

SX1230-11SKA

User's Guide: Advanced Mode



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1 Introduction

The SX1230 is a single chip transmitter IC designed for operation in the licence free ISM bands between 290 and 1020 MHz. The SX1230 is capable of operation either with or without an external companion microcontroller and features four internally de-bounced digital input pins to enable direct connection to switchgear for wireless remote control applications. Examples of both types of applications are shown below:

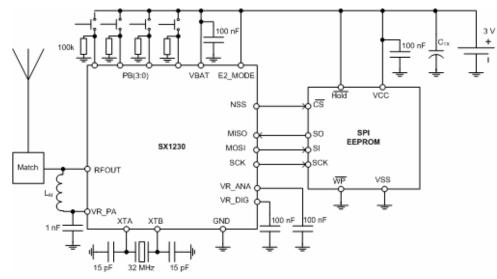


Figure 1. SX1230 Stand Alone Operation with Companion E²PROM

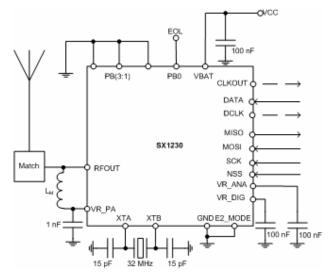


Figure 2. SX1230 Connections for Microcontroller Based Operation

The SX1230 main features include:

- > +17 dBm to -18 dBm Programmable output power
- > 1.8 to 3.7V Operating range with internal voltage regulation allowing constant RF performance
- Narrow and wide-band operation
- > (G)FSK, (G)MSK and both filtered and unfiltered OOK operation.
- Support of bit rates from 1.2 to 600 kbps.
- Low battery detection
- Integrated RC timer for timer / wake-up applications
- Low phase noise -95 dBc/Hz at 50 kHz offset.
- -40°C to +85°C Temperature Range



2 Getting Started

2.1 Kit Contents

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

- SX1230SKA board
- SX1211SKA board
- > SX1230-11SKA CDROM including all necessary PC software and documentation
- A CR2032 Cell for operation of the SX1230SKA in stand alone mode, in conjunction with the companion E²PROM.



Figure 3: SX1230-11SKA Contents (CR2032 Cell not Shown)

2.2 Installation

The software for the SX1211SKA and SX1230SKA must each be installed individually. The installation process for each is identical.

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.

SX1230SKA Advanced Mode Software Installation

- 8- Put the CDROM in your computer and browse the contents of the CD.
- 9- Open the "sx1230starterkitsetupweb.exe" manually. It can be found in the \Installers sub directory of the CD-ROM.
- 10- 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.
- 11- Connect the SX1230SKA board to the PC via the USB interface.
- 12- Launch "SX1230SKA" from the Start menu.
- 13- Click on "Connect" button in toolbar or in File menu.
- 14- SX1230SKA is now installed and ready to be used.



3 Hardware Description

SX1230SKA and SX1211SKA boards are summarised in this chapter. Please refer to the schematics and layout provided in the document for further information about each hardware implementation.

3.1 SX1230SKA Overview

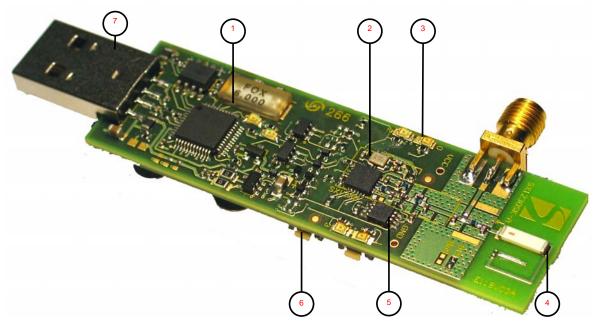


Figure 4: SX1230SKA, 868 and 915 MHz Band, Board Picture

The SX1230SKA is a USB based evaluation tool, which sees the SX1230 reference design (2) connected to a host PC via an FTDI USB to SPI bridge (1) and USB type 'A' connection (7). The SX1230SKA can also operate with in stand alone mode when battery powered. In this mode the initial configuration of the radio is downloaded from the first 77 bytes of the companion E^2PROM (5). In response to a user push button input (6) a specific payload may be transmitted. The LED (3) corresponding to that button press illuminates to indicate transmission.

For operation in the 868 MHz and 915 MHz bands the RF link between SX1230SKA and SX1211SKA is established through a ceramic antenna to give a realistic impression of the range and other performances attainable in a miniaturised application.

3.2 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. Unlike the SX1230SKA, it has no provision for operation disconnected form the USB port. Indication of transmission and reception is indicated on a pair of LEDs (4). The same type of ceramic antenna is employed (2) and optional provision for an SMA connector (not populated) is provided for laboratory testing.

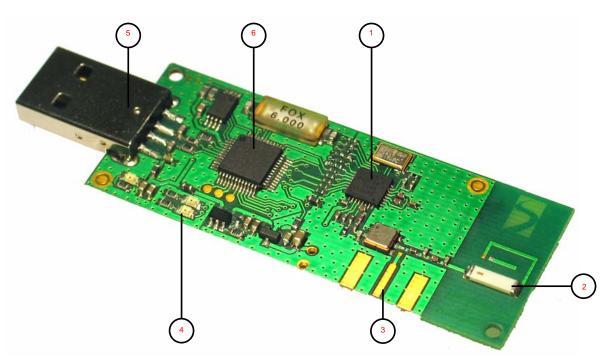


Figure 5: SX1211SKA Board Picture



4 Quick Start Guide: MCU Mode

With both SX1230SKA and SX1211SKA software installed, follow the sequence below to establish communication between the SX1230 as transmitter and the SX1211 as receiver.

4.1 SX1211SKA Quick Start

- 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.



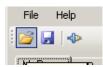
4. Once connected the SX1211SKA shows the default configuration of the SX1211 register settings upon power-up.

5 SX1211 Starter Kit A														_ 🗆 X
File Help														
i 💕 🛃 🐟														
McParam IrgParam R	Param TxParam	OscPa	ram Pac	ket					Register	Addr	Value	Register	Addr	Value
Band:	915-928	MH:	Hz Target RF frequency: 915000000 Hz					RegMcParam1	0x00	0x28	RegRxParam1	0x10	0xA3	
VCO trim:	0	_ ∙TmV			· 1	-	0		RegMcParam2	0x01	0x88	RegRxParam2	0x11	0x38
	-					0.1	0:	2	RegFDev	0x02	0x03	RegRxParam3	0x12	0x18
Modulation scheme:	● FSK C	OOK	B:			119	1	16	RegBitRate	0x03	0x07	RegRes19	0x13	0x07
OOK thres type:	Peak	•							RegOokFloorThres	0x04	0x0C	RegRssiValue	0x14	0x00
Data mode:	Continuous	-		1114	1.1.1.1	100		_	RegMcParam6	0x05	0x0F	RegRxParam6	0x15	0x00
IF gain:	0	- 	P:			100		38	RegR1	0x06	0x77	RegSyncByte1	0x16	0x00
-				1					RegP1	0x07	0x64	RegSyncByte2	0x17	0x00
Fdev:	100000	Hz	S:			50		50	RegS1	0x08	0x32	RegSyncByte3	0x18	0x00
Bitrate:	25000	bps	ps				-	RegR2	0x09	0x74	RegSyncByte4	0x19	0x00	
OOK floor thres:	6.0	÷ dB							RegP2	0x0A	0x62	RegTxParam	0x1A	0x72
FIFO size:	16	- byte							RegS2	0x0B	0x32	RegOscParam	0x1B	0xBC
									RegParamP	0x0C	0x38	RegPktParam1	0x1C	0x00
FIFO thres:		3							ReglrqParam1	0x0D	0x00	RegNodeAddr	0x1D	0x00
PA ramp:	23	• us							ReglrqParam2	0x0E	0x09	RegPktParam3	0x1E	0x48
									RegRssilrqThres	0x0F	0x00	RegPktParam4	0x1F	0x00
Gen	eral				Bx			Cor	ntrol					
Band:	915-928	MHz	Passive			378000	Hz		perating mode		Registers	config	RSSI	
RF frequency:						C Sleep			Write	┌	_			
Modulation scheme:					0.000					0 🕥				
Frequency Deviation:							© Standby © Synthesizer Read Read							
Bitrate:	25000						C Receiver C Transmitter Reset							
Operating mode:	STANDBY		Output p	iower:		10	dBm							
-							Confi	ig File:	-					.::

Figure 6. 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 6*).

6. The settings for communication between SX1211SKA and SX1230 SKA 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.



- 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 7*. These are the link parameters which match those which will be programmed to the SX1230SKA.

5 SX1211 Starter Kit A													>
File Help													
🖻 🛃 🐟													
McParam IrqParam Rx	Param TxParam	OscPa	ram Packet					Register	Addr	Value	Register	Addr	Value
Band:	Band: 902-915 MHz Target RF frequency: 908000000 Hz								0x00	0x60	RegRxParam1	0x10	0xA3
VCO trim:	0	_ ▼ mV	- augustin medianity.					RegMcParam2	0x01	0x8C	RegRxParam2	0x11	0x38
		_			• 1	0	2	RegFDev	0x02	0x07	RegRxParam3	0x12	0x18
Modulation scheme:	● FSK C	00K	B:	· · · · ·	125	-	116	RegBitRate	0x03	0x07	RegRes19	0x13	0x07
OOK thres type:	Peak	•	- <u></u>					RegOokFloorThres	0x04	0x0C	RegRssi¥alue	0x14	0x22
Data mode:	Packet	•			104			RegMcParam6	0x05	0xCF	RegRxParam6	0x15	0x00
IF gain:	0	- - dB	P:		104	1	98	RegR1	0x06	0x7D	RegSyncByte1	0x16	0xAA
-			- <u> </u>					RegP1	0x07	0x68	RegSyncByte2	0x17	A0x0
Fdev:	50000	Hz	s:		70		50	RegS1	0x08	0x46	RegSyncByte3	0x18	0x0B
Bitrate:	25000	bps						RegR2	0x09	0x74	RegSyncByte4	0x19	0x0C
OOK floor thres:	6.0	÷ dB						RegP2	0x0A	0x62	RegTxParam	0x1A	0x72
FIFO size:		- - − byte						RegS2	0x0B	0x32	RegOscParam	0x1B	0xBC
	-		~					RegParamP	0x0C	0x38	RegPktParam1	0x1C	0x02
FIFO thres:		=						ReglrqParam1	0x0D	0x08	RegNodeAddr	0x1D	0x00
PA ramp:	23	🕶 us						ReglrqParam2	0x0E	0x1F	RegPktParam3	0x1E	0x60
								RegRssilrqThres	0x0F	0x00	RegPktParam4	0x1F	0xC0
Gene	eral			В×] _ Con	rol					
Band:	902-915	MHz	Passive filter fc:	3	878000	Hz	Op	erating mode		Registers (config	-RSSI -	
RF frequency:	908000000	Hz	Butterworth fc-fo:	1	00000	Hz		C N			Write	□	
Modulation scheme:	FSK		Polyphase fo:	Polyphase fo: 🗖 100000 Hz				C Sleep					34 🎱
Frequency Deviation:	50000	Hz		Т×			C Standby C Synthesizer Read						Read
Bitrate:	25000	bps	Interpolator filter fc:	2	200000								
Operating mode:	RECEIVER		Output power:		10	dBm				_			
-						Con	fig File:	915_SX1211_pingpong.cf	g				

Figure 7. 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.

Register	s config	
	Write	
	Read	
	Reset	

10. Click on the 'Packet' tab to access the packet testing portion of the program. Within this window a pre-defined 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 the SX1230SKA transmitter must be configured.

ECH

File Help													
McParam IrqParam	RxParam TxParar	n OscPa	ram Packet					Register	Addr	Value	Register	Addr	Value
- Packet configuration							-1	RegMcParam1	0x00	0x60	RegRxParam1	0x10	0xA3
Preamble Sync s	ze Sync tol	Format	Address Filter	DC free		CRC		RegMcParam2	0x01	0x8C	RegRxParam2	0x11	0x38
	Fi	xed 🔻			-			RegFDev	0x02	0x07	RegRxParam3	0x12	0x18
4 bytes 💌 4 bytes		Length	OFF 💌	Manchester				RegBitRate	0x03	0x07	RegRes19	0x13	0x07
		0x02		Whitening	P A	Auto Clear		RegOokFloorThres	0x04	0x0C	RegRssiValue	0x14	0x24
B. I. I.								RegMcParam6	0x05	OxCF	RegRxParam6	0x15	0x00
Packet			RegR1	0x06	0x7D	RegSyncByte1	0x16	0xAA					
Preamble	-	Length	Address	Message		CRC	-11	RegP1	0x07	0x68	RegSyncByte2	0x17	0x0A
55-55-55-55 A	55-55-55 AA-0A-0B-0C							RegS1	0x08	0x46	RegSyncByte3	0x18	0x0B
Message								RegR2	0x09	0x74	RegSyncByte4	0x19	0x0C
	HEXADECIM	AL		ASCI	I			RegP2	0x0A	0x62	RegTxParam	0x1A	0x72
00 00						4		RegS2	0x0B	0x32	RegOscParam	0x1B	0xBC
								RegParamP	0x0C	0x38	RegPktParam1	0x1C	0x02
I						Ψ.		ReglrqParam1	OxOD	0x08	RegNodeAddr	0x1D	0x00
								ReglrqParam2	0x0E	0x1F	RegPktParam3	0x1E	0x60
C Transmition 💿 R	eception	Stop		Rx pack	iets:		<u> </u>	RegRssilrqThres	0x0F	0x00	RegPktParam4	0x1F	0xC0
Ge	eneral			Rx			- Coni	rol					
and:	902-915	i MHz	Passive filter fc:	378	3000	Hz	гОр	erating mode		Registers o	onfig	-RSSI -	
IF frequency:	908000000) Hz	Butterworth fc-fo:	100	0000	Hz					Write		
dulation scheme: FSK Polyphase fo: 100000 Hz					C Sleep		-			22 🙂			
requency Deviation:					0	Standby C Synthesi	zer		Read		Read		
litrate:	ate: 25000 bps Interpolator filter fc: 200000 Hz				0	Receiver 🛛 🔿 Transmit	ter		Reset	·			
)perating mode:	rating mode: RECEIVER Output power: 10 dBm								_				

Figure 8. The SX1211SKA User Interface whilst in Packet Receiver Mode

4.2 SX1230SKA Quick Start

- 1. Plug the SX1230SKA into the USB port of the computer.
- 2. Run the SX1230 User Interface software Start > All Programs > SX1230SKA > SX1230SKA
- The SX1230SKA 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 SX1230SKA shows the default configuration of the SX1230 register settings upon power-up (see *Figure 9*).

ECH

SX1230 Starter Kit A												
General [1] General [2]	EEPROM mode	MCU mo	de				Register	Addr	Value	Register	Addr	Valu
RF frequency:	915000	00 Hz	PLL Lock:				Mode	0x00	0x10	VcoCtrl3	0x0D	0x00
			PLL calibration done:				BrMsb	0x01	0x1A	VcoCtrl4	0x0E	0x00
Modulation type:							BrLsb	0x02	0x0B	ClockCtrl	0x0F	0x05
Modulation shaping [BT]	ation shaping (BT): OFF 🗾		PLL calibration OK:				FdevMsb	0x03	0x00	Eeprom	0x10	0x1
Bitrate:	48	00 bps	PLL divider:	Auto	-		FdevLsb	0x04	0x52	ClockSel	0x11	0x0
Frequency deviation:	50	05 Hz	PLL calibration:	Trigger	1		FrfMsb	0x05	0xE4	EolCtrl	0x12	0x0
	PA1	- 1	EEPROM section size:	16	븝		FrfMid	0x06	0xC0	PaOcpCtrl	0x13	0x1
Power Amplifier:		_		16	<u> </u>		FrfLsb	0x07	0x00	Unused	0x14	0x0
Output power:	itput power: 13 🗾 d		n Twakeup:		0 m	s	PaCtrl	0x08	0x3F	Unused	0x15	0x0
PA ramp rising time:	amp rising time: 40 💌 u		Battery EOL:				PaFskRamp	0x09	0x08	Unused	0x16	0x0
RC oscillator:	C ON G	OFF	EOL:	O ON I	• OFF		PIIStat	0x0A	0x18	PerDivider	0x17	0x0
CLKOUT source:	XTAL/32	•	EOL trim:	1.835	- v		VcoCtrl1	0x0B	0x00	BtnDeb	0x18	0x0
External clock:		OFF	E OE din.	1.000	·		VcoCtrl2	0x0C	0x00			
							Mode			Control		
Button debounce timer:	30	▼ ms	XTAL frequency:	32000	000 H:	z	C EEPROP	4 🔍	мсн	Operating mo	de	
										0 :	Sleep	
Over	view		Over	view	<u> </u>		Over	view		•	Standby	
Band	862-1020	MHz	Power Amplifier	PA1		Ex	ternal clock		OFF	0 s	Synthesizer	
RF frequency	915000000	Hz	Output power	13	dBm	PL	L lock			0	Fransmitter	
Iodulation type FSK			PA ramp rising time	40	us	PL	L Calibration done		۲	- Registers cor	fia	
Modulation shaping	OFF		Operating mode	STANDBY		PL	L Calibration OK		۲	Thegisters con		
Bitrate	4800	bps	RC oscillator	OFF		Ba	ttery EOL			Write	R	ead
Frequency Deviation	5005	Hz	CLKOUT source	XTAL/32	Hz	Btr	n debounce timer		30 r	ns		

Figure 9. SX1230 User Interface, Default Settings

5. The settings for communication between SX1211SKA and SX1230SKA 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.



- 6. Load the "XXX_SX1230_pingpong.cfg" file from the "SX1230 Demo Files" folder on the CD-ROM. Where XXX corresponds to the frequency band of the SX1230SKA (either 868 or 915 MHz).
- 7. The display will then appear as shown in Figure 10*Figure* 7. These are the link parameters which match those which will be programmed to the SX1211SKA.

File Help											
🎽 🛃 🚸											
General [1] General [2]	EEPROM mode MCU	mode				Register	Addr	Value	Register	Addr	Valu
RF frequency:	908000000	Hz PLLLock:	•			Mode	0x00	0x30	VcoCtrl3	0x0D	0x19
Modulation type:	• FSK • 00		ne: 🥥			BrMsb	0x01	0x05	VcoCtrl4	0x0E	0x1
						BrLsb	0x02	0x00	ClockCtrl	0x0F	0x0
Modulation shaping [BT]:	OFF 💌	PLL calibration OK	: 🥥			FdevMsb	0x03	0x03	Eeprom	0x10	0x0
Bitrate:	25000	bps PLL divider:	Auto	-		FdevLsb	0x04	0x33	ClockSel	0x11	0x0
Frequency deviation:	49988	Hz PLL calibration:	Trigger	1		FrfMsb	0x05	0xE3	EolCtrl	0x12	0x1
	PA1+ PA2 -	EEPBOM section :				FrfMid	0x06	0x00	PaOcpCtrl	0x13	0x1
Power Amplifier:		EEPHUM section :	size: [15	<u> </u>		FrfLsb	0x07	0x00	Unused	0x14	0x0
Output power:	13 🔻	dBm Twakeup:		0 m	s	PaCtrl	0x08	0x7B	Unused	0x15	0x0
PA ramp rising time:	40 💌	us Battery EOL:	e			PaFskRamp	0x09	0x08	Unused	0x16	0x0
RC oscillator:	O ON @ OF	F EOL:	O ON I	• OFF		PIIStat	0x0A	0x38	PerDivider	0x17	0x0
CLKOUT source:	OFF 💌	EQL trim:	1.835	▼ v		VcoCtrl1	0x0B	0x11	BtnDeb	0x18	0x0
			11.000	·		VcoCtrl2	0x0C	0x15			
External clock: ON ON FE			32000	000 H:	2	Mode C EEPRO	M © I	мси	Control Operating mode C Sleep		
Over	view	0	verview			Ove	rview		o	Standby	
land	862-1020 MH	z Power Amplifier	PA1+ PA2		Ext	ernal clock		OFF	0	Synthesizer	
RF frequency	908000000 Hz	Output power	13	dBm	PLL	lock		۲	•	Transmitter	
fodulation type	FSK	PA ramp rising time	40	us	PLL	. Calibration done		۲		nfia	
dodulation shaping			TRANSMITTER			_ Calibration OK		۲			
Bitrate	25000 bps		OFF			tery EOL		۲	Write	Be	ead
requency Deviation	49988 Hz	CLKOUT source	OFF	Hz	Btn	debounce timer		30 ms			

Figure 10. The New SX1230 Configuration: Ready to be Written

8. By clicking on the write button in the 'Registers config' section, the new register values are written to the SX1230 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.

Control
Operating mode
C Sleep
C Standby
C Synthesizer
Transmitter
Registers config
Write Read

9. Once successfully configured, the SX1230 must be placed in packet transmission mode. This is done by selecting the 'MCU mode' tab – note that a pre-configured frame format identical to that for the SX1211SKA is already entered into the display. It suffices simply to click on the 'Start' button to begin continuous transmission of this frame. For clarity a screenshot illustrating the display during transmission is shown in Figure 11.

MTECH

File Help												
i 🖌 🖌												
General [1] Genera	I[2] EEPROM mode	MCU mo	de				Register	Addr	Value	Register	Addr	Valu
Packet configuration	on						Mode	0x00	0x30	VcoCtrl3	0x0D	0x19
Preamble size	Sync size	Length	Address field	Whitening (CRC		BrMsb	0x01	0x05	VcoCtrl4	OxOE	0x10
4 🔻	4 💌 Fixe	d j	V OFF V	OFF 🔽 OFF	7]	BrLsb	0x02	0x00	ClockCtrl	0x0F	0x07
	Sync word	Length	Address				FdevMsb	0x03	0x03	Eeprom	0x10	0x0F
	AA-QA-OB-OC	0x02					FdevLsb	0x04	0x33	ClockSel	0x11	0x00
Packet	,						FrfMsb	0x05	0xE3	EolCtrl	0x12	0x12
					CRC	-1	FrfMid	0x06	0x00	PaOcpCtrl	0x13	0x10
Preamble 55-55-55-55	Sync word AA-0A-0B-0C	Length	Address	Payload	LHL	-11	FrfLsb	0x07	0x00	Unused	0x14	0x00
00-00-00-00	AA-UA-UB-UL					-11	PaCtrl	0x08	0x7B	Unused	0x15	0x00
Payload						511	PaFskRamp	0x09	0x08	Unused	0x16	0x00
	HEXADECIMA	L		ASCII			PIIStat	0x0A	0x38	PerDivider	0x17	0x00
48 49				HI			VcoCtrl1	0x0B	0x12	BtnDeb	0x18	0x03
							VcoCtrl2	0x0C	0x16			
					Ψ.		Mode			Control		
	St		Repeat value:	0 Tx Packets:		85	C EEPROF	1 0	мсн	- Operating m	ode	
	51	op	Tepear value. J							o	Sleep	
) verview			Dverview			Ove	view		0	Standby	
and	862-1020	MHz	Power Amplifier	PA1+ PA2		Ext	ernal clock		OFF	0	Synthesizer	
F frequency	908000000	Hz	Output power	13	dBm	PLI	_ lock		۲	0	Transmitter	
odulation type	FSK		PA ramp rising time	40	us	PLI	. Calibration done		۲	Registers co	nfia	
lodulation shaping	OFF		Operating mode	TRANSMITTER		PLI	_ Calibration OK		۲			
itrate	25000	bps	RC oscillator	OFF			tery EOL		۲	Write	Be	ead
requency Deviation	49988	Hz	CLKOUT source	OFF	Hz	Rh	debounce timer		30 ms			

Figure 11. SX1230 During MCU Mode Packet Transmission

4.3 Link Test

With both devices configured as described in the preceding two sections, reception of valid packets by the SX1211 should be visible. Note that during link testing be sure that the USB kits are separated by several cm. Note also, that it is possible to install the SX1211SKA user interface on one machine and the SX1230 SKA user interface on another allowing range test evaluation with full control over the link parameters.

Where a pair of computers is not available, the SX1230SKA can be configured in stand alone mode. Please see the next section for a quick start guide on operation of the SX1230SKA in this mode.



5 Quick Start Guide: Stand Alone Mode

5.1 SX1211SKA Configuration

Initiation of the SX1211SKA for operation in Stand Alone Mode is identical to that described in Section 4.1. Please configure the SX1211SKA as described therein and refer to the following section for configuration of the SX1230.

5.2 SX1230SKA Configuration

There are a few simple steps to follow to configure the SX1230SKA for stand alone mode operation. Figure 12 shows both top and bottom views of the SX1230SKA hardware. The SX1230SKA companion EEPROM comes preprogrammed with a band specific configuration file already loaded.

1. Insert the CR2032 button cell into the cell holder (1), taking care to respect the polarity. Note that there is some quiescent current drain caused by the USB interface, so to maximise battery life ensure this is removed when not in use.

2. Three of the four push buttons (labeled 0 to 3 on the PCB silkscreen) are connected to the general purpose digital inputs of the SX1230. The button labeled 3 is configured as a reset button. Push this button following connection of the cell. There should now be no LEDs illuminated on the SX1230SKA.

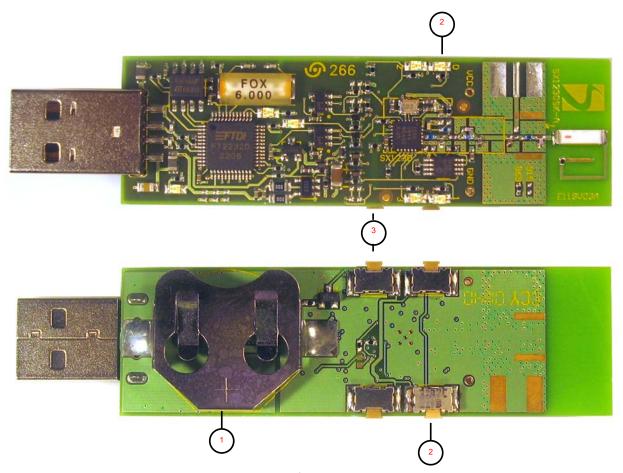


Figure 12. Hardware for E^2 PROM (Stand Alone) Operation



3. The SX1230SKA is not ready to be used in conjunction with the SX1211SKA in frame reception mode, as described in Section 4.1.

5.3 Link Test

Each push button has the same payload mapped to it. Push button 0 transmits this single, standard format frame, once. Push button 1 has a demonstration of packet repetition. Here the packet is programmed to be resent five times. Note that the SX1211SKA may not receive all five frames successfully. This is due to the time required to empty the FIFO, whereas SX1230 will transmit all five frames in quick succession. Finally, push button 2 gives a demonstration of periodic mode. Here the frame is configured to repeat several times a second whilst the push button is held down.

To modify the E^2PROM contents please see Section 6.7. Note also that the original quick start configuration is included on the CD. Please also refer to Section 6.7 on how to load a non-volatile memory configuration file and program the E^2PROM .

Otherwise, guidance for performing link testing is the same as that already given in Section 4.3.



6 SX1230SKA Software Description

6.1 Overview

Figure 13 shows the SX1230SKA graphical user interface (GUI). Each of the numbers surrounding the display corresponds to the Chapter within this section gives the description of that feature.

5 SX1230 Starter Kit A											
- File Help											
- 🖬 🖌											
General [1] General [2] El	EPROM mode	MCU mo	ode			Register	Addr	Value	Register	Addr	Value
RF frequency:	9150000	00 Hz	PLL Lock:			Mode	0x00	0x10	VcoCtrl3	0x0D	0x00
Modulation type:	€ FSK C		PLL calibration done:			BrMsb	0x01	0x1A	VcoCtrl4	0x0E	0x00
		_				BrLsb	0x02	0x08	ClockCtrl	0x0F	0x05
Modulation shaping [BT]:		•	PLL calibration OK:		_	FdevMsb	0x03	0x00	Eeprom	0x10	0x10
Bitrate:	48	00 bps	PLL divider:	Auto	-	FdevLsb	0x04	0x52	ClockSel	0x11	0x00
Frequency deviation:	50	05 Hz	PLL calibration:	Trigger		FifMsb	0x05	0xE4	EolCtrl	0x12	0x02
Power Amplifier:	PA1	-	EEPROM section size:	16	-	FrfMid	0x06	0xC0	PaOcpCtrl	0x13	0x11
		=			_	FrfLsb	0x07	0x00	Unused	0x14	0x00
Output power:		dBr	m Twakeup:		0 m	^s PaCtrl	0x08	0x3F	Unused	0x15	0x00
PA ramp rising time:	40	▼ us	Battery EOL:			PaFskRamp	0x09	0x08	Unused	0x16	0x00
RC oscillator:	O ON G	OFF	EOL:	C ON	 OFF 	PllStat	Ox0A	0x18	PerDivider	0x17	0x00
CLKOUT source:	XTAL/32	-	EOL trim:	1.835	• v	VcoCtrl1	0×08	0x00	BtnDeb	0x18	0x03
External clock:	C ON G	OFF			_	VcoCtrl2	0x0C	0x00			
Button debounce timer:	30	▼ ms	XTAL frequency:	3200	0000 H	Z Mode C EEPRO	м о	MCU	Control Operating mo	ode Sleep	-
Overvie	w		Over	view		0.	erview		•	Standby	
Band	862-1020	MHz	Power Amplifier	PA1		External clock		OFF	0	Synthesizer	
RF frequency	915000000	Hz	Output power	13	dBm	PLL lock			0	Transmitter	
Modulation type	FSK		PA ramp rising time	40	us	PLL Calbration done		۲	- Registers co	nfia	
Modulation shaping	OFF		Operating mode	STANDBY		PLL Calbration OK		۲			
Bitrate	4800	bps	RC oscillator	OFF		Battery EOL			Write	R	lead
Frequency Deviation	5005	Hz	CLKOUT source	XTAL/32	Hz	Btn debounce timer		30 m	: [
					Confi	g File: -					

Figure 13: SX1230SKA GUI Overview and References to the User Guide Description of this Chapter.

6.2 File Menu

File	Help
	Disconnect
	Open Config Save Config
	Save Config As Exit

File menu contains some general purpose functions. 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 unplugging the USB kit. This functionality may also be accessed through the short cut buttons (see Section 6.3).

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	Hel				
i 💕 🕻		User's Guide			
Gene	2	<u>A</u> bou	t SX1230 Starter Kit		



6.3 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 SX1230 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 SX1230SKA 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.

_	X1230_pingpong.cfg -	Notepad		- D ×
Eile Edit #Type REG REG REG REG REG REG REG REG REG REG	X1230_pingpong.cfg - Format View Help Register Name Mode BrMsb BrLsb FdevMsb FdevLsb FrfMsb FrfMid FrfLsb PaCtrl PaFskRamp PllStat VcoCtrl1 VcoCtrl2 VcoCtrl3 VcoCtrl4 ClockSel	Address[Hex] 0x00 0x01 0x02 0x03 0x04 0x05 0x06 0x07 0x08 0x09 0x00 0x08 0x09 0x00 0x00 0x00	Value[Hex] 0x30 0x05 0x00 0x03 0x33 0xE3 0x00 0x00 0x7B 0x08 0x7B 0x08 0x38 0x12 0x16 0x19 0x1C 0x07 0x07 0x07 0x07	
REG REG REG REG REG REG REG	PaFskRamp PllStat VcoCtrl1 VcoCtrl2 VcoCtrl3 VcoCtrl4 ClockCtrl Eeprom	0x09 0x0A 0x0B 0x0C 0x0D 0x0D 0x0E 0x0F	0x08 0x38 0x12 0x16 0x19 0x1C 0x07	
REG REG PKT	PerDivider BtnDeb	0x17 0x18 -0A-0B-0C;2;0;48	0×00 0×03	•

Figure 14. Example Text Editor Output of the SX1230 Configuration File



6.4 General Configuration Tabs

For clarity and ease of use the general configuration settings have been split between two tabs.

6.4.1 General [1]

The most commonly used configuration parameters are located on the General [1] tab. Each field is directly editable by the user and is refreshed every time a register read or write is performed.

General [1] General [2] EEI	PROM mode 🗍 MCU mode		
RF frequency:	915000000 Hz	PLL Lock:	
Modulation type:	⊙ FSK € OOK	PLL calibration done:	a
Modulation shaping [BT]:	OFF 💌	PLL calibration OK:	۲
Bitrate:	4800 bps	PLL divider:	Auto
Frequency deviation:	5005 Hz	PLL calibration:	Trigger
Power Amplifier:	PA1 💌	EEPROM section size:	16 💌
Output power:	13 T dBm	T wakeup:	0 ms
PA ramp rising time:	40 💌 us	Battery EOL:	
RC oscillator:	○ ON ④ OFF	EOL:	○ ON ④ OFF
CLKOUT source:	XTAL/32 💌	EOL trim:	1.835 💌 V
External clock:	○ ON ④ OFF		
Button debounce timer:	30 💌 ms	XTAL frequency:	32000000 Hz

Figure 15. The General Configuration Tab Features the most Commonly Used Configuration Parameters

Where the data entry field allows direct keyboard entry, the following background highlight conventions are used to aid the user in their choice of programmed value:

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 SX1230. 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.

Each data entry field and user control of the General [1] tab is described below.

RF Frequency

RF Frequency		The PE frequency field accepts a numerical text input
RF frequency:	915000000 Hz	The RF frequency field accepts a numerical text input from the keyboard. Values in any one of the three frequency bands from 862 to 1020 MHz are permitted. Please note that the entry units are Hz.
Modulation Type		
Modulation type:	🖸 FSK 🔿 OOK	The SX1230 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.
Modulation Shaping		
Modulation shaping [BT]:	OFF	The Tx bit-stream may be pre-filtered before modulation. Varying strengths of filtering are accessible. The filter type also depends upon the type of modulation used. Filter coefficients are selectable from a drop-down menu.
Bitrate		· ·
Bitrate:	4800 bps	The bit rate of the transmitted signal (in bps) can be directly edited in this data entry field.
Frequency Deviation		Text entry field for the frequency deviation when using
Frequency deviation:	5005 Hz	FSK modulation.
Power Amplifier		
Power Amplifier:	PA1 💌	Selection of single (low power) or dual (high power) operation. Note that PAs 1 and 2 must be enabled for +17 dBm operation.
Output Power Output power:	13 💌 dBm	The output power is selectable from a drop down list in the programmable 1 dB increments.
PA Ramping		The PA ramp rise time is selectable from the list of
PA ramp rising time:	40 💌 us	programmable values.
Oscillator		
RC oscillator:	○ ON ⊙ OFF	Although not directly accessible from the SX1230SKA, for completeness, the source of the clock output signal
CLKOUT source:	XTAL/32 💌	can be selected and its frequency altered in accordance with the range of programmable divider values. For
External clock:	○ ON ⊙ OFF	more information please consult the SX1230 datasheet.



Push Button Debouncer

Button debounce timer:	30	💌 ms

The four general purpose digital inputs – here connected to the four push buttons – has a variable debounce timer. Several common values are accessible from a drop down menu.

PLL Lock Detection Parameters

FLL LUCK.	
PLL calibration done:	
PLL calibration OK:	
PLL divider:	Auto 💌
PLL calibration:	Trigger

Three LED type indicators display the status of the SX1230 following the last register read cycle of the SX1230. Various options exist for changing the PLL divider ratio and triggering PLL calibration. Please consult the SX1230 datasheet for a more detailed description.

E²PROM Mode Parameters

EEPROM section size:	16	•
T wakeup:		0 ms

These two register settings are used to determine the size of each section in the E^2PROM memory and the wake-up time if periodic mode is enabled respectively. Please see Section 6.7, in conjunction with the SX1230 datasheet, for a description of how to use these E^2PROM parameters.

Low Battery Detection Parameters

Battery EOL:	
EOL:	○ ON ⊙ OFF
EOL trim:	1.835 💌 V

The battery end of life (EOL) indicator is set if the EOL is enabled (here controlled by a radio button input) and the supply voltage passes the corresponding threshold – EOL trim.

Crystal Frequency

XTAL frequency:	32000000	Hz

Most of the programmable communication setting parameters are a function of the crystal frequency used. This field allows other crystal frequencies to be tried, however, the SX1230SKA comes fitted with a 32 MHz crystal. The value should hence not be changed.



6.4.2 General [2]

PA Overload Current Protection	General [1] General [2]	EEPROM mode MCU mode
OCP. ON COSS	PA Overload Current Pr	rotection
	OCP:	• ON • OFF
DC load current thres: 50 mA	DC load current thres:	50 💌 mA

Figure 16. Second Page of the General Configuration Parameters

The second page of general configuration settings (see *Figure 16*) contains the user inputs for enabling of the power amplifier over current protection (OCP) and setting the current limit from a drop down menu. The current limit must be increased to 100 mA or higher for operation of the SX1230 at the maximum output power of +17 dBm.

6.5 Register Hexadecimal Display

Figure 17 shows the register summary of the SX1230. 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 SX1230 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
Mode	0x00	0x10	VcoCtrl3	0x0D	0x19
BrMsb	0x01	0x1A	VcoCtrl4	0x0E	0x1C
BrLsb	0x02	0x0B	ClockCtrl	0x0F	0x05
FdevMsb	0x03	0x01	Eeprom	0x10	0x10
FdevLsb	0x04	0x52	ClockSel	0x11	0x00
FrfMsb	0x05	0xE4	EolCtrl	0x12	0x12
FrfMid	0x06	0xC0	PaOcpCtrl	0x13	Ox1B
FrfLsb	0x07	0x00	Unused	0x14	0x00
PaCtrl	0x08	0x3F	Unused	0x15	0x00
PaFskRamp	0x09	0x08	Unused	0x16	0x00
PIIStat	0x0A	0x10	PerDivider	0x17	0x00
VcoCtrl1	0x0B	0x12	BtnDeb	0x18	0x03
VcoCtrl2	0x0C	0x16			

Figure 17. Register Hexadecimal Display

Note that values changed in this portion of the display cause the values in the tabbed configuration section to be changed dynamically.

6.6 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 covers all of the SX1230 register values, including those not displayed on the tab presently selected, and indicates the true value which will be written to the SX1230 configuration registers.

Ûve	rview		0	verview		0,	verview	
Band	862-1020	MHz	Power Amplifier	PA1		External clock	OFF	
RF frequency	915000000	Hz	Output power	13	dBm	PLL lock		
Modulation type	FSK		PA ramp rising time	40	us	PLL Calibration done	۲	
Modulation shaping	OFF		Operating mode	STANDBY		PLL Calibration OK	۲	
Bitrate	4800	bps	RC oscillator	OFF		Battery EOL		
Frequency Deviation	5005	Hz	CLKOUT source	XTAL/32	Hz	Btn debounce timer	30	ms

Figure 18. The Configuration Overview Display

6.7 E^2 PROM Mode Tab

The E²PROM mode tab is used to configure the contents of the E²PROM for stand alone mode operation of the SX1230SKA. In this mode the SX1230 acts as SPI master and can download both configuration and payload information from an SPI E²PROM. The E²PROM memory map is shown below:

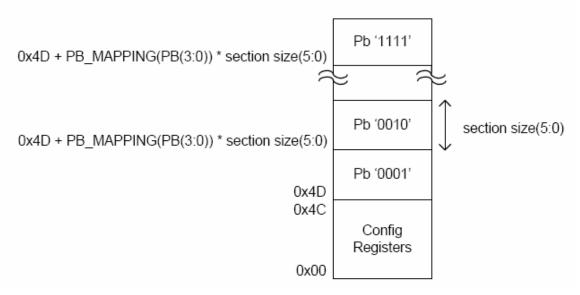


Figure 19. E²PROM Memory Mapping

The bottom 0x4C locations in the E²PROM are reserved general configuration information – configuration which is the same for every button press. The subsequent sections are then mapped to the remaining 15 possible combinations of the 4 digital inputs (for mapping details please see the SX1230 datasheet). These may contain either i) solely payload or ii) a combination of supplementary configuration information and payload.



Ger	neral [1] General [2]	EEPROM mode MCU mod	e		
FG	ienral Configuration Se	ction	В	uttons Section	
			Se	ection #: 🛛 🗧	
	RegMode	False 🔺	Ð	RF Frequency [Hz]	O, False
	RegBrMsb	True	Ð	Modulation type	FSK, False
	RegBrLsb	True	Ð	Bitrate [bps]	0, False
	RegFreqDMsb	True	Ð	Frequency deviation	0, False
	RegFreqDLsb	True	Ð	Power Amplifier	PA1, 13, False
	RegRfFreqMsb	True	Ð	T wakeup [ms]	O, True
	RegRfFreqMid	True	Ð	Packet	1,555555555AA0A0B0C
	RegRfFreqLsb	True			
	RegPaCtrl	True			
	RegPaEskBamp	False			
16	ŧ∨м	rvalue is included in the	R	F Frequency [Hz]	
	Write	Read		Write	Read
		Write		Read 🔍 N	ormal view 🔘 Raw view

Figure 20. The E²PROM Mode Tab 'Normal View'

The E²PROM mode display is broken down into two types, selectable by the radio button control in the bottom right hand corner of the display. The default is 'Normal view' which shows the E²PROM contents in human readable format (see Figure 20). The left hand 'General Configuration Section' dictates which registers are to be written to the general configuration section – True indicating that the value will be written, False that it will not. The values written to the configuration section are taken from the General setting tabs of Sections 6.4.1 and 6.4.2. The general configuration settings may be read or written independently of the rest of the E²PROM contents by clicking the Read or Write button within the section.

The rightmost frame contains the contents of each of the input specific sections. The contents of a particular section are displayed individually. The section may be changed by entering the desired section in the 'Section #:' input. Several useful common parameters and the payload itself are listed within the 'Buttons' section. Each can be edited directly. The input specific section of the E²PROM memory can be written or read independently of the rest of the E²PROM contents by clicking on the write or read button within the Buttons Section.

At the bottom of the display are the controls for global read or write of the E^2 PROM contents. These cause the whole E^2 PROM to be read or written, respectively.

The radio button control in the bottom right hand corner allows selection between Normal and Raw views of the E²PROM contents.

An alternative perspective of the E^2PROM contents is available in 'Raw view', illustrated in Figure 21. Here we see the E^2PROM contents in hexadecimal (centre column) and ASCII (right column) versus the E^2PROM address in hexadecimal (left column) in tabular format. Note also the addition of several short-cut buttons. These allow the user to save or recall E^2PROM (.NVM – non volatile memory) files to or from disc storage. Copy, cut and paste functionality is also provided.

Once programmed the SX1230 may be disconnected from the USB port, unplugged and used in stand-alone mode. The SX1230SKA comes pre-programmed with an example E²PROM contents (see the quick start Section for more details).



<u> </u>		X	þ	P	_	_	_	_	-			· · ·					
		00		<u> </u>													
0000	81	05	82	00	83	03	84	33	85	D9	86	00	87	00	88	ЗF	3.Ù?
0010	8A	18	8F	07	90	OF	93	1C	97	00	FF	FF	FF	FF	FF	FF	ÿÿÿÿÿÿ
0020	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	ŸŸŸŸŸŸŸŸŸŸŸŸŸŸŸŸŸ
0030	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	ŸŸŸŸŸŸŸŸŸŸŸŸŸŸŸŸŸ
0040	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	97	00	95	ŸŸŸŸŸŸŸŸŸŸŸŸŸ ~~~
0050	01	OA	55	55	55	55	AA	0A	0B	OC	20	00	97	00	95	ΟA	
0060	OA	55	55	55	55	AA	0A	0B	0C	20	00	97	28	95	01	OA	.0000ª (
0070	55	55	55	55	AA	OA	0B	0C	20	00	97	28	95	0A	OA	55	UUUUª(U
0080	55	55	55	AA	OA	0B	0C	20	00	95	00	OC	FF	FF	FF	FF	₩₩ ¹ ÿÿÿÿ
0090	FF	FF	FF	FF	FF	FF	FF	FF	95	00	OC	FF	FF	FF	FF	FF	<u> </u>
OAOO	FF	FF	FF	FF	FF	FF	FF	95	00	OC	FF	FF	FF	FF	FF	FF	<u> </u>
00B0	FF	FF	FF	FF	FF	FF	95	00	0C	FF	FF	FF	FF	FF	FF	FF	<u> </u>
0000	FF	FF	FF	FF	FF	95	00	0C	FF	FF	FF	FF	FF	FF	FF	FF	<u> </u>
OCDO	FF	FF	FF	FF	95	00	OC	FF	FF	FF	FF	FF	FF	FF	FF	FF	<u> </u>
OOEO	FF	FF	FF	95	64	OC	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	ÿÿÿ.d.ÿÿÿÿÿÿÿÿÿÿ
OOFO	FF	FF	95	00	oc	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	<u> </u>
0100	FF	95	00	OC	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	ÿ ÿÿÿÿÿÿÿÿÿÿÿ ÿ
0110	95	00	OC	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	95	
0120	~~	00	77	77	77	77	77	77	77	77	77	77	77	77	~~	~~	
																	Ln 1 Col 1
									Wri		11		Rea		7	0	Normal view 💿 Raw view

Figure 21. E²PROM Raw View

General [1]	Ge	eneral	[2]	EEPROM mode	МС
i 📂 🛃	¥	þ	2		

Figure 22. E²PROM Raw View Short-cut Buttons

6.8 MCU Mode Tab

General [1] ☐ Genera □ Packet configurati		ode MCU mode			
Preamble size	Sync size	Length Fixed	Address field	Whitening	CRC
	Sync word AA-0A-0B-0C	Length	Address		
Packet					
Preamble	Sync word	Length	Address	Payload	CRC
55-55-55-55	AA-0A-0B-0C				
Payload	HEXADE	CIMAL		ASCII	
48 49				HI	
		Start Rep	eat value:	0 Tx Pack	ets: 0

Figure 23. MCU Mode Tab Display

The MCU mode tab allows the user to define a custom packet for transmission by the SX1230SKA. The packet configuration section (top) allows the user enable and set the length of a pulse train preamble (sent at the data rate). A custom syncronisation word of up to 4 bytes may also be added. Fixed or variable length packets may also be stipulated (see the SX1211 datasheet for more information), as may an optional 1 byte address.

With these options entered the constructed packet is shown in the 'Packet' frame. The packet payload may also be edited in either ASCII or hexadecimal. Packet transmission 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.



6.9 The Mode Control Box

Control
Operating mode
C Sleep
C Standby
C Synthesizer
 Transmitter
Registers config
Write Read

Figure 24. The Control Box

The control box gives access to the operating modes of the SX1230. By selecting one of the radio buttons, the SX1230 is immediately transferred into that mode without the need to read or write to the registers. The control for reading and writing to the registers is also within the control frame. The Read button will read the contents of the SX1230 configuration registers and display them in the hexadecimal, overview and tabbed configuration areas.

Similarly, a register write can be performed by clicking the write button. Here the contents of the hexadecimal display are written directly to the SX1230 configuration registers.

Note that the E²PROM contents cannot be manipulated from this section instead see Section 6.7.

6.10 MCU / E²PROM Mode Selection

In the frame labeled 'Mode' either MCU or Stand Alone (E^2PROM) operation can be selected. This allows the stand alone mode to be entered whilst connected to the USB port. Note that transition to and from E^2PROM mode generates a hardware reset (transition cannot be made dynamically) and so the register contents of the SX1230 will be lost upon transition.

Mode	
C EEPROP	и 👁 мси



7 SX1211SXA Software Description

7.1 Overview

Figure 25 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.

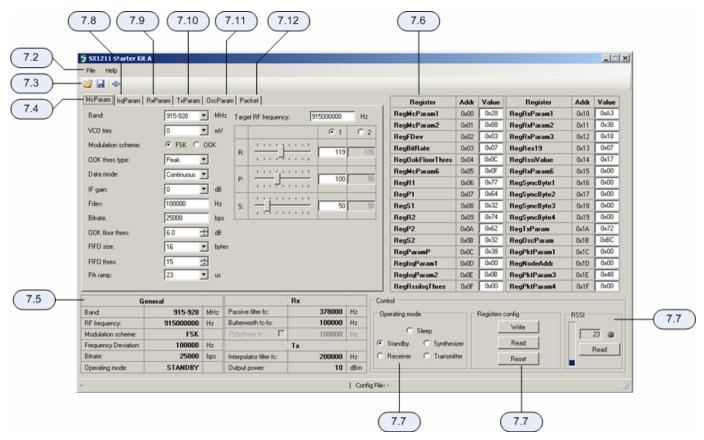


Figure 25. SX1211SKA GUI Overview and References to the User Guide Description of this Chapter

7.2 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 7.3).

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		About SX1230 Starter Kit



7.3 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.cf	g - Notepad		<u>_ ×</u>
<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	0×70	
RegMcParam2	0×01	0×8C	
RegFDev	0×02	0×07	
ReqBitRate	0×03	0×07	
RegOokFloorThres	0×04	0×0C	
ReqMcParam6	0×05	0xCF	
ReqR1	0×06	0x7D	
ReqP1	0×07	0×64	
RegS1	0×08	0×14	
RegR2	0×09	0x74	
ReqP2	0X0A	0x62	
ReqS2	0×0B	0x32	
RedParamP	0×0C	0x38	
ReqIrgParaml	0×0D	0×08	
ReqIrqParam2	0×0E	0x1F	
ReqRssiIrqThres	0×0F	0x00	
ReqRxParam1	0×10	0xa3	
RegRxParam2	0×11	0x38	
RegRxParam3	0x12	0×18	
RegRes19	0x13	0x07	
RegRssivalue	0×14	0×18	
RegRxParam6	0x15	0×00	
ReqSyncByte1	0x16	0XAA	
RegSyncByte2	0x17	0X0A	
ReqSyncByte3	0×18	0×0B	
RegSyncByte4	0x19	0x0C	
ReqTXParam	0x1A	0x72	
ReqOscParam	0×18	0xBC	
RegPktParam1	0x1C	0x02	
RegNodeAddr	0×1D	0x00	
RedPktParam3	0×1E	0x60	
RegPktParam4	0×1F	ĎxčŎ	
PKT	True;False;2;0		
		,,	

Figure 26. Example Text Editor Output of the SX1211 Configuration File



7.4 McParam Tab

Band Selection

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

|--|

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

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

OOK thres type: Peak 💌

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 7.12).

Gain of the IF Stage

IF gain:	0	▼ dB

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

Frequency Deviation

Fdev: 10	00000	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	-	dE
	,		

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 7.12).

PA Ramping

		_	
PA ramp:	23	-	us

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

Frequency of Operation

Targe	et RF frequency: 91	5000000	Hz
		• 1	02
R:	· · · · · · · · · · · · · · · · · · ·	119	116
P:		100	98
S:	· · · · · · · · · · · · · · · · · · ·	50	50

The frequency of operation of the SX1211 is a set by three frequency divider ratios. (See the illustration below). 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).

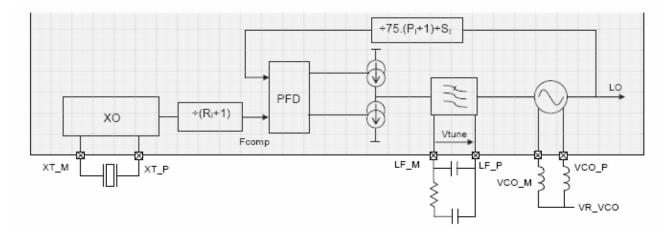


Figure 27. SX1211 Local Oscillator Generation

7.5 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.

General			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 28. The Overview Panel

7.6 Register Hexadecimal Display

Figure 29 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	Ox1B	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 29. The Hexadecimal Register Display Summary



7.7 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	Read
O Receiver O Transmitter	Reset	

Figure 30. 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.

7.8 The IrqParam Tab

McParam IrgParam RxPa	aram TxParam OscPara	m Packet	
Rx Standby IRQ_0:	Sync 💌	PLL lock on pin 23:	⊙ Yes ◯ No
Rx Standby IRQ_1:	DCLK	RSSI Irq Threshold:	0
TxIBQ_1:	DCLK 💌		
FIFO full:			
FIFO empty:			
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 31. 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 9.



7.9 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 32. The settings configurable in the receiver parameter tab correspond to the programmable baseband receiver functions.

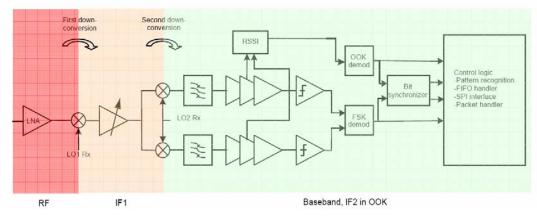


Figure 32. SX1211 Receiver Block Diagram, the Colours Correspond to the Frequency of Operation.

McParam IrqParam RxPa	ram TxParam OscParam P	'acket
Rx passive filter [fc]:	378000 💌 Hz	
Rx butterworth filter [fc-fo]:	100000 • Hz	
Rx polyphase filter [fo]:	100000 • Hz	
Polyphase filter:	C ON © OFF	
Bit synchronizer:	• ON C OFF	Sync word
Sync word recognition:	C ON © OFF	Sync word size [1-4]: 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 33. 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 7.12). 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.

7.10 The TxParam Tab

The transmitter configuration of the SX1211 is shown in Figure 34. 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.

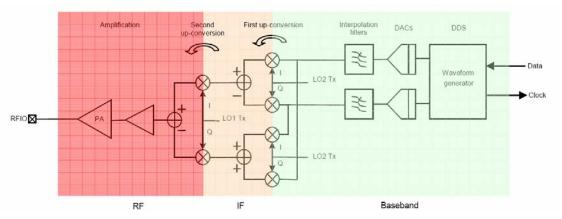


Figure 34. SX1211 Simplified Transmitter Block Schematic Diagram

McParam IrgParam R	Param TxParam OscParam Packet	
Tx interpolator filter:	200000 💌 Hz	
Output power:	10 💌 dB	

Figure 35. 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.

7.11 The OscParam Tab

McParam IrqParam RxPa	aram TxParam OscParam Packet
XTAL frequency:	12800000 Hz
CLK out:	⊙ ON ○ OFF
CLK out frequency:	426666 Hz

Figure 36. 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.

7.12 The Packet Test Tab

The 'Packet' tab is the principle interface for conducting transmission or reception testing. The display, as shown in Figure 35 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

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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.

reambie	Sync size	e Sync tol	Format	Address Field	DC free	CRC	
4 bytes 💌	4 bytes 💌	0 bit 💌	Fixed T	Add in Payload	Manchester	CRC	
			0x02		Whitening		
Packet							
Preamb	eamble Sync		Length	Address	Message	CRC	
55-55-55-5	55 00	00-00-00					
Managar							
Message HEXADECIMAL ASCII							
48 49					HI		

Figure 37. 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 7.7) is activated and continuously refreshed.

By way of example, Figure 38 shows the entire user interface display whilst receiving a valid packet payload.

- 🗆 🗙

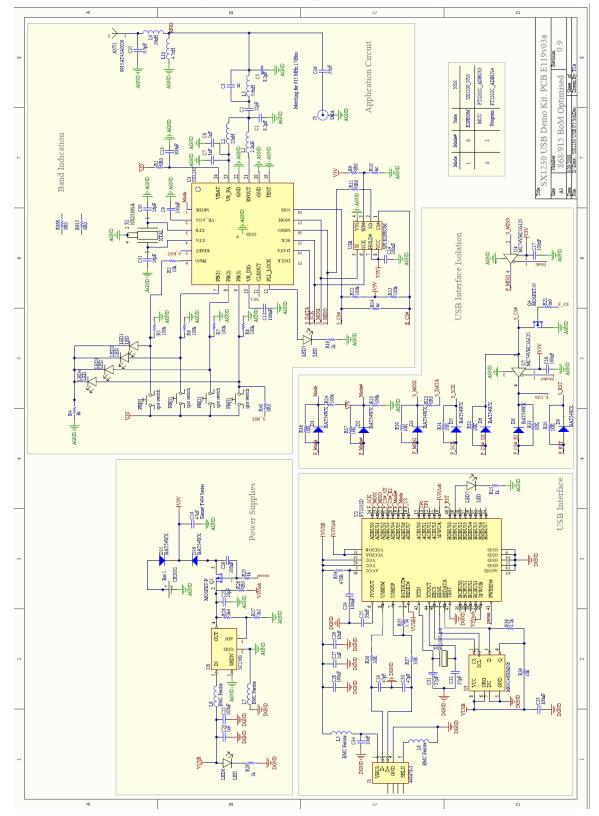
5 SX1211 Starter Kit A

File Help												
🎽 🛃 🕸												
McParam IrqParam RxParam TxParam OscParam Packet							Register	Addr	Value	Register	Addr	Value
Packet configuration							RegMcParam1	0x00	0x60	RegRxParam1	0x10	0xA3
							RegMcParam2	0x01	0x8C	RegRxParam2	0x11	0x38
Fixed T						RegFDev	0x02	0x07	RegRxParam3	0x12	0x18	
4 bytes 4 bytes 0 bit 1 ength OFF Manchester CRC				RegBitRate	0x03	0x07	RegRes19	0x13	0x07			
0x02 Whitening Auto Clear						RegOokFloorThres	0x04	0x0C	RegRssiValue	0x14	0x1A	
Packet						RegMcParam6	0x05	OxCF	RegRxParam6	0x15	0x00	
							RegR1	0x06	0x7D	RegSyncByte1	0x16	OxAA
Preamble	Sync L	ength	Address	Message	CRC		RegP1	0x07	0x68	RegSyncByte2	0x17	0x0A
55-55-55	AA-UA-UB-UL						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	Ox1B	OxBC
							RegParamP	0x0C	0x38	RegPktParam1	0x1C	0x02
							ReglrqParam1	0x0D	0x08	RegNodeAddr	0x1D	0x00
C Transmition © F	lagantian Ch			Rx packet		128	ReglrqParam2	0x0E	Ox1F	RegPktParam3	0x1E	0x60
• Hansmuon • P	Reception Sta	pp		пх раске	s	120	RegRssilrqThres	0x0F	0x00	RegPktParam4	0x1F	0xC0
G	eneral			Rx		Cor	trol					
Band:	902-915	MHz	Passive filter fc:	3780	00 Hz	11-00	erating mode		Registers (config	-RSSI	
RF frequency:	908000000	Hz	Butterworth fc-fo:	1000	00 Hz					Write		
Modulation scheme:	FSK		Polyphase fo:	1000	00 Hz		C Sleep		_		1	32 🕘
Frequency Deviation:	50000	Hz		Тх			Standby C Synthesi	zer	_	Read	F	Read
Bitrate:	25000	bps	Interpolator filter fc:	2000		0	Receiver C Transmit	ter		Reset		
Operating mode:	RECEIVER		Output power:		10 dBm							
					Cor	nfia File:	915_SX1211_pingpong.cf(1				
					,							

Figure 38. Software Display: Successful Packet Mode Reception

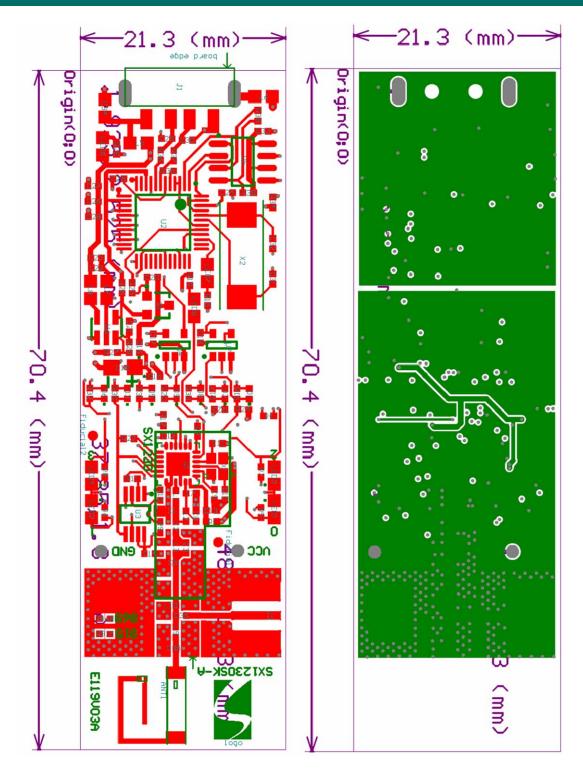


8 Schematics and 4-Layer PCB Layout: SX1230SKA

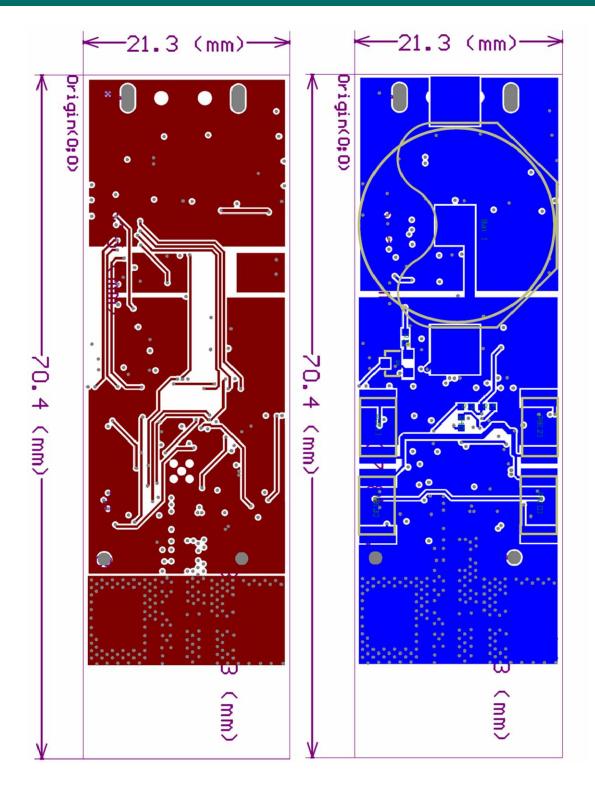


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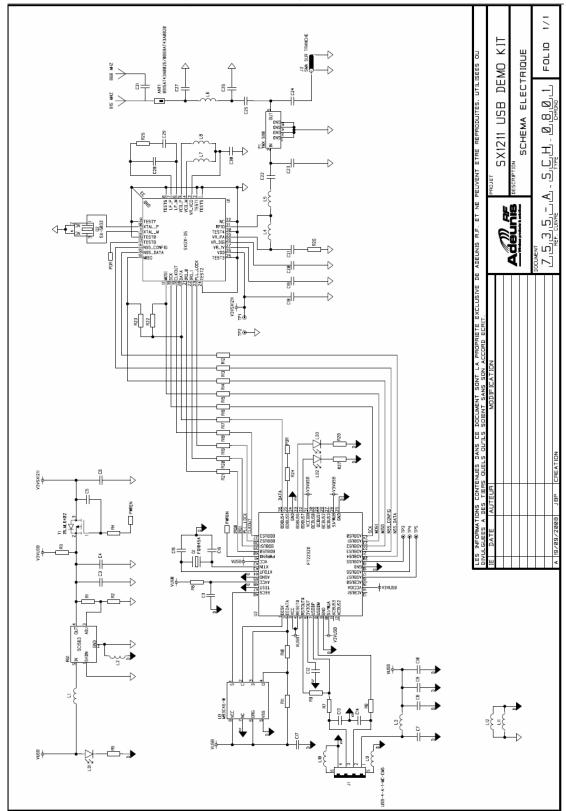






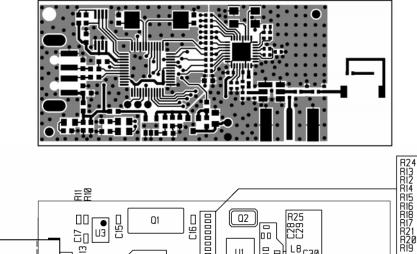


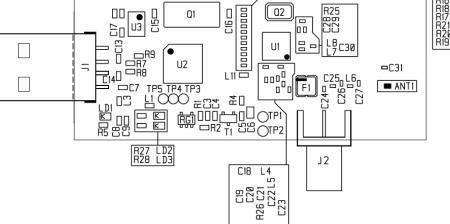


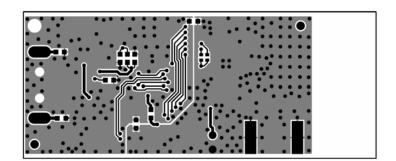


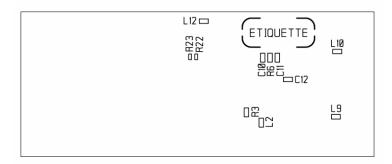
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10 References

- > [1] SX1230 Datasheet
- > [2] SX1211 Datasheet



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