SE-950

Integration Guide

symbol
The Enterprise Mobility Company ™

SE-950
Integration Guide

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symbol
The Enterprise Mobility Company™

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Patents

This product is covered by one or more patents listed on the website: http://www.symbol.com/patents.

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About This Guide

Introduction

The SE-950 is a high performance miniature scan engine offering best in class, size, quality, reliability, durability and performance. The SE-950 is built upon Symbol Technologies' long heritage of high-performance scan engines, and is a superior miniature scan engine, replacing the industry benchmark, the SE-900. The SE-950 has more features than any other scan engine available and will deliver a new level of performance giving your products a competitive advantage.

The SE-950 features include:

- Superior working range on all bar code densities.
- Steady and crisp easy to view scan line.
- 104 scans/second nominal.
- Fast decode time: typical 40 msec.
- Integration Flexibility - small size and lightweight to maximize customer's design.
- Miniature, industry standard form factor.
- Low power consumption that increases battery life in portable devices.
- I^2C interface for added programmable functionality:
  - AIM mode to easily adjust scan line with bar code
  - Flash upgradeable
  - Two different scan angles provides flexibility to customize application.
  - Remote scan engine diagnostics/status reporting capability built in.
- Drop shocks of 2,000G.
- Die cast chassis.
- Patented Liquid Polymer Technology.

- Optimum Retro-Collective optical design assures consistent performance in all environmental conditions.
- Variable scan angle.
- IEC laser Class 1 and Class 2 configurations.
- Backward compatibility enabling easy performance upgrades to existing products.
- RoHS compliant.

The SE-950 delivers a new level of performance in miniature scan engines and sets your product apart from the competition. With over 8 million scan engines installed worldwide, Symbol scan engines are unmatched for reliability, performance, durability and size.

The *SE-950 Series Integration Guide* provides general instructions for mounting and set up of the SE-950-I000WR and SE-950-E000WR scan engines as well as instruction for replacing existing Symbol SE-800HP, SE-900 or SE-1200 scan engine with an SE-950.

Note

This guide provides general instructions for the installation of the scan engine into a customer's device. It is recommended that an opto-mechanical engineer perform an opto-mechanical analysis prior to integration.

Configurations

Available versions of the SE-950 scan engine include:

- SE-950-I000WR - Class 2 undecoded engine; tin connector
- SE-950-I100R - Class 2 undecoded engine; gold connector
- SE-950-E000WR- Class 1 undecoded engine; tin connector
- SE-950-E100R - Class 1 undecoded engine; gold connector.

Throughout this guide, all specifications noted for SE-950-I000WR apply to SE-950-I100R. All specifications noted for SE-950-E000WR apply to SE-950-E100R.

Notational Conventions

The following conventions are used in this document:

- Italics are used to highlight specific items in the general text, and to identify chapters and sections in this and related documents.
- Bullets (•) indicate:
  - action items
  - lists of alternatives
  - lists of required steps that are not necessarily sequential
- Sequential lists (e.g., those that describe step-by-step procedures) appear as numbered lists.

Service Information

If you have a problem with your equipment, contact the *Symbol Support Center*. Before calling, have the model number, serial number, and several of your bar code symbols at hand.

Call the Support Center from a phone near the scanning equipment so that the service person can try to talk you through your problem. If the equipment is found to be working properly and the problem is symbol readability, the Support Center will request samples of your bar codes for analysis at our plant.

If your problem cannot be solved over the phone, you may need to return your equipment for servicing. If that is necessary, you will be given specific directions.

Note: Symbol Technologies is not responsible for any damages incurred during shipment if the approved shipping container is not used. Shipping the units improperly can possibly void the warranty. If the original shipping container was not kept, contact Symbol to have another sent to you.

Symbol Support Center

For service information, warranty information or technical assistance contact or call the Symbol Support Center listed below. For the latest service information go to http://www.symbol.com.

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If you purchased your Symbol product from a Symbol Business Partner, contact that Business Partner for service.

Warranty

a. Seller's hardware Products are warranted against defects in workmanship and materials for a period of twelve (12) months from the date of shipment, unless otherwise provided by Seller in writing, provided the Product remains unmodified and is operated under normal and proper conditions. Warranty provisions and durations on software, integrated installed systems, Product modified or designed to meet specific customer specifications ("Custom Products"), remanufactured products, and reconditioned or upgraded products, shall be as provided in the particular Product documentation in effect at the time of purchase or in the accompanying software license.

b. Products may be serviced or manufactured with parts, components, or subassemblies that originate from returned products and that have been tested as meeting applicable specifications for equivalent new material and Products.

c. The sole obligation of Seller for defective hardware Products is limited to repair or replacement (at Seller's option) on a "return to service depot" basis with prior Seller authorization. Customer is responsible for shipment to the Seller and assumes all costs and risks associated with this transportation; return shipment to the Customer will be at Seller's expense. Customer shall be responsible for return shipment charges for Product returned where Seller determines there is no defect ("No Defect Found"), or for Product returned that Seller determines is not eligible for warranty repair. No charge will be made to Buyer for replacement parts for warranty repairs. Seller is not responsible for any damage to or loss of any software programs, data or removable data storage media, or the restoration or reinstallation of any software programs or data other than the software, if any, installed by Seller during manufacture of the Product.

d. The above warranty provisions shall not apply to any Product (i) which has been repaired, tampered with, altered or modified, except by Seller; (ii) in which the defects or damage to the Product result from normal wear and tear, misuse, negligence, improper storage, water or other liquids, battery leakage, use of parts or accessories not approved or supplied by Seller, or failure to perform operator handling and scheduled maintenance instructions supplied by Seller; or (iii) which has been subjected to unusual physical or electrical stress, abuse, or accident, or forces or exposure beyond normal use within the specified operational and environmental parameters set forth in the applicable Product specification; nor shall the above warranty provisions apply to any expendable or consumable items, such as batteries, supplied with the Product.

EXCEPT FOR THE WARRANTY OF TITLE AND THE EXPRESS WARRANTIES STATED ABOVE, SELLER DISCLAIMS ALL WARRANTIES ON PRODUCTS FURNISHED HEREUNDER, INCLUDING ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR USE. THE REMEDY SET FORTH IN THIS SECTION 6 IS BUYER'S SOLE AND EXCLUSIVE REMEDY FOR WARRANTY CLAIMS, AND IS EXPRESSLY IN LIEU OF ALL OTHER REMEDIES THAT MAY BE AVAILABLE TO BUYER AT LAW OR IN EQUITY.

1 Getting Started

The scan engines described in this guide are Class 1 and Class 2 laser devices. When evaluating or integrating this device, the following precautions should be observed:

CAUTION

This laser component emits FDA/IEC Class 2 laser light at the exit port. Do not stare into beam.

Introduction

The SE-950 is a miniaturized, 650 nm laser-based, single-line scan engine intended for integration into customer devices. This guide covers both the Class 2 version SE-950-I000WR and the Class 1 version SE-950-E000WR.

Theory of Operation

The SE-950 is a scan engine combined with a microprocessor to control the functionality of the engine and provide a communication link to the host computer.

The scan engine provides the following functions:

- laser drive circuit controlling a 650 nm laser diode
- scan element drive circuit controlling a resonant single line scan element
- analog receiver with circuitry to identify the bar and space locations in the received signal
- temperature sensor
- power on reset functionality.

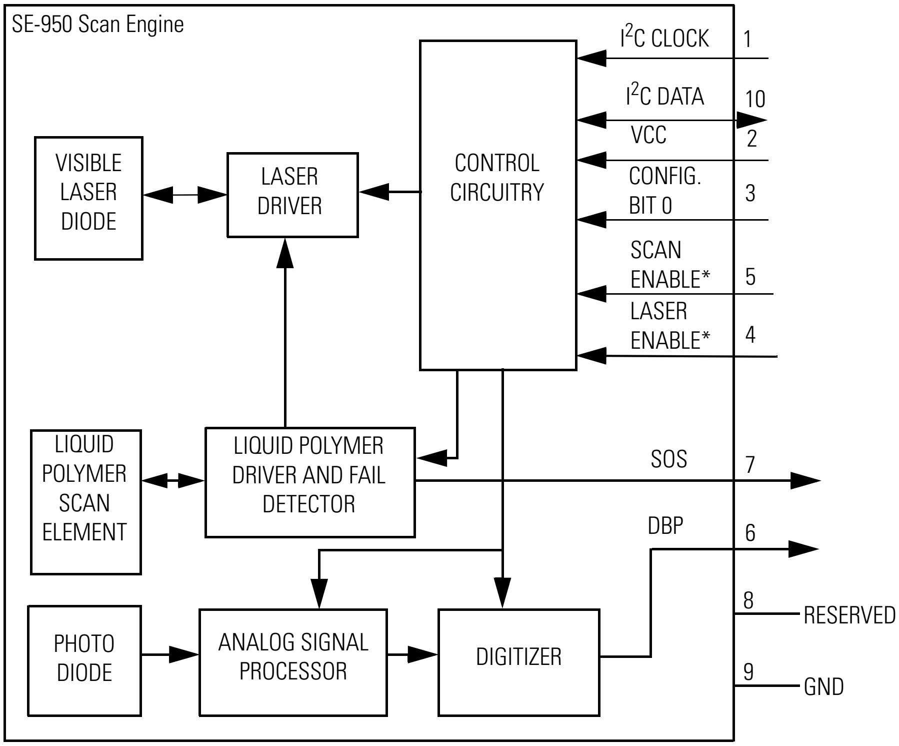
The microprocessor section provides the following functions:

- non-volatile memory for storing user preferences for digitizer capability parameters
- control over the programmable features of the analog circuitry used for optimizing decode performance

Scan Engine

The basic functionality of a scan engine is outlined below:

- A laser diode emits a coherent beam of light focused to a diameter appropriate for the bar code densities to be read.
- The laser beam strikes the mirror of the scan element. This mirror oscillates about its vertical axis and causes the beam to be deflected, forming the outgoing scan line.
- As the laser spot is swept across the bar code it is either reflected off the white spaces or absorbed by the black bars.
- A collection mirror tracks the location of the laser spot on the bar code, collects the reflected light and focuses it onto the receiver photodiode.
- The photodiode is a transducer that converts optical energy to electrical current. This current is fed into the analog signal processing circuitry.
- The analog signal processing circuitry amplifies, filters and edge enhances the signal returned from the bar code. These edges represent the place when the laser transitioned between a bar and a space, and represents the information contained in the bar code.
- The digitizer circuitry generates a digital waveform whose ones and zeros represent the widths of the bars and spaces in the bar code. This waveform is called the Digital Bar Pattern (DBP).
- The DBP is sent to the local microprocessor to be decoded.



* = Logic Low

Figure 1-1. Scan Engine Block Diagram

The laser drive uses multiple forms of feedback (optical and electrical) to control the diode laser to emit constant optical power, and to ensure compliance with the laser regulatory standards, described in *Chapter 5, Regulatory Requirements*.

The scan element is a mirror and magnet assembly cantilevered on a spring. This is a resonant system with a natural frequency of 52 Hz resulting in 104 scans per second. Alternating current forced through a drive coil mounted adjacent to the magnet causes the mirror to deflect to either side of its steady state position. This deflection causes the laser spot to be scanned across the bar code. A feedback coil coaxial with the drive measures the amplitude of the scan element and is used to set the scan amplitude. The SE-950 is factory calibrated to generate two user selectable scan angles, 35° and 47° (default).

Electrical Interface

Table 1-1 lists the pin functions of the SE-950 Series interface.

Table 1-1. Electrical Interface for SE-950 Series

<table>
<tr><th>Mnemonic</th><th>Pin No.</th><th>Type</th><th>Description</th></tr>
<tr><td>I^2C Clock (SCL)
I^2C Data (SDA)</td><td>1
10</td><td>I
I/O</td><td>Connects to I^2C Bus Master.
SDA is bi-directional pins with open drain outputs.
SCL is input only.
Notes:
1. If VCC is removed from the engine, these lines should be held low or made high impedance to prevent back-biasing of the engine.
2. See Figure 2-1 on page 2-2 for Pin 1 location.</td></tr>
<tr><td>VCC</td><td>2</td><td>I</td><td>Supplies power to the engine.
3.3 VDC,±10%, 78 mA typical</td></tr>
<tr><td>Configuration Bit 0 (Config0)</td><td>3</td><td>I</td><td>Configuration select pin.
High = Normal scan operation.
Low = Sets the scanner to either Aim or ScanStand mode, depending upon how the host programs the scanner using the I^2C Set Scan Engine Mode command. Default is AIM mode. See PARAM_SET_SCAN_ENGINE_MODE < AIM | SCANSTAND>, <csum> on page 7-6.
Note: Diode isolated to prevent back biasing of the engine.</td></tr>
<tr><td>Laser Enable*</td><td>4</td><td>I</td><td>Low = the laser is turned on only if pin 5 is also low.
High (or not connected) = Laser is off.
Note: Diode isolated to prevent back biasing of the engine.</td></tr>
<tr><td>Scan Enable*</td><td>5</td><td>I</td><td>Low = the scan element runs and all circuitry is activated.
High = the scan engine enters a low power mode.
Note: Diode isolated to prevent back biasing of the engine.</td></tr>
<tr><td>Digitized Bar Pattern</td><td>6</td><td>O</td><td>This output represents the widths of the bars and spaces in the symbol being scanned. Output is CMOS type ($V_{OH} = V_{CC}$ - 0.5V, $V_{OL} \le$ 0.5V). Valid DBP data should not be expected for about 40 msec after both Laser Enable and Scan Enable are active.
high = bar, low = space</td></tr>
<tr><td>Start of Scan</td><td>7</td><td>O</td><td>This output changes from high to low, or low to high, when the scanned laser changes its direction of travel at either end of the scan line. Output is CMOS type ($V_{OH} = V_{CC}$ - 0.5V, $V_{OL} \le$ 0.5V).</td></tr>
<tr><td>Reserved</td><td>8</td><td>PWR</td><td>Reserved, can be floating, driven or connected to ground.</td></tr>
<tr><td>Gnd</td><td>9</td><td>PWR</td><td>Ground.</td></tr>
</table>

2
Installation

Introduction

This chapter provides information for mounting and installing the SE-950 scan engine. Physical and electrical considerations are presented, together with recommended window properties.

Grounding

CAUTION

The SE-950 chassis is connected to GROUND. If you are installing the SE-950 to a hot or powered host, you must isolate the two.

An insulator can be inserted between the two chassis, and if metallic (non-magnetic) screws are used, shoulder washers must be used to isolate the screws from the host. Non-metallic screws may also be used if mechanical considerations permit.

ESD

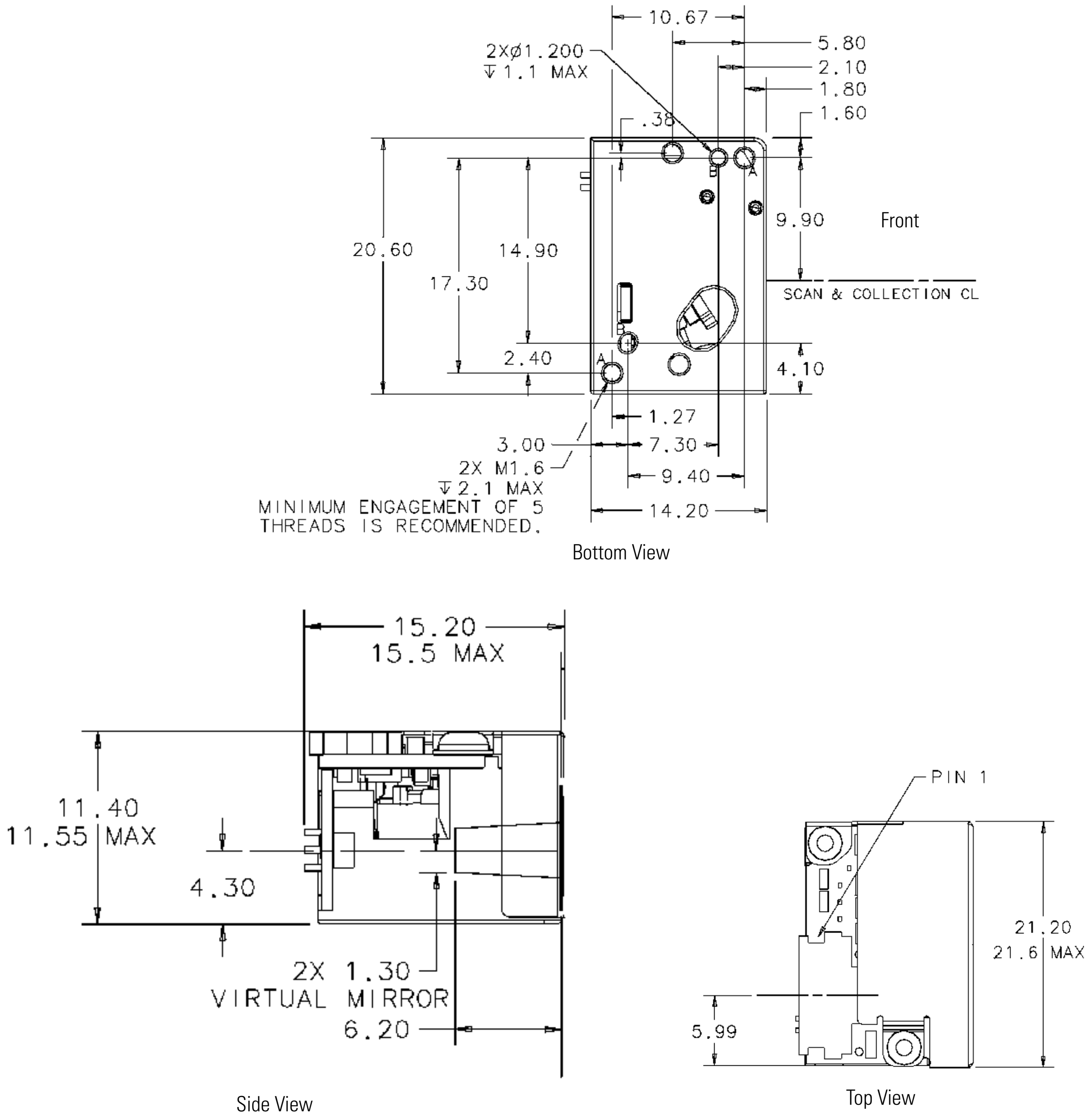
The SE-950 is protected from ESD events that may occur in an ESD-controlled environment. Always exercise care when handling the module. Use grounding wrist straps and handle in a properly grounded work area.

Environment

The SE-950 must be sufficiently enclosed to prevent dust particles from gathering on the mirrors, laser lens, and the photodiode. Dust and other external contaminants will eventually cause degradation in unit performance. Symbol does not guarantee performance of the engine when used in an exposed application.

Mounting

There are two mounting holes (M1.6 x 0.35), and two locator holes on the bottom of the chassis (see Figure 2-1). The SE-950 may be mounted in any orientation without any degradation in performance.



Dimensions are in: mm.

Notes:

1. Chassis is electrically connected to ground and must be isolated from VCC.
2. Mounting screws and locating pins must be non-magnetic material. Do not place any magnetic material within 1 inch of the SE-950 chassis without testing.
3. Holes marked 'A' are mounting holes. Holes marked 'B' are scan engine location aids.
4. This is a reference drawing and is not intended to specify or guarantee all possible integration requirements for this engine.

Figure 2-1. SE-950 Mounting Diagram

Installing the SE-950

Before installing the SE-950 into your host equipment, there are five important points to consider:

- The SE-950 chassis is electrically connected to ground. It must be isolated from VCC.
- Use only non-magnetic screws (i.e. stainless steel 300 Series screws), or locating pins when mounting the SE-950. Magnetic screws, or pins may cause the scan element/mirror neutral position to change. Recommended screw torque is shown in Table 2-1.

Table 2-1. Screw Torque

	Recommended
Standard	10 ± 2 oz-in
Metric	0.72 ± 0.14 kg-cm

- It is strongly recommended that you use a thread locking method, such as a Nylok patch (a thread locking compound pre-applied to the screws).

- Do not place magnetic material (i.e. dynamic speakers, ringers, vibrators, inductors, metal parts, etc.) within 1 inch of the SE-950 chassis. The SE-950 Liquid Polymer scan element used to generate the scan line has a magnet on one end. Locating magnetic or ferrous material near the scan engine may influence the pointing of the scan line coming out of the engine. Placement of all magnetic or ferrous material should be evaluated during system layout to determine if 1 inch is sufficient.
- Leave sufficient space to accommodate the maximum size of the engine.

CAUTION

When using metallic non-magnetic screws, ensure that the screwdriver or screw tip that you use is non-magnetic. Magnetic screwdrivers or screw tips will change the scan element/mirror neutral position. Note that magnetic screwdrivers will not permanently alter pointing, as long as they are removed.

Optical

The SE-950 uses a sophisticated optical system that is capable of providing scanning performance that can match or exceed the performance of much larger scanners. The performance of the scan engine will not be degraded by a properly designed enclosure.

Note

This guide provides general instructions for the installation of the scan engine into a customer's device. It is recommended that an opto-mechanical engineer perform an opto-mechanical analysis prior to integration.

The following guidelines are provided to aid the Optical Engineer in design and specification of the window and enclosure.

Housing Design

The orientation of the exit window has a large effect on scanner performance. See tables 2-4, 2-5, 2-6, 2-7 beginning on *page 2-10* for exit window distances. In addition to providing obstacle-free paths for outgoing and incoming light, a good housing design ensures that the outgoing laser light reflected off of the window back into the housing is attenuated sufficiently before reaching the detector.

Unwanted laser light reaching the detector is termed “stray light”. As a goal, stray light should be kept below 5 nanowatts for full range performance. Stray light is difficult to model and is highly dependent upon the housing design. It is influenced by the placement of the exit window and the surface properties of the components in the immediate vicinity of the scan engine. The surface color and finish of components surrounding the engine must be considered. Black surfaces can absorb as much as 90%-98% of the incident light. Smooth specular reflecting surfaces can be used to steer stray light away from the engine. Diffuse surfaces can be used to attenuate the light by spreading the reflected light over a wide range of angles. Use caution if the scan line reflects off of circuit boards. Traces and solder pads behave like mirrors and can inadvertently cause performance degradation.

The position of the detector creates a Side Field of View area where ambient light into this area can affect scanner performance. See *Figure 2-6 on page 2-11* for an illustration of the Side Field of View. Although not required, it is recommended that the housing be designed to block ambient light into the Side Field of View to increase performance at 10,000 FCD.

The tilt of the exit window is properly determined by ray tracing the exit beam reflection off of the window, and ensuring that the reflected light is directed away from the inside of the scan engine. This analysis should include the positional and angular tolerances of the scan engine and exit window. Recessing the window into the housing is also recommended to prevent scratches on the window. In keeping with good practice, a proper design should be supplemented with testing and verification.

The height and width of the exit window is determined such that the outgoing laser beam and return light is not clipped. See *Figure 2-6 on page 2-11*, Table 2-6 and Table 2-7 on *page 2-12* for recommended minimum widths at various window positions. It is highly recommended to analyze additional positioning tolerance of the scan engine based on your specific application and increase window size accordingly.

Note

SE-950 performance is not sensitive to exit window thickness. However, window thickness is application dependent. For most applications it is 1.0 mm to 2.0 mm (.039 in to 079 in).

Wavefront Distortion

Wavefront distortion is a measure of the window’s optical quality. Since the optical requirements of the exit window are different for the exit and entrance beam envelopes, a laser clear aperture and the collection clear aperture are defined. The laser clear aperture requires high optical performance, and the collection clear aperture requires fair optical performance. Refer to Figure 2-2 for the location of the two apertures.

The following Wavefront Distortion specifications are recommended:

Wavefront Distortion (transmission) measured at 633 nm

1. Within laser clear aperture: Over any 1.0 mm diameter area.
   - optical power measured in any direction: <0.050 waves
   - irregularities after subtracting optical power and astigmatism: <0.120 waves (P-V) and < 0.015 waves (RMS).
2. Within collection clear aperture: < 10 waves (P-V).

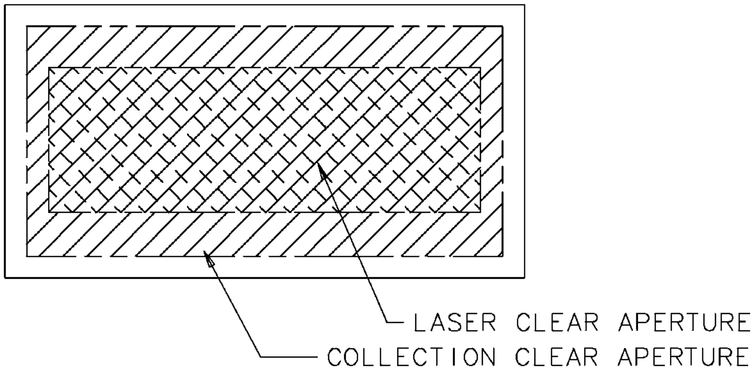


Figure 2-2. Clear Apertures

Collection Beam Geometry

Figure 2-2 also illustrates the beam envelope entering the scan engine. You must ensure that the collection path is free of obstructions for full scan angle performance.

Laser Clear Aperture

The laser clear aperture is the area on the exit window that intersects the exit beam envelope as shown in Figure 2-3. Note that at any instance in time, the outgoing laser beam is collimated and approximately 1 mm in diameter, while during scanner operation the beam is constrained within the exit beam envelope. For dimensions and information about clear aperture calculations see *Exit Window Characteristics on page 2-10* and *Exit Window Positioning on page 2-11*.

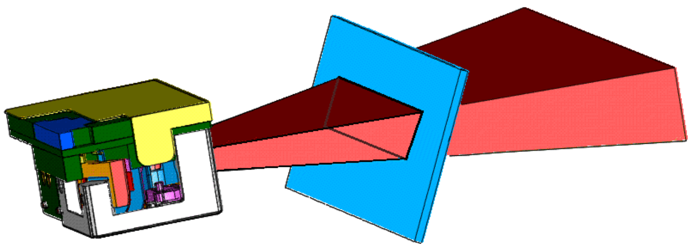


Figure 2-3. Exit Beam Envelope

Collection Clear Aperture

As shown in Figure 2-4, the collection clear aperture is the area on the exit window which intersects the collection beam envelope. In both cases, you must ensure that the paths are free of obstructions. In addition, you should incorporate a minimum of a 0.020” to 0.040” spacing between the clear apertures and the window borders.

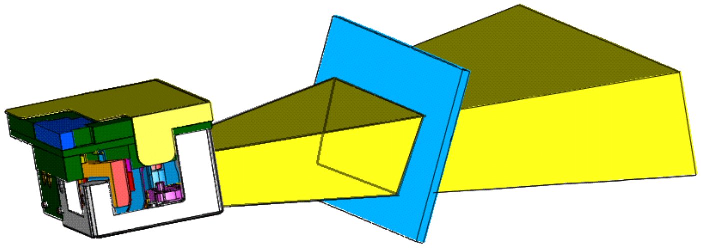


Figure 2-4. Entrance Beam Envelope

Exit Window Materials

Many window materials that look perfectly clear to the eye can contain stresses and distortions which affect the laser beam and reduce scan engine performance. For this reason, only optical glass or cell cast plastics are recommended. Following are descriptions of three popular exit window materials:

- Poly-methyl Methacrylic (PMMA)
- Allyl Diglycol Carbonate (ADC)
- Chemically tempered float glass.

Cell Cast Acrylic (ASTM: PMMA)

Cell Cast Acrylic, or Poly-methyl Methacrylic is fabricated by casting acrylic between two precision sheets of glass. This material has very good optical quality, but is relatively soft and susceptible to attack by chemicals, mechanical stress and UV light. It is strongly recommended to have acrylic hard-coated with Polysiloxane to provide abrasion resistance and protection from environmental factors. Acrylic can be laser-cut into odd shapes and ultrasonically welded.

Cell Cast ADC, Allyl Diglycol Carbonate (ASTM: ADC)

Also known as CR-39™, ADC, a thermal setting plastic widely used for plastic eyeglasses, has excellent chemical and environmental resistance. It also has an inherently moderate surface hardness and therefore does not require hard-coating. This material cannot be ultrasonically welded.

Chemically Tempered Float Glass

Glass is a hard material which provides excellent scratch and abrasion resistance. However, unannealed glass is brittle. Increased flexibility strength with minimal optical distortion requires chemical tempering. Glass cannot be ultrasonically welded and is difficult to cut into odd shapes.

Abrasion Resistance

To gauge a window's durability, it is useful to quantify its abrasion resistance using ASTM standard D1044, Standard Test Method for Resistance of Transparent Plastics to Surface Abrasion. Also known as the Taber Test, this measurement quantifies abrasion resistance as a percent increase in haze after a specified number of cycles and load. Lower values of the increase in haze correspond to better abrasion and scratch resistance. Refer to Table 2-2.

Table 2-2. Taber Test Results on Common Exit Window Materials

Sample	Haze 100 cycles	Haze 500 cycles	Abrasion Resistance
Chemically Tempered Float Glass	1.20%	1.50%	Best
PMMA with Polysiloxane Hardcoat	3%	10%	
ADC	5%	30%	
PMMA	30%		Worst
* All measurements use a 100 gram load and CS-10F Abraser			

Anti-Reflection (AR) Coatings

Anti-reflection coatings may be used for stray light control or to achieve maximum working range, however, they are expensive and therefore not recommended. Also, AR coatings have very poor abrasion and scratch resistance, making only single side AR coatings practical (the AR coated side of the window would face the interior of the scanner).

Color

Plastic is available in a wide range of colors. Exit windows can be colored if desired. The only requirement is the optical transmission in the spectral region between 640 nm and 670 nm, which should be a minimum of 85%.

Surface Quality

Surface quality refers to residual defects on the surfaces of the window. The recommended window specification for this follows the US Military Specification Standard MIL-0-13830A for scratch and dig performance.

Surface Quality: 60-20 per MIL-0-13830A

Commercially Available Coatings

Table 2-3 on page 2-7 lists some exit window manufacturers and anti-reflection coaters.

Polysiloxane Coating

Polysiloxane type coatings are applied to plastic surfaces to improve the surface resistance to both scratch and abrasion. They are generally applied by dipping and then allowed to air dry in an oven with filtered hot air.

Table 2-3. Exit Window Manufacturers and Coaters

Company	Discipline	Specifics
Evaporated Coatings, Inc. 2365 Maryland Road Willow Grove, PA 19090 (215) 659-3080	Anti-reflection coater	Acrylic window supplier Anti-reflection coater

Table 2-3. Exit Window Manufacturers and Coaters (Continued)

Company	Discipline	Specifics
Fosta-Tek Optics, Inc. 320 Hamilton Street Leominster, MA 01453 (978) 534-6511	Cell-caster, hard coater, laser cutter	CR39 exit window manufacturer
Glasflex Corporation 4 Sterling Road Sterling, NJ 07980 (908) 647-4100	Cell-caster	Acrylic exit window manufacturer
Optical Polymers Int. (OPI) 110 West Main Street Milford, CT 06460 (203)-882-9093	CR-39 cell-caster, coater, laser cutter	CR39 exit window manufacturer
Polycast 70 Carlisle Place Stamford, CT 06902 800-243-9002	acrylic cell-caster, hard coater, laser cutter	Acrylic exit window manufacturer
TSP 2009 Glen Parkway Batavia, OH 45103 800-277-9778	acrylic cell-caster, coater, laser cutter	Acrylic exit window manufacturer

Location and Positioning

Symbol Position with Respect to a Fixed-Mount Scan Engine

It is sometimes necessary to mount the SE-950 in such a way that it is able to read symbols that are automatically presented to it, or that are always presented in a pre-determined location. In these situations positioning of the SE-950 with respect to the symbol location is critical. Failure to properly position the scan engine and symbol may lead to unsatisfactory reading performance.

The SE-950 can be programmed to two different scan angles. It is recommended that the position of the scan engine is set using the widest scan angle (47°). Setting the position for the narrow scan angle (35°) and then changing the scan angle might cause clipping of the laser beam against the housing.

Following is a series of steps you should take to ensure satisfactory operation of the SE-950 in your installation:

1. Determine the optimum distance between the scan engine and the symbol. Due to the large variety of symbol sizes, densities, print quality, etc., there is no simple formula to calculate this optimum symbol distance. Try this:
   a. Measure the maximum and minimum distance at which your symbols can be read.
   b. Locate the scan engine so the symbol is near the middle of this range when being scanned.

   Check the near and far range on several symbols. If they are not reasonably consistent there may be a printing quality problem that can degrade the performance of your system. Symbol Technologies can provide advice on how to improve your installation.
2. Center the symbol (left to right) in the scan line whenever possible.
3. Position the symbol so that the scan line is as near as possible to perpendicular to the bars and spaces in the symbol.
4. Avoid specular reflection (glare) off the symbol by tilting the top or bottom of the symbol away from the engine. The exact angle is not critical, but it must be large enough so that if a mirror were inserted in the symbol location, the reflected scan line would miss the front surface of the engine. See *Exit Window Characteristics on page 2-10* for maximum angles.
5. If a window is to be placed between the engine and the symbol, the determination of optimum symbol location should be made with a representative window in the desired window position. Read the sections of this chapter concerning window quality, coatings and positioning.
6. Give the scan engine time to dwell on the symbol for a minimum of 40 msec. Poor quality symbols take longer to decode. When first enabled, the scan engine may take two or three scans before it reaches maximum performance. Enable the scan engine before the symbol is presented, if possible.

Exit Window Characteristics

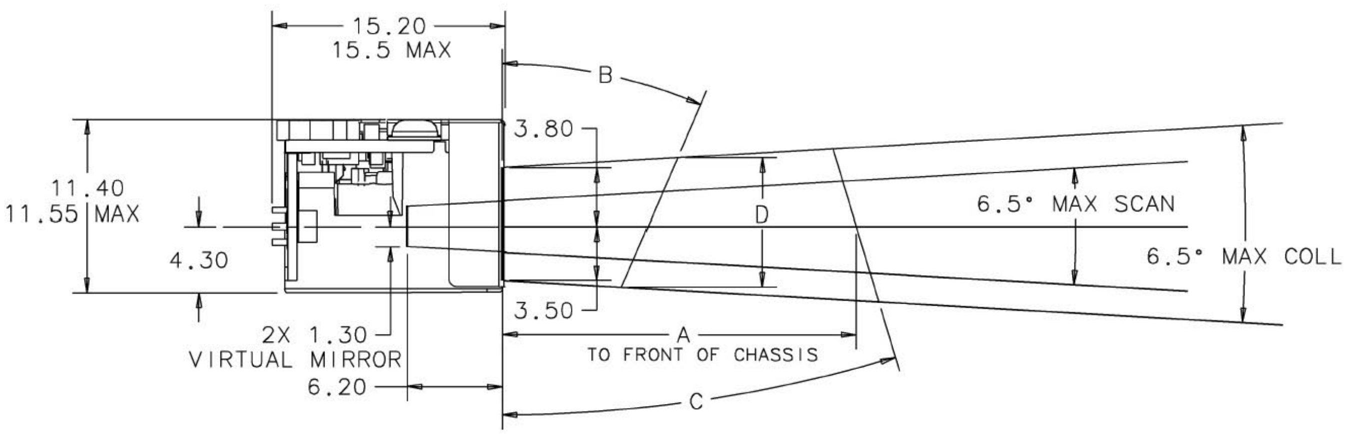


Figure 2-5. Exit Window Tilt Angle

Table 2-4. Exit Window Distance from Scan Engine: 0.15 in - 0.36 in (3.8 mm - 9.0 mm)

A	Distance from Scan Engine on center line (in./mm)*	0.15/ 3.8	0.156/ 4	0.18/ 4.5	0.20/ 5	0.22/ 5.5	0.24/ 6	0.25/ 6.35	0.26/ 6.5	0.28/ 7	0.31/ 8	0.36/ 9
B	Minimum Window Positive Tilt (degrees)	36.0	35.0	32.5	31.0	29.0	27.5	26.5	26.0	25.0	22.5	20.5
C	Minimum Window Negative Tilt (degrees)	34.0	33.5	31.0	29.5	27.5	26.0	25.0	24.5	23.5	21.5	19.5

Table 2-5. Exit Window Distance from Scan Engine: 0.39 in - 2.00 in (10.0 mm - 50.8 mm)

A	Distance from Scan Engine on center line (in./mm)*	0.39/ 10	0.48/ 12	0.50/ 12.7	0.55/ 14	0.75/ 19	1.00/ 25.4	1.25/ 31.8	1.50/ 38	1.75/ 44.5	2.00/ 50.8
B	Minimum Window Positive Tilt (degrees)	19.0	17.0	16.5	15.0	12.0	10.0	9.0	8.0	7.5	7.0
C	Minimum Window Negative Tilt (degrees)	18.5	16.0	15.5	14.5	12.5	9.5	8.5	7.5	7.0	6.5

Notes:

1. Chassis is electrically at ground.
2. Maximum horizontal scan/collection envelope (denotes max. scan/max. coll in top views) = nominal scan angle + tolerance.
   a. Two programmable nominal scan angles: 35°, 47°
   b. Total tolerance = 10°, includes:
      i. Scan amplitude tolerance: ± 2°.
      ii. Pointing error due to droop, temperature variation: ±2.5º Typ.
      iii. Pointing shift after 2,000G shock: ±1.5º Typ.
3. Maximum vertical scan/collection envelope (denotes max, scan/max. coll in side views) = nominal scan line + tolerance.
   a. Nominal vertical scan line: 0°
   b. Total tolerance = 6.5°, includes:
      i. Pointing tolerance: ± 2.5° Typ.
      ii. Pointing error due to droop, temperature variation: ±0.5º Typ.
      iii. Pointing shift after 2,000G shock: ±0.5º Typ.
4. Maximum envelope does not include integration tolerances.
5. To guarantee operation at 10,000 FCD, position opaque material to block ambient light from entering the zone labeled “Direct Field of View of Photo Detector.”
6. The SE-950 scan engine does not require margin on either side of the bar code to decode.The 47° scan line provides identical scanning performance to older scan engines with a scan line of 53°.
7. This is a reference drawing and is not intended to specify or guarantee all possible integration requirements for this engine.

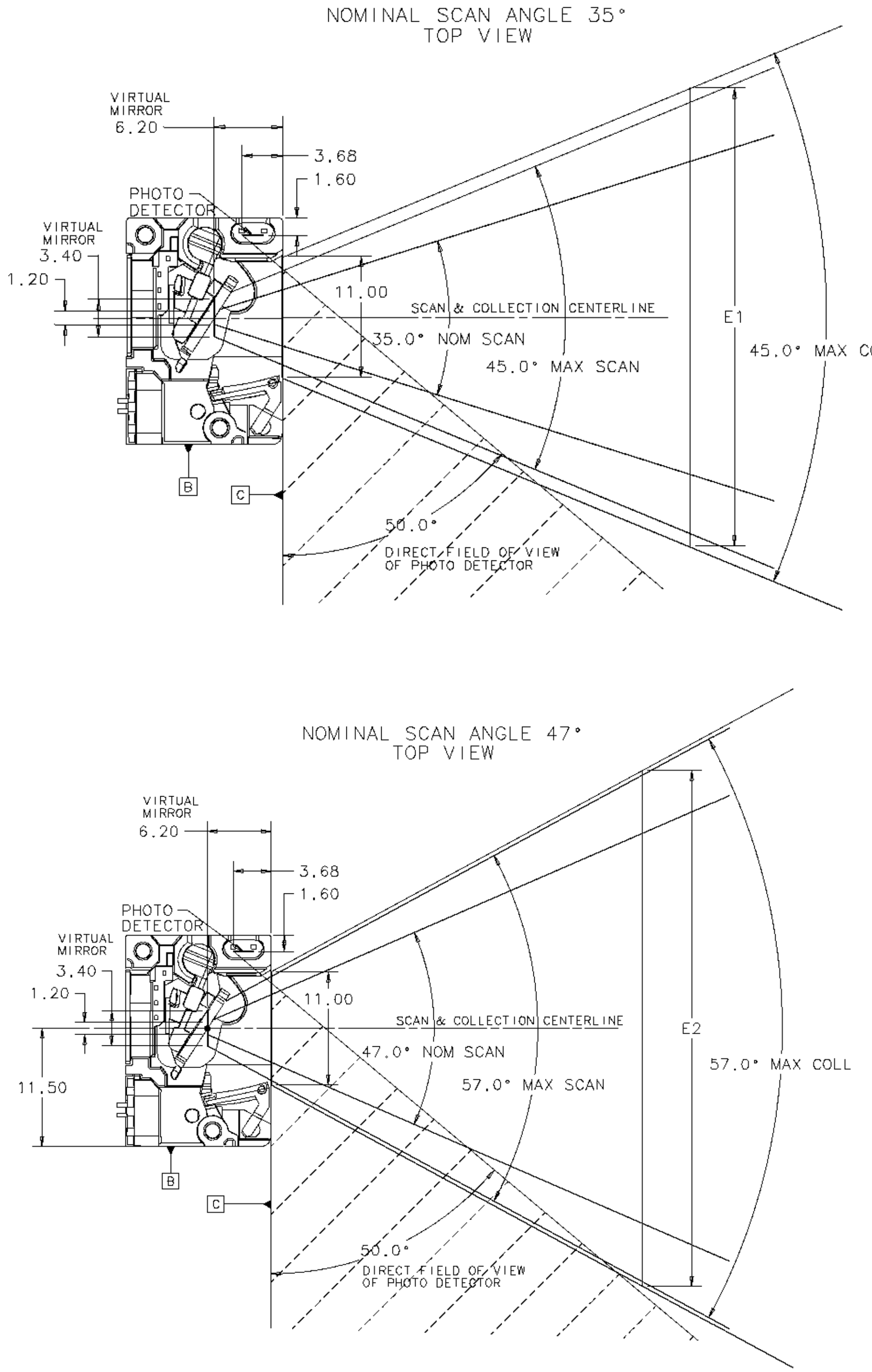


Figure 2-6. Exit Window Positioning

Table 2-6. Exit Window Distance from Scan Engine: 0.15 in - 0.36 in (3.8 mm - 9.0 mm)

A	**Distance from Scan Engine on center line (in./mm)***	**0.15/ 3.8**	**0.156/ 4**	**0.18/ 4.5**	**0.20/ 5**	**0.22/ 5.5**	**0.24/ 6**	**0.25/ 6.35**	**0.26/ 6.5**	**0.28/ 7**	**0.31/ 8**	**0.36/ 9**
D	Minimum Window Clear Aperture Height (mm)	8.2	8.2	8.2	8.3	8.3	8.4	8.4	8.4	8.5	8.6	8.7
E1	Minimum Window Clear Aperture Width (mm) at nominal scan plane (for 35° Scan Angle)	14.2	14.2	14.8	15.2	15.6	16.1	16.3	16.5	16.9	17.6	18.5
E2	Minimum Window Clear Aperture Width (mm) at nominal scan plane (for 47° Scan Angle)	15.2	15.2	15.9	16.5	17.0	17.6	18.0	18.3	18.7	19.7	20.8
	Note: Window is assumed non A/R coated. Illustrated window position is at the inner surface. For window positions not shown in the table, minimum window angle and width can be linearly interpolated between the two nearest shown positions.											

Table 2-7. Exit Window Distance from Scan Engine: 0.39 in - 2.00 in (10.0 mm - 50.8 mm)

A	**Distance from Scan Engine on center line (in./mm)***	**0.39/ 10**	**0.48/ 12**	**0.50/ 12.7**	**0.55/ 14**	**0.75/ 19**	**1.00/ 25.4**	**1.25/ 31.8**	**1.50/ 38**	**1.75/ 44.5**	**2.00/ 50.8**
D	Minimum Window Clear Aperture Height (mm)	8.8	9.0	9.1	9.3	9.7	10.5	11.1	11.8	12.7	13.5
E1	Minimum Window Clear Aperture Width (mm) at nominal scan plane (for 35° Scan Angle)	19.3	21.0	21.5	22.6	26.7	32.0	37.3	42.4	47.7	52.9
E2	Minimum Window Clear Aperture Width (mm) at nominal scan plane (for 47° Scan Angle)	21.9	24.1	24.9	26.2	31.7	38.6	45.5	52.2	59.2	66.0
	Note: Window is assumed non A/R coated. Illustrated window position is at the inner surface. For window positions not shown in the table, minimum window angle and width can be linearly interpolated between the two nearest shown positions.										

Accessories

Flex Cable

A flex strip cable can be used to connect the SE-950 scan engine to the host interface. Figure 2-7 illustrates the 10-pin flex strip cable (p/n 15-10414-01). Table 2-8 lists the available accessories for the scan engine, available from Symbol Technologies.

Table 2-8. Symbol Accessories: Flex Strip & Adapter Plate

Item	Symbol Part Number
Tapered 10-Pin Flex Strip	15-10414-01
Mounting Adapter Plate (for SE-1200 conversion only)	KT-1200MB-01

Hardware Accessories

Table 2-9 lists sources for hardware accessories for the scan engine.

Table 2-9. Hardware Accessories

Company	Discipline	Specifics
Tower Fasteners Inc. 1690 North Ocean Ave. Holtsville, New York 11742-1823 (631) 289-8800	Fasteners	Metallic, non-magnetic M1.6 x 0.35 machine screws. Length is integration dependent. However, a minimum of 5 threads is recommended.
AXON' Cable Inc. 1314 Plum Grove Road Schaumburg, IL 60173 (847) 230-7800	Flex Cables	950 connector to mate with Molex 54548-1070.

10-Pin Flex Cable

The 10-pin to 10-pin flex cable (p/n 15-10414-01), may be used only for evaluation purposes and not for production units (see Figure 2-7).

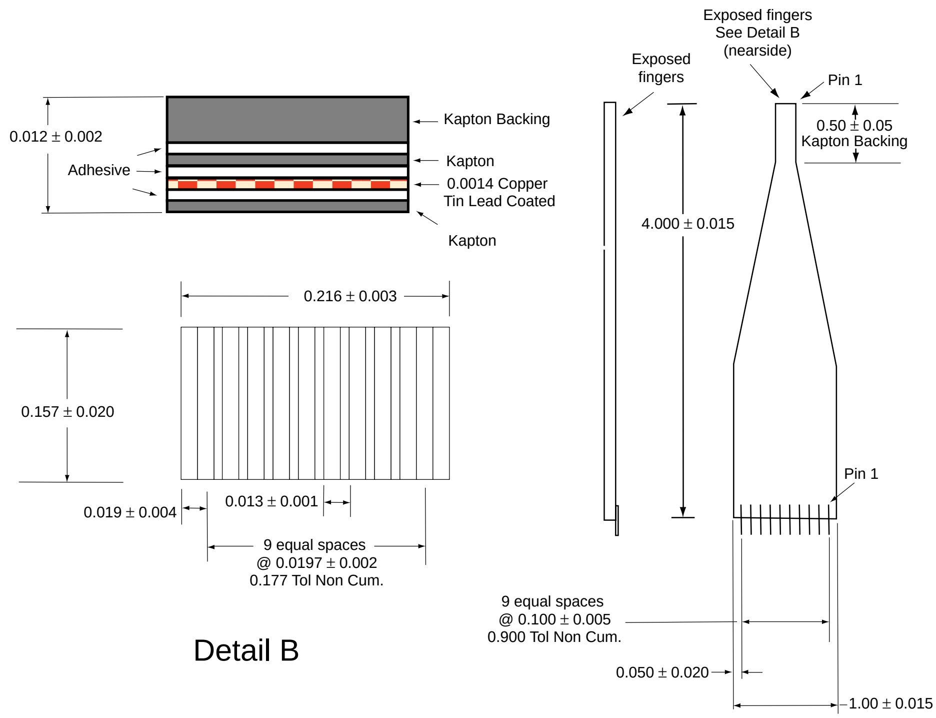


Figure 2-7. 10-Pin to 10-Pin Flex Cable

Regulatory Requirements

Integration requirements, and documentation and labeling requirements for Class 1 and Class 2 laser products are described in *Chapter 5, Regulatory Requirements*.

3

Replacing Existing Engines

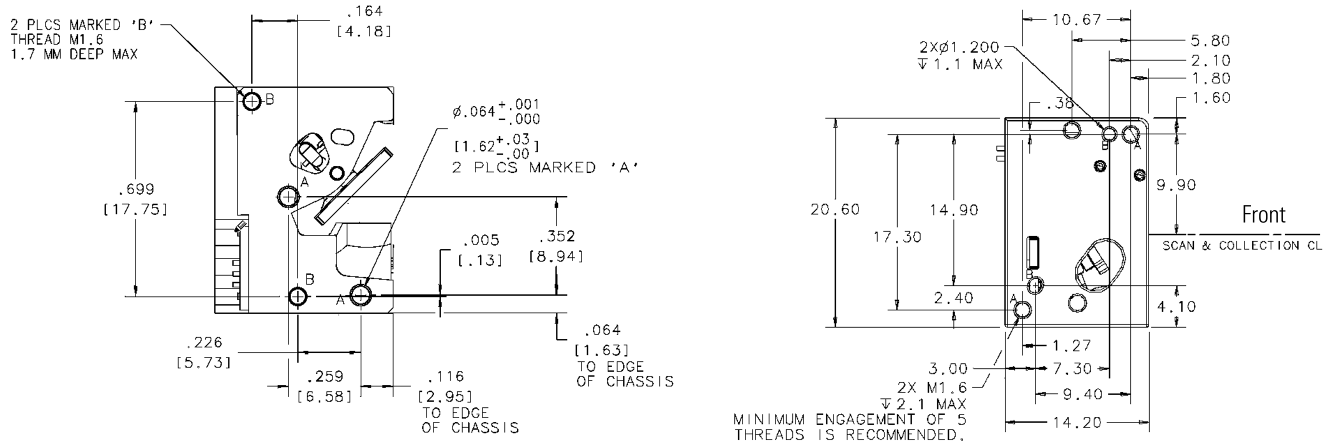
Introduction

This chapter provides information for replacing an SE-800HP, SE-900 or SE-1200 scan engine with the SE-950. Physical and electrical considerations are presented, together with recommended window properties.

Replacing an SE-800HP with the SE-950 Scan Engine

Mounting

Figure 3-1 illustrates the mounting differences between the SE-800HP and SE-950 scan engines. The SE-950 can be used as a replacement for the SE-800HP scan engine, however, the mounting holes for the SE-950 do not match those of the SE-800HP. You must modify the mounting holes and locating pins on the host device.



SE-800HP Bottom View SE-950 Bottom View

Figure 3-1. SE-800HP vs. SE-950 Mounting Diagram

Electrical

The SE-800HP chassis is electrically connected to VCC while the SE-950 chassis is electrically connected to ground. The SE-950 chassis must be isolated from the host ground.

The SE-800HP scan engine operates at a VCC of 3.3 - 5 VDC (±10%). The SE-950 scan engine operates at a VCC of 3.3 V (±10%) only.

The following I^2C features are supported:

- changing scan angle between 35° and 47°
- selecting Aim or Scanstand modes
- RSM reporting support
- reflash loading to upgrade firmware.

Refer to *Chapter 7, I^2C Interface* for detailed information on I^2C communication.

Optical

When replacing an SE-800HP scan engine with the SE-950 scan engine the following must be taken into consideration:

- Design of housing and scan engine must be reviewed by an optical-mechanical engineer.
- See Table 2-6 and Table 2-7 on *page 2-12* to verify whether the exit window angle and size satisfy the recommended minimum requirement.
- Baffles designed for the SE-800HP may not be applicable for the SE-950 due to the positioning of the photo-diode.
- The SE-950 scan engine can be programmed to two different scan angles. It is recommended that the position of the scan engine is set using the widest scan angle (47°). Setting the position for the narrow scan angle (35°) and then changing the scan angle might cause clipping (internal reflection) of the laser beam against the housing.
- The SE-950 scan engine does not require margin on either side of the bar code to decode.The 47° scan line provides identical scanning performance to older scan engines with a scan line of 53°.
- See *Optical on page 2-4* for recommendations on window properties (material, color, spectral transmission, wavefront distortion, surface quality, coating, etc.). Window properties that satisfy the recommendations for the SE-800HP scan engine automatically satisfy the recommendations for SE-950 scan engine.

Mechanical

When replacing an SE-800HP scan engine with the SE-950 scan engine the following must be taken into consideration:

- Regulatory labels must reflect new VLD power.
- Consider that existing cable flexes may not be compatible with the SE-950 scan engine.
- Consider mounting holes.

Regulatory

Integration requirements, and documentation and labeling requirements for Class 1 and Class 2 laser products are described in *Chapter 5, Regulatory Requirements*.

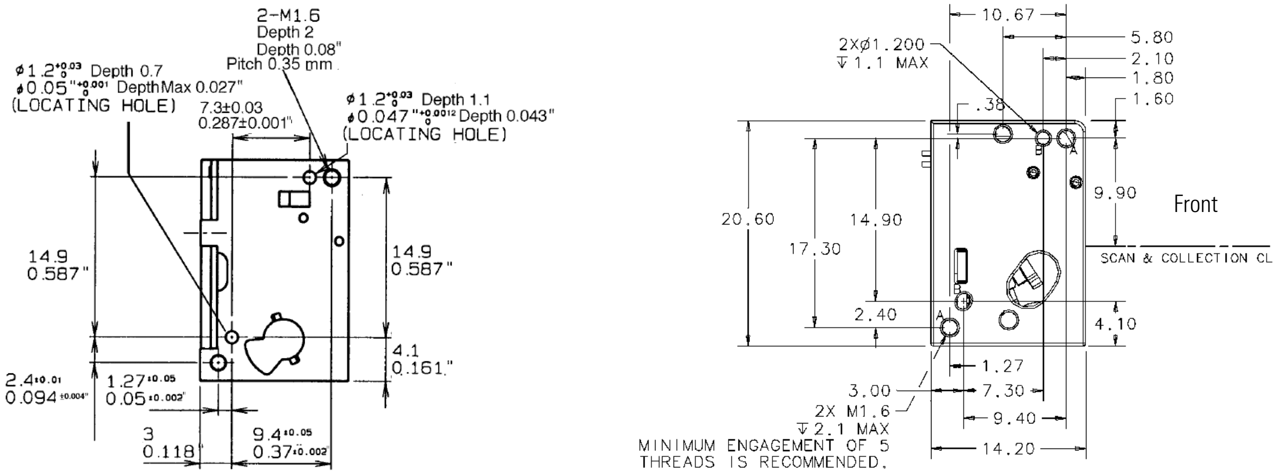
Replacing an SE-900 with the SE-950 Scan Engine

The SE-950 can be used as a replacement for the SE-900 scan engine. The mounting holes for the SE-950 match those of the SE-900.

The SE-900 scan engine chassis is electrically connected to VCC whereas the SE-950 scan engine chassis is electrically connected to ground and must be isolated from the host ground.

Mounting

Figure 3-1 illustrates the mounting differences between the SE-900 and SE-950. The SE-950 can be used as a replacement for the SE-900 scan engine because the mounting holes for the SE-950 exactly match those of the SE-900. You do not have to modify the mounting holes and locating pins on the host device.



SE-900 Bottom View

SE-950 Bottom View

Figure 3-2. SE-900 vs. SE-950 Mounting Diagram

Electrical

The SE-900 chassis is electrically connected to VCC while the SE-950 chassis is electrically connected to ground. The SE-950 chassis must be isolated from the host ground.

The SE-900 scan engine operates at a VCC of 3.3 - 5.0 VDC (±10%). The SE-950 scan engine operates at a VCC of 3.3 V (±10%) only.

The following I^2C features are supported:

- changing scan angle between 35° and 47°
- selecting Aim or Scanstand modes
- RSM reporting support
- reflash loading to upgrade firmware.

Refer to *Chapter 7, I^2C Interface* for detailed information on I^2C communication.

Optical

When replacing an SE-900 scan engine with the SE-950 scan engine the following must be taken into consideration:

- Design of housing and scan engine must be reviewed by an optical-mechanical engineer.
- See Table 2-6 and Table 2-7 on *page 2-12* to verify whether the exit window angle and size satisfy the recommended minimum requirement.
- Baffles designed for the SE-900 may not be applicable for the SE-950 due to the positioning of the photo-diode.
- The SE-950 can be programmed to two different scan angles. It is recommended that the position of the scan engine is set using the widest scan angle (47°). Setting the position for the narrow scan angle (35°) and then changing the scan angle might cause clipping (internal reflection) of the laser beam against the housing.
- The SE-950 scan engine does not require margin on either side of the bar code to decode.The 47° scan line provides identical scanning performance to older scan engines with a scan line of 53°.
- See *Optical on page 2-4* for recommendations on window properties (material, color, spectral transmission, wavefront distortion, surface quality, coating, etc.). Window properties that satisfy the recommendations for the SE-900 scan engine automatically satisfy the recommendations for SE-950 scan engine.

Mechanical

When replacing an SE-900 scan engine with the SE-950 scan engine the following must be taken into consideration:

- Regulatory labels must reflect new VLD power.
- Consider that existing cable flexes may not be compatible with the SE-950 scan engine.
- Consider mounting holes.

Regulatory

Integration requirements, and documentation and labeling requirements for Class 1 and Class 2 laser products are described in *Chapter 5, Regulatory Requirements*.

Replacing an SE-1200 with the SE-950 Scan Engine

Mounting

The SE-950 can be used as a replacement for the SE-1200 scan engine. However, the mounting holes for the SE-950 do not match those of the SE-1200. In order to mount the SE-950 in place of an SE-1200, you can use an adapter bracket, KT-1200MB-01, to mount the SE-950.

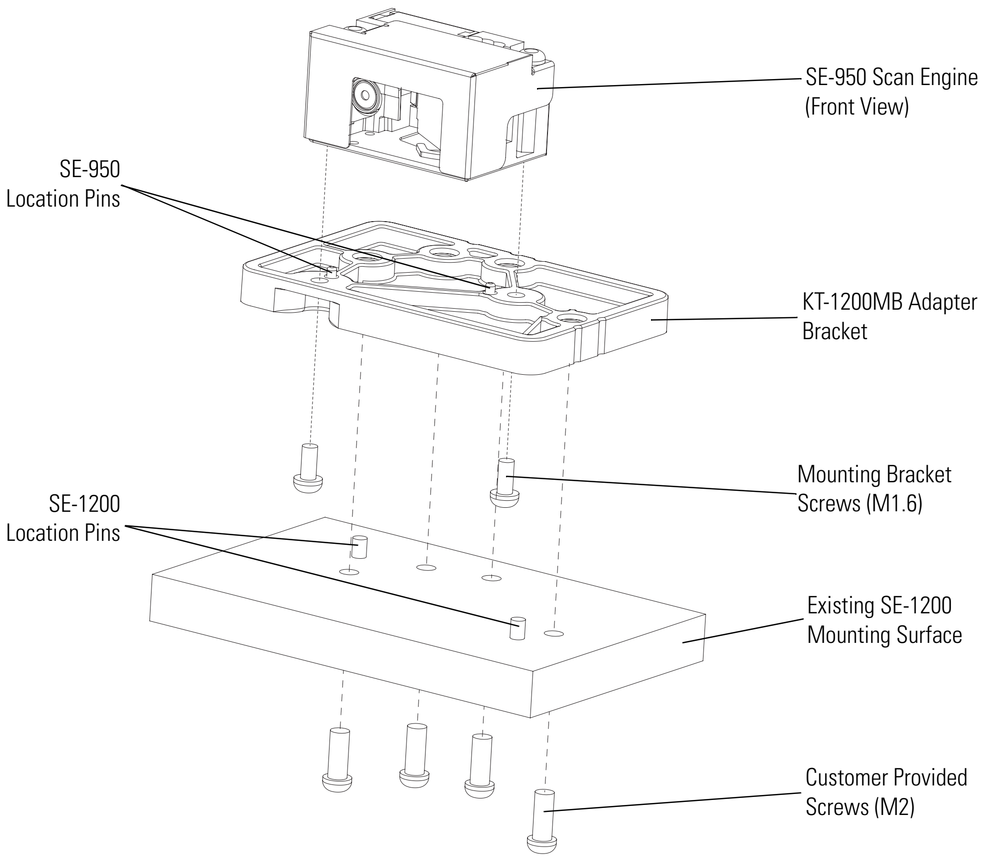


Figure 3-3. SE-1200 Adapter Bracket

Note: An extended flex cable is required to compensate for the adapter bracket when connecting the SE-950 scan engine to your host interface.

To mount the SE-950 scan engine and adapter bracket to an existing SE-1200 housing:

1. Align the locations pins on the adapter bracket with the holes on the SE-950.
2. Secure the adapter bracket to the SE-950 using the two screw provided.
3. Align the scan engine and adapter bracket with the location pins on the housing.
4. Secure the scan engine and adapter bracket with the housing using customer provided screws.

Electrical

The SE-1200 chassis is electrically connected to VCC while the SE-950 chassis is electrically connect to ground. The SE-950 must be isolated from the host ground.

The SE-1200 scan engine operates at a VCC of 3.3 - 5.0 VDC (±10%). The SE-950 scan engine operates at a VCC of 3.3 VDC (±10%) only.

The following I^2C features are supported:

- changing scan angle between 35° and 47°
- selecting Aim or Scanstand modes
- RSM reporting support
- reflash loading to upgrade firmware.

Refer to *Chapter 7, I^2C Interface* for detailed information on I^2C communication.

Optical

When replacing an SE-1200 scan engine with the SE-950 scan engine the following must be taken into consideration:

- Design of housing and scan engine must be reviewed by an optical-mechanical engineer.
- See Table 2-6 and Table 2-7 on *page 2-12* to verify whether the exit window angle and size satisfy the recommended minimum requirement.
- Baffles designed for the SE-1200 may not be applicable for the SE-950 due to the positioning of the photo-diode.
- The SE-950 can be programmed to two different scan angles. It is recommended that the position of the scan engine is set using the widest scan angle (47°). Setting the position for the narrow scan angle (35°) and then changing the scan angle might cause clipping (internal reflection) of the laser beam against the housing.
- The SE-950 scan engine does not require margin on either side of the bar code to decode.The 47° scan line provides identical scanning performance to older scan engines with a scan line of 53°.
- See *Optical on page 2-4* for recommendations on window properties (material, color, spectral transmission, wavefront distortion, surface quality, coating, etc.). Window properties that satisfy the recommendations for the SE-1200 scan engine automatically satisfy the recommendations for SE-950 scan engine.

Mechanical

When replacing an SE-1200 scan engine with the SE-950 scan engine the following must be taken into consideration:

- Regulatory labels must reflect new VLD power.
- Consider that existing cable flexes may not be compatible with the SE-950 scan engine.
- Consider mounting holes.

Regulatory

Integration requirements, and documentation and labeling requirements for Class 1 and Class 2 laser products are described in *Chapter 5, Regulatory Requirements*.

4 SE-950 Specifications

Introduction

This chapter provides the technical specifications of the SE-950 scan engine. Decode zone and exit window characteristics are also presented.

Technical Specifications

Table 4-1. Technical Specifications @ 23°C

Item	Description
Power Requirements **Input Voltage** **Input Current** **Standby Current** **V_{cc} Noise Level**	 3.3 VDC ±10% 76 mA typical / 81 mA max. 12 µA typical / 40 µA max 200 mV peak to peak max.
Surge Current	Engine power-up supply current < 200 mA (typical) Symbol recommends the use of a soft start power supply to minimize the maximum inrush current
Scan Repetition Rate	104 (± 12) scans/sec (bidirectional)
Laser Power (at 650 nm)	SE-950-I000WR: 1.7mW nominal SE-950-E000WR: 0.7mW nominal
Optical Resolution	0.004 in. minimum element width
Print Contrast	minimum 25% absolute dark/light reflectance measured at 650 nm.
Scan Angle **Wide (Default)** **Narrow**	 47° ± 3° (typical) 35° ± 3° (typical) Note: The SE-950 scan engine does not require margin on either side of the bar code to decode.The 47° scan line provides identical scanning performance to older scan engines with a scan line of 53°.
Decode Depth of Field	See decode zone diagrams beginning on *page 4-5*.
Pitch Angle	Condition: 100% UPC at 5 in. ± 65° from normal (see *Figure 4-1 on page 4-4*)
Skew Tolerance	Condition: 100% UPC at 5 in. ± 50° from normal (see *Figure 4-1 on page 4-4*)
Roll	Condition: 100% UPC at 5 in. ± 35° from vertical (see *Figure 4-1 on page 4-4*)
Specular Dead Zone	± 8°
Ambient Light Immunity **Sunlight** **Artificial Light**	 10,000 ft. candles (107,640 lux) - Guaranteed when mounted within a Symbol specified enclosure. 450 ft. candles (4,844 lux) Note: 10,000 ft. candles ambient light immunity is guaranteed when the engine is mounted using the illustrations and notes shown in *Figure 2-6 on page 2-11*. If a different mounting configuration is used, then ambient light immunity may be reduced.
Shock Endurance	2,000G applied via any mounting surface from -4° F to 140° F (-20° C to 60° C) for a period of 0.85 msec.
Vibration	Unpowered engine withstands a random vibration along each of the X, Y and Z axes for a period of one hour per axis, define as follows: 20 to 80 Hz — Ramp up to 0.04 G^2/Hz at the rate of 3 dB/octave. 80 to 350 Hz — 0.04 G^2/Hz 350 to 2000 Hz — Ramp down at the rate of 3 dB/octave.

Table 4-1. Technical Specifications @ 23°C (Continued)

Item	Description
Laser Class	**SE-950-I000WR / SE-950-I100R:** The scan engine is classified as a CDRH Class II/IEC Class 2 devices. **SE-950-E000WR / SE-950-E100R:** The scan engine is classified as an IEC Class 1 device.
Operating Temperature (chassis)	-4° F to 140° F (-20° C to 60° C)
Storage Temperature	-40°F to 158° F (-40° C to 70° C)
Humidity	5% to 95% (non-condensing)
Height	0.46 in (11.55mm) maximum
Width	0.85 in (21.6mm) maximum
Depth of Chassis	0.60 in (15.2mm) maximum
Depth of Chassis to Laser Boundary	0.61 in (15.5mm) maximum
Weight	0.265 ounces ± 0.009 ounces (7.5 grams ± 0.25 grams)

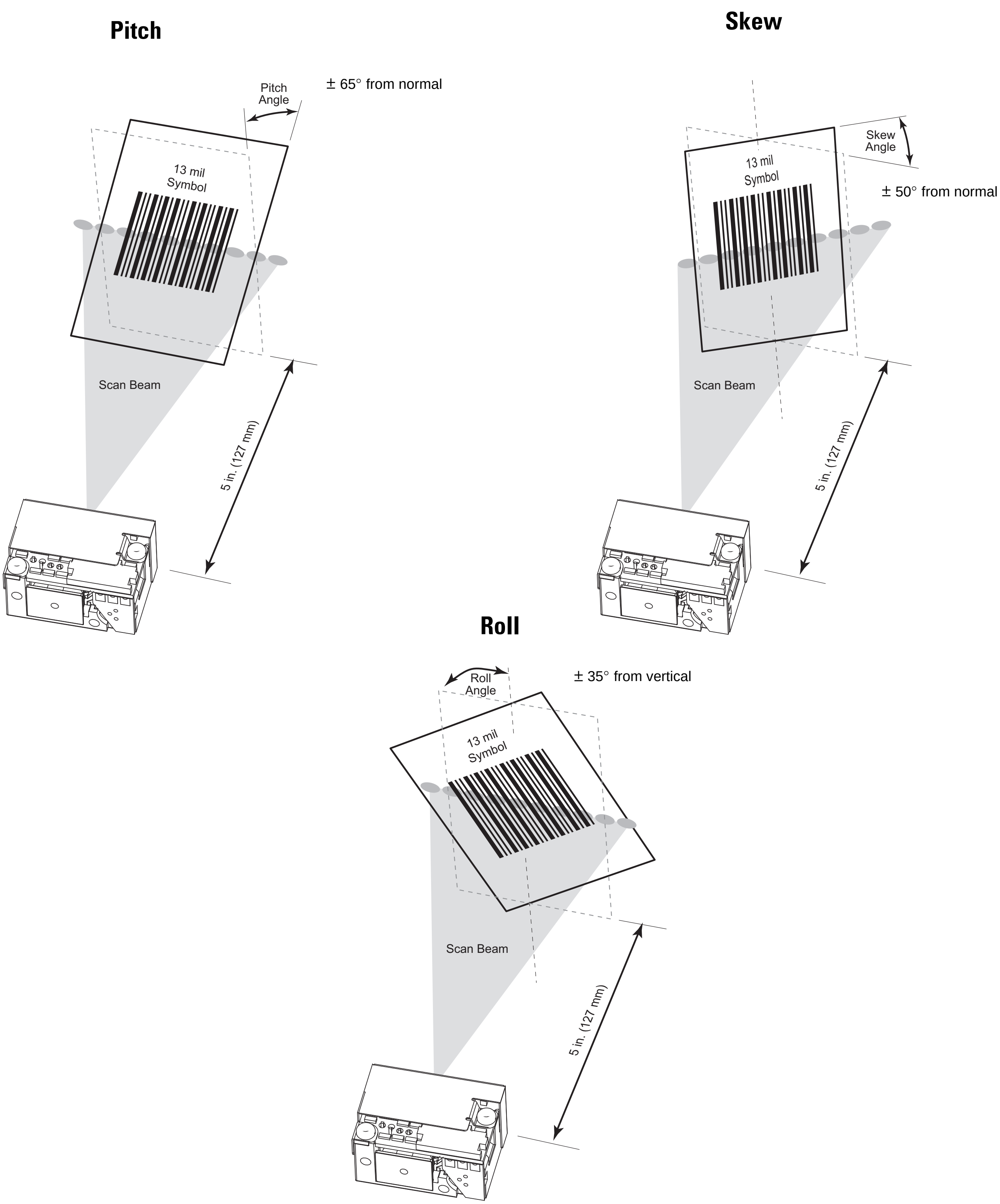


Figure 4-1. Pitch, Skew and Roll

Decode Zones

The decode zones for the SE-950-I000WR scan engines are shown in Figure 4-2 and Figure 4-3. The decode zones for the SE-950-E000WR scan engines are shown in Figure 4-4 and Figure 4-5. The figures shown are typical values. Table 4-2 and Table 4-3 lists the typical and guaranteed distances for selected bar code densities. The minimum element width (or "symbol density") is the width in mils of the narrowest element (bar or space) in the symbol.

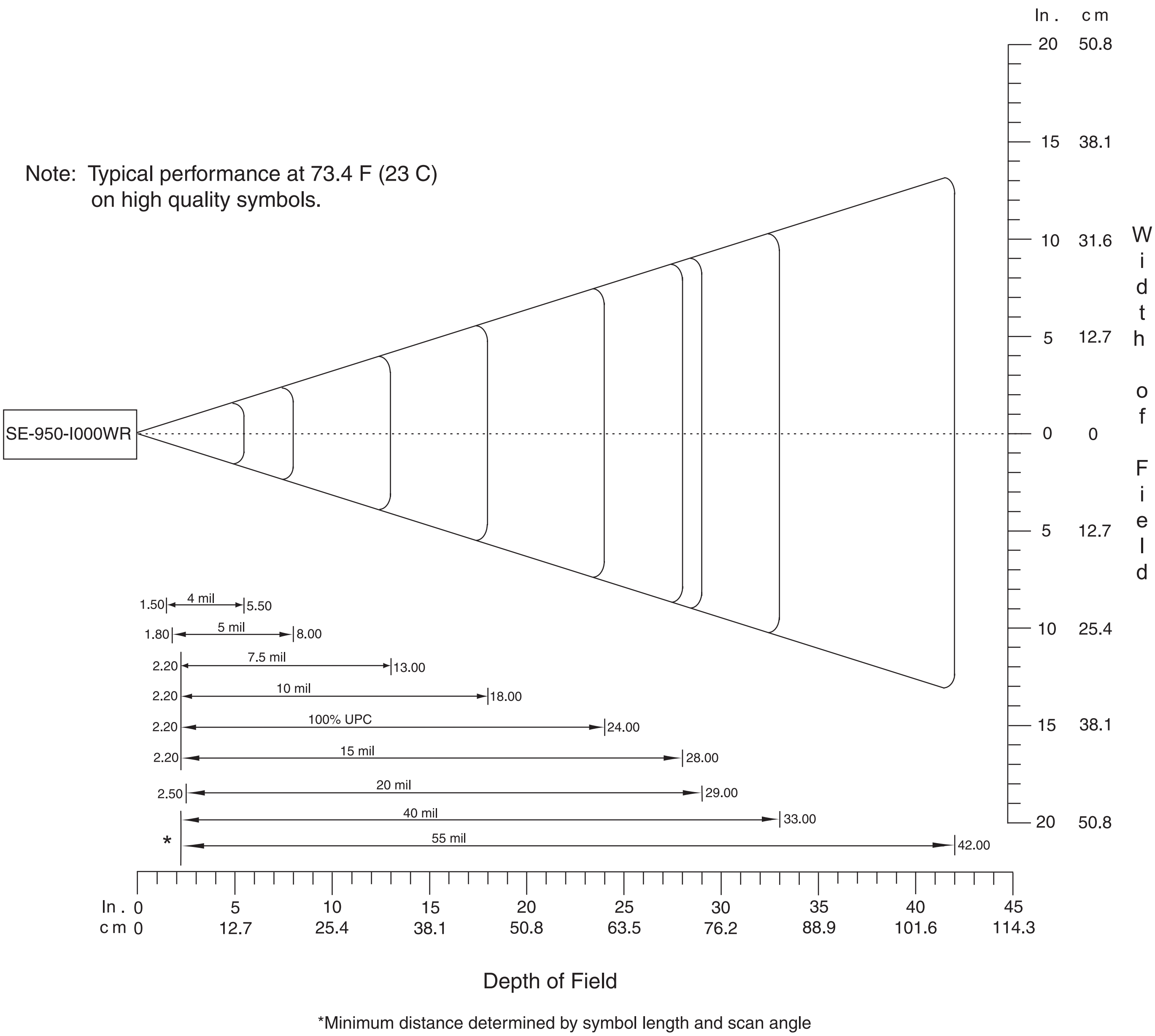


Figure 4-2. SE-950-I000WR Standard Version 35° Decode Zone

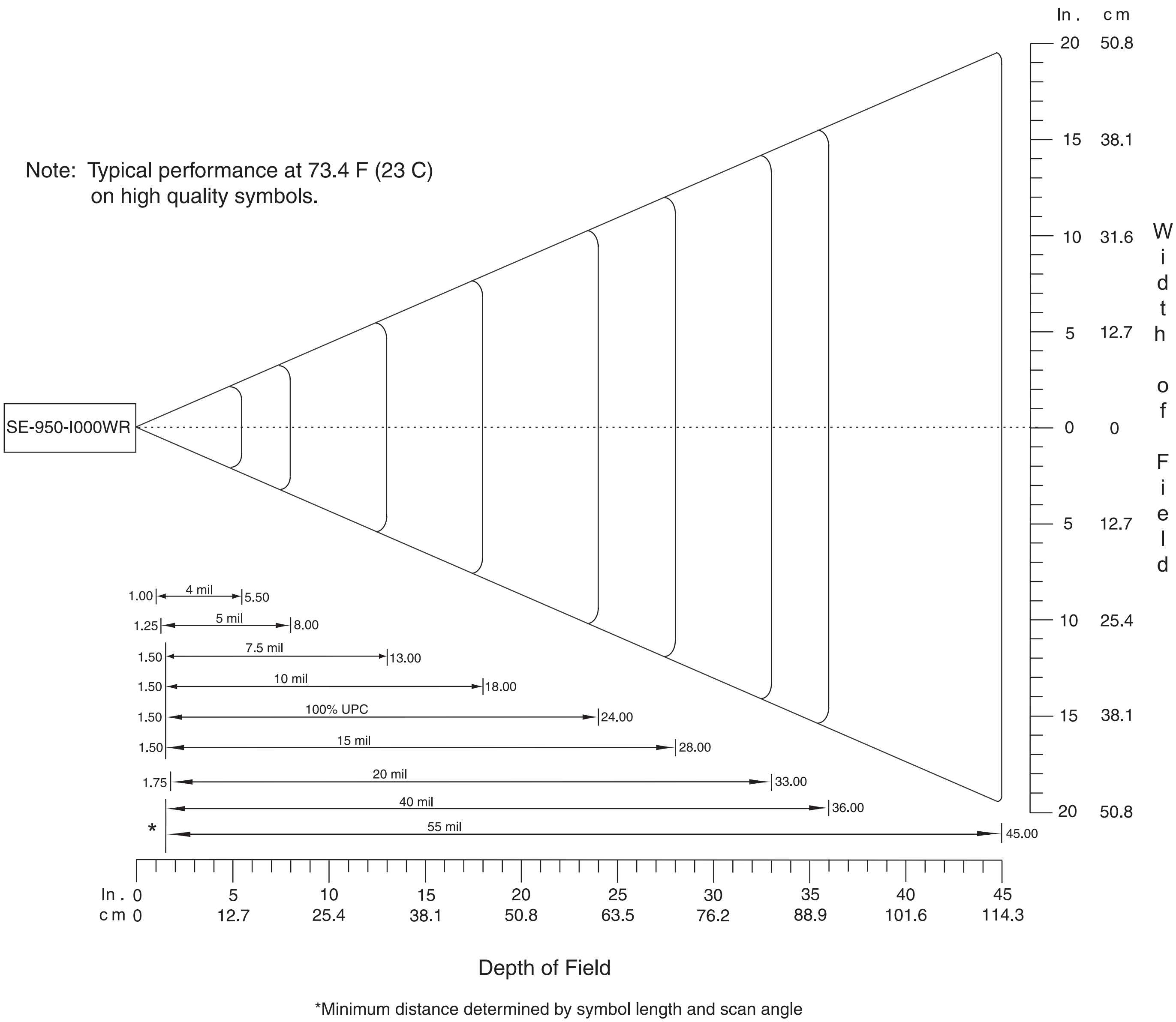


Figure 4-3. SE-950-I000WR Standard Version 47° Decode Zone

Table 4-2. SE-950-I000WR Decode Distances

Symbol Density/ Bar Code Type/ W-N Ratio	Bar Code Content/ Contrast[Note 1]	35 ° Typical Working Ranges		35 ° Guaranteed Working Ranges		47 ° Typical Working Ranges		47 ° Guaranteed Working Ranges	
		Near	Far	Near	Far	Near	Far	Near	Far
4.0 mil Code 39; 2.5:1	**ABCDEFGH** 80% MRD	**1.50 in** 3.81 cm	**5.50 in** 13.97 cm	**X**	**3.20 in** 8.13 cm	**1.00 in** 2.50 cm	**5.50 in** 13.97 cm	**2.20 in** 5.60 cm	**3.20 in** 8.13 cm

Table 4-2. SE-950-I000WR Decode Distances (Continued)

Symbol Density/ Bar Code Type/ W-N Ratio	Bar Code Content/ Contrast[Note 1]	35 ° Typical Working Ranges		35 ° Guaranteed Working Ranges		47 ° Typical Working Ranges		47 ° Guaranteed Working Ranges	
		Near	**Far**	**Near**	**Far**	**Near**	**Far**	**Near**	**Far**
5.0 mil Code 39; 2.5:1	**ABCDEFGH** 80% MRD	**1.80 in** 4.57 cm	**8.00 in** 20.32 cm	**X**	**5.50 in** 13.97 cm	**1.25 in** 3.18 cm	**8.00 in** 20.32 cm	**2.20 in** 5.60 cm	**5.50 in** 13.97 cm
7.5 mil Code 39; 2.5:1	**ABCDEF** 80% MRD	**2.20 in** 5.59 cm	**13.00 in** 33.02 cm	**X**	**9.50 in** 24.13 cm	**1.50 in** 3.81 cm	**13.00 in** 33.02 cm	**2.00 in** 5.08 cm	**9.50 in** 24.13 cm
10 mil Code 39; 2.5:1	**ABCDE** 90% MRD	**2.20 in** 5.59 cm	**18.00 in** 45.72 cm	**X**	**14.00 in** 35.56 cm	**1.50 in** 3.81 cm	**18.00 in** 45.72 cm	**1.75 in** 4.45 cm	**14.00 in** 35.56 cm
13 mil 100% UPC	**12345678905** 90% MRD	**2.20 in** 5.59 cm	**24.00 in** 60.96 cm	**2.50 in** 6.35 cm	**18.00 in** 45.72 cm	**1.50 in** 3.81 cm	**24.00 in** 60.96 cm	**1.75 in** 4.45 cm	**18.00 in** 45.72 cm
15 mil Code 39; 2.5:1	**ABCD** 80% MRD	**2.20 in** 5.59 cm	**28.00 in** 71.12 cm	**X**	**21.00 in** 53.34 cm	**1.50 in** 3.81 cm	**28.00 in** 71.12 cm	**1.75 in** 4.45 cm	**21.00 in** 53.34 cm
20 mil Code 39; 2.2:1	**123** 80% MRD	**2.50 in** 6.35 cm	**29.00 in** 73.66 cm	**X**	**23.00 in** 58.42 cm	**1.75 in** 4.45 cm	**33.00 in** 83.82 cm	**X**	**25.00 in** 63.50 cm
40 mil Code 39; 2.2:1	**AB** 80% MRD	**X**	**33.00 in** 83.82 cm	**X**	**24.00 in** 60.96 cm	**X**	**36.00 in** 91.44 cm	**X**	**26.00 in** 66.04 cm
55 mil Code 39; 2.2:1	**CD** 80% MRD	**X**	**42.00 in** 106.68 cm	**X**	**29.00 in** 73.66 cm	**X**	**45.00 in** 114.30 cm	**X**	**33.00 in** 83.82 cm

Notes:

1. CONTRAST measured as Mean Reflective Difference (MRD) at 650 nm.
2. Near ranges on lower densities (not specified) are largely dependent upon the width of the bar code and the scan angle.
3. Working range specifications at ambient temperature (23°C), Photographic quality symbols. pitch=10°, roll=0°, skew=0°, ambient light < 150 ft-candles.
4. X - Dependent on width of bar code.
5. Distances measured from front edge of chassis.

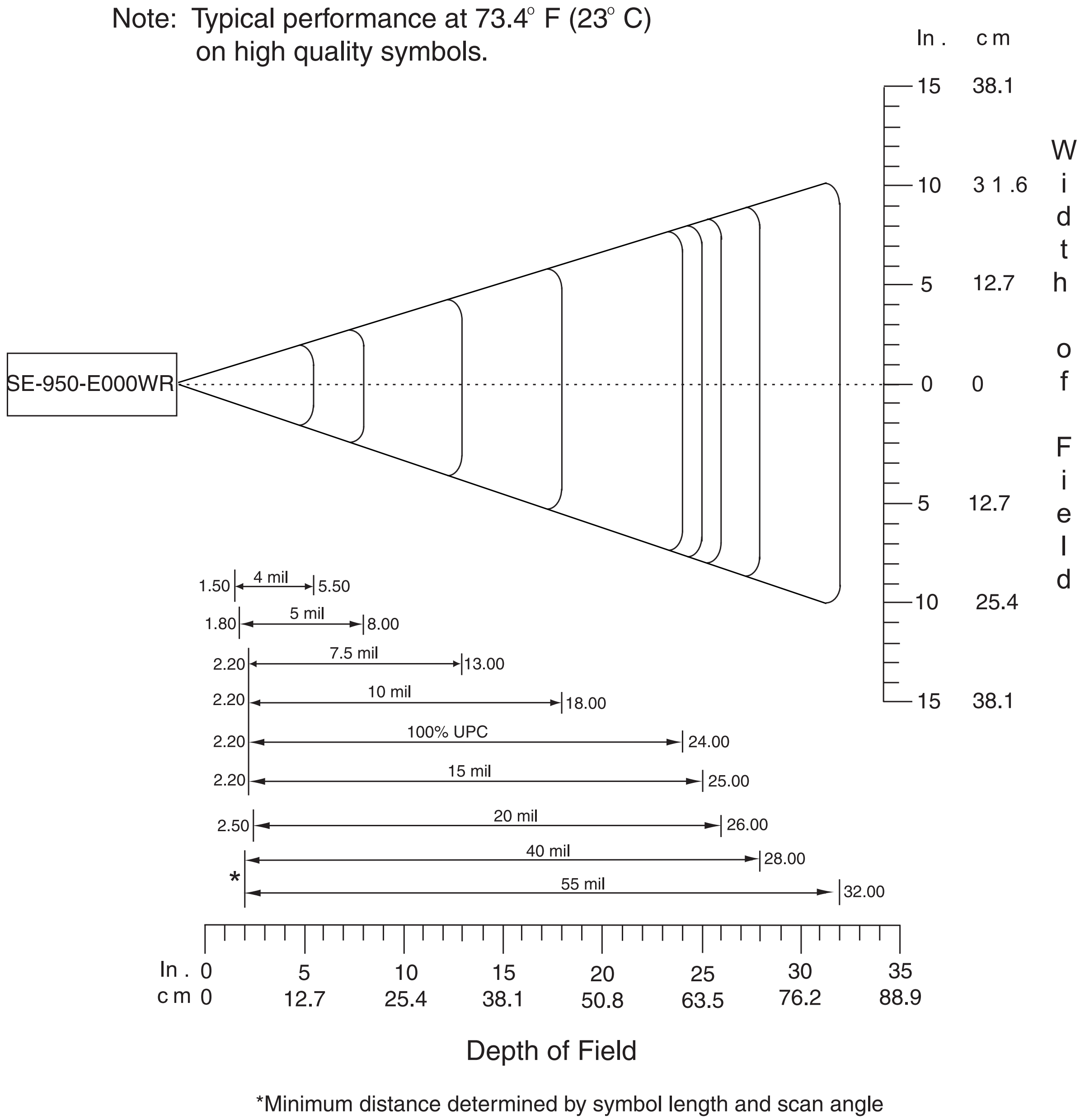


Figure 4-4. SE-950-E000WR Standard Version 35° Decode Zone

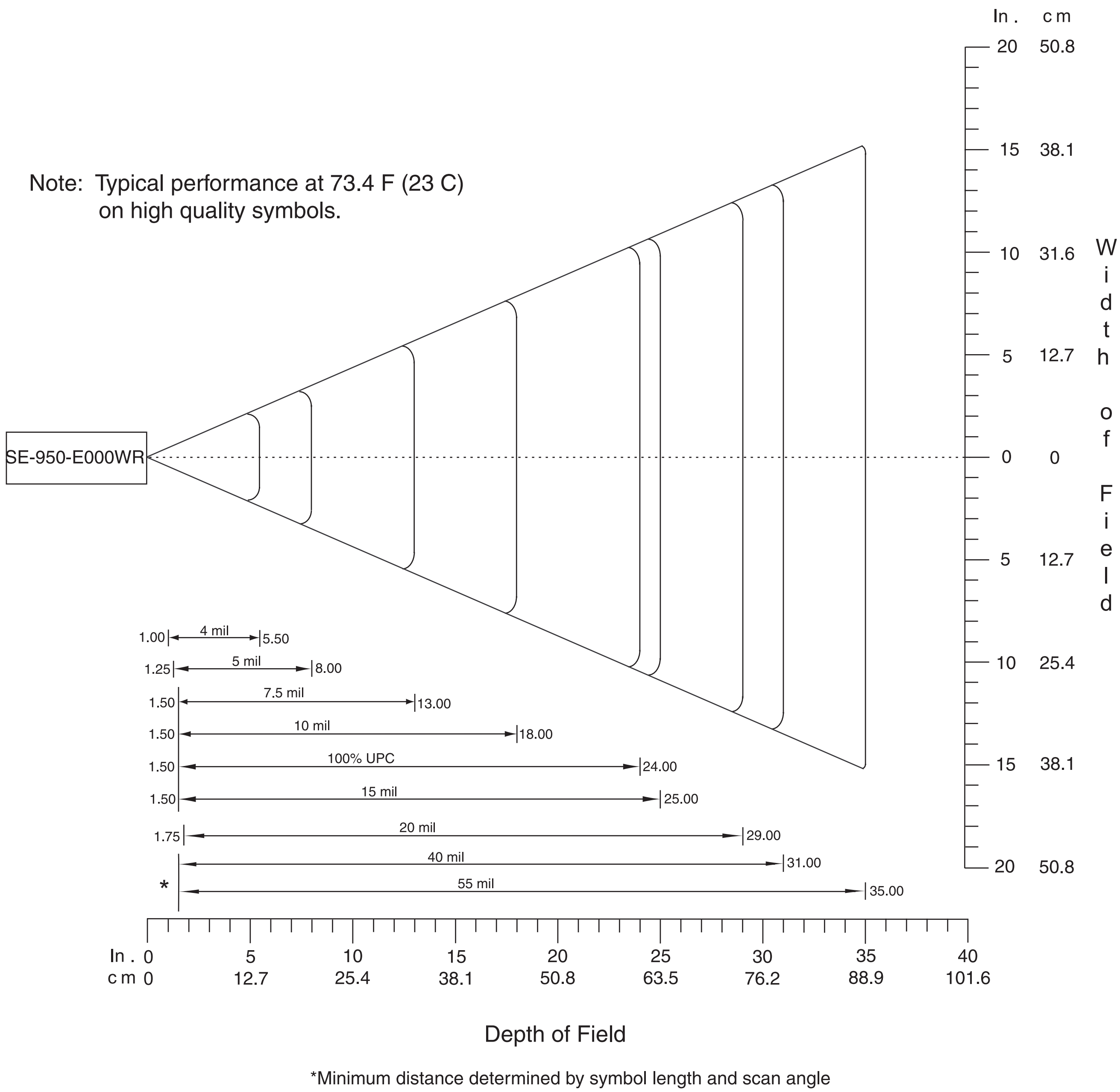


Figure 4-5. SE-950-E000WR Standard Version 47° Decode Zone

Table 4-3. SE-950-E000WR Decode Distances

Symbol Density/ Bar Code Type/ W-N Ratio	Bar Code Content/ Contrast[Note 1]	35 ° Typical Working Ranges		35 ° Guaranteed Working Ranges		47 ° Typical Working Ranges		47 ° Guaranteed Working Ranges	
		Near	Far	Near	Far	Near	Far	Near	Far
4.0 mil Code 39; 2.5:1	**ABCDEFGH** 80% MRD	**1.50 in** 3.81 cm	**5.50 in** 13.97 cm	**X**	**3.20 in** 8.13 cm	**1.00 in** 2.50 cm	**5.50 in** 13.97 cm	**2.20 in** 5.59 cm	**3.20 in** 8.13 cm
5.0 mil Code 39; 2.5:1	**ABCDEFGH** 80% MRD	**1.80 in** 4.57 cm	**8.00 in** 20.32 cm	**X**	**5.50 in** 13.97 cm	**1.25 in** 3.18 cm	**8.00 in** 20.32 cm	**2.20 in** 5.59 cm	**5.50 in** 13.97 cm
7.5 mil Code 39; 2.5:1	**ABCDEF** 80% MRD	**2.20 in** 5.59 cm	**13.00 in** 33.02 cm	**X**	**9.00 in** 22.86 cm	**1.50 in** 3.81 cm	**13.00 in** 33.02 cm	**2.00 in** 5.08 cm	**9.00 in** 22.86 cm
10 mil Code 39; 2.5:1	**ABCDE** 90% MRD	**2.20 in** 5.59 cm	**18.00 in** 45.72 cm	**X**	**13.00 in** 33.02 cm	**1.50 in** 3.81cm	**18.00 in** 45.72 cm	**1.75 in** 4.45 cm	**13.00 in** 33.02 cm
13 mil 100% UPC	**12345678905** 90% MRD	**2.20 in** 5.59 cm	**24.00 in** 60.96 cm	**2.50 in** 6.35 cm	**17.00 in** 43.18 cm	**1.50 in** 3.81 cm	**24.00 in** 60.96 cm	**1.75 in** 4.45 cm	**17.00 in** 43.18cm
15 mil Code 39; 2.5:1	**ABCD** 80% MRD	**2.20 in** 5.59 cm	**25.00 in** 63.50 cm	**X**	**18.00 in** 45.72 cm	**1.50 in** 3.81 cm	**25.00 in** 63.50 cm	**1.75 in** 4.45 cm	**18.00 in** 45.72 cm
20 mil Code 39; 2.2:1	**123** 80% MRD	**2.50 in** 6.35 cm	**26.00 in** 66.04 cm	**X**	**18.00 in** 45.72 cm	**1.75 in** 4.45cm	**29.00 in** 73.66 cm	**X**	**19.00 in** 48.26 cm
40 mil Code 39; 2.2:1	**AB** 80% MRD	**X**	**28.00 in** 71.12 cm	**X**	**19.00 in** 48.26 cm	**X**	**31.00 in** 78.74 cm	**X**	**21.00 in** 53.34 cm
55 mil Code 39; 2.2:1	**CD** 80% MRD	**X**	**32.00 in** 81.28 cm	**X**	**23.00 in** 58.42 cm	**X**	**35.00 in** 88.90 cm	**X**	**25.00 in** 63.50 cm

Notes:

1. CONTRAST measured as Mean Reflective Difference (MRD) at 650 nm.
2. Near ranges on lower densities (not specified) are largely dependent upon the width of the bar code and the scan angle.
3. Working range specifications at ambient temperature (23°C), Photographic quality symbols. pitch=10°, roll=0°, skew=0°, ambient light < 150 ft-candles.
4. X - Dependent on width of bar code.
5. Distances measured from front edge of chassis.

5

Regulatory Requirements

Regulatory Requirements

The sections that follow describe the integration, documentation, and labeling requirements for Class 1 and Class 2 laser products.

General Regulatory Requirements

When integrating the scan engines described in this guide, the following requirement must be met to maintain laser classification:

- The scan engine may not have the capability to be placed into AIM mode for more than 5 seconds continuously.

Required Documentation for Class 1 Laser Products

The documentation accompanying the end product should contain the following:

- "Complies with 21CFR1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, dated July 26, 2001. "
- "EN60825-1:1994+ A1:2002 +A2:2001"
- "IEC60825-1:1993+A1:1997+A2:2001"
- "Class 1 Laser devices are not considered to be hazardous when used for their intended purpose. The following statement is required to comply with US and international regulations:

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

A label such as the one below should appear in the product documentation, depending on the end product. Refer to the current applicable laser safety standards for the end product or specific requirements.

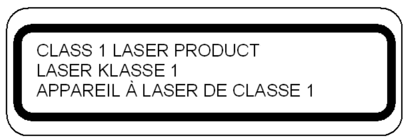


Figure 5-1. Example of Class 1 Laser Warning Label

Required Documentation for Class 2 Laser Products

The documentation accompanying the end product should contain the following:

- "Complies with 21CFR1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, dated July 26, 2001."
- "EN60825-1:1994+ A1:2002 +A2:2001"
- "IEC60825-1:1993+A1:1997+A2:2001"
- "Caution: Use of controls, adjustments or performance of procedures other than those specified herein may result in hazardous laser light exposure.

  Class 2 laser scanners use a low power, visible light diode. As with any very bright light source, such as the sun, the user should avoid staring directly into the light beam. Momentary exposure to a Class 2 laser is not known to be harmful."

A copy of the product's laser safety label, such as the one below, should appear in the product documentation, depending on the end product. Refer to the current applicable laser safety standards for the end product or specific requirements.

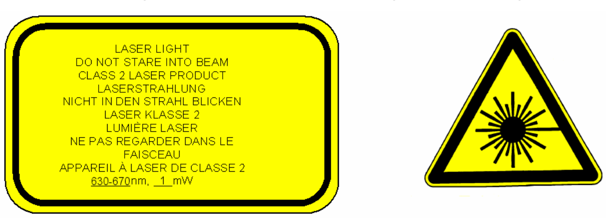


Figure 5-2. Example of Class 2 Laser Warning Label

Required Documentation for all End Products

The documentation should contain a diagram showing the location of the laser aperture and warning statement as shown in the example in Figure 5-3.

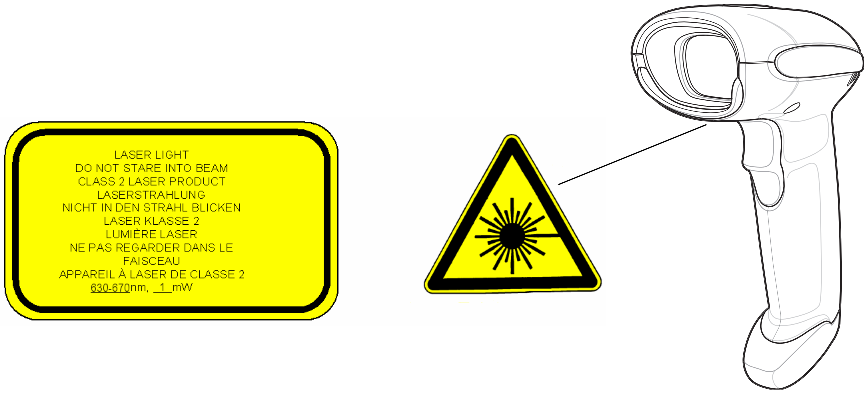


Figure 5-3. Example of Diagram Showing Class 2 Laser Labeling

Required Labeling for Class 1 End Products

The following guidance is provided for end product labelling for products containing Class 1 scan engines:

1 - Certification Statement from FDA/IEC Label Set, 2005

The following text must appear on the end product:

- "Complies with 21CFR1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, dated July 26, 2001. "
- "EN60825-1:1994+ A1:2002 +A2:2001"
- "IEC60825-1:1993+A1:1997+A2:2001"

Required location: For most end products, the label shown in Figure 5-3 should be located on the exterior of the product, or inside the battery compartment, software module compartment or other user accessible area. Access to these areas must not require special tools. Refer to the current applicable laser safety standards for the end product for specific requirements for the end product.

Font: Use a sans serif type font such as Arial or equivalent. The height must be at least 0.032 in. minimum.

Color: No color requirement. Contrast must be high enough to render this text legible.

2 - Identification

The name and address of the manufacturer must appear on the product.

3 - Laser Warning Label

Figure 5-4. Example of Class 1 Laser Warning Label

Required location: For most end products, the label shown in Figure 5-3 should be located on the exterior of the product, or inside the battery compartment, software module compartment or other user accessible area. Access to these areas must not require special tools. Refer to the current applicable laser safety standards for the end product for specific requirements for the end product.

Font: Use a sans serif type font such as Arial or equivalent. The height must be at least 0.032 in. minimum.

Color: No color requirement. Contrast must be high enough to render this text legible.

3 - Protective Housing Statement

Not required for Class 1.

Required Labeling for Class 2 End Products

The following guidance is provided for end product labelling for products containing Class 2 scan engines:

1 - Certification Statement from FDA/IEC Label Set, 2005

The following text must appear on the product:

- "Complies with 21CFR1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, dated July 26, 2001. "
- "EN60825-1:1994+ A1:2002 +A2:2001"
- "IEC60825-1:1993+A1:1997+A2:2001"

Required location: For most end products, the label shown in Figure 5-3 should be located on the exterior of the product, or inside the battery compartment, software module compartment or other user accessible area. Access to these areas must not require special tools. Refer to the current applicable laser safety standards for the end product for specific requirements for the end product.

Font: Use a sans serif type font such as Arial or equivalent. The height must be at least 0.032 in. minimum.

Color: No color requirement. Contrast must be high enough to render this text legible.

2 - Identification

The name and address of the manufacturer must appear on the product.

3 - Laser Warning Label

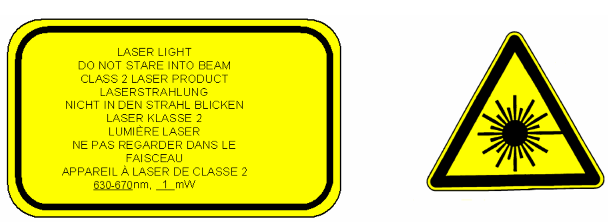


Figure 5-5. Example of Class 2 Laser Warning Label

Required location: For most end products, the label shown in Figure 5-5 should be located on the exterior of the product. Refer to the current applicable laser safety standards for the end product for specific requirements for the end product.

Font: Use a sans serif type font such as Arial or equivalent. The height must be at least 0.032 in. minimum.

Color: Must have a yellow background with black text

4 - Protective Housing Statements

CAUTION - CLASS 2 LASER LIGHT WHEN OPEN, DO NOT STARE INTO THE BEAM

ATTENTION - LUMIÈRE LASER EN CAS D'OUVERTURE. NE PAS REGARDER DANS LE FAISCEAU.

VORSICHT - LASERLICHT KLASSE 2, WENN ABDECKUNG GEÖFFNET. NICHT IN DEN STRAHL BLICKEN.

Required location: For most end products, the label shown in Figure 5-5 should be located on the exterior of the product, or inside the battery compartment, software module compartment or other user accessible area. Access to these areas must not require special tools. Refer to the current applicable laser safety standards for the end product for specific requirements for the end product.

Font: Use a sans serif type font such as Arial or equivalent. The height must be at least 0.032 in. minimum.

Color: No color requirement. Contrast must be high enough to render this text legible.

Recycling

The Customer shall be responsible for complying with all recycling laws and regulations, including European Directive: Waste Electrical and Electronic Equipment (WEEE). Symbol shall have no responsibility for collecting the products sold to Customer.

RoHS Compliance

This product is RoHS compliant.

6

Remote Scanner Management

Introduction

Symbol Technologies' Remote Scanner Management technology enables a host to manage a Symbol scanner or scan engine. The scanner can provide asset-tracking information (attributes) to the host such as serial number, date of manufacture and firmware version. In addition, Symbol's Remote Scanner Management technology provides the ability to automate the configuration process, monitor and optimize scanner operation, and enables firmware upgrade to support new features.

The SE-950 scan engine supports the ability to be remotely managed by supporting discovery, parameter configuration, and firmware updates electronically through the I^2C host interface.

Discovery is defined as the ability to query "born on" information such as the model number, scan engine serial number, date of manufacture, and firmware version. This information can be retrieved electronically from the scan engine (through the I^2C host interface) so that an application or Management Agent can publish the "discovered" information to the enterprise backend.

Parameter configuration allows the ability to query and set the device settings (i.e., scan amplitude) electronically.

For more information about the I^2C Host Command Set that supports the Remote Scanner Management architecture, see *Chapter 7, I^2C Interface*.

Hardware Signals

Figure 6-1 illustrates the SE-950 scan engine and host interconnection for the Remote Scanner Management transaction.

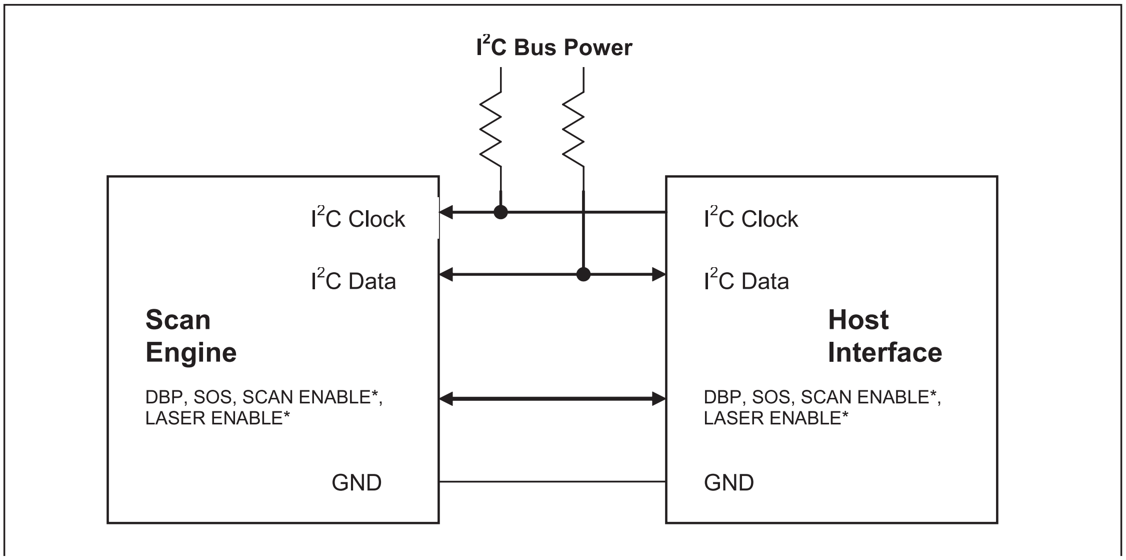


Figure 6-1. Remote Scanner Management via I^{2}C Interconnection

Attribute Storage/Retrieval

Attributes are defined as the general properties of the device that include configuration parameters, diagnostic data, and "born on" information such as firmware revision, model number, and date of manufacture. The SE-950 scan engine supports a new Remote Scanner Management protocol that defines a way to query/store these attributes over the I^{2}C host interface.

The tables that follow define the attributes that are used in the SE-950. The attribute numbers correspond to the command opcodes used in the I^{2}C protocol. For more information about the I^{2}C protocol, see *Chapter 7, I^{2}C Interface*.

Domain Tables

Table key:

User Mode Access - 'R' = Read, 'W' = Write

Data Type - 'B' = unsigned char, 'S' = String, 'W' = unsigned word, 'C' = signed char

Table 6-1. Discovery Domain

Attribute Number	Attribute Name	User Mode Access	Size (Bytes)	Data Type	Description
0x67	Model Number	R	18	'S'	The model number of the device. This field shall be programmed during Manufacturing. The format is: "SEXXXX-YYYY..Y"
0x65	Serial Number	R	14	'S'	This is the serial number of the device. This field shall be programmed during Manufacturing.

Table 6-1. Discovery Domain (Continued)

Attribute Number	Attribute Name	User Mode Access	Size (Bytes)	Data Type	Description
0x69	Date of Manufacture	R	7	'S'	The date of the manufacture DD- Day MMM- Month: Jan, Feb, Apr YY -Year This field shall be programmed during Manufacturing.
0x68	Date of Last Service	R	7	'S'	The date of the last service DD- Day MMM- Month: Jan, Feb, Apr YY -Year This field shall be programmed during Manufacturing and the Service Depot.
0x60	Firmware Version	R	8	'S'	This attribute represents the firmware version of the device. This field shall be determined at software build time.
0x63	Engine ID	R	1	'B'	The engine ID of the scan engine.
0x62	Hardware Version	R	1	'B'	The version or versions of the Printed Circuit Boards (PCB) in the system.
0x71 00	Scan Angle Mode	R	1	'B'	The scan engine can be set to narrow or wide scan angle.
0x77	Scan Engine Config0 Mode	R	1	'B'	The scan engine can be set to support AIM or Scanstand Modes.

Table 6-2. Hardware Diagnostics Domain

Attribute Number	Attribute Name	User Mode Access	Size (Bytes)	Data Type	Description
0x75	Internal Temperature	R	1	'B'	The scan engine internal temperature.
0x71 01	Motor Frequency	R	1	'B'	The motor frequency of the scan engine expressed in [Hz].
0x71 02	SOS Positive Duty Cycle	R	1	'B'	SOS Duty Cycle expressed in [%].

Table 6-3. Host Parameter Domain

Attribute Number	Attribute Name	User Mode Access	Size (Bytes)	Data Type	Description
0xC0	Scan Engine Config0 Mode	W	1	1	This command is used to configure the scan engine so that it supports either AIM or Scanstand Mode.
0xC2	Scan Angle Mode	W	1	1	This command is used to configure the scan engine for a specific scan angle.

7

I^2C Interface

Introduction

This chapter describes the I^2C interface, which provides a communications link between the SE-950 undecoded scan engine and a serial host. This serial interface performs the following major functions for the host device:

- Provides a bi-directional interface between the host (master) and the scan engine (slave)
- Host control of scan engine features
- Allows the scan engine to be calibrated in the Symbol Technologies Inc. manufacturing environment using undisclosed commands
- Supports the Symbol Technologies Inc. Remote Scanner Management architecture
- Automatic wakeup from low-power mode when scan engine detects its slave address.

Communication Protocol

The communication protocol between the host and the scan engine is based on a two-layer model. There exists only a physical layer and a data-link layer. All messages are sent and received by the application layer in the form of packets.

The I^2C interface is a powerful and flexible communication interface which requires only two bus lines, SDA (data) and SCL (clock). The scan engine is always the slave on the I^2C bus (master operation is not supported). As a slave device, the scan engine supports data rates up to 400 kHz (Fast Mode). It is assumed that the host has pull-up resistors on its SDA and SCL lines (the scan engine does not have pull-up resistors on the SDA and SCL lines).

Note: Pull-up resistors are not required if the I^2C interface is not used.

The scan engine must be assigned a slave address. It defaults to the slave address 0x50. In addition, the scan engine will not respond to the general call address 0x00.

CAUTION

It is important to note that if the host (I^2C master) removes power from the scan engine for any reason, it must also remove power from the two I^2C signals. If not, the scan engine enters a back-power condition.

This back-power condition must be avoided or other devices on the I^2C bus may not be able to communicate since the scan engine loads down the I^2C bus. This back-power condition can be avoided by adhering to one of the following suggestions:

- *Do not remove scan engine power if the I^2C interface is being used.*
- *If the Host removes scan engine power, isolate the I^2C interface with analog switches.*

Address Packet Format

All address packets transmitted on the I^2C bus are 9 bits long, consisting of seven address bits, one read/write (R/W) control bit and an acknowledge (ACK) bit. If the R/W control bit is set, a read operation is performed by the host (master), otherwise a write operation is performed. When the scan engine (slave) recognizes that it is being addressed, it should acknowledge by pulling SDA low in the ninth SCL (ACK) cycle. The MSB of the address byte is transmitted first (big-endian format). Refer to *I^2C Bus Specification, Version 2.1, January 2000* and *Atmel ATMega48/88/168 datasheet, July 2004* for more detailed information of the I^2C bus.

Data Packet Format

All data packets transmitted on the I^2C bus are nine bits long, consisting of eight data bits and an acknowledge (ACK) bit. The data packet is also transmitted in big-endian format. During a data transfer, the host (master) generates the clock (SCL) and the START and STOP conditions, while the receiver is responsible for acknowledging the reception by pulling the SDA line low during the ninth SCL cycle. If the receiver leaves the SDA line high during the ninth SCL cycle, a NACK is signaled. Refer to *I^2C Bus Specification, Version 2.1, January 2000* and *Atmel ATMega48/88/168 datasheet, July 2004* for more detailed information of the I^2C bus.

Combining Address and Data Packets into a Transmission

A transmission consists of a START condition, 7-bit Slave Address + R/W, one or more data packets and a STOP condition. The data transmission is illustrated in Figure 7-1.

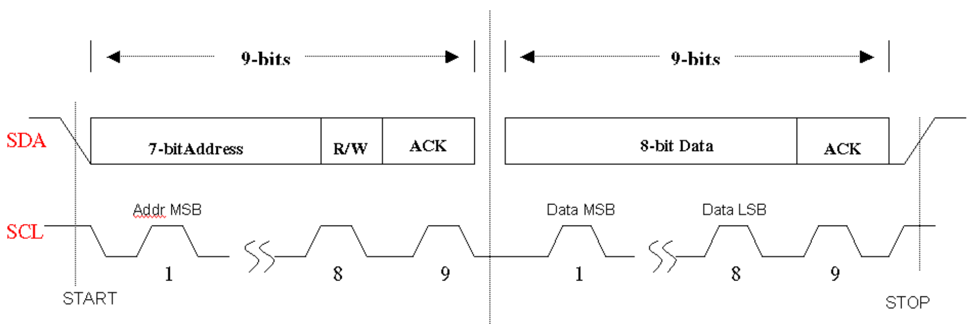


Figure 7-1. I^2C Data Transmission

Although Figure 7-1 shows one data packet being transmitted, it is possible that some scan engine messages require multiple data packets. Therefore, after the 7-bit slave address is transmitted, an 8-bit opcode representing a scan engine message is transmitted. If the message requires a parameter, it is sent in the subsequent data packet. The following summarizes the message frame:

Master to Slave Frame - A complete Message Frame consists of the following bytes:

Byte 1:	Master sends Slave Address + “Write” bit.
Byte 2:	Master sends Message Opcode.
Byte 3 to Last Byte-1:	Master sends Optional Message Parameter Value(s).
Last Byte:	Master sends Optional 2's complement checksum (csum) of all previous bytes on commands that use parameters (excluding Slave Address). Note that the checksum is used only with commands that require a parameter.

Slave to Master Frame - A complete Message Frame consists of the following bytes:

Byte 1:	Master sends Slave Address + “Read” bit.
Byte 2:	For Engine Control Commands, Slave sends CMD_ACK message if a valid Message Opcode received in previous frame AND a valid 2's complement checksum received in previous frame, otherwise Slave sends CMD_NACK or CMD_CSUM_ERR message. For Remote Monitoring Commands, Slave sends appropriate data byte as response.

Several Examples of “Complete Message Transactions” are provided in *Complete Command Transactions Examples on page 7-24*.

Acknowledge

It is important to distinguish between the “CMD_ACK” message above and the ACK bit that is the 9th bit of an I^2C byte. They are completely unrelated.

a. The ACK bit is defined in the I^2C specification and is defined below:

   The acknowledge-related clock pulse is generated by the master. The transmitter releases the SDA line (HIGH) during the acknowledge clock pulse. The receiver must pull down the SDA line during the acknowledge clock pulse so that it remains stable LOW during the HIGH period of this clock pulse.

   Usually, a receiver which has been addressed is obliged to generate an acknowledge after each byte has been received. When a slave doesn't acknowledge the slave address (for example, it's unable to receive or transmit because it's performing some real-time function), the data line must be left HIGH by the slave. The master can then generate either a STOP condition to abort the transfer, or a repeated START condition to start a new transfer.

   If a slave-receiver does acknowledge the slave address but, some time later in the transfer cannot receive any more data bytes, the master must again abort the transfer. This is indicated by the slave generating the not-acknowledge on the first byte to follow. The slave leaves the data line HIGH and the master generates a STOP or a repeated START condition.

   If a master-receiver is involved in a transfer, it must signal the end of data to the slave- transmitter by not generating an acknowledge on the last byte that was clocked out of the slave. The slave-transmitter must release the data line to allow the master to generate a STOP or repeated START condition.

b. On the other hand, the “CMD_ACK” message [opcode = 0x80], is sent by the scan engine to indicate that it recognized the recently received command and the checksum is correct. It is mandatory that the master ask the scan engine for the “CMD_ACK” message before it proceeds with other requests. In addition, as indicated above, if the host asks the scan engine for the “CMD_ACK” message (or a remote monitoring response) while the scan engine is performing some real-time function, the scan engine does not acknowledge its slave address.

Serial Response Time-out

The host can expect that the scan engine is ready to respond to most serial commands within 20 msec. The only exception to this is the STORE_SOFT_PARAMS command which requires 200 msec to complete. If the host does not receive a response within that time period, it should perform a command re-try. This means that the host should either resend the same command or abort any further attempts.

In addition, as indicated above, if the host asks the scan engine for a command response while the scan engine is performing some real-time function, the scan engine does not acknowledge its slave address by issuing a NACK bit on the 9th bit of the address byte. The master can then generate either a STOP condition to abort the transfer, or a repeated START condition to start a new transfer.

Note

After power is applied to the scan engine, the scan engine requires 10 msec to initialize the I^2C port. As a result, when power is applied, the user should wait 10 msec prior to sending any I^2C commands.

I^2C Messages

The following is a list of all I^2C opcodes supported by the SE-950 scan engine. It also identifies the I^2C partner allowed to send each message. The host transmits opcodes designated by type H, and the scan engine transmits opcodes designated by type S.

The general rule is that no I^2C messages should be sent to the scan engine while a scan session is in progress.

The messages are separated into two categories:

- Engine Control Commands - Commands that configure and control various scan engine features. These commands are considered public commands and are available to all hosts. These opcodes are in the range of [0x80 - 0xCF].
- Remote Monitoring Commands - Commands that are used for remote monitoring of the scan engine attributes. These commands are also considered public commands and are available to all hosts. These opcodes are in the range of [0x60 - 0x7F].

Engine Control Commands

Engine Control commands are used by the host to control an/or configure scan engine features like AIM/Scanstand and Scan Angle. These features are enabled when the host uses "Soft Parameters." The scan engine acknowledges all of these commands with either the **CMD_ACK**, **CMD_NACK** or **CMD_CSUM_ERR** command.

The opcodes of the Engine Control commands are in the range of [0x80 - 0xCF].

Several examples of “Complete Message Transactions” are provided in *Complete Command Transactions Examples on page 7-24*.

Table 7-1. Engine Control Commands

Name	Type	OpCode	Description	Page
PARAM_SET_SCAN_ENGINE_MODE	H	0xC0	This command is used to configure the scan engine to support either AIM or Scanstand Mode.	*page 7-6*
PARAM_SET_SCAN_ANGLE	H	0xC2	This command is used to configure the scan engine for a specific scan angle.	*page 7-7*
STORE_SOFT_PARAMS	H	0xCF	This command gives the host the ability to configure the scan engine permanently, by storing all current Soft Parameters into non-volatile memory (EEPROM).	*page 7-8*
SLEEP	H	0xB0	This command is used by the host to place the scan engine into a low-power mode.	*page 7-9*

Table 7-1. Engine Control Commands (Continued)

Name	Type	OpCode	Description	Page
CMD_ACK	S	0x80	This command is used by the scan engine to acknowledge that the command it just received is supported and the message checksum is validated.	page 7-10
CMD_NACK	S	0x82	This command is used by the scan engine to inform the host that it just received an unsupported command opcode.	page 7-11
CMD_CSUM_ERR	S	0x84	This command is used by the scan engine to inform the host that it just received a message with an incorrect checksum. The host should try to resend the same command.	page 7-12

PARAM_SET_SCAN_ENGINE_MODE < AIM | SCANSTAND>, <csum>

OpCode

Opcode = 0xC0: Type = H

Description

This command is used to configure the SE-950 scan engine to support either AIM or Scanstand Mode. The engine enters either of these modes when the Config0 pin (pin #3) at the interface is low. This command temporarily overrides the default soft parameter value associated with AIM and SCANSTAND. Note that this command takes effect at the start of a new scan session, even if the scan engine receives this command during a scan session.

Since the data associated with this command is stored in volatile memory, this command does not remain in effect after the engine power is cycled. However, if the **STORE_SOFT_PARAMS** command is issued, the data associated with this command remains in effect after the engine power is cycled.

Parameters

0x00	Scan engine activates AIM pattern when Config0 pin at interface asserted low (default).
0x01	Scan engine operates in SCANSTAND mode when Config0 pin at interface asserted low.

Example

Host wants to configure the scan engine to support AIM mode.

The host sends the following packet to the scan engine:

0x50, 0xC0, 0x00, 0x40

The host receives the CMD_ACK message from scan engine:

0x80

PARAM_SET_SCAN_ANGLE <NARROW | WIDE>, <csum>

OpCode

Opcode = 0xC2: Type = H

Description

This command is used to configure the scan engine for a specific scan angle. This command temporarily overrides the default soft parameter value associated with Scan Angle. Note that this command takes effect at the start of a new scan session, even if the scan engine receives this command during a scan session.

Since the data associated with this command is stored in volatile memory, this command does not remain in effect after the engine power is cycled. However, if the **STORE_SOFT_PARAMS** command is issued, the data associated with this command remains in effect after the engine power is cycled.

Parameters

0x00	Sets scan engine scan angle to narrow (35°) on subsequent scan sessions.
0x02	Sets scan engine scan angle to wide (47°) on subsequent scan sessions.

Example

Host wants to configure the scan engine to support Wide Scan Angle.

The host sends the following packet to the scan engine:

0x50, 0xC2, 0x02, 0x3C

The host receives the CMD_ACK message from scan engine:

0x80

STORE_SOFT_PARAMS

OpCode

Opcode = 0xCF: Type = H

Description

This command gives the host the ability to configure the scan engine permanently, by storing all current Soft Parameters into non-volatile memory (EEPROM). These Soft Parameters are then used as the default state after the scan engine powers-up.

Note: Due to the long EEPROM write access times, the host should delay approximately 200 msec before requesting the **CMD_ACK** message from the scan engine. In addition, the Host must not send this command too often since the EEPROM in the scan engine has an endurance rating of 100,000 cycles.

Example

Host wants to have the scan engine store present state of soft parameters.

The host sends the following packet to the scan engine:

0x50, 0xCF

The host receives the CMD_ACK message from scan engine:

0x80

SLEEP

OpCode

Opcode = 0xB0: Type = H

Description

This command is used by the host to place the scan engine into a low-power mode. When the scan engine detects and responds to an I^2C command, it does not enter a low-power mode until it receives the SLEEP command. After the scan engine receives the SLEEP command, it responds with a **CMD_ACK** and then enters the low-power mode.

In the case where the host does not support an I^2C interface, or if the I^2C interface is not used after a power-on condition, the scan engine automatically enters a low-power mode within 500usec of SCAN_EN* input de-asserted (logic high).

The scan engine wake-ups automatically when the scan engine detects an I^2C address match, or a low-level on the SCAN_EN* pin.

Note that this command is not accepted when a scan session is in progress, i.e., a **CMD_NACK** is returned to the host.

CMD_ACK

OpCode

Opcode = 0x80: Type = S

Description

This command is used by the SE-950 scan engine to acknowledge that the command it just received is supported and the message checksum is validated.

CMD_NACK

OpCode

Opcode = 0x82: Type = S

Description

This command is used by the SE-950 scan engine to inform the host that it just received an unsupported or unknown command opcode.

CMD_CSUM_ERR

OpCode

Opcode = 0x84: Type = S

Description

This command is used by the SE-950 scan engine to inform the host that it just received a message with an incorrect checksum. The host should try to resend the same command.

Remote Monitoring Commands

The function of the Remote Monitoring Commands is to support the Symbol Technologies, Inc. Remote Scanner Management architecture. The commands defined in Table 7-2 are used by the host to query the scan engine for important information like "serial number" and "date of manufacture." In addition, several of these commands can be used by the host to determine the status and overall health of several key scan engine subsystems.

The opcodes of the Remote Monitoring Commands are in the range of [0x60 - 0x7F] and are listed in Table 7-2. When the scan engine receives one of these commands, it responds with the appropriate data byte[s].

Several Examples of “Complete Message Transactions” are provided in *Complete Command Transactions Examples on page 7-24*.

Table 7-2. Remote Monitoring Commands

Name	Type	OpCode	Description	Page
REQUEST_FIRMWARE_REVISION	H	0x60	This command is used by the host to request the software revision of the scan engine.	*page 7-14*
REQUEST_ENGINE_ID	H	0x63	This command is used by the host to request the scan engine ID.	*page 7-15*
REQUEST_SERIAL_NUMBER	H	0x65	This command is used by the host to request the serial number of the scan engine.	*page 7-16*
REQUEST_DATE_OF_MANUFACTURE	H	0x69	This command is used by the host to request the manufacture date of the scan engine.	*page 7-17*
REQUEST_DATE_OF_LAST_SERVICE	H	0x68	This command is used by the host to request the last service date of the scan engine.	*page 7-18*
REQUEST_MODEL_NUMBER	H	0x67	This command is used by the host to request the scan engine part number.	*page 7-19*
REQUEST_HARDWARE_REVISION	H	0x62	This command is used by the host to request the scan engine hardware revision	*page 7-20*
REQUEST_MOTOR_STATUS	H	0x71	This command is used by the host to request the scan engine motor status.	*page 7-21*
REQUEST_ENGINE_TEMP	H	0x75	This command is used by the host to request the scan engine temperature.	*page 7-22*
REQUEST_ENGINE_CONFIG0_MODE	H	0x77	This command is used by the host to request the scan engine Config0 mode.	*page 7-23*

REQUEST_FIRMWARE_REVISION

OpCode

Opcode = 0x60: Type = H

Description

This command is used by the host to request the software revision of the scan engine.

Response Format

Number of Bytes Returned to Host	Byte 1 through Byte 8	Byte 9
9	Version	Csum on Byte1 through Byte 8

REQUEST_ENGINE_ID

OpCode

Opcode = 0x63: Type = H

Description

This command is used by the host to request the scan engine ID.

Response Format

Number of Bytes Returned to Host	Byte 1
1	Engine_ID

REQUEST_SERIAL_NUMBER

OpCode

Opcode = 0x65: Type = H

Description

This command is used by the host to request the serial number of the scan engine.

Response Format

Number of bytes returned to host	Byte 1 through Byte 14	Byte 15
15	Serial_Num	Csum on Byte 1 through 14

REQUEST_DATE_OF_MANUFACTURE

OpCode

Opcode = 0x69: Type = H

Description

This command is used by the host to request the manufacture date of the scan engine.

Response Format

Number of Bytes Returned to Host	Byte 1 through Byte 7	Byte 8
8	DD - Day MMM - Month (Jan, Feb, Apr, etc.) YY - Year	Csum on Byte 1 through 7

REQUEST_DATE_OF_LAST_SERVICE

OpCode

Opcode = 0x68: Type = H

Description

This command is used by the host to request the last service date of the scan engine.

Response Format

Number of Bytes Returned to Host	Byte 1 through Byte 7	Byte 8
8	DD - Day MMM - Month (Jan, Feb, Apr, etc.) YY - Year	Csum on Byte 1 through 7

REQUEST_MODEL_NUMBER

OpCode

Opcode = 0x67: Type = H

Description

This command is used by the host to request the scan engine part number.

Response Format

Number of Bytes Returned to Host	Byte 1 through Byte 18	Byte 19
19	The format is: SEXXX-YYYY...Y	Csum on Byte 1 through 18

REQUEST_HARDWARE_REVISION

OpCode

Opcode = 0x62: Type = H

Description

This command is used by the host to request the scan engine hardware revision.

Response Format

Number of Bytes Returned to Host	Byte 1
1	Engine_Hardware_Revision

REQUEST_MOTOR_STATUS <MOTOR_FREQ | MOTOR_DUTY_CYCLE | MOTOR_SCAN_ANGLE>, <csum>

OpCode

Opcode = 0x71: Type = H

Description

This command is used by the host to request the scan engine motor status.

For the MOTOR_FREQ | MOTOR_DUTY_CYCLE parameter, the value returned to the host represents the motor SOS frequency or SOS duty cycle. Therefore the SOS frequency and duty cycle measurements occur only when the scan engine is scanning. The value returned to the host immediately after power-on is 0x00. It is important to note that if it was a long time since the last scan session, the data returned to the host is considered "stale data."

For the MOTOR_SCAN_ANGLE parameter, the value returned to the host represents the present motor scan angle setting. The SE-950 scan engine supports two scan angles.

Parameter

0x00	request Scan Angle that is currently being used by the scan engine.
0x01	request scan engine SOS Frequency.
0x02	request scan engine SOS Duty Cycle.

Response Format

Number of Bytes Returned to Host	Byte 1 for MOTOR_FREQ Request	Byte 1 for MOTOR_DUTY_CYCLE Request	Byte 1 for MOTOR_SCAN_ANGLE Request
1	SOS_Frequency [Hz]	SOS_Duty_Cycle [%]	0x00 = narrow scan angle 0x02 = wide scan angle

Example

Host wants to request the present scan angle setting of the scan engine.

Host sends the following packet to scan engine:

0x50, 0x71, 0x00, 0x8F

Host receives the "wide angle" setting from scan engine:

0x02

REQUEST_ENGINE_TEMP

OpCode

Opcode = 0x75 Type = H

Description

This command is used by the Host to request the scan engine temperature. The value returned to the Host represents the temperature of the last measurement; and a measurement is taken only when the engine is scanning. The value returned to the host immediately after power-on is 0xFF. It is important to note that if it was a long time since the last scan session, the temperature returned to the Host is considered to be "stale data."

The 8-bit value returned by the host represents the voltage of the sensor output. The sensor output has a range of -40°C to 105°C, where the sensor slope is -7.75 mV / °C.

The sensor transfer function is linear according to the following: -40°C = 1.9V, 25°C = 1.4V and 105°C = 0.77V

To convert the 8-bit data value from scan engine to a temperature:

V = (8-bit data value/255) * 2.68 Volts
°C = {V - 1.59 } / { -0.00775 }

Response Format:

Response Format

Number of Bytes Returned to Host	Byte 1
1	Engine_Temp [8-bit data]

Example

Host wants to request the temperature of the scan engine.

Host sends the following packet to the scan engine:

0x50, 0x75

Host receives the "temperature" from scan engine:

0x90

This corresponds to a temperature of :

144/255 * 2.68V = 1.51V
°C = {1.51 - 1.59} / {-0.00775} = 9.9° C

REQUEST_ENGINE_CONFIG0_MODE

OpCode

Opcode = 0x77 Type = H

Description

This command is used by the host to request the scan engine Config0 Mode. When the Config0 pin at the interface is asserted, the scan engine enters either AIM Mode or Scanstand Mode, depending on the setting of the command **PARAM_SET_SCAN_ENGINE_MODE**.

Response Format

Number of Bytes Returned to Host	Byte 1
1	0x00 = Turn on AIM pattern when Config0 asserted 0x01 = Enter Scanstand mode when Config0 asserted

Example

Host wants to request the scan engine Config0 mode that will be used on the next scan session.

Host sends the following packet to scan engine:

0x50, 0x77

Host receives the "Scanstand" mode from scan engine:

0x01

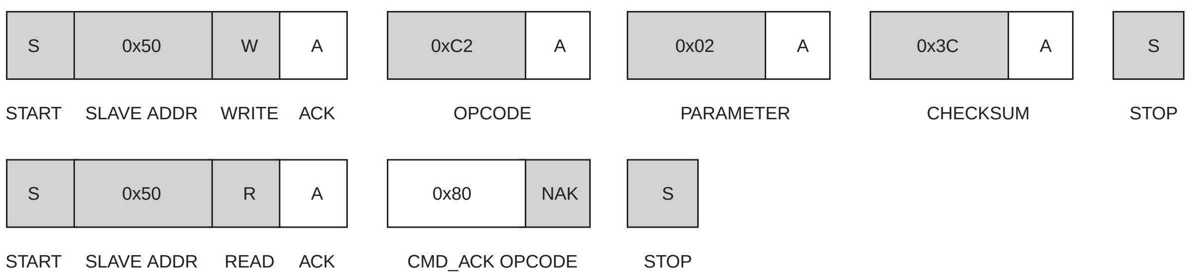
Complete Command Transactions Examples

The following provides examples of a complete message transfers for an Engine Control command, Remote Monitoring command and a Manufacturing command. In these examples the scan engine slave address is 0x50.

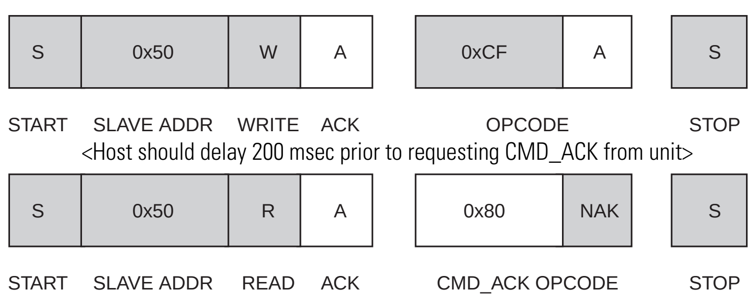
A gray box indicates the transfer is from the host to the scan engine. A white box indicates that the transfer is from the scan engine to the host.

Engine Control Commands

Host Sets Scan Angle to Wide (47°)



Host Stores All Current Soft Param Values in EEPROM



Remote Monitoring Commands

Host Requests Motor SOS Frequency

S	0x50	W	A	0x71	A	0x01	A	0x8E 5	A	S
START	SLAVE ADDR	WRITE	ACK	OPCODE		PARAMETER		CHECKSUM		STOP

S	0x50	R	A	0x30 4	NAK	S
START	SLAVE ADDR	READ	ACK	DATA = 48 Hz		STOP

Host Requests to Read “Scan Angle” Soft Parameter:

S	0x50	W	A	0x71	A	0x00	A	0x8F	A	S
START	SLAVE ADDR	WRITE	ACK	OPCODE		PARAMETER		CHECKSUM		STOP

S	0x50	R	A	0x02	NAK	S
START	SLAVE ADDR	READ	ACK	DATA = SCAN ANGLE 47 DEG.		STOP

Glossary

Aperture The opening in an optical system defined by a lens or baffle that establishes the field of view.

Bar The dark element in a printed bar code symbol.

Bar Code Density The number of characters represented per unit of measurement (e.g., characters per inch).

Bar Height The dimension of a bar measured perpendicular to the bar width.

Bar Width Thickness of a bar measured from the edge closest to the symbol start character to the trailing edge of the same bar.

CDRH Center for Devices and Radiological Health. A federal agency responsible for regulating laser product safety. This agency specifies various laser operation classes based on power output during operation.

Character A pattern of bars and spaces which either directly represents data or indicates a control function, such as a number, letter, punctuation mark, or communications control contained in a message.

Code 39 A versatile and widely used alphanumeric bar code symbology with a set of 43 character types, including all uppercase letters, numerals from 0 to 9, and 7 special characters (- . / + % $ and space). The code name is derived from the fact that 3 of 9 elements representing a character are wide, while the remaining 6 are narrow.

Dead Zone An area within a scanner's field of view, in which specular reflection may prevent a successful decode.

Decode To recognize a bar code symbology (e.g., UPC/EAN) and then analyze the content of the specific bar code scanned.

Depth of Field The range between minimum and maximum distances at which a scanner can read a symbol with a certain minimum element width.

Digitized Bar Pattern (DBP)	A digital representation of a decoded bar code.
I^2C	Interface that provides a communications link between the SE-950 undecoded scan engine and a serial host.
IEC	International Electrotechnical Commission. This international agency regulates laser safety by specifying various laser operation classes based on power output during operation.
MIL	1 mil = 1 thousandth of an inch.
Nominal	The exact (or ideal) intended value for a specified parameter. Tolerances are specified as positive and negative deviations from this value.
Nominal Size	Standard size for a bar code symbol. Most UPC/EAN codes can be used over a range of magnifications (e.g., from 0.80 to 2.00 of nominal).
PMMA	Polymethyl Methacyclic, or Acrylic.
Reflectance	Amount of light returned from an illuminated surface.
Remote Scanner Management	Symbol's Remote Scanner Management technology enables a host to manage a Symbol scanner or scan engine remotely.
Resolution	The narrowest element dimension which can be distinguished by a particular reading device or printed with a particular device or method.
RoHS	Restriction of Hazardous Substances - EU Directive 2002/95/EC. Restricts the use of certain hazardous substances in electrical or electronic equipment sold or used in Europe after July 1, 2006. These substances are lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls, and polybrominated diphenyl ethers.
SOS	Start of Scan. This signal marks the beginning of each scan and provides a window for the Digitized Bar Pattern.
Space	The lighter element of a bar code formed by the background between bars.
Specular Reflection	The mirror-like reflection of light from a surface, which can “blind” a scanner.
Symbol	A scannable unit that encodes data within the conventions of a certain symbology, usually including start/stop characters, quiet zones, data characters, and check characters.
Tolerance	Allowable deviation from the nominal bar or space width.
UPC	Universal Product Code. A relatively complex numeric symbology. Each character consists of two bars and two spaces, each of which can be any of four widths. The standard symbology for retail food packages in the United States.
Visible Laser Diode (VLD)	A solid state device which produces visible laser light. Laser light emitted from the diode has a wavelength of nominally 650 nanometers.
WEEE	Waste Electrical and Electronic Equipment - EU Directive 2002/96/EC. Electrical or electronic equipment which is waste within the meaning of Article 1(a) of Directive 75/442/EEC, including all components, subassemblies and consumables which are part of the product at the time of discarding. The directive regulates the separate collection, specified treatment, recovery and recycling targets, and funding for handling waste electrical and electronic equipment in Europe effective August 13, 2005.

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