GTE AUTOMATIC ELECTRIC
TYPE 101 (METRO) DIRECTOR SYSTEM
OPERATION

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1. GENERAL

1.01 This section provides information on the operation of the GTE Automatic Electric Type 101 (Metro) Director System. The operations covered are primarily for two of the Director System's essential components, the Register-Sender and the Translator.

1.02 Information on other 101 Director System components can be found in related Sections of the 240-202 and 240-205 series of GTE Practices.

2. REGISTER-SENDER ACCESS EQUIPMENT

Interconnection with Step-by-Step

2.01 The basic purpose of the Register-Sender Access Equipment is to provide interconnection between step-by-step switching equipment and a Director system. The interconnection is provided for:

(a) connection of the customer's loop via the linefinder to the register's input circuit.

(b) connection of the register-sender's output loop to the local selector.

When the functions of the Director system are completed for a call, the access equipment connects the linefinder to the selector, releasing the register-sender from that call. For additional information on Register-Sender Access Equipment consult the related sections of the 240-205 and 240-206 series of GTE Practices.

3. REGISTER-SENDER

Seizure and Reset

3.01 An idle register-sender is seized via the chain circuit shown in Figure 1. When a register-sender is idle, its R relay is operated. If the first register-sender is busy (relay R restored), ground from the link finder control circuit on lead FIA is extended on lead FOA to lead FIA of the second register-sender via the chain circuit. If the second register-sender is idle, ground is extended to lead ARA, which allows the access equipment to seize the register.

3.02 Once the R relay is restored (register-sender busy), it is not reset when the register-sender becomes idle. When all the R relays in a register-sender group are unoperated, the access equipment provides a reset mark to all of the R relays which resets all of the idle register-senders. In this manner, calls are distributed to prevent excessive use of any one register-sender.

Input Information

3.03 When the register-sender is ready to receive information, it returns dial tone to the customer calling for service. The call for service may originate from normal or abnormal conditions. Normal conditions being any which allow complete processing of a valid call, and abnormal conditions are any which arise from an invalid call or prevent call processing.

3.04 Normal conditions will consist of either digits dialed from a dial telephone or DTMF (dual tone multifrequency) digits from a Touch Calling telephone and possibly a class-of-service

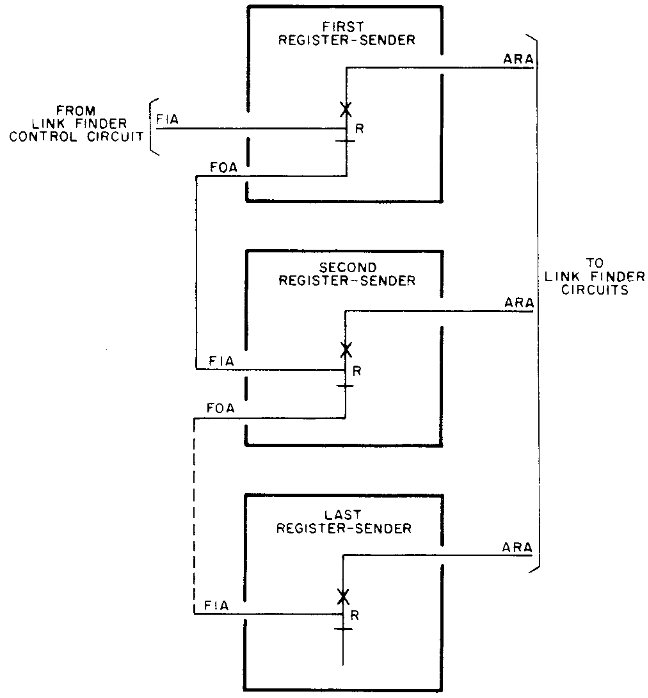


Figure 1. Chain Circuit.

mark on the EC lead and/or a TDM (time division multiplex) class-of-service mark on the C lead.

3.05 Abnormal conditions include permanent seizure of the loop, delay in dialing, excessive dialing, and hits (intermittent short circuits across the loop). All conditions will be discussed in subsequent paragraphs.

Digit Registration

3.06 Digit registration is accomplished in three steps:

(a) reception and recognition of the digit.

(b) conversion from input form to 2/5 coded form.

(c) distribution and storage.

Steps (a) and (b) differ for dialed digits and DTMF digits; however, step (c) is always the same.

3.07 Reception and recognition of the dialed digits is provided by the A and PR1 relays, the input counting chain, and its counting buffer. The A relay in the register-sender is the termination of the customer's loop. This relay follows the incoming dial pulses of each digit (as long as the register stays with the call) and causes the pulse repeating relay PR1 to follow the dialed digits. As the dialed digit is repeated by the relay PR1, it is counted by the mercury wetted relay counting chain. During the interdigital pause, the digit stored in the counting chain is converted to 2/5 coded ground marks which are forwarded for storage. By the end of the interdigital pause the digit has been stored, and the counting chain and buffer are reset; ready for the next digit.

3.08 Digits are distributed to storage in the register via five levels of the input rotary switch SQI. The wipers of the rotary switch are connected to both input digit converting circuits. The banks are wired so that each step of the rotary switch places each new digit is a succeeding storage area.

3.09 Rotary switch SQI is stepped off its normal position during seizure of the register, thereby connecting its wipers to the first storage area. The register is then ready to receive and store the first digit. A control relay (CB) is operated during reception and conversion of the incoming digit. Relay CB energizes the SQI motor magnet. During the interdigital pause while the digit is being stored, relay CB releases, thereby releasing the SQI motor magnet which steps the wipers to the next storage area. The combined release time of CB and SQI is sufficient to allow complete storage of each digit.

3.10 Each storage area contains five printed wiring card mounted correeds. 2/5 coded ground marks are forwarded by rotary switch SQI causing two of the five correeds to operate. The operated correeds lock via a set of their own contacts to store the digit.

3.11 The locking ground is provided by a control relay that operates during register seizure and remains operated throughout call processing, holding the digits in storage. Upon register release the locking ground is removed, clearing storage for the next call.

3.12 There are two storage areas per printed wiring card, therefore each step of the rotary switch stores a digit on one half of a card. There is provision for a total of seven cards which can store up to thirteen digits. Half of card seven is not used at this time.

Touch Calling Receiver

3.13 A touch calling receiver is provided for each register-sender whenever the Director System is serving DTMF traffic. The receiver provides:

(a) reception and recognition of the keyed digits.

(b) conversion from 2/8 DTMF code to 2/5 coded ground marks which are forwarded for distribution and storage (paragraphs 3.08 through 3.12).

3.14 There is no special action required of the register-sender to receive DTMF digits. When the register is seized, the customer's loop is extended to the input of the Touch Calling receiver and also to the A relay (paragraph 3.07). If the incoming digits are DTMF, the receiver will perform its functions. The Touch Calling receiver connected across the line, will not interfere with calls from dial telephones.

Class-of-Service Mark

3.15 There are two methods that can be employed to determine the class of the calling line. The first method utilizes an EC lead, through the access equipment, arranged to furnish one of three different class-of-service marks. This can be accomplished by treating an entire linefinder group as a single class, by level grouping via normal post springs on the linefinders, or by marking from the line equipment over the EC lead through the linefinder banks. The required markings are received as shown in Figure 2.

3.16 The class-of-service mark for the calling line provides one of three conditions on the EC lead:

(a) Class 1, no connection (absence of ground).

(b) Class 2, 2000-ohm resistance ground.

(c) Class 3, direct ground.

As shown in Figure 2, with no connection to the EC lead (absence of ground), neither relay SA nor relay SB operates. Lead TB is closed to lead CSA. The potential closed to lead TB through unoperated contacts of relays SA and SB to lead CSA indicates a class-of-service 1 mark.

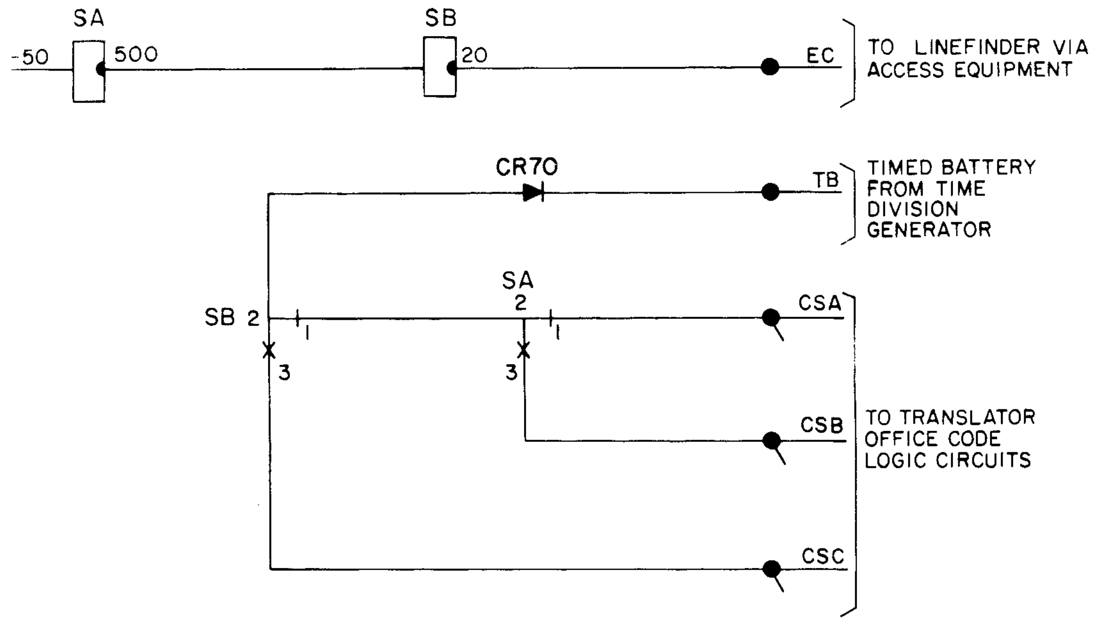


Figure 2. EC Lead Class-of-Service Markings.

3.17 When 2000-ohm resistance ground is closed to lead EC, relay SA operates in series with relay coil SB (relay SB does not operate from 2000-ohm ground), and closes lead TB from lead CSA to lead CSB. The potential closed to lead CSB indicates a class-of-service 2 mark.

3.18 When direct ground is closed to lead EC, relays SA and SB operate in series and close the potential on lead TB to lead CSC. The potential on lead CSC indicates a class-of-service 3 mark.

3.19 A strapping option is available to control the dial mode mark to the translator (Paragraph 3.28) through any one of the EC lead class-of-service marks.

3.20 The second method of class-of-service marking is called time division multiplex (TDM). It uses positive 24-volt pulses that are produced in the register by the time division power supply. These pulses are sent from the register through the access equipment and linefinder on the C lead of the calling line. The C lead of each line requiring a special class is terminated at the central distributing frame and connected to a TDM class-of-service access circuit (diode-resister isolating network). Any quantity of lines can have the same TDM class-of-service, but only one TDM class-of-service is permitted per line. The outputs of the individual isolating networks for all lines of the same class are grouped on one lead that goes to a class-of-service detector (paragraph 4.12) in the translator. This method does not require the storage of a class mark. There can be 80 TDM classes-of-service provided.

Abnormal Input Conditions

3.21 A permanent off-hook on the customer's loop is taken care of by a timer in the register. Every seizure of a register starts the timer. If the condition does not change (either a digit must be registered or the seizure removed), the timer causes a relay to operate. The time period before the relay operates is adjustable via a front panel control. It is normally set for 20 seconds. The timing relay controls other relays, one of which removes the locking ground, preventing storage of any information in the register digit storage cards.

3.22 The register has two strapable options by which it can complete this function. The first option causes the release relay to drop the access equipment interconnection and return the register-sender to an idle condition. The second option causes the no code relay to indicate a line permanent condition to the translator. The translator sends routing instructions for the register to connect the calling line to a busy tone trunk or an announcement trunk, and for the register to return to idle.

3.23 A "delay in dialing" condition refers to the time period between each successive dialed or keyed digit. This period is also timed by the timer. After the first digit has been registered, relay BB operates and connects another front panel control to the timer. This control is normally set for 10 seconds. If a customer fails to dial a digit within the prescribed interval, the timing relay operates causing the locking ground to be opened, erasing any stored digits, and preventing further storage. Strapable options again allow either immediate register release, or a "no code" translation of the call to a busy tone or announcement trunk.

3.24 Excessive digits dialed or keyed into the register will cause a "no code" translation or immediate register release. This function is accomplished by the SQI rotary input switch. When SQ1 is stepped one more time after the maximum number of digits allowed have been registered, an operate path pulls the "no code", or release relay, depending on the wiring option.

3.25 Hits on the line are defined as a short circuit repeated on an intermittent basis. The time duration of a hit as well as the spacing between hits will determine how the register handles the problem. If a single hit is less that 20 seconds (permanent timing) and goes away long enough (a few hundred milliseconds), the register and access equipment will release. A succeeding hit would appear as a new call for service and be assigned another register. All other hits will sooner or later fall into one of three other abnormal catagories and be treated accordingly.

First Digit Functions

3.26 Functions of the register-sender that are based on the occurrance of the first digit being registered include:

(a) Changing the timer from "line permanent" to "delay in dialing" for abnormal condition timing.

(b) Removing dial tone.

(c) Providing a dialing mode mark.

(d) Repeating the first dc dialed digit to the selector.

(e) Providing for control and separate storage of prefix digits 1 and 0, and marking prefix leads to the translator.

3.27 During first digit registration, when relay CB operates (paragraph 3.09), it energizes relay DT which removes dial tone from the loop. Relay DT locks via a set of its own contacts and remains operated until register release. (When the Director system is involved with a PABX, a register-sender option will allow the use of dial tone a second time based on a translator command. See paragraph 3.58.)

Dialing Mode Mark

3.28 When a call is initiated, the register-sender indicates to the translator, on lead TCM (Touch Calling Mode) or lead DPM (Dial Pulse Mode), the type of calling telephone. The purpose of this mark to the translator is to allow for different route instructions so the register can handle calls from the two different telephone types. The register must store all DTMF digits (provide translation if necessary) and resend any or all digits; however, for some dial pulse calls the register can release early (paragraphs 3.54 and 3.55) and have the remaining digits pulsed directly into the switchtrain.

3.29 The dial mode mark can be made on either a non-class mark basis or on one of the three EC lead class-of-service marks as shown in Figure 3.

3.30 During register-sender seizure the touch call relay is operated in anticipation of a DTMF call. The operated relay contacts provide a mark on lead TCM. If the call is via DTMF mode, the relay remains up until register release. If the call is via dial pulse mode, the touch call relay will be released during first digit registration and its contacts now provide a mark on lead DPM. The touch call relay is part of the register-sender and its operation remains the same whether or not touch calling service is provided.

Repeat First DC Dialed Digit (Options)

3.31 Two options are available for repeating the first dial pulsed digit to the selector. The DSA-DSB strapping option will cause the first dc dialed digit from any line to be repeated. The W wiring option will cause the first dc dialed digit to be repeated only when the call originates from a

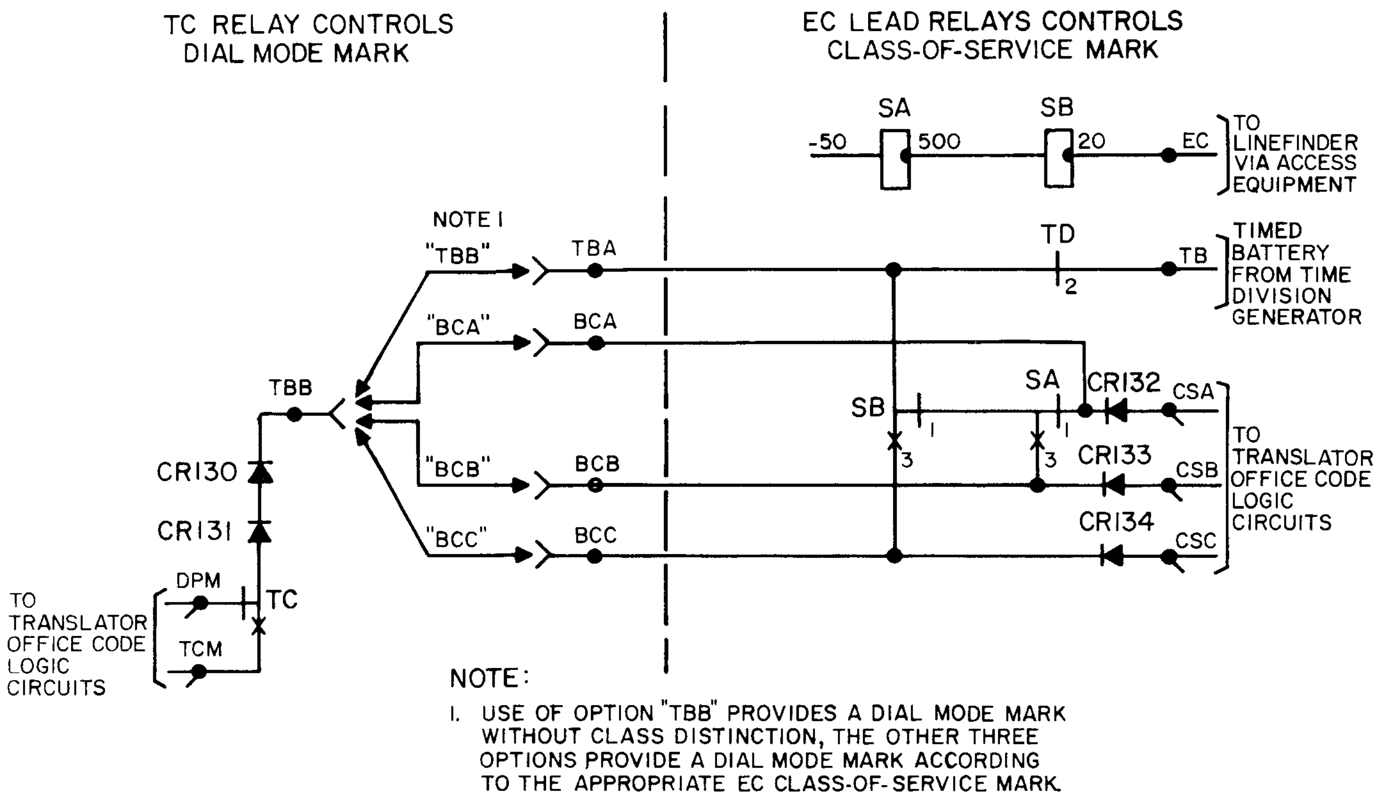


Figure 3. Dial Mode Markings.

line with a class-of-service 3 mark on it (paragraph 3.18).

3.32 The DSA-DSB strap provides a ground during seizure of the register through unoperated relay BB contacts to the DS relay. Relay DS operates and removes the short circuit across the contacts of pulse repeating relay PR2 in the outgoing loop. When a digit is dialed, relay PR2 follows relay A thereby repeating the dialed pulses to the selector. After the first digit has been registered, relay BB operates opening the path to relay DS. Relay DS restores, placing the short across relay PR2, and holding the output loop closed to the selector.

3.33 The operation of the circuit for the W wiring option is the same as DSA-DSB strap option. The only difference is in the operate path of the DS relay. The contacts of relay SB are used in place of the DSA-DSB strap. When a call is placed from a line with a class-of-service 3 mark, the SB relay operates forwarding ground to operate relay DS. Operation then continues as outlined above.

Prefix Digit Control

3.34 When the first digit received is a 1 it will be stored in the normal digit storage, and simultaneously by relays on the prefix digit card. During the interdigital pause, prefix digit control relays prevent rotary switch SQI from stepping (paragraph 3.09). They open the locking ground of the first storage area, removing the 1 stored there. After the interdigital pause, another prefix digit control relay operates due to relay CB releasing, marks the 1+ lead to the translator, and restores locking ground to the first storage area. The second digit will now be stored in the first storage area, the third digit stored in the second area, etc. As second digit registration occurs, the prefix control relays, holding rotary switch SQI so it won't step, are by-passed allowing normal distribution action of SQI.

3.35 There are two types of 0 traffic; 0- (zero minus) operator calls and 0+ (zero plus or EDDD) long distance calls requiring operator assistance. If an office handles both types of 0 calls through the same switchtrain, there is no need to differentiate between 0- and 0+ calls, the operator will. For such an office, immediate translation to route all 0 traffic will result upon registration in regular storage of a 0, and prefix digit control pertaining to 0 calls will have no effect.

3.36 When an office is arranged to have a separate route for the two different types of 0 traffic, the register differentiates between 0- and 0+ calls.

3.37 When the first digit is a 0, it will be stored normally and also stored by a prefix digit card relay. Registration of the 0 starts a timer in the register (normally set for 4 seconds), if a second digit is registered before the timer times out, the call becomes 0+ traffic; however, if no other digit follows within the time allowed, a relay is operated, and the call becomes 0- traffic.

3.38 The operated timer relay (due to 0- traffic) causes the following to occur:

(a) Momentary opening of the locking ground of all digit storage areas (removing the stored 0).

(b) Operation of relay CL providing either of the following options:

(1) TL wiring (translator logic) - a mark on the CLR lead to the translator, which will produce the desired routing of the call.

(2) SL wiring (strapped logic) — provides the desired routing of the call (without use of the translator) via strapped information within the register.

3.39 Having registered a zero and started the timer, if a second digit is received (relay CB operated) before time out, the digit will be stored and the timer reset. Now the call will be treated as a 0+ call.

Alternate Route Attempt Marks

3.40 The expanded routing printed wiring card gives the register the capacity to provide up to four possible routes to process a call. Each route is based on a different attempt lead marked to the translator. The four leads (LRA, LRB, LRC, and LRD) are controlled by four of the relays (RA, RB, RC, and RD) on the expanded routing card. During register seizure, relay RA is operated marking attempt lead LRA to the translator. Further information on alternate routing is given in paragraphs 3.74 through 3.85.

Call Data Available to the Translator

3.41 The preceeding paragraphs have detailed the source of origination and amount of all data which can be collected about a call. Some of this data is used directly by the register-sender in processing a call, however, most of the data is made available to the translator.

3.42 The data made available to the translator (Figure 4), is presented on leads called translator commons that are marked by:

(a) Contacts of digit storage correeds.

(b) Other data relay and correed contacts.

(c) TDM class-of-service positive signals.

The number of leads marked and the arrangement of those marks represents the specific information about a call at a given time.

Transfer of Call Data

3.43 Transfer of data from the register to the translator is accomplished by timed battery. Each timed battery pulse (from the time division generator) comes into the register and is distributed to all data relays and correeds. It then appears on those individual leads of the translator commons which are marked, thus presenting the data to the translator.

3.44 Because each register is being scanned at a rapid rate by the timed battery pulses, any data gathered about a call will be immediately presented to the translator. Therefore, as the number of 2/5 coded digits in storage increases, the number of digits (and possibly other data) presented to the translator increases.

Translation Returned

3.45 When sufficient data is presented, the translator turns on a route amplifier sending (via timed battery) one or more route instructions and

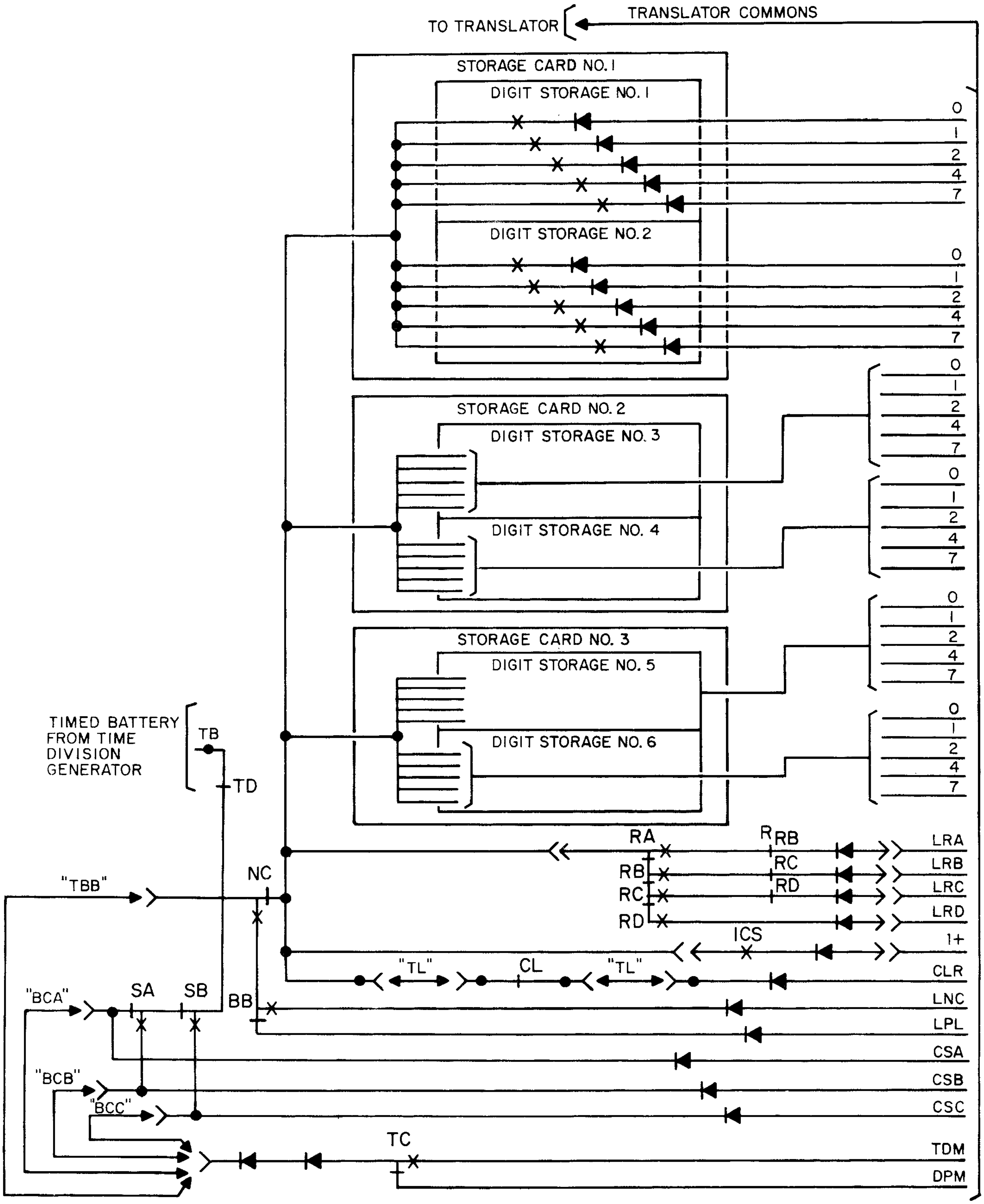


Figure 4. Call Information Available to Translator.

possibly one or more AR marks over the route commons to the register-sender.

3.46 A route instruction will consist of either a route digit (in 2/5 code) to be outpulsed, or a register command (in 3/5 code) to control the local switchtrain (between outpulsing of route digits) and register functions. An AR mark is used to give the register a "release command" after the stored digits are sent, or as an "alternate route possible" command prior to sending the stored digits.

3.47 Route instructions and AR marks are sent from the translator to the register-sender via the route commons. The route commons terminates on six levels (D, E, F, G, H, and J) of the SQO (Sequence Out) rotary switch.

Route Commons and Rotary Switch SQO

3.48 Levels D through J of rotary switch SQO connect route instructions, AR marks, and thirteen digit storage areas to the register instruction detect relays, consisting of one L relay and five T relays (Figure 5).

3.49 Level J of rotary switch SQO has all of its bank contacts (1 through 25) connected to route commons and its wiper connected to relay L to provide the AR marks. Levels D through H of SQO have their bank contacts 1-12 connected to the route commons to receive route instructions, and bank contacts 13-25 connected to the storage areas for stored digit readout. The wipers of levels D through H, of SQO, are connected to the five T relays (T0, T1, T2, T4, and T7) which provides decoding of the route instructions and stored digits.

3.50 Rotary switch SQO is stepped off normal during register seizure, and its wipers are setting on the bank contacts of the first space ready to receive the first routing instruction. As routing information is received from the translator, and each instruction is carried out, rotary switch SQO is advanced (one or more steps depending on the information received) to the next instruction. When all routing digits have been outpulsed an "advanced" sequence will cause rotary switch SQO to advance to the eleventh (L) or twelfth (M) step where the "delete digit" command is given (how many of the stored digits are not to be sent). The delete digit causes rotary switch SQO to step to the proper storage area. Outpulsing begins.

Operating the L and T Relays

3.51 Timed battery pulses are extended from the translator (through the route commons and rotary switch SQO) to the L and T relays which have the capacitors wired across the No. 1 winding (Figure 5). When sufficient timed battery pulses (approximately five) have been applied to the capacitors, the voltage will be high enough to operate the x contacts of the relays. The relays will lock. Since the timed battery is coded for any single instruction, only those T relays corresponding to the code (and the L relay if there is an AR mark) will receive timed pulses.

3.52 The different combinations of operated T relays and the L relay cause the register-sender to perform its various functions such as repeat the next dialed digit, absorb a digit, outpulse a routing digit, etc.

Command Functions

3.53 When a 3/5 code is received from the translator, it always represents a register-sender command. A path provided by the combination of T relay contacts will cause the specific command relays to operate for that particular function. The command relays and control relays provide any required timing of a command function by using the pulse generator. No routing digits will be outpulsed by the pulse generator or the 2/6 MF sender during the execution of a register command. The register-sender commands; release, repeat next dialed digit, second dial tone, absorb, hold send, MF send, and advance sequence are explained in the following paragraphs.

3.54 For some dial pulse calls, early release of the register-sender can be accomplished after the outpulsing of one or more route digits. (Call originating from customer loops which exceed 1500 ohms total resistance or from touch calling telephones, require the register to remain with the call to store all digits and resend those necessary to complete the call.)

3.55 If the call being placed, can be routed without the necessity of sending stored digits, release can occur interdigitally; that is, in between successive dialed digits. The register will then release from the call and the remaining digits will be dialed directly into the switchtrain.

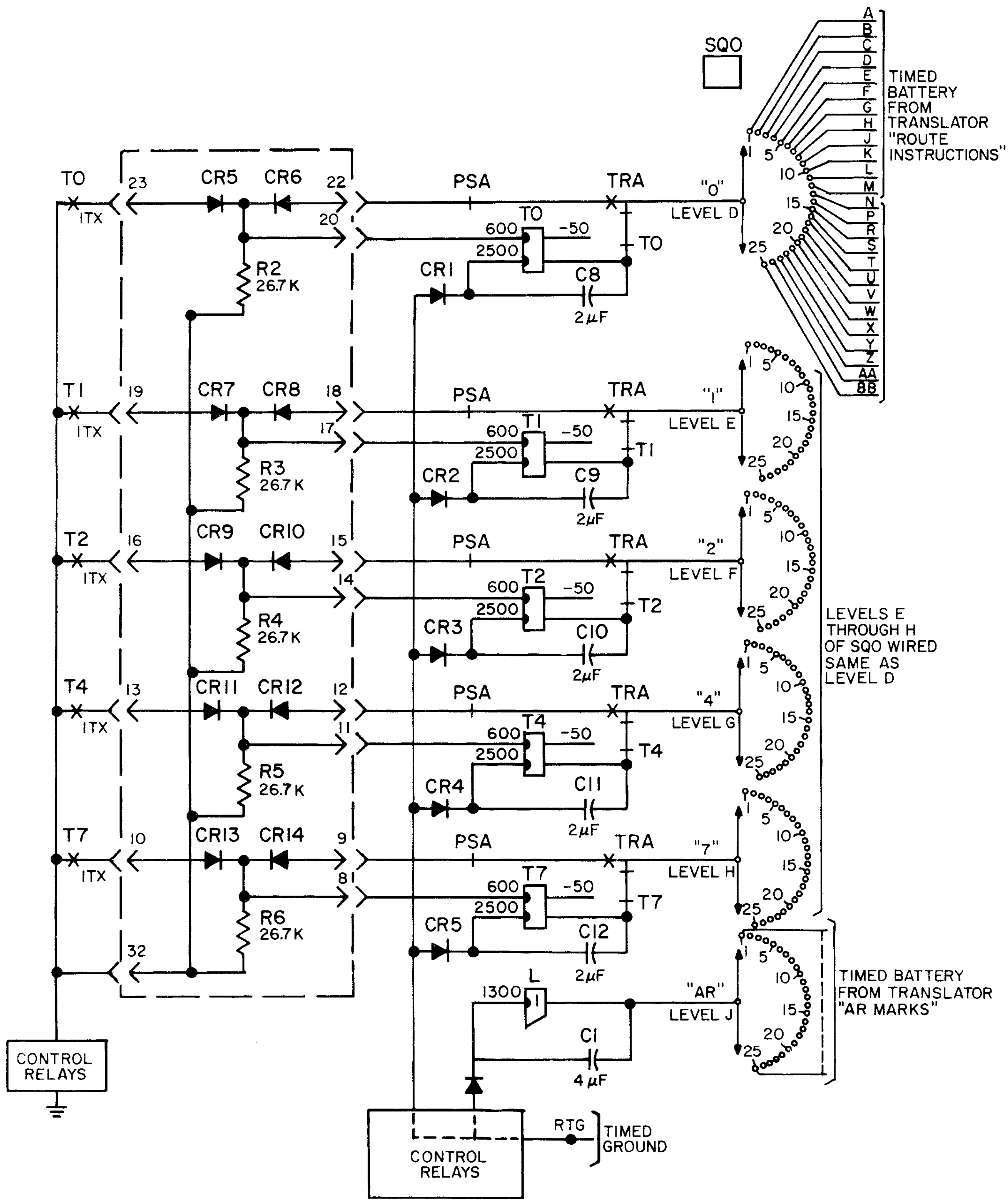


Figure 5. Operation of the "L" and "T" Relays.

3.56 The interdigital release command is code 012. This code operates relay RL which releases the access relay circuit thereby connecting the linefinder and selector together. The access relay circuit breaks the input loop circuit to the register, and causes the register to go through its release pattern, clearing digit storage, homing SQI and SQO, etc.

3.57 The repeat next dialed digit command is code 014. This code operates relay DS causing the next dialed digit to be repeated to the selector. Action is similar to that of paragraph 3.32, except that relay DS is operated by command.

3.58 The "second dial tone" command is code 047. Use of this code is based on the premise that the second dial tone option is wired in the register. Code 047 operates relay SDT momentarily which breaks the lock path of, and releases, the dial tone relay; thereby providing a second dial tone. During the next digit registration, when relay CB operates, it will again operate relay DT removing dial tone as happened during first digit registration (paragraph 3.27).

3.59 The "absorb" command is code 024. An absorb command is used to clear the switchtrain of any digits when there is a possible alternate route(s) available, and also to allow the register to sequence the various alternate route control relays if needed.

3.60 The parallel combination of the contacts of relays T0, T2, and T4 and the contacts of relay AB are in series with the outgoing register loop, and these contacts are all shunted by the set of contacts of relay QS (Figure 6). Relay QS (one of the expanded routing card components) determines whether an absorb command will be on an abbreviated or normal basis. Relay QS remains unoperated as long as nothing has been sent out on the loop, in which case an abbreviated cycle would take place if an absorb command were received.

3.61 Assume that relay QS is operated and a normal cycle will occur. Receipt of the absorb code will immediately open the outgoing loop via the contact combination of relays T0, T2, and T4. The T relays involved are only operated momentarily, long enough to operate relay AB which keeps the loop open. The T relays in operating also start an interdigital pause which provides sufficient time for any selectors to release. After the interdigital pause the AB relay is released, closing the loop again. The register is then ready to receive the next route instruction.

3.62 If relay QS is unoperated and the absorb command is received, the action of relays AB, T0, T2, and T4 will not effect the loop. Another set of QS contacts abort the interdigital pause and relay AB is released quickly thereby shortening the absorb cycle. The register is now ready to receive the next route instruction.

3.63 The "hold send" command is code 027. It is used when a route requires 2/6 MF sending to handle a call. Since long delays between digits are not tolerated when MF sending is used, most digits must be stored prior to outpulsing to another office.

3.64 Receipt of this code will operate relays DS and AB, which lock via their own contacts, placing a direct short across the outgoing loop. This short holds the switchtrain and any digits outpulsed on it. The DS relay prevents any further T relay action (no route instructions can be received) until the "hold send" condition is removed.

3.65 When enough of the digits are received (for the type of call being processed) a four second timer is started. At the end of the time period or if a total of 10 digits are dialed, whichever occurs first, the "hold send" is removed and the register is ready to receive the next route instruction.

3.66 The MF send command is code 147. Code 147 results in operation of relay MF. This changes control of sending stored digits to the MF equipment strip associated with each register.

3.67 The "advance sequence" command is code 017. The advance command is used to step rotary switch SQO to receive a delete digit at either step 12 (M) (if no crankback has occurred) or step 11 (L) (if crankback has occured). See paragraph 3.75 for crankback.

3.68 Code 017 operates relay AS providing a path from level C of rotary switch SQO [which is grounded through step 10 (K)] via the interrupter springs to the SQO motor magnet. (Step L level C is

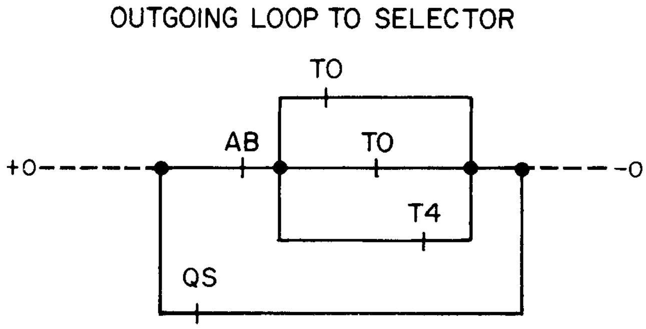


Figure 6. Effect on Outpulsing Loop by Absorb Command.

grounded through expanded route control relays if no crank back has occurred.) The rotary switch steps self interrupted to the correct space and stops, its wipers now connect the delete digit to the T relays.

Automatic Advance Sequence

3.69 The register provides for a maximum of up to five routing spaces in a group per route, with rotary switch SQO wired for two such groups of spaces. The first set of route instructions appear on spaces 1 through 5, with its delete digit on space 12, and the other set of instructions appear on spaces 6 through 10, with its delete digit on space 11.

3.70 When all five spaces are used for a route an automatic advance sequence occurs. At the completion of an instruction on space 5 or 10 the SQO will be advanced to the delete digit space (11 or 12). Spaces 6 and 11 of level B of SQO are unwired and the absence of ground releases an expanded route control relay which operates relay AS. The operation is then similar to paragraph 3.68, except that code 017 was not used.

Routing Digits

3.71 Routing digits are received from the translator in 2/5 code via the T relays. Whenever any two T relays operate, the pulse generator will start. The decimal digit outpulsed by the pulse generator is determined by the combination of T relays energized.

3.72 Adjustment of the pulse generator determines the pulse speed and percent break of the pulses sent to the switchtrain.

3.73 After a digit is outpulsed the outgoing loop is closed, the T relays are released, rotary switch SQO is advanced one step, and an interdigital pause takes place. Then the T relays are ready to receive the next code.

Alternate Routing

3.74 Two different types of alternate routing are available, one is by the use of route markings and the other is the crankback method. By using register route (attempt) marks, up to four separate routes can be examined for an ATB (all trunks busy) condition prior to outpulsing any digits. The crankback method can provide up to two different tries to process a call.

3.75 Crankback alternate routing is based on the fact that two different groups of route instructions may be available on the banks of rotary switch SQO (paragraph 3.69). If the first set of instructions can not be completed, then SQO will advance to the correct space for the next set of instructions.

3.76 Crankback alternate routing is used when an ATB condition is returned from the switchtrain after outpulsing a route digit, or when all route attempt marks fail to locate an idle route.

3.77 If an alternate route is available, an AR mark (to operate relay L) will be sent along with the route digit from the translator. During the interdigital pause, after the route digit is outpulsed, a busy test is made. If the selector encouters an idle trunk the L relay is released and operation proceeds on the same route.

3.78 If the busy test encounters an ATB condition, +24 volt battery is received operating relay BT.

3.79 Relays BT and L operated cause:

(a) an absorb sequence to take place, releasing the switchtrain.

(b) rotary switch SQO to advance to the first space of the next instruction.

(c) The attempt mark relays to sequence to the next attempt mark.

The register is again ready to receive routing instructions.

3.80 Alternate routing with route attempt marks is bases on an AR mark (returned from the translator) along with either a "hold send" or an "absorb" command. These routing instructions can only be programmed in the 1 (A) and/or 6 (F) steps rotary switch SQO.

3.81 The first set of route instructions are based on the LRA attempt mark (Paragraph 3.40) for a high usage or most direct route. Every route, for which there is an alternate, is monitored by an ATB relay in the translator, (maximum of 60 ATB relays). If the ATB relay for the first route chosen by the translator is released, indicating all trunks for that route are busy, an AR mark to operate relay L is sent to the register.

3.82 The combination of relay operated L and the control relays (from either the "hold send" or "absorb" command) cause the expanded routing card relays to sequence, i.e., RB operates and RA releases thereby changing the attempt mark from LRA to LRB, and prevent the rotary switch SQO from being stepped to the next space.

3.83 The LRB mark will cause the translator to produce a different set of route instructions to appear on the banks of rotary switch SQO, with the first instruction on step 1 (A) and the second on step 2 (B), etc. The register will handle the call accordingly, accepting the first instruction from step 1 (A).

3.84 If the second route also has an alternate (and its ATB relay is released), then the process described above will be repeated, producing the LRC mark. Sequencing of the expanded route relays will continue until relay RD is operated and lead LRD is marked.

3.85 If the LRD attempt mark fails to find an idle route, and an alternate route is available, the next AR mark sequence will operate relay RA for the second time causing crankback. A path via contacts of relays RA and RD will allow SQO to step self interrupted until its B wiper encounters absence of ground, step 6 (F). The routing on steps 6 through 10 will then be used to handle the call.

Midpoint and Parity Check

3.86 During an advance sequence, whether automatically or by command, the MP relay is operated, it locks via its own contacts and remains so until register release. The operated MP relay indicates the midpoint of operations for the register. Everything prior to the midpoint was concerned with initial routing of the call, after the midpoint is reached initial routing is finished and all that remains to be done is to send the correct number of stored digits.

3.87 The midpoint signifies three changes in register operation with regard to the marks received by the L and T relays. The midpoint changes are;

(a) The meaning of an AR mark (operating relay L) changes from "alternate route" to "release",

(b) Hereafter the only instructions received by the T relays will be in 2/5 code,

(c) A parity check is made for each operation of the T relays to ensure that only two T relays are operated.

3.88 The AR mark for release is programmed in the translator so that it occurs along with the last digit being read out from storage. The L relay cannot operate until the T relays have been released, therefore, the AR mark operates relay L only after the last digit has been sent. Operated relay L forwards ground via MP relay contacts to operate relay RL. Release action is similar to that described in paragraph 3.56, except code 012 is not used and the call is now completely routed.

3.89 The delete digit and the stored digits, both in 2/5 coding, can be easily checked to ensure the format is correct. When operated relay MP establishes a parity check circuit, and if more than two T relays are operated, the parity check relay operates freezing the action of the register, starting the four second timer. If the trouble clears (two and only two T relays operated) before four seconds elapse, the register continues operation. If time out occurs, busy tone is returned to the customer. When the customer hangs up, the register and access equipment will go through their release patterns.

Delete Digit Registration

3.90 There are two ways in which rotary switch SQO can be advanced to delete a digit. The method used depends upon whether or not the 2/6 MF sending equipment strip is included as part of each register.

3.91 If MF equipment is not present, the delete digit is read and held by the T relays. The pulse generator will step rotary switch SQO, according to the pattern of T relay contacts to the correct stored digit space.

3.92 If MF equipment is provided, the delete digit is read by the T relays and sent to the MF strip relays which produce a specific ground pattern on levels B and C of rotary switch SQO. Rotary switch SQO, via levels B and C and its self-interrupt contacts, advances to the proper stored digit space.

Readout From Storage

3.93 At the end of the delete function relay TRA operates, and changes the operate path of the T relays. Each digit from storage is readout via locking ground (Paragraph 3.12) through the operated locking contacts of the storage correeds, to the banks of rotary switch SQO (Figure 5), via SQO wipers through TRA contacts to the number two windings of the T relays which operate and lock.

Sending Digits

3.94 The sending of a dialed digit from storage is the same as sending a route digit. Sending MF 2/6 digits is accomplished by the MF equipment strip.

3.95 When storage digits are sent via MF, a "hold send" command is given until most digits are stored. When the "hold send" is removed, and dial pulse routing digits necessary to establish a connection to an interoffice trunk are sent, the MF send, advance sequence, and delete digit functions are executed. Now the register is in the MF mode ready to send the stored digits.

3.96 Readout from storage is the same for MF sending as it was for dial pulse sending. During MF sending when the T relays receive a digit from storage, forward 2/5 coded ground marks to the MF equipment which cause two of the M relays (M0, M1, M2, M4, and M7) to operate storing the same code (digit). Each 2/5 coded digit is converted by the contact pattern of the M relays to a specific combination of two-tones-out-of-six (Figure 7). The tone pair is sent as an audible signal through a repeat coil on the outgoing loop to the interoffice trunk.

3.97 The sequence for sending via MF is as follows:

(a) readout from storage (to the M relays) the first digit to be sent,

(b) send the KP signal,

(c) send the first digit,

(d) readout from storage and send each remaining digit,

(e) when all digits are sent, send the ST signal.

3.98 The sequence is automatic except for the ST signal. An AR mark from the translator on the same space of rotary switch SQO as the last digit, operates the L relay which in turn causes the ST relay to operate. The ST relay provides the ST signal, and also operates the release relay RL. The register and access equipment go through their release patterns.

3.99 The KP and ST signals are control signals used to inform the receiving office what to expect. The KP (key pulse) signal means that MF sending will commence, and the ST signal signifies the end of MF sending.

CLR (Operator) Calls to TSPS

3.100 When interconnection to a TSPS (Traffic Service Position System) office exists, the register can send a 0- (operator) call via MF, using only the KP and ST signals, with no other digits being sent between the two offices.

Stop Dial

3.101 For interoffice calls a stop dial signal is used to inform the originating office that the receiving office is not ready to receive information. This signal is applied to the circuit when an interoffice trunk is seized prior to any digits being sent. When dial pulse digits are sent to the next office a stop dial signal can occur during the interdigital pause after each digit is outpulsed,

DIGIT TO BE OUTPULSED	RELAYS OPERATED	FREQUENCIES APPLIED TO T&R LEADS
1	MO, M1	700, 900
2	MO, M2	700, 1100
3	M1, M2	900, 1100
4	MO, M4	700, 1300
5	M1, M4	900, 1300
6	M2, M4	1100, 1300
7	MO, M7	700, 1500
8	M1, M7	900, 1500
9	M2, M7	1100, 1500
0	M4, M7	1300, 1500
	KP	1100, 1700
	ST	1500, 1700

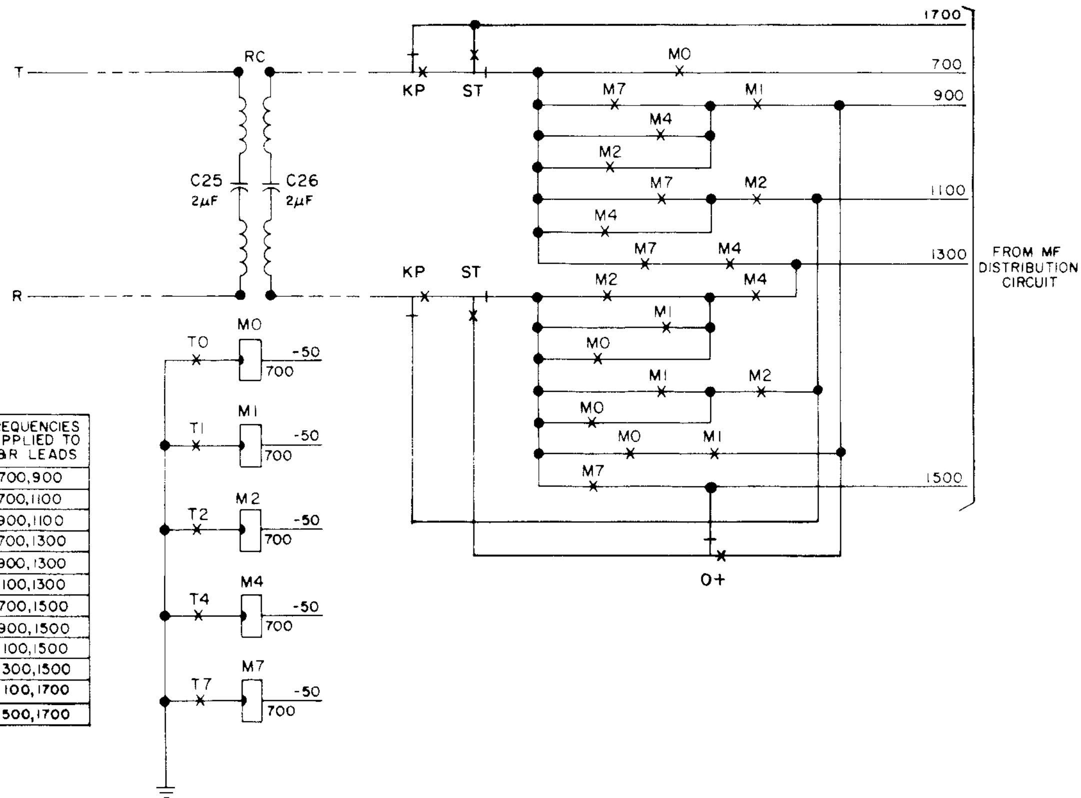


Figure 7. Multifrequency Control Circuit.

however, when MF digits are sent there is no stop dial once sending begins.

3.102 A shunt-field relay (SD) is in series with the outgoing loop to the selector. The stop dial (reversed battery) received from the interoffice trunk is returned via the switchtrain to the register's outgoing loop, the SD (stop dial) relay detects the battery reversal, operates, and opens the circuit to the T relays inhibiting sending. When the stop-dial is removed, the normal polarity of the outgoing loop to the selector is restored, the SD relay restores and sending can proceed.

4. TRANSLATOR

Time Division Access of the Translator

4.01 Time sharing of the translator logic circuitry by the register-senders and the monitor is accomplished through the common highway comprised of the translator commons and the route commons and the TDG (Time Division Generator), see Figure 8.

4.02 The common highway provides for the movement of information between the register-senders and the translator. The translator commons carry the call data from the register to the input of the translator, and the route commons carry the instructions from the output of the translator to the registers. The translator common leads of all registers are wired in parallel to the input of the translator, and the route common leads of all registers are wired in parallel to the output of the translator.

4.03 Although the registers are wired in parallel, the time division generator provides control of them so that only one register will access the translator via the common highway at a given time. Every register has its own set of leads from the TDG, and the TDG assigns each register a separate time slot during which timed battery and timed ground are applied to those leads.

4.04 When timed battery is applied it will cause a current pulse to flow from the TDG over the timed battery lead to the register, where it is distributed through those call data leads that are marked (Figure 4), through the translator commons to the translator. The current pulse, now in the form of call switching data, is translated by the logic circuits. It then appears on the route

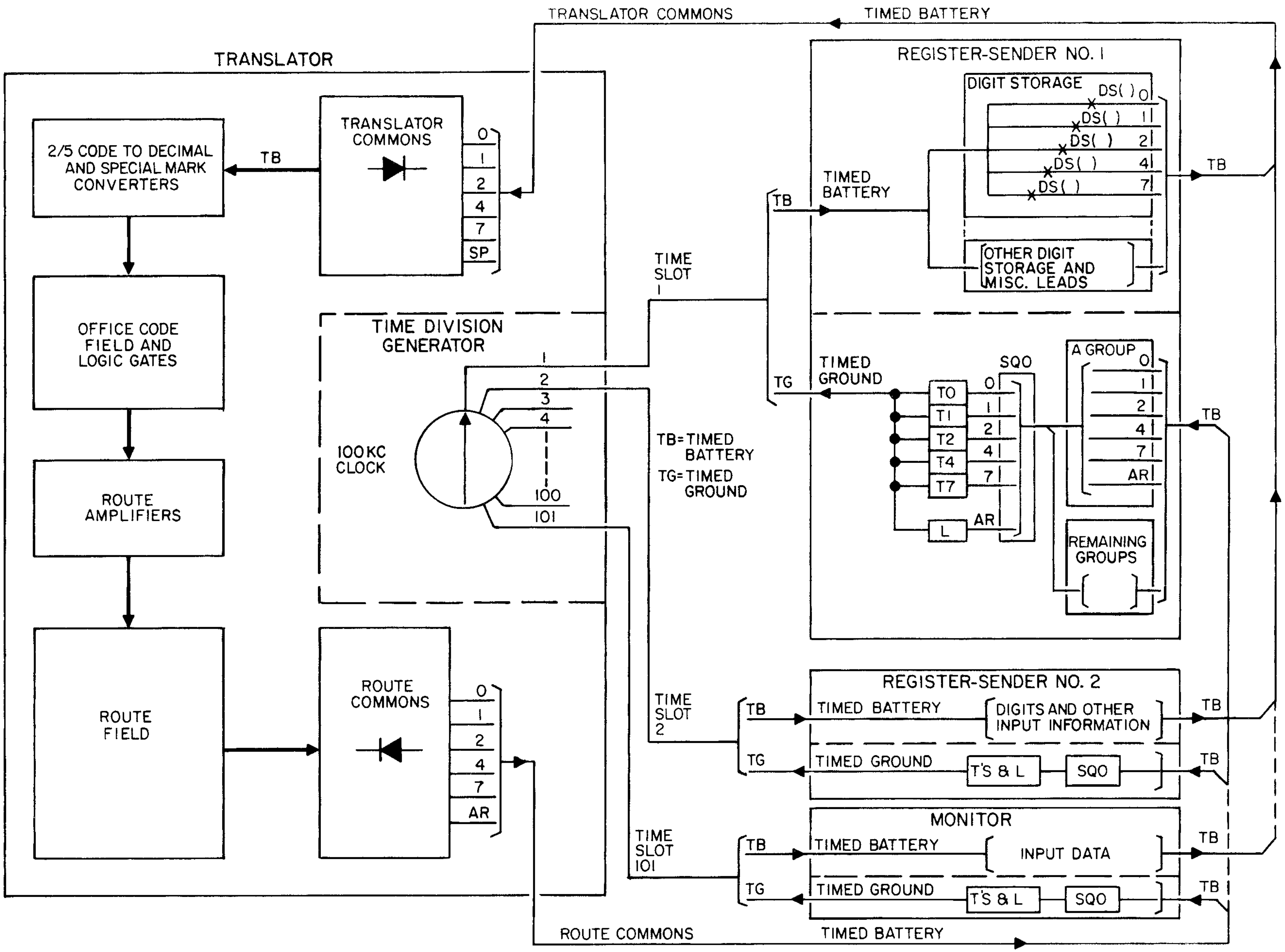


Figure 8. Time Division Access to Translator.

commons as instructions for the register, continues via the banks and wipers of rotary switch SQO to the appropriate windings of the L and T relays (Figure 5), through those windings to the timed ground lead.

4.05 A time slot 100 microseconds in duration is provided by the TDG for each register on a sequential basis, with the sequence being repeated continuously at the rate of one complete cycle every 10 milliseconds. Thus any change in call data (at the register) will almost immediately be seen and acted upon by the translator, with the resultant instructions returned to the register during the same time slot.

Receiving Call Data from the Register-Sender

4.06 The translator commons are terminated (Figures 9 and 10) in groups of five leads each, primarily to maintain the 2/5 coding for the digits which are extended from register storage. The number of translator common leads required is determined by the number of digits to be translated (up to a Maximum of four), plus the number of extra leads needed for special mark data. If the translator is required to translate a maximum of three digits (true of most offices), then a minimum of three groups of translator commons must be provided. One to three additional groups of translator commons are used to terminate leads such as LRA, LRB, LRC, and LRD (route attempt marks), DPM and TCM (dial mode marks), CSA, CSB, and CSC (EC lead class-of-service marks), and 1+, CLR, LPL, and LCN (special traffic marks).

4.07 The digital information received through the groups of translator commons is referred to as the N, P, R, and S digits, corresponding to the first four incoming digits of a call. The N digit is received first, then the P, R, and S digits in the same order as received in register storage.

4.08 During the time slot of a register, timed battery is extended through the closed contacts of the various data relays and correeds, digit storage assemblies and the translator commons to the code converters in the translator.

Code Converters

4.09 A code converter is a circuit consisting of a two input AND gate followed by an inverter. When there is a negative potential on each input simultaneously, the output terminal will exhibit a negative potential. Any other combination of signals at the input terminals will remove the negative output.

4.10 As shown in Figure 9, the digital group leads of the translator commons are connected to various code converter gate inputs corresponding to the 2/5 code. The converter gate requires timed battery at both inputs to produce an output. The leads from the translator commons are connected to the converters in such a way that, for any 2/5 code, only one converter will have timed battery on both its inputs. For example, if the N digit is 2, the translator common leads N0 and N2 extend timed battery to the converters. These two leads both appear only on gate 2, therefore, only gate 2 exhibits a negative output that represents the digit 2. Thus, the 2/5 code from storage is converted to a single decimal output and is extended to the office code circuits.

4.11 As shown in Figure 10, the special data (non digital) leads are also connected to converter gates. Since there is no coding involved for special marks, these converter gates all have one input terminal tied to a negative potential. Therefore, if a special mark is extended, from the register-sender via the translator commons, the special mark converter will have two negative inputs on it and will exhibit an output to the office code circuits.

Class-of-Service Detector

4.12 Separate translator common leads are provided from the central distribution frame for the required number of TDM (time division multiplex) classes-of-service and these leads terminate directly on the class detectors in the translator. The TDM class-of-service detector is connected to the C lead of each line requiring a special class-of-service mark. Positive pulses sent from the register-sender on the C lead are received by the detector as a class mark. A positive input to the detector results in a negative output that is compatible with the office code circuits. The class detector output can be extended directly to the office code circuits, and also to NOT gates and/or other special mark converters which produce additional special marks that go to the office code circuits.

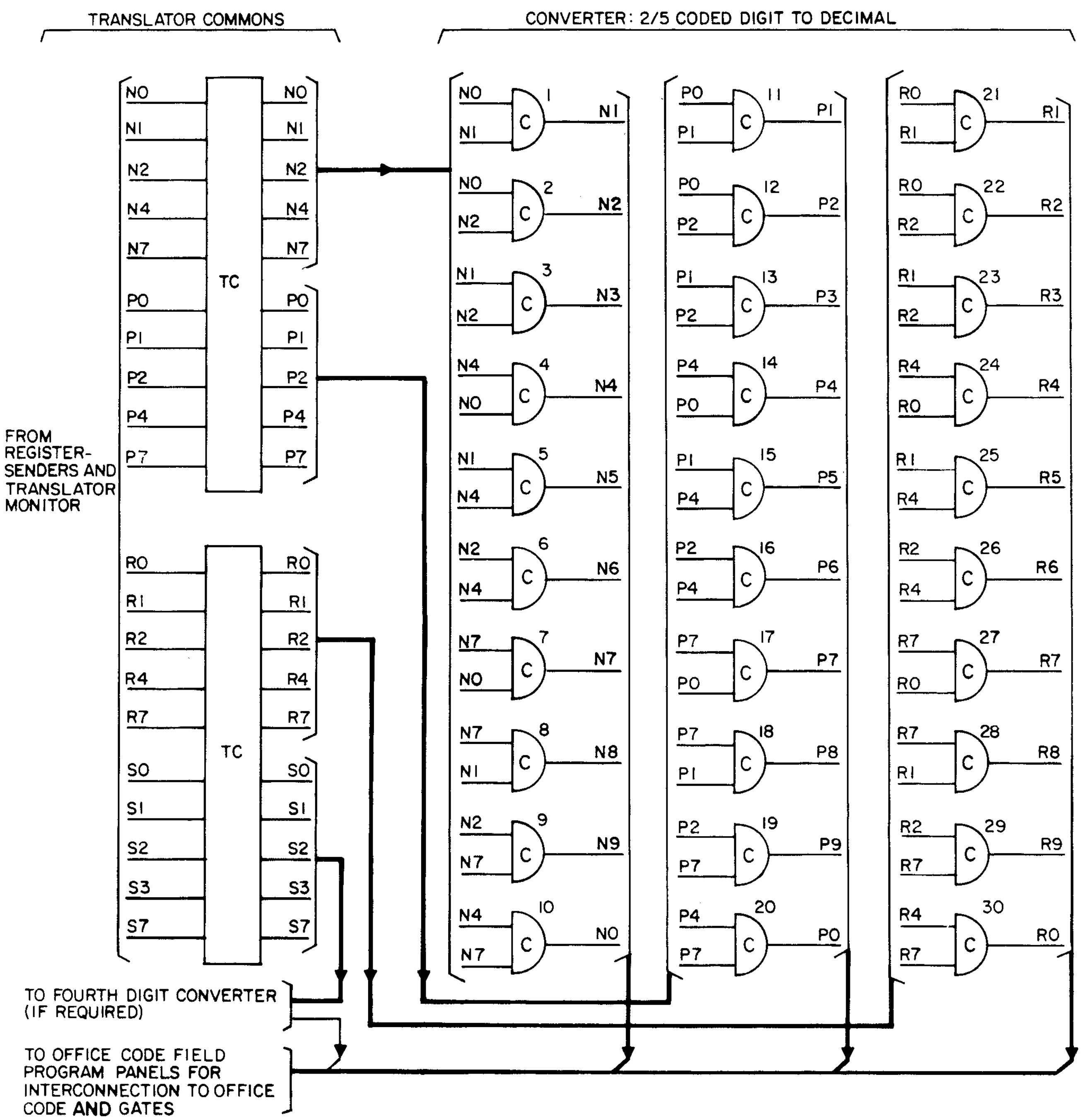


Figure 9. 2/5 Code Converters.

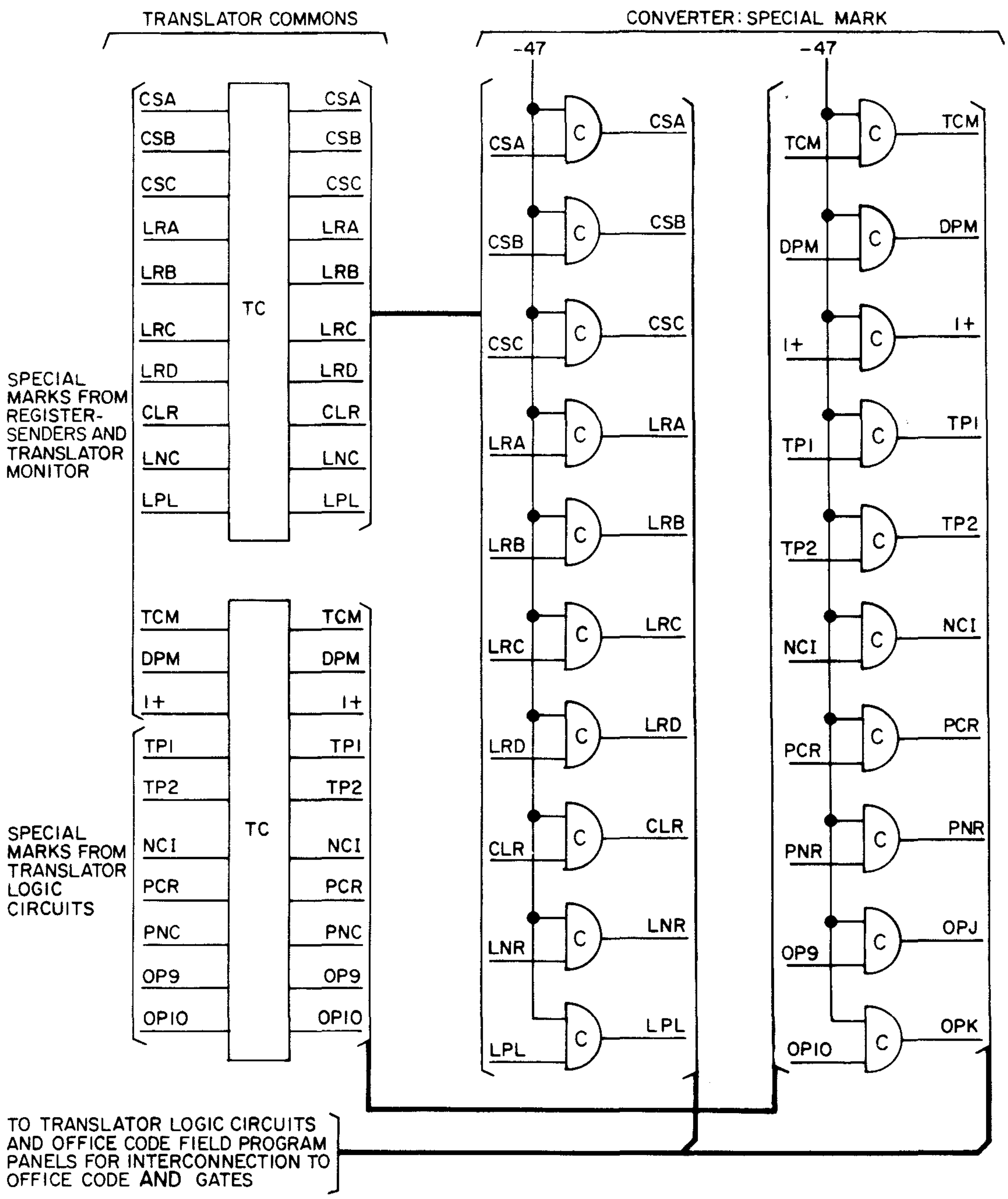


Figure 10. Special Mark Converters.

Office Code Field Program Panels

4.13 The office code field is comprised of a group of four program panels arranged in a vertical row (Figure 11) with up to eight such groups placed horizontally across the lower half of a translator rack (Figure 12). These panels provide facilities for connecting the output of digit converters, special mark converters, and class-of-service detectors to the input leads of the office code AND gates. The converter and detector outputs are connected to the horizontal rows of the program panels and the input leads of the office code AND gates are connected to the vertical rows.

4.14 Corresponding horizontal rows in adjacent digit panels are connected together making one continuous row across the field for each decimal digit. The special mark panels have only

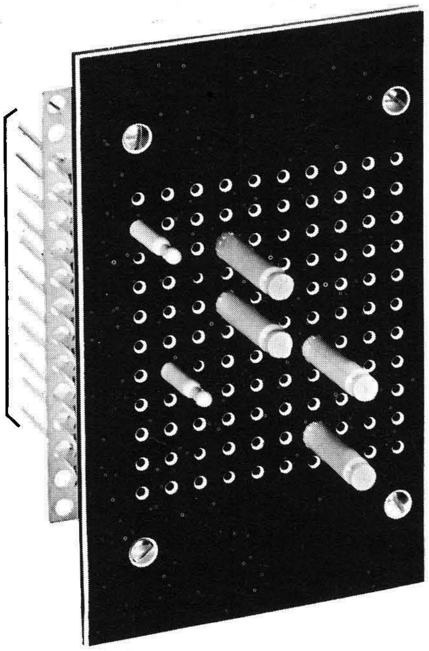


Figure 11. Program Panel.

the first four horizontal rows connected together across the field. The remaining six rows on each special panel are wired for the particulat installation.

4.15 The vertical rows of adjacent panels are not interconnected, instead, the leads from each panel go to the correspondingly numbered input leads of the AND gates associated with each vertical row of panels.

4.16 Interconnections at the office code field panels are made by inserting programming pins (Figure 13) at the desired output/input intersections. The placement of programming pins, the individual wiring arrangement of special mark panels, and other required special wiring will vary with each installation because of the variation between office codes and area codes served. (For translator programming information, refer to the related section in the 240-202 series of GTE Practices.)

Office Code Circuits

4.17 An office code circuit consists of an AND gate and a diode OR gate. The office code circuitry provides the capability by which the translator detects specific office codes.

4.18 Through the use of diode programming pins in an office code field program panel, arrangement can be made to provide the same routing for several different office codes. Such a group of diode pins is called an OR gate. It connects the output of more than one converter to the same verticle row on the panel. This allows different digits to put a signal on that particular input lead of an office code AND gate. For example, if 334, 335, or 336 are the first three digits dialed and require the same routing, the third digit (4, 5, or 6) as it appears at the output of its converter will be extended to the verticle row by one of the three diodes (OR gates) as shown in Figure 14. The diode OR gate exhibits as output when any of its inputs contains a negative voltage (digit 4, 5, or 6). The first and second digits (3, 3) are extended directly from the output of their converters to the proper verticle row and thus to the office code AND gate via shorting program pins; therefore, any of the three office codes will operate the AND gate.

4.19 The AND gates used in the office code circuits are either four or five input gates. All office code AND gates in the translator of a specific office are of the same input size. The size is determined by the office code requiring the most information. When all inputs of an AND gate are not needed for a translation, the remaining inputs are jumpered. The input size of the AND gate is based on the number of digits to be translated (usually three) plus an extra input for special marks. Therefore most offices will use four input AND gates (Figure 15).

NOT Gate

4.20 A NOT gate exhibits a negative output until it receives an input. The output of a NOT gate is connected to a converter circuit which feeds an office code AND gate. When the NOT gate receives an input, it effectively opens one input to the office code AND gate which disables that gate.

4.21 The class-of-service detector and NOT gates can be used in conjunction with information on the C lead to restrict service. A call received from a coin telephone, for example, provides an input to the NOT gate which turns it off and removes one input to the office code AND gate. Since all inputs to the office code AND gate are required for operation, that gate does not operate, thereby preventing a coin telephone from completing an unauthorized call.

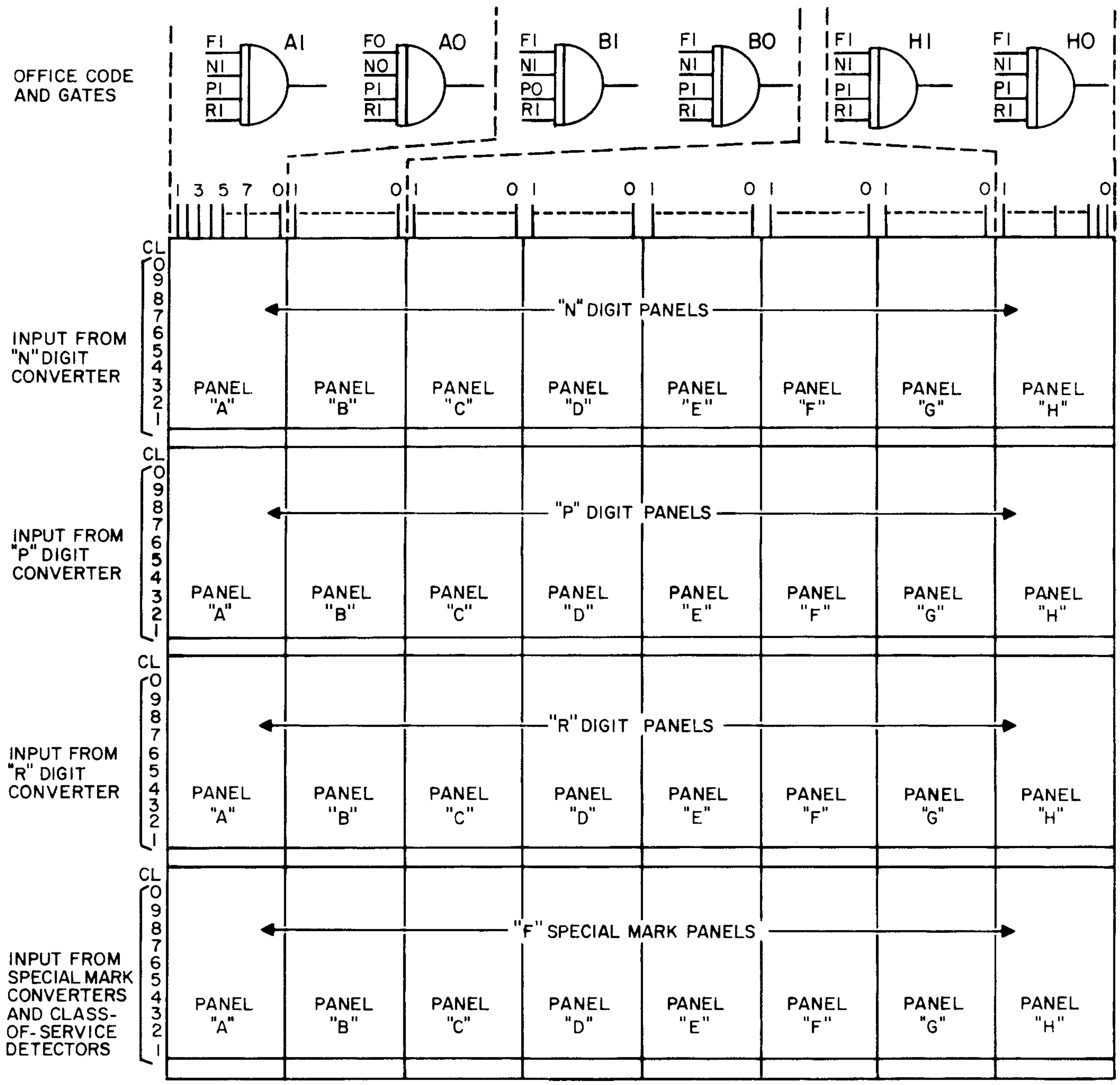


Figure 12. Office Code Field.

4.22 During the register's time slot, if a call is not from a coin telephone, class detector 6 (Figure 16) does not receive a class mark and does not exhibit a negative signal to the input of NOT gate 22. With no signal on the input, NOT gate 22 exhibits an output to lead 1 of converter 7. Timed battery is absent from lead 2 of converter 7 for the first 10 microseconds of each time slot (paragraph 4.38) and converter 7 has no output. After 10 microseconds converter 7 exhibits an output (since both inputs are receiving negative battery) to lead F of AND gate 39. When the correct N, P, and R digits are present at gate 39, it "turns on" to provide a route for the call. Since there is no output from detector 6 to lead F of AND gate 58, that AND gate cannot "turn on". Now if the same office code is dialed from a coin telephone, class detector 6 produces a negative output due to the class mark on lead CS6. This output at NOT gate 22 removes the signal from input lead 1 of

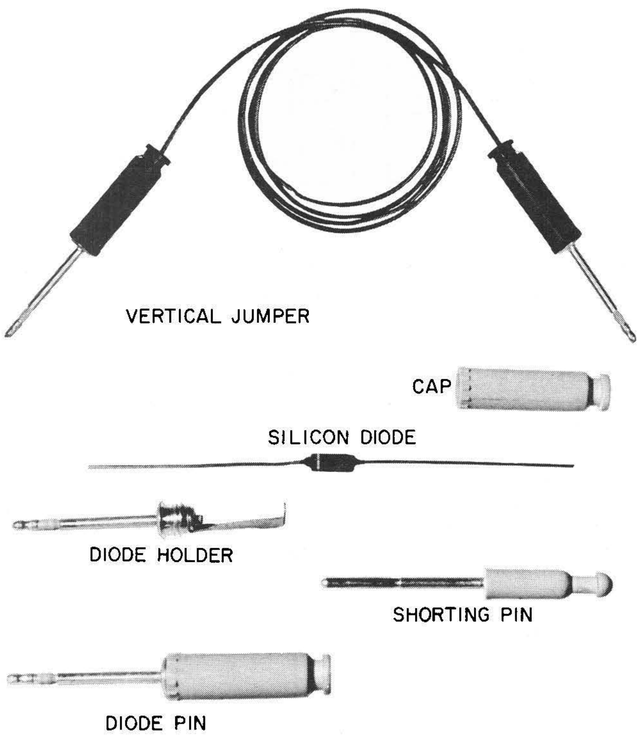


Figure 13. Programming Pins.

converter 7. Converter 7 is thus disabled (regardless of the delayed battery signal) and cannot provide a negative input to lead F of AND gate 39. AND gate 39 remains off. Detector 6 output on lead F of AND gate 58 plus the N, P, and R digits provides a different route for the call.

Route Amplifiers

4.23 When all inputs of an office code AND gate have negative potential on them, that gate extends a positive signal to its route amplifier (Figure 15). Each office code AND gate is wired directly to a specific route amplifier. The route amplifier turns on, amplifies and inverts the signal, and applies its negative output to the route field program panels. The same type of panel used for the office code field (Figure 11).

Route Field Program Panels

4.24 The route field (Figure 17) is comprised of a group of ten vertically arranged program panels, with from one to eight such groups placed horizontally across the upper half of a translator rack. Each panel has ten vertical rows and each row is connected to the same vertical row on adjacent panels. Each vertical row is designated as a route. The horizontal rows of each panel also connect to their equivalent rows on adjacent horizontal panels. Each horizontal row connects to one lead of the route commons.

4.25 The route panels provide for connecting the route amplifier output to the desired route common leads. The output lead of a route amplifier is connected to one specific vertical row on the program panels. By placing route diodes along that vertical row at the correct horizontal intersections the proper instructions will appear on the route commons as timed battery. Depending on the placement of the diodes the instructions may be used again (as route control signals) within the translator to turn on another route, or go directly to the bank positions of rotary switch SQO. Therefore, any detected office code can be programmed at the route field to send the appropriate combination of instructions to process the call. For translator programming information, refer to the related section in the 240-202 series of GTE Practices.

4.26 During a call process, when a route amplifier is turned on, its output appears on every route commons lead where there is a diode pin for that particular vertical route. Each time the register associated with that call receives timed battery, the same route amplifier or amplifiers will turn on, providing instructions to the banks of rotary switch SQO until the call is completed.

Route Commons Lead Arrangement

4.27 The arrangement of route commons wiring to rotary switch SQO in the register-senders and the lead designation for the lower five panels (06 through 10) of the route field remains the same regardless of installation. The arrangement of the wiring of the upper panels (01 through 05) is dependent on translator programming which is determined by office size and trunking requirements (Figure 18).

4.28 The leads to rotary switch SQO levels D, E, F, G, and H are arranged in groups of 5, keeping with the 2/5 and 3/5 coding for the register-sender. The delete digit can be programmed from either panels 04 or 05 as shown. Panels 02 and 03 are used for programming:

(a) AR marks to level J of rotary switch SQO which can be;

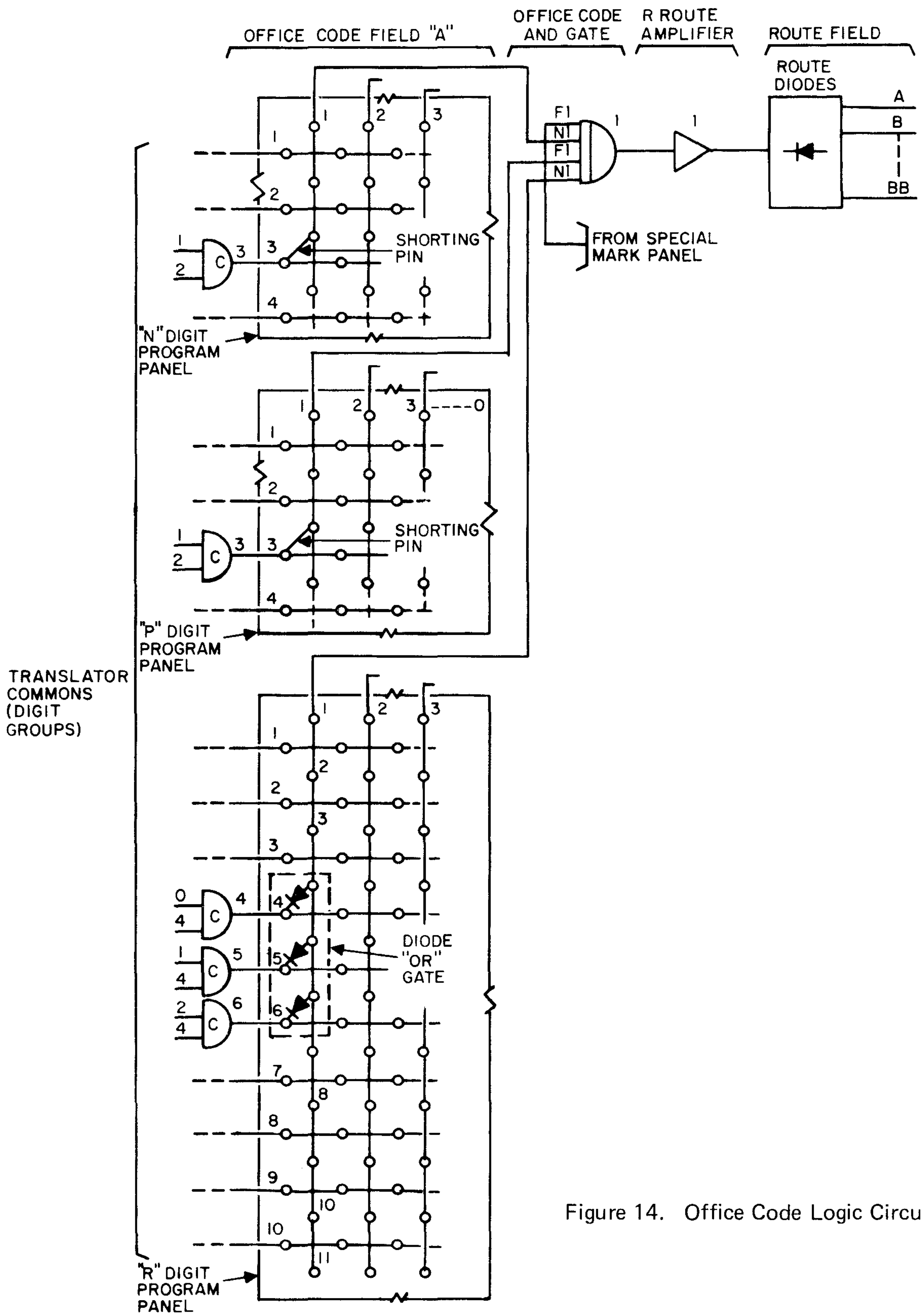


Figure 14. Office Code Logic Circuit.

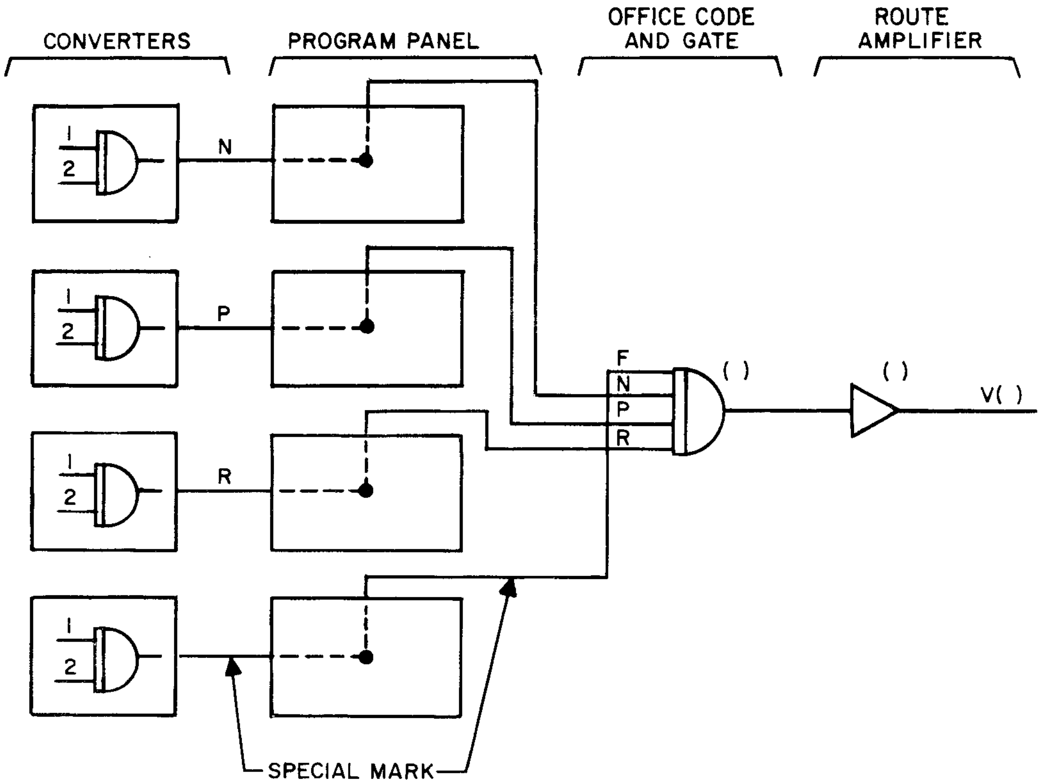


Figure 15. Office Code AND Gate.

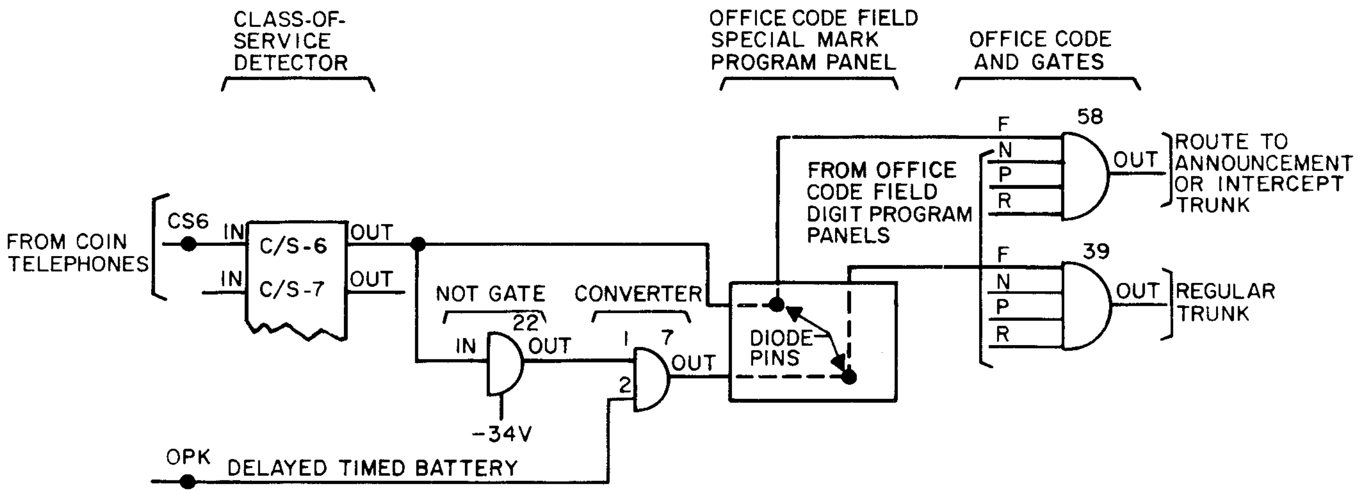


Figure 16. Application of a NOT Gate.

(1) crankback alternate routing marks (possible selector level busy) for rotary switch SQO steps 1 through 12.

(2) release marks (after storage digits are sent) for rotary switch SQO steps 13 through 25.

(b) route control marks (see paragraph 4.30).

Panel 01 is used for programming AR marks for ATB conditions to level J of rotary switch SQO steps 1 or 6.

ATB Alternate Route Wiring

4.29 Alternate route wiring for ATB conditions arising prior to outpulsing any digits from the horizontal leads of each separate 01 route field panel is assigned to the contacts of individual ATB relays. The other side of the relay contacts are assigned to the route commons going to level J of rotary switch SQO either step 1 or 6.

Route Control Marks

4.30 Route control leads from route field panels 02 and 03 are wired to the special marks translator commons (Figures 10 and 18). Assume a diode pin is programmed at a route control lead intersection. When that particular route receives timed battery from the route amplifier being turned on, the route control mark will appear on a special mark converter and produce an input which can be programmed in the office code field to turn on another route. An example of this is when the same alternate route can be used for several office codes.

Logic Transfer Circuit

4.31 The logic transfer circuit is used to switch the common highway leads from one translator to the other. The translator that is connected to the common highway by the transfer relays is said to be on-line, receiving information from and sending instructions to the registers. Normally, the primary translator is on line.

4.32 The transfer circuit is controlled by the translator monitor which checks the operation of both the on-line and off-line translator logics. If the translator monitor detects failure of the on-line translator logic, it will cause the transfer relays to place the faulty translator off-line and the remaining translator on-line.

Time Division Generator

4.33 The translator time division generator (TDG) is shown in block form in Figure 19. The translator is provided with primary and standby time division generators; however, only one of them is on-line at a time providing timed battery and timed ground signals to the register-senders. The TDG has two main sections; a timing section which is fully duplicated, and an amplifier section. The primary and standby portions of the timing section each consist of;

(a) a filtered and regulated power supply.

(b) an oscillator and reset circuit.

(c) a ring counter comprised of up to 101 stages; i.e. one stage for each register in use in the system, plus one stage for the translator monitor and timer reset.

(d) a delay reset circuit.

(e) a timed battery delay circuit.

The amplifier section contains power amplifiers that are controlled by ring counter signals to provide timed battery and timed ground for the system.

4.34 Since they are identical, the following discussion of timing operation will apply to both the primary and the standby timers. Both timers run continuously.

4.35 The oscillator and reset circuit produces the 100-microsecond time slots for the registers. Each time slot is comprised of an 80-microsecond pulse period and a 20-microsecond guard interval to prevent false triggering of the register-sender in the adjacent time slot. The time slot signal is fed in parallel to all ring counter stages and the timed battery delay circuit.

4.36 Each ring counter stage is activated individually by the oscillator and reset circuit, however, each stage must be conditioned before the time slot signal can activate it. The first ring counter stage is conditioned by the oscillator and reset circuit, and as each stage is activated, it conditions the following stage for operation. After a stage has been activated it can not be conditioned or activated again until it is reset. When the ring counter stage associated with the last register used in the system is activated, it conditions the stage associated with the translator monitor. The activated monitor stage conditions the reset stage. When activated, the reset stage produces a signal that is amplified and fed to all ring counter stages, the oscillator, and reset circuit to reset them. The oscillator and reset circuit conditions the first counter stage again, that stage is activated, and thus the cycle is repeated.

4.37 The rate at which the cycle is repeated (scan time) is 10 milliseconds; that is, each register-sender is allotted a 100-microsecond time slot every 10 milliseconds. The scan time is based on the use of 100 register-senders, which is the maximum number of register-senders that a single translator can serve. The number of register-senders a translator serves does not vary the length of the time slot; however, it does affect the cycle time between time slots. If less than 100 registers are provided in an office, a corresponding decrease in ring counter stages allows the reset stage to be activated sooner. The reset signal is fed through the reset delay circuit which prevents the ring counter from resetting too rapidly. The reset delay circuit is strappable to provide the proper amount of delay according to the number of registers in use.

4.38 The timed battery delay circuit produces delayed timed battery exclusively for use with NOT gates. The circuit is only provided for offices where NOT gate functions are required for translation. Every time slot signal from the oscillator and reset circuit triggers the timed battery delay circuit as well as one of the ring counter stages. When triggered, this delay circuit removes timed battery from the delay battery bus for a period of 10 microseconds, and then returns the timed battery for the remainder of the time slot.

4.39 The amplifier section can contain up to 104 power amplifiers (Figure 19). Two power amplifiers are provided for the translator monitor (one each from the primary and standby timers), one for the ring counter reset circuit of each timer, plus one for each register in use.

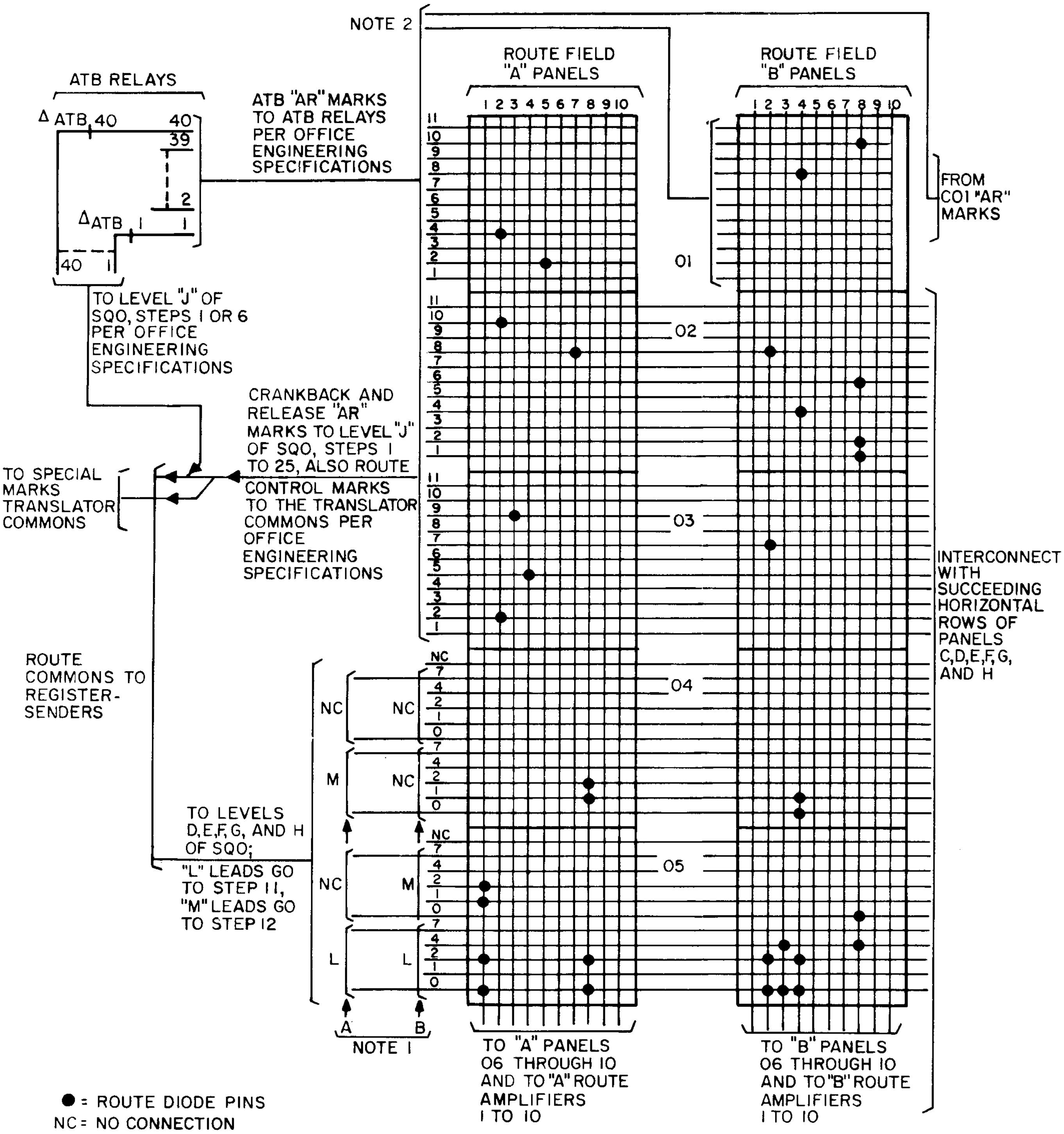
4.40 Each power amplifier associated with a register is also associated with two ring counter stages, one from each timer. Connecting the output of the ring counter stages of the primary and standby timers to their respective power amplifiers is accomplished by the time division generator transfer relays. In the unoperated state the transfer relays connect the primary ring counter stages to the power amplifiers, this condition is referred to as the primary time division generator being on-line. When operated, the transfer relays connect the standby ring counter stages to the power amplifiers, putting the standby time division generator on-line.

4.41 The on-line status of the TDG is controlled by the translator monitor. The monitor ring counter stage is directly connected to its monitor power amplifier thereby providing separate (primary and standby) timed battery and timed ground signals to the monitor. If either TDG fails to produce a time slot for the monitor, it will cause an alarm condition. Also, if the on-line TDG fails, the monitor will cause a transfer to take place.

5. TRANSLATOR MONITOR

5.01 The translator monitor provides automatic continuous testing of the primary and standby translators. The translator monitor provides the necessary facilities to automatically check the standby translator one time, after routining the primary translator 10, 20, or 25 times, depending on optional strapping. A manual transfer key to check the standby translator is also provided. When a transfer to test the standby translator occurs, the translator monitor is automatically placed in a fast scan condition.

5.02 The translator monitor simulates register-sender operation by applying office codes consisting of 2/5 code and special mark data to translator logic, and then checking that the returned information is correct. Test information is sent and received via timed battery and timed ground. If an irregularity in the returned information from the translator is detected, the monitor testing sequence stops, an alarm signal is activated, and the nature of the trouble is indicated by display lamps on the translator monitor. If the trouble is detected in an on-line translator a transfer occurs. If trouble is detected in the off-line translator, the appropriate alarm is indicated, but a translator transfer does not occur. Lamps display



NOTES:

1. OFFICE WITH SIMPLE TRUNKING REQUIREMENTS USE "B", OTHERWISE USE "A".
2. HORIZONTAL ROWS OF 01 PANELS ARE NOT INTERCONNECTED AS PER PARAGRAPH 4.24, INSTEAD EACH GROUP OF 01 PANEL LEADS ARE BROUGHT OUT SEPERATELY PER ENGINEERING SPECIFICATIONS.

Figure 18. Special Wiring of Route Commons.

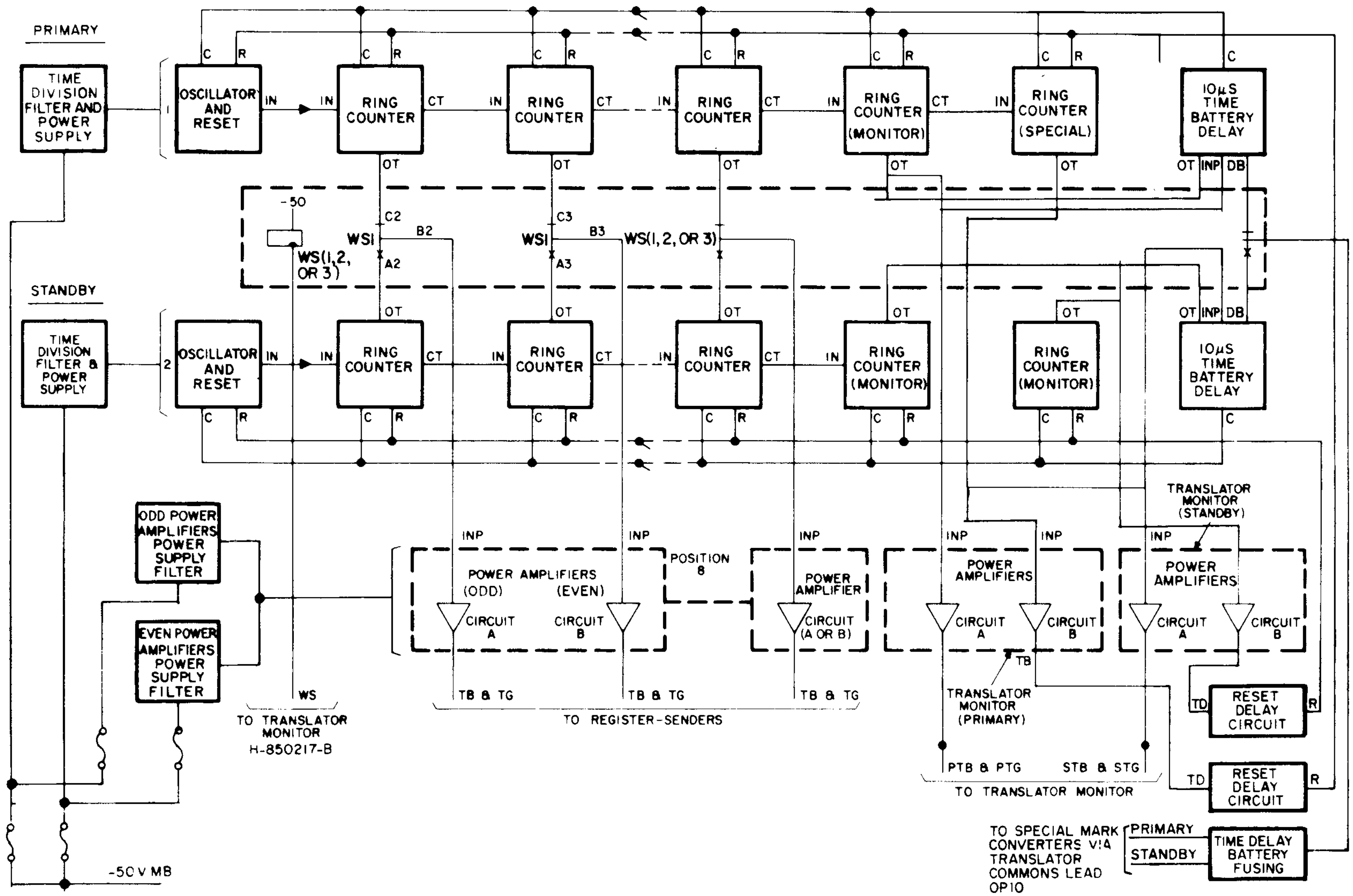


Figure 19. Block Diagram, Time Division Generator.

which translator is on-line serving traffic and which translator is in the process of being checked. The translator monitor is factory equipped to provide a 50 input code capability. The input code capacity is expandable in steps of twenty-five to a maximum of 300.

5.03 Both time division generators assign their next to last time slot to the translator monitor during which each generator extends timed battery and timed ground signals, thus each TDG is monitored separately but continuously. Failure of either TDG will result in an alarm condition, trouble lamp display, and transfer if necessary. For further information relative to the translator monitor, refer to the related sections of the 240-202 series of GTE Practices.

6. PLACING CALLS THROUGH THE SYSTEM

6.01 Various types of calls will be traced through the Metro Director in the following paragraphs. The types of calls are: Local, SATT, EAS, and No Code. These calls will be placed by both dial and DTMF telephones. Additional types of calls can be processed by the system and more translations made than are presented in this Part; however, the calls presented are typical and give a good idea of overall Metro Director system operation.

Register-Sender Access Equipment

6.02 The operation of the register-sender access equipment will not vary with the type of call and therefore is covered only once in this Part. See Figure 20.

6.03 When calling party lifts the handset, relay L of the line equipment is operated via the loop closed through the hookswitch. Relay L operating grounds the linefinder start lead (ST).

6.04 Ground, from the linefinder distributor, on the linefinder start lead (FSA) is extended by the TN and UN leads of the access relay circuit to the link finder control circuit to operate the proper tens and units relays to mark the access relay circuit desiring service on the allotter multiple bars of the link finder. The tens relay also extends ground, via lead FIA, to find an idle register-sender.

6.05 When an idle register-sender is found, ground is extended to the allotter relay of its associated link finder. The allotter relay in operating closes ground from the marked allotter multiple bars to the proper link finder tens and units relays to connect the access relay circuit desiring service to a register-sender.

6.06 Connecting a register-sender to the access relay circuit grounds lead EC2 and operates relay CO of the access relay circuit. Relay CO closes linefinder start lead (FSA) to the linefinder (via linefinder start lead FSB), releases the link finder control circuit, and closes the pulsing loop from the linefinder to the register-sender.

6.07 When operated, relay CO in the access relay circuit closes ground to the linefinder start lead (FSB) which marks the vertical bank, and operates a C relay in the group relays, Fingure 20. The linefinder begins vertical stepping, and stops on the marked vertical bank contact. The linefinder hunts rotary for the marked bank contact. When the marked bank contact is found, the linefinder has found the line calling for service and the line equipment CO relay will operate. The + and - leads are switched through to the access relay circuit which is connected to the register-sender. A dialing loop is established to the A relay in the register-sender, Figure 20.

Local Dial Call

6.08 In the original switchtrain of this office, local calls were made by dialing the office code 378, 379, or 655, plus the four terminal digits. The first two digits, 3-7 or 6-5, were absorbed in the local selector, the third digit, 8, 9, or 5 positioned the local selector to the corresponding level and the remaining four digits positioned the fourth selector, the fifth selector, and the connector; see Figure 21. The following paragraphs, 6.09 through 6.25 describe how a local call is processed with the Type 101 Metro Director Equipment.

NOTE: Figure 22 illustrates the translator wiring for all examples discussed.

6.09 When adding a Director the digit absorbing features of the local selectors are removed and some rewiring of selector levels may be required to take full advantage of the Director.

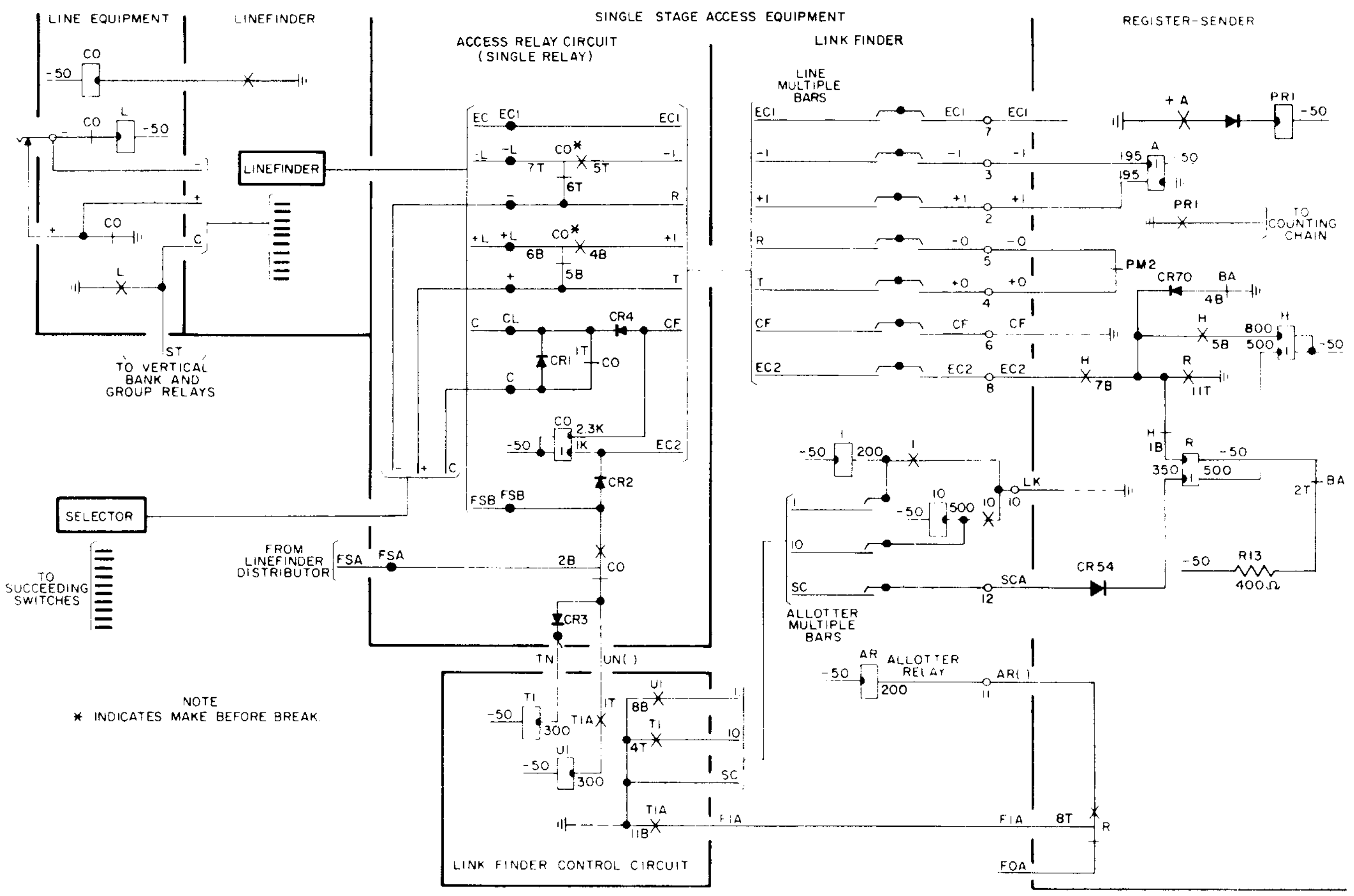


Figure 20. Calling Party Loop Switched through to Register-Sender.

6.10 When calling a local number 378, 379, or 655 the prefix digit 1 is not used, therefore, the 1+ lead to the translator cannot turn on the 1+ special converter (63) and no signal will appear at the 1+ NOT gate (82). Without an input signal NOT gate 82 exhibits a steady output.

6.11 If the call is from a dial telephone, the DPM lead will be marked during the registration of the first digit. During the register's time slot, timed battery will be extended via the translator commons to the DPM special converter (62). Converter 62 having both inputs with battery on them exhibits an output to extra converter 92, lead 1. The NOT 1+ signal on lead 2 and the DPM signal on lead 1 of converter 92 produces an output to A-15, the special mark panel. Because of the shorting pins in A-15 the converter 92 output is sent to the F1 and F2 leads, respectively, of office code AND gates 1 and 2.

6.12 On a local call, 378 or 379 the first digit received (3), whether dialed or keyed, is registered and appears in storage area number one. During the register-sender's timed slot, timed battery is closed through operated contacts of the storage correeds and extended to the translator via translator commons. Timed battery appears on translator commons N1 and N2. Digit converter 3, therefore, has timed battery on both inputs causing it to exhibit an output on lead N3 to the N digit program panel where it is routed, via shorting and diode pins on leads A1, A2, A3, A4, A5, and A10 to the associated office code AND gates.

6.13 When the calling party dials the second digit (7) it is stored, and during the register-sender's time slot both digits (3, 7) are sent to the translator. Timed battery is closed through contacts of the operated correeds to translator commons on leads N1-N2, and P0-P7 to the digit converters. Digit converters 3 and 17 have timed battery on both inputs causing them to exhibit an output on leads N3 and P7, respectively, to code field panels N and P.

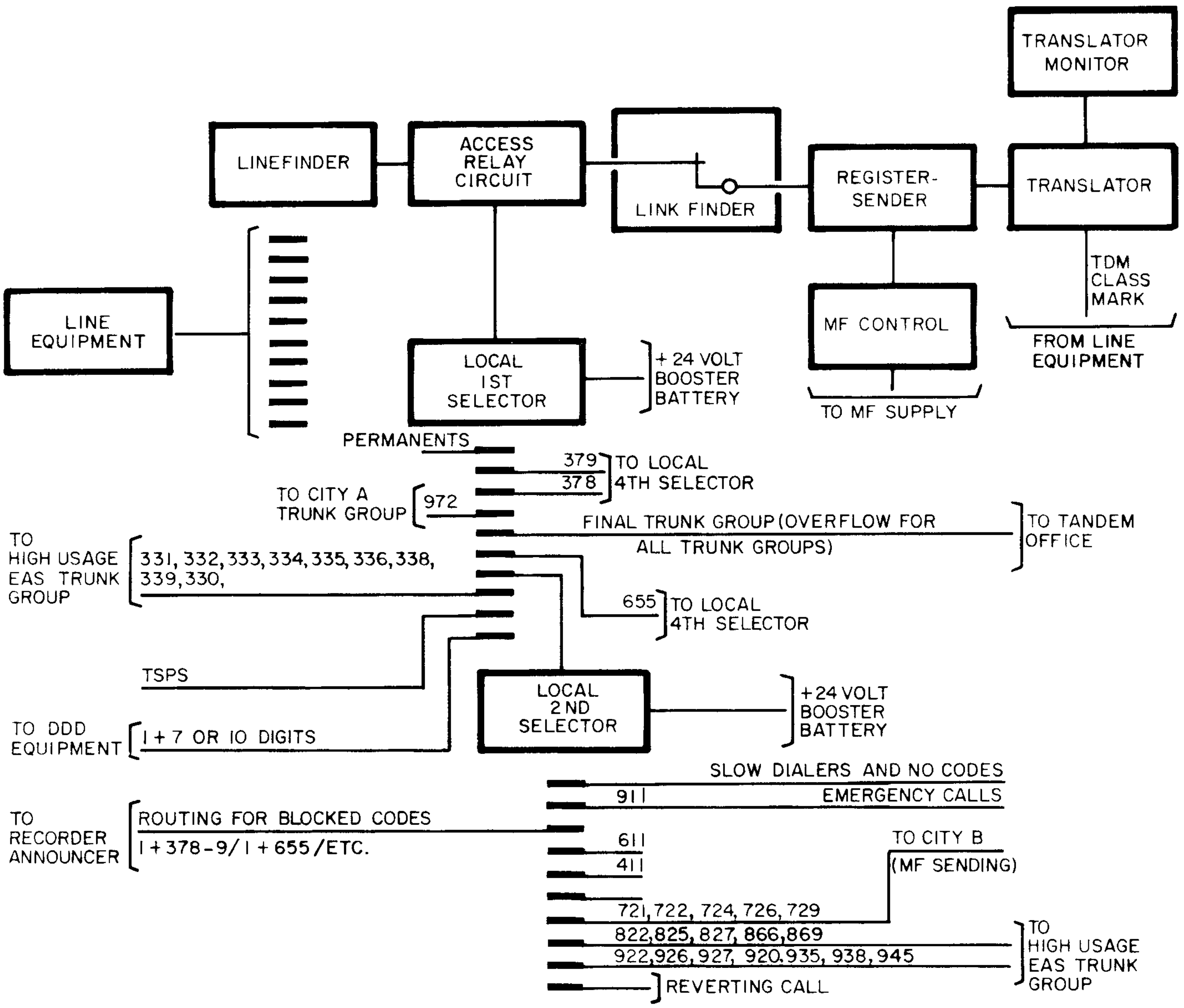


Figure 21. Trunking Diagram for Metro Director.

6.14 Due to diode and shorting pins in the P field, converter 17 output is extended on leads B1, B2, B3, B4, B6, B7, B8, and B10 to their associated AND gates. Due to jumper number 1 between the P and R fields, converter 17 output is also extended via lead C1 to office code AND gate 1.

6.15 When the second digit was extended to office code AND gate 1 all four inputs were satisfied and it turned on, thereby turning on route amplifier 1. Route amplifier 1 extends negative timed battery via route field vertical row VI, route diode pins, and route commons to rotary switch SQO (Figure 5).

6.16 The route diode pins mark code 0-1-4 on the 1st (a) step of rotary switch SQO. Code 0-1-4 indicates "repeat next dialed digit to selector". Timed battery on levels D, E, and G operate relays T0, T1, and T4 which prepares the register to repeat the next digit.

6.17 The calling party dials the third digit, which on a local call is 8 or 9. For this example, assume the digit is 8. When the third digit is being received, it is simultaneously registered in the register-sender and repeated to the local selector. The selector steps to the eighth level. During the next time slot for this register, timed battery is

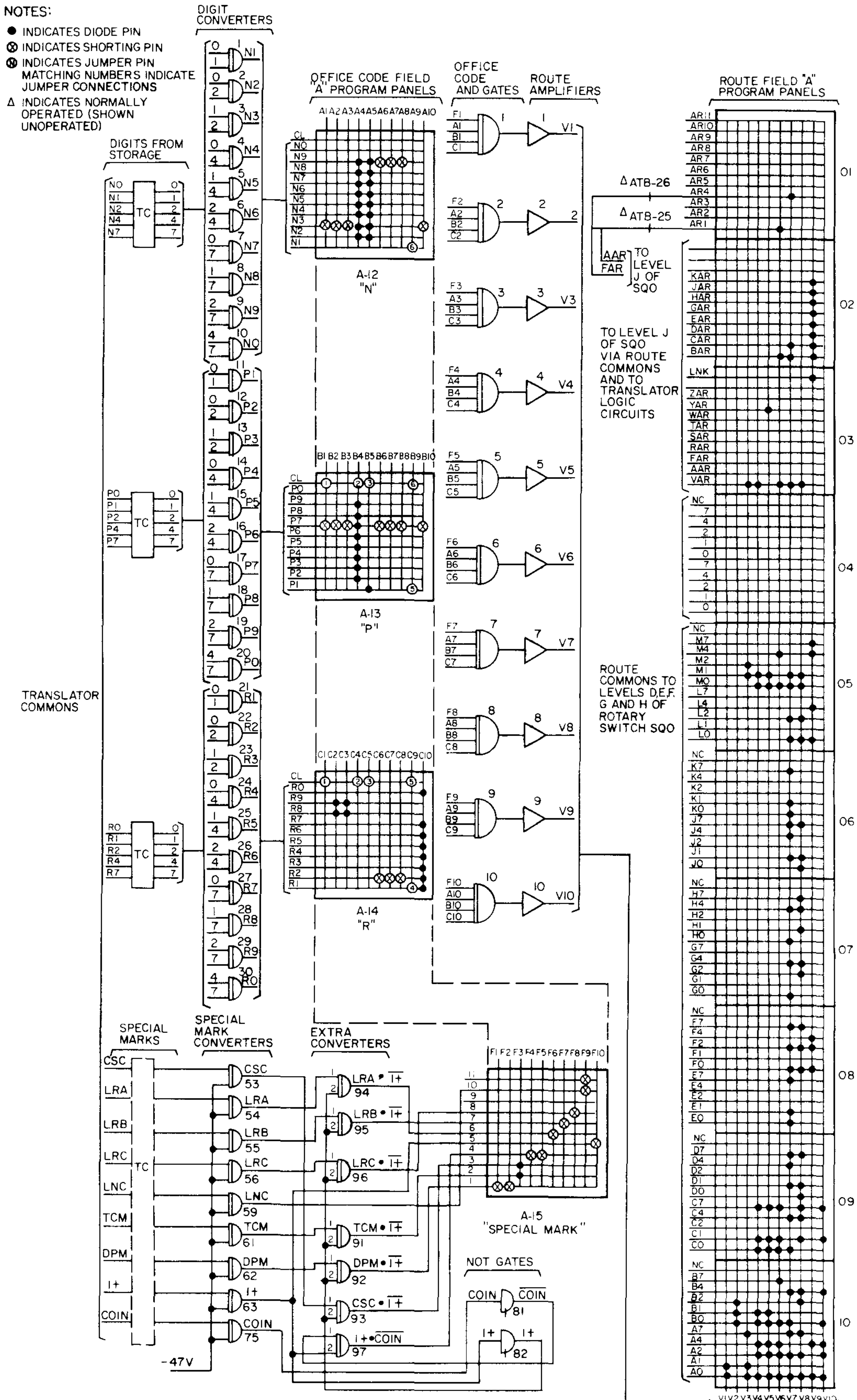


Figure 22. Translator Interconnections and Programming.

extended on translator commons N1-N2, P0-P7, R1-R7, and DPM. Special converter DPM and digit converters 3, 17, and 28 exhibit outputs which appear at office code AND gate 2 via the code field.

6.18 The output of office code AND gate 2 turns on route amplifier 2, which extends negative battery via vertical route row V2, the route diode pins, and route commons to the rotary switch SQO in the register-sender. The routing pins mark code 0-1-2 on the 2nd (b) step of rotary switch SQO. Rotary switch SQO has stepped once because of the previous translation. Code 0-1-2 indicates "release the register-sender". Timed battery on levels D, E, and F operate relays T0, T1, and T2 pulling relay RL, which releases the register-sender and connects the linefinder and selector together. The calling party continues to dial, however, his digits now go directly into the switchtrain.

Local Touch Call

6.19 Assume that the same call is made from a Touch Calling telephone. During the register's time slot, timed battery will appear on lead TCM instead of lead DPM, therefore, extra converter 92 can not turn on due to a lack of signal on its number 1 lead. This prevents the use of office code AND gates 1 and 2. Special converter TCM will exhibit an output to extra converter 91, lead 1. Since lead 2 has the NOT 1+ signal on it, converter 91 extends battery via A-15 field to office code AND gate 3, lead F3. As the calling party keys, each digit is stored in the register. The first and second digits are presented to the translator but produce no route instructions.

6.20 When the third digit is keyed (assuming an 8 or 9), timed battery on translator commons N1-N2, P0-P7, R1-R7 or R2-R7, and TCM causes converters TCM, 3, 17, and 28 or 29 to exhibit outputs which appear at office code AND gate 3. AND gate 3 turns on route amplifier 3 which extends negative battery via vertical row V3, route diode pins, and route commons to rotary switch SQO.

6.21 On the first (A) step of SQO, code 0-1-7 indicates "routing complete - advance register to receive delete digit". Relays T0, T1, and T7 operate, causing an advance sequence to take place to the 12th (M) step. The delete digit (3) code 1-2 is received by relays T1 and T2 causing rotary switch SQO to step three times deleting the first two digits from being sent out of storage. The third digit (either an 8 or 9) is read out of storage as code 1-7 or 2-7, received by the T relays and outpulsed, stepping the local selector to the 8th or 9th level. The remaining digits are sent from storage as they are registered. When rotary switch SQO steps to the last digit (19th) (V) space, the VAR mark is received on level J. After the last digit is outpulsed, the timed battery on level J operates relay L which in turn energizes relay RL initiating release of the register-sender.

Local 1700-Ohm Loop Call

6.22 Assume this office has some 1700-ohm customers loops. If these lines had only Touch Calling telephones, there would not be any changes needed to serve them, however, if dial phones are also used, the register must store and outpulse all necessary digits. Since the system is now programmed to repeat a certain dialed digit, this route cannot be used for dial phones on 1700-ohm loops.

6.23 In the register-sender the dial mode mark can be controlled by using EC lead strap BCA (Figure 3). All regular loop lines would not be grounded on the EC lead; the DPM mark would only appear whenever a long loop customer placed a call.

6.24 When a 1700-ohm loop customer goes off hook, relay SB operates removing the possibility of a DPM or TCM mark; however, the CSC mark is made available to the translator, and will cause the CSC special converter to exhibit an output to converter 93, lead 1. Extra converter 93, having the CSC output on lead 1 and the NOT 1+ output on lead 2, turns on, extending battery to the A-15 field horizontal row 3. By using diode programming pins to form an OR gate on the F3 lead in the special mark field, the same office code AND gate (3) and routing instructions (V3) can be used for either a 1700-loop or DTMF local call.

6.25 The remaining office code for local calls (655) would require 3 more separate routes similar to those discussed above; however translations would be based on the 6-5-DPM, 6-5-5-DPM, and either 6-5-5-TCM or 6-5-5-CSC combinations to obtain identical routing instructions for the type of call placed.

SATT Call

6.26 SATT calls are based on 7 or 10 digits being dialed or keyed prefixed by a 1. The office trunking plan requires the local selector to be positioned on level 1 for access to SATT trunks, Figure 21. Assuming a SATT call within the home area code as the calling party, no area code will be dialed or keyed, therefore, only 7 digits should be sent to the SATT trunk.

6.27 When the calling party dials or keys the digit 1, the prefix card correeds clear the first digit storage area and mark the 1+ lead to the translator. If the call is placed from a non-coin telephone the coin NOT gate 81 will exhibit an output since there is no input. The output of NOT gate 81 appears on lead 1 of extra converter 97. During the register's time slot, timed battery on the 1+ lead produces an output from the 1+ special converter to lead 2 of converter 97. With battery on both inputs, converter 97 extends a signal via the program panel shorting pin to lead F4 of office code AND gate 4.

6.28 The calling party dials or keys any digit 2 through 9 for the second digit, which is stored in storage area one. Timed battery through the first digit storage correeds results in one of the N digit converters from 2 through 9 to exhibit an output to the code field N panel. Due to the code field diode pins forming a large OR gate any digit 2 through 9 will put battery on the A4 lead of AND gate 4.

6.29 The third dialed or keyed digit produces the same result in code panel P and on lead B4 of AND gate 4. Since jumper 2 is between panel P and R, the R panel passes battery to lead C4 of AND gate 4. With all inputs of office code AND gate 4 satistfied, it turns on causing route amplifier 4 to extend negative battery via the vertical row V4, route diodes, and route commons to rotary switch SQO.

6.30 Code 0-2-4 on step 1 (A) of SQO causes an abbreviated "absorb" cycle, after that SQO steps once. On step 2 (B) of rotary switch SQO, the digit 1 appears as code 0-1. The register outpulses a 1 and the local selector steps to level 1. The next code on step 3 (C), is 0-1-7 (advance sequence), the SQO advances to the 12th (M) step to receive the delete digit. The delete digit 1 (code 0-1), meaning delete no digits, causes rotary switch SQO to step once to the first storage area. All seven digits are then read from storage into the SATT equipment with the VAR mark (step 19) on level J of rotary switch SQO providing the release command.

6.31 A SATT call that includes an area code will send 10 digits to the SATT trunk. The process of such a call for the first and second dialed or keyed digits is similar to the above, except office code AND gate 5 will be used.

6.32 The third digit received from the calling party should be a one or a zero. Timed battery through the second storage area correeds presents the digit to the translator. Digit converter 11 or 20 will turn on extending battery through the OR gate of the P code field panel to lead B5 of AND gate 5, and via jumper 3 between the P and R panels the battery will also appear on lead C5 of office code AND gate 5. Office code AND gate 5 turns on causing route amplifier 5 to extend negative battery via vertical row V5, route diodes, and route commons to rotary switch SQO.

6.33 Programming of the route diodes and action of the register-sender is identical to that explained above, except that the release mark is a YAR (step 22) instead of a VAR and the register will release after reading 10 digits out of storage instead of 7.

6.34 Since all digits are stored and resent for SATT calls there is no need to program separate routes for dial telephones, DTMF telephones, or 1700 loops.

EAS Call

6.35 The trunking plan for handling EAS traffic is shown in Figure 21. Most EAS calls are routed directly from either the first or second selector levels, with one alternate route available to a tandem office.

6.36 For city A there is a direct trunk group, a first alternate via city B, and the second alternate via the tandem office. A call will be traced to city A, showing the progress of the normal route, first alternate route, and second alternate route using both route attempt marks and crankback alternate routing methods.

6.37 When the caller has seized a register, the LRA mark is presented to the translator by timed battery. The LRA special converter extends timed battery to lead 1 of extra converter 94. Since this is not a call for SATT, the 1+ lead will have no signal on it and the 1+ NOT gate (82) will exhibit negative battery to lead 2 of converter 94. Converter 94 extends battery to office code AND gate 6, lead F6, via the special mark panel.

6.38 As the digits are received, they are presented by timed battery to the translator. The 9, 7, and 2 in storage, result in battery appearing on the A6, B6, and C6 leads, respectively, of office code AND gate 6. Office code AND gate 6 having all inputs satisfied turns on causing route amplifier 6 to extend negative battery via vertical row V6, route diodes, and route commons to rotary switch SQO.

Normal Routing

6.39 The first (A) step of rotary switch SQO receives code 0-2-4, "absorb", relays T0, T2, and T4 operate, and an abbreviated absorb cycle takes place. An AR1 mark is programmed in route field panel 01 extending timed battery to the contacts of the ATB relay 25 for the city A trunk group. If at least one trunk is idle ATB relay 25 remains operated preventing the AAR signal from reaching the first step (A) on level J of rotary switch SQO. At the end of the absorb cycle, rotary switch SQO steps and receives code 0-7. The digit 7 is outpulsed, stepping the local selector to level 7.

6.40 The BAR mark in route panel 02 extends timed battery to step 2 (B) on level J of rotary switch SQO operating the L relay. The register checks for selector cut-through, if the selector finds a trunk the L relay is released, and rotary switch SQO steps again.

6.41 The next code at step 3 (C), is 0-1-7 "advance sequence". It causes rotary switch SQO to go the 12th (M) step for the delete digit. The delete digit code is 0-4, which causes rotary switch SQO to step four times, deleting the first, second, and third stored digits. The register reads the remaining four digits from storage and receives the VAR mark (step 19) for release.

Alternate Routing – (ATB Relay Released)

6.42 Assume route V6 has just been turned on, extending timed battery to SQO step 1 (A), code 0-2-4 received starts an abbreviated "absorb" cycle. The trunks to city A are all busy and ATB relay 25 has been released allowing the AR1 mark to be extended via timed battery to relay L in the register. The L relay operates during the absorb cycle, and the combination of operated L and AB (absorb) relays occurring on the first step of SQO results in sequencing the expanded routing card correeds.

6.43 The LRB mark is now extended to the translator, and the LRA mark is removed. The LRA mark being removed, cuts off the special mark to office code AND gate 6, lead F6, thereby turning off AND gate 6 and effectively removing all instructions for route V6 from the register.

6.44 The LRB mark AND with the NOT 1+ mark by extra converter 95 and the office code 9-7-2 all appear as timed battery on the proper leads of office code AND gate 7. The result is route V7 instructions are extended to rotary switch SQO.

6.45 Rotary switch SQO (still on step 1) extends code 0-2-7, "hold send" to relays T0, T2, and T7. The AB and DS relays operate and hold until six digits are received plus four seconds. Assume one trunk to city B is available, so ATB relay 26 is operated preventing the AR4 mark from reaching level J of SQO step 1 (A) and operating relay L. When the L relay has not been operated and the timing internal has passed, the AB and DS relays release.

6.46 Rotary switch SQO having moved to step 2 (B) extends code 0-4 to the T relays. The digit 4 is outpulsed stepping the local selector to the fourth level. Step 2 of level J receives a BAR mark operating the L relay. The local selector cuts-through, and relay L releases, rotary switch SQO moves to step 3 (C).

6.47 Code 0-4 is again extended to relays T0 and T4, this time the second selector is stepped to level four. Step 3 (C) of level J of SQO receives a CAR mark operating relay L.

6.48 The second selector cuts-through and relay L releases, rotary switch SQO moves to step 4 (D). Code 1-4-7 "MF Send" is extended, operating relays T0, T4, and T7 changing the mode of sending and control to the MF equipment strip. Rotary switch SQO moves, to step 5 (E) and receives 0-1-7 code for the advance sequence command. Rotary switch SQO advances to step 12 (M) for the delete digit coded 0-1, which causes rotary switch SQO to step once to the first storage area. All seven digits are read out of storage and sent via 2/6 MF to city B, the VAR mark received on step 19 of level J releases the register.

Crankback Alternate Routing

6.49 For an example of crankback alternate routing review the progress of the call in paragraphs 6.44 to 6.47 then continue.

6.50 Assume that there is no idle trunk to city B by the time the second selector reaches level four and the selector cannot cut-through so it steps to the eleventh rotary position. The outgoing second selector returns positive 24 volts (from a booster battery) which operates relay BT. The combination of operated relays BT and L causes the AR relay to operate, which results in:

(1) an absorb cycle to the switchtrain.

(2) sequencing of the expanded routing card correeds.

(3) produces an advance sequence (crankback) of rotary switch SQO to step 6 (F).

6.51 When the expanded routing correeds have again sequenced, attempt mark LRB is removed and LRC is present in the translator. Route V7 is turned off and replaced by route V8 which is turned on in the same manner that V6 was replaced by V7 above.

6.52 Route V8 extends timed battery via the route diodes and route commons to the rotary switch SQO bank contacts. Rotary switch SQO has moved to step 6 (F) for the first instruction of the crankback alternate route. Code 0-2-7 produces a "hold send" command, but since all digits are stored there is only the four second delay and the "hold send" is removed.

6.53 The rotary switch SQO steps to step 7 (G) and extends code 2-4 which is outpulsed, stepping the local first selector to level 6. Note that no "AR" mark is used in either the 6 or 7 space (FAR or GAR) of rotary switch SQO since there is no other alternative route.

6.54 Rotary switch SQO steps to step 8 (H) extending code 1-4-7 "MF send" to the T relays, changing the sending control to the MF equipment. SQO steps to step 9 (J) giving the T relays the advance sequence code 0-1-7. Since there has been a crankback action, rotary switch SQO will advance to step 11 (L) to pick up the delete digit.

6.55 Delete code 0-2 steps rotary switch SQO from the step 11 (L) to step 13 (N) so readout begins from the first storage area. All seven digits are sent with the VAR mark on step 19 (V) providing register release.

No Code — Slow Dialer

6.56 If the calling party takes longer than 10 seconds to dial his next digit, after the first digit is registered, the register timer operates the NC relay. Timed battery extends the LNC mark through its special converter to the special mark panel. The shorting pin and jumpers 4, 5, and 6 in vertical row 9 of the code field, extend battery to the appropriate leads of office code AND gate 9, resulting in route V9 instructions appearing as negative battery on the banks of rotary switch SQO.

6.57 The code 0-2-4 on step 1 (A) causes a short absorb cycle then rotary switch SQO steps to step 2 (B). Step 2 of level J has a BAR mark which operates relay L. Combination of the operated L and NC relays cause the AR relay to operate which provides an "alternate route advance" stepping SQO to space 6 (F).

6.58 Code 0-2-4 on step 6 plus the GAR mark at level J step 7 is similar to the above, except rotary switch SQO advances to step 11 (L). The code 0-4 is received by the T relays and results in outpulsing a digit four, stepping the local first selector to level four. Rotary switch SQO steps to step 12 (M) and extends code 4-7 to the T relays, which results in outpulsing a zero, stepping the second selector to level 10.

6.59 When the NC relay is operated and rotary switch SQO steps to step 13 (N) the MP relay is operated by a ground path from relay BB and rotary switch SQO level A. The LNK mark programmed in route V9-panel 03-provides an AR mark (Figure 23) on all remaining steps of rotary switch SQO level J. Therefore, the NAR mark on step 13 is received by the register, operating relay L. Operated relays NC, MP and L provide ground to operate relay RL causing the register to release.

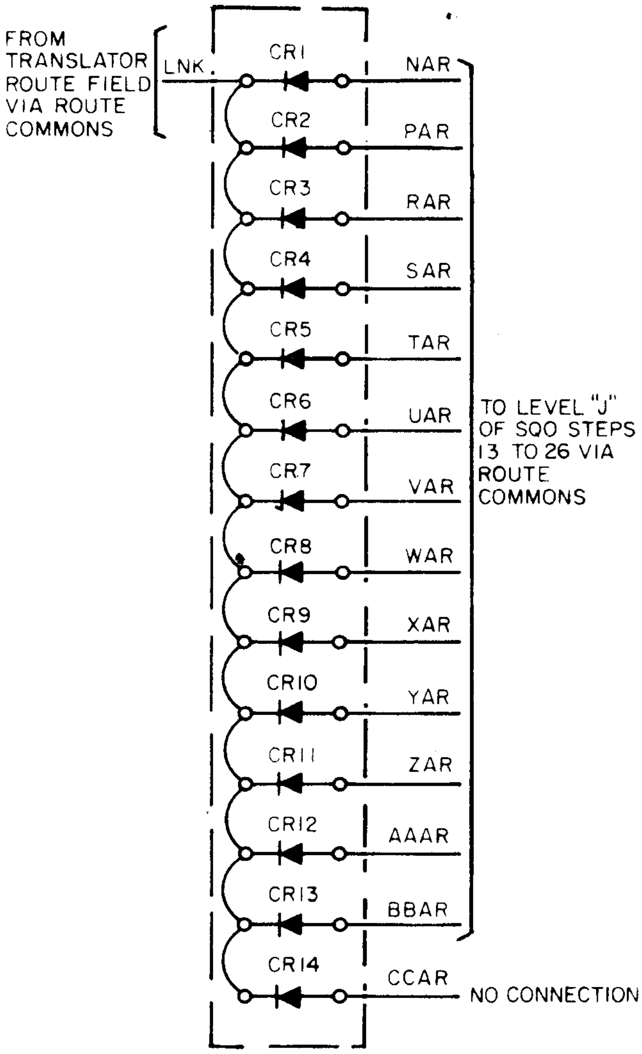


Figure 23. LNK Mark-No Code Release.