

## Note on the Printer Book

This was a prototype document to explain general principles of bar code printers. Bar code printers are not the most exciting of subjects. This manual was written in a humorous style to both convey the essential information about the printers and to hold the attention of the reader. This is a general introduction to bar code printers and each specific type of printer will have its own quirks and nuances. The intent with this document was to make an otherwise boring topic somewhat enjoyable.

## Preface

At the time of this printing Tony Cataldo spent lots of years in the automatic data collection industry. He programmed interfaces for a variety of truly strange equipment including handheld terminals, pen-based terminals, bar code printers, portable printers, Electronic Shelf Tags (ESLs), smart cards, Touch Memories, bar code network devices, fixed-scanner, RF equipment, bench and in-motion scales, postage meters, and other assorted strange stuff.

Some of these devices were intuitive forward and easy to program. Some were difficult to program but were fun and challenging to work with. However, many were very difficult and not fun at all. One particularly frustrating device was the bar code printer. Sometimes these seemingly simple devices took weeks to decipher. After deciphering the magic printer codes they were usually easy to program (key word: “usually”). This book provides some insight from a software engineer who spent many frustrating hours in front of a computer and bar code printer.

The author hopes that this book helps you save some time and effort in dealing with bar code printers.

## Introduction

Why bother with a book on bar code printers? After all, manufacturers provide printer manuals (a debatable point in some cases). While manuals do exist, these manuals often perplex and bewilder those unfamiliar with bar code printers. This book was written for the frustrated, the confused, and those who have a nagging urge to "adjust" their printer with an eight-pound sledgehammer. For all frustrated programmers of bar code printers rest assured that the author has "been there and done that." If you know the basics then bar code printers are pretty easy to deal with. Just keep reading and you will soon see.

Just think of it fellow engineers. Your company probably purchased these strange and expensive printers to solve some real labeling problem. You cannot get any Windows drivers to make these printers operate like you would for your standard office laser printer. Thus, your company now owns an expensive paperweight (or boat anchor) waiting to become useful. Your boss "volunteered" you to make this thing work. The fate of the company's huge all-encompassing system hinges on you and your ability to get the new applications running. You read the huge manuals and find yourself confused, perplexed, baffled, and befuddled. You get the simple labels to work but have trouble with the more advanced printing.

Then, you find this book. It solves your problems and answers your questions. You get your printing project done months ahead of schedule. The non-programmer peasants stand in awe. Managers write nice memos singing your praises. Warehouse workers smile at you and give you the thumbs up rather than trying to squash you with their forklifts. Labels print and everyone saves time. Your company recognizes your genius and promotes you to "Vice President of Labels and Stuff." You use your generous bonus to pay-off your house and expand your model railroad and power tool collections. Well, it could happen. If not, then you get your printing project done, move on to your next urgently hot project, and maybe not get laid-off this month.

In all seriousness, I do hope that this little manual will make programming bar code printers a little less painful. I was there and have done that. I got frustrated and spent many hours trying to make some of these printers work properly. I hope that the time I spent will save you both time and frustration.

Tony Cataldo, Computer CCBW (Chief Cook and Bottle Washer)

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## 0. What's this Book About?

This book contains information about bar code printers. Lots of printers exist in the marketplace. Bar code printers vary greatly and selecting one can be confusing. This book provides a basic general education about bar code printers and then provides detailed discussions about programming these printers. The book covers these topics:

### **Chapter 0: What's this Book About?**

This chapter is the current chapter that you are currently reading that gives you a brief outline of the rest of the book. This chapter also provides a very important printer lesson. Printers (and computer stuff in general) generally number things relative to zero. Of course, exceptions exist, but get used to things starting with zero.

### **Chapter 1: Bar Code Printer Basics**

Chapter One covers general bar code printer-related topics. You will learn what bar code printers are, why they are used, printing methods, printer features and options, and other general printer stuff.

### **Chapter 2: Selecting a Bar Code Printer**

Chapter Two gives some general guidelines for selecting a bar code printer. Do not expect information about specific printer models or manufacturers. Since printer models and capabilities change so quickly, any specific information would probably be obsolete by the time it got published. This section provides general information related to bar code printers. These general details apply to any new printers coming into the marketplace.

### **Chapter 3: Connecting the Bar Code Printer to your Computer**

This section includes general guidelines for getting your bar code printer and computer on speaking terms. Before getting your bar code printer to actually print you must first connect it to your computer (it does not print very fast otherwise). This section includes pinouts for various types of cables. This section does not contain the proper cable for every computer and printer combination, but it should get you on the right track.

### **Chapter 5: Basic Printing**

This section tells how to print basic labels on your bar code printer. This step helps ensure that you got the right connection between your printer and computer. This step also helps prove to yourself that your expensive printer can actually do something. After getting a simple label to print then you are ready to start learning about advanced printing techniques.

## **Chapter 6: Label Formats**

This section deals with downloading label formats and how to use these formats. The previous chapter told you how to print basic labels. This chapter gets into the advanced label printing required by real applications.

## **Chapter 7: Using Label Formats**

This chapter gives details about using label formats with some of different types of bar code printers. This section contains general information about some of the more well-know bar code printers. You can compare and contrast some of the printer commands and get a general idea of how these machines operate.

## ***0.1 Definition of Terms (Confusing Printer Lingo)***

I put this section in the front so that you will read it (wishful thinking perhaps). Even if you know about bar code printers at least look through the list of terms and be sure that you know them all. The remainder of the book uses these terms a lot so make sure you know them.

- Adhesive** The gluey, sticky stuff on the back of most labels. Media suppliers can adjust or create new adhesives depending on the application. You must choose the adhesive type based upon your application and what the label must stick to. Adhesive range from none, to repositionable (like on Post-It notes), to removable, to normal sticky, to “ain’t no way to remove it” super-sticky.
- Batch Take-up** A printer option that winds a long of printed labels onto a take-up spool. This is useful when printing lots of the same label (such as product serial number labels). Also called “rewind.”
- Card Stock** A heavy printer media. Card stock normally does not have any adhesive on the back (i.e., no gluey, sticky stuff). Think of card stock media as a continuous index card. This type of media may come perforated or continuous (requires a printer with cutter). Be sure the motors and gears can handle this heavy stock before trying to print on it. Light duty printers could get their gears stripped, burn out their motors, or cause some other unpleasant side effects. Remember that the longevity of the printer may be directly proportional to the longevity of your career.
- Continuous** A print mode where you print lots of labels at one time (called a batch). Continuous printing works well when printing the same label, labels with serial numbers, or doing such-like tasks. Contrast with “on-demand” mode. Continuous mode may benefit from the “Rewind” or “Batch take-up” options.
- Core** The center of the media roll. The part left after printing a roll of media. With a few thousand of these leftover cores and some glue you could probably build a new cubical. They also work well for making toy “telescopes” and “binoculars” for little kids.
- Die Cut** Media manufacturers cut their media from huge (like, very huge) master rolls. They then wind this cut media onto individual cores. In addition they can die cut this continuous strip of media into individual labels and then remove the thin strip of leftover media material from around and between the labels. The resulting labels are called “die cut” labels.
- Direct Thermal** A printing method that “burns” a desired image onto the heat-sensitive printer media. (Technically, the image is not burned onto the media but this is best way to explain it so that it makes sense).

- DFW** Don't {explicitive} Work. Generic technical acronym used when the printer (or other pieces of equipment) does not perform properly. Not to be confused with the Dallas Fort Worth airport. Usage: "This stupid printer is DFW! Who bought this thing?"
- DT or D.T.** An abbreviation for "Direct Thermal." Could also be used as an abbreviation for "Dumb Thing" or "Darn Tricky" depending on the context (or "Down Tube" for bicyclists).
- Format** Commands sent to the printer that gives details as to the format of the label. Think of it as a preprinted form. The format acts like the form and merely requires you to fill-in the data.
- High Energy** (1) Media that is scratch resistant, chemical resistant, and temperature resistant (requires a ribbon able to withstand high temperatures). (2) A four-year-old boy who ate too much candy loaded with sugar.
- Image Bands** Printer memory used to make printing more efficient. When optimizing the printer you must adjust the print speed and image bands. I have yet to find anyone who can give a precise explanation of exactly how image bands work. These are the types of terms found in printer marketing material.
- Imaging** Printers "image" a label when they take the label information and process this information into a series of dots actually printed on the label. After you send data to the printer there may a slight delay (depending on the speed of the printer, printer memory, and label complexity). This delay is typically the "imaging" time.
- Infrared (IR)** An infrared link uses a beam of light to move information between devices. An example is a television remote control. You point the control at the TV to change channels, etc. If you point the remote away from the TV then the TV does not receive the information. The same is true of IR printers. You must a point-to-point, clear link between the infrared devices before they can talk. Note: IR with portable printers and portable devices is a bad idea. It sounds good in theory but normally headaches in practice.
- IPS** Inches Per Second. Printer printing speeds are normally measure in Inches Per Second (IPS). This is the "how fast do it go" measurement.

<b>IrDA</b>	See Infrared.
<b>Linerless Labels</b>	These new fangled labels do not require backing material. The adhesive is not adhesive enough to adhere to the other labels on the roll. Without the backing you get more media per roll (this means you change rolls less often).
<b>Media</b>	<p>Printer media is the industry term for the labels. A roll of labels is simply referred to as the "printer media" or just "media."</p> <p>The thin stuff that the printer prints on (under ideal conditions).</p>
<b>On-Demand</b>	A printing mode that prints a single label at a time and waits for the operator to remove and apply the label. On-demand mode works best when you have a printer sitting in front of a conveyor line. As boxes move past the printer you print a label and stick it on the box. Contrast this with "continuous" mode. On-demand mode with self-strip is when the printer spits out a label with the backing removed.
<b>PCMCIA</b>	Credit card sized (but thicker) cards often used to expand a printer's memory. These can come in several varieties including static RAM (SRAM), Flash, etc. Don't worry too much about the specific card type but just realize that these expand your printer's memory capacity. PCMCIA stands for " <u>P</u> ersonal <u>C</u> omputer <u>M</u> emory <u>C</u> ard <u>I</u> nternational <u>A</u> ssociation," or " <u>P</u> eople <u>C</u> an't <u>M</u> emorize <u>C</u> omputer <u>I</u> ndustry <u>A</u> cronyms."
<b>Peel Mode</b>	Another way of saying "self-strip." This applies to removing the backing from the media so the label comes out of the printer with the sticky stuff exposed.
<b>Print</b>	What printers do best (under normal circumstances).
<b>Rewind</b>	See "Batch take-up."
<b>Ribbon</b>	A very thin-film roll that contains the "ink" used when printing thermal transfer (TTR) labels. If you need a thrill then just load a few of these babies onto a printer. Do not load the ribbon while wearing a white shirt (trust me on this one).
<b>Self Strip</b>	It's not what you were thinking! See "Peel Mode" and get your mind out of the gutter!
<b>Smart Reimaging</b>	Sometimes when you print labels some of the data stays the

same between labels. With smart reimaging the printer does not bother reimaging the data that stays the same. In theory this smart reimaging makes printing more efficient. In practice it can cause you to wonder why your first label prints correctly and the next labels have missing data.

**Tamp Arm** The thing on a printer/applicator (PL/A) that stamps the label onto the object (or onto the conveyor line or your face if you are not careful).

**Tamp Pad** The thing on the end of a tamp arm that holds the label (under ideal circumstances) until the tamp arm stamps the label onto the object (or stamps it onto the conveyor rollers or your face if you are not careful). The tamp arm normally has small holes that create a vacuum effect (in other words, the tamp pad sucks wind).

**Tear Bar** This bar sticks out of the front of the printer just below the Printhead. When a label prints the web between the labels should sit on the tear bar. You can then use the tear bar to tear the labels apart (hopefully on the webbing and not on the label).

**Thermal Compensation** The Printhead of the printer contains a row of hundreds of dots used to print the label. These dots are basically resistors. After awhile these resistors require more energy to create the same amount of heat. Thermal compensation compensates for the added resistance required by aging printheads. This is truly cool (or hot depending on your perspective) feature.

**Thermal Transfer** A printing method that transfers “ink” from a ribbon onto the printer media. This method normally produces the best quality label images. This ink is normally paraffin-based and stored on a thermal transfer ribbon. This ribbon looks much like the ribbon on an IBM-Selectric-type typewriter (am I dating myself), but the ribbon is the same width as the printer media.

**TTR** An abbreviation for “Thermal TRansfer.”

**Webbing** The webbing is the area between die-cut labels (where there is only the backing). This is a good place to separate the labels using a tear bar or cutter.

## 2. Bar Code Printer Basics

This section covers some basics regarding bar code printers. If you already know about bar code printers then quickly skim through this section. The rest of the book uses terms from this section so make sure you know them.

### ***2.1 What are Bar Code Printers?***

Bar code printers are special purpose printers used for printing labels. These specialized printers do not print general office correspondence as do laser and matrix printers. Bar code printers were designed and engineered to print labels using a long roll of media. These printers typically print labels that contain one or more bar codes as well as other information.

Bar code printers have several advantages and disadvantages over your standard office-style printers, including (but not limited to):

**Advantages**

**Speed:** Bar code printers can quickly print various types of labels even if the information in the label changes. Your labels may print continuously depending on the label format and the printer.

**Less waste:** You can probably get labels that are the perfect size for your application. Your standard office printer could have extreme difficulty printing your ideal labels (if it can print them at all).

**Self-strip:** Many bar code printers can automatically remove the label backing and spit out a label ready to apply. This can be very convenient in many applications. Self-strip may not sound like a big deal, but if you have to apply labels for an entire work shift then it becomes a real time-saver.

**Print quality:** Since bar code printers normally do not use inked ribbons, labels normally have a consistent and high-quality appearance. These labels typically are difficult to smear and do not suffer from fading-ink syndrome associated with inked printer ribbons.

**Space:** A bar code printer normally has a smaller footprint than a standard office printer. You can often mount them in cabinets or racks as long as you have a way to pull them out to load the media. For example, airlines typically mount their bar code printers in the cabinet under the ticket counters.

**Durability:** Most bar code printers were designed for industrial use and can survive warehouse and other "non office" environments. The author recalls traveling on a plane with a bar code printer in the checked baggage. On arrival, the printer box was burst on the bottom meaning that the box received some "less than careful" handling by the baggage gorillas (probably dropped from at least four feet). After re-seating the printhead, the printer worked fine.

**Lots of Options:** Bar code printers may offer a variety of specialized (and often expensive) options. Some may apply labels automatically, cut labels from a continuous roll of media, print the label and remove the backing for you, etc. Most office-style printers do not offer these specialized options.

**Disadvantages**

**These ain't no office printers:** Bar code printers are not your standard office printer. They do not act like office printers and will not perform general-purpose printing. Do not expect a general office printer to print labels like a bar code printer, and do not

expect the bar code printer to print anything but tags and labels.

**Programming:** Bar code printers normally speak in their own peculiar language. The programming language often varies greatly between manufacturers and sometimes between printers from the same manufacturer.

**Availability:** Manufacturers of bar code printers normally make their products easily available. However, you will probably not be able to get printers or supplies from your local office supply store (as you can with your normal office printer). When using a bar code printer you must plan ahead for your media supply and for handling service issues that will eventually arise.

**Price:** Normally these specialized bar code printers are expensive.

## **2.2 *Printing Methods***

The print method refers to the way that the label image gets onto the label. Printing methods for common office printers include laser, ink jet, dot matrix with inked ribbon, and so forth. Nearly all bar code printers use one of two printing methods, namely, direct thermal or thermal transfer.

Direct thermal printing requires label media coated with special heat-sensitive chemicals. The media passes under the Printhead. When areas on the printhead heat up it leaves a darkened image on the label media. Some of the advantages and disadvantages of direct thermal printing include:

**Advantages**

**Low Cost:** The media itself is more expensive than non-thermal media but the cost per label is lower. Direct thermal does not require printer ribbons and therefore is very cost effective.

**Simple Operation:** Operators need only load media into the printer. You do not need a ribbon. This is a bigger deal than it sounds. The label media and ribbons normally come in different lengths. Thus you often change the ribbon, print for awhile, change the media, print for awhile, change the ribbon, etc. Rarely do you change both media and ribbon at the same time and rarely (if ever) do you consume them at the same rate.

**Good Print Quality:** Direct thermal printing produces good quality labels readable by all sorts of bar code scanning equipment. The newer thermal labels also do surprising well in sunlight. Older versions of these labels darkened and discolored very quickly.

**Longer Printhead Life:** It takes less power to "burn" the label image onto the media than other methods. Less power to the printhead often translates to longer printhead life (ideally).

**Disadvantages**

**Limited Label Life:** Direct thermal labels deteriorate over time. Heat, sun, and other factors can make the labels darken. Eventually direct thermal labels suffer from the background darkening while the images fade. As the labels "fade" they become increasingly more difficult to read and scan. Remember that these labels can get a suntan (not good).

**Limited Print Quality:** While the print quality is good, other print methods can produce extremely excellent print quality.

Now let's examine the other major printing method of bar code printers, namely, Thermal Transfer (abbreviated TTR). In thermal transfer printing a ribbon passes between the printhead and the label media. This ribbon is normally a very thin mylar film covered with a wax-based "ink." As areas on the printhead heat up the ink transfers from the ribbon to the label. The unused ink stays on the ribbon and is eventually discarded. Some advantages and disadvantages of thermal transfer printing include:

**Advantages**

**Excellent Print Quality:** While direct thermal printers can produce very good images, thermal transfer printers can produce truly excellent images (like awesome, dude!). Thermal transfer printers typically produce the best images.

**Longer Label Life:** Thermal transfer labels are not heat sensitive and will last longer and withstand environments that will ruin direct thermal labels. Depending on conditions thermal transfer labels can last for many years.

**Variety of Media:** Thermal transfer "ink" can be applied to a variety of media stock including paper, vinyl, polyester, and a host of others. Thermal transfer printing allows you to choose the media stock that best fits the labeling application.

**Disadvantages**

**Cost:** Thermal transfer printing requires both a media stock and a ribbon. The media and ribbon together cost more (typically) than direct thermal media.

*(the advantages of thermal transfer printing come at a cost)*

**Difficult to Reload:** Thermal transfer printers require both media and ribbon. This means that operators must manage and replace both media and ribbon. Ribbons are typically produced on very thin Mylar and can be difficult to handle. Often the ribbon and media roll are the same length and both must be replaced at the same time. But printers with ribbon saver option consume media and ribbon at different rates. With ribbon save operators may have to replace media and ribbon at different times.

**Cool Trick:** Someone hands you a roll of media and wants to know if it will work in the printer. The first question you ask is "Does it look like I care?" The second question is "Is this a roll of thermal or thermal transfer media." An easy trick exists to instantly answer this second question. Run your fingernail quickly across the label (apply a little bit of pressure). Be sure to move your finger quickly. The friction created by your fingernail across the media creates heat. If you have a roll of direct thermal media then the label will turn black along the path of your fingernail. If it is thermal transfer media then you will see only a divot where your fingernail passed. This trick will truly amaze certain of your co-workers. Caution: if your co-workers find this extremely amazing and awe-inspiring then consider getting new co-workers.

## Bar Code Printer Features

This section describes some of the more common features related to bar code printers. Often times one or more of these features come built-in to specific printer models.

### Thermal Compensation

Printheads consist of a very large array of square dots. Each dot is like a tiny resistor that produces heat when triggered by the printer's control circuitry. When the dot heats it produces an image on the direct thermal media, or transfers the ink from the ribbon on thermal transfer printers. As time goes on (and as labels go through) these dots require more electricity to produce the same color image. Older technology printer without terminal compensation required you to turn a "burn pot" as the printer aged. A burn pot is a potentiometer that regulates the amount of current that goes to the printhead. Turning up the burn pot causes more electricity go to the printhead. More current made the image darker and compensated for the printhead getting older. Newer technology printers use thermal compensation to eliminate this manual tweaking. With thermal compensation the printer measures the resistance of the printhead and automatically supplies enough current to produce the proper image darkness. As the printhead ages you do nothing to adjust it. This feature makes it much easier to maintain the printers because it is very for the maintenance person to do nothing. I would highly recommend the thermal compensation feature when selecting a bar code printer (really cool option).

Thermal compensation allows your printer to produce high quality labels for nearly the entire life of the printhead. This is good because you get consistently good quality printed labels. However, be aware that these printheads often show few signs of wear before they finally die. Do not continue to use the printer year after year thinking that it will last forever. When these printheads go they tend to go very quickly and with very little warning. One week you may see a few burned-out dots and then next week the entire printhead could completely wear out.

### Battery Backup

Most bar code printers have their own memory that they use to store labels formats. Many of these printers also include an internal backup battery to retain any formats that you sent to it. This sounds like a really nice option but is actually overrated. Some manufacturers permanently affix the backup battery to the printer's circuit boards. They do this to reduce costs (and ensure that you have to pay for a service call something down the road). When you write an application you should have the application send any label formats each time the program starts (thereby making this battery option a mute point).

## **2.4 Bar Code Printer Options**

A host of companies manufacture bar code printers. These printers offer a variety of strange and often confusing features. The options required for your application often determines the specific printer needed. Before selecting a printer make sure that it supports the options that you may require in the future. A little forethought can prevent the printer of today from being the boar anchor of tomorrow. Take a look at the list below to get an idea of available bar code printer options (in alphabetical order):

### **Batch Take-up (Rewind)**

Use batch take-up (or rewind) to print lots of labels that you want wound on a spool. Batch labels make great asset labels for office equipment, serial number tags, or a host of other uses. Software manufacturers could print disk labels with general information and a unique serial number. You could print an entire roll of disk labels at a time each with a unique serial number. You could then take the entire printed roll to your duplication department where they would copy the software onto the disks and manually peel and apply a label on the disk. A batch-take-up option will save time and possible headaches when printing large batches of labels.

### **Black Mark Sensor**

Some labels use a black mark on the back of the stock. The black mark lets the printer know how big the label is. Perforated labels normally use black marks. Many printers come with this sensor as a standard feature, but others make you buy this as an option. Or, they make you upgrade to the next model printer to get this option. Be careful because you often figure this out only after buying the printer, unboxing it, and running some test labels. Then you are stuck with a printer that does not do your job. You may then be stuck with upgrading because you cannot get a refund on the current printer and switch to a different manufacturer's printer. And yes, been there done that.

### **Catch Tray (to catch or not to catch)**

A catch tray "catches" the cut label after the printer prints it. Catch trays normally hold only a few labels and are used for applications that print a small number of labels. One application might be printing airline bag tags (the labels that the airlines attach to luggage). The reservation attendant enters the destination information for your bags and the printer prints the bag tags. The catch tray holds the bag tags and the attendant then takes the cut tags and attaches them to the luggage. Larger catch trays do exist but you have to search them out. If you create lots of cut labels then consider the "stacker" option.

### **Communication Options (hello... is anyone out there?)**

Some printers include different communications options. These options allow the computer and printer to communicate in a variety of different ways. Communication options include RS-232 (usually standard), RS-422, current loop, Twinax, Coax, Ethernet, RF, etc. Most applications connect the printer to the computer's serial communication port (RS-232). Though this interface lacks flash and pizzazz, it works well and almost all PCs have at least one serial RS-232 port.

### **Cutter (the guillotine or pizza-cutter option)**

A cutter normally attaches to the front of the printer where the labels come out. Printers with cutters usually use "continuous" media stock. That is, material that consists of one, long, continuous label wound around the roll. The printer prints a label and then cuts the label to the proper length. This option is especially useful for applications that require labels of different lengths (the printer can cut the labels to the desired length). Note that printer media does not have to include adhesive on the back of the label. Some manufacturers offer rolls of card stock in either direct thermal or thermal transfer. With a continuous card stock you could print tickets, simple business cards, stock tags, and a host of other things.

Cutters come in two varieties. The knife cutter (guillotine) uses a straight knife blade to cut the printer media. A knife cutter uses an up and down motion to cut the media. The knife cutter works best when it cuts gapped media or card stock. Knife cutters typically get gummed-up when cutting through label adhesive. Gapped labels have the webbing between labels removed so the knife only cuts through the backing material on the label.

Rotary cutters are more like pizza cutters. These cutters roll a sharp knife through the label to cut them. Rotary cutters cut through adhesive material much more effectively than a knife cutter. The rotary cutter is less prone to getting gummed-up.

### **Gap Sensor (where do the labels stop)**

A gap sensor senses the gap between die cut labels. This sensor checks the amount of light reflected by the actual label. The gap between labels has the bare backing exposed and it reflects a different amount of light. This sensor detects the difference in reflectance and makes the printer stop after the gap (assuming it works properly). When running your printer make sure to clean and align this sensor occasionally.

### **Label Applicator (look Ma, no hands! -- and no money left in the printer account)**

When you need to apply lots of labels in a hurry then consider a printer with integrated label applicator (or PLA for short). A PLA mounts around a conveyor line and applies labels to packages moving down the line. Most PLAs include an

electronic eye that senses the package. The PLA prints the label, removes the label from the backing material, waits for the package, and then applies the label to the package. A PLA requires no operator intervention (unless it jams or breaks). These systems use the same type of print engine (technical term meaning the printing part of the printer) as desktop printers. Be forewarned! PLAs are large, bulky, heavy-duty, and expensive machines. Basic PLAs range (as of the time of this writing) from about \$12,000 to the price of an inexpensive house (I kid you not!). When you get bids for a PLA just make sure that you are sitting down before you get to the price. Many of the PLA companies use a base printer that they hack and butcher in order to create the 5-figure PLA. Thus, the print engine is often only as good as the engine of the base printer (which may only cost \$2,000). Note: do not have your face anywhere around the tamping device on these printers (unless you want your nose flattened). No, I have not personally tried it but that point sounded note-worthy anyway.

### **Memory (dah, what did you say? I don't remember)**

Often, a printer must produce complex labels or a wide variety of labels. When the printer must store lots of data then it requires memory. Many printers models support expanded memory options. Adding additional printer memory varies between manufacturers and between printers from the same manufacturer. Some printer memory must be installed at the factory. Some memory comes on small circuit boards and can be installed relatively easily. These memory boards may be called "memory boards," "expansion memory," "SIMMS," or other similar sounding names. Some memory comes on a chip or chip sets that plug into sockets inside the printer. Some memory now comes on PCMCIA cards that plug into a special slot on the printer. The PCMCIA cards look like thick credit cards and are a standard for all sorts of useful computer things (like memory, modems, hard drives, etc.).

### **Ribbon Save**

Some thermal transfer printers offer a ribbon save option. Normally thermal transfer printers consume the label media and the ribbon at the same rate. This normally leaves lots of "ink" wasted on the thermal transfer ribbon. With ribbon save the printer advances the ribbon only when needed. This makes the ribbon last much longer but requires that the printer operator monitor both the label media and the thermal transfer ribbon. With ribbon save the printer media and ribbon may run out at different times. Normally, the roll of media is the same length as the printer ribbon and both run out at the same time (makes it easier to change). Ribbon save may or may not be a good thing. If you print labels with lots of white space then maybe ribbon save is a good thing. If your labels are fairly dense then it may not be a good thing. You must weight the cost of replacing both the media and ribbon versus the cost of saving some ribbon. The printer marketing guys make a big deal out of this feature but it may cause more problems than it solves.

**Self-strip**

Printers with self-strip automatically remove the backing from the printed label. The printer spits out a printed label ready for the operator to apply. This feature works very well when the printer stays still and the item that needs a label moves to the printer. Self-strip works very well when labeling boxes moving down a conveyor line. If you have lots of labels to apply on a conveyor line then consider the “Label Applicator” option. Self-string works best in conjunction with the “rewind” option. “Rewind” allows the printer to wind the label backing paper back into the printer. Some printers include self-strip with no rewind. With these printers the backing comes out of the bottom front of the printer and collects there. You normally mount the printer near the front of a table and place a trashcan under it. While this works fine it looks tacky.

**Stacker (there’s nothing like a well-stacked printer)**

Usually cutters and stackers operate together. The stacker takes cut labels and stacks them into an output bin. Sometimes stackers are an option offered by the printer manufacturer and other times it is an add-on device offered by another manufacturer. These work like a “catch tray” but normally hold lots of labels.

### 3. Selecting a Bar Code Printer

You should now have a basic understanding of bar code printers. This section gives you some idea of how to select the proper bar code printer for your application. Bar code printers vary greatly in both form and function. Consider these factors when selecting a bar code printer: label size, label type speed, duty-cycle, label type, options needed, price, support, label type, and having a really cool looking printer doesn't hurt.

Before selecting a bar code printer, first analyze your application (YES, you have to think! – try not to hurt yourself). Carefully consider the following points before selecting and purchasing your bar code printer.

#### **Any label flexibility?**

Can you change your label size or format or do you have to use a specific label format. Some labels use rigid standards such as government shipping labels, AIAG labels, or Postal tags. If you have the flexibility to change the label size or format you may have more printers to choose from for your application.

#### **Give me some options**

What options does the printer require? Does the printer need a cutter, catch tray, stacker, batch take-up (rewinder), applicator, additional memory, or some other option? In some cases the option required may determine the printer (or at least limit the choice of printers). Weigh your options before jumping to a printer decision. Will you needs change in the future? Will you need some other trick option down the road? If so, make sure your printer accepts these options or be prepared to buy a new printer in the future.

#### **How to print?**

What print method will you use? Most printers support both direct thermal and thermal transfer printing. Most printers handle direct thermal printing easily. Some printers support thermal transfer but make ribbon loading difficult. If you need a thermal transfer printer make sure the media and ribbon are easy to install and remove. For printers that you are considering buying, have a sales representative show you a demo printer. Then ask for a roll of media and ribbon and try to install them yourself to see how easy (or not easy) it is to load. Remember, your operators must change the media and ribbon. If you need a degree in mechanical engineering to change the media then try looking at another printer. Also, be aware that some manufacturers build printers that support thermal transfer and direct thermal. However, they may require you to buy an option to actually make thermal transfer work on your printer. Sometimes the datasheets do not make this clear. The printer sales reps are usually very good at informing you of these little “inconveniences” after selling and delivering the printer.

## How fast is fast

How fast must the printer print? Is the printer used on a conveyor line that requires a certain throughput? If you have a very fast printer you may want to run it at a slower speed. Print speed can significantly affect label print quality. Faster printing labels (above about 6 IPS) usually cost more. Selecting the appropriate print speed must balance, media cost, print quality, and throughput requirements. Also, do not be too swayed by manufacturers print speed claims. There is more to print speed than how fast the printer can spit-out a label. You could have a very fast printer but your throughput can be low. You must consider both the imaging time (related to the horsepower of the printer's CPU) as well as the print speed. We will discuss this subject in greater detail later.

## Memory

Most bar code printers offer optional expansion memory. Loading label formats, graphics, fonts, etc. use memory. More complex labels require more memory (as does loading multiple formats). You must consider how many label formats you require and the size of the formats. The number of formats and the format sizes helps determine how much memory your printer needs. Before selecting a memory option also consider what your future requirements. If your printer will need more memory in the near future it may be cheaper and easier to order the printer with this memory installed. It may cost more for the initial printer purchase but it may save time and money in the near future.

## Printing volume

Consider the number of labels you need to print. Some applications print only a few labels per hour, some print a roll or two per day, and others print continuously all day long. If you require continuous-duty printing consider using multiple printers or planning to replace printers more often. Continuous duty printers often cost two or three times more than lesser duty printers. If you use a continuous duty printer then plan for the day when the printer fails or needs service. Any mechanical printer is prone to breakdown. Consider a printer breakdown as an eventuality and not as a mere possibility. Two lesser printers working in tandem can provide better overall throughput over a single printer and also a contingency plan when one breaks (note the word "when").

## Who built it?

Carefully consider the company before purchasing your printer. Do not buy the printer based solely on price. Make sure the printer company stands behind the printer. Remember, when you buy a car you would be foolish to walk on the car lot and say, "Just give me the cheapest car on the lot that runs." The same is true for bar code printers. See the following section for a manufacturer and service checklist. I

have seen old technology, slow, expensive, heavy printers that worked non-stop for five years replaced by new technology, state-of-the-art printers that last six months. So which one is really cheaper?

### **Service**

When the printer fails (note the word when) can the manufacturer repair it quickly and reliably? If the printer is used in a critical application does the manufacturer offer maintenance agreements? Does the manufacturer offer guaranteed repair turnaround or will they offer loaner printers? Look at the company behind the printer as well as the printer itself. Run away from any companies that do not offer serious service commitments. Make really sure about the service options if you need a mission critical or specialty printer (such as a printer applicator).

### **3.1 Printer Manufacturer Checklist**

Take the printer manufacturer into account. Will the company be around in the future? A ten-year printer warranty isn't worth much if the company dies after five years. Will the manufacturer continue to build and support the printer that you buy? If they discontinue your printer model do they offer compatible replacement printers? When (not if) the manufacturer discontinues a printer do they have a long end-of-life plan? Some companies discontinue a product but offer service and support for some number of years after discontinuing it. Do not automatically buy the lowest-cost printer since you may have to pay a higher price in the future for this decision. Remember that each printer model could require slightly different label formats or programming. You cannot just switch printer companies without having to modify (or rewrite) the software that controls your printers. Bar Code printers are much less "plug and play" than other office printers. If you use multiple printers can your software handle potentially different interfaces and formats for each printer? Below are some guidelines to consider:

How long has the company been in business? You want a company that stands behind its printers (not to mention, a company who will be around in the future).

Does this company have a good service record? Will they supply references (keep in mind that they will only supply references who say what they want you to hear).

What type of service plans does this company offer? Be careful to check carefully especially if you need a high-end printer such as a printer applicator. Depot service for a 100-pound printer is probably not a good option.

Does this company also supply media? If so, does the media department have a good record of supplying the media in a timely manner? If they offer media do they offer competitive prices? Some companies only warranty their printer if you use their media. These companies often charge an obscene price for this media. Be careful.

Does the company offer or provide competent and reliable customer support? Try asking them some pre-sales technical questions to give them a try. Remember: poor pre-sales answers usually mean worse post-sales answers.

Do you have to pay for technical support? If so, are the charges reasonable? Can the salesperson waive these charges if you buy him lunch or threaten him with bodily harm?

Does the company offer a limited amount of technical support (say 30 days free after the sale)? If so, then order the printer and start working with it immediately. Do not let the printer sit around in the box. When you actually get around to programming it you may find it more challenging than you anticipated. Remember, if the job were easy they would not pay you big bucks to do it.

Will the company allow returns or trades if the printer does not do the job? Remember you don't really know if the printer will do your job until it is doing your job. Do not expect the datasheets to tell you if the printer can do the job you want it to do.

Before the sale ask if they have other customers printing similar types of labels. This may sound like a strange request but take heed. The author once had to download a format to a printer's memory, send the data, and print the label. It turned out that on this printer model the entire company's technical support department could not do this simple operation (and the engineering department was no help either). The company could not name a single customer who made this work. The author spent over 60 hours figuring this out. In the process the author also figured out why this company did not sell very many of these printers (the manufacturer shall remain unnamed to protect the guilty).

Does the manufacturer offer all the printers needed? You may need some heavy-duty printers, light duty printers, and portable printers. It may be an advantage to use a single vendor for all printers instead of mixing and matching vendors. Of course, never tell the printer vendor that you use their printers exclusively. A little worry on their part can go a long way.

## **3.2 Typical Service Options**

Service details and options vary between companies. However, most companies offer some or all of the service options detailed below (or various thereof). This page provides some typical service options – check with your printer manufacturer for their specific options. Options are presented from the lowest to the highest levels of service.

### **Depot Service (ship it to us and we will fix it eventually)**

The “you bring it in and we fix it – eventually” option. Often called “depot service.” Get the printer to the company and they will put it in the repair queue and eventually return it to you. You must typically call the company and say, “My printer broke.” They normally issue an RMA (Return Merchandise Authorization) number, you send in the printer, they fix it, they send you a bill, and you faint (but you can print again). Be sure not to faint ON the printer otherwise you may have send it in again.

### **Guaranteed Depot Service (ship it to us and we guarantee we will fix it eventually)**

The same general idea as normal Depot Service but with a guaranteed response time. They may have different guaranteed response times for different prices.

### **Depot Exchange (ship us something and we will ship something back)**

With a depot exchange service you call the company and tell them your printer broke. They then overnight a working printer to you. When you receive the working printer you return your broken printer in the same shipping box. For many printing applications Depot Express provides an excellent compromise between price and printer availability.

### **On-Site Repair (tell us where you’re at and we will fix it eventually)**

With on-site repair a friendly service technician drops by your establishment and says (with a big smiley face) “Please may I have the distinct pleasure of fixing your piece of garbage printer.” Sometimes these guys develop an attitude (it’s a technician thing). They bring tools, funky test equipment, and all sorts of things to rip the printer apart, fix it, and put it back together. This type of service is normally expensive since the technicians normally repair to a major component level. That is, if the main processing board is bad they remove and replace it. In depot service the technician may try to fix the board rather than just replacing it. With some types of printers such as printer/applicators you may require on-site service.

**Guaranteed On-Site Repair (tell us where you're at & we guarantee we will fix it eventually)**

With guaranteed on-site service you have all the advantages of normal on-site repair with guaranteed response times. Keep in mind the speed of service is directly proportional to the price charged. Be sure to sit down before asking about guaranteed on-site service pricing.

**Hot Spare (unplug dis one and plug in dat one)**

A hot spare could allow a company to use a less expensive form of service contract and still maintain continuous service (unless, of course, two printers decide to die at the same time). You could use the hot spare and use a slower, less expensive, depot service arrangement to fix the dead printer. If you have a number of printers it may be cheaper to have a lesser service level and also have a hot spare.

**You Pay to Fly a Technician to the Site (hold on to your wallet)**

I kid you not! With some of the big, high-bucks, printer/applicators they offer return to depot service or you pay to fly someone to the site. Imagine returning one of the monsters to the depot. The printer may be 3' tall, 2' long, 18" wide, and weigh around 80 pounds. If it dies you may have fly a technician on site. This means paying for plane fare, rental car, expenses, and for the guy's time. This turns into some real money really quickly. Such a trip could easily run into the thousands. The price of a single repair could cover the cost of a manual backup printer (get the hint?).

## 4. Pre-Flight Checklist

Take some time before you jump into the bar code printer task with both feet. This section gives you ideas of what to look for before you start making a bar code printer work. Some of these ideas are intuitive and obvious and you probably did not think of some of the others. Give it a quick read (it's less than two pages anyway).

### **Order the right printer**

This may sound trivial, but these specialized printers often come with a variety of configurations, options, accessories, etc. Make sure to pick the right printer, options, and accessories. Will the application grow and can the printer grow with it? If you need specific options in the future does the printer support these options? This selection step requires some careful consideration and thought (this thinking stuff can prove dangerous). Be aware that some printer companies do not automatically include manuals with their printers (you may need to order manuals separately).

### **Order a cable (or, how to avoid looking stupid)**

Even the finest and most expensive printer starts to look like an expensive boat anchor if you forget the cable. Printers rarely include cables. Be sure to buy the proper cable for your computer/printer combination. Remember that cabling causes a lot of problems. Also, remember, cabling causes a lot of problems (that point bears repeating). Most printers can operate using a NULL modem cable (pin-outs later).

### **Printer Manual? (or, how to avoid looking really stupid)**

Be sure your printer comes with a manual. This may sound strange, but some printer manufacturers sell manuals as an option. This practice may sound like a consumer rip-off, but it actually makes some sense. Buyers of bar code printers often purchase dozens of printers but only need one or two manuals. Since bar code printer manuals are typically large (and probably expensive to produce), some companies include only a very brief summary with the printer and offer the full manual separately. Check with the printer supplier and make sure you order the proper number of manuals. Depending on the company they may also offer several manuals for the same printer. Manual types can include programming manuals, user guides, and service manuals. The programming guide tells you how to program the printer to make it do those fancy printing tricks. The user manual tells an end user how to operate the printer. The user manual usually tells how to plug in the printer, change the media, clean the printhead, and other normal operating exercises. The service manual normally tells how to fix the printer (or break the printer more thoroughly depending on your skill level). Check to see which manuals your printer manufacturer offers. Sometimes you can only order the Programming Manual after you receive the printer. For example, when you buy a Zebra printer the User's Guide includes a card that you must fill-out and mail or fax back to them. Then they send

the Programming Manual. The manual is free but be aware that you cannot order this manual separately before buying the printer (at least I couldn't).

### **Order the media (or, how to avoid looking incredibly stupid)**

The printer may or may not include sample media (usually media is not included). For some real embarrassment try ordering a printer and forgetting the media. Avoid that stupid look that comes when the end user asks, "well it looks good but can it print something?" Avoid that sinking feeling when your boss asks, "Can't we just use some laser printer paper in this thing until the media gets here." This situation is very embarrassing (says the author, "been there, done that.").

### **Who will make it work? (I need a volunteer – YOU!)**

After you go to all the trouble of acquiring a bar code printer do you know who will make it work. Remember that bar code printers are not "plug and play" devices. Making the printer work almost certainly requires some system installation and programming. Have you picked a qualified "volunteer" for this task (the one who is on vacation when the printer arrives normally makes a great volunteer)? Do not put this off until the last minute since getting the printer to work on your system may be a fairly complex process (depending on the application, printer, host computer system, and the skill level of the poor sap trying to drive the printer). Will MIS do the work (do they ever)? Do you have to schedule a technician's time in advance (if so, what's their lead time)? Does your department have responsibility? Do you have to hire an outside technical programmer or consultant? Think about these issues before the printer arrives on your doorstep. It could take days to actually get the printer to print the desired labels. If you have a complex printer and a difficult label it could even take an entire week or more just to program and print a label. Be forewarned, the author required about 60 hours to get a single label format to work properly (and the technical support department was amazed that it worked at all)!

### **It don't work no more (i.e., the printer is DFW (see glossary))**

When, I say when, the printer fails (not if, but when) do you have a plan. Does the printer need another printer as a backup? Can another printer handle a greater workload while the dead printer gets fixed? Do you need a four-hour warranty response program? Have a contingency plan in place for when the printer goes down. Many printer manufacturers offer express depot service, fast response repair services, exchange programs, etc. Do yourself a favor and know what your printer manufacturer offers. Be sure to have a plan in place for when the printer goes down. Note the subtle emphasis on the word, "when" and plan accordingly.

## 5. Connecting the Printer to the Computer

You must connect the printer to some kind of computer-like thing before you can expect it to print anything. Normally the printer connects to a computer either directly or through a network connection. The printer usually connects to the computer via a cable (a long wire with pluggy things on the ends). Cables often end up being the most difficult part of integrating systems. This section covers basic details related to connecting a bar code printer to a computer.

### Prepare and Test the Printer

Take the printer out of the box. Be sure to remove any shipping straps, tape, etc. Plug the printer into working power and turn it on (it prints much faster if it has power).

Find the self-test procedure in the manual and print a self-test label to make sure the printer works. Some printers need to know the media type, label length and/or width, the sensor type (black mark, gapped, or continuous). You might be surprised at how long this seemingly trivial step can take.

This may sound trivial but if this don't work then nothing else will either. Sometimes the printers have obscure lock-downs or other things that need to be removed before trying to print.

### Print a label from your computer

Connect the printer to a computer via a cable. The type of cable depends on the flow control method that you select for the printer. In general, a NULL modem cable works just fine. One of the appendices has pin-out diagrams. The section on flow control provides more details. Don't panic there is more on this later.

Use your computer and a terminal program to send and receive data through a communications port. If you have a protocol analyzer then go ahead and connect it now. If you plan on doing a fair bit of printer software then seriously consider investing in a protocol analyzer (see the appendix on protocol analyzers).

Set the printers configuration options. Some printers use DIP switches, others use a keypad, and others can use serial commands sent to it by a computer. At a minimum you will probably need to set the print mode (direct thermal or thermal transfer), the communications parameters (BPS, data bits, stop bits, parity, flow control), label type (black mark, gapped, notched), and perhaps the label length and/or width.

Send a test label to the printer. Start slow and just get the printer to spit out a label with some test information on it. Most manuals contain sample or test labels. Start simple! Just get the printer to print something. If you send data to the printer and it prints what you expected then this means you have the basic printer parameters set correctly, the

communications parameters are correct, and the cable is correct (or at least close to being correct). This may not seem like a big step but it is.

### **Design your label**

Now begins the real fun. Start designing your label. Add a few fields at a time and have the printer print test data in each data field. Do not try downloading formats yet. Just get the general format of the label to work with fixed data strings. Start with a single text line (text lines are usually very easy). Add more text lines to get the feel for the label coordinates. Then add a bar code field, then any lines, boxes, or other graphics. This step allows you to find the coordinates of the fields, experiment with font types and sizes, check the bar code format, etc.

After printing the static data try to scan the bar codes that you printed. When printing bar codes you need to consider symbol height, aspect ratios, element sizes, etc. You can print a proper bar code symbol but your scanner may not read it. Important factors include the minimum and maximum widths of the bars and spaces. The ratio between a narrow bar and a wide bar (aspect ratio), the dimensions of the bar code symbol, etc.

After printing a fixed label try to make it into a format with variable data. First, print your fixed data label as a format. Give it a format number or name (or both), download the format, send the command to select the format, and tell the printer to print. Use only fixed fields at first (variable data will be the next step). Get the printer to store the format and print the fixed label from its internal memory.

Now replace a fixed data fields with variable fields, download the format, send the print request along with the variable data, and print the label. Do not replace the fixed fields all at once. Try to replace only a single field first. Passing data to a stored format may not be as easy as you think it should.

Continue replacing all of the fixed data with variable fields until your label is complete. Replace only a field or two at a time. Se sure to save the previous version of your format and program code in case the format mysteriously stops working. Sometimes you cause it to stop working and have a really hard time figuring out why.

## 5.1 Flow Control Options

Imagine your friend Joe calls to dictate some important information. He speaks and you write the information as quickly as you can. You keep up for awhile time but then cannot write fast enough. You say “whoa Joe” and Joe stops speaking. You continue to write and when you are caught up. Then you say “go Joe” and Joe resumes talking. This is flow control.

Computers and bar code printers use their own types of flow control to transfer information. Flow control comes in two forms, namely, hardware and software. Bar code printers normally support several flow control protocols so you can usually pick the one that best suits your situation.

### **XON/XOFF (software flow control)**

XON/XOFF is a software flow control method. Your computer sends data to the printer. When the printer cannot accept any more data it sends an XOFF character (“whoa Joe”). When the computer receives the XOFF it stops sending data. When the computer receives an XON (“go Joe”) from the printer then it sends more data. If you must write your own communications functions then I would not recommend this method. If you use pre-written communications libraries then this method is easy (since someone else already did the work).

### **DTR/DSR (hardware flow control)**

The cable connecting the computer to the printer uses various wires to communicate information. These “control lines” include TxD (transmit data), RxD (receive data), DSR (Data Set Ready), GND (signal ground), etc. This hardware flow control method uses the DTR (Data Terminal Ready) and DSR (Data Set Ready) lines to manage the flow control. In DTR/DSR the printer raises (puts voltage on) the DSR line when it can receive data (“go Joe”). When it needs to tell the computer to stop sending data it lowers the DTR line (“whoa Joe”). When the computer sees that DTR was lowered it stops sending and waits for the printer to raise DTR again. With this method the cable connecting the computer to the printer needs to connect the DTR line on the printer side of the cable to the DSR line on the computer side of the cable (and vice versa).

### **RTS/CTS (hardware flow control)**

The RTS/CTS flow control method works the same way as the DTR/DSR methods but with different signals. The RTS (Request To Send) Line on the printer connects to the CTS (Clear To Send) line on the computer.

## **5.2 Computer to Printer Cable**

Bar code printer require only a few signals. The type of flow control used help determine the type of cable used. Usually, bar code printers require a null modem cable. Null modem cables switch various signal lines between the computer and the printer. This signal-swapping scheme works as like a telephone. The mouthpiece on your phone connects to the earpiece on a remote phone and vice versa. Null modem cables have a similar function. Typically these cables connect the signal ground lines and swap the transmit (TxD) and receive (RxD) lines, Request To Send (RTS) and Clear To Send (CTS), and Data Set Ready (DSR) and Data Terminal Ready (DTR).

Most computer stores stock ready-made null modem cables with a variety of different connectors. Most computers need a cable with a DB-25M (male) connector.

## 5.3 Protocol Analyzers

If you plan on working a lot with bar code printers then plan on acquiring a protocol analyzer (alias “data scope”). A protocol analyzer taps the line connecting your computer and bar code printer (or between lots of other devices) and allows you to see all the data exchanged. Protocol analyzers come in all sorts of shapes, capabilities, and prices (starting at around \$500 and going up to about \$10,000). A quick summary follows:

### Simple, Standalone Devices

These devices normally operate on battery or AC power and include a very small display. They show the data exchanged and may use one line for the computer’s data and another for the printer’s or they may display all data as a continuous stream (perhaps one device’s data in reverse video). These low-end analyzers are probably of marginal utility (i.e., not too hot) when dealing with long streams of data passed between a computer and a bar code printer.

### PC-Based Analyzer

You can convert an old desktop or laptop computer into a very nice analyzer using either software or a combination of hardware and software. PC-based analyzers typically cost between \$500 and \$1,500. Some use two serial ports and software (low cost), and others use an external hardware “pod” with software (more expensive, but more capability). You can recycle an old, aging, obsolete, and otherwise not-very-useful PC into a really cool analyzer. With the advent of PCMCIA serial cards you can add a second COM port to a laptop and turn it into an analyzer (with a large, easy-to-read display). Some packages allow you to connect to network and view, parse, and decipher network data (very handy if you are into that sort of stuff).

### Standalone Analyzers

A standalone analyzer is a self-contained box with all the analyzer functions built-in. These devices can be very small, battery-powered units with small displays, or large units that require AC power. These units are expensive. New devices normally start at about \$3,000 and go up from there (key word is “start”). If you need a standalone device on a budget then try a used equipment broker, as a manufacturer for a used or demo units, or try the internet auction sites. You can probably pick up an older, very heavy, very capable analyzer on the Internet for a few hundred dollars (check the auction sites). Beware of the new analyzers that sell for under \$1,000. These devices normally have very small displays and may show the send and receive data together with no way for you to know what one is which. You could use these simple

analyzers for very simple stuff but for the price it would be far better to use a software solution.

## 6. Before Programming the Printer

Bar code printers operate differently than standard office printers. Standard office printers generally print *something* when you send data to them. A bar code printer may receive lots of data and still not print or do anything. Bar code printers need data in a specific format and in the proper order (they are very picky in that regard). This situation can lead to premature baldness for the uninitiated bar code printer programmer and deafness for coworkers (baldness brought about by tearing one's hair out in complete and utter frustration and deafness due to said programmer's screaming in frustration).

Bar code printers operate on a string of characters called a "string of characters," "packet," "block," "format string," or some other catchy buzzword. We will refer to the data sent by the computer to the printer as a "packet." Packets may include printer setup commands, label format lines, or print commands. The host computer sends a packet to the printer and then the printer does something (hopefully).

You can send data packets to the printer and have it actually printer. However, computer work of any kind is just not fun unless it is difficult. So, using a bar code printer properly does involve more than simply sending data to it and expecting it to print. First, you must send the printer one or more label formats. Then you select the format that you want, then you send the data for that label, then you tell the printer to print the label. While this probably sounds like a lot of work to print a label there is method behind the madness.

### Why all this fuss?

Users typically demand a lot from their poor, misunderstood bar code printer. This poor printer often resides in a harsh environment (like a manufacturing floor) printing labels for people with very little patience. They must often label cartons moving down a conveyor line, or boxes being loaded onto a truck, or mail being processed. In any case, these printers often have someone standing next to them expecting a label in a very timely fashion. These printers often have a difficult time creating the label since labels normally contain bar code, lines, text in several fonts, etc. The bar code printer uses some simple techniques in order to make the labels print faster.

### A Real-World Analogy

Imagine for a moment that you were assigned to stand in a shopping mall and survey people walking by. You must ask each person for some demographic details (name, rank, serial number, measurements in centimeters, etc.), and then record the responses. Five of the questions involve simple YES and NO answers. Five questions include a list of choices and the surveyee (is this a real word?) must chose

one choice from each list. The next two questions involve responses that you must write.

On the day of the survey you take a clipboard, a pen (which you cannot erase), and a stack of blank paper. Before you stop someone you draw a form and write all the questions, draw the lines for your form, and label all the boxes on the form. You then stop an unsuspecting passer-by and fill out their responses on your newly drawn form. Having completed that form you put the form away, and redraw the entire form on the next blank sheet of paper. This process works but is hardly efficient. This redrawing process is slow, it takes lots of your time, and just isn't very efficient (or fun).

The next day you have a brilliant idea. "Why not draw my form once and then copy it," you cleverly say to yourself (remembering, of course, that it is bad form to talk with one's self in public). So you draw the form once taking care to make it look really spiffy. You then make copies of your form and put these on your clipboard. Then you simply take the information that your surveyees (is the plural form a word also?) give you and record it on your preprinted forms. You process more surveys with less effort and this makes much more efficient use of your time. However, this method requires more planning. You still had to draw the form. You also had an extra step of taking your form to a copy machine and duplicating it. You then had to put the data in the right spot of the form. So, what does this have to do with anything? Read on to find out the exciting answer to your question.

## Label Formats

The survey analogy fits the steps involved in using a bar code printer. A bar code printer normally needs a fair bit of data to print a label (even a relatively simple label). For example, printing text requires the actual text data, the coordinates of the text, the orientation on the label, the font, the font size, etc. Printing a bar code may require such data as the bar code data, the orientation, the coordinates, the width ratios, check digit details, etc. In short, a relatively simple label may require lots of stuff to describe to the printer exactly how that label will look.

The first step in printing "real" labels is sending, or "downloading," a description of the label format to the bar code printer. Downloading, in this instance, means sending data from a computer to the bar code printer. If the printer sends data to the computer then this transfer from printer to computer is called "uploading." This process is analogous to drawing your original survey form and making copies of the form. If you want the bar code to print different labels then you must download a format for each label. Each different format uses a unique identifier so you can tell the bar code printer which type of label format you want to print.

The bar code printer includes its own memory that it uses to store these forms. Storing more formats requires more memory (dah!). Also, larger and more

complicated format require more memory (double dah!). The number and complexity of formats needed helps you determine the amount of memory required in the bar code printer. If the bar code printer does not have enough memory then you must reduce your memory requirements by either simplifying the label format or removing some of your formats or buying a new printer or upgrading the memory in your current printer.

### **Filling-in the Details**

The bar code printer now has one or more label formats firmly tucked away in its memory chips. One additional point worth noting here. Most printers have good long-term memories and remember your formats when turned off. That is, most printers have a battery backup so that they maintain their formats in memory. But some printers have an attention span only as long as their extension cord and lose all their memory when powered off. It is good practice to download all of your label formats whenever you start your application. Downloading does not take too much time and then you can be sure that your printer is setup properly. After all, you may change your label formats, or someone could swap printers without telling you. Remember that printers are mechanical devices that will break. Swapping printers is not terribly uncommon. But, we digress.

Your printer now has all the label formats loaded. Now the printer needs the data to insert in the label format. Remember the survey form analogy? You asked questions and recorded responses. The printer now needs the “fill-in” data for the downloaded format. Your application gets your data, formats it, and sends it to the bar code printer. The printer adds your data to the specified form and makes the label to print.

### **Printing the Label**

The bar code printer has the label format, the data, it imaged the label, and is ready to print. By the way, imaging the label refers to the process of taking the generic label format that you downloaded, combining the format with the actual label data, and creating a final label “image” to print. Typically, a single character (or maybe a few characters) are all that is needed to signal the printer to print. Send the print command, wait for the label to print, remove the label from the backing and stick it.

### **About the Printer Details**

All bar code printers (at least all that the author has seen) require the same general setup. Each type of printer requires downloading some format commands and one or more label formats, then some actual data for the formats, and then a command to print the label. The general procedure remains the same for the different printers. However, the difficulty lies in the detail. The actual setup, format, data, and print commands vary from one manufacturer to another. These details often vary within a

single manufacturer's product line, and they may vary between different versions of the same model printer. But, if things were easy then they would be a lot less fun and challenging (and you would receive a much lower salary).

For full details as to programming a specific printer model you must refer to the instruction manual. I know this sends chills down the spines of most programmers who think that only wimps need manuals. In the case of bar code printers the manual is essential. So just get over it, break open that shrink-wrap, and do not be afraid to actually read some of it.

## 7. So, You Want to Program the Printer?

This is the time when the rubber meets the road. Up until now we looked at printer generalities, how to select a printer, basic pitfalls, and other preliminary nonsense. Now, by the time you get here and really read this section you have a printer staring you in the face taunting you, "So, hot shot, you really think a wimp like you can program a printer like me? Ha Ha, O foolish mortal!" Now, read carefully and learn the steps to making the printer work.

Stare the printer down. Give a confident smirk and do not let the printer see any fear in your eyes. These printers can sense fear, so show none and feel none. Programming them is not that bad -- trust me.

Load the labels and make them feed to the proper position. Make sure that when you press the FEED button the labels always feed to the same position on the label. This may sound trivial, but trust me it is not. In a single (seemingly trivial) project we once had to purchase, try, and return three printers before we got this step to work. The first printer would not accept tag media because it was too thick and the printer could feed it properly. The second printer did not like the position of the black mark on the back of the tags. This printer would feed the labels to the same position but there was no way to make it backfeed the tag and print in the proper position. The third printer did not support black mark stock. This was the first printer that I ever dealt with that did not come with a black mark sensor. You have been warned.

Find a very simple example in the manual and make the printer print something (anything). A simple text line in the upper left corner of the label. This may sound trivial, but take one step at a time. To do this "trivial" task you must first get your computer to talk to the printer. This requires the proper cable, proper flow control settings on the computer and printer, proper media settings, media loaded and ready, etc. Do not trivialize this seemingly easy step. This one seemingly simple step could take some time depending on the printer (some are difficult to set up -- if you doubt my wisdom go talk to a Monarch 9446).

Now that you printed a single text line, print lots of text lines. Try putting text roughly (very, very roughly) where they should go on your label. Use a single font. This step builds your confidence and gets more data on the label. Use fixed text strings (the fancy stuff comes later). Use text fields even where you want bar codes to go. Go slowly and take this one small step at a time.

Turn one of fields into a bar code field. Once you get a bar code to print make it print in the proper ratios, proper dimensions, proper height, and so on. If you have a test scanner then make sure the bar code scans. If the ratios are not correct or if the dimensions are wrong then the bar code may not print. Be aware that printing a bar code takes more parameters than printing plain text. You must define the bar code

position, height, and width like in a standard readable data field. But, you may also have to define the width of the narrow bars, the ratio of narrow to wide bars, a check digit (defined or not or the type), start/stop characters, whether there is an interpretive field, etc. Take the time to learn how to do this stuff. You could end up with labels that look really cool but your scanners will not read them (this is very embarrassing -- trust me).

## 8. Words of Wisdom

This section includes some bar code printer advice and words of wisdom. These suggestions were gained from several years of bar code printing experience. Hopefully these ideas can save you some time and headaches.

### **Never use metal around the printhead**

Never even think about using metal tools around the printhead. Do not even think about using metal objects around the printhead (that last sentence was worth repeating)! Printheads consist of hundreds of very tiny resistors that produce heat. The surface of the printhead conducts electricity and can be easily shorted by foreign objects that conduct electricity (especially metal objects). If you must use foreign objects around the printhead (not recommended) then use something that does not conduct electricity (i.e., no metal). Also, be very careful to use as little pressure as possible on the actual printhead. And, in closing, do not even think about using metal objects around the printhead (ya know what I mean?! P.S., no metal: no, no no, bad, bad, bad. And by the way, turn the printer off (unplugging it is better) before cleaning the printhead. And, in closing, no metal around the printhead! In summary, no metal!

### **What is your label's orientation?**

Sometimes changing a label's orientation increases the printing throughput. For example, you may need to print a label that is 2" x 4" and you may be printing it lengthwise. This means that you are printing a 4" long label. If you can print the label widthwise you print only a 2" long label. In this case changing the print orientation doubled the printer's throughput without any increase in the print speed. However, be sure to consider other factors such as printing the bar code in picket fence mode (good) versus ladder mode (not as good).

### **Don't forget to download!**

Make your applications download the printer setup commands and label formats. Even if the printer has non-volatile memory never assume that the printer is set the way you expect. Operators may have swapped printers, or the memory in the printer could have been erased (by mischievous aliens from a galaxy far, far away, or by a forklift jockey who likes to push buttons), or many other problems may have occurred. Downloading the printer setup and formats also allows the application to make sure that the printer is operating reliably. The author always makes his applications re-download the printer when the application starts.

### **Assume that there is problem**

Always assume that the printer may have a problem. Check the response codes from the printer and make sure that the printer receives and acknowledges each command line. Be especially careful to check for jam or out of media conditions. Remember, some sort of error code WILL occur even if this is only an out of media error.

### **Not too slow; not too fast**

Be careful to select the optimum printer speed. Faster printing generally means lower print quality. Faster printing normally reduces printhead life. Running at very fast print speeds often requires more sensitive (and expensive) media. Do a cost analysis before using the higher print speeds. Instead of buying expensive media to print at 8 IPS it may be more economical to print at 4 IPS and buy two printers. The payback time for the extra printer may not be nearly as long as you might think.

### **Optimizing the print speed**

Continuing the last theme you may need to consider the print time in conjunction with the imaging time. Let me use a simple analogy to demonstrate the point. Suppose you need to drive your car on a 50-mile stretch of road that contains a signal light every half-mile. You have a red Ferrari that can go 0-70 in 4 seconds. The driver next to you has a 1983 Toyota that does 0-60 in approximately 1½ minutes. If you maintain a constant 40 miles-per-hour you will hit green signals all the way to the end of the road. The speed limit is 65 miles-per-hour. At the first signal you stomp on the gas pedal of the red Ferrari, hit 80 miles-per-hour (for shame, for shame), and stop at the next signal. You repeat this fast start, go fast, and fast stop process for the entire length of the road. Meanwhile the humble Toyota accelerates to 40 MPH, runs at a constant rate, and comfortably cruises through all the green signals. The humble Toyota did not have to accelerate and brake, did not add the associated wear to the engine and brakes, and had a much easier time driving (although it would still be very cool to blast down the road in a red Ferrari).

Apply this to your bar code printer project. If you run the printer at 6 IPS does it have to start and stop with each label? Does the imaging or download time require the printer to not print in a smooth, continuous stream? If you lowered the print speed could the printer download and image the next label while printing the current one? If you can get the printer to run in a continuous mode at a lower speed then your throughput will be almost the same, the labels will probably look better, and you subject the printer to less mechanical wear. This may not be possible but be sure to consider this if your application could benefit from this type of print speed tuning.

**Are you into picket fences or drags (or ladders)?**

Watch bar code orientation. Printers have an easier time printing labels in drag (picket fence) mode than in ladder mode. In drag mode the printer turns on a print element and leaves the element on for the length of the bar. In ladder mode the printhead must turn the element on and off as the bar code passes under the head. Drag mode bar codes are easier to print, easier on the printhead, and generally of higher quality for the same print speed.

## 8. Glossary

<b>Bar</b>	The darker element of a bar code.
<b>Bar code</b>	An array of rectangular marks and spaces in a predetermined pattern.
<b>Bar code symbol</b>	A graphic (printed or photographically reproduced) bar code composed of parallel bars and spaces of various widths. A bar code symbol contains a leading quiet zone, a start character, one or more data characters including in some cases a check character, a stop character, and a trailing quiet zone.
<b>Continuous code</b>	In a continuous bar code the inter-character spaces is part of the code structure. Opposite of discrete code.
<b>Discrete code</b>	A bar code symbol in which the inter-character space (or gap) is not part of the code and is allowed to vary dimensionally within wide tolerance limits. Opposite of continuous code.
<b>Element</b>	A generic term referring to a bar or a space.
<b>Inter-character gap</b>	The space between the last element of one character and first element of the adjacent character of a discrete bar code symbol.
<b>Module</b>	See UNIT.
<b>Quiet zone</b>	The area immediately preceding the start character and following the stop character which contains no markings.
<b>Self-checking bar code</b>	A bar code which uses a checking algorithm which can be applied against each character such that substitution errors can only occur if two or more independent "printing" defects appear within a single character.
<b>Slew</b>	When the printer "slews labels" this means that the printer moves the labels through the printer at a high rate of speed. Or, the printer spits out one or more blank labels.
<b>Space</b>	The lighter element of a bar code.
<b>Start/stop characters</b>	Distinct characters used at the beginning and end of each bar code symbol that provide direction of read information to the decoding logic.
<b>Symbology</b>	The study or interpretation of symbols. This refers to the structural characteristics of bar code symbols.
<b>Unit</b>	(same as MODULE) The narrowest nominal bar or space in the code. Wider bars or spaces are often specified as multipliers of one unit.