

# n-Core<sup>®</sup>

## **n-Core<sup>®</sup> Configuration Tool** *Sensors Configuration*

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# 1. n-Core Sirius Devices

## 1.1. Ports

The following tables shows the ports and addresses that should be used for the definition of Behaviors and Rules.

| Port                        | Port Type | Port Address (Hex.) |
|-----------------------------|-----------|---------------------|
| <b>Sirius A</b>             |           |                     |
| GPO_1                       | GPO       | 0x01                |
| GPO_2                       | GPO       | 0x02                |
| GPO_3                       | GPO       | 0x03                |
| GPO_4                       | GPO       | 0x04                |
| GPI_1                       | GPI       | 0x01                |
| GPI_2                       | GPI       | 0x02                |
| GPI_3                       | GPI       | 0x03                |
| GPI_4                       | GPI       | 0x04                |
| ADC_1                       | ADC       | 0x01                |
| ADC_2                       | ADC       | 0x02                |
| I2C                         | I2C       | -                   |
| RELÉ_1                      | GPO       | 0x1D                |
| RELÉ_2                      | GPO       | 0x08                |
| IRQ 6 – Associated to GPI_3 | IRQ       | 0x06                |
| IRQ 7 – Associated to GPI_4 | IRQ       | 0x07                |
| Green Led                   | GPO       | 0x01                |
| Red Led                     | GPO       | 0x00                |
| USART_DTR                   | GPI/GPO   | 0x18                |
| ADC_3                       | GPI/GPO   | 0x1B                |
| BAT                         | GPI/GPO   | 0x1C                |
| 1WR                         | GPI/GPO   | 0x1D                |
| <b>Sirius B/D</b>           |           |                     |
| IRQ_6 – Left button (SW3)   | IRQ       | 0x06                |
| GPI – Left button (SW3)     | GPI       | 0x21                |
| IRQ_7 – Right button (SW4)  | IRQ       | 0x07                |
| GPI - Right button (SW4)    | GPI       | 0x22                |
| I2C                         | I2C       | -                   |
| ADC_1                       | ADC       | 0x01                |
| GPIO_2                      | GPI/GPO   | 0x02                |
| GPIO_13                     | GPI/GPO   | 0x0D                |
| GPIO_14                     | GPI/GPO   | 0x0E                |
| GPIO_15                     | GPI/GPO   | 0x0F                |
| GPIO_6                      | GPI/GPO   | 0x06                |
| USART_DTR                   | GPI/GPO   | 0x18                |
| ADC_3                       | GPI/GPO   | 0x1B                |
| BAT                         | GPI/GPO   | 0x1C                |
| 1WR                         | GPI/GPO   | 0x1D                |
| USART0_TXD                  | GPI/GPO   | 0x1E                |
| USART0_RXD                  | GPI/GPO   | 0x1F                |
| USART0_EXTCLK               | GPI/GPO   | 0x20                |
| Green Led                   | GPO       | 0x08                |

|  |         |      |
|--|---------|------|
| Red Led  | GPO     | 0x01 |
| Disable/enable Green Led normal operation for sending <sup>1</sup> | GPO     | 0x2F |
| Disable/enable Red Led normal operation for receiving <sup>2</sup> | GPO     | 0x30 |
| <b>Sirius Quantum/RadlOn</b>                                       |         |      |
| IRQ_2 – Left button (SW2)  | IRQ     | 0x02 |
| GPI – Left button  | GPI     | 0x23 |
| IRQ_3 – Right button (SW1)   | IRQ     | 0x03 |
| GPI - Right button   | GPI     | 0x24 |
| IRQ_4 – Accelerometer <sup>3</sup> INT_1                           | IRQ     | 0x04 |
| GPI – Accelerometer INT_1  | GPI     | 0x25 |
| IRQ_5 – Accelerometer INT2   | IRQ     | 0x05 |
| GPI - Accelerometer INT_2  | GPI     | 0x26 |
| I2C  | I2C     | -    |
| SPI_CS   | GPI/GPO | 0x27 |
| HW_SPI_CS  | GPI/GPO | 0x28 |
| SPI_SCK  | GPI/GPO | 0x29 |
| SPI_MOSI   | GPI/GPO | 0x2A |
| SPI_MISO   | GPI/GPO | 0x2B |
| Green Led (B5)   | GPO     | 0x2C |
| Red Led (B7)   | GPO     | 0x2E |
| GPI_1  | GPI/GPO | 0x19 |
| ADC_1  | GPI/GPO | 0x01 |
| <b>Common</b>  |         |      |
| I2C_CLK  | GPI/GPO | 0x11 |
| I2C_DATA   | GPI/GPO | 0x12 |
| USART1_TXD   | GPI/GPO | 0x13 |
| USART1_RXD   | GPI/GPO | 0x14 |
| USART1_EXTCLK  | GPI/GPO | 0x15 |
| USART_RTS  | GPI/GPO | 0x16 |
| USART_CTS  | GPI/GPO | 0x17 |
| USART0_TXD   | GPI/GPO | 0x1E |
| USART0_RXD   | GPI/GPO | 0x1F |
| USART0_EXTCLK  | GPI/GPO | 0x20 |

<sup>1</sup> Green Led Normal operation:

- Green led will turn on when the device is trying to send unicast or broadcast data over the air.
- Green led will turn off when the data has been sent correctly over the air.

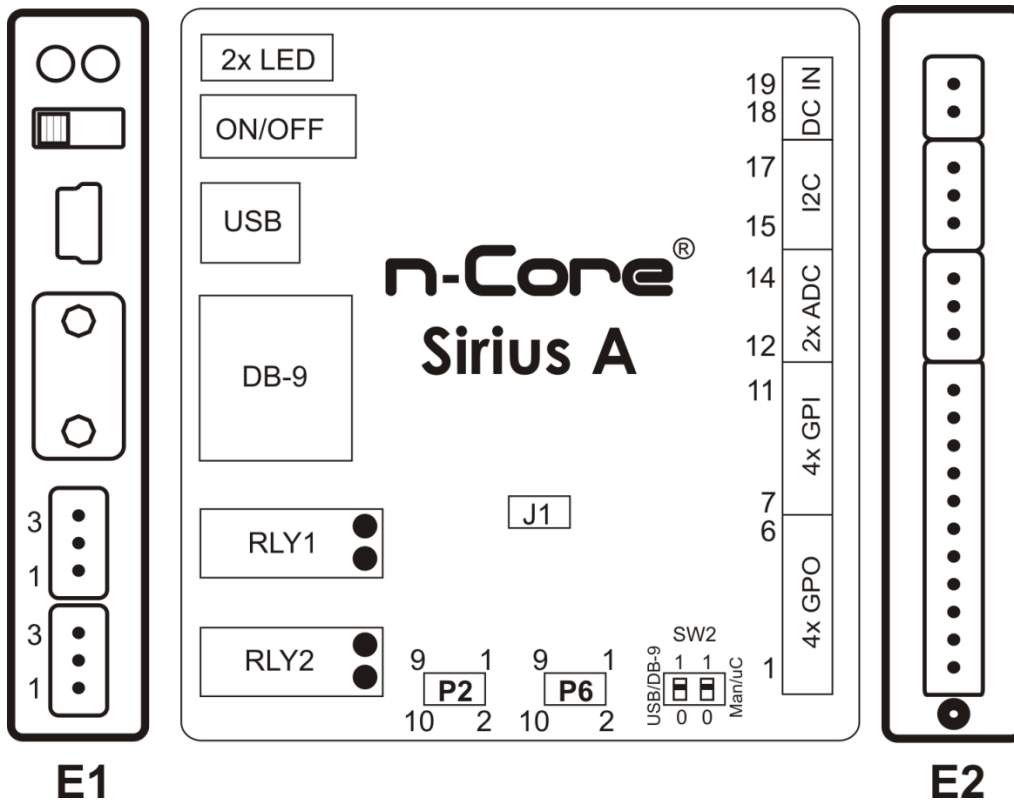
<sup>2</sup> Red Led Normal operation:

- Red led will turn on when the device has received some data over the air.
- Red led will turn off when the received data has been processed by the device.

<sup>3</sup> MMA8452Q Accelerometer.

## 1.2. Pinout

### 1.2.1. Sirius A



| Block E2 |            |
|----------|------------|
| 1        | GPO_1      |
| 2        | GPO_2      |
| 3        | GPO_3      |
| 4        | GPO_4      |
| 5        | GPO_VCC_IN |
| 6        | GND        |
| 7        | GND        |
| 8        | GPI_1      |
| 9        | GPI_2      |
| 10       | GPI_3      |
| 11       | GPI_4      |
| 12       | ADC_2      |
| 13       | ADC_1      |
| 14       | GND        |
| 15       | GND        |
| 16       | I2C SDA    |
| 17       | I2C SCL    |
| 18       | 5V IN      |
| 19       | GND        |

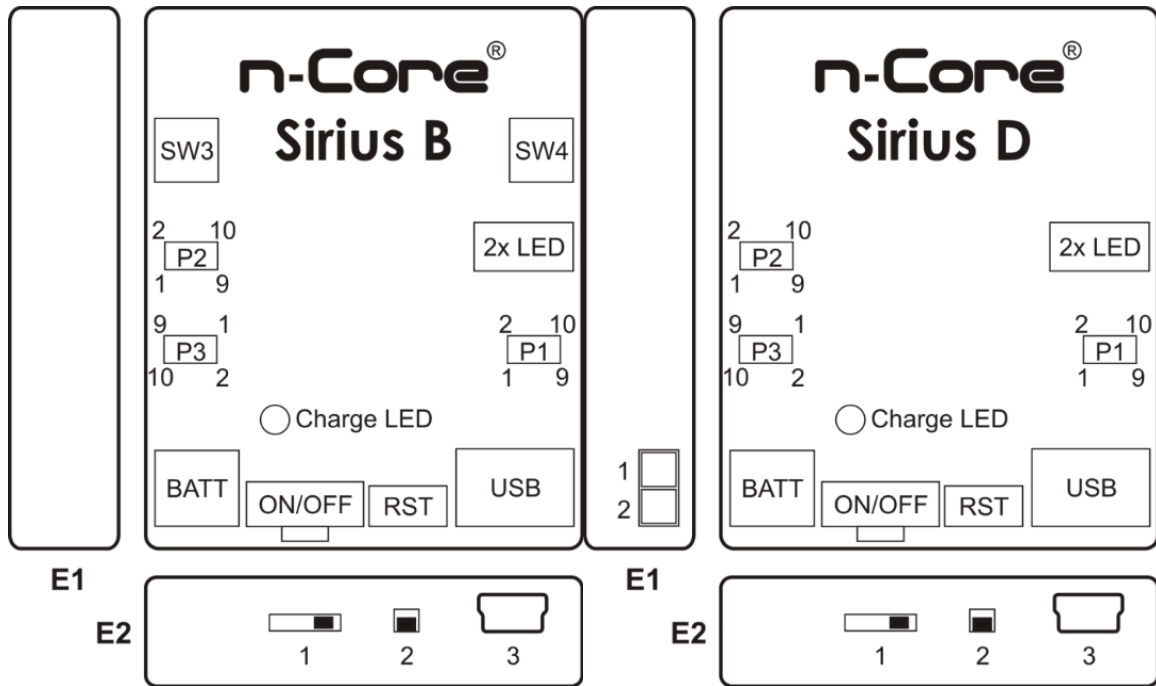
| Block P2 |                           |
|----------|---------------------------|
| 1        | 3.3 V output (controlled) |
| 2        | I2C SDA                   |
| 3        | SPI_CLK                   |
| 4        | I2C SCL                   |
| 5        | SPI_MOSI                  |
| 6        | ADC_3                     |
| 7        | SPI_MISO                  |
| 8        | 3.3 V output (permanent)  |
| 9        | 3.3 V (USB-dependent)     |
| 10       | GND                       |

| Block E1 (RLY1) |      |
|-----------------|------|
| 1               | COM  |
| 2               | N.C. |
| 3               | N.O. |

| Block P6 |                          |
|----------|--------------------------|
| 1        | TCK                      |
| 2        | GND                      |
| 3        | TDO                      |
| 4        | 3.3 V output (permanent) |
| 5        | TMS                      |
| 6        | RESET                    |
| 7        | N/C                      |
| 8        | N/C                      |
| 9        | TDI                      |
| 10       | GND                      |

| Block E1 (RLY2) |      |
|-----------------|------|
| 1               | COM. |
| 2               | N.C. |
| 3               | N.O. |

1.2.2. Sirius B/D



| Block P1 (JTAG) |         |
|-----------------|---------|
| 1               | TCK     |
| 2               | GND     |
| 3               | TDO     |
| 4               | VCC_OUT |
| 5               | TMS     |
| 6               | RESET   |
| 7               | N/C     |
| 8               | N/C     |
| 9               | TDI     |
| 10              | GND     |

| Block P2 |               |
|----------|---------------|
| 1        | I2C_SCL       |
| 2        | SPI_SCLK      |
| 3        | I2C_SDA       |
| 4        | SPI_MOSI      |
| 5        | USART0_EXTCLK |
| 6        | SPI_MISO      |
| 7        | USART0_TXD    |
| 8        | USART0_RXD    |
| 9        | N/C           |
| 10       | GND           |

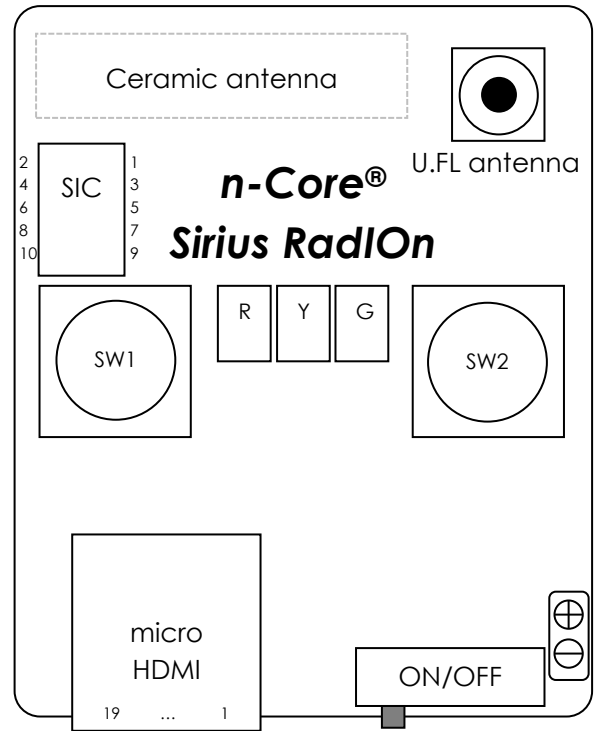
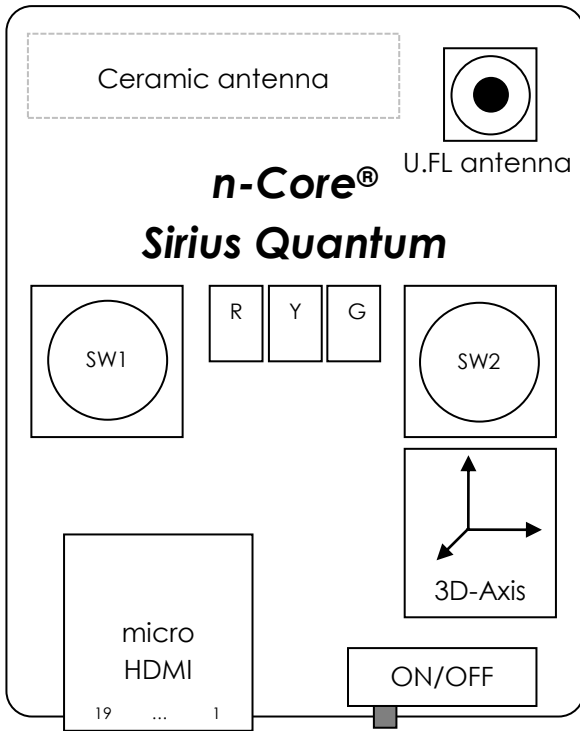
| Block P3 |             |
|----------|-------------|
| 1        | GPIO_6      |
| 2        | GPIO_2      |
| 3        | GPIO_7      |
| 4        | GPIO_13     |
| 5        | IRQ_6 (SW3) |
| 6        | GPIO_14     |
| 7        | IRQ_7 (SW4) |
| 8        | GPIO_15     |
| 9        | GND         |
| 10       | GND         |

| Block E1 (Sirius D) |        |
|---------------------|--------|
| 1                   | GND    |
| 2                   | VCC_IN |

| Block E2 |        |
|----------|--------|
| 1        | ON/OFF |
| 2        | RESET  |
| 3        | USB    |

1.2.3. Sirius Quantum/RadlOn



| micro HDMI |          |
|------------|----------|
| 1          | RESET    |
| 2          | UART TXD |
| 3          | JTAG TDI |
| 4          | UART RXD |
| 5          | JTAG TDO |
| 6          | SPI MISO |
| 7          | JTAG TMS |
| 8          | SPI MOSI |
| 9          | JTAG TCK |
| 10         | SPI CLK  |
| 11         | ADC 1    |
| 12         | UART CTS |
| 13         | VCC IN   |
| 14         | UART RTS |
| 15         | GND      |
| 16         | GPIO2    |
| 17         | I2C SCL  |
| 18         | GPIO1    |
| 19         | I2C SDA  |

| SIC |            |
|-----|------------|
| 1   | I2C SCL    |
| 2   | SPI SCLK   |
| 3   | I2C SDA    |
| 4   | SPI MOSI   |
| 5   | VCC IN     |
| 6   | SPI MISO   |
| 7   | USART0 TXD |
| 8   | USART0 RXD |
| 9   | ADC 1      |
| 10  | GND        |



## 2. Binary sensors (0/1)

### 2.1. GPI

Behavior for simple binary sensors, such as presence, open/close, buttons, bed sensors, etc.

| Parameter     | Value   |
|---------------|---|
| Port Type     | GPI_PORT  |
| Address (Hex) | Digital input to which the sensor is connected.<br>(e.g., 19) |
| Begin         | 0   |

### 2.2. IRQ

| Parameter          | Value  |
|--------------------|--|
| Port Type          | IRQ_PORT   |
| Address (Hex)      | Digital input to which the sensor is connected. <ul style="list-style-type: none"> <li>• 6 = left button in Sirius B</li> <li>• 7 = right button in Sirius B</li> <li>• 2 = left button in Sirius Quantum/RadIOn</li> <li>• 3 = right button in Sirius Quantum/RadIOn</li> </ul> |
| IRQ Guard Time     | User defined (e.g., 1500)  |
| IRQ Condition Type | LOW_LEVEL  |

**Note:** Addresses 0x19 (Sirius RadIOn), 0x21 and 0x22 (Sirius B/D) may be also used as GPI. In this cases, it is necessary to configure a polling behavior.

## 3. SHT25 (Temperature and Humidity)

[SHT25 datasheet.](#)

### 3.1. Temperature

| Parameter        | Value                     |
|------------------|---------------------------|
| Port Type        | I2C_PORT                  |
| Address (Hex)    | 40                        |
| Data Write (Hex) | e3                        |
| Data Read Length | 3                         |
| Type             | INT_16                    |
| Begin            | 0                         |
| Bitrate          | 125000                    |
| Polling Time     | User defined (e.g., 1000) |

The temperature ( $T$ ) is calculated by inserting the temperature signal output ( $S_T$ ) into the following formula (the result is in °C):  $T = -46.85 + 175.72 \frac{S_T}{2^{16}}$

### 3.2. Humidity

| Parameter        | Value                     |
|------------------|---------------------------|
| Port Type        | I2C_PORT                  |
| Address (Hex)    | 40                        |
| Data Write (Hex) | e5                        |
| Data Read Length | 3                         |
| Type             | UINT_16                   |
| Begin            | 0                         |
| Bitrate          | 125000                    |
| Polling Time     | User defined (e.g., 1000) |

The relative humidity ( $R_H$ ) is calculated by inserting the relative humidity signal output  $S_{RH}$  into the following formula (the result in %RH):  $RH = -6 + 125 \frac{S_{RH}}{2^{16}}$

## 4. TSL2561 (Light)

[TSL2561 datasheet.](#)

### 4.1. Step 1: initialization

| Parameter        | Value   |
|------------------|---|
| Port Type        | I2C_PORT  |
| Address (Hex)    | 29 or 39 (depending where the sensor is connected). |
| Data Write (Hex) | 8003  |
| Data Read Length | 0   |
| Type             | DUMMY   |
| Bitrate          | 62000   |
| Polling Time     | 0   |

### 4.2. Step 2: read value

| Parameter        | Value                     |
|------------------|---------------------------|
| Port Type        | I2C_PORT                  |
| Address (Hex)    | 29                        |
| Data Write (Hex) | 9c                        |
| Data Read Length | 4                         |
| Type             | BUFFER                    |
| Size             | 4                         |
| Begin            | 0                         |
| Bitrate          | 62000                     |
| Polling Time     | User defined (e.g., 1000) |

**Note:** To calculate the lux levels use the following function:

```
extern unsigned int CalculateLux(unsigned int iGain, unsigned int tInt, unsigned int
    ch0, unsigned int ch1, int iType)
```

where:

- iGain = 0
- tInt = 400
- iType = 1

In channel0 (ch0) and channel1 (ch1) you should enter bytes 0 and 1 as uint16 and bytes 2 and 3 as uint16 respectively.

## 5. TSL257LF (Light)

[TSL257LF datasheet.](#)

| Parameter        | Value   |
|------------------|---|
| Port Type        | ADC_PORT                                      |
| Address (Hex)    | 2 (ADC port to which the sensor is connected) |
| Data Read Length | 2   |
| Type             | BUFFER  |
| Size             | 2   |
| Begin            | 0   |
| Sample Rate      | 9600  |
| Bits per Sample  | 10  |
| Polling Time     | User defined (e.g., 1000)                     |

## 6. MMA8452Q (Accelerometer)

[MMA8452Q datasheet.](#)

### 6.1. Step 1: change the resolution to 8g

| Parameter              | Value                   |
|------------------------|-------------------------|
| Port Type              | I2C_PORT                |
| Address (Hex)          | 1c                      |
| I2C Int. Address (Hex) | 0E                      |
| Data Write (Hex)       | 0->2G<br>1->4G<br>2->8G |
| Data Read Length       | 1                       |
| Type                   | Buffer                  |
| Bit Rate               | 125000                  |
| Polling Time           | 0                       |

### 6.2. Step 2: change from standby to active mode

| Parameter              | Value    |
|------------------------|----------|
| Port Type              | I2C_PORT |
| Address (Hex)          | 1c       |
| I2C Int. Address (Hex) | 2A       |
| Data Write (Hex)       | 01       |
| Data Read Length       | 0        |

|              |        |
|--------------|--------|
| Type         | DUMMY  |
| Bit Rate     | 125000 |
| Polling Time | 0      |

**Note:** This behavior puts the sensor in active mode.

### 6.3. Step 2: read value

| Parameter              | Value                     |
|------------------------|---------------------------|
| Port Type              | I2C_PORT                  |
| Address (Hex)          | 1c                        |
| I2C Int. Address (Hex) | 01                        |
| Data Read Length       | 6                         |
| Type                   | BUFFER                    |
| Size                   | 6                         |
| Begin                  | 0                         |
| Bit Rate               | 125000                    |
| Polling Time           | User defined (e.g., 1000) |

**Note:** X, Y, Z. 12 bits per axis (2 bytes).

## 7. HMC6352 Compass

[HMC6352 datasheet.](#)

### 7.1. Step 1: initialization

| Parameter        | Value    |
|------------------|----------|
| Port Type        | I2C_PORT |
| Address (Hex)    | 21       |
| Data Write (Hex) | 474e00   |
| Data Read Length | 0        |
| Type             | DUMMY    |
| Bit Rate         | 125000   |
| Polling Time     | 0        |

### 7.2. Step 2: read Value

| Parameter        | Value                     |
|------------------|---------------------------|
| Port Type        | I2C_PORT                  |
| Address (Hex)    | 21                        |
| Data Write (Hex) | 41                        |
| Data Read Length | 2                         |
| Type             | BUFFER                    |
| Size             | 2                         |
| Bit Rate         | 125000                    |
| Polling Time     | User defined (e.g., 1000) |
|                  |                           |

## 8. Nunchuk

[Nunchuk datasheet.](#)

### 8.1. Step 1: first initialization

| Parameter        | Value        |
|------------------|--------------|
| Port Type        | I2C_PORT     |
| Address (Hex)    | 52           |
| Data Write (Hex) | f055fb004000 |
| Data Read Length | 0            |
| Type             | DUMMY        |
| Bit Rate         | 62000        |
| Polling Time     | 0            |

### 8.2. Step 2: second initialization

| Parameter        | Value                     |
|------------------|---------------------------|
| Port Type        | I2C_PORT                  |
| Address (Hex)    | 52                        |
| Data Write (Hex) | 00                        |
| Data Read Length | 0                         |
| Type             | DUMMY                     |
| Bit Rate         | 62000                     |
| Polling Time     | User defined (e.g., 1000) |

### 8.3. Step 3: read value

| Parameter        | Value                     |
|------------------|---------------------------|
| Port Type        | I2C_PORT                  |
| Address (Hex)    | 52                        |
| Data Read Length | 6                         |
| Type             | BUFFER                    |
| Size             | 6                         |
| Begin            | 0                         |
| Bit Rate         | 62000                     |
| Polling Time     | User defined (e.g., 1000) |

## 9. Potentiometer 10k

| Parameter        | Value    |
|------------------|----------|
| Port Type        | ADC_PORT |
| Address (Hex)    | 2        |
| Data Read Length | 2        |
| Type             | BUFFER   |
| Size             | 2        |

|                 |                           |
|-----------------|---------------------------|
| Begin           | 0                         |
| Bit Rate        | 9600                      |
| Bits per Sample | 10                        |
| Polling Time    | User defined (e.g., 1000) |

## 10. Battery

| Parameter    | Value                     |
|--------------|---------------------------|
| Port Type    | BATT_PORT                 |
| Begin        | 0                         |
| Polling Time | User defined (e.g., 1000) |

## 11. Sirius A Relays

**Note:** Relay 1 = 0x1D; Relay 2 = 0x08.

**Note:** "Data Write" = 1 (ON); "Data Write" = 0 (OFF), "Data Write" = 2 (toggle).

### 11.1. Relay 1

| Parameter        | Value                       |
|------------------|-----------------------------|
| Port Type        | GPO_PORT                    |
| Address (Hex)    | 1d                          |
| Data Write (Hex) | 1 (ON); 0 (OFF); 2 (toggle) |
| Polling Time     | 0                           |

### 11.2. Relay 2

| Parameter        | Value                       |
|------------------|-----------------------------|
| Port Type        | GPO_PORT                    |
| Address (Hex)    | 08                          |
| Data Write (Hex) | 1 (ON); 0 (OFF); 2 (toggle) |
| Polling Time     | 0                           |

## 12. Binary actuators (0/1)

| Parameter        | Value                               |
|------------------|-------------------------------------|
| Port Type        | GPO_PORT                            |
| Address (Hex)    | GPO where the actuator is connected |
| Data Write (Hex) | 1 (ON); 0 (OFF); 2 (toggle)         |
| Polling Time     | 0                                   |

## 13. Rules (Examples)

### 13.1. Example 1: Pushing left button on Sirius B → ON/OFF Relay 2 on Sirius A

The rule is composed of two behaviors:

- First Behavior: pressing the button launches an interruption.
- Second Behavior: the interruption sends a toggle to the relay.

There are three nodes in the network:

- Coordinator (Sirius D): NodeId 0
- Tag (Sirius B): NodeId 50075
- Router (Sirius A): NodeId 50

**Step 1:** define the first behavior.

| Parameter          | Value     |
|--------------------|-----------|
| Device             | 50075     |
| Port Type          | IRQ_PORT  |
| Address            | 6         |
| IRQ Guard Time     | 1500      |
| IRQ Condition Type | LOW_LEVEL |

**Step 2:** define the second behavior.

| Parameter  | Value    |
|------------|----------|
| Device     | 50       |
| Port Type  | GPO_PORT |
| Address    | 8        |
| Data Write | 2        |

### 13.2. Example 2: Temperature over XX°C → ON/OFF Relay 1 on Sirius A

The rule is composed of two behaviors:

- First Behavior: the temperature exceeds the threshold.
- Second Behavior: sends a toggle to relay.

Use the temperature signal output ( $S_T$ ) into the formula (See Section 3.1).  $S_T$  is a decimal number, therefore the value must be translated to a hexadecimal value:

$$S_T = \frac{T + 46.85}{175.72} \times 2^{16}$$

For example:

- Value Comp. = 30°C
- $S_T = \frac{30+46.85}{175.72} \times 2^{16} = 28661,74 \sim 28662$
- ST(Hex) = 6FF6

There are three nodes in the network:

- Coordinator (Sirius D): NodeId 0
- Router (Sirius D): NodeId 50020
- Router (Sirius A): NodeId 50

**Step 1:** define the first behavior.

| Parameter    | Value    |
|--------------|----------|
| Device       | 50020    |
| Port Type    | I2C_PORT |
| Address      | 40       |
| Data Write   | e3       |
| Type         | INT_16   |
| Begin        | 0        |
| Condition    | >=       |
| Type Comp.   | INT_16   |
| Value Comp.  | 6FF6     |
| Bit Rate     | 125000   |
| Polling Time | 1000     |

**Step 2:** define the second behavior.

| Parameter  | Value    |
|------------|----------|
| Device     | 50       |
| Port Type  | GPO_PORT |
| Address    | 1d       |
| Data Write | 2        |

### 13.3. Example 3: Acceleration exceeding the Z axis threshold → ON/OFF Relay 1 on Sirius A

The rule is composed of two behaviors:

- First Behavior: the acceleration in the Z axis exceeds the threshold.
- Second Behavior: sends a toggle to relay.

This example uses only one byte per axis (the resolution is 8 bits). By default, the MMA8452Q range is 2g.

Multiply the read value (1 byte) by 15.6mg to obtain a “real” value (mg). This example uses 1500mg as threshold. Then,  $1500\text{mg}/15.6\text{mg} = 96$  (60 hex).

There are three nodes in the network:

- Coordinator (Sirius D): NodeId 0
- Router (Sirius D): NodeId 50020
- Router (Sirius A): NodeId 50

**Step 1:** define the first behavior.

| Parameter | Value    |
|-----------|----------|
| Device    | 50075    |
| Port Type | I2C_PORT |
| Address   | 1c       |



|                  |        |
|------------------|--------|
| I2C Int. Address | 01     |
| Data Read Length | 6      |
| Type             | BUFFER |
| Size             | 1      |
| Begin            | 4      |
| Condition        | >=     |
| Type Comp.       | BUFFER |
| Value Comp.      | 60     |
| Bit Rate         | 125000 |
| Polling Time     | 0      |

**Step 2:** define the second behavior.

| Parameter  | Value    |
|------------|----------|
| Device     | 50       |
| Port Type  | GPO_PORT |
| Address    | 1d       |
| Data Write | 2        |



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