

2.1.3 Isolation between Transmitter and Receiver

Q21. Discuss the concept of isolation between transmitter and receiver.

Oct./Nov.-18, Set-4, Q3(a)

(or)

Explain how isolation is provided between transmitter and receiver of CW radar.

Nov./Dec.-14, Set-4, Q3(b)

(or)

Explain how isolation between transmitter and receiver is obtained in CW radar.

Dec.-13, Set-3, Q3(b)

(or)

Explain how isolation between transmitter and receiver of a radar system can be achieved if single antenna is used for transmission and reception.

Ans:

Isolation between Transmitter and Receiver

The transmitter and receiver are isolated to get rid of leakage due to transmitter. Even though isolation is possible using a single antenna, separate antennas are employed for both transmission and reception with the intention that there is no chance of leakage entering the receiver. The amount of isolation required in long-range CW radar is decided by the noise associated with the transmitter leakage signal. For example, a 10 mW of leakage signal is appeared at the receiver for a proper isolation between transmitter and receiver. The transmitter noise must be at least 110 dB below the transmitted carrier for a minimum detectable signal of 10^{-13} watt.

A single antenna can serve as both transmitter and receiver, provided good isolation exists between them. Isolation is necessary to prevent the interference of signals and to avoid the transmitter leakage signal from entering receiver. Some radar systems like CW radar system have inbuilt isolation, whereas for others systems some devices must be incorporated to establish isolation.

The amount of isolation required depends on the transmitter power and on the transmitter noise. The receiver sensitivity must also be considered while deciding the isolation requirement for a setup.

There are different techniques of providing isolation depending on types of radar like,

1. A simple CW radar has an inbuilt isolation developed between transmitter and receiver, because the frequency of transmitting and receiving signals are different because of the Doppler effect.
2. A pulse radar uses duplexer as a device to provide isolation. Duplexer short circuits the receiver input during the period of transmission and hence prevents transmitter leakage to enter receiver.
3. To prevent the transmitter leakage signal entering into the receiver of a CW radar, hybrid junctions such as magic T , rat race, short-slot coupler must be employed. They can provide an isolation of range between 20 to 30 dB. But, due to the 6 dB loss in their overall performance, the usage of hybrid functions in isolating devices is implemented only for short-range radars.
4. Another method of obtaining isolation is by using Ferrite devices like circulator that provides an isolation of 20 to 50 dB. They don't incur 6 dB loss as in case of hybrid junctions.
5. Another microwave device used for isolation purpose is turnstile junction that provides an isolation of range 40 to 60 dB.
6. For short range radars, orthogonal polarizations are used for transmitting and receiving signals for isolation.