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AMATEUR RADIO

Frequency (kHz)	BW (Hz)	Operation Modes And Applications
135.7 – 137.8	200	CW, QRSS and narrow band digital modes
1810 - 1838	200	CW, 1836 kHz - QRP Centre of Activity
1838 - 1840	500	Narrow band modes
1840 - 1843	2700	All modes – digimodes
1843 - 2000	2700	All modes
3500 - 3510	200	CW, priority for intercontinental operation
3510 - 3560	200	CW, contest preferred, 3555 kHz - QRS Centre of Activity
3560 - 3580	200	CW, 3560 kHz - QRP Centre of Activity
3580 - 3590	500	Narrow band modes - digimodes
3590 - 3600	500	Narrow band modes - digimodes, automatically controlled data stations (unattended)
3600 - 3620	2700	All modes - digimodes, automatically controlled data station (unattended)
3600 - 3650	2700	All modes, 3630 kHz - Digital Voice Centre of Activity, SSB contest preferred
3650 - 3700	2700	All modes, 3690 kHz - SSB QRP Centre of Activity
3700 - 3800	2700	All modes, SSB contest preferred
3775 - 3800	2700	All modes, priority for intercontinental operation
7000 - 7040	200	CW, 7030 kHz - QRP Centre of Activity
7040 - 7047	500	Narrow band modes - digimodes
7047 - 7050	500	Narrow band modes – digimodes, automatically controlled data stations (unattended)
7050 - 7053	2700	All modes - digimodes, automatically controlled data stations (unattended)
7053 - 7060	2700	All modes - digimodes
7060 - 7100	2700	All modes, SSB contest preferred
7100 - 7130	2700	All modes, 7110 kHz – Region 1 Emergency Centre of Activity
7130 - 7200	2700	All modes, SSB contest preferred, 7165 kHz - Image Centre of Activity
7175 - 7200	2700	All modes, priority for intercontinental operation
10100 - 10140	200	CW, 10116 kHz - QRP Centre of Activity
10140 - 10150	500	Narrow band modes – digimodes
14000 - 14060	200	CW, contest preferred, 14055 kHz - QRS Centre of Activity
14060 - 14070	200	CW, 14060 kHz - QRP Centre of Activity
14070 - 14089	500	Narrow band modes - digimodes
14089 - 14099	500	Narrow band modes - digimodes, automatically controlled data stations (unattended)
14099 - 14101		IBP, exclusively for beacons
14101 - 14112	2700	All modes - digimodes, automatically controlled data stations (unattended)
14112 - 14125	2700	All modes
14125 - 14300	2700	All modes, SSB contest preferred
14300 - 14350	2700	All modes, 14300 kHz - Global Emergency centre of activity
18068 - 18095	200	CW, 18086 kHz - QRP Centre of Activity
18095 - 18105	500	Narrow band modes - digimodes

18105 - 18109	500	Narrow band modes - digimodes, automatically controlled data stations (unattended)
18109 - 18111		IBP, exclusively for beacons
18111 - 18120	2700	All modes - digimodes, automatically controlled data stations (unattended)
18120 - 18168	2700	All modes
21000 - 21070	200	CW, 21055 kHz - QRS Centre of Activity 21060 kHz - QRP Centre of Activity
21070 - 21090	500	Narrow band modes - digimodes
21090 - 21110	500	Narrow band modes - digimodes, automatically controlled data stations (unattended)
21110 - 21120	2700	All modes (excluding SSB) - digimodes, automatically controlled data stations (unattended)
21120 - 21149	500	Narrow band modes
21149 - 21151		IBP, exclusively for beacons
21151 - 21450	2700	All modes, 21180 kHz - Digital Voice Centre of Activity
24890 - 24915	200	CW, 24906 kHz - QRP centre of activity
24915 - 24925	500	Narrow band modes - digimodes
24925 - 24929	500	Narrow band modes - digimodes, automatically controlled data stations (unattended)
24929 - 24931		IBP, exclusively for beacons
24931 - 24940	2700	All modes - digimodes, automatically controlled data stations (unattended)
24940 - 24990	2700	All modes, 24950 kHz – SSB QRP Centre of Activity 24960 kHz - Digital Voice Centre of Activity
28000 - 28070	200	CW, 28055 kHz - QRS Centre of Activity 28060 kHz - QRP Centre of Activity
28070 - 28120	500	Narrow band modes - digimodes
28120 - 28150	500	Narrow band modes - digimodes, automatically controlled data stations (unattended)
28150 - 28190	500	Narrow band modes
28190 - 28199		IBP, regional time shared beacons
28199 - 28201		IBP, worldwide time shared beacons
28201 - 28225		IBP, continuous duty beacons
28225 - 28300	2700	All modes - beacons
28300 - 28320	2700	All modes - digimodes, automatically controlled data stations (unattended)
28320 - 29100	2700	All modes
29000 - 29100	6000	All modes
29100 - 29200	6000	All modes - FM simplex – 10 kHz channels
29200 - 29300	6000	All modes - digimodes, automatically controlled data stations (unattended)
29300 - 29510	6000	Satellite- uplink + downlink
29510 – 29520		Guard channel
29520 – 29590	6000	All modes - FM repeater input (RH1 – RH8)
29600	6000	All modes - FM calling channel
29610	6000	All modes - FM simplex repeater (parrot - input and output)
29620 - 29700	6000	All modes - FM repeater outputs (RH1 – RH8)

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AUTOMOTIVE

Spectrum	System	Applications	Range
48 kHz	Ultrasonic	Park Assistance	0.2m to 3.0m
433 MHz, 868 MHz	RF	Remote Keyless Entry (RKE)	0m - 10m
1575.42, 1207.14, 1176.45, 1278.75 MHz	GNSS	Galileo	EU
*See EU Cellular Frequencies	Cellular	OnStar	EU Cellular
24 GHz	RADAR	Adaptive Cruise Control, Blind Spot Detection, Cross Traffic Alert, Rear Collision Warning	0.2m - 20m
76-81 GHz	RADAR	Adaptive Cruise Control, Emergency Breaking, Pedestrian Detection, Collision Avoidance	1m - 150m
532nm/1550nm	LIDAR	Emergency Breaking, Pedestrian Detection, Collision Avoidance	0.2m - 120m
visual spectrum	Video Camera	Traffic Sign Recognition, Lane Departure Warning, Surround View, Park Assistance	0m - 80m



SCIENTIFIC & MEDICAL

Frequency range		Bandwidth	Wavelength	Center frequency	Availability
6.765 MHz	6.795 MHz	30 kHz	44.2m	6.780 MHz	Subject to local acceptance
13.553 MHz	13.567 MHz	14 kHz	22.1m	13.560 MHz	Worldwide
26.957 MHz	27.283 MHz	326 kHz	11.1m	27.120 MHz	Worldwide
40.660 MHz	40.700 MHz	40 kHz	7.4m	40.680 MHz	Worldwide
433.050 MHz	434.790 MHz	1.74 MHz	0.69m	433.920 MHz	"Region 1 only and subject to local acceptance (within the amateur radio 70 cm band)"
902.000 MHz	928.000 MHz	26 MHz	0.33m	915.000 MHz	Region 2 only (with some exceptions)
2.400 GHz	2.500 GHz	100 MHz	120mm	2.450 GHz	Worldwide
5.725 GHz	5.875 GHz	150 MHz	50mm	5.800 GHz	Worldwide
24.000 GHz	24.250 GHz	250 MHz	12.4mm	24.125 GHz	Worldwide
61.000 GHz	61.500 GHz	500 MHz	4.9mm	61.250 GHz	Subject to local acceptance
122.000 GHz	123.000 GHz	1 GHz	2.4mm	122.500 GHz	Subject to local acceptance
244.000 GHz	246.000 GHz	2 GHz	1.2mm	245.000 GHz	Subject to local acceptance

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CELLULAR TELECOM

EU GSM CHANNELS (MHz)

#	DL	UL	BW (MHz)
1	395	385	9.6
2	425	415	9.6
3	464	454	6.8
4	492	482	6.8
5	737	707	18
6	755	785	16
7	858	813	15
8	881	836	24.6
9	947	902	24.6
10	942	897	34.6
11	940	895	38.6
13	1842	1747	74.6
14	1960	1880	59.6
25	1962	1882	65
26	876	831	35

FDD LTE

#	UL Fc	DL Fc	BW
1	1950	2140	60
2	1880	1960	60
3	1747	1842	75
4	1732	2132	45
5	836	881	25
6	835	880	10
7	2535	2655	70
8	897	942	35
9	1767	1862	35
10	1740	2140	60
11	1437	1485	20
12	707	737	17
13	782	751	10
14	793	763	10
17	710	740	12
18	822	867	15
19	837	882	15
20	847	806	30
21	1455	1503	15
22	3450	3550	80
23	2010	2190	20
24	1643	1542	34
25	1882	1962	65
26	831	876	35
27	815	860	17
28	725	780	45
29	--	722	11
30	2310	2355	10
31	455	465	5

* CDMA largely unused in Europe

EU UMTS FDD CHANNELS (MHz)

#	DL	UL	"Band-width (MHz)"
1	2140	1950	60
2	1960	1880	60
3	1842	1747	75
4	2132	1732	45
5	881	836	25
6	880	835	10
7	2655	2535	70
8	942	897	35
9	1862	1767	34.8
10	2140	1740	60
11	1485	1437	19.8
12	737	707	17
13	751	782	10
14	763	793	10
19	882	837	15
20	806	847	30
21	1503	1455	14.8
22	3550	3450	80

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SPACE & NAVAL EUROPEAN AND ASIAN GNSS FREQUENCIES

System	Signal Band	Frequency (MHz)	Wavelength (m)	Bandwidth (MHz)
GLONASS I	L1	1602	0.187	6.5
GLONASS I	L2	1246	0.241	5
GLONASS II	L1	1575.42	0.1904	6.5
GLONASS II	L1	1600.995	0.1874	15.365
GLONASS II	L2	1248.06	0.2404	8.75
GLONASS II	L3	1202.025	0.2496	20.46
GLONASS II	L5	1176.45	0.255	10.22
Galileo	E1	1575.42	0.1904	12
Galileo	E5b	1207.14	0.248	12.5
Galileo	E5a	1176.45	0.255	12.5
Galileo	E6	1278.75	0.2346	20
COMPASS CPII/ Beidou	E2	1561.098	0.1921	16
COMPASS CPII/ Beidou	E5	1207.14	0.248	16
COMPASS CPII/ Beidou	E6	1268.52	0.2364	16
COMPASS CPII/ Beidou	B1	1561.098	0.1921	4.092
COMPASS CPIII/Beidou	B1-2	1589.74	0.1887	4.092
COMPASS CPIII/Beidou	B2	1207.14	0.248	24
COMPASS CPIII/Beidou	B3	1268.52	0.2365	24
COMPASS CPIII/Beidou	B1-BOC	1575.42	0.1904	16.368
COMPASS CPIII/Beidou	B2-BOC	1207.14	0.248	5.115
COMPASS CPIII/Beidou	B3-BOC	1268.52	0.2365	35.805
COMPASS CPIII/Beidou	L5	1176.45	0.255	24
IRNSS-1	L5	1176.45	0.255	24
IRNSS-2	S-band	2492.028	0.1204	16.5
*Some GNSS systems are still being developed so specific frequency and bandwidth data may be subject to change				

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INTERNET OF THINGS/M2M

Name	Standard/Organization	Application	Spectrum Alloc.	Power	Range	Data Rate	Encryption	Network Type
Wireless USB	USB	Game controllers, printers, scanners, digital cameras, portable media players, hard disk drives, USB Flash drives	3.1-10.6 GHz	-41.3 dBm/MHz	3-10m	53-480 Mbps	possible	P2P
MA-USB			Agnostic					
DASH7	ISO/IEC 18000-7	wireless sensor networking applications: Building automation, Access Control, Smart Energy, Location-Based Services (Foursquare, Novitaz, Facebook, etc.), Mobile Advertising, Automotive (tire pressure monitoring system), Logistics (tracking of supplies/products)	433.92 MHz	1-2mW	2000m	200 kbs	128-bit AES	P2P
RFID	ISO 14223, ISO/IEC 14443, ISO/IEC 15693, ISO/IEC 18000, ISO/IEC 18092, ISO 18185, ISO/IEC 21481, ASTM D7434, ASTM D7435, ASTM D7580, ISO 28560-2	Logistics (inventory assets, people,etc), access management, Toll collections, Machine readable travel documents, Smartdust, Airport baggage, Timing Sporting events, telemetry	120-150 khz, 13.56 MHz, 433 MHz, 902-928 MHz, 2450-5800 MHz, 3.1-10 GHz	<1mW	200m	~26kbps	possible	P2P
Wireless HD	ITU-R 5.138	Digital network interface for wireless transmission of HD	59-66 GHz	<1W	10m	10-28 Gbps	DTCP	WWAN
TransferJet	ECMA 398, ISO/IEC 17568	Fast file transfer, data synchronization audio/video streaming	4.2-4.76 GHz	-70 dBm/MHz	0.3 m	375 Mbps	256-bit AES	P2P
NFC	ECMA 340, ISO/IEC 18092	Authentication, Authorization, Electronics Payment, ID Tagging	13.56 MHz	<1mW	<20cm	~424 kbps	possible	P2P
Miracast	Wi-Fi P2P, Wi-Fi Direct	Screen Mirroring	2.4GHz, 5 GHz	* See Wi-Fi IEEE 802.11a/b/g/n and IEEE 802.11a/ac/ax			WPA2	P2P
THREAD	IEEE 802.15.4 + 6LoWPAN	THREAD	2400-2483.5 MHz	100 mW	160 m	250 kb/s	128-bit AES	Mesh
ANT+	ANT+ Alliance	sports, wellness, calorimeters, blood pressure monitors, position tracking, homing devices, and thermometers	2.4 GHz	1 mW	100 m	1 Mb/s	AES-128	WSN
Cognitive Radio	IEEE 802.22 WG	Cognitive Radio	54-862 MHz	1 W	100 km	24 Mb/s	AES-GCM	WRAN
SigFox	SigFox	Global Cellular	902 MHz	25 mW	50 km	1kbps	possible	WSN
Weightless-N/W	Weightless SIG	M2M	915 MHz/TV White Space	40 mW / 4 W	5 km	0.001-10 Mb/s	128-bit	LPWAN
ZigBee	IEEE 802.15.4	Home automation, smart grid, remote control	2400-2483.5 MHz	100 mW	10m	20-250kbs	128-bit AES	Mesh
Bluetooth	Bluetooth (formerly IEEE 802.15.1)	wireless headsets, laptops, printers, wireless speakers, digital cameras, wireless keyboard, video games	2400-2483.5 MHz	100 mW	100 m	1-3 Mb/s	56/128-bit	WPAN
Bluetooth Smart (BLE)	Bluetooth (formerly IEEE 802.15.1)	Low-power IoT/M-M applications	2400-2483.5 MHz	10 mW	35 m	1 Mb/s	128-bit AES	WPAN
WiFi	IEEE 802.11a/b/g/n	WLAN	2400-2483.5 MHz	1 W	100 m	6-780 Mb/s	WEP, WPA, WPA2	WLAN
	IEEE 802.11a/ac/ax	WLAN	5 GHz	160 mW	35 m	*433 Mbps @ 80 MHz BW 867 Mbps @ 160 MHz BW 6.77 Gbps @ 160 MHz BW & 8x8 MIMO*	WEP, WPA, WPA2	WLAN
	IEEE 802.11af	WLAN	?	100 mW	> 1km	26.7 Mbps	WEP, WPA, WPA3	WLAN
	IEEE 802.11ah	WLAN	?	100 mW	1km	40 Mbps	WEP, WPA, WPA4	WLAN
	IEEE 802.11ad	WiFi/WiGig	60GHz	10 mW	10m	6.76 Gbps	128-bit AES	WLAN
Z-WAVE	IEEE 802.11ah	Home automation, security	908.42 MHz	1-100mW	30.5m	100 kbs	Triple DES	Mesh
Wireless HART	HART 7, IEC 62591, EN62591	HART Sensor Wireless Transfer, Wireless Sensors	2400-2483.5 MHz	100 mW	228 m	device data rate	128-bit AES	WSN
EnOcean	ISO/IEC 14543-3-10	Wireless Sensors, Controls, And Switches	315, 868, 902, 928.35 MHz	varies	30m Indoors, 300m Outdoors	125 kbps	Possible	Energy Harvesting
Insteon	Smarlabs, Inc	Home Automation	920-924 MHz	4 W	50m	13.165 kbps	rolling-code, managed-key and public-key algorithms	HAN

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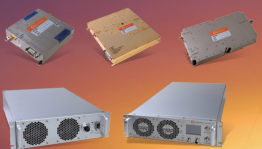
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