

SX1211-11SKA

User's Guide: Advanced Mode

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1 Introduction

The SX1211 is a single chip transceiver IC designed for operation in the European 868 MHz and U.S. 915 MHz licence free ISM bands. The SX1211 is optimized for very low power consumption (3mA in receiver mode). It incorporates a baseband modem with data rates up to 200 kb/s. Data handling features include a sixty-four byte FIFO, packet handling, automatic CRC generation and data whitening. Its highly integrated architecture allows for minimum external component count whilst maintaining design flexibility. All major RF communication parameters are programmable and most of them may be dynamically set.

The SX1211SKA is a USB evaluation tool designed to allow simple and easy evaluation of the suitability of the SX1211 for a given application. The low component count reference design implemented in the SX1211SKA is shown below:





The SX1211 main features include:

- Low Rx power consumption: 3mA
- Low Tx power consumption: 25 mA @ +10 dBm
- ▶ Good reception sensitivity: down to -107 dBm at 25 kb/s in FSK, -113 dBm at 2kb/s in OOK
- Programmable RF output power: up to +12.5 dBm in 8 steps
- > Packet handling feature with data whitening and automatic CRC generation
- Wide RSSI (Received Signal Strength Indicator) dynamic range, 70dB from Rx noise floor
- Bit rates up to 200 kb/s, NRZ coding
- On-chip frequency synthesizer
- FSK and OOK modulation
- Incoming sync word recognition
- > Built-in Bit-Synchronizer for incoming data and clock synchronization and recovery

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2 Getting Started

2.1 Kit Contents

As illustrated in the figure below, the SX1230-11SKA Evaluation kit is composed of:

- > A pair of SX1211SKA boards
- > SX1211-11SKA CDROM including all necessary PC software and documentation



Figure 2. SX1211SKA Contents

2.2 Installation

SX1211SKA Advanced Mode Software Installation

- 1- Put the CDROM in your computer and browse the contents of the CD.
- 2- Open the "sx1211starterkitsetupweb.exe" manually. It can be found in the \Installers sub directory of the CD-ROM.
- 3- Follow installation guidelines until the process is completed. Please note that .NET Framework 2.0 and the FTDI USB driver will be automatically installed if not detected on your computer.
- 4- Connect the SX1211SKA board to the PC via the USB interface.
- 5- Launch "SX1211SKA" from the Start menu.
- 6- Click on "Connect" button in toolbar or in File menu.
- 7- SX1211SKA is now installed and ready to be used.



2.3 SX1211SKA Overview

The SX1211SKA features the SX1211 reference design (1) and is also interfaced via an FTDI bridge (6) to the USB type 'A' interface (5) of a host PC. Indication of transmission and reception is indicated on a pair of LEDs (4). A Johanson Technologies ceramic antenna is employed (2) and optional provision for an SMA connector (not populated) is provided for laboratory testing.



Figure 3. SX1211SKA Board Picture



3 Quick Start Guide

With the SX1211SKA software installed, follow the sequence below to establish communication between the one SX1211SKA as transmitter and one SX1211SKA as receiver.

3.1 SX1211SKA Quick Start (All Modes)

- 1. Plug the SX1211SKA into the USB port of the computer.
- 2. Run the SX1211 User Interface software Start > All Programs > SX1211SKA > SX1211SKA
- The SX1211SKA should connect automatically to the User Interface Software. If not, then click on the USB connect short-cut button, located in the top left hand corner of the window.



4. Once connected the SX1211SKA shows the default configuration of the SX1211 register settings upon power-up.

5 SX1211 Starter Kit A													
File Help													
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McParam IrqParam RxParam TxParam OscParam Packet Register Addr Value Register Addr Value													
Band:	915-928	- мн	² Target BE frequenc	9150000	00	Hz		RegMcParam1	0x00	0x28	RegRxParam1	0x10	0xA3
VCD trime	- 0			. <u> </u>				RegMcParam2	0x01	0x88	RegRxParam2	0x11	0x38
VCO unin. j		• IIIV			1 (2		RegFDev	0x02	0x03	RegRxParam3	0x12	0x18
Modulation scheme:	• FSK C	OOK	B		119	116		RegBitRate	0x03	0x07	RegRes19	0x13	0x07
OOK thres type:	Peak	•	- [^{***}]					RegOokFloorThres	0x04	0x0C	RegRssiValue	0x14	0x00
Data mode:	Continuous	-	i i i i i i i i i i i i i i i i i i i					RegMcParam6	0x05	0x0F	RegRxParam6	0x15	0x00
IE gains	- 0		P:		100	98		RegR1	0x06	0x77	RegSyncByte1	0x16	0x00
ir yain.								RegP1	0x07	0x64	RegSyncByte2	0x17	0x00
Fdev:	100000	Hz	S:		50	50		RegS1	0x08	0x32	RegSyncByte3	0x18	0x00
Bitrate:	25000	bps						RegR2	0x09	0x74	RegSyncByte4	0x19	0x00
OOK floor thres:	6.0	÷ dB						RegP2	0x0A	0x62	RegTxParam	0x1A	0x72
FIED size:	16	- - bute						RegS2	0x0B	0x32	RegOscParam	0x1B	0xBC
111 0 3120.	10		••					RegParamP	0x0C	0x38	RegPktParam1	0x1C	0x00
FIFO thres:	15	=						ReglrqParam1	0x0D	0x00	RegNodeAddr	0x1D	0x00
PA ramp:	23	• us						ReglrqParam2	0x0E	0x09	RegPktParam3	0x1E	0x48
								RegRssilrqThres	0x0F	0x00	RegPktParam4	0x1F	0x00
General				Rx			Contr	ol					
Band:	915-928	MHz	Passive filter fc:	3780	JO Hz		Оре	rating mode		Registers	config	-RSSI	
RF frequency:	915000000	Hz	Butterworth fc-fo:	Butterworth fc-fo: 100000 Hz			C 01			Write	Γ		
Modulation scheme:	FSK		Polyphase fo: 🗖 100000 Hz			U Sleep					0 🕥		
Frequency Deviation:	uency Deviation: 100000 Hz Tx 6			• •	itandby C Synthes	izer	_	Read		Read			
Bitrate:	25000	bps	Interpolator filter fc:	2000	DO Hz		⊖ F	Receiver C Transmit	tter		Reset		
Operating mode:	STANDBY		Output power:	· · · ·	0 dBm								
	Config File:												

Figure 4. SX1211 User Interface, Default Settings

5. Once connected the SX1211SKA shows the default configuration of the SX1211 register settings upon power-up (as shown in Figure 4).

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6. The settings for communication between transceiver kits are located on the installation CD-ROM provided with the kit. Use the File > Open from the menu bar, or the open short-cut button to load a configuration file.

File	Help
12	-
(THE R	

- 7. Load the "XXX_SX1211_pingpong.cfg" file from the "SX1211 Demo Files" folder on the CD-ROM. Where XXX corresponds to the frequency band of the SX1211SKA (either 868 or 915 MHz).
- 8. The display will then appear as shown in Figure 5.

5 \$X1211 Starter Kit A													
File Help													
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McParam IrqParam RxParam TxParam OscParam Packet Addr Value Register Addr Value													
Band:	902-915	- MHz	Target RF frequence	y; 90	8000000	— на	2	RegMcParam1	0x00	0x60	RegRxParam1	0x10	0xA3
VCD trips:		- -			<i>C</i> .1	~		RegMcParam2	0x01	0x8C	RegRxParam2	0x11	0x38
VCO (IIII.		·				0	2	RegFDev	0x02	0x07	RegRxParam3	0x12	0x18
Modulation scheme:	• FSK C	OOK	B		125		16	RegBitRate	0x03	0x07	RegRes19	0x13	0x07
OOK thres type:	Peak	•			,			RegOokFloorThres	0x04	0x0C	RegRssiValue	0x14	0x22
Data mode:	Packet	-						RegMcParam6	0x05	0xCF	RegRxParam6	0x15	0x00
			P:		104		98	RegR1	0x06	0x7D	RegSyncByte1	0x16	0xAA
IF gain:	lo I						-1	RegP1	0x07	0x68	RegSyncByte2	0x17	0x0A
Fdev:	50000	Hz	s:	— I	70		50	RegS1	0x08	0x46	RegSyncByte3	0x18	0x0B
Bitrate:	25000	bps						RegR2	0x09	0x74	RegSyncByte4	0x19	0x0C
OOK floor thres:	6.0.08	a de						RegP2	0x0A	0x62	RegTxParam	0x1A	0x72
FIED view								RegS2	0x0B	0x32	RegOscParam	0x1B	0xBC
FIFU SIZE:	64		S					RegParamP	0x0C	0x38	RegPktParam1	0x1C	0x02
FIFO thres:	15	-						ReglrqParam1	0x0D	0x08	RegNodeAddr	0x1D	0x00
PA ramp:	23	🕶 us						ReglrqParam2	0x0E	0x1F	RegPktParam3	0x1E	0x60
								RegRssilrqThres	0x0F	0x00	RegPktParam4	0x1F	0xC0
Ge	neral			В×			Cor	itrol					
Band:	902-915	MHz	Passive filter fc:		378000	Hz		erating mode		Registers (config	-RSSI -	
RF frequency:	908000000	Hz	Butterworth fc-fo:		100000	Hz		G a			Write		
Modulation scheme:	FSK		Polyphase fo:		100000	Hz		○ Sleep					34 🕘
Frequency Deviation:	50000	Hz		Тх			0	Standby C Synthes	izer	_	Read		Read
Bitrate:	25000	bps	Interpolator filter fc:		200000	Hz	•	Receiver C Transmi	tter		Reset		
Operating mode:	RECEIVER		Output power:		10	dBm							
						Con	fig File:	915_SX1211_pingpong.cf	g				

Figure 5. The New SX1211 Configuration: Ready to be Written

9. By clicking on the write button in the 'Registers config' section, the new register values are written to the SX1211 registers. If successful, the red values in the hexadecimal register summary table will turn black. As a double check, the register read button may be pressed – the values presented on the user interface should remain unchanged.

Registers config							
	Write						
	Read						
	Reset						



3.2 SX1211SKA Receive Mode Configuration

1. Click on the 'Packet' tab to access the packet testing portion of the program. Within this window a predefined packet structure is already configured. It remains simply to click the 'Reception' radio button and press the Start button. At this point the SX1211SKA enters packet receive mode and is now listening for valid packets. At this juncture another SX1211SKA must be configured as transmitter.

SX1211 Starter Kit	A												_
File Help													
j 🛃 🕪													
tcParam IrqParam F	RxParam TxParam	0scPa	aram Packet					Register	Addr	Value	Register	Addr	Value
Packet configuration								RegMcParam1	0x00	0x60	RegRxParam1	0x10	0xA3
Preamble Sync siz	ze Synctol F	ormat	Address Filter	DC free		CRC		RegMcParam2	0x01	0x8C	RegRxParam2	0x11	0x38
	Fis	ked 🔻	ſ	-	-			RegFDev	0x02	0x07	RegRxParam3	0x12	0x18
4 bytes 💌 4 bytes	🕶 🛛 bit 💌 🗉	.ength	OFF 💌	Manchester		RC		RegBitRate	0x03	0x07	RegRes19	0x13	0x07
		0x02		Whitening		uto Ulear		RegOokFloorThres	0x04	OxOC	RegRssiValue	0x14	0x24
Dealert			1					RegMcParam6	0x05	OxCF	RegRxParam6	0x15	0x00
	-							RegR1	0x06	0x7D	RegSyncByte1	0x16	0xAA
Preamble	Sync I	ength	Address	Message		RC	-111	RegP1	0x07	0x68	RegSyncByte2	0x17	0x0A
55-55-55-55 A4	A-UA-UB-UC							RegS1	0x08	0x46	RegSyncByte3	0x18	0x0B
Message								RegR2	0x09	0x74	RegSyncByte4	0x19	0x0C
	HEXADECIM	۹L		ASCII	l i			RegP2	0x0A	0x62	RegTxParam	0x1A	0x72
00 00						A		RegS2	0x0B	0x32	RegOscParam	0x1B	OxBC
								RegParamP	0x0C	0x38	RegPktParam1	0x1C	0x02
						Ψ.		ReglrqParam1	0x0D	0x08	RegNodeAddr	0x1D	0x00
					. г			ReglrqParam2	0x0E	0x1F	RegPktParam3	0x1E	0x60
) Transmition 🤨 He	ception S	top		Hx pack	.ets:		<u> </u>	RegRssilrqThres	0x0F	0x00	RegPktParam4	0x1F	0xC0
Ge	neral	'		Bx		r	- Conl	rol					
and:	902-915	MHz	Passive filter fc:	378	8000	Hz	с Ов	erating mode		Benisters r	onfia	- BSSI	
F frequency:	90800000	Hz	Butterworth fc-fo:	100	0000	Hz) u (rito		
odulation scheme:	FSK		Polyphase fo:	100	0000	Hz		C Sleep			wille		22 🕘
Trequency Deviation: 50000 Hz Tx C 3trate: 25000 bps Interpolator filter fc: 200000 Hz G		0	Standby O Synthesizer Read Receiver O Transmitter Reset					Read					
		6						reau					
Iperating mode:	RECEIVER		Output power:		10	dBm							
						I Confid	File: 1	915_SX1211_pingpong.cf	3				

Figure 6. The SX1211SKA User Interface whilst in Packet Receiver Mode



3.3 SX1211SKA Transmit Mode Configuration

- 1. Repeat steps 1 to 9 of Section 3.1 with the second SX1211SKA provided in the kit. Then click on the 'Packet' tab.
- 2. The packet test display is preconfigured in transmit mode with a valid payload (see *Figure 7*). The 'Repeat value' may be edited according to the number of packets desired to be transmitted (leave equal to zero for continuous transmission).
- 3. Press the Start button. Packets will start to be sent, the 'Tx Packets' display indicating the number of packets sent.
- 4. The successful reception of packets will be indicated in the 'Rx packets' window of the receiver SX1211SKA.

5 \$X1211 Starter Kit A														
File Help														
McParam IrqParam										Value	Register	Addr	Value	
Packet configuration	n		I					RegMcParam1	0x00	0x60	RegRxParam1	0x10	0xA3	
Preamble Sync	size Sync tol F	ormat	Address Field	DC free	CR	С		RegMcParam2	0x01	0x8C	RegRxParam2	0x11	0x38	
	Fixed T Manakastar C CPC					RegFDev	0x02	0x07	RegRxParam3	0x12	0x18			
4 bytes 💌 4 bytes	: 🔽 🛛 bit 💌 Le	ength	Add in Payload	Whitening	one			RegBitRate	0x03	0x07	RegRes19	0x13	0x07	
		0x02		of writtening				RegOokFloorThres	0x04	0x0C	RegRssi¥alue	0x14	0x21	
- Paakat			· ·	'				RegMcParam6	0x05	0xCF	RegRxParam6	0x15	0x00	
								RegR1	0x06	0x7D	RegSyncByte1	0x16	0xAA	
Preamble	Sync L	ength	Address	Message	CH	Ľ	-11	RegP1	0x07	0x68	RegSyncByte2	0x17	0x0A	
55-55-55	AA-UA-UB-UC							RegS1	0x08	0x46	RegSyncByte3	0x18	0x0B	
Message								RegR2	0x09	0x74	RegSyncByte4	0x19	0x0C	
	HEXADECIMA	L		ASCII				RegP2	0x0A	0x62	RegTxParam	0x1A	0x72	
48 49				HI		-		RegS2	0x0B	0x32	RegOscParam	0x1B	0xBC	
								RegParamP	0x0C	0x38	RegPktParam1	0x1C	0x02	
						-		RegirqParam1	0x0D	0x08	RegNodeAddr	0x1D	0x00	
		1			_			ReglrqParam2	0x0E	0x1F	RegPktParam3	0x1E	0x60	
 Transmition C F 	ReceptionSta	art	Repeat value:	U Tx Packets		1		RegRssilrqThres	0x0F	0x00	RegPktParam4	0x1F	0xC0	
6	eneral			Bx	-		- Cont	rol						4
Band:	902-915	MHz	Passive filter fc:	37800	ю на	z	_ 0.s	arating mode		Begisters	config			
RF frequency:	BE frequency: 90800000 Hz Butterworth fc-fo: 100000 Hz			srading mode		registers		H331						
Modulation scheme:	Modulation scheme: FSK Polyphase for 100000 Hz			C Sleep		_	Write		0 😐					
Frequency Deviation: 50000 Hz Tx		0	Standby C Synthesi	zer		Read								
Bitrate:	Bitrate: 25000 bps Interpolator filter fc; 200000 Hz		\bullet	Receiver C Transmit	ter	Ē	Becet		fead					
Operating mode:	RECEIVER		Output power:	1	IO de	3m					Tieset			
المراجع														

Figure 7. The SX1211SKA User Interface Ready to Transmit the Demonstration Packet



4 SX1211SXA Software Description

4.1 Overview

Figure 8 shows the SX1211SKA graphical user interface. Each of the numbers surrounding the display corresponds to the Chapter within this section which corresponds to the description of that GUI feature.



Figure 8. SX1211SKA GUI Overview and References to the User Guide Description of this Chapter

4.2 File Menu

File	Help
	Disconnect
	Open Config Save Config Save Config As
	Exit

File menu contains some general purpose functions. Some of them can also be accessed on the toolbar by clicking directly on the icon. The first feature in the list provides the possibility of connecting or disconnecting to the USB kit. Care must be taken to ensure that the USB port is closed before removing the USB kit. This functionality may also be accessed through the short cut buttons (see Section 4.3).

The possibility of opening configuration files and saving the present configuration is also provided. This is done through a standard Windows file dialog box.

The Help menu contains two menu items. The first item provides a link to this user guide in PDF format. The second, About SX1230 Starter kit..., gives information in the revision of the software installed.

File	Help	
i 💕 🕻		User's Guide
Gene	Z	About SX1230 Starter Kit

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4.3 Shortcut Buttons

The shortcut buttons provide identical functionality to those listed under the file menu



The configuration file open shortcut button. This opens a windows file dialog box to allow access to previously saved SX1211 register configuration files.



The save configuration file shortcut button immediately saves and overwrites the existing configuration file.



The connect / disconnect button allows the user to manage manually connection and disconnection of the kit. Note that any time the SX1211SKA is to be removed from the system; the kit must first be disconnected.

The saved configuration files are designed to be a useful tool for embedded software development. The file can be opened in any text editor to display the programmed register name, address and hexadecimal value programmed to that address.

📕 868_5X1211_pingpong.cfg	- Notepad		
<u>File E</u> dit F <u>o</u> rmat <u>V</u> iew <u>H</u> elp			
#Register Name	Address[Hex]	Value[Hex]	*
RegMcParam1	0×00	0x70	_
RegMcParam2	0×01	0×8C	
RegFDev	0×02	0×07	
ReqBitRate	0×03	0×07	
RegookFloorThres	0×04	0×0C	
RegMcParam6	0×05	0xcf	
RegR1	0×06	0x7D	
RegP1	0×07	0×64	
RegS1	0×08	0×14	
RegR2	0×09	0x74	
RegP2	0×0A	0x62	
RegS2	0×0B	0x32	
RegParamP	0×0C	0×38	
RegIrqParam1	0×0D	0×08	
RegIrqParam2	0×0E	0×1F	
RegRssiIrqThres	0x0F	0×00	
RegRxParam1	0×10	0xa3	
RegRxParam2	0×11	0x38	
RegRxParam3	0x12	0×18	
RegRes19	0x13	0×07	
RegRssiValue	0×14	0×18	
RegRxParam6	0×15	0×00	
RegSyncByte1	0x16	0xaa	
RegSyncByte2	0x17	0X0A	
RegSyncByte3	0×18	0×0B	
RegSyncByte4	0x19	0×0C	
RegTxParam	0x1A	0x72	
RegOscParam	0×18	0×BC	
RegPktParam1	0×1C	0×02	
RegNodeAddr	0×1D	0×00	
RegPktParam3	0×1E	0×60	
RegPktParam4	0×1F	px⊂o	
РКТ	True;False;2;0);48,49	
			-

Figure 9. Example Text Editor Output of the SX1211 Configuration File

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4.4 Text Field Conventions for the SX1211SKA

RF frequency:	915000001 Hz
RF frequency:	1915000000 Hz

An orange background highlight indicates that the precise value entered into the data entry field is not directly addressable by the SX1211. Instead the closest (rounded) value will be used.

Conversely a red background highlight indicates where the maximum or minimum value for that register parameter has been exceeded.

4.5 McParam Tab

Band Selection

Band:	915-928	MH2

One of the three operating bands for the SX1211 may be selected here. The SX1211SKA hardware is band specific and so the corresponding band should be selected.

VCO Voltage Trim

VCO trim:	0	▼ mV

In some designs the VCO voltage requires trimming. The SX1211SKA reference design does not require this function, but is included here for completeness.

Modulation Selection

Modulation scheme:	Θ	FSK	○ 00K	
--------------------	---	-----	-------	--

The SX1211 is capable of both FSK and OOK modulation, they are selectable through the user interface by clicking with the mouse on the appropriate radio button.

OOK Receiver Detection Type



Several modes of OOK detection are possible, please see the SX1211 datasheet for mode information on configuring the OOK receiver.

Data Mode

Data mode:	Continuous	•	

Three data modes are available for the SX1211, typically packet mode is selected automatically, requiring no user selection, upon launching the Packet Test (see Section 4.13).

Gain of the IF Stage

IF gain:	0	💌 dB	
----------	---	------	--

The gain of the intermediate frequency amplifier chain can be adjusted manually.



Frequency Deviation

Fdev:	100000	Hz

Text entry field for the frequency deviation when using FSK modulation.

Bit Rate

Bitrate:

25000 bps

The bit rate of the transmitted signal (in bps) can be directly edited in this data entry field.

Floor Threshold for OOK Detection

OOK floor thres: 6.0) 📑 dB
----------------------	--------

Margin to the OOK demodulation threshold – see SX1211 datasheet for more details.

FIFO Settings

FIFO size:	16	•	bytes
FIFO thres:	15	÷	

Both the working size of the FIFO and the number of bytes it must store before generating a hardware interrupt are user defined. Again this functionality is largely automated in the packet test mode (Section 4.13).

PA Ramping

Frequency of Operation

PA ramp:	23	•	us

The PA ramp rise time is selectable from the list of programmable values.

915000000 Target RF frequency: Ηz ① 1 O 2 1 1 1 1 116 R: 119 1 I I I, I I I I I P: 100 98 . . . 🚽 1 1 1 50 50 S:

The frequency of operation of the SX1211 is a set by three frequency divider ratios (see Figure 10). Based upon the frequency of the crystal oscillator and the values of these divider ratios the local oscillator frequency may be determined.

To simplify this process, the SX1211SKA user interface sees this process completely automated. By entering the desired operating frequency in the text field at the top of the display, the resultant R, P and S divider ratios are calculated (see the SX1211 datasheet for information on their calculation).





Figure 10. SX1211 Local Oscillator Generation

4.6 Overview Panel

A summary of the values presently entered into the user interface software is shown in the overview display at the bottom of the screen. This is sub-divided into three sections pertaining to: general configuration, transmitter settings and receiver parameters.

G	General Rx		Rx		
Band:	915-928	MHz	Passive filter fc:	378000	Hz
RF frequency:	915000000	Hz	Butterworth fc-fo:	100000	Hz
Modulation scheme:	FSK		Polyphase fo:	100000	Hz
Frequency Deviation:	100000	Hz		Тх	
Bitrate:	25000	bps	Interpolator filter fc:	200000	Hz
Operating mode:	STANDBY		Output power:	10	dBm

Figure 11. The Overview Panel

4.7 Register Hexadecimal Display

Figure 12 shows the register summary of the SX1211. In addition to manual user entry in the fields described in the previous section, direct hexadecimal entries may be made into the register display. Note that values yet to be written to the SX1211 registers appear in red. Note, also, that for full control flexibility, incorrect (red) values entered in the hexadecimal section *will still be written* in the event of a register 'write'. So care must be exercised when editing the hexadecimal values.

Register	Addr	Value	Register	Addr	Value
RegMcParam1	0x00	0x28	RegRxParam1	0x10	0xA3
RegMcParam2	0x01	0x88	RegRxParam2	0x11	0x38
RegFDev	0x02	0x03	RegRxParam3	0x12	0x18
RegBitRate	0x03	0x07	RegRes19	0x13	0x07
RegOokFloorThres	0x04	0x0C	RegRssiValue	0x14	0x00
RegMcParam6	0x05	0x0F	RegRxParam6	0x15	0x00
RegR1	0x06	0x8F	RegSyncByte1	0x16	0x00
RegP1	0x07	0x79	RegSyncByte2	0x17	0x00
RegS1	0x08	0x14	RegSyncByte3	0x18	0x00
RegR2	0x09	0x74	RegSyncByte4	0x19	0x00
RegP2	0x0A	0x62	RegTxParam	0x1A	0x72
RegS2	0x0B	0x32	RegOscParam	0x1B	0xBC
RegParamP	0x0C	0x38	RegPktParam1	0x1C	0x00
ReglrqParam1	0x0D	0x00	RegNodeAddr	0x1D	0x00
ReglrqParam2	0x0E	0x09	RegPktParam3	0x1E	0x48
RegRssilrqThres	0x0F	0x00	RegPktParam4	0x1F	0x00

Figure 12. The Hexadecimal Register Display Summary

4.8 The Mode Control Box

The mode control box is sub-divided into three sections. The first 'Operating mode' allows the user to change the operating mode of the SX1211 by clicking on the radio button corresponding to the desired mode. Note that the transition between modes is instantaneous. The centre section, 'Registers config' allows the register settings entered elsewhere in the user interface to be written to the configuration registers of the SX1211 by clicking the write button. The read operation will read the configuration registers and refresh the user interface display with the values read from the SX1211.

Control		
Operating mode	Registers config	RSSI
C Sleep	Write	
💿 Standby 💿 Synthesizer	Read	Bead
C Receiver C Transmitter	Reset	

Figure 13. The Mode Control Box also Incorporates RSSI

The third, rightmost, section of the mode control box allows an instantaneous RSSI (received signal strength indicator) measurement. Please note that this feature is only accessible when the SX1211 is in the receiver operating mode.



4.9 The IrqParam Tab

McParam IrqParam RxParam TxParam OscParam Packet							
Rx Standby IRQ_0:	Sync 💌	PLL lock on pin 23:	⊙ Yes ◯ No				
Rx Standby IRQ_1:	DCLK 💌	RSSI Irq Threshold:	0				
TxIRQ_1:	DCLK						
FIFO full:	9						
FIFO empty:	۲						
FIFO overrun:	Clear						
FIFO fill method:	🖲 Auto 🔿 Manual						
FIFO fill:	Clear						
Tx done:							
Tx Start IRQ_0:	© FIFO Threshold C	FIFO Not empty					
RSSI Irq:	Clear						
PLL lock:	Clear						

Figure 14. The Interrupt Mapping Display

For total register coverage by the user interface, the interrupt mapping for the SX1211 can be controlled through the configuration of the IrqParam display. Note, however, that the hardware interrupt feature is not used directly by the GUI. For further information please see the corresponding register descriptions in the SX1211 datasheet and the PCB layout and schematics of Section 5.

4.10 The RxParam Tab

The receiver parameter field provides full access to all of the software configurable settings of the SX1211. For reference, a simplified block schematic of the SX1211 receiver is shown in figure Figure 15. The settings configurable in the receiver parameter tab correspond to the programmable baseband receiver functions.



Figure 15. SX1211 Receiver Block Diagram, the Colours Correspond to the Frequency of Operation.



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McParam IrqParam RxPa	ram TxParam OscParam Packet
Rx passive filter [fc]:	378000 THz
Rx butterworth filter [fc-fo]:	100000 • Hz
Rx polyphase filter [fo]:	100000 • Hz
Polyphase filter:	O ON O OFF
Bit synchronizer:	ON O OFF Sync word
Sync word recognition:	O ON OFF Sync word size [1-4]:
Sync word tolerance:	0 error Byte[1] Byte[2] Byte[3] Byte[4]
RSSI Value:	0 0x00 0x00 0x00 0x00
OOK threshold step:	0.5 • dB
OOK threshold dec period:	1 per chip 💌 periods
OOK avg threshold cutoff:	Bitrate / 8*PI

Figure 16. Receiver Parameter Display

For a complete description of the functionality of the receiver section please consult the SX121 datasheet. However, the principle fields of interest for general use are:

Rx Filters:

The first three text entry fields of the receiver parameters correspond to the baseband filtering section. Note that the Butterworth filter is the narrowest of the three filters and determines the receiver channel bandwidth.

Bit Synchroniser:

This block performs timing recovery and synchronises the decision on whether a given bit is logical high or low based upon the received bit stream. This block yields a substantial improvement in receiver sensitivity performance and it is hence recommended that it be left enabled.

Sync Word:

The synchronisation word is applicable to operation in buffered and packet modes. For packet mode operation the sync word is set using the packet editor – this may be found in the 'Packet' Tab (Section 4.13). Link testing by the SX1211SKA is done in packet mode only – sync word provision is made here for completeness.

OOK Settings:

OOK demodulation is based upon measurements from the RSSI block and there are a rich variety of settings for how the OOK signal is detected and processed. These techniques and the corresponding settings are given a detailed treatment in the SX1211 datasheet.



4.11 The TxParam Tab

The transmitter configuration of the SX1211 is shown in Figure 17. This shows that the modulating signal is generated by direct digital synthesis (DDS), unconverted through the superheterodyne mixer stages and then amplified by a power amplifier chain.



Figure 17. SX1211 Simplified Transmitter Block Schematic Diagram

McParam IrqParam	xParam TxParam OscParam Packet
Tx interpolator filter:	200000 V Hz
Output power:	10 dB

Figure 18. The Transmitter Parameter Tab Display

The two parameters which are configurable for transmit operation of the SX121 are:

Output Power:

The output power of the SX1211 can be programmed in 3 dB steps. Valid programmable powers are selected from a drop-down list of valid values.

Interpolation Filter Setting:

The DDS output requires filtering to remove the spurii common in the generation of signals through this technique; this is performed by the interpolation filters. The cut-off frequency of the interpolation filters can be selected from the drop down menu of valid values. The technique for calculating the cut-off frequency may be found in the SX1211 datasheet.



4.12 The OscParam Tab

McParam IrgParam RxF	Param TxParam OscParam Packet
XTAL frequency:	12800000 Hz
CLK out:	• ON O OFF
CLK out frequency:	426666 Hz

Figure 19. The Oscillator Parameter Display

The oscillator parameter display gives access to the clock output functionality. This can be enabled or disabled and the frequency changed by entering a value in the 'CLK out frequency' text field. Note also that there is provision to change the frequency of the crystal. Changing of the crystal frequency has a knock on effect on all parameters that are a function of the reference frequency, for example bit rate, filter settings, RF output frequency. The SX1211SKA is fitted with the 12.8 MHz crystal recommended in the SX1211 reference design. For this reason the crystal value should, typically, be left unchanged.

4.13 The Packet Test Tab

The 'Packet' tab is the principle interface for conducting transmission or reception testing. The display, as shown in Figure 18 is divided into three horizontal portions. The top portion of the display is given to the packet editor. Here the configuration of the packet, either to be transmitted or received by the SX1211SKA is constructed.

The packet layout contains all of the features described in the SX1211 datasheet. This includes:

Preamble

This input allows the user enable and set the length of a pulse train preamble (sent at the data rate).

Sync word size

A custom syncronisation word of up to 4 bytes may also be added.

Sync tol

The number of errors which may be accommodated in the sync word (bits), before the packet is rejected.

Format / Length / Address

Fixed or variable length packets may also be stipulated (see the SX1211 datasheet for more information), as may an optional 1 byte address.

Digital Coding

Optional channel coding including CRC, data whitening and Manchester coding are also available.

With these options entered the constructed packet is shown in the 'Packet' frame. Where the SX1211SKA is to be used in transmit mode, the packet payload may also be edited in either ASCII or hexadecimal. Packet transmission is enabled by selecting the 'Transmission' radio button. This starts when the 'Start' button is pressed. Either infinite transmission (repeat value = 0) or a finite number of packets may be transmitted by editing the repeat value.

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McParam IrqParam RxParam TxParam OscParam Packet								
Packet conf	iguration	Curra hal	F1	Address Field	DC (CDC		
4 bytes 💌	4 bytes 💌	0 bit 💌	Format Address Field Fixed Length Add in Payload 0x02		Manchester			
Packet								
Preambl	e S	ync	Length	Address	Message	CRC		
55-55-55-5	5 00-0	0-00-00						
- Message -								
message		HEXADEC	IMAL		ASCII			
48 49					HI			
Transmition O Reception Start Repeat value: 0 Tx Packets: 3								

Figure 20. The Packet Receiver / Transmitter Test Display

For receive mode, the normal mode of operation in conjunction with the SX1230SKA, the reception the 'Reception' radio button is selected and the start button pressed. From this moment the SX1211 is placed in receive mode and listens continuously for a packet corresponding to the format entered in the packet editor. Upon successful reception, the payload received is shown in the 'Message Box' and the number of received packets is incremented. For indication of the signal strength received by the SX1211SKA, the RSSI display (see Section 4.8) is activated and continuously refreshed.

By way of example, Figure 21 shows the entire user interface display whilst receiving a valid packet payload.

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5 SX1211 Starter Kit A

File Help												
🎽 📕 I 🗣												
McParam IrqParam RxParam TxParam OscParam Packet						Register	Addr	Value	Register	Addr	Value	
Packet configuration	n						RegMcParam1	0x00	0x60	RegRxParam1	0x10	0xA3
Preamble Sync size Sync tol Format Address Filter DC free CRC						RegMcParam2	0x01	0x8C	RegRxParam2	0x11	0x38	
	Fixe	ed 🔻			_		RegFDev	0x02	0x07	RegRxParam3	0x12	0x18
4 bytes 4 bytes 0 bit Length OFF Grand CRC			RegBitRate	0x03	0x07	RegRes19	0x13	0x07				
0x02				RegOokFloorThres	0x04	0x0C	RegRssiValue	0x14	Ox1A			
D. J. J.	I F		11	I			RegMcParam6	0x05	0xCF	RegRxParam6	0x15	0x00
Packet					RegR1	0x06	0x7D	RegSyncByte1	0x16	OxAA .		
Preamble	Sync L	ength	Address	Message	CRC		RegP1	0x07	0x68	RegSyncByte2	0x17	OxQA
55-55-55	AA-UA-UB-UC						RegS1	0x08	0x46	RegSyncByte3	0x18	OxOB
Message						_	RegR2	0x09	0x74	RegSyncByte4	0x19	OxOC
HEXADECIMAL ASCII						RegP2	0x0A	0x62	RegTxParam	0x1A	0x72	
48 49 HI						RegS2	0x0B	0x32	RegOscParam	0x1B	OxBC	
							RegParamP	0x0C	0x38	RegPktParam1	0x1C	0x02
						–	ReglrqParam1	0x0D	0x08	RegNodeAddr	0x1D	0x00
						100	ReglrqParam2	0x0E	Ox1F	RegPktParam3	0x1E	0x60
€ Fransmittion ® F	Heception 5th	pp		Hx packet:	s:	128	RegRssilrqThres	0x0F	0x00	RegPktParam4	0x1F	OxCO
G	ieneral	·		Bx	1		ntrol					
Band:	902-915	MHz	Passive filter fc:	3780	00 Hz		perating mode		Registers (confia	- BSSI —	
RF frequency:	908000000	Hz	Butterworth fc-fo:	1000	00 Hz		-			Write		
Modulation scheme:	FSK		Polyphase fo:	1000	00 Hz		C Sleep		_	W IIICS	1	32 🕘
Frequency Deviation:	50000	Hz		Тх		C	Standby C Synthe	sizer	_	Read		Bead
Bitrate:	25000	bps	Interpolator filter fc:	2000	00 Hz	Hz Receiver C Transmitter Reset						
Operating mode:	RECEIVER		Output power:		10 dB	dBm /						
					L	onfia File	: 915 SX1211 pinapona.cl	a				
								-				

Figure 21. Software Display: Successful Packet Mode Reception

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5 Schematics and 2-Layer PCB Layout: SX1211SKA



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6 References

> [1] SX1211 Datasheet



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