

2015 U.S. RADIO FREQUENCY ALLOCATIONS

microwaves&rf
TRUSTED ENGINEERING RESOURCE FOR OVER 50 YEARS

Brought to you by



AMATEUR RADIO

RADIO FREQUENCIES

f (GHz)
2.3-2.31
2.39-2.45
3.3-3.5
5.65-5.925
10-10.5
24-24.25
47-47.2
76-81
122.25-123
134-141
241-250
275+

Notes : All licenses except Novice are authorized on all modes. **76-81 GHz suspended pending review of vehicle radar interference

RADIO FREQUENCIES

f (MHz)	λ
1.8-2	160m
3.525-3.6	80m
3.5-3.6	80m
3.6-4	80m
3.8-4	80m
5.332-5.405	60m
7-7.125	40m
7.025-7.125	40m
7.125-7.3	40m
7.175-7.3	40m
10.1-10.15	30m
14-14.15	20m
14.025-14.15	20m
14.15-14.35	20m
14.225-14.35	20m
18.068-18.11	17m

18.11-18.168	17m
21-21.2	15m
21.025-21.2	15m
21.225-21.45	15m
21.275-21.45	15m
24.89-24.93	12m
24.93-24.99	12m
28-28.3	10m
28.3-28.7	10m
50-50.1	6m
50.1-54	6m
144-144.1	2m
144.1-148	2m
219-220	1.25m
420-450	70cm
902-928	33cm
1270-1295	23cm

2015 U.S. RADIO FREQUENCY ALLOCATIONS

microwaves&rf
TRUSTED ENGINEERING RESOURCE FOR OVER 50 YEARS

Brought to you by



SPACE & NAVAL

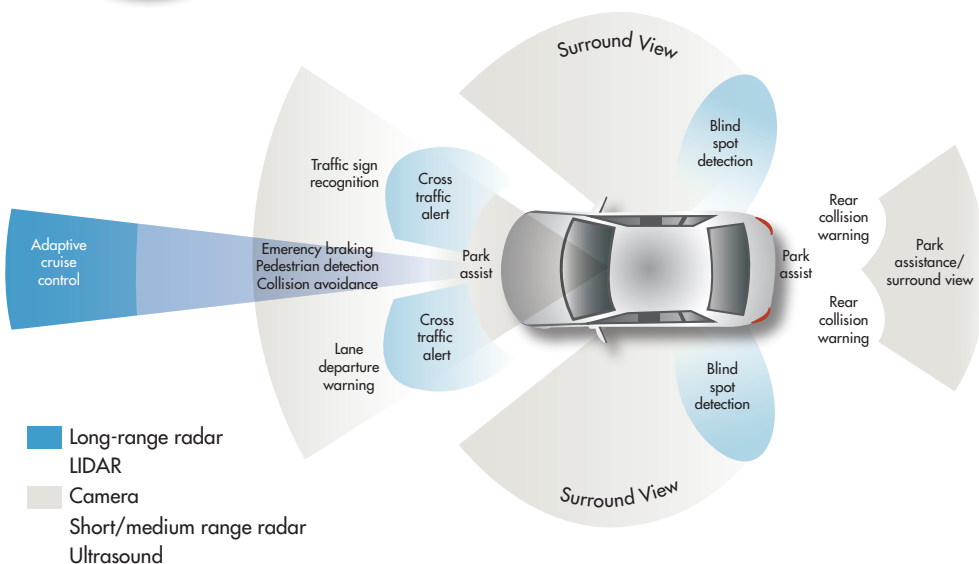
US AND PACIFIC GNSS FREQUENCIES

System	Signal	Frequency (MHz)	Wavelength (m)	Bandwidth (MHz)
GPS	L1	1575.42	0.190	15.345
GPS	L2	1227.6	0.244	11
GPS	L5	1176.45	0.255	12.5
QZSS	L5	1176.45	0.255	24
QZSS	L2C	1227.6	0.244	11
QZSS	E6/LEX	1278.75	0.235	20
QZSS	L1	1575.42	0.190	12

*Some GNSS systems are still being developed so specific frequency and bandwidth data may be subject to change



AUTOMOTIVE



- Long-range radar
- LIDAR
- Camera
- Short/medium range radar
- Ultrasound

AUTOMOTIVE SPECTRUM USE AND APPLICATIONS

Spectrum	System	Applications	Range
48 kHz	Ultra-sonic	Park Assistance	0.2m to 3.0m
433 MHz, 868 MHz	RF	Remote Keyless Entry (RKE)	0m - 10m
1575.42 MHz, 1227.6 MHz, 1176.45 MHz	GNSS	GPS	Global
800 MHz	Cellular	OnStar	Typical Cellular
24 GHz	RADAR	Adaptive Cruise Control, Blind Spot Detection, Cross Traffic Alert, Rear Collision Warning	0.2m - 20m
76-77 GHz	RADAR	Adaptive Cruise Control, Emergency Breaking, Pedestrian Detection, Collision Avoidance	1m - 150m
76-81 GHz	RADAR	Future Automotive Radar Frequencies	
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

2015 U.S. RADIO FREQUENCY ALLOCATIONS

microwaves&rf
TRUSTED ENGINEERING RESOURCE FOR OVER 50 YEARS

Brought to you by



CELLULAR TELECOM

US UMTS CHANNELS (MHz)

#	DL	UL	Bandwidth (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
25	1962	1882	65
26	876	831	35

US 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

FDD LTE

#	UL Fc	DL Fc	BW	DUPLEX
1	1950	2140	60	190
2	1880	1960	60	80
3	1747	1842	75	95
4	1732	2132	45	400
5	836	881	25	45
6	835	880	10	45
7	2535	2655	70	120
8	897	942	35	45
9	1767	1862	35	95
10	1740	2140	60	400
11	1437	1485	20	48
12	707	737	17	30
13	782	751	10	-31
14	793	763	10	-30
17	710	740	12	30
18	822	867	15	45
19	837	882	15	45
20	847	806	30	-41
21	1455	1503	15	48
22	3450	3550	80	100
23	2010	2190	20	180
24	1643	1542	34	-101.5
25	1882	1962	65	80
26	831	876	35	45
27	815	860	17	45
28	725	780	45	55
29	--	722	11	--
30	2310	2355	10	45
31	455	465	5	10

US CDMA CHANNELS (MHz)

#	DL	UL	BW
0	877	832	34
1	1960	1880	60
2	938	893	43
3	851	906	38
4	1855	1765	30
5	456	446	73
6	2140	1950	60
7	752	782	12
8	1842	1747	75
9	942	897	35
10	895	853	89
11	456	446	73
12	918	873	6
13	2655	2535	70
14	1962	1887	65
15	2132	1732	45
16	2657	2535	66
18	763	793	12
19	737	707	18
20	1542	1643	34
21	2190	2010	20

2015 U.S. RADIO FREQUENCY ALLOCATIONS

microwaves&rf
TRUSTED ENGINEERING RESOURCE FOR OVER 50 YEARS

Brought to you by



SAFETY & SECURITY

FEDERAL GOVERNMENT FREQUENCY ALLOCATIONS FROM 100MHz TO 1000 MHz

Frequency (MHz)	Allocation
108-117.975	Aeronautical Radionavigation
117.975-137	Aeronautical Mobile (Route)
137-138	Space Operation (space-to-Earth); Meteorological Satellite (space-to-Earth); Space Research (space-to-Earth); Mobile-Satellite (space-to-Earth)
148-149.9	Fixed; Mobile; Mobile-Satellite (Earth-to-space)
149.9-150.05	Mobile-Satellite (Earth-to-space); Radionavigation-Satellite
150.05-150.8	Fixed; Mobile
157.0375-157.1875	Maritime Mobile
162.0125-173.2	Fixed; Mobile
173.4-174	Fixed; Mobile
220-222	Fixed; Land Mobile
225-399.9	Fixed; Mobile; Mobile-Satellite; Aeronautical Radionavigation
399.9-401	Radionavigation Satellite; Standard Frequency and Time Signal Satellite; Mobile-Satellite (Earth-to-space); Meteorological Aids; Meteorological Satellite (space-to-Earth); Space Research (space-to-Earth); Mobile-Satellite (space-to-Earth); Space Operation (space-to-Earth)
401-402	Meteorological Aids (radiosonde); Space Operations (space-to-earth); Earth Exploration-Satellite (earth-to-space); Meteorological-Satellite (earth-to-space)
402-403	Meteorological Aids (radiosonde)
403-406	Meteorological Aids (radiosonde); Earth Exploration Satellite; Meteorological Satellite
406-406.1	Mobile-Satellite (Earth-to-space)
406.1-420	Fixed; Mobile; Radio Astronomy; Space Research (space-to-space)
420-450	Radiolocation
608-614	Land Mobile; Radio Astronomy
902-928	Radiolocation
932-935	Fixed
941-944	Fixed
960-1215	Aeronautical Radionavigation; Radionavigation Satellite (space-to-Earth)

FREQUENCY ALLOCATIONS FOR PUBLIC SAFETY (MHz)

25-50	764-776
150-162	794-806
173.2-173.4	806-821
220-222	821-824
450-470	851-866
470-512	866-869

NARROWBAND & BROADBAND PUBLIC SAFETY FREQUENCIES

Spectrum Alloc.	Standard/Organization	Application	Power	Range	Data Rate
758-763 MHz	IMT	Nation Broadband Network Safety	500W & 5W	503m & 1523m	384 kb/s
763-769 MHz	IMT	FirstNet (private entity for Nationwide Broadband Safety)	500W & 5W	503m & 1523m	384 kb/s
769-775 MHz	IMT	Narrow Band Segment	500W & 5W	503m & 1523m	384 kb/s
788-793 MHz	IMT	Nation Broadband Network Safety	500W & 5W	503m & 1523m	384 kb/s
793-799 MHz	IMT	FirstNet (private entity for Nationwide Broadband Safety)	500W & 5W	503m & 1523m	384 kb/s
799-805 MHz	IMT	Narrow Band Segment	500W & 5W	503m & 1523m	384 kb/s
806-809	IMT	NPSAPAC/Public Safety	500W & 5W	503m & 1523m	384 kb/s
809-815	IMT	Public Safety	500W & 5W	503m & 1523m	384 kb/s
815-816	IMT	Public Safety Expansion Band	500W & 5W	503m & 1523m	384 kb/s
4940-4990 MHz	IEEE 802.11y	Public Safety WLAN	1W	100m, P2P 50 km	216 Mb/s

2015 U.S. RADIO FREQUENCY ALLOCATIONS

microwaves&rf
TRUSTED ENGINEERING RESOURCE FOR OVER 50 YEARS

Brought to you by



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								
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	WVAN
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
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	* dictated by HART sensor	128-bit AES	WSN

HPAs
Modems
Mixers
Receivers
Detectors
Converters
Linearizers
Synthesizers
Integrated
Assemblies
Circuit Board
& Packaging

TWTs
Space
SatCom
Filters
YIG & BAW
Amplifiers
Components
Attenuators
Value Added
Services
Isolators &
Circulators

**Your Single Source
for Advanced
Microwave & RF Technologies**

**TELEDYNE
MICROWAVE SOLUTIONS**
Everywhere you look Everywhere you look Everywhere you look

800.832.6869 • microwave@teledyne.com
www.teledynemicrowave.com

© 2015 Teledyne Microwave Solutions

Real-time spectrum analyzers
without the cost.

1.800.260.TEST

SignalHound.com/mwrf

EXODUS

ADVANCED COMMUNICATIONS

High Power Amplifiers / Low Noise Amplifiers / Waveguide Components / Antennas & Cavity Filters
Modules & Systems / Power Levels available up to 3KW / Frequencies available up to 40GHz

**EXODUS ADVANCED
COMMUNICATIONS**

Exodus Advanced Communications, Corp.
172 S. Green Valley Parkway Suite 200 Henderson, NV 89012 U.S.A.
Tel: 1-702-534-4564 Fax: 1-702-441-7016
Email: sales@exoduscomm.com Web: www.exoduscomm.com

Sales contacts:
Inside Sales: Christy Strahan-Anderson
Domestic/International Sales: Bill Lieberman
Technical Sales: Effi Baimwell

Anritsu

envision : ensure

120 years
of history building
for a prosperous
future.

www.anritsu.com

DSA875 Spectrum Analyzer

Ideal for WiFi & 2.4 GHz Apps

Starting at \$7,999

- 100 kHz to 7.5 GHz Range
- DANL of -161 dBm (Typ) Normalized to 1 Hz
- Tracking Generator, EMI & VSWR Packages Available
- View 3rd Harmonic of 2.4 GHz Wireless Signals

RIGOL
Beyond Measure

Uncompromised Performance...
Unprecedented Value

DSG3000
RF Signal Generator

- Full RF Portfolio
- Lower Your Cost of Test

Visit RigolRF.com or call 877-4-RIGOL-1

Oscilloscopes • MSOs • Waveform Generators • RF Test • Precision Measurement

all around you

**Helping you shape core RF
solutions to connect and
protect the world.**

More products. More markets.
More scale. Faster.

qorvo.com