Strato Pi CM User Guide

August 2022

Revision 021

SCMB20X *Strato Pi CM Solo*

SCMB20XP1 *Strato Pi CM 3+ 8GB*

SCMB20XP2 *Strato Pi CM 3+ 16GB*

SCMB20XP3 *Strato Pi CM 3+ 32GB*

SCMB20X41 *Strato Pi CM 4S 8GB*

SCMB20X42 *Strato Pi CM 4S 16GB*

SCMB20X43 *Strato Pi CM 4S 32GB*

SFERALABS

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

Follow all applicable electrical safety standards, guidelines, specifications and regulations for installation, wiring and operations of Strato Pi CM.

Carefully and fully read this Strato Pi CM user guide before installation.

Strato Pi CM 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. Strato 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 Strato Pi CM 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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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.

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

This product 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

Strato Pi CM is an extremely powerful and compact industrial server based on the 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 2 modules DIN rail case.

It is available in several versions. Strato Pi CM 3+ ships with a Raspberry Pi Compute Module 3+ (8GB, 16GB and 32GB eMMC versions) pre-installed. Strato Pi CM 4S ships with a Raspberry Pi Compute Module 4S (8GB, 16GB and 32GB eMMC versions) pre-installed. Strato Pi CM Solo doesn't include the Compute Module and is compatible with all current versions of the Compute Module: 1, 3, 3+, 4S. It is not compatible with Compute Modules Lite models.

The information contained in this manual covers all Strato Pi CM versions. All Strato Pi CM versions are identical, except for the Compute Module model installed.

This manual generally refers to all products as Strato Pi CM.

Features

Strato Pi CM, all versions:

- ✓ 9-28Vdc power supply, with surge and reverse polarity protection, and 1.1A resettable fuse
- ✓ up to 1.9A max continuous current (3A peaks) to the 5V Raspberry Pi Compute Module power supply input pins (at 24Vdc)
- ✓ real time clock with replaceable CR1220 Lithium / Manganese Dioxide back-up battery
- ✓ standard RS-485 interface to the Raspberry Pi serial line, with opto-isolator and electrostatic discharge protection
- ✓ 10/100 Ethernet port
- ✓ two USB 2.0 type-A ports, with individual power control and fault detection
- ✓ hardware watchdog implemented in the Strato Pi CM micro-controller, fully independent from the Raspberry Pi Compute Module, controlled via the GPIO pins of the Raspberry Pi board and acting on the Raspberry Pi Compute Module hardware reset line
- ✓ integrated boot loader for the Strato Pi micro-controller, allowing in-field firmware upgrades directly from the Raspberry Pi
- ✓ embedded Microchip ATECC608 secure element chip
- ✓ front-panel LEDs for power supply, serial line activity, and one GPIO-controlled LED
- ✓ recessed push-button, hidden behind the front-panel, connected to a GPIO pin
- ✓ power supply and serial connections on a pluggable terminal block
- ✓ packaged in a compact 2 modules DIN rail case.

Strato Pi CM Solo:

- ✓ compatible with Raspberry Pi Compute Module 1, Raspberry Pi Compute Module 3, Raspberry Pi Compute Module 3+ 8GB, Raspberry Pi Compute Module 3+ 16GB, Raspberry Pi Compute Module 3+ 32GB, Raspberry Pi Compute Module 4S 8GB, Raspberry Pi Compute Module 4S 16GB, Raspberry Pi Compute Module 4S 32GB

Strato Pi CM 3+:

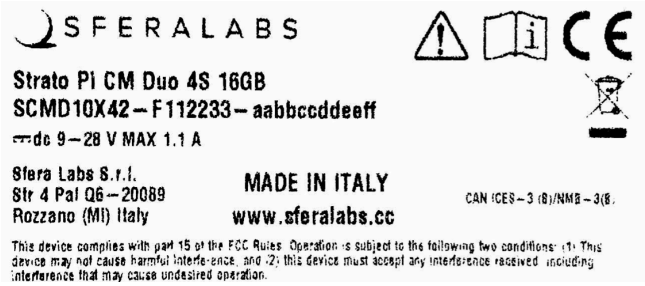
- ✓ pre-installed and tested Raspberry Pi Compute Module 3+, 8GB, 16GB or 32GB eMMC versions.

Strato Pi CM 4S:

- ✓ pre-installed and tested Raspberry Pi Compute Module 4S, 8GB, 16GB or 32GB eMMC versions

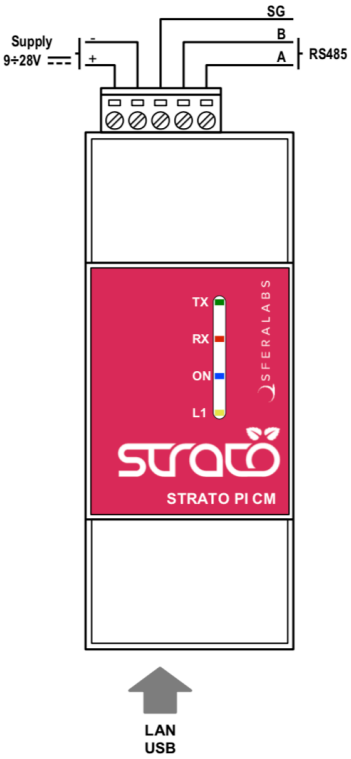
Device identification

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

Hardware Setup



STRATO PI CM CONNECTION DIAGRAM

For the initial set-up, the plastic DIN rail must be removed to access the circuit boards and internal connectors.

The case also needs to be opened if the factory configuration of the RS-485 termination resistors must be changed (see below).

NOTICE

Before opening the Strato Pi CM case, disconnect all power sources and any connection to external devices, including USB and Ethernet cables.

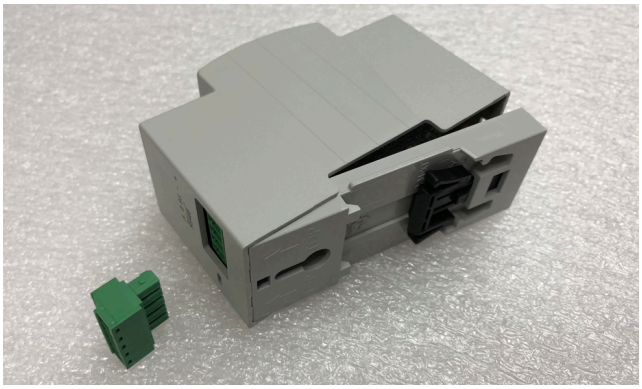
Opening the case

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

1. Remove the green pluggable terminal block
2. Remove the black plastic DIN rail hook
3. With a small flat screwdriver gently separate the bottom case and boards assembly from the top cover; lift the side next to the DIN rail hook first
4. The circuit boards assembly will simply slide out of the case, as it is mechanically held in place by the bottom case only

Closing the case

5. Replace the circuit boards assembly inside the case; ensure that the USB/Ethernet connectors are aligned with the opening in the case
6. Replace the case bottom, inserting the side opposite to the DIN rail hook first, then gently push the other side in place
7. Replace the black plastic DIN rail hook.



OPENING AND CLOSING THE CASE

Raspberry Pi Compute Module installation

To install your own Compute Module in Strato Pi CM Solo, or replace the pre-installed module, no tools are required. 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.

How to flash the eMMC

In order to flash the Compute Module's eMMC memory, an additional board, like the *Compute Module IO Board V3*, shall be used. Use the latest RPIBOOT utility from Raspberry Pi and refer to its documentation[1] for installation and usage details.

Alternatively, if using the Compute Module 4S (or a Compute Module 3/3+ with *USB host boot mode* previously enabled[2]) you can boot the unit from USB[3], access via SSH, and flash the eMMC which will be available as a local mass storage device.

Replacing the RTC backup battery

Strato Pi CM has a hardware real time clock with a dedicated long-life non-rechargeable back-up battery.

Strato Pi CM is shipped with a **CR1220**[4] 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 Strato Pi CM 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 Strato Pi CM, the battery is not accessible from the outside. You should first remove the case body to gain access to the Strato Pi CM circuit boards. 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.

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.

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[1] https://www.raspberrypi.com/documentation/computers/compute-module.html#flashing-the-compute-module-emmc

[2] https://www.raspberrypi.com/documentation/computers/raspberry-pi.html#usb-host-boot-mode

[3] https://www.raspberrypi.com/documentation/computers/raspberry-pi.html#booting-from-usb-mass-storage

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

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

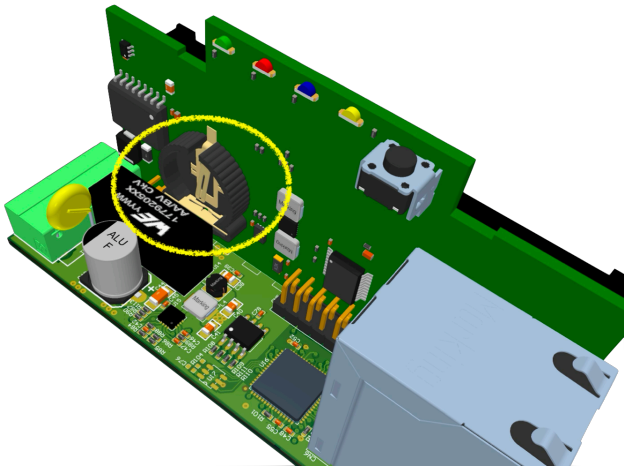
Before opening the Strato Pi CM case, disconnect all power sources and any connection to external devices, including USB cables.

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.

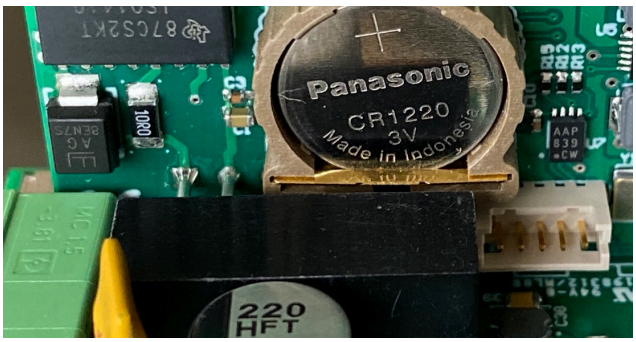
Be sure to insert the battery so that the negative (-) terminal is facing the vertical circuit board, and touches the contact pad at the center of the battery holder, as shown in the photo below.

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 block

Strato Pi CM has a 5 positions terminal block for power and serial connections.

The maximum conductor cross section is 1.5 mm^2 (16 AWG), or 0.5 mm^2 when using ferrules (highly recommended). Recommended stripping length is 5 mm. Screw thread is M2. Never exceed 0.25 Nm torque when tightening the screws.

Power supply

Strato Pi CM can be powered with DC voltage only:

✓ DC: nominal voltage range 9V to 28.0V.

Respect the correct polarity shown in the schematic diagram (+ -). The power supply circuit implements reverse polarity protection using an auto resetting fuse and surge protection up to ±1000V/2ohms 1.2/50µs.

A blue on-board LED, also visible through the front panel of the DIN rail case, is lit when power supply is available. This LED also blinks while the Compute Module boot process is in progress.

The Strato Pi CM power supply stage is optimised to deliver up to 1.9A at 5V to the Raspberry Pi Compute Module.

The voltage regulator can supply up to 3.0A 5V output short duration current peaks (<1sec).

Because Strato Pi CM has a 1.1A resettable fuse (polyfuse) on the power supply line, the maximum current that its regulator can deliver is also limited by this fuse, and depends on the input voltage.

The following table lists the typical measured output current of the power supply stage at different input voltages, and the corresponding input current. At high input voltage levels, the voltage regulator's thermal protection becomes the limiting factor.

		9V	12V	24V
Iout	**Vout**	**Iin**	**Iin**	**Iin**
0.1	5.00	0.07	0.06	0.03
0.5	4.98	0.33	0.25	0.13
1	4.95	0.69	0.50	0.25
1.3	4.93	0.93	0.66	0.33
1.5	4.92	1.11 FUSE	0.77	0.39
1.6	4.91		0.83	0.41
1.7	4.91		0.89	0.44
1.8	4.91		0.95	0.47
1.9	4.91		1.01	0.50
2	4.91		1.08 REG	0.54 REG

STRATO PI CM POWER SUPPLY STAGE TYPICAL IN/OUT VOLTAGE AND CURRENT[5]

[5] FUSE marks the level where the polyfuse opens to limit input current; REG is the voltage regulator's thermal protection limit.

Dedicated GPIO pins

Strato Pi CM uses some of the Raspberry Pi Compute Module GPIO pins. These pins should not be used for other functions.

GPIO pin	Direction	Description
GPIO2/SDA		I²C SDA line for the real time clock
GPIO3/SCL		I²C SCL line for the real time clock
GPIO14/TXD	out	serial TX line
GPIO15/RXD	in	serial RX line
GPIO32	out	cycle high/low for watchdog heartbeat
GPIO39	out	set to high to enable the watchdog
GPIO17	in	high on watchdog timeout
GPIO18	out	set to high to enable the shutdown cycle
GPIO16	out	set to high to turn on LED L1
GPIO38	in	high when P1 button pressed
GPIO37	out	soft serial TX for Strato MCU configuration
GPIO33	in	soft serial RX for Strato MCU configuration
GPIO30	out	set to low to enable USB1 (bottom) power
GPIO0	in	low on USB1 fault
GPIO31	out	set to low to enable USB2 (top) power
GPIO1	in	low on USB2 fault
GPIO6	out	expansion bus enable (reserved for future use)
GPIO34	in/out	expansion bus aux/act line (reserved for future use)

Software installation and configuration

All features of Strato Pi CM are controlled via dedicated GPIO, the I²C bus and a soft serial RX/TX interface to the embedded micro-controller and can be used with most operating systems and programming languages.

The following software installation notes are based on the Raspberry Pi OS (formerly Raspbian) operating system.

Installing the Strato Pi utility

The Strato Pi utility is a simple command-line script to control some of Strato Pi's basic functions.

Run the following commands to download and install the Strato Pi utility:

```
$ cd /usr/local/bin
$ sudo wget http://sferalabs.cc/files/stratocmduo/strato
$ sudo chmod 755 strato
```

You can run the Strato Pi utility without arguments to print its options:

```
$ strato
Usage: strato led on|off|length_millis|length_millis pause_millis repeats
       strato usb1|usb2 on|off|fault
       strato expbus on|off
       strato watchdog enable|disable|heartbeat|timeout
       strato reset
```

All commands should be run as superuser, so always use sudo to run strato.

Installing the Strato Pi kernel module

The Strato Pi kernel module can be used to easily access Strato Pi CM's features via sysfs file system.

Refer to the following instructions to download and install the module or go to:

https://github.com/sfera-labs/strato-pi-kernel-module

for updated instructions, usage details and examples.

Download and install:

```
$ sudo apt install git raspberrypi-kernel-headers
$ git clone --depth 1 --recursive https://github.com/sfera-labs/strato-pi-
kernel-module.git
$ cd strato-pi-kernel-module
$ make
$ sudo make install
$ dtc -@ -Hepapr -I dts -O dtb -o stratopi.dtbo stratopi.dts
$ sudo cp stratopi.dtbo /boot/overlays/
```

Add the following line to /boot/config.txt:

```
dtoverlay=stratopi
```

Optionally, to be able to use the sysfs files not as super user, create a new group "stratopi" and set it as the module owner group by adding an udev rule:

```
$ sudo groupadd stratopi
```

```
$ sudo cp 99-stratopi.rules /etc/udev/rules.d/
```

and add your user to the group, e.g., for user "pi":

```
$ sudo usermod -a -G stratopi pi
```

Reboot:

```
$ sudo reboot
```

You will find the directory /sys/class/stratopi/ which gives you access to Strato Pi CM's functionalities.

Installing the Real Time Clock software

The RTC is based on the Microchip MCP79410 module and is connected to the Raspberry Pi via its I²C serial bus.

Before downloading the installation utility, you should enable I²C and install the “i2c-tools” package.

To enable I²C, run the “raspi-config” configuration utility:

```
$ sudo raspi-config
```

Then go to “Interfacing Options”, “I2C” and select “yes” to enable the I²C interface, then reboot your Raspberry Pi.

To install the “i2c-tools” package:

```
$ sudo apt-get update
$ sudo apt-get install i2c-tools
```

With these prerequisite installs completed, you should download and run Strato Pi’s installation script:

```
$ cd
$ wget http://sferalabs.cc/files/strato/rtc-install
$ chmod 755 rtc-install
$ sudo ./rtc-install
```

If the script completes with no errors, delete the installation script and reboot:

```
$ rm rtc-install
$ sudo reboot
```

Testing the Real Time Clock

Assuming you are connected to the Internet and your Pi was able to reach a public NTP (Network Time Protocol) server, you should see the current date and time using the “date” command:

```
$ date
Thu Dec 10 18:02:32 CET 2015
```

Also check the date and time stored in the hardware clock:

```
$ sudo hwclock -r
Thu 10 Dec 2015 06:03:01 PM CET  -0.546570 seconds
```

If the returned date and time is not correct, or “hwclock” returns an error, use the “-w” option to set the hardware clock to the current time:

```
$ sudo hwclock -w
```

Then recheck the time stored in the hardware clock to ensure it matches. Linux may have failed to automatically update the hardware clock after the last reboot if its internal registers contained invalid values.

If the RTC still doesn’t work, you should check if the Pi sees the RTC chip on the I²C bus. Run these two commands:

```
$ sudo modprobe -r rtc_ds1307
$ sudo i2cdetect 1
WARNING! This program can confuse your I2C bus, cause data loss and worse!
I will probe file /dev/i2c-1.
I will probe address range 0x03-0x77.
Continue? [Y/n]
     0  1  2  3  4  5  6  7  8  9  a  b  c  d  e  f
00:          -- -- -- -- -- -- -- -- -- -- -- -- --
10: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
20: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
30: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
40: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
50: -- -- -- -- -- -- -- 57 -- -- -- -- -- -- -- --
60: 60 -- -- -- -- -- -- -- -- -- -- -- -- -- -- 6f
70: -- -- -- -- -- -- -- —
```

You should see “6f” in the address list. This is the address of the RTC.

If the RTC address is detected, double check your software installation for issues at the Linux modules level.

Run the “lsmod” command to list the loaded modules and check that “i2c_dev” and “i2c_bcm2708” are both listed.

If the RTC address is not detected, the cause could be a hardware problem, on the Strato board or the Raspberry Pi. If you have another Pi or Strato board, try swapping them to isolate the faulty board.

Configuring the serial port

By default, the Linux serial console is active on the main UART (/dev/ttyAMA0). If you are using the RS-485 interface for your applications, you should disable it to avoid console data being sent to the serial port.

To disable the ttyAMA0 console service, run:

```
$ sudo systemctl disable serial-getty@ttyAMA0.service
```

and edit the /boot/cmdline.txt file to delete the serial console configuration:

```
console=serial0,115200
```

Configuring the Ethernet port

Only when using the Compute Module 4S, add the following line in the /boot/config.txt file to enable the Ethernet port:

```
dtoverlay=dwc2,dr_mode=host
```

Using Strato Pi CM

Real Time Clock

Strato Pi CM has a hardware real time clock with a dedicated long-life non-rechargeable back-up battery.

Once the RTC modules and configuration files are properly installed, you will simply use the date and time commands to control the hardware clock.

RS-485 serial port

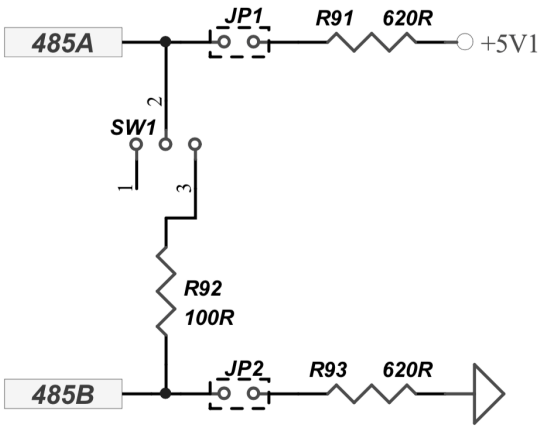
Strato Pi CM uses the Raspberry Pi standard UART TX/RX pins on the GPIO connector to implement a standard RS-485 port.

The RS-485 port is isolated from the Raspberry Pi's serial lines using dedicated opto-couplers and from the main power supply with a high-efficiency DC-DC converter. This configuration should prevent ground loops between devices connected through the serial line.

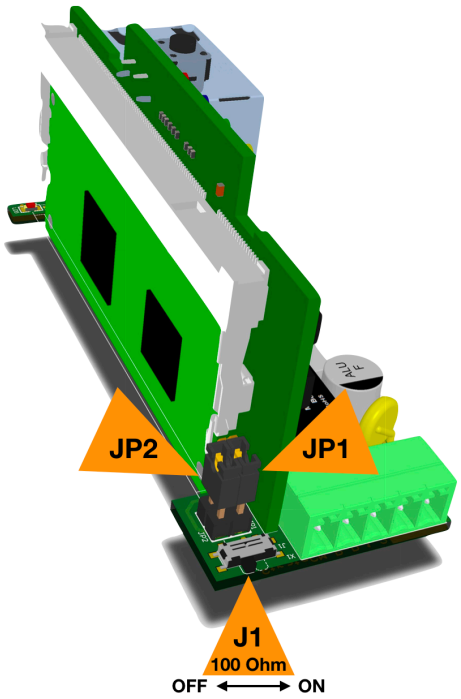
The RS-485 TX/RX switching is implemented automatically in the Strato Pi's micro-controller, based on speed and number of bits detection, and is completely transparent to the software controlling the UART on Raspberry Pi. It can also be manually configured to work with fixed communication parameters (speed, bits, parity, stop bits) or in passive mode (refer to the "Strato Pi Logic Controller Advanced Configuration Guide" document for additional information).

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 JP1 and JP2 respectively.

A 100 Ohm termination resistor between A and B is connected when the J1 micro-switch is moved toward the terminal block.



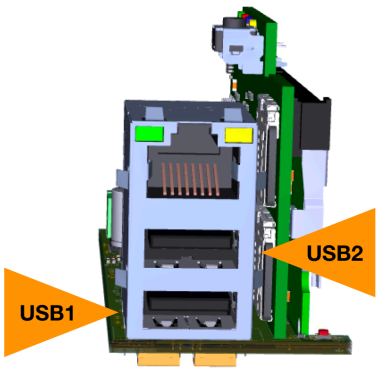
RS-485 JUMPERS AND SWITCH SCHEMATIC



RS-485 JUMPERS AND SWITCH POSITION

USB ports power management

Strato Pi CM has two USB ports, USB1 (bottom) and USB2 (top).



USB PORTS

Both 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. A fault status output flag is asserted during over-current and thermal shutdown conditions.

The power-enable inputs and the fault status outputs are routed to the Raspberry Pi's GPIO lines to easily control and monitor connected USB devices from your application.

Power is on by default. GPIO30 and GPIO31 control power to USB1 and USB2 respectively. Set GPIO30/31 low to enable power to USB1/2, or high to remove power.

The Strato Pi utility offers commands to control the USB ports power state.

USB1 on:

```
$ sudo strato usb1 on
```

USB1 off:

```
$ sudo strato usb1 off
```

GPIO0 and GPIO1 return the fault state of USB1 and USB2. These lines will be high in normal conditions, or low when a fault is present.

Print “1” if there is a fault on USB2, “0” if not:

```
$ sudo strato usb2 fault; echo $?
```

Secure element

Strato Pi CM embeds the ATECC608A or ATECC608B (depending on production lot) secure element chip from Microchip. The chip is connected to the Raspberry Pi Compute Module via the I2C bus (default address: 0x60).

Its key features are:

- ✓ Cryptographic co-processor with secure hardware-based key storage
- ✓ Protected storage for up to 16 Keys, certificates or data
- ✓ Hardware support for asymmetric sign, verify, key agreement – ECDSA: FIPS186-3 Elliptic Curve Digital Signature
    - ✓ ECDH: FIPS SP800-56A Elliptic Curve Diffie-Hellman
    - ✓ NIST standard P256 elliptic curve support
- ✓ Hardware support for symmetric algorithms
    - ✓ SHA-256 & HMAC hash including off-chip context save/restore
    - ✓ AES-128: encrypt/decrypt, Galois field multiply for GCM
- ✓ Networking key management support
    - ✓ Turnkey PRF/HKDF calculation for TLS 1.2 & 1.3
    - ✓ Ephemeral key generation and key agreement in SRAM – Small message encryption with keys entirely protected
- ✓ Secure boot support
    - ✓ Full ECDSA code signature validation, optional stored digest/signature – optional communication key disablement prior to secure boot
    - ✓ Encryption/Authentication for messages to prevent on-board attacks
- ✓ Internal high-quality FIPS 800-90 A/B/C Random Number Generator (RNG)
- ✓ Two high-endurance monotonic counters
- ✓ Guaranteed unique 72-bit serial number.

Push button

There is a recessed push button that is easily accessible removing the front panel. When this button is pressed, the Strato Pi CM controller will set GPIO38 high, so that an application can easily detect it by simply polling this GPIO line.

LED

Strato Pi CM has an on-board LED that can be controlled using GPIO16. Simply set GPIO16 high to turn on the LED.

The Strato Pi utility offers commands to control the LED.

LED on continuously:

```
$ sudo strato led on
```

LED off:

```
$ sudo strato led off
```

LED on for 500 milliseconds:

```
$ sudo strato led 500
```

LED on for 500 milliseconds, followed by 100 milliseconds off, repeated three times:

```
$ sudo strato led 500 100 3
```

Hardware watchdog

Strato Pi CM implements a dedicated hardware watchdog circuit that can be used to perform the hardware reset of the Raspberry Pi Compute Module.

Being controlled by Raspberry Pi's GPIO pins, it is extremely easy to control watchdog operation using simple custom scripts in your application.

Watchdog default behavior is described below, but all timing parameters and control logic can be modified as described in the "Strato Pi Logic Controller Advanced Configuration Guide" document.

The watchdog is normally disabled. To enable it, set GPIO39 pin to high. While GPIO39 is high, the Strato Pi CM controller will watch for state changes of the GPIO32 heartbeat pin. You should ensure that GPIO32 flips its state between high and low faster than every 60 seconds.

If the Strato Pi CM controller doesn't see GPIO32 changing state for more than 60 seconds, it will initiate a shutdown procedure, rising the GPIO17 timeout pin to high, to signal that a watchdog timeout has occurred.

If possible, you should immediately initiate a software shutdown on Raspberry Pi Compute Module, and set the GPIO18 shutdown pin to high. When GPIO18 is set to high or 60 seconds after the timeout, Strato Pi CM will wait 60 seconds more, then reset the Raspberry Pi Compute Module (pulling the RUN line low).

Note that Strato Pi CM will reset the Raspberry Pi Compute Module even if GPIO18 is not set high. In this case the power cycles occurs 120 seconds after the heartbeat timeout.

The Strato Pi utility can be used to control the watchdog from your own application.

Enable the watchdog:

```
$ sudo strato watchdog enable
```

Disable the watchdog:

```
$ sudo strato watchdog disable
```

Send the heartbeat:

```
$ sudo strato watchdog heartbeat
```

Print “1” if the watchdog timeout is expired, “0” if not:

```
$ sudo strato watchdog timeout; echo $?
```

Reset cycle

You can start a delayed reset cycle by rising Raspberry Pi’s GPIO18 pin.

When GPIO18 is set to high, Strato Pi CM will wait 60 seconds and then reset the Raspberry Pi Compute Module.

To initiate a delayed reset cycle:

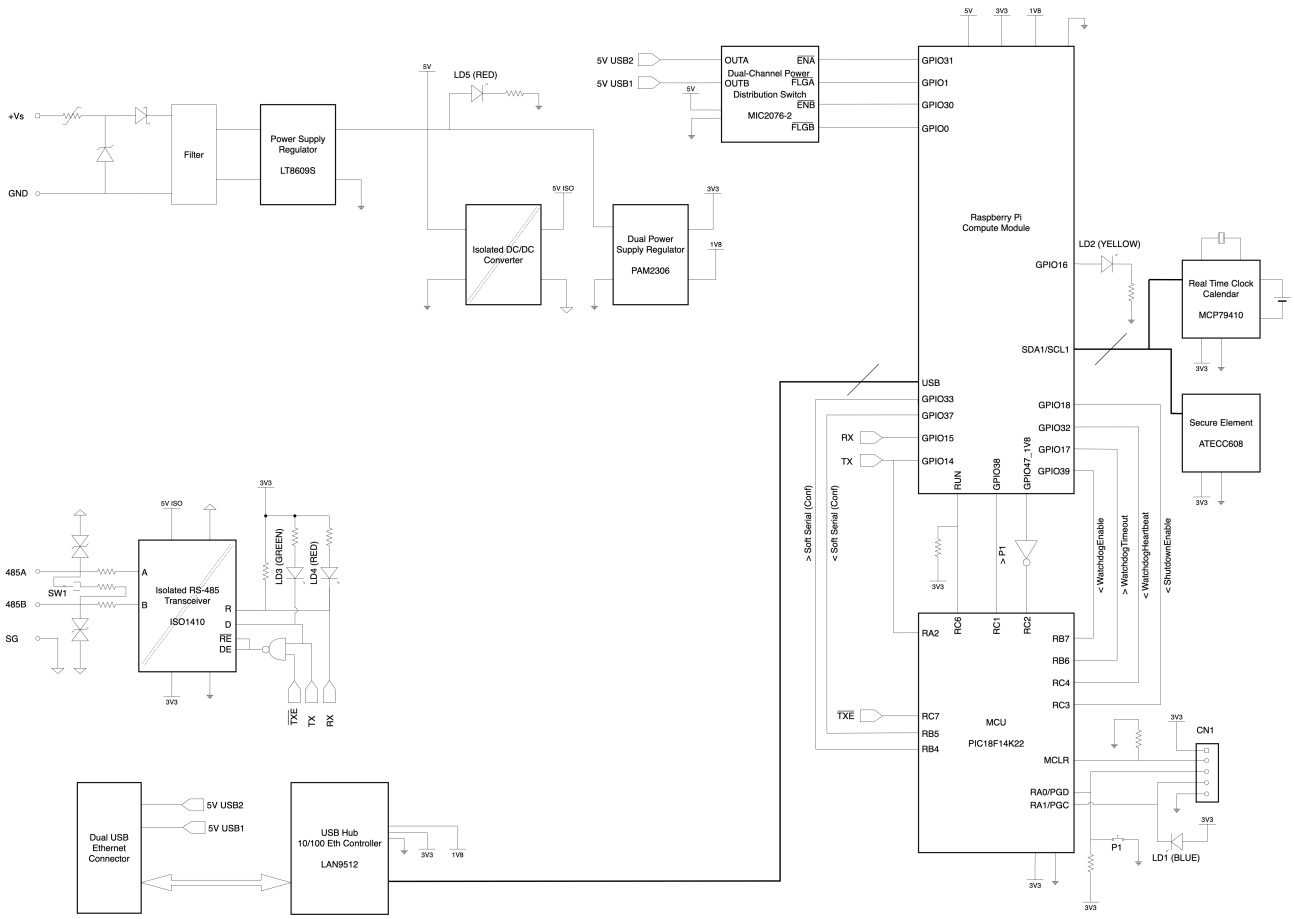
```
$ sudo strato reset
```

Advanced configuration

The Strato Pi CM logic controller can be configured from the Raspberry Pi to change the default behavior and timing of the hardware watchdog and reset features. The RX/TX switching mode (TX-Enable control) of the RS-485 serial port is also configurable.

These configuration parameters can be accessed using the Strato Pi kernel module or implementing the underlying ASCII-based serial protocol described in the "Strato Pi Logic Controller Advanced Configuration Guide" document.

Block diagram



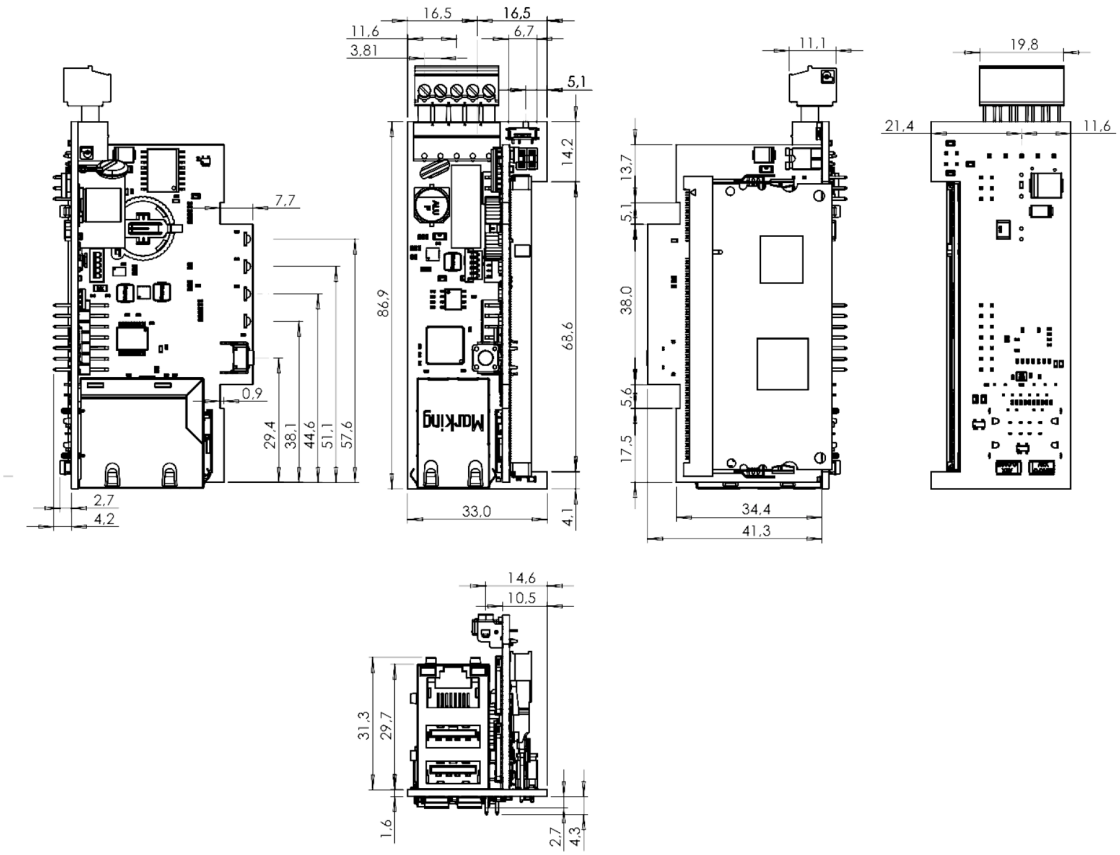
STRATO PI CM BLOCK DIAGRAM

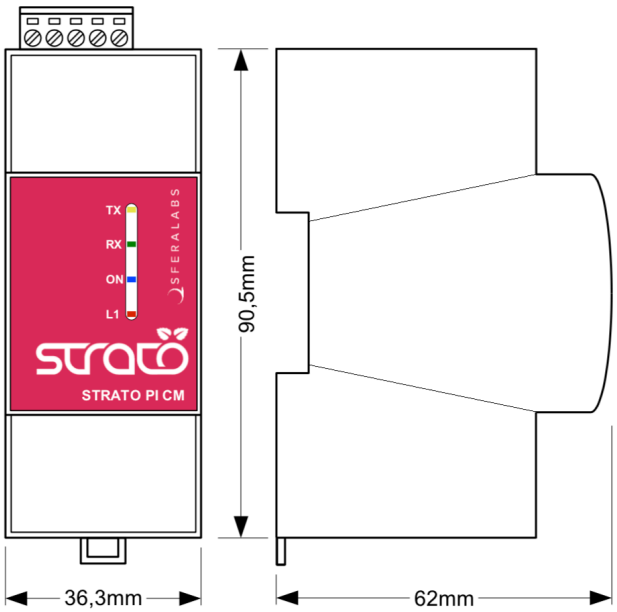
Technical specifications

Power supply	⎓dc 24 V nominal (range 9-28 V), max 1.1 A Reverse polarity protection with 1.1 A resettable fuse
Current consumption at VS+ 12 V⎓ including Raspberry Pi CM 3+, with Ethernet and RS-485 connected, no USB devices	low CPU load: 170 mA 100% CPU load: 410 mA Actual current consumption may vary based on working conditions
Current consumption at VS+ 24 V⎓ including Raspberry Pi CM 3+, with Ethernet and RS-485 connected, no USB devices	low CPU load: 100 mA 100% CPU load: 220 mA Actual current consumption may vary based on working conditions
Raspberry platform compatibility	Raspberry Pi Compute Module 1 Raspberry Pi Compute Module 3 Raspberry Pi Compute Module 3+ 8GB Raspberry Pi Compute Module 3+ 16GB Raspberry Pi Compute Module 3+ 32GB Raspberry Pi Compute Module 4S 8GB Raspberry Pi Compute Module 4S 16GB Raspberry Pi Compute Module 4S 32GB
Serial communication port	RS-485 Half-Duplex with automatic data direction management
Serial port baud rates	1200 to 115200
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
Real time clock	Internal RTCC circuit with backup lithium battery. Only use CR1220 or BR1220 batteries. Expected battery life without main power supply: ~2 years
Housing	standard 2M for DIN rail
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)
Operating temperature	CM1, CM3: -20…+50 °C CM3+, CM4S: -20…+60 °C
Storage temperature	-30…+80 °C
Altitude	Up to 2000 m

Humidity	5% to 95% RH noncondensing
Protection degree	IP20
Weight	160 g (including Raspberry Pi Compute Module)

Dimensions

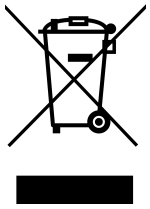




DIMENSIONS (mm)

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.

Strato Pi CM contains a small non rechargeable manganese dioxide lithium coin battery.

In the Strato Pi CM, the battery is not accessible from the outside. You should first remove the case body to gain access to the Strato Pi CM circuit board. 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.

Conformity Information

EU

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

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

✓ 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:

✓ 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 on the internet at the following address:

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.

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.