

SKYEMODULE M7 DATASHEET

VERSION 061013



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1 About this Document

This document covers the operating characteristics and modes of the SkyeModule M7. Included in this document are electrical connection diagrams, timing characteristics, electrical and mechanical specifications, system parameters, ordering information, and pin diagrams.

1.1 Revision History

Revision	Author	Change
100812	Ryan Smith	This revision includes updated timing characteristics, electrical connection diagrams, pinning information, ordering information, and mechanical specifications.
061013	Brad Alcorn	Fixes to the pinning information.

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 ² C	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

The M2 part number is constructed according to the SkyeTek part number specification below:



Table 3-1 SkyeTek Part Number Scheme

Details:

Code	Options	Description
Product Family	SM = SkyeModule	Highest level product family code.
Product Type	M7 = M7	Specifies the specific part type.
Build Type	MH = Mounting holes	Specifies standard form factors or custom builds.
Build Revision	1.3	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	00FD	The firmware revision denotes the firmware version loaded onto the module. This may impact the tags supported and may be custom for specific customers.
Parameter Settings	T0 = TTL Serial Interface U0 = USB Interface S0 = SPI Interface 20 = I2C Interface	The parameter settings denote the default system parameters that are set on the module. T0 is the standard. Other settings can be chosen, but additional costs may apply for customization. NOTE: In developer kits, the module comes programmed to USB.

Table 3-2 Part Number Details

As of the date of this document, the most current part numbers for the M7 are shown in Table 3-3 M7 Part Numbers. Always contact a reseller or the SkyeTek sales team for the latest part number.

Module	Part Number
SkyeModule M7	SM-M7-MH-1.3-00FD-T0

Table 3-3 M7 Part Numbers



4 SkyeModule M7 Overview

The SkyeModule M7 is the world's smallest and most cost-effective UHF (862-955 MHz) RFID reader platform. It can read and write to transponders based on the ISO 18000-6C (EPC C1G2/Gen2) air interface and communications standards. The RF output power of the SkyeModule M7 is software-adjustable from 9-24 dBm (8-250 mW) in 3 dB increments.

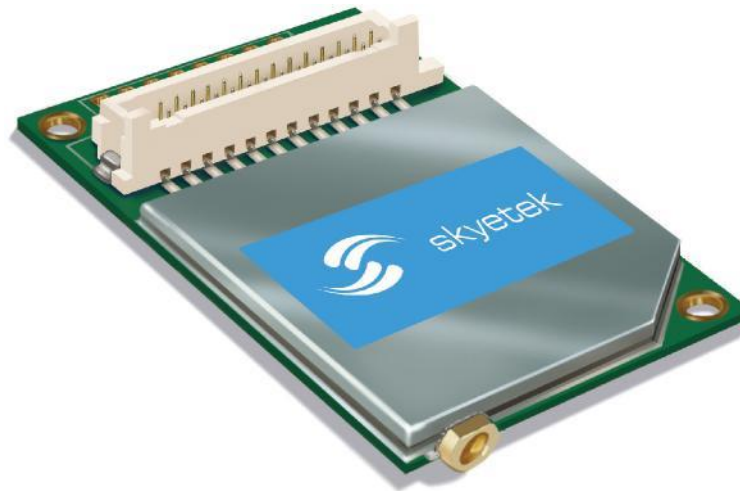


Figure 4-1 SkyeModule M7

4.1 Features

Designed for item-level tagging, consumables, handhelds, and label printers, the SkyeModule M7 offers the following features:

- Common communications protocol—All Skyetek products use Skyetek Protocol v3 (STPv3) to drive low level communications. Skyetek APIs built on top of STPv3 give you methods for exercising readers and reading tags from your custom software applications.
- The SkyeModule M7 is optimized to support a communication rate of 40 kbps. A standard 50 Ω antenna output enables use of an external antenna to optimize the read range/rate.
- The SkyeModule M7 has TTL (UART) serial and USB host-interface options. These options are software-selectable to support both loosely and tightly coupled integrations. The SkyeModule M7 has four programmable GPIO pins for I/O connections to peripherals. Serial data rates are adjustable from 9.6 to 115.2 kbps. Field-upgradable firmware provides forward compatibility for adding future tag protocols, security features, and customized enhancements.

4.2 Applications

The SkyeModule M7 is a small and inexpensive RFID reader module with support for a wide variety of tags and regions. The small size and wide feature set of the M7 lends itself well to the following types of applications:

- RFID Handhelds



- Machine Safety
- Integrated RFID Readers
- Label and Airline Tag Printers

4.3 SkyeWare™ Software

All SkyeModule M7 developer kits ship with the SkyeWare 4 software package for Microsoft® Windows® to aid your RFID development process. This package includes:

- **Setup Wizard** - This Wizard guides you through the setup, configuration, and testing of your new SkyeModule reader. It takes you through all the steps necessary for connecting your hardware, running diagnostic tests, and optimizing your reader configuration. It concludes with useful links to additional SkyeTek software and documentation.
- **Demonstration functions** - This utility offers a quick way to perform high-level demonstrations of the basic functionality of the SkyeModule M7. You can test read range, anti-collision (singulation) capabilities, and use inventory selection and memory functions.
- **Configuration** - You can easily view and change reader configuration parameters or perform basic tag operations, such as reading or writing to specified memory blocks on a tag.
- **Test Software** - The test utility provides a GUI interface for constructing the SkyeTek Protocol v3 commands in either ASCII or binary format, based on tag type and selected flags. You can build and test low-level SkyeTek protocol commands and use all the features of the reader at the protocol level. It is an excellent way to learn more about SkyeTek Protocol v3 commands. For more information, see the *SkyeTek Developer Kit User Guide*.
- **APIs** - SkyeTek offers C and .NET APIs so that you can easily create interfaces between your programming language and any SkyeTek reader modules that communicate using SkyeTek Protocol v3. The APIs provide a rich assortment of functions that allows complete access to and manipulation of your SkyeModule M7. Refer to the *SkyeTek C and .NET API Reference Guide*, installed in the Documentation folder installed with SkyeWare.



5 Mechanical Specifications

This list summarizes the SkyeModule M7 dimensions and clearances. See Figure 5-1 on page 12 for more detailed dimensions.

Outside Dimensions:	36.3 mm x 52.5 mm = 1905.75 mm ²
Height:	9.2 mm
Mounting holes:	3.0 mm diameter 29.3 mm center-to-center (width) 45.3 mm center-to-center (length)
Clearance:	Approx. 2.2 mm between edges of mounting hole and edges of printed circuit board (PCB) (antenna connector side) Approx. 2.3 mm between edge of mounting hole and front of PCB (main connector side)
Weight:	6.8 grams

NOTE - All drawing dimensions are in millimeters. Production units may vary slightly from the measurements given.



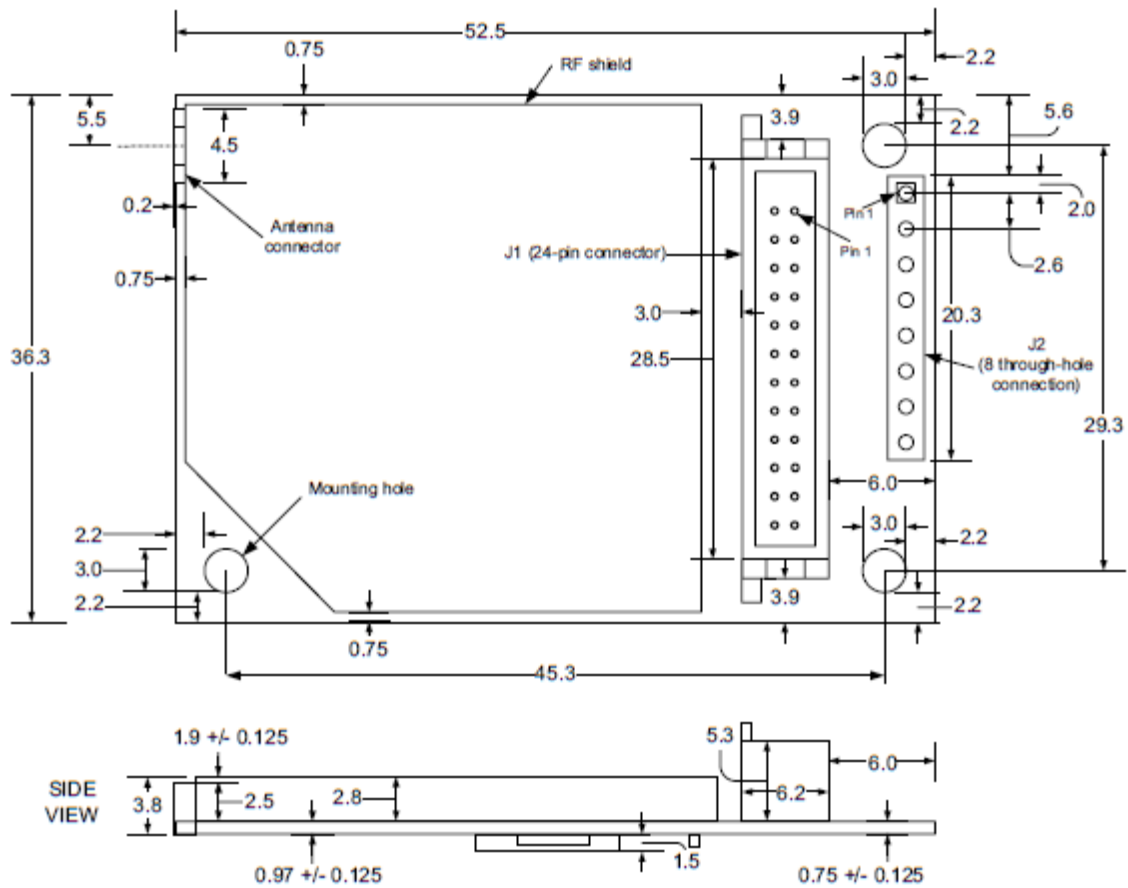


Figure 5-1 SkyeModule M7 Dimensions

6 Pinning Information

Table 6-1 SkyeModule M7 Connector Specifications

Connector Type	Manufacturer	Manufacturer's Part Number
Surface-mount protected header (receptacle on module)	Hirose	DF11Z-24DP-2V
MH counterpart to connect to module	Hirose	DF11Z-24DS-2V

6.1 Pin Mapping for the SkyeModule M7

The standard SkyeModule M7 host connector is a standard 24-pin male header connector.

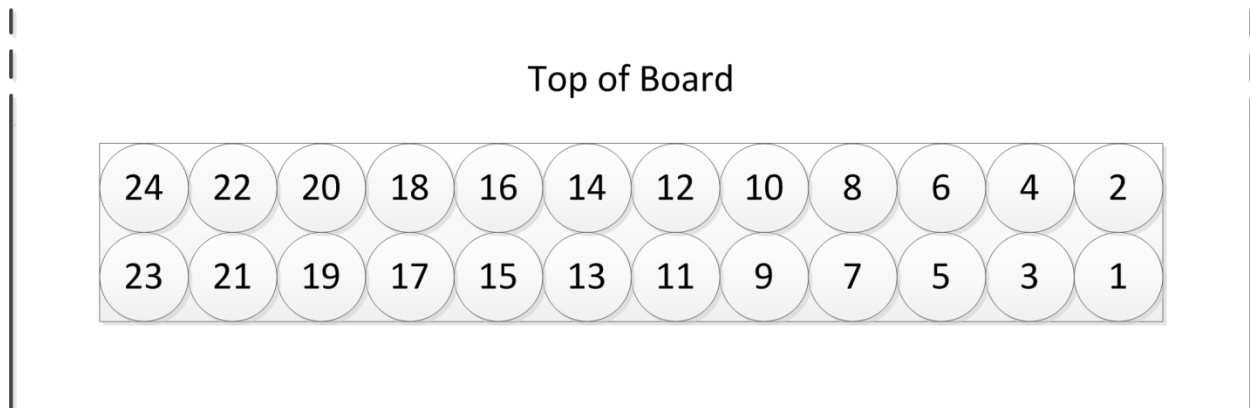


Figure 6-1 M7 Connector Pin-outs

Table 6-2 SkyeModule M7 Pinout

Pin	Name	Description	Pin	Name	Description
1	GPIO0	General-purpose I/O	13	DNEG	USB negative
2	RXD HOST	UART receive	14	ISP N	Reserved
3	GPIO1	General-purpose I/O	15	VCC	Supply voltage
4	TXD HOST	UART transmit	16	GND	Ground
5	GPIO2	General-purpose I/O	17	NC	Not connected
6	NC	Not connected	18	NC	Not connected
7	GPIO3	General-purpose I/O	19	RESET N	Reserved
8	NC	Not connected	20	NC	Not connected
9	VCC	Supply voltage	21	RXD ISP	Reserved
10	GND	Ground	22	NC	Not connected
11	DPOS	USB positive	23	TXD ISP	Reserved
12	NC	Not connected	24	NC	Not connected

CAUTION - If you perform custom integration work on your SkyeModule M7, make sure that you connect all available power and ground pins. Failure to do so will reduce read range and could cause failure of the module. Pins listed as not connected can be left floating.

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” on page 42
- “User Port Value” on page 42



6.3 Using the 8-Through-Hole I/O Option

The J3 header provides eight through-hole connections that let you construct your own custom host interface. (SkyeTek can assist you in this process. Contact Customer Support.) The pin-outs for the J3 header are as follows:

Table 6-3 **SkyeModule M7 J3 Connector Pin Mapping**

Pin	Name	Description
1	RXD_HOST	UART receive
2	TXD_HOST	UART transmit
3	GPIO0	General-purpose I/O
4	VCC	Supply voltage
5	DPOS	USB positive
6	DNEG	USB negative
7	RESET_N	Special function
8	GND	Ground



7 Environmental Specifications

7.1 Electrostatic Precautions



CAUTION - Failure to take proper electrostatic precautions may result in damage to or failure of your SkyeModule M7.

The SkyeModule M7 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

Table 7-1 Environmental Ratings/Operating Conditions

Specification	Rating
Temperature range	Temperature is 25 degrees Celsius unless otherwise noted
Operating	-20 to +70 degrees C
Storage	-30 to +85 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)



8 Electrical Specifications

This chapter discusses the electrical specifications of the SkyeModule M7. Unless otherwise noted, the following assumptions apply to these specifications:

- Temperature is 25 degrees Celsius.
- Frequency is 915.0 MHz.
- Supply voltage (VCC) is 5 V.

The SkyeModule M7 works under normal duty cycles at full output power without the need for external fans, additional heat sinks, etc., under the operating conditions described in these specifications.

NOTE - See “Electrostatic Precautions” on page 19 for electrical safety information.

Table 8-1 SkyeModule M7 Electrical Specifications

Specification	Min	Typical	Max	Units/Notes
Logic Inputs				
High state input voltage	2			V
Low state input voltage			0.8	V
Input Current (I_{INH}/I_{INL})		4	25	mA
Logic Outputs				
Output High Voltage (V_{OH})	2.9			V
Output Low Voltage (V_{OL})			0.4	V
Output Current (I_{INH}/I_{INL})		4	25	mA



Specification	Min	Typical	Max	Units/Notes
Power Supplies				
Voltage Supply	3.1	5.0	5.5	V Note that Skyetek has calibrated the M7 to use a regulated input voltage of 5 V to maintain a transmit power accuracy of +/- 1.5 dB. This accuracy is not valid for other input voltages.
Peak Transmit Current Consumption (under modulation)				
9 dBm		235		mA
12 dBm		202		mA
15 dBm		223		mA
18 dBm		254		mA
21 dBm		297		mA
24 dBm		370		mA
Low Power Sleep Mode		10		mA
Peak Transmit Current Consumption (non-modulated)				
24 dBm		556		mA

8.1 Absolute Maximum Range

Temperature for these specifications is assumed to be 25 degrees Celsius unless otherwise noted.

Table 8-2 Absolute Maximum Ratings/Operating Conditions

Specification	Rating
Maximum input voltage, high (V_{INH})	5.5 V
V_{SUPPLY} to GND	5.5 V
Digital I/O voltage to GND	5.5 V
Antenna VSWR characteristic	2:1 or better, as desirable for optimum performance



9 Host Interface Specifications

The following sections describe the power and host communication connections for the SkyeModule M7.

9.1 Host to Reader Interfaces

The SkyeModule M7 supports the following microcontroller host interfaces for easy integration into existing systems:

- TTL Serial
- USB

The SkyeModule M7, when used with a host interface board, supports RS-232 and USB communications. The host interface board provides a USB connector and a TTL-to-RS-232-level converter for the TTL host interface. Each interface is software-selectable and only one host interface is active at a time. The host interface is selected based on the power-up default value and can be changed at run time using the Host Interface Type system parameter. The SkyeModule M7 operates under host control using SkyeTek Protocol v3 sent over one of the host interfaces described in this chapter.

NOTE - SkyeModule M7s shipped with the SkyeTek Developer Kit are preset to use USB communications and a power level of 21 dBm.



9.2 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.

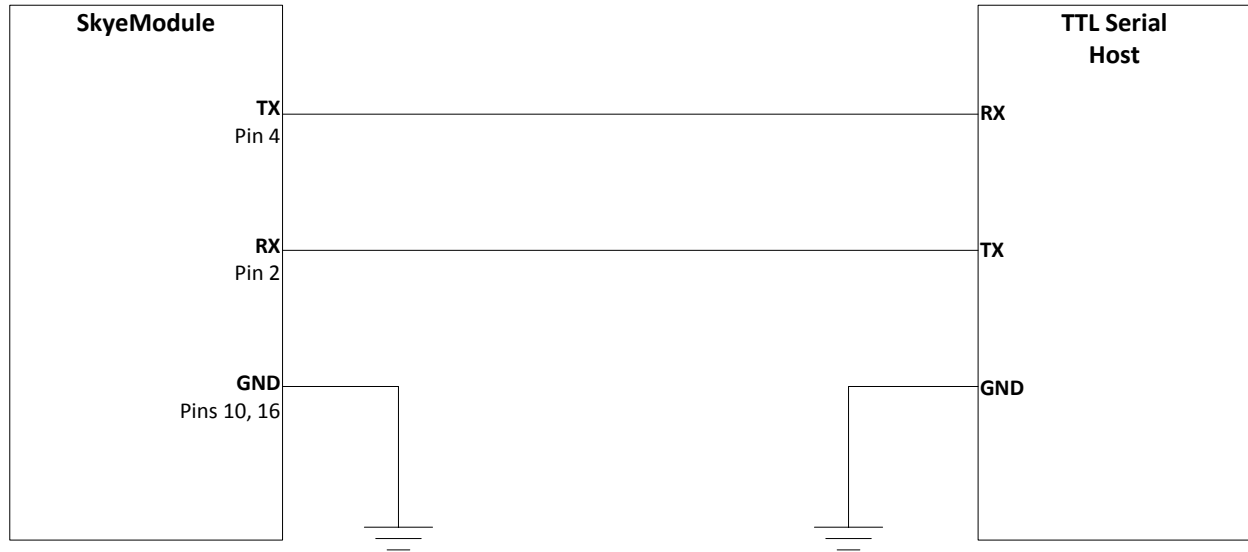


Figure 9-1 TTL Connection Diagram

Data exchange between the host and the SkyeModule M7 occurs according to SkyeTek Protocol v3 (ASCII or Binary mode). Figure 9-2 shows examples of typical communication.

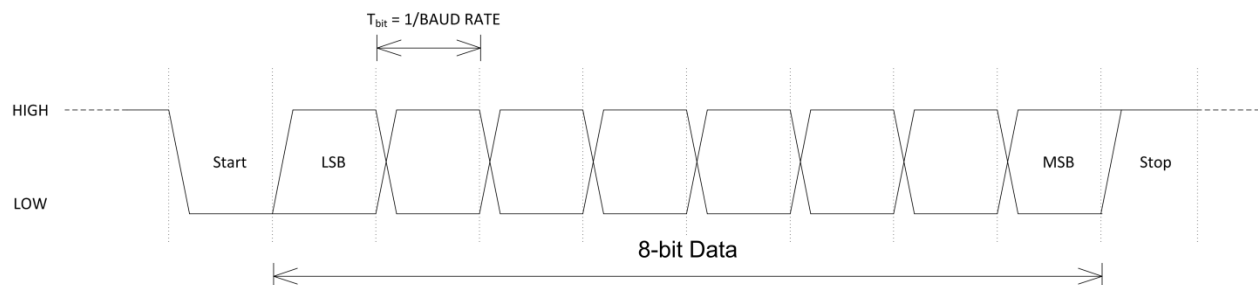


Figure 9-2 TTL Interface

- Baud rate is selectable via the appropriate system parameter. Pre-programmed factory default baud rate is 38,400 Baud, N, 8, 1 (no parity bit, 8 data bits, 1 stop bit).



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- 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 connection supports bit rates from 9,600 to 115,200 baud, 8 data bits, no parity, 1 stop bit.
- The option to add hardware flow control is not supported in this release.
- Host to reader interface shall be RS-232 TTL level (non-inverted).
- TTL low = 0 to 0.8V; TTL high = 2.0 to 5V.



9.3 USB 2.0

The SkyeModule M7 is seen by the host as a generic HID USB device.

The SkyeModule M7 is USB 2.0 High Speed compliant.

NOTE - When the SkyeModule M7 is USB-bus powered, maximum transit power should not exceed 20dBm. SkyeModule M7s shipped with the SkyeTek Development Kit are preset to use USB communications and a power level of 20dBm.

9.3.1 Bypassing the Host Interface Board

Figure 9-3 shows an example of a circuit to permit USB communications without using the host interface board.

CAUTION - When bypassing the HIB, make sure the SkyeModule M7's power is turned down to at least 20dBm to prevent damage to the host USB port.

- SkyeTek Recommends that the power supply for the circuit provides 1A of current to ensure proper operation.
- Be sure to connect the power and ground if you are powering the M7 with USB power.

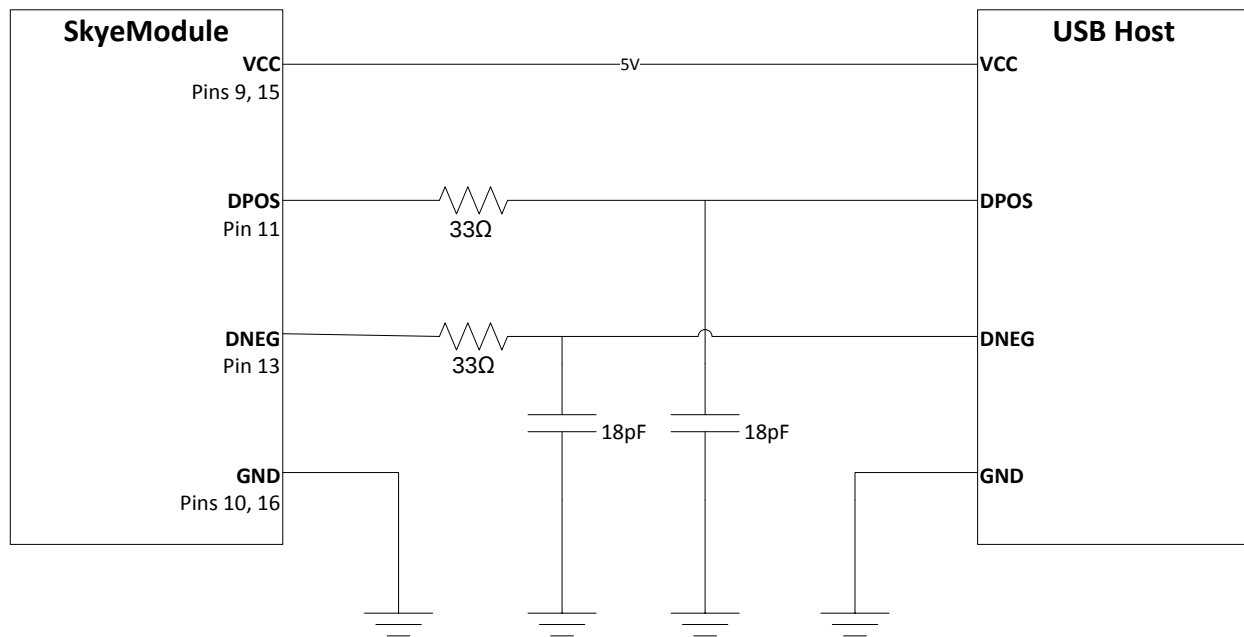


Figure 9-3 Circuit to Bypass Host Interface Board for USB Support

10 Radio Specifications and Regional Compliance

10.1 RF Radio Power

To minimize power consumption for systems that have lower power requirements, the RF transmit power of the SkyeModule M7 is user configurable from 9-24 dBm in steps of 3.0 dB with an accuracy of +/-1.5 dB across a temperature range of -10 to +55 degrees Celsius. See Chapter 13, “Customizing System Parameters,” for information on how to change the RF power level.

10.2 Frequency Range

The SkyeModule M7 is a multi-frequency device that operates in the 862-955 MHz range, which spans the world’s major UHF RFID bands. See “Adjusting System Parameters” below for information on changing operating frequency and region of operation of the M7.

10.3 Tag Protocols

The SkyeModule M7 supports the basic tag commands (identify, read, and write) for the EPC C1G2 (ISO18000-6C) protocol.

NOTE - For the most current listing of supported tags and features, see the Tag Support list included in the documentation folder installed from your distribution CD or on the SkyeTek Support Portal.



10.4 Recommended Radio Settings for Regional Compliance

The following settings are recommended to assist you in obtaining regulatory certification.

Table 10-1 Recommended Reader Settings for Regional Compliances

Region	Spectral Mask Settings (SkyeModule M7 System Parameters)							Tag Types Supported ^a
	Start Freq. (MHz)	Stop Freq. (MHz)	Output Power (conducted) (dBm)	Hop Channel Spacing (KHz)	Modulation Depth (%)	Frequency Hopping Sequence	Regulatory Mode	
Europe ^b	865.7	867.9	21	200	80	0x00	0x01	EPC Class 1 Gen2, ISO 18000-6C
North America	902.3	927.7	24	200	100	1x01	0x00	

- For an expanded listing of supported tags and features, see the Tag Support list included in the documentation folder installed from your distribution CD or on the SkyeTek Support Portal.
- Europe (ETSI) support requires firmware version 0x07010097 or higher.

10.5 Adjusting System Parameters

The SkyeModule M7 provides an adjustable system parameter for each spectral mask settings required to comply with the regions listed in Table 10-1. See “Customizing System Parameters” on page 33 for additional information on setting the system parameters.

10.6 Radio Test Models

For regulatory testing, the SkyeModule M7 now has a special system parameter that lets you set various test modes such as:

- Leaving the carrier on constantly, with or without closed loop power control
- Disabling listen before talk (LBT) to better view the regulatory spectrum.
- Combining these test modes to best suit your test needs.

For more information, please contact SkyeTek technical support at: <http://support.skyetek.com>



10.7 Regional Regulations

The M7 has been tested for agency compliance for the following region(s):

- North America (FCC, Part 15 standard)
- Europe (pre-scan compliant; fit-for-use products require certification)

Testing is conducted at a certified testing laboratory to verify compliance with the regulations shown in Table 10-2. All module testing is done as a pre-scan for each regulation. SkyeTek has not obtained any official agency certifications for the SkyeModule M7.

Table 10-2 SkyeModule M7 Agency Compliance

Region	Agency	Approvals	Publications/Regulations
North America	FCC	Part 15 standards	
Europe	ETSI	EN 301-489	“Electromagnetic and Radio Spectrum matters (ERM); Electromagnetic Compatibility (EMC); standard for radio equipment and services; Part 1: Common technical requirements”
		EN 61000-4-3	“Radio Frequency Electromagnetic Field”
		EN 302-208	“Electromagnetic Compatibility and Radio Spectrum Matters (ERM): Radio Frequency Identification equipment operating in the band 865 MHz with power levels up to 2 W: Part 2 Harmonized EN under article 3.2 of the R&TTE directive”



10.8 Radio Specifications

Specification	Min	Typical	Max	Units/Notes
RF Characteristics				
Frequency ranges (Direct output)	862.000	915.000	955.000	MHz
Hop channel spacing	100	200	300	KHz
Transmission Parameters				
Transmit Power	10	12	24*	dBm (See “Recommended Radio Settings for Regional Compliance” on page 27 for maximum power ratings under different regulatory environments.) * Depends on regional setting. When the SkyeModule M7 is USB-bus powered, maximum transmit power should not exceed 21 dBm. SkyeModule M7s shipped with the SkyeTek Development Kit are preset to use USB communications at a 21 dBm power level.
Transmit Power Variation vs. Temperature		+/- 1.5		dB (Temperature range: -10 C to +55 C.)
Transmit Power Variation vs. VCC		~3		dB (VCC is from 3.5-5 V)
Transmit Power Flatness vs. Frequency		+/- 1.5		dB (Frequency range: from 862-955 MHz)
Optimum PA Load Impedance		50		Ohms
Receiver Parameters				
Sensitivity at 40 kbps	40	45	55	dBm (at transmit power of 21 dBm and measured from 860-960 MHz)



11 Antenna Options

The SkyeModule M7 supports any 50 Ohm antenna tuned to the correct frequency range. Read range is highly dependent on antenna selection, tag selection, and operating environment.

Read range depends on your specific settings, including:

- Environment (to maximize accuracy for testing, SkyeTek recommends that you use an outdoor free-space test)
- Antenna gain: a higher-gain antenna provides a longer read range. However, this longer range is achieved through a smaller beam width, which in turn reduces the size of the read field, affecting read reliability.
- Antenna cable length: antenna-cable gain/loss is approximately -0.49 dB/meter (-0.15 dB/foot) for a standard RG58 coaxial cable.
- RF power: maximum RF power is 24 dBm.
- Frequency hopping settings (depends on antenna)
- Antenna polarization
- Tag orientation
- Tag type, manufacturer, and individual tag
- Tag mounting surface
- Tag dynamics (speed, moving, rotating)

NOTE - The MMCX antenna connector for the SkyeModule M7 allows quick connections but can let a loose antenna cable rotate, yaw, or pitch in the connector socket if you do not secure the cable. Cable motion increases the VSWR to the radio receiver and degrades performance. Make sure that you provide strain relief for the antenna cable to prevent any motion or mechanical stress at the MMCX connector.



12 Communication Specifications

12.1 Host Communication - Skyetek Protocol v3

The SkyeModule M7 operates under host control according to the Skyetek Protocol v3. For more information about this protocol, including commands, flags, request and response formats, please see the *Skyetek Protocol v3 Reference Guide*.

The basic command and response format is illustrated below.

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

Flags	Cmd.	RID	Tag Type	TID Len.	TID	AFI	Addr.	# of Blks.	Data Len.	Data	CRC
4	4	8	4	4	32 (max)	2	4	4	4	2K	4

Table 12-2 Request format (bytes), Binary Mode

Msg. Len.	Flags	Cmd.	RID	Tag Type	TID Len.	TID	AFI	Addr.	# of Blks.	Data Len.	Data	CRC
2	2	2	4	2	1	16 (max)	1	2	2	2	1K	2

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



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

Response Code	RID	Tag Type	Data Length	Response Data	CRC
4	8	4	4	2K	4

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

Message Length	Response Code	RID	Tag Type	Data Length	Response Data	CRC
2	2	4	2	2	1K	2

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

12.2 Software Developer Tools

All SkyeModule M7 Developer Kits ship with the following developer tools:

- **APIs** - SkyeTek offers C and .NET APIs so that you can easily create interfaces between your programming language and any SkyeTek reader modules that communicate using SkyeTek Protocol v3. The APIs provide a rich assortment of functions that allows complete access to and manipulation of your SkyeModule M7. You can find descriptions of the APIs in the Documentation folder installed with SkyeWare.
- **SkyeWare 4** - A Windows utility that lets you detect, configure and upgrade SkyeTek readers. It also lets you perform basic tag operations such as taking inventory of all tags in the field and performing read, write, and security operations on the tags. For more information on SkyeWare, see the *Developer Kit User Guide*.

See the *Developer Kit User Guide* and the *SkyeTek Protocol v3 Reference Guide* for more information about this topic.



13 Customizing System Parameters

System parameters let you configure reader settings to customize them for your environment. You can temporarily alter parameters in memory or change the default values that are stored on the SkyeModule M7 EEPROM. The following table summarizes the parameters for the SkyeModule M7. (See “System Parameter Descriptions” on page 39 for detailed information on each parameter.)

Table 13-1 System Parameter Addresses, Lengths, and Default Values

Parameter	Address	Hex # of Bytes	Default Value
Serial Number	0x0000	4	0x00000000
Firmware Version	0x0001	4	0xFFFFFFFF (depends on release)
Hardware Version	0x0002	4	0xFFFFFFFF (depends on release)
Product Code	0x0003	2	0x0007 (M7)
Reader ID	0x0004	4	0xFFFFFFFF
Reader Name	0x0005	32	SkyeModule M7 (in hex)
Host Interface Type	0x0006	1	0x01 (for UART1)
Host Interface Baud Rate	0x0007	1	0x02 (38400)
User Port Direction	0x0008	1	0x00 (GPIO pins are outputs)
User Port Value	0x0009	1	0x00 (GPIO pins are logic low)
MUX Control	0x000A	1	0x00 (no multiplexer)
Operating Mode	0x000C	1	0x00 (no active mode)
Command Retry	0x0011	1	0x05 (five retries)
Power Level	0x0012	1	0xA0 (21 dBm)
Current Frequency	0x0030	4	0x3689CAC0 (915 MHz)
Start Frequency	0x0031	4	0x35C80160 (902.3 MHz)
Stop Frequency	0x0032	4	0x374B9420 (927.7 MHz)
Hop Channel Spacing	0x0034	4	0x00030D40 (200 KHz)
Frequency Hopping Sequence	0x0035	1	0x01 (pseudo-random)
Modulation Depth	0x0036	1	0x64 (100%)
Regulatory Mode	0x0037	1	0x00 (FCC/no pulse shaping)
LBT Antenna Gain	0x0037	1	0x00 (no LBT antenna gain)

13.1 Changing System Parameters

CAUTION - Changing system parameter values - especially the default values - can render your SkyeModule M7 nonoperational 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 EEPROM.
- Retrieve Default System Parameter - reads the system parameter value at the address specified out of EEPROM.

See the *SkyeTek Protocol v3 Reference Guide* for a complete list of commands.

See “Understanding System Parameter Formats” on page 35 for more information about using these commands.

See “System Parameter Descriptions” on page 39 for information about individual parameters.

CAUTION - Resetting (cycling power) on your SkyeModule M7 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 EEPROM as the new default values. Any changes to the default values do not take effect until the reader is reset.



13.2 Understanding System Parameter Formats

This section provides format details for the commands used to change system parameters.

NOTE - The number of blocks field for each command in this section should equal the byte length for each system parameter. (See “System Parameter Descriptions” on page 39 and “Communication Specifications” on page 31 for more information.)

13.2.1 Read System Parameter Command Format

Table 13-2 Read System Parameter Command, ASCII Mode Request

System Parameter	Start:	Flags:	Command:	Address (hex):	Hex # of Blocks:	CRC	End:
Serial Number	<CR>	0020	1201	0000	0004	calculated by user*	<CR>
Firmware Version				0001	0004		
Hardware Version				0002	0004		
Product Code				0003	0002		
Reader ID				0004	0004		
Reader Name				0005	0020		
Host Interface Type				0006	0001		
Host Interface Baud Rate				0007	0001		
User Port Direction				0008	0001		
User Port Value				0009	0001		
MUX Control				000A	0001		
Operating Mode				000C	0001		
Command Retry				0011	0001		
Power Level				0012	0001		
Current Frequency				0030	0004		
Start Frequency				0031	0004		
Stop Frequency				0032	0004		
Hop Channel Spacing				0034	0004		
Frequency Hopping Sequence				0035	0001		
Modulation Depth				0036	0001		
Regulatory Mode				0037	0001		
LBT Antenna Gain				0038	0001		

* Calculated as per CRC Definition. See the *Skyetek Protocol v3 Reference Guide*.

	Values that are constant for all commands
--	---



Table 13-3 Read System Parameter Command, ASCII Mode Response

Start:	Response Code:	Data Length:	Data:	CRC:	End:
<LF>	1201	depends on system parameter		as calculated by the reader	<CR><LF>

Table 13-4 Read System Parameter Command, Binary Mode Request

System Parameter	STX:	Message Length	Flags:	Com-mand:	Address (hex):	Hex # of Blocks:	CRC
Serial Number	02	calculated by user*	0020	1201	0000	0004	calculated by user*
Firmware Version					0001	0004	
Hardware Version					0002	0004	
Product Code					0003	0002	
Reader ID					0004	0004	
Reader Name					0005	0020	
Host Interface Type					0006	0001	
Host Interface Baud Rate					0007	0001	
User Port Direction					0008	0001	
User Port Value					0009	0001	
MUX Control					000A	0001	
Operating Mode					000C	0001	
Command Retry					0011	0001	
Power Level					0012	0001	
Current Frequency					0030	0004	
Start Frequency					0031	0004	
Stop Frequency					0032	0004	
Hop Channel Spacing					0034	0004	
Frequency Hopping Sequence					0035	0001	
Modulation Depth					0036	0001	
Regulatory Mode					0037	0001	
LBT Antenna Gain					0038	0001	

* See the *SkyeTek Protocol v3 Reference Guide* for more information.

	Values that are constant for all commands
--	---

Table 13-5 Read System Parameter Command, Binary Mode Response

STX:	Message Length:	Response Code:	Data Length:	Data:	CRC:
<02>	0007	1201	varies with system parameter	varies with system parameter	calculated by the reader



13.2.2 Write System Parameter Format

Table 13-6 Write System Parameter Command, ASCII Mode Request

System Command	Start	Flags	Com- mand	Address (hex)	Hex # or Blocks	Data Length	Data	CRC	End
Serial Number	<CR>	0820	1202	0000	0004	user defined*	user defined	Calculated by user	<CR>
Firmware Version				0001	0004				
Hardware Version				0002	0004				
Product Code				0003	0002				
Reader ID				0004	0004				
Reader Name				0005	0020				
Host Interface Type				0006	0001				
Host Interface Baud Rate				0007	0001				
User Port Direction				0008	0001				
User Port Value				0009	0001				
MUX Control				000A	0001				
Operating Mode				000C	0001				
Command Retry				0011	0001				
Power Level				0012	0001				
Current Frequency				0030	0004				
Start Frequency				0031	0004				
Stop Frequency				0032	0004				
Hop Channel Spacing				0034	0004				
Frequency Hopping Sequence				0035	0001				
Modulation Depth				0036	0001				
Regulatory Mode				0037	0001				
LBT Antenna Gain				0038	0001				

* See the *SkyeTek Protocol v3 Reference Guide* for more information.

	Values that are constant for all commands
--	---

Table 13-7 Write System Parameter Command, ASCII Mode Response

Action:	Start:	Response Code:	CRC:	End:
Response	<LF>	1202	<8533>	<CR><LF>

This format is the same for all write commands.



Table 13-8 Write System Parameter Command, Binary Mode Request

System Parameter	STX:	Message Length:	Flags:	Com-mand:	Address (hex):	Hex # of Blocks:	CRC
Serial Number	02	calculated by user*	0820	1202	0000	0004	calculated by user*
Firmware Version					0001	0004	
Hardware Version					0002	0004	
Product Code					0003	0002	
Reader ID					0004	0004	
Reader Name					0005	0020	
Host Interface Type					0006	0001	
Host Interface Baud Rate					0007	0001	
User Port Direction					0008	0001	
User Port Value					0009	0001	
MUX Control					000A	0001	
Operating Mode					000C	0001	
Command Retry					0011	0001	
Power Level					0012	0001	
Current Frequency					0030	0004	
Start Frequency					0031	0004	
Stop Frequency					0032	0004	
Hop Channel Spacing					0034	0004	
Frequency Hopping Sequence					0035	0001	
Modulation Depth					0036	0001	
Regulatory Mode					0037	0001	
LBT Antenna Gain					0038	0001	

* See the *SkyeTek Protocol v3 Reference Guide* for more information.

	Values that are constant for all commands
--	---

Table 13-9 Write System Parameter Command, Binary Mode Response

STX:	Message Length:	Response Code:	CRC:
<02>	0004	1202	<E652>

This format is the same for all write commands.



13.3 System Parameter Descriptions

This section describes the SkyeModule M7 system parameters. See “Understanding System Parameter Formats” on page 35 for formats to use each parameter in a system command.

13.3.1 Serial Number

- Returns the serial number of the reader
- Parameter address: 0x0000
- Length (bytes): 1
- Default value: 0x00000000
- Read-only

13.3.2 Firmware Version

- Returns the firmware version currently loaded on the reader
- Refer to the *SkyeModule M7 Release Notes* for more information about the firmware release.
- Parameter address: 0x0001
- Length (bytes): 4
- Default value: 0xFFFFFFFF (depending on release)
- The firmware version uses this format:
 - Major revision (1 Byte)
 - Minor Revision (1 Byte)
 - Current build number (2 bytes)
- Read-only

13.3.3 Hardware Version

- Returns the current hardware version of the reader
- Parameter address: 0x0002
- Length (bytes): 4
- Default value 0xFFFFFFFF (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



13.3.4 Product Code

- Returns the SkyeTek product code identifier. (Each SkyeTek product has a unique product code.)
- Parameter address: 0x0003
- Length (bytes): 2
- Default value 0x0007
- Read-only

13.3.5 Reader ID

- Specifies the Reader ID, which is a reader-specific identifier. It lets the reader execute and respond only to those commands intended for it. The reader determines if the Reader ID in the request matches its internal Reader ID. If the ID does not match, the reader does not respond.
- Parameter address: 0x0004
- Length (bytes): 4
- Default value: 0xFFFFFFFF (depending on release)
- Select the Reader ID functionality by specifying the RID flag in the request. This setting lets you use multiple readers on the same bus or networked together.
- Read/write

NOTE - Changing the reader ID from the factory default of FFFFFFFF to any other value disables Loop Mode, which is used for read range demonstrations. See “Selecting Any Supported Tag Continuously (Loop Mode)” in the *Examples of Tag Usage* application note for an example of using Loop Mode.

13.3.6 Reader Name

- Identifies a reader with a 32-byte user-defined name.
- Parameter address: 0x0005
- Length (bytes): 32
- Default value: SkyeModule M7 (in hex)
- Read/write



13.3.7 Host Interface Type

- Identifies the type of host interface for the reader to use.
- Parameter address: 0x0006
- Length (bytes): 1
- Default value: 0x01
- Valid host interface values are:
 - 0x00 - not used
 - 0x01 - TTL
 - 0x03 - not used
 - 0x04 - not used
 - 0x06 - USB
- Any other values are not valid and are ignored.
- Read/write

NOTE - SkyeModule M7s shipped with SkyeTek Development Kits are preset to use USB communications.

13.3.8 Host Interface Baud Rate

- Sets the baud rate of the host interface.
- Parameter address: 0x0007
- Length (bytes): 1
- Default value: 0x02 (38,400)
- Works for the TTL Serial host interface only
- Valid baud rate values are:
 - 0x01 - 19,200
 - 0x02 - 38,400
 - 0x03 - 57,600
 - 0x04 - 115,200
 - Specifying any other value sets the baud rate to 9,600
- Write-only

NOTE - For firmware updates, you may need to limit the baud rate to 38,400.



13.3.9 User Port Direction

- Sets the direction of the GPIO pins of the reader.
- Parameter address: 0x008
- Length (bytes): 1
- Default value 0x00
- 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 - N/A
 - BIT5 - N/A
 - BIT6 - N/A
 - BIT7 - N/A
- Read/write

13.3.10 User Port Value

- Sets the value of the GPIO pins of the reader.
- Parameter address: 0x0009
- Length (bytes): 1
- Default value: 0x00
- 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.
- To enable bit (bit 7) must be set for the settings to take effect.
- Bits correspond to the pins as follows:
 - BIT0 - GPIO 0
 - BIT1 - GPIO 1
 - BIT2 - GPIO 2
 - BIT3 - GPIO 3
 - BIT4 - N/A
 - BIT5 - N/A
 - BIT6 - N/A
 - BIT7 - N/A
- Read/write



13.3.11 MUX Control

- Controls a SkyePlus multiplexer. See the *SkyePlus Multiplexer Reference Guide* for complete information about using this parameter.
- Parameter address: 0x000A
- Length (bytes): 1
- Default value: 0x00
- Read/write

13.3.12 Operating Mode

- Puts the reader into sleep mode.
- Parameter address: 0x000C
- Length (bytes): 1
- Default value 0x00
- Writing a value 0x01 to this parameter puts the reader into sleep mode.
- Sending any command on any interface wakes the reader from sleep mode.
- Read/write

NOTE - Sleep mode is not supported when the SkyeModule reader uses the USB host interface.

13.3.13 Command Retry

- One-byte value.
- Parameter address: 0x0011
- Length (bytes): 1
- Default value: 0x05
- Can be set by the host.
- Specifies the number of times a tag command is executed internally in the reader before responding with a failure response.
- Applies only to tag-specific SkyeTek Protocol commands.
- Valid range of values is 0-255 (0x00-0xFF).
- The command is repeated internally “n” number of times, where n is the value specified by the host, unless there is a successful response. When a successful response occurs, the reader stops repeating the command and sends a success response back to the host.
- Read/write

NOTE - Increasing the value for this parameter increases the time that the reader takes before it sends a failure message when a failure occurs. To avoid unnecessary delays, be sure to determine the optimal number of retries for your particular use.

13.3.14 Power Level

- Configures the power level for the reader.
- Parameter address: 0x0012
- Length (bytes): 1



- Default value: 0xA0 (21 dBm)
- Power level is set in steps of 3 dB from 9 dBm to 24 dBm.
- Power levels are written in hex corresponding to a decimal value between 40 and 190 (see Table 13-10).
- Use the following equation to calculate the value to be written for a desired power level:

$(\text{Desired power in dBm} - 5) / 3 = \text{decimal value to write to system parameter}$

Table 13-10 Common Power Values

Power (dBm)	SkyeTek Decimal Value	Hex Equivalent
9	40	0x28
12	70	0x46
15	100	0x64
18	130	0x82
21	160	0xA0
24	190	0xBE

- Read/write

NOTE - SkyeModule M7s shipped with the SkyeTek Development Kit are preset to a power level of 21 dBm, which is compatible with USB communications.



13.3.15 Current Frequency

- Sets the current frequency with which the reader detects (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 13-11 shows hex values for commonly used frequencies.
- Read/write

NOTE - See “Recommended Radio Settings for Regional Compliance” on page 27 to view compliance information and recommended reader settings.

13.3.16 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 13-11 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 “Recommended Radio Settings for Regional Compliance” on page 27 to view compliance information and recommended reader settings.



13.3.17 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 13-11 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 “Recommended Radio Settings for Regional Compliance” on page 27 to view compliance information and recommended reader settings.

Table 13-11 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



13.3.18 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 “Recommended Radio Settings for Regional Compliance” on page 27 to view compliance information and recommended reader settings.

13.3.19 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 “Recommended Radio Settings for Regional Compliance” on page 27 to view compliance information and recommended reader settings.



13.3.20 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 13-12 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 "Recommended Radio Settings for Regional Compliance" on page 27 to view compliance information and recommended reader settings.

13.3.21 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 “Recommended Radio Settings for Regional Compliance” on page 27 to view compliance information and recommended reader settings.

Table 13-13 Regulatory Mode Values

Mode	Hex Value
No pulse shaping—FCC/North America	0x00
ETSI/Europe ^a	0x01

- a. Requires firmware version



13.3.22 LBT Antenna Gain

- Controls the sensitivity of the listen-before-talk receiver.
- Setting this parameter can cancel out the gain from an external antenna when listening for other transmitting signals.
- Use this parameter only with European (ETSI) regional settings when the LBT radio is on.
- Do not use this parameter with FCC regional settings.
- Parameter address: 0x0038
- Length (bytes): 1
- Default value: 0x00 (no LBT antenna gain)
- Read/write
- Possible values are 0-255 (0x00 to 0xFF), using a signed 8-bit value that represents the range of -127 dBm to +128 dBm. The values 0x00 to 0x80 represent the zero to +128 dBm range, and the values 0x81 to 0xFF represent the -127 to -1 dBm range (see Table 13-14)

NOTE - See “Recommended Radio Settings for Regional Compliance” on page 27 to view compliance information and recommended reader settings.

Table 13-14 Examples of LBT Antenna Gain Adjustment Values

Hex Value	Antenna Gain (dBm)
0x81	-127
0x82	-126
...	...
0xFE	-2
0xFF	-1
0x00	0
0x01	+1
0x02	+2
...	...
0x7F	+127
0x80	+128

