# EBMM3
# Magnetic Mirror Controller


Revision 1.2

January, 2025

# Introduction

This manual describes the electronics hardware used to control the sercalo magnetic actuated mirror for optical beam steering and scanning. The controller communicates through UART and can follow signal in analog format.

# 1 Description

The EBMM3 is sold as a complete development kit which includes two electronics:

1) Driver board with a DSP unit and output connection for the MM mirrors .and an interface board
2) Interface board with USB interface, Analog IN/OUT, I/O extensions connector and Power management.

Both electronics are packaged in an enclosure.

On demand, the driver board could be sold separately to integrate the controller inside a small package.

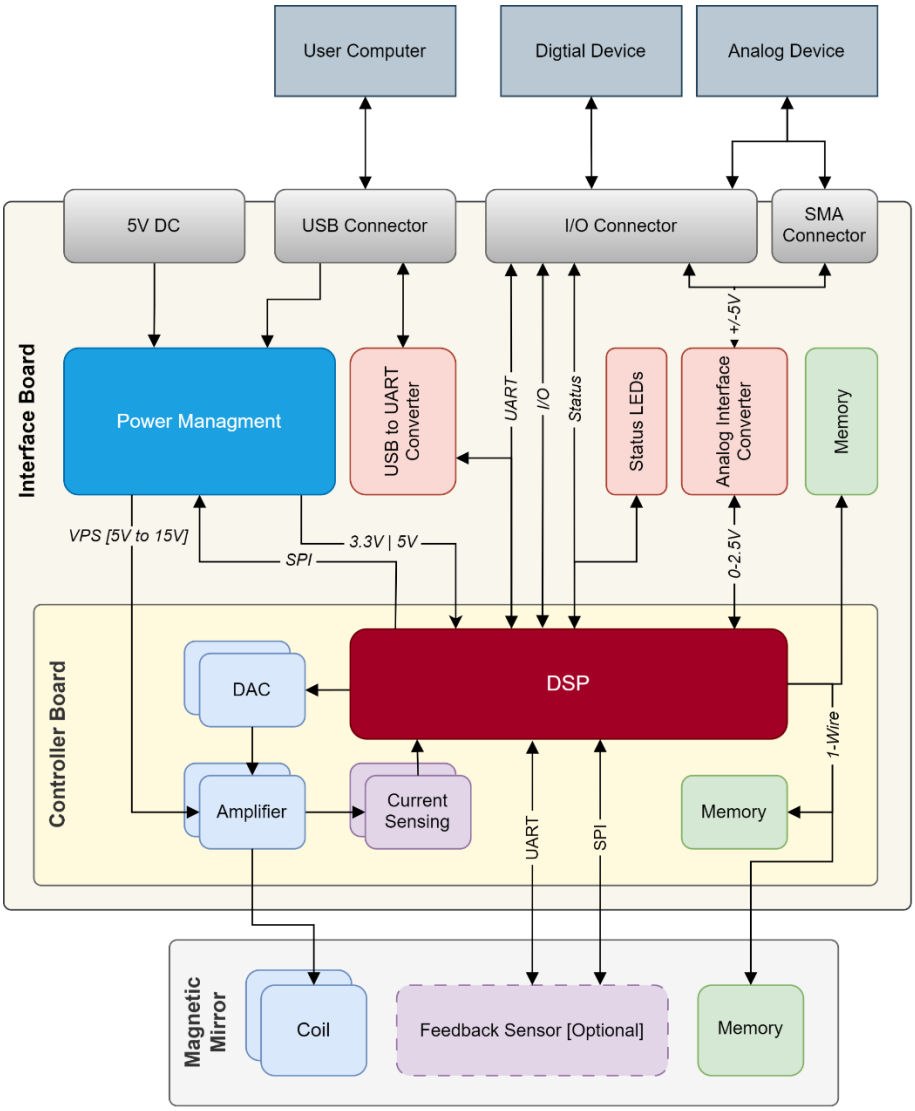



**Figure 1-1: EBMM3 functional diagram**

# 2 Specifications

## *2.1 Mechanical dimensions*

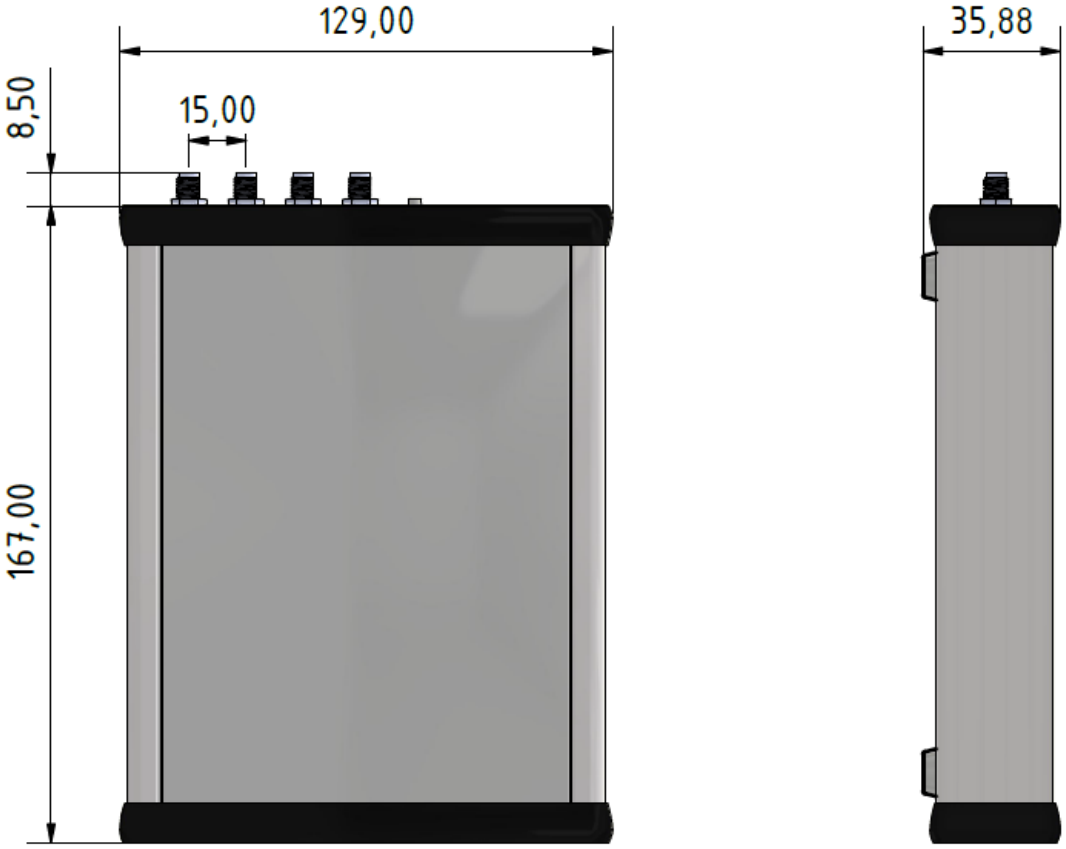



**Figure 2-1: Dimension for EBMM3 Box**

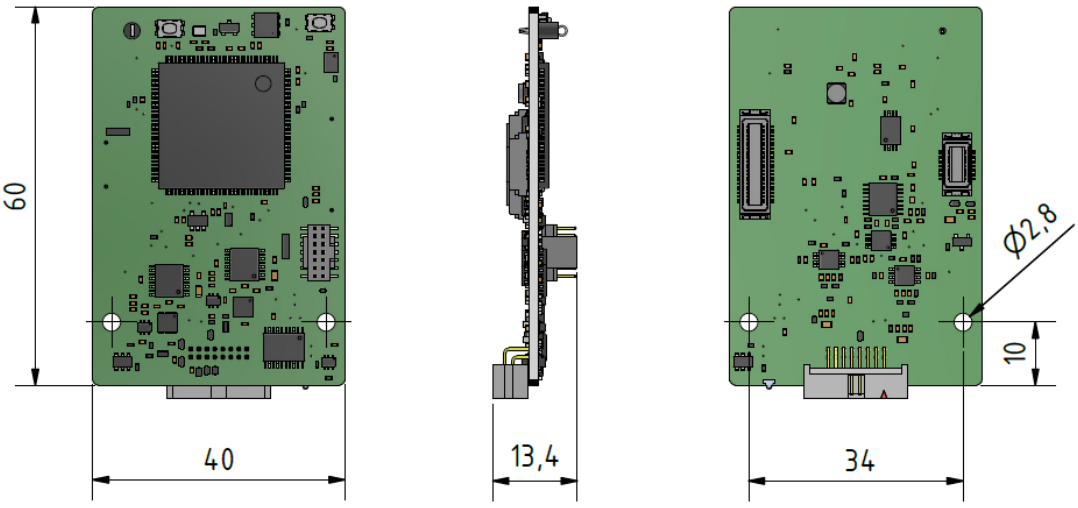



**Figure 2-2: Dimensions for EBMM3 Driver Board**

## 2.2 Front Panel

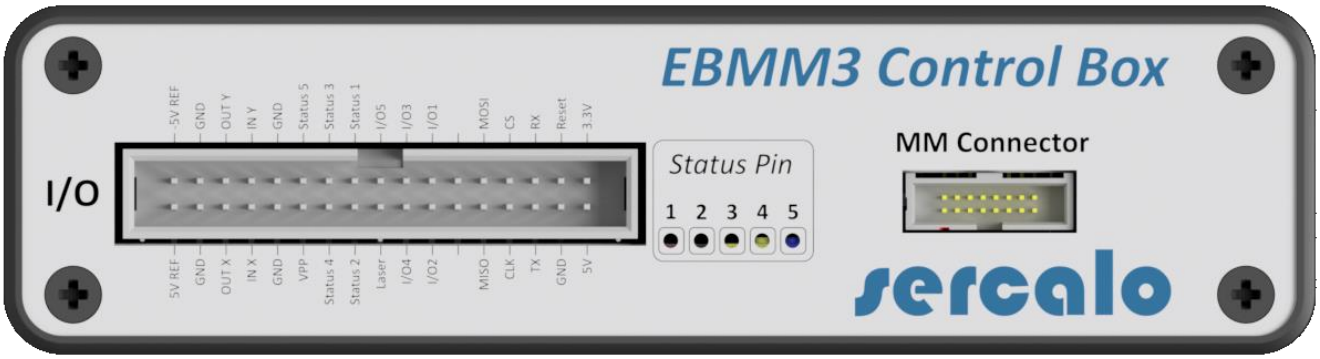



**Figure 2-3: EMM3 Front Panel**

### 2.2.1 MM Connector

The MM connector provides output for the connected mirror coils and connection to the sensor or mirror internal memory. During startup, the EBMM3 driver is switching between 5V or DATA line on pin 6 in function of connected device. When using a device with sensor the pins 7 to 16 are used to communicate with the on-board sensor. For devices without sensor, only pin 1 to 6 are used.

| Pin | Name | Description |
|---|---|---|
| 1 | X+ | X axis coil positive terminal |
| 2 | X- | X axis coil negative terminal |
| 3 | Y+ | Y axis coil positive terminal |
| 4 | Y- | Y axis coil negative terminal |
| 5 | GND | Ground for Sensor or EEPROM memory |
| 6 | 5V / DATA | 5V for Sensor OR 1-Wire Data output for EEPROM memory (Automatically switching in function of connected mirror). |
| 7 | UART TX | EBMM to Sensor UART Transmitter pin |
| 8 | UART RX | Sensor UART to EBMM Receiver pin |
| 9 | CS+ | Sensor SPI Chip Select Positive Line |
| 10 | CS- | Sensor SPI Chip Select Negative Line |
| 11 | SCLK+ | Sensor SPI Serial Clock Positive Line |
| 12 | SCLK- | Sensor SPI Serial Clock Negative Line |
| 13 | MOSI+ | EBMM OUT / Sensor IN SPI Positive Line |
| 14 | MOSI- | EBMM OUT / Sensor IN SPI Negative Line |
| 15 | MISO+ | EBMM IN / Sensor OUT SPI Positive Line |
| 16 | MISO- | EBMM IN / Sensor OUT SPI Negative Line |

**Table 2-1: MM Connector pin assignment**

### 2.2.2 I/O Connector

The pins of this connector are used as input or output to work with user electronics. Mainly the connector provides:

- UART communication to the microcontroller (same protocol than USB)
- SPI communication to send controller set point and return feedback position.
- 5 User programmable I/O pins
- 5 Status Pins
- Analog input for controller set point.
- Analog output for feedback position
- Various voltage references

| Pin | Name | Description | Pin | Name | Description |
|---|---|---|---|---|---|
| 1 | 3.3V | Regulated 3.3V | 2 | 5V | Regulated 5V |
| 3 | Reset | Reset pin | 4 | GND | Ground |
| 5 | RX | Main UART Receiver pin | 6 | TX | Main UART Transceiver pin |
| 7 | CS | SPI Chip Select | 8 | CLK | SPI Serial Clock |
| 9 | MOSI | SPI Master Out Slave IN | 10 | MISO | SPI Master In Slave Out |
| 11 | - | Reserved | 12 | - | Reserved |
| 13 | I/O1 | User programmable I/O pin 1 | 14 | I/O2 | User programmable I/O pin 2 |
| 15 | I/O3 | User programmable I/O pin 3 | 16 | I/O4 | User programmable I/O pin 4 |
| 17 | I/O5 | User programmable I/O pin 5 | 18 | Laser | Sync output for Laser |
| 19 | Status 1 | Status pin 1 | 20 | Status 2 | Status pin 2 |
| 21 | Status 3 | Status pin 3 | 22 | Status 4 | Status pin 4 |
| 23 | Status 5 | Status pin 5 | 24 | VPP | Variable Power Supply Voltage |
| 25 | GND | Ground | 26 | GND | Ground |
| 27 | IN Y | Analog Input for Y axis | 28 | IN X | Analog Input for X axis |
| 29 | OUT Y | Analog Output for Y axis | 30 | OUT X | Analog Output for Y axis |
| 31 | GND | Ground | 32 | GND | Ground |
| 33 | -5V REF | Analog Reference for -5V | 34 | +5V REF | Analog Reference for +5V |

**Table 2-2: MM Connector pin assignment**

### 2.2.3 Status LED

Provide visual information on the status of the firmware. The Status LED are directly linked to the status signals on I/O connector.

## 2.3 Back Panel

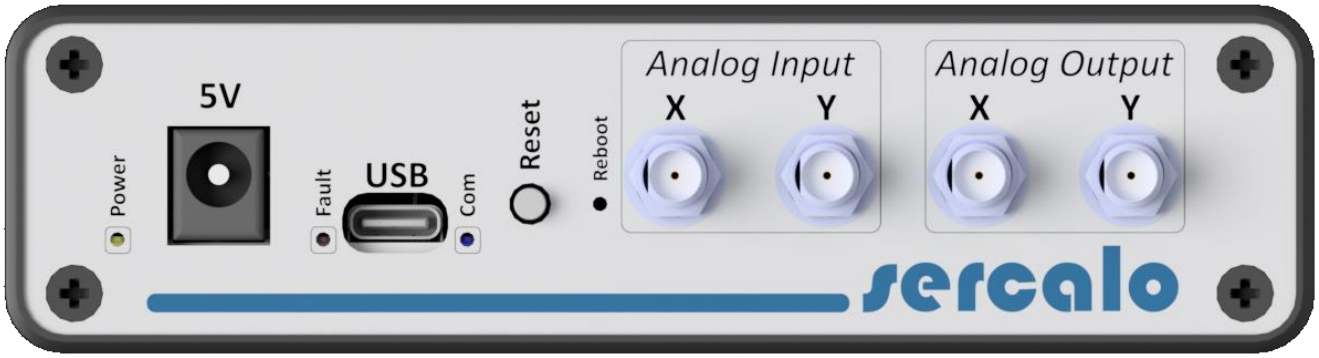



**Figure 2-4: EBMM3 Back Panel**

The back side provides a 2.1mm power jack, a USB-C connector, a reset button, 2 analog inputs and 2 analog outputs (SMA connectors). The analog IN/OUT are linked to the ones on the I/O connectors.

## 2.4 Recommended operating conditions

The recommended operating conditions of the EBMM3 box are listed in the tables below:

| Parameter | Min | Typical | Max | Unit |
|---|---|---|---|---|
| Supply voltage | 4.75 | 5 | 5.25 | V |
| Supply current | | 0.35 | | A |
| Logic Level low | 0 | 0 | 0.5 | V |
| Logic Level high | 2.5 | 3.3 | 3.6 | V |
| UART baudrate | | 115200 | | baud |
| SPI speed | 0.01 | 1 | 10 | MHz |
| Driver sampling frequency | | 15 | | kHz |

**Table 2-3 – Recommended operating conditions**

# 3 Communication

## 3.1 UART

The main communication with the driver is done through the UART bus. One can use the I/O connector pin 5 & 6 or the USB-C connector which acts as a virtual COM port on the computer. The communication settings are listed in Table 3-1. Additionally, the following conventions are adopted:

- The system works as a unix-like CLI (Command-Line-Interface)
- The system recognizes as terminator any of the forms: LF (Line feed, `\n`, `0x0A`) or CR+LF (carriage return and line feed, `\r\n`, ASCII `0x0D 0x0A`).
- Replies always end with the prompt symbol (`$` or `#`), which indicates the system is ready to accept new commands.
- Commands, parameters, and arguments are separated by one or more spaces (ASCII `0x20`)
- Parameters are indicated by `-` followed by a letter or `--` followed by the name of the parameter.

| Parameter | Value |
|---|---|
| Baudrate | 115200 |
| Data Length | 8 bits |
| Parity | None |
| Stop bits | 1 |
| Flow Control | None |

**Table 3-1 – Configuration of the UART bus**

The CLI is divided into modules which can be listed with the command `help`. Each module function can be listed with the command `<module> --help`, with `<module>` the name of the module.

A further description of the CLI interface can be found in the EBMM3 online documentation at this link:

https://www.sercalo.com/support/doc/ebmm3/index.html

## 3.2 SPI

Not available yet

## 3.3 User Programmable I/O

Five I/O pins are available to get info and trigger option during firmware execution. The `extension` module provides functionality for each I/O pins from `dig1` to `dig5`.

## 3.4 Status Pins

Status pins are read-only I/O pins that are preconfigured with a specific output usage. On the EBMM3 Box, the status pins are displayed as LED for visual information.

| Status Pin | LED Color | Description |
|---|---|---|
| 1 | Red | Indicate that an error occurs and all output to the MEMS were shut down. A reset is required. |
| 2 | Green | The firmware is running and ready. |
| 3 | Yellow | The controller loop is running, and the connected MM is activated. |
| 4 | Yellow | The firmware is entering the control loop interruption. |
| 5 | Blue | The firmware command parser is handling UART input. |

**Table 3-2: List of status LED indicator**

## 3.5 Laser synchronization

The laser pin is used to activate/deactivate an output laser by opening a MOSFET. Typically, the MOSFET can handle LED current up to 200mA. The `laser` module is used to configure the laser output.

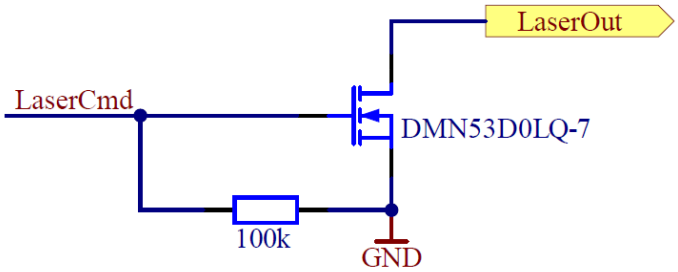



**Figure 3-1: Laser synchronization output schematics**

## 3.6 Analog Input [16bit ADC]

Each axis can be controlled with a ±5V reference signal. The input signal is provided to the EBMM box from the SMA connector on the back panel or the I/O connector on the front panel. The analog signal is shaped linearly with 0V=0° and 4V=MaxTiltAngle. A negative input corresponds to a negative angle. The maximum tilt angle is defined by the connected MEMS mirror. Use module and command `signal input --source=analog` to set the reference signal as analog output.

## 3.7 Analog Output [12bit DAC]

An output signal could be sent from the EBMM3 box SMA connector on the back panel or the I/O connector on the front panel. Two outputs are provided as X or Y axis. Actually, this is just a naming convention as both outputs could be interchanged or provide other output type. Each output could provide analog feedback for the reference signal, the drive voltage, the measured current, or the measured feedback sensor.

The `extension` module provides functionality for both analog pins `an1` (X) and `an2` (Y).

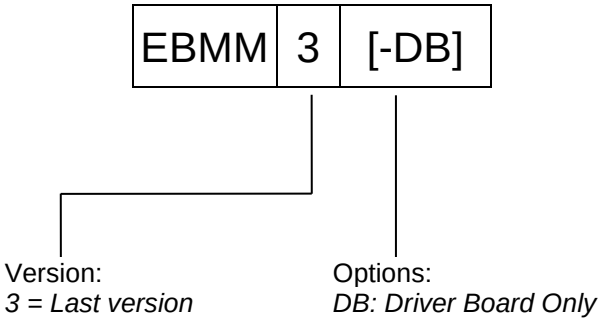
# 4 Absolute Maximum Ratings

Applicable absolute maximum ratings for the full operating temperature range without causing irreversible damage to the device are listed in Table 4-1.

| Parameter | Min | Max | Unit |
|---|---|---|---|
| Storage Temperature | -40 | 85 | °C |
| Operating Temperature | -40 | 85 | °C |
| Power Supply Voltage | | 6 | V |
| I/O pin voltages | | 5 | V |

**Table 4-1 – Absolute maximum ratings**

# 5 Label Information




# 6 Contact Information

**SERCALO MICROTECHNOLOGY LTD**

Landstrasse 151, 9494 Schaan

Principality of Liechtenstein

Tel.: +423 237 57 97

Fax: +423 237 57 48

www.sercalo.com

Email: info@sercalo.com