TN
89/72

COPY 1

FAA WJH Technical Center
00093210

Equipment Feasibility Study: Very High Frequency Communication Equipment (136-137 Megahertz)

SEP 17 1990
TECHNICAL CENTER LIBRARY
ATLANTIC CITY, N.J. 08405

James Aviles
Ed Lind
Larry McMillen

June 1990

DOT/FAA/CT-TN89/72

Document is on file at the Technical Center Library, Atlantic City International Airport, N.J. 08405

U.S. Department of Transportation
Federal Aviation Administration

Technical Center
Atlantic City International Airport, N.J. 08405

technical note techn

NOTICE

This document is disseminated under the sponsorship of the U.S. Department of Transportation in the interest of information exchange. The United States Government assumes no liability for the contents or use thereof.

The United States Government does not endorse products or manufacturers. Trade or manufacturers' names appear herein solely because they are considered essential to the objective of this report.

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
DOT/FAA/CT-TN89/72		

4. Title and Subtitle	5. Report Date
EQUIPMENT FEASIBILITY STUDY: VERY HIGH FREQUENCY COMMUNICATION EQUIPMENT (136-137 MEGAHERTZ)	June 1990
	6. Performing Organization Code
7. Author(s) James Aviles, Ed Lind, Larry McMillen	8. Performing Organization Report No. DOT/FAA/CT-TN89/72
9. Performing Organization Name and Address Federal Aviation Administration Technical Center Atlantic City International Airport, New Jersey 08405	10. Work Unit No. (TRAIS)
	11. Contract or Grant No.
12. Sponsoring Agency Name and Address U.S. Department of Transportation Federal Aviation Administration Technical Center Atlantic City International Airport, New Jersey 08405	13. Type of Report and Period Covered Technical Note
	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

This study investigated the feasibility of utilizing existing ground and airborne very high frequency (VHF) voice communication equipment for operation in the frequency range of 136-137 megahertz (MHz).

Existing general aviation databases were utilized and avionic transceiver manufacturers consulted in an effort to estimate the numbers and capabilities of existing VHF communication transceivers to operate or be modified to operate up to 137 MHz. Information gathered for a sample of VHF communication transceivers manufactured over a certain time period was statistically projected to the entire general aviation population. Results indicate that:

1. Sixty-eight percent of the actual VHF communication transceivers will not cover the new band 136-137 MHz.

2. Thirty-two percent of the actual VHF communication transceivers will cover the new band 136-137 MHz.

17. Key Words	18. Distribution Statement
VHF Communication Transceivers General Aviation (GA) Air Carrier (AC)	Document is on file at the Technical Center Library, Atlantic City International Airport, NJ 08405

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	19	

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

TABLE OF CONTENTS

	Page
INTRODUCTION	1
Purpose	1
Background	1
Objectives	1
DISCUSSION	1
GROUND EQUIPMENT TEST	2
AIRBORNE EQUIPMENT SURVEY	2
Air Carrier	2
General Aviation	3
RESULTS	3
CONCLUSIONS	4
REFERENCE	4
APPENDIX	

INTRODUCTION

PURPOSE.

The purpose of this study was to investigate the feasibility of utilizing existing ground and airborne very high frequency (VHF) voice communication equipment for operation in the frequency range 136-137 megahertz (MHz).

BACKGROUND.

The frequency band, 118-136 MHz is presently used for air traffic control (ATC) communication, aeronautical utility, and mobile stations. As of January 1, 1990, the frequency band, 136-137 MHz will also become available.

The Spectrum Engineering Division, ASM-500, requested that a study be performed to determine the feasibility of utilizing existing communication equipments to cover the additional 1 MHz. There is concern that much of the existing equipment, particularly general aviation avionics, will not be able to utilize the additional spectrum.

OBJECTIVES.

1. Verify that the Federal Aviation Administration (FAA) VHF ground communication equipment will operate satisfactorily in the new spectrum.

2. Determine the approximate percentage of existing air carrier VHF communication equipment which presently covers the additional spectrum or can be modified to do so.

3. Determine the approximate percentage of existing general aviation VHF communication equipment which presently covers the additional spectrum or can be modified to do so.

DISCUSSION

The FAA utilizes standard VHF communication ground equipment manufactured by International Telephone and Telegraph (ITT). The VHF Transmitter, AN/GRT-21; VHF Linear Amplifier, AM-6154/GRT-21; and VHF Receiver, AN/GRR-23, were built to operate in the frequency range of 116-150 MHz. However, the FAA has not operated the ground equipment above 136 MHz due to the present band assignment (118-136 MHz). Consequently, the performance of the VHF ground equipment was verified at 137 MHz.

The avionics equipment used for VHF voice communications is manufactured by numerous companies to varying specifications. Some of the existing avionics, particularly general aviation, is over 20 years old. The spectrum of avionics equipment ranges from state-of-the-art 760-channel VHF equipment (118-137 MHz, 25 kHz spacing) found on some air carrier aircraft to antiquated 360-channel equipment (118-136 MHz, 50 kHz spacing) found on many general aviation aircraft. It is believed that all of the air carrier VHF radios are 720 channels or more while there are many general aviation radios that are only 360 channels.

Because of the numerous manufacturers and many different models of airborne VHF communication radios that are in service today, it was impractical to determine the capabilities of each. Consequently, a method was sought whereby a reasonable estimate could be made as to the percentage of both air carrier and general aviation avionics equipment that could operate in the new band or be modified to do so.

The approach taken was to determine the major manufacturers of air carrier avionics equipment and the major manufacturers of general aviation avionics equipment. These manufacturers were then contacted by telephone and asked to identify the models of radios they had produced in large quantities over the last 20 years that were capable of at least 720-channel operation. After the most popular models were identified, the manufacturers were further queried as to which of them were 760 channel or could be modified to cover 760 channels.

From the above information, percentages were determined of the total most popular radios manufactured over the last 20 years that were initially 760 channels or can be modified to cover 760 channels. For example, percentages were determined that indicate the total of the most popular radios manufactured over the last 20 years that can utilize the new band segment. These percentages were then extended to the present air carrier and general aviation fleet that have VHF communication capability.

GROUND EQUIPMENT TEST

Two randomly selected pairs of AN/GRT-21 VHF air/ground transmitters and AN/GRR-23 VHF receivers and one AM-6154/GRT-21 linear amplifier were tested at the FAA Technical Center. Before testing, the equipment was tuned to 137 MHz (the highest frequency in the new band). ITT frequency synthesizers were used in the transmitters and receivers because crystals for 137 MHz were not readily available.

The ground equipment tests results were forwarded to ASM-500 as an attachment to ACN-210's memorandum dated January 26, 1989. A copy of the memorandum and the ground equipment test results are in the appendix.

AIRBORNE EQUIPMENT SURVEY

AIR CARRIER.

Two major manufacturers were contacted for the air carrier equipment survey. These companies were queried as to their most popular 720/760-channel air carrier type radios produced over the last 20 years. All air carrier type VHF radios are capable of at least 720-channel operation. Consequently, 360-channel radios were of no interest.

The two companies reported that approximately 26,700 air carrier type radios had been produced in only five different models. All of these radios are capable of utilizing the new band or can be modified to do so.

GENERAL AVIATION.

Six major manufacturers were contacted for the general aviation equipment survey. These companies were queried as to their most popular general aviation type radios produced over the last 20 years.

Responses from the six companies indicated that almost all 360-channel radios cannot be modified for 760-channel operation. The companies further reported that approximately 272,000 general aviation type radios (720/760 channels) had been produced in 25 different models. Approximately 52 percent of these radios are capable of utilizing the new band or can be modified to do so.

RESULTS

The results of the ground equipment test, included in the appendix, indicate that the FAA VHF ground communication equipment will perform per specifications in the new band segment.

The information verbally received from the two major manufacturers of air carrier type VHF radios indicates that almost all air carrier VHF radios can utilize the new band spectrum or be modified to do so.

According to the "General Aviation Activity and Avionics Survey, Annual Summary Report 1987 Data," FAA-MS-88-5, November 1988 (pages 1-18), there are approximately 93,000 general aviation aircraft that are equipped with 360-channel or less VHF communication radios and 149,000 general aviation aircraft that are equipped with 720-channel or more VHF radios (reference 3). Consequently, 39 percent (93,000/(93,000 + 149,00)) of the existing general aviation fleet cannot utilize the new band spectrum because they are equipped with 360-channel radios. Only a portion of the remaining 61 percent can utilize the new band spectrum because not all 720-channel radios can be modified for 760-channel operation.

Results of the general aviation survey indicated that 52 percent of the most popular radios (720/760 channels) produced over the last 20 years are capable of utilizing the new band spectrum or can be modified to do so. In order to arrive at an estimate of how many existing general aviation radios can utilize the new band spectrum, the 52 percent was extended to the existing fleet. Consequently, it is estimated that 32 percent (.52 x .61) can utilize the new band spectrum or be modified to do so.

CONCLUSIONS

Based on the survey techniques used, the conclusions are as follows:

1. The FAA VHF ground equipment will perform per specifications in the new band specturm.

2. It is believed that almost all of the existing air carrier type airborne VHF radios can utilize the new band spectrum or be modified to do so.

3. Approximately 32 percent of the existing general aviation VHF airborne radios can utilize the new band spectrum or be modified to do so.

REFERENCE

1. General Aviation Activity and Avionics Survey, FAA Annual Summary Report 1987 Data, Report No. FAA-MS-88-5, November 1988.

APPENDIX A

This appendix contains the results of previous tests performed on randomly selected FAA VHF ground communication equipment.

U.S. Department of Transportation
Federal Aviation Administration

Memorandum

Subject: ACTION: Utilization of Communication Band Extension

Date: JAN 26 1989

From: Manager, Navigation, Communications, Spectrum Branch, ACN-210

Reply to Attn. of:

To: Manager, Frequency Engineering Program, ASM-520

The frequency band 136-137 Megahertz (Mhz.) will become available to the aeronautical mobile service on January 1, 1990.

Existing Federal Aviation Administration (FAA) ground receivers/transmitters/linear amplifiers were manufactured for the FAA by the International Telephone and Telegraph Corporation (ITT) and were designed to operate between 116 and 150 Mhz. Attached are excerpts from the appropriate specifications that state that the ground equipment will operate between 116 and 150 Mhz.

Although the ground equipment is designed for operation between 116 and 150 Mhz., these equipments have never been operated above 136 Mhz. because the air/ground voice communications band is 118-136 Mhz. Even though the ground equipment should perform satisfactorily up to 137 Mhz., according to specifications, it was felt that the equipment should be tuned to 137 Mhz. and the operation verified.

Two randomly selected pairs of AN/GRT-21 Very High Frequency (VHF) air/ground transmitters and AN/GRR VHF receivers and one AM-615/GRT-21 linear amplifier were tested at the Consolidated/Collocated Experimental VORTAC, Building 196, at the Technical Center. We presently have only one linear amplifier and it was used on both transmitters. The equipment was tested at 137 Mhz. (the highest frequency in the new band). Both sets of equipment were tuned to this frequency using "optional" frequency synthesizers. This was done to detect any significant deviations from the nominal standards and tolerances.

The results of the above testing are tabulated in the attached technical performance records for each transmitter/receiver pair and the linear amplifier. Results indicate that no significant deviation from the standards were observed when the ground equipment was tuned to 137 Mhz. Consequently, it is believed that the ground transmitters/receivers/linear amplifiers will operate satisfactory in the new band, 136-137 Mhz, and similarly to the performance obtained in the present band, 118-136 Mhz..

FAA WJH Technical Center
00093210

The utilization of the new band by airborne transmitters/receivers is in question. The airborne VHF air/ground voice communications equipment is manufactured by numerous suppliers and is built to varying specifications. A representative sample of existing commercial airborne equipment will be required to determine if operation within specifications in the new band is possible and whether modifications will be required for such operations. We are presently obtaining information from various suppliers and are preparing for tests of representative airborne equipment.

Rodney C. Guishard

Attachment

cc:
ASM-501

SECTION 1

GENERAL INFORMATION AND REQUIREMENTS

1.1 INTRODUCTION

1.1.1 Purpose.- This instruction book provides the information necessary for the proper installation, operation, maintenance, and parts support of Transmitting Set, Radio, AN/GRT-21 and -22. Sufficient information, supplemented by relevant drawings and data, is presented to enable the technician to obtain optimum performance of the equipment.

1.1.2 Scope.- Section 1 of this instruction book describes the transmitting set's function, capabilities, limitations, and principal characteristics. Section 2 provides a detailed description of the technical characteristics. Section 3 deals with operating instructions and procedures. Section 4 presents the standard values and tolerances of the equipment. Section 5 lists maintenance and performance checks, which are described in section 6. Fault diagnosis, troubleshooting, and repair are covered in section 7. Section 8 lists the equipment parts. Section 9 presents installation procedures. Section 10 provides photographs, mechanical drawings, and parts location diagrams to support sections 7 and 8. Appendixes A and B furnish data for procuring quartz crystals used in the equipment. Section 11 (volume 2) provides schematic diagrams of the modules and precise access and blocked schematic diagrams and texts describing equipment functions.

1.1.3 Applicability.- This instruction book is applicable to the Transmitting Set, Radio, AN/GRT-21 and -22.

1.2 EQUIPMENT DESCRIPTION

1.2.1 Functional Description.- Transmitting Set, Radio, AN/GRT-21, hereinafter referred to as the vhf transmitting set, is comprised of Transmitter, Radio, T-1108/GRT-21, hereinafter referred to as the vhf exciter, and Amplifier, Radio Frequency, AM-6154/GRT-21, hereinafter referred to as the vhf power amplifier. When only 10 watts are required, the exciter is used without the power amplifier. Transmitting Set, Radio AN/GRT-22, hereinafter referred to as the uhf transmitting set, is comprised of Transmitter, Radio, T-1109/GRT-22, hereinafter referred to as the uhf exciter, and Amplifier, Radio Frequency, AM-6155/GRT-22, hereinafter referred to as the uhf power amplifier. When only 10 watts are required, the exciter is used without the power amplifier. Designed to perform in an air-traffic control environment, the vhf and uhf transmitting sets are deployed in air-traffic control service and provide ground-to-air and point-to-point voice communication. See figure 1-1.

1.2.1.1.- The vhf exciter is a crystal-controlled or oscillator-synthesized self-contained solid-state assembly that operates in the amplitude modulation (AM) mode. It is capable of transmitting on any one of 1,360 channels spaced 25 kHz apart between 116.00 MHz and 149.975 MHz when using crystals or the oscillator-synthesizer. The output frequency is determined by the operating frequency of the crystal used or the setting of thumbwheel switches on the synthesizer.

1.2.1.2.- The uhf exciter is a crystal-controlled or oscillator-synthesized self-contained solid-state assembly that operates in the amplitude modulation mode. It is capable of transmitting on any one of 7,000 channels spaced 25 kHz apart between 225.00 MHz and 399.95 MHz when using crystals or the oscillator-synthesizer. The output frequency is determined by the operating frequency of the

POWER AMPLIFIER (VHF) 2A10A2

The RF input is at a 50-ohm level from the driver output, and is fed through FL2 to P4, proceeding through the matching network consisting of L1, C1, C2, L3, C3, and C4 to the input amplifier Q1. The matching network provides the proper impedance match from the 50-ohm input to the input impedance of Q1. R1, R2, and L4 are d.c. bias dividers for Q1. The amplified output of Q1 is coupled through the broadband interstage matching network consisting of L5, C29, L16, L14, C11, L15, L7, C30, C16, and C17 to the input of Q2. R3, R8, and L9 provide the d.c. bias for Q2. The amplified output from the collector of Q2 is coupled through the matching network consisting of transformer L13, C26, and C27, providing the broadband output impedance of 50 ohms to the output connector P2. A detector circuit consisting of R4, R7, and CR1, with filter components R6, C23, R5, and C22 providing the proper filter of the detected output, provides a monitored RF test point output for RF power output at the PWR AMPL position of the front panel test switch. A considerable amount of decoupling is required in this module to prevent interstage oscillations and to prevent unwanted RF radiation into other areas of the exciter. C5, C6, C7, C8, C9, C10, C13, C14, C25, and C28 are all decoupling capacitors which work in conjunction with decoupling inductances L6 and L8 to provide the necessary decoupling. L17, L18, L19, L20, L21, and L22 are ferrite beads placed on the d.c. line to provide decoupling. The power amplifier is broadband, amplifying signals from 116 to 150 MHz. When driven with an 8-watt signal level at P4, approximately 50 watts is obtained from the output jack P2. The input d.c. required for this stage from FL1 is a nominal 20 volts d.c. As in the driver unit, lead lengths are extremely critical for proper operation.

SECTION 4

STANDARDS AND TOLERANCES

4.1 VHF/UHF TRANSMITTER STANDARDS AND TOLERANCES.- This section presents the standards and tolerances for the vhf/uhf transmitter in accordance with FAA Orders 6600.22 and 6630.2. The performance parameters are identified in tables 4-1 and 4-2. When the standards and tolerances listed below are in conflict with those in the order, those listed in the order shall supersede.

Table 4-1. VHF Transmitter Standards and Tolerances

Parameter	Reference paragraph	Standard	Tolerance/limit Initial	Tolerance/limit Operating
Transmitter output frequency				
25 kHz channel separation	6.9	Assigned frequency	±0.001%	±0.001%
Synthesizer control	6.9	Assigned frequency	±0.002%	±0.002%
Modulation level	6.8			
Voice peaks or 1,000 Hz audio tone	6.2	95% max	85% to 95%	60% to 95%
Power output				
Exciter only	6.4	10 W	±1 W	±2 W
Exciter with power amplifier	6.5	50 W	±2 W	35 to 55 W
VSWR at transmitter output	6.6	1.0:1	1.8:1	2.8:1

Table 4-2. UHF Transmitter Standards and Tolerances

Parameter	Reference paragraph	Standard	Tolerance/limit Initial	Tolerance/limit Operating
Transmitter output frequency				
25 kHz channel separation	6.9	Assigned frequency	±0.001%	±0.001%
Synthesizer control	6.9	Assigned frequency	±0.002%	±0.002%

SECTION 1

GENERAL INFORMATION AND REQUIREMENTS

1.1 INTRODUCTION

1.1.1 Purpose.- This instruction book provides the information necessary for the proper installation, operation, maintenance, and parts support of the Receiver, Radio, AN/GRR-23 and -24. Sufficient information, supplemented by relevant drawings and data, is presented to enable the technician to obtain optimum performance of the equipment.

1.1.2 Scope.- Section 1 of this instruction book describes the function, capabilities, limitations, and principal characteristics of the equipment. A discussion of how the unit operates is presented in section 2. Section 3 deals with operating instructions and procedures. Section 4 presents the essential equipment parameters, standard values, and tolerances. Section 5 lists maintenance and performance checks, which are described in section 6. Fault diagnosis, troubleshooting, and repair are covered in section 7. Section 8 is the equipment parts list. Section 9 describes installation procedures. Section 10 consists of photographs, mechanical drawings, and part location diagrams to support section 8. • Appendix A has been deleted. Appendix B furnishes data for procuring quartz crystals used in the equipment. Section 11 (volume 2) provides precise access and blocked schematic diagrams with associated keyed text, and schematic diagrams of the modules.

1.1.3 Applicability.- This manual is applicable to the Receiver, Radio, AN/GRR-23 and -24.

1.2 EQUIPMENT DESCRIPTION

1.2.1 Functional Description.- The AN/GRR-23 (vhf) receiver and the AN/GRR-24 (uhf) receiver (figure 1-1) are each designed for worldwide deployment in air-traffic control service and provide ground-to-air and point-to-point voice communication in an air-traffic control environment.

1.2.1.1.- The vhf receiver is a solid-state, single-channel, crystal-controlled, single-conversion, superheterodyne assembly that operates in the amplitude modulation (AM) mode. It is capable of receiving on any one of 680 channels spaced 50 kHz apart between 116.00 MHz and 149.95 MHz as determined by the operating frequency of the crystal used. The receiver may be modified for 25-kHz channel spacing by interchangeable modules, thus doubling the number of available channels. It is capable of secure voice operation with suitable interface equipment.

1.2.1.2.- The uhf receiver is a solid-state, single-channel, crystal-controlled, single-conversion, superheterodyne assembly that operates in the amplitude modulation (AM) mode. It is capable of receiving on any one of 3,500 channels spaced 50 kHz apart between 225.00 MHz and 399.95 MHz as determined by the operating frequency of the crystal used. The uhf receiver configuration is normally obtained by substituting uhf modules for the comparable vhf frequency determining and controlling modules. These modules are the A7 antenna coupler, FL2 tunable filter, and A2 mixer multiplier. The receiver may also be modified for 25-kHz channel spacing by interchangeable modules, thus doubling the number of available channels.

1.2.1.3.- The vhf and uhf receivers have provisions for use of an external precision frequency source • or an optional frequency synthesizer which is interchangeable with the oscillator-multiplier module (A1). • The synthesizer provides for direct dialing of the mixer multiplier frequency (see paragraph 9.5.1). Each receiver has an integral power supply.

SECTION 4

STANDARDS AND TOLERANCES

4.1 INTRODUCTION.- This section lists the standards and tolerances for the vhf/uhf receivers, as defined and described in FAA Order 6600.22. All performance parameters and inspection elements are identified in tables 4-1 and 4-2 for the vhf and uhf receivers, respectively. When these are in conflict with 6600.22, the standards and tolerances in the FAA Order shall prevail.

Table 4-1. VHF Receiver Standards and Tolerances

Parameter	Reference paragraph (performance check)	Standard	Tolerance/limit Initial	Tolerance/limit Operating
AGC threshold	9.7.2.5	5 μV (-93 dBm)	6 μV (-91 dBm)	8 μV (-89 dBm)
AGC level control	9.7.2.5 9.7.2.6	Shall not vary more than 3 dB from 3.0 μV to 50,000 μV (-98 dBm to -13 dBm)	Same as standard	Shall not vary more than 4 dB from 3.0 μV to 50,000 μV
Squelch action/adjust	6.5			
Open		1.5 μV max to open (-103 dBm)	1.5 to 4.0 μV (-103 to -95 dBm)	5.0 μV max to open (-93 dBm)
Closed		Approximately 2/3 of open value to close	Same as standard	Same as standard
Audio frequency response	6.9	Within 3 dB from 300 to 3000 Hz, continually decreasing above 3000 Hz and below 300 Hz	Same as standard	Within 4 dB from 300 to 3000 Hz, continually decreasing above 3000 Hz and below 300 Hz
Power output	6.6	100 mW min	100 mW min	90 mW min
Sensitivity	6.7	3.0 μV (-98 dBm) max for 90 mW into 600 ohms	Same as standard	5.0 μV max for 90 mW into 600 ohms
Selectivity (50 kHz channel spacing)	6.11			
6 dB		36 kHz min	35 kHz min	34 kHz min
60 dB		70 kHz max	70 kHz max	70 kHz max
Non-symmetry 60 dB		15% max	15% max	20% max

Table 4-1. VHF Receiver Standards and Tolerances (con.)

Parameter	Reference paragraph (performance check)	Standard	Tolerance/limit Initial	Tolerance/limit Operating
Selectivity (25 kHz channel spacing)	6.11			
6 dB		20 kHz min	16 kHz min	14 kHz min
60 dB		44 kHz max	44 kHz max	44 kHz max
Nonsymmetry 60 dB points		15% max	15% max	15% max
Oscillator frequency	6.4			
50 kHz channel spacing		±0.001%	±0.001%	±0.001%
25 kHz channel spacing		±0.001%	±0.001%	±0.001%

Table 4-2. UHF Receiver Standards and Tolerances

Parameter	Reference paragraph (performance check)	Standard	Tolerance/limit Initial	Tolerance/limit Operating
AGC threshold	9.7.2.5	5 μV (-93 dBm)	6 μV (-89 dBm)	8 μV (-91 dBm)
AGC level control	9.7.2.6	Shall not vary more than 3 dB from 3 μV to 50,000 μV (-98 dBm to -13 dBm)	Same as standard	Shall not vary more than 4 dB from 3 μV to 50,000 μV
Squelch action/adjust	6.5			
Open		1.5 μV max to open (-103 dBm)	1.5 to 4.0 V (-103 to -95 dBm)	5.0 μV max to open (-93 dBm)
Closed		Approximately 2/3 of open value to close	Same as standard	Same as standard
Audio frequency response	6.9	Within 3 dB from 300 to 3000 Hz, continuually decreasing above 3000 Hz and below 300 Hz	Same as standard	Within 4 dB from 300 to 3000 Hz, continually decreasing above 3000 Hz and below 300 Hz
Power output	6.6	100 mW min	100 mW min	90 mW min
Sensitivity	6.7	3.0 μV max for 100 mW into 600 ohms	Same as standard	5.0 μV max for 90 mW into 600 ohms

TECHNICAL PERFORMANCE RECORD — **VHF/UHF AIR/GROUND RECEIVERS/TRANSMITTERS**

FACILITY: EXPERIMENTAL VORTAC (Bldg. 196)
LOCATION (City, State, airport, other): FAA Technical Center, AC International Airport, NJ
DATE (From - to): 12/27/88 – 12/30/88
SUPERVISOR (Signature):

TYPE RECEIVER	SERIAL NO.	FREQUENCY	TYPE TRANSMITTER	SERIAL NO.	FREQUENCY
AN/GRR-25	37839	137.000 MHz	AN/GRT-21	35455	137.000 MHz

DATE	TIME (GMT)	RECEIVER: SENSITIVITY µV	RECEIVER: SQUELCH SENSITIVITY µV	RECEIVER: AVC LEVEL CONTROL dBm	RECEIVER: % FREQUENCY TOLERANCE	RECEIVER: SELECTIVITY 6dB BAND WIDTH (KHZ)	RECEIVER: SELECTIVITY 60dB BAND WIDTH (KHZ)	RECEIVER: NON SYMMETRY (%)	TRANSMITTER: MAX POWER (mW)	TRANSMITTER: AGC LEVEL (dB)	TRANSMITTER: POWER OUTPUT WATTS*	TRANSMITTER: VSWR*	TRANSMITTER: % FREQUENCY TOLERANCE	TRANSMITTER: % MODULATION VOICE	REMARKS	INITIALS
NOMINAL		< 3	1.5	< -93	± 0.001	> 20	< 44	15	≥ 100	≤ 3	10/50 *	< 2	± 0.002	90		
		1.07	1.5	-112	0.000025	23	39	5	110	3	10/50 *	< 1.1	0.000053	90	137.000 MHz **	

* 50 WATTS POWER OUTPUT REALIZED WITH LINEAR AMPLIFIER, AM-6154/GRT-21, S/N 16373, TUNED TO 137.000 MHz

** OPERATING FREQUENCY 137.000 MHz WAS obtained USING OPTIONAL FREQUENCY SYNTHESIZER

*Measure at transmitter.

Figure 9-14. Specimen FAA Form 6600.6

TECHNICAL PERFORMANCE RECORD — **VHF/UHF AIR/GROUND RECEIVERS/TRANSMITTERS**

FACILITY: EXPERIMENTAL VORTAC (BLDG-196)
LOCATION (City, State, airport, other): FAA TECHNICAL CENTER, AC INTERNATIONAL AIRPORT, NJ
DATE (From to): 01/03/89 – 01/06/89
SUPERVISOR (Signature):

RECEIVER TYPE	RECEIVER SERIAL NO.	RECEIVER FREQUENCY	TRANSMITTER TYPE	TRANSMITTER SERIAL NO.	TRANSMITTER FREQUENCY
AN-GRR-23	37855	137.000 MHz	AN/GRT-21	35013	137.000 MHz

DATE	TIME (GMT)	SENSITIVITY μV	SQUELCH THRESH OLD μV	AVC LEVEL CONTROL dBm	% FREQUENCY TOLERANCE	SELECTIVITY 6dB BAND WIDTH (KHZ)	SELECTIVITY 60dB BAND WIDTH (KHZ)	MOD SYMMETRY (%)	MAX POWER (mW)	AGC LEVEL (dB)	POWER OUTPUT WATTS*	VSWR*	% FREQUENCY TOLERANCE	% MODULATION VOICE	REMARKS	INITIALS
NOMINAL		< 3	1.5	< -93	± 0.001	> 20	< 44	15	≥ 100	≤ 3	10/50 *	< 2	± 0.002	90		
		1.02	1.5	-114	0.000072	24	39	5	110	2	10/50 *	< 1.1	-0.000520	90	137.000 MHz **	

* 50 WATTS POWER OUTPUT REALIZED WITH LINEAR AMPLIFIER, AM-6154/GRT-21, S/N 16373, TUNED TO 137.000 MHz

** OPERATING FREQUENCY 137.000 MHZ WAS OBTAINED USING OPTIONAL FREQUENCY SYNTHESIZERS.

*Measure at transmitter.

Figure 9-14. Specimen FAA Form 6600.6