Experiment No. 5

TARGET VELOCITY EMULATOR

Objective:

To emulate the variable speeds of moving objects using Target velocity Emulator.

Equipment Required:

1) Doppler Radar
2) PC with multimedia
3) Doppler power supply
4) Target velocity Emulator
5) Oscilloscope.

Procedure:

1. Connect the Power Supply +9V adaptor supplied, to the Doppler radar and the LED will glow on the back panel of radar. Connect power supply +9V to Target velocity Emulator. The variable pot fitted on target emulator varies frequency between 500Hz to 2 KHz.

2. Point the radar towards the Target velocity Emulator as shown in the image.

Doppler Radar

Target Emulator

3. Keep 4-6 inch distance between Doppler Radar and Target velocity Emulator for better results. Face the Doppler radar towards Target velocity Emulator.

4. Connect the output of the Doppler radar to the **DSO or** "**MIC IN**" of PC. This socket is provided at back of PC and is usually pink in colour and accepts microphone inputs.

5. Vary the Frequency of Target velocity Emulator so that we can receive square wave through radar on PC/Oscilloscope.

6. Increase the distance of the Target velocity Emulator from radar antenna and observe the fall in signal level.

7. Keep the Target velocity Emulator at different angles to the Horn dish and estimate the beam width of the Horn antenna.

Result:

When a square wave is modulated on Target velocity Emulator, it transmits the modulated signal at a frequency of 10.5 GHz, which is also the frequency at which radar transmits as well as receives. Hence the radar will presume as if it had transmitted a frequency in CW mode at 10.5GHz and is receiving a modulated 10.5GHz frequency after being reflected by some moving object due to which the transmitted wave has been shifted in phase. Now, as the amount of phase shift depends on the speed of moving object, increasing the frequency of modulated square wave being transmitted by Target velocity Emulator gives the same effect to radar as if the reflecting object is moving with a faster speed. Thus, increasing the frequency of modulating signal on Target velocity Emulator has same effect to radar as if the object is moving faster. Hence it is called Target velocity Emulator because it gives the effect of variable speed of moving object. The Target velocity Emulator is modulated with a frequency from DC to around 2 KHz results in a velocity simulation of 0-216 Km/Hr. Real objects moving at these speeds can be dangerous and expensive to reproduce in lab environments. The signal received by the radar goes down as the distance between the simulator and radar is increased. Although the Target velocity Emulator can be modulated upto 2KHz, the PC software might have difficulty in counting at that high frequency due to limitation of processing speeds.

Experiment No. 6

DOPPLER RADAR WITH TUNING FORK

Objective:

Doppler radar using tuning fork.

Equipment Required:

1) Doppler Radar

2) Multimedia PC

3) Tuning Fork

4) Oscilloscope

Procedure:

1. Read the frequency of tuning fork written on it. Say, it is 256 Hz approx that means when stroked it will vibrate at a frequency of 256 Hz approx.

2. Bring the vibrating tuning fork in front of radar. Radar will detect its vibration, which can be read on frequency counter on PC/Oscilloscope. A sine wave shall be seen of Tuning Form frequency.

3. If the frequency read is correct to a certain degree of accuracy, Radar is said to calibrated. Because there could be certain error in frequency of tuning fork also, due to manufacturing tolerances.

4. In case, the detected vibrations are low and radar is unable to display the frequency one can observe the vibrations in FFT mode where they will be much more discernible.

5. The radar uses a calibration factor of 19.49 Hz/Km/hr which has been calculated assuming Doppler radar carrier frequency of 10.5 GHz. This is factor that relates the Doppler frequency to object velocities. The user can program this factor in the software. This factor means that an object moving at 1 Km/hr towards or away from the radar shall produce a Doppler frequency of 19.49 Hz with a carrier frequency of 10.5GHz.

Result:

Calibrated radar will measure the frequency, RPM, velocities accurately. Tuning fork provides the standard frequency source, which can be read off from the PC for calibration.