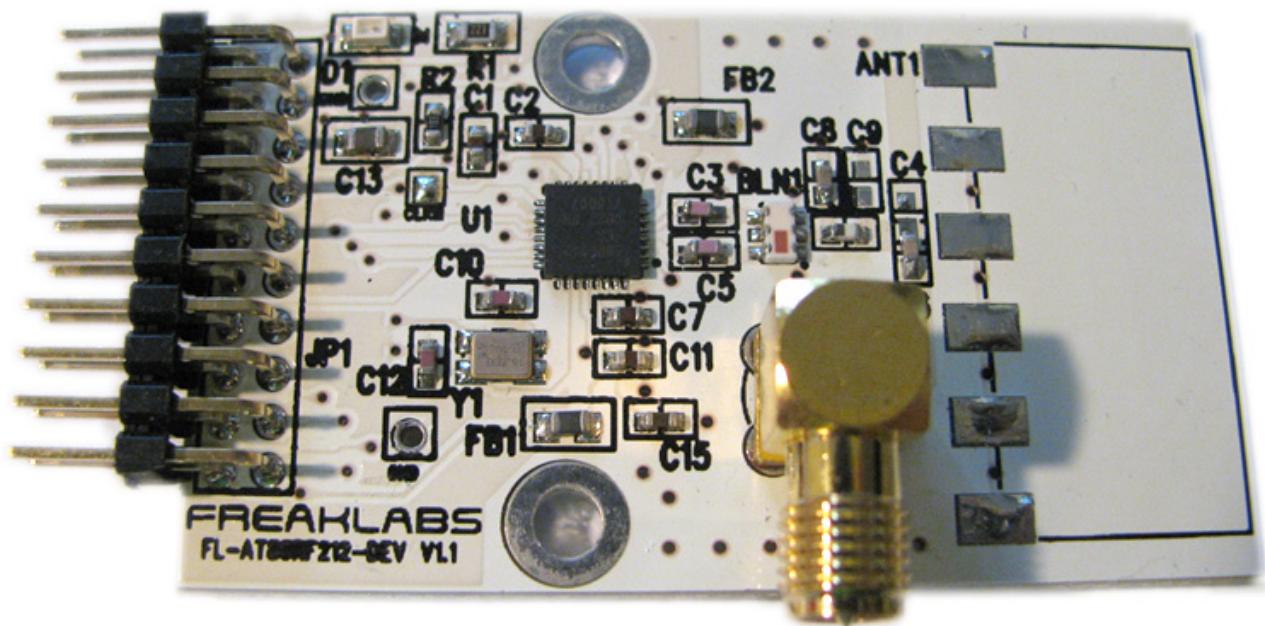


FREAKLABS

Rapid Prototyping Platform
900 MHz 802.15.4 Radio Board
FL-AT86RF212-DEV v1.1
User Guide v1.1A



Document Revision History

<i>Date</i>	<i>Description</i>
2010-04-01	Document creation

Specifications

The FreakLabs FL-AT86RF212-DEV 900MHz modular radio board is designed to be an easy way to rapidly prototype wireless sensor/actuator applications using the 900 MHz IEEE 802.15.4 protocol. It includes a complete radio circuit based on the Atmel AT86RF212 as well as a standard FreakLabs universal serial peripheral connector and either an external RP-SMA antenna connector or an on-board SMD antenna.

It's designed to work with MCU boards that support the standardized FreakLabs Universal Serial Connector and has a peripheral-side, right angle, male connector that fits into any of the FreakLabs MCU boards.

It is also supported by the Chibi open source wireless protocol stack for quick and easy wireless communication and testing.

Peripherals

The transceiver is the only peripheral on this board and it consists of the Atmel AT86RF212 900 MHz 802.15.4 radio. The AT86RF212 has a lot of built-in hardware to handle many of the time sensitive or repetitive tasks in the 802.15.4 specification such as automatic ACK generation, frame filtering based on address, auto-CRC generation and checking, automatic retries, and auto transmit after checking for a clear channel.

Some other nice features of the radio are that it supports the Chinese 780 MHz, European 868 MHz, and North American 916 MHz bands. There are also different modulation schemes that can be chosen based on requirements. The highest bitrates use O-QPSK modulation which can handle up to 1 Mbps data rates in proprietary mode or 250 kbps in IEEE 802.15.4 compliant mode. The modulation can also be changed to BPSK which yields approximately 5-10x improvement in receiver sensitivity and thus greater range. However using BPSK, the data rate goes down to 20-40 kbps.

The RF front end consists of a matching circuit to match the radio data signals to the 50 ohm antenna connector and optional discrete components to choose between the on-board SMD antenna and the external RP-SMA antenna connector. The components in the matching circuit are chosen and tested to be as close as possible to 50 ohms so that there will be very little power loss on the incoming and outgoing data signals.

Connectors

The universal serial connector (USC) interface is standard for all of the FreakLabs development boards. The FL-AT86RF212-DEV board contains a peripheral-side universal serial connector.

Universal Serial Connector Pinouts

The FL-AT86RF212-DEV radio board supports the Universal Serial Connector (USC) v1.1. The

QUICK SPECS

Radio: AT86RF212, 900 MHz, 802.15.4 radio

Connectors: 1 USC Peripheral

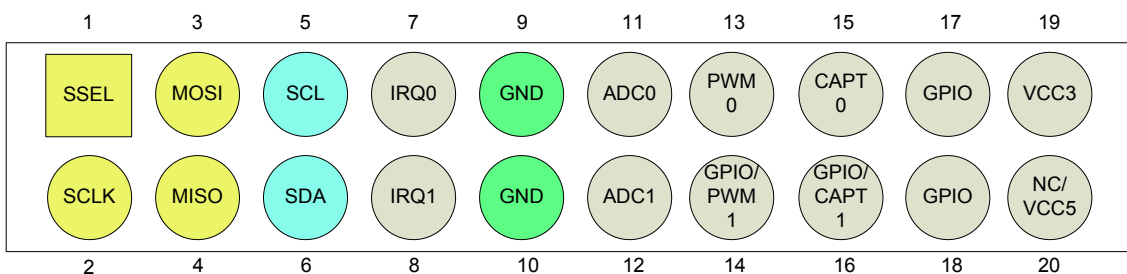
Antenna: RP-SMA external antenna, SMD antenna

connector supports an SPI bus, I2C bus, 2 interrupts, 2 analog inputs, 1 PWM output, 1 timer/capture input, 6 GPIOs, 3.3V supply, and optional 5V supply. All pins except power pins can also be used as GPIO if there is no need for the principal function. In the case of the radio board, only the SPI bus, 1 interrupt, and a few GPIO pins are used.

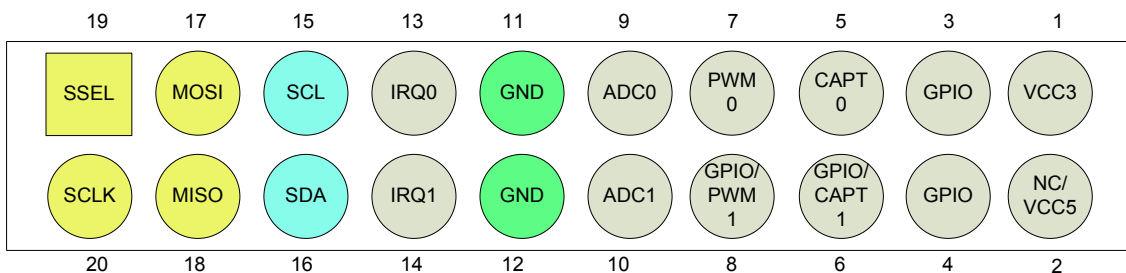
The connector consists of a host side which is a 20-pin, female, right-angle header and a peripheral side which is a 20-pin, male, right-angle header. The host side connector will always be on MCU boards and the peripheral connector will be found on peripheral boards that interface to the MCU boards.

The reason right angle connectors were chosen was so that the complete system can be level. This makes it easier to access individual signals and pins, as well as make modifications to the circuit. The following diagram shows the pinouts of the connectors:

Universal Serial Connector v1.1 – Host (MCU) side



Universal Serial Connector v1.1 – Peripheral side



The specific pinout of the universal serial peripheral connector of the FL-AT86RF212-DEV board can be found below:

USC Peripheral Connector (JP1)			
<i>Pin</i>	<i>Description</i>	<i>Pin</i>	<i>Description</i>
1	VCC3	2	NC
3	NC	4	NC

USC Peripheral Connector (JP1)

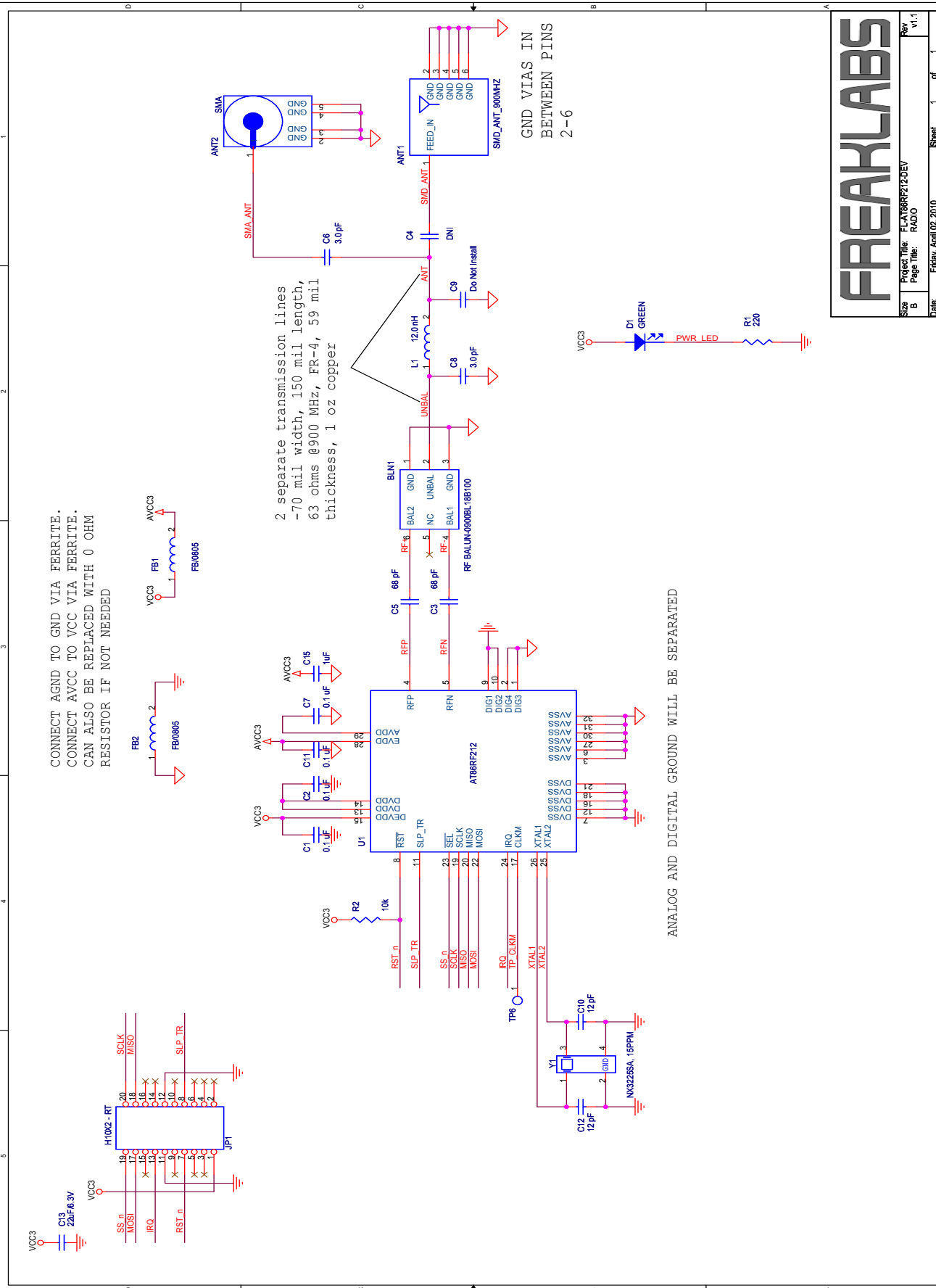
<i>Pin</i>	<i>Description</i>	<i>Pin</i>	<i>Description</i>
5	NC	6	NC
7	RST_n	8	SLP/TR
9	NC	10	NC
11	GND	12	GND
13	INT	14	NC
15	NC	16	NC
17	MOSI	18	MISO
19	SS_n (SPI Select)	20	SCLK

Disclaimer

The FL-AT86RF212-DEV board is NOT FCC approved. It is designed to comply with FCC Part 15 rules. However this board is not in a finished product form and is only intended for experimental and research/development purposes. If you wish to use this board in an actual product, you will need to attain certification with the appropriate local regulatory body for the complete system. Additionally, please use the wireless equipment in a responsible manner with regard for others and your surroundings.

Schematics

Schematics can be found on the following page:



CONNECT AGND TO GND VIA FERRITE.
 CONNECT AVCC TO VCC VIA FERRITE.
 CAN ALSO BE REPLACED WITH 0 OHM
 RESISTOR IF NOT NEEDED

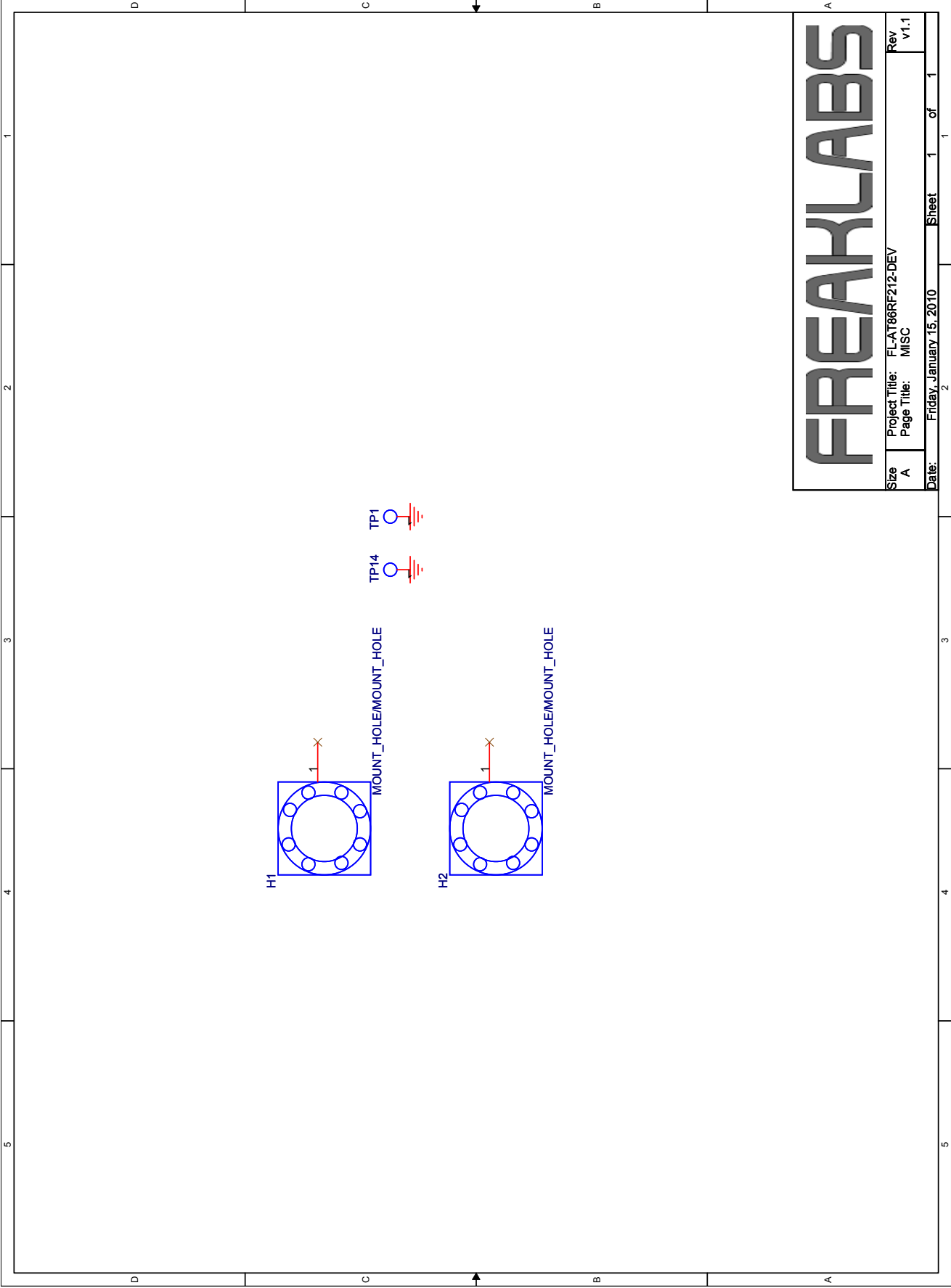
2 separate transmission lines
 -70 mil width, 150 mil length,
 63 ohms @900 MHz, FR-4, 59 mil
 thickness, 1 oz copper

GND VIAS IN
 BETWEEN PINS
 2-6

ANALOG AND DIGITAL GROUND WILL BE SEPARATED

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Project Title: FL-AT86RF212-DEV
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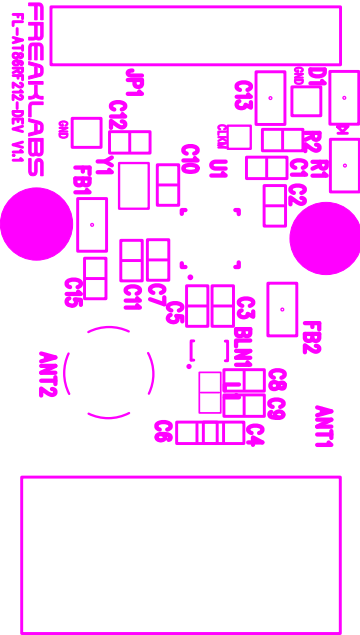
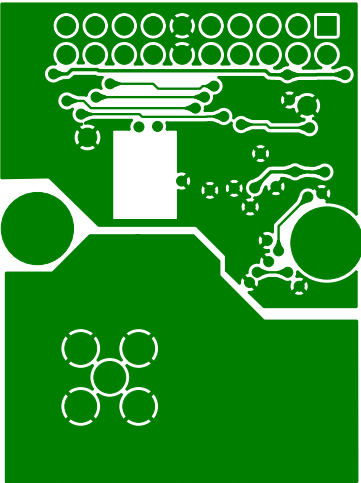
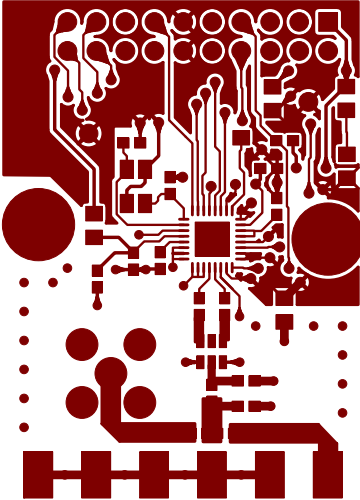
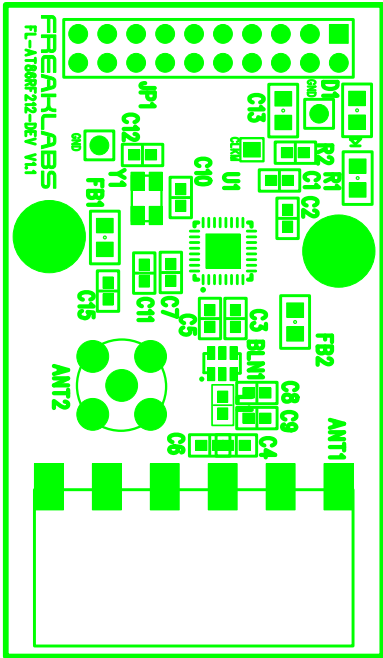
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Size	A	Project Title:	FL-AT86RF212-DEV	Rev	v1.1
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PCB Layout

PCB layout file order:

- 1. Assembly drawing
- 2. Top Layer
- 3. Bottom Layer
- 4. Silkscreen



Bill of Materials

Quantity	Reference	Manufacturer	Part Number	Description
1	ANT1	Antenna Factor	ANT-XXX-SP	900 MHz SMD Antenna (XXX=868 or 916)
1	ANT2	ChangHong	SMA-02-113-TGG	RP-SMA Connector
1	BLN1	Johanson Technology	0900BL18B100	900 MHz balun
4	C1, C2, C7, C11	Various		0.1uF/50V, 0603
2	C3,C5	Murata	ERB1885C2E-680JDX5D	68 pF/250V, 0603, high freq
2	C4, C9	N/A		Not Installed
2	C6,C8	Johanson Technology	251R14S3R0B-V4T	3.0 pF/250V, 0603, high freq
2	C10,C12	Various		12 pF/50V, 0603
1	C13	Various		22uF/6.3V, 0805, MLCC
1	C15	Various		1uF/50V, 0603
1	D1	Various		Green LED, 0805
2	FB1,FB2	Various		Ferrite Bead, 0805
1	JP1	Various		10x2 Right angle header, male, 0.100"
1	L1	Taiyo Yuden	HK1608-12NJ-T	12 nH, 0603, high freq
1	R1	Various		220 ohms, 0805
1	R2	Various		10 kohms, 0603
1	U1	Atmel	AT86RF212	900 MHz, 802.15.4 radio
1	Y1	NDK	NX3225SA	16 MHz crystal, 15 ppm