# Section 3

# SECTION III

# OPERATION

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## 1. GENERAL

**1.01** This section describes operation of the B325 channel bank. Transmit and receive functions, alarm conditions, and built-in maintenance features are discussed.

## 2. SYSTEM OPERATION

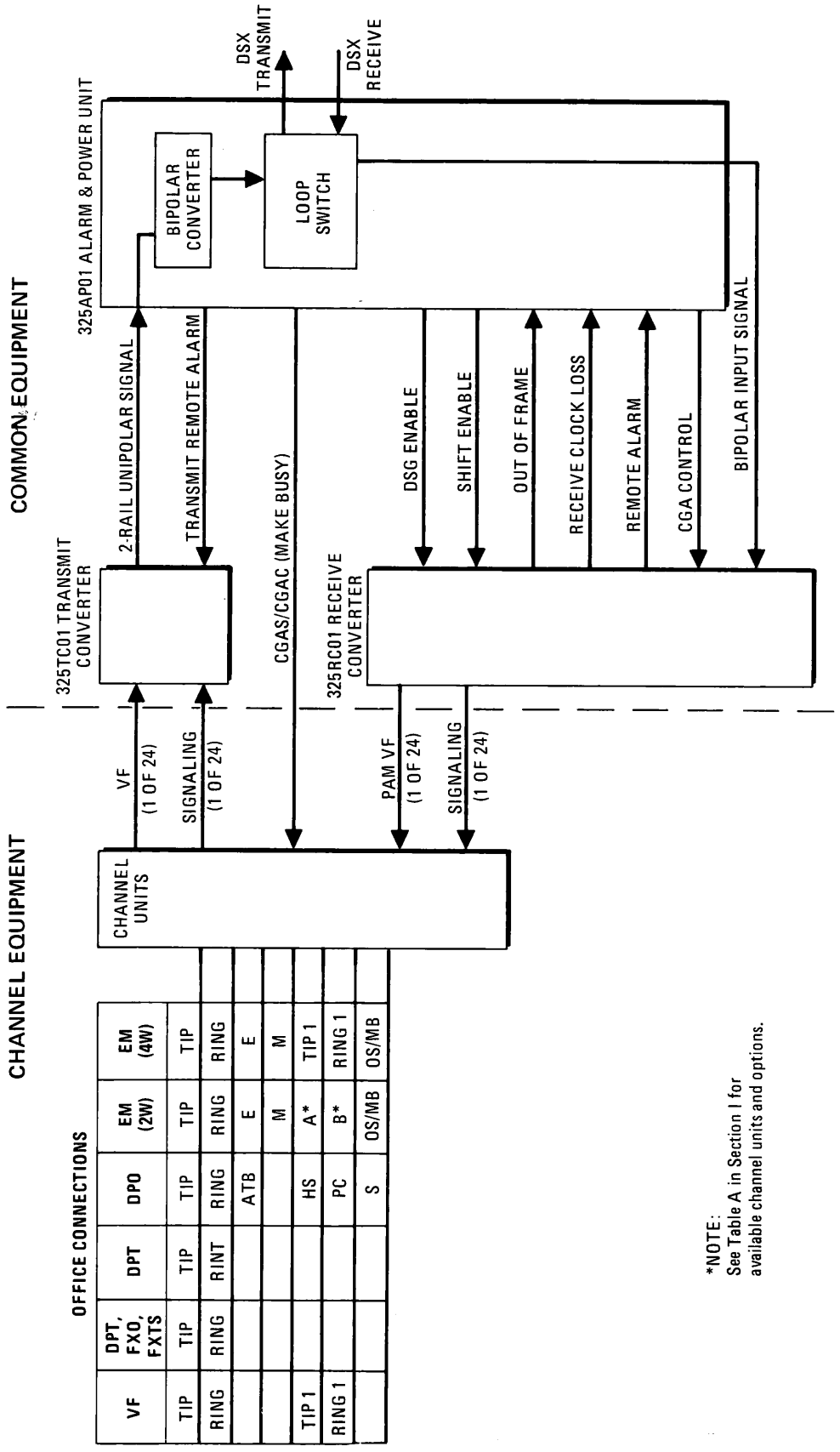
**2.01** The channel bank is designed to provide two-way signal conversion for pulse code modulation (PCM) transmission and reception across T1/T1C repeatered lines. The basic unit provides standard 24-channel operation; however, with the addition of an optional D4 converter plug-in unit, two channel units may be operated back-to-back providing a 48-channel multiplex system across T1C outside line. The following discussion concerns itself with basic channel bank operation without optional D4 converter or test and alignment panel, which are functionally described in Section V of this manual.

### TRANSMIT CONVERSION

**2.02** See Fig. 1. Voice frequency (VF) and signaling inputs from 24 parallel channel units are applied to a transmit converter (325TC01) for conversion to two-rail unipolar PCM data. This data is then routed to the alarm and power unit, where it is changed to bipolar format for transmission to the receiving (far end) B325 channel bank.

**2.03** The transmit converter produces a continuous stream of serial, digital pulses that represent the VF and signaling (hook) levels of the 24 channel unit inputs. The data stream is output at a 1,544,000 bit per second rate and consists of reoccurring 193-bit data frames. Each data frame contains 24 eight-bit words of channel data (VF plus signaling) and a frame identification bit (8 x 24 + 1 = 193 bits). To accomplish this, the channel unit outputs are sampled and digitized every 125 microseconds, producing an 8000-hertz sampling rate. After the entire 24 channel outputs have been sampled and converted to digital form, a frame bit is added to the serial stream to indicate one sampling cycle is complete.

**2.04** Frame bits are used at the receive end to maintain channel-to-channel synchronization and identify frames, which contain signaling data that is only transmitted in every sixth data frame. To be usable at the receive end, the frame bits must retain separate identity from channel data bits. This is guaranteed by inserting the frame bits in the data stream in a unique frame-to-frame sequence code that repeats itself every 12 data




*NOTE:
See Table A in Section I for available channel units and options.

**Fig. 1—B325 Terminal Block Diagram**

frames. The high-low logic level sequence of the code identifies the end of each data frame and the next frame containing signaling data.

**2.05** Fig. 2 illustrates successive sampling and digitizing of one channel. The width of the sampling pulses and the space between can be viewed as scaled in time. The time space between the examples shown is used for sampling the other 23 channels. Samples are obtained by briefly gating the individual channel VF signal onto a bus in the transmit converter to produce a pulse amplitude modulated (PAM) signal that is then measured and converted to an eight-bit digital code word.

**2.06** Bit-1 (most significant bit) of the code word indicates PAM pulse polarity with a logical "1" representing a positive level. The remaining seven bits represent amplitude of the PAM pulse as follows: bits 2, 3 and 4 encode the numbered segment on the voltage graph the pulse falls within. Minimum amplitude (binary "0") is equal to "1," and maximum amplitude (binary 7) is equal to 8. The last four bits (5 through 8) indicate steps (graduations) between segments of the graph (1 through 16).

**2.07** Negative logic is used in the formulation of segment and step bits to make zero state (logic low) condition bits contain the amplitude value. A maximum positive VF amplitude is represented by the code word 10000000, and a minimum positive amplitude by the code word 11111111. This type of coding increases the number of ones in an average data message, as most telephone conversation will encode in low amplitude portions of the graph. A maximum number of ones in the data message is desirable to optimize clock recovery in span line repeaters.

**2.08** Signaling information for each channel is transmitted in every sixth 193-bit frame. This is done by borrowing the least significant bit in each channel word for use as a signaling status indicator. The remainder of the word still contains VF data. Fig. 3 illustrates a 24-channel frame of data in D3 format. Sections B and C of the figure show sixth frame inclusion of signaling data.

**2.09** The output of the transmit converter is a unipolar pulse train, as depicted in Section E of Fig. 3. Conversion of the signal to bipolar form is done in the alarm and power unit by inverting the level of every other positive pulse. Bipolar signals are more desirable for transmission, because the average dc level at the signal is reduced to zero. Outgoing PCM signals are routed across contacts of a LOOP switch and transmitted to the far end.

### RECEIVE CONVERSION

**2.10** Message processing in the receive path is opposite to that of the transmit path. Bipolar PCM inputs are changed to unipolar form, then decoded and converted to PAM pulses and separate signaling discretes. These two products are then demultiplexed and routed to the individual channel units, where the original voice signal is reconstructed from the PAM pulses and signaling discretes are converted to office-compatible levels.

**2.11** Data message reframing and alarm condition monitor circuits are also part of the receive converter. Framer circuitry constantly monitors the received messages to detect an out-of-frame condition. If this occurs, the circuitry automatically reframes the receive converter by blocking the VF and signaling outputs to the channel units until the incoming frame bit is searched for and found. The channel unit outputs are then opened in the correct sequence to restore normal operation. This process typically restores system synchronization in 11 milliseconds or less. Alarm monitor outputs are routed to the alarm and power unit for detection of remote (REM) alarms transmitted from the end, receive clock loss, and out-of-frame conditions.

## 3. ALARM PROCESSING

**3.01** The alarm and power unit contains the alarm processing circuitry. This circuitry sends system alarms to the central office, inhibits receive PAM signals from the channel units and furnishes make-busy signals In addition, LED indicators come on to alert the craftsman to the cause of alarm. Alarm recovery is automatic, with system restoral occurring immediately after a remote alarm ceases and 12 seconds after a local alarm condition ceases.

**3.02** Alarm control circuits process local or remote alarm conditions, which are directly service-affecting. Local alarms cause the LOC LED

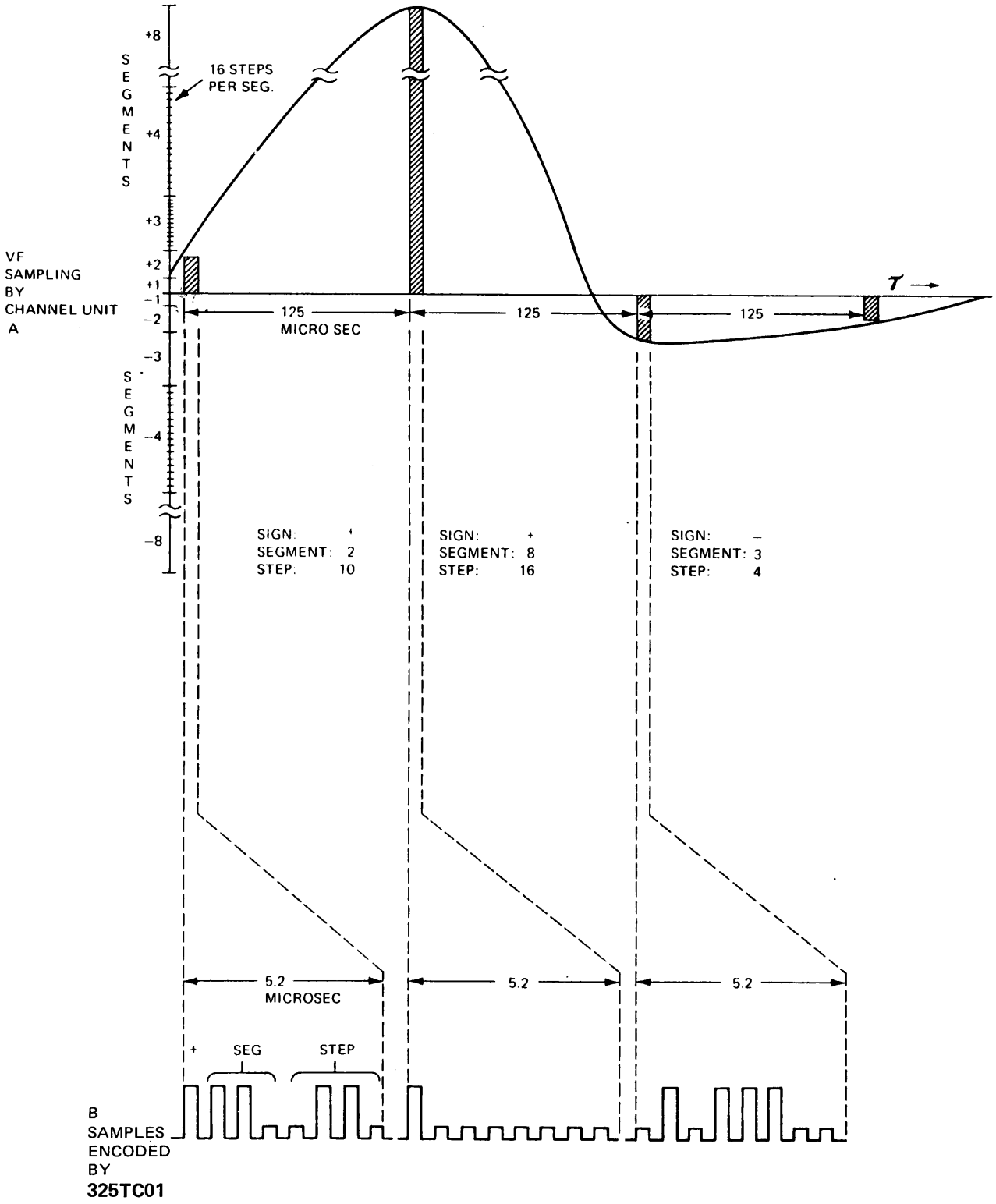



**Fig. 2—Successive Sampling of One Channel**

## TABLE 1-1

## B325 TERMINAL PLUG-IN UNITS

| PART NUMBER | NOMENCLATURE | FUNCTION | UNITS PER TERMINAL |
|---|---|---|---|
| 325AP01A | Alarm and Power Unit | Provides -48-Vdc, ±12-Vdc and +5-Vdc power to the terminal's electronics. Provides terminal fusing. Contains all alarm and CGA circuitry. Also provides bipolar conversion for XMT direction. | 1 |
| 325BR01 | 2-Wire Bridge Ringing CO Channel Unit | Central office 2-wire bridge ringing foreign exchange type signaling with VF channel unit provides loop-start operation only designed for use with B281 ESSS. | 1 to 24 |
| 325BR51 | 2-Wire Bridge Ringing Subscriber Channel Unit | Subscriber end of bridge ringing tandem channel units. | 1 to 24 |
| 325DP01 | Dial Pulse Originating Channel Unit | Works end-to-end with terminating dial pulse channel unit (325DP02) or equivalent. Provides 2-wire to 4-wire conversion, XMT and RCV signaling, reverse battery supervision and CGA alarm conditioning circuits. | 1 to 24 |
| 325DP02 | Dial Pulse Terminating Channel Unit | Provides 2-wire to 4-wire conversion with signaling for terminating office functions to match the 325DP01 channel unit. | 1 to 24 |
| 325DP11 | Dial Pulse Originating Channel Unit | Identical to the 325DP01 in operation, but some signaling interface leads are pinned out differently for special installation situations. | 1 to 24 |
| 325DP21A | Dial Pulse Originating Channel Unit | Identical to the 325DP11, but allows strapping options for B1 and B2 leads as well as for loaded cable interface applications. | 1 to 24 |
| 325DP22 | Dial Pulse Terminating Channel Unit | Identical to the 325DP02, but with strapping options for loaded cable interface applications. | 1 to 24 |
| 325EM01 | 4-Wire, 600-Ohm E & M Channel Unit | Two-way speech and signaling unit. Works end-to-end with any 325EMXX channel unit. Includes amplifiers, filters, XMT and RCV signaling circuits, test points/level controls and circuits for conditioning trunks during alarm conditions (CGA feature). | 1 to 24 |
| 325EM02 | 2-Wire, 600-Ohm E & M Channel Unit | Same as 325EM01, except 2-wire to 4-wire conversion with 600-ohm hybrid. A and B leads are provided as Option 1. | 1 to 24 |
| 325EM03 | 2-Wire, 900-Ohm E & M Channel Unit | Same as 325EM02, except 900-ohm hybrid. A and B leads are provided. | 1 to 24 |
| 325ET01 | Electronic Trunk Channel Unit | 2-wire, 900-ohm channel unit with options such as remote make-busy when B325 channel bank will interface with a digital central office. | 1 to 24 |

## TABLE 1-1 (Cont.)

## B325 TERMINAL PLUG-IN UNITS

| PART NUMBER | NOMENCLATURE | FUNCTION | UNITS PER TERMINAL |
|---|---|---|---|
| 325FX01 | Originating Foreign Exchange Channel Unit | Provides 2-wire to 4-wire conversion (station end) with 900-ohm hybrid. Provides loop supervision; opens T & R to stop charges and make-busy during CGA. Also, provides loop- and ground-start operation as a strap option. | 1 to 24 |
| 325FX02 | Terminating Foreign Exchange Channel Unit | Same as 325FX01, except used at central office. | 1 to 24 |
| 325MA01 | Mounting Assembly | Provides a mounting facility for all terminal plug-in assemblies. Backplane is configured for D3 channel numbering sequence. | 1 to 24 |
| 325PR01 | Pulse-Link Repeater Channel Unit | Identical in function to the 325EM01, but also provides strapping options for gain ranges and signaling converting for pulse-link repeater applications. | 1 to 24 |
| 325PR03 | Pulse-Link Repeater Channel Unit | 2-wire, 900-ohm E & M signaling channel unit provides strapping options for gain ranges and signaling converting. | 1 to 24 |
| 325PY01 | Pay Station Terminating Channel Unit | 2-wire speech and signaling for semipostpay paystation applications. Office End. | 1 to 24 |
| 325PY51 | Pay Station Originating Channel Unit | Remote mating end of semipostpay paystation channel unit. | 1 to 24 |
| 325RC01B | Receive Converter | Provides all receive-direction functions. Includes RCV timing, serial-to-parallel conversion, D/A conversion and VF demultiplexing. | 1 |
| 325TA01/ 325TA03 | Test and Alignment Panel | Provides test and alignment facilities and access jacks for external test equipment. | Can be shared by several terminals. |
| 325TC01B | Transmit Converter | Provides all transmit-direction functions, except bipolar conversion. Includes XMT timing, VF multiplexing, A/D conversion and parallel-to-serial conversion. | 1 |
| 325TD01 | Foreign Exchange (Tandem) Channel Unit | 4-wire, 600-ohm tandem channel unit for tandem foreign exchange applications. | 1 to 24 |
| 325VF01 | 4-Wire VF Channel Unit | Provides 4-wire VF transmit and receive paths, with no signaling provision. | 1 to 24 |

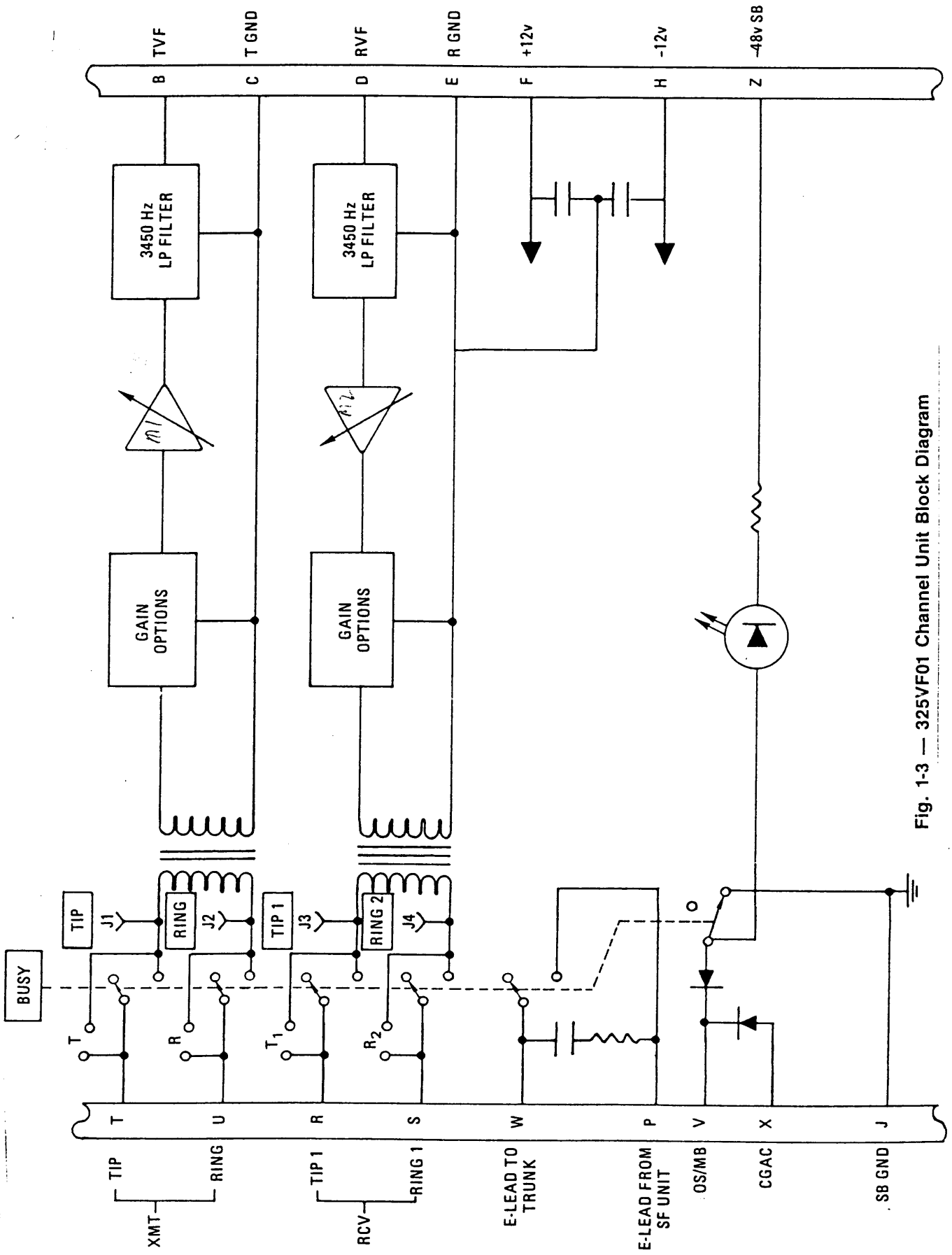



Fig. 1-3 — 325VF01 Channel Unit Block Diagram

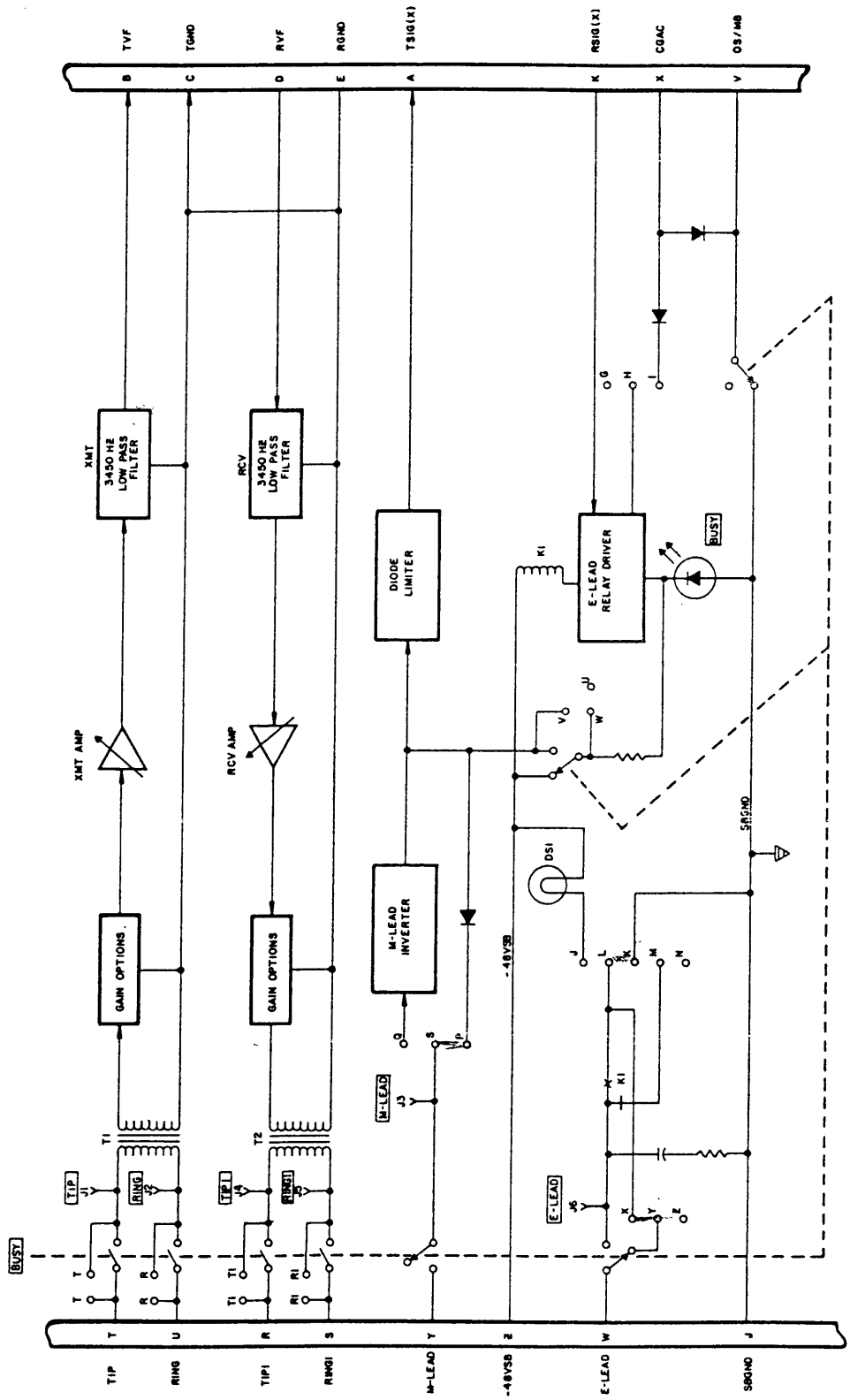



Fig. 1-4 — 325PR01 Channel Unit Block Diagram

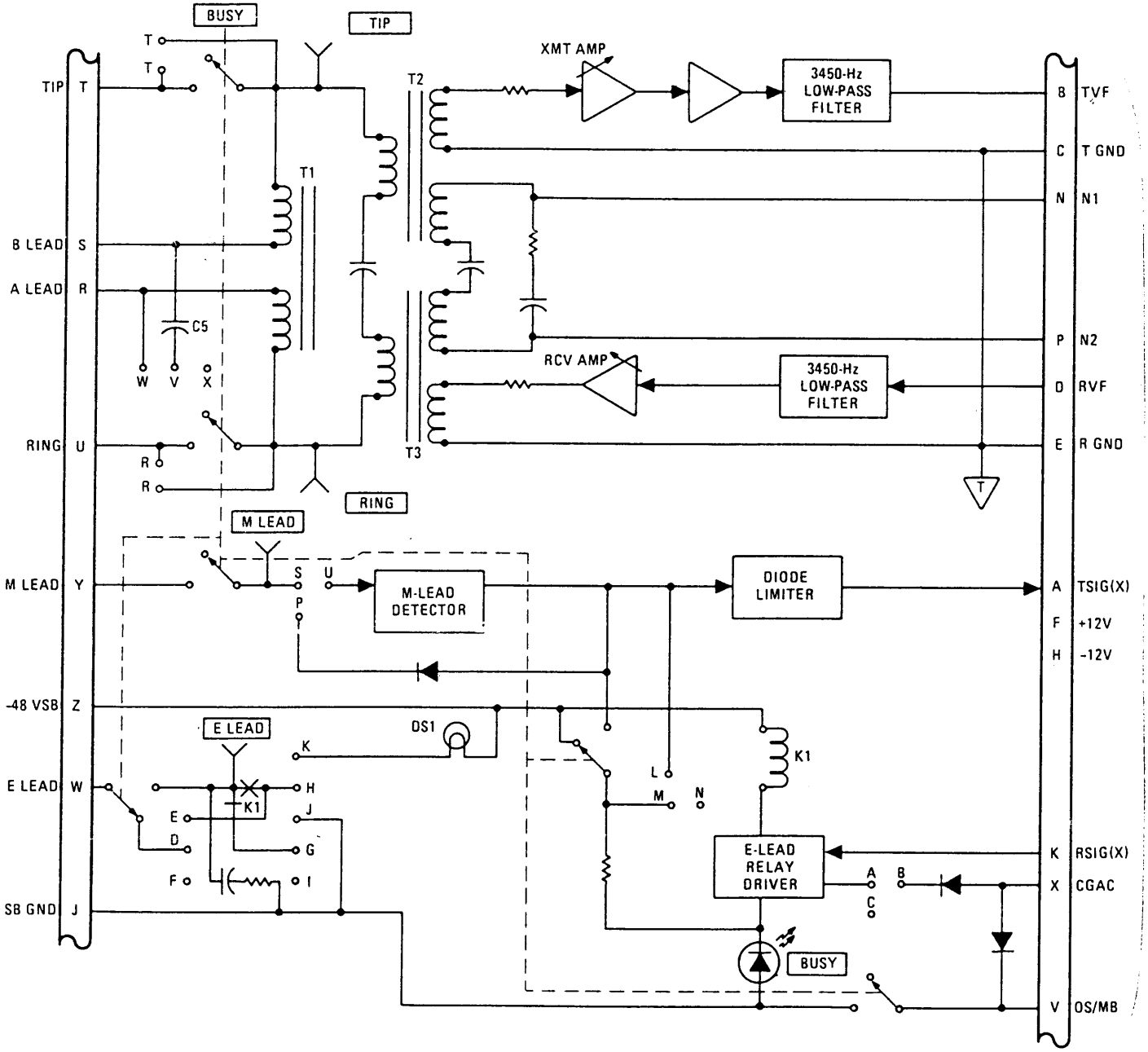



**Fig. 1-8 — 325PR03 Channel Unit Block Diagram**

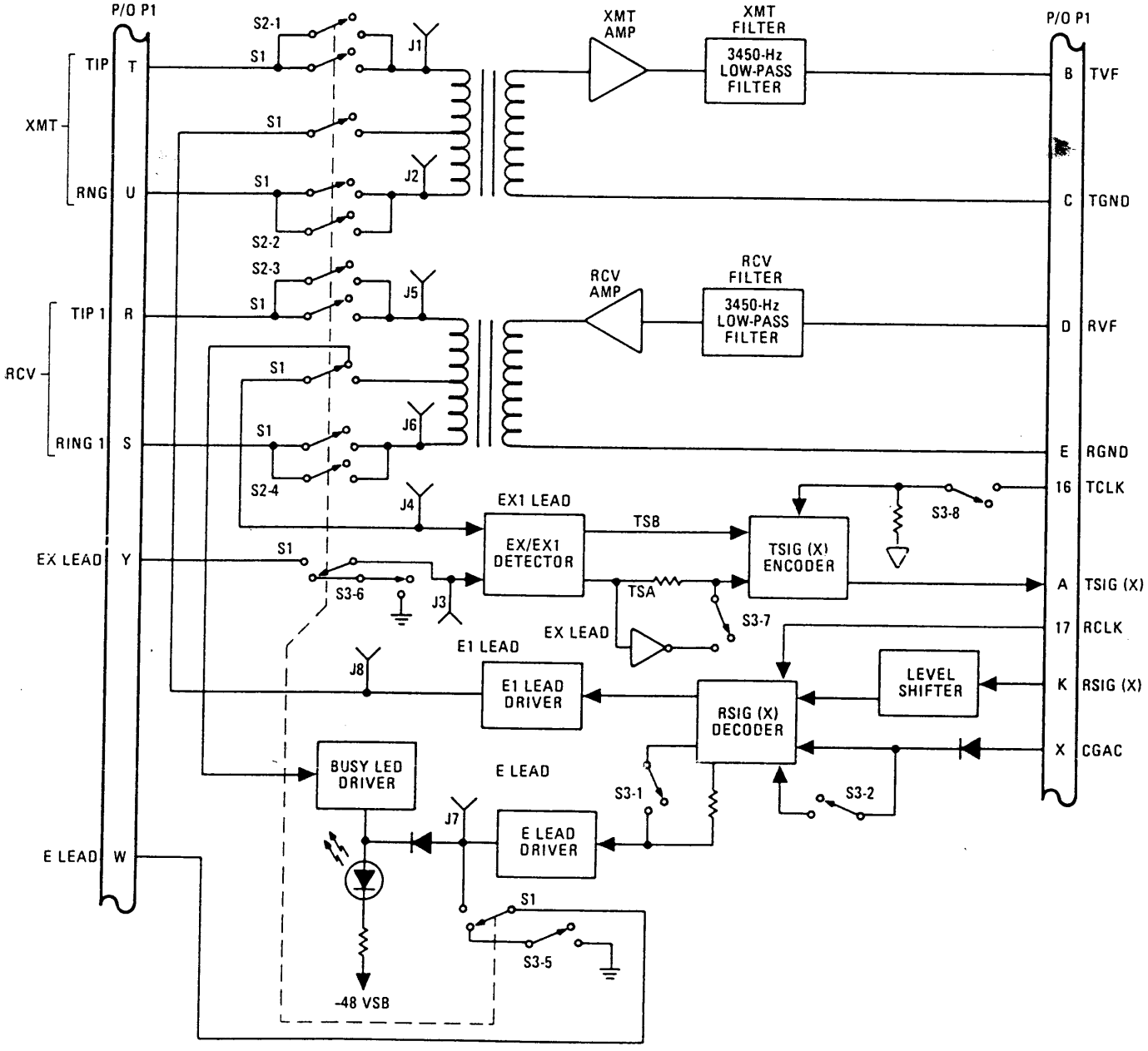



**Fig. 1-9 — 325TD01 Channel Unit Block Diagram**

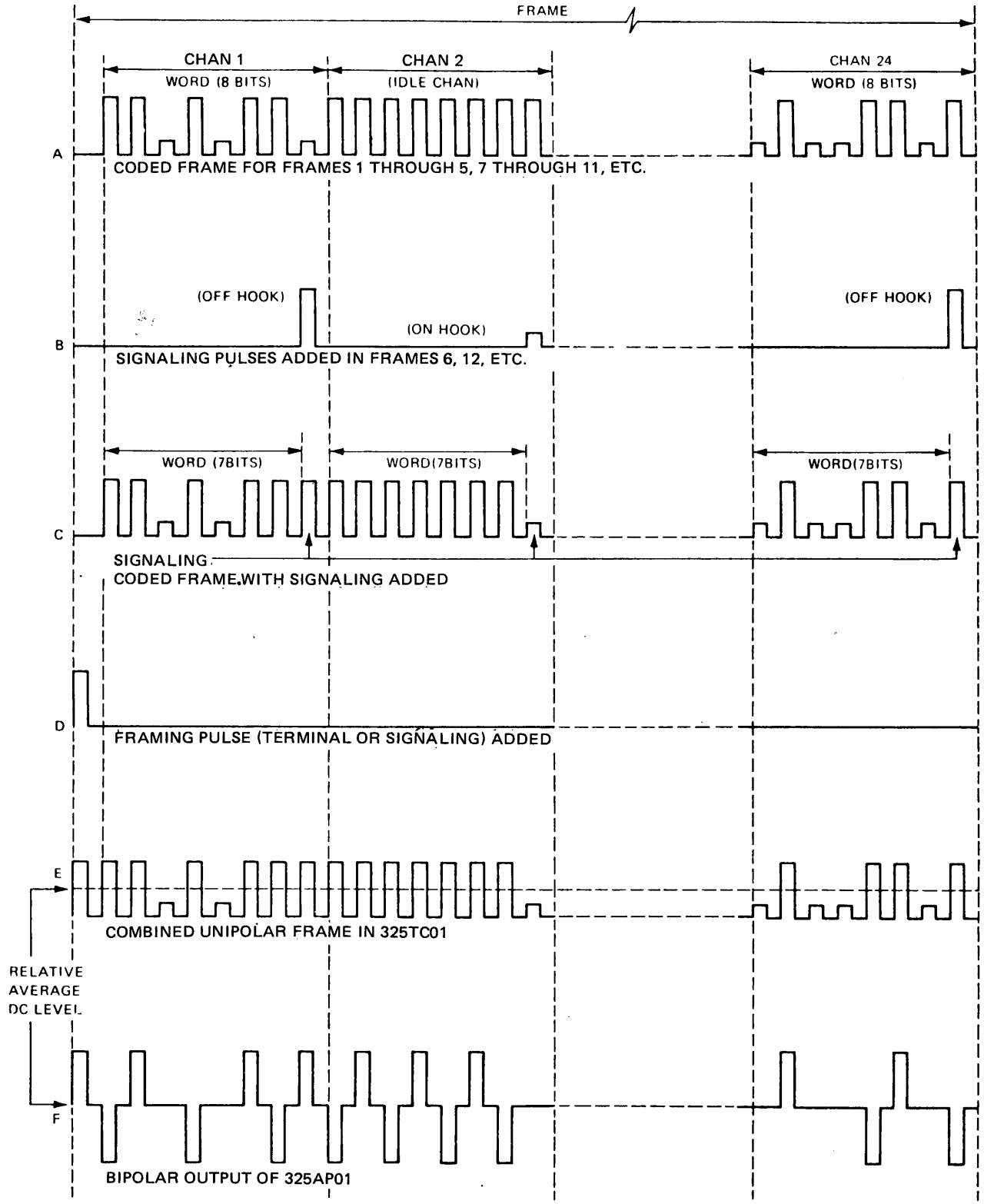



**Fig. 3—Pulse Order of Successive Channels**

to come on and demand transmission of a remote alarm signal to the far end. The remote alarm signal is generated by suppressing the second bit of each channel word (Bit 2) in the transmitted data message. This results in the detection and display of a remote alarm (REM LED illuminates) at the far end. Local alarms are generated by any of the following causes.

(a) Power supply or fuse failure, which causes a FUSE/PWR LED to illuminate.

(b) Loss of received signal, which causes a REC CLK LED to illuminate.

(c) Receive converter out-of-frame signal, which causes a FRAME LED to illuminate.

**3.03** All alarms (local and remote) cause carrier group alarm (CGA) trunk conditioning. The purpose of this conditioning is twofold; it stops charges to customers and makes busy all channels. Table A summarizes the effect of CGA trunk conditioning on various channel unit configurations.

**3.04** Dry relay contact closures provide office inputs for visual and audible indications of the alarm condition. These inputs may be normalized by pressing the alarm and power unit ACO switch for all alarms, except fuse failure. Fuse failure alarms bypass the ACO switch function to maintain the office indications until removal of the blown fuse. Pressing the ACO switch will also cause a "reminder" ACO LED to illuminate and remain illuminated, until the alarm is cleared.

## 4. MAINTENANCE FEATURES

**4.01** Built-in maintenance features consist of a LOOP switch, a digital signal generator (DSG) switch, and a SHIFT switch which are all panel-mounted on the alarm and power unit. The DSG switch and SHIFT switch are only functional when the channel bank is operating in the looped mode (LOOP switch pressed in).

**4.02** Actuation of the LOOP switch routes the transmission signal back into the receive path for test purposes and connects an "all ones" bipolar signal generator to the outgoing line. In addition, the incoming signal is isolated and a termination applied. Fig. 4 illustrates the looped condition, showing signal flow for Channel 1 only.

**4.03** When the DSG switch is used in conjunction with the LOOP switch, a 1-kHz 0-dBmO digital generator in the receive converter is activated to supply a test signal to all channel-unit receive sides. This is used during channel bank alignment. Fig. 5 illustrates this condition, showing signal flow for Channel 1 only.

**4.04** When the SHIFT switch is used in conjunction with the LOOP switch, the transmit channel unit to receive channel unit relationship is changed. Channel-1 transmissions are received on Channel 9, Channel-2 transmissions are received on Channel 10, etc. Fig. 6 illustrates a shifted condition, showing signal flow for Channel 1 only.

**TABLE A**

**CHANNEL UNIT CGA CONDITIONING**

| CHANNEL UNIT TYPE | CONDITIONING |
|---|---|
| E&M (325EM01, 325EM02 and 325EM03) | 1. OS/MB-lead is grounded upon alarm detection. Ground remains applied through duration of alarm.<br>2. E-lead control is strap optioned for one of two sequences according to trunk type.<br>a. E-lead is forced open upon alarm detection and remains open during entire alarm sequence.<br>b. E-lead is forced open upon alarm detection then busy (strappable ground or battery) after first alarm sequence*. Busy signal remains applied through duration of alarm. |
| Dial Pulse Originating (325DP01) | 1. S-lead is grounded and ATB-lead is forced open upon alarm detection. After first alarm sequence*, a 45 millisecond "wink" signal momentarily opens S-lead and grounds ATB-lead. Grounded S-lead and open ATB-lead conditions are then maintained through duration of alarm.<br>2. Tip and ring line reversal is inhibited through duration of alarm. |
| Dial Pulse Terminating (325DP02) | Loop closure is disabled upon alarm detection and remains disabled through duration of alarm. |
| Foreign Exchange Subscriber (325FX01) | 1. Tip ground removed upon alarm detection and remains removed through duration of alarm.<br>2. Ringing is inhibited upon alarm detection and remains inhibited through duration of alarm. |
| Foreign Exchange Office (325FX02) | 1. Loop closure is disabled upon alarm detection and remains disabled through duration of alarm.<br>2. Ring ground is disabled upon alarm detection and remains disabled through duration of alarm. |
| Voice Frequency (325VF01) | OS/MB-lead is grounded upon alarm detection. Ground remains applied through duration of alarm. |

*Alarm and power unit (325AP01) may be strapped to provide 2-second or 12-second first alarm sequence (trunk processing).

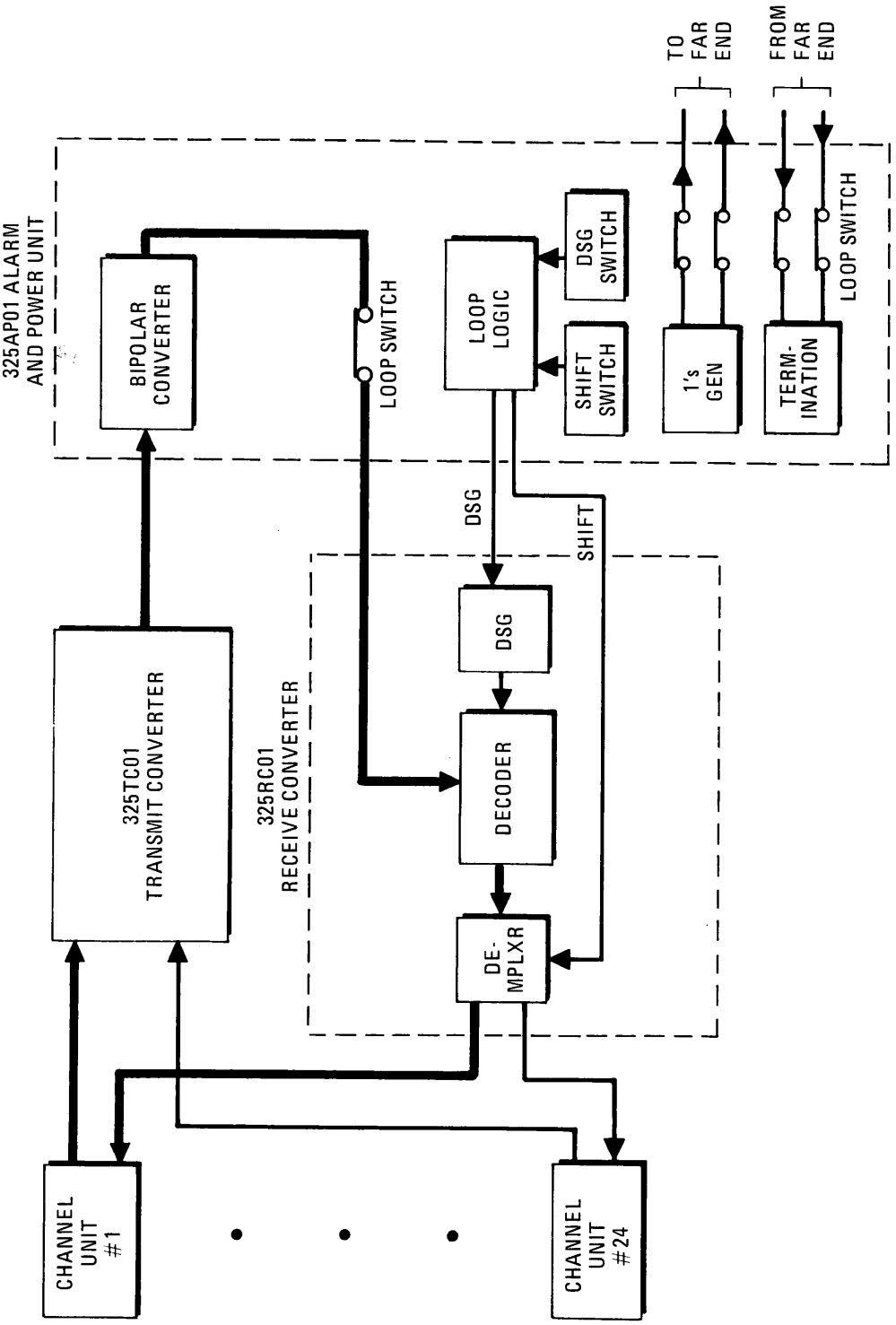



Fig. 4—Loop-Mode Signal Flow

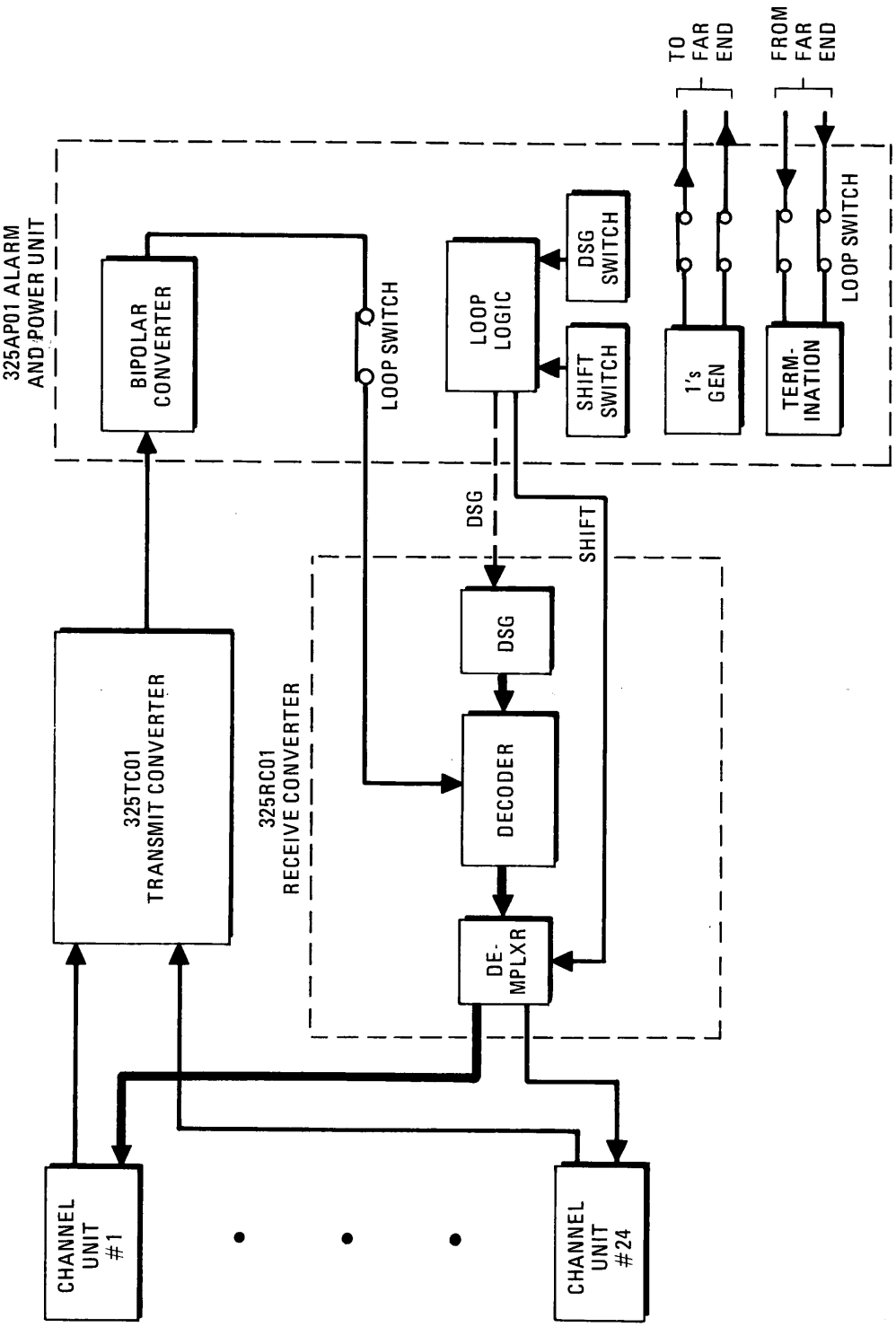



Fig. 5—Loop-Mode DSG Signal Flow

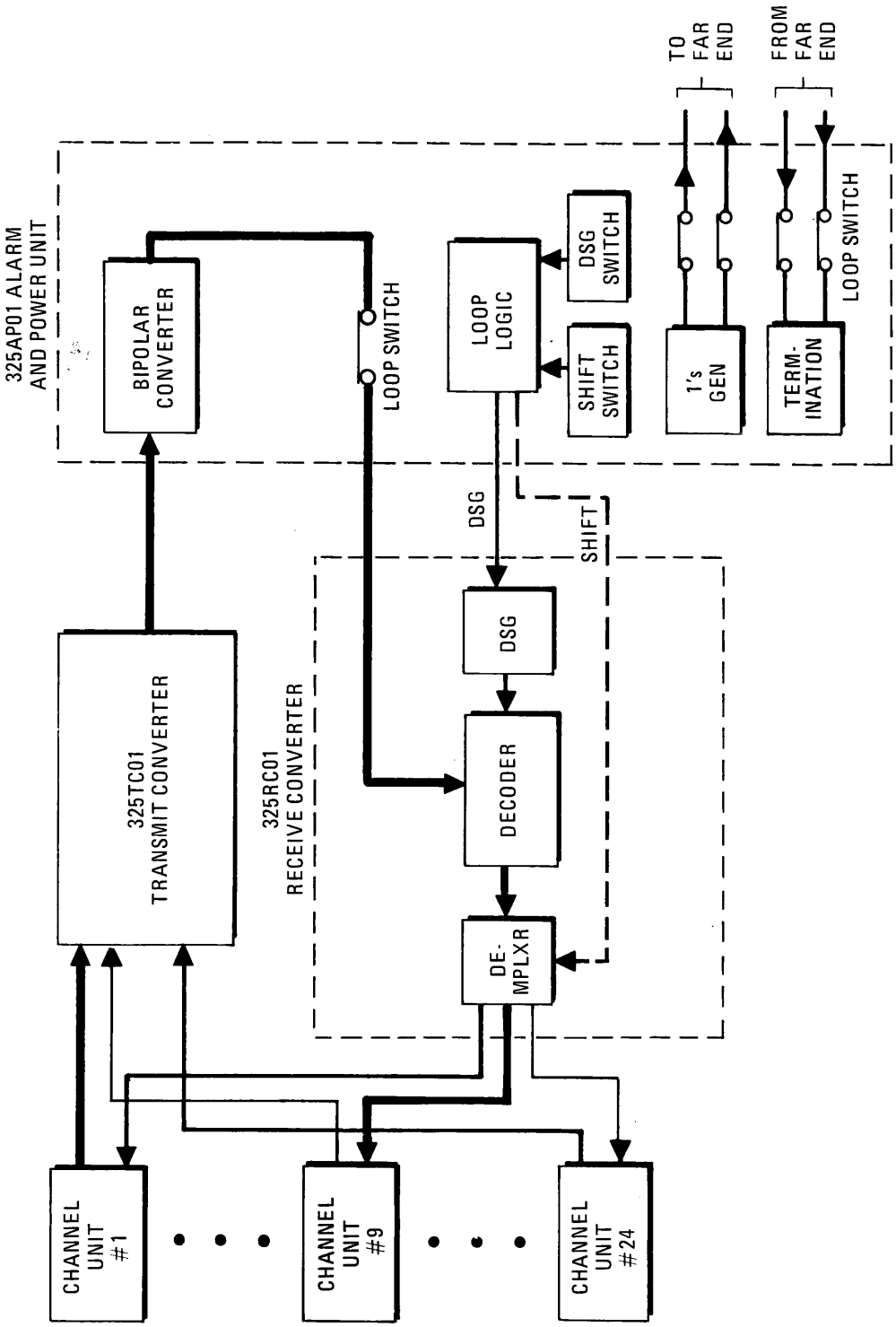



Fig. 6–Loop-Mode Shifted Signal Flow