Frequencies Below 3 GHz Available to Technicians

Lower Freq	Upper Freq	Bandwidth	Band Name	Emission Types	Class	PEP*
3.675 MHz	3.725 MHz	0.05 MHz	80 meters	CW Only	P	200 W
7.10 MHz	7.15 MHz	0.05 MHz	40 meters	CW Only	P	200 W
21.1 MHz	21.2 MHz	0.1 MHz	15 meters	CW Only	P	200 W
28.1 MHz	28.3 MHz	0.2 MHz	10 meters	CW, RTTY, Data	P	200 W
28.3 MHz	28.5 MHz	0.2 MHz	10 meters	CW, SSB Phone	P	200 W
50.0 MHz	50.1 MHz	0.1 MHz	6 meters	CW Only	T	1500 W
50.1 MHz	54.0 MHz	3.9 MHz	6 meters	All (except Pulse)	T	1500 W
144.0 MHz	144.1 MHz	0.1 MHz	2 meters	CW Only	T	1500 W
144.1 MHz	148.0 MHz	3.9 MHz	2 meters	All (except Pulse)	T	1500 W
222.0 MHz	225.0 MHz	3 MHz	1.25 meters	All (except Pulse)	T	1500 W
420.0 MHz	450.0 MHz	30 MHz	70 centimeters	All (except Pulse)	T	1500 W
902.0 MHz	928.0 MHz	26 MHz	33 centimeters	All	T	1500 W
1240 MHz	1300 MHz	60 MHz	23 centimeters	All (except Pulse)	T	1500 W
2300 MHz	2310 MHz	10 MHz	13 centimeters	All	T	1500 W
2390 MHz	2450 MHz	60 MHz	13 centimeters	All	T	1500 W

HF VHF UHF Amateur Bands

*PEP = Peak Envelope Power

Radio Frequency Bands

Frequency Subdivision	Abbr.	Frequencies
Very Low Frequency	VLF	0 - 30 kHz
Low Frequency	LF	30 - 300 kHz
Medium Frequency	MF	300 - 3000 kHz
High Frequency	HF	3 - 30 MHz
Very High Frequency	VHF	30 - 300 MHz
Ultra High Frequency	UHF	300 - 3000 MHz
Super High Frequency	SHF	3 - 30 GHz
Extremely High Frequency	EHF	30 - 300 GHz

Usage of the Radio Spectrum

The Federal Communications Commission (FCC) regulates usage of the electromagnetic spectrum in the US. Within the radio frequency portion of the spectrum specific ranges are assigned to various groups such as aviation, military, police, municipal authorities, business use, amateur radio, etc.

The government recognizes that it is in the best interest of the country to have experienced, trained radio operators in the general populace and encourages this by promoting the *amateur radio service* (aka Ham Radio). A number of bands in the HF, VHF, UHF and SHF regions are allocated to this service. The most popular of these is the "2 meter band", ranging from 144MHz to 148MHz.

The FCC administers access to these bands by granting licenses to individuals who pass specific examinations. Different classes of license grant successively higher privileges. There are 3 classes of license: **Technician** (lowest), **General** and **Extra** (highest).

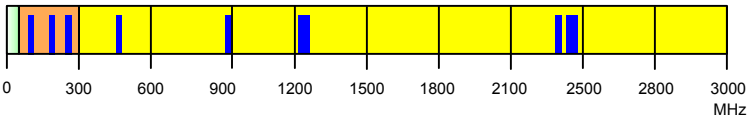
To encourage efficient sharing of the spectrum informal "band plans" are proposed which assign frequencies for particular usages. While not following the band plan is not strictly an offense, it is viewed as poor operating behaviour and will draw attention (warnings / notifications) from the FCC.

Finally, note that transmitting radio signals without proper authorization is a federal crime punishable by fines, confiscation of equipment, and even imprisonment depending on the circumstances.

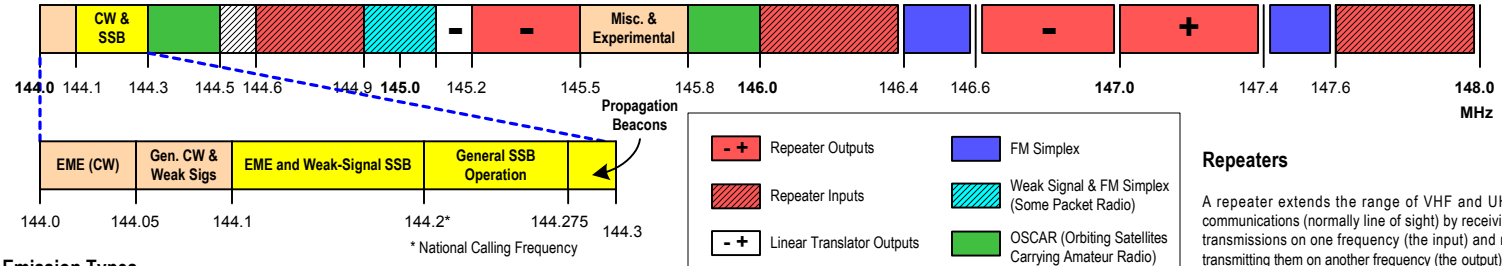
Radio Spectrum: 0 - 3 GHz

T = Technician
P = Technician Plus*

* Refers to a Technician who has successfully completed a Morse Code examination. This grants limited access to parts of the High Frequency region.



2-meter Band Plan



Repeaters

A repeater extends the range of VHF and UHF communications (normally line of sight) by receiving transmissions on one frequency (the input) and re-transmitting them on another frequency (the output).

Repeaters are usually elevated to a geographically advantageous position.

Emission Types

The FCC regulates the emission types that may be used in the various frequency bands and who may use them.

The term *emission* refers to any radio-frequency (RF) signal from a transmitter. A steady-state RF signal is known as a **Test Emission** and carries no information. The process of superimposing information onto this radio *carrier wave* is known as *modulation.*

The simplest form of modulation involves simply turning the transmitter on and off repeatedly and can be used to communicate using international ***Morse Code***. Also known as **Continuous Wave (CW)**, this code represents characters by a *variable length* codeword using two symbols (e.g., the character '**L**' is represented by " . – . . " and '**S**' by " . . . "). Symbols are identified by the durations of the ON periods of the transmitted signal ("short" and "long"). The main advantage of Morse Code is its ability to be received and understood in conditions where other modes of communication may be unintelligible due to interference and range limitations, etc.

Phone Emissions are transmissions used for *voice communications*. Carrier waves undergoing **Amplitude Modulation (AM)** have their amplitude varied in accordance with the variation in amplitude of the information signal. **Frequency Modulation (FM)** varies the frequency of the carrier wave instead of the amplitude. The main advantage of FM is that it is largely immune to static.

An analysis of the spectrum of AM signals shows that the information is contained within a short range of frequencies both above and below the carrier wave frequency. **Single Side-Band (SSB)** is a variation of AM which attempts to reduce bandwidth requirements by using only one of the side-bands of an AM signal (the carrier wave and the other side-band are removed before the transmission stage).

Radio Teletype (RTTY) and **Packet Radio** are forms of digital communications. An end user device (e.g., teleprinter or computer) sends information to a converter (modem or terminal network controller) which modulates and transmits it via radio. RTTY is a text based system. Packet Radio is classified as a **Data Emission** type as it allows the transfer of binary data files between computers. It includes features such as addressing, traversal of multiple "hops", receiver acknowledgements and error correction codes.

2-meter: Common Sub bands

Repeaters

Range (MHz)	Type
144.60 - 144.90	Input
145.20 - 145.50	Output
146.01 - 146.37	Input
146.61 - 146.97	Output
147.00 - 147.39	Output
147.60 - 147.99	Input

Simplex

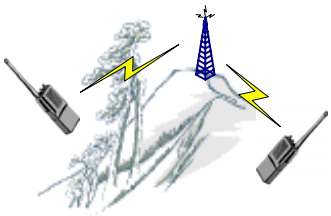
Range (MHz)
144.90 - 145.10*
146.40 - 146.58
147.42 - 147.57

* Packet Radio transmissions also occur here.

Note: Repeaters are forbidden from 144.0 to 144.5 and 145.5 to 146.0.

Common Input & Output Separations:

10m:	0.1 MHz
6m:	1 MHz
2m:	0.6 MHz
1.25 m:	1.6 MHz
70cm:	5 MHz
33 cm:	13 MHz
23 cm:	12 MHz



Repeaters are normally open for public use, but some may be closed and accessible only to a select group.

To prevent accidental activation many repeaters require a sub-audible tone, known as CTCSS (Continuous Tone-Coded Squelch System), to be transmitted by the radio in addition to the voice signal before functioning.

Repeaters are typically specified in terms of their output frequency, the input offset/separation (negative or positive) and the CTCSS tone.

2-meter: Common Frequencies

Simplex*

Freq (MHz)		
146.520**	147.420	147.510
146.535	147.435	147.525
146.550	147.450	147.540
146.565	147.465	147.555
146.580	147.480	147.570
146.595	147.495	147.585

Packet Radio

Freq (MHz)
145.01
145.03
145.05
145.07
145.09

* In general, channel separations of 15kHz and 30kHz are common for FM simplex operation.
** National Simplex Frequency: Commonly used for tactical communications during emergencies.

Bandwidth

"Bandwidth" refers to the amount of space in the RF spectrum that a signal occupies and is determined by the rate at which information is being sent. Lower information in a signal implies a lower bandwidth required to transmit the signal.

Example Bandwidths

CW:	250 - 500 Hz
RTTY:	~500 Hz
SSB Voice:	~3 kHz
FM Voice:	10 - 20 kHz

AMATEUR RADIO AND THE 2-METER BAND
First Version (1.0), January 2003
Latest Version (1.3), January 2004

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