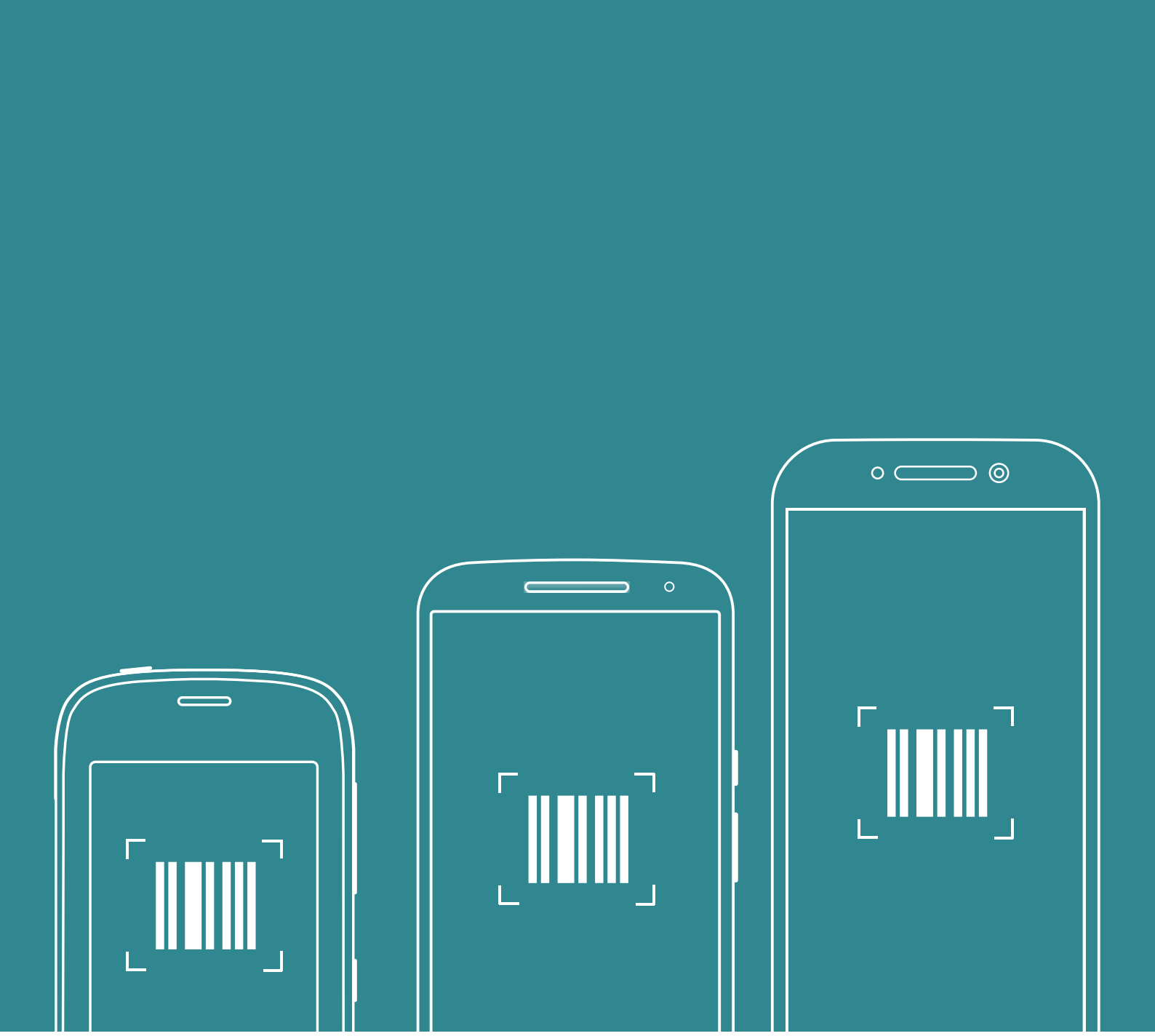


SCANDIT

Best Smartphones for Barcode Scanning

2016 Android Edition

Introduction

Choosing the right smartphone for your enterprise scanning use case can be difficult. With a variety of manufacturers, operating systems and device configurations to choose from, it can be hard to determine which device has the right features and capabilities to support your business needs.

At Scandit, we understand that choosing the right device is critical to your day-to-day operations. Choosing the wrong device can reduce workforce productivity, increase total cost of ownership (TCO) and lower your bottom line. As experts in the field of smartphone-based barcode scanning, we've developed this guide in order to help identify some of the best Android scanning devices on the market today.

In this guide, you'll find:

- The most important factors to consider when purchasing smartphones for enterprise-grade barcode scanning use cases
- Scandit's approach to decoding barcodes and testing smartphone performance
- Side-by-side comparisons of some of the most popular Android devices on the market

Scandit's Approach

Scandit's Barcode Scanner SDK is designed to provide enterprise-grade scanning performance across the widest range of smartphones on the market today. Customers using Scandit's Barcode Scanner SDK experience unmatched decoding speed, reliability and overall ease-of-use, no matter what mobile device they choose to use.

This is because Scandit's approach to barcode scanning computes sharp barcodes from blurred barcodes, high resolution barcodes from low resolution barcodes and high contrast barcodes from low contrast barcodes. The result: a barcode decoder engine that reads 1D and 2D barcodes faster—and more accurately—than competing software solutions for smartphones, while simultaneously matching the scanning performance of a dedicated scanner or mobile computer.

Scandit's advanced image decoding algorithm also handles a wide range of barcode quality and scanning environment related issues to meet enterprise needs including:

- High glare
- Shadows
- Low light
- Low contrast
- Poorly printed codes
- Scratched codes
- Broken codes

While Scandit's Barcode Scanner SDK is designed to work across all major smartphones and operating systems, choosing the right device for your application will further optimize the scanning performance for specific use cases. This is especially important for scanning in difficult scenarios that present environmental challenges, damaged or hard-to-read barcodes and high-throughput scanning requirements.

Pictured: Samsung Xcover 3 (Left) and Samsung Galaxy S6 (Right) with Scandit Barcode Scanner SDK

To determine the best device for your scanning application, you must look beyond the hard-ware itself.

Hardware and Software

It's important to remember that not every smartphone is created equal when scanning barcodes. Each smartphone, and most importantly its camera hardware, is designed and implemented very differently, meaning that some smartphones provide better scan performance than others. In addition, certain camera modules can be better optimized with software for image recognition purposes, such as barcode scanning with Scandit's Barcode Scanner SDK.

To determine the best device for your scanning application, you must look beyond the hardware itself. You can't determine how well a smartphone will scan barcodes by simply reviewing a spec sheet. Just because the device has a relatively high number of megapixels, doesn't mean it will ultimately be the best device for your scanning scenario.

More important than any individual specification alone is the performance of the camera hardware and software in real-world scenarios. Here are some important questions to consider when choosing a smartphone for a mobile scanning solution:

1) How fast does the camera adapt to changes in lighting?

2) How well can the camera focus and keep the focus on the object with the barcode?

3) Does the camera software run image enhancing algorithms that beautify regular photos but interfere with the readability of a barcode?

4) Can the camera focus on objects with little contrast, such as barcodes printed at a very small scale?

In addition, physical attributes of a smartphone are also important to consider. Characteristics such as battery type, form factor and ruggedness should play an important role in determining which device to choose for your industry use case and scanning application.

What to consider when choosing the best smartphone for your mobile scanning solution

Barcode Scanning Requirements

When choosing the best smartphone for any use case, it's important to consider the existing scanning requirements for your business needs. It helps to assess how often a device will be used to scan barcodes, and what types of codes you will be scanning.

- What types of barcodes will you be scanning?
- Will you be scanning high volumes of barcodes (hundreds vs dozens)?
- Are the barcodes small, poorly printed or damaged?
- What type of lighting is present in the scanning environment?

Scandit has tested smartphone scanning performance across a wide variety of devices and use cases. We've outlined the key performance factors to consider when testing a device's scanning capabilities.

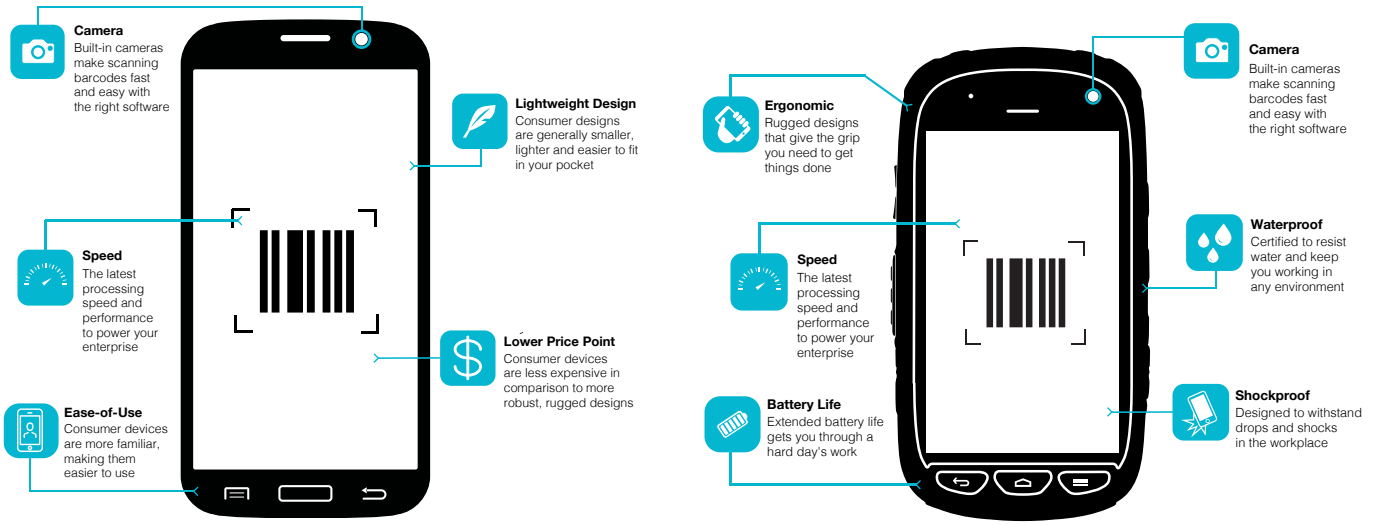
Power Requirements

When considering any device, you must take its power consumption into account. A major benefit of a camera-based scanner—over a peripheral device or dedicated scanner—is the lower power requirements necessary to operate a smartphone camera as compared with a 1D or 2D scanning imager. Depending on your scanning requirements, you may need a device to last for a single shift, or all day without the opportunity to charge a device. This may require the use of additional batteries or a larger, extended-use Li-Ion battery pack, if available for your target device.

Environmental and Application Demands

Another important factor to consider is how and where the device will be used. Environmental and application demands should play a big role in determining the right device. If you expect scanning to occur in harsh environments such as warehouses, construction sites or distribution centers, a fully-rugged device may be required to help increase device lifecycle. Other features such as form factor and glove touch capabilities might also be important to consider. See exhibit below:

Consumer Smartphones vs. Rugged Smartphones



Speed

Scenario

Decode speed is critical for any scanning use case—not just in high-throughput scanning scenarios—because user experience can often determine the success or failure of your app. In employee-facing applications, the scan speed can be even more important to ensure improved worker efficiency for key operations. In back-office applications such as warehouse picking, low latency scanning is essential for a smooth and efficient workflow because users expect the same scan performance as dedicated devices traditionally used in these scenarios.

What determines performance?

The speed at which a smartphone can scan a barcode has a lot to do with how fast the camera can adjust to the scene featuring a barcode, and how fast the camera images can be processed.

This is impacted by a number of factors:

- Camera initialization speed
- Autofocus control
- Exposure control
- Frame rate
- CPU

The faster the camera can be initialized, the shorter the time to the first barcode scan. It is thus an important measure especially if barcodes are not decoded in batch but individually. Exposure and autofocus control are also important because they determine how fast the camera responds to scene changes. While Scandit's unique blurry barcode decoding approach can decode blurry barcodes (even those taken with fixed focus cameras), autofocus adjustments are needed when barcodes need to be decoded far away from the camera or when tiny barcodes need to be scanned close up to the camera. A high frame rate and CPU speed are also important because it helps to process and decode the camera images faster and improves the overall scan performance.

What we measure

The speed test is conducted by scanning a number of barcodes in sequence at varying distances.

Measurements include:

- The time it takes to process an individual camera frame with a barcode
- The time to (re-)start the camera and scan a barcode in scences with varying lighting conditions and barcode-to-camera distances.
- The frame rate (how many frames per second the camera records)

Maximum Scan Range

Scenario

In certain situations, it is important to have the capability to scan items that are further away than arm's length.

Some industry examples include:

- Scanning items on the bottom shelf without having to repeatedly bend down
- Scanning pallets out of reach, or raised on shelves
- Scanning an event ticket that a customer is holding

What determines performance?

The algorithms within Scandit's Barcode Scanner SDK help extend the maximum decode range of a smartphone camera. In fact, it is not uncommon to see a 2x-3x increase in the decode range on any given device compared with competing mobile scanning solutions. However, the decode range is not completely solution-specific. The decode is also affected by the barcode in question (size, print quality and type) and camera capabilities (exposure and focus handling, and resolution). Some built-in smartphone cameras have a hard time consistently focusing on far away codes, which ultimately limits their range.

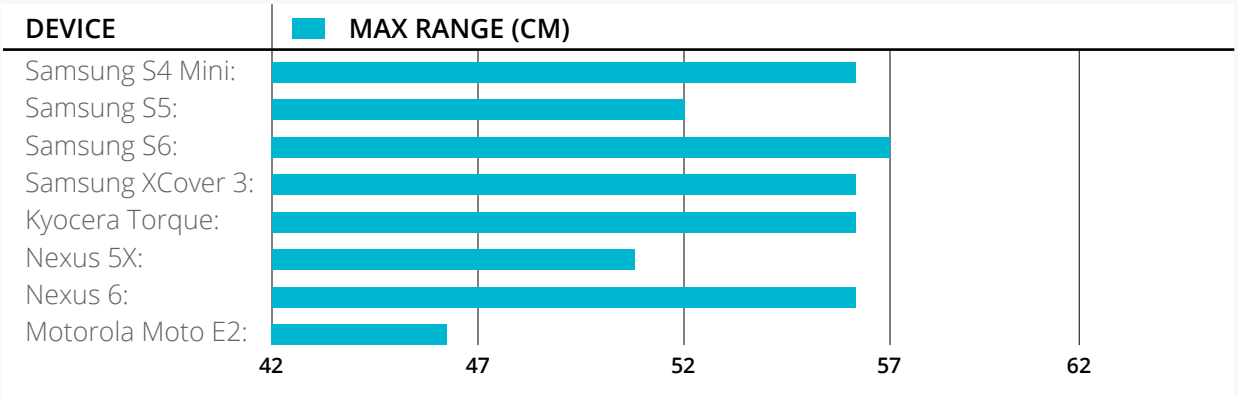
What we measure

In order to determine if a device is suitable for increased scan range, we test the "maximum decode range", which is the maximum distance the scanner can scan a barcode.

For this test we use a UPC-A barcode at 100% (14 mil), which is very common.

A good camera-based scanning device can routinely scan a standard size barcode at distance of 50cm or more with the Scandit Barcode Scanner SDK.

Maximum Scan Range (by Device)[2]



A rugged handheld computer with an integrated Zebra 4500 standard resolution imager module can scan a 14 mil UPC-A code at 39.4 cm according to specifications.*

Tiny codes

Scenario

Certain use cases require the ability to read tiny barcodes printed or etched on small objects. This is quite common in industrial scenarios where codes hold a significant amount information. These types of barcodes tend to be printed on products with limited space, such as consumer electronics or fresh produce. We define tiny barcodes as codes where the thinnest bar is smaller than 5 mil (=0.005 inches or 0.13mm). In comparison, a typical UPC code printed at 100% size has an x-Dimension of 14 mil, which is almost triple the size.

The Zebra SE4500 imaging module referenced* above is able to scan 5 mil or larger codes (standard resolution module).

What determines performance?

The smartphone's ability to decode a tiny barcode is primarily influenced by camera resolution, autofocus and exposure capabilities. The scanning environment also influences the phone's ability to focus on the barcode. Some devices have a hard time focusing on a barcode that is printed on, or placed on a dark background due to exposure control issues.

What we test

We test the device's ability to decode tiny codes printed on a number of different materials (paper, flat and round objects). Under good conditions, a good device can decode a 2.8 mil EAN 13 code using the Scandit SDK thanks to its ability to decode blurry codes. For reference, this is an extremely small barcode. The standard width (from first bar to last) of a EAN 13 code is approximately 37 mm. This 2.8 mil code is only 6 mm wide, so only 1/6th of the size of a standard code size.

Fast Batch

Scenario

If you are deploying a smartphone solution in a high-throughput scanning use case (more than 500 scans per day), the ability to scan quickly is crucial to providing an efficient user experience.

Some common use cases include:

- Order Entry
- Stock Taking
- Warehouse Picking
- Package Delivery
- Ticketing

What determines performance?

When the user moves the device from code to code, adjusting the focus takes a certain amount of time. The Scandit SDK reduces this time to a minimum with the ability to decode blurry images, so the code can be read before the focus adjustment has finished. If the camera can be set to fixed-focus mode,[3] scanning high volumes at a high speed becomes possible. Even in fixed focus mode, there is room to vary the distance to the barcode thanks to the Scandit SDK's ability to decode blurry barcodes.

What we test

In this test scenario we measure the time it takes to manually scan a set of 8 EAN 13 and Code 128 barcodes.

Low Light

Scenario

Scanning in low light is a very common requirement for Scandit Customers. In these cases, a camera that performs well in low-light conditions will significantly enhance the user experience. High low-light scanning performance is important in a variety of use cases.

What determines performance?

Low light presents a challenge for any camera, especially for smartphone cameras due to their smaller sensor size. A combination of factors determine a camera's low-light performance. At the core of a good low-light performance measurement is the camera sensor's ability to capture the maximum amount of light for any given shutter speed. The implementation of optical image stabilization is another important factor that controls blur at slower shutter speeds.

What we test

To evaluate a device's low-light performance, we test two use scenarios: with and without LED flashlight. If the phone has an LED flash (that can be used as flashlight) it can be used for scanning in very dark situations. Ideally, we try to avoid using the LED torch because it can introduce glare, depending on the barcode material.

Power Efficiency

Scenario

Being able to use a device for a full workday or shift on one charge can be critical for certain use cases where access to power or backup devices/batteries is not given, or are not practical.

As far as scanning is concerned, we look at different use cases that have varying power requirements ranging from tens of scans per day to thousands of scans per day.

Some common use cases include:

- Field Service
- Event or Transportation Ticketing
- Warehouse Picking
- Inventory Management

What determines performance?

Device power consumption is influenced by many factors, primarily display backlighting, GPS, Bluetooth and Wi-Fi activity. While scanning, running the display and the camera are the main drivers of power consumption. In general, the larger the battery size the longer it will run between charges. Still, certain devices are better at power management than others.

What we test

We evaluate the impact of a typical scanning process on the battery by measuring the power consumption of defined scanning sequences, e.g. one scan every 4 seconds for 30 minutes. Typically, scanning processes include running the app, running the camera, lighting up the screen and processing power consumed to run the decoding engine.

Today, almost any smartphone equipped with the Scandit Barcode Scanner SDK can easily perform 1,000 scans on one charge. Depending on scan intervals the number of scans can go as high as 10,000 on certain devices.

Ergonomics

Scenario

Good ergonomics are important in high-throughput and prolonged scanning use cases in order to reduce strain and improve overall workflow efficiency.

What determines performance?

Several physical characteristics and design elements contribute to the ergonomics of any given smartphone. Some important factors to consider include device size, weight, design and form factor.

What we test

We rate the device based on the combined impression across all factors above.

Testing Results[2]

Scan Performance Summary

DEVICE	SAMSUNG GALAXY S6	SAMSUNG XCOVER 3	SAMSUNG GALAXY S4 MINI	KYOCERA TORQUE	GOOGLE NEXUS 6	GOOGLE NEXUS 5X	MOTOROLA MOTO E2	SAMSUNG GALAXY S5
SCANNER								
SPEED	9	7	5	8	8	7	8	7
RANGE	9	8	8	8	8	7	6	7
TINY CODES	9	7	9	7	8	5	7	4
FAST BATCH	8	9	8	8	9	9	7	5
LOW LIGHT PERFORMANCE	9	8	8	8	5	5	4	6
POWER EFFICIENCY	9	9	8	8	9	7	7	8
ERGONOMICS	8	9	9	8	7	7	9	7
TOTAL SCORE	61	57	55	54	54	48	48	44

Samsung Galaxy S6

All measurements are scored on a scale of 1 – 10 with 10 being the highest.

SCANNER

SPEED	9
RANGE	9
TINY CODES	9
FAST BATCH	8
LOW LIGHT PERFORMANCE	9
POWER EFFICIENCY	9
ERGONOMICS	8
TOTAL SCORE	61

DESIGN

DIMENSIONS	5.65 X 2.78 X 0.27 INCHES (143.4 X 70.5 X 6.8 MM)
WEIGHT	4.87 OZ (138 G)

RUGGEDNESS

RUGGEDNESS	N / A
IP CERTIFIED	N / A

CAMERA

CAMERA	16 MP
FLASH	LED
FEATURE	AUTOFOCUS
FRONT-FACING CAMERA	5 MP

BATTERY

BATTERY CAPACITY	2550 MAH

HARDWARE

PROCESSOR	OCTA-CORE, 2100 MHZ, ARM CORTEX-A57 AND ARM CORTEX-A53 , 64-BIT

Samsung XCover 3

All measurements are scored on a scale of 1 – 10 with 10 being the highest.

SCANNER

SPEED	7
RANGE	8
TINY CODES	7
FAST BATCH	9
LOW LIGHT PERFORMANCE	8
POWER EFFICIENCY	9
ERGONOMICS	9
TOTAL SCORE	57

DESIGN

DIMENSIONS	5.23 X 2.76 X 0.39 INCHES (132.9 X 70.1 X 9.95 MM)
WEIGHT	5.43 OZ (154 G)

RUGGEDNESS

RUGGEDNESS	WATER, DUST, SHOCK, VIBRATION, TEMPERATURE RESISTANT
IP CERTIFIED	IP 67

CAMERA

CAMERA	5 MP
FLASH	LED
FEATURE	AUTOFOCUS
FRONT-FACING CAMERA	2 MP

BATTERY

BATTERY CAPACITY	2200 MAH

HARDWARE

PROCESSOR	QUAD-CORE, 1200 MHZ, ARM CORTEX-A53

Samsung Galaxy S4 Mini

All measurements are scored on a scale of 1 – 10 with 10 being the highest.

SCANNER

SPEED	5
RANGE	8
TINY CODES	9
FAST BATCH	8
LOW LIGHT PERFORMANCE	8
POWER EFFICIENCY	8
ERGONOMICS	9
TOTAL SCORE	55

DESIGN

DIMENSIONS	4.91 X 2.41 X 0.35 INCHES (124.6 X 61.3 X 8.94 MM)
WEIGHT	3.77 OZ (107 G)

RUGGEDNESS

RUGGEDNESS	N / A
IP CERTIFIED	N / A

CAMERA

CAMERA	8 MP
FLASH	LED
FEATURE	AUTOFOCUS
FRONT-FACING CAMERA	1.9 MP

BATTERY

BATTERY CAPACITY	1900 MAH

HARDWARE

PROCESSOR	DUAL-CORE, 1700 MHZ, KRAIT 300

Kyocera Torque

All measurements are scored on a scale of 1 – 10 with 10 being the highest.

SCANNER

SPEED	8
RANGE	8
TINY CODES	7
FAST BATCH	8
LOW LIGHT PERFORMANCE	8
POWER EFFICIENCY	8
ERGONOMICS	8
TOTAL SCORE	54

DESIGN

DIMENSIONS	4.44 X 2.38 X 0.56 INCHES (113 X 60 X 14 MM)
WEIGHT	5.5 OZ (156 G)

RUGGEDNESS

RUGGEDNESS	WATER, DUST, SHOCK, VIBRATION, TEMPERATURE, HUMIDITY RESISTANT
IP CERTIFIED	IP 67

CAMERA

CAMERA	5 MP
FLASH	LED
FEATURE	AUTOFOCUS
FRONT-FACING CAMERA	1.3 MP

BATTERY

BATTERY CAPACITY	2500 MAH

HARDWARE

PROCESSOR	QUAD-CORE, 1200 MHZ, ARM CORTEX-A53

Google Nexus 6

All measurements are scored on a scale of 1 – 10 with 10 being the highest.

SCANNER

SPEED	8
RANGE	8
TINY CODES	8
FAST BATCH	9
LOW LIGHT PERFORMANCE	5
POWER EFFICIENCY	9
ERGONOMICS	7
TOTAL SCORE	54

DESIGN

DIMENSIONS	6.27 X 3.27 X 0.40 INCHES (159.26 X 82.98 X 10.06 MM)
WEIGHT	6.49 OZ (184 G)

RUGGEDNESS

RUGGEDNESS	N / A
IP CERTIFIED	N / A

CAMERA

CAMERA	13 MP
FLASH	DUAL LED
FEATURE	AUTOFOCUS
FRONT-FACING CAMERA	2 MP

BATTERY

BATTERY CAPACITY	3220 MAH

HARDWARE

PROCESSOR	QUAD-CORE, 2700 MHZ, KRAIT 450

Google Nexus 5X

All measurements are scored on a scale of 1 – 10 with 10 being the highest.

SCANNER

SPEED	8
RANGE	7
TINY CODES	5
FAST BATCH	9
LOW LIGHT PERFORMANCE	5
POWER EFFICIENCY	7
ERGONOMICS	7
TOTAL SCORE	48

DESIGN

DIMENSIONS	5.79 X 2.86 X 0.31 INCHES (147 X 72.6 X 7.9 MM)
WEIGHT	4.80 OZ (136 G)

RUGGEDNESS

RUGGEDNESS	N / A
IP CERTIFIED	N / A

CAMERA

CAMERA	12.3 MP
FLASH	DUAL LED
FEATURE	AUTOFOCUS
FRONT-FACING CAMERA	5 MP

BATTERY

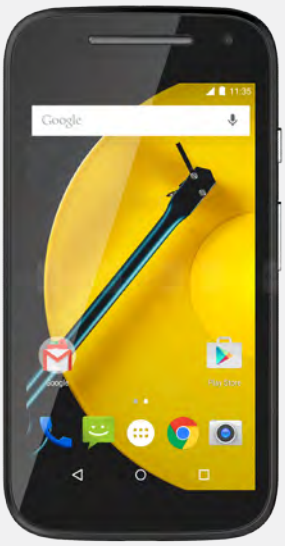
BATTERY CAPACITY	2700 MAH

HARDWARE

PROCESSOR	HEXA-CORE, 1800 MHZ, ARM CORTEX-A57 AND ARM CORTEX-A53, 64-BIT

Motorola Moto E2

All measurements are scored on a scale of 1 – 10 with 10 being the highest.



SCANNER

SPEED	8
RANGE	6
TINY CODES	7
FAST BATCH	7
LOW LIGHT PERFORMANCE	4
POWER EFFICIENCY	7
ERGONOMICS	9
TOTAL SCORE	48

DESIGN

DIMENSIONS	5.11 X 2.63 X 0.48 INCHES (129.8 X 66.8 X 12.2 MM) 3.77
WEIGHT	5.11 OZ (145 G)

RUGGEDNESS

RUGGEDNESS	N / A
IP CERTIFIED	N / A

CAMERA

CAMERA	5 MP
FLASH	NO
FEATURE	AUTOFOCUS
FRONT-FACING CAMERA	0.3 MP VGA

BATTERY

BATTERY CAPACITY	2390 MAH

HARDWARE

PROCESSOR	QUAD-CORE, 1200 MHZ, ARM CORTEX-A53, 64-BIT

Samsung Galaxy S5

All measurements are scored on a scale of 1 – 10 with 10 being the highest.

SCANNER

SPEED	7
RANGE	7
TINY CODES	4
FAST BATCH	5
LOW LIGHT PERFORMANCE	6
POWER EFFICIENCY	8
ERGONOMICS	7
TOTAL SCORE	44

DESIGN

DIMENSIONS	5.59 X 2.85 X 0.32 INCHES (142 X 72.5 X 8.1 MM)
WEIGHT	5.11 OZ (145 G)

RUGGEDNESS

RUGGEDNESS	WATER, DUST RESISTANT
IP CERTIFIED	IP 67

CAMERA

CAMERA	16 MP
FLASH	LED
FEATURE	AUTOFOCUS
FRONT-FACING CAMERA	2.1 MP

BATTERY

BATTERY CAPACITY	2800 MAH

HARDWARE

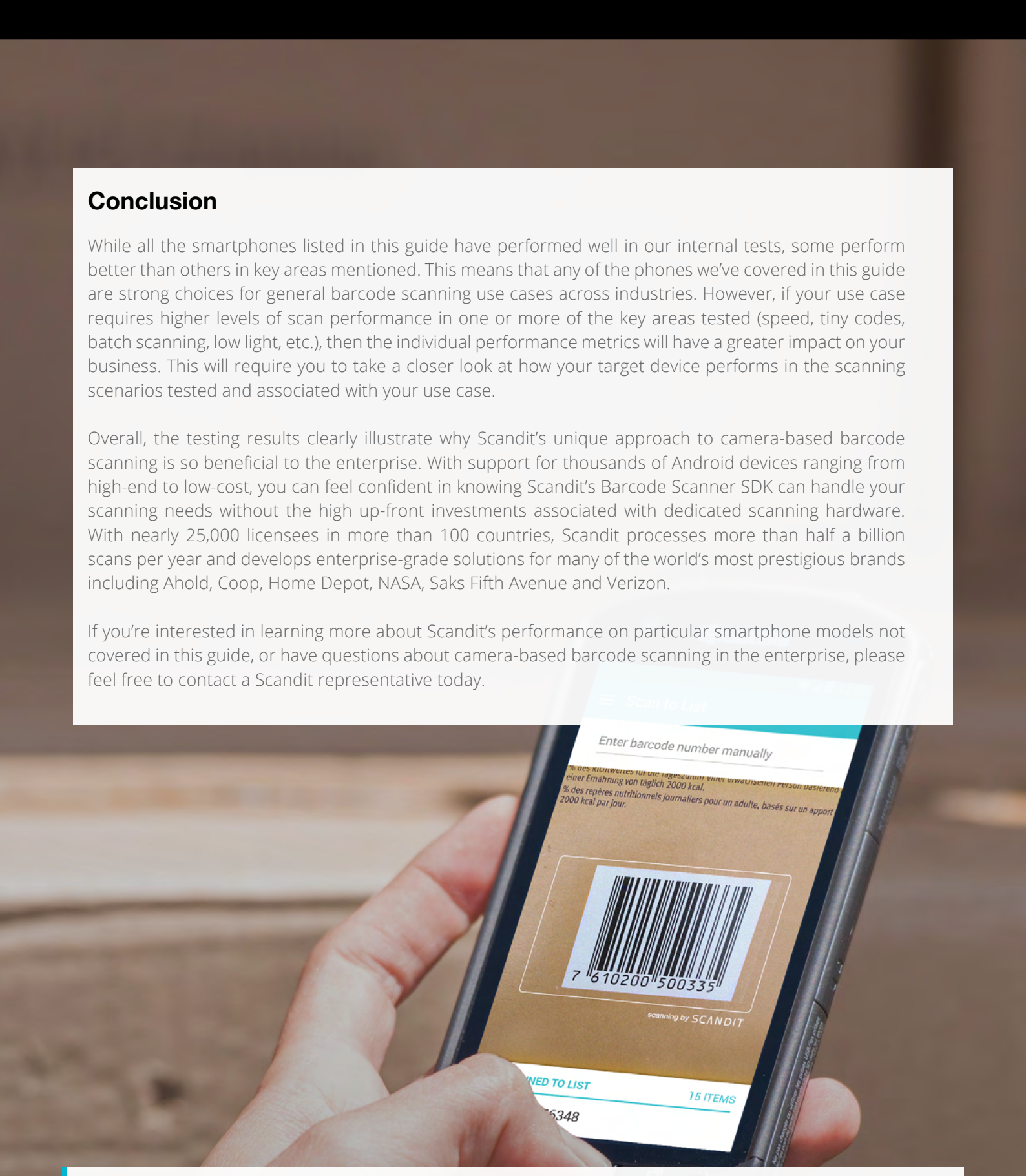
PROCESSOR	QUAD-CORE, 2500 MHZ, KRAIT 400

Conclusion

While all the smartphones listed in this guide have performed well in our internal tests, some perform better than others in key areas mentioned. This means that any of the phones we've covered in this guide are strong choices for general barcode scanning use cases across industries. However, if your use case requires higher levels of scan performance in one or more of the key areas tested (speed, tiny codes, batch scanning, low light, etc.), then the individual performance metrics will have a greater impact on your business. This will require you to take a closer look at how your target device performs in the scanning scenarios tested and associated with your use case.

Overall, the testing results clearly illustrate why Scandit's unique approach to camera-based barcode scanning is so beneficial to the enterprise. With support for thousands of Android devices ranging from high-end to low-cost, you can feel confident in knowing Scandit's Barcode Scanner SDK can handle your scanning needs without the high up-front investments associated with dedicated scanning hardware. With nearly 25,000 licensees in more than 100 countries, Scandit processes more than half a billion scans per year and develops enterprise-grade solutions for many of the world's most prestigious brands including Ahold, Coop, Home Depot, NASA, Saks Fifth Avenue and Verizon.

If you're interested in learning more about Scandit's performance on particular smartphone models not covered in this guide, or have questions about camera-based barcode scanning in the enterprise, please feel free to contact a Scandit representative today.



Sources and Footnotes

1 Zebra Technology - https://www.zebra.com/gb/en/products/oem/oem-engines/oem-array-imager-scan-engines/se4500/se4500-spec-sheet-en.html

2 Scan performance tests results provided by Scandit, based on own measurements

3 Not all device platforms allow necessary access to the camera driver software for the Scandit SDK to control these settings

Resources

White Papers and eBooks

Check out Scandit's latest content, which provides valuable information across industries to help you find the right barcode scanning solution.

Learn More →

Case Studies

Scandit's mobile solutions are used by some of the world's most prestigious brands. See how customers have utilized our innovative software.

Learn More →

Videos

Check out Scandit's video showcases to see the performance of our mobile solutions. See our innovative solutions in action.

Watch Now →

Demo Apps

Interested in our solutions? Download one of our demo apps for a showcase of the performance and precision Scandit can offer your business.

Download Now →

Customer Apps

With hundreds of clients in over 25 countries, our mobile solutions are the technology of choice for many major brands around the globe.

Learn More →

Frequently Asked Questions

Find the resources and answers you need to know before choosing Scandit as your mobile solution provider.

Learn More →

Have Questions?

Talk to a Scandit Rep

Contact Us

About Scandit

Scandit delivers high performance mobile solutions for smartphones, tablets and wearables, designed to transform consumer engagement and operational efficiency for today's forward-looking enterprises.

Scandit solutions are built on its patented software-based barcode scanner and are used in a variety of industries including retail, manufacturing and logistics. With nearly 25,000 licensees in more than 100 countries, Scandit processes more than half a billion scans per year and develops enterprise-grade solutions for many of the world's most prestigious brands including Ahold, Coop, Home Depot, NASA, Saks Fifth Avenue and Verizon.

Founded in 2009 by a group of researchers from MIT, ETH Zurich and IBM Research, today Scandit and its network of global integration and technology partners are pushing the boundaries of mobile AIDC (automatic identification and data capture), delivering groundbreaking identification and data capture applications to customers. For more information visit www.scandit.com.

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