

Integrated Transceiver Modules for ZigBee / 802.15.4 (900 MHz)

Development Kit Available: LSDEV-SI02-A30

FEATURES

- 250mW output power
- Long range: 2 miles
- Up to 1Mbps RF data rate
- Miniature footprint: 0.9" x 1.63"
- Multiple antenna options
- Agency Approvals: FCC and IC
- Powerful Atmel 256k ATXMEGA256A3 with 802.15.4 MAC or ZigBee Stack
- LSR serial interface based on 802.15.4 MAC
- Low power operation
- RoHS compliant
- Streamlined development with LSR design services.
- License options available to purchase design or integrate design.

APPLICATIONS

- Security
- Lighting Control
- HVAC Control
- Sensor Networks
- Medical
- Industrial Automation

DESCRIPTION

The SiFLEX module is a high performance 900MHz IEEE 802.15.4 radio (AT86RF212 & RF amplifier circuit) and microcontroller (ATXMEGA256A3) in a cost effective, pre-certified footprint.



The module comes preloaded with the Atmel MAC-Stack that can be used with the LSR host serial interface.

Full debug and programming capabilities are included to develop custom applications. Easily load the ZigBee or MAC stack onto the module and create your own network.

Need to get to market quickly? Not an expert in 802.15.4 or ZigBee? Need a custom antenna? Would you like to own the design? Would you like a custom design? Not quite what you need? Do you need help with your host board? LS Research Design Services will be happy to develop custom hardware or software, integrate the design, or license the design so you can manufacture yourself. Contact us at sales@lsr.com or call us at 262-375-4400.

ORDERING INFORMATION

Order Number	Description
LS900-SI-02-A20	SiFLEX Module with U.FL connector for external antenna
LS900-SI-02-A30	SiFLEX Module with wire antenna
LS900-SI-02-A40	SiFLEX Module with helical antenna
LS900-SI-02-A50	SiFLEX Module with castellated RF trace for off board antenna. Note: See Antenna Options section for more details.
LSDEV-SI02-A30	SiFLEX Development Kit

Table 1 Orderable SiFLEX Model Numbers

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BLOCK DIAGRAM

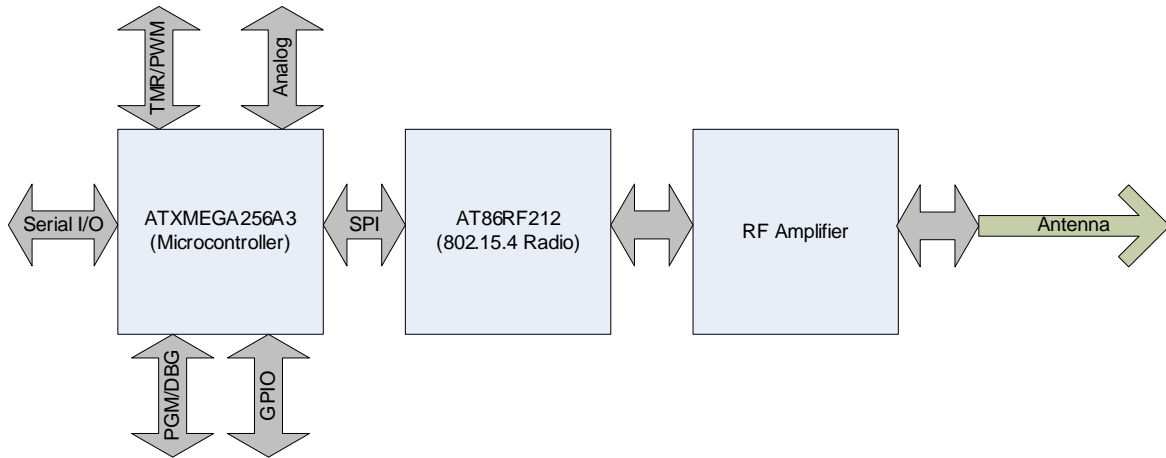


Figure 1 SiFLEX Module Block Diagram – High-Level

DEVELOPMENT KIT

The SiFLEX Development Kit can be used out of the box to evaluate RF range performance with the simple press of a button.

Users interested in further investigating the performance and capabilities of the SiFLEX Module can use the SiFLEX Test Tool. This PC-based software can demonstrate just how easy it is to send & receive data, collect performance data, change channels, power levels, or addresses using the LSR Serial Host Protocol with another microcontroller.

More advanced users can use the development board to create and debug their own software for the SiFLEX module using the 802.15.4 MAC or ZigBee stack from Atmel.



Figure 2 SiFLEX Development Board

Part Number	Description
LSDEV-SI02-A30	SiFLEX Development Kit

Kit Contents

- SiFLEX Development Board with SiFLEX Series Transceiver Module with Wire antenna (x2)
- USB Cable (x2)
- AA Batteries (x4)
- Software & Technical Information CD
- Quick Start Guide

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MODFLEX™ GENERIC MODULE FOOTPRINT

To maintain compatibility with all ModFLEX™ family transceiver modules it is important to use the module pins in your application as they are designated in Figure 3. Not all the pins on the SiFLEX module may be used, refer to Figure 4 for specifics.

ModFLEX™ Generic Module Footprint																														
GND	1																										69	GND		
GND	2																											68	GND	
GND	3																											67	GND	
NC	4																											66	NC	
NC	5																											65	NC	
NC	6																											64	NC	
NC	7																											63	NC	
NC	8																											62	NC	
JTAG - TMS	9																											61	SPI - MOSI	
JTAG - TDI	10																											60	SPI - MISO	
JTAG - TCK	11																											59	SPI - SCK	
JTAG - TDO	12																											58	SPI - SS	
JTAG/PDI/JRST	13																											57	IIC - SDA	
nReset	14																											56	IIC - SCL	
Analog REF	15																											55	GPIO 16	
Analog REF	16																											54	GPIO 15	
CMP+	17																											53	GPIO 14	
CMP-	18																											52	GPIO 13	
CMPOUT	19																											51	GPIO 12	
ADC1	20																											50	GPIO 11	
ADC2	21																											49	GPIO 10	
ADC3	22																											48	GPIO 9	
ADC4	23																											47	GPIO 8	
ADC5	24																											46	GPIO 7	
ADC6	25																											45	GPIO 6	
VCC - 3V3DC	26																											44	GND	
		27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43												
		TMR/PWM 1	TMR/PWM 2	TMR/PWM 3	TMR/PWM 4	TMR/PWM 5	TMR/PWM 6	TMR/PWM 7	TMR/PWM 8	UART - TX	UART - RX	UART - CTS	UART - RTS	GPIO 1	GPIO 2	GPIO 3	GPIO 4	GPIO 5												

Figure 3 ModFLEX™ Generic Module Footprint

PIN DESCRIPTIONS

Module Pin	Name	MCU Pin	Type	Description
1	GND	N/A	GND	Ground
2	GND	N/A	GND	Ground
3	GND	N/A	GND	Ground
4	NC	N/A	NC	No Connect
5	NC	N/A	NC	No Connect
6	NC	N/A	NC	No Connect
7	NC	N/A	NC	No Connect
8	NC	N/A	NC	No Connect
9	JTAG TMS	10	I/O	General-purpose digital I/O (PB4), Analog input, JTAG TMS
10	JTAG TDI	11	I/O	General-purpose digital I/O (PB5), Analog input, JTAG TDI
11	JTAG TCK	12	I/O	General-purpose digital I/O (PB6), Analog input, JTAG TCK
12	JTAG TDO	13	I/O	General-purpose digital I/O (PB7), Analog input, JTAG TDO
13	JTAG/PDI/JRST	56	I/O	PDI/PDI_DATA
14	nRESET	57	Input	RESET/PDI_CLOCK
15	PA0	62	I/O	General-purpose digital I/O, Analog input, Analog REF A
16	PB0	6	I/O	General-purpose digital I/O, Analog input, Analog REF B
17	PA2	64	I/O	General-purpose digital I/O, Analog input, Analog comparator 2
18	PA1	63	I/O	General-purpose digital I/O, Analog input, Analog comparator 1
19	PA7	5	I/O	General-purpose digital I/O, Analog input, Analog comparator output
20	PA4	2	I/O	General-purpose digital I/O, Analog input
21	PA5	3	I/O	General-purpose digital I/O, Analog input
22	PA6	4	I/O	General-purpose digital I/O, Analog input
23	PB1	7	I/O	General-purpose digital I/O, Analog input
24	PB2	8	I/O	General-purpose digital I/O, Analog input
25	PB3	9	I/O	General-purpose digital I/O, Analog input
26	VCC - 3V3DC	VCC	VCC	Supply Voltage
27	PF3	49	I/O	General-purpose digital I/O, Output Compare, UART Tx
28	PF2	48	I/O	General-purpose digital I/O, Output Compare, UART Rx
29	PF1	47	I/O	General-purpose digital I/O, Output Compare, UART XCK0

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Module Pin	Name	MCU Pin	Type	Description
30	PF0	46	I/O	General-purpose digital I/O, Output Compare
31	PE5	41	I/O	General-purpose digital I/O, Output Compare, UART XCK1, SPI MOSI
32	PE4	40	I/O	General-purpose digital I/O, Output Compare, SPI SS
33	PE3	39	I/O	General-purpose digital I/O, Output Compare, UART Tx
34	PE2	38	I/O	General-purpose digital I/O, Output Compare, UART Rx
35	PC3, UART TX	19	I/O	General-purpose digital I/O, Output Compare, UART Tx
36	PC2, UART RX	18	I/O	General-purpose digital I/O, Output Compare, UART Rx
37	PC1	17	I/O	General-purpose digital I/O, Output Compare, IIC SCL
38	PC0	16	I/O	General-purpose digital I/O, Output Compare, IIC SDA
39	PF5	51	I/O	General-purpose digital I/O
40	PF6	54	I/O	General-purpose digital I/O
41	PF7	55	I/O	General-purpose digital I/O
42	PA3	1	I/O	General-purpose digital I/O, Analog input
43	NC	N/A	NC	No Connect
44	GND	N/A	GND	Ground
45	NC	N/A	NC	No Connect
46	NC	N/A	NC	No Connect
47	NC	N/A	NC	No Connect
48	NC	N/A	NC	No Connect
49	NC	N/A	NC	No Connect
50	NC	N/A	NC	No Connect
51	NC	N/A	NC	No Connect
52	NC	N/A	NC	No Connect
53	NC	N/A	NC	No Connect
54	NC	N/A	NC	No Connect
55	NC	N/A	NC	No Connect
56	PE1	37	I/O	General-purpose digital I/O, Output Compare, IIC SCL
57	PE0	36	I/O	General-purpose digital I/O, Output Compare, IIC SDA
58	PC4	20	I/O	General-purpose digital I/O, Output Compare, SPI SS
59	PC7	23	I/O	General-purpose digital I/O, Output Compare, UART Tx, SPI SCK
60	PC6	22	I/O	General-purpose digital I/O, Output Compare, UART Rx, SPI MISO

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Module Pin	Name	MCU Pin	Type	Description
61	PC5	21	I/O	General-purpose digital I/O, Output Compare, UART XCK1, SPI MOSI
62	NC	N/A	NC	No Connect
63	NC	N/A	NC	No Connect
64	NC	N/A	NC	No Connect
65	NC	N/A	NC	No Connect
66	NC	N/A	NC	No Connect
67	GND	N/A	GND	Ground
68	GND	N/A	GND	Ground
69	GND	N/A	GND	Ground

Table 2 SiFLEX Module Pin Descriptions

MODULE OVERVIEW

Figure 5 shows the internal interconnects of the ICs on the SiFLEX module. Consult the respective IC datasheets for details, or contact LSR sales to purchase the SiFLEX module schematics as part of LSR's ModFLEX™ design program. For a high-level block diagram of the SiFLEX module, see Figure 1.

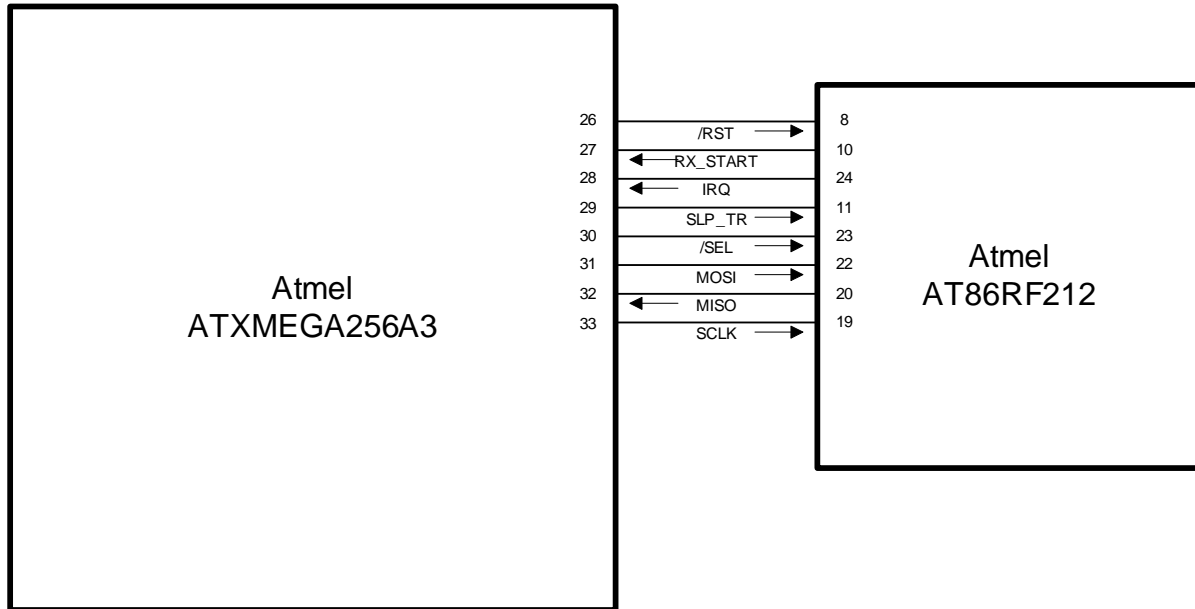


Figure 5 SiFLEX Module Block Diagram – Internal Interconnects

Microcontroller

The XMEGA A3 is a family of low power, high performance and peripheral rich CMOS 8/16-bit microcontrollers based on the AVR® enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the XMEGA A3 achieves throughputs approaching 1 Million Instructions Per Second (MIPS), thus allowing the system designer to optimize power consumption versus processing speed. Figure 6 shows a block diagram of the ATXMEGA256A3.

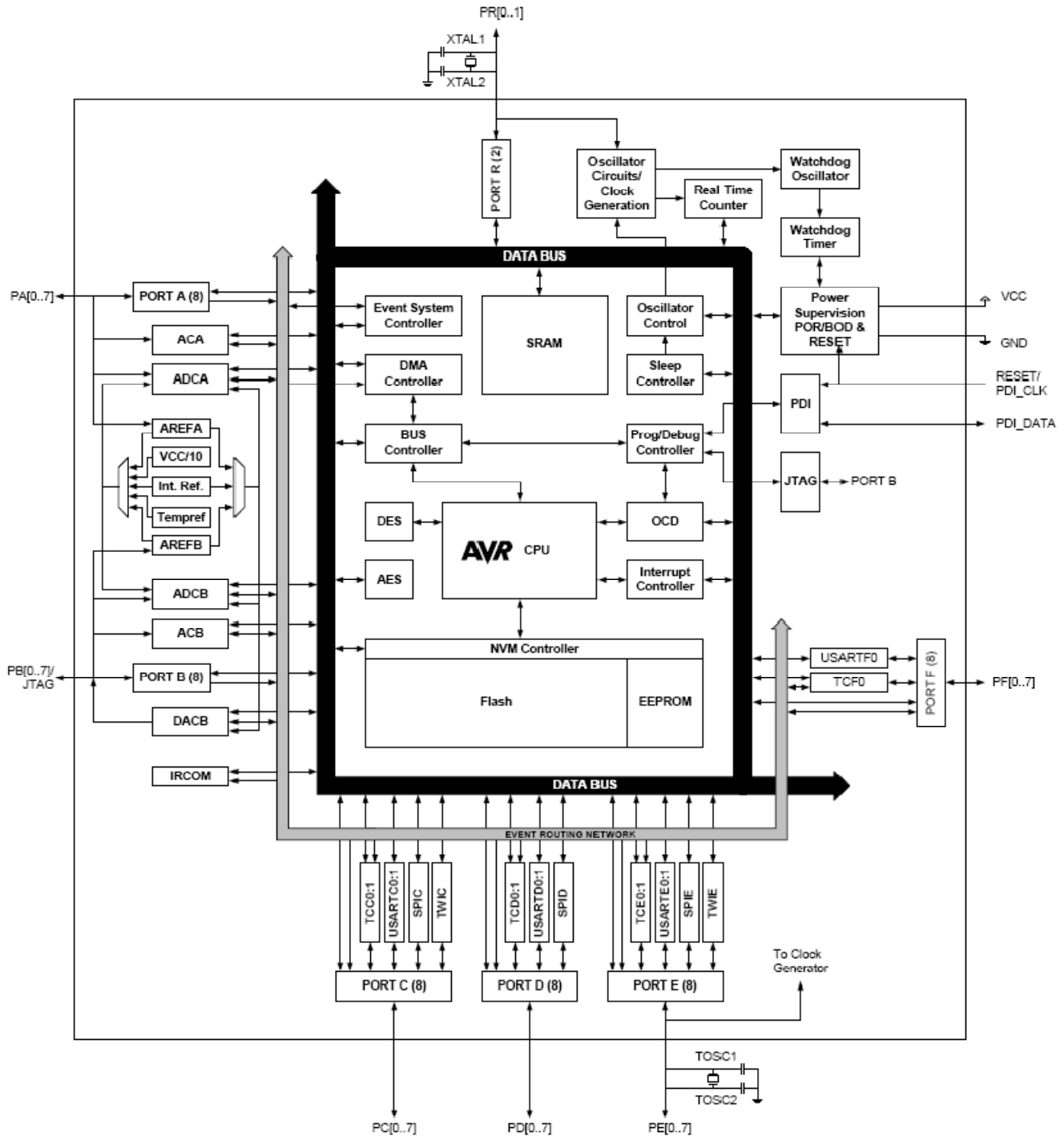


Figure 6 ATXMEGA256A3 Block Diagram

The AVR CPU combines a rich instruction set with 32 general purpose working registers. All the 32 registers are directly connected to the Arithmetic Logic Unit (ALU), allowing two independent registers to be accessed in one single instruction, executed in one clock cycle. The resulting architecture is more code efficient while achieving throughputs many times faster than conventional single-accumulator or CISC based microcontrollers.

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The XMEGA A3 devices have five software selectable power saving modes. The Idle mode stops the CPU while allowing the SRAM, DMA Controller, Event System, Interrupt Controller and all peripherals to continue functioning. The Power-down mode saves the SRAM and register contents but stops the oscillators, disabling all other functions until the next TWI or pin-change interrupt, or Reset. In Power-save mode, the asynchronous Real Time Counter continues to run, allowing the application to maintain a timer base while the rest of the device is sleeping. In Standby mode, the Crystal/Resonator Oscillator is kept running while the rest of the device is sleeping. This allows very fast start-up from external crystal combined with low power consumption. In Extended Standby mode, both the main Oscillator and the Asynchronous Timer continue to run. To further reduce power consumption, the peripheral clock for each individual peripheral can optionally be stopped in Active mode and Idle sleep mode.

Radio

The AT86RF212 is a low-power, low-voltage 800/900 MHz transceiver specially designed for low-cost IEEE 802.15.4, ZigBee™, and high data rate ISM applications. For the sub-1 GHz bands, it supports a low data rate of 40kbps of the IEEE 802.15.4-2003 standard [2] and provides an optional data rate 250kbps using O-QPSK, according to IEEE 802.15.4-2006. Furthermore hardware accelerators improve overall system power efficiency and timing.

The receiver path is based on a low-IF architecture. After channel filtering and down conversion the low-IF signal is sampled and applied to the digital signal processing part. Communication between transmitter and receiver is based on direct sequence spread spectrum with different modulation schemes and spreading codes. The AT86RF212 supports the IEEE 802.15.4-2006 standard mandatory BPSK modulation and optional O-QPSK modulation in the 800 and 900 MHz band. For applications not necessarily targeting IEEE compliant networks the radio transceiver supports proprietary High Data Rate Modes based on O-QPSK.

The AT86RF212 features hardware supported 128 bit security operation. The standalone AES encryption/decryption engine can be accessed in parallel to all PHY operational modes. Configuration of the AT86RF212, reading, and writing of data memory as well as the AES hardware engine are controlled by the SPI interface and additional control signals.

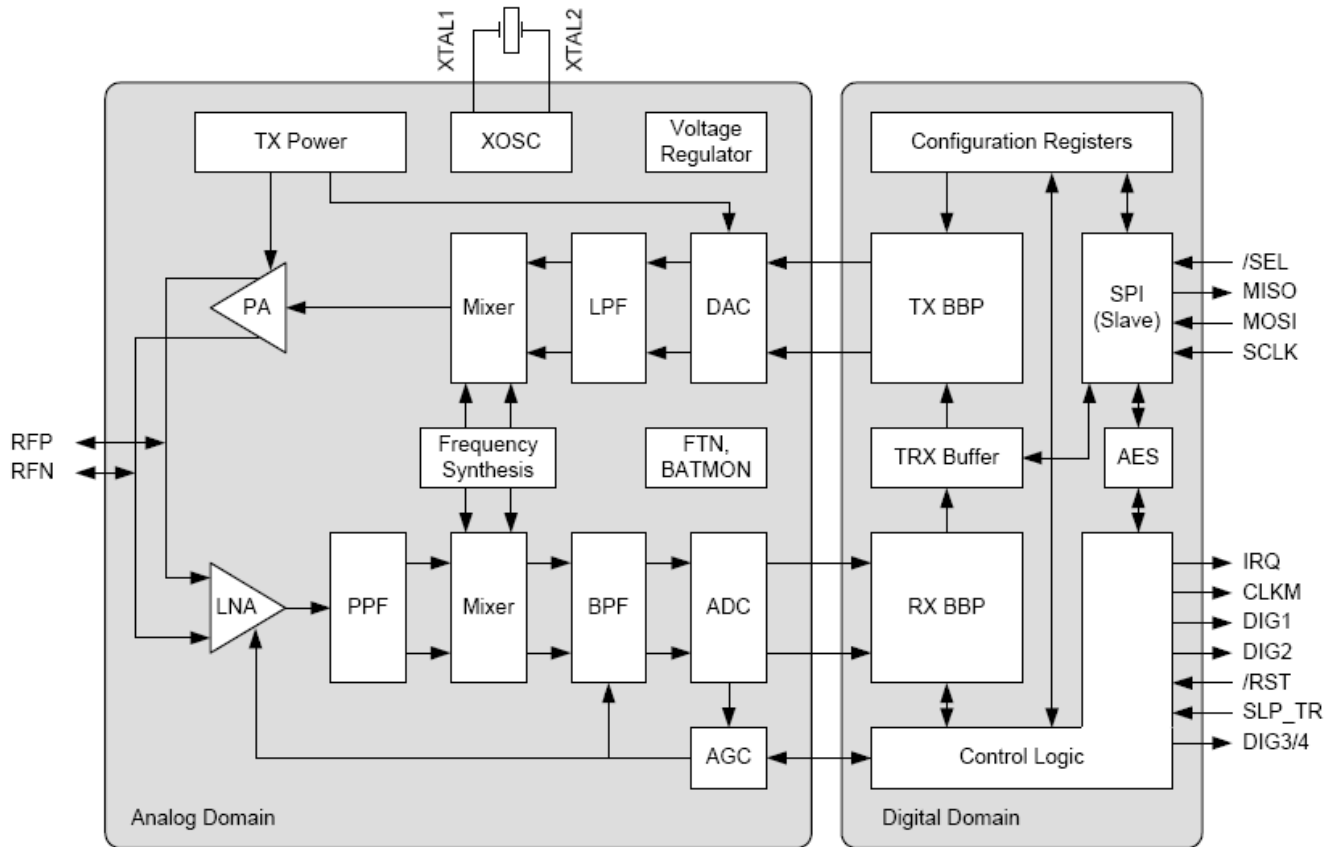


Figure 7 AT86RF212 Block Diagram

RF Amplifier

The SiFLEX module contains a discrete high performance RF Front End for low-power and low-voltage 900MHz wireless applications. It is capable of 250mW output power, providing miles of range in outdoor applications.

Antenna Options

The SiFLEX module includes multiple antenna options. The module's regulatory certification has been completed with the following antennas:

- Integrated 3.2-inch wire monopole soldered to the board.
- Pulse W3112A helical antenna
- Nearson S467AH-915 dipole antenna attached to the board via 6-inch cable with connector.

The SiFLEX castellated RF trace is not covered in the modular certification. If a host board is designed that will utilize an off board antenna via the castellated antenna connection an additional certification will be required. LS Research is equipped with a certification lab and can assist in getting this done at a very reasonable cost in a short period of time.

An adequate ground plane is necessary to provide good efficiency. The ground plane of the host board on which the module is mounted increases the effective antenna ground plane size and improves the antenna performance.

The environment the module is placed in will dictate the range performance. The non-ideal characteristics of the environment will result in the transmitted signal being reflected, diffracted, and scattered. All of these factors randomly combine to create extremely complex scenarios that will affect the link range in various ways.

It is also best to keep some clearance between the antenna and nearby objects. This includes how the module is mounted in the product enclosure. Unless the items on the following list of recommendations are met, the radiation pattern can be heavily distorted.

Whichever antenna is used, it is best to keep a few things in mind when determining its location.

- Never place ground plane or copper trace routing underneath the antenna.
- LSR recommends keeping metal objects as far away from the antenna as possible. At a very minimum keep the antenna at least 5 cm from any metallic objects, components, or wiring. The farther the antenna is placed from these interferers, the less the radiation pattern and gain will be perturbed.
- Do not embed the antenna in a metallic or metalized plastic enclosure.
- If located within a plastic enclosure, keep the enclosure at least 1 cm from the antenna.

MODES OF OPERATION

- With a host microcontroller
- With the Atmel 802.15.4 MAC
- With the Atmel ZigBee stack

Host Microcontroller

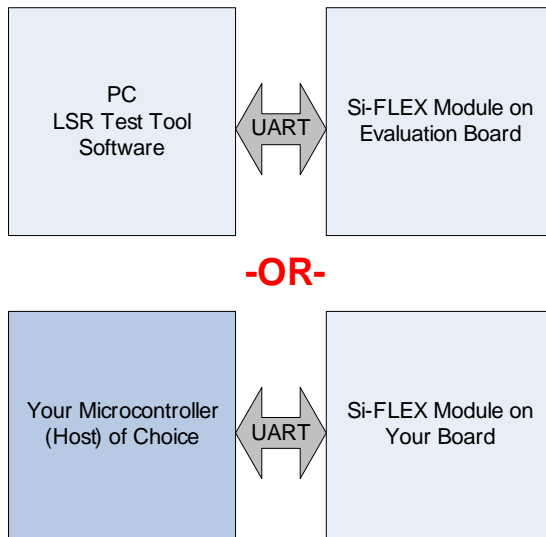


Figure 8 Host Microcontroller Modes of Operation

Out of the box the SiFLEX module contains an 802.15.4 based application that uses a host serial processor. This allows features of the module to be explored with the LSR PC based test tool, or controlled with a host microcontroller. The advantage of this method is simplicity; all major features of using the radio are simplified into a simple serial message, taking the burden of becoming a radio expert off the developer.

Use the Communications Log in the ModFLEX™ Test Tool software and serial host protocol documents to see the messages in action. It will help you become familiar with the serial commands and how to implement them on your own microcontroller.

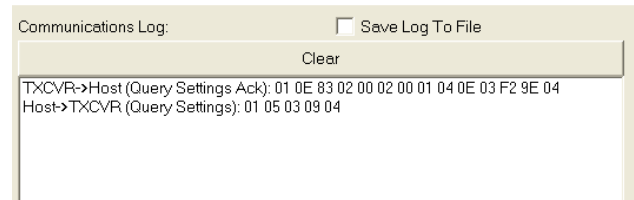


Figure 9 ModFLEX™ Test Tool Communications Log

Some examples of serial commands that can be used with the SiFLEX Module:

- Set/Query RF channel
- Set/Query RF power
- Set/Query device address
- Transmit RF data or notification RF data received
- Go to Sleep

Software Stacks

There are two software stacks provided by Atmel to streamline development:

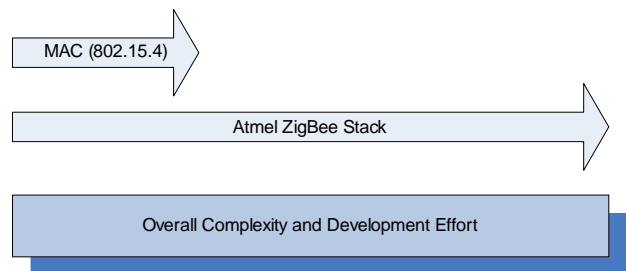


Figure 10 SiFLEX Compatible Stacks

802.15.4 MAC

- Use for applications requiring point-to-point or star network topology.
- Advantages: Quick learning curve, minimize software development, easy to deploy in the field
- Disadvantages: No mesh networking

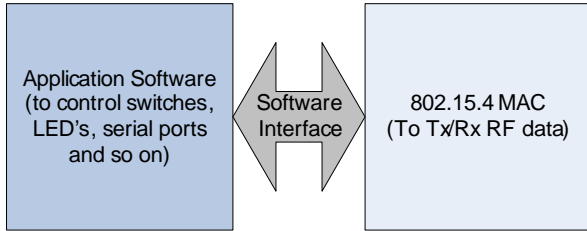


Figure 11 SiFLEX with 802.15.4 MAC

Atmel ZigBee Stack

- Use when mesh networking is required.

- Advantages: Covers a large area with a ZigBee network.
- Disadvantages: Large learning curve, more software development, complexity

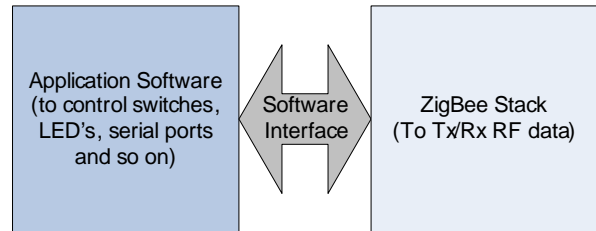


Figure 12 SiFLEX with Atmel ZigBee Stack

DEVELOPMENT TOOLS

AVR Studio

AVR Studio® is an Integrated Development Environment (IDE) for writing and debugging AVR® applications in Windows® 9x/NT/2000/XP/Vista(32- and 64-bit) environments. AVR Studio 4 includes an assembler, simulator, and in-circuit debugger.

AVR Studio is the Integrated Development Environment (IDE) developed by Atmel for writing and debugging Atmel AVR applications.

Eclipse

Eclipse is an IDE for C/C++ developers.

The Eclipse IDE requires a Java Runtime Environment (JRE) be installed on your machine to run. While it can run using a Java 1.4 JRE, a Java5 JRE (minimum) is recommended.

See the SiFLEX User's Guide for detailed instructions for installing Eclipse and integrating it with AVR Studio and WinAVR.

WinAVR

WinAVR is a suite of executable, open source software development tools for the Atmel AVR series of RISC microprocessors hosted on the Windows platform. It includes the GNU GCC compiler for C/C++.

WinAVR contains all the tools for developing on AVR family microcontrollers from Atmel. This includes avr-gcc (compiler), avrdude (programmer), avr-gdb (debugger), and more.

AVR JTAGICE mkII

Custom firmware development can be done on the SiFLEX module using development tools available through Atmel. Shown in Figure 13, a JTAGICE mkII interface is required. It plugs

into the ModFLEX™ Development Board, and can easily be adapted to other hardware. See the Atmel website for more information and ordering options.



Figure 13 AVR JTAGICE mkII

AVRISP mkII

Another option for in-circuit programming is the AVRISP mkII from Atmel, Figure 14. The AVRISP mkII combined with AVR Studio® can program new AVR 8-bit RISC microcontrollers with ISP Interface.



Figure 14 AVRISP mkII

IAR Embedded Workbench for Atmel AVR

Another option is IAR Embedded Workbench for Atmel AVR. IAR Embedded Workbench for AVR is an integrated development environment for building and debugging embedded applications. Visit the IAR Systems website for additional information.

ELECTRICAL SPECIFICATIONS

The majority of these characteristics are based on the use of the Atmel IEEE 802.15.4 MAC loaded with the generic application firmware written by LSR. Custom firmware may require these values to be re-characterized by the customer.

Absolute Maximum Ratings

Rating	Min	Max	Unit
Power supply voltage	0	3.6	V
Voltage on any pin with respect to ground	-0.3	V _{cc} + 0.3	V
RF input power		+10	dBm
Operating temperature range	-40	+85	°C
Storage temperature	-50	+150	°C

Table 3 Absolute Maximum Ratings¹

Recommended Operating Conditions

Characteristic	Min	Typ	Max	Unit
Power supply voltage (V _{dd})	2.0	3.3	3.45	V _{dc}
Ambient temperature range	-40	25	85	°C

Table 4 Recommended Operating Conditions

Module will NOT transmit, if VCC > 3.5V.

¹ Under no circumstances should exceeding the maximum ratings specified in the Absolute Maximum Ratings section be allowed. Stressing the module beyond these limits may result permanent damage to the module that is not covered by the warranty.

General Characteristics

Parameter	Min	Typ	Max	Unit
RF frequency range	906		924	MHz
RF data rate	40		1000	kbps
Host data rate	1.2	19.2	921.6	kbps
Flash memory		256		kB
RAM		16		kB
EEPROM		4		kB

Table 5 General Characteristics

Power Consumption

($T_a = 25^\circ\text{C}$, $V_{cc} = 3.3\text{V}$, $f_c = 906\text{-}924\text{MHz}$, $R_{load} = 50\Omega$)

Parameter	Test Conditions	Min	Typ	Max	Unit
Transmit mode	Maximum power step	270	285	300	mA
Receive mode		27	30	33	mA
Sleep mode			2	5	μA

Table 6 Power Consumption

DC Characteristics – General Purpose I/O

Parameter	Test Conditions	Min	Typ	Max	Unit
Logic input low		-0.3		$0.2 * V_{CC}$	V
Logic input high		$0.8 * V_{CC}$		$V_{CC} + 0.3$	V
Logic output low	$I_{out} = 15\text{mA}$ $V_{cc} = 3.3\text{V}$		0.4		V
Logic output high	$I_{out} = -8\text{mA}$ $V_{cc} = 3.3\text{V}$		2.9		V

Table 7 DC Characteristics – General Purpose I/O

RF Characteristics

Transmitter Characteristics

(TA =25°C, VDD=3.3 V, fc =906-924 MHz)

Parameter	Test Conditions	Min	Typ	Max	Unit
Nominal max output power	250mW	22	24.0	25	dBm
Programmable output power range	22 Steps	-6.0		25	dBm
Harmonics (2fo)			-34		dBm
Harmonics (3fo)			-38		dBm
Error vector magnitude			10	35	% rms

Table 8 Transmitter RF Characteristics

Host Protocol RF Power Level	AT86RF212 PHY_TX_PWR Register Value	BPSK into 50 ohms at U.FL		OQPSK into 50 ohms at U.FL	
		RF Output Power (dBm)	Typical Current Consumption (mA)	RF Output Power (dBm)	Typical Current Consumption (mA)
21	0x0C	23.9	260	24.4	285
20	0x0B	23.8	255	24.3	275
19	0x0A	23.4	245	24.0	270
18	0x09	23.0	235	23.5	260
17	0x08	21.8	200	22.0	220
16	0x07	20.7	185	20.7	195
15	0x06	20.0	175	20.0	185
14	0x05	19.5	165	19.5	175
13	0x04	18.6	150	18.5	160
12	0x03	17.6	140	17.5	145
11	0x02	16.2	125	16.0	130
10	0x23	15.6	120	15.0	120
9	0x22	14.0	105	13.0	105
8	0x42	12.0	95	10.5	90
7	0x41	9.0	80	8.0	80
6	0x61	7.0	75	5.0	70
5	0x60	4.5	68	2.5	65
4	0x83	1.0	62	0.0	61
3	0x82	-1.5	59	-3.0	57
2	0x81	-4.0	57	-5.0	55
1	0xA1	-6.0	55	-7.0	54
0	0xC0	-8.0	54	-9.0	53

Table 9 RF Power Settings
**Receiver Characteristics
 (TA =25°C, VDD=3.3 V, fc =906-924 MHz)**

Parameter	Test Conditions	Min	Typ	Max	Unit
Receiver Sensitivity @ 1% PER	BPSK 40kbit/s ANT1 Port		-102		dBm
Saturation Level @ 1% PER	ANT1 port		-2		dBm

Table 10 Receiver RF Characteristics

For additional details regarding the electrical specifications, refer to the ATXMEGA256A3 and AT86RF212 datasheets on the Atmel website.

SOLDERING RECOMMENDATIONS

Recommended Reflow Profile

- Ramp up rate (from Tsoakmax to Tpeak) 3°/sec max
- Minimum Soak Temperature 150°C
- Maximum Soak Temperature 200°C
- Soak Time 60-120 sec
- TLiquidus 217°C
- Time above TL 60-150 sec
- Tpeak 260°C
- Time within 5° of Tpeak 20-30 sec
- Time from 25° to Tpeak 8 min max
- Ramp down rate 6°C/sec max
- Achieve the brightest possible solder fillets with a good shape and low contact angle.

Lead (Pb) Free Soldering Paste

Use of a “No Clean” Lead (Pb) free Tin/Silver/Copper solder paste is strongly recommended. Melting temperature 216-221°C.

Note: The quality of solder joints on the castellations (‘half vias’) where they contact the host board should meet the appropriate IPC Specification. See IPC-A-610-D Acceptability of Electronic Assemblies, section 8.2.4 Castellated Terminations.”

The soldering temperatures and profile chosen depends on additional factors such as choice of soldering paste, size, thickness and other properties of the host board.

Cleaning

In general, cleaning the populated modules is strongly discouraged. Residuals under the module cannot be easily removed with any cleaning process.

- Cleaning with water can lead to capillary effects where water is absorbed into the gap between the host board and the module. The combination of soldering flux residuals and encapsulated water could lead to short circuits between neighboring pads. Water could also damage any stickers or labels.
- Cleaning with alcohol or a similar organic solvent will likely flood soldering flux residuals into the RF shield, which is not accessible for post-washing inspection. The solvent could also damage any stickers or labels.
- Ultrasonic cleaning could damage the module permanently.

Consider using a “no clean” soldering paste and thus eliminate the post-soldering cleaning step completely.

Optical Inspection

After soldering the Module to the host board, consider optical inspection to check the following:

- Proper alignment and centering of the module over the pads.
- Proper solder joints on all pads.
- Excessive solder or contacts to neighboring pads, or vias.

Repeating Reflow Soldering

Only a single reflow soldering process is encouraged for host boards.

Wave Soldering

If wave soldering is required on the host boards due to the presence of leaded components, only a single wave soldering process on the side opposite the module is encouraged.

Hand Soldering

Hand soldering is possible. Use a soldering iron temperature setting equivalent to 350°C, follow IPC recommendations/reference document IPC-7711.

Rework

The SiFLEX module can be unsoldered from the host board. Use of a hot air rework tool and hot plate for pre-heating from underneath is recommended. Avoid overheating.

Never attempt a rework on the module itself, e.g. replacing individual components. Such actions will terminate warranty coverage.

Additional Grounding

Attempts to improve module or system grounding by soldering braids, wires, or cables onto the module RF shield cover is done at the customer's own risk. The numerous ground pins at the module perimeter should be sufficient for optimum immunity to external RF interference.

SHIPPING, HANDLING, AND STORAGE

Shipping

Bulk orders of the SiFLEX modules are delivered in trays of 50.

Handling

The SiFLEX modules are designed and packaged to be processed in an automated assembly line.

Warning! The SiFLEX modules contain a highly sensitive electronic circuitry. Handling without proper ESD protection may destroy or damage the module permanently.

Warning! According to JEDEC ISP, the SiFLEX modules are moisture sensitive devices. Appropriate handling instructions and precautions are summarized in Section 2.1. Read carefully to prevent permanent damage due to moisture intake.

Moisture Sensitivity Level (MSL)

MSL 3, per J-STD-033

Storage

Storage/shelf life in sealed bags is 12 months at <40°C and <90% relative humidity.

AGENCY CERTIFICATIONS

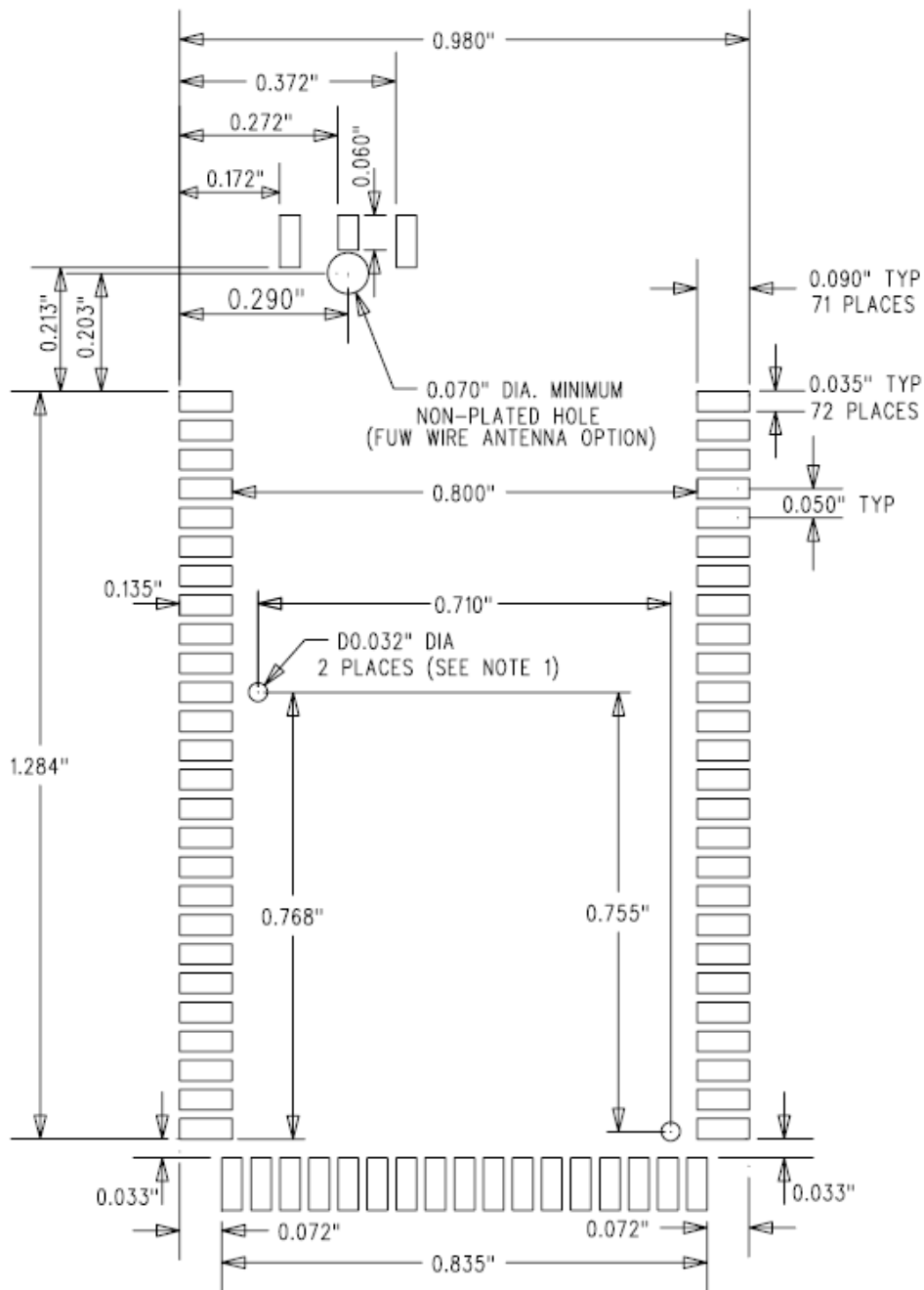
FCC ID: TFB-SiFLEX1

IC ID: 5969A-SiFLEX1

See the User's Guide for detailed information regarding agency approvals.

MECHANICAL DATA

PCB Footprint



NOTES:

- 1 - OPTIONAL ALIGNMENT HOLES ARE FOR USE WITH FIXTURED PLACEMENT AND HAND SOLDERING OPERATIONS.
- 2 - SEE SiFLEX02 MODULE USER'S GUIDE SFLX-UG-0002 FOR ADDITIONAL INFORMATION

Figure 15 PCB Footprint

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General Module Dimensions

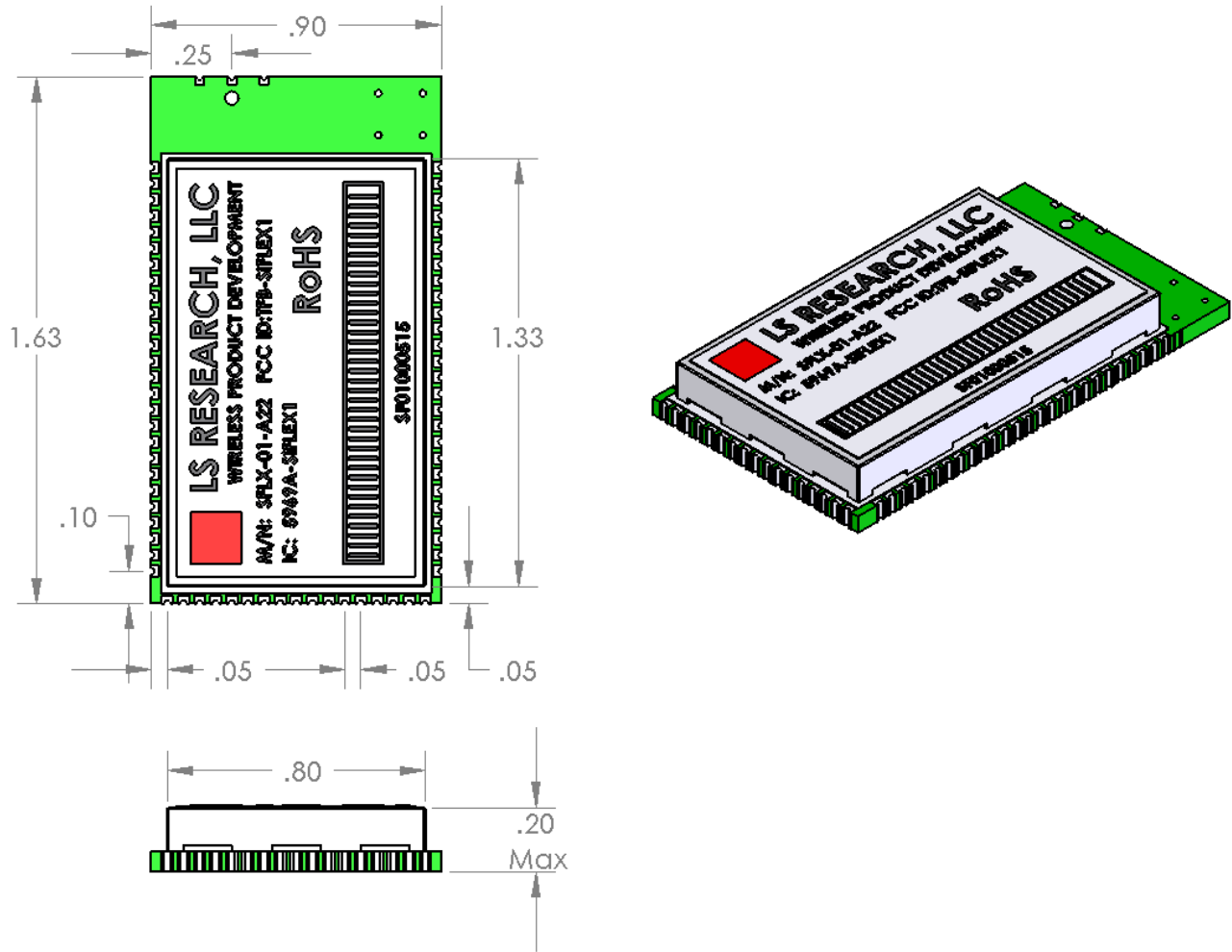


Figure 16 Basic dimensions

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Module with Wire Antenna

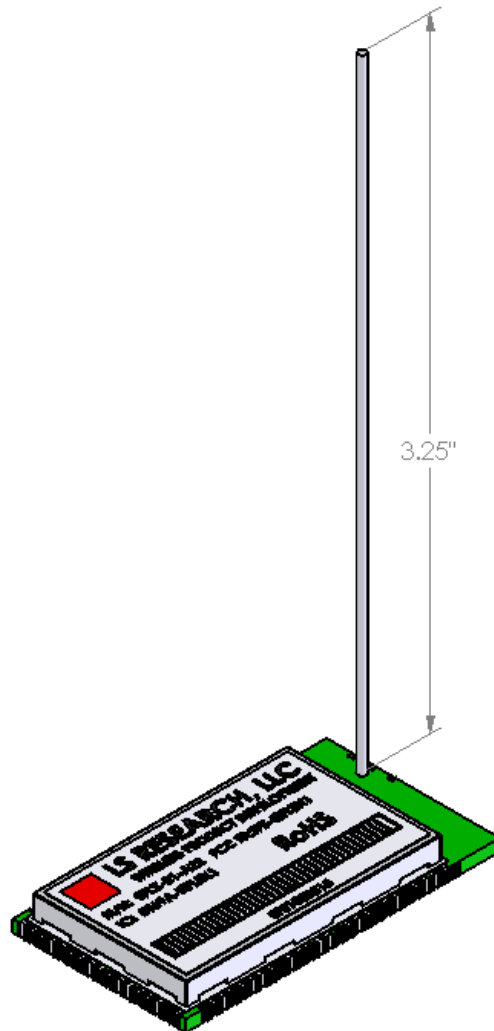


Figure 17 SiFLEX with wire antenna

Module with Helical Antenna

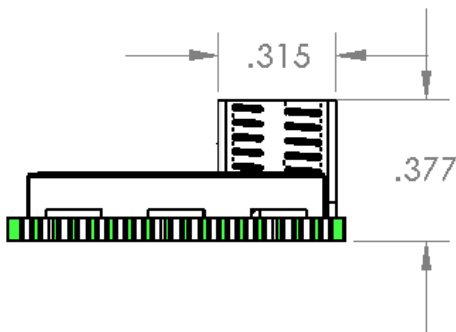
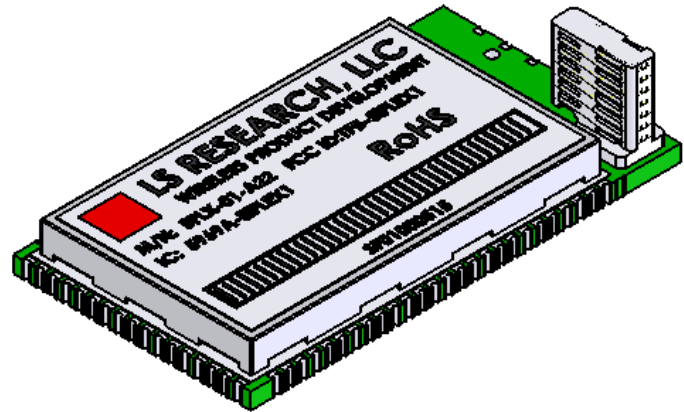
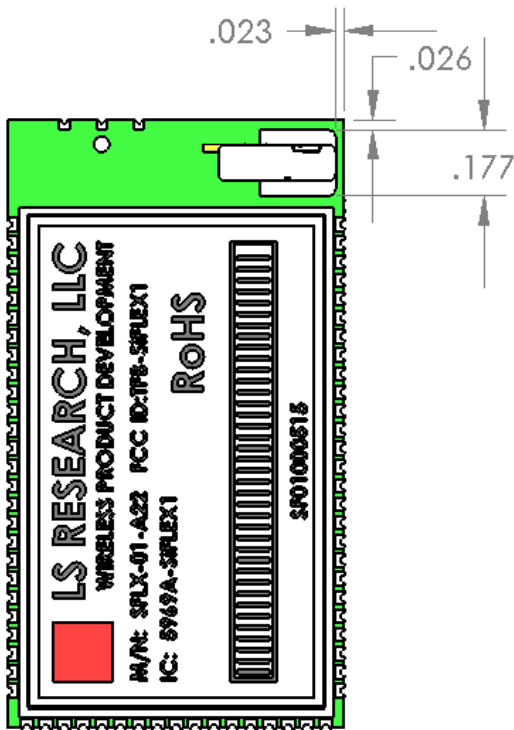


Figure 18 SiFLEX with helical antenna

MODULE REVISION HISTORY

Rev A

- Engineering Samples.

Rev B

- Performance Improvements, removed second antenna, added helical antenna option

Rev C

- Added castellated antenna option

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