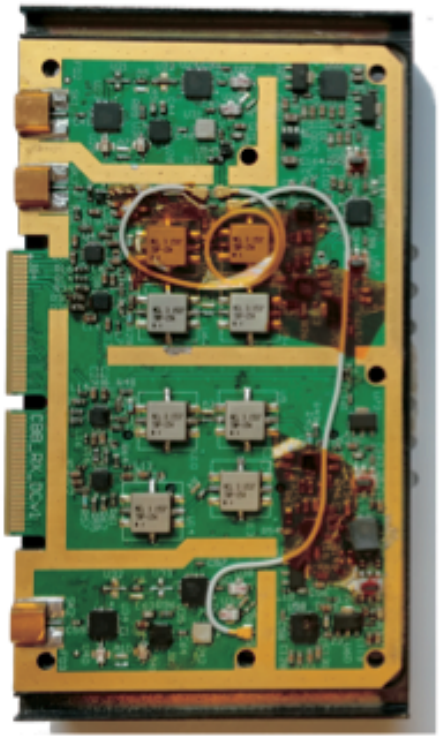
Focus on CSIR

Dual Channel Receiver Module

A compact radar receiver for Digital Array Radar



Introduction

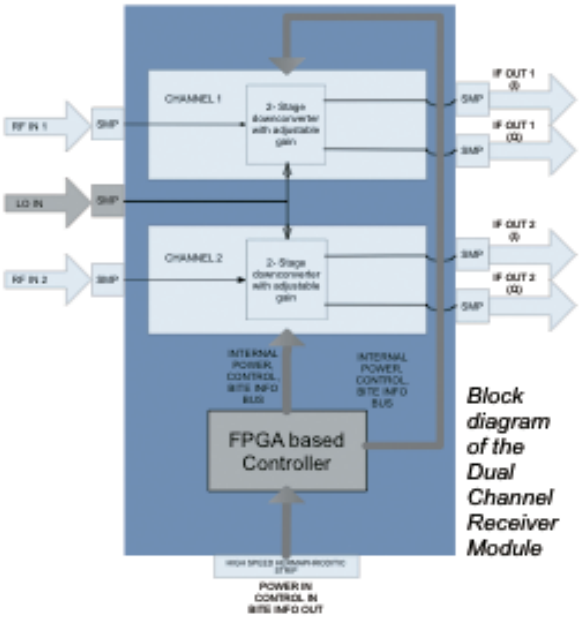
Radar systems require high performance receiver modules with good spurious free dynamic range, low phase noise and low noise figure. Furthermore, recent advances in processing technology has opened up the opportunity for digital beamforming and digital array radar, that typically requires multi-channel receivers with very high channel counts at low cost.

CSIR, in partnership with Lochtron and KACST has developed a dual-channel multi-band radar receiver that is compact and low-weight. The receiver is capable of operating up to 12 GHz, through choice of components at assembly. CSIR currently use the receivers produced at C-Band operating between 5.25GHz to 5.85GHz.

The Receiver Modules will be used within a broad range of next generation radars currently under development at the CSIR. These include a multi-static close-range surveillance radar system for perimeter surveillance and key-point protection; a ground-based surveillance radar system for border and wildlife protection; an aerostat-based long-range surveillance radar system and an airborne UAV SAR system. The wide range of applications illustrates well the flexibility in the design, which caters for both narrow-band and wide-band radar applications, with variable channel counts.

The receiver module is the first in a family of generic RF modules, referred to as common building blocks, currently being developed by the CSIR in partnership with Lochtron and KACST. The product roadmap for this family of products include:

- Front Ends to couple with the receiver from L to X Band
- A flexible exciter/up-converter module capable of both narrow and wide band waveform generation and de-chirp modes
- A GPS disciplined local oscillator module (LOM) that will allow operation of radar systems in both mono- and bistatic configurations.
- RF backplanes that can host several modules in a compact space, providing all the control and power conditioning, whilst still allowing the modules to be easily replaced.



Block diagram of the Dual Channel Receiver Module

Features

- Dual- channel receiver in a single module
- Small- and lightweight design
- High-performance wide-band operation
- Up to 400MHz instantaneous bandwidth (when configurred for IF sampling)
- Adjustable gain
- On-board controller unit
- Tuneable IF frequency
- Option of either I/Q baseband or IF mixing
- High Spurious Free Dynamic Range
- Quick-mating SMP connectors for RF in, LO in and IF out
- Rugged high speed digital connectors

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Uniquely flexible design

To ensure operation of the design over a large range of frequencies, as well as have variable IF bandwidths, a flexible and innovative approach was used.

At assembly time the receiver is fitted with a specific choice from a range of footprint-compatible IF filters. Furthermore, the option of using either an IF output to the digital front end or an I/Q baseband signal is available. This stems from the configurable double or single stage mixing topology.

The receiver supports a wide range of adjustable gains, which allows coupling of various input / output levels to the module.

These design features collectively enable the modules to be well suited for use in a wide range of applications.

Control and Operation

Control of the receivers is implemented through an integrated FPGA module pre-programmed with the required firmware.

Variable attenuators control the gain of each receiver to desired levels. The FPGA module also enables the reading of BITE information and can control synchronous switching required in the receiver or RF front end interface.

RF front end Interface

To ensure further flexibility, receiver is always paired with a RF front end that is customised for each radar application. Thus, the major change required from one application to the next is limited to the front end RF module and the receiver modules can be used as is.

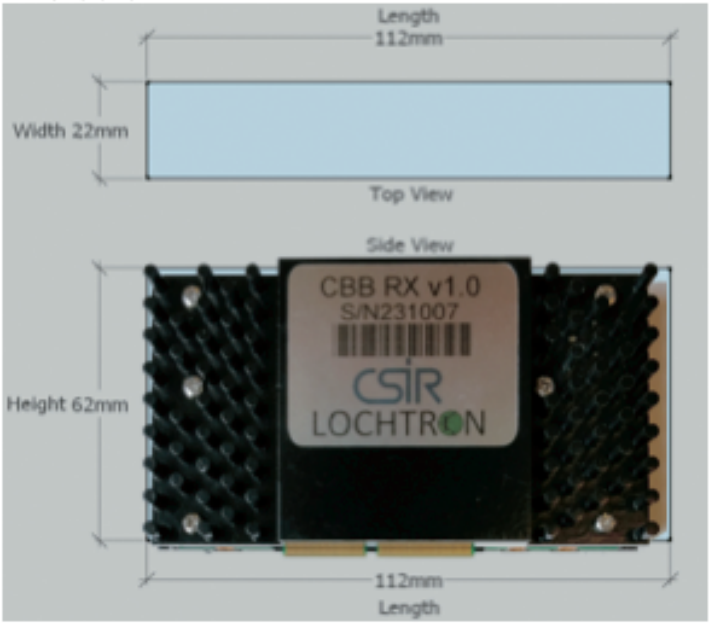
An RF Front-End (RFFE) module for use with this receiver has been developed as a separate unit to allow greater customisation per application. Prototype units designed to operate optimally in the 5.25GHz to 5.85GHz range have been developed and are undergoing testing and qualification.

Applications

These modules were developed to facilitate rapid prototyping and system development for airborne and/or multi-channel radar systems where size, weight and cost are of particular concern. Their ease of use and configurability make them an agile and affordable solution for both small-and large scale radar systems development.

Internally to the CSIR, the receiver has already lowered the cost of NRE for future radar systems significantly. Externally, several parties have expressed interest in acquiring such receiver modules for their own development projects.

Dimensions



Specifications (Preliminary)

Gain: 30 dB

Attenuation: adjustable up to 63dB

Noise Figure: 12 dB nominal
Note: Typically these modules are used in conjunction with a low-noise front end to reduce noise figure

Output 1dB compression point:
3 dBm

Spurious Free Dynamic Range (SFDR): *> 50 dBc*

Inter Channel Isolation: ~30 dB

Power Supply:
Input 1: 3V @ 900 mA
Input 2: 6V @ 1539 mA

Interfaces:

RF Interfaces:
SMP edge connectors
2 RF channels in (A/B)
2 LOs (High, Low)
(see accompanying LO module datasheet)

IF/Baseband:
Outputs:
SAMTEC LSHM Edge Connector

Control:
Ethernet and other digital control all via SAMTEC LSHM Edge Connector

The Dual Channel Receiver Module was developed in partnership with Lochtron Pty Ltd and the King Abdulaziz City for Science and Technology (KACST) Saudi Arabia

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