RADIOMODEM
BK8
TRANSCEIVER

Application Note AN_B014

Wireless M-Bus applications
BK8xx3xx W-Mbus Series Radio-Modem

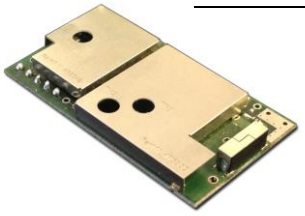
October 2013

M-BUS : A PAN-EUROPEAN STANDARD FOR WIRELESS METERING

Wireless M-bus is derived from Wired M-bus specifications initially written in the 90' for remote reading of gas, water and electricity meters. Later the Wired M-bus was extended and the radio variant Wireless M-Bus was introduced into the European Standard EN 13757 as Part 4 and 5.
The Standard currently consists of:

- EN 13757 - 1 : 2002 Data exchange
- EN 13757 - 2 : 2004 Physical and link layer
- EN 13757 - 3 : 2011 Dedicated application layer
- EN 13757 - 4 : 2011 Wireless meter readout
- EN 13757 - 5 : 2009 Wireless relaying
- EN 13757 - 6 : 2009 Local Bus

Wireless M-bus is specified in EN 13757-4 to operate on the ISM European frequency bands (868 - 434 - 169 MHz) and must comply with the SRD (Short Range Devices) standard EN 300 220-1 v2.4.1 (2012.01) and with the CEPT Recommendation ERC REC70-03 (May 2013 edition) – Annex 1 and Annex 2.



Radio Modem - BK8 EVO VERSION
169 MHz up to 500 mW RF output Power

169MHz Field of Applications

- Telemetering
- Asset Tracking and Tracing
- Social Alarms
- Meter Reading
- Wireless M-Bus

SOCIAL ALARM
AMR
LOGISTIC
LEVEL MEASUREMENT
ASSET TRACKING

WIRELESS M-Bus

Devices employed in the Wireless M-Bus Network are classified as either "METER" or "OTHER".
"OTHER" defines any device employed to collect data from the "Meter", "Concentrators", "Gateways", "Bridge", "Repeaters" and "Receivers" (stationary or mobile).
The EN 13757- 4 defines six "Modes" for the RF Link to collect data and to send commands to "Meters".

"MODE" DESCRIPTION

EN 13757-4 Standard for a detailed "Mode" description.
Below a summarized description with special emphasis on "RF-LINK" specs and on STE/Ksolutions BK8xx "EVO" version Radio-modem Family. The "EVO" version is specific for M-bus wireless metering and is derived from the BK8xx3xx general purpose data communication family of Radio-modem.

Mode "S" Stationary Mode

Unidirectional or bidirectional communication.
One wideband radio channel at 868,300 MHz.
32,768kcps data-rate with Manchester encoding.

Mode "T" Frequent Transmit

Mode T1 for transmit only meter applications.
Bidirectional mode T2 – Receiver activated for very short period after transmission.
One wideband channel at 869,950 MHz - 100kcps – Meter to Other – 3 to 6 encode.
One wideband channel at 868,300 MHz - 32,768kcps – Other to Meter – (Manchester).

Mode "R" Frequent receive

Bidirectional mode R2 – the Meter listens every few seconds for a Wake-up message.
One channel at 868,950 MHz – Other to Meter – 4,8kcps – (Manchester encode).
Ten channels at 868,330 MHz–Meter to Other-ch. Sep.=60kHz - 4,8kcps-(Manchester).

Mode "C" Compact mode

Similar to mode T – C2 bidirectional mode is suitable for Walk-by or Drive-by readout.
One wideband channel at 868,950 MHz – 100kcps – Meter to Other – FSK – (NRZ).
One wideband channel at 869,925 MHz – 50kcps – Other to Meter – GFSK – (NRZ).
The 869,925 MHz freq. is into the g3 band where a 500mW erp power is allowed.

Mode "F" Frequent TX and RX

UHF Narrow Band NBFM at 434 MHz for long range communication.
F2 bidirectional mode- 433,050 to 434,790 MHz - One channel specified at 433,820MHz.
2,4kcps data-rate – (NRZ) – Receiver selectivity = 25kHz - sensitivity up to -120 dBm.

Mode "N" VHF long range

Narrow Band Frequency Modulation (NBFM) on the 169 MHz SRD band.
500mW erp RF Power - 10 channels from 169,400 to 169,475 MHz .
Channel spacing: 12,5 – 25 – 50 kHz - 2,4 - 4,8 - 9,6 kcps - GFSK – 4GFSK - (NRZ).

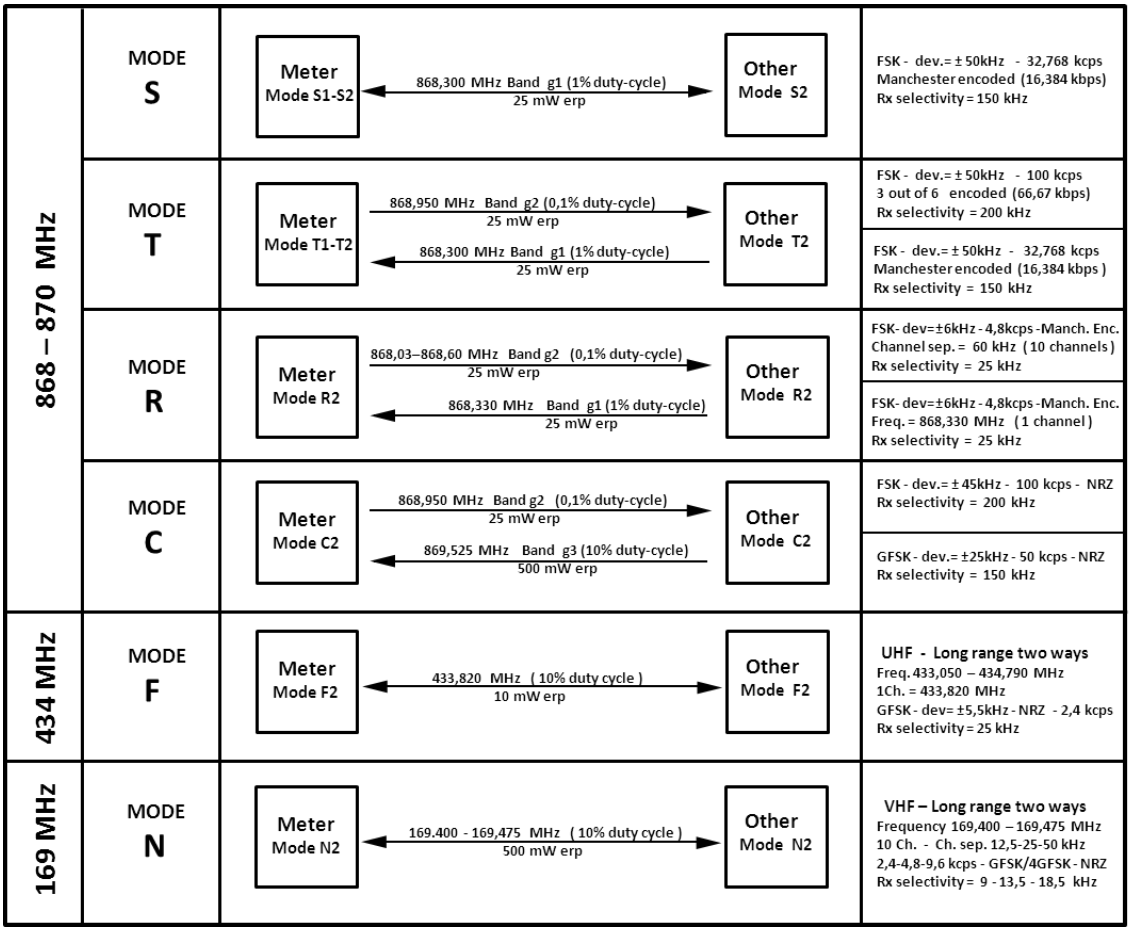


Table 1 – M-Bus Radio RF-Link "MODE"

Radiomodem with embedded protocol supporting EN 13757-4 M-Bus standard

The BK8xx family Radiomodem module comes with wireless modem functionality and a powerfull capability to implement the M-Bus protocol to be used as "Meter" or "Concentrator" and "Bridge/Repeater".
The BK8xx3xx "EVO" versions are summarized in table 2.
A block diagram is represented in figure 1.
The RF data transceiver is designed around the Analog Devices ADF702xx Family.
The appropriate IC is employed depending on the M-bus "Mode" and the required data speed / Rx selectivity.

Model	Band	IC2 TRX	Channel spacing	Rx select.	Antenna	
BK82N3EVH	169 MHz	ADF7021N	12,5/25/50 kHz	9/13,5/18,5 kHz	External	Mode N
BK82N3EVL	169 MHz	ADF7021N	12,5/25/50 kHz	9/13,5/18,5 kHz	Integral (Loop)	Mode N
BK87F3EVH	434 MHz	ADF7021	60kHz	25 kHz	External	Mode F
BK87F3EVL	434 MHz	ADF7021	60kHz	25 kHz	Integral (Loop)	Mode F
BK88B3EVH	868 MHz	ADF7020	wideband	100/150/200 kHz	External	Mode S – T - C
BK88B3EVC	868 MHz	ADF7020	wideband	100/150/200 kHz	Integral (Ceramic)	Mode S – T - C
BK88F3EVH	868 MHz	ADF7021	60 kHz	25 kHz	External	Mode R
BK88F3EVC	868MHz	ADF7021	60 kHz	25 kHz	Integral (Ceramic)	Mode R

Table 2 - BK8xx3xx "EVO" version

The BK8xx3xx Radiomodem Family is deliverable in two versions (1) External antenna version - Fig.1 version "H" and (2) Integral antenna - fig.2 version"L" and "C".
The "Integral" antenna is a tuned magnetic "Loop" for the 169MHz and 434MHz models which is caracterized by an high radiation efficiency despite the small dimensions (Patent pending).
The 868MHz integral antenna version has a small "Multilayer Ceramic" antenna.

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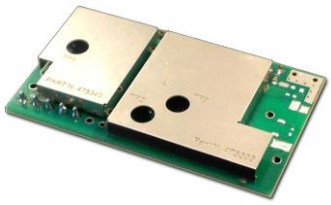
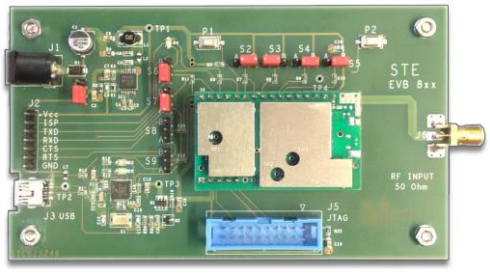


Radio Modem - BK8 EVO VERSION
169 MHz up to 500 mW RF output Power

Radio Modem - BK8 EVO VERSION with external antenna
169 MHz up to 500 mW RF output Power



The EVB 8x3xx
Demo Board

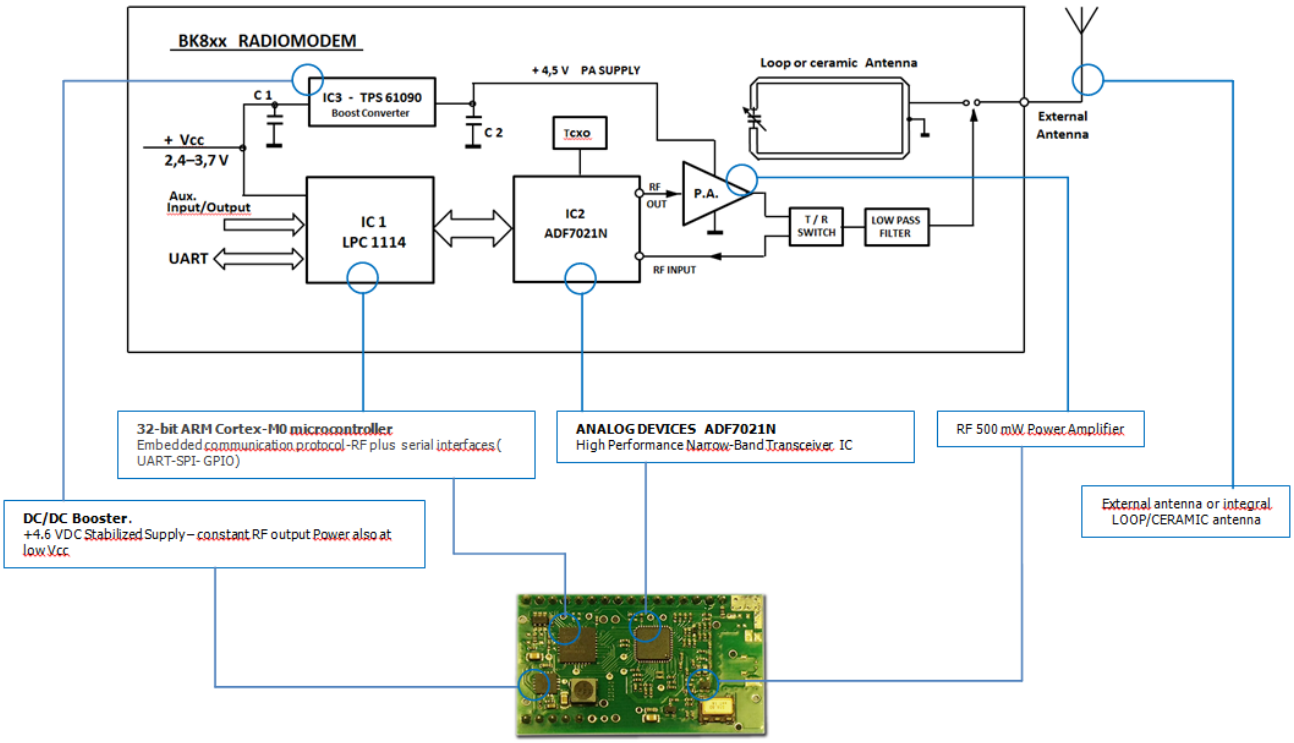


Figure 3 - Radiomodem Architecture

- An RF high gain transistor is employed to increase output power up to 400/600 mW .
- An RF SiGe very low noise transistor is employed to increase Rx sensitivity .
- To obtain and maintain constant high output power a DC/DC Booster provides to bring the input voltage (2,4 to 3,7 V) to a regulated +4,6V DC PA supply.
- A stable TCXO (± 2,5 ppm) is employed to ensure frequency accuracy over the operating temperature range.

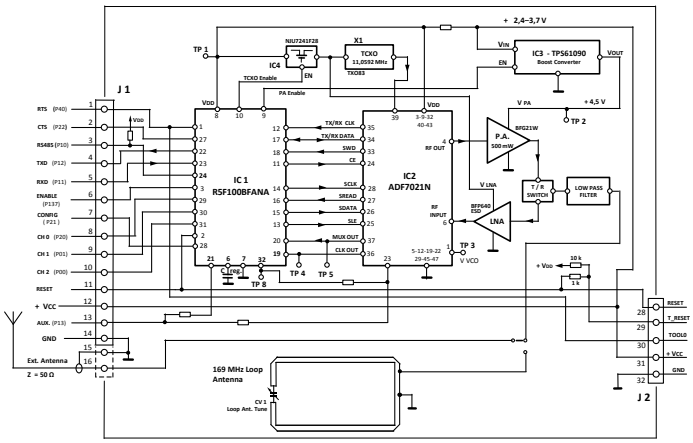
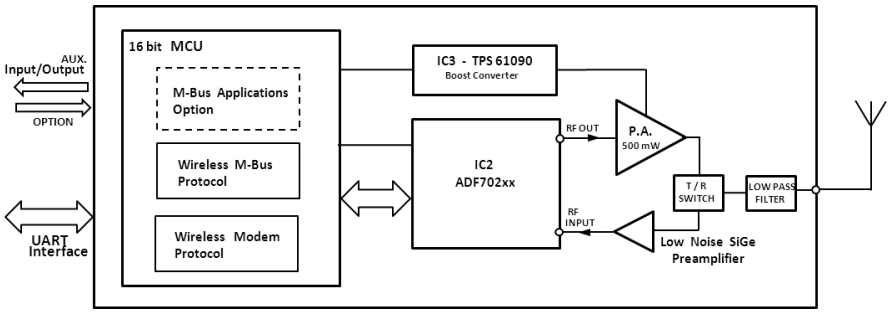


Figure 4 - BK8xx3xx Radiomodem "EVO" version Block Diagram

THE EMBEDDED COMMUNICATION PROTOCOL

The data exchange protocol must take in consideration the RF channel characteristics and limits.
The RF link is simplex , the "on-air" data/rate is usually much lower than the "Serial Port" data speed, then there is a data "Latency" and must be taken in consideration the Tx-to-Rx and Rx-to-Tx switching time and many other limits directly connected to the RF.
In some M-Bus "Mode" to be transmitted and reliably decoded by the receiver, data must be "encoded" (Manchester or "3out of 6" encode).



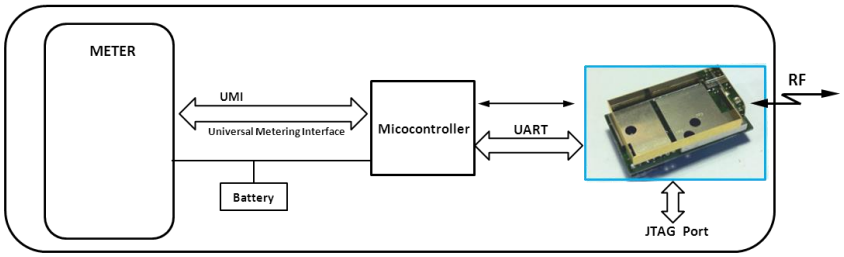
The Radiomodem MCU has an embedded modem protocol, the UART interface and controls the RF transceiver.
Data to be transmitted are sent to UART Rxd input and buffered into the MCU.
The data packet is then assembled with "Preamble","Syncword","Frame Length" etc. and sent to the IC2 Transceiver to be transmitted on RF.
Received data are demodulated by the IC2 transceiver , checked for correct CRC and then the data packet is sent to theUART Txd output .
The Embedded M-Bus protocol transmits and receives the data packets based on dedicated application messages from an external device (the "Meter" or the "Concentrator").
Configuration parameters, unique address, destination address, etc. are stored in non-volatile memory either through serial interface or asserting the "CONFIG" pin.
The Radiomodem can enter "Sleep" mode to reduce the power consumption.

As an option, on the basis of "Customer specifications", additional M-Bus application layers can be integrated into the "Application option" part. These are some of the applications optional.

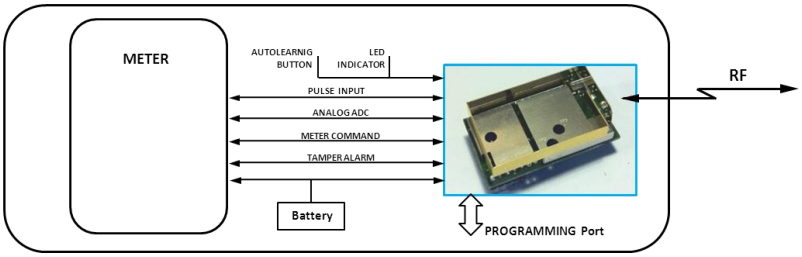
- Non volatile Memory for storing meter data.
- Frame Filtering (ID Filtering).
- AES-128 encryption.
- Auxiliary input/output pins.
- Alarms – tamper detection.
- Analogue ADC input.

THE M-BUS WIRELESS METER

(A) USING THE BK8xx3xx "EVO" AS A MODEM IN WIRELESS M-Bus METER APPLICATION



(B) USING THE BK8xx3xx "EVO" WITH CUSTOM DIRECT CONTROL OF THE METER



BATTERY OPERATION AND MANAGEMENT MODE TO LOW ENERGY CONSUMPTION

USING THE BK8xx3xx "EVO" IN BATTERY OPERATED WIRELESS METER APPLICATION