Flowfinity M1 Hardware Guide

August 2021

Revision 001

IFM1R1 *Flowfinity M1*

SFERALABS

Be sure to always remove the power supply before inserting or removing the Raspberry Pi Compute Module from the Flowfinity M1.

Follow all applicable electrical safety standards, guidelines, specifications and regulations for installation, wiring and operations of Flowfinity M1.

Carefully and fully read this Flowfinity M1 hardware guide before installation.

Flowfinity M1 is not authorised for use in safety-critical applications where a failure of the product would reasonably be expected to cause personal injury or death. Safety-critical applications include, without limitation, life support devices and systems, equipment or systems for the operation of nuclear facilities and weapons systems. Flowfinity M1 is neither designed nor intended for use in critical military or aerospace applications or environments and for automotive applications or environment. Customer acknowledges and agrees that any such use of Flowfinity M1 is solely at Customer's risk, and that Customer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

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http://www.sferalabs.cc

Safety information

Carefully and fully read this user guide before installation and retain it for future reference.

Qualified personnel

The product described in this manual must be operated only by personnel qualified for the specific task and installation environment, in accordance with all relevant documentation and safety instructions. A qualified person should be capable of fully identifying all installation and operation risks and avoid potential hazards when working with this product.

Hazard levels

This manual contains information you must observe to ensure your personal safety and prevent damage to property. Safety information in this manual are highlighted by the safety symbols below, graded according to the degree of danger.

⚠ DANGER

Indicates a hazardous situation which, if not avoided, **will** result in death or serious personal injury.

⚠ WARNING

Indicates a hazardous situation which, if not avoided, **may** result in death or serious personal injury.

⚠ CAUTION

Indicates a hazardous situation which, if not avoided, can result in minor or moderate personal injury.

NOTICE

Indicates a situation which, if not avoided, can result in damage of property.

Safety instructions

General safety instructions

Protect the unit against moisture, dirt and any kind of damage during transport, storage and operation. Do not operate the unit outside the specified technical data.

Never open the housing. If not otherwise specified, install in closed housing (e.g. distribution cabinet). Earth the unit at the terminals provided, if existing, for this purpose. Do not obstruct cooling of the unit. Keep out of the reach of children.

⚠ WARNING

Life threatening voltages are present within and around an open control cabinet.

When installing this product in a control cabinet or any other areas where dangerous voltages are present, always switch off the power supply to the cabinet or equipment.

⚠ WARNING

Risk of fire if not installed and operated properly.

Follow all applicable electrical safety standards, guidelines, specifications and regulations for installation, wiring and operations of this product.

The Raspberry Pi Compute Module board could generate a substantial amount of heat when the software forces the CPU and/or GPU to operate at high load levels. Ensure that the product is properly installed and ventilated to prevent overheat.

The Flowfinity M1 internal power supply could generate a substantial amount oh heat, particularly when subject to a significant amount of electrical load.

An internal fan significantly improves the airflow and heat dissipation. Depending on external environment conditions, the fan could collect a significant amount of dust or other impurities, that could prevent it from spinning or could reduce its effectiveness. Periodically check that the fan is not blocked or partly obstructed.

NOTICE

The connection of expansion devices to this product may damage the product and other connected systems, and may violate safety rules and regulations regarding radio interference and electromagnetic compatibility.

Use only appropriate tools when installing this product. Using excessive force with tools may damage the product, alter its characteristics or degrade its safety.

Battery

Flowfinity M1 uses a small lithium non-rechargeable battery to power its internal real time clock (RTC).

⚠ WARNING

Improper handling of lithium batteries can result in an explosion of the batteries and/or release of harmful substances.

Worn-out or defective batteries can compromise the function of this product.

Replace the RTC lithium battery before it is completely discharged. The lithium battery must be replaced only with an identical battery. See the "Replacing the RTC backup battery" section for instructions.

Do not throw lithium batteries into fire, do not solder on the cell body, do not recharge, do not open, do not short-circuit, do not reverse polarity, do not heat above 100°C and protect from direct sunlight, moisture and condensation.

Dispose of used batteries according to local regulations and the battery manufacturer's instructions.

Introduction

Flowfinity M1 is a versatile industrial edge computing controller with a huge variety of Input/Output lines and standard communication interfaces, based on the embedded Raspberry Pi Compute Module, suitable for use in professional and industrial applications where reliability and service continuity are key requirements, and housed in a compact 6 modules DIN rail case.

Flowfinity M1 can be used for an incredible range of applications, from data acquisition and control, to home and building automation, as well as access control, hotel room control solutions, environmental monitoring and many others.
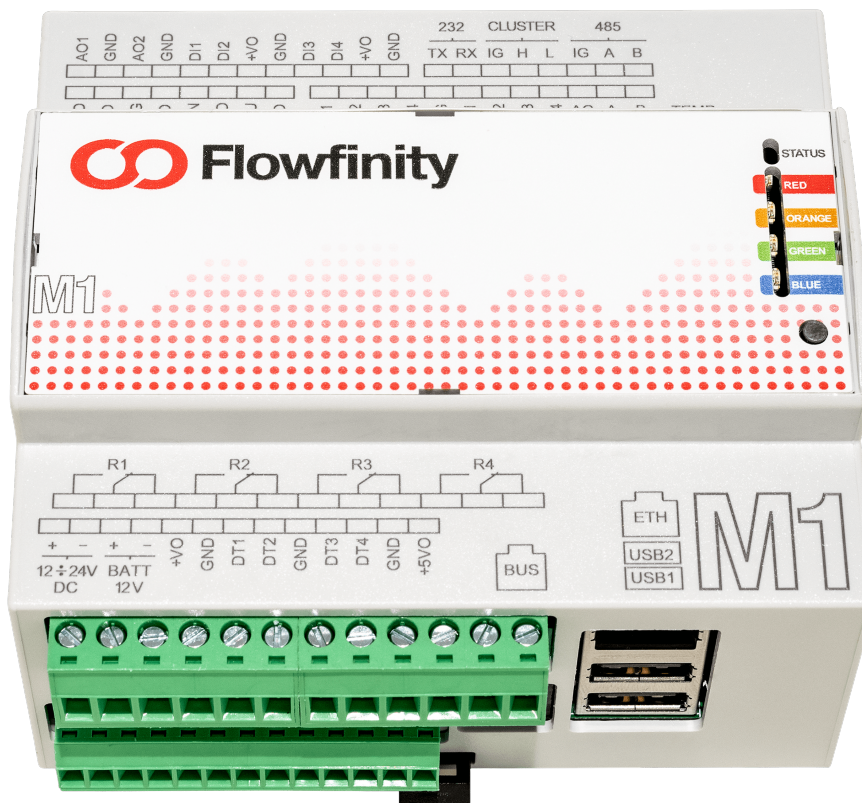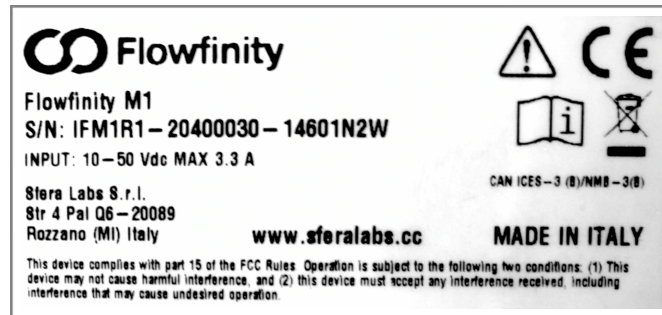

FLOWFINITY M1

Features

Flowfinity M1:

✓ 10-50Vdc power supply, with surge and reverse polarity protection, and 3.3A resettable fuse

✓ integrated uninterruptible power supply (UPS), with external lead-acid 12V or 24V battery (with reverse polarity and over-current protection)

✓ software-controlled auxiliary 12-24Vdc stabilised supply output, to power external devices through Flowfinity M1 UPS

✓ software-controlled auxiliary 5Vdc stabilised supply output

✓ voltage and current monitoring of power supply input, battery and auxiliary supply output

✓ real time clock with replaceable CR1220 Lithium / Manganese Dioxide back-up battery

✓ standard RS-232 interface, up to 115.200 bps

✓ standard RS-485 interface, with opto-isolator and electrostatic discharge protection, up to 115.200 bps

✓ High speed controller clustering interface, with opto-isolator and electrostatic discharge protection

✓ 5V-level, protected, I2C expansion bus

✓ 4 power relay outputs rated for 6A at 250V, with NO and NC contacts

✓ 4 open-collector outputs

✓ 2 0-10V or 0-20mA analog outputs

✓ 4 analog voltage inputs 0-20V

✓ 4 analog current inputs 0-20mA

✓ 2 Pt100 or Pt1000 temperature sensor inputs

✓ 4 digital input lines

✓ 4 digital 5V-level I/O lines, with 1-Wire and Wiegand support

✓ 10/100 Ethernet port

✓ two USB 2.0 type-A ports, with individual power control and fault detection

✓ one internal USB 2.0 type-A port, to embed USB dongles inside the enclosure

✓ dual microSD card architecture. Flowfinity M1 routes its two microSD card holders to the Compute Module through a high-speed switching matrix, controlled by the on-board microcontroller. The microSD slots are hidden, and can be accessed opening the case

✓ powerful 32 bit microcontroller (ATSAME54), with 1 MB program memory and 256 KB RAM.

✓ embedded Microchip ATECC608A secure element chip used for dual-factor authentication

✓ front-panel RGB LEDs

✓ on-board piezoelectric buzzer, for acoustic feedback

✓ front-panel push-button

✓ power supply, serial and I/O connections on pluggable terminal blocks

✓ internal temperature sensors for system temperature monitoring

✓ internal fan, controlled by the microcontroller based on current load and internal temperature

✓ packaged in a compact 6 modules DIN rail case

✓ optional earthquake sensor module

✓ pre-installed and tested Raspberry Pi Compute Module 3+ Lite
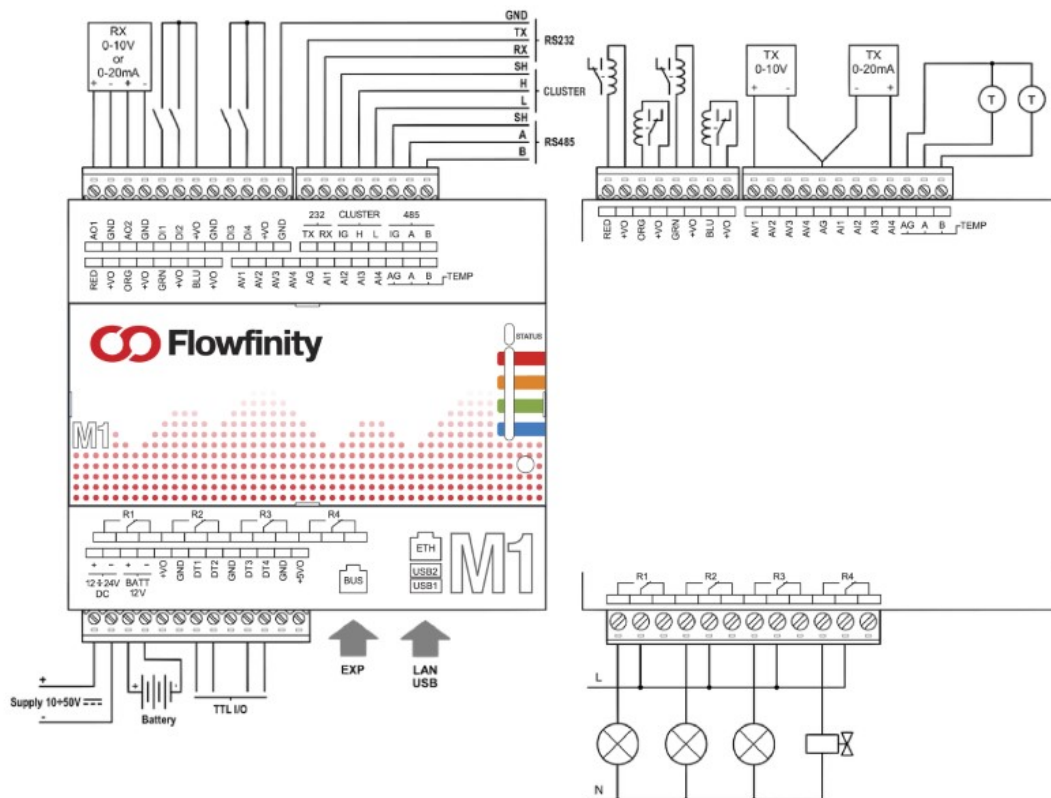
Hardware setup

Device identification

The device can be identified with the information provided in the rating and identification plate, permanently attached to the side of the case.

EXAMPLE RATING AND IDENTIFICATION PLATE

Connections

FLOWFINITY M1 CONNECTION EXAMPLE

Flowfinity M1 ships pre-configured for most typical applications. Do not open the case unless instructed by support personnel or in case you need to replace RTC battery as described below.

NOTICE

Before opening the Flowfinity M1 enclosure, disconnect all power sources and any connection to external devices, including USB and Ethernet cables.

Opening the case

Follow these steps, in the exact order, to open the case:

1. Remove the green pluggable terminal blocks

2. Remove the black plastic DIN rail hook

3. With a small flat screwdriver gently separate the case bottom and boards assembly from the top shell; lift both sides gradually; pay attention not to touch the circuit boards with the screwdriver's tip

4. The circuit boards assembly will simply slide out of the case, as it is mechanically held in place by the case bottom only.

Closing the case

5. Remove the front panel. This will help aligning the circuit boards assembly with the case walls

6. Replace the circuit boards assembly inside the case; ensure that the USB/Ethernet connectors and terminal blocks are aligned with the openings in the case

7. Replace the case bottom, partially inserting both sides, then gently push on both sides. The case bottom must perfectly fit and firmly hook to the case cover. If it doesn't, the circuit boards assembly is not perfectly fit into the case top shell

8. Replace the front panel, ensuring that the frontal push-button is aligned to the panel's hole

9. Replace the black plastic DIN rail hook.

OPENING AND CLOSING THE CASE

Raspberry Pi Compute Module installation

To replace the pre-installed Compute Module module, no tools are required once the plastic enclosure has been removed and the circuit boards assembly is exposed. The Compute Module fits in a standard 200 pin DDR2 SODIMM (JEDEC MO-224 mechanical specification) slot.

NOTICE

Static electricity can damage the components in your system. To protect your system's components from static damage during the installation process, touch any of the unpainted metal surfaces on your computer's frame or wear an ESD wrist strap before handling internal components. Either method will safely discharge static electricity that's naturally present in your body.

When handling the Raspberry Pi Compute Module, be sure to hold it along the side edges using your thumb and index finger. Avoid touching the components and pin connectors as damage can occur.

Align the notches on the Compute Module with the ridges in the DDR2 slot. Insert the module using firm and even pressure, and push down on the module until the clips on the side of the slot snap into place.

microSD installation

Flowfinity M1 has two microSD slots to install flash memory cards.

The microSD slots are not directly accessible with the case closed. The slots are located on the vertical board, next to the USB/Ethernet modular connector.

The bottom slot is SDA, and the top is SDB.

MICRO SD SLOTS

Flowfinity M1 User Guide
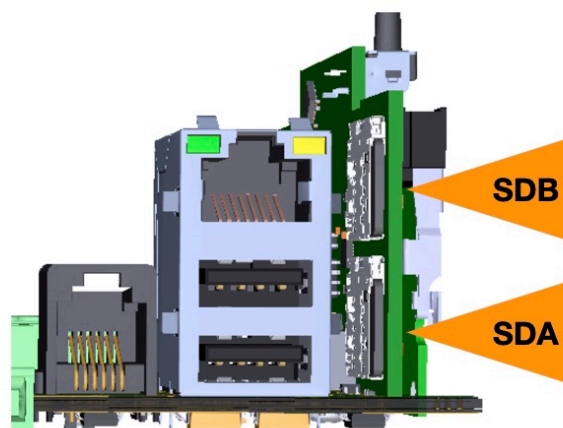
The external UPS battery

To take advantage of the UPS features of Flowfinity M1, you can connect an external lead acid rechargeable battery to the BATT terminals. See the connection diagram above.

⚠ **WARNING**

Improper handling of lead acid batteries can result in an explosion of the batteries and/or release of harmful substances.

Worn-out or defective batteries can compromise the function of this product.

Replace the battery every 5 years even if the battery is still working properly.

Only use a lead acid battery with electrical ratings recommended in the technical specifications for this product (12V, 7Ah max).

Reversing the battery polarity may damage the product and the battery.

Dispose of used batteries according to local regulations and the battery manufacturer's instructions.

Follow the battery manufacturer's instructions when installing the external UPS battery (not provided).

Replacing the RTC backup battery

Flowfinity M1 has a hardware real time clock with a dedicated long-life non-rechargeable back-up battery.

Flowfinity M1 is shipped with a **CR1220**[1] Lithium / Manganese Dioxide (Li/MnO2) battery installed.

The battery is only used to power the RTC chip when the main power is not available. Depending on operating conditions it should last up to two years if the Flowfinity M1 is not powered, more if it regularly receives external power.

The RTC backup battery holder is on the vertical circuit board, opposite the Compute Module slot. In the Flowfinity M1, the battery is not accessible from the outside. You should first remove the case body to gain access to the Flowfinity M1 circuit boards assembly. Follow the procedure described at the beginning of this chapter to open and replace the case.

⚠ **WARNING**

Improper handling of lithium batteries can result in an explosion of the batteries and/or release of harmful substances.

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[1] BR1220 batteries (Lithium Poly-carbonmonofluoride) can also be used, for improved shelf and service life.

Worn-out or defective batteries can compromise the function of this product.

KEEP OUT OF REACH OF CHILDREN. Swallowing may lead to serious injury or death in as little as 2 hours due to chemical burns and potential perforation of the esophagus. Immediately see doctor.

Replace the RTC lithium battery before it is completely discharged. Replace the battery every 5 years even if the battery is still working properly. The lithium battery must be replaced only with an identical **CR1220** or **BR1220** battery.

Do not throw lithium batteries into fire, do not solder on the cell body, do not recharge, do not open, do not short-circuit, do not reverse polarity, do not heat above 100°C and protect from direct sunlight, moisture and condensation.

Dispose of used batteries according to local regulations and the battery manufacturer's instructions.

NOTICE

Before opening the Flowfinity M1 enclosure, disconnect all power sources and any connection to external devices, including USB cables.

Once the circuit boards assembly is extracted from the enclosure, the most convenient way to access the battery holder is to first separate the vertical board from the base board.

This is easily accomplished by unscrewing the two screws on the bottom side of the base board, that secure the vertical board to it. Pay attention not to touch any of the electronic components with the screwdriver head. Once the screws are removed, the vertical board easily separates from the base. Be careful not to stress the board-to-board connector.
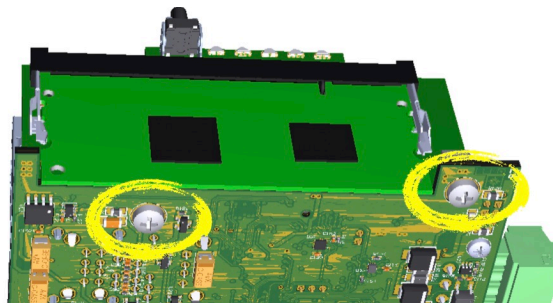
VERTICAL BOARD SCREWS

Use a non-conductive pin or small tool to help extract the battery from its holder. Insert the new battery with a gentle push. You don't need tools to insert the battery. The battery is held into place by a spring contact.

Be sure to insert the battery so that the negative (-) terminal is facing the vertical circuit board, and touches the contact pad at the center of the battery holder, as shown in the photo below. Reattach the vertical board to the base; use light torque to tighten the screws.

Reversing the battery polarity may damage the product.

The real time clock will reset its time immediately when the RTC backup battery is disconnected.
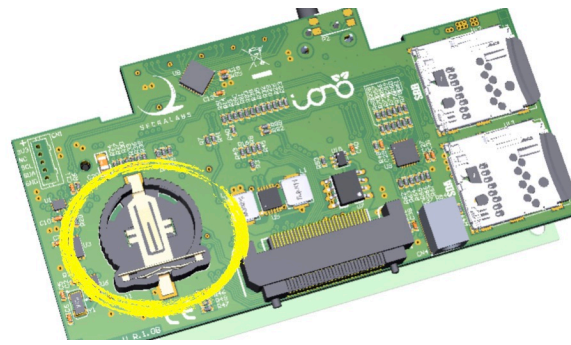
RTC BACKUP BATTERY HOLDER

RTC BACKUP BATTERY INSTALLED

Terminal blocks

Flowfinity M1 has several pluggable terminal blocks.

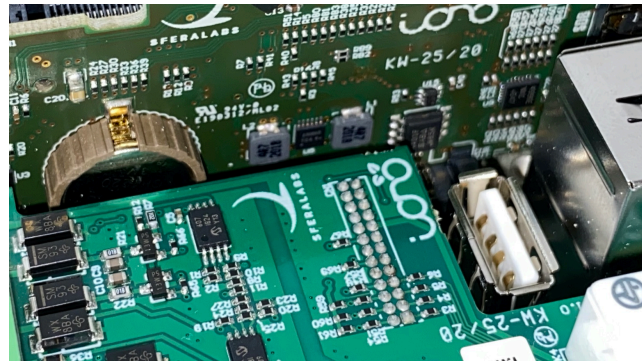All power supply, input/output and serial interfaces are on 3.81mm pitch terminal blocks.

The maximum conductor cross section is 1.31 mm^2 (16 AWG), or 0.5 mm^2 when using ferrules (highly recommended). Recommended stripping length is 6 mm. Screw thread is M2. Never exceed 0.3 Nm torque when tightening the screws.

Two 6 positions terminal blocks are dedicated to the power relays outputs.

The maximum conductor cross section is 3.31 mm^2 (12 AWG). Recommended stripping length is 7 mm. Screw thread is M3. Never exceed 0.5 Nm torque when tightening the screws.
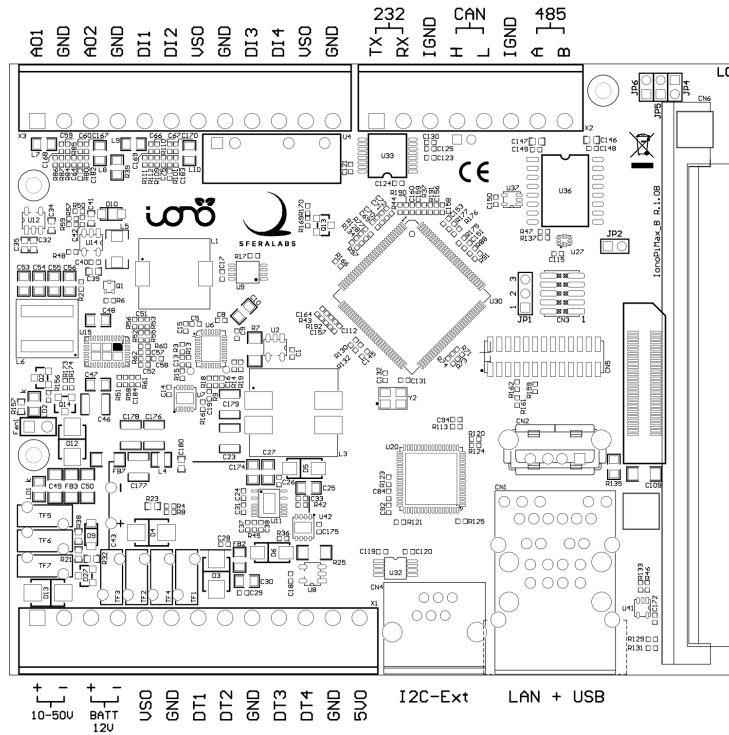
THE FLOWFINITY M1 BOTTOM CIRCUIT BOARD WITH TERMINAL BLOCKS
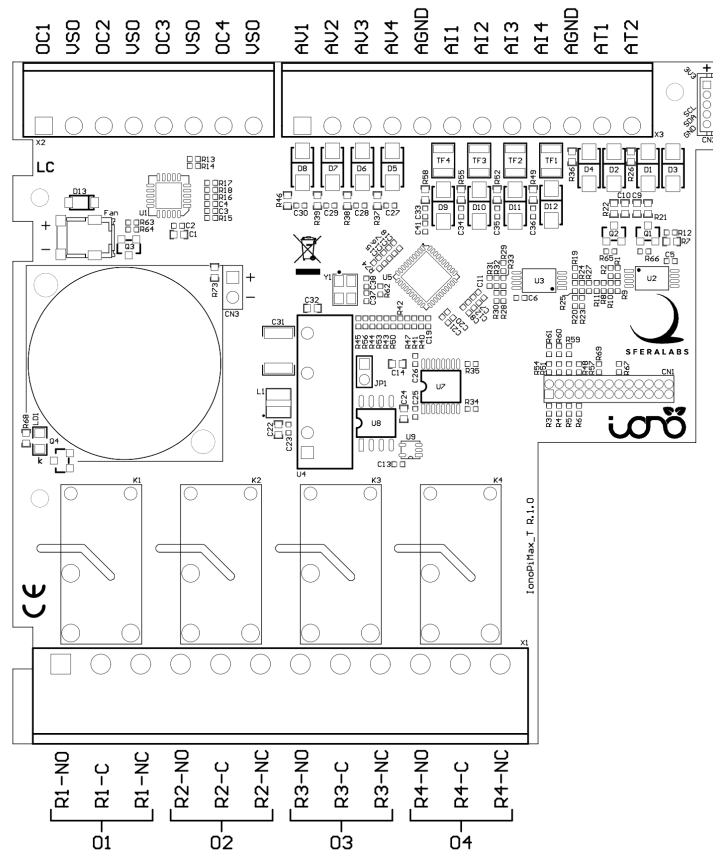
THE FLOWFINITY M1 TOP CIRCUIT BOARD WITH TERMINAL BLOCKS

Power supply

Flowfinity M1 can be powered with DC voltage only:

✓ DC: nominal voltage range 10.0V to 50.0V.

Respect the correct polarity shown in the schematic diagram (+ -). The power supply circuit implements reverse polarity protection using auto resetting fuses and surge protection up to ±1000V (line to earth, common mode) 1.2/50µs. The resetting fuse threshold is 3.3A at 20C ambient temperature.

The STATUS color LED, visible through the front panel of the DIN-rail case, is lit when power supply is available.

The Flowfinity M1 power supply stage is optimised to deliver up to 30W total power through its 5V main regulator. This regulator supplies all internal voltages, including the battery charger voltage, but not the VSO (auxiliary regulated 12-24Vdc output) regulator voltage, that draws directly from VIN or battery and can deliver up to 8W.

When the input voltage is below 24V, if the total power demand is very high from both the main regulator and the VSO output, the input current threshold limit could be exceeded, causing the resettable fuse to trip.

Battery charger

The Flowfinity M1 UPS (uninterruptible power supply) implements a battery charger, that can charge an external lead-acid battery. Battery connected to the BATT terminals can be charged either by this internal charger or by an external charger. If using external charger you need to leave the internal charger disabled, in which case you can use either 12V or 24V batteries. If you would like to use internal charger, only a single Yuasa NP7-12 or NP7-12FR battery is supported.

The battery line is protected by an internal 3.3A resettable fuse.

⚠ WARNING

Ensure that the charger parameters are correctly configured before connecting the battery to the battery terminals.

Auxiliary voltage outputs

Flowfinity M1 has an auxiliary regulated voltage output, labeled +VO on the terminal block, that can be set in a 12Vdc to 24Vdc voltage range, and is powered by the UPS. It can deliver up to 8W, and its output is protected by a 1.1A resettable fuse.

Flowfinity M1 also has an auxiliary 5Vdc voltage output pin on the terminal block, labeled +5VO, to supply power to external 5V loads, like 1-Wire devices. The current output limit is 500mA. An internal protection circuit shuts down the +5VO line if the current limit is exceeded.

In the factory default configuration, both the +5VO and +VO outputs are enabled, with +VO set for 12V output voltage.

RS-232 serial port

Flowfinity M1 implements a standard RS-232 port, without hardware flow control. This port is not galvanically isolated.

RS-485 serial port

Flowfinity M1 implements a standard RS-485 port.

The RS-485 port is galvanically isolated using a dedicated isolated differential line transceiver and a high-efficiency DC-DC converter. This configuration should prevent ground loops between devices connected through this port.

The IGND terminal is the isolated ground reference for the RS-485 serial lines. Always use this line, not GND, for the RS-485 connection.

The RS-485 line has 620 Ohm pull-up and pull-down resistors on lines A and B. The biasing resistors ensure that, during idle periods the data lines are kept at a stable voltage level and prevent false triggering of receiver input. These resistors can be disabled by removing jumpers JP4 and JP6 respectively.

A 100 Ohm termination resistor between A and B is connected when the JP5 jumper is inserted.

Jumpers JP4, JP5 and JP6 are located on the base circuit board, to the left of the RS-485 terminal block.
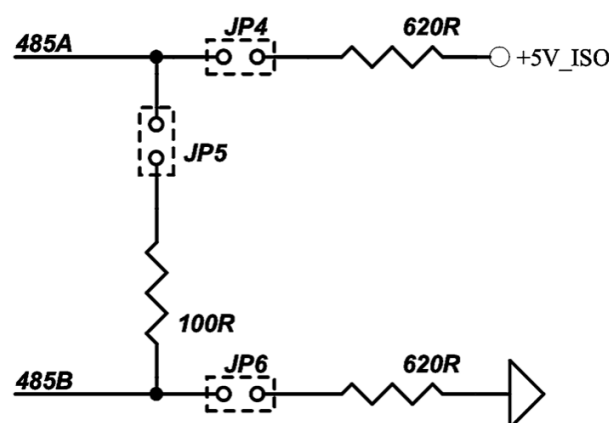
RS-485 JUMPERS SCHEMATIC
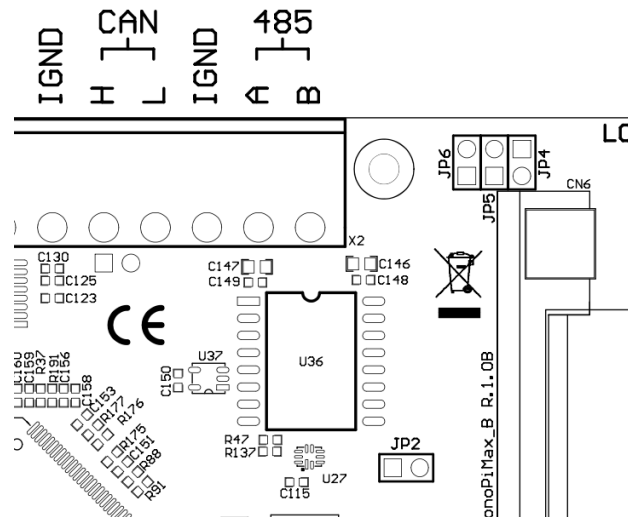
RS-485 JUMPERS AND SWITCH POSITION

BUS port

The BUS port is a proprietary 5V bidirectional I2C interface exposed on a 6-position RJ12 socket that can be used to connect external devices.

NOTICE

All lines of the BUS port are at 5V level. Do not connect incompatible devices, like 3.3V I2C devices, telephone equipment or any other device not specifically designed to be connected to this proprietary port.

Pin #	Description
1	5 VDC out
2	AUX in/out (active low)
3	SCL
4	SDA
5	GND
6	GND
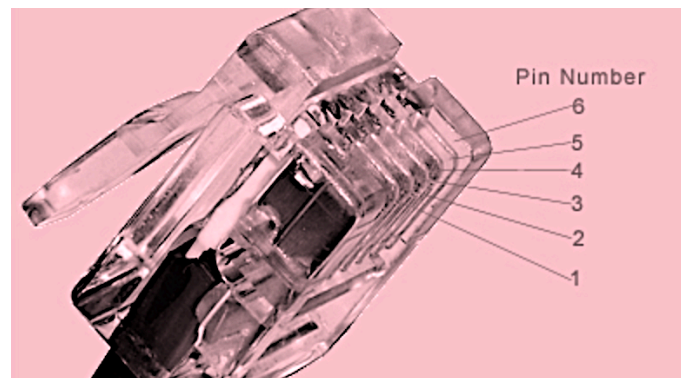
EXP INTERFACE PLUG PINS

USB ports power management

Flowfinity M1 has two external USB ports, USB1 (bottom) and USB2 (top), and one additional internal port.
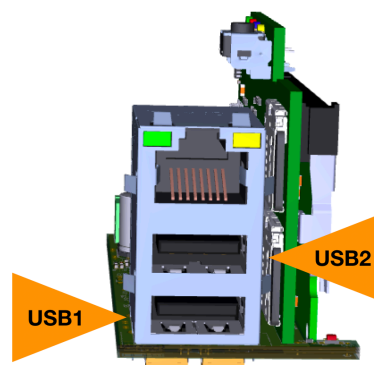
USB PORTS

These ports are individually controlled by the MIC2076, a power distribution controller with circuit protection. The MIC2076 is internally current limited and has thermal shutdown that protects the device and load (0.5A max). A fault status output flag is asserted during over-current and thermal shutdown conditions. The top and internal ports share the same power control line, and can't be powered independently. They share the 0.5A maximum load.

LEDs

Flowfinity M1 has five RGB LEDs visible through the front panel.

An additional blue LED on the bottom and top circuit boards, that is not visible from the outside, flashes continuously when Flowfinity M1 is powered and the Microcontroller control firmware is running. It remains steadily on when the firmware is not running (microcontroller reset or not programmed, or critical firmware error conditions).

The top LED is a STATUS indicator. Please refer to Flowfinity M1 User Guide for detailed information on STATUS LED.

UPS and battery charger

When an external lead-acid rechargeable battery is connected to Flowfinity M1 battery terminals, the Raspberry Pi Compute Module and all Flowfinity M1 features will remain powered when the main power supply fails, as long as there is enough energy in the battery.

When power is available and internal charger is enabled in the Flowfinity M1 configuration, the external rechargeable battery is charged with a current that depends on the battery voltage, or kept fully charged with a minimal floating current.

Battery operations status is visually indicated with the STATUS front panel LED.

Starting from a power off condition, Flowfinity M1 will not power-up if only the back-up battery is connected.

Auxiliary voltage outputs

Flowfinity M1 has an auxiliary regulated voltage output, labeled +VO on the terminal block, that can be set in a 12Vdc to 24Vdc voltage range, and is powered by the UPS.

In the factory default configuration, +VO is enabled, and set for 12V output voltage.

Flowfinity M1 also has an auxiliary 5Vdc voltage output pin on the terminal block, labeled +5VO, to supply power to external 5V loads, like 1-Wire devices. The current output limit is 500mA. An internal protection circuit shuts down the +5VO line if the current limit is exceeded.

In the factory default configuration, +5VO is enabled.

Analog inputs

Flowfinity M1 has voltage, current and Pt100/Pt1000 sensors analog inputs. All analog inputs are galvanically isolated from the main power supply rail and all digital logic in Flowfinity M1.

The AGND terminals are the ground reference for the analog inputs.

All these inputs are connected to a low-noise, high-resolution 24-bit analog-to-digital converter, the Analog Devices AD4112, which is factory calibrated to achieve a high degree of accuracy.

AVx: Analog voltage inputs

Flowfinity M1 has 4 single-ended analog voltage inputs that can be individually configured in unipolar mode, with a 0-20V range, or in differential mode, with a -20V to +20V range.

The ADC is factory calibrated to achieve a ±0.06% accuracy (at 25°C). The voltage inputs front-end impedance is ≥1 MOhm.

NOTICE

The voltage inputs are protected from electrostatic discharge with transient voltage suppression diodes. The AD4112 voltage inputs have a ±50V absolute maximum rating. Connecting a voltage source outside the measuring range could damage the ADC or other electronic components.

AIx: Analog current inputs

Flowfinity M1 has 4 analog current inputs with a 0-20mA range.

The ADC is factory calibrated to achieve a ±0.08% accuracy (at 25°C). The current inputs front-end impedance is 240 Ohm.

NOTICE

The current inputs are protected from electrostatic discharge with transient voltage suppression diodes. Resettable fuses on each input line also protect from over-current events. Even with these protections in place, input currents exceeding 50mA could damage the ADC or other electronic components.

TEMPx: Temperature sensors inputs

Flowfinity M1 has two inputs dedicated to connect two-wire resistance temperature sensors (RTD). Both Pt100 and Pt1000 standard sensors are supported.

The two sensors included with Flowfinity M1 package are PT1000 type with general purpose accuracy rating.

AOx: Analog voltage and current outputs

Two analog outputs can be independently configured as 0-10V voltage or 0-20mA current drivers. The current outputs are active, as they supply, not sink, current to the current loop.

DIx: Digital inputs

Flowfinity M1 has four general purpose digital inputs.

They are protected by a resistor network, and pulled to ground when not connected.

NOTICE

The DIx digital inputs accept positive voltage levels up to 40Vdc. Applying out of range voltages could damage the product and connected devices.

Open collector outputs (RED, ORG, GRN, BLU)

Flowfinity M1 has four open collector outputs, with open circuit fault detection, and over-current/short detection and protection.

NOTICE

The open collector outputs can operate with positive voltage levels up to 50Vdc. Applying out of range voltages could damage the product and connected devices.

DTx: Digital input/output (Wiegand, 1-Wire)

DTx are four bidirectional TTL-level I/O lines (0÷5V), connected through bidirectional level shifters. They can be used as general purpose bidirectional data lines, as 1-Wire bus lines, or as couples of DATA0/DATA1 lines of up to two Wiegand interfaces.

Each DTx front-end circuit has a 10.0kOhm pull-up and 220Ohm series resistors, and is protected from over-voltage and electrostatic discharge.

NOTICE

Never apply voltages outside the 0-5V range to this pin to avoid damage to the Flowfinity M1.
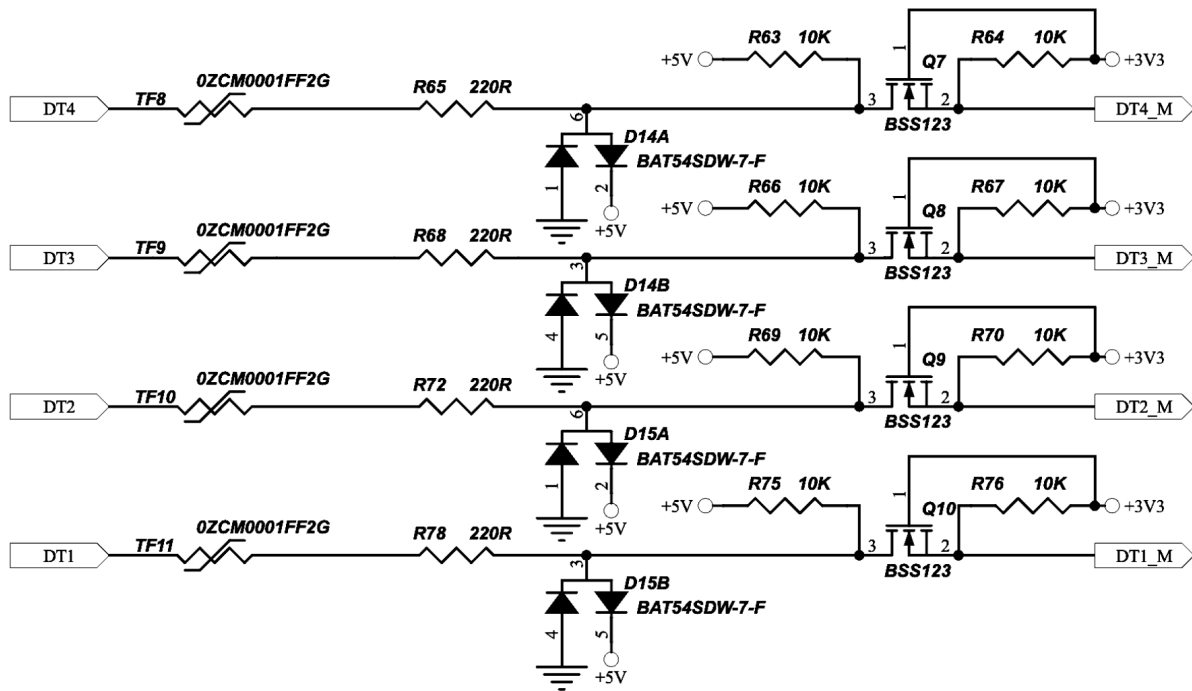
TTL LEVEL CONVERTER CIRCUIT AND PROTECTION

Rx: Relays

Flowfinity M1 has four relays with change-over (CO), Single Pole Double Throw (SPDT) terminals, with normally open (NO) and normally closed (NC) contacts=.

Earthquake sensor module

Flowfinity M1 can be shipped with an optional, factory-installed earthquake sensor module based on the OMRON D7S vibration sensor.

This module is soldered to the bottom side of the top circuit board (the analog, open collector and relays board) and cannot be removed by the user.

Thermal considerations for Flowfinity M1

The Raspberry Pi Compute Module draws power and generates heat proportionally to CPU and GPU load.

The Flowfinity M1 main regulator, battery charger and VSO regulator also generate a substantial heat proportionally to the total amount of current that has to be supplied to the Pi and, if present, external devices.

The thermal behaviour of Flowfinity M1 is dynamic and affected by operating conditions and the external environment temperature.

A small internal fan, directly overhead the voltage regulators area of the main circuit board, plays an important role keeping the temperature inside the enclosure at reasonable levels, even under heavy electrical load conditions. The fan starts only when temperature or power draw exceed preset levels, or when internal battery charger is charging the external backup battery.

The following charts show the thermal behaviour of Flowfinity M1 in different conditions, in a typical installation with the device under test installed in a standard, not ventilated DIN cabinet:

- 30C and 45C ambient temperature (the ambient temperature is measured inside the DIN cabinet, so it is the actual air temperature surrounding the Flowfinity M1 enclosure)

- Raspberry Pi 3 Compute Module 3 B+

- Low electrical load versus high electrical load conditions.
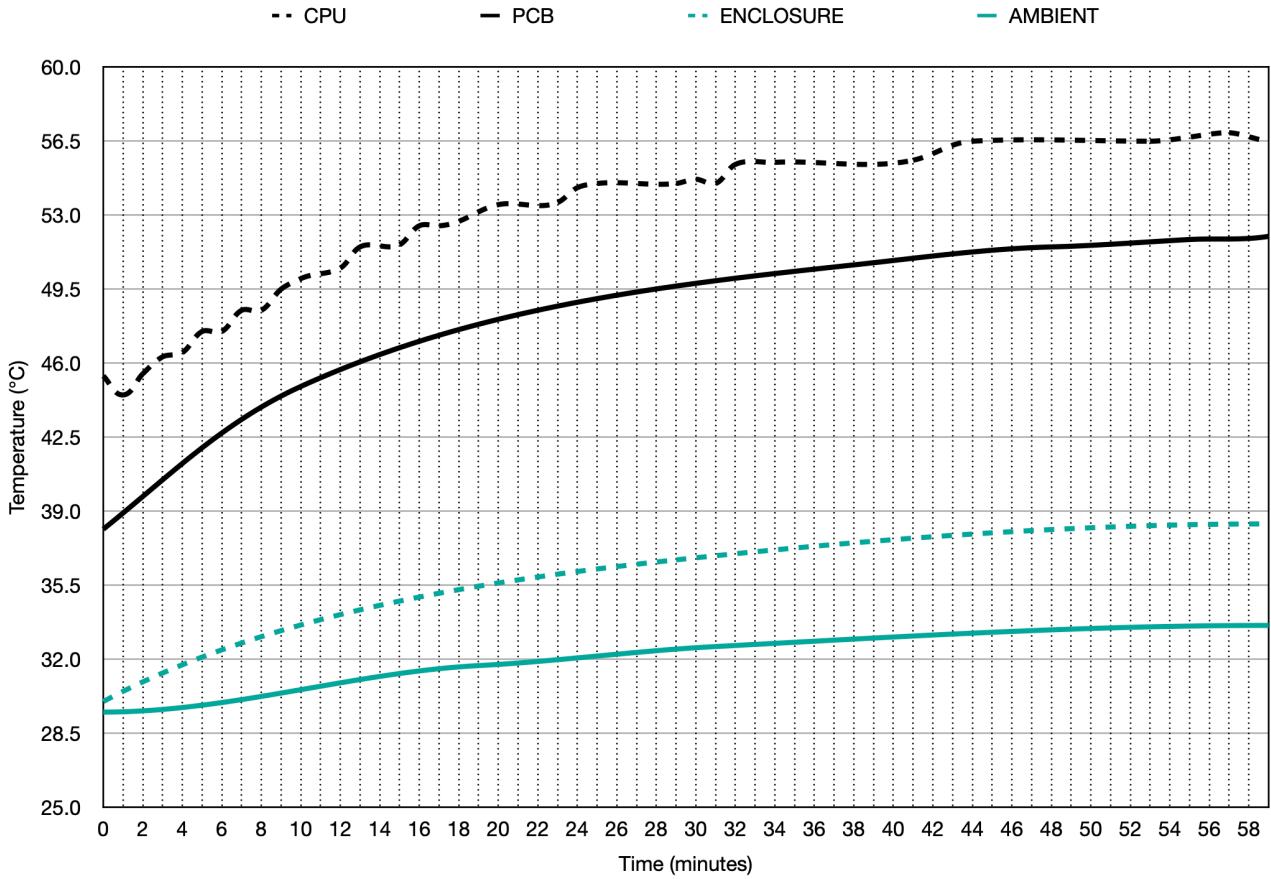
30C AMBIENT TEMPERATURE, LOW ELECTRICAL LOAD (VIN 24 V, IIN 0.15 A)
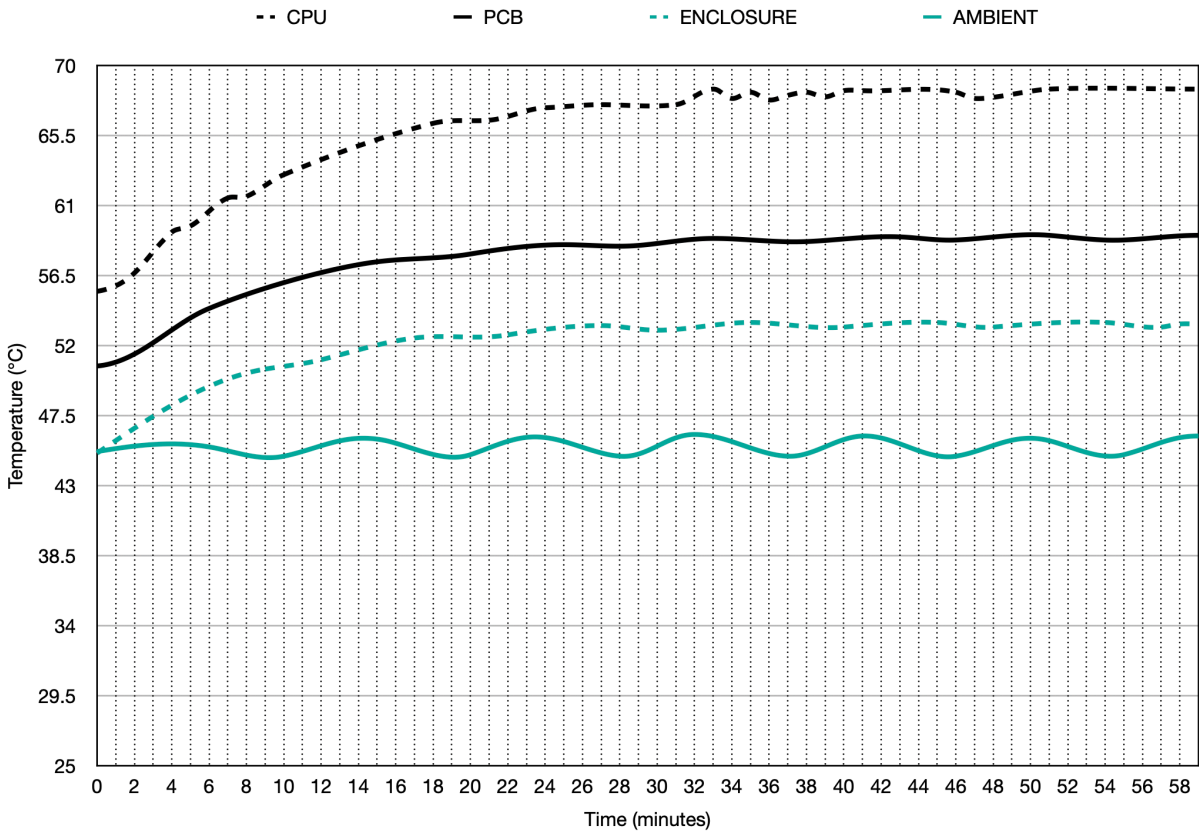
45C AMBIENT TEMPERATURE, HIGH ELECTRICAL LOAD (VIN 24 V, IIN 0.75 A)

Technical specifications

Note: all values typical, at +25 °C and under normal operating conditions.

POWER SUPPLY	
Power supply operating voltage(VS) (marked "12÷24V DC")	10…50 V⎓ (VDC) Reverse polarity protection with 3.3 A resettable fuse. Surge protection up to ±1000 V / 2 Ohms 1.2/50 µs
Current consumption at VS+ 12 V⎓ including Raspberry Pi CM3+, with Ethernet connected, no USB devices, VSO off, 5V0 off, UPS enabled, battery fully charged, relays off	low CPU load: 0.31 A, 100% CPU load, before throttling: 510 mA
Current consumption at VS+ 12 V⎓ including Raspberry Pi CM3+, with Ethernet connected, no USB devices, VSO on 24 V 8 W, 5V0 on 500 mA, UPS enabled, battery fully charged, relays off	low CPU load: 1.40 A
Current consumption at VS+ 12 V⎓ including Raspberry Pi CM3+, with Ethernet connected, no USB devices, VSO on 24 V 8 W, 5V0 on 500 mA, UPS enabled, battery charging, relays all on	100% CPU load, before throttling: 1.95 A
Current consumption at VS+ 24 V⎓ including Raspberry Pi CM3+, with Ethernet connected, no USB devices, VSO off, 5V0 off, UPS enabled, battery fully charged, relays off	low CPU load: 0.17 A, 100% CPU load, before throttling: 0.27 A
Current consumption at VS+ 24 V⎓ including Raspberry Pi CM3+, with Ethernet connected, no USB devices, VSO on 24 V 8 W, 5V0 on 500 mA, UPS enabled, battery fully charged, relays off	low CPU load: 0.67 A
Current consumption at VS+ 24 V⎓ including Raspberry Pi CM3+, with Ethernet connected, no USB devices, VSO on 24 V 8 W, 5V0 on 500 mA, UPS enabled, battery charging, relays all on	100% CPU load, before throttling: 0.90 A
UPS external battery for backup power source charged by external charger (not included)	12 V or 24 V lead acid battery. Suggested capacity: 7 Ah. Reverse polarity protection with 3.3 A resettable fuse. Surge protection up to ±500 V / 2 Ohms 1.2/50 µs
UPS external battery (not included) for use with internal charger	Yuasa NP7-12 or NP7-12FR Reverse polarity protection with 3.3 A resettable fuse. Surge protection up to ±500 V / 2 Ohms 1.2/50 µs
UPS battery charge voltage	15 V (Max. for 12V batteries)
UPS battery charge current	500 mA (Max. for 12V batteries)

|	
Voltage threshold for switching to battery mode	below 7.0 V
VSO output voltage range (marked "+VO")	+11.5…+24.5 V
VSO output power	8W (Max)
VSO output resettable fuse	1.1 A
5VO output voltage (marked "+5VO")	4.7 V (no load) 4.6 V (10 Ohm load)
5VO output current (marked "+5VO")	500 mA (Max)
USB1 port output current	500 mA (Max)
USB2 + USB_INTERNAL port output current	500 mA (Max)
BUS port output voltage	5 V
BUS port output current	500 mA (Max)
COMMUNICATION PORTS	
Serial communication ports	RS-485 Half-Duplex with automatic data direction management RS-232 Full-Duplex
Baud Rates on COMM ports	1200 to 115200
ESD-Protection Voltage on RS-232 TX/RX	±15 kV human body model ±8 kV contact discharge
ESD-Protection Voltage on RS-485 A/B	±15 kV human body model ±8 kV contact discharge
Surge protection on RS-485 A/B	Surge protection up to ±500 V / 2 Ohms 1.2/50 µs; 600 W peak pulse power capability at 10/1000 µs waveform
Fail safe feature on RS-485	Yes
USB ports	USB 2.0 Type A
Ethernet Port	10/100 Mbps
AVx: ANALOG VOLTAGE INPUTS	
Input voltage range	0…20 V
Input impedance	> 1 MOhm
Total Unadjusted Error (TUE)	±0.06 % of full-scale
Resolution	24 bits (Max)
AIx: ANALOG CURRENT INPUTS	
Input current range	-0.5…+24 mA
Input impedance	240 Ohm
Total Unadjusted Error (TUE)	±0.08 % of full-scale
Resolution	24 bits (Max)

TEMPx: TEMPERATURE SENSORS INPUTS (PT100, PT1000)	
Temperature range	-150…+400 °C
Accuracy (not including Pt and cable errors)	± 0.3 °C ± 0.05 % of reading
Resolution	24 bits (Max)
AOx: ANALOG VOLTAGE OUTPUTS	
Output range	0…+10 V
Output drive current	15 mA (Max)
Total Error	±0.5 % of full-scale (Max)
Resolution	12 bits
AOx: ANALOG CURRENT OUTPUTS	
Output range	0…+20 mA
Output drive voltage	12 V (Max)
Total Error	±0.5 % of full-scale (Max)
Resolution	12 bits
DIx: DIGITAL INPUTS	
Input voltage range	0…40 V
Input impedance	6.9 kOhm
Voltage threshold	VIH: 4.2 V VIL: 3.4 V
OPEN COLLECTOR OUTPUTS (MARKED "RED", "ORG", "GRN", "BLU")	
Sink current	200 mA (Max)
On resistance	3 Ohm
Voltage range	0…50 V
DTx: DIGITAL INPUT/OUTPUT	
Output voltage	VOL: 0.2 V VOH: 5.0 V
Input voltage threshold	VIH: 2.4 V VIL: 0.8 V
Pull-up (+5 V)	10 kOhm
Rx: RELAYS	

Maximum output contact rating (each output)	Resistive load (cos φ = 1): 6A at 250V~ (1500VA) Inductive load (cos φ = 0.5): 1A at 250V~ (250VA) Fluorescent lamps:150W with 20uF MAX power factor correction capacitor Resistive load (DC1): • 3 A at 30 Vdc • 0.35 A at 110 Vdc • 0.2 A at 220Vdc
Electrical life at rated load AC1	50000 cycles
Mechanical life	20000000 cycles
REAL TIME CLOCK	
Oscillator frequency	32768 Hz
Frequency Tolerance	±20.00 ppm
Backup battery	Internal RTCC circuit with backup lithium battery. Only use CR1220 or BR1220 batteries. Expected battery life without main power supply: ~2 years
EERAM	
Capacity	16 Kbit (2048 x 8 bits)
SRAM r/w cycles	Infinite
EEPROM store cycles	> 1000000
Data retention	> 200 years
INTERNAL TEMPERATURE SENSORS	
Temperature accuracy	±2 °C
Resolution	11 bits (0.125 °C)
INTERNAL VOLTAGE SENSORS (VS, BATT, VSO)	
Voltage range	0…58 V (VS) 0…30 V (BATT, VSO)
Total Unadjusted Error (TUE)	±0.25 % of full-scale
Resolution	12 bits
INTERNAL CURRENT SENSORS (VS, BATT, VSO)	
Current range	0…4 A (VS) 0…1 A (BATT, VSO)
Total Unadjusted Error (TUE)	±2.5 % of full-scale
Resolution	12 bits
EMI IMMUNITY STANDARDS	

Electromagnetic immunity compliance	EN 61000-4-2 (ESD) EN 61000-4-3 (Radiated RF Field) EN 61000-4-4 (Burst/fast transient) EN 61000-4-5 (Surge) EN 61000-4-6 (Conducted) EN 61000-4-8 (Power frequency magnetic field)
ENVIRONMENTAL	
Operating temperature	-20…+60 °C (non-condensing humidity)
Storage temperature	-30…+80 °C
Protection degree	IP20
MECHANICAL	
3.81 mm pitch terminal block characteristics	Maximum conductor cross section: 1.3 mm2 (16AWG), or 0.5 mm2 when using ferrules (highly recommended) Recommended stripping length: 6 mm Screw thread: M2 Maximum screws tightening torque: 0.3 Nm
5.08 mm pitch terminal block characteristics (relays)	Maximum conductor cross section: 3.3 mm2 (12AWG) Recommended stripping length: 7 mm Screw thread: M3 Maximum screws tightening torque: 0.5 Nm
Dimensions	6 module Din Rail enclosure width: 106.5 mm height: 90.5mm depth: 62.0mm
Weight	330 g (including Raspberry Pi Compute Module)

Dimensions

DIMENSIONS (mm)

Flowfinity M1 User Guide

Disposal

Waste Electrical & Electronic Equipment
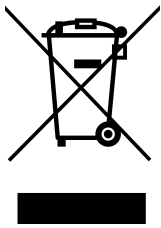
(Applicable in the European Union and other European countries with separate collection systems). This marking on the product, accessories or literature indicates that the product should not be disposed of with other household waste at the end of their working life. To prevent possible harm to the environment or human health from uncontrolled waste disposal, separate these items from other types of waste and recycle them responsibly to promote the sustainable reuse of material resources.

Household users should contact either the retailer where they purchased this product, or their local government office, for details of where and how they can take these items for environmentally safe recycling. This product and its electronic accessories should not be mixed with other commercial wastes for disposal.

Flowfinity M1 contains a small non rechargeable manganese dioxide lithium coin battery.

In the Flowfinity M1, the battery is not accessible from the outside. You should first remove the case body to gain access to the Flowfinity M1 circuit boards. Always remove the battery before disposing of this product.

Installation and use restrictions

Standards and regulations

The design and the setting up of electrical systems must be performed according to the relevant standards, guidelines, specifications and regulations of the relevant country. The installation, configuration and programming of the devices must be carried out by trained personnel.

The installation and wiring of connected devices must be performed according to the recommendations of the manufacturers (reported on the specific data sheet of the product) and according to the applicable standards.

All the relevant safety regulations, e.g. accident prevention regulations, law on technical work equipment, must also be observed.

Safety instructions

Carefully read the safety information section at the beginning of this document.

Set-up

For the first installation of the device proceed according to the following procedure:

✓ make sure all power supplies are disconnected

✓ install and wire the device according to the schematic diagrams on the specific product user guide

✓ after completing the previous steps, switch on the power supply and other related circuits.

SFERALABS

Conformity Information

EU

This device complies with the following applicable European Community harmonised standards:

✓ 2014/30/EU - Electromagnetic Compatibility Directive (EMC)

✓ 2014/35/EU - Low Voltage Directive (LVD)

✓ 2011/65/EU and 2015/863/EU - Restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS)

The following harmonised standards have been used to demonstrate conformity to these directives:

✓ EN60664-1:2007 - Insulation coordination for equipment within low-voltage systems

✓ EN61000-6-2:2019 - EMC Immunity standard for industrial environments

✓ EN 61000-6-3:2007/A1:2011/AC:2012 - EMC Emission standard for residential, commercial and light-industrial environments

The declaration of conformity is available at: https://www.sferalabs.cc

USA

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

• Reorient or relocate the receiving antenna

• Increase the separation between the equipment and receiver

• Connect the equipment into an outlet on a circuit different from that to which the receiver is connected

• Consult the dealer or an experienced radio/TV technician for help.

Shielded cables must be used with this equipment to maintain compliance with FCC regulations.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

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CANADA

This Class B digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.

RCM AUSTRALIA / NEW ZEALAND

This product meets the requirements of the standard EN 61000-6-3:2007/A1:2011/AC:2012 - Emission for residential, commercial and light-industrial environments.