

35 CALL CONTROL UNIT

GENERAL DESCRIPTION AND PRINCIPLES OF OPERATION

CONTENTS	PAGE	CONTENTS	PAGE
1. GENERAL DESCRIPTION	1	4. CALL CONTROL UNIT - 35 AUTOMATIC SEND-RECEIVE (ASR) SET	14
2. CALL CONTROL UNIT - 35 RECEIVE-ONLY (RO) SET	3	DESCRIPTION	14
DESCRIPTION	3	PRINCIPLES OF OPERATION	14
PRINCIPLES OF OPERATION	4	A. Originating a Call	14
A. Originating a Call	4	B. Speaker Amplifier System	14
B. Answering a Call - Manual and Automatic	4	C. Dial Mechanisms	14
C. Signal Generation	5	D. Answering a Call - Manual and Automatic	14
D. Receive Circuit	5	E. Automatic Mode Switching	14
E. Disconnecting a Call	6	F. Send Circuit - Signal Regenerator	16
F. Out of Service Switch	6	G. Keyboard Send Circuits	17
G. Low Paper Alarm	6	H. Transmitter Distributor Con- trol and Send Circuits	17
H. Make Busy Circuit	7	I. Receive Circuits	18
I. Form Feed-Out	7	J. Auxiliary Local Circuits	19
J. Test Mode	7	K. Disconnecting a Call	19
K. Auxiliary ROTR	7	L. Local Operation	19
3. CALL CONTROL UNIT - 35 KEYBOARD SEND-RECEIVE (KSR) SET	7	M. Out of Service Switch	19
DESCRIPTION	7	N. Low Paper Alarm	19
PRINCIPLES OF OPERATION	9	O. Make Busy Circuit	19
A. Originating a Call	9	P. Form Feed-Out	19
B. Speaker Amplifier System	9	Q. Test Mode	19
C. Dial Mechanism	9	R. Auxiliary ROTR	19
D. Answering a Call - Manual and Automatic	12	1. GENERAL DESCRIPTION	
E. Send Circuit - Signal Regenerator	13	1.01 This section is reissued to convert it from a preliminary publication to a stand- ard publication.	
F. Receive Circuit	13	1.02 The 35 Call Control Unit (LCCU) is an electrical control device which, when used in conjunction with a Data Set, provides for both automatic and manual control of 35 page printing and tape equipment over standard tele- phone networks.	
G. Disconnecting a Call	13	1.03 The call control units, as discussed in this section, are for use in the Bell Sys- tem Wide Area Data Service (WADS) telephone network. Two different call control units are	
H. Local Mode	13		
I. Out of Service Switch	13		
J. Low Paper Alarm	13		
K. Make Busy Circuit	13		
L. Form Feed-Out	13		
M. Test Mode	14		
N. Auxiliary ROTR	14		

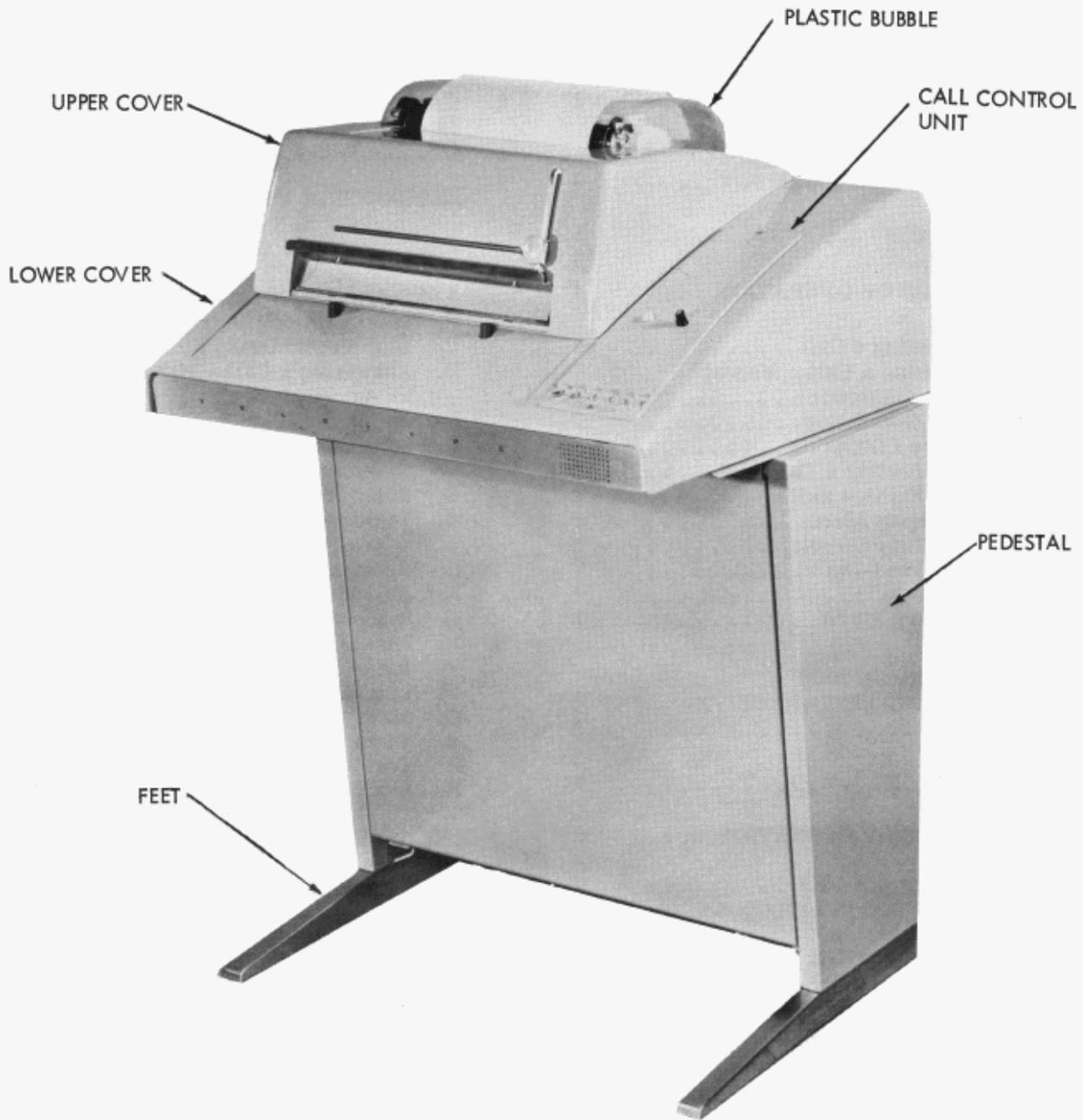


Figure 1 - Receive Only Set with Call Control Unit

utilized in this system: an LCCU 300 (Bell 35A), and an LCCU 301 (Bell 35B). The units are essentially identical in relation to their basic function (i. e., control of page printing and tape equipment in conjunction with a Data Set), differing mainly in the number of features and/or functions controlled by the units. As part of the WADS system, the call control units are used in the following sets:

- (a) Call Control Unit LCCU 301 (Bell 35B) is used in the 35 Receiving-Only (RO) Set.
 - (b) Call Control Unit LCCU 300 (Bell 35A) is used in both the 35 Keyboard Send-Receive (KSR) and Automatic Send-Receive (ASR) Sets.
- 1.04 Complete operation of the call control units requires connections with a Data Set (see appropriate section), and with an electrical service unit (LESU) (see the appropriate section).

- (a) Data Set: The Data Set's function is to provide the modulating and demodulating apparatus necessary for transmission of telegraph signals over telephone circuits. It also provides the call-connecting devices which condition the sending and receiving station(s) for reception and/or transmission of a message.
- (b) Electrical Service Unit: The electrical service unit, used in conjunction with the call control unit, provides relay, circuit, and wiring facilities necessary to operate the various components, lights, and controls which are associated with a given set. The facilities provided by the electrical service unit will vary, depending on the number and complexity of functions performed by the set.

1.05 In the paragraphs that follow, the complete description and principles of operation of the call control units will be presented in the following order:

- (a) Paragraph 2 will discuss the LCCU 301 (Bell 35B) as used in 35 RO Sets.
- (b) Paragraph 3 will discuss the LCCU 300 (Bell 35A) as used in the 35 KSR Sets.
- (c) Paragraph 4 will discuss the LCCU 300 (Bell 35A) as used in the 35 ASR Sets.

Operating principles of the associated electrical service units will be incorporated in the above

discussions, as necessary. General description of the electrical service units, however, will be covered in another section. Discussion of the Data Set will be limited to a description of the call connection, input, and output circuits, but only in sufficient detail to indicate how they condition - or are conditioned by - the call control unit.

1.06 Wiring diagrams referred to in paragraphs 2, 3, and 4 may be found in the RO, KSR, or ASR section with which the Call Control Unit is associated.

2. CALL CONTROL UNIT - 35 RECEIVE-ONLY (RO) SET

DESCRIPTION (See Figure 1)

2.01 The Call Control Unit is located to the right of the page printer, mounted on the cabinet pan assembly. The LCCU extends from the front to the rear of the set, and is higher at the rear than at the front. At the front of the unit is a row of six illuminating push buttons designated (from left to right):

- (1) ORIG (Originate)
- (2) CLR (Clear)
- (3) ANS (Answer)
- (4) TST (Test)
- (5) LCL (Local)
- (6) BUZ RLS (Buzzer Release)

The first three (ORIG, CLR, and ANS) are momentary-type push buttons, while the last three are locking-type. An OUT OF SERVICE switch and lamp are located behind and above the six illuminating push buttons.

2.02 Other features of the call control unit include:

- (a) A ringer mechanism to signal an incoming call.
- (b) A transistorized selector magnet driver assembly.
- (c) A power supply which provides the necessary operating potentials and current for the various controls and circuits.
- (d) Fuses, for circuit protection, and a 117 volt convenience outlet.

- (e) A cable termination area, at the rear, which provides eight female receptacles for interconnection of components.
- (f) An AC power cord for connection of the set to the power line.

A BK (Break) switch, HERE IS switch, and terminals for connection of a dial are also provided. These facilities are normally used for maintenance purposes, and are not readily accessible when the set is in an operating condition, with its cover on.

2.03 In addition to the above, the call control unit can be adapted for the following features:

- (a) A Make Busy circuit.
- (b) Connection of an auxiliary receive-only typing reperforator (ROTR).
- (c) Alternate mode functions.

PRINCIPLES OF OPERATION - See WD6040 (RO)

A. Originating a Call

2.04 General: Normally, only maintenance personnel will have reason to originate a call. Screw connections are provided to connect a temporary dialer for station calling purposes.

2.05 Calling: A call is originated by depressing the ORIG push button. This connects the station to the line, and lights the ORIG lamp. The lamp will remain lit until the originate mode is terminated. In cases where the Data Set relay will not lock up to connect the station to the line, the ORIG push button (a non-locking type) must be held depressed. If the line is busy, or a wrong number or no connection signal is received, depressing the CLR push button will disconnect the set from the line so the call can be re-made.

2.06 Hand Held Receiver: The receiver is used for monitoring the call progress. It is connected to the line via the buffer amplifier in the Data Set limiter. The line connection permits monitoring of supervisory signals when originating a call or when operating an out of service switch in the restore position.

2.07 Rotary Dial: For pulse dialing application, a rotary dialer can be temporarily

connected to the call control unit for maintenance purposes. The manual rotary dial is equipped with a normally closed pulsing contact, and a normally opened off-normal contact. The pulsing contact is inserted into the telephone line when the station originates a call. When answering, a short circuit is applied across the pulsing contact. The off-normal contact is placed across the amplifier output, and silences the receiver whenever the dialing disk is moved.

B. Answering a Call - Manual and Automatic Manual Answering

2.08 To answer a call manually, the ANS push button is momentarily depressed. This connects the station to the line, and lights the ANS lamp. The lamp remains lit until the answer mode is terminated. Manual answering is necessary only when the automatic answer-back circuit is disabled. The automatic answer-back circuit is disabled by the tabulating contacts, form feed contacts, low paper contacts, low tape contacts (auxiliary ROTR), Data Set relay contacts (when in local mode), and the out of service switch.

Automatic Answer Back

2.09 General: The answer-back message is a fixed series of characters used to identify a station. The mechanism is mounted behind the page printer, and consists of a commutation disk and brush type of distributor, and a coded drum with sensing contacts to determine the message. The drum has 21 positions for characters. This can be reduced to three sections of 7 positions by removing tines in the drum. The output can be blinded on a given character position by one of the sensing contacts if the associated tine on the drum is removed. The drum is coded to send the required message by removal of the appropriate tines on the drum. Any fixed message (from 1 to 20 characters in length) can be sent out by the answer back mechanism.

NOTE: The first character position must always be blinded for timing reasons.

2.10 Circuit Description: The answer-back drum is allowed to rotate by pulsing the armature coil from either the Data Set, WRU contacts in the page printer stunt box, or the HERE IS key. When the Data Set at an answering station makes a complete connection to the sending station, it puts ground on the answer-back coil circuit and allows the coil to energize and trip the answer back. When the drum starts ro-

tating, the answer back off-normal contacts close and allow the non-repeat relay (ABR) to energize. The break contacts on the ABR relay open the pulsing circuit to the answer-back coil (ABC), and permit only a single operation of the mechanism. The make contacts on the ABR relay provide the holding circuit for the ABR relay until the call has been completed or the circuit interrupted.

2.11 During a call, the answer-back mechanism can be tripped manually via the HERE IS switch, or by stunt box code recognition (WRU). The make contacts provide ground to operate the answer-back clutch trip magnet.

C. Signal Generation

2.12 The receive-only (RO) set can send by operating the answer-back mechanism or break (BK) key. The answer-back distributor is connected to the Data Set. The BR key is connected to the Data Set on separate leads. The BK key sends a spacing signal which the Data Set limits to about 120 milliseconds. Thus, the local printer runs open for about 100 milliseconds until the break detector operates, lighting the break release lamp.

D. Receive Circuit

General

2.13 The Data Set supplies a 20 milliampere DC signal to the selector magnet driver associated with the page printer. The selector magnet driver amplifies the signal to 500 milliamperes to operate the selector on the page printer. The output of the selector magnet driver is automatically maintained at 500 milliamperes. Provision is made for insertion of an auxiliary ROTR selector magnet driver in series with the page printer selector magnet driver. The ROTR can be equipped with turn around traffic control to blind the ROTR selector magnet driver to locally generated traffic.

Selector Magnet Driver

2.14 General: The selector magnet driver is a two stage transistorized amplifier capable of switching high output currents (0.500 ampere) at very closely controlled input current levels. The output of the driver is automatically regulated, and is essentially independent of normal variations in power supply voltage and of selector magnet and current limiting resistance values.

NOTE: Not all sets will be equipped with a constant current selector magnet driver. In some early units, a non-regulated driver circuit card will be supplied instead. For a discussion of this circuit, refer to Par. 4.35 through 4.39 of this section.

2.15 Open Line: When the line circuit is open (SPACING), transistor Q1 will be turned on by the regulated current flowing through R1 into its base. This current, which is controlled by R1, will be set near the desired switching level. With Q1 conducting, Q2 will be cut off, since the potential at the base of Q2 will be more positive than at the emitter. In this condition, only small leakage currents will flow in the collector circuit.

2.16 Space-To-Mark Transition: As the SPACE-TO-MARK transition begins, the negative bias current flowing in the base of Q1 is diverted to the line circuit. As the line current rises toward the MARKING current value, it extracts base current from Q1. When the line current approaches the total current supplied to the base of Q1 to within 0.001 ampere, which is about one half the nominal mark current value, Q1 begins to turn OFF. Q2 will then begin to receive forward bias current from R8 and begin to turn ON. The base current will then be amplified by Q2, and a current which is a multiple of the base current will appear in the emitter circuit. This increase in emitter current results in an increase in the negative potential measured across R3. The increase in the negative potential at the emitter of Q1 causes it to go further into cut-off. The feedback process continues until the current in the selector magnet reaches a value which is determined by the zener reference voltage, clamp diode CR4, and the emitter resistance of Q2 (the emitter resistance of Q2 is adjusted by R4 to compensate for component variations). As the line current completes the transition to the final marking current value, the base of Q1 becomes positively biased. The positive bias current will be approximately one-half the total marking line current. The positive potential at the base of Q1 is clamped to approximately 0.6 volts by the input protecting varistor, CR5.

2.17 Mark-To-Space Transition: The line current, in changing from MARK-TO-SPACE, will finally reach the point where R1 will begin to supply some forward current to the base of Q1. The line current level at which this occurs will be a little more negative than the point at which the circuit switched from space to mark, due to the common emitter resistor volt-

age feedback. As Q1 begins to turn ON, the current through R8 will be diverted from the base of Q2 causing it to begin to turn OFF. As Q2 turns OFF, the voltage across R4 will begin to go positive, causing Q1 to be further turned ON. This effect gives regeneration to the MARK-TO-SPACE transition.

2.18 Mark-To-Space Switching Transient:

When Q2 is turned off during the MARK-TO-SPACE transition, a negative voltage transient is developed at its collector. This transient is due to dissipation of the energy stored in the magnetic field of the driven magnet when energized by 0.500 ampere. If the high voltage developed at the collector of Q2 is not limited, it would continue to rise until the collector-to-emitter breakdown voltage is exceeded. It has been found that repeated breakdown of this kind causes deterioration of the transistor, and finally, a collector-to-emitter short circuit. Therefore, it is necessary to provide a transient suppressing network at the collector of Q2. The transient suppression network presently in use is a compromise which affords a minimum peak voltage combined with a magnet release time to provide for adequate printer margins. The network consists of C1 in parallel with R9. CR3 isolates the network from voltages more positive than negative battery potential.

E. Disconnecting a Call

2.19 A call is normally terminated by the EOT code combination which provides fast disconnect without introducing hit characters. This is accomplished by the Data Set, in response to EOT contact closures in the stunt boxes of both the sending and receiving sets.

2.20 A call connection can also be cleared manually by momentarily depressing the CLR push button. This triggers the clearing sequence in the Data Set, and lights the CLR lamp. The CLR lamp will remain lit for the duration of the call. During the first 100 milliseconds of the clearing sequence, the BK lamp will also light.

F. Out-of-Service Switch

2.21 The out-of-service switch prevents the automatic answering of incoming calls. In its NORMAL position, it has no effect or function (arrow upright); in the OUT-OF-SERVICE position (rotated counterclockwise and detented) it sets the following conditions.

- (a) A contact is closed that applies power to the out-of-service light.

- (b) A contact is closed and shorts the ringer coils. This makes the ringer inoperative. As an option the contact can be located to shunt both the ringer and series capacitor (i.e., the telephone line). This makes the station appear off hook or busy to the central office.

- (c) A contact is opened that breaks the automatic answer circuit to the answer relay. This prevents the relay from operating in response to the ring up relay and thus the set will not answer.

2.22 For stations that are not in terminal hunting groups, the operator may return the set to service by turning the out-of-service switch to its NORMAL position. For terminal hunting stations, however, the operator must turn the switch to the RESTORE position and hold it until a dial tone is heard. In this position:

- (a) A contact is closed that shorts the tip to ring (off-hook condition). This condition is detected by the central office which then releases the set from lock-out and applies the dial tone.

- (b) A contact closes which completes a path from the ORIG lamp to ground.

G. Low Paper Alarm

2.23 A low paper alarm is provided in the page printer and the auxiliary ROTR, either of which can independently operate the low paper buzzer. The set provides low paper alarm circuits in friction feed sets and, in addition, a paper-out disconnect feature and a form out and tabulating system. The out-of-service switch may be used to facilitate paper insertion.

2.24 When a low paper condition occurs, make contacts in the low paper switch provide ground to the low paper buzzer permitting it to operate. Depressing the BUZ RLS key (locking) in the call control unit silences the buzzer and provides an operate path to the BUZ RLS lamp. Attempting to release the key without replenishing the paper supply will cause the buzzer to operate. When the paper has been replenished, the set is returned to normal by releasing the BUZ RLS key. When used with more complex circuits, the key can be made non-locking.

2.25 Break contacts on the low paper switch disable the automatic answer-back circuit placing the set in a don't answer condition. A low tape condition also prevents an automatic

answer. The operator can override the don't answer condition by manually answering. If the low paper alarm occurs during a call, the operator has the option of completing the call before changing the paper or interrupting the call. To interrupt the call, the operator stops transmission by depressing the BREAK key followed by depressing the BK RLS key to notify the distant station of the problem. The connection is cleared by simultaneously operating the control and EOT keys. Turning the out-of-service switch to the detent position insures that the set will not automatically answer a call while paper is being replenished.

2.26 To restore the set to service, after paper has been inserted, depress the CLR button. This enables the low paper buzzer and the answer-back mechanism. Return the OUT-OF-SERVICE switch to its normal position. (For sets in terminal hunting groups, turn the switch to its RESTORE position and hold it there. When a dial tone is heard, release the switch.) The set is now in a normal idle operating position.

H. Make Busy Circuit

2.27 A make busy option is provided for specific applications. Separate low paper make contacts connect the make busy lead from the TIP side of the telephone line to the Data Set. The option is obtained by a wiring change in the electrical service unit wiring field. The contacts are adjusted so that as the paper runs low the alarms are activated before the make busy circuit takes effect.

I. Form Feed-Out

2.28 In the sprocket feed printers paper out make contacts provide a disconnect feature. These contacts, when paper has been exhausted, perform the same functions as the CLR key. The paper out contacts are used in conjunction with the low paper contacts therefore, no calls will be accepted following the disconnect until the paper supply has been replenished.

2.29 In sprocket feed printers the form feed mechanism is tripped mechanically from stunt box recognition of the FORM code and in addition whenever the Data Set disconnects unless the paper is between forms. The Data Set energizes the form out solenoid during the disconnect sequence when the form out off-normal contacts in the printer are closed.

2.30 The sprocket feed printer is also equipped with horizontal and vertical tabbing

mechanisms which are controlled by code recognition in the stunt box. During the tabbing or form feed operation the associated stunt box contacts hold the motor control relay (MCR) energized and open the automatic answer back circuit. This allows the tabbing or form out operation to be completed before any subsequent call is answered.

J. Test Mode

2.31 If the TST key is operated while the set is connected to a test center, the message sent by the test center will be recorded on the page printer and turned around and sent back for analysis. This is accomplished by connecting the teletypewriter to the Data Set through a set of transfer contacts and a break contact to ground. This type of operation can be terminated by momentarily operating any of the non-locking keys which will then release the TST locking key.

K. Auxiliary ROTR

2.32 A set can be equipped with a self-contained typing reperforator which operates on the same signal as the page printer. The ROTR features automatic non-interfering tape feed out, turn-around-traffic-control, selective operation controlled by stunt box code recognition, all traffic switch, motor control, and low tape alarm contacts and lamps. Detailed description of the ROTR is covered in a separate section.

3. CALL CONTROL UNIT - 35 KEYBOARD SEND-RECEIVE (KSR) SET

DESCRIPTION (See Figure 2)

3.01 The Call Control Unit for the KSR Set is located to the right of the page printer and is mounted on the cabinet pan assembly. It is almost physically identical to the call control unit used in the 35 receive-only (RO) set (refer to Par. 2.01 and 2.02), but is electrically more complex.

3.02 The most obvious physical feature which distinguishes the LCCU 300 (Bell 35A) from the LCCU 301 (Bell 35B), is the presence of a rotary or touch-tone dialing mechanism located immediately behind the front row of illuminating push buttons.

3.03 The call control unit includes the following features:

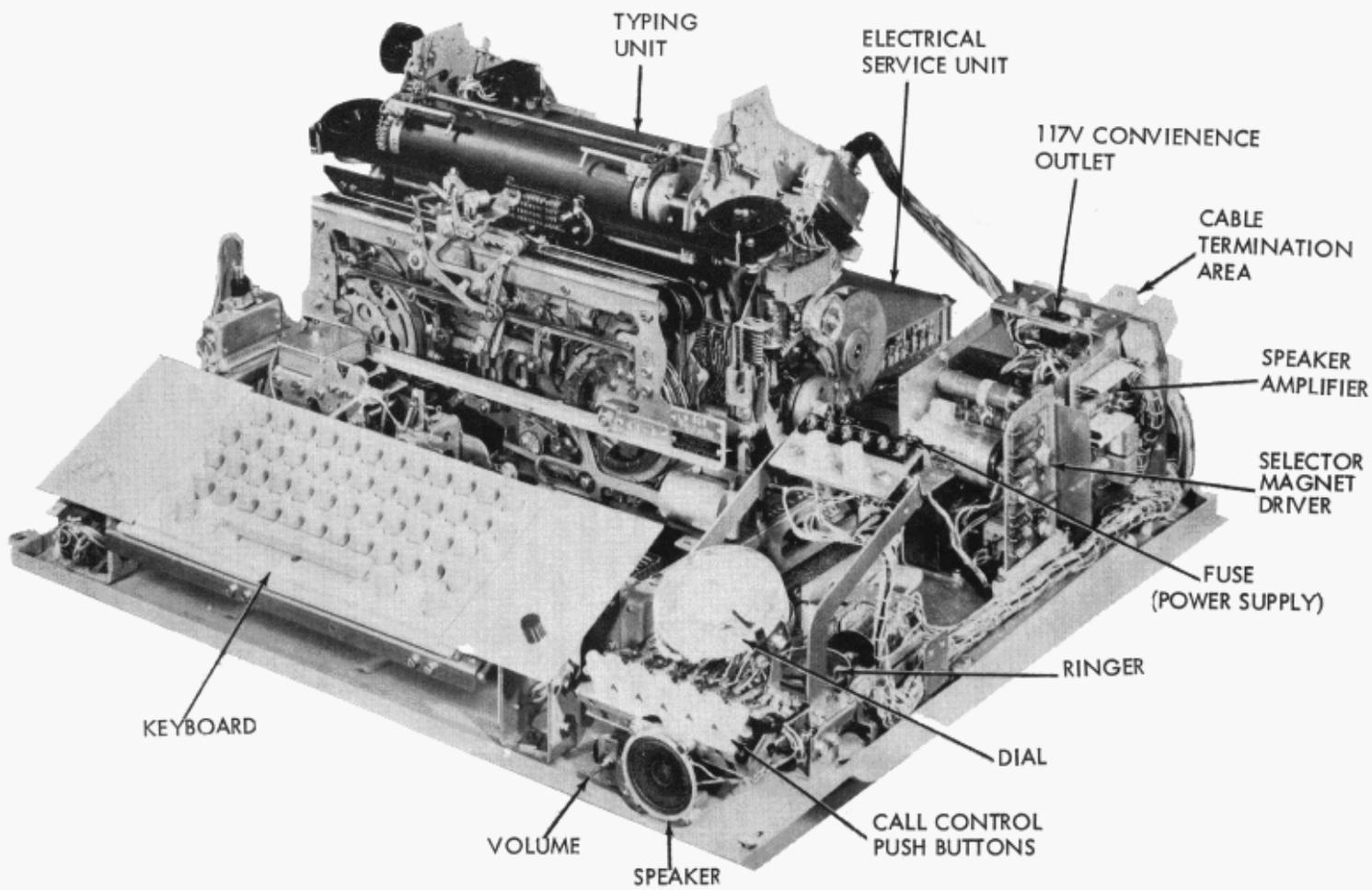


Figure 2 - Keyboard Send Receive Set with Call Control Unit

- (a) A ringer mechanism to signal an incoming call.
 - (b) A transistorized selector magnet driver assembly.
 - (c) A transistorized speaker - amplifier assembly.
 - (d) A volume control to set the speaker level.
 - (e) A power supply which provides the necessary operating potentials and current for the various controls and circuits.
 - (f) Fuses for circuit protection, and a 117 volt convenience outlet.
 - (g) A cable termination area, at the rear, which provides eight female receptacles for interconnection of components.
 - (h) An AC power cord for connection of the set to the power line.
 - (i) A combined break (BK) lamp and reset push button (white, upper), REST lamp (amber), OUT-OF-SERVICE lamp (white, lower), and out of service rotary switch. This group of controls is located behind the dial mechanism. The lamps which separate the controls are for future system use.
- 3.04 In addition to the above, the call control unit can be adapted for the following features:
- (a) Automatic pulsing or tone card dial mechanism.
 - (b) Make busy circuit.
 - (c) Call progress lamps.
 - (d) Hand held receiver.
 - (e) Connection of an Auxiliary Receive-Only Typing Reperforator (ROTR).

PRINCIPLES OF OPERATION - See WD6020 (KSR)

A. Originating a Call

3.05 To originate a call, the ORIG nonlocking key is momentarily operated. This connects the station to the line and lights the ORIG lamp. The lamp remains lit until the originate mode is terminated. If the line is busy, or a

wrong number or no connection signal is received, depressing the CLR push button will disconnect the set from the line so the call can be re-made.

B. Speaker Amplifier System

3.06 The loudspeaker amplifier is powered only after the ORIG key is operated, and is operated, and is quieted when the station connects. It has two inputs, one from the line via the buffer amplifier in the Data Set limiter and the other from the touch-tone dial (TTD). Three outputs are provided: (1) into the loudspeaker or optional hand held receiver, (2) into the line through the sending amplifier in the Data Set, and (3) an auxiliary output into the Data Set. The line to loudspeaker connections permits monitoring of supervisory signals when originating a call. The touch-tone dial-to-line and touch-tone dial-to-loudspeaker connection provides for amplification of the outgoing multifrequency dialing signals and for monitoring them during outpulsing. The line-to-second output connection is provided for the dial tone detector (when furnished). The various connections mentioned are established by switching in the Data Set, and by the common switch in the touch tone dial.

3.07 The speaker amplifier is a conventional direct coupled 2-transistor audio amplifier. The input signals from the line are fed through the receiving buffer amplifier in the Data Set into the primary winding of the input transformer. The primary winding continuously carries approximately 4 MA quiescent current from the receiving buffer amplifier. The other input, from the TTD, is fed directly into Q1 through C5A. Both inputs are DC isolated from the amplifier stages.

3.08 Two outputs are taken from transistor Q2A, one from the collector circuit and the other from the emitter.

(1) The collector output is fed through a step down output transformer (T2) into the loudspeaker (or receiver). Potentiometer RS is used to set proper volume for varying loop loss and ambient noise level. The TTD signals are independent of loop loss.

(2) The emitter output splits into two signal lines: one for injecting the multifrequency (MF) dial tones into the Data Set sending amplifier, and the other for feeding the dial tone detection circuit (when provided). The signal level from the emitter output is essentially independent from the setting of potentiometer RS.

3.09 By-passed R6A is a supply voltage dropping resistor. Diode CR1A is provided to block a sneak path (in the answer mode) from ground through the ANS and ORIG lamps. Without CR1A, the ORIG lamp would be dimly lit and the amplifier would not be silent, when the station is in the answer mode. The amplifier operates only in the originate mode until the station connects. In any mode other than originate, the ground is disconnected. When the station connects, the amplifier input is short circuited in Data Set.

C. Dial Mechanisms

Rotary Pulsing Dial

3.10 For pulse dialing application, a pulsing contact of the rotary dial is inserted in the telephone line. The manual rotary dial is equipped with a normally closed pulsing contact and a normally opened off-normal contact. The pulsing contact is inserted into the telephone line when the station originates a call. When answering, a short circuit is applied across the pulsing contact. The off-normal contact is placed across the output of the amplifier, and silences the loudspeaker (and receiver) whenever the dialing disk is moved.

Pulsing Card Dial

3.11 To use the card dialer, the ORIG key is operated. After dial tone has been received, a card with the telephone number punched is fully inserted in the slot. This operation winds a spring motor, which later pushes the card out of the slot as the dialing proceeds.

3.12 The dialer is started by momentarily depressing the START bar. This operates the DIAL START contact, and establishes a path from the ring side of the telephone line through point 5 on the dialer, the released pulsing relay contacts K (P), pulsing relay K (P), released HOME and DIAL START contacts, operated DIAL START contacts, and point 2 on the dialer to the tip side of the telephone line. The current from the central office battery operates the pulsing relay K (P), which transfers the ring to tip path to the Matrix. This path is closed or opened according to the code punched in the card. The dial pulse is transmitted as the sensing springs sense the holes in the card.

3.13 Sending of the dial pulse means interruption of the current in the telephone line. This releases the K (P) relay. Movement of the K (P) relay armature rotates the scanning drum

by 1/16 revolution so that the next digit pulse can be sensed and transmitted as the K (P) relay re-operates. After two pulses have been transmitted, the HOME contacts operate and remain operated until the end of the scanning drum revolution. This establishes a direct operating path for the K (P) relay so that, when the station is returned on-hook in the middle of the digit, the digit pulsing can be completed and the drum will be returned to its normal (HOME) position.

3.14 In this manner, the drum completes the revolution in 16 steps. 10 of the steps are required to send the digit, and 6 to provide the interdigital time. At the completion of revolutions, an escapement is tripped which permits the next row of holes on the card to be placed in position for sensing.

3.15 This sequence is repeated at each row as the card advances out of the dial. If no STOP code is punched in the card, the dialer will keep advancing the card (even if no number code is punched) until the card is released. If a STOP code is sensed, the DIAL STOP contacts operate. With the HOME contacts released, a transmission path is established from the telephone line to the Data Set input as follows: RING - point 5, DIAL STOP contact operated, HOME contacts released, point 1, hybrid coil in the Data Set, TIP. The Data Set can then complete the connection.

3.16 When the station is connected, the card can be released by operating the RELEASE bar. No attempt should be made to release the card by operating the START bar, as this will trigger the dialing mechanism and the following short circuit will be placed across the output of the Data Set: point 1, HOME and DIAL START contacts released, DIAL START contacts operated, point 2. And, after the first two pulses on each revolution: point 1, HOME contacts operated, point 6. This shunt will prevent the station from receiving or sending until the card is disengaged. If this condition persists, the Data Set will disconnect.

Touch-Tone Dial

3.17 For multifrequency dialing (MF) application, the dialing frequencies generated by the touch-tone dial are fed through the loudspeaker amplifier and into the telephone line via the sending amplifier in the Data Set. The touch-tone dial can be equipped with the card dialer. To use it, the ORIG key is operated, creating the off-hook condition. When the dial tone is received, the card is inserted and the START bar is operated. The spring motor wound by insertion of the card pushes the card out of the

dialer past sensing contacts. The contacts determine the dialing frequencies which are generated by the associated touch-tone dial. If the STOP code is punched in the card following the address, the dialing stops when the STOP code is read. The card should then be released by reoperating the START bar. Dialing proceeds much faster than with the pulsing card dialer. As the station connects, the output of the touch-tone dial is disconnected from the Data Set so that there is no hazard connected with improper operation of touch-tone dial or card dialer at that time.

3.18 The touch-tone multifrequency signal generator is a one transistor oscillator generating two frequencies any time a single push button is operated. Seven frequencies are provided, with each dial digit corresponding to two frequencies according to the table below:

Touch-Tone Frequencies	Dial Digits		
CPS	1209	1336	1477
697	1	2	3
770	4	5	6
851	7	8	9
941		10	

3.19 When the station is idle, a current of about 25 MA flows from ground through RT resistance of point 1 of the touch-tone dial; then through varistors RV3 and RV4, resistor R1, and out of point 6 to -20 V in the Data Set. The transistor Q1 is energized so that there will be no click when the circuit starts to generate the MF signal. The oscillations are suppressed by DC current through the tank coils T1 and T2 maintained by the potential difference across RV4. By interrupting this initial coil current the oscillation's build up time is minimized.

3.20 To dial a digit, a push button on the dialing plate is operated. This closes two frequency determining contacts, one for the T1-C1 tank circuit, and the other for the T2-C2 tank circuit. The Common Switch operates in following sequence:

- (1) y-z contacts open, making the loudspeaker amplifier input available to MF signal only.
- (2) s-t contacts close, and establish a path from the loudspeaker amplifier, through the sending amplifier in the Data Set, and into the line. The feedback through the receiving buffer amplifier in the Data Set back into the

loudspeaker amplifier is disabled by previously opened y-z contacts.

- (3) w₂-v contacts open, disabling the receiving buffer amplifier in the Data Set. This eliminates a possibility of false connect due to MF signals.
- (4) q-p contacts open, together with w₂-v contacts, resetting the dial tone detecting circuit when furnished.
- (5) w₁-u contacts open, interrupting the DC current through the tank coils. Since the tanks T1-C1 and T2-C2 are coupled to the coils in Q1 circuit, the unit starts oscillating with a very short build-up time.

The same functions could be assured with w₂-v contacts operating first and y-z contacts eliminated. However, the interruption of current in the primary coil of the input transformer in the loudspeaker amplifier would cause a loud click to be heard every time a digit is dialed.

3.21 The frequencies above 1000 cycles per second are generated at a somewhat higher level to compensate for greater line loss at those frequencies. Also, there is a variation of amplitude for various digits. The PT resistor is set at the time of assembly of the attendant circuit with the Data Set for an output of 0 dbm on the line for the digit with highest output level.

Touch-Tone and Card Dialer

3.22 To use the automatic card dialer, the ORIG key is operated. After the dial tone has been received, a punched card is inserted into the slot and pushed down. The START bar is then momentarily operated. The card dialer proceeds with dialing under power of a spring motor wound by insertion of the card. When a STOP code is read, the dialing stops. The card should then be released by reoperating the START bar.

3.23 As seen in the wiring diagram, the sensing contacts in the card dialer are in parallel with the frequency determining contacts in the associated touch-tone dial. As the card advances out of the slot, the sensing contacts which sense the holes punched in the card determine the proper frequencies to be transmitted. This occurs for every row on the card. The normally opened E contacts in the card dialer are placed across the excitation w₁-u contacts in the TTD. When dialing manually, the E contacts are opened and there is no interference

from the card dialer. With the card down in the slot, the operation of the START bar closes the E contacts and operates the common switch, through mechanical linkage, for the duration of dialing. The common switch connects the input and output circuits of the loudspeaker amplifier as described in Par. 3.20. Opening of the w_1-u contacts transfers the excitation function to the E contacts in the card dialer. As the card advances out of the slot, the E contacts open for each row exciting the TTD into generating the MF dial signals.

3.24 During dialing, there are short intervals of time when all the sensing contacts are opened and the E contacts are open. Therefore, the TTD will break into spurious oscillations somewhere between 7 KC and 14 KC. Although this frequency band is suppressed by the telephone line, these frequencies would be noticeable on the loudspeaker. The action of capacitors CT and C4A in the loudspeaker amplifier combine to suppress this spurious signal from reaching the loudspeaker.

3.25 Since the card advances out of the slot very rapidly, there is no need for a separate release bar. When the station connects, relay contacts in the Data Set (CON 8 in 101C) disconnect the MF signal input and remove any hazard connected with false operation of the MF dials.

D. Answering a Call - Manual and Automatic Manual Answering

3.26 Refer to Par. 2.08, in this section, for a discussion of this circuit.

Automatic Answer-Back

3.27 Refer to Par. 2.09, in this section, for a general discussion of this circuit.

3.28 Circuit Description: The answer-back drum is allowed to rotate by pulsing the armature coil from either the Data Set, WRU contacts in the page printer stunt box, or the HERE IS key.

(a) When the Data Set at an answering station makes a complete connection to the sending station, it applies a ground to the answer-back coil circuit and allows the coil to energize and trip the answer back. When the drum starts rotating, the answer back off normal contacts close and allow the non-repeat relay (ABR) to energize. The break contacts on the ABR relay open the pulsing circuit

to the answer-back coil (ABC) and permit only a single operation of the mechanism. The make contacts on the ABR relay provide the holding circuit for the ABR relay until the call has been completed or the circuit interrupted.

(b) During a call, the ABR relay holding circuit can be interrupted by either the operation of the HERE IS key or by recognition of the WRU code in the stunt box. This interrupting pulse allows the ABR relay to de-energize, allowing the answer-back mechanism to repeat its cycle.

(c) The page printers at both the sending and receiving stations recognize the WRU code, and the associated stunt box contacts are operated. However, only the receiving station's answer back is allowed to trip. The sending station's answer back is not operated as a result of the WRU contacts being electrically disabled by the non-contention relay (NCT) contacts.

(d) The non-contention relay is operated by the keyboard universal contact whenever the transmission is from the keyboard. The relay is slow release as a result of shorting its secondary windings by the NCT 6 make contacts. The release time of the NCT relay allows the WRU contacts to operate in the page printer stunt box without interrupting the ABR relay holding circuit. Thus the answer back at the station which originated the WRU does not operate.

(e) If the set originated the call, the answer back coil must be pulsed to provide operation. Transmitting a WRU character the NCT 12 break contacts interrupt the coil operating circuit through the WRU make contacts. Therefore, no answer-back operation is permitted. When the set receives a WRU and the contacts close in the stunt box the answer-back coil is connected to ground through the NCT 12 break contacts.

(f) If the set answered the call, the ABR relay holding circuit must be interrupted. Transmitting a WRU the NCT 8 make contacts allow the holding circuit to be continuous throughout the operation of the WRU stunt box contacts. When a WRU is received the WRU break contacts interrupt the ABR relay holding circuit permitting the answer-back mechanism to repeat its cycle.

(g) The HERE IS key allows the station to operate its answer back. At the originating

station the HERE IS make contacts permit the answer-back coil to energize operating the answer-back mechanism. If the HERE IS key is continually depressed the ABR relay remains energized until the key has been released, providing the non-repeat feature.

(h) At the answering station the HERE IS contacts interrupt the ABR holding circuit allowing the ABR relay to de-energize. When the key is released the answer-back coil energizes permitting the answer back to cycle.

E. Send-Circuit - Signal Regenerator

General

3.29 The KSR can send by operating the keyboard, the answer-back mechanism or the BREAK key. The keyboard signal generator is connected to a signal regenerator which is in turn, connected to the Data Set. The answer back signal generator is in series with the output of the signal regenerator. The BREAK key is connected to the Data Set on separate leads. The signal regenerator is used to improve the signal quality obtained from the keyboard signal generator.

Signal Regenerator Circuit

3.30 The main component of the circuit is a silicon controlled rectifier (SCR) which is controlled by the keyboard timing contacts. The timing contacts are opened by a cam at the middle of each generated pulse from the signal generator, and switch the SCR on or off in accordance with the marking (closed) or spacing (open) condition of the signal generator.

3.31 When the timing contacts are open and the signal generator contacts are closed, the gate current, from +20 VDC through the 10,000ohm resistor and the varistor to the gate, turns the SCR on producing a marking output. The SCR will remain on until the current through it drops below 8 milliamperes. Since the current can pass through either the signal generator marking contacts or the timing contacts the SCR stays on until both the timing contacts and the signal generator contacts are opened simultaneously. The mark to space transition is triggered by the timing contacts and therefore, the output of the SCR is as good as the timing of these contacts.

3.32 The BREAK key sends a spacing signal which the Data Set limits to about 120

milliseconds. Thus the local printer runs open for about 100 milliseconds until the break detector operates, lighting the break release lamp.

F. Receive Circuit

3.33 Refer to Par. 2.13 through 2.18, in this section, for a discussion of this circuit.

G. Disconnecting a Call

3.34 Refer to Par. 2.19 and 2.20 in this section, for a discussion of this circuit.

H. Local Mode

3.35 The local mode provides off-line operation of the set. The operator selects the local mode by depressing the LCL locking key. The LCL key lights the LCL lamp and operates the motor control relay (MCR) to energize the motor. The Data Set connects the sending circuit to the receiving circuit, and enables the keyboard and answer back to transmit to the page printer and the auxiliary ROTR (if one is used). A pair of make contacts on the LCL key operate to disable the turn-around-traffic-control so that the ROTR can receive local traffic in the LCL mode. If the set is in a terminal hunting group, the operator must turn the out-of-service switch to the RESTORE position until a dial tone is received after finishing the operation in the local mode.

I. Out-of-Service Switch

3.36 Refer to Par. 2.21 through 2.22(a), in this section, for a discussion of this circuit. In addition to operating a contact which shorts the tip to ring (Par. 2.22(a)) when in the RESTORE position, the switch also closes a contact which completes a path from the speaker-amplifier system to ground. This permits the amplifier to pass the line signals (dial tone).

J. Low Paper Alarm

3.37 Refer to Par. 2.23 through 2.26, in this section, for a discussion of this circuit.

K. Make Busy Circuit

3.38 Refer to Par. 2.27, in this section, for a discussion of this circuit.

L. Form Feed-Out

3.39 Refer to Par. 2.28 through 2.30, in this section, for a discussion of this circuit.

M. Test Mode

- 3.40 Refer to Par. 2.31, in this section, for a discussion of this circuit.

N. Auxiliary ROTR

- 3.41 Refer to Par. 2.32, in this section, for a discussion of this feature.

4. CALL CONTROL UNIT - 35 AUTOMATIC SEND-RECEIVE (ASR) SET

DESCRIPTION (See Figure 3)

- 4.01 Refer to Par. 3.01, in this section, for a description of the Call Control Unit.

4.02 Because of the more complex and flexible nature of the Automatic Send-Receive (ASR) Set, a more involved control system is required. Since the call control unit itself is identical to that used on the KSR Set (Par. 3 in this section), the necessary controls are included on the associated electrical service unit. As discussed in Par. 1.03 and 1.04, however, because of the close relationship between the call control unit and the electrical service unit, the operation of these controls will be discussed in this paragraph as though they were a part of the call control unit. Refer to the appropriate section for a description of the associated electrical service unit.

PRINCIPLES OF OPERATION - See WD6000 (ASR)

A. Originating a Call

- 4.03 Refer to Par. 3.05, in this section, for a description of this circuit.

B. Speaker - Amplifier System

- 4.04 For a discussion of this circuit, refer to Par. 3.06 through 3.09 in this section.

C. Dial Mechanisms

Rotary Pulsing Dial

- 4.05 Refer to Par. 3.10, in this section, for a discussion of this circuit.

Pulsing Card Dial

- 4.06 Refer to Par. 3.11 through 3.16, in this section, for a discussion of this circuit.

Touch-Tone Dial

- 4.07 Refer to Par. 3.17 through 3.21, in this section, for a discussion of this circuit.

Touch-Tone and Card Dialer

- 4.08 Refer to Par. 3.22 through 3.25, in this section, for a discussion of this circuit.

D. Answering a Call - Manual and Automatic

Manual Answering

- 4.09 Refer to Par. 2.08, in this section, for a discussion of this circuit.

Automatic Answer Back

4.10 Refer to Par. 2.09, in this section, for a general discussion of the answer-back mechanism. Note that the mechanism is not located behind the page printer (as mentioned in Par. 2.09), but is mounted at the rear of the transmitter distributor base and is driven by its own motor unit.

4.11 Circuit Description: Refer to Par. 3.28 (a) through (h), in this section, for a discussion of this circuit. Note that the non-contention relay is also operated whenever the transmitter distributor is sending traffic, in addition to operating via the keyboard universal contact (refer to Par. 3.28 (d)).

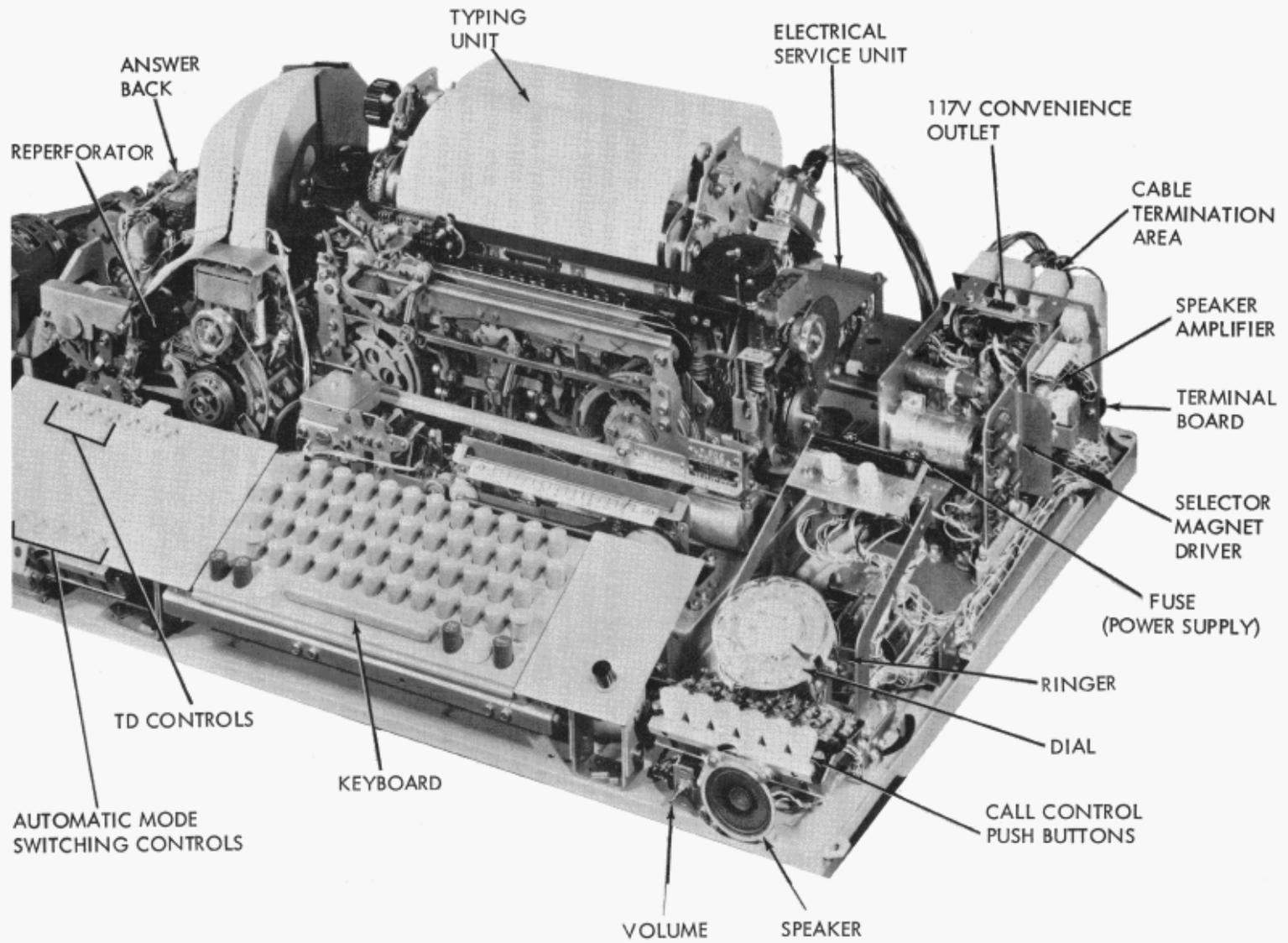
E. Automatic Mode Switching

4.12 Automatic mode switching for the 35 ASR Set provides the:

- (a) Ability to prepare tape while transmitting or receiving traffic,
- (b) Ability to transmit or receive traffic using codes foreign to the equipment,
- (c) Ability to receive traffic on tape and by page copy simultaneously,
- (d) Ability to revert to a common mode of operation when clearing the set or on a break or call disconnect.

To obtain the feature mentioned above, the keyboard and reperforator are switched between the data set signal circuit and the auxiliary local circuit according to the following:

Figure 3 - Automatic Send Receive Set with Call Control Unit



MODE	TD	KBD	LRPE	LP
K	*	L	O	L
KT	L	L	L	L
T	L	O	O	L
TTs	L	O	O	B
TTr	*	O	L	B

L - Indicates signal line circuit

O - Indicates auxiliary local circuit

B - Indicates unit is blinded in signal line circuit

* - TD is disabled

K - Keyboard

KT - Keyboard - Tape

T - Tape

TTs - Tape-Tape Send (Disabled at customers request)

TTr - Tape-Tape Receive (Disabled at customers request)

4.13 Automatic reversion of all other modes (other than T) to the T mode occurs when the clear key is operated or upon initiating a break or call disconnect (EOT) signal. The set idles in the T mode when not in use. When either originating or answering a call, the set provides the necessary facilities for transmitting or receiving traffic and still provides auxiliary local operation.

4.14 In addition to the five mode keys, a MOTOR ON key has been provided. This key, when in the operate position, allows the set motors to remain on continuously. This feature allows the operator to prepare traffic in the auxiliary local circuit, after the set has been cleared on a call, without introducing garble as a result of the motors turning off. In the MOTOR ON position, the operator does not have the option of switching modes, but is allowed to prepare tape when in the T mode.

4.15 Operation of the LCL key on the call control unit will provide off line operations equivalent to those when the set is in the answer or originate conditions. Depressing either the ANS or ORIG keys when in local mode will revert any existing mode to the T mode of operation.

4.16 Switching from one mode into another is accomplished without transmitting a

character to the line or punched in the reperforator tape. The reperforator is isolated from one circuit before it is switched into the other.

4.17 The components of the ASR Set will operate, depending on the mode selected, as follows:

(a) In the TTs and TTr modes the page printer is blinded by MSP 8 make contacts. These contacts provide a continuous 20 milliampere signal to the selector magnet driver.

(b) In the KT and TTr modes, the reperforator is connected to the line circuit through the MSR 6 and MSR 10 make contacts. During switching the MSR 2 make contacts provide a continuous 20 milliampere signal to the selector magnet driver and after switching has been completed the MSR 7 break contacts open this continuous signal circuit.

(c) In the K, KT, and T mode, the page printer is capable of monitoring both transmitted and received traffic.

(d) In the KT mode, the reperforator is also capable of monitoring transmitted traffic for future multiple transmissions.

4.18 All modes are associated with lamps that indicate in which mode the set is operating. The lamps are controlled by the mode switching relays, except the motor on lamp which is controlled by its associated key. For proper operation, a key must be depressed until its associated lamp is lit. The prominent feature of the automatic mode switching circuitry is that it permits simultaneous and uninterrupted performance of two separate operations.

F. Send Circuit - Signal Regenerator

General

4.19 The ASR Set can send by generation of pulses from the keyboard and transmitter distributor signal generators depending upon the mode of operation, the answer-back commutator, and the break key. The keyboard and transmitter distributor signal generators are connected in series to the signal regenerator which relays their outputs to the Data Set. The output from the answer back is in series with the signal regenerator output. The signal regenerator is used to improve the signal quality obtained from the keyboard and transmitter distributor signal generators.

Signal Regenerator Circuit

4.20 Refer to Par. 3.30 through 3.32, in this section, for a discussion of this circuit. Note that, besides being controlled via operation of the keyboard timing contacts, the SCR is also controlled when the transmitter distributor signal generator operates.

G. Keyboard Send Circuits

4.21 Of the five available modes of operation, K (keyboard) and KT (keyboard-tape) are the only two modes where transmission to the signal line is available from the keyboard. The keyboard is connected in the sending circuit through the MSK 8, MSK 2, and MSK 11, make contacts in both K and KT modes. Generated pulses from the keyboard signal generator and timing contacts provide operation of the SCR as described in Par. 4.20.

4.22 In the KT mode, the transmitter distributor is prevented from being accidentally operated, when transmitting from the keyboard, by the NCT 2 break contacts. The NCT (non-contention) relay is energized through the keyboard universal contact which closes every time a key on the keyboard is depressed.

4.23 When a break has been received from the distant station, the keyboard signal generator is shunted by the Data Set. To provide indication of the break condition the BRK RLS lamp, controlled by the Data Set, lights. To provide line operation from the keyboard the operator must depress the BRK RLS key.

4.24 When communicating with slower speed TWX stations, the operator will receive a visual indication to slow down by the restrain (REST) lamp. If the warning is ignored, a break occurs, lighting the BRK RLS lamp. To restore transmission, the BRK RLS key must be depressed.

H. Transmitter Distributor Control and Send Circuits

4.25 The transmitter distributor is capable of sending traffic to the line in the T, KT and TTs modes. With tape in the transmitter distributor, the operation of the TD ON key allows the TDC (TD control) relay to energize through the Tape Out contacts, the MSR 5 and MSK 5 break contacts, (MSR 1 make and MSP 10 break contacts in the KT mode), the TDC 4 and NCT 2 break contacts. After the TDC relay has pulled up, it is held energized through the TDC 5 make contacts to ground. The TDC 2 make contacts allow the

transmitter distributor clutch trip magnets to energize tripping the start clutch. The TD ON lamp is lit through the TDC 1 make contacts.

4.26 The generated pulses from the transmitter distributor signal generator and timing contacts provide the input to the SCR, resulting in signal output to the Data Set. When the tape has completely passed through the transmitter distributor, the tape out contacts open permitting the TDC relay to de-energize. This results in de-energizing the clutch trip magnets and extinguishing the TD ON lamp.

4.27 When requesting a WRU from the transmitter distributor, a set of WRU stunt box break contacts in the sending printer open and allow the TDC to de-energize. The receiving station transmits an X ON code at the end of its identification. This will operate the stunt box make contacts in the originating station's page printer, allowing the TDC to energize. This requirement results in the switch on the transmitter distributor being biased in the run position and, therefore, requiring ON and OFF keys for manual operation of the unit. The originating station is prevented from remotely turning on the answering station's TD by the Data Set.

4.28 Transmitting the X OFF will also turn off the transmitter distributor. When either TAB, VT, or FORM is transmitted, the TD clutch trip magnets are de-energized until the tabbing or form-out operation has been completed.

4.29 The transmitter distributor signal generator is shunted by the Data Set when a break signal has been received from the distant station. The BRK RLS lamp lights, giving a visual indication of the break condition. Transmission is restored by the depression of the BRK RLS key.

4.30 When communicating with slower speed TWX stations, the transmitter distributor is controlled, from sending too rapidly, by the Data Set. The transmitter distributor clutch trip magnet circuit is opened intermittently to restrain transmission. During the time that transmission is restrained, the REST lamp is lit.

4.31 When desired, the set operator may prevent the transmitter distributor from operating upon receiving a stunt box start code. This is accomplished by the TD CALL IN key which, in normal position, prevents the controller from starting the transmitter distributor.

If the operator desires to have the transmitter distributor started by stunt box code, the TD CALL IN key is twisted to the ON position. Make contacts on the key permit the TD call in lamp to light.

I. Receive Circuits

4.32 The Data Set supplies a 20 milliamper DC signal to the selector magnet drivers associated with the page printer and reperforator. The selector magnet drivers are connected in series, and amplify the signal to 500 milliamperes to operate the selector magnets.

4.33 In early production ASR Sets, two different types of selector magnet drivers are supplied:

(1) A constant current driver used to control the page printer selector magnets. For a discussion of this driver, refer to Par. 2.14 through 2.18 in this section.

(2) A non-regulated driver used to control the reperforator selector magnets. Discussion of this driver will be found in Par. 4.35 through 4.39 of this section.

4.34 Provisions have been made for insertion of an auxiliary ROTR selector magnet driver in series with the page printer and reperforator drivers. The ROTR can only be operated in the signal line circuit either manually, by depressing the ROTR ON key, or by printer stunt box make contacts. The reperforator can be equipped with turn-around-traffic control which blinds both the reperforator and ROTR to locally generated traffic.

Selector Magnet Driver

4.35 General: The selector magnet driver is a two stage transistorized amplifier capable of switching high output currents (0.500 ampere) at very closely controlled input current levels. The output of the driver is adjustable to 0.500 ampere output, but may change slightly due to normal supply voltage and component variations.

4.36 Open Line: When the line circuit is open (SPACING), transistor Q1 will be turned on by the regulated current flowing through R1 into its base. This current, which is controlled by R1, will be set near the desired switching level. With Q1 conducting Q2 will be cut off, since the potential at the base of Q2 will be more positive than at the emitter. In this condition,

only small leakage currents will flow in the collector circuit.

4.37 Space - To - Mark Transition: As the SPACE-TO-MARK transition begins, the negative bias current flowing in the base of Q1 is diverted to the line circuit. As the line current rises toward the MARK current value, it extracts base current from Q1. When the line current approaches the total current supplied to the base of Q1 to within 0.001 ampere, which is about half the nominal MARK current value, Q1 begins to turn OFF. Q2 will then begin to receive forward bias current from R3 and begin to turn ON. The base current will then be amplified by Q2, and a current which is a multiple of the base current will appear in the emitter circuit. This increase in emitter current results in an increase in the negative potential measured across R4. The emitter of Q1 will then go negative at the rate of increase of the current in Q2. This negative voltage feedback causes Q1 to go further into cutoff, allowing more current to be passed into the base of Q2. The feedback process continues until the current in Q2 reaches a value which is limited by the resistance in series with its collector-emitter circuit. As the line current rises past the halfway point, the base of Q1 will become positively biased. The positive bias current will be approximately equal to the line current minus the input bias current. The positive voltage developed will be clamped by the input, protecting varistor CR1 to approximately 0.6 volts.

4.38 Mark-To-Space Transition: The line current in changing from MARK-TO-SPACE will finally reach the point where R1 will begin to supply some forward current to the base of Q1. The line current level at which this occurs will be a little more negative than the point at which the circuit switched from space to mark due to the common emitter resistor voltage feedback. As Q1 begins to turn ON, the current through R3 will be diverted from the base of Q2 causing it to begin to turn OFF. As Q2 turns OFF, the voltage across R4 will begin to go positive, causing Q1 to be further turned ON. This effect gives regeneration to the MARK-TO-SPACE transition.

4.39 Mark - To - Space Switching Transient: When Q2 is turned off during the MARK-TO-SPACE transition, a negative voltage transient is developed at its collector. This transient is due to dissipation of the energy stored in the magnetic field of the driven magnet when energized by 0.500 ampere. If the high voltage developed at the collector of Q2 is not limited,

it would continue to rise until the collector-to-emitter reach through breakdown voltage is exceeded. It has been found that repeated breakdown of this kind causes deterioration of the transistor and finally a collector-to-emitter short circuit. Therefore, it is necessary to provide a transient suppressing network at the collector of Q2. The transient suppression network presently in use is a compromise which affords a minimum peak voltage combined with a magnet release time which provide for adequate printer margins. The network consists of C1 in parallel with R5. CR3 isolates the network from voltages more positive than negative battery potential.

J. Auxiliary Local Circuits

4.40 The T and TTs modes provide the necessary facilities for secondary sets operation. In the T mode, the keyboard and reperforator are linked together in a 40 VDC, 20 milliampere auxiliary local circuit through the MSR 4, MSR 10, MSK 4, and MSK 7 break contacts. While in this mode, the operator can prepare traffic for future transmission while the printer is monitoring incoming traffic (or traffic being transmitted from the transmitter distributor).

4.41 The TTs mode is useful for transmitting foreign coded traffic, and provides the same auxiliary local circuit as the T mode does. In the TTs mode, the page printer is blinded by a continuous 20 milliamper DC signal.

K. Disconnecting a Call

4.42 Refer to Par. 2.13 through 2.18, in this section, for a discussion of this circuit.

L. Local Operation

4.43 Local operation permits the set to operate in an off line circuit. The operator selects the local operation by depressing the LCL locking key which lights the LCL lamp and energizes the motor control relay (MCR), turning on the set motors. The Data Set connects the sending and receiving circuits together enabling the keyboard, transmitter distributor,

and answer-back mechanism to send to the page printer and reperforator (depending upon the mode of operation). The turn-around-traffic-control is disabled, by make contacts on the LCL key, allowing the reperforator and the auxiliary ROTR (if one is used) to receive the locally generated traffic.

4.44 If the set is in a terminal binary group, the operator, when she has completed the local operation, must turn the out-of-service switch to the restore position until dial tone is received. When the set is in local, any operating mode may be chosen. The operator may prepare traffic for future transmission while monitoring (or not monitoring), or make multiple tapes of any traffic simultaneously if an auxiliary ROTR is used.

M. Out of Service Switch

4.45 Refer to Par. 3.36, in this section, for a discussion of this circuit.

N. Low Paper Alarm

4.46 Refer to Par. 2.23 through 2.26, in this section, for a discussion of this circuit.

O. Make Busy Circuit

4.47 Refer to Par. 2.27, in this section, for a discussion of this circuit.

P. Form Feed-Out

4.48 Refer to Par. 2.28 through 2.30, in this section, for a discussion of this circuit.

Q. Test Mode

4.49 Refer to Par. 2.31, in this section, for a discussion of this circuit.

R. Auxiliary ROTR

4.50 Refer to Par. 2.32, in this section, for a discussion of this circuit.