DEFENSE INFORMATION SYSTEMS AGENCY
JOINT INTEROPERABILITY TEST COMMAND
2001 BRAINARD ROAD
FORT HUACHUCA, ARIZONA 85613-7051

IN REPLY
REFER TO Networks, Transmission and
Intelligence Division (JTE)

DEC 5 2002

Rohde and Schwarz, Inc.
7150-K Riverwood Drive
Columbia, MD 21046

Dear Mr. Steinberg:

The Joint Interoperability Test Command (JITC) has completed the test procedures for North Atlantic Treaty Organization (NATO) Standards Agreement (STANAG) 4203 annexes, B and C. These will be used to test your XK-2900L High Frequency (HF) transceiver and are provided for your records.

The JITC point of contact is Mr. Joseph Schulte, (520) 538-5483, DSN 879-5483 or E-mail: schultej@fhu.disa.mil.

Sincerely,

LESLIE F. CLAUDIO
Chief
Networks, Transmission and
Intelligence Division

1 Enclosure a/s

DEFENSE INFORMATION SYSTEMS AGENCY

JOINT INTEROPERABILITY TEST COMMAND
FORT HUACHUCA, ARIZONA

STANAG 4203, ANNEXES B AND C CONFORMANCE TEST PROCEDURES FOR EQUIPMENT TECHNICAL CHARACTERISTICS OF HIGH FREQUENCY RADIOS

NOVEMBER 2002

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STANAG 4203, ANNEXES B AND C CONFORMANCE TEST PROCEDURES FOR EQUIPMENT TECHNICAL CHARACTERISTICS OF HIGH FREQUENCY RADIOS

DECEMBER 2002

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INTRODUCTION

Standardization Agreement (STANAG) 4203 defines the technical standards required to ensure interoperability of land, air, and maritime Single Channel High Frequency (HF) radio equipment. STANAG 4203 contains the minimum interoperability standards for single channel HF radio equipment. It does not contain performance specifications.

This document contains the test procedures that will be used to determine the level of compliance of a HF radio transceiver to the requirements established in STANAG 4203, annexes B and C. The test procedures are intended to be generic, so they can be used to test any HF radio transceiver that requires conformance to STANAG 4203 annexes B and C. If the Unit Under Test is an exciter and power amplifier, all test measurements should be taken with the exciter and power amplifier configured as they would be in an operational environment.

The Joint Interoperability Test Command will conduct the standards and conformance test at Fort Huachuca, Arizona.

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APPENDIX A

ACRONYMS

<	less than
µs	microsecond
Ω	ohm
AGC	Automatic Gain Control
ALC	Automatic Level Control
AM	Amplitude Modulation
bps	bits per second
CW	Continuous Wave
dB	decibel
dBc	decibels referenced to full-peak envelope power
dBm	decibels referenced to one milliwatt
f_o	Oscillator Frequency
FSK	Frequency Shift Keying
HF	High Frequency
HFTF	High Frequency Test Facility
Hz	hertz
IMD	Intermodulation Distortion
ISB	Independent Sideband
ITU	International Telecommunications Union
JITC	Joint Interoperability Test Command
kHz	kilohertz
LSB	Lower Sideband
MHz	megahertz
MIL-STD	Military Standard
msec	millisecond
PEP	Peak Envelope Power
PSK	Phase Shift Key
QAM	Quadrature Amplitude Modulation

RATT	Radio Teletype
RF	Radio Frequency
RMS	Root Mean Squared
SC	Single Channel
SSB	Single Sideband
STANAG	Standardization Agreement
TIMS	Transmission Impairment Measurement Set
USB	Upper Sideband
UUT	Unit Under Test
wpm	words per minute

APPENDIX B

STANAG 4203 REQUIREMENTS MATRIX

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Table B-1. STANAG 4203 Requirements Matrix

Reference Number	STANAG 4203 Paragraph	Requirements	Subtest Number
1	Annex B Paragraph 1.	FREQUENCY RANGE. The frequency range for both transmission and reception shall be: a. 2.0 to 30.0 MHz for aircraft installations. b. 1.6 to 30 MHz for all other application.	1
2	Annex B Paragraph 2.	TUNING. a. Equipment shall tune to integral multiples of 100 Hz, starting at 1.5 MHz, and for maritime use, it is desirable that the receiver be able to tune in increments of 10 Hz. b. The frequency of the suppressed carrier shall be the reference frequency and it is mandatory that this be also the equipment display frequency (if available).	1
3	Annex B Paragraph 3.	FREQUENCY ACCURACY/STABILITY. The radio frequency tolerance shall be within ±30 Hz for manpack equipment and within ±10 for all other equipment. The frequency stability of the transmitter carrier frequency shall be $1X10^{-8}$ per day or better (±10 Hz in 30 days).	1
4	Annex B Paragraph 4.	The base-band frequency response of the transmitter and of the receive over the range 300 Hz to 3050 Hz shall be within ±2 dB of the response at 1000 Hz for manpack equipment and within ±1.5 dB for all other equipment. The group delay shall not very by more than 0.5 msec over 80% of the passband if 300 Hz to 3050 Hz. The maximum Time Delay measured between the input and the output of either the transmitter or the receiver shall be less than 2.5 msec over this passband.	2
5	Annex B Paragraph 5.	PHASE NOISE. The over all radio system RMS phase noise as measured at the transmitter output while transmitting a single tone at the maximum PEP shall not exceed the following values: a.- 65 dBc/Hz for manpacks and –75 dBc/Hz for all other equipment at offsets greater than ±100 kHz and less than ±100 kHz from the tone. b. –145 dBc/Hz (-165 dBc/Hz high desirable) at all offsets greater then +/- 100kHz from the tone.	3

Table B-1. STANAG 4203 Requirements Matrix (continued)

Reference Number	STANAG 4203 Paragraph	Requirements	Subtest Number
6	Annex B Paragraph 6.	LINEARITY. The IMD products of HF transmitters by any two equal-level signals within the 300-3050 Hz passband shall be at least 35 dB below either tone when the transmitter is operating at PEP. The frequencies of the two audio test signals shall not be harmonically or sub-harmonically related and shall have a minimum separation of 300Hz.	4
7	Annex B Paragraph 7.	SPECIAL CONTAINMENT OF TRANSMITTED SIGNAL. Ninety-nine percent of the total mean radiated power shall be contained with in a bandwidth of 3000 Hz; the power of any spurious emission shall be at least 40 dB below the peak envelope power within ±10 kHz of the carrier frequency and at least 60 dB below the peak envelope power at any other frequency. Inter-modulation products in the adjacent channel shall be at least 30 dB below the level of two equal tones modulation the transmitter at peak envelope power	5

Table B-1. STANAG 4203 Requirements Matrix (continued)

Reference Number	STANAG 4203 Paragraph	Requirements	Subtest Number
8	Annex B Paragraph 8.	MODULATION. (a) For analog voice, digital voice and in-band RATT/data, the carrier shall be single sideband suppressed-carried modulated, with the carrier and Lower Sideband suppressed to at least 40 dB below the peak envelope power. (b) Single channel RATT shall be sent by two-tone FSK with a mark (or 1) frequency of 1575 Hz±5 Hz and a space (or 0) frequency of 2425 Hz ±Hz (2000 Hz sub-carrier with 425 Hz shift) or 1615 Hz with a sub-carrier shift of –42.5 Hz ±1 Hz representing a mark (or 1) and shift of +42.5 Hz ±1 Hz representing a space (or 0). (c) Multi-channel RATT shall be sent by two-tone of sub-carriers centered on 425 Hz, 595 Hz, 935 Hz, 110 Hz, 1275 Hz,1445 Hz, and 1615 Hz, with a sub-carrier shift of ±42.5 Hz ±1 Hz. In multi-channel fleet broadcast operation it shall be normally arranged that the channel centered on 765 Hz can be received as a single channel*). (d) Morse telegraphy shall be sent by on-off keying of a 1000 Hz ±5 Hz, tone at rates up to 30 wpm (manual) and up to 300 wpm (burst). (e) Digital voice at 2400 bps when using the vocoder specified in STANAG 4198, shall be sent by means of a modem having the characteristics specified in STANAG 4197. (f) For narrowband direct printing telegraphy in the maritime mobile service, the ITU has outlined parameters in the in the Radio Regulations. These provide for F1B emissions of 170 Hz frequency shift at a maximum rate of 100 baud. The frequency tolerance is sited as ± 40 Hz for ship equipment and ±15 Hz for coast stations. (g) Single channel data transmissions using common single channel radio equipment and sent by means of modems (internal/external) at data-rates of 75 bps and above shall be sent by the (serial-tone) waveforms as described in the referenced STANAG's 4285, 4415, 4529, 4538 and 4539. Note: ISB (6 kHz operation) is likely to be required to support future enhanced data rate modes yet to be standardized. *US reservation: "is not compatible with the narrowband FSK center frequency agreed in other documents such as MIL-STD-188C where the 1232.5 Hz for a mark (or 1) and 1317.5 Hz for a space (or 0) is prescribed. Under this condition the assignment of a channel with a center frequency of 1275 Hz is appropriate for single channel operation."	6, 10

Table B-1. STANAG 4203 Requirements Matrix (continued)

Reference Number	STANAG 4203 Paragraph	Requirements	Subtest Number
9	Annex B Paragraph 9.	MODE OF OPERATION. Equipment shall be capable of operation in the single frequency simplex/half duplex mode, split frequency half mode is highly desirable.	6
10	Annex B Paragraph 10.	TRANSMIT/RECEIVE SWTCHING TIME. The changeover time between transmit and receive modes shall meet the following requirements: a. Transmit to receive changeover time shall not be greater than 15 msec from keying-off for the receiver to achieve 90% of full specified sensitivity. b. Receiver to transmit changeover time shall not be greater than 25 msec (10 msec highly desirable) from keying-on for the transmitter to achieve 90% of full specified output power.	7
11	Annex B Paragraph 11.	Transmit Automatic Level Control (ALC). Transmitter ALC action in data modes shall be implemented in such a way as to not degrade waveform performance. Note: this is known to be a concern particularly for high order modulation schemes such as QAM (e.g. as used in STANAG 4539).	8
12	Annex B Paragraph 12.	Receive Automatic Gain Control. These requirements apply to receivers that employ AGC. Any change in input level above the receiver AGC threshold shall produce an output change of less than ±3 dB. The AGC time constants during non-data operating modes shall be as follows: a. Attack: <30 msec b. Decay: between 500 msec and 1.5 seconds. The AGC time constants during single channel (not Link 11) data communications shall be as follows: a. Attack: <10 msec b. Decay: <25 msec (modes not employing amplitude modulation, e.g. PSK) c. Decay: between 500 msec and 1second. (modes employing amplitude modulation, e.g. QAM).	8

Table B-1. STANAG 4203 Requirements Matrix (continued)

Reference Number	STANAG 4203 Paragraph	Requirements	Subtest Number
13	Annex C Paragraph 3.	Lower side band (LSB) For LSB operation or the Lower Sideband during ISB operation the amplitude versus frequency response between (f_0 – 300 Hz) and (f_0 – 3050 Hz) shall be within 3 dB (total) where f_0 is the carrier frequency. The attenuation shall be at least 20 dB from f_0 to (f_0 + 400 Hz), and at least 60 dB above (f_0 + 400 Hz). Attenuation shall be at least 40 dB from (f_0 – 3500 Hz) to (f_0 – 4000 Hz) and at least 60 dB below (f_0 – 4000 Hz).	10
14	Annex C Paragraph 2.	Link 11 data link operations, where employed, shall be as per STANAG 5511 and utilize USB, LSB, or ISB modes.	9
15	Annex C Paragraph 4.	AGC SSB/ISB Operation During ISB operation the AGC shall be developed independently for the two sidebands as specified in STANAG 5511. The implementation shall be such that the sideband of greater magnitude controls the gain of the receiver RF stages. When in SSB mode, the receiver shall prevent any AGC voltage developed by the unused sideband from controlling the RF gain.	11

Legend: AGC – Automatic Gain Control; ALC – Automatic Level Control; bps – bits per second; dB – decibels; dBc – decibels referenced to full-peak envelope power; fo – Oscillator Frequency; FSK – Frequency Shift Keying; HF – High Frequency; Hz – Hertz; IMD – Intermodulation Distortion; ISB - Independent Sideband; ITU – International Telecommunications Union; LSB – Lower Sideband; MHz – Megahertz; MIL-STD – Military Standard; msec – millisecond; PEP – Peak Envelope Power; PSK – Phase Shift Keying; QAM – Quadrature Amplitude Modulation; RATT – Radio Teletype; RF – Radio Frequency; RMS – Root Mean Squared; SSB – Single Sideband; STANAG – Standardization Agreement; USB – Upper Sideband; wpm – words per minute; < - Less Than

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APPENDIX C

STANAG 4203 TEST PROCEDURES

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C-1 SUBTEST 1, FREQUENCY RANGE, TUNING, AND ACCURACY

C-1.1 Objective. To determine the extent of compliance with the requirements for frequency range of transmission and reception, tuning intervals, frequency tolerance, and carrier frequency stability, (table B-1, reference numbers 1, 2, and 3).

C-1.2 Criteria

a. The frequency range for both transmission and reception shall be:

(1) 2.0 to 30.0 megahertz (MHz) for aircraft installations.

(2) 1.6 to 30 MHz for all other applications.

(STANAG 4203 annex B, paragraph 1)

b. Equipment shall tune to integral multiples of 100 Hz, starting at 1.5 MHz, and for maritime use, it is desirable that the receiver be able to tune in increments of 10 Hz. The frequency of the suppressed carrier shall be the reference frequency and it is mandatory that this be also the equipment display frequency (if available). (STANAG 4203 annex B, paragraph 2)

c. The radio frequency tolerance shall be within ±30 Hz for manpack equipment and within ±10 Hz for all other equipment. The frequency stability of this transmitter carrier frequency shall be 1 x 10^{-8} per day or better (±10 Hz in 30 days). (STANAG 4203 annex B, paragraph 3)

C-1.3 Test Procedures

a. Test Equipment Required

(1) Audio Generator (accurate to within ±1 Hz)

(2) Watt Meter

(3) Signal Generator (accurate to within ±1 Hz)

(4) Attenuator

(5) Frequency Counters (accurate to within ±1 Hz)

(6) Directional Coupler

b. Test Configuration. Figures C-1.1, C-1.2, and C-1.3 show the equipment configuration for this subtest.

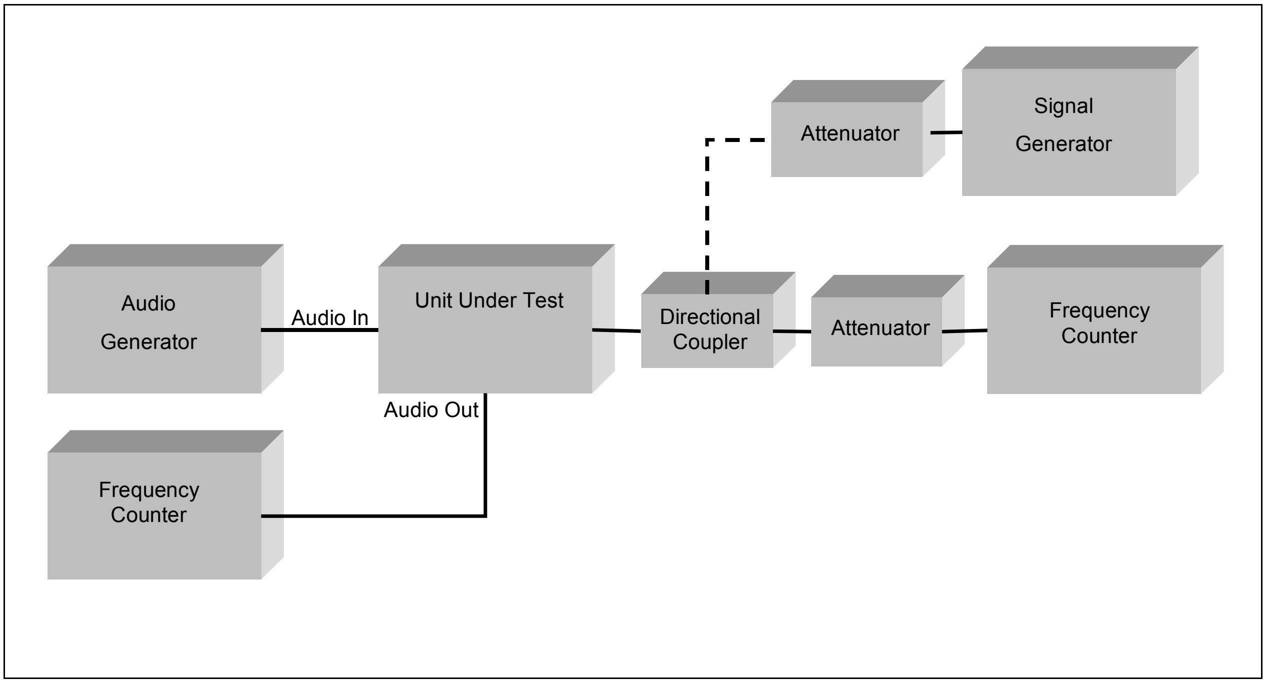

Figure C-1.1. Equipment Configuration for Measuring Transmitter and Receiver Frequency Range, Tuning and Frequency Tolerance

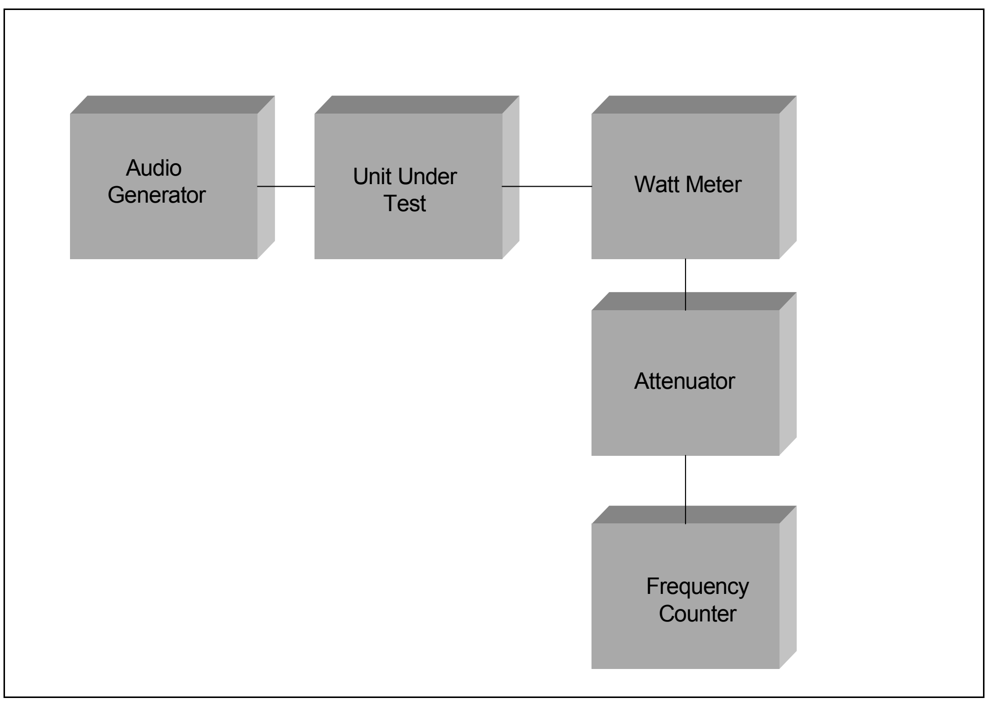

Figure C-1.2. Equipment Configuration for Measuring Transmitter Frequency Stability

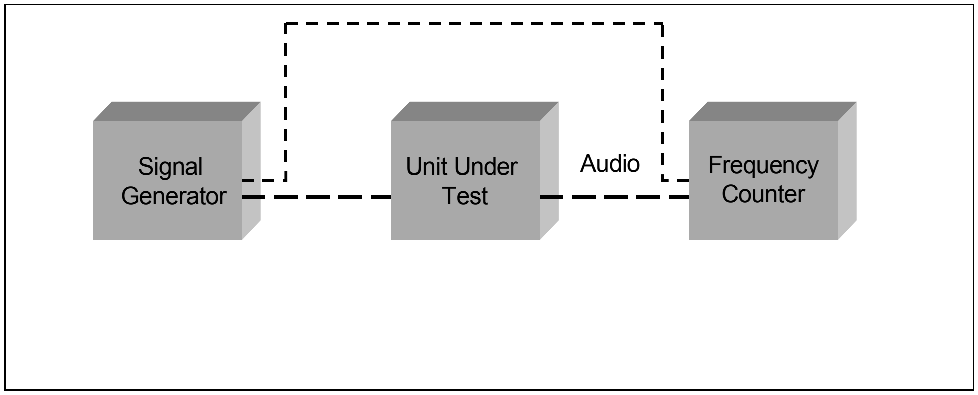

Figure C-1.3. Equipment Configuration for Measuring Receiver Frequency Stability

c. Test Conduct. The test procedures for this subtest are given in tables C-1.1, C-1.2, and C-1.3. The test procedures in table C-1.2 are required if the UUT is a receive-only system.

Table C-1.1. Procedures for Transmitter and Receiver Frequency Range and Tolerance

Step	Action	Settings/Action	Result
The following procedure is for reference numbers 1, 2 and 3.			
1	Set up equipment.	See figure C-1.1.	
2	Allow UUT to warm up by leaving it powered on, in receive mode for 30 minutes.		
3	Tune UUT.	Frequency: Test frequency given in steps 7 through 75. Mode: USB	
4	Set up audio generator.	Frequency: 1000 Hz Level: Set to a minimum audio input level into UUT to drive transmitter so that the RF output can be measured with the frequency counter. Impedance: 600 ohm	
5	Set up signal generator.	Frequency: Test frequency + 1000 Hz (given in steps 7 through 75) Level: Set to a minimum RF input level into UUT to drive receiver so that the audio output can be measured with the frequency counter.	

Table C-1.1. Procedures for Transmitter and Receiver Frequency Range and Tolerance (continued)

Step	Action	Settings/Action	Result
6	In steps 7 through 75, transmit with UUT and record the RF frequency minus the audio tone (measure with the frequency counter). Then, place UUT in receive mode and set the frequency of the signal generator to test frequency + 1000 Hz. Record the frequency of the audio tone measured with the frequency counter.		
7	Record RF and audio frequencies.	1.5 MHz (This test frequency is required for all applications except for aircraft installations.)	TX:
			RX:
8	Record RF and audio frequencies.	1.6 MHz (This test frequency is required for all applications except for aircraft installations.)	TX:
			RX:
9	Record RF and audio frequencies.	1.7 MHz (This test frequency is required for all applications except for aircraft installations.)	TX:
			RX:
10	Record RF and audio frequencies.	1.8 MHz (This test frequency is required for all applications except for aircraft installations.)	TX:
			RX:
11	Record RF and audio frequencies.	1.9 MHz (This test frequency is required for all applications except for aircraft installations.)	TX:
			RX:
12	Record RF and audio frequencies.	2.0000 MHz	TX:
			RX:
13	Record RF and audio frequencies.	2.0001 MHz	TX:
			RX:
14	Record RF and audio frequencies.	2.0002 MHz	TX:
			RX:
15	Record RF and audio frequencies.	2.0003 MHz	TX:
			RX:
16	Record RF and audio frequencies.	2.0004 MHz	TX:
			RX:
17	Record RF and audio frequencies.	2.0005 MHz	TX:
			RX:
18	Record RF and audio frequencies.	2.0006 MHz	TX:
			RX:
19	Record RF and audio frequencies.	2.0007 MHz	TX:
			RX:
20	Record RF and audio frequencies.	2.0008 MHz	TX:
			RX:
21	Record RF and audio frequencies.	2.0009 MHz	TX:
			RX:
22	Record RF and audio frequencies.	2.0019 MHz	TX:
			RX:

Table C-1.1. Procedures for Transmitter and Receiver Frequency Range and Tolerance (continued)

Step	Action	Settings/Action	Result
23	Record RF and audio frequencies.	2.0029 MHz	TX: RX:
24	Record RF and audio frequencies.	2.0039 MHz	TX: RX:
25	Record RF and audio frequencies.	2.0049 MHz	TX: RX:
26	Record RF and audio frequencies.	2.0059 MHz	TX: RX:
27	Record RF and audio frequencies.	2.0069 MHz	TX: RX:
28	Record RF and audio frequencies.	2.0079 MHz	TX: RX:
29	Record RF and audio frequencies.	2.0089 MHz	TX: RX:
30	Record RF and audio frequencies.	2.0099 MHz	TX: RX:
31	Record RF and audio frequencies.	2.0199 MHz	TX: RX:
32	Record RF and audio frequencies.	2.0299 MHz	TX: RX:
33	Record RF and audio frequencies.	2.0399 MHz	TX: RX:
34	Record RF and audio frequencies.	2.0499 MHz	TX: RX:
35	Record RF and audio frequencies.	2.0599 MHz	TX: RX:
36	Record RF and audio frequencies.	2.0699 MHz	TX: RX:
37	Record RF and audio frequencies.	2.0799 MHz	TX: RX:
38	Record RF and audio frequencies.	2.0899 MHz	TX: RX:
39	Record RF and audio frequencies.	2.0999 MHz	TX: RX:
40	Record RF and audio frequencies.	2.1999 MHz	TX: RX:
41	Record RF and audio frequencies.	2.2999 MHz	TX: RX:
42	Record RF and audio frequencies.	2.3999 MHz	TX: RX:
43	Record RF and audio frequencies.	2.4999 MHz	TX: RX:
44	Record RF and audio frequencies.	2.5999 MHz	TX: RX:
45	Record RF and audio frequencies.	2.6999 MHz	TX: RX:
46	Record RF and audio frequencies.	2.7999 MHz	TX: RX:

Table C-1.1. Procedures for Transmitter and Receiver Frequency Range and Tolerance (continued)

Step	Action	Settings/Action	Result
47	Record RF and audio frequencies.	2.8999 MHz	TX: RX:
48	Record RF and audio frequencies.	2.9999 MHz	TX: RX:
49	Record RF and audio frequencies.	3.9999 MHz	TX: RX:
50	Record RF and audio frequencies.	4.9999 MHz	TX: RX:
51	Record RF and audio frequencies.	5.9999 MHz	TX: RX:
52	Record RF and audio frequencies.	6.9999 MHz	TX: RX:
53	Record RF and audio frequencies.	7.9999 MHz	TX: RX:
54	Record RF and audio frequencies.	8.9999 MHz	TX: RX:
55	Record RF and audio frequencies.	9.9999 MHz	TX: RX:
56	Record RF and audio frequencies.	10.9999 MHz	TX: RX:
57	Record RF and audio frequencies.	11.9999 MHz	TX: RX:
58	Record RF and audio frequencies.	12.9999 MHz	TX: RX:
59	Record RF and audio frequencies.	13.9999 MHz	TX: RX:
60	Record RF and audio frequencies.	14.9999 MHz	TX: RX:
61	Record RF and audio frequencies.	15.9999 MHz	TX: RX:
62	Record RF and audio frequencies.	16.9999 MHz	TX: RX:
63	Record RF and audio frequencies.	17.9999 MHz	TX: RX:
64	Record RF and audio frequencies.	18.9999 MHz	TX: RX:
65	Record RF and audio frequencies.	19.9999 MHz	TX: RX:
66	Record RF and audio frequencies.	20.9999 MHz	TX: RX:
67	Record RF and audio frequencies.	21.9999 MHz	TX: RX:
68	Record RF and audio frequencies.	22.9999 MHz	TX: RX:
69	Record RF and audio frequencies.	23.9999 MHz	TX: RX:
70	Record RF and audio frequencies.	24.9999 MHz	TX: RX:

Table C-1.1. Procedures for Transmitter and Receiver Frequency Range and Tolerance (continued)

Step	Action	Settings/Action	Result
71	Record RF and audio frequencies.	25.9999 MHz	TX: RX:
72	Record RF and audio frequencies.	26.9999 MHz	TX: RX:
73	Record RF and audio frequencies.	27.9999 MHz	TX: RX:
74	Record RF and audio frequencies.	28.9999 MHz	TX: RX:
75	Record RF and audio frequencies.	29.9999 MHz	TX: RX:
75	Record RF and audio frequencies.	30.0000 MHz	TX: RX:
76	Review the results of steps 7 through 75, and verify that the accuracy (tolerance) of the carrier frequency is within ±30 Hz for manpack equipment and within ±10 Hz for all other equipment.		
Legend: Hz – hertz; MHz – megahertz; RF – Radio Frequency; RX – Receiver; TX – Transmitter; USB – Upper Sideband; UUT – Unit Under Test			

Table C-1.2. Procedures for Frequency Stability of Transmitter

Step	Action	Settings/Action	Result
The following procedure is for reference number 3.			
1	Set up equipment.	See figure C-1.2.	
2	Set up audio generator.	Frequency: 1000 Hz Level: Set to a minimum audio input level into UUT to drive transmitter so that the RF output can be measured with the frequency counter. Impedance: 600 ohm	
3	Measure the RF output of the transmitter at 4.000 MHz, 8.000 MHz, and 16.000 MHz (USB mode) once a day for 30 days. Leave the UUT powered on for the duration of this 30-day test. The UUT should be left in receive mode when frequency measurements are not being taken.	In steps 4 through 33, record the RF frequency minus the audio tone to the tenth of a Hz.	
4	Day 1	4.000 MHz	
		8.000 MHz	
		16.000 MHz	
		Record date of measurement.	
5	Day 2	4.000 MHz	
		8.000 MHz	

Table C-1.2. Procedures for Frequency Stability of Transmitter (continued)

Step	Action	Settings/Action	Result
		16.000 MHz	
		Record date of measurement.	
6	Day 3	4.000 MHz	
		8.000 MHz	
		16.000 MHz	
		Record date of measurement.	
7	Day 4	4.000 MHz	
		8.000 MHz	
		16.000 MHz	
		Record date of measurement.	
8	Day 5	4.000 MHz	
		8.000 MHz	
		16.000 MHz	
		Record date of measurement.	
9	Day 6	4.000 MHz	
		8.000 MHz	
		16.000 MHz	
		Record date of measurement.	
10	Day 7	4.000 MHz	
		8.000 MHz	
		16.000 MHz	
		Record date of measurement.	
11	Day 8	4.000 MHz	
		8.000 MHz	
		16.000 MHz	
		Record date of measurement.	
12	Day 9	4.000 MHz	
		8.000 MHz	
		16.000 MHz	
		Record date of measurement.	
13	Day 10	4.000 MHz	
		8.000 MHz	
		16.000 MHz	
		Record date of measurement.	
14	Day 11	4.000 MHz	
		8.000 MHz	
		16.000 MHz	
		Record date of measurement.	
15	Day 12	4.000 MHz	
		8.000 MHz	
		16.000 MHz	
		Record date of measurement.	
16	Day 13	4.000 MHz	
		8.000 MHz	
		16.000 MHz	
		Record date of measurement.	
17	Day 14	4.000 MHz	
		8.000 MHz	
		16.000 MHz	
		Record date of measurement.	

Table C-1.2. Procedures for Frequency Stability of Transmitter (continued)

Step	Action	Settings/Action	Result
18	Day 15	4.000 MHz	
		8.000 MHz	
		16.000 MHz	
		Record date of measurement.	
19	Day 16	4.000 MHz	
		8.000 MHz	
		16.000 MHz	
		Record date of measurement.	
20	Day 17	4.000 MHz	
		8.000 MHz	
		16.000 MHz	
		Record date of measurement.	
21	Day 18	4.000 MHz	
		8.000 MHz	
		16.000 MHz	
		Record date of measurement.	
22	Day 19	4.000 MHz	
		8.000 MHz	
		16.000 MHz	
		Record date of measurement.	
23	Day 20	4.000 MHz	
		8.000 MHz	
		16.000 MHz	
		Record date of measurement.	
24	Day 21	4.000 MHz	
		8.000 MHz	
		16.000 MHz	
		Record date of measurement.	
25	Day 22	4.000 MHz	
		8.000 MHz	
		16.000 MHz	
		Record date of measurement.	
26	Day 23	4.000 MHz	
		8.000 MHz	
		16.000 MHz	
		Record date of measurement.	
27	Day 24	4.000 MHz	
		8.000 MHz	
		16.000 MHz	
		Record date of measurement.	
28	Day 25	4.000 MHz	
		8.000 MHz	
		16.000 MHz	
		Record date of measurement.	
29	Day 26	4.000 MHz	
		8.000 MHz	
		16.000 MHz	
		Record date of measurement.	

Table C-1.2. Procedures for Frequency Stability of Transmitter (continued)

Step	Action	Settings/Action	Result
30	Day 27	4.000 MHz	
		8.000 MHz	
		16.000 MHz	
		Record date of measurement.	
31	Day 28	4.000 MHz	
		8.000 MHz	
		16.000 MHz	
		Record date of measurement.	
32	Day 29	4.000 MHz	
		8.000 MHz	
		16.000 MHz	
		Record date of measurement.	
33	Day 30	4.000 MHz	
		8.000 MHz	
		16.000 MHz	
		Record date of measurement.	
34	Review results of steps 4 through 33 and verify that the frequency stability of the transmitter carrier frequency is within ±10 Hz over the 30-day period.		
Legend: Hz – hertz; MHz – megahertz; RF – Radio Frequency; USB – Upper Sideband; UUT – Unit Under Test			

Table C-1.3. Procedures for Frequency Stability of Receiver

Step	Action	Settings/Action	Result
The following procedure is for reference number 3.			
1	Set up equipment.	See figure C-1.3.	
2	Allow UUT to warm up by leaving it powered on in receive mode for 30 minutes.	Tune UUT to 4 MHz; Mode: USB.	
3	Connect the frequency counter directly to the output of the RF generator. Set the RF generator to 4.001 MHz.	Using the frequency counter, measure the exact frequency of the RF from the RF generator. Record result.	
4	Connect the signal generator to the RF port of the UUT.	Set the RF output level of the signal generator to 0 dBm.	
5	Connect the frequency counter to the audio output of the UUT.	Record the audio frequency measured on the frequency counter.	

Table C-1.3. Procedures for Frequency Stability of Receiver (continued)

Step	Action	Settings/Action	Result
6	Verify that the accuracy of the UUT's carrier frequency is within ±30 Hz for manpack equipment and ±10 Hz for other equipment. Remember to account for any error in the RF generators output frequency accuracy found in step 3.	To verify accuracy, note that if there is no error in the frequency accuracy of the UUT, then the audio frequency measured in step 5 will be 1000 Hz (± any error in the RF generators frequency accuracy found in step 3). If the UUT's local oscillator frequency is off by 1 Hz, then the audio frequency measured in step 5 will be 999 Hz or 1001 Hz (± any error in the RF generators frequency accuracy found in step 3).	
7	Tune UUT to 16 MHz, USB.		
8	Connect the frequency counter directly to the output of the RF generator. Set the RF generator to 16.001 MHz.	Using the frequency counter, measure the frequency of the RF from the RF generator. Record result.	
9	Connect the signal generator to the RF port of the UUT.	Set the RF output level of the signal generator to 0 dBm.	
10	Connect the frequency counter to the audio output of the UUT.	Record the audio frequency measured on the frequency counter.	
11	Verify that the accuracy of the UUT's carrier frequency is within ±30 Hz for manpack equipment and ±10 Hz for other equipment. Remember to account for any error in the RF generators output frequency accuracy found in step 8.	To verify accuracy, note that if there is no error in the frequency accuracy of the UUT, then the audio frequency measured in step 10 will be 1000 Hz (± any error in the RF generators frequency accuracy found in step 8). If the UUT's local oscillator frequency is off by 1 Hz, then the audio frequency measured in step 10 will be 999 Hz or 1001 Hz (± any error in the RF generators frequency accuracy found in step 8).	
12	Tune UUT to 28 MHz, USB.		
13	Connect the frequency counter directly to the output of the RF generator. Set the RF generator to 28.001 MHz.	Using the frequency counter, measure the frequency of the RF from the RF generator. Record result.	
14	Connect the signal generator to the RF port of the UUT.	Set the RF output level of the signal generator to 0 dBm.	
15	Connect the frequency counter to the audio output of the UUT.	Record the audio frequency measured on the frequency counter.	
16	Verify that the accuracy of the UUT's carrier frequency is within ±30 Hz for manpack equipment and ±10 Hz for other equipment. Remember to account for any error in the RF generators output frequency accuracy found in step 13.	To verify accuracy, note that if there is no error in the frequency accuracy of the UUT, then the audio frequency measured in step 15 will be 1000 Hz (± any error in the RF generators frequency accuracy found in step 13). If the UUT's local oscillator frequency is off by 1 Hz, then the audio frequency measured in step 15 will be 999 Hz or 1001 Hz (± any error in the RF generators frequency accuracy found in step 13).	
17	Steps 18 through 60 measure the UUTs stability over a 30-day period.		

Table C-1.3. Procedures for Frequency Stability of Receiver (continued)

Step	Action	Settings/Action	Result
18	Tune UUT to 4 MHz, USB.		
19	Connect the frequency counter directly to the output of the RF generator. Set the RF generator to 4.001 MHz.	Using the frequency counter, measure the exact frequency of the RF from the RF generator with 0.1 Hz accuracy. Record result.	
20	Connect the signal generator to the RF port of the UUT.	Set the RF output level of the signal generator to 0 dBm.	
21	Connect the frequency counter to the audio output of the UUT.	Record the audio frequency measured on the frequency counter with 0.1 Hz accuracy.	
22	Tune UUT to 16 MHz, USB.		
23	Connect the frequency counter directly to the output of the RF generator. Set the RF generator to 16.001 MHz.	Using the frequency counter, measure the frequency of the RF from the RF generator with 0.1 Hz accuracy. Record result.	
24	Connect the signal generator to the RF port of the UUT.	Set the RF output level of the signal generator to 0 dBm.	
25	Connect the frequency counter to the audio output of the UUT.	Record the audio frequency measured on the frequency counter with 0.1 Hz accuracy.	
26	Tune UUT to 28 MHz, USB.		
27	Connect the frequency counter directly to the output of the RF generator. Set the RF generator to 28.001 MHz.	Using the frequency counter, measure the frequency of the RF from the RF generator with 0.1 Hz accuracy. Record result.	
28	Connect the signal generator to the RF port of the UUT.	Set the RF output level of the signal generator to 0 dBm.	
29	Connect the frequency counter to the audio output of the UUT.	Record the audio frequency measured on the frequency counter with 0.1 Hz accuracy.	
30	Leave UUT powered on for 24 hours.		
31	Day 1: Repeat steps 18 through 30.	Record new result from step 19:	
		Record new result from step 21:	
		Record new result from step 23:	
		Record new result from step 25:	
		Record new result from step 27:	
		Record new result from step 29:	
32	Day 2: Repeat steps 18 through 30.	Record new result from step 19:	
		Record new result from step 21:	
		Record new result from step 23:	
		Record new result from step 25:	
		Record new result from step 27:	
		Record new result from step 29:	
33	Day 3: Repeat steps 18 through 30.	Record new result from step 19:	
		Record new result from step 21:	
		Record new result from step 23:	
		Record new result from step 25:	
		Record new result from step 27:	
		Record new result from step 29:	

Table C-1.3. Procedures for Frequency Stability of Receiver (continued)

Step	Action	Settings/Action	Result
34	Day 4: Repeat steps 18 through 30.	Record new result from step 19:	
		Record new result from step 21:	
		Record new result from step 23:	
		Record new result from step 25:	
		Record new result from step 27:	
		Record new result from step 29:	
35	Day 5: Repeat steps 18 through 30.	Record new result from step 19:	
		Record new result from step 21:	
		Record new result from step 23:	
		Record new result from step 25:	
		Record new result from step 27:	
		Record new result from step 29:	
36	Day 6: Repeat steps 18 through 30.	Record new result from step 19:	
		Record new result from step 21:	
		Record new result from step 23:	
		Record new result from step 25:	
		Record new result from step 27:	
		Record new result from step 29:	
37	Day 7: Repeat steps 18 through 30.	Record new result from step 19:	
		Record new result from step 21:	
		Record new result from step 23:	
		Record new result from step 25:	
		Record new result from step 27:	
		Record new result from step 29:	
38	Day 8: Repeat steps 18 through 30.	Record new result from step 19:	
		Record new result from step 21:	
		Record new result from step 23:	
		Record new result from step 25:	
		Record new result from step 27:	
		Record new result from step 29:	
39	Day 9: Repeat steps 18 through 30.	Record new result from step 19:	
		Record new result from step 21:	
		Record new result from step 23:	
		Record new result from step 25:	
		Record new result from step 27:	
		Record new result from step 29:	
40	Day 10: Repeat steps 18 through 30.	Record new result from step 19:	
		Record new result from step 21:	
		Record new result from step 23:	
		Record new result from step 25:	
		Record new result from step 27:	
		Record new result from step 29:	
41	Day 11: Repeat steps 18 through 30.	Record new result from step 19:	
		Record new result from step 21:	
		Record new result from step 23:	
		Record new result from step 25:	
		Record new result from step 27:	
		Record new result from step 29:	

Table C-1.3. Procedures for Frequency Stability of Receiver (continued)

Step	Action	Settings/Action	Result
42	Day 12: Repeat steps 18 through 30.	Record new result from step 19:	
		Record new result from step 21:	
		Record new result from step 23:	
		Record new result from step 25:	
		Record new result from step 27:	
		Record new result from step 29:	
43	Day 13: Repeat steps 18 through 30.	Record new result from step 19:	
		Record new result from step 21:	
		Record new result from step 23:	
		Record new result from step 25:	
		Record new result from step 27:	
		Record new result from step 29:	
44	Day 14: Repeat steps 18 through 30.	Record new result from step 19:	
		Record new result from step 21:	
		Record new result from step 23:	
		Record new result from step 25:	
		Record new result from step 27:	
		Record new result from step 29:	
45	Day 15: Repeat steps 18 through 30.	Record new result from step 19:	
		Record new result from step 21:	
		Record new result from step 23:	
		Record new result from step 25:	
		Record new result from step 27:	
		Record new result from step 29:	
46	Day 16: Repeat steps 18 through 30.	Record new result from step 19:	
		Record new result from step 21:	
		Record new result from step 23:	
		Record new result from step 25:	
		Record new result from step 27:	
		Record new result from step 29:	
47	Day 17: Repeat steps 18 through 30.	Record new result from step 19:	
		Record new result from step 21:	
		Record new result from step 23:	
		Record new result from step 25:	
		Record new result from step 27:	
		Record new result from step 29:	
48	Day 18: Repeat steps 18 through 30.	Record new result from step 19:	
		Record new result from step 21:	
		Record new result from step 23:	
		Record new result from step 25:	
		Record new result from step 27:	
		Record new result from step 29:	
49	Day 19: Repeat steps 18 through 30.	Record new result from step 19:	
		Record new result from step 21:	
		Record new result from step 23:	
		Record new result from step 25:	
		Record new result from step 27:	
		Record new result from step 29:	

Table C-1.3. Procedures for Frequency Stability of Receiver (continued)

Step	Action	Settings/Action	Result
50	Day 20: Repeat steps 18 through 30.	Record new result from step 19:	
		Record new result from step 21:	
		Record new result from step 23:	
		Record new result from step 25:	
		Record new result from step 27:	
		Record new result from step 29:	
51	Day 21: Repeat steps 18 through 30.	Record new result from step 19:	
		Record new result from step 21:	
		Record new result from step 23:	
		Record new result from step 25:	
		Record new result from step 27:	
		Record new result from step 29:	
52	Day 22: Repeat steps 18 through 30.	Record new result from step 19:	
		Record new result from step 21:	
		Record new result from step 23:	
		Record new result from step 25:	
		Record new result from step 27:	
		Record new result from step 29:	
53	Day 23: Repeat steps 18 through 30.	Record new result from step 19:	
		Record new result from step 21:	
		Record new result from step 23:	
		Record new result from step 25:	
		Record new result from step 27:	
		Record new result from step 29:	
54	Day 24: Repeat steps 18 through 30.	Record new result from step 19:	
		Record new result from step 21:	
		Record new result from step 23:	
		Record new result from step 25:	
		Record new result from step 27:	
		Record new result from step 29:	
55	Day 25: Repeat steps 18 through 30.	Record new result from step 19:	
		Record new result from step 21:	
		Record new result from step 23:	
		Record new result from step 25:	
		Record new result from step 27:	
		Record new result from step 29:	
56	Day 26: Repeat steps 18 through 30.	Record new result from step 19:	
		Record new result from step 21:	
		Record new result from step 23:	
		Record new result from step 25:	
		Record new result from step 27:	
		Record new result from step 29:	
57	Day 27: Repeat steps 18 through 30.	Record new result from step 19:	
		Record new result from step 21:	
		Record new result from step 23:	
		Record new result from step 25:	
		Record new result from step 27:	
		Record new result from step 29:	

Table C-1.3. Procedures for Frequency Stability of Receiver (continued)

Step	Action	Settings/Action	Result
58	Day 28: Repeat steps 18 through 30.	Record new result from step 19:	
		Record new result from step 21:	
		Record new result from step 23:	
		Record new result from step 25:	
		Record new result from step 27:	
		Record new result from step 29:	
59	Day 29: Repeat steps 18 through 30.	Record new result from step 19:	
		Record new result from step 21:	
		Record new result from step 23:	
		Record new result from step 25:	
		Record new result from step 27:	
		Record new result from step 29:	
60	Day 30: Repeat steps 18 through 30.	Record new result from step 19:	
		Record new result from step 21:	
		Record new result from step 23:	
		Record new result from step 25:	
		Record new result from step 27:	
		Record new result from step 29:	
61	Review data from steps 18 through 60. Verify that the frequency stability of the UUT is within ±10 Hz over the 30-day period.	Remember to account for any drift in the RF generators output frequency.	
Legend: dBm – decibels referenced to one milliwatt; Hz – hertz; MHz – megahertz; RF – Radio Frequency; USB – Upper Sideband; UUT – Unit Under Test			

C-1.4 Presentation of Results. The results will be shown in table C-1.4 indicating the requirement and measured value or indications of capability.

Table C-1.4. Frequency Range, Tuning and Accuracy Results

Reference Number	STANAG 4203 Annex B Paragraph	Requirement	Required Result	Measured Result	Finding	
					Met	Not Met
1	1	The frequency range for both transmission and reception shall be: a) 2.0 to 30.0 MHz for aircraft installations. b) 1.6 to 30 MHz for all other applications.	Aircraft: 2.0 to 30.0 MHz Other: 1.6 to 30.0 MHz	Does UUT operate over required frequency range?		

Table C-1.4. Frequency Range, Tuning and Accuracy Results (continued)

Reference Number	STANAG 4203 Annex B Paragraph	Requirement	Required Result	Measured Result	Finding	
					Met	Not Met
2	2	a) Equipment shall tune to integral multiples of 100 Hz, starting at 1.5 MHz, and for maritime use it is desirable that the receiver be able to tune in increments of 10 Hz. b) The frequency of the suppressed carrier shall be the reference frequency and is mandatory to be the equipment display frequency (if available).	Tune to integral multiples of 100 Hz	Does UUT tune to integral multiples of 100 Hz?		
			Reference frequency = carrier frequency			
3	3	The radio frequency tolerance shall be within ±30 Hz for manpack equipment and within ±10 Hz for all other equipment. The frequency stability of this transmitter carrier frequency shall be 1 x 10^{-8} per day or better (±10 Hz in 30 days).	Manpack: ±30 Hz Other: ±10 Hz	Max Frequency Deviation:		
			Minimum Stability: ±10 Hz over 30 days	Max Frequency Deviation over 30 days:		
Legend: Hz – hertz; MHz – megahertz; STANAG – Standardization Agreement; UUT – Unit Under Test						

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C-2 SUBTEST 2, FREQUENCY RESPONSE, GROUP AND TIME DELAY

C-2.1 Objective. To determine the extent of compliance with the requirements for transmitter base-band frequency response, group delay, and input to output delay of the transmitter or receiver, (table B-1, reference number 4).

C-2.2 Criteria

a. The base-band frequency response of the transmitter and of the receiver over the range 300 Hz to 3050 Hz shall be within ±2 dB of the response at 1000 Hz for manpack equipment and within ±1.5 dB for all other equipment. (STANAG 4203 annex B, paragraph 4)

b. The group delay shall not vary by more than 0.5 milliseconds (msec) over 80% of the passband of 300 Hz to 3050 Hz. The maximum time delay measured between the input and the output of either the transmitter or the receiver shall be less than 2.5 msec over this passband. (STANAG 4203 annex B, paragraph 4)

C-2.3 Test Procedures

a. Test Equipment Required

(1) Spectrum Analyzer

(2) Audio Generator

(3) RF Attenuator

(4) Watt Meter

(5) Super Transmission Impairment Measurement Set

(6) Signal Generator

(7) Oscilloscope

b. Test Configuration. Figures C-2.1, C-2.2, C-2.3, C-2.4 and C-2.5 show the equipment setup for this subtest.

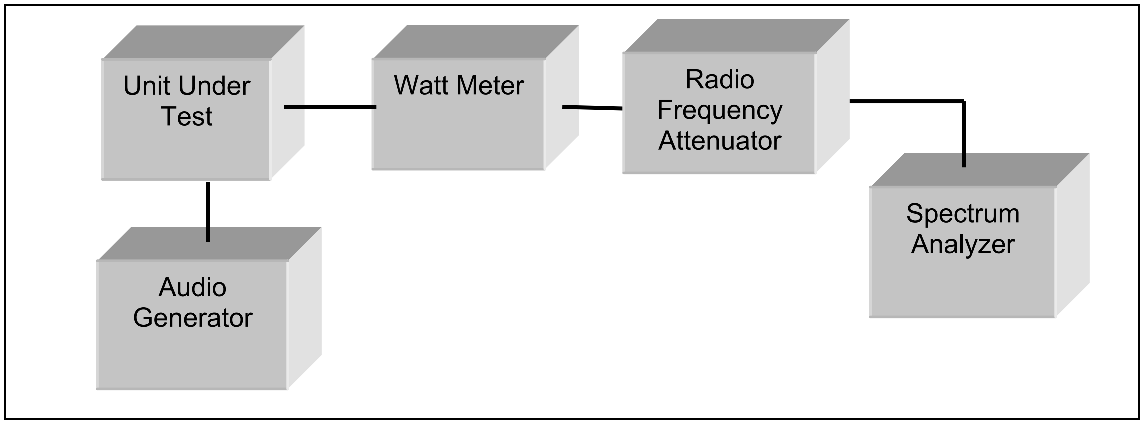

Figure C-2.1. Equipment Configuration for Transmitter Frequency Response

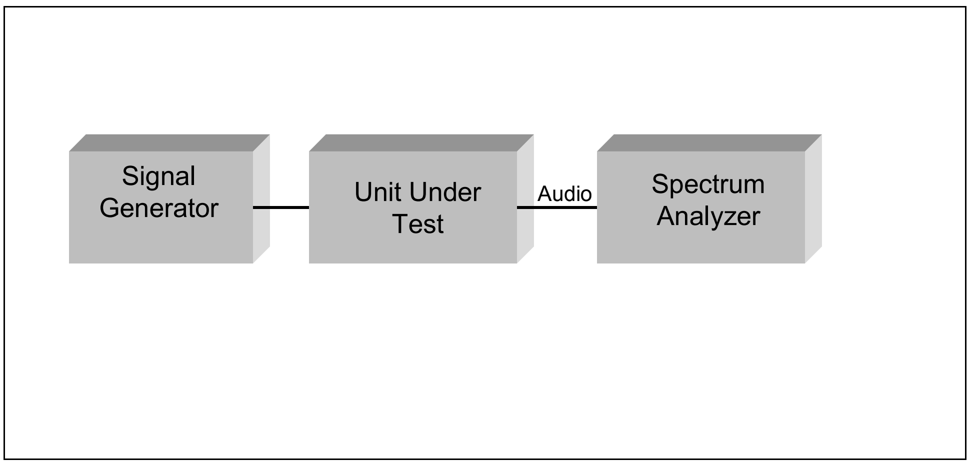

Figure C-2.2. Equipment Configuration for Receiver Frequency Response

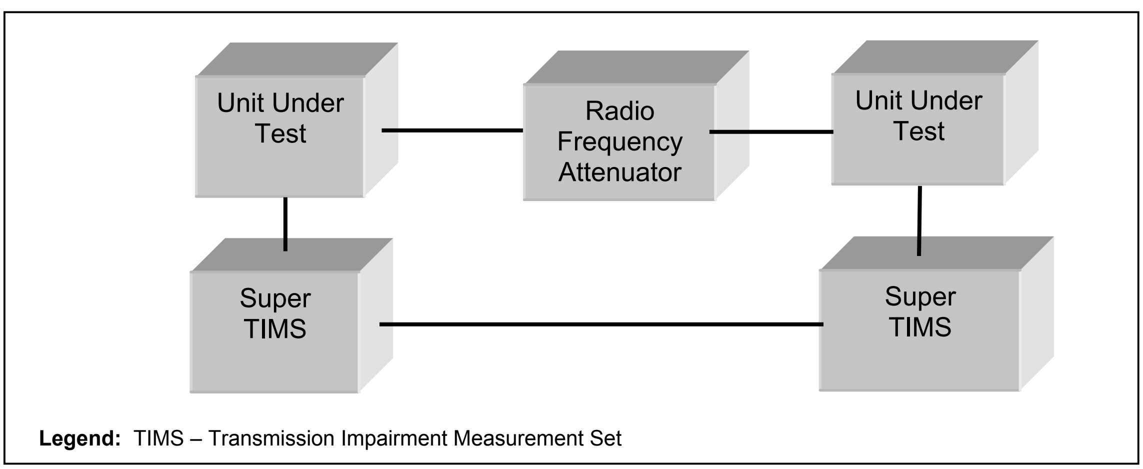

Figure C-2.3. Equipment Configuration for Group Delay

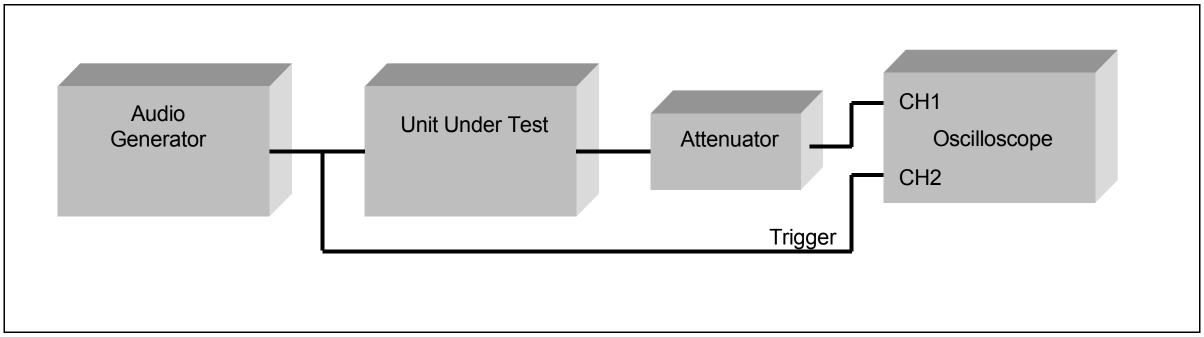

Figure C-2.4. Equipment Configuration for Transmitter Time Delay

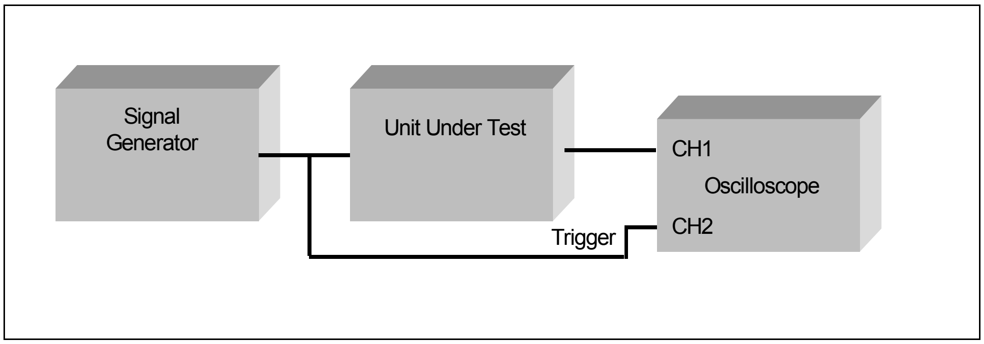

Figure C-2.5. Equipment Configuration for Receiver Time Delay

Table C-2.1. Procedures for Transmitter Frequency Response

Step	Action	Settings/Action	Result
The following procedure is for reference number 4.			
1	Set up equipment.	See figure C-2.1.	
2	Tune UUT.	Frequency: 8.0000 MHz; Mode: USB	
3	Set up spectrum analyzer.	Set reference level on spectrum analyzer to 0 and turn Max Hold on. Center Frequency: 8.0000 MHz Span: 12 kHz (15 kHz for four channel radio) RBW: 30 Hz VBW: 30 Hz	
4	Set up audio generator.	Frequency: 300 Hz Output Level: Drive UUT to full rated PEP.	
5	Press sweep on the spectrum analyzer.		
6	Increase the audio generator frequency in 100 Hz steps to 3500 Hz.	Sweep the spectrum analyzer at each step.	
7	Observe the amplitude of each audio tone (in dBm) on the display of the spectrum analyzer. Print spectrum.		

Table C-2.1. Procedures for Transmitter Frequency Response (continued)

Step	Action	Settings/Action	Result
8	Review each tone. Record the maximum and minimum output power in dB from 300 Hz to 3050 Hz. Also record the output power in dB of the 1000 Hz tone.		
Legend: dB – decibels; dBm – decibels referenced to one milliwatt; Hz – hertz; kHz – kilohertz; MHz – megahertz; PEP – Peak Envelope Power; RBW – Resolution Bandwidth; USB – Upper Sideband; UUT – Unit Under Test; VBW – Video Bandwidth			

Table C-2.2. Procedures for Receiver Frequency Response

Step	Action	Settings/Action	Results
The following procedure is for reference number 4.			
1	Set up equipment.	See figure C-2.2.	
2	Tune UUT.	Frequency: 8.0000 MHz; Mode: USB	
3	Set up RF signal generator.	Test frequency + 300 Hz Level: –47 dBm	
4	Set up spectrum analyzer.	Set reference level on spectrum analyzer to 0 dBm and turn Max Hold on. Center Frequency: 2.5 kHz Span: 5 kHz RBW: 30 Hz VBW: 30 Hz	
5	Press sweep on the spectrum analyzer.		
6	Increase the frequency of the signal generator in 100 Hz steps to test frequency + 3050 Hz.	Sweep the spectrum at each frequency step.	
7	Observe the amplitude of each tone (in dBm) on the display of the spectrum analyzer. Print spectrum.		
8	Review results of step 7. Record the maximum and minimum output power in dB across the passband from Fc + 300 Hz to Fc + 3050 Hz. Record the output power in dB of Fc + 1000 Hz.		
Legend: dB – decibels; dBm – decibels referenced to one milliwatt; Fc – Center Frequency; Hz – hertz; kHz – kilohertz; MHz – megahertz; RBW – Resolution Bandwidth; RF – Radio Frequency; UUT – Unit Under Test; VBW – Video Bandwidth			

Table C-2.3. Procedures for Group Delay

Step	Action	Settings/Action	Results
The following procedure is for reference number 4.			
1	Set up equipment.	See figure C-2.3.	
2	Tune UUT.	Frequency: 8.0000 MHz; Mode: USB	
3	Set up Super TIMS.	Connect the control path between the two Super TIMS as shown in figure C-2.3. Level: 0 dBm Setup: MASTER SLAVE on Test: ENVELOPE DELAY Program Sweep: 300 Hz to 3100 Hz in 100 Hz steps.	

Table C-2.3. Procedures for Group Delay (Continued)

Step	Action	Settings/Action	Results
4	Measure total time delay at 300 Hz.	Record result.	
5	Measure total time delay at 400 Hz.	Record result.	
6	Measure total time delay at 500 Hz.	Record result.	
7	Measure total time delay at 600 Hz.	Record result.	
8	Measure total time delay at 700 Hz.	Record result.	
9	Measure total time delay at 800 Hz.	Record result.	
10	Measure total time delay at 900 Hz.	Record result.	
11	Measure total time delay at 1000 Hz.	Record result.	
12	Measure total time delay at 1100 Hz.	Record result.	
13	Measure total time delay at 1200 Hz.	Record result.	
14	Measure total time delay at 1300 Hz.	Record result.	
15	Measure total time delay at 1400 Hz.	Record result.	
16	Measure total time delay at 1500 Hz.	Record result.	
17	Measure total time delay at 1600 Hz.	Record result.	
18	Measure total time delay at 1700 Hz.	Record result.	
19	Measure total time delay at 1800 Hz.	Record result.	
20	Measure total time delay at 1900 Hz.	Record result.	
21	Measure total time delay at 2000 Hz.	Record result.	
22	Measure total time delay at 2100 Hz.	Record result.	
23	Measure total time delay at 2200 Hz.	Record result.	
24	Measure total time delay at 2300 Hz.	Record result.	
25	Measure total time delay at 2400 Hz.	Record result.	
26	Measure total time delay at 2500 Hz.	Record result.	
27	Measure total time delay at 2600 Hz.	Record result.	
28	Measure total time delay at 2700 Hz.	Record result.	

Table C-2.3. Procedures for Group Delay (Continued)

Step	Action	Settings/Action	Results
29	Measure total time delay at 2800 Hz.	Record result.	
30	Measure total time delay at 2900 Hz.	Record result.	
31	Measure total time delay at 3000 Hz.	Record result.	
32	Measure total time delay at 3050 Hz.	Record result.	
33	Measure total time delay at 3100 Hz.	Record result.	
34	Analyze data from steps 4 through 32.	Verify that the time delay of the system does not exceed 2.5 msec.	
35	Verify that the group delay does not vary by more than 0.5 msec over a minimum of 80% of the points tested in steps 4 through 32 (i.e. 23 of the 28 test points must have a group delay within 0.5 msec).		
Legend: dBm – decibels referenced to one milliwatt; Hz – hertz; MHz-megahertz; msec – millisecond; TIMS – Transmission Impairment Measurement Set; UUT – Unit Under Test; μs – microseconds			

Table C-2.4. Procedures for Time Delay

Step	Action	Settings/Action	Results
The following procedure is for reference number 4.			
1	Set up equipment for transmitter time delay.	See figure C-2.4.	
2	Tune UUT.	Frequency: 8.0000 MHz; Mode: USB	
3	Set up audio generator.	Frequency: 1004 Hz Level: Drive transmitter to full rated PEP.	
4	Set up oscilloscope.	Set horizontal scale to 5 msec/div. Set vertical scale to 0.5 V.div. Set trigger to single sweep, channel 2. Set level to trigger when AF output on audio generator is toggled ON/OFF.	
5	Set AF output on audio generator to off position.		
6	Select RUN on oscilloscope.		
7	Key transmitter.		
8	Turn audio generator AF output on.	Capture transmitter time delay.	
9	Measure transmitter time delay.	The transmitter time delay is measured by placing vertical marker #1 at the point where the AF output on the audio generator is turned on (measured on channel two), and vertical marker #2 at the point where the amplitude of the audio signal on channel one reaches 90% of its steady-state value. The time difference between the two vertical markers is the transmitter time delay.	
10	Set up equipment for receiver time delay.	See figure C-2.5.	
11	Set up signal generator.	Frequency: 8.001 MHz Level: 0 dBm	

Table C-2.4. Procedures for Time Delay (Continued)

Step	Action	Settings/Action	Results
12	Set up oscilloscope.	Set horizontal scale to 5 msec/div. Set vertical scale to 0.5 V.div. Set trigger to single sweep, channel 2. Set level to trigger when RF output on signal generator is toggled ON/OFF.	
13	Set RF output on signal generator to off position.		
14	Select RUN on oscilloscope.		
15	Ensure UUT is in receive mode.		
16	Turn signal generator RF output on.	Capture receiver time delay.	
17	Measure receiver time delay.	The receiver time delay is measured by placing vertical marker #1 at the point where the RF output on the signal generator is turned on (measured on channel two), and vertical marker #2 at the point where the amplitude of the audio signal on channel one reaches 90% of its steady-state value. The time difference between the two vertical markers is the receiver time delay.	
Legend: AF – Audio Frequency; dBm – decibels referenced to one milliwatt; kHz – kilohertz; MHz – megahertz; msec – millisecond; PEP – Peak Envelope Power; RF – Radio Frequency; UUT – Unit Under Test; V – Volt			

C-2.4 Presentation of Results. The results will be shown in table C-2.5 indicating the requirement and measured value or indications of capability.

Table C-2.5. Frequency Response, Group and Time Delay Results

Reference Number	STANAG 4203 Annex B Paragraph	Requirement	Result		Finding	
			Required Value	Measured Value	Met	Not Met
4	4	The base-band frequency response of the transmitter and of the receiver over the range 300 Hz to 3050 Hz shall be within ±2 dB of the response at 1000 Hz for manpack equipment and within ±1.5 dB for all other equipment. The group delay shall not vary by more than 0.5 msec over 80% of the passband of 300 Hz to 3050 Hz. The maximum time delay measured between the input and the output of either the transmitter or the receiver shall be less than 2.5 msec over this passband.	Frequency Response for manpack: ±2 dB	TX:		
				RX:		
			Other: ±1.5 dB	TX:		
				RX:		
			Group delay < 0.5 msec over 80% of passband			
			Max Time Delay < 2.5 msec	TX:		
				RX:		
Legend: dB – decibels; Hz – hertz; msec – milliseconds; RX – Receiver; STANAG – Standardization Agreement; TX – Transmitter						

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C-3 SUBTEST 3, PHASE NOISE

C-3.1 Objective. To determine the extent of compliance with the requirements for transmitter phase noise, (table B-1, reference number 5).

C-3.2 Criteria. The overall radio system Root Mean Squared (RMS) phase noise as measured at the transmitter output, while transmitting a single tone at the maximum Peak Envelope Power (PEP) shall not exceed the following values:

a. -65 decibels referenced to full-peak envelope power per hertz (dBc/Hz) for manpacks and –75 dBc/Hz for all other equipment at offsets greater than ±100 Hz and less than ±100 kHz from the tone. (STANAG 4203 annex B, paragraph 5)

b. -145 dBc/Hz (-165 dBc/Hz highly desirable) at all offsets greater than ±100 kHz from the tone. (STANAG 4203 annex B, paragraph 5)

C-3.3 Test Procedures

a. Test Equipment Required

(1) System Personal Computer Controller with E5500 Software

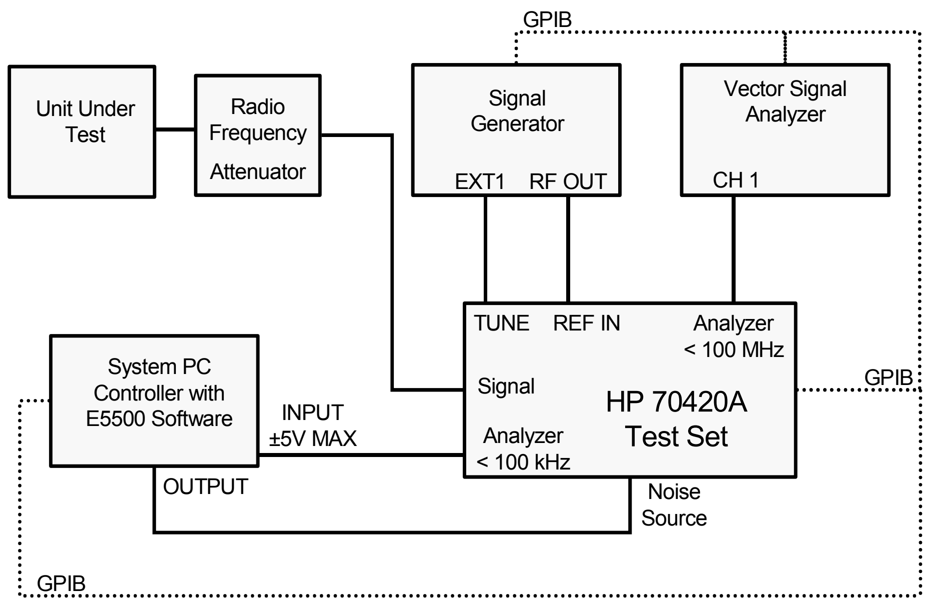
(2) Lowest Phase Noise Signal Generator Available

(3) Hewlett Packard (HP) 70420A Phase Noise Test Set

(4) Vector Signal Analyzer

(5) Radio Frequency Attenuator

b. Test Configuration. Figure C-3.1 shows the equipment setup for this subtest.



Legend: CH – Channel; EXT – External; GPIB – General Purpose Interface Bus; HP – Hewlett Packard; kHz – kilohertz; MHz – megahertz; PC – Personal Computer; REF – Reference; RF – Radio Frequency; V – Volt

Figure C-3.1. Equipment Configuration for Phase Noise

Table C-3.1. Procedures for Phase Noise

Step	Action	Settings/Action	Result
The following procedure is for reference number 5.			
1	Set up equipment as shown in figure C-3.1.		
2	Program UUT.	Frequency: 4 MHz; Mode: CW Adjust attenuation to provide a +10 dBm signal into the 70420A test set.	
3	Load the E5500 user interface software.		
4	Click on server hardware connections under the system menu.	General Assets Tab: Test Set: Agilent/HP 70420A FFT Analyzer: Agilent/HP 89410A Sources Tab: Reference Source: Agilent/HP E4425B	

Table C-3.1. Procedures for Phase Noise (continued)

Step	Action	Settings/Action	Result
5	Click on measurements under the define menu.	Enter the following settings: Measurement type: Absolute phase noise (using a phase locked loop). Start offset Frequency: 1 Hz Stop offset Frequency: 1 MHz Minimum number of FFT averages: Select value required to give desired output. Carrier source Frequency: 4.001 MHz Detector input Frequency: 4.001 MHz Detector: Automatic detector selection Detector constant cal method: Derive from measured beatnote. VCO tune constant cal method: Calculate the tune constant from nominal value. PLL integrator attenuation: 0 dB Carrier source: manual Reference source: Select the signal generator used in test setup. VCO tuned using: DC FM. LNA LPF: 2 MHz Time Base: None Downconverter: None	
6	Place UUT in transmit mode.		
7	Click on New measurement under the measure menu.	Measure phase noise.	
8	When the measurement is complete, un-key the UUT.		
9	Print results.		

Legend: CW – Continuous Wave; dB – decibels; dBm – decibels referenced to one milliwatt; DC – Direct Current; FFT – Fast Fourier Transform; FM – Frequency Modulation; HP – Hewlett Packard; Hz – hertz; LNA – Low Noise Amplifier; LPF – Low Pass Filter; MHz – megahertz; PLL – Phase Locked Loop; UUT – Unit Under Test; VCO – Voltage Controlled Oscillator

C-3.4 Presentation of Results. The results will be shown in table C-3.2 indicating the requirement and measured value or indications of capability.

Table C-3.2. Phase Noise Results

Reference Number	STANAG 4203 Annex B Paragraph	Requirement	Result		Finding	
			Required Value	Measured Value	Met	Not Met
5	5	The overall radio system RMS phase noise, as measured at the transmitter output, while transmitting a single tone at the maximum PEP shall not exceed the following values: a) -65 dBc/Hz for manpacks and –75 dBc/Hz for all other equipment at offsets greater than ±100 Hz and less than ±100kHz from the tone. B) -145 dBc/Hz (-165 dBc/Hz highly desirable) at all offsets greater than ±100 kHz from the tone.	Manpack: -65 dBc/Hz Other: –75 dBc/Hz			
			Offset > ±100 kHz from the tone: -145 dBc/Hz			
Legend: dBc – decibels referenced to full-peak envelope power; Hz – hertz; kHz – kilohertz; PEP – Peak Envelope Power; RMS – Root Mean Squared; STANAG – Standardization Agreement						

C-4 SUBTEST 4, LINEARITY

C-4.1 Objective. To determine the extent of compliance with the requirements for transmitter linearity, (table B-1, reference number 6).

C-4.2 Criteria. The Intermodulation (IMD) products of High Frequency transmitters by any two equal-level signals within the 300 – 3050 Hz passband shall be at least 35 dB below either tone when the transmitter is operating at rated PEP. (STANAG 4203 annex B, paragraph 6)

C-4.3 Test Procedures

a. Test Equipment Required

(1) Spectrum Analyzer

(2) Audio Generator with Multiple Outputs

(3) Watt Meter

(4) Radio Frequency Attenuator

b. Test Configuration. Figure C-4.1 shows the equipment setup for this subtest.

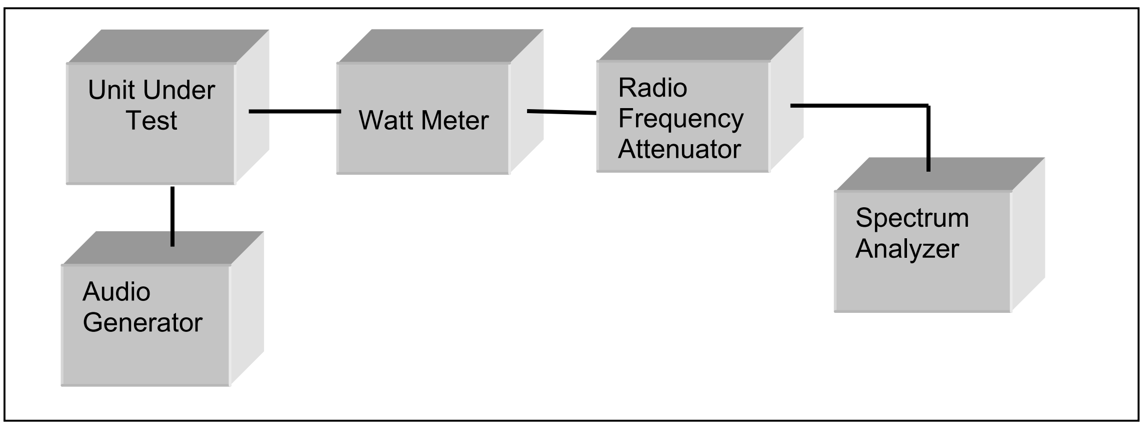


Figure C-4.1. Equipment Configuration for Linearity

Table C-4.1. Procedures for Linearity

Step	Action	Settings/Action	Result
The following procedure is for reference number 6.			
1	Set up equipment.	See figure C-4.1.	
2	Tune UUT.	Frequency: 8.0000 MHz; Mode: USB	
3	Set up audio generator.	Frequency A: Channel 1 800 Hz Frequency B: Channel 1 1125 Hz Raise level of audio to drive transmitter to rated PEP. Both frequencies must be the same level going into the UUT.	
4	Set up spectrum analyzer.	Center Frequency: 8.0000 MHz Frequency Span: 10 kHz RBW: 30 Hz VBW: 30 Hz Sweep: Continuous Noise Level: Off	
5	Key radio and capture spectrum analyzer display.	Set reference level on spectrum analyzer so the highest point is at 0 dB.	
6	Measure peaks on spectrum.	Identify in-passband peaks other than frequencies A and B on the spectrum analyzer. Record the frequency and the difference (dB) between peak levels and two-tone levels for all peaks not less than 30 dB below the peak of either tone.	
7	Analyze the IMD products.	Record the highest peak value (dB) in step 6.	
8	Print spectrum analyzer display.		
9	Set up audio generator.	Frequency A: Channel 1 1400 Hz Frequency B: Channel 1 1775 Hz Raise level of audio to drive transmitter to rated PEP. Both frequencies must be the same level going into the UUT.	
10	Set up spectrum analyzer.	Center Frequency: 8.0000 MHz Frequency Span: 10 kHz RBW: 30 Hz VBW: 30 Hz Sweep: Continuous Noise Level: Off	
11	Key radio and capture spectrum analyzer display.	Set reference level on spectrum analyzer so the highest point is at 0 dB.	

Table C-4.1. Procedures for Linearity (Continued)

Step	Action	Settings/Action	Result
12	Measure peaks on spectrum.	Identify in-passband peaks other than frequencies A and B on the spectrum analyzer. Record the frequency and the difference (dB) between peak levels and two-tone levels for all peaks not less than 30 dB below the peak of either tone.	
13	Analyze the IMD products.	Record the highest peak value (dB) in step 12.	
14	Print spectrum analyzer display.		
15	Set up audio generator.	Frequency A: Channel 1 2000 Hz Frequency B: Channel 1 2375 Hz Raise level of audio to drive transmitter to rated PEP. Both frequencies must be the same level going into the UUT.	
16	Set up spectrum analyzer.	Center Frequency: 8.0000 MHz Frequency Span: 10 kHz RBW: 30 Hz VBW: 30 Hz Sweep: Continuous Noise Level: Off	
17	Key radio and capture spectrum analyzer display.	Set reference level on spectrum analyzer so the highest point is at 0 dB.	
18	Measure peaks on spectrum.	Identify in-passband peaks other than frequencies A and B on the spectrum analyzer. Record the frequency and the difference (dB) between peak levels and two-tone levels for all peaks not less than 30 dB below the peak of either tone.	
19	Analyze the IMD products.	Record the highest peak value (dB) in step 18.	
20	Print spectrum analyzer display.		
21	Set up audio generator.	Frequency A: Channel 1 2700 Hz Frequency B: Channel 1 3050 Hz Raise level of audio to drive transmitter to rated PEP. Both frequencies must be the same level going into the UUT.	
22	Set up spectrum analyzer.	Center Frequency: 8.0000 MHz Frequency Span: 10 kHz RBW: 30 Hz VBW: 30 Hz Sweep: Continuous Noise Level: Off	

Table C-4.1. Procedures for Linearity (Continued)

Step	Action	Settings/Action	Result
23	Key radio and capture spectrum analyzer display.	Set reference level on spectrum analyzer so the highest point is at 0 dB.	
24	Measure peaks on spectrum.	Identify in-passband peaks other than frequencies A and B on the spectrum analyzer. Record the frequency and the difference (dB) between peak levels and two-tone levels for all peaks not less than 30 dB below the peak of either tone.	
25	Analyze the IMD products.	Record the highest peak value (dB) in step 24.	
26	Print spectrum analyzer display.		
Legend: dB – decibels; Hz – hertz; IMD – Intermodulation Distortion; kHz – kilohertz; MHz – megahertz; PEP – Peak Envelope Power; RBW – Resolution Bandwidth; USB – Upper Sideband; UUT – Unit Under Test; VBW – Video Bandwidth			

C-4.4 Presentation of Results. The results will be shown in table C-4.2 indicating the requirement and measured value or indications of capability.

Table C-4.2. Linearity Results

Reference Number	STANAG 4203 Annex B Paragraph	Requirement	Result		Finding	
			Required Value	Measured Value	Met	Not Met
6	6	The IMD products of HF transmitters by any two equal-level signals within the 300 – 3050 Hz passband shall be at least 35 dB below either tone when the transmitter is operating at rated PEP. The frequencies of the two audio test signals shall not be harmonically or sub-harmonically related and shall have a minimum separation of 300 Hz.	IMD > 35 dB below tones			
Legend: dB – decibels; HF – High Frequency; Hz – hertz; IMD – Intermodulation Distortion; PEP – Peak Envelope Power; STANAG – Standardization Agreement						

C-5 SUBTEST 5, SPECTRAL CONTAINMENT OF TRANSMITTED SIGNAL

C-5.1 Objective. To determine the extent of compliance with the requirements for spurious emissions, (table B-1, reference number 7).

C-5.2 Criteria. Ninety-nine percent of the total mean radiated power shall be contained within a bandwidth of 3000 Hz; the power of any spurious emission shall be at least 40 dB below the PEP within ±10 kHz of the carrier frequency and at least 60 dB below the PEP at any other frequency. Intermodulation products in the adjacent channel shall be at least 30 dB below the level of either of the two equal tones modulation the transmitter at PEP. (STANAG 4203 annex B, paragraph 7)

C-5.3 Test Procedures

a. Test Equipment Required

(1) Spectrum Analyzer

(2) Audio Generator

(3) Radio Frequency Attenuator

(4) Watt Meter

b. Test Configuration. Figure C-5.1 shows the equipment setup for this subtest.

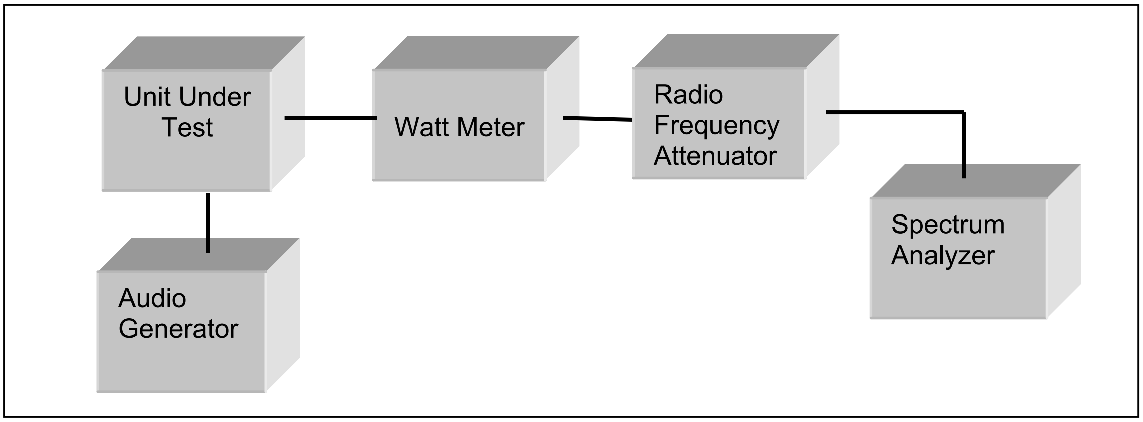


Figure C-5.1. Equipment Configuration for Spectral Containment of Transmitted Signal

Table C-5.1. Procedures for Spectral Containment of Transmitted Signal Subtest

Step	Action	Settings/Action	Result
The following procedure is for reference number 7.			
1	Set up equipment.	See figure C-5.1.	
2	Tune UUT.	Frequency: 3.0000 MHz; Mode: USB	
3	Set up audio generator.	Channel 1: 1000 Hz Raise level of audio to drive UUT to full rated PEP.	
4	Set up spectrum analyzer.	Center Frequency: 3.0000 MHz Frequency Span: 10 kHz RBW: 30 Hz VBW: 30 Hz Sweep: Continuous Noise Level: Off	
5	Configure the Agilent 8560 spectrum analyzer to measure the occupied bandwidth of the UUT's transmitted signal.	Front-panel key access: MEAS/USER	
6	Transmit UUT using a 1000 Hz signal from the audio generator to drive transmitter to full rated PEP.	Verify that 99% of the total mean radiated power is contained between center frequency plus 300 Hz to center frequency plus 3300 Hz.	
7	Set up spectrum analyzer.	Center Frequency: 3.0000 MHz Frequency Span: 20 kHz Noise Level: Off	
8	Insert audio into the UUT.	Frequency: 1004 Hz Raise level of audio to drive UUT to full rated PEP.	
9	Sweep the spectrum.	Record the level of any spurious emissions. Use the "Find Peak" and "Next Peak" functions.	
10	Verify that all spurious emissions within ±10 kHz of the carrier frequency are at least 40 dB below the peak envelope power.		

Table C-5.1. Procedures for Spectral Containment of Transmitted Signal Subtest (continued)

Step	Action	Settings/Action	Result
11	Increase the frequency span of the spectrum analyzer to 4 MHz.		
12	Set the center frequency of the spectrum analyzer to 4 MHz.	Record the level of any spurious emissions that are less than 60 dB below PEP. Use the "Find Peak" and "Next Peak" functions. Verify that all spurious emissions (excluding those within ±10 kHz of the carrier frequency) are at least 60 dB below the peak envelope power.	
13	Set the center frequency of the spectrum analyzer to 8 MHz.	Record the level of any spurious emissions that are less than 60 dB below PEP. Use the "Find Peak" and "Next Peak" functions. Verify that all spurious emissions are at least 60 dB below the peak envelope power.	
14	Set the center frequency of the spectrum analyzer to 12 MHz.	Record the level of any spurious emissions that are less than 60 dB below PEP. Use the "Find Peak" and "Next Peak" functions. Verify that all spurious emissions are at least 60 dB below the peak envelope power.	
15	Set the center frequency of the spectrum analyzer to 16 MHz.	Record the level of any spurious emissions that are less than 60 dB below PEP. Use the "Find Peak" and "Next Peak" functions. Verify that all spurious emissions are at least 60 dB below the peak envelope power.	
16	Set the center frequency of the spectrum analyzer to 20 MHz.	Record the level of any spurious emissions that are less than 60 dB below PEP. Use the "Find Peak" and "Next Peak" functions. Verify that all spurious emissions are at least 60 dB below the peak envelope power.	
17	Set the center frequency of the spectrum analyzer to 24 MHz.	Record the level of any spurious emissions that are less than 60 dB below PEP. Use the "Find Peak" and "Next Peak" functions. Verify that all spurious emissions are at least 60 dB below the peak envelope power.	
18	Set the center frequency of the spectrum analyzer to 28 MHz.	Record the level of any spurious emissions that are less than 60 dB below PEP. Use the "Find Peak" and "Next Peak" functions. Verify that all spurious emissions are at least 60 dB below the peak envelope power.	
19	Steps 20 through 26 measure intermodulation products in the adjacent channel.		
20	Tune UUT.	Frequency: 8.0000 MHz; Mode: LSB	

Table C-5.1. Procedures for Spectral Containment of Transmitted Signal Subtest (continued)

Step	Action	Settings/Action	Result
21	Set up audio generator.	Frequency A: Channel 1 800 Hz Frequency B: Channel 1 1125 Hz Raise level of audio to drive transmitter to rated PEP. Both frequencies must be the same level going into the UUT.	
22	Set up spectrum analyzer.	Center Frequency: 8.0000 MHz Frequency Span: 10 kHz RBW: 30 Hz VBW: 30 Hz Sweep: Single Noise Level: Off	
23	Key radio and capture the spectrum analyzer display.	Set reference level on spectrum analyzer so the highest point is at 0 dB.	
24	Measure peaks on spectrum.	Identify the highest two peaks in the adjacent passband on the spectrum analyzer. Record the frequency and the difference (dB) between peak levels and two-tone levels.	
		Peak 1	
		Peak 2	
25	Analyze the IMD products.	Record the highest peak value (dB) in step 24.	
26	Print the spectrum captured on spectrum analyzer.		
Legend: dB – decibels; Hz –hertz; IMD – Intermodulation Distortion; kHz – kilohertz; LSB – Lower Sideband; MHz – megahertz; PEP – Peak Envelope Power; RBW – Resolution Bandwidth; USB – Upper Sideband; UUT – Unit Under Test; VBW – Video Bandwidth			

C-5.4 Presentation of Results. The results will be shown in tabular format (table C-5.2) indicating the requirement and measured value or indications of capability.

Table C-5.2. Spectral Containment of Transmitted Signal Results

Reference Number	STANAG 4203 Annex B Paragraph	Requirement	Result		Finding	
			Required Value	Measured Value	Met	Not Met
7	7	99% of the total mean radiated power shall be contained within a bandwidth of 3000 Hz; the power of any spurious emission shall be at least 40 dB below the peak envelope power within ±10 kHz of the carrier frequency and at least 60 dB below the peak envelope power at any other frequency, Inter-modulation products in the adjacent channel shall be at least 30 dB below the level of either of the two equal tones modulation the transmitter at peak envelope power.	99% of power contained in 3 kHz bandwidth.			
			Spurs: ±10 kHz: 40 dB down > ±10 kHz: 60 dB down			
			IMD: 30 dB below PEP			

Legend: dB – decibels; Hz – hertz; IMD – Intermodulation Distortion; kHz – kilohertz; PEP – Peak Envelope Power; STANAG – Standardization Agreement

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C-6 SUBTEST 6, MODULATION

C-6.1 Objective. To determine the extent of compliance with the requirements for modulation of the transmitted radio signal, (table B-1, reference numbers 8 and 9).

C-6.2 Criteria

a. (1) Single Channel Radio Teletype (RATT) shall be sent by two-tone Frequency Shift Keying (FSK) with a mark (or 1) frequency of 1575 Hz ±5 Hz and a space (or 0) frequency of 2425 Hz ±5 Hz (2000 Hz sub-carrier with a 425 Hz shift); or 1615 Hz with a sub-carrier shift of –42.5 Hz ±1 Hz representing a mark (or 1), and a shift of +42.5 Hz ±1 Hz representing a space (or 0).

(2) Multi-channel RATT shall be sent by two-tone FSK of sub carriers centered on 425 Hz, 595 Hz, 935 Hz, 1105 Hz, 1275 Hz, 1445 Hz, and 1615 Hz, with a sub-carrier shift of ±42.5 Hz ±1 Hz. In multi-channel fleet broadcast operation, it shall be normally arranged that the channel centered on 765 Hz can be received as a single channel.

(3) Morse telegraphy shall be sent by on-off keying of a 1000 Hz ±5 Hz tone at rates up to 30 words per minute (wpm) (manual) and up to 300 wpm (burst).

(4) Digital voice at 2400 bps when using the vocoder specified in STANAG 4198, shall be sent by means of a modem having the characteristics specified in STANAG 4197.

(5) For narrowband, direct printing telegraphy in the maritime mobile service, the International Telecommunications Union (ITU) has outlined parameters in the Radio Regulations. These provide for F1B emissions of 170 Hz frequency shift at a maximum rate of 100 baud. The frequency tolerance is cited as ±40 Hz for ship equipment and ±15 Hz for coast stations.

(6) Single channel data transmissions using common single channel radio equipment and sent by means of modems (internal/external) at data rates of 75 bps and above (i.e. 75, 150, 300, 600, 1200, and 2400 bps) shall be sent by the (serial-tone) waveforms as described in the referenced STANAG's 4285, 4415, 4529, 4538, and 4539. Note: Independent Sideband (ISB) (6 kHz operation) is likely to be required to support future enhanced data rate modes yet to be standardized. (STANAG 4203 annex B, paragraph 8)

b. Equipment shall be capable of operating in the single frequency simplex/half-duplex mode; split frequency half-duplex mode is highly desirable. (STANAG 4203 annex B, paragraph 9)

C-6.3 Test Procedures

a. Test Equipment Required

(1) Bit Error Rate Tester

(2) Oscilloscope

(3) Attenuators

(4) Personal Computer with Morse Code Software

(5) Modems (KY-99, RF-5710A, MDM-2001)

b. Test Configuration. Figures C-6.1 and C-6.2 show the equipment setup for this subtest.

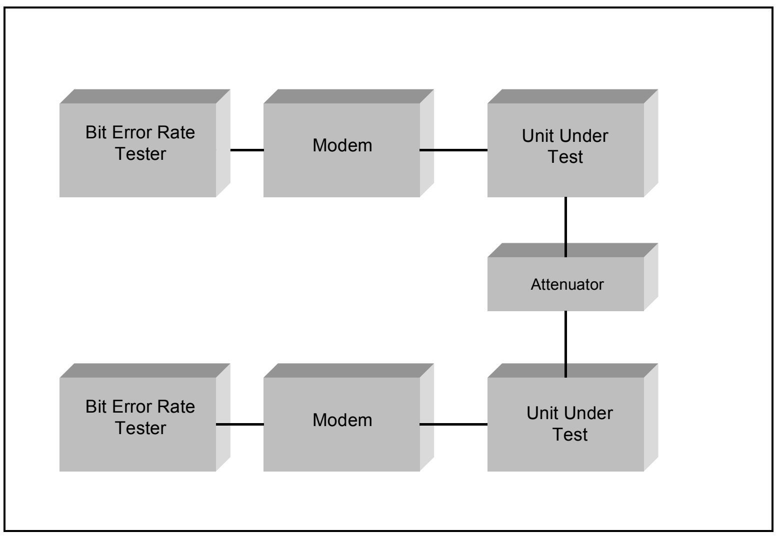

Figure C-6.1. Equipment Configuration for Modulation Subtest

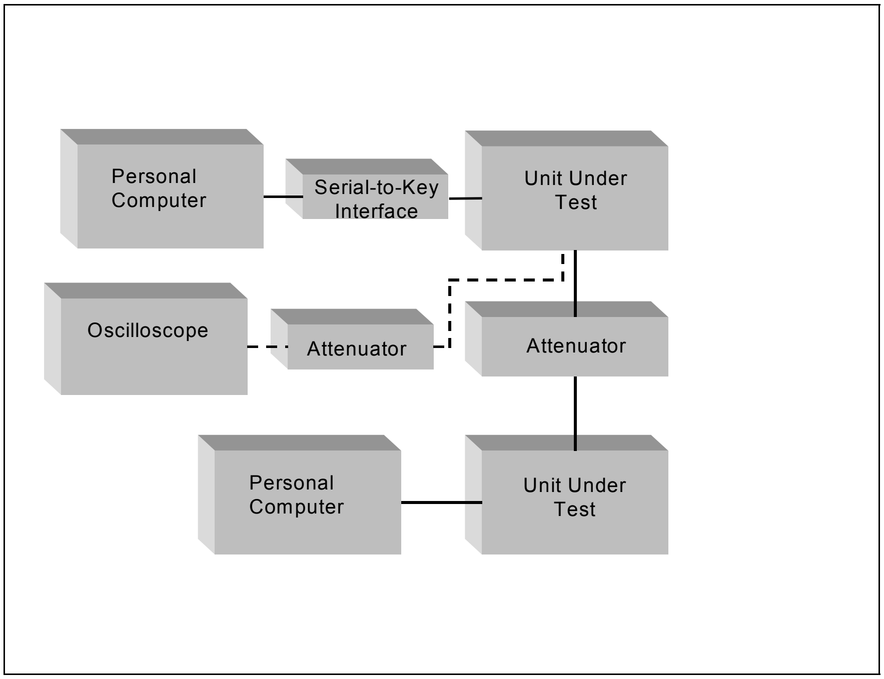

Figure C-6.2. Equipment Configuration for Morse Telegraphy

Table C-6.1. Procedures for Modulation Subtest

Step	Action	Settings/Action	Result
The following procedure is for reference number 8.			
1	Set up equipment.	See figure C-6.1.	
2	Set up UUTs.	Frequency: 12.000 MHz Mode: USB AGC: DATA	
3	Set up oscilloscope.	Channel 1: 5 mV/div, 1 msec/div	
4	Set up BERT.		
5	Single channel RATT: Program RF-5710A modems for FSK operation at 600 bps (2000 Hz sub-carrier with 425 Hz shift).	Run test for 15 minutes. Record number of errors.	
6	Single channel RATT: Program RF-5710A modems for FSK operation at 75 bps for 1615 Hz with a sub-carrier shift of –42.5 Hz representing a mark (or 1) and a shift of +42.5 Hz representing a space (or 0).	Run test for 15 minutes. Record number of errors.	
7	Program RF-5710A modems to provide FSK emissions of 170 Hz frequency shift at a rate of 100 baud with a 1000 Hz center frequency.	Run test for 15 minutes. Record number of errors.	

Table C-6.1. Procedures for Modulation Subtest (Continued)

Step	Action	Settings/Action	Result
8	Multi-channel RATT: Program MDM-2001 modems to send 8 tone FSK modulation with sub-carriers centered on 425 Hz, 595 Hz, 935 Hz, 1105 Hz, 1275 Hz, 1445 Hz, and 1615 Hz, with a sub-carrier shift of ±42.5 Hz.	Run test for 15 minutes. Record number of errors.	
9	Serial-tone waveforms: Program RF-5710A modems to send serial-tone waveforms at 75 bps.	Run test for 15 minutes. Record number of errors.	
10	Program RF-5710A modems to send serial-tone waveforms at 150 bps.	Run test for 15 minutes. Record number of errors.	
11	Program RF-5710A modems to send serial-tone waveforms at 300 bps.	Run test for 15 minutes. Record number of errors.	
12	Program RF-5710A modems to send serial-tone waveforms at 600 bps.	Run test for 15 minutes. Record number of errors.	
13	Program RF-5710A modems to send serial-tone waveforms at 1200 bps.	Run test for 15 minutes. Record number of errors.	
14	Program RF-5710A modems to send serial-tone waveforms at 2400 bps.	Run test for 15 minutes. Record number of errors.	
15	Digital voice: Replace modems with KY99s	Send digital voice at 2400 bps. Measure voice quality using Rhyme test (with scale from 1 to 5; 5 being highest quality voice and 1 being unintelligible voice).	
16	Morse telegraphy: Set up equipment.	As shown in figure C-6.2. Place UUT in CW Mode.	
17	Using Oscilloscope, measure and record the frequency of the CW tone.	Verify that the tone is at 1000 Hz ±5 Hz.	
18	Use CwType (shareware) software to send Morse telegraphy at 30 wpm.	Verify that UUT is capable of sending Morse telegraphy at 30 wpm. Use CwGet (shareware) software to receive the Morse telegraphy.	
19	Place UUT in USB Mode.	Configure the Serial-to-Key interface between the PC and UUT to key the radio, and add the CW tone to drive the transmitter. See note 1.	
20	Use CwType software to send the characters "TST" using Morse telegraphy at 300 wpm.	Verify that UUT is capable of sending Morse telegraphy at 300 wpm. Use CwGet software to receive the Morse telegraphy.	

Table C-6.1. Procedures for Modulation Subtest (Continued)

Step	Action	Settings/Action	Result
The following procedure is for reference number 9.			
21	Is the UUT capable of operating in the single frequency simplex/half duplex mode?		
Note 1. The Serial-to-Key interface is a circuit that allows the PC to key the radio using its serial port. Drawings are available under the help menu in CwType. **Legend:** AGC – Automatic Gain Control; BERT – Bit Error Rate Tester; bps – bits per second; CW – Continuous Wave; FSK – Frequency Shift Keying; Hz – hertz; MHz – megahertz; msec – millisecond; PC – Personal Computer; RATT – Radio Teletype; USB – Upper Sideband; UUT – Unit Under Test; wpm – words per minute			

C-6.4 Presentation of Results. The results will be shown in table C-6.2 indicating the requirement and measured value or indications of capability.

Table C-6.2. Modulation Subtest Results

Reference Number	STANAG 4203 Annex B Paragraph	Requirement	Result		Finding	
			Required Value	Measured Value	Met	Not Met
8	8b	Single channel RATT shall be sent by two-tone FSK with a mark (or 1) frequency of 1575 Hz ±5 Hz and a space (or 0) frequency of 2425 Hz ±5 Hz (2000 Hz sub-carrier with 425 Hz shift) or 1615 Hz with a sub-carrier shift of –42.5 Hz ±1 Hz representing a mark (or 1) and a shift of +42.5 Hz ±1 Hz representing a space (or 0).	BER = 0 over 15 minute test period.			
8	8c	Multi-channel RATT shall be sent by two-tone FSK of sub-carriers centered on 425 Hz, 595 Hz, 935 Hz, 1105 Hz, 1275 Hz, 1445 Hz and 1615 Hz, with a sub-carrier shift of ±42.5 Hz ±1 Hz. In Multi-channel fleet broadcast operation it shall be normally arranged that the channel centered on 765 Hz can be received as a single channel*).	BER = 0 over 15 minute test period.			
8	8d	Morse telegraphy shall be sent by on-off keying of a 1000 Hz ±5 Hz tone at rates up to 30 wpm (manual) and up to 300 wpm (burst).	Tone: 1000 Hz ±5 Hz Manual: 30 wpm Burst: 300 wpm			
8	8e	Digital voice at 2400 bps when using the vocoder specified in STANAG 4198, shall be sent by means of a modem having the characteristics specified in STANAG 4197.	Voice Quality = 4 or 5 (Rhyme Test)			

Table C-6.2. Modulation Subtest Results (continued)

Reference Number	STANAG 4203 Annex B Paragraph	Requirement	Result		Finding	
			Required Value	Measured Value	Met	Not Met
8	8f	For narrowband direct printing telegraphy in the maritime mobile service, the ITU has outlined parameters in the Radio Regulations. These provide for F1B emissions of 170 Hz frequency shift at a maximum rate of 100 baud. The frequency tolerance is cited as ±40 Hz for ship equipment and ±15 Hz for coast stations.	BER = 0 over 15 minute test period.			
8	8g	Single channel data transmissions using COMMON single channel radio equipment and sent by means of modems (internal/external) at data rates of 75 bps and above shall be sent by the (serial-tone) waveforms as described in the referenced STANAG's 4285, 4415, 4529, 4538, and 4539. Note: ISB (6 kHz operation) is likely to be required to support future enhanced data rate modes yet to be standardized.	BER = 0 over 15 minute test period.			
9	9	Equipment shall be capable of operating in the single frequency simplex/half duplex mode, split frequency half duplex mode is highly desirable.	capable of operating in the single frequency simplex/half duplex mode			

Legend: BER – Bit Error Rate; bps – bits per second; FSK – Frequency Shift Keying; Hz – hertz; ISB – Independent Sideband; ITU – International Telecommunications Union; RATT – Radio Teletype; STANAG – Standardization Agreement; wpm – words per minute

C-7 SUBTEST 7, TRANSMIT/RECEIVE SWITCHING TIME

C-7.1 Objective. To determine the extent of compliance with the requirements for changeover times between transmit and receive modes, (table B-1, reference number 10).

C-7.2 Criteria. The changeover time between transmit and receive modes shall meet the following requirements:

a. Transmit to receive changeover time shall not be greater than 15 msec from keying-off for the receiver to achieve 90% of full specified sensitivity. (STANAG 4203 annex B, paragraph 10)

b. Receive to transmit changeover time shall not be greater than 25 msec (10 msec highly desirable) from keying-on for the transmitter to achieve 90% of full specified output power. (STANAG 4203 annex B, paragraph 10)

C-7.3 Test Procedures

a. Test Equipment Required

(1) Oscilloscope

(2) Attenuators

(3) Signal Generator

(4) Break Out Box

(5) Audio Generator

(6) Dummy Load

(7) Directional Coupler

(8) Spectrum Analyzer

C-7.4 Test Configuration. Figures C-7.1 and C-7.2 show the equipment setup for this subtest.

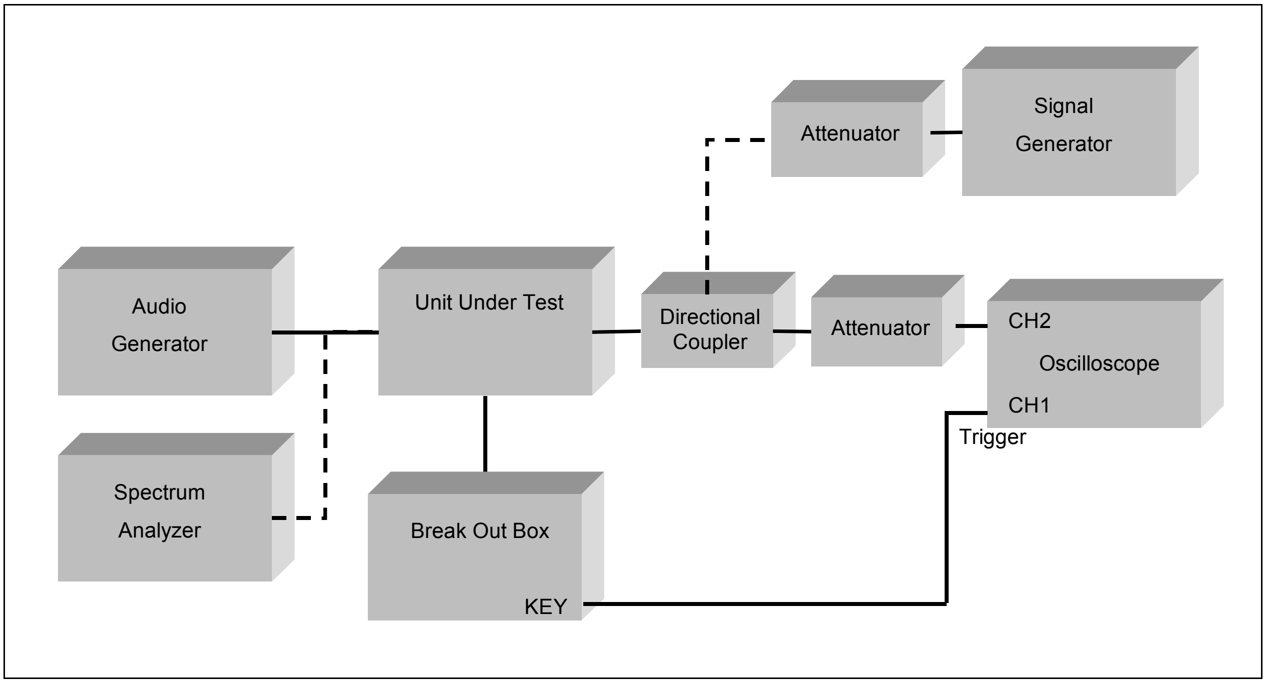

Figure C-7.1. Equipment Configuration for Receive to Transmit Changeover Time

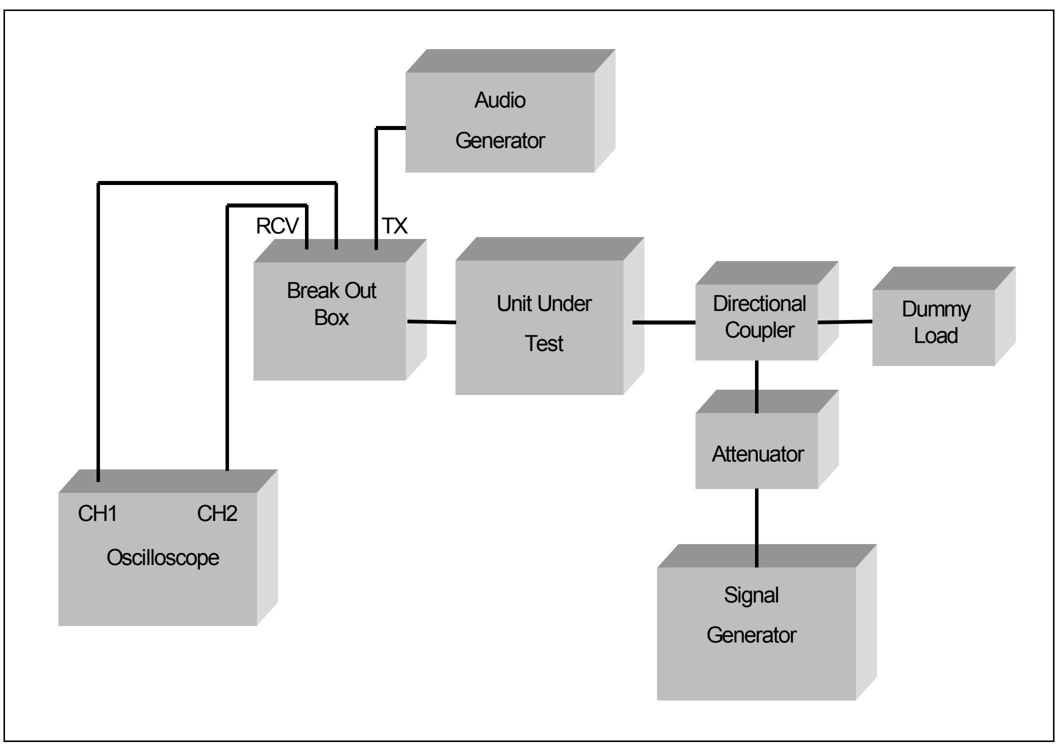

Figure C-7.2. Equipment Configuration for Transmit to Receive Changeover Time

Table C-7.1. Procedures for Receive to Transmit Changeover Time

Step	Action	Settings/Action	Result
The following procedure is for reference number 10.			
1	Set up equipment.	See figure C-7.1.	
2	Tune UUT.	Frequency: 8.0000 MHz; Mode: USB	
3	Set up oscilloscope.	Set horizontal scale to 5 msec/div. Set vertical scale to 0.5 V/div. Set trigger to single sweep. Trigger on channel 1, (+) slope.	
4	Set up signal generator.	Frequency: 8.001 MHz Level: -90 dBm (after attenuator)	
5	Set up audio generator.	Frequency: 1004 Hz Level: Drive transmitter to full rated PEP.	
6	Press RUN on oscilloscope and key UUT to capture the receive to transmit changeover time.		
7	Measure and record the receive to transmit changeover time.	The receive to transmit changeover time is measured by placing vertical marker #1 on the trigger position (from channel one), and vertical marker #2 at the point where the amplitude of the signal on channel two reaches 90% of its steady-state value. The time difference between the two vertical markers is the receive to transmit changeover time.	
Legend: Hz – hertz; MHz – megahertz; PEP – Peak Envelope Power; USB – Upper Sideband; UUT – Unit Under Test			

Table C-7.2. Procedures for Transmit to Receive Changeover Time

Step	Action	Settings/Action	Result
The following procedure is for reference number 10.			
1	Set up equipment.	See figure C-7.2.	
2	Tune UUT.	Frequency: 8.0000 MHz; Mode: USB	
3	Set up RF generator.	Frequency: 8.000 MHz + 1000 Hz Level: -90 dBm into UUT (after attenuator). Note: RF should always be on.	
4	Set up audio generator.	Frequency: 1004 Hz Level: Drive transmitter to full rated PEP.	
4	Set up oscilloscope.	Set horizontal scale to 2 msec/div. Set vertical scale to 0.5 V/div. Set trigger to channel 1, single sweep.	
5	Key UUT, press RUN on Oscilloscope, then key-off UUT to capture the transmit to receive changeover time.		

Table C-7.2. Procedures for Transmit to Receive Changeover Time (continued)

Step	Action	Settings/Action	Result
6	Measure and record the transmit to receive changeover time.	The transmit to receive changeover time is measured by placing vertical marker #1 on the point where the UUT is keyed-off (trigger position on channel 1), and vertical marker #2 at the point where the amplitude of the 1000 Hz audio signal increases to 90% of its steady-state value. The time difference between the two vertical markers is the transmit to receive changeover time.	
Legend: dBm – decibels referenced to one milliwatt; Hz – hertz; kHz – kilohertz; MHz – megahertz; USB – Upper Sideband;			

C-7.4 Presentation of Results. The results will be shown in table C-7.3 indicating the requirement and measured value or indications of capability.

Table C-7.3 Transmit/Receive Switching Time Results

Reference Number	STANAG 4203 Annex B Paragraph	Requirement	Result		Finding	
			Required Value	Measured Value	Met	Not Met
10	10	The changeover time between transmit and receive modes shall meet the following requirements: a) Transmit to receive changeover time shall not be greater than 15 msec from keying-off for the receiver to achieve 90% of full specified sensitivity. b) Receive to transmit changeover time shall not be greater than 25 msec (10 msec highly desirable) from keying-on for the transmitter to achieve 90% of full specified output power.	Transmit to Receive: > 15 msec Receive to Transmit: > 25 msec			
Legend: msec – milliseconds; STANAG – Standardization Agreement						

C-8 SUBTEST 8, GAIN CONTROL

C-8.1 Objective. To determine the extent of compliance with the requirements for Transmit Automatic Level Control and Receive Automatic Gain Control, (table B-1, reference numbers 11 and 12).

C-8.2 Criteria

a. Transmit Automatic Level Control (ALC). Transmitter ALC action in data modes shall be implemented in such a way as to not degrade waveform performance. Note: This is known to be a concern particularly for high order modulation schemes such as Quadrature Amplitude Modulation (QAM) (e.g. as used in STANAG 4539). (STANAG 4203 annex B, paragraph 11)

b. Receive Automatic Gain Control (AGC). These requirements apply to receivers that employ AGC. Any change in input level above the receiver AGC threshold shall produce an output change of less than ±3 dB. (STANAG 4203 annex B, paragraph 12)

The AGC time constants during non-data operating modes shall be as follows:

(1) Attack: < 30 msec.

(2) Decay: between 500 msec and 1.5 seconds.

The AGC time constants during single channel (not Link 11) data communications shall be as follows:

(1) Attack: < 10 msec.

(2) Decay: < 25 msec (modes not employing amplitude modulation)

(3) Decay: between 500 msec and 1 second. (modes employing amplitude modulation, e.g. QAM). (STANAG 4203 annex B, paragraph 12)

C-8.3 Test Procedures

a. Test Equipment Required

(1) Storage Oscilloscope

(2) Signal Generator

(3) Modem

(4) Distortion Analyzer

(5) Bit Error Rate Test Set

(6) Directional Coupler

b. Test Configuration. Figures C-8.1, C-8.2, C-8.3, and C-8.4 show the equipment setups for this subtest.

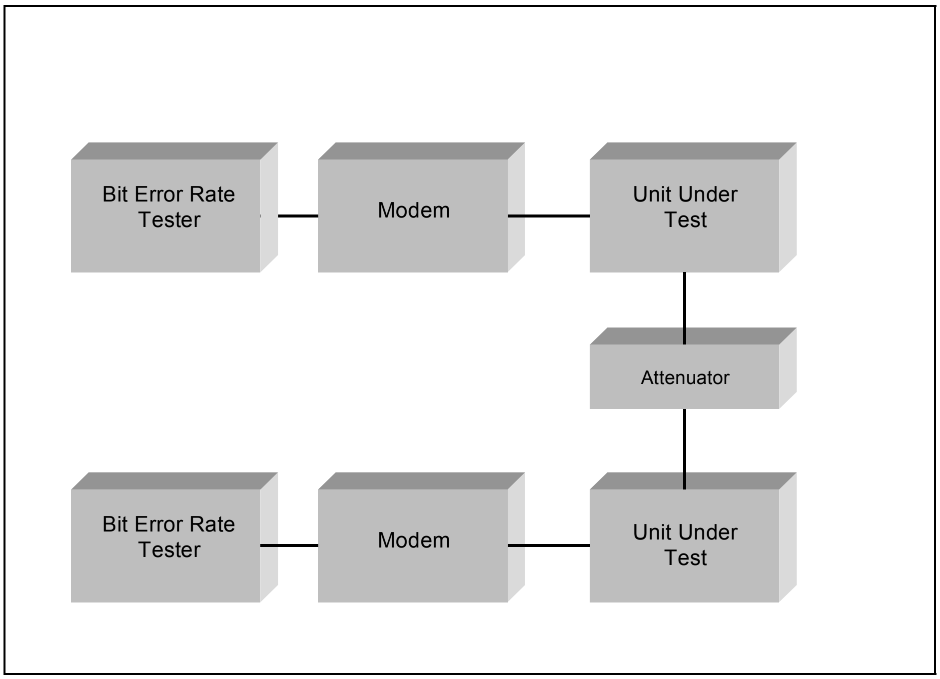

Figure C-8.1. Equipment Configuration for Transmit Automatic Level Control

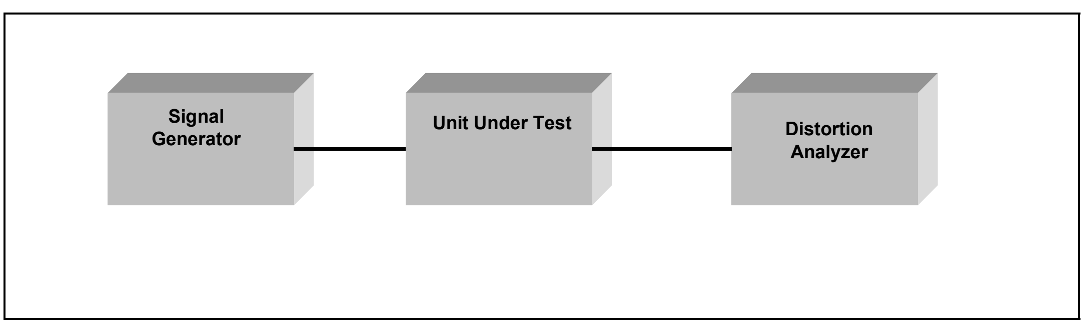

Figure C-8.2. Equipment Configuration for Automatic Gain Control Steady State

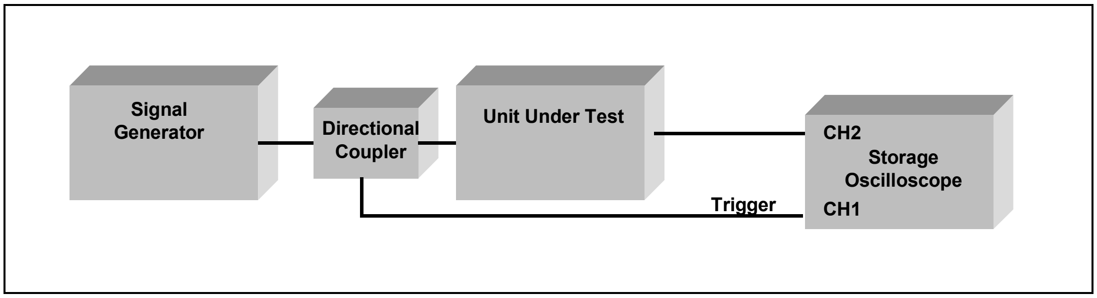

Figure C-8.3. Equipment Configuration for Automatic Gain Control Attack and Decay Time

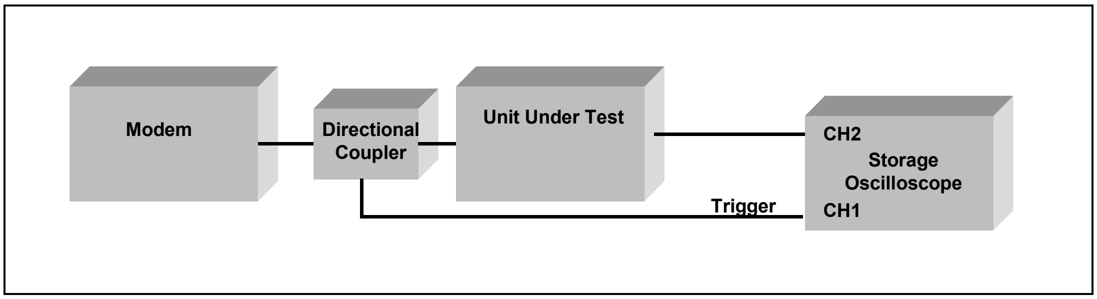

Figure C-8.4. Equipment Configuration for Automatic Gain Control Attack and Decay Time in DATA Mode

Table C-8.1. Procedures for Transmit Automatic Level Control Subtest

Step	Action	Settings/Action	Result
The following procedure is for reference number 11.			
1	Set up equipment.	See figure C-8.1.	
2	Set up UUT.	Frequency: 8.000 MHz; Mode: USB	
3	Set up modem for QAM(64) modulation at 9600 bps.	If an internal modem is being used that does not support QAM(64), acquire external modem that supports QAM(64).	
4	Increase modem output level until the transmitter ALC reacts.		
5	Set BERT to 2047 pattern.	Run test for 15 minutes.	
6	Record bit error rate.		
Legend: ALC – Automatic Level Control; BERT – Bit Error Rate Tester; MHz – megahertz; QAM – Quadrature Amplitude Modulation; USB – Upper Sideband			

Table C-8.2. Procedures for Automatic Gain Control Steady State

Step	Action	Settings/Action	Result
		The following procedure is for reference number 12.	
1	Set up equipment.	See figure C-8.2.	
2	Set up distortion analyzer.	Input: Normal Function: Voltmeter Mode: Automatic Termination: 600Ω	
3	Tune UUT.	Frequency: 8.000 MHz; Mode: USB	
4	Set RF signal generator to test frequency + 1 kHz.	Set RF signal generator output level < -120 dBm.	
5	Increase RF signal generator output level in 1 dB steps until AGC threshold triggers. Record RF output level of the signal generator at AGC threshold, and the audio output level of the UUT.	The AGC threshold is found by increasing the level of the RF signal generator until the audio output level of the receiver reaches steady state.	
6	Increase RF signal generator output level in 3 dB steps until +13 dBm is reached.	Record RF output level of the signal generator, and audio output level of the UUT each time the RF output level is incremented.	**Audio Level**
		Step 1:	
		Step 2:	
		Step 3:	
		Step 4:	
		Step 5:	
		Step 6:	
		Step 7:	
		Step 8:	
		Step 9:	
		Step 10:	
		Step 11:	
		Step 12:	
		Step 13:	
		Step 14:	
		Step 15:	
		Step 16:	
		Step 17:	
		Step 18:	
		Step 19:	
		Step 20:	
		Step 21:	
		Step 22:	
		Step 23:	
		Step 24:	
		Step 25:	
7	Review the results of step 6, and verify that the change in audio output level of the UUT is less than ±3 dB for each RF input level.		

Legend: AGC – Automatic Gain Control; dBm – decibels referenced to 1 milliwatt; MHz – megahertz; RF – Radio Frequency; USB – Upper Sideband; UUT – Unit Under Test; Ω – Ohm; < – less than

Table C-8.3. Procedures for Automatic Gain Control Attack Time

Step	Action	Settings/Action	Result
The following procedure is for reference number 12.			
1	Set up equipment.	See figure C-8.3.	
2	Set up oscilloscope.	Set horizontal scale to 5 msec/div. Set vertical scale to 0.5 V/div. Set trigger to single sweep, 50%, channel 1.	
3	Tune UUT to 8.000 MHz, USB.	Set AGC to MEDIUM (if available).	
4	Set RF signal generator to test frequency + 1 kHz.	Set RF signal generator output level to 0 dBm.	
5	Using a directional coupler, trigger the oscilloscope on channel one with the RF ON/OFF of the RF signal generator.		
6	Turn RF output off. Select RUN on oscilloscope.	Turn RF output on to capture the attack time.	
7	Measure the AGC attack time delay.	The attack time delay is measured by placing vertical marker #1 at the point where the RF output on the signal generator is turned on (measured on channel one), and vertical marker #2 at the point where the amplitude of the audio signal on channel two reaches 90% of its steady-state value. The time difference between the two vertical markers is the attack time delay.	
Legend: AGC – Automatic Gain Control; dBm – decibels referenced to one milliwatt; kHz – kilohertz; MHz – megahertz; RF – Radio Frequency; USB – Upper Sideband; V/div – Volts per division			

Table C-8.4. Procedures for Automatic Gain Control Decay Time

Step	Action	Settings/Action	Result
The following procedure is for reference number 12.			
1	Set up equipment.	See figure C-8.3.	
2	Set up oscilloscope.	Set horizontal scale to 5 msec/div. Set vertical scale to 0.5 V/div. Set trigger to single sweep, 50%, channel 1.	
3	Tune UUT to 8.000 MHz, USB.	Set AGC to MEDIUM (if available).	
4	Set RF signal generator to test frequency + 1 kHz.	Set RF signal generator output level to 0 dBm.	
5	Using a directional coupler, trigger the oscilloscope with the RF ON/OFF of the RF signal generator.		
6	Turn RF output on. Select RUN on oscilloscope.	Turn RF output off to capture the decay time.	

Table C-8.4. Procedures for Automatic Gain Control Decay Time (Continued)

Step	Action	Settings/Action	Result
7	Measure the AGC decay time.	The decay time is measured by placing vertical marker #1 at the point on channel one where the RF output on the signal generator is turned off, and placing vertical marker #2 at the point where the amplitude of the audio signal on channel two decreases to 10% of its keyed-on steady-state value. The time difference between the two vertical markers is the decay time.	
Legend: AGC – Automatic Gain Control; dBm – decibels referenced to one milliwatt; kHz – kilohertz; MHz – megahertz; msec – millisecond; RF – Radio Frequency; USB – Upper Sideband; V/div – Volts per division			

Table C-8.5. Procedures for Automatic Gain Control Data Mode

Step	Action	Settings/Action	Result
The following procedure is for reference number 12.			
1	Set up equipment.	See figure C-8.4.	
2	Set up oscilloscope.	Set horizontal scale to 5 msec/div. Set vertical scale to 0.5 V/div. Set trigger to single sweep, 50%, channel 1.	
3	Tune UUT to 8.000 MHz, USB.	Set AGC to DATA (if available).	
4	Program RF-5710A modem for PSK operation at 2400 bps.		
5	Using a directional coupler, trigger the oscilloscope on channel one with the KEY ON/OFF of the RF-5710A modem.		
6	Un-key modem. Select RUN on oscilloscope.	Key modem to capture the attack time.	
7	Measure the AGC attack time.	The attack time delay is measured by placing vertical marker #1 at the point where the modem begins sending data (measured on channel one), and vertical marker #2 at the point where the amplitude of the audio signal on channel two reaches 90% of its steady-state value. The time difference between the two vertical markers is the attack time delay.	
8	Verify that the AGC attack time is < 10 msec.		
9	Key modem. Select RUN on oscilloscope.	Un-key modem to capture the decay time.	

Table C-8.5. Procedures for Automatic Gain Control Data Mode (Continued)

Step	Action	Settings/Action	Result
10	Measure the AGC decay time.	The decay time is measured by placing vertical marker #1 at the point on channel one where the modem is un-keyed, and placing vertical marker #2 at the point where the amplitude of the audio signal on channel two decreases to 10% of its keyed-on steady-state value. The time difference between the two vertical markers is the decay time.	
11	Verify that the AGC decay time is < 25 msec.		
12	Program modem for QAM modulation at 9600 bps.		
13	Key modem. Select RUN on oscilloscope.	Un-key modem to capture the decay time.	
14	Measure the AGC decay time.	The decay time is measured by placing vertical marker #1 at the point on channel one where the modem is un-keyed, and placing vertical marker #2 at the point where the amplitude of the audio signal on channel two decreases to 10% of its keyed-on steady-state value. The time difference between the two vertical markers is the decay time.	
15	Verify that the AGC decay time is between 500 msec and 1 second.		
Legend: AGC – Automatic Gain Control; bps – bits per second; FSK – Frequency Shift Keying; MHz – megahertz; msec – millisecond; QAM – Quadrature Amplitude Modulation; USB – Upper Sideband; V/div – Volts per division			

C-8.4 Presentation of Results. The results will be shown in table C-8.6 indicating the requirement and measured value or indications of capability.

Table C-8.6. Gain Control Subtest Results

Reference Number	STANAG 4203 Annex B Paragraph	Requirement	Result		Finding	
			Required Value	Measured Value	Met	Not Met
11	11	<u>Transmit Automatic Level Control (ALC)</u>. Transmitter ALC action in data modes shall be implemented in such a way as to not degrade waveform performance. Note: this is known to be a concern particularly for high order modulation schemes such as QAM (e.g. as used in STANAG 4539).	BER = 0 over 15 minute test period.			

Table C-8.6. Gain Control Subtest Results (continued)

Reference Number	STANAG 4203 Annex B Paragraph	Requirement	Result		Finding	
			Required Value	Measured Value	Met	Not Met
12	12	<u>Receive Automatic Gain Control</u>. These requirements apply to receivers that employ AGC. Any change in input level above the receiver AGC threshold shall produce an output change of less than ±3 dB. The AGC time constants during non-data operating modes shall be as follows: a) Attack: <30 msec. b) Decay: between 500 msec and 1.5 seconds. The AGC time constants during single channel (not Link 11) data communications shall be as follows: a) Attack: <10 msec. b) Decay: <25 msec (modes not employing amplitude modulation, e.g. PSK). c) Decay: between 500 msec and 1 seconds. (modes employing amplitude modulation, e.g. QAM).	Output change < ±3 dB Non-data modes: Attack: <30 msec Decay: Between 500 msec and 1.5 seconds Single channel data: Attack: <10ms Decay: <25ms (not employing AM) Modes employing AM: Decay: between 500 msec and 1 second.			

Legend: AGC – Automatic Gain Control; ALC – Automatic Level Control; AM – Amplitude Modulation; BER – Bit Error Rate; dB – decibels; msec – milliseconds; PSK – Phase Shift Keying; QAM – Quadrature Amplitude Modulation; sec – second; STANAG – Standardization Agreement; < – less than

C-9 SUBTEST 9, LINK 11 DATA LINK OPERATIONS

C-9.1 Objective. To determine the extent of compliance with the requirements for Link 11 data link operations, (table B-1, reference number 14).

C-9.2 Criteria. Link 11 data link operations, where employed, shall be as per STANAG 5511 and utilize Upper Sideband, Lower Sideband, or Independent Sideband modes. (STANAG 4203 annex C, paragraph 2)

C-9.3 Test Procedures

a. Test Equipment Required

(1) Audio Generator

(2) Spectrum Analyzer

(3) Attenuator

b. Test Configuration. Figure C-9.1 shows the equipment setup for this subtest.

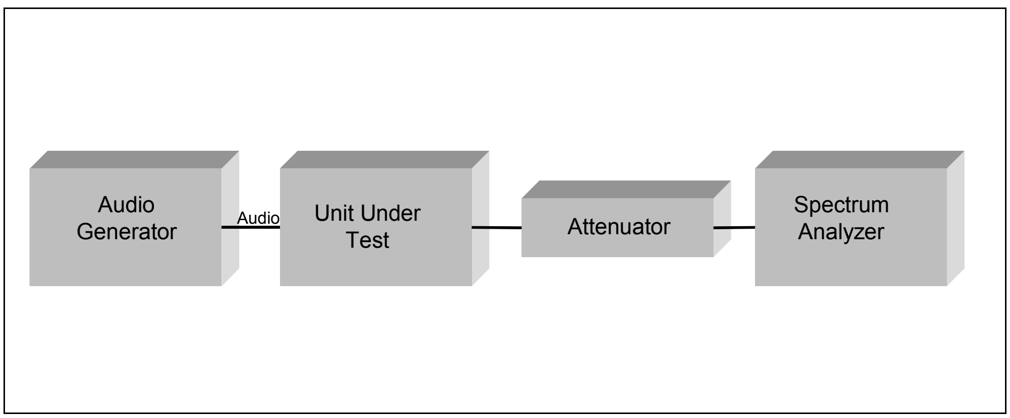

Figure C-9.1. Equipment Configuration for Link 11 Data Link Operations Subtest

Table C-9.1. Procedures for Link 11 Data Link Operations Subtest

Step	Action	Settings/Action	Result
The following procedure is for reference number 14.			
1	Set up equipment.	See figure C-9.1.	
2	Set up spectrum analyzer.	Center Frequency: 8.000 MHz Span: 4 kHz RBW: 100 Hz VBW: 100 Hz Sweep Time: 2.0 seconds Reference Level: As required to prevent overload. Max Hold: On	
3	Set up audio generator.	Channel 1: 1004 Hz Channel 2: 1004 Hz Level: Drive UUT to full rated PEP.	
4	Tune UUT.	Frequency: 8.000 MHz	
5	Put UUT in USB mode and transmit a 1004 Hz tone from channel one of the audio generator.	Record the power output and spectrum using the spectrum analyzer.	
6	Put UUT in LSB mode and transmit a 1004 Hz tone from channel one of the audio generator.	Record the power output and spectrum using the spectrum analyzer.	
7	Put UUT in ISB mode and transmit two 1004 Hz tones from channels one and two of the audio generator.	Record the power output and spectrum using the spectrum analyzer.	
Legend: Hz – hertz; ISB – Independent Sideband; kHz – kilohertz; LSB – Lower Sideband; MHz – megahertz; PEP – Peak Envelope Power; RBW – Resolution Band Width; USB – Upper Sideband; UUT – Unit Under Test; VBW – Video Bandwidth			

C-9.4 Presentation of Results. The results will be shown in table C-9.2 indicating the requirement and measured value or indications of capability.

Table C-9.2. Link 11 Data Link Operations Subtest Results

Reference Number	STANAG 4203 Annex C Paragraph	Requirement	Results	Finding	
				Met	Not Met
14	2	Link 11 data link operations, where employed, shall be as per STANAG 5511 and utilize USB, LSB, or ISB modes.	Does UUT Utilize USB mode? ☐ Yes ☐ No		
			Does UUT Utilize LSB mode? ☐ Yes ☐ No		
			Does UUT Utilize ISB mode? ☐ Yes ☐ No		
Legend: ISB – Independent Sideband; LSB – Lower Sideband; STANAG – Standardization Agreement; USB – Upper Sideband; UUT – Unit Under Test					

C-10 SUBTEST 10, LOWER SIDEBAND

C-10.1 Objective. To determine the extent of compliance with the requirements for lower sideband operation, (table B-1, reference number 13).

C-10.2 Criteria

a. For analog voice, digital voice and in-band Radio Teletype (RATT)/data, the carrier shall be Single Sideband (SSB) suppressed-carrier modulated, with the carrier and Lower Sideband (LSB) suppressed to at least 40 dB below the PEP. (STANAG 4203 annex B, paragraph 8)

b. For LSB operation or the LSB during Independent Sideband (ISB) operation the amplitude versus frequency response between (f_0 – 300 Hz) and (f_0 – 3050 Hz) shall be within 3 dB (total) where f_0 is the carrier frequency. The attenuation shall be at least 20 dB from f_0 to (f_0 + 400 Hz), and at least 60 dB above (f_0 + 400 Hz). Attenuation shall be at least 40 dB from (f_0 – 3500 Hz) to (f_0 – 4000 Hz) and at least 60 dB below (f_0 – 4000 Hz). (STANAG 4203 annex C, paragraph 3)

C-10.3 Test Procedures

a. Test Equipment Required

(1) Spectrum Analyzer

(2) Audio Generator

(3) Watt Meter

(4) Radio Frequency Attenuator

(5) Modem

b. Test Configuration. Figure C-10.1 shows the equipment setup for this subtest.

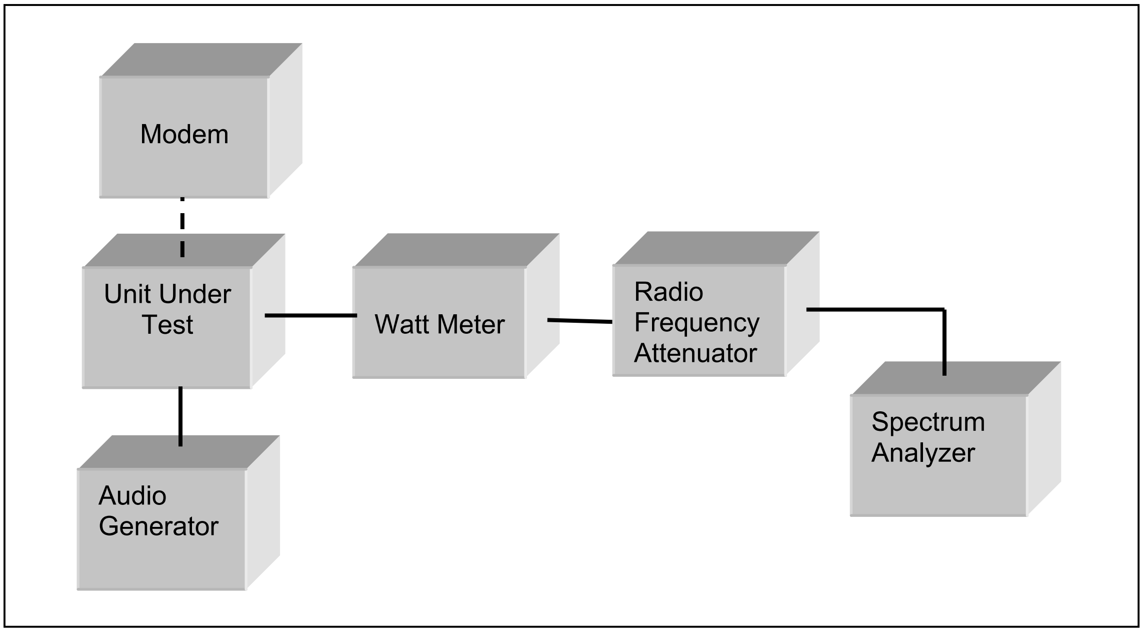

Figure C-10.1. Equipment Configuration for Lower Sideband Subtest

Table C-10.1. Procedures for Lower Sideband Subtest

Step	Action	Settings/Action	Result
The following procedure is for reference numbers 8 and 13.			
1	Set up equipment.	See figure C-10.1.	
2	Tune UUT.	Frequency: 8.0000 MHz; Mode: LSB	
3	Modulate transmitter to full rated PEP using audio generator at 1004 Hz.	Determine with measurement from watt meter.	
4	Set up spectrum analyzer.	Set reference level on spectrum analyzer to 0 and turn Max Hold on. Center Frequency: 8.0000 MHz Span: 12 kHz (15 kHz for four channel radio) RBW: 30 Hz VBW: 30 Hz	
5	Sweep the audio generator from 300 Hz to 5000 Hz in 100 Hz steps.		
6	From spectrum analyzer display, verify that the amplitude of the signal from f_0 - 300 Hz to f_0 - 3050 Hz is within 3 dB (total).	Print spectrum analyzer display.	
7	Check frequency response from f_0 - 3500 Hz to f_0 - 4000 Hz.	Verify that the attenuation is at least 40 dB.	
8	Check frequency response -4000 Hz below the carrier.	Verify that the attenuation below f_0 - 4000 Hz is at least 60 dB.	
9	Check frequency response from the carrier to +400 Hz.	Verify that the attenuation from f_0 to f_0 + 400 Hz is at least 20 dB.	
10	Check frequency response +400 Hz above the carrier.	Verify that the attenuation above f_0 + 400 Hz is at least 60 dB.	
11	Place UUT in USB mode.		

Table C-10.1. Procedures for Lower Sideband Subtest (Continued)

Step	Action	Settings/Action	Result
12	Transmit a 1000 Hz tone from the audio generator.	Use spectrum analyzer to verify that the carrier and LSB are suppressed to at least 40 dB below the PEP.	
13	In-band RATT/DATA: Program RF-5710A modem for FSK operation at 600 bps. Connect the modem to UUT as shown in figure C-10.1.	Transmit data and verify that the carrier and the LSB are suppressed to at least 40 dB below the PEP.	
14	Replace modem with KY99A. Place UUT in USB mode. Set the center frequency to 8.000 MHz.	Send digital voice at 2400 bps. Verify that the carrier and the LSB are suppressed to at least 40 dB below the PEP.	
Legend: bps – bits per second; dB – decibels; f_0 – Oscillator Frequency; Hz – hertz; ISB – Independent Sideband; kHz – kilohertz; LSB – Lower Sideband; MHz – megahertz; PEP – Peak Envelope Power; RATT – Radio Teletype; RBW – Resolution Bandwidth; USB – Upper Sideband; UUT – Unit Under Test; VBW – Video Bandwidth			

C-10.4 Presentation of Results. The results will be shown in table C-10.2 indicating the requirement and measured value or indications of capability.

Table C-10.2. Lower Sideband Subtest Results

Reference Number	STANAG 4203 Paragraph	Requirement	Result		Finding	
			Required Value	Measured Value	Met	Not Met
8	Annex B Paragraph 8	For analog voice, digital voice, and in-band RATT/data, the carrier shall be single sideband suppressed-carrier modulated, with the carrier and Lower Sideband suppressed to at least 40dB below the PEP.	Carrier and LSB suppressed 40 dB			
13	Annex C Paragraph 3	For LSB operation or the lower side band during ISB operation the amplitude versus frequency response between (f_0 – 300 Hz) and (f_0 – 3050 Hz) shall be within 3 dB (total) where f_0 is the carrier frequency.	Max – Min ≤ 3 dB	Max: Min:		
13	Annex C Paragraph 3	The attenuation shall be at least 20 dB from f_0 to (f_0 + 400 Hz)	20 dB attenuation			
13	Annex C Paragraph 3	and at least 60 dB above (f_0 + 400 Hz).	60 dB attenuation			
13	Annex C Paragraph 3	Attenuation shall be at least 40 dB from (f_0 – 3500 Hz) to (f_0 – 4000 Hz)	40 dB attenuation			
13	Annex C Paragraph 3	and at least 60 dB below (f_0 – 4000 Hz).	60 dB attenuation			
Legend: dB – decibels; f_0 – Oscillator Frequency; Hz – hertz; ISB – Independent Sideband; LSB – Lower Sideband; PEP – Peak Envelope Power; RATT – Radio Teletype; STANAG – Standardization Agreement						

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C-11 SUBTEST 11, AGC SSB/ISB OPERATION

C-11.1 Objective. To determine the extent of compliance with the requirements for Automatic Gain Control during SSB/ISB operation, (table B-1, reference number 15).

C-11.2 Criteria. During ISB operation, the AGC shall be developed independently for the two sidebands as specified in STANAG 5511. The implementation shall be such that the sideband of greater magnitude controls the gain of the receiver RF stages. When in SSB mode, the receiver shall prevent any AGC voltage developed by the unused sideband from controlling the RF gain. (STANAG 4203 annex C, paragraph 4)

C-11.3 Test Procedures

a. Test Equipment Required

(1) Dual Channel Signal Generator

(2) Spectrum Analyzer

b. Test Configuration. Figure C-11.1 shows the equipment setup for this subtest.

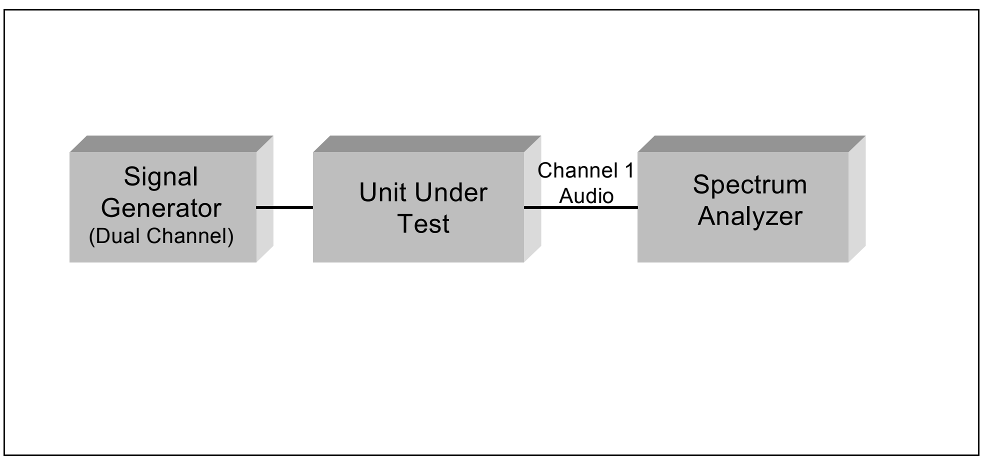

Figure C-11.1. Equipment Configuration for Automatic Gain Control Single Sideband/Independent Sideband Operation Subtest

Table C-11.1. Procedures for Automatic Gain Control Single Sideband/Independent Sideband Operation Subtest

Step	Action		Results
The following procedure is for reference number 15.			
1	Set up equipment.	See figure C-11.1.	
2	Tune UUT.	Frequency: 8.0000 MHz; Mode: USB	
3	Set up signal generator.	Channel 1: 8.001 MHz, -120 dBm Channel 2: 7.999 MHz, -120 dBm	
4	Set up spectrum analyzer.	Set reference level on spectrum analyzer to 0 dBm. Center Frequency: 2.5 kHz Span: 3 kHz RBW: 30 Hz VBW: 30 Hz	
5	Increase signal generator channel 1 output level in 1 dB steps until the AGC threshold triggers. Record the RF output level of the signal generator at AGC threshold.	The AGC threshold is found by increasing the level of the signal generator until the audio output level of the receiver reaches steady state.	
6	View the audio signal level on the spectrum analyzer.	Record the level of the signal for reference.	
7	Set the level of both channels of the signal generator 10 dBm below the AGC threshold found in step 5.	Increase the RF level of channel 2 in 3 dB steps to 11 dBm above the AGC threshold.	
8	Verify that increasing the RF level of channel two does not change the audio signal level out of the receiver.		
9	Place UUT in ISB mode.		
10	Set the level of signal generator channel 1 20 dBm above the AGC threshold found in step 5.	Set the level of signal generator channel 2 10 dBm below the AGC threshold found in step 5.	
11	Increase the RF level of channel 2 in 3 dB steps to 11 dBm above the AGC threshold.		
12	Verify that increasing the RF level of channel two does not change the RF gain of the receiver.		
Legend: AGC – Automatic Gain Control; dB – decibels; dBm – decibels referenced to one milliwatt; Hz – hertz; ISB – Independent Sideband; kHz – kilohertz; MHz – megahertz; RBW – Resolution Bandwidth; RF – Radio Frequency; USB – Upper Sideband; UUT – Unit Under Test; VBW – Video Bandwidth			

C-11.4 Presentation of Results. The results will be shown in table C-11.2 indicating the requirement and measured value or indications of capability.

Table C-11.2. Automatic Gain Control Single Sideband/Independent Sideband Operation Subtest Results

Reference Number	STANAG 4203 Annex C Paragraph	Requirement	Results	Finding: Met	Finding: Not Met
15	4	During ISB operation the AGC shall be developed independently for the two sidebands as specified in STANAG 5511. The implementation shall be such that the sideband of greater magnitude controls the gain of the receiver RF stages.	During ISB operation, is the AGC developed independently for the two sidebands? ☐ Yes ☐ No		
15	4	When in SSB mode, the receiver shall prevent any AGC voltage developed by the unused side band from controlling the RF gain.	When in SSB mode, does the receiver prevent any AGC voltage developed by the unused side band from controlling RF gain? ☐ Yes ☐ No		
Legend: AGC – Automatic Gain Control; ISB – Independent Sideband; RF – Radio Frequency; SSB – Single Sideband; STANAG – Standardization Agreement					

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APPENDIX D

REFERENCES

MILITARY STANDARD (MIL-STD)

D-1 MIL-STD-188-141B "Interoperability and Performance Standards for Medium and High Frequency Radio Systems," dated 1 March 1999

NORTH AMERICAN TREATY ORGANIZATION STANDARDIZATION AGREEMENT (STANAG)

D-2 STANAG 4203, "Technical Standards for Single Channel HF Radio Equipment," dated 31 May 1988