

J99395CA AND DA LOOP REVERSE BATTERY SIGNALING UNITS

DESCRIPTION

TYPE G SINGLE FREQUENCY SIGNALING SYSTEM

CONTENTS	PAGE
1. GENERAL	1
A. System and Unit Description	1
B. Application	2
2. TERMINATION CIRCUIT	2
3. SIGNALING UNIT OPERATION	2
A. G-Signaling Converter Circuit	2
B. Dial Pulsing and Supervision	4
4. CARRIER GROUP ALARM	5
A. GCA Signaling Unit	5
B. GDA Signaling Unit	6
5. PULSING CHARACTERISTICS	6
A. Transmitting	6
B. Receiving	6
6. TRANSMISSION CHARACTERISTICS	7
A. Transmitting Circuit	7
B. Receiving Circuit	7
7. COMPATIBILITY	7
8. MAINTENANCE	7

1. GENERAL

1.01 This section describes the GCA and GDA loop reverse battery signaling units, SD-7C064-01 and SD-7C065-01, which are component parts of the Type G Signaling System. Figure 1 is a photograph showing the faceplate and printed wiring board configuration. Figures 2 and 3 are photographs showing the location of the NBOC, BOR, and CGA switches. Figure 4 is a drawing of the faceplate showing the TRMT and RCV attenuator pads and the LINE TRMT and LINE RCV test jacks. The Type G Signaling System supersedes the Type E and F Signaling Systems.

1.02 Whenever this section is reissued, the reason for reissue will be stated in this paragraph.

A. System and Unit Description

1.03 The G-Signaling System offers substantial improvements over the E and F systems such as reduced size, lower power consumption, signaling and transmission performance, operating stability and component reliability. Unlike most F-signaling applications, using two signaling units (converter and auxiliary) to complete a circuit end, only one G-signaling unit is required to perform this function.

1.04 The G-Signaling System uses a modular design concept containing 26 plug-in units: 24 signaling units, power converter unit, and fuse and alarm unit. All plug-in units interface an edge-board connector arrangement on a backplane. Intrabay wiring utilizes quick-connect mass termination devices also mounted on the backplane. This modular design may be utilized in any one of three

NOTICE

Not for use or disclosure outside the
Bell System except under written agreement

bay configurations (standalone, consolidated, and unitized). A detailed description of the modular design and bay configurations may be found in Section 179-400-100.

1.05 The G-signaling plug-in units are assembled on a metallic-base printed wiring board 7.3 inches high and 10.3 inches long having a faceplate with standard latching features. All interconnections between the plug-in units and the bay are via a 50-pin connector which is part of the printed wiring board. The units are placed into service by inserting them into the guides on the shelf and sliding them toward the rear of the bay. A locking device on the faceplate locks the unit in place when sufficient contact with the bay mounting is made. The unit may be removed from service by releasing the locking device and withdrawing the unit.

1.06 Switches are provided on the printed wiring board to implement such features as network build-out capacitors, build-out resistors, reverse make-busy condition and carrier group alarm control (see Fig. 2 and 3).

B. Application

1.07 The GCA signaling unit is designed to be used at the originating end of a trunk and the GDA unit is designed for the terminating end. These units utilize the loop reverse battery signaling technique for processing dial pulse and supervisory information to and from the office trunk equipment. These DC signals are converted into a voiceband tone (2600 Hz) suitable for transmission over carrier facilities. The units also provide transmission conversion from a 2-wire (900 ohm) operation to a 4-wire (600 ohm) interface.

2. TERMINATION CIRCUIT

2.01 The GCA and GDA signaling units provide the 2-wire to 4-wire transmission conversion with a 2-transformer term set arrangement. Provisions are made for network build-out capacitance (NBOC) adjustments from 0.0 through 0.126 μf in 0.002 μf steps (see Fig. 2 and 3). This permits balancing against office cabling. Inductors are provided in series with the A and B leads from the term set to isolate possible signaling interference from the voice path.

2.02 The GDA signaling unit provides build-out resistors (BOR) that may be manually switched

(see Fig. 3) in series with the A and B leads. ***These resistors are used to limit the current when the external circuit resistance is less than 900 ohms.***

3. SIGNALING UNIT OPERATION

3.01 The following tables and figures may be helpful in the succeeding discussions concerning the operation of the GCA and GDA signaling units:

- (1) Table A lists each unit function, application, and the comparable type F unit.
- (2) Table B lists G, F, and E unit compatibility.
- (3) Table C lists the conditions of open and closure of the loop under operating conditions.
- (4) Table D lists the conditions of the transmitting and receiving circuits related to changes in the 2600-Hz signaling tone.
- (5) Figures 5 and 6 are simplified schematics of the GCA and GDA units.

A. G-Signaling Converter Circuit

3.02 All G-signaling single frequency (SF) signaling units utilize a common converter circuit to convert DC supervisory and dial pulse information to SF tone signals for transmission over the voice path of a 4-wire line or carrier facility. The converter circuit was designed for adaptation to the circuit functions peculiar to each G unit. Paragraphs 3.03 through 3.13 will be a discussion of the G-signaling converter circuit operation as applicable to the GCA and GDA signaling units.

3.03 The G-signaling converter can be divided into two functional sections; the transmitter circuit and the receiver circuit. The transmitter is used for sending 2600-Hz supervisory and dial pulse information and provides an outgoing transmission path for speech or data. The receiver detects the incoming 2600-Hz signals and provides a transmission path for the received speech or data. The transmit circuit also provides a time base for use in the digital timers in the transmit and receive sections and in the associated signal timing circuits.

Transmitter Circuit

3.04 The transmitter portion of the G-signaling converter can be divided into four functional areas: (1) transmission path, (2) tone injection circuit, (3) high level timing and control circuit, (4) cut timing and control circuit.

3.05 The transmitter transmission path provides a balanced 600-ohm output at the LINE TRMT port (T and R terminals). Transmit attenuator pads, located on the faceplate, may be manually adjusted to provide the required output to interface a 4-wire line or carrier transmission system.

3.06 A 2600-Hz tone from the tone generator in the common equipment (GYA unit) is applied to the transmitter section of the unit. The application and removal of tone to the outgoing line is controlled by the HL signal from the transmit pulse corrector.

3.07 The level of 2600-Hz tone is controlled by the HL timer. The initial application of tone to the line is at a level of -24 dBm (-8 dBm0). If tone is present for more than 400 ms, the HL timer reduces the level to -36 dBm (-20 dBm0) where it remains for the duration of the idle state. High level (-24 dBm) tone is transmitted initially so that the far end detector, in the narrowband state, can easily detect the presence of tone. The tone is reduced to the low level (-36 dBm) after 400 ms to minimize the probability of crosstalk in adjacent channels. After 400 ms of transmitted tone, the trunk is idle and the far end detector is in the broadband state; therefore, the low level tone is adequate to maintain tone detection.

3.08 A cut in the transmission path is provided to prevent the possibility of noise and/or voice from interfering with signal detection at the far end. This cut is controlled by the CT and HL signals from the transmit pulse corrector. The CT signal provides a timed cut of approximately 585 ms in the transmitter of the terminating unit. This cut occurs after an off-hook transition by the originating unit and after an on-hook transition by the terminating unit. A continuous cut is invoked in both the originating and terminating units while the trunk is idle. The HO timer provides a 120 ms holdover cut following an off-hook transition by either unit.

Receiver Circuit

3.09 The receiver section of the G-signaling converter provides a voice transmission path and detects the presence or absence of 2600-Hz supervisory and dial pulse signals. These signals are converted from 2600-Hz tone to a dc state for application to the associated timing and control circuits. The receiver circuit can be divided into four functional areas: (1) the transmission path, (2) the signal-guard (S/G) detection circuit, (3) the guard (G) timing and control circuit, and (4) the band-elimination filter (BEF) timing and control circuit.

3.10 The receive transmission path provides a balanced 600-ohm input at the LINE RCV (T1, R1) terminals. Receive attenuator pads, located on the faceplate, may be manually adjusted to provide the required output to the office trunk equipment.

3.11 The signal-guard detection circuit monitors the transmission path of the receiver and separates the voiceband into two frequency segments: (1) signal (2600 Hz) and (2) guard (audio and noise). This is done by the S/G filter which has two filter characteristics: a bandpass filter for the signal and a band-elimination filter for guard, both centered at 2600 Hz. The relative gains of both the signal and guard channels provide a signal-to-guard ratio of approximately 10 dB. This essentially means that at the LINE RCV port the signal level must exceed the guard level by 10 dB for tone detection to occur. The signal-to-guard comparison technique aids in minimizing the possibility of 2600-Hz components of the voice or data signals, occurring during the talk period, from being detected as valid tone. Such an occurrence may result in a condition known as "TALK-OFF" (call termination). The comparison and detection of signal and guard forms the E1 signal which essentially is an indication of the presence or absence of tone. The E1 signal is distributed to the associated circuits where timing delay and other functions are performed.

3.12 The guard timer circuit controls the insertion and removal of the guard amplifier causing the receiver to be placed in a broadband (BB) or narrowband (NB) mode of operation. Approximately 50 ms after the initial removal of tone from the line (seizure), the receive signal timer places a low signal state on the GD lead. This causes the G timer to insert the guard amplifier into the

signal-guard detector circuit. Insertion of the guard amplifier places the receiver in the narrowband mode. This reduces the possibility of a false disconnect during the talk period. When tone has been received for approximately 50 ms, the receive signal timer places a low signal state on the GD lead activating the G timer. After a 180 ms delay, the G timer removes the guard amplifier, placing the receiver in the broadband mode. During the idle period (tone on), the broadband state minimizes the possibility of noisy conditions, such as deep carrier fades, from causing false seizure. An exception to the above operation takes place during a free call. In this case tone is not removed toward the calling end. This causes the receiver in the originating unit to remain in the broadband state. The broadband state minimizes the possibility of voice and/or noise (from the called end) from overriding the detection of tone and erroneously initiating billing.

3.13 The band-elimination filter timer controls the insertion and removal of the band-elimination filter (BEF) in the receive transmission path. When the signal on the E1 lead indicates that tone has been removed from the line, the BEF timer delays this event for 300 ms and removes the BEF from the receive path. This relatively slow removal of the BEF prevents a condition of fast in-out cycling of the filter which may be detected by the customer during speech simulations of tone. When a low signal state on the E1 lead indicates that tone has been received, the BEF timer delays the event by 12 ms and inserts the BEF into the receive path. The fast insertion of the filter prevents the transmission of tone bursts in excess of 12 ms beyond the signaling unit where they may interfere with subsequent signaling. Short bursts (over 12 ms) of data signals having a high content of 2600-Hz components may cause insertion of the band-elimination filter in the receive path. This operation may result in errors in full-duplex data transmission, but will not cause "TALK-OFF". The BEF is removed from the receive transmission path during the conversation period except in the case of a free call. For a free call condition, tone is not removed toward the calling end so the BEF must remain inserted to eliminate the 2600-Hz signaling tone from the receive transmission path.

B. Dial Pulsing and Supervision

3.14 The GCA unit is designed to be used at the originating end of a trunk and the GDA

unit is designed to be used at the terminating end. Although the GCA and GDA units are compatible with various E, F, and G signaling units, the following discussion will assume that a GCA unit is used at the originating end and a GDA unit is used at the terminating end.

3.15 In loop reverse battery operation, a connect (off-hook) signal to the originating (GCA) SF unit is a low dc resistance path (loop closure) applied to the T and R leads causing the unit to remove the 2600-Hz tone from the line. This is detected by the terminating (GDA) SF unit which applies a low dc resistance path (loop closure) across the T and R leads toward the connecting trunk equipment. Dial pulsing is then applied to the originating SF unit by opening and closing the loop causing the application and removal of 2600-Hz tone toward the terminating unit.

3.16 The terminating (GDA) SF unit receives the 2600-Hz tone pulses and transfers this information to the connecting trunk circuit by opening and closing the low resistance dc path between the T and R leads. When the called party answers, the connecting trunk circuit reverses battery polarity on the T and R leads toward the terminating unit. This causes the terminating unit to remove the 2600-Hz tone from the line toward the originating unit. The originating unit detects the absence of tone on the line and reverses battery polarity on the T and R leads toward the connecting trunk circuit. This battery reversal to the trunk circuit initiates billing.

DP Operation — Transmitting

3.17 The GCA transmit timing circuit can be divided into two functional areas: (1) loop current detector, and (2) transmit signal timer (see Fig. 5). When the originating end goes off-hook, a closure in the T and R leads occurs. The resulting loop current is detected by the loop current detector and transferred to the transmit signal timer. This event is delayed approximately 19 ms to verify that an authentic (as opposed to a seizure caused by noise transitions) seizure has taken place. The transmit signal timer provides pulse shaping which assures an output with a minimum break interval of approximately 51 ms and a minimum make interval of approximately 26 ms on the HL lead. The signal timer also supplies a cut signal via the CT lead to the transmit converter. The cut signal controls the transmission path cut that takes place during the idle state and dial pulsing.

DP Operation — Receiving

3.18 The GDA receive timing circuit consists of the receive pulse corrector, seizure detector, and the R relay (see Fig. 6). When the originating unit removes tone from the line, the receive signal timer delays the initial tone removal by 55 ms and each subsequent tone application by 90 ms. This delaying action provides appreciable immunity to noise conditions which may be interpreted as a false tone state. The tone-off state operates the R relay applying a line closure to the terminating trunk circuit and switches the receiver in the converter to the narrowband condition. The receive signal timer also performs pulse correction by generating an output pulse with a constant percent break independent of the input percent break.

Supervision

3.19 When the terminating end goes off-hook, the connecting trunk circuit reverses the voltage polarity on the T&R leads toward the GDA unit. The reverse battery detector in the GDA detects this and places a low signal state on the HL lead removing the 2600-Hz tone from the line. The low state signal on the HL lead also causes the HO timer to insert a 120 ms cut in the transmission path. A timed cut of 585 ms is generated in the transmit pulse corrector and applied to the transmission path when any of the following conditions take place: (1) seizure of the trunk, (2) after dial pulsing, (3) and while the trunk is seized (no received tone), a terminating end on-hook signal occurs. These timed cuts minimize the possibility of noise or voice in the transmission path from interfering with the signaling phase of the call.

3.20 The removal of the 2600-Hz tone at the terminating end is detected by the receiver in the GCA signaling unit, resulting in a high signal state on the E1 lead. The change in the E1 signal is forwarded to the receive signal timer which operates the R relay. Operation of the R relay reverses the T and R leads repeating the reversed battery polarity at the terminating end. This polarity reversal is sent to the outgoing trunk circuit to initiate customer billing.

Disconnect

3.21 When the originating end goes on-hook (disconnect), the connecting trunk circuit will

open the tip and ring leads toward the GCA unit. This will be recognized by the loop detector in the transmit portion of the GCA unit. This disconnect signal initiates a high signal state on the HL lead, causing the converter to apply tone to the line. At the terminating end, the tone-on condition is detected as a disconnect signal and passed on to the switching equipment. A disconnect from the terminating end is handled in a similar manner except that the loop battery polarity is the controlling signal.

Multifrequency Operation

3.22 The GCA and GDA signaling units operate the same way for multifrequency (MF) signaling as they do on dial pulse (DP) signaling except the MF tones take the place of dial pulses and are passed through the transmission path.

4. CARRIER GROUP ALARM

4.01 The GCA and GDA signaling units are provided with carrier group alarm (CGA) features which may be selected by switches on the unit (see Fig. 2 and 3). A trunk may be placed in one of three conditions: (1) circuit release and make busy, (2) circuit release with delayed make busy, and (3) circuit release. Table E lists the switch settings required to obtain the desired conditions for a particular type of application. When a carrier failure occurs, -12 Vdc is applied to the alarm (ALM) lead of the signaling unit. The delayed make-busy signal is applied as -12 Vdc for 2.5 seconds followed by a continuous +5 Vdc to the alarm make-busy (ALB) lead. A wink (W) lead in the GCA unit is used to release the switch train in step-by-step offices.

A. GCA Signaling Unit**Circuit Release — Make Busy**

4.02 A -12V on both the ALM and the ALB leads initiates the release of the R relay which restores normal battery to the loop, releasing the trunk circuit. The B relay operates when -12V is on the ALM lead and the E switch is closed. For No. 1 crossbar or crossbar tandem offices, the operated B relay applies ground to the sleeve lead. For No. 5 crossbar, the operated B relay causes a closure of the B1 and B2 leads. These conditions make the trunk busy to outgoing traffic. After 2.5 seconds, the CGA common control circuit

(GYA unit) applies +5V to the ALB lead operating the R relays, forcing a busy polarity on the tip and ring leads. Alarm override is not provided in the GCA and GDA units.

Circuit Release — Delayed Make Busy

4.03 For step-by-step offices *with* trunk circuits, a -12 Vdc signal on the ALM lead initiates operation of the B relay which transfers control of the sleeve lead to the W lead. This results in a ground on the sleeve lead toward the switching equipment. Carrier failure also places a -12 Vdc signal on the ALB lead releasing the R relays, forcing an idle tip-ring polarity for 2.5 seconds. After 2.5 seconds, ground is momentarily removed from the W lead to release the step-by-step switch train. Ground is then reapplied to the W lead which in turn grounds the sleeve lead making the trunk busy. A -12 Vdc signal on the ALM lead and a +5 Vdc signal on the ALB lead causes the R relays to operate, forcing a busy tip-ring polarity.

4.04 For step-by-step offices *without* trunk circuits, the operation is similar except the sleeve lead is controlled by the B relay which is controlled in turn by the W lead.

Circuit Release

4.05 For No. 1 and No. 2 ESS offices, the B relay is not used. When carrier failure occurs, the GYA unit applies a -12 Vdc signal on the ALM lead which causes the R relays to release, forcing an idle tip-ring polarity. The trunk make-busy function is performed by the office control processor.

B. GDA Signaling Unit

Circuit Release

4.06 A carrier failure places -12V on the ALM lead causing the release of the R relay. This opens the 2-wire loop and releases the connecting trunk circuit on switching equipment.

5. PULSING CHARACTERISTICS

A. Transmitting

5.01 The GCA signaling unit is capable of transmitting dial pulses in the range of 7.5 through 12.5 pps. A minimum input pulse of 20 ms and a minimum interval between pulses of

14 ms are required to operate the transmitter. The dial pulses are transmitted with a minimum break interval of 51.4 ms and a minimum make interval of 25.6 ms. The input dial pulses can vary as follows:

PPS	% BREAK
7.5	15.0 - 89.5
10.0	20.0 - 86.0
12.5	25.0 - 82.5

5.02 The GDA unit is required to transmit supervisory and/or wink signals. A wink signal may be either a momentary off-hook or on-hook transmitted toward the originating unit. An off-hook wink (delay dial) signal is transmitted toward the call originating end until the terminating end is ready to receive address pulsing. Normal off-hook signals are 200 ms for mechanical switching and 150 ms for electronic switching. Off-hook wink signals are transmitted with less than 2 ms distortion. On-hook wink signals (rering) are generated by an operator or subscriber to alert (flash) another operator or attendant.

B. Receiving

5.03 The GDA signaling unit is capable of receiving dial pulse signals (2600-Hz bursts) in the range of 7.5 through 12.5 pps. A minimum pulse of 36 ms and a minimum interval between pulses of 11 ms are required to operate the receiver. The receive signaling output is corrected to provide 56.5 ±1.5 percent break independent of the input percent break. The input receive pulses can vary as follows:

PPS	% BREAK
7.5	27.0 - 91.7
10.0	36.0 - 89.0
12.5	45.0 - 86.2

5.04 The GCA unit is required to receive supervisory and/or wink signals. Off-hook wink signals (delay dial) are transmitted from the terminating end with less than 2 ms distortion. On-hook wink signals (rering) are corrected at the originating end (GCA unit). On-hook wink signals between

43 and 68 ms are stretched to 68.5 ± 1.5 ms. On-hook wink signals having a longer period are repeated without correction.

6. TRANSMISSION CHARACTERISTICS

6.01 The operational stability of the transmit and receive circuits is dependent upon various environmental conditions, such as temperature, impedance, aging, and operating voltages. The following discussion assumes that the temperature is approximately 70° F and the dc source voltages are within ± 5 percent of the ± 12 V and $+5$ V. The G-signaling units will, however, remain stable unless there is a severe change in environmental conditions.

A. Transmitting Circuit

6.02 The envelope delay present in the transmit and receive circuits can be seen in Fig. 7. For both the GCA and GDA units, the delay is for frequencies of 3000 Hz and above for either the transmit or receive circuits. The rise in delay is quite rapid below 2000 Hz.

6.03 The transmit path in the GCA and GDA units provides adjustable attenuation with up to 16.5 dB loss in 0.1 dB steps (see Fig. 4). This adjustment is used to obtain -16 TLP at the LINE TRMT jack on the unit. The loss of the transmit circuit path can be seen in Fig. 8. The 4 dB midband loss is due to the terminating set.

B. Receiving Circuit

6.04 The receive path in the GCA and GDA units is also provided with adjustable attenuation with up to 16.5 dB loss in 0.1 dB steps (see Fig. 4). This allows the output level of the receiver to be varied well beyond the required 0 through -8.9 TLP at the EQPT TRMT port. The loss variation between the input and output levels in the voice frequency range with and without the band-elimination filter in the circuit is shown in Fig. 9 and 10. The terminating sets in the units add 4 dB loss to the circuit. The sharp dip between 2200 and 2800 Hz in Fig. 9 is caused by the band-elimination filter.

6.05 The 2-wire return loss and the transhybrid loss curves are shown in Fig. 11 and 12 respectively.

7. COMPATIBILITY

7.01 Compatibility must be assured between the signaling leads of the SF units and the switching equipment. That is, these leads must have the proper polarity, voltage, and resistance and each circuit must provide the signals needed by the other in proper timing and in proper sequence.

7.02 All loop type G signaling units are designed to work with connecting circuits in which battery is on the ring lead for the on-hook state. This polarity arrangement is satisfactory in most applications. In a few cases where standard options in connecting circuits do not permit working with this polarity arrangement it will be necessary to reverse the T and R leads on a job basis.

7.03 Loop-type incoming trunk circuits, such as SD-26070-01, are frequently used with an E&M trunk circuit at the distant end. One method of making the E&M to loop conversion is by the use of an auxiliary trunk circuit which immediately precedes the incoming trunk circuit. When this arrangement is used with a delay-dial option, the incoming trunk circuit returns off-hook supervision when idle, but this off-hook is not passed through the auxiliary circuit until the trunk is seized at the originating end. This is required to prevent the normal off-hook of the incoming trunk circuit from holding the outgoing trunk circuit in a Crossbar No. 4 office permanently busy. A similar arrangement can be provided with SF signaling by using an E&M unit at the originating end and a loop unit at the terminating end. The auxiliary trunk circuit is not required because E&M to loop conversion is accomplished within the SF link. However, if the delay dial option is used and the originating office is Crossbar No. 4, the loop terminating SF unit must provide the blocking feature of the auxiliary trunk circuit; therefore, the RMB feature must be disabled by closing the RMB switch in the GDA unit.

7.04 Additional information concerning compatibility may be found in Table B and in Sections 179-100-308 and 179-100-312.

8. MAINTENANCE

8.01 Field adjustments are not provided on the GCA and GDA units. Circuit options such as level adjust pads, CGA options, BOR, and NBOC may be prescription set or manually selected by measurement. SF units not meeting circuit

SECTION 179-406-100

requirements should be sent to the Western Electric Company for repair. Defective units should be replaced with spare units.

8.02 The type G test extender SD-7C080-01 is designed to provide access to the transmission and signaling ports. Use of the test extender necessitates the removal of the SF unit from the

bay. The test extender provides monitoring jacks to all transmission and signaling ports of the SF units.

8.03 Descriptive or test practices on other related components within the Type G Signaling System can be found under individual component headings in the BSP index 179-000-000.

TABLE A

TYPE G LOOP REVERSE BATTERY
GENERAL INFORMATION AND APPLICATION

CODE	FUNCTIONAL DESCRIPTION	GENERAL APPLICATION	SPECIFIC USE	SIMILAR F TYPE SF UNIT
GCA	Loop reverse battery originating	1-way outgoing trunks	DP or MF 2W — 900 ohm	FUA + FCA
GDA	Loop reverse battery terminating	1-way incoming trunks	DP or MF 2W — 900 ohm	FUA + FDA FUA + FDB

TABLE B
 COMPATIBILITY OF G-SIGNALING UNITS WITH E AND F SF UNITS

		TERMINATING END																								
		GAA GAB		GBA		GDA		FAA FAC FAD FAE FAF		FBA FBB FBC FBN FBO		FDA FDB		FWA		FWB		FWC		E1AK E1AKD E1BK E1BKD	E2BK E2BKA E3BK E3BKA E4B	E2D	E3D	E4D	E5D	
		DP	MF	DP	MF	DP	MF	DP	MF	DP	MF	DP	MF	DP	MF	DP	MF	DP	MF							
ORIGINATING END	GAA, GAB	DP	✓	✓		4		✓		✓		4		✓						✓	✓	4		2,4	4	
		MF		✓	✓		4		✓		✓		4		✓		✓	✓	✓	✓	✓	✓	4	✓	2,4	4
	GBA	DP	✓	✓		4		✓		✓		4		✓						✓	✓	4		2,4	4	
		MF		✓	✓		4		✓		✓		4		✓		✓	✓	✓	✓	✓	✓	4	✓	2,4	4
	GCA	DP	✓	✓		4		✓		✓		4		✓						✓	✓	4		2,4	4	
		MF		✓	✓		4		✓		✓		4		✓		✓	✓	✓	✓	✓	✓	4	✓	2,4	4
	FAA, FAC	DP	✓	✓		4		✓		✓		4		✓						✓	✓	4		2,4	4	
		MF		✓	✓		4		✓		✓		4		✓		✓	✓	✓	✓	✓	✓	4	✓	2,4	4
	FAD, FAE, FAF	DP	✓	✓		4		✓		✓		4		✓						✓	✓	4		2,4	4	
		MF		✓	✓		4		✓		✓		4		✓		✓	✓	✓	✓	✓	✓	4	✓	2,4	4
	FBA, FBB, FBC	DP	✓	✓		4		✓		✓		4		✓						✓	✓	4		2,4	4	
		MF		✓	✓		4		✓		✓		4		✓		✓	✓	✓	✓	✓	✓	4	✓	2,4	4
	FBM, FBN, FBO	DP	✓	✓		4		✓		✓		4		✓						✓	✓	4		2,4	4	
		MF		✓	✓		4		✓		✓		4		✓		✓	✓	✓	✓	✓	✓	4	✓	2,4	4
	FCA	DP	✓	✓		4		✓		✓		4		✓						✓	✓	4		2,4	4	
		MF		✓	✓		4		✓		✓		4		✓		✓	✓	✓	✓	✓	✓	4	✓	2,4	4
	FWA	DP	3		3		3		3		3		3		3											
		MF		✓	✓		4		✓		✓		4		✓		✓	✓	✓	✓	✓					
	FWB	DP	3		3		3		3		3		3		3											
		MF		✓	✓		4		✓		✓		4		✓		✓	✓	✓	✓	✓					
FWC	DP			3		3		3		3		3														
	MF		✓	✓		4		✓		✓		4		✓		✓	✓	✓	✓	✓						
E1AK, E1AKD, E1BK, E1BKD			1	✓	1	✓	1,4	4	1	✓	1	✓	1,4	4						✓	✓					
E2BK, E2BKA, E3BK, E3BKA, E4B			3	3	3	3	3,4	4	3	3	3	3	3,4	4												
E2C			✓	✓		✓		✓		✓		✓										✓				
E3C				✓		✓		4		✓		✓		4									✓			
E4C, E5C			✓	✓	✓	✓	4	4	✓	✓	✓	✓	4	4										✓	✓	

Notes:

1. Transmission cut circuit SD-99778-01 required in all DP applications.
2. Release current of associated A relay or its equivalent must be greater than 3.7 ma.
3. M lead pulse corrector SD-99766-06 required in all nonsenderized SXS applications.
4. Compatible only in association with trunk circuits having a long disconnect time (140 ms minimum).

TABLE C

SF SIGNALS USED IN REVERSE BATTERY T AND R LOOP SIGNALING

GCA UNIT (ORIGINATING END)				GDA UNIT (TERMINATING END)			
SIGNAL OR STATE	OFFICE T AND R TO SF UNIT	SF UNIT TO OFFICE T AND R	2600 SF TONE OUT	2600 SF TONE OUT	SF UNIT TO OFFICE T AND R	OFFICE T AND R TO SF UNIT	SIGNAL OR STATE
Idle	Open	Normal Batt ³	On	On	Open	Normal Batt	Idle
Connect ¹	Closure	Normal Batt ³	Off	On	Closure	Normal Batt	Connect
Stop Dialing	Closure	Rev Batt	Off	Off	Closure	Rev Batt	Stop Dialing ²
Start Dialing	Closure	Normal Batt ³	Off	On	Closure	Normal Batt	Start Dialing ²
Dial Pulsing ¹	Open	Normal Batt ³	On	On	Open	Normal Batt	Dial Pulsing
	Closure		Off		Closure		
Answer (Off-Hook)	Closure	Rev Batt	Off	Off	Closure	Rev Batt	Answer ² (Off-Hook)
Ring Forward ¹	Open	Rev Batt	On	Off	Open	Rev Batt	Ring Forward
	Closure		Off		Closure		
Ringback	Closure	Normal Batt ³	Off	On	Closure	Normal Batt	Ringback ²
		Rev Batt	Off	Off		Rev Batt	
Flashing	Closure	Normal Batt ³	Off	On	Closure	Normal Batt	Flashing ²
		Rev Batt	Off	Off		Rev Batt	
Hang-Up (On-Hook)	Closure	Normal Batt ³	Off	On	Closure	Normal Batt	Hang-Up ² (On-Hook)
Disconnect	Open	Normal Batt ³	On	On	Open	Normal Batt	Disconnect

Notes:

1. Originating office generates signal.
2. Terminating office generates signal.
3. Normal battery for trunks is generally battery on the ring and ground on the tip. Exceptions to this are documented in Section 179-100-312.

TABLE D

TYPES GCA AND GDA UNITS
 CONDITION OF TRANSMITTING AND RECEIVING SPEECH PATHS RELATED TO CIRCUIT AND SIGNAL TONE CONDITIONS
 (REFERENCES ARE TO SF UNIT AT NEAR END)

	CIRCUIT CONDITION	SIGNAL TONE CONDITION		CONDITION OF TRANSMITTING SPEECH PATH			RECEIVING SPEECH PATH BANDSTOP FILTER
		OUTGOING	INCOMING	BEFORE	CHANGE	AFTER	
ORIGINATING END (GCA)	1. Idle	On	On	Cut	—	Cut	In circuit
	2. Near End Seized	On-Off Transition	On	Cut	Stays cut additional 105-135 ms	Not Cut	In circuit
	3. Far End Returns "Delay" Signal	Off	On-Off Transition	Not Cut	—	Not Cut	Switched out after 285-320 ms
	4. Far End Returns "Start" Signal	Off	Off-On Transition	Not Cut	—	Not Cut	Switched in after 12±5 ms
	5. Near End Dial Pulsing	Off-On Transition, Then On-Off, Off-On, Etc, Ending with On-Off Transition	On	Not Cut	Cut as long as outgoing make intervals (tone off) are less than 105-135 ms apart. Remains cut 105-135 ms after last outgoing dial pulse (tone-on interval).	Not Cut	In circuit
	6a. Far End Answers—Free Call	Off	On	Not Cut	—	Not Cut	In circuit
	6b. Far End Answers—Pay Call	Off	On-Off Transition	Not Cut	—	Not Cut	Switched out after 285-320 ms
	7. Talking—Pay Call	Off	Off	Not Cut	—	Not Cut	Out of circuit
	8. Near End Hangs Up First	Off-On Transition	Off	Not Cut	—	Cut	Out of circuit
9. Far End Hangs Up Later	On	Off-On Transition	Cut	—	Cut	Switched in after 12±5 ms	
TERMINATING END (GDA)	10. Far End Seized	On	On-Off Transition	Cut	Stays cut additional 620-660 ms	Not Cut	Switched out after 285-320 ms
	11. Near End Returns "Delay" Signal	On-Off Transition	Off	Not Cut	Cut 105-130 ms	Not Cut	Out of circuit
	12. Near End Returns "Start" Signal	Off-On Transition	Off	Not Cut	Cut 565-605 ms	Not Cut	Out of circuit
	13. Far End Dial Pulsing	On	Off-On Transition, Then On-Off, Off-On, Etc, Ending with On-Off Transition	Not Cut	Cut as long as incoming on-off transitions are less than 565-605 ms apart. Remains cut 565-605 ms after last incoming on-off transition.	Not Cut	Switched in after 12±5 ms. Remains in circuit until 285-320 ms after last incoming on-off transition.
	14a. Near End Answers—Free Call	On	Off	Not Cut	—	Not Cut	Out of circuit
	14b. Near End Answers—Pay Call	On-Off Transition	Off	Not Cut	Cut 105-135 ms	Not Cut	Out of circuit
	15. Talking—Pay Call	Off	Off	Not Cut	—	Not Cut	Out of circuit
	16. Far End Hangs Up First	Off	Off-On Transition	Not Cut	—	Not Cut	Switched in after 12±5 ms
	17. Near End Hangs Up Later	Off-On Transition	On	Not Cut	Cut	Cut	In circuit
18. Idle	On	On	Cut	—	Cut	In circuit	

TABLE E

CARRIER GROUP ALARM SWITCH SETTINGS

UNIT	TYPE OF APPLICATION	FEATURE	SWITCHES OPERATED	CGA INTERFACE
GCA (ORIG)	Step-by-Step — With Trunk Circuits	Circuit Release Delayed Make-Busy	B, E, F, G, J	ALM, ALB, W S, S2
	Step-by-Step Selector Multiple Without Trunk Circuits	Circuit Release Delayed Make-Busy	A, C, J	ALM, ALB, W S
	No. 1 Crossbar or Crossbar Tandem	Circuit Release Make-Busy	C, E, G, J	ALM, ALB, S or S1
	No. 4 Crossbar No. 5 Crossbar	Circuit Release Make-Busy	D, E, G, J	ALM, ALB, B1, B2
	No. 1 or No. 2 ESS	Circuit Release		ALM
GDA (TERM)	All Switching Offices	Circuit Release	ALM	ALM

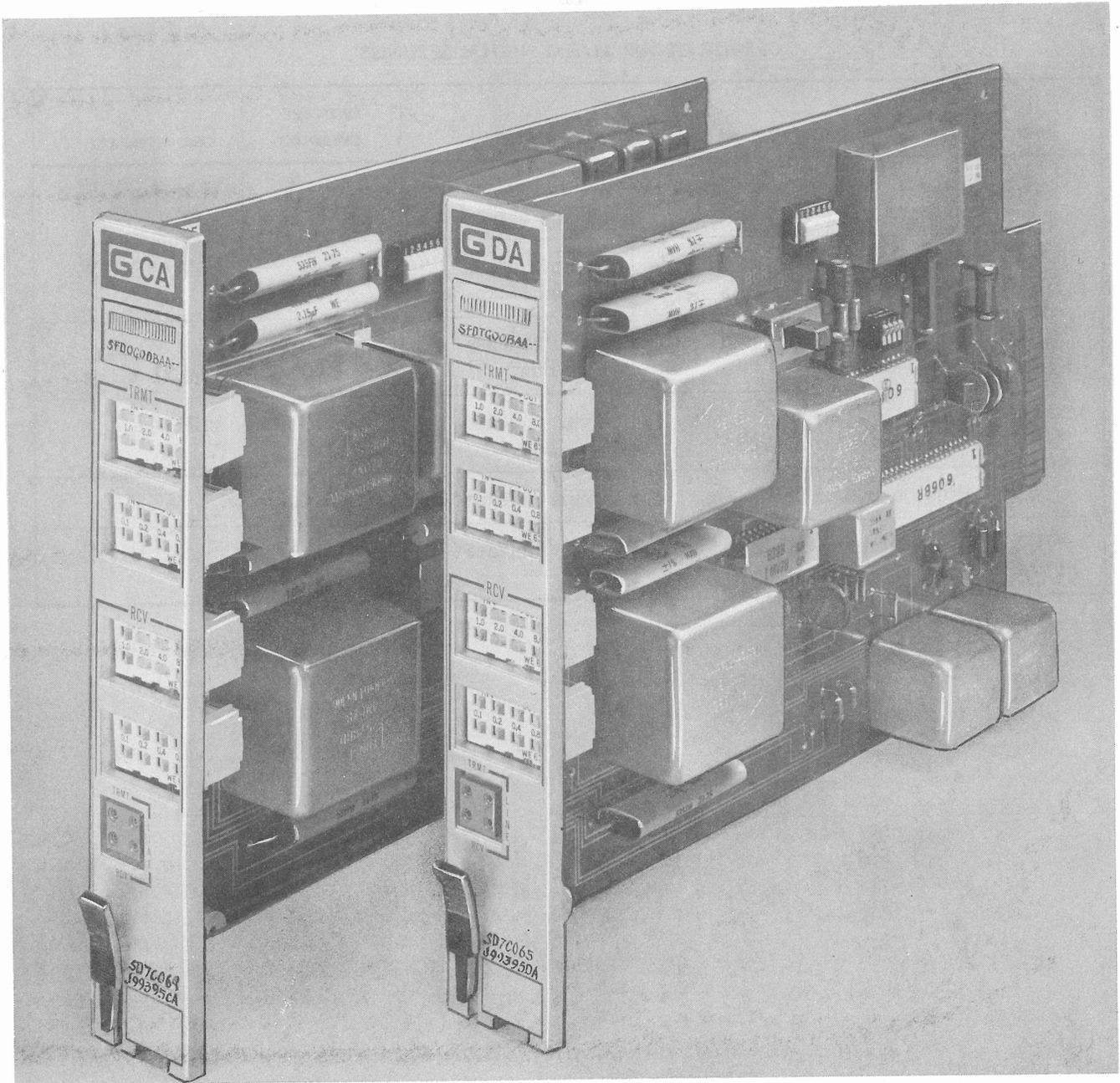


Fig. 1—GCA and GDA Units

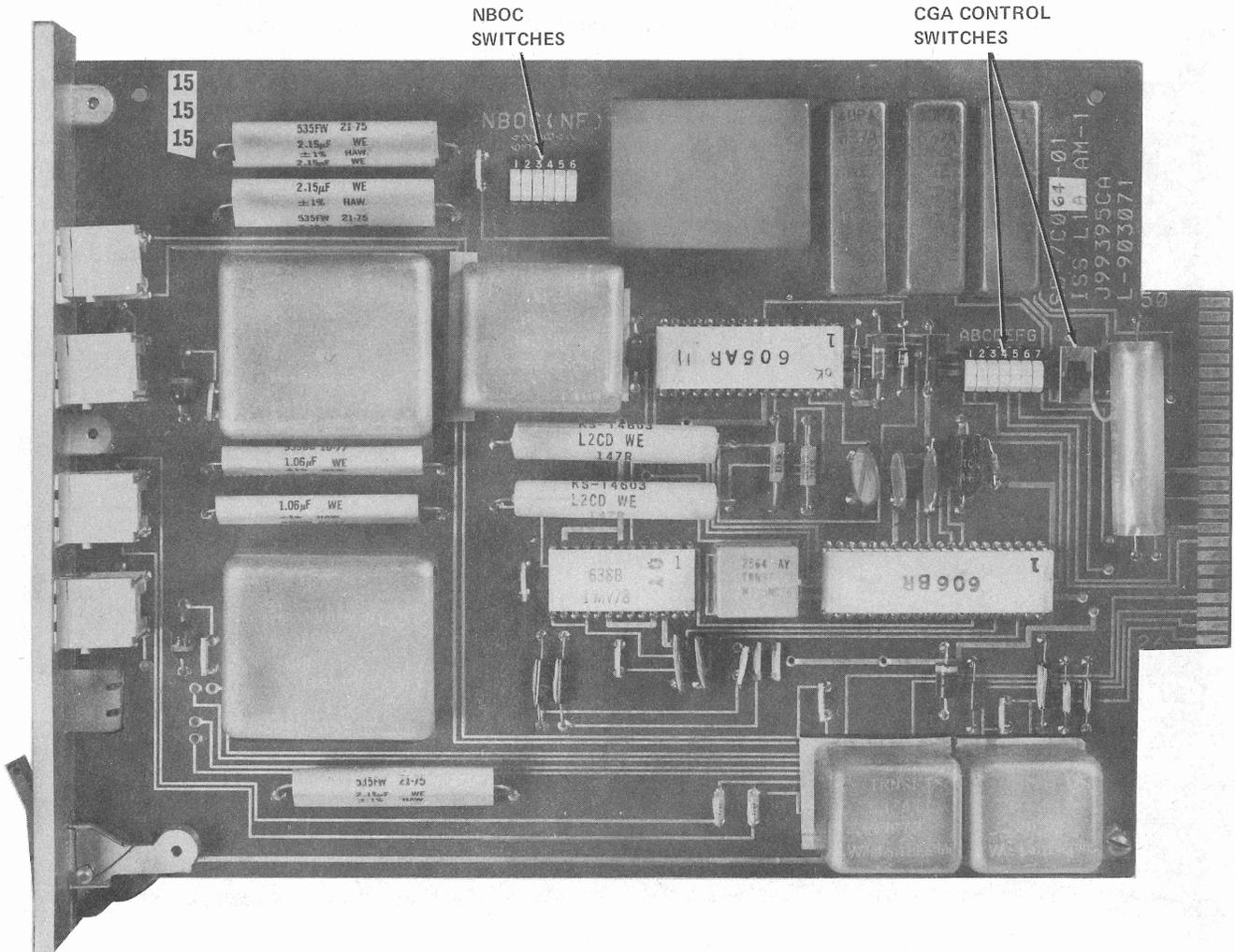


Fig. 2—GCA Unit (Switch Locations)

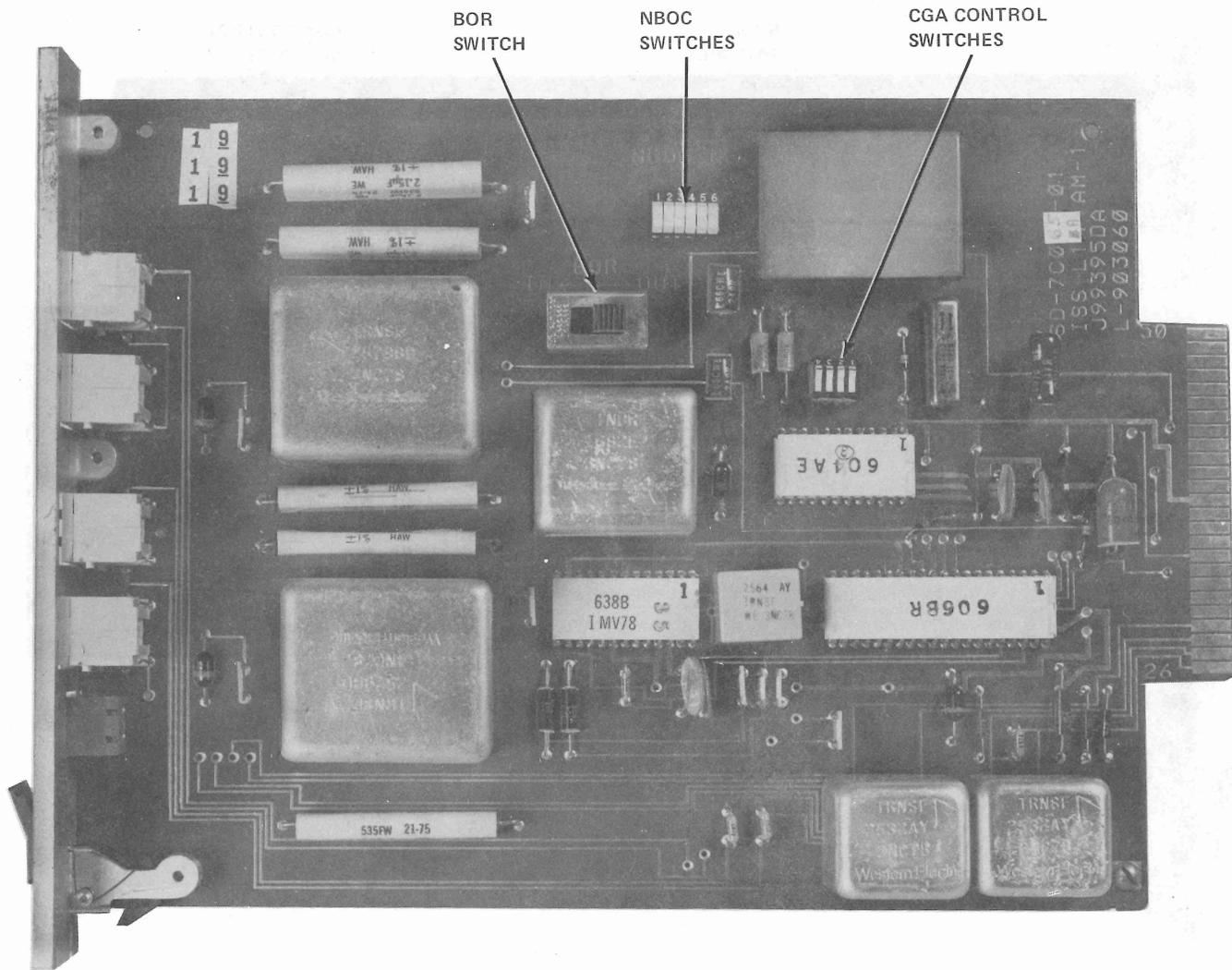


Fig. 3—GDA Unit (Switch Locations)

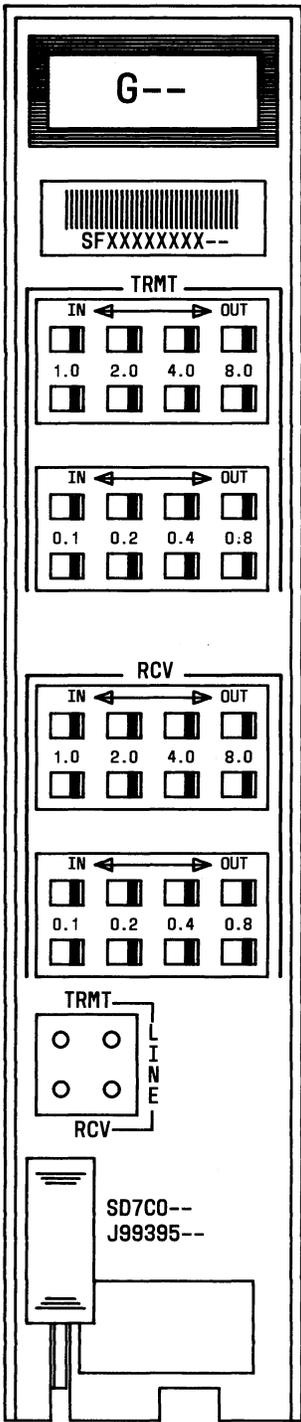


Fig. 4—GCA and GDA Unit Faceplate

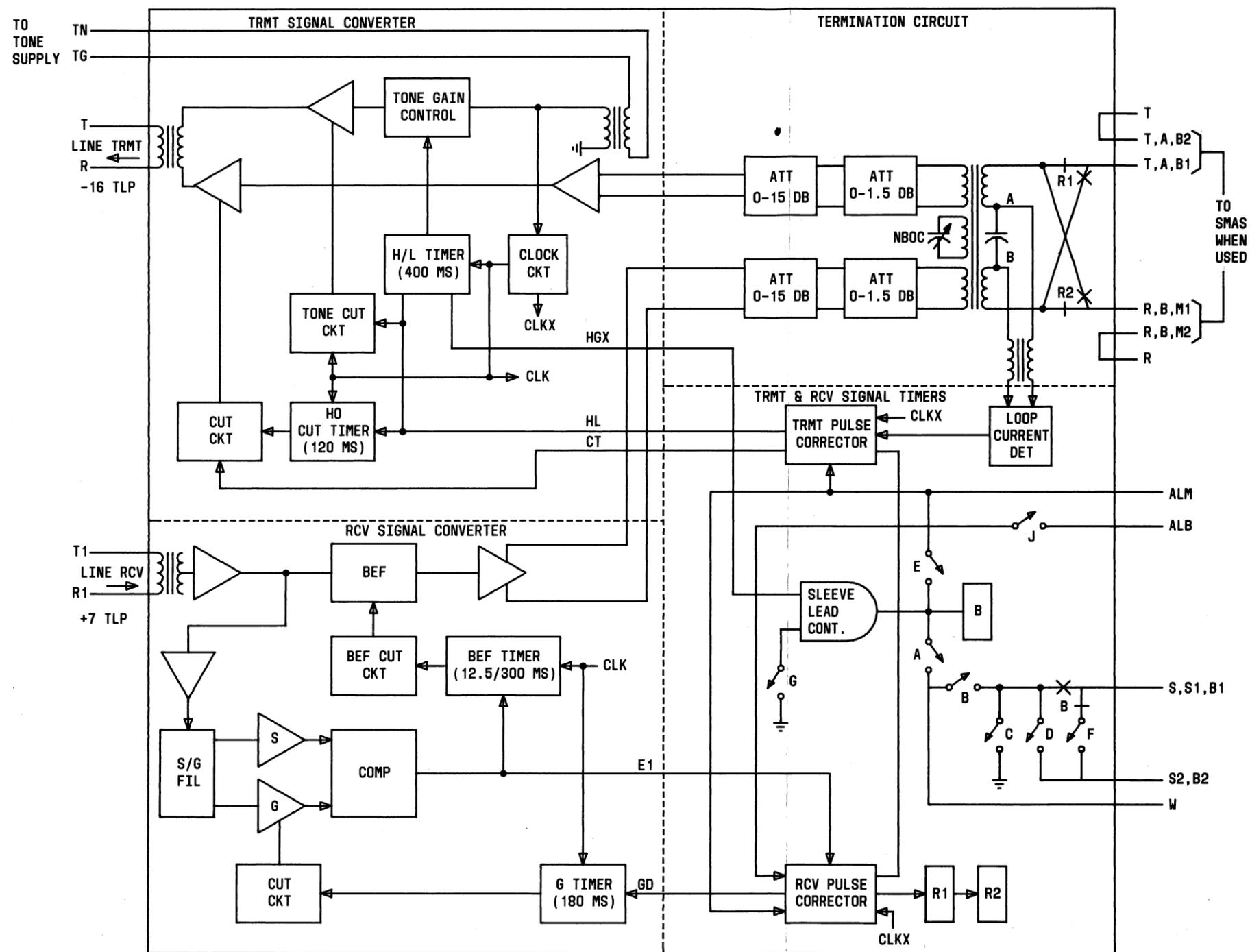


Fig. 5—GCA Unit

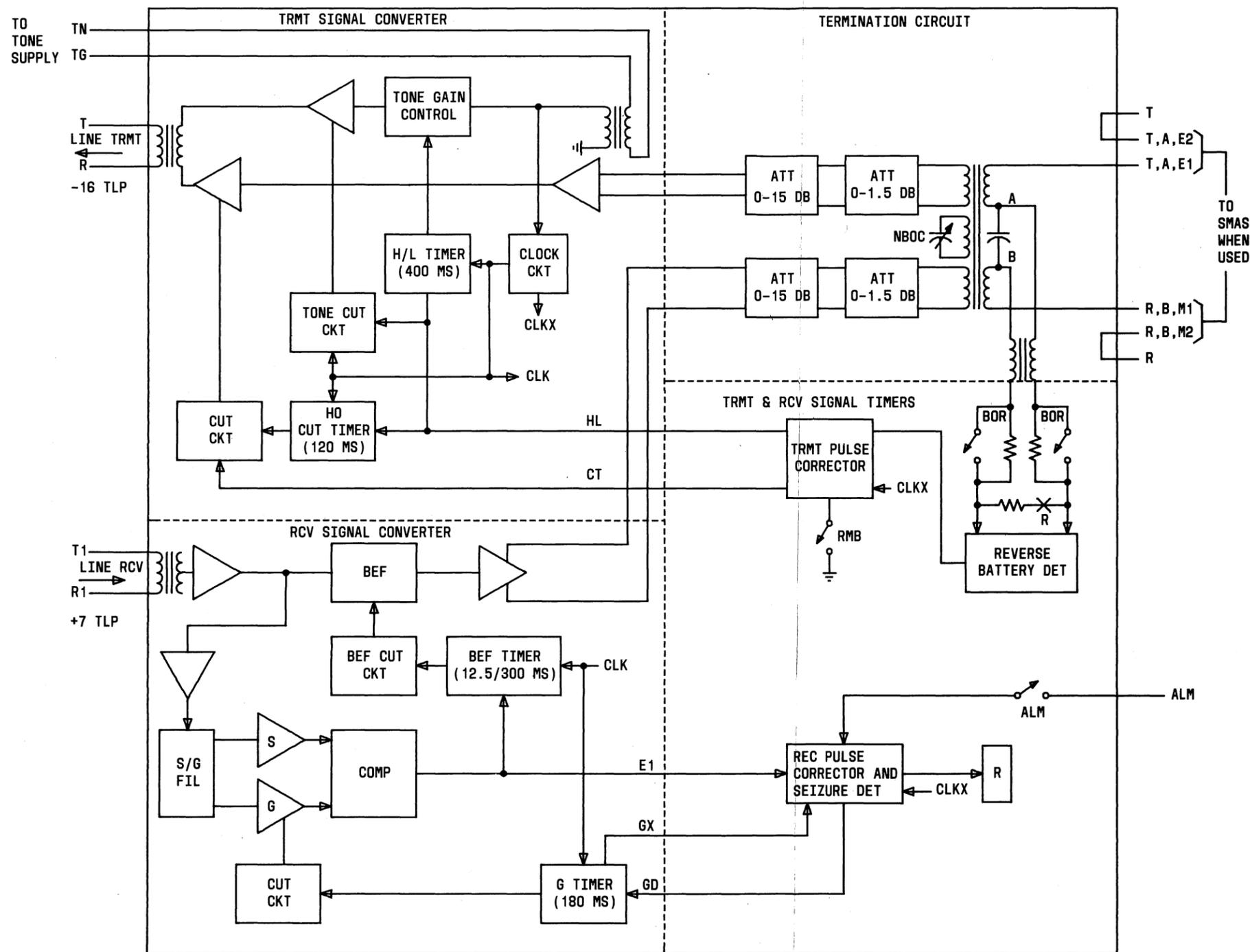


Fig. 6—GDA Unit

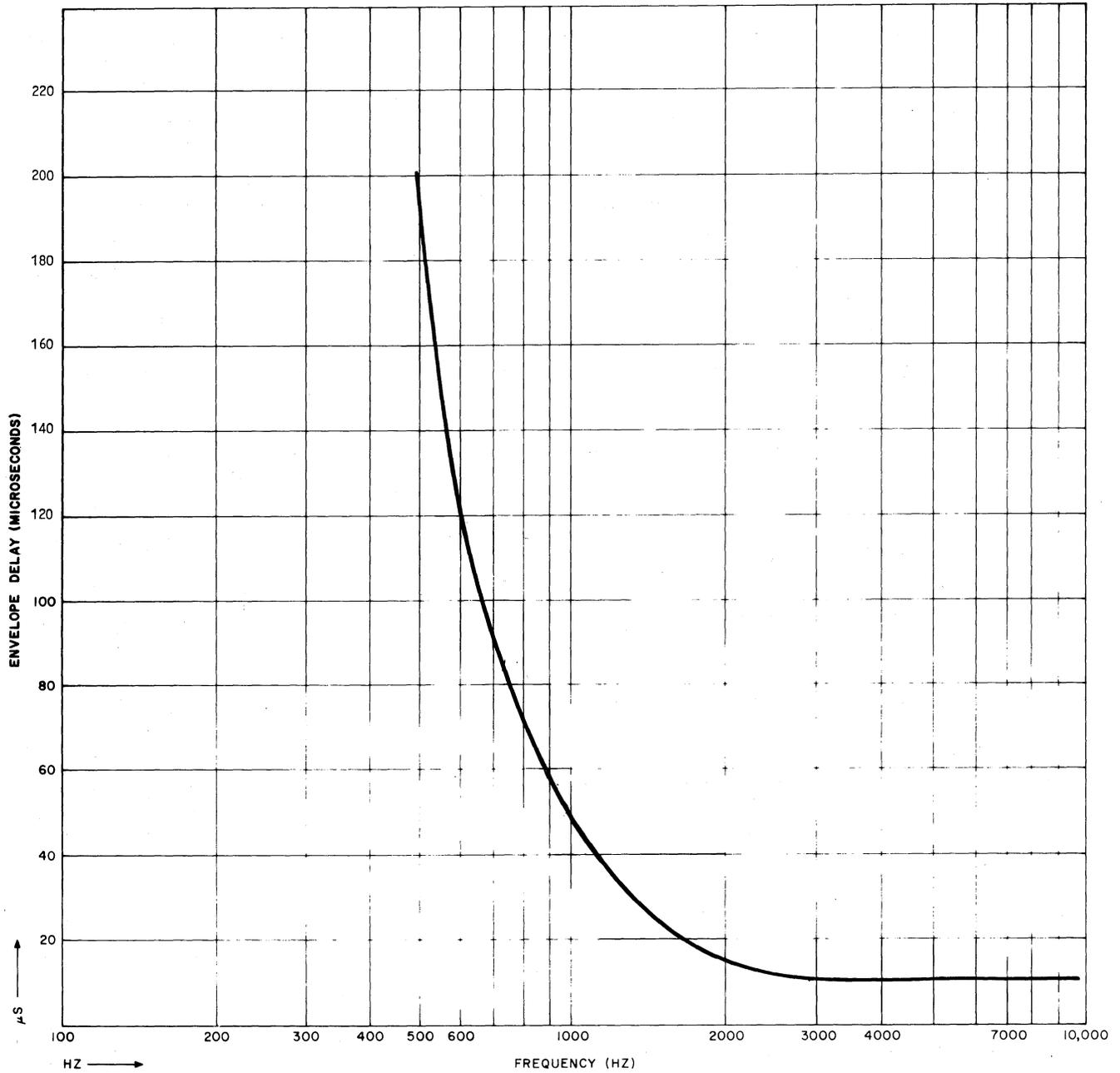


Fig. 7—Transmit and Receive Envelope Delay for the GCA and GDA Units

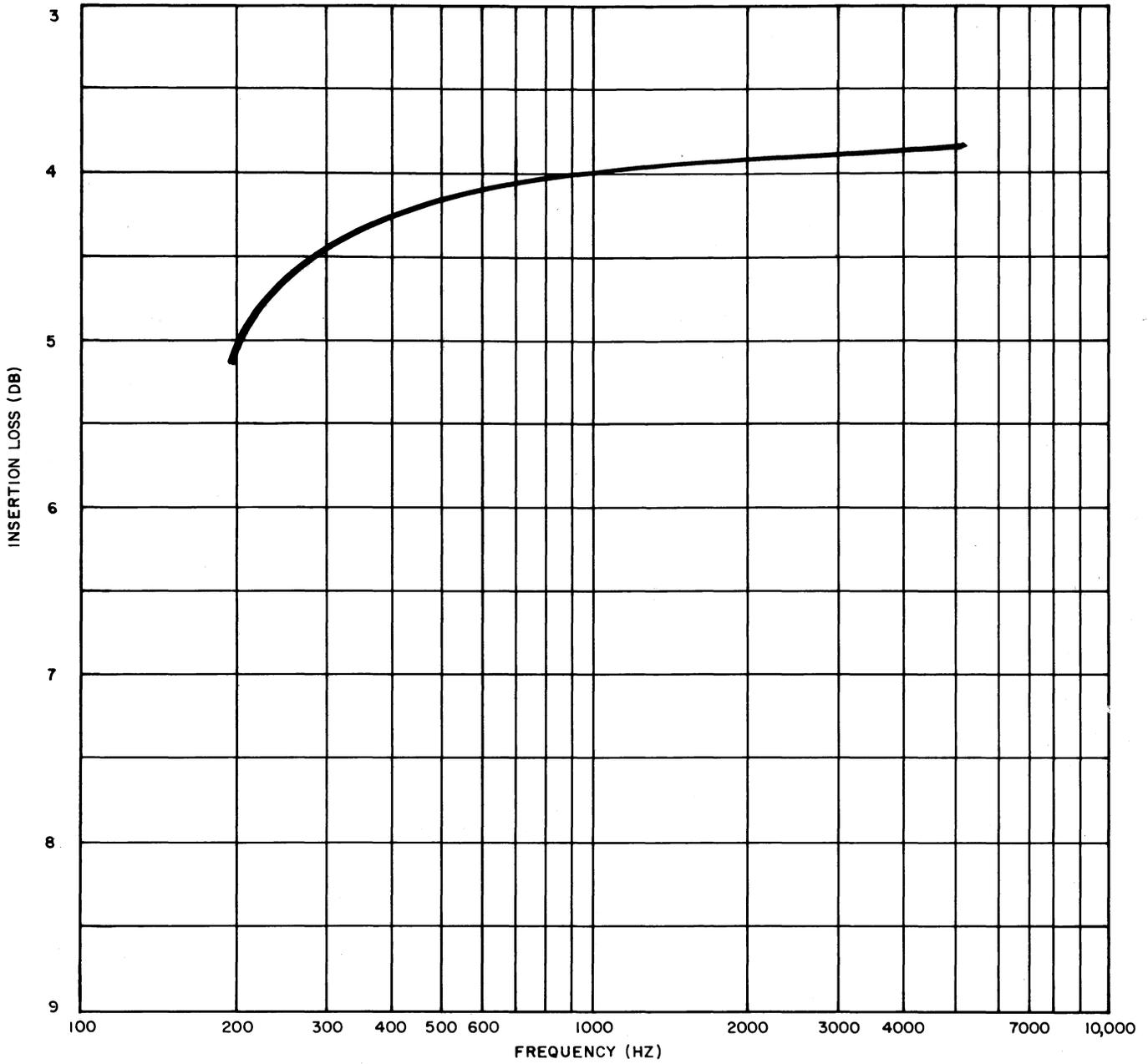


Fig. 8—Nominal Transmit Circuit Insertion Loss for the GCA and GDA Units With Transmit Attenuator Set for Zero Loss

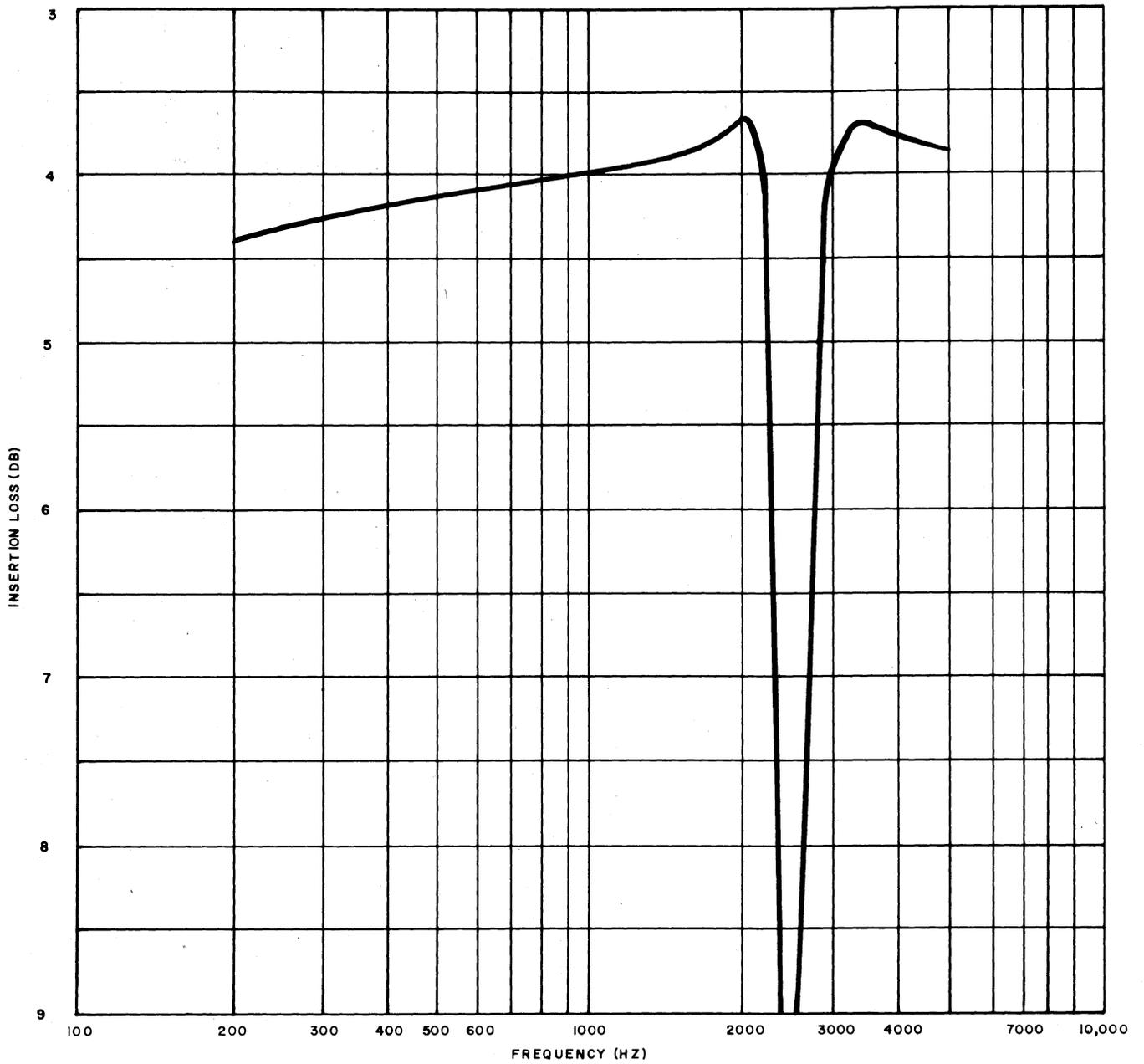


Fig. 9—Nominal Receive Circuit Insertion Loss With Band-Elimination Filter In for the GCA and GDA Units With Receiver Attenuator Set for Zero Loss

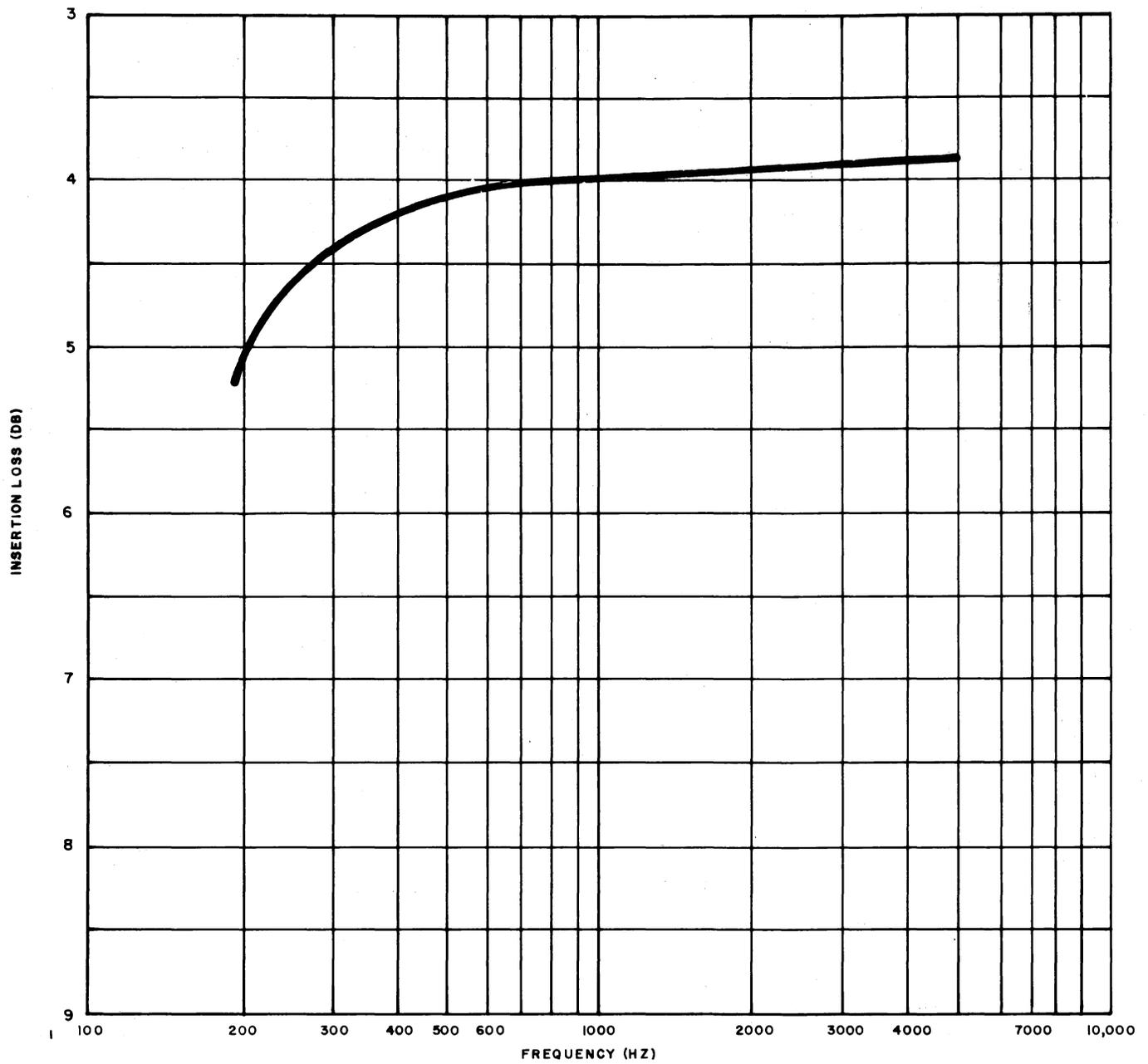


Fig. 10—Nominal Receive Circuit Insertion Loss With Band-Elimination Filter Out for the GCA and GDA Units With Receiver Attenuator Set for Zero Loss

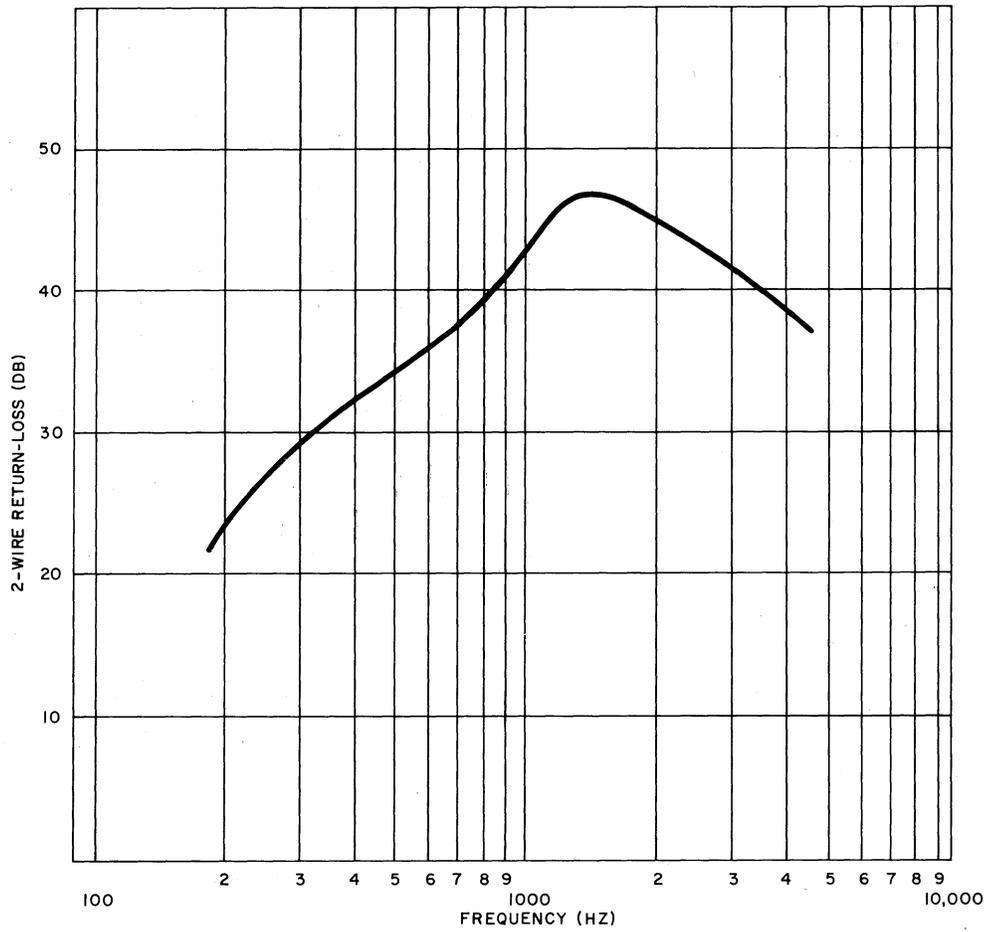


Fig. 11—Nominal Return Loss—Frequency Characteristics—2-Wire Side Against 900 Ohms Plus 2.15 μ f—GCA and GDA Units

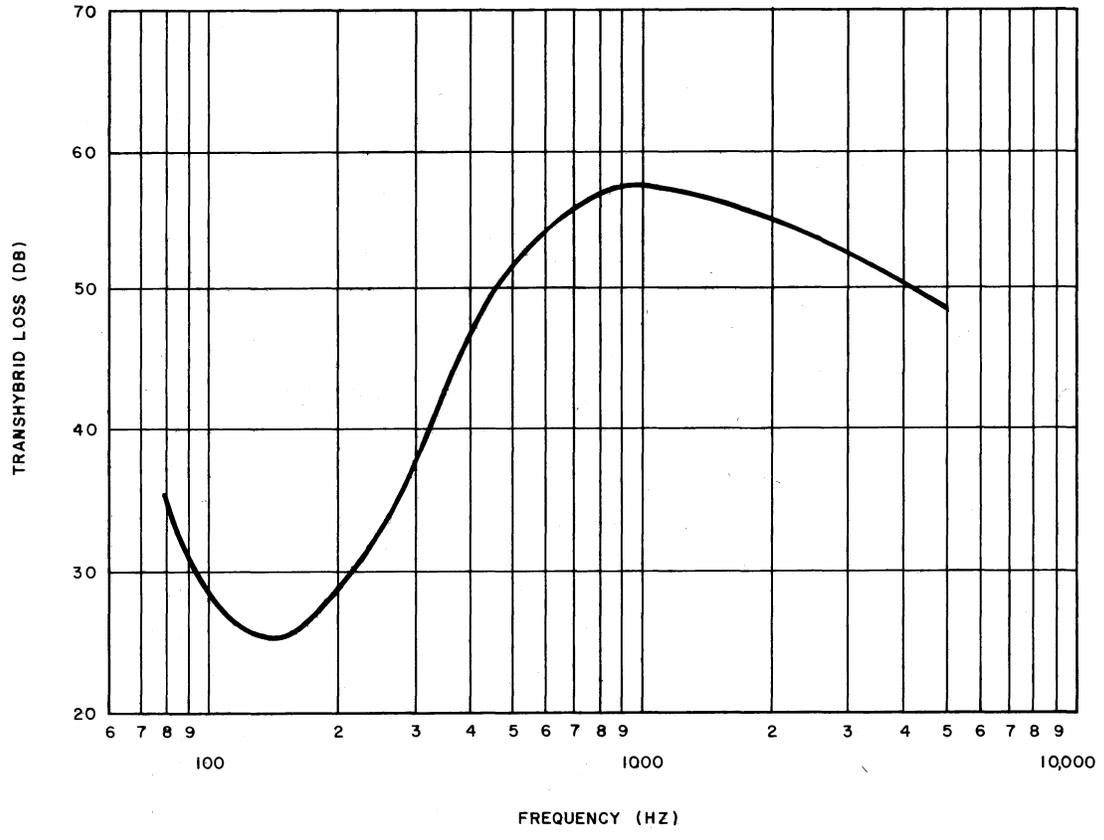


Fig. 12—Nominal Transhybrid Loss—GCA and GDA Units