SKYEMODULE M1 DATASHEET

VERSION 100112

COPYRIGHT INFORMATION:

Version 100112

TECHNICAL SUPPORT AND CONTACT INFORMATION

SkyeTek, Inc.

1525 Market Street. Suite 200

Denver, CO 80202

http://www.skyetek.com

SALES:

sales@skyetek.com

TECHNICAL SUPPORT:

support@skyetek.com

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 About this Document

1.1 Intended Audience

The topics described in this document are intended for technical personnel interested in the SkyeModule™ M1 device.

1.2 Topics Covered

The following topics are discussed in this document:

- Product overview
- Transponder compatibility
- Mechanical characteristics
- Electrical characteristics
- Tag timing table
- Pin descriptions
- Power supply
- Host interface connections
- Antenna connections
- Firmware upgrade
- Host software
- System parameters

1.3 Topics Not Covered

The following topics are covered in other documents offered by SkyeTek (See the "Technical Resources" section of this document for more information.):

- SkyeTek Protocol specifications
- Troubleshooting
- SkyeWare SkyeTek Protocol HF tag commands (AN002)

1.4 Additional Documentation

The following technical references provide additional information on the topics described in this document:

- *M1 Tag Support Matrix*
- *SkyeTek Protocol V2 Guide*
- *Using Tag Commands with STPv2*

1.5 Revision History

Revision	Author	Change
100112	Brad Alcorn	Updated the formatting of the document and revised errors.

Table 1-1: Revision History

2 Definition of Terms

3DES	Triple Data Encryption Standard
AES	Advanced Encryption Standard
API	Application Programming Interface
DES	Data Encryption Standard
GPIO	General Purpose Input/Output
HID	Human Interface Device
HMAC	Hash-based message authentication code
I^2C	Inter-integrated Circuit
LSB	Least Significant Bit
MD5	Message-Digest Algorithm
MSB	Most Significant Bit
NC	No Connect
PRNG	Pseudo-Random Number Generator
RoHS	Reduction of Hazardous Substances
SHA	Secure Hash Algorithm
SPI	Serial Peripheral Interface
SSEL	Slave Select
STP V3	SkyeTek Protocol Version 3
TTL	Transistor-transistor Logic

3 Ordering Information

3.1 Part Numbers

The M1 part number is constructed according to the SkyeTek part number specification below:

Figure 3-1: SkyeTek Part Number Scheme

Details:

Code	Options	Description
Product Family	SM = SkyeModule	Highest level product family code.
Product Type	M1 = M1	Specifies the specific part type.
Build Type	00 = Standard	Specifies standard form factors or custom builds.
Build Revision	8.0	The build revision denotes the exact hardware assembly version. Contact SkyeTek or a reseller for latest build version. NOTE: Older revisions are always drop in replacements.
Firmware Revision	F009 = Serial FW 4009 = SPI FW B009 = I2C FW	The firmware revision denotes the firmware version loaded onto the module. This may impact the tags supported and may be custom for specific customers. Note that on the M1, the interface type is firmware specific and must be ordered correctly as such.
Parameter Settings	00 = Standard	The parameter settings denote the default system parameters that are set on the module.

Table 3-1: Part Number Details

As of the date of this document, the most current part numbers for the M2 are shown in Table 3-2. Always contact a reseller or the SkyeTek sales team for the latest part number.

Module	Part Number
SkyeModule M1 –Serial	SM-M1-00-8.0-F009-00
SkyeModule M1 – SPI	SM-M1-00-8.0-4009-00
SkyeModule M1 – I2C	SM-M1-00-8.0-B009-00

Table 3-2: M1 Part Numbers

3.2 How to Buy

SkyeTek products are distributed through a worldwide distribution network as well as directly through SkyeTek. For more information on how to purchase SkyeTek products in your area, please visit the How To Buy page on the SkyeTek website at SkyeTek.com/HowToBuy.

4 SkyeModule M1 Overview

The SkyeModule M1 is an ISO15693 radio frequency identification (RFID) read/write module for use with most industry standard ISO15693, 13.56 megahertz (MHz) RFID tags and smart labels. The low-profile, small-footprint and on-board antenna makes the SkyeModule M1 an ideal choice for enabling any device or equipment with RFID technology.

This highly integrated design offers maximum functionality in a very low component-count device, making the SkyeModule M1 a very affordable, easy-to-use RFID module.

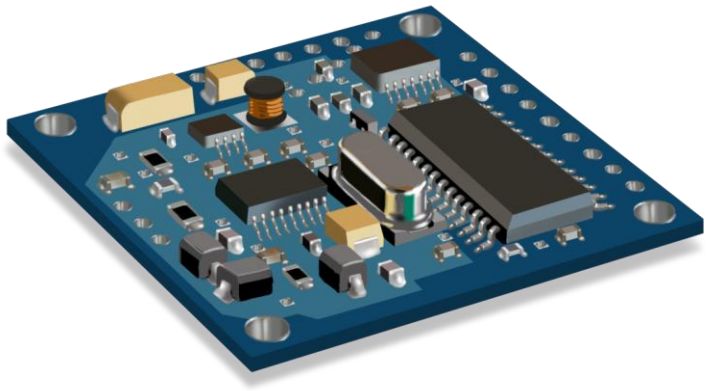

Figure 4-1: SkyeModule M1

4.1 Features

- Low Profile – only 4 millimeter (mm)
- Small Footprint – only 38mm x 40mm
- ISO15693 RFID Transponder support
- Four Standard Host Interface options – RS-232, Transistor-transistor logic (TTL), Inter-IC (I^2C), Serial Peripheral Interface (SPI) host interfaces
- On-board antenna with up to 3.5 inches (90 mm) range with credit card size tags
- External antenna option with 50 Ohms output
- Low voltage operation to 1.8 volt (V)
- Low current consumption
- Powerful, easy-to-use host interface protocol (SkyeTek Protocol)
- Eight user-configurable I/O – for general-purpose input and output (GPIO)

4.2 Applications

- Product and Consumable Tracking
- Device Accessory Recognition
- ISO15693 RFID Card Printers
- Library tracking systems
- Pharmaceutical /Sample Tracking
- Document Tracking
- Proximity Sensing

4.3 SkyeTek Host Software

The *SkyeTek Protocol Command Builder* software is a low-level tool to show the software developer exactly how a request is sent to the SkyeModule M1 by a host and the exact response from the SkyeModule M1 is provided to the host.

The *SkyeWare RFID Demo Software* is built on the SkyeTek Protocol and is used to create presentations that demonstrate the features, functions and benefits of RFID technology.

5 Mechanical Specifications

The M1 comes in a single rectangular form factor. A smaller version of the M1 is the M1 Mini at about the size of a quarter. Its feature set is similar but slightly different than the M1 and more information can be found on the SkyeTek website at SkyeTek.com.

5.1 Detailed Dimensions

Dimensions: 38 mm x 40 mm x 4 mm
Mass (Weight): 8g (0.3 oz)

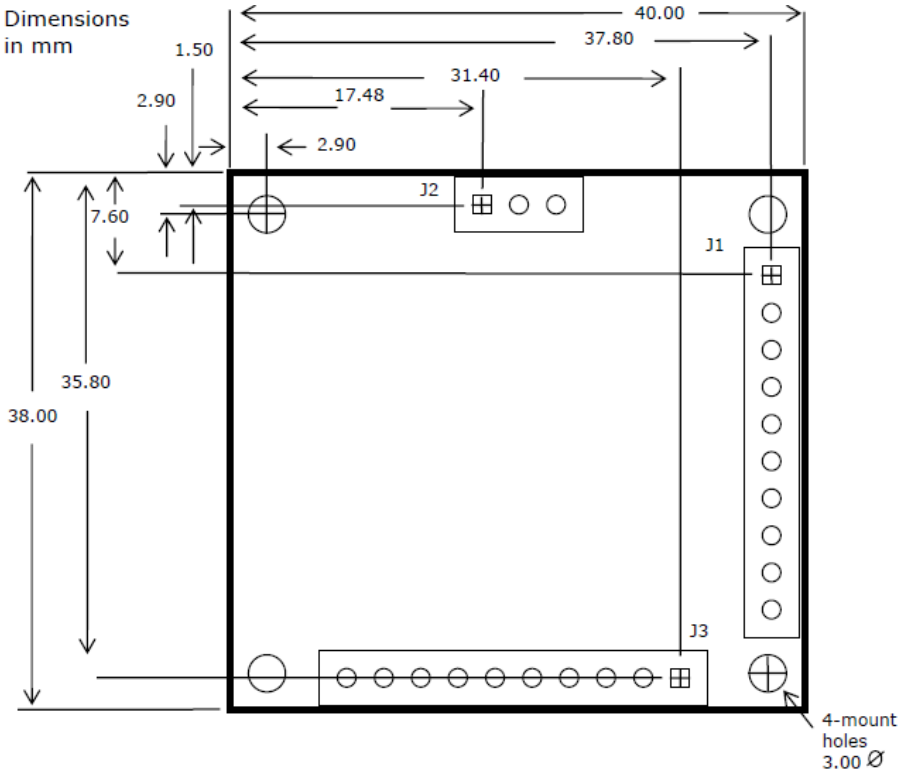

Figure 5-1: SkyeModule M1 Top View

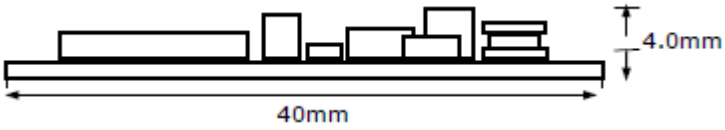

Figure 5-2: SkyeModule M1 Side View

6 Pinning Information

6.1 Pin Mapping

The following sections describe the J1, J2 and J3 pins on the SkyeModule M1.

J1 Pin	Silkscreen	Name	Description
1	V5	V5	5V regulated output
2	GND	GND	Power supply ground.
3	VIN	VIN	1.8 – 5V input.
4	nRST	nRST	0 = resets the SkyeModule M1 1 = normal operation.
5	SCK/SCL	SCK/SCL	SCK is the serial clock input signal for the SPI interface, controlled by the host. SCL is the shift clock signal for the I2C interface.
6	SDI/SDA/RX_TTL	SDI/SDA/RX_TTL	SDI (MOSI) is the serial data input for the SPI interface from the module perspective SDA is the bi-directional serial data I/O pin for the I2C interface to/from the host. RX_TTL is a 0 to 5V TTL receive signal from the module perspective
7	SDO/TX_TTL	SDO/TX_TTL	SDO (MISO) is the serial data output for the SPI interface from the module perspective TX_TTL is a 0 to 5V TTL transmit signal from the module perspective
8	GND	GND	Signal Ground.
9	TX_232	TX_232	RS-232 transmit signal to the RS-232 host (PC)
10	RX_232	RX_232	RS-232 receive signal from the RS-232 host (PC)

Table 6-1: J1 Pin Descriptions

J2 Pin	Name	Description
1	GND	Antenna Ground
2	ANT	Antenna Output pin ANT provides 50 ohms output for matching an external antenna
3	INT	Internal Antenna pin

Table 6-2: J2 Pin Descriptions

Antenna Connections:

- Internal Antenna
  - Jumper ANT to INT to enable the internal antenna
- External Antenna
  - No jumper between ANT and INT to connect an external antenna
  - An external antenna must be connected to ANT and to GND

J3 Pin	Name	Description
1	D7	User-configurable I/O
2	D6	User-configurable I/O
3	D5	User-configurable I/O
4	D4	User-configurable I/O
5	D3	User-configurable I/O
6	D2	User-configurable I/O
7	D1	User-configurable I/O
8	D0	User-configurable I/O
9	V5	Electrically Connected to J1 pin 1 (5V regulated output)
10	GND	Electrically Connected to J1 pin 2 (GND)

Table 6-3: J3 Pin Descriptions

6.2 Using the GPIO Pins

You can use the User Port Direction and User Port Value system parameters to address the GPIO pins to set the user port direction (input or output) and the user port value (high or low). For more information, see the following:

- “User Port Direction” in section 13.2.6
- “User Port Value” in section 13.2.7

7 Environmental Specifications

7.1 Electrostatic Precautions

CAUTION – Failure to take proper electrostatic precautions may result in damage to or failure of your SkyeModule M1.

The SkyeModule M1 contains static-sensitive parts. Observe the following precautions to prevent damage to these parts.

- Wear a static grounding strap when handling electronic control components
- Keep all plastic, vinyl, and Styrofoam (except antistatic versions) away from printed circuit boards.
- Do not touch the components or conductors on a printed circuit board with your hands or with conductive devices.

7.2 Temperature Ratings

Stresses beyond these ratings may cause permanent damage. Exposure to absolute maximum conditions for extended periods may degrade device reliability. These maximum stress ratings do not imply maximum operating conditions.

Specification	Rating
Temperature range	Temperature is 25 degrees Celsius unless otherwise noted
Operating	-10 to +70 degrees C
Storage	-20 to +85 degrees C

8 Electrical Specifications

This chapter discusses the electrical specifications of the SkyeModule M1. Unless otherwise noted, the following assumptions apply to these specifications:

- Temperature is 25 degrees Celsius.
- Frequency is 13.56 MHz.

Specification	Min	Typ	Max	Units/Notes
RF Characteristics				
Frequency (Direct output)		13.56		MHz
Transmission Parameters				
Output Power	16.0	18.0	20.0	dBm
Optimum PA Load Impedance		50		Ohms
Logic Inputs				
High state input voltage	2			V
Low state input voltage			0.8	V
Input Current (IINH/IINL)			± 20	mA
RS-232 input voltage	-14		14	V
Logic Outputs				
Output High Voltage (VOH)	4.3	5		V
Output Low Voltage (VOL)		0	0.6	V
Output Current (IINH/IINL)			± 20	mA
Power Supply				
VIN Input Voltage Range	1.8		5.5	V
Power Supply Current consumption at 5V				
Active (scanning)		60		mA
Idle		20		mA
Sleep		50		uA

8.1 Absolute Maximum Ratings

Stresses beyond these ratings may cause permanent damage. Exposure to absolute maximum conditions for extended periods may degrade device reliability. These maximum stress ratings do not imply maximum operating conditions.

Specification	Rating
Maximum power supply voltage	5.5 V
Digital I/O voltage to GND	-0.3 to 5.3 V

8.2 Power Supply Options

The power supply options for the SkyeModule M1 are described in this section. The figure below shows an example the standard power configuration.

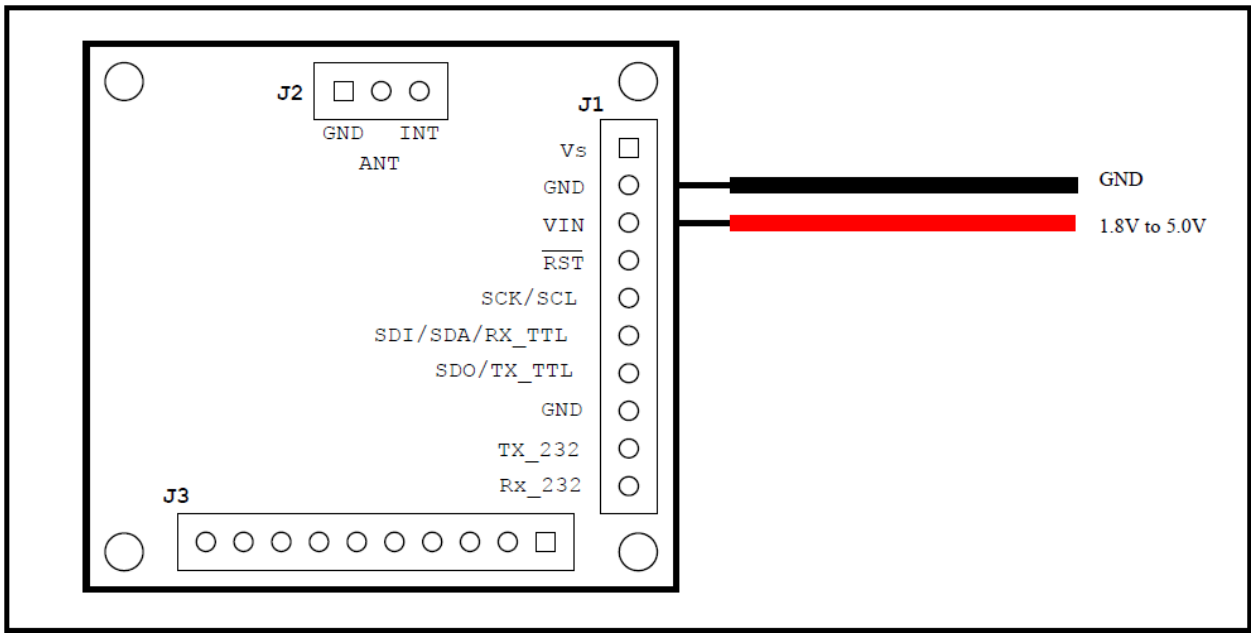

Figure 8-1: SkyeModule M1 Powered at VIN ≤ 5V

In the configuration shown in Figure 8-1, an on-board boost regulator generates 5V from the input applied at VIN. In this case, the host interface signals and digital I/O have logic 1 voltage levels equivalent to 5V, regardless of the input voltage level supplied at VIN (1.8V to 5V). V5 can be used to source at least 100mA at 5V to external circuitry such as microcontrollers and sensors and other peripherals.

NOTE – In this configuration V5 is an output.

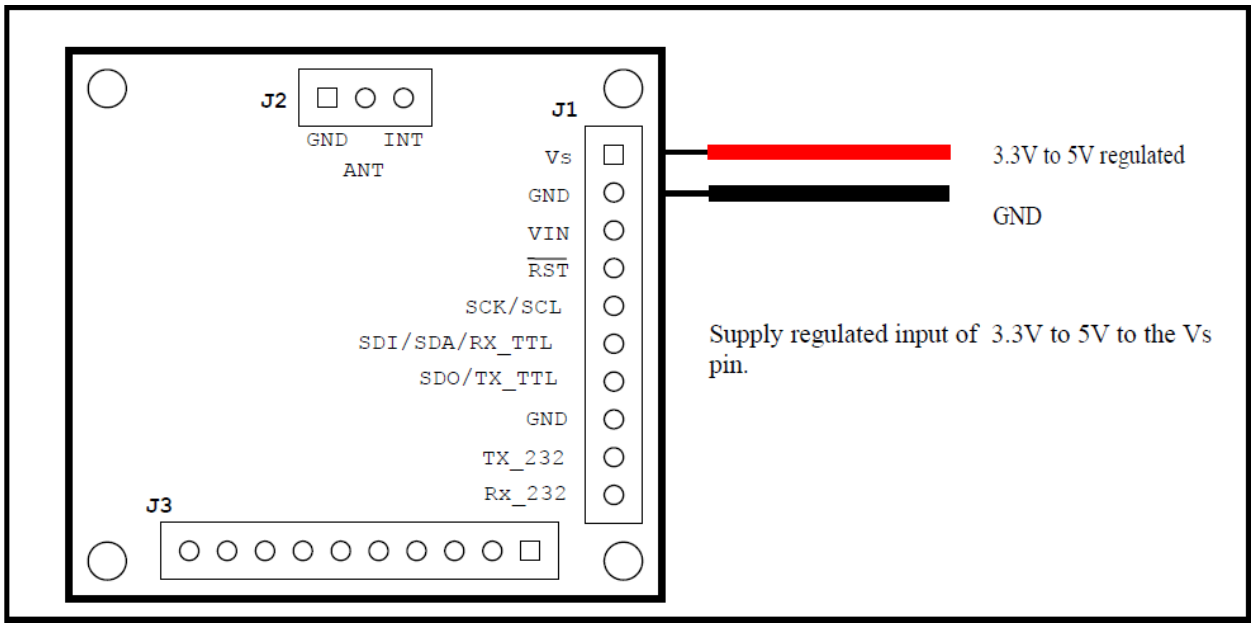

Figure 8-2: SkyeModule M1 Powered from V5 = 3.3V to 5V DC

In the configuration shown in Figure 8-2, the SkyeModule M1 requires a regulated input voltage in the range from 3.3V to 5V input to V5 (an input in this configuration). In this case, the host interface signals and digital I/O have logic 1 voltage levels equivalent to V5 (3.3V to 5V). No connection at VIN is required in this configuration.

NOTE – In this configuration V5 is an input.

9 Host Interface Specifications

The SkyeModule M1 is supplied with RS-232 and TTL serial as the standard host interface. SPI and I^2C host interface types are available with separate firmware.

9.1 RS-232

Use the RS-232 Host Interface to communicate with a PC or other terminal with a standard serial port connection. A three-wire interface (Rx, Tx, and Gnd) is used. The RS-232 serial data rate is selectable and changeable.

9600 bits/sec	N,8,1
19200 bits/sec	N,8,1
38400 bits/sec	N,8,1
57600 bits/sec	N,8,1

Table 9-1: RS-232 Data Rates (Baud Rates)

NOTE – N,8,1 means No Parity Bit, 8 Data Bits, 1 Stop Bit.

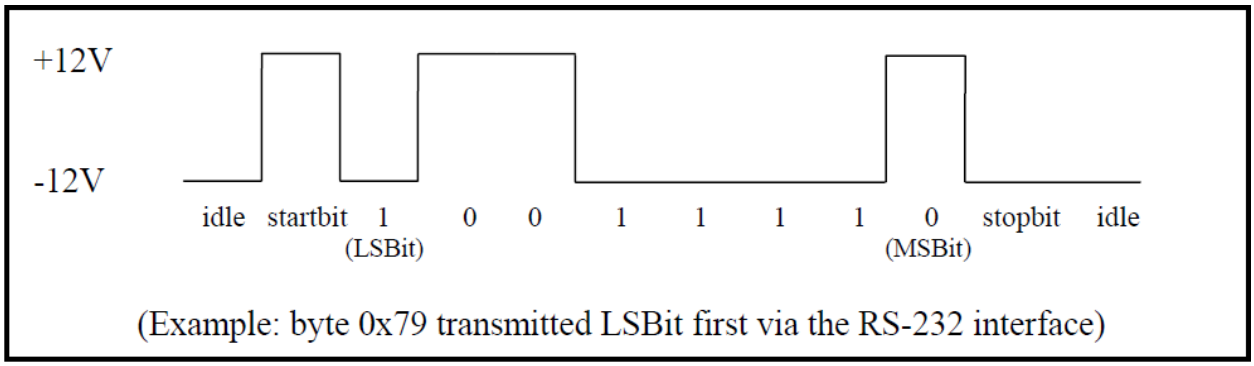

Figure 9-1: RS-232 Communication Timing Diagram

- Output to the PC signal is on TX_232 (J1 pin 9)
- Input from the PC signal is on RX_232 (J1 pin10)

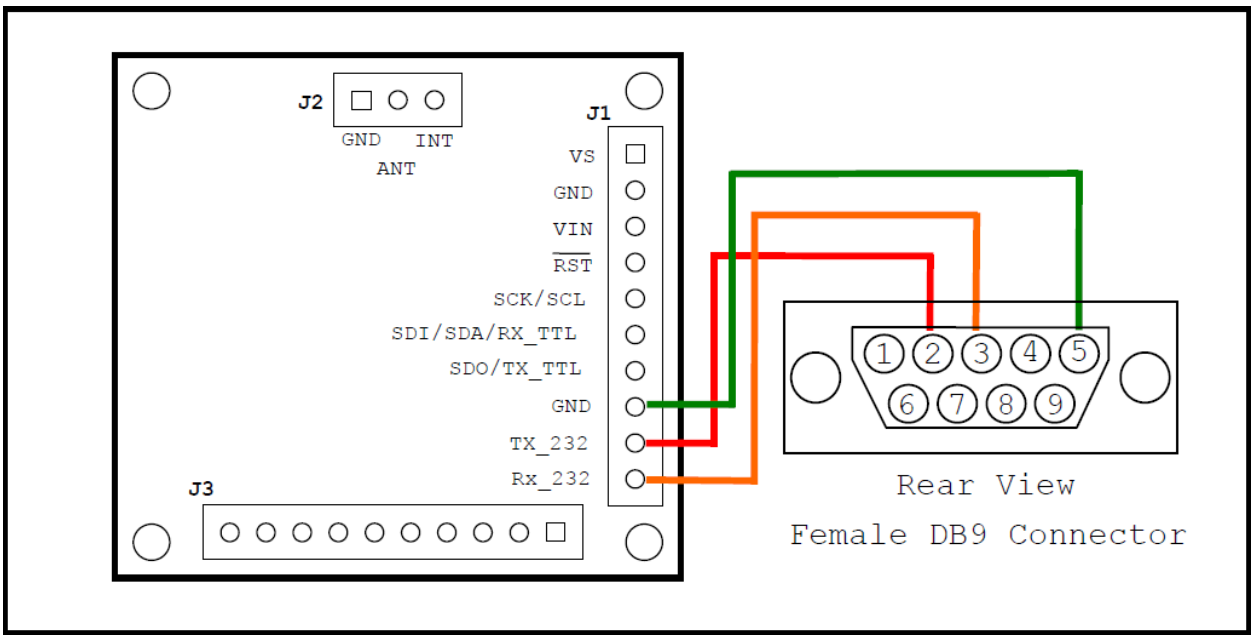

Figure 9-2: RS-232 Connection Diagram

- Use a standard serial cable to connect from the DB9 connector to an available serial port on a PC, as shown in Figure 9-2. A null-modem cable will not work.
- In addition to the signal connections, the host must supply input voltage.

9.2 TTL Serial

Use the TTL host interface to communicate with a microcontroller unit or other device with a standard 0-5V serial communication interface.
The TTL serial data rate is selectable and changeable.

9600 bits/sec	N,8,1
19200 bits/sec	N,8,1
38400 bits/sec	N,8,1
57600 bits/sec	N,8,1

Table 9-2: TTL Data Rates (Baud Rates)

NOTE – N,8,1 means No Parity Bit, 8 Data Bits, 1 Stop Bit.

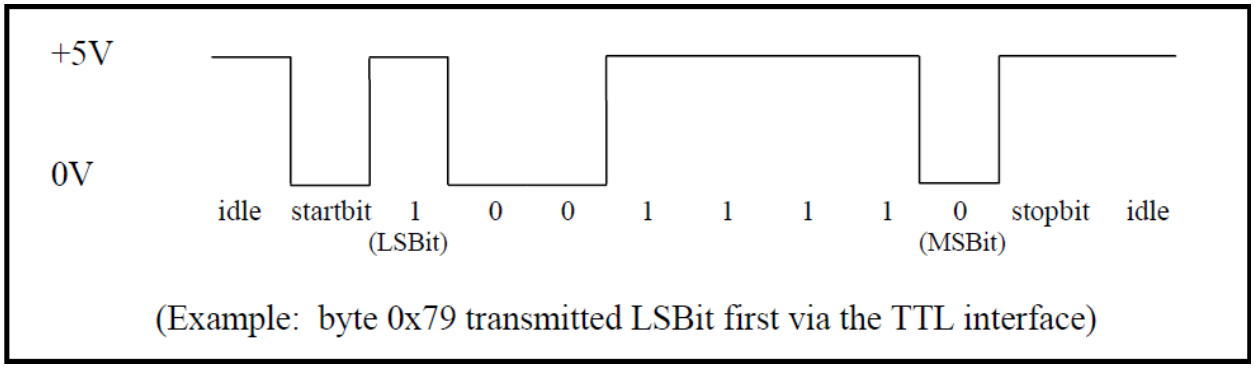

Figure 9-3: TTL Serial Communication Timing Diagram

- Output to the host is on SDO/TX_TTL (J1 pin 7)
- Input from the host is on SDI/SDA/RX_TTL (J1 pin6)

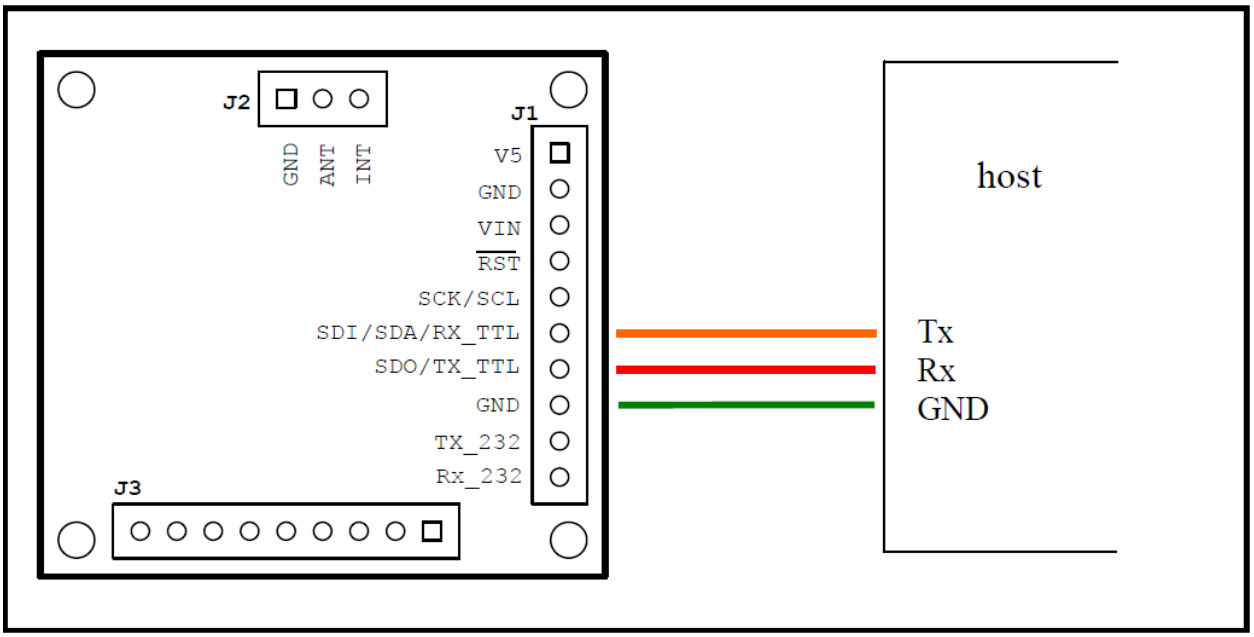

Figure 9-4: TTL Serial Connection Diagram

- In addition to the signal connections, the host must supply input voltage.

9.3 SPI

The SkyeModule M1 allows the use of a standard Serial Peripheral Interface (SPI) for connecting to a host controller. The SkyeModule M1 must have the proper firmware to enable a SPI operation. The SkyeModule M1 operates as an SPI slave device; the clock is always controlled by the host system. The SPI interface uses three wires: SCK, SDI, and SDO. SDO is the serial data out (from the SkyeModule M1 to the host system). SDI is the serial data in (to the SkyeModule M1 from the host system). SCK is the serial clock (controlled by the host system.

Data exchange between the host and the SkyeModule M1 is defined according to the SkyeTek Protocol, Binary Mode. Request packets are sent first by the host and SDO can be ignored. A delay must be included between the request and response for tag commands to function properly. The host then must send the clock in order to receive the response packet. During the response, SDI is ignored and zeros (0x00) are typically sent by the host. Be sure to send at least enough clocks to receive the entire response, including CRC, for each response sequence or future responses from the module may give unexpected results.

NOTE – Loop and Inventory modes are not supported for the SPI host interface.

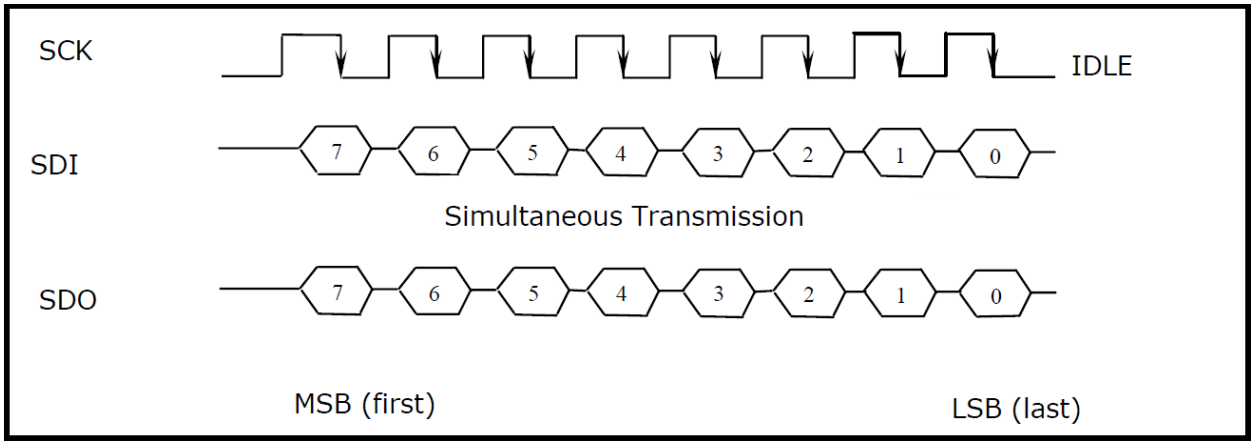

Figure 9-5: SPI Communication Timing Diagram

- Idle clock should be held low
- Data is transitioned on the rising edge of the clock
- Data is latched on the falling edge of the clock
- Data is sent and received MSB first
- The maximum clock rate is 3 MHz. Care should be taken to minimize the distance between SkyeModule M1 and host.

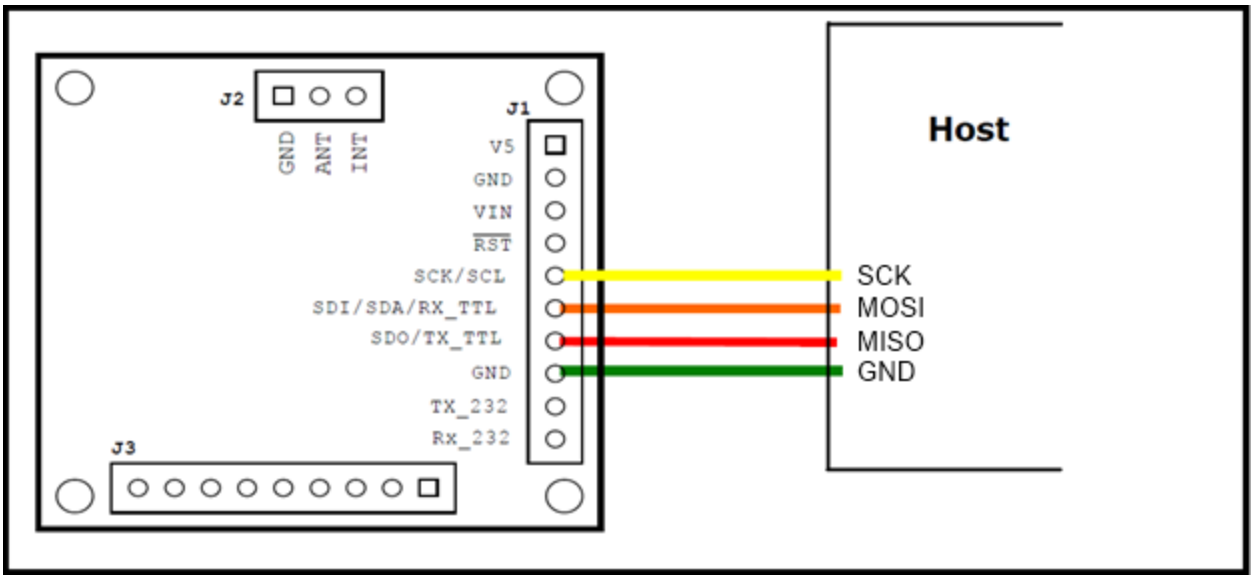

Figure 9-6: SPI Connection Diagram

- In addition to the signal connections, the host must supply input voltage.
- Care should be taken to minimize signal length between the host and the module.

9.4 I²C

The SkyeModule M1 supports the I²C standard for connecting to a host controller. The SkyeModule M1 operates as an I²C slave device. Standard 2-wire connection is used with SCL and SDA. SCL is the bi-directional system clock line. SDA is the bi-directional serial data line. The SkyeModule M1 must have proper firmware to enable I²C operation. I²C fast mode is supported to provide a 400kHz data rate or slower 100kHz data rate. The data is sent and received MSB first. Data exchange between the host and the SkyeModule M1 is defined according to the SkyeTek Protocol, Binary Mode.

NOTE – Loop and Inventory modes are not supported for the I²C host interface.

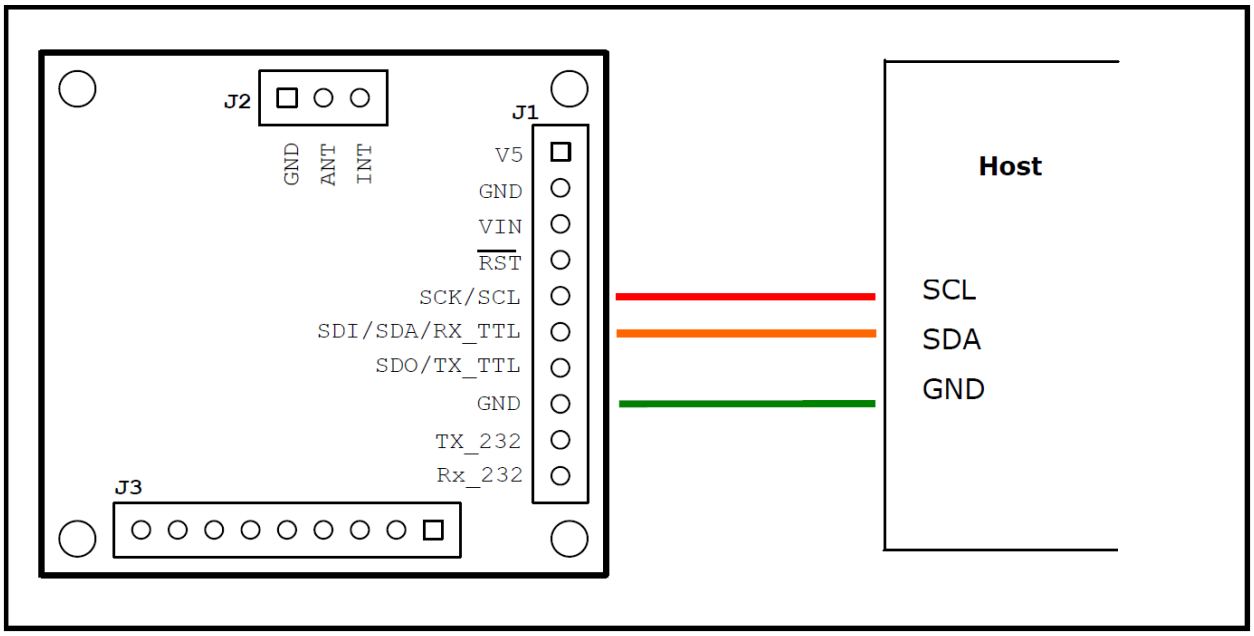

Figure 9-7: I²C Connection Diagram

- Both 100kHz and fast mode 400kHz clock rates are supported
- External pull up resistors are required but should be strong (less than or equal to 2.2kΩ) for fast mode to function properly
- I2C address should be 0x3F; 7-bit address mode should be used
- Write should be used for the request
- Read should be used for the response
- A delay must be included between the request and response for tag commands to function properly
- Be sure to read at least enough bytes to receive the entire response, including CRC, for each response sequence or future responses from the module may give unexpected results

10 Radio Specifications and Regional Compliance

10.1 Agency Approvals

As part of a host system, the SkyeModule M1 will not interfere with the overall system's compliance with agency requirements for emissions and susceptibility, including:

- United States: FCC 15.225
- Europe: EN300-330, EN301-489, EN 61000-4-3, RoHS
- Australia/New Zealand: AS/NZS 4268:2003
- Taiwan: DGT LP002
- Hong Kong: HKTA 1035
- Singapore: IDA TS SRD

10.2 Frequency Band

The M1 operates in the 13.56MHz (+/- 7KHz) ISM unlicensed band and is suitable for worldwide use. The frequency is not adjustable.

10.3 Tag Protocols

The SkyeModule M1 supports ISO15693 tags. For the most current listing of supported tags and features, see the *SkyeModule M1 Tag Support List*.

11 Antenna Options

11.1 Internal Antenna

All models of the SkyeModule M1 have an internal antenna that can be enabled by connecting pin 2 and pin 3 of J2. No tuning or adjustments are required.

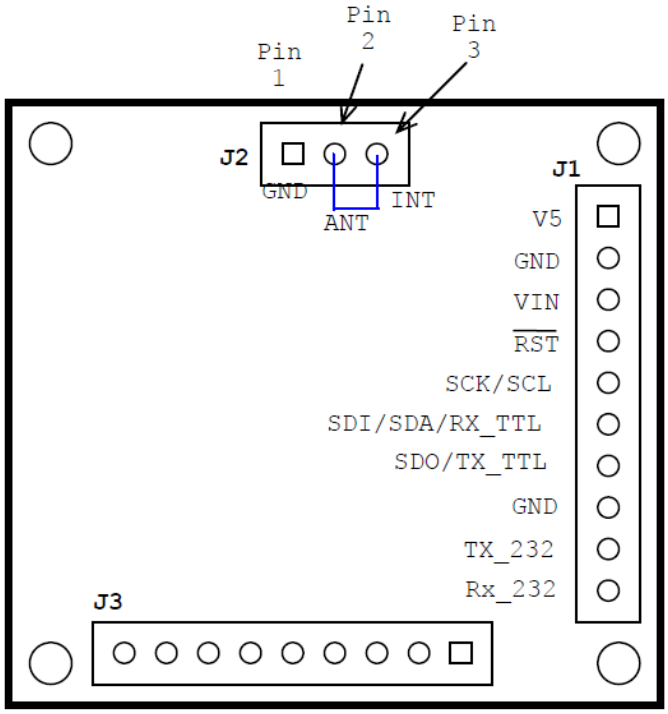

Figure 11-1: Internal Antenna Connection Diagram

The internal antenna is a single PCB trace that outlines the perimeter of the back of the SkyeModule M1 PCB.

11.2 External Antenna

An external antenna can be connected at J2. Remove the jumper between ANT and INT to disable the on-board antenna. Connect the external antenna between ANT and GND as shown in the diagram.

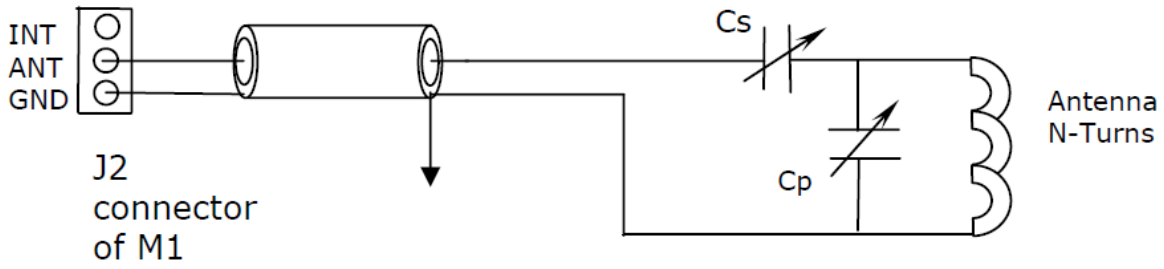

Figure 11-2: External Antenna Circuit

The following antenna configurations are possible:

- Connection from the SkyeModule M1 directly to the external antenna
- Connection from the SkyeModule M1 to an external antenna less than 10 cm away using twisted pair cable
- Connection from the SkyeModule M1 to an external antenna more than 10 cm away using 50ohm coaxial cable.

12 Communication Specifications

12.1 SkyeTek Protocol v2

The SkyeModule M1 device communicates with a host controller using the SkyeTek Protocol v2 for all host interfaces. The SkyeTek Protocol defines the data exchange between a host controller and a SkyeTek RFID radio module. It specifies how a host controller can address, configure and command a radio module in order to read and write to RFID tags and smart labels.

The following sections of this document explain a very basic overview of the protocol. Refer to the SkyeTek Protocol *v2 Guide* document for detailed information.

12.2 Request Formats

Flags	Cmd.	RID	Tag Type	TID	AFI	Starting Block	# of Blocks	Data	CRC
2	2	2	2	16	2	4	2	n	4

Table 12-1: Request Format (bytes), ASCII Mode

Msg. Len.	Flags	Cmd.	RID	Tag Type	TID	AFI	Starting Block	# of Blocks	Data	CRC
1	1	1	1	1	8	1	1	1	n	2

Table 12-2: Request Format (bytes), Binary Mode

	Optional fields (depending on the command and flags)
	Required Fields (must be present at all times)

12.3 Response Formats

Response Code	RID	Tag Type	Response Data	CRC
2	2	2	n	4

Table 12-3: Response Format (bytes), ASCII Mode

MSG Length	Response Code	RID	Tag Type	Response Data	CRC
1	1	1	1	n	2

Table 12-4: Response Format (bytes), Binary Mode

	Optional fields (depending on the command and flags)
	Required Fields (must be present at all times)

13 Customizing System Parameters

System parameters let you configure reader settings to customize the reader for your environment. All parameters can be changed in both volatile and non-volatile memory. When changing a parameter in volatile memory the change in the parameter is realized immediately, but is reset upon power-cycling the SkyeModule M1. Alternatively, when changing a parameter in non-volatile memory the change in the parameter is *not* realized immediately, but will only be realized after power-cycling the SkyeModule M1.

The following table summarizes the parameters for the SkyeModule M1. (See **Error! Reference ource not found.** in section **Error! Reference source not found.** for detailed information about each parameter)

Name	Parameter Address	Request Blocks	Length (bytes)	Parameter Values	Factory Default Parameter Value	Specifies	READ	WRITE
SERIAL NUMBER	0x00	2	4	0x00000000-0xFFFFFFFF	custom	serial number	custom	no
FIRMWARE VERSION	0x01	1	2	0x0000-0xFFFF	depends on release	firmware version	yes	no
READER ID (RID)	0x02	1	1	0x00-0xFF	0xFF (“no RID”)	reader network ID	yes	yes
BAUD RATE	0x03	1	1	0xFF **0x00** 0x01 0x02 0x03 0x04-0xFE	**0x00**	4800 **9600** 19200 38400 57600 reserved	no	yes
SLEEP MODE	0x04	1	1	0x00 0x01-0xFF	not applicable	sleep active	no	yes
Reserved	0x05				None		no	no
Reserved	0x06				None		no	no
USER PORT DIRECTION	0x07	1	1		0x00	defines pins as inputs or outputs	yes	yes
USER PORT VALUE	0x08	1	1		0x00	writes values of output pins reads values of input pins	yes	yes
Reserved	0x09-0x11				None		no	no
STARTUP COMMAND	0x12	1	1	see detailed description	0x00	see notes	no	yes
Reserved	0x13-0x80				None		no	no

Table 13-1: SkyeModule M1 System Parameters

13.1 Changing System Parameters

CAUTION – Changing system parameter values – especially the default values – can render your SkyeModule M1 non-operational in your environment. Research, record, and test all planned changes to make sure they are compatible with your system.

You can read or write system parameters via the following commands:

- Read System Parameter (0x22) – Reads the current value of the system parameter at the memory address specified.
- Write System Parameter (0x42) – Writes a new value to the system parameter at the memory address specified.
- Read Memory (0x21) – Reads the system parameter value at the address specified out of non-volatile memory.
- Write Memory (0x41) - Writes a new system parameter value to the non-volatile memory. This saves the setting even after a power cycle or reset.

See System Parameter Descriptions in section 13.2 for detailed information about individual parameters.

Also, see the *SkyeTek Protocol v2 Guide* for a full description of the system parameter commands.

CAUTION – Resetting (or cycling power) on your SkyeModule M1 causes all system parameters to revert to their default values. Any changes made to system parameters in RAM are lost at reset unless you write them to the non-volatile memory as the new default values. Any changes to the default values do not take effect until the reader is reset.

13.2 System Parameter Descriptions

This section describes the SkyeModule M1 system parameters in detail.

13.2.1 Serial Number

The Serial Number system parameter is a read only parameter set by SkyeTek at manufacture time. It is not a unique number for each module. It can be set to a specific value upon request. By default, it is set to 0x00000000.

13.2.2 Firmware Version

The Firmware Version system parameter is a read-only parameter that contains a two-byte firmware version number. The firmware version number can only be changed by a firmware upgrade. The firmware version number is read with a Read System command.

13.2.3 Reader ID

The Reader ID system parameter is a read/write system parameter that contains a one-byte Reader ID value. The Reader ID can be changed in both volatile memory (Write System command) and nonvolatile memory (Write Memory command). The Reader ID can be read out of either volatile (Read System command) or non-volatile memory (Read Memory command). All non-volatile writes have to be followed by a power cycle before the settings take effect. Reader ID values can take on any value from 0x00-0xFF. 0xFF is the default and the reader responds to commands sent to it not containing the Reader ID. From this point forward examples some examples are in ASCII mode and some are in binary mode.

13.2.4 Baud Rate

The Baud Rate system parameter controls the baud rate for serial data communication. This applies to the RS232 and TTL serial interfaces. The following table contains the possible values for the data field.

Baud Rate	Data Field
4800	0xFF
9600	0x00
19200	0x01
38400	0x02
57600	0x03

Table 13-2: Baud Rate Parameter Settings

13.2.5 Sleep Mode

The reader can be set to a low power sleep mode through software using this system parameter. Sleep mode is activated by setting this system parameter to 0x00. Sleep is explained in detail in the Operating Modes section of the document, specifically section 14.1.

13.2.6 User Port Direction

The value stored in the User Port Direction system parameter controls the IN/OUT directions of the User Port pins. Each bit of the system parameter represents a single GPIO pin. A bit value of 1 corresponds to an input and a bit value of 0 corresponds to an output. Bits correspond to the pins as follows:

- BIT0 – GPIO D0 (J3, pin 8)
- BIT1 – GPIO D1 (J3, pin 7)
- BIT2 – GPIO D2 (J3, pin 6)
- BIT3 – GPIO D3 (J3, pin 5)
- BIT4 – GPIO D4 (J3, pin 4)
- BIT5 – GPIO D5 (J3, pin 3)
- BIT6 – GPIO D6 (J3, pin 2)
- BIT7 – GPIO D7 (J3, pin 1)

13.2.7 User Port Value

The User Port Value system parameter sets or reads (depending on input output setting in User Port Direction) the logic level of the User Port pins. Each bit of the system parameter represents a single GPIO pin. A bit value of 1 corresponds to a logic high and a bit value of 0 corresponds to a logic low. Bits correspond to the pins as follows:

- BIT0 – GPIO D0 (J3, pin 8)
- BIT1 – GPIO D1 (J3, pin 7)
- BIT2 – GPIO D2 (J3, pin 6)
- BIT3 – GPIO D3 (J3, pin 5)
- BIT4 – GPIO D4 (J3, pin 4)
- BIT5 – GPIO D5 (J3, pin 3)
- BIT6 – GPIO D6 (J3, pin 2)
- BIT7 – GPIO D7 (J3, pin 1)

13.2.8 Startup Command

The Startup Command system parameter allows the user to set any command to run at module power up. This command can be very useful in battery powered or otherwise power sensitive applications as it minimizes runtime. The full functionality of this system parameter including examples is explained in detail in the Operating Modes section of the document, specifically section 0.

14 Operating Modes

The SkyeModule M1 has three operating modes: Sleep, Active, and Loop. Active is the normal mode of operation. The following sections explain the Sleep and Loop modes as well as how to set a specific command to run on startup using the Startup Command system parameter.

14.1 Sleep Mode

The low-power Sleep mode can be used to conserve battery or system power.

The reader can be put into Sleep mode by writing the Data 0x00 to the Sleep Mode system parameter using the Write System command. After the reader gives a positive response, it enters Sleep mode. Any command wakes the reader from Sleep mode. Even sending a single byte to the reader wakes it from Sleep mode. The reader gives the same positive response upon waking from Sleep mode as it gives upon entering Sleep mode.

14.1.1 Write System Parameter – Sleep Mode Example (ASCII)

The following request puts the reader into Sleep mode if it is in active mode, and brings it out of Sleep mode if the reader is already in Sleep mode.

		Flag	Command	Starting Block	Number of Blocks	Data	CRC	
Request	<CR>	20	42	04	01	00	35E9	<CR>

		Response	CRC	
Response	<LF>	42	6116	<CR><LF>

14.1.2 Write System Parameter – Sleep Mode Example (Binary)

The following request puts the reader into Sleep mode if it is in active mode, and brings it out of Sleep mode if the reader is already in sleep mode.

		Length	Flag	Command	Starting Block	Number of Blocks	Data	CRC
Request	<STX>	0x07	0x20	0x42	0x04	0x01	0x00	0x35E9

		Length	Response	CRC
Response	<STX>	0x03	0x42	0x4B7E

14.1.3 Write Memory – Sleep Mode Example (Binary)

The following request puts the reader into Sleep mode upon power up. This process is done provided that no startup command is stored using the Startup Command system parameter.

		Flag	Command	Starting Block	Number of Blocks	Data	
Request	<CR>	00	41	04	01	00	<CR>

		Response	
Response	<LF>	41	<CR><LF>

14.2 Loop Mode

Loop mode allows the user to send a single select tag command to the reader and receive responses from the reader each time a tag is present in the field with no further requests necessary. The loop flag is used in conjunction with the Select Tag command to set the reader into Loop mode.

NOTE – Loop Mode is not supported for the SPI or I^2C host interface.

14.2.1 Select Tag – Loop Mode Example (ASCII)

The following request initiates Loop Mode with Auto-detect selected as the tag type:

		Flag	Command	Tag Type	
Request	<CR>	01	14	00	<CR>

		Response	
Response	<LF>	1C	<CR><LF>

The response 1C is immediately sent to indicate that the reader has successfully entered loop mode.

The following responses will be received when an ISO-15693 tag is introduced into the reader's field. The responses below show the tag being read three times:

		Response	Tag Type	Data (TID)	
Response	<LF>	14	01	E0 07 00 00 01 64 5E 37	<CR><LF>
Response	<LF>	14	01	E0 07 00 00 01 64 5E 37	<CR><LF>
Response	<LF>	14	01	E0 07 00 00 01 64 5E 37	<CR><LF>

14.2.2 Select Tag – Loop Mode Example (Binary)

The following request initiates Loop Mode with Auto-detect selected as the tag type:

		Length	Flag	Command	Tag Type	CRC
Request	<STX>	0x05	0x21	0x14	0x00	0xC541

		Length	Response	CRC
Response	<STX>	0x03	0x1C	0xF085

The response 1C is immediately sent to indicate that the reader has successfully entered loop mode.

The following responses will be received when an ISO-15693 tag is introduced into the reader's field. The responses below show the tag being read three times:

		Length	Response	Tag Type	Data (TID)	CRC
Response	<STX>	0x0C	0x14	0x01	E0 04 01 00 08 AE D8 BD	0xBBF3
Response	<STX>	0x0C	0x14	0x01	E0 04 01 00 08 AE D8 BD	0xBBF3
Response	<STX>	0x0C	0x14	0x01	E0 04 01 00 08 AE D8 BD	0xBBF3

14.3 Startup Command

The SkyeModule M1 has a provision to store a single command that is executed upon power up. This command is stored by writing to the Startup Command system parameter using the Write System command. The SkyeModule M1 executes the command upon power up and sends the response in either Binary or ASCII mode depending on the mode in which the command was stored.

The entire command must be stored—all the fields relevant to the command must be present. For example if the CRC, TID and/or RID flags are set, then the respective fields must have the correct information. In the case of Binary mode, the message length must also be stored as part of the command. The delimiting characters (<CR> in ASCII mode and <STX> in Binary mode) should not be stored.

This system parameter can only be written for the Write System command, so there is no Read System and Write/Read Memory support for this system parameter.

If no command needs to be executed upon power up, then a single-byte data value should be written to this system parameter. This process turns off the Start Up command functionality. The single byte can be any value, for example 0x00 – 0xFF.

14.3.1 Write System Parameter – Startup Command Example (ASCII)

The following request stores the Select Tag (0x14) command with tag type ISO-15693 (0x01) to be executed upon startup. Since the command is stored in ASCII mode, the response upon power up is sent in ASCII mode.

		Flag	Command	Starting Block	Number of Blocks	Data	
Request	<CR>	00	42	12	01	00 14 01	<CR>

		Response	
Response	<LF>	42	<CR><LF>

14.3.2 Write System Parameter – Startup Command Example (Binary)

The following request stores the select tag command (0x14) with the tag type set to Auto-Detect (0x00). The flags field in the command, which is stored, shows that the CRC and the Loop flags are set (0x21). This process causes the reader to go into loop mode upon power up and sends responses in Binary mode along with the CRC. The message length (0x05) is also stored along with the rest of the command because it is part of any command sent in Binary mode.

		Length	Flag	Command	Starting Block	Number of Blocks	Data	CRC
Request	<STX>	0x0C	0x20	0x42	0x12	0x01	0x05211400C541	0xD591

		Length	Response	CRC
Response	<STX>	0x03	0x42	0x4B7E

14.3.3 Write System Parameter – Disable Startup Command Functionality (ASCII)

The following request turns off the Start Up command functionality. It is sent in ASCII mode.

		Flag	Command	Starting Block	Number of Blocks	Data	
Request	<CR>	00	42	12	01	00	<CR>

		Response	
Response	<LF>	42	<CR><LF>