

MICROSCAN®

*MS-520 Scan Head
User's Manual*



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About This Manual

This manual provides complete information on setting up and installing the MS-520 fixed-mount scan head.

Unless otherwise noted, this manual applies to the MS-525 infrared laser beam scan head as well as the MS-520.

Keystroke Entries

Keystrokes to be entered from your terminal are highlighted in bold, as in **<D>**, including a < left angle bracket symbol (unless redefined by Command Start Character command) and followed by a > right angle bracket symbol.

Approvals

This equipment is approved for use by the following organizations:

- CDRH (Center for Devices & Radiological Health)
- UL (Underwriters Laboratories, Inc.)
- CSA (Canadian Standards Association)
- TÜV (Technischer Überwachungs-Verein) (MS-520 only)

Warning and Caution Summary

Note: The MS-520 scan head is designed to be connected to the MS-3000 decoder (single or dual). When installed, direct current power for the scan head is provided by the decoder.



WARNING

Use of controls, adjustments, or performance of procedures other than those specified herein may result in hazardous laser light radiation exposure.



WARNING

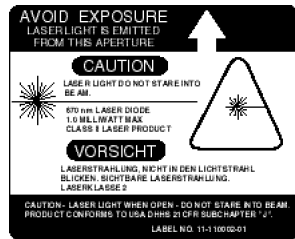
Up to 5 mW of laser diode power can be present in the interior. Avoid opening the scan head. Inspect housing to verify that loose casings or panels do not allow access to laser light.



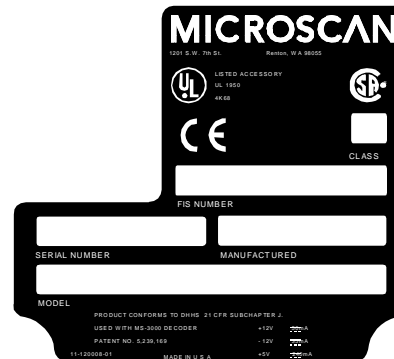
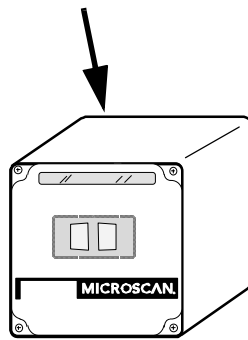
WARNING

The laser beam can be harmful to eyesight. Avoid direct eye contact with the laser beam. Never point the beam at other people, or in a direction where people may be passing.

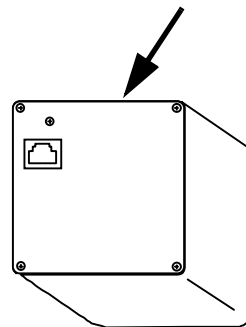
Safety Labels



Top Label



Back Label



Chapter 1

Introduction

Chapter Contents

MS-520 Scan Head Description.....	1-2
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Unless otherwise noted, this manual applies to the MS-525 scan head (infrared laser beam) as well as the MS-520.

MS-520 Scan Head Description

The MS-520 scan heads use a high-speed, ten-sided spinning mirror to direct laser beams across bar code labels (figure 1-1) and convert the reflected light to waveforms.

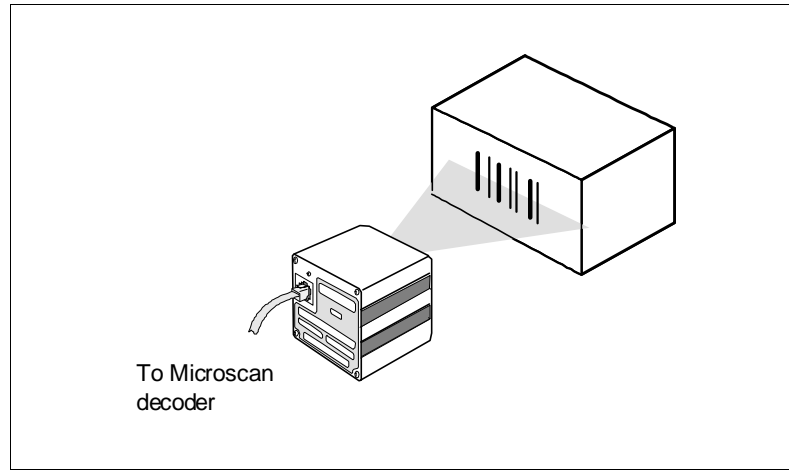


Figure A-1 Back View of MS-520 Scan Head Scanning a Label

Figure 1-1 shows a MS-520 scan head in operation. Standard features of the MS-520 include low power consumption, wide field of view, the ability to read a complete range of code densities (from .0047 inch to .040 inch and larger, depending on range option), at scan speeds of 330 scans per second.

Visible (MS-520 model) or infrared (MS-525 model) laser diode light wavelengths are available.

FIS Options

FIS (Final Instruction Sheet) numbers are assigned to each customer order. The MS-520 models are available in standard FIS options, listed in tables 1-1 and 1-2.

Table A-1 Available MS-520 Options (VLD)

FIS #	Spot Type	Scan Beam	Range
FIS-0520-0001	Round	Single Line	Standard
FIS-0520-0002	Round	Raster	Standard
FIS-0520-0003	Round	Single Line	UHD ^a
FIS-0520-0004	Round	Raster	UHD
FIS-0520-0009	Oval	Single Line	Standard
FIS-0520-0010	Oval	Raster	Standard
FIS-0520-0011	Oval	Single Line	UHD
FIS-0520-0012	Oval	Raster	UHD

a. Ultra High Density

Table A-2 Available MS-525 Options (IR)

FIS #	Spot Type	Scan Beam	Range
FIS-0525-0005	Round	Single Line	Standard
FIS-0525-0006	Round	Raster	Standard
FIS-0525-0007	Round	Single Line	UHD
FIS-0525-0008	Round	Raster	UHD
FIS-0525-0013	Oval	Single Line	Standard
FIS-0525-0014	Oval	Raster	Standard
FIS-0525-0015	Oval	Single Line	UHD
FIS-0525-0016	Oval	Raster	UHD

Spot Options

The laser beam on the scan head can be projected on the bar code label as a round or an oval spot, as shown in figure 1-2.

An oval spot is recommended for labels with voids, extraneous ink, or other imperfections.

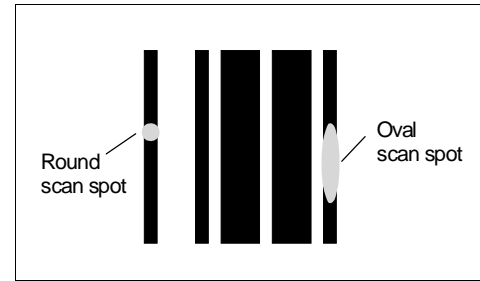


Figure A-2 Laser Beam Spot Types
(not to scale)

Scan Beam Options

Scan beams (figures 1-3 and 1-4) are projected either as a single line or as a raster pattern, depending on the FIS option ordered.

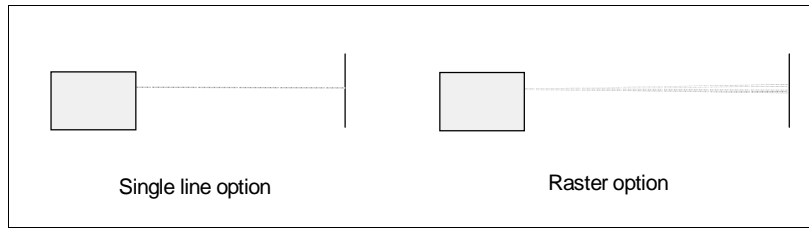


Figure A-3 Scan Beam Types, Side Views

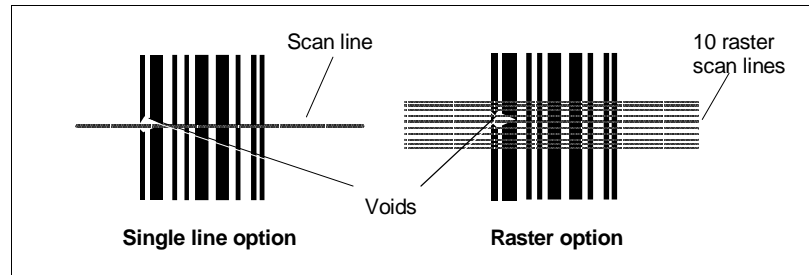


Figure A-4 Single Line and Raster Scan Patterns

Note: Unless otherwise noted, laser beams are represented as a single line throughout this manual.

Single Line Option

Scan beams projected across a label appear as a single scan line, as shown on the left label in figure 1-4.

Raster Option

The raster option projects ten individual scan lines through 2 degrees of arc with each rotation.

Table 1-3 shows estimated heights of raster images at selected scan ranges, measured from the front of the scan head.

Table A-3 Raster Heights per Label Distance

Scan Range	Raster Height
2 inches (50.8 mm)	.10 inch (2.54 mm)
4 inches (101.6 mm)	.17 inch (4.32 mm)
6 inches (152.4 mm)	.24 inch (6.1 mm)
8 inches (203.2 mm)	.31 inch (7.87 mm)
10 inches (254 mm)	.38 inch (9.65 mm)

Range Options

All models are available in standard and ultra high density (UHD) optics. See "Read Ranges" in chapter 2, "Setup" for specific range data.

Interfacing with Decoders

The MS-520 scan head consists of a scan head only. To decode and transmit bar code data, a separate series 3000 single (figure 1-5) or dual head decoder is required (via an 8-pin modular cable). For information on configuration and decoder setup, see the decoder user's manual.

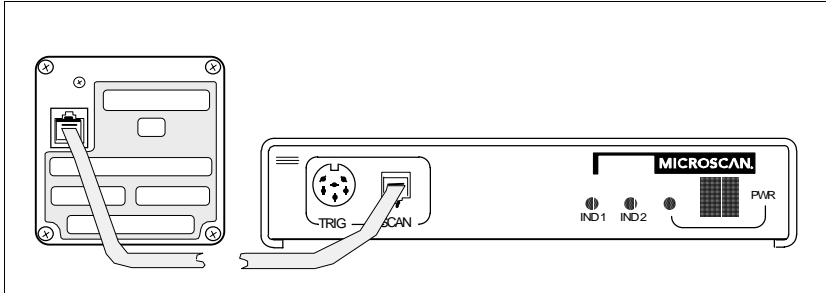


Figure A-5 Scan Head to Decoder Cabling

The Scanning System

Figure 1-6 shows a possible scanning system setup.

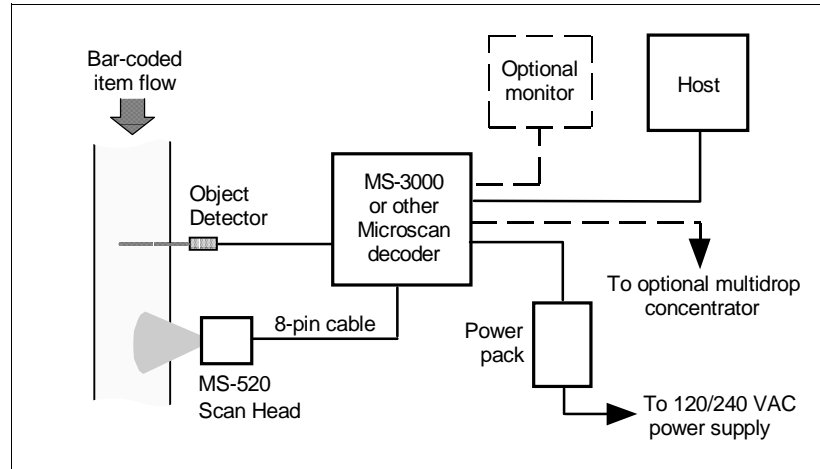


Figure A-6 System Diagram

Chapter 2

Setup

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This chapter provides instructions for orienting the MS-520 scan head in relation to labels, object detectors, read ranges, and ensuring a minimum number of scans.

Careful evaluation of the specific application, including the number, type, and location of scan heads, decoders, and object detectors, as required, is a prerequisite to successful bar code scanning.

Setup Goals

To achieve the desired number of scans required by the application, scan heads must be positioned so that the scan beam crosses a label within the read range. To accomplish this, refer to the range table, bar code label orientations, scan calculations, and scan head orientation, as described in this chapter.

In addition, a read rate test (see your decoder user's manual) should be performed to ensure that optimum scanning and decoding is occurring.

Determine the following before installation:

- a. **Label Orientation.** Position the scan head and label so that the label is given as many scans as possible. (Take into account, and adjust, if necessary, label speed and/or the distance between bar-coded objects.) Avoid angles that result in direct (specular) reflected light, or blurring.
- b. **Object Detector Orientation.** Position object detector (if used) so that the detector senses the object before the scan head can read it, and ensure that object detector light does not reflect back into the scan head sensor.
- c. **Read Range.** Position the scan head at a distance from the label that is within the ranges specified by your application and verify ranges by performing a read rate test.
- d. **Number of Scans.** Ensure that each label receives the minimum required number of scans for your application.

Label Orientation

If the bar code label bars are parallel to the direction of travel, as shown in figure 1-1, the label is said to be in a *ladder* orientation; if the bars are perpendicular with the direction of travel, the label is said to be in a *picket fence* orientation (figure 1-2).

Ladder Orientation,

In general, depending on label size and speed, ladder orientation is preferable because different portions of the label are scanned as the label goes by. In addition label placement is not as critical. As shown in figure 2-1, a label can be successfully read if placed anywhere within the scan line.

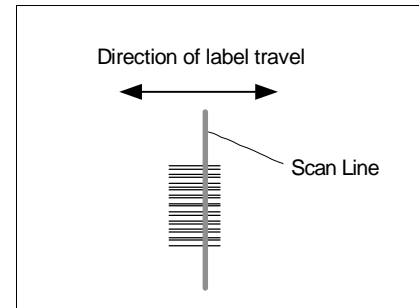


Figure 2-1 Ladder Orientation

Picket Fence Orientation

Unlike ladder, picket fence allows only a small portion of the entire label to be scanned. As a result, labels must be of good quality since even slight label imperfections such as extraneous ink, voids, etc., can cause misreads or non-reads. (See figure 1-5 in chapter 1.)

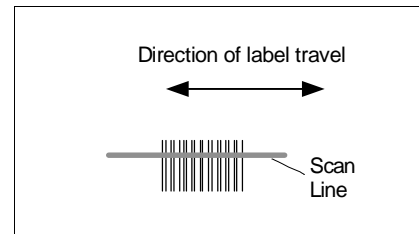


Figure 2-2 Picket Fence Orientation

Note: Either ladder or picket fence can be rotated without losing its orientation, provided that the label's direction of travel does not change in relation to the scan line.

Angled Picket Fence Orientation

The problems associated with picket fence can be minimized by slightly tilting the scan line (figure 2-). This allows a larger portion of the label to be scanned and increases the label placement area by “simulating” the ladder orientation. This of course is impractical with a short bar code height.

Angled picket fence is recommended only where the bar code is reasonably tall and the label speed is not too fast in relation to the scan field width, since angling the label will reduce the number of scans on the label.

One advantage of the picket fence over the ladder orientation is in the area of label speed. In ladder mode, the label travel distance is the height of the bar code; in picket fence mode, the label can be read while it travels the full distance of the scan width.

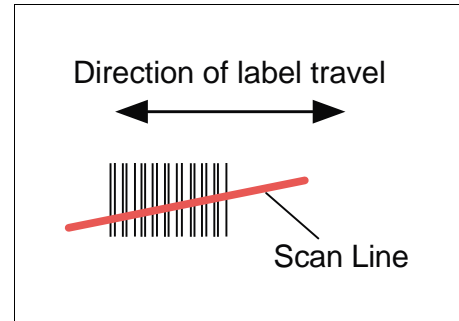


Figure 2-3 Angled Picket Fence Orientation

Tilt, Skew, and Pitch

Tilt refers to the label rotation, relative to the scan head, as it rotates on the tilt axis, as shown in figure 2-4.

Skew refers to the angle of the label, relative to the scan head, as it rotates on the skew axis, as shown in figure 2-4. MS-520 scan heads can be skewed to a maximum of ± 40 degrees from the centerline.

Pitch refers to the position of the label, relative to the scan head, as it rotates on the pitch axis. Maximum pitch is ± 50 degrees from the centerline. For the MS-520, pitch angles between $+3$ and $+5$ degrees should be avoided since they may cause *specular reflection*, the return of direct, non-diffuse light.

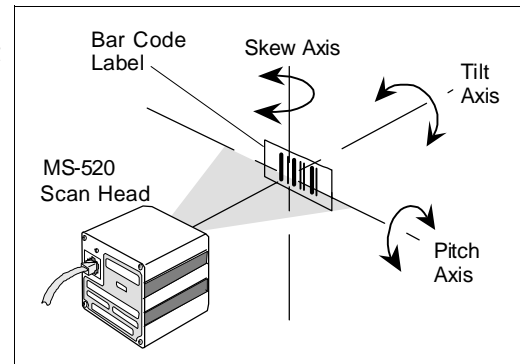


Figure 2-4 Tilt, Skew, and Pitch Axes

Object Detector Orientation

Microscan products can be triggered from either a host or an object detector.

An object detector uses infrared light to detect the presence of a bar-coded object and relays that information to the decoder, which will, if correctly configured, initiate a read cycle. Typically, a detector is positioned so that it will detect the presence of an object before the object's label can be scanned by the scan head.

An object detector is mounted in any position relative to the object as long as (1) the object passes within range of the detector and (2) direct or reflected light from the detector beam does not interfere with the scan head's reception.

Read Ranges

A label must be within the read range—the zone, as measured from the front of the scan head bezel, in which a label can be reliably read.

2-Setup

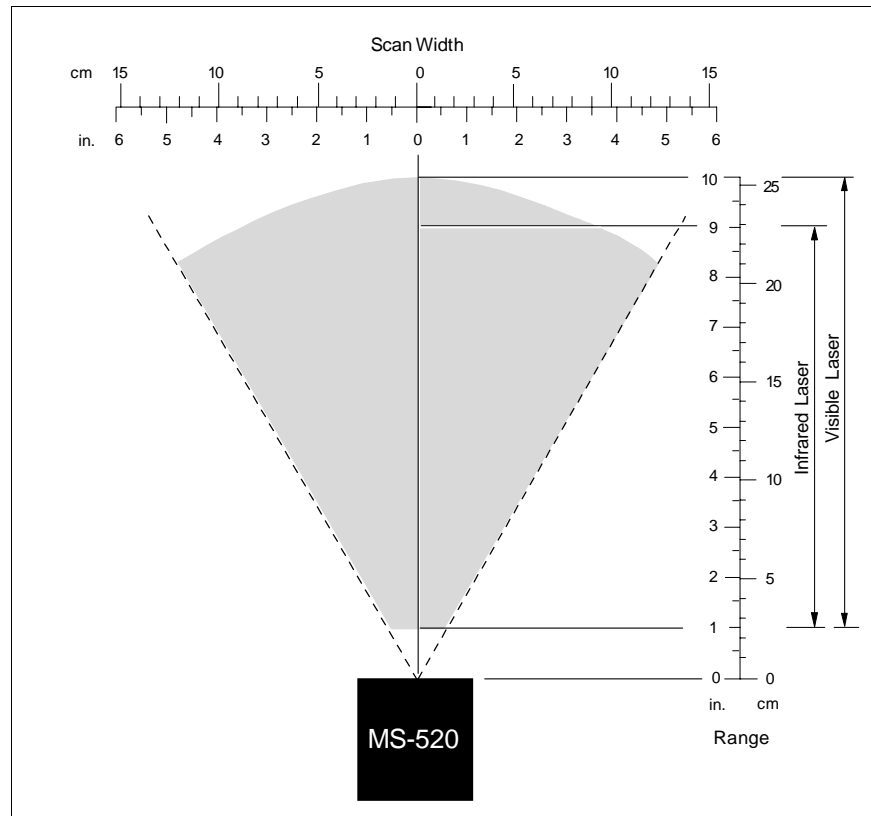


Figure 2-5 MS-520 Scan Width and Range

Figure 1-5 shows the read ranges of visible and infrared MS-520 scan heads. See table 1-4 for ranges and scan widths¹ per label densities (narrow-bar-widths).

1. Scan Width is the distance across the scan beam in which a given label can be reliably read. Scan width varies with read range. The greater the scan width, the longer a moving label will be readable and the greater the number of expected scans.

Table 1-4 MS-520 Read Ranges and Scan Widths*

	Narrow-Bar-Width	Read Range	Maximum Scan Width
Visible Laser			
UHD Range	.0047" (.119 mm)	1.75–3" (45–76 mm)	3" (76 mm)
	.0075" (.191 mm)	1–4" (25–102 mm)	4" (102 mm)
Standard Range	.0075" (.191 mm)	2–5" (51–127 mm)	4.75" (121 mm)
	.010" (.254 mm)	1.5–6" (38–152 mm)	6" (152 mm)
	.015" (.381 mm)	1–7" (25–178 mm)	7.5" (191 mm)
	.020" (.508 mm)	1–9" (25–229 mm)	9.25" (235 mm)
	.030" (.762 mm)	4–10" (102–254 mm)	9.5" (241 mm)
	.040" (1.02 mm)	4–10" (102–254 mm)	9.5" (241 mm)
	.050" (1.27 mm)	5–10" (127–254 mm)	9.75" (248 mm)
Infrared Laser			
UHD Range	.0047" (.119 mm)	1.75–3" (45–76 mm)	3" (76 mm)
	.0075" (.191 mm)	1.25–3" (32–76 mm)	3.5" (89 mm)
Standard Range	.0075" (.191 mm)	2–4.5" (51–114 mm)	3.5" (89 mm)
	.010" (.254 mm)	1.5–5" (38–127 mm)	4.75" (121 mm)
	.015" (.381 mm)	1–6" (25–152 mm)	6" (152 mm)
	.020" (.508 mm)	1–7" (25–178 mm)	7" (178 mm)
	.030" (.762 mm)	4–9" (102–229 mm)	8.5" (216 mm)
	.040" (1.02 mm)	4–9" (102–229 mm)	8.5" (216 mm)
	.050" (1.27 mm)	5–9" (127–229 mm)	8.5" (216 mm)

2-Setup

* Performance may vary slightly for raster units.

To achieve optimum performance with your application,

1. Configure the decoder for read rate mode.¹
- b. Temporarily position the scan head.
- c. Map out a label placement area by manually moving your label in and out and back and forth while observing read rates on the screen.

Read rates will vary due to differences in label quality, positioning, etc.

1. See the decoder user's manual for read rate test information.

Calculating the Number of Scans

To ensure reliable scanning, it is recommended that a minimum of **five** scans be applied to each label.

The number of scans that a given label will receive can be calculated by formulas for both ladder and picket fence label orientations if the inputs listed below are known.

- Scan Rate (SR) is the number of scans per second that a given scan head is capable of emitting.
- Scan Width (SW) is the width across the scan beam, at a given distance from the scan head, in which a label can be read.
- Label Speed (LS) is the distance per second that a label moves as it travels through the scan lines.
- Label Length (LL) (for picket fence formula only) is the length of the longest printed label to be read plus the length of the quiet zones (figure 2-6).
- Label Height (LH) (for ladder formula only) is a measurement of the height of individual bars (figure 2-6).

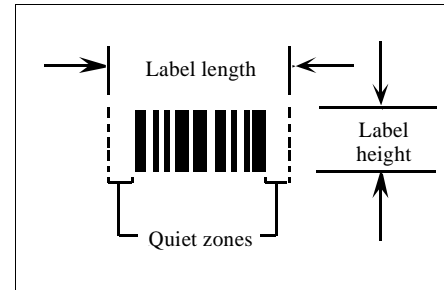


Figure 2-6 Label Dimensions

Note: Label length and label height are always measured as shown in figure 2-6, regardless of label orientation.

Use the formula¹ suitable for your application to predict the number of scans each label will receive.

Ladder Calculation

$$\left(\frac{LH \times SR}{LS} \right) - 3 = \text{number of complete scans}$$

Example 1:

LH = 1 inch

LS = 10 inches per second

SR = 330 scans per second

$$\left(\frac{1 \times 330}{10} \right) - 3 = 30 \text{ complete scans}$$

Picket Fence Calculation

$$\left(\frac{(SW - LL) \times SR}{LS} \right) - 3 = \text{number of complete scans}$$

Example 2:

LL = 1 inch (including quiet zones)

SW = 2 inches

LS = 10 inches per second

SR = 330 scans per second

$$\left(\frac{(2 - 1) \times 330}{10} \right) - 3 = 30 \text{ complete scans}$$

Note: If the number of complete scans calculates out to less than the minimum required for your application, assign the desired value to the number of complete scans and solve for any other parameter that can possibly be changed, such as label length, scan width, or label speed.

2-Setup

1. The -3 component (in both formulas) is added to allow for the first and last scans, and an AGC scan.

Comparing Label Orientation Calculations

When evaluating ladder versus picket fence orientations (figure 2-7), label height, label length, and scan width are critical parameters.

Note that in both previous examples, a 1 inch square label yields the same number of complete scans (30).

However, when label height or label length are changed, the resulting number of scans differs dramatically. For example, if both label height and label length are decreased to 0.5 inch for both examples (figure 2-7), the ladder orientation obtains 13 complete scans compared with 46 scans in the picket fence orientation.

If label height and label length are both increased to 1.5 inches, the ladder rate goes up to 46 complete scans, compared to 13 complete scans in picket fence.

Varying scan widths and label speeds will also alter the number of scans.

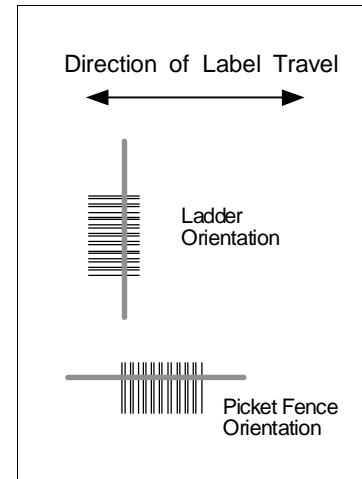


Figure 2-7 Label Orientations

Chapter
3

Installation

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Mounting the Scan Head.....	3-2
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This chapter provides instructions for mounting the MS-520 scan head, interfacing with a decoder, and initial operation.

Before permanently mounting the scan head, you should have read chapter 2, "Setup" and be confident that the scan head's mounting position and orientation will allow it to read the application's labels at the maximum read rate and with the desired number of scans.

Mounting the Scan Head

The MS-520 scan head can be mounted directly to a mounting surface of your choice, or indirectly, via a mounting plate and a universal stand. (See “Optional Equipment” on page A-5.)

To permanently mount the scan head:

1. Position the scan head in a dry place, devoid of sunlight, bright lights, or light from other sources.
2. Before mounting, ensure sufficient clearance at the rear of the scan head to allow for the 8-pin, RJ-45 connector and cable.
3. **If not using the mounting plate**, use the measurements provided in figure 1-1 to locate centers of mounting holes and drill four 5/32 inch (4 mm) holes.

If using the mounting plate and a universal stand (see “Optional Equipment” on page A-5), use the four perimeter holes for mounting the plate and mount scan head directly to the four inner holes on the plate.

4. Secure scan head with four 6-32 screws.

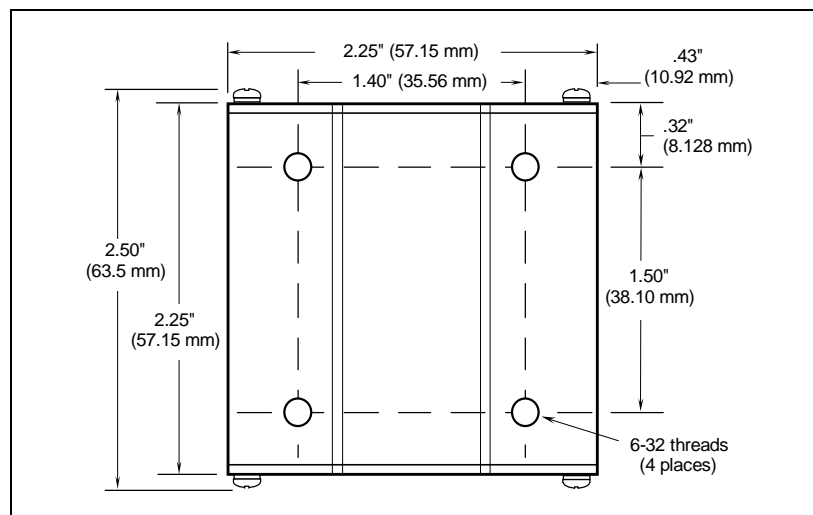
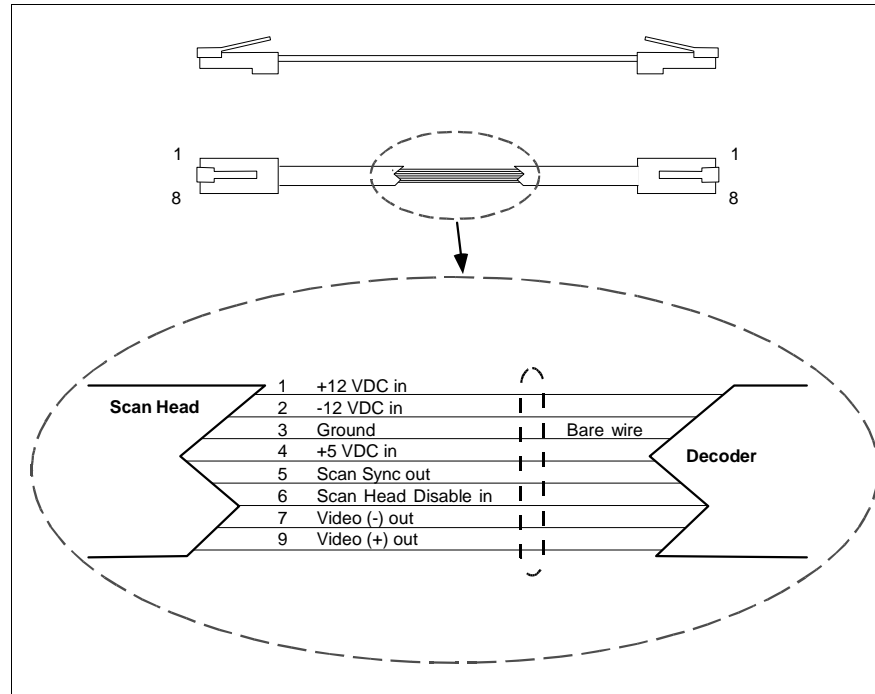


Figure 3-1 MS-520 Bottom Mounting Holes (full size)

Caution: Do not allow the mounting screws to penetrate into the scan head case more than .175 inch (4.4 mm) or damage to the scan head may result.

Cabling

The standard cable supplied with a MS-520 scan head is 6 feet (1.83 cm) in length, wired with an 8-pin RJ-45 modular plug at each end.



3-Installation

Figure 3-2 Scan Head/Decoder Interface Cable P/N: 61-130001-XX

Cables are also available in lengths from 1 to 15 feet, and are represented by a cable part number. For example, if 01 is substituted for XX in part number (PN) 61-130001-XX in figure 1-2, then the cable length would equal 1 foot (30.5 cm).

To prevent voltage loss, cables between the decoder and scan head should not exceed 15 feet (5.9 m) unless wire sizes exceed the minimum 26 AWG, or power supply voltages at the scan head are verified to be within 8 percent.

Operational Tips

Do:

- Check the label for readability in the visible (670 nm) or infrared (780 nm) range. If there is any question about the readability of the label, contact your Microscan representative.
- Check inputs (label speed, length, height, etc.) to ensure the minimum number of scans per label required for your application.
- As much as possible, avoid excessive tilt, pitch, and skew of the bar code label.
- Test scan head readability with a label that is known to be good and log the results.
- Clean the laser window on a regular basis with a clean, dry Q-tip or cotton cloth, without using excessive force.

Do Not:

- Aim the scan head into sunlight, photo detectors, or other light-emitting sources.
- Obstruct the laser window with mounting hardware or other objects.
- Connect chassis of scan heads, decoders, and host to different ground potentials.
- Operate the scan head in excessive temperature environments (see appendix A, "Scan Head Specifications").
- Connect or disconnect scan head/decoder interface cable while decoder power is ON.

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Appendices

Appendix A — Scan Head Specifications

Except where otherwise noted, the following specifications are true for all MS-520 scan heads:

Physical

- Length 2.25 in. (57.15 mm)
- Width..... 2.25 in. (57.15 mm)
- Height..... 2.25 in. (57.15 mm)
- Cable Length... 6 ft. (183 cm) standard
- Interface Connector RJ-45 8-pin modular socket
- Weight..... 8 oz. (227 g)

Scanning Parameters

- Type..... Rotating 10-sided mirror
- Scan Rate Up to 330 scans per second
- Scan Angle..... 60°
- Pitch..... ±50° maximum
- Skew ±40° maximum

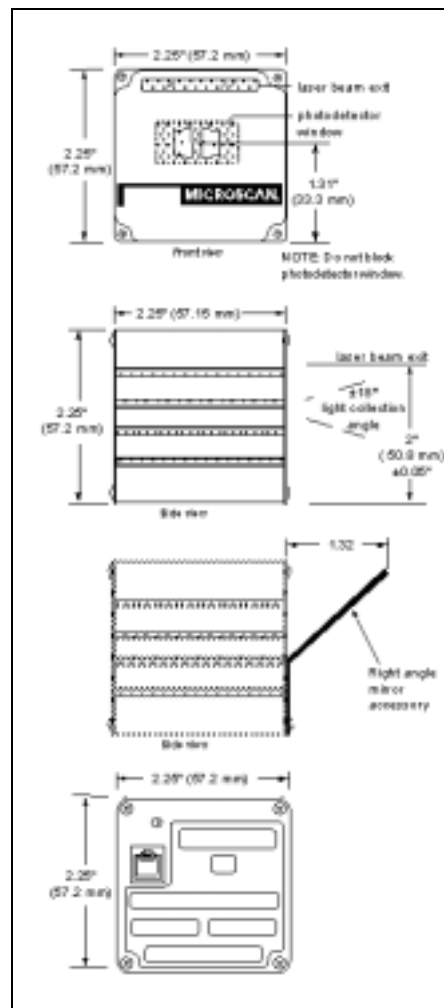


Figure A-1 Mechanical Dimensions

Laser Light

	Visible Laser	Infrared Laser
Wavelength	670 nm nominal	780 nm nominal
Safety class	CDRH Class II	CDRH Class I
Operating life	50,000 hrs. @ 25° C	400,000 hrs. @ 25° C

Optical

Composite read ranges for several Code 39 narrow-bar-width sizes at 2.5:1 wide-to-narrow bar ratios. See “Read Ranges” in chapter 2.

	Operating Ranges	
	Visible	Infrared
Standard Range	1 to 10 in. (2.54 to 25.4 cm)	1 to 9 in. (2.54 to 22.86 cm)
UHD Range	1 to 4 in. (2.54 to 10.16 cm)	1.25 to 3 in. (3.18 to 7.62 cm)

Scan Width8.5 inches at an 8-inch distance

Label Contrast: Visible: 25% min. absolute dark/light differential at 670 nm wavelength

 Infrared: 40% min. absolute dark/light differential at 780 nm wavelength

Raster Image 10 raster scan lines over a 2-degree arc (or 0.24 inch raster at 6-inch distance)

Decoder Interface

(Compatible with Microscan series 3000 decoder.)

Port Socket for 8-pin RJ-45 modular connector

Cabling 6-foot cable standard, available in 1-foot increments to 15 feet

Appendices

Electrical

Power Requirements:

+12 VDC @ 50 mA maximum, 20 mV p-p maximum allowed ripple

-12 VDC @ 35 mA maximum, 20 mV p-p maximum allowed ripple

+5 VDC @ 240 mA maximum, 200 mV p-p maximum allowed ripple

Input Signals TTL high enable for laser-diode and motor (controlled by decoder software)

Output Signals: Scan Sync: TTL level

Video Out: RS-422

Interface

8-pin RJ-45 modular connector

- Pin Assignments:
- Pin 1: +12 VDC in
 - Pin 2: -12 VDC in
 - Pin 3: Ground
 - Pin 4: +5 VDC in
 - Pin 5: Scan sync out
 - Pin 6: Scan Head Disable in
 - Pin 7: Video (-) out
 - Pin 8: Video (+) out

Environmental

Operating Temp.: Visible: 32° to 104°F (0° to 40°C)

Infrared: 32° to 113°F (0° to 45°C)

Storage Temperature -58° to 158° F (-50° to 70° C)

Humidity Up to 95% (non-condensing)

Ambient Light Immunity:

450 foot candles: Indoor: fluorescent, incandescent, mercury vapor, sodium vapor

2000 foot candles: Soft outdoor



Appendix B — Optional Equipment

Mounting Plate Kit

Part Number: 98-500002

To mount the scan head with the mounting plate, “pair up” the mounting plate’s four inner screw holes to the scan head’s mounting holes (see figure 3-1 in chapter 3, “Installation”) and attach plate to scan head. Next, mount entire assembly using the four outer holes on the plate.

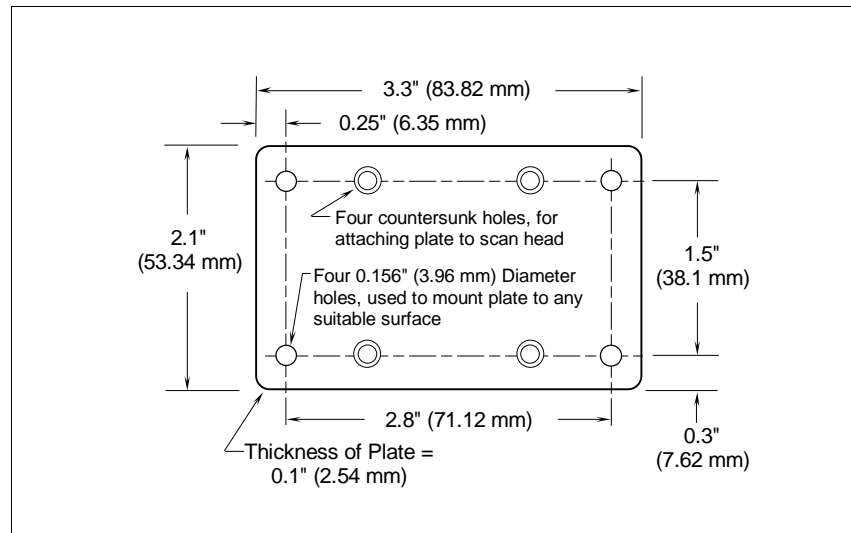


Figure A-2 MS-520 Bottom Mounting Plate (not full size)

Universal Stand

The Microscan Universal Stand is available in 4-inch, 6-inch, and 10-inch flex models as well as a 7-1/4" extension kit.

4-inch, knob adjustable handle	98-200008
6-inch, knob adjustable head and foot	98-200007
10-inch flex neck, adjustable head	98-200006
7-1/4-inch extension kit	98-200024
MS-520 Adapter plate	98-200011

Appendices

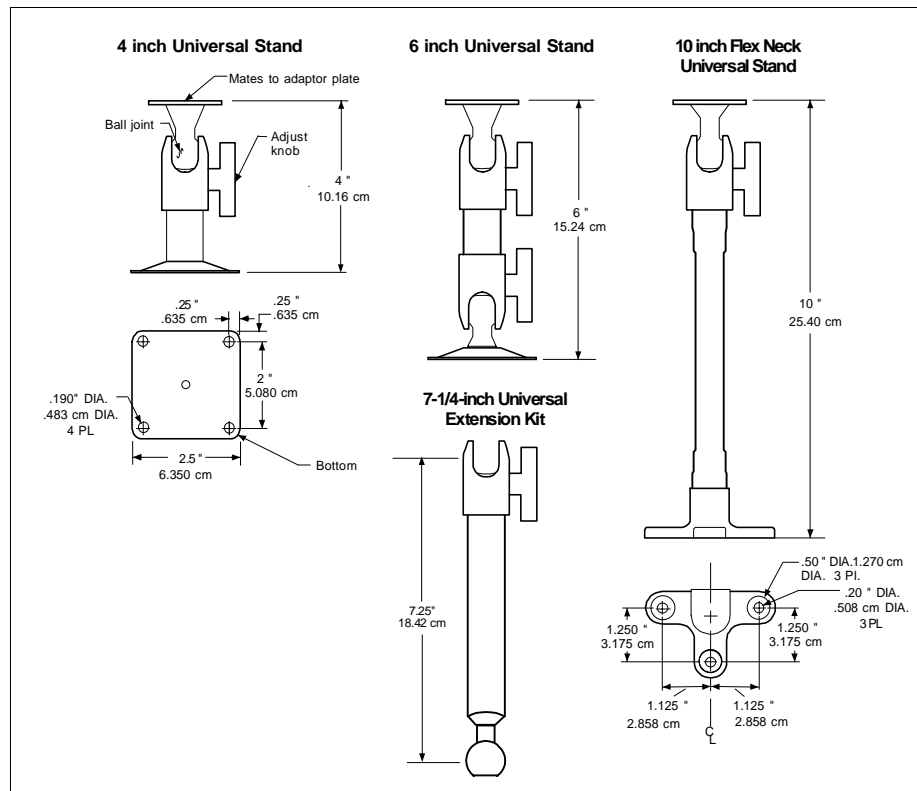


Figure A-3 Universal Stand

Appendix C — Glossary of Terms

Bar Code. Data that has been encoded into an array of parallel bars and spaces of varying widths.

Bar Code Density. Number of characters per inch or other unit of measure.

Decoder. A device that analyzes digital input provided by the scan head and translates it into bar code information.

Focal Length. The distance measured from the scan head to the center of the depth of field, or *focal* point.

Label Height. Regardless of orientation, the measurement taken along the length of a bar.

Label Length. Regardless of orientation, the measurement taken across the label's bars from one end to the other, including the quiet zone.

Label Speed. The rate in inches or centimeters per second that a label moves through the scan beam.

Ladder Label Orientation. A bar code label in which the bars are parallel to the direction of travel.

Mil. One thousandths of an inch or .0254 mm. In bar-coding, a measurement that identifies a bar code label by the width of its narrowest element.

Number of Scans Calculation. The number of times a bar code label is scanned by the scan head during one pass through the laser beam.

Object Detector. A photo electric device used to sense the presence or absence of an object.

Oval Spot. An elongated laser beam involving custom optics that is designed to project lengthwise with the label's bars and spaces.

Picket Fence Label Orientation. A bar code label in which the bars are perpendicular to the direction of travel.

Pitch. Label (or scan head) rotation around the center of the pitch axis.

Port. An access point for data entry and exit.

Read Range. The distances in which a label can be reliably read, as measured from the front of the scan head.

Read Rate. The reading performance of the scan head for a given label based on the percentage of good reads per a determined number of scans.

Round Spot. The standard laser beam as it appears on the label being scanned, sometimes slightly ovalized.

Scan Head. The module that projects laser light on bar code labels and receives reflected light back. This device changes the analog signal to a digital representation of the bar code and outputs it to a decoder.

Scan Rate. Number of scan lines created by the scan head per second.

Scan Width. The measurement (inches or centimeters) of the scan beam line at the readable scan range of a given application.

Skew. Label (or scan head) rotation around the center of the skew axis.

Specular Reflection. The direct, mirror-like reflection of laser light back to the scan head, causing over-light saturation.

Tilt. Label (or scan head) rotation around the center of the tilt axis.

Trigger. A signal, either external or serial, that initiates the read cycle and causes the decoder to expect label input.

Wide-to-narrow Ratio. The ratio of the width of the widest (or wider) bar to the narrowest bar of a given bar code symbology. For example, 2:1, 2.5:1, 3:1, and 4:1.

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