

PBX SYSTEMS  
NO. 756A  
DIAL PULSE REGISTER CIRCUIT

CHANGES

B. Changes in Apparatus

B.1 Added

RF Resistor - KS-13490, L1, 2000 ohms -  
Option YN

D. Description of Changes

D.1 In FS8, option YM is designated and option YN is added to limit the current through diode Z and transistor T to a safe value when battery is applied to a single digit dialing timing and control circuit in which option YA has been specified.

D.2 In Circuit Note 104, option YM is rated MFR DISC and option YN is rated STD.

D.3 Circuit Note 113 is added.

BELL TELEPHONE LABORATORIES, INCORPORATED

(WEC 7760HW-WES-JGW)  
DEPT 5337-RAV

PBX SYSTEMS  
NO. 756A  
DIAL PULSE REGISTER CIRCUITCHANGESB. Changes in Apparatus

B.1	<u>Superseded</u>	<u>Superseded By</u>
	A Connector Amphenol 26-4501- 165, Option YK, App. Fig. 8.	Wiring part of option YL.
	DT Resistor, KS-13490, L1, 3000 ohms, Option ZY, App. Fig. 8 or 9.	Wiring part of option YH.

C. Changes in Circuit Requirements Other  
Than Those Caused by Changes in Apparatus

C.1 For the H1, H2, H3, L1, L2, L3, L4 and STR1 relays, the circuit requirements are designated for use when option YI is provided and the circuit requirements are added for use when option YJ is provided.

D. Description of Changes

D.1 The option designation of resistor DT in FS1 and in App. 8 and 9 is changed from YF to ZY on a no-record basis as requested by Western Electric Company.

D.2 Option YH is added and supersedes option ZY to provide a record of the removal of resistor DT.

D.3 Option YI is designated and option YJ is added. Option YJ supersedes option YI and provides for use of the TOUCH-TONE translation circuit, FS9, with receiving circuits, types A2 and A3.

D.4 In FS9, the windings of relays L(1-4), H(1-3) and STR1 are connected to RC ground when option YI is provided or

connected to RC -48 battery when option YJ is provided.

D.5 Option YK is designated and is superseded by option YL which is added. Options YK and YL provide for use of the translation circuit, FS9, with TOUCH-TONE receiving circuits, types A2 and A3, respectively.

D.6 In FS9, options YK and YL enable the translation circuit to be provided without connector A.

D.7 In Circuit Note 102, reference to dial tone generator for PBX TOUCH-TONE calling is added.

D.8 In Circuit Note 102, reference to the use of Apparatus Figure 8 with a type A2 receiving circuit is removed.

D.9 In Circuit Note 104, options YH, YJ and YL are rated STANDARD and options ZW, ZY, YI and YK are rated MANUFACTURE DISCONTINUED.

D.10 Circuit Notes 109 and 112 are rated MANUFACTURE DISCONTINUED.

F. Changes in CD Sections

F.1 In Section III, Paragraph 4 should read as follows after item (f):

- (g) TOUCH-TONE Calling Receiving Circuit - Type A2 - SD-95287-01.
- (h) TOUCH-TONE Calling Receiving Circuit - Type A3 - SD-98148-01.
- (i) TOUCH-TONE Calling Receiving Circuit - Type C1 - SD-67027-01.
- (j) Signaling Circuit - Tone Generator for PBX TOUCH-TONE Calling - SD-81719-01.

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DEPT 5337-RAV

PEX SYSTEMS

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DIAL PULSE REGISTER CIRCUIT

CHANGES

B. Changes in Apparatus

B.1 Removed

DT resistor KS13490, L1, 3000 - YF  
option - FS1

D. Description of Changes

D.1 On Sheet B1, options YG and YF are added. Option YG adds lead TTL to the 404C Tone Generator to provide new dial tone for TOUCH-TONE calling. Option YF, which is rated Manufacture Discontinued, includes lead DT from the power supply circuit and use of the DT resistor which was provided to lower the level of dial tone supply for use with TOUCH-TONE calling.

D.2 On Sheet D1, circuit note 112 is added.

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DEPT 5337-RAV

PBX SYSTEMS  
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DIAL PULSE REGISTER CIRCUIT

CHANGES

B Changes in Apparatus

B.1 Added

TM diode 426F - YC option - FS3  
KRA diode 446F - YE option - FS2

D. Description of Changes

D.1 On sheet B3, options YB and YC are added. Option YC prevents the operation of the tens and units relays when both registers are on HOLD and one times out.

D.2 On sheet C1, TM diode is added under Apparatus Figure 3.

D.3 On sheet D1, circuit note 110 is added.

D.4 On sheet B3, options YD and YE are added. Option YE prevents operation of relay STR when a TOUCH-TONE station selects an unequipped 6 or 7 tens group.

D.5 On sheet C1, KRA diode is added under Apparatus Figure 2.

D.6 On sheet D1, circuit note 111 is added.

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PEX SYSTEMS  
NO. 756A  
DIAL PULSE REGISTER CIRCUIT

CHANGES

B. Changes in Apparatus

B.1 SUPERSEDED

C Capacitor KS-13810  
ZZ option

SUPERSEDED BY

C Capacitor KS-14105  
YA option

D. Description of Changes

- D.1 On Sheet B8, options YA and ZZ are added. Option YA will insure that the capacitor retains charge and remains properly formed during idle state.
- D.2 On Sheet D1, ZS option is added to Note 102.
- D.3 On Sheet D2, the timing requirements listed under Note 302 are changed to 3  $\pm$ 1/2 second.

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DEPT 5332-EHB-HFH

PEX SYSTEMS  
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DIAL PULSE REGISTER CIRCUIT

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SECTION I - GENERAL DESCRIPTION1. PURPOSE OF CIRCUIT

1.01 The dial pulse register functions as a dial pulse counter and digit and class information store on all calls passing within the PBX. It is not operative on outgoing central office calls after the central office has been engaged.

1.02 When either a station or a trunk originates a call into the PBX, the marker selects and connects an idle dial pulse register to it. The register receives and stores the originating line or trunk class information from the marker and then transmits dial tone to the line or trunk. After dialing is completed, the register engages the marker to terminate the call and transmits the information needed to establish a connection to the called station or trunk to the marker. When the connection has been established, the marker releases the register.

1.03 If the marker finds the busy tone trunk busy when trying to complete a call to it, it notifies the register to return the busy tone to the calling line.

1.04 The register allows from 8 to 16 seconds after seizure during which dialing must be completed. If dialing is not completed in this time, the register signals the marker to route this call to an attendant trunk.

1.05 The register is arranged to receive either dial pulses, direct station selection key pulses, or the output of a translator circuit associated with a push-button calling receiver.

1.06 The dial pulse register functions to receive units and tens information from a direct station selection console key and transmit this information to the marker in the regular manner.

1.07 When a station is provided with the necessary auxiliary equipment, the dial pulse register may function to receive units and tens information from a direct station selection key in the telset. This information is transmitted to the marker in the regular manner.

1.08 The dial pulse register may be arranged for connecting to certain station lines by dialing a single digit. The proper tens digit is dialed, and after a timed interval (5 seconds) the digit 0 is automatically set up in the register with a 2-digit code being transmitted to the marker in the regular manner.

1.09 By using the single digit dialing equipment for stations, a single digit code may be used for a trunk to the

toll operator. When the single digit is dialed and a timer operates, the register functions to set up a 2-digit code, which when transmitted to the marker, causes the marker to connect to a central office trunk that has been connected to the toll switch-board.

2. GENERAL METHOD OF OPERATION

2.01 When the receiver is lifted off-hook at a station, or a trunk circuit requests inward PBX service, the respective line or trunk tens relay in the marker operates. This operation sets off a train of events that result in the marker connecting the line through an idle link to an idle register.

2.02 As soon as the class identity of the calling circuit is known, after the register has been allotted, the marker transmits originating class information which is stored in the register for use when dialing is completed. The following classes of service exist:

(a) Restricted Line or Dial Repeating Tie Trunk: All restricted lines are restricted from central office trunks, and may or may not be restricted from dial repeating tie trunks.

(b) Restricted Central Office Trunks and Ringdown Tie Trunks: All central office and ringdown tie trunks are restricted from other central office and ringdown tie trunks and may or may not be restricted from dial repeating tie trunks.

(c) Nonrestricted Central Office Trunks and Ringdown Tie Trunks: All central office and ringdown tie trunks are permitted access to other central office trunks, ringdown tie trunks, and dial repeating tie trunks.

(d) Toll Denied Line or Dial Repeating Tie Trunks: The line or trunk can dial intralocal central office and extended area central office calls but not toll calls.

(e) Toll Allowed Line or Dial Repeating Tie Trunk: The line or trunk can dial all calls.

2.03 When the register hold magnet closes the tip, ring, and sleeve of the line through to the register, the register off-normal relay operates. The off-normal relay furnishes holding battery and ground for most of the register and closes the dial tone path to the calling line. This connection is known as the dial tone connection and is an indication that dialing may proceed.

2.04 The dial pulse register is arranged to receive 1- or 2-digit codes for station lines, ringdown tie trunks, miscellaneous trunks, or central office trunks,

and a 1-digit code for attendant trunks or long distance trunks.

2.05 Access to trunk code 8- may be restricted or nonrestricted without regard to the access to the central office code. Thus, a line may be restricted from both codes 8- and 9-, or it may be restricted from code 9- only.

2.06 After the calling line dials the one or two digits required for identification of the called line, the register recognizes dial completion and engages the marker for termination of the call.

2.07 The digit steering relays determine when the tens and units digits have been registered; the tens digit being stored in the TD register relays and the units digit in the pulse counter and the UD register relays.

2.08 If a 1-digit central office trunk code is provided and a 9 or 0 is dialed, the steering circuit recognizes that only one digit will be dialed, and therefore engages the marker to either a central office or attendant trunk to complete the call. If a restricted line dials codes 8- or 9- (code 8- being restricted) or should an unequipped code be dialed, the call will be diverted to an attendant trunk. If code 8 is used for long distance, a code 8 will be translated into a 2-digit code 90. With single digit dialing, any tens digit so arranged will be translated into a 2-digit code by the addition of a zero.

2.09 The number dialed determines the terminating class of call, which directs the marker in its method of call completion. There are two terminating classes of calls: (a) Junctor Class - Calls which require a junctor, and (b) Trunk Class - Calls which do not require a junctor.

2.10 When the digit registration is completed and the marker engaged, the register transmits the class information and the called number data to the marker.

2.11 When a dial tone call is established, the register memory hold magnet in the marker remembers which link was used for the connection from the calling line to the register, so that the same link can be reused when the call is later terminated via a junctor or a trunk.

2.12 After the marker performs its functions in terminating the call, it transmits a release signal to the register. The register then opens the tip, ring, and sleeve connections to the link, restores to normal, makes itself available to the marker for reseizure, and releases the register work and memory hold magnets.

2.13 If the marker encounters a busy condition and the busy tone trunk is also busy, it signals the register to transmit a busy tone to the calling line.

SECTION II - DETAILED DESCRIPTION

1. REGISTER SEIZURE

REGISTER SELECTION

1.01 When a register is idle, battery and ground through break contacts of the ON relay operate the associated register allotter (RA-) relays in the marker. Operation of RA- prepares an operate path for the register hold magnets and the class relays. In the process of link selections, the select magnet timing relays SMT (A, B) in the marker operate and furnish ground for operating the register hold magnets.

REGISTRATION OF CLASS

1.02 As soon as the class and originating line selection circuits have operated in the marker, an operate path for the class relays in the register is established through the make contacts of the RA-- relays in the marker. The following is a tabulation of class conditions that can exist for incoming calls to the register.

<u>Class Relays Operated</u>	<u>Originating Class of Service</u>
None	Restricted Station, or an Attendant Trunk
TT	Restricted Dial Repeating Tie Trunk
TLD	Toll Denied Station
TT and TLD	Toll Denied Dial Repeating Tie Trunk
TLA and TLD	Toll Allowed Station
TT, TLA, and TLD	Toll Allowed Dial Repeating Tie Trunk
COT	Restricted Incoming Central Office or Ringdown Tie Trunk
COT and TLD	Nonrestricted Incoming Central Office or Ringdown Tie Trunk

1.03 These class relays operate on signals from the marker and hold through their own contacts to off-normal battery.

DIAL TONE CONNECTION ESTABLISHED (SC-1)

1.04 While the originating class information is being transmitted to the register from the marker, the marker is selecting an idle link circuit. When the select magnet timing relays, SMT-, operate in the marker, the register work and memory hold magnets, THM-8 and THM-9, operate. Operation of THM-9 performs no function in the register and is explained in 2. of Section I. Operation of THM-8 closes the

tip, ring, and sleeve of the register through the link to the calling line circuit. The tip and ring closure operates the L relay through the windings of the tone coil. L operates SR. Relay SR provides holding ground for THM-8 and THM-9, closes through the 100-ohm holding ground for the calling party hold magnet, prepares the operate path for P1 in the pulse counter circuit through break contact 4 of the L relay, and operates ON. ON supplies battery for the class, steering, and timing relays; closes the dial tone supply to the tertiary winding of the tone coil, thus transmitting dial tone to the line; opens the register allotter circuit in the marker, which indicates a busy register; and provides paths for operation of PU, RA, RRLA, RRLB, and the pulse counter relays. The dial tone connection is now established.

## 2. DIAL PULSE COUNTING AND REGISTRATION

### GENERAL

2.01 The dialing of a digit consists of one to ten equally spaced momentary line openings generated by the calling line dial. The number of opens corresponds to the number dialed. Between the tens and units digit is an interdigital interval during which the line remains closed. The L relay responds to the dial pulses and the counting relays count the number of pulses in each digit. In the interdigital time the tens digits information is transferred to the tens digit register and the counting relays are released, preparing the circuit for receipt of the units digit. The units digit is counted and registered by the pulse counter relays. Relay RA recognizes the beginning and ending of each digit.

### PULSING RELAY

2.02 The L relay is a 3-winding magnetically biased polarized mercury contact relay. The primary winding is in series with the calling line dial contacts and is used as a line winding to operate L in response to the dial pulses. The secondary winding is used to aid the release of L. When L operates, the No. 1 make contact furnishes ground for the secondary circuit, which is poled opposite to the primary circuit. This opposition of ampere turns when the relay is operated tends to make L easier to release. The value of resistor L has been set at a value that will give the optimum benefit from this winding. The tertiary winding is a pulse aiding winding. The tertiary circuit consists of the pulse help capacitor, PH, and the winding. The side of PH that is connected to ground through the No. 1 contact is also connected to the winding of relay SR. When L operates, the charging current through the PH capacitor is in the direction to hold L operated. As the capacitor becomes fully charged, the charging current becomes zero and the other windings regain full control. When the

primary circuit opens L releases, removing ground from the No. 1 make contact. The PH capacitor then discharges through the SR relay winding. This discharge current through the tertiary winding is in such a direction as to hold L released. The tertiary winding and PH capacitor thus act to insure that once L operates it will remain operated for a definite minimum time, and that once it releases it will remain released for a definite minimum time. This pulse correcting action permits longer maximum loops to be used than would otherwise be possible.

2.03 The LW capacitor and resistor (ZN option) is connected to the line side of the primary winding of the L relay to prevent the premature release of the relay when dialing over a line which has high capacity ringing bridges. On each open pulse on these lines, the line current momentarily dips and then increases as the bridged capacitor charges in series with the inductive ringer. The LW capacitor holds the L relay over the dip in line current.

2.04 The LW capacitor and resistor also prevents a false momentary release of the L relay which may otherwise occur when the retard coil holding bridge in the attendants position circuit is reinserted in loop at the end of each dialed digit.

### SUPERVISORY CONTROL

2.05 The supervisory relay, SR, operates from ground through the No. 1 make contact of L. It holds over momentary opens of the make contact of L but will release when the register is dismissed by the marker or when the calling line disconnects before completion of dialing.

2.06 The register advance relay, RA, operates during the first open of the dial pulse when L releases and remains operated until the interdigital interval when L is held operated. RA is fast operating but is made slow release through use of its secondary winding, which is short-circuited when RA is operated. Thus RA is made to recognize the start and stop of pulse trains for each digit.

### PULSE COUNTING (SC-1, SC-26)

2.07 The pulse counting circuit consists of dial pulse counter relays P1 to P5 and P2A, which prevents registration of preliminary pulses and removes dial tone from the line at the beginning of a dialing. The P1 and P2 relays function as a pulse divider, each relay operating at half the speed of the L relay. When L releases on the first break of the dial, P1 operates through the continuity transfer contact of P2. P1 locks through its own contact to ON ground. When L reoperates at the end of the first open pulse, the pulsing ground transfers to contact No. 2 of the L relay and

operates P2 through the operated make contact of P1. P2 operating locks itself through P1 operated to ON ground, opens its operate path, and transfers the locking path of P1 from ON ground to the make contact of No. 2 of L. On the next release of L, P1 releases and closes ON ground through to operate P3 and P2A. When L reoperates on the second pulse, P2 releases. This cycle of P1-P2 combination repeats itself with P1 and P2 remaining operated at the end of odd numbered pulses and remaining normal at the end of even number pulses. Relay P4 operates when P2 operates at the end of the third open pulse, and P5 operates when P2 releases at the end of the sixth open pulse. The sequence of operation of these relays is given in sequence chart SC-26. The following table gives the sequential information.

Pulse	L	P1	P2	P3	P4	P5	P2A	Relays Remaining Operated
1	BK MK	R O	O					P1, P2
2	BK MK	R O	R R	O			O	P2A, P3
3	BK MK	R O	O		O		O	P1, P2, P2A, P3, P4
4	BK MK	R O	R R				O	P2A, P3, P4
5	BK MK	R O	O	R			O	P1, P2, P2A, P4
6	BK MK	R O	R R			O	O	P2A, P4, P5
7	BK MK	R O	O				O	P1, P2, P2A, P4, P5
8	BK MK	R O	R R	O			O	P2A, P3, P4, P5
9	BK MK	R O	O		R		O	P1, P2, P2A, P3, P5
10	BK MK	R O	R R				O	P2A, P3, P5

DIGIT STEERING AND REGISTRATION (SC-1, SC-6, SC-7)

2.08 The digit steering circuit directs the output of the tens digit from the pulse counter relays to the TD register and then releases the pulse counter relays. When the units digit is dialed, the pulse counter relays lock up and the units digit is then steered to the marker via the UD register.

2.09 When the dialing of the tens digit is completed, the respective P-relay combination for the digit dialed transmits operate ground to the proper TD relay when RA restores to normal. SW operates from RA normal after the tens digit has been dialed. The TD relay operates and locks to its own contact, through a break contact on TMO to ground, during the operate time of SW. SW operating releases the P-relays and operates STR, preparing the register for receipt of the units digit. Relay STR transfers the output circuit of the pulse counter relays to the units digit register.

2.10 On the first open dial pulse of the units digit, RA operates UD. Make contacts on UD provide the necessary ground path to hold the pulse counter circuit operated after dialing is completed. UD operating prepares the operate path for DC.

A. Z Option (SC-9)

2.11 If the PBX is equipped with 40 lines, Z option is furnished so that when tens digit 6 or 7 is dialed, the dialed digit is translated to the zero code. Relay OT operates and locks when TD (6-7) operates, OT prepares the operate path for the register cut through relay, RCA (A,B), in the marker, operates UD, transmits ground through the TR contacts to the units digit register input for the artificially generated units digits, and opens the normal units digit data ground so that dialed units digits are not passed to the marker. Relay UD operates DC, which in turn locks the L relay, preventing any subsequent pulsing action. The tens digit is thus translated to T0 and the dialed units digit is not effective due to the locking of the L relay, but artificially generated units digits U1 and U4 are transmitted to the marker. Closure of the operate path for RCT- in the marker is the trunks class of call indication described in 2., Section I.

2.12 Combinations of four options are available for class of service treatment:

(a) W option. If the PBX is not equipped with trunks which use codes beginning with 8, W option is furnished. With W option, any call resulting from a dialed trunk code 8- will be handled as described in 2. of Section I for unequipped code 6 and 7.

(b) Y option. If the PBX is equipped with trunks which use codes beginning with 8, Y option may be furnished. With Y option, restricted stations and restricted dial repeating tie trunks are denied access to 2-digit codes beginning with 8.

(c) X option. If the PBX is equipped with trunks which use codes beginning with 8, X option may be furnished. With X option, restricted stations and restricted dial repeating tie trunks are denied access to 1- or 2-digit codes beginning with 9, but are allowed access to codes beginning with 8. TLD relay normal routes tens lead 9 to tens lead 0, but with X option tens lead 8 is connected through to the marker.

(d) S option. If central office trunks or ringdown tie trunks are not restricted, S option is furnished. With S option, operation of relay COT (see 1.02 and 1.03) will operate relay TLD. Relay TLD operated completes a path for both tens lead 8 and 9 to the marker, with the result that neither 8 nor 9 codes are restricted from CO or ringdown tie trunks. Omission of S option

65-5-7

results in the same restriction as provided for restricted stations.

#### B. W Option

2.13 If W option is provided, the action resulting from a dialed trunk code 8- will be the same as explained in 2. of Section I.

2.14 Two options are available for the CO trunk code, V option for the 1-digit code and T option for the 2-digit code.

#### C. V Option (SC-6)

2.15 If a restricted line dials the trunk code 9, when TD9 operates the tens digit 9 is translated to T0 through the normal TLD, and relay OT operates and locks to ON ground. Subsequent action is as in 2.11 and 2.12.

2.16 If a nonrestricted line dials the trunk code 9, TLD is operated so that the tens digit 9 is not translated to T0 but remains T9 when TD9 operates. Relay OT operates as in 2.15, and the artificially generated units digit ground is fed to the units digit outputs U1 and U4.

#### D. T Option (SC-7)

2.17 If a restricted line dials the trunk code 9-, the subsequent action is as in 2.15 and 2.16.

2.18 If a nonrestricted line dials the trunk code 9-, TLD is operated so that the tens digit 9 is not translated to T0 but remains T9 when TD9 operates. Relay TR then operates and locks to ON ground. Subsequent action is as in 2.16.

#### E. Attendant Trunk Dialed (SC-23)

2.19 If the attendant trunk code, 0, is dialed, TR operates and locks to ON ground when TDO operates. TR operates OT and gives a trunk class of call indication. OT operates UD and transmits ground through the TR contacts to the units digit input for the artificially generated units digits U5 and U9. Comparing 2.11 and 2.12 and this paragraph, it can be seen that U1 and U4 are generated for intercept conditions and U5 and U9 are generated for dialed 0 code conditions. This is for proper identification to the attendant trunk circuit which functions both as intercept and attendant trunk.

#### TENS AND UNITS DIGIT REGISTERS

2.20 The TD and UD register relay units consist of five dry reed relays each enclosed in a sealed container. Each relay consists of an operating coil surrounding two dry reed switches. One of these switches performs the function of holding the relay operated and the other acts as a load contact.

One side of each coil is wired internally to one side of its respective holding contact. The load contact pair, one side of the holding contact, and the winding pairs are all brought out on individual terminals which have appearances on both front and back sides of the container. For ease of wiring, three sets of these terminals are strapped internally.

#### PRELIMINARY PULSES

2.21 Since the number 1 is not assigned as a tens digit and since means for eliminating single pulses due to accidental momentary line opens must be provided, the pulsing circuit is designed to refuse registration of the tens digit 1. The P2A relay accomplishes this task by keeping the information ground path for the TD relays open at make contact No. 4 until it operates, and by not providing the locking ground path for P1 and P2 when RA restores to normal. P2A remaining inoperative also maintains the dial tone output to the calling line.

#### DIRECT STATION SELECTION

#### F. Attendants Direct Station Selection (Option ZB)

2.22 With direct station selection, the attendant may enter a call into the PBX over an attendant trunk or complete a call into the PBX from a central office, long distance, or ringdown tie trunk.

2.23 When an attendant trunk, ringdown tie trunk, long distance, or central office trunk initiates a request for dial tone, one of the marker TRCO or TRC1 relays will be operated. Depending on which register is available to serve the call, ground from the operated TRCO or TRC1 relay is extended through the marker RGA and RAOA or RGB and RALA relays to operate relay AC in the connected register. Relay AC operated: (a) locks operated under control of relays SR and DC, (b) connects leads T2-T8 from the position relays to the tens digit relays, (c) connects leads U0-U9 from the position relay to unit digit relays, and (d) closes lead HA1 to operate relay UD when relay HA operates in the cordless position circuit. When the attendant depresses one of the direct station selection keys, ground is connected to the corresponding unit and tens leads and to lead H1. The ground on lead H1 results in the same function as if the hold key at the attendant cordless had been operated. Ground on the tens lead operates one of the tens digit relays (TD2-8). Ground on the units lead operates one of the units digit relays (UDO-9). The units and tens digit relays (T- and U-) lock operated to off-normal ground. The ground on lead H1 causes relay HA in the cordless position circuit to operate, which in turn operates relay UD via leads HA1 and HA2. Relay UD operated causes relay DC to operate, and the

register completion to the marker is as will be described in 3.

### G. Station Direct Station Selection (Option ZE)

2.24 When direct station selection by stations is provided, additional equipment per schematic drawing Auxiliary Relay Circuit for Direct Station Selection by Stations will be required. When a station arranged for direct station selection has a register attached, the operation of a DSS key: (a) connects ground to the units and tens lead at the station, and (b) operates the key relay K associated with that station. The key relay operated: (a) opens the tip and ring of the station loop, (b) connects ground to the ring side of the loop to hold relay L in the register, and (c) connects the station connector relay to the tip side of the loop. If the station has preference, the station connector and direct station connector relays will operate to extend ground from the DSS key on a unit and a tens lead to operate a units dialed UD- and a tens dialed TD- relay. Relay UD is also operated, in turn operating relay DC, and the register completion to the marker is as described in 3.

### SINGLE DIGIT DIALING (APP FIG. 5, 6, AND 7 AND OPTION ZC)

#### H. Single Digit Dialing for Stations

2.25 With this arrangement stations 20, 30, 40, 50, 60, 70, and 80 may be called by dialing a single digit. The normal tens digit is dialed as described in 2.01 to 2.12, which results in the operation of one of the tens dialed relays TD-. The TD- relay operated locks to off-normal ground and grounds one of the ST- leads.

2.26 The single digit dialing, timing, and control circuit FSB utilizes the turn-on characteristics of a 3-terminal PNP transistor. This transistor requires a current of a specified amount in the base for turn-on. In the normal condition the T transistor is in the off condition due to the negative bias on its base through 12B of the STR relay and the 2740-ohm protective resistor RB.

2.27 When relay STR operates, the negative bias is removed from the base of the transistor. The capacitor potential at the midpoint between the RE resistor and the Z diode starts to rise towards ground (positive) until the breakdown point of the zener diode (Z) is exceeded. At this time the base potential starts to rise. Resistor RC is used to drain off a fixed amount of current and therefore sets the minimum amount of current required to turn on the transistor over the range of base turn-on currents encountered in this type of transistor. When the voltage reaches a magnitude such that the base is forward-biased the transistor will switch

to the on stage. Current will flow through the SD relay which operates. The difference in time between the operation of relays STR and SD is a function of T1, R, RE, and RC. This time delay can be adjusted to 3-1/2 seconds using potentiometer R.

2.28 Relay SD operated (a) grounds lead CO to operate the units dialed relay UDO, and (b) operates the units digit relay UD. Relay UD operated in turn operates the digits complete relay. DC and register completion is as described in 3. With the operation of relay DC or the release of relay STR, negative battery is again placed on the base of the transistor. This negative battery, however, is insufficient to cause the transistor to cease conducting. Conduction ceases allowing the SD relay to release when ground is removed from the ST- lead. Contact 8 of the SD relay is for test purposes only.

### I. Single-Digit Dialing 8 for Long Distance (Option ZK)

2.29 To single-digit dial 8 for the long distance operator, the single digit dialing equipment for stations is used and option ZK added. With this arrangement the tens digit 8 is reserved for long distance. When the tens digit 8 is dialed, relay SD operates as described in 2.25 to 2.28. The operation of relay SD: (a) translates the tens digit 8 into a tens digit 9 by transferring ground from lead T8 to lead T9 which operates relay OT, (b) operates relay UDO, (c) disconnects ground from contacts 2 and 12 of relay OT to prevent the selection of central office trunk units 5 or 9, and (d) connects lead LD from central office trunk units 6-9 to the marker. When the register completes to the marker (as in 3.) the marker will make a connection to one of the central office trunk units 6-9.

2.30 The central office trunk units are connected to a toll subscriber line circuit. They also are removed from the regular hunting arrangement used for 1- or 2-digit code 9 dialing. The trunks are made busy to the marker unless a code 8 has been dialed.

### "TOUCH-TONE" CALLING - TYPE A2 OR A3 RECEIVER CIRCUIT

2.31 When making a TOUCH-TONE call, the station or attendant obtains dial tone in the usual manner. Depressing the proper keys on the TOUCH-TONE dial transmits a low and a high tone to the pushbutton calling receiver that is associated with the dial pulse register.

2.32 The pushbutton receiver responds to the 2-tone receiver and in turn (a) operates relay STR, and (b) operates one of the L1-L4 and one of the H1-H3 relays in the translator circuit. The operation of these relays in the translator circuit (a) operates relay KRA- over lead KRA- and (b) operates

one of the tens digit relays (TDO-9) over its respective lead (KPO-9). Relay KRA-operated (a) operates relay P2A in the pulse counter circuit, which locks through its own contacts to off-normal ground, and (b) prevents relay P3 from operating. The operated tens digit relay locks operated through its own contacts and also grounds the associated tens lead (T2-T0) to the marker tens connector circuit. Relay KRA operates relay SW, which in turn operates steering relay STR1. Relay STR operated transfers the (KPO-9) leads from the tens digit relay to the unit digit relays (UDO-9) and locks operated to off-normal ground.

2.33 After approximately 45 seconds the receiver will release all operated relays in the translator circuit and relay KRA will also release. When the second pushbutton is depressed the receiver will again respond to the two tones and operate relay STR and one of relays L1-L4 and H1-H3, to (a) operate relay KRA over lead KRA, and (b) operate one of the units digit relays UDO-9 over its respective UDO-9 lead. Battery for the operation of UDO-9 relays is furnished over lead B and locking ground over lead A. Relay KRA operated (a) releases relay SW, and (b) operates relay UD which locks operated to off-normal ground. The one operated UDO-9 relay locks operated and connects ground to the marker units selection circuit over the associated UO-9 lead.

#### "TOUCH-TONE" CALLING TYPE C1 RECEIVER CIRCUIT

2.34 The pushbutton receiver responds to the 2-tone receiver and in turn grounds STR lead and operates KRA relay. The translation relays are associated with the PBX receiver circuit and it in turn grounds the proper KPO-9 leads that operate the proper tens and units relays. The KRA relay advances the register as described in 2.31. All other functions are the same except the translation relays are in the receiver circuit.

2.35 After approximately 45 seconds this receiver will release all operated relays in the translator circuit and relay KRA will release. Relay KRA released operates relay DC, which functions as described in 3.

### 3. REGISTER COMPLETION TO MARKER

#### DIAL COMPLETION (SC-1, SC-4)

3.01 When RA restores to normal after completion of the units digit or when UD operates on calls to a trunk code, DC operates. DC operating is an indication that the register is ready to transmit its stored data to the marker. DC: (a) operates the register relay R (0-1) in the tens selection circuit in the marker, (b) closes battery through for the class call information to the marker, (c) opens the battery supply for

PU, (d) transmits the register terminating ground on lead RT to the alarm, transfer, interrupter, and test circuit, (e) prepares the operate path for RRL (A, B), (f) opens the operate path for SW, (g) locks relay L through its tertiary winding, and (h) places a 200-ohm bridge across the tip and ring conductors if COT is not operated. This 200-ohm bridge is required by the junctor in the establishment of junctor class calls.

#### TRANSFER OF REGISTER DIGITS AND CLASS INFORMATION (SC-1, SC-4)

3.02 After the units digit has been dialed or when the artificially generated units digits have been prepared on a trunk call, the full called number information is available to the marker. When DC operates R- in the marker, the marker functions to terminate the call and accepts the digit information accordingly.

3.03 If the call is from a station to a station or from a tie trunk to a station, a junctor class of call exists. On a junctor class of call, when DC operates the junctor terminating relays JT (A, B) in the marker operate through the normally closed contacts on OT, TR, and COT. All other types of call will require that OT, TR, or COT be operated individually or in combination so that a trunk class of call exists. The register cut through relays RCT (A, B) in the marker operate when DC operates on a trunk class of call.

3.04 If the call originates in a central office or ringdown tie trunk, battery is fed to the central office terminating relay COT (A, B) in the marker over leads CT (A, B). If a trunk code is dialed the TT relay will operate through contacts of the operated TR and COT relays. The register then transmits TR (0, 1) ground to the marker through TT operated contacts so that when the register connector relay RCB (0, 1) operates in the marker, the originating central office or ringdown tie trunk will have the information necessary to function with a trunk. When the register connector relay RCA (0, 1) in the marker operates, RV operates and reverses the tip and ring of the register connection to the calling central office or ringdown tie trunk. This battery and ground reversal trunk is required for the proper operation originating central office or ringdown tie trunk.

3.05 As stated above, if a call from a central office or ringdown tie trunk is completed to a ringdown tie trunk, the TR relay in operating will operate the TT relay through contacts of the operated COT relay. Another effect of having the TT relay operated for this type of call is that it causes the pad control relays in the originating or terminating (or both) ringdown tie trunk to operate from the trunk to operate from the ground on the TR (0, 1) leads.

## PEG COUNT

3.06 When either TT or COT functions, the originating peg count traffic register operates over leads PCG and TPC or OPC via the marker.

## CALLED LINE IS BUSY (SC-20)

3.07 If a calling station or dial repeating tie trunk dials a called line which is busy, the marker routes the call to the busy tone trunk, which returns busy tone to the calling line. If, however, the busy tone trunk is engaged and the marker finds the called line busy, the marker requests the register to return busy tone to the calling line.

3.08 Relay BY- in the marker operates BY in the register, which feeds busy tone through the tone coil in the register to the calling line or trunk. BY locks through its own contact to ON ground, opens the RR (A, B) and DC- leads to the marker, and releases DC, thus preventing release of the register until it times out (as explained in 5.10), or until the calling line disconnects, whichever is earlier, thus preventing the reseizure of the marker after it once releases from the connection and prepares an operate path for RRL (A, B).

4. RELEASE OF REGISTER (SC-1, SC-2, SC-3, SC-10)

## GENERAL

4.01 The register is released under condition of (a) normal release by the marker, or (b) time-out due to marker or register malfunctioning.

## ABANDONED CALL

4.02 If the calling line disconnects before the marker releases during the origination of a call, L releases. L releases SR, which in turn releases ON, RH-, and MH-.

4.03 If the calling line disconnects after DC operates and the marker has been engaged, the marker will, when it tests for the originating circuit, find the line disconnected and will then proceed to time itself out. The marker then functions to operate its release relays, which transmit release ground over the RR (A, B) leads to the register to operate RRLA and RRLB. Relays RRL (A, B) lock to their own contacts, and open the tip and ring to the calling line, releasing DC, which then releases L, which opens the holding circuit for SR. SR restoring to normal releases ON, which releases the rest of the register and reallots it for subsequent usage.

## NORMAL RELEASE

4.04 After the marker has completed its function of terminating a call, its release relays transmit a release ground signal over the RR (A, B) leads which operates RRLA and RRLB. Relays RRL (A, B) lock to their own contacts through the operated ON. RRL (A, B) open the tip and ring leads to the L relay and open the battery supply to the DC relay. When DC releases, the locking path on L is removed and it releases. DC released also opens the 200-ohm bridge across the tip and ring toward the calling line. L releasing opens the holding circuit for SR. SR restoring to normal releases ON, which releases the rest of the register and reallots it for subsequent usage.

## TIME-OUT RELEASE

4.05 If for some reason the marker does not release the register after its functions are completed, TMO operates. TMO operates RRLA and RRLB, which release the register as in 4.02. Further analysis of the case is explained in 5.10.

5. REGISTER TIME-OUT (SC-10, SC-11, SC-24, SC-25)

## GENERAL

5.01 To be sure that the register will not be permanently engaged by a receiver off-hook or by incomplete dialing (thereby reducing traffic efficiency) a timing circuit operates on every register seizure to insure that suitable terminating action occurs to release it within a nominal period of time. This timing circuit consists of relays PU and TMO, which operate from timed pulses originating in the power plant.

5.02 The power plant furnishes two timing pulses, TM and PU, which are of 1/4 second duration and are separated in time by approximately 1/5 second, each of which has cyclic rate of one pulse every 8 seconds. Sequence Chart SC-25 diagrams this grounded timing pulse action.

5.03 Because of the pulse stagger, two timing extremes are possible. The first condition, for minimum time-out, occurs when the PU pulse coincides with the seizure of the register. The PU pulse duration is long enough for the slow operate PU relay to function. PU prepares the operate path for TMO. Eight seconds later, the TM pulse occurs, operating TMO. The second condition, for maximum time-out, occurs when the tail end of the PU pulse is just passing as the register is seized. Under these conditions, the register has to wait approximately 7.5 seconds before the next PU pulse arrives.

When the PU pulse does arrive, PU operates preparing the operate path for TMO. Eight seconds later the TM pulse occurs, operating TMO. Thus, the time-out extremes are approximately 8.0 and 15.5 seconds, respectively.

5.04 In a normal call PU will have its battery supply fed through the normal break contacts of SW and DC. SW operates when RA releases after the first digit is dialed, but releases when the dial goes off-normal for the second digit, if PU has not previously operated.

5.05 In a normal call, with PU operated after the first digit has been dialed, SW operates and locks to PU. When DC operates on dial completion, the battery is removed from PU. PU releases causing SW to release. SW normal provides battery to PU again, preparing PU for reoperation when the PU ground recurs. The register is thus re-timed upon dial completion.

**PERMANENT SIGNAL TIME-OUT**

5.06 When ON operates and if the PU ground pulse is present, relay PU operates and locks through its own contact to ON ground. Since no dialing action takes place, when the TM ground pulse appears TMO operates. TMO operating, with DC normal, supplies ground to the TO and UO leads, and operates OT in the register and RCT- and R- in the marker. This is a trunk class of call and is routed to the attendant, as an intercept call explained in 2.11.

**PARTIAL DIAL TIME-OUT**

5.07 If only the first digit of a directing code is dialed before time-out, a partial dial condition exists. Under this condition, the tens digit is registered in TD-. With PU operated when the TM ground pulse appears, TMO operates. Operation of TMO: (a) removes the ground from the respective T- and U- leads, which have dialed information standing on them, (b) supplies ground to the TO and UO leads, and (c) operates OT in the register and RCT- and R- in the marker. This is a trunk class of call which is routed to the attendant as an intercept call, as explained in 2.11

**A. ZO Option**

5.08 When a call is routed, as explained in the above paragraph, to an attendant trunk using R option, ZO option must be provided. R option in the attendant trunk is provided to give reverse battery supervision on calls from dial tie trunks.

5.09 When a station line is routed to an attendant trunk as outlined above, relay DC is normal and relay L is in parallel with the A relay in the attendant trunk. Under some long station loop conditions,

relay A may not receive sufficient current to operate when R option is provided in the attendant trunk, due to the higher operate value of the R option A relay. ZO option places the 200-ohm H bridge across the line, with the TMO relay operated to insure the operation of relay A in the attendant trunk.

**TIME-OUT AFTER DIAL COMPLETION**

5.10 If for some reason the register is not released by the marker upon completion of its functions, the register times itself out and releases. With DC or BY operated, the operate paths for RRLA and RRLB are prepared. When PU releases SW as explained in 5.01, or DC releases when BY operates, the reoperate path for PU is prepared. The timing sequence of PU and TMO follows. When TMO operates, RRLA and RRLB operate and the register releases as in 4.02.

**6. REGISTER TESTING**

**GENERAL**

6.01 When the register is to be tested, the No. 310 plug of the test cord is inserted into the TST jack in the register. Insertion of the plug into the jack causes RT to operate. RT operating: (a) opens the tip and ring towards the marker, (b) closes the tip and ring toward the register through to the test cord, (c) prevents THM-8 and THM-9 in the marker from operating, (d) prevents marker seizure by opening the ground to leads DC (1, 5) and DC (3, 7), (e) lights the RT lamp in the register and the TR lamps in the cordless position circuit and alarm circuit, indicating that there is an off-normal condition to be cared for in the PBX, and (f) makes the register busy to the marker by opening the ONG lead ground.

**Caution:** When testing the 293A (TD- or UD-) relays, avoid the use of any testing equipment which might permit currents over 0.5 ampere to pass through the reeds. Do not use headsets with low resistance receivers, such as the 56-ohm 528 receiver or the 1011G hand set, unless a 1000-ohm resistor is put in series with the unit. Such a resistor has been made available in SD-65743-01, the alarm, transfer, interrupter, and test circuit, as the RB resistor (terminal HRB) located on slide 6 of the PBX. When using a lamp as the testing device, take particular care that tungsten filament lamps are not used.

**SECTION III - REFERENCE DATA**

**1. WORKING LIMITS**

1.01 Maximum External Loop Resistance - 2000 ohms.

**VOLTAGE LIMITS**

<u>Voltage</u>	<u>Minimum</u>	<u>Maximum</u>
-48	-45	-52

2. FUNCTIONAL DESIGNATIONS

2.01 The functional meanings of the designations of the relays of the register are listed below.

<u>Designation</u>	<u>Meaning</u>
AC	Attendant Connector
BY	Busy
COT	Central Office Terminating
DC	Dial Completion
H1-H3	High Tone
KPC	Key Pulsing Connector
KRA	Key Pulsing Register Advance
L	Line
L1-L4	Low Tone
ON	Off-Normal
OT	Only Tens
P1-P5	Pulse Counter
P2A	Pulse Counter Auxiliary
PU	Pick Up
RA	Register Advance
RRL (A, B)	Register Release
RT	Register Test
RV	Reversing
SD (0, 1)	Single Digit
SR	Supervisory
STR	Steering
SW	Switching
TD (0-9)	Tens Digit Register
TLA	Toll Allowed
TLD	Toll Denied
TMO	Time-Out
TR	Two-Digit Trunk
TT	Trunk Terminating
UD	Units Digit
UD (0-9)	Units Digit Register
STR1	Translator Steering
POS (1, 2)	Position

3. FUNCTIONS

- 3.01 Make itself busy either with the register engaged on a service call, or the register under test of make busy by means of a plug in the test jack.
- 3.02 Time and generate a units digit 0 when single digit dialing is required.
- 3.03 Hold the register work and memory hold magnets in the marker under control of a slow releases supervisory when the marker releases.
- 3.04 Register originating class of service and/or class of call when seized by the marker. This data may be retransmitted to the marker on completion of the call for terminating circuit usage.
- 3.05 Transmit dial tone to the calling line when the register has been connected to the line and is ready to receive dial pulses.
- 3.06 Disconnect dial tone after the second pulse of the tens digit has been received.

- 3.07 Count the number of pulses in each digit.
- 3.08 Register the units digit count on a group of 10 tens register relays on a 1 out of 10 basis.
- 3.09 Register the units digit count on a group of 10 units register relays on a 1 out of 10 basis.
- 3.10 Utilize the counter relays as the units digit register. (Mfr Disc.)
- 3.11 Recognize that only one digit is to be received on calls to the attendant.
- 3.12 Recognize that one or two digits are to be received on calls to a central office or ringdown tie trunk depending upon the option provided.
- 3.13 Engage the marker after the units digit has been dialed or after a single digit central office or attendant code has been dialed.
- 3.14 Hold the register after dial completion so that the calling subscriber cannot release the connection while the marker is engaged.
- 3.15 Transfer the class of call and class of service indication to the marker.
- 3.16 Reverse battery and ground to the link connection upon receiving the RV ground from the marker on a call to be terminated from a central office or ringdown tie trunk.
- 3.17 Release when the marker grounds the RR- leads and return to normal.
- 3.18 Measure time, (see Section II, 5. for specific details), 8 seconds nominal, while waiting for the two digits to be dialed. If the digits are not dialed, or are only partially dialed, when the register times out, the line is connected to intercept.
- 3.19 Measure the time between dial completion and release of the register, 8 seconds nominal. If the register does not release in this time due to release ground signals from the marker, the register releases itself and is reallocated for subsequent usage.
- 3.20 Route unequipped number codes to intercept.
- 3.21 Supply busy tone to the calling line when the busy tone trunk is engaged.
- 3.22 Operate a traffic register to record the originating trunk traffic.
- 3.23 Translate a single digit 8 into 90 when long distance dialing is required.

4. CONNECTING CIRCUITS

4.01 When this circuit is listed on a key-sheet, the connecting information thereon is to be followed.

- (a) Marker Circuit - SD-65741-01.
- (b) Alarm, Transfer and Test Circuit - SD-65743-01.
- (c) Power Supply Circuit - SD-81296-01.
- (d) PBX Cabling Diagram - SD-65746-01.
- (e) Cordless Position Circuit - SD-65757-01.
- (f) Auxiliary Relay Circuit for Direct Station Selection by Stations - SD-65942-01.
- (g) Pushbutton Calling Receiving Circuit-SD-95287-01.
- (h) Pushbutton Calling Receiver Circuit PBX Type SD-67027-01.

5. MANUFACTURING TESTING REQUIREMENTS

5.01 The dial pulse register shall be capable of performing all the service functions specified in this circuit description and meeting all the requirements of the Circuit Requirements table and also shall be capable of functioning under test conditions listed below.

- (a) The pulsing and counting functions of the register shall be checked with the following conditions: A precision pulse generating circuit such as SD-25680-0113 or equivalent capable of generating dial pulses within the limits of accuracy given in Fig. 1 in the Information Note 301 on the SD.
- (b) Nominal circuit conditions may be employed in these tests except as specified in (d) and (e).

(c) The pulsing and counting features of the register circuit under test shall be checked using the pulsing and loop conditions covered in Note 301 on the drawing. Two digits, a digit of less than five pulses (preferably a 2 or 3) followed by a digit of more than five pulses (preferably a 9 or 0), shall be dialed under each condition and all digits dialed shall be correctly registered.

(d) The test circuit shall provide an interdigital interval of  $183 \pm 13$  msec for the pulsing conditions of Fig. 1C. For other pulsing conditions this time may be exceeded.

(e) All timing and operation tests shall be performed with the test voltages within the limits of 45 to 52 volts.

6. TAKING EQUIPMENT OUT OF SERVICE

REGISTER CIRCUIT

6.01 The register can be taken out of service by inserting a No. 258 plug in the TST jack in the register unit.

Note: Make sure that the register is not in use before inserting the No. 258 plug.

SECTION IV - REASONS FOR REISSUE

B. Changes in Apparatus

<u>B.1 REMOVED</u>	<u>REPLACED BY</u>
F2A Relay AF63 Fig. 1 ZX Option	F2A Relay AK30 Fig. 1 ZY Option
<u>B.2 ADDED</u>	
App. Fig. 9 (DT) Resistor KS-13490, L1 3000-Fig. 8	

D. Description of Changes

D.1 Options ZW, ZX, and ZY are added. Circuit Note 109 is added.

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