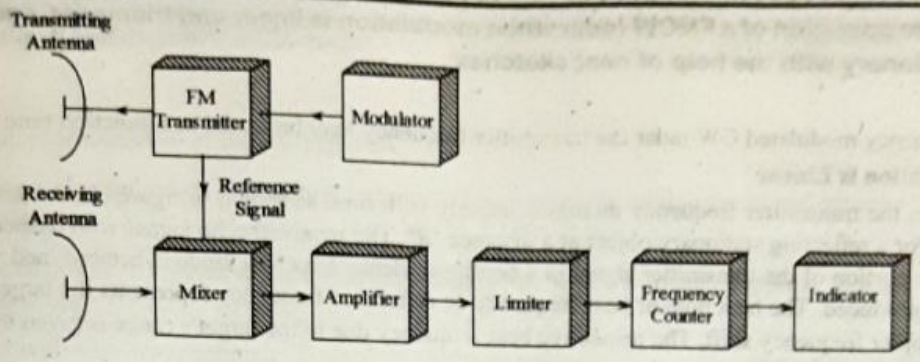

Figure (1)

The beat frequency can be produced by a portion of the transmitter signal which acts as a reference signal. A direct connection is used to introduce reference signal into the receiver. The transmitter leakage signal level can be reduced to a negligible value by providing sufficient large isolation between transmitting and receiving antennas. Any type of amplitude fluctuations are removed by amplifying the beat frequency. A cycle-counting frequency meter is used to measure the frequency of the amplitude-limited beat note.

In the above case, if the target is not stationary then an erroneous range measurement is produced. Figure 2(a) shows the frequency-time plot of the echo signal, which may be shifted up or down depending on the Doppler frequency shift. This Doppler shift is increase the beat frequency in one portion of the frequency-modulation cycle and similarly decrease the beat frequency in other portion.

For example, When the target is approaching the radar, the beat frequency, f_b(up) is produced during the increasing portion and f_b(down) is produced during the decreasing portion of the FM cycle i.e.,

$$f_b(\text{up}) = f_r - f_d \quad \ldots (1)$$

$$f_b(\text{down}) = f_r + f_d \quad \ldots (2)$$

When the target is moving away from the radar, the beat frequency, f_b(up) is produced during the decreasing portion and f_b(down) is produced during the increasing portion of the FM cycle i.e.,

$$f_b(\text{up}) = f_r + f_d \quad \ldots (3)$$

$$f_b(\text{down}) = f_r - f_d \quad \ldots (4)$$

Then using above expressions, the range frequency, f_r may be extracted as,

$$f_r = \frac{1}{2}[f_b(\text{up}) + f_b(\text{down})] \quad \ldots (5)$$

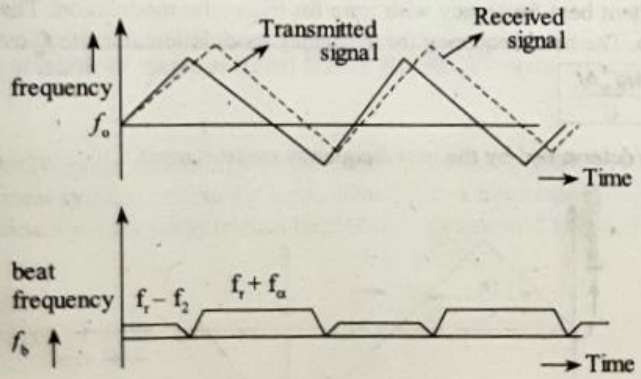

Figure (2)

When $f_r > f_d$, f_b(up) and f_b(down) are measured separately by switching a frequency counter every half modulation cycle and the Doppler frequency is produced by maintaining a one half difference between frequencies. When $f_r > f_d$, that is occurrence of a high-speed target at short range, the roles of averaging and difference frequency measurements are reversed. Thus, the difference meter measures range and the average meter measures Doppler velocity, due to the change in the inequality sign between f_r and f_d.

Thus, the direction of the Doppler is identified using a FM-CW radar.