

# EXHIBIT 8

## USERS MANUAL

**APPLICANT NAME:**

Intermec Technologies Corporation  
Amtech Systems Division

**FCC ID:**

FIH261105392-01

---

**§2.983(d)(8) Instruction Manual**

# User Guide

P/N 411303

# IT2611 RF Module

**Intermec**

Amtech Systems Division

A **UNOVA** Company

Information in this document is subject to change and does not represent a commitment on the part of Amtech Systems Corporation.

© 1998-1999 Amtech Systems Corporation. (Amtech Systems Corporation is a wholly owned subsidiary of Intermec Technologies Corporation.) All rights reserved. No portion of this publication may be reproduced or transmitted in any form by any means without prior written permission of Amtech Corporation.

Aspects of the wireless data and security equipment and systems marketed by Amtech Systems Corporation and its affiliates are protected by patents and patents pending in the United States and other countries.

Amtech, Dynamic Tag, Dynicom, Intellitag, PassKey, RideMaster, SmartPass, and TollTag are either trademarks or registered trademarks of Amtech Systems Corporation.

All other trademarks listed are the property of their respective owners. Throughout this manual, trademarked names may be used. Rather than put a trademark (™ or ®) symbol in every occurrence of a trademarked name, we state that we are using the names only in an editorial fashion and to the benefit of the trademark owner, with no intention of infringement. Printed in the U.S.A.

For further information, contact:

Amtech Systems Corporation  
19111 Dallas Parkway, Suite 300  
Dallas, Texas 75287-3106 USA

Phone: (972) 733-6600  
Fax: (972) 733-6699

Amtech Response Center  
19111 Dallas Parkway, Suite 300  
Dallas, Texas 75287-3106 USA

Phone: (972) 733-6681  
Fax: (972) 733-6695

**WARNING TO USERS IN THE UNITED STATES**  
**FEDERAL COMMUNICATIONS COMMISSION (FCC) RADIO FREQUENCY**  
**INTERFERENCE STATEMENT**  
**47 CFR §15.105(a)**

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device pursuant to Part 15 of the Federal Communications Commission (FCC) rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency (RF) energy and may cause harmful interference to radio communications if not installed and used in accordance with the instruction manual. Operating this equipment in a residential area is likely to cause harmful interference, in which case, depending on the laws in effect, the users may be required to correct the interference at their own expense.

**NO UNAUTHORIZED MODIFICATIONS**  
**47 CFR §15.21**

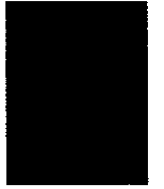
CAUTION: This equipment may not be modified, altered, or changed in any way without permission from Amtech Corporation. Unauthorized modification may void the equipment authorization from the FCC and will void the Amtech warranty.

**USE OF SHIELDED CABLES IS REQUIRED**  
**47 CFR §15.27(a)**

Shielded cables must be used with this equipment to comply with FCC regulations.

A license issued by the FCC is required to operate this RF identification device in the United States. Contact Amtech Corporation for additional information concerning licensing requirements for specific devices.

**Amtech Corporation**  
**USA**



# ***Contents***

# Table of Contents

## 1

### **Introduction**

*IT 2611 RF Module Review 1-3*

**Features 1-4**

*Dual-Frequency System 1-4*

*IT2000 Compatible 1-4*

*Patented Design: High-Speed Signal Capture, Noise Immunity 1-4*

*Line Driver Output 1-5*

*Bistatic Operation 1-5*

*Connections 1-5*

*Circuit Protection 1-5*

*Output Power 1-5*

*Weatherproof Enclosure 1-5*

*Replacement Parts 1-5*

## 2

### **Installing the RF Module**

*Introduction 2-3*

*Equipment 2-3*

*Positioning 2-3*

*Terminal Connections 2-4*

*Grounding 2-4*

*Terminal Designations 2-5*

*Normal Mode Connections 2-6*

## 3

### **Testing the RF Module**

*Testing 3-3*

## 4

### **Adjusting the RF Power**

*Adjusting the RF Power 4-3*

**5**

---

**Firmware Commands**

**Command Messages 5-3**

**Command Response Messages 5-3**

*Command Codes 5-4*

*Response Codes 5-4*

*Command Processing 5-5*

*Set Uplink Power 5-5*

*Get Uplink Power 5-5*

*Set Downlink Power 5-6*

*Get Downlink Power 5-6*

*Set Uplink Frequency 5-6*

*Get Uplink Frequency 5-6*

*Set Downlink Frequency 5-7*

*Get Downlink Frequency 5-7*

*Set Uplink Attenuation 5-7*

*Get Uplink Attenuation 5-8*

*Set Downlink Attenuation 5-8*

*Get Downlink Attenuation 5-9*

*Set Checktag State 5-9*

*Get Checktag State 5-9*

*Get RF Module Status 5-9*

*Get Firmware Version 5-10*

*Reset RF Module 5-10*

---

**A**

**IT2611 Module Block Diagram**

---

**B**

**Technical Specifications**



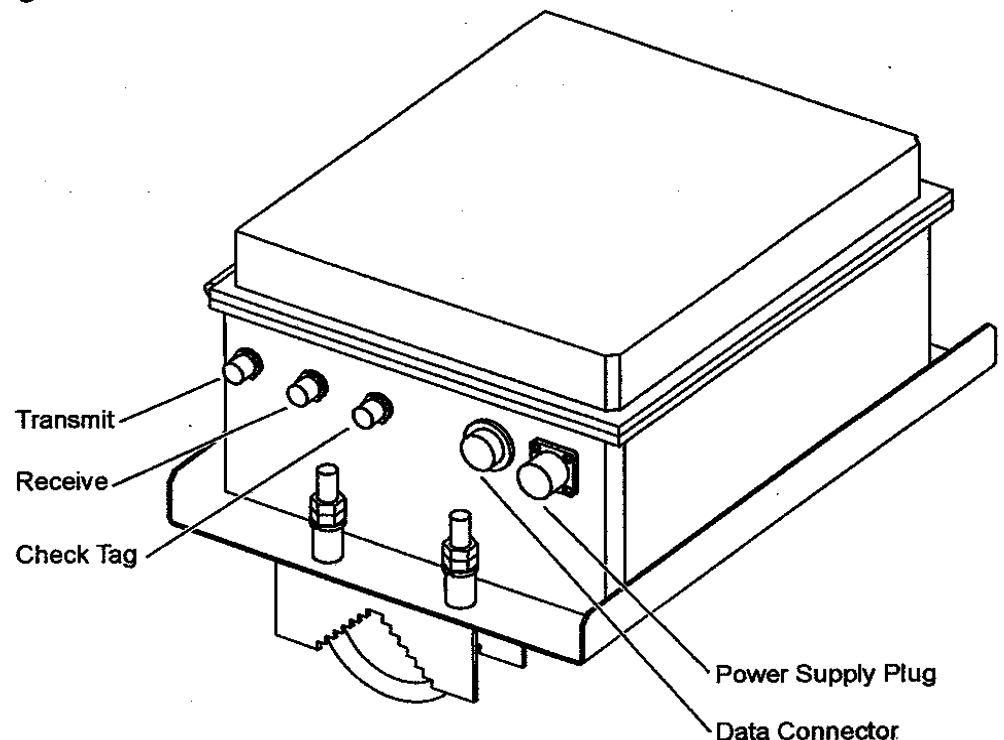
*1*

## ***Introduction***

**This User's Guide contains the procedures for connecting an Amtech IT2611 RF Module, hereafter referred to as the RF module, to an IT2020 Reader Logic Card. This document is designed to be used by technical personnel of Amtech and its distributors, as well as authorized customer and third-party systems integration personnel.**

## **IT 2611 RF Module Review**

Figure 1-1 shows the front view of the RF module interface.



HW-0016

**Figure 1-1 IT2611 RF Module showing connector ports**

**Note:** See Appendix A of this User's Guide for RF module component block diagrams.

The RF module is a radio transmitter/receiver that, on command from an Amtech reader, generates a radio frequency (RF) signal in the location and monitoring service (LMS) radio frequency sub-bands (902-904 and 909.75-921.75 MHz) and delivers the signal to the antenna for broadcast. The RF module also receives and demodulates the reflected tag signal returned through the antenna, then preamplifies and conditions the demodulated signal before sending it to the reader. The RF module generates the RF power necessary to read an Amtech tag. It also contains receiver and preamplifier circuitry to preprocess the tag signal returned through the antenna. Once connected to the antenna and reader, the RF module should require no additional mechanical adjustment by the user.

The RF module receives DC power through an internal power supply that is connected to an external AC voltage source. A separate reader-to-RF module cable carries the demodulated tag signals from the RF module to the reader and the control signals from the reader to the RF module.

*Note: Long coaxial cable runs between the RF module and antenna can degrade system performance and should be avoided in system configuration.*

RF output power is on whenever the reader activates the RF module. RF output power may be turned off through reader firmware commands.

Increasing or decreasing the RF signal strength directly impacts the system's reading range. To confine the reading range to its optimal area, you can connect internal attenuators that decrease the RF signal to the RF module.



**Caution**

*Do not attempt to increase the RF signal strength. Contact Amtech if you think any adjustments to the RF signal strength are necessary.*

For ease of installation the RF module is connected to the reader by a cable attached to a removable 26-pin circular connector.

See Appendix B of this User's Guide for a listing of RF module specifications.

## **Features**

---

The RF module has the following features:

### **Dual-Frequency System**

A dual-channel transmitter that allows for optimal tag read/write operations. Channels are individually tunable within the LMS sub-bands.

### **IT2000 Compatible**

The RF module meets the criteria for equipment configuration and performance specified by the Intellitag™ identification standard.

### **Patented Design: High-Speed Signal Capture, Noise Immunity**

The RF demodulation circuitry consists of a 3-channel homodyne receiver patented by Amtech that prevents signal dropout, allowing the system to read tags moving at high speeds. The differential aspect of the RF receiver design improves system immunity to noise.

Amtech RF modules are programmable in a range of 902.25-903.75 MHz to 910.00-921.50 MHz band frequencies depending on the application. The default frequencies for the RF module are 903 and 918.75 MHz. For multiple RF modules at one site,

Amtech recommends separate frequencies. Amtech can provide units operating at multiple frequencies in the authorized band.

### **Line Driver Output**

The interface input/output provides balanced low-impedance analog signal lines capable of driving up to 500 ft. of cable. The output incorporates electrostatic discharge protection.

*Note: Cable lengths over 500 ft. should be used with discretion; longer cables are more susceptible to receiving electrical noise.*

### **Bistatic Operation**

By using separate transmit and receive antenna ports, maximum isolation of the signal is achieved. This feature increases receiver sensitivity.

### **Connections**

The RF module is connected to the reader through a cable attached to a 26-pin circular connector. The 26-pin plug mates with a 25-pin DB connector on the RF module interface board. The antenna's coaxial cables connect to the RF module through N-type connectors on the side of the RF subassembly.

### **Circuit Protection**

The RF module power supply board filters AC power received from the transformer and protects output circuitry from damage caused by transients on the cable.

### **Output Power**

The maximum output power of the RF module is set at the factory to 1.0 watt per channel.

### **Weatherproof Enclosure**

The RF module is housed in a weatherproof NEMA-4 enclosure that is ready for installation.

### **Replacement Parts**

The IT2611 RF Module should be repaired by factory-trained personnel only.

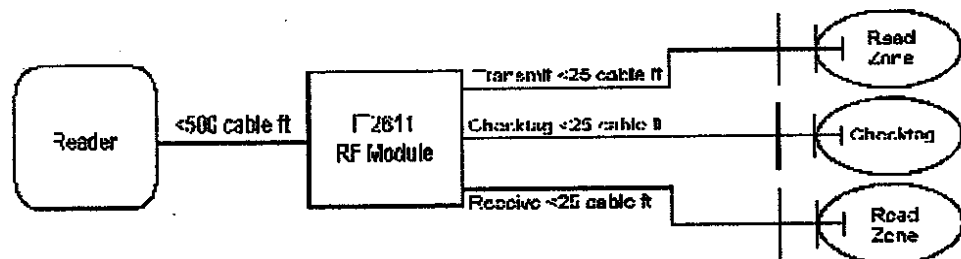
## ***Installing the RF Module***

**This Chapter describes the installation procedures for the RF2611, including information on equipment, positioning, terminal connections, and grounding.**

## Introduction

The RF module has dual-antenna ports for transmitting and receiving signals. An additional antenna port is provided for the internal system check tag. In normal mode, an RF module is connected to the reader through its 26-pin circular connector.

The following figure depicts the system configuration for normal mode.



**Figure 1-2 Normal Mode Configuration**

You need the following supplies and equipment to install the RF module.

### Equipment

- Computer with terminal emulator
- 50 ohm load (placed at the antenna port for testing)
- Communications software

### Positioning

In permanent installations, the RF module should be positioned as close as possible to the antenna and within 500 ft. of the reader. Long cable runs will increase system sensitivity to noise. Coaxial cable runs in excess of 25 ft. between the RF module and antenna are not recommended.<sup>1</sup> Longer cable connections (up to 1,000 cable ft.) should be made on the reader-to-RF module link.

1. Based on 1 dB loss, Andrews LDF4-50A 0.5 in. OD coaxial cable. If a 3 dB loss is tolerable, cable up to 75 ft. long may be used between the RF module and the antenna.

---

## Terminal Connections

The RF module data-plug connector is a MIL-C-26482 style commercial grade connector with 26 terminals. Figure 10 shows the pin designations for the connector.

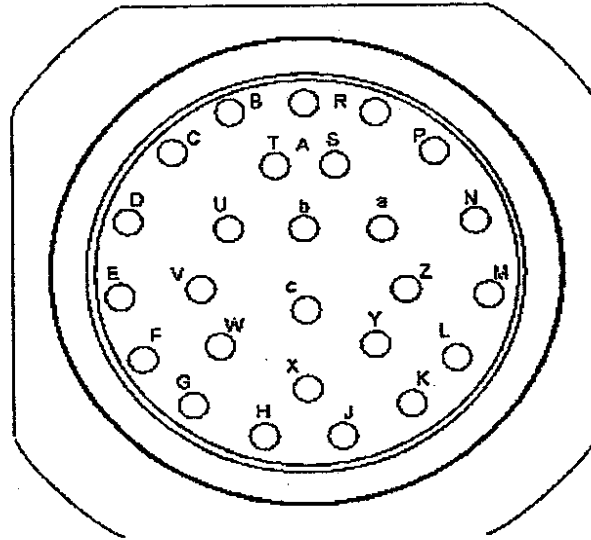


Figure 10 Twenty-six Pin Circular Connector Showing Pin Designations

Figure 1-3 Twenty-six Pin Circular Connector Showing Pin Designations

---

## Grounding

The CHASSIS terminal is electrically connected to case ground at the factory. Case ground must be connected to earth ground. Amtech does not recommend that a conduit connection be used as a grounding point. Ground points must make metal-to-metal connections.

*Note: Grounding through nonconducting finishes, such as paint, anodize, or erudite is not recommended.*

## Terminal Designations

The jack and plug terminals are designated for use as shown in Table 1.

Plug	Pin	Designation	Purpose
A	1	IF_A+	Uplink tag data, channel A+
B	14	IF_A-	Uplink tag data, channel A-
T	2	NC	--
C	15	IF_B+	Uplink tag data, channel B+
D	3	IF_B-	Uplink tag data, channel B-
U	16	NC	--
E	4	IF_C+	Uplink tag data, channel C+
F	17	IF_C-	Uplink tag data, channel C-
V	5	NC	--
G	18	MOD+	Downlink modulation data, pos
H	6	MOD-	Downlink modulation data, neg
W	19	NC	--
J	20	CTL_XMT+	Control interface transmit, pos
K	8	CTL_XMT-	Control interface receive, pos
X	21	NC	--
L	9	CTL_RCV+	Control interface receive, pos
Y	22	CTL_RCV-	Control interface receive, neg
Z	10	NC	--
M	23	UL_RF_OFF+	Uplink RF power control, pos
N	11	UL_RF_OFF-	Uplink RF power control, neg
a	24	NC	--
P	12	DL_RF_OFF+	Downlink RF power control, pos
R	25	DL_RF_OFF-	Downlink RF power control, neg
S	13	NC	--
b,c	7	NC	--



---

## **Normal Mode Connections**

To install your RF module for operation in normal mode, follow the these directions:

1. Connect power to RF module by inserting connector into mounted plug and tightening sleeve until snug (see Figure 1).
2. Connect transmit and receive antennas to RF module by plugging coaxial cable connectors into appropriate plugs (see Figure 1) and tighten sleeves until snug.
3. Connect 26-pin circular connector from reader cable to RF module by lining up connector with key at bottom of connector and inserting plug into adapter (see Figure 1). Tighten sleeve on plug until it locks into place. You will hear a "click" as the cap locks.



### **Caution**

*Turning on RF power with the antenna ports disconnected could damage the RF module.*

## ***Testing the RF Module***

*This chapter provides information on testing the RF module.*

## Testing

---

After connecting the data cable between the RF module and the reader, the RF module should be tested. You will need a data terminal or computer connected to the reader.

The RF module has two test points at the transmit and receive antenna ports (see Figure 1).

The test points are defined as follows:

**Table 0-1**

Test Point	Purpose
Transmit	+30 dBm dual-frequency RF output port
Receive	RF receive port

Additional information needed:

- Instructions on connecting data terminal or computer to RF Module
- Type of connecting cable
- Location of connection

## ***Adjusting the RF Power***

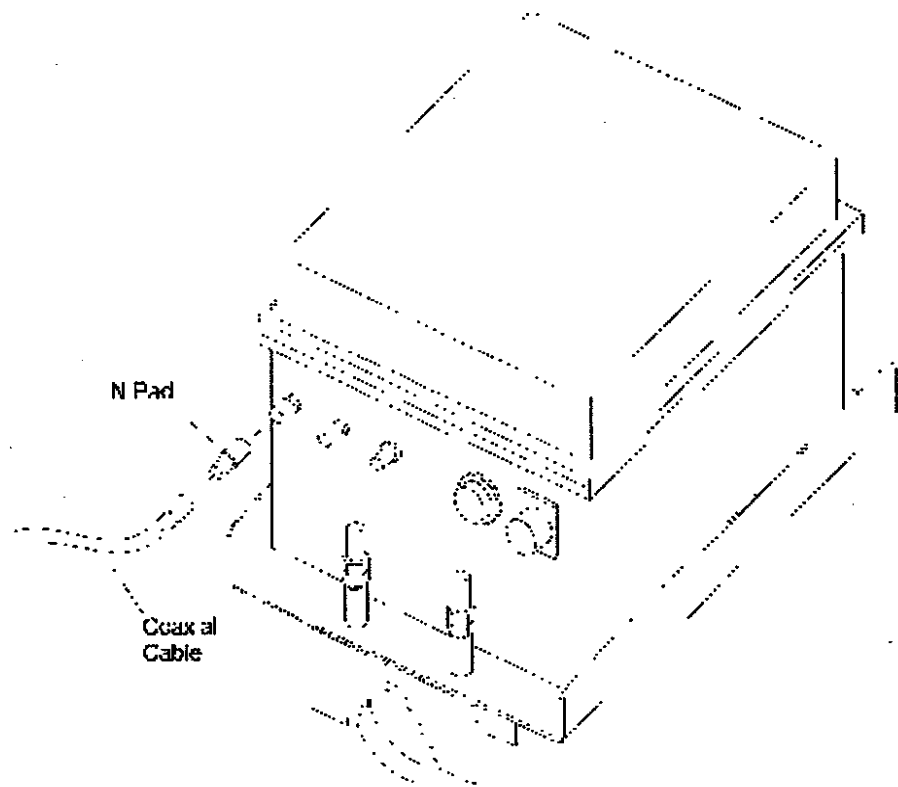
*This chapter provides information on how to adjust the RF power using reader commands.*

## ***Adjusting the RF Power***

---

RF internal power may be reduced, when necessary, by IT2020 reader commands. This reduces the internal RF power generated. Refer to IT2020 Reader User Guide for more information.

A pad added to the transmit antenna port only decreases RF output power. It does not attenuate the incoming tag signal on that channel. To install an attenuator pad at the transmit antenna output port, turn off power to the RF module, disconnect the transmit antenna cable, install the pad, and reconnect the cable. Figure 12 shows attenuator pad location.



**Figure 2-1 External Attenuator Pad Location**

# ***Firmware Commands***

*This chapter provides the commands needed to control and monitor the status of the RF module.*

## **Command Messages**

---

The RF module firmware allows the user to control and learn the status of the RF module through commands. A command message contains a two-byte ASCII code, referred to as the command code, which uniquely identifies the command. Optional ASCII data and an ASCII carriage return as an end-of-message indicator follow the command code. The command message format that follows specifies the components of a valid command message with < > indicating a mandatory component and [ ] indicating an optional component.

<command-code>[command-data]<end-of-message>

The following example illustrates the components of a command message that sets the uplink power on. The hexadecimal representation of the ASCII command message is shown such that all bytes are illustrated.

Example Command Message: 3030310Dh

## **Command Response Messages**

---

The RF module firmware implements command responses that are sent to the ISA reader in response to a command. All command responses contain a one-byte ASCII code that specifies the response status, followed by optional ASCII data, and an ASCII carriage return as the end-of-message indicator. The command response message format that follows specifies the items of a valid command response with < > indicating a mandatory item and [ ] indicating an optional item.

<response-code>[response-data]<end-of-message>

The following example illustrates the components of a command response message that gets the uplink power. The hexadecimal representation of the ASCII command response message is shown such that all bytes are illustrated.

Example Command Response Message: 30310Dh

## Command Codes

The following table contains each of the command codes that the firmware implements.

Command Code	Description
00	Set Uplink Power
01	Get Uplink Power
02	Set Downlink Power
03	Get Downlink Power
04	Set Uplink Frequency
05	Get Uplink Frequency
06	Set Downlink Frequency
07	Get Downlink Frequency
08	Set Uplink Attenuation
09	Get Uplink Attenuation
0Ah	Set Downlink Attenuation
0Bh	Get Downlink Attenuation
0Ch	Set Checktag State
0Dh	Get Checktag State
0E-0Fh	Spare
10h	Get RF Module Status
11h	Get Firmware Version
11h	Get Firmware Version
12h	Set RF Module

## Response Codes

The RF module firmware implements response codes that indicate the status of the previous command message received from the ISA reader. A response code of ASCII 0 indicates the previous command is complete and optional response data may be contained in the message. A response code of ASCII 1 indicates



the previous command or command data was invalid and no response data is present in the message.

**Table 5-1**

Response Code	Description
0	Command complete
1	Command or command data invalid

## Command Processing

The RF module firmware validates command messages for the command code, data, and data length. An invalid command message causes the firmware to send an invalid response code and no data in a command response message to the ISA reader on the asynchronous serial interface. A valid command is processed to completion by the firmware before sending a corresponding command response message.

### Set Uplink Power

The firmware processes this command code by setting the RF uplink power to the state specified by the ASCII command data.

Command Code: 00

**Table 5-2**

Command Data	Description
0	Uplink power off
1	Uplink power on

### Get Uplink Power

The firmware processes this command code by sending a command response message containing the current uplink power state, on or off, being used by the RF module.

Command Code: 01

**Table 5-3**

Response Code	Description
0	Uplink power off
1	Uplink power on

### Set Downlink Power

The firmware processes this command code by setting the RF downlink power to the state specified by the ASCII command data.

Command Code: 02

Table 5-4

Response Code	Description
0	Downlink power off
1	Downlink power on

### Get Downlink Power

The firmware processes this command code by sending a command response message containing the current downlink power state, on or off, being used by the RF module.

Command Code: 03

Table 5-5

Response Code	Description
0	Downlink power off
1	Downlink power on

### Set Uplink Frequency

The firmware processes this command code by setting the uplink frequency to the value specified by the ASCII command data. The firmware sends a command invalid response code if either the uplink or downlink power is on when attempting to change the uplink frequency.

Command Code: 04

Table 5-6

Command Data	Frequency (MHz)	Description
00h-68h	902-928	Frequency offset from 902 MHz in.25 MHz resolution

### Get Uplink Frequency

The firmware processes this command code by sending a command response message containing the current uplink frequency being used by the RF module.

Command Code: 05

Table 5-7

Command Data	Frequency (MHz)	Description
00h-68h	902-928	Frequency offset from 902 MHz in.25 MHz resolution

### Set Downlink Frequency

The firmware processes this command code by setting the downlink frequency to the value specified by the ASCII command data. The firmware sends a command invalid response code if either the uplink or downlink power is on when attempting to change the downlink frequency.

Command Code: 06

Table 5-8

Command Data	Frequency (MHz)	Description
00h-68h	902-928	Frequency offset from 902 MHz in.25 MGz resolution

### Get Downlink Frequency

The firmware processes this command code by sending a command response message containing the current downlink frequency being used by the RF Module.

Command Code: 07

Table 5-9

Command Data	Frequency (MHz)	Description
00h-68h	902-928	Frequency offset from 902 MHz in.25 MHz resolution

### Set Uplink Attenuation

The firmware processes this command code by setting the uplink attenuation to the value specified by the ASCII command data.

Command Code: 08h

Table 5-10

Command Data	Description
00h-0Fh	Uplink attenuation in dB

### Get Uplink Attenuation

The firmware processes this command code by a command response message containing the current uplink frequency being used by the RF Module.

Command Code: 09h

Table 5-11

Command Data	Description
00h-0Fh	Uplink attenuation in dB

### Set Downlink Attenuation

The firmware processes this command code by setting the downlink attenuation to the value specified by the ASCII command data.

Command Code: 0Ah

Command Data	Description
00h-0Fh	Downlink attenuation in dB

### Get Downlink Attenuation

The firmware processes this command code by sending a command response message containing the current downlink being used by the RF Module.

Command Code: 0Bh

Command Data	Description
00h-0Fh	Downlink attenuation in dB

### Set Checktag State

The firmware processes this command code by setting the checktag to the state specified by the ASCII command data.

Command Code: 0Ch

Command Data	Description
0	Checktag off
1	Checktag on

### Get Checktag State

The firmware processes this command code by setting a command response message containing the current checktag state, on or off, being used by the RF Module.

Command Code: 0Dh

Response Data	Description
0	Checktag off
1	Checktag on

### Get RF Module Status

The firmware processes this command code by sending a command response message containing the current RF Module status.

Command Code: 10h

Table 5-12

Response Data	Description
0-7	Status

The status contains a byte that is composed of multiple fields with each field indicating specific conditions. The following table describes the fields of the status before the status is converted to ASCII.

**Table 5-13**

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	0	0	PLL Lock	EEPROM Data Valid	Powerup

The Powerup field contains the current state of the RF module with respect to powerup. A binary value of 1 indicates the RF module has not received a “Get RF Module Status” command since it was powered up. A binary value of 0 indicates the RF module has not powered up since the last “Get RF Module Status” command.

The EEPROM Data Valid field contains the current state of the EEPROM data memory for the RF module. A binary value of 1 indicates the EEPROM data memory is valid. A binary value of 0 indicates the EEPROM data memory is not valid and the factory default values for all parameters stored in this memory are being used.

The PLL Lock field contains the current state of the PLLs of the RF module. A binary value of 1 indicates the PLLs are locked. A binary value of 0 indicates the PLLs are not locked.

**Get Firmware Version**

The firmware processes this command code by sending a command response message containing the firmware version executing in the RF module.

Command Code: 11h

**Table 5-14**

Response Data	Description
11169-00 XX.XX	11169-00 is the Amtech part number for the firmware XX.XX is the version number

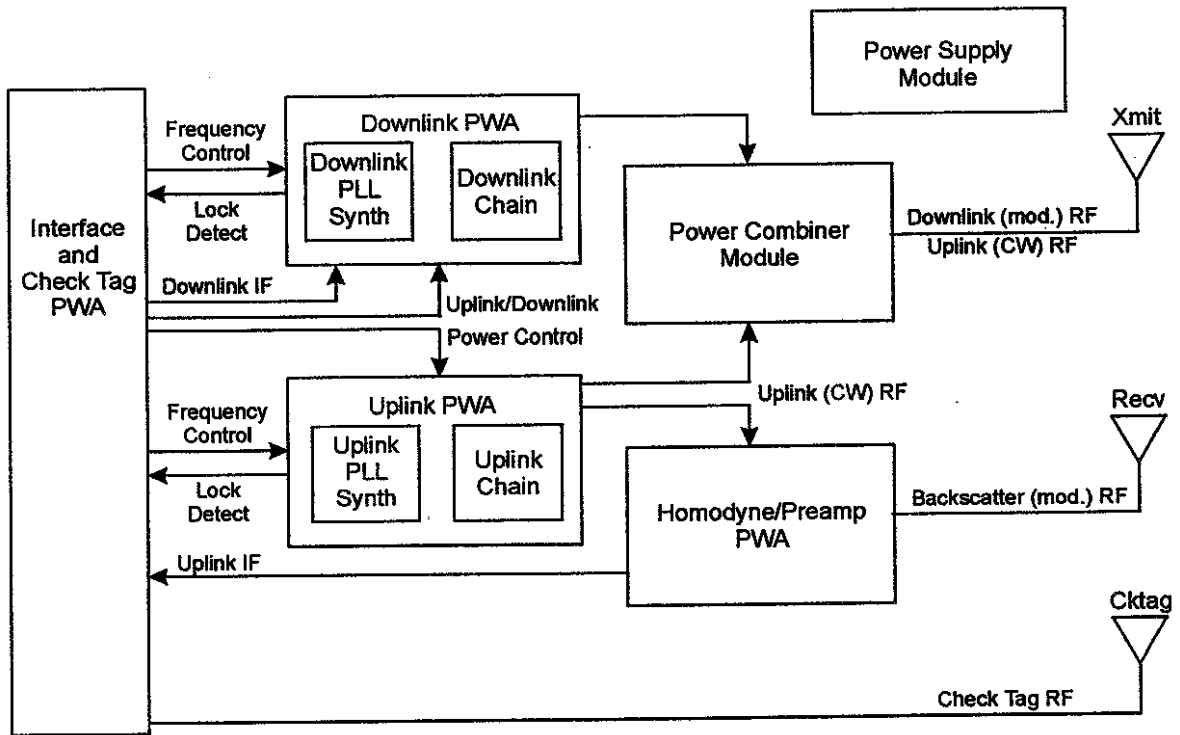
**Reset RF Module**

The firmware processes this command code by not servicing the external watchdog timer such that a hardware reset occurs. The firmware sends the command response message before the reset is performed.

Command Code: 12h



# ***IT2611 Module Block Diagram***



SC-0011

Figure A-1 IT2611 Module Block Diagram





# ***Technical Specifications***

**Table B-1 IT2611 RF Module Technical Specifications**

Frequency Range	CW: 902.25 to 903.75 and 912.75 to 918.75 MHz MOD: 912.75 to 918.75 (adjustable in 0.25 MHz steps*)
RF Transmit Bandwidth	± 3 MHz at -50 dBc
Frequency Stability	≤ 25ppm
Antenna Interface	RF coax, Type N socket
Downlink Data Rate	Manchester encoded:300kbps
Uplink Data Rate	FSK encoded: 300 kbps
RF Power	200 mW to 2.0 W adjustable in 1 dB steps
Power Consumption	40 W maximum
Input Voltage	19-28 VAC, 47-63 HZ, or 16-28 VDC
Harmonic Output	-60 dBc
Spurious Output	-60 dBc
Size	46 x 33 x 23 cm (18 x 13 x 9 in)
Weight	2.27 kg (5 lb) 11.3 kg (25 lb) with mounting plate 13.6 kg (30 lb) with mounting brackets
Mounting	Mounting features include optional brackets for positioning the module near an installed antenna.
Operating Temperature	-20° C to +55° C (-4° F to +131° F)
Humidity	95% noncondensing
Vibration Tolerance	1 G <sub>rms</sub> , 10 to 500 HZ
Shock	5 G, 1/2 sine pulse, 10 ms, 3 axes

\* Operation in the United States is regulated by the Federal Communications Commission (FCC). Local regulations apply. The user is required to obtain a license issued by the FCC. Contact Amtech for more information.