MOBILE RADIO

MAINTENANCE MANUAL FOR GETC SHELF ASSEMBLY

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INTRODUCTION

This manual contains maintenance information on the GE Trunking Card (GETC). The GETC consists of the GETC Logic Board, 9600 baud modem, and Regulator Assembly all mounted on a tray and enclosed in a shelf. Included in this manual are GETC specifications and theory of operations.

SPECIFICATIONS

Specifications for the GETC are given in LBI-31852. These specifications are meant as an aid in servicing and do not represent performance standards.

DESCRIPTION

The GE Trunking Card (GETC) is used in a 16 PLUS™ Public Service Trunked (PST) communication system to provide control and interface to the station, site controller, dispatch console, and other stations.

The GETC (19D901868) consists of the GETC Logic Board (19D901855), 9600 baud Modem Board (19A705178), and the Regulator Assembly (19C336816), all mounted on a Tray (19C851553) and enclosed in a Shelf (19C851587). The GETC Shelf is a one-rack-unit assembly (1.75 inches by 19 inches) which is mounted in a 69-inch station. The GETC is shown in Figure 1.

When installed in a station, the GETC is mounted above the station radio assembly. When used for downlink interfacing, the GETC is mounted in the computer cabinet. The station GETC provides control-channel (CC) and working-channel (WC) processing. The downlink (DL) GETC provides site-controller-to-dispatch-console interface.

The control channel GETC (CC-GETC) performs a continuous 9600 bit per second communication to mobiles and portables in the 16PLUS™ system. Mobile/portable channel requests are received by the control channel, and the control channel sends the information to the site controller. The site controller makes a channel assignment which is relayed back to the mobile/portable unit(s).

A working channel GETC (WC-GETC) performs channel handshaking with the mobile/portable unit(s), and allows voice/data/Voice Guard® (VG) communication to other units in the system. The working channel also allows communication from mobile/portable unit(s) to the dispatch console and telephone interconnect at the site.

Site controller to dispatch console communication is performed by the downlink GETC (DL-GETC). The DL-GETC allows channel requests on the control channel, channel assignments on the working channels, and dispatch communication to mobile/portable units on working channels.

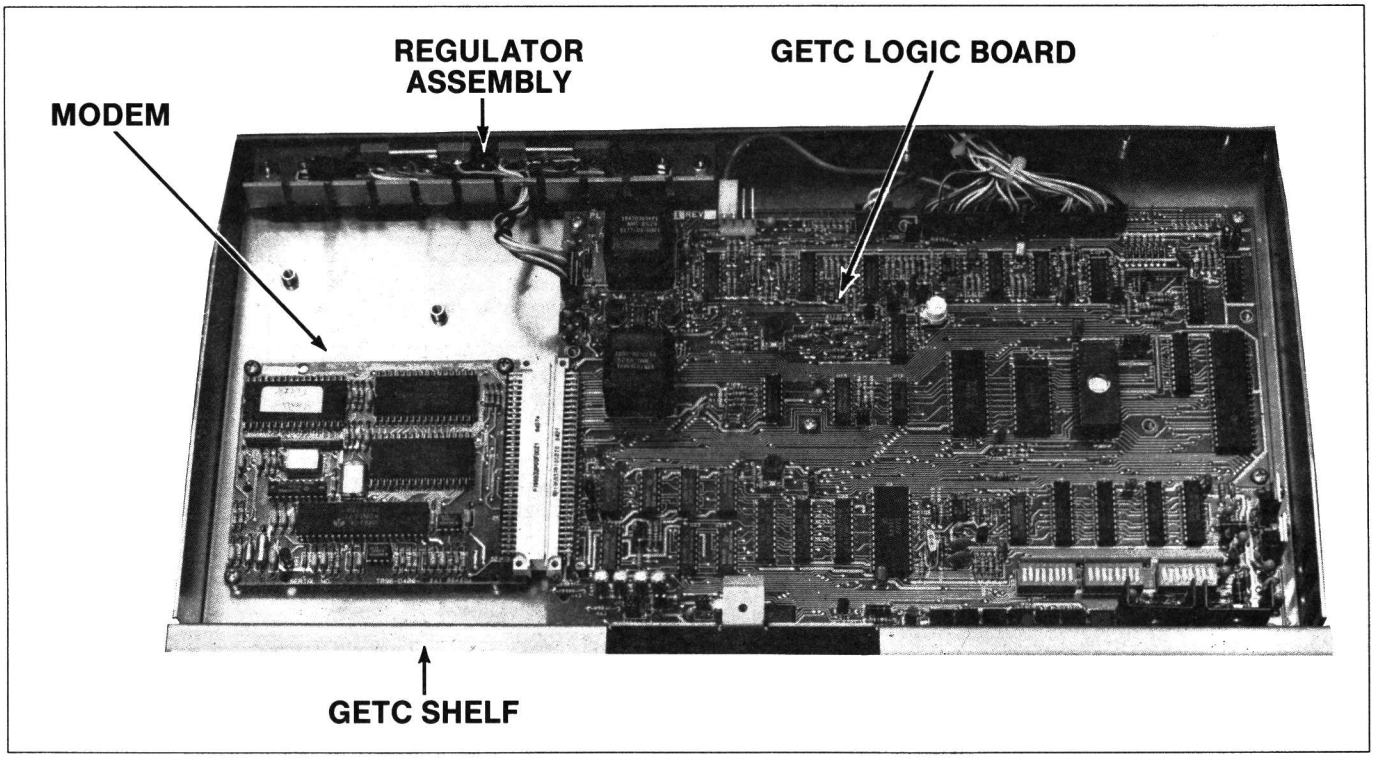

FIGURE 1 - GETC SHELF

The GETC communicates with the site controller (at the main site) to receive and transmit channel assignments and requests. Each GETC can communicate with up to two site controllers at the site location; the master site controller (MSC) and the backup site controller (BSC). Only one site controller is actively communicating with the GETCs, the other is invoked if a failure occurs. Limited trunking is maintained if the control channel to site controller (both the MSC and the BSC) communication link is disabled or inoperative. This backup mode is the failsoft mode. The control channel processes all requests/data from the mobile/portable unit(s), as well as the dispatch console link. If the failsoft link is inoperative, the 16PLUS™ system will revert to the conventional repeater mode of operation. The GETC communication links and failure mode are shown in Figure 2.

The GETC Shelf is interconnected to the station via a station interconnect harness (19C320811).

GETC COMMUNICATION LINKS

Communication between the GETC and master site controller (or backup site controller) is over an RS-232C bus, operating at 19.2 kilobaud. One start bit, eight data bits, and one stop bit are used. Communication with the master site controller and backup site controller, are on two independently steered ports on the GETC.

The GETC communicates with other GETCs, in the failsoft mode of operation, over a 0-13.8 volt bus operating at 19.2 kilobaud. One start bit, eight data bits, and one stop bit are used. This third independently steered port on the GETC is used for failsoft communications.

Communications between the control-channel GETC and other GETCs, is via a sync line. This sync line is used by the working channel GETCs to detect outbound control-channel frames, and subsequent mobile/portable arrivals (voice, data, or Voice Guard® communications). The sync line is a 0-13.8 volt bus consisting of a periodic negative pulse at 30 ms intervals. The width of the pulse is 833 ms in normal operation (with active site controller), and 2.5 ms in failsoft operation (no active site controller).

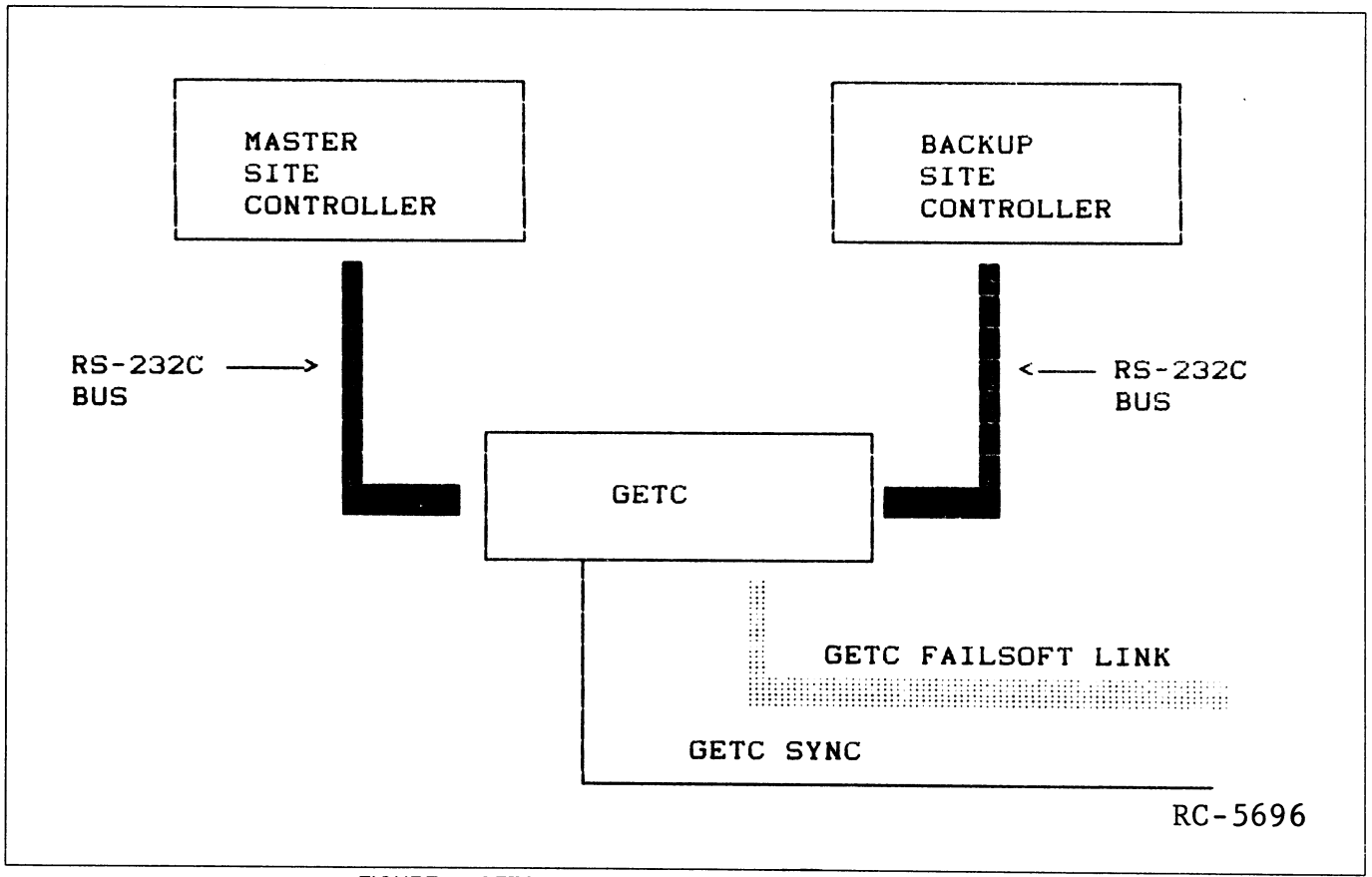

FIGURE 2 - GETC COMMUNICATION LINKS AND FAILURE MODES

CONTROL CHANNEL (CC)

The control channel (CC) receives requests/data from the mobile/portable unit(s) in the system via the 9600 bit per second, demodulated rf input. Mobile and portable units receive assignments/data from the control channel, via the 9600 bit per second, modulated rf output.

The physical control-channel link consists of an RS-232C line between the control-channel GETC and the site controller, a 0-13.8 volt sync bus from the control-channel GETC to the working channel GETCs, and the radio station interface.

Outbound (transmitted) serial control channel data to mobile/portable units in the system is at a continuous 9600 baud. The outbound data stream is segmented into message frames. A message frame is 30 ms long, and can consist of a maximum of two channel assignments for mobile/portable units. An outbound channel assignment consists of three repeats of the message (with an appended error correcting code) in one half the frame time (15 ms).

Outbound control-channel messages (from control channel GETC) originate from the site controller (when active), the working channel GETC (failsoft operation), the downlink GETC (failsoft operation), or the control channel GETC itself (due to periodic control channel update information). Channel assignments are sent in both half-slots of the frame time (30 ms).

The type of information contained in a channel assignment includes the originator mobile/portable ID, communication type (voice, data or Voice Guard®), communication path (mobile/portable, telephone interconnect, dispatch console), and the communications channel (a working channel for transmission or message trunked communications).

Inbound (received) control channel data (from mobile/portable units) are synchronized to the outbound (transmitted) data from the control channel. This tells the control and working channels when to expect incoming mobile/portable transmissions, and minimize "falsing" on the channels due to noise. The incoming messages are processed by the control channel prior to being passed to the site controller. This processing includes voting on the messages, and error detection and correction. In the failsoft mode, the control channel also produces the required channel assignments. A flowchart of the control channel processing is depicted in Figure 3.

WORKING CHANNEL (WC)

The working channel (WC) receives handshaking/data from the mobile/portable unit(s) via the 9600 bit per second, demodulated rf input. The mobile/portable unit(s) receive channel-confirmation and channel-drop messages via the 9600 bit per second, modulated rf transmitter output. The working channel also supplies the 150 bit per second subaudible signalling (low speed data), which is sent with the analog voice on the voice-communication channel.

The working channel physically consists of a 19.2 kilobaud RS-232C data link (to the site controller), a 0-13.8 volt sync bus from the control channel GETC to the Working channel GETC, and station radio interface.

The working channel is configured for voice/data/Voice Guard® communication via the site controller (if active) or from the control channel (in the failsoft mode of operation). Channel assignments are received from the site controller (normal mode) or from the control channel (failsoft mode), and this information is used to generate an update on the low-speed data. Low-speed data is impressed upon the voice for mobile/portable unit updates (voice communication).

The working channel operates in the transmission-trunked or message-trunked modes. Transmission trunking allows for an instantaneous channel drop, upon receipt of an "unkey" from the mobile/portable units. Message trunking allows for a channel-hang time on the working channel, subsequent to a channel drop. Transmission trunking is used to prevent long tie-ups of the working channel when site rf communication is high. When rf communication is low, transmission trunking is used to prevent inefficient turn-on and turn-off of the working channel. In an emergency situation, message trunking is used to provide communication between source and destination, without interruption back to the control channel. A flowchart of the working channel processing is depicted in Figure 4. The working channel also performs the Morse code station identification under control of Site Controller.

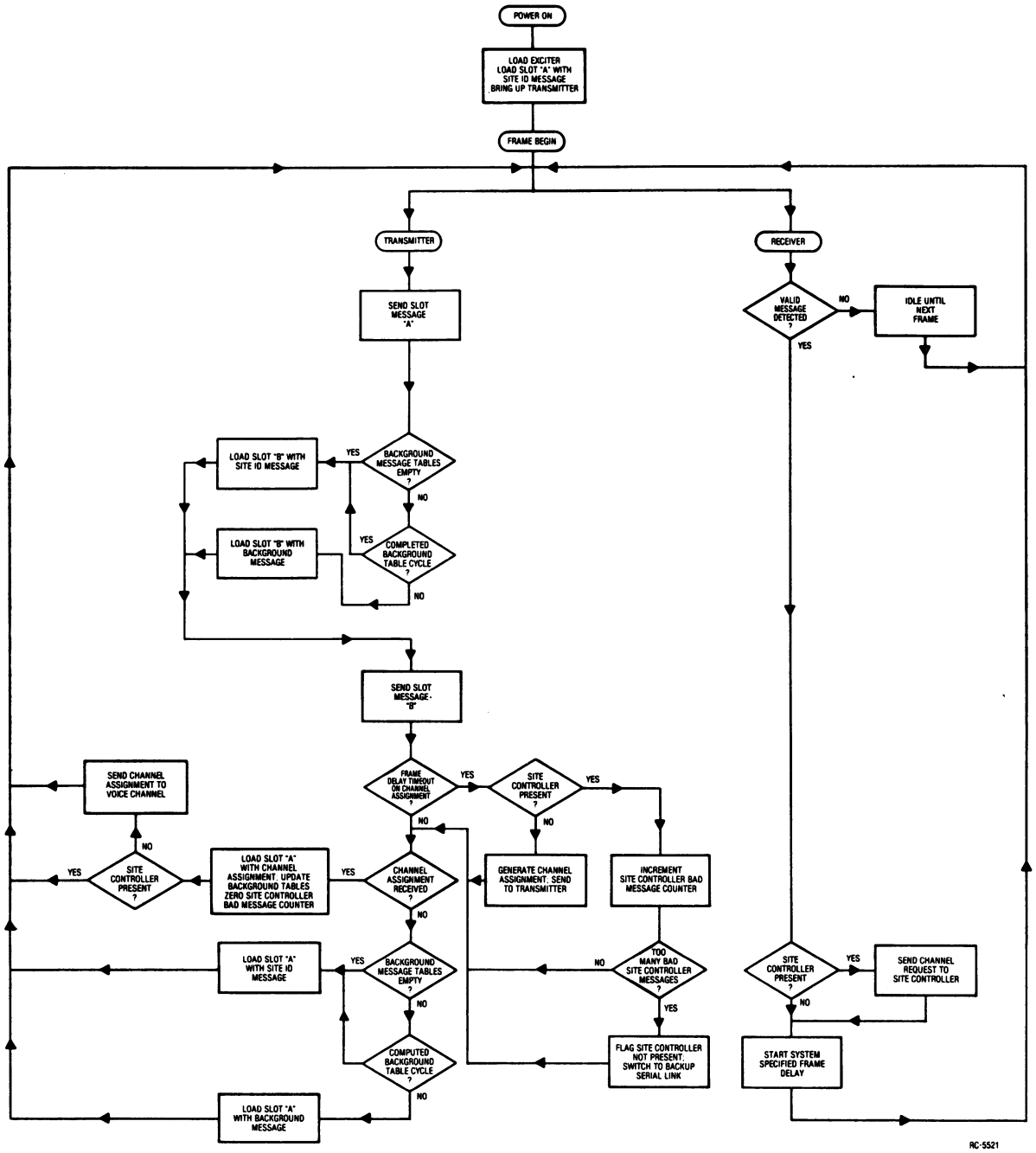

FIGURE 3 - CONTROL CHANNEL FLOWCHART

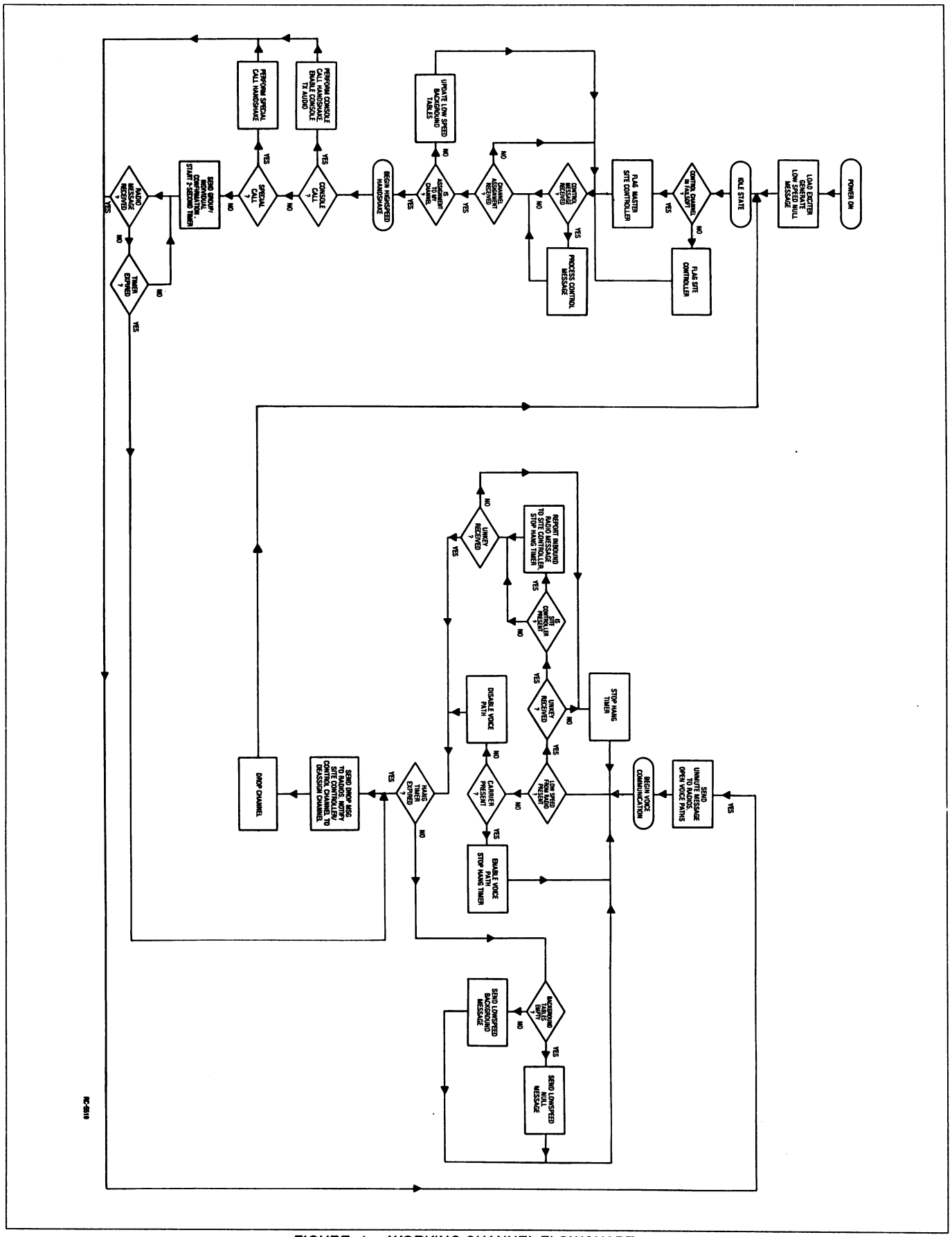

FIGURE 4 - WORKING CHANNEL FLOWCHART

DOWNLINK CHANNEL (DL)

Interface between the site and the dispatcher/console switch is provided by the downlink channel. The downlink channel GETC (DL-GETC) is located at the site, and communicates to the console switch via a serial data stream sent over a four-wire telephone line (3002 grade, duplex line).

Physically, the downlink consists of a 19.2 kilobaud, RS-232C data link (from the site controller to the downlink GETC), a 9600 baud, four-wire link (from the downlink GETC to the TSIN-GETC), a 19.2 kilobaud, RS-232C data link (from the TSIN-GETC to the console processor), and a 2400 baud link from the console processor to the individual dispatcher position.

The downlink channel processes requests from the dispatch console. It also processes channel assignments for the dispatcher, from the site controller (if active), or the control channel (in failsoft), and provides the interface from the site location to the console switch. The messages on the downlink channel are characterized as control channel, working channel, patch, or administrative messages. Except for the administrative messages, there is a direct relationship between the downlink messages and the messages that are transferred on the control and working channels. A flowchart of the downlink channel processing is shown in Figure 5.

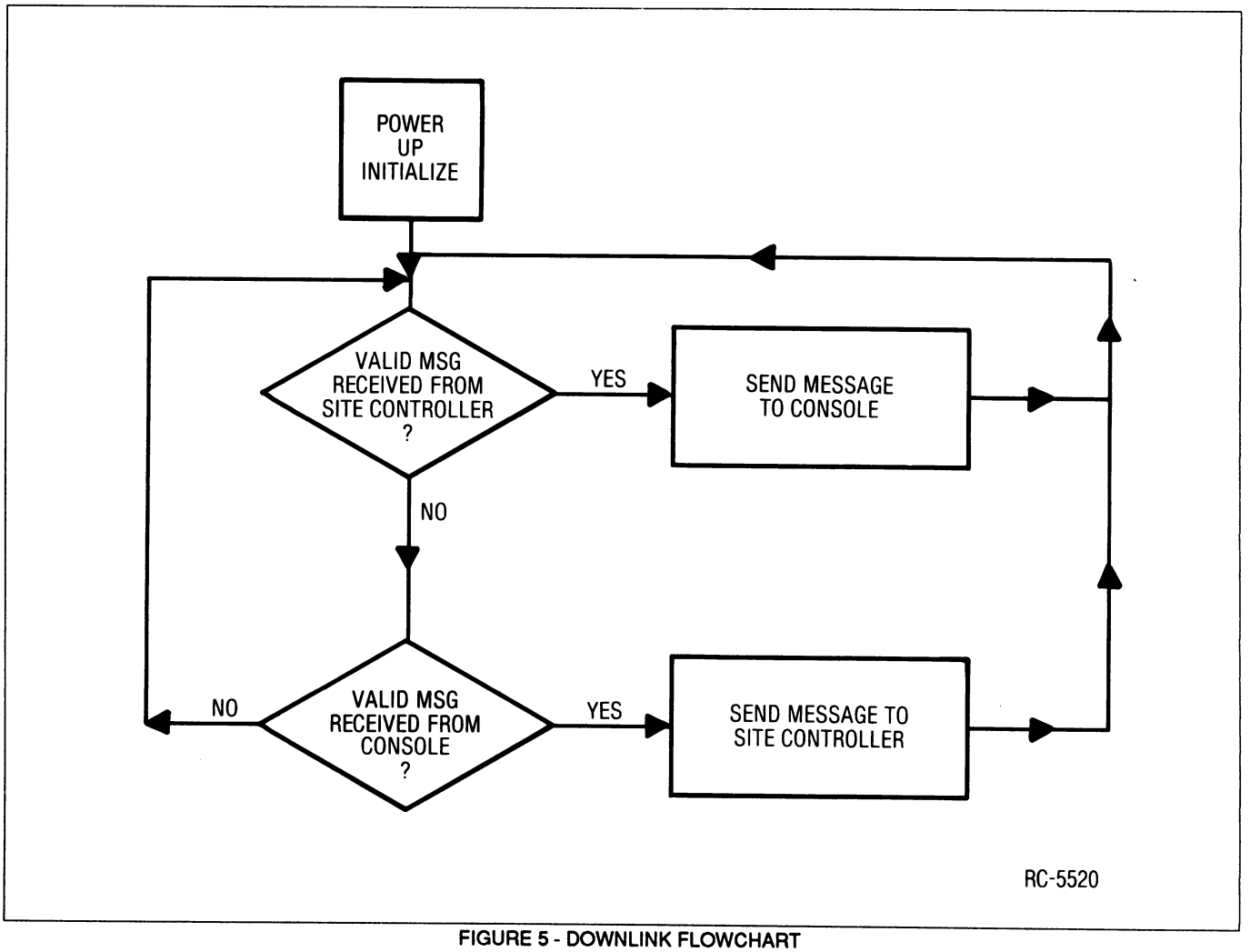

FIGURE 5 - DOWNLINK FLOWCHART

FAILSOFT OPERATION

The failsoft mode of operation is invoked when the site-controller link becomes inoperative (both the master site-controller link and the backup site-controller link). When the control-channel GETC detects a failure, it initiates the failsoft mode of operation via the sync bus to the working-channel GETCs.

Failsoft mode is signified (from the control channel GETC) to the working channel GETCs, by a 2.5 ms pulse repeating every 30 ms. In the normal mode of operation (with active site controller), the pulse width is 833 ms periodically repeating every 30 ms.

In the failsoft mode, the control working, and downlink channels communicate over the backup serial link (BSL). The BSL is a 0-13.8 volt bus operating at 19.2 kilobaud. All channel assignments from the control channel to the working channel, occur over the BSL. Also, the downlink-channel GETC communicates with the control-channel GETC. The failsoft mode provides limited trunked operation, not involving the site controller.

CONVENTIONAL OPERATION

In the event that the site controller links, as well as the failsoft links, are inoperative, the GETC will revert to the conventional mode of operation. Conventional mode includes repeat and remote repeat.

STATION CONTROL, SIGNALLING, AND INTERFACE

The control-channel GETC and the working channel GETCs, attach to the station radio to perform station control, signalling, and interface in the 16PLUS system. The GETC uses the following lines to perform control in the station:

DELAY PTT - station transmit control

RUS OUT - audio squelch control

LOCK DETECT - synthesized-exciter lock detect indicator

CLK - synthesized-exciter clock line

DATA - synthesized-exciter data line

LOAD ENABLE - synthesized-exciter load enable pulse line

These lines are used to perform signalling in the station:

MODULATION - direct modulation input to the synthesizer-exciter

VOL/SQ HI - station demodulated rf receiver input

CG HI - low-speed signalling to the synthesizer-exciter

The GETC uses the following lines to perform interface functions in the PST station:

11/73-1 TX - RS-232C transmit line to master site controller

11/73-1 RX - RS-232C received line from master site controller

11/73-2 TX - RS-232C transmit line to backup site controller

11/73-2 RX - RS-232C received line from backup site controller

BACKUP TX LINK/VOTER SEL TX - backup serial link, transmit output

BACKUP RX LINK/VOTER SEL RX - backup serial link, received input

SLOT SYNC - sync line from control channel to working channels

In the 16PLUS station, the GETC is configured so that the backup serial link (BSL) receive and transmit lines are tied together. This is accomplished by a jumper on the GETC.

CIRCUIT ANALYSIS

Theory of operation for each circuit card assembly and module used in the GETC shelf is described in the following paragraphs. Refer to the schematic diagrams while reading these descriptions. A block diagram of the GETC is shown in Figure 6.

GETC LOGIC BOARD

The GETC logic board (19D901852) is used to perform the control, signalling, and interface in the station.

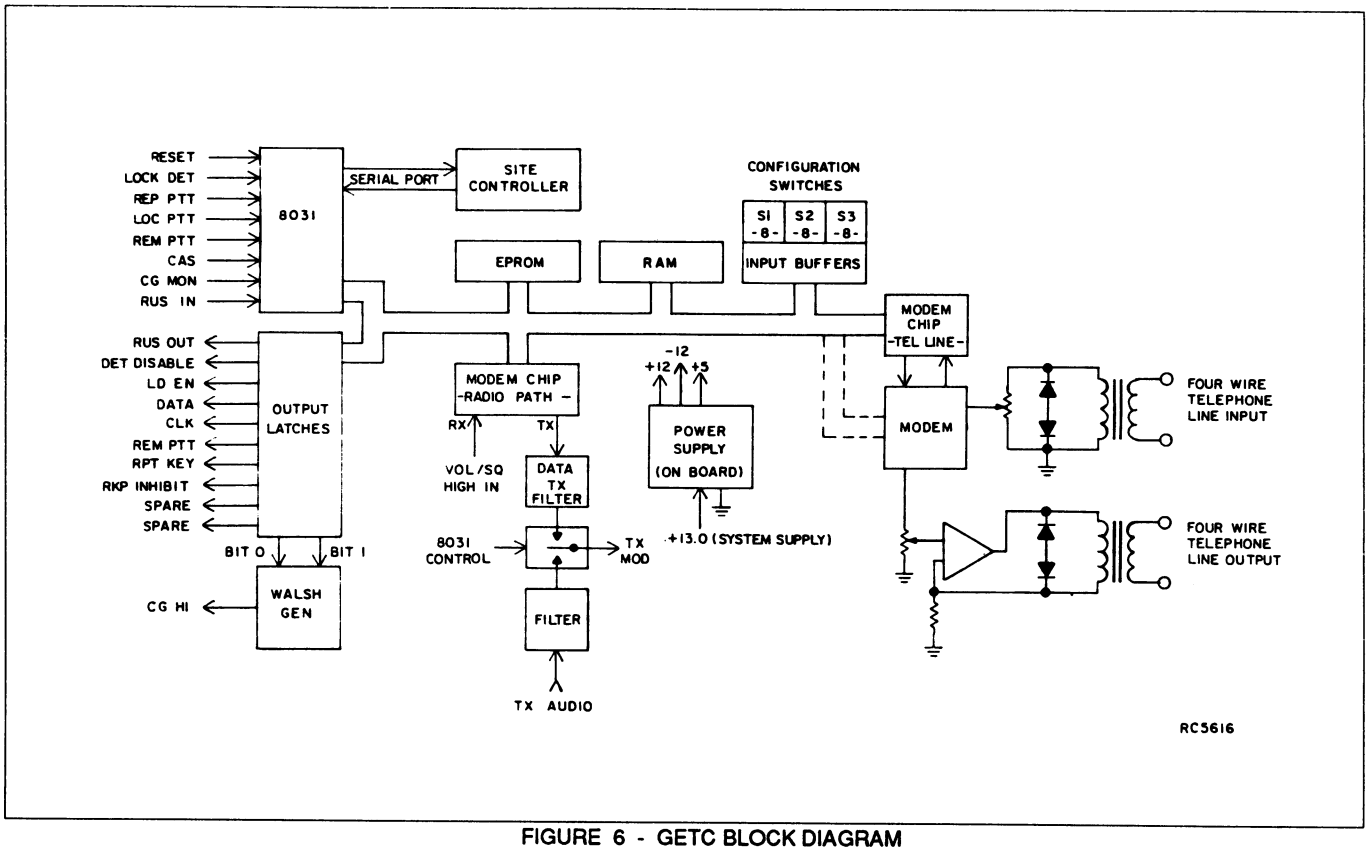

FIGURE 6 - GETC BLOCK DIAGRAM

Reset Circuitry

The GETC Logic Board contains a power-on/manual-reset circuit to initialize the programmed code and hardware devices on the board. The reset circuitry consists of comparator U17B, Zener diode D9, RESET switch S4, driver Q2, and associated circuitry.

Comparator U17B compares the +5.0 line with a reference level to generate a reset to the GETC logic board. A reset can also occur manually via RESET switch S4. An external device can also reset the GETC, via a logic low on J7-3, which is diode-coupled to the comparator.

A reference level of 2.7 Vdc is set up on pin 6 of the comparator by Zener diode D9. After power up, the steady-state level on pin 5 is set to 3.2 volts by the resistor divider (R17 and R19). Normally, the output of comparator U17B is pulled to +0.8 volts (nominal logic 1) through resistor R20.

When RESET is pressed, U17B-5 goes to ground, and the comparator output (U17-7) goes to 0 volt (nominal logic 0) turning transistor Q2 off. The collector of Q2 goes high, sending a pulse to the reset input (RES IN) of the modem (U4-25). The modem RES OUT line (U4-3) is the logical-or of the RES IN line and the internal, watchdog-timer pulse (if not serviced by microcomputer U1).

The reset out (RES OUT) of the modem is sent to the microcomputer and other logic devices on the GETC logic board. When the RESET button is released, the level on U17B-5 returns to +3.2 volts. The comparator output (U17B-7) turns off, allowing the base of Q2 to be pulled high (to 0.8 volt) as C5 charges. The time constant set up by R20 and C5, results in a 5 ms turn-off delay for Q2. After the reset pulse is gone, the microcomputer restarts operation from program counter address 0.

When an external device resets the GETC through J7-3, operation is similar to that described for the RESET switch (S4). Another reset can occur if the microcomputer does not service the watchdog timer internal to modem U4. This reset will occur if the microcomputer misses a service for a two-second time period.

Clock Circuitry

The clock drive for the GETC logic board is derived from modem U4. The clock oscillator consists of crystal Y1, modem U4, and associated circuitry. A built-in oscillator circuit within the modem runs at 11.059 MHz, as determined by crystal Y1. The CLK 1 line (U4-14) is the clock input to the modem (U19-16) and microcomputer U1. Jumper J30 configures the proper clock input to the microcomputer.

Jumper Configuration

There are jumpers on the GETC Logic board that configure the shelf for 16PLUS and Voice Guard® operation (repeat, remote repeat, remote, voter selector and voter receiver). The jumper configuration in Table 1 must be set to enable full functions to be performed during 16PLUS operation.

TABLE 1 - JUMPER CONFIGURATION

CONNECTOR	JUMPER	FUNCTION
J11-1&2	P11	Receive data from 9600 baud Modem board
J12-1&2	P12	Clear to send from 9600 baud Modem board
J13-1&2	P13	Route backup serial link tx output to backup serial link rx input
J14-1&2	P14	Master site controller path selection enable
J15-1&2	P15	Backup site controller path selection enable
J16-1&2	P16	Backup serial link selection enable
J17-1&2	P17	Low-speed data encode path enable
J18-1&2	P18	Low-speed data decode path enable
J20-1&2	P20	Combined ptt from station disable
J21-1&2	P21	High-speed, data-acquisition rate control
J22-1&2	P22	4800 Hz tone notch path enable
J24-1&2	P24	Backup serial link selection enable
J25-1&2	P25	Low-speed data encode path enable
J26-1&2	P26	Lock-detect input path enable
J28-1&2	P28	Sync line input path enable
J29-1&2	P29	No function
J30-2&3 J30-4&5	P30 P31	Enable clock drive to microcomputer for CMOS configuration

Switch Settings

The three, eight-position DIP switches (S1 thru S3) on the GETC Logic board, configure the shelf for a personality at the site location. A logic 0 is closed (on) and a logic 1 is open (off). These switches configure the shelf with the rf transmit frequency, channel number at the site, default failsoft operation, default control channel operation, default downlink channel operation, and data inversion to the transmitter.

The rf transmit frequency is set by S1-1 through S1-7 and S2-1 through S2-4. These 11 bits encode the transmitter frequency, in the range from 850 to 870 MHz, at a 12.5 kHz channel spacing. At power up, reset, or out-of-lock condition of the synthesizer, the GETC will attempt to load the transmit frequency code to the Synthesized-Exciter board (19D438214).

The GETC is able to invert the high-speed and the low-speed data to the synthesized-exciter board. When switch S2-8 is closed, the data is not inverted. When S2-8 is open, the data are inverted. Inversion of data allows the possibility of a synthesized-exciter board replacement. Normally, this switch (S2-8) is set to open (off). In this mode of operation, the direct frequency-modulated carrier is at a higher rf frequency for a logic 1 and a lower rf frequency for a logic 0. Switches S2-5 thru S2-7 may be in any position.

Default failsoft operation is defined by S3-8. When switch S3-8 is open, the forced failsoft mode is enabled. When S3-8 is closed, the forced failsoft mode is disabled.

The GETC is configured as a downlink channel by setting the address to 26 (11010 binary).

Switches S3-1 through S3-5 configure the GETC with the channel number at the site location. Allowable channel numbers range from 1 (00001 binary) to 20 (10100 binary). Channel numbers 0, 25, 27, and 30 are reserved, and channel number 31 (11111 binary) is used in the GETC test mode. Switch S3-5 is the most-significant bit (MSB), and S3-1 is the least-significant bit (LSB) of the GETC channel number. Also, a logic 0 is defined as a closed (on) switch setting, and a logic 1 is defined as an open (off) switch setting. Switches S3-6, S3-7, S1-8, S2-5 thru S2-7 may be in any position.

Power Supplies and Regulators

The GETC receives its primary power from the station power supply (13.8 volt nominal) through connector J10-1. Regulated +5.0 volts, +12.0 volts and the -12.0 volts are derived from this supply.

Generation of the regulated +5.0 volts is accomplished through the Regulator Assembly (19C336816). This assembly gets 13.8-volt station power through connector J27-4. Regulated +5.0 volts is returned to the GETC logic board devices through J27-6. Regulated +5.0 volts used to power the 9600 baud Modem board is returned at connector J27-1.

Capacitors C47 thru C49 and C51 thru C53 filter the +5.0-volt regulators. The +5.0-volt supply is filtered by C51 thru C53. Diodes D22 and D23 provide back-bias protection on the +5.0 power regulators.

Regulated +12.0 and -12.0 volts are generated using the oscillator-inverter circuitry. These sources supply power to the analog circuits and RS-232C driver devices on the GETC logic board, as well as the 9600 baud Modem board.

The oscillator-inverter circuit obtains a 9600 Hz square-wave input, from modem U4-27, which is sent to the base of transistor Q14. Transistor Q14 translates the TTL square wave to a 0 to +13.8 Volt square wave. Transistors Q8 and Q9 provide additional buffering to drive Q11 and Q10, respectively. Transistors Q11 and Q10 drive Q12 and Q13 to obtain a push-pull, high-level drive output. Capacitor C56 and diode D28 are used to quickly turn off Q13. Resistor R127 is used to minimize the crossover transition in the push-pull circuit. The output at the collectors of transistors Q12 and Q13, is a high-drive, 9600 Hz squarewave which swings from 0 to +13.8 volts. Capacitors C57 thru C60 and diodes D31 thru D34 comprise a negative-voltage doubler, which maintains a nominal value of -23 volts to the input of the negative-voltage regulator (U39). Capacitors C62 and C63, and diodes D29 and D30 comprise a positive-voltage doubler which maintains a nominal +25 volts to the input of the positive-voltage regulator (U40). Resistor R128 is used as a current limiting resistor to reduce the case temperature of regulator U40.

The two voltage regulators, U39 and U40, break down the input voltage to obtain a regulated -12.0 volts and a regulated +12.0 volts, respectively. Capacitors C61 and C64 provide additional ripple filtering on the -12.0 and the +12.0 volt lines.

Logic

The GETC logic board provides the station control and interfacing in the system. The main controller on the GETC shelf is the 8031 microcomputer (U1) found on the GETC logic board. The

microcomputer obtains its instructions from the program stored in PROM U2 - a 32 kilobyte device. The upper eight address lines of the microcomputer (U1) go directly to the PROM, while the lower address lines are latched into register U5. The output of U5 supplies the lower eight address lines to the PROM. The microcomputer accesses the data from the PROM via the control line PSEN (program sense) on U2-22. A 2k external RAM (U3) holds data and tables. The address lines to the RAM are identical to that of PROM U2.

Microcomputer U1 accesses the modem (U19) to interface to the 9600 baud Modem board. This provides the transmit and receive downlink processing to the dispatch/console location. Modem U4 provides high-speed data encode to the transmitter in the station, as well as the high-speed data decode from the station receiver.

Configuration of the GETC is determined by the settings of switches S1 thru S3. The microcomputer reads these settings through octal buffers U7 thru U9. Resistor packs R8, R9 and R39 are pull-ups for the switch lines.

The microcomputer accesses data to or from RAM (U3), modem U19, modem U4, and octal buffers U7 thru U9, through octal transceiver U6. Transceiver U6 connects to the BD (buffered data) bus. Access to data going to or from the PROM, and octal registers U20, U21, and U38 is handled by the D (data) bus.

Program memory is accessed by the PSEN (U1-29) strobe. It addresses the devices on the A (address) bus by latching the lower eight bits of the address through U5, and sending the upper eight bits of the address directly to the devices. The two-to-four demux/decoder (U10) is used to decode the upper address lines (A11 thru A13), enabling the desired device to transmit or receive data. The 9600 baud modem board may also be accessed to provide communication over the telephone line to the dispatch/console The devices on the microcomputer bus are addressed according to the Table 2.

TABLE 2 - MICROCOMPUTER MEMORY-MAPPED I/O

DEVICE	HEXADECIMAL ADDRESS
U3	0000-07FF
U4	A080-A082
U7	B800
U8	B000
U9	A800
U19	A100-A102
U20	A800
U21	B000
U38	B800
9600 baud Modem board	A1E7

4800 Hz Tone Notch Filter

The 4800 Hz Tone Notch Filter is comprised of U37A, U37B and associated circuitry. The notch filter is a two-stage, independently adjusted filter used to eliminate the 9600 baud dotting pattern from the received audio. The 9600 baud dotting pattern is generated by the mobile/portable units to initiate channel-drop messages on the working channels.

Audio (voice and low-speed data) comes to the GETC logic board on connector J7-5 and enters the 4800 Hz notch filter. The first stage of the notch filter consists of U37A, R106 thru R110, C43 and C44. The second stage consists of U37B, R111 thru R115, C45 and C46. Resistor R110 is used to center the notch of the first stage at 4800 Hz, and R115 is used to center the notch of the second stage at 4800 Hz. The overall notch depth is 30 dB. A frequency response curve of the notch filter is shown in Figure 7.

The output of the notch filter (U37B-7) is sent to the analog switch (U15A-13). Resistor R10 is used to provide residual dc bias to switch U15A. The microcomputer selects the audio path, or the high-speed data path, through the analog switch.

Low Speed Data Encode Filter

The Low-Speed-Data Encode Filter is comprised of U30, U32A, U32D, and associated circuitry. This filter is a low-frequency response filter consisting of a two-stage gyrator section. The filter is used to smooth out the transitions of data which is impressed upon the voice audio. Low-speed data is a 150 bit per second data stream generated by the microcomputer, and used to produce subaudible data on the voice audio.

Low-speed data is generated by the microcomputer on Walsh bits 1 and 2 on octal register U38 (pins 2 and 5). For low speed data, the two Walsh bits are logically identical at all times. The two walsh bits are scaled and summed through resistors R84 and R129, and sent through the analog switch (U34C) to the input of the low-speed-data encode filter. Output of the filter leaves the GETC logic board on J19-5, and goes to the Synthesized-Exciter board where the filtered data is added to the voice audio. The audio (plus low-speed data) combination comes back to the GETC logic board, where the analog and digital paths are controlled by the microcomputer through switch U15A. The frequency response of the low-speed-data encode filter is shown in Figure 8.

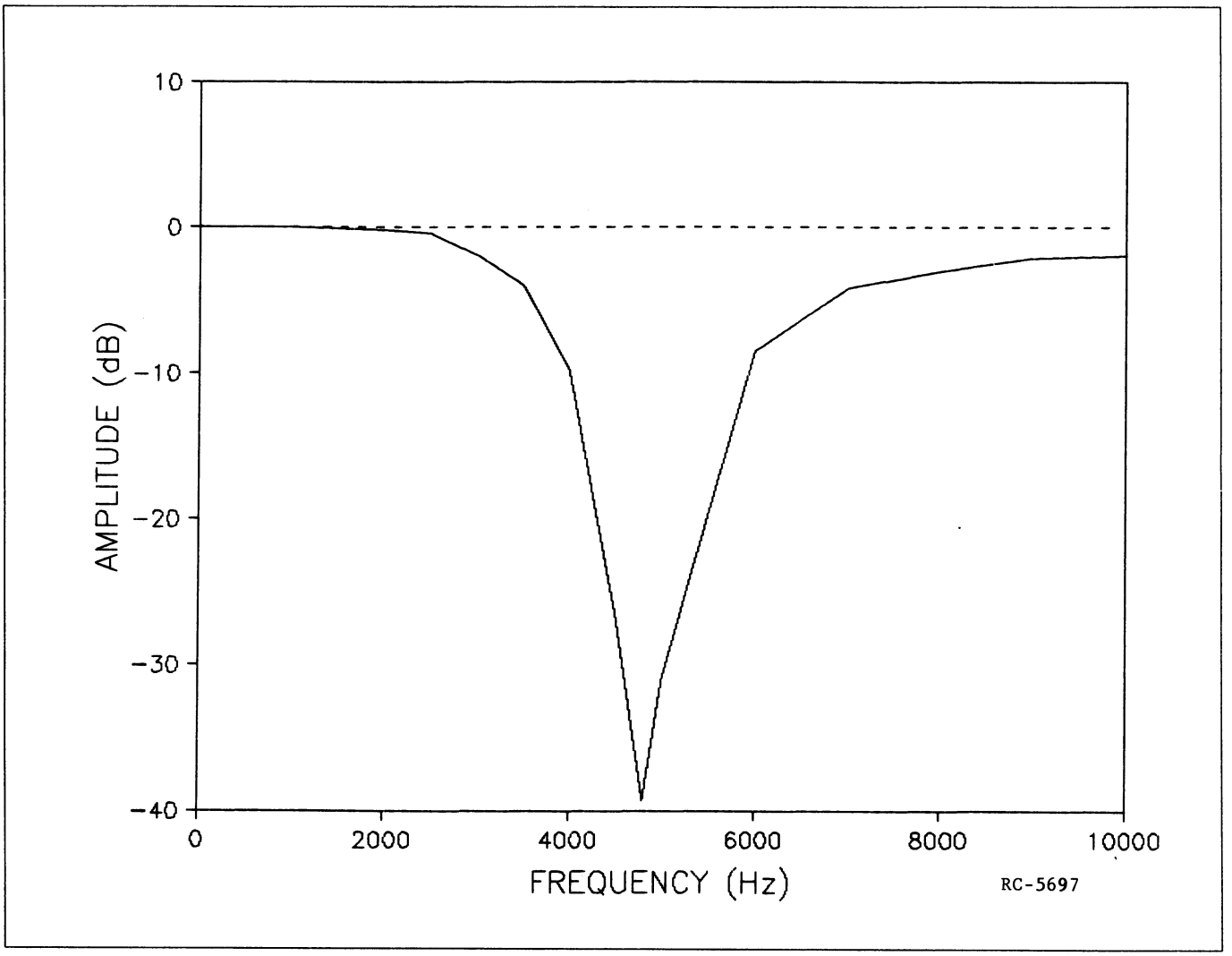

FIGURE 7 - FREQUENCY RESPONSE OF 4800 HZ NOTCH FILTER

Voice-Reject Filter and Limiter

The Voice-Reject Filter is comprised of U33, U32B, U32C, and associated circuitry. This filter is a low frequency response filter, consisting of a two-stage gyrator section. The filter is used to reject the voice audio and obtain the low-speed data or subaudible signalling. Low-speed data is a 150 bit per second data stream which is impressed upon the voice audio.

The station received (demodulated) audio arrives on the GETC logic board at J7-2. The VOL/SQ HI audio is sent to the Voice-Reject filter, where the voice audio (300 - 3000 Hz) is attenuated. Only the low-speed or subaudible data is left at U32-8.

The low-speed data goes to a limiter consisting U31A and associated circuitry. Analog switch U34B switches the low-speed data acquisition time constant from a higher rate to a slower rate. The output at U31-1 is a data waveform swinging from -12 volts to about 1 volt. This waveform is converted to a TTL waveform by Q5, and sent to U11-7 where the microcomputer software decodes the low speed data. The frequency response of the low-speed-data decode filter is shown in Figure 8.

High-Speed-Data Filter

The High-Speed-Data Filter is comprised of U16 and associated circuitry. High-speed data is a 9600 bit per second data stream generated by the microcomputer through the rf data modem (U4). The four sections of U16 serve as the transmit filter and buffer/driver. Integrated circuit U16A is a voltage follower, and U16B and U16C provide the bessel

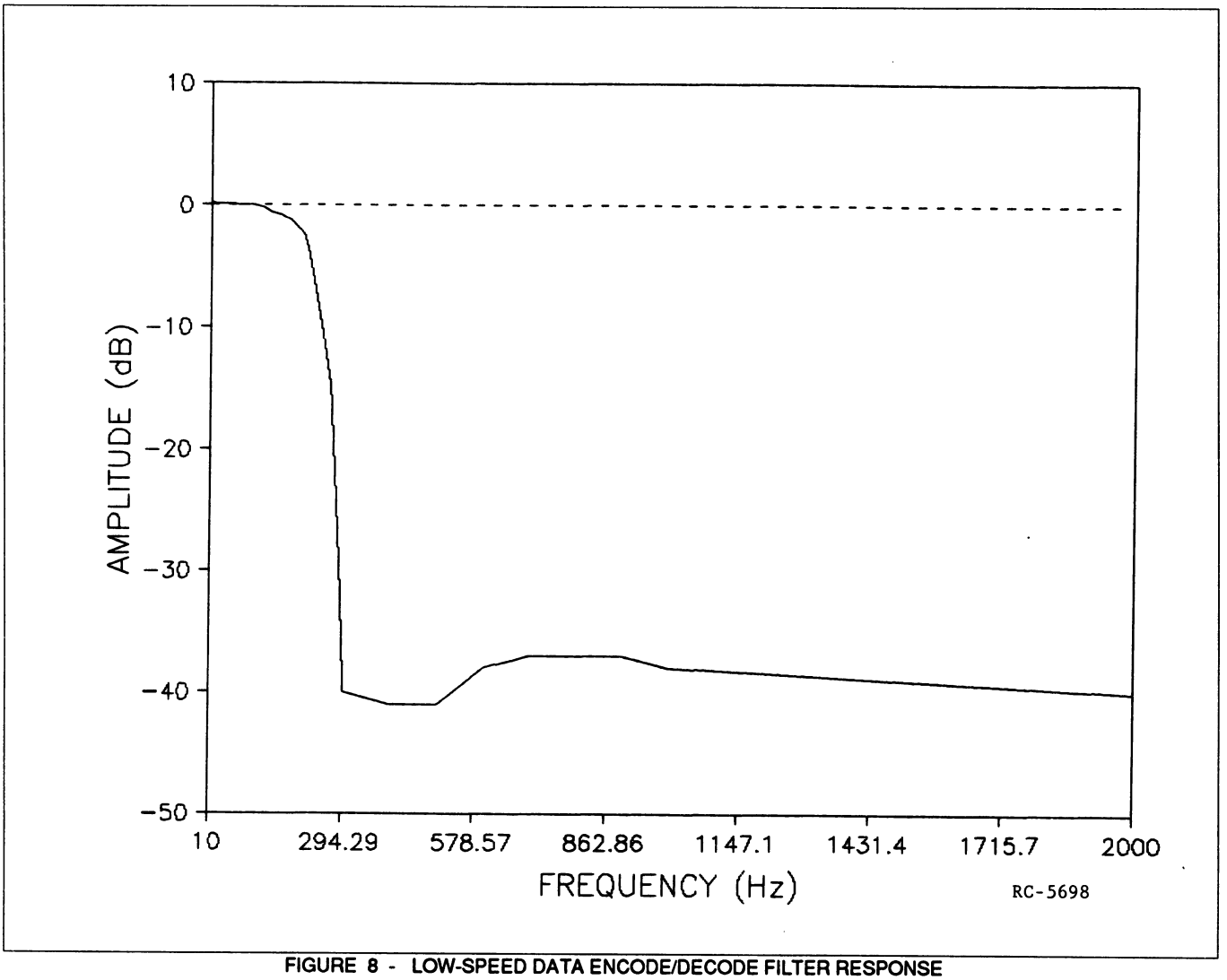

FIGURE 8 - LOW-SPEED DATA ENCODE/DECODE FILTER RESPONSE

(constant-phase) filtering of the high-speed data. High speed data-to-analog switch U15A is driven by U16D.

Variable resistor R31 is used to set the high-speed data deviation in the station. This is the only deviation control on the GETC logic board. The voice and low-speed data deviation is set on the Synthesizer-Exciter board at the station transmitter.

The high-speed-data filter is an active GMSK (Gaussian Minimum Shift Keying) filter that filters the data transitions so the high-speed-data transmission bandwidth is minimized. The frequency response of the high-speed-data filter is shown in Figure 9.

High-Speed-Data Detector

The High-Speed-Data Detector is comprised of U17A and associated circuitry. The received input (VOL/SQ HI) enters the GETC logic board at J7-2. This signal is sent to the data limiter (U17A). The microcomputer controls the acquisition rate of the high-speed-data detector through switch U15C. A low acquisition rate is set when the microcomputer brings U21-16 low, similarly a high on U21-16, sets the rate high.

Low acquisition rate is used if the GETC logic board has locked onto mobile/portable transmissions. The high acquisition rate is used if the GETC is looking

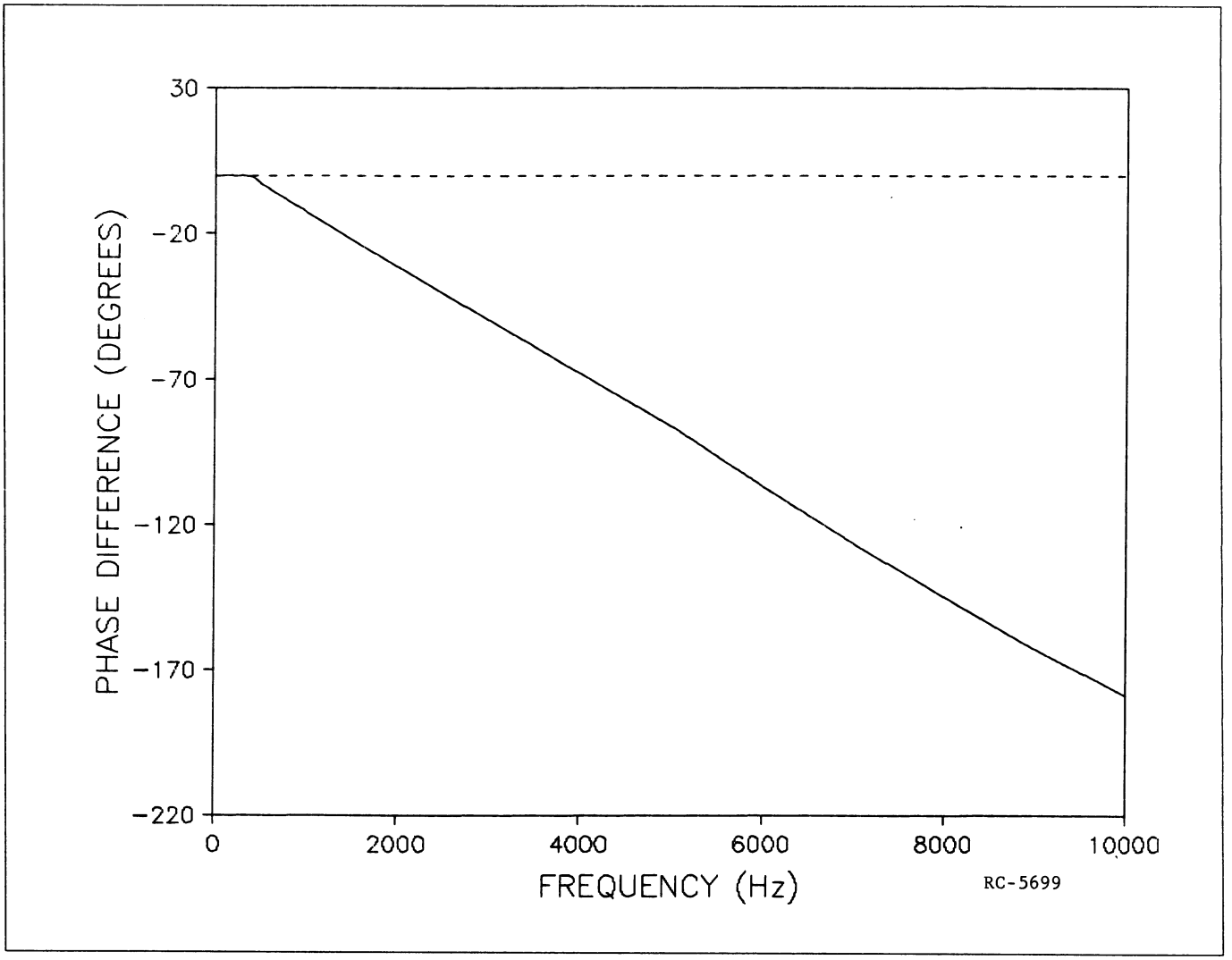

FIGURE 9 - HIGH-SPEED DATA FILTER RESPONSE

for mobile/portable transmissions. Speeding up the acquisition rate is achieved by allowing the bias level on U17A to adapt quickly to the dc bias level on the incoming VOL/SQ HI received signal.

9600 Baud Modem Board and Telephone Line Interface

The GETC interfaces to the 9600 Baud Modem board through connector J3. Address and control of the 9600 Baud Modem board is over the A bus (lower seven address lines), the BD bus, and modem U19. The microcomputer addresses the 9600 Baud Modem board (A1E7 hex) to set the modem board timing for external clock, and sends data to the modem board through U19. When data is to be sent, the microcomputer sends a request to send (RTS) and waits for a clear to send (CTS) from the Modem board. The RTS line is sent to the modem board from U21-2, and is an active-low TTL signal. The CTS signal back to the microcomputer is read on U1-15, and is an active-low signal from the modem board. The telephone hybrid transformers T1 and T2, coupled the four-wire telephone line to the 9600 baud Modem board.

Transformer T1 receives data from the telephone line, and couples the data to the Modem board at J3-32A. A voltage follower (U18A) drives the data to the modem board. Resistor R1 is used to adjust the dedicated telephone line to the proper receive reference level. The reference level is 0.16 volts rms at U18-1, for a 0 dBm telephone line level from the source. Diodes D10 and D11 are used for surge protection.

Transformer T2 transmits data from the modem board to the telephone line. The serial transmit data is obtained from J3-32C, and sent to U18B for coupling to the telephone line. Resistor R2 is used to adjust the dedicated telephone line to the proper transmit reference level. The reference level is 0.77 volts rms (0 dBm) on J6-8 and J6-9. Diodes D12 and D13 are used for surge protection.

Synthesizer-Exciter Board Interface

The GETC logic board loads the transmit frequency information into the Synthesizer-Exciter Board (19D438214) in the station. The DATA (J6-11), CLK (J6-12), LOAD ENABLE (J6-15), and LOCK DETECT (J6-13) signals are used. The microcomputer loads the frequency code into the Synthesizer-Exciter board at power up, reset, or whenever an out-of-lock indication is obtained from the Synthesizer-Exciter board.

The frequency code is generated by the microcomputer based upon the settings of the DIP switches on the GETC logic board. Switches S1-1 through S1-7 and S2-1 through S2-4 are used to derive the frequency code.

A 32-bit pattern, consisting of a reference number (R), the synthesizer divide-by-N counter value (N), the synthesizer divide-by-A counter value (A), and a control bit, make up the frequency code. Reference number, R consists of 14 bits and is calculated by dividing the synthesizer reference oscillator frequency by the transmit channel spacing. The resulting R value is 800 (00 0011 0010 0000 binary).

The divide-by-N counter value consists of 10 bits and is calculated by taking the absolute integer value of the rf transmit frequency divided by 128 times the transmitter channel spacing.

N = ABS INT (rf transmit frequency in MHz/(transmit channel spacing in MHz * 128))

The divide-by-A counter value consists of 7 bits and is calculated as follows:

A = (fractional part of (ABS (rf transmit freq)/(128 * channel spacing))) * 128

The control bit is always a logic 1 to enable the reference counter information to be loaded via the LOAD ENABLE pulse. The reference value R is fixed for the PST system (fixed channel spacing and reference oscillator) and is calculated to be 800 (or 00 0011 0010 0000 binary). This R value is fixed in the microcomputer program memory.

The sequence of entering data into the Synthesized-Exciter board is

MSB LSB

R VALUE (14 bits)	N VALUE (10 bits)	A VALUE (7 bits)	CONTROL (1 bit)

32-BIT DATA LOAD TO SYNTHESIZER-EXCITER BOARD

The clock, data, and load enable lines are initialized to logic 0 by octal register U20. The data is presented on U20-16 (bit 6). After about 40 usec, the clock is set to logic 1 on U20-9 (bit 3) for 40 usec, and then lowered to logic 0. After about 40 usec, the data is changed to reflect the next data bit of the 32-bit data pattern. After 32 bits have been clocked into the Synthesized-Exciter board, the load enable line is raised to a logic 1 on U20-5 (bit 1) for a 20 millisecond period, and then lowered to logic 0. Lock detect is checked for a logic 0 value on U13-2. If the value is a logic one (lock not achieved), then the GETC attempts to reload the Synthesized-Exciter board until a lock-detect is established.

The data, clock, and load enable lines are inverted as they leave the GETC and become DATA (J6-11), CLK (J6-12), and LOAD ENABLE (J6-15). However, the Synthesized-Exciter buffers and inverts these lines, so that the polarity described above is maintained. The open-collector drivers on the GETC (U23A-2, U23A-4, and U23A-12) drive the DATA, CLOCK, and LOAD ENABLE lines to the Synthesized-Exciter board over a bus which includes a pull-up to 7.6 volts. The LOCK DETECT (J6-13) line is high for a positive lock-detect indication. This signal arrives at U13-3 which inverts the logic level so that the microcomputer detects a lock-detect indication by a logic 0 on U13-2.

Station Control Interface

The microcomputer on the GETC logic board controls the Station operation using the following control and interface lines:

J6-11	DATA
J6-12	CLK
J6-15	LOAD ENABLE
J6-13	LOCK DETECT
J6-1	DELAY PTT
J7-15	RUS OUT
J7-4	MODULATION
J7-2	VOL/SQ HI
J19-5	CG HI

The DATA, CLK, LOAD ENABLE and LOCK DETECT lines enable the microcomputer to load the frequency code to the synthesized-exciter board.

The DELAY PTT line enables the microcomputer to turn on the station transmitter if an active low is on J6-1 (logic high on U20-19). The station transmitter is turned on to 90% of full power (100 watts for the station) in less than 10 ms.

The RUS OUT line enables the GETC logic board to disable the voice audio from the transmitter (0 volts on J7-15 or logic high on U21-6). The voice audio is disabled during high-speed signalling, and during periods when no carrier is present during voice communications (low speed data is still being sent during voice communications).

The MODULATION line is the direct fm signal from the GETC to the synthesized-exciter board.

The VOL/SQ HI line is the received signal (demodulated waveform from the station receiver) and includes high-speed data, low-speed data, and voice audio.

The CG HI line is the low-speed data line to the synthesized-exciter board.

Site Controller Interface

The GETC communicates with the site controller (both the master and the backup site controllers) through an RS-232C port. The characteristics of the communication link are given below:

Type	RS-232C
Baud rate	19.2 kilobaud
Start bit	1
Stop bit	1
Data bits	8
Pairty	None
Data type	binary

The GETC communicates to the master and backup site controllers through U14B, U27C, U28B, and U27D. The serial transmit data from the microcomputer (U1-11) is sent to the RS-232C drivers (U14B and U28B). The TX output (U14B-6) to the primary controller leaves the logic board at J8-1, and the output to the backup controller (U28-6) leaves the board at J19-1. The serial receive data from the master site controller, enters the logic board at J8-2 and goes to the RS-232C receiver (U27C-10). The serial receive data from the backup site controller, enters the logic board at J19-2 and goes to the RS-232C receiver (U27D-13). The output of the master site controller receiver (U27C-8) is OR-tied with the output of the backup site controller receiver (U27D-11). This common output is sent to the analog switch (U15B-1). The output of the analog switch (U15B-15) is sent to the receive input of the microcomputer (U1-10). The other input to the analog switch is derived from the backup serial link, and sent to U15-2. The microcomputer selects which path to route over to the RXD input (U1-10).

The decoding scheme used by the microcomputer to select the serial path to be route to the RXD input (U1-10) is given int Table 3.

TABLE 3 - DECODING SCHEME

LOGIC LEVEL U20-2	LOGIC LEVEL U38-12	LOGIC LEVEL U20-15	SIGNAL TO U15-15	PATH SELECTED
0	1	0	U27-8	Master site controller
1	0	0	U27-11	Backup site controller
X	X	1	U29-2	Backup serial link
X = any state				

A high on U20-2 will turn on the open-collector driver (U25-12) and pull the control line (U27-9) to ground, disabling the output line (U27-8). A logic high on U38-12 will turn on the open-collector transistor (Q15), and pull the control line (U27-12) to ground, disabling output line U27-11. If either of the control lines, U27-9 or U27-12, are left floating, the appropriate device driver output will be enabled.

The signal at U20-15 is inverted by the open-collector driver (U23E), and sent to analog switch U15B. If control line U15-10 is grounded, the path selected is the backup serial link.

Failsoft Operation

Failsoft mode of operation is selected by the microcomputer (via analog switch U15B) by grounding control line U15-10. This happens by setting U20-15 high.

Communication between GETCs along the backup serial link (BSL) takes place through J8-5 and J8-6. The characteristics of the communication link are given below:

Level	0 to 13.8 volts (nominal)
Mark/Space	13.8 volts (mark)/0 volts (space)
Baud rate	19.2 kilobaud
Start bit	1
Stop bit	1
Data bits	8
Parity	None
Data type	Binary

The control channel GETC becomes the controller in the failsoft mode. The serial, transmit-data line from the microcomputer is sent to buffer U12C, and output to open-collector driver U25E. The open-collector output is sent to other GETCs at the site through the backup serial link. This same signal is routed to the double buffers (U29B and U29A) and sent to the analog switch (U15-2).

Front Panel LED Indicators

The front panel LED indicators are used to monitor the state or operation of the GETC. Table 4 lists the indicators and their functions. If both L6 and L7 are on simultaneously, the GETC is in the control channel mode of operation.

TABLE 4 - GETC INDICATORS

Indicator	LED number	Function ON	Function OFF
L1	H7	Failsoft	Site controller link
L2	H6	Failure	Normal operation
L3	H5	Tx load	None
L4	H4	Tx data	None
L5	H3	Tx clock	None
L6	H2	LSD and voice	None
L7	H1	HSD	Voice path

9600 BAUD MODEM BOARD

The 9600 baud Modem Board (19A705178) is used in the GETC Shelf to generate a fast-train, synchronous, serial data stream. The data stream is sent to a full-duplex, four-wire, dedicated, unconditioned telephone line connected to the dispatcher/console.

REGULATOR ASSEMBLY

The Regulator Assembly (19C336816) is used in the GETC Shelf to generate the +5.0 volt regulated power source for the GETC logic board devices and the 9600 baud Modem board. Input power to the regulator assembly is received from the station power supply (13.8 volts nominal). Two +5.0-volt supplies are generated. Resistors R1 and R2 are used to lower the voltage across the regulators, reducing their heat dissipation. Terminal strips TB1 and TB2 serve as interconnect points for the harness that mates into the GETC logic board.

The 5-volt regulators (U1 and U2) supply 5 volts to the GETC logic board and the 9600 baud Modem Board. Regulator U2 is the power source for the GETC logic board devices, while U1 is the power source for the 9600 baud Modem board. Ripple filtering for the regulator assembly is provided on the GETC logic board.

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ADDENDUM NO. 1 TO LBI-31858

This addendum incorporates the 19D901868G2 GETC Shelf Assembly which includes the 19D901995G1 GETC circuit card assembly. The board uses a new layout and added jumpers for additional applications.

All sections of this manual should have the following signal names changed:

LOCK DETECT to SYNTH LCK DET

CLK to SYNTH CLK

DATA to SYNTH DATA

LOADENABLE to SYNTH LD EN

11/73-1 TX to SITE CNTROL RX 1

11/73-2 TX to SITE CNTROL RX 2

11/73-1 RX to SITE CNTROL TX 1

11/73-2 RX to SITE CNTROL TX 2

BACKUP SEL to FAILSOFT EN(-)

Jumper Configuration, page 10

Add the following:

TABLE 1 - JUMPER CONFIGURATION

JUMPER INSTALLED	FUNCTION
J11-1&2 P11	Receive data from 9600 baud Modem board
J12-1&2 P12	Clear to send from 9600 baud Modem board
J13-1&2 P13	Route backup serial link tx output to backup serial link rx input
J14-1&2 P14	Master site controller path selection enable

TABLE 1 - JUMPER CONFIGURATION (CONTINUED)

JUMPER INSTALLED	FUNCTION
J15-1&2 P15	Backup site controller path selection enable
J16-1&2 P16	Backup serial link selection enable
J17-1&2 P17	Low-speed data encode path enable
J18-1&2 P18	Low-speed data decode path enable
J20-1&2 P20	Combined ptt from station disable
J21-1&2 P21	High-speed, data-acquisition rate control
J22-1&2 P22	4800 Hz tone notch path enable
J24-1&2 P24	Backup serial link selection enable
J25-1&2 P25	Low-speed data encode path enable
J26-1&2 P26	Lock-detect input path enable
J28-1&2 P28	Sync line input path enable
J29-1&2 P29	No function
J30-2&3 P30 J30-4&5 P31	Enable clock drive to microcomputer for CMOS configuration
J44-2&3 P44	EPROM size
J45-1&2 P45	A11 select
J46-2&3 P46	INTO for voter concentrator
J47-1&2 P47	Backup serial link select
J48-1&2 P48	Backup serial link select
J50-1&2 P50	Tone control for voted system
J51-2&3 P51	Morse code ID enable
J52-2&3 P52	TXD polarity select
J53-2&3 P53	RXD polarity select

The jumpers installed for your particular application are shown on the table on the schematic diagram.

Failsoft Operation, page 18

Failsoft mode of operation is selected by the microcomputer (via analog switch U15B) by grounding control line U15-10. This happens by setting U20-15 high.

Communication between GETCs along the backup serial link (BSL) takes place through J8-5 and J8-6. The characteristics of the communication link are given below:

Level	0 to 13.8 volts (nominal)
Mark/Space	13.8 volts (mark)/0 volts (space)
Baud rate	19.2 kilobaud
Start bit	1
Stop bit	1
Data bits	8
Parity	None
Data type	Binary (no ASCII)

The control channel GETC becomes the controller in the failsoft mode. The serial, transmit-data line from the microcomputer is sent through J52 to buffer U25E, and output to 13.8-Volt driver Q16. The output is sent to other GETCs at the 16PLUS site through the backup serial link . This same signal is routed to the double buffers (U29B and U29A) and sent to the analog switch (U15-2).