Intermec

White Paper

GUIDE TO SCANNING TECHNOLOGIES

Intermec

INTRODUCTION

There's a debate over scanning technologies that rivals the religious fervor of the PC vs. Macintosh debate. When it comes to scanning technology, the two competing camps are lasers and Linear Imagers. Much of the laser bias can be chalked up to the "it's a laser so it must be better" argument, whereas Linear Imager advocates tout its unmatched reliability and value.

The reality is somewhere in the middle. Both technologies are exceptionally good at what they do, as long as they're used in the correct environment on the proper application. Both technologies have been around for many years and continue to improve — although recent advances in Linear Imaging technology, which make them superior in reading many types of bar codes, have changed the playing field considerably.

The question then arises: "How do I choose the best scanner for my application?" This guide is designed to help you do just that. We'll present the technical information and application guidelines to help you choose what will work best for you. And since Intermec has a wide variety of each type of scanner, we'll be able to give you the straight information on both technologies.

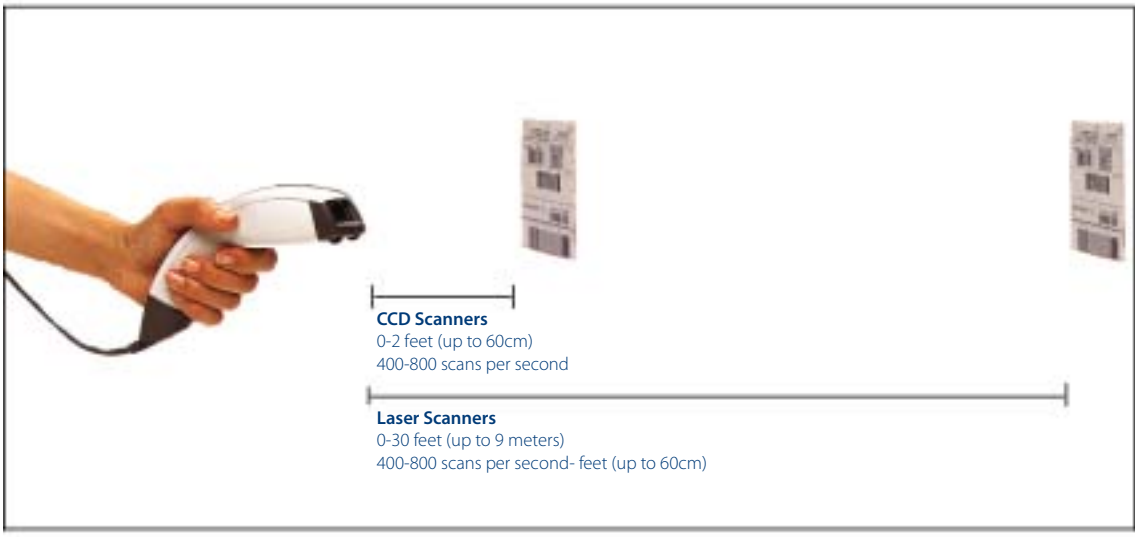
LINEAR IMAGERS

The basic technology of a Linear Imager is called a Charge Coupled Device (CCD). These solid state components are found in a wide variety of devices from simple scanners and image capture devices such as fax machines to highly sophisticated devices, like Linear Imagers, video cameras, and digital cameras. In a Linear Imager, the CCD captures different levels of reflected light from a symbology's marks and spaces and converts them into a video signal.

Since Linear Imagers are solid state without moving parts, they are inherently more reliable than laser scanners, which use fast-moving mirrors to move a beam across the bar code. To read a bar code, a Linear Imager illuminates it with light from the LED and uses a lens to focus the image of the bar code onto the CCD component. The simplest reading process identifies the peaks and troughs in the signal and applies one or a number of decode algorithms to get the bar code data. This is done by the scanner's analog-to-digital converter and by software running on the processor. The speed of the processor and efficiency of the software largely determine how fast this happens and how snappy the scanner feels to the user.

While Linear Imaging capability has been around for many years, recent advances in the technology have dramatically improved the performance of this type of scanner. Manufacturers of these next-generation Linear Imagers have developed advanced ways of reading the video signal and special decode hardware/software to improve speed, depth-of-field and read success rates. These refinements, coupled with faster scan rates (up to 10 times faster than a laser scanner) and faster processors, helps explain why some Linear Imagers are better or snappier than others when it comes to reading poor quality or laminated bar codes.

LASER SCANNERS



Graphic 1
CCD scanners scan most effectively at shorter distances, but scan at a much higher rate of speed. Lasers are ideal for long-range scanning applications.

Laser scanners read bar codes with a laser beam in conjunction with oscillating mirrors to automatically move the beam back and forth across the symbol. Laser engines come in a variety of configurations (e.g. standard range, wide angle, high density, long range and high visibility) to meet the needs of different applications. The major advantage to lasers is their depth of field; they can read bar codes from several feet away. In fact, if the symbol is printed large enough, the laser can read it from as far away as 35 feet (11 meters). For applications such as a forklift operator in warehouse, the ability to read a bar code without having to constantly get off the forklift is a distinct advantage.

On the downside, lasers tend to be more expensive than CCDs and have moving parts (those oscillating mirrors), which can be sensitive to rough use and wide temperature extremes.

Another advantage of lasers is that they can be focused to a very small beam. Because the light is coherent (a single frequency), the beam will not spread much over a given distance. Therefore the diameter of the beam will remain small enough to resolve the wide and narrow bars of the bar code even if the reading distance varies. That property allows laser scanners to read bar codes over wide depths of field.

Laser scanners, like Linear Imagers, include handheld or fixed position models. Handheld units generally operate at the lower end of scanning speeds (30-50 times a second) because the symbol being scanned is usually stationary. Fixed position scanners on a conveyor operate at the higher end (50 – 14,000 times a second) to be fast enough to read the label before it moves past the scanning area.

CONSIDERATIONS FOR SELECTING A SCANNER

Both lasers and Linear Imagers are excellent technologies and while there are some overlaps in their appropriate applications, each technology has characteristics that make it better for specific uses.

The criteria used to decide which technology to use — or how to mix the technologies within your enterprise — should be based on the scanning application (from what distances will scans be made; what is the condition of the bar codes being scanned; etc.) as well as price/performance considerations.

The chart below summarizes the characteristics of the most recent generation of Linear Imaging and laser scanning technologies:

Application	CCD Scanners	Laser Scanners
Scanning distances less than 18 inches (45 cm)	✔	
Scanning distances up to 35 feet (9 meters)		✔
Higher bar codes densities	✔	requires special scan engine
Poor quality/damaged bar codes	✔	
Over-laminated bar codes	✔	
Linear bar codes	✔	✔
2D stacked bar codes – PDF 417, Code 29 (requires special software)	✔	requires special scan engine
Matrix codes (Datamatrix, QR code)	(see "Future Trends")	
Reliability	✔	
Scan rate: 30-50 scans per second		✔
Scan rate: 400-800 scans per second	✔	
Very bright spotting and scanning beam		✔
Fast scanning in fixed positions	✔	✔
Retail price (with cable): US$150 - $700	✔	
Retail price (with cable): US$500 - $2,000		✔

What is the reading distance and item to be scanned?
Linear Imagers work exceptionally well at medium-to-close range, less than 18 inches (45cm), so if the scanner can be brought close to the label (or vice versa), a Linear Imager would be a good choice. However, if the labels are more than 18 inches (45cm) away, laser scanners are the only option.

What type of code will be used?
Most scanning technologies read the same common set of bar code symbologies, including EAN/UPC, Code 39 and Code 128. Linear Imagers work best on these codes at higher code densities, in the region of X (narrow bar width) dimensions between 2 mil and 5 mil (0.05 and .1mm) and with code widths up to 8 inches (200 mm) for X dimensions between 10 and 20 mil (0.25 mm and 0.5mm).

What is the condition or source of the bar codes?
Linear Imagers are not only excellent at higher densities, they also read poor quality codes. Reading bar codes through over-laminates (e.g. video rental store cases) can be very tough for lasers, but Linear Imagers read them consistently well. Generally, Linear Imagers can read codes with low contrast between bars and spaces (caused by the color or poor printing/fading). Some Linear Imagers can also cope well with damaged codes. The fast scan rate of Linear Imaging engines plays a significant role in reading these, as do the methods used to decode the complex video signal information provided by the Linear Imager. This is in turn dependent on the investment the supplier has made in decoding techniques.

One unique application for Linear Imagers is reading bar codes off computer screens. This is extremely helpful in configuring the devices via bar codes, especially if you have a large number of devices to configure. Instead of printing out a series of bar codes, you simply display them on a computer monitor and scan them directly.

What are the environmental conditions?
Linear Imagers are solid state without any moving parts. Because of that, they tend to be more reliable than lasers, which use moving mirrors to make a laser spot travel across a code. However, it's the casing of the scanner that dictates its suitability for certain environments. In retail, a Linear Imager in a standard ABS plastic case will provide a durable, long-life solution (for example, Intermec's Scan-Plus Vista), whereas a more durable casing would be needed for the same scanner in a warehouse or industrial application (e.g. Intermec's Sabre 1400).

How important is performance?
If a scanner, regardless of its technology, reads a code, then the performance differences between it and another will be judged on issues like speed of read, depth of field and definition of reading zone. Within its depth of field, a Linear Imager can provide exceptional performance. Scan rates of 100 scans per second are common, and top of the range scanners offer up to 800 scans per second. Linear Imagers can, in certain circumstances, read a set of codes faster than laser scanners simply because they do not need a trigger.

Some Linear Imagers are contact readers and will only read if the scanner's nose is touching the code. This is appropriate for flat surfaces, but can give problems if the code is on a curved surface. Long-range Linear Imagers and lasers are better for curved surfaced scans. The latest generation extended or "long" range Linear Imagers can read up to 18 inches (460mm).

As the reading distance increases, it becomes more important to know where the scan line is. With laser scanners, this is clearly marked by the laser line, but Linear Imagers depend on the illumination of the LEDs. As a result, the scan line for Linear Imagers becomes more difficult to see as the reading distance increases or in high ambient light conditions such as direct sunlight.

How much do I want to pay?

Linear Imagers are generally less expensive than lasers. With US retail prices between $150 and $700, Linear Imagers are easy to justify. However, the range in price is still quite wide (and even wider with lasers), which can be an issue for some buyers, particularly when high volumes are being considered. If price is an issue, take care not to compromise on the following features, particularly if the purchase is intended to improve productivity.

1. Is the scanner's depth of field suited to the application? Is there a "comfort zone" (depth of field on the actual code of at least 0.4 inches/1cm) to make reading intuitive and allow curved labels to be read? Does the user need to see the scan line on the bar code?
2. Is the resolution range of the scanner suitable for the application? The scanner should read the codes with some comfort zone.
3. Does the scanner read all the possible qualities of code the application will present?
4. Is the scanner easy and comfortable to use? Can it be picked up and set back down easily? Is the scanning plane and zone suitable for the operator's position and placement of the coded items? If the scanner has a trigger, is it easy to use?
5. If an extended depth of field is necessary, does the scanner have adequate field depth on the actual codes?
6. Does the scanner read all the codes easily or does it take time to read? A good test is to check the time it takes to read 10 or 20 real-world codes rather than just test on one sample.
7. Is the scanner suitable for the environment, i.e. ruggedness, style, cable strength and length, sealing against water, dust and vibration; ambient light; temperature; etc.?
8. Check that the more obvious requirements are actually met, including symbology type, data formatting needs, etc.

FUTURE TRENDS

Linear Imagers and lasers are technologies that continue to evolve. Both have improved dramatically over the years and advances in performance as well as reduction in price can be expected. The most dramatic area of change has been the increased depth of field and decode performance of the latest generation of Linear Imagers.

- **Linear Imager and lasers scan engines** will continue to decrease in size, allowing better form factors for some applications.
- **Active Pixel Sensors (APS)** imagers are a new form of solid state scanning technology that allows you to program individual pixels on the sensors. This will make it easier to read a variety of different symbologies from the same device. For example, to read PDF symbols, a square pixel is better than a rectangular one. APS scanners can be reprogrammed on the fly to accommodate more efficient pixel configurations. Intermec is developing APS scanners now for release in the near future.
- **Laser safety** will continue to grow as an issue, especially in Europe where concern over high-energy lasers hitting the eyes already is a hot topic of discussion. In the U.S., the move to bring scanners into the home for e-commerce applications is raising the question of laser safety around children.
- **Rastering lasers** have mirrors that dither on two axis (up and down, back and forth). This allows them to read PDF symbology and capture linear codes in any orientation. Advanced long-range lasers also are in development.
- **Long-range Linear Imagers** have increased the scan range to 19 inches (45cm) with longer ranges in the future, making them more competitive with the types of standard range lasers used in retail and other applications. This and the length of the scan line will help remove some of the code-width limits. The illumination will become brighter and sharper, helping users to see where the Linear Imager's scanning plane is.
- **The size of the optics** will also decrease. This has a big influence on the shape of the scanner, since a long optical path needs a long scanner. Shorter optical paths will allow different and increasingly ergonomic shapes, as well as facilitate Linear Imager integration into other products.

SCANNING SOLUTIONS FROM INTERMEC TECHNOLOGIES

Intermec offers a full range of laser and Linear Imagers to meet virtually every application requirement along the supply chain. From fixed position to corded and wireless handheld scanners, and for applications from industrial to retail and health care, Intermec has a product designed specifically to meet every environmental, scanning and ergonomic need.

TO LEARN MORE

For more information on Intermec scanning solutions, contact Intermec Technologies Corporation at 1-800-347-2636 or visit Intermec's Web site at www.intermec.com.

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