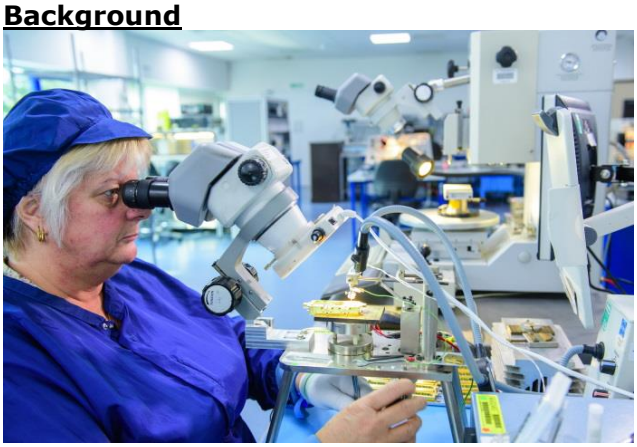
Case Study: FMCW Transceivers

Background



FMCW(Frequency Modulated Continuous Wave) radars operate differently from more traditional pulsed radar solutions in that they are almost continually transmitting and receiving.
The transmission is typically a linearly changing frequency which means the further a target is away from the radar, the longer it takes the signal to return, which leads to a bigger difference between that returning signals frequency and the current frequency of transmission. This difference in frequency is therefore directly proportional to distance to target. The more linear the ramped frequency the more accurate the distance measurement and the faster the ramped frequency the finer the possible distance resolution. Using higher frequencies that are quickly attenuated through the air can also help to quickly attenuate out of range returns leading to false targets in the ranges of interest.

Like traditional radars a narrow beam width and a rotating antenna can be used to transmit / receive along a narrow spoke to eventually build up a 360° picture of the local environment as the antenna cycles through one full rotation. Alternatively fixed antennas can be used with triangulation employed to measure a target's bearing.

Challenge

To develop a 77GHz FMCW transmit and receive module with industry leading linearity, low harmonic content and ideally separate transmit and receive ports to support bi-static bearing determination with a fixed antenna setup.

The module was to be driven by a low power X band source which would require multiplication and amplification to realise the required 77GHz output frequency.

Approach

The first step was to identify chipsets from packaged and bare die components available in the market place. Once it was clear that bare die options offered the most gain, power and bandwidth a carrier based solution was to be pursued taking the X band frequency source and integrating it with an amplifier and frequency multiplier chain to derive the signal to be transmitted.

The same transmit signal would also be split to provide the LO source for the down converting receive channel.

Outcome

An integrated microwave component was developed using an external X band source. This was then amplified and multiplied up to 77GHz. Thermal compensation was introduced to maintain linearity over temperature. Distributed integrated filtering was employed to remove unwanted frequency spurs generated by the multiplication process A sample of this transmitted signal was fed to a down converting mixer in the receive path.
The use of a mmWave frequency transceiver offers a number of advantages. The higher frequency allows for a higher resolution of the target. This can provide a more accurate determination of the target range and/or determination of the target size and shape factor depending upon the end application and signal processing capabilities.

Frequency bandwidth allocations are normally increased at higher frequencies which allows for either increased range resolution for a given detection range or the potential for an increased detection range with reduced range resolution.

The overall form factor of the system is reduced by operating at higher frequencies. The reduced wavelength allows for reduced antenna size for a given beamwidth or a higher antenna gain for a given size of antenna and hence increased detection range capability.

The transmit power levels achievable will increase as the high frequency MMIC device technology develops allowing for new longer range detection applications to be considered.

Linwave offer FMCW transceiver solutions in both the 24GHz and 77GHz frequency bands and can provide bespoke solutions allowing a high level of integration and customisation for the customer end application

Applications

- Surveillance radar
- Proximity sensors
- Tracking sensors
- Automotive safety sensors
- Communication links

For further information contact sales@linwave.co.uk or +44 (0)1522 681811

Data-sheet link