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DATA SHEET

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SYDRE

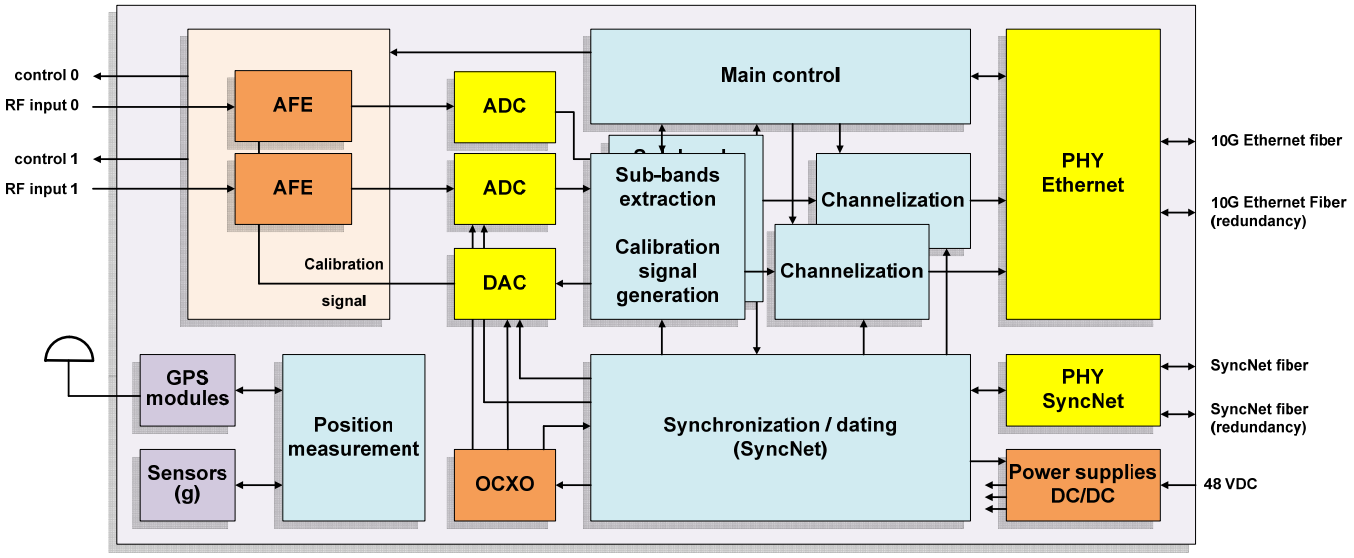
Synchronous Digital HF Receiver

The SYDRE synchronous digital receiver is mainly designed for use in HF antenna arrays, and allows at-the-antenna full HF band digitization and channelization over ethernet. Time alignement between receivers relies on FEE's SyncNet picosecond-level synchronization system. An auto-calibration system allows integrated equalization of the analog front-end (AFE).

The rack receiver (prototype below) is aimed to be used in radio shack or lab, mainly for system integration purposes. The outdoor receiver (prototype below) is aimed to be used for at-the-antenna digitization.

The receiver's architecture includes 2x 50-ohm Analog Front-Ends (AFE) modules feeding a 2-input digitization board which includes 2x 10G SFP+ ethernet links and 2x SyncNet ports, associated with a DSP daughter board.

Channelizing Synchronous Digital Receiver
1-input 3535 8-kHz BW channels in 2-30 MHz (28.28 MHz BW)
or
2-input 1515 8-kHz BW channels in 2-30 MHz (2x 12.12 MHz BW)



After digitization, the HF signal is channelized and equalized, the time-stamped output data are packetized and sent through ethernet multicast. A given user can then subscribe (through IGMP protocol) only for its channels packets of interest to the ethernet switch, allowing minimal overhead. Time stamping is same for all receivers, but packets' sending order is different for each receiver, in order to spread traffic and reduce bottlenecks. Any number of users can be handled, as long as the ethernet network (switches tree) is well designed. Users can scale from laptop to massive computers. A specific FEE's protocol (ADCP, Antenna Discovery and Control Protocol) relying on UDP/IP is used for configuration, management and data packets.

An additional multicast address can be used to periodically transmit mean and peak power values for each channel, allowing real-time full HF spectrum visualization (up to 50 fps) at low data rate and minimal computing cost on user side.

In 1-input configuration, channelization provides 3535 consecutive channels of 8 kHz bandwidth complex signals (28.28 MHz total bandwidth), each sampled at 10 kHz. If required, an efficient user-level FFT-based preprocessing stage allows higher bandwidth signal reconstruction.

Network required bare bandwidth is 80 Mbits/s per channelized MHz. Packetization overhead, due to data and network headers, consumes about 10% more. The ethernet network must be sized at least for 100 Mbits/s per channelized MHz, ie about 3…4 Gbits/s per receiver ().

Of course, the receiver can be used alone, without SyncNet (internal timebase used then).

Main features

- 1 full-band or 2 half-band RF inputs
- Auto-calibration of analog chain
- Equalized and channelized digital data broadcasted through ethernet 10G optical links
- 1-input version : 3535 channels, 8 kHz-spaced, 10 kHz-sampled, >100 dB alias rejection (28.28 MHz channelized band, at least 3 Gbits/s ethernet bandwidth allocation required)
- 2-inputs version : 2x1515 channels, 8 kHz-spaced, 10 kHz-sampled, >100 dB alias rejection (12.12 MHz channelized band, at least 2.5 Gbits/s ethernet bandwidth allocation required)
- Global channelized band positionable with a 1-channel resolution
- Wideband signal reconstruction from adjacent channels can be done on user side through efficient FFT-based preprocessing stage.
- Parametrable packetization (channels number, time samples per packet)
- Low input-to-user latency (packetization-dependant) : typically 10…20 ms.
- Power supply: 48...60VDC at receiver input
- Power consumption is configuration- and temperature- dependant : 60..90W

- In option, bias power supply generation on coaxial input for third-party active antennas, 16…28VDC

Interfaces

- 1-2 50 ohms inputs dedicated to extended HF band (1.6...30 MHz)
- 1-2 50 ohms outputs for remote head calibration
- 2 inputs for active GPS antennas (relative positioning option, eases array's installation)
- 1-2 control ports for optional specific auto-calibrating remote HF antenna heads (outdoor version only)
- Power supply input
- Fiber connector : 4 monomode fibers G652/G657
    - Double (redundancy) 10G ethernet optical links (1 fiber/link)
    - Two (redundancy) SyncNet ports for synchronization (1 fiber/port)

Applications of at-the-antenna receiver for HF arrays

- Software-Defined Radio (SDR)
- Beamforming
- Spatial diversity (long baseline arrays)
- Polarization diversity (multi-antennas types arrays)
- Direction-Of-Arrival (DOA) estimation