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NATO STANDARDIZATION AGENCY
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14 April 2011 NSA/0410(2011)-C3/4231

STANAG 4231 (EDITION 5) - DIGITAL INTEROPERABILITY BETWEEN ULTRA HIGH FREQUENCY (UHF) SATELLITE COMMUNICATIONS TERMINALS

Reference:
NSA/0383-C3/4231 dated 14 April 2003 (Edition 4)

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 reference listed above is to be destroyed in accordance with local document destruction procedures.

3. The NHQC3S considers this an editorial edition of the STANAG; previous ratifying references and implementation details are deemed to be valid.

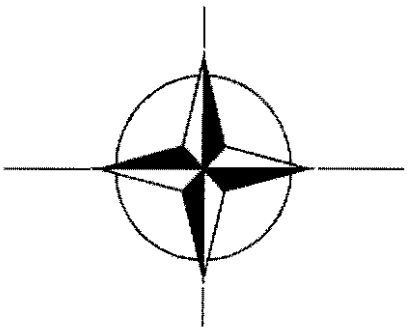
Cihangir AKSIT, TUR Civ
Director, NATO Standardization Agency

Enclosure:
STANAG 4231(Edition 5)

NATO Standardization Agency – Agence OTAN de normalisation
B-1110 Brussels, Belgium Internet site: http://nsa.nato.int
E-mail: c3s@hq.nato.int – Tel 32.2.707.5433 – Fax 32.2.707.5709

STANAG 4231
(Edition 5)

NORTH ATLANTIC TREATY ORGANIZATION
(NATO)



NATO STANDARDIZATION AGENCY
(NSA)

STANDARDIZATION AGREEMENT
(STANAG)

SUBJECT: DIGITAL INTEROPERABILITY BETWEEN ULTRA HIGH FREQUENCY (UHF) SATELLITE COMMUNICATIONS TERMINALS

Promulgated on 14 April 2011

Cihangir AKSIT, TUR Civ
Director, NATO Standardization Agency

RECORD OF AMENDMENTS

N°	Reference/ date of amendment	Date entered	Signature

EXPLANATORY NOTES

AGREEMENT

1. This 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 - BEL.

NATO STANDARDIZATION AGREEMENT (STANAG)

DIGITAL INTEROPERABILITY BETWEEN ULTRA HIGH FREQUENCY (UHF) SATELLITE COMMUNICATION TERMINALS

ANNEXES

A. Definitions and Terms
B. Satellite System Considerations
C. Requirements for Single-Access and Frequency-Division Multiple Access (FDMA) Operating in 5-kHz and 25-kHz Bandwidths
D. Baseband Interoperability between Co-Sited Terminals
E. 25-kHz UHF TDMA/DAMA Waveform (Including 5- and 25-kHz Slave Channels)
F. Submarine UHF SATCOM Data Communications
G. UHF Frequency Plans

RELATED DOCUMENTS

STANAG 4198:	Parameters and Coding Characteristics That Must Be Common to Assure Interoperability of 2400 bps Linear Predictive Encoded Digital Speech
STANAG 4291: (NU)	Coding and Modulation Characteristics That Must Be Common to Ensure Interoperability of 2400 bps Wire-line Modems for Use in Narrowband Secure Voice Systems
STANAG 4295: (NR)	Significant Data and Telegraph Signaling Conditions
STANAG 5036: (NU)	Parameters and Practices for the Use of the NATO 7 Bit Code
STANAG 5045: (NU)	Interoperability Characteristics for Teleprinters Using the NATO 7 Bit Code
MIL-STD-188-183A	Interoperability standard for 25-kHz TDMA/DAMA terminal waveform (Including 5- and 25-kHz Slave Channels)

AIM

1. The aim of this agreement is to define the technical characteristics necessary and sufficient to ensure interoperability of digital voice, data and telegraph between UHF satellite communications (SATCOM) terminals when operating over any of the NATO nation's UHF satellites.

AGREEMENT

3. Participating nations agree to use the characteristics contained in this STANAG for their UHF SATCOM terminals used to transmit and receive digital voice, data and telegraph.

PROTECTION OF PROPRIETARY RIGHTS

4. NATO and member Governments assume no responsibility for possible infringement of any inventions, trade-marks, copyrights, etc., embodied in this STANAG. It is the sole responsibility of anyone using the information to acquire the necessary rights.

IMPLEMENTATION OF THE AGREEMENT

5. This STANAG is implemented by a nation when digital interoperability between UHF SATCOM terminals in that nation's forces complies with the characteristics detailed in this agreement and when the necessary equipment is placed in service.

ANNEX A

DEFINITIONS AND TERMS

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TERMS AND DEFINITIONS

1. ACRONYMS AND ABBREVIATIONS

The following acronyms and abbreviations are employed in this STANAG:

ACI	adjacent channel interference
BCA	broadcast control authority
BER	bit error ratio
bps	bit per second
BPSK	binary phase-shift keying
C/kT	carrier-to-noise power density
CCOW	channel control orderwire
CELT	cryptographic equipment for low-speed telegraphy
COMSEC	communications security
CRC	cyclic redundancy check
CTIC	COMSEC/TRANSEC integrated circuit
CVSD	continuously variable slope delta
DAMA	demand-assigned multiple access
dB	decibel
dBW	decibel relative to 1 watt
DEPSK	differentially encoded phase-shift keying
DEQPSK	differentially encoded quadrature phase-shift keying
E_b/N_o	energy-per-bit to noise-power-spectral-density ratio
eirp	effective isotropically radiated power
FCS	frame check sequence
FDMA	frequency-division multiple access
FEC	forward error correction
FSK	frequency-shift keying
G/T	system gain-to-noise temperature ratio
Hz	hertz
I	in phase

IEEE	Institute of Electrical and Electronics Engineers
k	constraint length
K	degrees Kelvin
kbps	kilobit per second
kHz	kilohertz
MAS	Military Agency for Standardization
MHz	megahertz
MIL-STD	Military Standard
ms	millisecond
MSB	most-significant-bit
N/A	not applicable
NATO	North Atlantic Treaty Organization
NU	NATO Unclassified
OQPSK	offset quadrature phase-shift keying
ppm	part per million
PSK	phase-shift keying
Q	quadrature phase
RCCOW	return channel control orderwire
RF	radio frequency
RHCP	right-hand circular polarization
rms	root mean square
SATCOM	satellite communications
SBPSK	shaped binary phase-shift keying
SOM	start-of-message
SOQPSK	shaped offset quadrature phase-shift keying
sps	symbol per second
STANAG	standardization agreement
SUBOPAUTH	submarine operating authorities
TDMA	time-division multiple access
TRANSEC	transmission security
UHF	ultra high frequency

2. DEFINITIONS

The following acronyms and abbreviations are employed in this STANAG:

Baseband	This is the data/audio side of the modem and its interconnection (two-way) with land lines and man/machine interfaces, such as computer, telephone lines and so on.
Transmitter Turn-on Time	The time interval between baseband equipment key down and the time at which the transmitter has stabilized to within 90% of the steady-state transmit power and ±20Hz of the steady-state transmit center frequency.

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ANNEX B

SATELLITE SYSTEM CONSIDERATIONS

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SATELLITE SYSTEM CONSIDERATIONS

GENERAL

1. This STANAG specifies the interoperability and performance characteristics of terminal equipment that will operate over NATO or national UHF satellite systems. It is recognized that terminals are procured to meet specific national requirements. Therefore, basic system characteristics will be dictated partly by national system requirements, partly by the satellite to be used, and partly by the control to be exercised by the agency or nation managing the satellite. National SATCOM programs may result in satellites of varying capacity, channelization, channel effective isotropically radiated power (eirp), channel bandwidth, and satellite frequency translation. Satellite control procedures may also vary, due to national requirements. Determining adequacy of the satellite channel to meet desired link parameters must be evaluated by the satellite host nation or NATO, if applicable.

OPERATION

2. This STANAG specifies the parameters necessary to achieve interoperability during normal, unstressed operation.

CONCEPT

3. To achieve interoperability of UHF SATCOM terminals procured primarily to meet national requirements, without incurring significant technical or cost penalties, the parameters specified are the minimum necessary to achieve interoperability in an austere mode. It is recognized that national systems incorporate more complex operating modes to meet national requirements. To meet these characteristics for interoperability may require modifications to nonconforming national systems. It is hoped that these systems will eventually comply with the technical characteristics of this STANAG.

DATA RATES

4. The mandatory data rates are as follows: when operating in the narrowband mode, 1200 or 2400 bps will be the data rate for data and 2400 bps will be the data rate for voice. When operating in the wideband mode, 16000 bps will be the data rate for both data and voice. Other data rates, included in this STANAG for information only, may be employed to satisfy specific operational requirements which the equipment is to fulfill.

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ANNEX C

REQUIREMENTS FOR A SINGLE-ACCESS AND FREQUENCY-DIVISION MULTIPLE ACCESS (FDMA) OPERATING IN 5-kHz AND 25-kHz BANDWIDTHS

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TABLES

FIGURES

REQUIREMENTS FOR SINGLE-ACCESS AND FREQUENCY-DIVISION MULTIPLE ACCESS (FDMA) OPERATING IN 5-kHz AND 25-kHz BANDWIDTHS

GENERAL

1. This annex specifies (a) the interoperable data rates, (b) the individual interoperable modes, and (c) the minimum transmission function and reception function parameters necessary to achieve interoperability and performance of UHF SATCOM when operating in single-access or FDMA modes. In the single-access mode the terminals use the entire channel bandwidth. In the FDMA mode the channel bandwidth is divided into smaller bands for multiple networks to access the transponder. Channels are pre-assigned and dedicated to individual subscribers. The channel is not released to other users upon completion of a call.

OPERATING MODES

2. Narrowband mode: Operation shall be limited to a 5-kHz bandwidth on a single 5-kHz channel, or a 5-kHz bandwidth of a wider bandwidth channel.

3. Wideband mode: Operation shall be limited to a 25-kHz bandwidth on a single 25-kHz channel, or a 25-kHz bandwidth of a wider bandwidth channel.

INTEROPERABLE DATA RATES

4. The interoperable data rates are shown in Table C-1.

TABLE C- 1. INTEROPERABILITY I/O DATA RATES.

OPERATING MODES	NARROWBAND MODE RATES (bps)	WIDEBAND MODE RATES (kbps)
Voice (Mandatory)	2400	16
Voice (Optional)	4800	
Data (Mandatory)	1200/2400	16
Data (Optional)	75/300/600/ 4800/6400	9.6/16/19.2/ 32/38.4

INTEROPERABLE MODES

5. The mandatory interoperability modes shall be in accordance with Table C-2. Forward error correction (FEC) is not mandatory for any of the modes.

TRANSMISSION FUNCTION AND RECEPTION FUNCTION PARAMETERS

6. UHF frequency coverage. The terminal frequency coverage shall be as follows:

Receive:	243.00 to 270.00 MHz	Essential
	225.00 to 400.00 MHz	Desirable
Transmit:	291.00 to 318.00 MHz	Essential
	225.00 to 400.00 MHz	Desirable

POLARIZATION

7. The terminal polarization shall be as follows:

Up-link	right-hand circular polarization (RHCP) (IEEE Standards)
Down-link	RHCP (IEEE Standards)

TUNING INCREMENTS

8. The terminal tuning increment shall be as follows:

Narrowband**:**	Integral 5-kHz increments over the range specified in paragraph 6, above.
Wideband**:**	Integral 25-kHz increments over the range specified in Paragraph 6, above.

TABLE C-2. INTEROPERABLE MODES.

INTEROPERABLE FUNCTION	MODULATION	MODULATION RATE	MODULATION CODING	CRYPTOGRAPHIC EQUIPMENT	SPEECH CONVERSION
Narrowband Data	BPSK	1200/2400 bps	DEPSK	KG-84	N/A
Narrowband Voice	BPSK	2400 bps	DEPSK	KYV-5	STANAG 4198
Wideband Data	FSK	16000 bps	N/A	VINSON/LAMBERTON-compatible TSEC/KY-57/58	N/A
Wideband Voice	FSK	16000 bps	N/A	VINSON/LAMBERTON-compatible TSEC/KY-57/58	CVSD

SUSCEPTIBILITY TO ADJACENT CHANNEL INTERFERENCE, NARROWBAND

9. The terminal shall achieve a bit error ratio (BER) of 1 x 10^{-5} or better at the *C/kT* specified in Table C-3, when operating in the presence of adjacent channel interference (ACI), at 5-kHz offset. For test conditions, ACI power in the desired channel shall be 15 dB below the average power of the desired signal, where the ACI signal is a 2400-bps random bit pattern that is 50-percent SBPSK-modulated.

TABLE C- 3. SUSCEPTIBILITY TO ADJACENT CHANNEL INTERFERENCE, NARROWBAND MODE

BIT RATE (bps)	*C/kT* FOR BER ≤ 1 x 10^{-5} (dB-Hz)
75	32.3
300	38.3
600	41.3
1200	44.3
2400	47.3
4800	51.8
6400	52.8

DIFFERENTIAL ENCODING, NARROWBAND

10. All baseband data following the preamble bit pattern shall be differentially encoded. For BPSK/SBPSK the differential encoding shall be as follows:

$$C(k) = \{ C(k-1) \oplus m(k) \}$$

where

$C(k)$	=	present code bit
$C(k-1)$	=	prior code bit
$\oplus$	=	exclusive OR operation
$m(k)$	=	message bit

For QPSK/SOQPSK the differential coding shall be as follows:

$$C(2k) = \{ C(2k - 2) \oplus m(2k) \}$$

$$C(2k + 1) = \{ C(2k - 1) \oplus m(2k + 1) \}$$

where

$C(2k)$	=	present I code bit
$C(2k-2)$	=	previous I code bit
$C(2k+1)$	=	present Q code bit
$C(2k-1)$	=	previous Q code bit
$\oplus$	=	exclusive or operation
$m(2k)$	=	I message bit
$m(2k+1)$	=	Q message bit

MODULATION, NARROWBAND

11. For code rate 1, the modulation shall be interoperable with BPSK and 50-percent SBPSK for data rates of 1200 and 2400 bps and, if implemented, for data rates of 75, 300, and 600 bps. If a 4800- or 6400-bps rate is implemented, the modulation shall be interoperable with OQPSK and 50-percent SOQPSK. The phase vector rotation caused by modulation shall not cause a frequency shift in the transmitted data. If FEC coding is implemented, the modulation shall be as defined in Table C-4. BPSK and SBPSK waveforms are depicted in Figure C-1.

TABLE C- 4. 5-KHz CHANNEL FEC CODING VERSUS MODULATION OPTIONS

OPTION #	I/O DATA RATE (bps)	CODING RATE	MODULATION TYPE	MODULATION RATE (sps)
1	75	1/2	BPSK or SBPSK	150
2		1		75
3	300	1/2	BPSK or SBPSK	600
4		1		300
5	600	1/2	BPSK or SBPSK	1200
6		1		600
7	1200	1/2	BPSK or SBPSK	2400
8	1200*	1		1200
9	2400*	1	BPSK or SBPSK	2400
10	2400	1/2	OQPSK or SOQPSK	2400
11	4800	1	OQPSK or SOQPSK	2400
12		3/4	OQPSK or SOQPSK	3200
13	6400	1	OQPSK or SOQPSK	3200

* Note: Mandatory

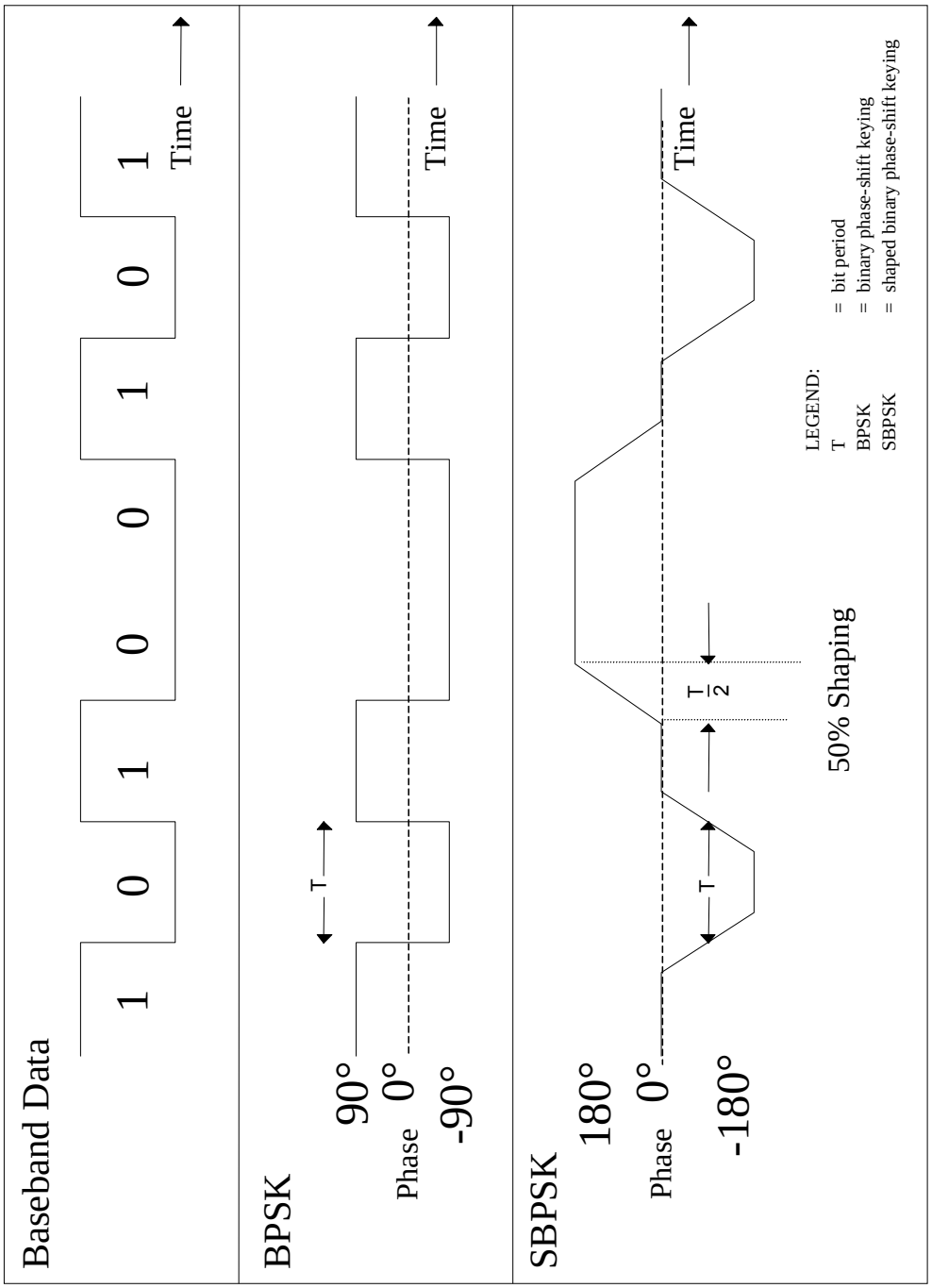

FIGURE C-1. BPSK AND SBPSK WAVEFORMS.

SUSCEPTIBILITY TO ADJACENT CHANNEL INTERFERENCE, WIDEBAND

12. The terminal shall achieve a BER of 1 x 10^{-5} or better, at the *C*/*kT* specified in Table C-5, when operating in the presence of ACI at a 50-kHz offset. For test conditions, ACI power in the desired channel shall be 20 dB below the average power of the desired signal, where the ACI signal is 19.2-kbps bit pattern that is 50-percent SBPSK-modulated.

TABLE C- 5. MODULATION TYPES AND SUSCEPTIBILITY TO ADJACENT CHANNEL INTERFERENCE, WIDEBAND MODE

SYMBOL RATE (sps)	MODULATION	*C*/*kT* FOR BER ≤ 1 x 10^{-5} (dB-Hz)
9600 (Optional)	BPSK/SBPSK	53.3
16000 (Optional)	BPSK/SBPSK	55.5
16000 (Mandatory)	FSK	58.5
19200 (Optional)	BPSK/SBPSK	56.3
32000 (Optional)	OQPSK/SOQPSK	58.5
38400 (Optional)	OQPSK/SOQPSK	59.3

DIFFERENTIAL ENCODING, WIDEBAND

13. Differential encoding shall be in accordance with paragraph 10.

MODULATION, WIDEBAND

14. Modulation shall be as shown in Table C-5. If FEC coding is implemented, the modulation shall be as defined in Table C-6. For PSK modulation the phase vector rotation caused by modulation shall not cause a frequency shift in the transmitted data. For FSK the modulation characteristics shall be as follows:

a. Deviation**:** The deviation of the modulated signal shall be 5.6 kHz ±1 kHz for a binary 0 and -5.6 kHz ±1 kHz for a binary 1. The demodulator shall be interoperable with modulated signals that have deviations of 5.6 kHz ±1.2 kHz for a binary 0 and -5.6 kHz ±1.2 kHz for a binary 1.

b. Input data signal sense**:** A binary 1 shall be indicated by a voltage that is negative with respect to the reference point, and a binary 0 by a voltage that is positive with respect to the reference point.

TABLE C- 6. 25-KHZ CHANNEL FEC CODING VERSUS MODULATION OPTIONS

OPTION #	I/O DATA RATE (bps)	CODING RATE (CR)	MODULATION TYPE	MODULATION RATE (sps)
1	9600	1	BPSK/SBPSK	9600
2		1/2		19200
3	16000	1	BPSK/SBPSK	16000
4		1/2	OQPSK/SOQPSK	16000
5*		1	FSK	16000
6	19200	1	BPSK/SBPSK	19200
7		1/2	OQPSK/SOQPSK	19200
8	32000	1	OQPSK/SOQPSK	16000
9		3/4		21333.3
10	38400	1	OQPSK/SOQPSK	19200

* Note: Mandatory

FREQUENCY UNCERTAINTY

15. The terminal shall achieve acquisition and demodulate the signal for signal frequency uncertainties up to $\pm$1.2 kHz from the desired channel center frequency.

ADJACENT CHANNEL EMISSIONS, NARROWBAND

16. In a nominal 5-kHz bandwidth whose center frequency is displaced by Δf from a terminal transmitter's carrier frequency, the eirp shall be as specified in the following two paragraphs:

a. For carrier eirp levels less than +18 dBW, the eirp (relative to the terminal′s total output eirp) shall not exceed the values in Table C-7. These values shall apply when the transmitter carrier frequency is either unmodulated or modulated.

b. For carrier eirp levels equal to or greater than +18 dBW, the maximum eirp values shall not exceed the values specified in Table C-7.

TABLE C- 7. ALLOWABLE ADJACENT CHANNEL EMISSIONS, NARROWBAND

∆f (kHz)	RELATIVE EIRP (dB) (CARRIER LEVEL < +18 dBW)	MAXIMUM EIRP (dBW) (CARRIER LEVEL ≥ +18 dBW)
5	-14	+4
10	-34	-16
15	-38	-20
≥20	-40	-22

ADJACENT CHANNEL EMISSIONS, WIDEBAND

17. For frequency-shift keying (FSK) modulation, the total of all emissions outside the 25-kHz channel shall be less than 1 percent of the total transmitted power. For PSK modulation in a nominal 25-kHz bandwidth whose center frequency is displaced by Δf from the terminal transmitter's carrier frequency, the eirp shall not exceed the values specified in Table C-8A for a carrier level less than 18 dBW and Table C-8B for a carrier level greater than or equal to +18 dBW.

TABLE C- 8A. ALLOWABLE ADJACENT CHANNEL EMISSIONS, 25-KHZ CHANNEL, WIDEBAND (MODERATE POWER)

∆f (kHz)	RELATIVE EIRP (dB) (CARRIER LEVEL < +18 dBW)				
	9.6 kbps BPSK/SBPSK INTEROPERABLE	19.2 kbps BPSK/SBPSK INTEROPERABLE	32 kbps OQPSK/SOQPSK INTEROPERABLE	38.4 kbps OQPSK/SOQPSK INTEROPERABLE	ALL OTHER RATES AND MODULATION
25	-17	-11	-16	-13	-11
50	-37	-26	-23	-21	-21
75	-40	-34	-37	-35	-34
100	-40	-40	-39	-40	-39
≥125	-40	-40	-40	-40	-40

TABLE C- 8B. ALLOWABLE ADJACENT CHANNEL EMISSIONS, 25-KHZ CHANNEL, WIDEBAND (HIGH POWER)

Δf (kHz)	RELATIVE EIRP (dB) (CARRIER LEVEL ≥ +18 dBW)				
	9.6 kbps BPSK/SBPSK INTEROPERABLE	19.2 kbps BPSK/SBPSK INTEROPERABLE	32 kbps OQPSK/SOQPSK INTEROPERABLE	38.4 kbps OQPSK/SOQPSK INTEROPERABLE	ALL OTHER RATES AND MODULATION
25	+1	+7	+2	+5	+7
50	-19	-8	-5	-3	-3
75	-22	-16	-19	-17	-16
100	-22	-22	-21	-22	-21
≥125	-22	-22	-22	-22	-22

PREAMBLE GENERATION

18. The transmitting radio shall generate a preamble as specified in Figure C-2A for BPSK/SBPSK and Figure C-2B for OQPSK/SOQPSK if implemented. Baseband data shall follow the preamble bit pattern without a shift in data bit timing greater than 25 percent of a bit interval. Figure C-2A shows the preamble bit pattern for BPSK and SBPSK for all date rates.

EIRP

19. The terminal shall be capable of providing EIRP of at least 16 dBW with respect to right-hand circular polarization. The terminal eirp shall be incrementally or continuously adjustable between a minimum setting no greater than 10 dBW and the maximum eirp, with a power setting resolution of 2 dB or better. The terminal shall maintain an eirp accuracy of ±1.5 dB, assuming antenna gain and passive losses are fixed.

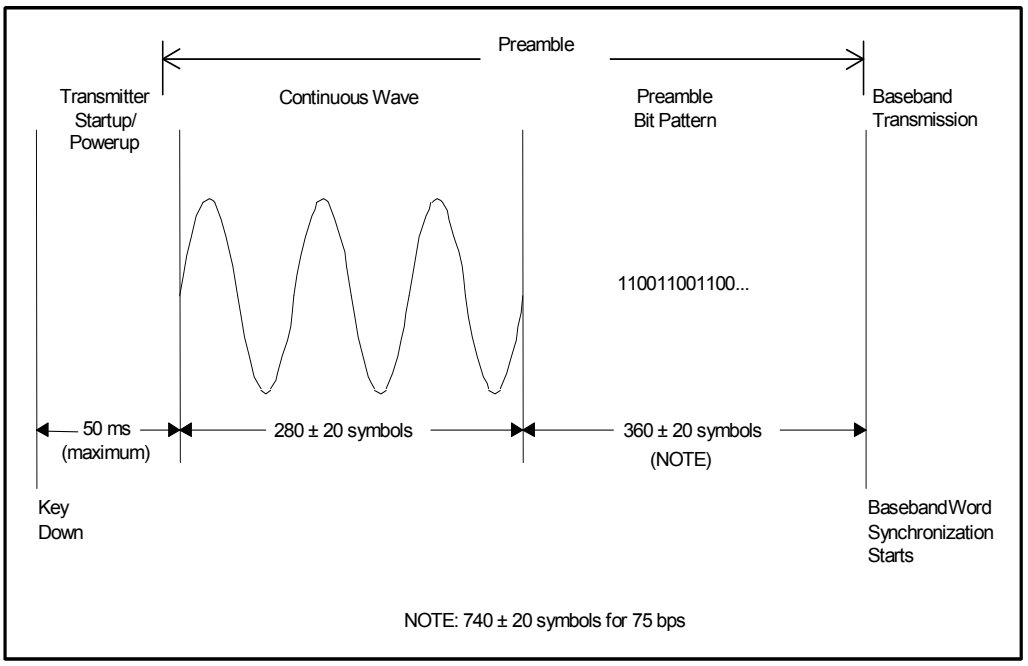

FIGURE C-2A. SYNCHRONIZATION METHOD FOR BPSK/SBPSK.

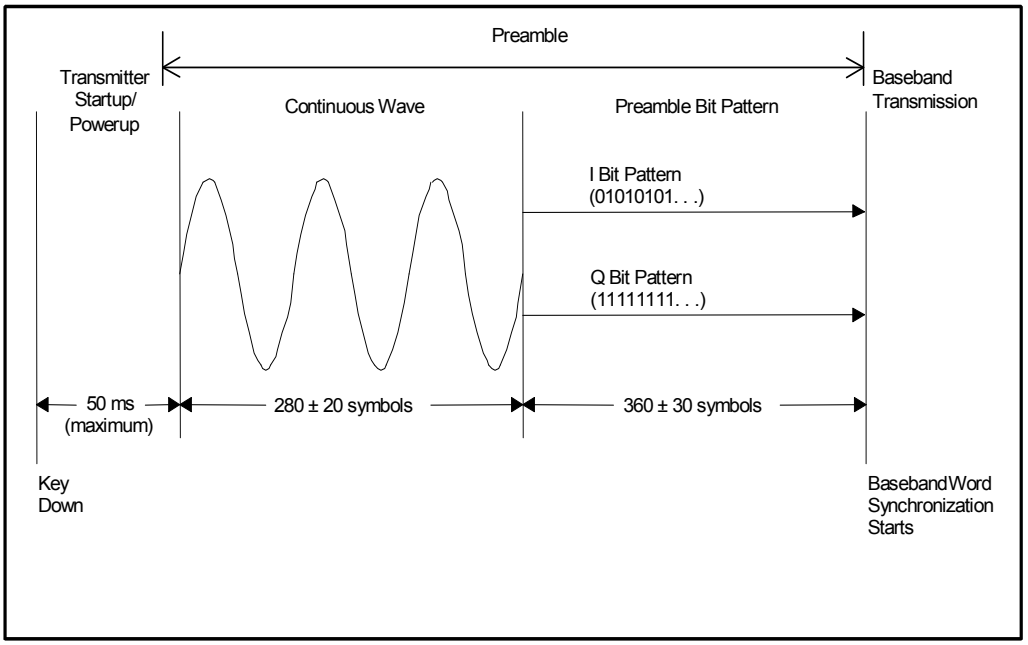

FIGURE C-2B. SYNCHRONIZATION METHOD FOR OQPSK/SOQPSK.

TRANSMITTER TURN-ON TIME

20. The transmitter turn-on time shall not exceed 50 ms.

FREQUENCY GENERATION AND ACCURACY

21. The frequency generation system shall provide long-term plus short-term frequency accuracy within ±1 part per million (ppm) across the full range of environmental conditions outlined in the terminal specification. The root-mean-square (rms) value of the phase noise shall not exceed 10 degrees over the specified frequency range in a bandwidth of 10 Hz to 15 kHz.

RECEIVER ACHIEVING ACQUISITION

22. Upon successful acquisition the terminal shall output, as a minimum all baseband data that immediately follows the preamble bit pattern. The probability of achieving acquisition on the first attempt and E_b/N_o equal to or higher than the reference E_b/N_o shall exceed 95 percent, with a confidence level of 90 percent. Baseband data shall follow the preamble bit pattern without a shift in data bit timing greater than 25 percent of a bit interval. The terminal shall be able to achieve acquisition and demodulate the carrier for carrier frequency uncertainties up to ±1.2 kHz. The reference E_b/N_o is defined as the E_b/N_o needed by the terminal to achieve a BER of 10^{-3}.

MAINTAINING BIT SYNCHRONIZATION

23. The probability of maintaining bit synchronization for at least 10 seconds when the $(G/T)/(E_b/N_o)$ is degraded by up to 3 dB from that which is specified in paragraph 22 shall be 95 percent with a confidence level of 90 percent. For PSK signals the terminal shall maintain bit synchronization if the carrier is interrupted (lost and returns within 230 milliseconds). For any signal (PSK or FSK) if after a 250-millisecond interruption another carrier is received, the terminal shall synchronize to and process the new carrier.

RECEIVE TIMING STABILITY

24. The terminal shall maintain the frequency of it's receive clock output to data terminal equipment within ±1 percent of the clock frequency for the selected operating data rate, under all conditions where bit synchronization can be maintained.

BIT ERROR RATIO

25.

a. Narrowband bit error ratio**:** The BER measured at the output of the demodulator, for FEC code rate 1, shall not exceed 1 x 10^{-5} for a data rate of 2400 bps and a $(G/T)/(E_b/N_o)$ of -34.7 dB/K (or -42.4 dB/K for aircraft and submarine installations), assuming a sky noise temperature of 200 K and a 0-dB gain antenna for airborne platforms. The required $(G/T)/(E_b/N_o)$ for rate 3/4 and 1/2 codes shall be reduced by 3.0 dB and 4.25 dB, respectively. The G/T and E_b/N_o of terminals may be independently evaluated for test purposes. However, when performance of the independent components is combined analytically, the calculated value of system performance shall comply with the requirements of this paragraph.

b. Wideband bit error ratio, FSK**:** The BER measured at the output of the demodulator shall not exceed 1 x 10^{-5} for a data rate of 16 kbps and a $(G/T)/(E_b/N_o)$ of -37.7 dB/K (or -45 dB/K for aircraft and submarine installations), assuming a sky noise temperature of 200 K and assuming a 0-dB gain antenna for airborne platforms. The G/T and E_b/N_o of terminals may be independently evaluated for test purposes. However, when the performance of the independent components is combined analytically, the calculated value of system performance shall meet the requirements of this paragraph.

c. Wideband bit error ratio, PSK**:** The BER measured at the output of the demodulator, for FEC code rate 1, shall not exceed 1 x 10^{-5} for a data rate of 19.2 kbps and a $(G/T)/(E_b/N_o)$ of -34.7 dB/K (or -42.4 dB/K for aircraft and submarine installations), assuming a sky noise temperature of 200 K and a 0-dB gain antenna for airborne platforms. The required $(G/T)/(E_b/N_o)$ for rate 3/4, and 1/2 codes shall be reduced by 3.0 dB and 4.25 dB, respectively. The G/T and E_b/N_o of terminals may be independently evaluated for test purposes. However, when performance of independent components is combined analytically, the calculated value of system performance shall comply with the requirements of this paragraph.

FORWARD ERROR CORRECTION (FEC) CODING (OPTIONAL)

26.

a. Convolutional error correction coding at rates 1/2 and 3/4 is provided as an optional capability. If the terminal implements FEC, it shall be compliant with this STANAG.

b. If FEC coding is implemented, the terminal shall add a Start-of-Message (SOM) data field to the preamble shown in Figures C-2A or C-2B preceding the baseband transmission. For BPSK/SBPSK, the SOM shall be the 37-bit

sequence, 11100010000100011110100110111011001 01. For OQPSK/SOQPSK, the 42-bit SOM shall be a 21-bit sequence in each I and Q channel, where the I channel sequence is 000000101110100111001 and the Q channel sequence, offset one-half symbol later, is 001101100001000010101. The SOM shall be transmitted in the order shown with the left-most bit transmitted first. For OQPSK/SOQPSK modulation with FEC coding, the first FEC-encoded user data bit shall be sent on the I channel. The output of the FEC encoder shall be identical to the output of the rate 1/2 constraint length 7 convolutional encoder shown on Figure C-3. For rate 3/4 the output of the encoder shall be identical with the output described in
Table C-9.

c. FEC CHARACTERISTICS. The code tap positions shall be as follows:

Rate = 1/2 $k = 7$

P1 1111001

P2 1011011

[Note: The most significant bit (MSB) is farthest left, and the least significant bit (LSB) is farthest right. The encoder tap connections shall be as shown in Figure C-3. The new data bit is shifted into the left-most position of Figure C-3.]

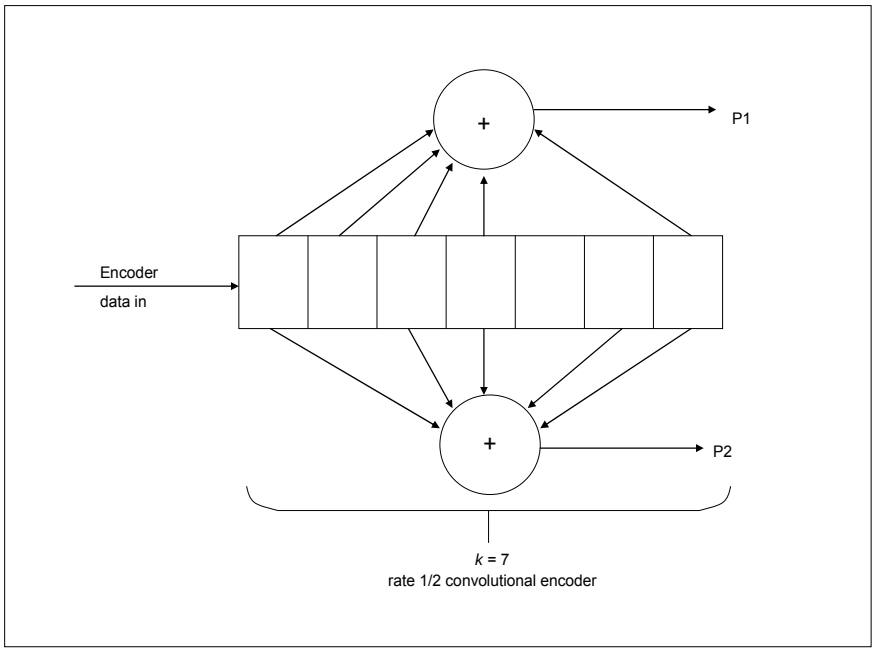

FIGURE C-3. CONVOLUTIONAL ENCODER TAP CONNNECTIONS

d. Punctured forward-error-correction codes. From the rate 1/2 code, higher rate 3/4 code could be constructed by a technique known as *puncturing*. The puncturing pattern is given in Table C-9. Only those bits identified with a 1 in Table C-9 are transmitted. They are transmitted in pairs and are transmitted from left to right.

TABLE C- 9. PUNCTURE CODE PATTERNS

CODE RATE	SYMBOL	PUNCTURE PATTERN (0 = DELETED BIT)
3/4	P1:	1 0 1
	P2:	1 1 0

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ANNEX D

BASEBAND INTEROPERABILITY BETWEEN CO-SITED TERMINALS

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BASEBAND INTEROPERABILITY BETWEEN CO-SITED TERMINALS
(For Information Only)

1. The baseband interfaces for certain traffic modes are covered by selected STANAG series and, when taken together, specify all the technical characteristics, parameters and procedures necessary for the digital exchange of information. Within a particular scenario, accesses would be:

1.2 and 2.4 kbps

The baseband interfaces at these data rates are covered in part by STANAGs: 4198, 4291, 4295, 5000, 5036 and 5045. Other traffic rates of interest not covered will be added to the series as the STANAGs become available.

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ANNEX E

25-kHz UHF TDMA/DAMA WAVEFORM (Including 5- and 25-kHz Slave Channels)

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25-kHz UHF TDMA/DAMA WAVEFORM (Including 5- and 25-kHz Slave Channels)

INTRODUCTION

1. The purpose of this annex is to specify the parameters to achieve interoperability with the next generation of UHF SATCOM terminals. To overcome the severe shortage of UHF satellite channels, the new terminals will use demand-assigned multiple access (DAMA) techniques in conjunction with time-division multiple access (TDMA). By using TDMA, multiple users can share a satellite channel. A summary of the technical parameters necessary to achieve interoperability are below, in paragraph 3. Detailed parameters are below, in the referenced document in paragraph 2. The referenced document will be maintained by the United States. NATO acceptance of any changes to the referenced document will be subject to approval by the C3 Board supported by the appropriate NATO SATCOM Capability Team/Working Group. In addition to the referenced document the information in Annex G of this STANAG regarding the use of a second UHF frequency table shall be considered when implementing this edition 5 of the STANAG.

REFERENCE DOCUMENT

2. The following document is referenced:

MIL-STD-188-183A, Dated 20 March 1998	Interoperability Standard for 25-kHz TDMA/DAMA Terminal Waveform (Including 5- and 25-kHz Slave Channels)

TECHNICAL PARAMETERS

3. Concept of TDMA/DAMA

a. In TDMA/DAMA, subscriber terminals send burst transmissions during a fraction of time known as a *time slot*. Access to the waveform's time slots can be obtained on demand by having a channel controller manage the TDMA time slots automatically. When an approved user needs to communicate, his terminal will request satellite access from the satellite channel controller. After completion of the call, the time slot is released to the controller for other users. Communications between users and the controller is provided by way of dedicated-control time slots, known as *control orderwires*. In addition to using the control orderwires, the user terminal has to transmit after "POWER UP", and, periodically thereafter, into other common time slots to make measurements of his own link. These measurements are required by the user terminal and the controller to maintain waveform integrity and to properly allocate the time slots.

b. Control Orderwires. The UHF DAMA orderwires are the channel control orderwire (CCOW) and the return channel control orderwire (RCCOW). Terminals wishing access to the waveform request it through the RCCOW, and the controller permits access through messages sent over the CCOW. The CCOW slot carries all message information required to control the waveform and its usage. The CCOW messages designate such information as frame number, encryption synchronization counts, user slot assignments, and frame format in current use. The RCCOW slot provides time for the subscriber terminals to request from the channel controller access to the waveform. RCCOW message includes information such as requester identification (ID), called party ID and requesting party precedence. The 13-byte CCOW and RCCOW messages include a 2-byte cyclic redundancy check (CRC) that ensures they are received correctly. In addition, all CCOW and RCCOW messages are security-encrypted by a KGV-11-compatible device. The communications security/transmission security (COMSEC/TRANSEC) integrated circuit (CTIC) is planned to be used for this purpose.

c. Forward error correction (FEC) coding. The FEC used is convolutional coding rate one-half (R=1/2) constraint length k=7, or rate three-fourths (R=3/4) with constraint length k=9.

d. Modulation formats and rates

BPSK: Binary phase-shift keying for 9,600 symbols per second (sps) or 19,200 sps

DEQPSK: Differentially encoded quadrature phase-shift keying for 19,200 sps or 32,000 sps

e. Error detection. In addition to convolutional encoding and interleaving, orderwires undergo 2-byte CRC on their 13 bytes. To encode the message polynomial $G(x)$, using a generator polynomial $P(x)$ of order n, $G(x)$ is first multiplied by x^n. The result is divided by $P(x)$ to form both the quotient, $Q(x)$, and the remainder, $R(x)$. The polynomial is

$$x^n G(x) = Q(x) P(x) + R(x)$$

where

$$P(x) = x^{16} + x^{15} + x^2 + 1$$

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ANNEX F

SUBMARINE UHF SATCOM DATA COMMUNICATIONS

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SUBMARINE UHF SATCOM DATA COMMUNICATIONS

INTRODUCTION

1. The purpose of this annex is to specify the parameters to achieve interoperability of submarine UHF SATCOM data communications, that is, a UHF SATCOM system that provides two-way data exchange between a subscriber submarine and its broadcast control authority (BCA). A summary of the technical parameters necessary to achieve interoperability is below, in paragraphs 3 and 4. Detailed parameters are below, in the referenced document in paragraph 2. The referenced document will be maintained by the appropriate Submarine Communications Working Group.

REFERENCE DOCUMENT

2. The following document is reference:

Specification	Technical Interface Specification for NATO Submarine Ultra High Frequency Satellite Communications Enclosure to AC/302 (SG/11-WG/8) Serial 32, dated 11 November 1992

SYSTEM DESCRIPTION

3. The system provides a 4800-bps, automated network for the two-way exchange of test messages between submarines and their shore-based submarine operating authorities (SUBOPAUTH).
Two modes of operation are provided:

a. Group broadcast. During group broadcast periods, a submarine can receive messages transmitted via the satellite at scheduled intervals.

b. Query/response. Between group broadcasts, submarines can transmit messages to the BCA, including a request for any messages held in a queue. The shore terminal responds to these transmissions with acknowledgments for the individual messages it has just received and transmits all messages held for this particular submarine.

TECHNICAL PARAMETERS

4. Satellite link protocol. A random access protocol shall permit terminal operation in broadcast and query/response modes. The satellite link protocol structure shall be in accordance with the above referenced document.

ERROR DETECTION

5. To protect against undetected errors, each message shall use a 16-bit cyclic redundancy frame check sequence (FCS) of the polynomial form $G(x) = x^{16} + x^{12} + x^5 + 1$. FCS implementation within the satellite link protocol shall be in accordance with the above referenced document.

ALPHABET CODE

6. The alphabet code employed by the satellite link protocol shall be in accordance with the above referenced document.

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ANNEX G

UHF FREQUENCY PLANS

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TABLES

UHF FREQUENCY PLANS

INTRODUCTION

1. This Annex is a mandatory part of this STANAG. The information contained herein is intended for compliance. All frequencies used to communicate in the narrowband and wideband modes of Annex E are required to conform to the frequency plans defined in this Annex. The frequency plans for use on 5- and 25-kHz channels are defined.

DEFAULT FREQUENCY TABLE

2. Table G-1 provides the default frequency plans as defined in MIL-STD-188-183A and includes the United States FLTSATCOM, UHF Follow-on, and the legacy LEASAT and MARISAT (Gapfiller) systems. In addition Table G-1 includes a limited number of frequency plans for the Skynet 4 satellites from the United Kingdom, noted as UK.

USER'S DEFINABLE FREQUENCY TABLE

3. Pending NATO agreements on NATO UHF Allocation Plans, additional NATO SATCOM frequencies are available to the NATO Nations. To allow operation at these new frequencies a second frequency table is added that includes these frequency pairs. The second frequency table will not be fixed but can be defined by the user and any UHF frequency pairs can be entered, with the note that entries 129 through 239 are reserved for 5-kHz channels with exception of entries 192 and 193 which can also be 25-kHz channels. Table G-2 presents an EXAMPLE of such a user's definable frequency table and includes known frequency pairs of UHF satellites from Italy, noted as IT, United Kingdom, noted as UK, and Germany, noted as GE. Table G-2 can be modified by the user through a local control panel or through a host computer connected to the remote control interface of the terminal.

4. Only one of the frequency Tables (G-1 or G-2) can be used at a time, where it is important that both the UHF DAMA controller and user terminals use the same version of the table. The selection of either frequency table shall be done by the user through a configuration set up on a terminal. The selection shall be made by the user before logging on the network and will remain unchanged while the terminal is logged-on to the specific network.

5. Table G-2 can change and the latest agreed table entries and copies are available upon request from the NHQC3S.

Table G-1. Default UHF frequency plans.

CHANNEL NUMBER	UPLINK FREQUENCY (MHz)	DOWNLINK FREQUENCY (MHz)	PRESENT CHANNEL	UFO CHANNEL	NOTES
0	NONE	NONE	NONE	N/A	
1	SHF	250.350	W1	N1	Fleet broadcast, 25-kHz Channel
2	SHF	250.400		N'1	"
3	SHF	250.450	A1	O1	"
4	SHF	250.500		O'1	"
5	SHF	250.550	B1	P1	"
6	SHF	250.600		P'1	"
7	SHF	250.650	C1	Q1	"
8	SHF	250.700		Q'1	"
9	292.850	251.850	W3	N2	NAVY 25-kHz CHANNELS, 41 MHz OFFSET
10	292.950	251.950	A2	O2	"
11	293.050	252.050	B2	2	"
12	293.150	252.150	C2	Q2	"
13	294.550	253.550	W4	N3	"
14	294.650	253.650	A3	O3	"
15	294.750	253.750	B3	3	"
16	294.850	253.850	C3	Q3	"
17	296.250	255.250	W5	N4	"
18	296.350	255.350	A4	O4	"
19	296.450	255.450	B4	P4	"
20	296.550	255.550	C4	Q4	
21	297.850	256.850	W6	N5	"
22	297.950	256.950	A5	O5	"
23	298.050	257.050	B5	P5	"
24	298.150	257.150	C5	Q5	"
25	299.350	258.350	W7	N6	"
26	299.450	258.450	A6	O6	"
27	299.550	258.550	B6	P6	"
28	299.650	258.650	C6	Q6	"
29	306.250	265.250	W8	N7	"
30	306.350	265.350	A7	7	"
31	306.450	265.450	B7	P7	"
32	306.550	265.550	C7	Q7	"
33	307.750	266.750	*	N8	"
34	307.850	266.850	A8	8	"
35	307.950	266.950	B8	P8	"
36	308.050	267.050	C8	Q8	"
37	309.150	268.150		N9	"
38	309.250	268.250	A9	O9	"

Table G-1. Default UHF frequency plans.

CHANNEL NUMBER	UPLINK FREQUENCY (MHz)	DOWNLINK FREQUENCY (MHz)	PRESENT CHANNEL	UFO CHANNEL	NOTES
39	309.350	268.350	B9	P9	NAVY 25-kHz CHANNELS, 41 MHz OFFSET
40	309.450	268.450	C9	Q9	”
41	310.650	269.650		N10	”
42	310.750	269.750	A10	O10	”
43	310.850	269.850	B10	P10	”
44	310.950	269.950	C10	Q10	”
45	293.950	260.350	A23-1		DoD 500-kHz CHANNELS/ UFO 25-kHz CHANNELS
46	293.975	260.375	A23-2	N11	”
47	294.000	260.400	A23-3		”
48	294.025	260.425	A23-4	P11	”
49	294.050	260.450	A23-5		”
50	294.075	260.475	A23-6	N12	”
51	294.100	260.500	A23-7		”
52	294.125	260.525	A23-8	P12	”
53	294.150	260.550	A23-9		”
54	294.175	260.575	A23-10	O11	”
55	294.200	260.600	A23-11		”
56	294.225	260.625	A23-12	Q11	”
57	294.250	260.650	A23-13		”
58	294.275	260.675	A23-14	O12	”
59	294.300	260.700	A23-15		”
60	294.325	260.725	A23-16	Q12	"
61	294.350	260.750	A23-17		"
62	294.375	260.775	A23-18		”
63	294.400	260.800	A23-19		”
64	294.425	260.825	A23-20		”
65	294.450	260.850	A23-21		”
66	295.050	261.450	B23-1		”
67	295.075	261.475	B23-2		”
68	295.100	261.500	B23-3		”
69	295.125	261.525	B23-4		”
70	295.150	261.550	B23-5		”
71	295.175	261.575	B23-6	N13	”
72	295.200	261.600	B23-7		”
73	295.225	261.625	B23-8	P13	”
74	295.250	261.650	B23-9		”
75	295.275	261.675	B23-10	N14	”

Table G-1. Default UHF frequency plans.

CHANNEL NUMBER	UPLINK FREQUENCY (MHz)	DOWNLINK FREQUENCY (MHz)	PRESENT CHANNEL	UFO CHANNEL	NOTES
76	295.300	261.700	B23-11		DoD 500-kHz CHANNELS/ UFO 25-kHz CHANNELS
77	295.325	261.725	B23-12	P14	”
78	295.350	261.750	B23-13		”
79	295.375	261.775	B23-14	N15	”
80	295.400	261.800	B23-15		”
81	295.425	261.825	B23-16	P15	”
82	295.450	261.850	B23-17		
83	295.475	261.875	B23-18	N16	”
84	295.500	261.900	B23-19		”
85	295.525	261.925	B23-20	P16	”
86	295.550	261.950	B23-21		”
87	295.650	262.050	C23-1		”
88	295.675	262.075	C23-2	O13	”
89	295.700	262.100	C23-3		”
90	295.725	262.125	C23-4	Q13	”
91	295.750	262.150	C23-5		”
92	295.775	262.175	C23-6	O14	”
93	295.800	262.200	C23-7		”
94	295.825	262.225	C23-8	Q14	”
95	295.850	262.250	C23-9		”
96	295.875	262.275	C23-10	O15	”
97	295.900	262.300	C23-11		”
98	295.925	262.325	C23-12	Q15	”
99	295.950	262.350	C23-13		”
100	295.975	262.375	C23-14	O16	”
101	296.000	262.400	C23-15		”
102	296.025	262.425	C23-16	Q16	”
103	296.050	262.450	C23-17		”
104	296.075	262.475	C23-18		”
105	296.100	262.500	C23-19		”
106	296.125	262.525	C23-20		”
107	296.150	262.550	C23-21		”
108	297.150	263.550	W2-1		”
109	297.175	263.575	W2-2	N17	”
110	297.200	263.600	W2-3		”
111	297.225	263.625	W2-4	P17	
112	297.250	263.650	W2-5		”
113	297.275	263.675	W2-6	N18	”

Table G-1. Default UHF frequency plans.

CHANNEL NUMBER	UPLINK FREQUENCY (MHz)	DOWNLINK FREQUENCY (MHz)	PRESENT CHANNEL	UFO CHANNEL	NOTES
114	297.300	263.700	W2-7		DoD 500-kHz CHANNELS/ UFO 25-kHz CHANNELS
115	297.325	263.725	W2-8	P18	”
116	297.350	263.750	W2-9		”
117	297.375	263.775	W2-10	O17	”
118	297.400	263.800	W2-11		”
119	297.425	263.825	W2-12	Q17	”
120	297.450	263.850	W2-13		”
121	297.475	263.875	W2-14	O18	
122	297.500	263.900	W2-15		”
123	297.525	263.925	W2-16	Q18	”
124	297.550	263.950	W2-17		”
125	297.575	263.975	W2-18		”
126	297.600	264.000	W2-19		”
127	297.625	264.025	W2-20		”
128	297.650	264.050	W2-21		”
129	302.445	248.845		N27	GAPFILLER 500-kHz CHANNELS/ UFO 5-kHz CHANNELS
130	302.450	248.850	G1		”
131	302.455	248.855		N28	”
132	302.465	248.865		N29	”
133	302.475	248.875	G2	N30	”
134	302.485	248.885		N31	”
135	302.495	248.895		N32	”
136	302.500	248.900	G3		”
137	302.505	248.905		N33	”
138	302.515	248.915		N34	”
139	302.525	248.925	G4	N35	”
140	302.535	248.935		N36	”
141	302.545	248.945		N37	”
142	302.550	248.950	G5		”
143	302.555	248.955		N38	”
144	302.565	248.965		N39	”
145	302.575	248.975	G6	O27	”
146	302.585	248.985		O28	”
147	302.595	248.995		O29	”
148	302.600	249.000	G7		”
149	302.605	249.005		O30	”

Table G-1. Default UHF frequency plans.

CHANNEL NUMBER	UPLINK FREQUENCY (MHz)	DOWNLINK FREQUENCY (MHz)	PRESENT CHANNEL	UFO CHANNEL	NOTES
150	302.615	249.015		O31	GAPFILLER 500-kHz CHANNELS/ UFO 5-kHz CHANNELS
151	302.625	249.025	G8	O32	”
152	302.635	249.035		O33	”
153	302.645	249.045		O34	”
154	302.650	249.050	G9		”
155	302.655	249.055		O35	”
156	302.665	249.065		O36	”
157	302.675	249.075	G10	O37	”
158	302.685	249.085		O38	”
159	302.695	249.095		O39	”
160	302.700	249.100	G11		”
161	302.705	249.105		P27	”
162	302.715	249.115		P28	”
163	302.725	249.125	G12	P29	”
164	302.735	249.135		P30	”
165	302.745	249.145		P31	”
166	302.750	249.150	G13		”
167	302.755	249.155		P32	”
168	302.765	249.165		P33	”
169	302.775	249.175	G14	P34	”
170	302.785	249.185		P35	”
171	302.795	249.195		P36	”
172	302.800	249.200	G15		”
173	302.805	249.205		P37	”
174	302.815	249.215		P38	”
175	302.825	249.225	G16	P39	”
176	302.835	249.235		Q27	"
177	302.845	249.245		Q28	”
178	302.850	249.250	G17		"
179	302.855	249.255		Q29	”
180	302.865	249.265		Q30	”
181	302.875	249.275	G18	Q31	”
182	302.885	249.285		Q32	”
183	302.895	249.295		Q33	”
184	302.900	249.300	G19		”
185	302.905	249.305		Q34	”
186	302.915	249.315		Q35	”
187	302.925	249.325	G20	Q36	”
188	302.935	249.335		Q37	”
189	302.945	249.345		Q38	”

Table G-1. Default UHF frequency plans.

CHANNEL NUMBER	UPLINK FREQUENCY (MHz)	DOWNLINK FREQUENCY (MHz)	PRESENT CHANNEL	UFO CHANNEL	NOTES
190	302.950	249.350			GAPFILLER 500-kHz CHANNELS/ UFO 5-kHz CHANNELS
191	302.955	249.355		Q39	”
192	307.750	254.150	GA		GAPFILLER 25-kHz (UFO CHAN N8 UPLINK)
193	311.150	257.550	GB		GAPFILLER 25-kHz
194	316.955	243.855	W9		AFSAT/ LEASAT NON-PROC. 5-kHz REPLACE-MENT CHANNELS
195	316.960	243.860	W10		AFSAT/ LEASAT NON-PROC. 5-kHz REPLACE-MENT CHANNELS
196	316.975	243.875	W11		”
197	317.000	243.900	W12		”
198	317.010	243.910	W13		”
199	317.015	243.915		N19	”
200	317.025	243.925		N20	”
201	317.035	243.935		N21	”
202	317.045	243.945	A11	N22	”
203	317.055	243.955	A12	N23	”
204	317.065	243.965	A14	N24	”
205	317.075	243.975	A16	N25	”
206	317.085	243.985	A18	N26	”
207	317.090	243.990	A19		”
208	317.095	243.995	A20	O19	”
209	317.100	244.000	A21		”
210	317.105	244.005		O20	”
211	317.110	244.010	A22		”
212	317.115	244.015		O21	”
213	317.125	244.025		O22	”
214	317.135	244.035		O23	
215	317.145	244.045	B11	O24	”
216	317.155	244.055	B12	O25	”
217	317.165	244.065	B14	O26	”

Table G-1. Default UHF frequency plans.

CHANNEL NUMBER	UPLINK FREQUENCY (MHz)	DOWNLINK FREQUENCY (MHz)	PRESENT CHANNEL	UFO CHANNEL	NOTES
218	317.175	244.075	B16	P19	AFSAT/ LEASAT NON-PROC. 5-kHz REPLACE-MENT CHANNELS
219	317.185	244.085	B18	P20	”
220	317.190	244.090	B19		”
221	317.195	244.095	B20	P21	”
222	317.200	244.100	B21		”
223	317.205	244.105		P22	”
224	317.210	244.110	B22		”
225	317.215	244.115		P23	”
226	317.225	244.125		P24	”
227	317.235	244.135		P25	”
228	317.245	244.145	C11	P26	”
229	317.255	244.155	C12	Q19	”
230	317.265	244.165	C14	Q20	”
231	317.275	244.175	C16	Q21	”
232	317.285	244.185	C18	Q22	”
233	317.290	244.190	C19		”
234	317.295	244.195	C20	Q23	”
235	317.300	244.200	C21		”
236	317.305	244.205		Q24	”
237	317.310	244.210	C22		”
238	317.315	244.215		Q25	”
239	317.325	244.225		Q26	”
240	307.550	253.950		NATO IVB/ SKYNET 4A	25-kHz (UK)
241	307.700	254.100		NATO IVA	25-kHz
242	311.050	257.450		NATO IVB SKYNET 4A	25-kHz (UK)
243	311.200	257.600		NATO IVA	25-kHz
244	307.750	254.150		SKYNET 4B	25-kHz (UK)
245	311.250	257.650		SKYNET 4B	”
246	307.650	254.050		SKYNET 4C	”
247	311.150	257.550		SKYNET 4C	”
248	294.800 to 314.800	253.650 to 254.350		SKYNET 4D	** 25-kHz (UK)
249	298.300 to 318.300	257.150 to 257.850		SKYNET 4D	** 25-kHz (UK)
250					
251					
252					

Table G-1. Default UHF frequency plans.

CHANNEL NUMBER	UPLINK FREQUENCY (MHz)	DOWNLINK FREQUENCY (MHz)	PRESENT CHANNEL	UFO CHANNEL	NOTES
253					
254					
255					

Notes:

* 307.750 was used as the Gapfiller channel A uplink frequency.
266.750 is not in correct use as a downlink frequency.

** The uplink and downlink frequencies associated with these channel frequency codes should be programmable in 25-kHz increments over the frequency ranges shown.

KEY TO CHANNEL NUMBERS

6. There are several frequency plans used on UHF satellites for the DoD. The FLTSATCOM satellites use frequency plans *A*, *B*, and *C*. The Leased Satellites (LEASATs) use frequency plans *X*, *Y*, and *Z*, which are abbreviated versions of plans A, B, and C (LEASATs have fewer channels). In addition, LEASAT has plan W, which shares frequencies with AFSATCOM polar frequency plan *E*. Gapfiller has been labeled for this table as *G*. UHF Follow-On (UFO) uses four frequency plans, *N*, *O*, *P*, and *Q*. In addition, there are alternate Fleet Broadcast downlink frequencies labeled *N*', *O*', *P*', and *Q*'. Table G-1 lists present Channel and UFO Channel as follows: Frequency plan, transponder number, and an optional transponder subdivision. As an example, Channel Number 46(Hex 2E) is A23-2. This corresponds to FLTSATCOM frequency plan A23, a DoD 500-kHz wideband channel (used as a 25-kHz sub-channel) that is being replaced by UFO 25-kHz channel N11 (frequency plan N, transponder 11).

Table G-2. EXAMPLE of User's Definable UHF Frequency Plans

CHANNEL NUMBER	Uplink Frequency (MHz)	Downlink Frequency (MHz)	Channel ID	NOTES
1			RESERVED	
2			RESERVED	
3			RESERVED	
4			RESERVED	
5			RESERVED	
6			RESERVED	
7			RESERVED	
8			RESERVED	
9	299,175	258,175	SIC1 B1	25 kHz
10	299,200	258,200	SIC1 B2	25 kHz
11	299,225	258,225	SIC1 B3	25 kHz
12	299,250	258,250	SIC1 B4	25 kHz
13	299,275	258,275	SIC1 B5	25 kHz
14			RESERVED	
15			RESERVED	
16	308,125	267,125	SIC1 C1	25 kHz
17	308,150	267,150	SIC1 C2	25 kHz
18	308,175	267,175	SIC1 C3	25 kHz
19	308,200	267,200	SIC1 C4	25 kHz
20	308,225	267,225	SIC1 C5	25 kHz
21			RESERVED	
22	293,225	252,225	SIC1 A1	25 kHz
23	293,250	252,250	SIC1 A2	25 kHz
24	293,275	252,275	SIC1 A3	25 kHz
25	293,300	252,300	SIC1 A4	25 kHz
26	293,325	252,325	SIC1 A5	25 kHz
27	293,200	252,200	SIC1 A0	25 kHz
28	293,350	252,350	SIC1 A6	25 kHz
29	299,150	258,150	SIC1 B0	25 kHz
30	299,300	258,300	SIC1 B6	25 kHz
31	308,100	267,100	SIC1 C0	25 kHz
32	308,250	267,250	SIC1 C6	25 kHz
33			RESERVED	
34			RESERVED	
35	309,700	252,400	SIC1B A35	25 kHz
36	309,725	252,425	SIC1B A36	25 kHz
37	309,750	252,450	SIC1B A37	25 kHz
38	309,775	252,475	SIC1B A38	25 kHz
39	309,800	252,500	SIC1B A39	25 kHz
40	309,825	252,525	SIC1B A40	25 kHz
41	309,850	252,550	SIC1B A41	25 kHz
42	309,875	252,575	SIC1B A42	25 kHz
43	309,900	252,600	SIC1B A43	25 kHz

Table G-2. EXAMPLE of User's Definable UHF Frequency Plans

CHANNEL NUMBER	Uplink Frequency (MHz)	Downlink Frequency (MHz)	Channel ID	NOTES
44	309,925	252,625	SIC1B A44	25 kHz
45	309,950	252,650	SIC1B A45	25 kHz
46	310,175	259,975	SIC1B B46	25 kHz
47	310,200	260,000	SIC1B B47	25 kHz
48	310,225	260,025	SIC1B B48	25 kHz
49	310,050	260,050	SIC1B B49	25 kHz
50	310,275	260,075	SIC1B B50	25 kHz
51	310,100	260,100	SIC1B B51	25 kHz
52	310,125	260,125	SIC1B B52	25 kHz
53	310,300	260,150	SIC1B B53	25 kHz
54	310,325	260,175	SIC1B B54	25 kHz
55	310,375	267,875	SIC1B C55	25 kHz
56	310,400	267,900	SIC1B C56	25 kHz
57	310,425	267,925	SIC1B C57	25 kHz
58	310,450	267,950	SIC1B C58	25 kHz
59	310,475	267,975	SIC1B C59	25 kHz
60	310,500	268,000	SIC1B C60	25 kHz
61	310,525	268,025	SIC1B C61	25 kHz
62	310,550	268,050	SIC1B C62	25 kHz
63	310,575	268,075	SIC1B C63	25 kHz
64	310,600	268,100	SIC1B C64	25 kHz
65			RESERVED	25 kHz
66			RESERVED	25 kHz
67			RESERVED	25 kHz
68			RESERVED	25 kHz
69			RESERVED	25 kHz
70			RESERVED	25 kHz
71			RESERVED	25 kHz
72			RESERVED	25 kHz
73			RESERVED	25 kHz
74			RESERVED	25 kHz
75			RESERVED	25 kHz
76			RESERVED	25 kHz
77			RESERVED	25 kHz
78			RESERVED	25 kHz
79			RESERVED	25 kHz
80			RESERVED	25 kHz
81			RESERVED	25 kHz
82			RESERVED	25 kHz
83			RESERVED	25 kHz
84			RESERVED	25 kHz
85			RESERVED	25 kHz
86			RESERVED	25 kHz
87			RESERVED	25 kHz
88			RESERVED	25 kHz

Table G-2. EXAMPLE of User's Definable UHF Frequency Plans

CHANNEL NUMBER	Uplink Frequency (MHz)	Downlink Frequency (MHz)	Channel ID	NOTES
89			RESERVED	25 kHz
90			RESERVED	25 kHz
91			RESERVED	25 kHz
92			RESERVED	25 kHz
93			RESERVED	25 kHz
94			RESERVED	25 kHz
95			RESERVED	25 kHz
96			RESERVED	25 kHz
97			RESERVED	25 kHz
98			RESERVED	25 kHz
99			RESERVED	25 kHz
100			RESERVED	25 kHz
101			RESERVED	25 kHz
102			RESERVED	25 kHz
103			RESERVED	25 kHz
104			RESERVED	25 kHz
105			RESERVED	25 kHz
106			RESERVED	25 kHz
107			RESERVED	25 kHz
108			RESERVED	25 kHz
109			RESERVED	25 kHz
110			RESERVED	25 kHz
111			RESERVED	25 kHz
112			RESERVED	25 kHz
113			RESERVED	25 kHz
114			RESERVED	25 kHz
115			RESERVED	25 kHz
116			RESERVED	25 kHz
117			RESERVED	25 kHz
118			RESERVED	25 kHz
119			RESERVED	25 kHz
120			RESERVED	25 kHz
121			RESERVED	25 kHz
122			RESERVED	25 kHz
123			RESERVED	25 kHz
124			RESERVED	25 kHz
125			RESERVED	25 kHz
126			RESERVED	25 kHz
127			RESERVED	25 kHz
128			RESERVED	25 kHz
129			RESERVED	5 kHz
130			RESERVED	5 kHz
131			RESERVED	5 kHz
132			RESERVED	5 kHz
133			RESERVED	5 kHz

Table G-2. EXAMPLE of User's Definable UHF Frequency Plans

CHANNEL NUMBER	Uplink Frequency (MHz)	Downlink Frequency (MHz)	Channel ID	NOTES
134			RESERVED	5 kHz
135			RESERVED	5 kHz
136			RESERVED	5 kHz
137			RESERVED	5 kHz
138			RESERVED	5 kHz
139			RESERVED	5 kHz
140			RESERVED	5 kHz
141			RESERVED	5 kHz
142			RESERVED	5 kHz
143			RESERVED	5 kHz
144			RESERVED	5 kHz
145			RESERVED	5 kHz
146			RESERVED	5 kHz
147			RESERVED	5 kHz
148			RESERVED	5 kHz
149			RESERVED	5 kHz
150			RESERVED	5 kHz
151			RESERVED	5 kHz
152			RESERVED	5 kHz
153			RESERVED	5 kHz
154			RESERVED	5 kHz
155			RESERVED	5 kHz
156			RESERVED	5 kHz
157			RESERVED	5 kHz
158			RESERVED	5 kHz
159			RESERVED	5 kHz
160			RESERVED	5 kHz
161			RESERVED	5 kHz
162			RESERVED	5 kHz
163			RESERVED	5 kHz
164			RESERVED	5 kHz
165			RESERVED	5 kHz
166			RESERVED	5 kHz
167			RESERVED	5 kHz
168			RESERVED	5 kHz
169			RESERVED	5 kHz
170			RESERVED	5 kHz
171			RESERVED	5 kHz
172			RESERVED	5 kHz
173			RESERVED	5 kHz
174			RESERVED	5 kHz
175			RESERVED	5 kHz
176			RESERVED	5 kHz
177			RESERVED	5 kHz
178			RESERVED	5 kHz

Table G-2. EXAMPLE of User's Definable UHF Frequency Plans

CHANNEL NUMBER	Uplink Frequency (MHz)	Downlink Frequency (MHz)	Channel ID	NOTES
179			RESERVED	5 kHz
180			RESERVED	5 kHz
181			RESERVED	5 kHz
182			RESERVED	5 kHz
183			RESERVED	5 kHz
184			RESERVED	5 kHz
185			RESERVED	5 kHz
186			RESERVED	5 kHz
187			RESERVED	5 kHz
188			RESERVED	5 kHz
189			RESERVED	5 kHz
190			RESERVED	5 kHz
191			RESERVED	5 kHz
192			RESERVED	25 kHz
193			RESERVED	25 kHz
194			RESERVED	5 kHz
195			RESERVED	5 kHz
196			RESERVED	5 kHz
197			RESERVED	5 kHz
198			RESERVED	5 kHz
199			RESERVED	5 kHz
200			RESERVED	5 kHz
201			RESERVED	5 kHz
202			RESERVED	5 kHz
203			RESERVED	5 kHz
204			RESERVED	5 kHz
205			RESERVED	5 kHz
206			RESERVED	5 kHz
207			RESERVED	5 kHz
208			RESERVED	5 kHz
209			RESERVED	5 kHz
210			RESERVED	5 kHz
211			RESERVED	5 kHz
212			RESERVED	5 kHz
213			RESERVED	5 kHz
214			RESERVED	5 kHz
215			RESERVED	5 kHz
216			RESERVED	5 kHz
217			RESERVED	5 kHz
218			RESERVED	5 kHz
219			RESERVED	5 kHz
220			RESERVED	5 kHz
221			RESERVED	5 kHz
222			RESERVED	5 kHz
223			RESERVED	5 kHz

Table G-2. EXAMPLE of User's Definable UHF Frequency Plans

CHANNEL NUMBER	Uplink Frequency (MHz)	Downlink Frequency (MHz)	Channel ID	NOTES
224			RESERVED	5 kHz
225			RESERVED	5 kHz
226			RESERVED	5 kHz
227			RESERVED	5 kHz
228			RESERVED	5 kHz
229			RESERVED	5 kHz
230			RESERVED	5 kHz
231			RESERVED	5 kHz
232			RESERVED	5 kHz
233			RESERVED	5 kHz
234			RESERVED	5 kHz
235			RESERVED	5 kHz
236			RESERVED	5 kHz
237			RESERVED	5 kHz
238			RESERVED	5 kHz
239			RESERVED	5 kHz
240			RESERVED	25 kHz
241			RESERVED	25 kHz
242			RESERVED	25 kHz
243			RESERVED	25 kHz
244			RESERVED	25 kHz
245			RESERVED	25 kHz
246			RESERVED	25 kHz
247			RESERVED	25 kHz
248			RESERVED	25 kHz
249			RESERVED	25 kHz
250			RESERVED	25 kHz
251			RESERVED	25 kHz
252			RESERVED	25 kHz
253			RESERVED	25 kHz
254			RESERVED	25 kHz
255			RESERVED	25 kHz

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