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**MIL-STD-461B**

1 April 1980

**SUPERSEDING  
MIL-STD-461A**

# MILITARY STANDARD

## ELECTROMAGNETIC EMISSION AND SUSCEPTIBILITY REQUIREMENTS FOR THE CONTROL OF ELECTROMAGNETIC INTERFERENCE



**FSC EMCS**

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DEPARTMENT OF DEFENSE  
Washington, DC 20360

Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference

MIL-STD-461B  
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1. This military standard is approved for use by all Departments and Agencies of the Department of Defense.
2. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Electronic Systems Command, ATTN: ELEX 5043, Washington, DC 20360, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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## FOREWORD

1. This standard is established to:

- (a) Ensure that interference control is considered and incorporated into the design of equipments and subsystems; and
- (b) Provide a basis for evaluating the electromagnetic characteristics of equipments and subsystems, as well as for inputs to analyses of the electromagnetic compatibility and effectiveness of systems in a complex electromagnetic environment.

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## 1. SCOPE

1.1 Purpose. This standard establishes the documentation and design requirements for the control of the electromagnetic emission and susceptibility characteristics of electronic, electrical and electromechanical equipments and subsystems (as defined herein) designed or procured for use by activities and agencies of the Department of Defense. Such equipments and subsystems may be used independently or as an integral part of other subsystems or systems.

1.2 Application. The requirements of this standard are applicable to the extent specified in the individual equipment or subsystem specification, contract or order. The applicability of the emission and susceptibility requirements are dependent upon the type of equipment or subsystem, its mission and intended installation. When engineering analyses on equipments or subsystems being procured for use in specific systems or platforms reveal that the requirements in this standard are not adequate for that procurement, they may be tailored by the procuring activity and incorporated into the request-for-proposal, specification, contract or order. In cases where a system or integrating contractor is required to prepare a detailed equipment or subsystem specification containing requirements for electromagnetic compatibility (EMC) including electromagnetic interference (EMI), electromagnetic pulse (EMP), electromagnetic (EM) radiation hazards, and so forth, the requirements of this standard shall be tailored as needed to achieve overall required system or platform performance. For equipments and subsystems in feasibility or advanced development stages of the acquisition process, this standard shall be used as a guide in formulating the appropriate requirements. Those requirements shall be enumerated in the individual equipment development or purchase description.

1.3 Units. Symbols, units and physical constants used in this standard are in accordance with the International System of Units (SI), as described in MIL-STD-463.

1.4 Emission and susceptibility designations. The emission and susceptibility requirements in this standard and corresponding test methods of MIL-STD-462 are designated in accordance with an alpha-numeric coding system where:

C = Conducted  
R = Radiated  
E = Emission  
S = Susceptibility  
UM = Unique requirement(s) intended for a miscellaneous,  
general-purpose equipment or subsystem

## 2. APPLICABLE DOCUMENTS

2.1 Government documents The following documents, of the issue listed in the Department of Defense Index of Specifications and Standards (DoDISS) and its supplements, form a part of this document to the extent specified herein. The date of the applicable DoDISS and supplements thereto shall be as specified in the solicitation.

### SPECIFICATIONS

#### MILITARY

MIL-B-5087	Bonding, Electrical, And Lightning Protection, For Aerospace Systems
MIL-E-6051	Electromagnetic Compatibility Requirements, Systems

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## STANDARDS

### MILITARY

MIL-STD-285	Attenuation Measurements For Enclosures, EM Shielding, For Electronic Test Purposes, Method Of
MIL-STD-462	Electromagnetic Emission And Susceptibility, Test Methods For
MIL-STD-463	Definitions And System Of Units, Electromagnetic Interference And Electromagnetic Compatibility
MIL-STD-480	Configuration Control - Engineering Changes, Deviations And Waivers
MIL-STD-1377 (NAVY)	Effectiveness Of Cable, Connector And Weapon Enclosure Shielding And Filters In Precluding Hazards Of Electromagnetic Radiation To Ordnance, Measurement Of
MIL-STD-1385 (NAVY)	Preclusion Of Ordnance Hazards In Electromagnetic Fields; General Requirements For
MIL-STD-1512 (USAF)	Electro-explosive Subsystems, Electrically Initiated, Test Methods And Design Requirements
MIL-STD-1541 (USAF)	Electromagnetic Compatibility Requirements For Space Systems
MIL-STD-1542 (USAF)	Electromagnetic Compatibility (EMC) And Grounding Requirements For Space System Facilities

### NATO STANAGS

3516	EMC Test Methods For Aerospace Electrical And Electronic Equipment
3614	EMC Of Installed Equipment In Aircraft
3659	Bonding And In-Flight Lightning

## HANDBOOKS

### MILITARY

MIL-HDBK-235	Electromagnetic (Radiated) Environment Considerations For Design And Procurement Of Electrical And Electronic Equipment
MIL-HDBK-237	Electromagnetic Compatibility/Interference Program Requirements
MIL-HDBK-241	Design Guide For EMI Reduction In Power Supplies
MIL-HDBK-253	Guidance For The Design And Test Of Systems Protected Against The Effects Of Electromagnetic Energy

## PUBLICATIONS

AFSC DH 1-4	Air Force Systems Command Design Handbook, EMC
AFSC DH 2-5	Air Force Systems Command Design Handbook, Armament
AFSC DH 2-7	Air Force Systems Command Design Handbook, System Survivability
AMC Pamphlet 706-235	Hardening Weapon Systems Against RF Energy
AMC Pamphlet 706-410	Engineering Design Handbook, EMC
NAVELEX 0101, 106	Naval Shore Electronics Criteria, EMC/EMR Hazards
NAVSEA OD 30393	Design Principles And Practices For Controlling Hazards Of Electromagnetic Radiation To Ordnance

(Copies of specifications, standards, drawings, and publications required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this standard to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

## SOCIETY OF AUTOMOTIVE ENGINEERS

SAE J551	Measurement of Electromagnetic Radiation From Motor Vehicles
SAE AIR 1423	Electromagnetic Compatibility On Gas Turbine Engines For Aircraft Propulsion
SAE AIR 1425	Methods Of Achieving Electromagnetic Compatibility Of Gas Turbine Engine Accessories, For Self-Propelled Vehicles

(Application for copies should be addressed to the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.)

## 3. DEFINITIONS

The terms used in this standard are defined in MIL-STD-463. In addition, the following definitions are applicable for the purpose of this standard:

3.1 Critical area. A location on a platform or installation containing equipments or subsystems which, if malfunctioning due to unwanted electromagnetic energy, could degrade the overall system performance and result in failure or abortion of a primary mission. All locations on a submarine and surface ship are considered critical areas.

3.2 Equipment. Any electrical, electronic or electromechanical device, or collection of items, intended to operate as an individual unit and performing a singular function. As used herein equipments include, but are not limited to the following: receivers, transmitters, transceivers, transponders, power supplies, electrical office machines, hand tools, processors, test apparatus and instruments, and material handling equipment.

3.3 Interconnecting leads. Control and signal lines which interface with other equipments or subsystems not being supplied under the same contract.

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3.4 Non-critical area. A location in a ground installation where EMI will not result in failure or abortion of a mission or degradation of the overall system performance. Examples of areas which may be considered non-critical are: office buildings, recreational areas, laundry areas, food servicing areas, drafting rooms and woodworking shops.

3.5 Sheltered subsystem. Equipments and components designed specifically for installation in standard military shelters which comply with MIL-STD-285 and which are not intended to meet the natural environments, such as humidity, temperature, and so forth.

3.6 Subsystem. For the purpose of this standard, the definition in 3.6 a or 3.6 b shall be considered as a subsystem. In either case, the devices or equipments may be physically separated when in operation and will be installed in fixed or mobile stations, vehicles or systems.

- a. A collection of devices or equipments designed and integrated to function as a single entity but wherein any device or equipment is not required to function as an individual equipment, as defined in 3.2.
- b. A collection of equipments and subsystems, as defined in 3.6 a, designed and integrated to function as a major subdivision of a system and to perform an operational function, or functions, therein.

3.7 System. A composite of equipment, subsystems, skills and techniques capable of performing or supporting an operational role. A complete system includes related facilities, equipment, subsystems, materials, services and personnel required for its operation to the degree that it can be considered self-sufficient within its operational or support environment. (EMC requirements for systems are not included in this standard, but rather in such documents as MIL-E-6051, MIL-STD-1541 and MIL-STD-1542.)

3.8 Tailoring. The process by which the requirements of this standard are adapted (that is, modified, deleted or supplemented) to the peculiarities, characteristics or operational requirements of the material in an individual equipment or subsystem specification. The tailoring process does not constitute a waiver or deviation. The latter terms are defined in MIL-STD-480.

3.9 Telecommunications equipment. Any equipment which transmits, emits or receives signs, signals, writing, images, sounds or information of any nature by wire, radio, visual or other electromagnetic means.

#### 4. GENERAL REQUIREMENTS

Electronic, electrical and electromechanical equipments and subsystems shall comply with the applicable requirements in 4.1 through 4.9. These requirements are in addition to the applicable emission and susceptibility requirements and limits defined in other portions of this standard.

4.1 Joint procurements. Equipments or subsystems procured by one DoD activity for multi-agency use shall comply with the requirements of the user agencies.

4.2 North Atlantic Treaty Organization (NATO) procurements. Equipments or subsystems procured by a DoD activity in support of NATO shall comply with the applicable requirements of this standard and any applicable NATO standardization agreement (STANAG), such as STANAGs -3516, -3614 and -3659. The NATO STANAGs are not to be waived, deviated from, or tailored unless specific authority has been granted by the procuring activity.

4.3 Design requirements. Equipments and subsystems shall be designed in accordance with the criteria and guidance contained in the following documents, as applicable: MIL-HDBK-235, MIL-HDBK-237, MIL-HDBK-241, MIL-HDBK-253, AFSC DH 1-4, AFSC DH 2-5 and AFSC DH 2-7, AMC Pamphlets 706-235 and 706-410, and NAVELEX 0101,106.

**4.3.1 Filtering.** The use of line-to-ground filters for EMI control shall be minimized. Such filters establish low impedance paths for structure (common-mode) currents through the ground plane and can be a major cause of interference in systems, platforms or installations because the currents can couple into other equipments using the same ground plane. If such a filter must be employed, the total line-to-ground capacitance shall not exceed 0.1 microfarads ( $\mu\text{F}$ ) for 60 hertz (Hz) equipment and 0.02  $\mu\text{F}$  for 400 Hz equipment. The filtering employed shall be fully described in the equipment or subsystem technical manual as well as the EMI Test Report.

**4.3.2 Equipments or subsystems employing electro-explosive devices (EEDs).** When EEDs are employed in, or are an integral part of, equipments or subsystems required to meet the requirements of this standard, the EED and associated wiring shall meet the requirements in 4.3.2.1, 4.3.2.2, or 4.3.2.3, as applicable.

**4.3.2.1 Air Force procurements.** AFSC DH 2-5 shall be used as a design guide and compliance with MIL-STD-1512 shall be accomplished.

**4.3.2.2 Navy procurements.** Compliance with MIL-STD-1385 shall be accomplished and OD 30393 shall be used as a design guide in implementing the principles outlined in MIL-STD-1385. In addition, MIL-STD-1377 shall be used to determine the effectiveness of cable, connector and weapon enclosure shielding and filtering. For air weapons, all circuits shall be isolated from the equipment or subsystem case and the case bonded to airframe.

**4.3.2.3 Army procurements.** The requirements in 4.3.2.1 and 4.3.2.2 shall be used as specified in the procurement documentation.

**4.4 Self-compatibility.** The operational performance of an equipment or subsystem shall not be degraded nor shall it malfunction when all of the units or devices in the equipment or subsystem are operating together at their designed levels of efficiency, or nominal design capability.

**4.5 Commercial off-the-shelf equipments.**

**4.5.1 Used in equipments or subsystems.**

**4.5.1.1 Selected by contractor.** When it is demonstrated by the contractor that a commercial item selected by the contractor is responsible for an equipment or subsystem failing to meet its contractual EMI requirements, either the commercial item shall be modified or replaced, or, interference suppression measures shall be employed so that the equipment or subsystem can meet its contractual EMI requirements.

**4.5.1.2 Specified by procuring activity.** When it is demonstrated by the contractor that a commercial item specified by the procuring activity for use in an equipment or subsystem is responsible for failure of the equipment or subsystem to meet its contractual EMI requirements, the data indicating such failure shall be included in the EMI Test Report. No modification nor replacement shall be made unless authorized by the procuring activity.

**4.5.2 Used as an individual equipment.** Commercial equipments without any previous EMI certification shall meet the applicable requirements in Parts 2 through 10 of this standard.

**4.6 Government furnished equipment (GFE).** When it is demonstrated by the contractor that a GFE is responsible for failure of an equipment or subsystem to meet its contractual EMI requirements, the data indicating such failure along with descriptions of possible modifications to the GFE shall be included in the EMI Test Report. No modification shall be made unless authorized by the procuring activity.

**4.7 Short-duration emissions.** Radiated and conducted transient emissions resulting from automatic cycling of electronic or electrical switching circuitry and manually controlled operational mode switching functions required for normal operation of the equipment or subsystem shall meet all applicable requirements of this standard.



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4.8 Procurements of equipments and subsystems having met other EMI requirements. Procurements of production-type equipments and subsystems electrically and mechanically identical to those previously procured by activities of DoD or other Federal agencies, or their contractors, shall meet the EMI requirements and associated limits, as applicable in the earlier procurement, unless otherwise specified by the command or agency concerned.

4.9 Testing requirements. The testing requirements and procedures of MIL-STD-462, as implemented by a Government approved EMI test plan, shall be used to determine compliance with the applicable emission and susceptibility requirements of Section 5 and Parts 2 through 10 of this standard. When performing susceptibility testing, the thresholds of susceptibility shall be determined and reported in the EMI Test Report, whether below the contractual EMI requirement or above, within the maximum capability of the test equipment used. Data gathered as a result of performing tests in one electromagnetic discipline may be sufficient to satisfy requirements in another. Therefore, to avoid unnecessary duplication, a single test program should be established with similar tests conducted concurrently whenever possible. Equipments that are intended to be operated as a subsystem shall be tested as such to the applicable emission and susceptibility requirements and limits whenever practical. Formal testing is not to commence without approval of the test plan by the command or agency concerned.

## 5. EMISSION AND SUSCEPTIBILITY REQUIREMENTS AND LIMITS

5.1 General. TABLE 1-I is a list of emission and susceptibility requirements established by this standard. General test procedures for these requirements are contained in MIL-STD-462. All results of tests performed to demonstrate compliance with these requirements are to be documented in the EMI Test Report and forwarded to the command or agency concerned for evaluation prior to acceptance of the equipment or subsystem. Approval of design procedures and techniques described in the EMI Control Plan does not relieve the supplier of the responsibility of meeting the contractual emission, susceptibility, and design requirements. The test report shall be required by the contract and is to be forwarded to the command or agency concerned for evaluation prior to acceptance of the equipment or subsystem.

5.2 Equipment and subsystem classes. TABLE 1-II defines equipment and subsystem classes in accordance with their intended installation, platform and mission. In addition, TABLE 1-II denotes the applicable part of this standard wherein emission and susceptibility requirements and limits are specified. When an equipment or subsystem falls into more than one class, it shall comply with the most stringent of the applicable requirements and limits. (CAUTION: Care should be exercised when specifying classes inasmuch as the class designations used herein are different from those employed in previous issues of this standard.)



TABLE 1-I. Emission and susceptibility requirements.

Requirement	Description
CE01	Conducted Emissions, Power and Interconnecting Leads, Low Frequency (up to 15 kHz)
CE03	Conducted Emissions, Power and Interconnecting Leads, 0.015 to 50 MHz
CE06	Conducted Emissions, Antenna Terminals 10 kHz to 26 GHz
CE07	Conducted Emissions, Power Leads, Spikes, Time Domain
CS01	Conducted Susceptibility, Power Leads, 30 Hz to 50 kHz
CS02	Conducted Susceptibility, Power Leads, 0.05 to 400 MHz
CS03	Intermodulation, 15 kHz to 10 GHz
CS04	Rejection of Undesired Signals, 30 Hz to 20 GHz
CS05	Cross-modulation, 30 Hz to 20 GHz
CS06	Conducted Susceptibility, Spikes, Power Leads
CS07	Conducted Susceptibility, Squelch Circuits
CS09	Conducted Susceptibility, Structure (Common Mode) Current, 60 Hz to 100 kHz
RE01	Radiated Emissions, Magnetic Field, 0.03 to 50 kHz
RE02	Radiated Emissions, Electric Field, 14 kHz to 10 GHz
RE03	Radiated Emissions, Spurious and Harmonics, Radiated Technique
RS01	Radiated Susceptibility, Magnetic Field, 0.03 to 50 kHz
RS02	Radiated Susceptibility, Magnetic Induction Field, Spikes and Power Frequencies
RS03	Radiated Susceptibility, Electric Field, 14 kHz to 40 GHz
UM03	Radiated Emissions, Tactical and Special Purpose Vehicles and Engine-Driven Equipment
UM04	Conducted Emissions and Radiated Emissions and Susceptibility Engine Generators and Associated Components UPS and MEP Equipments
UM05	Conducted and Radiated Emissions, Commercial Electrical and Electromechanical Equipments

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TABLE 1-II. Equipment and subsystem classes vs. applicable part of MIL-STD-461 for emission and susceptibility requirements and limits.

Class	Description	Applicable Part
A	Equipments and subsystems which must operate compatibly when installed in critical areas, such as the following platforms or installations:	
A1	Aircraft (including associated ground support equipment)	2
A2	Spacecraft and Launch Vehicles (including associated ground support equipment)	3
A3	Ground facilities (fixed and mobile, including tracked and wheeled vehicles)	4
A4	Surface Ships	5
A5	Submarines	6
B	Equipments and subsystems which support the Class A equipments and subsystems but which will not be physically located in critical ground areas. Examples are electronic shop maintenance and test equipment used in non-critical areas; aerospace ground equipment used away from flightlines; theodolites, nav aids and similar equipments used in isolated areas.	7
C	Miscellaneous, general purpose equipments and subsystems not usually associated with a specific platform or installation. Specific items in this class are:	
C1	Tactical and special purpose vehicles and engine-driven equipment	8
C2	Engine generators and associated components, uninterruptible power sets (UPS) and mobile electric power (MEP) equipment supplying power to or used in critical areas	9
C3	Commercial electrical or electromechanical equipment	10

## 6. NOTES

6.1 Deliverable data items requirements. When this standard is used in a procurement which incorporates a DD Form 1423 and invokes the provisions of 7-104.9(n) of the Defense Acquisition Regulation (DAR), the data requirements identified herein will be developed as specified by the approved Data Item Descriptions (DID) (DD Form 1664) and delivered in accordance with the approved Contract Data Requirements List (CDRL) (DD Form 1423) incorporated into the contract. When the provisions of DAR 7-104.9(n) are not invoked, the data specified herein will be delivered by the contractor in accordance with the contract requirements. Deliverable data required by this standard are as follows:

<u>Applicable Para.</u>	<u>Data requirement</u>	<u>Applicable DID</u>
5.1	Electromagnetic Interference Control Plan	DI-R-7061
4.9	Electromagnetic Interference Test Plan	DI-R-7063
5.1	Electromagnetic Interference Test Report	DI-R-7062

(Copies of data item descriptions required by the contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

6.2 Certain provisions of this document are the subject of international standardization agreement (STANAGs -3516, -3614, and -3659). When change notice, revision, or cancellation of this document is proposed which will affect or violate the international agreement concerned, the preparing activity shall take appropriate reconciliation action through international standardization channels, including departmental standardization offices, if required.

Custodians  
Army - CR  
Navy - EC  
Air Force - 11

Preparing Activity:  
Navy-EC  
(Project EMCS-0018)

Review Activities  
Army - MI, AV  
Navy - SH, OS, AS, YD, MC, CG, TD  
Air Force - 13, 15, 17, 19, 68, 69, 79, 99  
NSA  
DCA  
DoDECAC

User Activities:  
Army - AT, ME, GL, CE, MD

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## 1. SCOPE

This part of MIL-STD-461 supplements Part 1 of the standard by defining emission and susceptibility requirements and limits for equipments and subsystems intended for use aboard aircraft (class A1), including associated ground support equipment.

1.1 Determining requirements.

1.1.1 Air Force and Navy procurements. TABLE 2-I defines categories of class A1 equipments and subsystems. TABLE 2-II shall be used to determine the requirements applicable for equipments and subsystems procured for Air Force or Navy use. The table also denotes the paragraphs wherein the requirements and limits are defined. A Y entry in the table means the requirement is applicable and the limit shall be met using the procedures in MIL-STD-462 or the approved EMI Test Plan. A Y<sub>L</sub> entry means the applicability of the requirement is limited and is specified in the appropriate corresponding paragraph. The limit shall be met using the procedures in MIL-STD-462 or the approved EMI Test Plan. A T entry means that the applicability of the requirement must be determined on a case-by-case basis and that if the requirement is to be imposed, it must be so specified in the appropriate procurement document. When required, the limit shall be met using the procedures in MIL-STD-462 or the approved EMI Test Plan. Absence of an entry means the requirement is not applicable.

TABLE 2-I. Categories of Class A1 equipments and subsystems.  
(For Air Force and Navy use)

Category	Description
A1a	Air-launched missiles
A1b	Equipment installed on aircraft (internal or external to airframe)
A1c	Aerospace ground equipment required for the checkout and launch of the aircraft, including electronic test and support equipment
A1d	Trainers and simulators
A1e	Portable medical equipment used for aeromedical airlift
A1f	Aerospace ground equipment used away from the flightline, such as engine test stands and hydraulic test fixtures
A1g	Jet engine accessories

1.1.2 Army procurements. TABLE 2-III shall be used to determine the specific requirements for class A1 equipments and subsystems procured for Army use. The table also denotes the paragraphs wherein the requirements and limits are defined. A Y entry in the table means the requirement is applicable and the limit shall be met using the procedures in MIL-STD-462 or the approved EMI Test Plan. A Y<sub>L</sub> entry means the applicability of the requirement is limited and is specified in the appropriate corresponding paragraphs. When applicable, the limit shall be met using the procedures in MIL-STD-462 or the approved EMI Test Plan. A T entry means that the applicability must be determined on a case-by-case basis and that if the requirement is to be imposed, it must be so specified in the appropriate procurement document. When required, the limit shall be met using the procedures in MIL-STD-462 or the approved EMI Test Plan. Absence of an entry means the requirement is not applicable. For procurements of subsystems, such as radar, EW, surveillance, navigation, and the like, comprised of individual equipments listed in TABLE 2-III, the applicable emission and susceptibility requirements for the subsystem shall be tailored by the procuring activity based on the requirements of the individual equipments.

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**TABLE 2-II. Emission and susceptibility requirements for Class A1 equipments and subsystems (for Air Force and Navy use).**

Requirement	CATEGORIES OF CLASS A1 EQUIPMENTS AND SUBSYSTEMS							Applicable	
	A1a	A1b	A1c	A1d	A1e	A1f	A1g <sup>1</sup>	Paragraph	Limit Curve
CE01		Y <sub>L</sub>					Y <sub>L</sub>	2	2-1
CE03	Y	Y	Y	Y	Y	Y	Y	3	2-2, 2-3
CE06	Y <sub>L</sub>	Y <sub>L</sub>	Y <sub>L</sub>					4	
CE07	Y	Y	Y	Y	T			5	
CS01	Y	Y	T	Y	T		Y	6	2-4
CS02	Y	Y	Y	Y	T	T	Y	7	
CS03	Y <sub>L</sub>	Y <sub>L</sub>	Y <sub>L</sub>					8	
CS04	Y <sub>L</sub>	Y <sub>L</sub>	Y <sub>L</sub>			Y <sub>L</sub>		9	2-5
CS05	Y <sub>L</sub>	Y <sub>L</sub>	Y <sub>L</sub>			Y <sub>L</sub>		10	
CS06	Y	Y	Y	Y	Y		Y	11	2-6
CS07		Y <sub>L</sub>	Y <sub>L</sub>					12	
CS09		Y <sub>L</sub>						13	2-7
RE01		Y <sub>L</sub>						14	2-8
RE02	Y	Y	Y	Y	Y	Y	Y	15	2-9, 2-10
RE03	T	T	T					16	
RS01	T	Y <sub>L</sub>						17	2-11
RS02		Y	Y	Y	Y	T	Y	18	2-6
RS03	Y	Y	Y	Y	Y	T	Y	19	

<sup>1</sup> See SAE AIR 1423 and 1425 for additional guidance on tailoring.



TABLE 2-III. Emission and susceptibility requirements for Class A1 equipments and subsystems (For Army use).

Requirement	Specific Equipment/Subsystem	Applicable Paragraph																																	
		Receivers	Transmitters	Antenna Multicouplers	Amplifier, Tuned, RF	Amplifier, Untuned, RF	Intercom/Interphone	Modem	Repeater	Amplifier, Power/Audio	Modulators	Multiplexers	Laser Devices	IR Devices	Transponders	Beacons	Power Supplies	Sensors/Antennas	Inertial Guidance	Teletypewriters	Recorders	Visual Displays	Digital Equipment	Data Annotation	Camera Data	Telephone SWBD	Servo/Synchro	Test Equipment	Time/Frequency STDS	Ultrasonic Devices	Telephones	Trainers/Simulators	Commercial Eq.	All Others Not Listed Herein	
CE01		T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T				
CE03		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			
CE06		Y	Y												Y																	Y	Y		
CE07		T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T			
CS01		Y <sub>L</sub>	Y <sub>L</sub>	Y <sub>L</sub>	Y <sub>L</sub>	Y <sub>L</sub>	Y <sub>L</sub>	Y <sub>L</sub>	Y <sub>L</sub>	Y <sub>L</sub>	Y <sub>L</sub>	Y <sub>L</sub>	Y <sub>L</sub>	Y <sub>L</sub>	Y <sub>L</sub>	Y <sub>L</sub>	Y <sub>L</sub>	Y <sub>L</sub>	Y <sub>L</sub>	Y <sub>L</sub>	Y <sub>L</sub>	Y <sub>L</sub>	Y <sub>L</sub>	Y <sub>L</sub>	Y <sub>L</sub>	Y <sub>L</sub>	Y <sub>L</sub>	Y <sub>L</sub>	Y <sub>L</sub>	Y <sub>L</sub>	Y <sub>L</sub>	Y <sub>L</sub>	Y <sub>L</sub>		
CS02		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		
CS03		T			T										T																				
CS04		T			T										T																				
CS05		T			T										T																				
CS06		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		
CS07		T																																	
RE02		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		
RE03			Y												Y																			Y	Y
RS01																		T	T																
RS02										T							T	T	T	T	T											T			
RS03		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		

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## 2. CE01 (limited applicability)

**2.1 CE01 applicability.** This requirement is applicable only for equipments and subsystems installed on aircraft having an anti-submarine warfare (ASW) capability. When required, CE01 is applicable only for narrowband emissions between 30 Hz and 15 kilohertz (kHz) on the following types of leads: alternating current (AC) or direct current (DC) leads which obtain power from other sources or provide power to other equipments, distribution panels, or subsystems; grounds or neutrals which are not grounded internally to the subsystem or equipment being measured; and control circuits using test sample power, which provide power to, or control, relays, solenoids, valves, intervalometers, bomb releases, and the like. The requirement is not applicable for signal leads such as clock, IF, audio, firing, digital, RF and the like, unless otherwise specified by the Command or agency concerned.

## 2.2 CE01 limits.

**2.2.1 AC, DC and interconnecting control leads.** Electromagnetic emissions shall not appear on AC, DC and interconnecting control leads in excess of the values shown on FIGURE 2-1. The limits shall be met when measured with an effective bandwidth not exceeding 75 Hz.

**2.2.2 Interconnecting signal leads.** If compliance with this requirement is required for signal leads, limits shall be developed on a case-by-case basis considering the intentional transmission, its specified power level, necessary information bandwidth and pulse rise time. Such limits must be approved by the Command or agency concerned.

## 3. CE03

**3.1 CE03 applicability.** This requirement is applicable for the following types of leads: AC and DC leads which obtain power from other sources or provide power to other equipments, distribution panels or subsystems; ground or neutrals which are not grounded internally to the subsystem or equipment being measured; and control circuits using test sample power, which provide power to, or control, relays, solenoids, valves, intervalometers, bomb releases, and the like. The requirement is not applicable for signal leads such as a clock, IF, audio, firing, digital, radio frequency (RF), and the like, unless otherwise specified by the Command or agency concerned. For Army procurements, the requirement is applicable using the Line Impedance Stabilization Network, as described in MIL-STD-462.

## 3.2 CE03 limits.

**3.2.1 AC, DC, and interconnecting control leads.** Electromagnetic emissions shall not appear on AC, DC and interconnecting control leads in excess of the values shown on FIGURES 2-2 and 2-3 for narrowband and broadband emissions, respectively.

**3.2.2 Interconnecting signal leads.** If compliance with this requirement is required for signal leads, limits shall be developed on a case-by-case basis considering the intentional transmission, its specified power level, necessary information bandwidth and pulse rise time. Such limits must be approved by the Command or agency concerned.

## 4. CE06 (limited applicability)

**4.1 CE06 applicability.** This requirement is applicable for those equipments and subsystems with antenna leads or those designed to be connected to antennas. Transmitters with absolute peak powers less than or equal to -10 decibels above one watt (dBW) (0.1 watt) are exempt from meeting the harmonic and spurious portions of this requirement. The transmitter (key-down mode), harmonic and spurious emission portions of this requirement are not applicable for equipments and subsystems procured solely for Army use when any of the following conditions exist: (a) transmitter power exceeds 5 kilowatts (kW) average; (b) the fundamental frequency of the test sample exceeds 1.24 gigahertz (GHz); (c) the test sample's antenna is an integral part of the transmitter and cannot be replaced by a suitable dummy load; or (d) for equipments and subsystems with waveguide transmission lines and operating below 1.24 GHz. For cases (a) through (d) use RE03. The frequency range of this requirement is dependent on the operating frequency of the test sample (see MIL-STD-462). The transmitter (key-down) portion of this requirement is not applicable within either the test sample's necessary bandwidth or  $\pm 5$  percent of the fundamental frequency.

4.2 CE06 limits. Conducted emissions in excess of the values given in 4.2.1 through 4.2.3 shall not appear at the test sample's antenna terminals.

4.2.1 Receivers.

- a. Narrowband emissions: 34 decibels above 1 microvolt (dB $\mu$ V)
- b. Broadband emissions: 40 dB $\mu$ V/megahertz (MHz)

4.2.2 Transmitters (key-up and standby).

- a. Narrowband emissions: 34 dB $\mu$ V
- b. Broadband emissions: 40 dB $\mu$ V/MHz

4.2.3 Transmitters (key-down mode). Harmonics, except the second and third and all other spurious emissions shall have peak powers 80 decibels (dB) down from the power at the fundamental. The second and third harmonics shall be suppressed by:  $40 + 10 \log P$ , (where P = peak power, in watts, at the fundamental) or 80 dB, whichever requires less suppression.

5. CE07

5.1 CE07 applicability. This requirement is applicable for Air Force and Navy procurements for the following types of leads: AC or DC leads which obtain power from or provide power to other equipments or subsystems.

5.2 CE07 limits. Conducted switching transients shall not exceed the following, as applicable:

- a. AC leads:  $\pm 50$  percent of nominal rms voltage.
- b. DC leads:  $+ 50$  percent,  $-150$  percent of nominal line voltage.

6. CS01 (limited applicability)

6.1 CS01 applicability. This requirement is applicable to equipment and subsystem power leads, including grounds and neutrals which are not grounded internally to the equipment or subsystem. The requirement is not applicable within  $\pm 5$  percent of the power frequency(ies). This requirement may be deleted, with the approval of the Command or agency concerned, if no circuit within the equipment or system is more sensitive than 100 millivolts (mV). For equipments and subsystems procured solely for Army use, this requirement is applicable for DC leads only.

6.2 CS01 limits. The test sample shall not exhibit any malfunction, degradation of performance or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when subjected to electromagnetic energy injected onto its power leads equal to the values on FIGURE 2-4. The requirement is also met when the power source specified in CS01 of MIL-STD-462, adjusted to dissipate 50 watts in a 0.5 ohm load, cannot develop the required voltage at the test sample power input terminals and the test sample is not susceptible to the output of the signal source.

7. CS02

7.1 CS02 applicability. This requirement is applicable to equipment and subsystem power leads, including grounds and neutrals which are not grounded internally to the equipment or subsystem.

7.2 CS02 limits. The test sample shall not exhibit any malfunction, degradation of performance or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when subjected to 1-volt from a 50 ohm source across the calibrating resistor shown in the test setup for FIGURE CS02-1 as shown in MIL-STD-462. The test signal shall be applied directly to the equipment input terminals, not through the test sample's power line cord. The requirement is also met when a 1-watt source of 50 ohms impedance cannot develop the required voltage at the test sample power input terminals and the test sample is not susceptible to the output of the signal source.

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## 8. CS03 (limited applicability)

8.1 CS03 applicability. This requirement is applicable to receiving equipments and sub-systems, such as receivers, RF amplifiers, transceivers, and the like. The applicable frequency range of this requirement is dependent on the operating frequency of the test sample as specified in MIL-STD-462.

8.2 CS03 limits. The test sample shall not exhibit any intermodulation products from two signals, beyond those permitted in the individual equipment or subsystem specification when:

- a. Signal generator #1 is set 66 dB above the level required to obtain the standard reference output as specified in MIL-STD-462, except that when  $f_1$  is in the frequency range of either 200 to 400 MHz or 2 to 25 MHz, the generator output shall be 80 dB above the reference level.
- b. Signal generator #2 is set 66 dB above the level required to obtain the standard reference output, as specified in MIL-STD-462, but the generator output level shall not exceed a power level of 10 dBm.

## 9. CS04 (limited applicability)

9.1 CS04 applicability. This requirement is applicable to receiving equipment and sub-systems, such as receivers, RF amplifiers, transceivers and the like. The applicable frequency range of this requirement is dependent on the operating frequency of the test sample, as specified in MIL-STD-462.

9.2 CS04 limits. The test sample shall not exhibit any undesired response when subjected to the test signal shown on FIGURE 2-5.

## 10. CS05 (limited applicability)

10.1 CS05 applicability. This requirement is applicable to receiving equipment and sub-systems such as receivers, RF amplifiers, transceivers and the like. The applicable frequency range of this requirement is dependent on the operating frequency of the test sample, as specified in MIL-STD-462.

10.2 CS05 limits. The test sample shall not exhibit, due to cross modulation, any malfunction, degradation of performance or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when subjected to the following from signal generator #2: a signal 66 dB above the level required to obtain the standard reference output, as specified in MIL-STD-462, but not to exceed a power output level of 10 dBm.

## 11. CS06

11.1 CS06 applicability. This requirement is applicable to equipment and subsystem power leads, including grounds and neutrals which are not grounded internally to the equipment or subsystem.

11.2 CS06 limits. The test sample shall not exhibit any malfunction, degradation of performance or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when the test spikes each having the waveform shown on FIGURE 2-6 are applied sequentially to the AC and DC power input leads. The values of  $E$  and  $t$  are given below. Each spike shall be superimposed on the powerline voltage waveform.

- |                                  |   |
|----------------------------------|---|
| a. Spike #1 (Army)               | $E_1 = 200 \text{ Volts}; t_1 \leq 10 \text{ microseconds}$   |
| b. Spike #2 (Air Force and Navy) | $E_2 = 200 \text{ Volts}; t_2 \leq 0.15 \text{ microseconds}$ |

11.2.1 For equipments and subsystems whose power inputs are protected with varistors, the requirement is also met if the equipment or subsystem is not susceptible to values of  $E$ , equal to the maximum safe level of the varistor.

## 12. CS07 (limited applicability)

12.1 CS07 applicability. This requirement is applicable for receiving equipments and subsystems which utilize squelch circuits.

12.2 CS07 limits.

12.2.1 Requirement 1. Squelch circuits shall not open when the output of a 50-ohm impedance impulse generator, set at 90 dB $\mu$ V/MHz is applied and matched to the input terminals of the test sample.

12.2.2 Requirement 2. The squelch circuit shall not open when two signals are applied at the input of the test sample. One signal shall be an unmodulated RF signal at the receiver tuned frequency whose amplitude is two-thirds of the RF voltage used to adjust the squelch threshold. The second signal shall be an impulse signal of 50 dB $\mu$ V/MHz.

## 13. CS09 (limited applicability)

13.1 CS09 applicability. This requirement is applicable to Navy equipment and subsystems that have an operating frequency range of 100 kHz or less and an operating sensitivity of 1 $\mu$ V or less, such as 0.5 $\mu$ V.

13.2 CS09 limits. The test sample shall not exhibit any malfunction, degradation of performance or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when subjected to the levels shown on FIGURE 2-7 across the applicable test points.

## 14. RE01 (limited applicability)

14.1 RE01 applicability. This requirement is applicable only for equipments and subsystems installed in aircraft having an ASW capability. When required, RE01 is applicable for radiated emissions from equipments and subsystems, cables (including control, pulse, intermediate frequency (IF), power antennas transmission lines) and interconnecting wiring of the test sample. The requirement applies at the fundamental frequencies, and all spurious emissions including harmonics, but does not apply for radiation from antennas.

14.2 RE01 limit. Magnetic field emissions shall not be radiated in excess of the levels shown on FIGURE 2-8.

## 15. RE02

15.1 RE02 applicability. This requirement is applicable for radiated emissions from equipments and subsystems, cables (including control, pulse, IF, power and antennas transmission lines) and interconnecting wiring of the test sample; for narrowband, it applies at the fundamental frequencies, and all spurious emissions including harmonics, but does not apply for radiation from antennas. This requirement is applicable for broadband emissions from 14 kHz to 1 GHz and for narrowband emissions from 14 kHz to 10 GHz.

15.2 RE02 limits. E-field emissions shall not be radiated in excess of those given in 15.2.1 and 15.2.2. Above 30 MHz, the limits shall be met for both horizontally and vertically polarized waves.

15.2.1 Narrowband electric field emissions. Narrowband E-field emissions shall not be radiated in excess of the applicable limit curve shown on FIGURE 2-9 at the required test distance, as specified in MIL-STD-462.

15.2.2 Broadband electric field emissions. Broadband E-field emissions from all equipments and subsystems, including radiated switching transients resulting from: (1) automatic cycling of electronic or electrical switching circuitry, (2) actuation of push-to-talk mechanisms (that is, keying of transmitters); or (3) manual switching, shall not be radiated in excess of the applicable limit curve shown on FIGURE 2-10 at the required test distances, as specified in MIL-STD-462.

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## 16. RE03 (limited applicability)

**16.1 RE03 applicability.** This requirement is applicable for transmitting equipments and subsystems with antenna leads or those designed to be connected to antennas. Transmitters with absolute peak powers less than or equal to -10 dBW (0.1 watt) are exempt from meeting this requirement. The frequency range of this requirement is dependent on the operating frequency of the test sample (see MIL-STD-462). The requirement is not applicable within either the test sample's necessary bandwidth or  $\pm 5$  percent of the fundamental frequency.

**16.1.1 Army procurements.** This requirement is applicable for transmitting equipments and subsystems procured solely for Army use when any of the following conditions exist: (a) transmitter power exceeds 5 kW average; (b) the fundamental frequency of the test sample exceeds 1.24 GHz; (c) the test sample's antenna is an integral part of the transmitter and cannot be replaced by a suitable dummy load; or (d) for equipments and subsystems with waveguide transmission lines and operating below 1.24 GHz.

**16.1.2 Air Force and Navy procurements.** This requirement is applicable, with the approval of the procuring activity, when the transmitter spurious emissions and harmonics cannot be determined using the procedures in CE06.

**16.2 RE03 limit.** Harmonics, except the second and third, and all other spurious emissions shall have peak powers 80 dB down from the power at the fundamental. The second and third harmonics shall be suppressed by:  $40 + 10 \log P$  (where  $P$  = peak power, in watts, at the fundamental) or 80 dB whichever requires less suppression.

## 17. RS01 (limited applicability)

**17.1 RS01 applicability.** This requirement is applicable only for equipments and subsystems installed in aircraft having an ASW capability. When required, RS01 is applicable to equipments and subsystems, and their associated cabling and connectors.

**17.2 RS01 limit.** The test sample shall not exhibit any malfunction, degradation of performance, or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when subjected to magnetic fields equal to the levels shown on FIGURE 2-11.

## 18. RS02

**18.1 RS02 applicability.** This requirement is applicable to equipment and systems as indicated in 18.1.1 and 18.1.2.

**18.1.1 Part I - spikes applicability.** This portion of RS02 is applicable for all Department of Defense (DoD) activities.

**18.1.2 Part II - power frequency applicability.** This requirement is applicable for equipments and subsystems procured for Air Force and Navy use.

## 18.2 RS02 limits.

**18.2.1 Part I - spikes.** The test sample shall not exhibit any malfunction, degradation of performance, or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when subjected sequentially to the test spikes each having the waveform shown on FIGURE 2-6. The values of  $E_1$  and  $t_1$  are given below:

- |                                  |   |
|----------------------------------|---|
| a. Spike #1 (Army)               | $E_1 = 200$ Volts; $t_1 \leq 10$ microseconds   |
| b. Spike #2 (Air Force and Navy) | $E_2 = 200$ Volts; $t_2 \leq 0.15$ microseconds |

**18.2.2 Part II - power frequency.** The test sample shall not exhibit any malfunction, degradation of performance, or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when 20 amperes are applied to the test wire at the power frequency(ies) of the test sample.



## 19. RS03

19.1 RS03 applicability. This requirement is applicable for all equipments and subsystems between 14 kHz and 10 GHz. Above 10 GHz up to 40 GHz this requirement applies only at all intentionally generated frequencies of known intentional emitters on the aircraft.

19.2 RS03 limits. The test sample shall not exhibit any malfunction, degradation of performance, or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when subjected to the radiated electric fields (E) specified herein. Above 30 MHz, the requirement shall be met for both horizontally and vertically polarized waves. Appropriate consideration shall be given to the operational radiated electromagnetic environment from both friendly and hostile emitters which an equipment or subsystem may encounter during its life cycle. Applicable portions of MIL-HDBK-235 shall be used to determine the anticipated environment. As a minimum, the following levels apply. If levels substantially higher than those given herein are specified, modifications to the procedure in MIL-STD-462 may be required. Such modifications are to be described in the EMI Test Plan.

<u>Frequency Range</u>	<u>E-Field (Volts/Meter (V/m))</u>
14 kHz to 2 MHz	10, except that for Army procurements the level is 1 V/m.
2 to 30 MHz	10
30 MHz to 10 GHz	5
10 to 40 GHz	20

19.2.1 Air Force and Navy equipments and subsystems installed in non-metallic aircraft, non-metallic structures on metallic aircraft or externally mounted on metallic aircraft. Such equipments shall not malfunction when subjected to a radiated E-field of 200 V/m over the required frequency range.

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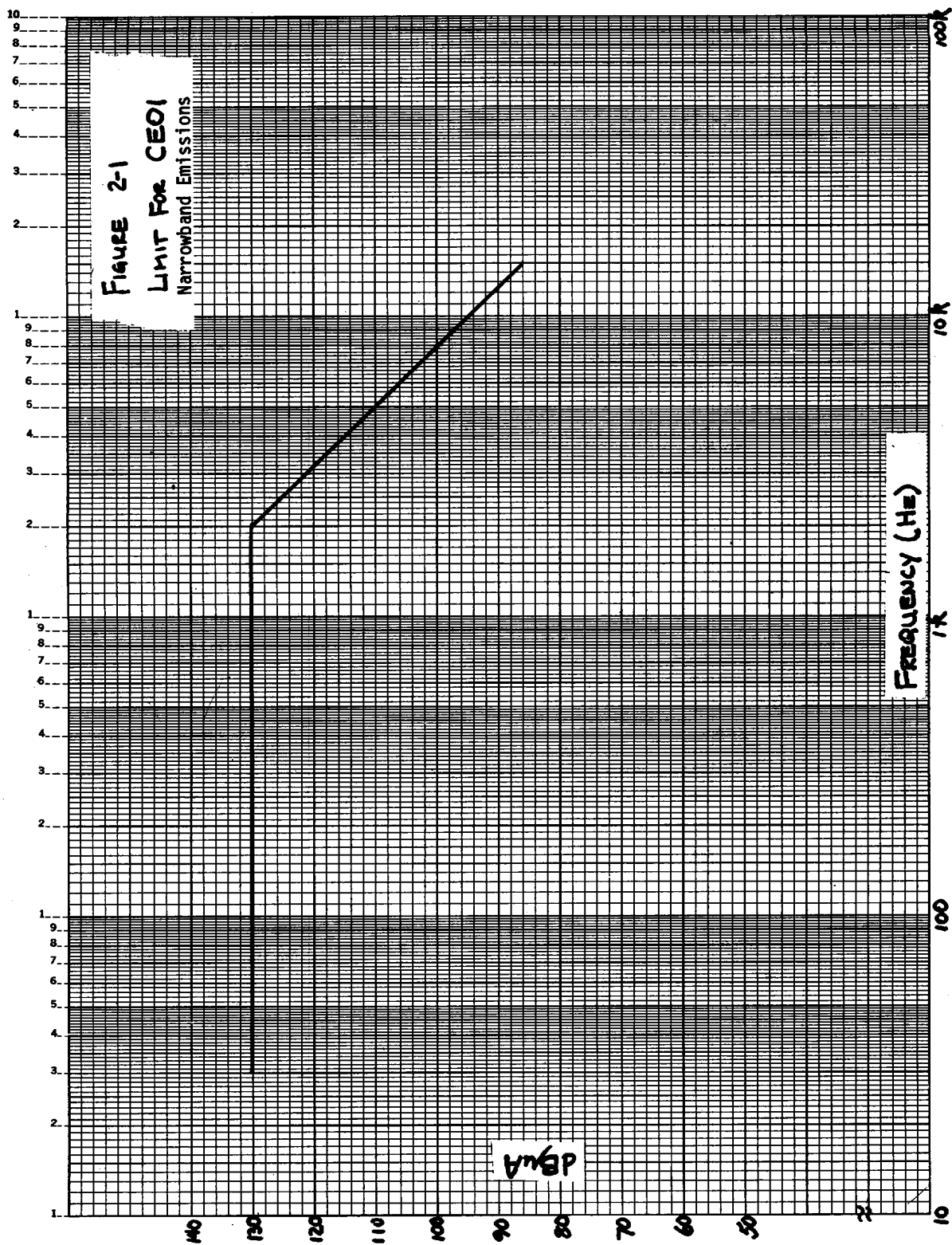


FIGURE 2-1. Limit for CEOI narrowband emissions.



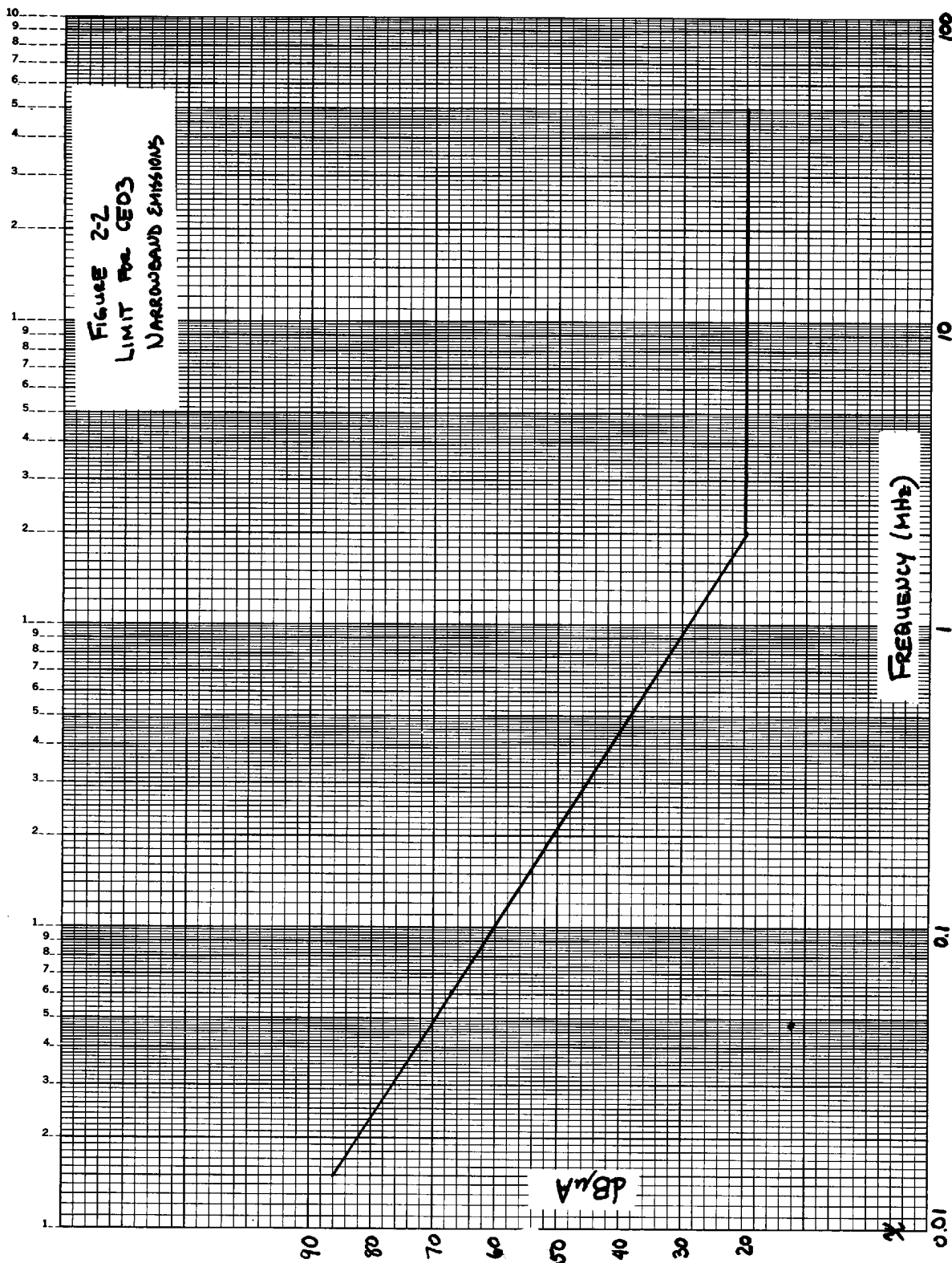


FIGURE 2-2. Limit for CE03 narrowband emissions.

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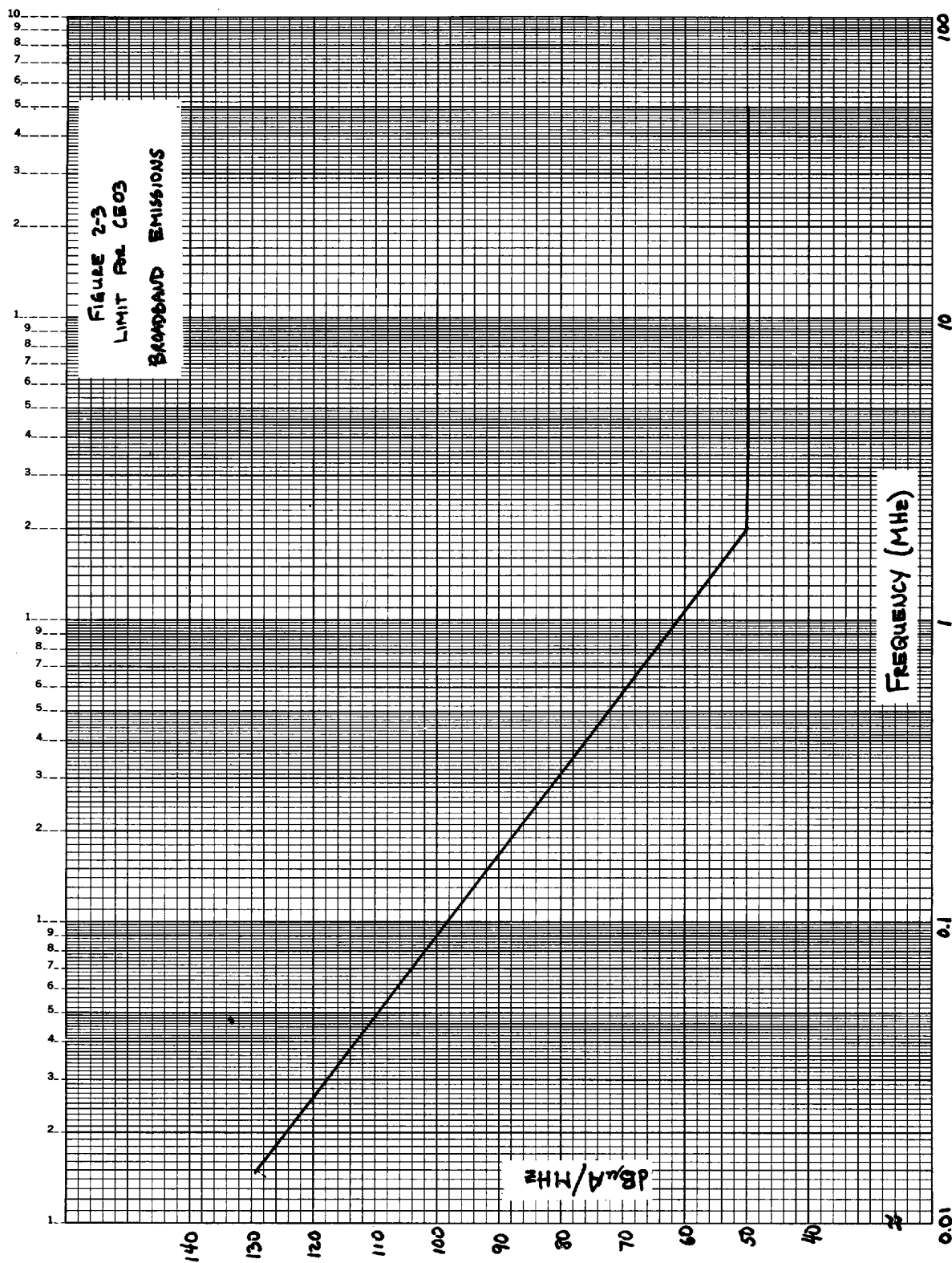


FIGURE 2-3. Limit for CE03 broadband emissions.

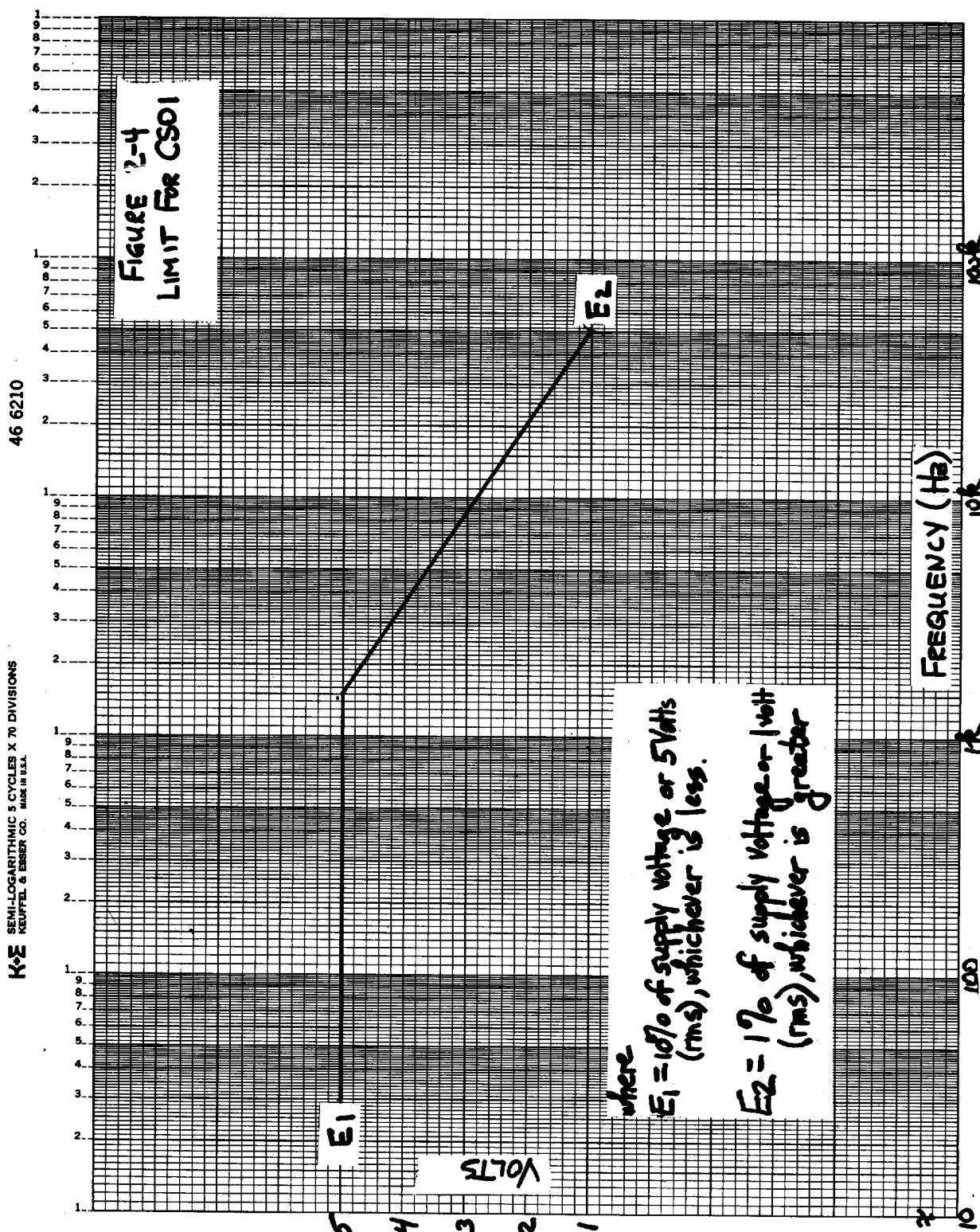
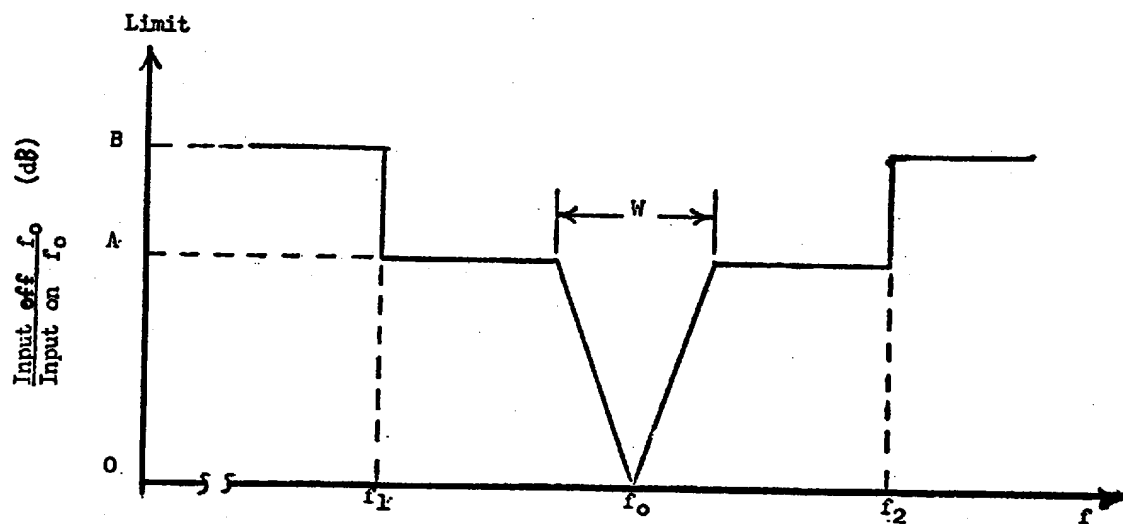


FIGURE 2-4. Limit for CS01.

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$f_o$  = Receiver tuned frequency or band center for amplifiers.

$f_1$  = Lowest tunable frequency of receiver band in use or the lowest frequency of amplifier passband.

$f_2$  = Highest tunable frequency of receiver band in use or the highest frequency of amplifier passband.

$W$  = Bandwidth between the 80 dB points of the receiver selectivity curve as defined in the test sample's technical requirements or the control plan.

#### Limits:

1. The limit at A is 80 dB above the input level required to produce the standard reference output. (This limit shall not be used for amplifiers)
2. The limit at B shall be set as follows:
  - a. Receivers: 0 dBm applied directly to the receiver input terminals.
  - b. Amplifiers: The limit shall be as specified in the test sample's technical requirement or control plan. If no limit is defined in the above documents, the 0 dBm value shall be used.

FIGURE 2-5. Limit for CS04.



FIGURE 2-6  
LIMIT FOR CS06 AND RS02

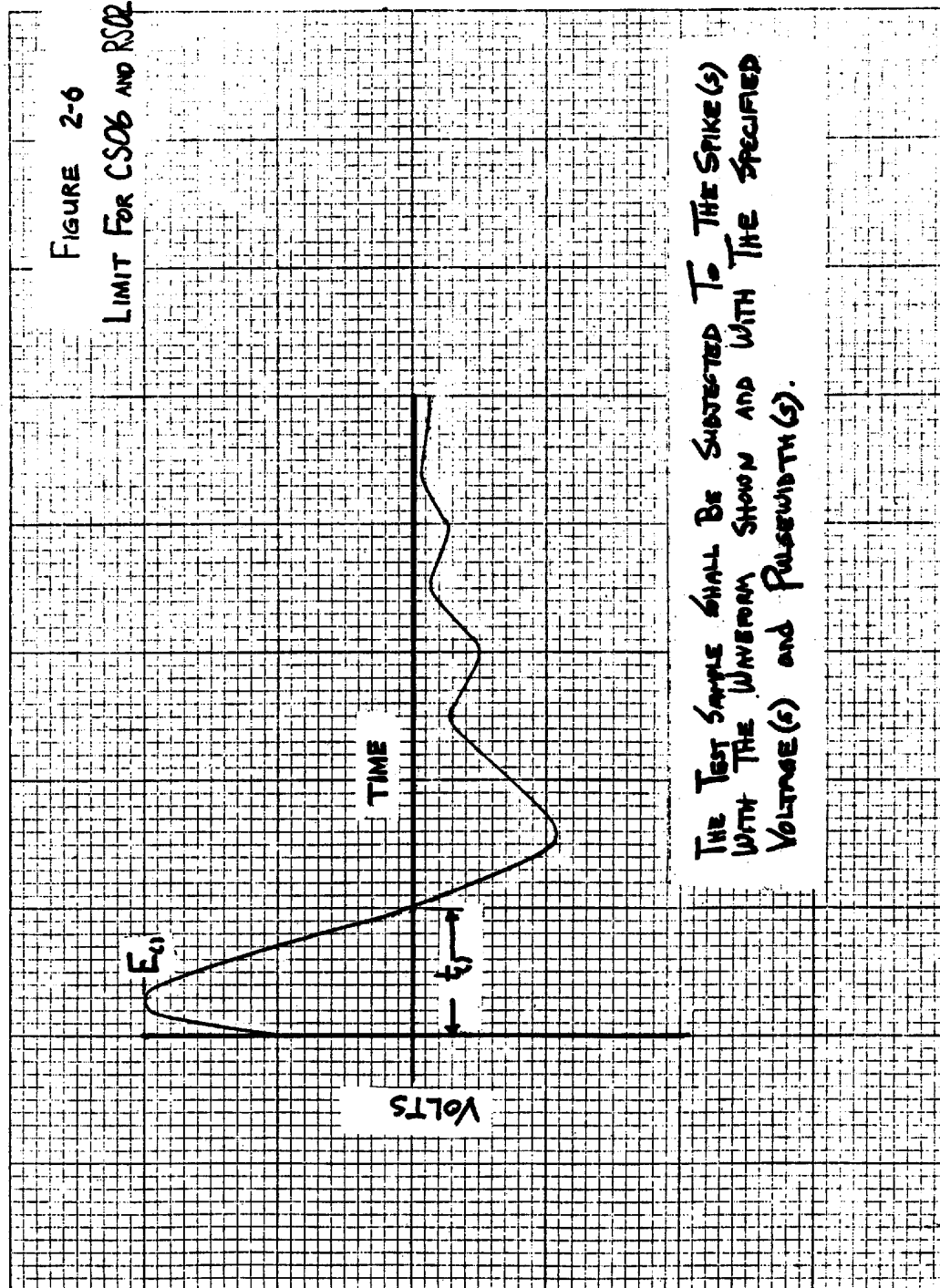


FIGURE 2-6. Limit for CS06 and RS02.

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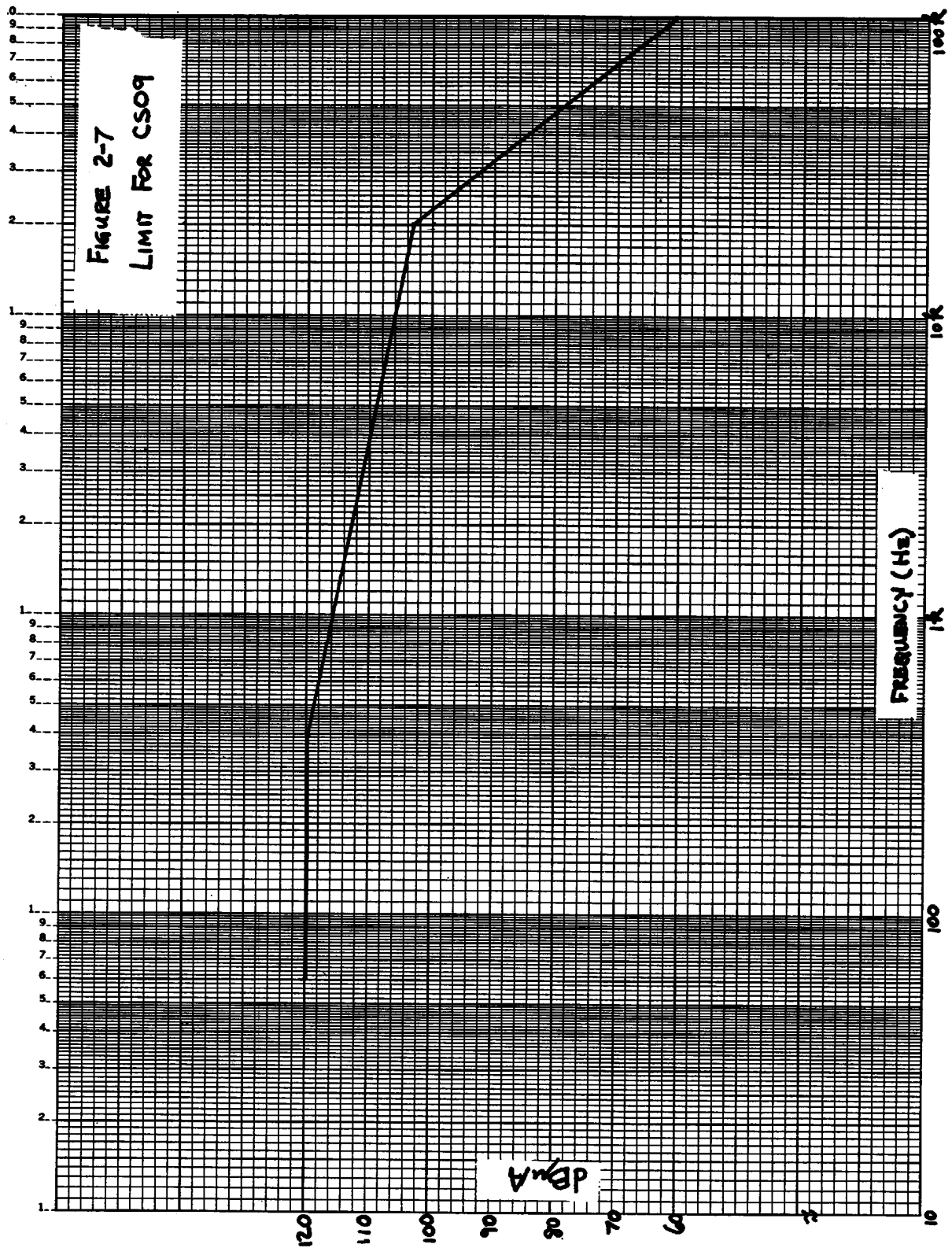


FIGURE 2-7 Limit for CS09.

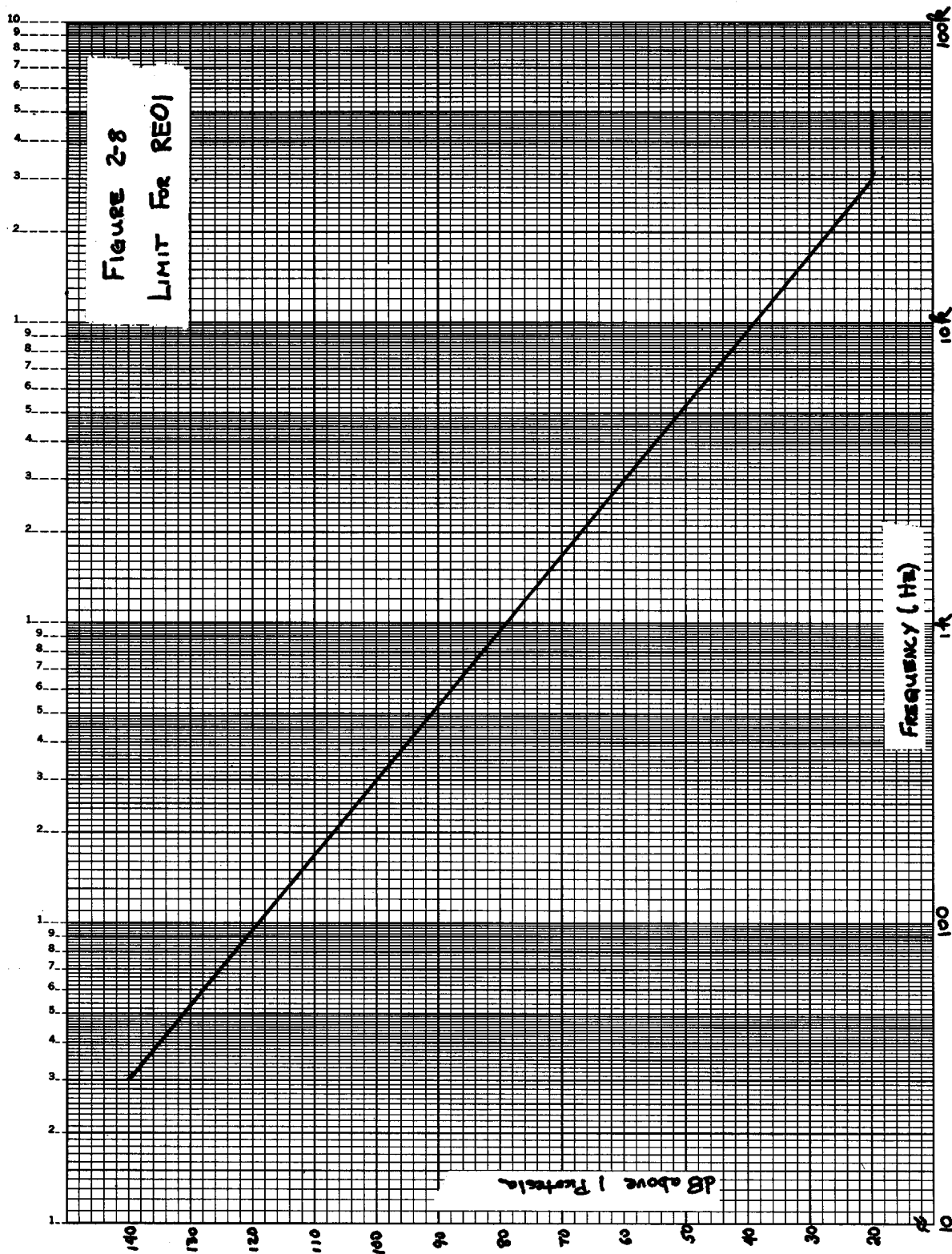


FIGURE 2-8. Limit for REO1.

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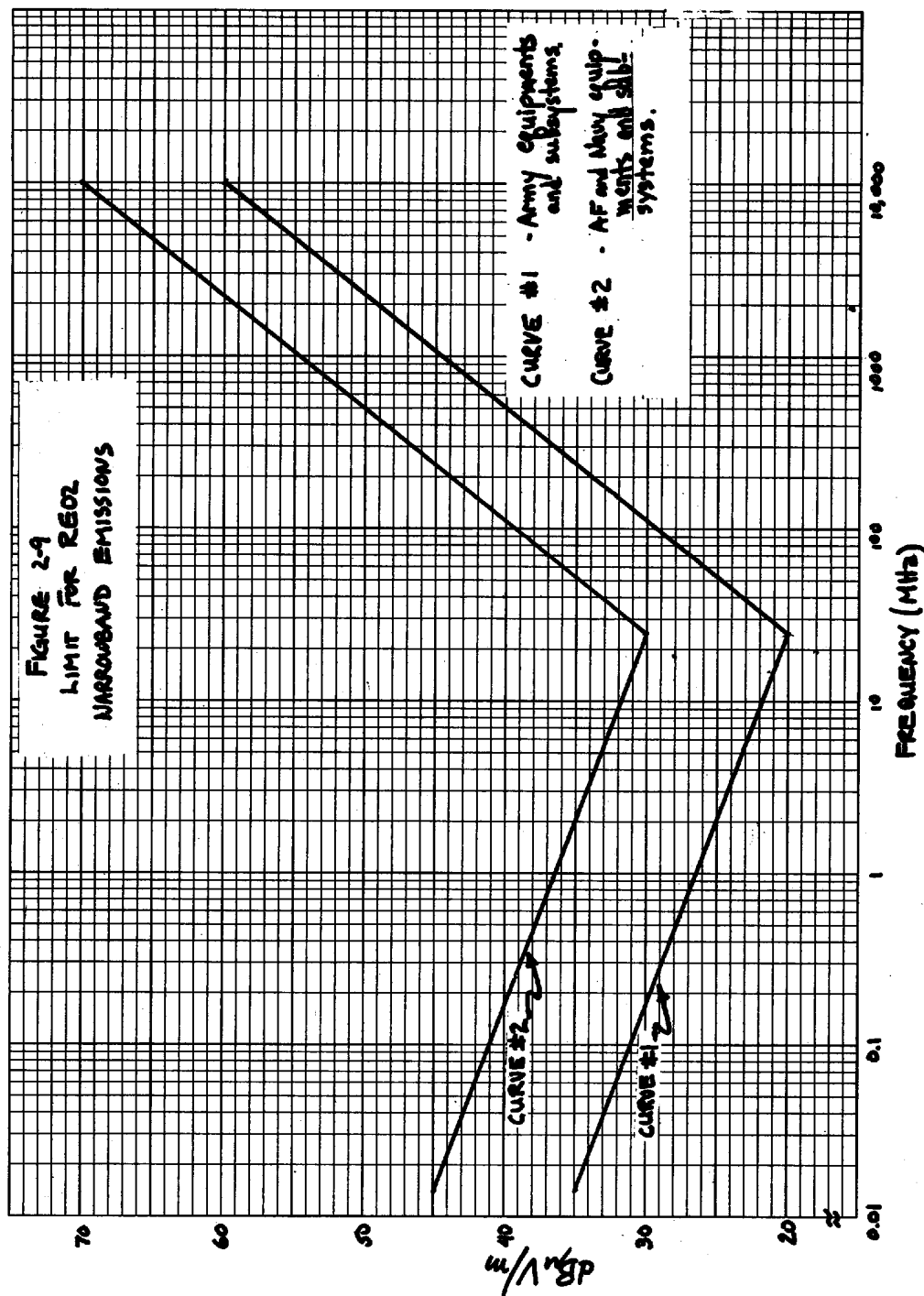


FIGURE 2-9. Limit for RE02 narrowband emissions.



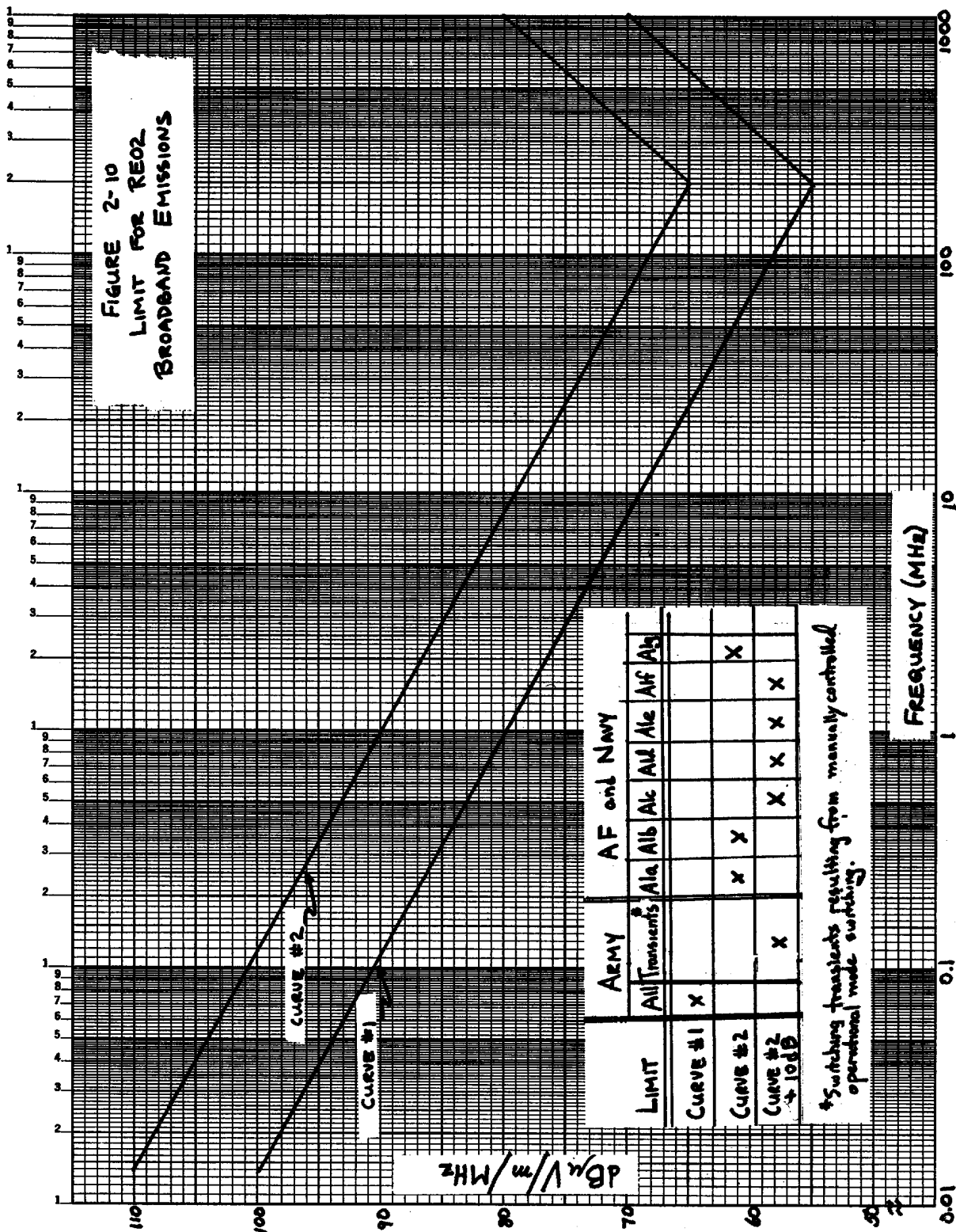


FIGURE 2-10. Limit for RE02 broadband emissions.

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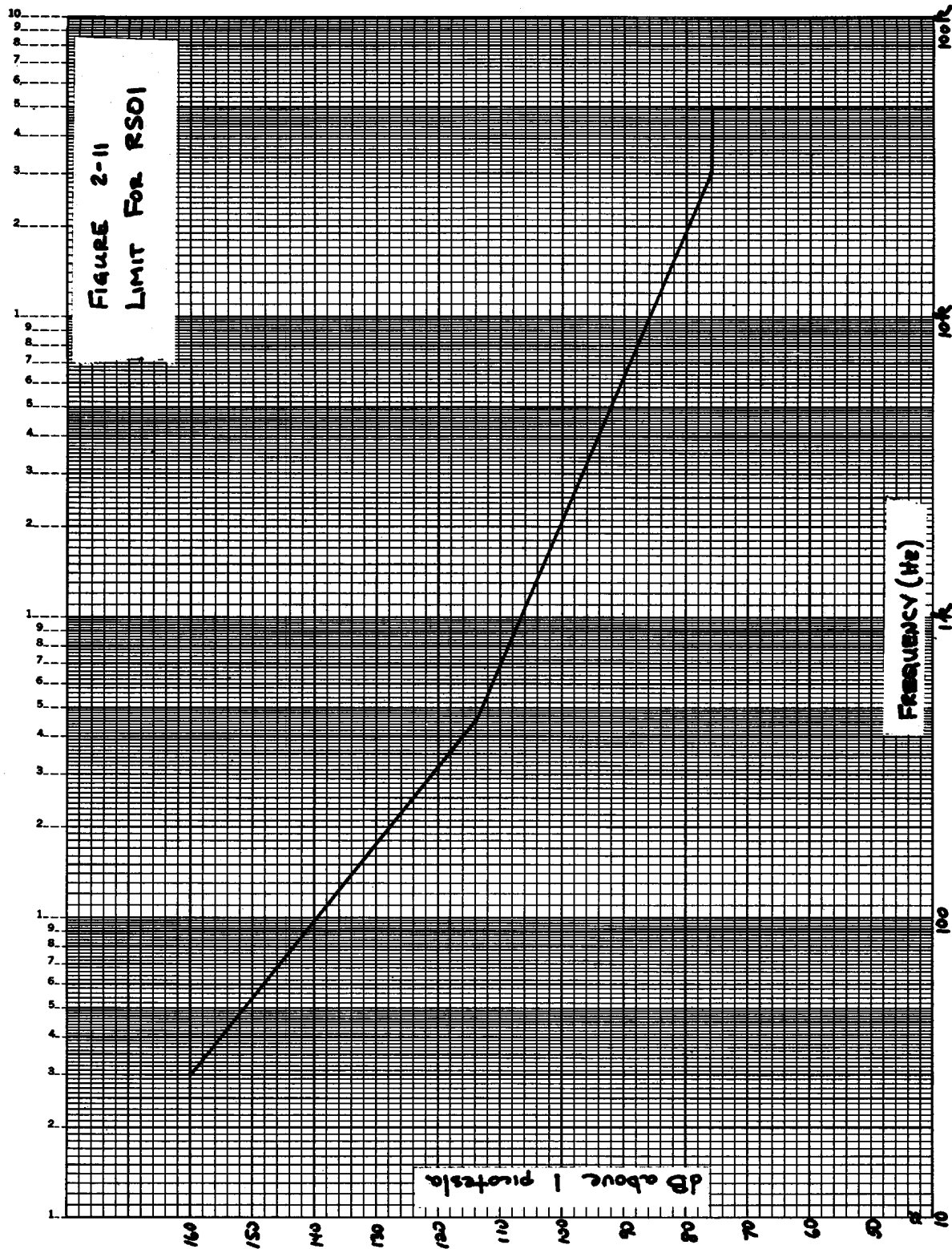


FIGURE 2-11. Limit for RS01.

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## 1. SCOPE

This part of MIL-STD-461 supplements Part 1 of the standard by defining emission and susceptibility requirements and limits for equipments and subsystems intended for use aboard spacecraft and launch vehicles (class A2), including associated ground support equipment.

1.1 Determining requirements. TABLE 3-I defines categories of class A2 equipments and subsystems. TABLE 3-II shall be used to determine the requirements applicable to class A2 equipments and subsystems. The table also denotes the paragraphs wherein the requirements and limits are defined. A Y entry in the table means the requirement is applicable and the limit shall be met using the procedures in MIL-STD-462 or the approved EMI Test Plan. A Y<sub>L</sub> entry means the applicability of the requirement is limited and is specified in the corresponding appropriate paragraph. When applicable, the limit shall be met using the procedures in MIL-STD-462 or the approved EMI Test Plan. A T entry means that the applicability of the requirement must be determined on a case-by-case basis and that if the requirement is to be imposed, it must be so specified in the appropriate procurement document. When required, the limit shall be met using the procedures in MIL-STD-462 or the approved EMI Test Plan. Absence of an entry means the requirement is not applicable.

TABLE 3-I. Categories of Class A2 equipments and subsystems.

Category	Description
A2a	Equipment installed on spacecraft or launch vehicle
A2b	Aerospace ground equipment required for the checkout and launch, including electronic test and support equipment
A2c	Trainers and simulators

## 2. CE01 (limited applicability)

2.1 CE01 applicability. When required, CE01 is applicable only for narrowband emissions between 30 Hz and 15 kHz on the following types of leads: AC or DC leads which obtain power from or provide power to other equipments, distribution panels or subsystems; grounds or neutrals which are not grounded internally to the subsystem or equipment being measured; and control circuits using test sample power, which provide power to, or control, relays, solenoids, valves, intervalometers, bomb releases, and the like. The requirement is not applicable for signal leads such as clock, IF, audio, firing, digital, RF and the like unless otherwise specified by the Command or agency concerned.

2.2 CE01 limits.

2.2.1 AC, DC and interconnecting control leads. Electromagnetic emissions shall not appear on AC, DC and interconnecting control leads in excess of the values shown on FIGURE 3-1. The limits shall be met when measured with an effective bandwidth not exceeding 75 Hz.

2.2.2 Interconnecting signal leads. If compliance with this requirement is required for signal leads, limits shall be developed on a case-by-case basis considering the intentional transmission, its specified power level, necessary information bandwidth and pulse rise time. Such limits must be approved by the Command or agency concerned.

## 3. CE03

3.1 CE03 applicability. This requirement is applicable for the following types of leads: AC and DC leads which obtain power from other sources or provide power to other equipments, distribution panels or subsystems; grounds or neutrals which are not grounded internally to the subsystem or equipment being measured; and control circuits using test sample power, which provide power to, or control, relays, solenoids, valves, intervalometers, bomb releases, and the like. The requirement is not applicable for signal leads such as clock, intermediate frequency (IF), audio, firing, digital, RF and the like unless otherwise specified by the Command or agency concerned.

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**TABLE 3-II. Emission and susceptibility requirements for Class A2 equipments and subsystems.**

Requirement	Categories of Class A2 Equipments/ Subsystems			Applicable	
	A2a	A2b	A2c	Paragraph	Limit Curve
CE01	T			2	3-1
CE03	Y	Y	Y	3	3-2, 3-3
CE06	Y <sub>L</sub>	Y <sub>L</sub>		4	
CE07	Y	Y	Y	5	
CS01	Y	T	Y	6	3-4
CS02	Y	Y	Y	7	
CS03	Y <sub>L</sub>	Y <sub>L</sub>		8	
CS04	Y <sub>L</sub>	Y <sub>L</sub>		9	3-5
CS05	Y <sub>L</sub>	Y <sub>L</sub>		10	
CS06	Y	Y		11	3-6
CS07	Y <sub>L</sub>	Y <sub>L</sub>		12	
RE01	T			13	3-7
RE02	Y	Y	Y	14	3-8, 3-9
RE03	Y <sub>L</sub>	Y <sub>L</sub>		15	
RS02	Y	Y	Y	16	3-6
RS03	Y	Y	Y	17	



### 3.2 CE03 limits.

3.2.1 AC, DC and interconnecting control leads. Electromagnetic emissions shall not appear on AC, DC and interconnecting control leads in excess of the values shown on FIGURES 3-2 and 3-3 for narrowband and broadband emissions, respectively.

3.2.2 Interconnecting signal leads. If compliance with this requirement is required for signal leads, limits shall be developed on a case-by-case basis considering the intentional transmission, its specified power level, necessary information bandwidth and pulse rise time. Such limits must be approved by the Command or agency concerned.

### 4. CE06 (limited applicability)

4.1 CE06 applicability. This requirement is applicable for those equipments and subsystems with antenna leads or those designed to be connected to antennas. Transmitters with absolute peak powers less than or equal to -10dBW (0.1 watt) are exempt from meeting the harmonic and spurious portions of this requirement. The transmitter (key-down mode), harmonic and spurious emission portions of this requirement are not applicable for equipments and subsystems procured solely for Army use when any of the following conditions exist: (a) transmitter power exceeds 5 kW average; (b) the fundamental frequency of the test sample exceeds 1.24 GHz; (c) the test sample's antenna is an integral part of the transmitter and cannot be replaced by a suitable dummy load; or (d) for equipments and subsystems with waveguide transmission lines and operating below 1.24 GHz. For cases (a) through (d) use RE03. The frequency range of this requirement is dependent on the operating frequency of the test sample (see MIL-STD-462). The transmitter (key-down) portion of this requirement is not applicable within either the test sample's necessary bandwidth or  $\pm 5$  percent of the fundamental frequency.

4.2 CE06 limits. Conducted emissions in excess of the values given in 4.2.1 through 4.2.3 shall not appear at the test sample's antenna terminals.

#### 4.2.1 Receivers.

- a. Narrowband emissions: 34 dB  $\mu$ V
- b. Broadband emissions: 40 dB  $\mu$ V/MHz

#### 4.2.2 Transmitters (key-up and standby).

- a. Narrowband emissions: 34 dB  $\mu$ V
- b. Broadband emissions: 40 dB  $\mu$ V/MHz

4.2.3 Transmitters (key-down mode). Harmonics, except the second and third and all other spurious emissions shall have peak powers 80 dB down from the power at the fundamental. The second and third harmonics shall be suppressed by:  $40 + 10 \log P$ , (where  $P$  = peak power, in watts, at the fundamental), or 80 dB whichever requires less suppression.

### 5. CE07

5.1 CE07 applicability. This requirement is applicable for the following types of leads: AC or DC leads which obtain power from or provide power to other equipments or subsystems.

5.2 CE07 limits. Conducted switching transients shall not exceed the following, as applicable:

- a. AC leads:  $\pm 50$  percent of nominal root mean square (rms) voltage.
- b. DC leads: + 50 percent, -150 percent of nominal line voltage.

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## 6. CS01

6.1 CS01 applicability. This requirement is applicable to equipment and subsystem power leads, including grounds and neutrals which are not grounded internally to the equipment or subsystem. The requirement is not applicable within + 5 percent of the power frequency(ies). This requirement may be deleted with the approval of the Command or agency concerned, if no circuit within the equipment or system is more sensitive than 100 mV.

6.2 CS01 limits. The test sample shall not exhibit any malfunction, degradation of performance, or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when subjected to electromagnetic energy injected onto its power leads less than or equal to the values on FIGURE 3-4.

6.2.1 The requirement is also met under the following condition: when the power source specified in MIL-STD-462, adjusted to dissipate 50 watts in a 0.5 ohm load, cannot develop the required voltage at the test sample power input terminals and the test sample is not susceptible to the output of the signal source.

## 7. CS02

7.1 CS02 applicability. This requirement is applicable to equipment and subsystem power leads, including grounds and neutrals which are not grounded internally to the equipment or subsystem.

7.2 CS02 limits. The test sample shall not exhibit any malfunction, degradation of performance or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when subjected to 1 volt from a 50-ohm source across the calibrating resistor shown in MIL-STD-462, FIGURE CS02-1. The test signal shall be applied directly to the equipment input terminals, not through the test sample's power line cord. The requirement is also met under the following condition: when a 1-watt source of 50 ohms impedance cannot develop the required voltage at the test sample power input terminals and the test sample is not susceptible to the output of the signal source.

## 8. CS03 (limited applicability)

8.1 CS03 applicability. This requirement is applicable to receiving equipments and subsystems, such as receivers, RF amplifiers, transceivers, and the like. The applicable frequency range of this requirement is dependent on the operating frequency of the test sample, as specified in MIL-STD-462. For Army equipment and subsystems, the requirement is applicable only when specifically called out in the procurement documentation.

8.2 CS03 limits. The test sample shall not exhibit any intermodulation products from two signals, beyond those permitted in the individual equipment or subsystem specification when:

- a. Signal generator #1 is set 66 dB above the level required to obtain the standard reference output as specified in MIL-STD-462, except that when  $f_1$  is in the frequency range of either 200 to 400 MHz or 2 to 25 MHz, the generator output shall be 80 dB above the reference level.
- b. Signal generator #2 is set 66 dB above the level required to obtain the standard reference output, as specified in MIL-STD-462, but the generator output level shall not exceed a power level of 10 dBm.



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## 9. CS04 (limited applicability)

**9.1 CS04 applicability.** This requirement is applicable to receiving equipment and subsystems, such as receivers, RF amplifiers, transceivers and the like. The applicable frequency range of this requirement is dependent on the operating frequency of the test sample, as specified in MIL-STD-462. For Army equipments and subsystems the requirement is applicable only when specifically called out in the procurement documentation.

**9.2 CS04 limits.** The test sample shall not exhibit any undesired response when subjected to the test signal shown on FIGURE 3-5.

## 10. CS05 (limited applicability)

**10.1 CS05 applicability.** This requirement is applicable to receiving equipment and subsystems, such as receivers, RF amplifiers, transceivers and the like. The applicable frequency range of this requirement is dependent on the operating frequency of the test sample as specified in MIL-STD-462. For Army equipment and subsystems the requirement is applicable only when specifically called out in the procurement documentation.

**10.2 CS05 limits.** The test sample shall not exhibit, due to cross modulation, any malfunction, degradation of performance or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when subjected to the following from signal generator #2: a signal 66 dB above the level required to obtain the standard reference output, as specified in MIL-STD-462, but not to exceed a power output level of 10 dBm.

## 11. CS06

**11.1 CS06 applicability.** This requirement is applicable to equipment and subsystem power leads, including grounds and neutrals which are not grounded internally to the equipment or subsystem.

**11.2 CS06 limits.** The test sample shall not exhibit any malfunction, degradation of performance, or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when the test spikes, each having the waveform shown on FIGURE 3-6, are applied sequentially to the AC and DC power input leads. The values of  $E_1$  and  $t_1$  are given below. Each spike shall be superimposed on the powerline voltage waveform.

- a. Spike #1  $E_1 = 200$  Volts;  $t_1 \geq 10$  microseconds
- b. Spike #2  $E_1 = 100$  Volts;  $t_2 \geq 0.15$  microseconds.

**11.2.1 Protected power inputs.** For equipments and subsystems whose power inputs are protected with varistors, the requirement is also met if the equipment or subsystem is not susceptible to values of  $E_1$ , equal to the maximum safe level of the varistor.

## 12. CS07 (limited applicability)

**12.1 CS07 applicability.** This requirement is applicable for receiving equipments and subsystems which utilize squelch circuits.

### 12.2 CS07 limits.

**12.2.1 Requirement 1.** Squelch circuits shall not open when the output of a 50-ohm impedance impulse generator, set at 90 dB  $\mu$ V/MHz is applied and matched to the input terminals of the test sample.

**12.2.2 Requirement 2.** The squelch circuit shall not open when two signals are applied at the input of the test sample. One signal shall be an unmodulated RF signal at the receiver tuned frequency whose amplitude is two-thirds of the RF voltage used to adjust the squelch threshold. The second signal shall be an impulse signal of 50 dB  $\mu$ V/MHz.

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### 13. RE01 (limited applicability)

**13.1 RE01 applicability.** Applications of this requirement are to be determined on a case-by-case basis. When required, RE01 is applicable for radiated emissions from equipments and subsystems, cables (including control, pulse, IF, power and antennas transmission lines) and interconnecting wiring of the test sample. The requirement applies at the fundamental frequencies, and all spurious emissions including harmonics, but does not apply for radiation from antennas.

**13.2 RE01 limit.** Magnetic field emissions shall not be radiated in excess of the levels shown on FIGURE 3-7.

### 14. RE02

**14.1 RE02 applicability.** This requirement is applicable for radiated emissions from equipments and subsystems, cables (including control, pulse, IF, power and antennas transmission lines) and interconnecting wiring of the test sample; for narrowband, it applies at the fundamental frequencies, and all spurious emissions including harmonics, but does not apply for radiation from antennas. This requirement is applicable for broadband emissions from 14 kHz to 1 GHz and for narrowband emissions from 14 kHz to 10 GHz.

**14.2 RE02 limits.** E-field emissions shall not be radiated in excess of those given in 14.2.1 and 14.2.2. Above 30 MHz, the limits shall be met for both horizontally and vertically polarized waves.

**14.2.1 Narrowband electric field emissions.** Narrowband E-field emissions shall not be radiated in excess of the limit curve shown on FIGURE 3-8 at the required test distance, as specified in MIL-STD-462.

**14.2.2 Broadband electric field emissions.** Broadband E-field emissions from all equipments and subsystems, including radiated switching transients resulting from: (1) automatic cycling of electronic or electrical switching circuitry, (2) actuation of push-to-talk mechanisms (that is, keying of transmitters), or (3) manual switching, shall not be radiated in excess of the applicable limit curve shown on FIGURE 3-9 at the required test distances as specified in MIL-STD-462.

### 15. RE03 (limited applicability)

**15.1 RE03 applicability.** This requirement is applicable for those equipments and subsystems with antenna leads or those designed to be connected to antennas. Transmitters with absolute peak powers less than or equal to -10 dBW (0.1 watt) are exempt from meeting this requirement. The frequency range of this requirement is dependent on the operating frequency of the test sample (see MIL-STD-462). The requirement is not applicable within either the test sample's necessary bandwidth or  $\pm 5$  percent of the fundamental frequency.

**15.1.1 Army procurements.** This requirement is applicable for transmitting equipments and subsystems procured solely for Army use when any of the following conditions exist: (a) transmitter power exceeds 5 kW average; (b) the fundamental frequency of the test sample exceeds 1.24 GHz; (c) the test sample's antenna is an integral part of the transmitter and cannot be replaced by a suitable dummy load; or (d) for equipments and subsystems with waveguide transmission lines and operating below 1.24 GHz.

**15.1.2 Air Force and Navy procurements.** This requirement is applicable, with the approval of the procuring activity, when the spurious emissions and harmonics cannot be determined using the procedures of CE06.

**15.2 RE03 limit.** Harmonics, except the second and third, and all other spurious emissions shall have peak powers 80 dB down from the power at the fundamental. The second and third harmonics shall be suppressed by:  $40 + 10 \log P$  (where  $P$  = peak power, in watts, at the fundamental), or 80 dB, whichever requires less suppression.

## 16. RS02

16.1 RS02 applicability. Parts I and II are applicable for all DoD activities.

16.2 RS02 limits.

16.2.1 Part I - spikes. The test sample shall not exhibit any malfunction, degradation of performance, or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when subjected sequentially to the test spikes, each having the waveform shown on FIGURE 3-6. The values of  $E_1$  and  $t_1$  are given below:

- a. Spike #1  $E_1 = 200$  Volts;  $t_1 \geq 10$  microseconds
- b. Spike #2  $E_2 = 100$  Volts;  $t_2 \geq 0.15$  microseconds

16.2.2 Part II - power frequency. The test sample shall not exhibit any malfunction, degradation of performance, or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when 20 amperes are applied to the test wire at the power frequency(ies) of the test sample.

## 17. RS03

17.1 RS03 applicability. This requirement is applicable for all equipments and subsystems between 14 kHz and 10 GHz. Between 10 GHz and 40 GHz this requirement applies only at all intentionally generated frequencies of any known emitter on the spacecraft or launch vehicle.

17.2 RS03 limits. The test sample shall not exhibit any malfunction, degradation of performance, or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when subjected to the radiated electric fields (E) less than or equal to those specified herein. Above 30 MHz, the requirement shall be met for both horizontally and vertically polarized waves. Appropriate consideration shall be given to the operational radiated electromagnetic environment from both friendly and hostile emitters which an equipment or subsystem may encounter during its lifecycle. Applicable portions of MIL-HDBK-235 shall be used to determine the anticipated environment. As a minimum, the following levels apply. If levels substantially higher than those given herein are specified, modifications to the procedures in MIL-STD-462 may be required. Such modifications are to be described in the EMI Test Plan.

<u>Frequency Range</u>	<u>E-Field (Volts/meter)</u>
14 kHz to 30 MHz	10
30 MHz to 10 GHz	5
10 to 40 GHz	20

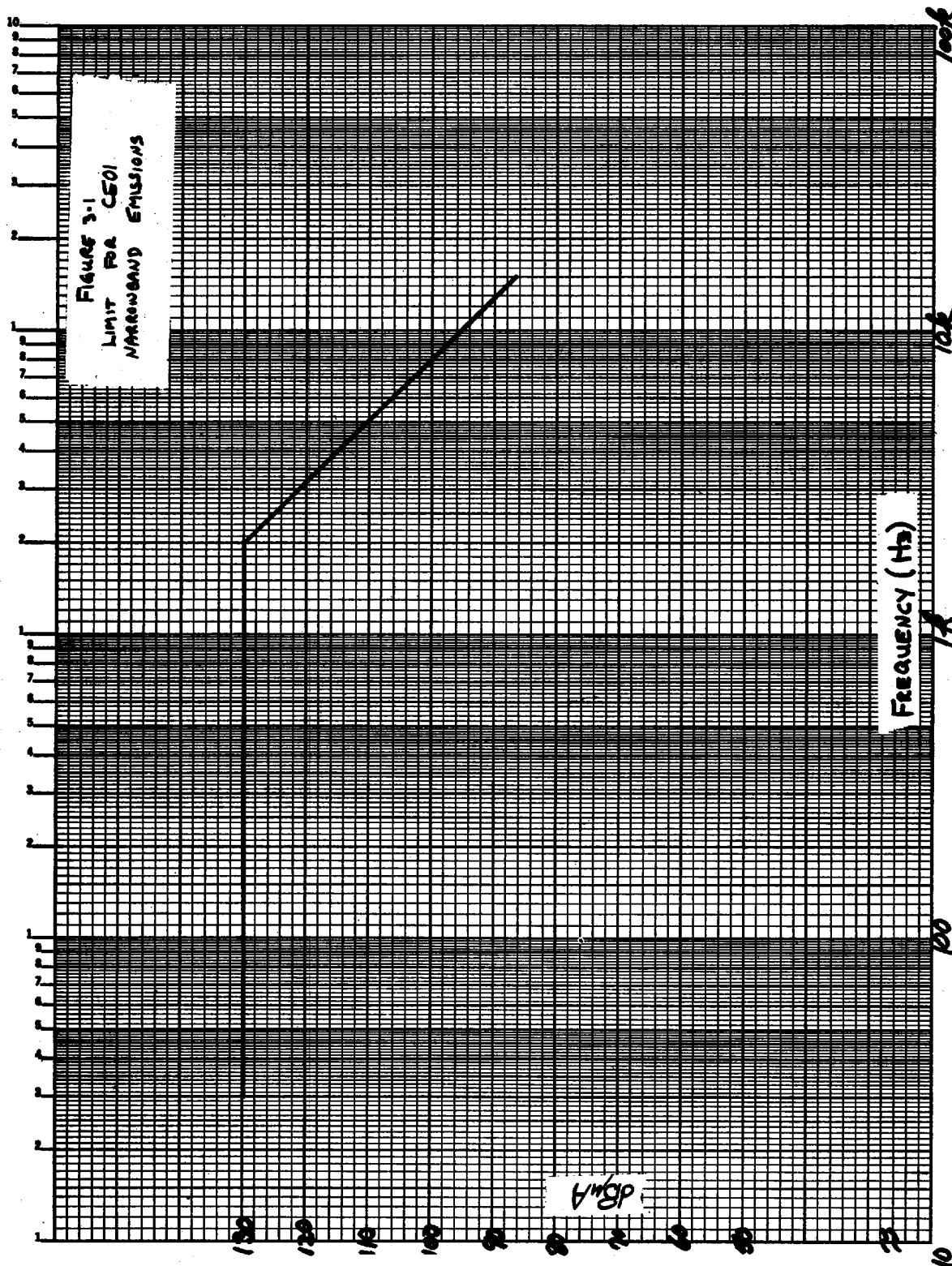


FIGURE 3-1. Limit for CE01 narrowband emissions.

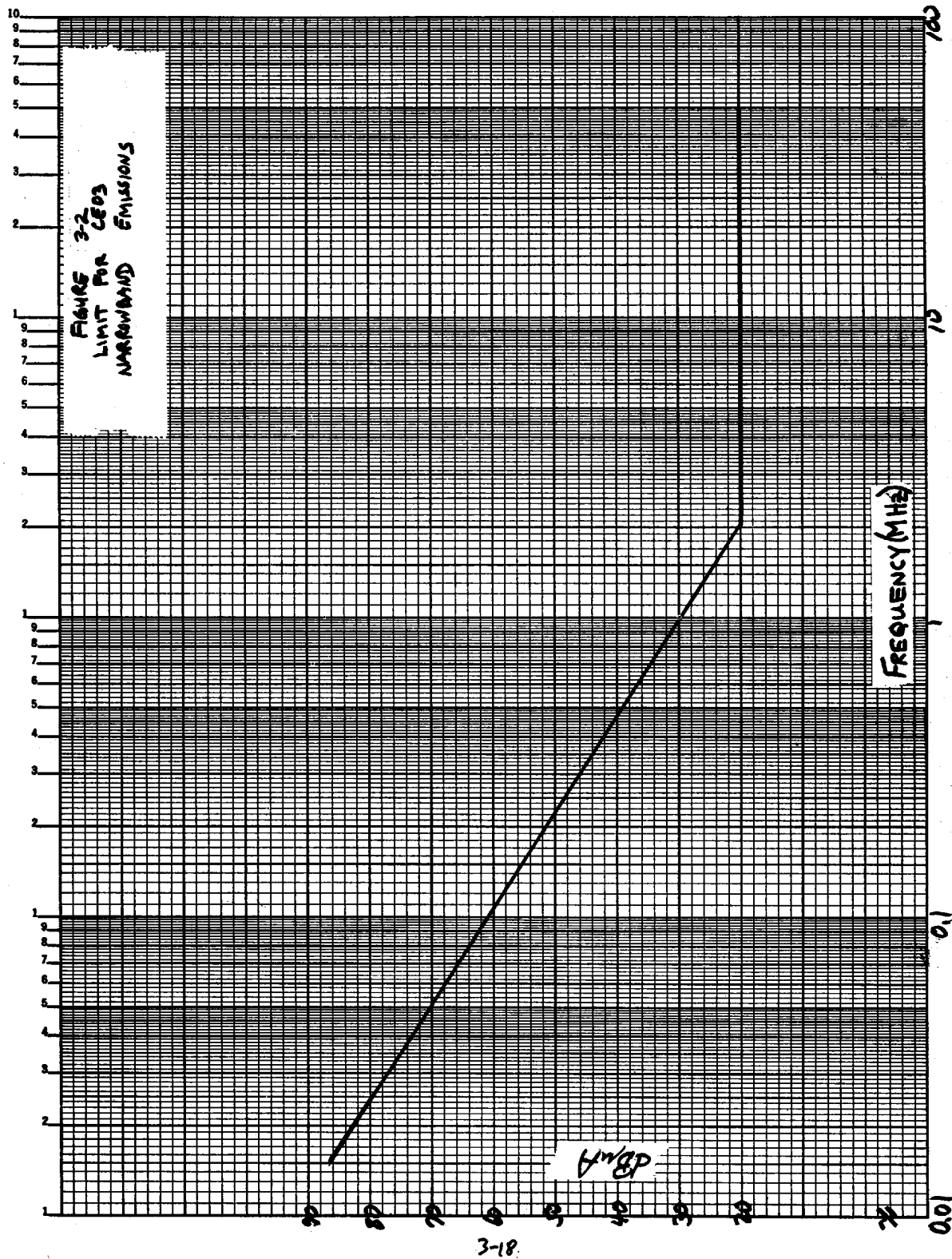


FIGURE 3-2. Limit for CE03 narrowband emissions.



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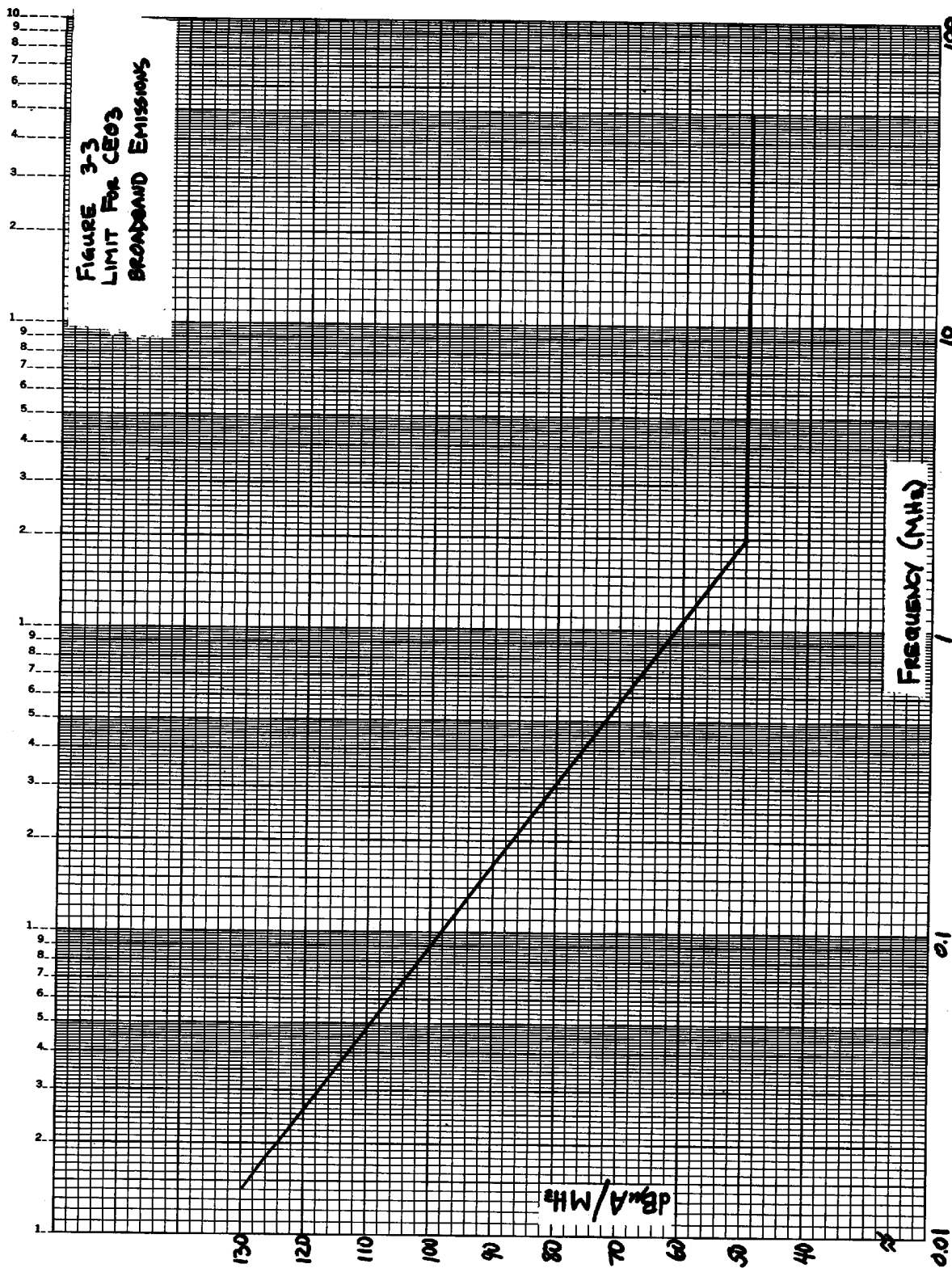


FIGURE 3-3. Limit for CE03 broadband emissions.

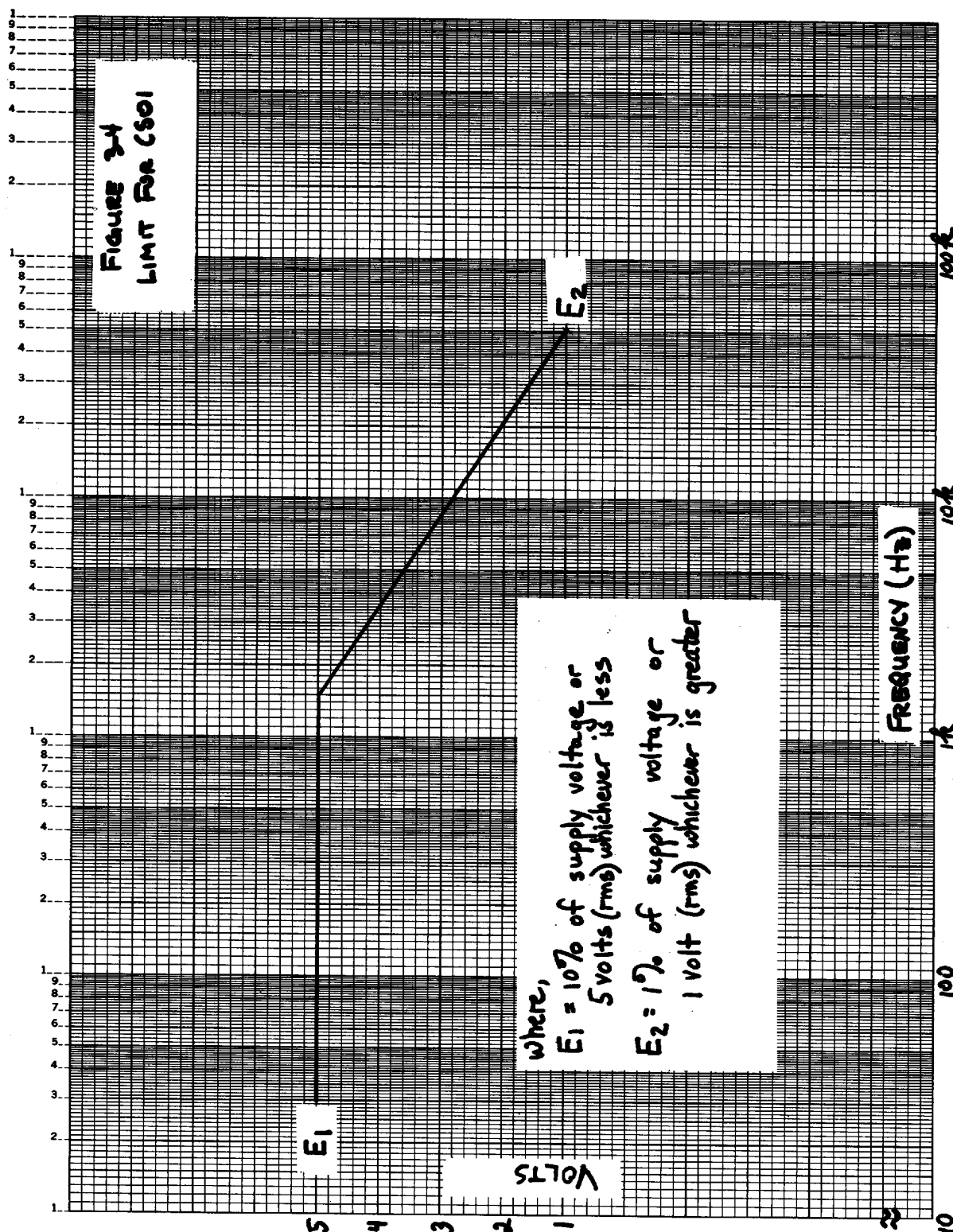
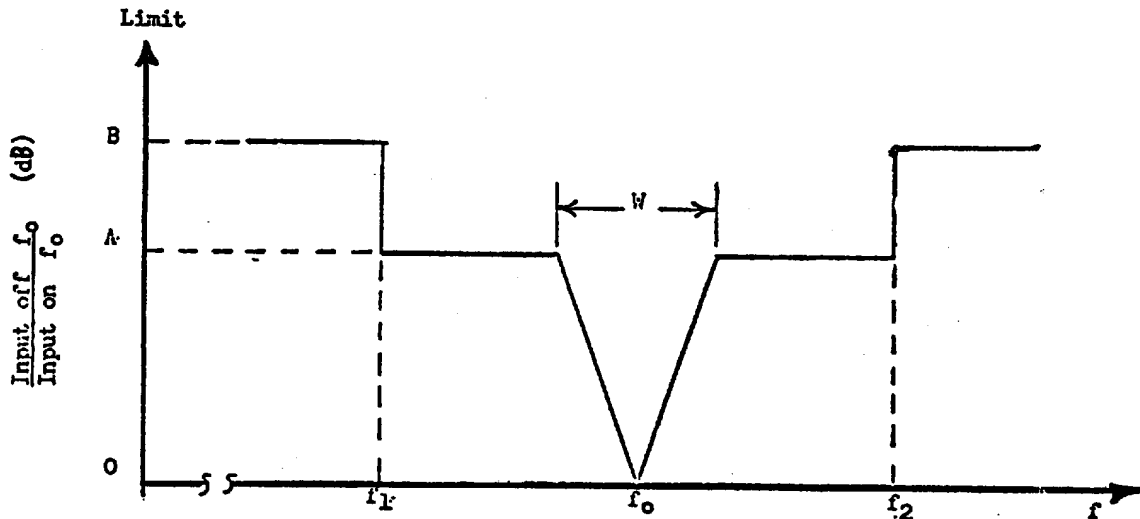


FIGURE 3-4. Limit for CS01.

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$f_o$  = Receiver tuned frequency or band center for amplifiers.

$f_1$  = Lowest tunable frequency of receiver band in use or the lowest frequency of amplifier passband.

$f_2$  = Highest tunable frequency of receiver band in use or the highest frequency of amplifier passband.

$W$  = Bandwidth between the 80 dB points of the receiver selectivity curve as defined in the test sample's technical requirements or the control plan.

#### Limits:

1. The limit at A is 80 dB above the input level required to produce the standard reference output. (This limit shall not be used for amplifiers)
2. The limit at B shall be set as follows:
  - a. Receivers: 0 dBm applied directly to the receiver input terminals.
  - b. Amplifiers: The limit shall be as specified in the test sample's technical requirement or control plan. If no limit is defined in the above documents, the 0 dBm value shall be used.

FIGURE 3-5. Limit for CS04.



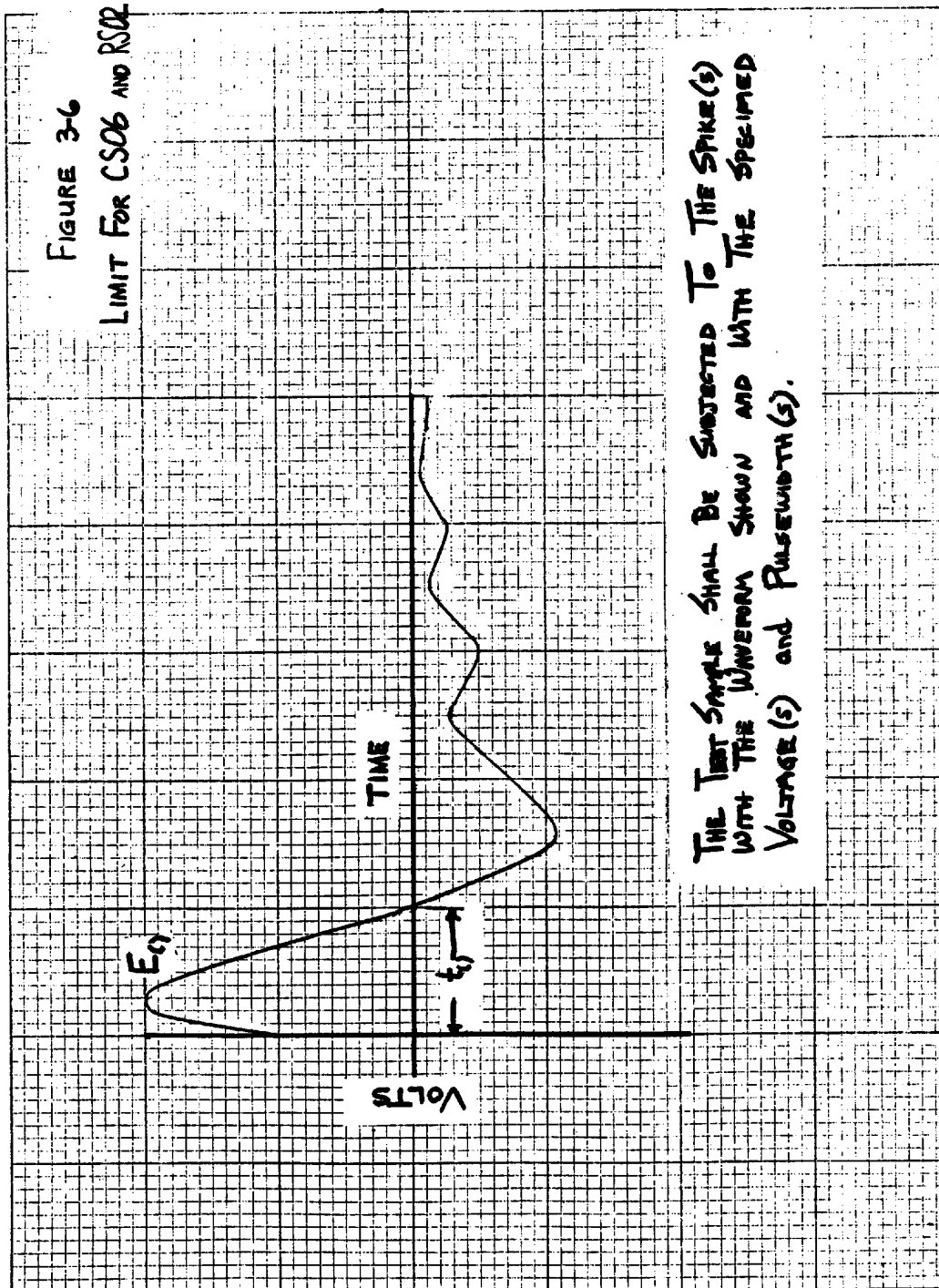


FIGURE 3-6. Limit for CS06 and RS02.

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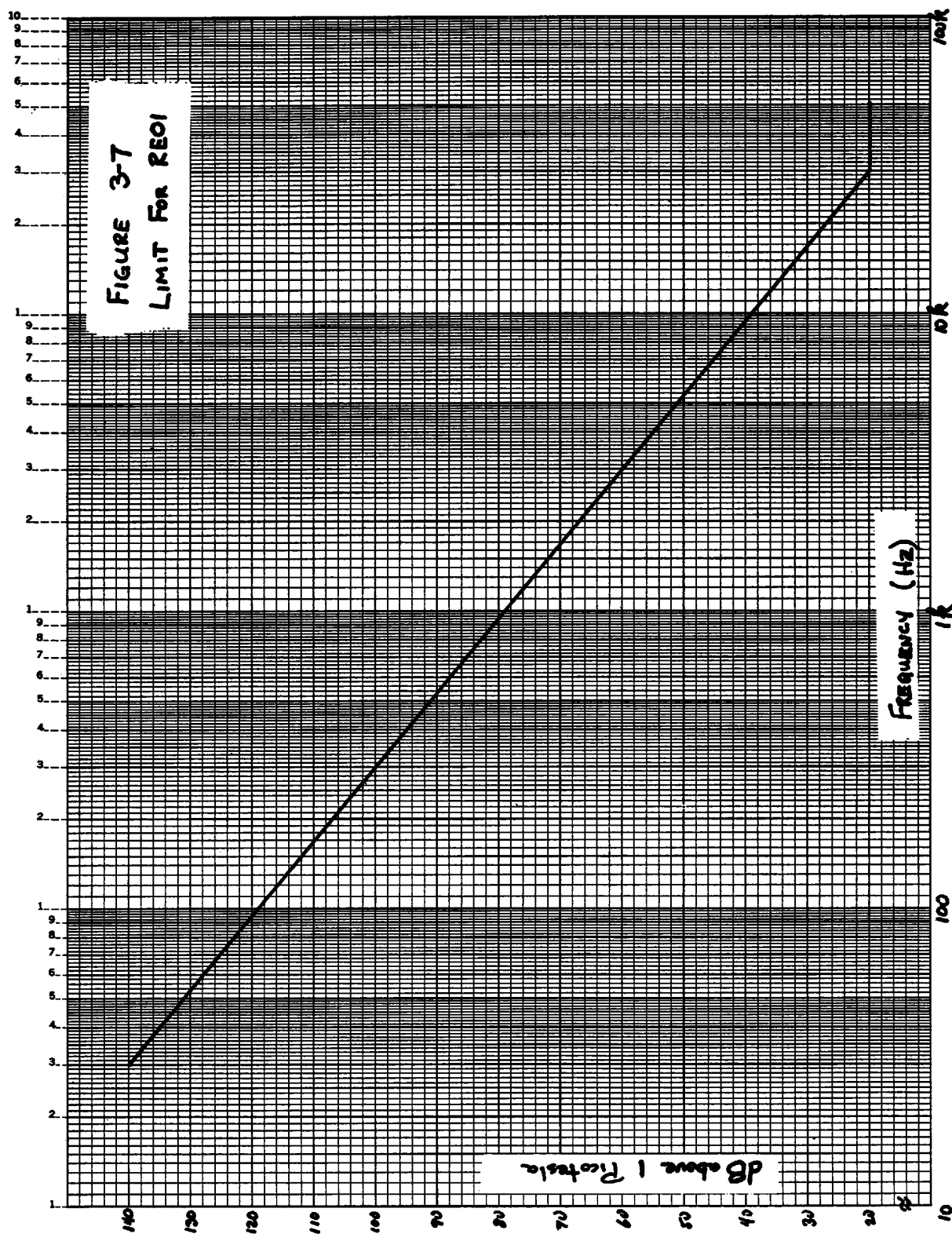


FIGURE 3-7. Limit for REOI.

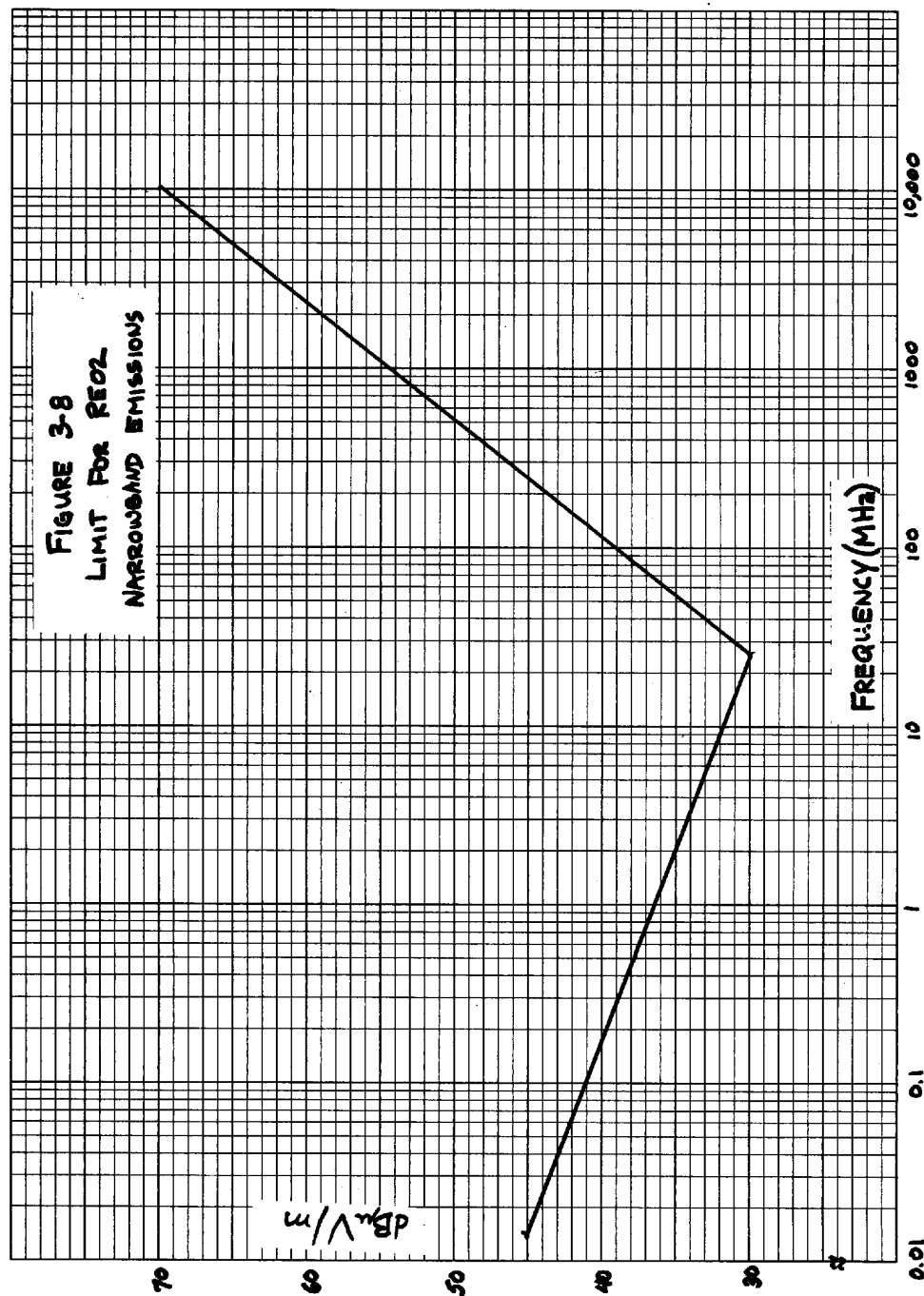


FIGURE 3-8. Limit for RE02 narrowband emissions.

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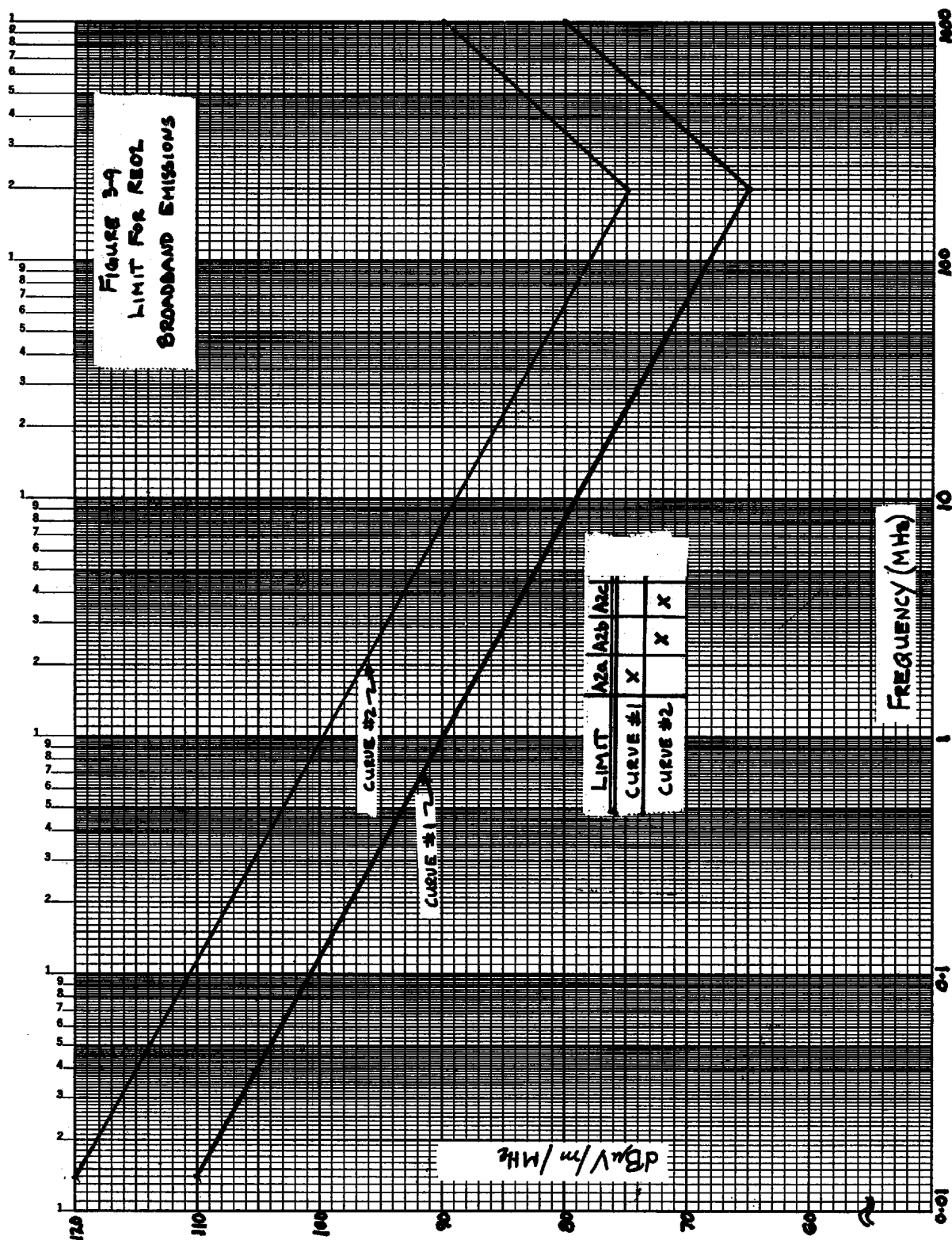


FIGURE 3-9. Limit for RE02 broadband emissions.

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## 1. SCOPE

This part of MIL-STD-461 supplements Part 1 of the standard by defining emission and susceptibility requirements and limits for equipments and subsystems intended for use in ground fixed and mobile facilities, including tracked and wheeled vehicles (Class A3). Requirements for ground support equipment used for checkout and launch of aircraft and spacecraft and launch vehicles are contained in Parts 2 and 3 of MIL-STD-461.

1.1 Determining requirements. TABLE 4-I shall be used to determine the specific requirements for class A3 equipments and subsystems. The table also denotes the paragraphs wherein the requirements and limits are defined. A Y entry in the table means the requirement is applicable and the limit shall be met using the procedures in MIL-STD-462 or the approved EMI Test Plan. A Y<sub>L</sub> entry means the applicability of the requirement is limited and is specified in the appropriate corresponding paragraph. When applicable, the limit shall be met using the procedures in MIL-STD-462 or the approved EMI Test Plan. A T entry means that the applicability must be determined on a case-by-case basis and that if the requirement is to be imposed, it must be so specified in the appropriate procurement document. When required, the limit shall be met using the procedures in MIL-STD-462 or the approved EMI Test Plan. Absence of an entry means the requirement is not applicable. For procurements of subsystems, such as radar, EW surveillance, and the like, comprised of individual equipments listed in TABLE 4-I, the applicable emission and susceptibility requirements for the subsystem shall be tailored by the procuring activity based on the requirements of the individual equipments.

## 2. CE01 (limited applicability).

2.1 CE01 applicability. This requirement is applicable for the following types of leads: AC or DC leads which obtain power from or provide power to other equipments, distribution panels or subsystems; grounds or neutrals which are not grounded internally to the subsystem or equipment being measured; and control circuits using test sample power, which provide power to, or control, relays, solenoids, valves, and the like. The requirement is not applicable for signal leads such as clock, IF, audio, firing, digital, RF and the like unless otherwise specified by the Command or agency concerned. For Army equipments and subsystems the requirement is applicable only when specifically called out in the procurement documentation.

2.1.1 DC and interconnecting leads. This requirement is applicable for narrowband emissions from 30 Hz to 15 kHz.

2.1.2 AC leads. This requirement is applicable for equipments and subsystems procured for Navy use. The requirement is applicable for narrowband emissions from the power frequency(ies) of the test sample to 15 kHz. Other applications and limits for this requirement are to be determined and specified on a case-by-case basis.

2.2 CE01 limits.

2.2.1 DC leads. Electromagnetic emissions shall not appear on DC leads in excess of the values shown on the applicable curve on FIGURE 4-1. The limits shall be met when measured with an effective bandwidth not exceeding 75 Hz.

2.2.2 AC leads. Electromagnetic emissions shall not appear on AC leads in excess of the values shown on the applicable limit line on FIGURE 4-2.

2.2.3 Interconnecting leads.2.2.3.1 Army and Air Force procurements.

2.2.3.1.1 Interconnecting control leads. Electromagnetic emissions shall not appear on interconnecting control leads in excess of the values shown on the applicable curve on FIGURE 4-1. The limits shall be met when measured with an effective bandwidth not exceeding 75 Hz.



2.2.3.1.2 Interconnecting signal leads. If compliance with this requirement is required for signal leads, limits shall be developed on a case-by-case basis considering the intentional transmission, its specified power level, necessary information bandwidth and pulse rise time. Such limits must be approved by the Command or agency concerned.

2.2.3.2 Navy procurements.

- (a) For interconnecting control and signal leads having the outer shield connected, and for twisted pairs with the pairs together, electromagnetic emissions shall not appear on the leads in excess of the values shown on the applicable curve on FIGURE 4-1.
- (b) For interconnecting control and signal leads having the outer shield disconnected, and for twisted pairs having the pairs separated, the limits shall be developed on a case-by-case basis considering the intentional transmission, its specified power level, necessary information bandwidth and pulse rise time. Such limits must be approved by the Command or agency concerned.

3. CE03

3.1 CE03 applicability. This requirement is applicable for the following types of leads: AC and DC leads which obtain power from other sources or provide power to other equipment, distribution panels or subsystems; grounds or neutrals which are not grounded internally to the subsystem or equipment being measured; and control circuits using test sample power, which provide power to, or control, relays, solenoids, valves and the like. The requirement is not applicable for signal leads such as clock, IF, audio, firing, digital, RF and the like unless otherwise specified by the Command or agency concerned. For Army procurements, the requirement is applicable using the Line Impedance Stabilization Network, as described in MIL-STD-462.

3.2 CE03 limits.

3.2.1 DC leads. Electromagnetic emissions shall not appear on DC leads in excess of the values shown on the applicable curve on FIGURES 4-3 and 4-4 for narrowband and broadband emissions, respectively.

3.2.2 AC leads.

3.2.2.1 Army and Air Force procurements. Electromagnetic emissions shall not appear on AC leads in excess of the values shown on FIGURES 4-3 and 4-4 for narrowband and broadband emissions, respectively.

3.2.2.2 Navy procurements. Electromagnetic emissions shall not appear on AC leads in excess of the values shown on FIGURES 4-5 and 4-6 for narrowband and broadband emissions, respectively.

3.2.3 Interconnecting leads.

3.2.3.1 Army and Air Force procurements.

3.2.3.1.1 Interconnecting control leads. Electromagnetic emissions shall not appear on interconnecting control leads in excess of the values shown on the applicable curve on FIGURES 4-3 and 4-4 for narrowband and broadband emissions, respectively.

3.2.3.1.2 Interconnecting signal leads. If compliance with this requirement is required for signal leads, limits shall be developed on a case-by-case basis considering the intentional transmission, its specified power level, necessary information bandwidth and pulse rise time. Such limits must be approved by the Command or agency concerned.

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3.2.3.2 Navy procurements.

- (a) For interconnecting control and signal leads having the outer shield connected, and for twisted pairs with the pairs together, electromagnetic emissions shall not appear on the leads in excess of the values shown on the applicable curve on FIGURES 4-3 and 4-4 for narrowband and broadband emissions, respectively.
- (b) For interconnecting control and signal leads having the outer shield disconnected, and for twisted pairs having the pairs separated, the limits shall be developed on a case-by-case basis considering the intentional transmission, its specified power level, necessary information band-width and pulse rise time. Such limits must be approved by the Command or agency concerned.

## 4. CE06 (limited applicability)

4.1 CE06 applicability. This requirement is applicable for those equipments and subsystems with antenna leads or those designed to be connected to antennas. Transmitters with absolute peak powers less than or equal to -10dBW (0.1 watt) are exempt from meeting the harmonic and spurious portions of this requirement. The transmitter (key-down mode) harmonic and spurious emission portions of this requirement are not applicable for equipments and subsystems procured solely for Army use when any of the following conditions exist: (a) transmitter power exceeds 5 kW average; (b) the fundamental frequency of the test sample exceeds 1.24 GHz; (c) the test sample's antenna is an integral part of the transmitter and cannot be replaced by a suitable dummy load; or (d) for equipments and subsystems with waveguide transmission lines and operating below 1.24 GHz. For cases (a) through (d), use RE03. The frequency range of this requirement is dependent on the operating frequency of the test sample (see MIL-STD-462). The transmitter (key-down) portion of this requirement is not applicable within either the test sample's necessary bandwidth or  $\pm 5$  percent of the fundamental frequency.

4.2 CE06 limits. Conducted emissions in excess of the values given below shall not appear at the test sample's antenna terminals.

4.2.1 Receivers.

- a. Narrowband emissions: 34 dB $\mu$ V
- b. Broadband emissions: 40 dB $\mu$ V/MHz

4.2.2 Transmitters (key-up and standby).

- a. Narrowband emissions: 34 dB $\mu$ V
- b. Broadband emissions: 40 dB $\mu$ V/MHz

4.2.3 Transmitters (key-down mode). Harmonics, except the second and third and all other spurious emissions shall have peak powers 80 dB down from the power at the fundamental. The second and third harmonics shall be suppressed by:  $40 + 10 \log P$ , (where  $P$  = peak power, in watts, at the fundamental) or 80 dB whichever requires less suppression.

## 5. CE07

5.1 CE07 applicability. Applications of this requirement are to be determined on a case-by-case basis for Air Force and Navy procurements for the following types of leads: AC or DC leads which obtain power from or provide power to other equipments or subsystems.

5.2 CE07 limits. Conducted switching transients shall not exceed the following, as applicable:

- a. AC leads:  $\pm 50$  percent of nominal rms voltage.
- b. DC leads:  $\pm 50$  percent, -150 percent of nominal line voltage.

## 6. CS01 (limited applicability)

6.1 CS01 applicability. This requirement is applicable to equipment and subsystem power leads, including grounds and neutrals which are not grounded internally to the equipment or subsystem. The requirement is not applicable within  $\pm 5$  percent of the power frequency(ies). This requirement may be deleted, with the approval of the Command or agency concerned if no circuit within the equipment or system has a sensitivity of 100 mV or better. For equipments and subsystems procured solely for Army use, this requirement is applicable for DC leads only with other applications as specified in the procurement documentation.

6.2 CS01 limits. The test sample shall not exhibit any malfunction, degradation of performance or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when subjected to electromagnetic energy injected onto its power leads less than or equal to the values on FIGURE 4-7.

6.2.1 The requirement is also met under the following condition: when the power source specified in MIL-STD-462, adjusted to dissipate 50 watts in a 0.5 ohm load, cannot develop the required voltage at the test sample power input terminals and the test sample is not susceptible to the output of the signal source.

## 7. CS02

7.1 CS02 applicability. This requirement is applicable to equipment and subsystem power leads, including grounds and neutrals which are not grounded internally to the equipment or subsystem.

7.2 CS02 limits. The test sample shall not exhibit any malfunction, degradation of performance or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when subjected to 1-volt from a 50-ohm source across the calibrating resistor shown in MIL-STD-462, Figure CS02-1. The test signal shall be applied directly to the equipment input terminals not through the test sample's power line cord. The requirement is also met under the following condition: when a 1-watt source of 50 ohms impedance cannot develop the required voltage at the test sample power input terminals and the test sample is not susceptible to the output of the signal source.

## 8. CS03 (limited applicability)

8.1 CS03 applicability. This requirement is applicable to receiving equipments and subsystems, such as receivers, RF amplifiers, transceivers, and the like. The applicable frequency range of this requirement is dependent on the operating frequency of the test sample, as specified in MIL-STD-462. For Army equipments and subsystems the requirement is applicable only when specifically called out in the procurement documentation.

8.2 CS03 limits. The test sample shall not exhibit any intermodulation products from two signals, beyond those permitted in the individual equipment or subsystem specification when:

- a. Signal generator #1 is set 66 dB above the level required to obtain the standard reference output as specified in MIL-STD-462, except that when  $f_1$  is in the frequency range of either 200 to 400 MHz or 2 to 25 MHz, the generator output shall be 80 dB above the reference level.
- b. Signal generator #2 is set 66 dB above the level required to obtain the standard reference output, as specified in MIL-STD-462, but the generator output level shall not exceed a power level of 10 dBm.

## 9. CS04 (limited applicability)

9.1 CS04 applicability. This requirement is applicable to receiving equipment and subsystems, such as receivers, RF amplifiers, transceivers and the like. The applicable frequency range of this requirement is dependent on the operating frequency of the test sample, as specified in MIL-STD-462. For Army equipments and subsystems the requirement is applicable only when specifically called out in the procurement documentation.

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9.2 CS04 limits. The test sample shall not exhibit any undesired response when subjected to the test signal shown on FIGURE 4-8.

#### 10. CS05 (limited applicability)

10.1 CS05 applicability. This requirement is applicable to receiving equipment and subsystems, such as receivers, RF amplifiers, transceivers and the like. The applicable frequency range of this requirement is dependent on the operating frequency of the test sample, as specified in MIL-STD-462. For Army equipments and subsystems the requirement is applicable only when specifically called out in the procurement documentation.

10.2 CS05 limits. The test sample shall not exhibit, due to cross modulation, any malfunction, degradation of performance or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when subjected to the following from signal generator #2: a signal 66 dB above the level required to obtain the standard reference output, as specified in MIL-STD-462, but not to exceed a power output level of 10 dBm.

#### 11. CS06

11.1 CS06 applicability. This requirement is applicable to equipment and subsystem power leads, including grounds and neutrals which are not grounded internally to the equipment or subsystem.

11.2 CS06 limits. The test sample shall not exhibit any malfunction, degradation of performance or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when the test spikes each having the waveform shown on FIGURE 4-9 are applied to the AC and DC power input leads. The values of  $E_{( )}$  and  $t_{( )}$  are given below. The spike shall be superimposed on the powerline voltage waveform.

- |                                  |  |
|----------------------------------|--|
| a. Spike #1 (Army)               | $E_1 = 100 \text{ Volts}; t_1 \leq 10 \mu\text{sec}$ |
| b. Spike #2 (Air Force and Navy) | $E_2 = 400 \text{ Volts}; t_2 \leq 5 \mu\text{sec}.$ |

11.2.1 Protected power inputs. For equipments and subsystems whose power inputs are protected with varistors, the requirement is also met if the equipment or subsystem is not susceptible to values of  $E_{( )}$  equal to the maximum safe level of the varistor.

#### 12. CS07 (limited applicability)

12.1 CS07 applicability. This requirement is applicable for receiving equipments and subsystems which utilize squelch circuits.

#### 12.2 CS07 limits.

12.2.1 Requirement 1. Squelch circuits shall not open when the output of a 50-ohm impedance impulse generator, set at 90 dB $\mu$ V/MHz is applied and matched to the input terminals of the test sample.

12.2.2 Requirement 2. The squelch circuit shall not open when two signals are applied at the input of the test sample. One signal shall be an unmodulated RF signal at the receiver tuned frequency whose amplitude is two-thirds of the RF voltage used to adjust the squelch threshold. The second signal shall be an impulse signal of 50 dB $\mu$ V/MHz.

#### 13. CS09 (limited applicability)

13.1 CS09 applicability. This requirement is applicable to Navy equipment and subsystems that have an operating frequency range of 100 kHz or less and an operating sensitivity of 1  $\mu$ V or less, such as 0.5  $\mu$ V. Other applications of this requirement are to be determined on a case-by-case basis.



13.2 CS09 limit. The test sample shall not exhibit any malfunction, degradation of performance or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when subjected to levels less than or equal to those on FIGURE 4-10 across the applicable test points.

#### 14. RE01 (limited applicability)

14.1 RE01 applicability. This requirement is applicable for Navy equipments and subsystems installed in fixed or mobile ground facilities. Other applications of this requirement are to be determined on a case-by-case basis. When required, RE01 is applicable for radiated emissions from equipments and subsystems, cables (including control, pulse, IF, power and antennas transmission lines) and interconnecting wiring of the test sample. The requirement applies at the fundamental frequencies, and all spurious emissions including harmonics, but does not apply for radiation from antennas.

14.2 RE01 limit. Magnetic field emissions shall not be radiated in excess of the levels shown on FIGURE 4-11.

#### 15. RE02

15.1 RE02 applicability. This requirement is applicable for radiated emissions from equipments and subsystems, cables (including control, pulse, IF, power and antennas transmission lines) and interconnecting wiring of the test sample. For narrowband, it applies at the fundamental frequencies, and all spurious emissions including harmonics, but does not apply for radiation from antennas. This requirement is applicable for broadband emissions from 14 kHz to 1 GHz and for narrowband emissions from 14 kHz to 10 GHz.

15.2 RE02 limits. E-field emissions shall not be radiated in excess of those given in 15.2.1 and 15.2.2. Above 30 MHz, the limits shall be met for both horizontally and vertically polarized waves.

15.2.1 Narrowband electric field emissions. Narrowband E-field emissions shall not be radiated in excess of the limit curve shown on FIGURE 4-12 at the required test distance, as specified in MIL-STD-462.

15.2.2 Broadband electric field emissions. Broadband E-field emissions from all equipments and subsystems, including radiated switching transients resulting from: (1) automatic cycling of electronic or electrical switching circuitry, (2) actuation of push-to-talk mechanisms (that is, keying of transmitters); or (3) manual switching, shall not be radiated in excess of the limit curve shown on FIGURE 4-13 at the required test distances, as specified in MIL-STD-462.

#### 16. RE03 (limited applicability)

16.1 RE03 applicability. This requirement is applicable for those equipments and subsystems with antenna leads or those designed to be connected to antennas. Transmitters with absolute peak powers less than or equal to -10 dBW (0.1 watt) are exempt from meeting this requirement. The frequency range of this requirement is dependent on the operating frequency of the test sample (see MIL-STD-462). The requirement is not applicable within either the test sample's necessary bandwidth or  $\pm 5$  percent of the fundamental frequency.

16.1.1 Army procurements. This requirement is applicable for transmitting equipments and subsystems procured solely for Army use when any of the following conditions exist: (a) transmitter power exceeds 5 kW average; (b) the fundamental frequency of the test sample exceeds 1.24 GHz; (c) the test sample's antenna is an integral part of the transmitter and cannot be replaced by a suitable dummy load; or (d) for equipments and subsystems with waveguide transmission lines and operating below 1.24 GHz.

16.1.2 Air Force and Navy procurements. This requirement is applicable, with the approval of the procuring activity, when the spurious and harmonics cannot be determined using the procedures of CE06.



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16.2 RE03 limit. Harmonics, except the second and third, and all other spurious emissions shall have peak powers 80 dB down from the power at the fundamental. The second and third harmonics shall be suppressed by:  $40 + 10 \log P$  (where  $P$  = peak power, in watts, at the fundamental) or 80 dB, whichever requires less suppression.

## 17. RS01 (limited applicability)

17.1 RS01 applicability. This requirement is applicable for Navy equipments and subsystems installed in fixed or mobile ground facilities. Other applications of this requirement are to be determined on a case-by-case basis. When required, RS01 is applicable to equipments and subsystems, and their associated cabling and connectors.

17.2 RS01 limit. The test sample shall not exhibit any malfunction, degradation of performance, or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when subjected to magnetic fields less than or equal to the applicable limit curve shown on FIGURE 4-14.

## 18. RS02

18.1 RS02 applicability. This requirement is applicable to equipment and systems as indicated in 18.1.1 and 18.1.2.

18.1.1 Part I - spikes applicability. This portion of RS02 is applicable for all DoD activities.

18.1.2 Part II - power frequency applicability. This requirement is applicable for equipments and subsystems procured for Air Force and Navy use. For Army equipments and subsystems the requirement is applicable only when specifically called out in the procurement documentation.

## 18.2 RS02 limits.

18.2.1 Part I - spikes limits. The test sample shall not exhibit any malfunction, degradation of performance, or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when subjected to the test spikes each having the waveform shown on FIGURE 4-9. The values of  $E_1$  and  $t_1$  are given below:

- |                                  |  |
|----------------------------------|--|
| a. Spike #1 (Army)               | $E_1 = 100 \text{ Volts}; t_1 \leq 10 \mu\text{sec}$ |
| b. Spike #2 (Air Force and Navy) | $E_2 = 400 \text{ Volts}; t_2 \leq 5 \mu\text{sec}.$ |

18.2.2 Part II - power frequency. The test sample shall not exhibit any malfunction, degradation of performance, or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when 20 amperes are applied to the test wire at the power frequency(ies) of the test sample.

## 19. RS03

19.1 RS03 applicability. This requirement is applicable for all equipments and subsystems between 14 kHz and 10 GHz. Above 10 GHz this requirement is not mandatory unless otherwise required by the procuring activity.

19.2 RS03 limits. The test sample shall not exhibit any malfunction, degradation of performance, or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when subjected to radiated electric fields ( $E$ ) less than or equal to those specified herein. Above 30 MHz, the requirement shall be met for both horizontally and vertically polarized waves. Appropriate consideration shall be given to the operational radiated electromagnetic environment from both friendly and hostile emitters which an equipment or subsystem

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may encounter during its life cycle. Applicable portions of MIL-HDBK-235 shall be used to determine the anticipated environment. As a minimum, the levels given below apply. If levels substantially higher than those shown herein are specified, modifications to the procedures in MIL-STD-462 may be required. Such modifications are to be described in the EMI Test Plan.

<u>Frequency range</u>	E-field (volts/meter)			
	Army	Navy RCVR sites	All other sites	Air Force
14 kHz to 2 MHz	1	1	10	10
2 to 30 MHz	10	1	10	10
30 to 2000 MHz	5	1	5	5
2 to 10 GHz	5	1	40	5
Above 10 GHz	20	1	40	20

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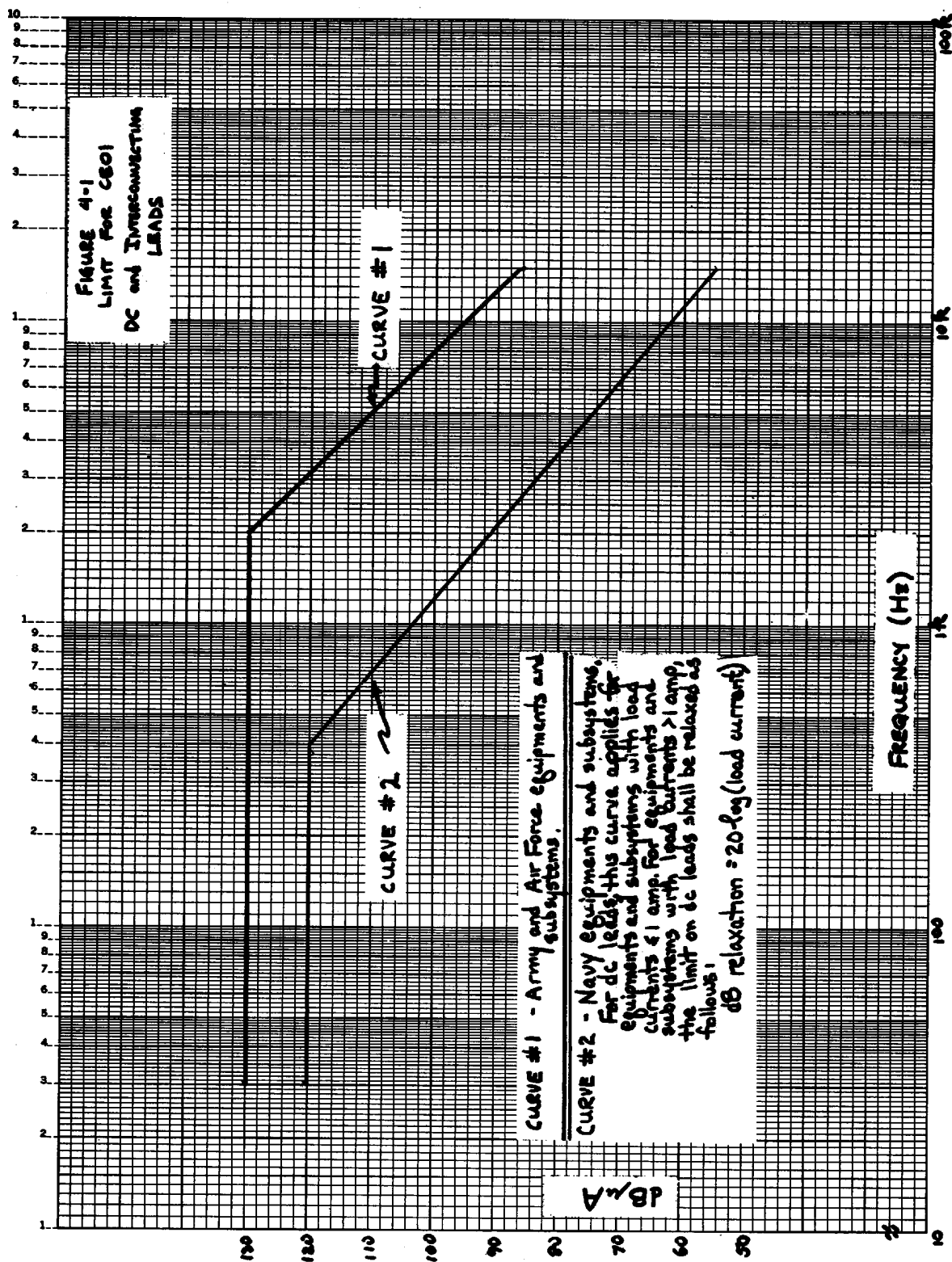


FIGURE 4-1. Limit for CE01 DC and interconnecting leads.

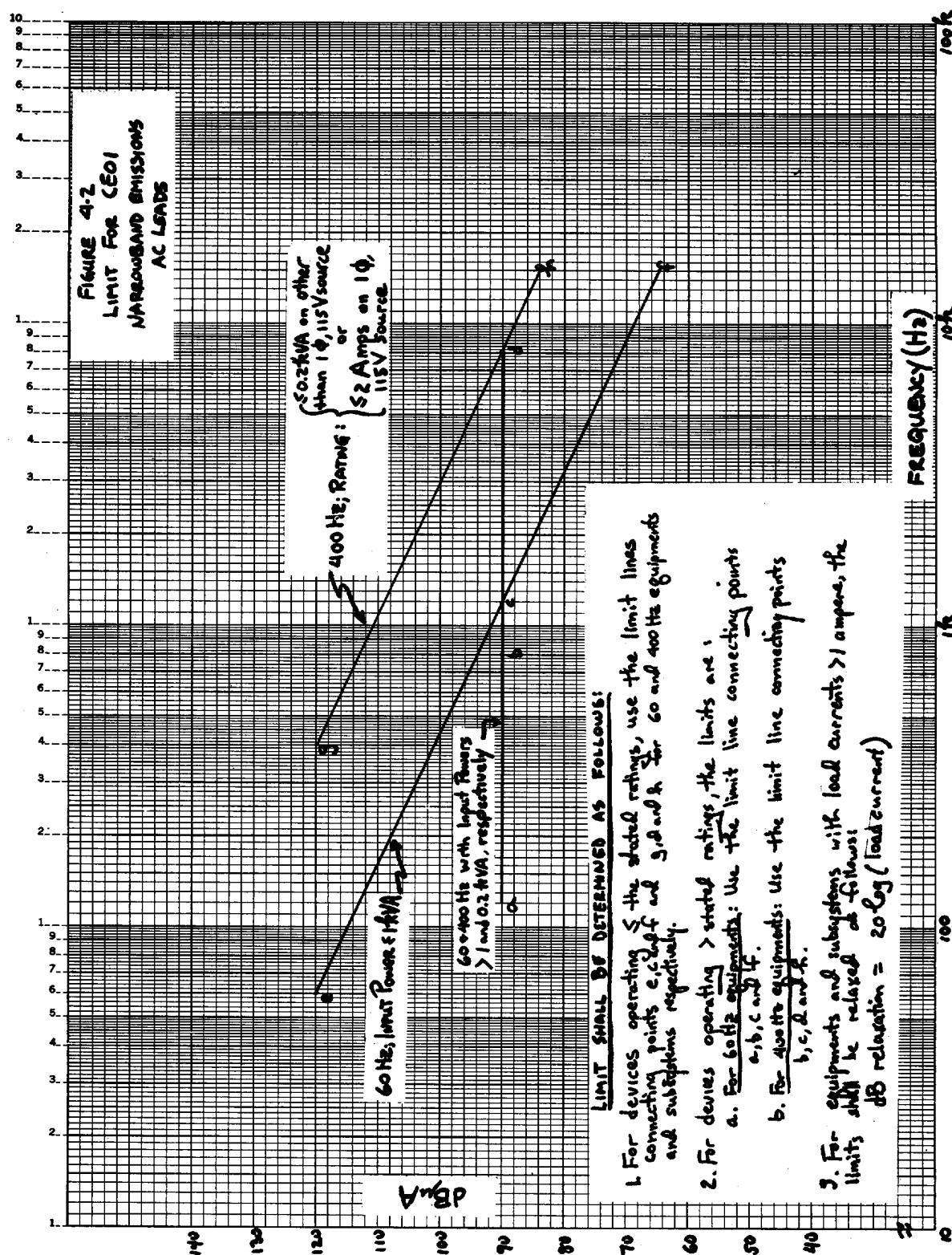


FIGURE 4-2. Limit for CEO1 Narrowband emissions AC leads.

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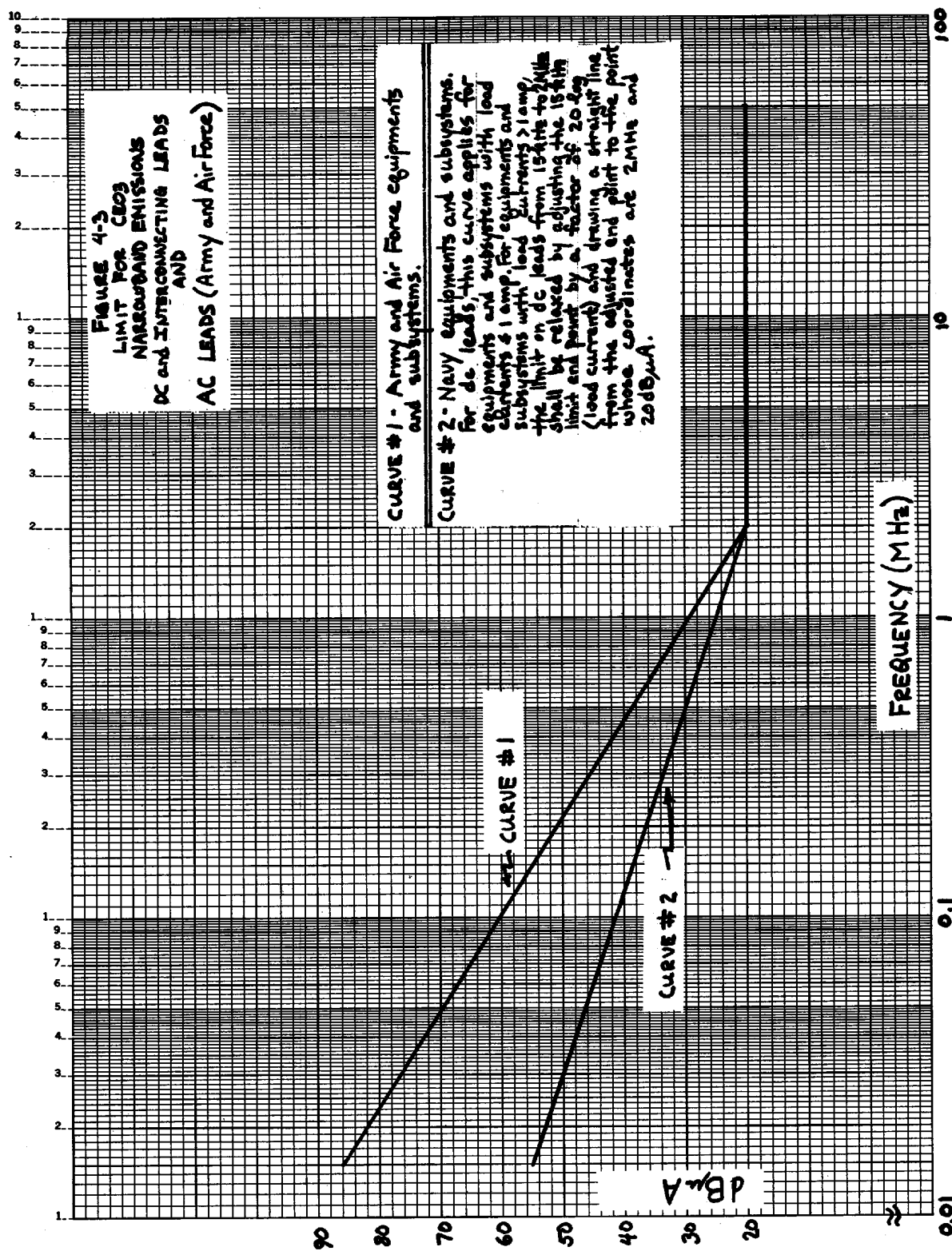


FIGURE 4-3. Limit for CE03 narrowband emissions DC and interconnecting leads and AC leads (Army and Air Force).



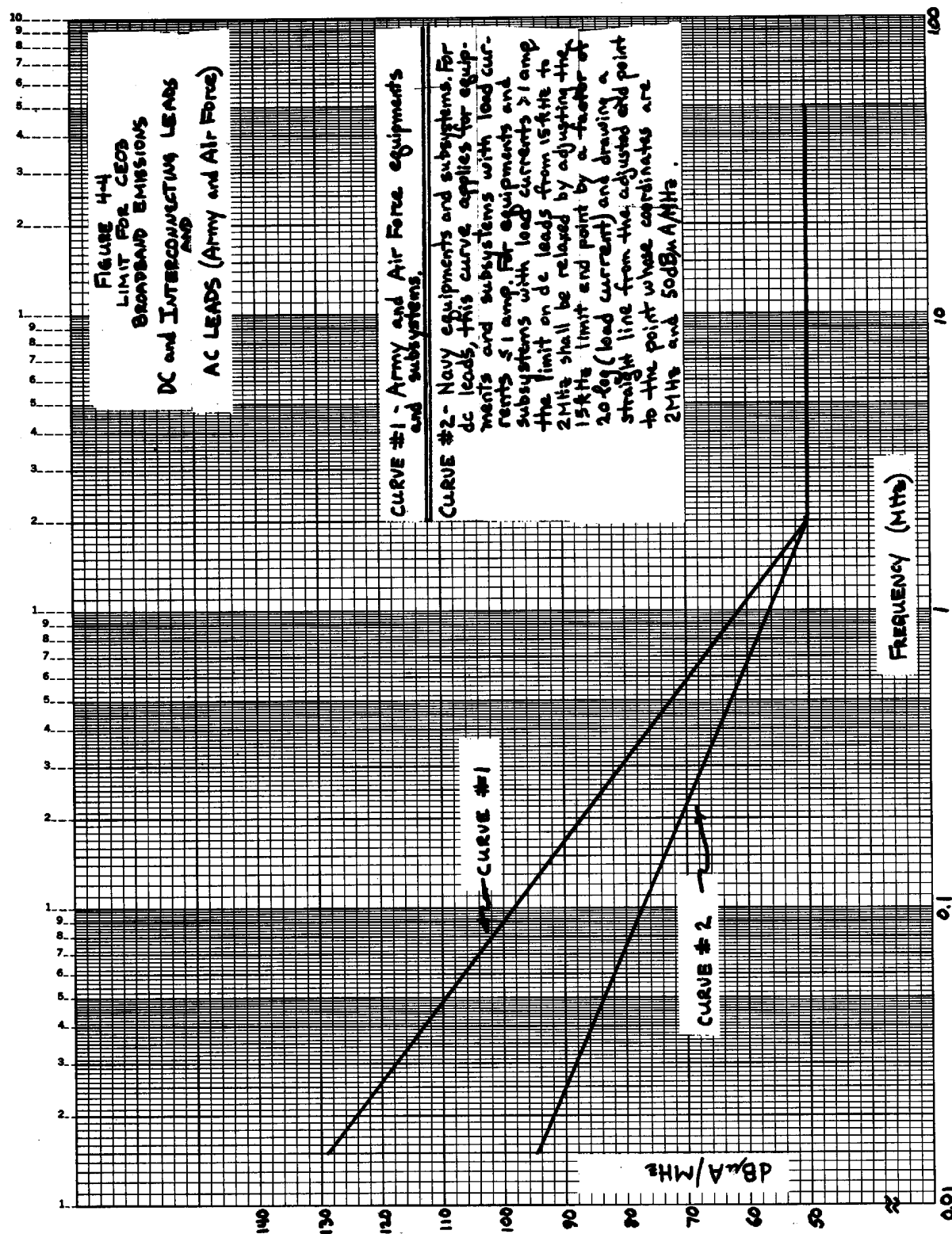


FIGURE 4-4. Limit for CE03 broadband emissions DC and interconnecting leads and AC leads (Army and Air Force).



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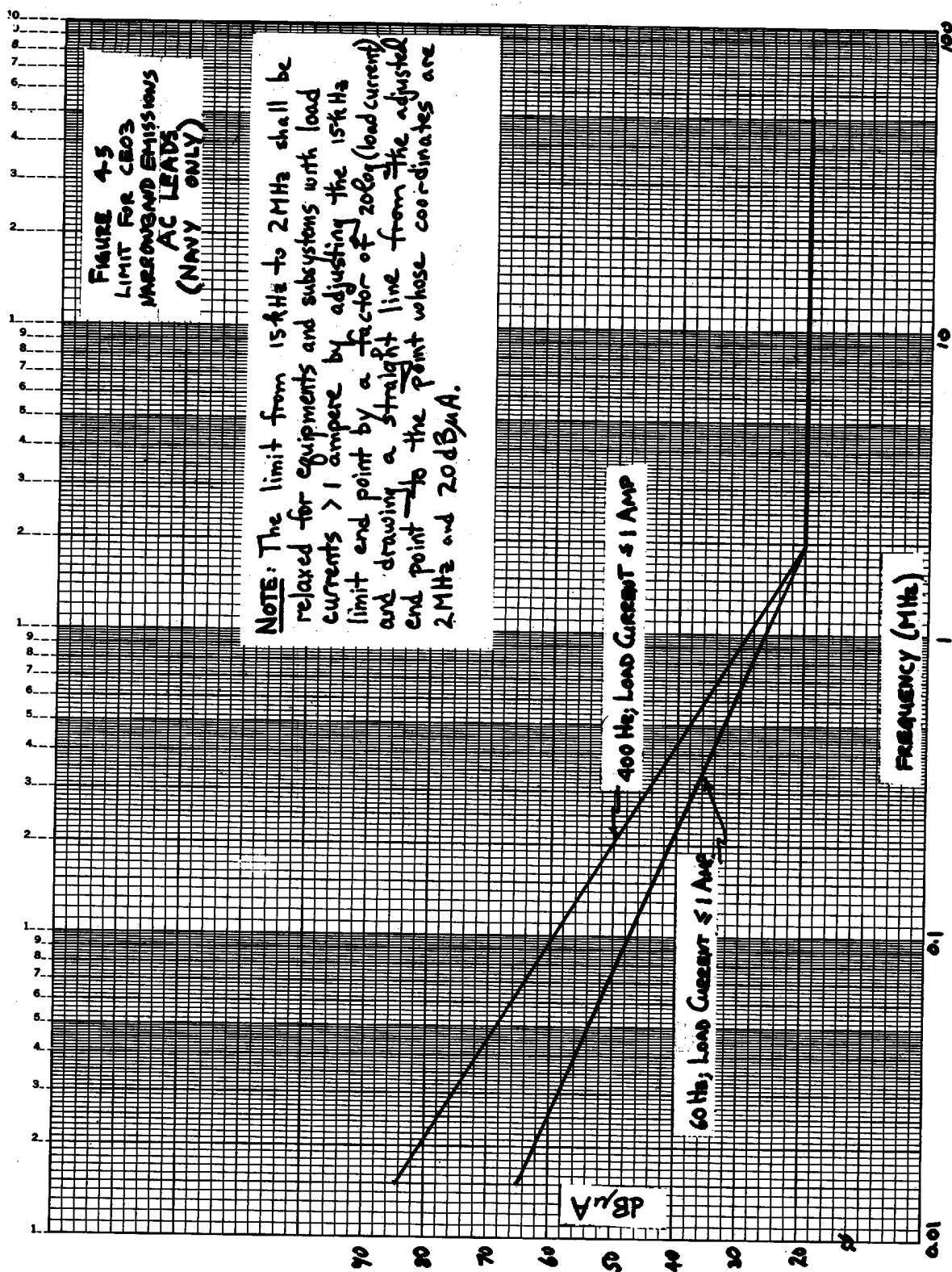


FIGURE 4-5. Limit for CE03 narrowband emissions AC leads (Navy only).

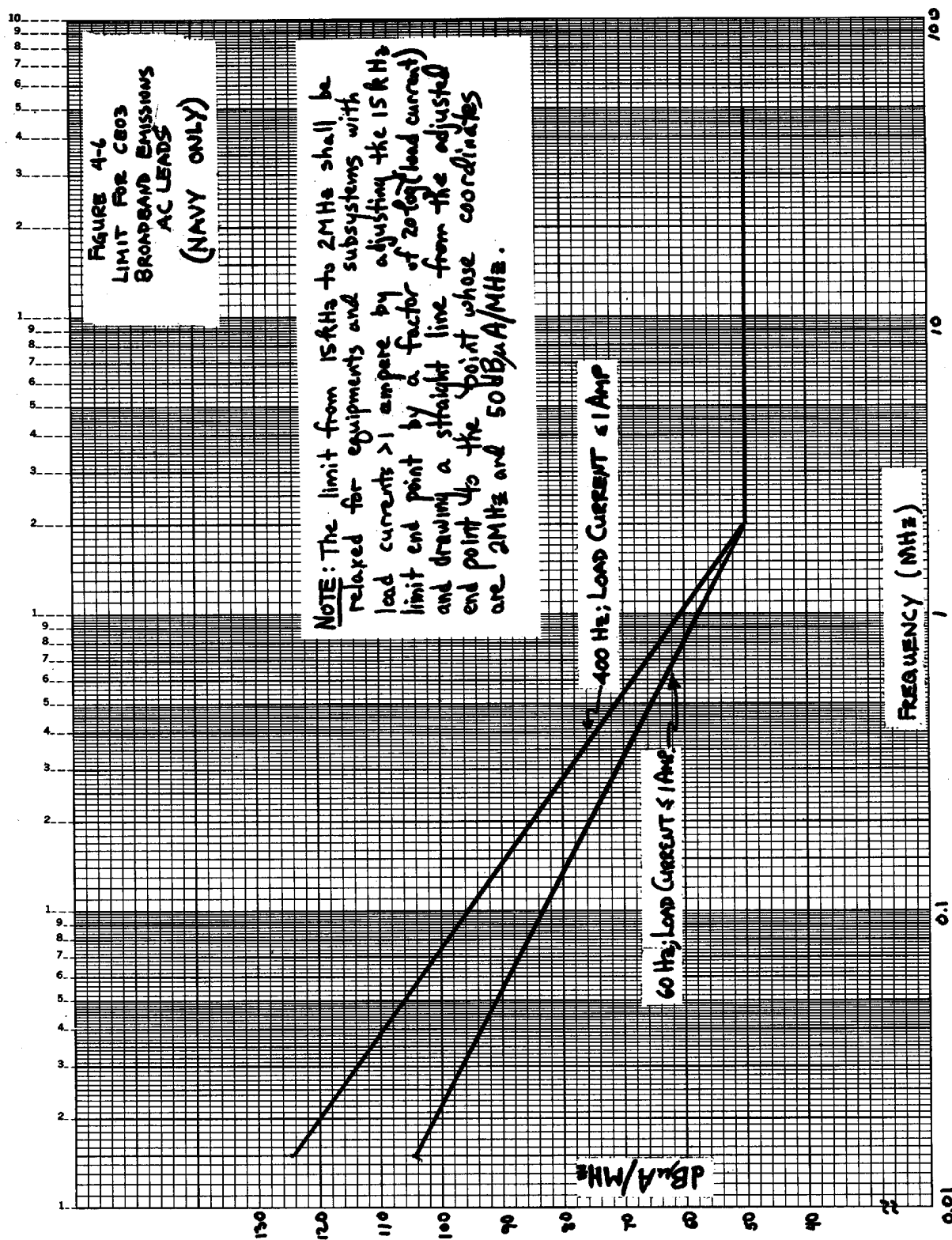
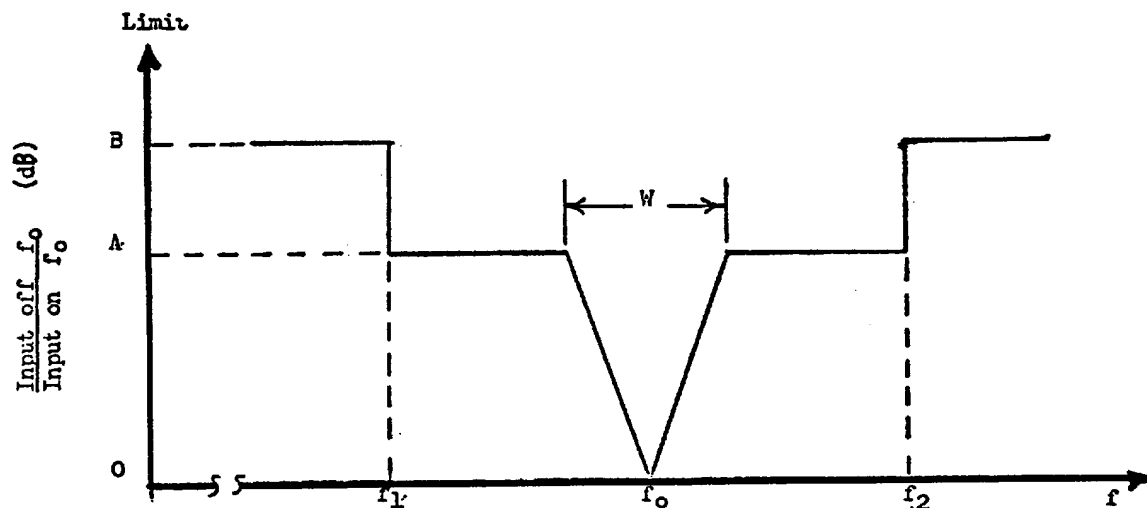


FIGURE 4-6. Limit for CE03 broadband emissions AC Leads (Navy only).





$f_o$  = Receiver tuned frequency or band center for amplifiers.

$f_1$  = Lowest tunable frequency of receiver band in use or the lowest frequency of amplifier passband.

$f_2$  = Highest tunable frequency of receiver band in use or the highest frequency of amplifier passband.

$W$  = Bandwidth between the 80 dB points of the receiver selectivity curve as defined in the test sample's technical requirements or the control plan.

#### Limits:

1. The limit at A is 80 dB above the input level required to produce the standard reference output. (This limit shall not be used for amplifiers)
2. The limit at B shall be set as follows:
  - a. Receivers: 0 dBm applied directly to the receiver input terminals.
  - b. Amplifiers: The limit shall be as specified in the test sample's technical requirement or control plan. If no limit is defined in the above documents, the 0 dBm value shall be used.

FIGURE 4-8. Limit for CS04.



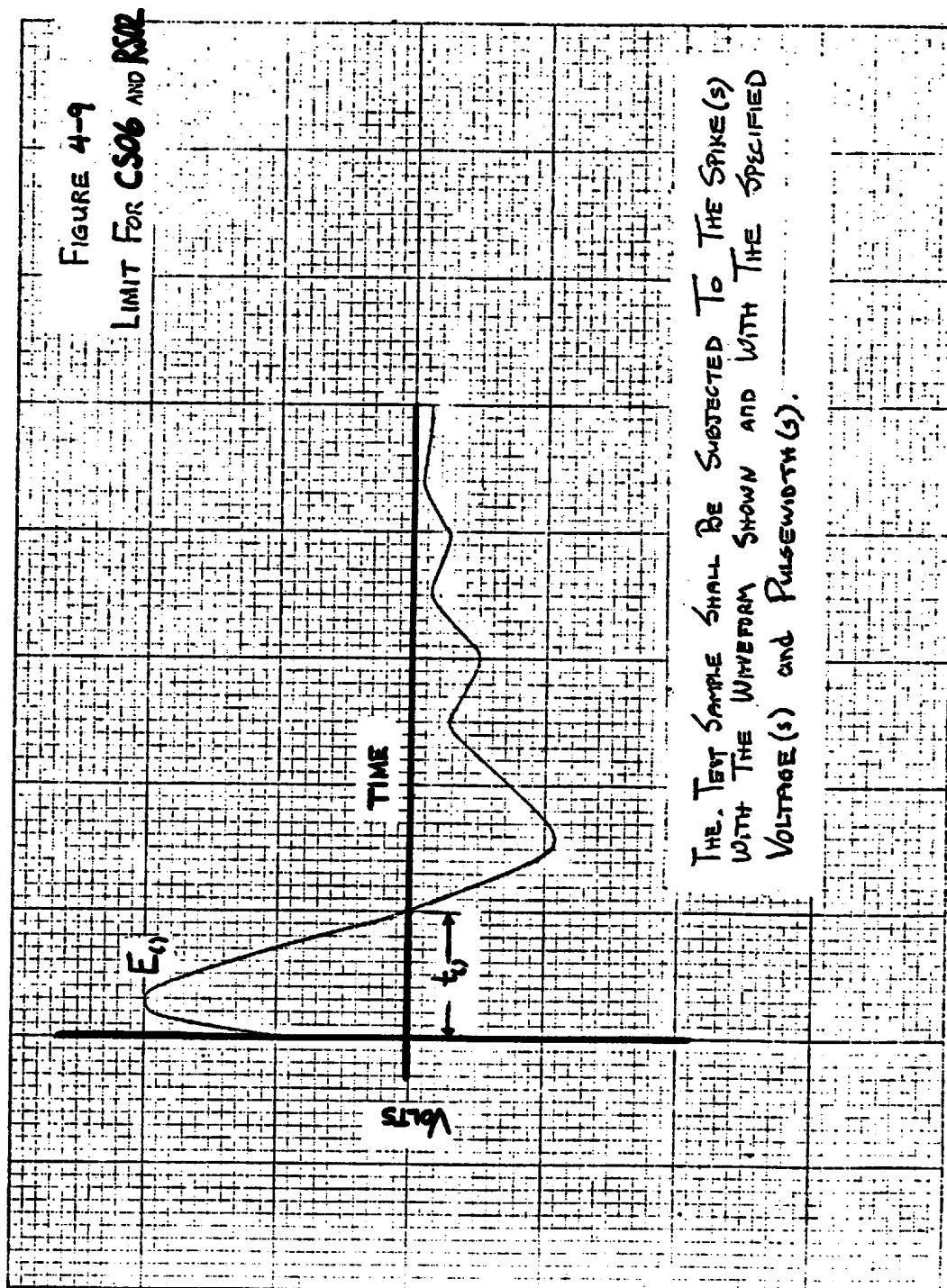


FIGURE 4-9. Limit for CS06 and RS02.

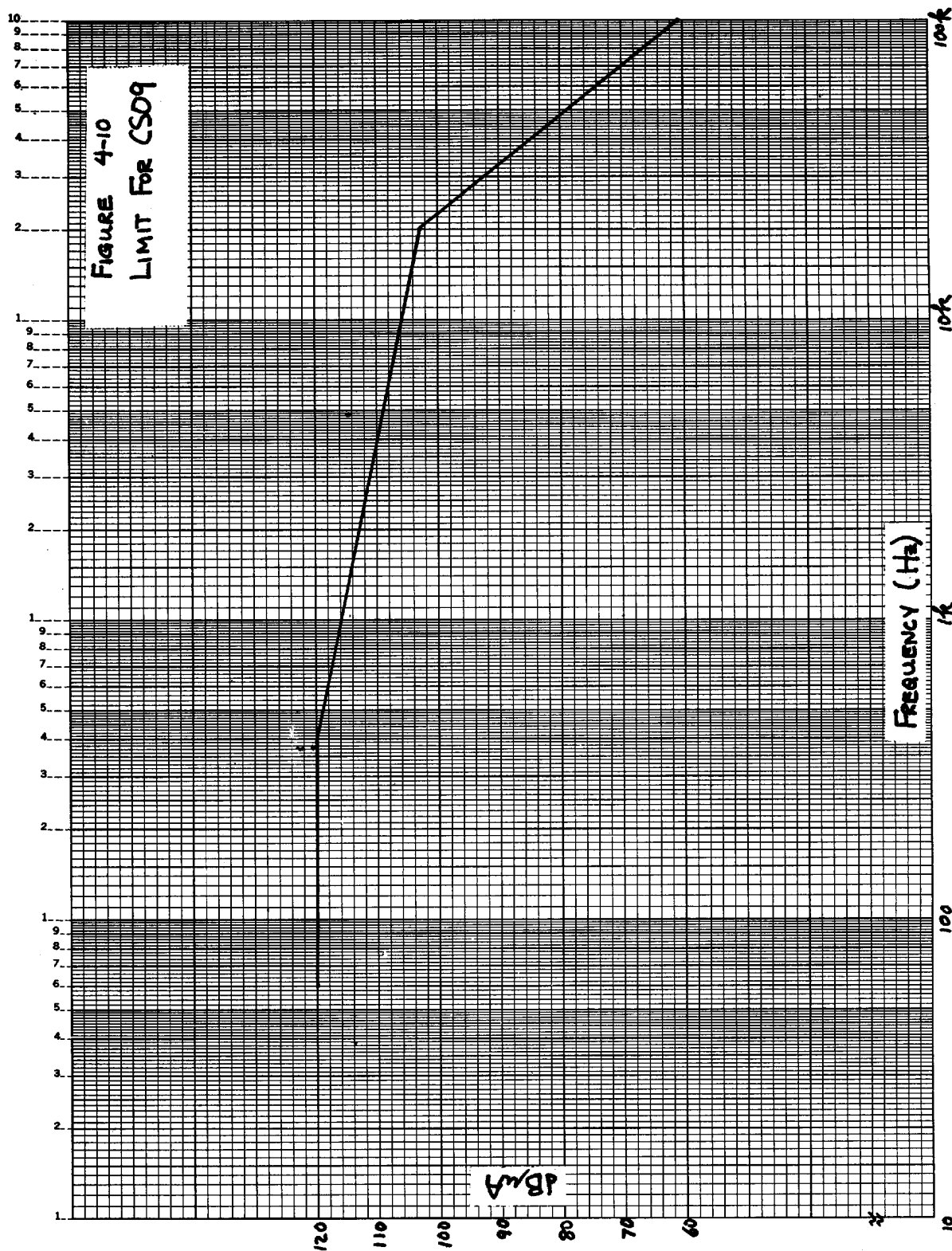


FIGURE 4-10. Limit for CS09.



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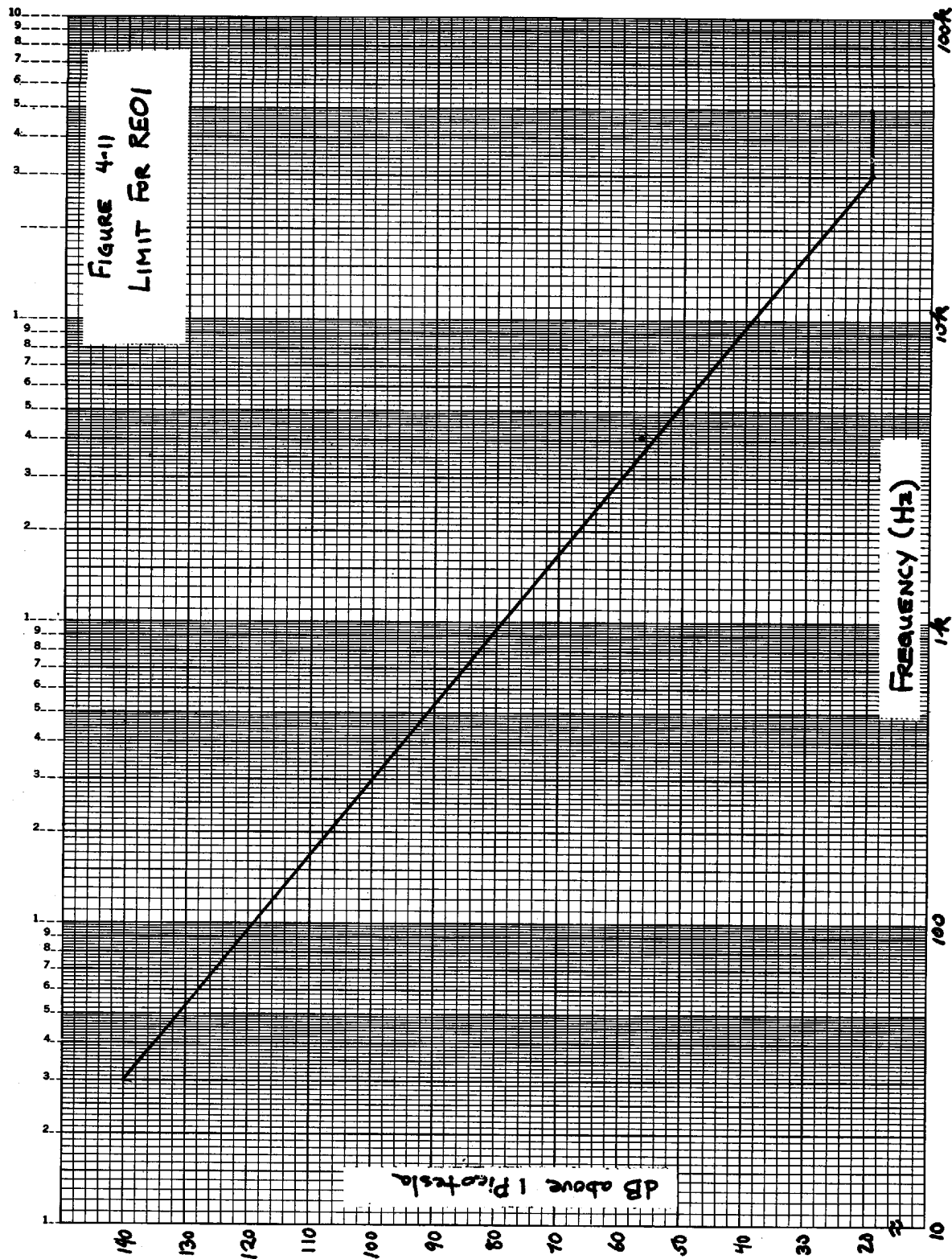


FIGURE 4-11. Limit for REO1.

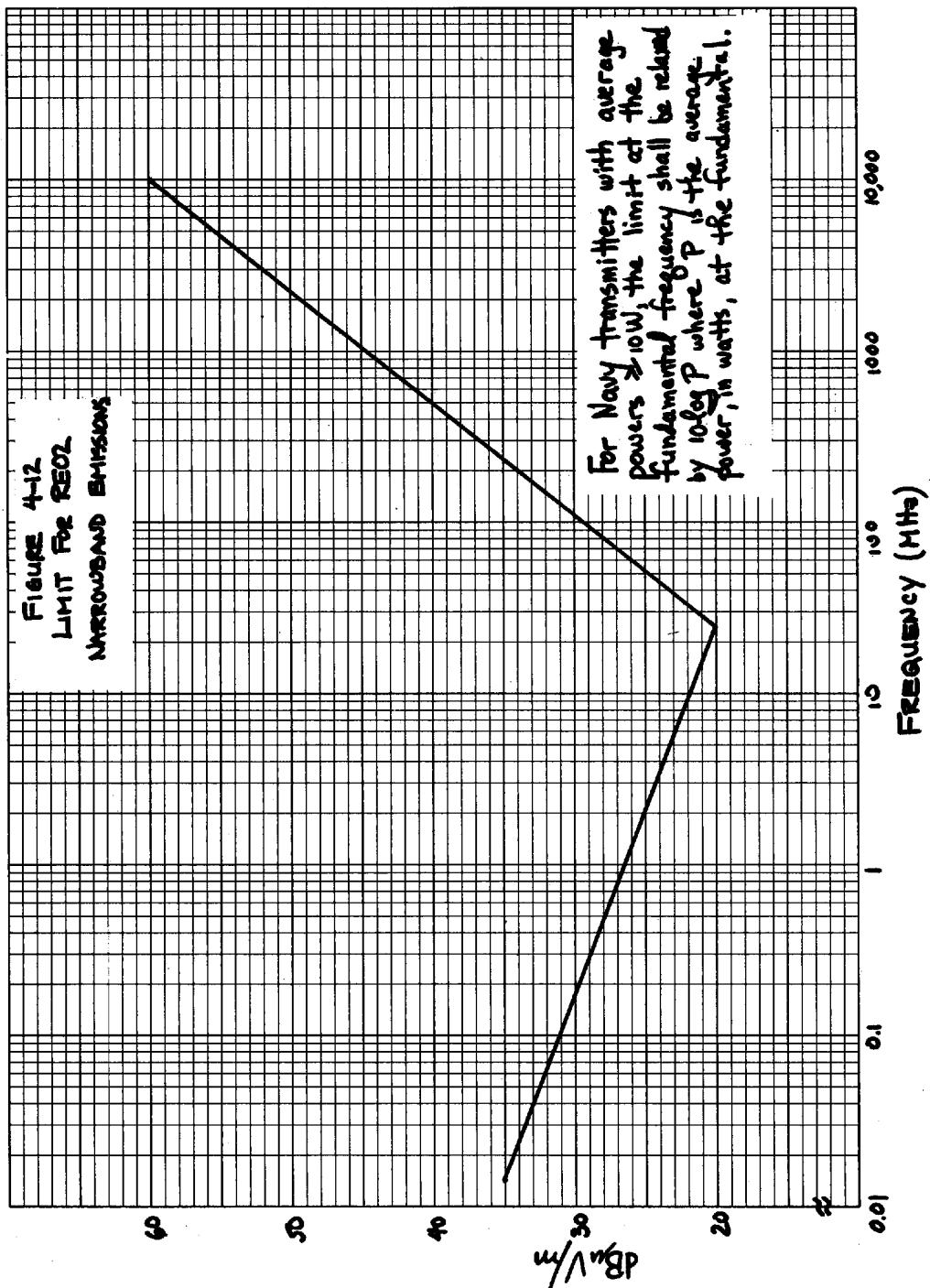


FIGURE 4-12. Limit for RE02 narrowband emissions.

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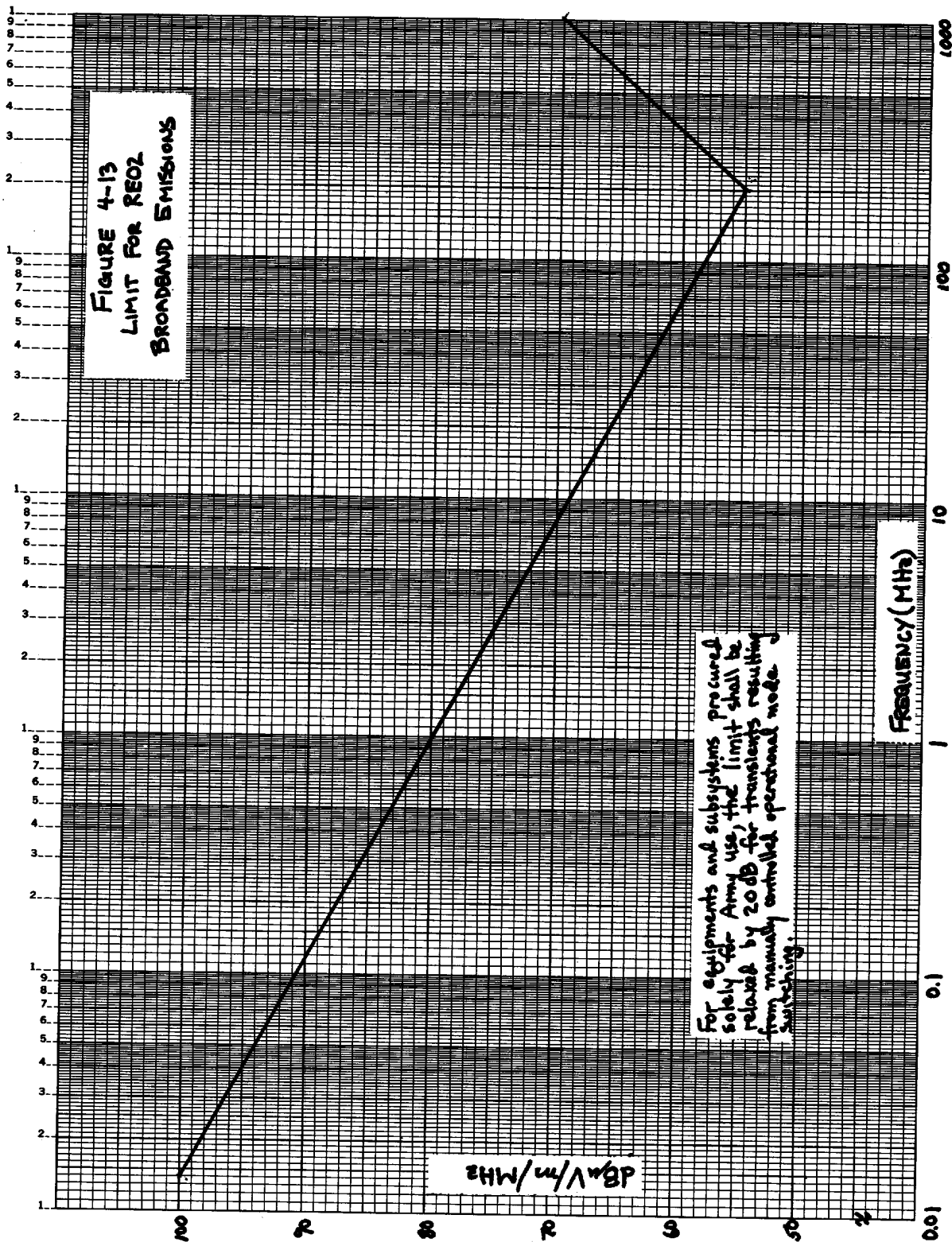


FIGURE 4-13. Limit for REO2 broadband emissions.

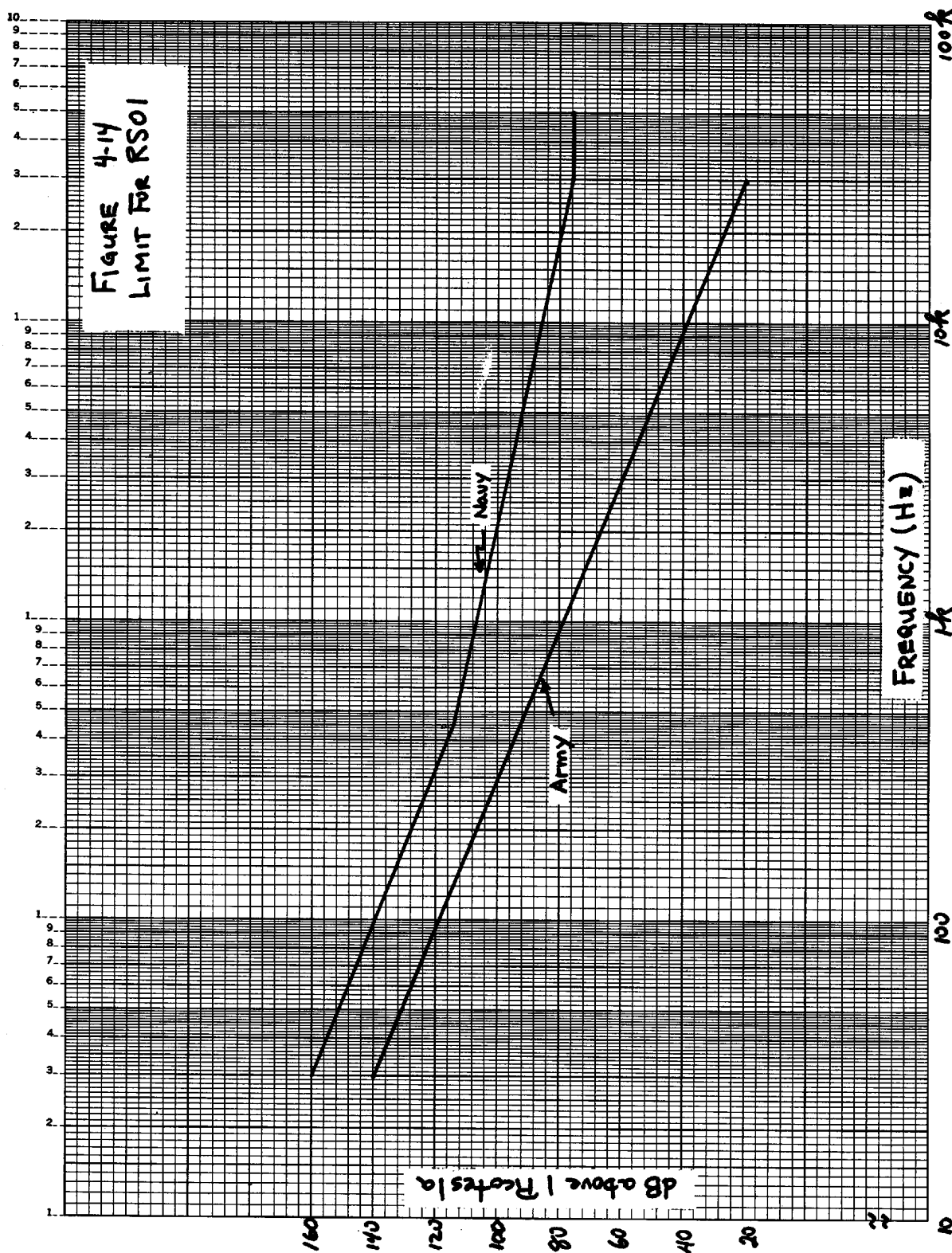


FIGURE 4-14. Limit for RS01.



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## 1. SCOPE

This part of MIL-STD-461 supplements Part 1 of the standard by defining emission and susceptibility requirements and limits for equipments and subsystems intended for use in surface ships (class A4).

1.1 Determining requirements. TABLE 5-I shall be used to determine the specific requirements for class A4 equipments and subsystems. The table also denotes the paragraphs wherein the requirements and limits are defined. A Y entry in the table means the requirement is applicable and the limit shall be met using the procedures in MIL-STD-462 or the approved EMI Test Plan. A Y<sub>L</sub> entry means the applicability of the requirement is limited and is specified in the corresponding appropriate paragraph. The limit shall be met using the procedures in MIL-STD-462 or the approved EMI Test Plan. A T entry means that the applicability must be determined on a case-by-case basis and that if the requirement is to be imposed, it must be so specified in the appropriate procurement document. When required, the limit shall be met using the procedures in MIL-STD-462 or the approved EMI Test Plan. Absence of an entry means the requirement is not applicable. For procurements of subsystems such as radar, EW surveillance, and the like, comprised of individual equipments listed in TABLE 5-I, the applicable emission and susceptibility requirements for the subsystem shall be tailored by the procuring activity based on the requirements of the individual equipments.

## 2. CE01

2.1 CE01 applicability. This requirement is applicable for the following types of leads: AC or DC leads which obtain power from or provide power to other equipments, distribution panels or subsystems; grounds or neutrals which are not grounded internally to the subsystem or equipment being measured; and control circuits using test sample power, which provide power to, or control, relays, solenoids, valves, and the like. The requirement is not applicable for signal leads such as clock, IF, audio, firing, digital RF and the like, unless otherwise specified by the Command or agency concerned.

2.1.1 DC and interconnecting leads. This requirement is applicable for narrowband emissions from 30 Hz to 15 kHz.

2.1.2 AC leads. The requirement is applicable for narrowband emissions from the power frequency(ies) of the test sample to 15 kHz.

2.2 CE01 limits.

2.2.1 DC leads. Electromagnetic emissions shall not appear on DC leads in excess of the values shown on FIGURE 5-1. The limits shall be met when measured with an effective bandwidth not exceeding 75 Hz.

2.2.2 AC leads. Electromagnetic emissions shall not appear on AC leads in excess of the values shown on the applicable limit line on FIGURE 5-2.

2.2.3 Interconnecting leads.

- a. Connected outer shields and twisted pairs together. For interconnecting control and signal leads having the outer shield connected, and for twisted pairs with the pairs together, electromagnetic emissions shall not appear on the leads in excess of the values shown on FIGURE 5-1.
- b. Disconnected outer shield and twisted pairs separated. For interconnecting control and signal leads having the outer shield disconnected, and for twisted pairs having the pairs separated, the limits shall be developed on a case-by-case basis considering the intentional transmission, its specified power level, necessary information bandwidth and pulse rise time. Such limits must be approved by the Command or agency concerned.

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TABLE 5-1. Emission and susceptibility requirements for Class A4 equipments and subsystems.

Requirement	Specific Equipment/Subsystem	Applicable Paragraph																	
		CE01	CE03	CE06	CS01	CS02	CS03	CS04	CS05	CS06	CS07	CS09	RE01	RE02	RE03	RS01	RS02	RS03	
Receivers		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Transmitters		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Antenna Multicouplers		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Amplifier, Tuned, RF		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Amplifier, Untuned, RF		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Intercom/Interphone		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Modem		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Repeater		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Amplifier, Power/Audio		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Modulators		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Multiplexers		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Laser Devices		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
IR Devices		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Transponders		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Beacons		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Power Supplies		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Sensors		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Inertial Guidance		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Teletypewriters		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Recorders		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Visual Displays		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Digital Equipment		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Data Annotation		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Camera Data		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Switching Signal Junction Boxes																			
Telephone SWBD		Y	Y		Y	Y			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Servo/Synchro		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Test Equipment		Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Time/Frequency STDS		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Ultrasonic Devices		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Telephones		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Sonar Devices		Y	Y		Y	Y			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Manpack or Helmut with Self-contained Battery				Y			Y	Y	Y		Y			Y			Y	Y	
Manpack or Helmut Using Ship Power		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y		Y	Y	
All Others Not Listed Herein		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Applicable Paragraph		2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	

## 3. CE03

3.1 CE03 applicability. This requirement is applicable for the following types of leads: AC and DC leads which obtain power from other sources or provide power to other equipment distribution panels or subsystems; ground or neutrals which are not grounded internally to the subsystem or equipment being measured; and control circuits using test sample power, which provide power to, or control, relays, solenoids, valves and the like. The requirement is not applicable for signal leads such as clock, IF, audio, firing, digital, RF and the like, unless otherwise specified by the Command or agency concerned.

3.2 CE03 limits.

3.2.1 DC leads. Electromagnetic emissions shall not appear on DC leads in excess of the values on FIGURES 5-3 and 5-4 for narrowband and broadband emissions, respectively.

3.2.2 AC leads. Electromagnetic emissions shall not appear on AC leads in excess of the values shown on the applicable limit lines on FIGURES 5-5 and 5-6 for narrowband and broadband emissions, respectively.

3.2.3 Interconnecting leads.

3.2.3.1 Connected outer shield and twisted pairs together. For interconnecting control and signal leads having the outer shield connected, and for twisted pairs with the pairs together, electromagnetic emissions shall not appear on the leads in excess of the values shown on FIGURES 5-3 and 5-4 for narrowband and broadband emissions, respectively.

3.2.3.2 Disconnected outer shield and twisted pairs separated. For interconnecting control and signal leads having the outer shield disconnected, and for twisted pairs having the pairs separated, the limits shall be developed on a case-by-case basis considering the intentional transmission, its specified power level, necessary information bandwidth and pulse rise time. Such limits must be approved by the Command or agency concerned.

## 4. CE06 (limited applicability)

4.1 CE06 applicability. This requirement is applicable for those equipments and subsystems with antenna leads or those designed to be connected to antennas. Transmitters with absolute peak powers less than or equal to -10dBW (0.1 watt) are exempt from meeting the harmonic and spurious portions of this requirement. When any of the following conditions exist, the transmitter (key-down) harmonic and spurious emission portions of this requirement may be measured using the procedures in RE03 in lieu of those of CE06, with the approval of the command or agency concerned: (a) transmitter power exceeds 5 kW average; (b) the fundamental frequency of the test sample exceeds 1.24 GHz; (c) the test sample's antenna is an integral part of the transmitter and cannot be replaced by a suitable dummy load; or (d) for equipments and subsystems with waveguide transmission lines and operating below 1.24 GHz. The frequency range of this requirement is dependent on the operating frequency of the test sample (see MIL-STD-462). The transmitter (key-down) portion of this requirement is not applicable within either the test sample's necessary bandwidth or  $\pm 5$  percent of the fundamental frequency.

4.2 CE06 limits. Conducted emissions in excess of the values given below shall not appear at the test sample's antenna terminals.

4.2.1 Receivers.

- a. Narrowband emissions: 34 dB  $\mu$ V
- b. Broadband emissions: 40 dB  $\mu$ V/MHz

4.2.2 Transmitters (key-up and standby)

- a. Narrowband emissions: 34 dB  $\mu$ V
- b. Broadband emissions: 40 dB  $\mu$ V/MHz

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4.2.3 Transmitters (key-down mode). Harmonics, except the second and third and all other spurious emissions shall have peak powers 80 dB down from the power at the fundamental. The second and third harmonics shall be suppressed by:  $40 + 10 \log P$  (where  $P$  = peak power, in watts, at the fundamental), or 80 dB, whichever requires less suppression.

## 5. CS01

5.1 CS01 applicability. This requirement is applicable to equipment and subsystem power leads, including grounds and neutrals which are not grounded internally to the equipment or subsystem. The requirement is not applicable within  $\pm 5$  percent of the power frequency(ies). This requirement may be deleted, with the approval of the Command or agency concerned, if no circuit within the equipment or system has a sensitivity of 100 mV or better.

5.2 CS01 limits. The test sample shall not exhibit any malfunction, degradation of performance or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when subjected to electromagnetic energy injected onto its power leads less than or equal to the values on FIGURE 5-7. The requirement is also met under the following condition: when the power source specified in MIL-STD-462, adjusted to dissipate 50 watts in a 0.5 ohm load, cannot develop the required voltage at the test sample power input terminals and the test sample is not susceptible to the output of the signal source.

## 6. CS02

6.1 CS02 applicability. This requirement is applicable to equipment and subsystem power leads, including grounds and neutrals which are not grounded internally to the equipment or subsystem.

6.2 CS02 limits. The test sample shall not exhibit any malfunction, degradation of performance or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when subjected to 1 volt from a 50 ohm source across the calibrating resistor shown in MIL-STD-462, FIGURE CS02-1. The test signal shall be applied directly to the equipment input terminals, not through the test sample's power line cord. The requirement is also met under the following condition: when a 1-watt source of 50 ohms impedance cannot develop the required voltage at the test sample power input terminals and the test sample is not susceptible to the output of the signal source.

## 7. CS03 (limited applicability)

7.1 CS03 applicability. This requirement is applicable to receiving equipments and subsystems, such as receivers, RF amplifiers, transceivers, and the like. The applicable frequency range of this requirement is dependent on the operating frequency of the test sample, as specified in MIL-STD-462.

7.2 CS03 limits. The test sample shall not exhibit any intermodulation products from two signals, beyond those permitted in the individual equipment or subsystem specification when:

- a. Signal generator #1 is set 66 dB above the level required to obtain the standard reference output as specified in MIL-STD-462, except that when  $f_1$  is in the frequency range of either 200 to 400 MHz or 2 to 25 MHz, the generator output shall be 80 dB above the reference level.
- b. Signal generator #2 is set 66 dB above the level required to obtain the standard reference output as specified in MIL-STD-462, but the generator level shall not exceed a power level of 10 dBm.

## 8. CS04 (limited applicability)

8.1 CS04 applicability. This requirement is applicable to receiving equipment and subsystems, such as receivers, RF amplifiers, transceivers and the like. The applicable frequency range of this requirement is dependent on the operating frequency of the test sample as specified in MIL-STD-462.

8.2 CS04 limits. The test sample shall not exhibit any undesired response when subjected to the test signal shown on FIGURE 5-8.

## 9. CS05 (limited applicability)

9.1 CS05 applicability. This requirement is applicable to receiving equipment and subsystems, such as receivers, RF amplifiers, transceivers and the like. The applicable frequency range of this requirement is dependent on the operating frequency of the test sample as specified in MIL-STD-462.

9.2 CS05 limits. The test sample shall not exhibit, due to cross modulation, any malfunction, degradation of performance or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when subjected to the following from signal generator #2: a signal 66 dB above the level required to obtain the standard reference output, as specified in MIL-STD-462, but not to exceed a power output level of 10 dBm.

## 10. CS06

10.1 CS06 applicability. This requirement is applicable to equipment and subsystem power leads, including grounds and neutrals which are not grounded internally to the equipment or subsystem.

10.2 CS06 limits. The test sample shall not exhibit any malfunction, degradation of performance or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when the test spike having the waveform shown on FIGURE 5-9 is applied to the AC and DC power input leads. The values of  $E_1$  and  $t_1$  are given below. The spike shall be superimposed on the powerline voltage waveform. ( ) ( )

a. Spike #1  $E_1 = 400$  volts;  $t_1 \leq 5$  microseconds.

10.2.1 Protected power inputs. For equipments and subsystems whose power inputs are protected with varistors, the requirement is also met if the equipment or subsystem is not susceptible to a value of  $E_1$  equal to the maximum safe level of the varistor.

## 11. CS07 (limited applicability)

11.1 CS07 applicability. This requirement is applicable for receiving equipments and subsystems which utilize squelch circuits.

11.2 CS07 limits.

11.2.1 Requirement 1. Squelch circuits shall not open when the output of a 50-ohm impedance impulse generator, set at 90 dB  $\mu$ V/MHz is applied and matched to the input terminals of the test sample.

11.2.2 Requirement 2. The squelch circuit shall not open when two signals are applied at the input of the test sample. One signal shall be an unmodulated RF signal at the receiver tuned frequency whose amplitude is two-thirds of the RF voltage used to adjust the squelch threshold. The second signal shall be an impulse signal of 50 dB  $\mu$ V/MHz.



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## 12. CS09 (limited applicability)

12.1 CS09 applicability. This requirement is applicable to equipment and subsystems that have an operating frequency range of 100 kHz or less and an operating sensitivity of 1  $\mu$ V or less, such as 0.5  $\mu$ V.

12.2 CS09 limit. The test sample shall not exhibit any malfunction, degradation of performance or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when subjected to levels less than or equal to those on FIGURE 5-10 across the applicable test points.

## 13. RE01

13.1 RE01 applicability. This requirement is applicable for radiated emissions from equipments and subsystems, cables (including control, pulse, IF, power and antennas transmission lines) and interconnecting wiring of the test sample. The requirement applies at the fundamental frequencies, and all spurious emissions including harmonics, but does not apply for radiation from antennas.

13.2 RE01 limit. Magnetic field emissions shall not be radiated in excess of the levels shown on FIGURE 5-11.

## 14. RE02

14.1 RE02 applicability. This requirement is applicable for radiated emissions from equipments and subsystems, cables (including control, pulse, IF, power and antennas transmission lines) and interconnecting wiring of the test sample; for narrowband, it applies at the fundamental frequencies, and all spurious emissions including harmonics, but does not apply for radiation from antennas. This requirement is applicable for broadband emissions from 14 kHz to 1 GHz and for narrowband emissions from 14 kHz to 10 GHz, except that for sonar equipment the requirements are applicable up to 75 MHz.

14.2 RE02 limits. E-field emissions shall not be radiated in excess of those given in 14.2.1 and 14.2.2. Above 30 MHz, the limits shall be met for both horizontally and vertically polarized waves.

14.2.1 Narrowband electric field emissions. Narrowband E-field emissions shall not be radiated in excess of the limit curve shown on FIGURE 5-12 at the required test distance, as specified in MIL-STD-462.

14.2.2 Broadband electric field emissions. Broadband E-field emissions from all equipments and subsystems, including radiated switching transients resulting from (a) automatic cycling of electronic or electrical switching circuitry, (b) actuation of push-to-talk mechanisms (that is, keying of transmitters); or (c) manual switching, shall not be radiated in excess of the limit curve shown on FIGURE 5-13 at the required test distances, as specified in MIL-STD-462.

## 15. RE03 (limited applicability)

15.1 RE03 applicability. This requirement is applicable, with the approval of the procuring activity when the spurious and harmonics cannot be determined using the procedures of CE06. Transmitters with absolute peak powers less than or equal to -10dBW (0.1 watt) are exempt from meeting this requirement. The frequency range of this requirement is dependent on the operating frequency of the test sample (see MIL-STD-462). The requirement is not applicable within either the test sample's necessary bandwidth or  $\pm 5$  percent of the fundamental frequency.

15.2 RE03 limit. Harmonics, except the second and third, and all other spurious emissions shall have peak powers 80 dB down from the power at the fundamental. The second and third harmonics shall be suppressed by:  $40 + 10 \log P$  (where  $P$  = peak power, in watts, at the fundamental) or 80 dB whichever requires less suppression.

## 16. RS01

16.1 RS01 applicability. This requirement applies to equipments and subsystems and their associated cabling and connectors.

16.2 RS01 limits. The test sample shall not exhibit any malfunction, degradation of performance, or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when subjected to magnetic fields less than or equal to the limit curve shown on FIGURE 5-14.

## 17. RS02

17.1 RS02 applicability. Parts I and II of this requirement are applicable for equipments and subsystems procured for use on surface ships.

17.2 RS02 limits.

17.2.1 Part I - spikes. The test sample shall not exhibit any malfunction, degradation of performance, or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when subjected to the test spike having the waveform shown on FIGURE 5-9. The values of  $E_1$  and  $t_1$  are given below:

a. Spike #1  $E_1 = 400$  volts;  $t_1 \leq 5 \mu\text{sec}$

17.2.2 Part II - power frequency. The test sample shall not exhibit any malfunction, degradation of performance, or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when 20 amperes are applied to the test wire at the power frequency(ies) of the test sample.

## 18. RS03

18.1 RS03 applicability. The requirement is applicable from 14 kHz to 10 GHz plus at all intentionally generated frequencies between 10 and 40 GHz of any known intentional emitter located on the ship.

18.2 RS03 limits. The test sample shall not exhibit any malfunction, degradation of performance, or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when subjected to radiated electric fields (E) less than or equal to those specified herein. Above 30 MHz, the requirements shall be met for both horizontally and vertically polarized waves. Appropriate consideration shall be given to the operational radiated electromagnetic environment from both friendly and hostile emitters which an equipment or subsystem may encounter during its life cycle. Applicable portions of MIL-HDBK-235 shall be used to determine the anticipated environment. As a minimum, the levels given below apply. If levels substantially higher than 50 volts/meter are specified, modifications to the procedure in MIL-STD-462 may be required. Such modifications are to be described in the EMI Test Plan.

Frequency	E-field level (volts/meter) at anticipated location of equipment or subsystem	
	Areas not exposed to the weather (i.e., below deck)	Areas exposed to the weather (i.e., above deck), all surface ships
14 kHz to 30 MHz	1	100
30 MHz to 10 GHz	1	200
Above 10 GHz	1	200

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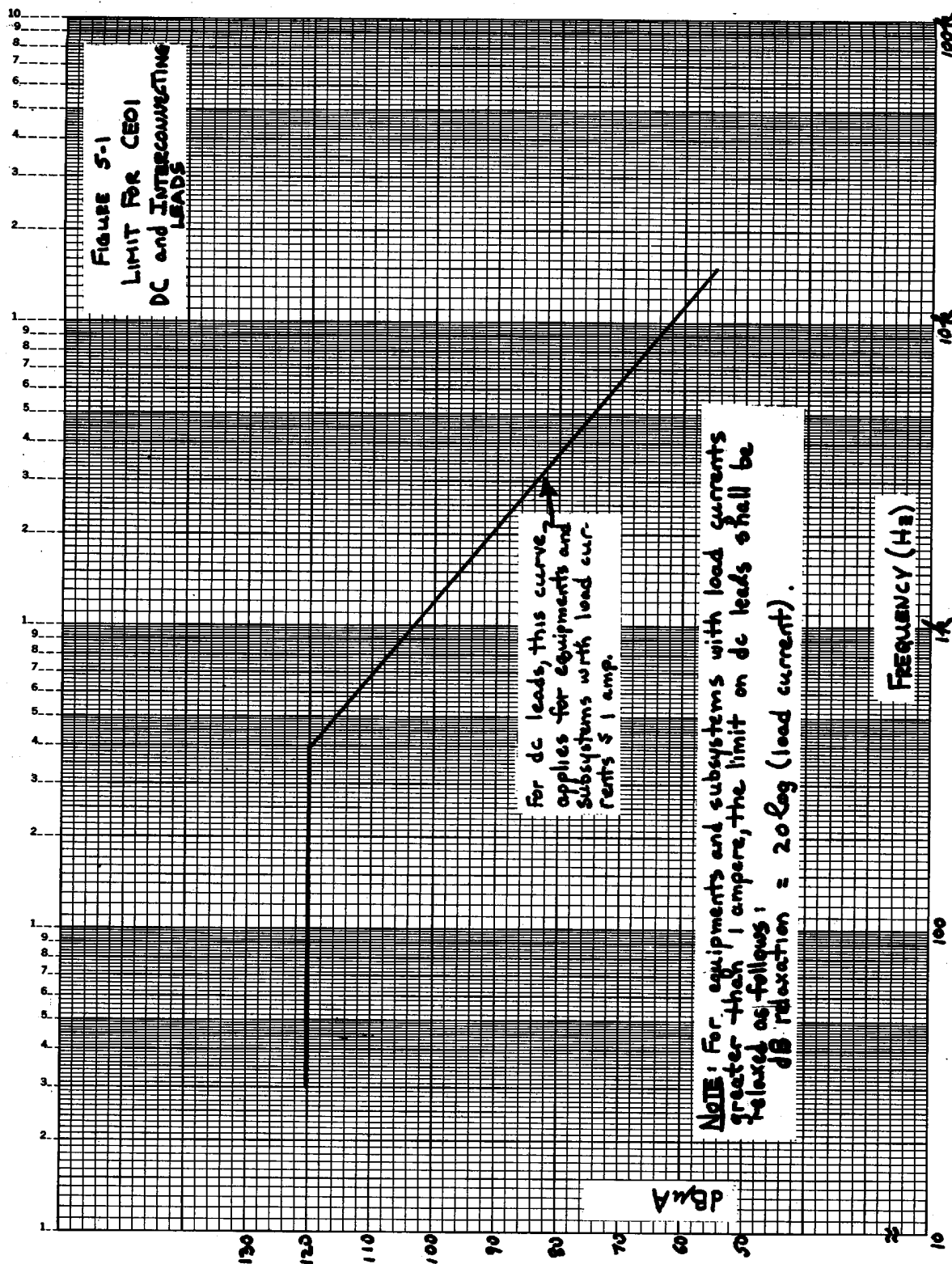


FIGURE 5-1. Limit for CE01 DC and interconnecting leads.

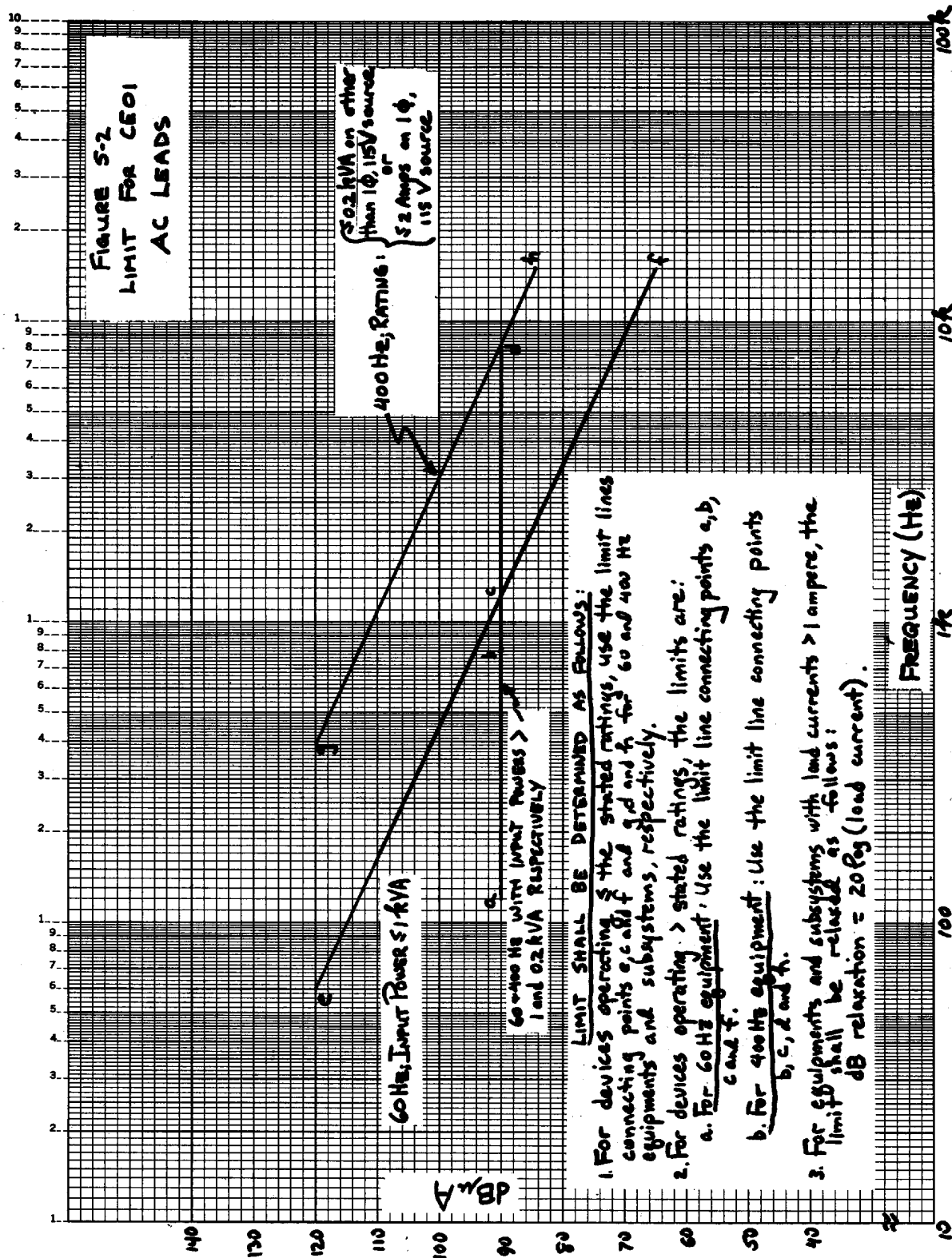


FIGURE 5-2. Limit for CE01 AC leads.



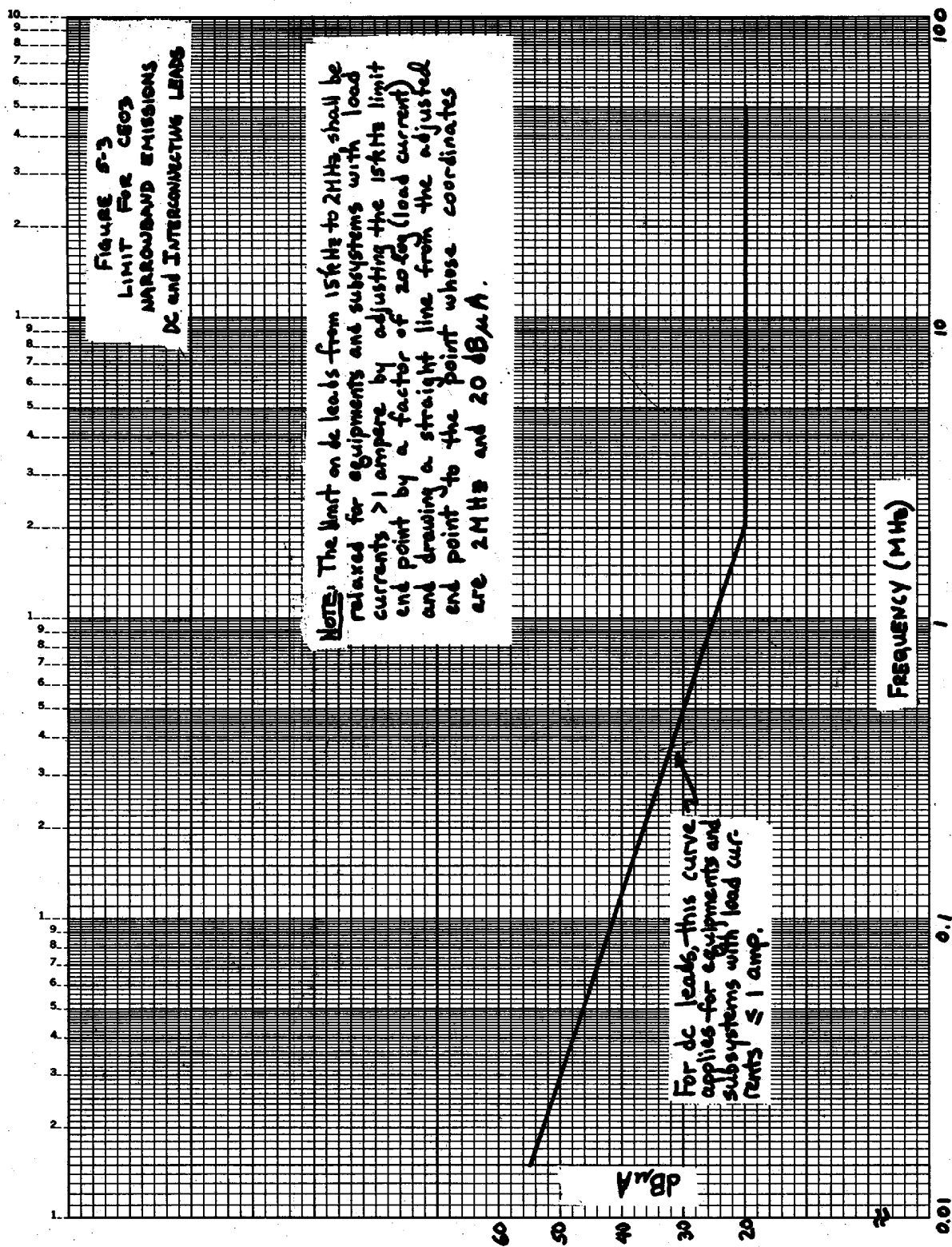


FIGURE 5-3. Limit for CE03 narrowband emissions DC and interconnecting leads.

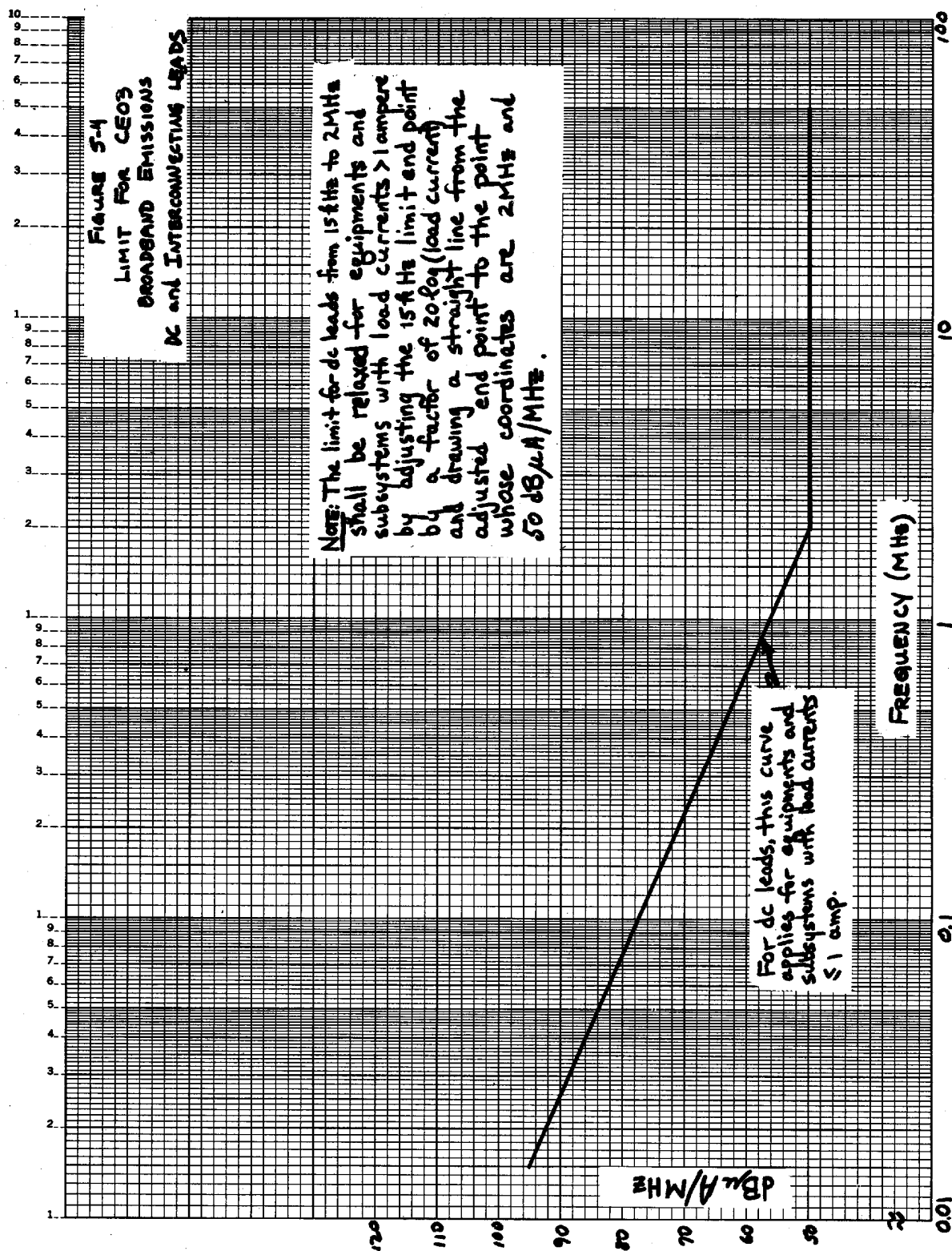


FIGURE 5-4. Limit for CE03 broadband emissions DC and interconnecting leads.



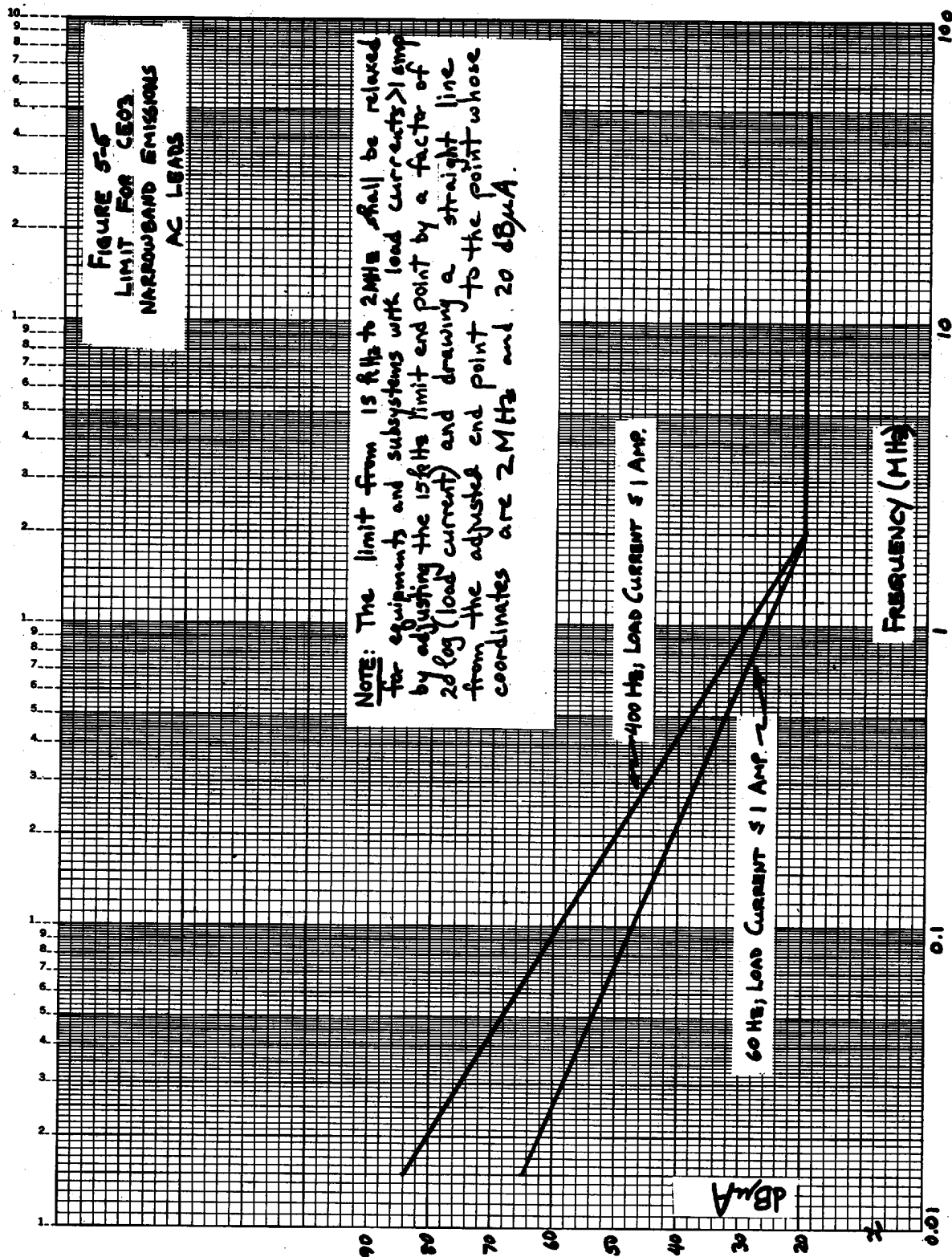


FIGURE 5-5. Limit for CE03 narrowband emissions AC LEADS.

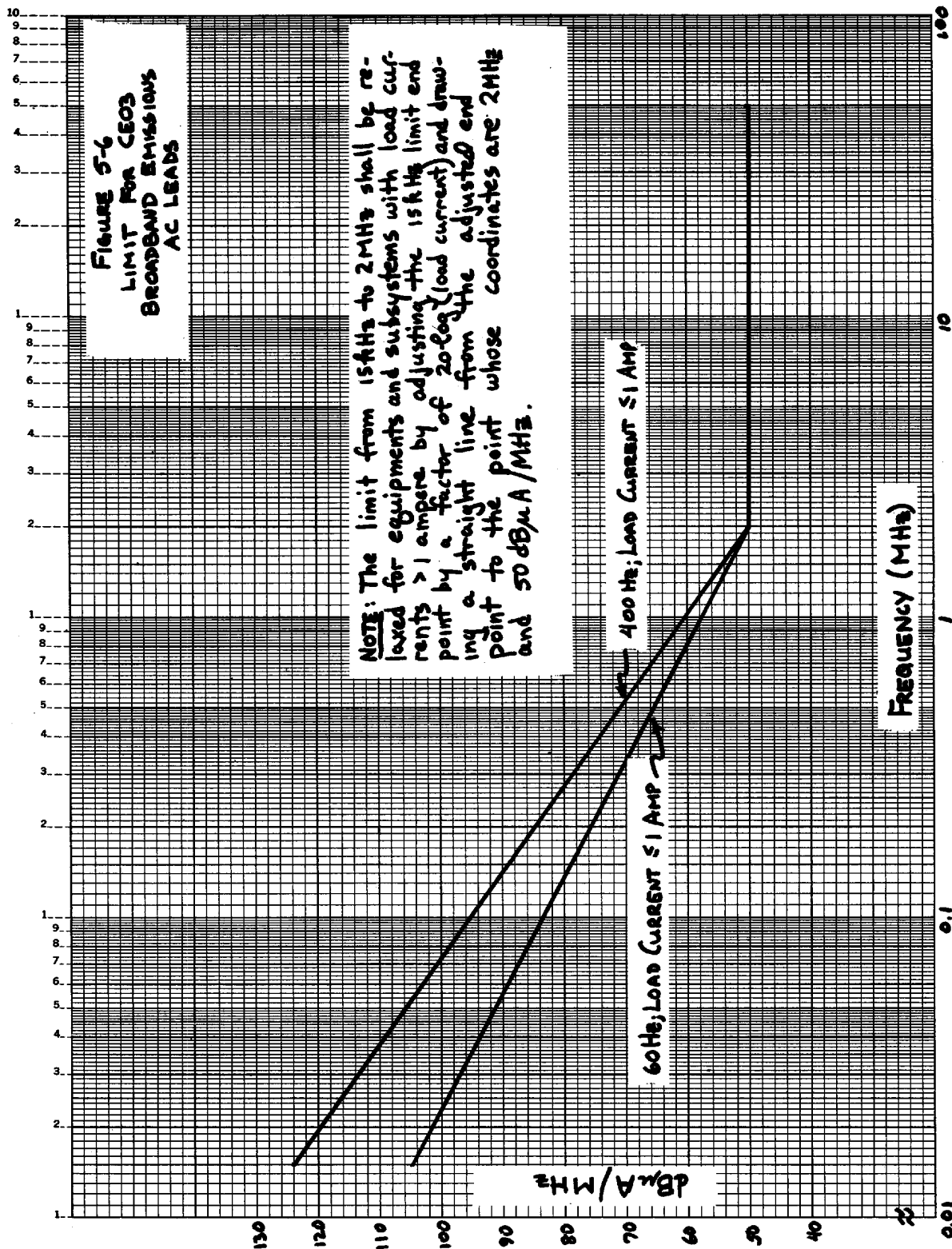


FIGURE 5-6. Limit for CE03 broadband emissions AC leads.

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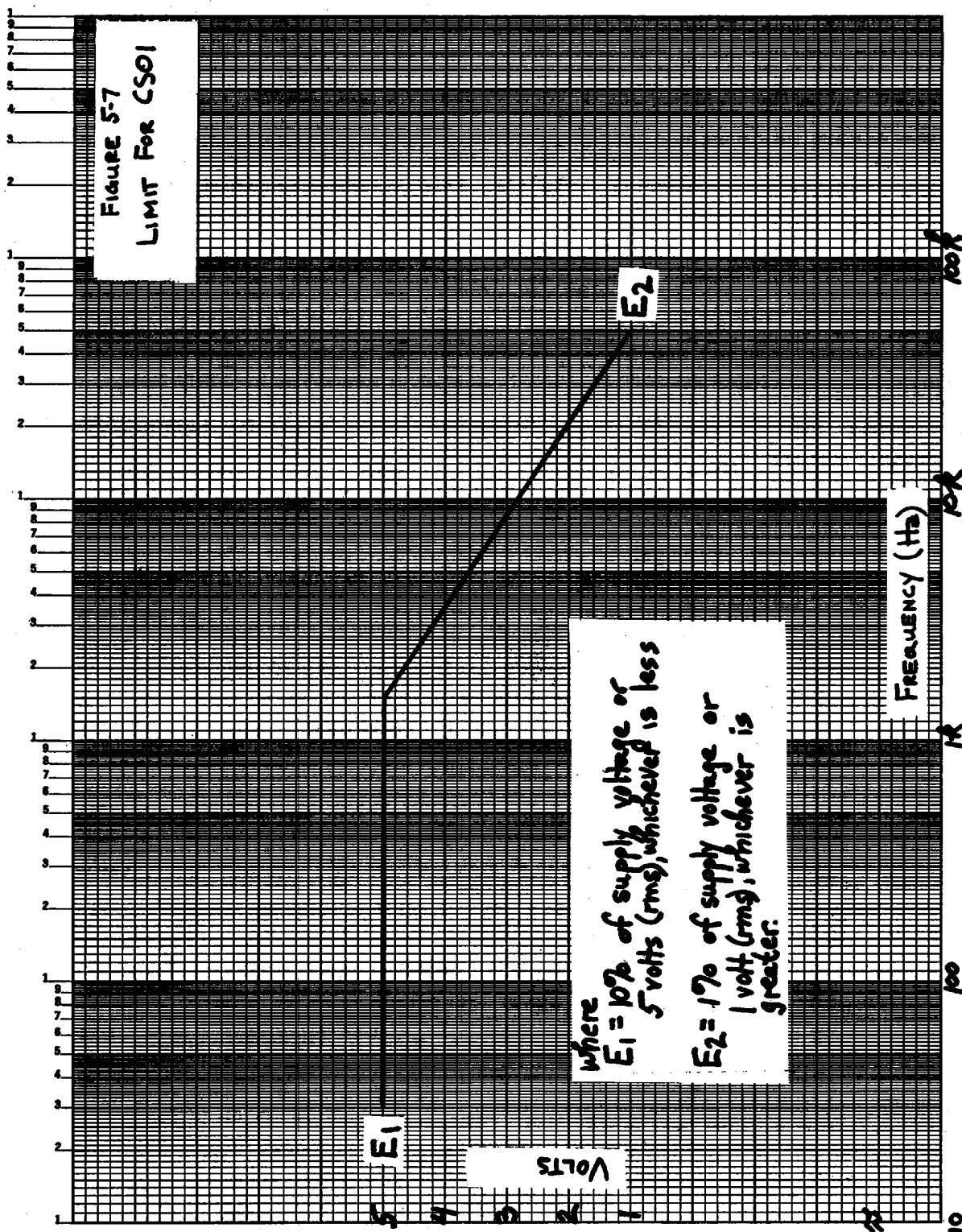
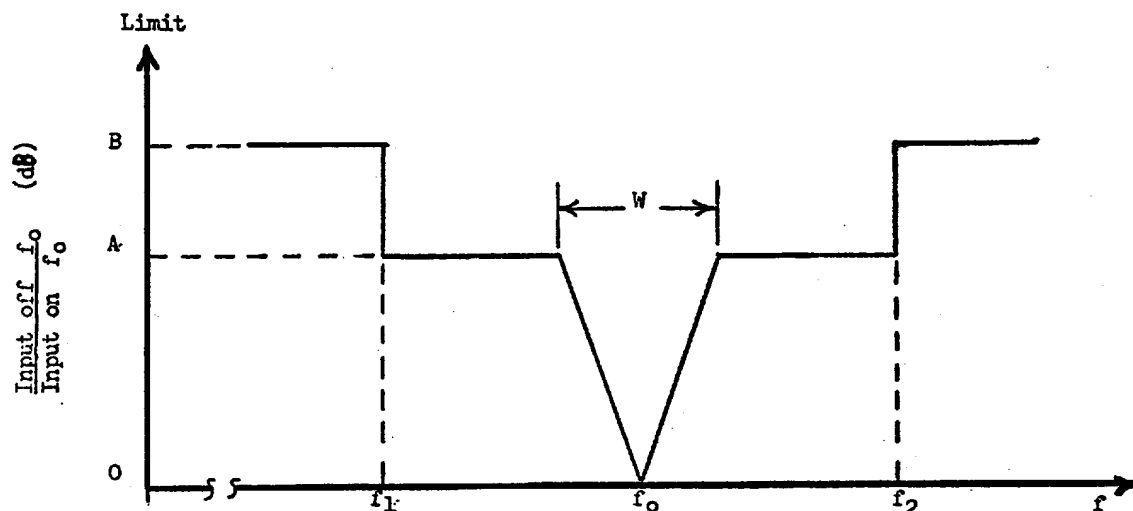


FIGURE 5-7. Limit for CS01.



$f_0$  = Receiver tuned frequency or band center for amplifiers.

$f_1$  = Lowest tunable frequency of receiver band in use or the lowest frequency of amplifier passband.

$f_2$  = Highest tunable frequency of receiver band in use or the highest frequency of amplifier passband.

$W$  = Bandwidth between the 80 dB points of the receiver selectivity curve as defined in the test sample's technical requirements or the control plan.

#### Limits:

1. The limit at A is 80 dB above the input level required to produce the standard reference output. (This limit shall not be used for amplifiers)
2. The limit at B shall be set as follows:
  - a. Receivers: 0 dBm applied directly to the receiver input terminals.
  - b. Amplifiers: The limit shall be as specified in the test sample's technical requirement or control plan. If no limit is defined in the above documents, the 0 dBm value shall be used.

FIGURE 5-8. Limit for CS04.



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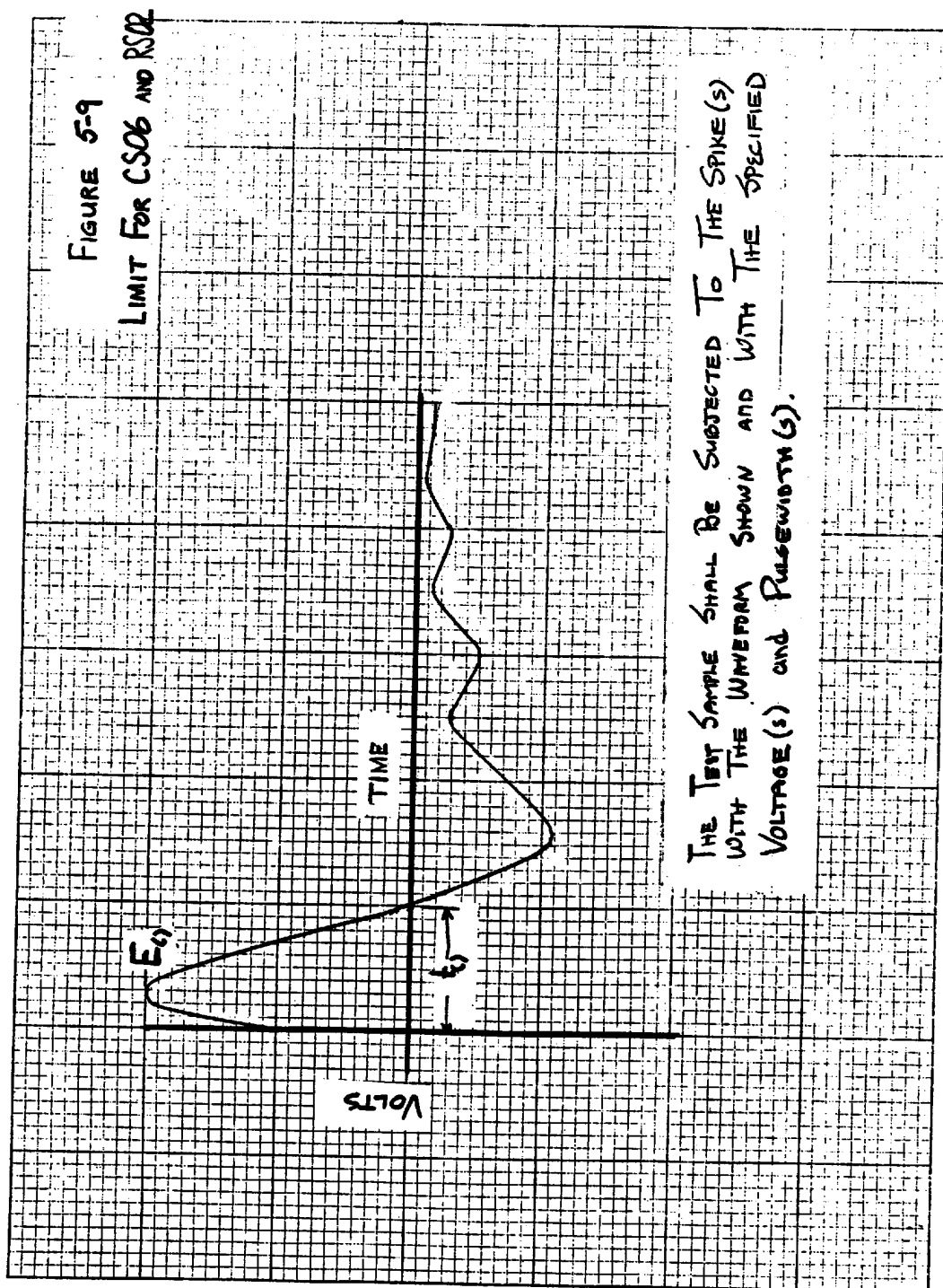


FIGURE 5-9. Limit for CS06 and RS02.

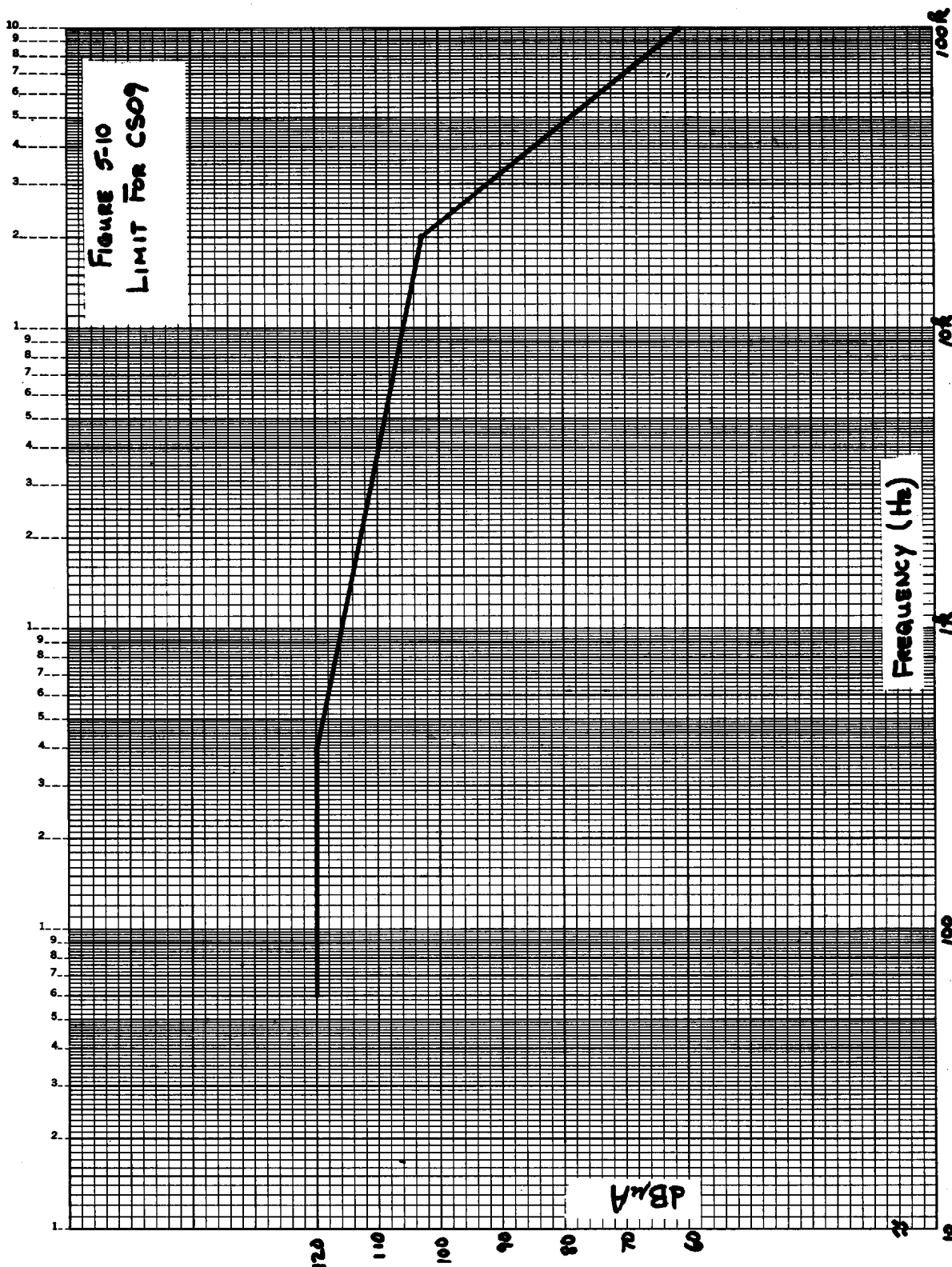


FIGURE 5-10. Limit for CS09.



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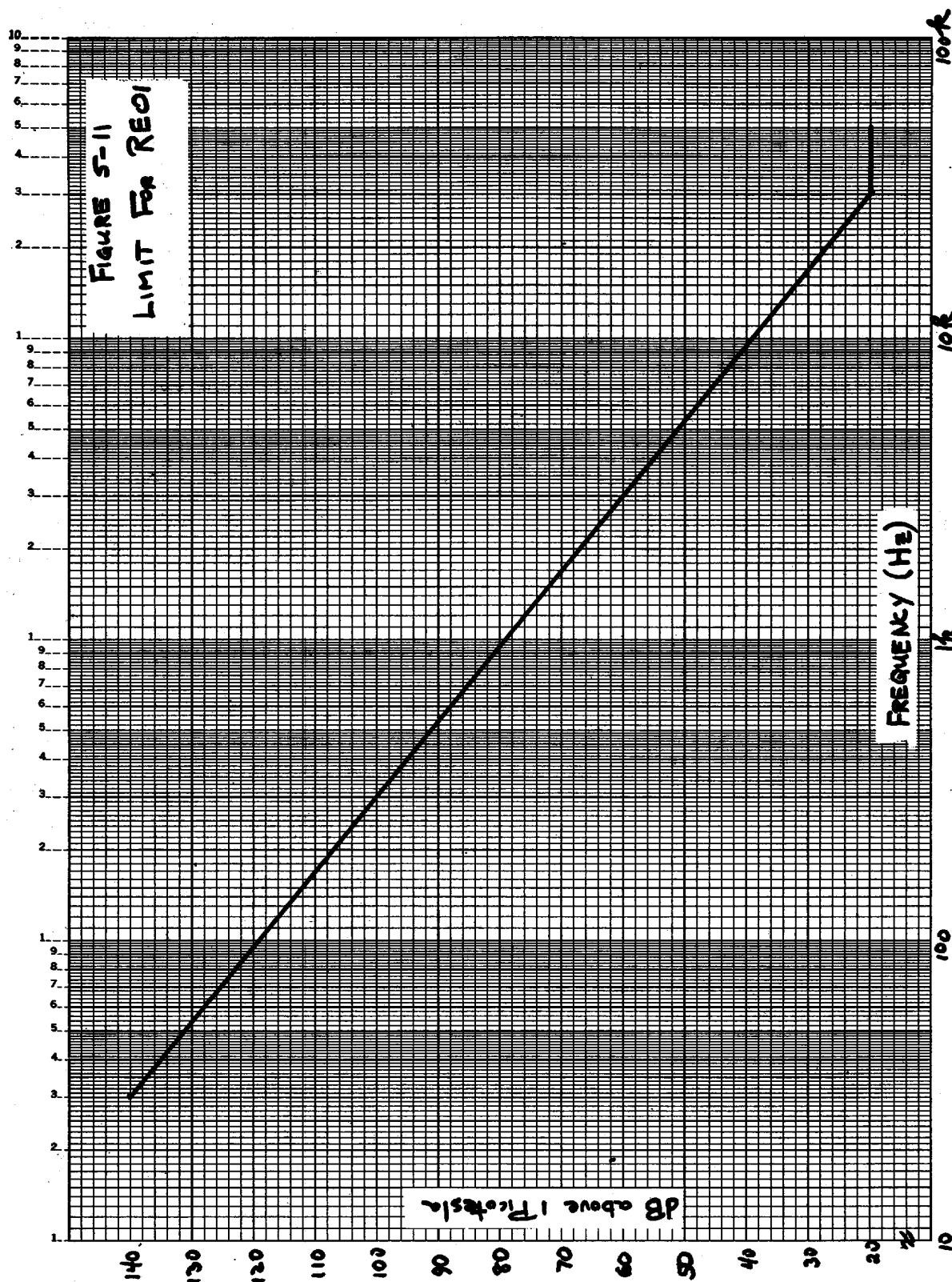


FIGURE 5-11. Limit for REO1.

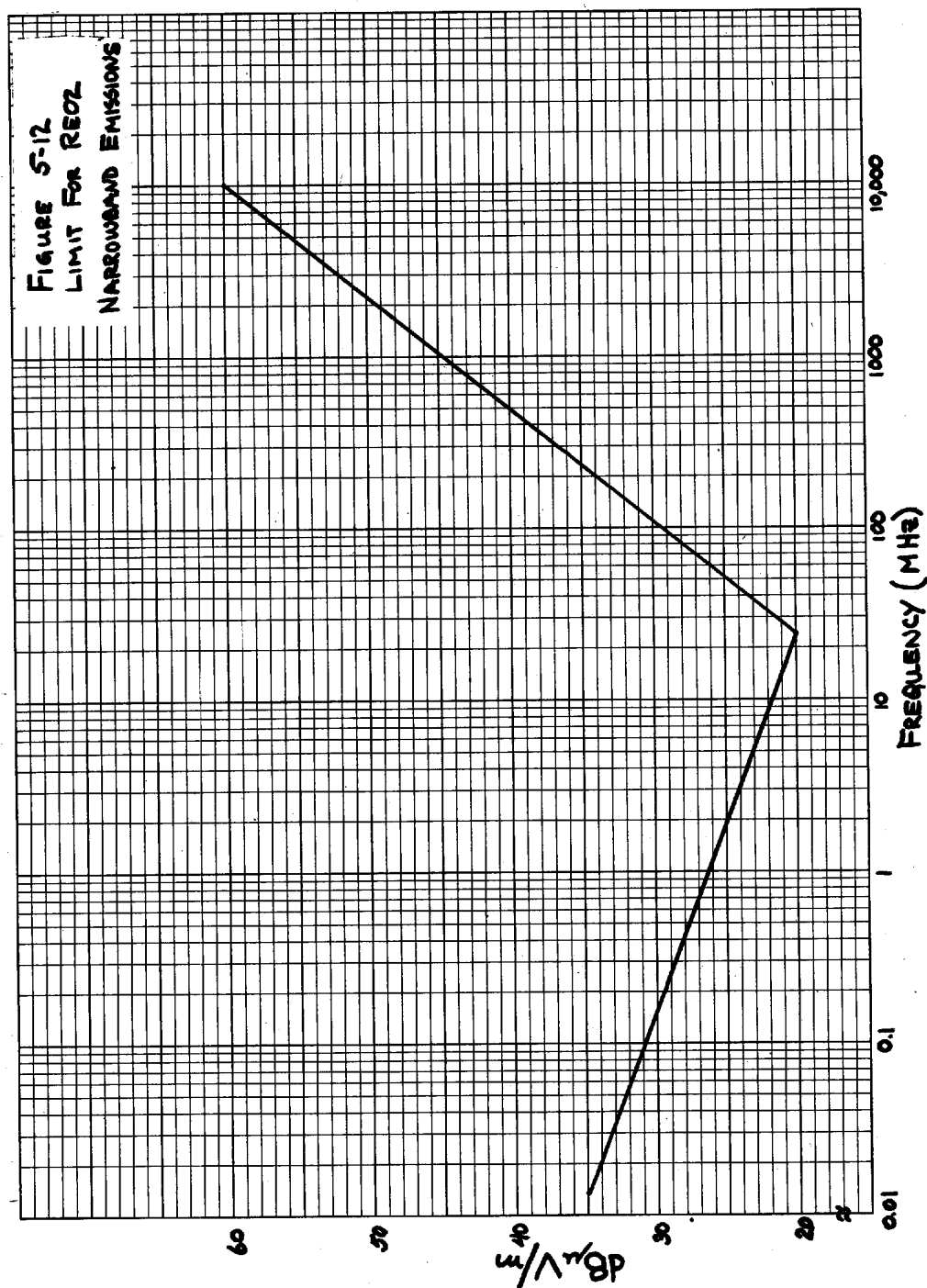


FIGURE 5-12. Limit for RE02 narrowband emissions.

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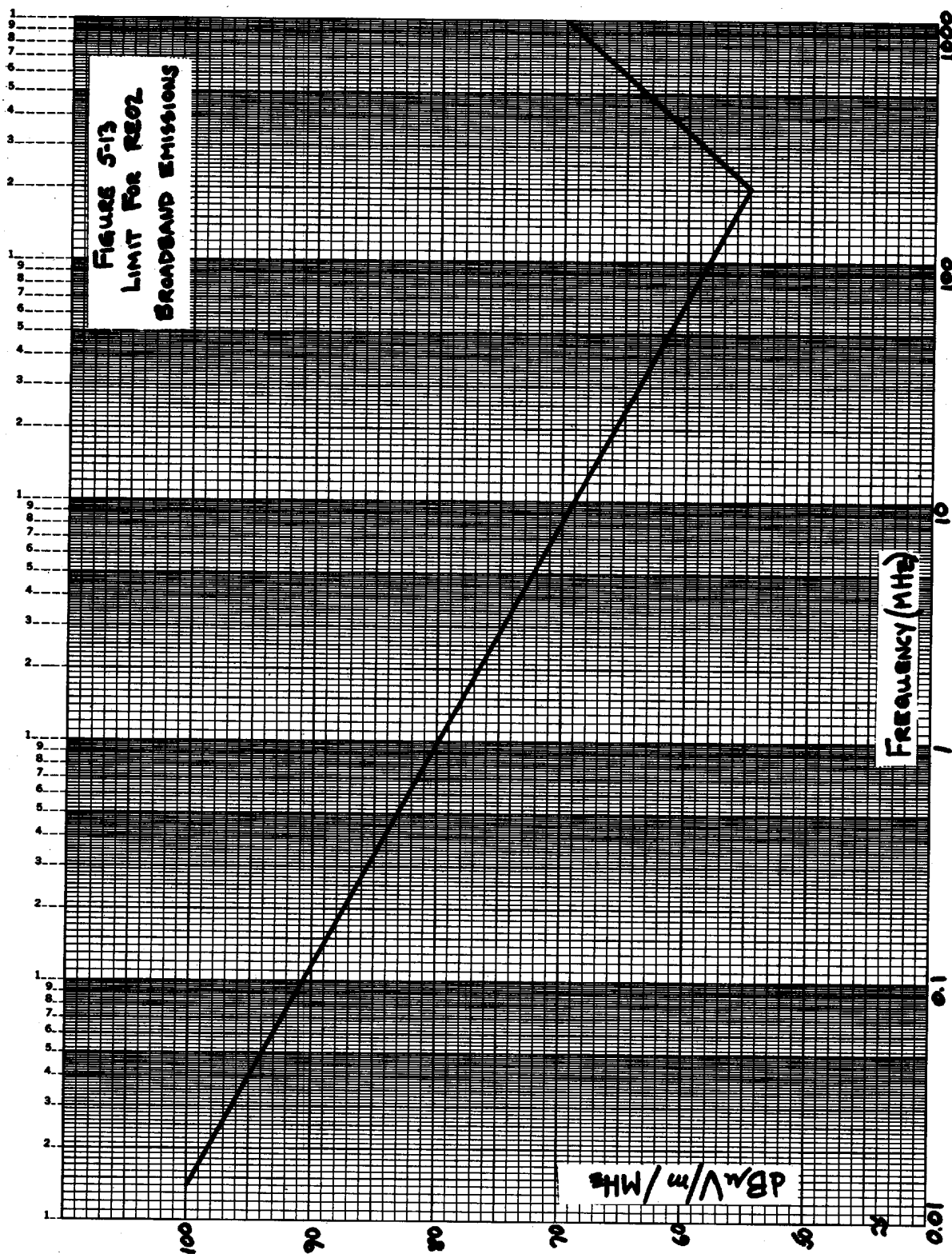


FIGURE 5-13. Limit for RE02 broadband emissions.

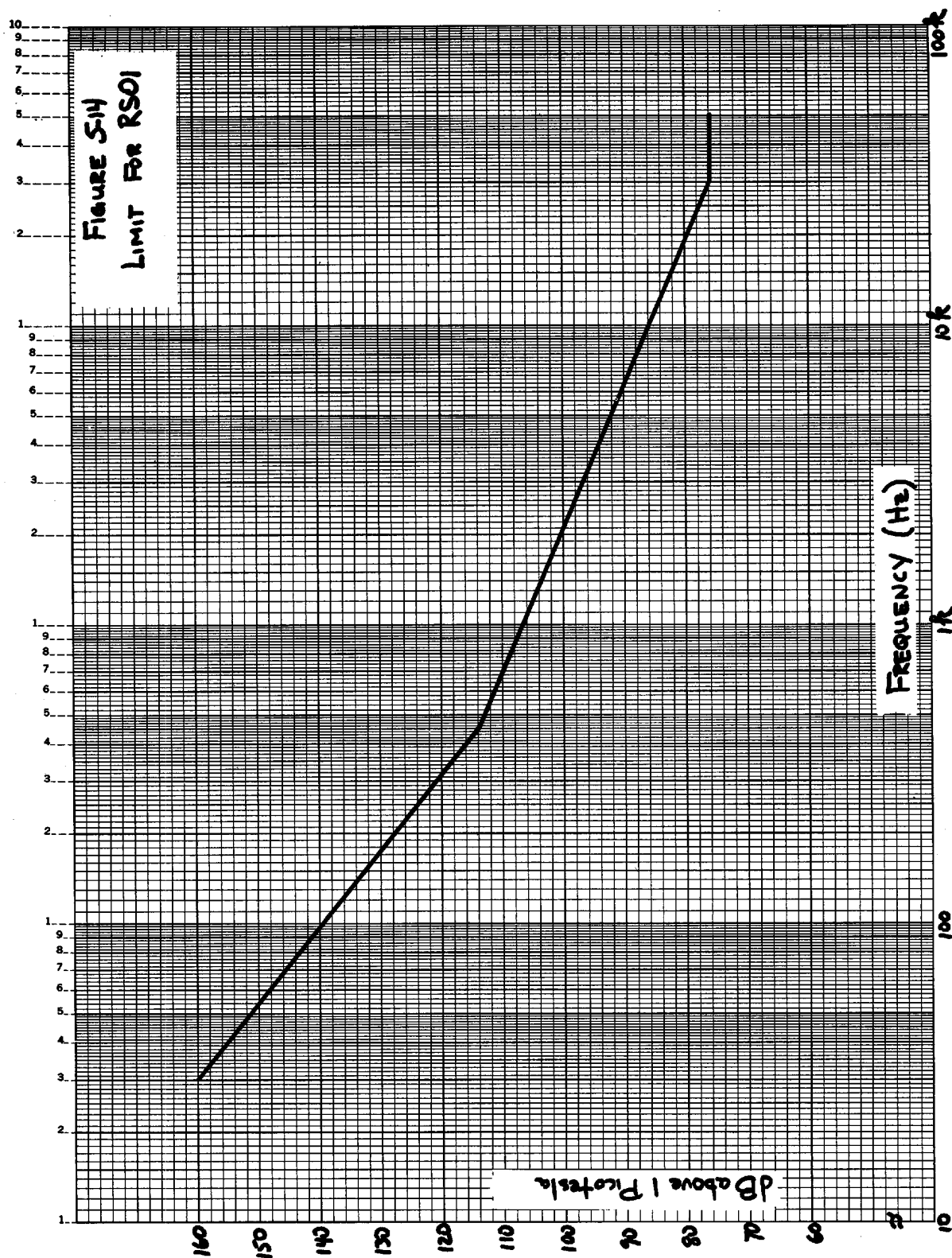


FIGURE 5-14. Limit for RSOL.

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## 1. SCOPE

This part of MIL-STD-461 supplements Part 1 of the standard by defining emission and susceptibility requirements and limits for equipments and subsystems intended for use in submarines (class A5).

1.1 Determining requirements. TABLE 6-I shall be used to determine the specific requirements for class A5 equipments and subsystems. The table also denotes the paragraphs wherein the requirements and limits are defined. A entry in the table means the requirement is applicable and the limit shall be met using the procedures in MIL-STD-462 or the approved EMI Test Plan. A Y<sub>L</sub> entry means the applicability of the requirement is limited and is specified in the corresponding appropriate paragraph. The limit shall be met using the procedures in MIL-STD-462 or the approved EMI Test Plan. A T entry means that the applicability must be determined on a case-by-case basis and that if the requirement is to be imposed, it must be so specified in the appropriate procurement document. When required, the limit shall be met using the procedures in MIL-STD-462 or the approved EMI Test Plan. Absence of an entry means the requirement is not applicable. For procurements of subsystems, such as radar, EW surveillance and the like, comprised of individual equipments listed in TABLE 6-I, the applicable emission and susceptibility requirements for the subsystem shall be tailored by the procuring activity based on the requirements of the individual equipments.

## 2. CE01

2.1 CE01 applicability. This requirement is applicable for the following types of leads: AC or DC leads which obtain power from or provide power to other equipments, distribution panels or subsystems; grounds or neutrals which are not grounded internally to the subsystem or equipment being measured; and control circuits using test sample power, which provide power to, or control, relays, solenoids, valves, and the like. The requirement is not applicable for signal leads such as clock, IF, audio, firing, digital RF and the like, unless otherwise specified by the Command or agency concerned.

2.1.1 DC and interconnecting leads. This requirement is applicable for narrowband emissions from 30 Hz to 15 kHz.

2.1.2 AC leads. The requirement is applicable for narrowband emissions from the power frequency(ies) of the test sample to 15 kHz.

2.2 CE01 limits.

2.2.1 DC leads. Electromagnetic emissions shall not appear on DC leads in excess of the values shown on FIGURE 6-1. The limits shall be met when measured with an effective bandwidth not exceeding 75 Hz.

2.2.2 AC leads. Electromagnetic emissions shall not appear on AC leads in excess of the values shown on the applicable limit line on FIGURE 6-2.

2.2.3 Interconnecting leads.

2.2.3.1. Connected outer shield and twisted pairs together. For interconnecting control and signal leads having the outer shield connected, and for twisted pairs with the pairs together, electromagnetic emissions shall not appear on the leads in excess of the values shown on FIGURE 6-1.

2.2.3.2 Disconnected outer shield and twisted pairs separated. For interconnecting control and signal leads having the outer shield disconnected, and for twisted pairs having the pairs separated, the limits shall be developed on a case-by-case basis considering the intentional transmission, its specified power level, necessary information bandwidth and pulse rise time. Such limits must be approved by the Command or agency concerned.

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TABLE 6-I. Emission and susceptibility requirements for Class A5 equipments and subsystems.

Requirement		Applicable Paragraph																																
Specific Equipment/Subsystem		Receivers	Transmitters	Antenna Multicouplers	Amplifier, Tuned	Amplifier, Untuned	Intercom/Interphone	Modem	Repeater	Amplifier, Power/Audio	Modulators	Multiplexers	Laser Devices	IR Devices	Transponders	Bacons	Power Supplies	Sensors	Inertial Guidance	Teletypewriters	Recorders	Visual Displays	Digital Equipment	Data Annotation	Camera Data	Receive Signal Junction Boxes	Telephone SWBD	Servo/Synchro	Test Equipment	Time/Frequency STDS	Ultrasonic Devices	Telephones	Sonar Devices	All Others Not Listed Herein
CE01		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
CE03		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
CE06		Y <sup>L</sup>	Y <sup>L</sup>	T	Y <sup>L</sup>	Y <sup>L</sup>	Y <sup>L</sup>	Y	Y	Y	Y	Y	Y	Y	Y <sup>L</sup>	Y <sup>L</sup>	Y <sup>L</sup>	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y <sup>L</sup>	Y <sup>L</sup>	
CS01		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
CS02		T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	
CS03		Y		T	T	T	Y		Y	Y					Y			T																
CS04		Y		T	T	T	T		T	T					T												Y <sup>L</sup>							
CS05		Y		T	T	T	Y		Y	Y					Y			T																
CS06		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
CS07		Y <sup>L</sup>																																
CS09		Y <sup>L</sup>	Y <sup>L</sup>	Y <sup>L</sup>	Y <sup>L</sup>	Y <sup>L</sup>	Y <sup>L</sup>	Y <sup>L</sup>	Y <sup>L</sup>	Y <sup>L</sup>	Y <sup>L</sup>	Y <sup>L</sup>	Y <sup>L</sup>	Y <sup>L</sup>	Y <sup>L</sup>	Y <sup>L</sup>	Y <sup>L</sup>	Y <sup>L</sup>	Y <sup>L</sup>	Y <sup>L</sup>	Y <sup>L</sup>	Y <sup>L</sup>	Y <sup>L</sup>	Y <sup>L</sup>	Y <sup>L</sup>	Y <sup>L</sup>	Y <sup>L</sup>	Y <sup>L</sup>	Y <sup>L</sup>	Y <sup>L</sup>	Y <sup>L</sup>	Y <sup>L</sup>	Y <sup>L</sup>	
RE01		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
RE02		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
RE03		Y <sup>L</sup>													Y <sup>L</sup>	Y <sup>L</sup>	Y <sup>L</sup>															Y <sup>L</sup>	Y <sup>L</sup>	
RS01		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
RS02		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
RS03		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	

### 3. CE03

**3.1 CE03 applicability.** This requirement is applicable for the following types of leads: AC and DC leads which obtain power from other sources or provide power to other equipments, distribution panels or subsystems; ground or neutrals which are not grounded internally to the subsystem or equipment being measured; and control circuits using test sample power, which provide power to, or control, relays, solenoids, valves and the like. The requirement is not applicable for signal leads such as clock, IF, audio, firing, digital, RF and the like unless otherwise specified by the Command or agency concerned.

#### 3.2 CE03 limits.

**3.2.1 DC leads.** Electromagnetic emissions shall not appear on DC leads in excess of the values on FIGURES 6-3 and 6-4 for narrowband and broadband emissions, respectively.

**3.2.2 AC leads.** Electromagnetic emissions shall not appear on AC leads in excess of the values shown on FIGURES 6-5 and 6-6 for narrowband and broadband emissions, respectively.

#### 3.2.3 Interconnecting leads.

**3.2.3.1 Connected outer shield and twisted pairs together.** For interconnecting control and signal leads having the outer shield connected, and for twisted pairs with the pairs together, electromagnetic emissions shall not appear on the leads in excess of the values shown on FIGURES 6-3 and 6-4 for narrowband and broadband emissions respectively.

**3.2.3.2 Disconnected outer shield and twisted pairs separated.** For interconnecting control and signal leads having the outer shield disconnected, and for twisted pairs having the pairs separated, the limits shall be developed on a case-by-case basis considering the intentional transmission, its specified power level, necessary information bandwidth and pulse rise time. Such limits must be approved by the Command or agency concerned.

### 4. CE06 (limited applicability)

**4.1 CE06 applicability.** This requirement is applicable for those equipments and subsystems with antenna leads or those designed to be connected to antennas. Transmitters with absolute peak powers less than or equal to -10 dBW (0.1 watt) are exempt from meeting the harmonic and spurious portions of this requirement. When any of the following conditions exist, the transmitter (key-down) harmonic and spurious emission portions of this requirement may be measured using the procedures in RE03, in lieu of those of CE06, with the approval of the Command or agency concerned: (a) transmitter power exceeds 5 kW average; (b) the fundamental frequency of the test sample exceeds 1.24 GHz; (c) the test sample's antenna is an integral part of the transmitter and cannot be replaced by a suitable dummy load; or (d) for equipments and subsystems with waveguide transmission lines and operating below 1.24 GHz. The frequency range of this requirement is dependent on the operating frequency of the test sample (see MIL-STD-462). The transmitter (key-down) portion of this requirement is not applicable within either the test sample's necessary bandwidth or  $\pm 5$  percent of the fundamental frequency.

**4.2 CE06 limits.** Conducted emissions in excess of the values given below shall not appear at the test sample's antenna terminals.

#### 4.2.1 Receivers.

- a. Narrowband emissions: 34 dB  $\mu$ V
- b. Broadband emissions: 40 dB  $\mu$ V/MHz

#### 4.2.2 Transmitters (key-up and standby).

- a. Narrowband emissions: 34 dB  $\mu$ V
- b. Broadband emissions: 40 dB  $\mu$ V/MHz



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4.2.3 Transmitters (key-down mode). Harmonics, except the second and third and all other spurious emissions shall have peak powers 80 dB down from the power at the fundamental. The second and third harmonics shall be suppressed by:  $40 + 10 \log P$ , (where  $P$  = peak power, in watts, at the fundamental) or 80 dB, whichever requires less suppression.

## 5. CS01

5.1 CS01 applicability. This requirement is applicable to equipment and subsystem power leads, including grounds and neutrals, which are not grounded internally to the equipment or subsystem. The requirement is not applicable within  $\pm 5$  percent of the power frequency(ies). This requirement may be deleted with the approval of the Command or agency concerned, if no circuit within the equipment or system has a sensitivity of 100 mV or better.

5.2 CS01 limits. The test sample shall not exhibit any malfunction, degradation of performance or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when subjected to electromagnetic energy injected onto its power leads less than or equal to, the values on FIGURE 6-7. The requirement is also met under the following condition, when the power source specified in MIL-STD-462 adjusted to dissipate 50 watts in a 0.5 ohm load, cannot develop the required voltage at the test sample power input terminals and the test sample is not susceptible to the output of the signal source.

## 6. CS02 (limited applicability)

6.1 CS02 applicability. Applications of this requirement are to be determined on a case-by-case basis. When specified, this requirement is applicable to equipment and subsystem power leads, including grounds and neutrals which are not grounded internally to the equipment or subsystem.

6.2 CS02 limits. The test sample shall not exhibit any malfunction, degradation of performance or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when subjected to 1-volt from a 50 ohm source across the calibrating resistor shown in MIL-STD-462, FIGURE CS02-1. The test signal shall be applied directly to the equipment input terminals, not through the test sample's power line cord. The requirement is also met under the following condition: when a 1-watt source of 50 ohms impedance cannot develop the required voltage at the test sample power input terminals, and the test sample is not susceptible to the output of the signal source.

## 7. CS03 (limited applicability)

7.1 CS03 applicability. This requirement is applicable to receiving equipments and subsystems, such as receivers, RF amplifiers, transceivers, and the like. The applicable frequency range of this requirement is dependent on the operating frequency of the test sample, as specified in MIL-STD-462.

7.2 CS03 limits. The test sample shall not exhibit any intermodulation products from two signals, beyond those permitted in the individual equipment or subsystem specification when:

- a. Signal generator #1 is set 66 dB above the level required to obtain the standard reference output as specified in MIL-STD-462, except that when  $f_1$  is in the frequency range of either 200 to 400 MHz or 2 to 25 MHz, the generator output shall be 80 dB above the reference level.
- b. Signal generator #2 is set 66 dB above the level required to obtain the standard reference output as specified in MIL-STD-462, but the generator level shall not exceed a power level of 10 dBm.

## 8. CS04 (limited applicability)

8.1 CS04 applicability. This requirement is applicable to receiving equipment and subsystems, such as receivers, RF amplifiers, transceivers and the like. The applicable frequency range of this requirement is dependent on the operating frequency of the test sample, as specified in MIL-STD-462.

8.2 CS04 limits. The test sample shall not exhibit any undesired response when subjected to the test signal shown on FIGURE 6-8.

## 9. CS05 (limited applicability)

9.1 CS05 applicability. This requirement is applicable to receiving equipment and subsystems, such as receivers, RF amplifiers, transceivers and the like. The applicable frequency range of this requirement is dependent on the operating frequency of the test sample, as specified in MIL-STD-462.

9.2 CS05 limits. The test sample shall not exhibit, due to cross modulation, any malfunction, degradation of performance or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when subjected to the following from signal generator #2: a signal 66 dB above the level required to obtain the standard reference output, as specified in MIL-STD-462, but not to exceed a power output level of 10 dBm.

## 10. CS06

10.1 CS06 applicability. This requirement is applicable to equipment and subsystem power leads, including grounds and neutrals which are not grounded internally to the equipment or subsystem.

10.2 CS06 limits. The test sample shall not exhibit any malfunction, degradation of performance or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when the test spike having the waveform shown on FIGURE 6-9 is applied to the AC and DC power input leads. The values of  $E_1$  and  $t_1$  are given below. The spike shall be superimposed on the powerline voltage waveform.

a. Spike #1  $E_1 = 400$  volts;  $t_1 \leq 5$   $\mu$ sec.

10.2.1 Varistor-protected inputs. For equipments and subsystems whose power inputs are protected with varistors, the requirement is also met if the equipment or subsystem is not susceptible to a value of  $E_1$  equal to the maximum safe level of the varistor.

## 11. CS07 (limited applicability)

11.1 CS07 applicability. This requirement is applicable for receiving equipment and subsystems which utilize squelch circuits.

11.2 CS07 limits.

11.2.1 Requirement 1. The squelch circuits shall not open when the output of a 50-ohm impedance impulse generator, set at 90 dB  $\mu$ V/MHz is applied and matched to the input terminals of the test sample.

11.2.2 Requirement 2. The squelch circuit shall not open when two signals are applied at the input of the test sample. One signal shall be an unmodulated RF signal at the receiver tuned frequency whose amplitude is two-thirds of the RF voltage used to adjust the squelch threshold. The second signal shall be an impulse signal of 50 dB  $\mu$ V/MHz.

## 12. CS09 (limited applicability)

12.1 CS09 applicability. This requirement is applicable to equipment and subsystems that have an operating frequency range of 100 kHz or less and an operating sensitivity of 1  $\mu$ V or less, such as 0.5  $\mu$ V.

12.2 CS09 limit. The test sample shall not exhibit any malfunction, degradation of performance or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when subjected to levels less than or equal to those on FIGURE 6-10 across the applicable test points.

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### 13. RE01

**13.1 RE01 applicability.** This requirement is applicable for radiated emissions from equipments and subsystems, cables (including control, pulse, IF, power and antennas transmission lines) and interconnecting wiring of the test sample. The requirement applies at the fundamental frequencies, and all spurious emissions including harmonics, but does not apply for radiation from antennas.

**13.2 RE01 limit.** Magnetic field emissions shall not be radiated in excess of the levels shown on FIGURE 6-11.

### 14. RE02

**14.1 RE02 applicability.** This requirement is applicable for radiated emissions from equipments and subsystems, cables (including control, pulse, IF, power and antennas transmission lines) and interconnecting wiring of the test sample; for narrowband, it applies at the fundamental frequencies, and all spurious emissions including harmonics, but does not apply for radiation from antennas. This requirement is applicable from 14 kHz to 1 GHz for narrowband and broadband emissions except that for sonar equipments and subsystems, the requirement is applicable from 14 kHz to 10 MHz.

**14.2 RE02 limits.** E-field emissions shall not be radiated in excess of those given in 14.2.1 and 14.2.2. Above 30 MHz, the limits shall be met for both horizontally and vertically polarized waves.

**14.2.1 Narrowband electric field emissions.** Narrowband E-field emissions shall not be radiated in excess of the limit curve shown on FIGURE 6-12 at the required test distance, as specified in MIL-STD-462.

**14.2.2 Broadband electric field emissions.** Broadband E-field emissions from all equipments and subsystems, including radiated switching transients resulting from: (1) automatic cycling of electronic or electrical switching circuitry, (2) actuation of push-to-talk mechanisms (that is, keying of transmitters); or (3) manual switching, shall not be radiated in excess of the limit curve shown on FIGURE 6-13 at the required test distances, as specified in MIL-STD-462.

### 15. RE03 (limited applicability)

**15.1 RE03 applicability.** This requirement is applicable, with the approval of the procuring activity, when the spurious emissions and harmonics cannot be determined using the procedures of CE06. Transmitters with absolute peak powers less than or equal to -10 dBW (0.1 watt) are exempt from meeting this requirement. The frequency range of this requirement is dependent on the operating frequency of the test sample (see MIL-STD-462). The requirement is not applicable within either the test sample's necessary bandwidth or  $\pm 5$  percent of the fundamental frequency.

**15.2 RE03 limit.** Harmonics, except the second and third, and all other spurious emissions shall have peak powers 80 dB down from the power at the fundamental. The second and third harmonics shall be suppressed by:  $40 + 10 \log P$  (where  $P$  = peak power, in watts, at the fundamental) or 80 dB, whichever requires less suppression.

### 16. RS01

**16.1 RS01 applicability.** This requirement applies to equipments and subsystems and their associated cabling and connectors.

**16.2 RS01 limit.** The test sample shall not exhibit any malfunction, degradation of performance, or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when subjected to magnetic fields less than or equal to the limit curve shown on FIGURE 6-14.

## 17. RS02

17.1 RS02 applicability. Parts I and II of this requirement are applicable for equipments and subsystems procured for use on submarines.

17.2 RS02 limits.

17.2.1 Part I - spikes. The test sample shall not exhibit any malfunction, degradation of performance, or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when subjected to the test spike having the waveform shown on FIGURE 6-9. The values of  $E_1$  and  $t_1$  are given below:

a. Spike #1  $E_1 = 400$  volts;  $t_1 \leq 5$   $\mu$ sec.

17.2.2 Part II - power frequency. The test sample shall not exhibit any malfunction, degradation of performance, or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when 20 amperes are applied to the test wire at the power frequency(ies) of the test sample.

## 18. RS03

18.1 RS03 applicability. This requirement is applicable for all equipments and subsystems between 14 kHz and 1 GHz. Above 1 GHz this requirement is not mandatory unless otherwise required by the procuring activity.

18.2 RS03 limits. The test sample shall not exhibit any malfunction, degradation of performance, or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when subjected to a radiated electric field less than or equal to those specified herein. Above 30 MHz, the requirement shall be met for both horizontally and vertically polarized waves. Appropriate consideration shall be given to the operational radiated electromagnetic environment from both friendly and hostile emitters which an equipment or subsystem may encounter during its lifecycle. Applicable portions of MIL-HDBK-235 shall be used to determine the anticipated environment. As a minimum, equipments and subsystems are to meet this requirement when subjected to a field of 1 volt/meter from 14 kHz to 1 GHz. If levels comparable to those in MIL-HDBK-235 are specified, modifications to the procedures in MIL-STD-462 may be required. Such modifications are to be described in the EMI Test Plan.

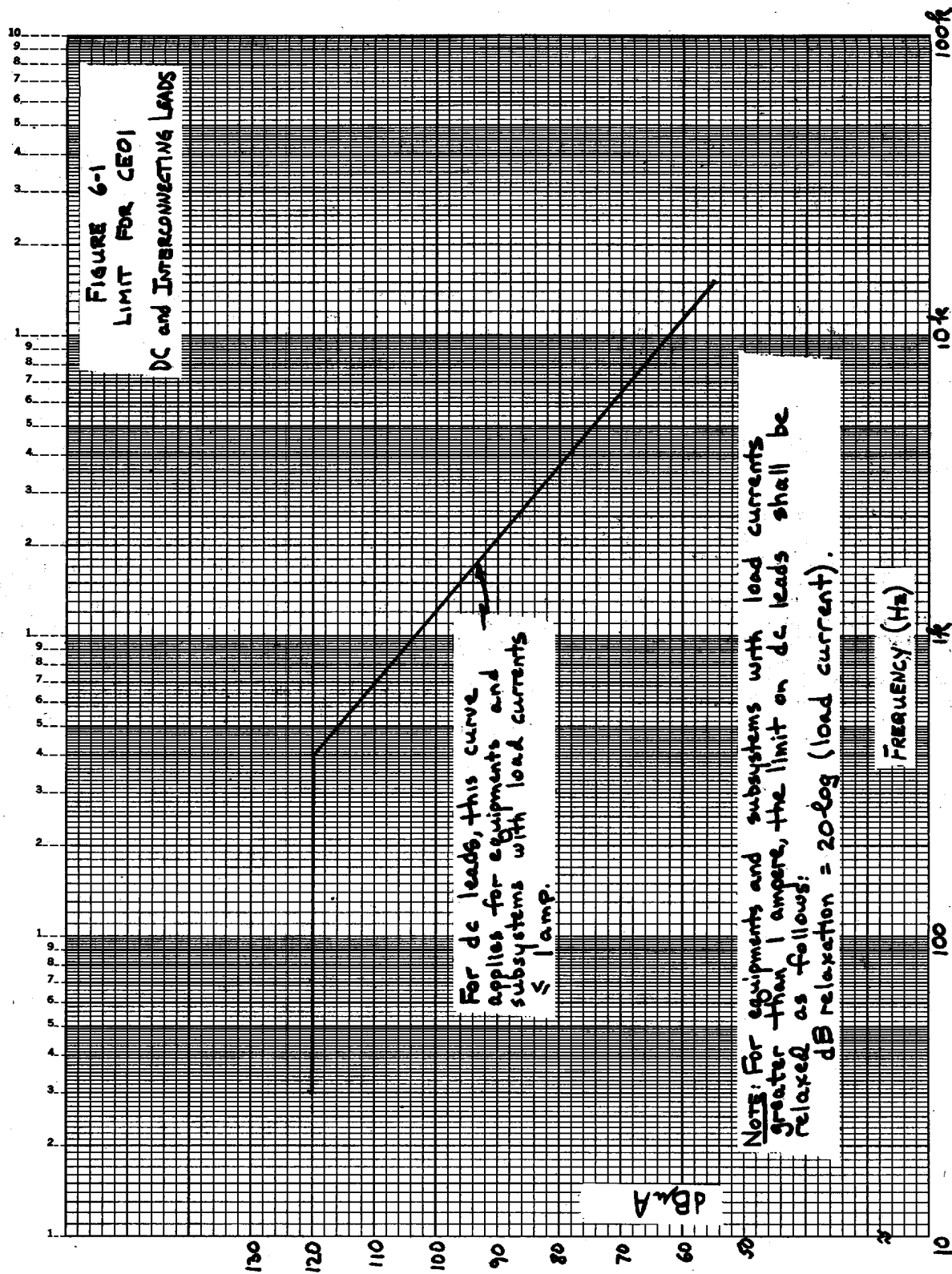


FIGURE 6-1. Limit for CEOI DC and interconnecting leads.



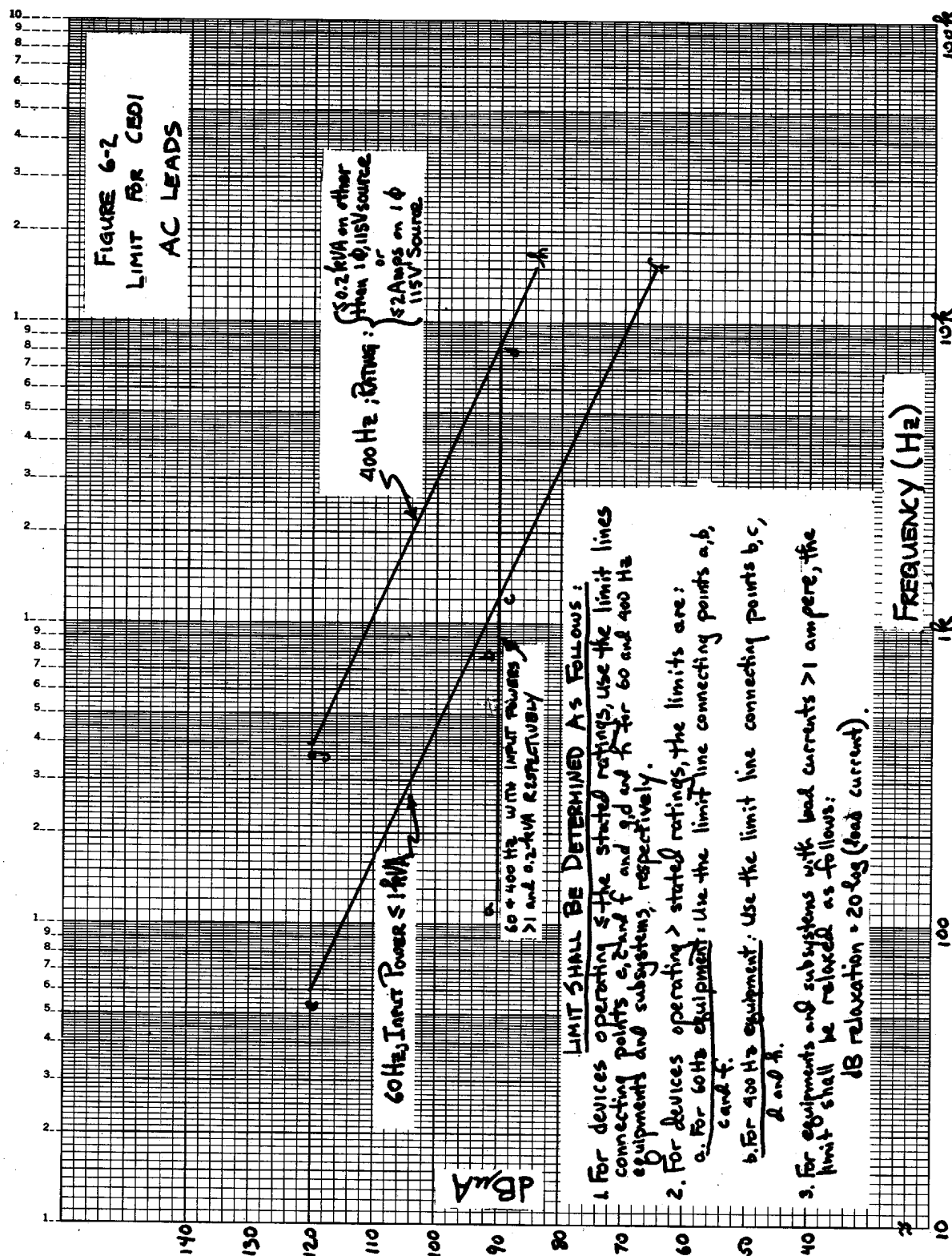


FIGURE 6-2. Limit for CE01 AC leads.



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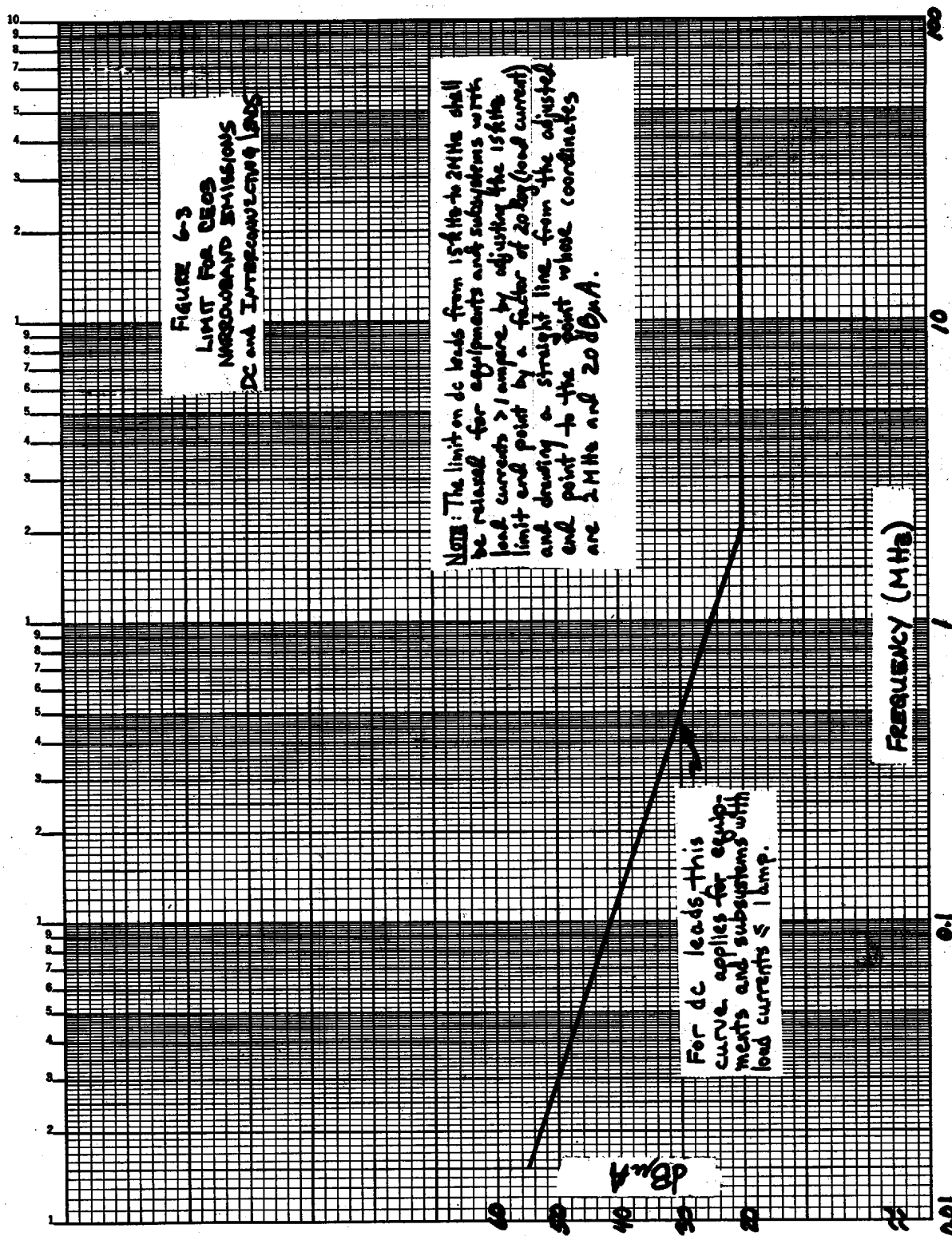


FIGURE 6-3. Limit for CE03 narrowband emissions DC and interconnecting leads.

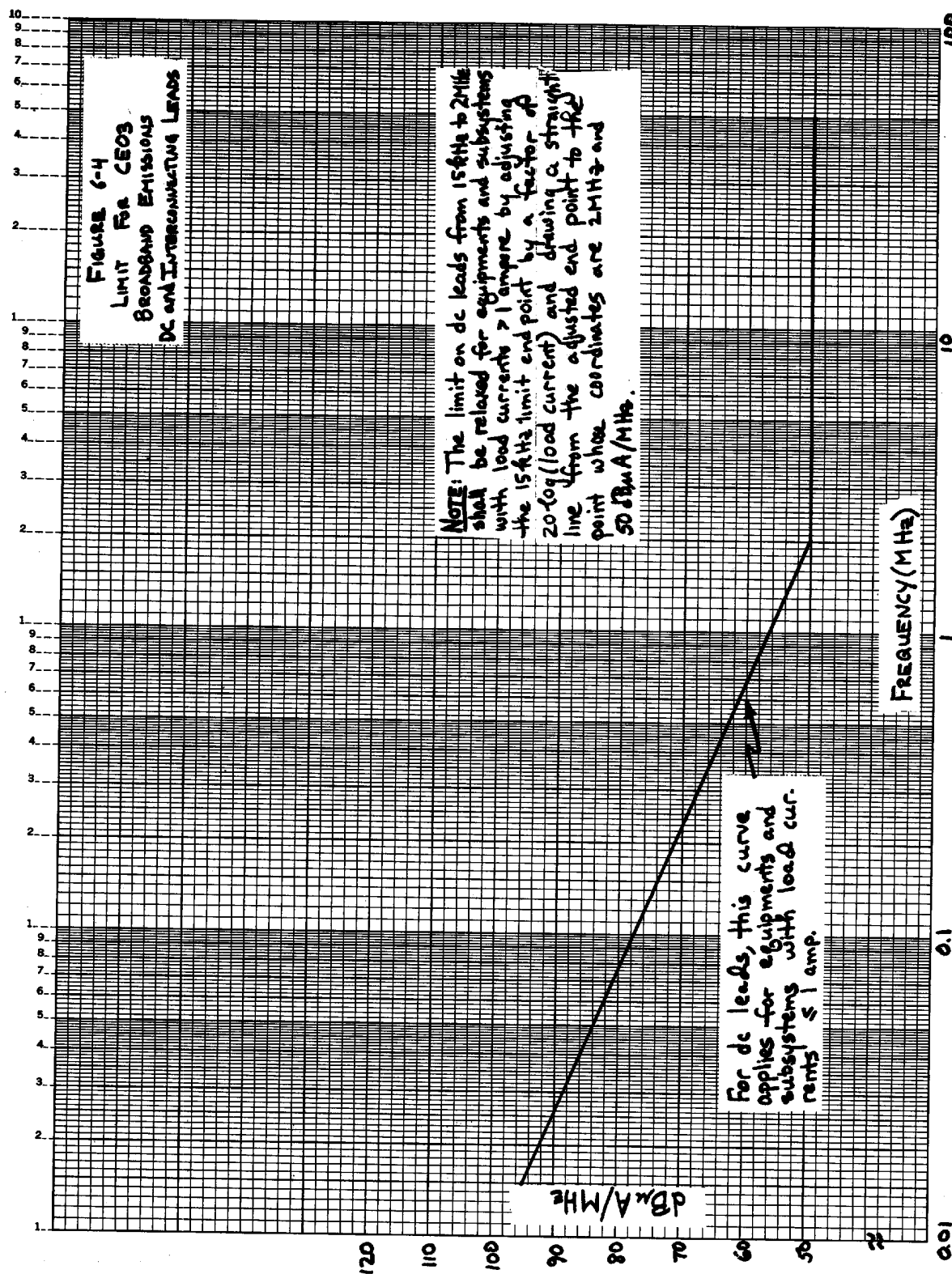


FIGURE 6-4. Limit for CE03 broadband emissions DC and interconnecting leads.

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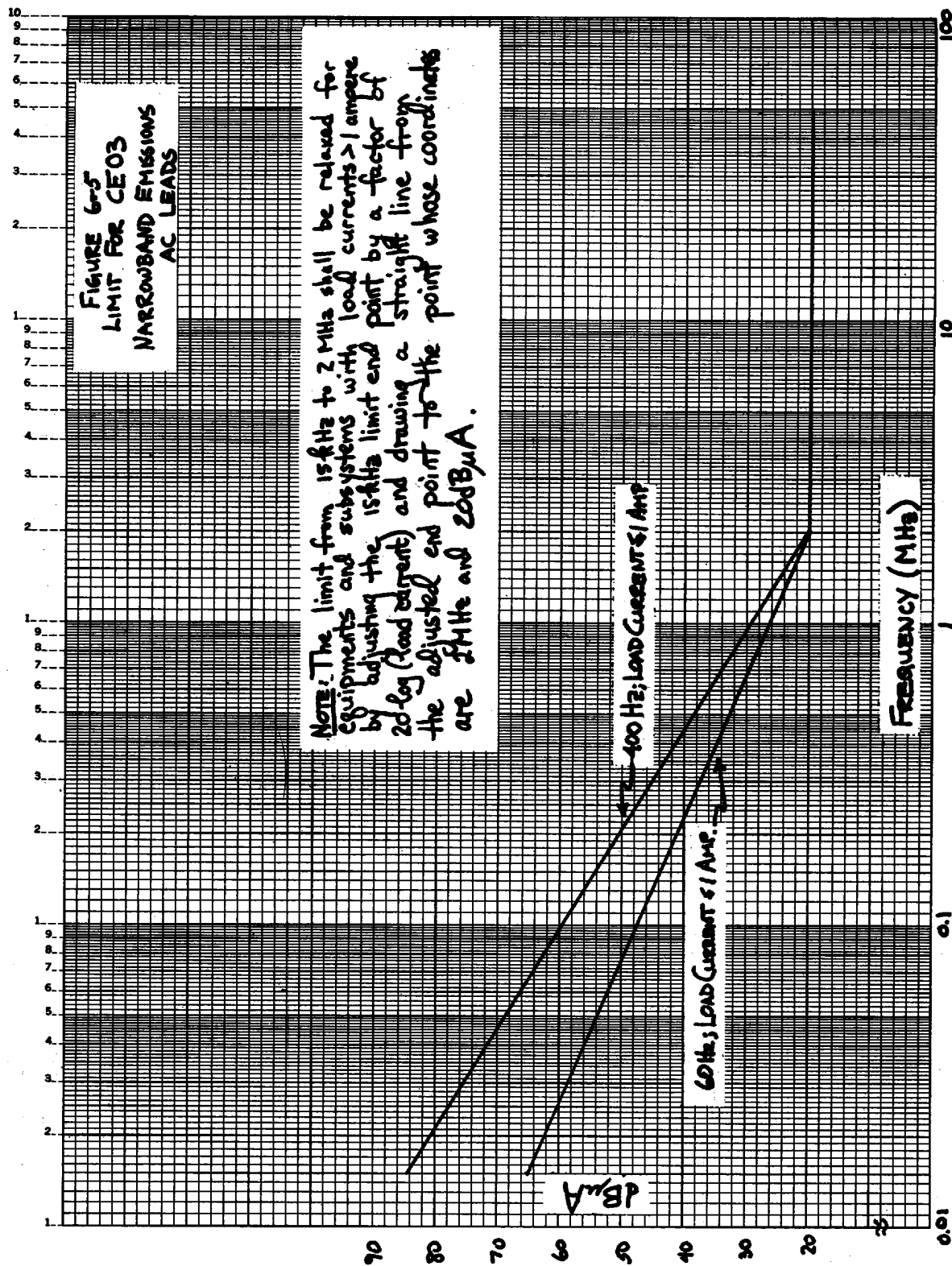


FIGURE 6-5. Limit CE03 narrowband emissions AC leads.



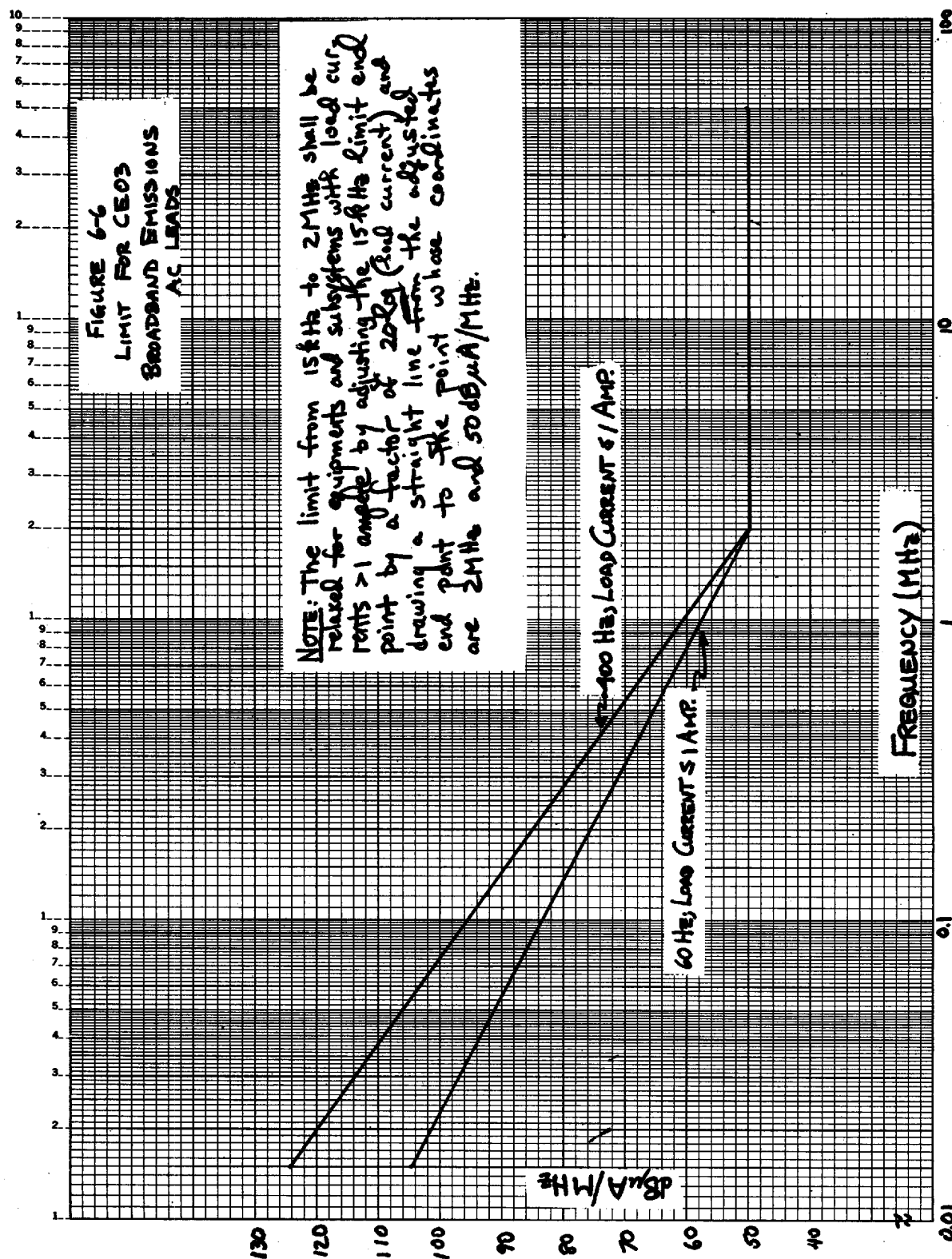


FIGURE 6-6. Limit for CE03 broadband emissions AC leads.

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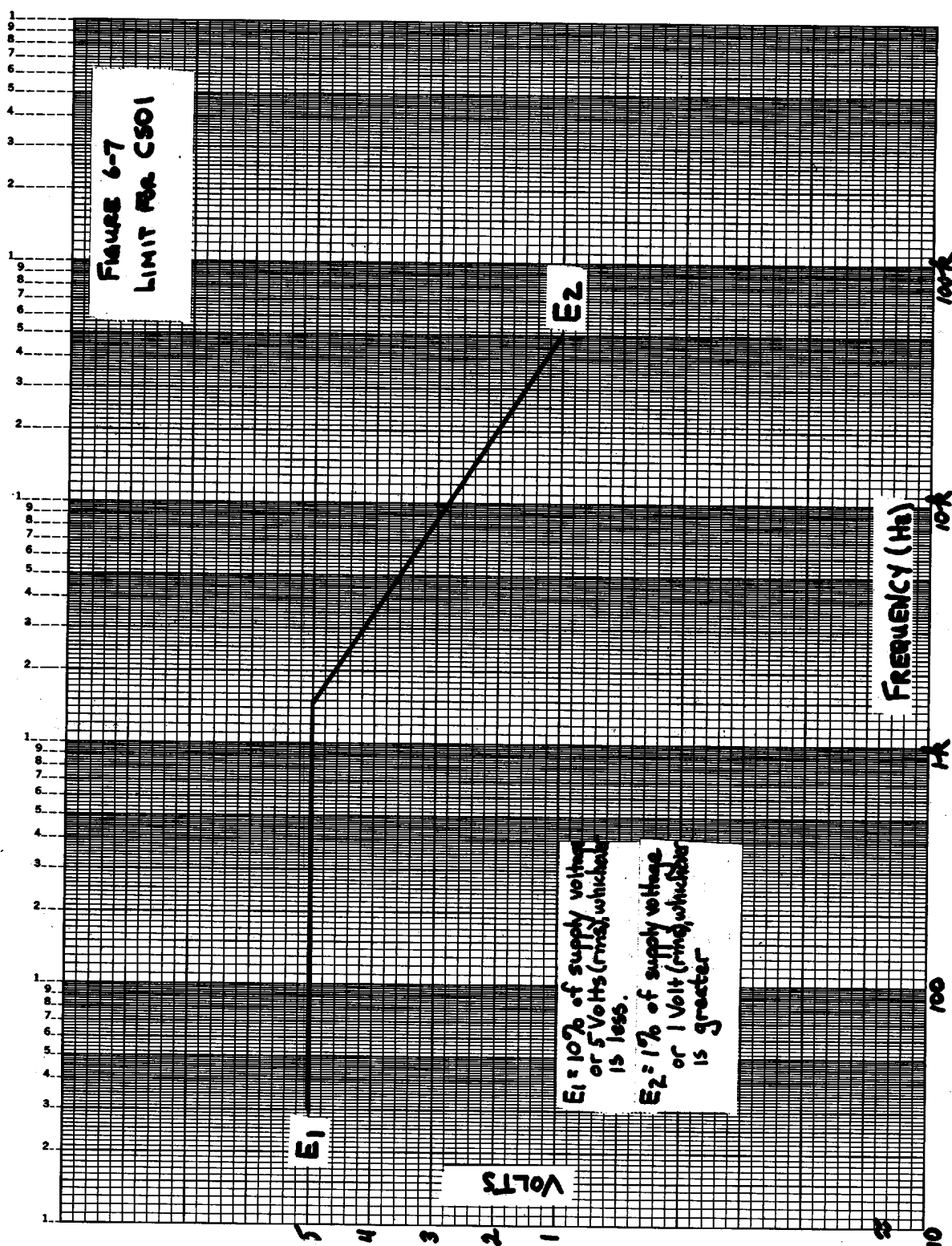
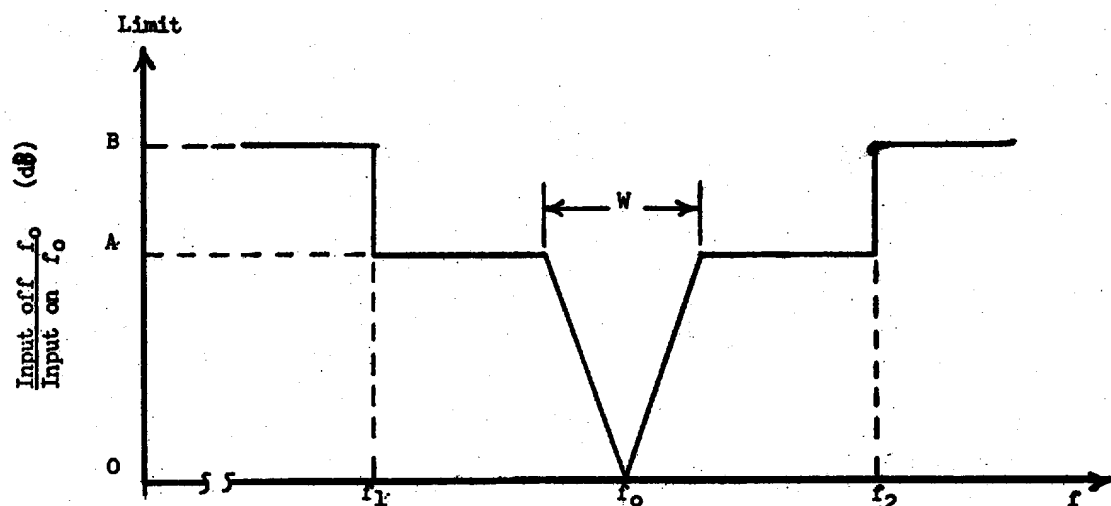


FIGURE 6-7. Limit for CSOI.





$f_0$  = Receiver tuned frequency or band center for amplifiers.

$f_1$  = Lowest tunable frequency of receiver band in use or the lowest frequency of amplifier passband.

$f_2$  = Highest tunable frequency of receiver band in use or the highest frequency of amplifier passband.

$W$  = Bandwidth between the 80 dB points of the receiver selectivity curve as defined in the test sample's technical requirements or the control plan.

#### Limits:

1. The limit at A is 80 dB above the input level required to produce the standard reference output. (This limit shall not be used for amplifiers)
2. The limit at B shall be set as follows:
  - a. Receivers: 0 dBm applied directly to the receiver input terminals.
  - b. Amplifiers: The limit shall be as specified in the test sample's technical requirement or control plan. If no limit is defined in the above documents, the 0 dBm value shall be used.

FIGURE 6-8. Limit for CS04.

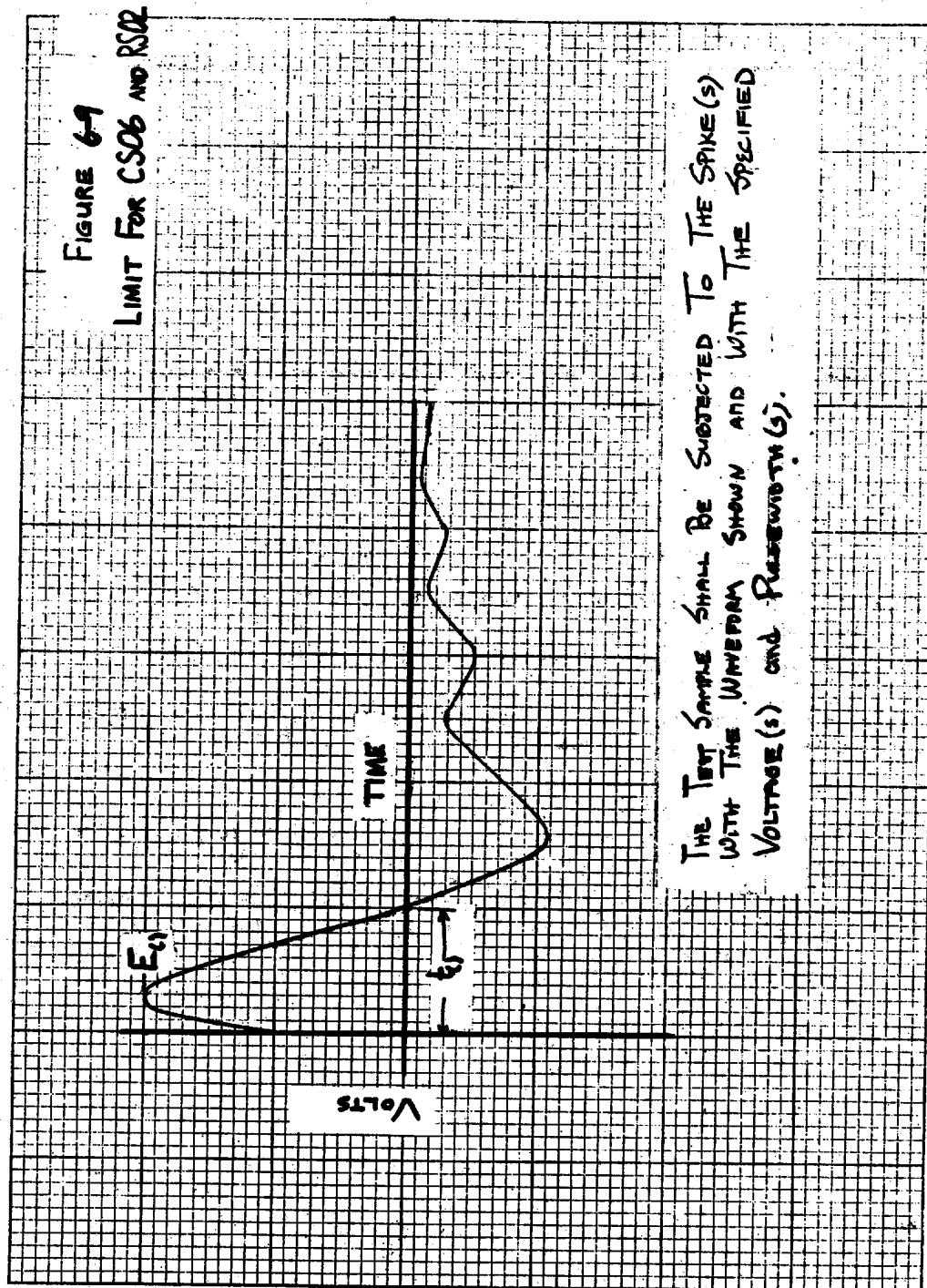


FIGURE 6-9. Limit for CS06 and RS02.

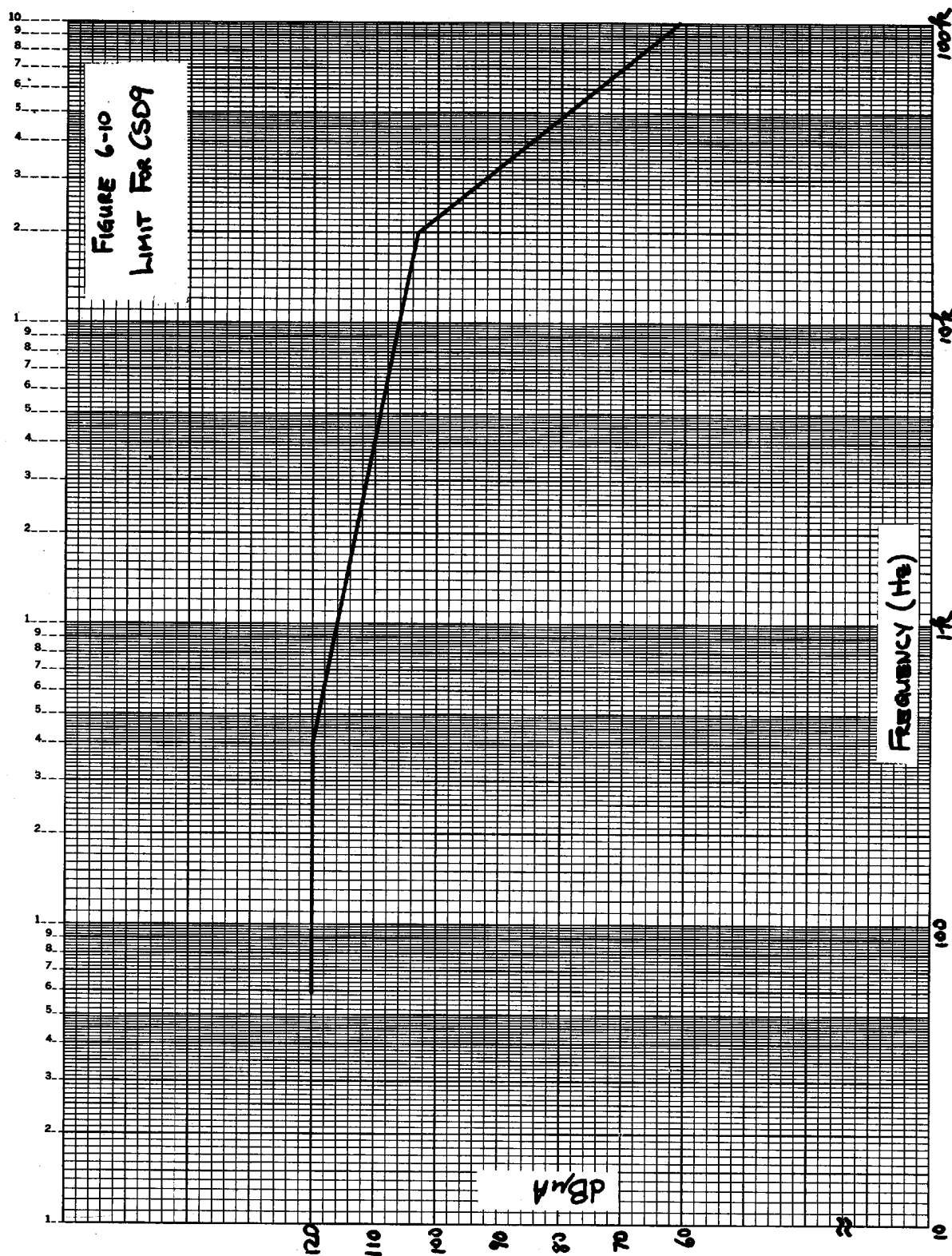


FIGURE 6-10. Limit for CS09.

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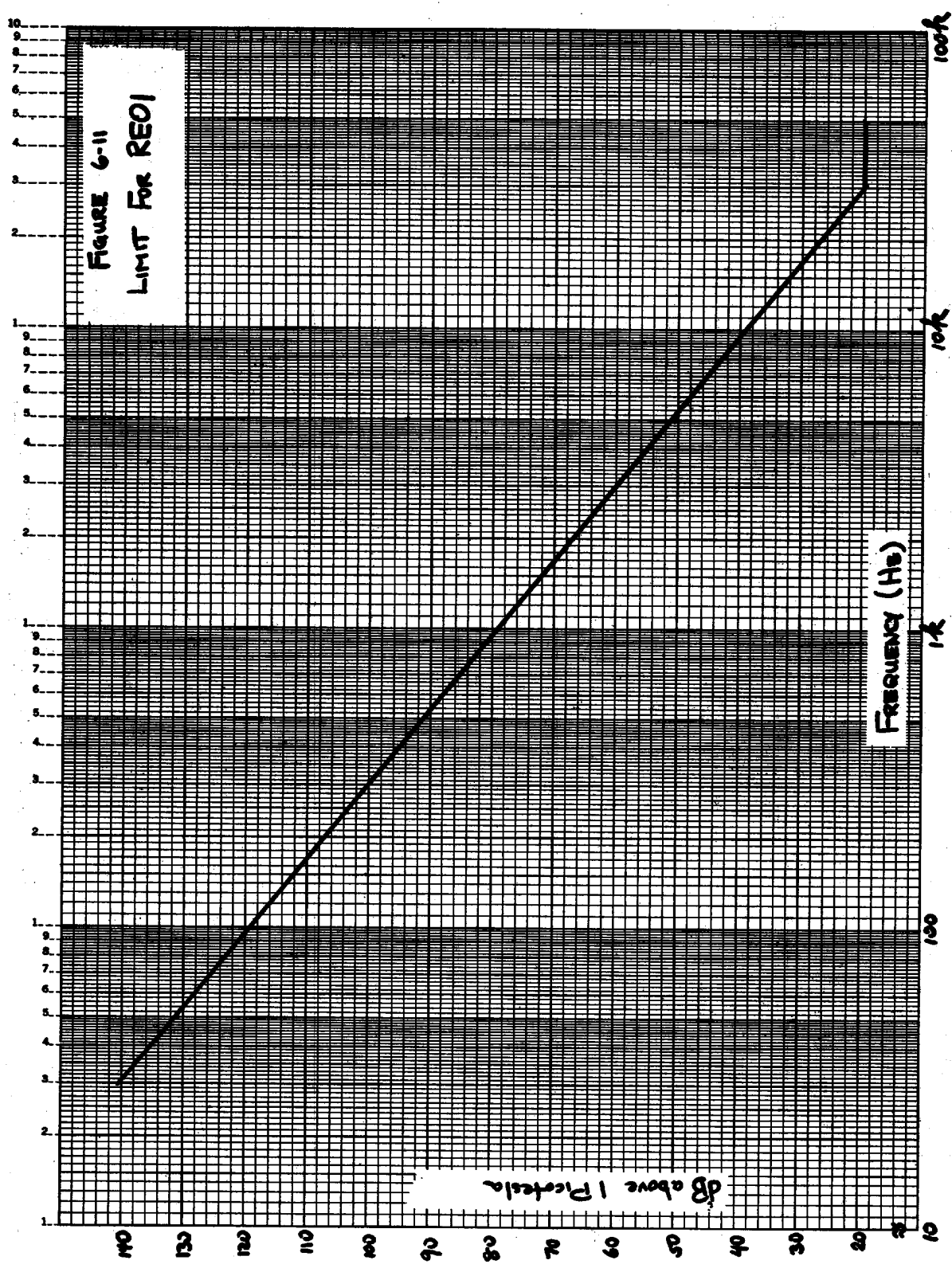


FIGURE 6-11. Limit for REO1.



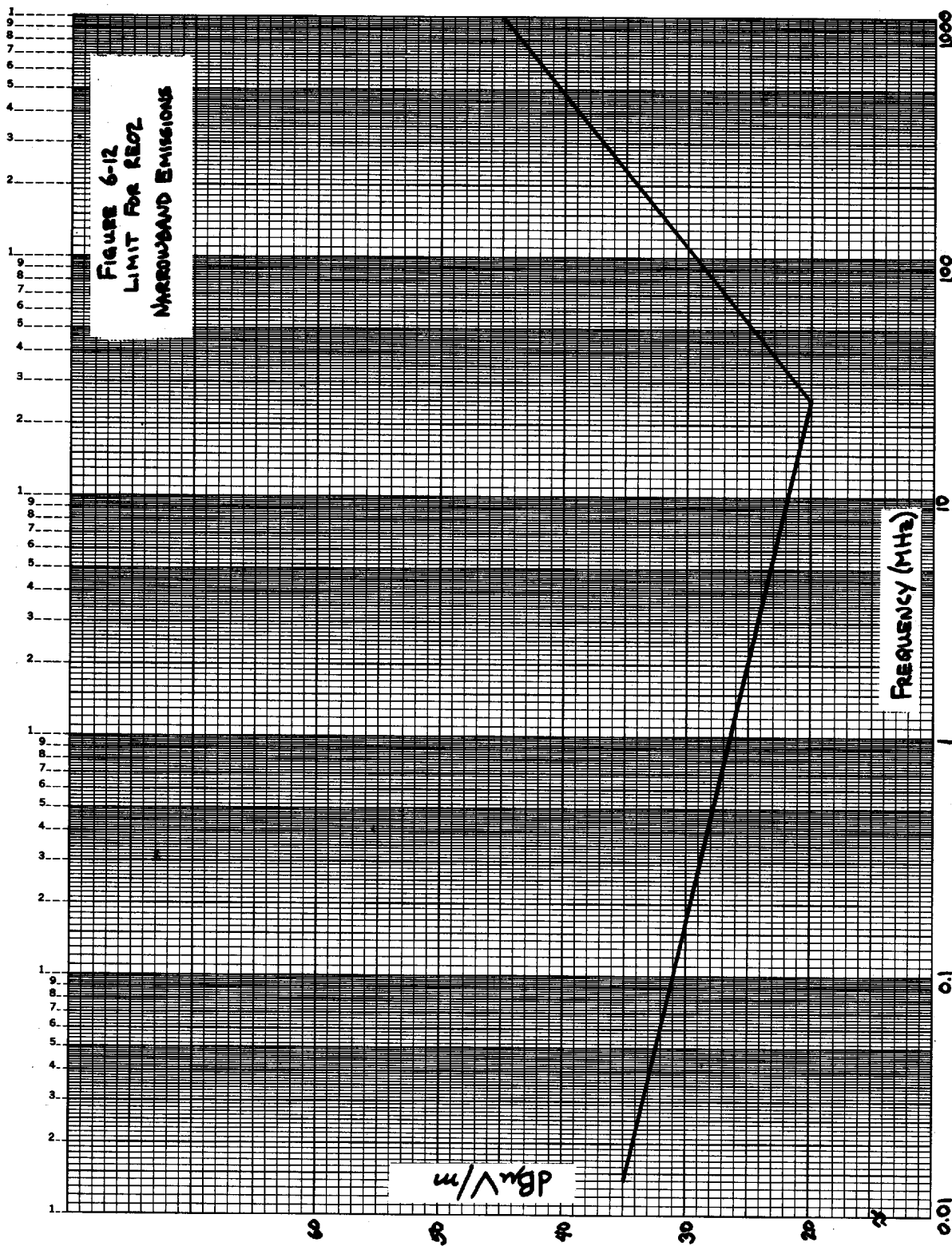


FIGURE 6-12. Limit for RE02 narrowband emissions.



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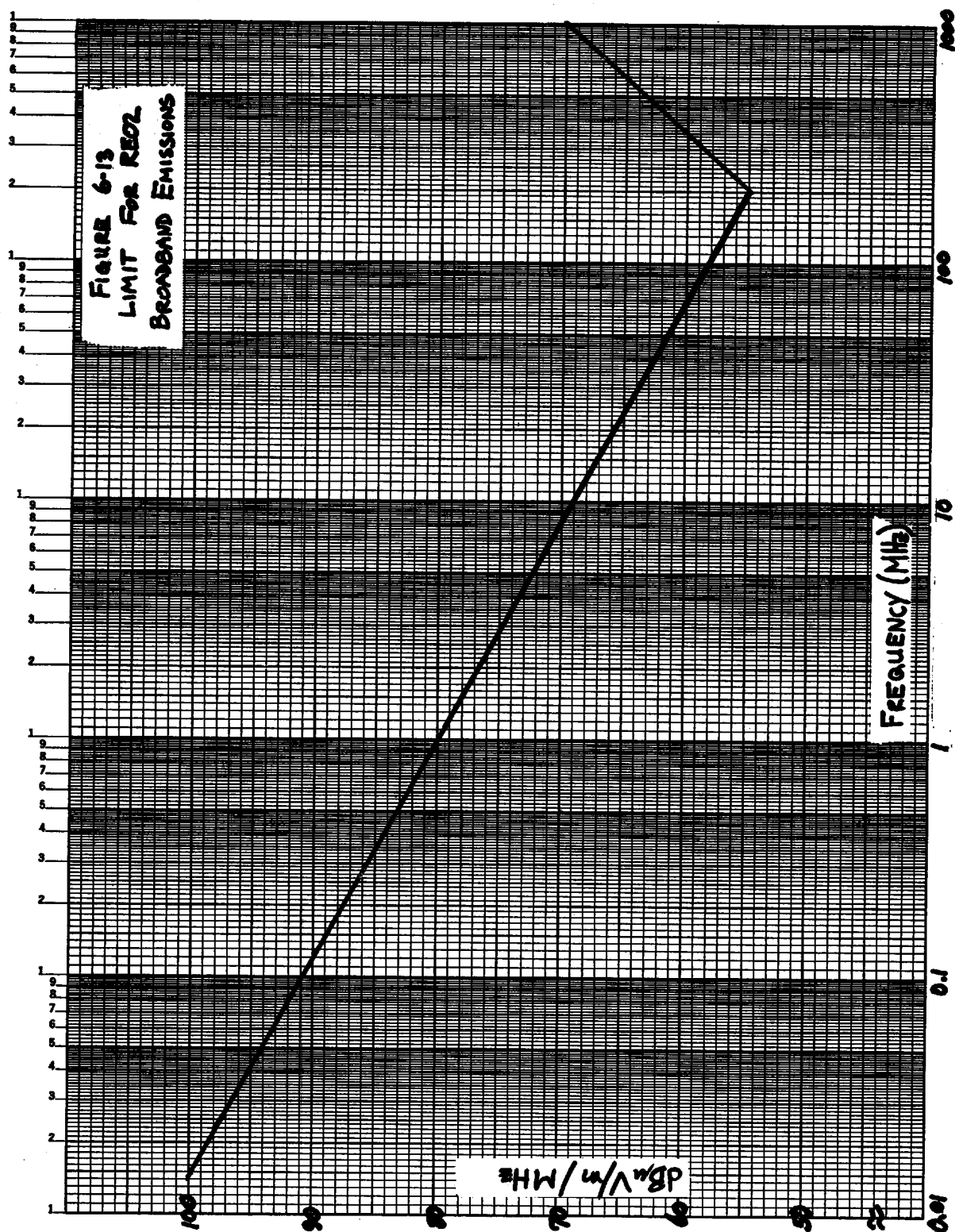


FIGURE 6-13. Limit for RE02 broadband emissions.

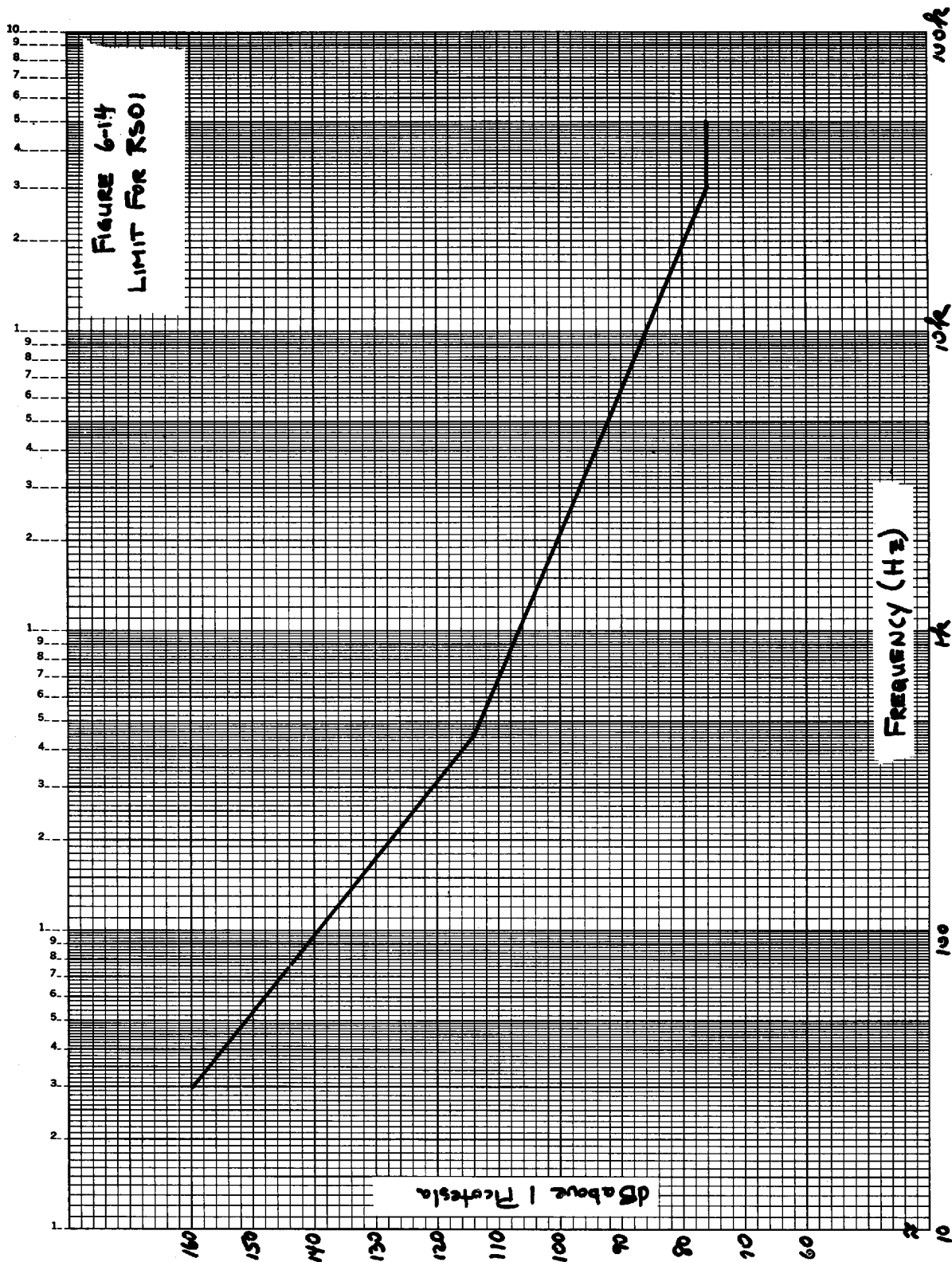


FIGURE 6-14. Limit for RS01.

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## 1. SCOPE

This part of MIL-STD-461 supplements Part 1 of the standard by defining emission and susceptibility requirements and limits for equipments and subsystems which support the class A equipments and subsystems but which will not be physically located in critical ground areas (class B). Examples of some of the class B equipments and subsystems include: electronic shop maintenance and test equipment used in non-critical ground areas; aerospace ground equipment used away from the flightline; theodolites, nav aids and other similar equipments and subsystems used in non-critical areas.

1.1 Determining requirements.

1.1.1 Air Force and Navy procurements. TABLE 7-I shall be used to determine the requirements applicable for equipments and subsystems procured for AF or Navy use. The table also denotes the paragraphs wherein the requirements and limits are defined. A Y entry in the table means the requirement is applicable and the limit shall be met using the procedures in MIL-STD-462 or the approved EMI Test Plan. A Y<sub>L</sub> entry means the applicability of the requirement is limited and is specified in the corresponding appropriate paragraph. The limit shall be met using the procedures in MIL-STD-462 or the approved EMI test Plan. A T entry means that the applicability of the requirement must be determined on the case-by-case basis and that if the requirement is to be imposed, it must be so specified in the appropriate procurement document. When required, the limit shall be met using the procedures in MIL-STD-462 or the approved EMI Test Plan. Absence of an entry means the requirement is not applicable.

1.1.2 Army procurements. This part of MIL-STD-461 shall not be used unless otherwise specified by the Command or agency concerned.

## 2. CE03

2.1 CE03 applicability. This requirement is applicable for the following types of leads: AC and DC leads which obtain power from other sources or provide power to other equipment, panels or subsystems; grounds or neutrals which are not grounded internally to the subsystem or equipment being measured; and control circuits using test sample power, which provide power to, or control, relays, solenoids, valves, and the like. The requirement is not applicable for signal leads such as clock, IF, audio, digital, RF and the like unless otherwise specified by the Command or agency concerned.

2.2 CE03 limits.

2.2.1 DC and interconnecting control leads. Electromagnetic emissions shall not appear on DC and interconnecting control leads in excess of the values shown on FIGURES 7-1 and 7-2 for narrowband and broadband emissions, respectively.

2.2.2 AC leads. Electromagnetic emissions shall not appear on AC leads in excess of the values shown in FIGURES 7-3 and 7-4 for narrowband and broadband emissions, respectively.

2.2.3 Interconnecting signal leads. If compliance with this requirement is required for signal leads, limits shall be developed on a case-by-case basis considering the intentional transmission, its specified power level, necessary information bandwidth and pulse rise time. Such limits must be approved by the Command or agency concerned.

## 3. CE06 (limited applicability)

3.1 CE06 applicability. This requirement is applicable for those equipments and subsystems with antenna leads or those designed to be connected to antennas. Transmitters with absolute peak powers less than or equal to -10dBW (0.1 watt) are exempt from meeting the harmonic and spurious portions of this requirement. When any of the following conditions exist, the transmitter (key-down), harmonic and spurious emission portions of this requirement may be measured using the procedures in RE03 in lieu of CE06, with the approval of the Command or agency concerned: (a) transmitter power exceeds 5 kW average; (b) the fundamental frequency of the test



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**TABLE 7-I. Emission and susceptibility requirements for Class B equipments and subsystems (for Air Force and Navy use).**

Requirement	Applicability	Applicable	
		Paragraph	Limit Curve
CE03	Y	2	7-1
CE06	Y <sub>L</sub>	3	7-2, 7-3, and 7-4
CE07	T	4	
CE01	Y <sub>L</sub>	5	
CE02	T	6	7-5
CE03	T	7	
CE04	T	8	
CE05	T	9	7-6
CE06	Y	10	
RE02	Y	11	
RE03	T	12	7-8 and 7-9
RS02	T	13	
RS03	Y	14	

sample exceeds 1.24 GHz; (c) the test sample's antenna is an integral part of the transmitter and cannot be replaced by a suitable dummy load; or (d) for equipments and subsystems with waveguide transmission lines and operating below 1.24 GHz. The frequency range of this requirement is dependent on the operating frequency of the test sample (see MIL-STD-462). The transmitter (key-down) portion of this requirement is not applicable within either the test sample's necessary bandwidth or  $\pm 5$  percent of the fundamental frequency.

3.2 CE06 limits. Conducted emissions in excess of the values given below shall not appear at the test sample's antenna terminals.

3.2.1 Receivers.

- a. Narrowband emissions: 34 dB  $\mu$  V
- b. Broadband emissions: 40 dB  $\mu$  V/MHz

3.2.2 Transmitters (key-up and standby).

- a. Narrowband emissions: 34 dB  $\mu$  V
- b. Broadband emissions: 40 dB  $\mu$  V/MHz

3.2.3 Transmitters (key-down mode). Harmonics, except the second and third and all other spurious emissions shall have peak powers 80 dB down from the power at the fundamental. The second and third harmonics shall be suppressed by:  $40 + 10 \log P$ , (where  $P$  = peak power, in watts, at the fundamental) or 80 dB, whichever requires less suppression.

4. CE07 (limited applicability)

4.1 CE07 applicability. Applications of this requirement are to be determined on a case-by-case basis for the following types of leads: AC or DC leads which obtain power from or provide power to other equipments or subsystems.

4.2 CE07 limits. Conducted switching transients shall not exceed the following, as applicable:

- a. AC leads:  $\pm 50$  percent of nominal rms voltage.
- b. DC leads:  $+ 50$  percent,  $-150$  percent nominal line voltage.

5. CS01 (limited applicability)

5.1 CS01 applicability. This requirement is applicable to equipment and subsystem power leads, including grounds and neutrals which are not grounded internally to the equipment or subsystem. The requirement is not applicable within  $\pm 5$  percent of the power frequency(ies). This requirement may be deleted, with the approval of the Command or agency concerned, if no circuit within the equipment or system is more sensitive than 100 mV.

5.2 CS01 limits. The test sample shall not exhibit any malfunction, degradation of performance or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when subjected to electromagnetic energy injected onto its power leads equal to the values on FIGURE 7-5. The requirement is also met under the following condition: when the power source specified in MIL-STD-462, adjusted to dissipate 50 watts in a 0.5 ohm load, cannot develop the required voltage at the test sample power input terminals and the test sample is not susceptible to the output of the signal source.

6. CS02 (limited applicability)

6.1 CE02 applicability. Applications of this requirement are to be determined on a case-by-case basis for equipment and subsystem power leads, including grounds and neutrals which are not grounded internally to the equipment or subsystem.

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6.2 CS02 limits. The test sample shall not exhibit any malfunction, degradation of performance or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when subjected to 1-volt from a 50 ohm source across the calibrating resistor shown in MIL-STD-462, FIGURE CS02-1. The test signal shall be applied directly to the equipment input terminals not through the test sample's power line cord. The requirement is also met under the following condition: When a 1-watt source of 50 ohms impedance cannot develop the required voltage at the test sample power input terminals and the test sample is not susceptible to the output of the signal source.

7. CS03 (limited applicability)

7.1 CS03 applicability. Applications of this requirement are to be determined on a case-by-case basis for receiving equipments and subsystems, such as receivers, RF amplifiers, transceivers, and the like. The applicable frequency range of this requirement is dependent on the operating frequency of the test sample as specified in MIL-STD-462.

7.2 CS03 limits. The test sample shall not exhibit any intermodulation products from two signals, beyond those permitted in the individual equipment or subsystem specification when:

- a. Signal generator #1 is set 66 dB above the level required to obtain the standard reference output as specified in MIL-STD-462, except that when  $f_1$  is in the frequency range of either 200 to 400 MHz or 2 to 25 MHz, the generator output shall be 80 dB above the reference level.
- b. Signal generator #2 is set 66 dB above the level required to obtain the standard reference output, as specified in MIL-STD-462, but the generator output level shall not exceed a power level of 10 dBm.

8. CS04 (limited applicability)

8.1 CS04 applicability. Applications of this requirement are to be determined on a case-by-case basis for receivers, RF amplifiers, transceivers and the like. The applicable frequency range of this requirement is dependent on the operating frequency of the test sample, as specified in MIL-STD-462.

8.2 CS04 limits. Test sample shall not exhibit any undesired response when subjected to the test signal shown in FIGURE 7-6.

9. CS05 (limited applicability)

9.1 CS05 applicability. Applications of this requirement are to be determined on a case-by-case basis for receivers, RF amplifiers, transceivers and the like. The applicable frequency range of this requirement is dependent on the operating frequency of the test sample, as specified in MIL-STD-462.

9.2 CS05 limits. The test sample shall not exhibit, due to cross modulation, any malfunction, degradation of performance or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when subjected to the following from signal generator #2: a signal 66 dB above the level required to obtain the standard reference output, as specified in MIL-STD-462, but not to exceed a power output level to 10 dBm.

10. CS06

10.1 CS06 applicability. This requirement is applicable to equipment and subsystem power leads, including grounds and neutrals which are not grounded internally to the equipment or subsystem.

10.2 CS06 limits. The test sample shall not exhibit any malfunction, degradation of performance or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when the test spike having the waveform shown on FIGURE 7-7 is applied to the AC and DC power input leads. The values of  $E_1$  and  $t_1$  are given below. The spike shall be superimposed on the powerline voltage waveform.

a. Spike #1  $E_1 = 400 \text{ Volts}; t_1 \leq 5 \mu \text{ sec}$

10.2.1 Varistors - protected inputs. For equipments and subsystems whose power inputs are protected with varistors, the requirement is also met if the equipment or subsystem is not susceptible to values of  $E_1$  equal to the maximum safe level of the varistor.

## 11. RE02

11.1 RE02 applicability. This requirement is applicable for radiated emissions from equipments and subsystems, cables (including control, pulse, IF, power and antennas transmission lines) and interconnecting wiring of the test sample; for narrowband, it applies at the fundamental frequencies, and all spurious emissions including harmonics, but does not apply for radiation from antennas. This requirement is applicable for broadband emissions from 14 kHz to 1 GHz and for narrowband emissions from 14 kHz to 10 GHz.

11.2 RE02 limits. E-field emissions shall not be radiated in excess of those given in 11.2.1 and 11.2.2. Above 30 MHz, the limits shall be met for both horizontally and vertically polarized waves.

11.2.1 Narrowband electric field emissions. Narrowband E-field emissions shall not be radiated in excess of the limit curve shown on FIGURE 7-8 at the required test distance, as specified in MIL-STD-462.

11.2.2 Broadband electric field emissions. Broadband E-field emissions from all equipments and subsystems, including radiated switching transients resulting from: (a) automatic cycling of electronic or electrical switching circuitry, (b) actuation of push-to-talk mechanisms that is, keying of transmitters), or (c) manual switching, shall not be radiated in excess of the limit curve shown on FIGURE 7-9 at the required test distances, as specified in MIL-STD-462.

## 12. RE03 (limited applicability)

12.1 RE03 applicability. This requirement is applicable, with the approval of the procuring activity, when the spurious and harmonics cannot be determined using the procedures of CE06. Transmitters with absolute peak powers, less than or equal to -10 dBW (0.1 watt) are exempt from meeting this requirement. The frequency range of this requirement is dependent on the operating frequency of the test sample (see MIL-STD-462). The requirement is not applicable within either the test sample's necessary bandwidth or  $\pm 5$  percent of the fundamental frequency.

12.2 RE03 limit. Harmonics, except the second and third, and all other spurious emissions shall have peak powers 80 dB down from the power at the fundamental. The second and third harmonics shall be suppressed by:  $40 + 10 \log P$ , (where  $P$  = peak power, in watts, at the fundamental) or 80 dB whichever requires less suppression.

## 13. RS02 (limited applicability)

13.1 RS01 applicability. Applications of Parts I and II of this requirement are to be determined on a case-by-case basis.

### 13.2 RS02 limits.

13.2.1 Part I - spikes. The test sample shall not exhibit any malfunction, degradation of performance, or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when subjected to the test spike having the waveform shown in FIGURE 7-7. The values of  $E_1$  and  $t_1$  are given below:

a. Spike #1  $E_1 = 400 \text{ Volts}; t_1 \leq 5 \mu \text{ sec}$

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13.2.2 Part II - power frequency. The test sample shall not exhibit any malfunctions, degradation of performance, or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when 20 amperes are applied to the test wire at the power frequency(ies) of the test sample.

14. RS03

14.1 RS03 applicability. This requirement is applicable for all equipments and subsystems between 14 kHz and 10 GHz. Above 10 GHz this requirement is not mandatory unless otherwise required by the procuring activity.

14.2 RS03 limits. The test sample shall not exhibit any malfunction, degradation of performance, or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification when subjected to a radiated electric field of 1 Volt/meter. Above 30 MHz, the requirement shall be met for both horizontally and vertically polarized waves.



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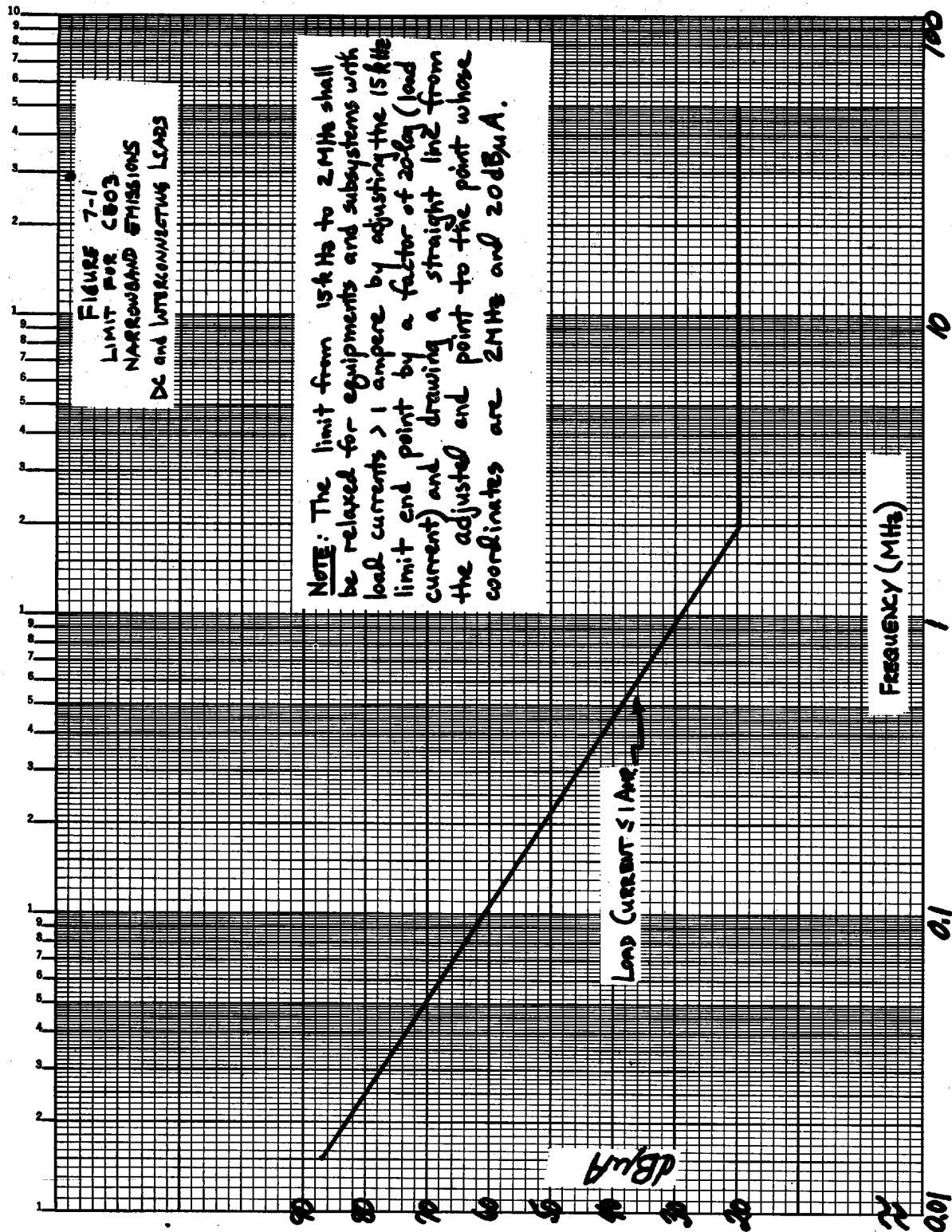


FIGURE 7-1. Limit for CE03 narrowband emissions DC and interconnecting leads.

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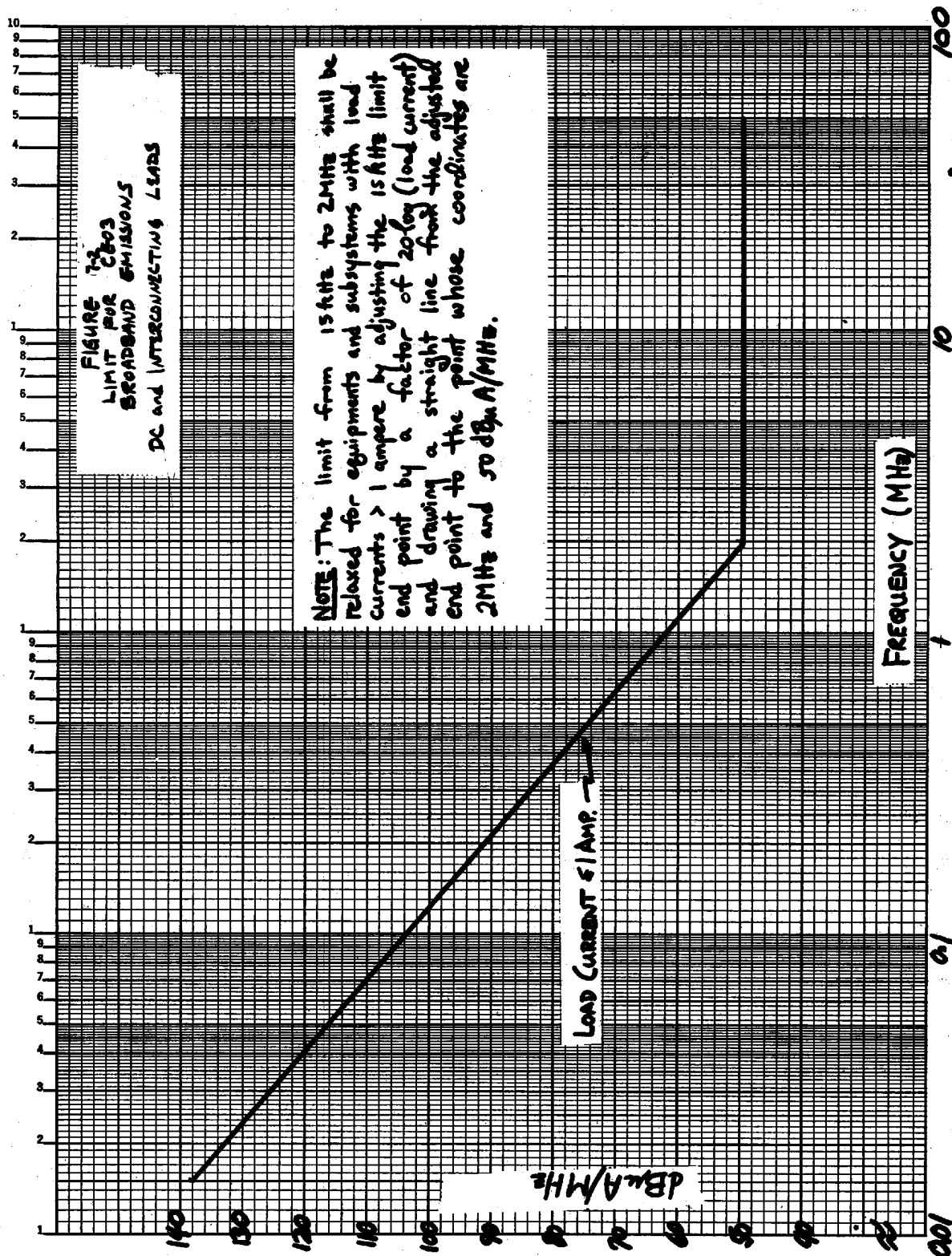


FIGURE 7-2. Limit for CE03 broadband emissions DC and interconnecting leads.

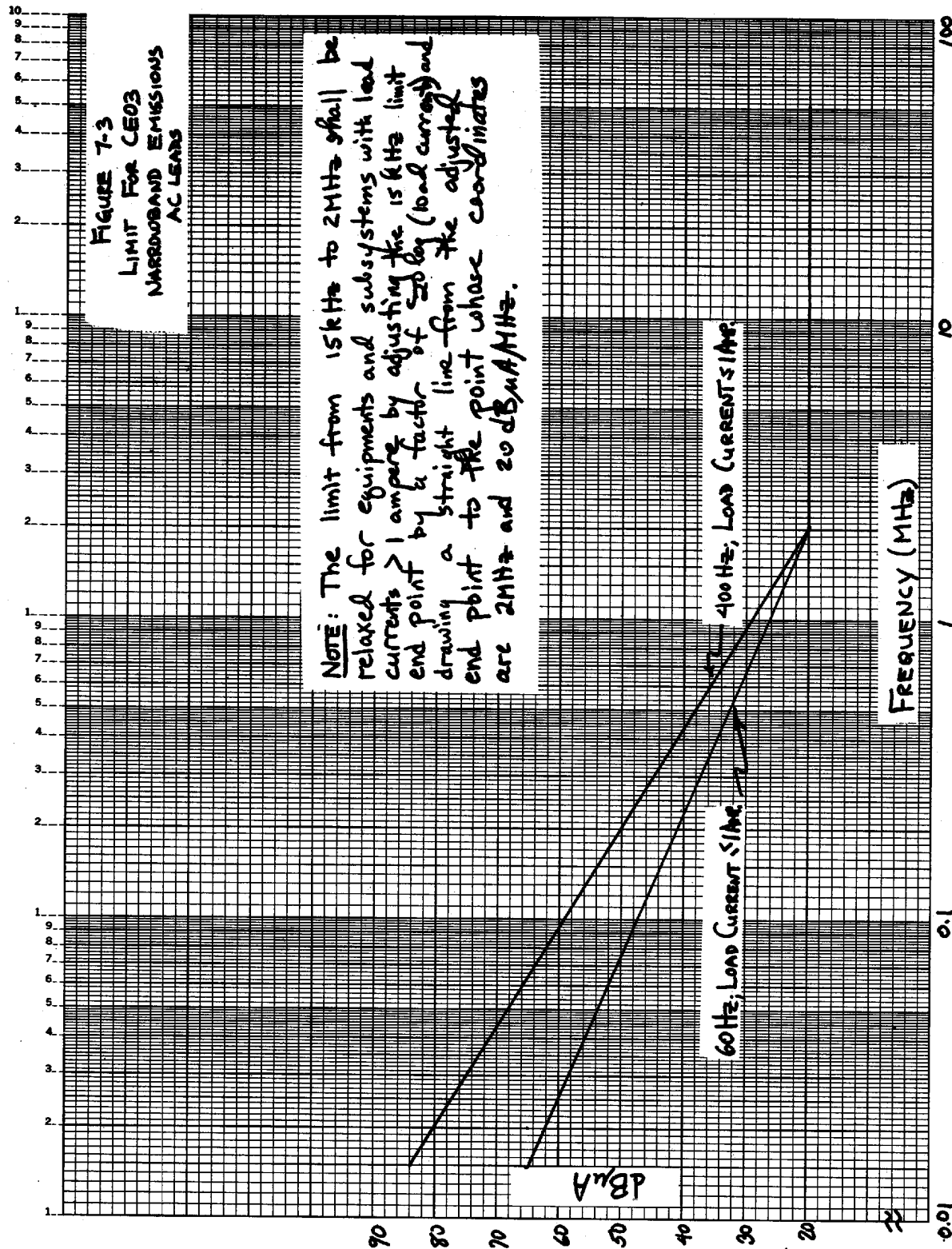


FIGURE 7-3. Limit for CE03 narrowband emissions AC leads.



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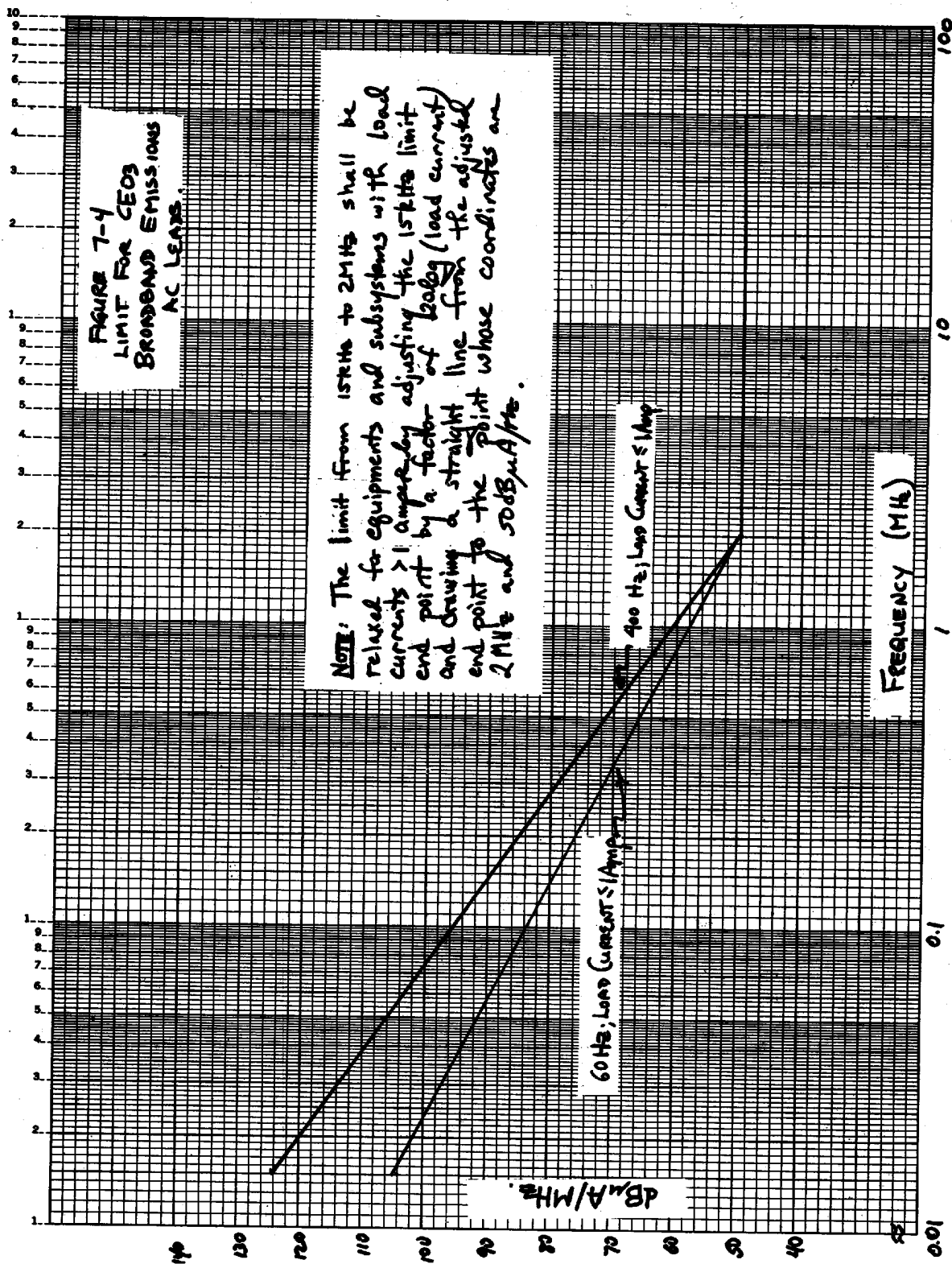


FIGURE 7-4. Limit for CE03 broadband emissions AC leads.

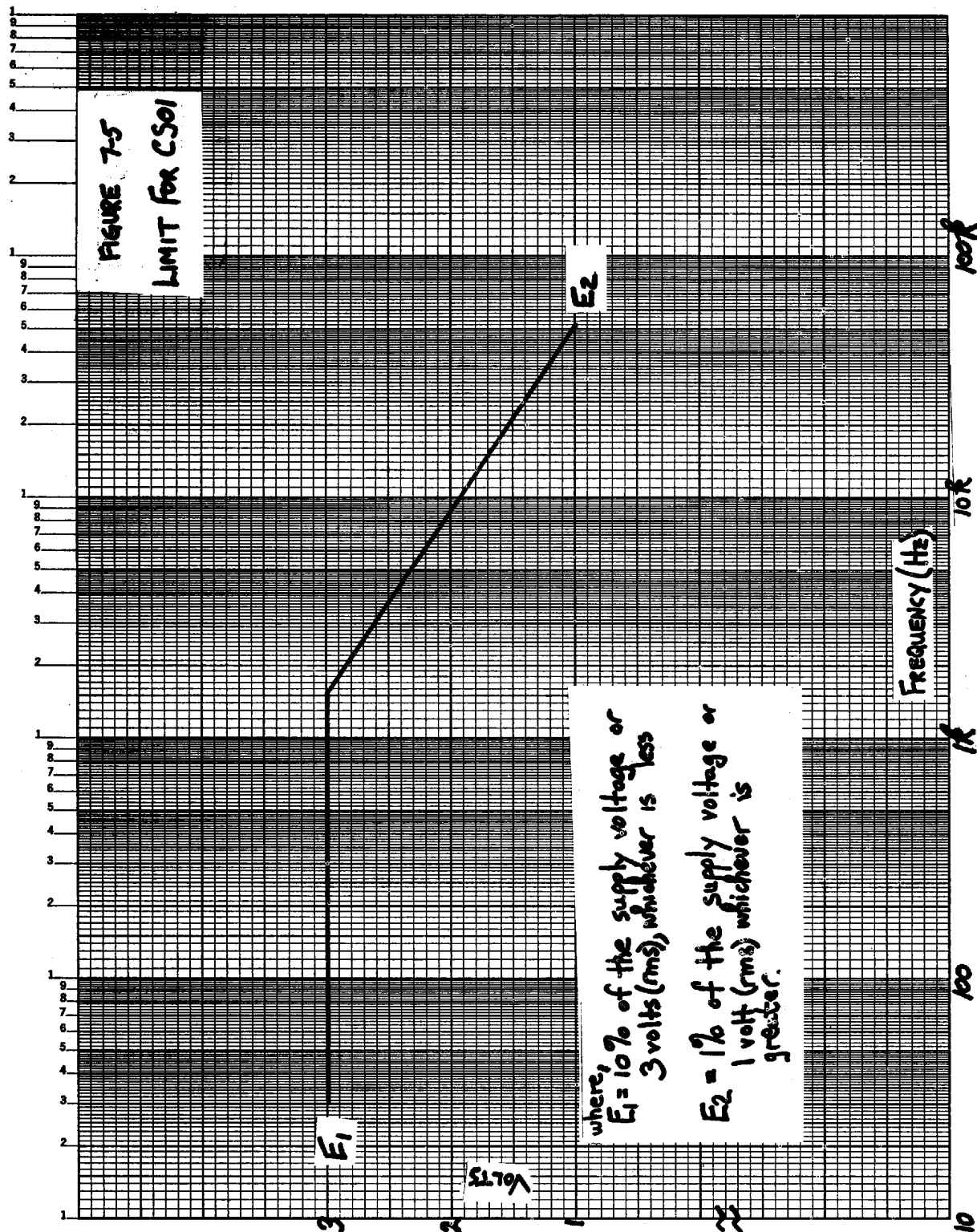
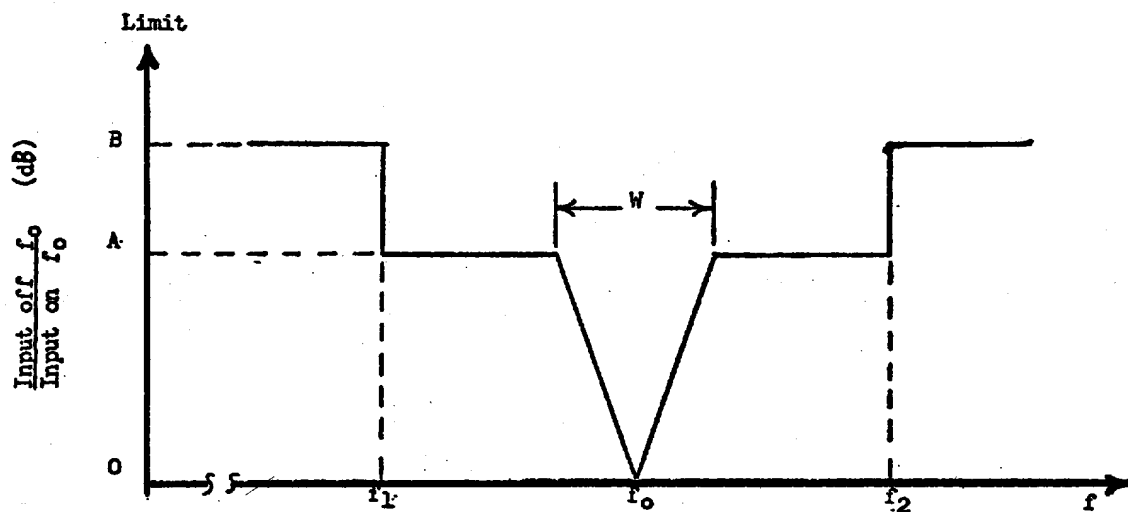


FIGURE 7-5. Limit for CS01.



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$f_0$  = Receiver tuned frequency or band center for amplifiers.

$f_1$  = Lowest tunable frequency of receiver band in use or the lowest frequency of amplifier passband.

$f_2$  = Highest tunable frequency of receiver band in use or the highest frequency of amplifier passband.

$W$  = Bandwidth between the 80 dB points of the receiver selectivity curve as defined in the test sample's technical requirements or the control plan.

#### Limits:

1. The limit at A is 80 dB above the input level required to produce the standard reference output. (This limit shall not be used for amplifiers)
2. The limit at B shall be set as follows:
  - a. Receivers: 0 dBm applied directly to the receiver input terminals.
  - b. Amplifiers: The limit shall be as specified in the test sample's technical requirement or control plan. If no limit is defined in the above documents, the 0 dBm value shall be used.

FIGURE 7-6. Limit for CS04.

FIGURE 7-7  
LIMIT FOR CS06 and RS02

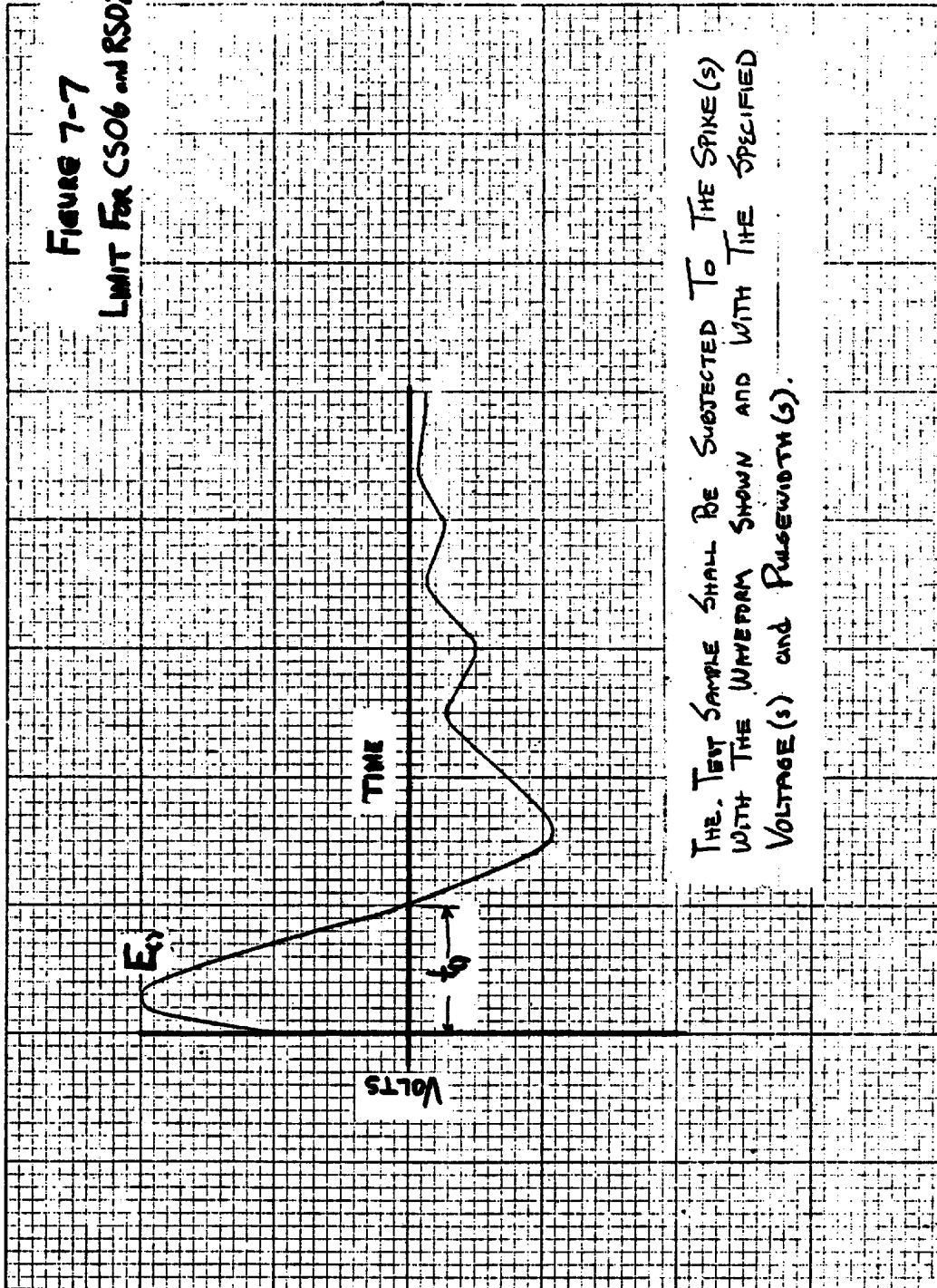


FIGURE 7-7. Limit for CS06 and RS02.

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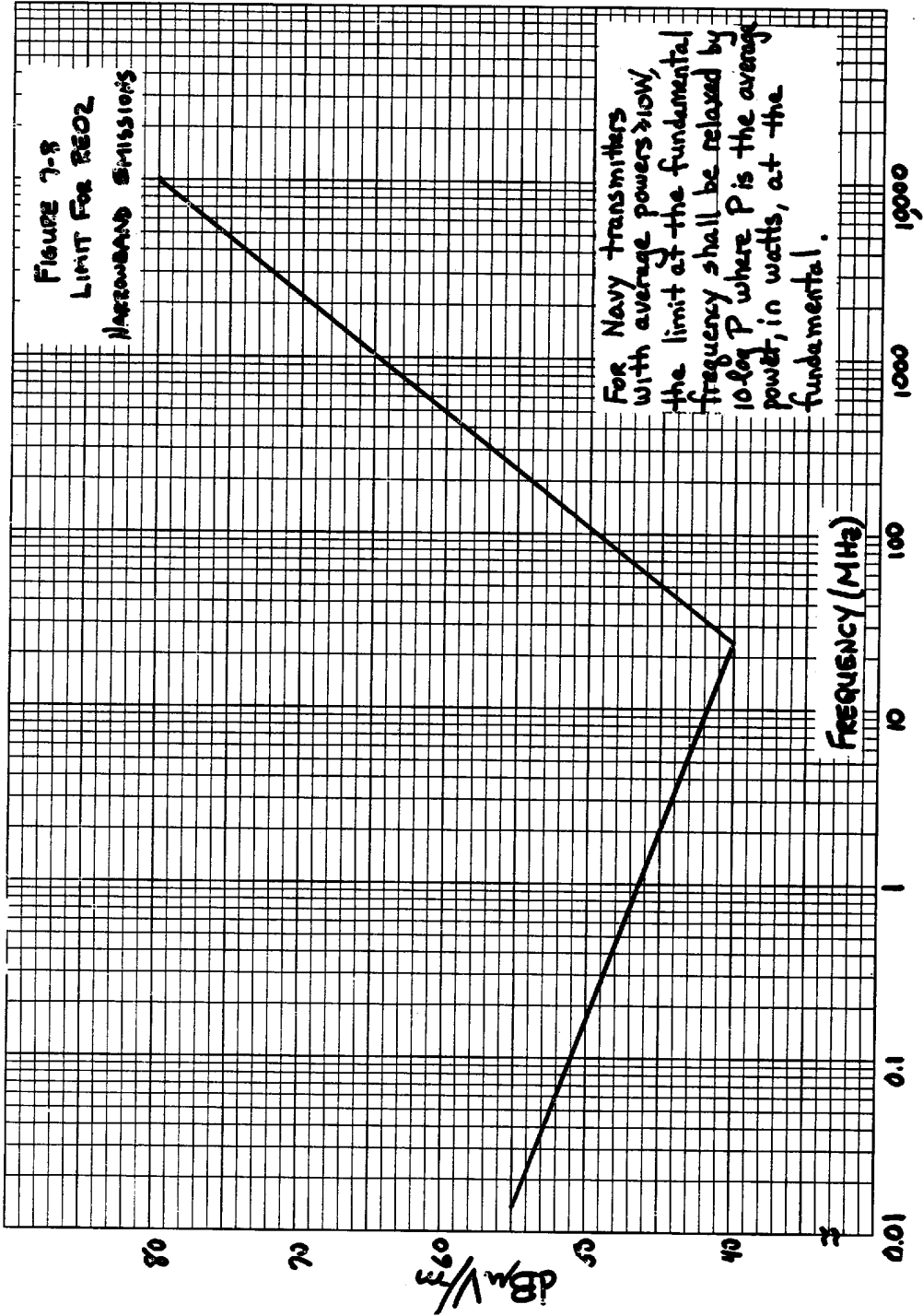


FIGURE 7-8. Limit for REO2 narrowband emissions.

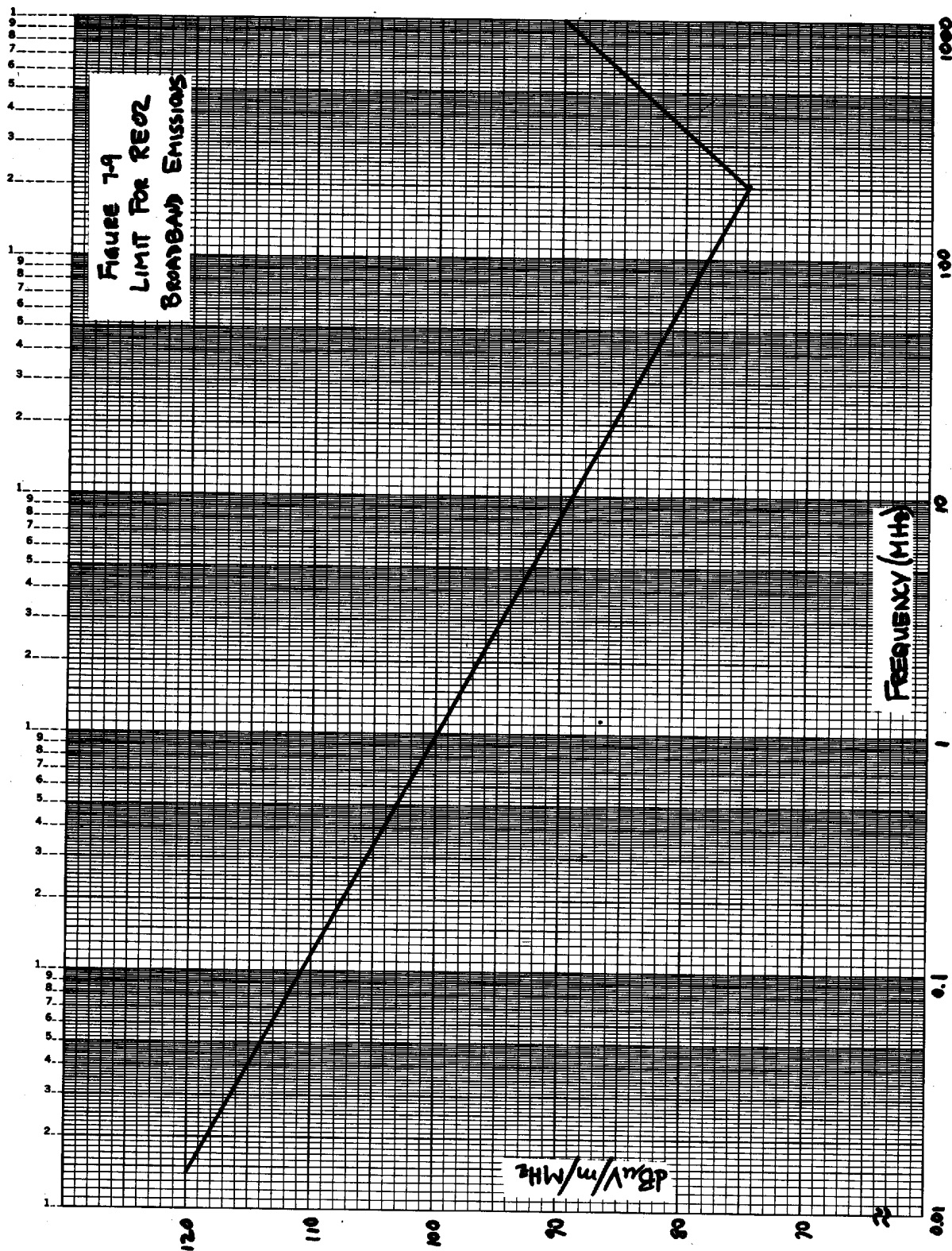


FIGURE 7-9. Limit for RE02 broadband emissions.

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## FIGURE

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## 1. SCOPE

This part of MIL-STD-461 supplements Part 1 of this standard by defining emission requirements and limits for tactical and special purpose vehicles and engine-driven equipment (class C1).

## 2. REQUIREMENTS

The following requirements apply for the groups of tactical and special purpose vehicles and engine-driven equipment defined on TABLE 8-I.

**2.1 Group I.** Group I items shall comply with UM03 over the frequency range of 150 kHz to 1000 MHz.

**2.2 Group II.** Group II items shall comply with UM03 over the limited frequency range of 1.5 to 400 MHz except that commercial general-purpose and construction Group II items procured for use solely in non-critical areas may be exempt from UM03 when specified by the Command or agency concerned.

**2.2.1 Group II items with electronic equipment, mobile telephones or communications.** When electronic equipment, mobile telephones or communications are to be installed in Group II items, including those used in non-critical areas, additional EMI suppression is required. This suppression shall be provided in a kit to be installed by the user and shall include installation components, parts and instructions necessary for suppressing the ignition, windshield wiper, brake and signal lights, siren, and so forth, so as to result in compliance with UM03.

**2.3 Group III.** Group III items shall meet the requirements of SAE J551.

**2.3.1 Group III items with electronic equipment, mobile telephones or communications.** When electronic equipment, mobile telephones or communications are to be installed in Group III items, including those used in non-critical areas, additional EMI suppression is required. This suppression shall be provided in a kit to be installed by the user and shall include installation components, parts and instructions necessary for suppressing the ignition, windshield wiper, brake and signal lights, siren and so forth. The suppression kit, when installed, shall result in compliance with UM03.

## 3. UM03

**3.1 UM03 applicability.** UM03 applies to tactical and special purpose vehicles and engine driven equipments, including the electrical equipments and parts installed thereon.

**3.2 UM03 limit.** E-field broadband emissions shall not be radiated in excess of the levels shown on FIGURE 8-1 at the required test distance, as specified in MIL-STD-462 for the applicable frequency range of the requirement. Above 30 MHz, the limit shall be met for both horizontally and vertically polarized waves.

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TABLE 8-I. Groupings of class C1 vehicles and equipment.

GROUP 1	GROUP II	GROUP III
Crash rescue trucks Wheeled vehicles, tactical Armored and track vehicles Off-the-road cargo carriers Armored personnel carriers Assault and landing craft Amphibious vehicles Patrol boats Gun motor carriages Railway maintenance-of-way equipment Storm boats Heaters, gasoline Replacement engines for all of the above	Motorcycles Harbor tugs Fork-lift trucks Outboard motors Floodlight trailers Cargo loading and handling equipment Engine-driven air conditioners Maintenance and service trucks/vans Earth augers General purpose and construction equipment (i.e., cranes, bulldozers, heaters (gasoline and water), ditch diggers, air compressors, cement loaders, concrete mixer, pumps, blowers, etc. Replacement engines for all of the above	Sedans Staff cars Delivery trucks Moving vans Ambulances Cargo trucks Fire trucks Other similar administrative vehicles which are basically civilian in nature

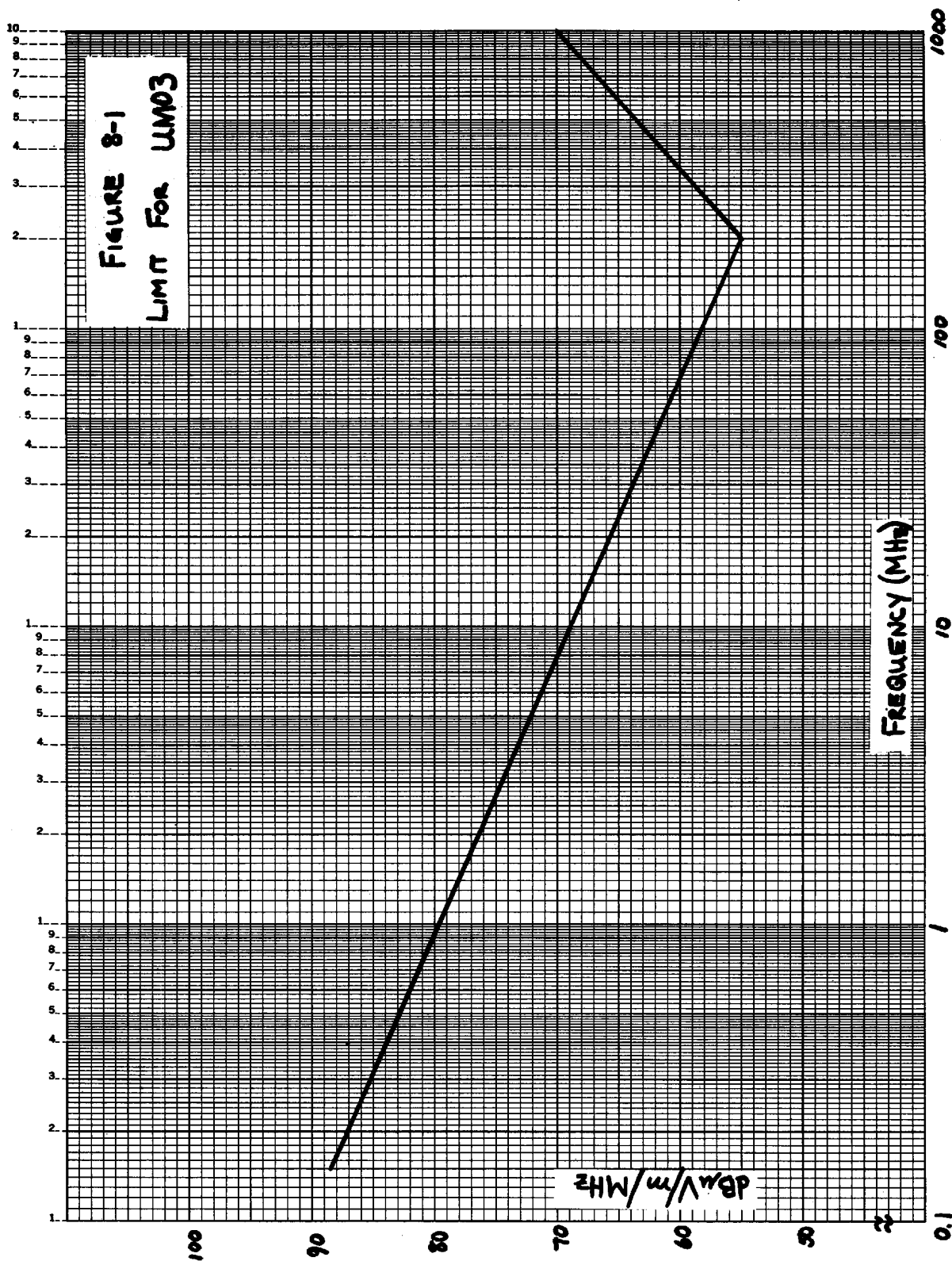


FIGURE 8-1. Limit for UMO3.

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## 1. SCOPE

This part of MIL-STD-461 supplements Part 1 of this standard by defining emission and susceptibility requirements and limits for engine generators and associated components, uninterruptible power sets (UPS) and mobile electric power (MEP) equipment supplying power to or used in critical areas (class C2).

## 2. REQUIREMENTS

The following requirements apply for class C2 items.

2.1 Class C2 items with power output ratings  $\leq 240$  kilovolt amperes (kVA). All class C2 items with power output ratings  $\leq 240$  kVA shall meet the conducted and radiated emission requirements of UM04 (with the radiated emission requirements applicable at a distance of 1 meter).

2.2 Class C2 items with power output ratings  $> 240$  kVA. All class C2 items with power output rating  $> 240$  kVA shall meet the radiated emission requirements of UM04 (at a distance of 1 meter) when specified by the Command or agency concerned.

2.3 Engine generators with electronic circuitry. Engine generators employing electronic circuitry for regulation or control, or sets with amplifiers for electronically controlling regulation, temperature, frequency, stability, and so forth, shall meet the radiated susceptibility requirement of UM04 in addition to the applicable requirements in 2.1 and 2.2.

## 3. UM04

3.1 UM04 applicability. UM04 applies to engine generators and associated components, UPS, and MEP equipment supplying power to or used in critical areas.

3.2 UM04 limits.

3.2.1 Conducted emissions. Broadband electromagnetic emissions shall not appear on the power leads in excess of the levels shown on FIGURE 9-1.

3.2.2 Radiated emissions. Broadband electromagnetic emissions shall not be radiated in excess of the levels shown on FIGURE 9-2 at the required test distance. Above 30 MHz, the limit shall be met for both horizontally and vertically polarized waves.

3.2.3 Radiated susceptibility. Engine generators required by 2.3 to meet this requirement shall not exhibit any malfunction, degradation of performance, or deviation from specified indications beyond the tolerances indicated in the individual equipment specification when subjected to the following radiated E-fields in the frequency range of 2 MHz to 10 GHz:

<u>Frequency Range</u>	<u>E-Field (Volts/meter)</u>
2 to 400 MHz	10
400 MHz to 10 GHz	5

Above 30 MHz the requirement shall be met for both horizontally and vertically polarized waves.



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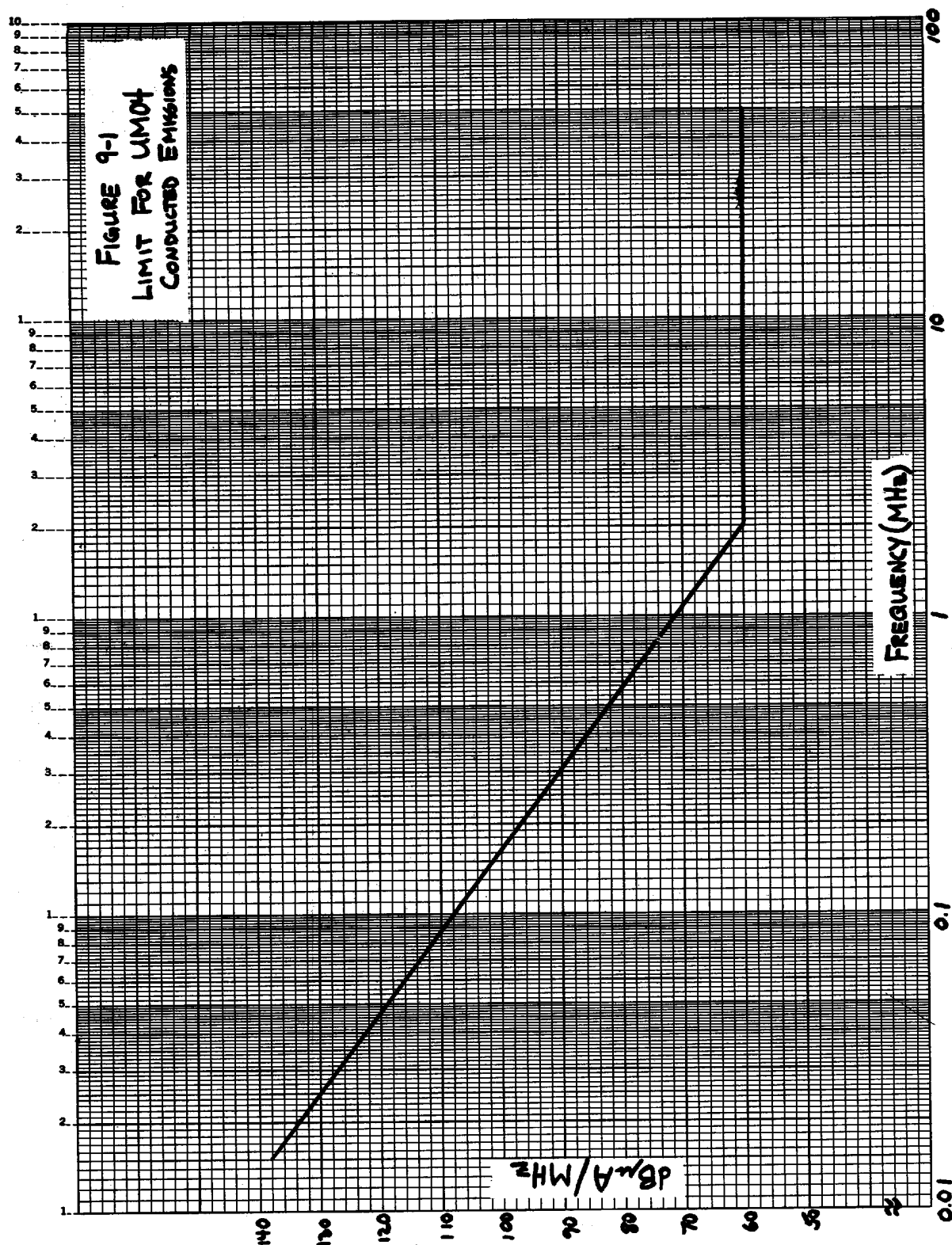


FIGURE 9-1. Limit for UM04 conducted emissions.

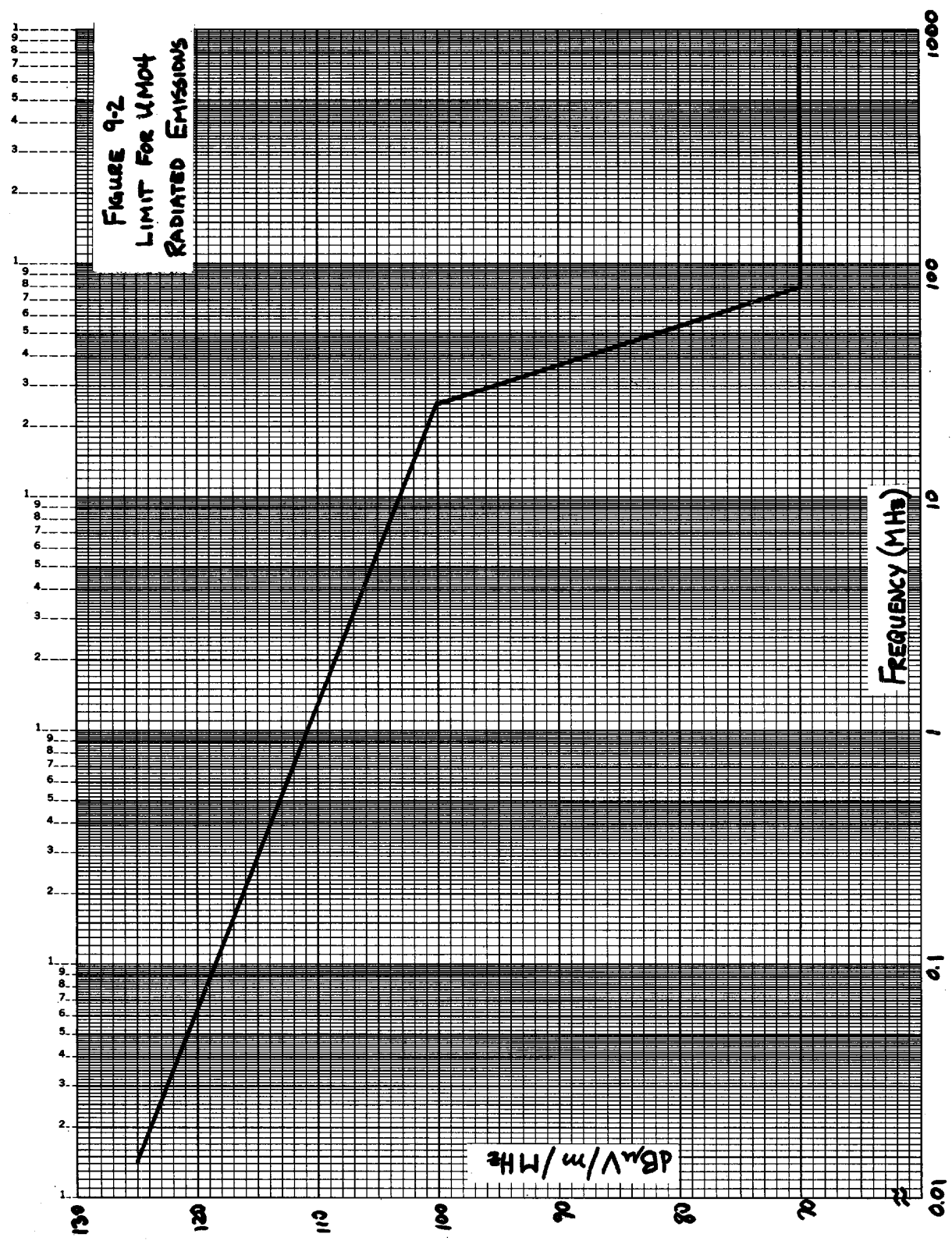


FIGURE 9-2. Limit for UMO4 radiated emissions.

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## 1. SCOPE

This part of MIL-STD-461 supplements Part 1 of the standard by defining emission requirements and limits for commercial electrical and electromechanical equipments and subsystems.

## 2. REQUIREMENTS

The following requirements apply for the groups of commercial electrical and electromechanical equipments defined by TABLE 10-1.

2.1 Group I. Except as noted in 2.1.1, all Group I items shall meet the conducted and radiated emission requirements of UMO5.

2.1.1 Group I items used in non-critical areas. Group I items procured for use solely in non-critical areas are exempt from the emission requirements of this standard.

2.2 Group II. Group II items are exempt from the emission requirements of this standard unless otherwise specified by the Command or agency concerned. However, these equipments shall display a label or sign with the following wording:

### WARNING

DO NOT OPERATE WITHIN 30 METERS (100 FEET) OF ELECTRONIC  
EQUIPMENT OR SUBSYSTEMS OR ASSOCIATED ANTENNAS

2.3 Group III. Group III items are examples of electrical and electromechanical equipments which are usually interference free and, for which, written approval to forego emission testing may be obtained when procured as individual equipments. As a means of establishing whether an equipment will require testing, the equipment manufacturer shall forward to the Command or agency concerned a complete electrical description of the equipment and justification to forego testing. Written approval to forego testing must be obtained from the Command or agency concerned and shall be requested as early in the procurement cycle as possible. This exemption does not apply when the item is to be procured as a component of another equipment or subsystem.

## 3. UMO5

3.1 UMO5 applicability. UMO5 applies to all Group I commercial electrical and electromechanical equipments procured for use in critical areas.

### 3.2 UMO5 limits.

3.2.1 Conducted emissions. Broadband electromagnetic emissions shall not appear on the power leads in the frequency range of 50 kHz to 50 MHz in excess of the levels shown on FIGURE 10-1.

3.2.2 Radiated emissions. Broadband electromagnetic emissions shall not be radiated in the frequency range of 150 kHz to 400 MHz in excess of the applicable limit curve shown on FIGURE 10-2 when measured at the required test distance as specified in MIL-STD-462.

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TABLE 10-1. Groupings of class C3 equipments.

GROUP I	GROUP II	GROUP III
<p>Portable electric tools, both double insulated and metal case, such as sabre saws, drills, impact wrenches, rivet guns, nut drivers and so forth.</p> <p>Repair and maintenance shop equipment</p> <p>Facilities equipment installed in buildings or at sites such as air conditioners, generators, elevators, exhaust fans</p> <p>Reperforators</p> <p>Projectors and flash units</p> <p>Heaters (all types)</p> <p>Lithographic and photoprocessing equipment</p> <p>Battery chargers</p> <p>Fixed garrison type kitchen and commissary equipments</p> <p>Office equipment</p> <p>Vending machines</p> <p>Laundry and dry cleaning equipments</p>	<p>Machine and semi-portable tools, such as lathes, ring grinders, welders, stamping presses and so forth.</p> <p>Arc welders</p> <p>Engine generators used for construction or shop support</p>	<p>Inherently interference-free items, such as:</p> <p>Ammeter</p> <p>Antennas, passive</p> <p>Controller, motor manual (except those using electronic components)</p> <p>Cubicle, power</p> <p>Distribution Networks, passive</p> <p>Incandescent Lighting Fixture</p> <p>Main Line Switch</p> <p>Motor, induction</p> <p>Panel, welding</p> <p>Regulator, passive element line</p> <p>Starter, motor, manual</p> <p>Switchboard, power</p> <p>Transformer used below saturation level</p> <p>Voltmeter</p>



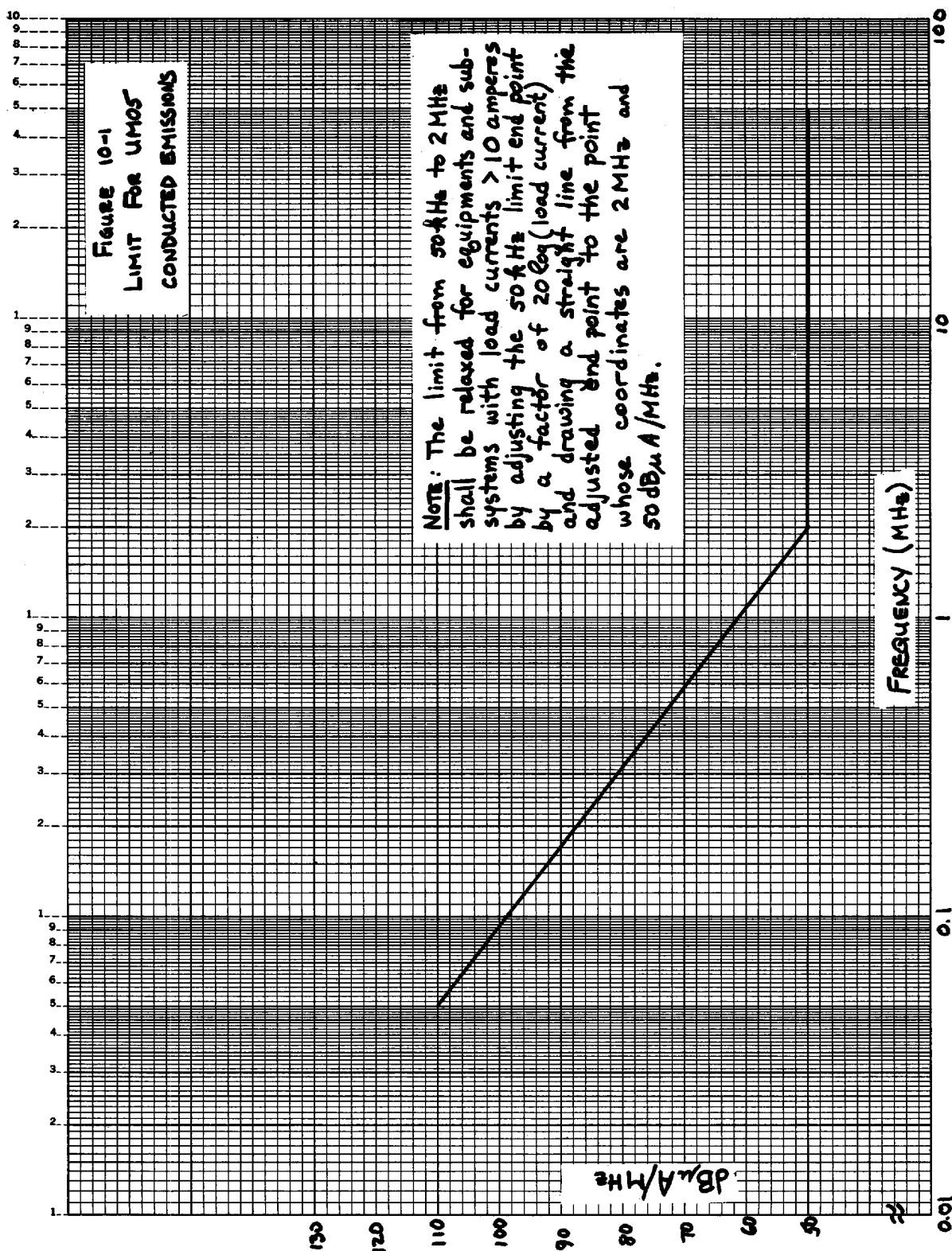


FIGURE 10-1. Limit for UMOS conducted emissions.

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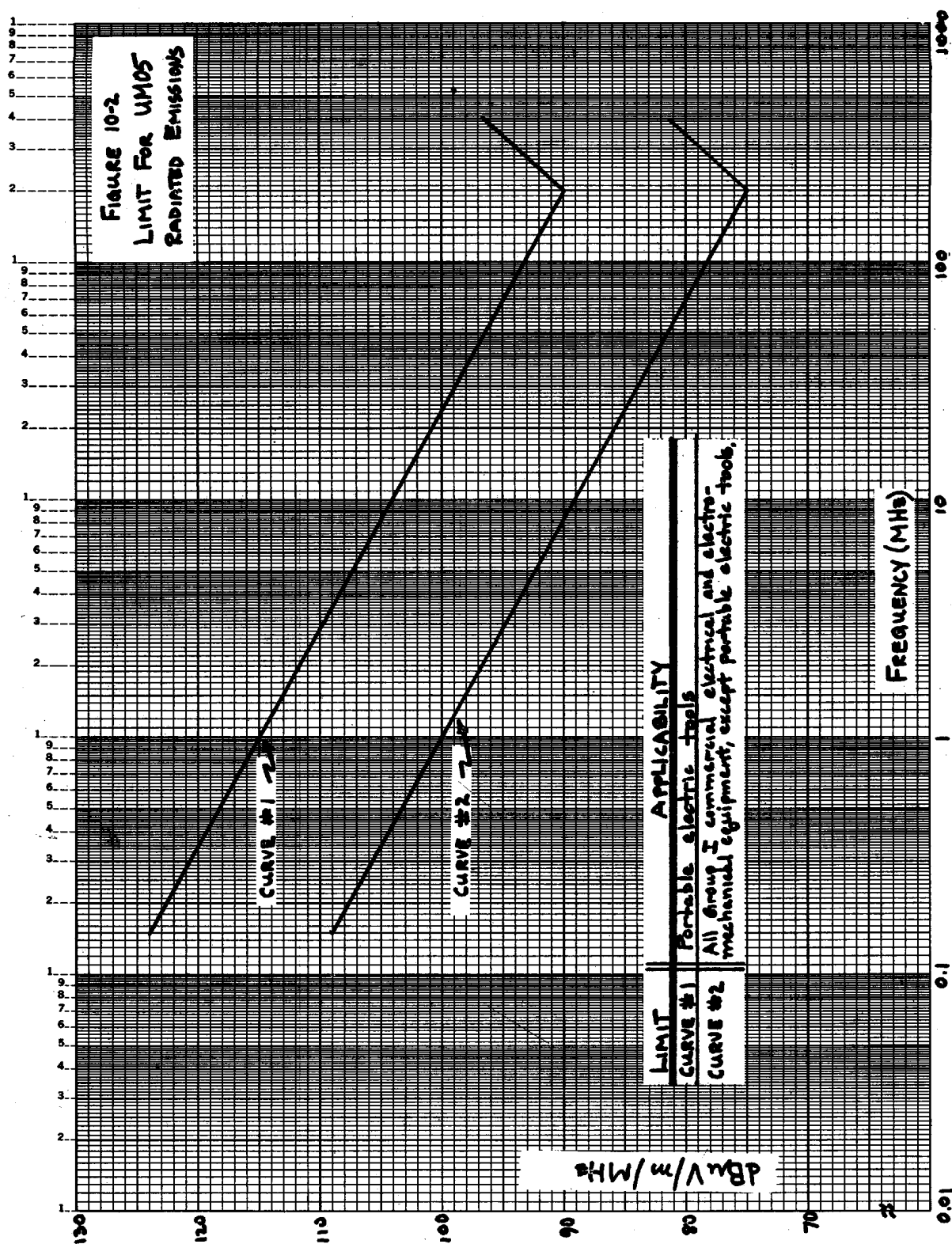


FIGURE 10-2. Limit for UM05 radiated emissions.