

ECE 453

Wireless Communication Systems

Broadcast

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Radio Frequency Bands

- **AM radio** - 535 kilohertz to 1.7 megahertz
- **Short wave radio** - bands from 5.9 megahertz to 26.1 megahertz
- **Citizens band (CB) radio** - 26.96 megahertz to 27.41 megahertz
- **Television stations** - 54 to 88 megahertz for channels 2 through 6
- **FM radio** - 88 megahertz to 108 megahertz
- **Television stations** - 174 to 220 megahertz for channels 7 through 13

Radio Frequency Bands

- Garage door openers, [alarm systems](#), etc. - Around 40 megahertz
- Standard [cordless phones](#): Bands from 40 to 50 megahertz
- Baby monitors: 49 megahertz
- [Radio controlled airplanes](#): Around 72 megahertz,
- [Radio controlled cars](#): Around 75 megahertz
- Wildlife tracking collars: 215 to 220 megahertz
- MIR [space station](#): 145 megahertz and 437 megahertz
- [Cell phones](#): 824 to 849 megahertz
- New 900-MHz cordless phones: Obviously around 900 megahertz!
- [Air traffic control](#) radar: 960 to 1,215 megahertz
- [Global Positioning System](#): 1,227 and 1,575 megahertz
- Deep space radio communications: 2290 megahertz to 2300 megahertz

Up- and Down-Conversion

(1) Up - conversion: $f_{IF} > f_{cmax} > f_{cmin}$

$$(1a) f_{LO} = f_{IF} + f_c \quad f_{IM} = f_c + 2f_{IF} \quad |f_{IM} - f_c| = 2f_{IF}$$

$$(1b) f_{LO} = f_{IF} - f_c \quad f_{IM} = 2f_{IF} - f_c \quad |f_{IM} - f_c| = 2f_{LO}$$

(2) Down - conversion: $f_{IF} < f_{cmin} < f_{cmax}$

$$(2a) f_{LO} = f_{IF} + f_c \quad f_{IM} = f_c + 2f_{IF} \quad |f_{IM} - f_c| = 2f_{IF}$$

$$(2b) f_{LO} = f_c - f_{IF} \quad f_{IM} = |f_c - 2f_{IF}| \quad |f_{IM} - f_c| = 2f_{IF} \text{ if } f_c > 2f_{IF}$$
$$|f_{IM} - f_c| = 2f_{LO} \text{ if } f_c < 2f_{IF}$$

Example WILL: $f_c = 580$ kHz; $f_{LO} = 1035$ kHz ($f_{IF} = 455$ kHz). Preselector filter at $f_{IM} = 1490$ kHz

Both LO and preselector must be tuned simultaneously

AM Broadcasting

- Carriers in range 540 - 1700 kHz.
- Adjacent channel separation is 10 kHz.
- IF frequency: 455 kHz

FM Broadcasting

- The FM broadcast band covers 88 - 108 MHz.
- The channels are separated by 200 kHz and
- Channels assigned to odd multiples of 100 kHz.
- IF frequency at 10.7 MHz.
- high-side" LO from 98.7 to 118.7 MHz.
- IF used for FM substantially higher than that of AM
- image frequency separated from carrier by $2f_{IF}$