SkyeModule Nova Datasheet

PRELIMINARY

VERSION 031014

skyetek

COPYRIGHT INFORMATION:

Version 031014

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1 Introduction

1.1 Getting Started

Operating your SkyeModule Nova begins with finding a method to connect to a host. The SkyeModule itself does not operate without direction (commands) from a host. The host can be in the form of a PC or, more typically, an embedded microcontroller. This document explains the physical and electrical characteristics of the module, so you can understand how to integrate the Nova into a finished product.

For **initial demonstration** of the module, **SkyeWare v4 software** is available on the media that came with the developer/evaluation kit or available for download at support.skyetek.com. Open this software on your windows PC and it will be recognized when you connect through USB or RS232 (with developer kit interface board). The software demonstrates features like selecting tags, reading and writing. It also has a powerful command builder that lets you format, send and receive any command to and from the reader. More about SkyeWare can be found in the SkyeWare User Guide. See the Additional Reading section below.

The **next step** after demonstrating the module's functionality is **developing your own communication with the module**. This can be achieved with simple code on a microcontroller or using the SkyeTek API on a PC. Once connected to a host through one of the four host interfaces, the reader to host communication is formatted with a full featured protocol called SkyeTek Protovol v3. In order to make learning commands and formatting easy, we have developed a series of application notes with examples to get you started. The application notes start with basic tag and reader commands and become very detailed for tags with special features. Read more about the protocol and commands in section 13, Communicating with the Module and then move on to the Additional Reading in section 1.3.

1.2 Why a SkyeTek Module?

Many customers may wonder, "What value does a module add over an RFID transceiver chip?"

RFID transceiver chips may seem simple, but they actually require significant engineering time and capital investment to integrate. Transceiver chips contain up to 50 registers for configuration and functionality. In addition, communicating over air protocols such as ISO18000-6C is complex, described in nearly 150 pages of cryptic procedures. For example, just selecting a tag requires a minimum of 6 and up to 100 over air interactions with multiple tags present. SkyeTek has also optimized the complex RF chain to give the best performance and efficiency possible. **SkyeTek modules mask the complexities of RFID from the user and pack functionality into just a few commands.**

SkyeTek's core set of commands allow the user to read and write to tags with a single command, regardless of the tag type. The module is also field upgradable, so you can use the latest security algorithms and tag features as they are released. Power regulation and filtering for the radio are handled in the Nova, so you can supply voltage directly from an unregulated source like a battery. Finally, the Nova will be modularly approved by the FCC and CE, so you can bypass expensive radio testing at a certified test lab and avoid potential schedule delays due to failures.

Using a SkyeTek module will greatly reduce time to market and upfront development costs. Allow SkyeTek to take the burden of developing an RF system so you can focus your energy on your core products.

1.3 Additional Reading

SkyeTek Protocol v3 Reader Commands – Application note with descriptions and examples of the reader commands: read/write system, read/write default system, load defaults, and reset

1.4 Revision History

Revision	Author	Change
031014	Josh Peifer	Initial draft.

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
I^2C	Inter-integrated Circuit
LSB	Least Significant Bit
MSB	Most Significant Bit
NC	No Connect
RoHS	Reduction of Hazardous Substances
SPI	Serial Peripheral Interface
SSEL	Slave Select
STP V3	SkyeTek Protocol Version 3
TTL	Transistor-transistor Logic

3 Ordering Information

3.1 Nova Standard Part Numbers

Part Number	Host Interface	Baud Rate	Description
SM-NV-00	USB (HID)	12Mbps	Mini PCI express connector

Table 3-1: Nova Standard Part Numbers

NOTE – The Nova will always communicate via USB, when a USB host is connected.

3.2 Part Number Details

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

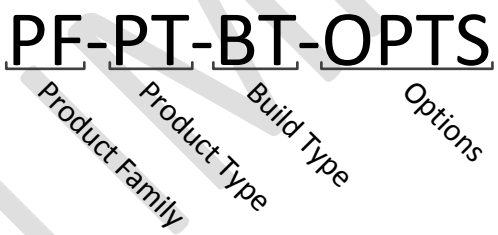

Figure 3-1: SkyeTek Part Number Format

Code	Options	Description
Product Family	SM = SkyeModule	Highest level product family code.
Product Type	NV = NOVA	Specifies the specific part type.
Build Type		Specifies hardware form factor.
Options	Blank = Standard	This field is left for special customer part numbers or standard variations such I2C for I2C as the default host interface. Consult the SkyeTek sales team for custom orders.

Table 3-2: Part Number Details

3.3 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 www.skyetek.com/howtobuy.

4 SkyeModule Nova Overview

4.1 Description

The SkyeModule™ Nova marks the next generation of SkyeTek UHF reader modules. The Nova is an ultra-small, 2 port, 500mW EPC Class 1 Gen 2 reader/writer module. A cutting edge ARM Cortex microcontroller, latest UHF transceiver technology and cutting edge adaptive antenna tuning coupled with the reader's intelligent operating system make this module the most powerful and feature rich UHF reader module of its size. Manufactured in accordance with ISO 9001 and ISO 13485, quality is a top priority for all SkyeTek modules.

Figure 4-1: SM-NV-00

4.2 Block Diagram

[PICTURE]

Figure 4-2: SkyeModule Nova Block Diagram

4.3 Features

- Selects, Reads and writes to transponders based on EPC Global Class 1 Gen 2v2 (ISO 18000-6C)
- Return Signal Strength Indicator (RSSI)
- 2 antenna ports, each capable of 500mW output power
- Adaptive Antenna Tuning
- Mini PCIe half card form factor
- Wide and efficient power supply with input from 2.0 – 5.5V
- Deep sleep mode current down to 10uA
- Easy migration to and from the M7/M9/M10
- Supported host interfaces include USB, TTL level RS232, SPI, I2C
- Modularly certified (coming soon)

4.4 Applications

- Mobile Computing
- Inventory and Asset Management
    - Retail Inventory
    - In Transit Inventory
- Access Control

4.5 Agency Approvals

- RoHS 2
- FCC Modular – Seeking approval
- CE Mark – Seeking approval
- Manufactured according to ISO9001 and ISO13485

5 Mechanical Specifications

Dimensions: 25 mm x 30 mm = 750 mm^2
Height: 5 mm

[PICTURE]

Figure 5-1: SM-NV Mechanical Drawing

6 Pinning Information

6.1 Connector Descriptions

The SM-NV-00 is the standard version of the Nova module and use the 52 pin Mini PCIe connector. In production, customers can connect a host to the module in one of three ways:

Connector Type	Description	Ref Des	Man.	Man. P/N	Mating Connector
52 pin Mini PCIe	Host interface connector	J3	Molex	N/A	0679101002

Table 6-1: SkyeModule Nova Connector Specification

Custom connectors and antenna configurations can be ordered with a minimum order quantity. Please contact a SkyeTek sales representative or local reseller to discuss ordering options. 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.

6.2 Host Interface Connector Pin Mapping

The SkyeModule Nova host connector is a 52-pin Mini PCI Express edge connector. The pin numbers are located as illustrated in Figure 6-1 below. The pin mappings and descriptions are shown in Table 6-2. Note that all unconnected pins should be left floating.

[PICTURE]

Figure 6-1: Host Interface Connector Pin Numbering

Pin	Name	Description	I/O	Pin	Name	Description	I/O
1	NC	Not Connected	N/A	2	VIN	Input Power Supply	Input
3	NC	Not Connected	N/A	4	GND	Ground	Input
5	NC	Not Connected	N/A	6	NC	Not Connected	N/A
7	NC	Not Connected	N/A	8	MISO	SPI Master In, Slave Out	Output
9	GND	Ground	Input	10	MOSI	SPI Master Out, Slave In	Input
11	NC	Not Connected	N/A	12	SCK	SPI Clock IN	Input
13	NC	Not Connected	N/A	14	SSEL	SPI Slave Select	Input
15	GND	Ground	Input	16	NC	Not Connected	N/A
17	NC	Not Connected	N/A	18	GND	Ground	Input
19	NC	Not Connected	N/A	20	Deep Sleep	Active Low Deep Sleep	Input
21	GND	Ground	Input	22	Reset	Active Low Reset	Input
23	NC	Not Connected	N/A	24	VIN	Input Power Supply	Input
25	NC	Not Connected	N/A	26	GND	Ground	Input
27	GND	Ground	Input	28	NC	Not Connected	N/A
29	GND	Ground	Input	30	SCL	I2C Clock	Input
31	NC	Not Connected	N/A	32	SDA	I2C Data	I/O
33	NC	Not Connected	N/A	34	GND	Ground	Input
35	GND	Ground	Input	36	D-	USB D minus	I/O
37	GND	Ground	Input	38	D +	USB D Plus	I/O
39	VIN	Input Power Supply	Input	40	GND	Ground	Input
41	VIN	Input Power Supply	Input	42	GPIO0	General Purpose I/O 0	I/O
43	GND	Ground	Input	44	GPIO1	General Purpose I/O 1	I/O
45	GPIO3	General Purpose I/O 3	I/O	46	GPIO2	General Purpose I/O 2	I/O
47	NC	Not Connected	N/A	48	NC	Not Connected	N/A
49	RXD	UART Receive	Input	50	GND	Ground	Input
51	TXD	UART Transmit	Output	52	VIN	Input Power Supply	Input

Table 6-2: SkyeModule Nova Pin Descriptions

6.3 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 14.3.9
- "User Port Value" in section 14.3.10

NOTE – GPIO3 is used as a data ready pin when in SPI or I^2C mode. GPIO3 cannot be used as GPIO when using these interfaces.

7 Environmental Specifications

7.1 Electrostatic Precautions

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

The SkyeModule Nova 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 General Ratings and Operating Conditions

Specification	**Rating**
Temperature range	Temperature is 25 degrees Celsius unless otherwise noted
Operating	-20 to +70 degrees C
Storage	-40 to +125 degrees C
Humidity	
Operating, continuous storage	10-90 percent (non-condensing)
Transient storage (<24 hours)	5-95 percent maximum (non-condensing)
ESD protection	< 1kV (ESD HBM 15500 Ω, 100pF) —or— 100V (ESD MM 0.75uH, 200pF)

Table 7-1: Environmental Ratings/Operating Conditions

8 Electrical Specifications

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

- Temperature is 25 degrees Celsius.
- Frequency is 915 MHz.
- Supply voltage (VCC) is 5 V.

8.1 Electrical Characteristics

Specification	Min	Typ	Max	Units/Notes
RF Characteristics				
Frequency ranges (Direct output)		860-960		MHz
Transmission Parameters				
Transmit Power		500		mW
Optimum PA Load Impedance		50		Ohms
Logic Inputs				
High state input voltage	2.3		5.0	V
Low state input voltage	0		1	V
Input Current (IINH/IINL)			10	nA
Logic Outputs				
Output High Voltage (VOH)	2.8	3.3	3.6	V
Output Low Voltage (VOL)			0.4	V
Output Current (IINH/IINL)			4	mA
Power Supplies				
Voltage Supply	2.0		5.5	V
Idle Current @ 5V Supply		150		mA
Continuous Transmit Current @ 5V Supply		500		mA
Low Power Software Sleep Mode Current @ 5V Supply		10		mA
Deep Sleep Mode Current @ 5V Supply		5		uA

Table 8-1: SkyeModule Nova Electrical Specifications

8.2 Absolute Maximum Ratings

Specification	Rating
V_{SUPPLY} to GND	7.0 V
Digital I/O voltage to GND	5.5 V

Table 8-2: Absolute Maximum Ratings

9 Performance Specifications

9.1 Range Specifications

The range measurements below should be used as a guideline and not a guarantee. Environment can play a major role on tag range performance. Be sure to avoid any conductor in or near the field, as eddy currents can significantly reduce energy transfer between the reader antenna and the tag.

Specification	Min	Typ	Max	Units/Notes
Select Tag Range (6dBi Broad Band Antenna)				
Avery Dennison Label, Monza 3 Chip		6	10	m

Figure 9-1: Range Specifications

WARNING: Read ranges are not guaranteed and are subject to change without warning due to tag silicon or inlay variations.

10 Radio Specifications

10.1 Agency Approvals

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

- United States: Seeking FCC 15.247 modular approval
- Europe: Seeking EN302-208, EN301-489, EN 61000-4-3
- RoHS

10.2 Frequency Band

The Nova operates in the 860-960MHz band. Allowed frequency bands and channels are subject to regional regulatory standards. Operating frequency of the Nova is software adjustable.

10.3 Tag Protocols

The SkyeModule Nova supports at least the basic tag commands (select, read, and write) for EPC Class 1 Gen 2 (ISO 18000-6C) compliant tags. For the most current listing of supported tags and features, see the *SkyeModule Nova Tag Support List*.

11 Host Interface Specifications

The SkyeModule Nova supports the following microcontroller host interfaces for easy integration into existing systems:

- USB (Overrides other interfaces when connected)
- TTL Serial
- SPI
- I^2C

The SkyeModule Nova and the host interface board support TTL Serial and USB communications. The host interface board provides a USB connector and a TTL to RS-232 level converter for the TTL Serial host interface. The Host Interface system parameter determines which host interface is used to communication with the host. Each interface is software selectable and only one host interface is active at a time, however, USB may always be connected and overrides the current interface. The host interface is selected based on the power-up default value and can be changed at run time. The SkyeModule Nova operates under host control using SkyeTek Protocol v3 sent over one of the host interfaces described in this chapter.

The following sections describe the power and host communication connections for the SkyeModule Nova. The SkyeTek Protocol and commands are described further in section 13, Communicating with the Module.

11.1 USB 2.0

As a USB device, the host detects the SkyeModule Nova as an HID device. The SkyeModule Nova uses a standard HID driver but is not a certified USB device. The SkyeModule Nova supports both standard and high speed USB hosts and enumerates correctly on both Windows and UNIX platforms. The USB interface is typically only used for demonstration as a USB host controller is not usually available for in embedded systems. To communicate with the reader in USB mode, either SkyeTek demonstration software or the SkyeTek APIs can be used. See the SkyeTek support site for the latest software and API downloads at support.skyetek.com.

Figure 11-1 shows an example of a circuit to permit USB communications without using the host interface board.

[PICTURE]

Figure 11-1: USB Connection Diagram

NOTE – If powered by USB, the USB host must be capable of supplying the USB standard high power device, 500mA at 5V.

11.2 TTL Serial

A two-wire serial connection (no handshaking) is provided on the TXD and RXD lines where TXD and RXD are from the module's point of view. Data exchange between the host and the SkyeModule Nova occurs according to SkyeTek Protocol v3 (ASCII or Binary mode). See more about the protocol in section 13, Communicating with the Module.

Serial communication is the most common and robust host interface for this module in an embedded system. Because the interface is asynchronous, the module responds immediately upon command completion instead of waiting for a host clock as in SPI or I^2C.

Figure 11-2 shows a sample circuit that lets you connect the SkyeModule Nova without the host interface board. Figure 11-3 shows examples of typical communication on a signal level.

[PICTURE]

Figure 11-2: TTL Serial Connection Diagram

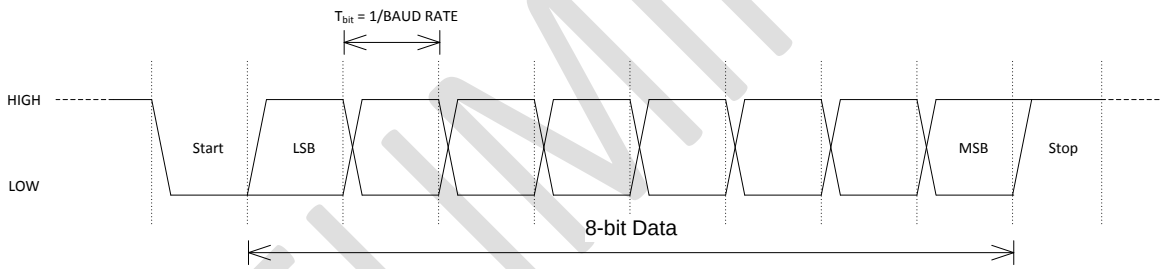

Figure 11-3: TTL Serial Timing Diagram

Notes:

- Baud rate is selectable via the appropriate system parameter. Preprogrammed factory **default baud rate is 38,400 Baud**.
- Bytes are transmitted least-significant bit (LSB) first using the typical serial data format of *Start Bit* followed by *8 data bits* followed by a *Stop Bit*.
- The TTL Serial connection supports bit rates from 9,600 to 115,200 Baud, 8 data bits, no parity, 1 stop bit.
- Host to reader interface shall be TTL level (non-inverted). Both **3.3V and 5V logic levels are allowed**. See logic levels in section 8.1, Electrical Characteristics.

11.3 SPI

The SkyeModule Nova provides a simple four-wire SPI host interface. There is also an optional data ready signal to indicate that the current command is complete and data is available for the host. Figure 11-4 shows an example of a host interface connection using SPI.

[PICTURE]

Figure 11-4: SPI Connection Diagram

The protocol for requests to the SkyeModule Nova is outlined below:

- The data packet exchange between the host (SPI Master) and the Nova (SPI Slave) uses SkyeTek Protocol v3 (Binary Mode only). See more about the protocol in section 13, Communicating with the Module.
- The host must implement SPI master functionality.
- The SCK line is the master clock controlled by the host and should remain low during idle state.
- The slave select line is active low.
- The data is setup on the rising edge of SCK.
- The message data is latched on the falling edge of SCK.
- The MOSI signal line provides the data from the host to the SkyeModule Nova.
- Supports data rates **up to 4 MBit**
- Both **3.3V and 5V logic levels are allowed**. See logic levels in section 8.1, Electrical Characteristics.

The timing diagram in Figure 11-5 illustrates this behavior.

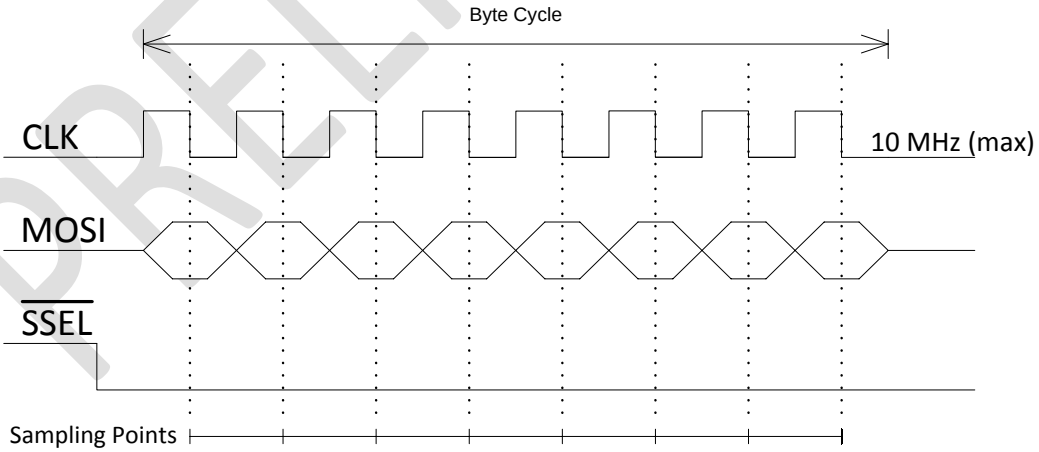

Figure 11-5: SPI Request Setup and Sample Timing

- For the request data on the MOSI line, the host software should keep the SSEL pin at steady state low as shown in Figure 11-6 below.
- The time delay $T_{d,MAX}$ between byte cycles in a request should not exceed 5 ms. After 5 ms the SkyeModule Nova will timeout, signifying the end of the request.

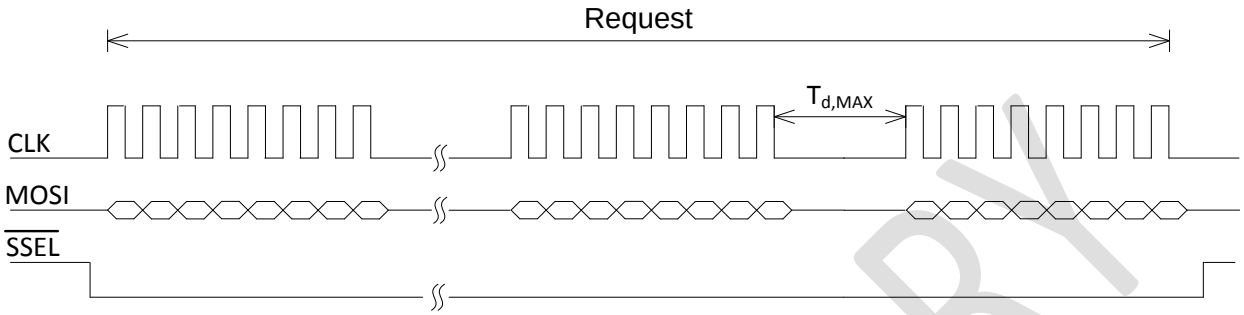

Figure 11-6: SPI Request Timing

The protocol for retrieving the response data is outlined below:

- The SkyeModule Nova is half duplex so the response data must be retrieved after the request has been sent.
- The GPIO3_DR (data ready) signal will transition high when data is available for the host.
- If data ready is not implemented on the host, the host can poll the module starting 1ms after the command send is complete. The module will respond with 0x00 when no data is present, and 0x02 (start of frame) when data is available.
- Response data will be thrown away if not read within 10 seconds of becoming available.
- The MISO signal provides the response data from SkyeModule Nova to the host.
- To retrieve data on the MISO line, the SSEL (Slave Select) signal must be low when the clock is sent for an entire byte. Between bytes, SSEL can either stay low or transition high again as long as it transitions low before the first clock of the next byte.
- The host can use the data length field (response bytes 2 and 3) in order to determine how many bytes to read from the module as these first bytes will always be present immediately following a start of frame (0x02).

Figure 11-7 below shows the timing required to retrieve data on the MISO line.

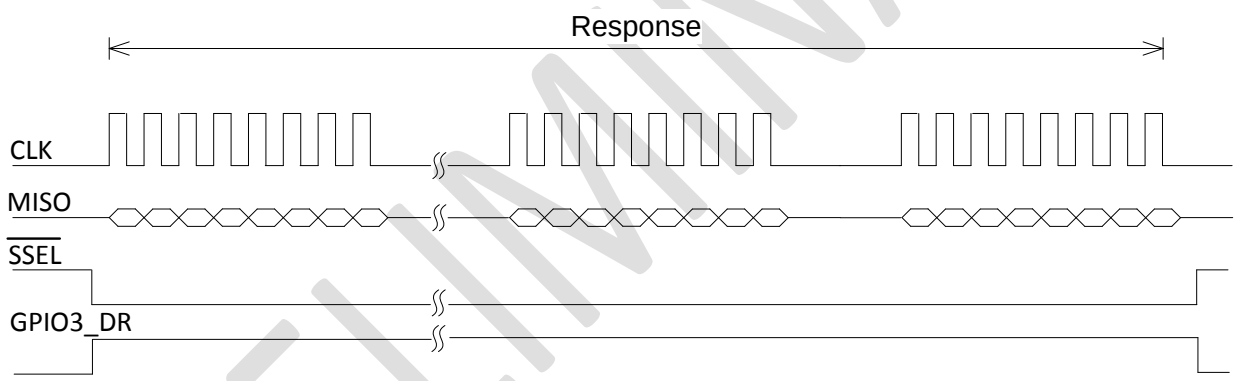

Figure 11-7: SPI Response Timing

NOTE – Not reading the entire response before sending another command can cause undesired behavior. Always make sure to read the entire response when using the SPI interface.

11.4 I²C

The SkyeModule Nova supports can act as an I²C slave device. External pull up resistors are required on the SDA and SCL lines as shown in Figure 11-8: I²C Connection Diagram. There is also an optional data ready signal to indicate that the current command is complete and data is available for the host.

[PICTURE]

Figure 11-8: I²C Connection Diagram

The protocol for communicating via I²C is outlined below:

- The I²C interface uses a standard two-wire connection in which SCL is the master clock and SDA is a bidirectional serial data line.
- The data packet exchange between the host (I²C Master) and the Nova (I²C Slave) uses SkyeTek Protocol v3 (Binary Mode only). See more about the protocol in section 13, Communicating with the Module.
- I²C fast mode plus (**1MHz**), I²C fast mode (**400 kHz**), and **100kHz** data rates are all supported.
- The data is sent and received MSB first.
- Up to 5V logic levels are allowed. See logic levels in section 8.1, Electrical Characteristics.
- The device uses a 7-bit address
- The default **address = 0x7F**, but the address can be changed with the Reader ID system parameter. See more about this system parameter in section 14.3.5, Reader ID.

The communication scheme from host to module is as follows:

- Initiate a start condition (SDA transitions low while SCL is high).
- Send the nine bits of the initial start packet as follows:
    - Send the 7-bit address.
    - Send a write bit as the eighth bit (0 for writing from the host to the slave).
    - Send the ninth bit as the "acknowledge" bit (ACK)
    - If the reader recognizes the address, it pulls SDA low to acknowledge
- Use the bus to clock each byte of the SkyeTek protocol request.
- After sending the entire request, initiate a stop condition. (SCL transitions high, and then SDA transitions high while SCL is high)

Wait for command to complete:

- The GPIO3_DR (data ready) signal will transition high when data is available for the host to read.
- If data ready is not implemented on the host, the host can poll the module after the request is sent. The module will NAK to a read while it is busy executing a command.

Communication scheme from module to host is as follows:

- Initiate a start condition. (SDA transitions low, and then SCL transitions low.)
- Send the nine bits of the initial start packet as follows:
    - Send the 7-bit address.
    - Send a read bit as the eighth bit (1 for reading from the slave to the host).
    - Send the ninth bit as the "acknowledge" bit (ACK)
    - If the reader recognizes the address, it pulls SDA low to acknowledge
    - If the address isn't recognized or the module is busy the SDA bit will remain high during the ACK bit.
- Clock each byte of the SkyeTek protocol response from the module.
- After receiving the response, is received, initiate a stop condition. (SDA transitions high while SCL is high.)
- SDA must transition while the clock is low and remain stable while the clock is high.
- Response data will be thrown away if not read within 10 seconds of becoming available.

Recommended response handler method #1 (polling):

- Read a single byte continuously until the reader ACKs and a 0x02, start of frame is received
- Read two bytes which contain the message length
- Read the remaining message length

Recommended response handler method #2 (using data ready signal):

- Poll on the data ready signal until it transitions high, indicating that data is present
- Read three bytes, the last two contain the message length
- Read the remaining message length

A timing diagram illustrating the I^2C data transfer is shown in the figure below:

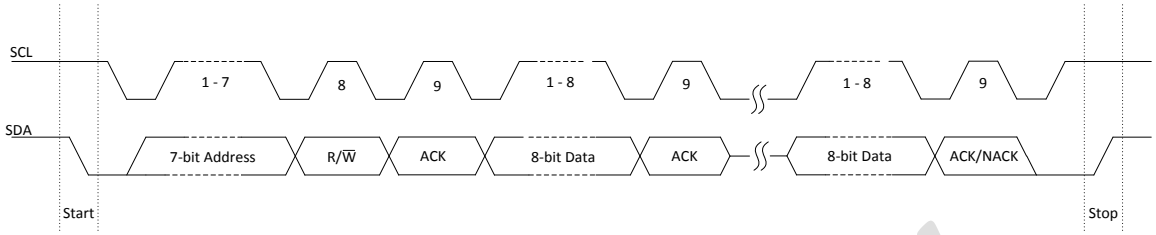

Figure 11-9: I^2C Timing Diagram

NOTE – Not reading the entire response before sending another command can cause undesired behavior. Always make sure to read the entire response when using the I^2C interface.

12 SkyeModule Nova Antenna Options

The SkyeModule Nova has 2 antenna ports to connect external antennas. The ports use an Ultra Miniature Connector (U.FL) to save space and cost. Any 50 ohm antenna in the appropriate frequency band (865-868MHz for Europe, 920-928MHz for North America) can be used with the Nova.

The SkyeModule Nova also uses an advanced Adaptive Antenna Tuning circuit to ensure a quality impedance match with any antenna. The user can take advantage of this feature by first attaching the antenna to the port they would like to use, then sending a SkyeTek Protocol command to the Nova for it to execute its tuning sequence. The Nova will measure the reflected power caused by impedance mismatch and then will automatically compensate, delivering the maximum power to the antenna while reducing noise in the system.

NOTE – Read range depends on antenna choice and operating environment. Range can vary widely, depending on your choice of tag inlay and antenna gain. See section 9.2, Range Specifications for expected range performance with different antennas.

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13 Communicating with the Module

13.1 Host Communication (SkyeTek Protocol v3)

The SkyeModule Nova operates under control of a host according to SkyeTek Protocol v3. The basic command and response formats are illustrated for your reference in the following two sections 13.2 and 13.3. The best way to get started creating and understanding commands is to follow the application notes below while using the Protocol Builder in SkyeWare v4:

- Nova Basic Tag Commands – Guides you through the select tag, read tag and write tag commands.
- SkyeTek Protocol v3 Reader Commands – Explains how to read and write system parameters.

For more feature specific commands, use the tag specific application notes listed in the Additional Reading section 1.3.

For a quick reference on the protocol if you already know the command you want to use, see the *SkyeTek Protocol v3 Reference Guide*. This provides detailed information on each command structure, error codes, and tags types. Be warned that this document is very length as it details every command available for every SkyeTek module.

13.2 Request Formats

Flags	Cmd.	Tag Type	TID Len.	TID	Addr.	# of Blks.	Data Len.	Data	CRC
4	4	4	4	32 (max)	4	4	4	2K	4

Table 13-1: Request Format (bytes), ASCII Mode

Msg. Len.	Flags	Cmd.	Tag Type	TID Len.	TID	Addr.	# of Blks.	Data Len.	Data	CRC
2	2	2	2	1	32 (max)	2	2	2	1K	2

Table 13-2: Request Format (bytes), Binary Mode

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

13.3 Response Formats

Message Length	Response Code	Tag Type	Data Length	Response Data	CRC
2	2	2	2	1K	2

Table 13-3: Response Format (bytes), Binary Mode

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

14 System Parameters

14.1 System Parameter Summary

System parameters let you configure reader settings to customize the reader for your environment. You can temporarily alter parameters in memory or change the default values that are stored on the SkyeModule Nova's non-volatile memory. The following table summarizes the parameters. (See System Parameter Detail in section 14.3 for detailed information about each parameter)

Parameter Name	Address (hex)	Num. Blocks (hex)	Read /Write	Default Value
Serial Number	0x0000	0x0004	R	0x00000000
Firmware Version	0x0001	0x0004	R	0xXXXXXXXX (depending on release)
Hardware Version	0x0002	0x0004	R	0xXXXXXXXX (depending on release)
Product Code	0x0003	0x0002	R	0x0010
Reader ID	0x0004	0x0004	R/W	0xFFFFFFFF
Reader Name	0x0005	0x0032	R/W	SkyeModule Nova (in ASCII Format)
Host Interface Type	0x0006	0x0001	R/W	0x01 (TTL)
Interface Baud Rate	0x0007	0x0001	R/W	0x02 (38400)
User Port Direction	0x0008	0x0001	R/W	0x00
User Port Value	0x0009	0x0001	R/W	0x0F
MUX Control	0x000A	0x0001	R/W	0x00
Operating Mode	0x000C	0x0001	W	N/A
Tag Command Retries	0x0011	0x0001	R/W	0x03
Power Level	0x0012	0x0001	R/W	0xDC (27 dBm)
Current Frequency	0x0004	0x0004	R/W	0x3689CAC0 (915 MHz)
Start Frequency	0x0031	0x0004	R/W	0x35C80160 (902.3 MHz)
Stop Frequency	0x0032	0x0004	R/W	0x374B9420 (927.7 MHz)
Hop Channel Spacing	0x0034	0x0004	R/W	0x00030D40 (200 KHz)
Frequency Hopping Sequence	0x0035	0x0001	R/W	0x01 (pseudo-random)
Modulation Depth	0x0036	0x0001	R/W	0x64 (100%)
Regulatory Mode	0x0037	0x0001	R/W	0x00

Table 14-1: SkyeModule Nova System Parameters

14.2 Changing System Parameters

CAUTION – Changing system parameter values – especially the default values – can render your SkyeModule Nova 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 – Reads the current value of the system parameter at the memory address specified.
- Write System Parameter – Writes a new value to the system parameter at the memory address specified.
- Store Default System Parameter – Writes a new system parameter value to the non-volatile memory. This saves the setting even after a power cycle or reset.
- Retrieve Default System Parameter – Reads the system parameter value at the address specified out of non-volatile memory.

See System Parameter Detail in section 14.3 for detailed information about individual parameters.

For full examples of how to use these commands, see the system parameter examples found in the *Using SkyeProtocol V3 Reader Commands* application note.

CAUTION – Resetting (cycling power) on your SkyeModule Nova causes all system parameters to revert to their default values. Any changes made to system parameters in memory 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.

14.3 System Parameter Details

This section describes the SkyeModule Nova system parameters.

14.3.1 Serial Number

- Returns the serial number of the reader
- Parameter address: 0x0000
- Length (bytes): 4
- Default value: 0x00000000
- Read-only

14.3.2 Firmware Version

- Returns the firmware version currently loaded on the reader. (Refer to the *SkyeModule Nova Release Notes* for more information about the specific firmware release.)
- Refer to the *SkyeWare User Guide* for information about updating firmware.

- Parameter address: 0x0001
- Length (bytes): 4
- Default value: 0xXXXXXXXX (depending on release)
- The firmware version uses this format:
    - Major revision (1 Byte)
    - Minor revision (1 Byte)
    - Current build number (2 bytes)
- Read-only

14.3.3 Hardware Version

- Returns the current hardware version of the reader
- Parameter address: 0x0002
- Length (bytes): 4
- Default value: 0xXXXXXXXX (depending on release)
- The hardware version uses the following format:
    - Major revision (1 Byte)
    - Minor revision (1 Byte)
    - Current build number (2 bytes)
- Read-only

14.3.4 Product Code

- Returns the SkyeTek product code identifier. (Each SkyeTek Product has a unique product code.)
- Parameter address: 0x0003
- Length (bytes): 2
- Default value: 0x0010
- Read-only

14.3.5 Reader ID

- This was used for a deprecated SkyeTek protocol feature. It is now used as the I^2C address of the reader in I^2C mode. The least significant 7 bits of the reader ID act as the 7-bit I^2C address.
- Example: A value of 0x0000001B would indicate an I^2C address of 0x1B
- Parameter address: 0x0004
- Length (bytes): 4
- Default value: 0xFFFFFFFF
- Read/write

14.3.6 Reader Name

- Identifies a reader with a 32-byte user-defined name.

- Parameter address: 0x0005
- Length (bytes): 32 (20 hex)
- Default value is “SkyeModule Nova” (in hex)
- Read/write

14.3.7 Host Interface Type

- Identifier for the type of host interface being used.
- Parameter address: 0x0006
- Length (bytes): 1
- Default value: 0x01 (TTL Serial)
- Valid host interface values are:
  - 0x01 – TTL Serial
  - 0x03 – SPI
  - 0x05 – I^2C
  - 0x06 – USB
  - Any other values are invalid and are ignored.
- Read/write

14.3.8 Interface Baud Rate

- Sets the baud rate of the host interface.
- Works for the TTL Serial host interface only.
- Parameter address: 0x0007
- Length (bytes): 1
- Default value: 0x02 (38,400)
- Valid baud rate values are:
  - 0x01 – 19200
  - 0x02 – 38400
  - 0x03 – 57600
  - 0x04 – 115200
  - 0x05 – 1 MBaud
  - Any other value – 9600
- Read/write

14.3.9 User Port Direction

- Sets the direction of the GPIO pins of the reader.
- Parameter address: 0x0008
- Length (bytes): 1
- Default value: 0x00
- Default value is 0x00 (GPIO pins are outputs).
- A one in the bit position indicates that the corresponding GPIO pin is an input.

- A zero in the bit position indicates that the corresponding GPIO pin is an output.
- Bits correspond to the pins as follows:
    - BIT0 – GPIO 0
    - BIT1 – GPIO 1
    - BIT2 – GPIO 2
    - BIT3 – GPIO 3
    - BIT4 - BIT7 – Reserved
- Read/write

14.3.10 User Port Value

- Sets or reads the value of the GPIO pins of the reader.
- Parameter address: 0x0009
- Length (bytes): 1
- Default value is 0x0F (GPIO pins are logic high).
- A one in the bit position indicates that the corresponding GPIO pin is logic high.
- A zero in the bit position indicates that the corresponding GPIO pin is logic low.
- Bits correspond to the pins as follows:
    - BIT0 – GPIO 0
    - BIT1 – GPIO 1
    - BIT2 – GPIO 2
    - BIT3 – GPIO 3
    - BIT4 - BIT7 – Reserved
- Read/write

14.3.11 Operating Mode

- Can put the reader into sleep mode or into keyboard wedge mode.
- Parameter address: 0x000C
- Length (bytes): 1
- Default value is 0x00 (active).
- Writing a value 0x01 to this system parameter puts the reader in sleep mode.
- Sending a single byte on the interface that put the reader to sleep wakes the reader from sleep mode.
- **NOTE: SOFTWARE SLEEP MODE DOES NOT FUNCTION IN USB COMMUNICATIONS.** This is planned for future firmware releases.
- Write Only

14.3.12 Tag Command Retries

- Sets the number of times a tag command will be retried internally.
- Parameter address: 0x0011
- Length (bytes): 1
- Default value is 0x03

- In very time dependent applications, it is recommended to set this parameter to 0 as this removes much of the variability of response time.
- In most situations, a retry number of 3 is sufficient.
- Read/write
- **WARNING:** Setting this parameter too high can cause very long response times when there is no tag or a failing tag in the field.

14.3.13 Power Level

- Configures the power level for the reader.
- Parameter address: 0x0012
- Length (bytes): 1
- Default value: 0xDC (27 dBm)
- Power level is set in steps of 0.1 dB from 10 dBm to 27 dBm.
- Power levels are written in hex corresponding to a decimal value between 50 and 220 (see Table 14-10).
- Use the following equation to calculate the value to be written for a desired power level:

  (Desired power in dBm – 5)/0.1 = decimal value to write to system parameter

Table 14-2: Common Power Values

Power (dBm)	SkyeTek Decimal Value	Hex Equivalent
10	50	0x32
12	70	0x46
15	100	0x64
17	120	0x78
20	150	0x96
21	160	0xA0
24	190	0xBE
27	220	0xDC

- Read/write

NOTE – SkyeModule Nova's shipped with the SkyeTek Development Kit are preset to a power level of 27 dBm.

14.3.14 Current Frequency

- Sets the current frequency with which the reader singulates a tag.
- Parameter address: 0x0030
- Length (bytes): 4
- Default value: 0x3689CAC0 (915 MHz)

- This parameter is a 4-byte hex equivalent of the frequency. Table 14-11 shows hex values for commonly used frequencies.
- Read/write

NOTE – See "**Error! Reference source not found.**" on page **Error! Bookmark not defined.** to view compliance information and recommended reader settings.

14.3.15 Start Frequency

- Sets the low end of the frequency range under which the reader operates.
- Parameter address: 0x0031
- Length (bytes): 4
- Default value: 0x35C80160 (902.3 MHz)
- This parameter is written with a 4-byte hex equivalent of the frequency desired. See Table 14-11 for commonly used frequencies and their hex values.
- To enable frequency hopping, set a frequency range using the Start Frequency and Stop Frequency system parameters. Then use the Frequency Hopping Sequence parameter to set the frequency hopping mode (either sequential or pseudo-random). To disable frequency hopping, set the Start Frequency and Stop Frequency parameter to the same value.
- Read/write

NOTE – See "**Error! Reference source not found.**" on page **Error! Bookmark not defined.** to view compliance information and recommended reader settings.

14.3.16 Stop Frequency

- Sets the high end of the frequency range under which the reader operates.
- The parameter address: 0x0032
- Length (bytes): 4
- Default value: 0x374B9420 (927.7 MHz)
- This parameter is written with a 4-byte hex equivalent of the frequency desired. See table 14-11 for commonly used frequencies and their hex values.
- To enable frequency hopping, set a frequency range using the Start Frequency and Stop Frequency system parameters. Then use the Frequency Hopping Sequence parameter to set the frequency hopping mode (either sequential or pseudo-random). To disable frequency hopping, set the Start Frequency and Stop Frequency parameter to the same value.
- Read/write

NOTE – See "**Error! Reference source not found.**" on page **Error! Bookmark not defined.** to view compliance information and recommended reader settings.

Table 14-3: Commonly Used Frequencies

Frequency (MHz)	Hex Equivalent	Description
865.7	0x339988A0	EU Start
866.7	0x33A8CAE0	EU Center
867.9	0x33BB1A60	EU Stop
902.3	0x35C80160	NA Start
915.0	0x3689CAC0	NA Center
927.7	0x374B9420	NA Stop

14.3.17 Hop Channel Spacing

- Controls the hop channel spacing when frequency hopping is enabled.
- Parameter address: 0x0034
- Length (bytes): 4
- Default value: 0x00030D40 (200 KHz)
- To enable frequency hopping, set a frequency range using the Start Frequency and Stop Frequency system parameters. Then use the Frequency Hopping Sequence parameter to set the frequency hopping mode (either sequential or pseudo-random). To disable frequency hopping, set the Start Frequency and Stop Frequency parameter to the same value.
- Read/write

NOTE – See "**Error! Reference source not found.**" on page **Error! Bookmark not defined.** to view compliance information and recommended reader settings.

14.3.18 Frequency Hopping Sequence

- Switches the hopping sequence between pseudo-random and sequential mode.
- Parameter address: 0x0035
- Length (bytes): 1
- Default value: 0x01 (pseudo-random)
- To set the reader to sequential hopping mode, write 0x00 to this parameter.
- To reset the reader to pseudo-random hopping sequence, write 0x01 to this parameter.
- To enable frequency hopping, set a frequency range using the Start Frequency and Stop Frequency system parameters. Then use the Frequency Hopping Sequence parameter to set the frequency hopping mode (either sequential or pseudo-random). To disable frequency hopping, set the Start Frequency and Stop Frequency parameter to the same value.
- Read/write

NOTE – See "**Error! Reference source not found.**" on page **Error! Bookmark not defined.** to view compliance information and recommended reader settings.

14.3.19 Modulation Depth

- Sets the modulation depth of the reader-to-tag transmissions, as calculated by the equation: $(V_{max} – V_{min})/V_{max}$
- Parameter address: 0x0036
- Length (bytes): 1
- Default value: 100%
- The values for the modulation depths are in steps of 10, ranging from 10% to 100%.
- The values are the hex equivalent of the corresponding modulation depth.

Table 14-4: Common Modulation Depth Values

Modulation Depth (%)	Hex Equivalent
30	0x1E
80	0x50
90	0x5A
100	0x64

- The modulation depth is calculated by the reader using the equation: $(V_{MAX} – V_{MIN})/V_{MAX}$ where V_{MAX} is the RF voltage when transmit power is maximum and V_{MIN} is the RF voltage when the transmit power is minimum. (For 100% modulation depth, V_{MIN} equals zero.)
- See the manufacturer's tag data sheet for the modulation depth supported for the tags in your application.
- Read/write

NOTE – See "**Error! Reference source not found.**" on page **Error! Bookmark not defined.** to view compliance information and recommended reader settings.

14.3.20 Regulatory Mode

- Enables pulse shaping, listen before talk, and timing modifications for regions with special regulatory requirements, such as Europe.
- Parameter address: 0x0037
- Length (bytes): 1
- Default value 0x00 (no pulse shaping)
- Read/write

NOTE – See "**Error! Reference source not found.**" on page **Error! Bookmark not defined.** to view compliance information and recommended reader settings.

Table 14-5: Regulatory Mode Values

Mode	Hex Value
No pulse shaping—Australia/New Zealand, Hong Kong, North America, Singapore, Taiwan	0x00
ETSI/Europe	0x01
Not used	0x02
Not used	0x03
Korea	0x04

15 Special Features

15.1 Sleep Modes

The Nova has two low power sleep modes: deep sleep (hardware controlled) and software sleep mode. The deep sleep mode has the lowest power consumption but a longer wake time. It can only be set using the N_DEEP_SLEEP pin 20 of the host interface connector. There is an internal pull-up on this pin, so if it is unused it can be left floating. To put the reader into deep sleep, set this pin low. Software sleep mode can be set using the Operating Mode system parameter. See the System Parameters section 14 for details. Current consumption and wake times for both modes can be found in the Electrical Characteristics section 8.1 and **Error! Reference source not found.** section **Error! Reference source not found.**, respectively.

NOTE: SOFTWARE SLEEP MODE DOES NOT WORK IN USB COMMUNICATIONS. This is planned for future firmware releases.

15.2 Feature Requests

Request a feature for the Nova module on the SkyeTek support page at support.skyetek.com!