Consumer LiDAR Explorer Edition Interface Control Document (ICD)

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IMPORTANT NOTICE

1. All design and engineering decisions with regard to the integration of Consumer LiDAR Explorer Edition module or simply ‘Engine’, inside the customer’s products are the responsibility of the customer. This includes all decisions related to the application of the Engine, including any beam redirection and/or manipulation external to the Engine.

2. Use of external optics or controls, adjustments of performance other than those specified in the ICD, the Quick Start Guide or the User Guide may result in hazardous laser radiation exposure and may affect the laser classification of customer’s products.

3. This Interface Control Document is proprietary information of MicroVision.

Contents

Laser safety notice

This Consumer LiDAR Explorer Edition module is a Class 1 Laser Product as defined in IEC60825-1:2014 (Edition 3). This device also complies with the US FDA 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50 dated June 24, 2007. This Engine is intended to be embedded inside a host system, therefore the system integrator must ensure that the end product meets all applicable laser safety requirements.

1. Introduction

This Interface Control Document (ICD) details the mechanical, optical and electrical interfaces of MicroVision's Consumer Lidar Explorer Edition. This Engine is intended to be used by customers wishing to embed a small LiDAR sensor inside their product. MicroVision also provides a Starter Kit that is intended for standalone evaluation of the Engine. The Starter Kit is described in a separate document. The information contained in this document is subject to change and provided for guidance purposes only.

The Engine consists of an Integrated Photonics Module (IPM) and two PCBs which form the electronics. **The electronics and IPM are a matched pair and may not be swapped between different Engines or will require factory recalibration if swapped.** To provide maximum flexibility to the user, the scan frame timing signals are exposed. The specifications herein represent MicroVision's reference design.

2. References

MicroVision documents

These may be useful for reference in connection with this ICD.

- Consumer LiDAR Explorer Edition Product Brief (DA0140020)
- Explorer Edition Starter Kit (MV-2400li3)

Industry standards

- IEC 60825-1:2014 Safety of Laser Products – Part 1: Equipment Classification, Requirements and User's Guide
- CDRH Laser Notice No. 50 Laser Products-Conformance with IEC 60825-1

3. Mechanical Interface

3.1 Mechanical Dimensions

The Engine dimensions in millimeters are shown in Figure 1. A dimensional value with two significant figures has a positional tolerance of ± 0.13mm; three significant figures has a positional tolerance of ± 0.05 mm.

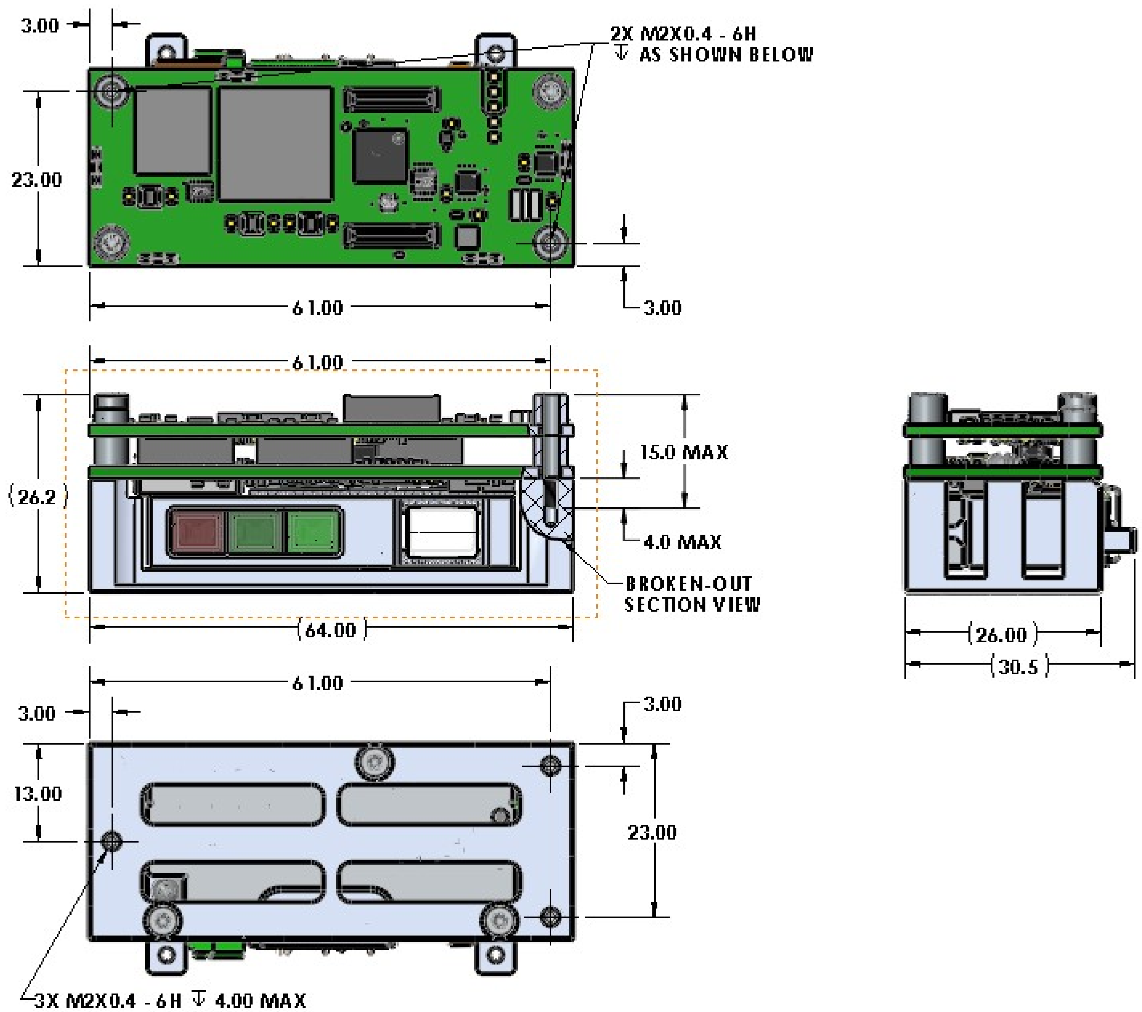

Figure 1. Explorer Edition mounting frame dimensions

Three threaded holes are provided on the bottom of the Engine frame to mount it to a host system using M2 fasteners. Figure 1 shows the position of these three mounting points. Two additional M2 standoffs are provided on the digital board to secure a user developed PCB. These M2 standoffs are used to mount MicroVision's MIPI CSI to USB 3.x converter board which is shipped in the available Starter Kit.

The IPM is rigidly mounted to an aluminum frame **and must not be detached from this frame**. This frame provides mounting features for the PCBs and also serves as a thermal interface. Heat developed by the IPM must be managed in the industrial design of the customer product for proper LiDAR operation. (see Thermal Interface section)

3.2 Scan Field

Figure 2 shows the exit position of the chief ray and the angular extents of the scan field of the Engine.

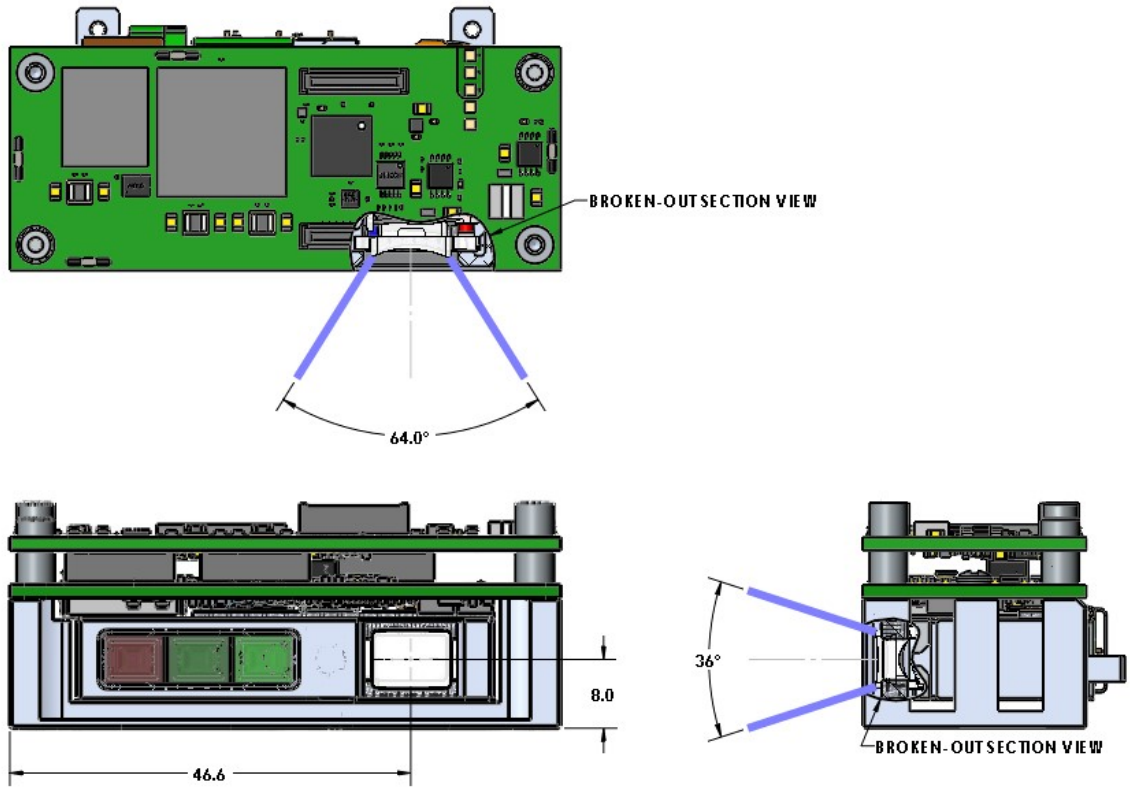

Figure 2 – Explorer Edition Scan Field

Pointing Angle	0.0° ± 1.5°
Horizontal Field of View	Max 64°
Vertical Field of View	Max 36°

Table 2. Explorer Edition field of view dimensions.

3.3 Environmental Shock

The Engine should be mounted such that any accelerations applied to it are limited to ±1500g along all three axes.

4. Electrical Interface

The Explorer Edition provides electrical connectivity through a single connector, J6 shown in Figure 1. This connector provides power and ground, MIPI CSI-2 (camera serial interface) and CCI (camera control interface) signals, a UART channel and a thermal control signal.

4.1 Electrical Signals

At J6 is a Hirose DF40HC(4.0)-50DS-0.4V(51) 50-position, 0.4 mm contact pitch, dual row board to board connector. The mating connector for user developed hardware is Hirose DF40C-50DP-0.4V. The relevant signals at J6 are described in the table below.

Signal	Type	Signal level	Pin No.	Description
				Power Interface
GND	Pwr	GND	5 ,6, 7,8, 13, 14, 19, 20, 24, 25, 33, 34, 35, 36	System Common
VCC	Pwr	4.5-5.5V	1, 2, 3, 4, 37, 38, 39, 40	4.5V to 5.5A @ 2A max.
				Power Enable Interface
MPEN	I	0V/1.8V	29 & 32	Module Power Enable [Note 1]. On low side, driver must maintain < 0.2V while sinking 1mA. 1.8V = module on. This should be driven with standard reset monitor functionality, such that MPEN is driven to a logic low if VCC drops below 4.5V.
				Communication Interface
CSI2 D0	I	LP Mode 0V/1.2V HP Mode 200mV pk-pk 200mv CM	9, 11	CSI2 D0 pair
CSI2 D1	I		15, 17	CSI2 D1 pair
CSI2 CLK	O		10, 12	CSI2 clock pair operating at 200MHz
CCI I2C	I/O	0V/1.8V	21,23	CCI I2C data (SDA) and clock (SDC). Requires pull-up resistors (4.7k to 10k) on these lines on the host side.
UART_TX	O	0V/1.8V	16	UART Transmit data. Baud rate = 115200, 8-N-1. (8 bit data, no parity, 1 stop bit). Typical input capacitance of 22 pF. Driver capable of sourcing/sinking 2 mA current.
UART_RX	I/O	0V/1.8V	18	UART Receive data. 115200, 8-N-1. Typical input capacitive load 22 pF. V_{ILO} < 0.8V, V_{IHI} > 2.0V.
				Thermal Control
THRM	O	0V/1.8V	22	Logic 0 (0V) when IPM temperature < 41.5°C Logic 1 (1.8V) when IPM temperature > 42.5°C
				Sync
VSYNC	O	0V/1.8V	30	Vertical sync. Rising edge signals the start of new frame.

Table 2 – J6 pin numbering and description

Notes:
[1] The Engine will draw < 1 μA (maximum 10 μA) of current unless MPEN is asserted. All other input signals must remain at 0 V when MPEN is de-asserted.

Table 2 shows the pin number convention for the 50 pin Hirose DF40C-50DP-0.4V connector. Table 3 shows the pin assignments on that connector. Legend: NC = not connected. DNC = do not connect.

Pin	Description	Pin	Description
1	5V	2	5V
3	5V	4	5V
5	GND	6	GND
7	GND	8	GND
9	CSI2 D0 -	10	CSI2 CLK +
11	CSI2 D0 +	12	CSI2 CLK -
13	GND	14	GND
15	CSI2 D1 -	16	SENSOR UART TX
17	CSI2 D1 +	18	SENSOR UART RX
19	GND	20	GND
21	CCI I2C SDA	22	THERMAL CNTRL
23	CCI I2C SDC	24	GND
25	GND	26	DNC
27	DNC	28	DNC
29	MODULE PWR EN	30	SENSOR VSYNC
31	DNC	32	MODULE PWR EN
33	GND	34	GND
35	GND	36	GND
37	5V	38	5V
39	5V	40	5V
41	NC	42	NC
43	NC	44	NC
45	DNC	46	NC
47	NC	48	NC
49	NC	50	NC

Table 3. J6 Pin numbers and description

4.2 VSYNC

The Engine provides a VSYNC (vertical sync) signal that is pulsed once per scan frame. VSYNC is a buffered 1.8V output and is capable of sourcing or sinking 12mA. VSYNC is pulsed high 1 (1.8V).

4.3 Module Power Enable

The Engine will typically draw less than 1 μA (maximum 10 μA) of current unless MPEN is asserted (logic 1). The host must ensure that the power rail voltage supplied to the Engine exceeds 4.5 V before MPEN is asserted. Additionally, the host must ensure that MPEN is driven to a logic 0 if VCC drops below 4.5V.

A blinking green LED on the digital board indicates the system is operational.

4.4 Electromagnetic Compatibility

The Engine is designed to be compliant with FCC electromagnetic capabilities defined by Part 15, Subpart J, Class B as well as EN55022:1998 Class B and EN55024:1998 when appropriately housed inside a host device.

During handling and integration of the Engine in a customer product, take appropriate ESD precautions to prevent ESD damage.

The Engine includes an internal permanent magnet associated with MEMS mirror control. The maximum magnetic field external to the Engine is 3000 gauss. The maximum field is located near the optical exit aperture. This field falls to ~100 gauss 1 mm further away. External magnetic fields greater than approximately 500 gauss can cause scan distortion. Above approximately 2000 gauss the MEMs can be damaged.

4.5 Control & Service Interface

The Explorer Edition module interface provides a path for the host device to:

1. Issue control commands to the Engine
2. Upgrade software

Example application software is provided by MicroVision to enable a host device to exercise this interface. A data viewer, an SDK with sample applications, source code and descriptions are available.

The physical interface includes MIPI CSI, CCI / I2C and UART.

The Engine will initiate shutdown under fault conditions that include:

- Laser over-power fault
- MEMS under-angle safety fault
- Internal over-temperature fault

5. Thermal Interface

There are two thermal paths that can be used to manage the IPM temperature. The first path is through the bottom of the IPM frame. The second is by airflow across the back side of the IPM wall. The amount of heat to be managed through the bottom of the IPM case is approximately 0.5W.

Pin 22 on J6, THERMAL CONTROL, issues a control signal for use by a host system. When the IPM wall temperature is below 41.5°C this signal is at a logic low (0VDC). When the IPM wall temperature is above 42.5°C this signal is at a logic high (1.8VDC). The Δ1°C of hysteresis restricts rapid toggling of the thermal control system near the trip temperature. The host system ensures an optimal IPM wall temperature of 42°C to maintain the specified range and accuracy.