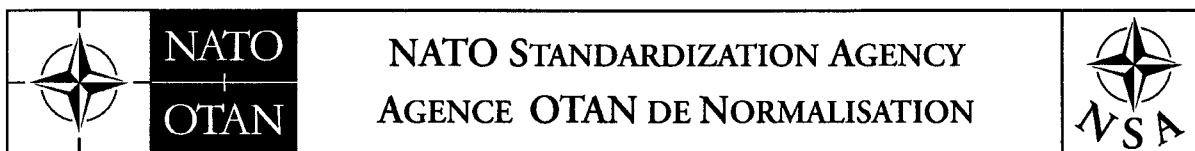


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27 April 2007

NSA/0428(2007)C3/4203

**STANAG 4203 C3 (EDITION 3) – TECHNICAL STANDARDS FOR SINGLE CHANNEL HF RADIO EQUIPMENT**

**References:**

- a. AC/322(SC/6)(DS(2006)0001, dated 6/03/2006, Para 10.2 and Annex 38
- b. AC/322(SC/6)N/455, dated 13 March 2002 (NU) – Ratification Request

1. The enclosed NATO Standardization Agreement, which has been ratified by nations as reflected in the **NATO Standardization Document Database (NSDD)**, is promulgated herewith.

2. The references listed above are to be destroyed in accordance with local document destruction procedures.

**ACTION BY NATIONAL STAFFS**

3. National staffs are requested to examine their ratification status of the STANAG and, if they have not already done so, advise the NHQC3S, through their national delegation as appropriate of their intention regarding its ratification and implementation.

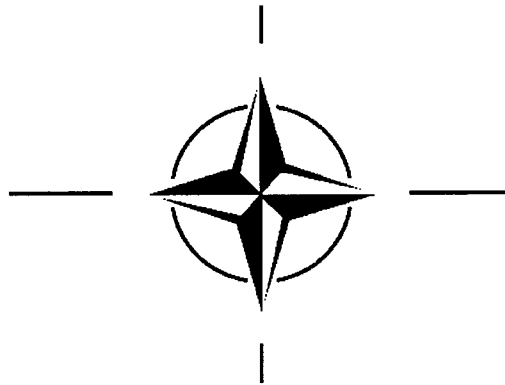


J. MAJ  
Major General, POL(A)  
Director, NSA

Enclosure:  
STANAG 4203 (Edition 3)

NATO Standardization Agency – Agence OTAN de Normalisation  
B-1110 Brussels, Belgium Internet site: <http://nsa.nato.int>  
E-mail: [c3s@hq.nato.int](mailto:c3s@hq.nato.int) – Tel 32.2.707.4311 – Fax 32.2.707.5709

**NORTH ATLANTIC TREATY ORGANIZATION  
(NATO)**



**NATO STANDARDIZATION AGENCY  
(NSA)**

**STANDARDIZATION AGREEMENT  
(STANAG)**

**SUBJECT: TECHNICAL STANDARDS FOR SINGLE CHANNEL HF RADIO  
EQUIPMENT**

Promulgated on 27 April 2007

A handwritten signature in black ink, appearing to read 'J. MAJ', is written over the printed name.

J. MAJ  
Major General, POL(A)  
Director, NSA

A handwritten signature in black ink, appearing to be the initials 'JMA', is written to the left of the printed name.

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RECORD OF AMENDMENTS

No.	Reference/date of Amendment	Date Entered	Signature

EXPLANATORY NOTES

AGREEMENT

1. This NATO Standardization Agreement (STANAG) is promulgated by the Director NATO Standardization Agency under the authority vested in him by the NATO Standardization Organisation Charter.
2. No departure may be made from the agreement without informing the tasking authority in the form of a reservation. Nations may propose changes at any time to the tasking authority where they will be processed in the same manner as the original agreement.
3. Ratifying nations have agreed that national orders, manuals and instructions implementing this STANAG will include a reference to the STANAG number for purposes of identification.

RATIFICATION, IMPLEMENTATION AND RESERVATIONS

4. Ratification, implementation and reservation details are available on request or through the NSA websites (internet <http://nsa.nato.int>; NATO Secure WAN <http://nsa.hq.nato.int>).

FEEDBACK

5. Any comments concerning this publication should be directed to NATO/NSA – Bvd Leopold III - 1110 Brussels - BE.

**NATO STANDARDIZATION AGREEMENT  
(STANAG)**

**TECHNICAL STANDARDS FOR SINGLE CHANNEL HF RADIO EQUIPMENT**

- Annexes:
- A. Terms and Definitions
  - B. Technical Standards to Ensure Interoperability of COMMON Single Channel HF Radio Equipment
  - C. Independent side-band (ISB) operations
  - D. References to more stringent HF radio requirements in other STANAGs.
  - E. Implementation matrix.

Related Documents for COMMON single channel radios:

- STANAG 4202 - Transmission envelope characteristics for high reliability data exchange between land tactical data processing equipment over single channel radio links.
- STANAG 4197 - Modulation and coding characteristics that must be common to assure interoperability of 2400 bps linear predictive encoded digital speech transmitted over HF radio facilities.
- STANAG 4285 - Characteristics of 1200/2400/3600 bits per second single tone modulators/demodulators for HF radio links.
- STANAG 4529 - Characteristics of single tone modulators/demodulators for maritime HF radio links with 1240 Hz bandwidth.
- STANAG 4415 - Characteristics of a robust, non-hopping, serial tone modulator/demodulator for severely degraded HF radio links.
- STANAG 4481 - Minimum technical equipment standards for naval HF shore to ship broadcast systems.
- STANAG 4538 - Technical standards for an Automatic Radio Control System (ARCS) for HF communication links.
- STANAG 4539 - Technical standards for non-hopping HF communication waveforms.
- STANAG 4591 - The 1K2 and 2K4 Nato interoperable narrow band voice coder.
- STANAG 5514 - Tactical data broadcasting - Link 14
- ACP-167 (G) - Glossary of communications - electronics terms
- ITU-R - Radio Regulations

**AIM**

1. The aim of this agreement is to define the technical standards required to ensure interoperability of land, air and maritime COMMON single channel HF radio equipment. For technical standards of SPECIFIC single channel radio equipment reference should be made to the appropriate STANAGs (e.g. STANAGs 4444 and 5511, see Annex D).

**AGREEMENT**

2. Participating nations agree to use the standards defined in this STANAG for the traffic mode or modes in which interoperability is required.

**GENERAL**

3. STANAG 4203 contains the minimum interoperability standards for single channel HF radio equipment. It does not contain performance specifications. For performance specifications reference should be made to other standards such as MIL-STD-188-141.  
The terms and definitions are detailed in Annex A. The technical standards are in Annex B. Annex C contains references to the more stringent HF radio requirements in the various SPECIFIC STANAGs. An implementation matrix is added in Annex D.

**IMPLEMENTATION OF THE AGREEMENT**

4. This STANAG is implemented by a nation when it is national policy that all new single channel HF equipment placed in service in that nation's forces comply with the standards described in this STANAG. It is not intended that existing equipment and systems be immediately converted to comply with the provisions of this standard but that compliance be enforced as those systems undergo major modification or rehabilitation.

## **TERMS AND DEFINITIONS**

### **BANDWIDTH, OCCUPIED** (See also ACP-167 (G))

1. The width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage of B/2 of the total mean power of a given emission. Unless otherwise specified, the value of B/2 should be taken as 0.5%.

### **CARRIER** (See also ACP-167 (G))

2. A electromagnetic wave suitable for modulation by the intelligence to be transmitted over a communication system.

### **FREQUENCY, DISPLAY**

3. The frequency indicated on the dial settings of RF equipment.

### **FREQUENCY, TOLERANCE** (See also ACP-167 (G))

4. The maximum permissible departure by the centre frequency of the frequency band occupied by an emission from the assigned frequency, or by the characteristic frequency of an emission from the reference frequency.

### **FREQUENCY, ACCURACY/STABILITY**

5. The accuracy of the radio carrier frequency, including tolerance and long-term stability, but not any variation due to Doppler shift.

### **PHASE NOISE**

6. The short term frequency/phase tolerance of the radio carrier frequency due to external influences e.g. thermal effects and power supply variations.

### **LINEARITY**

7. A measure of intermodulation distortion at the output of a device.

### **MODULATION** (See also ACP-167 (G))

8. The process of varying some characteristics of the carrier wave in accordance with the instantaneous value of samples of the intelligence to be transmitted. See CARRIER.

### **MODULATION, AMPLITUDE (AM)** (See also ACP-167 (G))

9. The form of modulation in which the amplitude of the carrier varies in accordance with the instantaneous value of the modulation signal.

**MODULATION, PHASE (PSK)**

10. The form of modulation in which the phase of the carrier varies in accordance with the instantaneous value of the modulation signal.

**MODULATION, QUADRATURE AMPLITUDE (QAM)**

11. *The form of modulation with the characteristics of both the modulation schemes described at item no. 9 and no. 10 above.*

**RATT (See also ACP-167 (G))**

12. The system of communication by teletypewriter over radio circuits.

**RECEIVER ATTACK-TIME**

13. The time interval from the application of a step input RF signal (for all signal levels within the receiver input range) to the receiver input until the receiver output amplitude reaches 90% of its steady-state value. This time delay includes the time for the receiver to unsquelch, if applicable.

**RECEIVER RELEASE-TIME**

14. The time interval from removal of the RF energy at the receiver input until the receiver output falls to 10% of its steady value, or until the receiver output is squelched if applicable.

**TRANSMITTER ATTACK-TIME**

15. The time interval from keying-on a transmitter until the transmitted RF signal amplitude has increased to 90% of its steady-state value. The delay excludes any necessary time for automatic antenna tuning.

**TRANSMITTER RELEASE-TIME**

16. The time interval from keying-off a transmitter until the transmitted RF signal amplitude has decreased to 10% of its key-on steady-state value.

**TRANSMISSION, SIDEBAND (See also ACP-167 (G))**

17. The band of frequencies produced on either side of a carrier frequency when the carrier frequency is (amplitude or phase) modulated by a base-band signal. For amplitude modulation components whose frequencies are, respectively, the sum

or difference of the carrier and the modulating frequencies. The sum frequencies form the “upper side-band” and the difference frequencies form the “lower side-band”.



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ANNEX A to  
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**TECHNICAL STANDARDS TO ENSURE INTEROPERABILITY  
OF SINGLE CHANNEL HF RADIO EQUIPMENT**

**FREQUENCY RANGE**

The frequency range for both transmission and reception shall be:

- a. 2.0 to 30.0 MHz for aircraft and manpack installations.
- b. 1.6 to 30.0 MHz for all other applications.

**TUNING**

2. (a) Equipment shall tune to integral multiples of 100Hz, starting at 1.6 MHz, and for maritime use it is desirable that the receiver be able to tune in increments of 10Hz.
- (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).

**FREQUENCY ACCURACY/STABILITY**

3. The radio frequency accuracy shall be within  $\pm 30$ Hz for manpack equipment and within  $\pm 10$ Hz for all other equipment. The frequency stability of the transmitter carrier frequency shall be  $1 \times 10^{-8}$  per day or better ( $\pm 10$ Hz in 30 days).

**FREQUENCY RESPONSE/GROUP DELAY**

4. The base-band frequency response of the transmitter and of the receiver over the range 300Hz to 3050Hz shall be within  $\pm 2$ dB of the response at 1000Hz for manpack equipment and within  $\pm 1.5$ dB for all other equipment.  
The group delay shall not vary by more than 0.5 ms over 80% of the pass-band of 300Hz to 3050Hz. The maximum time delay measured between the input and the output of either the transmitter or the receiver shall be less than 10 ms (design objective 5ms) over this pass-band.

**PHASE NOISE**

5. The overall radio system RMS phase noise as measured at the transmitter output while transmitting a continuous carrier 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  $\pm 100$ Hz and less than  $\pm 100$ kHz from the tone.

- (b) 145 dBc/Hz (-165 dBc/Hz highly desirable) at all offsets greater than  $\pm 100$  kHz from the tone.

*Please note:* QAM modulation schemes require a linear graph for “receiver SNR (dB)” versus “transmitter SNR (dB)” values for any transmission considered (otherwise there may be several dB of transmission losses).

## **LINEARITY**

6. The IMD products of HF transmitters by any two equal-level signals within the 300 - 3050 Hz pass-band shall be at least 30 dB (design objective 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.

## **SPECTRAL CONTAINMENT OF TRANSMITTED SIGNAL**

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  $\pm 10$  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 two equal tones modulating the transmitter at peak envelope power.

## **MODULATION**

8. (a) For analogue voice, digital voice and in-band RATT/data, the carrier shall be single side-band suppressed-carrier modulated, with the carrier and lower side band 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  $\pm 5$  Hz and a space (or 0) frequency of 2425 Hz  $\pm 5$  Hz (2000 Hz sub-carrier with 425 Hz shift) or 1615 Hz with a sub-carrier shift of -42.5 Hz  $\pm 1$  Hz representing a mark (or 1) and a shift of +42.5 Hz  $\pm 1$  Hz representing a space (or 0).
- (c) Multi-channel RATT shall be sent by two-tone FSK of sub-carriers centred on 425 Hz, 595 Hz, 765 Hz, 935 Hz, 1105 Hz, 1275 Hz, 1445 Hz and 1615 Hz, with a sub-carrier shift of  $\pm 42.5$  Hz  $\pm 1$  Hz. In multi-channel fleet broadcast operation it shall be normally arranged that the channel centred on 765 Hz can be received as a single channel\*).
- (d) Morse telegraphy shall be sent by on-off keying of a 1000 Hz  $\pm 5$  Hz tone at rates up to 30 wpm (manual) and up to 300 wpm (burst).

- (e) Digital voice at 2400bps 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 narrow band direct printing telegraphy in the maritime mobile service, the ITU has outlined parameters in the Radio Regulations. These provide for F1B emissions of 170Hz frequency shift at a maximum rate of 100 baud. The frequency tolerance is cited as  $\pm 40\text{Hz}$  for ship equipment and  $\pm 15\text{Hz}$  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 75bps 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 standardised.

\*) US reservation: "is not compatible with the narrow band FSK centre frequency agreed in other documents such as MIL-STD-188C where the 1232.5Hz for a mark (or 1) and 1317.5Hz for a space (or 0) is prescribed. Under this condition the assignment of a channel with a centre frequency of 1275Hz is appropriate for single channel operation."

## **MODE OF OPERATION**

- 9. Equipment shall be capable of operating in the single frequency simplex/half duplex mode, split frequency half duplex mode is highly desirable.

## **TRANSMIT/RECEIVE SWITCHING TIME**

- 10. The change-over time between transmit and receive modes shall meet the following requirements:
  - (a) Transmit to receive changeover time shall not be greater than 15ms from keying-off for the receiver to achieve 90% of full specified sensitivity.
  - (b) Receive to transmit changeover time shall not be greater than 25ms (10ms highly desirable) from keying-on for the transmitter to achieve 90% of full specified output power.

## GAIN CONTROL

### **11. Transmit Automatic Level Control (ALC)**

Transmitter ALC action shall be implemented in such a way as to not degrade waveform performance e.g. switch-off and/or set very slow in data mode. Note: this is known to be a concern particularly for high order modulation schemes such as QAM (e.g. as used in STANAG 4539).

## **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  $\pm 3\text{dB}$ .

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

- a. Attack:  $< 30\text{ms}$
- b. Decay: between  $500\text{ms}$  and  $1.5\text{sec}$ .

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

- a. Attack:  $< 10\text{ms}$
- b. Decay:  $< 25\text{ms}$  (modes not employing amplitude modulation, e.g. PSK)
- c. Decay: between  $500\text{ms}$  and  $1\text{sec}$ . (modes employing amplitude modulation, e.g. QAM).

**INDEPENDENT SIDE-BAND (ISB) OPERATIONS.**

1. Independent side band (ISB) (6 kHz operation) is likely to be required to support future enhanced data rate modes yet to be standardised.
2. Link 11 data link operations, where employed, shall be as per STANAG 5511 and utilise USB, LSB or ISB modes.
3. **Lower side band (LSB)** - 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. 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).
4. **AGC SSB/ISB Operation** - During ISB operation the AGC shall be developed independently for the two side bands as specified in STANAG 5511. The implementation shall be such that the side band 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 side band from controlling the RF gain.

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**REFERENCES TO MORE STRINGENT HF  
RADIO REQUIREMENTS IN OTHER STANAGS**

**1. STANAG 4444 Technical Standards for a Slow Hop HF EPM Communications System (edition 1)**

Annex B Functional Characteristics and Technical overview of a HF EPM Communications system

Chapter 4 Physical layer characteristics  
Paragraph 4.3 Equipment characteristics  
Table 4.3-1

**2. STANAG 5511 Tactical data Exchange – Link 11/Link 11B (edition 4)**  
Annex B Technical description

Chapter 3 Special functions  
Chapter 4 Link 11 type of transmissions  
Paragraph 4.a For ranges beyond line of sight  
Chapter 5 Link 11 Frequency setting accuracy and stability  
Paragraph a, b and c  
Chapter 7 Equipment Technical characteristics  
Paragraph 7.1 HF Transmitter  
Paragraph 7.2 HF Receiver



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**IMPLEMENTATION MATRIX**

	LINK11 HF	LINK 22 HF	HF EPM	ARCS 3G ALE	BRASS BCT	BRASS S/S	HF e-mail
STANAG 4203	X	X	X	X	X	X	X
STANAG 4285					X	X	X
STANAG 4415							
STANAG 4444			X				
STANAG 4481					X		
STANAG 4529					X	X	
STANAG 4538				X			
STANAG 4539							X
STANAG 5066						X	X
STANAG 5511	X						
STANAG 5522		X					

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