

DIAL PULSE OUTGOING SENDERS
FOR LINE LINK PULSING
TESTS USING AUTOMATIC MONITOR,
REGISTER, AND SENDER TEST CIRCUIT
NO. 5 CROSSBAR OFFICES

1. GENERAL

1.01 This section describes tests of dial pulse outgoing senders SD-26050-01, arranged for line link pulsing (LLP) and dial pulse outgoing senders SD-27629-01, used only for line link pulsing.

1.02 The reasons for reissuing this section are listed below. Revision arrows are used to emphasize the more significant changes. Equipment Test Lists are not affected.

(a) To revise test procedures to include offices arranged with Electronic Translation System (ETS) prior to being equipped with line link pulsing.

(b) To make minor changes as required.

1.03 When testing dial pulse outgoing senders SD-26050-01, only those tests which are not made in Section 218-150-501 need be made in this Section.

1.04 The tests covered are:

A. Regular Call: This test checks that the sender records information from a marker and that it outputs satisfactorily. 4

B. Abandoned Call: This test checks that the sender releases when the call is abandoned. 4

C. Deleted:

D. Reversed Trunk and Intersender

Timing: This test checks that the sender will recognize a reversed line circuit and set the line circuit to overflow. It also checks on line circuits where timing is required for connection of sender at the distant office, that if start pulsing polarity is not returned in 4 to 8 seconds and the marker finds all other outgoing senders of the group busy, the line circuit is set to overflow and the sender releases.

5

E. Battery and Ground Pulsing:

This test checks that when the sender class relay CL5 is operated, battery and ground pulsing is supplied by the sender and that the pulsing relay closes and opens both the tip and ring leads to the line circuit.

5

F. Fixed Arbitrary Digit: This

test checks that the sender will output pulse cross-connected arbitrary digits when the sender class relay CL1 is operated.

6

G. Antiglare Test: This test checks

that when the sender is used with 2-way line circuits with sender class relay CL6 operated, the sender will time properly for changes in supervision before pulsing and during interdigital timing.

6

NOTICE

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

H. Trunk Test-Open Trunk: This test checks on one-way line circuits where the initial supervision is expected to be on-hook, that an initial off-hook will be recognized by the sender which will set the line circuit to overflow and release. 7

I. Wink-Start Test: This test checks that when the sender class relay CL3 is operated, the sender will recognize a wink-start reversal as a valid start dial signal. 7

J. Timing Features: This test checks that the sender releases and sets the outgoing trunk to overflow if it cannot complete its functions in 20 to 32 seconds. 7

K. Cancel-Timed Release and Alarm: This test checks that, with the associated CTR_ key operated, the sender will not release after time-out and will operate the stuck sender alarm. 8

L. Sender Busy: This test checks that the sender appears busy when in use or when made busy at the associated MB_ jack, and also that it appears idle when not in use or made busy. 8

M. Reorder Test: This test checks the ability of the sender to set the line circuit to overflow and release when a second off-hook signal is received with the sender class relay CL6 operated. 9

N. Stop Dial Test: This test checks that on a line circuit to offices requiring the pulsing to stop momentarily, the sender will recognize a reversal of the tip and ring during the between digit interval as a stop dial signal, and a return to on-hook supervision will cause the sender to continue to output. 9

O. Marker Reorder Test: This test checks the ability of the marker to operate the sender RO relay causing the sender to set the line circuit to overflow and release. 10

P. Recycle of TM Timer: This test checks the ability of the sender to recycle the TM timer (when this feature is provided) on line circuits where timing is required for connection of a sender at the distant office. 10

Q. Immediate Reorder on Stop Dial Signal and Hold Forward Feature: This test checks that immediate reorder is returned when a stop dial signal is received during the interdigital interval on calls to a step-by-step office not requiring stop-go dialing operation. It also checks that the sender will hold the trunk connection to the called step-by-step office when an unexpected stop dial signal is encountered. 10

1.05 Lettered Steps: A letter a, b, c, etc, added to a step number in Part 3 or 4 of this section, indicates an action which may or may not be required depending on local conditions. The condition under which a lettered step or series of lettered steps should be made is given in the ACTION column, and all steps governed by the same condition are designated by the same letter within a test. Where a condition does not apply, all steps designated by that letter should be omitted.

1.06 Local instructions should be followed for recording and reporting stuck sender register operations caused by performing these tests.

1.07 The manner of selecting some circuits and test conditions at the master test frame (MTF) and its associated circuits varies depending on the apparatus options furnished with these circuits. Therefore, where variable means of selection are provided, precise instructions for the selection of circuits and test conditions are not given. Precise instructions for the use of these variable means are given in Section 218-106-301.

1.08 The location statement, At MTF—, is used to refer to all apparatus located on the four basic bays of the MTF.

1.09 On Issue 76D of SD-25800-01, a group of 18 "class of test" lamps was replaced by a single "start test" lamp designated STT. Since the designation given to the lamp is not specific, the lamp will not be called out in the section, as

well as the 18 discontinued lamps, such as DT, ORIG, ITDO, ITNP, OGT, etc.

2. APPARATUS

Tests A Through K, M Through Q

- 2.01 Master test control circuit, SD-25800-01.
2.02 Automatic monitor, register, and sender test circuit, SD-25680-01.

Tests D, G, J, K, P, Q

- 2.03 KS-3008 stopwatch or equivalent.

3. PREPARATION

STEP	ACTION	VERIFICATION
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All Tests Except L

- | | | |
|-----|----------------------------------------------------------------------------------|-------------------------|
| 1 | At MTF—
Restore all keys and switches. | |
| 2 | Momentarily operate RL key. | All lamps extinguished. |
| 3 | Select sender under test.

<i>Note:</i> Refer to paragraphs 1.07 and 1.08. | |
| 4 | Select completing marker. | |
| 5 | Select sender class of test. | |
| 6 | Operate MAC key. | |
| 7 | Operate STT key. | |
| 8 | Operate LLPT key. | |
| 9a | If SLL key is provided—
Operate SLL key. | |
| 10b | ◆If a particular line circuit is to be used—
Select LLP line circuit.◆ | |
| 11c | If selected line circuit is made busy—
Operate NTLS key. | |

All Tests Except K

- 12 At jack, lamp, and key circuit—
Release (push-in) CTR_ key.

Test L

- 2.04 67C test set or equivalent, equipped with one KS-6278 connecting clip (for checking for the presence or absence of ground).

◆Test D, L, Q◆

- 2.05 Blocking and insulating tools as required. Apply tools as covered in Section 069-020-801.

◆Test K, L◆

- 2.06 322A (make-busy) plugs as required.

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STEP	ACTION	VERIFICATION
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Note: When the SSTI circuit (SD-27839-01) is in use in the office, the SSI and ACTR keys should be in the OFF position when testing senders.

4. METHOD

STEP	ACTION	VERIFICATION
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A. Regular Call

- | | | |
|-----|-------------------------------------------------------------------------------------------|-------------------------|
| 13 | Operate keys and set switches in accordance with Test Chart Tests 1 through 14. | |
| 14 | Momentarily operate ST key. | OK lamp lighted. |
| 15 | Momentarily operate RL key. | All lamps extinguished. |
| 16 | Repeat Steps 13 through 15 for various class marks and digits as indicated in Test Chart. | |
| 17d | If no further tests are to be made—
Restore all keys and switches. | |
| 18d | At jack, lamp, and key circuit—
Operate (pull-out) CTR_ key. | |
| 19d | Restore to service any circuits made busy. | |

B. Abandoned Call

Note: If this test fails, a line hold magnet may be held operated while line circuit relays are normal. To insure against this, a made-busy line circuit should be selected.

- | | | |
|-----|----------------------------------------------------------------------------------|-------------------------|
| 13 | Operate keys and set switches in accordance with Test Chart Tests 15 through 18. | |
| 14 | Momentarily operate ST key. | OK lamp lighted. |
| 15 | Momentarily operate RL key. | All lamps extinguished. |
| 16d | If no further tests are to be made—
Restore all keys and switches. | |
| 17d | At jack, lamp, and key circuit—
Operate (pull-out) CTR_ key. | |
| 18d | Restore to service any circuits made busy. | |

C. Deleted

STEP	ACTION	VERIFICATION
D. Reversed Trunk and Intersender Timing		
Reversed Trunk		
13	Operate keys and set switches in accordance with Test Chart Tests 20 through 28.	
14	Momentarily operate ST key.	OK lamp lighted. Overflow tone heard in test receiver circuit.
		Note: With CL2 operated and CL6 not operated the sender may not set the outgoing line circuit to overflow depending upon options in the sender.
15	Momentarily operate RL key.	All lamps extinguished. Overflow tone silenced.
Intersender Timing (W-S senders only)		
16	At outgoing sender group release circuit— Block operated R_ relay associated with sender under test.	
17	At MTF— Operate keys and set switches in accordance with Test Chart.	
18	Momentarily operate ST key; <i>start timing.</i>	In approximately 4 to 9 seconds— OK lamp lighted. Overflow tone heard in test receiver circuit.
19	Momentarily operate RL key.	All lamps extinguished. Overflow tone not heard.
20	At outgoing sender group release circuit— Remove blocking tool from R_ relay.	
21d	If no further tests are to be made— At MTF— Restore all keys and switches.	
22d	At jack, lamp, and key circuit— Operate (pull-out) CTR_ key.	
23d	Restore to service any circuits made busy.	
E. Battery and Ground Pulsing		
13	Operate keys and set switches in accordance with Test Chart Tests 29 and 30.	

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STEP	ACTION	VERIFICATION
14	Operate BGO key.	
15	Momentarily operate ST key.	OK lamp lighted.
16	Momentarily operate RL key.	All lamps extinguished.
17	Release BGO key.	
18	Momentarily operate ST key.	OK lamp lighted.
19	Momentarily operate RL key.	All lamps extinguished.
20d	If no further tests are to be made— Restore all keys and switches.	
21d	At jack, lamp, and key circuit— Operate (pull-out) CTR_ key.	
22d	Restore to service any circuits made busy.	

F. Fixed Arbitrary Digits

13	Operate keys and set switches in accordance with Test Chart Tests 31 through 41.	
14	Momentarily operate ST key.	OK lamp lighted.
15	Momentarily operate RL key.	All lamps extinguished.
16d	If no further tests are to be made— Restore all keys and switches.	
17d	At jack, lamp, and key circuit. Operate (pull-out) CTR_ key.	
18d	Restore to service any circuits made busy.	

G. Antiglare Test

13	Operate keys and set switches in accordance with Test Chart Tests 42 and 43.	
14	Momentarily operate ST key.	In approximately 2 to 4 seconds— OK lamp lighted.
15	Momentarily operate RL key.	All lamps extinguished.
16d	If no further tests are to be made— Restore all keys and switches.	
17d	At jack, lamp, and key circuit— Operate (pull-out) CTR_ key.	

STEP	ACTION	VERIFICATION
18d	Restore to service any circuits made busy.	
H. Trunk Test—Open Trunk		
	<i>Note:</i> One-way line circuits only.	
13	Operate keys and set switches in accordance with Test Chart Tests 44 and 45.	
14	Momentarily operate ST key.	OK lamp lighted. Overflow tone heard in test receiver circuit.
15	Momentarily operate RL key.	All lamps extinguished. Overflow tone not heard.
16d	If no further tests are to be made— Restore all keys and switches.	
17d	At jack, lamp, and key circuit— Operate (pull-out) CTR_ key.	
18d	Restore to service any circuits made busy.	
I. Wink Start Test		
13	Operate keys and set switches in accordance with Test Chart Tests 46 through 49.	
14	Momentarily operate ST key.	OK lamp lighted.
15	Momentarily operate RL key.	All lamps extinguished.
16d	If no further tests are to be made— Restore all keys and switches.	
17d	At jack, lamp, and key circuit— Operate (pull-out) CTR_ key.	
18d	Restore to service any circuits made busy.	
J. Timing Features		
13	Operate keys and set switches in accordance with Test Chart Tests 50 through 56.	
14	Momentarily operate ST key; <i>start timing.</i>	TMT lamp lighted. In 20 to 32 seconds— OK lamp lighted. Overflow tone heard in test receiver circuit.
15	Momentarily operate RL key.	All lamps extinguished.

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STEP	ACTION	VERIFICATION
16d	If no further tests are to be made— Restore all keys and switches.	
17d	At jack, lamp, and key circuit— Operate (pull-out) CTR_ key.	
18d	Restore to service any circuits made busy.	
K. Cancel-Timed Release and Alarm		
12	Operate keys and set switches in accordance with Test Chart Tests 54 through 56.	
13	At jack, lamp, and key circuit— Operate (pull-out) CTR_ key.	
14	At MTF— Momentarily operate ST key; <i>start timing</i> .	In 20 to 32 seconds— At jack, lamp, and key circuit— TO_ lamp lighted. Overflow tone heard at test receiver circuit. In 10 to 15 seconds after TO_ lamp lighted— R-S-TOA lamp lighted. Major alarm sounds.
15	At jack, lamp, and key circuit— Insert make-busy plug into MB_ jack of sender under test.	R-S-TOA lamp extinguished. Major alarm silenced. Overflow tone not heard.
16	Release (push-in) CTR_ key.	TO_ lamp extinguished. At MTF— OK lamp lighted.
17	Momentarily operate RL key.	All lamps extinguished.
18d	If no further tests are to be made— Restore all keys and switches.	
19d	At jack, lamp, and key circuit— Operate (pull-out) CTR_ key.	
20d	Restore to service any circuits made busy.	
L. Sender Busy		
1	At jack, lamp, and key circuit— Insert make-busy plugs into MB_ jacks of all senders in subgroup associated with sender under test.	At sender frame— Ground not present on G26 (SIE lead), G36 (SIO lead), G33 (SP lead), terminals of sender control unit terminal strip.
2	Block operated SB relay.	

STEP	ACTION	VERIFICATION
3	At jack, lamp, and key circuit— Remove make-busy plug from MB_ jack of sender under test.	At sender frame— Ground not present on G26 (SIE lead), G36 (SIO lead), G33 (SP lead) terminals of sender control unit terminal strip.
4	Remove blocking tool from SB relay. Note: Sender may be seized.	Ground present on G26 (SIE lead), G36 (SIO lead), G33 (SP lead) terminals of sender control unit terminal strip.
5	At jack, lamp, and key circuit— Remove make-busy plugs from MB_ jacks of senders in subgroup associated with sender under test.	

M. Reorder Test

13	Operate keys and set switches in accordance with Test Chart Test 57.	
14	Momentarily operate ST key.	Overflow tone heard at test receiver circuit. OK lamp lighted.
15	Momentarily operate RL key.	All lamps extinguished. Overflow tone silenced.
16d	If no further tests are to be made— Restore all keys and switches.	
17d	At jack, lamp, and key circuit— Operate (pull-out) CTR_ key.	
18d	Restore to service any circuits made busy.	

N. Stop Dial Test

13	Operate keys and set switches in accordance with Test Chart Tests 58 through 62.	
14	Momentarily operate ST key.	OK lamp lighted.
15	Momentarily operate RL key.	All lamps extinguished.
16d	If no further tests are to be made— Restore all keys and switches.	
17d	At jack, lamp, and key circuit— Operate (pull-out) CTR_ key.	
18d	Restore to service any circuits made busy.	

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STEP	ACTION	VERIFICATION
O. Marker Reorder Test		
13	Operate keys and set switches in accordance with Test Chart Test 63.	
14	Momentarily operate ST key.	OK lamp lighted. Overflow tone heard at test receiver circuit.
15	Momentarily operate RL key.	All lamps extinguished.
16d	If no further tests are to be made— Restore all keys and switches.	
17d	At jack, lamp, and key circuit— Operate (pull-out) CTR_ key.	
18d	Restore to service any circuits made busy.	
P. Recycle of TM Timer		
13	Operate keys and set switches in accordance with Test Chart Tests 64 through 67.	
14	Momentarily operate ST key; <i>start timing</i> .	
15	After 15 seconds but before 19 seconds— Momentarily release TMT key; <i>start timing</i> .	Sender outpulses first digit.
16	After 15 seconds but before 19 seconds— Release TMT key.	Sender completes outpulsing. OK lamp lighted.
17	Momentarily operate RL key.	All lamps extinguished.
18d	If no further tests are to be made— Restore all keys and switches.	
19d	At jack, lamp, and key circuit— Operate (pull-out) CTR_ key.	
20d	Restore to service any circuits made busy.	
Q. Immediate Reorder on Stop Dial Signal and Hold Forward Feature		
13d	If 2-way trunk is used for selected route— At distant office— Have trunk removed from service.	
14e	If 2-way line circuit, with line link pulsing and E&M lead supervision is used— Insulate contact 4M of OF relay in the line circuit.	

STEP	ACTION	VERIFICATION
15f	If sender under test is arranged for immediate reorder on stop dial signal without hold forward feature— At MTF— Operate keys and set switches in accordance with Test Chart Test 68.	
16f	Momentarily operate ST key.	OK lamp lighted. Overflow tone heard.
17f	Momentarily operate RL key.	All lamps extinguished. Overflow tone silenced.
18f	At jack, lamp, and key circuit— Operate (pull-out) CTR_ key.	
19g	If sender under test is arranged for immediate reorder on stop dial signal with hold forward feature— At MTF— Operate keys and set switches in accordance with Test Chart Test 69.	
20g	Momentarily operate ST key.	OK, PL, TK1, lamps lighted. Overflow tone heard. At jack, lamp, and key circuit— TO_ lamp lighted.
21g	At MTF— Momentarily operate RL key.	OK, PL, TK1 lamps extinguished. Overflow tone silenced.
22g	At jack, lamp, and key circuit— Release (push-in) CTR_ key.	TO_ lamp extinguished.
23g	Operate (pull-out) CTR_ key.	
24h	If sender is arranged for hold forward feature without immediate reorder on stop dial signal— At MTF— Operate keys and set switches in accordance with Test Chart Test 70.	
25h	Momentarily operate ST key; <i>start timing</i> .	In 20 to 32 seconds— PL, TK1, lamps lighted. Overflow tone heard. At jack, lamp, and key circuit— TO_ lamp lighted.
26h	At MTF— Momentarily operate RL key.	PL, TK1 lamps extinguished. Overflow tone silenced.

STEP	ACTION	VERIFICATION
27h	At jack, lamp, and key circuit— Release (push-in) CTR key.	TO_ lamp extinguished.
28h	Operate (pull-out) CTR_ key.	
29d	If 2-way trunk is used for selected route— At distant office— Have trunk restored to service.	
30e	If 2-way line circuit, with line link pulsing and E&M lead supervision is used— Remove insulator from OF relay.	
31i	If no further tests are to be made— At MTF— Restore all keys and switches.	

5. PREPARATION OF TEST CHART

5.01 The Test Chart is used as a particular number chart and provides the priming information required for each test. Information obtained from local office records shall be used to fill in the Test Chart in the following manner.

- (a) Select Office Designation (OA, OB, etc) required for the marker to direct the call to the proper number group which contains the directory numbers of the line link pulsing line circuit. Record in Office Designation column.
- (b) Record A through K digits required for the marker to direct the call to a working line link pulsing line circuit.
- (c) If the SLL key is provided, place a check mark in the SLL column. If the LLS switch is provided, record the setting determined from Table A in the LLS column.

TABLE A

NO. OF OFFICE CODE DIGITS NORMALLY RECEIVED BY MARKER*	NO. OF NUMERICAL DIGITS (TH, H,T,U) TO BE DELETED*	LLS-SWITCH POSITION
3	0	3
	1	4
	2	5
	3	6
	4	7
2	0	2
	1	3
	2	4
	3	5
	4	6
1	0	1
	1	2
	2	3
	3	4
	4	5
0	0	0

* Consult local office records.

- (d) Place a check mark in the C20H and/or CX columns when required for proper supervision of the line link pulsing line circuit.

Note: In case where the type of supervision is pertinent to a particular test, a check mark has been preprinted.

(e) Record any arbitrary digits prefixed by the marker in the Arbitrary Digits columns.

(f) In the Class Mark to Sender column, record the class mark sent to the sender by the marker.

Note: In cases where the class mark is pertinent to a test it has been preprinted. This class mark may be used alone or in combination with other class marks.

(g) Record the number of digits to be deleted in the DL_ column. This is determined by the marker cross-connections with the operation of the SLL key or LLS switch.

5.02 Test A

(a) Apply paragraph 5.01 (a) through (g).

Note: Directory numbers should be selected for each LR_ relay that presents a different CL_ class mark or combination of class marks, arbitrary digits, or delete mark to the sender. If possible numbers should also be selected to check each two-of-five digit combinations outpulsed by the sender.

5.03 Test B

(a) Apply paragraph 5.01 (a) through (c), (e) through (g).

5.04 Test D

(a) Tests 20 through 24, apply paragraph 5.01 (a) through (c), (e) through (g).

(b) Tests 25 through 28, apply paragraph 5.01 (a) through (c), (e), and (g).

5.05 Test E

(a) Apply paragraph 5.01 (a) through (c), (e), and (g).

5.06 Test F

(a) Apply paragraph 5.01 (a) through (e) and (g).

Note: Class mark CL1 may be used in combination with any other class mark.

5.07 Test G

(a) Apply paragraph 5.01 (a) through (c), (e), and (g).

5.08 Test H

(a) Apply paragraph 5.01 (a) through (c), (e), and (g).

5.09 Test I

(a) Apply paragraph 5.01 (a) through (c), (e), and (g).

5.10 Test J

(a) Apply paragraph 5.01 (a) through (c), (e) through (g).

5.11 Test K

(a) Apply paragraph 5.01 (a) through (g).

5.12 Test M

(a) Apply paragraph 5.01 (a) through (c), (e), and (g).

5.13 Test N

(a) Apply paragraph 5.01 (a) through (c), (e) through (g).

5.14 Test O

(a) Apply paragraph 5.01 (a) through (g).

5.15 Test P

(a) Apply paragraph 5.01 (a) through (g).

5.16 Test Q

(a) Apply paragraph 5.01 (a) through (c), (e), and (g).

Note: An office code that will not operate sender class relays CL2, CL3, or CL6 must be used.



TEST CHART

TEST	TYPE OF TEST	TEST NO	MASTER TEST FRAME PRIMING													MISCELLANEOUS INFORMATION*					TEST NO.	TEST							
			DIRECTORY NUMBER										DELETE INFORMATION		SUPERVISION		MISCELLANEOUS KEYS & SWITCHES			ARBITRARY DIGITS			CLASS MARK TO SDR	DELETE MARK TO SDR					
			A	B	C	D	E	F	G	H	J	K	SLL	LLS	C20H	CX								AR	BR	CR	CL-	DL-	
A	Regular Call	1																								1	A		
		2																										2	
		3																										3	
		4																										4	
		5																										5	
		6																										6	
		7																										7	
		8																										8	
		9																										9	
		10																										10	
		11																										11	
		12																										12	
		13																										13	
		14																										14	
B	Abandoned Call	15																								15	B		
		16																√										16	
		17																√	√									17	
		18																	√									18	
C	CANCELED																								19				
D	Reversed Trunk	20																		SPD	DTR	MOTL					20	D	
		21																			SPD	DTR	MOTL			2			21
		22																√			SPD	DTR	MOTL						22
		23																√	√		SPD	DTR	MOTL						23
		24																	√		SPD	DTR	MOTL						24
	Intersender Timing	25																			TMT	MOTL				6			25
		26																	√		TMT	MOTL				6			26
		27																	√	√	TMT	MOTL				6			27
		28																		√		TMT	MOTL				6		

* This information is determined from marker and sender cross-connections and is recorded here for convenience of the tester.





TEST CHART

TEST	TYPE OF TEST	TEST NO	MASTER TEST FRAME PRIMING														MISCELLANEOUS INFORMATION*					TEST NO.	TEST				
			DIRECTORY NUMBER										DELETE INFORMATION		SUPERVISION		MISCELLANEOUS KEYS & SWITCHES			ARBITRARY DIGITS				CLASS MARK TO SDR	DELETE MARK TO SDR		
			A	B	C	D	E	F	G	H	J	K	SLL	LLS	C20H	CX	AGR	MOTL		AR	BR			CR	CL-	DL-	
M	Reorder Test	57														√	√	AGR	MOTL					6		57	M
N	Stop Dial Test	58																SPD								58	N
		59																SPD								59	
		60														√		SPD								60	
		61														√	√	SPD								61	
		62															√	SPD								62	
O	Marker Reorder	63															ROT	MOTL							63	O	
P	Recycle of TM Timer	64															TMT								64	P	
		65													√		TMT								65		
		66													√	√	TMT								66		
		67														√	TMT								67		
Q	Immediate Reorder on Stop Dial Signal and Hold Forward Feature	68															SPD	OTR	MOTL						68	Q	
		69															SPD	OTR	MOTL	C20H					69		
		70															SPD	OTR	MOTL	C20H					70		

* This information is determined from marker and sender cross-connections and is recorded here for convenience of the tester.

