SE4710
INTEGRATION GUIDE

SE4710
INTEGRATION GUIDE

MN000130A01

Revision A

March 2014

Motorola Solutions, Inc.
One Motorola Plaza
Holtsville, New York 11742-1300
http://www.motorolasolutions.com

Warranty

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

Revision History

Changes to the original manual are listed below:

Change	Date	Description
Rev A	3/2014	Initial Release

TABLE OF CONTENTS

ABOUT THIS GUIDE

Introduction

The *SE4710 Integration Guide* discusses the theory of operation, installation, and specifications of the engine, 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. Motorola recommends that an opto-mechanical engineer perform an opto-mechanical analysis prior to integration.

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, 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 SE4710's bi-directional control interface.
- *Chapter 6, Application Notes* describes SE4710 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 I²C-Bus Specification, Version 2.1*, http://www.semiconductors.philips.com/acrobat/literature/9398/39340011.pdf
- *OmniVision OV9212 (mono) 1/4" CMOS WXGA Megapixel HD Sensor* datasheet, http://www.ovt.com/. (Refer to the OV9712 Datasheet, the color version of the OV9212.)
- *Molex connector specification*, *54809 Series*, http://www.molex.com.
- *Kyocera connector specification, 6841 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 Motorola Solutions Global Customer Support Center at: http://www.motorolasolutions.com/support.

When contacting Motorola Solutions support, please have the following information available:

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

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

If your problem cannot be solved by Motorola Solutions support, you may need to return your equipment for servicing and will be given specific directions. Motorola is not responsible for any damages incurred during shipment if the approved shipping container is not used. Shipping the units improperly can possibly void the warranty.

If you purchased your business product from a Motorola Solutions business partner, contact that business partner for support.

CHAPTER 1 GETTING STARTED

Introduction

The SE4710 is a sub-miniature area imager engine optimized for bar code reading. The engine captures digital images of a bar code for transmission to a decoder to decode a 1D or 2D bar code of any format supported by the decoding software. The SE4710 includes an LED aiming system, and an LED illumination system.

LED Compliance Statement:

The SE4710 imager is classified as "EXEMPT RISK GROUP" according to IEC 62471:2006 and EN 62471:2008.

SE4710

The SE4710 contains:

- a monochrome CMOS image sensor, and its imaging lens
- an LED based aiming system
- an LED based illumination system
- a software selectable MIPI or parallel interface port, and bi-directional control interface (I^2C).

NOTE Both interfaces exist in a single configuration. The user must select the desired interface with the proper flex and software command.

Figure 1-1 provides a block diagram of the imager system.

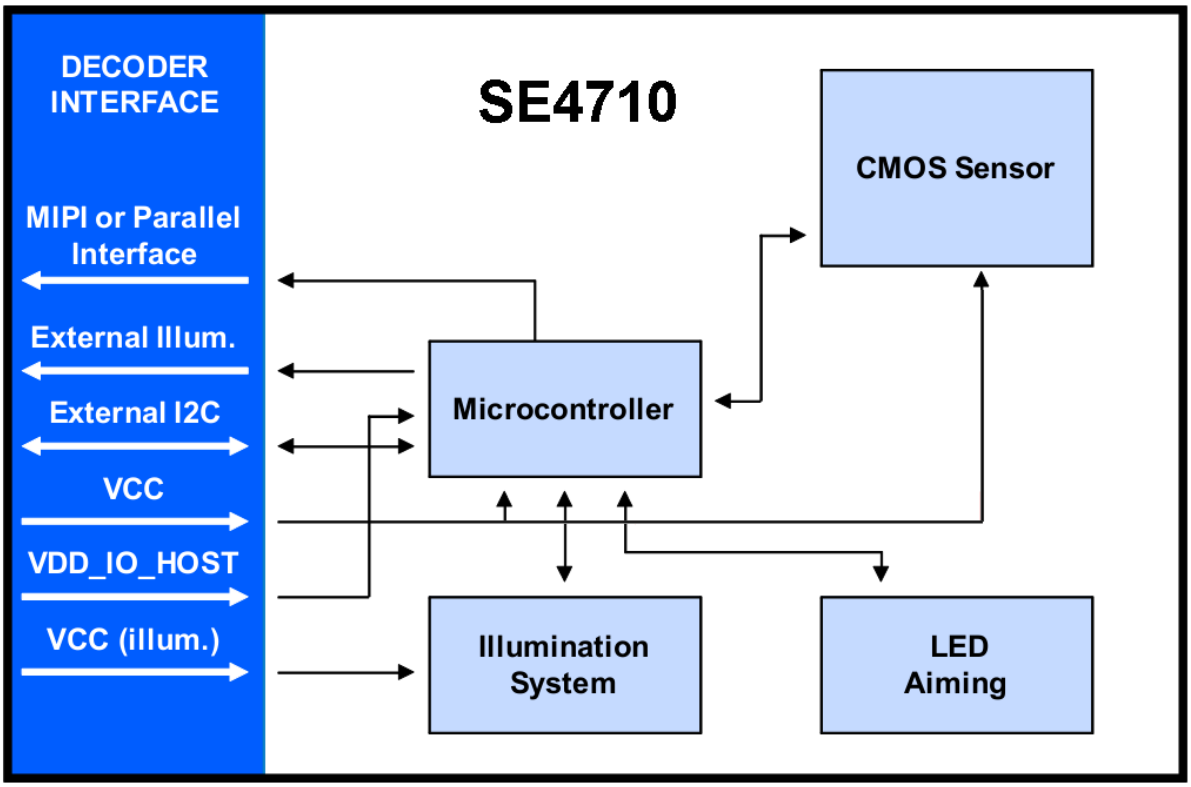


Figure 1-1 *SE4710 Block Diagram*

A 27-pin ZIF connector on the SE4710 allows connection of the engine and the host device via a 3.52 in (89.4mm) flex strip.

The flex is available from Motorola. For information about this connector, see *Figure 4-1 on page 4-3*.

An LED and associated optics generate an aiming pattern, and a single, high output LED provide illumination for the imager under virtually any lighting condition. The aiming subsystem, illumination system, and frame rate are under dynamic software control.

The primary component of the SE4710 imager is a 1/4 in. format CMOS 1280 H x 800 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 610 nm LED is used to generate a circular aiming pattern which indicates the center of the imager's field of view.

Aiming Error

The aiming pattern is rotated by 2º relative to the imaging axis in the horizontal plane to minimize parallax between the aiming axis and the imaging axis at 195 mm (7.7 in.) from the engine. See *LED Aiming Element on page 3-5* for Aiming Element specifications.

Aiming Control

The SE4710 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. Motorola 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 one red LED 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 SE4710 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 a minimum of 30 fcd on the document surface. See also *Thermal Considerations on page 2-2*.

Frame Rate Control

The SE4710 outputs images at 30 frames per second by default. The SE4710 can also output images at 60 fps, but at reduced frame size (640 x 400).

CHAPTER 2 INSTALLATION

Introduction

This chapter provides information for mounting and installing the SE4710, including physical and electrical considerations, and recommended window properties for the SE4710.

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 SE4710 when connected to a PL3307 decoder is Bus-Powered USB Mode (<500mA).

If operating in Self-Powered USB Mode (>500mA) or RS-232 Mode with VCC_ILLUM =3.3V, configure the PL3307 for one of these modes using config 0 and config 1 signals.

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 pattern forming element, optical lens, and illumination system LEDs. Dust and other external contaminants eventually degrade engine performance. Motorola does not guarantee performance of the SE4710 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 SE4710. 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.

Thermal Considerations

The SE4710 engine includes several high-power components (e.g., microcontroller, sensor, LEDs) that dissipate heat during operation. The engine temperature can reach as high as 72°C when the engine is running at 30 frames per second with full image resolution, full illumination, and aiming on. These extreme conditions can increase sensor noise, degrade image quality, and impact the scan engine's longevity. Use care when designing the SE4710 for integration into the target application.

As a protective measure for the scan engine, at extreme temperatures the SE4710 first shuts off the aiming LED and then dims the illumination LED (at 68°C engine temperature). Illumination shuts off at 72°C. As the engine temperature returns to normal levels the aiming and illumination power returns to nominal values.

In a thermal chamber with zero air flow and no heat sink attached, the thermal dissipation of the SE4710 engine can be simplified as the lumped capacitance thermal model shown in *Figure 2-1*. The parameters are listed below.

- P_{engine} : The total power consumption of the SE4710 engine (W)
- $T_{engine\_chassis}$: The SE4710 engine chassis temperature (K)
- $T_{ambient}$: The ambient temperature (K)
- R_{t_conv} : The thermal resistance between the SE4710 engine and the ambient through natural convection (reference: 50 K/W)
- C_{engine} : The thermal capacity of the SE4710 engine (reference: 5.4 Joule/K)
- $T_{thermal\_constant}$: The thermal time constant of SE4710 engine (reference: 270 sec), which equals R_{t_conv} * C_{engine}

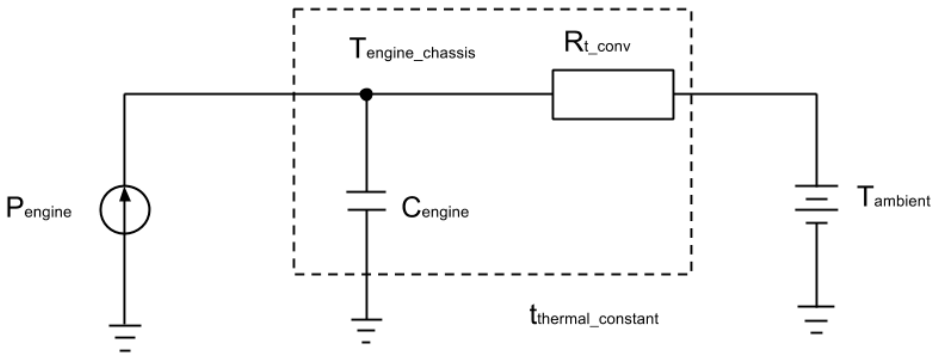


Figure 2-1 *Lumped Capacitance Thermal Model of SE4710 Scan Engine*

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

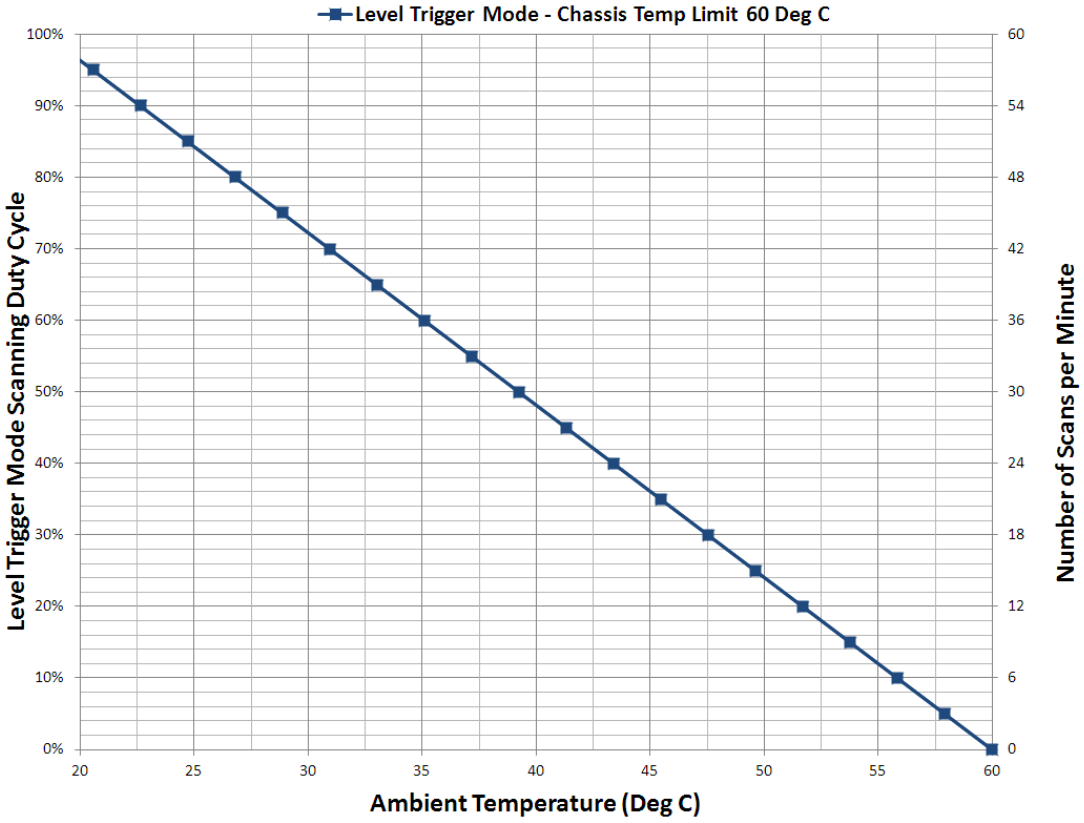


Figure 2-2 *Engine Scanning Duty Cycle in Level Trigger Mode, Chassis Temperature Limit = 60°C*

Engine Scanning Duty Cycle in Level Trigger Mode 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.

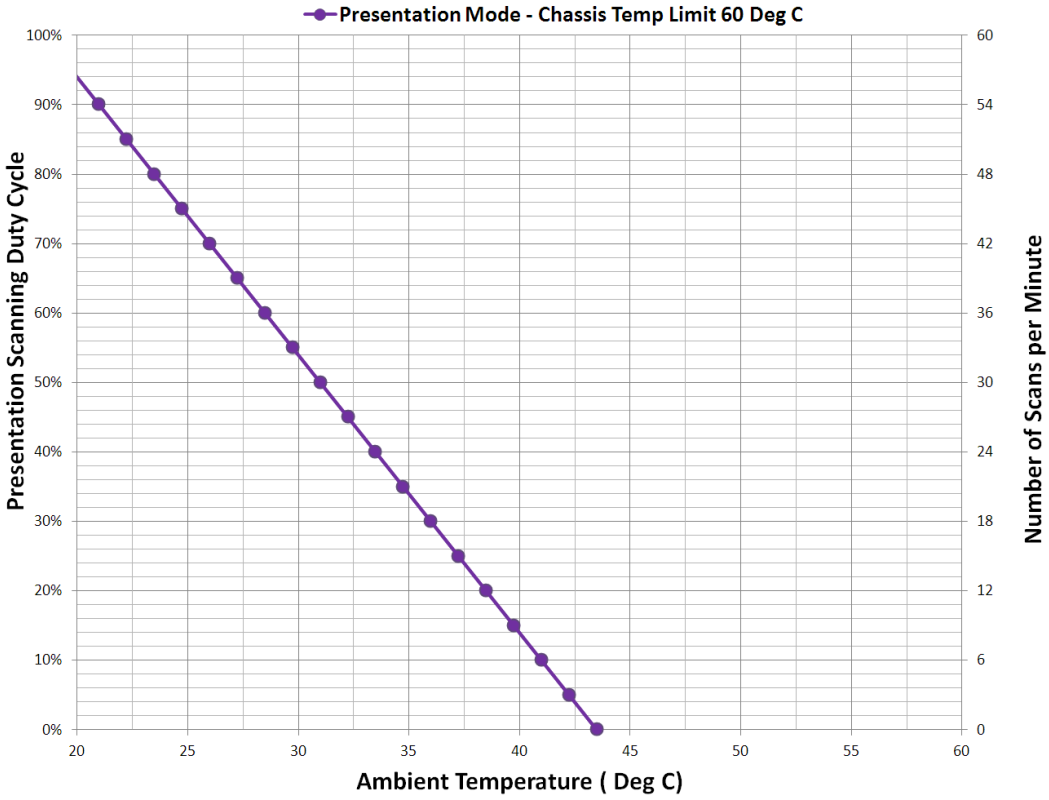


Figure 2-3 *Engine Scanning Duty Cycle in Presentation Mode, Chassis Temperature Limit = 60°C*

Engine Scanning Duty Cycle in Presentation Mode 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 30 fps video mode at full sensor resolution 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 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 a 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 and the ambient.

External Optics (LED Lenses and Pattern Forming Element)

Do not subject external optical components on the SE4710 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 Motorola sales representative for a technical document on image capture using the SE4710.

Regulatory Information

The SE4710 imager engine complies with exempt risk group emissions limits per the requirements of IEC 62471:2006 and EN 62471:2008. Any product containing the SE4710 can meet these same regulations. Contact a Motorola sales representative for further details.

Mounting

There are several mounting holes (M1.4x0.3) and locator holes on both the top and bottom of the chassis (see *Figure 2-4*). The SE4710 can be mounted in any orientation without degradation in performance.

When installing the mounting screws, 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 0.7 ±0.1 in-lbf (8.0 ± 1.0 cm-N).

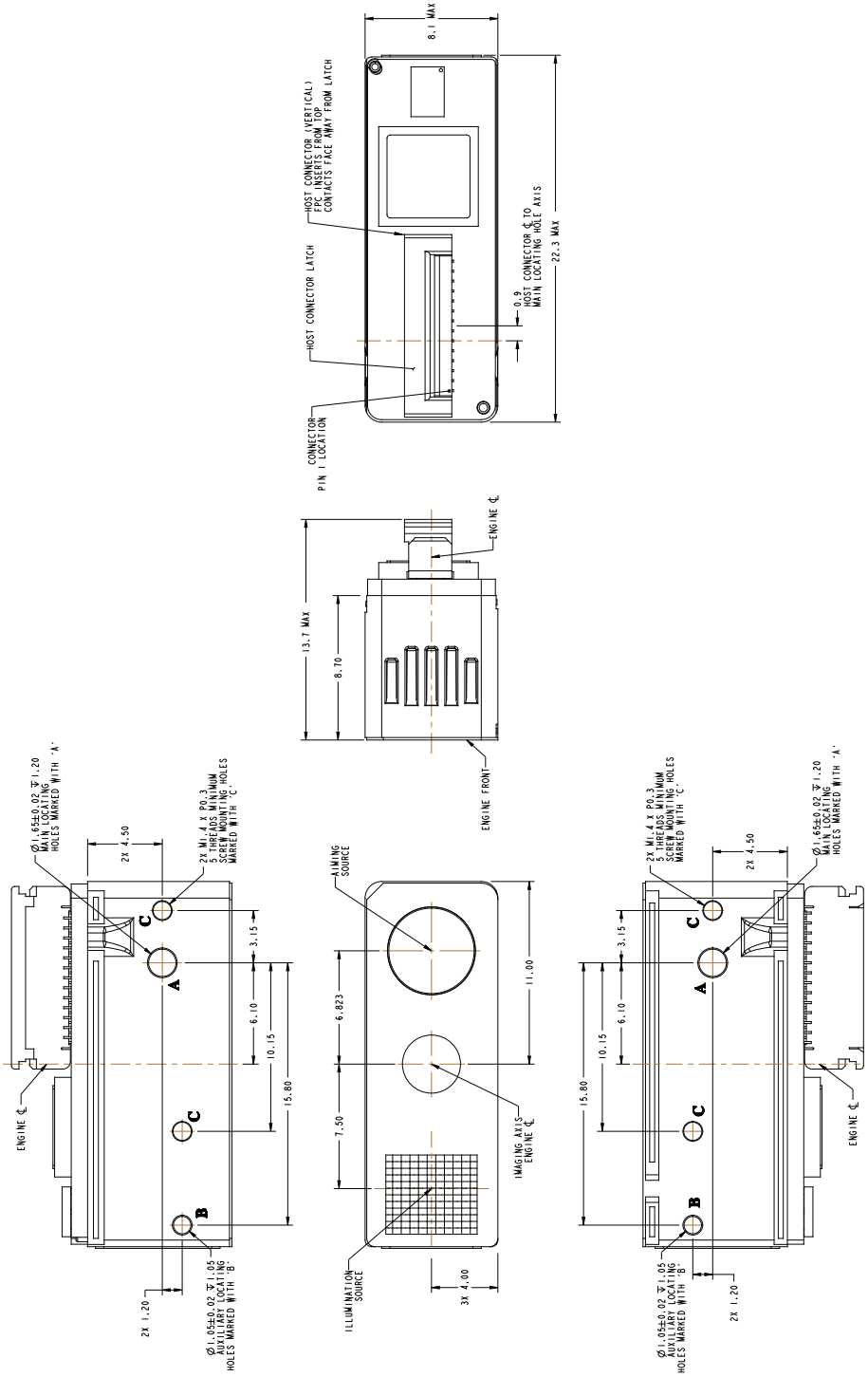


Figure 2-4 *SE4710 Mounting Diagram*

Notes

- Unless otherwise specified:
- Engine has two mounting surfaces with mirrored locating and mounting features, and can be secured to either surface.
- Holes marked "A" or "B" are engine locating aides.

  Holes marked "C" are threaded mounting holes.
- 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.

Housing Design

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

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. 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.

Recommended Exit Window Information on page 2-11 provides minimum exit window tilt angles. These dimensional requirements can vary. Consider using baffles or matte-finished dark internal housing colors.

Optical

The SE4710 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 SE4710.

Positioning the Exit Window

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 Information on page 2-11*). If the designed enclosure cannot accommodate the recommended window angle, contact Motorola 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 2-6 on page 2-11*.
- Tilted window - This is used for either laser or imager engines. Adhere to the minimum window tilt specifications in *Table 2-4 on page 2-12*.

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

Avoiding Scratched Windows

Scratches on the window can greatly reduce the performance of the imaging system. Motorola 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 2-1* outlines the suggested window properties.

Table 2-1 *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 wave front distortion recommendation specified above. Plastic materials are not recommended for tilted windows since surface scratches cause image artifacts. Colored windows are not recommended if motion detection mode is required since it reduces engine sensitivity to the moving target.

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 are 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 2-2*.

Table 2-2 *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 2-3* apply. Polysiloxane coating is not required. Recess the exit window to minimize scratches and digs.

Table 2-3 *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. AR coated glass is easier and more durable because of a better adhesion property on the glass structure. In addition, it can be more cost effective to put an AR coating on the glass substrate rather than on the 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. • For parallel windows, see *Figure 2-6 on page 2-11*.

Optical Path

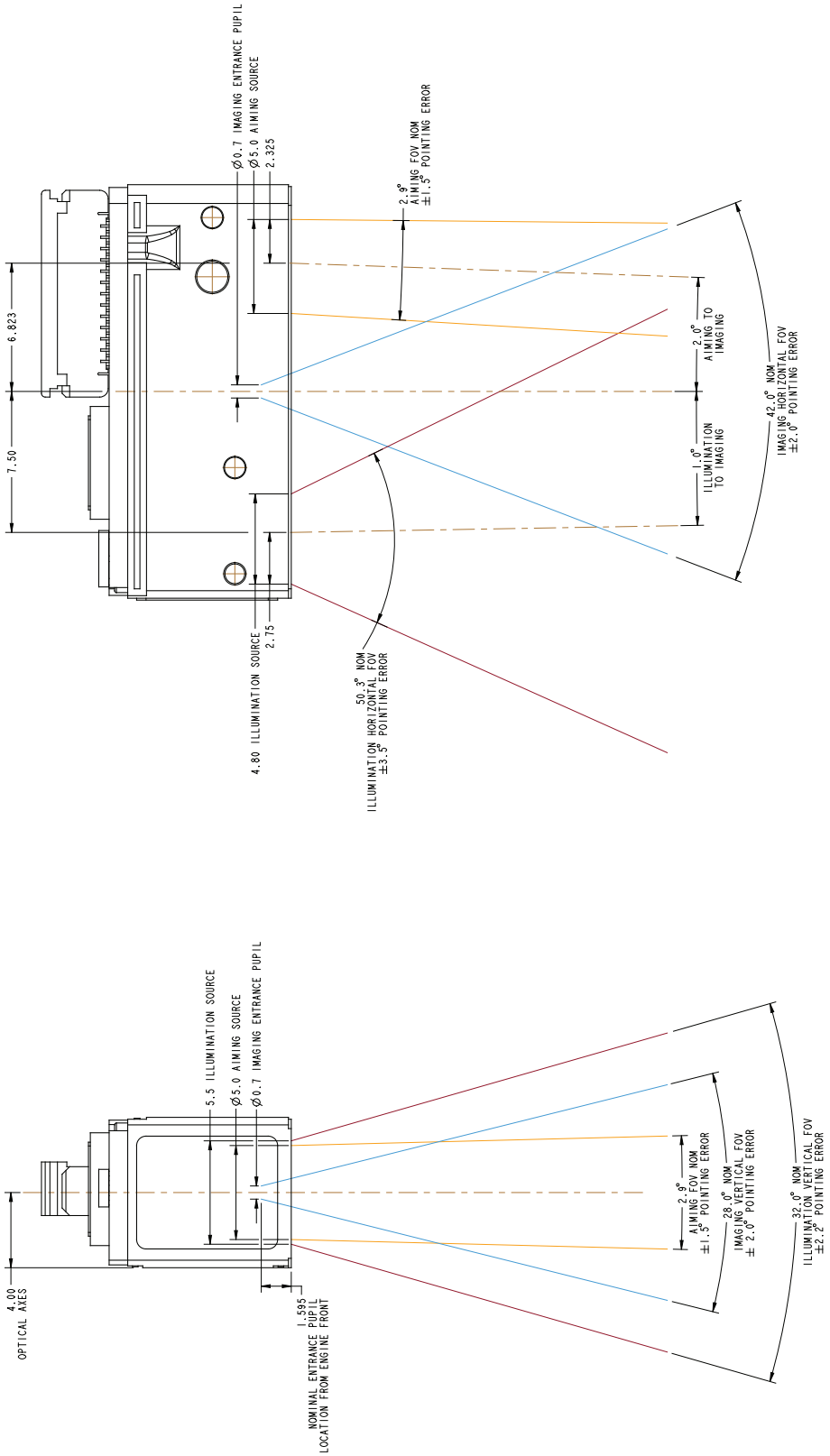


Figure 2-5 *SE4710 Optical Path*

Recommended Exit Window Information

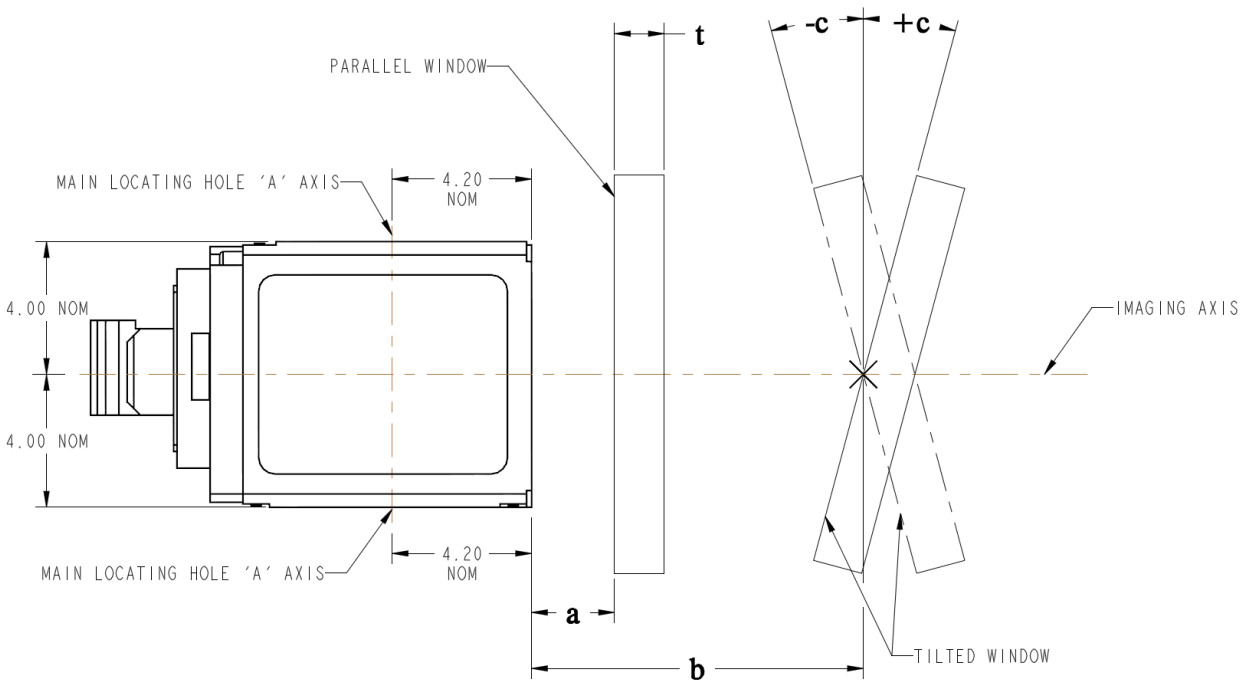


Figure 2-6 *Window Distances*

Window Distances Notes

Max distance 'a' for a parallel window.

- Uncoated window: a <= 2.0
- Single side coated window
  Coated side toward engine: a <= 2.25
- Double side coated window: a <= 2.5

Where

'a' is the window distance from engine front.

't' is the window thickness and is <=1.5 mm.

Anti-reflection coating specification:

Surface reflectance (average) < 0.5% for 420 - 730 nm at 0 - 60 degree angle of incidence.

Table 2-4 *Recommended Exit Window Information - Tilted Window*

Minimum Angle for a Tilted Window	Distance from Engine Front Surface (b) in mm			
	5mm	10mm	15mm	20mm
Non-coated, minimum window positive tilt (+c)	32°	35°	27°	20°
Non-coated, minimum window negative tilt (-c)				
AR coated, one side, minimum window positive tilt (+c)	32°	26°	24°	19°
AR coated, one side, minimum window negative tilt (-c)				
AR coated, two sides, minimum window positive tilt (+c)	21°	23°	21°	18°
AR coated, two sides, minimum window negative tilt (-c)				

Exit Window Notes

- Do not place the exit window between the maximum distance for a parallel window (“a” in *Figure 2-6*) and the minimum distance for a tilted window (5 mm in *Table 2-4*) in 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 2-5* 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. For comparison, parallel windows are located close enough to the engine that dust particles do not create image blemishes.

CHAPTER 3 SPECIFICATIONS

Introduction

This chapter provides the technical specifications of the SE4710, including electrical characteristics, engine technical specifications, decode zone, and exit window characteristics.

NOTE Additionally, the exit window is described in the section *Optical on page 2-7*.

Electrical Characteristics

Power

Table 3-1 *Power*

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	3.6	V

I²C 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

Parallel Host Interface

Table 3-3 *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

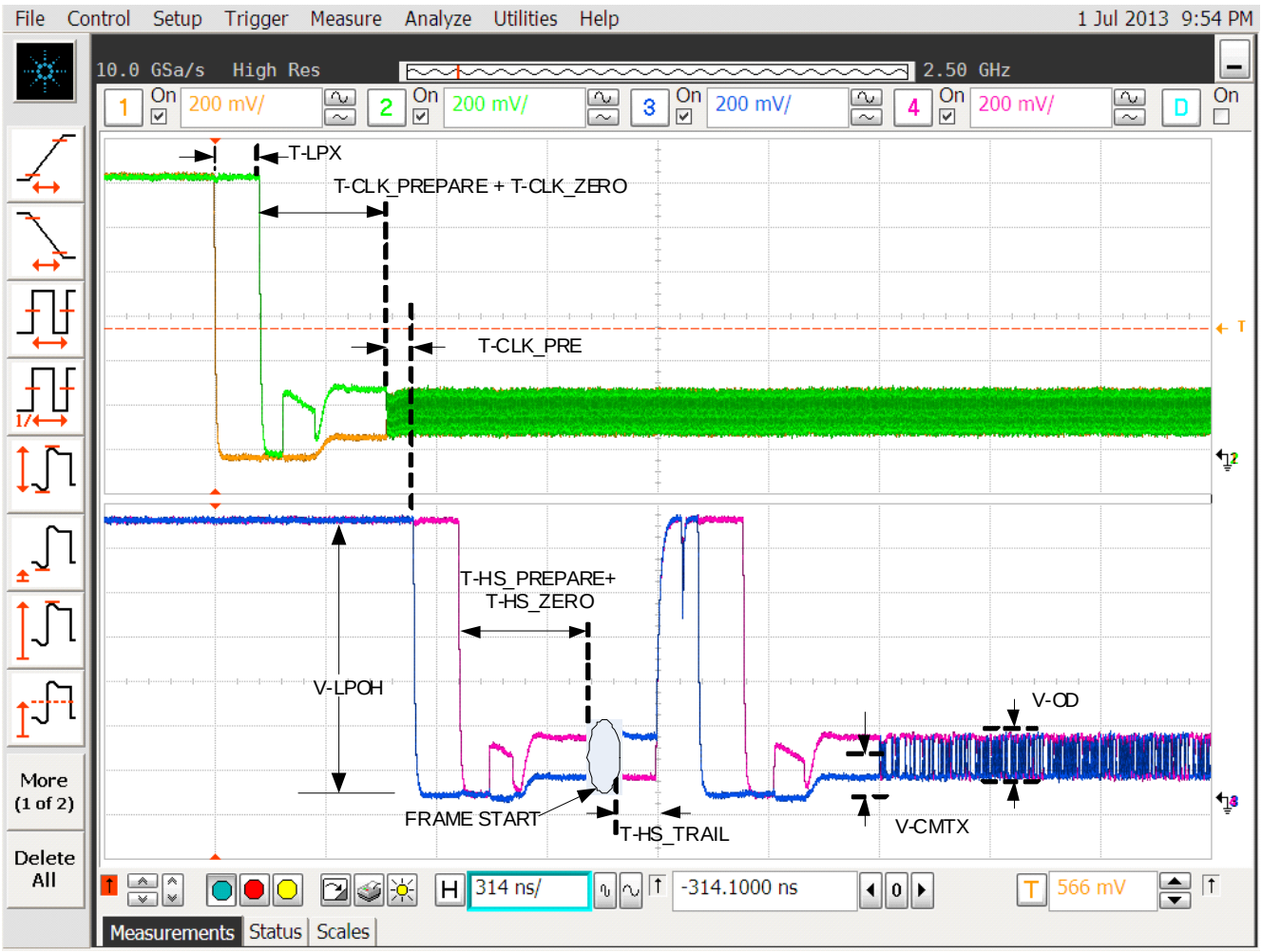


Table 3-4 *MIPI Host Interface*

Parameter	Description	Typical	Units
T-LPX	Transmitted length of any low power state period.	200	ns
T-CLK_PREPARE + T-CLK_ZERO	$T_{CLK-PREPARE}$ + time that the transmitter drives the HS-0 state prior to starting the clock.	400	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.	700	ns
$T_{HS-PREPARE}$ + $T_{HS-ZERO}$	$T_{HS-PREPARE}$ + time that the transmitter drives the HS-0 state prior to transmitting the sync sequence.	430	ns
T-HS_TRAIL	Time that the transmitter drives the flipped differential state after last payload data bit of an HS transmission burst.	100	ns

Table 3-4 *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

Parallel and MIPI Host Interfaces

Table 3-5 *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

Technical Specifications

Table 3-6 *SE4710 Technical Specifications*

Item	Description
Power Requirements - Input Voltage See *Supply Currents VCC = VCC_ILLUM = VDD_IO_HOST = 3.3V @ 23C*	VCC: 3.3V +/- 0.3V VCC_ILLUM: 3.3V +/- 0.3V VDD_IO_HOST: 1.8V +/- 0.1V to VCC
Maximum Sensor Power Supply Noise (VCC 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	5.0 mil (Code 39), 5.0 mil (PDF417)
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 3-10*)
Pitch Angle	± 60º (see *Figure 3-5 on page 3-10*)
Roll	360º (see *Figure 3-5 on page 3-10*)
Ambient Light Immunity (Sunlight)	10000 ft. candles (107,639 lux)
Imaging Sensor Image Resolution Field of View (FOV)	 1280 horizontal X 800 vertical pixels 42.0º horizontal, 28.0º vertical
Focusing Distance from Front of Engine	194mm / 7.64 inches
LED Aiming Element LED Aiming Dot Brightness Level	 610nm 130 fcd nominal
Illumination System LED Pattern Angle	 Hyper Red 660nm 50.3º horizontal, 32.0º vertical 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	Unpowered SE4710 withstands a 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

Table 3-6 *SE4710 Technical Specifications (Continued)*

Item	Description
LED Class	Exempt Risk Group
Temperature Operating Storage	 -20º to 50º C (-4º to 122º F) -30º to 70º C (-22º to 158ºF) See *Thermal Considerations on page 2-2* for more information.
Humidity Operating Storage	 95% RH, non-condensing at 50º C 85% RH, non-condensing at 70º C
Maximum Engine Dimensions	8.1 mm H x 22.3 mm W x 13.7 mm D 0.32 in. H x 0.88 in. W x 0.54 in D
Weight	4.8 grams (0.17 oz)
Electrical Interface	27 pin 0.3 mm pitch ZIF connector See *Chapter 4, Electrical Interface* for more information.
Minimum Bar Code Print Contrast	20%

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

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

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

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

Mode	VCC =3.3V		VCC_ILLUM = 3.3V	VDD_IO_HOST = 3.3V	Total Current	Notes
Low power	RMS	400 uA	0	0	400 uA	Hibernate
	RMS	1 uA	0	0	1 uA	Standby
Idle	PEAK	25	0	0 *	25	Not in low power mode but not triggered
	RMS	20	0	0 *	20	
Image Acquisition	PEAK	150	0	30 *	180	Illumination off, aim on
	RMS	115	0	15 *	130	
Image Acquisition with Illumination	PEAK	150	115	30 *	295	Normal acquisition mode, aim on
	RMS	115	100	15 *	230	

All currents measured in mA unless otherwise noted.
RMS value over one frame.
*** Parallel interface only, MIPI load < 5 mA.**

Sample Current Scope Plots

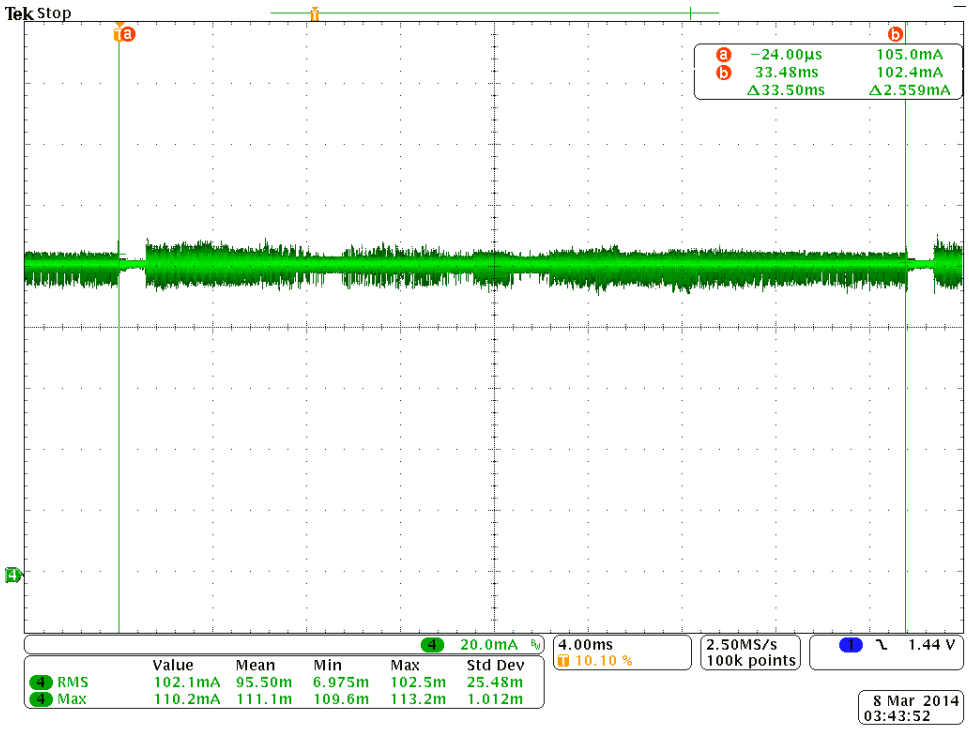


Figure 3-1 *VCC_ILLUM Current*

Figure 3-2 *VCC Current*

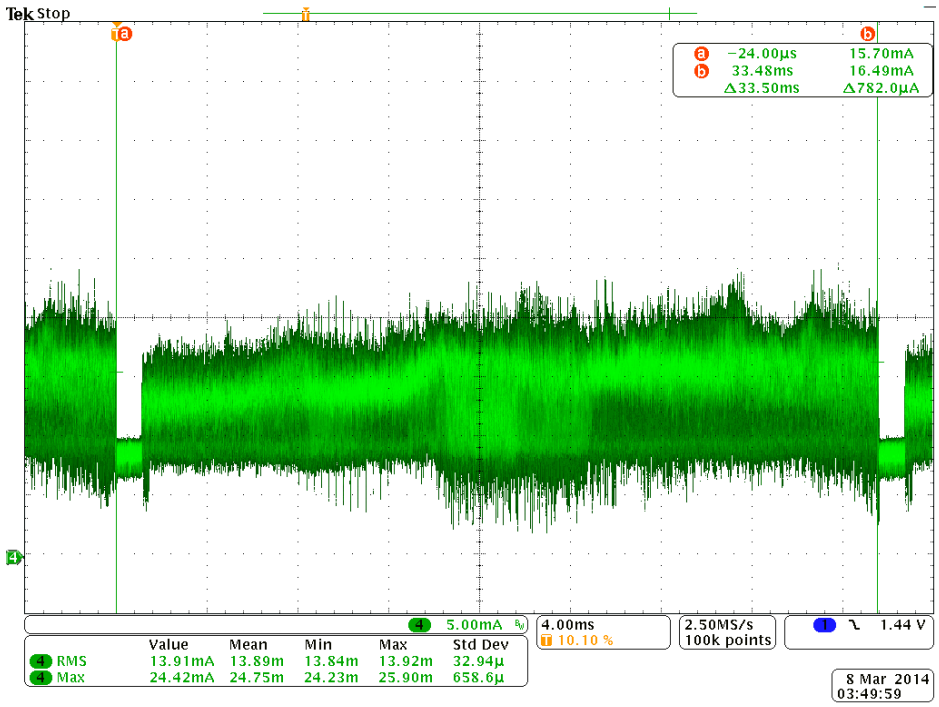


Figure 3-3 *VDD_IO Host Current*

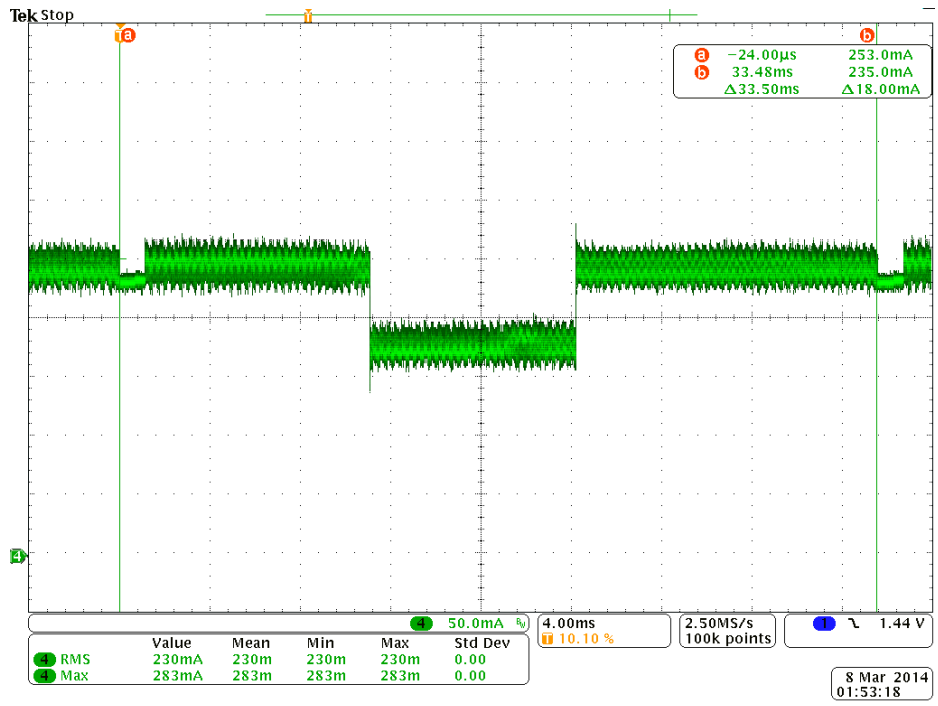


Figure 3-4 *Total Current (VCC_ILLUM + VCC + VDD_IO)*

Skew, Roll, and Pitch

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.

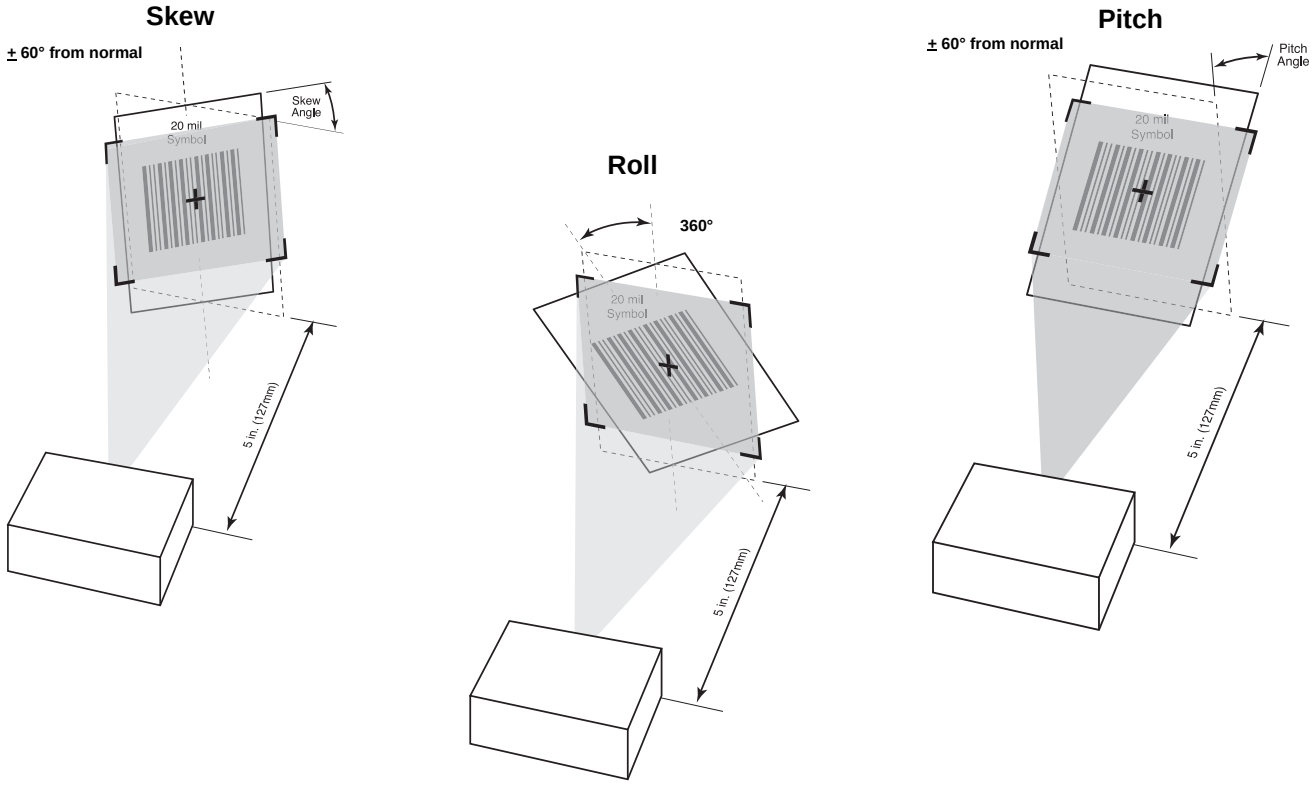


Figure 3-5 *Skew, Roll, Pitch*

Decode Ranges

Table 3-8 *SE4710 Trigger Level Mode Working Decode Ranges*

Bar Code Type	Near Distance	Far Distance
	Typical	Typical
4 mil Code 39	3.3 in / 8.4 cm	8.8 in / 22.4 cm
5 mil Code 128	2.8 in / 7.1 cm	8.2 in / 20.8 cm
5 mil Code 39	2.0 in / 5.08 cm	13.5 in / 34.3 cm
5mil PDF417	3.1 in / 7.9 cm	8.4 in / 21.3 cm
10 mil Data Matrix	2.9 in / 7.4 cm	10.1 in / 25.7 cm
100% UPCA	1.8 in / 4.6 cm*	26.0 in / 66.0 cm
20.0mil Code 39	2.0 in / 5.08 cm*	30.0 in / 76.2 cm

***Limited by width of bar code in field of view.**

Note: Photographic quality bar code at 15° tilt pitch angle under 30 fcd ambient illumination.

Table 3-9 *SE4710 Presentation Mode Working Decode Ranges (Swipe Speed: 30 in/sec)*

Bar Code Type	Near Distance	Far Distance
100% UPCA 80% MRD	2.0 in / 5.08 cm	8.0 in / 20.3 cm

CHAPTER 4 ELECTRICAL INTERFACE

Introduction

Table 4-1 lists the pins and signals of the pin connector on the SE4710. See *Figure 2-4 on page 2-6* for the pin 1 location on the rear of the engine, on the side opposite the aiming/illumination system.

Table 4-1 *SE4710 Host Interface Signal Information*

Pin Number	Signal Name	I/O	Description
1	GND	-	Ground Reference
2	PCLK	Out	Sensor Pixel Clock
3	GND	-	Ground Reference
4	HSYNC	Out	Horizontal Sync
5	VCC_ILLUM	In	Illumination Power
6	VCC_ILLUM	In	Illumination Power
7	VDD_IO_HOST	In	Digital I/O Reference Voltage and Power
8	VCC	In	Aim, Logic and Sensor Power
9	EXT_ILLUM_EN	Out	External Illumination Trigger
10	HOST_D0	Out	Sensor Pixel Data - LSB
11	HOST_D1	Out	Sensor Pixel Data
12	HOST_D2	Out	Sensor Pixel Data
13	HOST_D3	Out	Sensor Pixel Data
14	HOST_D4	Out	Sensor Pixel Data
15	HOST_D5	Out	Sensor Pixel Data
16	HOST_D6	Out	Sensor Pixel Data
17	HOST_D7	Out	Sensor Pixel Data - MSB

Table 4-1 *SE4710 Host Interface Signal Information (Continued)*

Pin Number	Signal Name	I/O	Description
18	HOST_VSYNC	Out	Vertical Sync
19	HOST_SDATA	I/O	I2C Data
20	HOST_SCLK	I/O	I2C Clock
21	MIPI_CN	Out	Mipi Clock-
22	GND	-	Ground Reference
23	MIPI_CP	Out	Mipi Clock+
24	GND	-	Ground Reference
25	MIPI_DP	Out	Mipi Data+
26	GND	-	Ground Reference
27	MIPI_DN	Out	Mipi Data-

IMPORTANT The SE4710 imaging system is electrically sensitive. Proper and complete insertion of flex cables into the connectors on the scan engine, PL3307 decoder, and host is required for proper operation.

Connector Drawings

For detailed connector information, refer to the manufacturer's specifications.

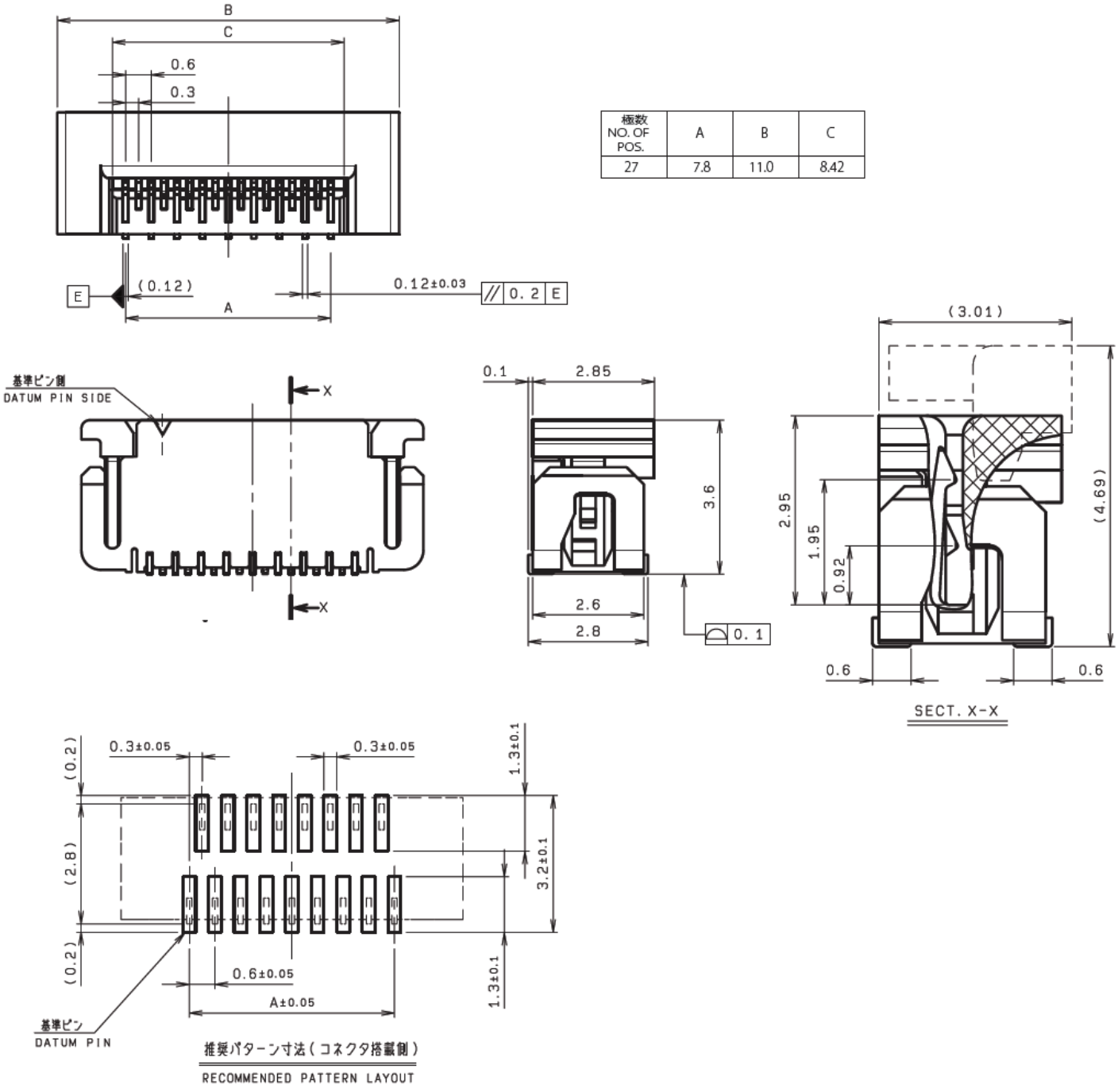


Figure 4-1 *27-Pin ZIF Connector (SE4710 Engine to Flex), Kyocera 6841 Series*

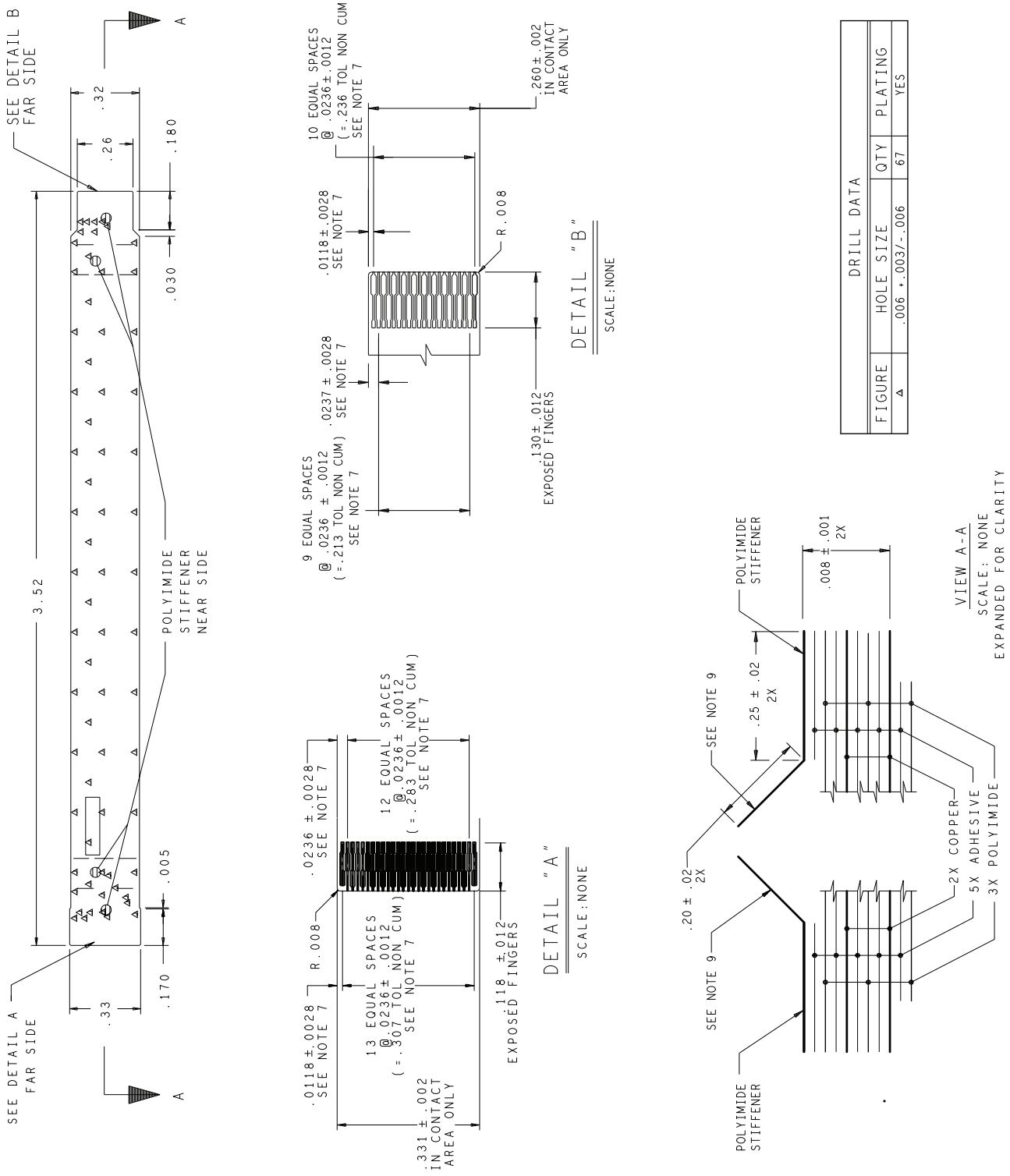


Figure 4-2 *MIPI Host Flex, p/n PF000084A01*

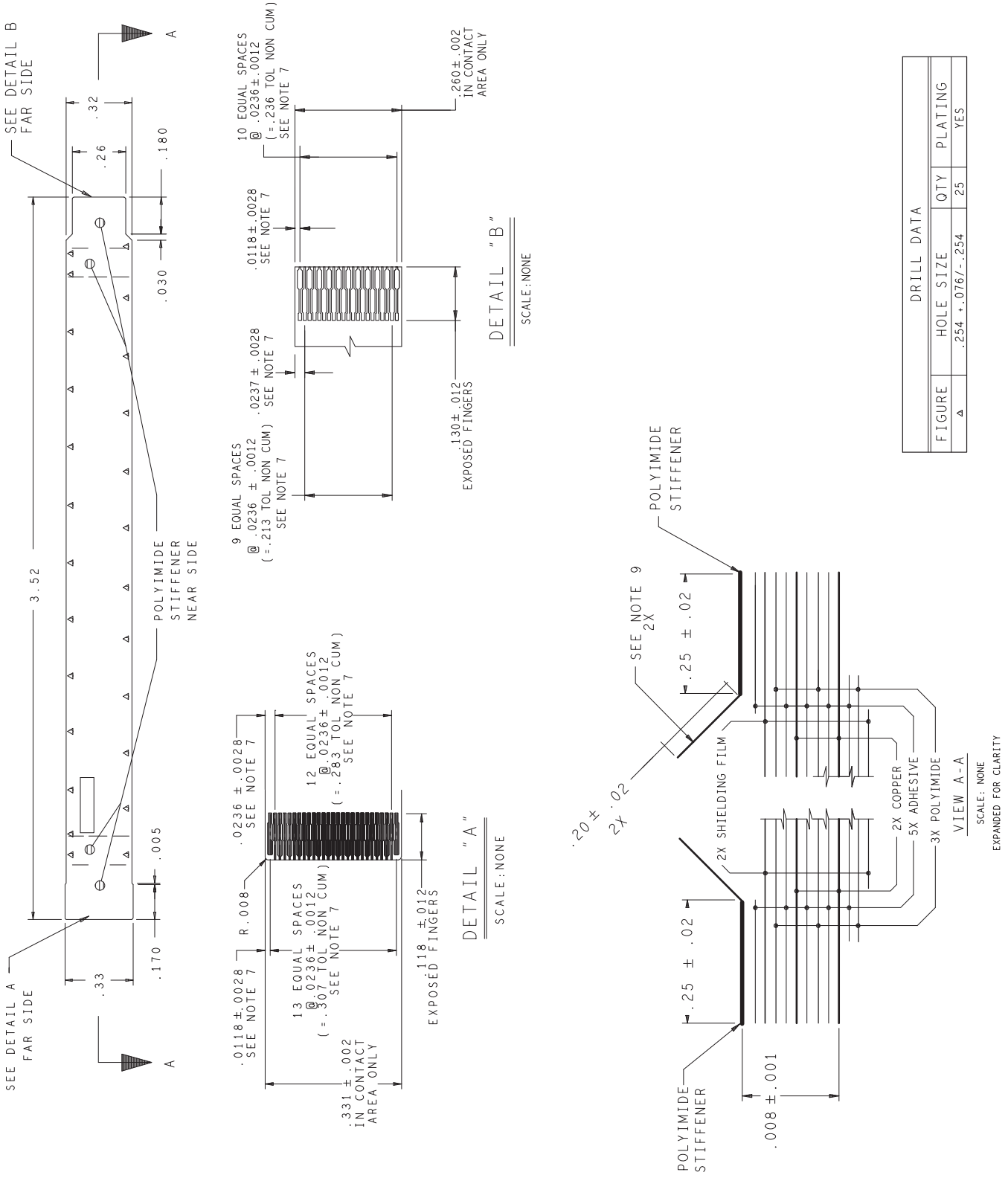


Figure 4-3 *Parallel Host Flex, p/n PF000062A01*

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

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.

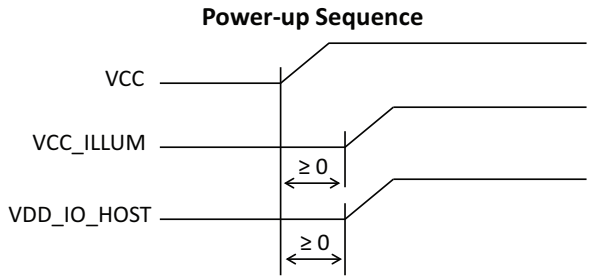


Figure 4-4 *Power-up Sequence*

Power-down

To power-down the engine, it is recommended that the host system send a command to the engine that causes it to enter 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. The VCC_ILLUM and VDD_IO_HOST supplies should be removed 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.

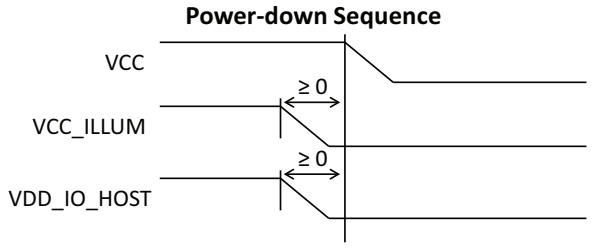


Figure 4-5 *Power-down Sequence*

CHAPTER 5 CONTROL INTERFACE

Introduction

The SE4710 bi-directional control interface uses the industry-standard I^2C protocol. The SE4710 protocol is a host-initiated command/response type protocol, and does not support unsolicited responses.

Command List

The SE4710 protocol supports the commands listed in *Table 5-1*. For detail on each command, see *Command Descriptions on page 5-5*.

Table 5-1 *SE4710 Command List*

I^2C Command Set	Opcode	Description	Page
ACQUISITION	0x58	Starts and stops image data output.	*5-5*
ACQUISITION_MODE	0x5B	Optimizes the SE4710 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*
AIM_POWER	0xF3	Sets the aim brightness.	
AUTO_POWER_REDUCTION	0x74	Places the SE4710 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*
EXEC_INLINE	0x83	Allows more than one engine command to be executed inline without first writing it to the engine.	*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 *SE4710 Command List (Continued)*

I^2C Command Set	Opcode	Description	Page
FRAME_RATE	0x5E	Sets the frame rate.	*5-6*
GET_EXTENDED_STATUS	0x79	Gets the SE4710 operating states.	*5-7*
GET_FSTATS	0x81	When issued, the command returns a response containing information about the last captured frame.	*5-7*
GET_PARAM	0x70	Gets SE4710 parameters.	*5-7*
ILLUMINATION_DURING_EXPOSURE	0x59	Turns illumination on and off.	*5-7*
ILLUMINATION_POWER_LEVEL	0xF0	Sets the illumination brightness level.	*5-8*
IMAGE_CROPPING	0x5D	Crops the output image.	*5-8*
IMAGE_RESOLUTION	0x5C	Sets the resolution of the output image.	*5-8*
IMAGER_INTERFACE_TYPE	0x86	Set the camera interface to MIPI or parallel.	*5-8*
LCD_MODE	0x82	Enables and disables LCD mode.	*5-8*
MIRROR_AND_FLIP	0x85	Mirrors and/or flips the image.	*5-8*
PICKLIST_MODE	0x7B	Enables and disables Picklist mode.	*5-9*
PING	0x7A	Used for test purposes.	*5-9*
POWER_MODE	0x5F	Places the SE4710 in low power mode.	*5-9*
RD_SENSOR	0x51	Reads the OmniVision OV9212 registers.	*5-9*
RESET	0x57	Returns engine components to a default state.	*5-9*
TIME_TO_LOW_POWER	0x75	Sets the length of time the SE4710 is idle before entering low power mode.	*5-9*
WR_SCRIPT	0x76	Programs more than one SE4710 command into one script.	*5-10*
WR_SENSOR	0x50	Writes to the OmniVision OV9212 registers.	*5-10*

Transactions

I^{2}C transactions control the SE4710, where a transaction consists of a command followed by a response. I^{2}C is a master/slave protocol, meaning the host initiates both transmissions.

The SE4710 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^{2}C master) should request a response, and if the SE4710 does not respond the host should retry the response request for up to 100 ms. If the SE4710 does not respond within this time, a hard failure occurred.

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

I^{2}C Command Format

<I2C-Start Bit> <SLA-W> <Cmd-Opcode> <[SE4710-Cmd-Data]> <Checksum> <I2C-Stop-Bit>

where:

- *I2C-Start-Bit* and *I2C-Stop-Bit* are as defined by the I^{2}C 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 *SE4710 Command Op* column in *Table 5-3 on page 5-11*.
- *[SE4710-Cmd-Data]* is from the *SE4710 Command Data* column in *Table 5-3 on page 5-11*. This can be NULL.
- *Checksum* is a 1 byte checksum of the *SE4710 Cmd Data* bytes. See *Command Checksum on page 5-4*.

I^{2}C Response Format

<I2C-Start Bit> <SLA-R> <Rsp-Opcode> <Status> <[SE4710-Rsp-Data]> <I2C-Stop-Bit>

Where:

- *I2C-Start-Bit* and *I2C-Stop-Bit* are as defined by the I^{2}C 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 *SE4710 Response Op* column in *Table 5-3 on page 5-11*.
- *Status* indicates whether the SE4710 successfully processed the command. See *Response Status Code on page 5-4*.
- *[SE4710-Rsp-Data]* is from the *SE4710 Response Data* column in *Table 5-3 on page 5-11*. 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 5-11* for command and response formats for all SE4710 commands.

ACQUISITION 0x58

ACQUISITION Start causes the SE4710 to output image data on the camera interface. ACQUISITION Stop stops the image data output.

NOTE The camera interface must be setup using IMAGER_INTERFACE_TYPE (0x86) prior to the execution of the ACQUISITION start command. (see page *5-8*).

After receiving the Stop command, the SE4710 may not respond to subsequent commands for up to one frame time (33 ms at 30 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_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.

AIM_POWER 0xF3

Sets the aim brightness.

AUTO_POWER_REDUCTION 0x74

Places the SE4710 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 SE4710 from low power mode.

NOTE The engine is designed to always NAK the first I^2C character when the engine is in low power mode. The host must initiate an I^2C retry before the time specified by TIME_TO_LOW_POWER.

The SE4710 is considered idle only if acquisition is stopped and aim is off. While acquisition is started, or aim is on, the SE4710 does not automatically enter low power mode.

DRIVE_STRENGTH 0x99

Use this command to set the appropriate parallel interface drive strength for the integration, and chosen VDD_IO_HOST voltage level.

It is up to the host to determine the correct drive strength level based on signal integrity and electromagnetic compatibility requirements. The default is 3.3V low.

ENTER_BOOTLOADER 0x91

In this mode, the SE4710 protocol changes and no longer supports this I^2C command set. Bootloader mode is necessary for firmware updates.

EXEC_INLINE 0x83

The command allows more than one engine command to be executed inline without first writing it to the engine. This method could be used for scripts that do not need to be executed more than once.

Example:

To execute inline with AIM-ON, ILLUM-ON, and ACQUISITION-ON the command is as follows:

```
<0x83><0x00><Len><C1Len><C1Op><C1Data><C2Len><C2Op><C2Data><C3Len><C3Op><C3Data><CS>
```

or

```
<0x83><0x00><0x09><0x02><0x55><0x01><0x02><0x59><0x01><0x02><0x58><0x01><0x70>
```

NOTE SE4710 buffer size = 150 byte max

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 SE4710 host connector.

FRAME_RATE 0x5E

Sets the frame rate.

GET_EXTENDED_STATUS 0x79

The SE4710 internally tracks various operating states and stores these states in the extended status structure. This command gets these states from the SE4710. 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)

- 0x01: The internal temperature reached thermal warning at which time the aimer is turned off, and the illumination dims.
- 0x02: The internal temperature reached thermal fatal at which time the illumination turns off.
- 0x02, 0x04, 0x20, 0x40: Internal warning.

GET_FSTATS 0x81

When issued, the command returns a response containing information about the last captured frame. This information includes the following: exposure (2 byte), gain (byte), bin (byte) and statistics (byte), where the statistics byte is defined as follows:

- 0x01 = Illumination on
- 0x02 = Aim on
- 0x10 = Picklist frame
- 0x20 = LCD frame

GET_PARAM 0x70

Allows a host to read out parameters stored in the SE4710 (non-volatile memory). See *Table 5-4 on page 5-14* 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 SE4710 illumination power (brightness) level. The valid ranges are from 1 to 27. The default is 7, or 100mA. Each count is in 12.5mA increments. It is not recommended to go below 7 due to the non-linearity of the illumination LED response.

IMAGE_CROPPING 0x5D

Crops the output image.

IMAGE_RESOLUTION 0x5C

Sets the resolution of the output image.

IMAGER_INTERFACE_TYPE 0x86

Use this command to output image data in MIPI or parallel.

NOTE The engine uses a single connector for both MIPI and parallel. The interface must be configured prior to an acquisition start command.

LCD_MODE 0x82

Enables and disables LCD mode. This command has two parameters:

- *Number of No-light Frames* (LCD frames)
- T*otal Number of Frames*

Setting the *Number of No-light Frames* to 0 disables LCD mode. Setting the *Number of No-light Frames* to 1 enables LCD mode. The *Total Number of Frames* field is ignored.

This command works in conjunction with ACQUISITION Start. Configure LCD_MODE before starting acquisition. When acquisition starts, the LCD mode sequence begins. Disable LCD mode (by setting the number of LCD frames to 0) after stopping acquisition. To track cell phone frames issue the GET_FSTATS command after every frame. The statistics byte specifies whether the frame was the LCD frame.

MIRROR_AND_FLIP 0x85

Use this command to mirror and/or flip the output image.

PICKLIST_MODE 0x7B

Enables and disables Picklist mode. 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: 1 = enabled, 0 = disabled
- Number of Frames: ignored

The host system can track Picklist frames by issuing the GET_FSTATS command after every frame. The statistics byte specifies whether the frame is a Picklist frame.

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

Changes the SE4710 power mode. Although this command offers a Full Power mode option, any command returns the SE4710 to full power mode.

NOTE This command is rejected (a NAK is sent) if acquisition is running (ACQUISITION = Start). If low power is required during acquisition, first send ACQUISITION = Stop, then POWER_MODE = Low Power.

RD_SENSOR 0x51

Reads directly from the OmniVision OV9212 sensor registers. Refer to the OV912 specifications from OmniVision for register descriptions.

RESET 0x57

Returns the SE4710 to a default state.

TIME_TO_LOW_POWER 0x75

Sets the length of time the SE4710 must be idle before it enters low power mode. This only applies if AUTO_POWER_REDUCTION is enabled.

WR_SCRIPT 0x76

Programs more than one SE4710 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 OmniVision OV9212 sensor registers. Refer to the OV912 specifications from OmniVision for register descriptions.

CAUTION The SE4710 controls many sensor registers. Using this command to write sensor registers may conflict with SE4710 requirements, causing unpredictable behavior.

Command / Response Formats

Table 5-3 depicts the command and response formats for all SE4710 commands.

In the columns *SE4710 Command Data* and *SE4710 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 *SE4710 Command and Response Formats*

Function	SE4710 Command			SE4710 Response		
	Op	SE4710 Command Data (see Note 1)		Op	SE4710 Response Data (see Note 2)	
WR_SENSOR	0x50	(B) Register	(B) Value	0x50	-	
RD_SENSOR	0x51	(B) 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 = SE4710		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		0x5A	-	
ACQUISITION_MODE	0x5B	(B) 0x00 = Barcode Decode* 0x01 = Document Capture 0x02 = Motion Detect 0x03 = Aim Capture 0x04 = Video 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 5-14* for the length of the field based on the param number.**

Table 5-3 *SE4710 Command and Response Formats (Continued)*

Function	SE4710 Command		SE4710 Response		
	Op	SE4710 Command Data (see Note 1)	Op	SE4710 Response Data (see Note 2)	
FRAME_RATE	0x5E	(B) 0x00 = 60 fps 0x01 = 30 fps*	0x5E	-	
POWER_MODE	0x5F	(B) 0x00 = Full* 0x01 = Low with Sensor On 0x02 = Standby 0x03 = Low with Sensor Off	0x5F	-	
GET_PARAM (see Note 3 and *Table 5-4*)	0x70	(W) Param#	0x70	(W) Param#	(A) Param Data (Note 3)
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	See *GET_EXTENDED_STATUS 0x79 on page 5-7*.	
PING	0x7A	-	0x7A	-	
PICKLIST_MODE	0x7B	(B) 0x00 = Disable* 0x01 = Enable	0x7B	-	
GET_FSTATS	0x81	-	0x81	See *GET_FSTATS 0x81 on page 5-7*.	
LCD_MODE	0x82	(B) 0x00 = Disable* 0x01 = Enable	0x82	-	

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 5-14* for the length of the field based on the param number.**

Table 5-3 *SE4710 Command and Response Formats (Continued)*

Function	SE4710 Command		SE4710 Response		
	Op	SE4710 Command Data (see Note 1)	Op	SE4710 Response Data (see Note 2)	
MIRROR_AND_FLIP	0x85	(B) 0x00 = Default Orientation* 0x01 = Mirror Only 0x02 = Flip Only 0x03 = Mirror and Flip	0x85	-	
IMAGER_INTERFACE_TYPE	0x86	(B) 0x00 = No configuration* 0x03 = MIPI 0x04 = Parallel	0x86	-	
ENTER_BOOTLOADER	0x91	(A) Signature (3 bytes: 0xAA, 0x50, 0x5F)	0x91	-	
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) 0x01 = Low 0x1B = High 0x07 = Default	0xF0	-	
AIM _POWER	0xF3	(B) 0x00 = Low 0x01 = Med 0x02 = High*	0xF3	-	

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 5-14* for the length of the field based on the param number.**

Table 5-4 *SE4710 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.

Image Acquisition

The SE4710 contains a 1280 H x 800 V CMOS sensor. *Figure 6-1* illustrates pixel output format, and *Figure 6-2* and *Figure 6-3* 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*.

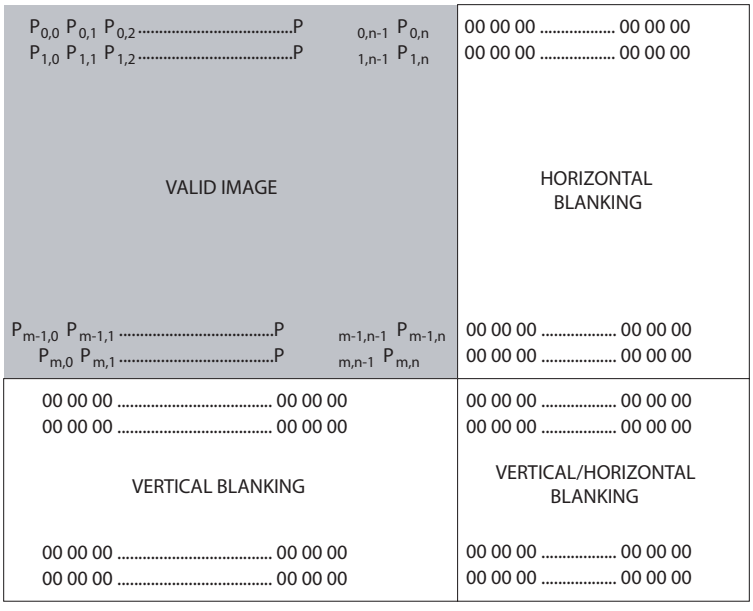


Figure 6-1 *Image Readout*

Output Data Timing

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

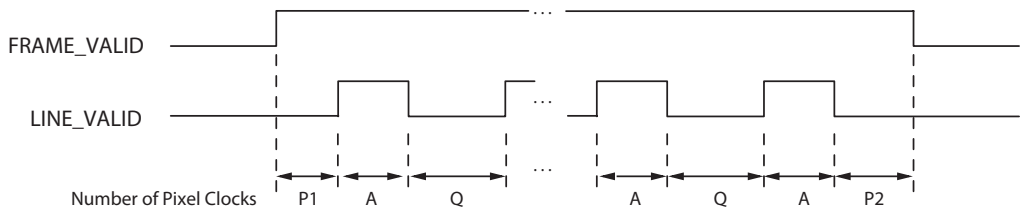


Figure 6-2 *Row Timing and FRAME_VALID / LINE_VALID Signals*

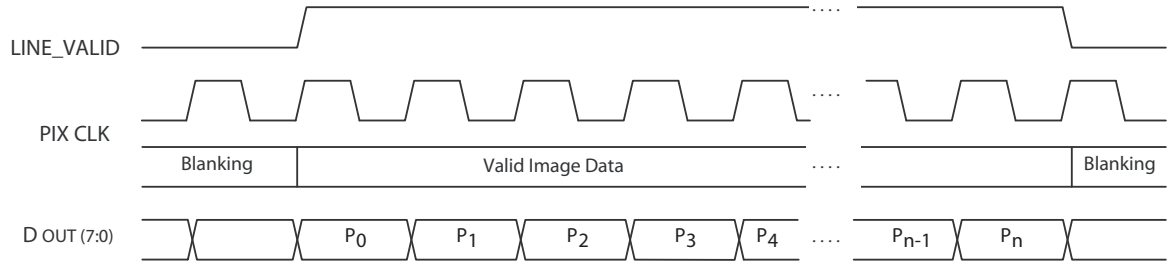


Figure 6-3 *Pixel Data Timing Example*

Table 6-1 *Frame Time @ 42 MHz*

Parameter	Description	Pixel Clock	Time	Units
A	Active data time	1280	30.48	µs
	With stats enabled	1360	32.38	µs
P1	Frame start blanking	18	0.43	µs
P2	Frame end blanking	14	0.33	µs
Q	Horizontal blanking	408	9.71	µs
	With stats enabled	328	7.81	µs
A + Q	Row time	1688	40.19	µs
V	Vertical blanking	47,638	1.13	ms
	With stats enabled	47,558	1.13	ms
Nrows	Frame	1,350,024	32.14	ms
	With stats enabled	1,350,104	32.15	ms
F	Total	1,397,662	33.28	ms

Recommended Procedures

The following trigger mode procedures describe the recommended transaction sequence between a host and the SE4710. These transaction sequences use discrete commands for clarity. Replace any set of discrete commands with a multi-command EXECUTE_SCRIPT to improve throughput.

System Initialization

The host sends the IMAGER_INTERFACE_TYPE command to configure the desired interface. This is done once per power cycle.

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 Acquisition Mode command with Barcode Decode.
- The SE4710 optimizes the image output for bar code decoding.
- The SE4710 enters standby mode (or low power mode if enabled).

Upon a trigger pull:

- The host sends the Illumination On command.
- The SE4710 exits standby mode (or low power mode if enabled).
- The host sends the Aim On command.
- The host sends the Acquisition Start command.
- The SE4710 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 SE4710 stops outputting images.
- The host sends the Aim Off command.
- The host sends the Illumination Off command.
- The SE4710 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 Acquisition Mode command with Barcode Decode.
- The SE4710 optimizes the image output for bar code decoding.
- The host sends the Picklist Mode command**.**
- The SE4710 enters standby mode (or low power mode if enabled).

Upon a trigger pull:

- The host sends the Illumination On command.
- The SE4710 exits standby mode (or low power mode if enabled).
- The host sends the Aim On command.
- The host sends the Acquisition Start command.
- The SE4710 begins outputting images. Use the GET_FSTATS (*page 5-7*) to determine which frame is a picklist frame.
- The host attempts to decode the images.

Upon a good decode or trigger release:

- The host sends the Acquisition Stop command.
- The SE4710 stops outputting images.
- The host sends the Aim Off command.
- The host sends the Illumination Off command.
- The SE4710 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 Mode command with Motion Detect.
- The SE4710 optimizes the image output for motion detection.
- The host sends the Acquisition Start command (and never sends the Stop command).
- The SE4710 continuously outputs images.
- In this mode, the SE4710 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 Acquisition Mode command with Barcode Decode.
- The SE4710 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 Acquisition Mode command with Motion Detect.
- The SE4710 optimizes the image output for motion detection.

During this mode:

- The SE4710 does not automatically enter standby or low power mode.
- The host uses the Power Mode command to put the SE4710 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 Acquisition Mode command with Motion Detect.
- The SE4710 optimizes the image output for motion detection.
- The host sends the Acquisition Start command (and never sends the Stop command).
- The host sends the Aim Off command.
- The SE4710 continuously outputs images

Upon the host detecting motion:

- The SE4710 optimizes the image output for bar code decoding.
- The host sends the Acquisition Mode command with Barcode Decode.
- The host sends the Aim On command.

Upon a trigger pull:

- The host sends the Illumination On command.
- 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 Acquisition Mode command with Motion Detect.
- The SE4710 optimizes the image output for motion detection.

During this mode:

- The SE4710 does not automatically enter low power mode.
- The host uses the Power Mode command to put the SE4710 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 Acquisition Mode command with Motion Detect.
- The SE4710 optimizes the image output for motion detection.
- The host sends the Picklist Mode command.
- The host sends the Acquisition Start command (and never sends the Stop command).
- The host sends the Aim Off command.
- The SE4710 continuously outputs images. Use the GET_FSTATS (*page 5-7*) to determine which frame is a picklist frame.

Upon the host detecting motion:

- The host sends the Acquisition Mode command with Barcode Decode.
- The SE4710 optimizes the image output for bar code decoding.
- The host sends the Aim On command.

Upon a trigger pull:

- The host sends the Illumination On command.
- 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 Acquisition Mode command with Motion Detect.
- The SE4710 optimizes the image output for motion detection.

During this mode:

- The SE4710 does not automatically enter low power mode.
- The host uses the Power Mode command to put the SE4710 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 Acquisition Mode command with Document Capture.
- The SE4710 optimizes the image output for image capture.
- The SE4710 (typically) enters low power mode.

Upon a trigger pull:

- The host sends the Illumination On command.
- The SE4710, 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 SE4710 captures an image.

Upon completion of an image capture:

- The SE4710 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 Acquisition Mode Barcode Decode.
- The SE4710 (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 Acquisition Mode command with Video Capture.
- The SE4710 optimizes the image output for video.
- The SE4710 (typically) enters low power mode.

Upon a trigger pull:

- The host sends the Illumination On command.
- The SE4710, 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 SE4710 begins outputting video stream.

Upon a trigger release:

- The host sends the Acquisition Stop command.
- The SE4710 stops outputting the video stream.
- The host sends the Aim Off command.
- The host sends the Illumination Off command.
- The SE4710 (when all conditions are met) enters Reduced Power mode.

Recommendations

Power Mode

The SE4710 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 *OmniVision OV9212 (mono) 1/4" CMOS WXGA Megapixel HD Sensor Datasheet*, available at: http://www.ovt.com/. (Refer to the OV9712 Datasheet, the color version of the OV9212.)

INDEX

F

H

I

L

M

N

O

P

R

S

T

V

W

Z

Tell Us What You Think...

We'd like to know what you think about this Manual. Please take a moment to fill out this questionnaire and fax this form to: (631) 627-7184, or mail to:

Motorola Solutions, Inc.
One Motorola Plaza M/S B-10
Holtsville, NY 11742-1300
Attention: Technical Publications Manager
Data Capture Solutions

IMPORTANT: If you need product support, please call the appropriate customer support number provided. Unfortunately, we cannot provide customer support at the fax number above.

Manual Title:_____
(please include revision level)

How familiar were you with this product before using this manual?

☐ Very familiar ☐ Slightly familiar ☐ Not at all familiar

Did this manual meet your needs? If not, please explain.

_____
_____
_____
_____

What topics need to be added to the index, if applicable?

_____
_____
_____
_____

What topics do you feel need to be better discussed? Please be specific.

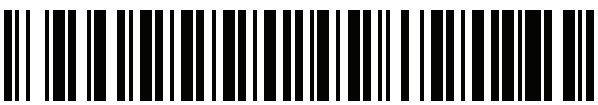
_____
_____
_____
_____

What can we do to further improve our manuals?

_____
_____
_____
_____

Thank you for your input—We value your comments.

Motorola Solutions, Inc.
One Motorola Plaza
Holtsville, New York 11742, USA
1-800-927-9626
http://www.motorolasolutions.com



MN000130A01 Revision A - March 2014