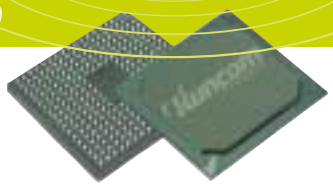
Runcom Technologies Ltd.

RN-2821 Typhoon



RN-2821 Modem Chip for Digital Terrestrial TV and Wireless Access

RN-2821 is an advanced chip that offers a cost effective Physical (PHY) solution for developers of Set-Top-Boxes (STB) for Interactive Digital Terrestrial TV and Customer Premises Equipment (CPE) of Broadband Wireless Access networks.

RN-2821 complies with the DVB-T/DVB-RCT standards and uses COFDM/OFDMA technology (see insert) to leverage broadband wireless communication in both downstream and upstream transmissions.

RN-2821 implements PHY and lower Media Access Control (MAC) layer functions (see diagram below), and includes analog modules to reduce the total cost of the STB/CPE.

The RN-2821 is supported by other Runcom products such as the RN-2821SDK (Software Developers Kit), the RN-2821MOD Reference Design Board and the RN-BS28 Base Station Reference Design which together comprise the Design Kit (RN-2821DK).

These products enable short development cycles and quick time to market of interactive STB and CPE.

Features

- DVB-T standard-compliant (ETSI EN300744) for downstream.
- DVB-RCT standard-compliant (ETSI EN301958) for upstream.
- High efficiency, downstream: 4 bits per second per Hz, upstream: 3.5 bits per second per Hz.
- Uses 2K/1K FFT size with BS3 mode for broadband upstream.
- Supports sub-channelization for upstream transmissions.
- Automatic power adjustment to meet variable transmission conditions.
- Adaptive modulation schemes, upstream and downstream: QPSK, 16QAM, 64QAM.
- Uses either advanced Turbo Coding or concatenated RS and convolutional coding for upstream FEC.
- Includes 10 bit A/D and 12 bit D/A analog cores.
- Supports interfacing to a CPU, an RF board, and an MPEG-2 decoder.
- Supports Rx diversity for improved indoor reception.

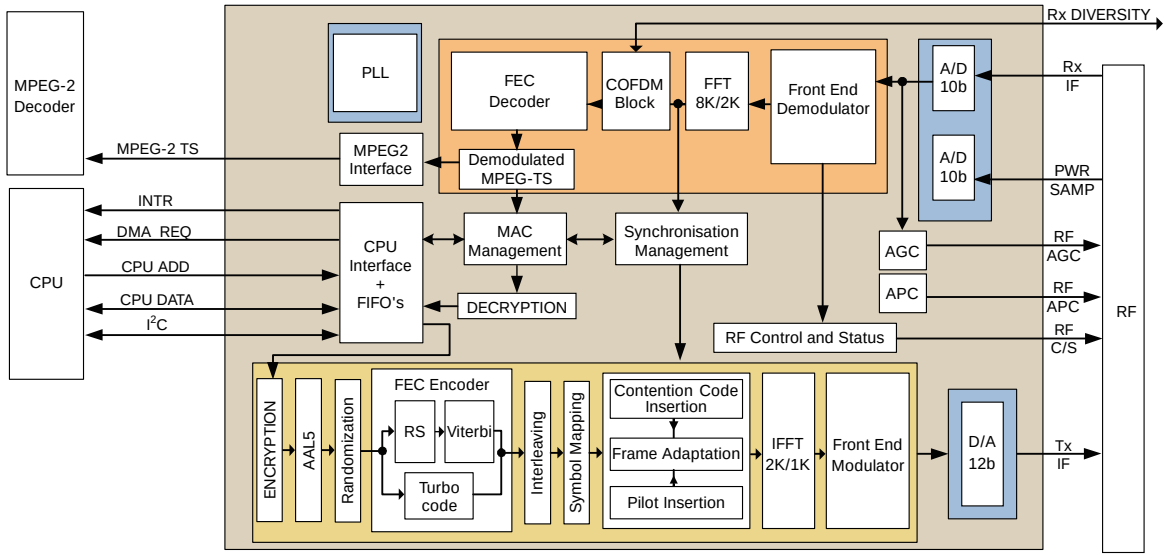
Benefits

- Highly efficient operation in non-line-of-sight and outdoor-to-indoor conditions.
- High throughput, downstream: 55Mbps, upstream: 47Mbps (for 14MHz channel).
- On chip modulation and demodulation for substantial cost savings and short time to market.
- Increases coverage and immunity in adverse multipath environments.
- Unique design eliminates the need for external A/D and D/A converters.
- Low BER is achieved using advanced FEC techniques.
- Supports low cost VCO.
- Supports Dynamic Bandwidth Allocation techniques.
- Complete design kit enables fast evaluation, development and compliance testing.
- Enables Return Channel implementation for ITV and BWA applications.
- Outstanding performance in terms of phase noise and backoff levels when compared to single carrier systems.

Target Applications

- Interactive TV
- Turbo Internet
- NLOS Virtual Private Networks
- IP and Legacy Telephony
- Mobile Reception
- Video Conferencing
- e-Learning
- DVB-T Reception

RN-2821 Block Diagram



Runcom RN-2821 Typhoon

RN-2821DK Design Kit

Runcom provides this design kit to fully evaluate the RN-2821 chip. The RN-2821DK design kit provides everything you need to develop an STB/CPE, and to exercise and test the performance of the modem in a laboratory and manufacturing test environment. The RN-2821DK includes a Reference Design Board (RN-2821MOD), a Base Station Module RN-BS28 (see the RN-BS28 Product Guide for further information) and a MAC layer software development package (RN-2821SDK).
The design kit enables the STB/CPE developer to develop interactive applications.

RN-2821MOD Reference Design Board Components

RN-2821MOD permits the evaluation of the RN-2821 chip within a complete STB/CPE modem, and as a full system solution, by co-testing with Runcom's Base Station, RN-BS28, which is part of the design kit. The reference board includes the following components:

RN-2821 Modem Chip - *Typhoon*

RN-2821 is a complete DVB-T / DVB-RCT PHY and lower MAC chip.

CPU and embedded RN-2821MAC SW

The CPU chip is a standard 32 bit MIPS core, implementing higher MAC functions. It uses high speed internal processing, DMA transfers and fast access to external SDRAM and FLASH memory. The CPU controls the data sent to the upstream return channel. The CPU integrates a 10/100BaseT Ethernet MAC, a UART port and a USB port.

Runcom also offers its embedded software (RN-2821MAC), which performs the following main functions:

- DVB-RCT standard MAC client
- Narrowband link interface (over DVB-CI)
- Broadband link interface (over USB or Ethernet)
- Control and monitor PHY parameters

DVB-Common Interface (CI)

The RN-2821MOD enables interfacing to an external application processor via standard DVB-Common Interface connector (68 pin).

STB Interface

The RN-2821MOD can interface to a user PC through one of the following interfaces: Ethernet, USB or RS232.

RN-2821UHF RF Transceiver

The RN-2821MOD includes a UHF transceiver: RN-2821UHF. This module includes two sub-modules, a DVB-T tuner-receiver and a DVB-RCT transmitter. Low analog IF is used as input and output to the RF module. The RN-2821 controls the RF module by SPI port, I^2C port and GPIO.

RN-2821SDK Software Development Kit

The RN-2821SDK is a comprehensive package of software (SW) development tools that includes an API, MAC SW documentation and ROM/FLASH image files.

STB Configurations

DVB-RCT embedded STB

A cost effective DVB-RCT compliant STB can be developed by incorporating the RN-2821 Modem chip into the STB motherboard and the RN-2821MAC software into the existing STB Application Processor (see RCT embedded STB diagram below).

DVB-T STB

The RN-2821 chip can be used in a standard DVB-T STB. It can be operated in receive-only mode, and can thus be controlled through a dedicated I^2C port.

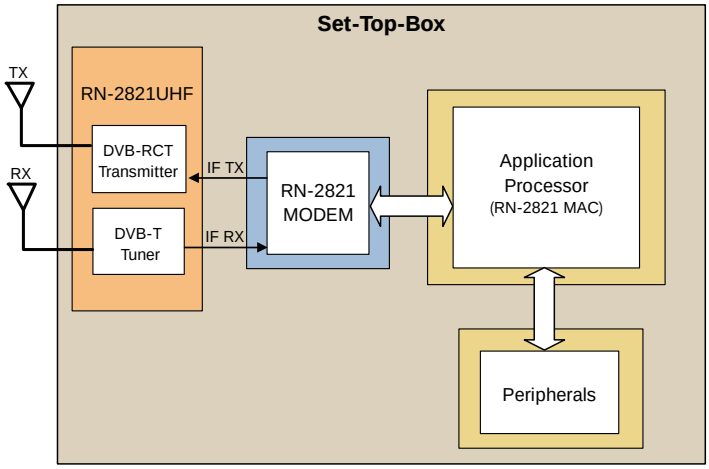
RCT Ready STB

The RN-2821MOD can be used as an extension module to different STB designs:

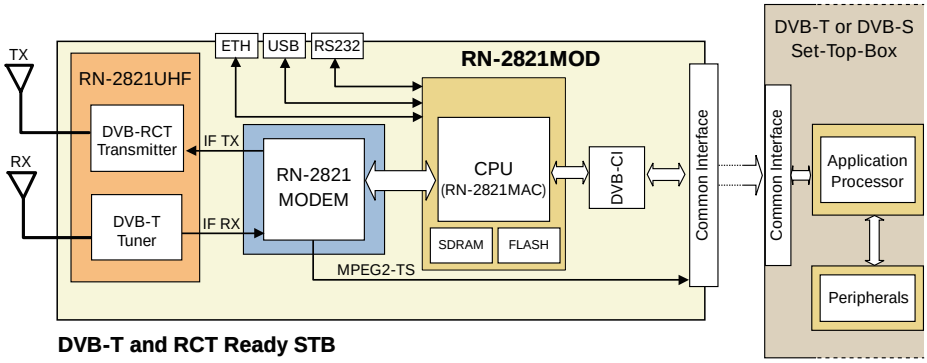
- DVB-T STB (see above)
- DVB-S (Satellite) STB

By using the CI connector to insert the RN-2821MOD, the different STB's can be upgraded to an interactive DVB-RCT STB with wireless return channel, as depicted in the RCT Ready STB diagram below.

Set-Top Box Configurations



DVB-RCT embedded STB



DVB-T and RCT Ready STB

RN-2821UHF Receiver

Interface	Parameter	Details
RF Input	Frequency	470-860MHz
	Bandwidth	6/7/8MHz
	Max. power	+10dBm
	Impedance	75Ω
IF Output	Frequency	4.57/36.166MHz
	Max. power	+10dBm
	PAPR	10dB
	Impedance	50Ω
AGC	Range	70dB
Control	I^2C protocol	
Compliance	ETSI EN300744	DVB-T

RN-2821UHF Transmitter

Interface	Parameter	Details
RF Output	Frequency	470-860MHz
	Bandwidth	6/7/8MHz
	Max. power	+24dBm
	Impedance	75Ω
IF Input	Frequency	30-58MHz
	Max. power	+10dBm
	Impedance	50Ω
Phase Noise		90dBc at 10KHz 1^0 RMS from 100KHz to 8MHz
APC	Analog control	30dB
Control	SPI Interface	
Compliance	ETSI EN301958	DVB-RCT

RN-2821MOD

OFDMA FACTS

Orthogonal Frequency Division Access

OFDMA uses 2K/1K frequency domain carriers for upstream transmissions, divided into sub-channels, allowing frequency and time domain diversity. OFDMA technology, when compared to competing technologies, effectively achieves a high coverage area, immunity to multipath interference, dynamic resource management and outdoor-to-indoor operation.

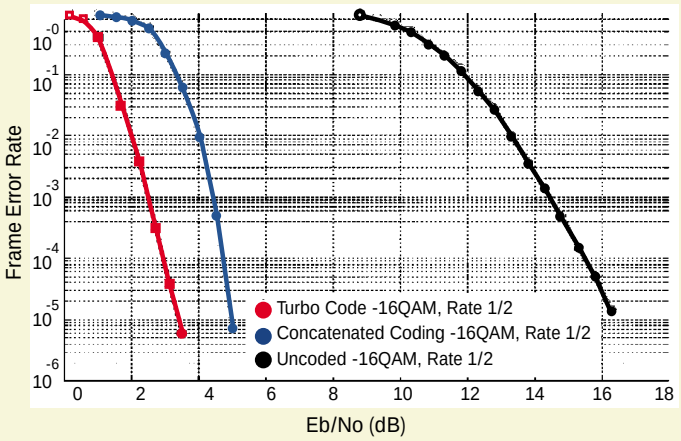
Upstream Spectral Power Density Gain:

A substantial increase to the OFDMA upstream link budget is obtained by transmitting a selected portion of the entire channel as sub-channels. The number of sub-channels that are transmitted changes dynamically depending on link conditions. Decreasing the number of sub-channels transmitted by the subscriber increases the spectral power density. The maximum link budget gain is obtained by dividing the entire channel bandwidth by the amount of transmitted bandwidth used, and then by plugging the result back into the following link budget equation (example for 2K FFT size):

$$\frac{1711}{29} = 59 \Longrightarrow 10\log 59 = 18\text{dB}$$

This additional spectral power density can be used for outdoor-to-indoor operation, enlarging cell coverage, reducing power amplifier costs, and overcoming obstacles in the link.

Forward Error Correction:



Using DVB-RCT concatenated and Turbo Coding (FEC) for the upstream channel, the RN-2821 generates major improvements in SNR and dramatically lowers amplifier costs.

Runs on Runcom

Runcom RN-2821 Typhoon

RN-2821 Specifications

Item	Description
Standard Compliance	Downstream ETSI EN300 744 DBV-T Upstream ETSI EN301 958 DVB-RCT Implements Burst Structure 3
Transmission Technology	Downstream: COFDM, upstream: OFDMA
FFT Size	Downstream: 8K and 2K, upstream: 2K and 1K
Bandwidth Channelization	Up to 14 MHz in both directions, supporting scale factors 1, 2, 4.
Number of Sub Channels for Return Channel (BS3)	59 sub-channels for 2K size mode 29 sub-channels for 1K size mode
Modulation Schemes	QPSK, 16-QAM, 64-QAM downstream and upstream
Guard Intervals	1/4, 1/8, 1/16, 1/32 in both directions (for upstream, Rectangular shaping only)
Interleaving	Downstream: Ramsey type 3 approach with I = 12, upstream: based on PRBS
Coding	Downstream: Concatenated RS and Convolution Coding rates: 1/2, 2/3, 3/4, 5/6, 7/8. Upstream: Turbo code or concatenated RS and Convolution Coding rates: 1/2, 3/4
Duplexing Techniques	FDD
Efficiency	Downstream: Up to 4 bits per second per Hertz Upstream: Up to 3.5 bits per second per Hertz
Throughput	Downstream: Up to 55Mbps (for 14MHz channel) Upstream: Up to 47Mbps (for 14MHz channel)
MPEG decoder interface	MPEG2 TS SPI decoder interface
RF control signals	I^2C, SPI and GPIO
RF Interface	Downstream (receive): IF only Upstream (transmit): IF and Baseband
Host Interfaces	100 MHz SDRAM, supporting DMA transfer or I2C (for Rx only).
Low Level MAC	Prioritization, Fragmentation, Concatenation, Address Filtering
Encryption	56-bit DES
AGC, APC	12-bit resolution analog output
RF Power Sampling	10-bit ADC
Diversity	Rx Maximal-Ratio-Combining support
Package	304 pin LFBGA
Dimensions (mm)	19 x 19 x 1.5
Supply Voltage	1.8V core, 3.3V I/O
Maximum Power	1.5W
Maximum Junction Temp.	125^0C
Technology	0.18µ CMOS

RN-2821MOD Specifications

Item	Description
Chip Set	RN-2821, 32 bit MIPS core CPU, SDRAM and FLASH
Configuration	Single board
RF Front End	RN-2821UHF
Network Interface	Ethernet 10/100 BaseT, RJ45 USB or RS-232
Application Processor I/F	DVB-CI
DC Input	3A @ 15VDC
Operating Temperature	0^0 C - 50^0 C

Ordering Information for STB Developers

Part Number	Description
RN-2821DK	STB Design Kit
RN-2821	Modem Chip - *Typhoon*
RN-2821SDK	STB Software Development Kit
RN-2821MAC	RN-2821MOD embedded MAC License
RN-2821MOD	RN-2821 Reference Design Board
RN-2821UHF	RF Transceiver Reference Design

Ordering Information for BST Developers:

Part Number	Description
RN-BS28DK	Base Station Design Kit
RN-BS28PM	Base Station Modem Module
RN-BS28	Base Station Reference Design
RN-BS28SDK	BST Software Development Kit
RN-BS28MAC	RN-BS28PM embedded MAC License
RN-BS28UHF	Base Station RF Transceiver Reference Design

Runcom Technologies Ltd.

2 Hachoma St. Rishon-Lezion 75655 Israel
Telephone: 972-3-9528440 Fax: 972-3-9528805
Website:www.runcom.com
Email: info@runcom.co.il

RN2821 02- 0602