ThingMagic
A DIVISION OF TRIMBLE

875-0042-03 RevA

USB*Pro* Reader User Guide

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03 Revision A
January, 2016

USB*Pro* Reader Setup

Introduction

The ThingMagic USB*Pro* Reader allows solutions developers to support applications that require desktop reading and writing of EPC Global Gen2 tags and, with optional licenses, 18000-6B, IPX, and AEI ATA tags. Based on the best-in-class Micro-LTE UHF RFID module, the USB*Pro* Reader is controlled by, and powered from, a host PC or laptop through a USB interface. The ThingMagic USB*Pro* Reader is compatible with ThingMagic's application development tools, including the cross-product MercuryAPI, permitting rapid creation of solutions to support a wide range of applications.

The MercuryAPI supports Java, ".NET" and C programming environments. The MercuryAPI Software Development Kit (SDK) contains sample applications and source code to help developers get started demonstrating and developing functionality. For more information on the MercuryAPI SDK see the MercuryAPI Programmers Guide and the MercuryAPI SDK, available on the ThingMagic website.

Universal Reader Assistant, a demo application that supports many common functions such as reading and writing, is provided in the MercuryAPI SDK package and as a standalone installer. It is available at http://www.thingmagic.com/manuals-firmware. The source code for this example is included in the MercuryAPI SDK package under */cs/samples/exe/Universal-Reader-Assistant.exe*. A brief introduction to this application is given in Reading Tags with Universal Reader Assistant

See the *MercuryAPI Programming Guide* for details on using the MercuryAPI.

Included Components

With the USB*Pro* Reader, you will receive the following components:

- ThingMagic USB*Pro* Reader
- USB cable

Documentation and software development kit packages can be found at http://www.thingmagic.com/manuals-firmware

With the USB*Pro* Development kit, the following additional components are supplied:

- Selection of UHF RFID Tags and tag inlays
- One foot (30 cm) SMA cable, with reverse SMA connector on one side and SMA connector on the other
- Linear antenna with 3 dB gain, supporting a frequency range of 860 to 960 MHz (The antenna may be labeled “890 to 960 MHz” based on its original intended application as an indoor cell phone repeater).

Setting up the USB*Pro* Reader

When setting up the USB*Pro* Reader, use the following procedures. Please read the full setup procedures before beginning.

1. Installing the USB Driver
2. Connecting the USB Reader
3. Reading Tags with Universal Reader Assistant

Installing the USB Driver

If on a Windows PC, a few installation steps are required for Windows to recognize the USB*Pro* Reader and properly configure the communications protocol. In order to use the USB interface with Windows you must have the *Micro-USBDriver.inf* file (available for download from http://www.thingmagic.com/manuals-firmware). The installation steps are:

1. Plug in the USB cable to the USB*Pro* Reader and PC.
2. Windows should report it has “Found New Hardware - Micro” and open the Hardware Installation Wizard.
3. Select the Install from a list or specific location (Advanced) option, click Next.
4. Select Don’t search..., click Next, then Next again.
5. Click Have Disk and navigate to where the *Micro-USBDriver.inf* file is stored and select it, click Open, then OK.
6. “Micro” should now be shown under the Model list. Select it and click Next then Finished.

Note

The Micro driver file has not been Microsoft certified so compatibility warnings will be displayed. These can be ignored and clicked through.

7. A COM port should now be assigned to the Micro. If you aren’t sure what COM port is assigned you can find it using the Windows Device Manager:
   a. Open the Device Manager (located in Control Panel | System).
   b. Select the Hardware tab and click Device Manager.

c. Select View I Devices by Type I Ports (COM & LPT) The device appears as M6eMicro (COM#).

Connecting the USB Reader

1. Plug the micro-USB connector into the USB Reader.
2. Plug the **BLACK** communications USB connector into your PC.
3. If using an RF level of +23 dBm or above, plug the **RED** Auxiliary Power USB connector into your PC for additional power.

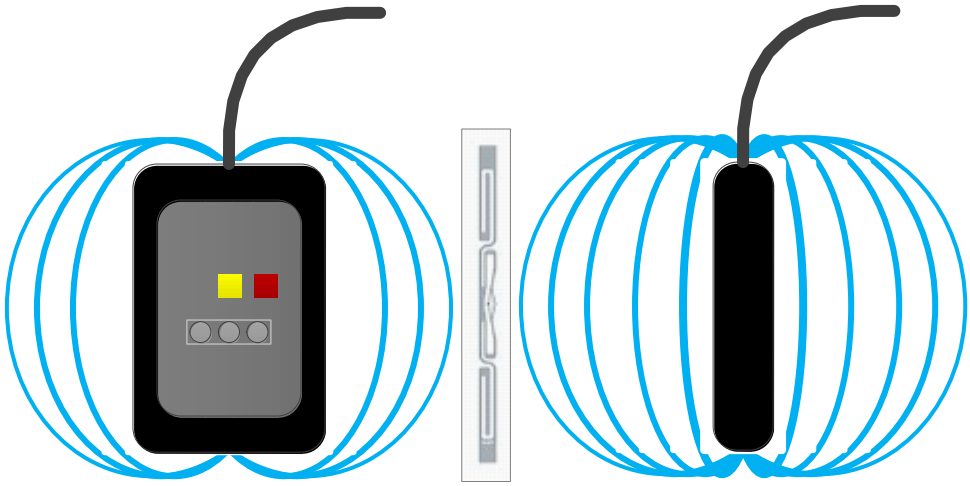
Note

The USB Reader draws 0.5 A at +23 dBm and 1 A at +30 dBm if the internal antenna is used or a high quality external antenna is used. The current consumption will be a bit higher if the antenna does not have return loss greater than 14 dBm across the band. One USB port is not guaranteed provide more than 0.5 mA and two ports are not guaranteed to supply more than 1 mA, but most do. If you receive an error from your PC that too much current is being drawn, you should reduce the RF output level by one dB (+22 dBm for 1 USB port, +29 dBm for 2 USB ports), and may have to reboot your PC to reset the USB port.

4. You will be prompted for driver installation if they are not already installed. If prompted follow the Installing the USB Driver instructions.

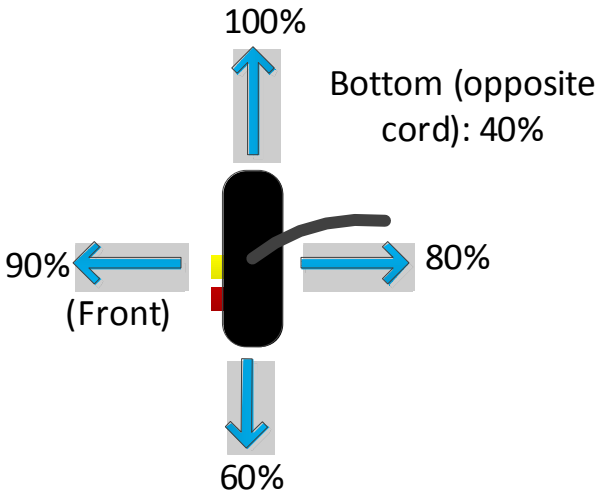
Internal Antenna

The USB*Pro* Reader has one internal antenna. The antenna is linear, as are most tags, so the USB*Pro* Reader reads tags best if the tags are aligned with the long side of the reader. The blue lines, below, represent the radiation pattern around the reader.



Front View **Best tag orientation** **Side View**

The radiation pattern is not completely symmetrical on all sides. Looking down on the reader (with the chord facing up), the read distance from each face of the reader is as shown here:



Top (Chord and RF Connector side) View

The absolute performance with a good folded-dipole tag (these are around 3.5 inches long by 0.5 inches wide = 9 cm x 1.3 cm) is shown in the following table:

Region	Maximum Read Distance for Internal Antenna
North America (902-928 MHz)	4 Feet (1.2 m)
EU (865-868 MHz)	4 Feet (1.2 m)

External Antenna Connections

The USB*Pro* Reader supports a monostatic (single port, bidirectional) RF antenna through one reverse-SMA connector.

The maximum RF power that can be delivered to a 50 ohm load from each port is 1 Watt, or +30 dBm (regulatory requirements permitting). Read distances as long as 30 feet (10 meters) can be achieved with high gain antennas and high quality tags.

Note

The internal and external RF ports can only be energized one at a time, although switching can be so quick it appears as if both antennas are reading at the same time.

Antenna Requirements

The performance of the Micro is affected by antenna quality. Antennas that provide good 50 ohm match at the operating frequency band perform best. Specified sensitivity performance is achieved with antennas providing 17 dB return loss or better across the operating band. Damage to the module will not occur for any return loss of 1 dB or greater. Damage may occur if antennas are disconnected during operation or if the module sees an open or short circuit at its antenna port.

Antenna Detection

C A U T I O N !

Unlike the Astra-EX, Mercury6, and Vega readers, the USB*Pro* Reader DOES NOT support automatic antenna detection via DC current sensing. It uses a return loss measurement across all channels in the defined region. Unlike the other readers, antenna detection is not done each time the reader is about to switch to a new antenna. Your application should frequently check the status of the antennas and change the antennas to be used based on this information. Using the MercuryAPI this requires creation of a SimpleReadPlan object with the list of antennas set and that object set as the active /reader/read/plan. For more information see the *MercuryAPI Programmers Guide* | *Level 2 API* | *Advanced Reading* | *ReadPlan* section.

Buttons and LEDs

To get the values of the USB Reader buttons and turn on/off the LEDs use the **GPIO** controls under the *Advanced Configuration* | *Advanced Reader Settings* of the *Options* menu. See the Button/LED to GPIO Line Mapping below for mapping.

- Buttons are “High” when not pressed, “Low” when pressed
- LEDs are “High” when on, “Low” when off.

Button/LED to GPIO Line Mapping

Button/LED	GPIO Line
Button 1 (Yellow)	GPIO Line 1 when configured as “Input”
Button 2 (Red)	GPIO Line 2 when configured as “Input”
LED 1 (Yellow)	GPIO Line 1 when configured as “Output”
LED 2 (Red)	GPIO Line 2 when configured as “Output”

Note

If both the Buttons and LEDs are being used, the GPIO lines should be configured as Inputs. If the state of the LED must be changed, then the GPIO line is configured as an Output, its desired state sent to the reader, and the line returned to an Input state. The reader will remember and hold the LED state until it is changed or power is removed from the reader.

Note

The buttons are level sensed and not edge sensed, that is, there is no memory of the button having been pushed. If a button is pushed momentarily during a time the application is not checking the state of the Input GPIO lines, the button press will not be detected. For that reason, it is recommended applications require the user to push a button until the software senses it and illuminates one of the LEDs. This ensure that the press has been detected.

Developing Applications for the USB*Pro* Reader

The USB*Pro* reader must communicate with a host application. It uses a packet-based communication protocol, which cannot be decoded by a simple ASCII-based terminal program. ThingMagic provides many resources to help you develop your host application, and provides samples of programs that you can use while you are developing your own.

- Universal Reader Assistant is a PC-based application that can demonstrate the most commonly used features of the reader.Instructions for installing and using it are provided in the next section and there is a User Guide available for download as well.
- The MercuryAPI SDK is available to help you develop your own control applications in Java, C or C# (for ".NET") programming languages. A user guide is available for this SDK, as well as help files and code samples within the SDK itself.
- The Autonomous Configuration Tool allows you to pre-configure the reader and have it execute a simple read command every time the reader is powered up or every time it is powered up and a GPI line is enabled. The output of the reader can be interpreted by a simple program which can be executed in any programming language, such as Python. A user guide is available for this application.

All these applications and their documentation is available here: http://www.thingmagic.com/manuals-firmware

Reading Tags with Universal Reader Assistant

Universal Reader Assistant is a Windows application that demonstrates all common UHF RFID reader operations. The following procedure explains how to install and activate Universal Reader Assistant on your PC. A user guide is available for further information.

1. Get ***Universal-Reader-Assistant*** from the ThingMagic website, its part of the MercuryAPI SDK package under /cs/samples/exe/Universal-Reader-Assistant.exe, and install it on the computer that is connected to the USB Reader (http://www.thingmagic.com/manuals-firmware).
2. Set up the computer to the USB Reader as described in Setting up the USBPro Reader
3. Start the Universal Reader Assistant by double-clicking the executable file Universal-Reader-Assistant.exe.
4. Select the appropriate COM port for Reader URI.

   The Universal Reader Assistant senses the COM ports that are located on your system. USB devices are typically assigned higher value COM ports. If many COM ports are listed in the menu and you aren't sure which is for the USB Reader you can find the assigned value using the Windows Device Manager:

   a. Open the Device Manager (located in *Control Panel* | *System*)

   b. Select the *Hardware* tab and click Device *Manager*

   c. Select *View* I *Devices by Type* | *Ports (COM & LPT)*

   The device appears as *USB Serial Port (COM#)*. The USB Reader COM port value is in parentheses.

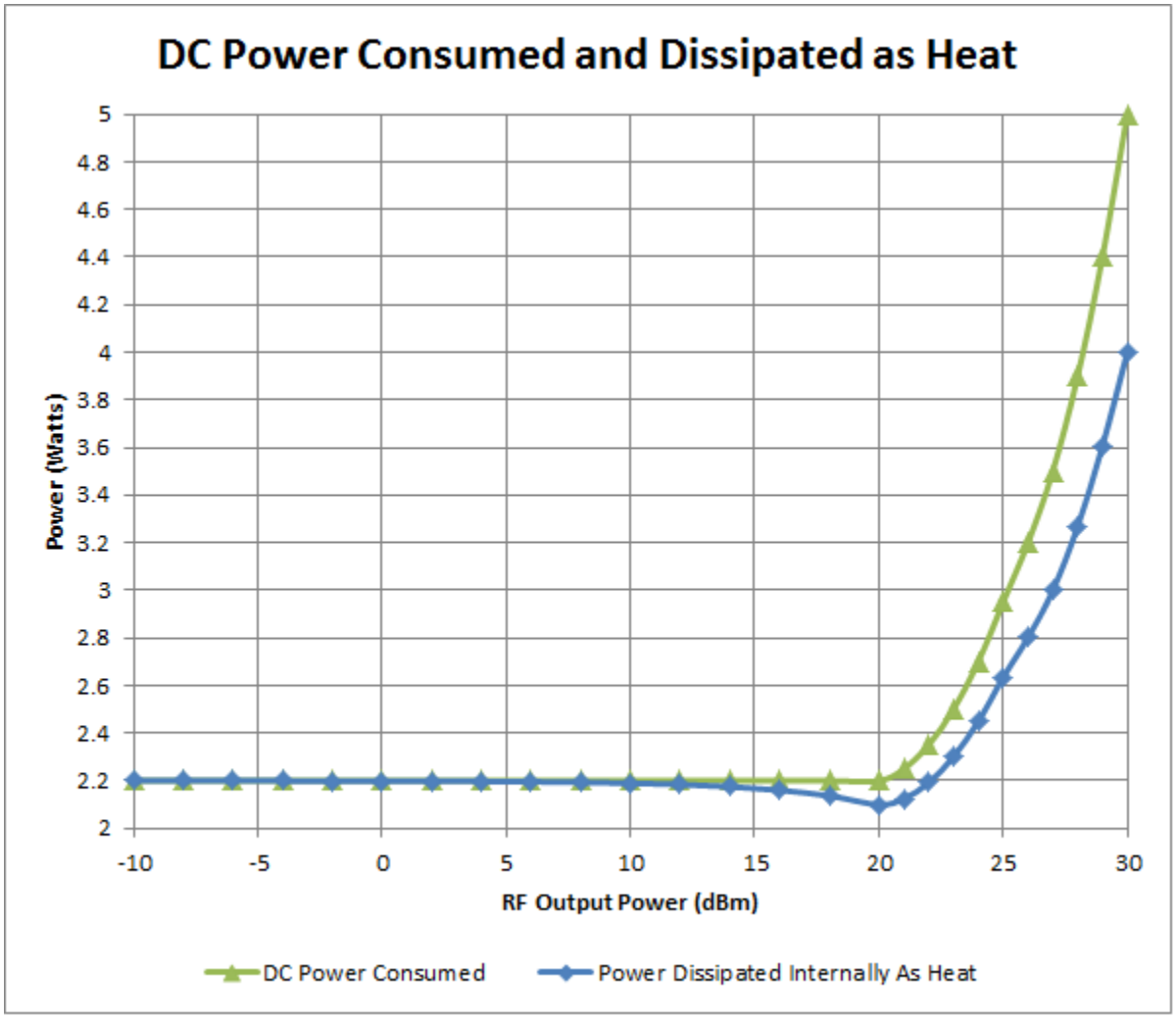
Follow the Readme.txt in /cs/samples/Universal-Reader-Assistant for steps to read and write tags.

Thermal Considerations

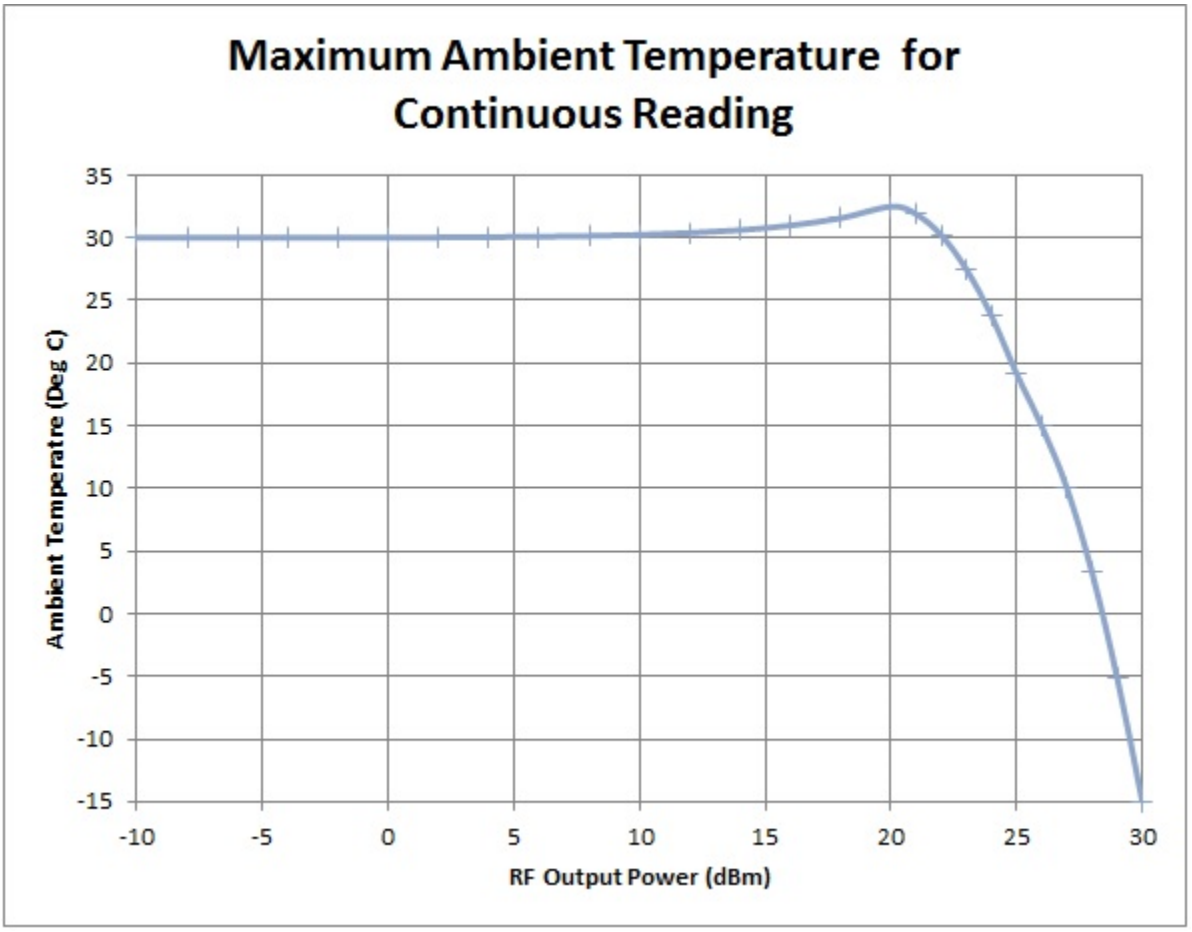
The plastic enclosure of the USB*Pro* reader, and the rubber boot that surrounds it, have limited ability to transfer heat from inside the reader to the ambient environment. We have determined that the temperature of the inside the reader will rise about 25 degrees C for every Watt of power dissipated as heat. The reader will not transmit unless its internal temperature is below 85 degrees C, so the total power that can be dissipated depends on the difference between ambient temperature and 85 degrees. For a given temperature, there are only two ways to decrease the amount of power dissipated by the module:

1. Decrease the RF Output level at which the module transmits
2. Lower the duty cycle so that the percentage of time that the reader is transmitting is lowered.

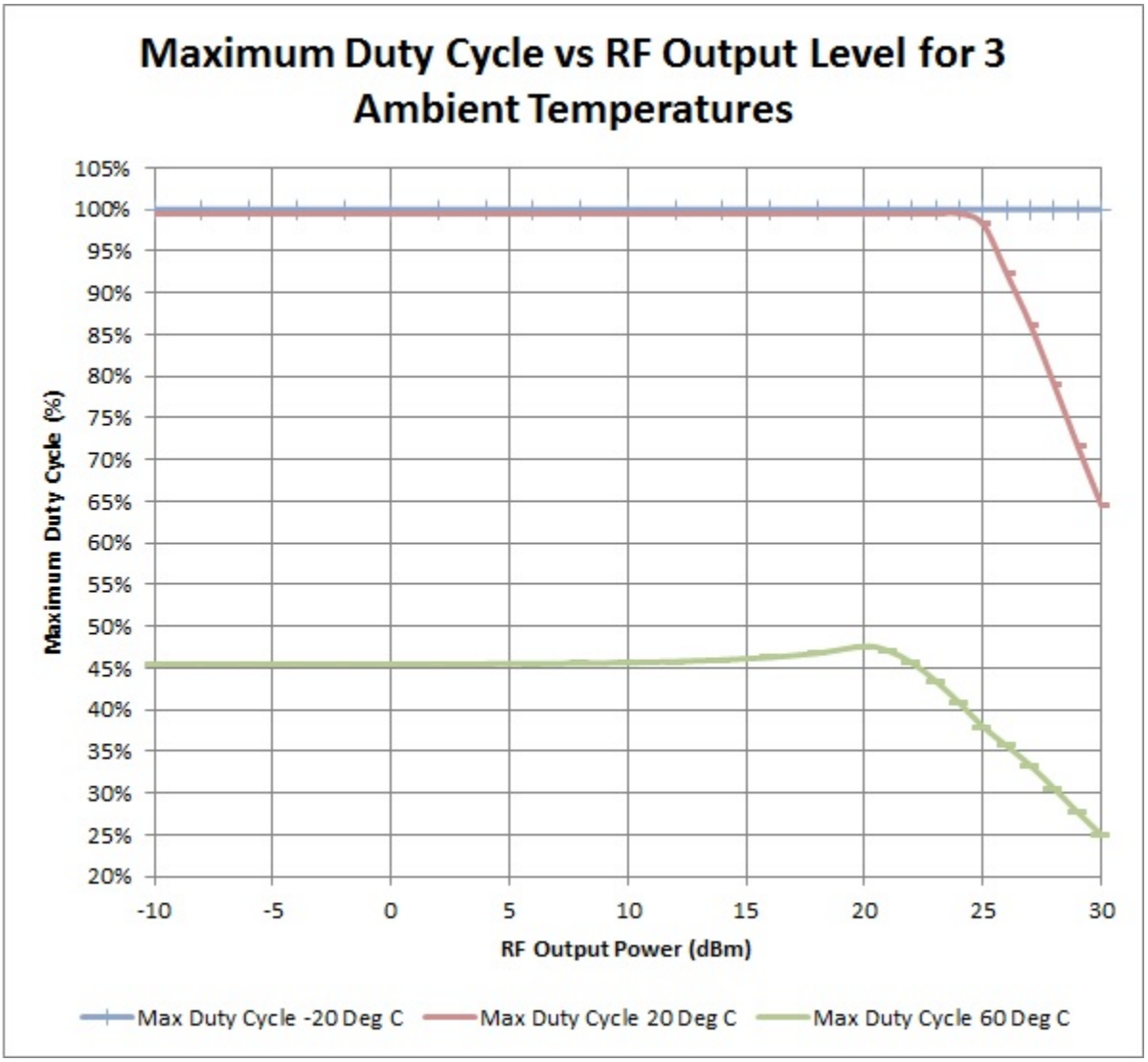
The following two charts should give you the information you need to compensate for temperature rise in your application. The first chart is the power both drawn from the USB connector and the power dissipated inside the reader (this is the DC power consumed, minus the RF power radiated).



If continuously reading (duty cycle = 100%), the temperature rise caused by the dissipated power inside the reader must not result in the inside temperature of the reader exceeding 85 C. The following chart shows the maximum ambient temperature that can be used for continuous reading based on the RF Output Level.



If the RF level cannot be reduced to compensate for the ambient temperature, then the duty cycle (percentage of time RF is on relative to total on/off cycle) must be reduced to limit the temperature rise to acceptable limits. The following chart gives the maximum duty cycle per RF Output Power level for three temperatures: -20 C, +20 C, and +60 C.



Note that there is no restriction at -20 C: 100% duty cycle is supported at all RF levels.

For any other temperature, determine the maximum power that can be dissipated by subtracting the ambient temperature (in degrees C) from 85 degrees and dividing that number by 25. Then look up the dissipated power for your RF Output Power setting. If the dissipation for continuous reading is greater than the maximum power that can be dissipated based on temperature, the duty cycle will have to be reduced. The maximum duty cycle will be the power you can dissipate divided by the power you must dissipate.

Note that the duty cycle does not address the maximum transmit time, only the percentage of on-time relative to the on/off cycle time. It is important to keep the on time as short as possible so that the maximum temperature is not exceeded before the off-time has a chance to cool the reader down. In our testing, we used a cycle time of 1 second, that is, the on-time plus off-time was one second. For example, if you need to limit the duty cycle to 25%, the recommended on-time would be 250 msec and the off-time 750 msec.

Reduction of the duty cycle may not significantly affect the maximum read rate. The specified maximum rate of 50 tags per second applies even when the reader is not reading for a portion of the time.

USB*Pro* Reader Specifications

Power

DC Power Required

DC Voltage: 5 VDC (Powered by USB interface)
DC Power: 5 W (1.0 A) typical. The power consumption can go as high as 7.5 W if the external port is terminated with a poorly tuned antenna and an attempt is made to transmit out it at +30 dBm.

Supplied interface cable terminates in two type-A plugs: one for power and signal, the second for additional power, for when higher RF output levels are desired.

Idle Power Consumption

0.35 W max at idle

Power management modes can be used to reduce this to as little as 0.1W

Environment

Operating Temp

-40 C to +60 C

Storage Temp

-40C to +85C

Regulatory Standards

FCC 47 CFR Ch. 1 Part 15
Industrie Canada RSS-21 0
ETSI EN 302 208 V1.4.1

Safety Standards

IEC 60950-1 (ed.2)

US-17650-UL

Architecture

RFID ASIC

Intel R2000

Performance

Tag Read Rate

50 tags/second

Tag Read Distance

4 ft (1.2 m) typical depending on tag sensitivity and orientation.

Tag / Transponder Protocols

RFID Protocol Support

EPCglobal Gen 2 (ISO 18000-6C) with Anti-Collision and DRM.

RF Interface

Antenna Connector

Internal ceramic antenna with an average gain of 1dBi from 860 to 960 MHz.

Reverse-SMA connector which supports an external antenna.

RF Power Output

Separate read and write levels (into the antenna), command-adjustable from -10 dBm to +30 dBm, +/-1.0 dBm accuracy*

Note

Maximum power may have to be reduced to meet regulatory limits, which specify the combined effect of the module, antenna, cable and enclosure shielding.

Frequencies

Pre-configured for the following regions:

- FCC 902-928,917.4-927,917.5-922.5 MHz (Americas)
- ETSI 865.6-867.6 MHz, 869.85 MHz (EU)
- TRAI 865-867 MHz (India)
- KCC 917-920.8 MHz (Korea)
- ACMA 920-926 MHz (Australia)
- SRRC-MII 920-925 MHz (P. R. China)
- MIC 916.7-920.9 MHz (Japan)
- Open (Customizable) 865-869 and 902-928 MHz

Data/Control Interface

Physical

USB mini-B connector, with 2 foot (61 cm) cable terminated in A-type plug.

GPIO Sensors and Indicators

Two I/O command controlled LEDs
Two I/O command queried switches

Physical

Dimensions

3.1 in L x 2.4 in W x 1.0 in H
(97 mm L x 61 mm W x 25 mm H)

Compliance Information

Regulatory Compliance

EMC FCC 47 CFR, Part 15
Industrie Canada RSS-210

Federal Communication Commission Interference Statement

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

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

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

FCC Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

Industry Canada

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

This radio transmitter (identify the device by certification number, or model number if Category II) has been approved by Industry Canada to operate with authorized antenna types (see Authorized Antennas)

Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that permitted for successful communication.

To comply with IC RF exposure limits for general population/uncontrolled exposure, the antenna(s) used for this transmitter must be installed to provide a separation distance of at least 25 cm from all persons and must not be collocated or operating in conjunction with any other antenna or transmitter.

Industrie Canada

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

Le présent émetteur radio (identifier le dispositif par son numéro de certification ou son numéro de modèle s'il fait partie du matériel de catégorie I) a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur

Le fonctionnement de l’ appareil est soumis aux deux conditions suivantes:

1. Cet appareil ne doit pas perturber les communications radio, et

2. cet appareil doit supporter toute perturbation, y compris les perturbations qui pourraient provoquer son dysfonctionnement.

Pour réduire le risque d'interférence aux autres utilisateurs, le type d'antenne et son gain doivent être choisis de façon que la puissance isotrope rayonnée équivalente (PIRE) ne dépasse pas celle nécessaire pour une communication réussie.

Au but de conformer aux limites d'exposition RF pour la population générale (exposition non-contrôlée), les antennes utilisés doivent être installés à une distance d'au moins 25 cm de toute personne et ne doivent pas être installé en proximité ou utilisé en conjonction avec un autre antenne ou transmetteur.

Authorized Antennas

Please contact ThingMagic at support@thingmagic.com for a list of antennas that are authorized to be used with this device. Detailed information on each antenna is available from their respective manufacturers. Antennas not included in this list or having a gain greater than 6 dBiL are strictly prohibited for use with this device. The required antenna impedance is 50 ohms

The internal antenna complies with all these requirements.

To comply with FCC requirements for RF exposure safety, a separation distance of at least 22 cm (8.7 inches) must be maintained between the radiating elements of the external antenna and nearby people. You must also provide strain relief for all Reader connections.