



Chapter 5 Radio Equipment

Building Blocks

Transmitters, Receivers

Station Installation, Interference



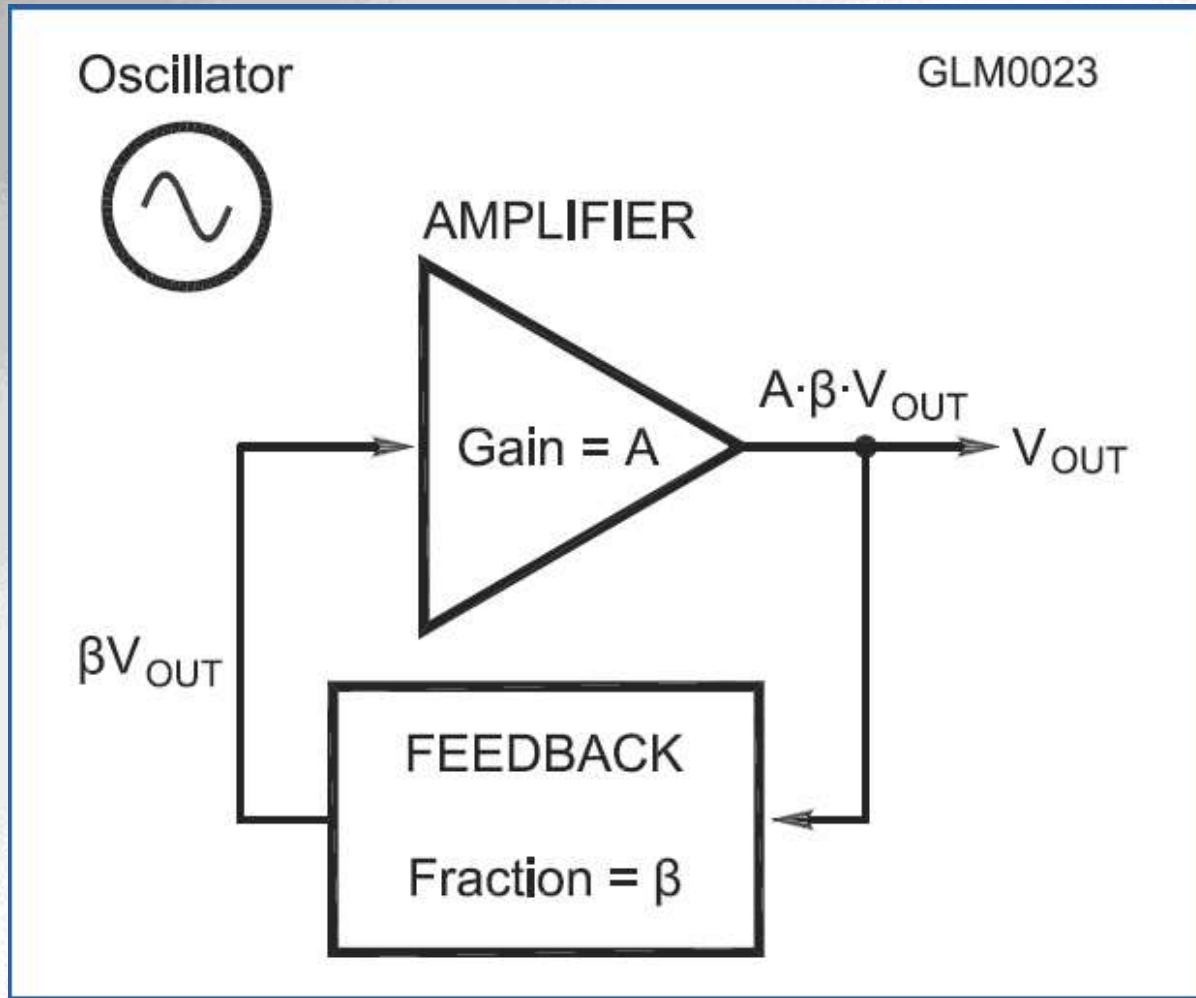
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Fundamental Circuits - Oscillators

Produces a single frequency sine wave for use as an input to other circuits.

- An amplifier with a resonant filter *feedback network*
- Positive feedback greater than unity for oscillation
- Network can be Resistance-Capacitance or Inductance-Capacitance – RC or LC
- In *Variable Frequency Oscillator* – VFO – C or L can be varied
- A quartz crystal can act like LC at one frequency
- Other methods: PLL and DDS

Oscillator Symbol and Circuit



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Fundamental Circuits - Mixers

A mixer output is the product of the mixer inputs.
One wave is multiplied by the other wave.

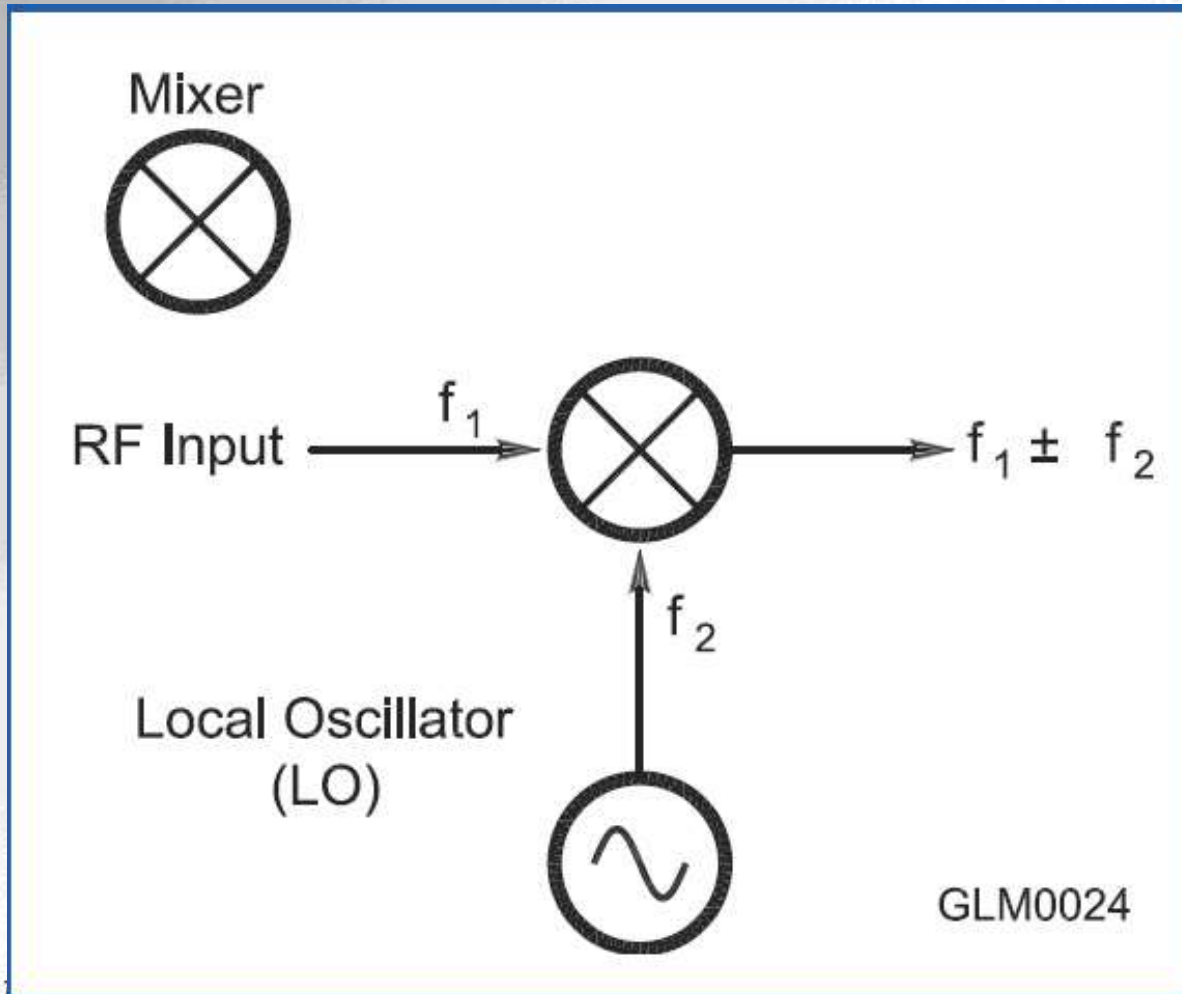
- Mixing is also called heterodyning and produces new frequencies at the sum and difference of the input frequencies.
- The output will also contain the input frequencies unless they are suppressed or filtered out.
- Usually only one of the mixer output frequencies is selected by using a filter.
- Do not confuse this mixer with an audio mixer where inputs are added together.



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Mixer Symbols and Signals



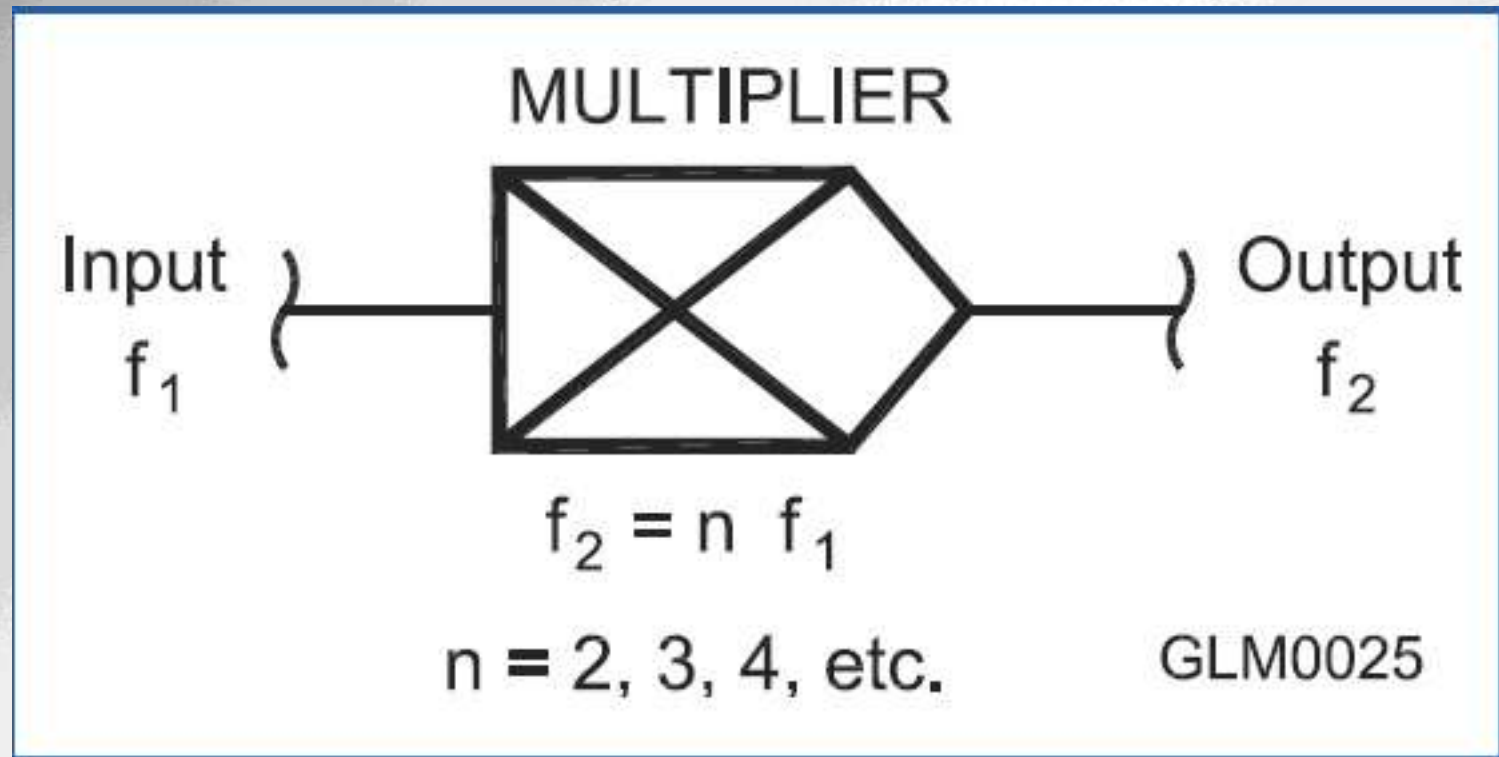
Fundamental Circuits - Multipliers

A Frequency Multiplier outputs a signal which is a *harmonic* of the input frequency. This is Not the same type of multiplication used in mixers.

- Amplifier driven to distortion produces harmonics.
- Resonant LC circuits are used to select the desired harmonic
- Multipliers may be cascaded for large frequency ratios. 7MHz => 2X => 5X => 3X => 210MHz
- Multipliers are called “Doubler”, “Tripler”, ... etc.
- Used to multiply a stable oscillator to a higher band.



Multiplier Symbol and Inputs



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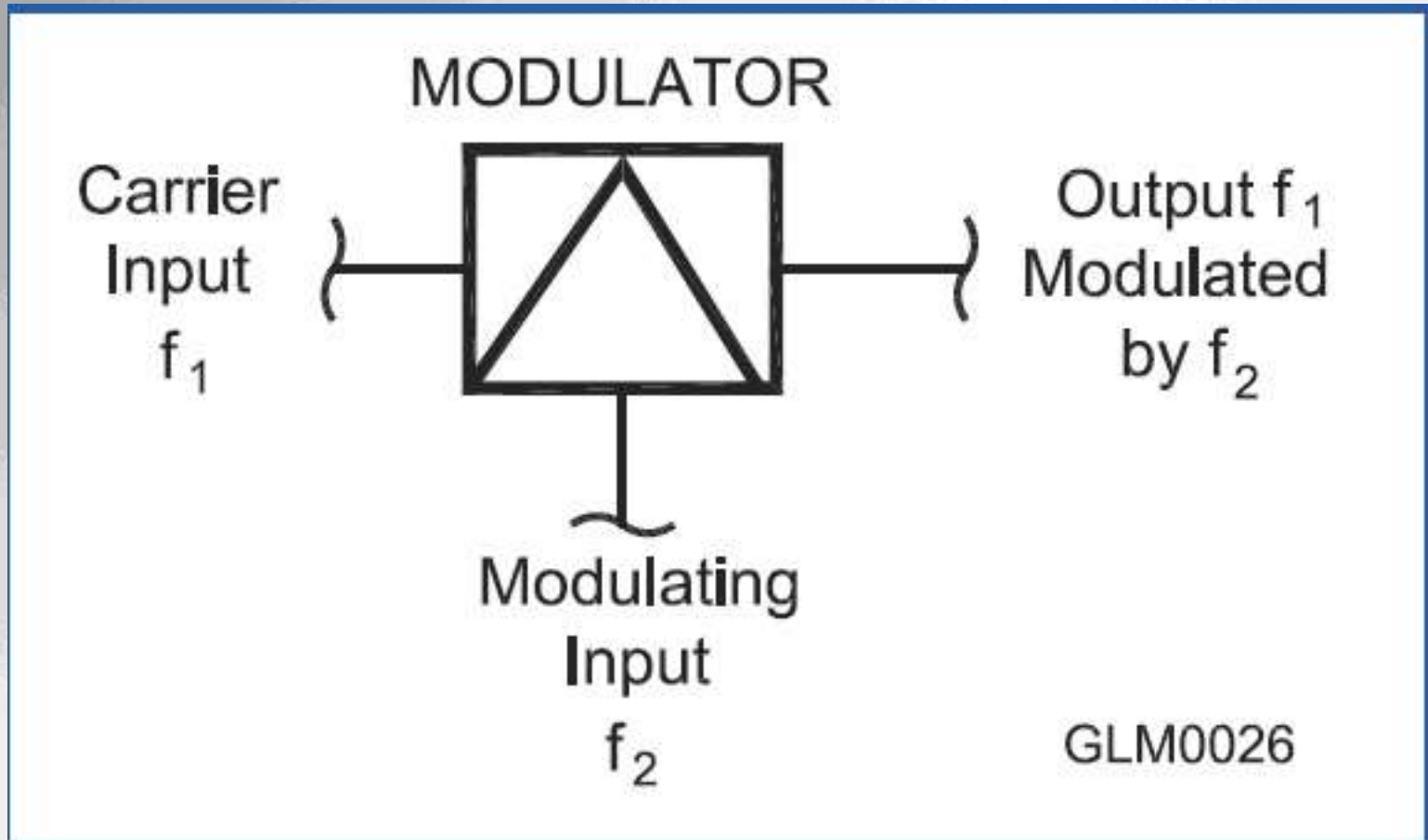


Fundamental Circuits – Modulators

Modulators, like mixers, perform a multiplication of one signal by another.

- Amplitude modulation – voltage is multiplied by a voltage
- Frequency modulation – frequency is multiplied by a voltage.
- Modulation creates new frequencies just like mixing.
- Balanced modulators cancel out one of the input frequencies, usually the carrier.

Modulator Symbol and Signals



GLM0026



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Amplitude Modulation Methods

Historical method is to apply modulating voltage to plate or grid of a high-level amplifier.

Low level method uses a mixer in *balanced modulator* configuration.

If f_1 is the modulating signal and f_2 is the carrier:

- Balance in the mixer output can eliminate the carrier frequency f_2 , leaving $f_2 + f_1$ and $f_2 - f_1$ – the USB and LSB. (f_1 is too low in frequency to be RF.)
- For Double sideband with carrier, some f_2 can be added in by unbalancing the mixer.



GLM0027

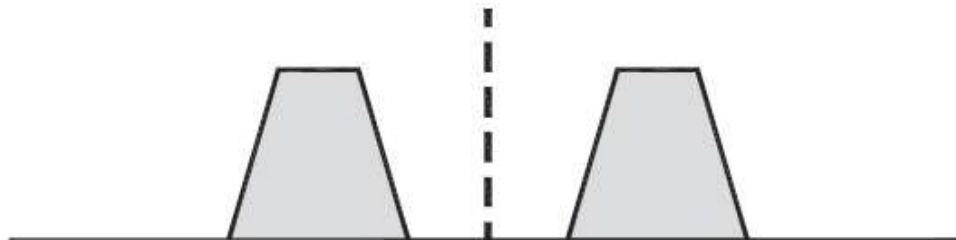
Carrier

Plate or
Collector
Modulator



AM
Carrier &
USB & LSB

Balanced
Modulator



DSB
USB & LSB
Carrier removed

Filter or
Phasing
Modulator



SSB
One sideband &
Carrier removed

LSB

USB



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Frequency Modulation Methods

FM and PM are equivalent if the audio for PM has high frequency de-emphasis. Which one is used depends on the design. Both are called *angle modulation* because changing the frequency causes a change to the phase angle.

- FM is produced by a reactance modulator in the Oscillator.
- PM is produced by a reactance modulator in an amplifier stage.
- The phase of the carrier will vary but the average frequency is not changed



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