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1 Overview

The **ML4064-XD-CNT** is designed to provide an efficient and easy method of programming and testing the ML4064-XD-TL thermal modules. It provides power and I2C communication to the modules, allowing the user to access any register in the memory through the I2C bus, where the user is able to control the power, monitor the voltage, temperature, etc.

2 ML4064-XD-CNT | Key Features

- QSFP-DD800 MSA Form Factor
- Four ports
- Supports up to 176W in total
- Supports up to 44W/port
- Four interfaces allowing to operate Four modules simultaneously
- I2C master driven from on board microcontroller
- Current Sensor at each port
- User friendly GUI for I2C R/W commands and loading custom MSA memory maps
- USB interface

3 ML4064-XD-CNT Hardware

The subsequent sections cover the essential parts in the hardware for board operation and testing.

3.1 Power-Up

The **ML4064-XD-CNT** host is powered up as following:

- Apply 24 V input, through banana plugs U6 and U7.
- Connect the host to your PC using a Type-B mini to Type-A USB cable.

3.2 Operating Conditions

The input voltage supply must follow the table below.

Parameter	Min	Typical	Unit
Vinput	12	24v	V
I _{max}	14.6a	7.3a	A

Table 1: Voltage Operating Conditions & Maximum current.

The **ML4064-XD-CNT** includes four ports, allowing communication with and configuration of all four modules simultaneously. The ML4064-XD-CNT supports a total of 176W, distributed over the four ports. The nominal power supported by each port is 44W/Port.

3.3 LED Indicator

The **ML4064-XD-CNT** includes on-board LEDs, for quick debugging and monitoring purposes. LEDs are summarized below:

- LED D3 indicates whether a USB cable is plugged or not.
- LEDs D1 and D2, colored green and red respectively, are used for diagnostic purposes:
 - If D1 is on: the USB is locked and device is recognized by the USB driver
 - If D2 is on: the USB is not connected or USB driver is not found
 - If both are off: the board is not powered correctly or firmware is corrupted
 - If both are blinking: the board is in Bootloader mode

3.4 Low Speed Signals

The low speed signals circuit shown below shows the connection of these signals to the microcontroller and the pin header connector for one of the ports. All the others ports are similar.

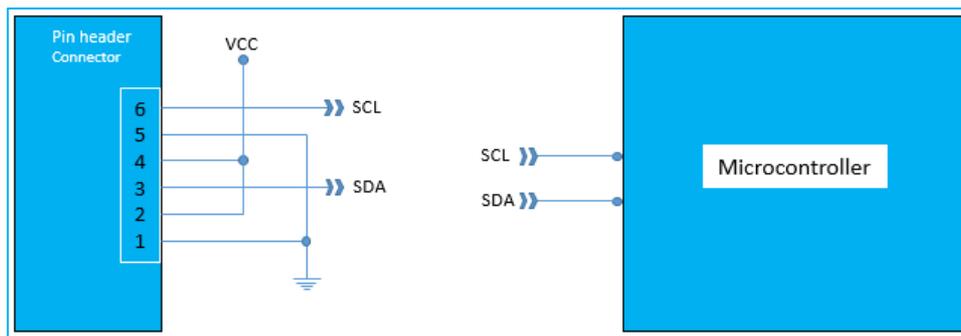


Figure 1: Low Speed Signals Diagram

4 ML4064-XD-CNT Software

The **ML4064-XD-CNT** is accessible and controlled through application software, which provides a user-friendly interface to operate the board and access all its features. The communication between the **ML4064-XD-CNT** board and the software is established through USB connection.

4.1 USB Driver

In order to be able to communicate with the board, user needs to install the USB driver of the **ML4064-XD-CNT**.

Below is a brief guide on how to install the USB Driver:

- Power up the board
- Connect the board to the PC through USB cable

- Download the USB driver file
- Go to “Device Manager”
- Find the target device that need to install the driver
- Right-click on the device and select Update Driver Software
- Select Browse my computer for driver software
- Browse you PC and select the driver file
- Click Next and wait until the driver is installed

4.2 GUI

For GUI installation and operation, refer to the link below. The GUI user manual is available for detailed description.

Link currently unavailable

5 Hardware Revision

- **ML4062-Controller-RevA1:** Initial Version

6 Firmware Revision

- **ML4064Controller_V1.0:** Initial version

7 Bootloader

Accessing in bootloader mode allows the user to reprogram the microcontroller, this is done as described below:

1. Connect a jumper on (J1) situated close to the microcontroller.
2. Connect a USB cable between the PC and Board.
3. Power up the board with a +3.3V supply.
4. LEDs (D1, D2) start blinking.
5. Remove jumper.
6. Open the software “Microchip USB HID Bootloader v2.3”.
7. Click on “Open Hex File”.
8. Choose the new FW to download.
9. Click on “Program/Verify”.
10. Once the software finishes programming press on “Reset Device”.
11. After reset the Firmware is successfully updated.

8 OSFP-XD GUI Overview

The ML-CMIS GUI is a common software interface that allows communication with the **ML4064-XD-TL** module, giving the user the capability to monitor the PCB and shell temperatures, voltage

and current of both the module and the ML4064 XD controller; controlling and monitoring power spots and total power of the module; and allowing the user to read/write the registers.

8.1 GUI Features

8.1.1 Configuration tab:

Allows the user to set the power configuration they require, with the ability to save and reuse it.

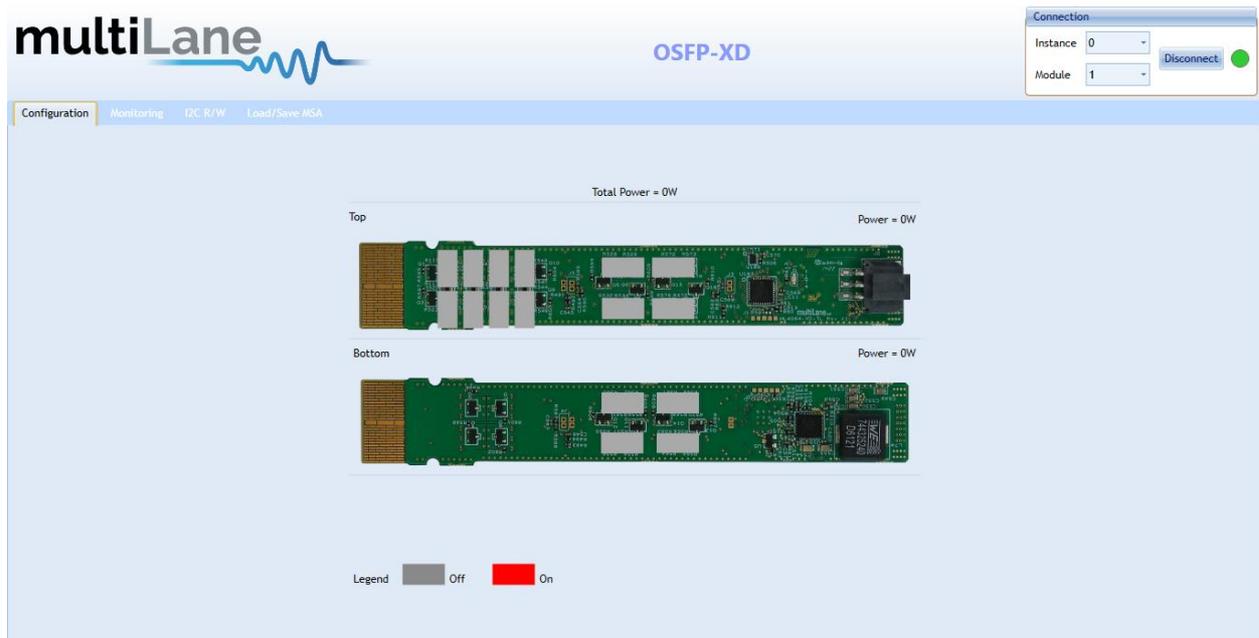


Figure 2: GUI Configuration screen

8.1.2 Monitoring tab:

Allows the user to monitor the temperature, current and voltage, simultaneously. This data can also be saved and exported.

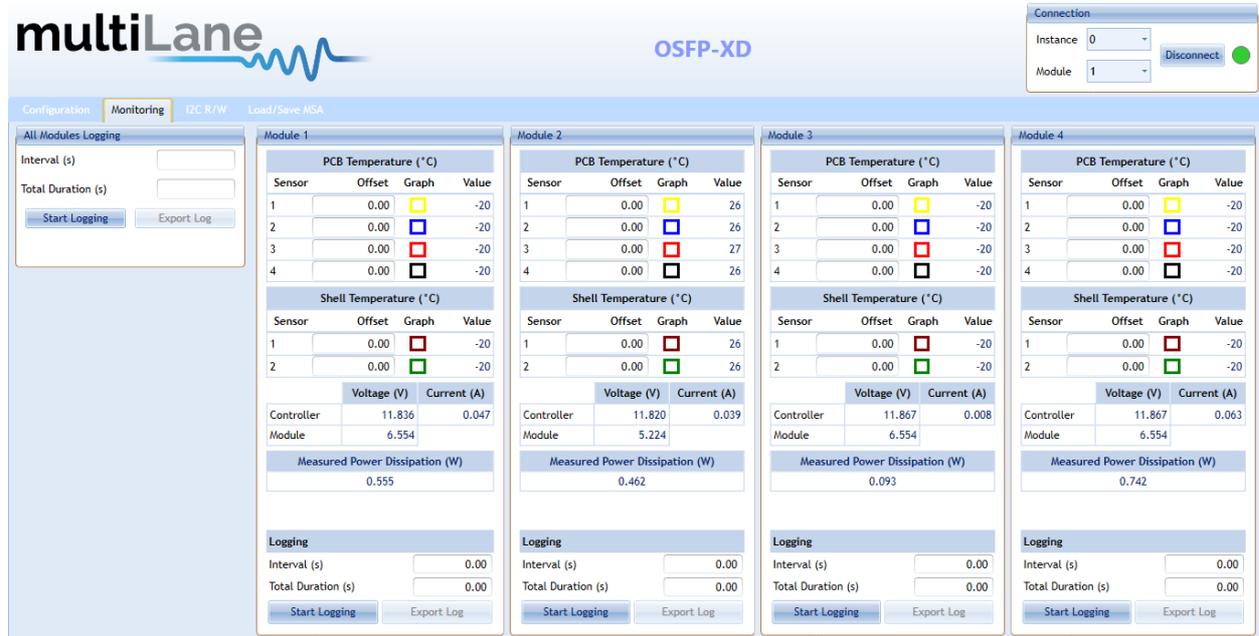


Figure 3: GUI monitoring screen

3. I2C R/W tab:

Allows the user to read from or write to the module EEPROM.



Figure 4: GUI I2C R/W screen

4. Load/Save MSA tab:

Gives access to the full module EEPROM.

The screenshot displays the multiLane OSFP-XD GUI in the 'Load/Save MSA' tab. The main area contains a table of memory addresses and their descriptions. To the right, there are three panels showing checksums for different memory pages.

Address	Hex	Decimal	ASCII	Description	Select All
LowMem0 (00h)	19	25		Identifier	<input type="checkbox"/>
LowMem1 (01h)	28	40	(Revision Compliance	<input type="checkbox"/>
LowMem2 (02h)	04	4		CLEI code present	<input type="checkbox"/>
LowMem3 (03h)	06	6		Module State	<input type="checkbox"/>
LowMem4 (04h)	00	0	▣	Bank 0 flag summary	<input type="checkbox"/>
LowMem5 (05h)	00	0	▣	Bank 1 flag summary	<input type="checkbox"/>
LowMem6 (06h)	00	0	▣	Bank 2 flag summary	<input type="checkbox"/>
LowMem7 (07h)	00	0	▣	Bank 3 flag summary	<input type="checkbox"/>
LowMem8 (08h)	00	0		Latched module state and FW error and flag for CDB completion	<input type="checkbox"/>
LowMem9 (09h)	50	80	P	Latched VCC3.3/Temp Alarm and Warning	<input type="checkbox"/>
LowMem10 (0Ah)	00	0	▣	Latched AUX1/2 Alarm and Warning	<input type="checkbox"/>
LowMem11 (0Bh)	00	0	▣	Latched Vendor Defined/AUX3 Alarm and Warning	<input type="checkbox"/>
LowMem12 (0Ch)	1A	26		Internally measured Temperature 1 MSB	<input type="checkbox"/>
LowMem13 (0Dh)	00	0	▣	Internally measured Temperature 1 LSB	<input type="checkbox"/>
LowMem14 (0Eh)	1A	26		Internally measured Temperature 2 MSB	<input type="checkbox"/>

Checksum (Page00 128-221)	Stored	Calculated
	144	144

Checksum (Page01 130-254)	Stored	Calculated
	2	2

Checksum (Page02 128-254)	Stored	Calculated
	65	65

Figure 5: GUI MSA load/save screen

9 Mechanical Dimensions

The ML4064-XD-CNT dimensions are as follows:

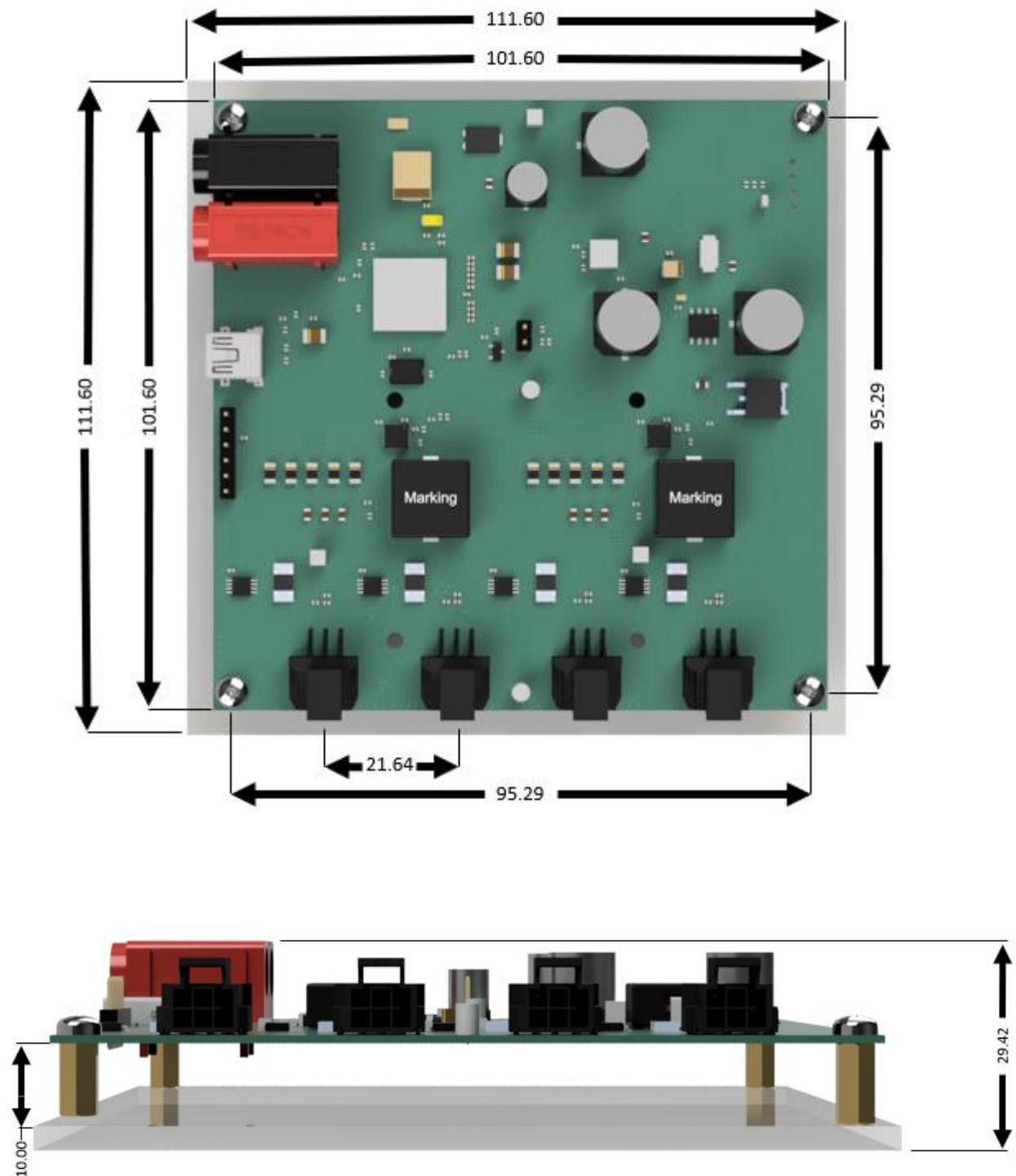


Figure 6: Mechanical Dimensions

10 ML4064-XD-TL General Features

The following paragraphs describe the main **ML4064-XD-TL** features.

10.1 General Description

The **ML4064-XD-TL** module is connected to the controller board using the **ML4064-XD-CNT-CBL**. This cable provides the connectors mating between the module and the controller, power for the module and allows I2C communication with the controller board.

10.2 Temperature Monitor

The **ML4064-XD-TL** has seven internal temperature sensors, four on the PCBA and three on the shell in order to continuously monitor the module temperature. Internally measured Module temperatures are represented as a 16-bit signed two's complement value in increments of 1/256 degrees Celsius, yielding a total range of -127°C to $+128^{\circ}\text{C}$ that is considered valid between -40 and $+125^{\circ}\text{C}$.

Address	Bit	Name	Description	Type
12 Lower page	All	Temperature MSB	Internally measured PCB TempSense1 (Top)	RO
13 Lower page	All	Temperature LSB	Internally measured PCB TempSense1 (Top)	
14 Lower page	All	Temperature MSB	Internally measured PCB TempSense2 (Top)	
15 Lower page	All	Temperature LSB	Internally measured PCB TempSense2 (Top)	
24 Lower page	All	Temperature MSB	Internally measured PCB TempSense3 (Bottom)	
25 Lower page	All	Temperature LSB	Internally measured PCB TempSense3 (Bottom)	
152 Page 03	All	Temperature MSB	Internally measured PCB TempSense4 (Bottom)	
153 Page 03	All	Temperature LSB	Internally measured PCB TempSense4 (Bottom)	
154 Page 03	All	Temperature MSB	Internally measured shell TempSense1 (Top)	
155 Page 03	All	Temperature LSB	Internally measured shell TempSense1 (Top)	
156 Page 03	All	Temperature MSB	Internally measured shell TempSense2 (Bottom)	
157 Page 03	All	Temperature LSB	Internally measured shell TempSense2 (Bottom)	
158 Page 03	All	Temperature MSB	Internally measured shell TempSense3 (Top)	
159 Page 03	All	Temperature LSB	Internally measured shell TempSense3 (Top)	

The distribution of internal temperature sensors is shown in the figure below.

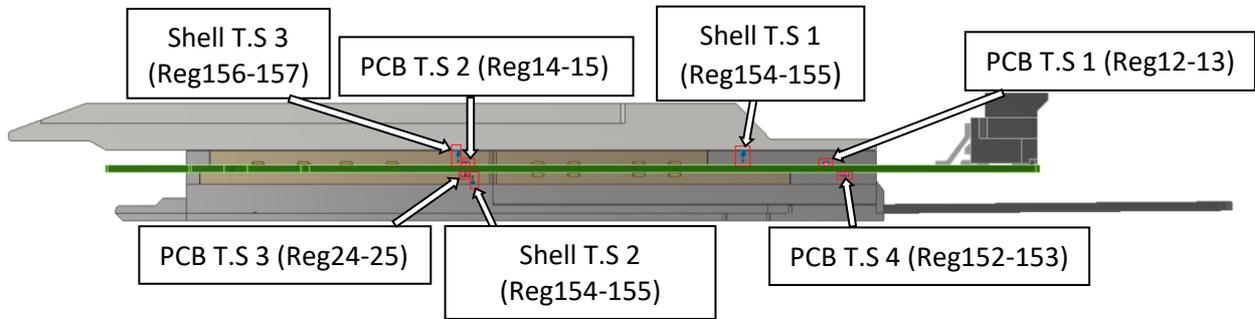


Figure 7: Temperature sensor location

10.3 Voltage Monitor

A voltage sense circuit is available in the **ML4064-XD-TL** that allows the measurement of internal module supplied voltage V_{cc} , with an LSB unit of 0.1 mV.

Address	Bit	Name	Description	Type
16	All	Supply voltage MSB	Internally measured supply voltage	RO
17	All	Supply voltage LSB	Internally measured supply voltage	

10.4 Programmable Power Dissipation and Thermal Emulation

The **ML4064-XD-TL** module contains sixteen thermal spots positioned as shown in Figure 6, to allow the user to emulate the thermal behavior of an optical module.

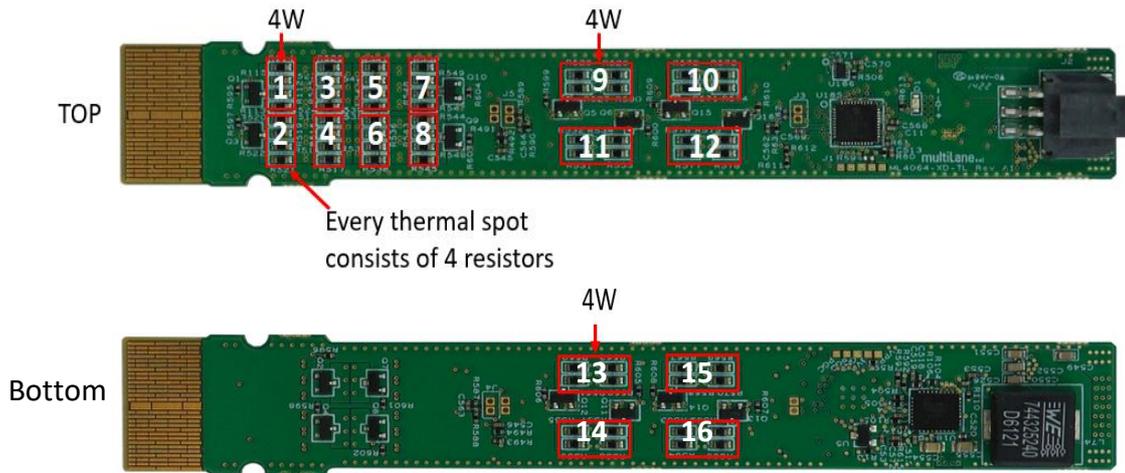


Figure 8: Thermal spots distribution

Power Spot number	Control Type
1-2-3-4-5-6-7-8-9-10-11-12-13-14-15-16	ON/OFF

Note that a maximum number of 11 spots can be activated simultaneously.

Registers 250 and 251, page 03h are used to control thermal spots over I2C. They are 8 bits data wide registers. The consumed power changes accordingly when the values of these registers are changed (only in high power mode). In Low-power mode the module automatically turns off all power spots. The values written in these registers are permanently stored.

The control registers of the thermal spots are shown in the table below:

Power Spot	Register	Bit	Power Consumption	Control Type	Memory Type
1	250 (Page 03)	0	4 W	ON/OFF	RW (NVR)
2		1	4 W		
3		2	4 W		
4		3	4 W		
5		4	4 W		
6		5	4 W		
7		6	4 W		
8		7	4 W		
9	251 (Page 03)	0	4 W	ON/OFF	RW (NVR)
10		1	4 W		
11		2	4 W		
12		3	4 W		
13		4	4 W		
14		5	4 W		
15		6	4 W		
16		7	4 W		

10.5 Cut-Off Temperature

To avoid overheating the module, a Cut-Off Temperature is pre-defined.

The module is continuously monitoring the temperature and checking its value against the Cut-Off temperature. Once the module temperature reaches the cut-off temperature, all power spots will automatically turn off in order to prevent overheating. Once the temperature is 5 degrees below cut-off value, the PWM goes back to its previous value.

The **ML4064-XD-TL** Cut-Off temperature is set to 85 °C by default, and can be programmed to any value from register 253 of memory page 03. Maximum Cut-Off temperature is 90 °C.

Address	Bit	Name	Description	Type
253	7:0	Cut-Off temperature	Module Cut-Off Temperature, LSB = 1 °C	RW (NVR)

Revision History

Revision number	Date	Description
0.1	9/12/2022	▪ Initial Version
0.12	9/13/2022	▪ Added GUI section

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