



Z - Selected so that the reflected impedance at tip and ring is 600 Ω, 135 Ω, or 100 Ω depending on the service type of EUT

**FIGURE 68.310 (f)  
REQUIRED TERMINATION FOR CONNECTIONS TO NON-REGISTERED EQUIPMENT**

[62 FR 61682, Nov. 19, 1997; 63 FR 25174, 25175 May 7, 1998]

**§ 68.312 On-hook impedance limitations.**

(a) *General.* Requirements in this section apply to the tip and ring conductors of 2-wire interfaces. These requirements also apply to 4-wire loop-start or ground-start interfaces, in the following configuration:

(1) The tip and ring conductors are connected together and treated as one of the conductors of a tip and ring pair.

(2) The tip 1 and ring 1 conductors are connected together and treated as the other conductor of a tip and ring pair.

NOTE TO § 68.312: Throughout this section, references will be made to simulated ringing. Ringing voltages to be used and impedance limitations associated with simulated ringing are shown in Table 68.312(a).

TABLE 68.312(a)

Ring type	Range of compatible ringing frequencies (Hz)	Simulated ringing voltage superimposed on 56.5 volts dc	Impedance limitations (ohms)
A	20±3	40 to 130 volts rms	1400
	30±3	40 to 130 volts rms	1000
B	15.3 to 34	40 to 130 volts rms	1600
	>34 to 49	62 to 130 volts rms	1600

TABLE 68.312(a)—Continued

Ring type	Range of compatible ringing frequencies (Hz)	Simulated ringing voltage superimposed on 56.5 volts dc	Impedance limitations (ohms)
	>49 to 68 .....	62 to 150 volts rms .....	1600

(b) *Limitations on individual equipment intended for operation on loop-start telephone facilities.* Registered terminal equipment and registered protective circuitry shall conform to the following limitations:

(1) *On-hook resistance, metallic and longitudinal (up to 100 Vdc).* The on-hook dc resistance between the tip and ring conductors of a loop start interface, and between each of the tip and ring conductors and earth ground, shall be greater than 5 megohms for all dc voltages up to and including 100 volts.

(2) *On-hook resistance, metallic and longitudinal (100 V to 200 Vdc).* The on-hook dc resistance between tip and ring conductors of a loop start interface, and between each of the tip and ring conductors and earth ground shall be greater than 30 kOhms for all dc voltages between 100 and 200 volts.

(3) *DC current during ringing.* During the application of simulated ringing, as listed in Table 68.312(a), to a loop start interface, the total dc current shall not exceed 3.0 milliamperes. The equipment must comply for each ringing type which is listed as part of the ringer equivalence.

(4) *Ring frequency impedance (metallic).* During the application of simulated ringing, as listed in Table 68.312(a), to a loop start interface, the impedance between the tip and ring conductors (defined as the quotient of applied ac voltage divided by resulting true rms current) shall be greater than or equal to the value specified in Table 68.312(a). The equipment must comply for each ringing type which is listed as part of the ringer equivalence.

(5) *Ring Frequency Impedance (longitudinal).* During the application of simulated ringing, as listed in Table 68.312(a), to a loop start interface, the impedance between each of the tip and ring conductors and ground shall be greater than 100 kohms. The equipment must comply with each ringing type listed in the ringer equivalence.

(c) *Limitations on individual equipment intended for operation on ground start telephone facilities.* Registered terminal equipment and registered protective circuitry shall conform to the following limitations:

(1) *DC current during ringing.* During the application of simulated ringing, as listed in Table 68.312(a), to a ground start interface, the total dc current flowing between tip and ring conductors shall not exceed 3.0 milliamperes. The equipment must comply for each ringing type listed as part of the ringer equivalence.

(2) *Ring frequency impedance (metallic).* During the application of simulated ringing, as listed in Table 68.312(a), to a ground start interface, the total impedance of the parallel combination of the ac impedance across tip and ring conductors and the ac impedance from the ring conductor to ground (with ground on the tip conductor) shall be greater than the value specified in Table 68.312(a). The equipment must comply for each ringing type listed as part of the ringer equivalence.

(d) *Ringer Equivalence Definition.* The ringer equivalence number is defined to be the value determined in paragraphs (d)(1) or (d)(2) of this section, as appropriate, followed by the ringer type letter indicator representing the frequency range for which the number is valid. If Ringer Equivalence is to be stated for more than one Ringing Type, testing shall be performed at each frequency range to which Ringer Equivalence is to be determined in accordance with the above, and the largest resulting Ringer Equivalence Number so determined will be associated with each Ringing Type letter designation for which it is valid.

(1) For individual equipment intended for operation on loop-start telephone facilities, the ringer equivalence is five times the impedance limitation listed in Table 68.312(a), divided by the

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minimum measured ac impedance, as defined in paragraph (b)(1)(iv) of this section, during the application of simulated ringing as listed in Table 68.312(a).

(2) For individual equipment intended for operation on ground-start telephone facilities, the ringer equivalence is five times the impedance limitation listed in Table 68.312(a), divided by the minimum measured ac impedance, defined in paragraph (c)(2) of this section, during the application of simulated ringing as listed in Table 68.312(a).

(e) *Ringer equivalence number labeling.* Registered terminal equipment and registered protective circuitry shall have at least one Ringer Equivalence Number shown on the registration label. Where options that will vary the Ringer Equivalence are involved, either each option that results in a Ringer Equivalence Number greater than 0.1 and its corresponding Ringer Equivalence shall be listed on the registration label, or the largest Ringer Equivalence Number that can result from such options shall be stated on the label. A trained, authorized agent of the Grantee may disconnect ringers, bridge ringers to another line, or execute options affecting Ringer Equivalence after the telephone company has been notified in accordance with § 68.106.

(f) *Maximum ringer equivalence.* All registered terminal equipment and registered protective circuitry that can affect the ringing frequency impedance shall be assigned a Ringer Equivalence. The sum of all such Ringer Equivalences on a given telephone line or loop shall not exceed 5. In some cases, a system that has a total Ringer Equivalence of 5 or less may not be usable on a given telephone line or loop.

(g) *OPS interfaces for PBX with DID (Ring trip requirement).* PBX ringing supplies whose output appears on the off-premises interface leads shall not trip when connected to the following tip-to-ring impedance that terminates the off-premises station loop: A terminating impedance composed of the parallel combination of a 15 kohms resistor and an RC series circuit (resistor and capacitor) whose ac impedance is as specified in Table 68.312(b) below.

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TABLE 68.312(b)

Ringing freq Hz	ac impedance ohms	
	Class B or C	Class A
20 ± 3 .....	7000/N	1400
30 ± 3 .....	5000/N	1000

N—Number of ringer equivalences, as specified by the manufacturer, which can be connected to the off-premises station loop.

(h) *Type Z Ringers.* Equipment that has on-hook impedance characteristics which do not conform to the requirements of this section may be conditionally registered, notwithstanding the requirements of this section, provided that it is labeled with a Ringing Type designation “Z”. It should be noted that registration of equipment bearing the designation “Z” does not necessarily confer any right of connection to the telephone network under these rules. Any equipment registered with the type Z designation may only be used with the consent of the local telephone company, provided that the local telephone company does not discriminate in its treatment of equipment bearing the type Z designation.

(i) *Transitioning to the Off-Hook State.* Registered terminal equipment and registered protective circuitry shall not by design leave the on-hook state by operations performed on tip and ring leads for any other purpose than to request service or answer an incoming call, except that terminal equipment that the user places in the off-hook state for the purpose of manually placing telephone numbers in internal memory for subsequent automatic or repertory dialing shall be registerable. Make-busy indications shall be transmitted by the use of make-busy leads only as defined in § 68.3 and § 68.200(j).

[62 FR 61689, Nov. 19, 1997]

§ 68.314 Billing protection.

(a) *Call duration requirements on data equipment connected to the public switched network, or to tie trunks, or to private lines that access the public switched network.* Registered data terminal equipment and registered protective circuitry shall comply with the following requirements when answering an incoming call, except in off-hook states in which the signals are