

Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of)
)
Amendment of Part 68 of the) CC Docket No. 96-28
Commission's Rules)

REPORT AND ORDER

Adopted: July 30, 1997

Released: August 22, 1997

By the Commission:

I. INTRODUCTION

1. In this Report and Order ("Order"), we adopt final rules to amend Part 68 of the Commission's rules, which governs the terms and conditions under which customer-provided terminal equipment may be connected to the telephone network without causing harm to the network.¹ The amendments we adopt herein are designed to harmonize United States and Canadian requirements governing connection of terminal equipment to the public switched network ("PSN") and to promote barrier-free trade between Canada and the United States, in keeping with the spirit of the North American Free Trade Agreement ("NAFTA").² As a result of these amendments to Part 68, manufacturers in one country will be able to design and test terminal equipment to comply with a single, consistent set of technical standards accepted in both the United States and Canada.

II. BACKGROUND

¹ See 47 C.F.R. Part 68. For a history of Part 68, see Proposals for New or Revised Classes of Interstate and Foreign Message Toll Telephone Service ("MTS") and Wide Area Telephone Service ("WATS"); Revision of Part 68 of the Commission's Rules to Specify Standard Plugs and Jacks for the Connection of Telephone Equipment to the Nationwide Telephone Network; and Amendment of Part 68 of the Commission's Rules (Telephone Equipment Registration) to Specify Standards for and Means of Connection of Telephone Equipment to Lamp and/or Annunciator Functions of Systems, Memorandum Opinion and Order, 70 FCC 2d 1800 (1979).

² In Canada, certification means the right to attach terminal equipment to the PSN. Certification requires submission of an application that includes a technical description of the equipment and a measurement report showing compliance with CS-03, the Canadian terminal attachment standard. Canadian requirements for terminal attachment are issued by Industry Canada ("IC"). Under the direction of IC, the Terminal Attachment Program Advisory Committee ("TAPAC"), a government and industry advisory committee, reviews and recommends changes to equipment certification programs. Canada amended its terminal attachment rules (CS-03 standards) to harmonize Canadian standards for terminal equipment with those set forth in Part 68 on August 14, 1996. Canada Gazette, Part I, June 15, 1996, Notice No. SMSE-003-96.

2. On March 9, 1995, the Telecommunications Industry Association ("TIA") filed a Petition for Rulemaking ("Petition") to amend Sections 68.300 - 68.318 and portions of Section 68.2 of the Commission's rules to harmonize United States network protection standards and corresponding Canadian CS-03 certification regulations. Subpart D of Part 68, which includes Sections 68.300 through 68.318, addresses "Conditions for Registration," including requirements for environmental simulation (simulation "mimics" stresses that terminal equipment undergoes in shipment and handling that could potentially damage it), leakage current limitations, hazardous voltage limitation, signal power limitations, longitudinal balance limitations, on hook impedance limitations, billing protection, and hearing aid compatibility. Section 68.2 addresses the scope of the Commission's rules for terminal attachment.

3. TIA is a national trade association with more than 570 member companies engaged in the manufacture, sale and distribution of telecommunications equipment including terminal equipment. TIA's Petition is the culmination of four years of technical effort by United States and Canadian industry. In September, 1990, TIA's Engineering Subcommittee TR-41, sponsored by its User Premises Equipment Division, proposed a project to "address differences" between Canadian and United States terminal attachment rules.³ The Subcommittee created a joint working group co-chaired by representatives from the United States and Canada to develop a harmonized set of rules to comply with both countries' requirements for terminal attachment.⁴

4. In February 1996, in response to TIA's Petition and comments received on the petition, the Commission issued a Notice of Proposed Rulemaking ("Notice") proposing to amend Part 68 to harmonize United States and Canadian requirements for connection to the PSN.⁵ In the Notice, the Commission tentatively concluded that the amended rules would promote barrier-free trade between the United States and Canada by eliminating unnecessary differences in terminal

³ TIA's technical work is conducted through its Engineering Committees, which develop, maintain, and publish voluntary standards and technical reports. TIA encourages these committees to work cooperatively with members of the American National Standards Institute ("ANSI"), as well as international standards bodies outside the United States, to harmonize telecommunications equipment standards to avoid duplicating standardization work already successfully completed. TIA's stated trade policy goals include "removal of barriers to market access, full participation of United States government and industry in the standards-setting process worldwide, and achievement of a minimum level of standards required to ensure interoperability and proper function of the international network." See TIA Petition at 2.

⁴ According to TIA, a wide range of interest groups in the United States and Canada were represented including carriers, manufacturers, laboratories, consultants and government personnel.

⁵ See Public Notice, "Pleading Cycle Established for Comments on TIA's Petition for Rulemaking to Amend Part 68, Subpart D", 10 FCC Rcd 4548 (March 27, 1995); Amendment of Part 68 of the Commission's Rules, Notice of Proposed Rulemaking, 11 FCC Rcd 13282 (1996); Erratum, (rel. March 29, 1996) ("Notice"). Seven parties filed comments in response to the Notice. On April 16, 1996, one party filed reply comments. Appendix A contains a list of parties that filed comments in this proceeding.

attachment requirements.⁶ We tentatively concluded that the amended rules would be consistent with the spirit of NAFTA, and might become a guide for harmonization efforts with other countries.⁷ Furthermore, we tentatively concluded that the amended rules would create a more competitive equipment marketplace, resulting in lower costs for equipment, thereby benefitting United States and Canadian consumers. We also stated that the proposed rules were consistent with our commitment to ensure that customers and manufacturers can connect terminal equipment to the telephone network without causing harm to the network.⁸ Finally, we tentatively concluded that the Commission must retain ultimate responsibility for Part 68 functions, but should rely on standards bodies whenever possible to resolve complex technical matters. We sought comment on these tentative conclusions.⁹

III. DISCUSSION

A. Technical Amendments

5. Positions of the Parties. There is unanimity of opinion among commenters that harmonization of Part 68 and CS-03 will benefit terminal equipment manufacturers as well as the telecommunications industry. There were no oppositions to any of the proposed rules. Northern Telecom ("Nortel"), for example, supports the Commission's proposal and suggests that harmonization of technical requirements for attachment of terminal equipment to the PSN will facilitate trade between the United States and Canada because manufacturers will need to design and test to only one set of common standards.¹⁰ Lucent agrees that the amendment of Part 68 will result in commercial advantages.¹¹ NYNEX argues that, under the proposed rules, a *de facto* barrier to trade that was inconsistent with NAFTA will be eliminated.¹² Ameritech says that the proposed rules are an example of how "the government and industry can achieve agreement without the need for additional regulation."¹³

6. TIA and Sprint propose editorial corrections to the Part 68 rules in attachments to

⁶ Notice, 11 FCC Rcd at 13295.

⁷ Id. The rules are consistent with the aims of the World Trade Organization, which like NAFTA, seek to reduce trade barriers in order to promote competition.

⁸ Id.

⁹ Id.

¹⁰ Nortel Comments at 1; see also VeriFone Comments at 1.

¹¹ Lucent Comments at 2.

¹² NYNEX Comments at 2.

¹³ Ameritech Comments at 1; see also Verifone Comments at 1.

each of their comments.¹⁴ Additionally, Sprint argues that the Commission should add any tariffed data rates, *i.e.*, all speeds of data communications that telephone companies agree to provide to the public for a requested service, to the amendments to Part 68.¹⁵ More specifically, Sprint states that 38.4 kbps is an existing T1 subrate service and as such "qualifies for protection in accordance with the purpose of the Part 68 rules."¹⁶

7. Discussion. Based on the record, we amend Part 68 to harmonize it with Canada's CS-03 and summarize our amendments as follows. Section 68.302 is designed to protect the network from harm by ensuring that, despite being subject to environmental stresses, terminal equipment will continue to comply with Part 68 and not harm the network. Amended Section 68.302 deletes vibration, temperature, and humidity stresses from Part 68, and applies mechanical shock stresses only to equipment that might be affected by such stress. We delete these stresses because experience has shown, and the record supports, that they are unnecessary given the technological evolution in telecom equipment from an arrangement of discrete electronic components to solid state circuitry. Over the past ten years, failures during Part 68 registration testing involving these stresses is negligible. The benefits of streamlining our regulations in this regard far outweigh any possible harm to the network created by these stresses. In addition, as the result of industry coordination, we are including a new Type B surge test to better assure operability of customer premises equipment during lightning storms.

8. Section 68.304 leakage current limitations ensure that telephone connections are adequately insulated against hazards to telephone company personnel caused by voltages within the equipment itself or as a result of accidental contact with commercial power sources. Previously, Section 68.304 required testing using a 60 Hertz test voltage. Amended Section 68.304 changes the 60 Hertz standard to either 50 or 60 Hertz to harmonize with international frequencies used for this purpose and with Underwriters Laboratories and Canadian Standards Association insulation standards.

9. Section 68.306 imposes "fail safe" requirements on hazardous voltage. These limits are generally used throughout the telephone industry as voltage limitations below which special protection of telephone craft personnel is not required. Equipment must be designed to avoid creating voltages exceeding these limits under normal operation. We amend this section to delete hazardous voltage requirements for Message Registration ("MR") and Automatic Identification of

¹⁴ Sprint Comments at 1; TIA Comments at 2.

¹⁵ Sprint Comments at 3.

¹⁶ Sprint requests that the valid tariffed data rate of 38.4 kbps be included in Section 68.308(h)(1)(i), Table 68.308(c), and Table 68.310(b). Notice, 11 FCC Rcd at 13241-42, 13431.

Outward Dialing ("AIOD") because these types of technology are no longer in use.¹⁷ In addition, this Order changes the current voltage limitation from 80 to 60 volts to harmonize it with international safety standards.

10. The signal power limitations of Section 68.308 are designed to protect the network from interference caused by excessive signal power. We update this section by revising the "Through Gain" Table to reflect services such as Integrated Services Digital Network ("ISDN") and to delete references to the 4-wire Conventional Termination Set interface.¹⁸ We also expand subrate digital channel rates to include all rates presently used by industry, and adopt the ANSI T1 standard to replace the standard in the previous rules.¹⁹ Section 68.308 also protects the network from harm by addressing crosstalk interference. We reword this section for clarity and rename this section "Transverse Balance Limitations" to harmonize it with internationally recognized Institute of Electrical and Electronic Engineers' ("IEEE") terminology.

11. Section 68.312 addresses the impedance (*i.e.*, the resistance a circuit offers to alternating current) that must be maintained on a telephone line. The amended rules reorganize and reword this section for clarity. Specifically, the amended rules reduce the categories of ringer types. We also delete those sections addressing message registration because this technology is no longer in use.

12. Section 68.314 ensures that transmission of signals in the network does not interfere with proper operation of network billing equipment. The amendments to this section include rewording the section for clarity and deleting operating requirements for AIOD because the technology has been replaced. We also add a new section to clarify reverse battery billing (a type of loop signaling) requirements. Section 68.316 Hearing Aid Compatibility requirements are not amended by this Order. Furthermore, we delete reference to 1.544 Mbps digital "keep-alive" requirements from Section 68.318 because they are no longer in effect.²⁰ Finally, we amend definitions in Section 68.3. For example, we delete references to MR and AIOD equipment, but clarify that any MR and AIOD equipment that remains connected to the network may continue to

¹⁷ Message Registration ("MR") was a specific traffic recording system provided by certain older types of telephone systems. Automatic Identification of Outward Dialing ("AIOD") was a private branch exchange (PBX) service feature that identified the calling line on calls directed to a public switched telephone network for automatic message accounting recording purposes.

¹⁸ The Through Gain Table shows the maximum net amplification permitted in multiport systems between ports. The 4-wire Conventional Terminating Set interface was an older technology used for connection of customer provided equipment to analog voiceband private line services.

¹⁹ Subrate digital channel rates previously used by the industry ranged from 2.4 to 64 kilobits/second (kbps).

²⁰ "Keep-alive" refers to constantly present direct current voltage formally provided from the central office. Section 68.318 previously stated that "[u]ntil December 18, 1989, terminal equipment connecting to 1.544 Mbps services shall contain circuitry that assures continuity of output signal."

be used under the provisions of Section 68.2.

13. The record supports our tentative conclusion that amendment of Part 68 as described above should lower the price consumers pay for terminal equipment by facilitating greater efficiencies in the manufacturing and testing of terminal equipment. Under the amended rules, the technical requirements of Part 68 and CS-03 would be harmonized so that a manufacturer in one country can design and test terminal equipment to a single, consistent set of technical standards accepted in both the United States or Canada. We conclude that these efficiencies will lead to an even more competitive market for terminal equipment than currently exists, resulting in lower costs for equipment, thus benefitting United States and Canadian consumers.

14. Moreover, as commenters recognize, the amendments to Part 68 reconcile differences in standards and testing consistent with NAFTA. Currently, terminal equipment manufactured for use in the United States must meet the technical requirements of Part 68. Similarly, terminal equipment manufactured for use in Canada must comply with the technical requirements contained in CS-03. Each country's respective technical requirements have differed sufficiently that terminal equipment complying with one set of regulations would not necessarily comply with the technical requirements of the other country. These differences, as NYNEX correctly states, have created unreasonable burdens on manufacturers and are a *de facto* barrier to trade inconsistent with the goals of NAFTA. By reconciling differences in standards and testing, harmonization promotes the goals of NAFTA.²¹ Furthermore, the record supports our tentative conclusion that, as amended, the rules remain consistent with the Commission's longstanding commitment to ensure that no public harm results from attachment of private equipment to the PSN. The record is unanimous that the amended rules in no way diminish network protection.

15. Finally, we have reviewed the editorial corrections proposed by TIA and Sprint and find that they clarify our rules. For this reason, our final rules incorporate these suggested changes. In addition, we have added the tariffed data rate that Sprint suggests to our rules. While we decline to require that all tariffed rates be included, we agree that the specific tariffed rate Sprint suggests should be included to cover its currently available service.

B. Grandfathering Provision

16. Positions of the Parties. Lucent argues that the Commission should amend Section 68.2(j) to "provide grandfathering for existing equipment, in order to avoid any requirement to re-

²¹ At a February 1997 meeting of the Telecommunications Standards Subcommittee ("TSSC"), Mexico agreed to a "minimal" set of network protection standards pursuant to NAFTA Article 1304-1 (with minor exceptions to accommodate national deviations in networks) consistent with our initiative here to harmonize United States and Canadian network protection standards. The TSSC was established under NAFTA (Article 913) to create a work plan for "making compatible the standards-related measures for authorized equipment." It is comprised of officials from NAFTA member countries.

register all the equipment that has already been registered under current rules."²² Lucent argues that a grandfathering provision is necessary to avoid re-registration of products that are already registered under current rules, are in use, and do not cause harm to the network. Several of the commenters add that re-registration of these products would impose substantial expense without yielding any benefits. We note that no party has objected to a grandfathering provision.

17. Discussion. We are persuaded by commenters that there would be no benefit to requiring the re-registration of equipment already in use and shown not to cause harm to the network. We therefore adopt a grandfathering provision.²³ The new rule 68.2(j) reads as follows:

Terminal equipment and systems registered prior to **(date these rules are effective)**, do not have to be re-registered unless subsequently modified. All new equipment and systems manufactured after **(18 months after effective date)** must conform to the requirements.

C. Regulatory Process

18. Background. In the Notice, we stated that although harmonization of technical requirements for attachment of terminal equipment satisfies NAFTA requirements in a manner consistent with the interests of United States industry in facilitating greater efficiencies in manufacturing terminal equipment, we recognized that the usefulness of a harmonized standard is jeopardized if our regulatory process does not allow the standard to evolve at the same pace as technology.²⁴ Consequently, we tentatively concluded that the Commission should rely, whenever possible, on standards bodies to resolve complex technical issues. We stated our reluctance, however, to substitute industry consensus for our Part 68 rulemaking function as such consensus may not always promote the public interest.²⁵ We noted that standards bodies often lack the Commission's authority to ensure compliance with fair rules supporting safe and direct electrical connection of subscriber's terminal equipment to the PSN.²⁶

19. Positions of the Parties. TIA and NYNEX urge the Commission to adopt a rule requiring manufacturers to comply with the technical recommendations of industry standards bodies with appropriate Commission oversight. NYNEX states that "[i]nstead of specifying technical

²² Lucent Comments at 2; see also TIA Comments at 2-3.

²³ We note, however, that based on past experience, the vast majority of equipment covered by the grandfathering rule will be phased out of production and replaced by models that will be subject to the new rules.

²⁴ Notice, 11 FCC Rcd at 13294.

²⁵ Id. at 13295.

²⁶ Id.

interfaces and requirements for terminal equipment in the rules, the Commission should simply adopt a rule that requires manufacturers of such equipment to comply with the technical requirements and technical recommendations developed by appropriate industry standards bodies under the Commission's auspices. . . ."27 NYNEX contends that through its oversight of industry standards bodies, the Commission should be satisfied as to the "reasonableness" of any resulting technical recommendations. TIA argues that the current regulatory rulemaking process lags behind changes in technology and supports NYNEX's proposal.²⁸ Moreover, TIA states that NYNEX's suggested approach would be consistent with recent congressional directives.²⁹ VeriFone contends that industry standards bodies should remain responsible for technical issues, but concurs with the Commission's decision to retain ultimate responsibility in matters pertaining to Part 68 rulemaking authority.

20. Discussion. We acknowledge that efforts to harmonize our terminal attachment rules with those of other countries will be impeded if the regulatory rulemaking process fails to keep pace with technological changes. Therefore, we conclude that the Commission should rely, whenever possible, on standards bodies composed of industry experts to resolve complex technical matters. As we stated in the Notice, the Consultative Committee on Telecommunications ("CCT") has substantially assisted various harmonization activities.³⁰ Additionally, we recently sought comment on whether standards for enhanced wire quality and for determining gold equivalence should be permanent standards and, if so, what industry body or bodies shall determine an appropriate voluntary standard.³¹ We decline, however, to substitute industry consensus completely for our Part 68 rulemaking function. While they often may most expeditiously resolve complex technical matters, standards bodies lack the Commission's authority to ensure compliance with fair rules supporting safe and direct electrical connection of subscribers' telephone terminal equipment to the PSN. We note, for example, that new Section 273(d)(4) of the Communications Act of 1934, as amended, seeks to ensure that voluntary standards do not become *de facto* standards that operate to exclude legitimate parties. Similarly, while it in this proceeding has strived to incorporate the advice and assistance of standards bodies to resolve complex technical matters, the Commission must continue to ensure through its rulemaking function that fair rules are developed.

IV. CONCLUSION

²⁷ NYNEX Comments at 3.

²⁸ TIA Comments at 3; TIA Reply Comments at 3-5.

²⁹ See, e.g., National Technology Transfer and Advancement Act of 1995, Pub. L. No. 104-113, § 12, 110 Stat. 775, 782-83 (1996).

³⁰ Notice, 11 FCC Rcd at 13294.

³¹ Review of Sections 68.104 and 68.213 of the Commission's Rules Concerning Connection of Simple Inside Wiring to the Telephone Network, Order on Reconsideration, Second Report and Order and Second Further Notice of Proposed Rulemaking, CC Docket No. 88-57, FCC 97-209 (rel. Jun. 17, 1997), at paras. 54-55.

21. We conclude that the rules we adopt herein will eliminate unnecessary differences in terminal attachment requirements, and thereby promote barrier-free trade, between the United States and Canada. We find this to be consistent with the spirit and letter of NAFTA, which mandates elimination of trade barriers through reconciliation of differences in standards and testing procedures. These rules may become a model for our harmonization efforts with countries around the world and should benefit consumers by creating a more competitive equipment marketplace, thereby lowering the prices they pay for equipment. We conclude that these rules are consistent with the Commission's long-standing commitment to ensure that no public harm results from attachment of private equipment to the public switched network.

V. REGULATORY FLEXIBILITY ANALYSIS

22. Final Regulatory Analysis: Pursuant to the Regulatory Flexibility Act of 1980, 5 U.S.C. Section 601, et seq., the Commission's final analysis in this Report and Order is provided in Appendix B.

VI. ORDERING CLAUSES

23. Accordingly, IT IS ORDERED that, pursuant to Sections 1, 4, 201-205, 218, 220, 226, 227, 255, and 710 of the Communications Act of 1934, as amended, 47 U.S.C. §§ 151, 154, 201-205, 218, 220, 226, 227, 255, and 610, and 5 U.S.C. §§ 552 and 553, this Report and Order is ADOPTED, and Part 68 of the Commission's Rules ARE AMENDED as set forth in Appendix C.

24. IT IS FURTHER ORDERED that the rule amendments set forth in Appendix C SHALL BE EFFECTIVE seventy days after publication in the Federal Register, except that the amendments to Section 68.308(h)(1)(i), Table 68.308(c), and Table 68.310(b) of Part 47 of the Commission's rules, 47 C.F.R. §§ 68.308(h)(1)(i), 68.308(c), and 68.310(b), SHALL BE EFFECTIVE 150 days after publication in the Federal Register.

25. IT IS FURTHER ORDERED, that the Commission SHALL SEND a copy of this Order, including the Final Regulatory Flexibility Analysis, to the Chief Counsel for Advocacy of the Small Business Administration.

FEDERAL COMMUNICATIONS COMMISSION

William J. Caton
Acting Secretary

APPENDIX A: LIST OF PARTIES

Comments

Ameritech (Ameritech)

Lucent Technologies Inc. (Lucent)

Northern Telecom (Nortel)

NYNEX Telephone Companies (NYNEX)

Telecommunications Industry Association User Premises Equipment Division (TIA)

Sprint Local Telephone Companies (Sprint)

VeriFone (VeriFone) (Late filed)

Reply Comments

TIA

APPENDIX B

FINAL REGULATORY FLEXIBILITY ANALYSIS

1. As required by the Regulatory Flexibility Act ("RFA"),³² an Initial Regulatory Flexibility Analysis ("IRFA") was incorporated in the Notice of Proposed Rulemaking in this proceeding, 11 FCC Rcd 13282 (1996); Erratum, (released March 29, 1996) ("Notice"). The Commission sought written public comments on the proposals in the Notice, including comment on the IRFA. This present Final Regulatory Flexibility Analysis ("FRFA") in this Report and Order ("Order") conforms to the RFA.

Need for, and Objectives of, this Order and the Rules Adopted Herein:

2. Consistent with the intent of the North American Free Trade Agreement ("NAFTA"), this Order amends Part 68 of the Commission's rules to promote barrier-free trade between the United States and Canada. Part 68 governs the terms and conditions under which customer provided terminal equipment may be connected to the telephone network. As a result of the amendments to Part 68, manufacturers will be able to test terminal equipment for compliance with a single, consistent set of technical standards accepted in both the United States and Canada. The harmonization of terminal attachment rules in the United States and Canada will be a model for our harmonization efforts with other countries. We adopt a grandfathering provision to cover equipment already registered under current rules.

Summary of Significant Issues Raised by Public Comments In Response to the IRFA:

3. No comments were submitted specifically in response to the IRFA. We have reviewed the general comments to identify issues that may have a significant economic impact on small businesses. All commenters addressing the proposed amendments to Part 68 of our Rules supported the amendments.

Description and Estimate of the Number of Small Entities To Which Rules Will Apply:

4. The RFA directs the Commission to provide a description of and, where feasible, an estimate of the number of small entities that will be affected by the proposed rules. The RFA defines the term "small entity" as having the same meaning as the terms "small business," "small

³² See 5 U.S.C. § 603. The RFA, see 5 U.S.C. § 601 et seq., has been amended by the Contract With America Advancement Act of 1996, Pub. L. No. 104-121, 110 Stat. 847 (1996) (CWAAA). Title II of the CWAAA is the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA).

organization," and "small business concern" under Section 3 of the Small Business Act.³³ A small business concern is one which: (1) is independently owned and operated; (2) is not dominant in its field of operation; and (3) satisfies any additional criteria established by the SBA.³⁴ SBA has defined a small business for Standard Industrial Classification ("SIC") category 4813 (Telephone Communications, Except Radiotelephone) to be a small entity when it has no more than 1,500 employees.³⁵

5. Consistent with our prior practice, we here exclude small incumbent local exchange carriers (LECs) from the definition of "small entity" and "small business concern." While such a company may have 1500 or fewer employees and thus fall within the SBA's definition of a small telecommunications entity, such companies are either dominant in their field of operations or are not independently owned and operated. Out of an abundance of caution, however, for regulatory flexibility analysis purposes, we will consider small incumbent LECs within this present analysis and use the term "small incumbent LECs" to refer to any incumbent LEC that arguably might be defined by SBA as a small business concern.

6. Manufacturers of Telecommunications Equipment The Commission has not developed a definition of small manufacturers of terminal equipment. The closest applicable definition under SBA rules is for manufacturers of telephone and telegraph apparatus (SIC 3661), which defines a small manufacturer as one having 1000 or fewer employees.³⁶ According to 1992 Census Bureau data, there were 479 such manufacturers, and of those, 436 had 999 or fewer employees, and 7 had between 1000 and 1499 employees.³⁷ Consequently, we estimate that there are fewer than 443 small manufacturers of terminal equipment that may be affected by the decision and rules adopted in this Order.

Description of Projected Reporting, Recordkeeping and Other Compliance Requirements:

7. There are no reporting or recordkeeping requirements. Manufacturers will be required to test terminal equipment to a single, consistent set of technical standards accepted in both the United States and Canada.

Steps Taken to Minimize Significant Economic Impact on Small Entities, and Significant

³³ See 5 U.S.C. § 601(3) (incorporating by reference the definition of "small business concern" in 5 U.S.C. § 632).

³⁴ 15 U.S.C. § 632.

³⁵ See 13 C.F.R. § 121.201.

³⁶ 13 CFR § 121.201, SIC 3661.

³⁷ 1992 Economic Census, Industry and Employment Size of Firm, Table 1D (data prepared by U.S. Census Bureau under contract to the U.S. Small Business Administration).

Alternatives Considered

8. We are adopting Section 68.2(j), which states that equipment already registered under the current rules does not need to be re-registered under the new rules. We believe that such a provision will save manufacturers, some of which may be small businesses, the expenses incurred in re-registering equipment that is already in use and has been shown not to cause harm to the network.³⁸ No alternative to this beneficial action was suggested.

Report to Congress:

9. The Commission will send a copy of the Order, including this FRFA, in a report to be sent to Congress pursuant to the Small Business Regulatory Enforcement Fairness Act of 1996, see 5 U.S.C. § 801(a)(1)(A). A copy of the Order and this FRFA (or summary thereof) will also be published in the Federal Register, see 5 U.S.C. § 604(b), and will be sent to the Chief Counsel for Advocacy of the Small Business Administration.

³⁸ The rule changes ameliorate potential technical barriers to entry in both the U.S. and Canada markets, thereby allowing manufacturers and suppliers, including smaller manufacturers and suppliers, a reasonable opportunity to conduct business in both markets. This result is consistent with the general purposes of Section 257 of the 1996 Telecommunications Act, 47 U.S.C. § 257. That section requires, among other things, that the Commission eliminate market entry barriers for small businesses who may provide parts or services to providers of telecommunications services and information services. Id. at § 257(a). The Commission recently issued a report in GN Docket No. 96-113 regarding its implementation of Section 257. See Section 257 Proceeding to Identify and Eliminate Market Entry Barriers for Small Businesses, Report No. 97-8, 1997 WL 232120 (1997).

Appendix C

Part 68 of Title 47 of the Code of Federal Regulations is amended as follows:

Part 68—CONNECTION OF TERMINAL EQUIPMENT TO THE TELEPHONE NETWORK

1. The authority citation for Part 68 continues to read as follows:

AUTHORITY: Sections 1, 4, 5, 201-5, 208, 215, 218, 226, 227, 303, 313, 314, 403, 404, 410, 522 of the Communications Act of 1934, as amended, 47 U.S.C. §§ 151, 154, 155, 201-5, 208, 215, 218, 226, 227, 303, 313, 314, 403, 404, 410, 522.

2. Section 68.2 is amended by revising paras. (a)(3); (d) introduction text and adding new para. (d)(4) to read as follows:

§ 68.2 Scope.

(a) * * *

(3) *Of all PBX (or similar) systems to private line services for tie trunk type interfaces and off premises station lines. Services may only be added to this section as a result of rulemaking proceedings and equipment connected to such added services is afforded a reasonable transition period.*

* * * * *

(d) *Grandfathered private branch exchange (or similar) systems for connection to private line type services (tie trunk type services, off-premises station lines automatic identified outward dialing, and message registration):*

* * * * *

(d)(4) *PBX (or similar) systems connected with automatic identified outward dialing or message registration private line services of a type that complies with paras. (d)(1) and (d)(2) of this section may remain connected for life without registration unless subsequently modified.*

* * * * *

(j) *Terminal equipment including premises wiring and protective apparatus (if any) directly connected to the network on (effective date 150 days after publication) may remain connected and be reconnected for life without registration, unless subsequently*

Appendix C

modified. New installations of terminal equipment, including premises wiring and protective apparatus (if any) may be installed (including additions to existing systems) up to (18 months after effective date), without registration of any terminal equipment involved, provided that the terminal equipment is of a type directly connected to the network as of (register only date _____). This terminal equipment may remain connected and be reconnected to the network for life without registration, unless subsequently modified.

3. Section 68.3 is amended by adding the following new definitions in alphabetical order to read as follows:

§ 68.3 Definitions.

Capture Level: Equipment with AGC (Automatic Gain Control) signal power limiting has virtually no output signal for input levels below a certain value. At some input signal power, the output level will become significant (usually corresponding to the expected output level) for the service application. The input level at which this occurs is defined as the "capture level."

DTMF: Dual Tone Multi Frequency (DTMF) network control signalling is a method of signalling using the voice transmission path. The method employs sixteen (16) distinct signals each composed of two (2) voiceband frequencies, one from each of two (2) geometrically spaced groups designated "low group" and "high group." The selected spacing assures that no two frequencies of any group combination are harmonically related.

Overload Point:

(1) For signal power limiting circuits incorporating automatic gain control method, the "overload point" is the value of the input signal that is 15 dB greater than the capture level.

(2) For signal power limiting circuits incorporating peak limiting method, the "overload point" is defined as the input level at which the equipment's through gain decreases by 0.4 dB from its nominal constant gain.

Appendix C

Voiceband: The voiceband for analog interfaces is the frequency band from 200 Hz to 3995 Hz.

Zero Level Decoder: The zero level decoder shall comply with the u=255 PCM encoding law as specified in ITU-TSS (CCITT) Rec. G.711 for voiceband encoding and decoding. See also Fig. 68.3(j).

by removing the definitions for:

AIOD data channel simulator,

AIOD leads,

Message register leads,

Message register signaling channel simulator,

Tie trunk transmission interfaces.

(c) 4-wire conventional terminating set (CTS),

and Figures 68.3(a), 68.3(f), 68.3(g), 68.3(h), 68.3(i), 68.3(j), 68.3(k), 68.3(l) and 68.3(m),

by adding Figures 68.3(a), 68.3(f), 68.3(g), 68.3(h), 68.3(i), 68.3(j), 68.3(k).

by correcting figure references in the following definitions as follows:

Local Area Data Channel Simulator: Reference to Figure 68.3(k) is corrected to Figure 68.3(i);

Loop Simulator Circuit: The reference to Figure 68.3(i) is corrected to Figure 68.3(g); and the reference to Figure 68.3(j) is corrected to Figure 68.3(h)

Section 68.222 is removed.

Appendix C

Section 68.300 is revised to read as follows:

§ 68.300 Labeling requirements.

(a) Registered terminal equipment and registered protective circuitry shall have prominently displayed on an outside surface the following information in the following format:

Complies With Part 68, FCC Rules

FCC Registration Number: _____

Ringer Equivalence: _____

(b) Registered terminal equipment and registered protective circuitry shall also have the following identifying information permanently affixed to it.

- (1) Grantee's name.
- (2) Model number, as specified in the registration application.
- (3) Serial number or date of manufacture.
- (4) Country of origin of the equipment: "Made in _____." Required if the equipment is not manufactured in the United States. (Country of origin shall be determined in accordance with 19 U.S.C. 1304 and regulations promulgated thereunder.)
- (5) As used herein, "permanently affixed" means that the required nameplate data is etched, engraved, stamped, indelibly printed or otherwise permanently marked. Alternatively, the required information may be permanently marked on a nameplate of metal, plastic, or other material fastened to the enclosure by welding, riveting, or with a permanent adhesive. Such a nameplate must be able to last for the expected lifetime of the equipment and must not be readily detachable.
- (6) When the device is so small or for such use that it is not practical to place the statements specified in this section on it, the information required by paras. (a) and

Appendix C

(b) of this section shall be placed in a prominent location in the instruction manual or pamphlet supplied to the user. The FCC Registration Number and the Model Number shall be displayed on the device.

5. Section 68.302 is revised to read as follows:

§ 68.302 Environmental simulation.

Unpackaged Registered Terminal Equipment and Registered Protective Circuitry shall comply with all the rules specified in this subpart, both prior to and after the application of the mechanical and electrical stresses specified in this section, notwithstanding that certain of these stresses may result in partial or total destruction of the equipment. Both telephone line surges, Type A and Type B, shall be applied as specified in paras.(b) and (c). Different failure criteria apply for each surge type.

(a) Mechanical Shock.

(1) Hand-Held Items Normally Used at Head Height: 18 random drops from a height of 1.5 meters onto concrete covered with 3 millimeters asphalt tile or similar surface.

(2) Table (Desk) Top Equipment 0-5 kilograms: Six random drops from a height of 750 millimeters onto concrete covered with 3 millimeters asphalt tile or similar surface.

(3) The drop tests specified in the mechanical shock conditioning stresses shall be performed as follows: The unit should be positioned prior to release to ensure as nearly as possible that for every six drops there is one impact on each of the major surfaces and that the surface to be struck is approximately parallel to the impact surface.

(b) Telephone Line Surge - Type A.

(1) Metallic. Apply two metallic voltage surges (one of each polarity) between any pair of connections on which lightning surges may occur, this includes:

(i) tip to ring;

(ii) tip 1 to ring 1; and

Appendix C

(iii) for a 4-wire connection that uses simplexed pairs for signalling, tip to ring 1 and ring to tip 1.

The surge shall have an open circuit voltage waveform in accordance with Figure 68.302(b) having a front time (t_r) of 10 μ s maximum and a decay time (t_d) of 560 μ s minimum, and shall have a short circuit current waveshape in accordance with Figure 68.302(c) having a front time (t_r) of 10 μ s maximum and a decay time (t_d) of 560 μ s minimum. The peak voltage shall be at least 800 volts and the peak short circuit current shall be at least 100 amperes. Surges are applied:

(A) With the equipment in all states that can affect compliance with the requirements of part 68. If an equipment state cannot be achieved by normal means of power, it may be achieved artificially;

(B) With equipment leads not being surged (including telephone connections, auxiliary leads, and terminals for connection to non-registered equipment) terminated in a manner that occurs in normal use;

(C) Under reasonably foreseeable disconnection of primary power sources, with primary power cords plugged and unplugged, if so configured.

(2) Longitudinal. Apply two longitudinal voltage surges (one of each polarity) from any pair of connections on which lightning surges may occur. This includes the tip-ring pair and the tip 1 - ring 1 pair, to earth grounding connections, and to all leads intended for connection to non-registered equipment, connected together.

The surge shall have an open circuit voltage waveform in accordance with Figure 68.302(b) with a front time (t_r) of 10 μ s (μ seconds) maximum and a decay time (t_d) of 160 μ s minimum, and shall have a short circuit current waveshape in accordance with Figure 68.302(c) having a front time (t_r) of 10 μ s maximum and a decay time (t_d) of 160 μ s minimum. The peak voltage shall be at least 1500 volts and the peak short circuit current shall be at least 200 amperes. Surges are applied:

(i) With the equipment in all states that can affect compliance with the requirements of Part 68. If an equipment state cannot be achieved by normal means of power, it may be achieved artificially;

(ii) With equipment leads not being surged (including telephone connections, auxiliary leads, and terminals for connection to non-registered equipment) terminated in

Appendix C

a manner that occurs in normal use;

(iii) Under reasonably foreseeable disconnection of primary power sources, as for example, with primary power cords plugged and unplugged.

(3) Failure Modes resulting from application of Type A telephone line surges. Regardless of operating state, equipment and circuitry are allowed to be in violation of the longitudinal balance requirements of § 68.310(b) and (c) and, for terminal equipment connected to Local Area Data Channels, the longitudinal signal power requirements of § 68.308(f)(3), if:

(i) Such failure results from an intentional, designed failure mode that has the effect of connecting telephone or auxiliary connections with earth ground; and,

(ii) If such a failure mode state is reached, the equipment is designed so that it would become substantially and noticeably unusable by the user, or an indication is given (e.g., an alarm), in order that such equipment can be immediately disconnected or repaired.

NOTE: The objective of subsection (ii) is to allow for safety circuitry to either open-circuit, which would cause a permanent on-hook condition, or to short-circuit to ground, as a result of an energetic lightning surge. Off-hook tests would be unwarranted if the off-hook state cannot be achieved. A short to ground has the potential for causing interference resulting from longitudinal imbalance, and therefore designs must be adopted which will cause the equipment either to be disconnected or repaired rapidly after such a state is reached, should it occur in service.

(c) Telephone Line Surge - Type B.

(1) **Metallic.** Apply two metallic voltage surges (one of each polarity) to equipment between any pair of connections on which lightning surges may occur; this includes:

(i) tip to ring;

(ii) tip 1 to ring 1; and

(iii) for a 4-wire connection that uses simplexed pairs for signalling, tip to ring 1 and ring to tip 1.

The surge shall have an open circuit voltage waveform in accordance with Figure 68.302(b) having a front time (t_f) of 9 μs ($\pm 30\%$) and a decay time (t_d) of 720 μs ($\pm 20\%$) and shall have a short circuit current waveshape in accordance with Figure 68.302(c) having a front time (t_f) of 5 μs ($\pm 30\%$) and a decay time (t_d) of 320 μs (\pm

Appendix C

20%). The peak voltage shall be at least 1000 volts and the peak short circuit current shall be at least 25 amperes. The wave shapes are based on the use of ideal components in Figure 68.302(a) with S_2 in Position M. Surges are applied:

(A) With the equipment in all states that can affect compliance with the requirements of part 68. If an equipment state cannot be achieved by normal means of power, it may be achieved artificially.

(B) With equipment leads not being surged (including telephone connections, auxiliary leads, and terminals for connection to non-registered equipment) terminated in a manner that occurs in normal use.

(C) Under reasonably foreseeable disconnection of primary power sources, as for example, with primary power cords plugged and unplugged.

(2) *Longitudinal.* Apply two longitudinal voltage surges (one of each polarity) from any pair of connections on which lightning surges may occur. This includes the tip-ring pair and the tip 1 - ring 1 pair to earth grounding connections and to all leads intended for connection to non-registered equipment, connected together.

For each output lead of the surge generator, with the other lead open, the surge shall have an open circuit voltage waveform in accordance with Figure 68.302(b) having a front time (t_f) of 9 μs ($\pm 30\%$) and a decay time (t_d) of 720 μs ($\pm 20\%$) and shall have a short circuit current waveshape in accordance with Figure 68.302(c) having a front time (t_f) of 5 μs ($\pm 30\%$) and a decay time (t_d) of 320 μs ($\pm 20\%$). The peak voltage shall be at least 1500 volts and the peak short circuit current shall be at least 37.5 amperes. The wave shapes are based on the use of ideal components in Figure 68.302(a) with S_2 in Position L. Surges are applied:

(i) With the equipment in all states that can affect compliance with the requirements of part 68. If an equipment state cannot be achieved by normal means of power, it may be achieved artificially.

(ii) With equipment leads not being surged (including telephone connections, auxiliary leads, and terminals for connection to non-registered equipment) terminated in a manner that occurs in normal use.

(iii) Under reasonably foreseeable disconnection of primary power sources, with primary power cords plugged and unplugged, if so configured.

Appendix C

(3) Failure Modes resulting from application of Type B telephone line surges . Registered terminal equipment and registered protective circuitry shall be capable of withstanding the energy of Surge Type B without causing permanent opening or shorting of the interface circuit and without sustaining damage that will affect compliance with these rules.

Appendix C

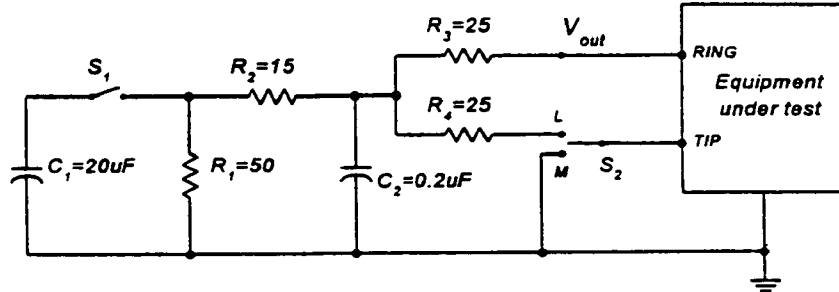


Fig. 68.302 (Xa) - Simplified Surge Generator

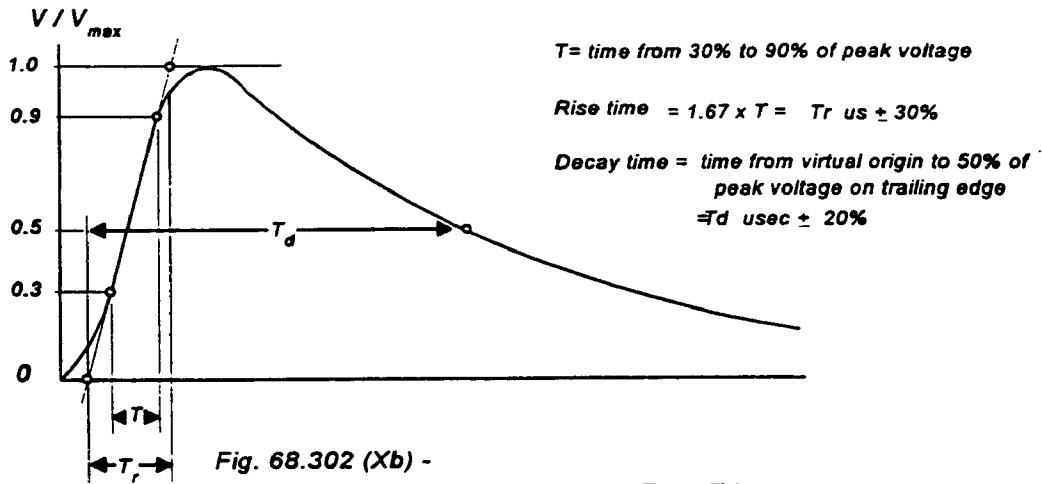


Fig. 68.302 (Xb) -
Open Circuit Voltage Waveshape, $T_r \times T_d$

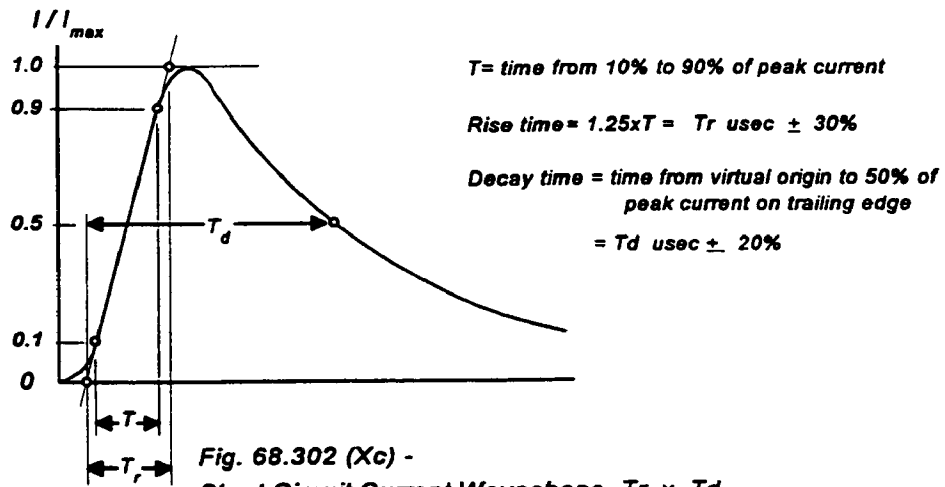


Fig. 68.302 (Xc) -
Short Circuit Current Waveshape, $T_r \times T_d$

Appendix C

(d) *Power Line Surge.*

(1) Apply six power line surges (three of each polarity) between the phase and neutral terminals of the ac power line while the equipment is being powered. The surge shall have an open circuit voltage waveform in accordance with Figure 68.302(b) having a front time (t_f) of 2 μ s maximum and a decay time (t_d) of 10 μ s minimum and shall have a short circuit current waveshape in accordance with Figure 68.302(c) with a front time (t_f) of 2 μ s maximum and a decay time (t_d) of 10 μ s minimum. The peak voltage shall be at least 2500 volts and the peak short circuit current shall be at least 1000 amperes. Surges are applied:

(i) With the equipment in all states that can affect compliance with the requirements of part 68. If an equipment state cannot be achieved by normal means of power, it may be achieved artificially;

(ii) With equipment leads not being surged (including telephone connections, auxiliary leads, and terminals for connection to non-registered/non-certified equipment) terminated in a manner which occurs in normal use.

(2) Failure Modes resulting from application of power line surge. Registered terminal equipment and registered protective circuitry shall comply with all the criteria contained in the rules and regulations in this subpart, both prior to and after the application of the power line surge specified in paragraph (d) of this section, notwithstanding that this surge may result in partial or total destruction of the equipment under test.

6. Section 68.304 is revised to read as follows:

§ 68.304 Leakage current limitations.

Registered terminal equipment and registered protective circuitry shall have a voltage applied to the combination of points listed in the table below. The test voltage shall be ac of 50 or 60 Hz rms.

(a) *All telephone connections;*

(b) *All power connections;*

(c) *All possible combinations of exposed conductive surfaces on the exterior of such equipment or circuitry including grounding connection points, but excluding*

Appendix C

terminals for connection to other terminal equipment;

(d) All terminals for connection to registered protective circuitry or non-registered equipment;

(e) All auxiliary lead terminals;

(f) All E&M lead terminals, and

(g) All PR, PC, CY1 and CY2 leads.

Gradually increase the voltage from zero to the values listed in the table below over a 30-second time period, then maintain the voltage for one minute. The current in the mesh formed by the voltage source and these points shall not exceed 10 mA peak at any time during this 90-second interval.

Equipment states necessary for compliance with the requirements of this section that cannot be achieved by normal means of power shall be achieved artificially by appropriate means.

Appendix C

Table 68.304(a)

**Voltage Applied for Various Combinations
Of Electrical Connections**

<u>Voltage source connected between:</u>	<u>ac Value*</u>
(a) and (b) (see NOTES 1, 2, 3)	1500
(a) and (c) (see NOTES 1, 2)	1000
(a) and (d) (see NOTES 1, 2)	1000
(a) and (e) (see NOTES 1, 2)	1000
(a) and (f) (see NOTES 1, 2)	1000
(a) and (g) (see NOTES 1,2)	1000
(b) and (c) (see NOTE 3)	1500
(b) and (d) (see NOTE 3)	1500
(b) and (e) (see NOTE 3)	1500
(b) and (f) (see NOTE 3)	1500
(b) and (g) (see NOTE 3)	1500
(c) and (e) (see NOTES 1, 2)	1000
(c) and (f) (see NOTES 1, 2)	1000
(d) and (e) (see NOTE 2)	1000
(d) and (f) (see NOTE 2)	1000
(e) and (f) (see NOTE 2)	1000

*Value to which test voltage is gradually increased.

NOTES:

- (1) A telephone connection, auxiliary lead, or E&M lead that has an intentional dc conducting path to earth ground at operational voltages (such as a ground start lead), may be excluded from the leakage current test in that operational state. Leads or connections excluded for this reason shall comply with the requirements of § 68.306(e)(1).

A telephone connection, auxiliary lead, or E&M lead that has an intentional dc conducting path to earth ground for protection purposes at the leakage current test voltage (such as through a surge suppressor), may have the component

Appendix C

providing the conducting path removed from the equipment for the leakage current test in that operational state. Components removed for this reason shall comply with the requirements of § 68.306(e)(2).

Filter paths, such as capacitors used in EMI filters, are left in place during leakage current testing, since these components can be a path for excessive leakage.

- (2) For multi-unit equipment interconnected by cables, that is evaluated and registered as an interconnected combination or assembly, the specified 10 mA peak maximum leakage current limitation other than between power connection points and other points, may be increased as described here to accommodate cable capacitance. The leakage current limitation may be increased to $(10N+0.13L)$ mA peak where L is the length of interconnecting cable in the leakage path in meters and N is the number of equipment units that the combination or assembly will place in parallel across a telephone connection.
- (3) RF filters and surge protectors on the line side of power supplies may be disconnected before making § 68.304 leakage measurements. As an alternative to disconnecting these filters and surge protectors, this measurement may be made using a dc voltage equal to the peak ac test voltage.

7. Section 68.306 is revised to read as follows:

§ 68.306 Hazardous voltage limitations.

(a) General. Under no condition of failure of registered terminal equipment or registered protective circuitry that can be conceived to occur in the handling, operation or repair of such equipment or circuitry, shall the open circuit voltage on telephone connections exceed 70 volts peak after one second, except for voltages for network control signalling, alerting and supervision.

(1) Type I E&M Leads. Registered terminal equipment shall comply with the following requirements for terminal equipment on the "A" or "B" side of the interface as shown in Figures 68.3(e)(I) & (ii):

(i) The dc current on the E lead shall not exceed 100 mA.

(ii) The maximum dc potentials to ground shall not exceed the following when measured across a resistor of 20 kohms \pm 10 %:

Appendix C

Table 68.306(a)

**Type I E&M
DC Potentials**

	E Lead	M Lead
TE on "B" side originates signals to network on E lead	$\pm 5 \text{ V}$	$\pm 5 \text{ V}$
TE on "A" side originates signals to network on M lead	-56.5V; no positive potential with respect to ground	-56.5V; no positive potential with respect to ground

(iii) The maximum ac potential between E&M leads and ground reference shall not exceed 5V peak.

(iv) M lead protection shall be provided to that voltages to ground do not exceed 60 volts. For relay contact implementation, a power dissipation capability of 0.5 watt shall be provided in the shunt path.

(v) If the registered terminal equipment contains an inductive component in the E lead, it must assure that the transient voltage across the contact as a result of a relay contact opening does not exceed the following voltage and duration limitations:

- (A) 300 volts peak,
- (B) A rate of change of one volt per microsecond, and
- (C) A 60-volt level after 20 milliseconds.

(2) Type II E&M Leads. Registered terminal equipment shall comply with the following requirements:

- (i) For terminal equipment on the "A" side of the interface, the dc current in the

Appendix C

E lead shall not exceed 100 mA. The maximum ac potential between the E lead and ground shall not exceed 5 V peak.

(ii) For terminal equipment on the "B" side of the interface, the dc current in the SB lead shall not exceed 100 mA. The maximum ac potential between the SB lead and ground shall not exceed 5 V peak.

(iii) The maximum dc potentials to ground shall not exceed the following when measured across a resistor of 20 kohms \pm 10 %:

Table 68.306(b)

**Type II E&M
DC Potentials**

	E lead	M lead	SB lead	SG lead
TE on "B" side of the interface originates signals to network on E lead	± 5 V	± 5 V	-56.5V; no positive potential with respect to ground	± 5 V
TE on "A" side of the interface originates signals to network on M lead	-56.5V; no positive potential with respect to ground	± 5 V	± 5 V	± 5 V

(iv) The maximum ac potential to ground shall not exceed 5V peak on the following leads, from sources in the terminal equipment:

(A) M, SG and SB leads for terminal equipment on the "A" side of the interface.

Appendix C

(B) E, SG and M leads for terminal equipment on the "B" side of the interface.

(v) If the registered terminal equipment contains an inductive component in the (E) or (M) lead, it must assure that the transient voltage across the contact as a result of a relay contact opening does not exceed the following voltage and duration limitations:

(A) 300 volts peak,

(B) A rate of change of one volt per microsecond, and

(C) A 60-volt level after 20 milliseconds.

(3) *Off premises station voltages.*

(A) Talking battery or voltages applied by the PBX (or similar systems) to all classes of OPS interface leads for supervisory purposes must be negative with respect to ground, shall not be more than -56.5 volts dc with respect to ground, and shall not have a significant ac component.*

*The ac component should not exceed 5 volts peak, when not otherwise controlled by § 68.308.

(ii) Ringing signals applied by the PBX (or similar systems) to all classes of OPS interface leads shall comply with requirements in paragraph (d) of this section. Ringing voltages shall be applied between the ring conductor and ground.

(4) Direct Inward Dialing (DID).

Voltages applied by the PBX (or similar systems) to DID interface leads for supervisory purposes must be negative with respect to ground, shall not be more than -56.5 volts dc with respect to ground, and shall not have a significant ac component.*

*The ac component shall not exceed 5 volts peak, where not otherwise controlled by § 68.308.

(5) Local Area Data Channel Interfaces. For Local Area Data Channel interfaces, during normal operating modes including terminal equipment initiated maintenance signals, registered terminal equipment shall ensure, except during the application of ringing (limitations specified in paragraph (d) of this section), with respect to telephone connections (tip, ring, tip 1, ring 1) that:

(i) Under normal operating conditions, the rms current per conductor between short-circuit conductors, including dc and ac components, does not exceed 350 milliamperes. For other than normal operating conditions, the rms current between any conductor and ground or between short-circuited conductors, including dc and ac components, may exceed 350 milliamperes for no more than 1.5 minutes;

(ii) The dc voltage between any conductor and ground does not exceed 60 volts. Under normal operating conditions it shall not be positive with respect to ground (though positive voltages up to 60 volts may be allowed during brief maintenance states);

(iii) Ac voltages are less than 42.4 volts peak between any conductor and ground, (terminal equipment shall comply while other interface leads are both
(A) unterminated, and

(B) individually terminated to ground); and,

(iv) Combined ac and dc voltages between any conductor and ground are less than 42.4 volt peak when the absolute value of the dc component is less than 21.2 volts, and less than $(32.8 + 0.454 \times V_{dc})$ when the absolute value of the dc component is between 21.2 and 60 volts.

(6) *Ringdown Voiceband Private Line and Voiceband Metallic Channel Interface*. During normal operation, registered terminal equipment for connection to ringdown voiceband private line interfaces or voiceband metallic channel interfaces shall ensure that:

(i) Ringing voltage does not exceed the voltage and current limits specified in paragraph (d), and is:

(A) applied to the ring conductor with the tip conductor grounded for 2-wire interfaces, or

(B) simplex on the tip and ring conductors with ground simplex on the tip 1 and ring 1 conductors for 4-wire interfaces.

(ii) Except during the signaling mode or for monitoring voltage, there is no significant positive dc voltage (not over +5 volts) with respect to ground:

(A) for 2-wire ports between the tip lead and ground and the ring lead and ground and

(B) for 4-wire ports between the tip lead and ground, the ring lead and ground, the tip 1 lead and ground, and the ring 1 lead and ground.

Appendix C

(iii) The dc current per lead, under short circuit conditions shall not exceed 140 milliamperes.

(b) Connection of non-registered equipment to registered terminal equipment or registered protective circuitry. General. Leads to, or any elements having a conducting path to telephone connections, auxiliary leads or E&M leads shall:

(i) Be reasonably physically separated and restrained from and be neither routed in the same cable as nor use the same connector as leads or metallic paths connecting power connections;

(ii) Be reasonably physically separated and restrained from and be neither routed in the same cable as nor use adjacent pins on the same connector as metallic paths to lead to nonregistered equipment, when specification details provided to the Commission, pursuant to, § 68.200(g), do not show that interface voltages are less than non-hazardous voltage source limits in para. 68.306(c) of this section.

(c) *Non-Hazardous Voltage Source.* A voltage source is considered a non-hazardous voltage source if it conforms with the requirements of § 68.302, § 68.304 and para. (b) of this section, with all connections to the source other than primary power connections treated as "telephone connections," and if such source supplies voltages no greater than the following under all modes of operation and of failure:

(1) AC voltages less than 42.4 volts peak;

(2) DC voltages less than 60 volts; and

(3) Combined ac and dc voltages less than 42.4 volts peak when the absolute value of the dc component is less than 21.2 volts and less than $(32.8 + 0.454 \times V_{dc})$ when the absolute value of the dc component is between 21.2 and 60 volts.

(d) Ringing Sources. Except for class A OPS interfaces, ringing sources shall meet all of the following restrictions:

(1) Ringing Signal Frequency. The ringing signal shall use only frequencies whose fundamental component is equal to or below 70 Hz.

(2) Ringing Signal Voltage. The ringing voltage shall be less than 300 V peak-to-peak and less than 200 V peak-to-ground across a resistive termination of at least 1 megohm.

Appendix C

(3) Ringing Signal Interruption Rate. The ringing voltage shall be interrupted to create quiet intervals of at least one second (continuous) duration each separated by no more than 5 seconds. During the quiet intervals, the voltage to ground shall not exceed the voltage limits given in para. (a)(3)(i) of this section.

(4) Ringing Signal Sources. Ringing voltage sources shall comply with the following requirements:

(i) If the ringing current through a 500 ohm(s) (and greater) resistor does not exceed 100 mA peak-to-peak, neither a ring trip device nor a monitoring voltage are required.

(ii) If the ringing current through a 1500 ohm (and greater) resistor exceeds 100 mA peak-to-peak, the ringing source shall include a current-sensitive ring trip device in series with the ring lead that will trip ringing as specified in Figure 68.306(a) in accordance with the following conditions:

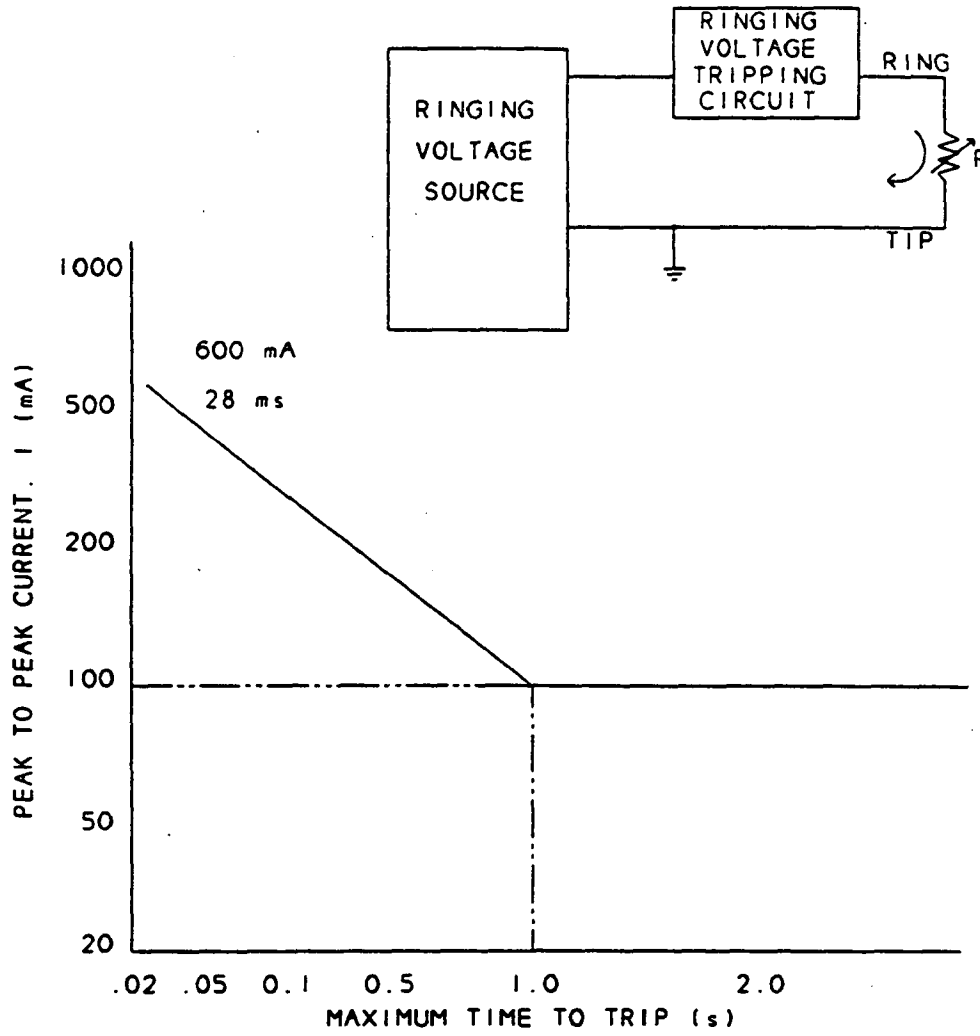
(A) If the ring trip device operates as specified in Figure 68.306(a) with $R = 500$ ohm (and greater) no monitoring voltage is required;

(B) If, however, the ring trip device only operates as specified in Figure 68.306(a) with $R = 1500$ ohm (and greater) then the ringing voltage source shall also provide a monitoring voltage between 19 V dc and 56.5 V dc, negative with respect to ground, on the tip or ring conductor.

(iii) If the ringing current through a 500-ohm (and greater) resistor exceeds 100 mA (peak-to-peak) but does not exceed 100 mA peak-to-peak with 1500-ohm (and greater) termination, the ringing voltage source shall include either a ring trip device that meets the operating characteristics specified in Figure 68.306(a) with 500-ohm (and greater) resistor, or a monitoring voltage as specified in (d)(4)(ii)(B) above.

NOTE: If the operating characteristics specified in Figure 68.306(a) are not met with both the 500-ohm and 1500-ohm terminations, then the terminal equipment under test fails (See Table 68.306(c)).

Appendix C



Appendix C

Table 68.306(C)

Summary of Ring Trip Requirements

Section 68.306 (d) (4).	Ringing Current (mA p.p)		Function Required		Ring Trip Device operates per Figure 68.306(a)
	R=500 ohms & Greater	R=1500 ohms & Greater	Ring Trip	Monitor Voltage	
(I)	< 100	< 100	Optional	Optional	Optional
(ii) (A)	N/A	> 100	Yes	Optional	Yes for both resistances
(ii) (B)	N/A	> 100	Yes	Yes	Yes for R=1500 ohms & greater No for R=500 ohms & greater
(iii)	> 100	< 100	Either Ring-Trip Device or Monitor Voltage required		Yes for R = 500 ohms & greater, if Ring Trip Device is used

(e) Intentional paths to ground (as required by § 68.304).

(1) Connections with operational paths to ground. Registered terminal equipment and registered protective circuitry having an intentional dc conducting path to earth ground at operational voltages that was excluded during the leakage current test of § 68.304 shall have a dc current source applied between the following points:

(i) Telephone connections, including tip, ring, tip 1, ring 1, E&M leads and

Appendix C

auxiliary leads, and

- (ii) Earth grounding connections.

For each test point, gradually increase the current from zero to 1 ampere, then maintain the current for one minute. The voltage between (i) and (ii) shall not exceed 0.1 volt at any time.

NOTE: In the event there is a component or circuit in the path to ground, the requirement shall be met between the grounded side of the component or circuit and the earth grounding connection.

(2) *Connections with protection paths to ground.* Registered terminal equipment and protective circuitry having an intentional dc conducting path to earth ground for protection purposes at the leakage current test voltage that was removed during the leakage current test of § 68.304 shall, upon its replacement, have a 50 or 60 Hz voltage source applied between the following points:

NOTE: The path to ground is reestablished when the leads are replaced.

- (i) Simplex telephone connections, including tip and ring, tip 1 and ring 1, E&M leads and auxiliary leads, and
- (ii) Earth grounding connections.

Gradually increase the voltage from zero to 120 volts rms for registered terminal equipment, or 300 volts rms for protective circuitry, then maintain the voltage for one minute. The current between (i) and (ii) shall not exceed 10 mA peak at any time.

As an alternative to carrying out this test on the complete equipment or device, the test may be carried out separately on components, subassemblies, and simulated circuits, outside the unit, provided that the test results would be representative of the results of testing the complete unit.

8. Section 68.308 is revised to read as follows:

§ 68.308 Signal power limitations.

- (a) *General.* Limits on signal power shall be met at the interface for all 2-wire

Appendix C

network ports and, where applicable to offered services, both transmit and receive pairs of all 4-wire network ports. Signal power measurements shall be made using terminations as specified in each of the following limitations. The transmit and receive pairs for 4-wire network ports shall be measured with the pair not under test connected to a termination equivalent to that specified for the pair under test. Through gain limitations apply only in the direction of transmission toward the network.

(b) *Voiceband metallic signal power.*

(1) Limitations at the interface on internal signal sources not intended for network control signaling:

(i) The power of all signal energy, in the 200 - 3995 Hz voiceband, delivered by registered terminal equipment or registered protective circuitry to the appropriate loop simulator – other than non-permissive data equipment or data protective circuitry shall not exceed -9 dBm when averaged over any 3 second interval.

(ii) For 2-wire and 4-wire lossless tie trunk type interfaces, the maximum power of other than live voice signals delivered to a 600-ohm termination shall not exceed -15 dBm when averaged over any three second interval.

(iii) For OPS lines, the maximum power of other than live voice delivered to an OPS line simulator circuit shall not exceed -9 dB with respect to one milliwatt, when averaged over any 3-second interval.

(iv) For registered test equipment or registered test circuitry the maximum signal power delivered to a loop simulator circuit shall not exceed 0 dBm when averaged over any 3-second interval.

(v) For voiceband private lines using ringdown or inband signaling the maximum power of other than live voice signals delivered to a 600 ohm termination shall not exceed -13 dBm when averaged over any 3-second interval.

(vi) For voiceband private lines using inband signaling in the band 2600 ± 150 Hz, the maximum power delivered to a 600 ohm termination shall not exceed -8 dBm during the signaling mode. The maximum power delivered to a 600 ohm termination in the on-hook steady state supervisory condition shall not exceed -20 dBm. The maximum power of other than live voice signals delivered to a 600 ohm termination during the non-signaling mode and for other inband systems shall not exceed -13 dBm when averaged over any 3-second interval.

Appendix C

(2) Limitations on internal signal sources primarily intended for network control signaling, contained in voice and data equipment.

(i) For all operating conditions of registered terminal equipment and registered protective circuitry, the maximum power in the frequency band below 3995 Hz delivered to a loop simulator circuit shall not exceed the following when averaged over any 3-second interval:

(A) 0 dBm when used for network control (DTMF);

(B) 0 dBm when DTMF is used for manual entry end-to-end signaling. When the device is used for this purpose it shall not generate more than 40 DTMF digits per manual key stroke.

(C) -9 dBm in all other cases.

(ii) For tie trunk applications, the maximum power delivered to a 600 ohm termination for registered terminal equipment and registered protective circuitry under all operating conditions shall not exceed -4 dBm over any 3 second interval.

(3) Registered one port and multipoint terminal equipment and protective circuitry with provision for through transmission from other terminal equipment, excluding data equipment and data protective circuitry that are registered in accordance with § 68.308(b)(4).

(i) Where through-transmission equipment provides a dc electrical signal to equipment connected therewith (e.g., for powering of electro-acoustic transducers), dc conditions shall be provided which fall within the range of conditions provided by a loop simulator circuit unless the combination of the through-transmission equipment and equipment connected therewith is registered as a combination which conforms to paras. (b)(1) and (2) of this section.

(ii) Through-transmission equipment to which remotely connected data terminal equipment may be connected shall not be equipped with or connected to either a Universal or Programmed Data Jack used in data configurations. (See paras. (b)(4) and (e) of this section).

(4) Registered data circuit terminal equipment shall be capable of operation in at least one of the states discussed in (i), (ii) or (iii). The output power level of the data circuit terminal equipment shall not be alterable, by the customer, to levels which

Appendix C

exceed the signal power limits specified herein.

(i) Data circuit terminal equipment intended to operate with a programming resistor for signal level control shall not exceed the programmed levels given in Table 68.308(a).

(ii) Data circuit terminal equipment intended to operate in the fixed loss loop (FLL) state shall not transmit signal power that exceeds -4 dBm, in the 200 - 3995 Hz voiceband, when averaged over any and all 3 second intervals.

(iii) Data circuit terminal equipment shall not transmit signals from 200 to 3995 Hz that exceed -9 dBm, when averaged over any and all 3 second intervals.

Appendix C

Table 68.308(a)

<i>Programming Resistor (R_p)* (ohms)</i>	<i>Programmed Data Equipment Signal Power Output</i>
short	0 dBm
150	-1 dBm
336	-2 dBm
569	-3 dBm
866	-4 dBm
1240	-5 dBm
1780	-6 dBm
2520	-7 dBm
3610	-8 dBm
5490	-9 dBm

*Tolerance) 1%

(5) Registered one-port and multiport terminal equipment and protective circuitry with provision for through-transmission from ports to other equipment which is separately registered for the public switched network, or ports to other network interfaces.

(i) Registered terminal equipment and registered protective circuitry shall have no adjustments that will allow net amplification to occur in either direction of transmission in the through-transmission path within the 200 - 3995 Hz voiceband that will exceed the following:

Appendix C

Table 68.308(b) Allowable Net Amplification Between Ports (A)(C)(D)(E)

TO	FROM (E)	Tie Trunk Type Ports			Integrated Services Trunk	OPS Ports (2-Wire) (B)	Public Switched Network Ports (2-Wire)	HCC Digital PBX-CO 4-Wire
		2/4-Wire	Substrate 1.544 Mbps Satellite 4W	Substrate 1.544 Mbps Tandem 4W				
2/4-Wire Tie		0 dB	3 dB	3 dB	3 dB	6 dB	-	-
Substrate 1.544 Mbps Satellite 4W Tie		0 dB	-	3 dB	3 dB	6 dB	-	-
Substrate 1.544 Mbps Tandem 4W Tie		-3 dB	0 dB	0 dB	0 dB	3 dB	-	-
Integrated Services Trunk		-3 dB	0 dB	0 dB	0 dB	3 dB	-	-
RTE Digital		0 dB	0 dB	0 dB	0 dB	3 dB	3 dB	0 dB
RTE (B) PSTN/OPS		-3 dB	-3 dB	-3 dB	-3 dB	0 dB	0 dB	-3 dB
OPS (B) (2-Wire)		-2 dB	1 dB	1 dB	1 dB	4 dB	4 dB	1 dB
Public Switched Network (2-Wire)		-	-	-	-	3 dB	3 dB	-
HCC Digital PBX-CO (4-Wire)		-	-	-	-	3 dB	-	-

Appendix C

(A) The source impedance for all measurements shall be 600 ohms. All ports shall be terminated in appropriate loop or private line channel simulator circuits or 600 ohm terminations.

(B) These ports are for 2-wire on-premises station ports to separately registered terminal equipment.

(C) These through gain limitations are applicable to multiport systems where channels are not derived by time or frequency compression methods. Terminal equipment employing such compression techniques shall assure that equivalent compensation for through gain parameters is demonstrated in the registration application.

(D) Registered terminal equipment and registered protective circuitry may have net amplification exceeding the limitations of this subsection provided that, for each network interface type to be connected, the absolute signal power levels specified in this section are not exceeded.

(E) The indicated gain is in the direction that results when moving from the horizontal entry toward the vertical entry.

(F) Registered terminal equipment or protective circuitry with the capability for through transmission from voiceband private line channels or voiceband metallic channels to other telephone network interfaces shall ensure that the absolute signal power levels specified in this section, for each telephone network interface type to be connected, are not exceeded.

(G) Registered terminal equipment or protective circuitry with the capability for through transmission from voiceband private line channels or voiceband metallic private line channels to other telephone network interfaces shall assure, for each telephone network interface type to be connected, that signals with energy in the 2450 to 2750 Hz band are not through transmitted unless there is at least an equal amount of energy in the 800 to 2450 Hz band within 20 milliseconds of application of signal.

(ii) The insertion loss in through connection paths for any frequency in the 800 to 2450 Hz band shall not exceed the loss at any frequency in the 2450 to 2750 Hz band by more than 1 dB (maximum loss in the 800 to 2450 Hz band minus minimum loss in the 2450 to 2750 Hz band plus 1 dB).

(6) For tie trunk interfaces - Limitation on idle circuit stability parameters. For idle state operating conditions of registered terminal equipment and registered

Appendix C

protective circuitry, the following limitations shall be met:

(i) For the two-wire interface:

$$RL \geq \begin{cases} 9 - 3 \frac{\log(f/200)}{\log(2.5)} \text{ dB} & ; \text{ for } 200 \text{ Hz} \leq f \leq 500 \text{ Hz} \\ 6 \text{ dB} & ; \text{ for } 500 \text{ Hz} \leq f \leq 3200 \text{ Hz} \end{cases}$$

(ii) For the four-wire lossless interface:

$$tl_r \geq \begin{cases} 10 - 4 \frac{\log(f/200)}{\log(2.5)} \text{ dB} & ; \text{ for } 200 \text{ Hz} \leq f \leq 500 \text{ Hz} \\ 6 \text{ dB} & ; \text{ for } 500 \text{ Hz} \leq f \leq 3200 \text{ Hz} \end{cases}$$

$$tl_r > 40 \text{ dB}$$

$$RL_r, RL_s \geq 3 \text{ dB}$$

NOTE: The following definitions apply to return loss requirements:

RL the return loss of 2-wire terminal equipment at the interface with respect to 600 ohms + 2.16 μ F (i.e., $Z_{ref} = 600 \text{ ohms} + 2.16 \mu\text{F}$).

$$RL \triangleq 20 \log_{10} \left| \frac{Z_{PBX} + Z_{ref}}{Z_{PBX} - Z_{ref}} \right|$$

Appendix C

RL_i the terminal equipment input (receive) port return loss with respect to 600 ohms (i.e., $Z_{ref} = 600$ ohms).

$$RL_i \triangleq 20 \log_{10} \left| \frac{Z_{PBX (input)} + Z_{ref}}{Z_{PBX (input)} - Z_{ref}} \right|$$

RL_o the terminal equipment output (transmit) port return loss with respect to 600 ohms (i.e., $Z_{ref} = 600$ ohms).

$$RL_o \triangleq 20 \log_{10} \left| \frac{Z_{PBX (output)} + Z_{ref}}{Z_{PBX (output)} - Z_{ref}} \right|$$

tl the transducer loss between the receive and transmit ports of the 4-wire PBX.

tl_f is the transducer loss in the forward direction from the receive port to the transmit port of the PBX.

$$tl_f \triangleq 20 \log_{10} \left| \frac{I_i}{I_r} \right|$$

where I_i is the current sent into the receive port and I_r is the current received at the transmit port terminated at 600 ohms.

tl_r is the transducer loss in the reverse direction, from the transmit port to the receive port of the PBX.

$$tl_r \triangleq 20 \log_{10} \left| \frac{I_i}{I_r} \right|$$

where I_i is the current sent into the transmit port and I_r is the current received at the receive port terminated at 600 ohms.

NOTE: The source impedance of I_i is 600 ohms

Appendix C

(7) Registered terminal equipment and registered protective circuitry shall provide the following range of dc conditions to off-premises station (OPS) lines.

(i) DC voltages applied to the OPS interface for supervisory purposes and during network control signaling shall meet the limits specified in § 68.306(a)(3)(i).

(ii) DC voltages applied to the OPS interface during the talking state shall meet the following requirements:

(A) The maximum open circuit voltage across the tip (T(OPS)) and ring (R(OPS)) leads for all classes shall not exceed 56.5 volts, and

(B) Except for class A OPS interfaces, the maximum dc current into a short circuit across tip (T(OPS)) and ring (R(OPS)) leads shall not exceed 140 mA.

(8) For connections to 1.544 Mbps digital services, the permissible code words for unequipped Mu-255 encoded subrate channels are limited to those corresponding to signals of either polarity, of magnitude equal to or less than $X48$, where code word, XN is derived by:

$$\begin{aligned} XN &= (255 - N) \text{ base } 2 \\ -XN &= (127 - N) \text{ base } 2 \end{aligned}$$

(c) Signal power in the 3995-4005 Hz frequency band

(1) Power resulting from internal signal sources contained in registered protective circuitry and registered terminal equipment (voice and data), not intended for network control signaling. For all operating conditions of registered terminal equipment and registered protective circuitry that incorporate signal sources other than sources intended for network control signaling, the maximum power delivered by such sources in the 3995-4005 Hz band to an appropriate simulator circuit, shall be 18 dB below maximum permitted power specified in paragraph (b) of this section for the voiceband.

(2) Terminal equipment with provision of through-transmission from other equipment. The loss in any through-transmission path of registered terminal equipment and registered protective circuitry at any frequency in the 600 to 4000 Hz band shall not exceed, by more than 3 dB, the loss at any frequency in the 3995 to 4005 Hz band, when measured into an appropriate simulator circuit from a source that appears as 600 ohms across tip and ring.

Appendix C

(d) *Longitudinal voltage at frequencies below 4 kHz.* The weighted rms voltage* averaged over 100 milliseconds that is resultant of all of the component longitudinal voltages in the 100 Hz to 4 kHz band after weighting according to the transfer function of $f/4000$ where f is the frequency in Hertz, shall not exceed the maximum indicated under the conditions stated in para. (g) of this section.

Frequency range	Maximum Weighted rms Voltage	Impedance
100 Hz to 4 kHz	- 30 dBV	500 ohms

* NOTE: Average magnitudes may be used for signals that have peak-to-rms ratios of 20 dB and less. The rms limitations must be used instead of average values if the peak-to rms ratio of the interfering signal exceeds this value.

(e) *Voltage in the 4 kHz to 6 MHz frequency range-general case - 2-wire and 4-wire lossless interface (except LADC).* Except as noted, rms voltage as averaged over 100 milliseconds at the telephone connections of registered terminal equipment and registered protective circuitry in all of the possible 8 kHz bands within the indicated frequency range and under the conditions specified in para. (g) of this section shall not exceed the maximum indicated below. For paras. (1)(i) and (2)(i) of this section, "f" is the center frequency in kHz of each of the possible 8-kHz bands beginning at 8 kHz.

(1) *Metallic Voltage*

(i) *4 kHz to 270 kHz.*

Center Frequency (f) of 8 kHz Band	Max Voltage in all 8 kHz bands	Metallic Terminating Impedance
8 kHz to 12 kHz	$-(6.4 + 12.6 \log f)$ dBV	300 ohms
12 kHz to 90 kHz	$(23 - 40 \log f)$ dBV	135 ohms
90 kHz to 266 kHz	-55 dBV	135 ohms

(2) *Longitudinal voltage*

(i) *4 kHz to 270 kHz.*

Appendix C

(ii) *270 kHz to 6 MHz.* The rms value of the longitudinal voltage components in the frequency range of 270 kHz to 6 MHz, shall not exceed -30 dBV. This limitation applies with a longitudinal termination having an impedance of 90 ohms.

Center Frequency (f) of 8kHz band	Max Voltage in all 8 kHz bands	Longitudinal Terminating Impedance
8 kHz to 12 kHz	$-(18.4 + 20 \log f)$ dBV	500 ohms
12 kHz to 42 kHz	$(2 - 40 \log f)$ dBV	90 ohms
42 kHz to 266 kHz	-62 dBV	90 ohms

(f) *LADC interface.* The metallic voltage shall comply with the general requirements in (1) below as well as the additional requirements specified in paras. (2) and (3) of this section. The requirements apply under the conditions specified in para. (g) of this section. Terminal equipment for which the magnitude of the source and/or terminating impedance exceeds 300 Ohms, at any frequency in the range of 100 kHz to 6 MHz, at which the signal (transmitted and/or received) has significant power, shall be deemed not to comply with these requirements. A signal is considered to have 'significant power' at a given frequency if that frequency is contained in a designated set of frequency bands that collectively have the property that the rms voltage of the signal components in those bands is at least 90% of the rms voltage of the total signal. The designated set of frequency bands must be used in testing all frequencies.

(1) *Metallic voltages - frequencies below 4 kHz.*

(i) *Weighted rms voltage in the 10 Hz to 4 kHz frequency band.* The weighted rms metallic voltage in the frequency band from 10 Hz to 4 kHz, averaged over 100 milliseconds that is the resultant of all the component metallic voltages in the band after weighting according to the transfer function of $f/4000$ where f is the frequency in Hertz, shall not exceed the maximum indicated below under the conditions stated in section (g).

Frequency range	Maximum voltage
10 Hz to 4 kHz	+3 dBV

Appendix C

(ii) *RMS Voltage in 100 Hz bands in the frequency range 0.7 kHz to 4 kHz.* The rms metallic voltage averaged over 100 milliseconds in the 100-Hz bands having center frequencies between 750 Hz and 3950 Hz shall not exceed the maximum indicated below.

Center frequency (f) of 100-Hz bands	Maximum voltage
750 to 3950 Hz	-6 dBV

(2) *Metallic Voltages - frequencies above 4 kHz - LADC interface.*

(i) *100-Hz bands over frequency range of 4 kHz to 270 kHz.* The rms voltage as averaged over 100 milliseconds in all possible 100-Hz bands between 4 kHz and 270 kHz for the indicated range of center frequencies and under the conditions specified in para. (g) of this section shall not exceed the maximum indicated below:

Center frequency (f) of 100-Hz bands	Maximum voltage in all 100-Hz bands
4.05 kHz to 4.60 kHz	0.5 dBV
4.60 kHz to 5.45 kHz	$(59.2 - 90 \log f)$ dBV
5.45 kHz to 59.12 kHz	$(7.6 - 20 \log f)$ dBV

Where f = center frequency in kHz of each of the possible 100 Hz bands.

(ii) *8-kHz bands over frequency range of 4 kHz to 270 kHz.* The rms voltage as averaged over 100 milliseconds in all of the possible 8-kHz bands between 4 kHz and 270 kHz for the indicated range of center frequencies and under the conditions specified in para. (g) of this section shall not exceed the maximum indicated below:

Center frequency (f) of 8-kHz bands	Maximum voltage in all 8-kHz bands
8 kHz to 120 kHz	$(17.6 - 20 \log f)$ dBV
120 kHz to 266 kHz	$(59.2 - 40 \log f)$ dBV

Appendix C

Where f = center frequency in kHz of each of the possible 8-kHz bands.

(iii) *RMS Voltage at frequencies above 270 kHz.* The rms value of the metallic voltage components in the frequency range of 270 kHz to 6 MHz, averaged over 2 microseconds, shall not exceed -15 dBV. This limitation applies with a metallic termination having an impedance of 135 ohms.

(iv) *Peak Voltage.* The total peak voltage for all frequency components in the 4 kHz to 6 MHz band shall not exceed 4.0 volts.

(3) *Longitudinal voltage.* Frequencies below 4kHz: The weighted rms voltage in the frequency band from 10 Hz to 4kHz, averaged over 100 milliseconds is the resultant of all the component longitudinal voltages in the band after weighing according to the transfer function of $f/4000$, where f is the frequency in Hz, shall not exceed the maximum indicated below under the conditions stated in para. (g) of this section.

(i) *Frequencies below 4kHz.* The weighted rms voltage in the frequency band from 10 Hz to 4kHz, averaged over 100 milliseconds is the resultant of all the component longitudinal voltages in the band after weighing according to the transfer function of $f/4000$, where f is the frequency in Hz, shall not exceed the maximum indicated below under the conditions stated in § 8.308(g).

Frequency range	Maximum RMS voltage
10 Hz - 4 kHz	-37 dBV

(ii) 4 kHz to 270 kHz

Center Frequency (f) of 8-kHz Band	Maximum Voltage in all 8-kHz Bands	Longitudinal Terminating Impedance
8 kHz to 12 kHz	$-(18.4 + 20 \log f)$ dBV	500 Ohms
12 kHz to 42 kHz	$(3 - 40 \log f)$ dBV	90 Ohms
42 kHz to 266 kHz	-62 dBV	90 Ohms

Appendix C

Where f = center frequency in kHz of each of the possible 8-kHz bands.

(iii) *270 kHz to 6 MHz.* The rms value of the longitudinal voltage components in the frequency range of 270 kHz to 6 MHz shall, averaged over 2 microseconds, not exceed -30 dBV. This limitation applies with a longitudinal termination having an impedance of 90 ohms.

(d) *Longitudinal voltage at frequencies below 4 kHz.* The weighted rms voltage* averaged over 100 milliseconds that is resultant of all of the component longitudinal voltages in the 100 Hz to 4 kHz band after weighting according to the transfer function of $f/4000$ where f is the frequency in Hertz, shall not exceed the maximum indicated under the conditions stated in § 68.308(g).

Frequency range	Maximum Weighted rms Voltage	Impedance
100 Hz to 4 kHz	- 30 dBV	500 ohms

* NOTE: Average magnitudes may be used for signals that have peak-to-rms ratios of 20 dB and less. The rms limitations must be used instead of average values if the peak-to rms ratio of the interfering signal exceeds this value.

(e) *Voltage in the 4 kHz to 6 MHz frequency range-general case - 2-wire and 4-wire lossless interface (except LADC).* Except as noted, rms voltage as averaged over 100 milliseconds at the telephone connections of registered terminal equipment and registered protective circuitry in all of the possible 8 kHz bands within the indicated frequency range and under the conditions specified in subsection (g) shall not exceed the maximum indicated below. For (1)(l) and (2)(l) below, "f" is the center frequency in kHz of each of the possible 8-kHz bands beginning at 8 kHz.

Appendix C

(1) *Metallic Voltage. 4 kHz to 270 kHz:*

Center Frequency (f) of 8 kHz Band	Max Voltage in all 8 kHz bands	Metallic Terminating Impedance
8 kHz to 12 kHz	$-(6.4 + 12.6 \log f)$ dBV	300 ohms
12 kHz to 90 kHz	$(23 - 40 \log f)$ dBV	135 ohms
90 kHz to 266 kHz	-55 dBV	135 ohms

(2) *Longitudinal voltage*

(i) *4 kHz to 270 kHz.*

(ii) *270 kHz to 6 MHz.* The rms value of the longitudinal voltage components in the frequency range of 270 kHz to 6 MHz, shall not exceed -30 dBV. This limitation applies with a longitudinal termination having an impedance of 90 ohms.

Center Frequency (f) of 8kHz band	Max Voltage in all 8 kHz bands	Longitudinal Terminating Impedance
8 kHz to 12 kHz	$-(18.4 + 20 \log f)$ dBV	500 ohms
12 kHz to 42 kHz	$(2 - 40 \log f)$ dBV	90 ohms
42 kHz to 266 kHz	-62 dBV	90 ohms

(f) *LADC interface.* The metallic voltage shall comply with the general requirements in (1) below as well as the additional requirements specified in (2) and (3) as stated. The requirements apply under the conditions specified in § 68.308(g). Terminal equipment for which the magnitude of the source and/or terminating impedance exceeds 300 Ohms, at any frequency in the range of 100 kHz to 6 MHz, at which the signal (transmitted and/or received) has significant power, shall be deemed not to comply with these requirements. A signal is considered to have 'significant power' at a given frequency if that frequency is contained in a designated set of

Appendix C

frequency bands that collectively have the property that the rms voltage of the signal components in those bands is at least 90% of the rms voltage of the total signal. The designated set of frequency bands must be used in testing all frequencies.

(1) *Metallic voltages - frequencies below 4 kHz.*

(i) *Weighted rms voltage in the 10 Hz to 4 kHz frequency band.* The weighted rms metallic voltage in the frequency band from 10 Hz to 4 kHz, averaged over 100 milliseconds that is the resultant of all the component metallic voltages in the band after weighting according to the transfer function of $f/4000$ where f is the frequency in Hertz, shall not exceed the maximum indicated below under the conditions stated in section (g).

Frequency range	Maximum voltage
10 Hz to 4 kHz	+3 dBV

(ii) *RMS Voltage in 100 Hz bands in the frequency range 0.7 kHz to 4 kHz.* The rms metallic voltage averaged over 100 milliseconds in the 100-Hz bands having center frequencies between 750 Hz and 3950 Hz shall not exceed the maximum indicated below.

Center frequency (f) of 100-Hz bands	Maximum voltage
750 to 3950 Hz	-6 dBV

(2) *Metallic Voltages - frequencies above 4 kHz - LADC interface.*

(i) *100-Hz bands over frequency range of 4 kHz to 270 kHz.* The rms voltage as averaged over 100 milliseconds in all possible 100-Hz bands between 4 kHz and 270 kHz for the indicated range of center frequencies and under the conditions specified in § 68.308(g) shall not exceed the maximum indicated below:

Appendix C

Center frequency (f) of 100-Hz bands	Maximum voltage in all 100-Hz bands
4.05 kHz to 4.60 kHz	0.5 dBV
4.60 kHz to 5.45 kHz	$(59.2 - 90 \log f)$ dBV
5.45 kHz to 59.12 kHz	$(7.6 - 20 \log f)$ dBV
59.12 kHz to 266.00 kHz	$(43.1 - 40 \log f)$ dBV

Where f = center frequency in kHz of each of the possible 100 Hz bands.

(ii) *8-kHz bands over frequency range of 4 kHz to 270 kHz.* The rms voltage as averaged over 100 milliseconds in all of the possible 8-kHz bands between 4 kHz and 270 kHz for the indicated range of center frequencies and under the conditions specified in § 68.308(g) shall not exceed the maximum indicated below:

Center frequency (f) of 8-kHz bands	Maximum voltage in all 8-kHz bands
8 kHz to 120 kHz	$(17.6 - 20 \log f)$ dBV
120 kHz to 266 kHz	$(59.2 - 40 \log f)$ dBV

Where f = center frequency in kHz of each of the possible 8-kHz bands.

(iii) *RMS Voltage at frequencies above 270 kHz.* The rms value of the metallic voltage components in the frequency range of 270 kHz to 6 MHz, averaged over 2 microseconds, shall not exceed -15 dBV. This limitation applies with a metallic termination having an impedance of 135 ohms.

(iv) *Peak Voltage.* The total peak voltage for all frequency components in the 4

Appendix C

kHz to 6 MHz band shall not exceed 4.0 volts.

(3) *Longitudinal voltage*

(i) *Frequencies below 4kHz.* The weighted rms voltage in the frequency band from 10 Hz to 4kHz, averaged over 100 milliseconds is the resultant of all the component longitudinal voltages in the band after weighing according to the transfer function of $f/4000$, where f is the frequency in Hz, shall not exceed the maximum indicated below under the conditions stated in § 8.308(g).

Frequency range	Maximum RMS voltage
10 Hz - 4 kHz	-37 dBV

(ii) 4 kHz to 270 kHz

Center Frequency (f) of 8-kHz Band	Maximum Voltage in all 8-kHz Bands	Longitudinal Terminating Impedance
8 kHz to 12 kHz	$-18.4 + 20 \log f$ dBV	500 Ohms
12 kHz to 42 kHz	$(3 - 40 \log f)$ dBV	90 Ohms
42 kHz to 266 kHz	-62 dBV	90 Ohms

Where f = center frequency in kHz of each of the possible 8-kHz bands.

(iii) *270 kHz to 6 MHz.* The rms value of the longitudinal voltage components in the frequency range of 270 kHz to 6 MHz shall, averaged over 2 microseconds, not exceed -30 dBV. This limitation applies with a longitudinal termination having an impedance of 90 ohms.

Figure 68.308(a)

Appendix C

(g) *Requirements in paragraphs (d), (e) and (f) apply under the following conditions:*

(1) All registered terminal equipment, except equipment to be used on LADC, and all registered protective circuitry must comply with the limitations when connected to a termination equivalent to the circuit depicted in Figure 68.308(a) and when placed in all operating states of the equipment except during network control signaling. LADC registered terminal equipment must comply with the metallic voltage limitations when connected to circuits of § 68.3(i) and must comply with the longitudinal limitations when connected to circuits of Figure 68.308(a), as indicated.

(2) All registered terminal equipment and registered protective circuitry must comply with the limitations in the off-hook state over the range of loop currents that would flow with the equipment *connected* to an appropriate simulator circuit.

(3) Registered terminal equipment and registered protective circuitry with provision for through-transmission from other equipments shall comply with the limitations with a 1000 Hz tone applied from a 600-ohm source (or, if appropriate a source which reflects a 600-ohm impedance across tip and ring) at the maximum level that would be applied during normal operation. Registered protective circuitry for data shall also comply with the tone level 10 dB higher than the overload point.

(4) For registered terminal equipment or registered protective circuitry with non-registered signal source input, such as music on hold, the out of band signal power requirements shall be met using an input signal with a frequency range of 200 Hz to 20 kHz and the level set at the overload point.

(5) Except during the transmission of ringing (§ 68.306(d)) and Dual Tone Multi-frequency (DTMF) signals, LADC registered terminal equipment shall comply with all requirements in all operating states and with loop current that may be drawn for such purposes as loop back signaling. The requirements in para. (f) (1) of this section except in paragraphs (i) and (ii) also apply during the application of ringing. The requirement in para. (d) and the requirements in para. f(1)(i) and (1)(ii) of this section apply during ringing for frequencies above 300 Hz and with the maximum voltage limits raised by 10 dB. DTMF signals which are used for the transmission of alphanumeric information and which comply with the requirements in para. (f)(1)(i) and in para. (f)(2) or (3) as applicable, shall be deemed to comply with the requirements in para. (f)(1)(ii) provided that, for automatically originated DTMF signals, the duty cycle is less than 50 percent.

(6) LADC registered terminal equipment shall comply with all applicable requirements, except those specified in paras. (f)(1)(i) and (ii) of this section, during the

Appendix C

transmission of each possible data signal sequence of any length. For compliance with para. (f)(3)(i) of this section, the limitation applies to the rms voltage averaged as follows:

(i) For digital signals, baseband or modulated on a carrier, for which there are defined signal element intervals, the rms voltage is averaged over each such interval. Where multiple carriers are involved, the voltage is the power sum of the rms voltages for the signal element intervals for each carrier.

(ii) For baseband analog signals, the rms voltage is averaged over each period (cycle) of the highest frequency of the signal (3 dB point on the spectrum). For analog signals that are modulated on a carrier (whether or not the carrier is suppressed), it is averaged over each period (cycle) of the carrier. Where multiple carriers are involved, the voltage is the power sum of the rms voltage for each carrier.

(iii) For signals other than the types defined in paras. (g)(6)(I) and (ii) of this section, the peak amplitude of the signal must not exceed +1 dBV.

(7) Equipment shall comply with the requirements in paras. (f)(1)(i) and (ii) of this section, during any data sequence that may be transmitted during normal use with a probability greater than 0.001. If the sequences transmitted by the equipment are application dependent, the user instruction material shall include a statement of any limitations assumed in demonstrating compliance of the equipment.

(8) In addition to the conditions specified in para. (5) of this section, LADC registered terminal equipment which operates in one or more modes as a receiver, shall comply with requirements in para. (f)(3) of this section with a tone at all frequencies in the range of potential received signals and at the maximum power which may be received.

(h) *Interference limitations for transmission of bipolar signals over digital services.*

(1) *Limitations on Terminal Equipment Connection to Subrate Digital Services.*

(i) *Pulse repetition rate.* The pulse repetition rate shall be synchronous with 2.4, 3.2, 4.8, 6.4, 9.6, 12.8, 19.2, 25.6, 38.4, 56.0, or 72 kbps per second.

(ii) *Template for maximum output pulse.* When applied to a 135 Ohm resistor, the instantaneous amplitude of the largest isolated output pulse obtainable from the registered terminal equipment shall not exceed by more than 10% the instantaneous voltage defined by a template obtained as follows: The limiting pulse template shall be

Appendix C

determined by passing an ideal 50% duty cycle rectangular pulse with the amplitude/pulse rate characteristics defined in Table 68.308(c) through a single real pole low pass filter having a cutoff frequency in Hertz equal to 1.3 times the bit rate. For bit rates of 2.4, 3.2, 4.8, 6.4, 9.6 and 12.8 kbps, the filtered pulses shall also be passed through a filter providing the additional attenuation in Table 68.308 (d).

Table 68.308(c) - Driving Pulse Amplitude

Line Rate (kbps)	User Data Rate (R) (kbps)	Amplitude (A) (volts)
2.4	2.4	1.66
3.2	2.4 with SC*	1.66
4.8	4.8	1.66
6.4	4.8 with SC*	1.66
9.6	9.6	0.83
12.8	9.6 with SC*	0.83
19.2	19.2	1.66
25.6	19.2 with SC*	1.66
38.4	38.4	1.66
51.2	38.4 with SC*	1.66
56	56	1.66
72	56 with SC*	1.66
72	64	1.66

SC: Secondary Channel

Appendix C

Table 68.308(d) - Minimum Additional Attenuation

Line Rate (R) (kbps)	Attenuation in Frequency Band 24-32 kHz (dB)	Attenuation in Frequency Band 72-80 kHz (dB)
2.4	5	1
3.2	5	1
4.8	13	9
6.4	13	9
9.6	17	8
12.8	17	8

The attenuation indicated may be reduced at any frequency within the band by the weighting curve of Table 68.308(e). Minimum rejection is never less than 0 dB; i.e., the weight does not justify gain over the system without added attenuation.

Table 68.308(e) Attenuation Curve

24-32 kHz Band	72-80 kHz Band	Attenuation Factor dB
24	72	-18
25	73	-3
26	74	-1
27	75	0
29	76	0
29	77	0
30	78	-1
31	79	-3
32	80	-18

Appendix C

(iii) *Average power.* The average output power when a random signal sequence, (0) or (1) equiprobable in each pulse interval, is being produced as measured across a 135 ohm resistance shall not exceed 0 dBm for 9.6 and 12.8 kbps or +6 dBm for all other rates shown in Table 68.308(b).

(iv) *Encoded analog content.* If registered terminal equipment connecting to subrate services contains an analog-to-digital converter, or generates signals directly in digital form that are intended for eventual conversion into voiceband analog signals, the encoded analog content of the digital signal must be limited. The maximum equivalent power of encoded analog signals for other than live voice as derived by a zero level decoder test configuration shall not exceed -12 dBm when averaged over any 3-second time interval. The maximum equivalent power of encoded analog signals as derived by a zero level decoder test configuration for signals intended for network control signaling shall not exceed -3 dBm when averaged over any 3-second interval.

(2) *Limitations on Terminal Equipment Connecting to 1.544 Mbps Digital Services.*

(i) *Pulse repetition rate:*

The free running line rate of the transmit signal shall be 1.544 Mbps with a tolerance of ± 32 ppm., i.e., ± 50 bps.

(ii) *Output pulse templates.* The registered terminal equipment shall be capable of optionally delivering three sizes of output pulses. The output pulse option shall be selectable at the time of installation.

(A) *Option A output pulse.* When applied to a 100 ohm resistor, the instantaneous amplitude of the largest output pulse obtainable from the registered terminal equipment shall fall within the pulse template illustrated in Figure 68.308 (b). The mask may be positioned horizontally as needed to encompass the pulse, and the amplitude of the normalized mask may be uniformly scaled to encompass the pulse. The baseline of the mask shall coincide with the pulse baseline.

Appendix C

(B) *Option B output pulse.* When applied to a 100-ohm resistor, the instantaneous amplitude of the output from the registered terminal equipment obtained when Option B is implemented shall fall within the pulse template obtained by passing the bounding pulses permitted by Figure 68.308(b) through the following transfer function.

$$\frac{V_{out}}{V_{in}} = \frac{n_2 S^2 + n_1 S + n_0}{d_3 S^3 + d_2 S^2 + d_1 S + d_0}$$

where:

$$n_0 = 1.6049 \times 10^6$$

$$n_1 = 7.9861 \times 10^{-1}$$

$$n_2 = 9.2404 \times 10^{-8}$$

$$d_0 = 2.1612 \times 10^6$$

$$d_1 = 1.7223$$

$$d_2 = 4.575 \times 10^{-7}$$

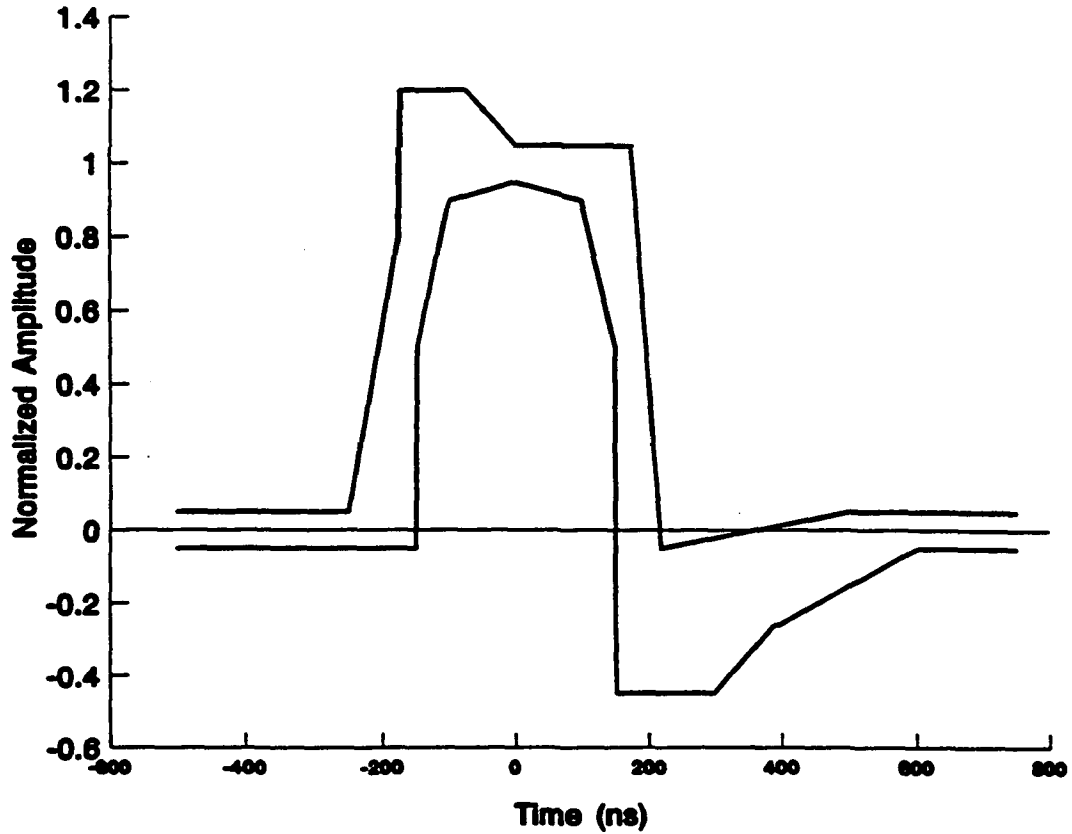
$$d_3 = 3.8307 \times 10^{-14}$$

$$S = j 2 \Pi f$$

$$f = \text{frequency (Hertz)}$$

(C) *Option C output pulse.* When applied to a 100-ohm resistor, the instantaneous amplitude of the output from the registered terminal equipment obtained when Option C is implemented shall fall within the pulse template obtained by passing the pulses obtained in Option B through the transfer function in Option B a second time.

Appendix C



MAXIMUM CURVE

NANO-SECONDS	-500	-250	-175	-175	-75	0	175	220	500	750		
NORMALIZED AMPLITUDE	.05	.05	.8	1.2	1.2	1.05	1.05	-.05	.05	.05		

MINIMUM CURVE

NANO-SECONDS	-500	-150	-150	-100	0	100	150	150	300	396	600	750
NORMALIZED AMPLITUDE	-.05	-.05	.5	.9	.95	.9	.5	-.45	-.45	-.26	-.05	-.05

Figure 68.308(b) (Ref. EIA/TIA 547-1989)

Isolated Pulse Template and Corner Points for 1.544 Mbps equipment

NOTE: The pulse amplitude is 2.4 to 3.6 V. (Use constant scaling factor to fit normalized template.)

Appendix C

(iii) *Adjustment of signal voltage.* The signal voltage at the network interface must be limited so that the range of pulse amplitudes received at the first telephone company repeater is controlled to ± 4 dB. This limitation is achieved by implementing the appropriate output pulse option as a function of telephone company cable loss as specified at time of installation.

Cable Loss at 772 kHz (dB)	Terminal Equipment	
	Output Pulse	Loss at 772 kHz
15 to 22	Option A	0
7.5 to 15	Option B	7.5
0 to 7.5	Option C	15

(iv) *Output power.* The output power in a 3 kHz band about 772 kHz when an all ones signal sequence is being produced as measured across a 100 ohm terminating resistance shall not exceed +19 dBm. The power in a 3 kHz band about 1.544 MHz shall be at least 25 dB below that in a 3 kHz band about 772 kHz.

(v) *Encoded Analog Content.* If registered terminal equipment connected to 1.544 Mbps digital service contains an analog-to-digital converter, or generates signals directly in digital form that are intended for eventual conversion into voiceband analog signals, the encoded analog content of the subrate channels within the 1.544 Mbps signal must be limited. The maximum equivalent power of encoded analog signals for other than live voice that are not intended for network control signaling as derived by a zero level decoder test configuration shall not exceed -12 dBm when averaged over any 3-second time interval. The maximum equivalent power of encoded analog signals as derived by a zero level decoder test configuration for signals intended for network control signaling shall not exceed -3 dBm when averaged over any 3-second interval.

Appendix C

9. Section 68.310 is revised to read as follows:

§ 68.310 Transverse balance limitations.

(a) *Technical Description and Application.* The Transverse Balance_{m-1} coefficient is expressed as

$$BALANCE_{m-1} = 20 \log_{10} \frac{e_M}{e_L}$$

Where e_L is the longitudinal voltage produced across a longitudinal termination Z_L and e_M is the metallic voltage across the tip-ring or tip 1 and ring 1 interface of the input port when a voltage (at any frequency between f_1 and $< f_2$, see Table 68.310(a) is applied from a balanced source with a metallic impedance Z_0 (see Table 68.310(a). The source voltage should be set such that $e_M = E$ volts (see Table 68.310(a) when a termination of Z_0 is substituted for the terminal equipment.

The minimum transverse balance coefficient specified in this section (as appropriate) shall be equalled or exceeded for all 2-wire network ports, OPS line ports and the transmit pair (tip and ring) and receive pair (tip 1 and ring 1) of all 4-wire network ports at all values of dc loop current that the port under test is capable of drawing when attached to the appropriate loop simulator circuit (See 68.3). An illustrative test circuit that satisfies the above conditions is shown in Figure 68.310-1(a) for analog and 68.310-1(b) for digital and substrate; other means may be used to determine the transverse balance coefficient specified herein, provided that adequate documentation of the appropriateness, precision, and accuracy of the alternative means is provided by the applicant.

Appendix C

The minimum transverse balance requirements specified below shall be equalled or exceeded under all reasonable conditions of the application of earth-ground to the equipment or protective circuitry under test.

Table 68.310(a)

	Analog Voiceband	Subrate Digital	1.544 Mbps Digital
Longitudinal Termination - Z_L	500 ohms	See Table 310(b)	90 ohms
Metallic Source Impedance - Z_0	600 ohms	135 ohms	100 ohms
Lower Frequency - f_1	200 Hz	200 Hz	10 kHz
Upper Frequency - f_2	4 kHz	*	1.544 MHz
Metallic Voltage for Test - E	0.775 V	0.367 V	0.316 V

* The upper frequency equals the digital line rate for the subrate service under test (See Table 68.310(b)).

(b) *Analog Voiceband Equipment.* All registered analog voiceband equipment shall be tested in the off-hook state. The minimum transverse balance requirement in the off-hook state shall be 40 dB, throughout the range of frequencies specified in Table 68.310(a). For some categories of equipment, additional requirements also apply to the on-hook state. When both off-hook and on-hook requirements apply, they are:

State	Frequency (f)	Balance
Off-hook	200 Hz : f \leq 4000 Hz	: 40 dB
On-hook	200 Hz : f \leq 1000 Hz	: 60 dB
On-hook	1000 Hz : f \leq 4000 Hz	: 40 dB

Appendix C

(1) For analog one-port 2-wire terminal equipment with loop-start, ringdown, or inband signaling or for voiceband metallic channel applications, both off-hook and on-hook requirements apply.

(2) For analog one port equipment with ground-start and reverse-battery signaling only off-hook requirements apply.

(3) For analog registered protective circuitry for 2-wire applications with loop-start, ringdown, or inband signaling; or for voiceband metallic channel applications, both off-hook and on-hook requirements apply.

Criteria shall be met with either terminal of the interface to other equipment connected to earth ground. The interface to other equipment shall be terminated in an impedance that will be reflected to the telephone connection as 600 Ohms in the off-hook state of the registered protective circuit, and the interface should not be terminated in the on-hook state. Figure 68.310(b) shows the interface of the protective circuitry being tested and the required arrangement at the interface to other equipment.

(4) For analog registered protective circuitry with ground-start and reverse-battery signaling only off-hook requirements apply. Criteria shall be met with either terminal of the interface to other equipment connected to earth ground. The interface to other equipment shall be terminated in an impedance that will be reflected to the telephone connection as 600 ohms in the off-hook state of the registered protective circuit. Figure 68.310(b) shows the interface of the protective circuitry under test and the required arrangement at the interface to the other equipment.

(5) For analog multi-port equipment with loop-start signaling both off-hook and on-hook requirements apply. Criteria shall be satisfied for all ports when all the ports not under test are terminated in their appropriate networks, as will be identified below, and when interface connections other than the ports are terminated in circuits appropriate to that interface. The minimum transverse balance coefficients shall also be satisfied for all values of dc loop current that the registered equipment is capable of drawing through each of its ports when these ports are attached to the loop simulator circuit specified in these rules. The termination for all ports other than the particular one whose transverse balance coefficient is being measured shall have a metallic impedance of 600 ohms.

(6) For analog multi-port equipment with ground-start and reverse-battery signaling, only off-hook requirements apply. Criteria shall be satisfied for all ports when all ports not under test are terminated in their appropriate networks as will be identified

Appendix C

below, and when interface connections other than the ports are terminated in circuits appropriate to that interface. The minimum transverse balance coefficients shall be satisfied for all values of dc loop current that the registered equipment is capable of drawing through each of its ports when these ports are attached to the loop simulator circuit specified in these rules. The terminations for all ports other than the particular one whose transverse balance coefficient is being measured shall have a metallic impedance of 600 ohms and a longitudinal impedance of 500 ohms. Figure 68.310(c) shows this termination.

(7) For analog registered terminal equipment and protective circuitry for 4-wire network ports, both the off-hook and on-hook requirements apply. The pair not under test shall be terminated in a metallic impedance of 600 ohms. Other conditions are as follows:

(i) For analog registered protective circuitry with loop-start, ground-start, reverse battery, ringdown, or inband signaling; or for voiceband metallic channel applications. Criteria shall be met with either terminal of the interface to other equipment connected to earth ground. The interface to other equipment shall be terminated in an impedance that will result in 600 ohms at each of the transmit and receive pairs of the 4-wire telephone connection in the off-hook state of the registered protective circuit, and the interface should not be terminated in the on-hook state. Figure 68.310(d) shows the interface of the protective circuitry being tested and the required arrangement at the interface to other equipment.

(ii) For analog multiport equipment with loop start, ground start, and reverse battery, ringdown, or inband signaling; or for voiceband metallic channel applications. Criteria shall be satisfied for all network ports when all the ports not under test are terminated as defined below, and when interface connections other than the network ports are terminated in circuits appropriate to the interface. The criteria shall also be satisfied for all values of dc loop current that when the port is connected to the appropriate 4-wire loop simulator circuit. The terminations for both pairs of all network ports not under test shall have a metallic impedance of 600 ohms and a longitudinal impedance of 500 ohms. Figure 68.310(c) shows this termination.

(8) For analog PBX equipment (or similar systems) with class B or class C off-premises interfaces, only off-hook requirements apply. Criteria shall be satisfied for all off-premises station interface ports when these ports are terminated in their appropriate networks for their off-hook state, and when all other interface connections are terminated in circuits appropriate to that interface. The minimum transverse balance coefficients shall also be satisfied for all values of dc loop current that the registered PBX is capable of providing through off-premises station ports when these

Appendix C

ports are attached to the off-premises line simulator circuit specified in these rules.

(9) For Type Z equipment with loop-start signaling, both off-hook and on-hook requirements apply. Equipment that has on-hook impedance characteristics which that do not conform to the requirements of § 68.312 (e.g., Type Z), shall comply with minimum transverse balance requirements of 40 dB in the voiceband. See § 68.312(h) for conditions upon registration of "Type Z" equipment.

(c) *Digital Equipment.* The minimum transverse balance requirements for registered terminal equipment connected to digital services shall be equalled or exceeded for the range of frequencies applicable for the equipment under test and under all reasonable conditions of the application of earth ground to the equipment. All such terminal equipment shall have a transverse balance in the acceptable region of Figure 68.310(e) for the range of frequencies shown in Table 68.310(b) for the specified digital service in question. The metallic impedance used for the transverse balance measurements for all subrate services shall be 135 ohms and for 1.544 Mbps shall be 100 ohms. The longitudinal termination for 1.544 Mbps and subrate services shall be as defined in Table 68.310(b).

Appendix C

Table 68.310(b)

Frequency Ranges of Transverse Balance Requirements for Digital Services

Digital Service	Frequency Range	Longitudinal Termination (ohms)	Metallic Termination (ohms)
2.4	200 to 2.4 kHz	500	135
3.2	200 to 3.2 kHz	500	135
4.8	200 to 4.8 kHz	500	135
6.4	200 to 6.4 kHz	500	135
9.6	200 to 9.6 kHz	500	135
12.8*	200 to 12.8 kHz	500/90	135
19.2*	200 to 19.2 kHz	500/90	135
25.6*	200 to 25.6 kHz	500/90	135
38.4*	200 to 38.4 kHz	500/90	135
56*	200 to 56 kHz	500/90	135
72*	200 to 72 kHz	500/90	135
1.544	10 kHz to 1.544 MHz	90	100

* NOTE: For 200 to 12 kHz the longitudinal termination shall be 500 ohms and above 12 kHz the longitudinal termination shall be 90 ohms.

Appendix C

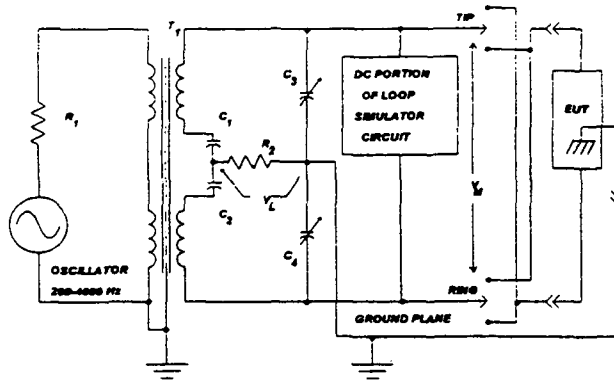


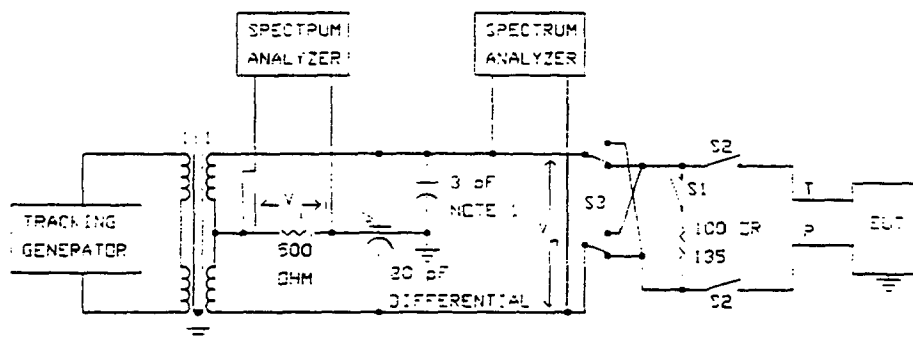
Figure 68.310-1(a)
Illustrative Test Circuit for Transverse Balance (Analog)

- T₁ 600 ohms:600 ohms split audio transformer
- C₁, C₂ 8 mF, 400 V dc, matched to within 0.1 %
- C₃, C₄ 100 to 500 pF adjustable trimmer capacitors
- Osc. Audio oscillator with source resistance R₁ less than or equal to 600 ohms
- R₁ Selected such that Z_{osc} + R₁ = 600 ohms
- R₂ 500 ohms

NOTES:

1. V_M should not be measured at the same time as V_L
2. Use trimmer capacitors C₃ and C₄ to balance the test circuit to 20 dB greater balance than the equipment standard for all frequencies specified, with a 600 ohm resistor substituted for the equipment under test.
3. Exposed conductive surfaces on the exterior of the equipment under test should be connected to the ground plane for this test.
4. When the Terminal Equipment makes provision for an external connection to ground (G), the Terminal Equipment shall be connected to ground. When the Terminal Equipment makes no provision for an external ground, the Terminal Equipment shall be placed on a ground plane which is connected to ground and has overall dimensions at least 50 % greater than the corresponding dimensions of the Terminal Equipment. The Terminal Equipment shall be centrally located on the ground plane without any additional connection to ground.

Appendix C



Notes:

1. The 3 pF capacitor may be placed on either line of the test set, as required, to obtain proper balancing of the bridge.
2. Use an R_{CAL} value of 100 ohms for 1.544 Mbps devices and 135 ohms for substrate devices.
3. The effective output impedance of the tracking generator should match the appropriate test impedance. See Note 2. The spectrum analyzer's input must be differentially balanced to measure V_m .
4. R_2 should be chosen according to Table 68.310(b).

T_1 : 100 ohms:100 ohms C.T. wide band transformer
12.4 to 24.5 pF differential trimmer

$R_2 = Z_1$ from Table 68.310(a)

$R_{CAL} = Z_0$ from Table 68.310(a)

R_1 - Selected so that $R_1 + 50 \text{ ohms} = Z_0$ from Table 68.310(a)

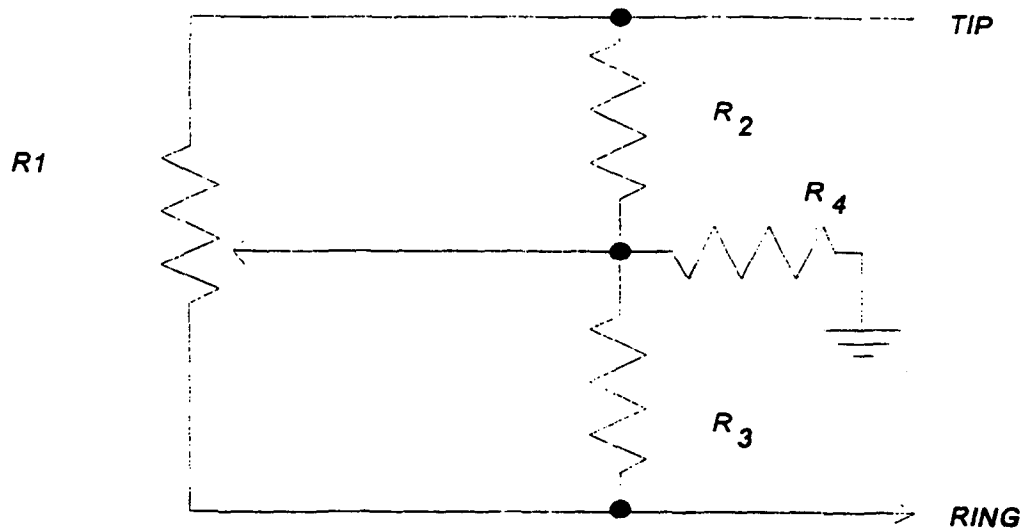
Figure 68.310-1(b)
Illustrative Test Circuit for Transverse Balance (Digital)

Appendix C

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

Figure 68.310(b)
Required Termination for Connections to Non-Registered Equipment

Appendix C



Where: $R_2 = R_3 = 300$ ohms, $R_4 = 350$ ohms, $R_1 = 300$ k ohms, for analog voiceband

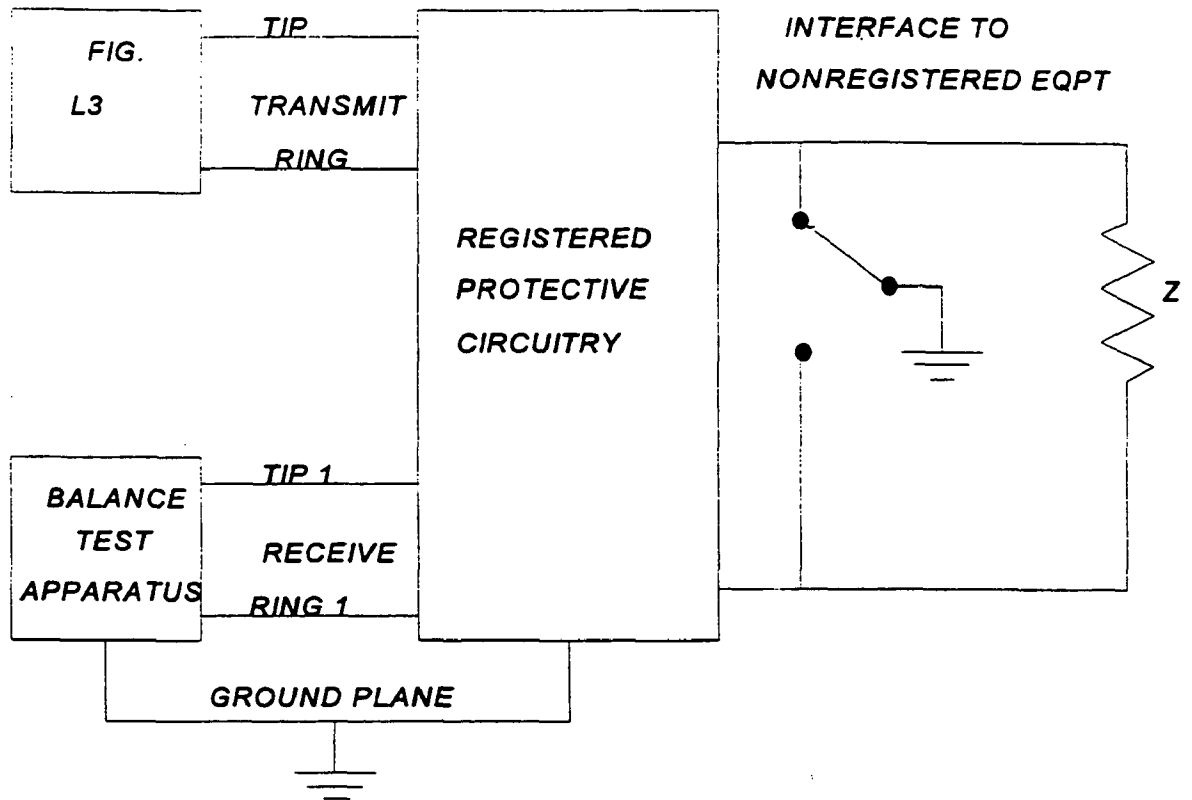
$R_2 = R_3 = 67.5$ ohms, $R_4 = 56.3$ ohms, $R_1 = 100$ kohms, for subrate digital

$R_2 = R_3 = 50$ ohms, $R_4 = 65$ ohms, $R_1 = 100$ k ohms, for 1.544 Mbps

R_1 is used to adjust termination balance. Balance of this termination shall be adjusted to at least 60 dB between 200 and 1000 Hz, and at least 40 dB between 1000 and 4000 Hz, and to at least 35 dB at 1.544 MHz.

Figure 68.310(C)
Off-Hook Termination of Multiport Equipment for Ports Not under Test

Appendix C



Z Selected so that the reflected impedance at tip 1 and ring 1 is 600 ohms, 135 ohms, or 100 ohms depending on service type of EUT.

Configuration shown is for measurement of receive pair.

Figure 68.310(d)
Required Termination for Connections to Non-Registered Equipment

Appendix C

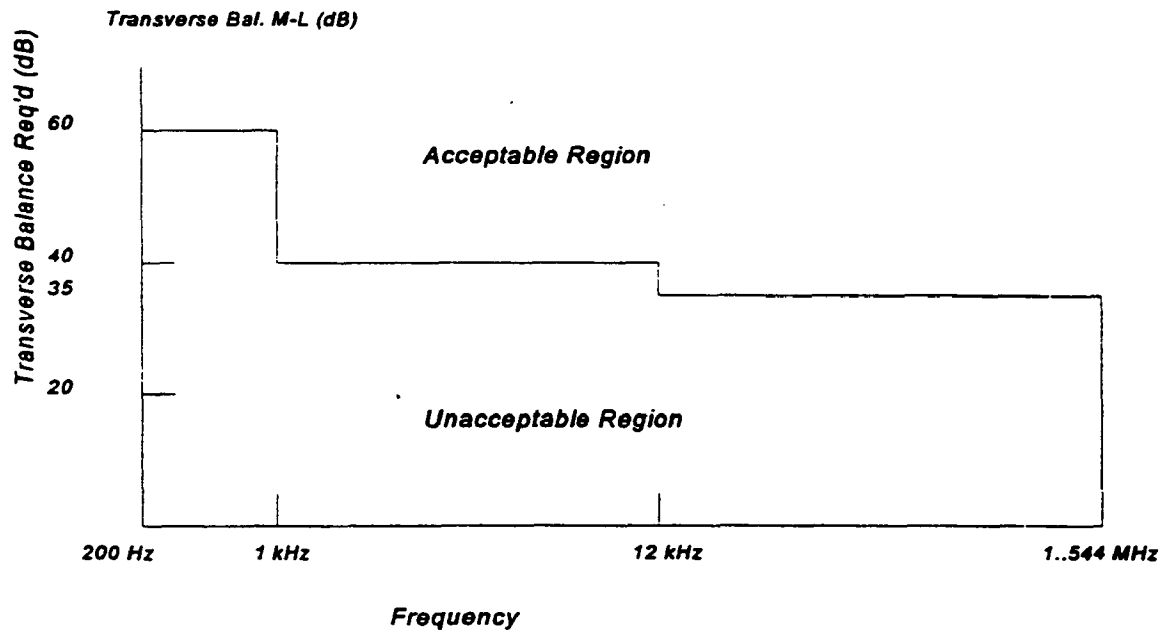


Figure 68.310(e)
Transverse Balance Requirements for Digital Services

Appendix C

10. Section 68.312 is revised to read as follows:

§ 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.

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)

Ringing 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
	> 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:

(i) *On-hook resistance, metallic and longitudinal (up to 100 Vdc).* The on-hook

Appendix C

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.

(ii) *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.

(iii) *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.

(iv) *Ringing 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.

(v) *Ringing 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) *Ringing 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

Appendix C

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 paras. (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 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

Appendix C

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.

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 labelled 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.

(l) *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).

11. Section 68.314 is revised to read as follows:

§ 68.314 Billing protection.

Appendix C

(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 transmitted and/or received by electroacoustic transducers only.

NOTE : Para. (a) of this section is applicable to terminal equipment and registered protective circuitry employed with digital services where such digital services are interconnected with the analog telephone network.

(1) *Registered Protective Circuitry.* Registered protective circuitry connected to associated data equipment shall assure that the following signal power limitations are met for at least the first 2 seconds after the off-hook condition is presented to the telephone network in response to an incoming call:

(i) Signals that appear at the protective circuitry/telephone network interface for delivery to the telephone network shall be limited to -55 dBm, (at any frequency in the range of 200 to 3200 Hertz), as such signals are delivered into a loop simulator circuit or a 600 ohm termination, as appropriate; and

(ii) Signals that appear at the protective circuitry-associated data equipment interface for delivery to associated data equipment shall be limited as follows: for any received signal power (appearing at the protective circuitry-telephone network interface) up to 0 dB with respect to one milliwatt (at any frequency in the range of 200 to 3200 Hertz), the power of signals delivered to associated data equipment shall be no greater than the signal power that would be delivered as a result of received signal power of -55 dBm

(2) *Registered Terminal Equipment.* Registered terminal equipment for data applications shall assure that, when an incoming telephone call is answered, the answering terminal equipment prevents both transmission and reception of data for at least the first two seconds after the answering terminal equipment transfers to the off-hook condition. For the purpose of this requirement, a fixed sequence of signals that is transmitted (and originated within) and/or received by the registered terminal equipment each time it answers an incoming call shall not be considered data, provided that such signals are for one or more of the following purposes:

(i) Disabling echo control devices,

Appendix C

- (ii) Adjusting automatic equalizers and gain controls,
- (iii) Establishing synchronization, or
- (iv) Signaling the presence and if required, the mode of operation, of the data terminal at the remote end of a connection.

(b) *Voice and data equipment on-hook signal requirements for equipment connected to the Public Switched Network, or to Tie Trunks, or to Private Lines that Access the Public Switched Network.* Registered protective circuitry and registered terminal equipment shall comply with the following:

(1) The power delivered into a 2-wire loop simulator circuit or into the transmit and receive pairs of a 4-wire loop simulator or into a 600 ohm termination (where appropriate) in the on-hook state, by loop-start or ground-start equipment shall not exceed - 55 dBm within the voiceband. Registered protective circuitry shall also assure that for any input level up to 10 dB above the overload point, the power to a 2-wire loop simulator circuit or the transmit and receive pairs of a 4-wire loop simulator circuit or into a 600 Ohm termination (where appropriate) does not exceed the above limits.

(2) The power delivered into a 2-wire loop simulator circuit or into the transmit and receive pairs of a 4-wire loop simulator circuit, in the on-hook state, by reverse battery equipment shall not exceed -55 dBm, unless the equipment is arranged to inhibit incoming signals.

(c) *Voice and data equipment loop current requirements for equipment connected to the Public Switched network.* The loop current through registered terminal equipment or registered protective circuitry, when connected to a 2-wire or 4-wire loop simulator circuit with the 600 ohm resistor and 500 microfarad capacitor of the 2-wire loop simulator circuit or both pairs of the 4-wire loop simulator circuit disconnected shall, for at least 5 seconds after the equipment goes to the off-hook state that would occur when answering an incoming call:

(1) Be at least as great as the current obtained in the same loop simulator circuit with minimum battery voltage and a maximum loop resistance when a 200 ohm resistance is connected across the tip and ring of the 2-wire loop simulator circuit or connected across the tip/ring and tip 1/ring1 conductors (tip and ring connected together and tip 1 and ring 1 connected together) of the 4-wire loop simulator circuit in place of the registered terminal equipment or registered protective circuitry; or

(2) Not decreased by more than 25 percent from its maximum value attained

Appendix C

during this 5-second interval; unless the equipment is returned to the on-hook state during the above 5 second interval.

(3) The above requirements also apply in the hold state and any off-hook state.

(d) *Signaling interference requirements.*

(1) The signal power delivered to the network interface by the registered terminal equipment and from signal sources internal to registered protective circuitry in the 2450 Hz to 2750 Hz band shall be less than or equal to the power present simultaneously in the 800 Hz to 2450 Hz band for the first 2 seconds after going to the off-hook state.

(2) Registered terminal equipment for connection to subrate or 1.544 Mbps digital services shall not deliver digital signals to the telephone network with encoded analog content energy in the 2450 to 2750 Hertz band unless at least an equal amount of encoded analog energy is present in the 800 to 2450 Hertz band for the first two seconds after going to the off-hook state.

(e) *On-Hook Requirements for registered terminal equipment for connection to subrate and 1.544 Mbps digital services.* Registered terminal equipment and registered protective circuitry shall comply with the following:

(1) The power delivered to the telephone network in the on-hook state as derived by a zero level decoder shall not exceed -55 dBm equivalent power for digital signals within the voiceband.

(2) Registered protective circuitry shall also assure that the power to a zero level decoder does not exceed the above limits for any input level up to 10 dB above the overload point.

(3) Reverse battery interface. The power derived by a zero level decoder, in the on-hook state, by reverse battery equipment, shall not exceed -55 dBm, unless the equipment is arranged to inhibit incoming signals.

(f) *Off Hook Requirements.* Off-hook signal requirements for registered terminal equipment connecting to 1.544 Mbps digital services. Upon entering the normal off-hook state, in response to alerting, for subrate channels, registered terminal equipment shall continue to transmit the signaling bit sequence representing the off-hook state for 5 seconds, unless the equipment is returned to the on-hook state during the above 5-second interval.

Appendix C

(g) Operating Requirements for Direct Inward Dialing.

(1) For registered terminal equipment, the off-hook state shall be applied within 0.5 seconds of the time that:

(i) The terminal equipment permits the acceptance of further digits that may be used to route the incoming call to another destination.

(ii) The terminal equipment transmits signals towards the calling party, except for the call progress tones, i.e., busy, reorder and audible ring, and the call is:

(A) Answered by the called, or another station;

(B) Answered by the attendant;

(C) Routed to a customer controlled or defined recorded announcement, except for "number invalid," "not in service" or "not assigned;"

(D) Routed to a dial prompt; or

(E) Routed back to the public switched telephone network or other destination and the call is answered. If the status of the answered call cannot be reliably determined by the terminal equipment through means such as, detection of answer supervision or voice energy, removal of audible ring, etc., the off-hook state shall be applied after an interval of not more than 20 seconds from the time of such routing.

The off-hook state shall be maintained for the duration of the call.

(2) For registered protective circuitry:

(i) Registered protective circuitry shall block transmission incoming from the network until an off-hook signal is received from the terminal equipment.

(ii) Registered protective circuitry shall provide an off-hook signal within 0.5 s following the receipt of an off-hook signal from the terminal equipment and shall maintain this off-hook signal for the duration of the call.

Appendix C

12. Section 68.316 is amended by revising the section heading to read as follows:

§ 68.316 Hearing aid compatibility: technical requirements.

13. Section 68.317 is amended by revising the section heading to read as follows:

§ 68.317 Hearing aid compatibility volume control: technical standards

14. Section 68.318 is amended to read as follows:

§ 68.318 Additional limitations.

(a) *General.* Registered terminal equipment for connection to those services discussed below must incorporate the specified features.

(b) *Registered terminal equipment with automatic dialing capability.*

(1) Automatic dialing to any individual number is limited to two successive attempts. Automatic dialing equipment which employ means for detecting both busy and reorder signals shall be permitted an additional 13 attempts if a busy or reorder signal is encountered on each attempt. The dialer shall be unable to re-attempt a call to the same number for at least 60 minutes following either the second or fifteenth successive attempt, whichever applies, unless the dialer is reactivated by either manual or external means. This rule does not apply to manually activated dialers that dial a number once following each activation.

NOTE: Emergency alarm dialers and dialers under external computer control are exempt from these requirements.

(2) If means are employed for detecting both busy and reorder signals, the automatic dialing equipment shall return to its on-hook state within 15 seconds after detection of a busy or reorder signal.

(3) If the called party does not answer, the automatic dialer shall return to the on-hook state within 60 seconds of completion of dialing.

(4) If the called party answers, and the calling equipment does not detect a compatible terminal equipment at the called end, then the automatic dialing equipment shall be limited to one additional call which is answered. The automatic dialing equipment shall comply with paras. (1), (2), and (3) of this section for additional call

Appendix C

attempts that are not answered.

(5) Sequential dialers shall dial only once to any individual number before proceeding to dial another number.

(6) Network addressing signals shall be transmitted no earlier than:

(i) 70 ms after receipt of dial tone at the network demarcation point;

OR

(ii) 600 ms after automatically going off-hook (for single line equipment that does not use dial tone detectors);

OR

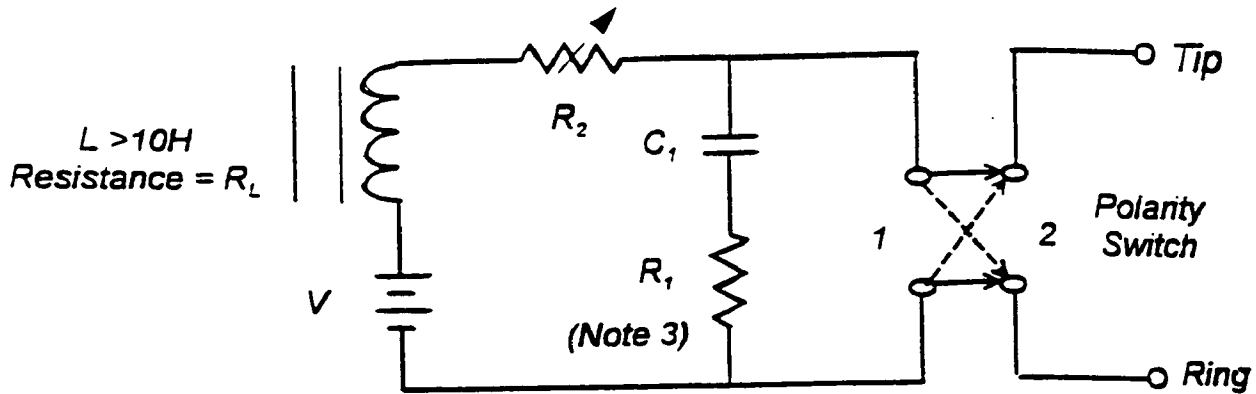
(iii) 70 ms after receipt of CO ground start at the network demarcation point.

(c) *Line seizure by automatic telephone dialing systems.* Automatic telephone dialing systems which deliver a recorded message to the called party must release the called party's telephone line within 5 seconds of the time notification is transmitted to the system that the called party has hung up, to allow the called party's line to be used to make or receive other calls.

(d) *Telephone Facsimile Machines; Identification of the sender of the message.* It shall be unlawful for any person within the United States to use a computer or other electronic device to send any message via a telephone facsimile machine unless such message clearly contains, in a margin at the top or bottom of each transmitted page or on the first page of the transmission, the date and time it is sent and an identification of the business, other entity, or individual sending the message and the telephone number of the sending machine or of such business, other entity, or individual. Telephone facsimile machines manufactured on and after December 20, 1992 must clearly mark such identifying information on each transmitted message.

(e) *Requirement that registered equipment allow access to common carriers.* Any equipment or software manufactured or imported on or after April 17, 1992, and installed by any aggregator shall be technologically capable of providing consumers with access to interstate providers of operator services through the use of equal access codes. The terms used in this paragraph shall have meanings defined in § 64.708 of this chapter (47 CFR 64.708).

LOOP SIMULATOR FOR LOOP START AND GROUND START CIRCUITS



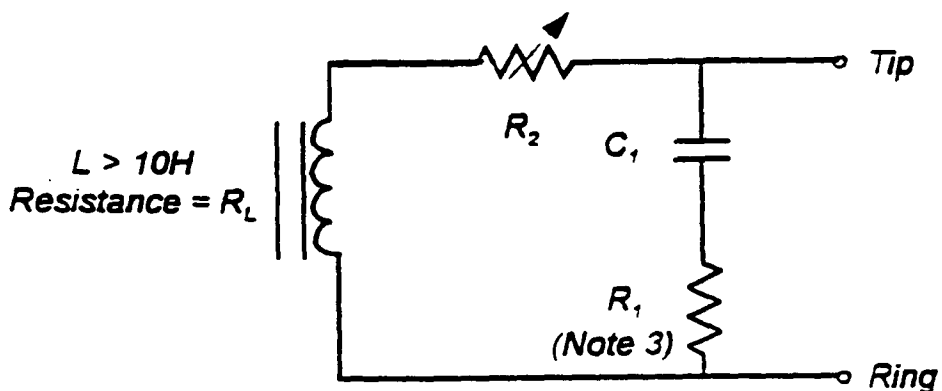
$C_1 = 500 \text{ mfd } -10\% + 50\%$ $R_1 = 600 \text{ ohms } \pm 1\%$

Condition	V - Volts	Switch Position for Test	$R_2 + R_L$
1	Min 42.5 Max 56.5	Both	Continuously variable over 400 to 1740 ohms
2	105	2	2000 ohms

1. Means shall be used to generate, at the point of tip and ring connections to the terminal equipment or protective circuitry, the parameters of dc line current and ac impedance which are generated by the illustrative circuit depicted above (as appropriate for the equipment under test).
2. In the Transverse Balance Limitations, Section 68.310, the use of the "dc portion of the loop simulator circuit" is specified. In such case components of R_1 and C_1 should be removed.
3. Tests for compliance may be made with either $R_1 = 600 \text{ ohms}$ or R_1 replaced by the alternative configuration shown in Figure 68.3(g).

Figure 68.3(a)

Loop Simulator for Reverse Battery Circuits



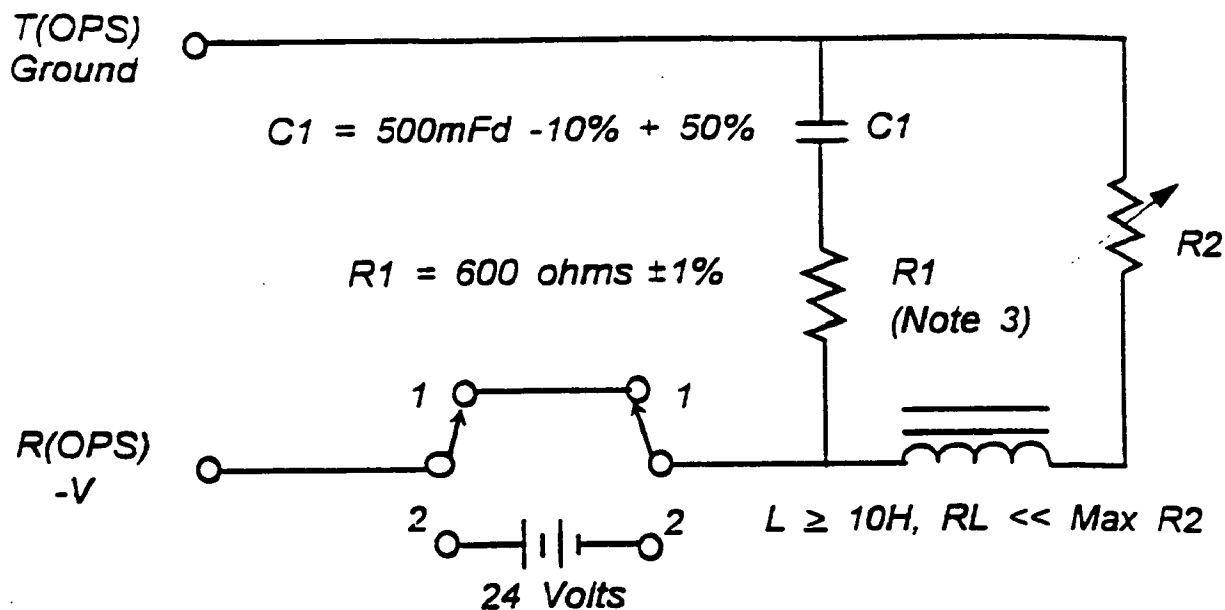
$$C_1 = 500 \text{ mFd } -10\% + 50\%$$

$$R_1 = 600 \text{ ohms } \pm 1\%$$

Notes for Figure 68.3(a)
apply also to this
drawing

$R_2 + R_L$
<i>Continuously variable over 400 to 2450 ohms</i>

Figure 68.3(b)



		R2 + RL Continuously Variable Over the Following Range		
Condition	Switch Position for Test	Class A RL	Class B RL	Class C RL
1	1	to 200 ohms	to 800 ohms	to 1800 ohms
2	2	N.A.	200 to 2300 ohms	900 to 3300 ohms

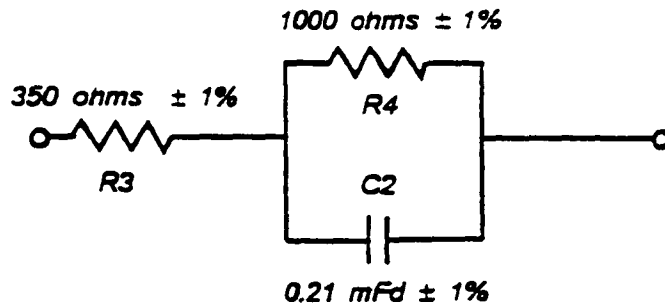
The minimum current for all resistance ranges shall be 16 mA.

- Notes: (1) Means shall be used to generate, at the point of tip (T OPS) and ring (R OPS) connections to the PBX, the range of resistance and impedance which are employed by the illustrative circuit depicted above.
 (2) In the transverse balance limitations, Section 68.310, the use of the "dc portion of the line simulator" is specified. In such case, components R1 and C1 above shall be removed.
 (3) Tests for compliance may be made with either R1 = 600 ohms or R1 replaced by the alternative termination specified in Figure 68.3(g).

OFF PREMISES LOOP SIMULATOR

Figure 68.3(f)

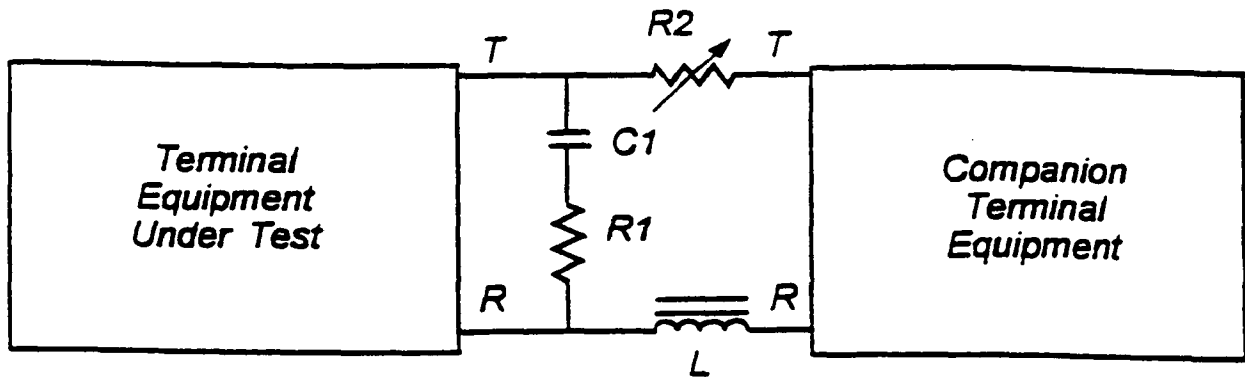
ALTERNATIVE TERMINATION



Note: When this alternative termination is used during signal power compliance testing, it replaces R_1 (600 ohms) in the loop simulator circuit.

Figure 68.3(g)

LOOP SIMULATOR CIRCUIT VOICEBAND METALLIC CHANNELS



$C1 = 500\text{mFd} -10\%, +5\%$

$R1 = 600 \text{ ohms } \pm 1\%$

$L = 10\text{H}, \text{ Resistance} = R_L$

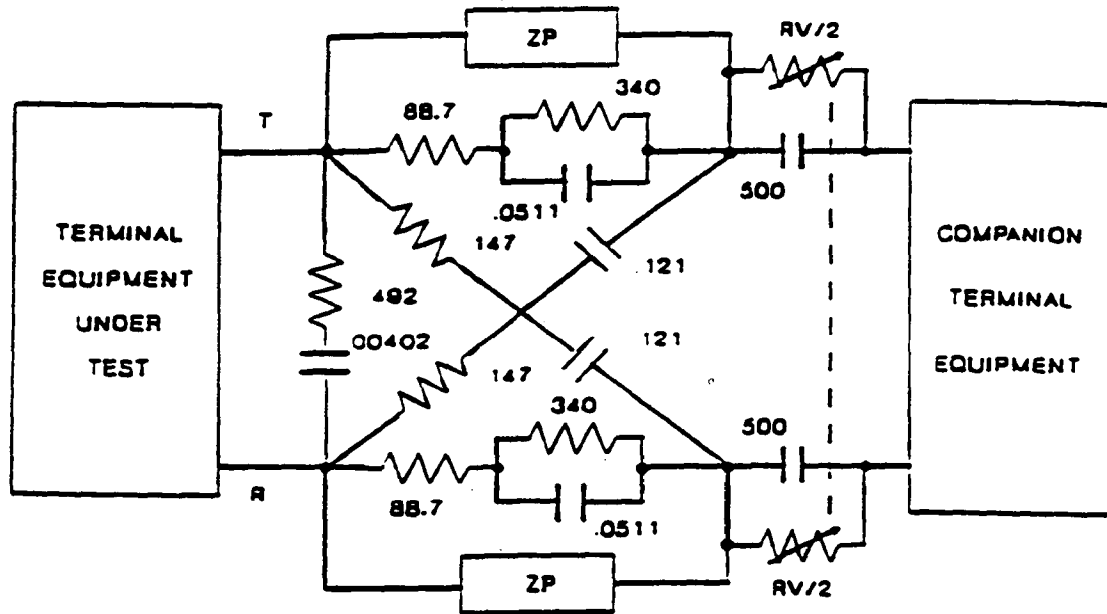
$R2 + R_L$ are continuously variable from R_L to R_X ;

Where $R_X =$ Signaling range of Equipment Under Test, and

$R_L \ll R_X$

Notes: For Transverse Balance Measurements, Section 68.310, the DC portion of the loop simulator should be provided by removing $R1$ and $C1$. Companion Terminal Equipment grounds (including power supplies) must be isolated from Transverse Balance circuit grounds.

Figure 68.3(h)



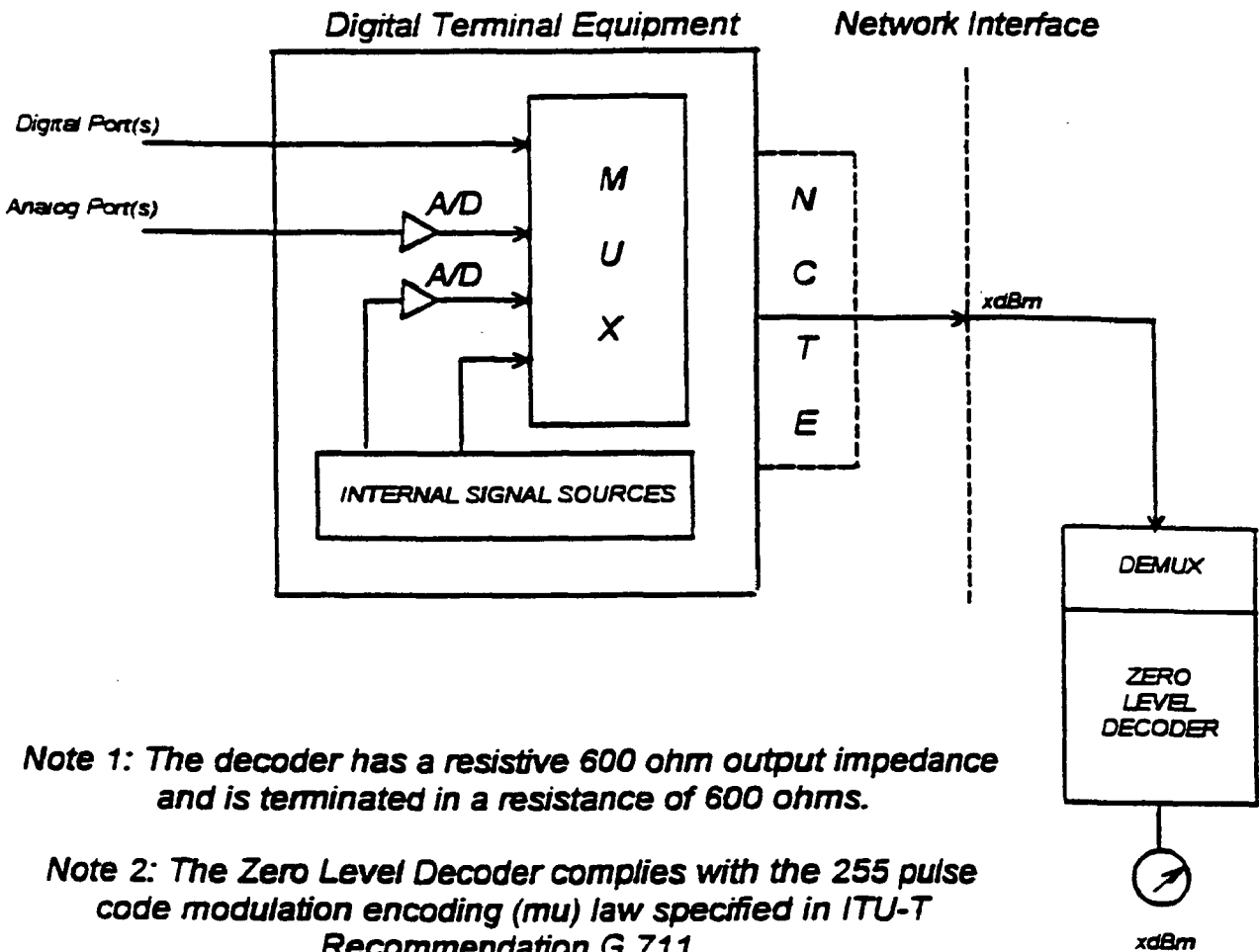
Resistances (Ohms), Capacitances (μF), Tolerances $\approx 2\%$.

$RV = RP = 50$ thru 3000 Ohms.

ZP is the magnitude of the lowpass filter impedance which is $\langle 25$ Ohm dc; $\rangle 3$ Kohm from 10 Hz to 6 KHz.

$RP/2 =$ dc resistance of lowpass filter, ZP in parallel with 428.7 Ohm.

Figure 68.3(i) LADC Impedance Simulator for Metallic Voltage Tests

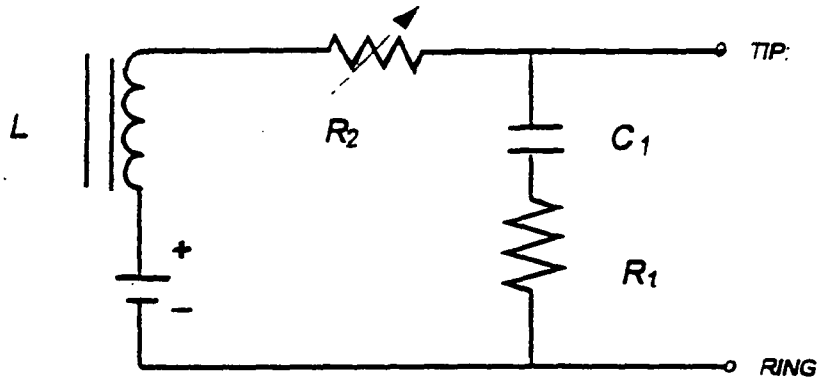


Note 1: The decoder has a resistive 600 ohm output impedance and is terminated in a resistance of 600 ohms.

Note 2: The Zero Level Decoder complies with the 255 pulse code modulation encoding (μ) law specified in ITU-T Recommendation G.711.

ZERO-LEVEL DECODER TEST CONFIGURATION FOR SUBRATE AND 1.544 MBPS DIGITAL CHANNELS

Figure 68.3 (j)



$L \geq 10H$ (Resistance = R_L)

$R_1 = 600 \text{ ohms} \pm 1\%$

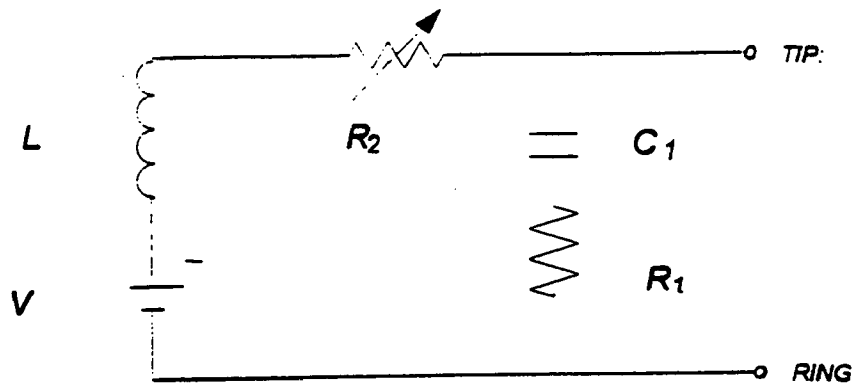
$C_1 = 500\text{mF}, -10\%, +50\%$

TEST CONDITIONS FOR ANALOG MODE

V (volts)		$R_2 + R_L$ (ohms)
Min	Max	continuously variable
36	46	610 to 1510

**SIMULATOR CIRCUIT FOR PSDS IN
ANALOG MODE**

Fig 68.3(k)



$L = \text{or } > 10H \text{ (Resistance} = R_L)$

$R_1 = 600 \text{ ohms } \pm 1\%$

$C_1 = 500mF, -10\%, +50\%$

TEST CONDITIONS FOR ANALOG MODE

V (volts)		R2 + RL (ohms) continuously variable
Min	Max	
36	46	610 to 1510

**SIMULATOR CIRCUIT FOR PSDS IN
ANALOG MODE
Fig 68.3(m)**