SE475X
INTEGRATION GUIDE

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Revision A

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Warranty

For the complete Zebra hardware product warranty statement, go to:
http://www.zebra.com/warranty.

Revision History

Changes to the original manual are listed below:

Change	Date	Description
-01 Rev A	11/2013	Initial release
-02 Rev A	9/2014	Added SE4757 Decoded Engine information, added Low Power Modes and Custom Flex descriptions, updated POWER_MODE section, added Asymmetric TIME_TO_LOW_POWER information, updated format of mechanical and optical drawings for clarity, added decode zone diagram
-03 Rev A	12/2014	Added SE4750 LED Aim engine information, updated Regulatory Information section, added/updated mechanical and optical drawings, added Additional Light Sources section, updated weight and LED aiming element specifications, added notes to Power Supply Sequencing section, added DRIVE_STRENGTH and MIRROR_AND_FLIP commands
-04 Rev A	2/2015	Zebra Rebranding.
-05 Rev A	4/2015	Added MR version information, updated Power Supply Sequencing section, updated 21-Pin ZIF Connector and Parallel Host Flex drawings
-06 Rev A	1/2017	Updated for DP engine version Updated digital image sensor reference information Updated regulatory information Updated POWER_MODE 0x5F section
-07 Rev A	8/2017	Replaced top drawing in Figure 2-14. Updated copyright statement. Replaced "Feedback" section with new email address.
-08 Rev A	1/2018	Updates: - Updated bullets on page 5-6 under "Operating States (individual bytes)". - Added QR Code working ranges to the existing Table 3-8, Table 3-9, Table 3-10, Table 3-11 and added cm values.

TABLE OF CONTENTS

Chapter 3: Specifications

ABOUT THIS GUIDE

Introduction

The *SE475X Integration Guide* discusses the theory of operation, installation, and specifications of the SE4750 and SE4757 engines, and how to integrate the engine into data capture devices.

✓ ***NOTE*** This guide provides general instructions for the installation of the engine into a customer's device. Zebra recommends that an opto-mechanical engineer perform an opto-mechanical analysis prior to integration.

Configurations

This guide provides information on the following SE475X configurations:

- SE4750SR Laser - Undecoded Standard Range engine with Laser aimer
- SE4750SR LED - Undecoded Standard Range engine with LED aimer
- SE4750MR Laser - Undecoded Mid-Range engine with Laser aimer
- SE4757SR Laser - Decoded Standard Range engine with Laser aimer
- SE4757SR LED - Decoded Standard Range engine with LED aimer
- SE4750DP Laser - Undecoded DPM engine with Laser aimer

Chapter Descriptions

This guide includes the following topics:

- *Chapter 1, Getting Started* provides an overview of the engine and the theory of operation.
- *Chapter 2, Installation* explains how to install the engine, including information on mounting, housing design, optical, grounding, ESD, thermal, and environmental considerations.
- *Chapter 3, Specifications* provides technical specifications for the engine, including decode ranges.

- *Chapter 4, Electrical Interface* includes signal information and connector drawings.
- *Chapter 5, Control Interface* describes the SE475X's bi-directional control interface.
- *Chapter 6, Application Notes* describes SE475X operating modes.
- *Appendix A, Register Settings* provides information on register settings for the engine.

Notational Conventions

This document uses the following conventions:

- *Italics* are used to highlight 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.

✓ ***NOTE*** This symbol indicates something of special interest or importance to the reader. Failure to read the note will not result in physical harm to the reader, equipment or data.

CAUTION This symbol indicates that if this information is ignored, the possibility of data or material damage may occur.

WARNING! **This symbol indicates that if this information is ignored the possibility that serious personal injury may occur.**

Related Documents

- *PL3307 Decoder Integration Guide*, p/n 72E-149624-xx
- *The I^2C-Bus Specification, Version 2.1*, http://www.semiconductors.philips.com/acrobat/literature/9398/39340011.pdf
- *ON Semiconductor® AR0134 (mono) 1/3-inch CMOS Digital Image Sensor Datasheet,* http://www.onsemi.com
- *ON Semiconductor AR0135 1/3-inch CMOS Digital Image Sensor Datasheet,* http://www.onsemi.com
- *Kyocera connector specification*, *6281 Series*, http://global.kyocera.com
- *Kyocera connector specification*, *6283 Series*, http://global.kyocera.com

Service Information

If you have a problem using the equipment, contact your facility's technical or systems support. If there is a problem with the equipment, they will contact the Support Center at: http://www.zebra.com/support.

When contacting support, please have the following information available:

- Serial number of the unit
- Model number or product name
- Software type and version number.

We respond to calls by e-mail, telephone or fax within the time limits set forth in support agreements.

If your problem cannot be solved by support, you may need to return your equipment for servicing and will be given specific directions. We are 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 you purchased your business product from a business partner, contact that business partner for support.

Provide Documentation Feedback

If you have comments, questions, or suggestions about this guide, send an email to EVM-Techdocs@zebra.com.

CHAPTER 1 GETTING STARTED

WARNING! **This device emits CDRH/IEC Class 2 laser light. Do not stare into beam.**

Introduction

The SE4750 undecoded imaging engine captures digital images for transmission to a decoder to decode a bar code of any format supported by the decoding software. The SE4750 uses laser or LED aiming, and LED illumination.

The SE4757 includes a PL3307-A decoder attached to the back of the SE4750 engine which decodes a bar code of any format supported by the decoding software.

The *PL3307 Integration Guide* (72E-149624-xx) is the primary information source for the SE4757. Use it in conjunction with this integration guide.

System Overview

The SE4750/SE4757 contains:

- a monochrome CMOS image sensor
- a laser or LED-based aiming system
- an illumination system
- a MIPI or parallel interface port and bi-directional control interface (I^2C) (SE4750)
- micro USB or RS-232 host interface (SE4757)
- PL3307-A decoder board (SE4757)

Figure 1-1 provides a block diagram of the undecoded SE4750 imager system, and *Figure 1-2* provides a block diagram of the decoded SE4757 imager system.

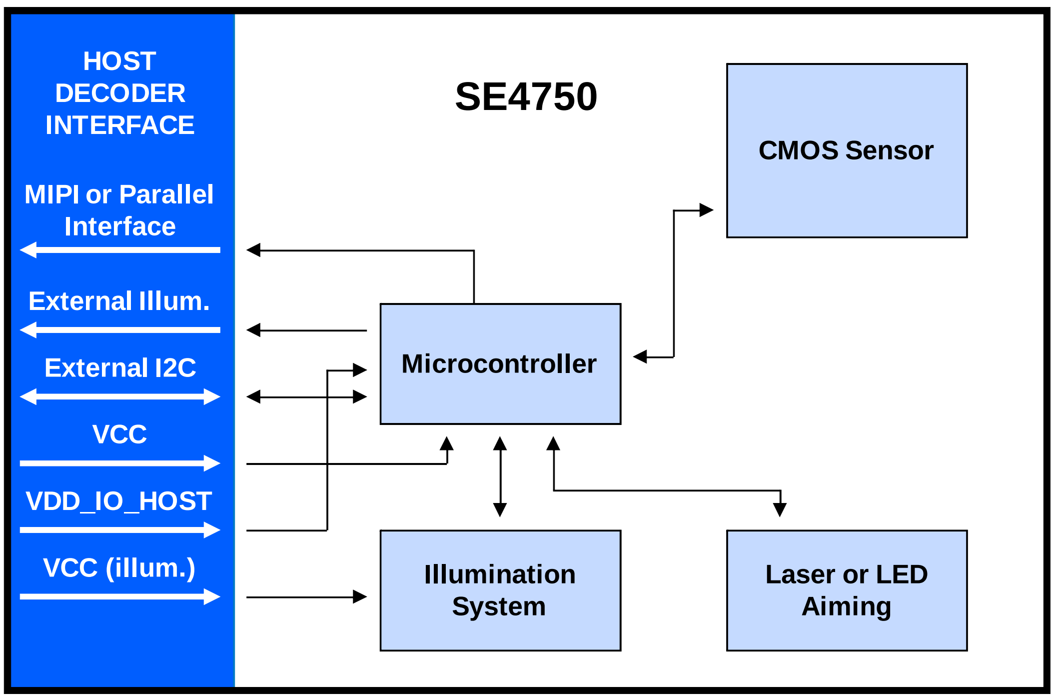


Figure 1-1 *SE4750 Block Diagram*

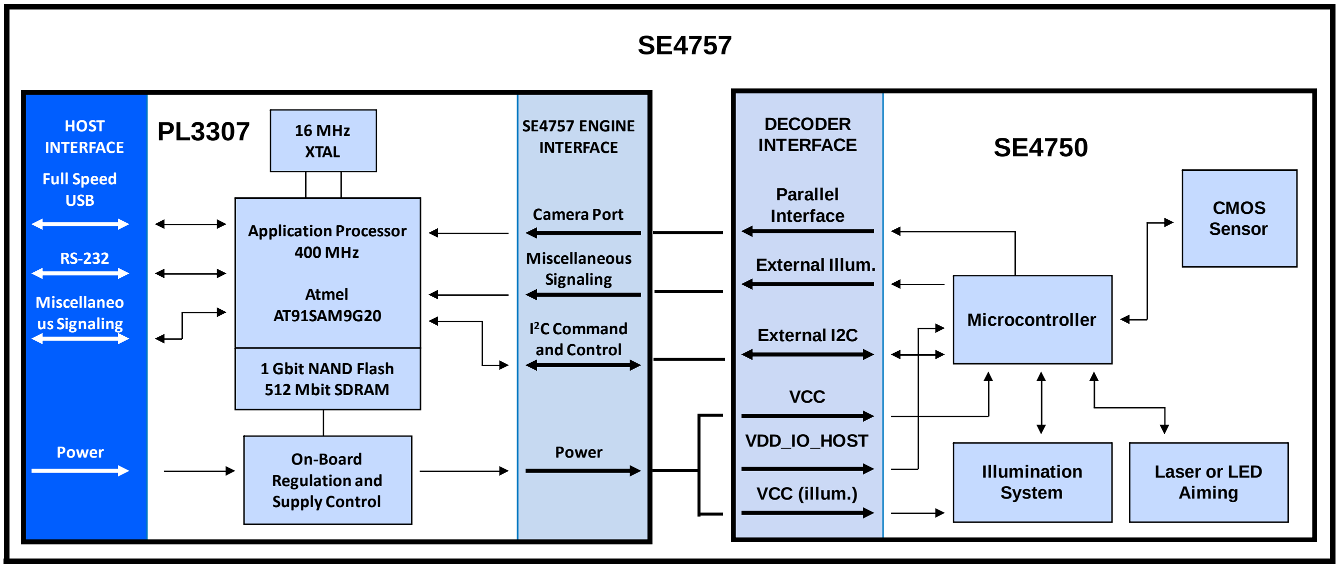


Figure 1-2 *SE4757 Block Diagram*

A 21-pin ZIF connector on the SE4750 connects the engine and the host device via a 55 mm flex (available from Zebra). For information about this connector, see *Figure 4-1 on page 4-4*. Also see *Figure 4-3 on page 4-6* and *Figure 4-4 on page 4-7* for host flex information.

A 31-pin ZIF connector on the SE4757 connects the engine and the host device via a 3 inch flex (available from Zebra). For information about this flex, refer to the PL3307-A accessory information in the *PL3307 Decoder Integration Guide*. A micro USB connector on the SE4757 can also be used to connect the SE4757 to the host.

The aiming subsystem, illumination system, and frame rate are under dynamic software control.

Imaging System

The primary component of the SE475X imager is a 1/3" format CMOS 1280 H x 960 V monochrome digital image sensor. The CMOS sensor converts photons to a digital representation (8 bits per pixel) of the image present on the sensor.

Aiming System

A 655 nm laser or 617 nm LED and aiming elements generate an aiming pattern that is visible in sunlight and other bright light applications.

The pattern center indicates the center of the field of view. For SE475XSR/MR laser aiming only, the aiming pattern cross-hairs indicate the full field of view for capturing images throughout its entire depth of field. The SE4750DP uses a laser aim dot.

See *Laser Aiming Element* and *LED Aiming Element on page 3-7* for aiming element specifications.

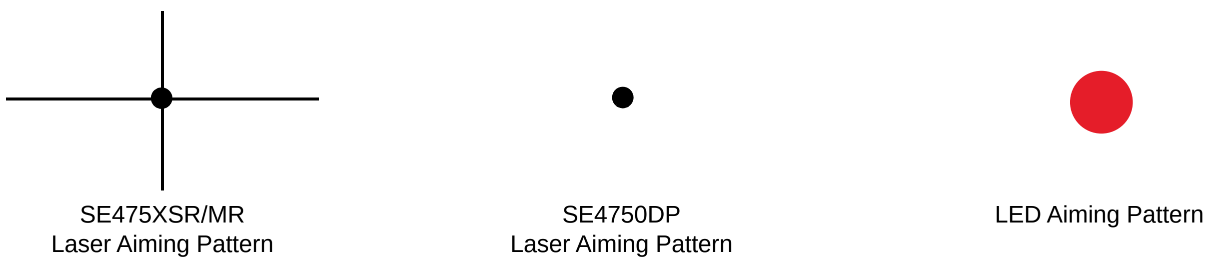


Figure 1-3 *Aiming Patterns*

Aiming Control

The SE4750 can capture images with both the aiming subsystem turned on during exposure (the image of the aiming pattern is visible in the digital image) or off. If the aiming system is turned off during exposure, brightness of the aiming pattern decreases as exposure increases.

The aiming subsystem can also be turned off completely. Zebra recommends shutting aiming off three frames prior to capturing documents to prevent the aiming pattern from appearing faintly in captured images. Note that this is not necessary for bar code decoding.

Illumination System

The illumination system consists of two high-output white LEDs and a sophisticated drive system that allows image capture and decoding throughout a full range of lighting conditions (total darkness to full sunlight).

Illumination Control

The SE4750 can capture images with the illumination subsystem turned on or off. LED illumination can be turned off when taking images of documents printed on semi-glossy or glossy paper or on a substrate with security marks. In this case, ensure ambient illumination provides minimum 5 fcd on the document surface.

Frame Rate Control

The SE4750 outputs images at 54 frames per second by default. When capturing images, use lower frame rates to increase image brightness. The aiming pattern appears to blink when the frame rate is 30 fps or lower.

CHAPTER 2 INSTALLATION

Introduction

This chapter provides information for mounting and installing the SE475X, including physical and electrical considerations, and recommended window properties for the SE475X.

CAUTION When handling engines, do not touch the imaging lens. Properly protect fingers to prevent prints on this lens.

CAUTION Use care not to touch the Illumination LEDs during handling. Improper handling can damage the LED lenses.

General Information

Default Power Mode

The default power mode for the SE4750 when connected to a PL3300 decoder is Bus-Powered USB Mode (<500mA). VCC_ILLUM must be 5V when in this mode to achieve expected illumination brightness.

If operating in Self-Powered USB Mode (>500mA) or RS-232 Mode with VCC_ILLUM =3.3V, configure the PL3300 for one of these modes using config 0 and config 1 signals in order to achieve expected illumination brightness.

IMPORTANT

Mixing Bus-Powered USB Mode with VCC_ILLUM =3.3V does not achieve the expected illumination brightness. This results in decode performance degradation and should be avoided.

Low Power Modes

NOTE In this guide, “low power” refers to hibernate mode unless stated otherwise.

The only low power mode associated with “auto low power” is hibernate.

The SE4750 has two low power modes:

- **Hibernate**: This puts the SE4750 engine in a low power state, however RAM remains powered in order to maintain memory contents. A small block of digital logic that runs off the 3.3V (VCC) supply and monitors the I^2C interface to the host also remains powered. The time to come out of hibernate until the first valid I^2C response is ~5ms for MIPI engines, and ~2ms for parallel engines.
- **Standby**: This is the lowest power state, and powers down all sections of the SE4750 engine including RAM. A small block of digital logic that runs off the 3.3V (VCC) supply and monitors the I^2C interface to the host remains powered. All configuration information sent from the host is lost when the engine enters standby. The time to come out of standby until the first valid I^2C response is ~35ms.

Grounding

The chassis is at ground. Isolate the SE4750 and host if installing the engine to a host that is not at ground, or has ground with the potential to inject noise.

Electrostatic Discharge (ESD)

Use care when handling this component and apply standard ESD handling procedures such as using grounding wrist straps and handling in a properly grounded work area.

Environment

The engine and decoder must be sufficiently enclosed to prevent dust from gathering on the aiming element, imaging lens, and illumination system LEDs. Dust and other external contaminants eventually degrade engine performance. Zebra does not guarantee performance of the SE475X when used in an exposed application.

Power Supply Noise

For reliable operation a low-noise power supply is required. Pay proper attention to power supply quality and testing to ensure the best possible performance from the SE475X. In bar code applications, up to 100 mV peak-to-peak noise is acceptable on all three power input pins (10 Hz to 100 kHz). For image capture applications, power supply noise for VCC must be limited to 30 mV (peak-to-peak), across the same frequency range.

External Optics (Imaging Lens, Illumination LEDs, and Aiming Element)

Do not subject external optical components on the SE475X engine to any external force. Do not hold the engine by an external optical component. This can place excessive stress in the mechanical joints that secure the components, which can cause failures such as joint cracking or breaking.

Image and Document Capture

For specific information on image and document capture applications, contact a Zebra sales representative for a technical document on image capture using the SE475X.

Custom Flex Considerations

When designing a custom flex, Zebra recommends the following:

- Consider the required current demands on VCC, VCC_ILUM, and VDD_IO_HOST, and size the flex traces appropriately to accommodate the supply current and minimize voltage drop. See *Table 3-7 on page 3-9*.
- For MIPI, use a two layer flex (a signal layer and ground layer). The MIPI signals require controlled impedance (100 ohm differential) and should be over the ground plane.
- For parallel, also use a two layer flex (a signal layer and ground layer). A high speed clock signal (~75 MHz) is transmitted over the flex and may require additional shielding to achieve EMI requirements.

Regulatory Information

The SE475X imager engine meets the accessible laser light limits for a CDRH/IEC Class 2 laser and an exempt risk group LED product. Any product containing the SE475X can meet these same regulations. Contact a Zebra sales representative for further details.

Laser products sold in North America must be reported to the U.S. Food and Drug Administration, Center for Devices and Radiological Health (CDRH) via a Laser Radiation Safety Report (Product Report).
Visit http://www.fda.gov.

Refer to the U.S. Code of Federal Regulations, 21CFR1040.10 for the specific North American requirements for laser products. For devices intended for international sale, refer to the IEC/EN60825-1 standard for the Safety of Laser Products.

Complies with 21CFR1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, dated June 24, 2007 and IEC 60825-1 (Ed. 3.0), EN60825-1:2014.

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 June 24, 2007."
- "EN60825-1:2014"
- "IEC 60825-1 (Ed. 3.0)"
- "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.

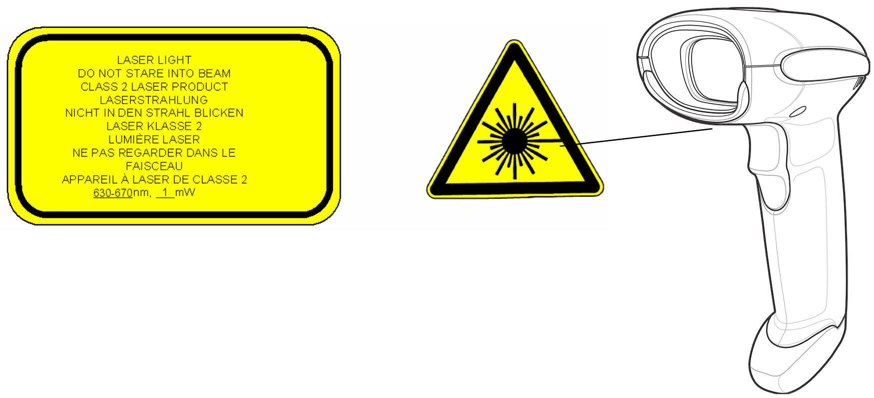


Figure 2-1 *Example of Placement of Class 2 Laser Warning Label*

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 2-1*.

Thermal Design

The SE475X engine includes several high-power components (e.g., microcontroller, sensor, LEDs) that dissipate heat during operation. The engine can reach very high temperatures when it is running at 54 frames per second with full illumination and aiming on. These extreme conditions can increase sensor noise, degrade image quality, and impact the laser diode's longevity. Use care when designing the SE475X for integration into the target application.

As a protective measure for the laser diode, the SE475X shuts off aiming and illumination at ~68°C chassis temperature. As the engine temperature returns to normal levels the laser and illumination turn back on.

For the LED aim version, aiming and illumination shut off at ~75°C chassis temperature. As the engine temperature returns to normal levels the LED aim and illumination turn back on.

In a thermal chamber with zero air flow and no heat sink attached, the thermal dissipation of the SE475X engine can be simplified as the lumped capacitance thermal model shown in *Figure 2-2*. The parameters are listed below.

- P_{engine} : The total power consumption of the SE475X engine (W)
- $T_{engine\_chassis}$: The SE475X chassis temperature (K)
- $T_{ambient}$: The ambient temperature (K)
- R_{t_conv} : The thermal resistance between the SE475X engine and the ambient through natural convection (reference: 38 K/W)
- C_{engine} : The thermal capacity of the SE475X engine (reference: 9.2 Joule/K)
- $T_{thermal\_constant}$: The thermal time constant of SE475X engine (reference: 350 sec), which equals R_{t_conv} * C_{engine}

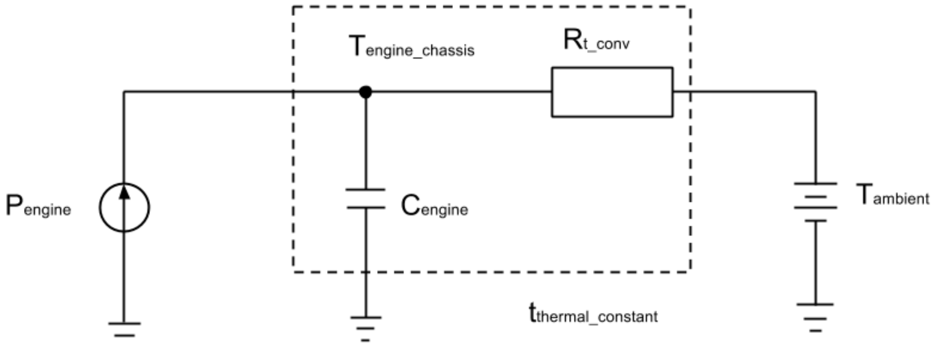


Figure 2-2 *Lumped Capacitance Thermal Model of SE475X Scan Engine*

Based on this lumped capacitance thermal model and the engine power consumptions (see *Table 3-7 on page 3-9*), the allowed engine scanning duty cycles can be calculated and plotted for a defined engine chassis temperature limit as *Figure 2-3* and *Figure 2-4*.

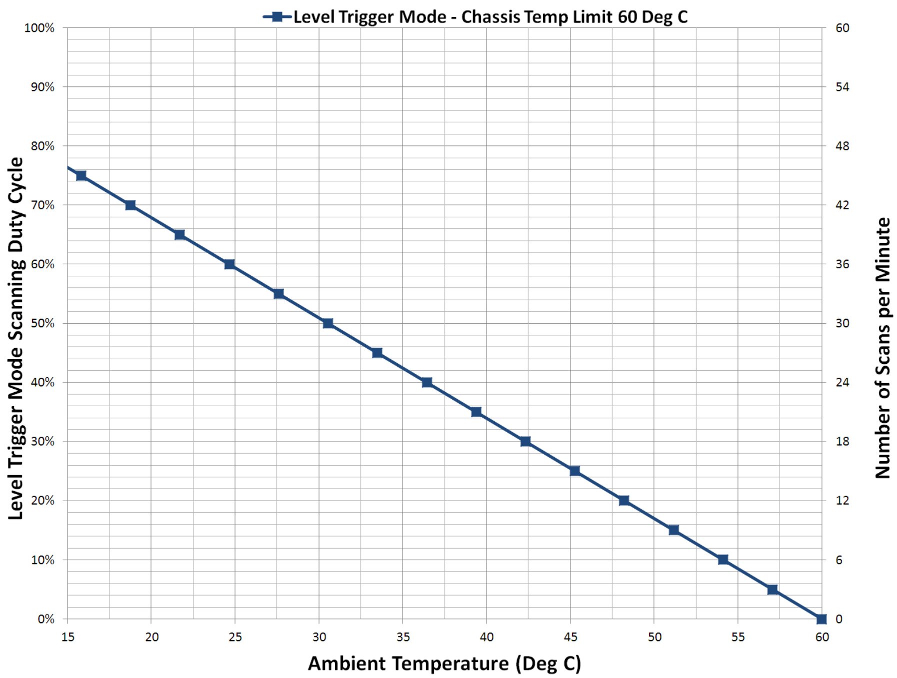


Figure 2-3 *Engine Scanning Duty Cycle in Level Trigger Mode, Chassis Temperature Limit = 60°C*

Notes:

- The plot represents the condition that the engine is in still air and with no heat sink attached, while the air temperature is measured as the ambient temperature.
- The scanning time is measured between the trigger event (pulling the trigger) and the end of the scanning session (decoding).
- The scanning duty cycle is the percentage of time when the engine is in full scanning mode.
- 0% scanning duty cycle in level trigger mode indicates that the engine is at idle.
- The number of scans per minute is based on the assumption that a typical scanning session requires 1 second of full scanning power. For example, 12 scans per minute equals 20% scanning duty cycle.

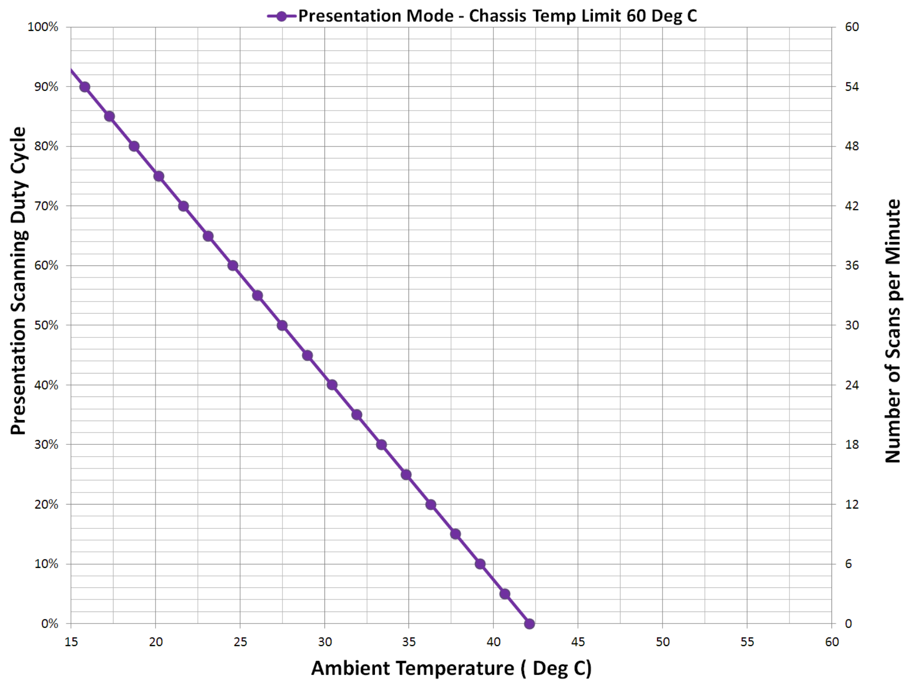


Figure 2-4 *Engine Scanning Duty Cycle in Presentation Mode, Chassis Temperature Limit = 60°C*

Notes:

- The plot represents the condition that the engine is in still air and with no heat sink attached, while the air temperature is measured as the ambient temperature.
- The scanning time is measured between the trigger event (object detection event) and the end of the scanning session (the bar code leaving the engine FOV).
- The scanning duty cycle is the percentage of time when the engine is in full presentation scanning mode.
- 0% scanning duty cycle in presentation mode indicates that the engine is in object detection mode.
- The number of scans per minute is based on the assumption that a typical scanning session requires 1 second of full scanning power. For example, 12 scans per minute equals 20% scanning duty cycle.

Running in continuous 54 fps video mode with both aiming and illumination enabled full time is highly uncommon. If a higher ambient temperature or higher scan rate is desired, the recommendations to reduce engine power consumption and increase heat removal include but are not limited to:

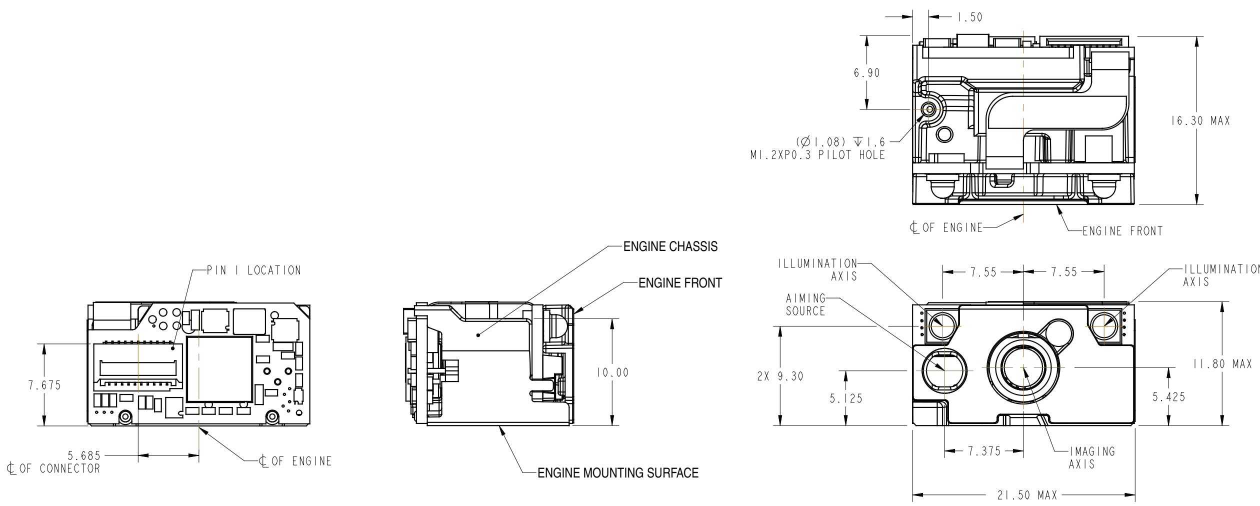
- Turning off the engine aiming and illumination whenever possible.
- Using the ambient light to assist the scan engine in bar code decoding, thereby reducing the illumination power consumption.
- Mounting on a solid metallic surface that facilitates conductive heat transfer from the engine metallic chassis and increases the combined thermal capacitance.
- Selecting a housing design that allows for natural or forced convection to reduce the convective thermal resistance between the engine and the ambient.
- Providing heat sink to the engine to create an alternative heat transfer path to the ambient in parallel to reducing the overall thermal resistance between the engine metallic chassis and the ambient.

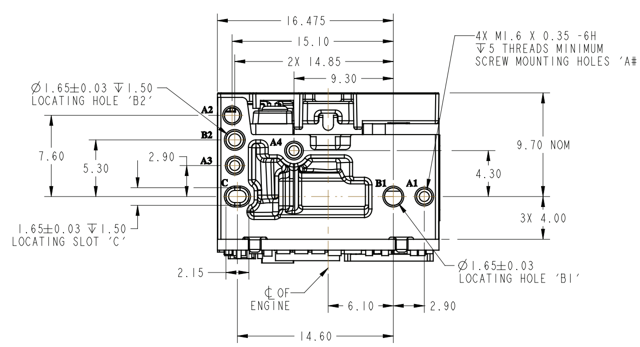
SE475X Mechanical Layout

SE4750SR Laser

There are several mounting holes (M1.6x0.35) and locator holes on the bottom of the chassis (see *Figure 2-5*). The SE4750 can be mounted in any orientation without degradation in performance.

✓ ***NOTE*** Mounting the SE4750 in a non-upright position results in images rotated accordingly in snapshot or video mode.





Notes: Unless otherwise specified:

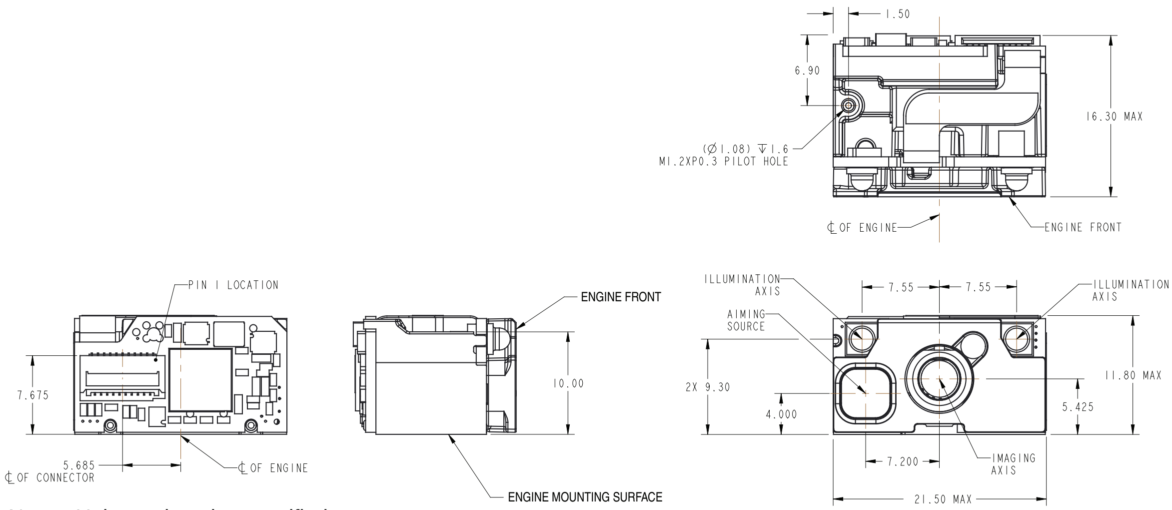
- Engine chassis is at ground.
- Holes marked "A#" are threaded mounting holes.
  Holes marked "B#" are engine location aides.
- It is recommended to secure the engine using a combination of two mounting screws and two locating pins, which must include A1 and B1.
- To ensure mounting compatibility with other engines in the SE4500 and SE4750 families the following is recommended:
  - Allocate screw holes for: A1, A3, A4
  - Provide locating pins for: B1, B2
  - Do not use locating pin for: C
- When installing the mounting screws using holes "A#", ensure they do not protrude past the mounting hole threads in the chassis; use 2.1 mm maximum mounting screw thread engagement. Recommended mounting screw torque is 1.25 ± 0.25 in-lb.
- This is a reference drawing and is not intended to specify or guarantee all possible integration requirements for this engine.
- All dimensions are in mm. All untoleranced dimensions follow a general tolerance of ± 0.15 mm.
- All optical integration information references engine locating hole "B1" axis, engine front, and the engine mounting surface.

Figure 2-5 *SE4750SR Laser Mechanical Integration*

SE4750SR LED

There are several mounting holes (M1.6x0.35) and locator holes on the bottom of the chassis (see *Figure 2-6*). The SE4750 can be mounted in any orientation without degradation in performance.

NOTE Mounting the SE4750 in a non-upright position results in images rotated accordingly in snapshot or video mode.



Notes: Unless otherwise specified:

- Engine chassis is at ground.
- Holes marked "A#" are threaded mounting holes.
  Holes marked "B#" are engine location aides.
- It is recommended to secure the engine using a combination of two mounting screws and two locating pins, which must include A1 and B1.
- To ensure mounting compatibility with other engines in the SE4500 and SE4750 families the following is recommended:
  - Allocate screw holes for: A1, A3, A4
  - Provide locating pins for: B1, B2
  - Do not use locating pin for: C
- When installing the mounting screws using holes "A#", ensure they do not protrude past the mounting hole threads in the chassis; use 2.1 mm maximum mounting screw thread engagement. Recommended mounting screw torque is 1.25 ± 0.25 in-lb.
- This is a reference drawing and is not intended to specify or guarantee all possible integration requirements for this engine.
- All dimensions are in mm. All untoleranced dimensions follow a general tolerance of ± 0.15 mm.
- All optical integration information references engine locating hole "B1" axis, engine front, and the engine mounting surface.

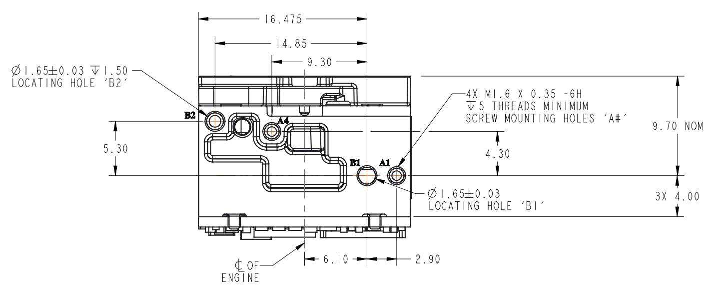
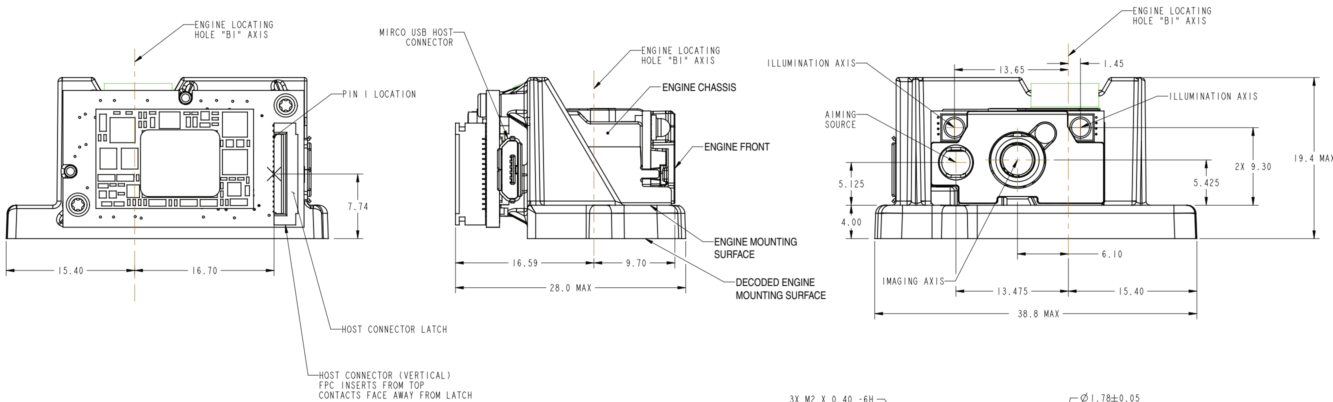


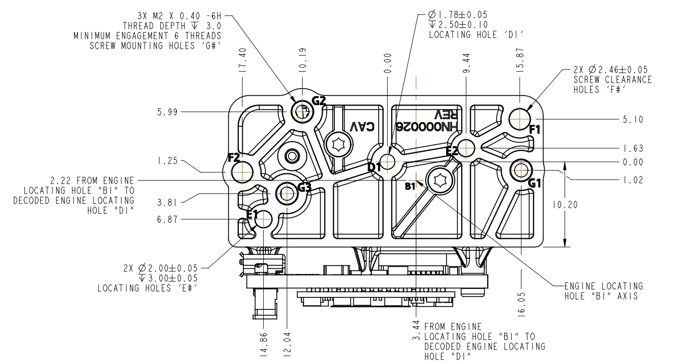
Figure 2-6 *SE4750SR LED Mechanical Integration*

SE4757SR Laser

There are several mounting holes (M2 x 0.40) and locator holes on the bottom of the engine bracket (see *Figure 2-7*). The SE4757 can be mounted in any orientation without degradation in performance.

NOTE Mounting the SE4757 in a non-upright position results in images rotated accordingly in snapshot or video mode.





Notes: Unless otherwise specified:

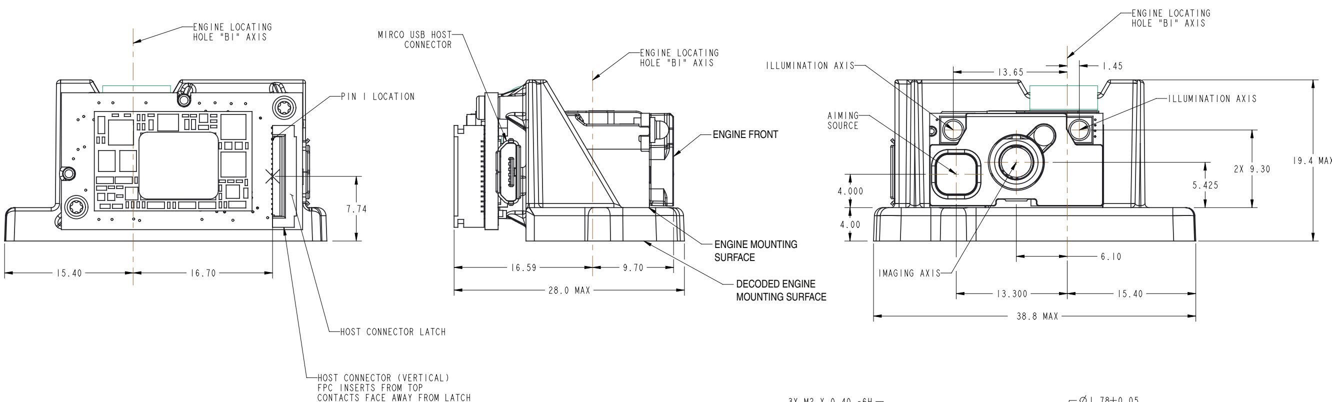
- Engine chassis is at ground.
- Holes marked "G#" are threaded mounting holes.
  Holes marked "D#", and "E#" are decoded engine locating aids.
  Holes marked "F#" are screw clearance holes.
- It is recommended to secure the engine using a combination of two mounting screws and two locating pins.
- When installing the mounting screws using holes "G#", ensure they do not protrude past the engine mounting surface; use 4.0 mm maximum mounting screw thread engagement. Recommended mounting screw torque is 1.33 ± 0.25 in-lb.
- This is a reference drawing and is not intended to specify or guarantee all possible integration requirements for this engine.
- All dimensions are in mm. All untoleranced dimensions follow a general tolerance of ± 0.15 mm.
- All optical integration information references engine locating hole "B1" axis, engine front, and the engine mounting surface.

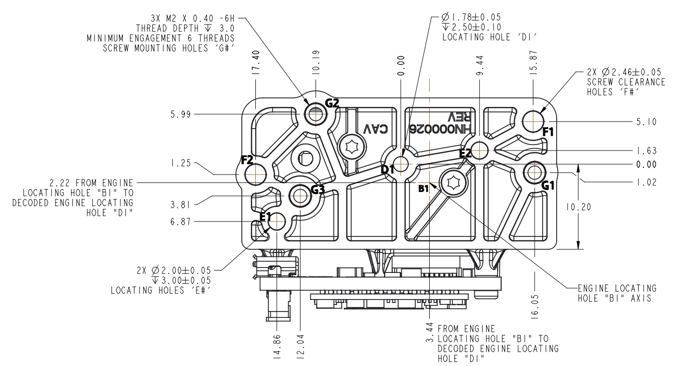
Figure 2-7 *SE4757SR Laser Mechanical Integration*

SE4757SR LED

There are several mounting holes (M2 x 0.40) and locator holes on the bottom of the engine bracket (see *Figure 2-8*). The SE4757 can be mounted in any orientation without degradation in performance.

NOTE Mounting the SE4757 in a non-upright position results in images rotated accordingly in snapshot or video mode.





Notes: Unless otherwise specified:

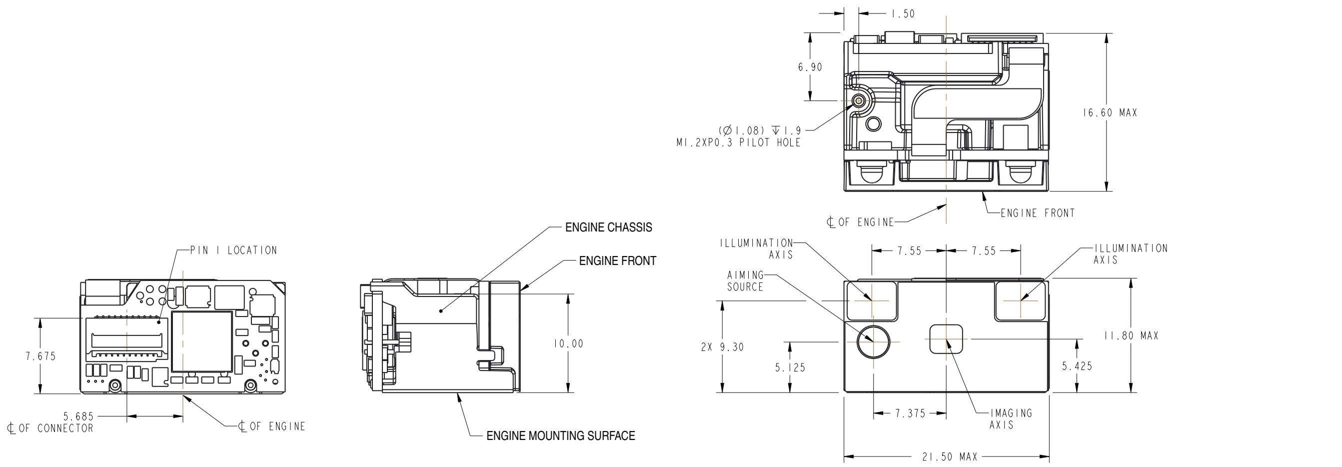
- Engine chassis is at ground.
- Holes marked "G#" are threaded mounting holes.
  Holes marked "D#", and "E#" are decoded engine locating aids.
  Holes marked "F#" are screw clearance holes.
- It is recommended to secure the engine using a combination of two mounting screws and two locating pins.
- When installing the mounting screws using holes "G#", ensure they do not protrude past the engine mounting surface; use 4.0 mm maximum mounting screw thread engagement. Recommended mounting screw torque is 1.33 ± 0.25 in-lb.
- This is a reference drawing and is not intended to specify or guarantee all possible integration requirements for this engine.
- All dimensions are in mm. All untoleranced dimensions follow a general tolerance of ± 0.15 mm.
- All optical integration information references engine locating hole "B1" axis, engine front, and the engine mounting surface.

Figure 2-8 *SE4757SR LED Mechanical Integration*

SE4750MR Laser

There are several mounting holes (M1.6x0.35) and locator holes on the bottom of the chassis (see *Figure 2-9*). The SE4750 can be mounted in any orientation without degradation in performance.

NOTE Mounting the SE4750 in a non-upright position results in images rotated accordingly in snapshot or video mode.



Notes: Unless otherwise specified:

- Engine chassis is at ground.
- Holes marked "A#" are threaded mounting holes.
  Holes marked "B#" are engine location aides.
- It is recommended to secure the engine using a combination of two mounting screws and two locating pins, which must include A1 and B1.
- To ensure mounting compatibility with other engines in the SE4500 and SE4750 families the following is recommended:
  - Allocate screw holes for: A1, A3, A4
  - Provide locating pins for: B1, B2
  - Do not use locating pin for: C
- When installing the mounting screws using holes "A#", ensure they do not protrude past the mounting hole threads in the chassis; use 2.1 mm maximum mounting screw thread engagement. Recommended mounting screw torque is 1.25 ± 0.25 in-lb.
- This is a reference drawing and is not intended to specify or guarantee all possible integration requirements for this engine.
- All dimensions are in mm. All untoleranced dimensions follow a general tolerance of ± 0.15 mm.
- All optical integration information references engine locating hole "B1" axis, engine front, and the engine mounting surface.

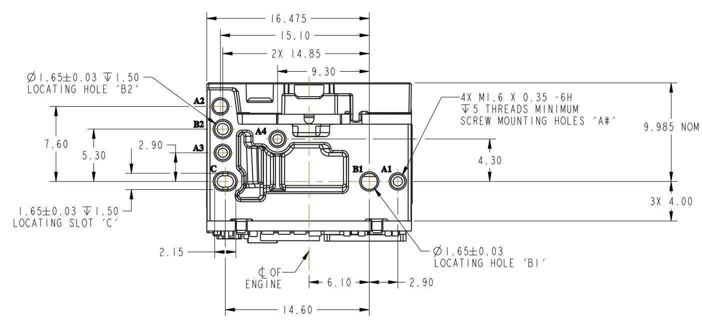
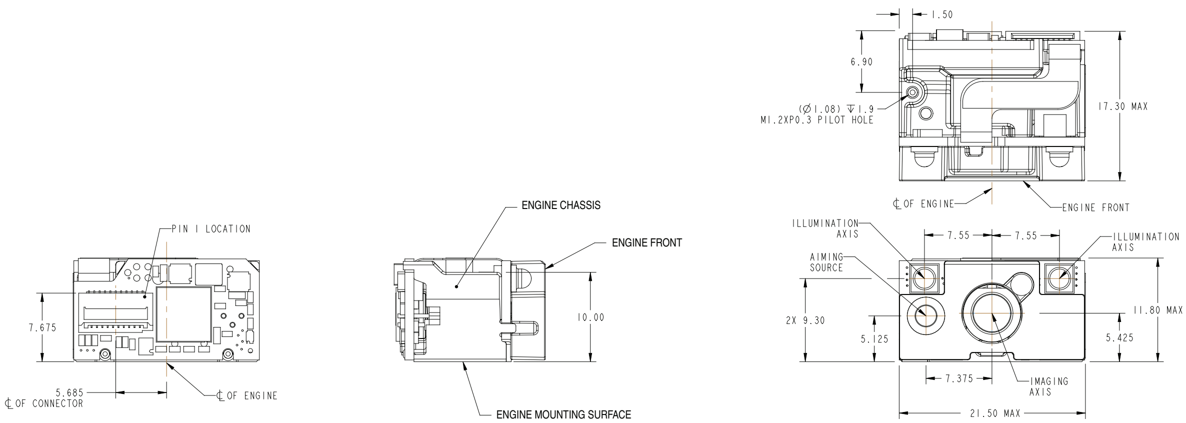


Figure 2-9 *SE4750MR Laser Mechanical Integration*

SE4750DP Laser

There are several mounting holes (M1.6x0.35) and locator holes on the bottom of the chassis (see *Figure 2-10*). The SE4750 can be mounted in any orientation without degradation in performance.

> **NOTE** Mounting the SE4750 in a non-upright position results in images rotated accordingly in snapshot or video mode.



Notes: Unless otherwise specified:

- Engine chassis is at ground.
- Holes marked "A#" are threaded mounting holes.
  Holes marked "B#" are engine location aides.
- It is recommended to secure the engine using a combination of two mounting screws and two locating pins, which must include A1 and B1.
- To ensure mounting compatibility with other engines in the SE4500 and SE4750 families the following is recommended:
  - Allocate screw holes for: A1, A3, A4
  - Provide locating pins for: B1, B2
  - Do not use locating pin for: C
- When installing the mounting screws using holes "A#", ensure they do not protrude past the mounting hole threads in the chassis; use 2.1 mm maximum mounting screw thread engagement.
  Recommended mounting screw torque is 1.25 ± 0.25 in-lb.
- This is a reference drawing and is not intended to specify or guarantee all possible integration requirements for this engine.
- All dimensions are in mm. All untoleranced dimensions follow a general tolerance of ± 0.15 mm.
- All optical integration information references engine locating hole "B1" axis, engine front, and the engine mounting surface.

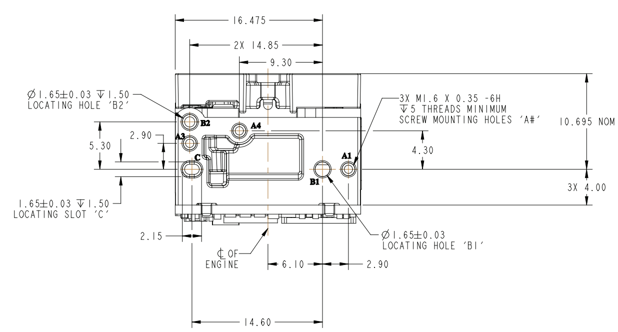


Figure 2-10 *SE4750DP Laser Mechanical Integration*

SE475X Optical Paths

The optical paths are shown positioned with respect to a simplified engine block (without all mechanical features).

The datum scheme (including engine mounting surface, engine front limit and locating pin B1) can be used to relate the position of the simplified block to the engine detailed mechanical layout.

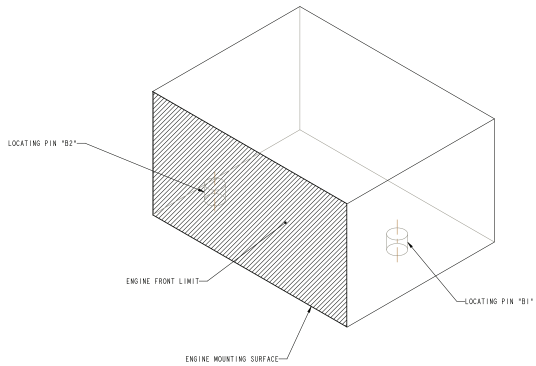


Figure 2-11 *Simplified Engine Block*

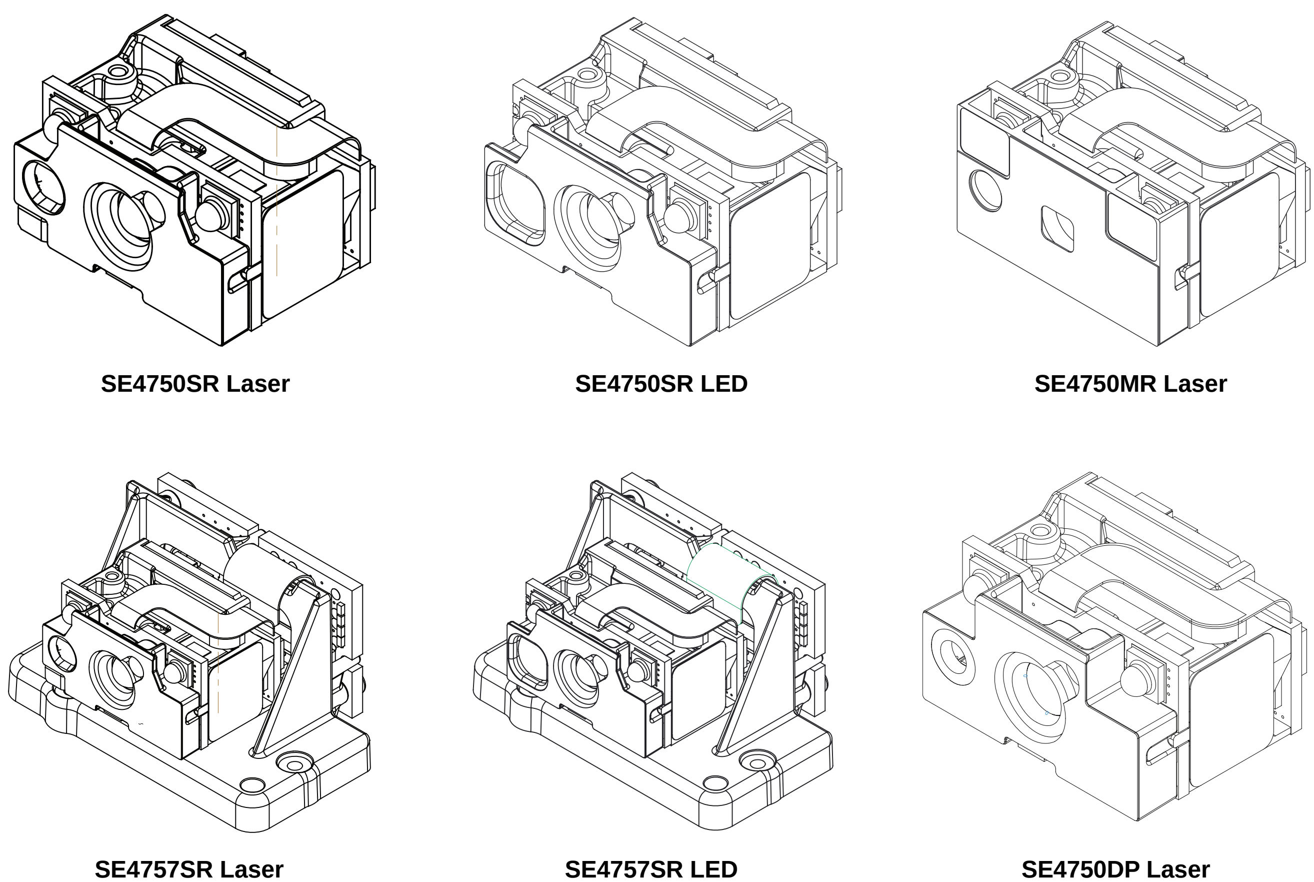


Figure 2-12 *Detailed Engine Mechanical Layouts*

SR Imaging Field of View

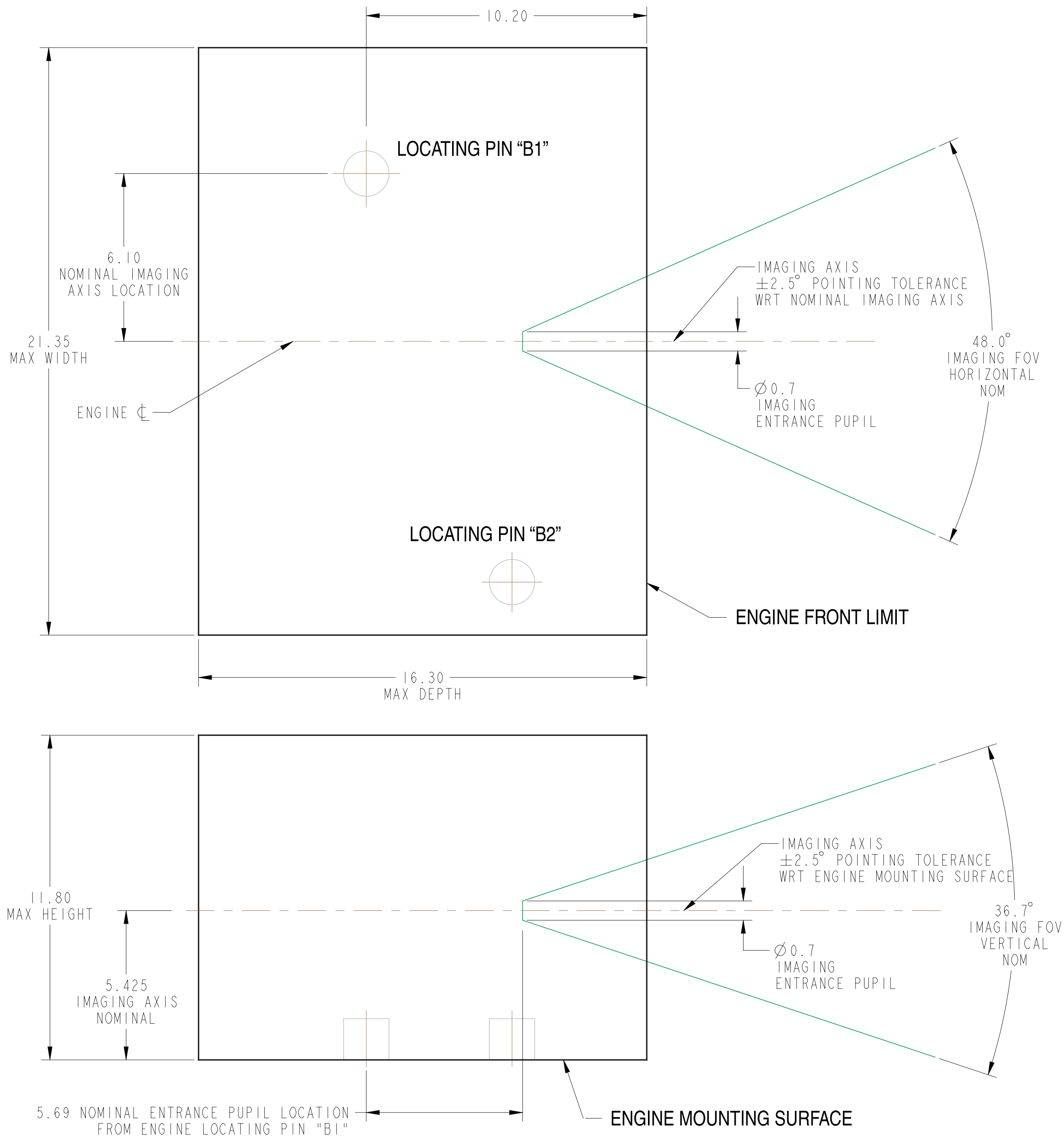


Figure 2-13 *SR Imaging Field of View*

MR Imaging Field of View

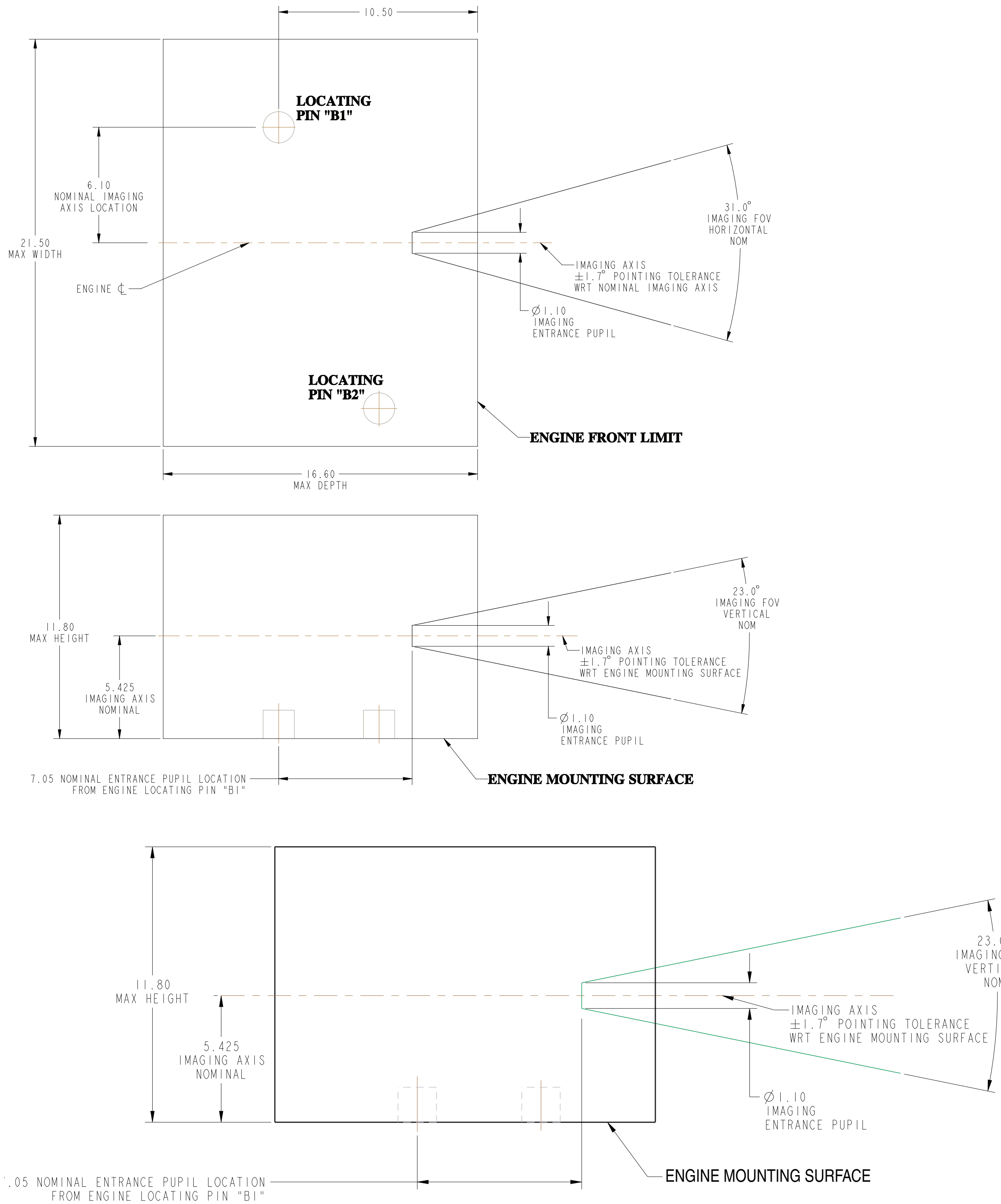


Figure 2-14 *MR Imaging Field of View*

DP Imaging Field of View

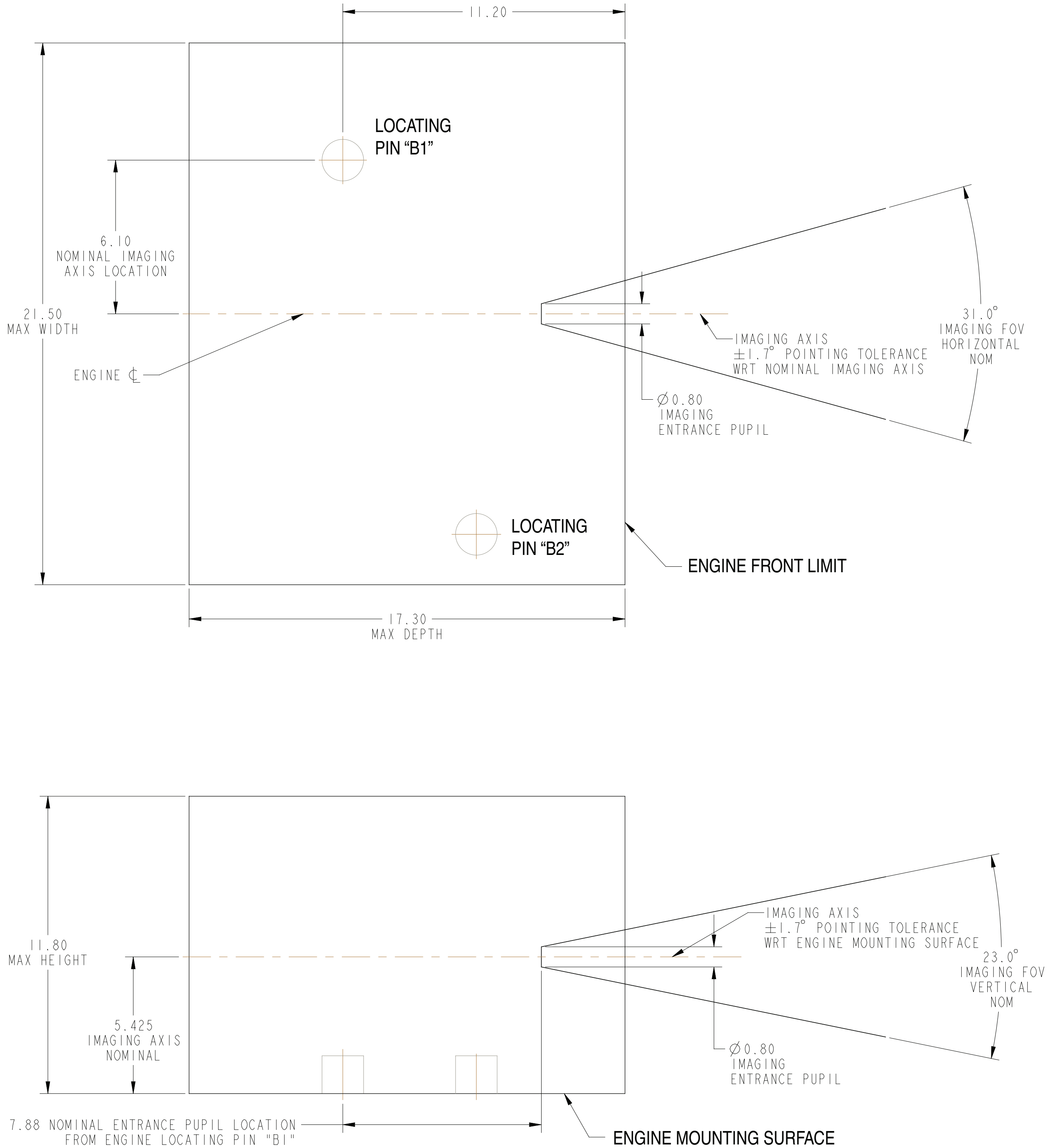


Figure 2-15 *DP Imaging Field of View*

SR Laser Aiming Pattern

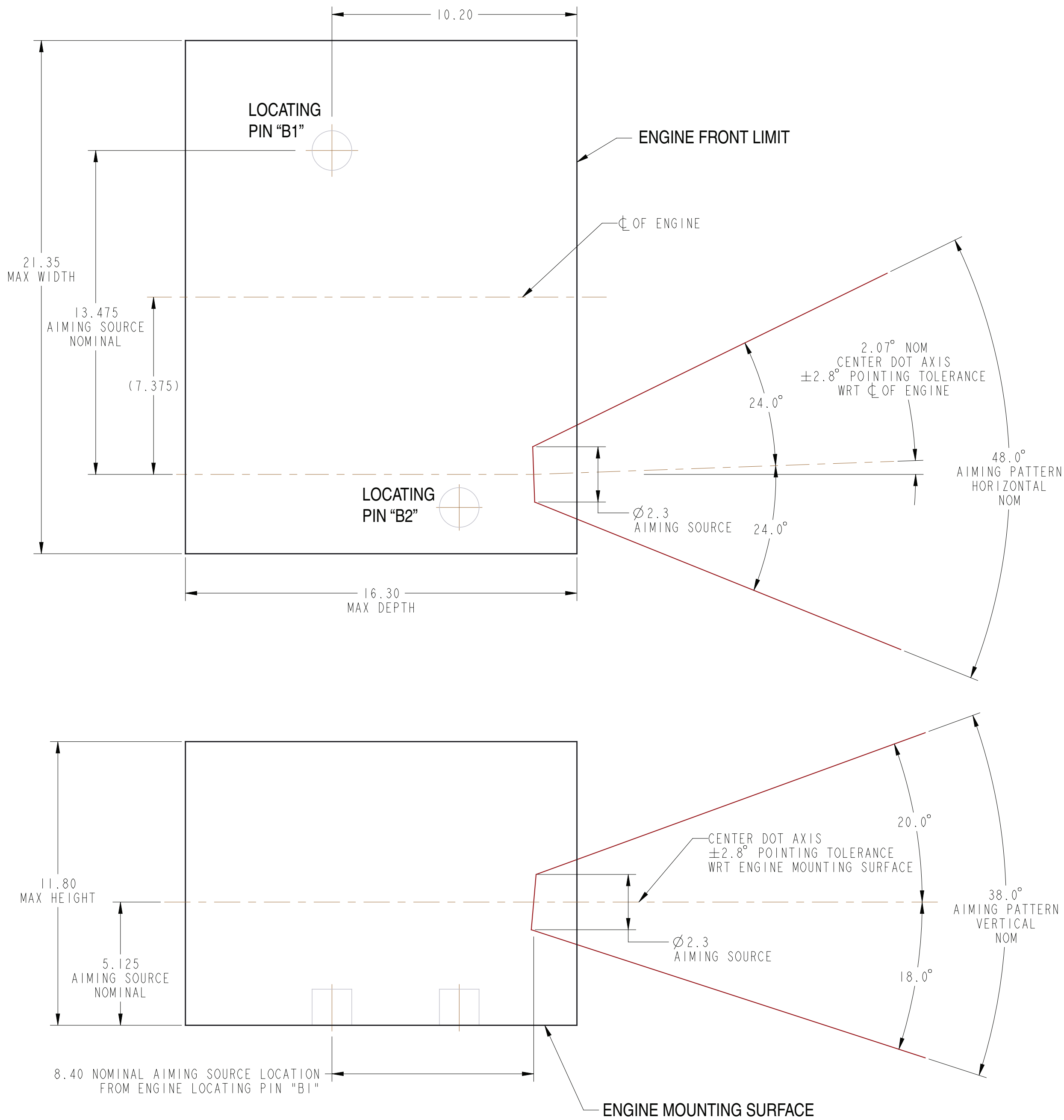


Figure 2-16 *SR Laser Aiming Pattern*

SR LED Aiming Pattern

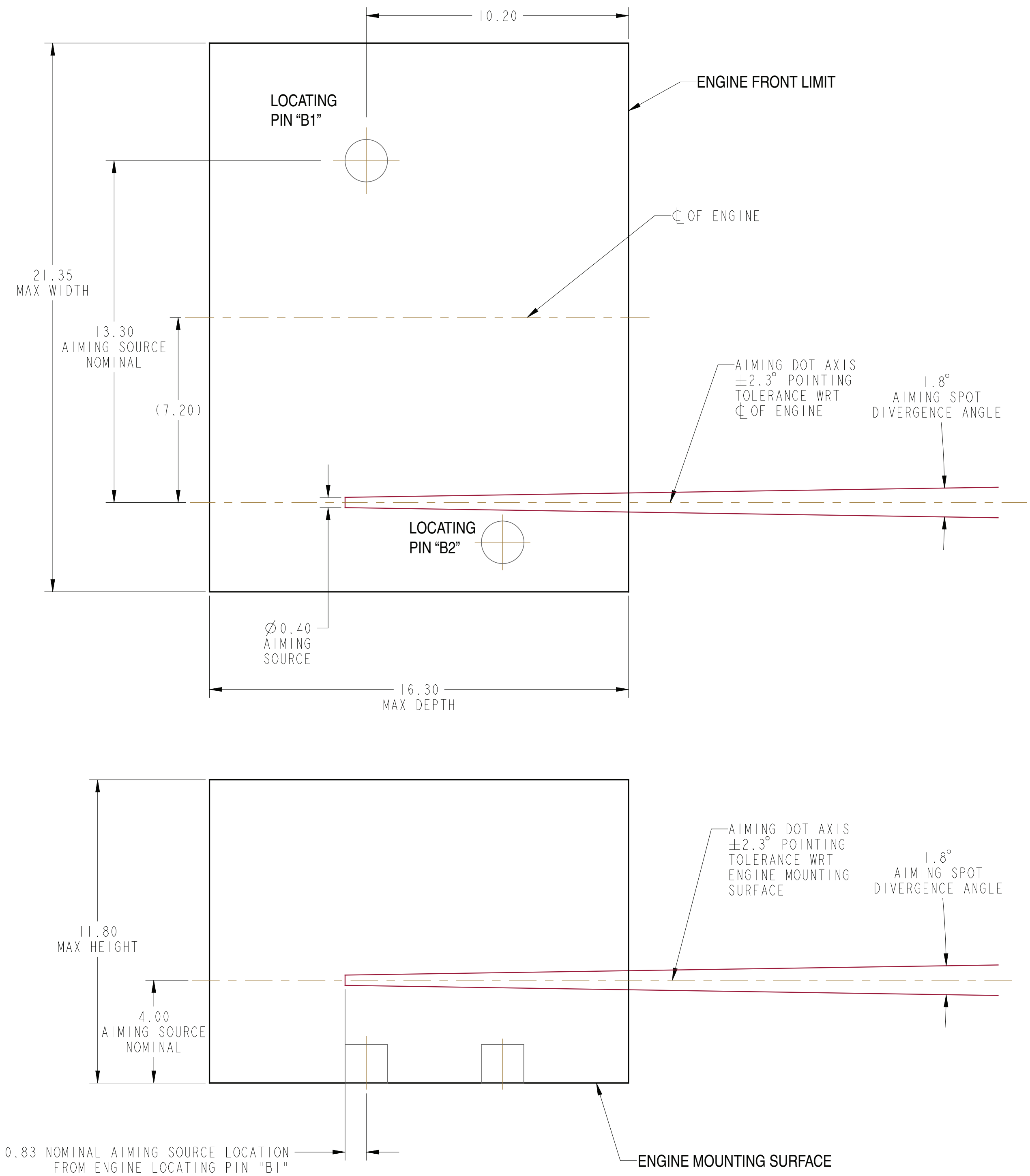


Figure 2-17 *SR LED Aiming Pattern*

MR Laser Aiming Pattern

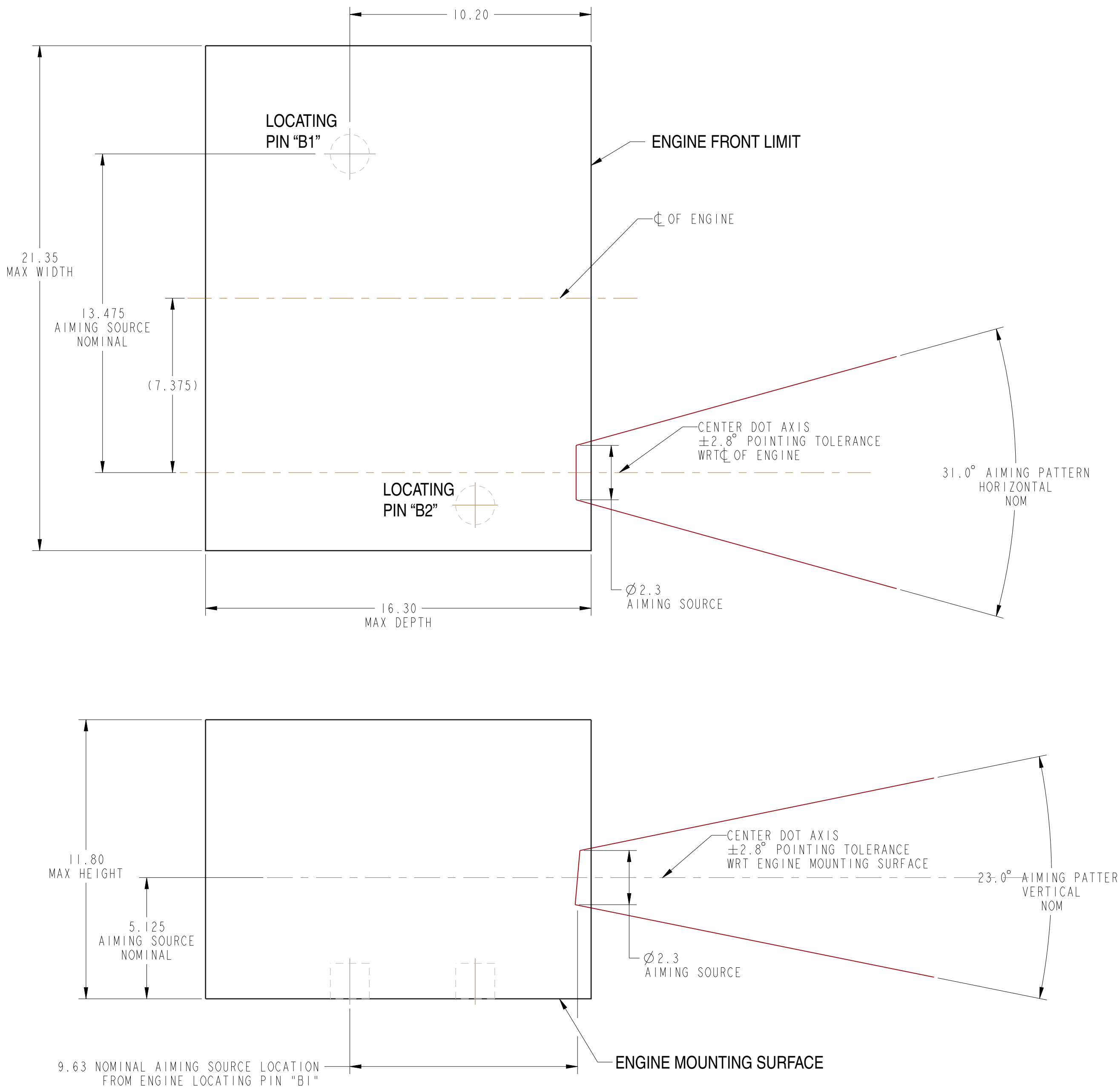


Figure 2-18 *MR Laser Aiming Pattern*

DP Laser Aiming Pattern

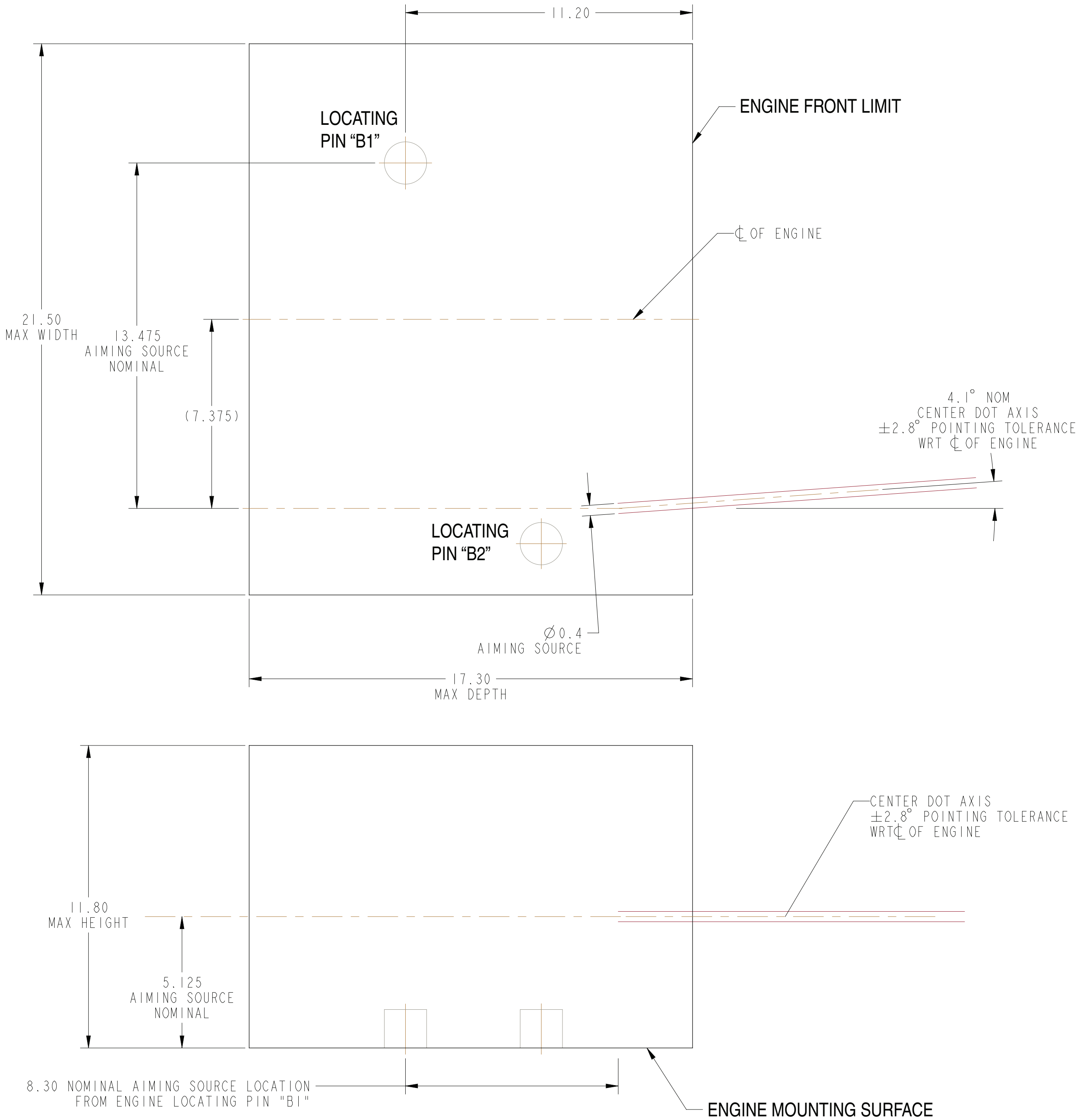
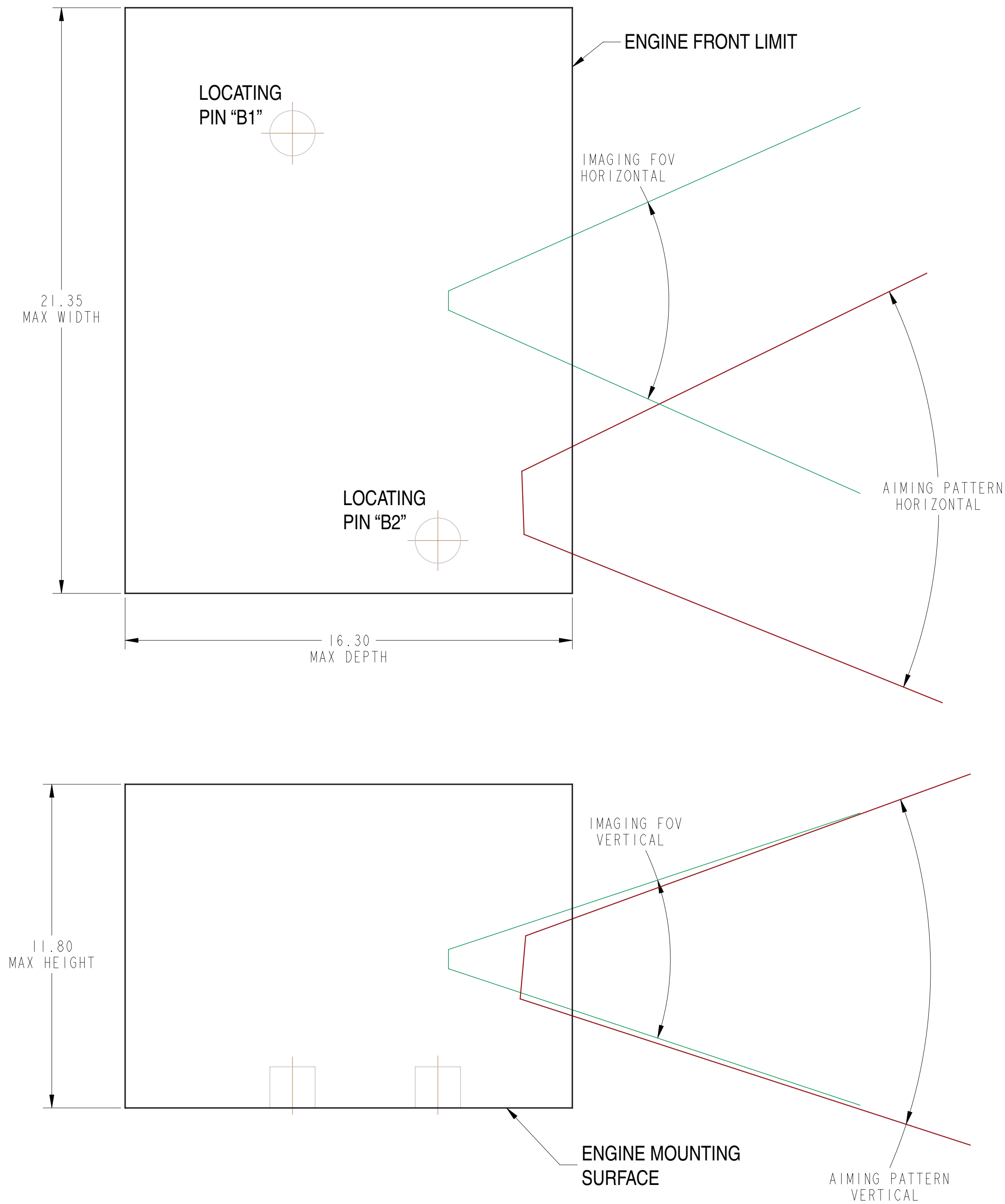


Figure 2-19 *DP Laser Aiming Pattern*

SR Imaging and Laser Aiming Parallax

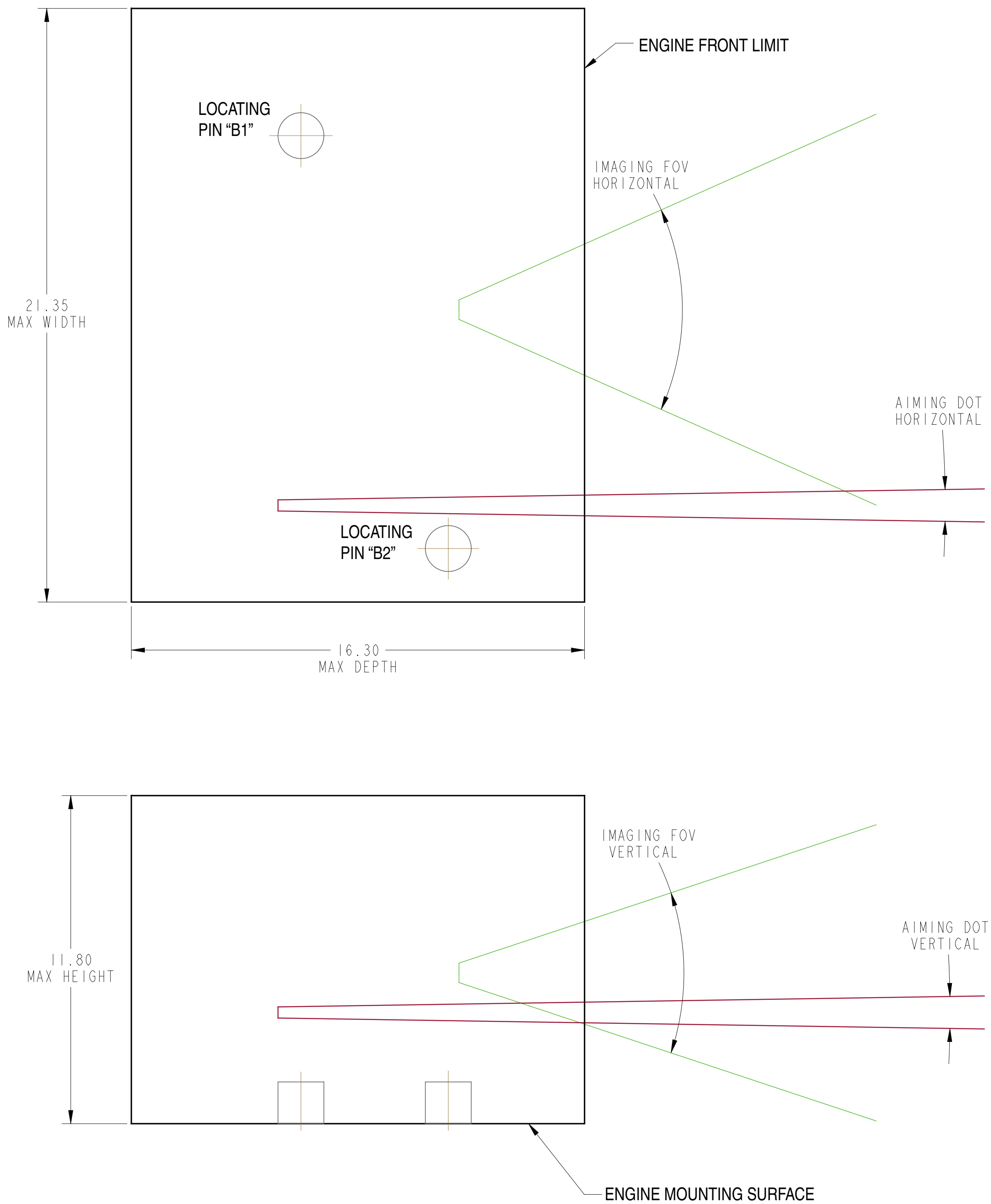


Notes:

The aiming pattern is rotated by 2.07^{o} relative to the imaging axis in the horizontal plane to minimize the effects of parallax. The aiming dot is located at the center of the image at 203.2 mm (8.0 inches).

Figure 2-20 *SR Laser Aiming Pattern Relative to SR Imaging Field of View*

SR Imaging and LED Aiming Parallax

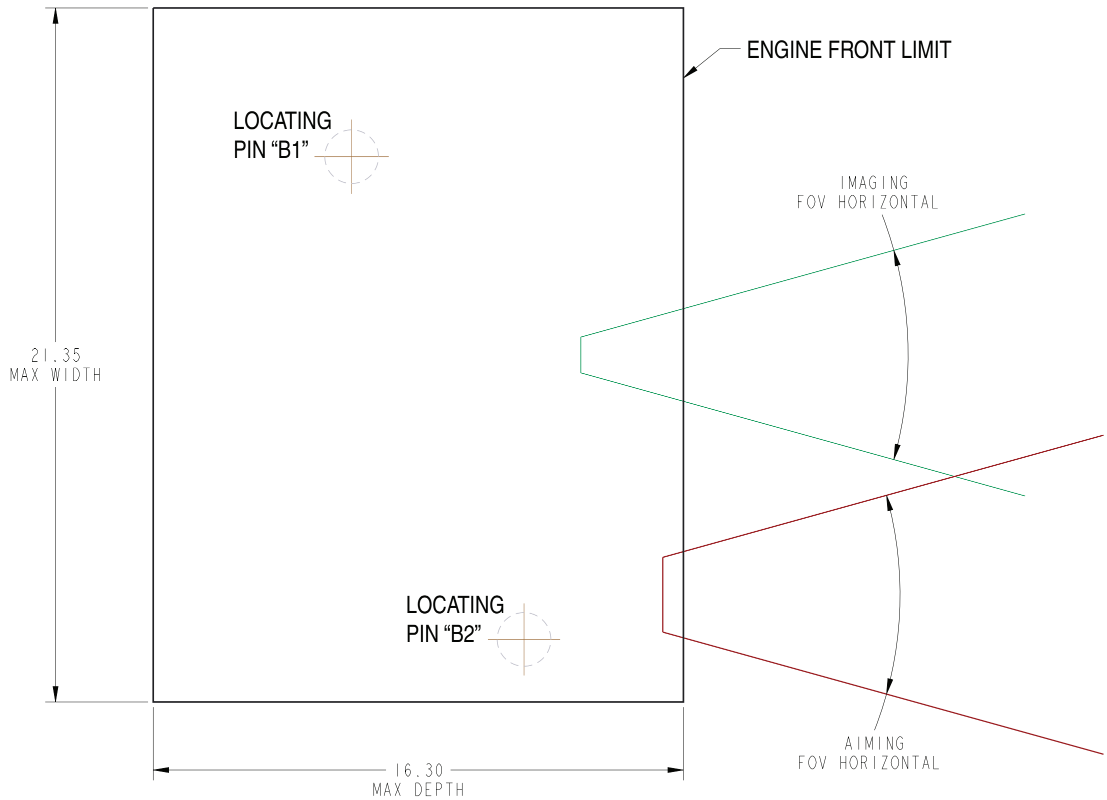


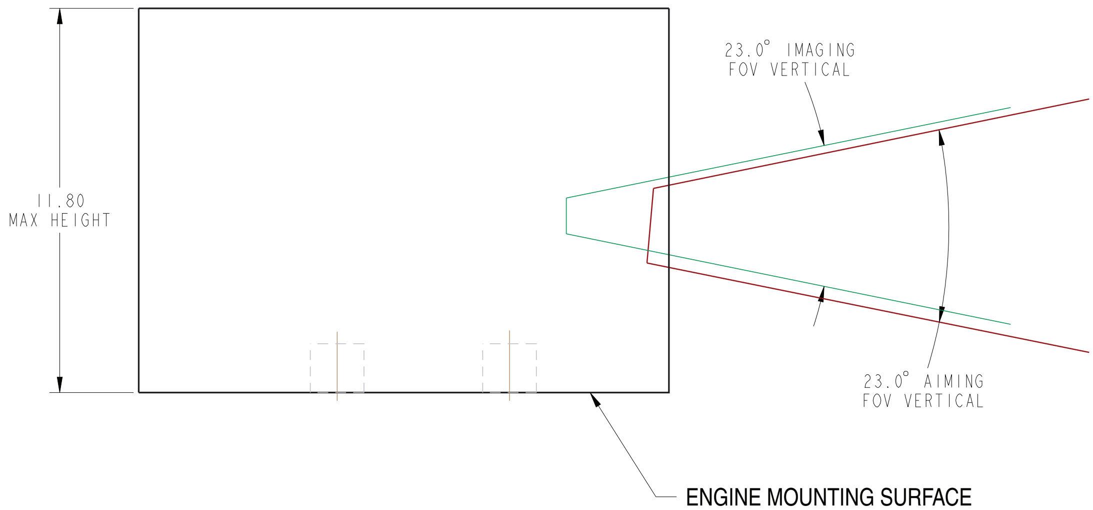
Notes:

The aiming dot is nominally offset 7.2 mm to the right and 1.425 mm down with respect to the imaging field of view at all distances from the engine front. Due to lens geometry, at very close distances the aiming dot does not appear round.

Figure 2-21 *SR LED Aiming Pattern Relative to SR Imaging Field of View*

MR Imaging and Laser Aiming Parallax



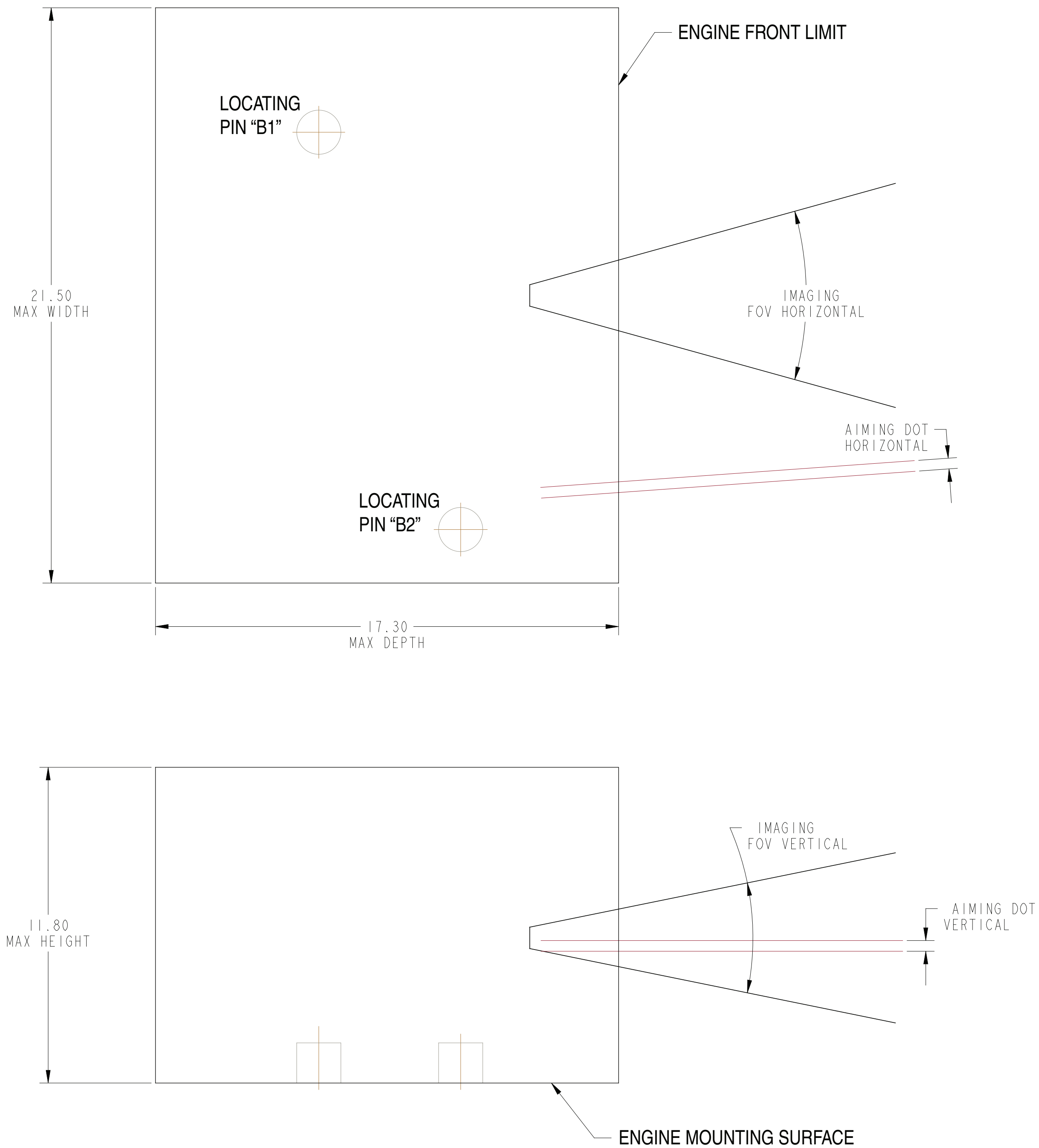


Note:

The aiming pattern center is nominally offset 7.375 mm to the right and 0.3 mm down with respect to the imaging field of view at all distances from the engine front.

Figure 2-22 *MR Laser Aiming Pattern Relative to MR Imaging Field of View*

DP Imaging and Laser Aiming Parallax



Note:

The aiming center dot is centered with respect to the imaging field of view at 100.0 mm (3.94 in) distance from the engine front.

Figure 2-23 *DP Laser Aiming Pattern Relative to DP Imaging Field of View*

Housing Design

✓ ***NOTE*** Perform an opto-mechanical analysis for the housing design to ensure optimal scanning or imaging performance.

The SE475X uses a sophisticated optical system that provides imaging performance that matches or exceeds the performance of much larger imagers. However, an improperly designed enclosure, or improper selection of window material, can affect the performance of the SE475X.

Design the engine's housing so that internal reflections from the aiming and illumination system are not directed back toward the engine. The reflections from the window or housing can cause problems, and for particular window tilt angles, these reflections can bounce off the top or bottom of the housing and reach the engine. Also, keep all housing elements outside the engine clear aperture (see *Figure 2-24 on page 2-27* and *Figure 2-25 on page 2-28*). Avoid any bright objects around the engine that can be reflected by a tilted window into the engine field of view and appear in a captured image.

For the SE475XSR, integrators should be aware of any housing elements within the Engine Stray Light Zone (see *Figure 2-30 on page 2-38*) and follow suggestions for eliminating stray light as outlined on *page 2-38*.

Recommended Exit Window Position on page 2-31 provides minimum exit window tilt angles. These dimensional requirements can vary. Consider using baffles or matte-finished dark internal housing colors.

SR Engine Clear Aperture

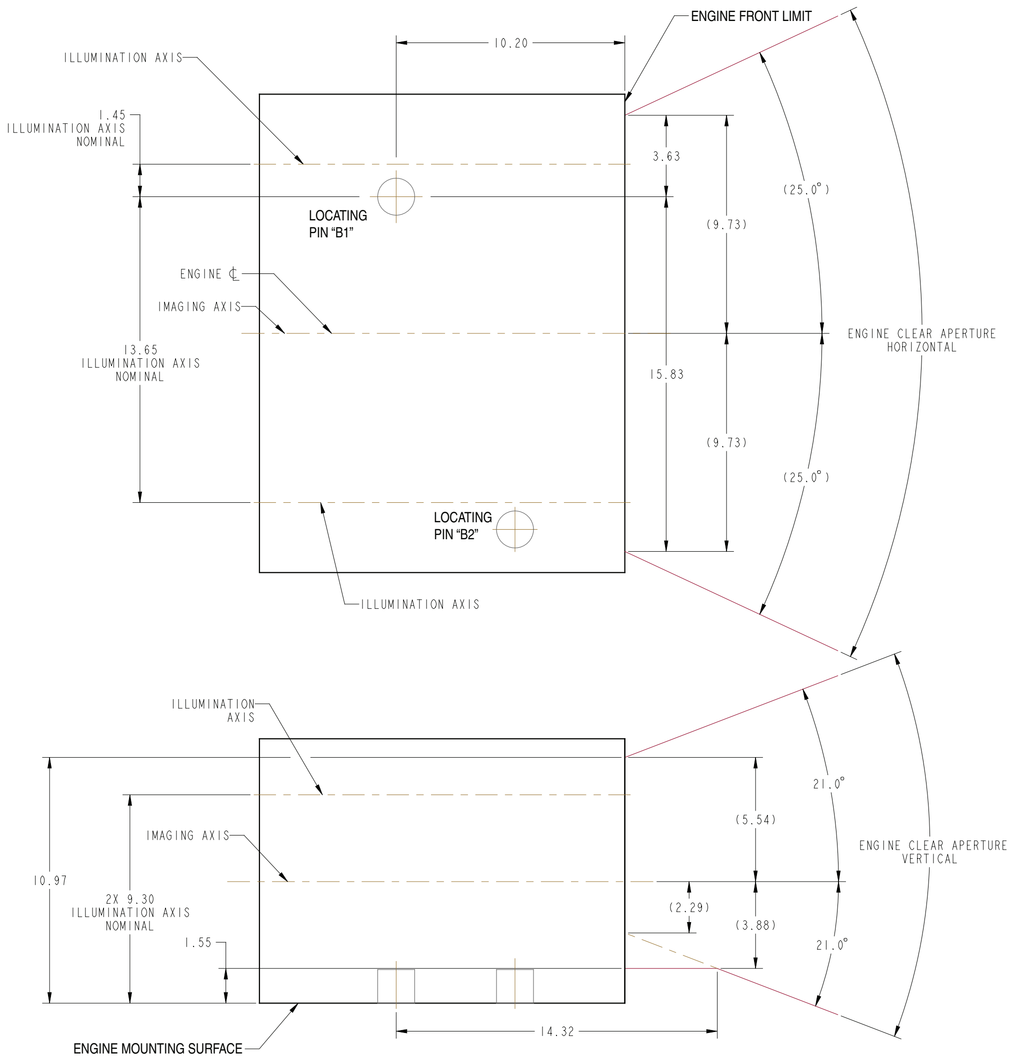


Figure 2-24 *SR Engine Clear Aperture*

MR Engine Clear Aperture

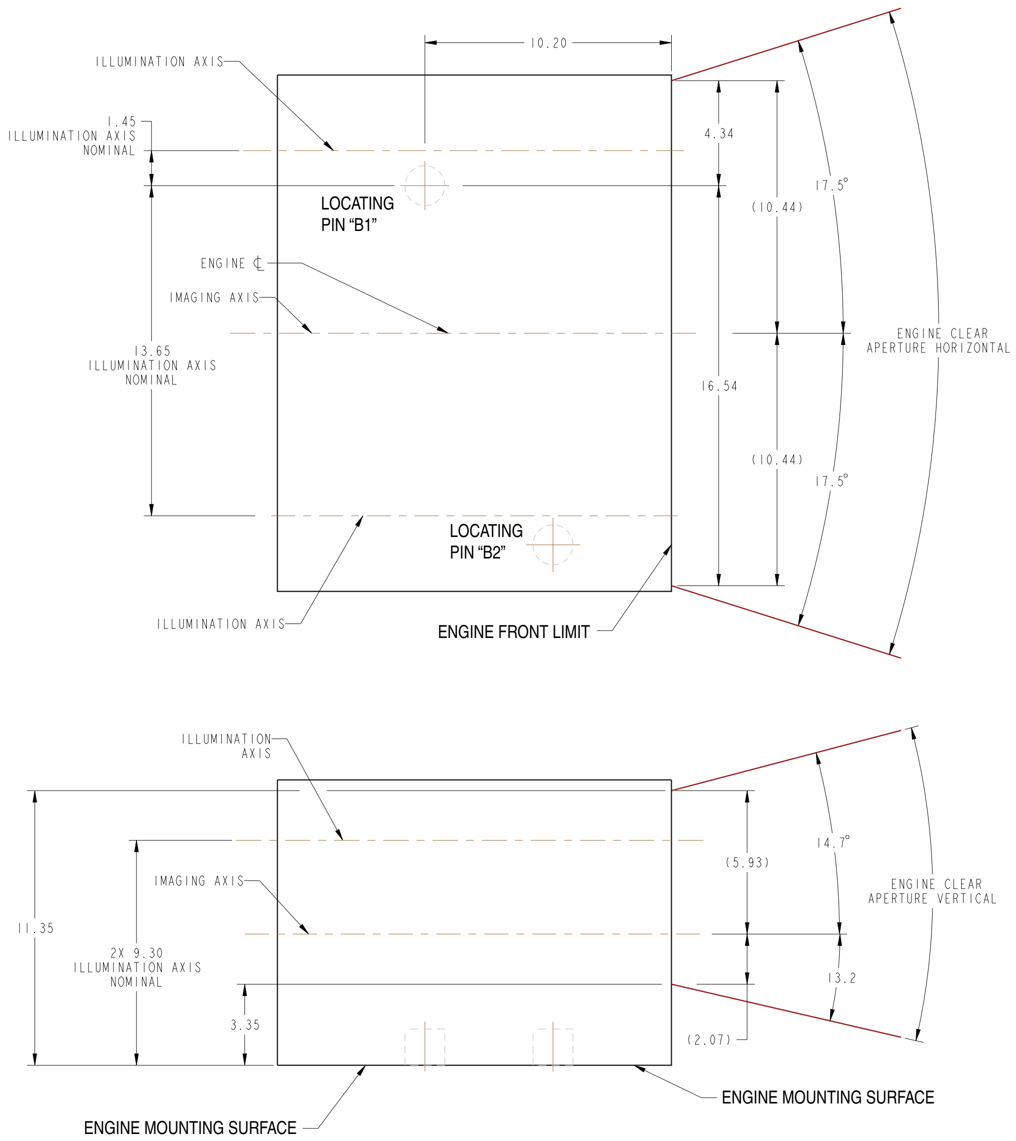


Figure 2-25 *MR Engine Clear Aperture*

DP Engine Clear Aperture

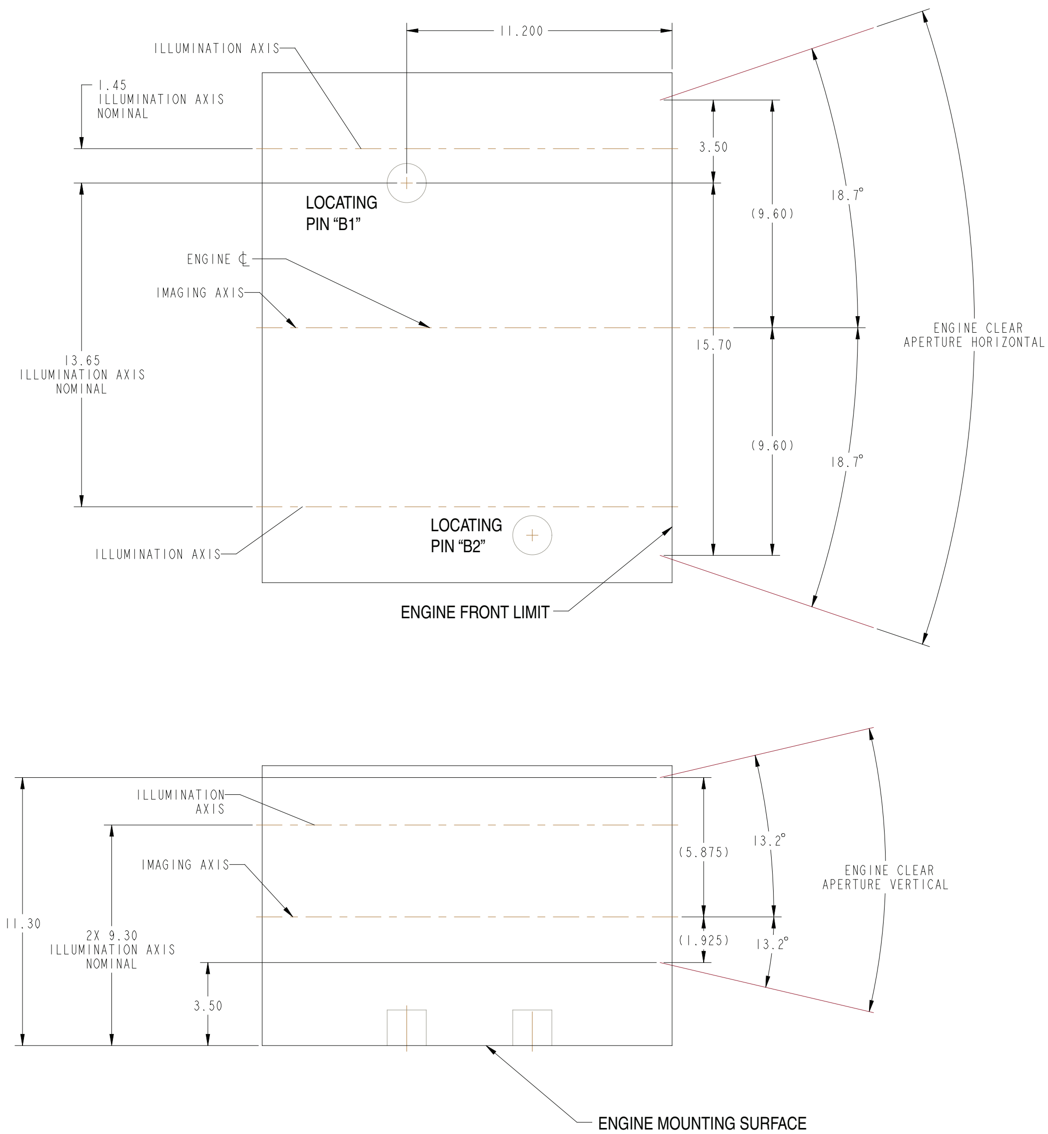


Figure 2-26 *DP Engine Clear Aperture*

Engine Clear Aperture Notes

Obstructing the engine clear aperture can result in one or more of the following effects:

- A captured image with non-uniformly illuminated areas.
- Obstructed imaging field of view.
- Obstructed aiming pattern.

Note for Engine Mounting in a Hands-Free Application

For optimum performance in presentation mode, allow only bar codes to enter the engine clear aperture. Other moving objects in the engine clear aperture can cause a false trigger of the object detection system. For example, in a table-top mounted application the engine should face down such that the clear aperture covers an area of the table that is free from moving objects.

Exit Window Position

Position the window so that illumination system light reflected off the inside of the window is not reflected back into the engine (see *Recommended Exit Window Position on page 2-31*). If the designed enclosure cannot accommodate the recommended window angle, contact Zebra to discuss positioning requirements. An improperly positioned window can significantly decrease performance.

Window Positioning Options

There are two options for window positioning:

- Parallel window - This is the preferred method for imager engines. Adhere to the maximum window distance specifications in *Figure 2-27 on page 2-31* and *Figure 2-28 on page 2-32*.
- Tilted window - This is used for either laser or imager engines. Adhere to the minimum window tilt specifications in *Table 2-1 on page 2-32* and *Table 2-3 on page 2-35*.

✓ ***NOTE*** For bar code reading, use either a parallel or tilted window. For document capture applications, Zebra strongly recommends the parallel window installation. For tilted windows, dust, contamination, and scratches on the window can cause visible blemishes in the images.

Recommended Exit Window Position

SR Exit Window Position

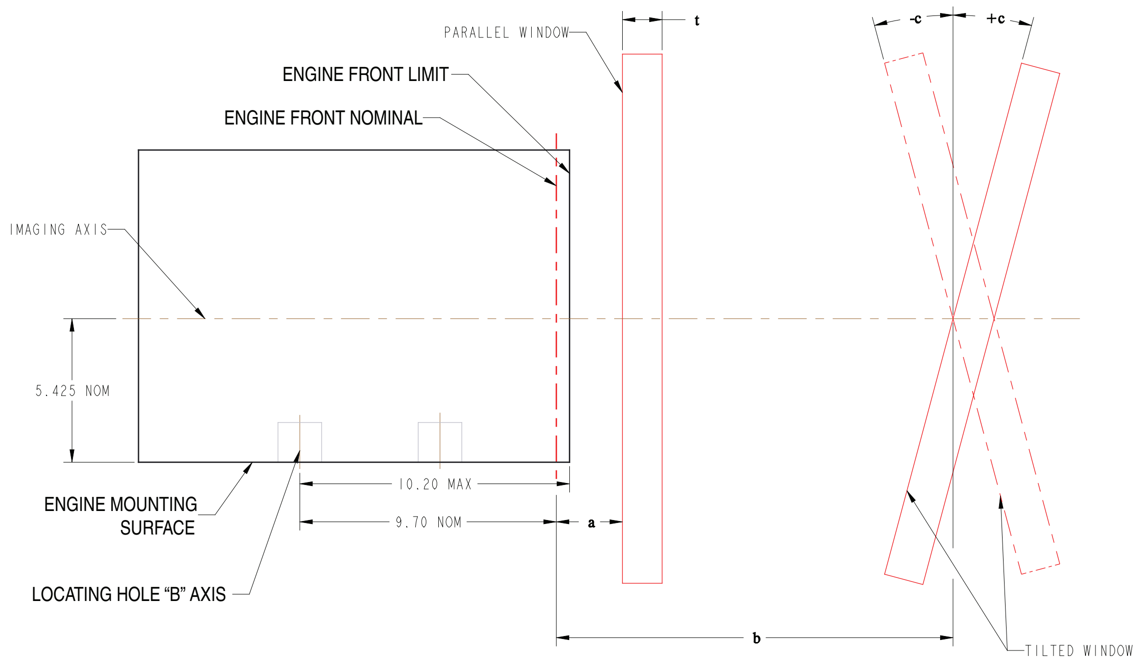


Figure 2-27 *SR Window Distances and Angles Relative to the Engine*

SR Engine Parallel Exit Window

Adhere to the maximum distance specifications when using a parallel exit window:

- Uncoated window: a < = 1.69 - (t/n)
- Single side coated window (coated side toward engine): a < = 1.94 - (t/n)
- Double side coated window: a < = 3.14 - (t/n)

where:

- **a** is the window distance from engine front
- **n** is the index of refraction of the window material (typically 1.5 to 1.6)
- **t** is the window thickness (typically 0.7 mm to 1.5 mm)

Anti-reflection coating specification: Surface reflectance (avg) < 0.5% for 420 - 730 nm at 0 - 60^{o} angle of incidence

SR Engine Tilted Exit Window

Adhere to the minimum angle specifications when using a tilted exit window. The following table expresses the minimum tilt angle "c" (in degrees) in relation to engine distance "b" (in mm).

Table 2-1 *Recommended Exit Window Information - SR, Tilted Window*

Window Specification	Distance from Nominal Engine Front Surface (b) in mm						
	5	5.8	10	12	15	20	25
Non-coated, minimum window positive tilt (+c)	+40º	+40º	+38º	+37º	+35º	+35º	+35º
Non-coated, minimum window negative tilt (-c)	N/A	N/A	-52º	-52º	-27º	-27º	-27º
AR coated, one side, minimum window positive tilt (+c)	+40º	+40º	+35º	+35º	+35º	+33º	+32º
AR coated, one side, minimum window negative tilt (-c)	N/A	N/A	-27º	-27º	-27º	-27º	-27º
AR coated, two sides, minimum window positive tilt (+c)	+37º	+36º	+33º	+32º	+31º	+29º	+28º
AR coated, two sides, minimum window negative tilt (-c)	-18º	-22º	-25º	-25º	-25º	-25º	-25º

MR Exit Window Position

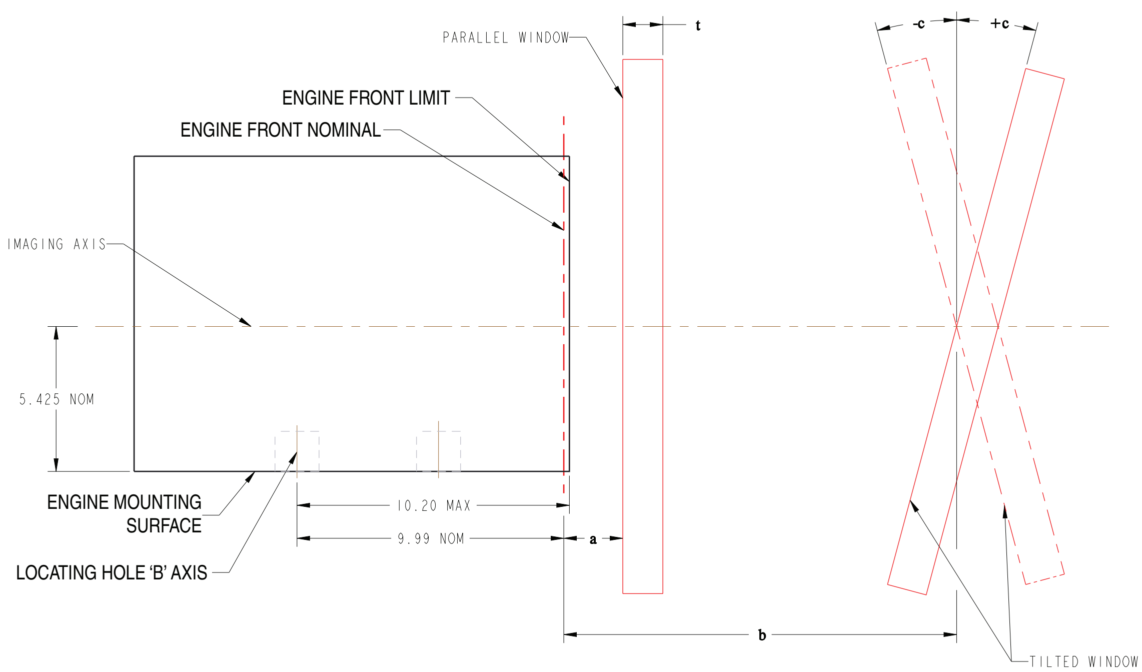


Figure 2-28 *MR Window Distances and Angles Relative to the Engine*

MR Engine Parallel Exit Window

Adhere to the maximum distance specifications when using a parallel exit window:

- Uncoated window: a < = 3.0 - (t/n)
- Single side coated window (coated side toward engine): a < = 3.5 - (t/n)
- Double side coated window: a < = 5.0 - (t/n)

where:

- **a** is the window distance from engine front
- **n** is the index of refraction of the window material (typically 1.5 to 1.6)
- **t** is the window thickness (typically 0.7 mm to 1.5 mm)

Anti-reflection coating specification: Surface reflectance (avg) < 0.5% for 420 - 730 nm at 0 - 60^{o} angle of incidence

MR Engine Tilted Exit Window

Adhere to the minimum angle specifications when using a tilted exit window. The following table expresses the minimum tilt angle "c" (in degrees) in relation to engine distance "b" (in mm).

Table 2-2 *Recommended Exit Window Information - MR, Tilted Window*

Window Specification	Distance from Nominal Engine Front Surface (b) in mm					
	5	10	12	15	20	25
Non-coated, minimum window positive tilt (+c)	+38^{o}	+32^{o}	+30^{o}	+30^{o}	+28^{o}	+26^{o}
Non-coated, minimum window negative tilt (-c)	-26^{o}	-28^{o}	-28^{o}	-28^{o}	-28^{o}	-26^{o}
AR coated, one side, minimum window positive tilt (+c)	+38^{o}	+32^{o}	+30^{o}	+28^{o}	+26^{o}	+26^{o}
AR coated, one side, minimum window negative tilt (-c)	-24^{o}	-26^{o}	-26^{o}	-26^{o}	-26^{o}	-26^{o}
AR coated, two sides, minimum window positive tilt (+c)	+36^{o}	+30^{o}	+28^{o}	+26^{o}	+26^{o}	+26^{o}
AR coated, two sides, minimum window negative tilt (-c)	-16^{o}	-20^{o}	-20^{o}	-22^{o}	-22^{o}	-22^{o}

DP Exit Window Position

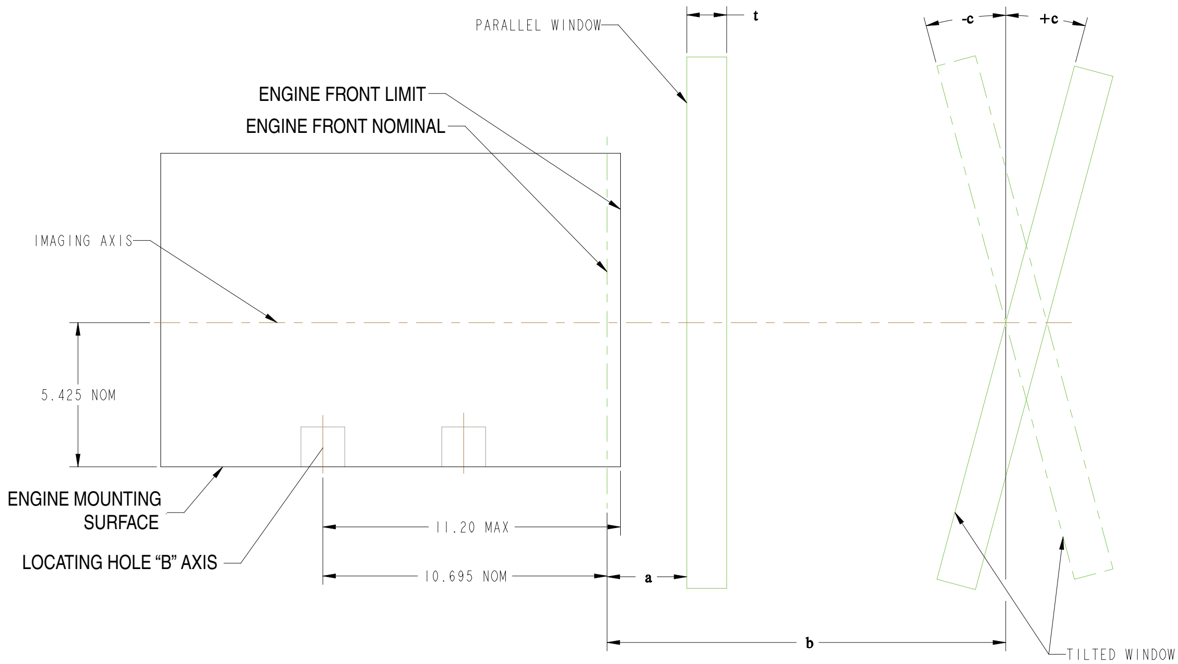


Figure 2-29 *DP Window Distances and Angles Relative to the Engine*

DP Engine Parallel Exit Window

Adhere to the maximum distance specifications when using a parallel exit window:

- Uncoated window: a < = 3.0 - (t/n)
- Single side coated window (coated side toward engine): a < = 4.25 - (t/n)
- Double side coated window: a < = 7.5 - (t/n)

where:

- **a** is the window distance from engine front
- **n** is the index of refraction of the window material
- **t** is the window thickness

Anti-reflection coating specification: Surface reflectance (avg) < 0.5% for 420 - 730 nm at 0 - 60^{o} angle of incidence

DP Engine Tilted Exit Window

Adhere to the minimum angle specifications when using a tilted exit window. The following table expresses the minimum tilt angle "c" (in degrees) in relation to engine distance "b" (in mm).

Table 2-3 *Recommended Exit Window Information - DP, Tilted Window*

Window Specification	Distance from Nominal Engine Front Surface (b) in mm					
	5	10	12	15	20	25
Non-coated, minimum window positive tilt (+c)	$+26^o$	$+28^o$	$+28^o$	$+28^o$	$+28^o$	$+28^o$
Non-coated, minimum window negative tilt (-c)	-24^o	-24^o	-24^o	-24^o	-24^o	-24^o
AR coated, one side, minimum window positive tilt (+c)	$+26^o$	$+28^o$	$+28^o$	$+28^o$	$+28^o$	$+28^o$
AR coated, one side, minimum window negative tilt (-c)	-18^o	-22^o	-22^o	-22^o	-22^o	-22^o
AR coated, two sides, minimum window positive tilt (+c)	$+22^o$	$+26^o$	$+28^o$	$+28^o$	$+28^o$	$+28^o$
AR coated, two sides, minimum window negative tilt (-c)	-12^o	-16^o	-16^o	-18^o	-18^o	-18^o

Exit Window Notes

- Do not place the exit window between the maximum distance for a parallel window (“a” in *Figure 2-27* and *Figure 2-28*) and the minimum distance for a tilted window (5 mm in *Table 2-1* and *Table 2-3*) with respect to the front of the engine.
- Integration tolerances are not included.
- Ensure the window size is large enough to cover the engine clear aperture specified in *Figure 2-24* and *Figure 2-25* plus mounting tolerances of the window relative to the engine.
- Using a tilted window is not recommended for intelligent document capture (IDC) applications because dust particles on the window surface scatter bright LED illumination and create image blemishes. The blemishes are not harmful for bar code reading but degrade quality of IDC. On the contrary, parallel windows are located close enough to the engine that dust particles do not create image blemishes.

Exit Window Specifications

Avoiding Scratched Windows

Scratches on the window can greatly reduce the performance of the imaging system. Zebra recommends recessing the window into the housing or applying a scratch resistance coating.

Window Material

Many window materials that look clear can contain stresses and distortions that reduce performance. For this reason, use only cell-cast plastics or optical glass (with or without an anti reflection coating, depending on the application). Following are descriptions of three popular window materials: PMMA, ADC (CR-39™), and chemically tempered glass. *Table 2-4* outlines the suggested window properties.

Table 2-4 *Suggested Window Properties*

Property	Description
Thickness	Typically 0.03 - 0.06 in. (0.7 - 1.5 mm)
Wavefront Distortion (transmission)	0.2 wavelengths peak-to-valley maximum and 0.04 λ maximum rms over any 0.08 in. diameter within the clear aperture
Clear Aperture	To extend to within 0.04 in. of the edges all around
Surface Quality	60-20 scratch/dig

When using plastic materials pay extra attention to the wavefront distortion recommendation specified above. Colored windows are not recommended because they can significantly degrade performance of the white illumination system and adversely affect cellphone reading mode.

Cell Cast Acrylic (ASTM: PMMA)

Cell Cast Acrylic, or Poly-methyl Methacrylic (PMMA) is fabricated by casting acrylic between two precision sheets of glass. This material has very good optical quality, reasonably good impact resistance and low initial cost, but is relatively soft and susceptible to attack by chemicals, mechanical stresses, and UV light. Therefore polysiloxane coating is strongly recommended. Acrylic can be laser cut into odd shapes and ultrasonically welded.

Cell Cast ADC (ASTM: ADC)

Also known as CR-39™, Allyl Diglycol Carbonate (ADC) is a thermal-setting plastic produced by cell-casting. Most plastic eyeglasses sold today are uncoated, cell-cast CR-39. This material has excellent chemical and environmental resistance, and reasonably good impact resistance. It also has quite good surface hardness, and therefore does not have to be hard-coated, but may be coated for severe environments. This material cannot be ultrasonically welded.

Chemically Tempered Glass

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

Commercially Available Coatings

Anti-Reflection Coatings

Anti-reflection coatings can be used for stray light control or to achieve maximum working range, and can be applied to the inside and/or outside of the window to reduce the amount of light reflected off the window back into the engine. However, they can be expensive and have very poor abrasion and scratch resistance.

Polysiloxane Coating

Polysiloxane type coatings are applied to plastic surfaces to improve the surface resistance to both scratch and abrasion. To apply, dip and air dry in an oven with filtered hot air.

To gauge a window's durability, use ASTM standard D1044, Standard Test Method for Resistance of Transparent Plastics to Surface Abrasion (the Taber Test), which 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. See *Table 2-5*.

Table 2-5 *Taber Test Results on Common Exit Window Materials*

Sample	Haze 100 cycles	Haze 500 cycles	Abrasion Resistance
Chemically Tempered 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.**			

A Word About Coatings

If using an anti-reflective (AR) coating, the specifications in *Table 2-6* apply. When using anti-reflection coating, the application of additional hard-coating is not recommended. Recess the exit window to minimize scratches and digs.

Table 2-6 *AR Coatings Specifications*

Specification	Description
Material	Both tempered glass and plastic (e.g., CR-39 or hard coated acrylic) exit windows can be AR coated. Glass is easier to AR coat and more durable due to its better adhesive properties. In addition, it can be more cost effective to put an AR coating on glass substrate than on plastic.
AR Coating Specification	• Single side AR-coating: 92% minimum transmittance within spectrum range from 420 nm to 730 nm. • Double side AR-coating: 97% minimum transmittance within spectrum range from 420 nm to 730 nm. • See *Figure 2-27 on page 2-31* for coating reflectivity requirements.

SR Engine Stray Light Zone

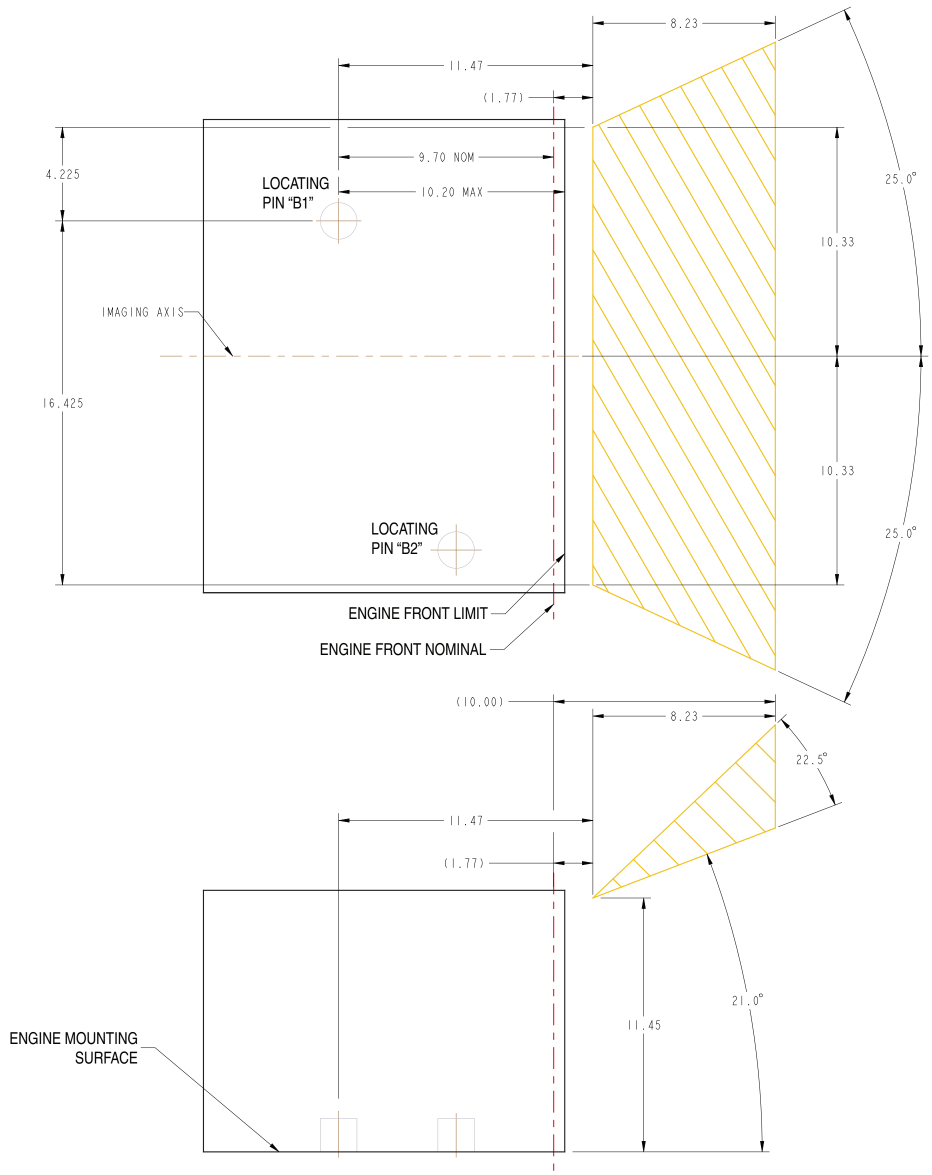


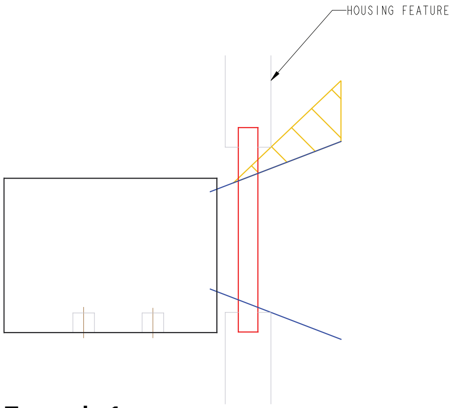
Figure 2-30 *SR Engine Stray Light Zone*

SR Engine Stray Light Zone Notes

Due to high illumination intensity certain objects in the defined stray light zone can reflect light back onto the engine creating blemishes in the image. Use the following suggestions to eliminate this effect:

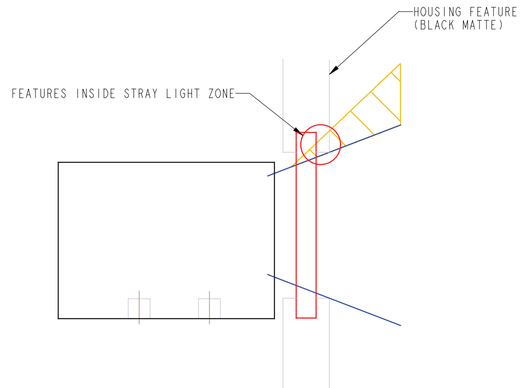
- Increase window size such that stray light can escape the system without reflecting back onto the engine. See **Example 1** in *Figure 2-31*.
- Occupy the stray light zone only with black matte surfaces that do not cause strong reflections back onto the engine. See **Example 2** in *Figure 2-31*.
- Block light from reaching the stray light zone by placing a matte black optical baffle near the engine such that only the clear aperture has its light path uninterrupted. See **Example 5** in *Figure 2-31*.

Exit Window Integration Examples



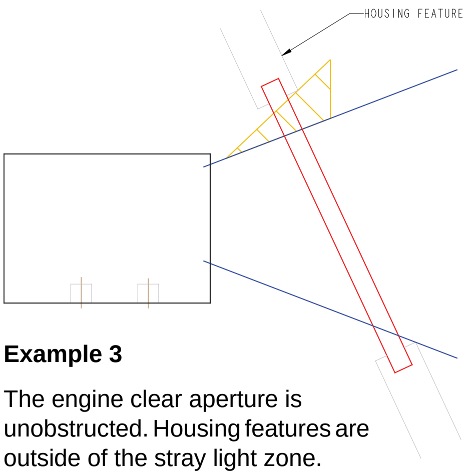
Example 1

The engine clear aperture is unobstructed.
Housing features are outside of the stray light zone.



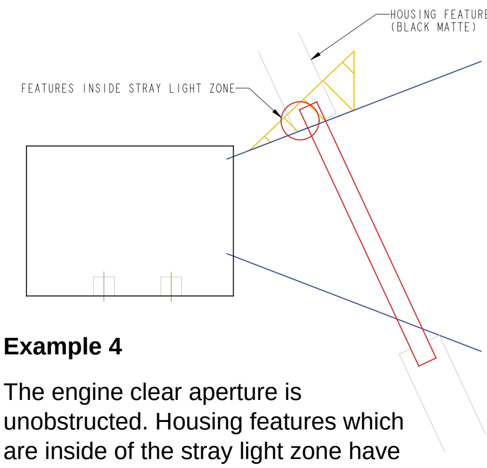
Example 2

The engine clear aperture is unobstructed.
Housing features which are inside of the stray light zone have black matte surfaces.



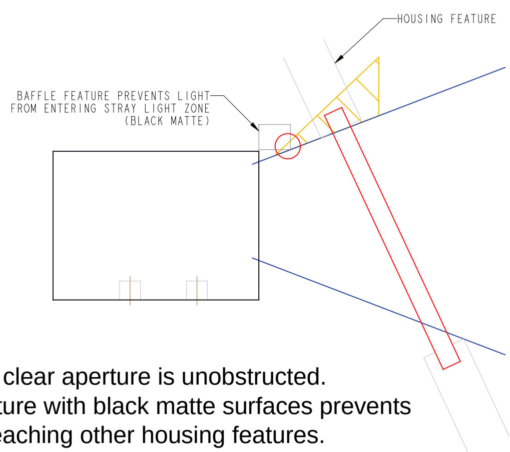
Example 3

The engine clear aperture is unobstructed. Housing features are outside of the stray light zone.



Example 4

The engine clear aperture is unobstructed. Housing features which are inside of the stray light zone have black matte surfaces.



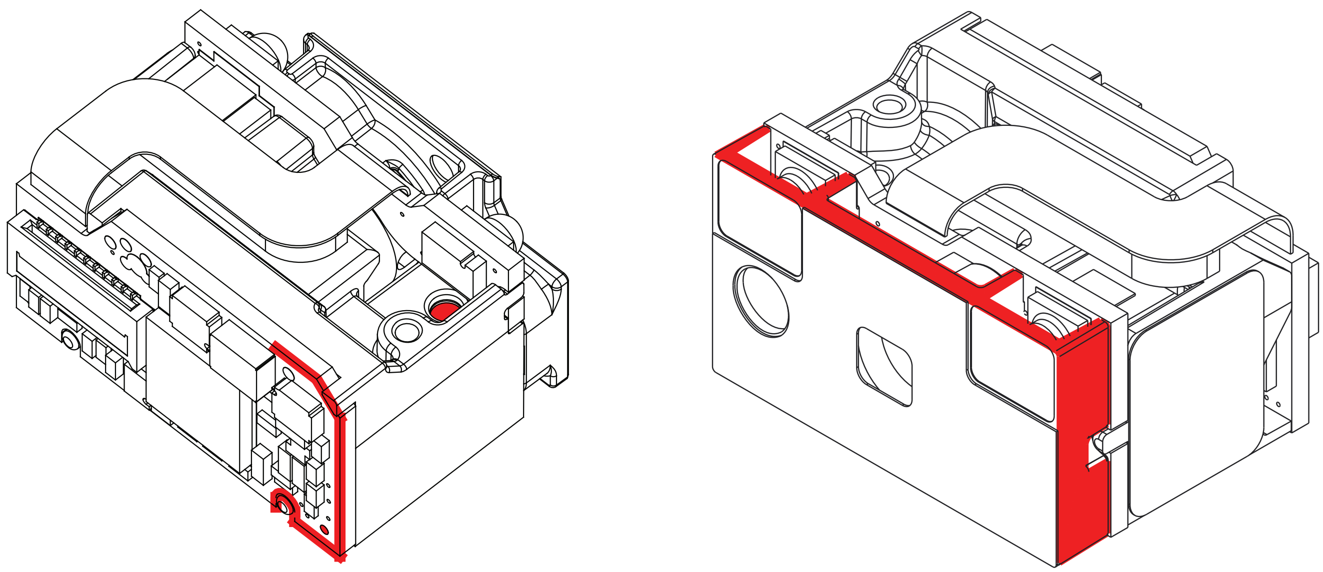
Example 5

The engine clear aperture is unobstructed.
A baffle feature with black matte surfaces prevents light from reaching other housing features.

Figure 2-31 *SR Engine Exit Window Integration Examples*

Additional Light Sources

The engine emits visible light from the highlighted areas. This light does not affect engine performance but should be blocked if it presents cosmetic concerns.



LED Engine Light Sources **MR Engine Light Sources**

Figure 2-32 *SE475X Emitted Light*

CHAPTER 3 SPECIFICATIONS

Introduction

This chapter provides the technical specifications of the SE4750, including electrical characteristics, engine technical specifications, decode zone, and exit window characteristics.

SE4750 Electrical Characteristics

✓ ***NOTE*** For SE4757 engine electrical characteristics, refer to the *PL3307 Decoder Integration Guide*, *Chapter 2 PL3307-A Installation and Specifications*.

Power, MIPI and Parallel Host Interface

Table 3-1 *Power, MIPI and Parallel Host Interface*

Symbol	Parameter	Condition	Minimum	Typical	Maximum	Units
VCC	Supply Voltage		3.0	3.3	3.6	V
VDD_IO_HOST	Supply Voltage		1.7	3.3	3.6	V
VCC_ILLUM	Supply Voltage - Illumination		3.0	3.3	5.5	V

I^2C, MIPI, and Parallel Host Interface

Table 3-2 *I2C_CLK, I2C_DATA Signals*

Symbol	Parameter	Condition	Minimum	Typ	Maximum	Units
V_{OL}	Output Low Voltage	3mA sink VDD_IO_HOST=3.3 3mA sink VDD_IO_HOST=1.8 6mA sink			0.4 0.2*VDD_IO_HOST 0.6	V V V
V_{IH}	Input High Voltage		0.7*VDD_IO_HOST		VDD_IO_HOST+0.5	V
V_{IL}	Input Low Voltage		-0.5		0.3*VDD_IO_HOST	V
T_R	Rise Time	Set by external pull-up and load 30 to 70% VDD_IO_HOST			$1.3*Rext*C_b$	ns
T_F	Fall Time		20		250	ns
C_b	Load Capacitance		10		400	pF

MIPI and Parallel Host Interface

Table 3-3 *EXT_ILLUM_EN Signal*

Symbol	Parameter	Conditions	Minimum	Typ	Maximum	Units
V_{OH}	Output High Voltage	VDD_IO_HOST=3.3 VDD_IO_HOST=1.8 I_{OH}=2mA	VDD_IO_HOST-0.2 VDD_IO_HOST-0.45			V
V_{OL}	Output Low Voltage	VDD_IO_HOST=3.3 VDD_IO_HOST=1.8 I_{OL}=2mA			0.2 0.45	V

Parallel Host Interface for HSYNC, VSYNC, PIXCLK, and PIX_DATA_x Signals

Table 3-4 *Parallel Host Interface for HSYNC, VSYNC, PIXCLK, and PIX_DATA_0 Through PIX_DATA_7 Signals*

Symbol	Parameter	Conditions	Minimum	Typ	Maximum	Units
V_{OH}	Output High Voltage	VDD_IO_HOST=3.3 VDD_IO_HOST=1.8 I_{OH}=8mA	VDD_IO_HOST-0.2 VDD_IO_HOST-0.45			V
V_{OL}	Output Low Voltage	VDD_IO_HOST=3.3 VDD_IO_HOST=1.8 I_{OL}=8mA			0.2 0.45	V

MIPI Host Interface

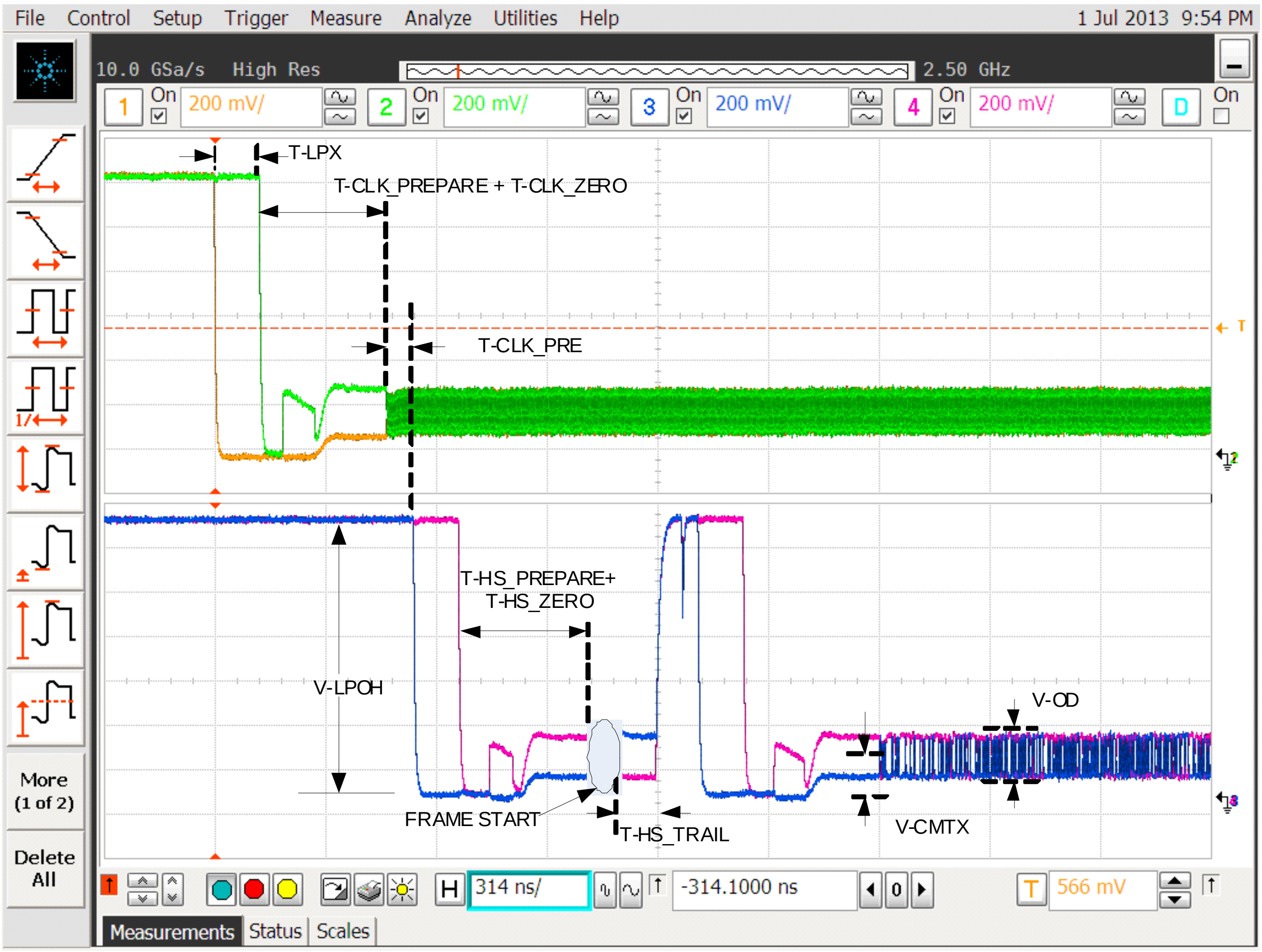


Table 3-5 *MIPI Host Interface*

Parameter	Description	Typical	Units
T-LPX	Transmitted length of any low power state period.	130	ns
T-CLK_PREPARE + T-CLK_ZERO	$T_{CLK\text{-}PREPARE}$ + time that the transmitter drives the HS-0 state prior to starting the clock.	320	ns
T-CLK_PRE	Time that the HS clock is driven by the transmitter prior to any associated data lane beginning the transition from LP to HS mode.	110	ns
$T_{HS\text{-}PREPARE}$ + $T_{HS\text{-}ZERO}$	$T_{HS\text{-}PREPARE}$ + time that the transmitter drives the HS-0 state prior to transmitting the sync sequence.	360	ns
T-HS_TRAIL	Time that the transmitter drives the flipped differential state after last payload data bit of an HS transmission burst.	118	ns

Table 3-5 *MIPI Host Interface (Continued)*

Parameter	Description	Typical	Units
V-LP0H	LP output high level.	1.2	V
V-CMTX	HS transmit static common mode voltage.	180	mV
V-OD	HS transmit differential voltage.	200	mV

Technical Specifications

Table 3-6 *SE475X Technical Specifications*

Item	Description
SE4750 Power Requirements - Input Voltage See *SE4750 Supply Currents VCC = VCC_ILLUM = VDD_IO_HOST = 3.3V @ 23C*	VCC: 3.3V +/- 0.3V VCC_ILLUM: 3.0V to 5.5V VDD_IO_HOST 1.7 to 3.6
Note: For the SE4757 engine power requirements, refer to the *PL3307 Decoder Integration Guide, Chapter 2 PL3307-A Installation and Specifications*	
Maximum Sensor Power Supply Noise (at 23° C)	100 mVp-p (3.3 V, 10 Hz - 100 kHz) for decoding 30 mVp-p (3.3 V, 10 Hz - 100 kHz) for image capture
Optical Resolutions SR MR DP	 3.0 mil (Code 39), 5.0 mil (PDF417) 5.0 mil (Code 39, PDF417) 3.0 mil (Code 39), 3.0 mil (Data Matrix)
Specular Dead Zone Illumination On Illumination Off	 Up to 20º depending on target distance and substrate glossiness None
Skew Tolerance	± 60º (see *Figure 3-5 on page 3-12*)
Pitch Angle	± 60º (see *Figure 3-5 on page 3-12*)
Roll	360º (see *Figure 3-5 on page 3-12*)
Ambient Light Immunity (Sunlight)	10,000 ft. candles (107,639 lux)
Imaging Sensor Resolution	1280 horizontal X 960 vertical pixels
Field of View (FOV) SR MR, DP	 48.0º horizontal, 36.7º vertical 31.0º horizontal, 23.0º vertical
Focusing Distance from Front of Engine SR MR DP	 177.8 mm / 7.0 inches 360.8 mm / 14.2 inches 76.2 mm / 3.0 inches
Laser Aiming Element Visible Laser Diode (VLD) Central Dot Optical Power SR Pattern Angle MR Pattern Angle	 655 ± 10 nm 0.6 mW (typical) 48.0º horizontal, 38.0º vertical 31.0º horizontal, 23.0º vertical

Table 3-6 *SE475X Technical Specifications (Continued)*

Item	Description
LED Aiming Element LED Wavelength Central Dot Optical Power Pattern Divergence	 617 ± 10 nm 0.29 mW at 8 inches (typical) 1.8º
Illumination System LEDs Pattern Angle	 Warm white LED 80° at 50% intensity
Shock	2000 G ± 5% applied via any mounting surface at -30º and 60º C for a period of 0.85 ± 0.10 msec 2500 G ± 5% applied via any mounting surface at 23º C for a period of 0.70 ± 0.10 msec
Vibration	Random vibration along each of the X, Y, and Z axes for a period of one hour per axis (6 G rms), defined as follows: 20 to 80 Hz Ramp up at 0.04 G^2/Hz at 3 dB/octave 80 to 350 Hz 0.04 G^2/Hz 350 Hz to 2 kHz Ramp down at 0.04 G^2/Hz at 3 dB/octave
ESD	± 2 kV HBM @ connector
Laser Safety Class	Class 2 per IEC 60825-1:2014
LED Class	Exempt Risk Group per IEC 62471
Chassis Temperature Operating Storage	 -30º to 60º C / -22º to 140º F -40º to 70º C / -40º to 158º F See *Thermal Design on page 2-5* for more information.
Humidity	95% RH, non-condensing at 60º C

Table 3-6 *SE475X Technical Specifications (Continued)*

Item	Description
Maximum Engine Dimensions	
SE4750	11.8 mm H x 21.5 mm W x 16.3 mm D 0.46 in. H x 0.85 in.W x 0.64 in. D
SE4757	19.4 mm H x 38.8 mm W x 28.0 mm D 0.76 in. H x 1.53 in. W x 1.10 in. D
SE4750DP Laser	11.8 mm H x 21.5 mm W x 17.3 mm D 0.46 in. H x 0.85 in.W x 0.68 in. D
Weight	
SE4750	8.5 ± 0.5 grams (0.30 ± 0.02 oz)
SE4757	15.0 ± 0.5 grams (0.53 ± 0.02 oz)
Electrical Interface	
SE4750	21 pin 0.3 mm pitch ZIF connector See *Chapter 4, Electrical Interface* for more information.
SE4757	31 pin 0.3 mm pitch ZIF connector MicroUSB Refer to the *PL3307 Decoder Integration Guide, Chapter 2 PL3307-A Installation and Specifications*

✓ ***NOTE*** Environmental and/or tolerance parameters are not cumulative. Zebra recommends a thermal analysis if the application is subject to an extreme temperature environment.

SE4750 Supply Currents VCC = VCC_ILLUM = VDD_IO_HOST = 3.3V @ 23C

✓ ***NOTE*** For SE4757 engine supply current information, refer to the *PL3307 Decoder Integration Guide*, *Chapter 2 PL3307-A Installation and Specifications*.

Parallel and MIPI Host Interface (Engine Only without PL3307 Decoder)

Table 3-7 *Parallel and MIPI Host Interface; Current (mA) Flowing into Power Domains @ 23^{o}C*

Mode		Total Current VCC+VCC_ILLUM (@3.3V)+ VDD_IO_HOST	VCC =3.3V	VCC_ILLUM		VDD_IO_HOST =3.3V	Notes
				3.3V	5V		
Low power	RMS	0.36	0.36	0	0	0	Hibernate
	RMS	0.89	0.89	0	0	0	Hibernate with MIPI Compliance
	RMS	0.015	0.015	0	0	0	Standby
Idle	PEAK	30[1]	30	350[1]	360[1]	0[3]	Not in low power mode but not triggered
	RMS	20[1]	20	0	0	0[3]	
Image Acquisition	PEAK	260	260	350[1]	360[1]	50[3]	Illumination off, aim on[2]
	RMS	190	190	0	0	30[3]	
Image Acquisition with Illumination	PEAK	580	260	350	360	50[3]	Normal acquisition mode, aim on[2]
	RMS	440	190	240	170	30[3]	
Bus Pwr USB (<500mA)	PEAK	400	260	N/A	200	50[3]	VCC_ILLUM should be USB 5V
	RMS	340	190	N/A	160	30[3]	

All currents measured in mA.
Note 1: ~1 ms pulse of ~350 mA every 4 to 5 seconds to keep illumination capacitor charged.
Note 2: The laser aim draws approximately 40 mA when on.
The LED aim draws approximately 70 mA when on.
Note 3: Parallel version only, MIPI load < 5 mA.

SE4750 Sample Current Scope Plots

✓ ***NOTE*** For SE4757 scope plots, refer to the *PL3307 Decoder Integration Guide*, *Chapter 2 PL3307-A Installation and Specifications*.

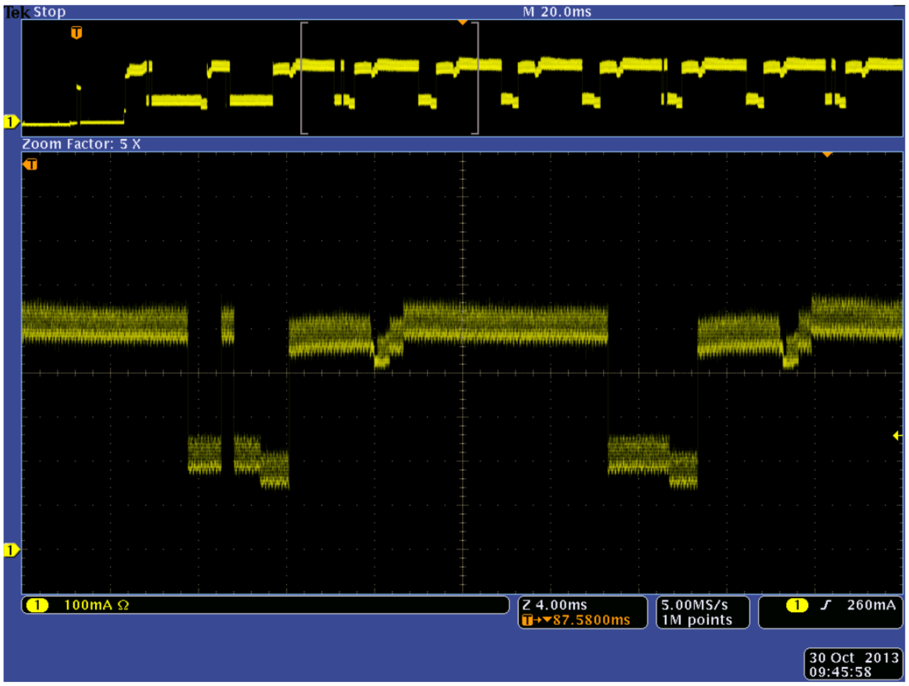


Figure 3-1 *Total Current (VCC_ILLUM + VCC + VDD_IO_HOST)*

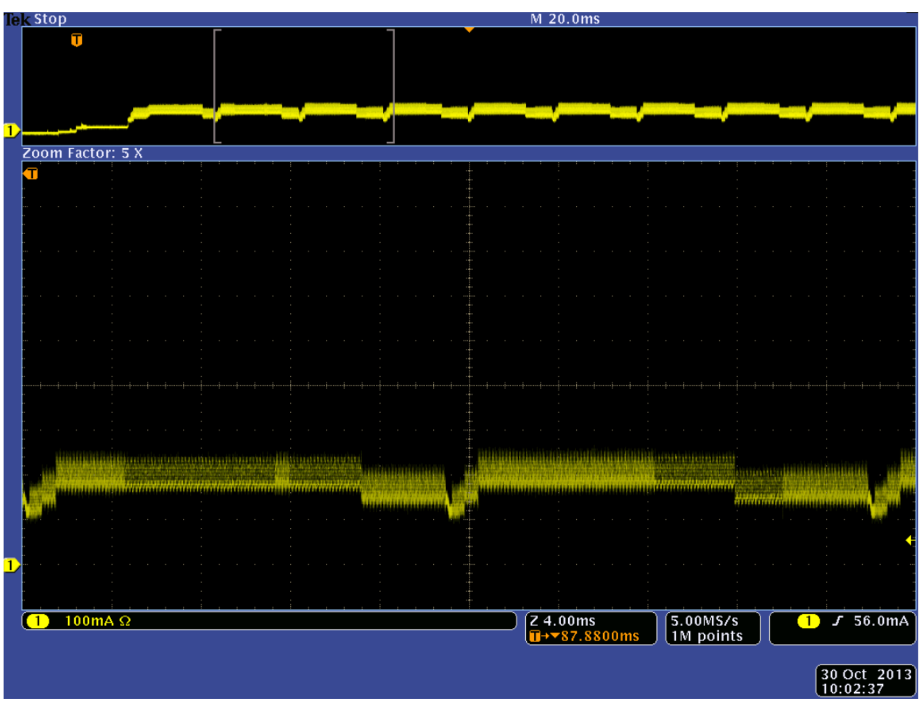


Figure 3-2 *VCC Current*

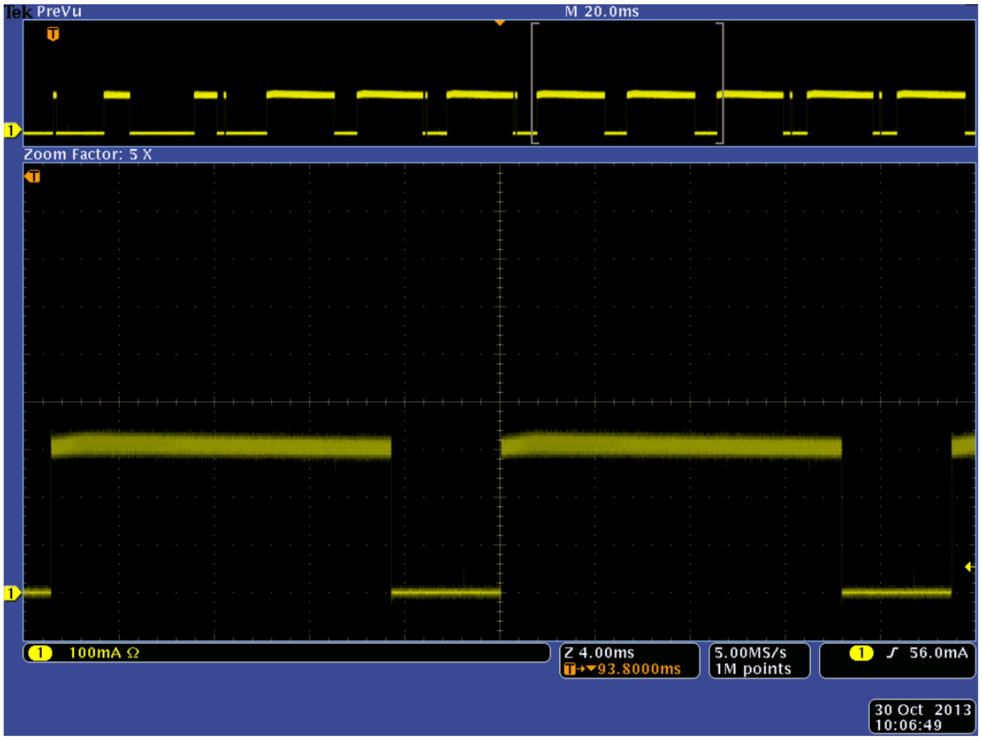


Figure 3-3 *VCC_ILLUM Current*

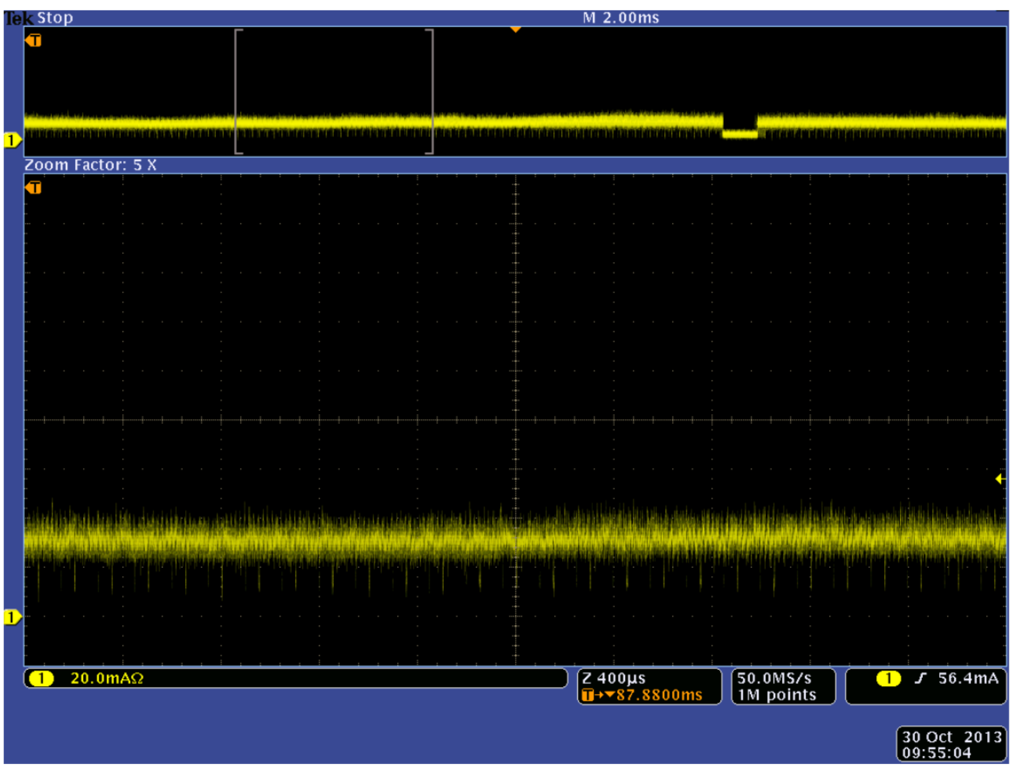


Figure 3-4 *VDD_IO Host Current (Parallel Version)*

Skew, Pitch, and Roll

Measured on a 20 mil Code 39 symbol at a distance of 5 inches. Tolerance for skew and pitch is reduced at extreme ends of the working range.

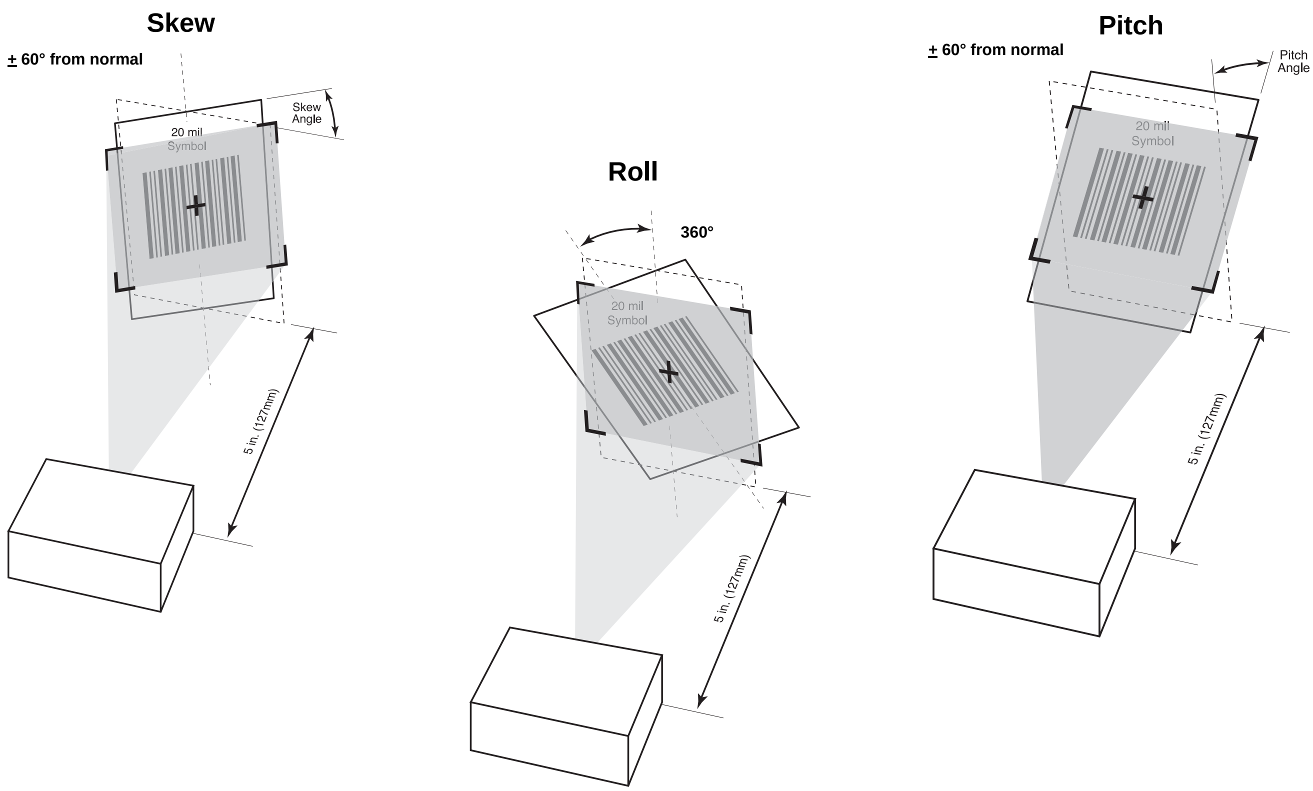


Figure 3-5 *Skew, Pitch, and Roll*

Decode Range Information

SE475XSR Decode Ranges

Table 3-8 *SE475XSR Decode Distances*

Bar Code Type	Near Distance (in / cm, typical)	Far Distance (in / cm, typical)
3 mil Code 39	2.8 in / 7.1 cm	6.2 in / 15.7 cm
5 mil Code 128	2.3 in / 5.8 cm	8.7 in / 22.1 cm
5 mil PDF417	3.0 in / 7.6 cm	8.1 in / 20.6 cm
6.67mil PDF417	2.2 in / 5.6 cm	10.6 in / 26.9 cm
10 mil Data Matrix	2.4 in / 6.1 cm	10.6 in / 26.9 cm
100% UPCA	1.6 in* / 4.1 cm	23.0 in / 58.4 cm
15 mil Code 128	2.4 in* / 6.1 cm	25.2 in / 64.0 cm
20.0 mil Code 39	1.6 in* / 4.1 cm	36.3 in / 92.2 cm
20.0 mil QR Code	0.9 in / 2.3 cm	16.6 in / 42.2 cm
* Limited by width of bar code in field of view. Note: Photographic quality bar code at 18^{o} tilt pitch angle under 30 fcd ambient illumination.		

Table 3-9 *SE475XSR Decode Distances - Dark Room*

Bar Code Type	Near Distance (in / cm, typical)	Far Distance (in / cm, typical)
3 mil Code 39	2.8 in / 7.1 cm	6.2 in / 15.7 cm
5 mil Code 128	2.3 in / 5.8 cm	8.7 in / 22.1 cm
5 mil PDF417	3.0 in / 7.6 cm	8.1 in / 20.6 cm
6.67mil PDF417	2.2 in / 5.6 cm	10.6 in / 26.9 cm
10 mil Data Matrix	2.4 in / 6.1 cm	10.6 in / 26.9 cm
100% UPCA	1.6 in* / 4.1 cm	21.6 in / 54.9 cm
15 mil Code 128	2.4 in* / 6.1 cm	21.3 in / 54.1 cm
20.0 mil Code 39	1.6 in* / 4.1 cm	28.5 in / 72.4 cm
20.0 mil QR Code	0.8 in / 2.0 cm	16.1 in / 40.9 cm
* Limited by width of bar code in field of view. Note: Photographic quality bar code at 18^{o} tilt pitch angle under 0.1 fcd ambient illumination.		

SE475XMR Decode Ranges

Table 3-10 *SE475XMR Decode Distances*

Bar Code Type	Near Distance (in / cm, typical)	Far Distance (in / cm, typical)
5 mil Code 128	7.4 in / 18.8 cm	16.0 in / 40.6 cm
5 mil PDF417	8.1 in / 20.6 cm	13.1 in / 33.3 cm
7.5 mil Data Matrix	8.3 in / 21.1 cm	12.8 in / 32.5 cm
10 mil Data Matrix	7.0 in / 17.8 cm	17.0 in / 43.2 cm
13 mil UPCA	2.3 in* / 5.8 cm	38.0 in / 96.5 cm
15 mil Code 128	4.0 in* / 10.2 cm	40.0 in / 101.6 cm
20 mil Code 39	2.1 in* / 5.3 cm	54.0 in / 137.2 cm
20.0 mil QR Code	2.8 in / 7.1 cm	26.6 in / 67.6 cm
100 mil Code 39	11.0 in / 27.9 cm	172.0 in / 436.9 cm
160 mil Data Matrix	11.5 in / 29.2 cm	138.0 in / 350.5 cm
*** Limited by width of bar code in field of view. Note: Photographic quality bar code at 18° tilt pitch angle under 30 fcd ambient illumination.**		

Table 3-11 *SE475XMR Decode Distances - Dark Room*

Bar Code Type	Near Distance (in / cm, typical)	Far Distance (in / cm, typical)
5 mil Code 128	7.4 in / 18.8 cm	16.0 in / 40.6 cm
5 mil PDF417	8.1 in / 20.6 cm	13.1 in / 33.3 cm
7.5 mil Data Matrix	8.3 in / 21.1 cm	12.8 in / 32.5 cm
10 mil Data Matrix	7.0 in / 17.8 cm	17.0 in / 43.2 cm
13 mil UPCA	2.3 in* / 5.8 cm	36.0 in / 91.4 cm
15 mil Code 128	4.0 in* / 10.2 cm	38.0 in / 96.5 cm
20 mil Code 39	2.1 in* / 5.3 cm	50.0 in / 127.0 cm
20.0 mil QR Code	2.8 in / 7.1 cm	25.6 in / 65.0 cm
100 mil Code 39	11.0 in / 27.9 cm	87.0 in / 221.0 cm
160 mil Data Matrix	11.5 in / 29.2 cm	65.0 in / 165.1 cm
*** Limited by width of bar code in field of view. Note: Photographic quality bar code at 18° tilt pitch angle under 0.1 fcd ambient illumination.**		

SE475XDP Decode Ranges

SE4750DP decode distances, paper bar codes only, 30 fcd ambient light and dark room.

Table 3-12 *SE475XDP Decode Distances*

Bar Code Type	Near Distance (in / cm, typical)	Far Distance (in / cm, typical)
3 mil Code 39	1.7 in / 4.3 cm	4.3 in / 10.9 cm
5 mil PDF417	1.7 in / 4.3 cm	4.3 in / 10.9 cm
6.67mil PDF417	1.7 in* / 4.3 cm	4.7 in / 11.9 cm
5 mil Data Matrix	1.9 in / 4.8 cm	4.0 in / 10.2 cm
10 mil Data Matrix	1.6 in / 4.1 cm	4.9 in / 12.5 cm
5 mil QR Code	1.9 in / 4.8 cm	4.0 in / 10.2 cm
10 mil QR Code	1.1 in / 2.6 cm	5.0 in / 12.7 cm
100% UPCA	2.4 in* / 6.1 cm	7.3 in / 18.5 cm

*** Limited by width of bar code in field of view.**
Note: Photographic quality bar code at 18^{o} tilt pitch angle under 30 fcd ambient illumination.

SE475XSR Decode Zone

Figure 3-6 shows the decode zone for the SE475XSR. Typical values appear 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.

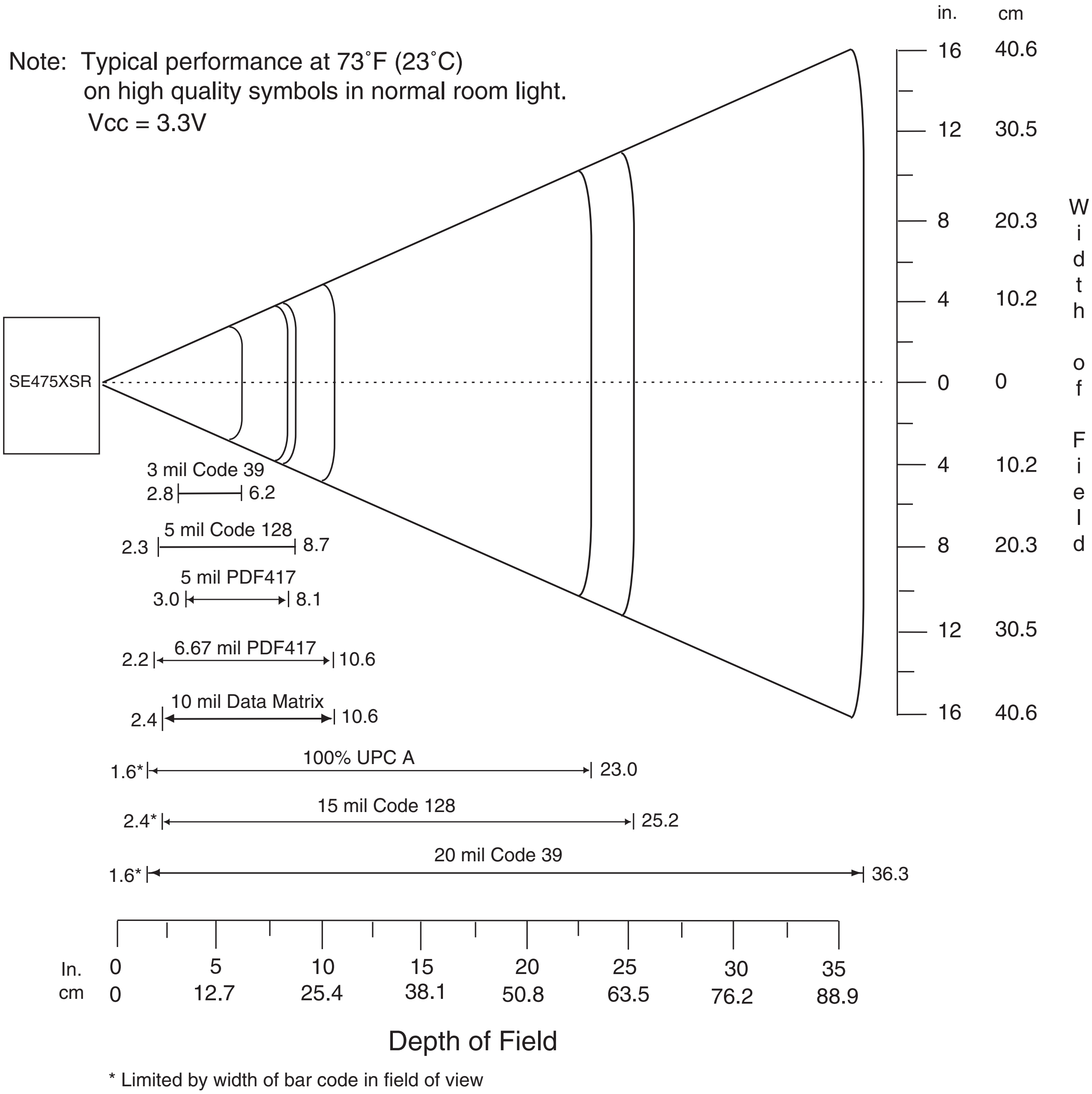


Figure 3-6 *SE475XSR Decode Zone*

SE475XMR Decode Zone

Figure 3-7 shows the decode zone for the SE475XMR. Typical values appear 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.

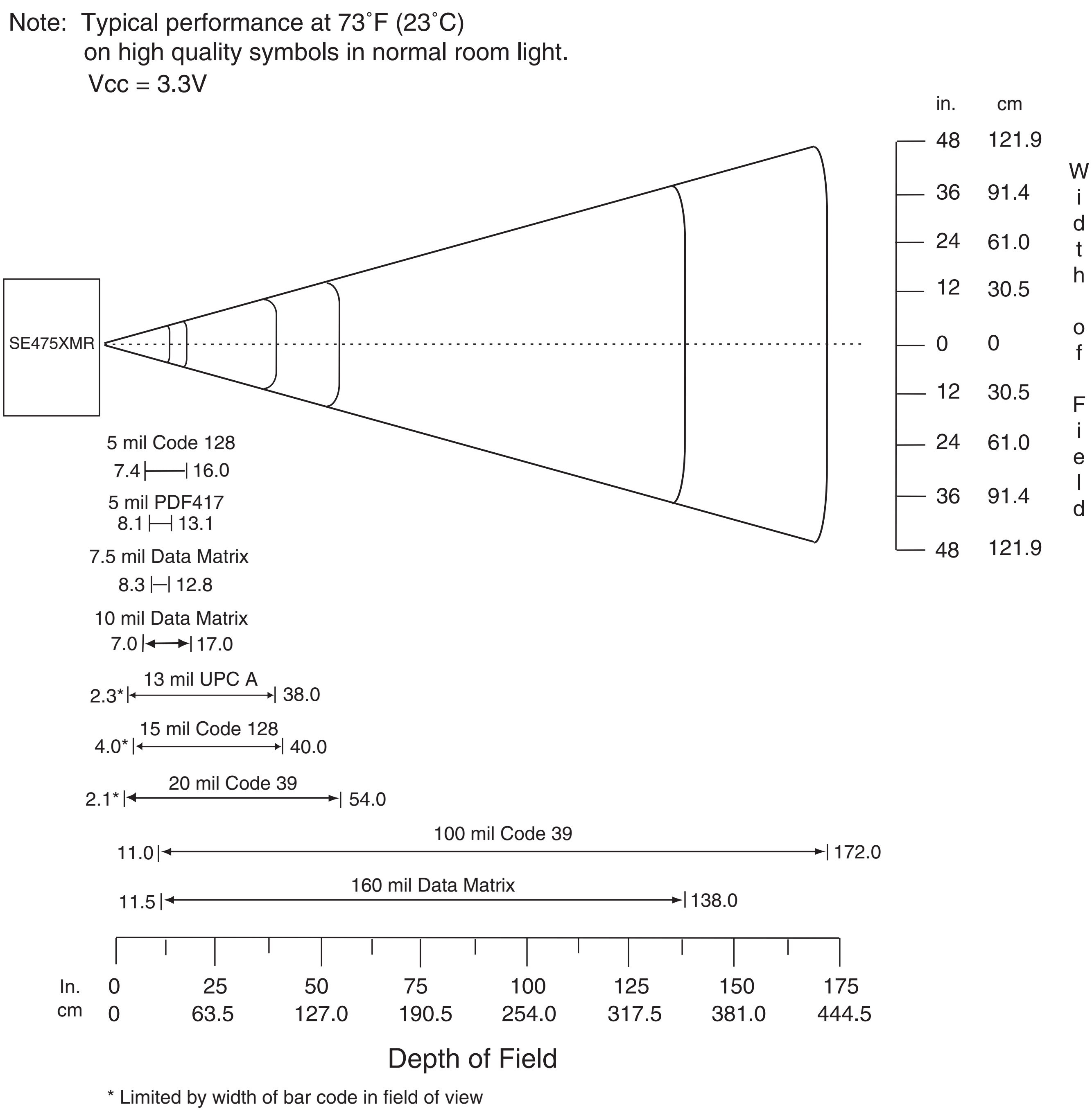


Figure 3-7 *SE475XMR Decode Zone*

SE475XDP Decode Zone

Figure 3-8 shows the decode zone for the SE475XDP. Typical values appear 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.

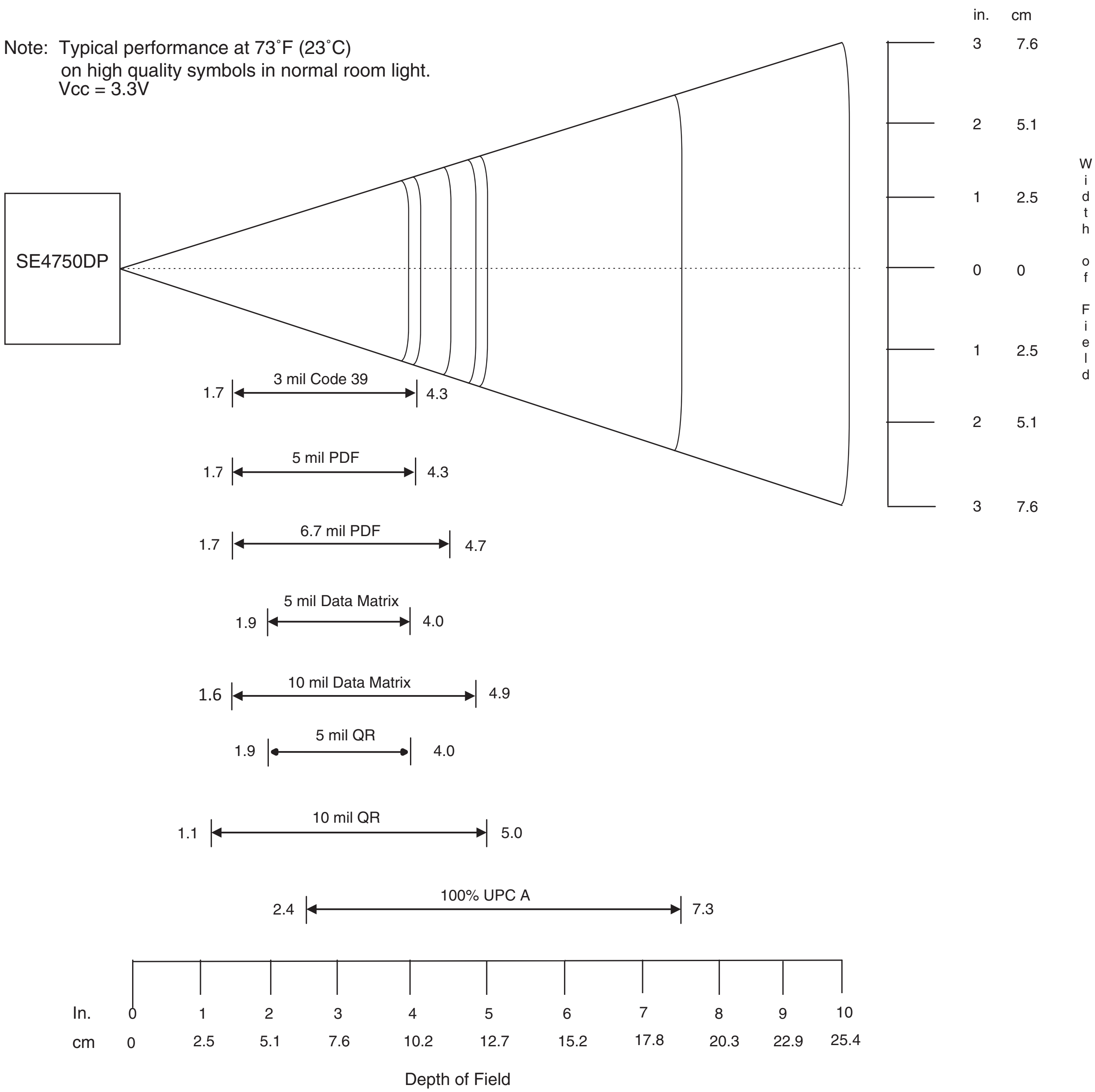


Figure 3-8 *SE475XDP Decode Zone*

CHAPTER 4 ELECTRICAL INTERFACE

Introduction

Table 4-1 lists the pins and signals of the 21-pin connector on the SE4750. See *Figure 2-5 on page 2-8* for the pin 1 location on the rear of the engine, on the side opposite the aiming/illumination system.

✓ ***NOTE*** For the SE4757 engine, refer to the *PL3307 Decoder Integration Guide*, *Chapter 2 PL3307-A Installation and Specifications*.

Table 4-1 *SE4750 Parallel Host Interface Signal Information*

Pin Number	SE4750 Signal Name	I/O	Notes
1	GND	-	Ground
2	GND	-	Ground
3	I2C_CLK	I	I^2C clock
4	I2C_DATA	I/O	I^2C data
5	VSYNC	O	Vertical sync
6	PIX_DATA_7	O	Sensor pixel data - MSB
7	PIX_DATA_6	O	Sensor pixel data
8	PIX_DATA_5	O	Sensor pixel data
9	PIX_DATA_4	O	Sensor pixel data
10	PIX_DATA_3	O	Sensor pixel data
11	PIX_DATA_2	O	Sensor pixel data
12	PIX_DATA_1	O	Sensor pixel data
13	PIX_DATA_0	O	Sensor pixel data - LSB
14	EXT_ILLUM_EN	O	External illumination trigger

Table 4-1 *SE4750 Parallel Host Interface Signal Information (Continued)*

Pin Number	SE4750 Signal Name	I/O	Notes
15	VDD_IO_HOST	PWR In	Host digital logic level
16	VCC	PWR In	Aiming and logic power
17	VCC_ILLUM	PWR In	Illumination power
18	HSYNC	O	Horizontal sync
19	GND	-	Ground
20	PIXCLK	O	Sensor pixel clock
21	GND	-	Ground

Table 4-2 *SE4750 MIPI Host Interface Signal Information*

Pin Number	SE4750 Signal Name	I/O	Notes
1	GND	-	GND, used to connect GUARD TRACE on flex
2	GND	-	GND
3	DN	O	MIPI data -
4	GND	-	GND
5	DP	O	MIPI data +
6	GND	-	GND
7	GND	-	GND, used to connect GUARD TRACE on flex
8	GND	-	GND
9	CP	O	MIPI clock+
10	GND	-	GND
11	CN	O	MIPI clock-
12	GND	-	GND, used to connect GUARD TRACE on flex
13	VDD_IO_HOST	PWR In	VDD_IO_HOST, host digital logic level of EXT_ILLUM_EN and I^2C signals
14	EXT_ILLUM_EN	O	EXT_ILLUM_EN, pulled up to VDD_IO_HOST
15	Reserved	-	Reserved - No connect
16	VCC	PWR In	Aiming and logic power
17	VCC_ILLUM	PWR In	Illumination power
18	VCC_ILLUM	PWR In	Illumination power

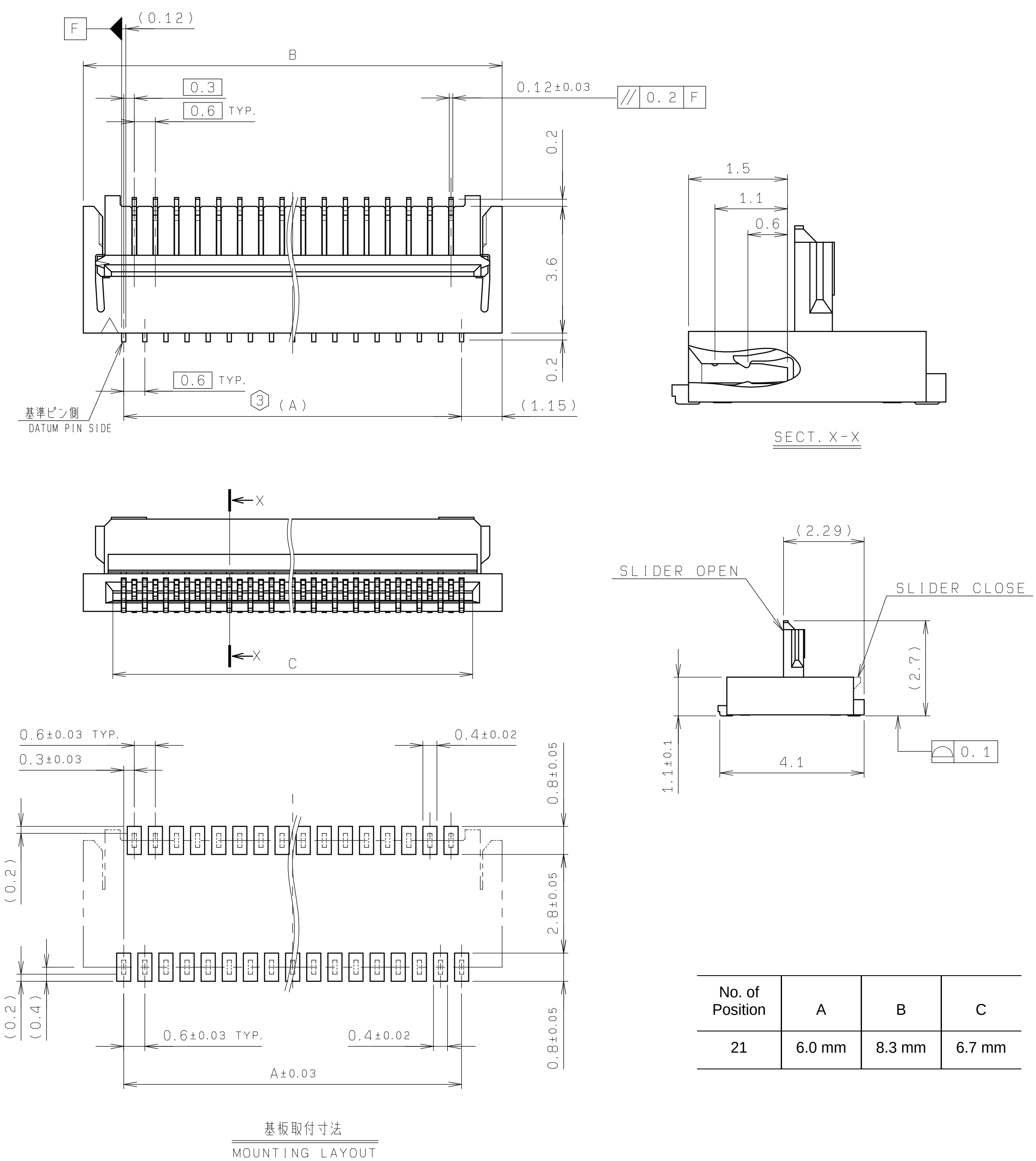
Table 4-2 *SE4750 MIPI Host Interface Signal Information (Continued)*

Pin Number	SE4750 Signal Name	I/O	Notes
19	I2C_CLK	I	I2C_CLK, pulled up to VDD_IO_HOST
20	I2C_DATA	I/O	I2C_DATA, pulled up to VDD_IO_HOST
21	GND	-	GND

SE4750 Connector Drawings

For detailed connector information, refer to the manufacturer's specifications: Kyocera 6283 Series.

NOTE For the SE4757 engine, refer to the PL3307-A accessory information in the *PL3307 Decoder Integration Guide*.



No. of Position	A	B	C
21	6.0 mm	8.3 mm	6.7 mm

Figure 4-1 *21-Pin ZIF Connector (SE4750 Engine, PL3307-A Decoder), Kyocera 6283 Series*

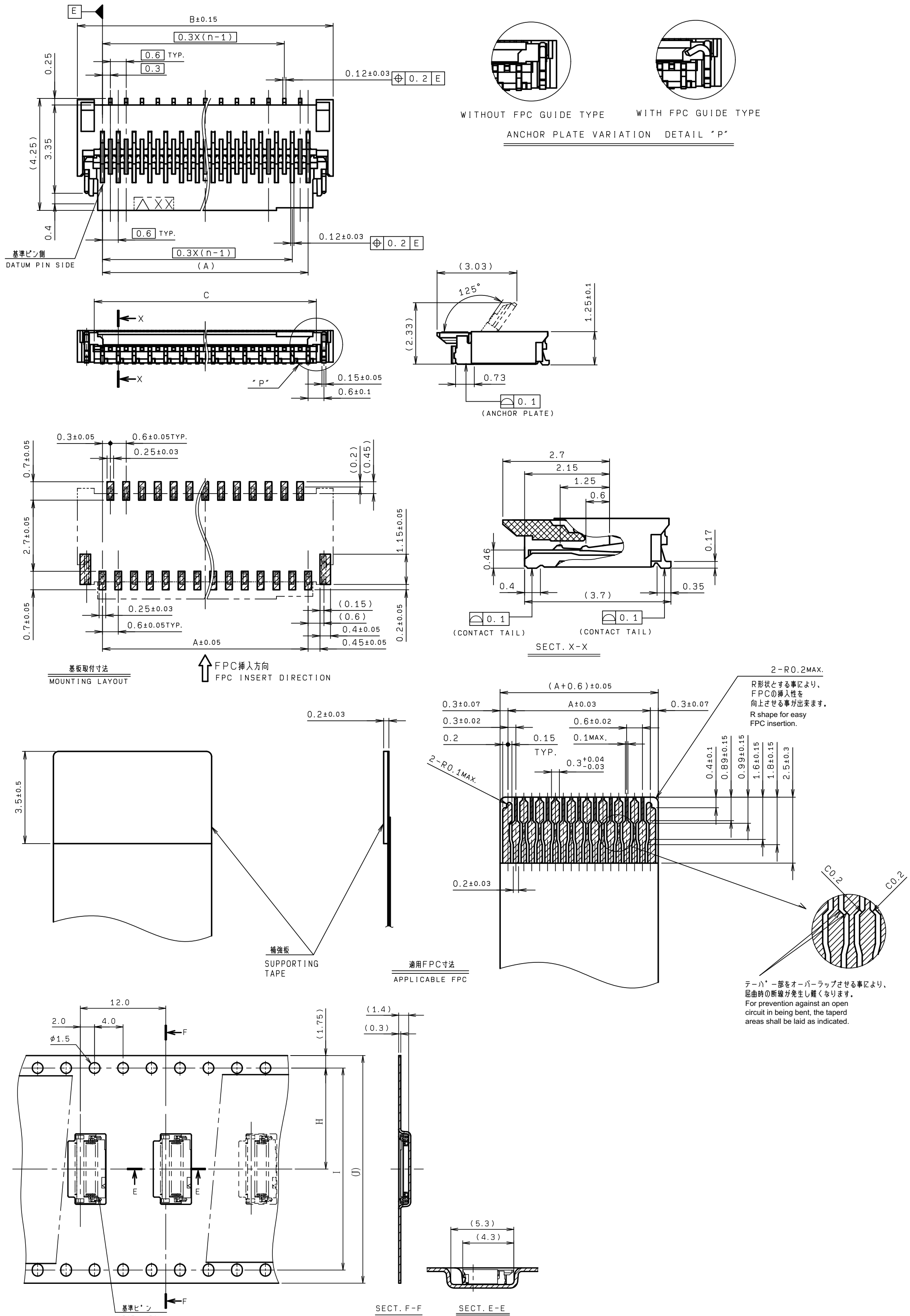


Figure 4-2 *21-Pin ZIF Connector (PL3307-B Decoder), Kyocera 6281 Series*

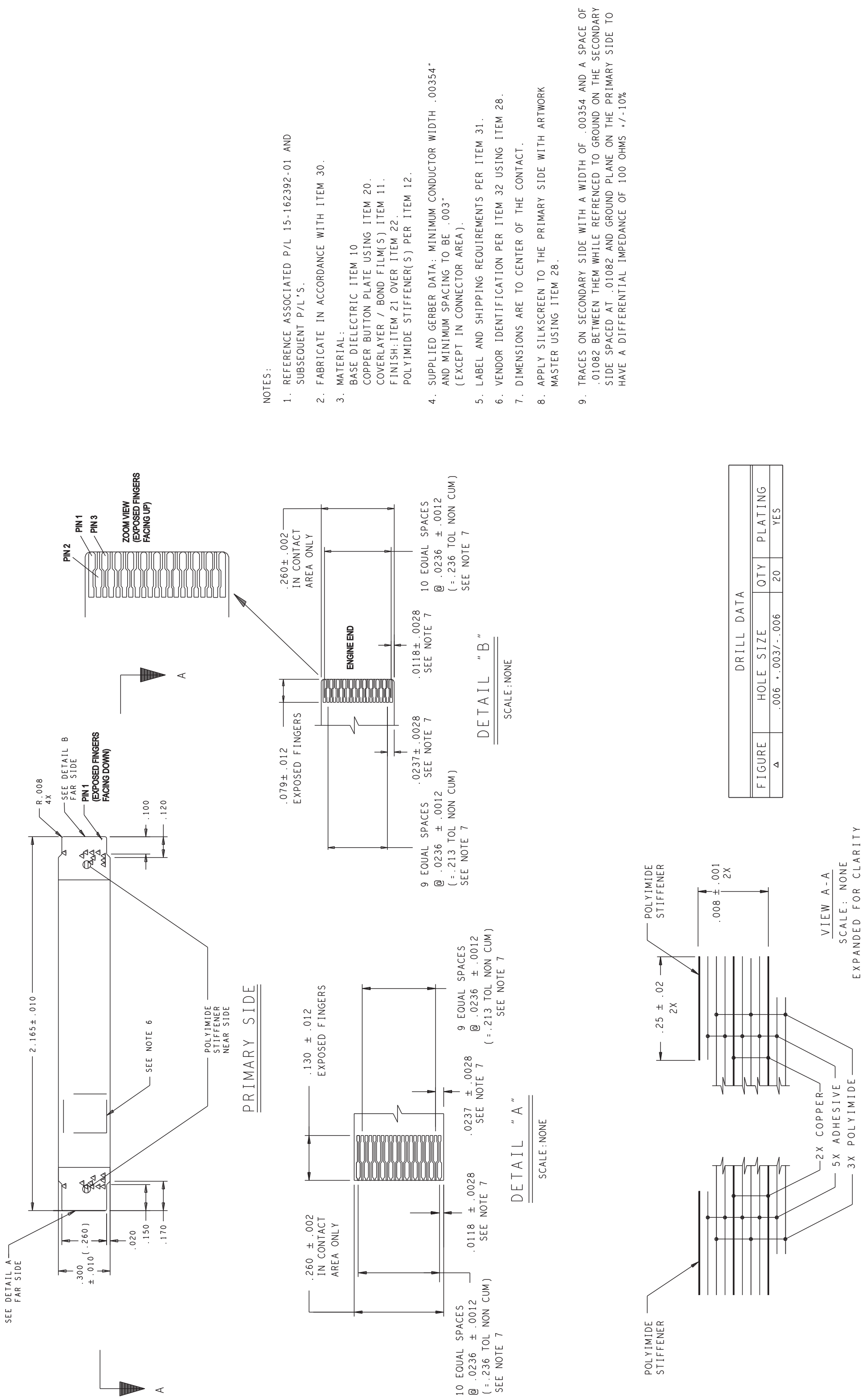


Figure 4-3 *MIPI Host Flex, p/n 15-162392-xx*

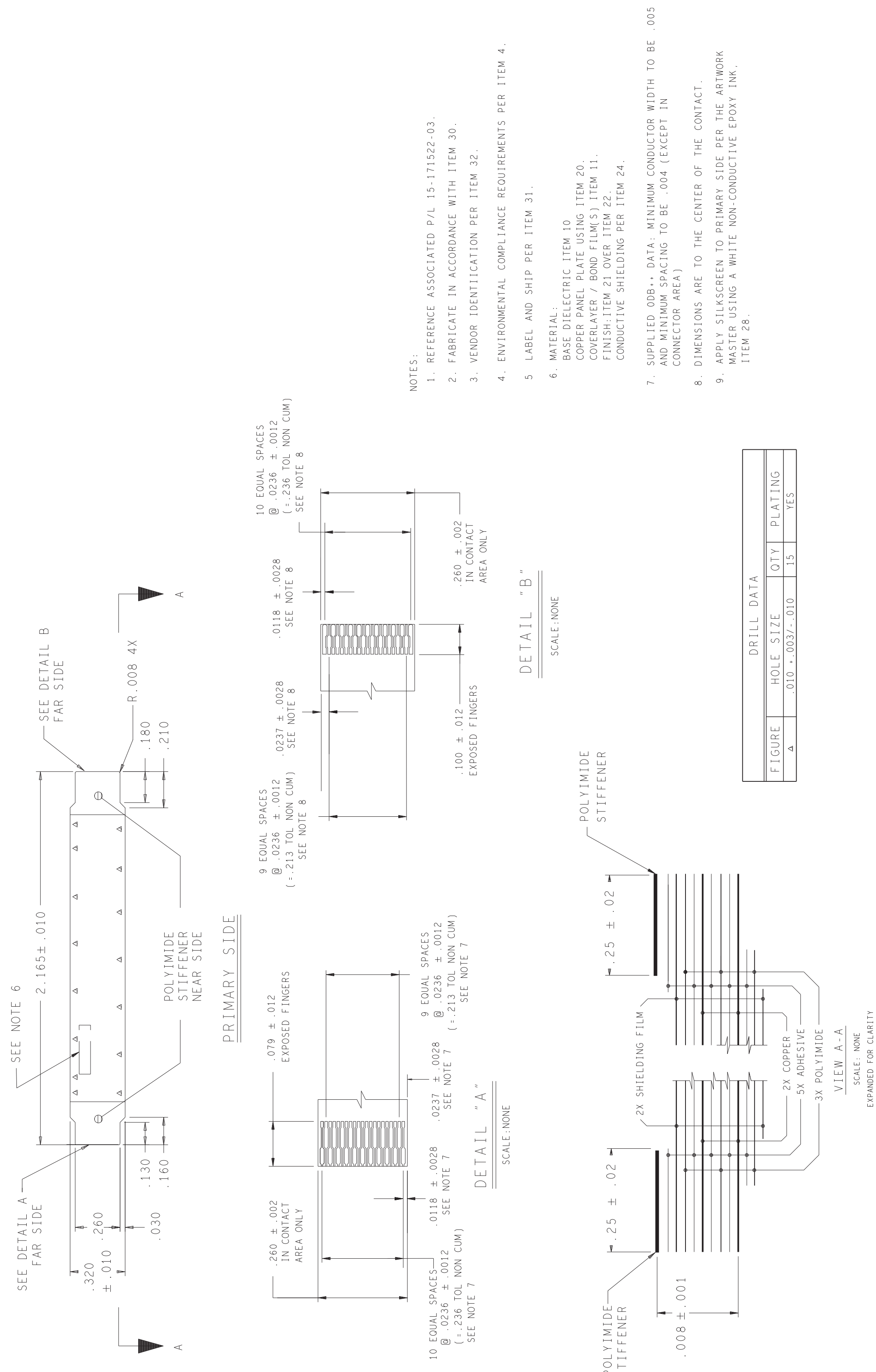


Figure 4-4 *Parallel Host Flex, p/n 15-171522-xx*

SE4750 Power Supply Sequencing

The imager engine contains three power domains: VCC, VCC_ILLUM, and VDD_IO_HOST. Specific power-up and power-down sequences of these three supplies are recommended to ensure proper operation.

Power Up

The preferred method for powering up the engine is to have independently controlled power switches with active pull downs for each power domain (*Figure 4-7*). This allows the timing adjustment as needed to meet the power up/down sequence shown in *Figure 4-5*, and the active pull downs guarantee the initial voltage condition (<0.1V) for the next power-up sequence. Active pull downs are also needed to sink any current generated by PN junctions exposed to light, as is the case with LEDs and the CMOS sensor used in the engine.

Power-up Sequence

During power up, the VCC supply ramps up before or at the same time as the VCC_ILLUM and VCC_IO_HOST supplies. The VCC_ILLUM and VDD_IO_HOST supplies can ramp up together or at different times. While supplies ramp up, however, the VCC_ILLUM and VDD_IO_HOST supplies should not exceed the voltage on the VCC supply.

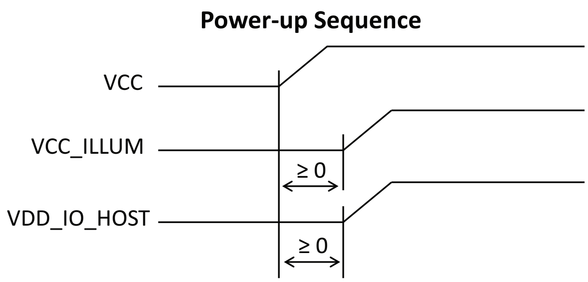


Figure 4-5 *Power-up Sequence*

NOTE A rise time of less than 4 ms on the VCC supply is necessary to properly initialize the imager engine.

Power Down

The preferred method for powering down the engine is to command the engine into **hibernate** or **standby** mode and not remove power from the engine. Hibernate mode draws ~350 uA and wakes up in ~5 mS, standby mode draws ~15 uA and wakes up in ~35 mS.

Use the following power-down sequence when power is removed from the engine.

Power-down Sequence

To power down the engine, it is recommended that the host system send a command to the engine that places the engine in the low power standby state. This ensures that critical operations, such as flash writes, are not interrupted when power is removed. Once the standby command is acknowledged, the power supplies can be safely removed. Remove the VCC_ILLUM and VDD_IO_HOST supplies before or at the same time as the VCC supply. While supplies are ramping down, however, the VCC_ILLUM and VCC_IO_HOST supplies should not exceed the voltage on the VCC supply.

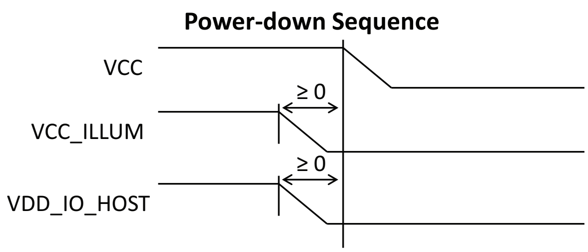


Figure 4-6 *Power-down Sequence*

Good Practice

In general, consider the following points when designing a power management system for the engine.

- Use independent controls (*Figure 4-7*) for each power supply domain to control sequencing as in *Figure 4-6*. This allows maximum flexibility in managing the peripheral.

  If using a less preferred arrangement where only one control line drives all three voltage domains, ensure that power sequencing is achieved as shown in *Figure 4-5* and *Figure 4-6*.
- Provide fast rise time and fall times on power supply ramps. < 4ms is necessary.
- Power domains must behave reliably in regard to turning on, remaining on, and turning off without momentary transitions.
- When removing power, pull each power supply domain to ground (<0.1V) with an active pull down to guarantee the initial condition for the next power-up event.

  The voltage of a floating power supply domain is undefined, and not guaranteed to be low.
- Add weak pull down resistors (*Figure 4-7*) on power domains in case the SW system is lost (due to fast battery removal, momentary connection loss, cold boot) and active pull downs are not properly managed.
- Add decoupling capacitance (*Figure 4-7*) near the engine connector to reduce noise spikes. 1 to 2.2 uF is recommended.
- Configure the reset state of the host system to remove power from the peripheral and quickly discharge all power domains that feed the peripheral.
- Provide the ability to remove power to force a reset (lock-up recovery) and/or to reduce current draw to a minimum.
- To improve reliability and reduce operator intervention, include an automatic recovery scheme to reset an engine that is unresponsive due to an ESD/EMI event, a drop-induced brown-out event, or mishandling. To do this, remove power (active pull downs in place), wait 200 ms, and reapply power.

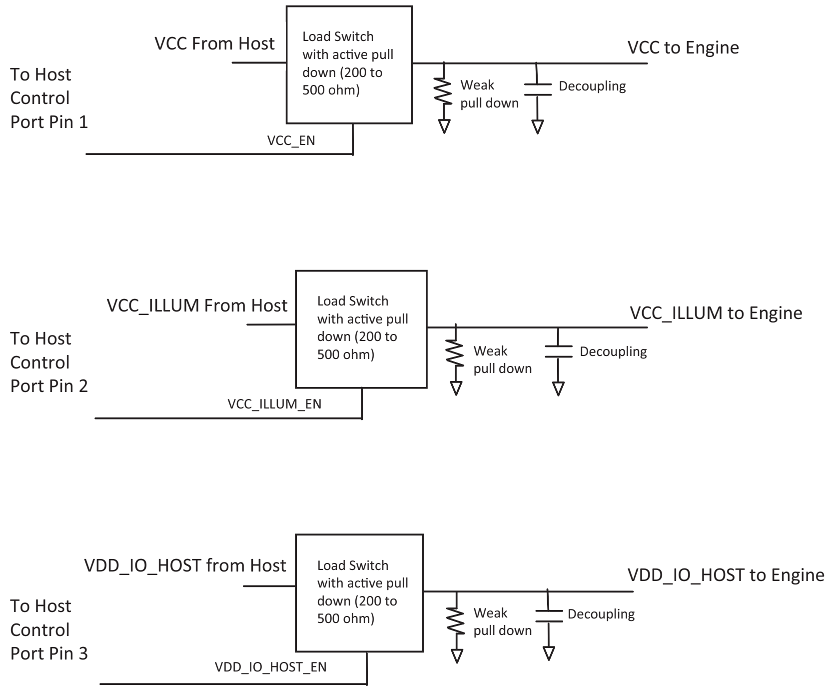


Figure 4-7 *Power Switches with Pull Downs*

CHAPTER 5 CONTROL INTERFACE

Introduction

The SE4750 bi-directional control interface uses the industry-standard I^2C protocol. The SE4750 protocol is a host-initiated command/response type protocol, and does not support unsolicited responses.

NOTE For the SE4757 engine, refer to the programming information in the *PL3307 Decoder Integration Guide*.

Command List

The SE4750 protocol supports the commands listed in *Table 5-1*. For detail on each command, see *Command Descriptions on page 5-5*.

Table 5-1 *SE4750 Command List*

I^2C Command Set	Opcode	Description	Page
ACQUISITION	0x58	Starts and stops image data output.	5-5
ACQUISITION_MODE	0x5B	Optimizes the SE4750 for a specific operation.	5-5
AIM	0x55	Turns the aim pattern on and off.	5-5
AIM_DURING_EXPOSURE	0x56	Captures the aim pattern in the image.	5-5
AUTO_POWER_REDUCTION	0x74	Places the SE4750 in a low power state when idle.	5-5
DRIVE_STRENGTH	0x99	Sets the output drive strength of the parallel interface based on host integration, and VDD_IO_HOST voltage level.	5-5
ENTER_BOOTLOADER	0x91	Enters bootloader mode.	5-6
EXECUTE_SCRIPT	0x77	Executes a programmed script.	5-6
EXTERNAL_ILLUMINATION	0x5A	Controls the operation of the EXT_ILLUM_EN signal.	5-6

Table 5-1 *SE4750 Command List (Continued)*

I²C Command Set	Opcode	Description	Page
GET_EXTENDED_STATUS	0x79	Gets the SE4750 operating states.	5-6
GET_PARAM	0x70	Gets SE4750 parameters.	5-6
ILLUMINATION_DURING_EXPOSURE	0x59	Turns illumination on and off.	5-6
ILLUMINATION_POWER_LEVEL	0xF0	Sets the illumination brightness level.	5-6
IMAGE_CAPTURE_MODE	0x73	Sets the image capture mode.	5-7
MIRROR_AND_FLIP	0x85	Mirrors and/or flips the image.	5-7
PICKLIST_MODE	0x7B	Sets the rate of picklist frames.	5-7
PING	0x7A	Used for test purposes.	5-7
POWER_MODE	0x5F	Places the SE4750 in low power mode.	5-8
RD_SENSOR	0x51	Reads the Aptina AR0134 registers.	5-8
RESET	0x57	Returns engine components to a default state.	5-8
TIME_TO_LOW_POWER	0x75	Sets the length of time the SE4750 is idle before entering low power mode.	5-8
WR_SCRIPT	0x76	Programs more than one SE4750 command into one script.	5-9
WR_SENSOR	0x50	Writes to the Aptina AR0134 registers.	5-9

Transactions

I^2C transactions control the SE4750, where a transaction consists of a command followed by a response. I^2C is a master/slave protocol, meaning the host initiates both transmissions.

The SE4750 typically processes a command in less than 1 ms, but some commands take up to 100 ms. For this reason, after sending a command, the host (I^2C master) should request a response, and if the SE4750 does not respond the host should retry the response request for up to 100 ms. If the SE4750 does not respond within this time, a hard failure occurred.

The I^2C format of these commands and responses is as follows.

I^2C Command Format

<I2C-Start Bit> <SLA-W> <Cmd-Opcode> <[SE4750-Cmd-Data]> <Checksum> <I2C-Stop-Bit>

where:

- *I2C-Start-Bit* and *I2C-Stop-Bit* are as defined by the I^2C specification
- *SLA-W* is 0xB8 (Slave-Addr + Write-Op) or
  - Slave Address is 0x5C (or 0xB8 after shifting into 7 MSBs)
  - Write-Op is 0x00
- *Opcode* is 1 byte from the *SE4750 Command Op* column in *Table 5-3 on page 5-10*.
- *[SE4750-Cmd-Data]* is from the *SE4750 Command Data* column in *Table 5-3 on page 5-10*. This can be NULL.
- *Checksum* is a 1 byte checksum of the *SE4750 Cmd Data* bytes. See *Command Checksum on page 5-4*.

I^2C Response Format

<I2C-Start Bit> <SLA-R> <Rsp-Opcode> <Status> <[SE4750-Rsp-Data]> <I2C-Stop-Bit>

Where:

- *I2C-Start-Bit* and *I2C-Stop-Bit* are as defined by the I^2C specification
- *SLA-R* is 0xB9 (Slave-Addr + Read-Op) or
  - Slave Address is 0x5C (or 0xB8 after shifting into 7 msb's)
  - Read-Op is 0x01
- *Opcode* is 1 byte from the *SE4750 Response Op* column in *Table 5-3 on page 5-10*.
- *Status* indicates whether the SE4750 successfully processed the command. See *Response Status Code on page 5-4*.
- *[SE4750-Rsp-Data]* is from the *SE4750 Response Data* column in *Table 5-3 on page 5-10*. This can be NULL.

Command Checksum

Every command must include a checksum, calculated as follows:

1. Sum the bytes in the command, starting from the opcode through the last command data byte.
2. Use only the low byte of this result.
3. Perform a 2's complement of this result.

This value is the checksum and is added to the checksum field of the command.

Response Status Code

Every response includes a status code that indicates the success of the command. A successful command returns an ACK or 0x80.

Table 5-2 lists status codes for single errors. Note that these error codes are bit positions within the status byte, and two errors can occur (e.g., NAK and AIM_POWER_FAIL), resulting in values not listed in this table.

Table 5-2 *Response Status Codes*

Status	Value	Cause / Meaning
ACK	0x80	Command was successful.
NAK	0x82 (Bit 1 set)	Command failed. Possible causes are: • Invalid opcode • Invalid command format • Invalid parameter value
CKSM_ERR	0x84 (Bit 2 set)	The transmitted checksum did not match the checksum of the data.
AIM_POWER_FAILURE	0x88 (Bit 3 set)	The aiming power exceeded its limit.
THERMAL_FAILURE	0x90 (Bit 4 set)	The internal temperature exceeded its limit.
INTERNAL_I2C_FAILURE	0xA0 (Bit 5 set)	The internal I^2C interface failed.

Command Descriptions

See *Table 5-3 on page 5-10* for command and response formats for all SE4750 commands.

ACQUISITION 0x58

ACQUISITION Start causes the SE4750 to output image data on the camera interface. ACQUISITION Stop stops the image data output.

After receiving the Stop command, the SE4750 may not respond to subsequent commands for up to one frame time (16.6 ms at 60 fps) because the system requires the current frame to complete before the engine processes new commands. Issuing commands during this time results in unacknowledged I^2C commands, requiring command retries.

ACQUISITION_MODE 0x5B

Optimizes the engine's behavior for bar code decoding, image capture, motion detection, or aiming pattern capture.

AIM 0x55

Turns the aiming pattern on and off. AIM only turns aiming on if acquisition is started. Setting AIM On while acquisition is stopped does not turn aiming on, although it turns aiming on upon the next ACQUISITION Start command.

AIM_DURING_EXPOSURE 0x56

When enabled, this keeps the aiming pattern on when capturing an image, meaning the pattern is visible in the image. When disabled, the aiming pattern is not visible in acquired images. The default is disabled.

Enabling AIM_DURING_EXPOSURE has no effect unless AIM is also on. Enabling AIM_DURING_EXPOSURE while acquisition is stopped does not turn aiming on, although it turns aiming on upon the next ACQUISITION Start command.

AUTO_POWER_REDUCTION 0x74

Places the SE4750 in a low power state when idle for the duration of time specified by the TIME_TO_LOW_POWER command. Any I^2C command wakes the SE4750 from low power mode.

The SE4750 is considered idle only if acquisition is stopped. While acquisition is started, the SE4750 does not automatically enter low power mode.

DRIVE_STRENGTH 0x99

Sets the appropriate parallel interface drive strength for the integration and chosen VDD_IO_HOST voltage level.

The host must determine the correct drive strength level based on signal integrity and electromagnetic compatibility requirements. The default is 3.3V high, 1.8V low.

ENTER_BOOTLOADER 0x91

In this mode, the engine protocol changes and no longer supports this I^2C command set. Bootloader mode is necessary for firmware updates.

EXECUTE_SCRIPT 0x77

After programming a script (via the WR_SCRIPT command), use this command to execute it.

EXTERNAL_ILLUMINATION 0x5A

Controls operation of the EXT_ILLUM_EN signal on the SE4750 host connector.

GET_EXTENDED_STATUS 0x79

The SE4750 internally tracks various operating states and stores these states in the extended status structure. This command gets these states from the SE4750. The following are the operating conditions and descriptions.

Each operating condition has 2 bits in the extended status:

- Instantaneous bit - set if the condition exists when the GET_EXTENDED_STATUS command is issued. If the condition occurred in the past and no longer exists, the bit is cleared. These bits are reported in the first byte of the extended status data.
- Latched bit - set when the condition is first detected and remains set (even if the condition no longer exists) until the GET_EXTENDED_STATUS command is issued, which clears the bit. If a latched bit is set when the GET_EXTENDED_STATUS command is issued, this indicates the condition occurred at some point since the last GET_EXTENDED_STATUS command. These bits are reported in the second byte of the extended status data.
- Note that these conditions are bit positions within the extended status bytes; these conditions can occur simultaneously resulting in values not shown below.

Operating States (Individual Bytes)

- 0x0001: The internal temperature is approaching the threshold at which it can affect laser operation.
- 0x0002: The internal temperature has reached the threshold at which it affects laser operation.

GET_PARAM 0x70

Allows a host to read out parameters stored in the SE4750 (non-volatile memory). See *Table 5-4 on page 5-12* for a list of these parameters.

ILLUMINATION_DURING_EXPOSURE 0x59

Turns Illumination on and off. Illumination only turns on if acquisition is started. Enabling illumination while acquisition is stopped does not turn illumination on, although it turns on illumination upon the next ACQUISITION Start command.

ILLUMINATION_POWER_LEVEL 0xF0

Sets the SE4750's illumination power (brightness) level. Settings are:

- Lowest power level = 1
- Highest power level = 18

IMAGE_CAPTURE_MODE 0x73

Sets image capture mode to one of the following:

- Continuous (0x00) - an ACQUISITION Start command results in continuous image frames (one right after another) until you issue the ACQUISITION Stop command.
- Snapshot (0x01) - an ACQUISITION Start command results in only one image frame. Issue another ACQUISITION Start command to acquire another image/frame.

The default is Continuous.

MIRROR_AND_FLIP 0x85

Mirrors and/or flips the output image.

PICKLIST_MODE 0x7B

Specifies the rate of picklist frames. For picklist frames, illumination is off and the aiming pattern is captured in the image, enabling you to locate (through software image processing) the aiming pattern in the image.

This command has two parameters:

- Number of Picklist Frames (referred to as **M**): how many consecutive Picklist frames are output.
- Number of Frames (referred to as **N**): how many frames before Picklist frames start again.

The default is 0,60, or 0 Picklist frames every 60 frames.

Example

Two picklist frames - every 60 frames use the arguments [<0x02> <0x3C>]

One picklist frame - every 30 frames use the arguments [<0x01> <0x1E>]

Configure PICKLIST_MODE before starting acquisition. When acquisition starts, the picklist sequence begins. The first **M** frames are picklist frames, and the next **N-M** frames are non-picklist frames. This sequences cycles every **N** frames. The host system must track/count every frame to determine when picklist frames and non-picklist frames occur.

In a typical triggering environment where acquisition starts with a trigger and stops with a decode (or trigger release), each trigger pull (ACQUISITION Start) restarts the picklist sequence.

Do not change PICKLIST_MODE when acquisition is started because this can result in an indeterminate number of picklist frames.

PING 0x7A

Use this command for test purposes to verify that the engine is in a powered state.

POWER_MODE 0x5F

The three power modes of the SE4750 are:

- **Hibernate** (0x01): Sending <0x5F, 0x01, CHKSUM> to the engine places the engine into hibernate power mode. In this mode the contexts of the SE4750 are saved, which means the engine wakes up faster and does not require reinitialization. This power mode is not compliant with entering and exiting MIPI ULP (Ultra Low Power). See *Table 3-7 on page 3-9*.
- **Hibernate with MIPI Full Compliance** (0x04): Sending <0x5F, 0x04, CHKSUM> to the engine places the engine into hibernate power mode. In this mode the contexts of the SE4750 are saved, which means the engine wakes up faster and does not require reinitialization. This power mode is compliant with entering and exiting MIPI ULP (Ultra Low Power). See *Table 3-7 on page 3-9*.
- **Standby** (0x02): Sending <0x5F, 0x02, CHKSUM> to the engine places the engine into standby power mode. In this mode the contexts of the SE4750 are not saved. When the host wakes the SE4750 with an I^2C command, the SE4750 resets. This power mode is not MIPI compliant. See *Table 3-7 on page 3-9*.

  The host must wait for the SE4750 to exit the reset condition before sending the first I^2C command. The SE4750 requires approximately 50 msec to exit a reset.

✓ ***NOTE*** Enabling a power mode requires stopping acquisition. Send ACQUISITION = Stop (0x00), then either POWER_MODE = 0x01 to enter hibernate, or 0x02 to enter standby. The power mode command is rejected (a NAK is sent) if acquisition is started.

RD_SENSOR 0x51

Reads Aptina AR0134 sensor registers. Refer to the AR0134 specification from Aptina for register descriptions.

RESET 0x57

Returns the SE4750 to a default state.

TIME_TO_LOW_POWER 0x75

Sets the length of time the SE4750 must be idle before it enters low power mode. This only applies if AUTO_POWER_REDUCTION is enabled.

Asymmetric TIME_TO_LOW_POWER

The SE4750 employs a power management feature to reduce current consumption. When this feature is enabled, the engine enters low power mode after a programmable period of inactivity. An I^2C transaction with the correct address wakes the SE4750 by first responding with a NACK. The SE4750 responds to the second I^2C command with an ACK.

This causes an issue when the I^{2}C Retry Rate is greater than the TIME_TO_LOW_POWER.

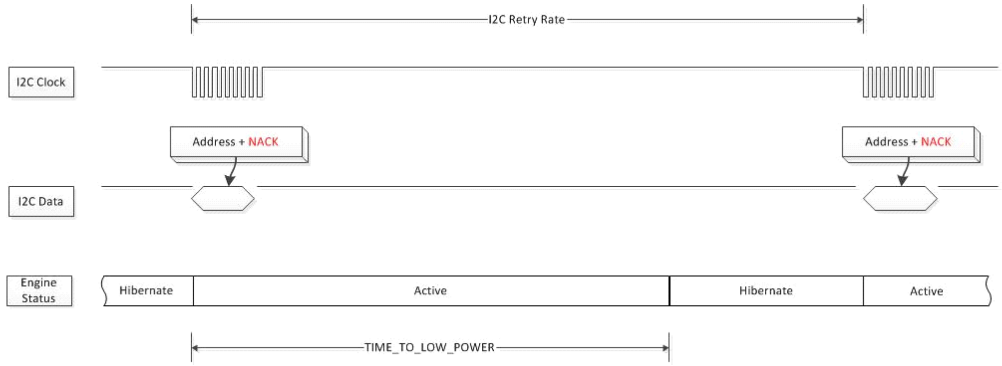


Figure 5-1 *Race Condition (Without Asymmetric TIME_TO_LOW_POWER)*

To correct this, the SE4750 uses a value of 1 second for TIME_TO_LOW_POWER for the first character that wakes it, so the engine is still awake when the decoder retries. This avoids a race condition. This feature is called Asymmetric TIME_TO_LOW_POWER. A value of 1 second was chosen because it is assumed that all decoders have a retry rate of less than 1 second. All following characters use the user-programmed value for TIME_TO_LOW_POWER.

WR_SCRIPT 0x76

Programs more than one SE4750 command into a script, which can be executed using a single command (EXECUTE_SCRIPT). Use this method whenever possible to increase performance and timing synchronization.

There are ten scripts (Script-0 through Script-9) and a total of 150 bytes for all scripts. Exceeding these limits results in a NAK status code. The general format for this command is:

<0x76><Script#><Len> [<C_1Len><C_1Op><C_1Data>] [<C_2Len><C_2Op><C_2Data>] [<C_3Len><C_3Op><C_3Data>] <Checksum>

✓ ***NOTE*** Brackets ([ ]) appear in this example for clarity only, and are not part of the commands.

Example

To program script 2 with AIM_ON, ILLUM_ON, and ACQUISITION_ON, format the WR_SCRIPT command as follows:

<0x76><0x02><0x09> [<0x02><0x55><0x01>] [<0x02><0x59><0x01>] [<0x02><0x58><0x01>] <0x70>

WR_SENSOR 0x50

Writes directly to the Aptina AR0134 sensor registers. Refer to the AR0134 specification from Aptina for register descriptions.

CAUTION The SE4750 controls many sensor registers. Using this command to write sensor registers may conflict with SE4750 requirements, causing unpredictable behavior.

Command / Response Formats

Table 5-3 depicts the command and response formats for all SE4750 commands.

In the columns *SE4750 Command Data* and *SE4750 Response Data*, the following letters identify the size of the data: (B) = Byte, (W) = Word, or (A) = Array. Words are in Little-Endian format (low byte first).

* indicates the default.

Table 5-3 *SE4750 Command and Response Formats*

Function	SE4750 Command			SE4750 Response		
	Op	SE4750 Command Data[Note1]		Op	SE4750 Response Data[Note2]	
WR_SENSOR	0x50	(W) Register	(W) Value	0x50	-	
RD_SENSOR	0x51	(W) Register		0x51	(W) Value	
AIM	0x55	(B) 0x00=Off* 0x01=On		0x55	-	
AIM_DURING_EXPOSURE	0x56	(B) 0x00=Off* 0x01=On		0x56	-	
RESET	0x57	(B) 0x00=Sensor 0x01=SE4750		0x57	-	
ACQUISITION	0x58	(B) 0x00=Stop 0x01=Start		0x58	-	
ILLUMINATION_DURING_EXPOSURE	0x59	(B) 0x00=Off* 0x01=On		0x59	-	
EXTERNAL_ILLUMINATION	0x5A	(B) 0x00=Floating Input* 0x01=On 0x02=Off 0x03=Follow Internal Illumination 0x04=Follow Trigger 0x05=Alternate with Internal Illumination		0x5A	-	
ACQUISITION_MODE	0x5B	(B) 0x00=Barcode Decode* 0x01=Document Capture 0x02=Motion Detect 0x03=Aim Capture		0x5B	-	

Notes:
1. Every command has a 1 byte checksum (last byte of command). See *Command Checksum on page 5-4*.
2. Every response has a 1 byte status code immediately following the Opcode. See *Response Status Code on page 5-4*.
3. These commands/responses have a variable length data field indicated by (A):Array. See *Table 5-4 on page 5-12* for the length of the field based on the param number.

Table 5-3 *SE4750 Command and Response Formats (Continued)*

Function	SE4750 Command			SE4750 Response	
	Op	SE4750 Command Data[Note1]		Op	SE4750 Response Data[Note2]	
POWER_MODE	0x5F	(B) 0x00=Full Power* 0x01=Hibernate 0x02=Standby		0x5F	-	
GET_PARAM (see Note 3 and *Table 5-4*)	0x70	(W) Param#		0x70	(W) Param#	(A) Param Data (Note 3)
IMAGE_CAPTURE_MODE	0x73	(B) 0x00 = Continuous 0x01 = Snapshot		0x73	-	
AUTO_POWER_REDUCTION	0x74	(B) 0x00=Disabled 0x01=Enabled		0x74	-	
TIME_TO_LOW_POWER	0x75	(B) 0x01* - 0x0A = 10-100 ms, 10 ms increments 0x0B - 0x14 = 100-900 ms, 100 ms increments 0x15 - 0xFF = 1s - 235 s, 1 s increments 0x00 = 5 ms		0x75	-	
WR_SCRIPT (Note 3)	0x76	(B) Script#	(A) Script Data	0x76	-	
EXECUTE_SCRIPT	0x77	(B) Script#		0x77	-	
GET_EXTENDED_STATUS	0x79	-		0x79	-	
PING	0x7A	-		0x7A	-	
PICKLIST_MODE	0x7B	(B) #Picklist-Frames	(B) #Frames	0x7B	-	
MIRROR_AND_FLIP	0x85	(B) 0x00 = Default Orientation* 0x01 = Mirror Only 0x02 = Flip Only 0x03 = Mirror and Flip		0x85	-	
ENTER_BOOTLOADER	0x91	(A) Signature (3 bytes: 0xAA, 0x50, 0x5F)		0x91	-	

Notes:
1. Every command has a 1 byte checksum (last byte of command). See *Command Checksum on page 5-4*.
2. Every response has a 1 byte status code immediately following the Opcode. See *Response Status Code on page 5-4*.
3. These commands/responses have a variable length data field indicated by (A):Array. See *Table 5-4 on page 5-12* for the length of the field based on the param number.

Table 5-3 *SE4750 Command and Response Formats (Continued)*

Function	SE4750 Command		SE4750 Response	
	Op	SE4750 Command Data[Note1]	Op	SE4750 Response Data[Note2]
DRIVE_STRENGTH	0x99	(B) 0x00 = Use Default Setting 0x01 = 1.8v Low* 0x02 = 1.8v Med 0x03 = 1.8v High 0x04 = 3.3v Low 0x05 = 3.3v Med 0x06 = 3.3v High*	0x99	-
ILLUMINATION_POWER_LEVEL	0xF0	(B) Lowest = 1 Highest Power Level = 18 Default = 13	0xF0	-

Notes:
1. Every command has a 1 byte checksum (last byte of command). See *Command Checksum on page 5-4*.
2. Every response has a 1 byte status code immediately following the Opcode. See *Response Status Code on page 5-4*.
3. These commands/responses have a variable length data field indicated by (A):Array. See *Table 5-4 on page 5-12* for the length of the field based on the param number.

Table 5-4 *SE4750 Parameter Numbers and Data Formats*

Parameter	Description	Number	Length (bytes)
MODEL_NUMBER	Engine model number	0	18
SERIAL_NUMBER	Engine serial number	1	16
DATE_MANUFACTURE	Engine manufacturing date	2	7
DATE_SERVICE	Engine service date	3	7
SCANNER_BOOTLOADER_FIRMWARE_VERSION	Engine bootloader version	10	8
SCANNER_PRODUCTCODE_FIRMWARE_VERSION	Engine firmware version	20004	8
ENGINE_ID	Engine ID number	20005	1
HARDWARE_VERSION	Engine hardware version	20006	1
DEVICE_CLASS	Engine device class.	20007	18
GUID	Generally Unique ID	14	32

CHAPTER 6 APPLICATION NOTES

Introduction

This chapter includes image acquisition and power consumption information. LED illumination is required for decoding.

Image Acquisition

The SE4750 contains a 1280 H x 960 V CMOS sensor. *Figure 6-1* illustrates pixel output format, and *Figure 6-3* and *Figure 6-2* show basic timing information.

Output Data Format

Image data can be read out in a progressive scan. Vertical and horizontal blanking surrounds valid image data, as shown in *Figure 6-1*.

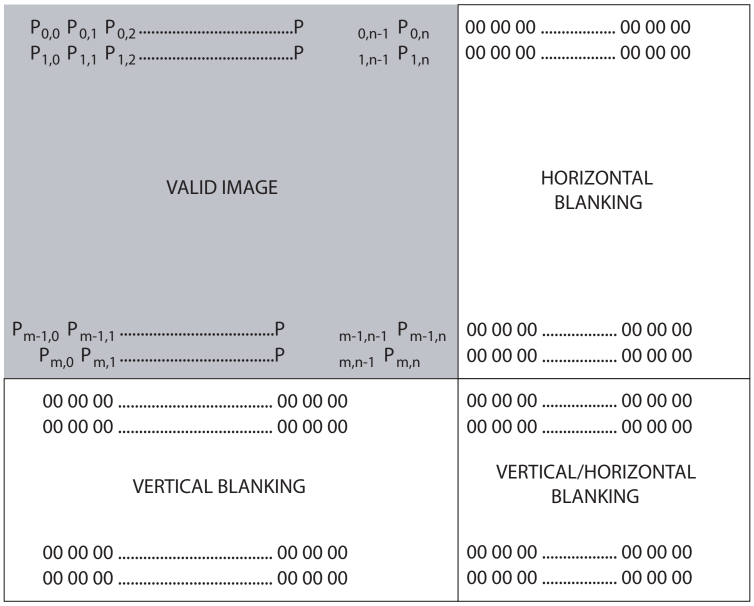


Figure 6-1 *Image Readout*

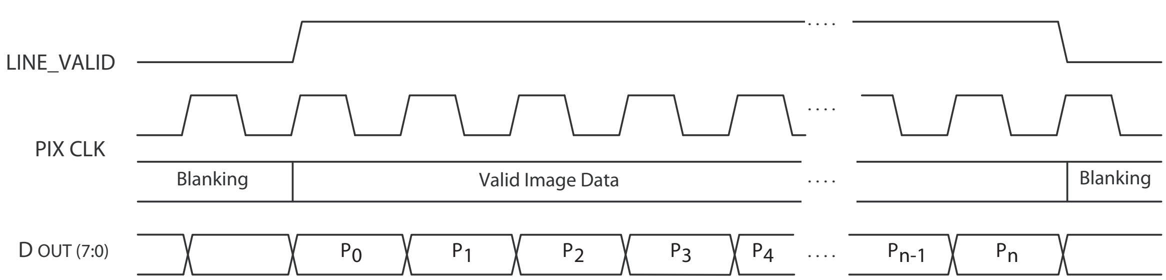


Figure 6-2 *Pixel Data Timing Example*

Output Data Timing (SE4750)

Data output is synchronized with the PIXCLK output. When LINE_VALID is high, one 8-bit pixel datum is output every PIXCLK period.

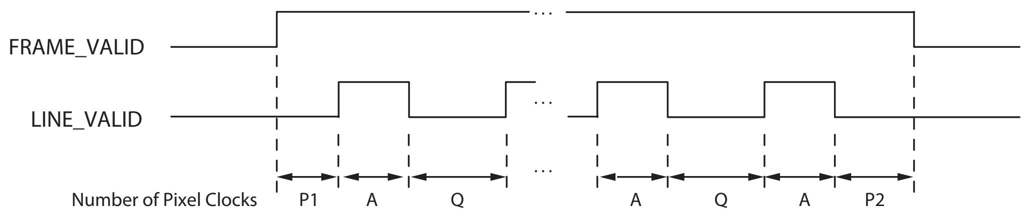


Figure 6-3 *Row Timing and FRAME_VALID / LINE_VALID Signals*

Table 6-1 *Frame Time @74.25 MHz*

Parameter	Description	Pixel Clock	Time	Units
A	Active data time	1280	17.23	µs
	With stats enabled	1360	18.31	µs
P1	Frame start blanking	6	0.08	µs
P2	Frame end blanking	6	0.08	µs
Q	Horizontal blanking	108	1.45	µs
	With stats enabled	28	0.37	µs
A + Q	Row time	1388	18.69	µs
V	Vertical blanking	51,356	691.7	µs
Nrows	Frame valid time	1,332,384	17.94	ms
F	Total frame time	1,383,836	18.6	ms

Host Parallel Video Interface Timing (SE4750)

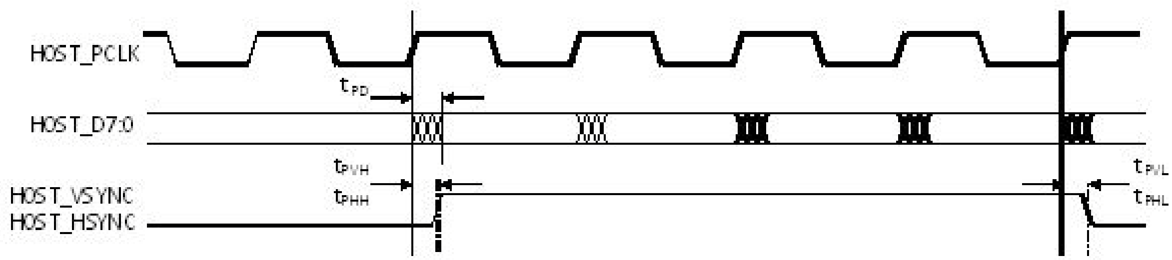


Figure 6-4 *Host Parallel Video Interface Timing*

Table 6-2 *Host Parallel Video Interface Timing*

Symbol	Definition	Min	Typ	Max	Unit
f_{HOST_PCLK}	HOST_PCLK frequency			75	MHz
	HOST_PCLK duty cycle	40	50	60	%
t_{PD}	HOST_PCLK to data valid	-0.5		1.0	ns
t_{PVH}	HOST_PCLK to HOST_VSYNC high	0		1.0	ns
t_{PHH}	HOST_PCLK to HOST_HSYNC high	0		1.0	ns
t_{PVL}	HOST_PCLK to HOST_VSYNC low	0		1.0	ns
t_{PVL}	HOST_PCLK to HOST_HSYNC low	0		1.0	ns

Recommended Procedures

The following trigger mode procedures describe the recommended transaction sequence between a host and the SE4750. These transaction sequences use discrete commands for clarity. Replace any set of discrete commands with a multi-command EXECUTE_SCRIPT to improve throughput.

Normal Decode Mode

Level Trigger Mode Procedure

The system is initialized as follows:

- The host sends the Aim Off command.
- The host sends the Illumination Off command.
- The host sends the Acquisition Stop command.
- The host sends the Barcode Decode mode command.
- The SE4750 optimizes the image output for bar code decoding.
- The SE4750 enters standby mode (or low power mode if enabled).

Upon a trigger pull:

- The host sends the Illumination On command.
- The SE4750 exits standby mode (or low power mode if enabled).
- The host sends the Aim On command.
- The host sends the Acquisition Start command.
- The SE4750 begins outputting images.
- The host attempts to decode the images.

Upon a good decode or trigger release:

- The host sends the Acquisition Stop command.
- The SE4750 stops outputting images.
- The host sends the Aim Off command.
- The host sends the Illumination Off command.
- The SE4750 enters standby mode (or low power mode if enabled).

Picklist in Level Trigger Mode Procedure

The system is initialized as follows:

- The host sends the Aim Off command.
- The host sends the Illumination Off command.
- The host sends the Acquisition Stop command.
- The host sends the Barcode Decode mode command.
- The host sends the Picklist Mode(1,60) command
- The SE4750 optimizes the image output for bar code decoding.
- The SE4750 enters standby mode (or low power mode if enabled).

Upon a trigger pull:

- The host sends the Illumination On command.
- The SE4750 exits standby mode (or low power mode if enabled).
- The host sends the Aim On command.
- The host sends the Acquisition Start command.
- The SE4750 begins outputting images. Starting with the first frame, every 60th frame is a picklist frame (1,61,121,181 …).
- The host attempts to decode the images.

Upon a good decode or trigger release:

- The host sends the Acquisition Stop command.
- The SE4750 stops outputting images.
- The host sends the Aim Off command.
- The host sends the Illumination Off command.
- The SE4750 enters standby mode (or low power mode if enabled).

Presentation Mode Procedure

The system is initialized as follows:

- The host sends the Aim Off command.
- The host sends the Illumination On command.
- The host sends the Illumination Power Off command (Off is the default, but power can be set low to allow motion detection in darkness).
- The host sends the Acquisition Start command (and never sends the Stop command).
- The host sends the Motion Detect mode command.
- The SE4750 optimizes the image output for motion detection.
- The SE4750 continuously outputs images.
- In this mode, the SE4750 does not enter standby or low power mode.

Upon the host detecting motion:

- The host sends the Aim On command.
- The host sends the Illumination Power Full command.
- The host sends the Barcode Decode mode command.
- The SE4750 optimizes the image output for bar code decoding.
- The host attempts to decode the images.

Upon a good decode:

- The host sends the Aim Off command.
- The host sends the Illumination Power Off command (Off is the default, but power can be set low to allow motion detection in darkness).
- The host sends the Motion Detect mode command.
- The SE4750 optimizes the image output for motion detection.

During this mode:

- The SE4750 does not automatically enter standby or low power mode.
- The host uses the Power Mode command to put the SE4750 into a low power mode (for support of Bus Powered USB).

Auto-AIM Mode Procedure

The system is initialized as follows:

- The host sends the Illumination Off command.
- The host sends the Aim On command.
- The host sends the Motion Detect mode command.
- The host sends the Acquisition Start command (and never sends the Stop command).
- The host sends the Aim Off command.
- The SE4750 optimizes the image output for motion detection.
- The SE4750 continuously outputs images

Upon the host detecting motion:

- The host sends the Barcode Decode mode command.
- The host sends the Aim On command.

Upon a trigger pull:

- The host sends the Illumination On command.
- The SE4750 optimizes the image output for bar code decoding.
- The host attempts to decode the images.

Upon a good decode or trigger release:

- The host sends the Aim Off command.
- The host sends the Illumination Off command.
- The host sends the Motion Detect mode command.
- The SE4750 optimizes the image output for motion detection.

During this mode:

- The SE4750 does not automatically enter low power mode.
- The host uses the Power Mode command to put the SE4750 into a low power mode (for support of Bus Powered USB).

Picklist in Auto-AIM Mode Procedure

The system is initialized as follows:

- The host sends the Illumination Off command.
- The host sends the Aim On command.
- The host sends the Motion Detect mode command.
- The host sends the Picklist Mode(1,60) command
- The host sends the Acquisition Start command (and never sends the Stop command).
- The host sends the Aim Off command.
- The SE4750 optimizes the image output for motion detection.
- The SE4750 continuously outputs images. Starting with the first frame, every 60th frame is a picklist frame (1,61,121,181 …).

Upon the host detecting motion:

- The host sends the Barcode Decode mode command.
- The host sends the Aim On command.

Upon a trigger pull:

- The host sends the Illumination On command.
- The SE4750 optimizes the image output for bar code decoding.
- The host attempts to decode the images.

Upon a good decode or trigger release:

- The host sends the Aim Off command.
- The host sends the Illumination Off command.
- The host sends the Motion Detect mode command.
- The SE4750 optimizes the image output for motion detection.

During this mode:

- The SE4750 does not automatically enter low power mode.
- The host uses the Power Mode command to put the SE4750 into a low power mode (for support of Bus Powered USB).

Snapshot Mode

Level/Presentation/Auto-Aim Trigger Mode Procedure

The system is initialized as follows:

- The host sends the Aim Off command.
- The host sends the Illumination Off command.
- The host sends the Acquisition Stop command.
- The host sends the Imaging mode command.
- The SE4750 optimizes the image output for image capture.
- The SE4750 (typically) enters low power mode.

Upon a trigger pull:

- The host sends the Illumination On command.
- The SE4750, if in low power mode, exits low power mode (either Reduced or Sleep).
- The host sends the Aim On command.
- The host sends the Acquisition Start command.
- The SE4750 captures an image.

Upon completion of an image capture:

- The SE4750 stops outputting image.
- The host sends the Acquisition Stop command.
- The host sends the Aim Off command.
- The host sends the Illumination Off command.
- The host goes back to Normal Decode Mode.
- The SE4750 (when all conditions are met) enters Reduced Power mode.

Video Mode

Level/Auto-Aim Trigger Mode

The system is initialized as follows:

- The host sends the Aim Off command.
- The host sends the Illumination Off command.
- The host sends the Acquisition Stop command.
- The host sends the Imaging mode command.
- The SE4750 optimizes the image output for video.
- The SE4750 (typically) enters low power mode.

Upon a trigger pull:

- The host sends the Illumination On command.
- The SE4750, if in low power mode, exits low power mode (either Reduced or Sleep).
- The host sends the Aim On command.
- The host sends the Acquisition Start command.
- The SE4750 begins outputting video stream.

Upon a trigger release:

- The host sends the Acquisition Stop command.
- The SE4750 stops outputting the video stream.
- The host sends the Aim Off command.
- The host sends the Illumination Off command.
- The SE4750 (when all conditions are met) enters Reduced Power mode.

Recommendations

Power Mode

The SE4750 powers up into full power mode. To save power, enable AUTO_POWER_REDUCTION.

Scripts

For improved performance and timing synchronization, replace a set of discrete commands with a multi-command EXECUTE-SCRIPT.

APPENDIX A REGISTER SETTINGS

For information on register settings for the engine, refer to the *ON Semiconductor® AR0134 (mono) 1/3-inch CMOS Digital Image Sensor Datasheet*, or *AR0135 1/3-inch CMOS Digital Image Sensor Datasheet*, available at http://www.onsemi.com

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