 31 — QPP427 Reorder Tone

QPP448-Test Access-Office (Fig. 32).

4.37 Functions of the QPP448 circuit pack are:

- (a) to provide circuits for the control of test access from an office test desk to the subscriber loops through a metallic test pair which bypasses the CCT and RCT terminals; used with
- a QPP425 SYSTEM TEST or a QPP450 TEST CONTROL, and ED7208-32, G3 office bypass assemblies on the line shelves at the CCT;
 - a QPP447 TEST ACCESS-REMOTE and ED7208-32 G4 remote bypass assemblies on the line shelves at each RCT;
 - the LD-1 order-wire system, or a separate metallic test pair which bypasses the CCT and RCT terminals.
- (b) to generate control signals to the system controller for operation of the remote test access circuits;
- (c) to provide faceplate indications of the test access system status;
- (d) to provide faceplate switches for manual control of the test access system;
- (e) to provide line drivers and receivers, and other circuits, for communication with the office bypass circuits on the CCT line shelves;
- (f) to provide intercommunication and interlock circuits to other DMS-1 systems when several DMS-1 systems are sharing one common test pair;
- (g) to detect conditions on the test train sleeves and test line sleeves;
- (h) to provide a real-time clock for timing coin-return and coin-collect pulses;
- (i) to provide relay switching for;
- disconnecting the test access system at the CCT from the LD-1 order-wire system;
 - connecting the office test bus to the test pair;
 - connecting a coin-return (-130 V) detector to the test pair;
 - applying test-result tones to the test pair;

(j) to provide internal selector switches for the following:

- spare lines selection (8 switches)
- automatic sparing
- manual sparing
- system test reporting
- INHIBIT switch disable
- MANUAL TEST switch disable
- INHIBIT switch definition
- sleeve busy states
- LD-1 order-wire use
- system identification number (3 switches)
- downstream disconnect.

(k) to provide jack access to the test pair for testing the subscriber loops from the CCT.

ED7208-32, G3 Office Bypass Assembly (Fig. 33)

4.38 Functions of the ED7208-32, G3 office bypass assemblies (one on each line shelf) are:

- (a) to provide relay switching for transferring incoming lines to the office 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 provide a coin-collect (+130 V) pulse detector on each incoming line;
- (d) to provide logic circuits for communication with the QPP448 Test Access-Office circuits;
- (e) to provide a selector (3-pole DIP switch) to select the line shelf address (0 to 8).

D. Digital Line Interface Block

4.39 The digital line interface circuit packs include:

QPP429	Protection Switch – Office
QPP499	1-for-n Protection Switch – Office
P0577076	Fail Safe Office Assembly
QPP436	Repeater
QPP437	Repeater/Line Power

QPP429 Protection Switch – Office (Fig. 34)

QPP499 1-for-n Protection Switch-Office (Fig. 35)

4.40 The QPP429 (or QPP499) circuit pack, together with QPP428 (or QPP498) at the RCT, provide automatic protection switching from working DS1 lines to one protection DS1 line without interrupting calls in progress (except in a single-digroup system). When QPP429 is used, switching is from either one of the working lines of a single CCT. When QPP499 is used, switching is from the working lines of two or more co-located systems. Features of the QPP429 are listed in 4.41. Features of the QPP499 are similar to those of the QPP429 with the exceptions listed in 4.42.

4.41 Features of the QPP429 are:

- (a) manual switches for,
 - *Protection Switching*. PROT SW A and PROT SW B to switch service from line A or line B to the protection line.
 - *Bypass*. BYPASS RCT0, BYPASS RCT1, BYPASS RCT2, and BYPASS RCT3 for bypassing the RCT.
 - *Loopback*. LOOPBACK RCT0, LOOPBACK RCT1, and LOOPBACK RCT2 for looping the DS1 lines at the RCT as required.
 - *An ARM switch*, which must be operated before any other manual switch has any effect; this prevents inadvertent operation of a switch and possible service interruptions.
- (b) indicators to display:
 - protection switch operated to line A or line B, and ARM switch operated
 - the number of protection-switch operations (3-digit LED display).

- (c) an output to drive an external mechanical counter to show the number of protection-switch operations.

4.42 The features of the QPP499 are similar to those of the QPP429 with the following exceptions:

- (a) on the QPP499, an additional indicator shows when the protection line is in use by another CCT;
- (b) on the QPP499, the 3-digit LED display is eliminated;
- (c) the mechanical counter is eliminated and replaced by three outputs which indicate failures on the A and B working lines and on the protection (P) line;
- (d) four interlock leads for interfacing with other CCT sharing the protection line are added; they prevent seizure of the protection line by one CCT when the protection line is already in use by another CCT;
- (e) a pattern generator is added to provide an idle signal on the protection line, in place of the bridge to working line A provided in the QPP429;
- (f) the break in transmission used to induce switching at the RCT is extended to 320 ms;
- (g) the delay in switching back to the working channel after the failure condition is removed, can be set to either 10 or 80 seconds (option setting);
- (h) the QPP499 can interface with LD-1 line terminal repeaters as well as with DMS-1 QPP436 and QPP437 terminal repeaters.

4.43 The operation of the protection switching system is as follows:

- (a) With all DS1 lines operating normally, the protection line is either bridged to the digroup A output and carries the same signal as working line A (QPP429), or has a signal from a pattern generator applied (QPP499).
- (b) All DS1 lines are monitored in the receive section of the line terminal repeaters at each of the RCT and the CCT. The lines are monitored for high violation rates and signal failure. Monitoring is by means of samples at 10 ms intervals to prevent switch operation on short transient conditions. Two successive samples must indicate a failure before switching of a line is initiated.

- (c) When a failure on a line occurs (Fig. 36) and is detected at the receive end of the failed section, both the receive protection switch of the failed section and the transmit protection switch for the next section of the line are operated, providing there are no higher priority conditions (e.g., protection line failed). In the example in Fig. 36, the protection line is connected to digroup B at RCT2 and working line B bypasses RCT2 when a failure occurs at point X.

- (d) When the switch occurs, line B is opened at RCT2 for either 80 ms (QPP429) or 320 ms (QPP499). This fails the succeeding line sections and operates the protection switches at the succeeding RCT, if applicable, and at the CCT. The signal is also removed from line B at the CCT for 80 ms or 320 ms, causing the protection switch at RCT1 to operate.

- (e) The protection switch counter at the CCT is incremented by one count (on QPP429 only), and a 100 ms pulse is produced to operate an external mechanical counter.

- (f) Line B now bypasses all RCT and is looped at the RCT furthest from the CCT; this permits the line fault to be located from the CCT.

- (g) When the CCT receives a failure indication from one of the lines (line B in the Fig. 36 example), reassignment of calls from the line is delayed for 0.5 seconds to allow the protection switch to operate and restore normal operating conditions. Off-hook conditions to the switching office are maintained to prevent dropping subscriber calls.

- (h) The same procedure occurs for both single- and dual-digroup systems. However, on a single digroup system, calls may be dropped since return signals to the CCT are lost until protection switching is completed, and the off-hook conditions to the switching office cannot be maintained.

- (i) When the failed line is repaired and the monitor circuits have indicated a good signal for 10 seconds (QPP429), or either 10 or 80 seconds (QPP499), the system controller automatically sends commands to each RCT to reset the protection switches and restore the normal conditions (see [a]).

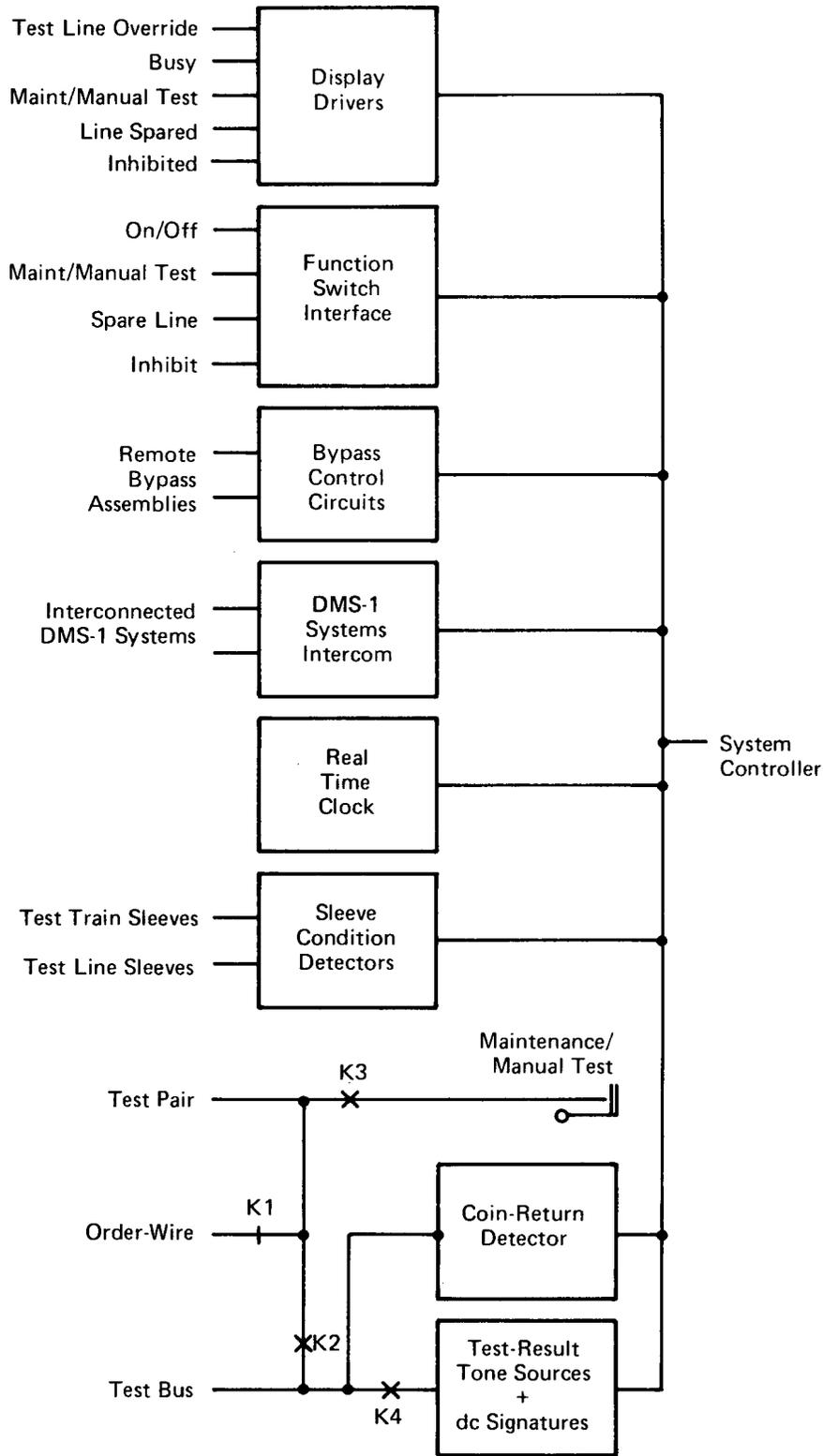


Fig. 32 – QPP448 Test Access – Office

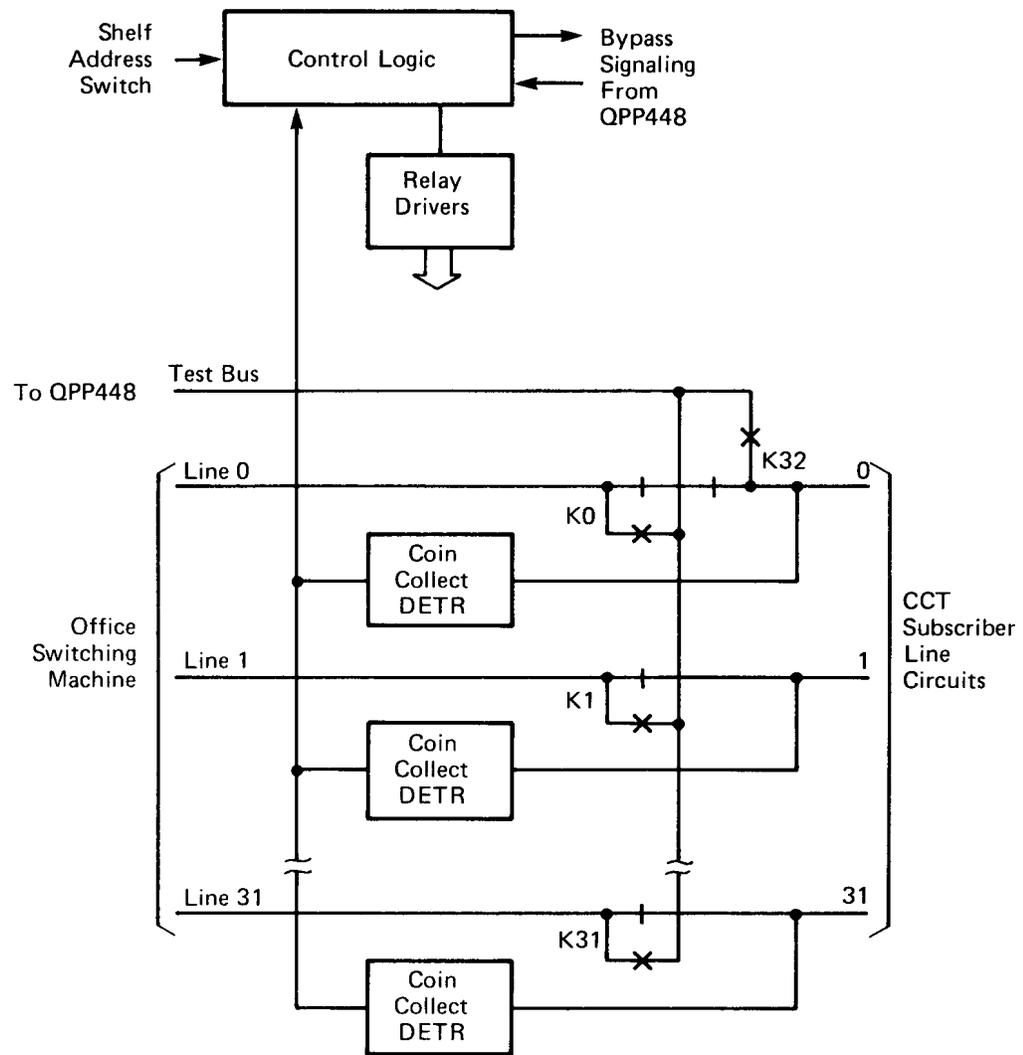


Fig. 33 – ED7208-32, G3 Office Bypass Assembly

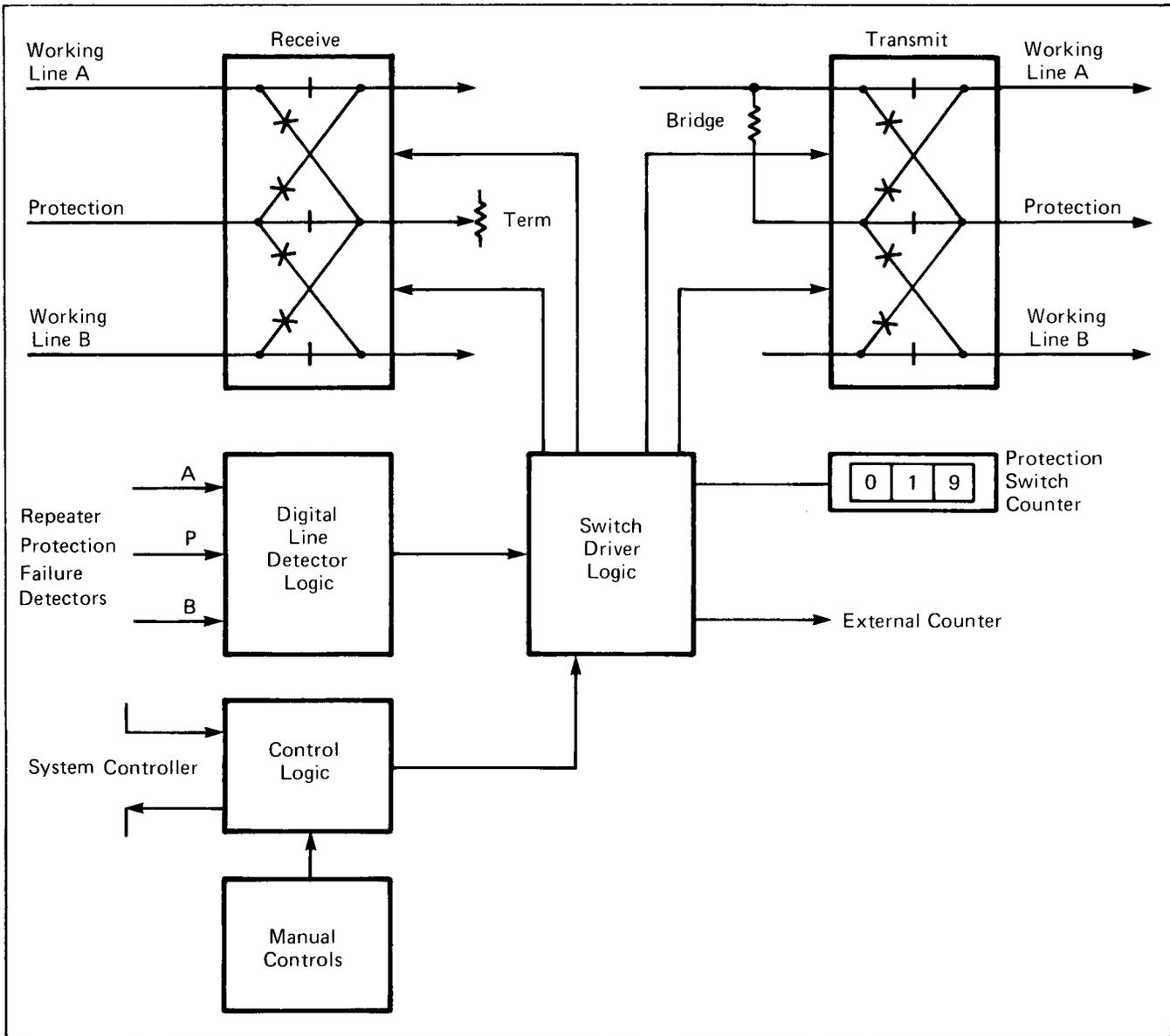


Fig. 34 – QPP429A Protection Switch – Office

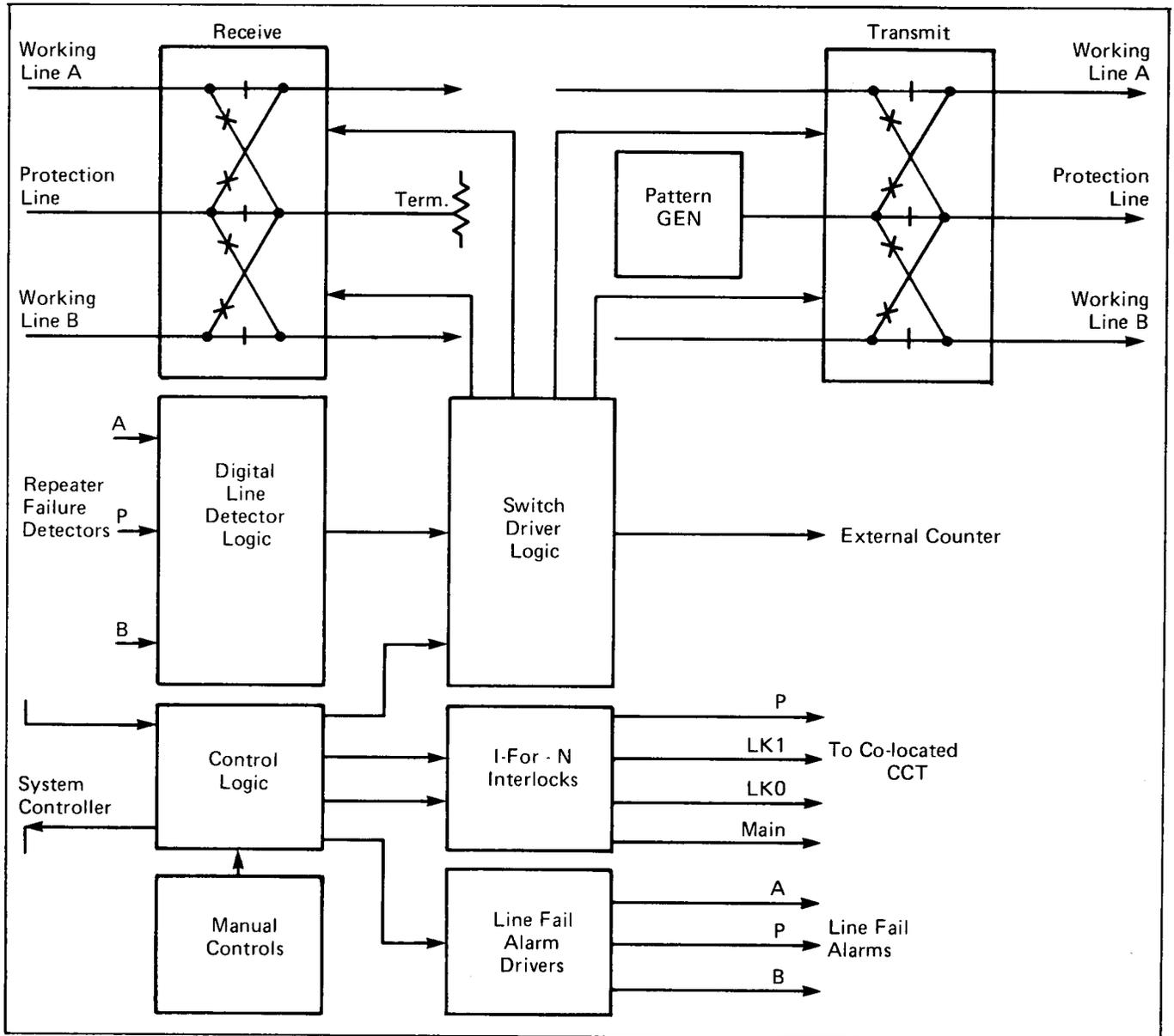
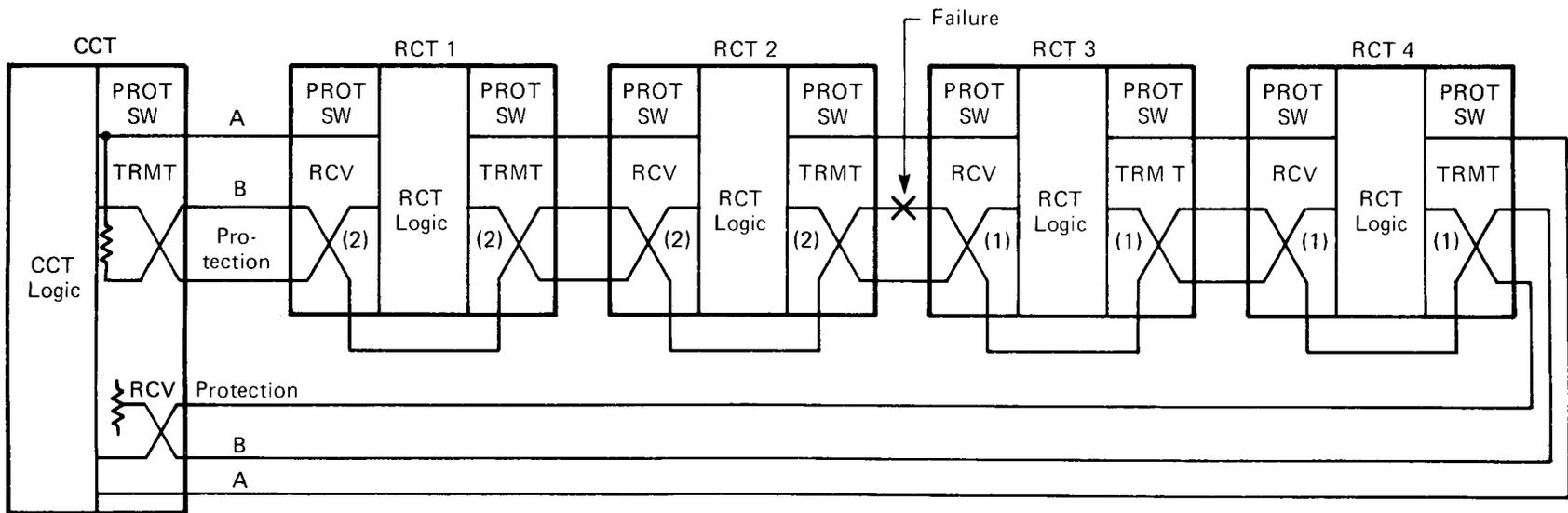
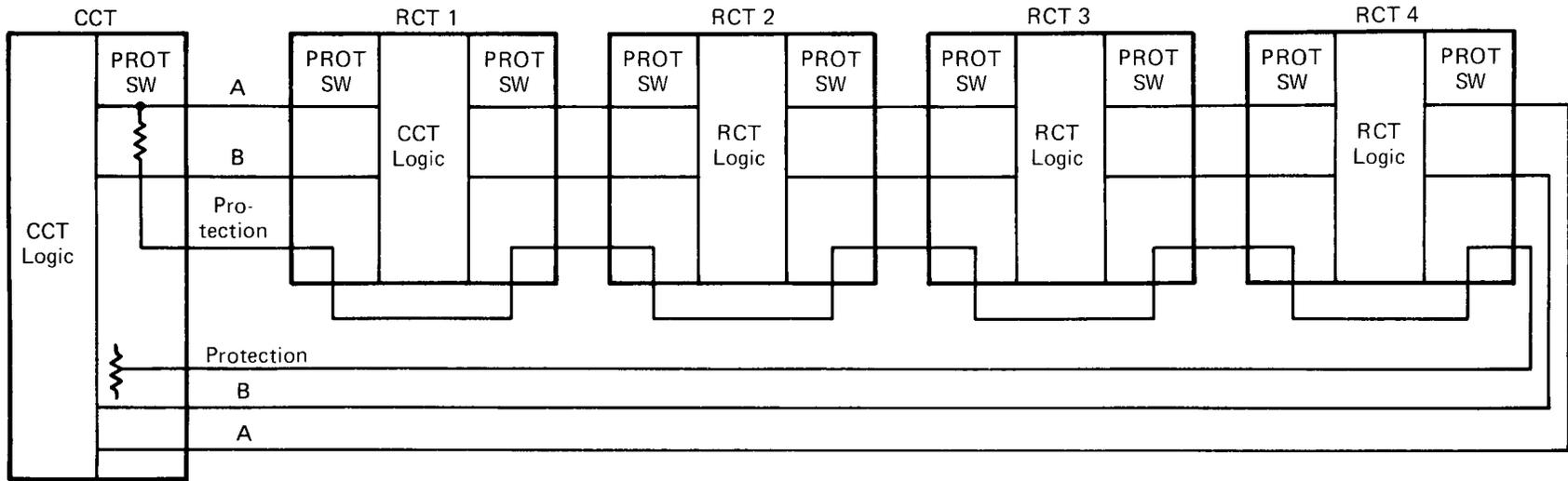


Fig. 35 - QPP499 1-for-n-Protection Switch - Office



- Notes:
1. Switches operated by protection switching logic.
 2. Switches operated by CCT control code.

Fig. 36 — Protection Switch Operation

Fail-Safe Office Assembly (P0577076)

4.44 The fail-safe assembly is an optional feature for use with either QPP429 or QPP499 circuit packs. Its purpose is to prevent failure of the system if the QPP429 or QPP499 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 QPP429 or QPP499. If the QPP429 or QPP499 is removed, the relay contacts on the fail-safe assembly close to complete the digital signal paths for both digroups A and B, and so prevent system failure. The assembly is mounted on the backplane of Common Shelf 2.

QPP436 and QPP437 Repeaters (Fig. 37)

4.45 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.

4.46 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 CCT is required; the QPP436 is used when line-powering from the CCT is not required. The functions of the repeaters are:

- (a) to reshape, retime, and regenerate the input signal from an LD-1 line, and produce standard level signals at the CCT 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 CCT to the digital line through a transformer for isolation and pads for loss adjustment;

(d) in the QPP437 only, provide a regulated 100-mA dc current, at up to +130 and -130 V for powering the DS1 line repeaters.

E. Power Block

4.47 The power block circuit packs include:

- QPC85 5/12-V Converter
- QPP439 Line Power Converter

QPC85 5/12-V Converter

4.48 The function of the QPC85 circuit pack is to provide +5 V to power the logic circuits; and +12 V and -12 V for the microprocessor, EPROM, and RAM on the system controller circuit pack.

QPP439 Line Power Converter

4.49 One QPP439 circuit pack is required for each line shelf (eight for a fully equipped CCT) 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 power, or of frame or clock signals for more than 4 seconds, and to disconnect power from the line circuit packs;
- (d) to indicate an alarm condition for power converter shutdown. Alarms are indicated by alarm outputs and by an LED mounted on the faceplate;
- (e) to restart if:
 - the fault condition has been removed,
 - either a restart pulse has been received from the system controller, or the RESET button on the faceplate has been pressed.

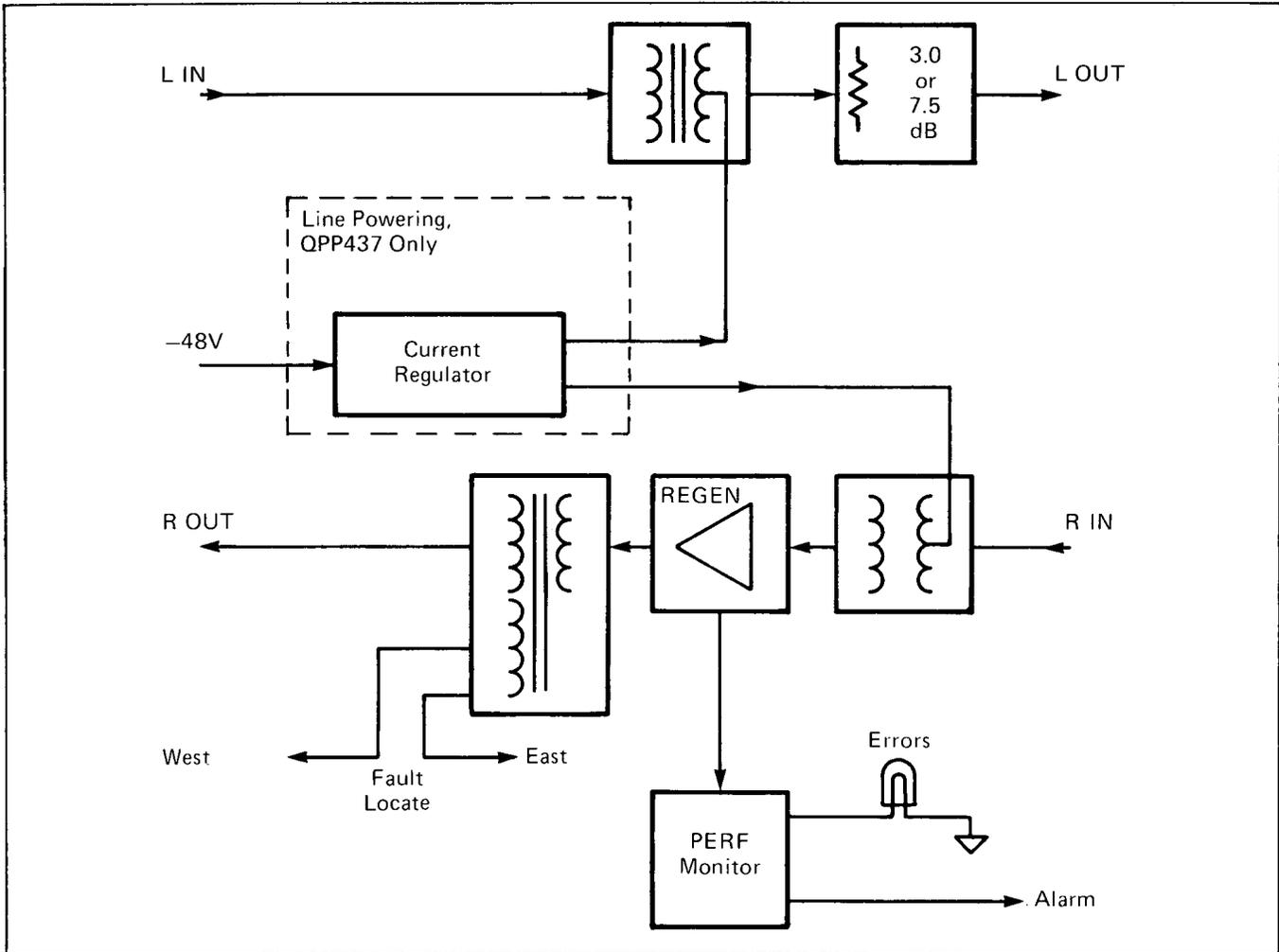


Fig. 37 – QPP436 and QPP437 Repeaters

**TABLE A
ALARM CONDITIONS**

ALARMS	DISPLAY AT		OFFICE MAJOR	OFFICE MINOR	NOTES
	CCT	RCT			
Digroup Fail A	X	X	X		} Note 3
Digroup Fail B	X	X	X		
Line Fail A	X	X		X	
Line Fail B	X	X		X	
Line Fail P	X	X		X	
Bypass Operate	X		X		Note 1
Loopback Operate	X		X		
Talk Battery Filter	X			X	
Line Power	X	X	X		
Ring Generator Minor		X		X	
Ring Generator Major		X	X		
Ring Generator	X		X	X	
Common Power Fail	X	X	X		
AC Fail	X	X		X	
Battery Fail	X	X	X		
Over Temperature	X	X		X	
Open Door	X	X		X	
Ring Distribution	X		X		
Fault Locate	X			X	
Local-Link Detector Fail	X			X	
System Controller Fail	X		X		
Fuse		X	X		Note 2
Spare Alarm 1	X	X		X	
Spare Alarm 2	X	X		X	
Spare Alarm 3	X	X		X	
Spare Alarm 4	X	X	X	X	

Notes:

1. Whether the following RCT and CCT alarms are generated depends on the number of ring generators installed and the number of ring generator failures.

NO. OF RING GENERATORS INSTALLED	NO. OF RING GENERATORS FAILED	RCT		CCT	
		LAMP	ALARM	LAMP	ALARM
1	1	Ring Gen Major	—	Ring Gen	Major
2	1	Ring Gen Minor	—	Ring Gen	Minor
	2	Ring Gen Major	—	Ring Gen	Major

2. This alarm indication can be selected to appear as either a major or minor. Selection is by a switch on the QPP421 alarm-office circuit pack.
3. DMS-1 office repeaters are required to generate these alarms. The line-fail indications are connected to the DMS-1 office repeaters by the PCB backplane. The spare alarms may be used provided that the external repeaters, if DMS-1 repeaters are not used, provide alarm outputs with a contact to ground.

**TABLE B
TEST RANGES AND ACCURACY**

TEST PARAMETER	TERMINALS	MEASUREMENT RANGE	ACCURACY	TEXT CONDITIONS (See Notes 1, 3)
Volts (ac)	Tip to Ground Ring to Ground	0 to 150 V rms	$\pm 10\% \pm 1 \text{ V}$	ALL
Volts (dc)	Tip to Ground Ring to Ground	+60 to -60 V	$\pm 5\% \pm 1 \text{ V}$	Foreign ac Volts <75 V rms
Resistance	Tip to Ground Ring to Ground Tip to Ring	1k to 750k Ω 0 to 1k Ω	$\pm 10\% \pm 0.2\text{k}\Omega$ $\pm 20\% \pm 0.1\text{k}\Omega$	Foreign ac Volts <75 V rms 9 V > Foreign dc > -9 V Only one display <10k Ω (see Note 2)
Capacitance	Tip to Ground Ring to Ground Tip to Ring	0 to 5 μF	$\pm 10\% \pm 0.1 \mu\text{F}$	Foreign ac Volts $\leq 75 \text{ V rms}$ 9 V > Foreign dc > -9 V dc Resistances > 10k Ω (see Note 2)
			$\pm 10\% \text{ to } \pm 0.2 \mu\text{F}$	
<p><i>Notes:</i></p> <ol style="list-style-type: none"> 1. Capacitance $\leq 5 \mu\text{F}$. 2. Selective resistance and capacitance measurements are valid only if foreign dc remains stable. 3. Resistance and capacitance measurements are valid only if the source resistances of the dc and ac voltage supplies are greater than 1kΩ. 				

**TABLE C
TESTING TIMES**

TEST PARAMETER	TIME TO TEST (Selective Mode) (Average cycle time in seconds)	
	TYPICAL (Note 2)	MAXIMUM (Note 3)
Foreign ac Volts	1.5	2.0 (Note 4)
Foreign dc Volts	1.5	12.0
Resistance	3.5	7.0
Capacitance	10.0	20.0 30.0 (Note 5)
TEST PARAMETER	TIME OF DISPLAY (Automatic Mode) (Cumulative time until displayed, in seconds) (Note 1)	
	TYPICAL (Note 2)	MAXIMUM (Note 3)
Foreign ac Volts	4.5	11.0
Foreign dc Volts	7.5	16.0
Resistance	11.0	20.0
Capacitance	16.0	35.0 45.0 (Note 5)
<p><i>Notes:</i></p> <ol style="list-style-type: none"> 1. Times for automatic measurements are cumulative. 2. Typical test times are applicable to a line with >100k leakage and 5 μF tip-gnd and 5 μF ring-gnd, and <30 V ac. 3. Maximum test times result from measurements displaying three high capacitances (4.8 μF), 600kΩ leakage, and 73 V ac on tip and ring. Maximum times may be exceeded if high capacitance, high voltage, leakage resistance, and dc voltage combine in a way that requires exceptionally long waits for settling. 4. The first reading will be the same as for the automatic mode. 5. Foreign ac volts \geq30 V rms. 		