LINE LEAKAGE AND RINGING BRIDGE LIMITATIONS

CONTENTS PAGE

1. GENERAL

1.01 This Section establishes minimum insulation resistance values and maximum ringer bridge loads for station lines served by step-by-step central offices or PABX systems.

1.02 These limitations must be observed if the switching equipment is to be maintained economically within the engineered design capabilities and render the intended grade of service. The loop resistance of a customer line, another important factor which must be considered, is covered in other Sections of these practices and on individual circuit drawings and range charts.

1.03 Ringing bridge limitations for special services are controlled by the specific equipment involved, and notes on the circuit drawings for that equipment should be followed.

2. LINE INSULATION RESISTANCE

2.01 Since d-c line leakage has a detrimental effect on the pulsing capabilities of switching equipment and contributes to noise which results in poor transmission, the insulation resistance between tip and ring conductors of the line, or between either conductor and ground, must be maintained at a minimum of 50,000Ω during the most adverse wet weather conditions. The line insulation resistance will normally be much higher during dry weather.

3. RINGING BRIDGES

3.01 For the purpose of this Section, ringing bridges are classified into two groups, defined as follows:

(a) Capacitor type – consisting of ringer coils in series with a matched capacitor.

(b) Tube type – consisting of ringer coils in series with the main gap of a polarized cold cathode electron tube, or of a two-element cold cathode electron tube in series with one (or with several parallel) capacitor-type ringing bridges.

3.02 The two-element, tube-type ringing bridge is used in single-frequency ringing systems, other than superimposed, in order to reduce induced metallic noise on a line. A similar bridge, also used for induced noise reduction or to permit connection of additional ringers to a line, is the ringer isolation relay. This device consists of a two-element cold cathode tube in series with a capacitor and a full-wave diode configuration, with the relay coil connected to the d-c output of the diodes (see Figure 5). When operated, the relay contacts connect one (or several parallel) capacitor-type ringing bridges directly to the line. For details, consult the Section in the 471-151 series entitled "Orbit TDD-3A1 Ringer Isolation Relay-Installation".

4. RINGING BRIDGE IMPEDANCES AND LIMITATIONS

4.01 Capacitor-type ringing bridge impedances are customarily grouped into high and low categories, based on their magnitude at voice frequencies. For the purpose of this Section, the impedance of a ringing bridge is defined as high or low on the basis of the designation applied by the ringer or signal manufacturer.

4.02 While transmission loss and noise susceptance are very important factors governing the number and nature of capacitor-type ringing bridges connected to a given subscriber line, the ringing capabilities of the central office equipment and the pulse distortion effect on its pulsing relays must also be considered.

4.03 If high and low impedance ringers are mixed on the same line, the high impedance ringers do not receive a proportionate share of the ringing current. Since this often results in BDR or Adjust Ringer complaints, all ringers on a given line should be in the same impedance category.

4.04 Each capacitor-type ringing bridge placed on a line adds additional capacitive and inductive

reactance to the loop as seen from the pulsing relays in the central office. A large number of ringing bridges placed on a short (under 400 Ω) loop adds enough reactance to cause pulse distortion which can result in WNO and BDR complaints. For this reason, the assignment of ringing bridges to a line must be limited in number and type in accordance with Table 1 and associated notes.

4.05 When conditions require limiting inductive noise on a divided ringing line, use only high impedance ringers. If the noise persists after eliminating all low impedance ringers and raising the line insulation resistance to at least the minimum value set forth in Paragraph 2.01, refer the problem to supervision for further investigation.

4.06 If the number of ringers required to provide service on a given line exceeds the total shown in Table 1, use a ringer isolation relay or an extension ringing relay unit in accordance with Table 1 and the following special limitations.

4.07 For each of the following types of equipment associated with a line, deduct one ringing bridge from the allowable number indicated in Table 1:

(a) Loud extension ringer

(b) Loud sounding signal (howler or klaxon)

(c) Intercept ringer

(d) Extension ringing relay unit (see Section 473-814-100 for maximum number of ringers)

(e) Ringer isolation relay (maximum load per relay, 4 high impedance ringers)

(f) PBX station on night connection (if trunk or cord circuit has an a-c bridge)

(g) Long line adapter (arranged to repeat or extend ringing)

4.08 For each of the following types of equipment associated with a line, deduct two ringing bridges from the allowable number indicated in Table 1:

(a) Key telephone system line circuit

(b) Automatic answering set

5. TYPICAL RINGING BRIDGE CONNECTIONS TO THE LINE

5.01 This Part presents some typical connection schemes in generalized schematic form. For specific wire-lead connections, see the appropriate Section in the 473 series covering the equipment involved.

5.02 On an individual line, the customary ringing arrangement is to bridge one or more straight line (SL) ringers across the line, as shown in Figure 1.

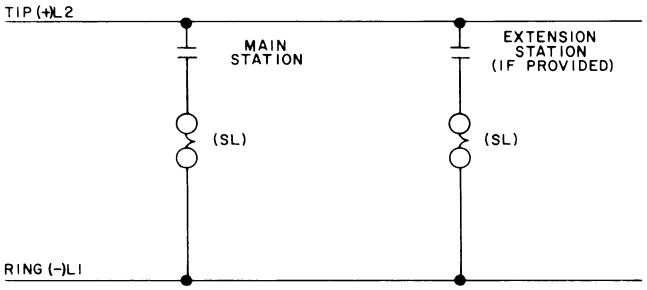

Figure 1. Individual Straight Line Bridged Ringing.

5.03 One method of providing fully selective ringing on a two-party line is to connect capacitor-type, frequency-selective ringing bridges across the line, as shown in Figure 2. Extension stations may be added by bridging ringers of the proper frequency across the line.

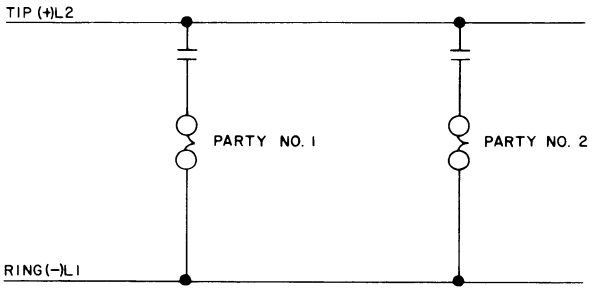

Figure 2. Two-Party Bridged Ringing, Using Frequency-Selective Ringers.

5.04 Another method of providing fully-selective ringing on a two-party line is to connect a capacitor-type ringing bridge between each side of the line and ground, as shown in Figure 3. The preferred method is to use straight line ringers, but frequency-selective ringers can be used when necessary to avoid early retirement in cases of general regrading. Extension stations may be provided by connecting additional ringing bridges between the appropriate side of the line and ground.

NOTE: As used in this Section, the term "ringing bridge" refers only to a given combination of apparatus, as defined in Part 3, and does not imply a bridged (metallic, or line conductor-to-conductor) connection of that combination. The combination may be connected on a divided (line conductor-to-ground) basis.

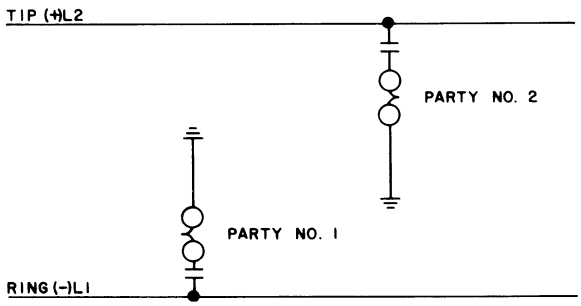

Figure 3. Two-Party Divided Ringing, Using Straight Line Ringers.

5.05 A less common method of providing fully-selective ringing on a two-party line is to connect a tube-type ringing bridge between each side of the line and ground, as shown in Figure 4, and to use superimposed ringing. This arrangement does not take full advantage of the selective properties of the superimposed scheme, and is not normally used on two-party lines except when the method of Figure 3 would result in excessive induced noise.

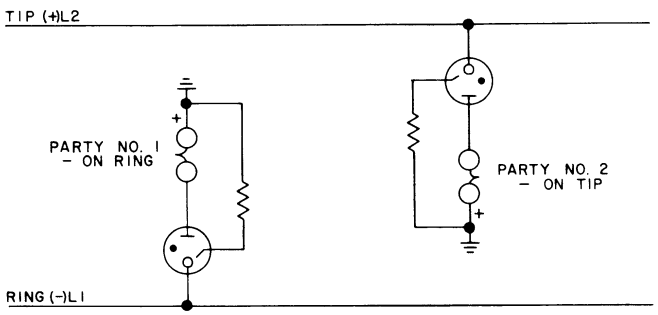

Figure 4. Two-Party Superimposed Ringing, Using Tube-Type Ringing Bridges.

5.06 A variation of the method shown in Figure 3 (and an alternate to the method of Figure 4) to avoid induced noise is to use a ringer isolation relay at each station, as shown in Figure 5. Note that extension ringers, if any, up to a maximum of three high-impedance units, are controlled by the same relay as the main station. As with the arrangement of Figure 3, the use of straight line ringers is the preferred method.

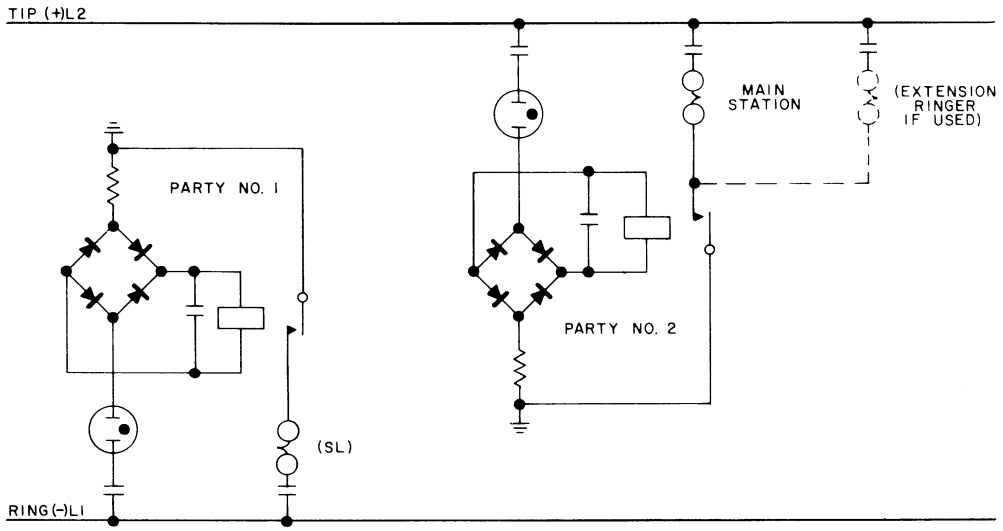

Figure 5. Two-Party Divided Ringing, Using Tube-Type Ringing Bridges (Ringer Isolation Relays).

5.07 To provide fully selective ringing on a four-party line, the methods of Figures 2 through 5 are expanded to provide two additional party selections. In the case of capacitor-type, frequency-selective ringing bridges, ringers responsive to a third and a fourth frequency are bridged across the line at the added stations, as shown in Figure 6. When divided ringing is used on a four-party line, fully-selective service requires two types of ringer response. One method, as shown in Figure 7, involves the use of frequency-selective ringers. For this application the preferred frequencies in the harmonic series are 25 Hz and 33 1/3 Hz, or 20 Hz and 30 Hz in the Synchromonic or Decimonic series. Another method, illustrated in Figure 8, uses both polarities of superimposed ringing potential and connects an additional tube-type ringing bridge (with the connection reversed) between each line conductor and ground. A variation on the method of Figure 7, suggested for reduction of induced noise when required, uses a ringer isolation relay at each station (see Figure 9).

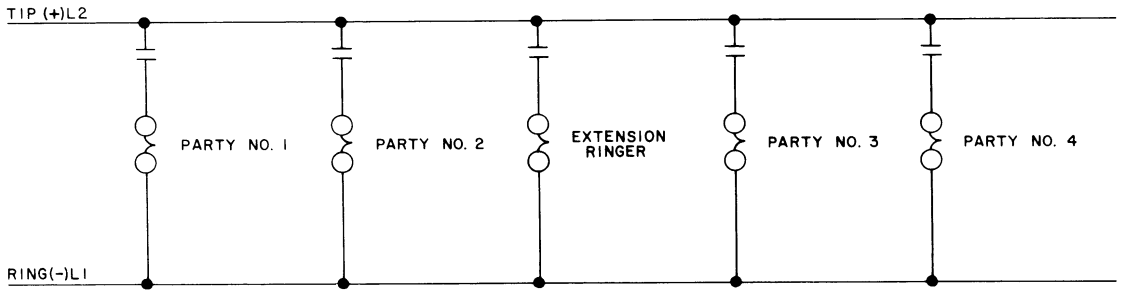

Figure 6. Four-Party Bridged Ringing, Using Frequency-Selective Ringers.

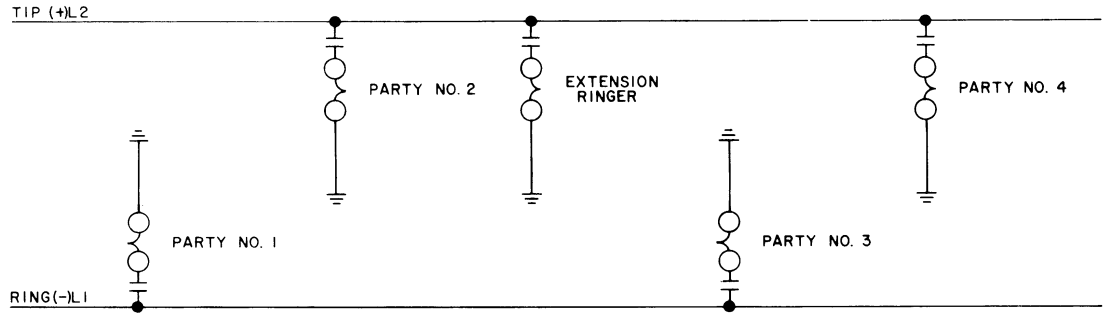

Figure 7. Four-Party Divided Ringing, Using Frequency-Selective Ringers.

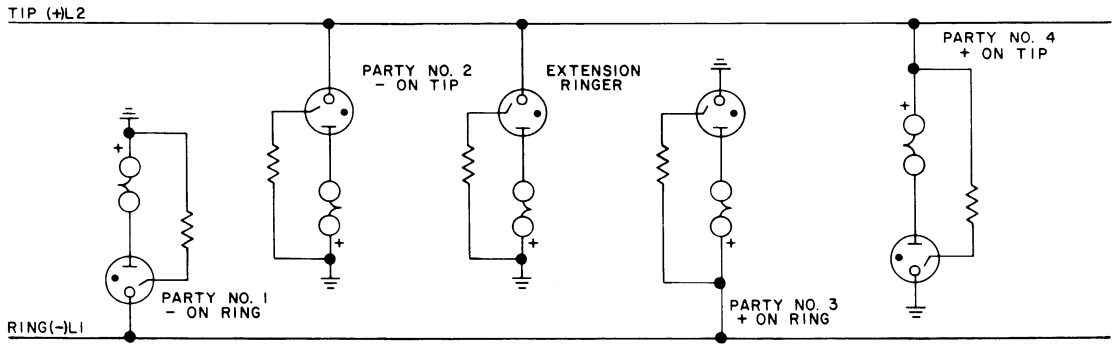

Figure 8. Four-Party Superimposed Ringing, Using Tube-Type Ringing Bridges.

5.08 On a multi-party line, fully selective ringing may be provided by connecting capacitor-type, frequency-selective ringing bridges between each side of the line and ground, as shown in Figure 10. If this method would result in excessive induced noise, the scheme illustrated in Figure 9 should be expanded to cover the additional stations by providing a ringer isolation relay and one or more frequency-selective ringers at each.

5.09 Semi-selective ringing may be provided on a multi-party line by connecting the tube-type ringing bridges between each side of the line and ground, as shown in Figure 11, and using coded superimposed ringing.

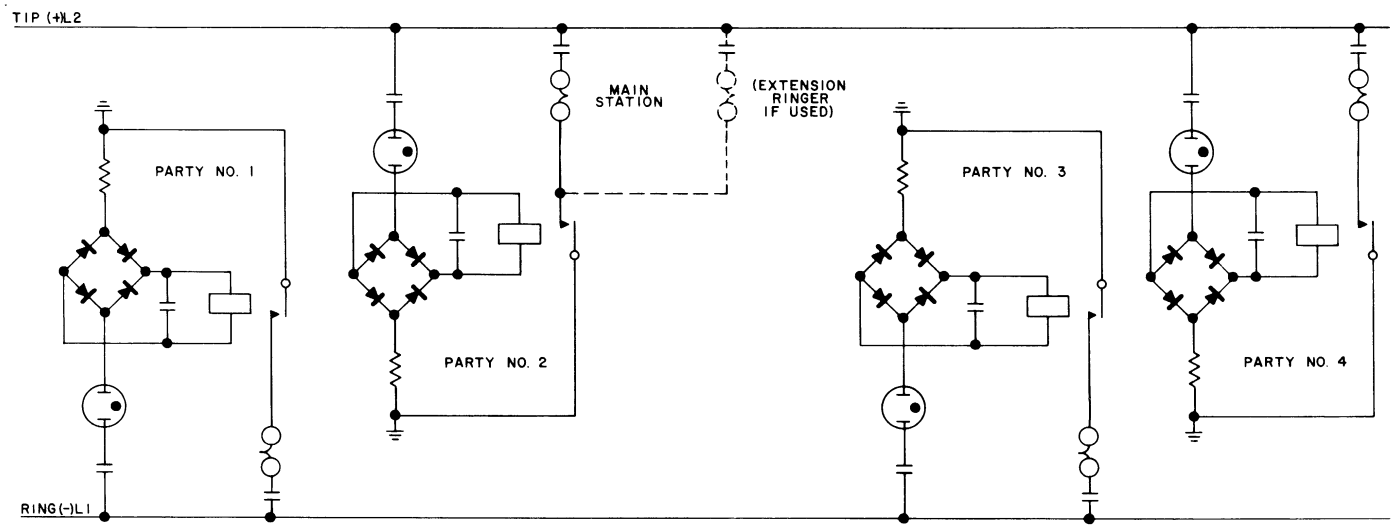

Figure 9. Four-Party Divided Ringing, Using Tube-Type Ringing Bridges (Ringer Isolation Relays) and Frequency-Selective Ringers.

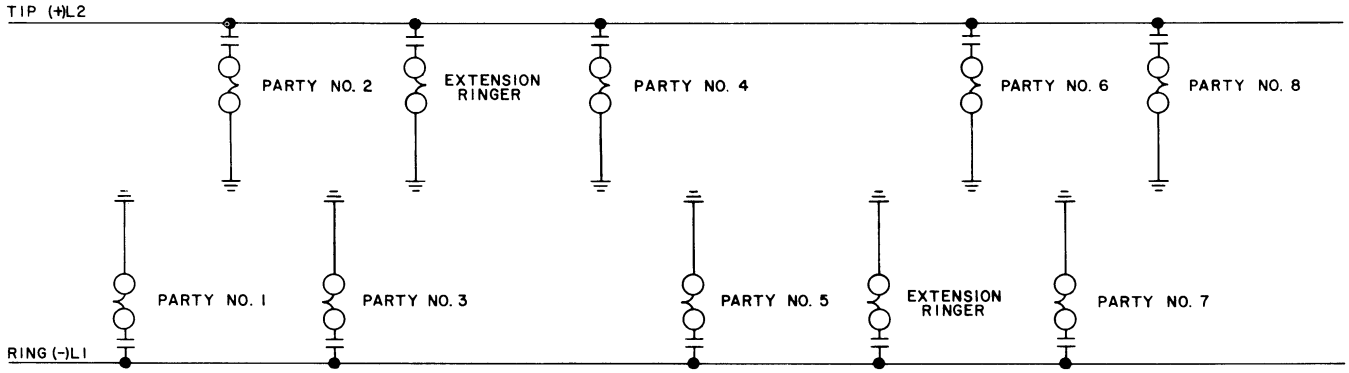

Figure 10. Multi-Party Divided Ringing, Using Frequency-Selective Ringers.

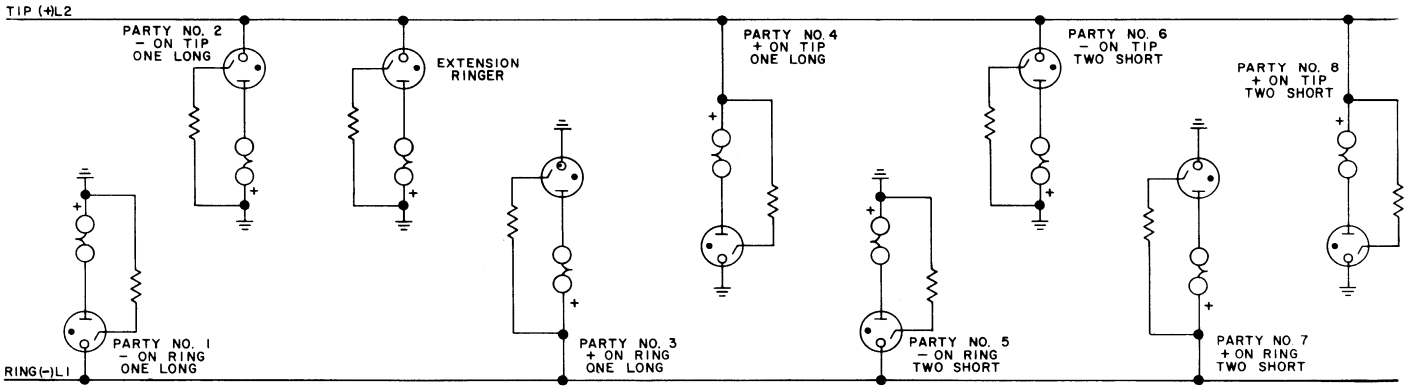

Figure 11. Multi-Party Semi-Selective Superimposed Ringing, Using Tube-Type Ringing Bridges.

Table 1. Ringing Bridge Limitations (See Paragraph 4.07 for Special Limitations).

	Individual Line		PABX Station Line		Two-Party Line			Four-Party Line			Multi-Party Line		
Method of Ringing	Max. No. of Ringers	Notes	Max. No. of Ringers	Notes	Max. No. of Ringers		Notes	Max. No. of Ringers		Notes	Max. No. of Ringers		Notes
Bridged Ringing													
Low Z Straight Line	3		2		3		5						
High Z Straight Line	4		3		4		5						
Low Z Freq. Selective	4	6			4		4	4					
High Z Freq. Selective	5	6, 8			5		4, 8	5		8	5		8
Divided Ringing					Tip	Ring		Tip	Ring		Tip	Ring	
Low Z Straight Line					3	3		3	3	5			
High Z Straight Line					4	4		4	4	5			
Low Z Freq. Selective					4	4	4,6	4	4	4	4	4	
High Z Freq. Selective					5	5	4, 6, 8	5	5	4, 8	5	5	8
High Z Tube Type					5	5	3, 7	5	5	3, 4, 7	5	5	3,7
Superimposed Ringing					Tip	Ring							
3 - Element Polarized Tube					3	3	3	12		1, 2	12		1, 2

Table 1 Notes

1. The maximum number of tube-type ringing bridges of each polarity allowed on each side of the line is three.

2. To prevent premature ring trip when more than two ringing bridges per polarity are used on the same side of the line, a minimum loop resistance of 300 Ω is required.

3. Normally not used except to provide for additional ringers or to reduce noise.

4. 25 Hz and 33 1/3 Hz (or 20 Hz and 30 Hz) frequency-selective ringers recommended whenever possible.

5. This method not recommended; requires code ringing and provides only semi-selective service.

6. Preferred method is to use straight line ringers.

7. This limitation applies to the number of ringer isolation relays. Maximum number of high impedance ringers per ringer isolation relay is four.

8. For purposes of this table, count each 16 Hz, 16 2/3 Hz or 20 Hz high impedance A.E.Co., Leich or North ringer as 1 1/2 ringing bridges, rather than one, because of the large capacitance involved.