MIL-STD-188-313
19 December 1973
SUPERSEDING
(SEE FORWORD PAGE)

MILITARY STANDARD

SUBSYSTEM DESIGN AND ENGINEERING STANDARDS AND EQUIPMENT TECHNICAL DESIGN STANDARDS FOR LONG-HAUL COMMUNICATIONS TRANSVERSING MICROWAVE LOS RADIO AND TROPOSPHERIC SCATTER RADIO

MIL-STD-188-313
19 December 1973

DEPARTMENT OF DEFENSE

WASHINGTON, D. C. 20301

SUBSYSTEM DESIGN AND ENGINEERING STANDARDS AND EQUIPMENT TECHNICAL DESIGN STANDARDS FOR LONG HAUL COMMUNICATIONS TRANSVERSING MICROWAVE LOS RADIO AND TROPOSPHERIC SCATTER RADIO MIL-STD-188-313

1. This Military Standard is approved and mandatory for use by all Department and Agencies of the Department of Defense.

2. Recommended corrections, additions, or deletions should be reported to the preparing activity (Rome Air Development Center). (See Defense Standardization Directory SD-1 for mailing address.)

FORWORD

In the past two decades MIL-STD-188, a Military Standard covering Military Communication System Technical Standards, has evolved from one applicable to all military communications (MIL-STD-188, MIL-STD-188A, and MIL-STD-188B) to one applicable to tactical communications only (MIL-STD-188C).

In the past decade, the Defense Communications Agency (DCA) has published DCA Circulars promulgating standards and criteria applicable to the Defense Communications System and to the technical support of the National Military Command System (NMCS).

Future standards for all military communications will be published as part of a MIL-STD-188 series of documents. Military Communication System Technical Standards will be subdivided into Common Standards (MIL-STD-188-100 series), Tactical Standards (MIL-STD-188-200 series), and Long Haul Standards (MIL-STD-188-300 series).

This document deals with subsystem, and equipment standards pertinent to multichannel communications circuits using Line of Sight (LOS) and Tropospheric Scatter radio transmission.

Values appearing herein may differ from those previously published in MIL-STD-188-100 based on later data or errata corrections. In case of conflict, MIL-STD-188-312 shall govern.

This standard supersedes paragraphs 3.2.2.4 through 3.2.2.4.8.3.2 and paragraphs 3.2.2.5 through 3.2.2.5.5.3.4 of DCAC 330-175-1, DCS Engineering Installation Standards Manual.

51

IDENTIFICATION OF

INTERNATIONAL STANDARDIZATION AGREEMENT

Certain provisions of this standard are the subject of international standardization agreement. When revision or cancellation of this standard is proposed, the departmental custodian will inform his respective Departmental Standardization Office so that appropriate action may be taken respecting the international agreement concerned.

TABLE OF CONTENTS

53

55

57

5-9

61

65

1.0 Scope.

1.1 Purpose. The purpose of this document is to provide technical design standards for subsystem and equipment performance for line-of-sight (LOS) radio transmission and Tropospheric Scatter radio transmission for use in Long Haul Communications.

1.2 Application. This standard applies to the design and performance of new line-of-sight (LOS) and Tropospheric Scatter radio relay communications subsystems and equipment. The LOS subsystems will normally operate in the 4-13 GHz frequency range while the Tropospheric Scatter Subsystems will normally operate in the 0.4 GHz to 5 GHz.

a. The use of the frequency spectrum is regulated by international agreements embodied in "Radio Regulations, General Secretariat of the International Telecommunications Union," Geneva, 1959. These regulations are further qualified at the national level through Government (Interdepartment Radio Advisory Committee, IRAC) and military agencies (Joint Chiefs of Staff, JCS, and Military Communications Electronics Board, MCEB).

b. For normal peacetime use, the choice and performance of equipment, as well as frequencies and emissions of any radio system, shall satisfy the provision of those regulations. Adequate familiarity with the latter is, therefore, required of designers and users of radio systems.

c. Military frequency planning, including joint function frequency allocation tables, is established as a joint military action area under the MCEB. Final approval of frequency bands, operating modes and equipment characteristics rests with the MCEB.

d. This standard is limited to frequency modulated (FM) subsystems with modulation bandwidths of 240 KHz (which is the equivalent of 60 each nominal 4 KHz channels) to 1364 KHz (which is the equivalent of 300 each nominal 4 KHz channels) and made up of fixed, or semi-fixed, plant equipment or transportable equipment operating in a fixed plant environment. However, the present limitation and/or restrictions for FM should not be construed as barring other transmission techniques which lend themselves to more efficient utilization of the transmission medium and/or of the available spectrum space or both. After development and testing of such improved techniques, appropriate modifications to this standard will be provided.

e. It is not intended that existing systems be immediately converted to comply with the requirements of this standard. New systems and those undergoing major modification (those systems where the original equipment meets the requirements of this standard are being rehabilitated) shall conform to these standards.

f. The standards described herein apply to microwave LOS subsystems and Tropospheric Scatter Subsystems that are used to carry frequency division multiplex traffic. Wherever unusual requirements call for extremely short or long hops, channel capacities in excess of 300 channels (for LOS Subsystems) or carrying video or time division multiplexed basebands, these standards shall serve only as guides for subsystem design, procurement of equipment, and subsystem testing.

1.3 Objective. The objective of this standard is to provide the electrical performance parameters required in long haul communications to enable design, engineering and installation of LOS and Tropospheric Scatter radio transmission circuits.

2.0 The following documents form a part of this standard to the extent specified herein.

2.1 Referenced Documents

STANDARDS

Military

MIL-STD-188-100	Common Long Haul and Tactical Communication System Technical Standards
MIL-STD-188-120	Common Long Haul/Tactical Telecommunications Terms and Definitions

OTHER PUBLICATIONS

Radio Regulations - 1959

(Copies may be obtained from General Secretariat of International Telecommunications Union,Geneva.)

3.0 Terms and Definitions

3.1 Definitions contained in this standard are intended to simplify or supplement those definitions in MIL-STD-188-120. In case of any conflict in definitions, the definitions contained herein shall govern.

4.0 Subsystem Standards. The analog line of sight (LOS) Radio Transmission Subsystem use the same basic radio equipment as does the analog Tropospheric Scatter Radio Transmission Subsystems. However, the longer propagation paths with higher losses on the Tropospheric Scatter Radio Transmission Subsystems require the use of higher power transmitters with higher gain antennas to meet the subsystem performance requirements. Because of the higher radiated power and interference with LOS and Satellite Radio Links, the Tropospheric Scatter Radio Transmission Systems are restricted, by ITU agreement to operation below 5,000 MHz.

4.1 LOS Radio Transmission Subsystems. The standards described herein apply to LOS Radio Transmission subsystems that are used to carry frequency division multiplexed traffic. Subsystems design considerations are given in 4.1.2.1. The FM Modulator, FM Demodulator, radio transmitter, radio receiver and antenna standards are presented in 5.4.3, 5.7.4, 5.5.3, 5.6.7 and 5.11.

4.1.1 LOS Radio Transmission Reference Section. The LOS Radio Transmission Reference Section is a 333 nautical mile (nmi) (nominal 600 Kilometer) transmission line facility including line conditioning equipment, amplifiers, pads, and repeaters as required, extending between the High Frequency Distribution Frames (HFDF's) of the Defense Communications System's transmission system. It consists of thirteen (13) radio frequency hops each nominally 26 nmi (nominal 50 Km) in length. Normally, IF heterodyne repeaters shall be employed at the intermediate repeater sites and frequency modulation and demodulation of the multiplex signal to baseband shall occur only at the end terminals. At the intermediate repeater sites, the frequency modulated signal is repeated at the 70 MHz intermediate frequency. Supervisory channels shall be inserted and dropped out at each repeater site. While IF heterodyne will normally be used at repeater sites where no requirement exists for message channel breakout, there may be other technical approaches that will provide comparable system performance. This reference section does not preclude consideration of other technical approaches. The characteristics defined below establish the minimum performance requirements for the tropospheric reference section, including radio carrier connecting hops, as measured between the High Frequency Distribution Frame points at each end of the reference section.

4.1.1.1 Interface Parameters. The following parameters are defined for the mission baseband at the interconnections between the multiplex equipment and the FM Modulating - Demodulating equipment. This interconnection point is commonly referred to as the HFDF. Figure 1 shows the location of this interface point.

4.1.1.1.1 Frequency. The mission baseband traffic shall occupy the frequency spectrum of 12 to 1300 kHz for 300 nominal 4 kHz channels. The equipment baseband of 0.3 to 1364 kHz is the frequency bandwidth required to accept the mission baseband spectrum and order wire service.

4.1.1.1.2 Levels. The per channel transmit reference test tone level at the HFDF shall be minus 45 dBm. The per channel receive test tone level at the HFDF shall be minus 15 dBm (± 0.5 dB).

4.1.1.1.3 Impedance. The nominal impedance at the HFDF shall be 75 ohms, unbalanced to ground. The return loss over the mission baseband shall be a minimum of 20 dB (DO: 26 dB) in both directions. (transmit and receive) compared to a 75 ohms resistive termination.

4.1.1.2 Transfer Function Parameters. The transfer function parameters defined below establish the minimum performance requirements.

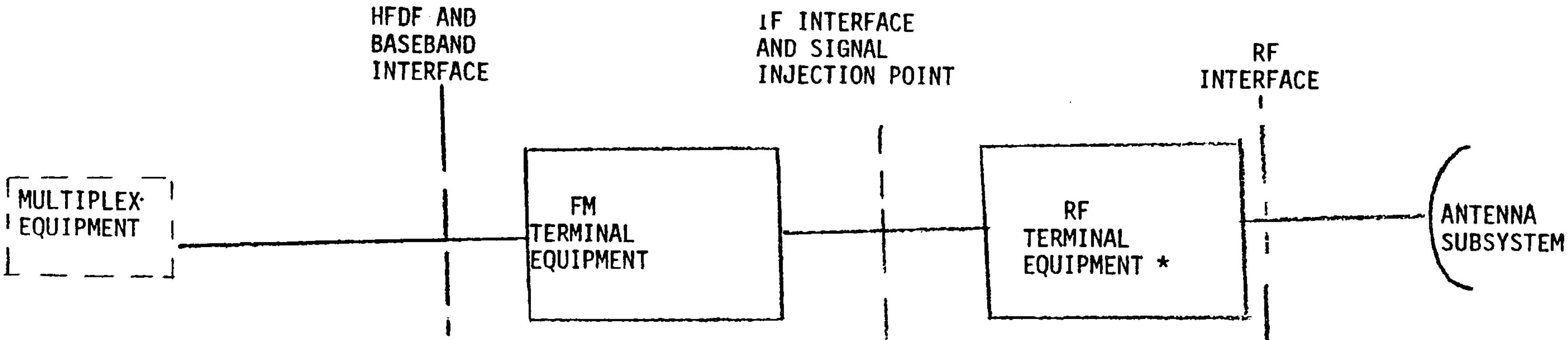
4.1.1.2.1 Net Gain. The net gain between HFDF's shall be 30 dB (± 1dB).

4.1.1.2.2 Net Gain Variations. Variations in the net gain between HFDF's shall not exceed ± 0.5 dB over any 30 day period.

4.1.1.2.3 Frequency Response. Variations in the net gain between HFDF's as a function of frequency shall not exceed ± 0.5 dB over the mission spectrum for all individual or combined channels of a diversity system.

4.1.1.2.4 Baseband Envelope Delay. The baseband envelope delay between HFDF's shall not exceed 200 nanoseconds over the 100 KHz to 1300 KHz band and shall not exceed 1 microsecond over the 12 KHz to 100 KHz band.

4.1.1.2.5 Variations in Absolute Delay. Variations in absolute delay time, such as after those occurring from combiners, diversity, path switching, or transfer between redundant equipment elements shall not exceed 10 nanoseconds at any frequency in the mission spectrum.



	HFDF and Baseband Interface	IF Interface and Signal Injection Point	RF Interface
FREQUENCY	12 - 1364 KHz accommodates 300 - 4 kHz Ch of mission spectrum	70 MHz	Microwave* 1700 - 15000 MHz
TEST TONE LEVEL			
TRANSMIT	-45 dBm		
RECEIVE	-15 dBm (± 0.5 dB)		
IF INTERFACE AND SIGNAL INJECTION POINT			
TRANSMIT		Input Level 0.3 V RMS (+0.8 dBm ± 0.5 dB)	+37 dBm (5 watts)
RECEIVE		Output Level 0.625 V RMS (+5.2 dBm ± 0.5 dB)	-30 dBm nominal (-80 dBm to -15 dBm range)
IMPEDANCE	75 ohms, unbalanced	75 ohms, unbalanced	WAVEGUIDE/or 50 ohms
RETURN LOSS	20 dB	20 dB 26 dB (De)	28 dB Toward Antenna 32 dB Toward Radio Receiver

* Discrete block frequency assignment within this range.

FIGURE 1. LOS RADIO TRANSMISSION TERMINAL, INTERFACE PARAMETERS

4.1.1.2.6 Total Reference 4 kHz Channel Median Noise. The total reference 4 kHz channel median noise shall meet the requirements of 4.1.2.1.1.

4.1.1.3 Baseband, IF, and RF Interfaces. The baseband, IF, and RF interface parameters are summarized in Figure 1.

4.1.2 Subsystem Design and Engineering Standards. The following standards are applicable to subsystem design, equipment performance, and subsystem performance of LOS Radio Transmission Subsystems of the Defense Communications System. These apportioned performance parameters meet the minimum requirements for the Reference Section described in 4.1.1 and in MIL-STD-188-100; 333 nmi (nominal 600 Km) Reference Transmission Line Section.

4.1.2.1 Subsystem Design Considerations. Overall subsystem design standards are not to be confused with equipment standards or specifications, or system performance standards. Some of the parameters used by the system designer cannot be conveniently tested in actual practice but are generally accepted parts of a model and necessary for determining the system configuration. Overall subsystem design includes consideration of the FM modulating-demodulating equipment, the radio equipment, antennas and the transmission media and required subsystem availability. Other design considerations are given in Appendix B.

4.1.2.1.1 Total Channel Noise. Tradeoffs in noise allocation from all sources may be made, provided the total noise of the worst real channel in each single hop being designed meets the worst hour median requirements over the reference section as stated in 4.1.1.2.6.

a. In computing the various souces of noise, the known characteristics of the equipment being procured shall be used. The allocation of noise attributable to the following sources shall be tabulated for the median values or each real hop and totaled for the complete subsystem:

(1) Thermal noise including path noise and residual radio equipment noise.

(2) Radio equipment intermodulation noise.

(3) Feeder echo intermodulation noise.

(4) Interference (includes noise and single tone as determined from Path Study).

b. Diversity improvement, while not a noise source, must be considered in the time distribution of system noise performance and time duration that the system noise objectives are met or exceeded.

4.1.2.1.1.1 Long Term Median Noise. The total long term median noise from all sources in any nominal 4 kHz channel shall not exceed 1110 pWp0 over the reference circuit.

a. The noise allowed in real sections shall be based upon the actual length (L) in nautical miles as follows:

Section Length (L)	Allowable Noise
L < 27 nmi	150 pWp0
27 < L > 151 nmi	2.76 L pWp0 + 85.5 pWp0
L > 151 nmi	3.33 L pWp0
L = 333 nmi	1,110 pWp0
L = 1,000 nmi	3,330 pWp0
L = 6,000 nmi	19,980 pWp0

b. For design noise calculations, the long-term median noise shall be taken as the noise existing when all hops of the real section are faded 3 dB below the level corresponding to the calculated median transmission loss value.

c. For field test purpose, median noise shall be taken as the noise measured with all hops of the real section in an unfaded condition, plus the calculated additional thermal (front end) noise which would result if each hop in the real section were faded 3 dB below the calculated median transmission loss value.

4.1.2.1.1.2 Short Term Mean Noise. The short term mean noise power, with an integration time of 5 ms, occurring on any referenced 4 kHz channel, shall not exceed 316,000 pWp0 for more than an accumulated 2 minutes in any month or more than 1 minute in any hour over any hop in a real section. Short term noise due to propagation characteristics shall be determined on the basis of measured or statistical data appropriate to the geographical region under consideration.

4.1.2.1.2 Subsystem Loading. LOS radio transmission subsystems of the DCS shall be designed to support 100 percent data loading represented by a Gaussian white noise signal distribution limited to an uniformly distributed over the mission baseband spectrum at a level of +14.8 dBm0. The value 14.8 dBm0 is determined by substituting N = 300, in the formula - 10 + 10 $\log_{10}$ N dBm0, where N is the design capacity of the system in terms of the total number of voice channels.

4.1.2.1.3 Other Characteristics of a Reference Channel. Long and short term test tone amplitude variations, phase jitter, absolute and relative delay variation, and frequency response of the reference channel shall not exceed the requirements of the applicable military standard for the type of multiplex equipment used.

4.1.2.2 Test and Acceptance. The overall performance standards specified in 4.1.2 are mainly of use to those involved in test and acceptance of installed subsystems. Subsystem tests, however, that include the effects of the medium of transmission, will yield results slightly worse than equipment set tests and will vary from the system designer's estimates. In some cases, the system designer's determinations are virtually impossible to measure because of the duration of time involved and the actual loading experienced in the real hop or system.

4.1.2.2.1 Necessary Bandwidth. For planning and equipment design purposes, the necessary bandwidth for wideband frequency modulated systems will be determined from the formula $2(\Delta F_c + f_m)$ where ΔF_c is the peak carrier deviation and f_m is the highest modulating frequency.

4.1.2.2.2 Measurement Bandwidth. The measurement bandwidth is determined by the formula $2.8\ (\Delta F_c = f_m)$, where ΔF_c is the peak carrier deviation and f_m is the highest message band modulating frequency in kHz. This measurement bandwidth also defines the radio equipment RF and IF passband bandwidth and 0.1 dB bandwidth. This measurement bandwidth should not be confused with "Necessary Bandwidth" defined in 4.1.2.2.1.

4.1.2.2.3 Linearity Bandwidth. The linear bandwidth is determined by the formula $1.4(\Delta F_c + F_m)$ where ΔF_c is the peak deviation and F_m is the highest modulating frequency. The linearity bandwidth should not be confused with the Measurement Bandwidth, defined in 4.1.2.2.1 nor with the Necessary Bandwidth defined in 4.1.2.2.2.

4.2 Tropospheric Scatter Radio Transmission Subsystem. The standards described herein apply to Tropospheric Scatter Radio Transmission subsystems that are used to carry frequency division multiplexed traffic. Subsystems design considerations are given in 4.2.2.1. The FM Modulator, FM Demodulator, radio transmitter, radio receiver and antenna standards are presented in 5.4.3, 5.7.4, 5.5.3, 5.6.7 and 5.11.

4.2.1 Tropospheric Scatter Radio Transmission Reference Section. The Tropospheric Scatter Radio Transmission Reference Section is a 333 nautical mile (nmi) (nominal 600 Kilometer) transmission line facility including line conditioning equipment, amplifiers, pads, and repeaters as required, extending between the HFDF's of the Defense Communications System's transmission system. It consists of two (2) radio frequency hops each nominally 167 nmi (nominal 300 Km) in length. Channels shall be inserted and dropped out at each repeater site. This reference section does not preclude consideration of other technical approaches. The characteristics defined below establish the minimum performance requirements for the tropospheric reference section, including radio carrier connecting hops, as measured between the HFDF points at each end of the reference section.

4.2.1.1 Interface Parameters. The following parameters are defined for the mission baseband at the interconnections between the multiplex equipment and the FM Modulating - Demodulating equipment. This interconnection point is commonly referred to as the HFDF. Figure 2 shows the location of this interface point.

4.2.1.1.1 Frequency. The mission baseband traffic shall occupy the frequency spectrum of 12 to 1300 kHz for 300 nominal 4 kHz channels. The equipment baseband of 0.3 to 1364 kHz is the frequency bandwidth required to accept the mission baseband spectrum and order wire service. For less than 300 channel spectrums, refer to Appendix B.

4.2.1.1.2 Levels. See 4.1.1.1.2.

4.2.1.1.3 Impedance. See 4.1.1.1.3.

4.2.1.2 Transfer Function Parameters. The transfer function parameters defined below establish the minimum performance requirements.

4.2.1.2.1 Net Gain. See 4.1.1.2.1.

4.2.1.2.2 Net Gain Variations. See 4.1.1.2.2.

4.2.1.2.3 Frequency Response. See 4.1.1.2.3.

HFDF and BASEBAND INTERFACE

IF INTERFACE AND SIGNAL INJECTION POINT

RF INTERFACE

ANTENNA SUBSYSTEM

MULTIPLEX EQUIPMENT

FM TERMINAL EQUIPMENT

RF TERMINAL EQUIPMENT *

ANTENNA

FREQUENCY	12 - 1340 kHz accommodates 300 channels of mission spectrum	70 MHz	350 - 8400 MHz *
TEST TONE LEVEL			
TRANSMITS	-45 dBm		
RECEIVE	-15 dBm (+ 0.5 dBm)		
IF INTERFACE AND SIGNAL INJECTION POINT			
TRANSMIT		input level 0.3 VRMS (+0.8 dBm) ± 0.5 dB	+40 to +77 dBm (10 watts to 50 KW)
RECEIVE		output 0.625 VRMS (+5.2 dBm) ± 0.5 dB	-80 dBm - Nominal (-97 dBm to -75 dBm range)
IMPEDANCE	75 ohms, unbalanced	75 ohms, unbalanced	WAVEGUIDE/or 50 ohms
RETURN LOSS	20 dB 26 dB (DO)	20 dB 26 dB(DO)	26 dB Toward Antenna 32 dB Toward Radio Receiver

* Discrete block frequency assignment are available within this range except for 7125 to 8400 MHz which are prohibited by ITU agreements for tropospheric scatter deployment.

FIGURE 2. TROPOSPHERIC SCATTER RADIO TRANSMISSION TERMINAL, INTERFACE PARAMETERS.

4.2.1.2.4 Baseband Envelope Delay. See 4.1.1.2.4.

4.2.1.2.5 Variations in Absolute Delay. See 4.1.1.2.5

4.2.1.2.6 Total Reference Channel Median Noise. The total reference 4 kHz channel median noise shall meet the requirements of 4.2.2.1.1.

4.2.1.3 Baseband, IF, and RF Interfaces. The baseband, IF, and RF interface parameters are summarized in Figure 2.

4.2.2 Subsystem Design and Engineering Standards. The following standards are applicable to subsystem design, equipment performance, and subsystem performance of Tropospheric Scatter Radio Transmission Subsystems of the Defense Communications System. These apportioned performance parameters meet the minimum requirements for the Reference Section described in 4.2.1 and in MIL-STD-188-100; 333 nmi (nominal 600 Km) Reference Transmission Line Section.

4.2.2.1 Subsystem Design Considerations. Overall subsystem design standards are not to be confused with equipment standards or specifications, or system performance standards. Some of the parameters used by the system designer cannot be conveniently tested in actual practice but are generally accepted parts of a model and necessary for determining the system configuration. Overall subsystem design includes consideration of the FM Modulating equipment, the radio equipment, antennas and the transmission media and required subsystem availability. Othe design considerations are given in Appendix B.

4.2.2.1.1 Total Channel Noise. Tradeoffs in noise allocation from all sources may be made provided the total noise of the worst real channel in each single hop being designed meets the worst hour median requirements over the reference section as stated in 4.2.1.2.6.

a. In computing the various sources of noise, the known characteristics of the equipment being procured shall be used. The allocation of noise attributable to the following sources shall be tabulated for the median values for each real hop and totaled for the complete subsystem:

(1) Thermal noise including path noise and residual radio equipment noise.

(2) Radio equipment intermodulation noise.

(3) Feeder echo intermodulation noise.

(4) Interference (includes noise and single tone as determined from path study).

b. Diversity improvement, while not a noise source, must be considered in the time distribution of system noise performance and time duration that the system noise objectives are met or exceeded.

4.2.2.1.1.1 Long Term Median Noise. The total long term median noise from all sources in any nominal 4 kHz channel shall not exceed 1110 pWp0 over the reference circuit.

a. The noise allowed in real sections shall be based upon the actual length L in nautical miles as follows:

Section Length (L)	Allowable Noise
L > 151 nmi	3 1/3 L pWp0
L = 333 nmi	1,110 pWp0
L = 1,000 nmi	3,333 pWp0
L = 3,000 nmi	10,000 pWp0
L = 6,000 nmi	20,000 pWp0

b. For design noise calculations, the long-term median noise shall be taken as the noise existing when all hops of the real section are faded 3 dB below the level corresponding to the calculated median scatter transmission loss value.

c. For field test purposes, median noise shall be taken as the noise measured with all hops of the real section in an unfaded condition, plus the calculated additional thermal (front end) noise which would result if each hop in the real section were faded 3 dB below the calculated median scatter transmission loss value level.

4.2.2.1.1.2 Worst-Hour of the Year. The worst hour of the year is defined as that hour of the year during which the median noise over any radio path is "greatest". This hour is considered to coincide with the hour during which the greatest transmission loss occurs.

4.2.2.1.1.2.1 Excessive Noise. The median noise in any nominal 4 kHz channel during the worst hour of the year shall not exceed 316,000 pWpO (55 dBrncO) for the 12,000 nmi reference circuit. The hourly median values of transmission loss from which the worst hour is determined shall be made on the basis of calculations (predicted values), measurements, or a proper combination of both.

4.2.2.1.1.2.2 Service Availability. Troposcatter systems shall be designed so that the probability of exceeding 316,000 pWpO is less than 0.01 percent for all hours of the year. This probability shall be determined to a 95 percent confidence level. (i.e. The margin between the design value and the calculated value shall be 1.65 times the standard deviation defining the prediction uncertainty).

4.2.2.1.2 Diversity Operation. All tropospheric scatter radio transmission subsystems shall be designed for multi-order diversity. With quadruple diversity systems, as a minimum, frequency diversity shall be one diversity element used. Equipment shall be so designed that it may be converted to frequency diversity without requiring additional equipment (except crystals, if applicable) after installation as a space diversity system.

4.2.2.1.3 Subsystem Loading. Tropospheric Scatter Radio Transmission subsystems of the DCS shall be designed to support 100 percent data loading represented by a Gaussian noise signal distribution limited to and uniformly distributed over the mission baseband spectrum at a level of +14.8 dBm0. The value 14.8 dBm0 is determined by substituting N=300, in the formula $-10 + 10 \log_{10} N$ dBm0, where N is the design capacity of the system in terms of the total number of voice channels. For field test purposes the loading formula, using the actual number of voice channels, shall be used.

4.2.2.1.4 Other Characteristics of a Reference Channel. Long and short term test tone amplitude variations, phase jitter, absolute and relative delay variation, and frequency response of the reference channel shall not exceed the requirements of the applicable military standard for the type of multiplex equipment used.

4.2.2.2 Test and Acceptance. The overall performance standards are mainly of use to those involved in test and acceptance of installed subsystems. Subsystem tests, however, that include the effects of the medium of transmission, will yield results slightly worse than equipment set tests and will vary from the system designer's estimates. In some cases, the system designer's determinations are virtually impossible to measure because of the duration of time involved and the actual loading experienced in the real hop or system.

4.2.2.2.1 Necessary Bandwidth. See 4.1.2.2.1.

4.2.2.2.2 Measurement Bandwidth. See 4.1.2.2.2.

4.2.2.2.3 Linearity Bandwidth. See 4.1.2.2.3.

5.0 Equipment Technical Design Standards. These standards provide the minimum electrical performance including the dynamic range of operation and interface characteristics based on the requirements of the overall subsystem designs specified in 4.1. (LOS Radio Transmission Subsystems) and in 4.2 (Tropospheric Scatter Radio Transmission Subsystems.)

a. As stated in 4.0, the basic 300 channel analog FM Modulator/Demodulator equipment and the RF equipment may be used for either LOS or Tropospheric Scatter Radio Transmission subsystems. Power amplifiers and higher gain antennas shall be required for tropospheric scatter radio transmission subsystems because of much greater transmission path losses due to longer paths. Further use of the tropospheric scatter radio transmission subsystem is prohibited by ITU agreement to frequencies below 5000 mHz. See Figure 2.

5.1 Types of Equipment. Overall technical design standards apply to:

a. FM equipment.

b. RF radio equipment.

c. Transmission lines and antennas.

5.1.1 LOS Radio Transmission Equipment Performance Requirements. The performance of the selected radio equipment shall be adequate to insure that the real LOS transmission section and the reference transmission section transfer function requirements are met. Unless otherwise stated, the interface parameters stated in 4.2.1 shall apply. The radio equipment shall meet the following minimum requirements.

5.1.2 Tropospheric Radio Transmission Equipment Performance Requirements. The performance of the selected radio equipment shall be adequate to insure that the real Tropospheric transmission section and the reference transmission section transfer function requirements are met. The interface parameters stated in 4.2 shall apply. Unless otherwise stated, the radio equipment shall meet the following minimum requirements.

5.1.3 Equipment Block Diagram. A generalized block diagram of the equipment layout is shown on Figures 3 and 4.

5.2 Interface Characteristics.

5.2.1 Channel Capacity. The inherent channel capacity of the radio equipment shall be 300 nominal 4 kHz (300-3400 Hz) voice channels occupying the mission baseband frequency spectrum from 12 kHz to 1300 kHz. The equipment baseband of 0.3 kHz to 1364 kHz is the bandwidth required to accept the mission baseband spectrum and order wire service.

5.2.2 Channel Loading. The radio equipment shall meet all performance requirements specified herein when loaded with +14.8 dBm0 of Gaussian white noise signal uniformly distributed over the baseband from 12 to 1300 kHz. (The value 14.8 dBm0 is determined by substituting N = 300 in the formula $-10 + 10 \log_{10} N$ where N is the number of channels.)

5.2.3 Frequency Tolerance. Equipment and subsystem design shall be such that the center frequency of the radiated signal in a real section from any transmitter shall be as follows:

a. Transmitters which operate with internal carrier generation: within 0.0001 percent (1 part in 10^6) of the assigned frequency.

b. Transmitters which depend upon the received signal for establishing the reference signal for the transmitted signal such as in heterodyne repeaters: within 0.0001 percent $\pm$ 0.07 kHz of the received signal.

c. The cumulative frequency error for a real section shall not exceed 0.0001 percent $\pm$ 0.07 times N kHz, where N is the number of heterodyne repeaters in the real section.

5.2.4 Emphasis. When pre-emphasis or de-emphasis circuits are used in newly designed radio equipment, they shall be in accordance with Appendix A.

5.2.4.1 Radio Equipment Intended for Less than 300 Channel Application. The channel capacity of the emphasis networks shall be variable to allow for less than 300 nominal 4 kHz channels. Provision for 60, 120 and 240 channels shall be made in addition to 300 channels.

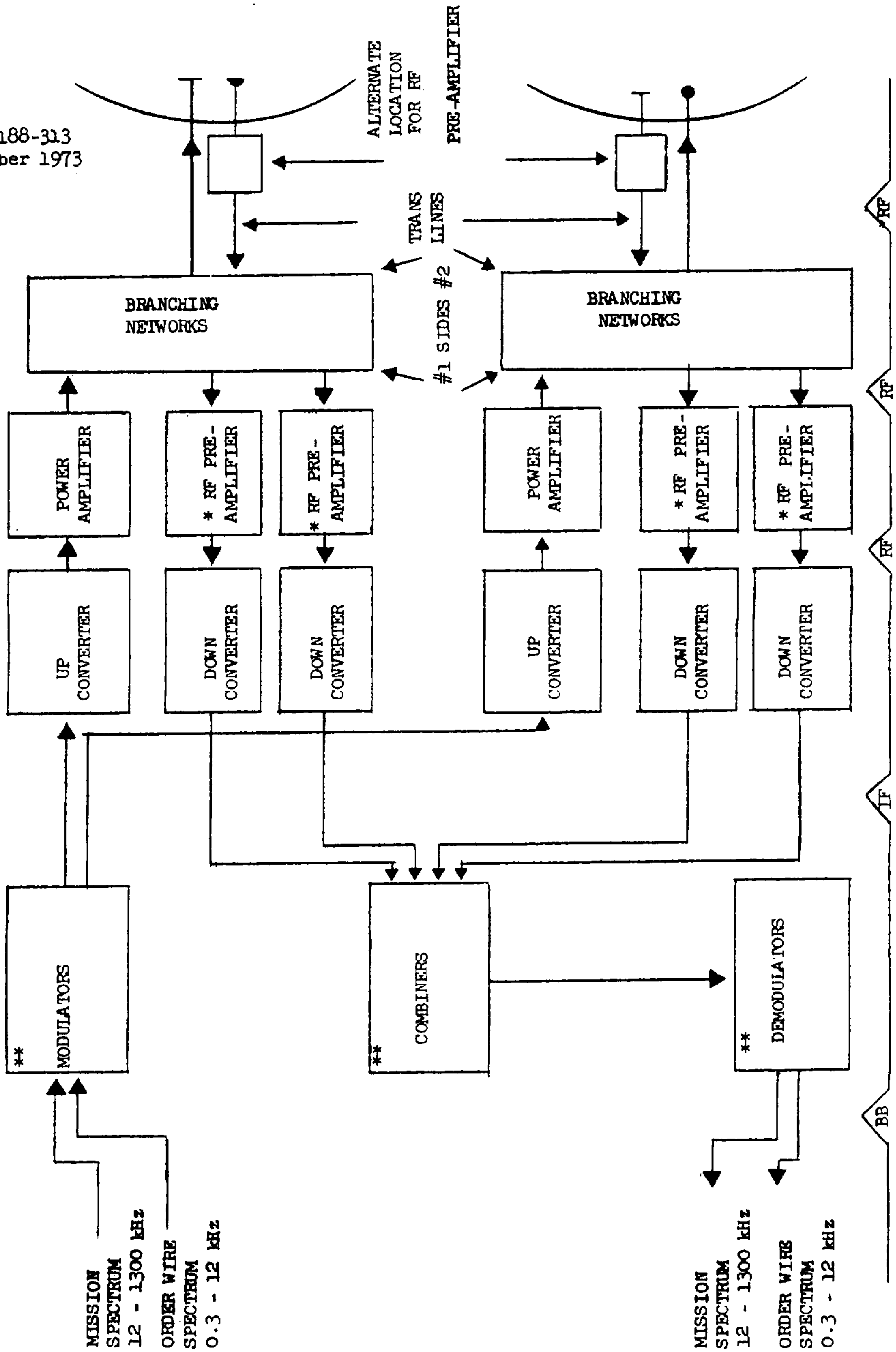
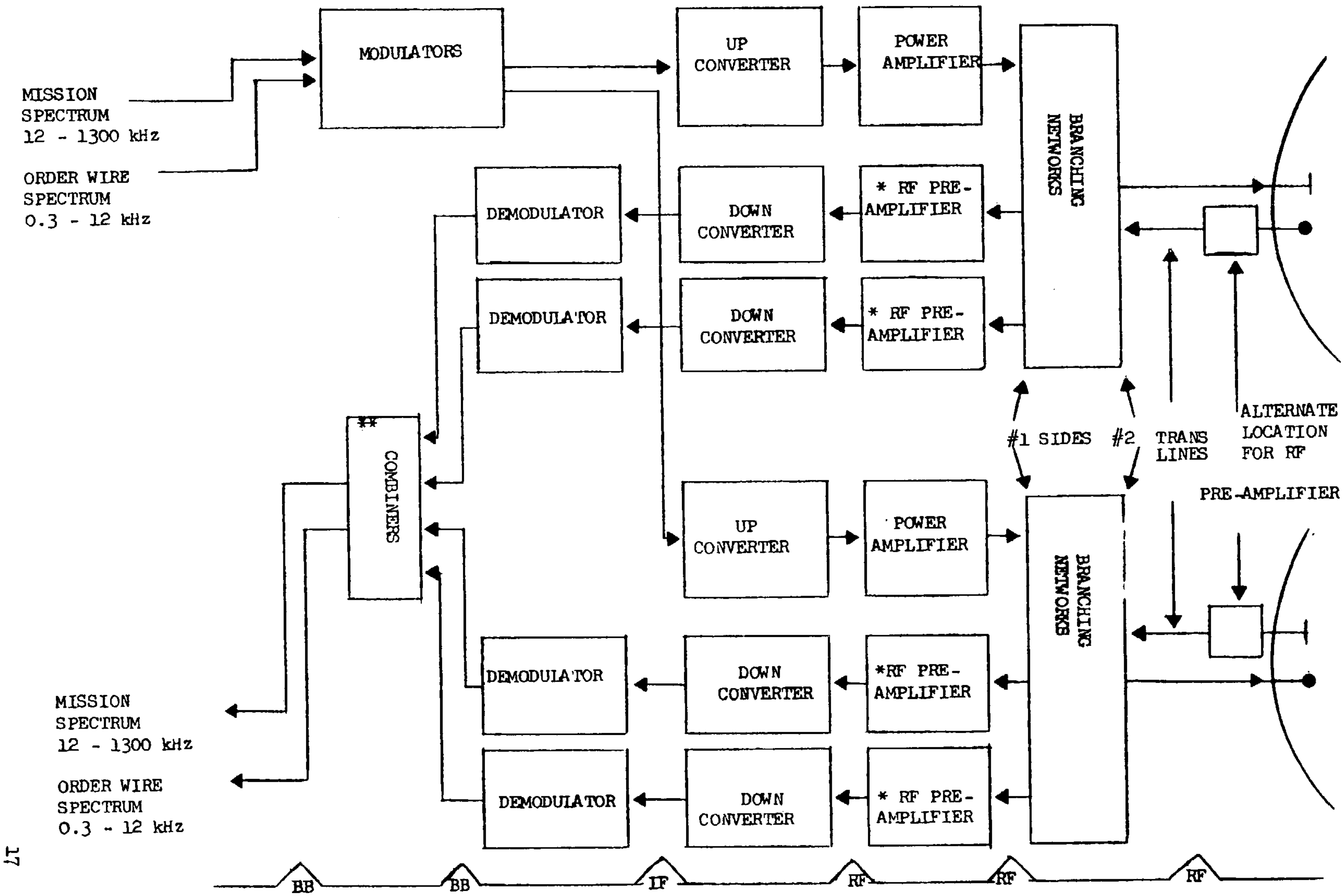


Figure 3. GENERAL EQUIPMENT BLOCK DIAGRAM,
PRE-DETECTION COMBINING

* OPTIONAL
** VARIABLE REDUNDANCY



* OPTIONAL
** VARIABLE REDUNDANCY

FIGURE 4. GENERAL EQUIPMENT BLOCK DIAGRAM, POST-DETECTION COMBINING

5.3 Transfer Function Parameters

5.3.1 Radio Transmission Sets.

5.3.1.1 LOS Radio Transmission Sets. The transfer function parameters for LOS radio transmission sets are defined from baseband input to baseband output at the high frequency distribution frames with the radio equipment operating at the same frequency and connected, in a non-diversity configuration, at the RF interface points through appropriate attenuators. The transmitter shall be operated at full power and the received signal level shall be adjusted to a level of -30 dBm. If pre-emphasis is employed, the per channel test tone deviation (RMS) requirements shall apply to the mean baseband frequency (i.e. The frequency at which the deviation is the same with or without pre-emphasis).

a. Unless otherwise stated, the overall performance between the baseband interface points shall meet the following minimum requirements.

5.3.1.2 Tropospheric Scatter Radio Transmission Sets. The transfer function parameters for Tropospheric Scatter Radio transmission sets are defined from baseband input to baseband output at the high frequency distribution frames with the radio equipment operating at the same frequency and connected, in a non-diversity configuration, at the RF interface points through appropriate attenuators. The transmitter shall be operated at full power and the received signal level shall be adjusted to a level of -80 dBm, except for noise measurements where the RF level shall be -40 dBm. If pre-emphasis is employed, the per channel test tone deviation (RMS) requirements shall apply to the mean baseband frequency (i.e. the frequency at which the deviation is the same with or without pre-emphasis). Unless otherwise stated, the overall performance between the baseband interface points shall meet the following minimum requirements.

5.3.2 Frequency Response. The frequency response of the radio set shall be ± 0.5 dB from 12 to 1364 kHz and ± 1 dB from 0.3 to 12 kHz.

5.3.3 In Band Noise. The noise power ratio (NPR) measured in the worst nominal 4 kHz slot in the baseband with noise loading of +14.8 dBm0, shall equal or exceed 55 dB.

5.3.4 In Channel Noise. The basic intrinsic noise ratio (BINR), measured in the worst nominal 4 kHz slot in the baseband, with no input loading to rated input noise loading of 14.8 dBm0, shall equal or exceed 57 dB.

5.3.5 Level Stability. The radio set shall be designed with sufficient regulation and feedback to provide long time stability such that for a constant level input, the output will not vary by more than ± 0.5 dB during a 30 day period without adjustments.

5.3.6 Envelope Delay. The envelope delay distortion of the radio set shall not exceed 200 ns over the 100 kHz to 1300 kHz band and shall not exceed 1 microsecond over the 12 to 100 kHz band. This is valid for high speed digital data transmission with all filters electrically disconnected.

5.3.7 Variations in Absolute Delay. Variations in absolute delay time such as those occurring from combiners, diversity path switching, or transfer between redundant equipment elements shall not exceed 10 nanoseconds at any frequency in the mission baseband spectrum. The time required for switching or transfer is not related to nor part of this parameter.

5.4 FM Transmitting Modulator. The FM transmitting modulator is part of the FM Terminal equipment and may also be an integral part of the RF Transmitting equipment.

5.4.1 Interface Points. The baseband interface point is defined for test purposes as the high frequency distribution frame point to which the FM transmitting modulator is connected.

a. The IF interface point is defined for test purposes as the point of interconnection between the FM transmitting modulator and the RF Transmitting equipment.

5.4.2 Baseband Interface Characteristics

5.4.2.1 Baseband Input Spectrums. The FM transmitting modulator shall have circuitry to accept both a mission baseband spectrum of 12 to 1300 kHz and an order wire spectrum of 0.3 to 12 kHz.

5.4.2.2 Input Impedances.

5.4.2.2.1 Mission Baseband. The mission baseband input impedance shall be 75 ohms, unbalanced to ground, with a minimum return loss of 20 dB (DO 26 dB) over the frequency range. It shall be a Design Objective that 130 ohms and 150 ohms, balanced to ground, also be provided as strapping options.

5.4.2.2.2 Order Wire Baseband. The orderwire baseband input impedance shall be 600 ohms, balanced to ground, with a minimum return loss of 20 dB over the frequency range. It shall be a design objective that 130 ohm, balanced, and 75 ohm, unbalanced, input impedances also be provided.

5.4.2.3 Input Signal Levels.

5.4.2.3.1 Mission Baseband. The per channel test tone level at the input to the FM modulator shall be -45 dBm (-45 dBr T.L.P.) Design Objective (DO) - the FM modulator shall have the capability to accommodate input test tone levels over a range of -15 dBm to -48 dBm for baseband interfacing the modulator at the Group Distributing Frame (GDF), Super Group Distribution Frame (SGDF) or HFDF multiplex output transmission level points. The composite power input to the FM modulator shall be equal to -30.2 dBm (+14.8 dBm0).

5.4.2.3.2 Order Wire Baseband. The per channel test tone level at the input to the FM modulator shall be -45 dBm (45 dBr T. L.P). The composite power input to the FM modulator shall be equal to -50.2 dBm (-5.2 dBm0).

5.4.3 FM Transmitter Modulator. Each FM transmitter or modulating portion of a remodulating transmitter shall possess the following operating characteristics:

a. Type of Modulation. The equipment shall employ frequency modulation of the 70 MHz intermediate frequency or transmitted RF signal.

b. Deviation Capability. The peak deviation capability of the equipment shall be at least ± 7 mHz. The ratio of carrier deviation to the highest baseband frequency shall be smoothly adjustable between the range of 0.5 and 7.0. All performance characteristics shall apply when operating at any combination of deviation ratio and peak deviation allowable under the formula for necessary bandwidth when the bandwidth is within the range of 5 mHz to 15 mHz inclusive.

c. Linearity. The modulator output frequency relationship to modulating voltage shall be linear over the linear bandwidth as defined herein, centered on the modulator nominal 70 MHz center frequency. The derivative response (dV/dF) of modulating voltage with respect to frequency deviation of the carrier shall vary less than one percent over this range.

5.4.3.1 Radio Pilot Tone. The radio pilot tone shall be located at 60 kHz in the baseband spectrum.

5.4.3.1.1 Frequency Accuracy and Stability. The radio pilot shall be set at 60 kHz ±1 Hz and maintained within ± 2 Hz from 60 kHz for any 30 day period.

5.4.3.1.2 Use of Pilot. The radio pilot will be used for radio system continuity assurance and for baseband level control within the radio equipment.

5.4.3.1.3 Filtering and Separation. Filtering of the radio pilot shall be sufficient that no measurable interference from the pilot occurs within the mission spectrum and that no frequency in the mission spectrum can cause measurable interference with the pilot and 2 or more pilots cannot interfere with each other.

5.4.3.1.4 Pilot Tone Level. The radio pilot shall be injected at a level that will produce minus 10 dBm0 equivalent deviation referenced to the mission spectrum.

5.4.4 IF Interface Point Characteristics. The output nominal impedance of the FM modulator shall be 75 ohms, unbalanced to ground.
5.4.4.1 Impedance.
5.4.4.2 IF Bandwidth. The 0.1 dB IF bandwidth of the FM transmitting modulator, shall be equal to 2.8 ($\Delta f_c + f_m$), where Δf_c is the peak carrier deviation in kHz and f_m is the highest mission band modulating frequency in kHz.

5.4.4.3 70 MHz Frequency Tolerance. The IF frequency shall have a center value of 70 MHz with a tolerance of $\pm$ 0.7 kHz.

5.4.4.4 70 MHz Harmonic Suppression. All harmonics of the FM modulator IF output shall be suppressed to at least 40 dB below the unmodulated IF output.

5.5 RF Transmitting Equipment. The RF transmitting equipment is part of the RF Terminal and consists of the RF Transmitter, filter networks, duplexing networks, switching networks and associated transmission line. The RF Transmitter may be either of the heterodyne up converter type driven by a 70 MHz signal with a separate modulator or a type that combines the function of the modulator and RF transmitter. The type selected shall be based upon the overall system performance requirements.

5.5.1 Interface Points. IF interface point is defined for test purposes as the point of interconnection between the FM transmitting modulator and the RF Transmitting equipment. The RF transmitter interface point is defined, for test purposes, as the point of interconnection between the RF transmitting equipment and antenna transmission line. All filter networks, duplexing networks, waveguide switching networks, etc., shall appear on the transmitter side of this interface point.

5.5.2 IF Interface Point Characteristics. The input nominal impedance of the RF transmitter shall be 75 ohms, unbalanced to ground.

5.5.2.1 Impedance

5.5.2.2 Input Level. The RF transmitter shall accept a frequency modulated 70 MHz carrier having any level between plus 0.8 dBm (0.3 volts, RMS) and plus 5.8 dBm (0.625 volts, RMS).

5.5.2.3 RF Bandwidth. The 0.1 dB bandwidth of the RF transmitter input signal shall be equal to 2.8 ($\Delta f_c + f_m$).

5.5.2.4 Return Loss. The input to the RF transmitter shall exhibit a return loss of 26 dB over the measurement bandwidth, centered on 70 MHz.

5.5.3 RF Transmitter. The RF transmitter shall accept a frequency modulated carrier of 70 MHz center frequency and translate it to the operational frequency, as required by system spectrum allocation. The RF transmitter shall consist of an up converter and the required power amplifier(s) to provide the RF output power as required by system design criteria. An all solid state RF Transmitter shall be a design objective. The use of the term up converter does not preclude any other method of frequency manipulation. See 5.5.3.2.

5.5.3.1 Up Converter.

5.5.3.1.1 Impedance. The up converter may have either a coaxial or waveguide output. If the output is coaxial line, the nominal impedance shall be 50 ohms, unbalanced to ground.

5.5.3.1.2 Output Level. The output level of the up converter shall be within the limits specified in Table 1 for the RF carrier frequencies listed.

5.5.3.1.3 RF Bandwidth. The output of the up converter shall have a 0.1 dB bandwidth of 2.8 ($\Delta f_c + f_m$) centered on the carrier frequency of the radio transmitter.

5.5.3.1.4 Return Loss. The up converter output shall exhibit a return loss of 26 dB or greater over the measurement bandwidth centered on the operating carrier frequency of the radio transmitter.

5.5.3.1.5 Carrier Frequency Tolerance. The up converter output carrier frequency tolerance shall be such that the overall requirements of 5.2.3 are met.

TABLE I. UP CONVERTER OUTPUT POWER LEVELS VERSUS RF FREQUENCY

TABLE IA

LOS RADIO TRANSMISSION SETS

FREQUENCY RANGE*	UP CONVERTER OUTPUT POWER	
	MINIMUM	MAXIMUM
1700 MHz to 2400 MHZ	500 mW	1 W
2400 MHz to 2700 MHz	500 mW	1 W
4400 MHz to 5000 MHz	500 mW	1 W
7125 MHz to 7750 MHz	150 mW	1 W
7750 MHz to 8400 MHz	150 mW	1 W
8400 MHz to 15000 MHz	100 mW	1 W

TABLE IB

TROPOSPHERIC SCATTER RADIO TRANSMISSION SETS

FREQUENCY RANGE *	UP CONVERTER OUTPUT POWER	
	MINIMUM	MAXIMUM
350 MHz to 450 MHz	10 W	20 W
755 MHz to 985 MHz	5 W	10 W
1700 MHz to 2400 MHz	500 mW	1 W
2400 MHz to 2700 MHz	500 mW	1 W
4400 MHz to 5000 MHz	500 mW	1 W

* Discrete block frequency assignments within these ranges.

5.5.3.2 Power Amplifier. The power amplifier, which may include an Intermediate Power Amplifier, shall accept the frequency modulated signal from the up converter and increase the power level to the extent required to meet the system design criteria. The power amplifiers may be thermionic (tubes).

5.5.3.2.1 Input Interface Characteristics.

5.5.3.2.1.1 Impedance. The input impedance of the power amplifier shall be 50 ohms, if it is coaxial. A waveguide input may be used.

5.5.3.2.1.2 Input Level. The power amplifier shall develop full rated output power when driven by the up converter minimum output as shown in Table 1. Input adjustments shall be provided to accommodate the maximum up converter output as shown in the same table.

5.5.3.2.1.3 RF Bandwidth. The 0.1 dB input bandwidth of the power amplifier shall be equal to $2.8\ (\Delta f_c + f_m)$, centered on the operating carrier frequency of the radio transmitter.

5.5.3.2.1.4 Return Loss. The input of the power amplifier, whether coaxial or waveguide, shall exhibit a return loss of 26 dB or greater over the measurement bandwidth centered on the carrier frequency of the radio transmitter.

5.5.3.2.2 Output Interface Characteristics.

5.5.3.2.2.1 Impedance. The output connector of the power amplifier shall be either coaxial or waveguide. If it is coaxial, the nominal impedance shall be 50 ohms, unbalanced to ground.

5.5.3.2.2.2 Output Level. The output level of the power amplifier shall be +37 dBm (5 watts) for LOS Radio Transmission Sets and in standard output values between plus 40 dBm to plus 77 dBm (10 watts to 50 KW) for Tropospheric Scatter Radio Transmission Sets or as required by the subsystem design criteria. Higher power may be developed in rare instances.

5.5.3.2.2.3 RF Bandwidth. The 0.1 dB output bandwidth of the power amplifier shall be equal to $2.8\ (\Delta f_c + f_m)$, centered on the operating carrier frequency of the radio transmitter.

5.5.3.2.2.4 Return Loss. The return loss, as measured toward the RF interface point, with all RF Transmitting equipment installed and the RF interface point terminated in its characteristic impedance, shall not be less than 26 dB over the measurement bandwidth, centered on the assigned frequency.

5.5.3.2.2.5 Reduced Power Operation. The power amplifier shall be capable of reduced power operation to approximately 50 percent of its normal value while still maintaining its specified noise, distortion, and spurious emission characteristics.

5.5.3.3 Duplexers. Duplexers permit simultaneous transmission and reception of signals in the same transmission line. Each duplexer shall be tunable over at least one half of the appropriate frequency band as specified in Table I. Preferably the tuning range shall include one entire band. Ferrite or other Faraday rotation devices are recommended. The duplexer shall have independent tuning for the transmit and receive frequency, but is not required to operate with a transmit and receive frequency spaced closer than the limits given in Appendix B.

5.5.3.4 RF Interface Point Characteristics.

5.5.3.4.1 Impedance. The RF Transmitting equipment shall have either coaxial or wave guide output. If a coaxial output is used, its nominal impedance shall be 50 ohms, unbalanced to ground.

5.5.3.4.2 Output Level. The RF output level shall be +37 dBm (5 watts) for LOS Radio Transmission Sets and in standard output values between 40 dBm to plus 77 dBm (10 watts to 50 KW) for Tropospheric Scatter Radio Transmission Sets or as required by the subsystem design. Higher power may be developed in rare instances.

5.5.3.4.3 RF Bandwidth. The 0.1 dB RF bandwidth of the transmitting equipment shall be equal to 2.8 $(\Delta f_c + f_m)$, centered on the operating carrier frequency of the radio transmitter.

5.5.3.4.4 Spurious Emission. All spurious emissions between $f_o \pm 5$ MHz and $f_o \pm (5 \text{ percent } f_o)$ shall be suppressed below a -50 dBm power level (DO: -60dBm), as measured at the RF interface, with Gaussian white noise loading of 14.8 dBm0 at the baseband and with full transmitter output power. If the peak deviation capability, Δf_c, is greater than ± 5 MHz, then $f_o \pm \Delta f_c$ will be used instead of $f_o \pm 5$ MHz. NOTE: MIL-STD-461 specifies the out of band emission for a bandwidth greater than $f_o \pm 5$ percent.

5.6 RF Receiving Equipment. The RF receiving equipment is part of the RF terminal equipment and consists of filter networks, duplexing and diplexing, networks, switching networks, associated RF transmission lines and RF receivers.

5.6.1 Interface Points. The RF interface point is defined for test purposes as the point of interconnection between the RF receiving equipment and the antenna- transmission lines. All filter networks, duplexing and diplexing networks, waveguide switching networks, etc., shall appear on the equipment side of this interface point. The IF interface point is defined for test purposes as the point of interconnection between the RF receiver and the FM receiving equipment.

5.6.2 RF Interface Point Characteristics

5.6.2.1 Impedance. The RF receiving equipment shall have either coaxial or waveguide input. If a coaxial input is used, its nominal impedance shall be 50 ohms, unbalanced to ground.

5.6.2.2 Input Level. The RF input level, to the RF receiving equipment, shall range from -15 dBm to -80 dBm, with a nominal value of -30 dBm for design purposes for LOS Radio Transmission sets and shall range from-40 dBm to -97 dBm, with a nominal value of -80 dBm for design purposes, for Tropospheric Scatter Radio Transmission Sets.

5.6.2.3 RF Bandwidth. The 0.1 dB RF bandwidth of the RF receiving equipment, shall be equal to 2.8 $(\Delta f_c + f_m)$, where Δf_c is the peak carrier deviation in kHz and f_m is the highest mission band modulating frequency in kHz.

5.6.2.4 RF Input Return Loss. The return loss, as measured toward the receiver from the RF interface point, and with all RF receiving equipment installed shall not be less than 32 dB over the measurement bandwidth centered on the assigned frequency (ies).

5.6.2.5 Local Oscillator Leakage. The receiver local oscillator leakage, as measured at the RF interface point, shall not exceed -85 dBm.

5.6.3 Transfer Characteristics. The unloaded voice channel output test tone signal to noise ratio of the receiver shall be linear dB for dB with respect to the RF signal input power at the RF interface point (adjusted for losses to the receiver input) from the threshold of full FM improvement to at least 35 dB above this threshold.

5.6.3.1 Noise Quieting Characteristic. The noise quieting characteristics as measured at the output of the radio receiver in the highest frequency baseband channel shall vary inversely dB for dB with an increase in the unmodulated RF signal input at the RF interface point varying from the threshold of full FM improvement to at least 35 dB above this threshold. This threshold of full FM improvement is defined as the point in radio receiver output post-detection noise quieting characteristic where the output noise power relationship to the predetection unmodulated RF signal input powers departs from a linear relationship by 1.0 dB.

5.6.3.2 Noise Figure

5.6.3.2.1 LOS Radio Transmission Sets. The receiving equipment noise figure shall not exceed 12 dB. The noise figure shall be determined by applying a noise generator input to the RF interface point and measuring the output at the IF interface point.

5.6.3.2.2 Tropospheric Scatter Radio Transmission Sets. The receiving equipment noise figure shall exhibit a noise figure of 5 dB or better. The noise figure shall be determined by applying a noise generator input to the RF interface point and measuring the output at the IF interface point.

5.6.4. Diplexers. Diplexers permit simultaneous reception of two or more signals at different frequencies in the same transmission line. Each diplexer shall be tunable over at least one half of the appropriate frequency band as specified in Table 1. Preferably the tuning range shall include one entire band. A diplexer shall have independent tuning for each operating frequency, but is not required to operate with any two simultaneous receive frequencies spaced closer than 0.5 percent of the average carrier frequencies.

5.6.5 Duplexers. Duplexers permit simultaneous transmission and reception of signals in the same transmission line. Each duplexer shall be tunable over at least one half of the appropriate frequency band as specified in Table I. Preferably the tuning range shall include one entire band. Ferrite or other Faraday rotation devices are recommended. The duplexer shall have independent tuning for the transmit and receive frequencies, but is not required to operate with a transmit and receive frequency spaced closer than the limits given in Appendix B.

5.6.6 Waveguide Switch. Solid-state waveguide switches shall be provided when required to permit both manual and automatic switching.

5.6.6.1 Isolation. The isolation between ports of the waveguide switch shall be at least 70 dB.

5.6.6.2 Switching Time. The maximum switching time shall be less than 10 microseconds.

5.6.7 RF Receiver. The RF receiver consists of that portion of the radio set that amplifies and converts the received RF signals to provide a 70 MHz IF output to the FM demodulator or heterodyne transmitter. A RF Receiver Pre-amplifier may be used in order to lower the RF receiving equipment noise figure or to offset the effects of the receiver transmission line loss by physically locating the RF pre-amplifier at the antenna. However, for purposes of performance characteristics, the pre-amplifier shall be included in the RF receiving equipment. The following requirements apply.

5.6.7.1 Impedance. The receiver shall have either coaxial or waveguide input. If a coaxial input is used, its nominal impedance shall be 50 ohms, unbalanced to ground.

5.6.7.2 Received Power Level.

5.6.7.2.1 LOS Radio Transmission Sets. The receiver shall be designed to operate with an RF signal level at the RF interface point in the range from -15 dBm to -80 dBm, with a nominal value of -30 dBm.

5.6.7.2.2 Tropospheric Scatter Radio Transmission Sets. The receiver shall be designed to operate with an RF signal level at the RF interface point in the range from -40 dBm to -97 dBm, with a nominal value of -80 dBm.

5.6.7.3 Noise Figure

5.6.7.3.1 LOS Radio Transmission Sets. The noise figure of the receiver, when the noise generator is applied directly to the receiver input terminals of the receiver or receiver pre-amplifier, shall not exceed 10 dB.

5.6.7.3.2 Tropospheric Scatter Radio Transmission Sets. The noise figure of the receiver, when the noise generator is applied directly to the receiver input terminals of the receiver or receiver pre-amplifier, shall not exceed 5 dB.

5.6.7.4 Dynamic Range. The receiver demodulation sensitivity (μ volts per megahertz) shall remain constant $\pm$ 0.5 dB for RF input signals in the range of 10 to 50 dB above the receiver threshold.

5.6.7.5 Frequency Tolerance. The receiver shall be capable of maintaining specified performance when the input RF carrier frequency varies over a range of ± 200 kHz from the assigned frequency. The decision of any receiver automatic frequency control circuitry, if used, shall insure that the receiver will not lock onto any received signal offset from the assigned RF carrier frequency by 7 MHz at an input level of -75 dBm at the RF interface in the absence of any received signal on the assigned frequency.

5.6.7.6 Pilot Tone. The pilot tone shall be detected at the receiver and monitored for level. After passing through the pilot detector, this signal shall be removed from the high frequency baseband. The residual amplitude of the pilot tone in the baseband shall not exceed -50 dBm0.

5.6.8 IF Interface Point Characteristics.

5.6.8.1 Impedance. The coaxial IF output of the receiver shall have a nominal impedance of 75 ohms, unbalanced to ground.

5.6.8.2 Output Level. The IF output level of the receiver shall be maintained at plus 5.2 dBm (0.625 volts, RMS), plus or minus 0.5 dB, for carrier input levels from 10 to 50 dB above FM detection threshold.

5.6.8.3 IF Bandwidth. The 0.1 dB IF bandwidth of the receiver shall be equal to 2.8 ($\Delta f_c + f_m$).

5.6.8.4 Output Return Loss. The IF output of the receiver shall exhibit a return loss of 26 dB or greater over the measurement bandwidth centered on the assigned frequency.

5.6.8.5 Local Oscillator Frequency Stability. The local oscillator shall be sufficiently stable that the 70 MHz output carrier is maintained within the specified limits of 0.0001 percent (1 part in 10^6) when the received carrier is at its assigned frequency.

5.7 FM Receiving Equipment. The FM receiving equipment is part of the FM Terminal equipment and consists of pre or post detection combiner(s), and FM Demodulator(s).

5.7.1 Interface Points. The IF interface point is defined for test purposes as the point of interconnection between the RF receiving equipment (IF output of the RF receiver) and the FM receiving equipment. The baseband interface point is defined for test purposes as the high frequency distribution frame point to which the FM receiving equipment is connected.

5.7.2 IF Interface Point Characteristics.

5.7.2.1 Impedance. The FM receiving equipment input impedance shall be 75 ohms, unbalanced to ground.

5.7.2.2 Input Level. The input level to the FM receiving equipment shall be plus 5.2 dBm (0.625 volts, RMS), plus or minus 0.5 dB.

5.7.2.3 IF Bandwidth. The 0.1 dB IF bandwidth of the FM receiving equipment shall be equal to 2.8 $(\Delta f_c + f_m)$.

5.7.3 Pre Detection Combiner. The pre-detection combiner shall be a completely solid state unit which combines at least four RF receiver outputs to provide a single 70 MHz output for demodulation.

5.7.3.1 Performance. The pre-detection combiner performance shall be degraded no more than 1 dB from the performance of a system equipped with a maximal ratio post detection combiner of equal order of diversity under the assumption of Rayleigh type fading with correlation coefficients of not greater than 0.5. The response time of the combiner shall be less than 100 microseconds.

5.7.3.2 Pre Detection Combiner Performance. With any two equal received input signal levels, the combined signal-to-noise (S/N) ratio and carrier to noise (C/N) ratio shall be at least 2.5 dB greater than either individual received channels.

5.7.3.3 Interface. The input-output interface characteristics shall be the same as for the IF interface to the FM receiving equipment.

5.7.4 FM Demodulator. The FM demodulator shall be a completely solid state unit which accepts a frequency modulated 70 MHz carrier and retrieves the information contained in the 0.3 to 1364 kHz baseband. The FM demodulator shall contain provisions for reducing the IF bandwidth from the 300 channel requirement by selecting passive filters for 180 channel or 120 channel or 60 channel for Tropospheric Scatter Radio Transmission Sets.

5.7.4.1 Demodulator Linearity. The FM demodulator voltage output to deviating frequency relationship shall be linear over a bandwidth defined in 4.1.2.2.3, centered on the demodulator nominal 70 MHz center frequency. The derivative of output voltage with respect to deviating frequency (dV/dF) characteristics shall vary less than one percent over this range.

5.7.5 Post Detection Combiner. The post-detection combiner shall be a completely solid state unit which adds the baseband outputs of two or more diversity receivers to provide a single baseband output.

5.7.5.1 Performance. The post-detection combiner performance shall be generally equivalent to that resulting from a system equipped with a maximal ratio post-detection combiner of equal order of diversity under the assumption of Rayleigh fading with correlation coefficients of not greater than 0.5. The response time of the combiner shall be less than 100 microseconds.

5.7.5.2 Post Detection Combiner S/N Ratio. With two equal received input signal levels, the combined S/N ratio shall be at least 2.5 dB greater than either individual received channels.

5.7.6 Baseband Interface Characteristics.

5.7.6.1 Baseband Output Spectrums. The FM receiving equipment shall have circuitry to provide both a mission baseband spectrum of 12 to 1300 kHz and an order wire spectrum of 0.3 to 12 kHz outputs.

5.7.6.2 Output Impedances.

5.7.6.2.1 Mission Baseband. The mission baseband output impedance shall be 75 ohms, unbalanced to ground, with a minimum return loss of 20 dB (DO 26 dB) over the frequency range. It shall be a design objective that 130 ohms and 150 ohms, balanced to ground, also be provided as strapping options.

5.7.6.2.2 Order Wire Baseband. The order wire baseband output impedance shall be 600 ohms, balanced to ground, with a minimum return loss of 20 dB over the frequency range. It shall be a design objective that 130 ohm, balanced, and 75 ohm, unbalanced, input impedances also be provided.

5.7.6.3 Output Signal Levels.

5.7.6.3.1 Mission Baseband. The per channel test tone level at the output of the FM Demodulator shall be -15 dBm $\pm$ 0.5 dB (-15 dBr Transmission Level Point (T.L.P.)). (DO - The FM demodulator shall have the capability to accommodate output test tone levels over a range of -9 dBm to -31 dBm; for interfacing with the Frequency Division Multiplex (FDM) equipment at the HFDF, SGDF or GDF interface transmission level points.) The composite power output from the FM demodulator shall be equal to -0.2 dBm (+13.8 dBm0).

5.7.6.3.2 Order Wire Baseband. The per channel test tone level at the output of the FM Demodulator shall be -15 dBm ± 1 dB (-15 dB T.L.P.). The composite power output from the FM Demodulator shall be equal to -20.2 dBm (-5.2 dBm0).

5.8 IF Heterodyne Repeating. The transfer function parameters for LOS Radio Transmission Sets and for Tropospheric Radio Transmission Sets are defined from the IF injection interface input point of the transmitter to the IF signal output at the receiving IF interface point with the radio equipment operating at the same frequency and connected, in a non-diversity configuration, at the RF interface points through appropriate attenuators. The transmitter shall be operated at full power and the received signal level shall be adjusted to a level of -30 dBm for LOS Radio Transmission sets and at -80 dBm for Tropospheric Scatter Radio Transmission Sets. The overall performance between the IF interface points shall meet the following minimum requirements.

NOTE: The above equipment configuration is for ease of measurements and available instrumentation. In actual circuits, for IF Heterodyne Repeating, the Received IF output is connected to the IF injection point of the transmitter.

5.8.1 Frequency Response. The maximum amplitude variation between frequencies of equal power fed to the RF transmitter input and measured at the RF receiver output shall not exceed ±0.1 dB across the measurement band.

5.8.2 Envelope Delay Distortion. Envelope delay distortion shall not exceed 2 nanoseconds over the linearity bandwidth. Variable equalizers shall be provided in the transmitter and in the receiver to permit adjustment of delay.

5.8.3 IF Carrier Resupply. A 70 MHz IF carrier resupply unit and appropriate control circuitry shall be provided with each RF transmitter set to provide a carrier for restoring the order wire and alarm signals to the RF transmitters of heterodyne repeaters during periods of system receiver carrier failure. The unit shall be activated within 1 millisecond from the time the system carrier fails. The carrier supply oscillator unit shall have a frequency tolerance of ± 0.07 kHz from 70 MHz.

5.8.4 IF Diversity Switch. When IF diversity switching is employed the heterodyne radio terminal shall be equipped with an IF diversity switch for each direction of transmission. The IF diversity switch shall monitor the received signal and the continuity pilot signal outputs of the two diversity RF receivers and select the output for application to the associated RF transmitter at 70 MHz.

5.8.4.1 Transfer Level. The diversity switch shall transfer to the output of the lower noise RF receiver whenever there is a noise difference of 6 dB or more between the outputs of the diversity receivers.

5.8.4.2 Switching Time. The baseband signal interruption time due to switching shall not exceed 10 µs. (DO 200 ns).

5.8.5 Frequency Tolerance. The frequency tolerance of the RF transmitter signal shall not exceed 0.0001 percent plus 0.07 kHz.

5.8.6 Drop-Insert Capability. All heterodyne repeaters shall have a capability of dropping and inserting the auxiliary baseband between 0.3 and 12 kHz in both directions.

5.9 Monitoring and Alarms. The radio set shall be provided with circuitry to monitor the following functions and provide an alarm in the event of any failure. The alarm function provided shall include the illumination of visible alarm indicator lamps on the front of the equipment and the operation of normally open dry relay contacts for connection to external alarm monitoring circuitry.

a. Transmitter Pilot. The continuity pilot shall be monitored for continuity at the FM transmitter output. In systems employing direct modulation of reflex klystrons, the pilot shall be monitored at the RF transmitter output.

b. Transmitter Output Power. Transmitter output power level shall be monitored to detect any decrease below a preset, adjustable level.

c. Received Pilot. The continuity pilot tone shall be monitored for continuity at the receiver.

d. Receiver Noise. The receiver noise level shall be monitored to detect any increase above a preset, adjustable level.

e. Combiner Action. Diversity combiner action shall be monitored to detect the muting of either receiver.

f. Received RF Signal Level. The received RF signal level shall be monitored to detect any decrease below a preset, adjustable level.

g. IF Carrier Resupply. The IF carrier resupply shall be monitored to detect failure of the 70 MHz input carrier to the radio transmitter.

5.10 Panel Meters and Test Points. Test points and metering circuits shall be provided for monitoring the performance of the radio equipment. Provision shall be made for access to all circuit points required for operation maintenance, or alignment. The parameters to be metered shall include, but shall not be limited to, the following.

a. Transmitter output power.

b. Transmitter automatic frequency control voltages (when used).

c. Transmitter final power amplifier voltages/currents.

d. Receiver automatic frequency control voltages (when used).

e. Receiver automatic gain control voltage.

f. Receiver mixer crystal currents.

g. Receiver local oscillator voltages/currents.

h. Direct current supply voltages.

i. Primary power source voltage.

5.11 Antenna Subsystem. The antenna subsystem consists of the transmission line and the antenna which converts the electromagnetic signal from a guided wave to a radiated wave and includes the antenna beam aiming devices and the supports for the antenna. Pressurization shall also be included. The antenna shall consist of a radiating structure capable of launching and receiving both vertically and horizontally polarized waves.

5.11.1 Interface Point. The RF interface point is defined for test purposes as the point of interconnection between the RF Terminal equipment (RF Transmitting equipment and RF Receiving equipment) and the antenna subsystem.

5.11.2 RF Interface Point Characteristics.

5.11.2.1 Impedance. The transmission line shall be either coaxial or wave guide. If coaxial lines are used, the nominal impedance shall be 50 ohms, unbalanced to ground.

5.11.2.2 Return Loss. The return loss of the installed antenna and transmission line subsystem, measured at RF interface, shall not be less than 26 dB (VSWR of 1.06:1) over the design frequency band.

5.11.3 Antenna Characteristics.

5.11.3.1 LOS Radio Transmission Antennas.

5.11.3.1.1 Side Lobes. All side lobes shall be at least 25 dB below the main lobe.

5.11.3.1.2 Wide Angle Radiation. The ratio of the intensity of the largest minor lobe (which is more than $\pm 45°$, but less than $\pm$ 110° from the center of the main lobe) shall not be greater than -45 dB.

5.11.3.1.3 Front-to-Back Ratio. The ratio of the intensity of the main lobe to the intensity of the largest lobe occurring between $\pm$ 110° and 180° from the center of the main lobe shall be at least 50 dB.

5.11.3.1.4 Cross-Polarization Discrimination. Antennas equipped with dual polarization feed shall have a minimum cross-polarization discrimination of 30 dB between vertically and horizontally polarized waves of the same frequency when measured at the antenna input.

5.11.3.2 Tropospheric Scatter Radio Transmission Antennas.

5.11.3.2.1 Gain. The antenna shall exhibit a gain, referred to the input port, of not more than 1 dB below the gain calculated according to the following formula for parabolic antenna with an aperture efficiency of 56 percent:

for dish diameters greater than 28.5 ft:

$$G = 20 \log D\ (M) + 20 \log F\ (MHz) - 42.10\ dB.$$

or $$G = 20 \log D\ (ft) + 20 \log F\ (MHz) - 52.42\ dB.$$

for dish diameters less than 28.5 ft:

$$G=23.3 \log D\ (M) + 23.3 \log F\ (MHz) -55.6\ dB$$

or $$G=23.3 \log D\ (ft) +23.3 \log F\ (MHz) -63\ dB.$$

This shall not preclude higher aperture efficiency or other methods of beam forming.

5.11.3.2.2 Cross-Polarization Discrimination. Antennas equipped with dual polarization feed shall have a minimum cross-polarization discrimination of 30 dB between vertically and horizontally polarized waves of the same frequency when measured at the antenna input.

5.11.4 Transmission Line Pressure Integrity. The transmission lines and associated gastight barriers shall be installed such that the flow rate does not exceed one-tenth cubic foot per hour with a nominal feed pressure of 0.5 psig.

Custodians:
Army - SC
Navy - EC
Air Force - 17
DCA - DC

Review Activities:
Army - SC, EL, CE, ME
Navy - AS, YD, MC, CG, SH
Air Force - 1, 11, 13, 71, 80, 89

User Activities
Army
Navy - OS
Air Force

Preparing activity:
Air Force - 17

Project SLHC-0011

Other Interest:
JCS-J6
NSA-NS

APPENDIX A

10.0 Pre-Emphasis - De-Emphasis Networks. When pre-emphasis or de-emphasis is used in FM line-of-sight radio relay systems or in FM Tropospheric Scatter Radio systems in conjunction with Frequency Division multiplex, the same normalized attenuation-frequency network characteristics shall be used for all systems up to and including 300 channels.

10.1 Emphasis Characteristics. The preferred emphasis characteristics and insertion loss of the network shall be obtained by use of the following formula:

$$20 \log_{10} \frac{e\ in}{e\ out} = 10 \log_{10} \left[1 + \frac{6.90}{1 + \frac{5.25}{\left(\frac{f_r}{f_{max}} \quad \frac{f_{max}}{f_r} \right)}} \right] \text{dB}$$

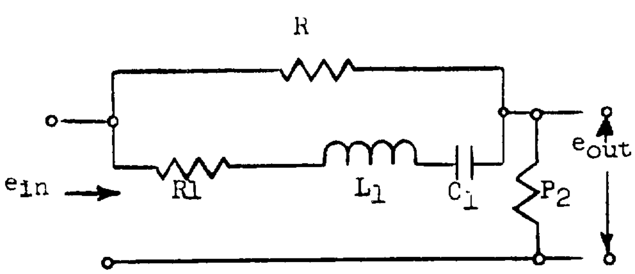
where e in + input voltage

e out = output voltage

f_r = (The resonant frequency of the network)
= 1.25 f max

f_{max} = The highest baseband frequency used.

10.2 Pre-Emphasis Network. The pre-emphasis network shall be derived from the following formula:



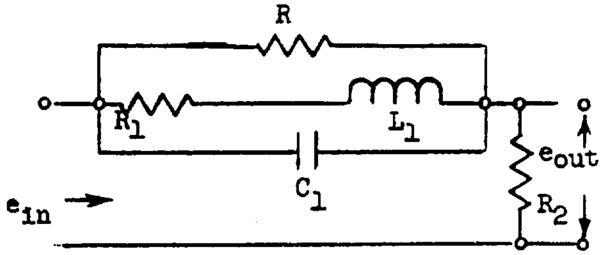
$R = 1.81P_2$

$R_1 \quad 0.01R_2 \quad 0 \quad f_r$

$$\sqrt{\frac{L_1}{C_1}} = 0.79R_2$$

$$f_r = 1.25\ f\ max = \frac{1}{2\pi} \sqrt{\frac{1}{L_1 \quad C_1}}$$

10.3 De-Emphasis Network. The de-emphasis network shall be derived from the following formula:



$R = 1.81R_2$

$R_1 \;\; 0.02R_2 \qquad f_r$

$\sqrt{\frac{L_1}{C_1}} = 1.47R_2$

$f_r = 1.25\ f\ max = \frac{1}{2\pi}\sqrt{\frac{1}{L_1 \ C_1}}$

NOTE: Tolerances both networks

Resistors $\pm$ 1 percent

Capacitors $\pm$ 0.5 percent

f_r $\pm$ 0.5 percent (L resonating with C).

10.4 Normalized Pre and De-emphasis Curve. The normalized curve for pre and de-emphasis shall be as shown in Figure 1.

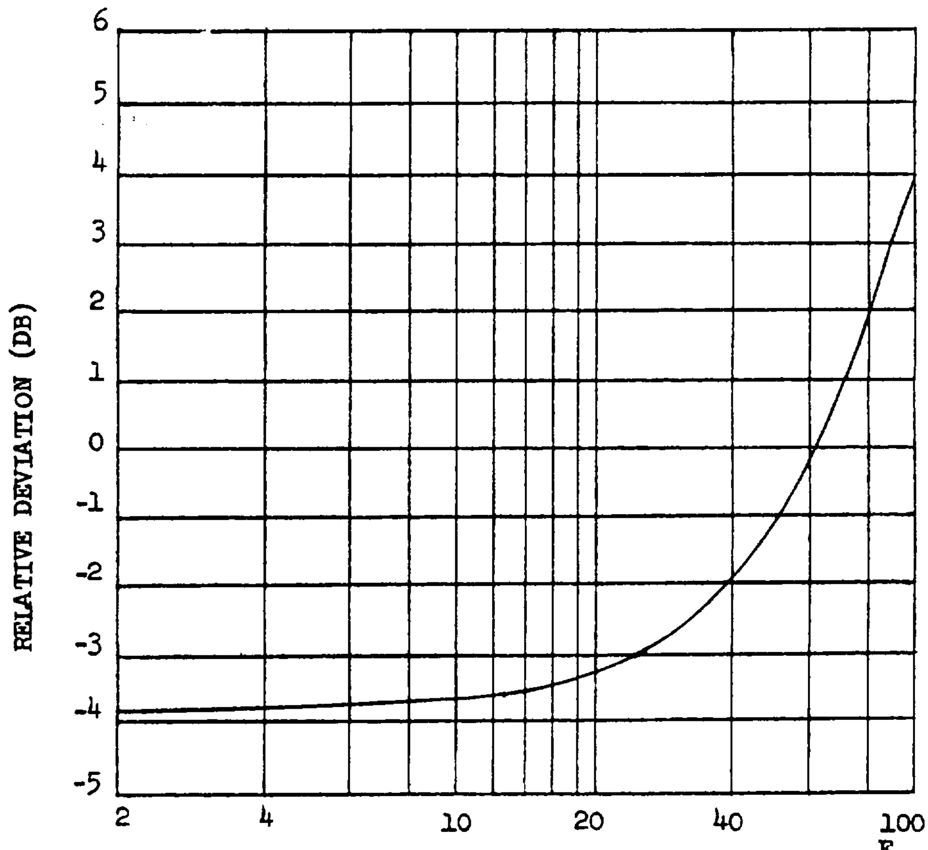


Figure 1. Normalized pre and de-emphasis curve

APPENDIX B

20.0 Additional Design Consideration

20.1 Multiplexer Noise. Multiplexer noise shall be determined by the known characteristics of the equipment being procured. In any case, the noise contributions for the various translations and filtering shall not exceed those for multiplex noise of voice bandwidth links specified in MIL-STD-188-100 for Common Long Haul and Tactical Communication System Technical Standards and reproduced in Table I.

TABLE I

FDM MULTIPLEXER NOISE

EQUIPMENT	Individual FDM Equipment Noise Allocation	
	Idle Noise pWp0	Loaded Noise pWp0
Channel Translation (1 set)	10	31
Group Translation (1 set) includes regulator	40	50
Supergroup Translation (1 set) includes regulator	25	50
Through Group Equipment	N/A	10
Through Supergroup Equipment	25	50
Total for Multiplex Terminal (no through equipment)	75	131

20.2 Multiplexer Bandwidths. Multiplexer bandwidths are shown in Table II.

TABLE II

MULTIPLEXER BANDWIDTHS:

Multiplexer Bandwidths:

Nominal 4KHz Channel	Bandwidth
60 channel operation	12 KHz to 300 KHz
120 channel operation	12 KHz to 552 KHz
180 channel operation	12 KHz to 804 KHz
240 channel operation	12 KHz to 1052 KHz
300 channel operation	12 KHz to 1300 KHz

NOTES: 1. Includes a Group A multiplexer, (12 ea nominal 4 KHz channels) bandwidth of 12 KHz to 60 KHz. See MIL-STD-188-311 for FDM multiplexer characteristics.

2. The required FM bandwidth, to support the multiplexer bandwidths, shall be greater, i.e. for 300 channel operation, the required FM bandwidth is 1364 KHz.

20.3 RF Plan. While no specific RF plan for each band is provided as a mandatory requirement of this standard, certain guides to be followed in frequency planning are included herein.

20.3.1 LOS Radio Transmission Systems.

20.3.1.1 The frequency band under consideration shall be divided into two equal segments. At a given station all of the transmit frequencies shall be in one of the two segments (upper or lower) and all of the receive frequencies in the other segment. At a given station, transmit frequencies shall be excluded from the regions located 35 MHz plus or minus 1/4 of the 3 dB IF bandwidth, and 70 MHz plus or minus 1/2 of the 3-dB IF bandwidth on either side of another transmit frequency. (See Figure 1.)

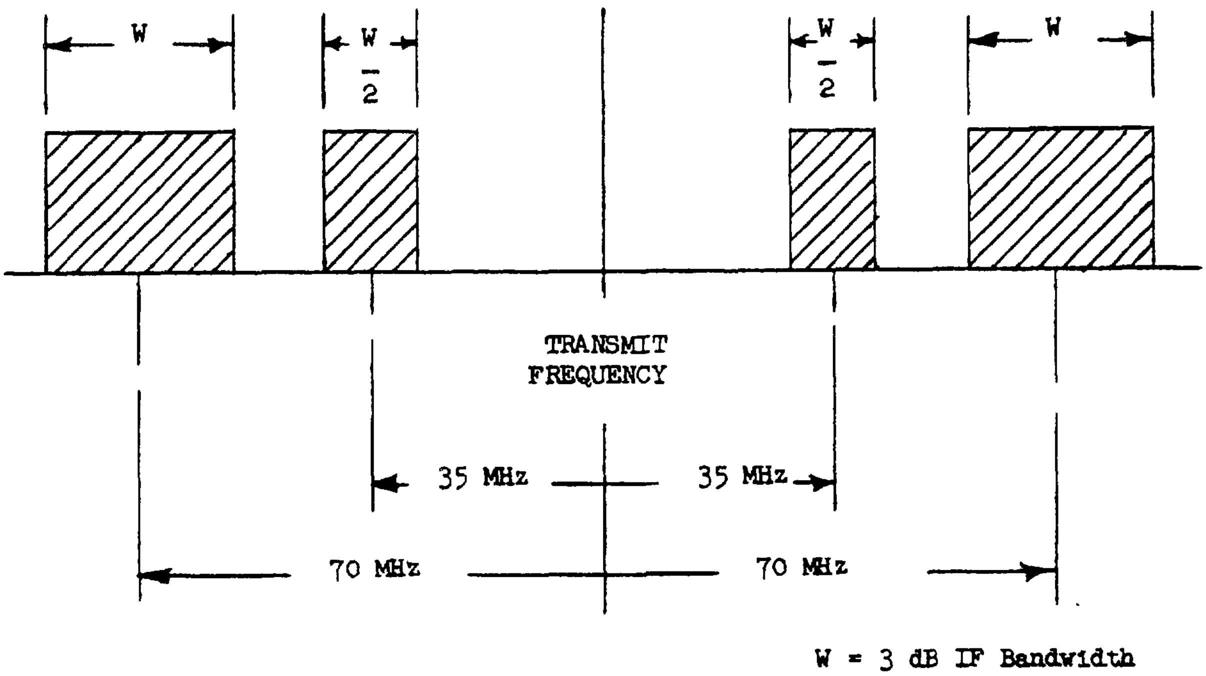


Figure 1. Forbidden Regions for Other Transmitters at the Same Station (LOS)

20.3.1.2 At a given station, transmit frequencies shall be exluded from the regions located within plus or minus 40 MHz of any receive frequency and from the regions located 140 MHz plus or minus 1/2 of the 3-dB (IF) bandwidth on either side of any receive frequency (See Figure 2). At certain stations, good system design constraints may dictate a more restrictive RF plan.

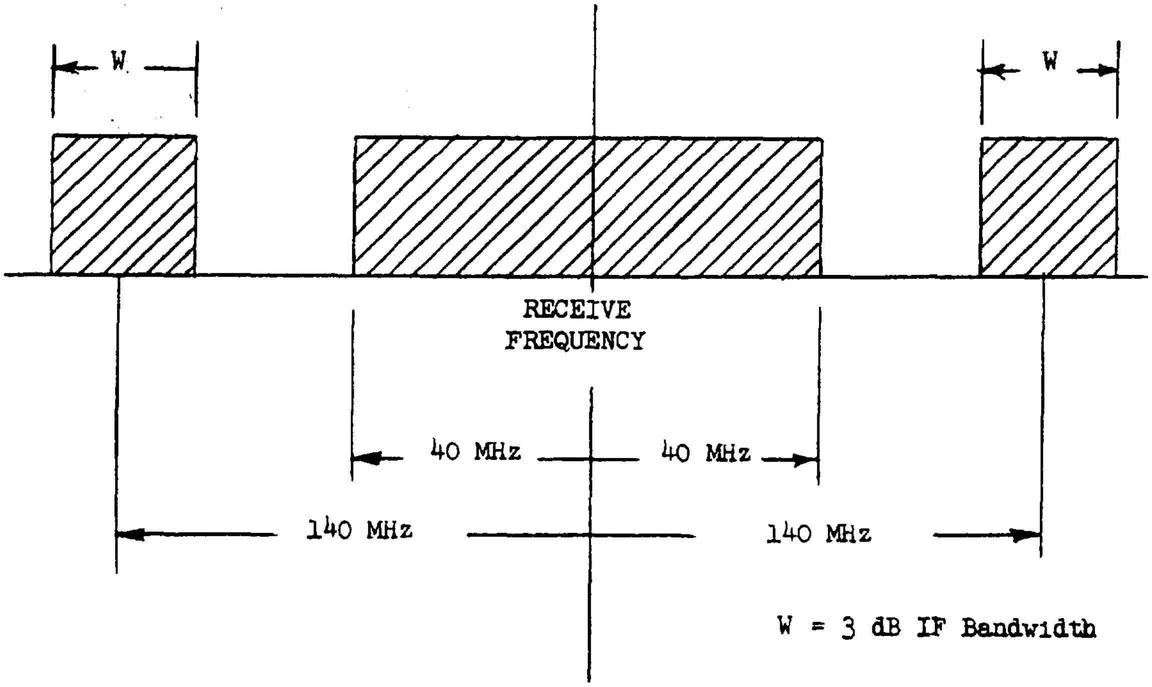


Figure 2. Forbidden Regions for Transmitters Relative to Receivers at a Station (LOS)

20.3.1.3 The RF plan shall be selected such that the value of unwanted signals from any source as measured at the receiver intermediate frequency (IF) interface shall be below the inherent noise level of the receiver.

20.3.2 Tropospheric Scatter Radio Transmission Systems.

20.3.2.1 The transmit to receive frequency separation where the transmitter and receiver share a common antenna shall be greater than that given in Table III.

TABLE III. TRANSMIT-TO-RECEIVE FREQUENCY SEPARATION ON A COMMON ANTENNA

FREQUENCY BAND	NOMINAL TRANSMITTER POWER	MINIMUM FREQUENCY SEPARATION (MHz)
350 to 450 MHz	10 watts (40 dBm)	40
	100 watts (50 dBm)	40
	1 KW (60 dBm)	40
	5 KW (67 dBm)	40
	10 KW (70 dBm)	50
	50 KW (77 dBm)	50
755 to 985 MHz	10 watts	80
	100 watts	80
	1 KW	80
	5 KW	100
	10 KW	100
	50 KW	100
All bands between 1700 MHz and 4400 MHz	10 watts	100
	100 watts	100
	1 KW	100
	5 KW	150
	10 KW	150
All bands between 4400 MHz and 5000 MHz	10 watts	150
	100 watts	150
	1 KW	200
	5 KW	200
	10 KW	200

20.3.2.2 The frequency band under consideration shall be divided into two equal segments. At a given station all of the transmit frequencies shall be in one of the two segments (upper or lower) and all of the receive frequencies in the other segment. At a given station, transmit frequencies shall be excluded from the regions located 35 MHz plus or minus 1/4 of the 3-db IF bandwidth, and 70 MHz plus or minus 1/2 of the 3-dB IF bandwidth on either side of another transmit frequency. (See Figure 3.)

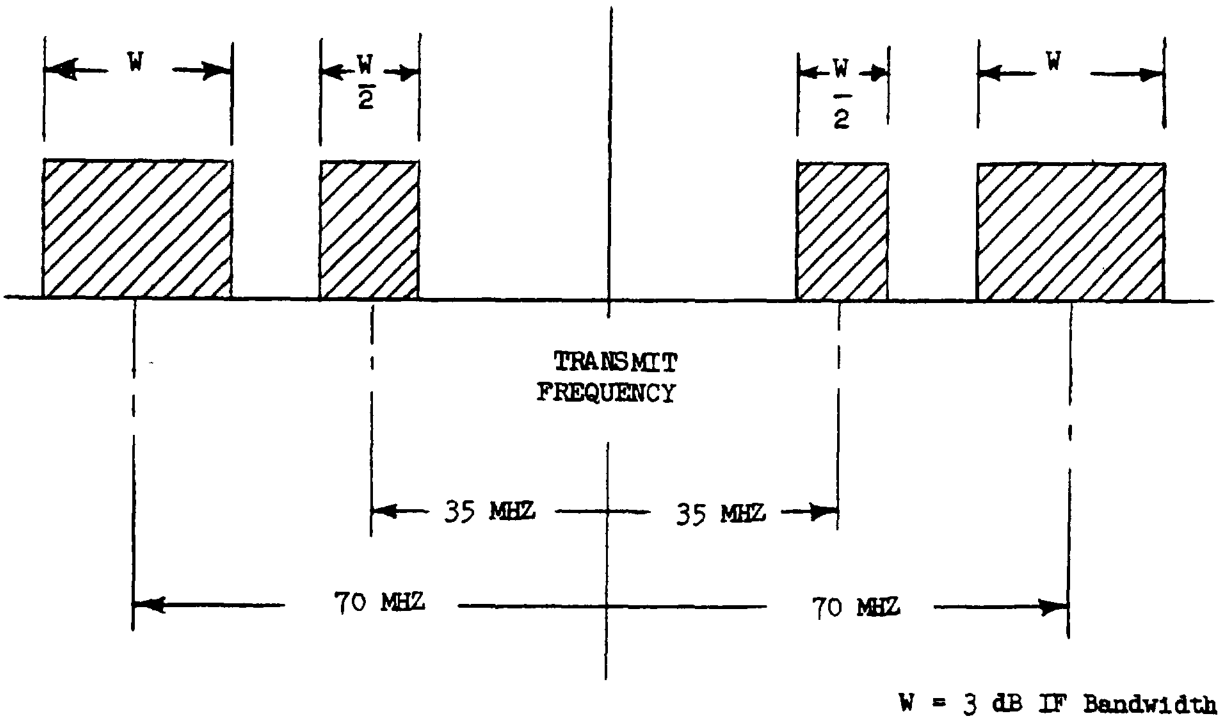


Figure 3. Forbidden Regions for Other Transmitters at the Same Station (Tropospheric Scatter)

20.3.2.3 At a given station, transmit frequencies shall be excluded from the regions located within plus or minus 40 MHz of any receive frequency and from the regions located 140 MHz plus or minus 1/2 of the 3-dB (IF) bandwidth on either side of any receive frequency (See Figure 4). At certain stations, good system design constraints may dictate a more restrictive RF plan.

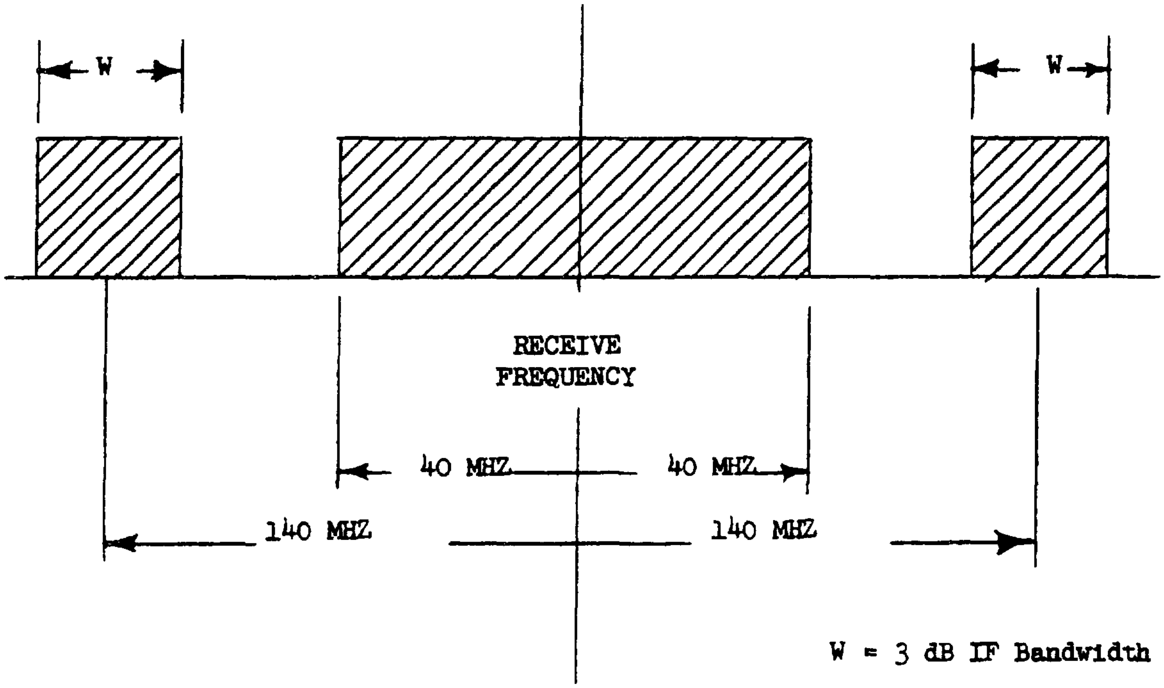


Figure 4. Forbidden Regions for Transmitters Relative to Receivers at A Station (Tropospheric Scatter)

20.3.2.4 The RF plan shall be selected such that the value of unwanted signals from any source as measured at the receiver intermediate frequency (IF) interface shall be below the inherent noise level of the receiver.

20.4 Electromagnetic Compatibility Engineering. The equipment siting must be based upon a study of the existing environment. This study normally encompasses the susceptibility and radiation characteristics of the equipment as well as the existing and potentially interferring signal levels that may be present. Some degree of EMC integrity beyond that actually required should be considered for future requirements.

20.5 Radio Regulations. The use of the frequency spectrum is regulated by international agreements embodied in "Radio Regulations, General Secretariat of the International Telecommunications Union," Geneva, 1959. These regulations are further qualified at the national level through Government (Interdepartment Radio Advisory Committee, IRAC) and military agencies (Joint Chiefs of Staff, JCS, and Military Communication Electronics Board, MCEB).

a. For normal peacetime use, the choice and performance of equipment, as well as frequencies and emissions of any radio system, shall satisfy the provision of those regulations. Adequate familiarity with the latter is, therefore, required of designers and users of radio systems.

b. Military frequency planning, including joint function frequency allocation tables, is established as a joint military action area under the MCEB. Final approval of frequency bands, operating modes and equipment characteristics rests with the MCEB.

INSTRUCTIONS: In a continuing effort to make our standardization documents better, the DoD provides this form for use in submitting comments and suggestions for improvements. All users of military standardization documents are invited to provide suggestions. This form may be detached, folded along the lines indicated, taped along the loose edge *(DO NOT STAPLE)*, and mailed. In block 5, be as specific as possible about particular problem areas such as wording which required interpretation, was too rigid, restrictive, loose, ambiguous, or was incompatible, and give proposed wording changes which would alleviate the problems. Enter in block 6 any remarks not related to a specific paragraph of the document. If block 7 is filled out, an acknowledgement will be mailed to you within 30 days to let you know that your comments were received and are being considered.

NOTE: This form may not be used to request copies of documents, nor to request waivers, deviations, or clarification of specification requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document*(s)* or to amend contractual requirements.

(Fold along this line)

(Fold along this line)

DEPARTMENT OF THE AIR FORCE

NO POSTAGE NECESSARY IF MAILED IN THE UNITED STATES

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE $300

BUSINESS REPLY MAIL
FIRST CLASS PERMIT NO. 73236 WASHINGTON D. C.

POSTAGE WILL BE PAID BY THE DEPARTMENT OF THE AIR FORCE

RADC (RBRC)
Griffiss AFB, New York 13441

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER

2. DOCUMENT TITLE

3a. NAME OF SUBMITTING ORGANIZATION

4. TYPE OF ORGANIZATION *(Mark one)*

☐ VENDOR

☐ USER

☐ MANUFACTURER

☐ OTHER *(Specify)*: ______

b. ADDRESS *(Street, City, State, ZIP Code)*

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional

b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional

c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional

8. DATE OF SUBMISSION *(YYMMDD)*

DD FORM 1426, 82 MAR

PREVIOUS EDITION IS OBSOLETE.