

A GUIDE

to

**RFID**

**PRINTERS**



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# INTRODUCTION

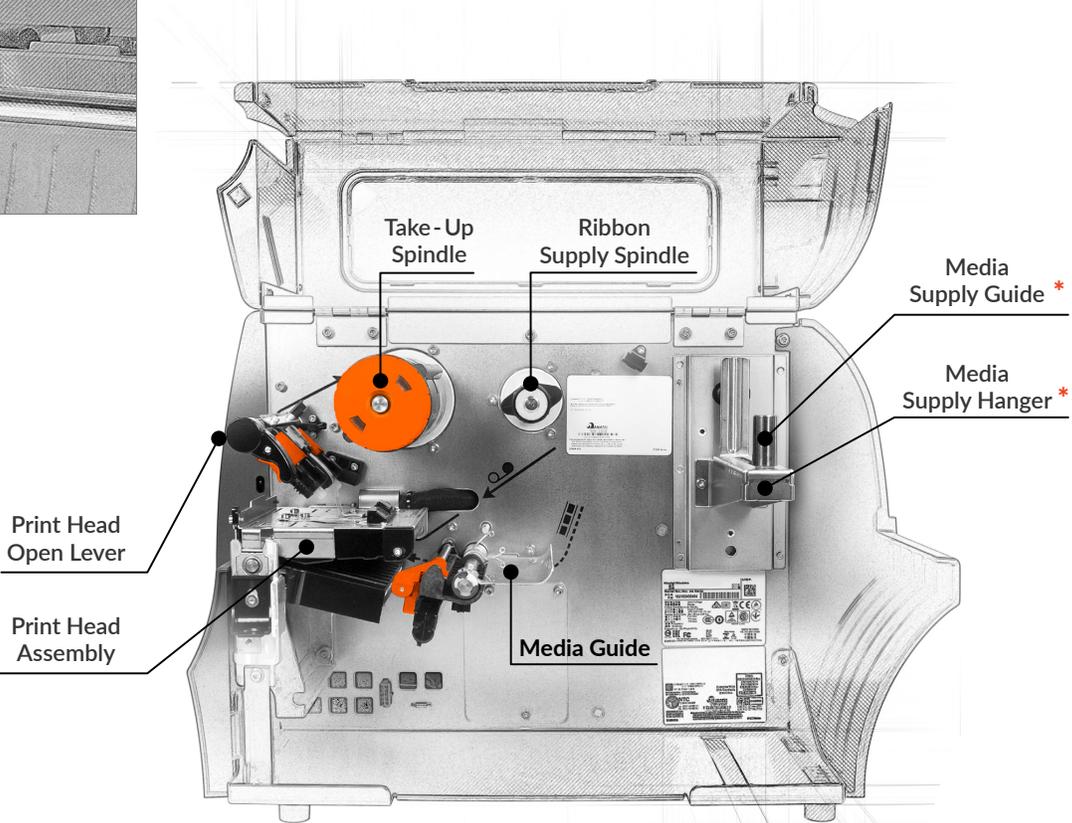
**RFID Printers** are devices that simultaneously print and encode information on **RFID inlays** or **labels**. These devices are the only way to print on labels, and they also save time by automating the manual process of encoding each tag. RFID Printers have the ability to print not only human-readable numbers and information, but graphics and 1D and 2D barcodes as well.

Even for applications that do not require printing, RFID Printers can add value by saving time on encoding. Industrial printers, for example, can print up to 14 inches per second in certain operations, which would be a little over 6 tags per second for 2-inch tags (including breaks).

# Diagram of an **RFID PRINTER**



Control Panel  
(on the front of the printer)



\* Determined by printer model

## TYPES OF RFID PRINTERS

There are several different ways to breakout and differentiate types of RFID printers. The most common is by the usage of the printer. Under printer usage there are three main categories: Industrial, Desktop, and Mobile. Another common way that RFID printers are categorized is according to RFID tag compatibility, usually by tag frequency or, sometimes, specialized tag types.

To listen to a podcast episode on Types of RFID Printers, [click here](#).

### PRINTER USAGE

#### Industrial (10,000+ tags per day)

**Industrial printers** are manufactured to be durable and able to be used in most application environments. Industrial printers stand out because of the sheer volume of labels they can print in a day, week, or month. For demanding applications with a large volume of labels, an industrial printer is the best-suited option.

#### Desktop (500+ tags per day)

As the name implies, **Desktop printers** are designed to be used in office-like environments. Typically, desktop printers are used to print a low-volume of labels a day and keep up with a mid-level quantity of items to be tagged. Desktop printers are also designed to be aesthetically pleasing, so they can be used in customer-facing applications.

#### Mobile (200+ tags per day)

**Mobile RFID printers** are not as common as Desktop and Industrial printers, but they can be very convenient, especially in large spanning applications such as warehouses or shipping yards. The availability of using a mobile printer when covering a large space is much more convenient than relying on a printer in a central location. Due to their compact size, mobile printers typically require specialized media.

### TAG TYPE

#### Frequency

The most common type of RFID printer is a UHF Passive RFID printer. UHF Passive RFID printers have an encoder that operates at the **860-960 MHz frequency range**. However, there are also NFC and HF printers available. These printers often look visually identical to their UHF Passive counterparts, but they have an encoder that operates at the **13.56 MHz frequency range**.

#### Specialized Printers

Another tag-based printer option is a specialized printer for tags like **RFID cards and badges**, foam backed tags, and all-surface labels that have a metal backing. RFID cards and badges generally aren't on a roll, but sold individually; so, normal RFID printers will not be able to read, write, or print on these. Instead, a **specialized card printer** is required along with specialized ribbon to print on the thick, plastic cardstock. Because the industry is growing and new types of tags are being made, new specialized printers and printer settings are being released to keep up with demand (e.g. printers designed for foam-backed and **metal-mount tags**).

## TYPES OF PRINTING - DIRECT VS. THERMAL TRANSFER

### DIRECT THERMAL

**Direct Thermal printing** is the standard in many industries that need to consistently print text or images, the best example being printing receipts. The Direct Thermal process involves two steps: heating up the printhead, and the printhead coming into contact with the heat-sensitive paper. The paper type is the key in this process because, if the paper is not chemically-coated to be heat-sensitive, the printhead will not be able to produce the color change that occurs when the paper is in contact with heat.

Direct Thermal printers are more expensive when compared to generic ink or LaserJet printers; however, because direct thermal printers do not require a regular ink supply the investment over the long term is typically much lower. The downside to direct thermal printing is that the paper used is very sensitive to light, heat, and abrasion, so if the label is exposed to any of those elements for too long, the printed information may become unreadable.

Direct thermal printing is also not recommended for items that need to be labeled for a long-time period because the text will begin to fade over time.

Barcodes on shipping labels, receipts, parking tickets, and some logistics applications use direct thermal printing because the labels do not need to have a long lifespan. Mobile printers typically use direct thermal as well, because of the transient nature of the barcode printed labels.

### THERMAL TRANSFER

**Thermal Transfer printing** is typically used in RFID label printing because of its general resistance to environmental elements and longer lifespan. Thermal Transfer printing requires purchasing a thermal transfer ribbon which is an added cost associated with this type of printing (in comparison to direct thermal). Thermal transfer involves the process of heating up the printhead and pressing it to the back of the thermal ribbon. The heated printhead melts the ribbon and transfers the color to the front of the label, which creates the printed text or image.

The pros of thermal transfer printing are long ink lifespan and little reactance to heat, light, or abrasions. Another positive aspect of this printing process is that there is a ribbon in between the printhead and label, which acts as a buffer for foreign items like dust and dirt. The ribbon helps keep these impurities out of the printed text or image as well as expands the lifespan of the printhead. A negative aspect of printing via thermal transfer is the reoccurring ribbon cost.

Due to the heavy use of Thermal Transfer printer with RFID tags, the remainder of this guide will focus solely on Thermal Transfer printing.

## PRINTER RIBBON

For Thermal Transfer printing, the printer must be equipped with a **ribbon**. Three groupings of ribbon are available for printing on RFID labels: Wax Ribbon, Wax-Resin Ribbon, and Resin Ribbon. Each of these ribbon types has its pros and cons as outlined below.

### WAX VS. RESIN VS. WAX RESIN

#### Facts about Wax Ribbon:

- Low melting point
- Most commonly used ribbon
- Should be used on paper labels, coated or non-coated
- Produces softer images
- Inexpensive
- Susceptible to smudges, scratches, and abrasions
- Printed images have a shorter lifespan

#### Facts about Wax-Resin Ribbon:

- Mid-level melting point
- Should be used on coated paper labels like glossy, smooth surfaces, and synthetic labels
- Clear, sharp image
- Mid-level price point
- Resistant to certain chemicals, abrasions, smudges, and scratches
- Printed images have a long lifespan

#### Facts about Resin Ribbon:

- High melting point
- Should be used on synthetic labels and garment labels
- Clear, sharp images
- Higher price point
- Highest resistance against chemicals, abrasions, smudges, and scratches
- Printed images have a very long lifespan

Compare/Contrast Ribbon:

	WAX RIBBON	WAX-RESIN RIBBON	RESIN RIBBON
MELTING POINT	LOW	MEDIUM	HIGH
DURABILITY	LOW	MODERATE	EXTREME
IMAGE QUALITY	SOFTER IMAGES	CLEAR/SHARP IMAGES	SHARP IMAGES
PRICE POINT	LOW	MEDIUM	HIGH
PRINT LIFESPAN	SHORT	LONG	LONGEST

Can be used with:

	WAX	WAX-RESIN	RESIN
PAPER LABELS, COATED, OR UNCOATED			
COATED, WEATHER-RESISTANT LABELS			
SYNTHETIC LABELS			

## PERFORMANCE & RESISTANCE LEVELS

After choosing what type of ribbon will work best for your media and application, there are still a few more choices to make before purchasing. Within each category (Wax, Wax-Resin, Resin), an array of different ribbons can be selected depending on application specifics. In order to decide the best within the class of ribbon, it is important to read each ribbon’s qualities front to back. If you are unsure which ribbon is right for your application, contact us and we’ll be happy to assist.

## CARD PRINTER RIBBON

Card Printer ribbon is a separate type of ribbon that is shaped and spooled differently than ribbon for typical label printers. These ribbons are available in solid black, monochrome, and color varieties and can be purchased in the form of a cartridge for ease-of-use.

## MEDIA

### MEDIA TYPES

As a general rule, there are two types of RFID tags: **inlays/labels** and **hard tags**.

Hard tags can be encoded, but, because they are not on a roll and generally thick, hard tags are usually encoded manually (one of the main exceptions is cards/badges.)

Wet inlays and RFID labels can be run through an RFID printer for encoding and printing purposes. The specifications relating to media size and roll size are imperative to take into consideration when purchasing a printer, as well as when purchasing tags for that printer. Most printer data sheets have a Media section that specifies the different sizes that can be used with the printer. Below are a few facts about each.

### MEDIA SIZE

#### Width

Most printers use media width as one of the key features of the printer. The media widths usually vary between 4 and 6 inches, depending on the printer.

#### Length

In printer data sheets, some manufacturers display the maximum label length and others denote the minimum label length. Generally, labels should be a minimum of 0.35" and a maximum of 157" long; but, the specific range depends on the exact printer and the printer's dots-per-inch, or DPI (a measurement of the printer's image resolution).

#### Thickness

Most labels will be in between 0.002" and 0.010" thick. For thicker labels, an exact printer configuration or special type of printer will be required. Tags/labels with special backing like **foam** or metal for **metal-mount tags** are prime examples of tags that cannot be printed with a typical printer or printer setting (see image on page 11).

### MEDIA SEPARATION

Because tags are manufactured on a single long liner, back-to-back, manufacturers created a way for RFID printers to determine where one tag ends and the other begins. There are a few of these separation indicators, and the one that is used varies depending on manufacturer and tag type. The three most common are called continuous, notch, and black-mark. Before an RFID printer starts encoding/printing, it must know what the separation indicator is in order to know when to encode/print.

## Continuous

Like it sounds, continuous means that there is no separation between each tag. For this type, the only way that the printer knows one tag from the other is pre-entered tag measurements during calibration.

## Notch

Notch, or gap, separation is fairly common on tag rolls and simply means there is a small area between each tag that the printer uses to identify one tag from another. The printer can tell from the reduction in thickness that no tag is in the space between tags.

## Black-Mark Separation

Black-Mark separation means that there is a black line that varies in thickness indicating the area between two tags. The printer identifies the color change and is able to use that as the indicator that there is no tag in that space. (These black-marks used for separation indicators between tags should not be confused with black marks that some manufacturers use to denote bad RFID tags.) (see image on page 11)

## SPECIAL MEDIA INDICATORS

Tags can have identifiers for various reasons that can be important to the printer during the calibration process. The most common special tag identifiers are die-cut tags and liner-less tags.

Die-cut indicates that the tag was cut with a “cookie-cutter” type instrument and is most easily recognized when tags are cut in special shapes or have rounded-edges. Liner-less indicates that the tag has no paper on the back or “liner”, meaning there is no waste during the printing process.

## OUTER ROLL & INNER CORE DIAMETER

A common problem that occurs when printing with RFID printers is purchasing a roll of tags that is physically too large to fit in the printer. While tags are usually cheaper purchased in bulk, the diameter of the roll can be too big to fit into the printer enclosure. Each printer has specifications for roll size in order to minimize the risk of purchasing a roll that cannot be used. Another issue is the roll of tags might have a too large or too small diameter core that doesn't fit, or doesn't fit properly, on the printer arm.

Tag roll cores vary in size depending on the type of tag, amount of tags, and tag manufacturer. If the core diameter is too large or small to fit on a printer arm, the best idea is to re-roll the tags on a different size core. Both the outer roll and inner core diameter specifications are available on most printer data sheet (see image on page 11).

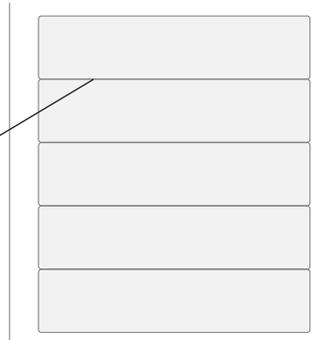
*\*These different media types are important to understand in order to properly calibrate a printer for a specific roll of RFID tags. If a printer is not properly calibrated, it could print in-between tags and not properly encode the tags resulting in a waste of resources. For more information on printer calibration, see Printer Maintenance on page 14.*

# Media Graphic

## Printer Media

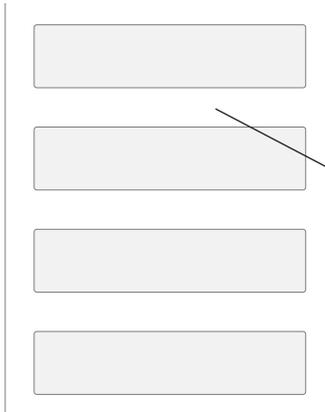
### Continuous

No gap in between the tags



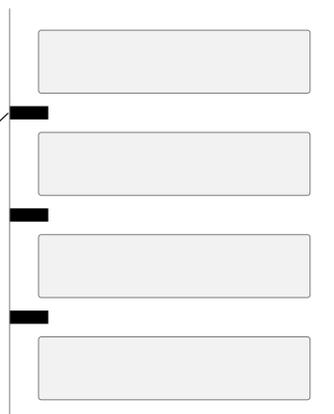
### Notch or Gap

Small area between each tag



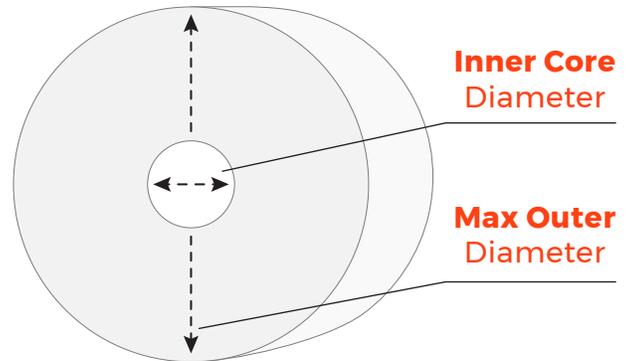
### Black Mark

Black mark separating each tag



\* In most cases the black marks are on the back side of the liners

## Roll Diameters



## Media Sizes



\* Label dimensions are written width first. For example, a 4" x 2" label is 4" wide and 2" long

# PRINTER SPECS TO KNOW (AND WHY THEY MATTER)

Printer specifications are the best tools for choosing the ideal printer for an application.

## OPERATING FREQUENCY

RFID printers have an RFID reader inside of them, so it is imperative to check which operating frequency the printer uses. Most printers are set to the Global standard of 865 – 960 MHz, while others can be set to the US (902 – 928 MHz) range, the EU (865 – 868 MHz) range, or even set to print and encode HF and NFC tags (13.56 MHz).

## DATA INTERFACE

Data Interface explains how the printer connects to a computer or network. The most common data interfaces are Wi-Fi, USB, RS-232, Ethernet, and Bluetooth.

For placing a printer on a network so that more than one computer can print to it, you can use Wi-Fi, Bluetooth, or Ethernet connections. To connect a printer with a single computer directly, USB, RS-232 (Serial Connection), Ethernet, and Bluetooth can be used.

## POWER SOURCE

Most RFID printers are powered by an AC cord, but mobile printers are powered using rechargeable batteries that must be charged every few hours depending on the size and type of battery, as well as printer usage. For battery-operated printers, it is useful to purchase additional batteries and a charging cradle so that the application is not interrupted due to a drained battery.

## OPERATING TEMPERATURE

If the application is outside, or in a non-temperature controlled environment, the printer's operating temperature will be important to consider. Most printers have similar operating temperature ranges as RFID readers, unless the printer specifically states that it can withstand **harsh environments** and extreme temperatures. Printers, like RFID readers, can overheat and shut down if they are not stored properly according to their operating temperature specifications.

## HOST API

Application Programming Interface, or API, is a set of protocols and tools on a device that allow a programmer to build software to interact with that device. Manufacturers create APIs in specific programming languages such as C#, Java, or their own, unique programming language. The programming language in which the API is available can be a significant advantage for a software programmer that is proficient in that language. For users looking to create a custom software for their RFID printer application, the Host (or manufacturer's) API programming language could be the deciding factor between two or more devices.

# PRINTER OPTIONS THAT AFFECT PRICING

## RESOLUTION/DPI

The resolution, or clarity of the text or image printed on the RFID tag, can be important in certain applications, especially when printing barcodes that will be scanned with a 1D or 2D barcode scanner. If the resolution is not clear, the barcode scanner may not retrieve the correct information for the user's application. On RFID printers, the resolution is described as DPI, or Dots Per Inch. The higher the DPI value, the clearer resolution of the printed text or image. Printers with higher options of DPI cost more because of the more sophisticated printhead required to produce enhanced clarity.

## PRINT WIDTH

Most printers are available with either a 4 or 6-inch maximum print width, which is important to note to ensure that the tag isn't too wide to be encoded and printed with the selected RFID printer. If the tag width is smaller than 4 inches, it can be used with any supported printer. Printers that have a 6-inch print width will generally be more expensive than printers with a 4-inch print width and allow more flexibility when choosing media.

## CUTTER/REWINDER/PEELER/AUTO-APPLICATOR

Some printer manufacturers can provide optional, user-friendly capabilities that can be purchased on, or in addition to, the printer. Below is a list of some of the more common options.

- **Cutter** – a cutter is positioned on the front of the RFID printer at the bottom of the opening where the tags are expelled. The cutter is used to cut the tags for you, instead of having to use scissors or additional equipment.
- **Rewinder** – a **rewinder** is a separate element that is very useful when printing hundreds of tags because it carefully winds the printed and encoded tags coming from the printer, onto a new roll for ease-of-use.
- **Peeler** – a peeler peels the tags off the liner as they come out of the printer for more automated applications and ease-of-use.
- **Auto-Applicator** – an auto-applicator is used in peel and stick applications on conveyor belts, usually in conjunction with a cutter and peeler, to replace the human element in the labeling process.

## PRINTER SOFTWARE

A few different boxed printer software options are available to use with an RFID printer. **Printer software** allows a computer to interface with an RFID Printer in order to create and send data for printing and encoding tags. Without out-of-the-box software, tags can be printed and encoded by creating a script in the printer's programming language and sending it to the RFID printer. Creating a script requires knowledge of programming in the printer's native language.

In order to print and encode tags without programming knowledge, printer software can be purchased making communication between the computer and printer seamless. Each boxed printer software is different, but the basic functionalities include creating or importing encoding data as well as the data to be printed on the tag face. Boxed printer software is designed to be easy to use, but can vary in price depending on features and the number of printers licensed to use the software.

Another option for interfacing with RFID Printers is to design a custom software using the printer's Host API and programming language. Custom software is a good option for companies that want to automate their printing or create a piece of software with additional capabilities like communication with other pieces of software or databases.

## PRINTER MAINTENANCE

### CALIBRATION

Because different RFID tags are used with RFID printers, the printer must be calibrated for a specific piece of media. Calibrating is basically configuring the printer settings to operate with a specific tag. There are two different types of calibrating when talking about RFID Printers – RFID Calibration and Media Calibration.

RFID Calibration refers to when the printer reads the tag and determines the best antenna position and read/write power for encoding to that particular tag.

Media Calibration refers to when the printer prints a few tags in order to adjust settings to accommodate for the tag's size and the gap in between each tag.

Both types of calibration must be completed each time a new tag/piece of media is placed inside the printer to be printed and encoded. Typically, each printer is shipped with either a booklet or loaded information about all the tags that can be printed on that printer and their calibration settings.

To watch a video on how to calibrate a printer, [click here](#).

## CLEANING

Cleaning is an important part of upkeep with an RFID printer. Printers in **environments** that produce a lot of dust, ash, or dirt will start to slow down or stop working due to an accumulation of debris inside the unit. For printers in this type of environment, it's important to clean the unit every couple of weeks to a month depending on the accumulation. Once every few months, even printers in cleaner environments will need to be cleaned so that dust does not affect printing speed or quality.

Cleaning a printer can be done carefully like any other piece of equipment using cleaning cloths and/or dusters. Alternatively, a specialized cleaning kit can be purchased for supported printers.

## RECURRING COSTS

Besides the obvious recurring costs of tags and ribbons, printers may have a few maintenance or equipment replacement costs. In addition to the cost of printer cleaning supplies, printheads may sometimes need to be replaced (although this is rare). Today's printers are built with high-quality materials and are made to last.

## ABOUT US

Founded in 2008, [atlasRFIDstore](#) is a trusted source in the RFID hardware industry. We are a global retailer providing customers a secure, one-stop location where you can buy RFID components for your own systems and applications.

atlasRFIDstore sells name-brand products in virtually every RFID hardware category, so you can build cost-effective RFID solutions across a variety of verticals.

The atlasRFIDstore team focuses on creating the absolute best customer service experience and works with you to select the right RFID equipment for your systems.

Our sales engineers are highly trained in the field of RFID and are ready to answer your questions, big and small. While we may not immediately have an answer, we'll diligently work for you to find a solution.

Our offices are located on Morris Avenue, in downtown Birmingham, Alabama. We have customers all around the globe and ship products worldwide.

# CONTACT

# THE

If you have any additional questions about RFID PRINTERS for your application, or general questions about RFID don't hesitate to [contact us](#).

# RFID

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# EXPERTS