SWITCHING SYSTEMS MANAGEMENT
CROSSBAR TANDEM
ASSIGNMENT PRACTICES
MARKER ASSIGNMENTS

CONTENTS PAGE

1. GENERAL

1.01 This section is provided to give the crossbar tandem machine administrator uniform guidelines for assigning markers in a "Crossbar Tandem Switching System."

1.02 Whenever this section is reissued, the reason for reissue will be listed in this paragraph.

1.03 The title for each figure includes a number(s) in parentheses which identifies the paragraph(s) in which the figure is referenced.

1.04 There are two types of crossbar tandem markers; ring markers and route relay markers. The difference between these two markers is in the means used to decode the routing and outpulsing information and scoring traffic registers.

The ring marker performs these functions by sending current over wires that are threaded through "rings". In the route relay marker the operation of a route relay is required.

1.05 The route relay marker operates its route relays in a definite route advance pattern which is determined by a combination of ground supplies and battery supplies. This arrangement limits the maximum number of trunks that can be tested in one routing pattern to 240 trunks in four groups or subgroups. This maximum may be expanded, however, by the use of group busy relays. A more detailed discussion of ground and battery supplies is included later in this section. The use of group busy relays is also discussed in this section.

1.06 The ring marker differs from the route relay marker in that it has no ground supplies and, therefore, no practical limitation on trunk group size or route advance.

2. ROUTING AND ASSIGNMENT ORDER ROUTINE

2.01 The Routing and Assignment Order is the standard marker cross connection form for crossbar tandem. The Routing and Assignment Order forms for ring markers (Form E-4913 is shown in Fig. 1) and route relay markers (Form E-4346 is shown in Fig. 2) are somewhat different, but the general procedures for preparing and handling the forms are the same. The recommended routine is as follows:

(1) The toll circuit facilities administrator prepares four copies of Form E-4913 or E-4346, retains one for his file and sends three copies to the machine administrator.

(2) The machine administrator adds the information for which he is responsible, keeps one copy for his file and sends two copies to the central office plant group.

(3) Plant completes the work, keeps one copy for its file, and returns the remaining copy to the machine administrator. The necessary information is transcribed and the copy forwarded to the facilities administrator.

2.02 When changes are made for other than routing purposes the following procedures are suggested:

(a) The machine administrator originates the necessary orders on Form E-4913A or E-4346A, which is the same form as Form E-4913 and E-4346 but printed on yellow paper. The machine administrator copies all of the routing information from the E-4913 (or E-4346), which is in effect, and adds the new assignment information, then prepares three copies, keeps one for his file and sends to plant.

(b) Plant completes the work, keeps one copy for its file, and returns the remaining copy to the machine administrator. The necessary information is transcribed, and the copy forwarded to the facilities administrator.

2.03 For initial installations and major additions, it may be desirable for the traffic facilities group to hold all forms until a date ageed to mutually by plant and traffic, after which the initial forms and all subsequent change forms would be promptly forwarded.

2.04 For offices that have both ring and route relay markers, two separate sets of forms (one for each type of marker) must be prepared and maintained.

3. RING MARKER ROUTE NUMBER CROSS CONNECTIONS

ROUTING AND ASSIGNMENT ORDER (FORM E-4913)

3.01 The Routing and Assignment Order, Form E-4913, shown in Fig. 1, is the standard cross-connection form used for ring markers. The ring marker can handle a maximum of 600 routing treatments. At least one form is required for each routing treatment per marker test span. A treatment is a unique set of conditions which, for a given group of codes, describe the routing, outpulsing, and scoring of registers on calls from a trunk class or group of classes. Any difference in routing, outpulsing, or scoring of registers requires a separate treatment. Relating this to Form E-4913, where any difference exists on Items 5 through 24, a separate form is required.

PREPARATION OF FORM E-4913

3.02 The individual items on Form E-4913 are discussed below. The numbering corresponds to the item numbers on the form. The toll circuit traffic facilities group generally is responsible for Items 1 through 13, while Items 14 through 19 and 21 through 24 usually are handled by the machine administrator. Item 20 is usually completed by the plant group. The responsibilities can be varied to permit more effective local arrangements.

ITEM NO. **DESCRIPTION**

1. **Route Number** - A standard numbering arrangement has been devised which permits the use of a single number to designate code points, second string firing circuits, and route advance points. The numbering consists of the first 30 numbers of each block of 50 numbers. For example 000 to 029, 050 to 079, and so on to 950 to 979. These 20 sets of 30 numbers constitute the 600 routing treatments available with the ring marker.

   Where trunks are assigned by marker pair rather than marker group, it is also necessary to denote the markers which are assigned to this route number; for example, 156-0 & 1 or 156-2 & 3. This means that as many as four forms will be required to satisfy a full complement of eight markers. An alternative procedure is to divide the lines for items 14 through 19 into columns (one for each marker pair).

   As mentioned previously a separate form is required for each routing treatment. In addition to the route number, it is necessary to indicate whether this is a first route or a route advance route. Where a group is both a first route and a route advance route, a separate routing treatment is required for each condition.

2. **Order Number** - Orders can be numbered consecutively from one up.

3. **Replaces Order Number** - When this order is replaced by another it can be removed from the active file, and the number of the replacing order entered in this space as a matter of record.

4. **Replaced by Order Number** - When this order is replaced by another it can be removed from the active file, and the number of the replacing order enterd in this space as a matter of record.

5. **Group** - Enter the **name** of the outgoing trunk group with which this route number will be associated.

6. **Number of Trunks** - Enter the number of working trunks plus spare terminals assigned to this group. By local agreement, this item may be filled in by the machine administrator.

7. **Effective Date** - Enter the date and time on which this routing is to be made effective. This can be indicated as "cutover", where major changes are involved. Any change affecting distance dialing should be effective on standard cutover dates and hours.

8. **Codes Connected to this Route Number** - This item applies to **first route numbers only.** Several different codes may be received which are to be sent out over the same trunk group test span with the same treatment. Such codes and their destination involve one route number and should be entered under this item. The exceptions to this are:

   (a) Codes of the 1XX type. These require a separate route number and order form, because the sender handles a 1XX code differently from other codes.

   (b) Cases where certain central office codes in the home area are to be denied to some trunk classes. Where this is done, separate route numbers must be assigned for each group of trunk classes so that all classes are included.

   (c) There may be cases where certain central office codes in foreign areas assigned to the translator frames are to be denied to some trunk classes. Where this is done, separate route numbers must be assigned for each

group of central ofice codes so that all of the central office codes for this partiular foreign area are included. When the codes connected to this relay will be routed or denied based on the first six digits, enter the entire 6-digit number.

Trunks to leave word (LW) and will hold register (WH) operator positions are assigned as separate test spans.

The class column is used to indicate those situations where certain incoming trunk groups are denied access to cetain detainations. This is accomplished by utilizing class indications on the incoming trunk relay equipments. Excluding class mark assigned to an incoming group (or groups) denies access of the group to the codes listed on the order.

9. **Route Numbers Advancing to this Route Number** - This item applies to route advanced test spans only and provides space to list, by route number, all of the first test spans or preceding route advance test spans which advance directly to this route number.

10-13 Fill in, for route numbers which represent:

First test spans - lines 10 and 13

Route advance test spans - lines 11 and 13

Route advance test spans which route advance to tone or announcement - lines 11 and 12

Tone or announcement test spans - lines 12 and 13 (For 120 IPM fill in line 12 only)

The various columns associated with items 10 to 13 are as follows:

(a) **Group** - Enter the name of the trunk group.

(b) **Route Number** - Enter the route numbers of the two test spans involved.

(c) **Code Conversion - Skip** - Enter the number of digits which are to be omitted (skipped) before the call is sent forward. If all the digits received are to be pulsed forward enter 0.

(c) All senders used with operator or direct distance dialing (DDD) can skip 1, 2, or 3 digits on 7-digit calls and can skip 1, 2, 3, 4, 5, or 6 digits on 10-digit calls. In addition, on private branch exchange (PBX) indialed (7-digit) calls these senders can skip 4, 5, or 6 digits.

(d) **Code Conversion - Replace** - Enter the exact digits which are to be generated and sent forward in place of those number plan area (NPA), routing or central office codes which were omitted under Item c. This may be any 1, 2, or 3-digit code.

(e) **Code Conversion - Prefix** - Enter the exact digits which are to be generated and sent forward ahead of those which have been received. For 7-digit calls, this may be any 1, 2, or 3-digit code. On 10-digit calls, 1, 2, or 3 digits can be prefixed for certain senders. This item is used only in conjunction with a skip 0 in Item c.

(f) **Number of Trunks** - Enter the number of working trunks in this test span. This normally is done by the machine administrator.

(g) **Group Span** - Enter the span of trunks (number of terminals) from group start to group end. This normally is done by the machine administrator.

14. **Office Frames** - Enter the numbers of each of the pairs of office link frames, such as 0 & 1, or 2 & 3, etc. The marker test spans associated with a large trunk group may be scattered over several pairs of office link frames or in some

unusual cases may be concentrated on one pair of frames.

15. **Trunk Level** - Enter the number of the trunk level which corresponds to the number of the marker test group to which this trunk group has been assigned.

16. **Group Start** - Enter the number of the first terminal of a marker test group to which the trunk group has been assigned. This will always be be an even-numbered terminal.

17. **Group End** - Enter the number of the last assigned terminal in the group span. This is always an odd-numbered terminal.

18. **Two-way** - Enter "Yes" for all two-way trunk groups and "No" for one-way outgoing groups.

19. **Type of Outpulsing** - Enter the type of outpulsing required (MF or DP) or "No" if no outpulsing is required.

20. **Sender Class** - The plant department will usually enter the class of service (numbered 0-20). This class tells the sender the type of outpulsing to use to complete the call.

21. **Traffic Separation Peg Count Register** - Enter "Yes" and the outgoing traffic separation class mark. It will be necessary to furnish separate traffic register assignments to the plant department. First routes only should be arranged for traffic separation peg count. For alternate route numbers, enter "No" for this item.

22. **Trunk Group Peg Count Register** - Enter "Yes" if a peg count register is to be associated with the outgoing trunk group. If no trunk group peg count register is required enter "No".

23. **Trunk Group Overflow Register** - Enter "Yes" if an overflow register is to be associated with the outgoing trunk group. If no register is required, enter "No".

24. **Traffic Usage Recorder Register** - Enter "Yes" if traffic usage recorder (TUR) registers are to be associated with the outgoing trunk group. If no registers are required, enter "No".

25. This line is available for local use. Where translator frames are involved with this route number, it may be convenient to use this line to enter the necessary frame number and code (foreign area or PBX) involved. It may also be used to enter the group busy relay number, if one is assigned to the route number.

4. ROUTE RELAY MARKER CROSS CONNECTIONS

ASSIGNMENT CONSIDERATIONS

A. Route Relay Requirements

4.01 The number of route relays provided for an office is specified in the traffic order. Every outgoing trunk group will require at least one route relay and some will require two or more depending upon the size of the group and the number of routing and traffic separation treatments required. When different routing or traffic separation treatments are involved on the same outgoing trunk group the marker must obtain specific information from the route relay cross connections regarding the particular point desired which does not necessarily apply to all points reached over this group. Basically, one route relay per marker is required for trunk groups assigned to one or two marke test groups (up to 80 trunks), two route relays for groups of 81 to 120 trunks, three route relays for groups of 121 to 200 trunks and four route relays for groups of 201 to 240 trunks. Over 240 trunks may be assignd in a routing pattern by use of group busy relays as outlined in Paragraph 5. Recommended route advance patterns for various trunk group arrangements are discussed in 4.09.

4.02 Additional route relays must be assigned to outgoing trunk groups or subgroups under the following conditions:

(a) For trunk groups carrying traffic requiring different code conversion treatments, one route relay per trunk group or subgroup per code conversion treatment. Code conversion covers the deletion, replacing, or prefixing of digits by the sender before the call is sent forward.

(b) For trunk groups carrying traffic requiring different traffic separation peg count treatment, one route relay per trunk group or subgroup per traffic separation treatment.

(c) For trunk groups which are alternate routes for other groups, but are also first route for some traffic, one route relay per group or subgroup for first routes and one route relay per group or subgroup for alternate routed traffic.

(d) For trunk groups to WH and LW operator positions.

(1) On groups containing more than 8 trunks per group, one route relay per group.

(2) On groups, containing 5 to 8 trunks per group, one route relay per five groups.

(3) On groups containing 4 or less trunks per group, one route relay per ten groups.

(e) For points reached with 1XX type toll center operator, one route relay per trunk group or subgroup to serve these codes only.

B. Ground Supplies and Battery Supplies

4.03 In the route relay marker, the information, regarding the particular terminals in the marker test group to be tested for an idle trunk in the desired trunk group, is secured from a route relay. A route relay may serve a maximum of either 40 trunks in a group assigned to one marker test group or 80 trunks in a group served by two marker test groups.

4.04 Each route relay is assigned to a "ground supply". There are five different ground supplies numbered 1, 2, 3, C and O. Ground supplies C (for Common) and O (for Overflow) are the fourth and fifth ground supplies, respectively. In testing for an idle trunk in several subgroups of 40, the order of test is always from the lower to the higher numbered ground supply, with the no circuit (NC) or reorder trunks always being assigned to ground supply O. In some instances, it may be necessary to assign more than one route relay to a trunk group located within a particlar marker test group. For example, when some codes are to have different code conversion or traffic separation treatment than other codes routing over the same trunk group, several route relays are required. When two or more route relays are assigned to the same trunk group, they may be assigned in different ground supply groups as required.

4.05 There are also four different "battery supply circuits" available for each route relay. The four battery supplies are designated BA, BB, BC,and BD. Each battery supply controls certain circuit operations. The uses of the battery supplies are as follows:

(a) **BA Supply** - The BA battery supply is used on route relays for original groups when there are 40 or less trunks in the group or for testing the first subgroup of 40 trunks in a group when the route relay is not arranged to test 80 trunks.

(b) **BB Supply** - The BB battery supply is used on route relays for original groups when the route relay is arranged for testing two subgroups (41 to 80 trunks) on each call.

(c) **BC Supply** - The BC battery supply is used on route relays for intermediate or last (alternate route) groups when the route relay is arranged to test 40 or less trunks.

(d) **BD Supply** - The BD battery supply is used on route relays for intermediate or last (alternate route) groups when the route relay is arranged to test 41 to 80 trunks.

4.06 The circuit limitations on the use of the battery supplies are as follows:

(a) **BA or BB** - must be used on the route relay connected to the code point and can only be used once in a route advance sequence.

(b) **BB and BD** - control "Flip-Flop" testing where one route relay tests two subgroups - 41 to 80 trunks. BB and BD can be used only once in a route advance sequence with one located in ground supply 1 or 2 and the other in ground supply 3 or 4.

(c) **BC** - may be used on any route relay except the first and may be used more than once in a route advance sequence.

4.07 A route relay can be arranged to cause the marker to test more than 40 trunks by the

use of a "subgroup allotter". Using a subgroup allotter (flip-flop testing) two subgroups or a maximum of 80 trunks in one trunk group may be tested. The subgroup allotter circuits are so designd that only 58 route relays can be arranged for flip-flop testing. This flip-flop arrangement can be used in two ways:

(a) It can permit the marker to test the first 40 trunks and, if these are all busy, to test the second 40 trunks before advancing to the next ground supply.

(b) It can permit the marker to test only 40 of the trunks on one call and the other 40 on the next call and in both cases to advance to the next ground supply.

4.08 When the first method is used, which is most common, as long as there are idle trunks in each subgroup, the two subgroups will be tested alternately on each succeeding call. When the second method is used the BB and BD battery supplies are not used.

C. Arrangement Numbers

4.09 The two charts (A and B) in Fig. 3 are used to determine the battery and ground supply associations of the route relays for any route advance sequence. The figures 40, 80, 120, etc, on Chart A indicate the number of subgroups of trunks (marker test groups) rather than the exact number of trunks. The 40 indicates one subgroup or any number of trunks from 2 to 40, the 80 indicates two subgroups either one of which can have from 2 to 40 (or a maximum of 80 if both subgroups have 40 trunks). The 120 indicates three subgroups, etc.

4.10 Assuming a simple case of a group of 18 trunks with no alternate route then looking at the 40 in Column 1, it is obvious that this is an original route so the 40 (maximum) is shown under "Orig." (Original in Column 2). The entry "1" or "2" in Column 6 means that either arrangement 1 or 2 on Chart B may be used.

4.11 A somewhat more involved case might be a high usage group consisting of 70 toll circuits with an alternate route to a final group of 36 circuits. Three marker test groups or subgroups are required, two for the 70 size group and one for the 36 size group. Looking under Column 1 for 3 subgroups and under Columns 2 and 3 for an original group of 80 with an alternate of 40, it can be see that there are five possible arrangements. The arrangement selected should take into consideration cross-connection changes due to circuit growth or the addition of intermediate alternate routes which might be anticipated during the engineering period.

ROUTING AND ASSIGNMENT ORDER (FORM E-4346)

4.12 One Form E-4346, Fig. 2, is prepared for each like-numbered route relay used in the office. In other words, one form is required for each outgoing trunk group or subgroup times the number of different routing treatments. The term treatment refers any difference in the way the codes are to be spilled forward (code conversion), any difference in the scoring of traffic separation peg count registers, distinctions due to class of service marks, etc. For example, if some calls are to be sent forward over a certain trunk group with all the digits as received (skip 0) and some are to be sent forward without the area code (skip 3) two route relays are required for that group and, therefore, two of these forms should be prepared.

4.13 In addition to the form outlined above for first routed traffic, if a group or subgroup carries any alternate routed traffic an additional route relay is required for each route treatment of the alternate routed traffic and a form is required for each such relay. In addition, if 1XX codes are to be routed over the same trunk group with other codes not beginning with "1", a separate relay (and form) is required for the 1XX Codes. This applies to first route groups only.

4.14 A crossbar tandem office may contain a maximum of 480 route relays. The 480 route relays are divided into four bays of 120 relays each. In the first bay the relays are numbered 000 through 119. The second bay of relays is numberd the same except the relay number is prefixed by an 0, eg, 0-0-0. In the third bay the relay number is prefixed by a 1; and by a 2 in the fourth bay. Relays 000 through 009 in each marker are reserved for tone and announcement trunks. The NC (tone and announcement) group should be assigned to relay 000.

4.15 It may be helpful in some offices to prepare cross-reference files by codes, order number, destination, and trunk group. However, these files

should neither be prepared nor maintained unless they are used frequently.

PREPARATION OF FORM E-4346

4.16 The individual items on Form E-4346, Fig. 2, are discussed below. The numbering corresponds to the item numbers on the form. The toll circuit traffic facilities administrator generally is responsible for Items 1 through 18, while Items 19 through 24 and 26 through 28 usually are handled by the machine administrator. Item 25 is usually completed by the central office plant group. The responsibilities can be varied to permit more effective local arrangements.

ITEM NO. DESCRIPTION

1. **Route Relay Number** - Enter the number of the route relay assigned to the outgoing group for the routing treatment desired. Indicate if it is a first or alternate route relay by crossing out the word which does not apply. Enter the number of letter designation of the ground supply of the relay. The toll circuit faciliies administrator should prepare a tentative list of the number of outgoing routing treatments and should obtain from the traffic order or the machine administrator a list of the route relays and their associated ground supplies.

2. **Order Number** - Orders can be numbered consecutively starting with 1.

3. **Replaces Order Number** - Enter the number of any previous orders which are replaced by this one.

4. **Replaced by Order Number** - When this order is replaced by another it can be removed from the active file and the number of the replacing order entered in this space as a matter of record.

5. **Group** - Enter the **name** of the outgoing trunk group or subgroup with which this route relay will be associated.

6. **Number of Trunks** Enter the number of working trunks plus any spare terminals assigned to this group or subgroup, (ie, group span).

7. **Effective Date** - Enter the date on which this routing is to be made effective. For the initial set of forms this can be indicated as "cutover".

8. **Codes Connected to this Relay** This item applies to **first route relays only.** For codes which are to be sent out over the same trunk group with the **same** treatments, only one route relay and one order form are required. The codes and their destination should be entered under this item. The exceptions to this are:

   (a) Codes of the 1XX type. These require a separate route relay and order form, because the sender handles a 1XX code differently from other codes.

   (b) Cases where certain central office codes in the home area are to be denied to some trunk classes. Where this is done, separate route relays must be assigned for each group of trunk classes so that all classes are included.

   (c) There may be cases where certain central office codes in foreign area assigned to the translator frames are to be denied to some trunk classes. Where this is done, separate route relays must be assigned for each group of central office codes so that all of the central office codes for this particular foreign area are included. When the codes connected to this relay will be routed or denied based on the first six digits, enter the entire 6-digit number.

   Trunks to LW and WH opeator positions are assigned as separate test spans.

   The "Class" column is used to indicate those situations where certain incoming trunk groups are denied access to certain destinations. This is accomplished by utilizng class indications on the incoming trunk relay equipments. Excluding

the classs mark assigned to an incoming group (or groups) denies access of the group to the codes listed on the order.

(c) The space provided on the form may be inadequate in cases where a large number of codes all having the same routing treatments are directed to the same route relay. In such cases, the additional codes connected to this relay may be listed on another form and attached to this order.

9. **Route Relays Advancing to this Relay** - This item applies to **alternate route relays only** and provides space to list, by relay number, all of the first route or preceding alternate route relays which advance directly to this relay.

For the relays which connect to the Reorder and NC tone groups the space provided on this form is usually inadequate. On the forms for these relays, the following statement may be entered in this space:

Note: The last relay listed in Items 10 (B) to 13 (B) on all forms markd "Reorder" (or "NC") in Item 14 (A) will advance to this relay.

10-14 **Associated Route Relays** - This block of items will be filled in on the forms covering **first route relays only.** It shows the alternate route pattern and code conversion required to follow thhat pattern. Line 10 applies to the first route relay. Lines 11-14 indicate, in order, the subsequent groups (and route relays) to which the traffic will be offered and the code conversion required to route over the subsequent groups. The final disposition of the call if no circits are available on the last choice route is indicated by entering "NC" or "Reorder" on line 14, column A. Intertoll trunk groups overflow to NC, and toll connecting groups overflow to reorder (tone).

Columns G and H should be completed by the machine administrator.

15. **Arrangement Number** - This item pertains to the recommended route advance arrangements for trunk groups of various sizes. This item pertains to **first route relays only.** Arrangement numbers are discussed in 4.09.

16. **Skip** - Enter the number of digits which are to be deleted (skipped) before the call is sent forward. If all the digits received are to be pulsed forward enter "0".

All senders used for operator or direct distance dialing can skip 1, 2, or 3 digits on 7-digit calls and can skip 1, 2, 3, 4, 5, or 6 digits on 10-digit calls.

17. **Replace** - Enter the exact digits which are to be generated and sent forward in place of those which were deleted under Item 16. This may be any one, two, or three digit code.

18. **Prefix** - Enter the exact digits which are to be generated and sent forward ahead of those which have been received. For 7-digit calls, this may be any 1, 2, or 3-digit code. On 10-digit calls, 1, 2, or 3-digits can be prefixed for certain senders. This item is only used in conjunction with a skip 0 in Item 16.

19. **Office Frames** - Enter the number of each of the pairs of office link frames, such as 0 & 1, 2 & 3, etc.

20. **Trunk Level** - Enter the number of the trunk level which corresponds to the number of the marker test group to which this trunk group has been assigned.

21. **Group Start** - Enter the number of the first terminal of a marker test group to which the trunk group has been assigned. This will always be an even-number terminal.

22. **Group End** - Enter the number of the last assigned terminal in the group span. This will always be an odd-numbered terminal.

22. In the case where one route relay accommodates from 41 to 80 trunks (flip-flop testing), two marker test groups will be involved. It will be necessary to enter on the order form "Office Frame", "Trunk Level", or "Group Start" and "Group End" information for each of the two subgroups to be tested. This can be done by dividing the space provided into two columns.

23. **Two-Way** - Enter " Yes" for all two-way trunk groups or "No" for one-way outgoing groups.

24. **Type of Outpulsing** - Enter the type of outpulsing required (DP or MF) or "No" if no outpulsing is required (Calls to WH, "121", or "131", ringdown applique, etc).

25. **Sender Class** - The plant department will usually enter the class of service (numbered 0-20). This class tells the sender the type of outpulsing to use to complete the call.

26. **Traffic Separation Peg Count** - Enter "Yes" and the outgoing traffic separation mark. It will be necessary to furnish separate traffic register assignments to the plant department. **First routes only** should be arranged for traffic separation peg count. For alternate routes enter "No" for this item.

27. **Trunk Group Peg Count** - Enter "Yes" if a peg count register is to be associated with the outgoing trunk group. If no register is required, enter "No".

28. **Trunk Group Overflow** - Enter "Yes" if an overflow register is to be associated with an outgoing trunk group. If no register is required, enter "No".

29. These lines are available for local use. They may be used to enter TUR register, foreign area translator, and group busy relay assignments.

5. MARKER GROUP BUSY RELAYS

5.01 In assigning group busy (GB) relays **in the marker** consideration must be given to their various possible uses, which are:

(a) To reduce marker holding time.

(b) To operate directional reservation equipment (DRE).

(c) To expand the 240 trunk limitation in route relay offices.

5.02 The limited number of marker GB relays available and the fact that they are assigned to individual route relays or route numbers (not the trunk groups) must also be given serious consideration to insure their optimum use. A maximum of 100 marker GB relays can presently be provided, and this is ordinarily reduced to 55 when a traffic supervisory cabinet is installed. Since some crossbar tandems require assignment of more than twenty route relays or route numbers to the final group to the next higher ranking office, the need for judgment in assigning the limited number of GB relays is readily apparent.

REDUCTION OF MARKER HOLDING TIME

5.03 Group busy relays may be used to advantage in both ring and route relay markers to reduce marker holding time by eliminating the necessity for the marker to seize a pair of office link frames to search for an idle trunk in a group or subgroup when none are available. The marker by-passes a busy group automatically when a GB relay is assigned.

5.04 Assignment of GB relays to route relays or route numbers for this purpose should be for high usage groups and final subgroups that are expected to **overflow heavily.** This precludes assignment of GBs on small final groups or the last subgroup of large final groups, except the "home" final with DRE as discussed below. However, a GB relay on the GB frame that does not have an associated marker GB relay should be assigned to these final groups or subgroups for NC lamp operation in the traffic supervisory cabinet. These are GB relays numbered 55 through 99 on the group busy frame. Where a traffic superviory cabinet is provided, these relays, if installed, do not have an associated GB relay in the marker.

5.05 While a GB relay may be associated with all 80 trunks (and associated trunk busy (TB) relays) assigned to a route relay arranged for "flip-flop" testing, it cannot determine which of the two subgroups of 40 trunks has idle trunks. So a high percent of calls entering this route relay will require teting for a trunk on both pairs of office link frames. This does not take full advantage of the possible reeduction of marker holding time. Therefore, assignment of GB relays to route relays arranged for "flip-flop" testing is not generally recommended. However, since this arrangement is workable and route relay changes require considerable plant work, existing assignments of GB relays to flip-flop route relays should be changed only in conjunction with normal route relay changes.

ASSOCIATION WITH DRE

5.06 Group busy relays are also required in both types of markers to operate directional reservation equipment (DRE). For DRE to be completely effective, it will be necessary to assign a GB relay to every route relay or route number associated with the final group to the next higher ranking office. As was mentioned previously, this might require assignment of a large percentage of the available GB relays. There may, however, be some route relays or route numbers on this final group that are **offered** very little traffic. An example of this might be route relays or route numbers assigned for traffic destined for small cross-boundary tributaries of the higher ranking office. With DRE, a review of all route relays (or route numbers) assigned to the home final group should be made to determine which route relays, if any, might be assigned without CB relays. If necessary a traffic register may be temporarily assigned to specific route relays or route numbers in order to secure peg count data on the offerd traffic.

EXPANSION OF ROUTING CAPABILITIES

5.07 For route relay markers an advantage is gained by removing the 240 trunk restriction on routing patterns. Once a route relay has been operated, if an idle trunk is not found in the group or subgroup associated with that route relay, the marker must advance to a higher number ground supply. Since a GB relay allows the marker to by-pass a route relay if all of the trunks associated with that route relay are busy, several route relays may be assigned in the same ground supply. The marker will only oerate one of these route relays when the associated GB relay indicates that one of the trunks associated with that route relay is actually idle. Since the GB relay indicates that a trunk is available, there is usually no reason to advance to a higher numbered ground supply.

5.08 In busy periods, however, more than one marker may receive the same indications. If only one trunk is available, one of the markers will need the ability to advance to another ground supply. Therefore, plant should be requested to cross-connect the route advance (RA) contacts on all route relays to another route relay (or GB relay) in a higher number ground supply.

5.09 Another problem associated with ground supply limitations in route relay offices is tone and announcement routing. The following are the recommended arrangements using GB relays as appropriate:

(a) The NCA group (tone-announcement-tone) must be assigned in ground supply 5.

(b) When a traffic supervisory cabinet is provided, the route relay assigned to the "Heavy Traffic" (N Announcement) and "Emergency" (X Announcement) groups which are associated with the traffic control, 2- and 3- position keys must be assigned in ground supply 5 with GB relays. Both of these groups must then be arranged to alternate route to the route relay associated with 120 IPM (FRA) tone trunks in the center of the NCA group.

(c) The route relay assigned to the ROA groups must also be assigned in ground supply 5 and with a GB relay and arranged to alternate route to the 120 IPM (FRA) group. This is required because if a call fails when the marker is in ground supply 4, the marker can only route advance to a higher numbered ground supply, ie, ground supply 5.

(d) All other announcements - VCA, SOA, MCA, UCA - must be assigned in ground supply 4 and arranged to alternate route to the 120 IPM (FRA) group.

RESPONSIBILITY FOR GB RELAY ASSIGNMENTS

5.10 The responsibility for assignment of group busy relays is dependent upon the use to

be made of these relays. If the group busy relays are to be used only to reduce marker holding time and operate DRE equipment the machine administrator should make the assignments. But if the group busy relays are to be used to expand the routing capabilities in a route relay office by assigning more than one route relay within ground supplies, the machine administrator and the toll circuit facilities administrator must coordinate in making these assignments.

FORM E-4913

ROUTING AND ASSIGNMENT ORDER FOR _____ TANDEM

1. ROUTE NUMBER _____ FIRST ROUTE ADV.

2. ORDER NO. _____	5. GROUP _____
3. REPLACES ORDER NO. _____	6. NO. OF TRUNKS _____
4. REPLACED BY ORDER NO. _____	7. EFFECTIVE DATE _____

8. CODES CONNECTED TO THIS ROUTE NUMBER

CODE	DESTINATION	CLASS	CODE	DESTINATION	CLASS

9. ROUTE NUMBERS ADVANCING TO THIS ROUTE NUMBER

ROUTE NO.											

ASSOCIATED TEST SPANS	GROUP (A)	ROUTE NUMBER (a)	CODE CONVERSION			NO. OF TRUNKS (F)	GROUP SPAN (G)
			SKIP (C)	REPLACE (D)	PREFIX (E)		
10. FIRST							
11. ROUTE ADVANCE							
12. TONE OR ANN.			X	X	X		
13. ROUTE ADVANCE							

ROUTE NUMBER CROSS CONNECTIONS

14. OFFICE FRAMES		20. SENDER CLASS	
15. TRUNK LEVEL		21. TR. SEP. PC REG.	
16. GROUP START		22. TRK. GRP. PC REG.	
17. GROUP END		23. TRK. GRP. OFL. REG.	
18. TWO-WAY		24. T.U.R. REG.	
19. TYPE OF OUTPULSING		25.	

GROUP	INITIALS	DATE	GROUP	INITIALS	DATE
TR. ROUTING			PLANT		
TR. ASSIGNMENT					

PRINTED IN U. S. A.

Fig. 1—Routing and Assignment Order (Form 4913)

Form E-4346

ROUTING AND ASSIGNMENT ORDER FOR _____

1. Route Relay No. _____ First / Alternate in Ground Supply _____

2. Order No. _____	5. Group _____
3. Replaces Order No. _____	6. No. of Trunks _____
4. Replaced by Order No. _____	7. Effective Date _____

8. Codes Connected to this Relay

Code	Destination	Class	Code	Destination	Class

9. Route Relays Advancing to this Relay

Relay No.										

Associated Route Relays	(a) Group	(b) R.Relay No.	(c) Grd. Sup.No.	(d) Skip	(e) Replace	(f) Prefix	(g) No. of Trunks	(h) Group Span
10. First								
11. First Alt.								
12. Second Alt.								
13. Final								
14. Overflow				x	x	x		
15. Arrangement No.								

Code Conversion

16. Skip _____ 17. Replace _____ 18. Prefix _____

Route Relay Cross Connections

19. Office Frames		25. Sender Class	
20. Trunk Level		26. Tr. Sep. PC	
21. Group Start		27. Trk. Grp. PC	
22. Group End		28. Trk. Grp. Ofl.	
23. Two-way		29.	
24. Type of Outpulsing		30.	

Group	Initials	Date	Group	Initials	Date
Tr. Routing Tr. Assignment			Plant		

Fig. 2—Routing and Assignment Order (Form 4346)

CHART A

FOR PREFERRED ARRANGEMENT						
TOTAL NO. OF TRUNKS AND (SUBGROUPS)	TRUNKS UP TO - SUBDIVISIONS OF TRUNKS ORIGINAL + ALTERNATES				ARRANGEMENT NO. SHOWN ON CHART B	
	ORIG.	1ST ALT.	2ND ALT.	3RD ALT.	AS SINGLE GROUP	AS ORIGINAL AND ALTERNATE GROUPS
40 (1 SUBGRP.)	40				1 OR 2	
80	80				5 OR 6	
(2 SUBGROUPS)	40	40				9
	120				25	
120	40	80				15 16 19 20 21
(3 SUBGROUPS)	80	40				22 23 24 25 26
	40	40	40			17 18
	160				39 OR 44	
	40	120				33 34 35
	80	80				39 42 43 44
160	120	40				33 41
(4 SUBGROUPS)	40	40	80			34 35
	40	80	40			32 33 41
	80	40	40			36 37 38
	40	40	40	40		31
	200				47	
	40	160				45 46
	80	120				47 51 53 54
	120	80				45 48 49 50 51 53
	160	40				46 47
200	40	80	80			45 49
(5 SUBGROUPS)	80	40	80			45 48 50 51 53
	80	80	40			46 47 52 54
	40	40	40	80		45
	40	40	80	40		46
	40	80	40	40		49
	80	40	40	40		52
	240				55 OR 56	
	80	160				55 56
	120	120				55 56
240	160	80				55
(6 SUBGROUPS)	200	40				56
	80	80	80			55
	80	40	40	80		55
	80	40	80	40		56

LARGER GROUPS WILL REQUIRE GRADED MULTIPLE ARRANGEMENTS.
THIS TABLE IS INTENDED TO TEST THE MOST TRUNKS IN THE LEAST ROUTE ADVANCES IN VIEW OF THE FACT THAT ALL SECOND TRIAL ATTEMPTS SKIP GROUND SUPPLIES 1 AND 2, AND TEST ONLY GROUND SUPPLIES 3 AND 4.

CHART B

POSSIBLE ARRANGEMENTS

40 TRUNKS

ARR. NO. →	1	2	3	4
GROUND SUPPLY NUMBERS OVERFLOW				
4		BA		
3	BA			BA
2			BA	
1				

80 TRUNKS

ARR. NO. →	5	6	7	8	9	10	11	12	13	14
GROUND SUPPLY NUMBERS OVERFLOW										
4		BB		BC	BC		BC			
3	BB		BC		BA	BC				
2						BA	BA	BC	BB	
1			BA	BA				BA		BB

120 TRUNKS

ARR. NO. →	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
GROUND SUPPLY NUMBERS OVERFLOW																
4		BD	BC	BC		BD	BD	BC			BC	BC		BC		
3	BD		BC	BC	BD		BA		BC	BC	BB				BC	
2				BA	BA	BA				BB		BB	BD	BC	BC	BC
1	BA	BA	BA					BB	BB				BA	BA	BA	BB

160 TRUNKS

ARR. NO. →	31	32	33	34	35	36	37	38	39	40	41	42	43	44
GROUND SUPPLY NUMBERS OVERFLOW														
4	BC	BC	BC	BD	BD	BC	BC	BC	BD				BD	
3	BC		BD	BC	BC	BC		BC		BD	BC	BD		BD
2	BC	BD			BA		BC	BB	BB	BC	BD			BB
1	BA	BA	BA	BA		BB	BB			BA	BA	BB	BB	

200 TRUNKS

ARR. NO. →	45	46	47	48	49	50	51	52	53	54
GROUND SUPPLY NUMBERS OVERFLOW										
4	BD	BC	BC	BD	BC	BD	BD	BC	BD	BC
3	BC	BD	BD		BC	BC	BC	BC	BC	BD
2	BC	BC	BB	BC	BD	BB	BB	BC		
1	BA	BA		BB	BA			BB	BB	BB

240 TRUNKS

ARR. NO. →	55	56
GROUND SUPPLY NUMBERS OVERFLOW		
4	BD	BC
3	BC	BD
2	BC	BC
1	BB	BB

LEGEND

LETTERS BA,, BB, ETC., REPRESENT ROUTE RELAY BATTERY SUPPLY REQUIRED FOR PROPER CIRCUIT OPERATION.
- HORIZONTAL LINES REPRESENT TRUNK TEST GROUP OF 40 TRUNKS OR LESS IN GIVEN GROUND SUPPLY.

CIRCUIT LIMITATIONS

1. BA OR BB MUST BE USED ON ROUTE RELAY CONNECTED TO THE CODE POINT AND ONLY ONE OF THESE CAN BE USED IN A ROUTE RELAY PATTERN.
2. BB AND BD CONTROL FLIP-FLOP TESTING (2 GROUPS OF 40).
3. ONLY TWO FLIP-FLOP RELAYS CAN BE IN A GIVEN PATTERN, ONE IN GROUND SUPPLY 1 OR 2, THE OTHER IN GROUND SUPPLY 3 OR 4.
4. WHERE 1-WAY OUT TRUNKS ARE FOLLOWED BY 2-WAY TRUNKS, THE 2-WAY SHOULD BE TREATED AS IF IT WERE AN ALTERNATE ROUTE.

Fig. 3—Battery and Ground Supply Association Tables