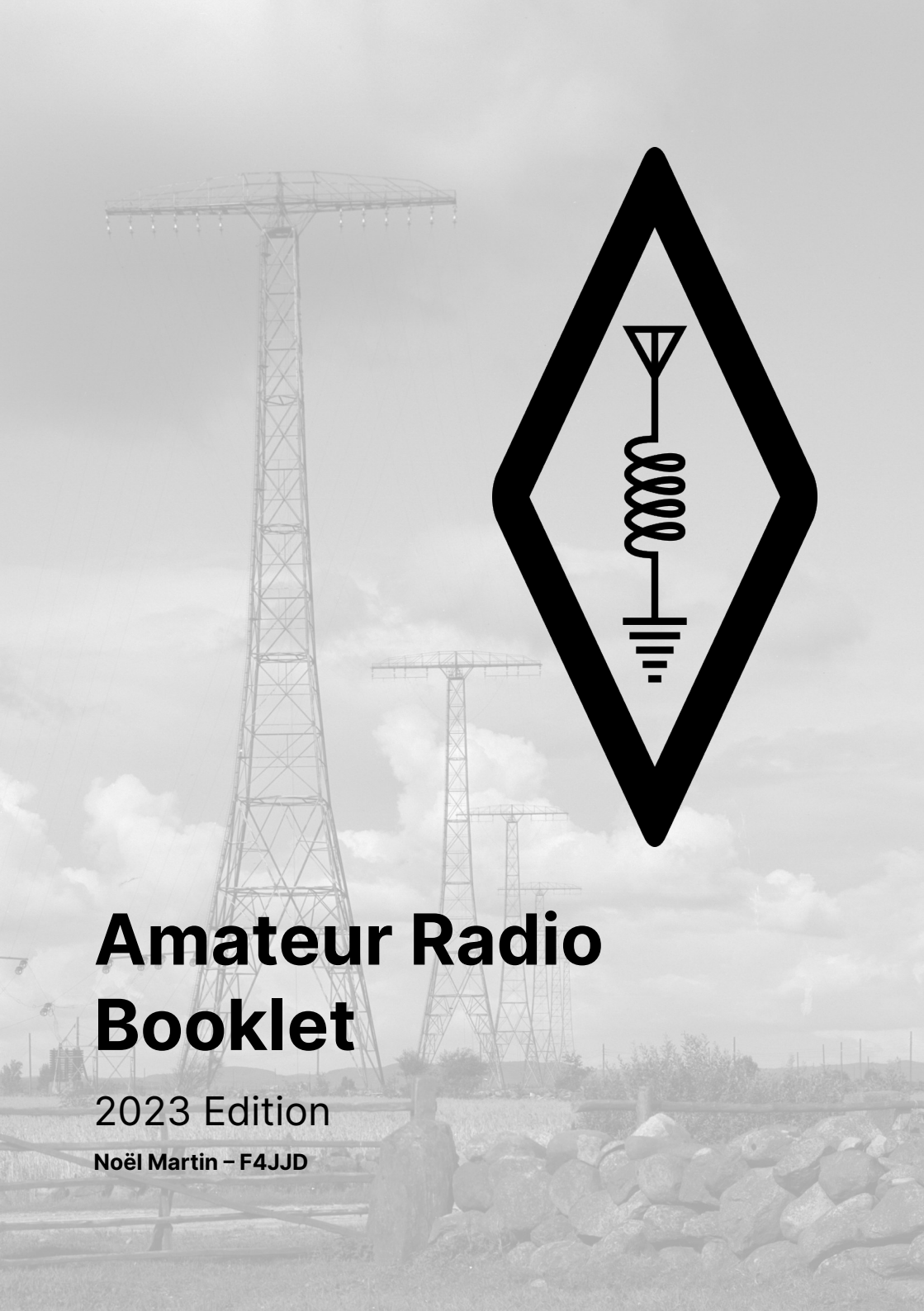

Amateur Radio Booklet

2023 Edition

Noël Martin – F4JJD

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Table of Contents

1 Band Plans

Summary

Primary allocations are written in bold, e.g. **14000 — 14350.** If the band is exclusive to the amateur service the frequencies are followed by the infinite symbol, e.g. **1800 — 1850 ∞.**

Secondary allocations are written in italic, e.g. *135.7 — 137.8*.

If the band allows **amateur satellite (AMSAT)**, the frequencies are followed by the lozenge symbol, e.g. **7000 — 7200 ◊.**

	Band	Region 1	Region 2	Region 3
LF (kHz)	2200m	*135.7 — 137.8*		
MF (kHz)	630m	*472 — 479*		
	160m	**1810 — 1850 ∞**	**1800 — 1850 ∞**	**1800 — 2000**
			1850 — 2000	
HF (kHz)	80m	**3500 — 3800**	**3500 — 3750 ∞**	**3500 — 3900**
	60m	*5351.5 — 5366.5*		
	40m	**7000 — 7100 ◊**		
		7100 — 7200 ∞		
		Forbidden	**7200 — 7300 ∞**	*Forbidden*
	30m	*10100 — 10150*		
	20m	**14000 — 14250 ◊**		
		14250 — 14350 ∞		
	17m	**18068 — 18168 ◊**		
	15m	**21000 — 21450 ◊**		
	12m	**24890 — 24990 ◊**		

	10m	**28000 — 29700 ◊**		
VHF (MHz)	6m	*50 — 52*	**50 — 54**	
	2m	**144 — 146 ◊**		
		Forbidden	**146 — 148 ∞**	**146 — 148**
	1.35m	*Forbidden*	**220 — 225**	*Forbidden*
UHF (MHz)	70cm	**430 — 440**	*430 — 440*	
	33cm	*Forbidden*	*902 — 928*	*Forbidden*
	23cm	*1240 — 1300*		
	13cm	*2300 — 2450*		
SHF (GHz)	9cm	*Forbidden*	*3.3 — 3.5*	
	5cm	*5.65 — 5.83*		
		5.83 — 5.85 ◊		
		Forbidden	*5.85 — 5.925*	*Forbidden*
	3cm	*10 — 10.45*		
		10.45 — 10.5 ◊		
	1.2cm	**24 — 24.05 ◊**		
		24.05 — 24.25		
	6mm	**47 — 47.2 ◊**		
	4mm	*76 — 77.5 ◊*		
		77.5 — 78 ◊		
		78 — 81 ◊		
	2.4mm	*122.25 — 123*		
	2.2mm	**134 — 136 ◊**		
		136 — 141 ◊		
	1.2mm	*241 — 248 ◊*		
		248 — 250 ◊		

2200 Meters

Region 1	Region 2	Region 3
135.7 — 137.8 kHz *BW 200Hz* CW, QRSS, DM	**135.7 — 137.8 kHz** *BW 200 Hz* All Modes	**135.7 — 137.8 kHz** *BW 500 Hz* CW, QRSS, DM

Max Power: 1W EIRP — Status: Secondary R1, R2, R3 (primary Fixed, Maritime Mobile, R3 Radio-navigation)

630 Meters

Region 1	Region 2	Region 3
472 — 475 kHz *BW 200 Hz* CW	**472 — 479 kHz** *BW 500 Hz* CW, DM	**472 — 479 kHz** *BW 500 Hz* CW, DM
475 — 479 kHz *BW 500 Hz* NBM		

Max Power: 1W EIRP — Status: Secondary R1, R2, R3 (primary Maritime Mobile)

160 Meters

Region 1	Region 2	Region 3
1810 — 1838 kHz *BW 200 Hz* CW, 1836 – CW QRP	**1800 — 1810 kHz** *BW: 500 Hz* DM	**1800 — 1830 kHz** *BW: 200 Hz* CW
1838 — 1840 kHz *BW: 500 Hz* NBM	**1810 — 1840 kHz** *BW: 200 Hz* CW, DM 1812 – CW QRP CoA	**1830 — 1840 kHz** *BW: 500Hz* CW (DX), NBM 1836 – CW QRP CoA
1840 — 1850 kHz *BW: 2700 Hz* All Modes	**1840 — 1850 kHz** *BW: 2700 Hz* CW, DM, SSB (DX)	**1840 — 2000 kHz** *BW: 2700 Hz* All Modes
	1850 — 2000 kHz *BW: 2700 Hz* All Modes 1910 – SSB QRP CoA	

Status: Primary R1, R2, R3

80 Meters

<table>
<tr><th>Region 1</th><th>Region 2</th><th>Region 3</th></tr>
<tr><td>3500 — 3580 kHz
BW: 200 Hz

CW (3505 – DX CoA)
3555 – CW QRS CoA
3560 – CW QRP CoA
> 3570 – NBM</td><td>3500 — 3580 kHz
BW: 200 Hz

CW (3505 – DX CoA)
3555 – CW QRS CoA
3560 – CW QRP CoA
> 3570 – NBM</td><td>3500 — 3535 kHz
BW: 200 Hz

CW (3505 – DX CoA)</td></tr>
<tr><td>3580 — 3600 kHz
BW: 500 Hz

NBM, DM</td><td>3580 — 3600 kHz
BW: 500 Hz

CW, DM</td><td rowspan="2">3535 — 3900 kHz
BW 2700 Hz

CW, SSB, DM
3560 – QRP CoA
3600 – EMCOM CoA
3690 – DV CoA
3690 – SSB QRP CoA
3735 – Image CoA
3795 – DX SSB CoA
3845 – Image CoA</td></tr>
<tr><td>3600 — 3800 kHz
BW: 2700 Hz

All Modes
3690 – SSB QRP CoA
3735 – Image CoA
3760 – EMCOM CoA
3775 – DX CoA</td><td>3600 — 4000 kHz
BW 2700 Hz

All Modes
3690 – SSB QRP CoA
3735 – Image CoA
3750 – EMCOM CoA
3775 – DX CoA
3845 – Image CoA
3885 – AM CoA
3985 – EMCOM CoA</td></tr>
</table>

Status: Primary R1, R2, R3

60 Meters

Region 1	Region 2	Region 3
5351.5 — 5354 kHz *BW 200 Hz* CW, NBM	**5351.5 — 5354 kHz** *BW 500 Hz* CW, DM	**5351.5 — 5354 kHz** *BW 500 Hz* CW, NBM, DM
5354 — 5366 kHz *BW 2700 Hz* All Modes, Pref. USB	**5354 — 5366 kHz** *BW 2700 Hz* All Modes	**5354 — 5366 kHz** *BW 2700 Hz* All Modes, Pref. USB
5366 — 5366.5 kHz ***BW 20 Hz*** Weak Signal	**5366 — 5366.5 kHz** ***BW 20 Hz*** CW, DM	**5366 — 5366.5 kHz** ***BW 20 Hz*** Weak Signal

Max Power: 15W EIRP — Status: Secondary R1, R2, R3 (primary Fixed, Mobile)

Warning: very small bandwidth between 5366-5366.5 kHz

40 Meters

<table>
<tr><th>Region 1</th><th>Region 2</th><th>Region 3</th></tr>
<tr><td>7000 — 7040 kHz
BW 200 Hz

CW
7030 – CW QRP CoA</td><td>7000 — 7040 kHz
BW 200 Hz

CW
< 7025 – DX
7030 – CW QRP CoA</td><td>7000 — 7030 kHz
BW 200 Hz

CW</td></tr>
<tr><td>7040 — 7050 kHz
BW 500 Hz

NBM, DM</td><td>7040 — 7050 kHz
BW 500 Hz

CW, DM</td><td rowspan="2">7030 — 7200 kHz
BW 2700 Hz

CW, SSB, DM
7030 – QRP CoA
7070 – DV CoA
7090 – SSB QRP CoA
7095 – DX Phone CoA
7110 – EMCOM CoA
7165 – Image CoA</td></tr>
<tr><td>7050 — 7200 kHz
BW 2700 Hz

All Modes
< 7060 – DM
7070 – DV CoA
7090 – SSB QRP CoA
7110 – EMCOM CoA
7165 – Image CoA
> 7175 – DX</td><td>7050 — 7300 kHz
BW 2700 Hz

All Modes
7060 – EMCOM CoA
7070 – DV CoA
7090 – SSB QRP CoA
7165 – Image CoA
7240 – EMCOM CoA
7275 – EMCOM CoA
7285 – SSB QRP CoA
7290 – AM CoA</td></tr>
</table>

Status: Primary R1, R2, R3; and 7000-7100 kHz AMSAT R1, R2, R3

30 Meters

<table>
<tr><th>Region 1</th><th>Region 2</th><th>Region 3</th></tr>
<tr><td colspan="3">10100 — 10130 kHz
BW 200 Hz

CW
10116 – CW QRP CoA</td></tr>
<tr><td rowspan="2">10130 — 10150 kHz
BW 500 Hz

NBM, DM</td><td>10130 — 10140 kHz
BW 500 Hz

CW, DM</td><td rowspan="2">10130 — 10150 kHz
BW 500 Hz

NBM, DM</td></tr>
<tr><td>10140 — 10150 kHz
BW 2700 Hz

CW, DM</td></tr>
</table>

Status: Secondary R1, R2, R3 (primary Fixed)

20 Meters

Region 1	Region 2	Region 3
14000 — 14070 kHz *BW 200 Hz* CW 14055 – CW QRS CoA 14060 – CW QRP CoA		
14070 — 14099 kHz *BW 500 Hz* NBM, DM		
14099 — 14101 kHz International Beacon Project		
14101 — 14350 kHz *BW 2700 Hz* All Modes 14130 – DV CoA 14195 – DX 14230 – Image CoA 14285 – SSB QRP 14300 – Glob EMCOM	**14101 — 14350 kHz** *BW 2700 Hz* All Modes 14195 – DX 14230 – Image CoA 14285 – SSB QRP 14285 – AM QRG 14300 – Glob EMCOM	**14101 — 14350 kHz** *BW 2700 Hz* All Modes 14130 – DV CoA 14195 – DX 14230 – Image CoA 14285 – SSB QRP 14300 – Glob EMCOM

Status: Primary R1, R2, R3; and 14000-14250 kHz AMSAT R1, R2, R3

17 Meters

Region 1	Region 2	Region 3
18068 — 18095 kHz *BW 200 Hz* CW 18086 – CW QRP CoA		
18095 — 18109 kHz *BW 500 Hz* NBM, DM		**18095 — 18109 kHz** *BW 2700 Hz* NBM, DM
18109 — 18111 kHz International Beacon Project		
18111 — 18168 kHz *BW 2700 Hz* All Modes 18130 – SSB QRP 18150 – DV CoA 18160 – EMCOM	**18111 — 18168 kHz** *BW 2700 Hz* All Modes 18130 – SSB QRP 18160 – EMCOM	**18111 — 18168 kHz** *BW 2700 Hz* All Modes 18130 – SSB QRP 18150 – DV CoA 18160 – EMCOM

Status: Primary and AMSAT R1, R2, R3.

15 Meters

<table>
<tr><th>Region 1</th><th>Region 2</th><th>Region 3</th></tr>
<tr><td colspan="3">21000 — 21070 kHz
BW 200 Hz

CW
21055 – CW QRS CoA
21060 – CW QRP CoA</td></tr>
<tr><td colspan="3">21070 — 21110 kHz
BW 500 Hz

NBM, DM</td></tr>
<tr><td colspan="2">21110 — 21120 kHz
BW 2700 Hz

All Modes, except SSB</td><td>21110 — 21125 kHz
BW 2700 Hz

CW, NBM, DM</td></tr>
<tr><td>21120 — 21149 kHz
BW 500 Hz

NBM</td><td>21120 — 21149 kHz
BW 500 Hz

All Modes</td><td>21125 — 21149 kHz
BW 2700 Hz

CW, NBM, DM
Satellite Uplink</td></tr>
<tr><td colspan="3">21149 — 21151 kHz

International
Beacon Project</td></tr>
<tr><td>21151 — 21450 kHz
BW 2700 Hz

All Modes
21180 – DV CoA
21285 – SSB QRP
21340 – Image CoA
21360 – Glob. EMCOM</td><td>18111 — 18168 kHz
BW 2700 Hz

All Modes
21285 – SSB QRP
21340 – Image CoA
21360 – Glob. EMCOM</td><td>18111 — 18168 kHz
BW 2700 Hz

All Modes
21180 – DV CoA
21295 – DX CoA
21340 – Image CoA
21360 – Glob. EMCOM</td></tr>
</table>

Status: Primary and AMSAT R1, R2, R3.

12 Meters

Region 1	Region 2	Region 3
24890 — 24915 kHz *BW 200 Hz* CW 24906 – CW QRP CoA		
24915 — 24929 kHz *BW 500 Hz* CW, NBM, DM		
24929 — 24931 kHz International Beacon Project		
24931 — 24990 kHz *BW 2700 Hz* All Modes 24950 – SSB QRP 24960 – DV CoA	**24931 — 24990 kHz** *BW 2700 Hz* All Modes 24950 – SSB QRP	**24931 — 24990 kHz** *BW 2700 Hz* All Modes 24950 – SSB QRP 24960 – DV CoA

Status: Primary and AMSAT R1, R2, R3.

10 Meters

<table>
<tr><th>Region 1</th><th>Region 2</th><th>Region 3</th></tr>
<tr><td colspan="2">28000 — 28070 kHz
BW 200 Hz

CW
28055 – CW QRS CoA
28060 – CW QRP CoA</td><td>28000 — 28070 kHz
BW 200 Hz

CW
28055 – CW QRS</td></tr>
<tr><td>28070 — 28190 kHz
BW 500 Hz

NBM, DM</td><td>28070 — 28190 kHz
BW 500 Hz

CW, DM</td><td>28070 — 28190 kHz
BW 500 Hz

CW, NBM
> 28050 – DX</td></tr>
<tr><td colspan="3">28190 — 28225 kHz
BW 200 Hz

Beacons
28200 – International Beacon Project</td></tr>
<tr><td colspan="2">28225 — 28300 kHz
BW 2700 Hz

Beacons</td><td>28225 — 28300 kHz
BW 6000 Hz

All Modes</td></tr>
<tr><td colspan="2">28300 — 29000 kHz
BW 2700 Hz

All Modes
28330 – DV CoA
28360 – SSB QRP CoA
28680 – Image CoA</td><td rowspan="2">28300 — 29510 kHz
BW 6000 Hz

Satellite
Up & Down-Links</td></tr>
<tr><td colspan="2">29000 — 29510 kHz
BW Unrestricted

All Modes
> 29300 – Satellite</td></tr>
<tr><td colspan="3">29510 — 29520 kHz

Guard Band
NO TRANSMISSION ALLOWED</td></tr>
</table>

29520 — 29590 kHz *BW 6000 Hz* All Modes Repeater Input (RH1 – RH8)
29590 — 29620 kHz *BW 6000 Hz* All Modes Repeaters Simplex 29600 – FM QRG
29590 — 29620 kHz *BW 6000 Hz* All Modes Repeater Output (RH1 – RH8)

Status: Primary and AMSAT R1, R2, R3.

6 Meters

<table>
<tr><th>Region 1</th><th>Region 2</th><th>Region 3</th></tr>
<tr><td>50 — 50.1 MHz
BW 500 Hz

CW
< 50.010 Beacons

50.050 – CoA
50.090 – DX CoA</td><td>50 — 50.1 MHz
BW 500 Hz

CW
50.010 – 50.020
Beacons</td><td>50 — 50.1 MHz
BW 200 Hz

CW
50.020 – 50.030
Beacons</td></tr>
<tr><td colspan="2">50.1 — 50.4 MHz
BW 2700 Hz

CW, SSB, NBM
50.110 – DX CoA
50.305 – PSK CoA
50.315 – EME CoA</td><td rowspan="2">50.1 — 50.5 MHz
BW 2700 Hz

CW, SSB, NBM
.110 – DX CoA</td></tr>
<tr><td>50.4 — 50.5 MHz
BW 1000 Hz

Beacons
<u>50.401 – WSPR</u></td><td>50.4 — 50.5 MHz
BW 2700 Hz

Beacons</td></tr>
<tr><td rowspan="3">50.5 — 52 MHz
BW 12 kHz

All Modes
50.510 – SSTV
50.530 – FM Internet
50.600 – RTTY
50.630 – DV Calling
51.210 – 51.590 – Repeaters

<u>Wideband Experiments</u>
BW unlimited

50.9 – 51.2
51.4 – 52</td><td>50.5 — 50.6 MHz
BW 2700 Hz

All Modes</td><td rowspan="3">50.5 — 54 MHz
BW 25 kHz

All Modes</td></tr>
<tr><td>50.6 — 51 MHz
BW 12 kHz

All Modes</td></tr>
<tr><td>51 — 51.11 MHz
BW 2700

CW, SSB
DX Window</td></tr>
</table>

52 — 54 MHz *BW 500 kHz* All Modes	**51.11 — 54 MHz** BW 12 kHz FM, DV 51.110 – 51.980 – Repeaters	

Status: Primary R1, R2, R3.

2 Meters

<table>
<tr><th>Region 1</th><th>Region 2</th><th>Region 3</th></tr>
<tr><td colspan="3">144 — 144.025 MHz
BW 2700 Hz

All Modes
Satellite Down-Links Only</td></tr>
<tr><td>144.025 —
144.150 MHz
BW 500 Hz

CW
144.050 – Telegraphy Calling Freq
144.350 – EME CoA</td><td>144.025 —
144.110 MHz
BW 500 Hz

CW, DM
EME, Weak Signals</td><td>144.025 —
144.035 MHz
BW N/A

CW, EME, Weak Signals</td></tr>
<tr><td rowspan="4">144.150 —
144.400 MHz
BW 2700 Hz

SSB, CW
144.300 – SSB CoA</td><td>144.110 —
144.275 MHz
BW 2700 Hz

CW, DM, SSB
Weak Signals
144.200 – QRG Calling</td><td rowspan="4">144.035 —
145.800 MHz
BW 25 kHz

All Modes
144.1 – DX CoA</td></tr>
<tr><td>144.275 —
144.300 MHz
BW 500 Hz

Beacons</td></tr>
<tr><td>144.275 —
144.360 MHz
BW 2700 Hz

CW, SSB
144.300 – QRG Calling</td></tr>
<tr><td>144.360 —
144.400 MHz
BW 12 kHz

DM
144.390 – APRS CoA</td></tr>
</table>

<table>
<tr><td>144.400 —
144.500 MHz
BW 500 Hz

Beacons
Weak Signals MGM</td><td>144.400 —
144.500 MHz
BW 500 Hz

CW, DM
Beacons</td><td rowspan="3"></td></tr>
<tr><td>144.500 —
144.794 MHz
BW 20 kHz

All Modes
144.5 – SSTV CoA
144.6 – Data CoA
144.75 – ATV</td><td rowspan="2">144.500 —
145.790 MHz
BW 12 kHz

FM, DV

<u>Repeaters Exclusive</u>
144.600 – 144.900
145.200 – 145.500

<u>Local Options</u>
144.500 – 144.600
145.100 – 145.200</td></tr>
<tr><td>144.794 —
145.800 MHz
BW 12 kHz

144.800 – APRS
145.375 – DV Calling
145.500 – FM Calling

<u>Repeaters Exclusive</u>
144.975 – 145.194
145.575 – 145.7935

<u>Space Communications</u>
144.975 – 145.194
145.794 – 145.800</td><td>145.790 —
145.800 MHz

Guard Band</td></tr>
<tr><td colspan="3">145.800 — 146.000 MHz
BW 12 kHz

FM, DV
Satellite Exclusive</td></tr>
<tr><td>Forbidden</td><td>146.000 —
148.000 MHz
BW 12 kHz

FM, DV
146.520 – FM Call Freq</td><td>146.000 —
148.000 MHz
BW 25 kHz

All Modes</td></tr>
</table>

2 International Beacon Project

The International Beacon Project (IBP) coordinates HF beacons worldwide. Each beacon transmits once on each band every 3 minutes, 24 hours a day.

The message starts by the station callsign in CW at 22 words-per-minutes. Then followed by a series of dashes sent at:
100 W, 10 W, 1 W and 1 mW.

10 seconds after the end of the transmission, the beacon goes to the band higher and starts to transmit the same message again.

Beacons List

Callsign	Country	QTH	Grid
4U1UN	United Nations	New York City	FN30as
VE8AT	Canada	Inuvik, NT	CP38gh
W6WX	United States	Mt. Umunhum	CM97bd
KH6RS	Hawaii	Maui	BL10ts
ZL6B	New Zealand	Masterton	RE78tw
VK6RBP	Australia	Rolystone	OF87av
JA2IGY	Japan	Mt. Asama	PM84jk
RR9O	Russia	Novosibirsk	NO14kx
VR2B	Hong Kong	Hong Kong	OL72bg
4S7B	Sri Lanka	Colombo	MJ96wv
ZS6DN	South Africa	Pretoria	KG33xi
5Z4B	Kenya	Kariobangi	KI88ks
4X6TU	Israel	Tel Aviv	KM72jb
OH2B	Finland	Lohja	KP20eh
CS3B	Madeira	São Jorge	IM12mt
LU4AA	Argentina	Buenos Aires	GF05tj

OA4B	Peru	Lima	FH17mw
YV5B	Venezuela	Caracas	FJ69cc

Frequencies

Band	Frequency (MHz)
20m	14.100
17m	18.110
15m	21.150
13m	24.930
10m	28.200

3 Digital Modes

Summary of the most used calling frequencies, if not specified the frequencies cover all IARU regions.

Usage of Digital Modes is not limited to the calling frequencies, but ruled by the Band Plans.

Band	FT4	FT8	JS8
160 m		1.840	1.842
80 m	3.575	3.573	3.578
60 m		5.357	
40m	7.0475	7.074	7.078
30 m	10.140	10.136	10.130
20 m	14.080	14.074	14.078
17 m	18.104	18.100	18.104
15 m	21.140	21.074	21.078
12 m	24.919	24.915	24.922
10 m	28.180	28.074	28.078
6 m	50.318	50.313 50.323 (DX)	50.318
2 m	144.170	144.174	144.178
1.25 m		222.065	
70 cm		432.065	

Before use: verify the frequency is allowed in your region.

Band	JT65	PSK31	RTTY
160 m	1.838	1.838	1.840
80 m	3.570	3.580	3.590
60 m	5.357		
40m	7.076	7.040	7.040
30 m	10.138	10.141	10.140
20 m	14.076	14.070	14.080
17 m	18.102	18.103	18.100
15 m	21.076	21.070	21.080
12 m	24.917	24.920	24.925
10 m	28.076	28.070 28.120	28.080
6 m	50.276	50.305	50.600
2 m	144.120	144.138	144.600
1.25 m			
70 cm	432.065	432.088	432.600
23 cm	1296.065	1296.138	1296.600
13 cm	2301.065	2320.138	

Before use: verify the frequency is allowed in your region.

Band	WSPR	FST4/W	SSTV
2200 m	0.136	0.136	
630 m	0.4742	0.4742	
160 m	1.8366	1.839 1.8368	
80 m	3.5686		3.733
60 m	5.2872 5.3647		
40m	7.0386		7.058
30 m	10.1387		
20 m	(13.5539) 14.0956		14.233 14.230 (Analogue)
17 m	18.1046		
15 m	21.0946		21.337
12 m	24.9246		
10 m	28.1246		
6 m	50.293	**APRS**	50.510
2 m	144.489	144.800 R1 144.390 R2	
1.25 m			
70 cm	432.300	432.500	
23 cm	1296.500		

Before use: verify the frequency is allowed in your region.

4 Morse Code

A	•—	N	—•
B	—•••	O	———
C	—•—•	P	•——•
D	—••	Q	——•
E	•	R	•—•
F	••—•	S	•••
G	——•	T	—
H	••••	U	••—
I	••	V	•••—
J	•———	W	•——
K	—•—	X	—••—
L	•—••	Y	—•——
M	——	Z	——••

1	•————	6	—••••
2	••———	7	——•••
3	•••——	8	———••
4	••••—	9	————•
5	•••••	0	—————

Full Stop [.]	•—•—•—	Understood	•••—•
Comma [,]	——••——	Error (8•)	••••••••
Colon [:]	———•••	Cross [+]	•—•—•
Question [?][1]	••——••	Transmit	—•—
Apostrophe [’]	•————•	Wait	•—•••
Hyphen [-]	—••••—	End	•••—•—
Slash [/]	—••—•	Start	—•—•—
LH Bracket [(]	—•——•	Mult [x]	—••—
RH Bracket [)]	—•——•—	At [@]	•——•—•
Quote [“”]	•—••—•		
Equal [=]	—•••—		

Timings

• (Dot)	Unit of time
— (Dash)	3 dots (•)
Between — and •	1 dot (•)
Between letters	3 dots (•)
Between words	7 dots (•)

[1] Ask for a repetition if the message is not understood.

5 Q Codes

A sample of the most used Q Codes from the ITU Rec. M.1172-0.

Code	Question	Answer or Advice
QRA	What is the name of your vessel (*or* station)?	The name of my vessel (*or* station) is …
QRB	How far approximately are you from my station?	The approximate distance between our stations is … nautical miles (*or* kilometers).
QRE	What is your estimated time of arrival at … (*or* over …) *(place)*?	My estimated time of arrival at … (*or* over …) *(place)* is … hours.
QRG	Will you tell me my exact frequency (*or* that of […])?	Your exact frequency (*or* that of …) is … kHz (*or* MHz).
QRH	Does my frequency vary?	Your frequency varies.
QRI	How is the tone of my transmission?	The tone of your transmission is: 1. good 2. variable 3. bad.
QRK	What is the intelligibility of my signals (*or* those of … *(name and/or call sign)*)?	The intelligibility of your signals (*or* those of … *(name and/or call sign)*) is: 1. bad 2. poor 3. fair 4. good 5. excellent.
QRL	Are you busy?	I am busy (*or* I am busy with … *(name and/or call sign)*). Please do not interfere.

QRM	Is my transmission being interfered with?	Your transmission is being interfered with: 1. nil 2. slightly 3. moderately 4. severely 5. extremely.
QRN	Are you troubled by static?	I am troubled by static: 1. nil 2. slightly 3. moderately 4. severely 5. extremely.
QRO	Shall I increase transmitter power?	Increase transmitter power.
QRP	Shall I decrease transmitter power?	Decrease transmitter power.
QRQ	Shall I send faster?	Send faster (… words per minute).
QRS	Shall I send more slowly?	Send more slowly (… words per minute).
QRT	Shall I stop sending?	Stop sending.
QRU	Have you anything for me?	I have nothing for you.
QRV	Are you ready?	I am ready.
QRW	Shall I inform … that you are calling him on … kHz (*or* MHz)?	Please inform … that I am calling him on … kHz (*or* MHz).
QRX	When will you call me again?	I will call you again at … hours on … kHz (*or* MHz).
QRZ	Who is calling me?	You are being called by … (on … kHz(*or* MHz)).

QSA	What is the strength of my signals (*or* those of … *(name and/or call sign)*)?	The strength of your signals (*or* those of … *(name and/or call sign)*) is: 1. scarcely perceptible 2. weak 3. fairly good 4. good 5. very good.
QSB	Are my signals fading?	Your signals are fading.
QSG	Shall I send … telegrams at a time?	Send … telegrams at a time.
QSL	Can you acknowledge receipt?	I am acknowledging receipt.
QSM	Shall I repeat the last telegram which I sent you (*or* some previous telegram)?	Repeat the last telegram which you sent me (*or* telegram(s) number(s) …).
QSN	Did you hear me (*or* … *(name and/or call sign)*) on … kHz (*or* MHz)?	I did hear you (*or* … *(name and/or call sign)*) on … kHz (*or* MHz).
QSO	Can you communicate with … *(name and/or call sign)* direct (*or* by relay)?	I can communicate with … *(name and/or call sign)* direct (*or* by relay through …).
QSP	Will you relay to … *(name and/or call sign)* free of charge?	I will relay to … *(name and/or call sign)* free of charge.
QSR	Shall I repeat the call on the calling frequency?	Repeat your call on the calling frequency; did not hear you (*or* have interference).
QSS	What working frequency will you use?	I will use the working frequency … kHz (*or* MHz) *(in the high frequency bands normally only the last three figures of the frequency need be given)*.
QSX	Will you listen to … *(name and/or call sign(s))* on … kHz (*or* MHz), or in the bands …/ channels …?	I am listening to … *(name and/or call sign(s))* on … kHz (*or* MHz), or in the bands …/ channels …
QSY	Shall I change to transmission on another frequency?	Change to transmission on another frequency (*or* on … kHz (*or* MHz)).

QTH	What is your position in latitude and longitude *(or according to any other indication)*?	My position is … latitude, … longitude *(or according to any other indication)*.
QTJ	What is your speed?	My speed is … knots (*or* kilometers per hour *or* … statute miles per hour).
QTR	What is the correct time?	The correct time is … hours.
QTS	Will you send your call sign (*and/or* name) for … seconds?	I will send my call sign (*and/or* name) for … seconds.
QUA	Have you news of … *(name and/or call sign)*?	Here is news of … *(name and/or call sign)*.
QUD	Have you received the urgency signal sent by … *(name and/or call sign)*?	I have received the urgency signal sent by … *(name and/or call sign)* at … hours.
QUE	Can you speak in … *(language)*, with interpreter if necessary; if so, on what frequencies?	I can speak in … *(language)* on … kHz (*or* MHz).

6 Classification of emissions

The classification of emissions is made of 3 symbols:

1. type of modulation of the main carrier;
2. nature of signal(s) modulating the main carrier;
3. type of information to be transmitted.

For instance, the Morse code is classified as **A1A**, the audio single-side band **J3E**, and radio teletype (RTTY) **F1B.**

Modulation of the main Carrier

Symbol	Definition
N	Emission of an unmodulated carrier
Amplitude Modulation	
A	Double-sideband
H	Single-sideband, full carrier
R	Single-sideband, reduced or variable level carrier
J	Single-sideband, suppressed carrier
B	Independent sidebands
C	Vestigial sideband
Angle Modulation	
F	Frequency modulation
G	Phase modulation
Amplitude and Angle Modulation	
D	Amplitude and Angle Modulation, simultaneously or in a pre-established sequence
Emission of Pulses	
P	Unmodulated pulses

K	Modulated in amplitude
L	Modulated in width/duration
M	Modulated in position/phase
Q	Carrier modulated during the angle-period of the pulse
V	Combination of the foregoing or is produced by other means
Other	
W	Combination of 2 or more of the previous modes
X	Not covered

Nature of signals

Symbol	Definition
0	No modulating channel
1	Single channel with **quantized or digital** information **without** a sub-carrier modulation
2	Single channel with **quantized or digital** information **with** a sub-carrier modulation
3	Single channel with **analogue** information
7	Two or more channel with **quantized or digital** information
8	Two or more channel with **analogue** information
9	Composite (analogue and digital)
X	Not covered

Type of Information

Symbol	Definition
N	No information transmitted
A	Telegraphy, aural reception
B	Telegraphy, automatic reception
C	Facsimile

Symbol	Definition
D	Data transmission, telemetry, telecommand
E	Telephony (includes sound broadcasting)
F	Television (video)
W	Combination of the above
X	Not covered

7 Wave Theory

Wave Theory

Period	$\tau = f^{-1}$, with f the frequency
Wave Length	$\lambda = c \cdot \tau$ $\lambda = c \cdot f^{-1}$
Angular Frequency	$\omega = 2 \pi f$
Angular Wave Vector	$k = 2 \pi \lambda$

Propagation

Band Definitions

Band number	Symbol	Frequency range (lower limit exclusive, upper limit inclusive)	Corresponding metric subdivision
4	VLF	3 to 30 kHz	Myriametric waves
5	LF	30 to 300 kHz	Kilometric waves
6	MF	300 to 3 000 kHz	Hectometric waves
7	HF	3 to 30 MHz	Decametric waves
8	VHF	30 to 300 MHz	Metric waves
9	UHF	300 to 3 000 MHz	Decimetric waves
10	SHF	3 to 30 GHz	Centimetric waves
11	EHF	30 to 300 GHz	Millimetric waves
12		300 to 3 000 GHz	Decimillimetric waves

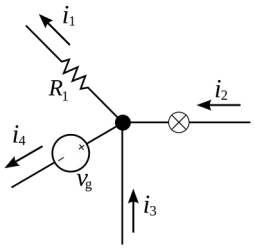
8 Electricity

Ohm's Law	$V = R \cdot I$
Power	$P = V \cdot I$
N resistors in series	$R_{total} = R_1 + \cdots + R_N$
N resistors in parallel	$\frac{1}{R_{total}} = \frac{1}{R_1} + \cdots + \frac{1}{R_N}$
N capacitors in series	$\frac{1}{C_{total}} = \frac{1}{C_1} + \cdots + \frac{1}{C_N}$
N capacitors in parallel	$C_{total} = C_1 + \cdots + C_N$
N inductances in series	$L_{total} = L_1 + \cdots + L_N$
N inductances in parallel	$\frac{1}{L_{total}} = \frac{1}{L_1} + \cdots + \frac{1}{L_N}$
Inductance of a Solenoid	$L = \frac{\mu N^2 A}{l}$, with *N* the number of turns, *A* the cross-section of the solenoid, and *l* the length

Kirchhoff's Law

Currents

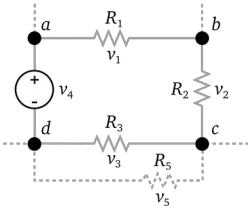
On a circuit node, the algebraic sum of all currents (positive for incoming and negative for exiting) is equal to zero: $\sum_{k=0}^{K} I_k = 0$.



For instance on the figure[2], the law reads as: $i_1 + i_4 - i_2 - i_3 = 0$.

Voltage

The directed sum of all voltage on a closed loop is equal to zero: $\sum_{k=0}^{K} V_k = 0$.

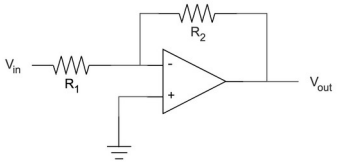


For instance on the figure[3], the law reads as: $v_1 + v_2 - v_3 - v_4 = 0$.

Operational Amplifiers

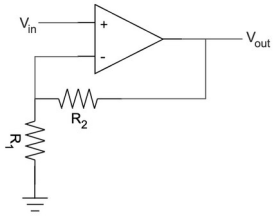
Inverting Configuration

$$\frac{V_{out}}{V_i} = -\frac{R_2}{R_1}$$



Non-inverting Configuration

$$\frac{V_{out}}{V_i} = 1 + \frac{R_2}{R_1}$$



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2 *M0tty*, CC BY-SA 3.0

3 *Kwinkunks*, CC BY-SA 3.0

Filters & RLC

Transistors

Resistor Colors

> *IEC 60062:2016 Standard*

Color	Number	Multiplier	Tolerance
Black	0	10^{0}	N/A
Brown	1	10^{1}	±1 %
Red	2	10^{2}	±2 %
Orange	3	10^{3}	±0.05 %
Yellow	4	10^{4}	±0.02 %
Green	5	10^{5}	±0.5 %
Blue	6	10^{6}	±0.25 %
Violet	7	10^{7}	±0.1 %
Gray	8	10^{8}	±0.01%
White	9	10^{9}	N/A
Silver		10^{-2}	±10 %
Gold		10^{-1}	±5 %

9 ITU Prefixes Allocation

With respect to the Appendix 42 of the RR:

> *The first two characters of a call sign shall be two letters or a letter followed by a digit or a digit followed by a letter. The first two characters or in certain cases the first character of a call sign constitute the nationality identification.*[4]

For instance, **Monaco** has the range **3AA – 3AZ**, so the country is identified with **3A**. If the allocation is wider, as **Spain** with **EAA – EHZ**, the country can be identified with **EA, EB, ..., EH.**

Range	Country or Organization
2—3	
2AA – 2ZZ	United Kingdom of Great Britain and Northern Ireland
3AA – 3AZ	Monaco (Principality of)
3BA – 3BZ	Mauritius (Republic of)
3CA – 3CZ	Equatorial Guinea (Republic of)
3DA – 3DM	Eswatini (Kingdom of)
3DN – 3DZ	Fiji (Republic of)
3EA – 3FZ	Panama (Republic of)
3GA – 3UZ	Chile
3VA – 3VZ	Tunisia
3WA – 3WZ	Viet Nam (Socialist Republic of)
3XA – 3XZ	Guinea (Republic of)
3YA – 3YZ	Norway
3ZA – 3ZZ	Poland (Republic of)
4	
4AA – 4CZ	Mexico
4DA – 4IZ	Philippines (Republic of the)

[4] For call sign series beginning with B, F, G, I, K, M, N, R, W and 2, only the first character is required for nationality identification. In the cases of half series (i.e. when the first two characters are allocated to more than one Member State), the first three characters are required for nationality identification.

4JA – 4KZ	Azerbaijan (Republic of)
4LA – 4LZ	Georgia
4MA – 4MZ	Venezuela (Bolivarian Republic of)
4OA – 4OZ	Montenegro
4PA – 4SZ	Sri Lanka (Democratic Socialist Republic of)
4TA – 4TZ	Peru
4UA – 4UZ	United Nations
4VA – 4VZ	Haiti (Republic of)
4WA – 4WZ	Timor-Leste (Democratic Republic of)
4XA – 4XZ	Israel (State of)
4YA – 4YZ	International Civil Aviation Organization
4ZA – 4ZZ	Israel (State of)
5	
5AA – 5AZ	Libya (State of)
5BA – 5BZ	Cyprus (Republic of)
5CA – 5GZ	Morocco (Kingdom of)
5HA – 5IZ	Tanzania (United Republic of)
5JA – 5KZ	Colombia (Republic of)
5LA – 5MZ	Liberia (Republic of)
5NA – 5NZ	Nigeria (Federal Republic of)
5PA – 5QZ	Denmark
5RA – 5SZ	Madagascar (Republic of)
5TA – 5TZ	Mauritania (Islamic Republic of)
5UA – 5UZ	Niger (Republic of the)
5VA – 5VZ	Togolese Republic
5WA – 5WZ	Samoa (Independent State of)
5XA – 5XZ	Uganda (Republic of)
5YA – 5ZZ	Kenya (Republic of)
6	
6AA – 6BZ	Egypt (Arab Republic of)
6CA – 6CZ	Syrian Arab Republic
6DA – 6JZ	Mexico

6KA – 6NZ	Korea (Republic of)
6OA – 6OZ	Somalia (Federal Republic of)
6PA – 6SZ	Pakistan (Islamic Republic of)
6TA – 6UZ	Sudan (Republic of the)
6VA – 6WZ	Senegal (Republic of)
6XA – 6XZ	Madagascar (Republic of)
6YA – 6YZ	Jamaica
6ZA – 6ZZ	Liberia (Republic of)
7	
7AA – 7IZ	Indonesia (Republic of)
7JA – 7NZ	Japan
7OA – 7OZ	Yemen (Republic of)
7PA – 7PZ	Lesotho (Kingdom of)
7QA – 7QZ	Malawi
7RA – 7RZ	Algeria (People's Democratic Republic of)
7SA – 7SZ	Sweden
7TA – 7YZ	Algeria (People's Democratic Republic of)
7ZA – 7ZZ	Saudi Arabia (Kingdom of)
8	
8AA – 8IZ	Indonesia (Republic of)
8JA – 8NZ	Japan
8OA – 8OZ	Botswana (Republic of)
8PA – 8PZ	Barbados
8QA – 8QZ	Maldives (Republic of)
8RA – 8RZ	Guyana
8SA – 8SZ	Sweden
8TA – 8YZ	India (Republic of)
8ZA – 8ZZ	Saudi Arabia (Kingdom of)
9	
9AA – 9AZ	Croatia (Republic of)
9BA – 9DZ	Iran (Islamic Republic of)
9EA – 9FZ	Ethiopia (Federal Democratic Republic of)

9GA – 9GZ	Ghana
9HA – 9HZ	Malta
9IA – 9JZ	Zambia (Republic of)
9KA – 9KZ	Kuwait (State of)
9LA – 9LZ	Sierra Leone
9MA – 9MZ	Malaysia
9NA – 9NZ	Nepal (Federal Democratic Republic of)
9OA – 9TZ	Democratic Republic of the Congo
9UA – 9UZ	Burundi (Republic of)
9VA – 9VZ	Singapore (Republic of)
9WA – 9WZ	Malaysia
9XA – 9XZ	Rwanda (Republic of)
9YA – 9ZZ	Trinidad and Tobago
A	
A2A – A2Z	Botswana (Republic of)
A3A – A3Z	Tonga (Kingdom of)
A4A – A4Z	Oman (Sultanate of)
A5A – A5Z	Bhutan (Kingdom of)
A6A – A6Z	United Arab Emirates
A7A – A7Z	Qatar (State of)
A8A – A8Z	Liberia (Republic of)
A9A – A9Z	Bahrain (Kingdom of)
AAA – ALZ	United States of America
AMA – AOZ	Spain
APA – ASZ	Pakistan (Islamic Republic of)
ATA – AWZ	India (Republic of)
AXA – AXZ	Australia
AYA – AZZ	Argentine Republic
B — C	
BAA – BZZ	China (People's Republic of)
C2A – C2Z	Nauru (Republic of)

C3A – C3Z	Andorra (Principality of)
C4A – C4Z	Cyprus (Republic of)
C5A – C5Z	Gambia (Republic of the)
C6A – C6Z	Bahamas (Commonwealth of the)
C7A – C7Z	World Meteorological Organization
C8A – C9Z	Mozambique (Republic of)
CAA – CEZ	Chile
CFA – CKZ	Canada
CLA – CMZ	Cuba
CNA – CNZ	Morocco (Kingdom of)
COA – COZ	Cuba
CPA – CPZ	Bolivia (Plurinational State of)
CQA – CUZ	Portugal
CVA – CXZ	Uruguay (Eastern Republic of)
CYA – CZZ	Canada
D	
D2A – D3Z	Angola (Republic of)
D4A – D4Z	Cabo Verde (Republic of)
D5A – D5Z	Liberia (Republic of)
D6A – D6Z	Comoros (Union of the)
D7A – D9Z	Korea (Republic of)
DAA – DRZ	Germany (Federal Republic of)
DSA – DTZ	Korea (Republic of)
DUA – DZZ	Philippines (Republic of the)
E	
E2A – E2Z	Thailand
E3A – E3Z	Eritrea
E4A – E4Z	State of Palestine[5]
E5A – E5Z	New Zealand – Cook Islands
E6A – E6Z	New Zealand – Niue
E7A – E7Z	Bosnia and Herzegovina

[5] In accordance with Resolution 99 Rev. Dubai, 2018

EAA – EHZ	Spain
EIA – EJZ	Ireland
EKA – EKZ	Armenia (Republic of)
ELA – ELZ	Liberia (Republic of)
EMA – EOZ	Ukraine
EPA – EQZ	Iran (Islamic Republic of)
ERA – ERZ	Moldova (Republic of)
ESA – ESZ	Estonia (Republic of)
ETA – ETZ	Ethiopia (Federal Democratic Republic of)
EUA – EWZ	Belarus (Republic of)
EXA – EXZ	Kyrgyz Republic
EYA – EYZ	Tajikistan (Republic of)
EZA – EZZ	Turkmenistan
F — G	
FAA – FZZ	France
GAA – GZZ	United Kingdom of Great Britain and Northern Ireland
H	
H2A – H2Z	Cyprus (Republic of)
H3A – H3Z	Panama (Republic of)
H4A – H4Z	Solomon Islands
H6A – H7Z	Nicaragua
H8A – H9Z	Panama (Republic of)
HAA – HAZ	Hungary
HBA – HBZ	Switzerland (Confederation of)
HCA – HDZ	Ecuador
HEA – HEZ	Switzerland (Confederation of)
HFA – HFZ	Poland (Republic of)
HGA – HGZ	Hungary
HHA – HHZ	Haiti (Republic of)
HIA – HIZ	Dominican Republic
HJA – HKZ	Colombia (Republic of)
HLA – HLZ	Korea (Republic of)

HMA – HMZ	Democratic People's Republic of Korea
HNA – HNZ	Iraq (Republic of)
HOA – HPZ	Panama (Republic of)
HQA – HRZ	Honduras (Republic of)
HSA – HSZ	Thailand
HTA – HTZ	Nicaragua
HUA – HUZ	El Salvador (Republic of)
HVA – HVZ	Vatican City State
HWA – HYZ	France
HZA – HZZ	Saudi Arabia (Kingdom of)
I — J	
IAA – IZZ	Italy
J2A – J2Z	Djibouti (Republic of)
J3A – J3Z	Grenada
J4A – J4Z	Greece
J5A – J5Z	Guinea-Bissau (Republic of)
J6A – J6Z	Saint Lucia
J7A – J7Z	Dominica (Commonwealth of)
J8A – J8Z	Saint Vincent and the Grenadines
JAA – JSZ	Japan
JTA – JVZ	Mongolia
JWA – JXZ	Norway
JYA – JYZ	Jordan (Hashemite Kingdom of)
JZA – JZZ	Indonesia (Republic of)
K — L	
KAA – KZZ	United States of America
L2A – L9Z	Argentine Republic
LAA – LNZ	Norway
LOA – LWZ	Argentine Republic
LXA – LXZ	Luxembourg
LYA – LYZ	Lithuania (Republic of)
LZA – LZZ	Bulgaria (Republic of)

M — N — O	
MAA – MZZ	United Kingdom of Great Britain and Northern Ireland
NAA – NZZ	United States of America
OAA – OCZ	Peru
ODA – ODZ	Lebanon
OEA – OEZ	Austria
OFA – OJZ	Finland
OKA – OLZ	Czech Republic
OMA – OMZ	Slovak Republic
ONA – OTZ	Belgium
OUA – OZZ	Denmark
P	
P2A – P2Z	Papua New Guinea
P3A – P3Z	Cyprus (Republic of)
P4A – P4Z	Netherlands (Kingdom of the) - Aruba
P5A – P9Z	Democratic People's Republic of Korea
PAA – PIZ	Netherlands (Kingdom of the)
PJA – PJZ	Netherlands (Kingdom of the) - Bonaire, Sint Eustatius and Saba
PJA – PJZ	Netherlands (Kingdom of the) - Curaçao
PJA – PJZ	Netherlands (Kingdom of the) - Sint Maarten (Dutch part)
PKA – POZ	Indonesia (Republic of)
PPA – PYZ	Brazil (Federative Republic of)
PZA – PZZ	Suriname (Republic of)
R — S	
RAA – RZZ	Russian Federation
S2A – S3Z	Bangladesh (People's Republic of)
S5A – S5Z	Slovenia (Republic of)
S6A – S6Z	Singapore (Republic of)
S7A – S7Z	Seychelles (Republic of)
S8A – S8Z	South Africa (Republic of)

S9A – S9Z	Sao Tome and Principe (Democratic Republic of)
SAA – SMZ	Sweden
SNA – SRZ	Poland (Republic of)
SSA – SSM	Egypt (Arab Republic of)
SSN – STZ	Sudan (Republic of the)
SUA – SUZ	Egypt (Arab Republic of)
SVA – SZZ	Greece
T	
T2A – T2Z	Tuvalu
T3A – T3Z	Kiribati (Republic of)
T4A – T4Z	Cuba
T5A – T5Z	Somalia (Federal Republic of)
T6A – T6Z	Afghanistan
T7A – T7Z	San Marino (Republic of)
T8A – T8Z	Palau (Republic of)
TAA – TCZ	Republic of Türkiye
TDA – TDZ	Guatemala (Republic of)
TEA – TEZ	Costa Rica
TFA – TFZ	Iceland
TGA – TGZ	Guatemala (Republic of)
THA – THZ	France
TIA – TIZ	Costa Rica
TJA – TJZ	Cameroon (Republic of)
TKA – TKZ	France
TLA – TLZ	Central African Republic
TMA – TMZ	France
TNA – TNZ	Congo (Republic of the)
TOA – TQZ	France
TRA – TRZ	Gabonese Republic
TSA – TSZ	Tunisia
TTA – TTZ	Chad (Republic of)
TUA – TUZ	Côte d'Ivoire (Republic of)

TVA – TXZ	France
TYA – TYZ	Benin (Republic of)
TZA – TZZ	Mali (Republic of)
U	
UAA – UIZ	Russian Federation
UJA – UMZ	Uzbekistan (Republic of)
UNA – UQZ	Kazakhstan (Republic of)
URA – UZZ	Ukraine
V	
V2A – V2Z	Antigua and Barbuda
V3A – V3Z	Belize
V4A – V4Z	Saint Kitts and Nevis (Federation of)
V5A – V5Z	Namibia (Republic of)
V6A – V6Z	Micronesia (Federated States of)
V7A – V7Z	Marshall Islands (Republic of the)
V8A – V8Z	Brunei Darussalam
VAA – VGZ	Canada
VHA – VNZ	Australia
VOA – VOZ	Canada
VPA – VQZ	United Kingdom of Great Britain and Northern Ireland
VRA – VRZ	China (People's Republic of) - Hong Kong
VSA – VSZ	United Kingdom of Great Britain and Northern Ireland
VTA – VWZ	India (Republic of)
VXA – VYZ	Canada
VZA – VZZ	Australia
W — X	
WAA – WZZ	United States of America
XAA – XIZ	Mexico
XJA – XOZ	Canada
XPA – XPZ	Denmark
XQA – XRZ	Chile
XSA – XSZ	China (People's Republic of)

XTA – XTZ	Burkina Faso
XUA – XUZ	Cambodia (Kingdom of)
XVA – XVZ	Viet Nam (Socialist Republic of)
XWA – XWZ	Lao People's Democratic Republic
XXA – XXZ	China (People's Republic of) - Macao
XYA – XZZ	Myanmar (Union of)
Y	
Y2A – Y9Z	Germany (Federal Republic of)
YAA – YAZ	Afghanistan
YBA – YHZ	Indonesia (Republic of)
YIA – YIZ	Iraq (Republic of)
YJA – YJZ	Vanuatu (Republic of)
YKA – YKZ	Syrian Arab Republic
YLA – YLZ	Latvia (Republic of)
YMA – YMZ	Republic of Türkiye
YNA – YNZ	Nicaragua
YOA – YRZ	Romania
YSA – YSZ	El Salvador (Republic of)
YTA – YUZ	Serbia (Republic of)
YVA – YYZ	Venezuela (Bolivarian Republic of)
Z	
Z2A – Z2Z	Zimbabwe (Republic of)
Z3A – Z3Z	North Macedonia (Republic of)
Z8A – Z8Z	South Sudan (Republic of)
ZAA – ZAZ	Albania (Republic of)
ZBA – ZJZ	United Kingdom of Great Britain and Northern Ireland
ZKA – ZMZ	New Zealand
ZNA – ZOZ	United Kingdom of Great Britain and Northern Ireland
ZPA – ZPZ	Paraguay (Republic of)
ZQA – ZQZ	United Kingdom of Great Britain and Northern Ireland
ZRA – ZUZ	South Africa (Republic of)
ZVA – ZZZ	Brazil (Federative Republic of)

10 International System of Units

The International System of Units, known under the abbreviation SI, is the modern form of the metric system. The system has been established and is maintained by the General Conference on Weight and Measures (CGPM).

Base Units

Symbol	Name	Quantity
s	Second	Time
m	Meter	Length
kg	Kilogram	Mass
A	Ampere	Electric Current
K	Kelvin	Temperature
mol	Mole	Amount of substance
cd	Candela	Luminous Intensity

Derived Units

A sample of the most common units for Amateur Radio

Symbol	Name	Quantity	Definitions
Hz	Hertz	Frequency	s^{-1}
W	Watt	Power	$J \cdot s^{-1}$ $kg \cdot m^2 \cdot s^{-3}$
C	Coulomb	Electric Charge	$s \cdot A$
V	Volt	Electric Potential, Voltage	$W \cdot A^{-1}$ $J \cdot C^{-1}$ $kg \cdot m^2 \cdot s^{-3} \cdot A^{-1}$
F	Farad	Capacitance	$C \cdot V^{-1}$ $kg^{-1} \cdot m^{-2} \cdot s^4 \cdot A^2$

Symbol	Name	Quantity	Definitions
Ω	Ohm	Resistance	$V \cdot A^{-1}$ $kg \cdot m^2 \cdot s^{-3} \cdot A^{-2}$
S	Siemens	Electrical Conductance	Ω^{-1}
Wb	Weber	Magnetic Flux	$V \cdot s$ $kg \cdot m^2 \cdot s^{-2} \cdot A^{-1}$
T	Tesla	Magnetic Flux Density	$Wb \cdot m^{-2}$ $kg \cdot s^{-2} \cdot A^{-1}$
H	Henry	Inductance	$Wb \cdot A^{-1}$ $kg \cdot m^2 \cdot s^{-2} \cdot A^{-2}$

Prefixes

10^n	Symbol	Name
10^{15}	P	Peta
10^{12}	T	Tera
10^{9}	G	Giga
10^{6}	M	Mega
10^{3}	k	Kilo
10^{2}	h	Hecto
10^{1}	da	Deca
10^{0}	*Unit*	
10^{-1}	d	Deci
10^{-2}	c	Centi
10^{-3}	m	Milli
10^{-6}	μ	Micro
10^{-9}	n	Nano
10^{-12}	p	Pico
10^{-15}	f	Femto

Conversions

Length	
1 inch	25.4 mm
1 feet	0.3048 m
1 yard	0.9144 m
1 mile	1.61 m
Time	
1 day	86400 s
1 hour	3600 s
1 minute	60 s
Speed	
1 mph	0.447 m/s (1.61 km/h)
1 knot	0.5144 m/s (1.852 km/h)
1 km/h	0.2778 m/s
Surface	
1 ha	10000 m^2
1 sq. feet	0.0929 m^2
1 sq. yard	0.8361 m^2
Power	
1 Wh	3600 J
1 cal	4.184 J
Mass	
1 pound	0.454 kg
1 once	0.028 kg
1 stone	6.35 kg

Pressure	
1 bar	10000 Pa
1 psi	6895 Pa
1 atmosphere	1013.25 hPa
Temperature	
0° Celsius	273.15 Kelvin *°K = 273.15 + °C*
0° Farhenheit	255.372 Kelvin *°K = (°F – 32) ·5/9 + 273.15*
Data	
1 B (byte)	8 b (bits)
1 kB	1000 B 10^3 B
1 kiB	1024 B 2^{10} B
Angle	
30 deg	π/6 rad
45 deg	π/4 rad
60 deg	π/3 rad
90 deg	π/2 rad
180 deg	π rad
360 deg	2π rad

Physics Constants

Symbol	Quantity	Value
c	Speed of Light	$2.99792458 \cdot 10^8$ m·s^{-1}
μ_0	Vacuum Magnetic Permeability	$1.257 \cdot 10^{-7}$ N·A^{-2}
Z_0	Characteristic Impedance of Vacuum	376.7 Ω
$\varepsilon_0 = 1/\mu_0 c^2$	Vacuum Electric Permittivity	$8.854 \cdot 10^{-12}$ F·m^{-1}
$k_e = 1/4\pi\ \varepsilon_0$	Coulomb Constant	$8.989 \cdot 10^9$ N·m^2·C^{-2}

Decibels

dB	0	1	2	3	4	5	6	7	10	16	20	30
Ratio	1	1.26	1.6	2	2.5	3.2	4	5	10	40	100	1000

Where the decibel is defined as: $dB = 10 \cdot \log_{10}\left(P_1 / P_2\right)$ and ratio P_1 / P_2.

11 Mathematics

A cheat-sheet of the most common rules and remarkable values.

Algebra

$$a(b+c)=ab+ac$$

$$(a+b)(c+d)=ac+ad+bc+bd$$

$$\frac{\left(\frac{a}{b}\right)}{c}=\frac{ab}{c}$$

$$\frac{a}{\left(\frac{b}{c}\right)}=\frac{ac}{b}$$

$$a\left(\frac{b}{c}\right)=\frac{ab}{c}$$

$$\frac{a}{b}+\frac{c}{d}=\frac{ad+bc}{bd}$$

$$a^n a^m=a^{n+m}$$

$$\left(a^n\right)^m=a^{nm}$$

$$a^0=1, a\neq 0$$

$$(ab)^n=a^n b^n$$

$$a^{-n}=\frac{1}{a^n}$$

$$a^{n-m}=\frac{a^n}{a^m}$$

$$\sqrt[n]{a}=a^{1/n}$$

$$\sqrt[m]{\sqrt[n]{a}}=\sqrt[mn]{a}=a^{1/mn}$$

$$\sqrt[n]{ab}=\sqrt[n]{a}\sqrt[n]{b}$$

$$\sqrt[n]{\frac{a}{b}}=\frac{\sqrt[n]{a}}{\sqrt[n]{b}}$$

$$i=\sqrt{-1}$$

$$i^2=-1$$

Logarithms

The function $\log_b$ denotes the b-basis logarithm.

$\log(1) = 0$

$\log_b(b) = 1$

$\log_b(b^x) = x$

$b^{\log_b(x)} = x$

$\log(a^r) = r\log(a)$

$\log(ab) = \log(a) + \log(b)$

$\log\left(\frac{a}{b}\right) = \log(a) - \log(b)$

Trigonometry

Angle (rad)	Sine	Cosine	Tangent
0	0	1	0
$\pi/6$	$1/2$	$\sqrt{3}/2$	$\sqrt{3}/3$
$\pi/4$	$\sqrt{2}/2$	$\sqrt{2}/2$	1
$\pi/3$	$\sqrt{3}/2$	$1/2$	$\sqrt{3}$
$\pi/2$	1	0	N/A
$2\pi/3$	$\sqrt{3}/2$	$-1/2$	$-\sqrt{3}$
$3\pi/4$	$\sqrt{2}/2$	$-\sqrt{2}/2$	-1
$5\pi/6$	$1/2$	$-\sqrt{3}/2$	$-\sqrt{3}/3$
π	0	-1	0

Remarkable Values

$e^{i\pi} = -1$

$e^{i\theta} = \cos(\theta) + i\sin(\theta)$

$\pi \approx 3.141593$

$e \approx 2.718282$

$\sqrt{2} \approx 1.414214$

$\sqrt{7} \approx 2.645751$

$\sqrt{3} \approx 1.732051$

$\sqrt{8} \approx 2.828427$

$\sqrt{4} = 2$

$\sqrt{9} = 3$

$\sqrt{5} \approx 2.236068$

$\sqrt{10} \approx 3.162278$ and $\sqrt{100} = 10$

$\sqrt{6} \approx 2.449490$

$\sqrt{1000} \approx 31.62278$

$\log_{10}(2) \approx 0.301030$

$\log_{10}(7) \approx 0.845100$

$\log_{10}(3) \approx 0.477121$

$\log_{10}(8) \approx 0,903090$

$\log_{10}(4) \approx 0.602060$

$\log_{10}(9) \approx 0.954243$

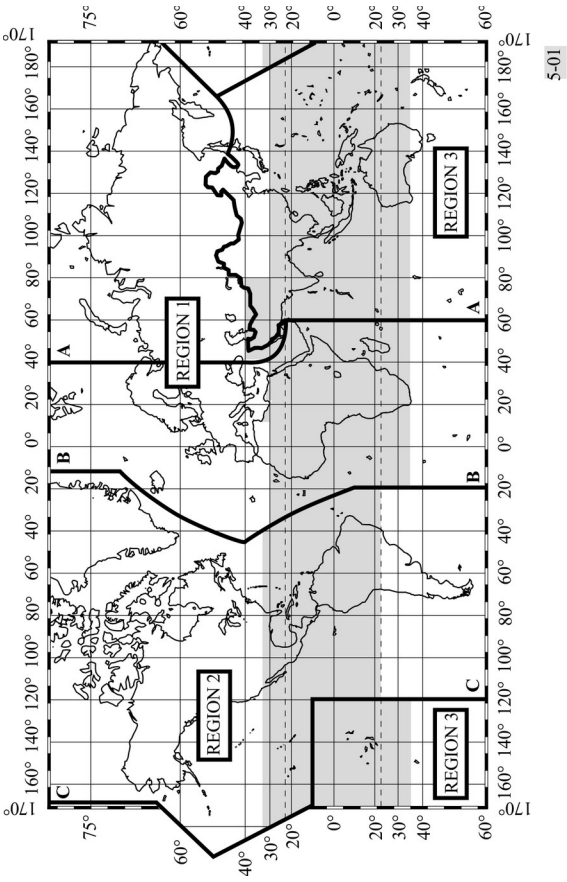
$\log_{10}(5) \approx 0.698970$

$\log_{10}(10) = 1$

$\log_{10}(6) \approx 0.778151$

$\log_{10}(20) \approx 1.301030$

12 ITU Regions



13 ITU Alphabet

A	Alpha	**N**	November
B	Bravo	**O**	Oscar
C	Charlie	**P**	Papa
D	Delta	**Q**	Quebec
E	Echo	**R**	Romeo
F	Fox-Trott	**S**	Sierra
G	Golf	**T**	Tango
H	Hotel	**U**	Uniform
I	India	**V**	Victor
J	Juliet	**W**	Whisky
K	Kilo	**X**	X-Ray
L	Lima	**Y**	Yankee
M	Mike	**Z**	Zulu

Widespread usage, occasionally replaced by country names.

1	Unaone	**6**	Soxisix
2	Bissotwo	**7**	Setteseven
3	Terrathree	**8**	Oktoeight
4	Kartefour	**9**	Novenine
5	Pantafive	**0**	Nadazero
•	Decimal		

Rare usage, only if transmission difficulties.

Abbreviations

Abbreviation	Description
AM	Amplitude Modulation
AMSAT	Amateur Satellite
BW	Band Width
CoA	Center of Activity
CW	Continuous Waves (Morse code)
DM	Digital Mode
DV	Digital Voice
DX	Distant contact (inter-continental)
EMCOM	Emergency Communication
Glob.	Global
ITU	International Telecommunication Union
NBM	Narrow Band Mode
Pref.	Preferred
RR	Radio Regulations
SSB	Single Side Band

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