User manual

Document information

Info	Content
Keywords	OL2381, User manual, GUI
Abstract	This user manual describes the architecture and functionalities of the OL2381 Demo kit including the use of the Graphical User Interface GUI.



Revision history

Rev	Date	Description
v.1	20111214	initial version

Contact information

For more information, please visit: http://www.nxp.com

For sales office addresses, please send an email to: salesaddresses@nxp.com

UM10472

© NXP B.V. 2011. All rights reserved.

1. Introduction

This user manual describes the architecture and functionalities of the OL2381 demo kit. The user manual also describes the hardware included in OL2381 demo kit and step-by-step setup of the OL2381 in both the transmit and receive mode. It demonstrates the OL2381 IC performance in an application-like environment. It is based on two boards: a Control Board and an OL2381 RF board shown in <u>Figure 1</u>.

The Control Board contains an NXP P89LPC936 microcontroller and features:

- A user interface comprising 4 DIP switches, 4 tactile switches, 2 LEDs and 1 buzzer.
- Two possibilities for power supply of the Control Board are a 3 V battery and an external power supply.
- A serial interface (TXD, RXD) which allows in-system programming of the microcontroller and the use of the HyperTerminal to control the microcontroller and/or receive information from it.
- A GUI interface which allows a direct control of the registers with a transparent mode of the microcontroller.
- 1 MB EEPROM memory with an I²C interface.
- A full port OL2381 connection named RF interface. It comprises an SPI interface and three additional lines (P10/DATA, P11/INT and P12/CLOCK) used for sending and/or receiving data during TX and RX operation of OL2381.

The OL2381 RF Board contains an OL2381 and features:

- An RF switch
- A 50 Ω connector to choose between an antenna printed on the PCB or an external antenna. It allows the RF signal to be monitored using standard lab equipment.



2. Hardware description

2.1 Deliverables

The OL2381 Demo Kit is delivered with the following hardware as shown in Figure 1:

- A Control Board
- An RF Board containing OL2381 IC (matched for frequency 315 MHz, 434 MHz or 868 MHz)
- A 20 wire flat cable for connection between boards
- An L-type RF probe with locking function from Murata

2.2 Control board description

2.2.1 On-board microcontroller

The serial flash In-System Programming (ISP) feature of the P89LPC936 microcontroller allows coding while the device is connected with a computer via an RS-232 interface.

2.2.2 OL2381 RF board interface

The minimum connection between the microcontroller and OL2381 RF Board comprises SPI lines SDIO, SCLK and SEN. The full four-line SPI mode can be configured using jumper JP5. In this case, line SDIO serves as data input and line P13/SDO as data output.

The SPI lines can be configured for shared transmit/receive data and clock, together with SPI communication. Alternatively, the device can also be configured for separate SPI lines and transmit/receive data (P10/Data) and Clock (P12/Clock).

Figure 2 presents the signal of the RF interface on the control board.



User manual

2.2.3 Jumpers

Several Jumpers are present on the control board to configure it and to observe some signals from the OL2381 as shown in <u>Table 3</u>. Each jumper is described in <u>Table 1</u>:



Fig 3. Control board jumper settings (default in RED)

Table 1. List of jumpers and connectors

Designation	Description
JP1 2.5 V/ 3.0 V /3.6 V	Selects the control board input voltage, when using an external input voltage. Default = center position (3.0 V)
JP2	Selects the supply for the control board. Connecting the two pins on the right, selects the external input voltage as the control board power supply. Connecting the two pins on the left, selects the battery as the control board power supply. Default = open
JP3	Enables a probe to be connected to the red LED voltage input.
JP4	Connects VCC_LOP and VCC to supply the RF board. Default = connected
JP5	Connecting the two pins at the bottom takes the SPI output data from the SDIO pin. Connecting the two pins on the top takes the output data from the SDO pin. Default = SDIO
JP6	Enables a probe to be connected to the green LED voltage input.
BUZZER	Enables a probe to be connected to the BUZZER voltage input.
RS232	RS-232 interface connector. Enables the microcontroller to be programmed and the hyper terminal interface to be used.

2.2.4 P89LPC936 Pin configuration

Table 2 provides an overview of the pin assignment of the microcontroller P89LPC936.

Table 2. P89	LPC936 pin assignment	
Pin reference	Configuration	Description
P0.0	input only (high impedance)	DIP switch S1
P0.1	input only (high impedance)	DIP switch S2
P0.2	input only (high impedance)	DIP switch S3
P0.3	input only (high impedance)	DIP switch S4
P0.4	input only (high impedance)	tactile switch SW4
P0.5	input only (high impedance)	tactile switch SW5
P0.6	input only (high impedance)	tactile switch SW6
P0.7	input only (high impedance)	tactile switch SW7
P1.0	quasi-bidirectional	RS-232 output - TXD
P1.1	quasi-bidirectional	RS-232 input - RXD
P1.2	open drain	serial clock (EEPROM)
P1.3	open drain	serial clock (EEPROM)
P1.4	input only (high impedance)	interface with OL2381 P11/INT/TEST5
P1.5	-	RESET
P1.6	quasi-bidirectional	configurable input/output P_TXD_LOP
P1.7	quasi-bidirectional	configurable input/output P_TXA_LOP
P2.0	quasi-bidirectional	configurable input/output P_RXA_LOP
P2.1	push-pull	green LED
P2.2	input only OR Push-pull	interface to OL2381 SDIO
P2.3	input only (high impedance)	interface to OL2381 SDIO or SDO
P2.4	push-pull	interface to OL2381 SEN
P2.5	input only OR push-pull	interface to OL2381 SCLK
P3.0	push-pull	red LED
P3.1	push-pull	buzzer
V _{SS}	-	0 V reference
V _{DD}	-	power supply

2.3 RF board description

This section briefly describes the RF board. The two-layer RF board contains the OL2381 IC, printed antenna, important test pins, 16 MHz crystal, switch connector for RF probe and transmit and receive matching components.



2.3.1 RF board schematic

2.3.2 RF board layout

The layout is realized using a 2-layer technique. The rear-side is mainly the ground layer. The eagle files are available for customers.



2.3.3 Power supply distribution

The supply voltage applied to the RF Board from the Control Board is split into several paths. Each supply path is routed from the star connection to the different supply pins of the OL2381. The supply voltage is the same as the supply voltage of the control board. This jumper (JP2) is used for monitoring the current consumption of the OL2381 which is quick and reliable indication of the OL2381 operation mode. In the standard receive configuration, current consumption is between 16 mA and 17 mA, and in the transmit operation, between 15 mA and 22 mA.

Each supply path is routed to the individual functional blocks of the OL2381 and uses separate bypass capacitors of 100 nF and 100 pF.

OL2381 has four built-in voltage regulators, which are required to stabilize and isolate the supply of functional blocks such as the power amplifier, VCO, PLL, and digital circuitry. Each regulator needs external bypassing capacitors for improved high frequency rejection and to ensure stability.

2.3.4 Test pins

The RF board contains several test pins for important signals as described in <u>Table 3</u> and shown in <u>Figure 6</u>:

Test pins	Description
SPI SDO, SCLK, SDIO, SEN	SPI communication pins, enabling communication between the microcontroller (on control board) and OL2381 (on RF Board). These pins can also be used to connect the RF board with another control board.
P10/DATA, P11/INT, P12/CLOCK	Enables a probe to be connected to the three outputs P10/DATA, P11/INT, P12/CLOCK of OL2381. Allows internal digital signals to be measured.
TEST1/TEST2	Allows internal analog signals of OL2381 to be measured.
VCC	Positive power supply for OL2381 and RF switch.

Table 3. P89LPC936 pin assignment



Fig 6. OL2381 RF board test pins

2.3.5 Pin description

Table 4: OL2381 pin description

Symbol	Pin	Description
GND	1	ground
VREG_VCO	2	VCO regulator output voltage
VCC_IF	3	IF power supply
TEST1	4	RX test I output
TEST2	5	RX test Q output
VCC_RF	6	LNA power supply
RF_IN	7	receive RF signal input (antenna or RX connector)
GND	8	ground
GND	9	ground
RF_OUT	10	transmitted RF signal output (antenna or TX connector)
VREG_PA	11	PA regulator output voltage
VCC_PA	12	PA power supply.
VREG_DIG	13	digital regulator output voltage
VCC_DIG	14	digital supply
P14/PIND	15	antenna switch control
GND	16	ground
SEN	17	serial interface enable, connected to P2.4 of microcontroller
SDIO	18	serial interface input/output connected to P2.3 (MISO) and P2.4 (MOSI) of microcontroller
SCLK	19	serial interface clock, connected to P2.5 of microcontroller
P10/DATA/TEST4	20	TX data input/RX data output, connected to P2.6 of microcontroller
P11/INT/TEST5	21	interrupt line connected to pin P1.4/INT of microcontroller
P12/CLOCK	22	TX/RX clock output connected to P2.7 of microcontroller

UM10472

© NXP B.V. 2011. All rights reserved.

Table 4:	OL238 1	l pin descr	iptioncontinued
Symbol		Pin	Description
P13/SDO		23	serial interface data output connected to P2.3 (MISO) of microcontroller when the 4-wire communication is selected
XTAL2		24	2-pin crystal oscillator
XTAL1		25	1-pin crystal oscillator
VCC_XO		26	crystal oscillator supply
RSTDIS		27	reset disable, connected either to ground or to VCC depending on the position of its dedicated jumper
TEN		28	test enable, set to ground
P15/RSSI/	TEST3	29	not connected
VREG_PLI	L	30	PLL regulator output voltage
VCC_REG		31	PLL, VCO regulators power supply
GND		32	ground

3. Demo kit setup

This chapter describes the step-by-step approach to set up the OL2381 for transmit and receive operation using the demo kit and GUI. The description starts with demo kit hardware connections followed by a brief discussion on GUI setup and GUI windows.

3.1 Hardware connections

The OL2381 demo kit includes the following items (shown in Figure 1):

- Control board
- OL2381 RF board, configurable to operate in one of three frequencies:
 - 315 MHz
 - 434 MHz
 - 868 MHz

The transceiver chip is almost the same. The RX path, TX path and antenna are matched differently to attain optimal performance at each frequency.

- A 20-pin flat cable connector
- A coax antenna cable (L-type RF probe)

Perform the following actions:

- 1. Jumper setting on controller board:
 - make the default jumper setting on controller board as described in <u>Section 2.2.2</u> on page 4.

Jumper number 4 is important. This jumper allows only the use of one supply for both boards. For high performance measurements, see <u>Section 6.1 on page 41</u>.

- 2. Connections:
 - Connect PC and control board with RS-232 Cable (cable not included)
 - Connect control board and RF board with 20-pin flat cable connector
 - Connect RF board and RF-analyzer, or RF-generator with coax antenna cable
- 3. Power supply:
 - Connect +3 V as shown in Figure 7

An overview of all connections is provided in Figure 7.

UM10472

OL2381 Demo kit



3.2 OL2381 Graphical User Interface (GUI)

The OL2381 demo kit includes Graphical User Interface (GUI) which enables easy real-time user access to the OL2381 registers for desired settings. The user can set several transmitter and receiver parameters such as:

- operating frequency
- data rate
- data coding and decoding
- modulation setting
- · baseband and channel filter settings
- transmit and receive command settings together with enable or disable transmit and/or receive operation

3.2.1 GUI installation

Install the OL2381 GUI as follows:

- 1. Copy the whole folder named "OL2381 SW Graphical User Interface GUI" to a desired location on a local PC.
- 2. Copy the contents of the folder Assemblies\WinSxS into the windir\WinSxS\ folder.
- 3. Select "Yes" when asked whether to overwrite the "Manifests" folder and select "No" for all other overwrite questions.
- 4. In the folder "LoPSTerConfig", click the file name "LoPSTerConfig.exe" (see Figure 8) and the OL2381_GUI with all three windows opens.

G Back	· 0 1	Search	Folders	· · ·		
Folders		×			IN	M
🗏 🚞 OL238	1 SW Graphical Use	Interface (📩				
E C Lo	PSTerConfig 1.0.22	0.0	LoPSTerCon	LoPSTerCon	LoPSTerGU	LoPSTerGUI.
H (Assemblies					
2	reference register	setup 🔍				
<		>				
	10					

3.2.2 RS-232 port configuration check

The GUI connection status with the control board and OL2381 RF board can check by clicking "Check now" button in OL2381 control window. The status message for connection is displayed as shown in Figure 9.

UM10472

OL2381 Demo kit

	🏶 LoPSTer Control GUI	Active register configuration
LoPSTer Control GUI Active register configuration © 1 C 2 Config	Active register configuration -	Config Active configuration Store Load Communication with LoPSTer Use COM port CoM1 Check now Check now
Active configuration	Store Load	Store Load Continuously monitor the communication with LoPSTer
Data flow from/to LoPSTer Transfer user settings (soft Write to device, read from Write to device, verify ono Transfer device settings (a Ignore register control auto	Data flow from/to LoPSTer Transfer user settings (Write to device, read fr Write to device, verify - Transfer device setting: Ignore register control	Data flow from/to LoPSTer Transfer user settings (software only) Write to device, read from software Write to device, verify once (read from sw or hw) Transfer device settings (always read from hardware) Ignore register control auto flags COM1 connected to LoPSTer on the demoboard Close Help
COM1: cannot communicate with d	emo board	Close Help

- "COMx connected to LoPSTer on Demoboard" reflects communication is made:
 - The GUI can communicate with the control board and with OL2381 RF board

Failure to communicate with the GUI could be due to problems with either the control board or the RF board. The following cases provide quick checks to resolve potential problems:

• "Cannot communicate with demo board" reflects a control board failure.

Quick check:

- RS-232 port configuration/selection
- Jumper settings for power supply
- Knob set to RUN position
- If all above PASS, although unlikely, it is possible that one of the devices has failed.
 If so, request a new board
- "Cannot communicate with LoPster" reflects RF board failure.

Quick check:

- Power supply check: pins VCC and Vreg
- SPI Check: probe SPI pins, write and read registers, SEN works accordingly
- Crystal check for reference frequency, i.e. 16 MHz for OL2381
- Check current consumption for: TX PA off, TX PA on and RX
- RF switch set to in-line for TX and RX configuration

3.2.3 GUI windows description

During start-up of OL2381, the GUI shows three different windows (see Figure 10) entitled:

- LoPSTer Control GUI
- LoPSTer Register Control
- LoPSTer Config GUI

These three windows are discussed in the following sections.



Fig 10. GUI windows

3.2.3.1 LoPSTer control GUI

The LoPSTer control GUI, shown in Figure 11, enables the user to:

- Check connection between the GUI and hardware (control board and RF board) by clicking the "Check now" button. This action displays the status message at the bottom of the window.
- Load and store OL2381 configuration files using "Store" and "Load" buttons, where:
 - Load writes configuration file values to the OL2381 registers
 - Store saves the OL2381 register values as the configuration file
- Switch between eight different stored configurations Active register configuration

OL2381 Demo kit

ei c	2 03	C <u>4</u> C <u>5</u>	C 6	CΖ	0
onfig					
Active configu	ration	Communication v	with LoPSTer		
Store	Load	Use COM port			
All configuratio	be and	COM1	Che	ck <u>n</u> ow	
All configuracio	l Lood	L Check the co	ommunication	with	
Store			or operangen	0.0010	
Store	Lõad		monitor the		
Store	<u> </u>	Continuous)	y monitor the on with LoPS	Ter	
Data flow from C Transfer u C Write to de Write to de Transfer d I Ignore reg	/to LoPSTer ser settings (softe evice, read from s evice, verify once evice settings (ak ister control auto	ware only) software (read from sw or hw) ways read from hardwar flags	v monitor the on with LoPS e)	Ter	

3.2.3.2 LoPSTer register control GUI

The LoPSTer register control GUI, shown in Figure 12, enables the user to:

- Read and write the OL2381 registers in real-time by clicking Read and Write buttons
- Show complete register bits by name by clicking Show Bit names
- Show each register with name, address and content in hexadecimal and decimal
- Update registers with the parameter changes made in LoPSTer control GUI
- Enable or disable auto read and write OL2381 registers

UM10472

OL2381 Demo kit

٨dd	ress	OxOD	(13)	: LO	CON	Reg	ister				Show	bit	names	V
7	<u>6</u>	5	4	3	2	1	Q	Hex	Dec	V	Auto	Г	Auto	
0	0	0	0	0	0	0	0	00	0	Y	⊻rite	I	Read	
			-	T	T	L	L	RF_LI	D_DIV					
					-	-	-	LOCK	DET	ON				
				-				CLK2	SCLK	DEL	AY			
\dd	ress	0x0E	(14)	: TIM	IING	DRe	gister				Show	bit	names	Г
7	6	5	4	3	2	1	Q	Hex	Dec	•	Auto	Г	Auto	
0	0	1	1	1	1	0	1	3D	61	Y	<u>V</u> rite	I	Read	
٨dd	ress	0x0F	(15)	TIM	ING	Re	gister	-			Show	bit	names	Г
Z	6	5	4	3	2	1	Q	Hex	Dec	Г	Auto	1	Auto	
0	1	0	1	1	0	1	0	5A	90	Y	<u>V</u> rite	I	Read	
dd	ress	0x10	(16)	PO	RTCO	ONO	Regis	ter	_		Show	bit	names	Г
7	<u>6</u>	5	4	3	2	1	Q	Hex	Dec	•	Auto	Г	Auto	
0	0	0	1	0	0	1	0	12	18	Y	⊻rite	I	Read	
dd	ress	0x11	(17)	PO	RTCO	DN1	Regis	ter			Show	bit	names	7
Z	<u>6</u>	5	4	3	2	1	Ū	Hex	Dec	1	Auto	Г	Auto	
	0	1	0	0	0	1	0	22	34	Y	Vrite	F	Read	

3.2.3.3 LoPSTer Config GUI

The LoPSTer configuration GUI, shown in <u>Figure 13</u>, provides an easy-to-use real-time interface. This interface enables the user to configure a wide range of transmit and receive parameters. The LoPSTer config GUI contains the following three tabs:

- General Settings
- Digital I/O Port Control
- Operational Settings

General Settings (see 1 in Figure 13) - enables the user to:

- Select **LoPSTer version**, an option for predecessor OL2380 that is no longer valid for OL2381 as it supports all frequencies.
- Calibrate reference XTAL frequency (if necessary)
- Select reset disable (RSTDIS) pin setting. For detailed information regarding RSTDIS, refer to the *Data sheet OL2381* or *Application note AN11039*.

and the second of the second of the production of the second	Status and State Control
LoPSTer version V1A VIA	Device Mode Idle V DPD RESET Read Registers
Reference (XTAL) frequency 16.000.000,0 Hz Calibrate	Force lock detector always on
when changing reference frequency settings:	Skip VCO re-calibration Galibrate VCO New
Keep LoPSTer settings, update controls Keep control values, update LoPSTer	Current RF ? Auto-Detect Current RF Channel
	Check LD status automatically after a Receive command
when changing the sigma-delta output gain: Keep center frequency values, update LoPSTer FC settings Keep LaPSTer FC settings	LO status: The device is in idle mode.
C Reep Lors rei ric searings, aplicate center nequency controls	Check LD Status
RSTDIS pin is set to high	Transmitter Transmit Command
	IX data sampling and PA control synchronized with IX clock Shut down the PA when SEN goes low Transmit Manchester encoded data sampled with TX clock Transmit power and modulation control selection ACDN0 Activate Deactivate Check device status automatically after each Transmit command Check device status automatically after each PAM change TX status: The device is in idle mode.
	Check TX Status
	Receiver
	Receive Command
	Sub-command CONT
	Gain switch use high gain settings
	Gain switch use high gain settings V Send Command
	Gain switch use high gain settings Send Command Command status: There either was no command issued recently, it is still ongoing or it completed successfully.



Digital I/O port control (see 2 in Figure 14) - allows the user to:

- Control port connection
- Configure either 3-wire or 4-wire SPI communication
- Configure SPI or separate pins (P10/DATA, P12/CLOCK) for TX/RX data and clock
- Scroll different options for pins Data, Clock and INT, i.e. TX/RX/chip/bit clock on P12/Clock, LO_RDY/RX_RDY/PA_ON status on P11/INT
- Configure P13/SDO and P14/PIND



Operational settings (see **3** in Figure 15):

- Separate section for transmitter parameter settings and receiver parameter settings on left-hand side (LHS)
- · Separate section for transmit command and receive command settings on LHS
- Common sections for RF center frequencies and device status and state control
- A choice between four different channels for TX and RX operation with the help of transmit channel and receive channel option block
- Status for local oscillator, PLL, transmit state and receive state can be checked at anytime by clicking the appropriate status button

ieneral Settings Digital I/O Port Control Operational Settings Local Dscillator and Clock Settings VCO band high (V1A) This is the required setting for LoPSTer version V1A. VCO sub-band 0 PLL ICP 0 Sigma-delta output gain ×1 (normal LO divider +2 (f > 512 MH RF frequency resolution 488.28 Hz	Status and State Control Device Mode Transmit Local Oscillator Force lock detector always on Skip VCD re-calibration Current RF 2 Auto-Detect Current RF Channel
Local Oscillator and Clock Settings VCD band high (V1A) This is the required setting for LoPSTer version V1A. VCD sub-band 0 PLL ICP 0 Sigma-delta output gain x1 (normal x LD divider +2 (f>512 MH x RF frequency resolution 488.28 Hz	Device Mode Transmit PD RESET Read Registers Local Oscillator Force lock detector always on Skip VCD re-calibration Current RF 2 Auto-Detect Current RF Channel
Sigma-delta output gain ×1 (normal v LD divider +2 (f > 512 MH v RF frequency resolution 488.28 Hz	Current RF ? Auto-Detect Current RF Channel
LD divider +2 (f > 512 MH 🐱 RF frequency resolution 488.28 Hz	
RF frequency resolution 488,28 Hz	Check LO status automatically after a Receive command
PE Castar Francisco	LO status: After the last VCO calibration the PLL was locked.
Channel 0 868.000.244 Hz Channel 2 512.000.244 Hz	Check LO Status
Channel 1 512.000.244 Hz Channel 3 512.000.244 Hz	Transmitter
	Transmit Command
Unipirate 62.500 chips/s	Transmit channel 0 💌
Modulation Control AMH0 0 Modulation type 0 FSK AMH1 0 Modulation type 1 FSK AML 0	Tx data samping and PX control synchronized with TX dock Shut down the PA when SEN goes low Transmit Manchester encoded data sampled with TX clock. Transmit power and modulation control selection ACONO Activate Deactivate
PAM 0 This is the recommended PAM setting. Invert transmitted data AM	Check device status automatically after each Transmit command Check device status automatically after each PAM change TX status: Transmitting.
ASK modulation depth 0.00 Relative ramp duration 0.00 % of chip On/Off ramp duration 0.00 % of chip Slew rate +unendli steps/µs FM FSK frequency deviation 0 Hz FSK modulation index 0.0	Check TX Status Receiver Receiver Receiver Command Receive channel CONT Gain switch use high gain settings Send Command Send Command
Relative ramp duration 0.0 % of chip BT +unen Slew rate +unendli Hz / μs	Command status: There either was no command issued recently, it is still origoing or it completed successfully.
Illustrate	Check Signal Monitoring Status
Timing	
TX synchronization clock source chip rate	
Transmit chip rate 62,500 chips/s	
Transmit clock. 62.500 Hz	

3.2.4 GUI transmitter and receiver parameters

3.2.4.1 Transmitter parameters

The transmitter parameters, indicated by **4** in <u>Figure 15</u>, are discussed briefly in this section.

- Modulation Control section allows the user to:
 - Select Modulation type either ASK or FSK
 - Set output power AMH0/AMH1/AML for modulated signal
 - Set power amplifier output power (PAM), PAM0 is recommended setting
- AM and FM blocks allows ASK and FSK settings
 - Amplitude modulation depth for ASK signal
 - Frequency deviation for FSK signal
 - Ramp control for soft ASK and FSK to achieve narrow signal bandwidth
- Timing block allows the chip or bit clock to be selected for TX synchronization
- Transmit Command block on right side allows the user to:
 - Select the desired Transmit Channel, i.e. Channel 0, 1, 2 or 3
 - Configure the transmit command for PA control
 - Enable or disable **Manchester** coding for TX Data
 - Select either ACON0 or ACON1 for output power and modulation selection.
 - Enable or disable PA by clicking Activate or Deactivate buttons.

3.2.4.2 Receiver parameters

The receiver parameters, shown by **5** in <u>Figure 16</u> and <u>Figure 17</u>, are discussed briefly in this section.

- **Gain Settings** defines the front-end gain, **LNA** and **IF** filter, where high gain, shown in Figure 16, is the recommended setting
- **Channel Filter** defines demodulation type (ASK or FSK) applied on receive signal and channel filter bandwidth.
- **Baseband Filter** defines the BBF corner frequency; the corner frequency must keep close to the expected data rate.
- Slicer and Coding defines the data slicer settings:
 - Implementation of edge or level slicer
 - **Recommendation: level slicer for ASK and edge slicer for FSK modulated signal
 - **Recommendation: edge slicer initial value as 70 % frequency deviation
 - **Recommendation: enable auto Initialization for edge Slicer
- Receive Command on right side allows the user to:
 - Select different receive subcommand, i.e. CONT, WUPS, PRDA or DATA
 - Select desire Receiver Channel, i.e. Channel 0, 1, 2 or 3
 - Select LNA gain control in Gain Switch option
 - Enable user send/receive command by clicking Send Command button

- The appropriate settings for signal monitor, wake-up, preambles, polling timer together with data and clock sections are scrolled down sections as shown in Figure 17. Examples of the types of data shown are:
 - Manchester decoding enable/disable in data and clock section
 - preambles definition in preamble settings
 - several signal monitors that can be enabled or disabled in the signal monitoring section

Any change performed in the LoPSTer config GUI is reflected in the corresponding registers in the LoPSTer register GUI.

Lile Heb	
The rank General 3 setting: Display 100 Fail Control Operational Setting: - Lond Display 100 Fail Control Operational Setting: - Lond Display 100 Fail Control Operational Setting: - VCD band High (VLa) - Display 100 Fail -	Statu and State Carded Carde Mode (Receive) P. C. Stat K. Read Register (Receive) Carde Mode (Receive) P. C. Stat K. Read Register (Receive) Carde Mode (Receive) P. C. Stat K. Read Register (Receive) Carde Mode (Receive) P. C. Stat K. Read Register (Receive) Carde Mode (Receive) P. C. Stat K. Read Register (Receive) Carde (Receive) P. C. Stat K. Receive) Carde (Receive) P. C. Stat K. Receive) Carde (Receive) P. C. Stat K. Receive) Carde (Receive) P. C. Stat K. Receive) Carde (Receive) P. C. Stat K. Receive) Carde (Receive) P. C. Stat K. Receive) Carde (Receive) P. C. Stat K. Receive) Carde (Receive) P. C. Stat K. Receive) Carde (Receive) P. C. Stat K. Receive) Carde (Receive) P. C. Stat K. Receive) Carde (Receive) P. C. Stat K. Receive) Carde (Receive) P. C. Stat K. Receive) Carde (Receive) P. C. Stat K. Receive) Carde (Receive) P. C. Stat K. Receive) Carde (Receive) P. C. Stat K. Receive) Care (Receive) P. C. Stat K. Receive)
Edge slicer modulation amplitude inne Upper modulation amplitude inni Lower modulation amplitude inni 0 Hz	
Level stoer initial threshold [100,000,000 [Hz]	

UM10472

OL2381 Demo kit



4. RF measurements using the demo kit

This section describes how to measure certain OL2381 RF parameters such as RF transmission power, receiver sensitivity, using a single demo kit set.

4.1 Transmission measurement

This section describes how to perform a transmission measurement. It uses the 868 MHz configuration but measurements at other frequencies can be done in a similar way.

The software package included in the demo kit contains OL2381 transmission configuration files for 315 MHz, 434 MHz and 868 MHz bands.

Click the "Load" button that appears in the OL2381 control GUI window. To configure OL2381 for 868 MHz transmission, select and load the file named "Config_868Mhz_FSK.Irg" (see Figure 18).

			C
		Config Active configuration Store Load Communication with LoPSTer Use COM port COM5 Check <u>now</u> All configurations Check the communication with	
oad active Lol	STer configu	iration 2 🔀	
LOOK jr.	Telelence in		
Documents	Config_868N	MHz_ASK.lrg	
Desktop My Documents	Image: Config_868N Image: C	<pre>vhc_FSK.lrg http://www.setup.org http</pre>	Help
Desktop My Documents DEPHBGGH11 NBB18	a Config_868M	<pre>/hc_FSK.lrg //hc_FSK_lrg //hc_FSK.lrg //hc_FSK.lrg //hc_FSK.lrg</pre>	Help
Desktop My Documents DEPHBGGH11 NBB18 My Network	File game:	Nb2_FSK.lrg http://www.star.lrg http://www.star.lrg http://www.star.lrg http://www.star.lrg http://www.star.lrg Config_868Mbz_FSK.lrg	Help

The OL2381 register content is seen in the OL2381 register window. The register can be read and written at anytime.

The OL2381 configuration file is set up for a 868 MHz Continuous Wave (CW) transmission, i.e. an unmodulated carrier.

A CW transmission can be set when frequency deviation (register Fdev) in FSK is 0 and the transmitter parameters appear in the transmitter section of OL2381 Config GUI window.

Constal Settings Digital I/O Part Control Operational Settings	Status and State Control
Local Decilator and Clock Settings	Device Mode Transmit PD PD BESET Read Registere
VC0 band bidb (V1A) This is the required setting for	
LoPSTer version V1A.	Local Uscillator
VLU sub-band 22	Skip VCD re-calibration
PLL ICP 4	
Sigma-delta output gain 🛛 🗙 🖌 🖌 x1 (normal 💟	Current RF U Auto-Detect Current RF Channel
LO divider +2 (f > 512 MH 👻	Check LU status automatically after a Receive command
RF frequency resolution 488,28 Hz	LO status: After the fast VLU calibration the PLL was locked.
RF Center Frequencies	Check 10 Status
Channel 0 868.000.244 Hz Channel 2 513.992.432 Hz	
Channel 1 1.022.000.24 Hz Channel 3 1.022.007.56 Hz	Transmitter Transmit Command
Chip rate 19.203 chips/s	
Transmitter Beceiver	TX data sampling and PA control synchronized with TX clock
Modulation Control	Shut down the PA when SEN goes low
AMH0 31 Modulation type 0 FSK	Transmit Manchester encoded data sampled with TX clock
AMH1 31 Modulation type 1 FSK	Transmit power and modulation control selection ACON0
AMI D	Activate Deactivate
DAME 0 This is the recommended PAM setting	Check device status automatically after each Transmit command
I have the second data	Check device status automatically after each PAM change
	TX status: Transmitting.
ASK modulation depth 1.00	
Belative ramp duration 7.44 % of chin	Lheck IX Status
On/Off rame duration 7.44 % of chin	Receiver
Slewrate 8000 steps/us	Heceive Lommand
	Receive channel U
	Sub-command
FSK meduency deviation 0 Hz	Gain switch keep gain as is 😽 😽
PSN modulation index 0,0	Send Command
Helative ramp duration U,U % of chip B1 +unen	Command status: There either was no command issued recently it is
Slew rate 1.201,9 Hz / µs	still ongoing or it completed successfully.
lliustrate	Check Signal Monitoring Status
Timing	
TX synchronization clock source chip rate	
Transmit chip rate 19.203 chips/s	
Transmit clock 19.203 Hz	

There are a number of important data captures shown in <u>Figure 19</u> that have been circled in red. These data captures are for OL2381 transmission and represent the following:

- Channel frequency set to 868 MHz
- Modulation type is FSK
- Frequency deviation for FSK
- Device mode is "Transmit"
- "Activate" button sends TX command
- Final status of transmission

4.1.1 Output power and harmonics

The L-type RF probe is connected between the RF board and spectrum analyzer to display the OL2381 output signal on the spectrum analyzer (see Figure 20).

Marker 1 points to the operating frequency, whereas marker 2 and marker 3 indicate the harmonics.

OL2381 Demo kit



The TX clock and data can also be observed with the help of data and clock pins on the RF board.

Changes in output spectrum can be observed by changing the following TX parameters:

- PAM setting
- RF frequency
- Data rate
- Modulation
- Coding
- Baud rate

Typical current consumption of RF board - 18 mA for an output power of 8 dBm.

4.2 Reception measurement

This section provides an example explaining how to perform reception measurements.

In this example, the 868 MHz configuration is used, but the same procedure applies to other configuration files.

The software package included in the demo kit contains OL2381 reception files for 315 MHz, 434 MHz and 868 MHz bands.

To configure the OL2381 for 868 MHz reception, click the "Load" button in the OL2381 control GUI window, select the "Config_868Mhz_FSK.Irg" file and then open it (see Figure 21).

		€1 C2 C3 C4 C5 C6 C	Z C 8
		Config	
		Active configuration Store Load Communication with LoPSTer Use COM port Com5 Check pow	~
.oad active Lo	PSTer configu	ration 💽 🛛 🕅 port	t
Look jn:	reference re	egister setup 💽 🚽 🗈 🖆 🏢 🕶 🔐	
	Config_868M	hte_FSK.htg htz_FSK_no_Manchester.htg	
Desktop My Documents DEPHBGGH11 NBB18	E example_Co	nfig_314_F5K.lrg	Help
Desktop My Documents DEPHBGGH11 NBB18 My Network Places	File game:	Config_868Mhz_FSK.lrg	Help

The receiver is activated by clicking the "Send command" button in the receive command section of OL2381 Config GUI as shown in Figure 22.

UM10472

OL2381 Demo kit



There are a number of important data captures shown in <u>Figure 22</u> that have been circled in red. These data captures are for the OL2381 reception and represent the following:

- Channel frequency
- LNA gain setting
- Channel and baseband filter bandwidth
- Modulation type
- Slicer setting
- Device mode
- · LO and PLL status
- Device is in data reception mode after sending receive command

For detailed information regarding receiver parameters, refer to *Data sheet OL2381* or *Application note AN11039*.

An R&S signal generator is used to generate the frequency of the expected signal, for this example, 868 MHz with:

- F_{dev} = 15 kHz
- Manchester coded data = 19200 chips/s
- Data = ...,0,1,0,1,0,1,0,...

Using an L-type RF probe, establish a connection between the signal generator and RF board and inject the RF signal from the signal generator to OL2381 on the RF board.

Using an oscilloscope, observe the data and clock pins on the RF board for received data and clock (see Figure 23).



4.2.1 Sensitivity measurement

The receiver is set to Manchester decoding for sensitivity measurements. As a result, the data output shows either constant "0" or constant "1" (see <u>Figure 24</u>) and the clock signal is divided by two.

The signal power from the signal generator can now be gradually reduced until noise replaces the data shown on the oscilloscope (see Figure 25).

This inserted power, is the minimum power the OL2381 receiver can receive and it represents the sensitivity of the receiver. The exact RF frequency of the RF generator is important and it may be necessary to fine-tune it.

UM10472

OL2381 Demo kit



5. Configuration files

This section contains brief description of OL2381 configuration files. It covers both transmission and reception at frequencies of 315 MHz, 434 MHz and 868 MHz. The same configuration files are included in the software package supplied with the OL2381 demo kit.

The following three configuration files are discussed briefly, together with GUI captures for TX and RX.

- TX/RX configuration file 315 MHz (FSK transmission/FSK reception)
- TX/RX configuration file 434 MHz (FSK transmission/FSK reception)
- TX/RX configuration file 868 MHz (FSK transmission/FSK reception)

5.1 315 MHz TX/RX configuration file (FSK)

Table 5 is an extract from *Data sheet OL2381* for the 315 MHz TX/RX FSK configuration file.

Table 5. Table extract

Symbol	Parameter	Conditions	Min	Тур	Мах	Unit
S _{RX}	receiver sensitivity	Manchester encoded data rate = 2.4 kbit/s; deviation = 2.4 kHz; channel filter B = 50 kHz	-109	-112	-	dBm



5.1.1 315 MHz transmission

- Center frequency: 315 MHz
- Data rate: 4.8 kbit/s Manchester coded (symbol rate = 9600 chips/s)
- Modulation type: FSK
- Frequency deviation: 4.8 kHz

Figure 26 is a compilation to enable all the relevant information to be visible on one page.

Ele Help General Settings Digital I/D Port Control Operational Settings Local Oscillator and Clock Settings VCD bade Iww (V1B) Wis setting is not appropriate VCD sub-band 38 PLL ICP 2 Sigma-delta output gain x1 (normal Calibrate VCD Now Lo divider +4 (f < 512 MH Calibrate VCD Now RF frequency resolution 244.14 Hz Check LD Status RF Center Frequencies Channel 314.996.216 Hz Channel 2 Chip rate 9.602 chips/s Check LO Status and PA control synchronized with TX clock. Modulation Control Modulation the D FSK FSK MHD Modulation the D FSK FSK	Elle Belo General Setting: Digital I/D Port Control Ucod Dacidator and Clock Setting: VCD back low VHB VCD back low I/HB Ye setting is not appropriate VCD back low I/HB Ye setting is not appropriate VCD back low I/HB Ye setting is not appropriate VCD back low I/HB Ye setting is not appropriate VCD back low I/HB Ye setting is not appropriate VCD back low I/HB Ye setting is not appropriate VCD back low I/HB Ye setting is not appropriate VCD back low I/HB Ye setting is not appropriate VCD back low I/HB Ye setting is not appropriate Cod Bacidator and Clock Setting: Skip YCD re-calibration Clast Setting: Auto-Detect Current RF Channel Device Mode Transmit error Check LD status automatically after a Receive command D back I/H Transmitter Transmitter Transmit Command Transmit Pacesiere Ye Setting: Modulation Control Modulation type 0 AMH I/H Modulation type 0 AMH I/H I/H AMH I/H I/H Sel	Eile Help	
General Settings Digital I/D Port Control Operational Settings Local Oscillator and Clock Settings VCD bade Iww (V1B) Vis setting is not appropriate VCD sub-band 38 PLL ICP PC Read Registers Sigma-delta output gain x1 (normal Calibrate VCD Now Calibrate VCD Now Current RF 0 Auto-Detect Current RF Channel LD divider +4 (f < 512 MH Check LD Status RF frequency resolution 244.14 Hz Check LD Status RF Center Frequencies Channel 124.936.216 Hz Check LD Status Channel 314.936.216 Hz Channel 2 297.316.528 Hz Check LD Status Chip rate 9.602 chips/s Transmitter Transmitter Transmitter Modulation Control Modulation type 0 FSK FSK Transmit Manchester encoded data sampling with TX clock AMH0 3 Modulation type 0 FSK FSK Transmit power and modulation control selection ACOND	General Settings Digital I/D Port Control Operational Settings Local Discillator and Clock Settings VCD bade Iww (V1B) VL bPST er version VIA VCD bade Iww (V1B) VL bPST er version VIA Porce lock detector always on VCD bade Signs-delta output gain K1 formal Coal Discillator Signs-delta output gain K1 formal Current RF 0 Auto-Detect Current RF Channel D drives 44.14 Hz PSE Check LD status automatically after a Receive command LD status: Atter the last VCD calibration the PLL was locked. Channel 31.4996.216 H Channel 2 297.316.528 Hz Check LD status Channel 34.996.216 H Channel 2 297.316.528 Hz Check LD status Transmitter Teaceive Check LD status Check LD status Transmitter Receiver Shu down the PA when SEN goes low Y TX data sampling and PA control synchronized with TX clock AMH0 31 Modulation type 1 FSK Y Activate Deactivate PAM This is the recommended PAM setting. Invert transmited data Check device status automatically after each Transmit command Check vice status automatically af		
AMH1 31 Modulation type 1 FSK ♥ AML 0 PAM 0 ♥ This is the recommended PAM setting. Invert transmitted data AM ASK modulation depth 1.00 Relative ramp duration 0.00 % of chip On/Off ramp duration 0.00 % of chip Slew rate Infinity steps/µs FM FSK frequency deviation 4.883 Hz FSK modulation index 1.0 Send Command	Relative ramp duration 0.0 % of chip BT Infinity Slew rate Infinity Hz / μs Command status: There either was no command issued recently, it is still ongoing or it completed successfully. Illustrate Check Signal Monitoring Status	General Settings Ügital I/D Port Control Uperational Settings Local Oscillator and Clock Settings Vis setting is not appropriate VCD bacd low (V1B) LLoPSTer version V1A. VCD sub-band 38 PLL ICP 2 Sigma-delta output gain x1 (normal v L0 divider +4 (f < 512 MH v RF frequency resolution 244.114 Hz RF Center Frequencies Channel 1 Channel 314.996.216 Hz Channel 1 272.281.372 Hz Channel 1 272.281.372 Hz Chip rate 9.602 chips/s Transmitter Receiver Modulation Control AMH0 AMH0 31 Modulation type 1 FSK Modulation depth 1.00 PAM 0 This is the recommended PAM setting. Invert transmitted data AM ASK modulation depth 1.00 Relative ramp duration 0.00 % of chip On/Off ramp duration 0.00 % of chip Slew rate 1.0 Relative ramp duration 0.00 % of chip FSK modulation inde	Status and State Control Device Mode Transmit PD RESET Read Registers Local Dacillator Skip VCD re-calibration Calibrate VCD Now Current RF Induce Detect Current RF Channel Check LD status automatically after a Receive command LD status: After the last VCD calibration the PLL was locked. Transmit Command Image: Command Status Transmit Manchester encoded data sampled with TX clock Shut down the PA when SEN goes low Image: Command Status Image: Command Activate Deactivate Image: Check device status automatically after each Transmit command Check device status automatically after each PAM change TX status: Transmitting. Check TX Status Receiver Sub-command DaTA S Send Command Sub-c



5.1.2 315 MHz reception

- Center frequency: 315 MHz
- Data rate: 4.8 kbit/s Manchester coded (symbol rate = 9600 chips/s)
- Modulation type: FSK
- Frequency deviation: 4.8 kHz
- OL2381 performed Manchester decoding

Figure 27 is a compilation to enable all the relevant information to be visible on one page.

<u>File H</u> elp	
General Settings Digital I/O Port Control Operational Settings Local Oscillator and Clock Settings VCD band Iow (V1B) His setting is not appropriate Iov.oPSTer version V1A. VCD sub-band 36 PLL ICP 2 Sigma-delta output gain x1 (normal v	Status and State Control Device Mode Idle PD RESET Read Registers Local Oscillator Force lock detector always on Skip VCD re-calibration Calibrate VCO Now Current RF 0 Auto-Detect Current RF Channel
L0 divider (+4 (f < 512 MH) RF frequency resolution 244.14 Hz RF Center Frequencies Channel 314.996.216 Hz Jhannel 2 297.316.528 Hz Channel 1 272.281.372 Hz Channel 3 264.031.372 Hz	Check LO status automatically after a Receive command LO status: The device is in idle mode. Check LO Status Transmitter
Chip rate 9,602 chips/s Transmitter Receiver Gain Settings Front-end LNA IF Channel Files, Combined	Transmit Command Transmit channel Image: TX data sampling and PA control synchronized with TX clock Shut down the PA when SEN goes low Image: Transmit Manchester encoded data sampled with TX clock Transmit Manchester encoded data sampled with TX clock Transmit power and modulation control selection ACON0
High gain 25.5 dB V 27 dB V 92.5 dB Channel Filter Demodulator selection FM V Channel filter bandwidth setting 5:50 kHz V Baseband Filter	Activate Deactivate Check device status automatically after each Transmit command Check device status automatically after each PAM change TX status: The device is in idle mode.
Baseband hiter corner frequency setting (47,0/30 kH2 V) Slicer and Coding Edge slicer modulation amplitude threshold 4,762 H2 wake up preamble data	Receiver Receive Command Receive channel O Sub-command DATA Gain switch use high gain settings
Slicer selection edge served e	Send Command Command status: There either was no command issued recently, it is still ongoing or it completed successfully. Check Signal Monitoring Status
Appy Manchester decoding	

Fig 27. 315 MHz FSK reception settings

5.2 434 MHz TX/RX configuration file (FSK)

Table 6 is an extract from *Data sheet OL2381* for the 434 MHz TX/RX FSK configuration file.

Symbol	Parameter	Conditions	Min	Тур	Max	Unit
S _{RX}	receiver sensitivity	Manchester encoded data rate = 9.6 kbit/s; deviation = 15 kHz; channel filter B = 75 kHz	-106	-109	-	dBm



5.2.1 434 MHz transmission

- Center frequency: 434 MHz
- Data rate: 9.6 kbit/s Manchester coded (symbol rate = 19200 chips/s)
- Modulation type: FSK
- Frequency deviation: 15 kHz

Eile Help	
General Settings Digital I/O Port Control Operational Settings	Status and State Control
Local Oscillator and Clock Settings	Device Mode Transmit 🗸 🗋 PD 📄 RESET 🛛 Read Registers
VC0 band high (V1A) VLPSTer version V1A	Local Oscillator
VCD sub-band 32	Force lock detector always on
PILICE 2	Skip VCO re-calibration Calibrate VCO Now
Cierca della sutarit asia vi (normal ve	Current BF 0 Auto-Detect Current BE Channel
Sigma-deita output gain XI (romina V	Check I 0 status automatically after a Beceive command
LU divider +4 (r < 512 MH V	LO status: After the last I O statup the PI I was locked
RF frequency resolution 244.14 Hz	
Channel A24 000 122 Us Channel 2 250 000 210 Us	Check LO Status
Channel 434,000,122 Hz Channel 2 256,356,216 Hz	Teneralitae
unannei 1 511,000,122 Hz unannei 3 511,003,784 Hz	Transmitter
Chip rate 19,203 chips	Transmit channel 0 🗸
Transmitter Receiver	✓ TX data sampling and PA control synchronized with TX clock
Modulation Control	Shut down the PA when SEN goes low
AMH0 31 Modulation wee 0 FSK 🗸	Transmit Manchester encoded data sampled with TX clock
AMH1 31 Modulation type 1 FSK V	I ransmit power and modulation control selection ACUNU
AML 0	Activate Deactivate
PAM 1 This is the recommended PAM setting.	Check device status automatically after each Transmit command
Invert transmitted data	Check device status automatically after each PAM change
	TX status: Transmitting.
ASK modulation depth 1.00	
Relative ramp duration 0.00 % of chip	Lheck TX Status
0n/Off ramp duration 0.00 % of chip	Receiver
Slew rate Infinitu stens/us	Receive Command
Storristo Inning Stopsrips	Heceive channel U
ESK frequency doubtion	Sub-command DATA
	Gain switch use high gain settings 🛛 👻
FSK modulation index	Send Command
Relative ramp duration 29.8 % of chip BT 2.75	Command status: There either was no command issued recently, it is
Slew rate 1,953.1 Hz / μs	still ongoing or it completed successfully.
Illustrate	Check Signal Monitoring Status
TX synchronization clock source chip rate /	
Transmit chin rate 19 203 chine/s	



5.2.2 434 MHz reception

- Center frequency: 434 MHz
- Data rate: 9.6 kbit/s Manchester coded (symbol rate = 9600 chips/s)
- Modulation type: FSK
- Frequency deviation: 15 kHz
- Channel filter bandwidth: 75 kHz
- OL2381 performed Manchester decoding

Figure 29 is a compilation to enable all the relevant information to be visible on one page.

Eile Help	
General Settings Digital I/O Port Control Operational Settings	Status and State Control
Local Oscillator and Clock Settings	Device Mode Receive 🗸 🗌 PD 🔲 RESET 🛛 Read Registers
VCD bend high (V1A) V Linis is the required setting for	Local Oscillator
VCD sub-band 32	Force lock detector always on
	Skip VCO re-calibration Calibrate VCO Now
	Current BE
Sigma-deita output gain XI (normal V	Check I 0 status automatically after a Receive command
LO divider +4 (r < 512 MH V	Check Lo status automatically after a necesive command
RF frequency resolution 244.14 Hz	Colordada. Some of the Colorada are not properly supplied.
RF Center Frequencies	Check LO Status
Lhannaru 434,000,122 Hz Channel 2 256,996,216 Hz	
Channel 1 511,000,122 Hz Channel 3 511,003,784 Hz	Transmitter
Chip rate 19,203 chips/s	
Transmitter Receiver	▼ TX data sampling and PA control synchronized with TX clock
C Gain Settings	Shut down the PA when SEN goes low
Front-end LNA IF Channel Filter Combined	Transmit Manchester encoded data sampled with TX clock
High gain 25.5 dB V 27 dB V 52.5 dB	Transmit power and modulation control selection
	Activate Deactivate
Channel Filter	Check device status automatically after each Transmit command
Demodulator selection FM	Check device status automatically after each PAM change
Channel filter bandwidth setting 4: 75 kHz	TX status: The device is not in transmit mode.
C Baseband Filter	
Baseband filter corner frequency setting 3: 14.204 kHz 🗸	Lheck TX Status
	Receiver
Slicer and Coding	Heceive Lommand
Edge slicer modulation amplitude threshold 10,317 Hz	Heceive channel
wate up preamble data	Sub-command DATA V
search detection reception	Gain switch use high gain settings 🔽 🖌
slicer selection edge sen 🗸 edge se 🗸 edge se 🗸	Send Command
	Command status: There either was no command issued recently it is
C Data and Clock	still ongoing or it completed successfully.
Invert slicer output	Check Signal Monitoring Status
Apply Manchester decoding	
	010220446

5.3 868 MHz TX/RX configuration file (ASK)

Table 7 is an extract from *Data sheet OL2381* for the 868 MHz TX/RX ASK configuration file.

Table 7.	Table	extract	for	868	MHz
----------	-------	---------	-----	-----	-----

Symbol	Parameter	Conditions	Min	Тур	Max	Unit
S _{RX}	receiver sensitivity	Manchester encoded data rate = 4.8 kbit/s ; channel filter B = 50 kHz .	-	-117	-	dBm



5.3.1 868 MHz transmission

- Center frequency: 868 MHz
- Data rate: 4.8 kbit/s Manchester coded (symbol rate = 9600 chips/s)
- Modulation type: ASK
- Modulation = 100 % (see AMH0 = 31 and AML = 0)

Figure 30 is a compilation to enable all the relevant information to be visible on one page.

STer Config GUI
Help
Ter Config GUI Image: Control Control Operational Setting: Setting: Digital I/O Port Control Operational Setting: VC0 Grad High (V1A) VFST er version V1A. VC1 Grad Setting: Calibrate VCD Nov L0 dridd: Calibrate VCD Nov L0 dridd: Current RF 0 dridd: Current RF 0 dridd: Siz:2000.244 Hz 1 dridd: Control synchronized with TX clock. 1 dridd: Control 1 dridd: Activate 1 dridd: Control 1 dridd: Control 1 dridd: Carenter 1 dridd: Carenter 1 dridd: Control 1 dridd: Control

39 of 44



5.3.2 868 MHz reception

- Center frequency: 868 MHz
- Data rate: 4.8 kbit/s Manchester coded (symbol rate = 9600 chips/s)
- Modulation type: ASK
- Channel filter bandwidth: 50 kHz
- OL2381 performed Manchester decoding

Figure 31 is a compilation to enable all the relevant information to be visible on one page.

Eile Help	
General Settings Digital I/O Port Control Operational Settings	Status and State Control
Local Oscillator and Clock Settings	Device Mode Idle V DPD RESET Read Registers
VCO band high (V1A) VCO ba	Local Oscillator
VCD sub-band 22	Force lock detector always on
PLL ICP 2	Skip VCD re-calibration Gelibrare VCD Novin
Sigma-delta output gain x1 (normal 🗸	Current RF 0 Auto-Detect Current RF Channel
I ∏ divider →2 (f> 512 MH →	Check LO status automatically after a Receive command
DE fragrianau reach tion 490 20 Hz	LO status: The device is in idle mode.
BE Center Frequencies	
Channel 0 868 000 244 Hz Channel 2 512 000 244 Hz	Check LC Status
Channel 1 512 000 244 Hz Channel 3 512 000 244 Hz	Transmitter
	Transmit Command
Chip rate 9,602 chip/s	Transmit channel 0 🐱
Transmitter Receiver	TX data sampling and PA control synchronized with TX clock
Gain Settings	Shut down the PA when SEN goes low
Front end LNA IF Channel Filter Combined	Transmit nower and modulation control selection ACOND
High gain 25.5 dB 👽 27 dB 👽 52.5 dB	
	Activate
Channel Filter	Check device status automatically after each Transmit command
Demodulator selection (AM)	TX status: The device is in idle mode
Channel filter bandwidth setting 5:50 kHz	Try status. The device is influe mode.
Baseband Filter	Check TX Status
Baseband filter corner frequency setting 4: 7.0795 kHz	
	Receiver Beceive Command
Slicer and Coding	Beceive channel 0
wake up preamble data	Sub-command DATA
search detection reception	Gris witch Use high gain settings
slicer selection level sen 👻 level se	
slicer threshold initialisation automati vatomatic intial aquisitio v	Send Command
	Command status: There either was no command issued recently, it is still ongoing or it completed successfully.
Data and Clock	
Invert slicer output	Lineck Signal Monitoring Status
Apply Manchester decoding	

UM10472 User manual

6. Improving RF performance

6.1 Supply voltage noise

The control board of the demo kit board uses the Maxim MAX3221 IC to raise the RS-232 interface output signal voltage up to the required level. To raise the output signal voltage, an internal charge pump working at a frequency of approximately 100 kHz, is used. The 100 kHz frequency is detectable on the board supply voltage.

In the default configuration, the control board supply voltage drives the OL2381. The noise on the supply causes interference on the RF output signal of the power amplifier. The signal shown in Figure 32 is the OL2381 CW output spectrum in the range of \pm 500 kHz.



The interference is visible at a distance from the carrier of n * 94 kHz with n = [-4, -3, -2, -1, 1, 2, 3 and 4].

To avoid interference, and to make precise measurements, it is recommended that a separate source supplies OL2381. To provide a separate supply, open jumper J4 on the control board and connect a power supply to pins VCC and GND on the OL2381 RF board. The adapted supply connections for OL2381 are illustrated in Figure 33.

UM10472 OL2381 Demo kit



Take care to avoid the supply from the ports being reversed when the OL2381 RF board is supplied by a source other than the control board. For this purpose, VCC_Lop must be greater or equal to VCC. In order to achieve the correct port input signal, VCC must be at least 0.8 * VCC_Lop.

For example, if VCC of the control board is set to 2.5 V, the supply voltage of OL2381 (VCC_Lop) must be between 2.5 V and 3.125 V.



Figure 34 depicts the CW output signal when OL2381 is supplied by an external source.

7. Legal information

7.1 Definitions

Draft — The document is a draft version only. The content is still under internal review and subject to formal approval, which may result in modifications or additions. NXP Semiconductors does not give any representations or warranties as to the accuracy or completeness of information included herein and shall have no liability for the consequences of use of such information.

7.2 Disclaimers

Limited warranty and liability — Information in this document is believed to be accurate and reliable. However, NXP Semiconductors does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information.

In no event shall NXP Semiconductors be liable for any indirect, incidental, punitive, special or consequential damages (including - without limitation - lost profits, lost savings, business interruption, costs related to the removal or replacement of any products or rework charges) whether or not such damages are based on tort (including negligence), warranty, breach of contract or any other legal theory.

Notwithstanding any damages that customer might incur for any reason whatsoever, NXP Semiconductors' aggregate and cumulative liability towards customer for the products described herein shall be limited in accordance with the *Terms and conditions of commercial sale* of NXP Semiconductors.

Right to make changes — NXP Semiconductors reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without notice. This document supersedes and replaces all information supplied prior to the publication hereof.

Suitability for use — NXP Semiconductors products are not designed, authorized or warranted to be suitable for use in life support, life-critical or safety-critical systems or equipment, nor in applications where failure or malfunction of an NXP Semiconductors product can reasonably be expected to result in personal injury, death or severe property or environmental damage. NXP Semiconductors accepts no liability for inclusion and/or use of NXP Semiconductors products in such equipment or applications and therefore such inclusion and/or use is at the customer's own risk.

Applications — Applications that are described herein for any of these products are for illustrative purposes only. NXP Semiconductors makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

Customers are responsible for the design and operation of their applications and products using NXP Semiconductors products, and NXP Semiconductors accepts no liability for any assistance with applications or customer product design. It is customer's sole responsibility to determine whether the NXP Semiconductors products product is suitable and fit for the customer's applications and products planned, as well as for the planned application and use of customer's third party customer(s). Customers should provide appropriate design and operating safeguards to minimize the risks associated with their applications and products.

NXP Semiconductors does not accept any liability related to any default, damage, costs or problem which is based on any weakness or default in the customer's applications or products, or the application or use by customer's third party customer(s). Customer is responsible for doing all necessary testing for the customer's applications and products using NXP Semiconductors products in order to avoid a default of the applications and the products or of the application or use by customer's third party customer(s). NXP does not accept any liability in this respect.

Export control — This document as well as the item(s) described herein may be subject to export control regulations. Export might require a prior authorization from competent authorities.

Evaluation products — This product is provided on an "as is" and "with all faults" basis for evaluation purposes only. NXP Semiconductors, its affiliates and their suppliers expressly disclaim all warranties, whether express, implied or statutory, including but not limited to the implied warranties of non-infringement, merchantability and fitness for a particular purpose. The entire risk as to the quality, or arising out of the use or performance, of this product remains with customer.

In no event shall NXP Semiconductors, its affiliates or their suppliers be liable to customer for any special, indirect, consequential, punitive or incidental damages (including without limitation damages for loss of business, business interruption, loss of use, loss of data or information, and the like) arising out the use of or inability to use the product, whether or not based on tort (including negligence), strict liability, breach of contract, breach of warranty or any other theory, even if advised of the possibility of such damages.

Notwithstanding any damages that customer might incur for any reason whatsoever (including without limitation, all damages referenced above and all direct or general damages), the entire liability of NXP Semiconductors, its affiliates and their suppliers and customer's exclusive remedy for all of the foregoing shall be limited to actual damages incurred by customer based on reasonable reliance up to the greater of the amount actually paid by customer for the product or five dollars (US\$5.00). The foregoing limitations, exclusions and disclaimers shall apply to the maximum extent permitted by applicable law, even if any remedy fails of its essential purpose.

Safety of high-voltage evaluation products — The non-insulated high voltages that are present when operating this product, constitute a risk of electric shock, personal injury, death and/or ignition of fire. This product is intended for evaluation purposes only. It shall be operated in a designated test area by personnel that is qualified according to local requirements and labor laws to work with non-insulated mains voltages and high-voltage circuits.

The product does not comply with IEC 60950 based national or regional safety standards. NXP Semiconductors does not accept any liability for damages incurred due to inappropriate use of this product or related to non-insulated high voltages. Any use of this product is at customer's own risk and liability. The customer shall fully indemnify and hold harmless NXP Semiconductors from any liability, damages and claims resulting from the use of the product.

7.3 Trademarks

Notice: All referenced brands, product names, service names and trademarks are the property of their respective owners.

UM10472

OL2381 Demo kit

8. Contents

1	Introduction	3
2	Hardware description	4
2.1	Deliverables	4
2.2	Control board description	4
2.2.1	On-board microcontroller	4
2.2.2	OL2381 RF board interface	4
2.2.3	Jumpers §	5
2.2.4	P89LPC936 Pin configuration	5
2.3	RF board description	5
2.3.1	RF board schematic	7
2.3.2	RF board layout	3
2.3.3	Power supply distribution	J
2.3.4	Pin des sin tion	9
2.3.5) -
3	Demo kit setup 12	2
3.1	Hardware connections 12	2
3.2	OL2381 Graphical User Interface (GUI) 14	1
3.2.1		4
3.2.2	RS-232 port configuration check 14	4
3.2.3		2
3.2.3.1		כ ד
3.2.3.2		/ 0
3.2.3.3	GIII transmitter and receiver parameters 2'	י כ
3241	Transmitter parameters 22	- 2
3242	Receiver parameters 22	2
4	RE measurements using the demo kit 2	5
	Transmission measurement 24	5
 // 1 1	Output power and harmonics	6
4.1.1	Recention measurement 28	R
4.2.1	Sensitivity measurement 30	5
5	Configuration files	2
5 1	315 MHz TX/PX configuration file (ESK) 31	2
511	315 MHz transmission 33	- 3
512	315 MHz reception 34	4
5.2	434 MHz TX/RX configuration file (FSK)	5
5.2.1	434 MHz transmission	6
5.2.2	434 MHz reception 37	7
5.3	868 MHz TX/RX configuration file (ASK) 38	3
5.3.1	868 MHz transmission 39	Э
5.3.2	868 MHz reception 40	С
6	Improving RF performance 4	1
6.1	Supply voltage noise	1
7	Legal information	3
7.1	Definitions 4:	3
7.2	Disclaimers	3

 7.3
 Trademarks
 43

 8
 Contents
 44

Please be aware that important notices concerning this document and the product(s) described herein, have been included in section 'Legal information'.

© NXP B.V. 2011.

All rights reserved.

For more information, please visit: http://www.nxp.com For sales office addresses, please send an email to: salesaddresses@nxp.com

Date of release: 14 December 2011 Document identifier: UM10472