DIAL TONE SPEED REGISTER CIRCUIT
GENERAL DESCRIPTIVE INFORMATION

1. GENERAL

1.01 The dial tone speed register circuit, SD-96403, Issue 26D, is an arrangement which indicates the grade of dial tone service in any local dial central office except step-by-step modified for TOUCH-TONE dialing (see Note in 4.02).

1.02 It originates test calls automatically at 4-second intervals on spare subscriber line circuits, and checks for dial tone 3 seconds after line closure. Pairs of registers designated T(test) and D(delay) record respectively the number of test calls, and the number on which dial tone is delayed more than 3 seconds. The result is usually expressed as, "Dial Tone Speed, Percent of Delays over Three Seconds", which has served as a dial service criterion for many years.

1.03 The types of circuits which can be connected to the dial tone speed unit include coin and non-coin line circuits, line concentrator control, and No. 5 crossbar, 4-wire. The test calls have no appreciable effect on dial equipment loading because the holding time after tone is less than 1 second, but in No. 5 crossbar it is advisable to allow for the maximum of 900 test calls during the busy hour in estimating requirements for dial tone markers.

Recent Improvements

1.04 The dial tone speed circuit and equipment arrangements have been substantially revised and improved in accordance with SD-96403, Issue 26D. The principal improvements include:

- A new cam timer which provides accurate timing of the 3-second delay interval, and maintains a precise 4-second interval between all test calls, insuring a consistent number of calls during any given period. The new timer also eliminates the need for any warm-up period and does not require calibration.
- A "dwell" feature which permits skipping as many as 18 terminals on one arc without disrupting the timing or spacing of test calls, and which can be used in special circumstances to limit the number of test calls.

1.05 The advantages of the improved circuit, SD-96403, Issue 26D, are such that it is expected that most of the existing units of previous issue will be modified or replaced. Accordingly, this section describes the circuit features and operation particularly as they apply to issue 26D. Details of the circuit operation for this and earlier versions of the dial tone speed circuit can be found in CD-96403-01, Issue 9AR.

Related Practices

1.06 Related system practices which may be of interest include the following:

- **Section AA388.058 (J99231)**

  This practice, which includes a reference list of supplementary information, covers the equipment design requirements for the engineering and installation of the dial tone speed circuit for all types of local dial central office.

- **Sections on Testing and Inspections**

  Section A204.535 which covered the testing and inspection of the dial tone speed register circuit for maintenance purposes has been replaced by the following four sections:

  215-188-501 — Panel

  216-772-501 — No. 1 Crossbar

  218-768-501 — No. 5 Crossbar

  226-812-501 — Step-by-Step

  These sections are similar, differing only in such details as apply to the respective types of office. Section A304.535, Alarm

Routine, has been cancelled because information on alarms is included in the four sections listed above, and in CD-96403-01, Issue 9AR.

- **Traffic Engineering Practice Division B, Section 4**

  This practice briefly describes the equipment and its purpose, and makes recommendations on the selection and assignment of test lines to obtain representative dial tone speed results for each type of central office.

- **Central Office Management Practice Division E, Sections 3 and 4**

  This practice describes the dial tone speed register equipment and its operation. It also discusses briefly the assignment of test lines, and the significance and value of day-to-day dial tone speed results.

2. EQUIPMENT AND CIRCUIT ARRANGEMENTS

Mounting

2.01 The principal components of the dial tone speed unit are arranged for rack mounting in a switch room. The new unit per issue 26D, occupies a vertical space of 22 inches on a 23-inch rack. Depending on the type of office and class of service, auxiliary relays may be required which can be located on a 2-inch mounting plate on a miscellaneous 23-inch rack. The associated registers are usually located adjacent to other traffic registers either in the same building or at a remote point within the limits of a specified conductor resistance. Provision is made, if required, for joint registration at both local and remote points.

Capacity

2.02 The dial tone speed unit has a capacity of 100 or 200 test circuits. Access to these test lines is gained through one or two 206-type selectors, each of which accommodates 100 lines on 5 arcs of 20 terminals each. Additional terminals and a sixth arc are provided for control purposes.

Input Connections

2.03 All line circuits regardless of type or class of service terminate at the selector in single-wire connections. For a majority of the test lines, this single wire is connected to the ring side of the line circuit; the others require connection either to the tip or to both sides of the line circuit. In some of the latter cases, particularly with prepay coin lines in line switch step-by-step offices, auxiliary relays are required to permit a single-wire connection at the access switch.

Arrangement of Registers

2.04 One pair of T and D registers is associated with each arc (20 test lines) so that a single dial tone speed unit can provide a separate indication for a maximum of ten classes of service. If separate dial tone speed data is required for more than five classes of service, the 200-line unit should be specified even though fewer than 100 test lines are to be connected.

2.05 It may be desired to consolidate the scorings for several arcs on a single pair of T and D registers. With a new unit per issue 26D, this is done by making appropriate cross connections at the punchings on the unit. Existing units, including those modified per issue 26D, have one hand-operated rotary switch per arc, each switch having six positions. Any one of the five arcs can be associated with any pair of T and D registers associated with that selector, by turning the rotary switch to the appropriate position. Setting a switch on position 6 causes the arc associated with that switch to be bypassed. The latter feature is provided in a new unit by a toggle switch associated with each arc. With the switch in position one (up), the arc is associated with a particular pair of registers in accordance with the cross connections mentioned above. With the switch in position two (down), the associated arc is bypassed. Although this feature might be used on special occasions to restrict the classes of service tested, its use in day-to-day operation is not recommended.

Specification of Options

2.06 In placing orders for a dial tone speed unit, in addition to the basic equipment items, it is necessary to specify certain options depending on the type of office, class of subscriber line circuits, and other considerations. Information which should prove helpful in establishing equipment and circuit requirements is provided in Section AA388.058 (Specification J99231) and in the circuit notes on SD-96403, Issue 26D.

2.07 In this connection it should be noted that normally only one entity should be assigned to a single dial tone speed unit. As stated in C.O.M. Practice. Division E, Section 3, this is partly a matter of obtaining an adequate sampling base, but more importantly, the various wiring options for the different types of office are not necessarily compatible.

3. SELECTION AND ASSIGNMENT OF TEST LINES

Assigned Terminals

3.01 In selecting spare subscriber line circuits for connection to the dial tone speed unit, it is necessary to pay close attention to their bank, group, or frame location, to obtain a representative sample as regards order of service. Recommendations on meeting this objective are given in T.E.P. Division B, Section 4, for step-by-step, panel, and crossbar offices.

3.02 It is customary, except in the case of No. 5 crossbar, to group the test lines on the various arcs according to class of service. As stated above, it is possible to obtain separate dial tone speed data for a maximum of ten classes of service. This is particularly desirable in cases where the busy hours for the various classes do not coincide.

Unassigned Terminals

3.03 Every unassigned terminal of a working arc must be designated either a "skip" or a "dwell." An open terminal appears as a working line to the dial tone speed circuit, and a false dial tone delay would be scored each time the selector reached that terminal.

3.04 Connection to the *VT* lead causes the selector to dwell on the terminal for approximately 4 seconds without making a test call or scoring the T register. Connection to the *VT2* lead permits skipping from 1 to 18 terminals of a working arc with two minor restrictions.

Restrictions on Skipping

3.05 These restrictions are:

(a) Any single terminal of a working arc except the first or last may be skipped without restriction. The first terminal may be a working line or a dwell; the last may also be a working line or a dwell but it is subject to restriction (b).

(b) If two or more adjacent terminals are skipped, the next terminal in the sequence must be a dwell.

Restriction (b) is imposed because the time required to skip several terminals might encroach on the 3-second dial tone interval and cause a timing error if the succeeding terminal were a working line.

Choice of Skip or Dwell

3.06 There may be some choice between skips and dwells in designating unassigned terminals. To achieve the maximum number of calls, test lines should be assigned to any given arc consecutively, starting with terminal one, the remaining terminals except the last should be skipped, and the last should be a dwell in accordance with restriction (b) of 3.05. If additional dwell terminals are used to limit the number of test calls, these should be interspersed among the working lines to avoid the bias effect of a concentrated idle period during each cycle.

Coin Line Restriction

3.07 There is also a restriction which applies to coin test lines in either a panel or a crossbar office. The number of coin groups is usually small so it may be expedient to multiple a single test line to other terminals on the same arc. With a panel or crossbar coin line, it is necessary to intersperse between each pair of multipled terminals at least one dwell or one appearance of another coin line. If this precaution is not observed, a delay in the coin control circuit in clearing a line might result in interference on a successive test on the same line.

4. CIRCUIT OPERATION

Starting

4.01 The dial tone speed register circuit becomes operative immediately on receipt of a start signal. This signal can be provided manually, or automatically by means of a program timer, at either a local or remote point. The KS-16663 cam timer which operates on 22-volt 60-cycle power causes the circuit to initiate a test call on a working terminal every 4 seconds, and to check for dial tone at the end of 3 seconds.

Operating

4.02 With the selector on a working terminal, a relay closure precisely at the start of a 3-second interval is equivalent to a receiver-off-

hook or ground start condition. If dial tone is received within 3 seconds, the circuit does not respond to the tone as such, but to a coincident and significant change in dc resistance (see Note). This causes the dial equipment to be released immediately, but the selector does not advance until the circuit condition has been checked at the end of 3 seconds. If dial tone has been received, the T register scores and the selector advances to the next working or dwell terminal. If tone has not been received, both the T and D registers score and the selector advances. The regular 4-second interval between test calls or dwells is not disrupted by skipping any number of terminals including complete arcs, so long as the restrictions in 3.05 are observed.

Note: TOUCH-TONE Dialing in Step-by-Step — A coincident change in dc resistance has served as a satisfactory indication of the receipt of dial tone in all types of local dial central office, until the recent modification in step-by-step to permit TOUCH-TONE dialing. In this modification there is a variable interval between the drop in resistance when the first selector is cut through, and the connection of a converter which furnishes dial tone. A new dial tone detector which will recognize and respond directly to a new dial tone is under development for this application. The present unit, however, can be used until the new detector is available, providing the test lines are restricted to line finder groups which have not been modified for TOUCH-TONE operation.

Stopping

4.03 When a dial tone speed circuit in regular operation is to be stopped, the circuit action depends on whether the unit is wired normally or for the ***ZU*** option. With normal wiring, opening the start lead or key causes the selectors to restore immediately to normal (position 1) by self-interruption. With the ***ZU*** wiring option, the normal progression is not interrupted by opening the start lead, but continues until the last terminal, No. 100 or 200, is reached. This insures a uniform number of test calls and complete cycles during each period of operation. This feature eases the requirements for an independent program timer to control the operation automatically, and it is particularly advantageous in the case of manual control.

Use of ZU Feature — Example

4.04 To illustrate with a numerical example, assume a 200-line unit with 160 working lines, 10 dwell, and 30 skip terminals.

Time per cycle = (160 + 10) x 4 seconds
= 680 seconds (11.3 minutes)
No. of cycles per hour = 3600/680 = 5.3

With ***ZU*** wiring, for nominal 1 hour operation the machine will complete six cycles, ie, 960 test calls.

Time for five cycles = 170 x 4 x 5
= 3400 seconds or
56.7 minutes

Time for six cycles = 170 x 4 x 6
= 4080 seconds or
68.0 minutes

If the start lead is opened during the sixth cycle, ie, during the last 11.3 minute interval, the machine will complete exactly six cycles or 960 test calls. For a 100-line unit the number of cycles will be about double and the time per cycle about half, or in the order of 5.5 minutes. The time per cycle and the number of cycles will be influenced, of course, by the proportion of skip terminals.

5. REMOTE CONTROL AND REGISTRATION

5.01 A manual start key and the T and D registers associated with the dial tone speed circuit are generally located at a point remote from the unit. When this apparatus is mounted on a traffic register rack or in a cabinet in a distant building, the resistance of each interconnecting loop may not exceed 4600 ohms. Remote control and registration can be effected over a single cable pair providing only one pair of T and D registers is used. If separate registration for the various classes of service is required, an additional cable pair and a pair of registers with associated relays must be provided for each additional class. The circuit is arranged to permit joint registration on both local and distant registers if desired.

Automatic Control

5.02 Provision has been made for controlling the circuit automatically by means of a program timer. The only standard arrangement now available utilizes the program timer asso-

ciated with the traffic usage recorder (TUR) or the traffic register camera control panel. The appropriate traffic register circuits for all local dial systems show the parallel connection between the timer circuit and the remote start key which permits both automatic and manual control of the dial tone speed circuit.

Separate Program Timer

5.03 In making use of the program timer which controls the TUR and the cameras, it is apparent that the dial tone speed circuit must follow the operating schedule of the cameras. There may be circumstances when a different schedule would be preferred or when a TUR program timer is not available. In such cases, a separate program timer (eg, the Paragon 1015-OS or the Tork 8007SK) can be installed on a job basis, preferably at the remote point rather than at the machine.

5.04 A proposal to standardize a program timer for use with the dial tone speed circuit is under consideration. In fact ***ST*** and ***TST*** leads are shown in Fig. 12 of issue 26D, to which independent program timers can be connected, one for regular operation and the other for the maintenance check. When the timer for regular operation is mounted at the machine, an additional conductor to the distant point will be required if remote manual control is also desired.

6. MAINTENANCE FEATURES

6.01 Earlier versions of the dial tone speed circuit, ie, prior to issue 26D, included a feature which on the first cycle of operation caused the circuit to block until dial tone was received on each test connection. If the delay exceeded 2 to 4 minutes, an alarm sounded and the circuit locked until it was checked and released. This feature was useful in uncovering trouble conditions which resulted in false delay indications. The disadvantages of this arrangement were: (1) it was partly responsible for an objectionable variation in the number of tests during any given period, (2) it entailed unnecessary maintenance effort in clearing alarms caused by long delays at the start of the test period.

6.02 This blocking feature was eliminated in the revised circuit to meet the principal objective of consistency in the number of test calls. It is still important, however, to detect trouble conditions such as an open terminal or defective line relay, and a periodic maintenance check is recommended to accomplish this.

Periodic Check Test Using TST Key

6.03 Provision has been made in the revised circuit for an operational check test during an off-hour under the control of the TST key. The circuit, which must be at rest when this key is operated, functions in the normal manner except that it blocks indefinitely if dial tone is not received. After 20 to 30 seconds, a minor alarm is sounded and the DT alarm lamp on the panel lights. The maintenance man's attention is directed to a likely trouble condition which should be cleared so the circuit can advance. If the terminal cannot be checked immediately, the TST key should be restored to normal, the terminal noted, the connection to it removed, and it should be temporarily strapped to the ***VT2*** lead. Note that if the trouble is not cleared before the next service period, the restriction on skipping (3.05) should be observed. When the TST key is then reoperated, this terminal will be skipped permitting the remaining terminals to be checked. Should dial tone be received either before or after the alarm sounds, as might occur with an intermittent trouble, the circuit will advance and the identity of the terminal in trouble may be lost. During this check test, the T and D registers score as they do under normal operation.

6.04 There are two general conditions which should be met in making this maintenance check. First, a period should be selected when no appreciable dial tone delay is expected; second, a maintenance man should be available to start and stop the check test and to investigate any indicated trouble. Provision has been made for the automatic control of the check test by bringing out a ***TST*** lead to which a separate program timer can be connected. With this arrangement the circuit can be checked regularly for perhaps 1 hour each week without any maintenance effort unless there is trouble, in which case a maintenance man must be available to correct it.

Stuck Switch Alarm

6.05 It should be noted that the minor alarm referred to above will also sound if a selector sticks on a terminal more than about 20 seconds for any reason. Such a condition might be caused by a mechanical failure of the selector

or by a trouble within the test circuit itself. The alarm will sound in the event of such an equipment failure whether the circuit is under normal operation or under control of the TST key.

7. SPECIAL CIRCUIT CONDITIONS

7.01 In No. 1 crossbar offices a special *CB* relay is required, one per dial tone speed unit. This relay insures a minimum line closure, preventing a short start condition which could cause the line link controller to time out.

7.02 As stated above, the dial tone speed register circuit responds to a coincident change of circuit resistance which in general corresponds closely to the receipt of dial tone. An exception was noted in the case of step-by-step offices modified for TOUCH-TONE dialing. There is also a condition in No. 5 crossbar in which this simulation of the dial tone interval results in a small error. A circuit condition involving "coin first" lines is described in the CD, paragraph 3042 which causes the dial tone speed circuit to respond about 0.16 to 0.34 seconds before dial tone is actually received. This small error is not very significant because dial tone delays in a coin group, when they do occur, are likely to be well in excess of 3 seconds.