Excellence in Compliance Testing

FCC Part 15.247
Transmitter Certification

Test Report

FCC ID: U9O-RFET

FCC Rule Part: 15.247

ACS Report Number: 07-0157-15C-RFET

Manufacturer: Wireless Control Network Solutions, LLC.; dba Synapse
Brand Name: RF Engine
Model: RFET

Manual

RF Engine Product Manual

Rev 0.1 – 5/1/2007

1.0 RF Engine OEM Modules

RF Engine modules meet IEEE 802.15.4 specifications. These modules provide a low power, highly reliable sensor wireless network at very low cost. The modules provide up to 16 channels of operation in the ISM 2.4GHz frequency band. The are two versions of modules. One version has an external power amplifier. This module will be referred to as RF Engine with amplifier. The other module has no external power amplifier and is referred to as RF Engine without amplifier.

1.1 Specifications

RF Engine Specifications		No Ext Amp	With Ext Amp
Performance	Indoor Range	200 ft.	1000 ft.
	Outdoor LOS Range	up to 1000 ft.	up to 3 miles
	Transmit Power Output	4 dBm	18 dBm
	RF Data Rate	250,000 bps	250,000 bps
	Receiver Sensitivity	~102 dBm (1% PER)	~102 dBm (1% PER)
Power Requirements	Supply Voltage	2.7 - 3.4 V	2.7 - 3.4 V
	Transmit Current (Typ)	40mA	110mA
	Idle/Receive Current (Typ)	50mA	50mA
	Power-down Current (Typ)	75uA @ 3 sec. wakeup cycle	75uA @ 3 sec. wakeup cycle
General	Frequency	ISM 2.4GHz	ISM 2.4GHz
	Spreading Method	Direct Sequence	Direct Sequence
	Modulation	O-QPSK	O-QPSK
	Dimensions	1.333" x 1.333"	1.333" x 1.333"
	Operating Temperature	~40 to 85 deg C.	~40 to 85 deg C.
	Antenna Options	Integrated F, External RPSMA	Integrated F, External RPSMA
Networking	Topology	SNAP (star)	SNAP (star)
	Error Handling	Retries and acknowledgement	Retries and acknowledgement
	Number of Channels	16	16
Available I/O	UARTS with HW Flow Control	2 Ports - 4 total I/O	2 ports - 4 total I/O
	GPIO	11 total; 8 can be analog in with 10bit ADC	11 total, 8 can be analog in with 10bit ADC
Agency Approvals	FCC Part 15.247	Yes	Yes
	Industry Canada (IC)	Yes	Yes

1.2 Module Pin Definitions

Pin No.	Name	Direction	Description
1	GND	-	Power Supply
2	GPIO0_TPM1CH2	Bidirectional	GPI/O, or Timer1 Channel 2
3	GPIO1_KBI0	Bidirectional	GPI/O, Keyboard In
4	GPIO2_KBI1	Bidirectional	GPI/O, Keyboard In
5	GPIO3_RX_UART0	Input	UART0 Data In
6	GPIO4_TX_UART0	Output	UART0 Data Out
7	GPIO5_KBI4_CTS0	Bidirectional	GPI/O, Keyboard In, or UART0 CTS
8	GPIO6_KBI5_RTS0	Bidirectional	GPI/O, Keyboard In, or UART0 RTS
9	GPIO7_RX_UART1	Input	RS232*/UART1 Data In
10	GPIO8_TX_UART1	Output	RS232*/UART1 Data Out
11	GPIO9_KBI6_CTS1	Bidirectional	GPI/O, Keyboard In, or RS232*/UART1_CTS
12	GPIO10_KBI7_RTS1	Bidirectional	GPI/O, Keyboard In, or RS232*/UART1_RTS
13	GPIO11_AD7	Bidirectional	GPI/O, or Analog In
14	GPIO12_AD6	Bidirectional	GPI/O, or Analog In
15	GPIO13_AD5	Bidirectional	GPI/O, or Analog In
16	GPIO14_AD4	Bidirectional	GPI/O, or Analog In
17	GPIO15_AD3	Bidirectional	GPI/O, or Analog In
18	GPIO16_AD2	Bidirectional	GPI/O, or Analog In
19	GPIO17_AD1	Bidirectional	GPI/O, or Analog In
20	GPIO18_AD0	Bidirectional	GPI/O, or Analog In
21	VCC	-	Power Supply
22	PTG0/BKDG	Bidirectional	Background Debug Communications
23	RESET*	Input	Module Reset, Active Low
24	GND	-	Power Supply

* RS232 levels only if MAX3232 chip installed.

1.3 Electrical Characteristics

Symbol	Parameter	Condition	Min	Typ	Max	Units	Note
Vcc	Supply Voltage	With RS232 Option	3.0	3.3	3.4	V	
		Without RS232 Option	2.7	3.0	3.4	V	
Top	Operating Temp		-40		85	Deg C	
Vih	Input Hi Voltage	Vcc = 3.3V	2.31			V	
Vil	Input Low Voltage	Vcc = 3.3V			1.15	V	
Vol	Output Low Voltage	Vcc = 3.3V (Iol = 2mA)			0.5	V	
Voh	Output High Voltage	Vcc = 3.3V (Ioh = -2mA)	Vcc – 0.5			V	
ILin	In Leakage Current	Vcc or Vss, all Pins			1	uA	
TX-Icc	Transmit Current	Vcc = 3.3V MCU Wait Mode		110		mA	1.
RX-Icc	Receive Current	Vcc = 3.3V MCU Wait Mode		50		mA	2.
SHDN-Icc	Shutdown Current	Doze Mode		75		uA	3

Notes:
1. This is for the maximum transmit power configuration.
2. This is the maximum receiver sensitivity configuration.
3. Based upon a 3 second wakeup cycle.

ADD Analog electrical specs **********

1.4 User Options

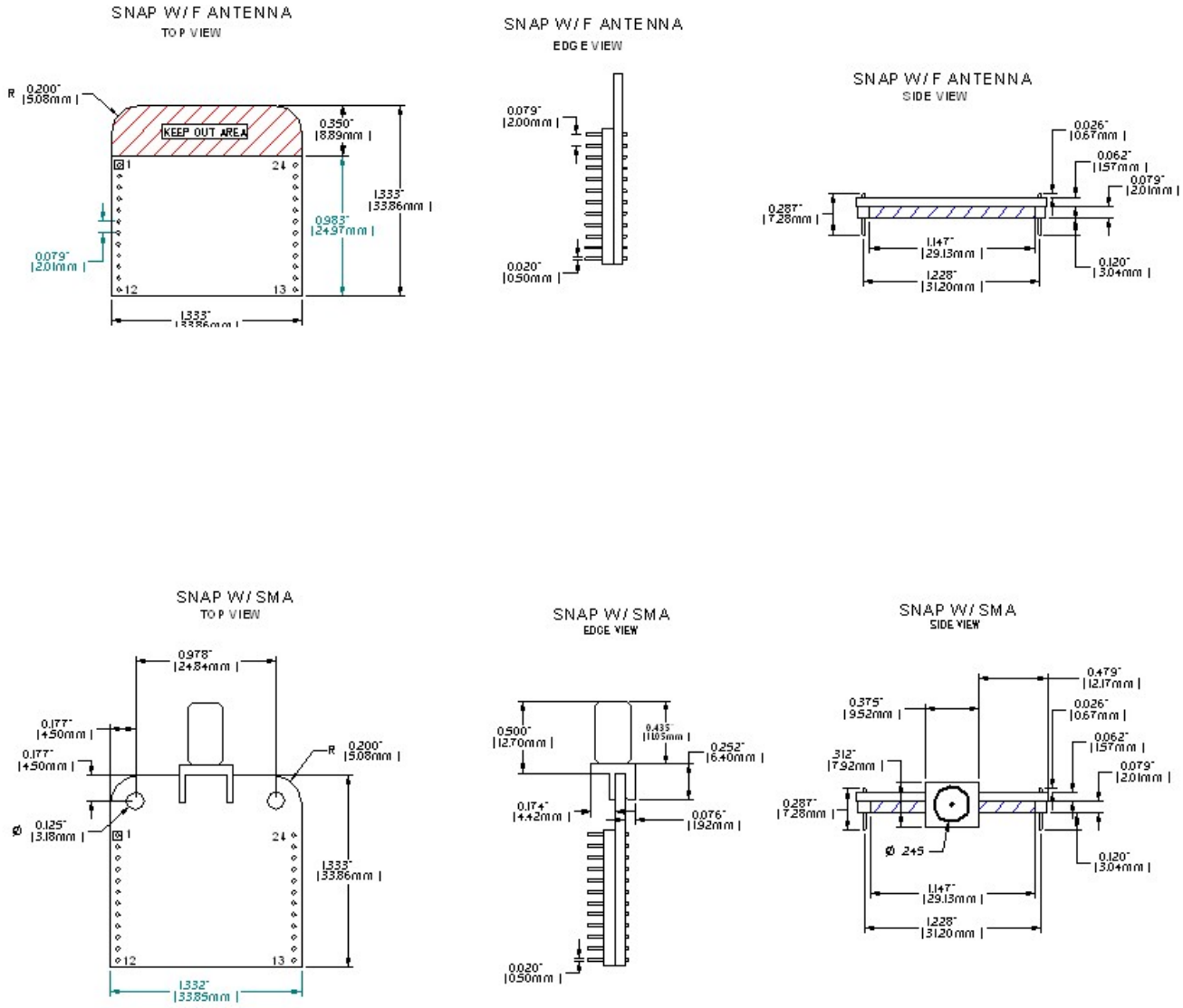
There are several options for the SNAP Module offerings to allow different capabilities for the user. Here is a partial list of these options.

Option	Description
Embedded F-Antenna	With the version of the module with embedded F-antenna, antenna is fully integrated into the module.
External Antenna	With the version of the module with RPSMA connector populated, an external antenna can be attached.
Increased RF Range	With the population of an external power amplifier on the transmitter, outdoor line of sight range can be increased from 300 meters to 3000 meters.

1.5 Mechanical Drawings

These drawings in Figure 1-1 show both the version of the module with integrated F antenna and the version of the module with the SMA connector for use with an external antenna.

Figure 1-1. Mechanical drawings of the RF Engine Modules.



1.6 Board Mounting Considerations

The RF Engine modules are designed to mount into a receptacle (socket) on the host board. Picture 1-1 shows the receptacle area of a host board and Picture 1-2 shows a RF Engine module plugged in. Suggested receptacles to be used on the host are:

(1) Suggested thru-hole receptacle is: Samtec MMS-112-01-T-SV
(2) Suggested surface mount receptacle is: Samtec MMS-112-02-T-SV

When the module with SMA connector is used, it is recommended that the mounting holes provided in the module on either side of the SMA connector be used with supporting mounting hardware to hard mount the module to either the host board or to the enclosure to handle the mechanical stresses that can occur when an external antenna is screwed into the SMA.

For the module with integrated F-antenna, in order to maximize RF range in the direction behind the module, it is recommended that no components and no metal (either traces or VCC and GND planes) be on any layers of the host board that lies underneath the module in the area designated by the "Keep Out Area" shown in the mechanical drawings of Figure 1-1.

Picture 1-1.

ADD Picture **********

Picture 1-2.

ADD Picture **********

2.0 Agency Certifications

2.1 United States (FCC)

The RF Engine nodules comply with Part 15 of the FCC rules and regulations. Compliance with the labeling requirements, FCC notices and antenna usage guidelines is required. In order to comply with FCC Certification requirements, the Original Equipment Manufacturer (OEM) must fulfill the following requirements.

1. The system integrator must place an exterior label on the outside of the final product housing the RF Engine Modules. Figure 1 below shows the contents that must be included in this label.
2. RF Engine Modules may only be used with antennas that have been tested and approved for use with the module. Please refer to the antenna tables provided in this section.

2.1.1 OEM Labeling Requirements

WARNING: The OEM must make sure that FCC labeling requirements are met. This includes a clearly visible exterior label on the outside of the final product housing that displays the contents shown in Figure 2-1 below.

Figure 2-1. FCC Label

MANUFACTURERS NAME
BRAND NAME or TRADE NAME

Contains RF Engine FCC ID: U9O-RFE*

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interferences, and (2) this device must accept any interference received, including interference that may cause undesired operation.

* The FCC ID for the RF Engine without external amplifier is “U9O-RFE”. The FCC ID for the RF Engine with external amplifier is “U9O-RFET”

2.1.2 FCC Notices

WARNING: The RF Engine modules have been tested by the FCC for use with other products without further certification (as per FCC Section 2.1091). Changes or modifications to this device not expressly approved by Synapse could void the user's authority to operate the equipment.

NOTICE: OEM's must certify final end product to comply with unintentional radiators (FCC Section 15.107 and 15.109) before declaring compliance of their final product to Part 15 of the FCC Rules.

NOTICE: The RF Engine modules have been certified for remote and base radio applications. If the module will be used for portable applications, the device must undergo SAR testing.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

2.1.3 FCC Approved Antennas

The RF Engine modules are FCC-approved for fixed base station and mobile applications on channels 11 thru 26 of the ISM 2.4GHz frequency band as defined in I.E.E.E 802.15.4 specifications. The FCC requirement for mobile applications states that the antenna must be mounted at least 20 cm (8 in) from nearby persons.

Notice: To reduce potential radio interference to other users, the antenna type and its gain should be chosen so that the equivalent isotropically radiated power (e.i.r.p) is not more than that permitted for successful communication. This module has been designed to operate with the antennas listed below in Table 2.1, and having a maximum gain of 5 dB. Antennas not included in this list or having a gain greater than 5 dB are strictly prohibited for use with this device. The required antenna impedance is 50 ohms.

Table 2.1. Approved Antennas

Part Number	Type	Gain	Application	Min. Separation
AC12000	Dipole (quarter-wave RPSMA)	3.2dBi	Fixed/Mobile	20 cm.
AC12001	Dipole (half-wave RPSMA)	5.0dBi	Fixed/Mobile	20 cm.
AC12002	Dipole (quarter-wave RPSMA)	4.9cBi	Fixed/Mobile	20 cm.
AC12003	Dipole (quarter-wave RPSMA)	2.0dBi	Fixed/Mobile	20 cm.

RF Exposure

Warning: This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator and your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Notice: The preceding statement must be included as a CAUTION statement in OEM product manuals in order to alert users of FCC RF Exposure compliance.

2.2 Canada (IC)

This Class B digital apparatus meets all requirements of the Canadian Interference Causing Equipment Regulations. Operation is subject to the following conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

2.2.1 OEM Labeling Requirements

Labeling requirements for Industry Canada are similar to those of the FCC. A clearly visible label on the outside of the final product housing must display the contents shown in Figure 2-2 below.

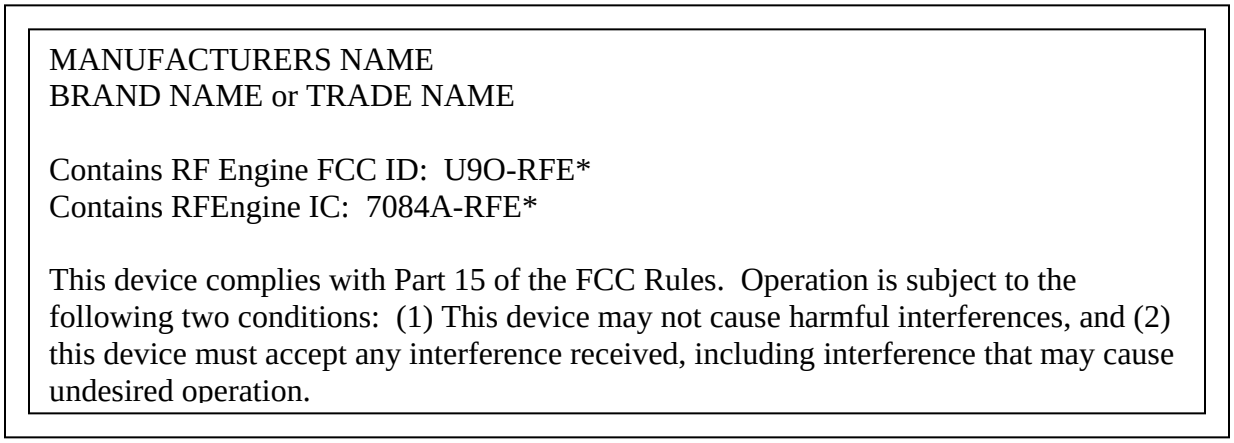
Figure 2-2. IC Label

MANUFACTURERS NAME
BRAND NAME or TRADE NAME
MODEL:
Contains RF Engine IC: 7084A-RFE*

***** The IC ID for the RF Engine without amp is "7084A-RFE". The IC ID for the RF Engine with amp is "7084A-RFET"

NOTE: The OEM can choose to implement a single label combined for both FCC and IC labeling requirements. If a combined single label is chosen, there must be a clearly visible label on the outside of the final product housing displaying the contents shown in Figure 2-3 below.

Figure 2-3. Combined FCC and IC Label



***** The FCC ID for the RF Engine without amp is “U9O-RFE”. The FCC ID for the RF Engine with amp is “U9O-RFET”. The IC ID for the RF Engine without amp is “7084A-RFE”. The IC ID for the RF Engine with amp is “7084A-RFET”