Technical Handbook for Radio Monitoring

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Acknowledgement:

Thanks for those who have supported me with information:

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Contents

General

The first part contains tables and descriptions which are necessary to understand the following parts. You will find a list of used alphabets with the used code for all characters in the most important systems. All systems are collected in two tables one sorted by baudrate and system and the other by system with their parameters.

Description of modulation states

In telegraph and data communication, information is transmitted in the form of characters, i.e. letters, figures and symbols. The information is represented by binary signals, which are characterized by two different levels. When considered electrically, these signals correspond to the states current and no current, or 1 (H),(Y) and 0 (L),(B), or - in accordance with CCITT recommendations - Z (stop) polarity and A (start polarity).

The following condition states are used :

data level 0	**data level 1**
A (on a wire circuit)	**Z (on a wire circuit)**
B (on a radio circuit)	**Y (on a radio circuit)**
free line	**idle circuit**
no current	**current**
no perforation	**perforation**
higher frequency	**lower frequency**
no tone	**tone**
phase shift	**no phase shift**
space	**mark**
start	**stop**
white (in FAX)	**black (in FAX)**

Table : Different description for data levels

Asynchronous Data Transmission

This kind of data transmission has also the name "Start-Stop-Mode" and is precursor of synchronous data transmission. In this transmission every character is synchronized between receiver and transmitter which is only valid for this one character. Every character starts with the start bit which is defined as 0 and ends with a stop bit which has the level 1. Between both the data are transmitted. One or more stop bits are possible. The space between two characters must not be fixed.

In pause time level 1or mark is transmitted. Transmission is started by switching to level 0 or space. This procedure needs only a minimum of technology.
The disadvantage is the length of the signs by the additional start - and stop bit. It reduces i.e. the data rate by use of only one start and stop bit to 80 % in comparison with the same synchronous mode.

Synchronous Data Transmission

In synchronous transmissions receiver and transmitter are synchronised to each other for the whole time of connection. The transfer rate of data is much higher than in asychronous mode.
Data are collected to frames and a flag is added for beginning and ending.
These flags are special bit combinations and are not allowed to appear in the text or data.
For synchronisation in time when there is no data exchange, idle signals are transmitted and give these communication lines an unique sound.

Simplex

In this mode only one data channel or frequency is available. An exchange of datas in both directions is possible. At the moment always one station is receiving and the other one transmitting.

Duplex

Duplex is working on two data channels or frequencies. An exchange of datas can be proceeded in both directions at the same time.

Half duplex

In half duplex channels or frequencies for duplex operation are available, but the connected equipment is not able to exchange datas at the same time in both directions.

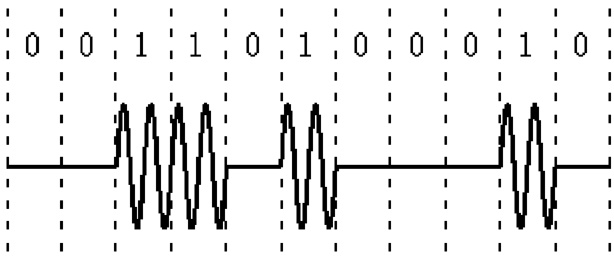
Semi duplex

In this mode also two data channels are available, but one station can only work in simplex mode, the other one in duplex mode.

Description of Waveforms

Amplitude Shift Keying (ASK)

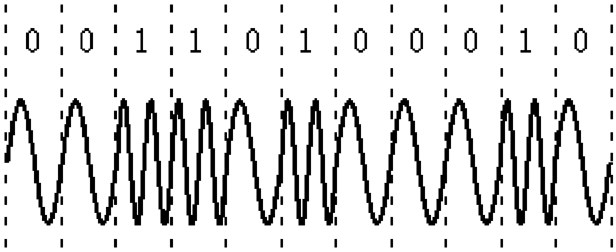
In amplitude shift keying, the carrier wave amplitude is changed between usullay two discrete levels in accordance with the digital data. A typical ASK signal might look like this:



The digital data to be transmitted is the binary number 1101. Two amplitudes are used to directly represent the data, either 0 or 1. In this case, the modulation is called binary amplitude shift keying or BASK. The signal is divided into four pulses of equal duration which represent the bits in the digital data.

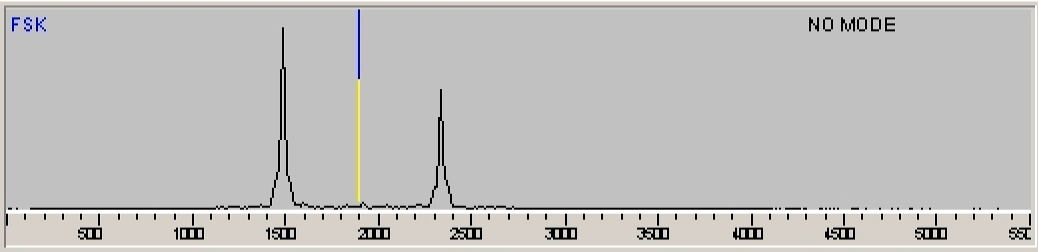
Frequency Shift Keying (FSK)

In frequency shift keying, the carrier frequency is changed between discrete values. If only two frequencies are used then this will be called BFSK, for binary frequency shift keying. In this figure, the same data is represented, 1011.



Normally FSK is generated by **A**udio **F**requency **S**hift **K**eying (AFSK) switching between two tones which then can be used in SSB technique to modulate the transmitter. In relation to the incoming data for a 0 tone 1 is transmitted and for a 1 tone 2.

The following picture shows the typical spectrum of a FSK:



Minimum Shift Keying (MSK)

MSK is a special form of FSK. This technique is used to find the minimum signal bandwidth for a particular method (usually FSK). In BFSK, the two frequencies are not chosen to be far enough apart, then it will become impossible to discriminate the two levels. The condition for the difference in frequencies, Df_{MSK}, such that the two levels can be determined accurately is

$$Df_{MSK} = 1/(4t_d)$$

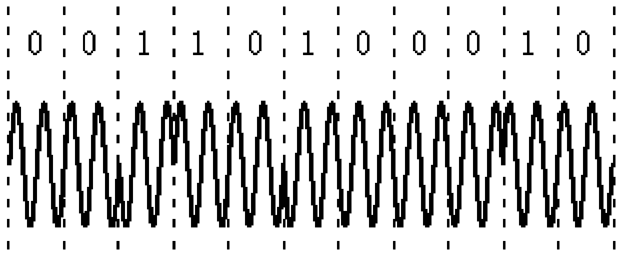
where t_d is the pulse duration as previously discussed. MSK is considered to be the most efficient way to use a given bandwidth. It maximizes the reliability (which is related to S/N) within a given bandwidth. MSK is very often used in the lower long wave frequency range.

Multi Frequency Shift Keying (MFSK)

In a MFSK 4 or more frequencies are used to transmit the information.

Phase Shift Keying (PSK)

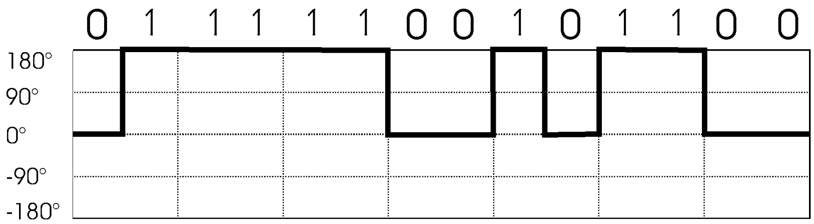
In a phase modulation information is transmitted by changing the phase of the signal.



BPSK

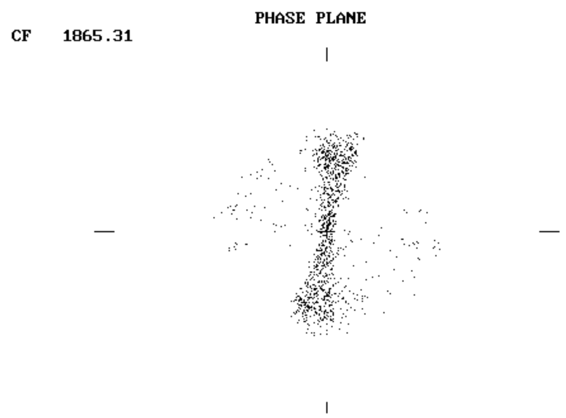
There are differnt possibilities to transmit information with phase shift keying. The various modes differ in number of phase shifts and the absolute value of phase shift . The simplest form is a 2-PSK (BPSK = Binary PSK). This PSK allows one or wo phase shifts. There are two different forms of a BPSK: the BPSK-A and BPSK-B.
In a BPSK-A for a logical 0 no phase shift is transmitted (0°) and in case of a logical 1 an absolute phase shift of 180°. As long in the data stream remains the logical 1 the phase will not change. The phase is only changing if there is a change from 1 to 0 or vis versa.

This is shown in the following picture:

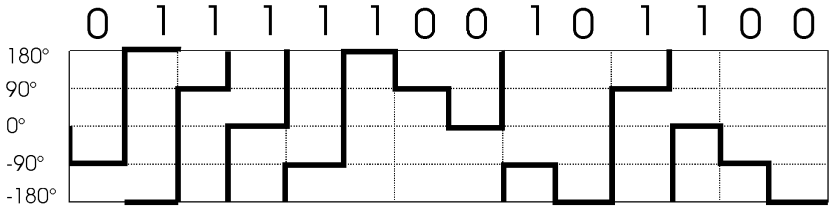


In a phase plane you will see two dot concentrations whjich present the state 0 and 1 in thew signal at the phase shift of 0° and 180°.

The following picture shows a BPSK in the phaseplane:



In the following example of a BPSK-B for a logical 0 an absolute phase shift of -90° is transmitted and for a logical 1 a shift of +270°. In case of two following 0's the phase is first shifted to -90° and then to -180°. If a logical 1 is following there will be a shift of +270° which results in -90°. A phase shift occurs if there is a change of the bit valus in the data stream.



Example of a BPSK-B

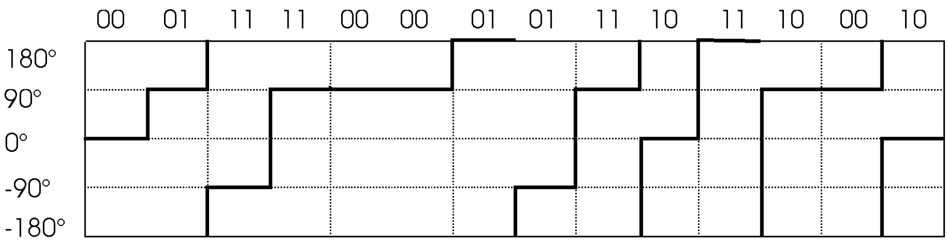
In the phase plane we will have for dot concentrations in the signal at 0°, 90°, 270° und 180°.

QPSK

Another type of phase modulation is called 4-PSK or QPSK (Quadratur Phase Shift Keying). This mode can also be differentiated in QPSK-A and QPSK-B.
The following phase shifts are possible:

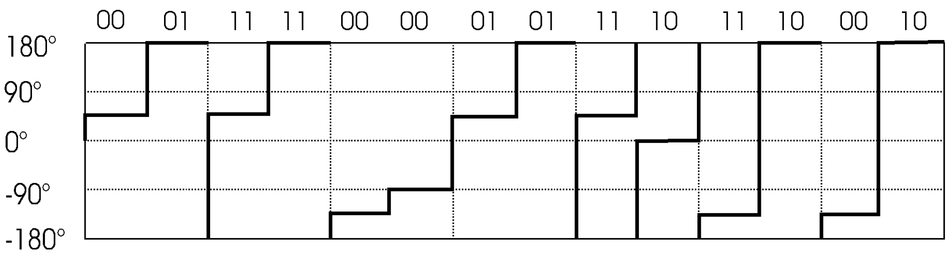
Di-bit value	QPSK-A	QPSK-B
00	No phase shift	Phase shift by 45°
01	Phase shift by 90°	Phase shift by 135°
11	Phase shift by 180°	Phase shift by 225°
10	Phase shift by 270°	Phase shift by 315°

Both versions are shown in the following drawings. For every phase shift the absolute phase shift for every di-bit value is added.



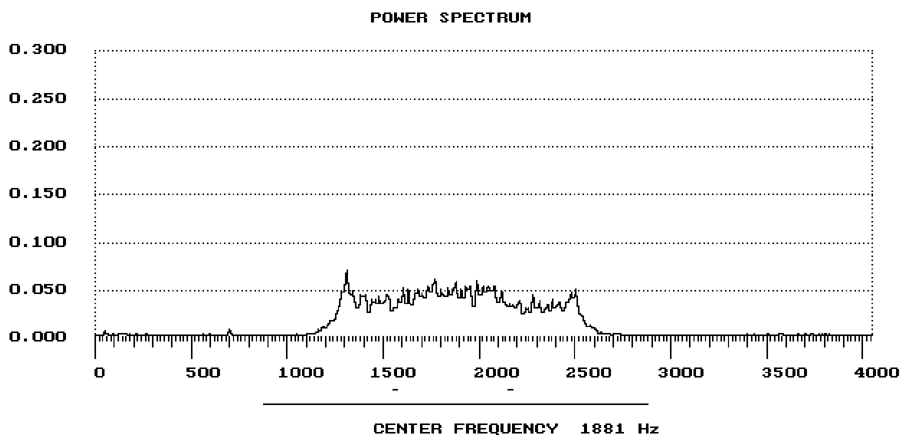
QPSK-A

In a QPSK-A only 4 absolute phase values will appear in the phase plane with a relative distance of 90°.
In a QPSK-B 8 phase values with a distance of 45° are possible which will be shown in the phase plane

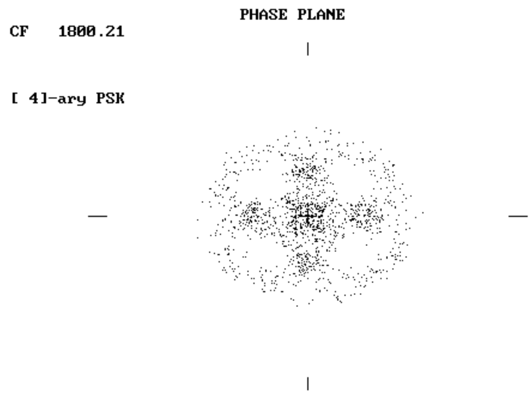


QPSK-B

The following picture show the typical spectrum of a phase modulation:



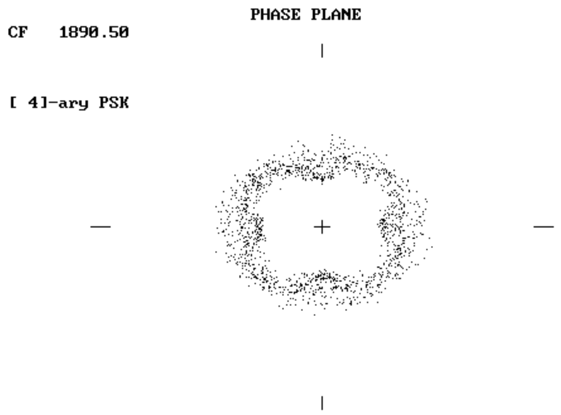
The next picture show the phase plane of a QPSK with all phase shifts:



OQPSK

OQPSK is a special version of QPSK in which the transmitted signal has no amplitude modulation. This disadvantage of a amplitude modulation are a result of 180° shifting in the phase.
In OQPSK the incoming signal is divided in the modulator into two portions I and Q which are then transmitted shifted by a half symbol duration.

The phase plane of a OQPSK is shown in the following picture. There is no phase shift through the zero crossing which means there are no phase shifts by 180° as in a standard QPSK.



8-PSK

In a 8-PSK instead of 4 phase shifts 8 are used.

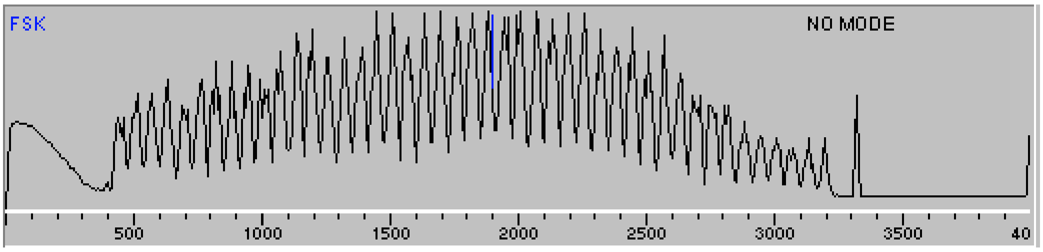
Quadrature Amplitude Modulation (QAM)

Quadrature amplitude modulation (QAM) is a modulation scheme in which two technics are combined: amplitude modulation and phase shift keying (PSK). A combination of two amplitude levels and a QPSK would result in a 8QAM with 8 states representing 8 different bit sequences:

Bit Sequence	Amplitude Level	Phase Shift
000	1	0°
001	2	0°
010	1	90°
011	2	90°
100	1	180°
101	2	180°
110	1	270°
111	2	270°

Orthogonal Frequency Division Multiplexing (OFDM)

Single high-frequency carrier is replaced by multiple subcarriers, each operating at a significantly lower frequency. It is a special method of multi-carrier modulation. OFDM transmits multiple high data rate signals concurrently on different frequencies. The channel spectrum is passed into a number of independent non-selective frequency sub-channels and these subchannels are used for one transmission link between two stations.



Spectrum of a OFDM with 45 channels

Used code tables

ITA2, ITA2P and ITA3(CCIR342-2)

ISO name ITU name			ITA 2	ITA 2P	ITA 3 CCIR342-2
	letter	**figure**			
1	A	-	11000	0110001	0011010
2	B	?	10011	0100110	0011001
3	C	:	01110	0011100	1001100
4	D	$	10010	0100101	0011100
5	E	3	10000	0100000	0111000
6	F	!	10110	0101100	0010011
7	G	&	01011	0010110	1100001
8	H	#	00101	0001011	1010010
9	I	8	01100	0011001	1110000
10	J	###	11010	0110100	0100011
11	K	(	11110	0111101	0001011
12	L	)	01001	0010011	1100010
13	M	.	00111	0001110	1010001
14	N	,	00110	0001101	1010100
15	O	9	00011	0000111	1000110
16	P	0	01101	0011010	1001010
17	Q	1	11101	0111011	0001101
18	R	4	01010	0010101	1100100
19	S	'	10100	0101001	0101010
20	T	5	00001	0000010	1000101
21	U	7	11100	0111000	0110010
22	V	=	01111	0011111	1001001
23	W	2	11001	0110010	0100101
24	X	/	10111	0101111	0010110
25	Y	6	10101	0101010	0010101
26	Z	+	10001	0100011	0110001
27	cr	cr	00010	0000100	1000011
28	lf	lf	01000	0010000	1011000
29	ls	ls	11111	0111111	0001110
30	fs	fs	11011	0110110	0100110
31	sp	sp	00100	0001000	1101000
32	Unperf. tape		00000	0000001	0000111
control signal 1 (CS 1)					
control signal 2 (CS 2)					
control signal 3 (CS 3)					
idle signal ###				1000110	0101100
idle signal ###				1001001	0101001
signal repetition RQ				1110000	0110100

CCIR476-4, HNG-FEC, PICCOLO MK VI

ISO name ITU name			CCIR476-4	HNG FEC	Piccolo MK VI
	letter	figure		tone 1/tone 2	
1	A	-	0001110	010 010 111 110 011	96
2	B	?	1011000	000 100 101 111 100	69
3	C	:	0100011	111 110 011 101 101	89
4	D	$	0011010	000 110 001 001 011	79
5	E	3	1001010	000 011 000 100 101	74
6	F	!	0010011	001 110 110 100 000	98
7	G	&	0101001	110 100 000 110 001	57
8	H	#	0110100	101 000 001 100 010	55
9	I	8	0100110	111 011 010 000 011	84
10	J	###	0001011	010 111 110 011 101	97
11	K	(	1000011	011 111 001 110 110	99
12	L	)	0101100	110 001 001 011 111	56
13	M	.	0110001	101 101 000 001 100	58
14	N	,	0110010	101 111 100 111 011	88
15	O	9	0111000	100 101 111 100 111	68
16	P	0	0100101	111 001 110 110 100	54
17	Q	1	1000101	011 000 100 101 111	44
18	R	4	0101010	110 110 100 000 110	87
19	S	'	0010110	001 011 111 001 110	95
20	T	5	1101000	100 000 110 001 001	65
21	U	7	1000110	011 010 000 011 000	94
22	V	=	1100001	111 100 111 011 010	59
23	W	2	0001101	010 000 011 000 100	46
24	X	/	1010001	001 100 010 010 111	48
25	Y	6	0010101	001 001 011 111 001	45
26	Z	+	0011100	000 001 100 010 010	64
27	cr	cr	1110000	100 111 011 010 000	78
28	lf	lf	1100100	110 011 101 101 000	86
29	ls	ls	1010010	011 101 101 000 001	49
30	fs	fs	1001001	010 101 010 101 010	47
31	sp	sp	1100010	101 010 101 010 111	85
32	Unperf. tape		1010100	100 010 010 111 110	67
control signal 1 (CS 1)			0101100		
control signal 2 (CS 2)			1010100		
control signal 3 (CS 3)			0110010		
idle signal ###			0000111		
idle signal ###			0011001		
signal repetition RQ			1001100		

In HNG FEC for the start sequence is used P 110 100 110 010 011 and N 001 011 001 101 100 which are inverted to each other. Piccolo MK VI for ITA 2 (6 of 12 possible tones)

ITA - 2

ITA 2 or CCITT 2 is one of the earliest coding systems and probably the most common in the world.
This Coding system is made up of 5 data elements and 2 synchronising elements. At the commencement of each character sent is a start - bit with a duration equal to the 5 data bits that will after it. The stop synchronising is made by a stop-bit, which is longer than a data bit. Common values are 1, 1,5 and 2 times the length of a data bit.
These 5 data bits give a total of 32 different combinations. This amount is not enough to code a complete alphabet with numbers, letters and punctuation. A minimum of two of these 32 characters are reserved for a figure shift and letter shift. If received, they shift the equipment between two or more tables of characters. One table is consisting of letters, the second one of numbers and punctuations.

Third shift alphabets are for example used in third shift cyrellic, greek, korean, amharic and thai.
Four shift alphabets are used in countries using the ATU 80 teleprinter alphabet.

Common use of the ITA 2 alphabet is in baudot and HC - ARQ

ITA 2 P

ITA 2 P is a derivation of ITA 2 but the basic 5 bit unit is converted into a 7 bit unit by the addition of a synchronising bit as the first element and a parity check in the 7th place.
The synchronising bit is always 0 except in case of the control signals RQ and idle-ling.
The value of the parity bit is chosen in this way, that the seven elements always have an odd number of 1's.
This alphabet is common used in FEC systems FEC 100 A and FEC 101 and the ARQ systems ARQ 1A and ARQ 1000D.

ITA 3

This alphabet is mainly used for ARQ duplex systems like ARQ - M2 242 and 342. ITA 3 is also used in system with ARQ - E3, SI - ARQ and SI - FEC.

CCIR 476

This alphabet was invented for SITOR ARQ. It is used worldwide in the MMS communication, but it can also be used according to CCIR 518 in fixed services.
The 5 bit basic code is increased to a 7 bit error detecting system. Among the 128 possible combinations of the seven bit there are 35 for which the ratio 1: 0 = 3:4. If a modified ratio is received this enables the receiving system to detect all errors and initial a request for retransmission of a corrupted character block.

ASCII / CCITT 5

This Alphabet was invented for data exchange between computer systems. This alphabet is using up to 8 bits for 256 characters. In some cases a 9th bit for parity check is added.

Decimal	Hex	Character
0	00	
1	01	
2	02	
3	03	♥
4	04	♦
5	05	♣

Decimal	Hex	Character
6	06	♠
7	07	•
8	08	
9	09	
10	0A	
11	0B	

Decimal	Hex	Character
12	0C	
13	0D	
14	0E	
15	0F	
16	10	
17	11	

Decimal	Hex	Character
18	12	
19	13	
20	14	
21	15	§
22	16	
23	17	
24	18	↑
25	19	↓
26	1A	→
27	1B	←
28	1C	
29	1D	↔
30	1E	
31	1F	
32	20	
33	21	!
34	22	„
35	23	#
36	24	$
37	25	%
38	26	&
39	27	‘
40	28	(
41	29	)
42	2A	*
43	2B	+
44	2C	,
45	2D	-
46	2E	.
47	2F	/
48	30	0
49	31	1
50	32	2
51	33	3
52	34	4
53	35	5
54	36	6
55	37	7
56	38	8
57	39	9
58	3A	:
59	3B	;
60	3C	<
61	3D	=
62	3E	>

Decimal	Hex	Character
63	3F	?
64	40	@
65	41	A
66	42	B
67	43	C
68	44	D
69	45	E
70	46	F
71	47	G
72	48	H
73	49	I
74	4A	J
75	4B	K
76	4C	L
77	4D	M
78	4E	N
79	4F	O
80	50	P
81	51	Q
82	52	R
83	53	S
84	54	T
85	55	U
86	56	V
87	57	W
88	58	X
89	59	Y
90	5A	Z
91	5B	[
92	5C	\
93	5D	]
94	5E	^
95	5F	_
96	60	
97	61	a
98	62	b
99	63	c
100	64	d
101	65	e
102	66	f
103	67	g
104	68	h
105	69	i
106	6A	j
107	6B	k

Decimal	Hex	Character
108	6C	l
109	6D	m
110	6E	n
111	6F	o
112	70	p
113	71	r
114	72	r
115	73	s
116	74	t
117	75	u
118	76	w
119	77	w
120	78	x
121	79	y
122	7A	z
123	7B	{
124	7C	|
125	7D	}
126	7E	~
127	7F	
128	80	Ç
129	81	ü
130	82	é
131	83	â
132	84	ä
133	85	à
134	86	å
135	87	ç
136	88	ê
137	89	ë
138	8A	è
139	8B	ï
140	8C	î
141	8D	ì
142	8E	Ä
143	8F	Å
144	90	É
145	91	æ
146	92	Æ
147	93	ô
148	94	ö
149	95	ò
150	96	û
151	97	ù
152	98	ÿ

Decimal	Hex	Character
153	99	Ö
154	9A	Ü
155	9B	¢
156	9C	£
157	9D	¥
158	9E	₧
159	9F	ƒ
160	A0	á
161	A1	í
162	A2	ó
163	A3	ú
164	A4	ñ
165	A5	Ñ
166	A6	ª
167	A7	º
168	A8	¿
169	A9	⌐
170	AA	¬
171	AB	½
172	AC	¼
173	AD	¡
174	AE	«
175	AF	»
176	B0	░
177	B1	▒
178	B2	▓
179	B3	│
180	B4	┤
181	B5	╡
182	B6	╢
183	B7	╖
184	B8	╕
185	B9	╣
186	BA	║
187	BB	╗
188	BC	╝
189	BD	╜

Decimal	Hex	Character
190	BE	╛
191	BF	┐
192	C0	└
193	C1	┴
194	C2	┬
195	C3	├
196	C4	─
197	C5	┼
198	C6	╞
199	C7	╟
200	C8	╚
201	C9	╔
202	CA	╩
203	CB	╦
204	CC	╠
205	CD	═
206	CE	╬
207	CF	╧
208	D0	╨
209	D1	╤
210	D2	╥
211	D3	╙
212	D4	╘
213	D5	╒
214	D6	╓
215	D7	╫
216	D8	╪
217	D9	┘
218	DA	┌
219	DB	█
220	DC	▄
221	DD	▌
222	DE	▐
223	DF	▀
224	E0	α
225	E1	ß
226	E2	Γ
227	E3	π

Decimal	Hex	Character
228	E4	Σ
229	E5	σ
230	E6	µ
231	E7	τ
232	E8	Φ
233	E9	Θ
234	EA	Ω
235	EB	δ
236	EC	∞
237	ED	φ
238	EE	ε
239	EF	∩
240	F0	≡
241	F1	±
242	F2	≥
243	F3	≤
244	F4	⌠
245	F5	⌡
246	F6	÷
247	F7	≈
248	F8	°
249	F9	•
250	FA	·
251	FB	√
252	FC	^{n}
253	FD	^{2}
254	FE	■
255	FF	

Data formats

The coded digital data are converted in a special signal form which contains different data formats.
The common data formats are shown in figure 1.
In accordance to the chosen format the possibility is given to add to the data signal the used clock signal.
These data formats are called self clocking. On the receiver side the data format is separated into the data stream and used clock.
The common self clocking data format is i.e. the very often used Bi-phase-format which is also called the manchester or split phase format.
For these formats sometimes is used the expression "code", for example Bi-phase-code or manchester code.

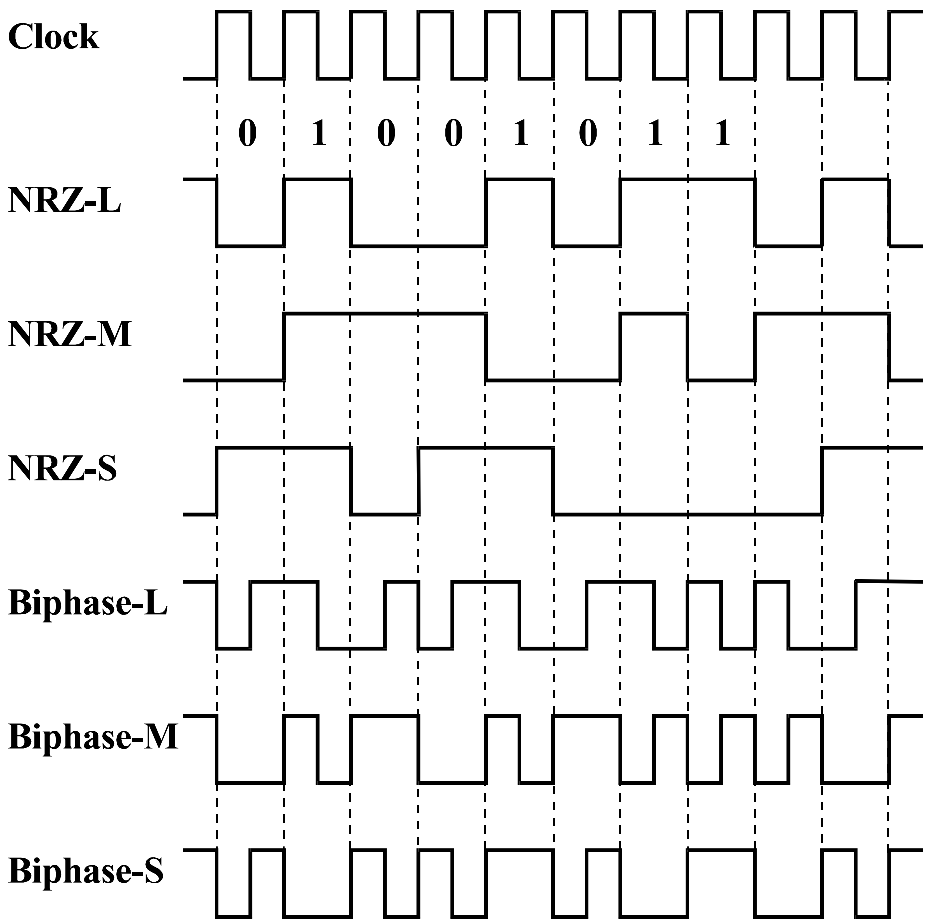


Figure : Common Data Formats

NRZ (Non Return to Zero)

In this data format every bit or bit cell is represented by a rectangle. The digital information logical one (H) is equal to level exist and the logical zero (L) equal to level does not exist.
The NRZ format is not self clocking and not free of direct current, because at long zero or one sequences there will be no change in the level.
The NRZ format is also called very often NRZ (L) or NRZ (C).
It is used for i.e. RTTY .

NRZ (S) (Non Return to Zero - Space)

In this data format only a zero will cause a change of level. Long sequences of ones will cause a high level of direct current.
The NRZ (S) format is also known under NRZI and is used in commercial protocol-controllers. Long one sequences are hindered by bit stuffing, which only allows a limited number of ones after each other.

NRZ (M) (Non Return to Zero - Mark)

The NRZ (M) format has a change of the level only if there is a one in the data stream. Long sequences of zeros will cause a high direct current level.

Bi-Φ-L (Biphase Level)

This data format is also known as Manchester format and as split phase. It is a self clocking format, which contains the clock for the receiver synchronisation. The change of level is at ones and zeros in the middle of the bit cell. The logical one (H) is represented as a sequence with change from one to zero and the logical zero as a sequence with change from zero to one.
This data format has only very little portion of direct current but is uses the double bandwidth of a NRZI format.
The generating of the Bi-Φ-L format is very easy : it needs only an EXOR gate to combine the clock signal with the data stream.

Bi-Φ- M (Biphase Mark)

This biphase data format is also called Manchester I-code or diphase. The logical zero will cause a change of the level at the begin of a bit cell. The logical one will cause an additional change in the middle of the cell.
Biphase Mark is also self clocking and the portion of direct current is very low.
The data transfer rate (NRZ) correspondents to the double data rate (Bi-Φ-M).

Bi-Φ-S (Biphase Space)

The biphase space format has at every logical one a change of the level at the beginning of the bit cell. The logical zero is causing a change in the middle of the bit cell. This format is equal to Bi-Φ-M.

Table of system and user sorted by baudrate

Baudrate in Baud	Datarate in Bit/s	Shift	Channels	No of Ch.	Mode	User	sync/ async
13,30		30	13		**COQUELET 13**	NATO, BEL	MFSK
13,30		30	8		**COQUELET 8**	ALG	MFSK
20,00		20	12	20	**PICCOLO MK VI**	G, AUS	MFSK
20,00		20	6		**PICCOLO MK VI**	G, AUS	MFSK
20,00		250			**Pseudo random**		
26,67		30	8		**COQUELET 8**	ALG	MFSK
31,50			1		**PSK 31**	HAM	
36,50		500	1		**8181**	RUS	sync
40,00		40	32	40	**CROWD 36**	RUS	MFSK
40,00		40	6		**PICCOLO MK VI**	G	MFSK
40,50		1000	1		**8181**	RUS	sync
40,50		125	1		**8181**	RUS	sync
40,50		200	1		**8181**	RUS	sync
40,50		250	1		**8181**	RUS	sync
40,50		500	1		**8181**	RUS	sync
42,10		500	2		**CIS 14/PARITY 14**	RUS	sync
45,45		1000	1		**BAUDOT 1,5 STB**	various	async
46,00		170	1		**ARQE**	various	sync
47,50		500	2		**CIS 14/PARITY 14**	RUS	sync
48,00		270	1		**ARQ-E3**	various	sync
48,00		300	1		**ARQ-E3**	various	sync
48,00		400	1		**ARQ-E3**	various	sync
48,00		850	1		**ARQ-E3**	various	sync
48,00		400	2		**ARQ-M2 242**	various	sync
48,00		170	1		**ARQE**	various	sync
48,00		400	1		**ARQE**	various	sync
48,00		850	1		**ARQE**	various	sync
48,00		500	2		**CIS 14/PARITY 14**	RUS	sync
50,00		250	1		**36-50**	RUS	sync
50,00		500	1		**36-50**	RUS	sync
50,00		1000	1		**BAUDOT 1 STB**	various	async
50,00		170	1		**BAUDOT 1 STB**	various	async
50,00		400	1		**BAUDOT 1 STB**	various	async
50,00		50	1		**BAUDOT 1 STB**	various	async
50,00		500	1		**BAUDOT 1 STB**	various	async
50,00		850	1		**BAUDOT 1 STB**	various	async
50,00		100	1		**BAUDOT 1,5 STB**	various	async
50,00		1400	1		**BAUDOT 1,5 STB**	various	async
50,00		1575	1		**BAUDOT 1,5 STB**	various	async
50,00		170	1		**BAUDOT 1,5 STB**	various	async
50,00		200	1		**BAUDOT 1,5 STB**	various	async
50,00		250	1		**BAUDOT 1,5 STB**	various	async
50,00		400	1		**BAUDOT 1,5 STB**	various	async
50,00		425	1		**BAUDOT 1,5 STB**	various	async
50,00		500	1		**BAUDOT 1,5 STB**	various	async
50,00		85	1		**BAUDOT 1,5 STB**	various	async
50,00		850	1		**BAUDOT 1,5 STB**	various	async
50,00		1000	1		**BAUDOT 2 STB**	various	async
50,00		400	1		**BAUDOT 2 STB**	various	async
50,00		850	1		**BAUDOT 2 STB**	various	async
50,00		500	1		**CIS 11/TORG 10/11**	RUS	sync
50,00		500	2		**CIS 14/PARITY 14**	RUS	sync
50,00		500	2		**CIS 27**	RUS	sync
50,00		1000			**Pseudo random**		
50,00		200			**Pseudo random**		
50,00		250			**Pseudo random**		
50,00		400			**Pseudo random**		
50,00		50			**Pseudo random**		
50,00		500			**Pseudo random**		
50,00		85			**Pseudo random**		
50,00		850			**Pseudo random**		

Baudrate in Baud	Datarate in Bit/s	Shift	Channels	No of Ch.	Mode	User	sync/ async
62,30			1		**AUTOSPEC**		sync
64,00			1		**ARQE**	various	sync
64,00			1		**ARQE**	various	sync
68,50		85	1		**AUTOSPEC**		sync
68,50			1		**SPREAD 11,21,51**		sync
68,60		85			**Pseudo random**		
70,50		500	2		**CIS 14/PARITY 14**	RUS	sync
72,00		400	1		**ARQ-E3**	various	sync
72,00		170	1		**ARQE**	various	sync
72,00		400	1		**ARQE**	various	sync
72,00		500	1		**ARQE**	various	sync
72,00		85	1		**ARQE**	various	sync
72,00			1		**ARQN**	I	sync
72,00		500	2		**CIS 14/PARITY 14**	RUS	sync
73,00		250	2		**8181**	RUS	sync
73,00		400	2		**8181**	RUS	sync
73,00		500	2		**8181**	RUS	sync
73,00		850	2		**8181**	RUS	sync
75,00		170	1		**BAUDOT 1 STB**	various	async
75,00		400	1		**BAUDOT 1 STB**	various	async
75,00		500	1		**BAUDOT 1 STB**	various	async
75,00		85	1		**BAUDOT 1 STB**	various	async
75,00		850	1		**BAUDOT 1 STB**	various	async
75,00		170	1		**BAUDOT 1,5 STB**	various	async
75,00		170	1		**BAUDOT 1,5 STB**	various	async
75,00		200	1		**BAUDOT 1,5 STB**	various	async
75,00		250	1		**BAUDOT 1,5 STB**	various	async
75,00		300	1		**BAUDOT 1,5 STB**	various	async
75,00		400	1		**BAUDOT 1,5 STB**	various	async
75,00		425	1		**BAUDOT 1,5 STB**	various	async
75,00		500	1		**BAUDOT 1,5 STB**	various	async
75,00		85	1		**BAUDOT 1,5 STB**	various	async
75,00		850	1		**BAUDOT 1,5 STB**	various	async
75,00		850	1		**BAUDOT 2 STB**	various	async
75,00		495	1		**IRA-ARQ**	BUL	async
75,00		170	1		**LINK 4**	NATO	sync
75,00		850	1		**LINK 4**	NATO	sync
75,00		1000			**Pseudo random**		
75,00		170			**Pseudo random**		
75,00		200			**Pseudo random**		
75,00		250			**Pseudo random**		
75,00		300			**Pseudo random**		
75,00		400			**Pseudo random**		
75,00		500			**Pseudo random**		
75,00		75			**Pseudo random**		
75,00		85			**Pseudo random**		
75,00		850			**Pseudo random**		
81,00		1000	2		**8181**	RUS	sync
81,00		200	2		**8181**	RUS	sync
81,00		250	2		**8181**	RUS	sync
81,00		400	2		**8181**	RUS	sync
81,00		500	2		**8181**	RUS	sync
83,30		500	2		**CIS 14/PARITY 14**	RUS	sync
84,21		500	2		**CIS 14/PARITY 14**	RUS	sync
86,00		170	1		**ARQE**	various	sync
94,11		500	2		**CIS 14/PARITY 14**	RUS	sync
96,00		170	1		**ARQ-E3**	various	sync
96,00		400	1		**ARQ-E3**	various	sync
96,00			2		**ARQ-M2 242**	various	sync
96,00		400	2		**ARQ-M2 242**	various	sync
96,00		400	2		**ARQ-M2 342**	various	sync
96,00		170	2		**ARQ-M2 342**	various	sync
96,00		400	4		**ARQ-M4 242**	various	sync
96,00			4		**ARQ-M4 242**	various	sync
96,00		170	1		**ARQE**	various	sync

Baudrate in Baud	Datarate in Bit/s	Shift	Channels	No of Ch.	Mode	User	sync/ async
96,00		200	1		**ARQE**	various	sync
96,00		330	1		**ARQE**	various	sync
96,00		500	1		**ARQE**	various	sync
96,00		85	1		**ARQE**	various	sync
96,00		850	1		**ARQE**	various	sync
96,00		400	1		**ARQN**	I	sync
96,00		170	1		**ARQS**	AUT, INS	sync
96,00		200	1		**ARQS**	AUT, INS	sync
96,00		400	1		**ARQS**	AUT, INS	sync
96,00		500	2		**CIS 14/PARITY 14**	RUS	sync
96,00		170	1		**FEC 100**	various	sync
96,00		400	1		**FEC 100**	D, various	sync
96,00		85	1		**FEC 100**	various	sync
96,00		850	1		**FEC 100**	various	sync
96,00		170	1		**FECS**	INS	sync
96,00		1400			**Pseudo random**		
96,00		500			**Pseudo random**		
96,00		850			**Pseudo random**		
100,00		400	1		**ARQ-E3**	various	sync
100,00		850	1		**ARQ-E3**	various	sync
100,00		170	1		**ARQE**	various	sync
100,00		330	1		**ARQE**	various	sync
100,00		400	1		**ARQE**	various	sync
100,00		170	1		**BAUDOT 1 STB**	various	async
100,00		200	1		**BAUDOT 1 STB**	various	async
100,00		85	1		**BAUDOT 1 STB**	various	async
100,00		850	1		**BAUDOT 1 STB**	various	async
100,00		170	1		**BAUDOT 1,5 STB**	various	async
100,00		200	1		**BAUDOT 1,5 STB**	various	async
100,00		300	1		**BAUDOT 1,5 STB**	various	async
100,00		330	1		**BAUDOT 1,5 STB**	various	async
100,00		400	1		**BAUDOT 1,5 STB**	various	async
100,00		500	1		**BAUDOT 1,5 STB**	various	async
100,00		85	1		**BAUDOT 1,5 STB**	various	async
100,00		850	1		**BAUDOT 1,5 STB**	various	async
100,00		500	1		**CIS 11/TORG 11**	RUS	sync
100,00		500	2		**CIS 14/PARITY 14**	RUS	sync
100,00			2		**CIS 27**	RUS	sync
100,00		200	1		**GTOR**		
100,00			1		**IRA-ARQ**	BUL	async
100,00		850	1		**LINK 4**	NATO	sync
100,00		170	1		**PACTOR**	HAM, UN, USA MARS	
100,00		200	1		**PACTOR**	HAM, UN, USA MARS	
100,00		240	1		**POL-ARQ**	POL	sync
100,00		340	1		**POL-ARQ**	POL	sync
100,00		100			**Pseudo random**		
100,00		1000			**Pseudo random**		
100,00		170			**Pseudo random**		
100,00		200			**Pseudo random**		
100,00		500			**Pseudo random**		
100,00		85			**Pseudo random**		
100,00		170	2		**SITOR, F7B**	various	B sync
100,00		200	2		**SITOR, F7B**	various	B sync
100,00		400	2		**SITOR, F7B**	various	B sync
100,00		500	2		**SITOR, F7B**	various	B sync
100,00		170	1		**SITOR A/B**	various	B sync
100,00		300	1		**SITOR A/B**	various	B sync
100,00		400	1		**SITOR A/B**	various	B sync
100,00		400	1		**SW-ARQ**	S	B sync
100,00		500	1		**TORG 10/11**	RUS	sync
100,00			8	200	**TT2300-ARQ**	G, F	MFSK
102,70			1		**AUTOSPEC**		sync
102,70			1		**SPREAD 11,21,51**		sync
106,70		180	1		**BAUDOT 2 STB**	various	async
108,90		170	1		**ARQE**	various	sync

Baudrate in Baud	Datarate in Bit/s	Shift	Channels	No of Ch.	Mode	User	sync/ async
108,90		170	1		**FEC 100**	various	sync
110,00		170	1		**ASCII**	HAM	sync
110,00		495	1		**IRA-ARQ**	BUL	async
110,00		1350			**Pseudo random**		
120,00			12	200	**4-DPSK**	RUS	
120,00		495	1		**BAUDOT 1,5 STB**	various	async
120,00		495	1		**BAUDOT 2 STB**	various	async
120,00		495	1		**IRA-ARQ**	BUL	async
125,00		170	1		**DUP-ARQ**	HNG	B sync
125,00		170			**Pseudo random**		
125,00		850			**Pseudo random**		
137,00			1		**SPREAD 11,21,51**		sync
144,00		170	1		**ARQE**	various	sync
144,00		400	1		**ARQE**	various	sync
144,00		170	1		**ARQN**	I	sync
144,00		170	1		**ARQS**	AUT, INS	sync
144,00		500	2		**CIS 14/PARITY 14**	RUS	sync
144,00		250	1		**FEC 100**	various	sync
144,00		400	1		**FEC 100**	F, various	sync
144,00		85	1		**FEC 100**	various	sync
144,00		850	1		**FEC 100**	TUR, various	sync
144,00		170			**Pseudo random**		
144,00		200			**Pseudo random**		
150,00		400	1		**BAUDOT 1,5 STB**	various	async
150,00		495	1		**BAUDOT 1,5 STB**	various	async
150,00		500	1		**BAUDOT 1,5 STB**	various	async
150,00		850	1		**BAUDOT 1,5 STB**	various	async
150,00		500	1		**CIS 11/TORG 11**	RUS	sync
150,00		495	1		**IRA-ARQ**	BUL	async
150,00		400			**Pseudo random**		
150,00		850			**Pseudo random**		
160,00		495	1		**BAUDOT 2 STB**	various	async
162,50		1000			**Pseudo random**		
164,50		400	1		**ROU-FEC**	ROU	sync
171,42		500	1		**IRA-ARQ**	SLO	async
180,00		495	1		**IRA-ARQ**	BUL	async
184,50		400	1		**ARQE**	F	sync
192,00		170	1		**ARQ-E3**	various	sync
192,00		400	1		**ARQ-E3**	various	sync
192,00		850	1		**ARQ-E3**	various	sync
192,00		170	1		**ARQE**	various	sync
192,00		200	1		**ARQE**	various	sync
192,00		400	1		**ARQE**	various	sync
192,00		85	1		**ARQE**	various	sync
192,00		170	1		**ARQN**	I	sync
192,00		170	1		**ARQS**	AUT, INS	sync
192,00		500	1		**BAUDOT 2 STB**	various	async
192,00		170	1		**FEC 100**	various	sync
192,00		400	1		**FEC 100**	F, various	sync
192,00		850	1		**FEC 100**	various	sync
192,00		170	1		**FECS**		sync
192,00		1000			**Pseudo random**		
192,00		500			**Pseudo random**		
195,30		200	1	3	**MFSK**		
200,00		400	1		**ARQ 6-70**	F	sync
200,00		400	1		**ARQ 6-90**	F	sync
200,00		400	1		**ARQ 6-98**	F	sync
200,00		400	1		**ARQ-E3**	various	sync
200,00		400	2		**ARQ-M2 342**	various	sync
200,00		400	4		**ARQ-M4 242**	various	sync
200,00		400	4		**ARQ-M4 342**	various	sync
200,00		400	1		**ARQE**	various	sync
200,00		170	1		**ARQS**	AUT, INS	sync
200,00		400	1		**BAUDOT 1,5 STB**	various	async
200,00		500	1		**CIS 11/TORG 11**	RUS	sync

Baudrate in Baud	Datarate in Bit/s	Shift	Channels	No of Ch.	Mode	User	sync/ async
200,00		500	2		**CIS 14/PARITY 14**	RUS	sync
200,00		170	1		**FECS**		sync
200,00		170	1		**GTOR**		
200,00		495	1		**IRA-ARQ**	BUL	async
200,00					**OQPSK**		
200,00		170	1		**PACTOR**	HAM, UN, USA MARS	
200,00		200	1		**PACTOR**	HAM, UN, USA MARS	
200,00		170	1		**PR**	HAM, USA, various	
200,00		1000			**Pseudo random**		
200,00		1400			**Pseudo random**		
200,00		500	1		**SYNC FEC**	RUS	sync
200,00			8	200	**TT2300-ARQ**	G, F	MFSK
200,20		495	1		**IRA-ARQ**	SLO	async
210,25		495	1		**BAUDOT 1,5 STB**	various	async
210,25		495	1		**IRA-ARQ**	BUL	async
218,50		400	1		**ROU-FEC**	ROU	sync
228,50		170	1		**RS-ARQ**	D, I, TUR, LBY	B sync
240,00			1		**HC-ARQ**	UN, RC	B sync
240,00		495	1		**IRA-ARQ**	BUL	async
240,00		240	8	240	**RS-ARQ**	D, I, TUR, LBY	MFSK
250,00			1		**DUP-ARQ 2**		B sync
266,66		850	1		**RAC-ARQ**	G	B sync
272,75		495	1		**IRA-ARQ**	BUL	async
288,00		170	1		**ARQE**	D, ISR	sync
288,00		330	1		**ARQE**	D, ISR	sync
288,00		400	1		**ARQE**		sync
288,00		500	2		**CIS 14/PARITY 14**	RUS	sync
288,00		170	1		**FEC 100**		
288,00		400	1		**FEC 100**		
300,00		170	1		**ASCII**	HAM	sync
300,00		500	1		**CIS 11/TORG 11**	RUS	sync
300,00		200	1		**GTOR**		
300,00		170	1		**PR**	HAM, USA, various	
300,00		200	1		**PR**	HAM, USA, various	
300,00		300	1		**PR**	HAM, USA, various	
300,00		170			**Pseudo random**		
300,30		495	1		**IRA-ARQ**	SLO	async
357,00			1		**RS-ARQ**	D, I, TUR, LBY	B sync
384,00		400	1		**FEC 100**	F	sync
600,00		495	1		**IRA-ARQ**	BUL	async
800,00		495	1		**IRA-ARQ**	BUL	async
1200,00		495	1		**IRA-ARQ**	BUL	async
1200,00			1	1	**PR**		
1440,00			12	120	**MS5**	RUS	
PSK	100,00				**2-BPSK**		
PSK	1200,00				**2-BPSK**		
PSK	2400,00				**2-BPSK**		
PSK	300,00				**2-DPSK**		
PSK	1200,00				**4-DPSK**		
PSK	250,00				**4-DPSK**		
PSK	100,00		7	200	**4-QPSK**		
PSK	1200,00				**4-QPSK**		
PSK	1600,00				**4-QPSK**		
PSK	1800,00				**4-QPSK**		
PSK	2400,00				**4-QPSK**	NATO, USA, UK, F, D	
PSK	250,00				**4-QPSK**	UK	
PSK	100,00		7	200	**4DPSK**		
PSK	600,00				**BPSK**	KRE	
PSK	3000,00		8	250	**CLOVER 2000, 16P4A mode**	USA	
PSK	2000,00		8	250	**CLOVER 2000, 8P2A mode**	USA	
PSK	1500,00		8	250	**CLOVER 2000, 8PSM mode**	USA	
PSK	500,00		8	250	**CLOVER 2000, BPSM**	USA	

Baudrate in Baud	Datarate in Bit/s	Shift	Channels	No of Ch.	Mode	User	sync/ async
					mode		
PSK	1000,00		8	250	**CLOVER 2000, QPSM mode**	USA	
PSK	500,00		4	125	**CLOVER, 16P2A mode**		
PSK	750,00		4	125	**CLOVER, 16P4A mode**		
PSK	375,00		4	125	**CLOVER, 16PSM mode**		
PSK	500,00		4	125	**CLOVER, 8P4A mode**		
PSK	375,00		4	125	**CLOVER, 8PSM mode**		
PSK	125,00		4	125	**CLOVER, BPSM mode**		
PSK	250,00		4	125	**CLOVER, QPSM mode**		
PSK	1800,00				**HF-Datalink**		
PSK	150,00				**HF-Datalink**		
PSK	300,00				**HF-Datalink**		
PSK	600,00				**HF-Datalink**		
PSK	1200,00				**HF-Datalink**		
PSK	1364,00		16		**LINK 11**	NATO	MFSK
PSK	2250,00		16		**LINK 11**	NATO	MFSK
PSK	4800,00		1		**LINK 11 LESW**	NATO	
PSK	1280,00				**OQPSK**	RUS	
PSK	800,00		1		**PACTOR II, 16-DPSK mode**	HAM, UN, USA MARS	
PSK	600,00		1		**PACTOR II, 8-DPSK mode**	HAM, UN, USA MARS	
PSK	200,00		1		**PACTOR II, DBPSK mode**	HAM, UN, USA MARS	
PSK	400,00		1		**PACTOR II, DQPSK mode**	HAM, UN, USA MARS	
PSK	2400				**MIL STD 188-110A/B, 8PSK mode**	MIL, diplo	
PSK	150 -1200				**MIL STD 188-110A/B, BPSK mode**	MIL, diplo	
PSK	150 -1200				**MIL STD 188-110A/B, QPSK mode**	MIL, diplo	
PSK	75 - 2400				**STANAG 4285, BPSK mode**	NATO	
PSK	75 - 2400				**STANAG 4285, QPSK mode**	NATO	
PSK	75 - 2400				**STANAG 4285, 8PSK mode**	NATO	
PSK	3200 - 9600				**STANAG 4539, QPSK mode**	NATO	
PSK	3200 - 9600				**STANAG 4539, 8PSK mode**	NATO	
PSK	3200 - 9600				**STANAG 4539, 16QAM mode**	NATO	
PSK	3200 - 9600				**STANAG 4539, 32QAM mode**	NATO	
PSK	3200 - 9600				**STANAG 4539, 64QAM mode**	NATO	
PSK	767 – 4409				**STANAG 4538 BW2, 8PSK mode**	NATO	
PSK	219 - 573				**STANAG 4538 BW3, 8PSK mode**	NATO	
PSK	75				**STANAG 4415, 8PSK mode**	NATO	

Table of systems and possible user sorted by baudrate

HF Modes

36-50

BEE, T600

It is a synchronous bit stream system most often found running at 50bd with no apparent ACF. When idling at 36bd it shows an ACF=2 and as it switches from 36bd to 50bd a preamble can be detected running with ACF=70. The system appears to be synchronous with 1 stop bit and common shifts of 85Hz, 125Hz, 250Hz and sometimes 500Hz having been recorded

Commonly found on the HF spectrum it is used mainly by the Russian Navy (RDL) and Polish Mil.

405-3915

Frost1t

Russian system with 40,5Bd and 1000Hz shift.

81-29

Frost

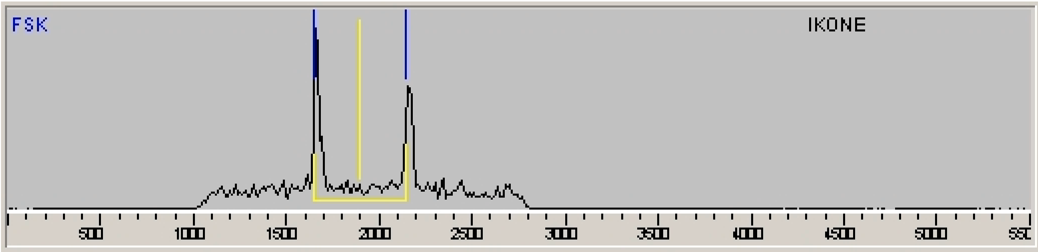
Russian system with 81Bd and 1000Hz shift.

81 81

CIS 81, IKONE

Former Soviet Union (FSU) Military system, it is believed that a number of ex-Eastern Bloc countries may use this system. The usual speed is 81 baud with 250, 500 or 1000Hz shift, rarely can be heard at 73, 96 and 162bd. It is a Pseudo Random TDM code with two channels, 12 bits and the traffic is always encrypted. There is a 40.5 baud variant with a single channel.

Please note: most traffic will be encrypted, mark / space must be set manually.



Typical spectrum of a 8181 signal with 500 Hz shift

ANNEX 10

ICAO Selcall

This module complies with ANNEX 10 of the Aeronautical Regulations 4.8 SELCAL system RED with all letters currently defined as A to S fully decoded.

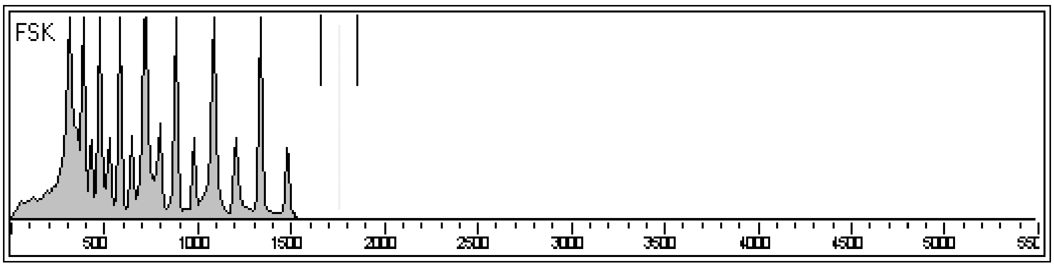
Because of the above tight tolerances in ANNEX10, the demodulation of these signals in SSB mode does not give the accuracy in frequency needed for correct assessment of the tones. These signals must be demodulated either in the AM mode or using a carrier synchronisation facility in the SSB mode fast enough to synchronise within 200 msec. This system will detect all tones sequences complying with the above mentioned regulations and a SELCAL repeated immediately may be detected incorrectly. For example the sequence transmitted "ABCD ABCD" may be occasionally decoded as: "ABCD CDAB ABCD"

Fortunately, because of the time stamp added to each decoded sequence, it would be possible to identify the occasional occurrence of this situation.

Aeronautical Ground stations use the H2B emission (USB with full carrier). According to the specification, the two pairs of tones transmitted have a quoted maximum decode tolerance of 0.15% (2.25 Hz at the top tone). Aeronautical Ground station carrier frequencies are supposed to have a frequency tolerance of 10 Hz maximum. Therefore, to comply fully with ANNEX10, the filters used in this decoding module have a bandwidth of 3 Hz. The allocation of selective call addresses is exclusively managed by Aeronautical Radio, Inc. ARINC (ICAO Designator Selcall Registry). Each address consists of two pairs of tones, e.g. "AB-CD". Both pairs have a duration of 1000 ms. Between each pair an interval of 200 ms is inserted.

Letter	Tone in Hz	Letter	Tone in Hz	Letter	Tone in Hz	Letter	Tone in Hz
A	312.6	B	346.7	C	384.6	D	424.6
E	473.2	F	524.8	G	582.1	H	645.7
J	716.1	K	794.3	L	881.0	M	977.2
P	1083.9	Q	1202.3	R	1333.5	S	1497.1

Table of Annex 10 Audio frequencies



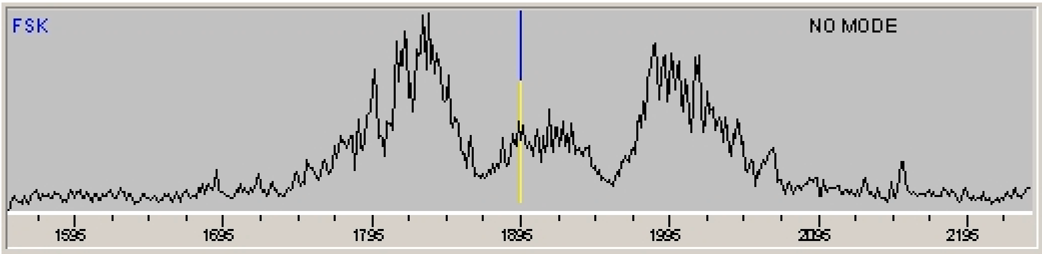
Typical spectrum of ANNEX 10

Because of the above tight tolerances in ANNEX10, the demodulation of these signals in SSB mode does not give the accuracy in frequency needed for correct assessment of the tones. These signals must be demodulated either in the AM mode or using a carrier synchronisation facility in the SSB mode fast enough to synchronise within 200 msec. This system will detect all tones sequences complying with the above mentioned regulations and a SELCAL repeated immediately may be detected incorrectly. For example the sequence transmitted "ABCD ABCD" may be occasionally decoded as: "ABCD CDAB ABCD"
Fortunately, because of the time stamp added to each decoded sequence, it will be possible to identify the occasional occurrence of this situation.

ARQ-E

ARQ-N, ARQ-1000 duplex

ARQ-E is a synchronous duplex ARQ with the 2 stations on different frequencies. It is using the 7 bit ITA 2-P alphabet with 4 or 8 character repetition cycle, inverting every 4th or 8th character.
In the ARQ-N system all characters are erect.



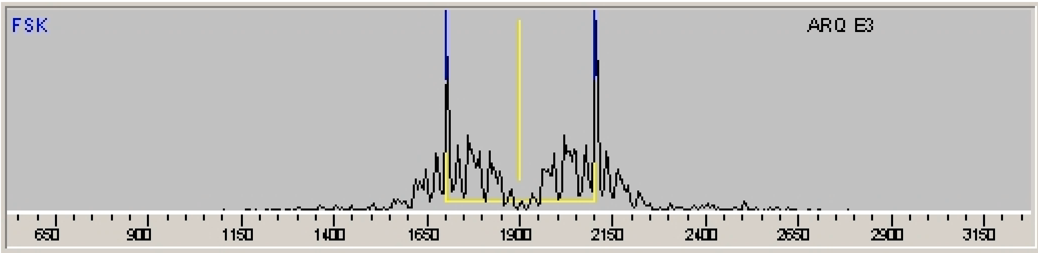
Spectrum of an ARQ-E signal with 288 Baud

ARQ-E3

CCIR 519 Variant, TDM 342 1 Channel

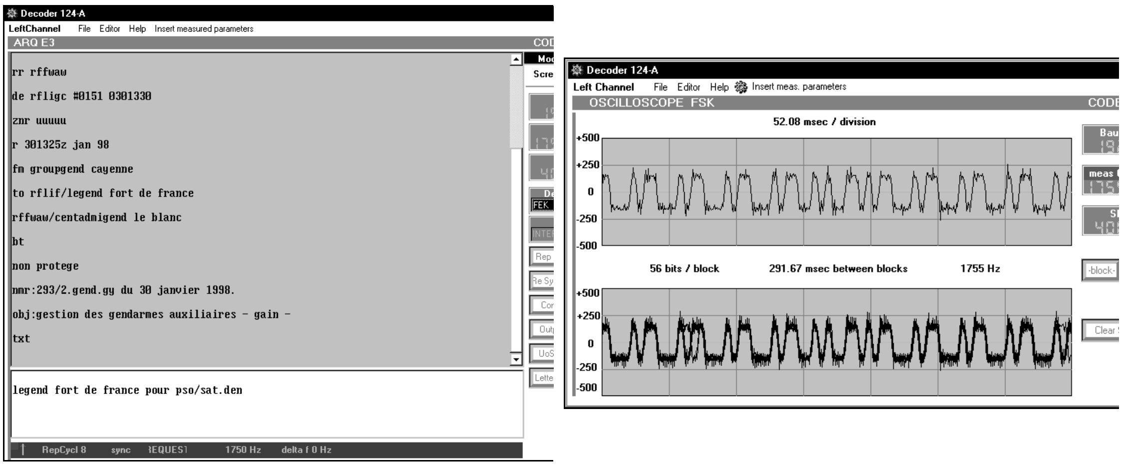
ARQ - E3 is a synchronous duplex ARQ using the 7 bit error correcting ITA 3 alphabet with repetition cycle of 4 or 8 characters.

Two stations are working on different frequencies as Master and Slave stations.
If another code than the 35 combinations of the allowed alphabet is received a repetition request is initiated. The RQ signal is initiating the retransmission. All characters are checked within one repetition cycle, an error signal is triggering another repetition process immediately until all signals are received correctly.
In a standard repetition cycle of 4 characters one RQ and three repeated characters and in a repetition cycle of 8 characters one RQ and 7 repeated characters are transmitted.



Spectrum of ARQ-E3 in idle mode

Note: In idle mode ARQ-E3 is often detected as FEC 100 !



ARQ-E3 – in this picture an example of a French Military station and signal structure

ARQ-M2

TDM 242, CCIR 242

ARQ - M2 CCIR 242 is a synchronous duplex ARQ system using the 7 bit error correcting ITA 3 alphabet consisting of two or four channels in time division multiplex in a single radio channel.

The two stations use different frequencies for full duplex operation.

The 2 channel system is simply made from interleaving erect characters for channel A and inverted characters for channel B, i.e. A, -B, A, -B, A, -B, A, -B etc.

The 4 channel system has channels A and C character interleaved and with the addition of channel B being bit interleaved with channel A and channel C bit interleaved with D. Channel A is erect, B/C/D inverted. Possible character repetition cycles are 4, 5 or 8 characters.

ARQ - M2 is used on fixed lines between two stations. Due to there automatic transmission they often have long idling periods in which no information is transmitted. These periods can be recognized by a typical rhythm on the signal. If there is any information transmitted this rhythm is not audible.

ARQ-M4

TDM 342, CCIR 342

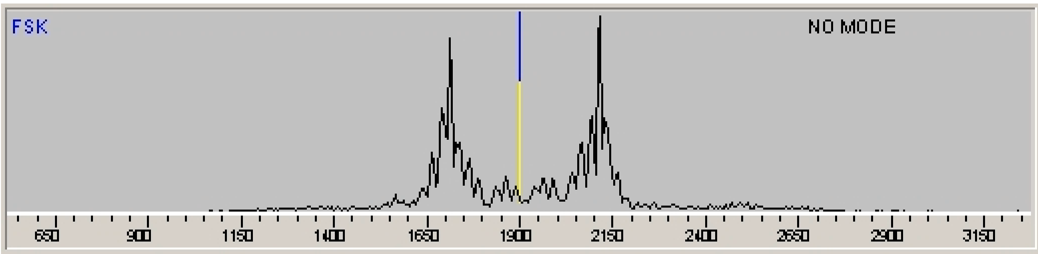
ARQ – M4 CCIR 342 is a synchronous duplex ARQ , which uses the ITA 3 alphabet 7 bit. Two or four channels in TDM (time division multiplex) are possible.

Two stations are working on different frequencies, working as ISS (transmitting) and IRS (receiving) station.

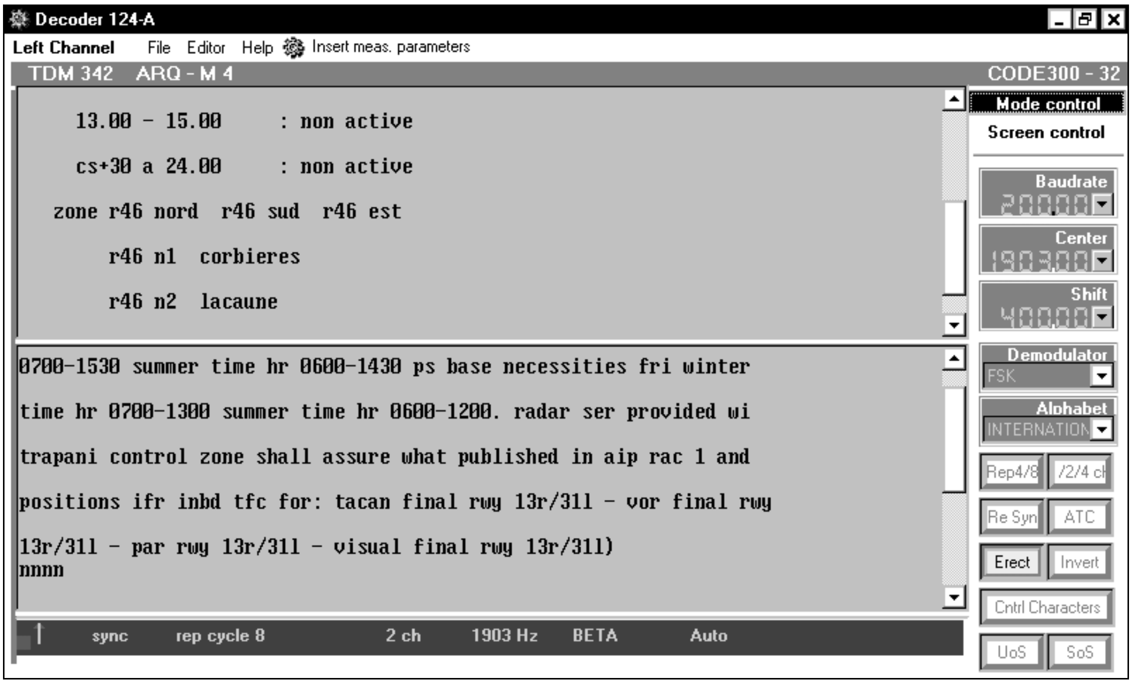
At start of a cycle the first characters of all channels are inverted ;
1 channel : A-channel erect
2 channel : A-channel erect, B-channel inverted, character interleaved.
4 channel : A-channel erect, B-channel inverted, C-channel inverted, D-channel erect
Channels A and B character interleaved, A/B and C/D bit interleaved.

Marked cycles of 4 and 8 characters.

ARQ – M4 is used on fixed lines between two stations. Due to there automatic transmission they often have long idling periods in which no information is transmitted. These periods can be recognized by a typical rhythm on the signal. If there is any information transmitted this rhythm is not audible.



Typical spectrum of an ARQ-M4



Typical message output on 2 channels

ARQ-S

ARQ 1000-S / Siemens ARQ 1000

ARQ-S is a synchronous simplex ARQ using the 7 bit error correcting ITA 3 alphabet with the addition of 1 bit for parity-check. The receiving station is checking the 3:4 ratio of the ITA 3 code. If the pulse polarity is not corresponding to this ratio, an automatically repetition is initiated. The additional parity of 1 bit is reducing the error rate. The receiving station is transmitting an acknowledgement signal RQ if the character block is received correctly and requests the next block. If the received block contains errors a repetition is requested. If the acknowledgement signal is not received correctly, a special character for retransmission is transmitted.

Two stations use the same frequency, working as ISS (transmitting) and IRS (receiving) stations.
For automatic setting - up selective calling is possible also FEC operation with error correction
in time diversity mode for broadcast transmissions.

Every odd numbered cycle has all bits inverted. Repetition cycle timings for block lengths of 3, 4, 5, 6 or 7 characters are as follows :

Circle	Characters	Transmission	Pause
438 msec	3 characters at 7 bits	219 msec	219 msec
583 msec	4 characters at 7 bits	292 msec	292 msec
729 msec	5 characters at 7 bits	365 msec	365 msec
875 msec	6 characters at 7 bits	438 msec	438 msec
1021 msec	7 characters at 7 bits	510 msec	510 msec

For FEC operation every message is transmitted twice in a time diversity procedure. After a space of 15 characters the first transmission is repeated. If a character block is received with errors, the system is waiting for the second transmission to print the correct information. If this is also not possible this character is replaced by a blank space.

This module does not auto-detect the character cycle rate, you must choose the correct one yourself.

ARQ-SWE

SWED ARQ / CCIR 518 Variant

SW ARQ is a synchronous simplex ARQ using the error correcting 7 bit ITA 3 alphabet with 1 extra bit for parity checking.

Two stations use the same frequency, working as ISS (transmitting) and IRS (receiving) stations. Every odd cycle has all the bits inverted. According to the quality of the radio link SW ARQ can change the block length between 3, 9 or 22 characters.
A block length of 3 characters is identical to SITOR A.

The repetition cycle is as follows,

Circle	Characters	Transmission	Pause
450 msec	3 characters at 7 bits	210 msec	210 msec
900 msec	9 characters at 7 bits	630 msec	270 msec
1800 msec	22 characters at 7 bits	1540 msec	260 msec

SW ARQ is normally using 100 baud and a shift of typical 400 Hz.
This system, based on normal SITOR, is used by the Ministry of Foreign Affairs (MFA) of Sweden. A similar ARQ is used by the MFA of Norway but without changing the character cycle.

ARQ 6-70S

CCIR 518 variant S

ARQ 6-70 is a synchronous simplex ARQ using the 7 bit error correcting ITA3 alphabet with two stations (usually) on the same frequency, one of them called the ISS (transmitting), the other the IRS (receiving) station.

Complete repetition cycle is as follows :

ARQ 6-70: 350 ms: 6 characters at 35 ms = 210 ms with 140 ms pause.

ARQ 6-70 is working with 200 baud.

ARQ 6-90/98

CCIR 518 variant

SITOR ARQ 6 - 90/98 is a synchronous simplex ARQ using the 7 bit error correcting CCIR 476 alphabet with two stations (usually) on the same frequency, one of them called the ISS (transmitting), the other the IRS (receiving) station. Each transmitted block contains 6 characters or 42 bit.

Complete repetition cycle is as follows :

ARQ 6-90: 450 ms: 6 characters at 35 ms = 210 ms with 240 ms pause.
ARQ 6-98: 490 ms: 6 characters at 35 ms = 210 ms with 280 ms pause.

ARQ 6-90/98 is working with 200 baud.

ASCII

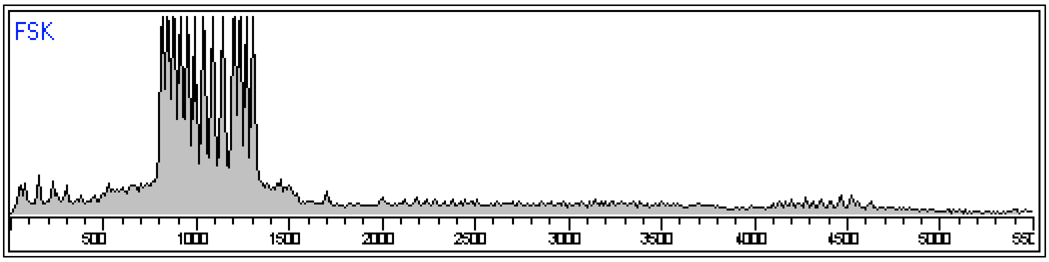
IRA-ARQ ITA No.5

ASCII is a continuous asynchronous signal with 1 start bit, 5, 6, or 7 data bits and optional a parity bit and 1 stop bit.
A character can consist of total 8, 9 and 10 bits. Parity can be none odd or even.

This system implements the parity check which means that one bit (parity bit) is added at the end for error detection. The number of *1's* is checked and if an odd number is found and parity has been defined as ODD, then the parity bit should be *1*, otherwise an error has occurred. If parity has been defined as EVEN and an even number of *1's* is found, then the parity bit should also be *1*.

AUM 13

No further details on this system……….



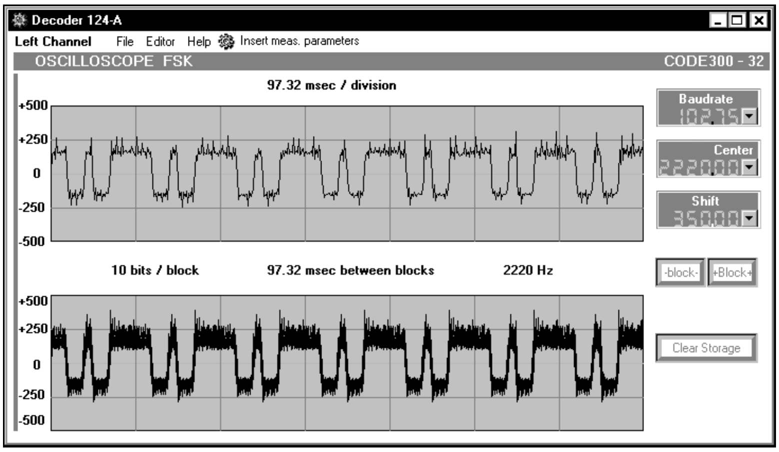
AUTOSPEC

AUTOSPEC with Spread 11, Spread 21, Spread 51

AUTOSPEC is a synchronous FEC system that converts the 7 1/2 unit ITA-2 code into 10 element error detectable characters. It is used in one way or two way radio links.

The original Mark I was 0 interleave, MK II introduced 10 (the 'norm'), 20 and 50 character interleave.

The system operates at 68.5 Bits/sec for 50 Baud input and 102.75 Bits/Sec for 75 Baud input.



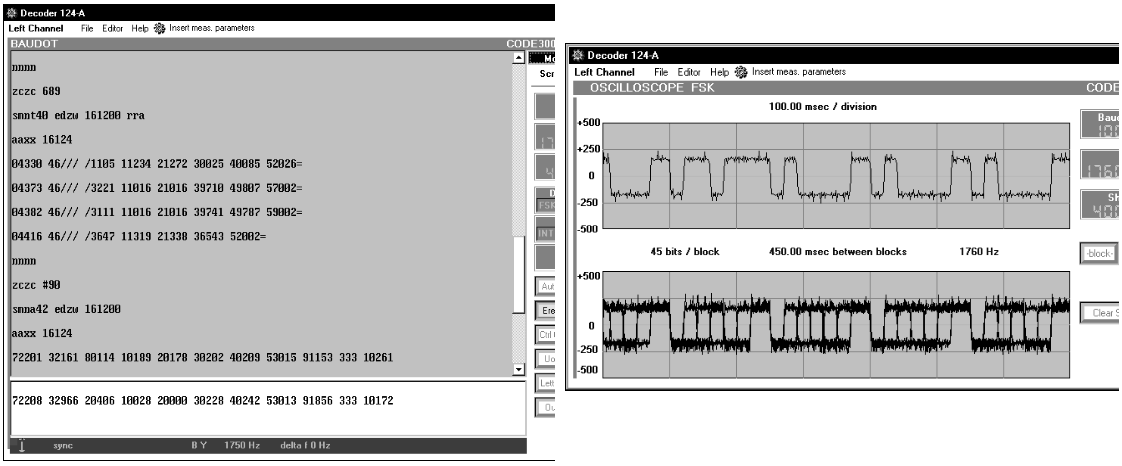
AUTOSPEC – in this picture an example of the signal structure

Baudot ITA No.2

RTTY, FSK

BAUDOT is a continuous asynchronous signal consisting of 1 start bit, 5 data bits and a stop bit (usually with either 1, 1.5 or 2 unit length).
Most common baud speeds in use are 50, 75 or 100 baud. Rare, but some stations use bit-inversion of some or all of the 5 data bits.
As there are 5 data bits which can be inverted relative to the normal use, there are 32 possible combinations of bit inversion.
Third and fourth shifts alphabets are used with BAUDOT (cyrellic, arabic, hebrew a.s.o).

On entry, the Baudot module will attempt to automatically detect the correct Marklevel and speed of the incoming BAUDOT signal. This works best on asynchronous Baudot signals. Synchronous Baudot transmissions with 1 element stop bits will not always be automatically detected correctly. Occasionally 7 Unit synchronous ITA-2 systems are mistaken for 45.45 Baud Asynchronous signals by this 'auto-detect' process. If you suspect this has occurred, select the appropriate baud speed and press [Erect] or [Invert] to reverse the polarity.



Baudot – in this picture an example of meteorological data and signal analysis with Oscilloscope

Baudot F7B

Baudot F7B – ITA-2 Twin, 2 channel ITA-2 RTTY

F7B BAUDOT is a FDM (4 frequency domain multiplex) 2 channel asynchronous system using the ITA 2 alphabet.

Baudot Sync

Sync Baudot

Continuous synchronous signal consisting of 1 start bit, 5 data bits and 1 stop bits, thus each character consists of a total of 7 bits. The synchronization of the system is achieved by the Start and Stop bits. Most common baud speeds are 50, 75 and 100 baud with shift of 400 and 850 Hz.

BF6 Baudot

BEE

36-50, T600

It is a synchronous bit stream system most often found running at 50bd with no apparent ACF. When idling at 36 bd it shows an ACF=2 and as it switches from 36bd to 50bd a preamble can be detected running with ACF=70. The system appears to be synchronous with 1 stop bit and common shifts of 85Hz, 125Hz, 250Hz and sometimes 500Hz having been recorded

Commonly found on the HF spectrum it is used mainly by the Russian Navy (RDL) and Polish Mil.

BR 6028 VFT

This 6028 VFT system is a commonly found VFT system using 7 channels of 45 bd to 100 bd Baudot each with 170 Hz shift. Channels are shifted in time, with each channel delayed by 1s. Any channel with heavy interference can be locked out. This is also the reason for signals with less than 7 channels.
The system is also named as "BARRIE", 6028 or USA 7 channel modem.

The Pilot tone at 560 Hz is an unmodulated tone.

Belgian Diplomatic (MFA Brussels, Embassy Beirut, circuits to South Africa, South America and southern Europe) have been noted using what seems to be a modified BR6028 system where channel 2 never seems to be present.

All channels carry 100 bd with 170 Hz shift Baudot delayed in time by 0.5 s.

CIS 14

AMOR, AMOR 96

It is a two channel duplex ARQ system using two frequencies and running at 96-192bd The system interleaves two channels into a 14 bit frame with 2 bit channel state to identify if the channel is on idle or traffic), 2 M2 characters bit interleaved and 2 final parity bits for error detection. CIS-14 is reported to be used by Russian PTT stations on links to the former republics, it is most commonly logged running with 96bd and most traffic appears to be encrypted. You may find CIS-14 referenced by the name AMOR or AMOR 96 (inofficial name used by some NATO members).

Clover

CLOVER had its beginnings about 15 years ago when amateurs were experimenting with very narrow bandwidth Morse called "Coherent CW".

CLOVER intends to support the many advantages of AMTOR and HF PACKET RADIO and fixes the major problems of these modes. The most serious limitation of RTTY, AMTOR, and HF PR is the data throughput and how the data is used to modulate the radio signal.
The ionosphere is not a friendly medium for data signals. HF signals often arrive at the receiving antenna by many different propagation paths ; two or more paths are common. Each signal path has its own time delay, amplitude, and even different center frequency. The receiving antenna does not discriminate ; it adds all the signals and passes the composite to the receiver. The amplitudes and phases of the separate AC signals combine algebraically to produce a widely varying receiver input. Deep selective fades and time-smearing of the data pulse transitions are the usual result.

HF PR, AMTOR, and RTTY are using FSK modulation. CLOVER uses different modulation techniques. CLOVER shifts the phase and not the frequency of the carrier. More than one bit of data can be sent per phase state. For example, BPSK (binary phase shift keying) has two phase state (0 or 180 degrees) which can be used to represent MARK and SPACE. QPSK (Quadrature PSK) has four phase states (0, 90, 180, 270 degrees). A single phase change in QPSK represents the state of two binary bits of data. Similarly, 8PSK can send the state of 3 bits per phase change and 16PSK can send 4 bits per phase change.

CLOVER also allows use of Amplitude Shift Keying (ASK) in the 8PSK and 16PSK modes. This mode is called "8P2A" (4 data bits per phase/amplitude change) and "16P4A" (6 bits per phase/amplitude change.)
Since all changes in phase or amplitude occur at the fixed base rate of 31.25 BPS (an equivalent pulse width of 32 ms), data errors due to multipath time smearing of data transitions are minimized.

The CLOVER modulation strategy is to always send data at a very slow base modulation rate and to use multi-level changes in phase or amplitude to speed up data flow. One final twist to CLOVER-II is that there are four separate transmitted pulses, each separated by 125 Hz.

Each of the pulses may be modulation by BPSK through 16PSK plus 8P2A or 16P4A modulation. This further multiplies that effective throughput by a factor of four. Putting it all together, CLOVER can send data at rates from its base data rate (31.25 bps) to 24 times its base rate (750 bps).

PSK modulation itself poses some problems. If a continual carrier is modulated using PSK, the frequency spectrum sidebands are strong and extend over a wide spectrum. CLOVER avoids this problem by two techniques:

1. Each of the four tones is an ON/OFF amplitude pulse and the phase is changed only when the pulse is OFF;

2. The amplitude waveform of each ON/OFF pulse is carefully shaped to minimize the resulting frequency spectra.

Combined, these techniques produce a composite CLOVER spectra that is only 500 Hz wide down to -60dB.

CLOVER uses a Reed-Solomon error correction code which allows the receiver to actually fix errors without requiring repeat transmissions.
For a moderate number of errors, CLOVER does not require repeats and the data continual flowing at the no-error rate. CLOVER is using an "error-correction" protocol. In addition,

like PR, CLOVER includes a CRC (Cyclic Redundancy Check sum) which is used when conditions are very bad and the number of errors exceeds the capacity of the Reed-Solomon error corrector.

CLOVER ARQ mode is adaptive. As a result of the DSP calculations necessary to detect multi-level PSK and ASK, the CLOVER receiver already has information which can be used to determine the signal-to-noise ratio (S/N), phase dispersion, and time dispersion of the received signal. CLOVER has 8 different modulation modes, 4 different error correction settings, and 4 different data block lengths which can be used- a total of 128 different modulation/code/block combinations.

Using real-time signal analysis, the CLOVER receiver will automatically signal the transmitting state to change modes to match existing ionosphere conditions. When propagation is very good, CLOVER can set itself to the higher speed and data literally "screams" down the path. When conditions are not so good, the data speed is slowed. The CLOVER character throughput rate under typical HF conditions is about ten times faster than AMTOR or HF PR. In all cases, CLOVER automatically changes speeds to give the maximum speed that the ionosphere will allow.

Clover 2000

CLOVER-2000 is an advanced digital modem waveform and protocol to pass data at the highest possible rate via standard High Frequency (HF) radio equipment. CLOVER-2000 uses adaptive ARQ control to match the data modulation format to measured signal conditions, Reed-Solomon error correction encoding of all data, and a selective ARQ protocol. CLOVER-2000 is capable of passing uncompressed data at up to 2000 bits per second, the bandwidth is tightly limited to 2000 Hz (500 to 2500 Hz). CLOVER-2000 delivers error-corrected data over a standard HF SSB radio channel at up to 210 bytes-per-second - over 1600 bps., including all overhead. CLOVER's maximum in-packet raw data rate is 3000 bps.

ARQ mode uses 5 different modulation forms:

BPSM (Binary Phase Shift Modulation)
QPSM (Quadrature PSM)
8PSM (8-level PSM)
8P2A (8PSM + 2-levelAmplitude Shift Modulation)
16P4A (16 PSM plus 4 ASM).

The maximum data throughput varies from 35 bytes-per-second for BPSM to 210 bytes-per-second for 16P4A modulation. BPSM is most useful for weak and badly distorted data signals while the highest format (16P4A) needs strong high quality signals.

The CLOVER receive demodulator measures and stores Signal-to-Noise ratio (SNR), phase dispersion (PHS), and error correction capacity (ECC) data for every data block received. This information is then compared with the calibration values for each format and an optimum modulation mode is chosen that matches current conditions. These measurements and modulation decisions are made every 5.5 seconds.

CLOVER-2000 uses a two-level ARQ protocol, sending system control information in the Clover Control Block (CCB) using a very robust modulation format and data in 256 byte data blocks using the modulation format that matches current conditions.

Error-Correction Coding

CLOVER-2000 incorporates error-correction encoding of all data transmitted. The Reed-Solomon code is used because of its superior ability to correct burst errors that are typical for HF communications paths. The Reed-Solomon code provides true error-correction without requiring repeat transmissions. Conversely, CCIR-476/625 (SITOR) and other popular HF ARQ protocols use error detection coding which requires one or more repeat transmissions before a data error
may be corrected. CLOVER only requires repeat transmission when errors have exceeded the capacity of the Reed-Solomon coding.

All data sent via CLOVER-2000 is encoded as 8- bit data bytes and the error-correction coding and modulation formatting processes are transparent to the data stream - every bit of source data is delivered without modification to the receiving terminal. Control characters and special "escape sequences" are not required or used by CLOVER-2000.

Selective ARQ Repeat

Unlike other block or packet ARQ protocols, CLOVER-2000 does not repeat data which has been received correctly. CLOVER-2000 buffers all received data packets and repeats only those packets that can not be fixed with Reed-Solomon coding. For example, if blocks 1,3,4, and 6 are received correctly, block 1 is passed to the receive terminal device, a request is issued to repeat blocks 2 and 5, and blocks 3, 4, and 6 are stored until 2 and 5 are received correctly.

The CLOVER ARQ time frame automatically adjusts to match the data volume to be sent in either or both directions. When first linked, both sides of the ARQ link exchange information using six bytes of the Clover Control Block (CCB). When one station has a large volume of data buffered and ready to send, ARQ mode automatically shifts to an expanded time frame during which one or more 255 byte data blocks are sent. If the second station also has a large volume of data buffered and ready to send, its half of the ARQ frame is also expanded.

Signal Format:

16ms data frames of 8 Dolph-Chebychev pulses interleaved in time and frequency. The frequency spectra has a -50dB bandwidth of 2000 Hz, centered at 1500 Hz.

Modulation Formats:

BPSM 2 phase, 500 bps
QPSM 4 phase, 1000 bps
8PSM 8 phase, 1500 bps
8P2A 8 phase, 2 amplitude, 2000 bps
16P4A 16 phase, 4 amplitude, 3000 bps

Error Correction Coding:

Reed-Solomon error correction coding based on GF (2e8); block sizes of 17, 51, 85, and 255 bytes; code rates of 60%, 75%, and 90%.

Data Modes:

Manual ARQ and Auto Adaptive ARQ. ARQ mode links two stations; Adaptive ARQ mode measures receive S/N, Phase Dispersion, and Error Corrector Loading. The correct modulation for the actual conditions is then chosen for transmission of the next frame of ARQ data. ARQ modes are bi-directional. Data may flow in either direction without the use of an “OVER” command. The ARQ “bias” sets error corrector efficiency - Robust = 60%, Normal = 75%, Fast = 90%.

Data Throughput (Bps)

Modulation	Robust	Normal	Fast
BPSM	28	35	42
QPSM	55	69	83
8PSM	83	104	125
8P2A	110	138	166
16P4A	165	207	249

CODAN

A commercial unit from Codan Pty of Australia currently used in Australia and Africa by the United Nations, aid agencies and various public authorities. The modem uses 16 tones and are QPSK modulated. The tones range from 656.25Hz to 2343.75Hz with a tone shift of 112.5Hz and runs at 2400bps. Each tone is 75 Bd QPSK modulated.
The modem is fully automatic and supports compression and selective calling. No ALE is used for link setup but a simple beacon call and audio analysis on the return signal is all that is needed.

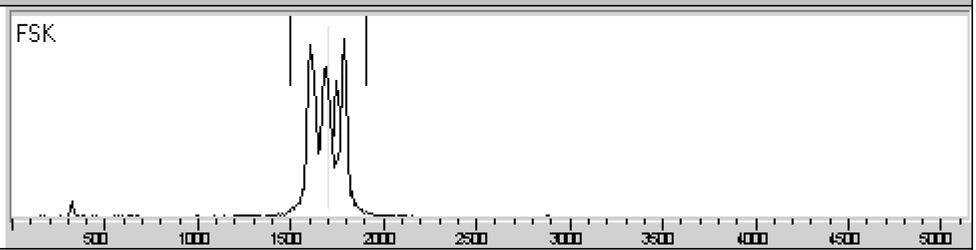
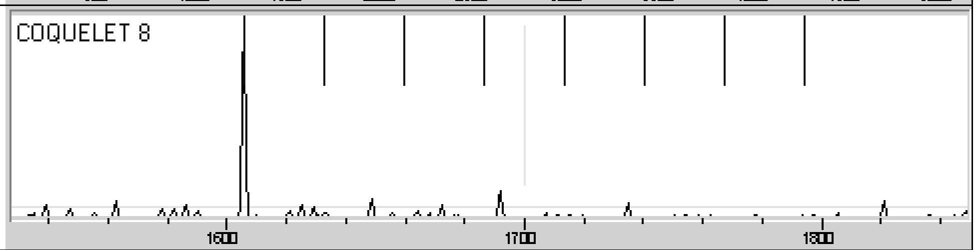
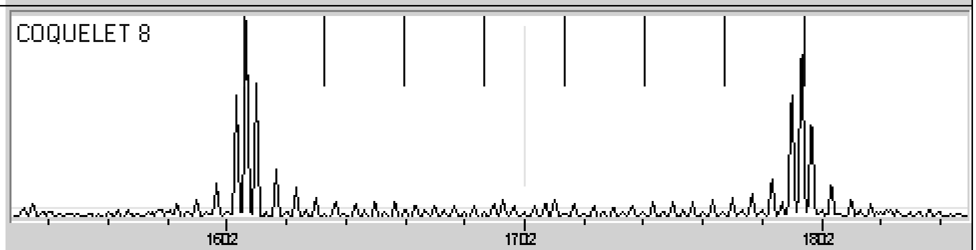
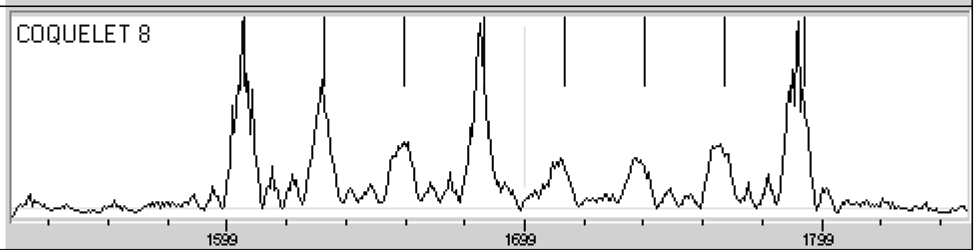
This modem is mainly used in mobile networks.

Tone	Frequency in Hz	Tone	Frequency in Hz
1	656,25	9	1556,25
2	768,75	10	1668,75
3	881,25	11	1781,25
4	993,75	12	1893,75
5	1106,25	13	2006,25
6	1218,75	14	2118,75
7	1331,25	15	2231,25
8	1443,75	16	2343,75

Coquelet 8

Coquelet 8 is a French designed system based on sending 2 audio tones, in sequence from a selection of 8 for each of the different characters to be sent.
Idle /standby condition is between tones 4 and 5.

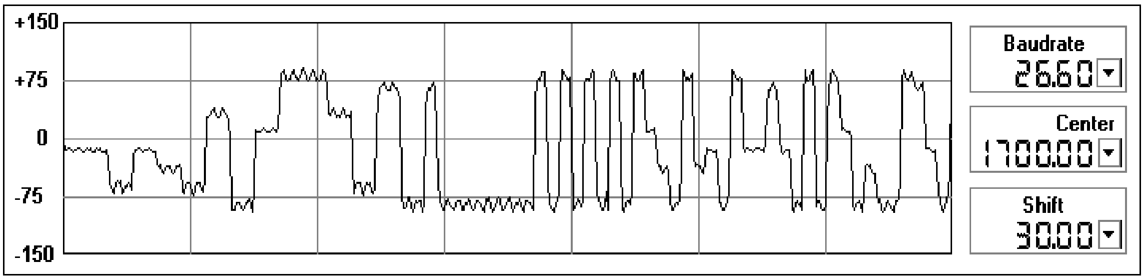
The tones used have a space of 27 Hz for the 13.3 Bd system and 26.7 Hz for the 26.67 Bd system. Both are grouped in 2 tone groups.

<table>
<tr><th colspan="2">Tuning</th></tr>
<tr><td>Spectrum Analyzer full scale</td><td>
</td></tr>
<tr><td>Transmission start
Only one tone present</td><td>
</td></tr>
<tr><td>Idle conditions
Only the first and the
last tone are presents</td><td>
</td></tr>
<tr><td>Transmission :
All eight tones are presents</td><td>
</td></tr>
</table>

Tone assignment

Group 1								Group 2			
1	2	3	4	5	6	7	8	9	10	11	12
773	800	826	853	880	907	933	960	880	907	933	960

Example of Coquelet-8 decoding



MFSK Coquelet-8 signal

Coquelet 8 Auto

Coquelet 8 is a 8/13 tone system which can switch between these two modes. The used alphabet is ITA2. The baudrate is 26.67 Bd The center frequency is normally 2210Hz.

Coquelet 8 Auto Start

Coquelet 8 AC EC

Coquelet 8 is using FEC where the conditions for the following transmission are exchanged by the start of the transmission.

Coquelet 8 FEC

Coquelet 80

Coquelet 8 FEC is a synchronous system with error correction. Similar to Coquelet 8 the system is using two tones assigned to two groups but with slightly different frequencies. The FEC is done by transmitting every character twice with a specific time between both transmissions. The second character has a different format caused by mathematical operations.

Tone assignment:

Group 1								Group 2				
1	2	3	4	5	6	7	8	1	5	6	7	8
773	800	827	853	880	907	935	960	773	880	907	935	960

Coquelet 100

Coquelet 100 is similar to Coquelet 8 using 8 tones in 2 groups. But the tone distance is 100Hz and the used speed is 100Bd.

Tone assignment:

Group 1								Group 2			
1	2	3	4	5	6	7	8	9	10	11	12

Coquelet 13

Coquelet MK1 – French Multitone

Coquelet 13 is a French designed system based on sending 2 audio tones, each 75 ms, in sequence from a selection of 12 for each of the different characters to be sent.
Idle /standby condition is tone 0.
This tone 0 is between the two center tones 8 and 9, thus making tuning easy when the station is in standby/ idling.
The baudrate transmitted is 13.33 Bd and 20 Bd.

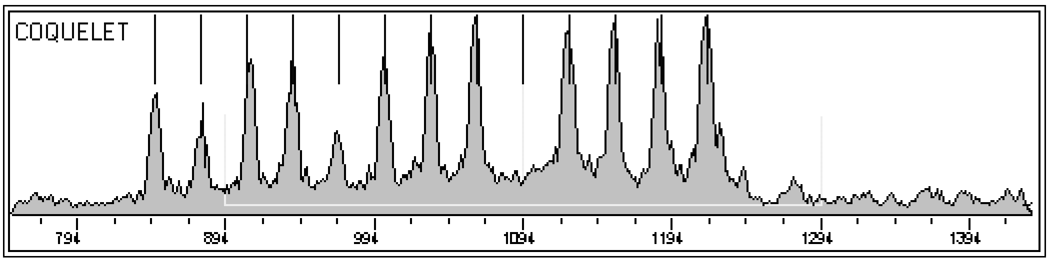
Tones used are No. 1 to 8 at 30 Hz apart for group I and tones No. 9 to 13 at 30 Hz apart for group II.
Coquelet is using the ITA 2 characters. They are converted into tones by the following table :

tone number	**Frequency**	**bit 1**	**bit 2**	**bit 3**	**bit 4**	**bit 5**
1	812			1	1	1
2	842				1	1
3	872					1
4	902			1		
5	932			1		1
6	962			1	1	
7	992				1	
8	1022					
0 idle tone	1052					
9	1082	1	1			
10	1112	1				
11	1142		1			
12	1172					

Table : Frequencies of Coquelet

The two tones are chosen from each frequency group for the transmitted characters.

Coquelet 13 – Algerian 'Press review"



Example of a correct Coquelet 13 tuning. Note that the tone 9 is missing during transmission

CROWD 36

CIS 36 / Russian Piccolo / URS Multitone / CIS 10 11 11

It is Soviet MFSK full duplex system on two transmission frequencies that can be also used in simplex mode. It uses 36 tones based on British Piccolo. This system runs usually at 40 baud with a single tone lasting 25ms and hand keyed traffic between operators at 10 baud with a single tone lasting 100ms. A spectrum analyzer will show the tones arranged in 3 distinct groups of 10+11+11 tones spaced 40Hz. Tones 1, 12, 24 and 36 are rarely used so you are likely to see an 80Hz gap between groups. Each of the 32 tones represents one ITA2 character code. CIS diplomatic and Mil service is the main user with suspected use by CIS Intel and Military services.

Preamble and 5 letter group transmission Op chat:'RYRYRY' and 'CFM' Op chat: 'QSL' and 'end of transmission'

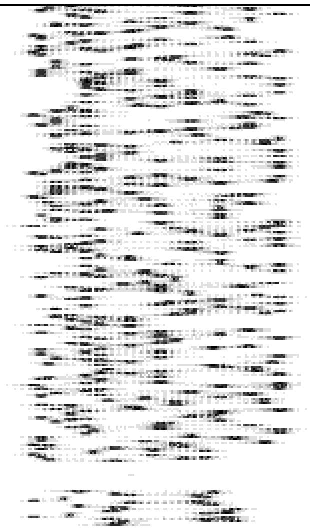
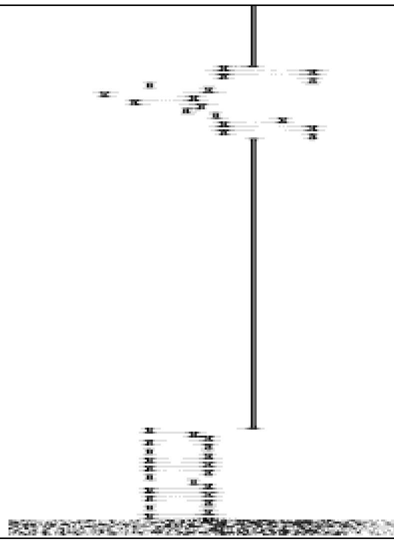
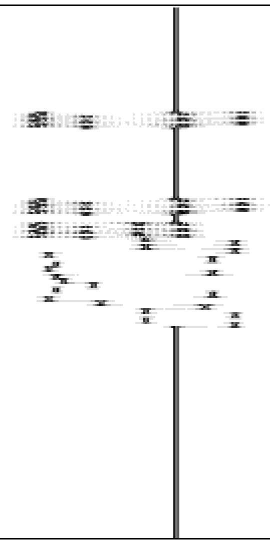
Idle tone is number 24. For encryption a shift register can be used. Transmission and chat are done in 10 baud mode.

There are used several 4 letter groups
for different transmission modes.

For example :

VDAE
VDBA Change to chat modus
VDBG
VDGB
VDCB
VDCE resynchronisation?
VDFB break
VDEA end of transmission

The following table shows the transmitted character to each tone :

		
Preamble and 5 ltrs group transmission	*Op chat : 'RYRYRY' and 'CFM'*	*Op chat: 'QSL' and 'end of transmission'*

CW

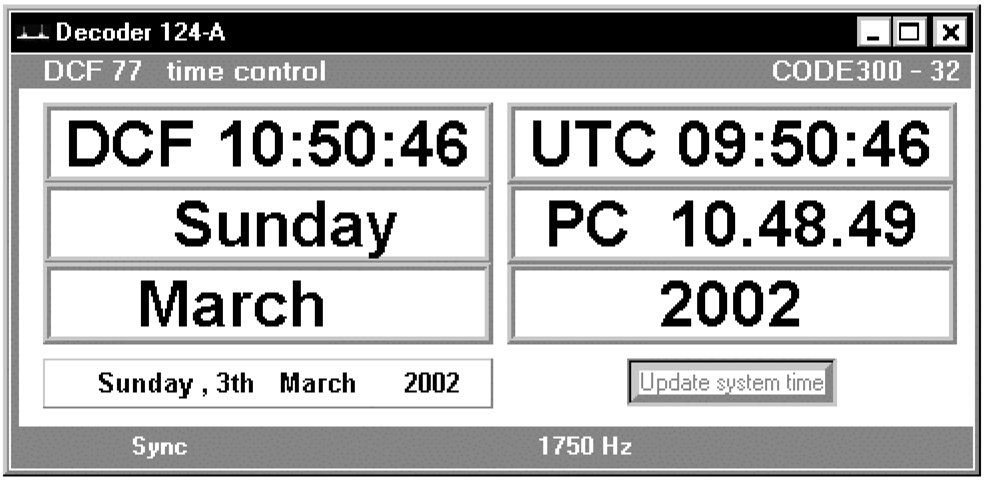
Morse

The oldest data transmission, still in use by the Amateur community, Marine and Military operations.
The code is as follows:

A	.-	N	-.	1	.----	.	.-.-.-
B	-...	O	---	2	..---	,	--..--
C	-.-.	P	.--.	3	...--	?	..--..
D	-..	Q	--.-	4	....-	(	-.--.
E	.	R	.-.	5	.....	)	-.--.-
F	..-.	S	...	6	-....	-	-....-
G	--.	T	-	7	--...	"	.-..-.
H	....	U	..-	8	---..	_	..--.-
I	..	V	...-	9	----.	'	.----.
J	.---	W	.--	0	-----	:	---...
K	-.-	X	-..-	/	-..-.	;	-.-.-.
L	.-..	Y	-.--	+	.-.-.	$	...-..-
M	--	Z	--..	=	-...-		

DCF 77

Tune your receiver to DCF77 on 77.5 kHz. Make sure the receiver is set to AGC SLOW or AGC OFF. This is because the station uses a -6dB drop in transmitter power to signal the time and slow data code. If you select a FAST AGC, your receiver may try to compensate for these sudden drops in signal strength and stop the program from decoding the time signal correctly. After a further 2 or 3 minutes, the screen text will start to display the correct date and approximate time.
If you click on [Update system time] your PC date and time will be set to UTC time.



DRM

Digital Radio Mondiale

Digital Radio Mondiale has different transmission modes. Each of these modes permits broadcasting in various channels. There are some variable channel constraints as well as some propagation conditions. While having a nominal bandwidth of 9 to 10 kHz, the DRM system also supports half channel modes with bandwidths of 4.5 kHz to 5 kHz allowing for simultaneous transmissions of analog AM and digital AM. The DRM system also supports double channel modes with bandwidths of approximately 18 kHz to 20 kHz. A typical data rate on a 9 to 10 kHz channel approaches 20 to 24 kbps. However, with double channel mode, maximum data rates may reach 72 kbps.

Orthogonal Frequency Division Multiplexing (OFDM)

Digital Radio Mondiale is based upon the OFDM technique. OFDM is essentially a FDM modulation technique which allows the transmission of large amounts of data over a single channel. OFDM splits a radio signal into multiple smaller sub-division signals. The sub-signals are then transmitted in a simultaneous manner at varying frequencies to the receiver. The OFDM can reduce crosstalk in signal transmissions.

MPEG -4

Audio, including both voice and music, will be encoded using the MPEG-4 format. MPEG-4 standard includes advanced audio encoding (AAC). Code excited linear prediction(CELP), HVXC (harmonic vector eXcitation). In order to achieve the sound quality of FM signals, the AAC is extended by SPR (Spectral Band Replication). SPR is a tool which uses the information of the spectral envelope in order to increase the audio signals bandwidth.

Advanced audio encoding (AAC)

The algorithms listed above with MPEG-4 format. The most generic audio coder is the AAC. This works with a wide range of bits. AAC was originally developed for the MPEG-2 format; however with the addition of new robust error correct, it has since been implemented into the MPEG-4 format. AAC's greatest features are that it offers higher resilience to those channels prone to errors. In addition, AAC in combination with UEP, provides are smooth degradation of the audio signal. In order to reach alignment with the DRM transmission, the frames with an audio length of 80 ms to 40 ms is used. These times correspond to frequencies of 12KHz to 24KHz. There will be five to ten of these frames each with a varying length. The combination of all these frames together is collectively called a super audio frame. With the AAC audio codec, DRM needed no additional synchronization, allowing for the transmission of both mono and joint stereo.

MPEG CELP

This speech coder allows for better resolution when transmitting at lower bit rates. There are two major advantages to using CELP as a speech coder. The first reason is that CELP allows for several different languages to be simultaneously broadcast, making this a great way to reach other countries around the world. On a brief tangent DRM using short wave in the evenings will be able to hopefully reach the entire circumference of the earth. This will allow for worldwide transmission of news to a great number of countries. The second reason for CELP is that if atmospheric conditions for transmission of the DRM are not conducive to high bit rates then CELP is able to raise the resolution of the signal, making it even more enticing for use as the speech coder. There are two versions of the CELP coder, a narrowband and wideband, provide the capability to both scale bitrate and bandwidth. The two version provide an audio bandwidth of 100 to 3800Hz and 50 to 7000Hz.

Harmonic Vector Excitation Coding

Harmonic Vector Excitation Coding (HVXC) enables the representation of speech signals at very low bit rates. The standard defines two HVXC bit rates: 2 kbps and 4 kbps. Unlike the code excited linear prediction (CELP) speech coder, HVXC is a parametric coding system, which means that certain aspects of the coded representation can be manipulated independently. For example, the playback speed of a HVXC-encoded bit stream can be altered without affecting the pitch of the voice. Similarly, the pitch of the voice can be modified without altering playback speed. HVXC is useful for a variety of synthetic speech applications in bandwidth-constrained environments."

Fast Access Channel (FDC) and Service description channel (SDC)

There are two important channels the FAC and the SDC. The FAC is the Fast Access Channel, and the SDC is the Service description channel. The channels are crucial in carrying information regarding both the signal configuration as well as the service information. The signal configuration's purpose is to let the decoder know how it is to decode the signal. Lastly the service information sets a signal label and presenting alternate frequencies that can be used.

Multilevel Coding

In the channel coding block, a Multilevel Coding scheme is used. MLC is used in combination with a 16 or 64 QAM, quadrature amplitude modulation, and a conventional cell interleaver. Both UEP (unequal error protection) and hierarchical modulation are supported. UEP is essentially applying more error correction to those bits that are more important for source fidelity. These bits are encoded\differently than those bits that are less essential to source fidelity. Hierarchical modulation means that two separate data streams are modulated onto a single DVB-T stream. One stream, called the "High Priority" (HP)-stream is embedded within a "Low Priority" (LP) stream. Receivers with "good" reception conditions can receive both streams, while those with poorer reception conditions may only receive the "High Priority" stream. Broadcasters can target two different types of DVB-T receiver with two completely different services. Typically, the LP stream is of higher bit rate, but lower robustness than the HP one.

QAM shifts both phase and amplitude to generate multiple constellation points.

DUP ARQ

ARTRAC

DUP ARQ is a synchronous duplex ARQ using the ITA 2 alphabet. To give error correction 7 parity check bits are added to every block of 5 characters. Each station's transmission consists of
bursts of 32 bits (5 characters at 5 bits + 7 parity check bits) lasting 256 ms with a 96 ms pause. Total
repetition cycle time is 704 ms.
DUP ARQ is using 125 bd, equal to 50 bd data flow and a shift of 170 Hz.
This system is used by the Ministry of Foreign Affairs in Hungary.

Every information during calls or traffic periods is divided into blocks. Every block has a length of 32 bit and a duration of 256 ms. There are seven different blocks :

Call block
Identification block
Answer block
Message block
System block
RQ block odd
RQ block even
Channel change block
Break block

During transmission of information special system messages are interchanged between the computers on both sides. These blocks have always five characters :

BEGTX : start text / data
ENDTX : end text / data
VOICE : pushbutton " voice " is pressed
NOVCE : pushbutton " voice " is not pressed
TPRNO : teleprinter off
TPROL : teleprinter on
JJJJJ : last block even
UUUUU : last block odd

Parenthesis are transmitted to indicate that a system message follows.

DUP ARQ is using fixed frequencies in up to eight different bands. Each band has five channels with a space of 400 Hz.
This system has the possibility to establish communication by selecting a frequency according to the best propagation. During idle condition all channels are examinated for the least interference. The results of these scanning cycles are stored in the system. The system always knows the best frequency for establishing a communication.
When scanning for a call the system is listening on every frequency for 330 ms. A selective call system of DUP ARQ is scanning incoming data for a SELCAL code.
DUP ARQ is always measuring the link quality. If the efficiency or the transfer rate of information is to low, the system is changing the frequency and orders simultaneously the second station to the new frequency.
A change of frequency is initiated by the change channel block, which is transmitted instead of an RQ block. This block contains the number for the best receiving channel.
Before this block is transmitted, the channels in the band are measured. After this the change channel block is transmitted ten times. Is this not successful a break block is transmitted.
If the transmitting station receives this block, the connection will be broken and after a pause of 30 s a recall is made.

DUP ARQ has the possibility of 15625 SELCAL numbers. By these SELCAL's a link to a requested station is automatically established. The system is checking the best frequency according to the time and propagation prediction for a communication to this station.
It is calling on the first frequency of the best channel and then, if no connection is possible, tries channel after channel. If the band is not acceptable, it will change to another one.

In case of no connection on all bands, the system stops and makes another call after several minutes.

The call for other stations is made by call and identification blocks. The Call block is transmitted 12 times and the identification block 3 times.
These blocks is following after a break of a half second an RQ block. If the call is received by the called station it will answer with an answer block. If this block is received by the calling station, the communication is established.
If there is no answer after two RQ blocks the calling station is changing the frequency as mentioned above.

During a connection both station can send messages. The information characters are put together into message blocks by the system. These blocks contain the parity bit with odd parity for the whole block, a five bit checksum generated as a Hamming checksum, five characters according ITA2 and a bit which gives reversal polarity in the middle of the message block between the second and third ITA2 character to guard against constant polarity.
The receiving station is controlling the checksum and parity of the received blocks. If an error is detected, the system is transmitting a repetition request block and the last transmitted block is repeated by the transmitting station. If there is no error detected the system returns to the interrupted transmission of message block.

DUP ARQ II

This ARQ system uses the same block timing as DUP-ARQ but runs at a baud rate of 250 Bd. The ITA2 or ITA5 character set is used.
The complete cycle consists of 176 Bit with 704 ms. Both stations are transmitting alternating their 64 Bit blocks. These blocks are 2 blocks of 32 Bit. These blocks contain a 5 Bit checksum for error detection and one bit for the odd parity. Each block also contains 3 character and two fill bit which are set to zero. These two bit can define the transmission of special blocks by using a predefined bit combination.

Automatic channel selection and channel hopping are supported.

DUP FEC II

This FEC system is a further development of DUP-ARQ II and can run at a baud rate of 125 or 250 Bd. The ITA2 or ITA5 character set is used.

DUP FEC II is used in full duplex systems where it is working on two different frequencies. In case of errors special blocks are used to request a re-transmission.
Automatic channel selection and channel hopping are supported.

ECHOTEL 1810

Single tone modem

ECHOTEL 1810 is working according STANAG 4285 (modified) with a QPSK in the upper sideband and suppressed carrier (J2D).
The datarate is 2400 Bit/s. Data are transmitted in frames of 3,2 s.

The transmission processor ARCOTEL is controlling the adaptive ARQ and the automatic frequency selection. Establishing of communication works automatic in relation to the propagation, mode and amount of data.

After the start of block transmission the information will be transmitted with 10 hopps/s. The next used frequency is send to the receiving station.
One net needs ca. 50 to 60 frequencies to have a connection of 95% of the time.

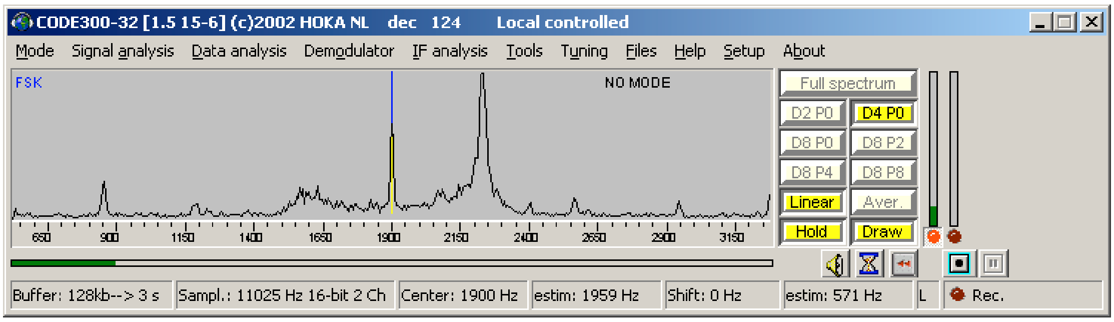
This modem is used by the German Army.

F7B-195.3 Bd 4-Tone

This system is using a waveform with 4 tones with a spacing of 195 Hz. The system speed can be measured with 195.3 Bd.

Fax

FAX stands short for "facsimili" and has the original meaning "make same ". It is used for transmitting pictures line by line. Synchronisation between transmitter and receiver is made by phasing, start and stop signals at the beginning and end of a transmission.
The synchronisation signals are used for selection of index of cooperation (IOC) and for the scanning speed of the picture.
Selection of IOC takes place by transmission of a start signal of alternating black and white for 5 to 10 s with 300 Hz for IOC 576 and 675 Hz for IOC 288.
Phasing and selection of scanning frequency is accomplished by a 30 second transmission alternating between black and white. Two wave forms are in use : symmetrical with half of line black and white or asymmetrical with 5% white and 95% black.
The stop signal for automatic picture transmission is a 5 s transmission alternating black and white at 450 Hz followed by 10 s continuous black.
FAX transmissions on shortwave and long wave are using different frequency shifts.
in the HF range a center frequency of 1900 Hz is shifted with - 400 Hz for black and + 400 Hz for white. In the VLF range the frequency shift for black is - 150 Hz and for white + 150 Hz.



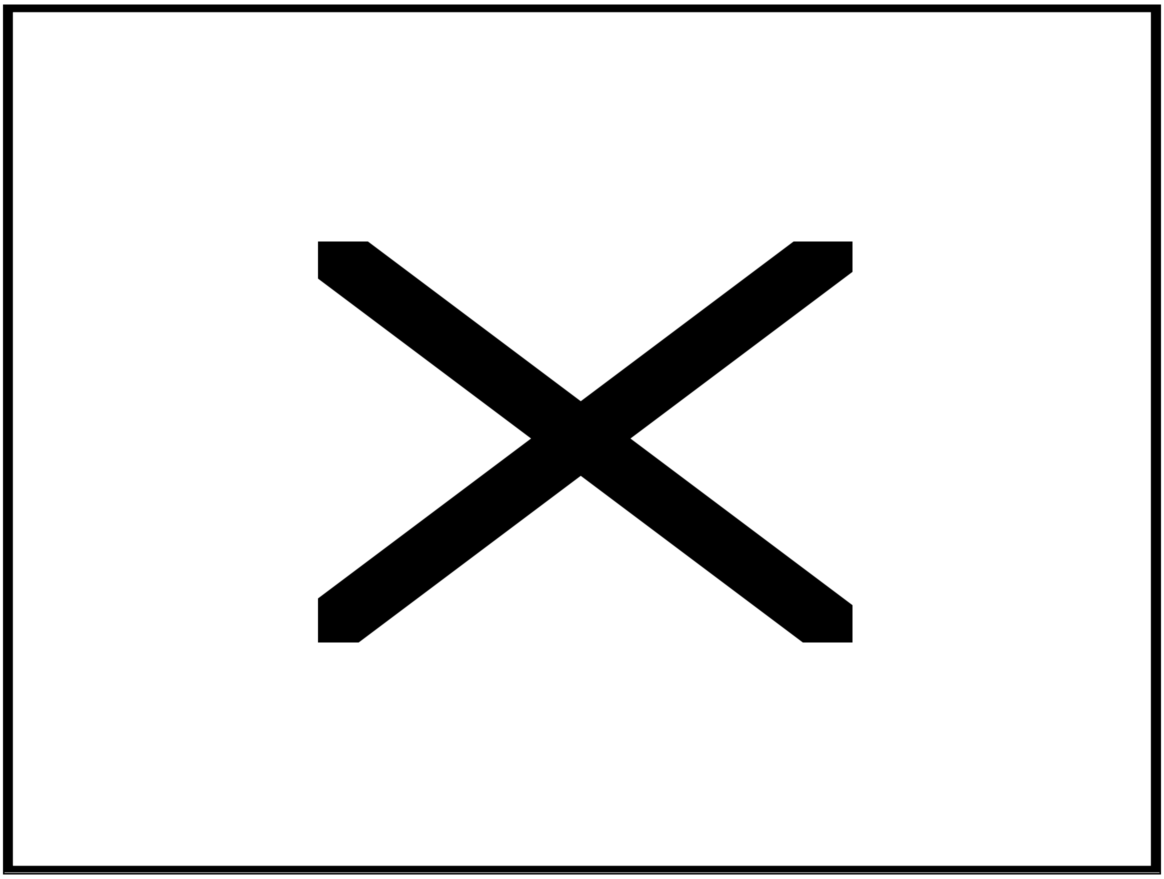
Spectrum of a FAX transmission

The quality of transmission of pictures depend on two factors: line density and pixel per line. The resolution is not effected by the number of lines scanned per minute but to the transmission time per picture and the bandwidth.

For correct receiving of a FAX picture in length and width the scanned lines per minute (drum speed) and the transmission module must be chosen according to the transmitter.

The transmission module IOC is the product of line density and drum diameter.
Common IOC's are 264, 288, 352 and 576.
The number of lines per minutes is the second parameter and can have values of 45, 48, 60, 90, 120, 180 and 240 LPM.
The necessary bandwidth is calculated by the used shift (800 or 300) + twice the modulation frequency.
The modulation frequency is the half product of IOC, line scans per second and pi (3.14).

FAX is mainly used for weather forecast. The number of news agencies transmitting pictures by FAX has been reduced during the last years.



Typical picture of a FAX transmission

Abbreviation for facsimile transmissions

In transmitting schedules and on transmitted charts contents and geographical area are coded by a four letter group.
The first two letters are giving the contents and the last two letters the area.

Abbreviation	Identification
	Surface data
SM	plotted surface data
SD	Radar summary
ST	Sea ice information
SO	Surface or sub surface sea temperature salinity or current data
SX	Miscellaneous surface data
	Upper air data
US	Plotted upper air data
UX	TEMP chart
	Analyses
AS	Surface analyses

AU	Upper air analyses
AU	Maximum air analyses
AH	Upper air thickness analyses
AR	Radar analyses
	Nephanalyses (satellite data)
AI	Sea ice analyses
AO	Surface or sub surface sea temperature salinity or current analyses
AW	Sea wave analyses
AX	Vorticity analyses
AX	Temperature and dew point depression analyses
AX	Freezing level analyses
	Forecasts
FS	Surface prognoses
FU	Upper air prognoses
FU	Maximum wind prognoses
FH	Upper air thickness prognoses
FI	Sea ice information (forecast)
FO	Surface or subsurface sea temperature, salinity or current prognoses
FW	Wave prognoses
FE	Extended forecast charts
FB	Significant weather charts
FX	Temperature and dew point
FX	Weather depiction prognoses
FX	Freezing level prognoses
FX	Vorticity prognoses
	Climatic data
CS	Monthly mean surface area
CS	Mean surface data
CU	Monthly mean upper air data
CU	Mean upper air data
CO	Monthly means (oceanic areas)
	Warnings
WP	Warnings in pictorial form

Geographical designator :

AA	Antarctic	ME	East Mediterranean Sea
AC	Arctic	MO	Mongolia
AE	South East Asia	NA	North America
AG	Argentina	NT	North Atlantic
AO	West Africa	OC	Oceania
AP	South Africa	PA	Pacific
AS	Asia	PN	North Pacific
AU	Australia	RA	Russia (Asia)
BZ	Brazil	SN	Sweden
CI	China	SP	Spain
CN	Canada	TH	Thailand
CZ	Czechoslovakia	TU	Turkey
DL	Germany	UK	United Kingdom
EA	East Africa	US	USA
EE	East Europe	XN	North Hemisphere
EG	Egypt	XS	South Hemisphere
EN	North Europe	XT	Tropic Area

EU	Europe
EW	West Europe
FE	Fare East
FR	France
GL	Greenland
IO	Indian Ocean
IR	Iran
JP	Japan
XX	if nothing matches
YG	Serbia
ZA	South Africa

FEC-A

FEC-A Broadcast / FEC100 A / FEC 101

FEC 100 is synchronous simplex ARQ which is using the ITA 2 alphabet one synchronous bit and a stop bit as parity check.
The ITA 2 code is converted into a 7 bit code similar to ARQ - E3 systems.

Common speeds are 96, 144,192 and 288 Bd.

This system is designed for error protected broadcast or one way transmission. A selective call possibility can address up to 17575 different stations. Group calling with up to 676 groups and each with 26 addresses is also implemented.
For message protection a bit oriented code is used. This system is suitable for direct coding and decoding of isochronous bit streams.
For error correction an expanded convolutional code is used. A correction of interruptions up to 7 seconds at a speed of 50 bd is possible.

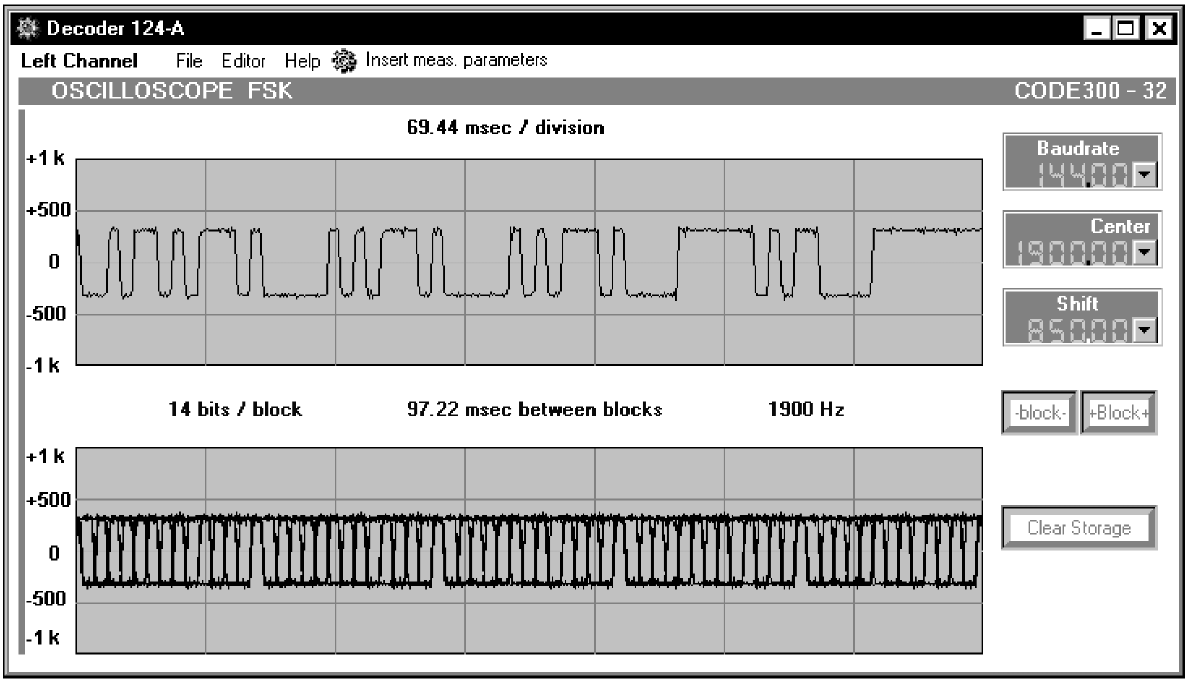
FEC-A Dirty

Fec-A

FEC-A Raw

Fec-A without sync

FEC-A exactly as described above except the error correction is switched off. Due to this fact, more errors will occur but the decoder in a very short time will process the message without delay in synchronizing.



FEC-A with raw decoding

FEC-A Var

FEC-A variable interleave

FEC-A exactly as described above except the error correction can be switched off and the Interleave length varied. The reason of this module is that although the most common interleave value is 72, interleaves of 144 have also been seen.

FEC-S Var

FEC 1000S / Siemens FEC 1000

FEC-S is a simplex ARQ system which is using the ITA 3 alphabet, 7 bit and which is character interleaved.

Each block of 15 characters is inverted and repeated after 1050 ms (time diversity procedure). Fading and noise interruptions up to 1 second have no effect on the transmission.

Two or more stations are working on the same frequency, transmitting mode in FEC (Forward Error Correction). Idle: Beta in RX and DX position.

G-TOR

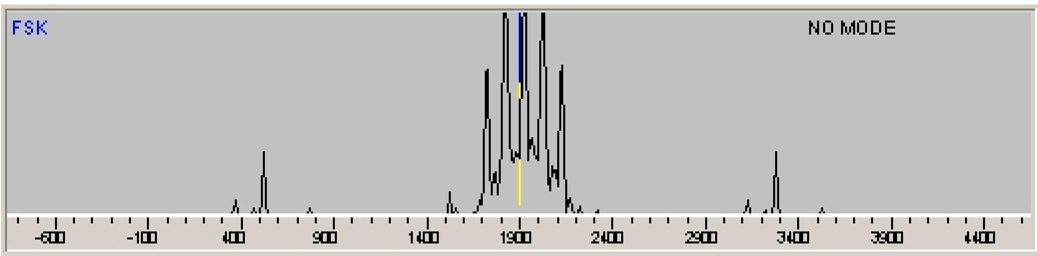
For fast, accurate digital communications, engineers have developed G-TOR.
G-TOR, short for Golay-TOR, was the name for M.J.E. Golay's error correction code, which was used by Voyager to transmit error-free color images from Jupiter and Saturn. This coding scheme provides the basis for G-TOR.
G-TOR's fast, error-free data transmission capabilities can be attributed to the unique combination of several techniques including :

1. full frame data interleaving
2. on-demand Huffman compression
3. run length encoding
4. variable baud rate capability
5. 16-bit CRC error detection with Hybrid ARQ
6. Golay forward error correction coding

To protect data from noise bursts during transmission, G-TOR makes use of a concept known as interleaving, similar to the approach used in the audio compact disc. Through interleaving, the bits of each data character are dispersed across the frame and the rearranged upon reception. Therefore, if a burst error occurs on the HF channel, the damage will be spread out into small pieces across the entire frame rather than mutilating large, non recoverable sections. Usually only one or two bits of a segment will be damaged, making the entire transmission easily recoverable.

At the same time, for fast and efficient transfer, data is condensed through Huffman compression and run length encoding. Each method may translate data into codes shorter than required by the original information. With Huffman, certain letters are assigned a code shorter
than the original 8-bit ASCII character. At times, however, Huffman compression may produce more bits than the original message, so G-TOR is designed to use Huffman encoding "on demand"-only when the compression actually reduces the total number of bits. Run-length encoding functions similarly, but assigns a single code to those characters which have been repeated. Through these two compression methods, the average number of bits for a message is reduced, often as much as 30 or 40 %.

During transmission, G-TOR automatically operates at one of three baud rates, 300, 200, or 100, whichever is optimal given the quality of the link. The G-TOR protocol adjusts the baud rate to ensure maximum throughput regardless of band conditions. Initially data transfer occurs at 100 baud, but if transfer proceeds smoothly, the baud rate increases to 300. In the event of persistent interference or poor band conditions, G-TOR will automatically adjust to 200 or 100 baud. When band conditions improve or interference subsides, G-TOR again operates at 300 baud.



Spectrum of a G-TOR signal

Once data is received and rearranged (de-interleaved), G-TOR uses 16-bit CRC error detection with a Hybrid ARQ scheme to detect and correct errors in transmission. The CRC

code is calculated by the receiving station, and this code must match the CRC code that is transmitted with the original data. If the CRC codes do not match, indicating that errors have occured, the hybrid ARQ system requests transmission of the correction bits. These are then combined with the damaged data bits in an attempt to recover the original data. The Golay error correction coding can correct 3 out of 24 transferred bits.
The G-TOR protocol permits up to 10 characters for a callsign.

GMDSS DSC

Global Maritime Distress and Safety System

Global Marine Distress and Selective calling System according to CCIR 493-6, CCIR 541-2 and ITU-R M.1159. This module supports also DSC and ATIS.

On HF GMDSS is at 100 Baud, at VHF it is 1200 Baud. Digital Selective Calling is a variation of Sitor-B, 100 baud 170 shift, but uses a special set of 127 symbols with a 10-bit error correcting code. The system is defined in the ITU recommendation ITU-R M493-6. A DSC signal is short, about 6-7 seconds on MF/HF and contains the following: station ID, priority, station being called, and frequency to use. This system is used to establish the initial contact between ships and shore stations using GMDSS.

DSC signals can be found the following frequencies:
2187.5, 4207.5, 6312.0, 8414.5, 12577.0, 16804.5 also on VHF on Ch. 70 - 156.525 with 1200bd

ATIS, automatic Identification of Marine Systems, is in using e.g. in Germany, The Netherlands and some other countries.

Although this module implements GMDSS faithfully, we cannot stress highly enough that we will not be held responsible for any errors in the decoding algorithms if this unit is used in a genuine Safety of Life situation. We have thoroughly tested this module (in association with one of Western Europe's largest Coast Station) and have not discovered any errors in the decoding. In fact it usually performed to lower signal levels than other, more expensive, commercial marine equipment! However we do not recommend you use this as a replacement for genuine Marine Type Approved GMDSS equipment.

HC-ARQ

Hagelin Crypto - ARQ

HC ARQ is a synchronous simplex ARQ using blocks of ITA-2 characters.
Complete repetition cycle is approx. 2771 ms made from 1 block of 665 bits at 240 Baud.

Each data lock consists of a synchronization sequence 1000 1011 1010 0010, a data block with ITA 2 characters and 32 check bits. The data block length must be agreed in advance and can be set to
30, 60 or 180 characters.

This system from Haegelin Cryptos was in use at the International Red Cross Organization.

HELL

FAX-like mode in that it was used to send pictures but works more like common RTTY. The Siemens systems used start/stop signalling (FSK) and the Field HELL unit was semi-synchronous. The system was used in the past in WW II by Dr. Hell in Kiel, D. and also from the Chinese Internal Press up until about 1993 but is now used by amateurs. Typical speeds are 122.5 baud.

A couple of different machines were available:

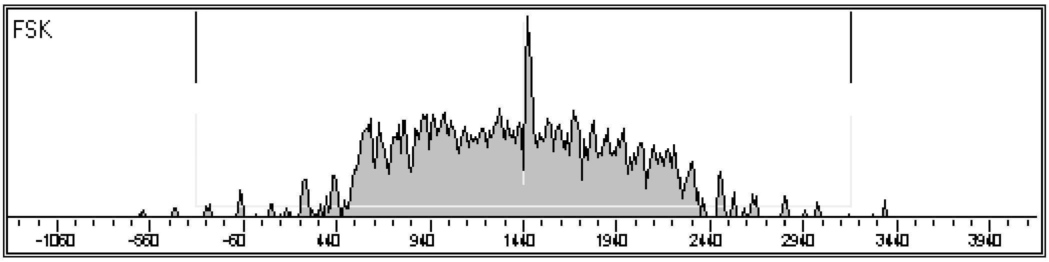
Name	Paper width	Chars/min	Chars/sec	baud rate	bandwidth	tone freq
Siemens GL72	9,5 mm	367,8	6,13	399	600 Hz	1000 Hz
Field HELL	15 mm	150	2,5	122,5	360 Hz	900 Hz
Siemens HELL 80	15 mm	300	5,0	300	900 Hz	1260 Hz

HFDL

HF-Datalink, HF ACARS

ARINC specification 635-2 27/02/1998

This module complies, at due time, with ARINC 635-2. Transmission is on a sub carrier 1440 Hz USB. Symbol speed is always 1800 baud. Modulation is 2psk, 4psk or 8psk. Effective bit rate: 300, 600, 1200, 1800 bits/sec.



STATION	ID	F21	F17	F15	F13	F11	F10	F8	F6	F5
CALIFORNIA	001	21934								
HAWAII	002		17934							
REYKJAVIK	003			15025		11184		8977	6712	
NEW YORK	004	21931			13276	11315		8912		
NEW ZEALAND	005									
HAT YAI	006		17928						6535	
SHANNON	007					11384		8942	6532	5547
JOHANNESBURG	008	21949						8834		
BARROW	009									
SANTA CRUZ	013				13315					
KRASNOYARSK	014				13321		10087			
BAHRAIN	015	21982	17967			11312				
GUAM	016									
Other poss. Freqs			17919			11348	10084	8843		

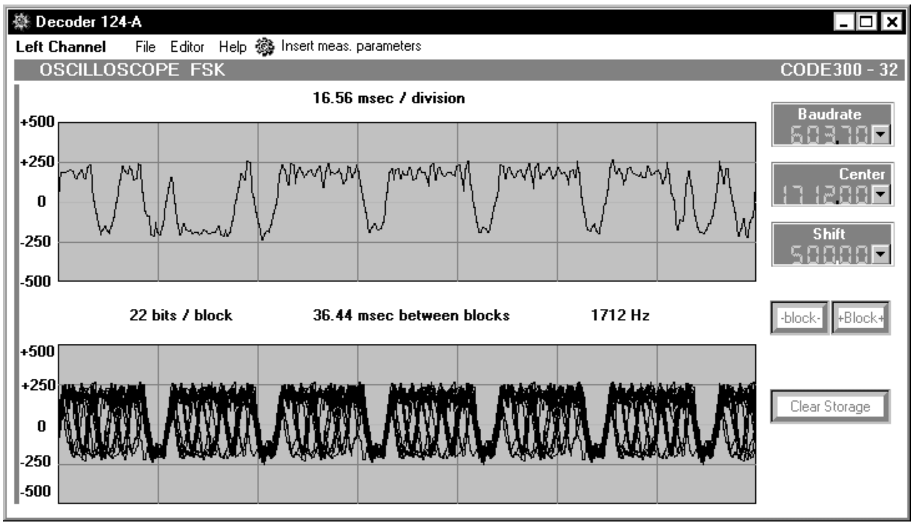
HNG-FEC

HNG FEC is a full duplex FEC system with a 15 bit code, which is mainly used in 100.5 baud.
The first 5 bits are used as ITA-2 characters, where the first and last bits are inverted.
The last ten bits are used for error detection and correction.
HNG FEC has an interleave of 64 bits, a new character starts at 15 bits after the preceding character.

Oscilloscope display of HNG-FEC

IRA-ARQ ITA 5

Continuous Asynchronous signal consisting of 1 start bit, 5, 6 or 7 data bits, 1 stop bit and optionally a parity bit, thus each character consists of a total of 8, 9 or 10 bits.
This system implements the parity check, which means that one, bit (parity bit) is added at the end for error detection. The number of 1's is checked and if an odd number is found and parity has been defined as ODD, then the parity bit should be 1, otherwise an error has occurred. If parity has been defined as EVEN and an even number of 1's is found, then the parity bit should also be 1.



Oscilloscope display of IRA-ARQ

LINK 1

LINK 1 is a duplex digital data link primarily used by NATO's Air Defence Ground Environment (NADGE). It was designed in the late 50s to cater for point-to-point data communication. LINK 1 mainly provides for exchange of air surveillance data between Control and Reporting Centres (CRCs) and Combined Air Operation Centres (CAOCs)/Sector Operation Centres (SOCs) and has a data rate of 1200/2400 bit per second (bps). It is not crypto secure and has a message set (S-series) limited to air surveillance and link management data.

Within NATO, LINK 1 is used by NADGE systems (NADGE/GEADGE/UKADGE, etc). Most mobile CRCs are also equipped with LINK 1 capabilities.
Additionally most NATO Nations employ receive-only equipment at air bases and SHORAD centres for Early Warning purposes.
Message standards are defined in STANAG 5501 while standard operating procedures are laid down in ADatP 31. The three new NATO members, (Czech Republic, Poland and Hungary) and two PfP nations will soon receive US built Air Sovereignty Operations Centres (ASOCs). These ASOCs are centres which will be capable of integrating up to 18 Air Traffic Control and Air Defence (Early Warning) Radars. The ASOCs will be equipped with a limited LINK 1 capability for data exchange between ASOCs and the NATO Air Defence Ground Environment. The US has tailored the NATO LINK 1 protocol to meet the ASOC requirements. (i.e. the exchange of air picture information). Other PfP nations have also shown interest in the ASOC Programme and will probably receive similar ASOCs.

LINK 4

This system is used on UHF to exchange data between ground station and airplanes.

LINK 11

TADIL A, TADIL B, MIL STD 188-203-1A, STANAG 5511, CLEW

LINK 11 (also known as TADIL A in the US) employs netted communication techniques using standard message formats. Data is exchanged over a differential quadrature phase-shift keying modulated data link operating at a rate of 1364 (HF/UHF) or 2250 (UHF) bits per second (bps). LINK 11 is designed for operation on High Frequency (HF) ground wave and thus has a beyond line of sight (BLOS) capability (to a theoretical range of approximately 300 NM).

Link 11 can also operate in the UHF band but is then limited to LOS ranges (approximately 25 NM surface-to-surface or 150 NM surface-to-air).
As an alternative, communication media satellite and fibre optic can be used. Units which exchange data via Link 11 are designated Participating Units (PUs) or Forwarding Participating Units (FPUs).
Link 11 is based on 1960s technology and is a relatively slow link which normally operates on a polling system with a Net Control Station polling each participant in turn for their data. In addition to this Roll Call mode, Link 11 may be operated in broadcast modes in which a single data transmission or a series of single transmissions is made by one participant. Link 11 is, therefore, a half duplex link. Link 11 is secure but not ECM-resistant.
Link 11 supports the exchange of air, surface and subsurface tracks, EW data and limited command data among C2 units, but does not support aircraft control nor other warfare areas. Within the UK Link 11 is employed by the Royal Navy, Royal Marines and Royal Air Force in its Ships, Ship Shore Ship Buffers (SSSBs), E-3D AEW, Nimrod MPA, Tactical Air Control Centre (TACC), etc. Within NATO Link 11 is primarily used as a Maritime Data Link. However, Link 11 will be adapted to cater for Theatre Missile Defence information exchange requirements, consequently Ground Based SAM Systems are or will be equipped with Link 11.

Link 11B employs a dedicated, point-to-point, full-duplex digital data link using serial transmission frame characteristics and standard message formats transmitted by individual signal elements or binary digits on a time sequential basis. Data is exchanged over a fully automatic, phase-continuous, full-duplex, frequency-shift-modulated data link operating at a standard rate of 1200 bps with optional capabilities of 600 and 2400 bps (or multiples of 1200 bps, e.g. 3600, 4800, etc.) Units which exchange data via Link 11B are designated Reporting Units (RUs) or Forwarding Reporting Units (FRUs).

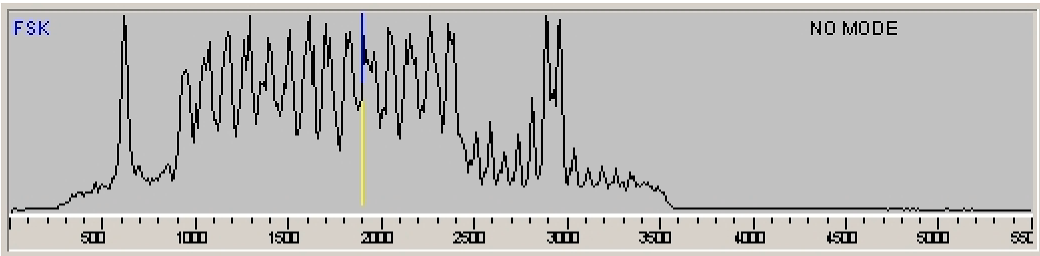
Within the UK Link 11B will be employed by the TACC, the second generation SSSBs and for ground-to-ground communications with the Iceland Air Defence System (IADS). Within NATO Link 11B is used to integrate Ground Based SAM Command and Control and Fire Distribution Centres into the Air Defence Ground Environment using CRC SAM Interfaces (CSI). Within the US, and some other NATO Nations (e.g. France), Link 11B is used as the primary data link for ground based TACS (e.g. USAF MCE, and USMC TAOC).
Message standards for both Link 11 and Link 11B are defined in STANAG 5511 while standard operating procedures are laid down in ADatP 11.

Link 11 is using 16 tones with a tone spacing of 110 Hz.

Frequency in Hz	Tone
605	Doppler tone
935	1. Tone
1045	2. Tone
1155	3. Tone
1265	4. Tone
1375	5. Tone
1485	6. Tone

1595	7. Tone
1705	8. Tone
1815	9. Tone
1925	10. Tone
2035	11. Tone
2145	12. Tone
2255	13. Tone
2365	14. Tone
2915	Synchronisation

Table LINK 11 frequencies



Spectrum of a LINK 11 transmission

All tones are send at the same time and are giving the typical sound of Link 11. Except the tones for synchronisation and doubler all tones can independently be modulated.

The datarate for the slow mode is 1364 Bit/s and fort he fast mode 2250 Bit/s.

The data packets are similar to X.25 but have a better error correction and data throughput.

LINK 11 Single Tone Modem

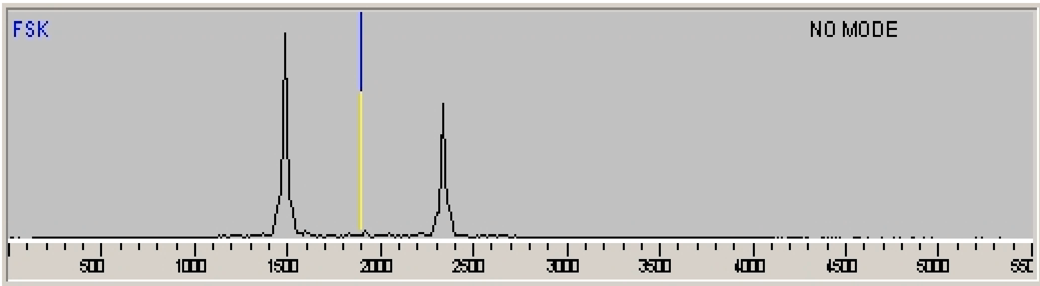
LESW

The single-tone waveform for Link-11 provides improved performance in HF Link-11 networks on a single sideband HF channel. Single-tone Link-11 uses an 8-phase modulated 1800-Hz tone. Adaptive equalization is used to demodulate the signal under the severe multipath conditions typical of HF propagation paths. Robust error detection and correction codes are used to provide enhanced message throughput.

LINK 14

BEAVER

LINK 14 is a broadcast HF teletype link for maritime units designed to transfer surveillance information from ships with a tactical data processing capability to non-tactical data processing ships. The design of the teletype transmission allows reception over very long ranges. Link 14 provides the capability to broadcast picture compilation and status information for use in units unable to receive Link 11 transmissions either direct or via an interface, e.g. non-Tactical Data System (TDS) units. The Link can be either HF, VHF or UHF dependent on unit-communication fits. More than one Link 14 net, with or without separate transmitting units, may be set up if desired, e.g. to split air and surface/sub-surface data. However, some units will be limited by communications fits in their capability to receive two nets. Few units will have the capability to transmit on two separate Link 14 channels at the same time. Selection of the Link 14 transmitting unit will depend on force disposition stationing of non-TDS units, Link 14 frequency, etc.
Each nation within NATO has its own Link 14 transmission formats which are promulgated in ADatP-14. Message protocol is defined in STANAG 5514.



Typical spectrum of a LINK 14 signal

LINK 16

TADIL J, MIDS, JTIDS

Multi-functional Information Distribution System - MIDS
Joint Tactical Information Distribution System - JTIDS
MIDS/JTIDS is a high capacity, ECM-resistant communications link designed for all services (air, surface and land) and all platform types, i.e. for C2 and non-C2 units. The requirement for high capacity constrained the link to a UHF solution, thereby limiting the range of the system to direct LOS, but uses relay techniques designed into the system to achieve BLOS performance.
The term MIDS was used to define NATO's requirement for an ECM resistant information distribution system, that was already defined by the US as JTIDS.
MIDS/JTIDS supports three message standards: Link 16, IJMS and Variable Message Format (VMF).

MIDS/JTIDS uses a Time Division Multiple Access (TDMA) architecture. An enhancement using a distributed TDMA architecture was also under development to provide a further increase in capacity but development was cancelled in the mid-1980s. Activities are being undertaken to examine other higher bandwidth options whilst retaining the basic MIDS/JTIDS waveform.

Link 16 (also known as TADIL J in the US) has been designed to optimise the use of the MIDS/JTIDS architecture. Link 16 has been developed to meet the information exchange requirements of all tactical units, supporting the exchange of surveillance data, EW data, mission tasking, weapons assignment s and control data. The Link 16 message standard uses J-series messages and completely meets the requirements for C2 functionality and aircraft control. In addition Link 16 has been selected by the US and NATO as the main tactical data link for Theatre Missile Defence.
Numerous platforms have been or will be equipped with Link 16 (Airborne Surveillance and Intelligence Systems, C2 Systems, Fighter and Bomber Aircraft, SAM Systems, Ships, etc). The UK has implemented Link 16 in its E-3D AWACS ; Tornado F3 fleet. Furthermore implementation is underway for RN ships and aircraft and other RAF C2 platforms and aircraft.
Message standards are defined in STANAG 5516 while standard operating procedures are laid down in ADatP 16.

Message Format - VMF
VMF is another Link 16 family protocol that uses Link 16 data elements to create variable length messages suitable for near real time data exchange in a bandwidth constrained combat environment. Earlier US Army VMF protocols contained ATDL-1 message elements.
The final and Joint Service version is still under development. VMF is intended to be filling the gap between what Link 16 & some other TDLs do and Message Text Formats.

Tactical Data Link - STDL: Link 16 via Satellite
The Royal Navy investigated the use of the
Link 16 message standard on a satellite bearer to provide BLOS communications using Link 16
Feasibility studies were undertaken in 1991/2.
The Satellite Tactical Data Link (STDL) is now part of the RN Ship System requirement and is to be implemented at the same time as MIDS/JTIDS Link 16.
STDL will be primarily used for the exchange of Surveillance and Mission Management Data.
The organisation of access to the satellite bearer will be TDMA on a single channel, i.e. the same basis as JTIDS. STDL can be operated in a broadcast mode or network mode.

LINK 22

NILE (NATO Improved Link Eleven)

NATO has designed a new data link, Link 22, which uses Link 16 elements in a TDMA architecture using either fixed frequency or frequency agile waveforms in the UHF (225- 400 MHz) and HF (3-30 MHz) bands. This programme was initially known as NILE (NATO Improved Link Eleven) and this name has been retained to some extent because the participants are called NILE Units; or NU's. It is intended that Link 22 will eventually replace Link 11 and will provide secure, ECM-resistant data communications for BLOS operations. The messages are defined in STANAG 5522 and are known as F-series messages. The messages are a mixture of completely new messages and messages in which Link 16 messages have been embedded without modification.
The aim is to use the data processing systems and radio equipments that are already installed in the candidate platforms and for nations to procure the cryptographic equipment from the USA under bilateral agreements.

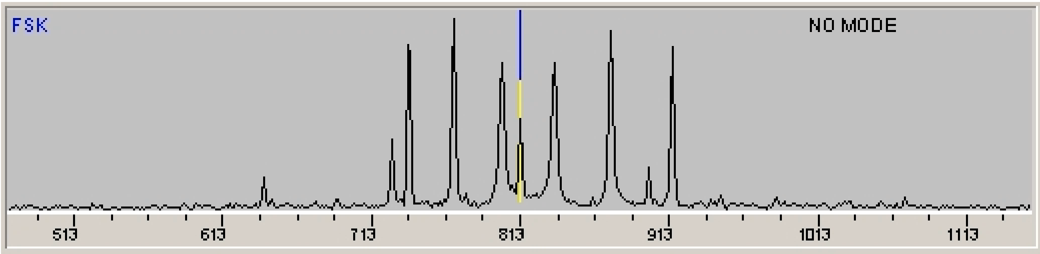
Marconi 25-Tone Modem

This system is using two groups of tones one with 13 and the other with 12 tones.
These groups are separated by a pilot tone.
Different modes are possible i.e. NON ECM and ECCM mode.

In case of the ECCM mode a preamble with a FSK sequence is transmitted in advance and the pilot tone is missing. This preamble is working with 48 Bd and 480 Hz shift.

Mazielka

Mazielka is very often heard with the system CROWD36. It is a selective calling system which can use 6 out of 13 different tones.
It is used to alarm a receiving station if a non scheduled transmission should take place.



Spectrum of Mazielka

MFSK 8

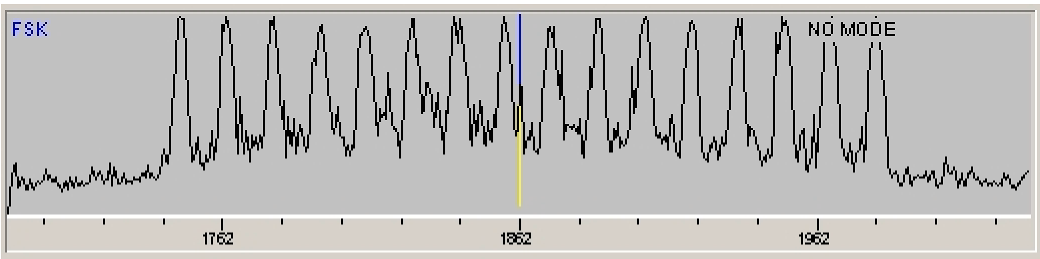
MFSK 8 is a multi-tone mode which uses 32 tones. Each tone is modulated with a symbol rate of 15.625 Bd or 62.5 Bps and FEC ½.
The tones are 15.625 Hz apart and use an overall frequency range of 316 Hz.

Spectrum of a MFSK 8 signal

MFSK 16

MFSK 16 is a multi-tone mode. It uses 16 tones in a bandwidth of 316 Hz. Each tone is modulated with a symbol rate of 15.625 Bd and FEC ½.
The transmission is based on 16-FSK (sequential single tone FSK), with continuous phase (CPSK) tones.
Tone weighting will be such that the lowest audio tone represents zeros in all bits. The weighting will increase in gray-code as the tone frequency is increased. This technique provides the least Hamming distance between adjacent tones:

Tone	Weight	Tone	Weight
0 (lowest)	0000	8	1100
1	0001	9	1101
2	0011	10	1111
3	0010	11	1110
4	0110	12	1010
5	0111	13	1011
6	0101	14	1001
7	0100	15 (highest)	1000



Spectrum of a MFSK 16 signal

MFSK BUL 8-Tone

This system is said to be used by Bulgaria diplomatic service. It uses 8 tones with a spacing of 240 Hz. The system speed is 240.18 Bd.

MFSK Chinese 4+4 Modem

This system is said to be in use by Chinese users. It is using two groups with 4 tones. The tones are 300 Hz apart, the groups 450 Hz.

Channel	1	2	3	4	5	6	7	8
Tone	615	915	1215	1515	1965	2265	2565	2865

Each tone is modulated with 150 Bd QPSK. The Chinese 4+4 modem is interleaved in time and frequency.

MFSK Modem ALCATEL 810

This modem uses different waveforms for transmission:

MFSK 4-TONE ARQ SYSTEM 150 to 1200 Bd

This high speed waveform uses 4 tones which are modulated with different speeds from 150 to 1200 Bd. The tone spacing is 600 Hz.

MFSK 8-TONE ARQ SYSTEM 16.7 & 100 Bd

This robust waveform uses 8 tones which are modulated with different speeds of 16,7 and 100 Bd. The tone spacing is 100 Hz.

MFSK TADIRAN HF Modem

This system is using a waveform with 4 tones with a spacing of 300 Hz. A reference tone can be found at 1000 Hz. The first tone is located at 2400 Hz. This FSK system is running with a speed of 125 Bd.

MFSK TE-204/USC-11 Modem

This modem is using a a waveform with 4 tones and a spacing of 450 Hz.

MFSK Thrane & Thrane TT2300-ARQ Modem

This system according the MIL 188-standard is sold by a Danish company Thrane & Thrane.

It is an full duplex, error correcting (24 unit CRC) multitone mode using 8 tones spaced 200 Hz with baudrates of 100 and 200 bd. Input is serial by a PC.
The signal is bit transparent and online encoded. This mode is adaptive.
Quality of connection and usefull frequencies are chosen by the system. If the datarate is below a chosen value, a new frequency is used.

This system is believed to be used by English and French authorities.

MIL 188-110A

MIL STD 188-110A is modem for data transmissions on shortwave over great distances. It is using 8PSK on a single carrier frequency of 1800Hz. The standard can use different settings for baudrate, interleave and FEC but uses a constant single tone waveform of 2400 Bd.
The following settings are possible:

Input datarate	FEC	Interleave
4800	None	Zero
2400	0.5	Short or long
1200	0.5	Short or long
600	0.5	Short or long
300	0.25	Short or long
150	0.125	Short or long
75	0.5	Short or long

The signal always starts with a preamble followed by the data bits which can be interleaved. Depending on the used interleaving the preamble has a length of 0.6s for short or zero interleave and a length of 4.8s for long interleave.

Lead-in sequences (when viewed in ITA2 mode) are useful for identification (especially in the absence of any ALE) of stations using the MIL-STD-188-110A :

User	*Czech Diplomatic Service (variable speed frames, ASCII text & binary files)*
Header	**BCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{l}**
User	*US Coast Guard (always 600bd frames with Short Interleave, KG84 encrypted)*
Header	**UUUUUUUyœ»V**
User	*Unidentified US Organization (always 1200bd frames with Short Interleave, KG84 encrypted)*
Header	**UUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUyœ»V**
User	*Mexican Navy (variable speed frames, plain text and on-line encrypted)*
Header	**####0123456789**
User	*Swedish Diplomatic Service, Venezuelan Army, Swiss Military (on-line encrypted)*
Header	**.q**
User	*Romanian Diplomatic Service (variable speed frames, on-line encrypted)*
Header	**xxxxxp** *and* **xxxxxq**

Because M188-110 serial is used as a transparent modem, any kind of output can be expected. Mainly VT100 output (ASCII) is reported, but also ITA 2 will be possible.

MIL 188-110A Appendix A 16-Tone

This system is using 16 tones each 75 Bd QPSK modulated. The spacing between tones is 105 Hz, an unmodulated pilot can be found at 605 Hz.

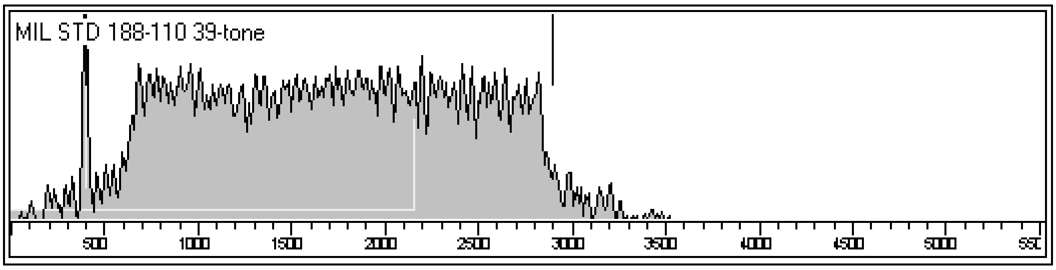
Tone	Frequency in Hz	Tone	Frequency in Hz
1	935	9	1815
2	1045	10	1925
3	1155	11	2035
4	1265	12	2145
5	1375	13	2255
6	1485	14	2365
7	1595	15	2475
8	1705	16	2585

A variant without pilot is also using 16 tones each 112,5 Hz apart. The fist tone is on 900 Hz.

Tone	Frequency in Hz	Tone	Frequency in Hz
1	900,0	9	1800,0
2	1012,5	10	1912,5
3	1125,0	11	2025,0
4	1237,5	12	2137,5
5	1350,0	13	2250,0
6	1462,5	14	2362,5
7	1575,0	15	2475,0
8	1687,5	16	2587,5

MIL 188-110 Appendix B 39-Tone

A phase PSK system implemented per MIL-STD-188-110A, 39-tone modem appendix B. The system supports data rates of 75 to 2400bps using 39 tones spread from 675Hz to 2812.5Hz with a spacing of 56.25Hz. 1 Doppler tone can be found at 393.75Hz. Block interleaving with up to 12s delay is supported. A 39-tone modem sounds like noise, so as you tune across this signal an S meter will rise and fall. It sounds very much like tuning a noisy frequency.
One has to know all details on mode output BEFORE starting decoding of this system, (Interleaving, symbol speed and output as ASCII or BAUDOT, qty of start- stop bit, parity etc)



Spectrum of MIL 188-110 39 tone

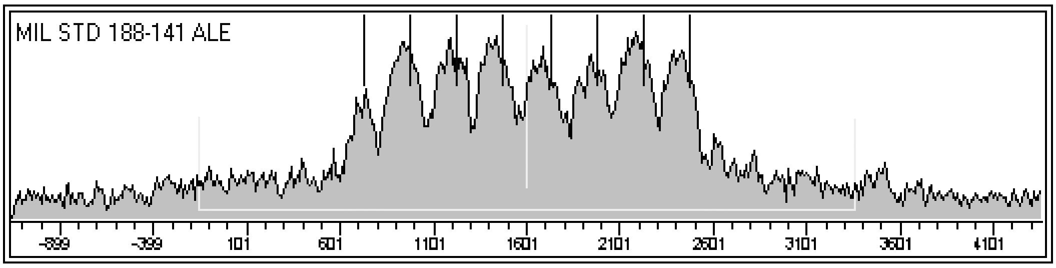
MIL 188-141A

ALE (Automatic Link Establishment)

This system allows automating the process of setting up a circuit on HF achieving a high percentage of first time link-up. The ALE controller (Automatic Link Establishment) system Mil Std 188-141A is designed to establish one to one/one to many links and once the link is established the controller has the option of passing data in a low speed manner using its internal provisions. Alternatively it may be switched manually or automatically to a different modem for high-speed FSK-PSK data, or voice.

Its waveform is designed to pass through the AF pass band of standard SSB equipment. It consists of 8 tones (MFSK) located on 750 - 1000 - 1250 – 1500 - 1750 - 2000 - 2250 - 2500 Hz. Each tone is 8mS in duration. This gives 125 symbols per second. With 8 tones (symbols or elements) we can support 3 data bits per symbol. This results in a transmitted data rate of 375 bits per second.

The bit stream of MIL 188-141A is structured in 24 bit frames. These include a preamble of 3 bit for the frame type and 3 ASCII characters with 7 bit or 21 unformated bit. The total frame is Golay encoded and interleaved which results into a frame of 49 bit (including on stuff bit). Each 49 bit frame is transmitted three times.

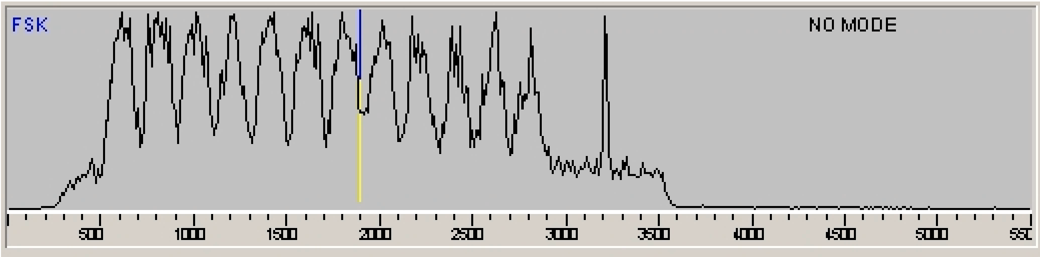


Spectrum of MIL 188-141A

MS 5

Fire

This is the Russian (Soviet) 12 tone Vocoder system with each channel QPSK modulated at 120 symbols/sec. Each tone has a shift of 200Hz and spans a frequency range of 700Hz to 2900Hz in the Lower Side Band. This system has a distinctive pilot tone (unmodulated) at 3200Hz above a kHz point with unconfirmed reports of a pilot tone at 3600Hz and has a maximum capacity of 4800 bits/s.



MS5 spectrum with reference tone at 3200 Hz

MT 63

MT63 is intended for conversational use between one of more Amateur Radio stations, providing performance in poor conditions, and consequently utilizes FEC rather than ARQ error correction processes.
The MT63 modem, constructed around a high speed DSP processor, either in a dedicated external DSP unit like the Motorola EVM, or in PC software using the PC sound card, transmits 64 tones spaced 15.625 Hz apart, in the 1 kHz bandwidth. The base-band signal occupies from 500 Hz to 1500 Hz. All 64 tones are differential bipolar phase shift keyed at 10 baud. Since the Walsh FEC code is 64 bit, the character rate is the same as the symbol rate, so the throughput with FEC is 10 7-bit ASCII characters/sec (about 100 WPM).

There are two other bandwidths that can be used, 500 Hz, and 2 kHz, where the tone spacing and baud rate is halved or doubled and the throughput halves or doubles respectively. Unless otherwise indicated, this description is of the default 1 kHz version. In addition, an optional doubling of the interleave period improves the temporal resistance at the expense of increased time delay through the encoder and decoders. The different speeds are achieved by scaling all the timing factors, although the lowest carrier frequency remains constant at 500 Hz.

Bandwidth	Audio Range	Symbol Rate	Char Rate	Interleave/char
500 Hz	500 - 1000 Hz	5 baud	5 char/sec	6.4 or 12.8 sec
1000 Hz	500 - 1500 Hz	10 baud	10 char/sec	3.2 or 6.4 sec
2000 Hz	500 - 2500 Hz	20 baud	20 char/sec	1.6 or 3.2 sec

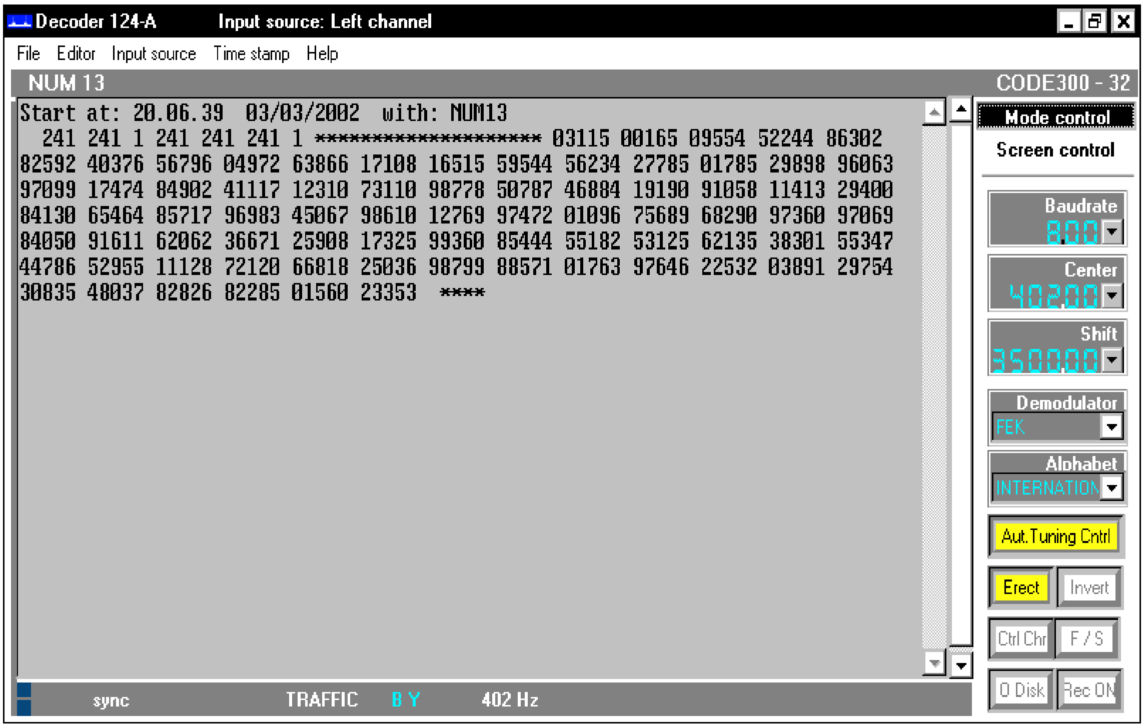
The user data from keyboard or file, (the data code is 7-bit ASCII), is further encoded into 64 bits using a Walsh function to provide a highly robust FEC technique with high redundancy. The Walsh function ensures that up to 16 of the 64 bits can be corrupted, yet decoding will still produce an unambiguous result.

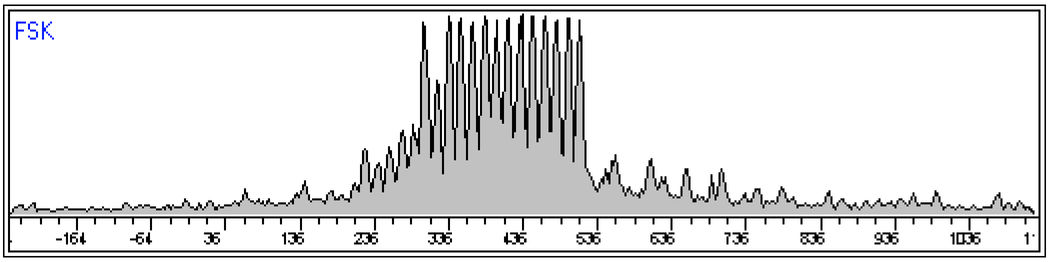
The MT63 signal is spread both temporally and spatially. To ensure that noise bursts and other time domain interference artefacts have minimal effect, each encoded character is spread over 32 sequential symbols (3.2 sec). To ensure that frequency domain effects such as selective fading and carrier interference have minimal effect, the character is also spread spectrally by using all the tones across the width of the transmission. In a "long interleave" option, the spreading is over 64 symbols (6.4 sec), with consequent improvement in resistance to impulse and periodic interference, but of course double the time taken for the data to "trickle through" the Walsh encoder and decoder pipeline

Nokia Adaptive Burst System

This system is using a FSK with different speeds of 150.6 Bd, 301.7 Bd and 602.14 Bd. The shift is 760 Hz.

NUM 13





Spectrum of NUM 13

PACTOR I

PACTOR is a synchronous half duplex system which is similar to SITOR and PR. It uses 100 Bd and 200 bd.
The system is using 12 bit control signals and a cyclic error correction code (16 bit CRC).

Data are compressed by Huffmann coding.

All packets have the same structure : a header for synchronisation, 192 data bits at 200 Bd and 80 bits at 100 Bd, 8 control bits with packet number, break or QRT request, transmitting mode aso. and 16 bits for error correction.

PACTOR is using four control signals CS 1 to CS 4 with a length of 12 bits.
CS 1/CS 2 have a normal acknowledge function, CS 3 for break in and change of direction of traffic and CS 4 for change of speed of transmission.

This system is used by radio amateurs. Various (7) modes are used by the International Red Cross Organization and the United Nations.

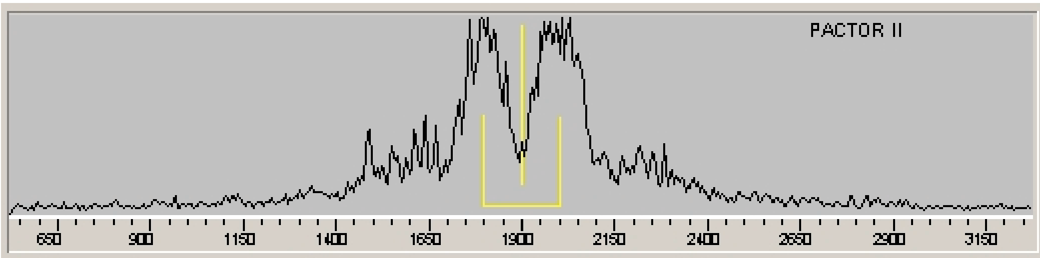
Variation	User
PACTOR 1	Radio amateurs
PACTOR 2	International Red Cross
PACTOR 3	UNHCR
PACTOR 4	French Red Cross
PACTOR 5	UNO
PACTOR 6	unknown
PACTOR 7	unknown

PACTOR II

Pactor II is DSP based and is as much as 7 times faster then Pactor I. A Pactor Level II signal features 2 tones w/200Hz shift using baud rates of 100 or 200 fitting into a 500Hz channel. Pactor II is a half-duplex synchronous ARQ system and designed to be backward compatible with the older Pactor Level I protocol.

The system can handle raw 8 bit data and ASCII compression with HUFFMAN or MARKOV method. Depending on band conditions the data throughput can be increased by changing the modulation form used. Maximum throughput is 800 bps.

Format	Description	Baud rate
DBPSK	**Differential Binary PSK**	**200 bps**
DQPSK	**Differential Quad PSK**	**400 bps**
8-DPSK	**8-phase Differential PSK**	**600 bps**
16-DPSK	**16-phase Differential PSK**	**800 bps**



Spectrum of PACTOR II

The actual user group is shown in the status line.

CRC: CODE300 does use an automatic detection of new user groups with different CRC's. A text file, called 'KNOWNCRCS' is present in the main directory of C300 and is loaded each time PACTOR II is started. A new detected CRC is automatically added into this list, the description is 'NEW 1', 'NEW 2' etc. This list can be edited and changed by an user to allow creating of his own CRC-list with description. An automatic backup file is created each time the list is loaded.

PACTOR III

PACTOR-III is a new data transmission mode which is upgrading the PACTOR-II.

PACTOR-III Protocol Specification:

SLV = Speedlevel, sub protocol level - adaptation fully automatic.
NTO = Number of tones (sub carriers) used on actual "Speedlevel".
PDR = Physical data rate, raw bit rate (Bit/sec) transferred on the physical protocol layer.
NDR = Net user data rate (without data compression) (Bit/sec). If PMC (automatic online data compression) is activated, multiply with factor 1.9 in case of text files.

SLV	NTO	PDR	NDR
1	2	200	76.8
2	6	600	247.5
3	14	1400	588.8
4	14	2800	1186.1
5	16	3200	2039.5
6	18	3600	2722.1

Maximum occupied bandwidth: 2.4 kHz @ -40 dB, audio passband: 400-2600 Hz.

Maximum net throughput with online data compression: ca. 5200 Bit/sec.

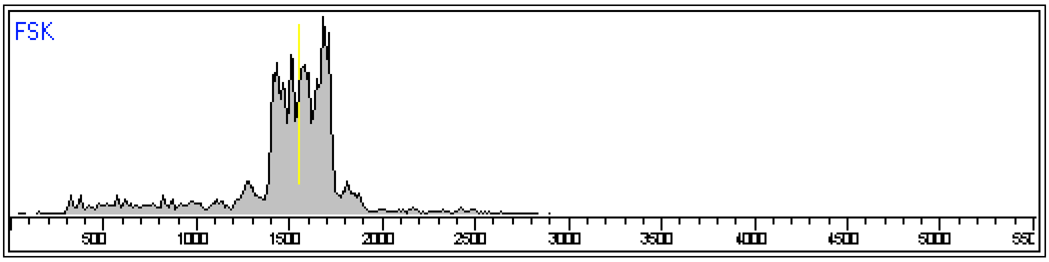
Link establishment:

The calling modems uses the PACTOR-I FSK connect frame to be compatible with the lowest (PT-I) level. The called modem then answers and the modems negotiate to the highest possible level both modems are capable of. If one modem is only capable of PACTOR-II, then the 500Hz PACTOR-II mode is used for the session.

Packet Radio

AX 25

Packet radio is a very complex error correcting data transmission system and an amateur radio version of CCIR recommendation X25 but with extended addressing fields.
PR is using 300 Bd with a shift of 200 Hz.



Spectrum of a Packet Radio signal

The error rate is reduced to 1 : 1000000000 and makes this system suitable for the transmission binary files and telemetry data.
Every packet frame consists of a synchronising sequence, a start-flag, address field, actual data packet of up to 256 characters in ASCII then the FCS and stop flag. The bytes building a packet are grouped in fields. These fields are arranged as follows :

Field name	Length	Description
start flag	1 byte	eight bit sequence 01111110, which must not be used anywhere within the packet, sent at least once at the start of the packet
address field	14 - 70 bytes	callsign of the receiving station callsign of the transmitting station up to eight callsigns of repeater station in between
control field	1 byte	indication of the status of the connection (establishment, execution, clearing) and transmission of control functions : I = information frame S = surveillance frame U = unnumbered frame
protocol identifier field	1 byte	indication, which protocol is used
data field	0 - 256 bytes	data is presented in ITA 5
check field FCS	2 bytes	frame check sequence for error detecting by a cyclic redundancy code
end flag	1 byte	eight bit sequence 01111110, which must not be used anywhere within the packet, sent at least once at the start of the packet

Table : X.25 Packet frame

The descriptions of the fields are as following :

Flag

The packet data frame is limited by flags. These frame border signs are at the beginning and the end of each data frame. If there are transmitted more frames in a sequence, the previously frame end flag could be the frame beginning flag of the following data frame. The flag contains a fixed bit sequence 01111110 equal to Hex 7E.
That these flags are recognized properly on the receiving station it must be guaranteed that this flag is not contained in the data field. This is done by bit stuffing. Bit stuffing is made on the hardware side in the High level Data Link Controller (HDLC controller).
This device is adding a zero to the data stream if there are 5 ones in a sequence. This added zero is removed in the receiver hardware.
Bit stuffing is causing a transparent data transmission, in that no other control signals are needed. In the data field can be transmitted any kind of data.
The flag is also used to synchronize the receiver to the transmitter.

Address field

The address field contains at least the callsign of the transmitter and the receiver.The receiver callsign is always the first to attach an immediate block interpretation.
If there are used several digipeaters these callsigns are also entered into the address field. The field is limited to 70 bytes so that 8 digipeater callsigns are possible. For every callsign are reserved 6 bytes for the callsign and 1 byte for the Secondary Station Identifier (SSID).
This SSID is a number between 0 and 15. For this only 4 bits of the whole byte are necessary. The other 4 bits are used for control functions. With the SSID it is possible to have 16 different PR channels with one callsign. The default value of the SSID is 0 and is normally used with different contents only by data transmissions via network nodes.

Control field

In the control field are entered all data like commands, responses and sequence numbers. The filed is 8 bit long and contains also information about the used data frames. The following frames are used :

1. Information frames (I - frames)
2. Sequence frames with sequence numbers (S - frames)
3. Sequence frames without sequence numbers (U - frames)

1. Information frames

Information frames are also called data frames. These frames have always a sequence number and are therefore numbered data frames. They have always a data field which contains the information that is transmitted.

2. Sequence frames with sequence numbers

These frames are never containing information. They are used as a acknowledgement message, request for transmission and for the current status of the connection.

They control the protocol conform data exchange between the stations.

3. Sequence frames without sequence numbers

These frames also do not contain any data. They are used for control functions as for example setup of connection and disconnection.

Frame sequence numbers

These frame sequence numbers are used for numbering and acknowledgement of frames. Information frames are provided with a send sequence number N (S). This number can have

the maximum value of 7, that means, there are 7 unconfirmed information frames allowed. This value is set by the user u accordance to the conditions of communication.
The station is transmitting only this number of information frames. Only if these information frames are acknowledged correct, the following I-frames are transmitted beginning with the number one.

The acknowledgement on the receiving station is made with the Receive Sequence Number N (R). This number is pointing to that information frame which was received without mistakes.
Has the receiving station no information for the transmitter station the acknowledgement is done with a numbered S-frame. If there are information, the acknowledgement is in the control field of the information frame.
The frame sequence numbers are generated by the software in the terminal node controller and are stored in the Send State Variable V (S) or the Receive State Variable V (R).
These counters are set to zero at the beginning of a connection or if the maximum of frames allowed is reached.
V (S) is increased after every transmission of a information frame and is showing always the next number of that frame which will be transmitted.
V (R) is only increased, if the information frame was received correctly.

Poll/Final Bit

The control field also contains a Poll/Final Bit (PFB). This can be set as P-Bit or as F-Bit to cause special reactions in the system. Is it set as P-Bit this bit is a command which is waiting for a response of the receiving station. In the answer frame which is the answer to a command frame the PFB is set as F-Bit (final).
The PFB is controlling the repetition of information frames if necessary. This is called check pointing.
A correct received and acknowledged I or S-frame with sat PFB must acknowledge all in a sequence received information frames of the transmitting station. If there is no acknowledgement all I-frames are transmitted again.

In the following are described those information which can be recognized during a packet radio connection. This can show a monitoring station for example the quality of a data transfer between two monitored stations.

Receive Ready RR

With RR all according to the rules of the protocol correct received data frames are acknowledged. With the PFB set the status of the other station could be requested.
RR is a S-frame and can be used as a command (P-Bit is set) or as a response (F-Bit is set).

Receive Not Ready RNR

With RNR all correct received information frames are acknowledged and the transceiving station is informed that no frames could be received. The anulment of RNR is made by transmitting a S-frame with RR / REJ or by an U-frame with UA / SABM.
RNR is a S-frame and can be used as a command (P-Bit is set) or as a response (F-Bit is set).

Reject REJ

Reject is a command to repeat the last information frames. Also the last correct received I-frames are acknowledged.
REJ is a S-frame and can be used as a command (P-Bit is set) or as a response (F-Bit is set).

Set Asynchronous Balanced Mode SABM

With this command a connection to another station is set up. If the other station is able to make the setup SAM is answered with an UA command. At the same time the sequence counter is set to zero. SABM can only be transmitted with an U-frame.

Disconnect DISC

With DISC the connection between two station is finished on link level. In this condition no I-frames can be transmitted or received.
DISC is transmitted as an U-frame and is answered with an UA command.

Unnumbered Acknowledge UA

With UA all commands as SABM and DISC in an U-frame are acknowledged. Commands are executed after the receiving of the UA command. UA is transmitted as a response in an U-frame.

Frame Reject FRMR

With FRMR a received command is rejected because there are differences in the protocol even if the check byte is correct. The answer FRMR is transmitted in a 24 bit data frame as an U-frame. The data field contains the contents of the control field and the values V (R) and V (S) of the rejected data field. error codes are also transmitted.

Disconnect Mode DM

With DM all data frames are answered if the calling station is not connected when they are not a S-frame or U-frame. DM is also transmitted if the called station is busy or not able to connect more stations.

Unnumbered Information UI

UI is transmitted with all unnumbered U-frames. U-frames are not data flow controlled so a missing UI-frame can not be recognised. UI-frames are containing a protocol identifier (PID) and a data field (I-frame).

Data field

The data or information field contains the transmitted information. The maximum length is 256 x 8 bit and can contain any combination of bits. A data field is always transmitted as an I or U-frame.

Frame Check Sequence FCS

The FCS is 16 bit long and is transmitted with the MSB first. The cyclic redundancy check is in accordance to the CCITT polynom for 8 bit codes as CRC 16 with

For calculation of the CRC the data are divided through this polynom and a possible rest is added to the FCS. In the receiver the frame is again divided through the polynom and is correct received if there is no rest.
If there is a failure, the frame is deleted at once. With this CRC every mistakes is recognized and the data transmission is error free.
The Open System Interface of International Standardization Organisation (OSI / ISO) applies, which has 7 layers, ranging from wire (layer 1) to application (layer 7).
Communication is usually executed from one microcomputer system end to another one of the receiving station. With modern microcomputer systems, mailbox and repeater facilities are available (OSI / ISO layer 6 and 7).
The above mentioned X.25 protocol comprises layer 2 to 3.
Messages can be send over several digital repeaters so that long distances even in the VHF / UHF range are possible.

PICCOLO Mark VI

Piccolo MK VI is a british designed system based on sending 2 audio tones in sequence from a selection of 6 for ITA-2 and 12 for ITA-5 for each of the different characters to be sent. Idle condition is tones 5 and 6 sent sequentially.
These two tones are the two center tones thus making tuning easy when the station is in standby.
Two baudrates are transmitted namely 50 and 75 Baud but the system keys as if the input terminal equipment was 75 Baud all the time by inserting idles whenever the transmit buffer gets empty (which it will do quite often at 50 Baud in 75 Baud out).

Tones used are No. 3 to 8 at 20 Hz apart for ITA-2 Baudot (Most common) No. 0 to 11 at 20 Hz apart for ITA-5 ASCII (Rare).
The tones are 400 to 620 Hz for ITA 3 and 460 to 560 Hz for ITA 2. The idle tones are 500 and 520 Hz.

Piccolo with 12 tones ITA-5		**Piccolo with 6 tones ITA-2**
Tone-number	**Frequency in Hz**	**Tone-number**
0	400	
1	420	
2	440	
3	460	0
4	480	1
5	500	2
6	520	3
7	540	4
8	560	5
9	580	
10	600	
11	620	

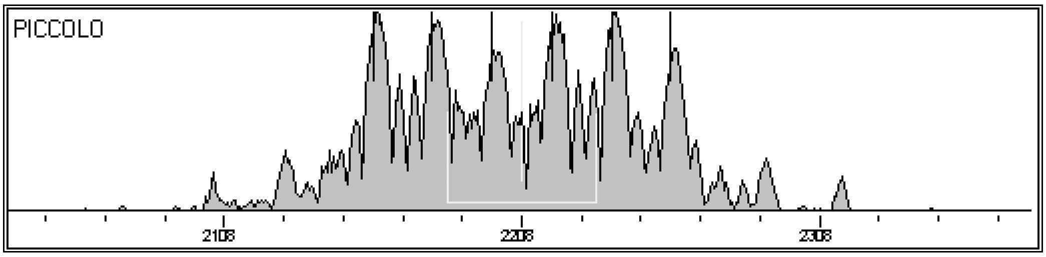
The following table gives on overview which tones are transmitted for the different characters and bit combination.

Ton 1/2	Bit combination 12345	Character
0/0	11101	Q
0/1	10101	Y
0/2	11001	W
0/3	11011	fs
0/4	10111	X
0/5	11111	ls
1/0	01101	P
1/1	00101	H
1/2	01001	L
1/3	01011	G
1/4	00111	M
1/5	01111	V
2/0	10001	Z
2/1	00001	T
2/2	Not used	
2/3	Not used	idle
2/4	00011	O
2/5	10011	B
3/0	10000	E

Ton 1/2	Bit combination 12345	Character
3/1	00000	null
3/2	Not used	
3/3	Not used	
3/4	00010	cr
3/5	10010	D
4/0	01100	I
4/1	00100	sp
4/2	01000	lf
4/3	01010	R
4/4	00110	N
4/5	01110	C
5/0	11100	U
5/1	10100	S
5/2	11000	A
5/3	11010	J
5/4	10110	F
5/5	11110	K

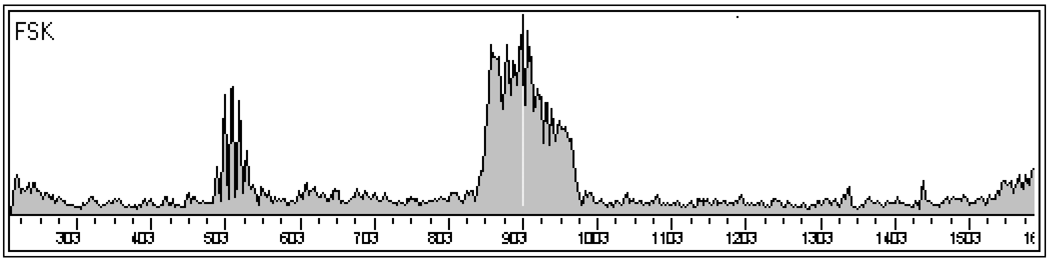
The next table shows the tone/bit combination for normal and inverted reception with or without letter/number shifting:.

	Normal		Inverted			Normal		Inverted	
Tones:	Letter Shift	Number Shift	Letter Shift	Number Shift	Tones:	Letter Shift	Number Shift	Letter Shift	Number Shift
00	Q	1	K	(	30	E	3	B	?
01	Y	6	F	!	31	null	null	O	9
02	W	2	J	bell	32				idle
03	fs	fs	A	-	33				
04	X	/	S	‘	34	cr	cr	T	5
05	ls	ls	U	7	35	D	$	Z	+
10	P	0	C	:	40	I	8	V	:
11	H	#	N	,	41	sp	sp	M	.
12	L	)	R	4	42	lf	lf	G	&
13	G	&	lf	lf	43	R	4	L	)
14	M	.	sp	sp	44	N	,	H	#
15	V	=	I	8	45	C	:	P	0
20	Z	+	D	$	50	U	7	ls	ls
21	T	5	cr	cr	51	S	‘	X	/
22					52	A	-	A	-
23	Standby	Standby			53	J	bell	W	2
24	O	9	null	null	54	F	!	Y	6
25	B	?	E	3	55	K	)	Q	1



Spectrum of PICCOLO MK VI

Multi-channel Piccolo's reside on 510, 910, 1310 and 1710 Hz offsets from a carrier point, look at the idle channel on 510 Hz. That is usually the engineers' channel and operator chat are usually in clear text.



Multi-channel Piccolo's on 510 Hz transmission in Stand By , on 910, transmission is active.

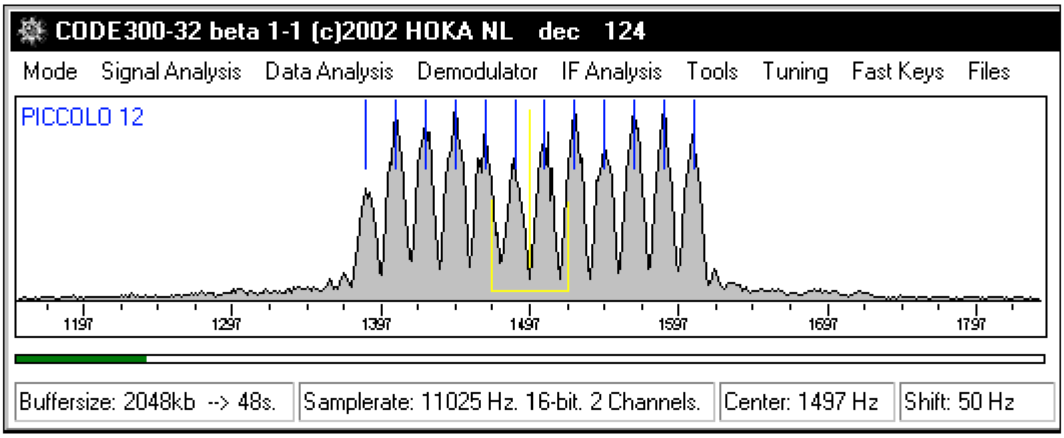
Be warned, this is not an easy system to get tuned into correctly first time because the receiver has to be very stable and it should also preferably have 1 Hz tuning. Whilst initially tuning around, switch [A]TC off. Then once correctly tuned in, switch it back on. You have to be within 6 Hz of the correct frequency otherwise this module will not decode correctly. Once correctly tuned, use ATC switched on at all times to compensate for any few Hz drift after correctly tuning in. It cannot compensate for miss-tuning in the first place. As with all modules, the ATC function can only compensate for drift up to a maximum of 1/3rd of the shift. In this case it would be 6 Hz.

PICCOLO 12

Piccolo ITA-5 is a 12 tone MFSK system based on the 7 bit ITA-5 characters.

The idle condition is represented by tones 5 and 6 sent sequentially. These two tones are also the two centre tones and therefore it is very easy to tune the station when idling. Two user baud rates of 50 and 75 Baud are possible but the on-air speed remains constant due to the use of inserted idles for 50 Baud.

The following table shows the bit and symbol combination of PICCOLO 12. The bold printed parts are showing that PICCOLO 6 is a special form of PICCOLO 12 where the three highest and lowest tones are not used.



Spectrum of PICCOLO 12

Tone 1/2	Bit combination	Symbol
0/0	Not used	
0/1	0000100	idle
0/2	1000100	dc4
0/3	1000110	4
0/4	0000110	0
0/5	Not used	
0/6	Not used	
0/7	0001110	8
0/8	1001110	<
0/9	1001100	fs
0/10	0001100	can
0/11	Not used	
1/0	0100100	dc2
1/1	0010100	dc1
1/2	0110100	dc3
1/3	0110110	3
1/4	0010110	1

Tone 1/2	Bit combination	Symbol
1/5	0100100	2
1/6	0101110	:
1/7	0011110	9
1/8	0111110	;
1/9	0111100	Esc
1/10	0011100	Em
1/11	0101100	Sub
2/0	1100100	syn
2/1	1010100	nak
2/2	1110100	etb
2/3	1110110	7
2/4	1010110	5
2/5	1100110	6
2/6	1101110	>
2/7	1011110	=
2/8	1111110	?
2/9	1111100	us

Tone 1/2	Bit combination	Symbol
2/10	1011100	gs
2/11	1101100	rs
3/0	1100101	V
3/1	1010101	U
3/2	1110101	W
3/3 (0/0)	**11101**11	w (Q)
3/4 (0/1)	**10101**11	u (Y)
3/5(0/2)	**11001**11	v (W)
3/6 (0/3)	**11011**11	~ (fs)
3/7 (0/4)	**10111**11	} (X)
3/8 (0/5)	**11111**11	del (ls)
3/9	1111101	_
3/10	1011101	]
3/11	1101101	^
4/0	0100101	R
4/1	0010101	Q
4/2	0110101	S
4/3 (1/0)	**01101**11	s (P)
4/4 (1/1)	**00101**11	q (H)
4/5 (1/2)	**01001**11	r (L)
4/6 (1/3)	**01011**11	z (G)
4/7 (1/4)	**00111**11	Y(M)
4/8 (1/5)	**01111**11	{ (V)
4/9	0111101	[
4/10	0011101	Y
4/11	0101101	Z
5/0	Not used	
5/1	0000101	P
5/2	1000101	T
5/3 (2/0)	**10001**11	t (Z)
5/4 (2/1)	**00001**11	p (T)
5/5 (2/2)	Not used	
5/6 (2/3)	**idle**	idle
5/7 (2/4)	**00011**11	x (O)
5/8 (2/5)	**10011**11	| (B)
5/9	1001101	\
5/10	0001101	X
5/11	Not used	
6/0	Not used	
6/1	0000001	@
6/2	1000001	D
6/3 (3/0)	**10000**11	d (E)
6/4 (3/2)	**00000**11	` (null)
6/5 (3/2)	Not used	

Tone 1/2	Bit combination	Symbol
6/6 (3/3)	Not used	
6/7 (3/4)	**00010**11	l (D)
6/8 (3/5)	**10010**11	h (cr)
6/9	1001001	L
6/10	0001001	H
6/11	Not used	
7/0	0100001	B
7/1	0010001	A
7/2	0110001	C
7/3 (4/0)	**01100**11	c (I)
7/4 (4/1	**00100**11	a (sp)
7/5 (4/2)	**01000**11	b (lf)
7/6 (4/3)	**01010**11	j (R)
7/7 (4/4)	**00110**11	i (N)
7/8 (4/5)	**01110**11	k (C)
7/9	0111001	K
7/10	0011001	I
7/11	0101001	J
8/0	1100001	F
8/1	1010001	E
8/2	1110001	G
8/3 (5/0)	**11100**11	g (U)
8/4 (5/1)	**10100**11	e (S)
8/5 (5/2)	**11000**11	f (A)
8/6 (5/3)	**11010**11	n (J)
8/7 (5/4)	**10110**11	m (F)
8/8 (5/5)	**11110**11	o (K)
8/9	1111001	O
8/10	1011001	M
8/11	1101001	N
9/0	1100000	acq
9/1	1010000	enq
9/2	1110000	bell
9/3	1110010	‘
9/4	1010010	%
9/5	1100010	&
9/6	1101010	.
9/7	1011010	-
9/8	1111010	/
9/9	1111000	si
9/10	1011000	cr
9/11	1101000	so
10/0	0100000	stx
10/1	0010000	soh

Tone 1/2	Bit combination	Symbol
10/2	0110000	etx
10/3	0110010	#
10/4	0010010	!
10/5	0100010	„
10/6	0101010	*
10/7	0011010	)
10/8	0111010	+
10/9	0111000	vt
10/10	0011000	tab
10/11	0101000	lf
11/0	Not used	
11/1	0000000	null
11/2	1000000	eot
11/3	1000010	$
11/4	0000010	space
11/5	Not used	
11/6	Not used	
11/7	0001010	(
11/8	1001010	,
11/9	1001000	ff
11/10	0001000	bs
11/11	Not used	

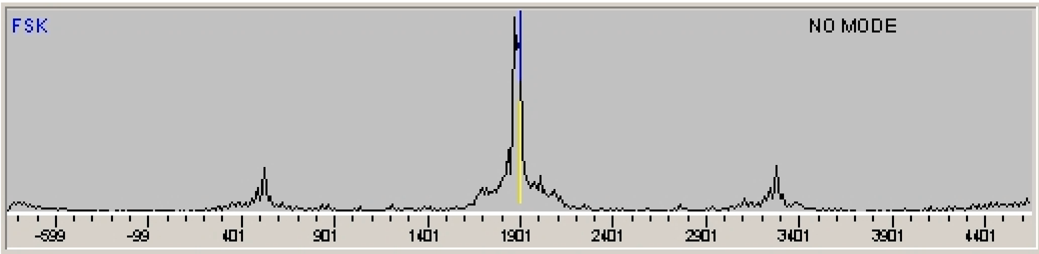
POL-ARQ

CCIR 518 variant

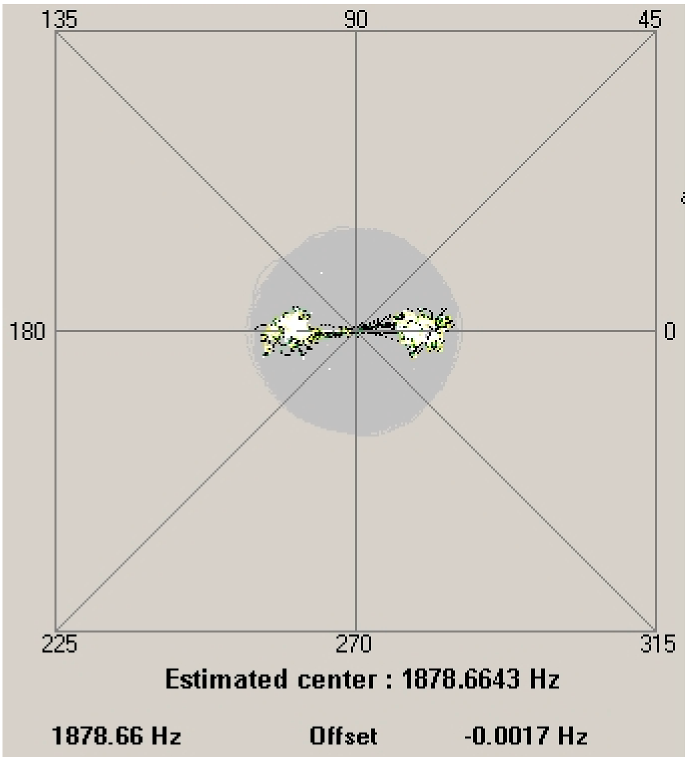
POL - ARQ is a synchronous duplex ARQ using the 7 bit error correcting CCIR 476 alphabet with two stations on different frequencies, one of them called the ISS (transmitting), the other the IRS (receiving) station. Complete repetition cycle is made up of either 4,5 or 6 characters.
POL - ARQ is a standard SITOR B teleprinter system in which the repetition of characters is missing.
On a request signal the last four characters which have been sent, are repeated.
This system is used by the Ministry of Foreign Affairs (MFA) of Poland.

PSK 31

PSK-31 is a modern, very narrow-band and reliable mode developed by radio amateurs. The good behaviour against disturbances is achieved by the use of DPSK modulation. Two demodulators can be selected:
For normal use DBPSK can be selected to demodulate a bi-phase modulated signal. The baud rate is fixed to 31.25 Baud and is optimized to transfer the data rate.
Alternatively DQPSK can be selected to demodulate a four-phase modulated signal.
In the DQPSK mode this mode is using a FEC of ½ and Viterbi coding.



Spectrum of PSK31 signal



Phase plane of a BPSK PSK31 signal

PSK 31 can be heard on or nearby the following frequencies :
1.83815, 3.58015, 7.07015, 7,03515, 14.07015, 21.08015, 28.07015, and 28.12015 with 10.13715, 18.10015, and 24.92500 suggested for the WARC bands.

PSK 63 FEC

PSK-68F is a modern, very narrow-band and reliable mode developed by radio amateurs using a datarate of 62.5 Bd.
The good behaviour against disturbances is achieved by the use of DBPSK modulation with forward error correction(FEC).
In comparison to PSK31 this mode was improved concerning bit error rate (BER) and propagation effects like mulit-path, fading and Doppler.
This mode is using a FEC of ½ and Viterbi coding.

PSK 125 FEC

PSK-125F is a modern, very narrow-band and reliable mode developed by radio amateurs using a datarate of 125 Bd.
The good behaviour against disturbances is achieved by the use of DBPSK modulation with forward error correction(FEC). In comparison to PSK31 this mode was improved concerning bit error rate (BER) and propagation effects like multi-path, fading and Doppler.
This mode is using a FEC of ½ and Viterbi coding.

R-37

R-37 is a special demodulator setting to decode a Russian baudot system.

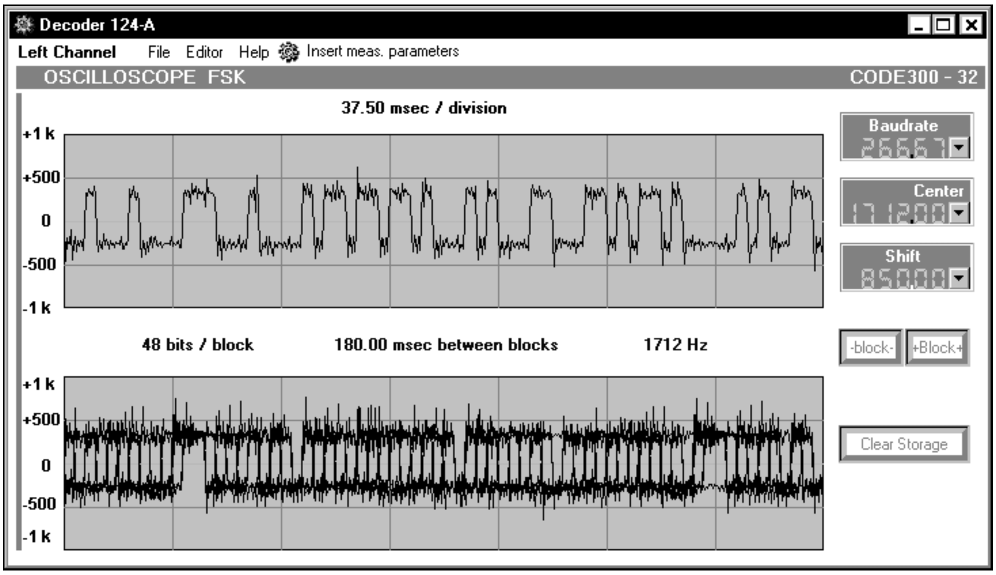
RAC-ARQ

MEROD (Message Entry and Read Out Device)

RAC - ARQ (RACAL teleprinter system) is a synchronous system with a speed of 150 Bd and 266.67 Bd and a error correcting BCH code which can correct 7 errors in 127 bits. The shift is 800 hz.

Selective addressing is possible also group addressing with up to 4 separate addresses per message. The message consists of random data for starting up the communication link, 64 bits pseudo preamble sequence for synchronization, 90 bits message length with error protection included and 127 * 1000 bits for message including address, key, sender and parity for error correction.

The message bits itself are encrypted and interleaved.



Oscilloscope display of RAC-ARQ

ROU-FEC

RUM-FEC

ROU - FEC is a Roumanian duplex FEC system with a baudrate of 164.5 Bd but sometimes also in 218,3 bd. This system was mentioned for a long time as " SAUD-FEC ".

The interleave factor is 128 bits, each new character has its beginning 16 bits from the preceding character.
This system is in use of the Ministry of Foreign Affairs (MFA) in Bucharest.

RS-ARQ

ALIS

RS - ARQ (Rhode & Schwarz) is a synchronous simplex ARQ using the CCIR 476 alphabet. Additional this system allows transmission of 7 bit ASCII and the extended 8 bit IBM G2 character set.
The default speed is 228,5 bd which is equal to a data modem input of 720 bd. This corresponds to 92,6, 88,2 or 84,9 bd when a 5 bit, 7 bit or 8 bit format is transmitted.
The error detection is realized with a redundant code. The block length is 48 bit with a linear cycle block code. These 48 bits are divided into 32 bit data and 16 bit for error detection. This system is much more error free in comparison to a normal SITOR system.

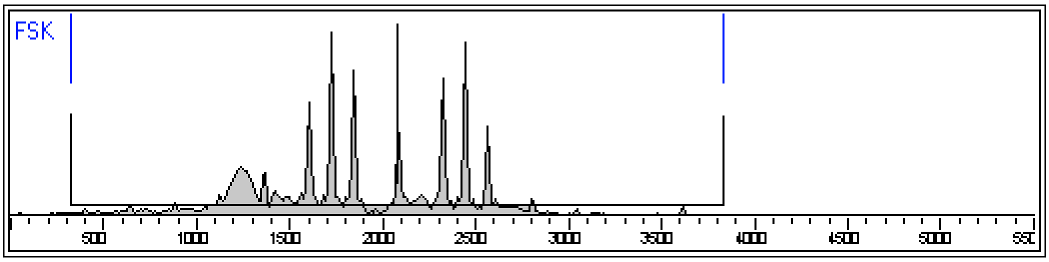
If due to propagation or noise the error rate on a radio links is decreased to a value below the defined one, a frequency change takes place. If the link is lost an automatic re-phasing is started.
This system has the possibility of a passive channel analysis and can determine the maximum useable frequency. The communication is established by a calling station, which transmits a defined number of frames on several defined frequencies. The receiving station is calculating a weighted bit addition and scans all pre-programmed frequencies to receive at least three fames on each single frequency for synchronisation. After the correct reception of three fames, the receiving station transmits a synchronisation acknowledgement and information about the quality of reception. Also a confirmation of the received status of the sending station is retransmitted. These acknowledgements are several times repeated so that the calling station can evaluate the propagation time of the radio link.

If there is no answer from the called station or a to high error rate, this procedure is repeated on another set of frequencies.
If communication is established successfully a start signal is transmitted to finish the link set up phase.
The number of transmitted frames is not fixed. It is calculated around 3 times the number of pool frequencies.
One frame is build up of 24 bits correlation code to detect the start of the frame, 15 bits address code including one parity bit, 22 bits of status information of the master station and 7 bits frame counter, which is depending on the number of pool frequencies.
If the address field is 0 the system is in broadcast mode.
A correct reception which is confirmed by the synchronization acknowledgement consists of 24 bits synchronization an 4 bit quality of received signal.
The start signal to mark the end of set up phase consists of 14 bits synchronization word and 15 bits address of the master station.

RS-ARQ II

ALIS 2 / MERLIN /RS-ARQ 240

This is a burst 8 tones MFSK ARQ system made by Rohde & Schwarz with a standard speed of 240 baud (equivalent to 720 bit/s). Shift between tones is 240 Hz, and the tone duration is 4.15254 ms. The transmission block consists of 55 tri-bits, resulting in 165 bits per frame. The system can use either 5 bits ITA2 or 8 bits ASCII alphabet.
Turkish and Italian diplomatic stations are the most commonly found users.



Spectrum of RS-ARQ II

SITOR AUTO

CCIR 476 Mode A or B

ARQ mode A

ARQ CCIR 476, CCIR 625 mode A

SITOR A is a synchronous simplex ARQ using the CCIR 476 alphabet with 7 bit. Two stations are working on the same frequency, one of them is the ISS (information sending station), the other is the IRS (information receiving station).

Cycle 450 ms : 3 characters with 70 ms = 210 ms transmitting, 240 ms pause.

Transmitting speed is 100 bd with a common shift of 170 Hz.

FEC mode B :

SITOR B is a simplex ARQ using the CCIR 476 alphabet with 7 bit. Two or more stations are working on the same frequency, transmitting mode in FEC.

This system is character interleaved, each character is repeated after 350 ms.

Idle: SBRS (selective) beta in dx and rx position
Idle: CBRS (collective) alpha in rx and rq in dx position.

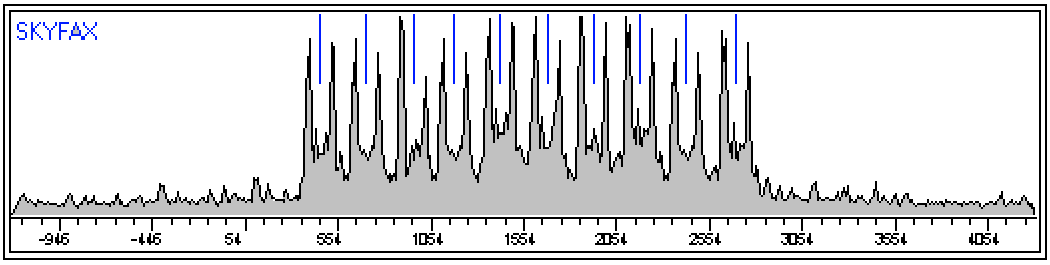
SKYFAX

HF Fax/Data Modem

SKYFAX is a standalone modem which makes possible transmission and reception of faxes and computer data files between most conventional HF radios with error free output at the receiving end. The system uses a maximum on-air data rate of 3600 bps with fallback in stages ultimately to a robust 53 bps under extremely adverse propagation conditions or interference.

The Medium Speed Modem (MSM) uses 10 parallel data channels in the audio baseband of the transceiver. Each of the data channels is modulated at 125 bps, providing a total capacity of 1250 bps. Advanced digital signal processing techniques are employed to generate the tones and recover the data from each tone. The most dominant effect of ionospheric propagation is the selective fading of frequencies within the channel baseband. The communications protocol divides the data into packets and sub-packets with each data channel carrying one sub-packet at a time. Each data packet and sub-packet is individually checked for errors and re-transmission is requested (ARQ) if an error is detected.

The optional enhanced High Speed Modem (HSM) adds a high speed serial tone modem to the functions and facilities of the SkyFax. Skyfax-HSM offers selectable traffic data rates of 3600, 2400 or 1200 bps and with favourable propagation conditions, fax and data files can be transferred in significantly less time than with the standard MSM.



Spectrum of SKYFAX

Robust Operation

SkyFax supports a low speed "Robust" mode for use when propagation conditions are too poor to support the higher rates. This allows single page faxes (or small computer files) to be transferred using an extremely robust Low Speed Modem (LSM) at 187 or 53 bps.

Automatic "Fall-Back"

Skyfax provides automatic "fallback" to a lower data rate if repeated attempts to transfer a file or fax fail. When a fax or data file is sent to the SkyFax, the system will establish a radio link to the destination radio and make several attempts to transmit the file at the user selected data rate.
If transmission fails due to adverse radio propagation conditions the system will automatically adjust to a lower data rate and attempt transmission again. If HSM is in use and all HSM speeds fail then the next stage in this process is a switch to the MSM parallel tone modem for transmission of the fax or data. If MSM fails it will switch to "Robust" mode (provided that the fax/file is smaller than a threshold size). Finally, in the extremely rare event that 187 bps fails, the SkyFax automatically falls-back to 53 bps. All of this activity is carried out automatically without any user or operator intervention.

Error Detection and Correction

The data transport protocol chosen to protect the traffic data is a well proven proprietary error detection and correction system using Automatic Repeat Request (ARQ), Forward Error Correction (FEC) and Cyclic Redundancy Checks (CRC) specifically designed for the adverse conditions encountered during ionospheric propagation.

High Speed Modem Characteristics

Traffic Data Rates
1200, 2400, 3600 bits per second

On-air Waveform
2400, 4800, 7200 bps. STANAG 4285

Symbol Rate
2400 symbols per second

Modulation
1800 Hz carrier 2, 4 or 8 phase DPSK

Throughput
Up to 750, 1500, 2250 bits per second depending upon channel condition
Half duplex adaptive ARQ with CRC error

Medium Speed Modem Characteristics

Traffic Data Rate
1250 bits per second

On-air Waveform
10 parallel FSK tones

Symbol Rate
125 symbols per second

Tone Set
437.5 to 2687.5 in 250Hz steps

Modulation
FSK ±62.5 Hz

Throughput
Up to 600 bits per second depending upon channel conditions
Half duplex adaptive ARQ with CRC error

Robust Modem Characteristics

Traffic Data Rate
53.57 or 187.5 bits per second

On-air Waveform
8-ary FSK

Symbol Rate
125 symbols per second

Tone Set
750, 1000, 1250, 1500, 1750, 2000, 2250, 2500 Hz

Throughput
Up to 187.5 bits per second depending upon channel conditions
Half duplex adaptive ARQ with CRC error Mode detection, Forward Error Correction (FEC) and Interleaving.

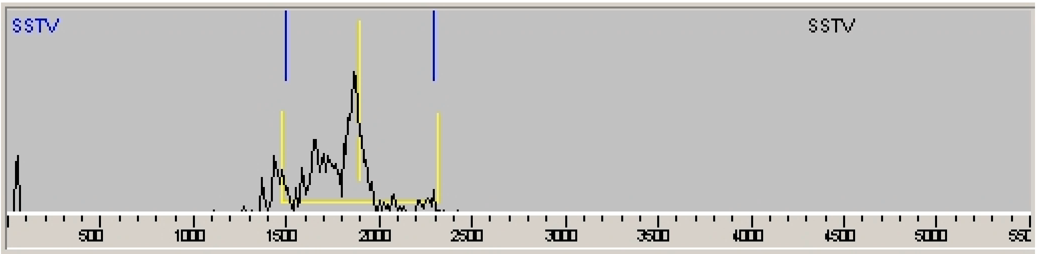
SSTV

Slow Scan Television

SSTV is used from radio amateur to transmit images over a voice channel with a normal SSB transceiver. SSTV is a television standard as the images are scanned row by row and then transmitted at a very low rate hence the designation Slow Scan TeleVision. SSTV and exclusive used by radio amateurs. SSTV transmissions come in variety of modes. The picture resolution varies from 120 x 120 and a transmission time of 8 seconds to 640 x 480 with a transmission time of over seven minutes. Some transmissions are black-and-white only, and others are in colour using either R-G-B or Y-U-V colour coding. On the air, the most common modes are Martin modes.

SSTV Standards for Synchronization

Synch Tone	1200 Hz
Black Tone	1500 Hz
White Tone	2300 Hz



Spectrum of a SSTV transmission calling CQ

Meanwhile there are 55 different SSTV modes. The following SSTV modes are used by radio amateurs:

Mode	Resolution	Colour	Transmission time
AVT 24	120/128	Colour	24 s
AVT 90	240/256	Colour	90 s
AVT 94	200/320	Colour	94 s
Wraase 24	128/128	Colour	24 s
Wraase 48	256/128	Colour	48 s
Wraase 96	256/256	Colour	96 s
Scottie S1	256/256	Colour	110 s
Scottie S2	256/256	Colour	71 s
ScanMate 1	512/320	Colour	391 s
ScanMate 2	512/320	Colour	261 s
Martin Mode 1	256/256	Colour	114 s
Martin Mode 2	256/256	Colour	58 s
Robot 8	120/128	B/W	8 s
Robot 12	120/128	B/W	12 s
Robot 24	240/256	B/W	24 s
Robot 36	240/256	B/W	36 s
Robot 12	120/128	Colour	12 s
Robot 24	120/128	Colour	24 s
Robot 36	240/256	Colour	36 s
Robot 72	240/256	Colour	72 s

The naming is given the developer of the system:

Martin	Martin Emmerson, United Kingdom
Wraase	Volker Wraase, Germany
Scottie	Eddy T.J. Murphy, United Kingdom
AVT	AMIGA Video Transceiver, USA
Robot	Robot Research Corporation, USA

Additionally SSTV is also used for military picture transmissions.

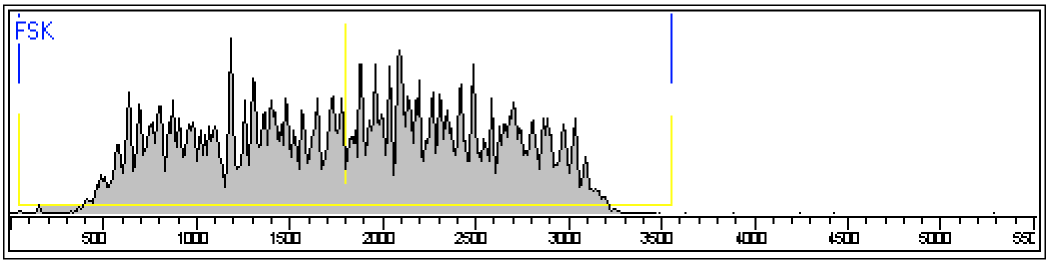
STANAG 4285

The STANAG 4285 waveform supports data rates of 75, 150, 300, 600, 1200, (Serial Tone) 2400 coded and 1200, 2400 bps uncoded. The STANAG 4285 is similar to the MIL STD 188 110 but does not support the auto baud feature. As modulation scheme BPSK, QPSK and 8PSK are possible.

Code rate can be from 1/16 to 2/3 with an interleaver of 0.852s or 10.24s convolutional.

IF-Bandwidth must be 3 KHz at least, automatic choice of mode and symbol speed. Center frequency is chosen, receiver tuning with USB mode for round KHz values.

STANAG 4285 is not supporting autobaud and therefore is not suitable for Turbo equalization.



Spectrum of a typical STANAG 4285 signal

STANAG 4415

The STANAG 4415 describes a very robust data modem according to the MIL STD 188-110A standard with 75 bps. The code rate is ½ and an interleaver of 0.6s /4.8s is used. Modulation scheme is 8PSK. This waveform is very robust and can be detected 10 db below the noise floor.

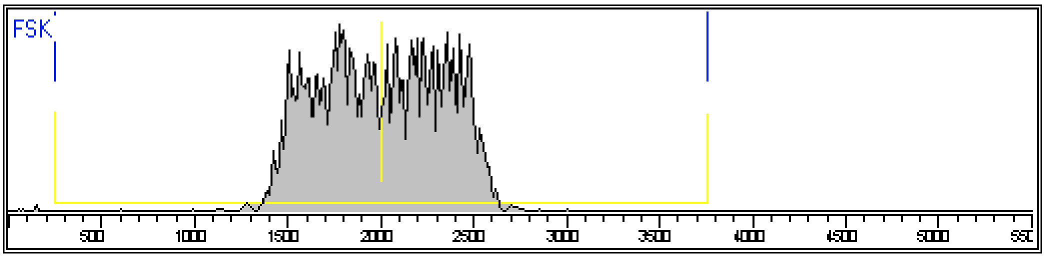
STANAG 4444

STANAG 4444 described a technical standard for a slow hop HF ECCM communication system.

STANAG 4529

STANAG 4529 is using a single tone waveform with datarates up to 1200 Bit/s (75, 150, 300, 600, 1200 bps). The used bandwidth is limited to 1240 Hz. Modulation scheme can be BPSK, QPSK and 8PSK. The interleaver can be 1.706s and 20.48s.
STANAG 4529 uses for error correction a constraint length 7 convolutional code with the generator polynomials (133,171) and a FEC rate of 1/2, 1/8, 1/4 and 2/3.

STANAG 4529 is not supporting autobaud and therefore is not suitable for Turbo equalization.



Typical spectrum of a STANAG 4529 signal

STANAG 4538

STANAG 4538 is one of the third generation improved modes. Some of these improvements are:

- Faster link establishment
- Linking at lower SNR
- Improved channel efficiency
- ALE and data use the same waveform
- Higher throughput for short and long messages
- Better support for IP and applications

The STANAG 4538 is used with two different waveforms:

BW2 : high rate data link (HDL)
BW3 : low latency data link (LDL)

Both waveforms use 8PSK. Each waveform derived from the MIL STD 188-110A is possible.

The BW2 is supporting datarates from 767 to 4409 bps without interleaving. The code rate can be 1/4 to 1/1.
BW3 supports datarates from 219 to 573 bps, code rate of 1/4 to 1/2 and an interleaver from 0.96 to 6.923s.

STANAG 4539

STANAG 4539 is a high datarate mode similar to the MIL STD 188-110B. The supported datarate is 3200 to 9600 bps. The code rate is fixed to ¾. The interleaver can be between 0.12 and 8.64s. The signal constellation can be chosen from QPSK, 8PSK, 16QAM, 32QAM and 64QAM.

STANAG 4539 is suitable for Turbo equalization.

e

STANAG 5066

STANAG 5066 describes the technical and interoperability requirements for several sublayers in a HF subnetwork, including the following:

- a subnetwork-interface sublayer (SIS),
- a channel-access sublayer (CAS)
- a data-transfer sublayer (DTS)
- a subnetwork management sublayer (SMS).

In addition to these mandatory sublayer definitions, STANAG 5066 defines recommended and advisory support for the subnetwork profiles with standard modem and radio equipment, based on the use of STANAG 4285, MIL-STD-188-110A, and STANAG 4529. In addition, the STANAG supports evolutionary growth to include high-speed serial-tone waveforms at rates as high as 9600 bps. The protocol profile includes definition of the subnet interface layer requirements for standard application clients (but not of the clients themselves) for reliable message transfer, Z-modem applications, an HF Simple Mail Transfer Protocol (HF-SMTP), and HF-POP (Post-Office-Protocol) Mail, to name a few.

The protocol profile defined in STANAG 5066 provides a common air interface and open systems specification for the following data services over arbitrary HF channels:

- reliable point-to-point data transfer using an automatic repeat request (ARQ) protocol;
- unreliable (or non-ARQ) point-to-point, broadcast, or multicast (i.e., group broadcast) data transfer;
- regular data services using ARQ and non-ARQ delivery modes;
- expedited data services using ARQ and non-ARQ delivery modes;
- link establishment and teardown services for simple channel access;
- management services for automatic data rate change (DRC) protocols.

TMS 430 Modem

This system is used in Switzerland and has a baudrate of 220 Bd with a shift of 330 Hz. The modem is called Telematik-Set TmS-430 and uses for cyphering the TC 535.

TOR-Dirty

TORG 10/11

TORG 10/11 is a russian synchronous duplex system consisting of 11 bits made up from a cyrellic ITA-2 alphabet with additional synchronizing and parity bits. Two variants of this 11 bit system are known as TORG 10 and TORG 11.
One 11 bit frame consists of five bits for ITA 2, two synchronization and 4 parity bits. The synchronisation signal α is 01101001100, the synchronisation signal β 10101000001.
The baudrate is normaly 100 bd with 500 Hz shift.

TWINPLEX

TWINPLEX is a FDM (4 frequency domain multiplex) synchrounus simplex 2 channel ARQ system using the CCIR 476 alphabet. Two channels of 3 characters are transmitted with 7 bit per character.

Cycle: 450 msec, 6 characters 210 msec transmitting, 240 msec pause

The transmission can be word, bit character or not interleaved. The four types of interleave are arranged as follows :

(in the following explanation letters refer to the character being sent, e.g normal SITOR would be ABC DEF GHI JKL and numbers refer to the bits of the letter, so if letter A was sent by normal SITOR it would be A1... A7, that means all are sent after the other). Big letters and small letters differentiate between the two channels :

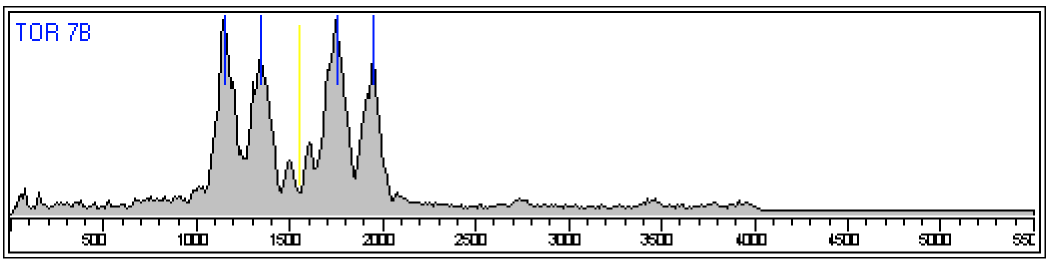
Word interleaved (W)	: ABC abc DEF def EFG efg GHI ghi.....
Bit interleaved (B)	: A1 a1 A2 a2 A3 a3 A4 a4 A5 a5 A6 a6 A7 a7
Character interleaved (C)	: A a B b C c D d E e F f G g H h I i....
not interleaved (N)	: ABC DEF GHI JKL MNO PQR STU.....

The four frequencies f1 to f4 can be sent in six basically different ways. This is leading to the different modes of TWINPLEX :

Mode	Ch1	Ch2
F7B - 1	BBYY	BYBY
F7B - 2	BBYY	BYYB
F7B - 3	BYBY	BBYY
F7B - 4	BYBY	BYYB
F7B - 5	BYYB	BBYY
F7B - 6	BYYB	BYBY

There are an infinite number of varations the sending station can set up the equipment to the audio tones generated for the four different frequencies. The following shifts between the four frequencies are possible and used :

Shift 1	Shift 2	Shift 3
85	85	85
115	170	115
200	400	200
100	170	100
170	170	170
200	200	200
300	300	300
300	600	300
170	340	170
115	400	515



VISEL

This system is working with 12 Bit and datarates of 120,96 or 81,3 Bd.
The shift is 300 Hz and the ITA-2 alphabet is used.

VFT

Voice Frequency Telegraphy

In radio telegraph communication there is often a need to simultaneously transmit several messages and data signals over one radio link. This is made possible by multiple utilization of voice-frequency channels between 0.3 and 3 KHz.
With the use of voice-frequency telegraph (VFT) system, these voice frequency channels can be split up into a number of narrow - band subchannels. This is called frequency division multiplex (FDM).
The messages in the individual channels are independent of each other, i.e. they can be transmitted at different bit data rates depending on the channel bandwidth.
Information from different channels can also be sequently interleaved during transmission by the time division multiplex (TDM) method. In order to retain the original bit rate, it is necessary to shorten the pulses on the transmission path. Thus, when two 50 Baud channels are combined, the modulation rate on the communication channel circuit is 100 Baud.

Maximal telegraph speed	Frequency shift	channel separation
50 Baud	60 / 70 Hz	120 Hz
100 Baud	80 / 85 Hz	170 Hz
100 Baud	120 Hz	240 Hz
200 Baud	170 Hz	360 Hz
200 Baud	220 Hz	480 Hz

Table : Typical parameters for VFT

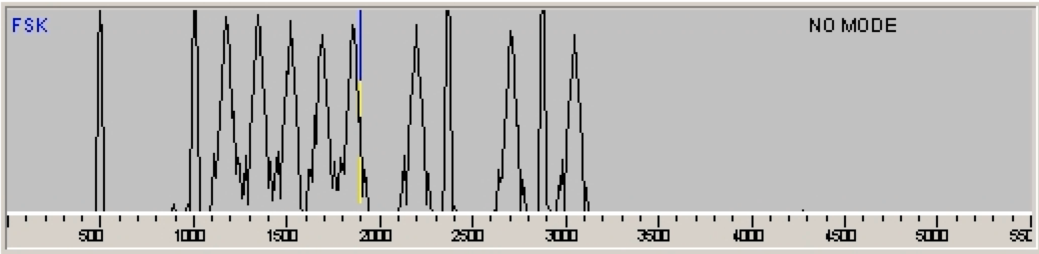
The following table shows the channel numbers and the corresponding center frequencies (in Hz) of VFT channels for different CCITT Recommendation :

CCITT No.	R.31 FM 120	R. 36 FM 120	R.37 FM 240	R.38A FM 480	R.38B FM 360	R.38B FM 360	R.39-1 FM 170	R.39-2 FM 120	FM 960
Chann el									
1	420	420	480	600	540	510	425	420	600
2	540	540	720	1080	900	850	595	540	1560
3	660	660	960	1560	1260	1190	765	660	2520
4	780	780	1200	2040	1620	1530	935	780	
5	900	900	1440	2520	1980	1870	1105	900	
6	1020	1020	1680	3000	2340	2210	1275	1020	
7	1140	1140	1920		2700	2550	1445	1140	
8	1260	1260	2160		3060	2890	1615	1260	
9	1380	a1 1560	2400				1785	1380	
10	1500	a2 2040	2640				1955	1500	
11	1620	17 2340	2880				2125	1620	
12	1740	18 2460	3120				2295	1740	
13	1860	b1 2640					2465	1860	
14	1980	b2 2880					2635	1980	
15	2100	b3 3120					2805	2100	
16	2220							2220	
17	2340							2340	
18	2460							2460	
19	2580							2580	
20	2700							2700	
21	2820								
22	2940								

CCITT No.	R.31 FM 120	R. 36 FM 120	R.37 FM 240	R.38A FM 480	R.38B FM 360	R.38B FM 360	R.39-1 FM 170	R.39-2 FM 120	FM 960
23	3060								
24	3180								

Table : Center frequencies in different VFT systems

Many stations do not transmit all channels given in the recommendation. In addition, particular channels may represent the pilot channel or carry the space frequency only.



Typical spectrum of a VFT signal

YUG 20-Tone Modem

This modem is using 20 tones each PSK modulated with a datarate of 75 Bd. The tone spacing is 110 Hz which results in a total bandwidth of 2240 Hz.

Other Systems on HF

DECCA

DECCA is the oldest navigation system which is using the hyperbolic calculation. It can be used by ships or planes up to a distance of 250 nautical miles.
The system is working on several frequencies from 70 to 128 kHz.This distribution of frequencies is necessary because DECCA is working with a continuous carrier.
The resolution is better than 0,1 nautical mile.
DECCA transmitters are collected to a system of one master transmitter and 3 secondary transmitters. These secondary transmitters are called slave red, slave green and slave purple.
All carriers are phase synchronous and derivated from one basic frequency.
The purple frequency is 5 times the basic frequency, the red frequency 8 times and green 9 times.
Additional there is the orange frequency, 8,2 times the basic frequency, on which all DECCA transmitters are activ. The master frequency is 6 times the basic frequency.

OMEGA

OMEGA is a radionavigation system which covers the whole world by use of 8 transmitters in Australia, Reunion, Japan, Hawaii, Liberia, Norway and USA.
The system is measuring the phase difference betwen signals received from various stations.
It is using frequencies in the range from 10 kHz to 14 kHz. Each station has it is own letter and the frequencies are distributed as following :

Norway	A	12,1 kHz
Liberia	B	12,0 kHz
Hawaii	C	11,8 kHz
USA, ND	D	13,1 kHz
Reunion	E	12,3 kHz
Argentinia	F	12,9 kHz
Australia	G	13,0 kHz
Japan	F	12,8 kHz

These stations are transmitting in a very precise frame on five different frequencies. Each station has its own frequency according the table above and all station are also transmitting in rotation on 10,2 khz, 11,05 kHz, 11,33 khz and 13,6 kHz.
With the help of the OMEGA system it is possible to take a position all over the world with an accuracy of around 4 nautical miles.

D-OMEGA

For a definition of the own position which is better than 4 nautical miles, for MMS is used the differential OMEGA. This system is used near harbours and the coast.
50 nautical miles around such OMEGA stations it is possible to navigate with an accuracy of 0,3 nautical miles and 500 natical miles around these station with an accuracy of 1 nautical mile.
This system is working on higher frequencies in the longwave range.

Russian ALPHA and LORAN-C System

In the former UDSSR parallel to the OMEGA and LORAN - C system a similar system for navigation was developed.
The ALPHA system is working with 3 transmitters on the frequencies 11,905 kHz, 12,649 kHz and 14,881 kHz.
The Russian LORAN - C is also working on frequencies nearby 100 kHz. At this time there are two systems active. They are so similar to the American system, that several manufacturer of navigational systems have developed an equipment which can receive both systems.

LORAN-C

LORAN is a navigation system used by ships and planes to accurately determine their position. It is hyperbolic navigation system which uses three to five transmitters. These transmitters are located several 100 miles on land.
LORAN transmits on a centre frequency of 100 kHz. The net has one master station and several secondary stations which are called W, X, Y and Z.
The transmission signal of the secondary stations are synchronised to the signal of the master station.
For navigation is measured the time difference between the master station and a minimum of two secondary stations. This measurement gives to every station a line of position. The crosspoint of several lines of position gives the location of the user.
Every LORAN - C net is transmitting group repetition intervals which is unique for this net. Every master has 10 ms and the secondary station 8 ms for his group transmission.
The minimum length of group of intervals is determinded by the number of stations.
The master station is transmiiting 8 pulses with a space of 1000us, additional a ninth pulse which follows after 2000 us behind the 8. pulse.

The secondary station is transmitting 8 pulses with a space of 1000 us. The ninth pulse gives the information, that the pulse group is transmitted by a master station. The pulse is also coded for internal informations.

The identification of the group repetition interval is a fixed length devided by ten. The following table gives the LORAN - C nets working in different areas :

GRI number	Location of LORAN - C net
9990	North Pacific
9970	North West Pacific
9960	USA North East Coast
9940	USA West Coast
8970	Great Lakes
7990	Mediterranean Sea
7980	USA South East Coast
7970	Norway Sea
7960	Gulf of Alaska
7930	North Atlantic
5990	Canadian Pacific Coast
5930	Canadian Atlantic Coast
4990	Central Pacific
9980	Iceland
8000	Russia West
8990	Saudi Arabia North
7170	Saudi Arabia South
8290	USA North
9610	USA South

7950	Russia East
5970	Asia East
6930	China
	India Bombay
	India Calcutta

Table : LORAN chains and their identification numbers

Time Signal Stations

On many Frequencies in the shortwave and longwave range a great number of stations transmitting time signals can be received.
These signals are used by many services like military, navigational and scientific purposes or other establishments.
The type of transmissions are different in every system. Some systems are transmitting BCD NRZ codes which contains the month, hour and minute like the time signal MSF of the national Physical Laboratory in Great Britain. Or they transmit different modulations on a CW carrier like the RUS station UPD 8 in Arkhangelsk.
Another possibility is the transmission of pulses per second with a fixed length.

All these time stations are using an atomic frequency standard which is regulating a high performance crystal oscillator.
Time corrections to UTC are made in step adjustments of 1 second. They are directed by the Buro International des Poids et Mesure. These adjustment ensure, that the boadcasted UTC signals never differ from UT 1 (time corrected with periodic variations) longer than 0,7 s.
The adjustment is made by inserting a leap second if necessary.This happens preferable at the end of a month like 31. of December or 30. of June. The corrected minute contains in this case 59 or 61 seconds depending on whether the correction must be positive or negative.
If a more exact time signal is needed the difference between UT 1 and UTC can be received by many time signal stations which transmit a DUT1 code in a coded format.

Stations which deliver this code are transmitting the first 1 to 15 seconds pulses of a minute twice or they transmit a sligthly longer or shorter pulse. If for example the pulses between the first and the 7th second are doubled the DUT 1 value is positive, if the pulses between the 8th and 15th second are doubled, it is a negative value.

Beacons

In the shortwave range a hugh amount of beacons are active. These beacons are working for different services :

Maritime mobile service (MMS):

MMS beacons, called phares, are working in a system of several beacons. They transmit a carrier and an identification callsign of 1 to 3 letters which is not according the regulations of ITU. These callsigns are short abbreveation for the location of the beacon.
They are used for navgation nearby the coast and are today the cheapest way to find the own position.

Areonatical mobile service (AMS):

A number of radio navigation aids are used for pilot guidance along airways and on approch and landing.
These aids are called non directional beacons (NDB).

NDB transmit 2 or 3 letters in morse code. On board the aircraft this callsign is received by a special navigational receiver.
The range of NDB`s is proportional to their power but the typical range is about 500 nautical miles over water and 150 nautical miles on land.

Amateur radio :

Amateurs have installed a great number of beacons to check the propagation to different areas of the world mainly in the higher frequency ranges.
Very interesting is the beacon system on 14100 kHz. These beacons are located in every continent and transmit in a fixed timing schedule. During the transmission the transmitting

Power is decreased in steps from 100 W to 10 W to 1 W to 100 mW. This gives a very sensitve prediction about the propagation. The foolowing table gives an overview of all beacons and their locations:

Slot	**Country**	**Call**	**Location**	Latitude	Longitude
1	United Nations	4U1UN	New York City	40º 45' N	73º 58' W
2	Canada	VE8AT	Eureka, Nunavut	79º 59' N	85º 57' W
3	United States	W6WX	Mt. Umunhum	37º 09' N	121º 54' W
4	Hawaii	KH6WO	Laie	21º 38' N	157º 55' W
5	New Zealand	ZL6B	Masterton	41º 03' S	175º 36' E
6	Australia	VK6RBP	Rolystone	32º 06' S	116º 03' E
7	Japan	JA2IGY	Mt. Asama	34º 27' N	136º 47' E
8	Russia	RR9O	Novosibirsk	54º 59' N	82º 54' E
9	Hong Kong	VR2B	Hong Kong	22º 16' N	114º 09' E
10	Sri Lanka	4S7B	Colombo	6º 54' N	79º 52' E
11	South Africa	ZS6DN	Pretoria	25º 54' S	28º 16' E
12	Kenya	5Z4B	Kiambu	1º 01' S	37º 03' E
13	Israel	4X6TU	Tel Aviv	32º 03' N	34º 46' E
14	Finland	OH2B	Karkkila	60º 32' N	24º 06' E
15	Madeira	CS3B	Santo da Serra	32º 43' N	16º 48' W
16	Argentina	LU4AA	Buenos Aires	34º 37' S	58º 21' W
17	Peru	OA4B	Lima	12º 04' S	76º 57' W
18	Venezuela	YV5B	Caracas	10º 25' N	66º 51' W

The beacons are operating in the following time schedule:

Call	**Location**	**14.100**	**18.110**	**21.150**	**24.930**	**28.200**
4U1UN	United Nations	00:00	00:10	00:20	00:30	00:40
VE8AT	Canada	00:10	00:20	00:30	00:40	00:50
W6WX	United States	00:20	00:30	00:40	00:50	01:00
KH6WO	Hawaii	00:30	OFF	00:50	OFF	01:10
ZL6B	New Zealand	00:40	00:50	01:00	01:10	01:20
VK6RBP	Australia	00:50	01:00	01:10	01:20	01:30
JA2IGY	Japan	01:00	01:10	01:20	01:30	01:40
RR9O	Russia	01:10	01:20	01:30	01:40	01:50
VR2B	Hong Kong	01:20	01:30	01:40	01:50	02:00
4S7B	Sri Lanka	OFF	OFF	OFF	OFF	OFF
ZS6DN	South Africa	01:40	01:50	02:00	02:10	02:20
5Z4B	Kenya	OFF	OFF	OFF	OFF	OFF
4X6TU	Israel	02:00	02:10	02:20	02:30	02:40
OH2B	Finland	02:10	02:20	02:30	02:40	02:50
CS3B	Madeira	02:20	02:30	02:40	02:50	00:00
LU4AA	Argentina	02:30	02:40	02:50	00:00	00:10
OA4B	Peru	02:40	02:50	00:00	00:10	00:20
YV5B	Venezuela	02:50	00:00	00:10	00:20	00:30

Single letter beacons:
(Russian Single-Letter Channel Markers)

On several frequencies these so-called SLB can be heard transmitting only one letter. They are orginating from Russia and have a function as channel marker.
On the same frequency sometimes data transmissions can be heard.

All of these markers are CW, continuous wave, standard on-off keyed Morse, but a few used to be frequency-shift keyed with a wide shift. These markers occurred in closely spaced groups, typically 0.5 or 0.1 kHz apart, called the "cluster beacons".

The Russian navy is suspected as the source, and the following locations have been identified :

C	Moscow
F	Vladivostok
K	Sakhalin?
L	St. Petersburg
P	Kaliningrad
R	Ustinov
S	Arkhangelsk
V	Tashkent

NAVTEX

Over the NAVTEX system navigational and meteorological warnings and other important imformations are transmitted.
This is a part of the Maritime Safety Information (MSI) net which is part of the Global Maritime Distress and Safety System (GMDSS).
These information are transmitted on 518 kHz by selected coast stations in SITOR B. This time shared service is designed for a distance of 400 nautical miles around the coast station.

For differentiation the following identifications are used :

A	: navigational warnings
B	: meteorological warnings
C	: ice messages
D	: search and rescue information
E	: meteorological forecast
F	: pilot message
G	: information about DECCA
H	: information about LORAN - C
I	: information about OMEGA
J	: information about SATNAV
K	: information about other navigational systems
L	: navigational warnings
Z	: QRU

NAVTEX messages are started with an identification group which has the following meaning:

1. identification letter of radio station
2. identifation for message type
3. and 4. message number 01 to 99, 00 is used for emerency messages.

Chirpsounder

The Tactical Frequency Management System offers a two-fold approach to improving greatly the quality and constant reliablity of hf circuits by giving the operator instrumentation which continuously measures and displays the best frequency for communication as conditions change.

The three components of the system are a

- Spectrum monitor
- Chirpsounder transmitter
- Chirpsounder receiver

The spectrum monitor is an HF receiver, processor and display system which presents HF spectrum occupancy information in a convenient, comprehensive manner.
It scans the entire HF spectrum in fixed intervals and compiles and continuously update occupancy statistics (histograms) in 5- and 30- minute time blocks.
The parameter measured is which, if any, of four amplitude thresholds (i.e. 10 dB apart) have been crossed in each of the channels.

The receiver gain is automatically adjusted to make the lowest amplitude threshold of each Mhz segment correspond to slightly above the atmospheric noise level. A digital readout of the threshold value (in dBm) appears on the CRT.
These systems have been designed especially for use in locating clear channels within larger frequency bands. Features which contribute to simple and rapid operation include a digital readout of centre frequency on the CRT spectrum data display and controls to increase or decrease continously the displayed centre frequency. The centre frequency can be slipped across the CRT at a fast or slow rate, or in one-channel-at-a-time steps.

Possible Technical Specification :

Modes: Monitoring of indicated centre frequency with internal speaker or headphones; selectable USB,LSB,AM or FM

Frequency Range:
2-16 Mhz
2-13 Mhz
2-26 Mhz
2-30 Mhz

Number of frequencies (channels) analysed:	9333
Channel spacing:	3kHz
Analysis B/W (3 dB):	6 kHz max
Sweep rates :	50 kHz/s or 100 kHz/s

The Chirpsounder transmitter is the transmit terminal of the system.
Transmitting simultaneously with the communications transmitters on a single antenna (Diplexed version), a measurement of path loss and multipath is made which takes into account antenna patterns as well as propagation characteristics. Using the widely accepted FM/CW technique, the transmitter transmits a sweep through the HF spectrum in synchronism with a remotely located Chirpsounder receiver.
Received signal power and multi-path conditions are displayed on the receiver in an easily understood manner.

Negligible interference to other spectrum users is assured by low power, -55 dB harmonic and spurious levels, and provision to inhibit transmission on up to 16 channels. The system operates unattended except for initial time synchronisation with the receiver, which is simple.
The Chirpsounder receiver provides realtime measurement, sweeping through the HF spectrum in synchronism with a Chirpsounder transmitter and displaying incoming signal
strength and multi-path as functions of radio frequency. From the display of the receiver the operator obtains received signal amplitude and multi-path versus frequency, from which channel-to-channel trade-offs are readily determined. It stores and displays data from seperate, remotely located Chirpsounder transmitters.

Chirpcomm:

Chirpcomm is an 'add-on' feature which enables short messages of prime importance (38 characters, maximum) to be carried via HF radio on (Chirpsounder) systems.
Chirpcomm also enables message receipients to identify the sending transmitter.
The message (plus an identifier) is sent a total of 77 times during the 4 minutes and 40 second frequency sweep (from 2 to 16 or from 2 to 30 MHz).
This provides a high probability that an entire message will be received error-free even under difficult propagation conditions.

VHF Modes

ACARS

ACARS Category A&B / SITA according to ARINC 597

ACARS is a 2400 bps PSK packet-like system used by Civilian Aircraft for onboard flight-deck computer interconnections into ground stations. As with all high-speed PSK systems, subsequent demodulation is very sensitive to inter-symbol interference. Your receiver's AGC characteristic may mean that its if will overload at the beginning of a transmission, just when the preamble is being sent, it may also be that the Squelch does not open fast enough to pass all of the preamble through to the audio stages in time. For these reasons, if all packets are not being decoded properly, check the start preamble is complete and undistorted on your receiver set-up.

ATIS

Automatic Transmitter Identification System

ATIS is used in the VHF radio systems on some river of Netherlands, Germany, and Switzerland, This system generates automatically the identification signal at the end of each period of speech transmission. The ATIS signal is required to be transmitted at least once every five minutes in case of lengthy transmissions. The ATIS sequence consists of the country identifier and a four digit callsign.

ATIS conforms to the CCITT Recommendation 493-3. ATIS signal sequence is transmitted using the FSK with space and mark frequencies of 1300 Hz and 2100 Hz and a modulation rate of 1200 Baud. The higher frequency corresponds to the 0 of the signal and the lower to the 1.

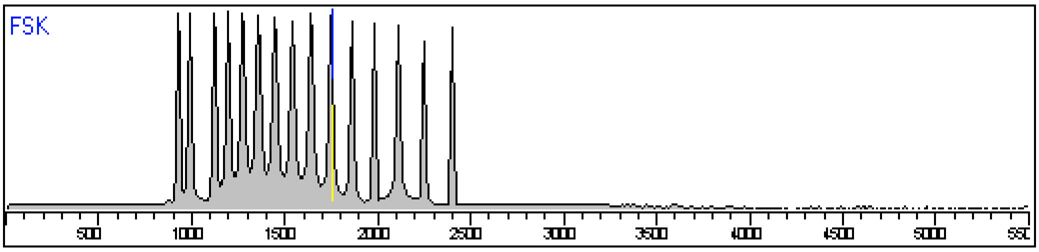
All sequences are transmitted twice (DX and RX positions). A 10-bit error code is used in this synchronous system.

CCIR-1

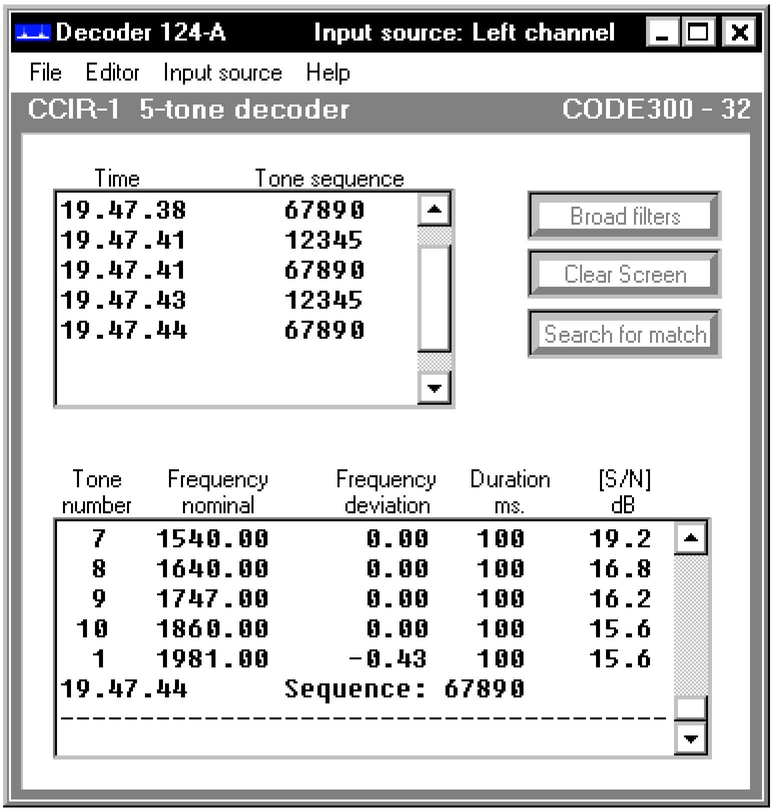
Comite Consultatif International De Radio Recommendation 1

This module is fully compliant with Comite Consultatif International De Radio Recommendation 1 for VHF SELCAL. Each frequency is transmitted with a duration of 100mS according to the following table:

1	2	3	4	5	6	7	8
1124	1197	1275	1358	1446	1540	1640	1747
9	0	A	B	C	D	E	
1860	1981	2400	930	2247	991	2110	



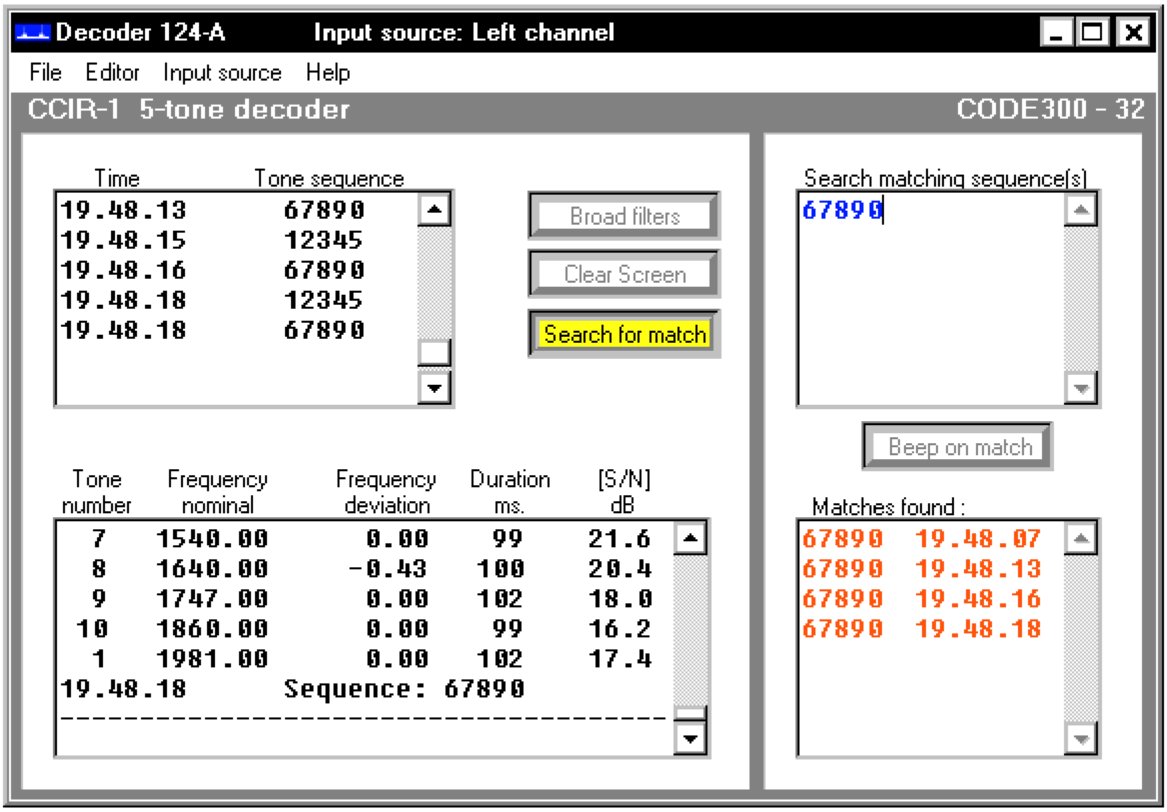
CCIR-1 signal



Two decode windows are provided.
The first decode window is an accurate analysis of the parameters of the Selcal signal sequence. The Date/Time stamp is followed by the actual tone channel number received, its nominal measured frequency, its frequency error, its duration in milliseconds and its measured signal to noise ratio. Finally the decoded tone sequence is displayed.

The second small window merely displays the decoded tone sequence, system name (in this case CCIR1), and the date/time stamp.

When replaying tape recordings it is useful to be able to widen the bandwidth of the tone filters. Press Broad Filter button to select either Narrow or Broad filter bandwidths. Please bear in mind the problems with tape speed variation when using analogue recordings!



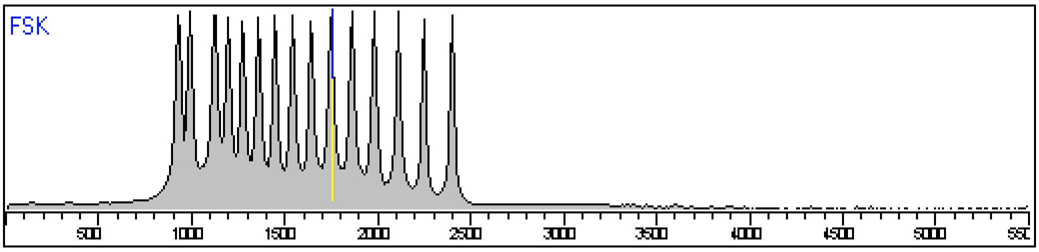
The two additional search windows are opened if the search function is requested. In the upper window you can insert the sequence you are looking for. In case this sequence is detected, the lower right screen shows the sequence together with a time stamp.

CCIR-2

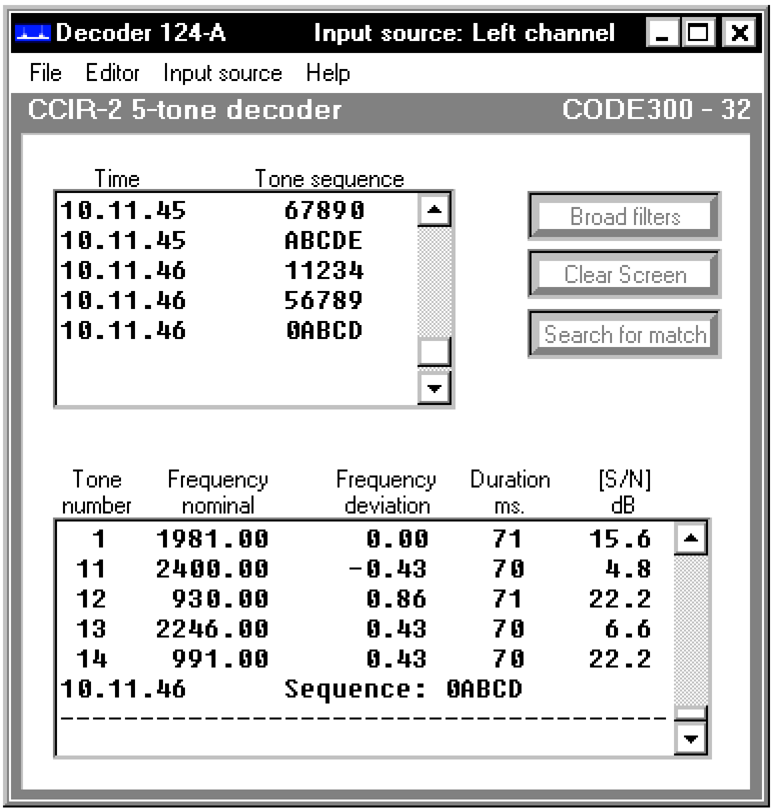
Comite Consultatif International De Radio Recommendation 7

This module is fully compliant with Comite Consultatif International De Radio recommendation 2 for VHF SELCAL. Each frequency is transmitted with a duration of 70mS according to the following table:

1	2	3	4	5	6	7	8
1124	1197	1275	1358	1446	1540	1640	1747
9	0	A	B	C	D	E	
1860	1981	2400	930	2247	991	2110	



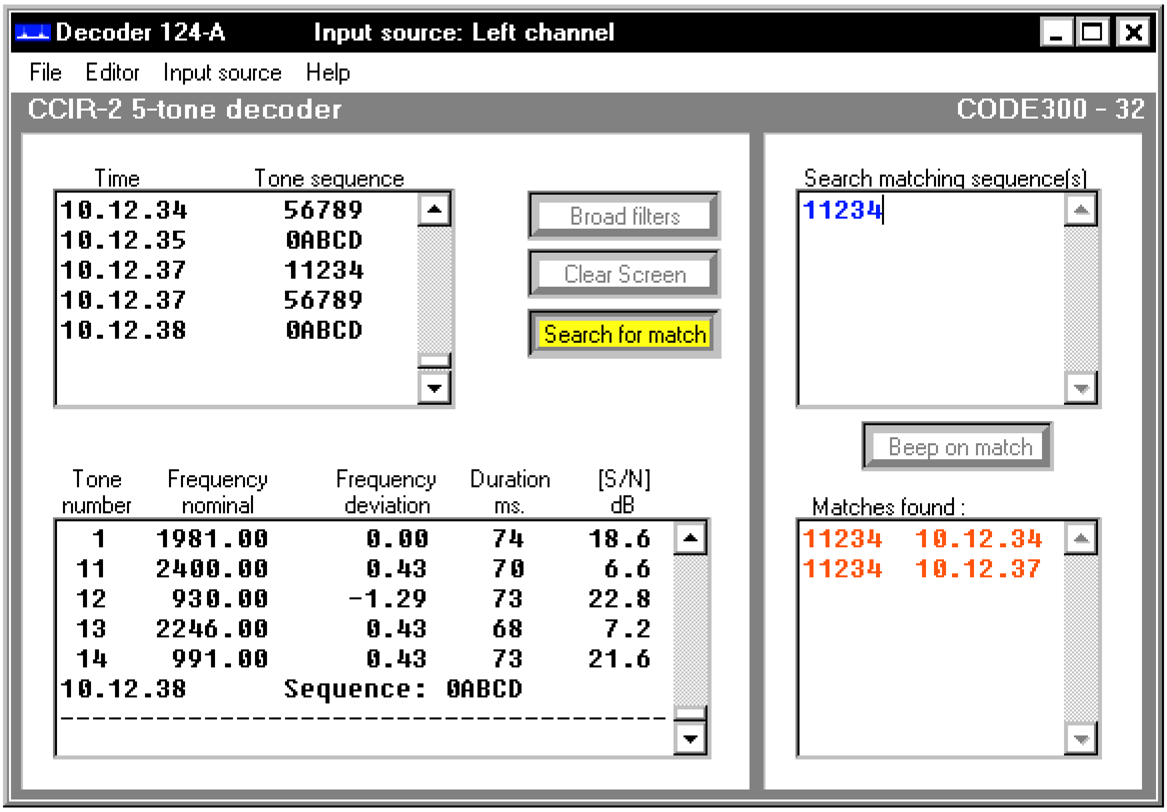
CCIR-2 signal



Two decode windows are provided.
The first decode window is an accurate analysis of the parameters of the Selcal signal sequence. The Date/Time stamp is followed by the actual tone channel number received, its nominal measured frequency, its frequency error, its duration in milliseconds and its measured signal to noise ratio. Finally the decoded tone sequence is displayed.

The second small window merely displays the decoded tone sequence, system name (in this case CCIR2), and the date/time stamp.

When replaying tape recordings it is useful to be able to widen the bandwidth of the tone filters. Press Broad Filter button to select either Narrow or Broad filter bandwidths. Please bear in mind the problems with tape speed variation when using analogue recordings!



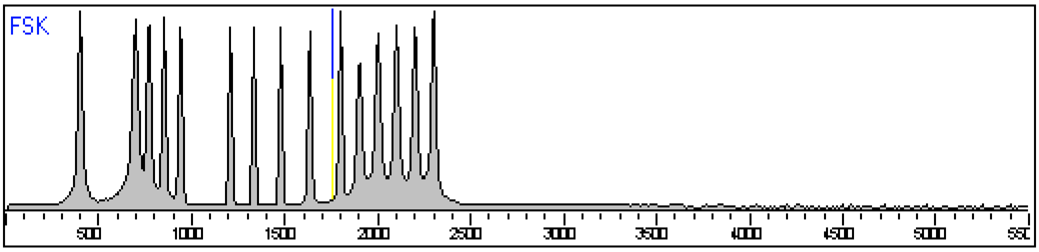
The two additional search windows are opened if the search function is requested. In the upper window you can insert the sequence you are looking for. In case this sequence is detected, the lower right screen shows the sequence together with a time stamp.

CCITT

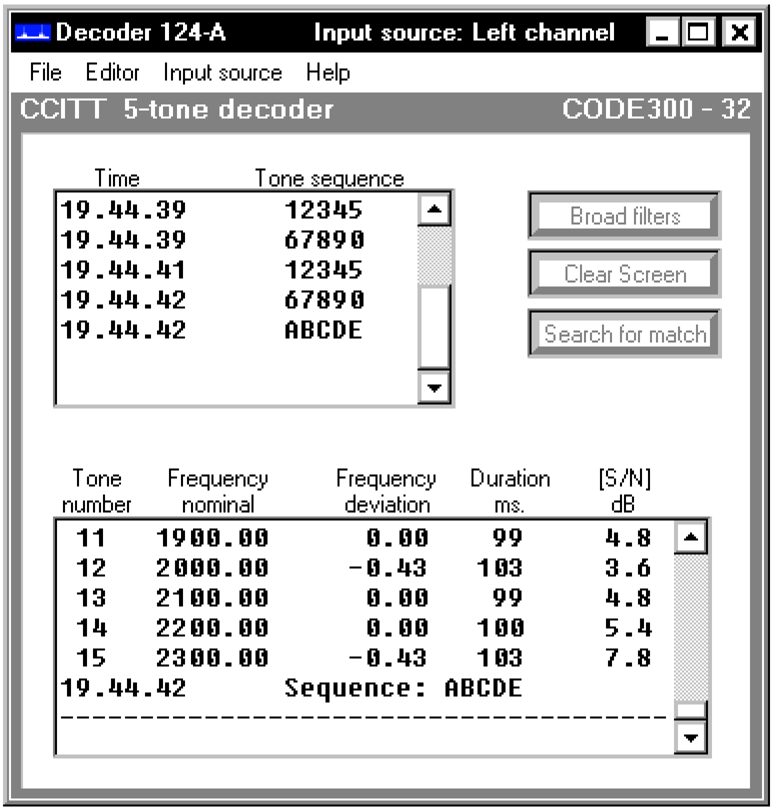
Committee Consultative International Telegraph and Telephone

This module is fully compliant with the CCITT recommendations for VHF SELCAL. Each frequency is transmitted with a duration of 100mS according to the following table:

1	2	3	4	5	6	7	8
697	770	852	941	1209	1335	1477	1633
9	0	A	B	C	D	E	
1800	400	1900	2000	2100	2200	2300	



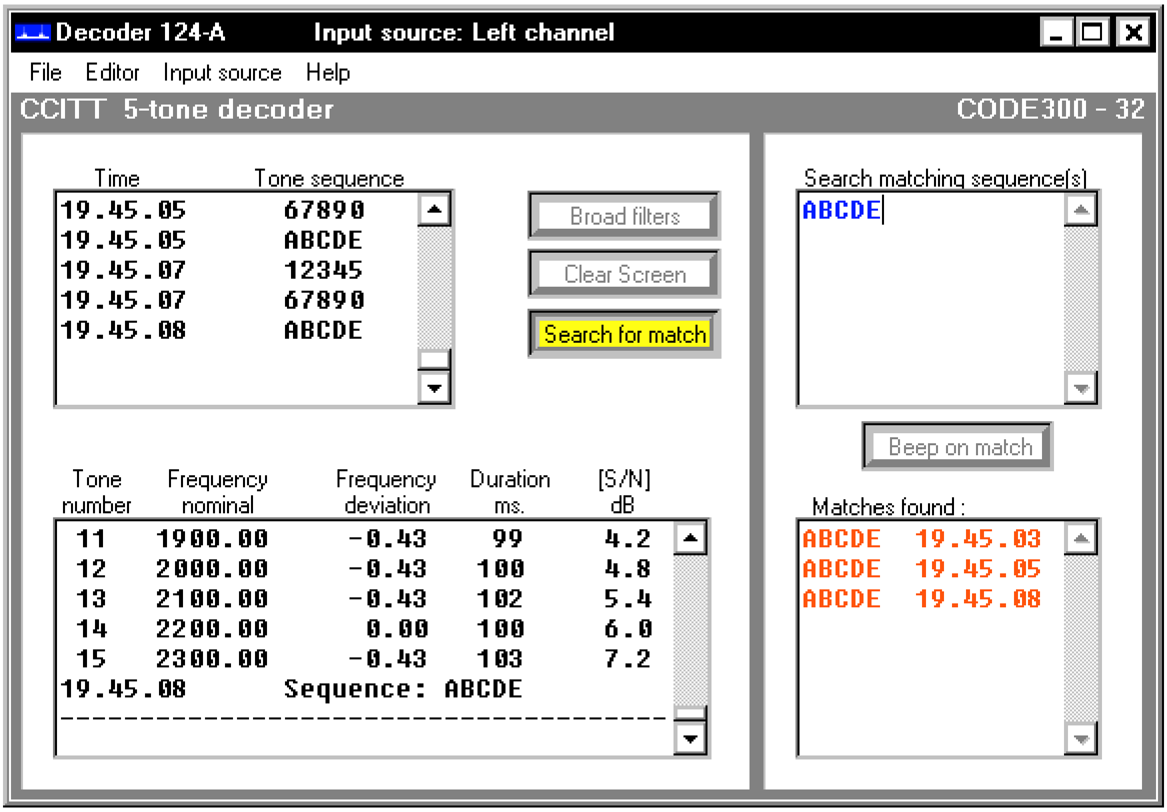
CCITT signal



Two decode windows are provided.
The first decode window is an accurate analysis of the parameters of the Selcal signal sequence. The Date/Time stamp is followed by the actual tone channel number received, its nominal measured frequency, its frequency error, its duration in milliseconds and its measured signal to noise ratio. Finally the decoded tone sequence is displayed.

The second small window merely displays the decoded tone sequence, system name (in this case CCITT), and the date/time stamp.

When replaying tape recordings it is useful to be able to widen the bandwidth of the tone filters. Press Broad Filter button to select either Narrow or Broad filter bandwidths. Please bear in mind the problems with tape speed variation when using analogue recordings!



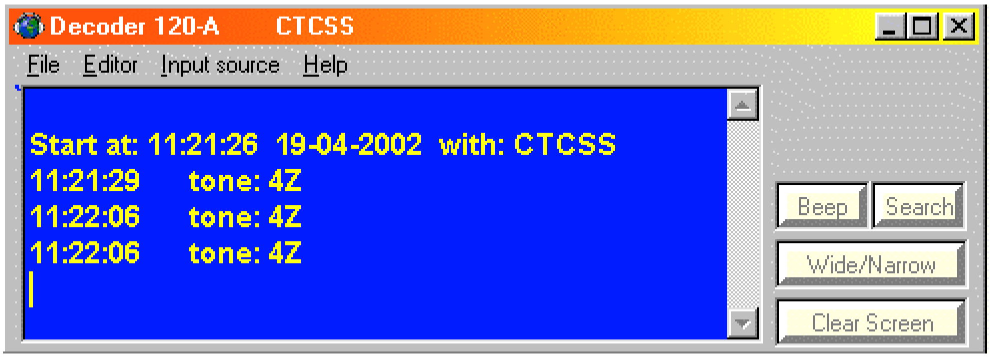
The two additional search windows are opened if the search function is requested. In the upper window you can insert the sequence you are looking for. In case this sequence is detected, the lower right screen shows the sequence together with a time stamp.

CTCSS

Continuous Tone Controlled Signalling System / MPT1306 / PL

CTCSS ‘continuous tone controlled signalling system’ defines a system in which the radio equipment is fitted with devices that at the transmitter generate a specified continuous tone during transmission and at the receiver respond to a specific continuous tone.

Tone	Grp	Tone	Grp	Tone	Grp	Tone	Grp
67.0	A	110.9	B	146.2	B	192.8	B
71.9	B	114.8	A	151.4	A	203.5	A
77.0	A	118.8	B	156.7	B	210.7	B
82.5	B	123.0	A	162.2	A	218.1	A
88.5	A	127.3	B	167.9	B	225.7	B
94.8	B	131.8	A	173.8	A	233.6	A
103.5	B	136.5	B	179.9	B	241.8	B
107.2	A	141.3	A	186.2	A	250.3	A



A typical CTCSS screenshot

DCSS

Digitally Coded Squelch Signalling System / MPT1381

DCS ‘Digital Coded Squelch’ defines a system in which the radio equipment is fitted with devices that at the transmitter generate a specified digital coded signal during transmission and the receiver respond to a specific digital coded signal.

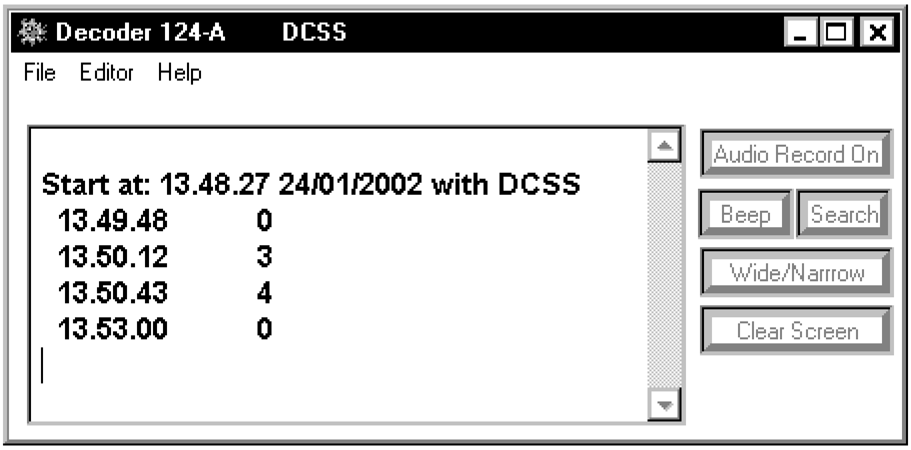
The DCS codeword is a specific digitally coded signal transmitted continuously on the carrier frequency. The DCS codeword consists of a 23-bit frame that is transmitted at 134.4 bit/s. The codeword is generated from a (23,12) cyclic Golay code and consists of the basic components:

1	9	10	12	13	23
9 data bits		3 fixed bits		11 check bits	

Bits 1 to 9 are the originating DCS code and are normally expressed as a 3 digit octal (base 8) number (where bit 1 is the least significant bit).
Bits 10 to 12 are fixed at 0012.
Bits 13 to 23 are the check bits generated by the Golay algorithm.

Bit 1 is transmitted first.

Group 1	3 contiguous bits: lowest frequency 22.33 Hz	Code 212 to 431
Group 2	4 contiguous bits: lowest frequency 16.75 Hz	Code 114 to 654
Group 3	5 contiguous bits: lowest frequency 13.40 Hz	Code 043 to 624
Group 4	6 contiguous bits: lowest frequency 11.17 Hz	Code 023 to 036

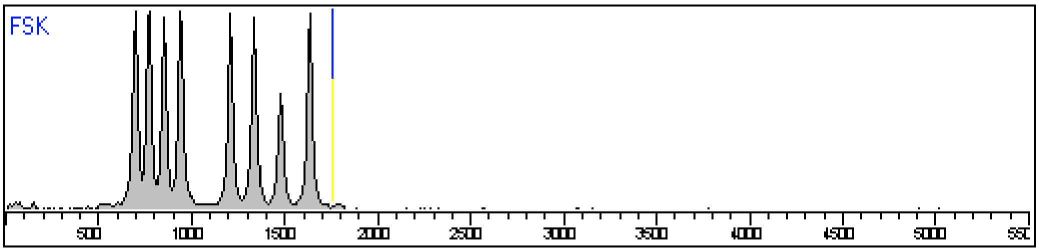


DTMF

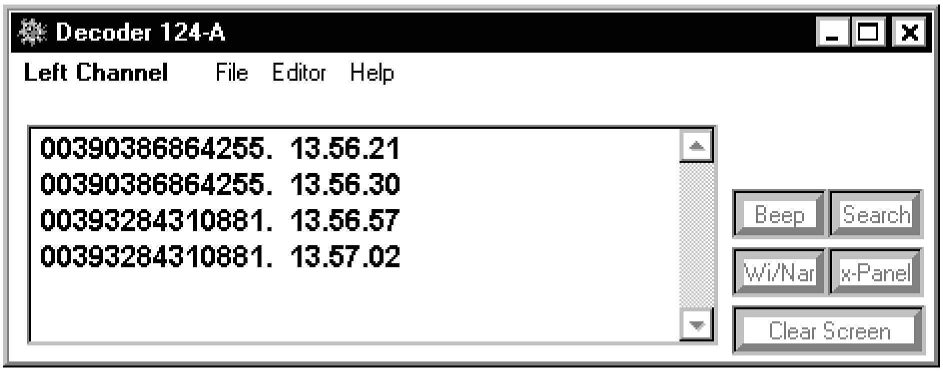
VHF Signalling system usually used for sending the required digits to be dialled on a telephone system.

The tone system is as follows:

T1/T2 Hz	1208	1336	1477	1633
697	1	2	3	A
770	4	5	6	B
852	7	8	9	C
941	*	0	#	D



The first column is the low frequency channel number (697 to 941Hz), the second column is the low channel frequency error, the third column is the high frequency channel number (1208 to 1633Hz) and finally the fourth column is its frequency error. A Date/Time stamp is added at the end of each sequence of tones.

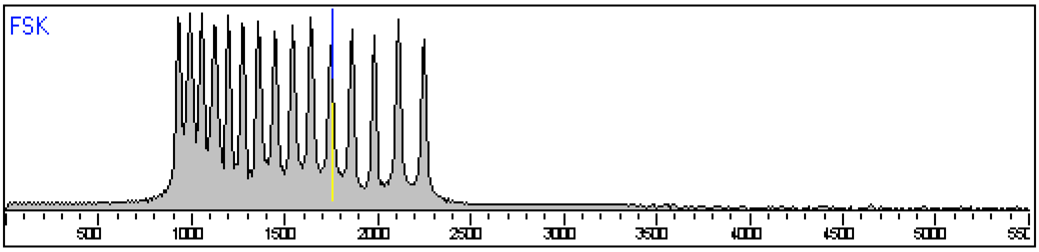


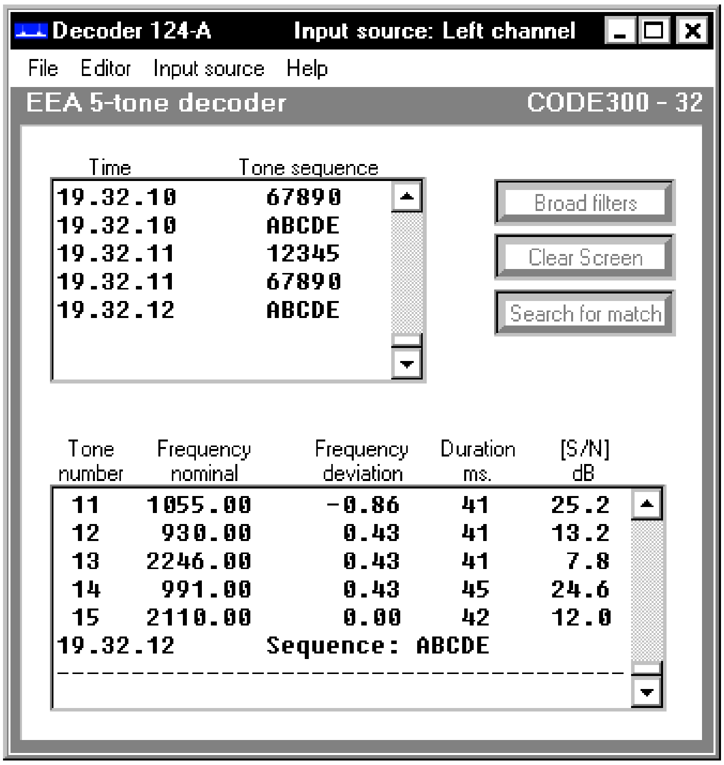
EEA

Electronic Engineering Association recommendations for VHF SELCAL / MPT1316

This module is fully compliant with the Electronic Engineering Association recommendations for VHF SELCAL. (See MPT1316). Each frequency is transmitted with a duration of 40mS according to the following table.

1	2	3	4	5	6	7	8
1124	1197	1275	1358	1446	1540	1640	1747
9	0	Group	Repeat				
1860	1981	1055	2110				

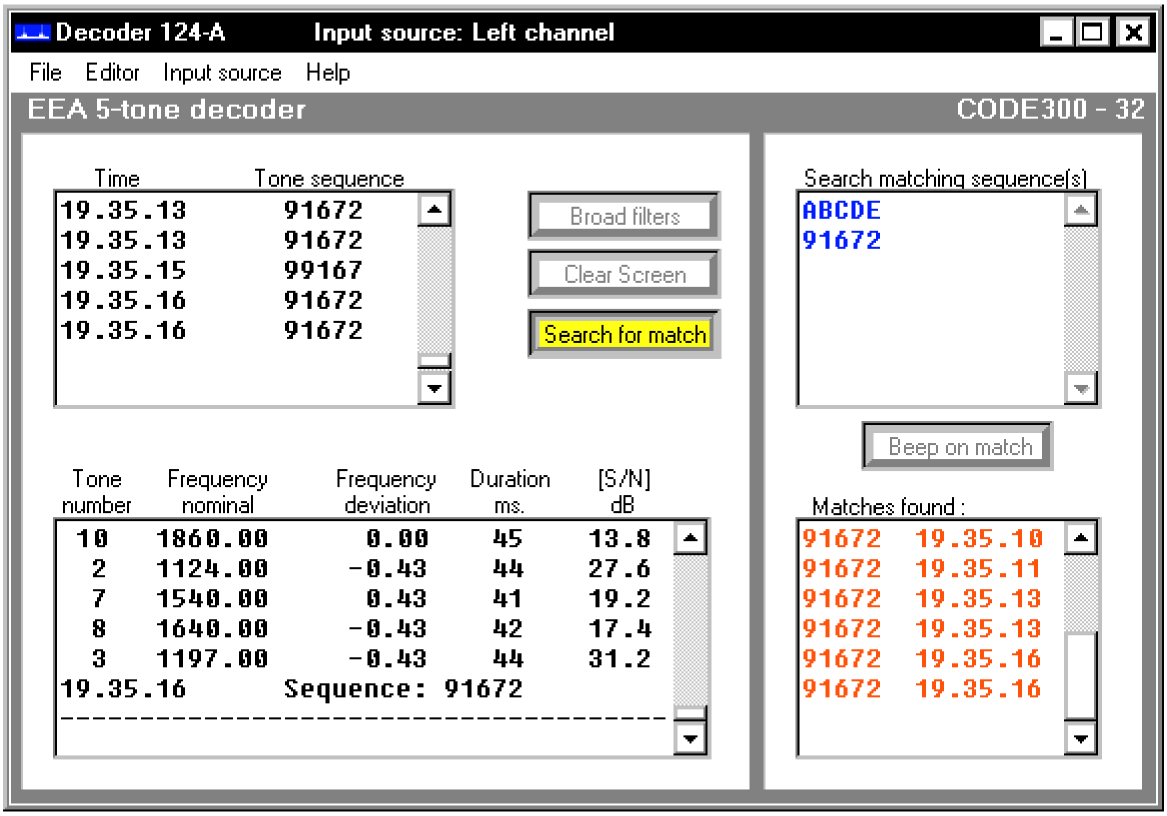




Two decode windows are provided.
The first decode window is an accurate analysis of the parameters of the Selcal signal sequence. The Date/Time stamp is followed by the actual tone channel number received, its nominal measured frequency, its frequency error, its duration in milliseconds and its measured signal to noise ratio. Finally the decoded tone sequence is displayed.

The second small window merely displays the decoded tone sequence, system name (in this case EEA), and the date/time stamp.

When replaying tape recordings it is useful to be able to widen the bandwidth of the tone filters. Press Broad Filter button to select either Narrow or Broad filter bandwidths. Please bear in mind the problems with tape speed variation when using analogue recordings!



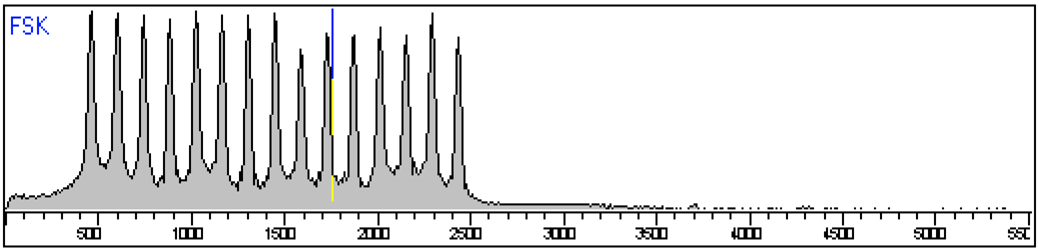
The two additional search windows are opened if the search function is requested. In the upper window you can insert the sequence you are looking for. In case this sequence is detected, the lower right screen shows the sequence together with a time stamp.

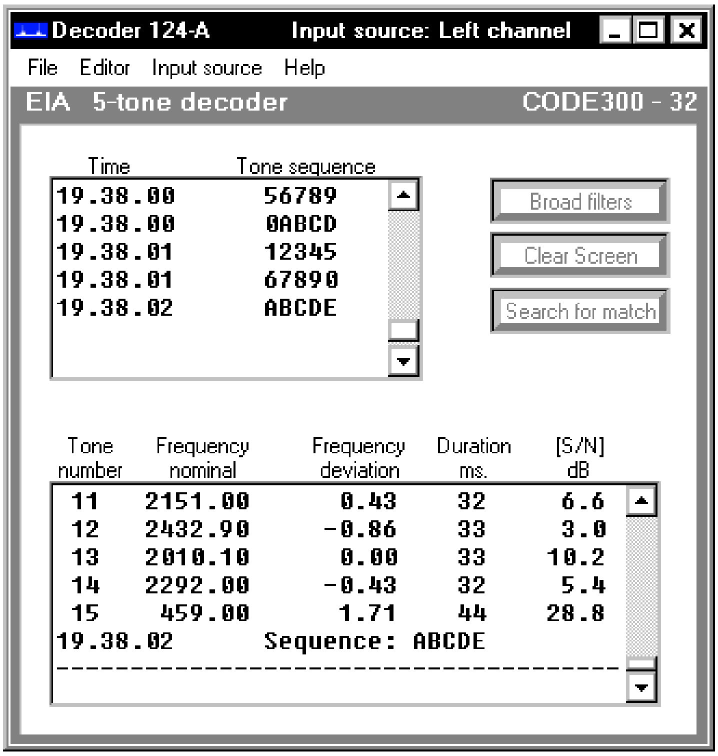
EIA

Electronic Engineering Association recommendations for VHF SELCAL

This module is fully compliant with the American Electronics Industries Association recommendations for VHF SELCAL. Each frequency is transmitted with a duration of 33mS according to the following table:

1	2	3	4	5	6	7	8
741	882	1023	1164	1305	1446	1587	1728
9	0	A	B	Group	D	Repeat	
1869	600	2151	2433	2010	2292	459	

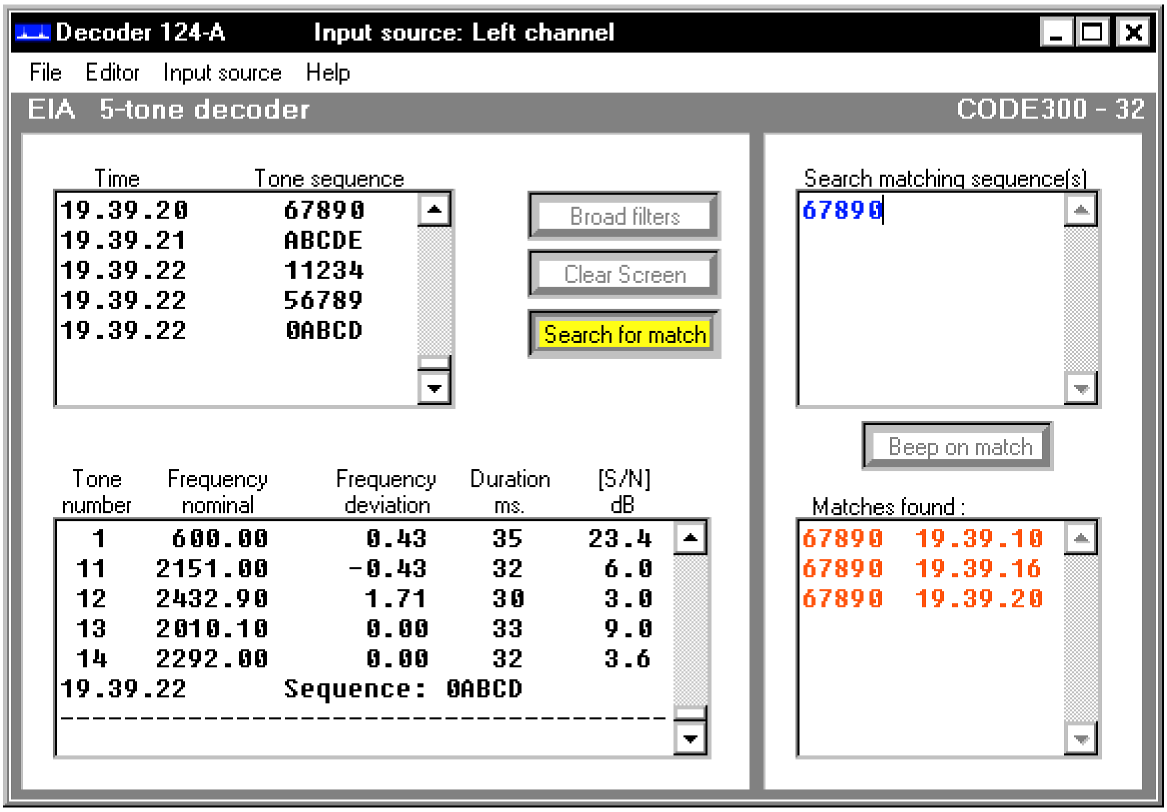




Two decode windows are provided.
The first decode window is an accurate analysis of the parameters of the Selcal signal sequence. The Date/Time stamp is followed by the actual tone channel number received, its nominal measured frequency, its frequency error, its duration in milliseconds and its measured signal to noise ratio. Finally the decoded tone sequence is displayed.

The second small window merely displays the decoded tone sequence, system name (in this case EIA), and the date/time stamp.

When replaying tape recordings it is useful to be able to widen the bandwidth of the tone filters. Press Broad Filter button to select either Narrow or Broad filter bandwidths. Please bear in mind the problems with tape speed variation when using analogue recordings!



The two additional search windows are opened if the search function is requested. In the upper window you can insert the sequence you are looking for. In case this sequence is detected, the lower right screen shows the sequence together with a time stamp.

EPIRB

Emergency Position Indicating Radio Beacon

EPIRB stands for **E**mergency **P**osition **I**ndicating **R**adio **B**eacon used in the Inmarsat E system on 1646 MHZ which is a float-free, automatically activated EPIRB.

It is detectable by Inmarsat geostationary satellite and recognized by GMDSS. This system is using FSK with 240 Hz shift, NRZ G2B) and a datarate of 32 Bd or 160 bit/s. The system is using 667 channels, 300 Hz spacing from 1,645 GHz on.

Inmarsat EPIRBs are equipped with a built-in GPS receiver because, due to the missing satellite movement, no Doppler estimation can be performed. Inmarsat EPIRBs transmit the position in case of an emergency as part of the message. Inmarsat EPIRBs do not need programming because they transmit a unique system code. The identity of the user is assigned by completing a form on purchase of the beacon and sending it to Inmarsat by fax at no extra cost compared to programming a beacon.
Inmarsat EPIRBs are also the first EPIRBs to comply to new IMO recom-mendations that include several features against false alarms. For example there is a two minute period after activation where an audible alarm will be generated by the EPIRB to give the user the last chance to deactivate the beacon. After this two minute period the beacon transmits via the geostationary Inmarsat satellites with no additional delay.
Inmarsat EPIRBs transmit the type of emergency, if the ships sinks and the beacon is released from the float free cradle “sinking” will be transmitted. If the beacon is activated manually then “unspecified distress” will be transmitted as the type of emergency.
Inmarsat EPIRBs may also be extended with a remote control unit (RCU) that allows for manual input of the type of emergency (IMO codes).

ERMES

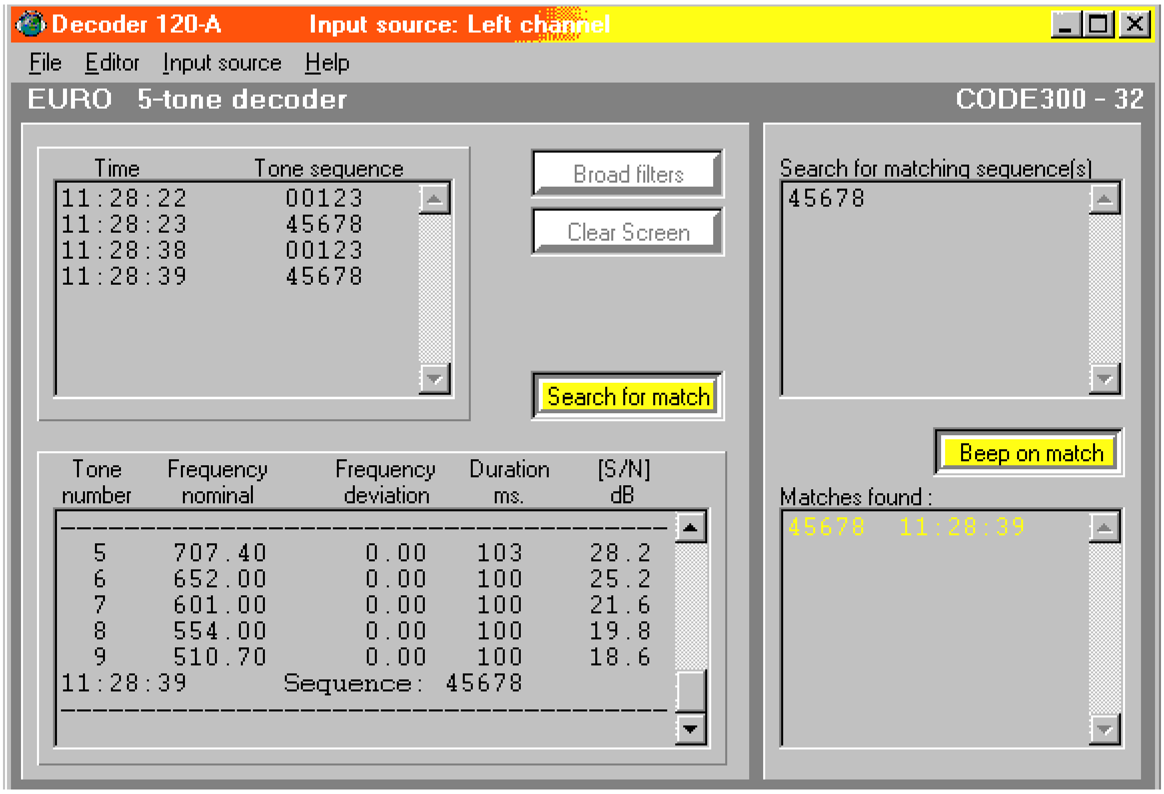
Latest Pan-European Messaging Pager system, originally conceived in 1990 by ETSI (European Telecommunications Standards Institute). System uses a 4-frequency twinplex format at 6250 bps.

As with POCSAG, this system needs a direct output from the FM discriminator. Specifications are that there should be a DC coupling between the discriminator of the monitor receiver and the input to the sound card. However the detector in this module has been specially modified to allow for some high-pass filtering, but for best performance this should be kept at a minimum.

EURO

This module is fully compliant with the EURO recommendations for VHF SELCAL. Each frequency is transmitted with a duration of 100mS according to the following table:

1	2	3	4	5	6	7	8
903	833	767	707	652	601	554	511
9	0	A	B	C	D	Repeat	
471	980	434	400	369	1153	1063	



FLEX

Reflex / Flex / Flexible wide area paging protocol

FLEX operates as either a four level code or a two level code. The concept of a four level code is not new, as other protocols have utilised four level transmission for quite some time. The modulation range of FLEX is plus and minus forty-eight hundred kilohertz of deviation. FLEX's four levels are defined as -4,800 hertz, -1,600 hertz, +1,600 hertz, and +4,800 hertz (referencing the operating frequency). Each level represents two bits in a given transmission. They represent `00', `01', `11', and `10' respectively. Additionally, FLEX will adjust its bit rate based upon the channel loading. It can operate at 1,600, 3,200, and 6,400 bits per second. During times of peak traffic, FLEX will adjust its operating speed to the maximum bit rate of 6,400. During times of low traffic (such as the early morning hours), the bit rate will be adjusted to the minimum speed of 1,600 bits per second. During times of moderate traffic, the bit rate of 3,200 will be used. Additionally, FLEX can switch between four level and two level operation as needed.
The advantages of these flexibility's are to improve paging quality during times of low or reduced activity and increase channel capacity during times of high traffic. This allows maximum optimisation of the medium as a function of loading. Tolerance for errors in transmission is quite good considering that FLEX allows a quarter period error of the pulse duration. At a bit rate of 6,400 bits per second, FLEX will not miss a character during a fade of ten milliseconds or less.
This module does not need any further manual settings, baud speed and level are selected automatically.

Example of a FLEX message, CAP no 2009090 is monitored and each message with this CAP no. will be shown in the lower part of the screen.
(Simply type a requested CAP no into the ' MONITOR CAP' field…)

FMS BOS

Funkmeldesystem für Behörden und Organisationen mit Sicherheitsaufgaben

FMS BOS is a German system which stands for Funkmeldesystem fur Behörden und Organisationen mit Sicherheitsaufgaben, which translates as Radio Communications System for Security Authorities and Organisations.

System consists of 48 bit blocks at 1200 bps. Each 48-bit block is sub-divided into 6 parameters consisting of BOS-ID, Country-code, Trunk-code, vehicle-id and status.

FSK 441

FSK441 is designed for high speed meteor scatter communication using short pings of signals reflected from the ionized trails of meteors about 100 km above the earth's surface.
Such pings are typically a few dB above the receiver noise and may last from ten to a few hundred milliseconds.

FSK441 uses Frequency Shift Keying at a baud rate of 441 Hz. Four distinct tones are used, namely 882, 1323, 1764, and 2205 Hz. Each encoded character uses three tone intervals and therefore requires 3/441 seconds (approx. 2.3 ms) for its transmission. FSK441 accommodates a potential "alphabet" of 48 characters. The present encoding scheme uses 43 of these characters, the same ones used in the PUA-43 alphabet.

The present encoding of each character is defined in the table below.
The four tones are 0-3 for the tones 882 through 2205 Hz, in increasing order. The four possible "single-tone" encodings, namely 000, 111, 222, and 333, are reserved in WSJT for special use as shorthand messages. (These characters sent repeatedly amount to pure single-frequency carriers, and their pings are easily recognized by the software and by the human ear.) The present definition of the shorthand messages is respectively "R26", "R27", "RRR", and "73".

Character Number	Tones	Character	Character Number	Tones	Character
0	000	Reserved	24	120	H
1	001	1	25	121	I
2	002	2	26	122	J
3	003	3	27	123	K
4	010	4	28	130	L
5	011	5	29	131	M
6	012	6	30	132	N
7	013	7	31	133	O
8	020	8	32	200	P
9	021	9	33	201	Q
10	022	.	34	202	R
11	023	,	35	203	S
12	030	?	36	210	T
13	031	/	37	211	U
14	032	#	38	212	V
15	033		39	213	W
16	100	$	40	220	X
17	101	A	41	221	Y
18	102	B	42	222	reserved
19	103	C	43	223	0
20	110	D	44	230	E
21	111	reserved	45	231	Z
22	112	F		….	
23	113	G	63	333	reserved

GMDSS – DSC

Global Maritime Distress and Safety System

Global Marine Distress and Selective calling System according to CCIR 493-6, CCIR 541-2 and ITU-R M.1159. This module supports also DSC and ATIS.

On VHF GMDSS is at 1200 Baud. Digital Selective Calling is a variation of Sitor-B, 100 baud 170 shift, but uses a special set of 127 symbols with a 10-bit error detection code. This system is used to establish the initial contact between ships and shore stations using GMDSS.

DSC signals can be found the following frequencies:
VHF on Ch. 70 - 156.525 with 1200bd

Although this module implements GMDSS faithfully, we cannot stress highly enough that we will not be held responsible for any errors in the decoding algorithms if this unit is used in a genuine Safety of Life situation. We have thoroughly tested this module (in association with one of Western Europe's largest Coast Station) and have not discovered any errors in the decoding. In fact it usually performed to lower signal levels than other, more expensive, commercial marine equipment! However we do not recommend you use this as a replacement for genuine Marine Type Approved GMDSS equipment.

JT44

JT44 is a time-synchronized frequency shift keying mode that uses one tone frequency to provide frequency and time synchronization for the communicating stations, and another 43 tone frequencies to encode 43 permissible characters. It differs from PUA43 in its use of the 44th tone for synchronization.

Each JT44 transmission lasts approximately 25.08 seconds, containing 135 intervals of data. 69 of these intervals contain only the synchronizing tone, and the other 66 contain the encoded data. The synchronizing and data intervals are interleaved in a pseudo-random pattern such that the auto-correlation function has a large spike at correct alignment, and very small values elsewhere. This property allows JT44 stations to achieve alignment with each other without the need for special hardware.
Inspired by the PUA43 alphabet this system was developed to recover signals 30db below the noise floor.

The system is mainly used for Troposcatter transmissions and EME by radio amateurs.

MPT 1327

MPT1327 is a 1200bps trunking protocol first defined in 1987 by the UK Department of Trade and Industry. The system operates in VHF 136MHz to 178MHz and UHF 403MHz to 528MHz. The MPT 1327 standards define rules for communication between radio units and trunking system controllers operating in land mobile radio systems.

The standard includes procedures for sending:

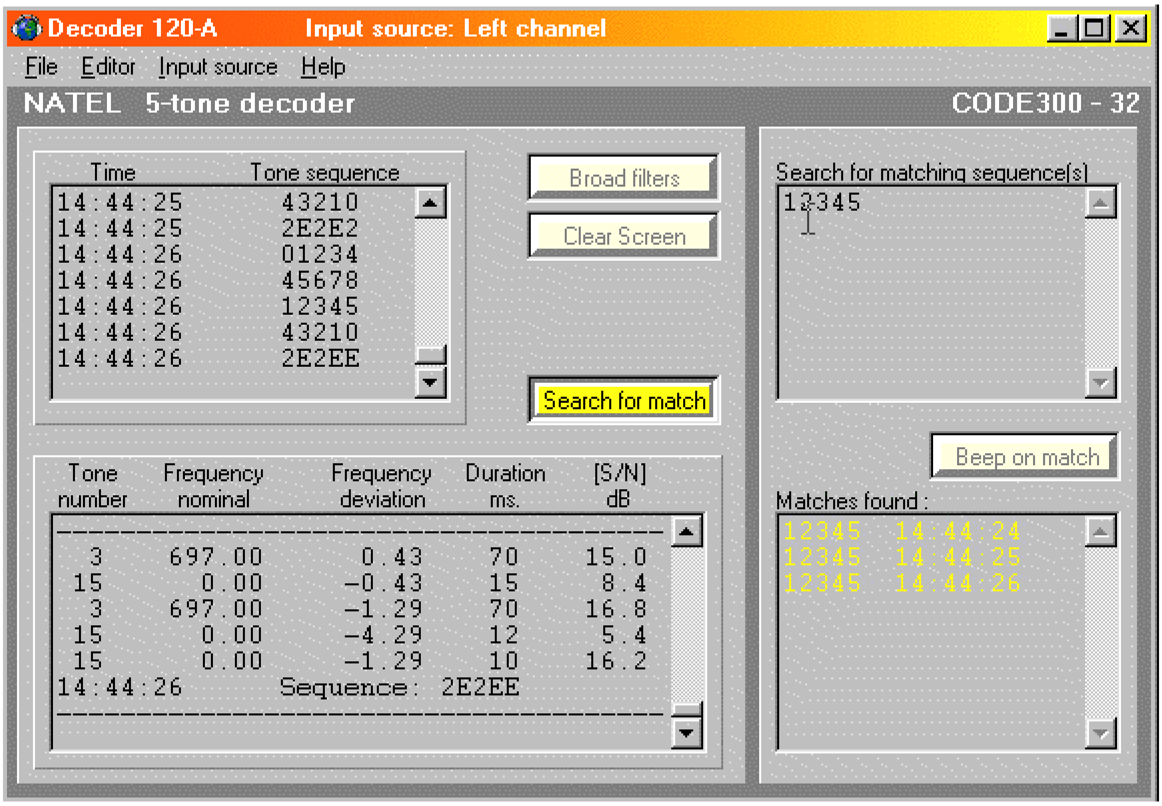
- Status messages on a control channel. The status message is a number between 0 and 31.
- Short data on a control channel. Up to 176 or 184 bits of free format data or 25 ASCII characters.
- Extended data on a control channel. Up to 704 bits of free format data or 100 ASCII characters.
- Standard data on a dedicated data channel. Packet switched data with a defined bit rate of 1200 bit/s but an option for customised higher bit rates.

NATEL

Scandinavian National Telephone recommendations for VHF SELCAL

This module is fully compliant with the Scandinavian National Telephone recommendations for VHF SELCAL. Each frequency is transmitted with a duration of 70mS according to the following table:

1	2	3	4	5	6	7	8
631	697	770	852	941	1040	1209	1336
9	0	A	B	Group	D	Repeat	
1477	200	1633	600	1995	2205	1805	

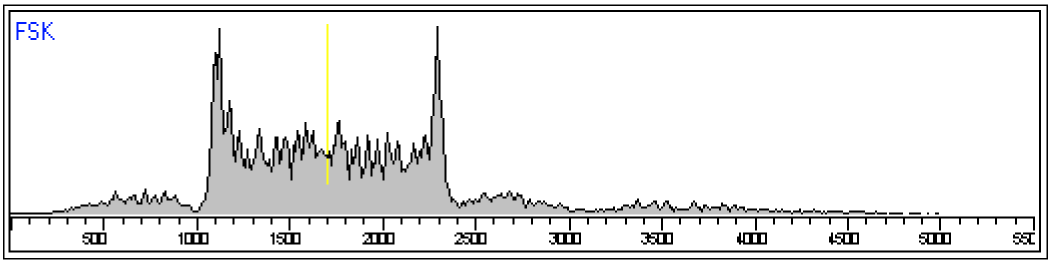


Typical NATEL decoder screen with 'search for match' enabled, sequence '12345' was found..

Packet Radio

Racket Radio / AX 25

Amateur radio version of CCIR recommendation X25 but with extended addressing fields. Transmission consists of packets of synchronous data transmission at 300 Bd (mainly on HF) and 1200 Bd and 9600 Bd at VHF. Every packet frame consists of a synchronizing sequence, a start-flag, address field, actual data packet of up to 256 characters in ASCII then the CRC information and finally the stop flag.



POCSAG

POCSAG / SUPER POCSAG / CityRuf

Pocsag is described in CCIR rec. 584 annex rec. 900. This module fully complies with these recommendations. The BCH error correction system is designed to correct up to 2 errors in each data block. If more than 2 consecutive error-blocks are detected then the system will immediately drop further decoding of the data block and wait for a new valid call. Many stations force two false errors at the end of their transmissions to instruct battery powered pagers to switch back to 'sleep' mode. This forced error condition is auto detected and triggers an 'end of transmission' date/time stamp and immediately stops further decoding until a valid synchroniser header is detected.

Note: Audio output feeds from VHF receivers will NOT pass the ± 4kHz FSK DC components through to a record output or loudspeaker output undistorted - this will mean you will not be able to decode any Pocsag data blocks from these sockets. Some receiver equipment manufacturers provide a method of connecting a CTCSS board to a buffered, unfiltered wide-band audio feed direct from the discriminator. This can sometimes be sufficient. If this type of unfiltered feed is not available, then you will need to connect a buffered feed of your own, as soon after the discriminator as you can, but before any filter that may be part of any audio amplifier circuit. If a centre zero meter is provided on the receiver one can sometimes take a tap point off somewhere half way between the discriminator and the centre zero detector/amplifier circuits. This type of circuitry is usually DC coupled from the discriminator and provides an adequate feed.

Auto detects ZVEI1/2, CCIR1, CCIR2, EIA, EEA, NATEL, VDEW, EURO, CCITT and DTMF VHF tone systems.

Some tone systems have tone frequencies that are similar to more than one system. Therefore wait until you have decoded a small number of different selcall's before taking the decoded classification as being correct.

E.g. if whilst decoding a DTMF system, one could receive the following:

ZVEI1/2 DTMF DTMF ZVEI1/2 DTMF DTMF DTMF DTMF ZVEI1/2 DTMF DTMF ZVEI1/2 DTMF DTMF

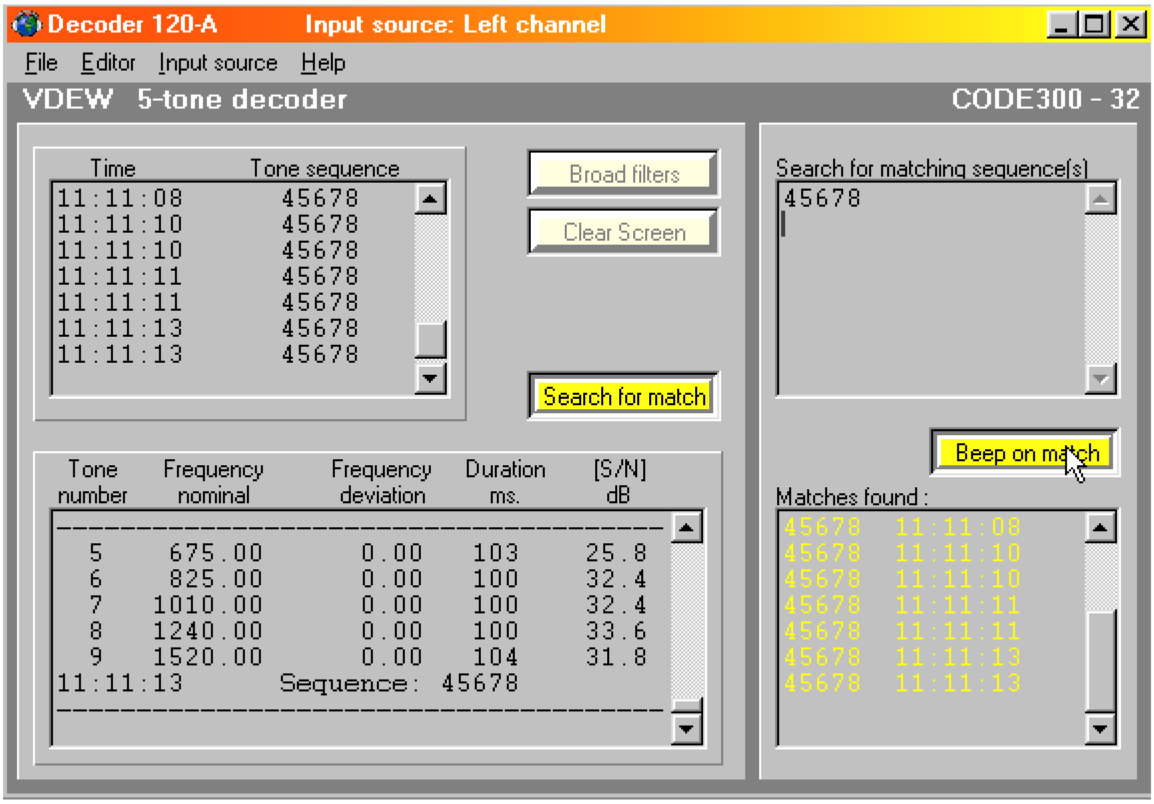
One can therefore assume the system is actually a DTMF system.

VDEW

Vereinigung Deutscher Elektrizitaetswerke recommendations for VHF SELCAL

This module is fully compliant with the Vereinigung Deutscher Elektrizitaetswerke (literally "German Electricity Works") recommendations for VHF SELCAL. Each frequency is transmitted with a duration of 100mS according to the following table:

1	2	3	4	5	6	7	8
370	450	550	675	825	1010	1240	1520
9	0	A	B	C	D	E	



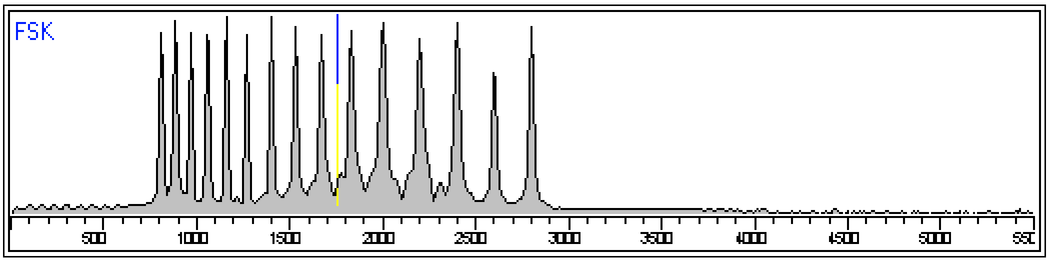
A typical 5-tone sequence with Search Panel activated, sequence 45678 was found.

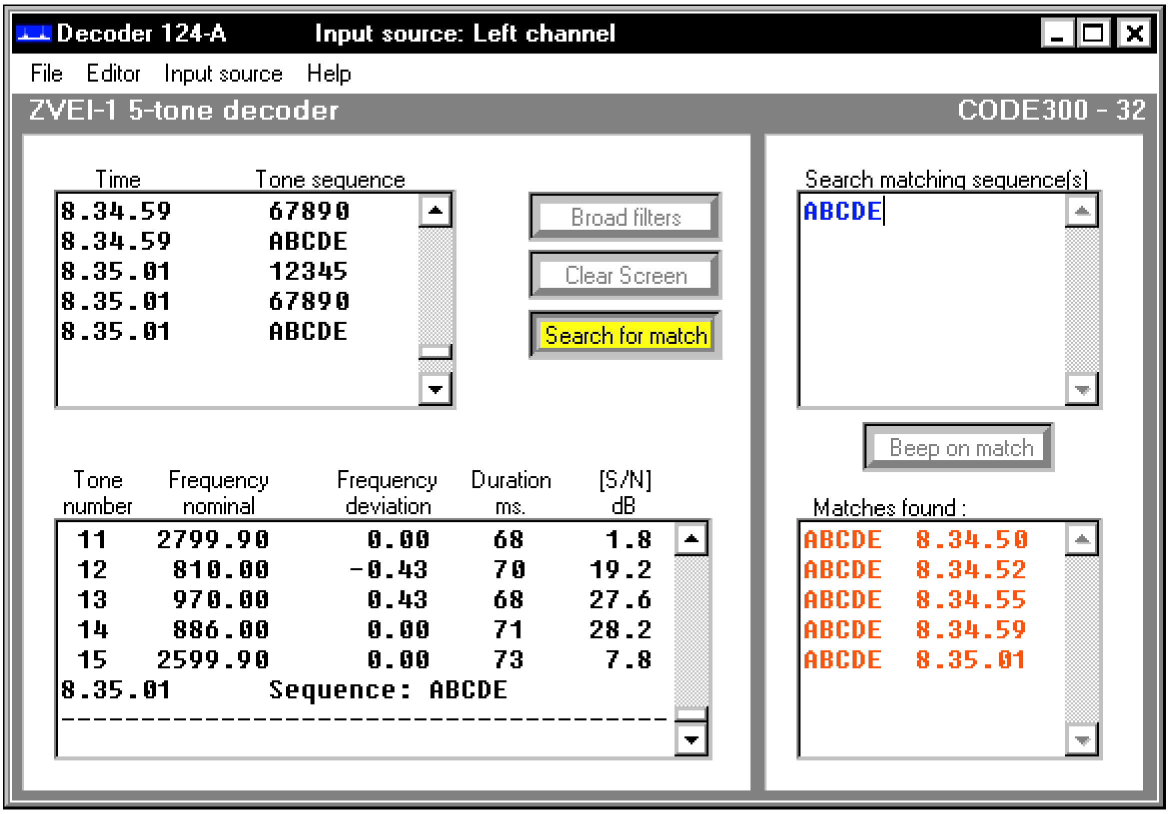
ZVEI 1

Zentralverband der Electrotechnischen Industrie recommendation 1 for VHF Selcal

This module is fully compliant with Germany's Zentralverband der Electrotechnischen Industrie recommendation 1 for VHF Selcal. Each frequency is transmitted with a duration of 70mS according to the following table:

1	2	3	4	5	6	7	8
1060	1160	1270	1400	1530	1670	1830	2000
9	0	Group	B	C	D	Repeat	
2200	2400	2800	810	970	886	2600	



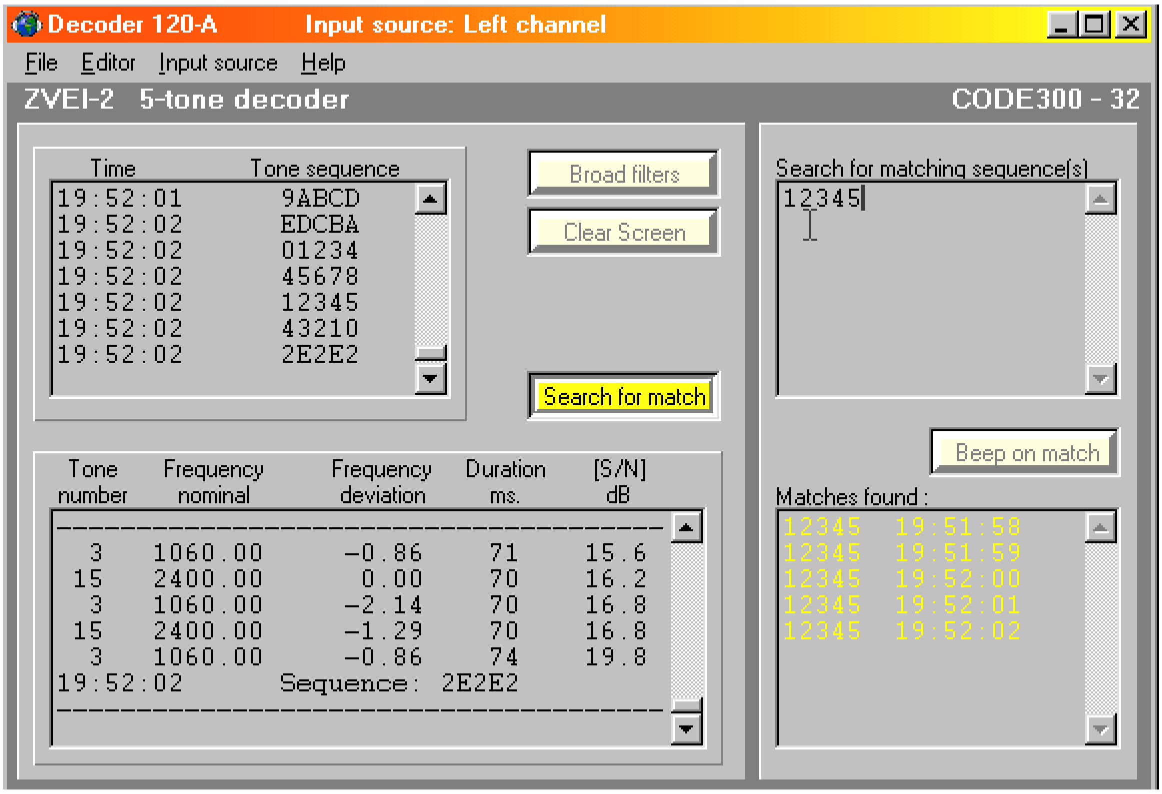


ZVEI 2

Zentralverband der Elektrotechnischen Industrie recommendation for VHF Selcal / DZVEI

This module is fully compliant with Germany's Zentralverband der Electrotechnischen Industrie recommendation 2 for VHF Selcal. Each frequency is transmitted with a duration of 70mS according to the following table:

1	2	3	4	5	6	7	8
2200	970	1060	1270	1400	1530	1670	1830
9	0	Group	B	C	D	Repeat	
2000	1160	2600	2800	810	886	2400	



A typically screen shot of a ZVEI 2 decoder, watching for sequence '12345'

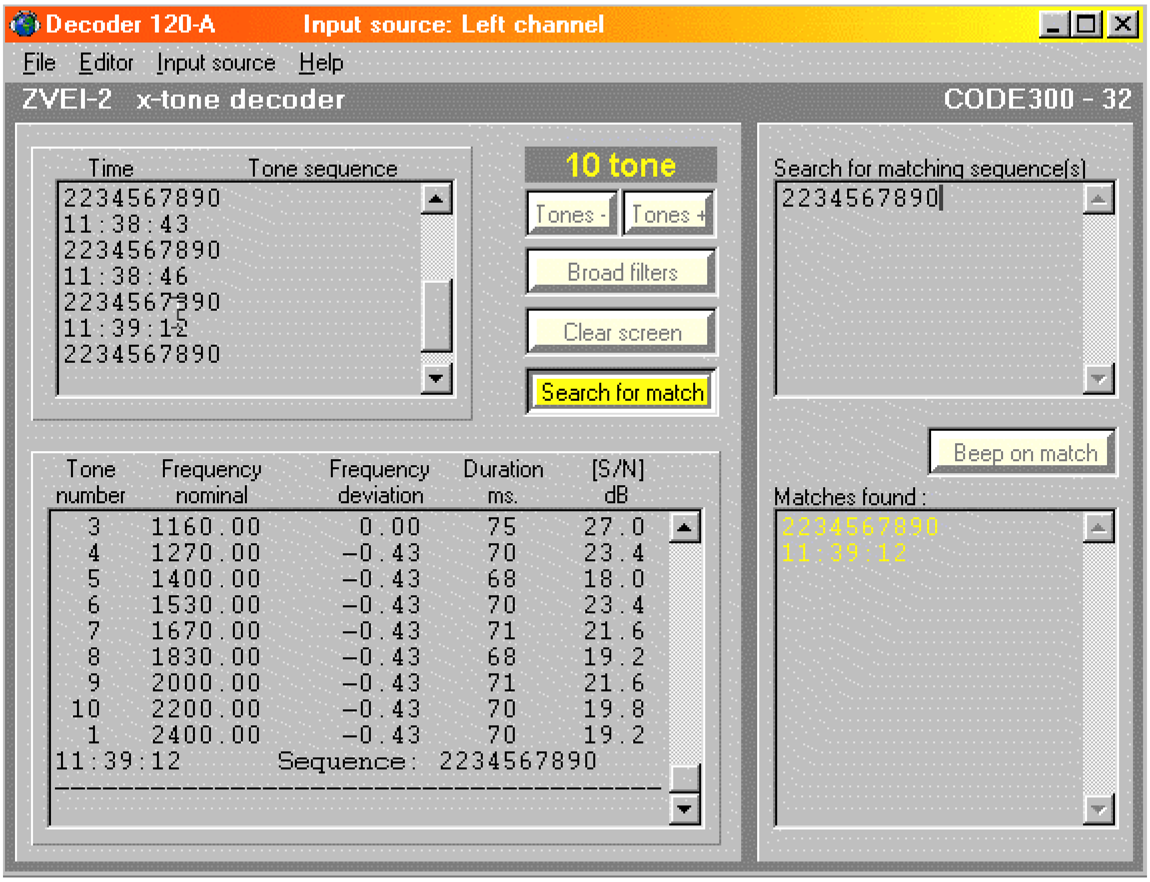
ZVEI 2 xx tones

Zentralverband der Elektrotechnischen Industrie recommendation for VHF Selcal / DZVEI

This module is fully compliant with Germany's Zentralverband der Elektrotechnischen Industrie recommendation 2 for VHF Selcal. Each frequency is transmitted with a duration of 70mS according to the following table:

1	2	3	4	5	6	7	8
2200	970	1060	1270	1400	1530	1670	1830
9	0	Group	B	C	D	Repeat	
2000	1160	2600	2800	810	886	2400	

Additional one can choose the quantity of expected tones, in this case 10 tones.
The buttons [tones -] and [tones +] allow setting of the necessary tone sequence.



A full sequence of ten tones is shown in this example, search mode for a 2234567890 sequence.

Tables for Radio Monitoring

Allocation of International Call Signs

Call Sign Serie	Allocation
AAA - ALZ	United States of America
AMA - AOZ	Spain
APA - ASZ	Pakistan
ATA - AWZ	India
AXA - AXZ	Australia
AYA - AZZ	Argentinia
A2A - A2Z	Botswana
A3A - A3Z	Tonga
A4A - A4Z	Oman
A5A - A5Z	Bhutan
A6A - A6Z	United Arab Emirates
A7A - A7Z	Qatar
A8A - A8Z	Liberia
A9A - A9Z	Bahrain
BAA - BZZ	China
CAA - CEZ	Chile
CFA - CKZ	Canada
CLA - CMZ	Cuba
CNA - CNZ	Morocco
COA - COZ	Cuba
CPA - CPZ	Bolivia
CQA - CUZ	Portugal
CVA - CXZ	Uruguay
CYA - CZZ	Canada
C2A - C2Z	Nauru
C3A - C3Z	Andorra
C4A - C4Z	Cyprus
C5A - C5Z	Gambia
C6A - C6Z	Bahamas
C7A - C7Z	World Meteorological Organization
C8A - C9Z	Mocambique
DAA - DRZ	Germany
DSA - DTZ	Republic of Korea
DUA - DZZ	Philippines
D2A - D3Z	Angola
D4A - D4Z	Cape Verde
D5A - D5Z	Liberia
D6A - D6Z	Comoros
D7A - D9Z	Republic of Korea
EAA - EHZ	Spain
EIA - EJZ	Ireland
EKA - EKZ	Armenia
ELA - ELZ	Liberia
EMA - EOZ	Ukriane
EPA - EQZ	Iran
ERA - ESZ	Moldova
ETA - ETZ	Ethopia
EUA - EWZ	Byelorussian Soviet Socialist Republic
EXA - EXZ	Kyrgyz Republic
EYA - EYZ	Tajikistan
EZA - EZZ	Turkmenistan
E2A - E2Z	Thailand

Call Sign Serie	Allocation
E3A - E3Z	Eritrea
FAA - FZZ	France
GAA - GZZ	Great Britain and Northern Ireland
HAA - HAZ	Hungary
HBA - HBZ	Switzerland
HCA - HDZ	Ecuador
HEA - HEZ	Switzerland
HFA - HFZ	Poland
HGA - HGZ	Hungary
HHA - HHZ	Haiti
HIA - HIZ	Dominican Republic
HJA - HKZ	Columbia
HLA - HLZ	Republic of Korea
HMA - HMZ	Democratic People's Republic of Korea
HNA - HNZ	Iraq
HOA - HPZ	Panama
HQA - HRZ	Honduras
HSA - HSZ	Thailand
HTA - HTZ	El Salvador
HVA - HVZ	Vatican City
HWA - HYZ	France
HZA - HZZ	Saudi Arabia
H2A - H2Z	Cyprus
H3A - H3Z	Panama
H4A - H4Z	Solomon Island
H6A - H7Z	Nicaragua
H8A - H9Z	Panama
IAA - IZZ	Italy
JAA - JSZ	Japan
JTA - JVZ	Mongolian People's Republic
JWA - JXZ	Norway
JYA - JYZ	Jordan
JZA - JZZ	Indonesia
J2A - J2Z	Djibouti
J3A - J3Z	Grenada
J4A - J4Z	Greece
J5A - J5Z	Guinea - Bissau
J6A - J6Z	Saint Lucia
J7A - J7Z	Dominica
J8A - J8Z	St. Vincent and the Grenadines
KAA - KZZ	United States of America
LAA - LNZ	Norway
LOA - LWZ	Argentinia
LXA - LXZ	Luxembourg
LYA - LYZ	Union of Sovjet Socialist Republics
LZA - LZZ	Bulgaria
L2A - L9Z	Argentinia
MAA - MZZ	Great Britain and Nothern Ireland
NAA - NZZ	United States of America
OAA - OAZ	Peru
ODA - ODZ	Lebanon
OEA - OEZ	Austria
OFA - OJZ	Finland
OKA - OLZ	Czech Republic
OMA - OMZ	Slovak Republic
ONA - OTZ	Belgium

Call Sign Serie	Allocation
OUA - OZZ	Denmark
PAA - PIZ	Netherland
PJA - PJZ	Netherland Antilles
PKA - POZ	Indonesia
PPA - PYZ	Brazil
PZA - PZZ	Suriname
P2A - P2Z	Papua New Guinea
P3A - P3Z	Cyprus
P4A - P4Z	Aruba
P5A - P9Z	Democratic People's Republic of Korea
QAA - QZZ	Service abbreviations
RAA - RZZ	Union of Sovjet Socialist Republics
SAA - SMZ	Sweden
SNA - SRZ	Poland
SSA - SSZ	Egypt
SVA - SZZ	Greece
S2A - S3Z	Bangladesh
S6A - S6Z	Singapore
S7A - S7Z	Seychelles
S9A - S9Z	Sao Tome and Principe
TAA - TCZ	Turkey
TDA - TDZ	Guatemala
TEA - TEZ	Costa Rica
TFA - TFZ	Iceland
TGA - TGZ	Guatemala
THA - THZ	France
TIA - TIZ	Costa Rica
TJA - TJZ	Cameroon
TKA - TKZ	France
TLA - TLZ	Central African Republic
TMA - TMZ	France
TNA - TNZ	Congo
TOA -TQZ	France
TRA - TRZ	Gabon
TSA - TSZ	Tunisia
TTA - TTZ	Chad
TUA - TUZ	Ivory Coast
TVA - TVZ	France
TYA - TYZ	Benin
TZA - TZZ	Mali
T2A - T2Z	Tuvula
T3A - T3Z	Kiribati
T4A - T4Z	Cuba
T5A - T5Z	Somalia
T6A - T6Z	Afghanistan
T7A - T7Z	San Marino
T9A - T9Z	Bosnia and Herzegovina
UAA - UIZ	Union of Soviet Socialist Republics
UJA - UMZ	Uzbekistan
UNA - UQZ	Kazakhstan
UUA - UZZ	Ukraine
URA - UTZ	Ukrainian Soviet Socialist Republics
UUA - UZZ	Union of Soviet Socialist Republics
VAA - VGZ	Canada
VHA - VNZ	Australia
VOA - VOZ	Canada

Call Sign Serie	Allocation
VPA - VSZ	Great Britain and Northern Ireland
VTA - VWZ	India
VXA - VYZ	Canada
VZA - VZZ	Australia
V2A - V2Z	Antigua and Barbuda
V3A - V3Z	Belize
V4A - V4Z	St. Christopher and Nevis
V5A - V5Z	Namibia
V6A - V6Z	Micronesia
V7A - V7Z	Marshall Islands
V8A - V8Z	Brunei
WAA - WZZ	United States of America
XAA - XIZ	Mexico
XJA - XOZ	Canada
XPA - XPZ	Denmark
XQA - XRZ	Chile
XSA - XSZ	China
XTA - XTZ	Burkina Faso
XUA - XUZ	Kampuchea
XVA - XVZ	Viet Nam
XWA - XWZ	Laos
XXA - XXZ	Portugal
XYA - XZZ	Myanmar
YAA - YAZ	Afghanistan
YBA - YHZ	Indonesia
YIA - YIZ	Iraq
YJA - YJZ	New Hebrides
YKA - YKZ	Syria
YLA - YLZ	Union of Soviet Socialist Republics
YMA - YMZ	Turkey
YNA - YNZ	Nicaragua
YOA - YRZ	Romania
YSA - YSZ	El Salvador
YTA - YUZ	Yugoslavia
YVA - YYZ	Venezuela
YZA - YZZ	Yugoslavia
Y2A - Y9Z	Germany
ZAA - ZAZ	Albania
ZBA - ZJZ	Great Britain and Northern Ireland
ZKA - ZMZ	New Zealand
ZNA - ZOZ	Great Britain and Northern Ireland
ZPA - ZPZ	Paraguay
ZQA - ZQZ	Great Britain and Northern Ireland
ZRA - ZUZ	South Africa
ZVA - ZZZ	Brazil
Z2A - Z2Z	Zimbabwe
Z3A - Z3Z	Macedonia
2AA - 2ZZ	Great Britain and Northern Ireland
3AA - 3AZ	Monaco
3BA - 3BZ	Mauritius
3CA - 3CZ	Equatorial Guinea
3DA - 3DM	Swaziland
3DN - 3DZ	Fidji
3EA - 3FZ	Panama
3GA - 3GZ	Chile
3HA - 3UZ	China

Call Sign Serie	Allocation
3VA - 3VZ	Tunisia
3WA - 3WZ	Viet Nam
3XA - 3XZ	Guinea
3YA - 3YZ	Norway
3ZA - 3ZZ	Poland
4AA - 4CA	Mexico
4DA - 4IZ	Philippines
4JA - 4JZ	Union of Soviet Socialist Republics
4LA - 4LZ	Georgia
4MA - 4MZ	Venezuela
4NA - 4OZ	Yugoslavia
4PA - 4SZ	Sri Lanka
4TA - 4TZ	Peru
4UA - 4UZ	United Nations Organization
4VA - 4VZ	Haiti
4WA - 4WZ	Yemen
4XA - 4XZ	Israel
4YA - 4YZ	International Civil Aviation Org.
4ZA - 4ZZ	Israel
5AA - 5AZ	Libya
5BA - 5BZ	Cyprus
5CA - 5GZ	Morocco
5HA - 5IZ	Tanzania
5JA - 5KZ	Colombia
5LA - 5MZ	Liberia
5NA - 5OZ	Nigeria
5PA - 5QZ	Denmark
5RA - 5SZ	Madagaskar
5TA - 5TZ	Mauretania
5UA - 5UZ	Niger
5VA - 5VZ	Togo
5WA - 5WZ	Western Samoa
5XA - 5XZ	Uganda
5YA - 5YZ	Kenya
6AA - 6BZ	Egypt
6CA - 6CZ	Syria
6DA - 6JZ	Mexico
6KA - 6NZ	Republic of Korea
6OA - 6OZ	Somalia
6PA - 6SZ	Pakistan
6TA - 6UZ	Sudan
6VA - 6WZ	Senegal
6XA - 6XZ	Madagascar
6YA - 6YZ	Jamaica
6ZA - 6ZZ	Liberia
7AA - 7IZ	Indonesia
7JA - 7NZ	Japan
7OA - 7OZ	Yemen
7PA - 7PZ	Lesotho
7QA - 7QZ	Malawi
7RA - 7RZ	Algeria
7SA - 7SZ	Sweden
7TA - 7YZ	Algeria
7ZA - 7ZZ	Saudi Arabia
8AA - 8IZ	Indonesia
8JA - 8NZ	Japan

Call Sign Serie	Allocation
8OA - 8OZ	Botswana
8PA - 8PZ	Barbados
8QA - 8QZ	Maledives
8RA - 8RZ	Guyana
8SA - 8SZ	Sweden
8TA - 8YZ	India
8ZA - 8ZZ	Saudi Arabia
9BA - 9DZ	Iran
9EA - 9FZ	Ethopia
9GA - 9GZ	Ghana
9HA - 9HZ	Malta
9IA - 9JZ	Zambia
9KA - 9KZ	Kuwait
9LA - 9LZ	Sierra Leone
9MA - 9MZ	Malaysia
9NA - 9NZ	Nepal
9OA -9TZ	Zaire
9UA - 9UZ	Burundi
9VA - 9VZ	Rwanda
9YA - 9ZZ	Trinidad and Tobago

Table : International callsigns

Alphabetical List of Country Codes

ABBR.	Country
ADM	Andaman and Nicobar Island
AFG	Afghanistan
AFS	South Africa
AGL	Angola
AIA	Anguilla
ALB	Albania
ALG	Algeria
ALS	Alaska
AMS	Amsterdam and Saint Paul
AND	Andorra
ANG	Anguilla
ANO	Annoban
ANT	Antarctica
ARG	Argentinia
ARM	Armenia
ARS	Saudi Arabia
ARU	Aruba
ASC	Ascension Island
ATG	Antigua
ATN	Neth. Antilles
ATW	St. Maarten
AUS	Australia
AUT	Austria
AVE	Aves Island
AZE	Azerbaidzhan
AZR	Azores
B	Brazil
BAH	Bahamas
BAL	Balleny Island
BAN	Banaba
BDI	Burundi
BEL	Belgium
BEN	Benin
BER	Bermuda
BFA	Burkina Faso
BGD	Bangladesh
BHG	Bosnia / Hercegovina
BHR	Bahrain
BHU	Bhutan
BIO	British Indian Ocean Territory
BLR	Belarus
BLZ	Belize
BOL	Bolivia
BOT	Botswana
BOV	Bouvet Island
BRB	Barbados
BRM	Myanmar (Burma)
BRU	Brunei
BTN	Bhutan
BUL	Bulgaria
CAB	Cabinda
CAE	Canton and Enderbury Island
CAF	Central African Republik
CAN	Canada
CAR	Caroline Island (Palau)

ABBR.	Country
CBG	Cambodia
CEU	Ceuta
CHL	Chile
CHN	China
CHR	Christmas Island
CKH	Cook Island
CKN	Manihiki Island
CLM	Columbia
CLN	Sri Lanka
CLP	Clipperton
CME	Cameroon
CNR	Canary Island
COG	Congo
COM	Comoro
CPV	Cape Verde
CRO	Crozet Archipelago
CTI	Ivory Coast
CTR	Costa Rica
CUB	Cuba
CVA	Vatikan City
CYM	Cayman Island
CYP	Cyprus
CZR	Czech Rep.
D	Germany
DAI	Daito Island
DES	Desventurados Island
DGA	Diego Garcia
DJI	Djibouti
DMA	Dominica
DNK	Denmark
DOM	Dominican Republic
E	Spain
EGY	Egypt
EQA	Ecuador
ERT	Eritrea
EST	Estonia
ETH	Ethopia
F	France
FJI	Fiji
FLK	Falkland Island
FNL	Finland
FRI	Faroe Island
FSM	Micronesia
G	United Kindom
GAB	Gabon
GDL	Guadeloupe
GEO	Georgia
GHA	Ghana
GIB	Gibraltar
GMB	Gambia
GNB	Guinea Bissau
GNE	Equatorial Guinea
GPG	Galapagos Island
GRC	Greece
GRD	Grenada
GRL	Greenland
GTM	Guatemala

ABBR.	Country
GUF	French Guinea
GUF	Guiana
GUI	Guinea
GUM	Guam
GUY	Guyana
HKG	Hong Kong
HMD	Heard and McDonald Island
HND	Honduras
HNG	Hungary
HRV	Croatia
HTI	Haiti
HWA	Hawaii
HWL	Howland Island
I	Italy
ICO	Cocos Island
IND	India
INS	Indonesia
IRL	Ireland
IRN	Iran
IRQ	Iraq
ISL	Iceland
ISR	Israel
ISZ	Neutral Zone IRQ - ARS
IWA	Bonin and Volcno Island
J	Japan
JAR	Jarvis Island
JMC	Jamaica
JMY	Jan Mayen Island
JON	Johnston Island
JOR	Jordan
JUF	Juan Fernandez Island
KAL	Kaliningrad
KAZ	Kazakhstan
KEN	Kenya
KER	Kerguelen Island
KGZ	Kyrgyzstan
KIR	Kiribati
KOR	Korea Republic
KRE	Korea PDR
KWT	Kuwait
LAO	Laos
LBN	Lebanon
LBR	Liberia
LBY	Libya
LCA	St.Lucia
LIE	Lichtenstein
LSO	Lesotho
LTU	Lithuania
LUX	Luxembourg
LVA	Latvia (Lettland)
MAC	Macau
MAU	Mauritius
MCO	Monaco
MCS	Marcus Island
MDA	Moldova
MDG	Madagascar
MDN	Macedonia

ABBR.	Country
MDR	Madeira
MDW	Midway Island
MEL	Melilla
MEX	Mexico
MLA	Malaysia
MLD	Maledives
MLE	Sabah, Sarawak (Malaysia)
MLI	Mali
MLT	Malta
MNG	Mongolia
MOZ	Mozambique
MRA	Marianas (Northern)
MRC	Morocco
MRL	Marshall Islands
MRN	Marion Island
MRQ	Marquesas Island
MRT	Martinique
MSR	Montserrat
MTN	Mauretania
MWI	Malawi
MYT	Mayotte
NAK	Nachitschewan
NAV	Navassa Island
NCG	Nicaragua
NCL	New Caledonia
NGR	Niger
NIG	Nigeria
NIU	Niue Island
NLD	Netherlands
NMB	Namibia
NOK	Norfolk Island
NOR	Norway
NPL	Nepal
NRU	Nauru
NZL	New Zealand
OCE	French Polynesia
OMA	Oman
PAK	Pakistan
PAQ	Easter Island
PEI	Prince Edward Island
PHL	Phillipines
PHX	Phoenix Islands
PLM	Palmyra Island
PLW	Palau
PNG	Papua New Guinea
PNR	Panama
PNZ	Panama Canal Zone
POL	Poland
POR	Portugal
PRG	Paraguay
PRU	Peru
PRV	Paresce Vela Island
PTC	Pitcairn Island
PTI	Peter 1st Island
PTR	Puerto Rico
QAT	Qatar
REU	Reunion

ABBR.	Country
ROU	Romania
RRW	Rwanda
RUS	Russia
S	Sweden
SAP	San Andres and Providencia Isl.
SCN	St.Kitts & Nevis
SCO	Scott Island
SDN	Sudan
SEN	Senegal
SER	Serbia
SEY	Seychelles
SGA	St. Georgia Island
SHN	St. Helena
SLM	Solomon Island
SLO	Slovakia
SLV	El Salvador
SMA	American Samoa
SMO	Western Samoa
SMR	San Marino
SNG	Singapore
SOK	S. Orkney Island
SOM	Somalia
SPM	St. Pierre & Miquelon
SPR	Sprathly Island
SRL	Sierra Leone
SSI	S. Sandwich Island
STB	St. Barthelemy Island
STP	Sao Tome and Principe Island
SUI	Switzerland
SUR	Surinam
SVN	Slovenia
SWN	Swan Islands
SWZ	Swaziland
SYR	Syria
TCA	Turks & Caicos
TCD	Chad
TCH	Czech & Slovak Rep.
TGO	Togo
THA	Thailand
TJK	Tadzhikistan
TKL	Tokelau Islands
TKM	Turkmenistan
TOB	Toubouai Island
TON	Tonga
TRC	Tristan da Cunha
TRD	Trinidad and Tobago
TRI	Trinidada & Martim Vaz Island
TUN	Tunesia
TUR	Turkey
TUV	Tuvalu
TWN	Taiwan
TZA	Tanzania
UAE	United Arab Emirates
UGA	Uganda
UKR	Ukraine
URG	Uruguay

ABBR.	Country
USA	USA
UZB	Uzbekistan
VCT	St. Vincent & Grenadines
VEN	Venezuela
VIR	Virgin Island (USA)
VRG	Virgin Island (Br.)
VTN	Viet Nam
VUT	Vanuatu
WAB	Walvis Bay
WAK	Wake Island
WAL	Wallis & Futuna
YEM	Yemen
YUG	Yugoslawia
ZAI	Zaire
ZMB	Zambia
ZWE	Zimbabwe

Table : Country codes

Selective Calling

SITOR is synchronous system which is transmitting information in data bursts from an information sending station (ISS) to an information receiving station (IRS).

This mode of operation is used in different services like amateur radio, fixed service (diplomatic aso.) and the maritime mobile service.

For establishing communication it is possible to use a selective call specially in the case of automatic operation like usage of a mailbox in amateur radio or traffic between a ship station and a coast station. The selective call is detected by the called station and responding will follow up immideately.
This call signal should be unique for every station and can also used as an identification in radio monitoring.
The fixed service is choosing the selective call from the 26 letters of the alphabet.
In amateur radio service the 4 letter selective call group are built from the first and the last three letters of the callsign, i.e. DL0KF =DLKF, WA6TZG = WTZG or I3IY = IIIY.

In the maritime mobile service the selective call is used for establishing communication and for rephasing in an interrupted circuit by noise or fading.

The selective call is converted from the cost station identification number into a four letter group by the following translation table according to the relevant CCIR Recommendations :

Number	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**0**
Letter	**X**	**Q**	**K**	**M**	**P**	**C**	**Y**	**F**	**S**	**V**

Table 13 : Translation of a four digit number

You will find the selective callsign for most coast station ready translated in our database system.

In case of ship station a larger number of identification numbers is necessary. For translation of a 5 digit number into a 4 letter selective call the following translation table is used :

First Digit		1	2	3	4	5	6	7	8	9	0
Second Digit	1	X	X	X	B	B	B	X	X	X	B
	2	Q	Q	Q	U	U	U	Q	Q	Q	U
	3	K	K	K	E	E	E	K	K	K	E
	4	M	M	M	O	O	O	M	M	M	O
	5	P	P	P	I	I	I	P	P	P	I
	6	C	C	C	R	R	R	C	C	C	R
	7	Y	Y	Y	Z	Z	Z	Y	Y	Y	Z
	8	F	F	F	D	D	D	F	F	F	D
	9	S	S	S	A	A	A	S	S	S	A
	0	V	V	V	T	T	T	V	V	V	T
Third Digit	1	B	X	X	B	X	X	B	B	X	X
	2	U	Q	Q	U	Q	Q	U	U	Q	Q
	3	E	K	K	E	K	K	E	E	K	K
	4	O	M	M	O	M	M	O	O	M	M
	5	I	P	P	I	P	P	I	I	P	P
	6	R	C	C	R	C	C	R	R	C	C
	7	Z	Y	Y	Z	Y	Y	Z	Z	Y	Y
	8	D	F	F	D	F	F	D	D	F	F
	9	A	S	S	A	S	S	A	A	S	S
	0	T	V	V	T	T	V	V	T	T	V
Fourth Digit	1	X	B	X	X	B	X	B	X	B	X

	2	Q	U	Q	Q	U	Q	U	Q	U	Q
	3	K	E	K	K	E	K	E	K	E	K
	4	M	O	M	M	O	M	O	M	O	M
	5	P	I	P	P	I	P	I	P	I	P
	6	C	R	C	C	R	C	R	C	R	C
	7	Y	Z	Y	Y	Z	Y	Z	Y	Z	Y
	8	F	D	F	F	D	F	D	F	D	F
	9	S	A	S	S	A	S	A	S	A	S
	0	V	T	V	V	T	V	T	V	T	V
Fifth Digit	1	X	X	B	X	X	B	X	B	B	X
	2	Q	Q	U	Q	Q	U	Q	U	U	Q
	3	K	K	E	K	K	E	K	E	E	K
	4	M	M	O	M	M	O	M	O	O	M
	5	P	P	I	P	P	I	P	I	I	P
	6	C	C	R	C	C	R	C	R	R	C
	7	Y	Y	Z	Y	Y	Z	Y	Z	Z	Y
	8	F	F	D	F	F	D	F	D	D	F
	9	S	S	A	S	S	A	S	A	A	S
	0	V	V	T	V	V	T	V	T	T	V

Table : Translation of a five digit number

The following table gives an overview of the number blocks assigned to different countries :

Number Block	Country	Number Block	Country
0060 - 0069	Ethopia	2930 - 2949	Poland
0100 - 0119	Argentina	2950 - 2959	Sweden
0120 - 0129	Peru	3170 - 3179	Maledives
0140 - 0149	Bolivia	3200 - 3259	United Kingom
0150 - 0159	Tanzania	3450 - 3459	Israel
0180 - 0189	Cyprus	3500 - 3509	Switzerland
0210 - 0219	Bangladesh	3560 - 3579	Portugal
0220 - 0229	Cape Verde	3620 - 3639	Azerbaijani Republic
0270 - 0279	Algeria	3640 - 3649	Georgia
0330 - 0339	Australia	3650 - 3699	Ukraine
0480 - 0489	Belgium	3700 - 3769	Russian Fed.
0570 - 0579	Romania	3800 - 3819	Malaysia
0580 - 0589	Canada	3830 - 3839	Thailand
0690 - 0699	Czech Republic	3850 - 3859	Serbia
0700 - 0719	Brazil	3870 - 3879	Uruguay
0770 - 0779	Colombia	3910 - 3919	Venezuela
0810 - 0819	Bulgaria	3950 - 3959	Sudan
0830 - 0899	Denmark	4010 - 4029	New Zealand
0990 - 1089	Spain	4050 - 4069	Pakistan
1090 - 1139	USA	4150 - 4159	Phillipines
1590 - 1609	Finland	4330 - 4349	South Africa
1630 - 1669	France	4360 - 4369	Turkey
1780 - 1789	Greece	4400 - 4499	RussianFed.
1820 - 1889	Chile	4500 - 4509	Kazakhstan
1920 - 1929	Ghana	4510 - 4519	Turkmenistan
1950 - 1959	Ethopia	4520 - 4529	Belarus
1980 - 1989	Ireland	4600 - 4619	Germany
2010 - 2039	China	4620 - 4629	Singapore
2070 - 2109	Italy	4630 - 4639	United Kingdom
2130 - 2149	Iraq	4640 - 4649	Sierra Leone
2180 - 2189	Kuwait	4650 - 4659	Bahrain
2200 - 2209	Indonesia	4660 - 4669	Seychelles
2280 - 2289	Libya	4670 - 4679	Slovak Republic
2300 - 2339	India	4680 - 4689	Djibouti

Number Block	Country	Number Block	Country
2360 - 2409	Japan	5690 - 4699	Qatar
2450 - 2459	Morocco	4710 - 4719	United Arab Emirates
2480 - 2489	Malta	4750 - 4759	Ecuador
2500 - 2509	Monaco	4800 - 4809	Zaire
2510 - 2519	Cuba	4810 - 4819	Yemen
2520 - 2529	Mauretania	4820 - 4829	Egypt
2550 - 2599	Norway	4830 - 4839	Saudi Arabia
2740 - 2749	Iceland	4860 - 4869	Surinam
2770 - 2779	Netherlands	4900 - 4939	Mexico
2790 - 2799	Kenya	4980 - 4999	Syria
2830 - 2849	Germany	5010 - 5019	Oman
2890 - 2899	Panama	5100 - 5109	Senegal
		5250 - 5259	Venezuela
		5300 - 5309	Iran
		6200 - 6209	Jordan

Table : Coast station identification numbers by blocks and countries

NATO Routing Indicators

A great number of stations do not use a callsign according to the officiall ITU identification regulations. Special miltitary stations of the NATO use their routing indicators.
These routing indicators are consisting of four or more letters. The first four letters give the location of a mitlitary station and the rest the addressed subunit.

The location can be decoded by the following table :

First Letter	Second Letter Country		Third Letter Area of Operation	Fourth Letter Service
A	Australia	AUS	East Asia	A
B	British Commonwealth			A
C	Canada	CAN	Central North America	A
D	Denmark	DNK	Inited Kingdom, Iceland	A
E	Spain	E	Eastern North America	A
F	France	F	Europe	A
G	Germany	G		A
H	USA	USA	Central South Pacific	A
I	Italy	I		N
J	Argentina	ARG		N
K	Greece	GRC	Alaska, Aleuten	N
L	Luxembourg	LUX	South America, Caribbean	N
M	ASEAN		South East Asia	N
N	Netherland	NLD		N
O				N
P	Portugal	POR		AF
Q	Belgium	BEL	Middle East	AF
R				AF
S	South Africa	AFS	Western Asia	AF
T	Turkey	TUR	North West Africa, Iberia	AF
U	USA	USA		AF
V			South Africa	AF
W			Western North America	
X				
Y	Norway	NOR	Australia	
Z	New Zealand	NZL		

The first letter U is also used for tactical, R for strategic and Q for reserve strategic indication

Table : NATO routing indicators

Beside these indicators, in most messages is used a circuit identifier followed by a message number. This can give you the actual location of the station, which you are monitoring. The callsign or better routing indicator used in the header of a message will only give the sender and destination of the telex.

In the following table are listed some channel indicators and the network they belong to :

Circuitl identifier	Callsign of Sender	User	Country	Callsign of Receiver	User	Country
	RFTJ	F F Dakar	SEN	RFTJF	F F Port Bouet	CTI
	RFFZEVM	F F Montargis	F	RFFZEVL		
ABC	RFFXHOY	F F Zagreb	HRV	RFFXMOY		
AFL	RFTJFA	F F Praia	CPV	RFFA	MOD Paris	F
AFL	RFTJF	F F Port Bouet	CTI	RFFA	MOD Paris	F
AFL	RFTJ	F F Dakar	SEN	RFFA	MOD Paris	F

Circuitl identifier	Callsign of Sender	User	Country	Callsign of Receiver	User	Country
ALI	RFLI	F F Fort de France	MRT	RFFA	MOD Paris	F
ATQA	RPTTA	P AF Ponta Delgada	AZR			
BFL	RFLI	F F Fort de France	MRT	RFFA	MOD Paris	F
BSL	RFLI	F F Fort de France	MRT	RFFA	MOD Paris	F
BSS	RPFNS	POR N Sagres	POR	RPFNC		
CBA	RFFMHOY	F F Bihac	BHE	RFFXHOY	F F Zagreb	HRV
DAD	RFTJDA	F F Libreville	GAB	RFTJD	F F Douala	CME
DET	RFFVAE	F F Dhahran	ARS	RFFA	MOD Paris	F
DJI	RFQP	F F Djibouti	DJI	RFVI	F F Le Port	REU
DKX	RETDKX	S F Valencia	E	RETDKY		E
DNI	RFVI	F F Le Port	REU	RFFA	MOD Paris	F
EHO	RFFE	F F Bordeaux	F	RFFX	F F Versailles	F
EHQ	RFFHCA	F F Ajaccio	F			
FDA	RFFB	MOD Paris	F			
FDI	RFLI	F F Fort de France	MRT	RFFA	MOD Paris	F
FDX	RFFA	MOD Paris	F	RFFVAT	F F Incirlik	TUR
FDXA	RFFP	MOD Paris	F	RFFVAY	F F Sarajewo	BHE
FDXB	RFFP	MOD Paris	F	RFFVAY	F F Sarajewo	BHE
FDXA	*RFFA*	*MOD Paris*	*F*	*RFQP*	*F F Djibouti*	*DJI*
FDZ 2	RFPTC	F F N´djamena	TCD	RFFA	MOD Paris	F
FDZA	RFFA	MOD Paris	F	RFFVA		
FDZB	RFFA	MOD Paris	F	RFFVA		
FDZA	*RFPTC*	*F F N´djamena*	*TCD*			
FKN	RFVI	F F Le Port	REU	RFQP	F F Djibouti	DJI
FKO	RFQP	F F Djibouti	DJI	RFVI	F F Le Port	REU
FKO	RFQP	F F Djibouti	DJI	RFTJ	F F Dakar	SEN
FKWA	RFFVAY	F F Sarajevo	BHE	RFFP	MOD Paris	F
FKWB	RFFVAY	F F Sarajevo	BHE	RFFP	MOD Paris	F
FKW 4	RFFVAT	F F Incirlik	TUR	RFFVH		
FTI	RFTJD	F F Libreville	GAB	RFFA	MOD Paris	F
FTI	*RFTJD*	*F F Douala*	*CME*	*RFFA*	*MOD Paris*	*F*
HII	RFHI	F F Noumea	NCL			
HJL	RFHJ	F F Papeete	OCE			
IAA	RFFC	F F Lille	F			
IBA	RFFS	F F Metz	F	RFFC	F F Lille	F
IBA	RFFE	F F Bordeaux	F	RFFC	F F Lille	F
IFD	RFGW	MFA Paris	F			
IGA	RFFH	F F Marseilles	F	RFFGX		
IGA	RFLIG	F F Cayenne	GUF	RFLIA		
IGU	RFFA	MOD Paris	F			
IKD	RFFA	MOD Paris	F	RFFH	F F Marseilles	F
IKG	RFFDC	F F Rennes	F			
IKG	RFFA	MOD Paris	F	RFFF	F F Lyon	F
ILD	RFFH	F F Marseilles	FF	RFFX	F F Versailles	F
ILG	RFFF	F F Lyon	F	RFFDC	F F Rennes	F
IMA	RFVI	F F Le Port	REU	RFVIMA	F F Phnom Penh	CBG
IQJ	RFFA	MOD Paris	F			
IRE	RFFA	MOD Paris	F	RFVI	F F Le Port	REU
IRT	RFLI	F F Fort de France	MRT			
ISG	RFFA	MOD Paris	F	RFTJ	F F Dakar	SEN
ITF	RFFA	MOD Paris	F	RFTJD	F F Douala	CME
ITF	RFTJD	F F Douala	CME	RFTJF	F F Port Bouet	CTI
IVW	RFFG	F F Straßbourg	F			
IWV	FIT 75	MOI Paris	F	RFFG	F F Straßbourg	F
IWV	RFFF	F F Lyon	F	RFFG	F F Straßbourg	F
IXV	RFFG	F F Straßbourg	F	RFFA	MOD Paris	F
IXV	RFFQ	F F Nice	F	RFFD		

Circuitl identifier	Callsign of Sender	User	Country	Callsign of Receiver	User	Country
IXV	RFFA	MOD Paris	F	RFFD		
JBL	RFFX	MOD Paris	F	RFFXL	F F Beirut	LBN
JDA	RFTJD	F F Douala	CME	RFFA	MOD Paris	F
JDF	RFTJDA	F F Libreville	GAB			
JDJ	RFTJD	F F Douala	CME	RFTJ	F F Dakar	SEN
JFD	RFTJF	F F Port Bouet	CTI	RFTJD	F F Douala	CME
JFJ	RFTJF	F F Port Bouet	CTI	RFTJ	F F Dakar	SEN
KQI	RFFK	F F Brest	F			
LFA	RFFA	MOD Paris	F	RFTJ	F F Dakar	SEN
LFB	RFFA	MOD Paris	F	RFLI	F F Fort de France	MRT
LIH	RFLI	F F Fort de France	MRT	RFHJ		
LIJ	RFLI	F F Fort de France	MRT	RFTJ	F F Dakar	SEN
LSB	RFFA	MOD Paris	F	RFLI	F F Fort de France	
MAI	RFVIMA	F F Phnom Penh	CBG	RFVI	F F Le Port	REU
MEB	RFFBBWM	F F Avant	F			
PQB	RFFA	MOD Paris	F	RFQP	F F Djibouti	DJI
PVX	RFFP	MOD Paris	F	RFFVAY	F F Sarajevo	BHE
QPA	RFQP	F F Djibouti	DJI	RFFA	MOD Paris	F
QPB	RFQP	F F Djibouti	DJI	RFFA	MOD Paris	F
QPC	RFQP	F F Djibouti	DJI	RFFA	MOD Paris	F
QPE	RFQP	F F Djibouti	DJI	RFFA	MOD Paris	F
QPF	RFQP	F F Djibouti	DJI	RFFA	MOD Paris	F
QPS	RFQP	F F Djibouti	DJI			
QRG	RFQP	F F Djibouti	DJI	RFFA	MOD Paris	F
QVA	RFFA	MOD Paris	F	RFQP	F F Djibouti	DJI
QVA	*RFFUAJ*	*F F Villacoublay*	*F*			
REI	RFVI	F F Le Port	REU	RFFA	MOD Paris	F
REU	RFVI	F F Le Port	REU			
REX	RFGW	MFA Paris	F		to all embassies	
RQF	RFQP	F F Djibouti	DJI			
RQG	RFFA	MOD Paris	F			
RTC	RFFE	F F Bordeaux	F	RFFZ		
RTI	RFLIG	F F Cayenne	GUF			
RUN	RFVI	F F Le Port	REU	RFQP	F F Djibouti	DJI
RVA	RFFP	MOD Paris	F	RFFVAY	F F Sarajevo	BHE
SGI	RFTJ	F F Dakar	SEN	RFFA	MOD Paris	F
TJA	RFTJ	F F Dakar	SEN			
TJD	RFTJ	F F Dakar	SEN	RFTJD	F F Douala	CME
TJF	RFTJ	F F Dakar	SEN	RFTJF	F F Port Bouet	CTI
TJI	RFTJ	F F Dakar	SEN	RFLI	F F Fort de France	MRT
TJI	RFTJ	F F Dakar	SEN	RFFA	MOD Paris	F
UAQ	RFFX	MOD Paris	F	RFFXQA		
UAB	RFFL	F F Toulon	F			
UBD	RFFDC	F F Rennes	F			
UBM	RFFB	MOD Paris	F	RFFX	F F Versailles	F
UBZ	RFFH	F F Marseilles	F	RFFXL	F F Beirut	LBN
UGF	RFFE	F F Bordeaux	F			
UGI	RFLIG	F F Cayenne	GUF	RFFA	MOD Paris	F
UQA	RFFXQA	F F Sarajevo	BHE	RFFX	F F Versailles	F
UQA	*RFFX*	*F F Versailles*	*F*	*RFFW*		
VII	RFVI	F F Le Port	REU			
XXI	RFFXI	F F Bangui	CAF	RFFX	F F Versailles	
XXI	RFFX	F F Versailles	F	RFFXI	F F Bangui	CAF
XXI	RFFA	MOD Paris	F	RFFXI	F F Bangui	CAF

Circuitl identifier	Callsign of Sender	User	Country	Callsign of Receiver	User	Country
XXL	RFFX	F F Versailles	F	RFFXL	F F Beirut	LBN
XXL	RFFXL	F F Beirut	LBN	RFFX	F F Versailles	F
XXS	RFFX	MOD Paris	F	RFFXS	F F Mogadishu	SOM
XXX	RFLI	F F Fort de France	MRT	RFLIG	F F Cayenne	GUF
XZI	RFFXI	F F Bangui	CAF	RFFX	F F Versailles	F
XZL	RFFXL	F F Beirut	LBN	RFFX	F F Versailles	F
XZS	RFFXS	F F Mogadishu	SOM	RFFX	F F Versailles	F

Table : List circuits and their routing indicators

Example :

1. ZCZCRUN567
2. OO RFVI
3. DE RFFAXD 0740806
4. ZNR UUUU
5. TEXT....
6. NNNN

1.	ZCZC	= starting signal
	RUN	= channel number for line between rfvi and rfqp
	567	= message number
2.	OO	= priority indicator for operational message
3.	RFVI	= NATO routing indicator for the destination
3.	DE RFFAXD	= orginator of message (must not be the transmitting station)
	0740806	= date / time group 74th day at 0806 UTC
4.	ZNR UUUU	= secrecy classification here unclassified
5.	TEXT	
6.	NNNN	= ending signal

Areonautical Fixed Telecommunication Network

Many Airports have teletype connection to other airports in their area.
These telecommunication links are part of the areonautical fixed telecommunication network AFTN.
They are used i.e. for passenger lists, important messages, weather forecast, security informations a.s.o. The ASECNA (Agence pour la Securite de la Navigation Aerienne en Afrique et a Madagascar) is for example such an organisation responsible for Africa.
These telecommunication lines have also circuit identifiers, which make it possible to find out who is transmitter and receiver of messages.
In the following table are listed some of the well known routes between airports. Note, that in different parts of the world the same circuit identifier could be used.

Circuit identifier	Callsign from	User from	Country from	Callsign to	User to	Country to
KFA	TJK 28	Douala Air	CME	TNL 25	Brazzaville Air	COG
	4RM	Colombo Air	CLN	8Q9	Male Air	MLD
	5TX	Nouadhibou Air	MTN	6VU	Dakar Air	SEN
	6VU 38	Dakar Air	SEN	5TX	Nouadhibou Air	MTN
	NKW	USN Diego Garcia	DGA	3BZ	Mauritius Air, Plaisance	MAU
KNA	5NK	Kano Air	NIG	5UA	Niamey Air	NGR
	5HD	Dar es Salaam Air	TZA			RRW
	9JZ 6	Lusaka Air	ZMB	7QZ	Lilongwe Air	MWI
	AVO 2	Port Blair Air	ADM	AWC	Calcutta Air	IND
	S7Z	Seychelles Air, Mahe	SEY	3BZ	Mauritius Air, Plaisance	MAU
	9NK	Kathmandu Air	NPL	AWC	Calcutta Air	IND
BDA	HSD 87	Bangkok Air	THA	S2D	Dhaka Air	BGD
BDA	9UA	Bujumbara Air	BDI	5HD	Dar es Salaam Air	TZA
BNA	TNL 48	Brazzaville Air	COG	5UA	Niamey Air	NGR
CGA	TYE	Cotonou Air	BEN	9GC	Accra Air	GHA
CMA	D4B	Sal Air	CPV	CSY	Santa Maria Air	AZR
CVA	9JZ 8	Lusaka Air	ZMB	FLLI		
DBA	6VU 45	Dakar Air	SEN	TZH	Bamako Air	MLI
DBA	S2D	Dhaka Air	BGD	HSD	Bankgog Air	THA
DBA	5HD	Dar es Salaam Air	TZA	9UA	Bujumbara Air	BDI
ESA	SUC 60	Cairo Air	EGY	STK	Khartoum Air	SDN
ESB	SUC	Cairo Air	EGY	STK	Khartoum Air	SDN
FGA	TNL	Brazzaville Air	COG	TRK	Libreville Air	GAB
FHA	TNL	Brazzavile Air	COG			
FKA	TNL 25	Brazzaville Air	COG	TJK	Douala Air	CME
FLA	TNL	Brazzavile Air	COG	TTL	N`djamena Air	TCD
FOA	TNL	Brazzavile Air	COG			
LFA	TTL	N`djamena Air	TCD	TNL	Brazzaville Air	COG
GCA	9GC6	Accra Air	GHA	TYE	Cotonou Air	BEN
GFA	TRK	Libreville Air	GAB	TNL	Brazzaville Air	COG
GIA	9GC	Accra Air	GHA	TUH	Abidjan Air	CTI
HVA	DJR	Djibouti Air	DJI	ETD 3	Addis Abeba Air	ETH
IBA	TUH	Abidjan Air	CTI	TZH	Bamako Air	MLI
IGA	TUH 55	Abidjan Air	CTI	9GC	Accra Air	GHA
IKA	AWD	New Delhi Air	IND	9NK	Kathmandu Air	NPL
ILA	TUH	Abidjan Air	CTI	ELRB	Monrovia Air	LBR
INA	TUH	Abidjan Air	CTI	5UA	Niamey Air	NGR
ISA	CAI7E	Mataveri Air	PAQ	CAK	Santiago Air	CHL
JVA	HZJ	Jeddah Air	ARS	ETD 3	Addis Abeba Air	ETH
KLA	TJK	Douala Air	CME	TLO	Bangui Air	CAF
KMA	5YD	Nairobi Air	KEN	6OM	Mogadishu Air	SOM
KSA	5YD	Nairobi Air	KEN	STK	Khartoum Air	SDN
KTA	YAV	Kabul Air	AFG	EPD	Teheran Air	IRN

KVA	5YD	Nairobi Air	KEN	ETD 3	Addis Abeba Air	ETH
LMA	5AF	Tripoli Air	LBY	9HA	Luqa Air	MLT
LOA	ELRB	Monrovia Air	LBR	6VU	Dakar Air	SEN
LSA	5AF	Tripoli Air	LBY	STK	Khartoum Air	SDN
LZA	9JZ 9	Lusaka Air	ZMB	9PL	Kinshasa Air	ZMB
MCA	8Q9	Male Air	MLD	4RM	Colombo Air	CLN
MCA	CSY	Santa Maria Air	AZR	D4B	Sal Air	CPV
MLA	9HA	Luqa Air	MLT	5AF	Tripoli Air	LBY
MSA	CSY 40	Santa Maria Air	AZR	EIP	Shannon Air	IRL
NKA	5UA 41	Niamey Air	NGR	5NK	Kano Air	NIG
NOA	5UA 31	Niamey Air	NGR	XTU 31	Ouagadougou Air	BFA
NOA	8BN	Medan Air	INS		Padang Air	
NUA	5UA 46	Niamey Air	NGR	TYE	Catonou Air	BEN
NZA	9UA	Bujumbara Air	BDI	9PL	Kinshasa Air	ZAI
OLA	6VY 50	Dakar Air	SEN	ELRB	Monrovia Air	LBR
ONA	XTU 31	Ouagadougou Air	BFA	5UA 31	Niamey Air	NGR
PTA	3BZ	Mauritius Air, Plaisance	MAU	5ST	Antananarivo Air	MDG
RFA	TNO	Pointe Noir Air	COG	TNL	Brazzavile Air	COG
SEB	STK	Khartoum Air	SDN	SUC	Cairo Air	EGY
SIA	CAK	Santiago Air	CHL	CAI7E	Mataveri Air	PAQ
SKA	STK 70	Khartoum Air	SDN	5YD	Nairobi Air	KEN
SLA	STK	Khartoum Air	SDN	5AF	Tripoli Air	LBY
SMA	EIP	Shannon Air	IRL	CSY	Santa Maria Air	AZR
SVA	STK	Khartoum Air	SDN	ETD 3	Addis Abeba Air	ETH
SZA	STK	Khartoum Air	SDN	9PL	Kinshasa Air	ZAI
TKA	EPD 58	Teheran Air	IRN	YAV	Kabul Air	AFG
TPA	5ST	Antananarivo Air	MDG	3BZ	Mauritius Air, Plaisance	MAU
TTA	5ST	Antananarivo Air	MDG	3BZ	Mauritius Air, Plaisance	MAU
UNA	TYE 41	Catonou Air	BEN	5UA	Niamey Air	NGR
VBA	XTU	Ouagadougou Air	BFA	TZH	Bamako Air	MLI
VJA	ETD 3	Addis Abeba Air	ETH	HZJ	Jeddah Air	ARS
VKA	ETD 3	Addis Abeba Air	ETH	5YD	Nairobi Air	KEN
VWB	ETD 3	Addis Abeba Air	ETH	7OC	Aden Air	YEM
WVB	7OC	Aden Air	YEM	ETD 3	Addis Abeba Air	ETH
ZDA	9PL	Kinshasa Air	ZAI			AGL
ZLA	9PL	Kinshasa Air	ZAI	9JZ	Lusaka Air	ZMB
ZSA	9PL	Kinshasa Air	ZAI	STK	Khartoum Air	SDN
ZUA	9PL	Kinshasa Air	ZAI			SDN

Table : Circuits in the AFTN

AFTN Messages

There are three diffferent kind of messages which are usally transmitted on these telecommunciation links : standard messages, notices to airmen (NOTAM) and weather messages (TAF : aerodrome forecast, METAR : aviation routine weather report)

Standard Messages

A typical message consist of a header with zczc followed by the circuit identifier and the channel sequence number. The first letter of the circuit identifier identifies the transmiting station of the circuit (transmitting terminal letter) and the second the receiving station (receeiving terminal letter). The third letter identifies the channel (channel identification letter)
These letters are i.e. a, b aso. The channel sequence number gives the number of messages transmitted on this channel. It is started at 000 at 00.00 UTC every day.

An additional service indication is the time of transmission of the message on the used channel.

The next part contains the address information with a priority indicator followed by the stations to which the message should be forwarded.
Valid priority indicators include :

SS	Distress traffic and urgent messages
DD	Message requiring special priority handling
FF	Flight safety message
GG	Aeronautical administrative messages
	Flight regulatory message
	Meteorological messages
--	Service message
KK	Reservation messages
	General aircraft operating agency message

The following line gives the orginator of the message with a date/time group.
After this is transmitted the text in brackets beginning with the message designator in front of the text, which gives the contents in a short abbreveation, what kind of message follows

Possible designators are :

ACP	Acceptance message
ALR	Alerting message
ARR	Arrival message
CDN	Coordination message
CHG	Flight plan modification message
CNL	Flight plan cancellation message
CPL	Current flight plan message
DEP	Departure message
DLA	Delay message
EST	Estimate message
FPL	Filed flight plan message
LAM	Local acknowledgement message
RCF	Radio communication failure message
RQP	Requested flight plan message
RQS	Request supplementary flight plan message
SCN	Slot cancellation message
SLT	Slot allocation message
SPL	Supplementary flight plan message
SRQ	Slot request message

After the text follows the ending group NNNN.

Example :

```
ZCZC PSA099 301200
FF LECMZQ
301200 LPPTTPZI
(DEP LH123 LPPT1100 LECM)
NNNN
```

ZCZC : starting signal

PSA099 : Channel between Lisbon (P) and Madrid (S) channel number A (there is only one channel between both stations), message number 099 for this day (changes daily at 00.00 o'clock to 000)

301200 : transmitted at 30th of this month at 1200 o'clock

FF LECMZQ	: flight safety message for Madrid (lecm), officer in charge at flighth information center (zq)
301130LPPTTPZI	: orginator indicator at 30th of this month at 11.30 o'clock Lisbon (lppt) from Air Portugal (tp), flight information center (zi)
(DEP LH123	: departure of Lufthansa flight LH123
LPPT 1100	: at 11.00 o'clock from Lisbon
LECM)	: destination Madrid
NNNN	: ending signal

Notice to Airmen (NOTAM)

In the NOTAM code are distributed messages which contain information regarding establishment, condition or change of radio aids, aerodromes and lighting facilities, dangers to aircraft in flight or search and rescue facilities.
NOTAM messages contain groups of total five letters. The first letter is always Q to indicate the code abbreviation.
The second and third letter identifies the object reported on and the fourth and fifth letter the status of operation.

The format of a NOTAM is as follows :

Open bracket followed by the orginators message series and number with orginator identifier

NOTAMC for a NOTAM cancelling a previous NOTAM
NOTAMN for a NOTAM containing new information
NOTAMR for a NOTAM replacing a previous NOTAM

In case of NOTAMR and NOTAMC follows the series and number of the NOTAM to be cancelled or replaced.
The next lines start with the letters from a to g. If there is no information for a letter, this line is not transmitted.

a) identification of location in which the facility, airspace or condition is reported on
b) start of period of validity
c) end of period of validity
d) time schedule fot period of validity
e) text
f) lower limit (for navigation warnings)
g) upper limit (for navigation warnings)

The end is marked with a closing bracket.

The significations assigned to the NOTAM groups are according the following table :

Second and third letter

A. Airspace organisation (RAC)

AA minimum altitude
AC control zone
AD air defence identification zone
AE control area
AF flight information region
AH upper control area
AL Minimum useable flight level
AN area navigation route
AO oceanic control area
AP reporting point
AR ATS route
AT terminal control area
AU upper flight information region
AV upper advisory area
AX intersection
AZ aerodrome traffic zone

C. Communication/radar facilities (COM)

CA air/ground facility
CE en route surveillance radar
CG ground controlled approach system
CL selective calling system
CM surface movement radar
CP precision approach radar
CR surveillance radar element of CP
CS secondary surveillance radar
CT terminal area surveillance radar

F. Facilities and services (AGA)

FA aerodrome
FB braking action measurement equipment
FC Ceiling measurement equipment
FD docking system
FF fire fighting and rescue
FG ground movement control
FH helicopter alighting platform/area
FL landing direction indicator
FM meteorological service
FO fog dispersal system
FP heliport
FS snow removal equipment
FT tranmissometer
FU fuel availability
FW wind direction indicator
FZ customs

I. Instrument /microwave landing system (COM)

IC instrument landing system
ID DME associated with ILS
IG glide path ILS
II inner marker ILS
IL localizer ILS
IM middle marker ILS
IO outer marker ILS

IS ILS category I
IT ILS category II
IU ILS category III
IW microwave landing system
IX locator outer ILS
IY locator middle ILS

L. Lighting facilities (AGA)

LA approach lighting system
LB aerodrome beacon
LC runway center line lights
LD landing direction indicator lights
LE runway edge lights
LF sequenced flashing lights
LH high intensity runway lights
LI runway identifier lights
LJ runway alignment indicator lights
LK category II components of approach lighting system
LL low intensity runway lights
LM medium intensity runway lights
LP precision approach path indicator
LR all landing area lighting facilities
LS stopway lights
LT threshold lights
LV visual approach slope indicator system
LW heliport lighting
LX taxiway center line lights
LY taxiway edge lights
LZ runway touchdown zone lights

M. Movement and landing area (AGA)

MA movement area
MB bearing strength
MC clearway
MD declared dictances
MG taxiing guidance system
MH runway arresting gear
MK parking area
MM daylight markings
MN apron
MP aircraft stands
MR runway
MS stopway
MT threshold
MU runway turning bay
MW strip
MX taxiway

N. Terminal/en route navigation facilities (COM)

NA all radio navigation facilities (except...)
NB non directional radio beacon
NC DECCA
ND distance measurement equipment
NF fan marker
NL locator
NM VOR/DME
NN TACAN

NO OMEGA
NT VORTAC
NV VOR
NX direction finding system

O. Other information

OA aeronautical information service
OB obstacle
OE aircraft entry requirements
OL obstacle lights on...
OR rescue coordination center

P. Air traffic procedure (RAC)

PA standard instrument arrival
PD standard instrument departure
PF flow control procedure
PH holding procedure
PI instrument approach procedure
PL obstacle clearance limit
PM aerodrome operating minima
PO obstacle clearance altitude
PP obstacle clearance height
PR radio failure procedure
PT transition altitude
PU missed approach procedure
PX minimum holding altitude
PZ ADIZ procedure

R. Navigation warnings/airspace restrictions

RA airspace reservation
RD danger area
RO overflying of...
RP prohibeted area
RR restricted area
RT temporary restricted area

S. Air traffic/VOLMET services (RAC)

SA automatic terminal information service
SB ATS reporting service
SC area control center
SE flight information service
SF aerodrome flight information service
SL flow control center
SO oceanic area control center
SP approach control center
SS flight service station
ST aerodrome control tower
SU upper area control center
SV VOLMET broadcast
SY upper advisory service

W. Navigation warnings

WA air display
WB aerobatics
WC captive balloon or kite
WD demolition of explosives
WE excercises

WF	air refueling
WG	glider flying
WJ	banner/target towing
WL	ascent of free balloon
WM	missile, gun or rocket firing
WP	parachute excercise
WS	burning or blowing gas
WT	mass movement of aircrafts
WV	formation flight
WW	significant volcanic activity
WZ	model flying

Fourth and fifth letter

A. Availability

AC	withdrawn for maintenance
AD	available for daylight operation
AF	flight checked and found reliable
AG	operating but ground check only awaiting flight check
AH	hours of service are now
AK	resumed normal operation
AL	operative subject to previously published limitations/conditions
AM	military operations only
AN	available for night operation
AO	operational
AP	available, proir permission required
AR	available on request
AS	unserviceable
AU	not available
AW	completely withdrawn
AX	previously promugated shutdown has been cancelled

C. Changes

CA	activated
CC	completed
CD	deactivated
CE	erected
CF	operating frequency changed to
CG	downgraded to
CH	changed
CI	identification or radio callsign changed to
CL	realigned
CM	displaced
CN	cancelled
CO	operating
CP	operating on reduced power
CR	temporarily repaced by
CS	installed
CT	on test, do not use

H. Hazard conditions

HA braking action is 1.poor 2.medium/poor
3.medium
4.medium/good
5.good

HB	braking coefficent is...
HC	covered by compact snow to a depth of
HD	covered by dry snow to a depth of
HE	covered by water to a depth of
HF	totally free of snow and ice
HG	grass cutting in progress
HH	hazard due to
HI	covered by ice
HJ	launch planned...
HK	bird migration in progress
HL	snow clearance completed
HM	marked by
HN	covered by wet snow or slush to a depth of
HO	obscured by snow
HP	snow clearence in progress
HQ	operation cancelled...
HR	standing water
HS	sanding in progress
HT	approach according to signal area only
HU	launch in progress...
HV	work completed
HW	work in progress
HX	concentration of birds
HY	snow banks exist
HZ	covered by frozen ruts and ridges

L. Limitations

LA	operating on auxilary power supply
LB	reserved for aircraft based therein
LC	closed
LD	unsafe
LE	operating without auxilarx power supply
LF	interference from
LG	operating without identification
LH	inserviceable for aircrafts heavier than
LI	closed for IFR operations
LK	operating as a fixed light
LL	useable for lenght of... and width of...
LN	closed to all night operations
LP	prohibeted to
LR	aircraft restricted to runway and taxiways
LS	subject to interruption
LT	limited to
LV	closed to VFR operations
LW	will take place
LX	operating but caution advised due to

XX Other

plaine voice is following

Weather Forecast (TAF and METAR)

These messages are aviation routine weather report (METAR) and aerodrome forecast (TAF).

The used code forms are as follows :

TAF

TAF CCCC ($G_1G_1G_2G_2$) dddff/f_mf_m VVVV w'w' $N_sCCh_sh_sh_s$ TTTTT GGG_eG_e...
oder CAVOK

METAR

METAR CCCC (GGgg) dddff/f_mf_m VVVV w'w' $N_sCCh_sh_sh_s$ T'T'/T'$_d$T'$_d$ $P_HP_HP_HP_H$ NOSIG or TTTTT...
or CAVOK

The groups have the following meaning :

CCCC	ICAO international four letter location indicator
$G_1G_1G_2G_2$	Time of commencment of period of forecast G_1G_1 to G_2G_2
GGgg	Time of observation
dddff/f_mf_m	ddd = wind speed, ff = speed in knots f_mf_m = maximum wind speed
VVVV	Horizontal visibility on surface in increments of 100 m up to 5 km, between 5 km and 10 km in 1000 m increments, 9999 is 10 km or more)
w'w'	Significant present and forecast weather consisting of 2 numbers and up to 6 letters

04FU	Smoke
05HZ	Dust haze
06HZ	Dust haze
07SA	Sandstorm
08PO	Dust devil
10BR	Mist
11MIFG	Shallow fog
12MIFG	shallow fog
17TS	Thunderstorm
18SQ	Squall
19FC	Funnel cloud
20REDZ	Drizzle
21RERA	Rain
22RESN	Snow
23RERASN	Rain and snow
24REFZRA	Freezing rain
25RESH	Showers
26RESNSH	Snow showers
27REGR	Hail
29RETS	Thunderstormr
30SA	Sand-/ duststorm
31SA	Sand-/ duststorm
33XXSA	Heavy Sand-/ duststorm
34XXSA	Heavy Sand-/ duststorm
35XXSA	Heavy Sand-/ duststorm

36DRSN	Low drifting snow
37DRSN	Low drifting snow
38BLSN	Blowing snow
38BLSN	Blowing snow
40BCFG	Fog patches
41BCFG	Fog patches
42-47FG	Fog
48FZFG	Freezing fog
49FZFG	Freezing fog
50DZ-53DZ	Drizzle
54XXDZ	Heavy drizzle
55XXDZ	Heavy drizzle
56FZDZ	Freezing drizzle
57XXDZ	Heavy freezing drizzle
58- 63RA	Rain
64XXRA	Heavy rain
65XXRA	Heavy rain
66FZRA	Freezing rain
67XXFZRA	Heavy freezing rain
68RASN	Rain and snow
69XXRASN	Heavy rain and snow
70-72SN	Snow
74XXSN	Heavy snow
75XXSN	Heavy snow
77SG	Snow grains
79PE	Ice pellets
80RASH	Showers
81XXSH	Heavy showers
82XXSH	Heavy showers
83RASN	Showers of rain and snow
84XXRASN	Heavy showers of rain and snow
87GR	Soft hail
88GR	Soft hail
89GR	Hail
90XXGR	Heavy hail
91RA	Rain
92XXRA	Heavy rain
93GR	Hail
94XXGR	Heavy hail
95TS	Thunderstorm
96TSGR	Thunderstorm with hail
97XXTS	Heavy thunderstorm with hail
98TSSA	Thunderstorm with sand-/ duststorm
99XXTSGR	Heavy thunderstorm with hail

N_S Amount of cloud covering the sky in oktas (9 = sky obscured)

CC Genus of clouds

CI	Cirrius
CC	Cirrocumulus
CS	Cirrostratus
AC	Altocumulus
AS	Altostratus
NS	Nimbostratus
SC	Stratocumulus
ST	Stratus
CU	Cumulus
CB	Cumulonimbus
/	clouds not visible

$h_sh_sh_s$ Hight of clouds obove surface in 100 ft steps

CAVOK Replacment for thr group VVVV w'w' $N_SCCh_sh_sh_s$ wif sight better than 10 km, no fog or precipiation and clouds above 5000 ft

T'T' Temperature in whole degrees Celsius

$T'_dT'_d$ Dew point temperature in whole degrees Celsius (M= minus)

$P_HP_HP_HP_H$ Pressure in hPa

TTTTT Change indicators in the time from GG to G_eG_e

GRADU	gradual change
RAPID	rapid change
TEMPO	temporary change
INTER	intermitting exchange
PROB	probability of forecast in percent

NOSIG no significant change

Designation of Emissions

Emissions are named by the necessary bandwidth and their mode of transmission they need. The bandwidth is composed by three numbers and one letter.
The letter is placed instead of a comma and gives the unit for the bandwidth
The necessary bandwidth

between 0,001 and 999 Hz is in Hz (Buchstabe H)
between 1,00 and 999 kHz is in kHz (Buchstabe K)
between 1,00 and 999 MHz is in MHz (Buchstabe M)
between 1,00 and 999 GHz is in GHz (Buchstabe G)

First Symbol - type of modulation of the main carrier

- Emission of an unmodulated carrier	N

Emission in which the main carrier is amplitude modulated
(including cases where sub carriers are angle modulated)

- Double sideband	A
- Single sideband, full carrier	H
- Single sideband, reduced or variable level carrier	R
- Single sideband, suppressed carrier	J
- Independent sidebands	B
- Vestigal sideband	C

Emission in which the main carrier is angle modulated

- Frequency modulation	F
- Phase modulation	G
- Main carrier amplitude and angle modulated simultaneously or in a pre established sequence	H

Emission of pulses

- Sequence of unmodulated pulses	P
- Sequence of pulses amplitude modulated	K
- Sequence of pulses width/duration modulated	L
- Sequence of pulses position/phase modulated	M
- Sequence of pulses where carrier is angle modulated during the period of pulses	Q
- Sequence of pulses which is a combination of the foregoing or is produced by other means	V
- Cases not covered above, in which an emission consist of carrier modulated, either simultaneously or in a pre established sequence, in a combination of two or more of the following modes :	W
- amplitude	
- angle	
- pulse	
- Cases not otherwise covered	X

Emission of pulses (emissions where the main carrier is directly modulated by a signal which has been coded into quantized form (e.g. pulse code modulation) should be designated under amplitude modulation or angle modulation above)

Second symbol - nature of signal modulating the main carrier

- No modulating signal	0
- Single channel containing quantized or digital information without use of a modulating sub-carrier	1

(excluding time devision multiplex)
- Single channel containing quantized or digital information with use of a modulating sub-carrier — 2
- Single channel containning analogue information — 3
- Two or more channels containing quantized or digital information — 7
- Two or mor channels containing analogue information — 8
- Composite system with one or more channels containing quantized or digital information, together with one or more channels containing analogue information — 9
- cases not otherwise covered — X

Third symbol - type of transmitted information

(in this context the word "information" does not include information of a constant, unvarying nature as is provided by standard frequency emissions, continous wave and pulse radars, etc.)

- No information transmitted — N
- Telegraphy - for aural reception — A
- Telegraphy - for automatic reception — B
- Facsimile — C
- Data transmission, telemetry, telecommand — D
- Telephony - including sound broadcasting — E
- Television - video — F
- Combination of the above — W
- Case not otherwise covered — X

Fourth Symbol - details of signal(s)

- Two condition code with elements of differing numbers and/or duration — A
- Two condition code with elements of the same number and duration without error correction — B
- Two condition code with elements ot the same number and duration with error correction — C
- Four condition code with each condition representing a signal element (of one or more bits) — D
- Multi condition code with each condition representing a signal element (of one or more bits) — E
- Multi condition code with each condition or combination of conditions representing a character — F
- Sound of broadcasting quality (monophonic) — G
- Sound of broadcasting quality (stereophonic or quadrophonic) — H
- Sound of commercial quality (excluding categories given below) — I
- Sound of commercial quality with the use of frequency inversion or band splitting — K
- Sound of commercial quality with seperate frequency modulated signals to control the level of demodulated signal — L
- Monochrome — M
- Colour — N
- Combination of the above — W
- Cases not otherwise covered — X

Fifth symbol - nature of multiplexing

- None — N
- Code division multiplex (include bandwidth expansion technique) — C
- Frequency division multiplex — F
- Time division multiplex — T
- Combination of time and frequency division multiplex — W
- Other types of multiplexing — X

Example :

Telephony, single side band,
suppressed carrier, one channel 2K70J3EJN

The following table gives an overview on common modes and their abbreviation :

Modulation of main carrier	Mode	remarks	new designation	old designation
AM	without modulation		N0N	A0
	telegraphy		A1A	A1
	teletype		A1B	A1
	telegraphy audio modulated		A2A	A2
	teletype		A2B	A2
	telegraphy	ESB suppressed carrier	J2A	A2J
	teletype	ESB suppressed carrier	J2B	A2J
	telegraphy	ESB reduced carrier	R2A	A2A
	telegraphy	ESB full carrier	H2A	A2H
	Telephony	two sidebands	A3E	A3
	Telephony	ESB reduced carrier	R3E	A3A
	telephony	ESB full carrier	H3E	A3H
	Telephony	ESB suppressed carrier	J3E	A3J
	Telephony	two independant sidebands	B8E	A3B
	Facsimile		A3C	A4
	Facsimile	ESB reduced carrier	R3C	A4A
	Facsimile	ESB suppressed carrier	J3C	A4J
	Television	two sidebands	A3F	A5
	Television	vestigal sideband	C3F	A5C
	Television	ESB suppressed carrier	J3F	A5J
	audio frequency multiple telegraphy	ESB reduced carrier	R7B	A7A
	audio frequency multiple telegraphy	ESB suppressed carrier	J7B	A7J
	Other		AXX	A9
FM	FSK morsetelegraphy		F1A	F1
	FSK teletype		F1B	F1
	AFSK morsetelegraphy		F2A	F2
	AFSK teletype		F2B	F2
	telephony and sound broadcasting		F3E	F3
		telephony phase modulated	G3E	F3
	Facsimile	1 channel with analogue information	F3C	F4
	Television		F3F	F5
	four frequency diplex telegraphy		F7B	F6
	Other		FXX	F9
PM	without modulation		P0N	P0
	telegraphy		K1A	P1D
	telegraphy	mod. of pulsamplitude	K2A	P2D
	telegraphy	mod. of pulsduration	L2A	P2E
	telegraphy	mod. of pulsphase	M2A	P2F
	telephony	mod. of pulsamplitude	K2E	P3D

Modulation of main carrier	Mode	remarks	new designation	old designation
	telephonie	mod. of pulsduration	L3E	P3E
	telephonie	mod. of pulsphase	V3E	P3G
	other		XXX	P9

Table 19 : Common used transmission modes

Hints for Radio Monitoring

Recognizing of PSK-, MSK- and TFM - Signals

The recognizing of PSK-, MSK-, TFM-signals is one of the most difficult things on shortwave. You are never sure whether you hear one of those signals or only inter modulation or similar.
Extreme difficult is to recognize systems with more than one channel or hybrid modulation which normally can not be demodulated by „normal“ shortwave listeners.
Hybrid modulations transmit their information in a combination of modulation parameters i.e. amplitude-, frequency and phase modulation.

In case of using PSK modulation there are different modes. They are named by the used phase shift and phase difference.

Kind of PSK	Transmitted data	Phaseshift
2 PSK A	0	none
	1	180°
2 PSK B	0	90°
	1	270°
4 PSK A	00	none
	01	90°
	10	180°
	11	270°
4 PSK B	00	45°
	01	135°
	10	225°
	11	315°

Different PSK modulationen

In the following part are shown some hints to recognize PSK with a minimum of equipment. Necessary are

- a frequency decade
- a storage oscilloscope
- an audio spectrum analyzer (software decoder or similar)

With the help of an audio spectrum analyzer it is possible to identify the baudrate of a PSK.
The signals must be amplitude demodulated. Very important is a bandwidth, which matches to this baudrate.
If the signal is a real PSK there will be a peek in the audio spectrum of the signal. This peek is equal to the used baudrate.

I.e. a baudrate of 1200 Bd will give a peek at 1200 Hz.

In this case it is very important that an idle signal will give a wrong interpretation of the baudrate by analysing the frequency of the bit frame. A special case will be a MSK or TFM signal. They will give the same peek as a PSK. But the speed to generate this peek is for a TFM not so fast as for MSK or PSK.

For confirmation of a PSK modulation it is possible to use the aid of Lissajous figures. But it is necessary to use a very precise reference signals. The signals which will be analysed must be connected to the X input of an oscilloscope and the reference signal to the Y input. This principle allows a measurement of phase differences on a single frequency. Typical discrete frequencies in a PSK spectrum are on the carrier frequency and in a distance of integer multiplem parts of the baudrate.

Lissajous figures are giving information about the phase difference between reference and input signal. A circuit i.e. means a difference of 90 or 270 degree, a line from top right to left bottom with an angle of 45 degree means a difference of 0 degree aso.
With this method it is possible to recognize all discrete frequencies in the spectrum of a signal.

In case of a PSK signal there will be only one discrete frequency on the audio mid frequency (2PSK A).
A 2 PSK B, MSK or TFM modulation will have, with the same baudrate and mid frequency like a 2PSK A, more than one discrete frequency in a distance of ± a quarter of the baudrate.

Example :

Audio Mid Frequency 2000 Hz
Baudrate 1200 Bd

Discrete Frequencies :	2 PSK A	2000 Hz
	4 PSK A	2000 Hz
	2 PSK B	1700 Hz, 2000 Hz, 2300 Hz
	MSK	1700 Hz, 2000 Hz, 2300 Hz
	TFM	1700 Hz, 2000 Hz, 2300 Hz
	4 PSK B	1850 Hz, 2000 Hz, 2150 Hz

Another possibility is by using the eye pattern which can be generated with a frequency decade and a frequency discriminator on the screen of an oscilloscope. The audio frequency of the receiver must be frequency demodulated and shown on the screen. The trigger input is connected to the frequency decade. Triggering will happen at the frequency of the baudrate. This procedure will give the discrete frequencies of the signal. A MSK will have two frequencies with floating transition. A TFM is generating three frequencies and a PSK two frequencies symmetrical to the mid frequency.

Teleprinter Alphabets

The following table for comparison and for translating Arabic characters into normal text is a good help to "read" transmissions, which have been received without correct switching between numbers and figures. It is also very helpful to translate Arabic into Latin text, so that names of cities or countries can be recognised.

Letter	Figure	Arabic Letter Meaning	Arabic Figure Meaning	ATU-A Letter	ATU-A Figure
A	-	s	s	q	-
B	?	a		ch	?
C	:	y	i	t	:
D	$	q	q	l	$
E	3	t	7		3
F	!	f	a	r	!
G	&	g	g	n	&
H	#		/	t	#
I	8	b	2	z	8
J		h	h	m	
K	(	h	h	a	(
L	)	j	j	u	)
M	.	m	m	d	.
N	,	n	n	t	,
O	9	t	1	g	9
P	0	g	0	s	0
Q	1	l	9	j	1
R	4	u	6	h	4
S	'	t	i	i	'
T	5	u	5	h	5
U	7	t	3	f	7
V	=	al-	l		=
W	2	la	8	k	2
X	/	s	s	s	/
Y	6	r	4	b	6
Z	+		s	sh	+
CR	CR	k	k	CR	CR
LF	LF	CR/LF	wru	LF	LF
LS	LS	LS	LS	LS	LS
FS	FS	FS	FS	FS	FS
Sp	sp	sp	sp	sp	sp

Table 20 : Teleprinter Alphabets for Comparison

ATU 80 Words Identification

JG	from
KDS	to
YPHKG	embassy
?KFK?K?	Caracas
?KYL?	Kabul
BLGSL KSF?	Buenos Aires
BSJG? KSF?	Buenos Aires
CDOYVO	Tel Aviv
CFKBD?	Tripoli
CG?R	Tanger
CTFK?	Teheran
DGMG	London
DKQLP	Lagos
DLKGMK	Luanda
DLPK?K	Lusaka
DYTFSG	Bahrain
FLJK	Rome
GLKWZLC	Nouakchott
GMQKJSGK	N'djamena
GSFLY	Nairobi
GSKJ?	Niamey
GSLMDT?	New Delhi
GSLSLF	New York
GSQLSK	Nicosia
HGK	Tirana
HLGP	Tunis
JAMSZSL	Mogadishu
JKGK?LK	Managua
JKGS?	Manila
JLG?FSK?	Montreal
JLPWL	Moscow
JMFSM	Madrid
JPAC	Muscat
K?SGK	Athene
KBLCB	Abu Dhabi
KDAMSJR	Kaduna
KDBFCLJ	Khartoum
KDFSKX	Riyadh
KDFYKC	Rabat
KDIGKIR	Manama
KDMLTR	Doha
KDWLSH	Kuwait
KDQIKEF	Alger
KGAFR	Ankara
KMSGK	Aden
KMS? KBKBK	Addis Abeba
KPDKJKYKM	Islamabad
KWFK	Accra
KYL CYS	Abu Dhabi
LKZGCG	Washington
MJ?Q	Damascus
MKF KDPDKJ	Dar es Salaam
MKWKF	Dakar
MY?	Dubai
OJKG	Amman
QMR	Jeddah
QSYLHS	Djibouti
TKGLK	Hanoi
USSGK	Vienna
WJYKDK	Kampala

WLGKWFS	Conakry
WSGZKPK	Kinshasa
XLUSK	Sofia
YDQFKM	Belgrade
YFDS?	Berlin
YFLWPD	Bruessels
YFS?LFSK	Pretoria
YJKWL	Bamako
YKFSP	Paris
YLG	Bonn
YLBKFPH	Bucharest
YSFLH	Beirut
YSGL? SKG?	Pyongyang
YSPKL	Bissau
YSWSG	Bejing
YTFG	Bahrain
YVMKM	Baghdad
YWSG	Bejing
BKFQSR KDAKRFR	MFA Cairo
FEKPR KDZYWR	MFA Cairo
KDHJNSD KDHQKFS	MFA Cairo
VMK	tomorrow
KDKFYOKE	today
KJP	yesterday
UAC	only
YBXLX	special
FAJ	number
KDKWHUKE	enough
HJKJ	ok
VDC	wrong
HXTST	correct
KDFESPSR	main
USLI	fuse
LTMR	unit
US	the
KDDS	in
HUXD	please
FQKE	please
YGZFR	news
KDKODKJ	information
JOS	me
KGHCF	wait
DTCR	wait
MAKEA	minutes
USX	without
LPLU	i will
PLU	will
KDKUKMR, KZOF	inform
JGWJ	with you
MLDKF	dollar
KDYGW	the bank
JDSLG	million
NKGSK	second
NKDNK	third
FKYOK	fourth
KDVS	cancel
JGKLDR	to hand
DSXYT	become
WKDKHS	as following
USR	there is
KBS	brother
KDKBH	sister

KDZWF	thanks
JO	with
LKUF	best
KPHOM	be ready
KDDR	allah
YKS YKS	bye bye
HPDJ	with peace
KJKG	good bye
KPU	sorry
HTSKHS	regards
HDSULGRK	telephone
OG	about
KDHOFU	recognice
ODS	on
KYDVRJ	tell them
RD	is
KDFESP	president
KDLIFKE	prime minister

Arabic words identification

AKBF'	press
B, B	ANA (Aden NEWS Agency)
IOYB	PETRA (Jordan Press Agency)
BYNB	IRNA (Islamic Repubilc News Agency)
BFI, PFI	AFP (Agence France Press)
PCNB	IINA (International Islamic News Agency)
P+P	MENA (Middle East News Agency)
P N P, P,P	ANA (Aden News Agency)
XTNB	SUNA (Sudan News Agency)
<TNB	KUNA (Kuwait News Agency)
.≡, T.&	MAP (Maghreb Arab Press)
TB., TB(	GNA (Gulf News Agency)
TB	news agency
T.B	AMP (Agence Mauritanienne de Press)
TB)	APS (Algerie Press service)
TB/	SPA (Saudi Press Agency)
TB&	INA (Iraqui News Agency)
TBO	TAP (Tunis Afrique Press)
TP(	GNA
TP)	APS
TPP	JNA (Jordan News Agency)
BT)	JANA (Jamahiriyah News Agency)
TBF, TPF	WAFA (Palestine News Agency)
XBNB	SANA (Syrian Arab News Agency)
ZCNKTB	XINHUA (New china News Agency)
PQMKY	Al Muharram (1st islamic month)
AFY	Safar (2nd islamic month)
YIC& bwt	Rabi al Awwal (3rd islamic month)
YIC& VUBN	Rabi al Tani (4th islamic month)
LMBR∩ BWQT:	Jumada-l-Ula (5th islamic month)
LMBR∩ BWKY	Jumada-l-Ahira (6th islamic month)
YLI	Rajab (7th islamic month)
ZHIB,	Shaban (8th islamic month)
YMAB,	Ramadan (9th islamic month)
ZTB;	Shawwal (10th islamic month)
RT VDHR!	Du-l-Kada (11th islamic month)
RT VKL!	Du-l-Hijja (12th islamic month)
CNBCY	january
FIYBCY	february
MBY/	march
BIYC;	april
MBCT, MB'	may
CTNCT	june
CTQCT	july
PGXE/, PI	august
PCQT	september
B<OTIY	october
NTFMIY	november
RLINY	december
PXYBSC;	Israel
O: PICI	Tel Aviv
OTN/	Tunesia, Tunis
VCM,	Yemen
VATMB;	Somalia
MDRCZCT	Mugadishu
MAY	Egypt
BQDBJY!	Cairo
BCYB,	Iran
EJYB,	Teheran
FYNXB	France

IBYC/	Paris
BWYR,	Jordan
VHFBD:	Iraq
IBGRBR	Baghdad
VXHTRC' VHYI!	Saudi Arabia
LR!	Jeddah
YCBR!	Riyadh
M<'	Mekka
VMRCN!	Medina
XTYCB	Syria
PCEVCB	Italy
YTMB	Rome
VMBNCB	Germany
IT,	Bonn
IYQC,	Berlin
FYBN<FTY	Bahrain
VMNBM!	Manama
VLYBSY	Alger, Algeria
VKIZ!	Ethopia
VKYET.	Khartoum
VHYBDC!	Greece
BUCNB	Athen
V<TCO	Kawait
VOY<C!	Turkey
BNDY'	Ankara
IYCEBNCB	Great Britain
QNR,	London
GMB,	Oman
MXDE	Muscat
LCITO:	Djibouti
YTXCB	Russia
MTX<T	Moscow
DEY	Qatar
ITQTNCB	Poland
IQHYBR	Belgrade
JNHBYCB	Hungary
ITRBIXO	Budapest
YTMBNCB	Roumania
ITKBYXO	Bucharest
NCTCTY	New York
VJNRC!	India
NCTRQJ:	New Delhi
BMXYORB.	Amsterdam
BFHBNXOB,	Afghanistan
IPQHBYCB	Bulgaria
ATFCB	Sofia
IB<XOB	Pakistan
ICTN) CBN)	Pyongyang
QINB,	Beirut
VACN:	China
I<C	Bejing
NCLYCB	Nigeria
NBMCICB	Namibia
GBMICB	Gambia
GCNCB	Guinea
FCONB.	Vietnam
BXIBNCB	Spain
MRYCR	Madrid
OBNXBNCB	Tanzania
QCICB	Libya
VXTRB,	Sudan
VXTC/	Switzerland

VXTCR	Sweden
VNCLY	Niger
BFYCDCB	Africa
BTYTIB	Europe
BMYC<B	America
BMYC<B VWOCNC	Latin America
GYI:	arabic
BWNIB?	news
&	from
YBRCT	radio
VXCR	mister
VRTQC!	Ministry of Foreign Affairs
V:, BQ:	to
OQHYBF	telegram
COI&	more
VQKC)	gulf
VKBY)	foreign country
XFCY	ambassador

Q and Z - Code

Q - Groups

These code abbreviations can be used as a question, answer or advise. In case of a question a question mark must be transmitted behind the group.
Times should be given in UTC only.
Q code abbreviations beginning with QAA to QNZ are used in AMS service and groups from QOA to QQZ for MMS service.
Data filled in where blanks appear shall be sent in the order as shown in the table.

Q Code	Meaning
QAB	You are cleared (*or*... is cleared) by... from... (*place*) to... (*place*) at flight level/altitude...
QAF	I am (was) at (over)... (*place*)(at... hours) at flight level/altitude...
QAG	I am arranging my flight in order to arrive over... (*place*) at... hours
QAH	I am at flight level/altitude...
QAI	The essential traffic respecting your aircraft is...
QAK	There is risk of collision
QAL	I am going to land at... (*place*)
QAM	Meteorological observation made at... (*place*) at... hours was as follows
QAN	The surface wind direction and speed at... (*place*) at... hours is... (*direction*)... (*speed figures and units*)
QAO	The wind direction and speed at... (*position or zone/s*) at flight level/altitude... is... (*vertical distance in figures and units*)... degrees true (*speed in figures and units*)
QAP	Listen for me (*or* for...) on... kHz (... MHz)
QAQ	You are 1. near 2. flying within area... (*identification of area*)
QAR	You may stop listening on the watch frequency for... minutes
QAU	I am about to jettison fuel
QAW	I am about to carry out overshoot procedure
QAY	I passed...(*place*) bearing... degrees relative to my heading at... hours
QAZ	I am experiencing communication difficulties through flying in a storm
QBA	The horizontal visibility at... (*place*) at... hours is... (*distance figures units*)
QBB	The amount, type and height above official aerodrome elevation of the base of the clouds at... (*place*) at... hours is... eights (... type) at... (*figures and units*) heigt above official aerodrome elevation
QBC	The metorological conditions as observed from my aircraft at... (*position or zone*) at... hours at... (*figures and units*) height above...(*datum*) are...
QBD	My fuel endurance is... (*hours and/or minutes*)
QBE	I am about to wind in my aerial
QBF	I am flying in cloud at flight level/altitude... (and i am ascending (descending) to flight level/altitude...)
QBG	I am flying above cloud and at flight level/altitude...
QBH	I am flying below cloud and at flight level/altitude...
QBI	Flight under IFR is compulsory at... (*place*)(*or* from... to... (*place*))
QBJ	At... hours at... (*position or zone*) the top of the cloud is amount... eights (...type) at... (*figures and units*) height above... (*datum*)
QBK	I am flying with no cloud in my vicinity and at flight level/altitude...
QBM	Here is the message sent by... at... hours
QBN	I am flying between two layers of cloud and at flight level/altitude...
QBO	Flying under VFR is permissible at... (*place*) which would be suitable for your landing
QBP	I am flying in and out cloud and at flight level/altitude...
QBS	Ascend (*or* descend) to... (*figures and units*) height above... (*datum*) before encountering instrument meteorological conditions or if visibility falls below... (*figure and units of distance*) and advise

Q Code	Meaning
QBT	The runway visual range at... (*place*) at... hours is... (*distance figures and units*)
QBV	I have reached flight level/altitude... (*or*... (*area or place*)
QBX	I have left flight level/altitude... (*or*... (*area or place*)
QBZ	I am reporting my flight conditions in relation to clouds
QCA	I am changing my flight level/altitude from... to...
QCB	Delay is being caused by 1. your transmitting out of turn 2. your slowness in answering 3. lack of reply to my...
QCE	Expect approach clearance at... hours
QCF	Delay indefinite. Expect approach clearance not later than... hours
QCH	Cleared to taxi to... (*place*)
QCI	I am making a 360 degree turn immediately (turning to the...)
QCS	My reception on... frequency has broken down
QCX	My full call sign is...
QCY	I am working on trailing aerial
QDB	I have sent message... to...
QDF	My D-value at... (*position*) at... (*figures and units*) height above the 1013.2 hectopascal datum is... (*D-value figures and units*)... (*specify plus or minus*)
QDL	I intend to ask you for a series of bearings
QDM	The magnetic heading for your steer to reach me (*or*...) with no wind was... degrees (at... hours)
QDP	I will accept control (*or* responsibility) of (for)... now (*or* at... hours)
QDR	Your magnetic bearing from me (*or* from...) was... degrees (at... hours)
QDT	I am flying in visual meteorological conditions
QDU	Cancelling my IFR flight
QDV	I am flying in a flight visibility of less than... (*figures and units*) at flight level/altitude...
QEA	You may cross the runway ahead of you
QEB	Taxi as follows at the intersection... (turn left *left* turn right *rite*)
QEC	You may make a 180 degree turn and return down the runway
QED	Follow the pilot vehicle
QEF	I have reched my parking area
QEG	I have left the parking area
QEH	I have moved to the holding position for runway number...
QEJ	I am assuming take off position for runway number... and i am holding
QEK	I am ready for immediate take off
QEL	You are cleared to take off (turn as follows after take off...)
QEM	The condition of the landing surface at... (*place*) is...
QEN	Hold your position
QEO	I have cleared the runway (*or* landing area)
QES	A right hand circuit is in force at... (*place*)
QFA	The meteorological forecast for... (*flight, route, section of route or zone*) for the period... hours until... hours is...
QFB	The 1. approach 2. runway 3. approach and runway lights are out of order
QFC	At... (*place, position, or zone*) the base of the cloud is... eighths... type at (*figures and units*) height above... (*datum*)
QFD	1. The... visual beacon (at...(*place*)) is in operation 2. I will extinguish the aerodrome visual beacon (at... (*place*)) until your landing is completed
QFE	If you set the subscale of your altimeter to read... hectopascal, the instrument would indicate its height above aerodrome elevation (above threshold, runway number...)
QFF	At... (*place*) the atmospheric pressure converted to mean sea level in accordance with meteorological practice is... (*or* is determined at... hours to be)... hectopascal

Q Code	Meaning
QFG	You are overhead
QFH	You may descend below the clouds
QFI	The aerodrome lights are lit
QFM	1. Maintain (or fly at) flight level/altitude... 2. I am maintaining flight level/altitude... 3. I intend cruising at flight level/altitude...
QFO	You may land immediately
QFP	The last information concerning... facility (at... (*place*)) is as follows
QFQ	The approach and runway lights are lit
QFR	Your landing gear appears damaged
QFS	The radio facility at... (*place*) is in operation (*or* will be in operation in... hours)
QFT	Ice formation have been observed at... (*position or zone*) in the type of... and with an accretion rate of... between... (*figures and units*) heights above... (*datum*)
QFU	The magnetic direction (*or* number) the runway to be used is...
QFV	The floodlights are switched on
QFW	The length of runway... now in use is... (*figures and units*)
QFX	I am working (*or* going to work) on a fixed aerial
QFY	The present meteorologocal landing conditions at... (*place*) are...
QFZ	The aerodrome meterological forecast for... (*place*) for the period... hours until... hours is...
QGC	There are obstructions to the... of runway...
QGD	There are obstructions on your track... (*figures and units*) height above... (*datum*)
QGE	Your distance to my station (*or* to...) is... (*distance figures and units*)
QGH	You may land using... (*procedure or facility*)
QGK	I am making good a track from... (*place*) on... degrees.. (*true or magnetic*)
QGL	You may enter the... (*control area or zone*) at... (place)
QGM	Leave th... (*control area or zone*)
QGN	You are cleared to land (at... *place*)
QGO	Landing is prohibited at... (*place*)
QGP	You are number... to land
QGQ	Hold at... (*place*) at flight level/altitude..., and await further clearance
QGT	Fly for... minutes on a heading that will enable you to maintain a track reciprocal to your present one
QGU	Fly for... minutes on a magnetic heading of... degrees
QGV	I see you at... (*cardinal or quadrantal point of direction*) *or* I can see the aerodrome *or* I see... (*aircraft*)
QGW	Your landing gear appears to be down and in place
QGZ	Hold on... direction of... facility
QHE	I am on 1. cross wind leg 2. down wind leg 3. base leg 4. final leg of approach
QHG	Cleared to enter traffic circuit at flight level/altitude...
QHH	I am making an emergency landing
QHI	I am (*or*... is) 1. waterborne 2. on land at... hours
QHQ	I am making a... approach
QHZ	Circle the aerodrome (*or* go around)
QIC	I will establish communication with... radio station on... kHz (*or*... MHz)now (*or* at...hours)
QIF	... is using... kHz (*or*...MHz)
QJA	Your 1. tape 2. mark and space is reversed

Q Code	Meaning
QJB	I will use 1. radio 2. cable 3. telegraph 4. teletypewriter 5. telephone 6. receiver 7. transmitter 8. reperforator
QJC	I will check my 1. transmitter 2. auto head 3. perforator 4. reperforator 5. printer 6. printer motor 7. keyboard 8. antenna system
QJD	you are transmitting in 1. letters 2. figures
QJE	Your frequency shift is too 1. wide 2. narrow 3. correct (by... cycles)
QJF	My signal as checked by monitor... is satisfactory 1. locally 2. as radiated
QJG	Revert to automatic relay
QJH	Run 1. your test tape 2. a test sentence
QJI	I am transmitting a continuous 1. mark 2. space
QJK	I am receiving 1. a continuous mark 2. a continuous space 3. a mark bias 4. a space bias
QKC	The sea conditions (at... position)... 1. permit aligthing but not take off 2. render aligthing extremely hazardous
QKF	You may expect to be relieved at... hours (by 1. aircraft... (identification)(type) 2. vessel whose call sign is... (*call sign*) (*and/or* whose name is... (*name*))
QKG	Relief will take place when... (*identification*) establishes 1. visual 2. communication contact with survivor
QKH	The parallel sweep (track) search is being (*or* to be) conducted 1. with direction of sweeps... degrees... (*true or magnetic*) 2. with... (*distance figures and units)* separation between sweeps 3. at flight level/altitude...
QKN	Aircraft plotted (believed to be you) in position... on track... degrees at... hours
QKO	In the operation (...(*identification*)), the following units are (*or* will be) taking part... (*name of units*)

Q Code	Meaning
QKP	The search pattern is 1. parallel sweep 2. square search 3. creeping line ahead 4. track crawl 5. contour search 6. combined search by aircraft and ship 7..... (*specify*)
QLB	I have monitored... station and report (*briefly*) as follows...
QLH	I will know key simultaneously on... frequency and... frequency
QLV	The... radio facility is still required
QMH	Shift to transmit and receive on... kHz (or... MHz); if communication is not established within 5 minutes, revert to present frequency
QMI	The vertical distribution of cloud as observed from my aircraft at... hours at... (*position or zone*) is : lowest layer observed... eights (... type) with base of... (*figures and units*) and tops of... (*figures and units*) height above... (*datum*)
QMU	The surface temperature at... (*place*) at... hours is... degrees and the dew point temperature at that time and place is... degrees
QMW	At... (*position or zone*) the zero celcius isotherm(s) is (are) at flight level/altitude...
QMX	At... (position or zone) at... hours the air temperature is... (degrees and units) at flight level/altitude...
QMZ	The following amendment(s) should be made to the flight level forecast...
QNE	On landing at... (*place*) at... hours, with your subscale being set to 1013.2 hectopascal, your altimeter will indicate... (*figures and units*)
QNH	If you set the subscale of your altimeter to read... hectopascal, the instrument would indicate its elevation if your aircraft were on the ground at my station at... hours
QNI	Turbulence has been observed at... (*position or zone*) with an intensity of... between... (*figures and units*) and... (*figures and units*) heights above... (*datum*)
QNO	I am not equipped to give the information (*or* provide the facility) requested
QNR	I am approaching my point with no return
QNT	The maximum speed of the surface wind at... (*place*) at... hours is... (*speed figures and units*)
QNY	The present weather and intensity thereof at... (*place, position or zone*) at... hours is...
QOA	I can communicate by radiotelegrapy (500 kHz)
QOB	I can communicate by radiotelephony (2182 kHz)
QOC	I can communicate by radiotelephony (channel 16 - frequency 156.8 MHz)
QOD	I can communicate with you in 0. Dutch 1. English 2. French 3. German 4. Greek 5. Italian 6. Japanese 7. Norwegian 8. Russian 9. Spanish
QOE	I have received the safety signal sent by... (*name and/or call sign*)
QOF	The quality of your signal is 1. not commercial 2. marginally commercial 3. commercial
QOG	I have... tapes to send
QOH	Send a phasing signal for... seconds
QOI	Send your tape
QOJ	I am listening on... kHz (*or* MHz) for signals of emergency position indicating radio beacons

Q Code	Meaning
QOK	I have received the signal of an emergency position indicating radio beacon on... kHz (*or* MHz)
QOL	My vessel is fitted for the reception of selective calls. My selective call number or signal is...
QOM	My vessel can be reached by a selective call on the following frequency/ies... (*periods of time to be added if necessary*)
QOO	I can send on any working frequency
QOT	I hear your call ; the approximate delay is... minutes
QRA	The name of my station is...
QRB	The approximate distance between our stations is... nautical miles (*or*... kilometres)
QRC	The accounts for charge of my station are settled by the privat enterprise... (*or* state administration)
QRD	I am bound for... from...
QRE	My estimate time of arrival at... (*or* over...)(*place*) is... hours
QRF	I am returning to... (*place*)
QRG	Your exact frequency (*or* that of...) is... kHz (*or*... MHz)
QRH	Your frequency varies
QRI	The tone of your transmission is 1. good 2. variable 3. bad
QRJ	I have... radiotelephone to book
QRK	The intelligibility of your signals (*or* those of...) is 1. bad 2. poor 3. fair 4. good 5. excellent
QRL	I am busy (*or* i am busy with...). Please do not interfere
QRM	I am being interferred with 1. nil 2. slightly 3. moderately 4. severely 5. extremely
QRN	I am troubled by static 1. nil 2. slightly 3. moderately 4. severely 5. extremely
QRO	Increase transmitter power
QRP	Decrease transmitter power
QRQ	Send faster (... words per minute)
QRR	I am ready for automatic operation. Send at... words per minute
QRS	Send more slowly (... words per minute)
QRT	Stop sending
QRV	I have nothing for you
QRW	Please inform... that i am calling him on... kHz (*or*... MHz)
QRX	I will call you again at... hours (on... kHz (*or*... MHz))
QRY	Your turn is number... (*or according to any other indication*)
QRZ	You are being called by... (on... kHz (*or*... MHz))
QSA	The strength of your signal (*or* those of...) is 1. scarcely perceptible 2. weak 3. fairly good 4. good 5. very good

Q Code	Meaning
QSB	Your signal is fading
QSC	I am a cargo vessel
QSD	Your keying is defective
QSE	The estimated drift of the survival craft is... (*figures and units*)
QSF	I have effected rescue amd i am proceeding to... base (with... persons injured requiring ambulance)
QSG	Send... telegrams at a time
QSH	I am able to home on my D/F equipment (on station...)
QSI	I have been unable to break into your transmission
QSJ	The charge to be collected to... including my internal charge is... francs
QSK	I can hear you between my signals; break in on my transmission
QSL	I am acknowledging receipt
QSM	Repeat the last telegram which you sent to me (*or* telegram(s) number(s)...)
QSN	I did hear you (*or*...(*call sign*)) on...kHz (*or*...MHz)
QSO	I can communicate with... direct (*or* by relay through...)
QSP	I will relay to... free of charge
QSQ	I have a doctor on board (*or*... (*name of person*) is on board)
QSR	Repeat your call on the calling frequency ; did not hear you (*or* have interference)
QSS	I will use the working frequency... kHz (*normally only the last three digits of the frequency need be given*)
QSU	Send or reply on this frequency (*or* on...kHz (*or*... MHz))
QSV	Send a series of V's on this frequency (*or*... kHz (*or*... MHz)
QSW	I am going to send on this frequency (*or* on... kHz (*or*... MHz)) (with emissions of class...)
QSX	I am listening to... (*call sign(s)*) on... kHz (*or*... MHz)
QSY	Change to transmission on another frequency (*or* on...kHz (*or*... MHz))
QSZ	Send each word or group twice (*or*... times)
QTA	Cancel telegram number...
QTB	I do not agree with your counting of words; I will repeat the first letter or digit of each word or group
QTC	I have... telegrams for you (*or* for...)
QTD	... (*identification*) has recovered 1.... (*number*) survivors 2. wreckage 3.... (*number*) bodies
QTE	Your true bearing from me is... degrees at... hours
QTF	The position of your station according to the bearings taken by the DF stations which i control was... latitude,... longitude (*or other indication of position*), class... at... hours
QTG	I am going to send two dashes of ten seconds each followed by my call sign (repeated... times) (on... kHz (*or*... MHz))
QTH	My position is... latitude,.. longitude (*or according to any other indication*)
QTI	My true track is... degrees
QTJ	My speed is... knots (*or*... kilometres per hour *or*... statute miles per hour)
QTK	The speed of my aircraft in relation to the surface of the earth is... knots (*or*... kilometres per hour *or*... statute miles per hour)
QTL	My true heading is... degrees
QTM	My magnetic heading is... degrees
QTN	I departed from... (*place*) at... hours
QTO	I have left dock (*or* port) *or* i am airborne
QTP	I am going to enter dock (*or* port) *or* i am going to alight (*or* land)
QTQ	I am going to communicate with your station by means of the International Code of Signals
QTR	The correct time is... hours
QTS	I will send my call sign for tuning purposes or so that my frequency my be measured now (*or* at... hours) on... kHz (*or*... MHz)
QTT	The identification signal which follows is superimposed to another transmission
QTU	My station is open from... to... hours

Q Code	Meaning
QTV	Stand guard for me on the frequnecy of... kHz (*or*... MHz) (from... to... hours)
QTW	Survivors are in... conditionand urgently need...
QTX	I will keep my station open for further communication with you until further notice (*or* until... hours)
QTY	I am proceeding to the position of incident and expect arrive at... hours (on... (*date*))
QTZ	I am continuing the search for... (aircraft, ship, survival craft, survivors or wreckage)
QUA	Here is news of... (*call sign*)
QUB	Here is the information requested
QUC	The number (*or other indication*) of the last message i received from you (*or* from... (*call sign*)) is...
QUD	I have received the urgency signal sent by... (*call sign of mobile station*) at... hours
QUE	I can use telephony in... (*language*) on... kHz (*or*... MHz)
QUF	I have received the distress signal sent by... (*call sign of mobile station*) at... hours
QUG	I am forced to alight (*or* land) immediately
QUH	The present barometric pressure at sea level is... (*units*)
QUI	My navigation lights are working
QUJ	The true track to reach me (*or*...) is... degrees at... hours
QUK	The sea at... (*place or coordinates*) is...
QUL	The swell at... (*place or coordinates*) is...
QUM	Normal working may be resumed
QUN	My position, true course and speed are...
QUO	Please search for 1. aircraft 2. ship 3. survival craft in the vicinity of... latitude,... longitude (*or according to any other indication*)
QUP	My position is indicated by 1. searchlight 2. black smoke trail 3. pyrotechnic lights
QUQ	Please train your searchlight on a cloud, occulting if possible and, if my aircraft is seen or heard, deflect the beam up wind on the water (*or* land) to facilitate my landing
QUR	Survivors 1. are in possession of survival equipment dropped by... 2. have been picked up by rescue vessel 3. have been reached by ground rescue party
QUS	Have sigthed 1. survivors in water 2. survivors on raft 3. wreckage in position... latitude,... longitude (*or according to any ohter indication*)
QUT	Position of incident is marked by 1. flame or smoke float 2. sea marker 3. sea marker dyce 4.... (*specify other marking*)
QUU	Home ship or aircraft... (*call sign*) 1. to your position by transmitting your call sign and long dashes an... kHz (*or*... MHz) 2. by transmitting on... kHz (*or*... MHz) true track to reach you
QUW	I am in the... (*designation*) search area
QUX	I have the following navigational warning(s) or gale warning(s) in force :...

Q Code	Meaning
QUY	Position of survival craft was marked at... hours by 1. flame or smoke float 2. sea marker 3. sea marker dyce 4.... (*specify other marking)*
QUZ	Distress phase still in force ; restricted working may be resumed

Z - Groups

Z code abbreviations are used with additional numbers. These numbers have the following meaning :

1. Very slight
2. Slight
3. Moderate
4. Severe
5. Extreme

Italic written codes are used in military services.

Z Code	Meaning
ZAA	You are not observing circuit discipline
ZAB	Your speed key is improperly adjusted
ZAC	Advise (*call sign of*) the frequency you are reading... running dual for you
ZAC	Cease using speed key
ZAD	Signal 1. not understood 2. not held
ZAE	Unable to receive you, try via...
ZAF	Reroute the circuit by patching
ZAH	Unable to relay, we file
ZAI	Run (*foxes, ry's, mk etc*)
ZAJ	Have been unable to break you
ZAK	Transmission interrupted at... hours
ZAL	Alter your wavelength
ZAL	Closing down due to...
ZAN	We can receive absolute nothing
ZAN	Only transmit telegrams with precedence... (Z, Y, O, P, R, M) or higher
ZAO	Can't understand voice, use telegraphy
ZAP	Acknowledge, please
ZAP	Use traffic 1. simplex 2. duplex 3. diplex 4. multiplex 5. SSB / ISB
ZAQ	The last word i 1. received 2. transmitted was...
ZAR	Revert to automatic relay
ZAS	Rerun tapes on... since...
ZAT	Punching tape for transmission
ZAV	Send blind until advised
ZAX	You are causing interference 1. listen before transmitting 2. by ignoring my wait signal 3. by transmitting simultaneously with... 4. by answering to slowly 5. by answering to slowly my call to you.You are causing a delay 6. by not answering on your turn
ZAY	Send on... kHz. Will confirm later
ZBA	Cause of delay is...
ZBB	Make... copies of the following message
ZBD	Following was sent... hours

Z Code	Meaning
ZBE	Retransmit message... to... 1. action 2. information 3. comment
ZBF	Use large message formula for the following telegram
ZBG	You are sending upper case
ZBH	Make call before transmitting traffic
ZNI	Listen for telephony
ZBL	Do not use break in
ZBM	Put... (*speed operator*) this frequency
ZBN	Break and go ahead with new slip
ZBN	Your tape reversed
ZBO	I have traffic
ZBP	1. Characters indistinct 2. Spacing bad
ZBQ	When and on what frequency was message received ?
ZBR	Break circuit, retuning
ZBR	Transmit your message via the 1. R (receipt) 2. F (not answer) 3. I (interruption) 4. G (read back) method
ZBS	Your signals blurring
ZBT	Count... as... groups
ZBU	Report when in communication with...
ZBV	Answer on... MHz
ZBW	I (*or* station...) changes for transmission on... kHz
ZBX	I (*or* station...) changes for reception to... kHz
ZBY	Break, go back yard (*or* metre)
ZCA	Circuit seriously affected. all signals or channels from... unreadable. Please try to supply us with a readable signal or any frequency of that circuit for contact.
ZCB	Circuit interrupted (or broken). Signals unheard. Please cover and supply any... heard
ZCC	Collate code
ZCD	Your collation is different
ZCF	Check your center frequency, please
ZCI	Circuit interrupted. We are advised that... running and available. Please cover also and supply the signal which first becomes useable.
ZCK	Check keying
ZCL	Transmit call letters intelligibly (international morse code, at speed not exceeding 24 words per minute, or by voice) for station identification
ZCO	Your collation omitted
ZCP	Local receiving conditions poor ; please increase to maximum
ZCR	Now using concentrator. Please make warning signals
ZCS	Cease sending
ZCT	Send code twice
ZCW	Are you in direct communication with... ?
ZDA	here formal message, priority...
ZDB	Accelerate answering my 1. preceded Z code 2. requests for repeat and correction 3. signal serving message
ZDC	We are diagnosing circuit faults, and will advise shortly
ZDC	Last message transmitted requests execution signal

Z Code	Meaning
ZDE	Message undelivered ; 1. will keep trying 2. advise disposal 3. cancelling 4. better ads
ZDE	Message... undelivered
ZDF	Your frequency is drifting to degree indicated
ZDF	Message... receiving by addressee
ZDG	Accuray of following doubtful
ZDH	Your dots are to heavy (long), adjust ligther
ZDJ	I have a message of... groups for you
ZDK	The following is a repeat as requested
ZDL	Your dots are too light (short), adjust heavier
ZDL	Approval 1. is omitted 2. differs in its content
ZDM	Your dots missing
ZDM	This is a multiple addressee message
ZDN	Report disposal of message...
ZDO	I have been unable to transmit the message to...
ZDQ	Message ... relayed to... at
ZDS	Message just transmitted erroneous. Correct version is...
ZDT	Following transmitters running dual
ZDT	Don't transmit exercise messages until advised
ZDV	Your dots varying length, please remedy
ZDV	Privat message received for..., advise
ZDY	No privat message until ordered
ZEC	Message 1. not received 2. undelivrable
ZED	We are experiencing drop outs to degree indicated
ZEF	We are experiencing fill ins to degree indicated
ZEG	We are experiencing garbles to degree indicated
ZEH	1. Correctness of service part 2. Text parts 3. Groups... till... is doubtful. Approval will be given after receipt
ZEI	Accuracy of header doubtful
ZEK	No answer required
ZEL	This message is correction to...
ZEN	Drop copy to unit having same routing indicator as orginator
ZEN	This message is classified
ZEO	Parts marked ZEP coming later
ZES	Your message... received 1. not complete, 2. distorted, I request transmission
ZEU	Exercise (drill message) coming now
ZEV	This is an acknowledgement of message...
ZEX	This is a booking message it may be delivered to addresses for who you are responsible
ZFA	Failing auto
ZFA	Message intercepted or copied blind
ZFB	Signals are fading badly
ZFB	Pass this message to...
ZFC	Check the FSK shift, please
ZFD	Depth of fading of your signal is as indicated
ZFD	This message is a suspected duplicate
ZFF	Please observe and furnish FRAME code reports on... (*call letters and frequency in kHz*)

Z Code	Meaning
ZFF	Advise when message received by...
ZFH	Message by... for 1. action 2. information 3. comment
ZFI	Reply to message ? There is no reply
ZFK	Revert to FSK
ZFL	The following... was addressed to you between serial number... and... of this network
ZFO	Signals faded out
ZFQ	Frequency shift of your signal is... Hz
ZFR	Rapidity of fading of your signal as indicated
ZFR	Cancel transmission
ZFS	Signals are fading slightly
ZGA	The call sign assigned to you is...
ZGB	Answer in alphabetical numerical order
ZGC	Answer in alphabetical numerical order and transmit your call sign... times
ZGE	Transmit your call sign... times
ZGF	... signals good for... words per minute
ZGF	Make call signs more distinctly
ZGG	Call sign of... is...
ZGI	... has called you on... kHz
ZGJ	I'll call you back at... hours on... khz
ZGK	Call me back at... hours on... kHz
ZGL	... will answer for me or for...
ZGM	I was not able to contact you since... hours
ZGN	Nothing was heard from you since... hours
ZGO	Your number is... answer after...
ZGP	Please give priority
ZGP	Answer each station calling me on... khz
ZGS	Your signal is getting stronger
ZGW	Your signal is getting weaker
ZHA	How are conditions for auto reception ?
ZHA	Lower your frequency to avoid interference
ZHB	Raise your frequency to avoid interference
ZHC	How are your receiving conditions ?
ZHM	Indicating reception of harmonic radiation from some transmitter, followed by indication of the order of harmonic followed by the microvolt input to receiver of the radiation
ZHS	Send high speed auto... words per minute
ZHY	We are hoding your...
ZIA	This messge is sent outside the normal serial numbers
ZIB	Correct serial number of message...
ZIC	The last message sent by me was...
ZII	The last message received by me was...
ZIM	Interruption by industrial or medical interference of the degree indicated
ZIP	Increase power
ZIP	Postal address is...
ZIR	Your transmitter has strong idle radiation
ZIS	Intensity of atmospheric interference on... of severity indicated
ZJF	Your frequency is jumping to degree indicated
ZJJ	Wire via the double flash method
ZJO	Compare each group of text
ZKA	Who is contolling station ?
ZKB	Permission necessary before transmitting messges
ZKC	Replace the z code by the call sign or code name of the control station
ZKD	Take control of net...

Z Code	Meaning
ZKE	I (or...) report(s) into circuit (net)
ZKF	Station leaves net temporarily
ZKI	Listen on... kHz 1. continuously 2. till new order
ZKJ	1. Close your station 2. I close my station
ZKL	Resume radio watch on... hours
ZKM	Keep radio watch on... khz
ZKO	Revert to on/off keying
ZKP	... has radio watch for station... on... kHz
ZKQ	Say when ready to resume
ZKR	I am maintaining a watch on... kHz (*or*... MHz)
ZKS	What station keeps watch on... ?
ZKW	The key weight of your signal is... (*expressed in %*)
ZLB	Give long breaks, please
ZLD	We are getting long dash from you
ZLL	Distorted landline control signals apparently caused by control wire pickup
ZLP	Low (minimum) power
ZLS	We are suffering from a ligthning storm
ZMH	Magnetic activity
ZMO	Stand by a moment
ZMP	Mispunch *or* perforator failures
ZMQ	Stand by for...
ZMU	Multipath effect causing... signals to appear heavy (*followed by indication of percentage of marking if able to estimate*)
ZNB	We do nat get your breaks, we send twice
ZNC	No communication with...
ZNC	All transmissions on 1. all radionets 2. this radionet 3.... must be confirmed
ZND	Your certification is incorrect ; 1. verify your coed book 2. check confirmation of last message
ZNE	The last transmission on this radionet 1.... 2. by station was authentic
ZNG	Receiving conditions not good for code
ZNI	No call letters (identification) heard
ZNJ	Message may be forwarded by radio or unsafe liaisons
ZNL	Questions concerning the text of the message must be directed to the encoding officer of station...
ZNM	Check the encoding message and repeat
ZNN	All clear for traffic
ZNO	Not on the air
ZNR	Not received
ZNS	Here new slip
ZOA	We chave checked... (*transmitter call sign*) signals are radiating on air okay
ZOC	relay to your sub stations
ZOD	We are observing... and will make transition when as good or better
ZOD	Act as a radio link between me and...
ZOE	Can you accept message ? Give me message
ZOF	Relay this message
ZOG	Transmit this message to station... 1. for action 2. for information
ZOH	What traffic have you on hand ?

Z Code	Meaning
ZOH	Transmit this message to... on... kHz via the... method
ZOJ	I can't forward this message becaus 1. the call sign of the code name is not encoded 2. the contents are not encoded
ZOK	We are receiving okay
ZOK	Relay this message via...
ZOL	Okay on line
ZOM	mail delivery possible
ZOR	Transmit only reversals
ZOU	Give instructions on routing traffic
ZOZ	Obtain retransmission of message...
ZPA	Printer line advance (feed) not received
ZPA	Your speech distorted
ZPC	Printer carriage return not receinved
ZPC	Signals fading to degree indicated
ZPE	Punch everything
ZPE	I transmit with maximum power
ZPF	Printer motor fast
ZPF	Readebility is as indicated
ZPG	Signal strength is as indicated
ZPO	Send plain once
ZPP	Punch plain only
ZPR	Re-run slip at present running
ZPS	Printer motor slow
ZPT	Send plain twice
ZRA	Reversed auto tape
ZRA	Your frequency is 1. correct 2.... khz higher 3.... khz lower
ZRB	Your relayed signal is bad ; please adjust your received signal
ZRB	Check your frequency on this circuit
ZRC	Can you receive code ?
ZRC	Adjust your frequency on the 1. correct frequency 2. frequency of my transmitter
ZRE	Her you best on... kHz
ZRF	Send tuning signal on present frequency
ZRG	Changing frequency will be necessary on... hours
ZRK	Reversed keying
ZRL	Re-run slip before one now running
ZRM	Please remove modulation from...
ZRM	I receive... (USB, LSB, ISB)
ZRN	Rough note
ZRO	Are you receiving okay ?
ZRR	Run reversals
ZRS	Re-run message number... (*or* slip containing message number)
ZRT	Revert to traffic
ZRY	Run test slip, please
ZSF	Send faster
ZSH	static heavy here
ZSI	Please furnish signal intensity of... (*microvolts input to receiver*)
ZSM	Microvolt input to receiver is...
ZSN	Please observe and furnish SINPO code reports on... (*call letters and frequency in kHz*)
ZSO	Transmit slip once
ZSR	Your signals strong readable

Z Code	Meaning
ZSS	Send slower
ZST	Transmit slips twice
ZSU	Your signal is unreadable
ZSV	Your speed varying
ZTA	Transmit by auto
ZTD	Please use...
ZTE	I am not able to use...
ZTG	1. radiotelegraphy 2. modulated radiotelegraphy 3. radiotelephony transmission 4. radioteletype 5. radiobearing
ZTH	Transmit by hand
ZTH	1. FM 2. AM 3. PM 4. FSK 5. AJ transmission
ZTI	Transmitter temporarily interrupted
ZTI	1. Receiver 2. Transmitter 3. Power supply 4. Antenna system
ZTJ	Stop using...
ZUA	Our conditions unsuitable for undolator or automatic recording
ZUA	Timing signal will be transmitted
ZUB	We have been unable to break you
ZUB	At... hours
ZUC	Unable to comply. Will do so at...
ZUE	Affirmative (yes)
ZUG	Negative (no)
ZUH	Unable to comply
ZUI	Your attention is drawn to...
ZUJ	Wait. Stand by
ZUK	... is ready for keying with...
ZVB	Varying bias
ZVF	Signals varying in frequency
ZVP	Send V's please
ZVR	Pass at once to sub station
ZVS	Signals varying in intensity
ZWB	Name of operator in watch
ZWC	Wipers or clicks here
ZWF	Inexact
ZWG	Correct
ZWL	Except...
ZWO	Send words once
ZWR	Your signal weak but readable
ZWS	Wavelength (frequency) is swinging to degree indicated
ZWT	Send words twice
ZXA	We are adjusting (*or* phase adjust) to receive speed
ZXC	Pictures... conditionelly accepted. Will advise
ZXD	Send dashes, please
ZXF	You are floating fast
ZXH	Your limits are high. Please reduce... Hz
ZXJ	You are jumping out of phase
ZXK	Is your synchronising correct ?
ZXL	Your limits are low. Please increase... Hz
ZXO	Last run defaced due to

Z Code	Meaning
ZXP	Go ahead with pictures
ZXS	You are floating slow
ZXV	Your modulation is varrying
ZYA	Cease traffic on all channels ; send A's on A channel for lineup
ZYC	Cycling on automatic error corection with 7 units errors stored at your end
ZYK	Your keying on... channel affected ; please check
ZYN	Reduce the bias
ZYO	Message orginated with mobile units
ZYP	Change from multiplex to single printer
ZYR	Please put... on multiplex revolutions
ZYS	The speed of transmission is...
ZYT	Check your thyratrons
ZYT	Forward this mesage without service action
ZYX	Please revert to multiplex revolutions... channels
ZZA	Tell name of operator who has transmitted last message (*or* message...)
ZZF	Incorrect
ZZG	Correct
ZZH	Try again
ZZN	Message is a drill message for 1. beginning operators 2. advanced operators 3. operators on watch
ZZO	Beginning operator

Abbreviations

Abbreviation	Description
AA	Anadolu Ajansi
AB	Airbase
ACB	Auto Correlation Bit
ACF	Auto Correlation Frequency
AEROFLOT	Russian Airlines
AFB	Air Force Base
AFC	Area Forcast Center
AFI	MWARA Africa
AFTN	Aeronautical Fixed Telecommunication Network
AGRCRM	Austrian German Red Cross Relief Organisation
AL	Alabama
AM	Amplitude Modulation
AMS	Aeronautical Mobile Service
AMTOR	Amateur Microprocessor Teleprinting Over Radio
ANSA	Agenzia Nazionale Stampa Associata
AP	Associated Press
APA	Austrian Press Agency
AR	Arkansas
ARQ	Synchronous transmission and automatic repetition teleprinter system
ARQ 6-70	6 character blocks simplex ARQ teleprinter system
ARQ 6-90/98	6 character blocks simplex ARQ teleprinter system
ARQ-E3	Single channel ARQ ITA 3 teleprinter system
ARQ-M2	Multiplex ARQ teleprinter system with 2 channels according CCIR 342-2
ARQ-M2 242	Multiplex ARQ teleprinter system with 2 channels according CCIR 242-2
ARQ-M4	Multiplex ARQ teleprinter system with 4 channels according CCIR 342-2
ARQ-M4 242	Multiplex ARQ teleprinter system with 4 channels according CCIR 242-2
ARQE	Single channel ARQ teleprinter system
ARQN	Single channel ARQ teleptinting system without bit inversion
ARQS	SIEMENS simplex ARQ teleprinter system
ASECNA	Agence pour la Securite de la Navigation Aerienne en Afrique et a Madagascar
ATU	Arabic Telecommunication Union
ATU-A	Arabic ATU alphabet
AUTOSPEC	Automatic Single Path Error Correcting teleprinter system
AWS	Air Weather Service
AZ	Arizona
BA	Britsh Army
BAS	British Antarctic Survej
BC	Broadcast
BD	Baud
BFBS	Britsh Forces Broadcasting Service
BIPM	Bureau International des Poids et des Mesures
BK	Break In
BSKSA	Broadcasting Service Kindom of Saudi Arabia
BTA	Bulgarska Telegrafitscheka Agentzia
CA	California
CAP	Civil Air Patrol
CAR	MWARA Caribbean
CCIR	Committee Consultative International Radio
CCITT	Committee Consultative International Telegraph and Telephone
CEP	MWARA Central East Pacific
CFARS	Canadian Forces Affiliated Radio System
CG	Coast Guard
CH	channel
CIRM	Centro Internatzionale Radio Medico
CNA	Central News Agency
CO	Colorado
CQ	General call to all stations
CROSS	Centre Regional Operationnel de Surveillance et de Sauvetage

CRS	Compagnie Republicaine de Securite
CS	Coast Station
CT	Connecticut
CW	Continuous Wave = Morse
CWP	MWARA Central West Pacific
DC	District of Columbia
DE	Delaware
DEA	Drug Enforcement Agency
DGPT	Directorate General of Posts and Telecommunicatios
DIPLO	Direction des Services d ` Information et de Presse
DPR	Democratic People´s Republic
DSB	Double Side Band
DSC	Digital Selctive Calling
DSP	Digital Signal Processing
DTG	Date Time Group
DTRE	Direction des Telecommunications des Reseaux Exterieurs
DTS	Droit de Tirage Special
DUP-ARQ	Hungarian simplex ARQ teleprinter system
DW	Deutsche Welle
DYN	Diarios Y Noticas
E	Embassy
E	East
EA	MWARA East Asia
ETR	Electronic Tracking Radar
EUR	MWARA Europe
F	Feeder
F	Forces
FAX	Facsimile
FEC	Forward Error Correction
FEC 100	One way traffic FEC teleprinter system
FECS	SIEMENS simplex FEC teleprinter system
FFSK	Fast Frequency Shift Keying
FL	Florida
FM	Frequency Modulation
FRC	French Red Cross
FSK	Frequency Shift Keying
G	Gonio
GA	Georgia
GC	Guardia Civil
GMDSS	Global Maritime Distress and Safety System
GMT	Greenwich Mean Time
H	Hour
HAB	Hamburger Abendblatt
HC-ARQ	Haegelin Cryptos simplex teleprinter system
HF	High Frequency
HNG-FEC	Hungarian FEC teleprinter system
IA	Iowa
IAT	International Atomic Time
ICAO	International Civil Aviation Organization
ICRC	International Committee of Red Cross
ID	Idaho
ID	Identification
IFL	International Frequency List
IFRB	International Frequency Registration Board
IL	Illinois
IMO	International Maritime Organization
IN	Indiana
INA	Iraqi News Agency
INO	MWARA Indian Ocean
INTERPOL	Organisation Internationale de la Police Criminelle
IOC	Index of Cooperation
IRNA	Islamic Republic News Agency

ISB	Independant Side Band
ISD	Inverted Scanning Direction
ITA	International Telegraph Alphabet
ITU	International Telecommunication Union
JANA	Jamahiriyah News Agency
KC	Kilocycles
KCNA	Korean Central News Agency
KUP	Kwacha Unita Press
KY	Kentucky
KYODO	Kyodo Tsushin
LA	Louisana
LORAN	Longe Range Navigation System
LPM	Lines per Minute
LSB	Lower Side Band
M	Meteo
MA	Massachussetts
MAFOR	Marine Forecast
MAP	Magreb Arab Press
MARS	Military Affiliated Radio System
MC	Megacycles
MD	Maryland
ME	Maine
MENA	Middle East News Agency
MFA	Ministry for Foreign Affairs
MI	Michigan
MID	MWARA Middle East
MMS	Maritime Mobile Service
MN	Minnesota
MO	Missouri
MOD	Ministry of Defense
MOI	Ministry of Interior
MS	Mississippi
MSA	Maritime Safety Agency
MSF	Medicines sans frontieres
MSG	Message
MSI	Maritime Safety Information
MSK	Minimum Shift Keying
MT	Montana
MUX	Multiplex
MWARA	Major World Air Route
N	Navy
N	North
NASA	North American Space Agency
NAT	MWARA North Atlantic
NATO	North Atlantic Treaty Organization
NAVTEX	Navigational Telex system
NBDPT	Narrow Band Direct Printing Telegraphy
NBFM	Narrow Band Frequency Modulation
NC	North Carolina
NCA	MWARA North Central Asia
ND	North Dakota
NDB	Non Directional Beacon
NE	Nebraska
NI	Norfolk Island
NJ	New Jersey
NOAA	National Oceanic and Atmospheric Administration
NP	MWARA North Pacific
NR	Number
NV	Nevada
NX	News
NY	New York
OH	Ohio

OK	Oklahoma
OR	Oregon
OR	Off Route fligth communication
P	Phare
PA	Pennsylvania
PACTOR	Combination of Packet Radio and SITOR
PANA	Pan African News Agency
PAP	Polska Agencja Prasowa
PETRA	Jordan News Agency
PIAB	Presse - und Informationsdienst der Bundesregierung
PIX	Press Picture
PLO	Palestine Liberation Organization
POL-ARQ	Polish ARQ teleprinter system
PR	Packet Radio
PTT	Post, Telegraph and Telephone Administration
R	Radio
RAF	Royal Air Force
RAN	Royal Australien Navy
RC	Red Cross
RDARA	Regional and Domestic Air Route
RF	Radio Frequency
RFDS	Royal Flying Doctor Service
RFE	Radio Free Europe
RN	Royal Navy
RNZAF	Royal New Zealand Airforce
RNZN	Royal New Zealand Navy
ROMPRES	Agentia Romana de Presa
ROU-FEC	Romanian FEC teleprinter system
RS-ARQ	Rhode & Schwarz simplex ARQ teleprinter system
RTT	Regie des Telegraphes et des Telephones
RTTY	Radio Teletype
RX	Receiver
RY	Test loop ryryryry...
RYI	Test loop ryiryiryi...
S	South
SAAM	Russian Arctic and Antarctic Institut
SABS	Saudi Arabien Broadcasting Service
SALINI	Salini Costruttori
SAM	MWARA South America
SANA	Syrian Arab News Agency
SAR	Search and Rescue
SAT	MWARA South Atlantic
SAUDIA	Saudi Arabien Airlines
SC	South Carolina
SD	South Dakota
SEA	MWARA South East Asia
SITOR	Simplex Teleprinting over Radio
SITOR A	Simplex Teleprinting over Radio Mode ARQ
SITOR B	Simplex Teleprinting over Radio Mode FEC
SKH	Schweizerische Katastrophenhilfe
SOS	Distress Signal
SP	MWARA South Pacific
SPREAD	FEC teleprinter system with 10 bit BAUER code
SRK	Schweizer Rotes Kreuz
SS	Ship Station
SSB	Single Side Band
SUNA	Sudan News Agency
SW-ARQ	Adaptive Swedish simplex ARQ teleprinter system
SWL	Shortwave Listener
TAAF	terres Australes et Antarctiques Francaises
TANJUG	Telegrafska Agencija Nova Jugoslavija
TAP	Tunis Afrique Presse

TDM	Time Devision Multiplex
TFC	Traffic
TFM	Tamed Frequency Modulation
tlgr	Telegram
TS	Time signal station
TTY	Teletype
TV	Television
TWINPLEX	Four frequency ARQ teleprinter system
TX	Transmitter
TX	Texas
txt	Text
UI	Unidentified
UNHCR	United Nation
UNID	Unidentified
UNIFIL	United Nations Interim Forces in Lebanon
UNO	United Nation Organization
USAF	United States Airforce
USARP	United State Antarctic Research Programm
USCG	United State Coast Guard
USMILGP	United State Military Group
USN	United State Navy
USNG	United State National Guard
UT	Universal Time
UT	Utah
UTC	Universal Time Coordinated
VA	Virginia
VAFI	Africa VOLMET Area
VCAR	Caribbean VOLMET Area
VEUR	European VOLMET Area
VFT	Voice Frequency Telegraphy
VMID	Middle East VOLMET Area
VNA	Viet Nam News Agency
VNAT	North Atlantic VOLMET Area
VNCA	North Central Asia VOLMET Area
VOA	Voice of America
VOLMET	Meteorological information for aircraft in flight
VPAC	Pacific VOLMET Area
VSAM	South America VOLMET Area
VSEA	South East Asia VOLMET Area
W	West
W I	World wide allotment area I (RDARA 1, 2, 3)
W II	World wide allotment area II (RDARA 10, 11, 12A, 12B, 12C, 12D)
W III	World wide allotment area III (RDARA 6, 8, 9, 14)
W IV	World wide allotment area IV (RDARA 12E, 12F, 12G, 12H, 12J, 13)
W V	World wide allotment area V (RDARA 4, 5, 7)
WA	Washington
WARC	World Administrative Radio Conference
WEFAX	Weather FAX
WI	Wisconsin
WMC	World Meteorological Centre
WMO	World Meteorological Organization
WPM	Words per Minute
WV	West Virginia
WW	World Wide
WX	Weather
WX	Weather
WY	Wyoming
XINHUA	New China News Agency
YONHAP	Hapdong News Agency
Z	Universal Time Coordinated