Case Study Marine Navigation Beacons

Background

Navigation support beacons: known as Racons have been around for several decades aiding navigation by clearly identifying a hazard by marking it with a selectable Morse character that appears on the radar screen of any local marine traffic. They've changed little over the years because radars haven't changed. Most radars today still use a magnetron source to transmit a single frequency high power RF pulse. New radar solutions are coming to market that use solid state RF sources; these don't need to be swapped out after a few thousand hours of operation. BUT these new sources currently cannot easily and cheaply generate the same power levels as a magnetron. To achieve similar levels of performance they use swept frequencies and pulse compression techniques which the traditional racons cannot respond to.

Challenge

At the heart of the challenge is to identify a particular radar signal accurately and quickly and to then respond at the same frequency to it. Whilst a swept frequency complicates the problem a little the larger issue is that just transmitting back a swept frequency mirroring the received one will not work as the receiving solid state radar will process this signal compressing it down into a dot. The required racon would have to transmit a complex signal back that once processed by the receiving radar would result in the intended Morse character being displayed. Digital technology evolutions over the last few years have opened up the possibility of using superfast digital signal processing (DSP) to both measure the incoming radar signal and generate the required complex RF signal to be transmitted back.

Fast DSP though takes current and a racon is often running off batteries and solar cells and therefore must be frugal. A new approach was required to manage power usage to compete successfully.

Linwave undertook to develop a racon that could respond to swept frequency solid state radars and to do this at a price point that would still remain competitive against legacy racon designs. The mantra was “same or better” whether it be a technical performance parameter, operational mode or physical characteristic.

Approach

Linwave has decades of RF experience across a multitude of fields and coupled this with additional skill sets in advanced DSP and Antenna design. Leading this complex development activity required Linwave to employ its structured NPI process to define the disparate requirements, allocate tasks appropriately, and then project manage the internal and external teams to meet the challenge set. The final realised solution then had to undertake regulatory approval for spectrum, EMC, Safety and Marine use. The unit has also been submitted to Radio Equipment Directive testing RED.

Currently even superfast cost-effective FPGA’s cannot directly sample the incoming RF signals so a novel down converting architecture was developed to handle both of the marine radar bands then passing amplitude and frequency information to a superfast FPGA that then works in conjunction with a microprocessor to characterise the local radar environment. By identifying what radars are present and when they are looking at the racon an efficient transmission of a complex RF Morse signal can be sent only when it’s needed. The rest of the time quiescent modes were used to minimise power consumption.

Outcome

The Phalcon-NT has been developed and is now in serial manufacturing. It meets the original technical aims of being able to respond to swept frequency solid state radars and legacy ones too whilst meeting or exceeding the performance specifications of existing legacy racons. It currently has met several international compliance standards i.e. R&TTE, REDS, IMO, CE, FCC and is about to start compliance activities on the new UKCA standard.

Applications

Whilst state of art as a racon the technologies combined to realise the racon solution have potentially further applications:

- RF transceivers
- Elint surveillance
- Pulsed RF analysers
- Racon test sets
- Digital frequency synthesis
- Pulsed RF power amplification
- Sequenced DC power control
- BITE – RF frequency to voltage auto-calibration

Further Information
https://www.linwave.co.uk/products/s-x-band-radar-beacon-racon/

For Marine installation support please contact our Value added Installation Partner Pharos Marine

For bespoke solutions please contact Linwave Technology directly.

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