



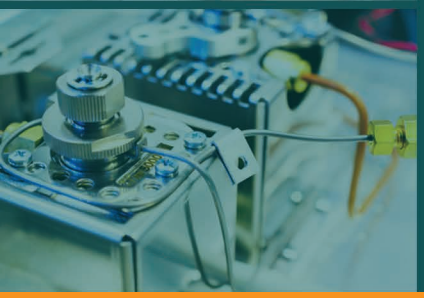


Radiocrafts

Embedded Wireless Solutions

AN019: MBUS4 ITALIAN AND CIG REQUIREMENTS

APPLICATION NOTE

We Make Embedded Wireless Easy to Use

MBUS4 and Italian CIG Requirements

Introduction

The Italian "CIG Interchangeability Task Force" has published UNI/TS 11291-11-4, Gas measurement systems – Hourly based gas metering systems, Part 11-4, Communication profile PM1.

This application note points out how the RC1701HP/VHP-MBUS4 module can be used to meet the requirements of this companion standard.

Configuration for CIG

The TS 11291-11-4 is a companion standard, on top of EN 13757-4 mode N and EN 13757-3, but using DLMS / COSEM as application layer. The TS 11291-11-4 specify some new requirements to the DLL/MAC (Dynamic Link Layer and Medium Access layer).

The CIG specification has introduced Listen Before Talk (LBT) as part of the medium access. The RF transmission power shall be configurable in 3 dB steps over a 54 dBm range (-27 dBm to +27/30 dBm). Further, the CIG use Frame Format B only.

Radiocrafts provides two variants of the RF module supporting these new requirements;

- RC1701HP-MBUS4, with up to 27 dBm output power
- RC1701VHP-MBUS4, with up to 30 dBm output power

The same configurations apply for both variants, although the maximum output power for the VHP variant is 30 dBm (setting 0x14), allowing one more output power step.

Use the settings in the table below to:

- Configure default radio channel
- Configure default data rate
- Set M-Bus mode for two-way communication (N2)
- Use Frame Format B
- Configure default output power, and using power control in fine steps
- Enable LBT
- Configure parameters for the LBT algorithm
- (optional) Use Category 1 receiver settings (improved selectivity and blocking properties)

Parameter	Description	Address hex	Argument hex	Factory setting hex (dec)	Comment
Radio configuration for CIG					
RF_CHANNEL	Default RF channel for N mode	0x00	0x01-0x0A	0x03 (3)	See data sheet for channel frequencies
RF_POWER	Default RF output power	0x01	(not used)	0x05 (5)	See data sheet for output power levels

DATA_RATE	Data rate	0x02	0x01: 2.4 kbps 0x02: 4.8 kbps	0x01 (1)	
MBUS_MODE	M-Bus mode	0x03	0x10: N2 mode	0x10 (16)	Use 'G' command to change value in volatile memory only
PA_TABLE_EXTENDED	Default RF output power, using fine steps	0x06	0x14: Maximum output power	0x00	0: Disabled. 1 - 20 is on. See data sheet for output power levels
CAT1_ENABLE	Radio performance	0x07	0x00: Disabled 0x01: Enabled (optional)	0x00	Improved selectivity and blocking properties
PREAMBLE_ LENGTH	Frame Format	0x0A	0x02: FFB	0x00	Transmit Frame format B
LBT_ENABLE	LBT enable	0x18	0x01	0x00	
LBT_RSSI_THRESHOLD	LBT parameter	0x2A	0x50	0x50 (80)	80 (50-110) [-dBm]
LBT_MAX_ATTEMPT	LBT parameter	0x2B	0x05	0x05	5 (3-8)
LBT_BO_PERIOD	LBT parameter	0x2C	0x04	0x04	4 (=40 ms) In 10 ms step
LBT_BO_FLAT	LBT parameter	0x2D	0x03	0x03	3 (1-8)
LBT_MAX_DELAY	LBT parameter	0x2E	0x4B	0x4B (75)	750 (=75) 250 to 1000 ms, in 10 ms step

LBT algorithm

The LBT algorithm is used to back off and delay the RF transmission in case the channel is already occupied. If the channel is occupied (i.e. the RSSI value is above the threshold), the module will back off for some time, before doing a new attempt.

The LBT algorithm us an exponentially increasing random back-off time, but with a flattening roof, with limited allowed maximum time delay, and with a maximum number of attempts. The algorithm may use LBT override if the maximum time and attempt limit is reached (configurable).

The following parameters configure the LBT:

- LBT_RSSI_THRESHOLD – if the RSSI is above (stronger signal) than this threshold, the channel is considered occupied
- LBT_MAX_ATTEMPT – maximum number of attempts before giving up, or transmitting anyway (override)
- LBT_BO_PERIOD – the time used to calculate the back-off time
- LBT_BO_FLAT – a parameter to limit the exponential increase of back-off time

- LBT_MAX_DELAY – the maximum delay before giving up, or transmitting anyway (override)

The values given in the table above are the default values recommended by CIG.

It is also possible to override the LBT. That is; if after the maximum number of attempts or the maximum delay is reached, and the channel is still not free, - then transmit anyway. This is controlled by the application by sending the 0xFA command, before the message data is sent to the module. It applies only for one message and is automatically cleared after this one transmission.

If the LBT algorithm fails (channel is not free), a command/result message is sent from the module on the UART. The result message is 0x01 for failure. After successful TX, the 0x00 is sent. This result message is sent always when LBT is enabled, even if it is overridden.

Below are some figures showing the operation of the LBT algorithm. The plots show the following signals (from top down):

- UART RXD data to transmitter (message to be transmitted)
- LBT active on transmitter
- TX on transmitter
- UART TXD on transmitter (acknowledge successful / unsuccessful LBT)
- RX on receiver
- UART TXD on receiver (received message)
- Jammer signal

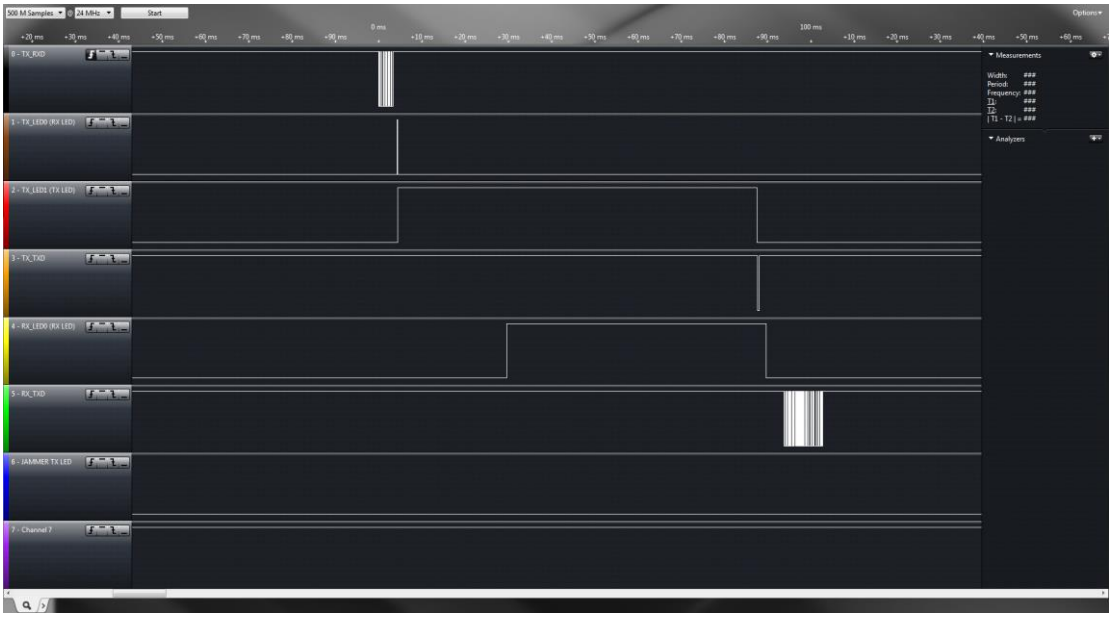

Figure 1. LBT with no jammer. Message is sent immediately.

Figure 2. LBT with jammer. Message is not sent.

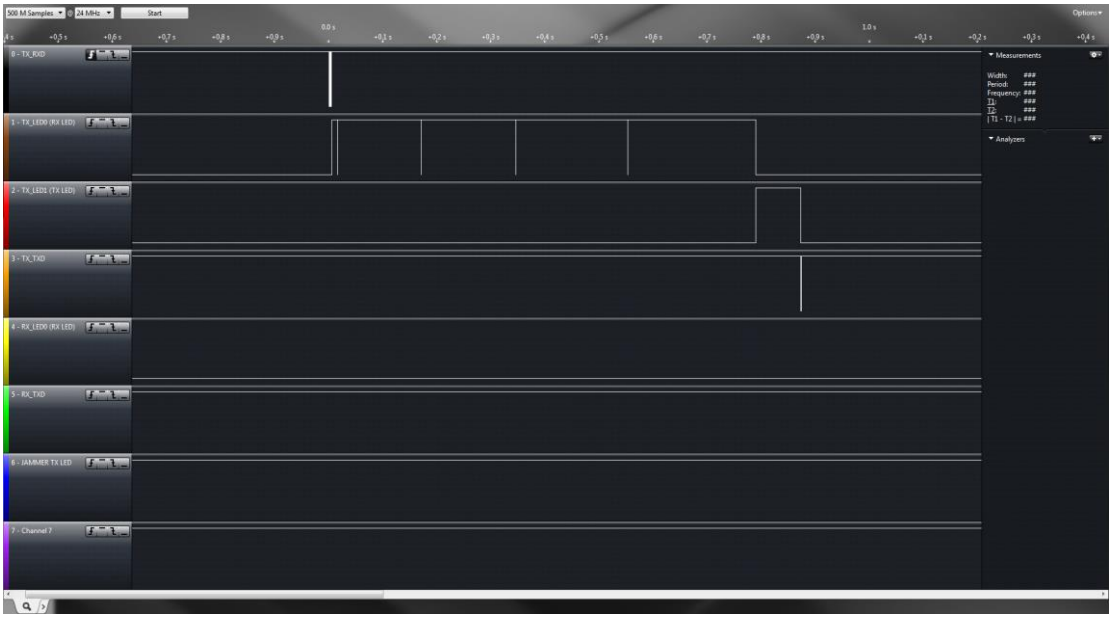

Figure 3. LBT with jammer. Message is sent by override.

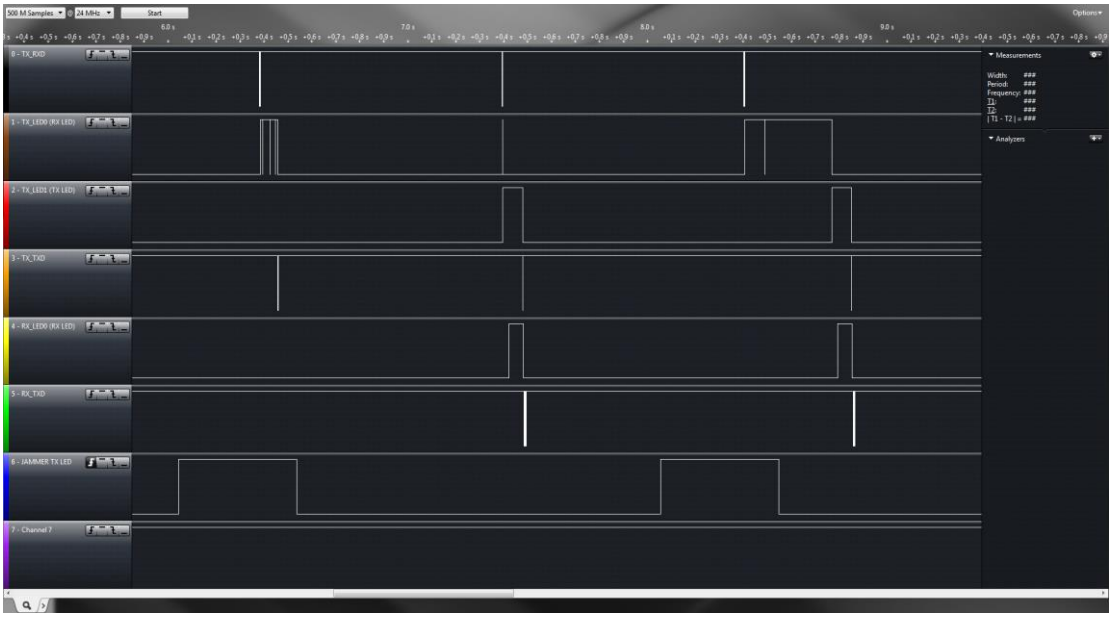

Figure 4. LBT with pulse jammer. a) Message is not sent, b) message is sent, c) message is sent when channel becomes free.

Category 1

The EN 300 220 standard describes categories of receiver performances. The category 1 is the best in terms of selectivity and blocking properties. In a real life scenario, the selectivity may be more important than the sensitivity of the radio. In this case the Category 1 radio performance setting can be selected.

Category 1 means:

- Adjacent channel selectivity > 55 dB
- Blocking rejection > 84 dB at 2MHz and 10 MHz offset
- Spurious response rejection > 60 dB

The Data Sheet shows the sensitivity for Category 1 settings vs the default setting (optimized for sensitivity).

RF channel and data rate

The default radio channel and data rate is configured by the configuration parameters in the table above, and is stored in Flash. It is possible to change the radio channel, without storing to Flash, by using the 'C' command.

The RF channel and data rate can be configured freely, that is, there is no limitation of the combinations (as there is in EN13757-4).

RF output power

The default RF output power is configured by the configuration parameter PA_TABLE_EXTENDED in the table above, and is stored in Flash. It is possible to change the output power, without storing to Flash, by using the 'P' command. The 'P' command should be used for dynamic adjustment of the output power, as there is a write cycle limit if writing to Flash.

If PA_TABLE_EXTEDED is set to 0, then the output power is controlled by RF_POWER in 5 steps. This is the default setting, in order to be backward compatible. These five steps are specified in the Data Sheet.

If PA_TABLE_EXTEDED is set to > 0, then this extended setting will take precedence, and set the new default output power. The output power can be set in 20 small steps, also using the 'P' command.

The output power is given, approximately, by the following equation:

P_out = (PA_TABLE_EXTENDED -1) x 3dB -27 dBm

RC1701HP-MBUS4 gives 27 dBm for both steps 19 and 20. RC1701VHP-MBUS4 gives 30 dBm for step 20.

Document Revision History

Document Revision	Changes
1.0	First release
1.1	Design Update

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