SmartLEWIS™ RX+

TDA5240 Family

Enhanced Sensitivity Multi-Configuration Receiver

Protocol Examples for ISM Band Applications

Standard Configuration Set for the SmartLEWIS™ RX+ Receiver TDA5240 / 35

Application Note

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Wireless Control

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Protocol Examples

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Previous Revision:

Page	Subjects (major changes since last revision)

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Last Trademarks Update 2010-03-22

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1 Protocol Examples for the ISM Frequency Bands

In general the RF protocol is always a compromise in terms of sensitivity, current consumption, data throughput, jammer immunity and regional legislative restrictions. The given protocol examples are typical compromises of the above mentioned parameters but of course can always be optimized towards a certain parameter.

1.1 Legislative Restriction

The USA patterns are defined to fulfill the FCC Part 15 requirements and take advantage out of the Duty Cycle Correction Factor. The Duty Cycle (FCC15.35) which is mentioned is related to Carrier ON time within a 100ms time slot.

This Duty Cycle Correction Factor allows the transmitter counterpart of the TDA5240 receiver family to send with higher output power then initially defined. In the equation below the calculation of the correction factor is depicted.

$$K_E = 20\log\left(\frac{T_X \ time\ on\ in\ a\ 100ms\ window}{100ms}\right)(dB)$$

The European equivalent to the FCC is called ETSI. This regulation framework allows in the 434MHz band (433.05 - 434.79MHz) an output power of 10mW if the transmitter has an ON/OFF Duty Cycle below 10% otherwise the output power is limited to 1mW.

1.2 Jammer Immunity

The immunity against jammers can be improved by several methods. The best method to achieve excellent immunity performance is the multi-channel concept. The TDA5240 receiver is able to handle this challenge in a very elegant way. The receiver scans several Radio Frequency (RF) channels and processes the data without the need of a microcontroller. If a jammer appears on one of the channels the communication is possible on the other remaining channels.

In principle can be stated that the modulation technique has also a contribution to the receiver immunity performance. It can be stated that for limiter based receiver systems, Frequency Shift Keying (FSK) has a higher interferer immunity compared to OOK (On/Off Keying == ASK with 100% modulation index). During the OFF period of the signal the interferer can be directly seen on the Receive Signal Strength Indicator (RSSI) voltage. In FSK the signal is always present and the Interferer will be suppressed to a certain extend by the limiter effect.

1.3 Current Consumption

All protocols are designed with a Wake up Pattern (WUP), SYNC Pattern, Telegram Start Identifier (TSI) and Payload Data. The most important part to reduce the average current consumption on the receiver side is the WUP frame, which allows the receiver to perform a polling strategy. Polling means that the TDA5240/TDA5235 receiver is alternately changing from active mode (RXRUN Mode) to sleep mode within a specified time period. This polling strategy allows the receiver to reduce the active time significantly and of course the average current consumption. The TDA5240/TDA5235 receiver is able to handle this polling method by itself (autonomous receiver) and just alerts the microcontroller by an Interrupt if the appropriate WUP or TSI Pattern or EOM (End of Message) were found. This very important feature of the TDA5240/TDA5235 receiver family reduces the overall system current consumption because the microcontroller will sleep most of the time and is just interrupted and activated if a valid packet was received.

2 Tools

To get the defined protocols properly running, Infineon provides a toolset which helps the developer to verify his work and to see that the receiver is correctly configured.

2.1 TDA5240 Family Explorer (Wizard tab) and Protocol Examples

The pre-defined pattern of the protocol examples are all implemented in the so called TDA5240 Family Explorer (use the Wizard pages), which is a GUI describing all registers of the TDA5240/TDA5235 receiver in a way that is easy to understand (TDA5240-35-25_Explorer_B12).

For all of the protocol examples described below the configuration files are available and part of this package.

The given protocol examples can be used as they are or to ease up your development as starting point for your customizations.

2.2 Polling Strategy Excel Sheet

The above mentioned polling strategy is also described in an Excel sheet which automatically calculates the required ON and OFF timings for the given protocol. Infineon also provides this Excel sheet in this package (see file "PollingStrategy__SP_Timings__IFXrefPattern2__2010_06_06.xls").

2.3 TDA5240 Family Explorer (Explore tab)

For working with our evaluation boards, the configurations that are built within the Wizard can be downloaded to the receiver by the TDA5240 Family Explorer software. The Explore tab provides also some basic functionality to react on the occurrence of an interrupt and read out the FIFO automatically, when using the "Run" function. For your test purpose a fixed payload data can be used, and then the add-on function "Correctly received payload data" can be used to provide a vey easy method for a MER measurement (Message Error Rate).

2.4 Download Information

The latest documentation and other helpful information can be downloaded from our product homepage (TDA5240 Family).

3 10 Steps to get it running

1. Download and Install the above mentioned Software Tool (TDA5240-35-25_Explorer_B12).

2. Use the unzipped files from folder \Protocol_Example_V1.0\ and copy these files to your preferred location on your hard or network drive.

3. Connect the TDA5240 Family Eval Board via USB to the PC or Notebook. Then press “Refresh” and afterwards “Open” in the “Chip Control” section to establish a connection to the Eval Board.

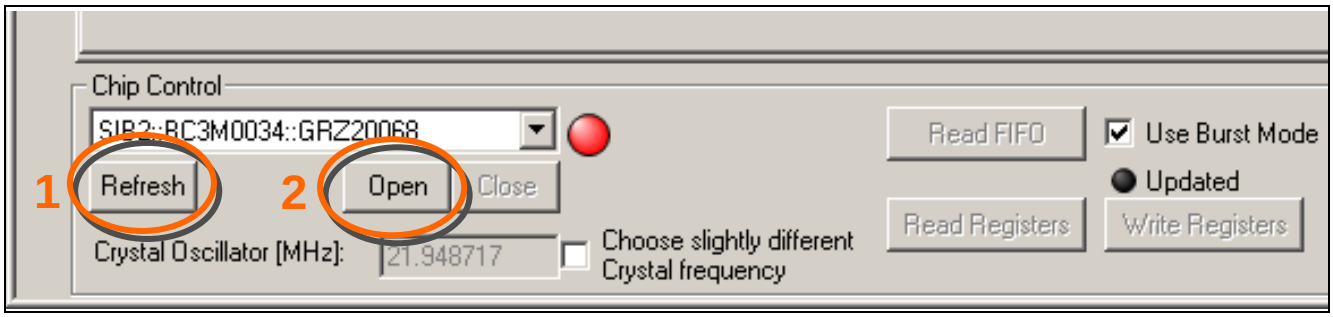

Figure 1 Refresh and Open Communication

4. Within the specified Protocol folders the following files are of importance:

a. ProtocolName_spi.def → Configuration File (output of Wizard)

b. PollingStrategy_SP_Timings_IFXrefPattern2_2010_06_06.xls → Polling Strategy XLS Sheet

5. In the TDA5240 Family Explorer load the Configuration File (“Registers” tab ➔ “Open” button in the “Register Map / SPI File Control” section, then select the desired file from the file dialog) and download the content to the Eval Board via the “Write Registers” button.

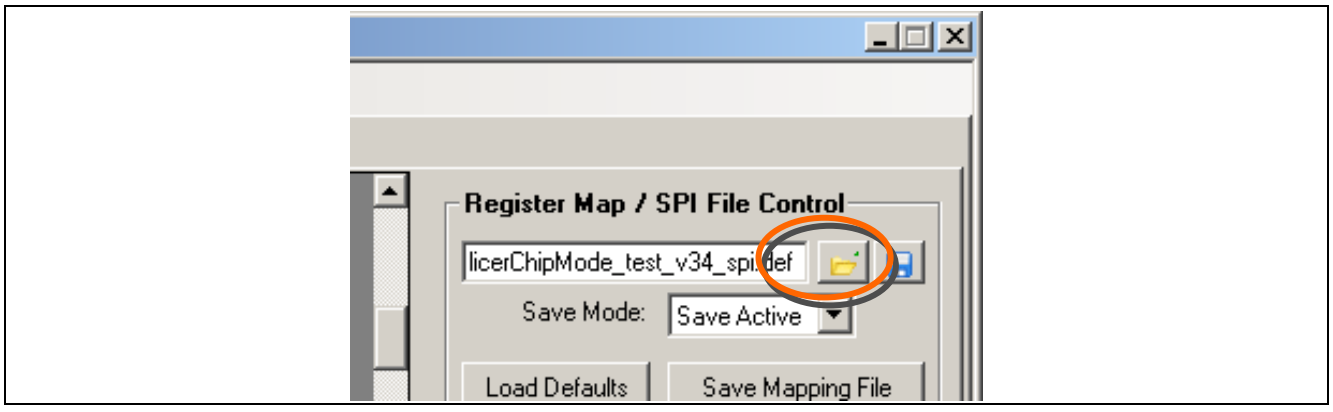

Figure 2 Open SPI File

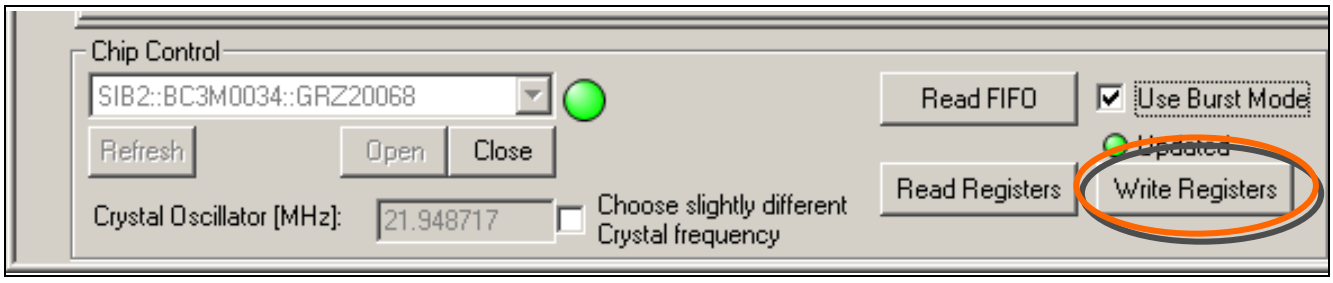

Figure 3 Write Registers

6. Connect the 50 Ohm Antenna to the Eval Board

7. Implement the described Protocol Example into an RF transmitter.

8. Switch to the “Explorer” tab within the Explorer tool and activate the “Run” function. You can use the add-on function “Correctly received payload data” as described above.

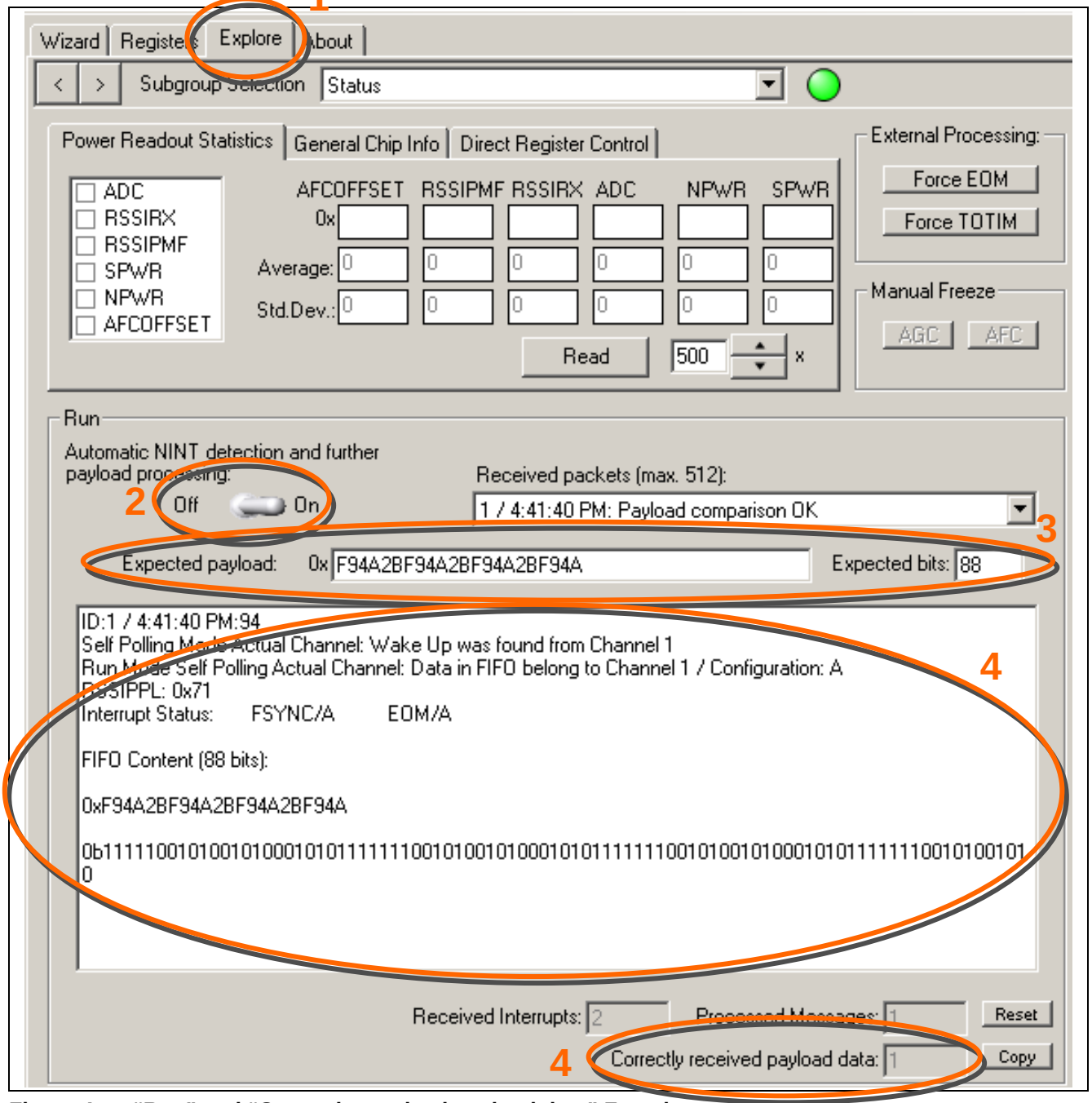

Figure 4 “Run” and “Correctly received payload data” Function

9. Trigger the RF transmitter to send out the protocol.

10. The payload of the transmitted data will be depicted in the output fields of the Explorer Tool (see step 4 in Figure above).

4 Detailed Description of Protocol Examples

4.1 2 kbit ASK USA Pattern

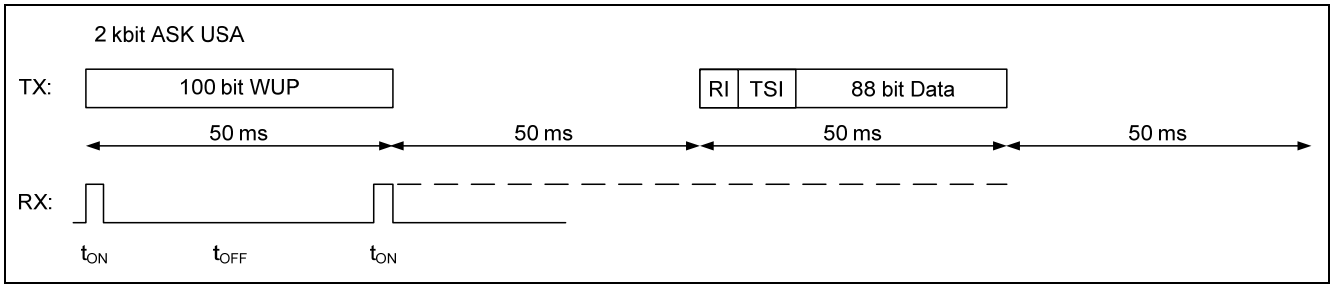

Figure 5 2 kbit ASK USA Pattern

Modulation:	ASK
Data Rate:	2 kbit
Channel frequency:	315.00 MHz
Coding:	Manchester
WUP Data:	100 bit all 0
SYNC Data:	4 bit → all 0
TSI Data:	8 bit → 00010101
Payload:	11 byte data (could be modified for different applications)

Main target:	typical application case with high sensitivity
Fast Fallback to Sleep Mode (FFB):	
RX sensitivity:	-110.2 dBm
Average RX current of TDA5240/35:	1.07 mA
Ultra Fast Fallback to Sleep Mode (UFFB):	
RX sensitivity:	-110.2 dBm
Average RX current of TDA5240/35:	0.57 mA
FCC Duty Cycle factor for TX:	12.04 dB

4.2 2 kbit FSK EU Pattern

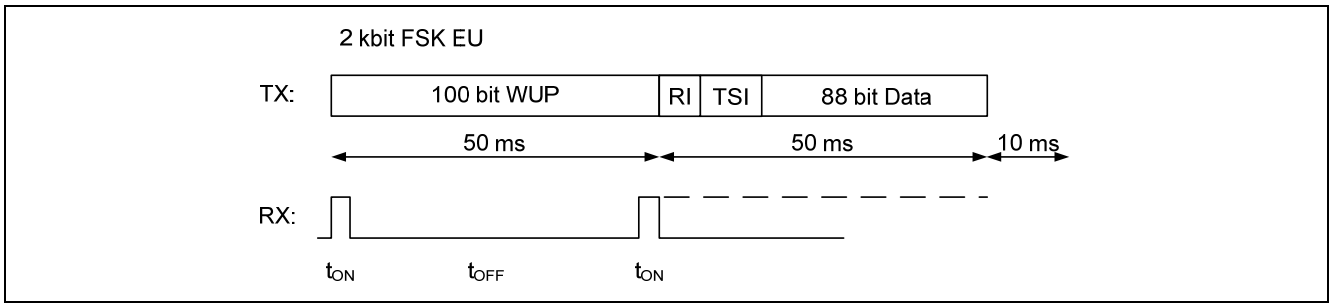

Figure 6 2 kbit FSK EU Pattern

Modulation:	FSK
Data Rate:	2 kbit
Channel frequency:	433.92 MHz
FSK Deviation:	+/- 35 kHz
Coding:	Manchester
WUP Data:	100 bit all 0
SYNC Data:	4 bit → all 0
TSI Data:	8 bit → 00010101
Payload:	11 byte data (could be modified for different applications)

Main target: typical application with high sensitivity, higher immunity against jammer

Fast Fallback to Sleep Mode (FFB):

RX sensitivity:	-112.0 dBm
Average RX current of TDA5240/35:	1.07 mA

Ultra Fast Fallback to Sleep Mode (UFFB):

RX sensitivity:	-112.0 dBm
Average RX current of TDA5240/35:	0.58 mA

4.3 2 kbit FSK EU Pattern – Multi-Channel using 2 RF channels

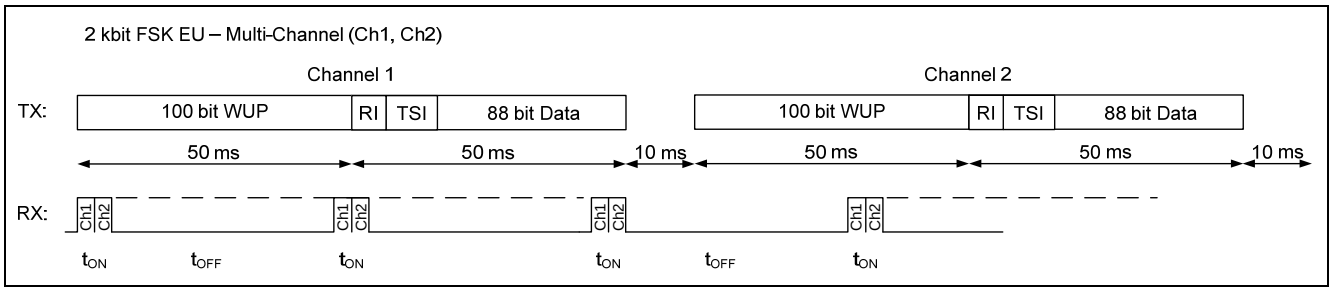

Figure 7 2 kbit FSK EU Pattern – Multi-Channel

Modulation:	FSK
Data Rate:	2 kbit
Channel frequency:	Ch1: 433.92 MHz
	Ch2: 434.42 MHz
FSK Deviation:	+/- 35 kHz
Coding:	Manchester
WUP Data:	100 bit all 0
SYNC Data:	4 bit → all 0
TSI Data:	8 bit → 00010101
Payload:	11 byte data (could be modified for different applications)

Main target: typical application with high sensitivity, even higher immunity against jammer

Fast Fallback to Sleep Mode (FFB):

RX sensitivity:	-112.1 dBm
Average RX current of TDA5240:	2.1 mA

Ultra Fast Fallback to Sleep Mode (UFFB):

RX sensitivity:	-112.0 dBm
Average RX current of TDA5240:	1.1 mA

Note: On using TDA5235 a two channel configuration can be established when setting RF channel 1 within Configuration A and RF channel 2 within Configuration B. The polling strategy keeps the same as the required time for a channel hop and for a configuration hop is the same.

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