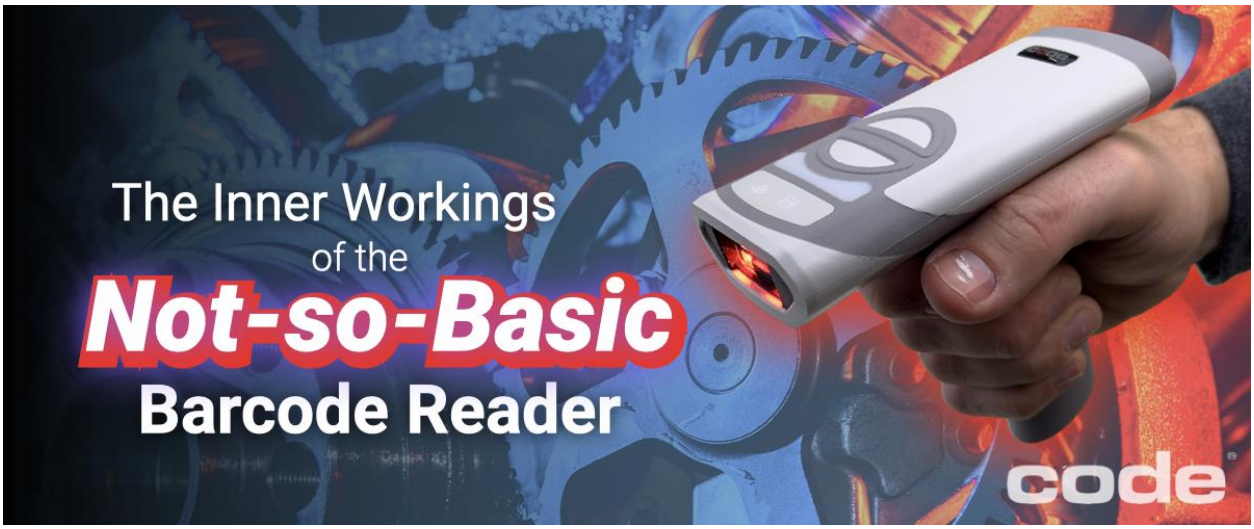


Covering the Barcode Scanner Basics

Barcode FAQs: What you need to know about the not-so-basic barcode reader
Est read time: 7 min.

$215.7 billion.

That's the estimated value of big data and business analytics in 2021, according to global data specialist, Statista. This considerable number makes shopping for automatic identification and data collection (AIDC) technology, like barcode scanning software and barcode scanners, a big deal.



Figure 1: Code's Barcode Readers serve a wide range of industries.

To help, we've crafted this "barcode basics blog" to familiarize you with these mission-critical data capture devices. Being informed enables you to ask sharper questions when shopping and communicate effectively with a buying committee or influential users. Taking these steps will ensure that whatever barcode scanner (also called a barcode reader) you buy is the best tool for the job, making it the best value for you.

- ➔ To craft this blog, we consulted Vernon Witney at Code Corporation, which has specialized in barcode scanning hardware and software for 20+ years. Witney, Code Corp's London-based solutions architect, and his colleagues have been asked just about everything barcode-related when businesses shop, "spec," and buy barcode scanners.

The commonly asked questions covered here are:

- *What is a barcode scanner?*
- *How does a barcode scanner work?*
- *What makes a barcode scanner good?*
- *What are the main barcode scanning technologies?*
- *How does a laser barcode scanner work?*
- *Can a barcode scanner harm you?*

Q: What is a barcode scanner?
A: Barcode scanners can be anything from a purpose-built device to a smartphone that reads a barcode, which is an optical pattern encoded with data. A barcode scanner can read a barcode and put it through an integrated decoder algorithm to access the barcode's original data.

➔ Decoding algorithms are very well-defined lists of instructions that machines and computers use to solve a problem or perform functions.

In their early days, barcode scanners were laser-based devices that read 1D barcodes—a good example is the supermarket device that beeps when scanning an item's UPC. After seeing how successful the first commercial barcode application was, the original barcode spawned 40+ types (also called symbologies) to tackle all sorts of problems, from tracking medical components to catching expired or recalled food at the point of sale.



Figure 2: Code's CR950 Barcode Reader

Barcode scanners have since evolved into camera-based devices that can read sophisticated, data-rich 2D barcodes like QR codes; these camera-based scanners belong to a group of devices called "charge-coupled devices" (CCDs). Giving them additional appeal, CCDs can read barcodes more than an arm's length away.

"So that's what our whole barcode system is about," explains Witney. "It's about being able to read a barcode, decode that pattern, and output data quickly and reliably."

Q: How does a barcode scanner work?
A: In a two-step process, a barcode scanner captures an image, then "decodes" the barcode.

In the barcode's beginning, a laser or CCD device "saw" a small part of a barcode. Today, a camera "sees" either the complete code or an image that has the code within it. Inside this image, the camera looks for areas of light and dark. A barcode's dark areas absorb light; the light areas reflect it to provide a contrasting image. Once an image is captured, the barcode reader uses a decoder algorithm to unlock the data invisible to the naked eye.

“So, the decoding algorithm is actually looking for the barcode, then applying it to various barcode standards, and finding something that fits,” Vernon shares. “Once it finds a standard that fits within the image it has, it can decode the data and output the information encoded within that barcode.”

That’s how, for instance, scanning a barcode can help tell a sales associate what sizes/types of an item are in stock or how a courier gets parcel delivery instructions.

Q: *What makes a barcode scanner good?*
A: Good barcode scanners quickly capture an image, decode its data, and transmit the data swiftly.

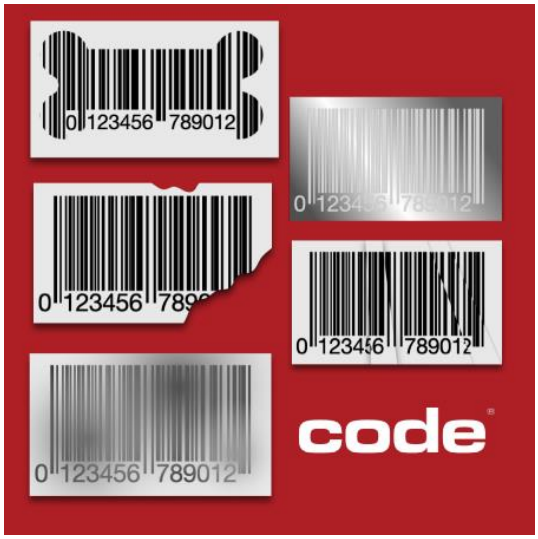


Figure 3: Barcode readers must scan and compensate for issues, e.g., damage or special shapes.

“People don't want to have to orient barcodes [properly for scanning] or find that it takes time to read their barcode,” Witney shares.

Sounds simple enough, right? However, a well-sorted barcode scanner can do the same for dirty, smudged, or partially damaged barcodes. The device’s decoding algorithm should then be robust enough to account for damage when decoding data. A good example of barcode scanning software (sometimes called soft-scan software development kits or barcode scanning SDK) is Code Corp’s CortexDecoder SDK. This SDK is used in smartphone devices, embedded in machines, or as a web-based scanning app.

“We have to deal with poor-quality barcodes,” Witney says. “So, we need to apply those same rules. We need to read them quickly, reliably, and at a distance. These are all the things that make a good barcode scanner.”

Q: What are the main barcode scanning technologies?
A: There are three: laser-, CCD-, and image-based technologies.

Laser-based scanning:
The oldest of the trio, laser-based scanning is the type people are probably most familiar with because supermarkets have used it heavily for years. While not as prominent in stores today, laser-based scanning enjoys popularity in applications requiring high-speed scanning, e.g., parcel sortation. Industrial firms employ laser-based scanning to read barcodes that may be more than a meter away.
“What we're using is a laser source and mirrors that reflect around an optical cavity within a supermarket scanner,” Witney shares. “That creates many lines at different

angles, and that's how we can read one barcode at all sorts of angles within that application."

CCD-based scanning:
Charge-coupled devices gained a following because they were a cost-effective way to scan a 1D barcode in applications where high throughput and speed weren't required. These were essentially linear imagers that could take a very narrow image across a barcode and use it as their image for their decoding.

Image-based scanning:
Devices utilizing image-based scanning are widely used today—especially because this imaging technology is the only way that you can read data-dense two-dimensional barcodes. These 2D barcodes "stack" information both horizontally and vertically; for reference, the often-seen QR code can hold up to 7,089 characters.

"Once again, we're catching a code and applying a set of digital rules, but barcodes are now so much more complex because we can get a lot more data into them," Witney explains.



Figure 4: Code's handheld CR1100; presentation stand is optional.

Of course, increasingly sophisticated barcode symbologies mean that the devices reading them had to evolve too. Witney discloses that image-based scanners were once quite slow compared to 1D barcode scanners, but thanks to improved processing power, they are now as fast as 1D barcode scanners. The speed, complexity, and power of 2D barcode scanners have made them viable data capture devices for a wide range of applications from patient care to retail. Additionally, 2D barcode scanners aren't limited to form factor. Camera-equipped smartphones are now powerful enough to capture images, run a decoding algorithm from a reputed barcode scanning specialist, and decode.

Q: How does a laser barcode scanner work?
A: Short answer: a light source illuminates a barcode, highlighting the contrasts within that barcode. From there, diodes create a signal that is fed into a higher-end system (like an inventory system).

Long answer: Decades of faithful service in grocery stores have ingrained the general populace to automatically assume all barcode readers have high-powered lasers

because they glow or blink red (and sometimes blue). So what is it about barcode scanners that have folks “seeing red?”



Figure 5: Select scanners, like Code’s CR6000, can read DPM barcodes on medical devices.

When barcodes were developed, there wasn’t a clear way of reading them. A very very intense form of light was needed to show the differences between light and dark within a barcode, leading to the incorporation of lasers.

“Lasers are very articulated, concentrated beams of light,” Witney says. “When it's reflected from the surface, it remains focused and can be seen by an optical sensor.”

The first lasers used deep red rubies as a lasing medium before moving on to laser tubes, which are glass tubes with mirror end caps. One cap is a high reflector; the other is an output coupler. When a very high voltage is applied across the tube, it creates a lasing function to provide the typical red laser that comes from a helium-neon tube.

“The first lasers were large and very fragile, needing large power supplies to drive them,” Witney points out. “That's why some of the retail scanners were so big.”

The 1990s saw wide propagation of the laser diode, a technological leap that enabled people to use five volts and a battery to power lasers. This change created an opening for handheld barcode scanners that could read barcodes as effectively as many laser-tube-based devices.

Q: Can a barcode scanner harm you?
A: The answer to this frequently asked barcode question is no. Many older barcode scanners use a laser as a light source, but these are Class 1 lasers, which are the safest type. In fact, CD players (remember those?) and other optical disc drives use Class 1 lasers.

“People think of lasers as something that can burn or cut steel, and they can. But these are very high-powered lasers,” Witney clarifies.

While most modern devices use optical- or image-based scanning technology to read barcodes, laser-based devices still have their place. Typical applications are industrial, where laser-based devices excel at reading barcodes from a distance, like in a sortation plant. In general, lasers have moved away from places, like retail, where people can access them easily.

“Having said all that, imaging technology uses bright LEDs; with those, the same rules apply as they do to any bright light source like a torch, the sun, or your car’s headlights,”Witney cautions. “You shouldn't stare into these bright forms of light because they can damage your eyes.”

Besides being a frequently asked barcode scanner question, this last question is important because barcodes and barcode scanners play a large role in protecting all of us. Did you know that:

- Barcodes on patient ID wristbands have reduced medication errors by 85%?
- Reliable barcode scanning tech has a key role in helping reduce mass transit-related emissions to combat global warming?
- Offline barcode scanning technology offered by advanced barcode readers is improving access to healthful food in Mexico?



Figure 6: Code’s CR5200

There you have it, a primer on the not-so-basic barcode scanner that will be helpful as you evaluate barcode scanners. If you need help shopping barcode scanners for your operation, Code has seasoned AIDC experts across North America and the EMEA and APAC regions who can help you find the right data capture solution.

Feel free to contact us with any questions at info@codecorp.com or 801-495-2200.