USE OF COMPENSATING RESISTANCE REVERTIVE AND PCI PULSING CIRCUITS

1. GENERAL

1.01 This section describes the method of using compensating resistance in all offices employing revertive and panel call indicator pulsing circuits.

1.02 This section is reissued to incorporate material from the addendum in its proper location. In this process marginal arrows have been omitted.

1.03 Compensating resistance is used during revertive selections to limit the current flow in the fundamental circuit in order to insure proper release of the sender stepping relay on short loops and under adverse shunting conditions caused by resistance in the selector commutator path, and during call indicator pulsing to limit the current flow in the relays of call indicator control circuits.

1.04 The maximum loop resistance over which pulsing may take place is limited only by the capability of the incoming selector or trunk circuit. The sender circuit itself imposes no limitations in this respect.

1.05 Since the considerations governing the use of the sender MTG relay are not affected by compensating resistance requirements, no reference to them is included in this section.

2. FACILITIES FOR COMPENSATING

2.01 Some sender circuits are arranged so that compensating resistance may be introduced by means of translator, decoder, or marker cross-connections. When senders control office selections as well as selections beyond the office selector, one value of compensating resistance may be effective during office selections and another value during selections beyond office (trunk test, incoming and final selections, and call indicator pulsing). The compensating resistance may be introduced in steps of 300 ohms, from 0 to 900 ohms (1200 ohms in the case of certain early type senders). Due to the compensating resistance arrangement of the sender circuits, the selections beyond office compensating resistance cannot exceed the office selections compensating resistance.

Note: Crossbar tandem dial pulsing senders are arranged to compensate either 0 or 900 ohms for office selections. No. 4 type toll switching system outgoing senders are not furnished with facilities for compensation. If compensating resistance is required it is introduced at the outgoing trunk circuit.

2.02 Certain outgoing trunk circuits and certain panel selector circuits are equipped with compensating resistance facilities. Variations in compensating resistance for these circuits may be made effective by changing the strapping at the wiring terminals of the resistances. These resistances are intended to be used (1) when the conductor resistance is less than the required minimum loop resistance and the senders either do not compensate or the maximum available in the sender is not sufficient to bring the compensated conductor loop resistance up to the minimum required or (2) when due to the use of different cable routes for trunks in the same group, the amount of compensating resistance which may be provided by the sender is limited by the loop resistance of the longest trunk, and consequently the additional compensating resistance required for the shorter trunks may be provided at the associated trunk or selector circuit. The values of compensating resistance provided in the various trunk and selector circuits are shown in Table A.

2.03 Distant office selectors (office selector tandem) are equipped with compensating resistance for use during office selections, and are also provided with other compensating resistances which are effective only during selections beyond office. These latter are intended to be used when the trunk conductor resistance to distant office selectors in the same group varies to the extent that satisfactory compensation cannot be obtained during selections beyond office without equalizing at least partially the loop resistance to the office selectors.

2.04 Local (3-wire) incoming selectors with the exception of ES-207896 are provided with fixed compensating resistances.

2.05 No compensating resistance is provided in local (3-wire) office selectors, crossbar incoming and crossbar tandem trunk circuits, full

selector tandem district selectors, manual call indicator trunk circuits and operator type trunk circuits.

Note: Certain early manual call indicator control circuits were designed for use with senders not equipped with compensating resistance, and were therefore arranged to provide the necessary compensation, when required. For the purposes of this section it should be determined that such compensating resistance is not effective.

3. REQUIREMENTS

3.01 Minimum: The minimum compensated trunk loop resistance for revertive selections, call indicator pulsing, or trunk test on operator class calls, shall not be less than the value specified for the particular type of selector or trunk circuit. By compensated trunk loop resistance is meant the total resistance in the fundamental circuit between the sender and the selector or trunk circuit, including any compensating resistance in the sender and selector circuits, the trunk conductor resistance, and the resistance of the polarized relay of distant office selectors, dial coin zone outgoing trunk circuits, or crossbar tandem senders.

3.02 Maximum: The maximum compensated trunk loop resistance shall not exceed the equivalent maximum external circuit loop resistance over which the selector or trunk circuit is capable of operating, taking into consideration the resistance of the sender stepper (STP) and polarized overflow (OF) relays.

3.03 For revertive selections, the minimum compensated trunk loop resistance is 1200 ohms for those selectors having line relays of 650 ohms or less, and 900 ohms for selectors having line relays of 900 ohms or more and for calls to crossbar and crossbar tandem equipment.

3.04 For call indicator pulsing and trunk test on operator type trunks, the minimum compensated trunk loop resistance is 900 ohms, except as shown below:

(a) In some instances, battery and ground for trunk test on operator class calls are supplied by auxiliary equipment at the local central office (e.g. recording-completing trunk circuits, etc). In these cases, on operator class calls, the compensating resistance for trunk test in panel and No. 1 crossbar originating senders should be 900 ohms regardless of the trunk loop resistance beyond the local central office.

(b) Compensating resistance for operator class trunk test in No. 5 crossbar offices need not be considered, since an outgoing sender is not used.

(c) In crossbar tandem offices, compensating resistance information for operator class trunk test must be cross-connected in the tandem marker to satisfy marker functions. However, crossbar tandem senders do not introduce compensating resistance into the fundamental circuit for trunk test on this class of call and, therefore, any value may be used.

(d) In crossbar tandem offices equipped with revertive pulsing senders, compensating resistance information for call indicator pulsing class of call must be cross-connected in the tandem marker to satisfy marker functions. However, revertive pulsing senders do not introduce compensating resistance into the fundamental circuit during call indicator pulsing and, therefore, any value may be used.

3.05 For all classes of calls routed via distant office selectors, the resistance of the office selector polarized relay (50 ohms) and the selections beyond (C) resistance are effective during selections beyond. The conductor resistance effective is the sum of the resistance from the originating office to the distant office selector and the resistance from the distant office selector to the terminating office.

3.06 For PCI class calls routed via crossbar tandem revertive pulsing senders, the resistance of the tandem sender polarized relay (50 ohms) is effective during call indicator pulsing. The conductor resistance effective is the sum of the resistance from the originating office to the tandem office and the resistance from the tandem office to the terminating office. The compensating resistance setting of the tandem sender is ineffective and should be arbitrarily set at 900 ohms, unless the same tandem marker route relay is also used for calls routed through crossbar tandem dial pulsing senders, in which case the setting will be governed by the requirements of that routing.

3.07 For PCI class calls routed via crossbar tandem dial pulsing senders, the call indicator pulses are generated by the tandem sender and the sender should be compensated as required by the resistance of the conductor between the tandem office and the call indicator incoming trunk circuit.

3.08 For full selector class calls, (panel, crossbar and step-by-step) routed via crossbar tandem revertive pulsing senders, incoming and final selections are registered in the tandem sender in the same manner as office selections and therefore the originating sender should be compensated the same during selections beyond office as during office selections. The tandem senders should be compensated as required by the resistance of the conductors between the

tandem and terminating offices, except on out dial pulsing calls, in which case the use of compensating resistance is not required.

3.09 For full selector class calls routed via crossbar tandem dial pulsing senders, the tandem senders should be compensated as required by the resistance of the conductors between the tandem and terminating offices, except on out dial pulsing calls, in which case the use of compensating resistance is not required.

3.10 For full selector (panel sender) tandem class calls routed via coin dial zone outgoing trunks, the resistance of the polarized relay (50 ohms) of the trunk circuit is included in the call indicator pulsing loop.

3.11 For skip-office calls, the office selections compensating resistance of the sender is ineffective. However, in order to permit the use of any value of compensating resistance for selections beyond office, 900 ohms (or 1200 ohms, when available) should be used for skip-office calls.

3.12 Allowance for deviation of conductor and compensating resistances from nominal: The tables provided in this section allow for deviation from nominal values of conductor resistance due to temperature variations and the resistance of the compensating resistances due to manufacturing tolerances.

3.13 For minimum requirements a deviation of −5% from nominal resistance has been allowed for compensating resistances and −6.8% (approx.) for the deviation of conductor resistance from its nominal value (at 68°F.) to its minimum value (at 37°F.). For maximum tolerances a deviation of +5% from nominal resistance has been allowed for compensating resistances. No allowance has been made for increase in conductor resistance due to temperature, since this factor is included in the maximum conductor range of the various circuits.

3.14 Distribution of compensating resistance: When compensating resistance is required, as much as possible of the total should be provided at the senders in order to avoid compensation at selectors whenever possible.

3.15 When the trunks in a group have different cable routings, the trunk conductor resistances may vary considerably, and consequently the amount of compensation which may be placed at the senders will be limited by the maximum permissible for the trunks having the greatest conductor resistance. In this case it may be necessary to compensate at the incoming selectors having the lesser conductor resistances sufficiently to meet the minimum total requirement.

Note: If it should be found that both the minimum and maximum requirements cannot be met for all trunks in the group, it is an indication that the variation in conductor resistance is too great, and therefore that such routings cannot be employed.

3.16 Compensating to equalize the resistance of the trunks in a group for the sole purpose of applying more severe tests with the panel incoming selector test frame does not appear to be warranted. However, if it is necessary to compensate at incoming selectors in order to meet the minimum requirements, it would be desirable to provide such additional compensating resistance as is required to equalize the resistance of the trunks.

3.17 When more than one type of selector is included in a trunk group, the amount of compensation which may be placed at the senders may be limited by the capabilities of a particular type of selector, and consequently it may be necessary to compensate at the selectors of the other type in order to meet their minimum total requirement.

3.18 For routings via distant office selectors, when the trunk conductor resistance to the office selectors varies considerably between trunks in the same group, it may not be possible during selections beyond to meet the minimum compensating resistance requirements of the shorter routes without exceeding the trunk capabilities for the longer routes. In this case it will be necessary to use the selections beyond (C) compensating resistance of the office selectors having the lower conductor resistances in order to equalize, to some extent, the resistance of all trunks in the group during selections beyond office.

Note: If it should be found that even with the use of the maximum (C) compensating resistance available at the office selector (600 ohms) it is not possible to meet both the minimum and maximum compensating resistance requirements for all trunks in the group, it should be understood that the variation in conductor resistance is too great and consequently such routings cannot be employed.

3.19 In some cases it may be desirable to use the beyond office (C) compensating resistance at distant office selectors in order to avoid compensating at incoming selectors, even though there is little or no variation in trunk conductor resistance. An example of this is the case where the cable resistance from the originating office to the office selector is low, and consequently, on routes to incoming selectors which are close to the office selectors, compensating resistance is required in addition to that which the sender is capable of providing. If this resistance were provided at the incoming selectors, it

might cause the maximum capability of the incoming selectors to be exceeded on calls from some other originating office having considerable conductor resistance to the office selectors. In that case, compensating at the office selectors first mentioned would render it unnecessary to compensate at these incoming selectors. On the other hand, this would decrease the range of these office selectors, and might consequently result in exceeding their capability for completing calls to some other outlying terminating point. The decision as to where compensating resistance should be placed will therefore depend upon an analysis of the trunking plan of the office selector tandem center.

3.20 Compensating above minimum requirements: The amount of compensating resistance provided may exceed the minimum required provided that this does not raise the total compensated loop resistance above the allowable maximum.

4. METHOD

4.01 The compensating resistance required at senders and panel selector circuits should be determined from the trunk conductor resistance and the minimum and maximum requirements for the type of termination involved.

> Note: No. 4 type toll switching system outgoing senders are not furnished with facilities for compensation. If compensating resistance is required it is introduced at the outgoing trunk circuit.

4.02 Table A lists some of the various types of routings and terminations and shows for each the minimum compensated trunk loop resistance, the maximum conductor resistance, the compensating resistances available at the selectors, and lists the tables which have been prepared for determining the compensating resistance requirements. For working limits and available compensating resistances of circuits not listed in Table A refer to the circuit drawing and choose a line in Table A with corresponding requirements.

4.03 Composite Tables 1 and 2, show the nominal amount of compensating resistance which should be placed at the senders and selectors for the particular conductor loop resistance and type of selector or trunk involved. It is assumed that the variation in resistance of the trunks in a group will be small enough so that one value of sender compensating resistance will be satisfactory for all trunks. These tables are based primarily on providing the minimum amount of compensating resistance required. In using these tables the trunk conductor resistance should be considered to be increased by 50 ohms when the polarized relay of distant office selectors, crossbar tandem senders, or dial coin zone outgoing trunks is included in the routing, as covered in Part 3.

4.04 Individual Tables (3 to 15), show for each type of termination the nominal minimum and maximum compensating resistance which may be used for a particular conductor resistance. This resistance may be provided at either the sender, the selector, or part may be provided in each, as required for the individual case. These tables include in addition to requirements for direct routings, those for routings via distance office selectors both with and without office selector beyond office (C) compensating resistance, routings via crossbar tandem, and via dial coin zone outgoing trunks. Allowance has been made for the resistance of the polarized relay of distant office selectors, etc., and also for the office selector beyond office compensating resistance, so that the compensating resistance values shown are exclusive of these items. These tables are intended for use particularly in those cases where the trunks in a group are routed over different cable routes or terminate on selectors of different types. Since the values of compensating resistance given are the theoretical minimum and maximum values, the use of these tables permits the widest possible latitude in fixing compensating resistance values, and in addition indicates clearly those cases where the variation in conductor resistance of trunks in a group is excessive.

4.05 Allowance has been made in all the above-mentioned tables for the manufacturing tolerances of compensating resistances and the variation of trunk conductor resistance with temperature.

4.06 When using Tables 3 to 15, it will be necessary to apportion the total compensating resistance required between the senders and the selector circuits, as described in other paragraphs of this section.

5. EXAMPLES OF USE OF TABLES

5.01 Several examples of the use of the tables in this section follow.

(A) Group of Long Range Battery Cutoff Incoming Selectors

5.02 Assume a trunk group containing only long range battery cutoff incoming selectors and having trunk conductor resistance of 340 ohms. From Table A it is found that this type of selector is covered in Tables 1 and 12. Referring to Table 1, it is found that sender compensating resistance of 900 ohms should be used, together with selector compensating resistance of 300 ohms. It should be understood in this connection that if the sender is capable of furnishing 1200 ohms, that value may be used and the 300 ohms omitted at the selector. If it is desired to use Table 12, which also covers this type of selector, it is found that the compensation must lie between 1200 ohms and 2100 ohms. If the sender were capable of providing only 900 ohms, it would be necessary to provide at least 300 ohms at the

selector. It would be permissible, however, to provide the full amount of compensation available at the selector (900 ohms) since this would bring the total to 1800 ohms, which is below the permissible maximum.

(B) Mixed Group of Local (3-wire) and Non-repeating Incoming Selectors

5.03 Assume an intra-building trunk group containing both local (3-wire) incoming selectors per ES-226882 and 2-wire non-repeating incoming selectors. From Table A, it is found that the local 3-wire incoming selector compensating resistance is fixed and that sender compensating resistance of 600 ohms must be provided. Table 8 covers the requirements for 2-wire non-repeating incoming selectors and indicates that a minimum of 1000 ohms, maximum 1200 ohms is required. Since 600 ohms is to be provided in the senders, the additional 400 to 600 ohms compensating resistance must be provided in the 2-wire non-repeating incoming selectors.

(C) Group of Non-repeating Incoming Selectors with Different Cable Routings

5.04 Assume a group of ground cutoff non-repeating incoming selectors routed over different cables with resistances as shown below. From Table A, it is found that the requirements for this type of selector are covered in Table 8 and are as follows:

Cable Route	Conductor Resistance	Compensating Resistance Min.	Max.
A	320	700	900
B	1180	0	100

Since route B permits no more than 100 ohms compensating resistance, the sender compensating resistance, must be 0. The selectors using route A will therefore require compensation of from 700 ohms to 900 ohms. The selectors using route B require no compensation.

(D) Group of Long Range Battery Cutoff Incoming Selectors Routed Via Distant Office Selectors - Different Cable Routes to Office Selectors

Example 1

5.05 Assume a group of long range battery cutoff incoming selectors which are reached via distant office selectors. The cable routes from the originating office to the terminating office vary in resistance as indicated below. From Table A it is found that this type of incoming selector is covered in Table 12. The compensating resistances required for each route via distant office selectors using 0 ohms office selector beyond office (C) compensating resistance are as indicated:

Cable Route	Conductor Resistance Orig. Off. to Off. Sel.	Off. Sel. to Inc. Sel.	Total	Compensating Res. Min.	Max.
A	370	280	650	600	1800
B	1570	280	1850	0	600

The trunks using cable route A require a minimum of 600 ohms compensating resistance. This amount may be placed in the senders, since it does not exceed the maximum permissible compensating resistance for cable route B.

Example 2

5.06 Assume the same type of routing as in 5.05 with the exception of the cable resistance.

Cable Route	Conductor Resistance Orig. Off. to Off. Sel.	Off. Sel. to Inc. Sel.	Total	Compensating Res. Min.	Max.
A	250	280	530	900	1800
B	1570	280	1850	0	600

In this case it will be noted that with 0 ohms office selector beyond office compensating resistance, the trunks using cable route A require at least 900 ohms compensating resistance, while those using cable route B can tolerate no more than 600 ohms. Since the conductor resistance between the office selectors and the incoming selectors is the same for both routes, it is obvious that the inability to meet the requirements of both cable routes is due to the difference in conductor resistance of the trunks between the originating office and the office selectors. Consequently, it will be necessary to compensate those office selectors using cable route A during selections beyond in order to equalize to some extent the resistance of the trunks to the office selectors. Referring to Table 12, it will be seen that if 200 ohms selections beyond (C) compensating resistance is provided at the office selectors using cable route A, the compensating resistance requirements become:

Cable Route	Office Sel. (C) Comp.	Compensating Res. Min.	Max.
A	200	600	1800
B	0	0	600

600 ohms sender compensating resistance will now satisfy the minimum requirement for trunks using cable route A, and will not exceed that allowable for cable route B. Therefore, the senders should be compensated for 600 ohms, and 200 ohms beyond office compensating resistance should be provided at the office selectors using cable route A. Since this involves a change in the office selector beyond office compensating resistance, all routings through these selectors should be inspected to insure that this will not cause any route to fail to meet the compensating resistance requirements.

TABLE A

Type of Selector,** Trunk, or Routing			Minimum Compensated Loop Res.	Maximum Conductor Res.		Selector Compensating Resistance	Comp. Res. Required	
				Direct	Via Dist. Off.		Composite Table	Individual Table
Skip-Office (See 3.11)			-	-	-	-	900W**	
Local (3-W) Office Selector			900W	-	-	-	Table 2	
Distant (2-Wire) Office Selector	ES-226137	Short Range	1200W	1670W	-	T 200-400ϕ R 100-500 C 200-400	Table 1	Table 3
		Long Range		2700W				Table 4
	SD-21092-01 SD-21092-02 SD-21733-01	Short Range		1670W		D 300-600ϕ C 200-400		Table 5
		Long Range		2700W				Table 6
Crossbar Tandem Trunk			900W	2900W	-	-	Table 2	Table 7
Local (3-Wire) Incoming Selector	ES-20090-01 ES-240092 ES-240093		-	-	-	Fixed#	0W##	
	ES-207490 ES-226310 ES-226882		-	-	-	Fixed (500W)	600W##	
	ES-207371		-	-	-	Fixed (1200W)	0W##	
	ES-207896		900W	-	-	T 200-400 R 100-500	900W*	
Ground Cutoff Incoming Selector	Non-Repeating		900W	1300W	1245W	T 200-400 R 100-500	Table 2	Table 8
	Repeating		1200W	***	***	300-600	Table 1	Table 9
						500-500		Table 10
Battery Cutoff Incoming Selector	Short Range		1200W	1640W	1590W	300-600	Table 1	Table 11
	Long Range			***	***			Table 12
Crossbar Incoming Trunk	Short Range		900W	2585W	2530W	-	Table 2	Table 13
	Long Range			2900W	2845W			Table 14
Panel Call Indicator and Full Selector Tandem Incoming Trunks			900W	2640W	2585W	-	Table 2	Table 15
Operator Type Trunks			900W	ϕϕ		-	Table 2	

* Use 1200 ohms if this amount can be furnished by sender.

\# Fixed compensation of 500 ohms during incoming selections; 1000 ohms during final selections.

ϕ T and R (or D) resistances effective only during office selections; C resistance effective only during selections beyond office.

** Long range panel selectors are equipped with L, N or S type line relays. Long range crossbar incoming trunks are equipped with S type A relays.

*** See working limits for selector circuit.

Sender compensating resistance required in addition to fixed compensating resistance in selector.

ϕϕ See working limits for trunk circuit.

TABLE 1

Composite Table for Distant (2-Wire) Office and Repeating and Battery Cutoff Incoming Selectors.

Trunk Conductor Resistance #	Compensating Resistance	
	Sender	Selector
0 - 65	900	600
66 - 375	900	300
66 - 375	1200	0
376 - 685	900	0
686 - 1000	600	0
1001 - 1310	300	0
1311 Up	0	0

Add 50 ohms for all routings via distant office selectors and dial coin zone outgoing trunks and for PCI classes via crossbar tandem. (See 4.03.)

TABLE 2

Composite Table for Local (3-Wire) Office and Ground Cutoff Non-Repeating Incoming Selectors, Crossbar Incoming and Crossbar Tandem Trunks, Manual P.C.I. Incoming Trunks, Full Selector Tandem and Operator Type Trunks.

Trunk Conductor Resistance #	Compensating Resistance	
	Sender	Selector
0 - 40	900*	0
41 - 350	900	0
351 - 660	600	0
661 - 975	300	0
976 Up	0	0

* Use 1200 ohms if available.

Add 50 ohms for all routings via distant office selectors and dial coin zone outgoing zone outgoing trunks and for PCI classes via crossbar tandem. (See 4.03.)

TABLE 3

Short Range Distant Office Selector Equipped with 200-400 and 100-500 Ohm Compensating Resistances. (See 4.04.)

Trunk Conductor Resistance	Compensating Resistance	
	Min.	Max.
0 - 62	1300	1500
63 - 95	1200	1500
96 - 164	1200	1400
165 - 200	1100	1400
201 - 266	1100	1300
267 - 305	1000	1300
306 - 368	1000	1200
369 - 410	900	1200
411 - 470	900	1100
471 - 515	800	1100
516 - 572	800	1000
573 - 620	700	1000
621 - 674	700	900
675 - 725	600	900
726 - 776	600	800
777 - 830	500	800
831 - 878	500	700
879 - 935	400	700
936 - 980	400	600
981 - 1040	300	600
1041 - 1082	300	500
1083 - 1145	200	500
1146 - 1184	200	400
1185 - 1250	100	400
1251 - 1286	100	300
1287 - 1355	0	300
1356 - 1460	0	200
1461 - 1565	0	100
1566 - 1670	0	0

TABLE 4

Long Range Distant Office Selector Equipped with 200-400 and 100-500 Ohm Compensating Resistances. (See 4.04.)

Trunk Conductor Resistance	Compensating Resistance	
	Min.	Max.
0 - 62	1300	2400
63 - 164	1200	2400
165 - 180	1100	2400
181 - 266	1100	2300
267 - 285	1000	2300
286 - 368	1000	2200
369 - 390	900	2200
391 - 470	900	2100
471 - 495	800	2100
496 - 572	800	2000
573 - 600	700	2000
601 - 674	700	1900
675 - 705	600	1900
706 - 776	600	1800
777 - 810	500	1800
811 - 878	500	1700
879 - 915	400	1700
916 - 980	400	1600
981 - 1020	300	1600
1021 - 1082	300	1500
1083 - 1125	200	1500
1126 - 1184	200	1400
1185 - 1230	100	1400
1231 - 1286	100	1300
1287 - 1335	0	1300
1336 - 1440	0	1200
1441 - 1545	0	1100
1546 - 1650	0	1000
1651 - 1755	0	900
1756 - 1860	0	800
1861 - 1965	0	700
1966 - 2070	0	600
2071 - 2175	0	500
2176 - 2280	0	400
2281 - 2385	0	300
2386 - 2490	0	200
2491 - 2595	0	100
2596 - 2700	0	0

TABLE 5

Short Range Distant Office Selector Equipped with 300-600 Ohm Compensating Resistance (See 4.04)

Trunk Conductor Res.	Comp. Res. Min.	Comp. Res. Max.
0- 62	1500	1500
63- 95	1200	1500
96- 368	1200	1200
369- 410	900	1200
411- 674	900	900
675- 725	600	900
726- 980	600	600
981-1040	300	600
1041-1286	300	300
1287-1355	0	300
1356-1670	0	0

TABLE 6

Long Range Distant Office Selector Equipped with 300-600 Ohm Compensating Resistance (See 4.04)

Trunk Conductor Res.	Comp. Res. Min.	Comp. Res. Max.
0- 62	1500	2100
63- 368	1200	2100
369- 495	900	2100
496- 674	900	1800
675- 810	600	1800
811- 980	600	1500
981-1125	300	1500
1126-1286	300	1200
1287-1440	0	1200
1441-1755	0	900
1756-2070	0	600
2071-2385	0	300
2386-2700	0	0

TABLE 7

Crossbar Tandem Incoming Trunk (See 4.04)

Trunk Conductor Res.	Comp. Res. Min.	Comp. Res. Max.
0- 47	1200*	1200
48- 353	900	1200
354- 659	600	1200
660- 965	300	1200
966-1640	0	1200
1641-1955	0	900
1956-2270	0	600
2271-2585	0	300
2586-2900	0	0

* 900 ohms may be used.

TABLE 8

Ground Cutoff 2-Wire Non-Repeating Incoming Selector (See 4.04)

Direct Routing			Routing Via Distant Office Selector											
			Beyond Office (C) Compensating Resistance Effective in Distant Office Selector											
			0W			200W			400W			600W		
Trunk Conductor Res.	Comp. Res. Min.	Comp. Res. Max.	Trunk Conductor Res.	Comp. Res. Min.	Comp. Res. Max.	Trunk Conductor Res.	Comp. Res. Min.	Comp. Res. Max.	Trunk Conductor Res.	Comp. Res. Min.	Comp. Res. Max.	Trunk Conductor Res.	Comp. Res. Min.	Comp. Res. Max.
0- 40	1000*	1200	0- 95	900	1100	0- 95	700	900	0- 95	500	700	0- 95	300	500
41- 47	1000*	1100	96- 200	800	1000	96- 200	600	800	96- 200	400	600	96- 200	200	400
48- 147	900	1100	201- 303	700	900	201- 303	500	700	201- 303	300	500	201- 303	100	300
148- 251	800	1000	304- 405	600	800	304- 405	400	600	304- 405	200	400	304- 405	0	200
252- 354	700	900	406- 510	500	700	406- 510	300	500	406- 510	100	300	406- 510	0	100
355- 457	600	800	511- 608	400	600	511- 608	200	400	511- 618	0	200	511- 618	0	0
458- 557	500	700	609- 618	300	600	609- 618	100	400	619- 723	0	100			
558- 565	400	700	619- 710	300	500	619- 710	100	300	724- 828	0	0			
566- 659	400	600	711- 723	200	500	711- 723	0	300						
660- 670	300	600	724- 812	200	400	724- 828	0	200						
671- 761	300	500	813- 828	100	400	829- 933	0	100						
762- 775	200	500	829- 914	100	300	934-1028	0	0						
776- 863	200	400	915- 933	0	300									
864- 880	100	400	934-1028	0	200									
881- 965	100	300	1029-1143	0	100									
966- 985	0	300	1144-1245	0	0									
986-1090	0	200												
1091-1195	0	100												
1196-1300	0	0												

* 900 ohms may be used.

TABLE 9

Ground Cutoff Repeating Incoming Selector Equipped with 300-600 Ohm Compensating Resistance (See 4.04)

Direct Routing			Routing Via Distant Office Selector											
			Beyond Office (C) Compensating Resistance Effective in Distant Office Selector											
			0W			200W			400W			600W		
Trunk Conductor Res.	Comp. Res. Min.	Comp. Res. Max.	Trunk Conductor Res.	Comp. Res. Min.	Comp. Res. Max.	Trunk Conductor Res.	Comp. Res. Min.	Comp. Res. Max.	Trunk Conductor Res.	Comp. Res. Min.	Comp. Res. Max.	Trunk Conductor Res.	Comp. Res. Min.	Comp. Res. Max.
0- 62	1500	1800	0- 11	1500	1800	0- 113	1200	1500	0- 215	900	1200	0- 11	900	1200
63- 120	1200	1800	12- 65	1200	1800	114- 170	900	1500	216- 275	600	1200	12- 65	600	1200
121- 368	1200	1500	66- 317	1200	1500	171- 419	900	1200	276- 521	600	900	66- 317	600	900
369- 435	900	1500	318- 380	900	1500	420- 485	600	1200	522- 590	300	900	318- 380	300	900
436- 674	900	1200	381- 623	900	1200	486- 725	600	900	591- 878	300	600	381- 623	300	600
675- 750	600	1200	624- 695	600	1200	726- 800	300	900	879- 905	0	600	624- 695	0	600
751- 980	600	900	696- 929	600	900	801-1031	300	600	906-1220	0	300	696-1010	0	300
981-1065	300	900	930-1010	300	900	1032-1115	0	600	1221-1535	0	0	1011-1325	0	0
1066-1286	300	600	1011-1235	300	600	1116-1430	0	300						
1287-1380	0	600	1236-1325	0	600	1431-1715	0	0						
1381-1695	0	300	1326-1640	0	300									
1696- *	0	0	1641- *	0	0									

*See working limits for selector circuit.

TABLE 10

Ground Cutoff Repeating Incoming Selector
Equipped with 500-500 Ohm Compensating Resistance (See 4.04)

Direct Routing			Routing Via Distant Office Selector											
			Beyond Office (C) Compensating Resistance Effective in Distant Office Selector											
			0W			200W			400W			600W		
Trunk Conductor Res.	Comp. Res.		Trunk Conductor Res.	Comp. Res.		Trunk Conductor Res.	Comp. Res.		Trunk Conductor Res.	Comp. Res.		Trunk Conductor Res.	Comp. Res.	
	Min.	Max.		Min.	Max.		Min.	Max.		Min.	Max.		Min.	Max.
0- 15	1300	1900	0- 11	1300	1800	0- 11	1100	1600	0- 11	900	1400	0- 11	800	1200
16- 62	1300	1700	12- 65	1200	1800	12- 65	1000	1600	12- 65	800	1400	12- 65	600	1200
63- 164	1200	1700	66- 113	1200	1700	66- 113	1000	1400	66- 170	800	1300	66- 113	600	1100
165- 225	1100	1700	114- 170	1100	1700	114- 215	900	1400	171- 215	800	1200	114- 170	500	1100
226- 266	1100	1600	171- 215	1100	1600	216- 275	800	1400	216- 275	600	1200	171- 275	500	1000
267- 330	1000	1600	216- 317	1000	1600	276- 380	800	1300	276- 317	600	1100	276- 317	500	900
331- 368	1000	1400	318- 330	900	1600	381- 419	800	1200	318- 380	500	1100	318- 380	300	900
369- 470	900	1400	331- 419	900	1400	420- 485	600	1200	381- 485	500	1000	381- 485	300	800
471- 540	800	1400	420- 485	800	1400	486- 521	600	1100	486- 521	500	900	486- 623	300	600
541- 623	800	1300	486- 590	800	1300	522- 590	500	1100	522- 590	300	900	624- 695	0	600
624- 645	600	1300	591- 623	800	1200	591- 695	500	1000	591- 695	300	800	696- 800	0	500
646- 725	600	1200	624- 695	600	1200	696- 725	500	900	696- 827	300	600	801-1010	0	300
726- 750	500	1200	696- 725	600	1100	726- 800	300	900	828- 905	0	600	1011-1325	0	0
751- 855	500	1100	726- 800	500	1100	801- 905	300	800	906-1010	0	500			
856- 929	500	1000	801- 905	500	1000	906-1031	300	600	1011-1220	0	300			
930- 960	300	1000	906- 929	500	900	1032-1115	0	600	1221-1535	0	0			
961-1065	300	900	930-1010	300	900	1116-1220	0	500						
1066-1170	300	800	1011-1115	300	800	1221-1430	0	300						
1171-1286	300	600	1116-1235	300	600	1431-1745	0	0						
1287-1380	0	600	1236-1325	0	600									
1381-1485	0	500	1326-1430	0	500									
1486-1695	0	300	1431-1640	0	300									
1696- *	0	0	1641- *	0	0									

* See working limits for selector circuit.

TABLE 11

Short Range Battery Cutoff Incoming Selector (See 4.04)

Direct Routing			Routing Via Distant Office Selector											
			Beyond Office (C) Compensating Resistance Effective in Distant Office Selector											
			0W			200W			400W			600W		
Trunk Conductor Res.	Comp. Res.		Trunk Conductor Res.	Comp. Res.		Trunk Conductor Res.	Comp. Res.		Trunk Conductor Res.	Comp. Res.		Trunk Conductor Res.	Comp. Res.	
	Min.	Max.		Min.	Max.		Min.	Max.		Min.	Max.		Min.	Max.
0- 65	1500	1500	0- 12	1500	1500	0- 115	1200	1200	0- 215	900	900	0- 12	900	900
66- 368	1200	1200	13- 317	1200	1200	116- 419	900	900	216- 223	600	900	13- 317	600	600
369- 380	900	1200	318- 328	900	1200	420- 433	600	900	224- 521	600	600	318- 328	300	600
381- 674	900	900	329- 623	900	900	434- 725	600	600	522- 538	300	600	329- 623	300	300
675- 695	600	900	624- 643	600	900	726- 748	300	600	539- 827	300	300	624- 643	0	300
696- 980	600	600	644- 929	600	600	749-1031	300	300	828- 853	0	300	644- 958	0	0
981-1010	300	600	930- 958	300	600	1032-1063	0	300	854-1168	0	0			
1011-1286	300	300	959-1235	300	300	1064-1378	0	0						
1287-1325	0	300	1236-1273	0	300									
1326-1640	0	0	1274-1590	0	0									

TABLE 12

Long Range Battery Cutoff Incoming Selector (See 4.04)

Direct Routing			Routing Via Distant Office Selector											
			Beyond Office (C) Compensating Resistance Effective in Distant Office Selector											
			0W			200W			400W			600W		
Trunk Conductor Res.	Comp. Res.		Trunk Conductor Res.	Comp. Res.		Trunk Conductor Res.	Comp. Res.		Trunk Conductor Res.	Comp. Res.		Trunk Conductor Res.	Comp. Res.	
	Min.	Max.		Min.	Max.		Min.	Max.		Min.	Max.		Min.	Max.
0- 62	1500	2100	0- 11	1500	2100	0- 113	1200	2100	0- 20	900	2100	0- 11	900	1800
63- 368	1200	2100	12- 317	1200	2100	114- 230	900	2100	21- 215	900	1800	12- 125	600	1800
369- 495	900	2100	318- 440	900	2100	231- 419	900	1800	216- 335	600	1800	126- 317	600	1500
496- 674	900	1800	441- 623	900	1800	420- 545	600	1800	336- 521	600	1500	318- 440	300	1500
675- 810	600	1800	624- 755	600	1800	546- 725	600	1500	522- 650	300	1500	441- 623	300	1200
811- 980	600	1500	756- 929	600	1500	726- 860	300	1500	651- 827	300	1200	624- 755	0	1200
981-1125	300	1500	930-1070	300	1500	861-1031	300	1200	828- 965	0	1200	756-1070	0	900
1126-1286	300	1200	1071-1235	300	1200	1032-1175	0	1200	966-1280	0	900	1071-1385	0	600
1287-1440	0	1200	1236-1385	0	1200	1176-1490	0	900	1281-1595	0	600	1386-1700	0	300
1441-1755	0	900	1386-1700	0	900	1491-1805	0	600	1596-1910	0	300	1701-2015	0	0
1756-2070	0	600	1701-2015	0	600	1806-2120	0	300	1911-2225	0	0			
2071-2385	0	300	2016-2330	0	300	2121-2435	0	0						
2386- *	0	0	2331- *	0	0									

* See working limits for selector circuit.

TABLE 13

Short Range Crossbar Incoming Trunk (See 4.04)

Direct Routing			Routing Via Distant Office Selector											
			Beyond Office (C) Compensating Resistance Effective in Distant Office Selector											
			0W			200W			400W			600W		
Trunk Conductor Res.	Comp. Res. Min.	Comp. Res. Max.	Trunk Conductor Res.	Comp. Res. Min.	Comp. Res. Max.	Trunk Conductor Res.	Comp. Res. Min.	Comp. Res. Max.	Trunk Conductor Res.	Comp. Res. Min.	Comp. Res. Max.	Trunk Conductor Res.	Comp. Res. Min.	Comp. Res. Max.
0- 47	1200*	1200	0- 302	900	1200	0- 98	900	1200	0- 200	600	1200	0- 302	300	1200
48- 353	900	1200	303- 608	600	1200	99- 404	600	1200	201- 506	300	1200	303- 640	0	1200
354- 659	600	1200	609- 914	300	1200	405- 710	300	1200	507- 850	0	1200	641- 955	0	900
660- 965	300	1200	915-1270	0	1200	711-1060	0	1200	851-1165	0	900	956-1270	0	600
966-1325	0	1200	1271-1585	0	900	1061-1375	0	900	1166-1485	0	600	1271-1585	0	300
1326-1640	0	900	1586-1900	0	600	1376-1690	0	600	1486-1795	0	300	1586-1900	0	0
1641-1955	0	600	1901-2215	0	300	1691-2005	0	300	1796-2110	0	0			
1956-2270	0	300	2216-2530	0	0	2006-2320	0	0						
2271-2585	0	0												

* 900 ohms may be used.

TABLE 14

Long Range Crossbar Incoming Trunk (See 4.04)

Direct Routing			Routing Via Distant Office Selector											
			Beyond Office (C) Compensating Resistance Effective in Distant Office Selector											
			0W			200W			400W			600W		
Trunk Conductor Res.	Comp. Res. Min.	Comp. Res. Max.	Trunk Conductor Res.	Comp. Res. Min.	Comp. Res. Max.	Trunk Conductor Res.	Comp. Res. Min.	Comp. Res. Max.	Trunk Conductor Res.	Comp. Res. Min.	Comp. Res. Max.	Trunk Conductor Res.	Comp. Res. Min.	Comp. Res. Max.
0- 47	1200*	1200	0- 302	900	1200	0- 98	900	1200	0- 200	600	1200	0- 302	300	1200
48- 353	900	1200	303- 608	600	1200	99- 404	600	1200	201- 506	300	1200	303- 955	0	1200
354- 659	600	1200	609- 914	300	1200	405- 710	300	1200	507-1165	0	1200	956-1270	0	900
660- 965	300	1200	915-1585	0	1200	711-1375	0	1200	1166-1480	0	900	1271-1585	0	600
966-1640	0	1200	1586-1900	0	900	1376-1690	0	900	1481-1795	0	600	1586-1900	0	300
1641-1955	0	900	1901-2215	0	600	1691-2005	0	600	1796-2110	0	300	1901-2215	0	0
1956-2270	0	600	2216-2530	0	300	2006-2320	0	300	2111-2425	0	0			
2271-2585	0	300	2531-2845	0	0	2321-2635	0	0						
2586-2900	0	0												

* 900 ohms may be used.

TABLE 15

Manual PCI, Tandem PCI, and Full Selector Tandem (See 4.04)

Direct # Routing			Routing Via Distant Office Selector											
			Beyond Office (C) Compensating Resistance Effective in Distant Office Selector											
			0W#			200W			400W			600W		
Trunk Conductor Res.	Comp. Res. Min.	Comp. Res. Max.	Trunk Conductor Res.	Comp. Res. Min.	Comp. Res. Max.	Trunk Conductor Res.	Comp. Res. Min.	Comp. Res. Max.	Trunk Conductor Res.	Comp. Res. Min.	Comp. Res. Max.	Trunk Conductor Res.	Comp. Res. Min.	Comp. Res. Max.
0- 47	1200*	1200	0- 302	900	1200	0- 98	900	1200	0- 200	600	1200	0- 302	300	1200
48- 353	900	1200	303- 608	600	1200	99- 404	600	1200	201- 506	300	1200	303- 695	0	1200
354- 659	600	1200	609- 914	300	1200	405- 710	300	1200	507- 905	0	1200	696-1010	0	900
660- 965	300	1200	915-1325	0	1200	711-1115	0	1200	906-1220	0	900	1011-1325	0	600
966-1380	0	1200	1326-1640	0	900	1116-1430	0	900	1221-1535	0	600	1326-1640	0	300
1381-1695	0	900	1641-1955	0	600	1431-1745	0	600	1536-1850	0	300	1641-1955	0	0
1696-2010	0	600	1956-2275	0	300	1746-2060	0	300	1851-2165	0	0			
2011-2325	0	300	2276-2585	0	0	2061-2375	0	0						
2326-2640	0	0												

For routings via crossbar tandem or dial coin zone outgoing trunk, use column for routing via distant office selector with 0W(C) compensating resistance.

* 900 ohms may be used.