Flowfinity M1 User Guide

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IFM1R1 *Flowfinity M1*

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https://www.flowfinity.com

Introduction

The Flowfinity M1 is an edge computing controller with a variety of industrial input / output lines and standard communications interfaces, integrated with Flowfinity Actions workflow and data collection software. The Flowfinity M1 expands Flowfinity Actions applications with ability to collect data automatically from variety of sensors and filter data at the edge to quickly react to changes in the environment and execute control actions, signal process states to on site users using tower lights, and receive inputs from people using industrial push buttons or foot-operated pedals.

The controller can execute computation cycles up to 10 times per second for rapid data acquisition and quick control actions. These capabilities allow for the seamless augmentation of Flowfinity Actions workflows with automated machine logic to extend business processes to enterprise edge while providing end-to-end security and centralized system management.

The Flowfinity M1 is comprised of industrial-quality hardware manufactured in Italy by Sfera Labs S.r.l. and on-device software called "firmware" that is designed by Flowfinity Wireless Inc. Please review the accompanying Flowfinity M1 Hardware Guide for device specifications and important safety notices.

NOTICE: There is a separate category of industrial control products designated as "safety controllers" which are designed specifically for safety operations. These products have special internal features designed to make sure that these devices fail in predictably safe manner. The Flowfinity M1 is not a safety device and is not designed for safety applications. The M1 is designed to be economically efficient general purpose solution and as such it should not be used for applications where hardware or software failure can lead to injury, loss of life, environmental or other catastrophes or critical damages.
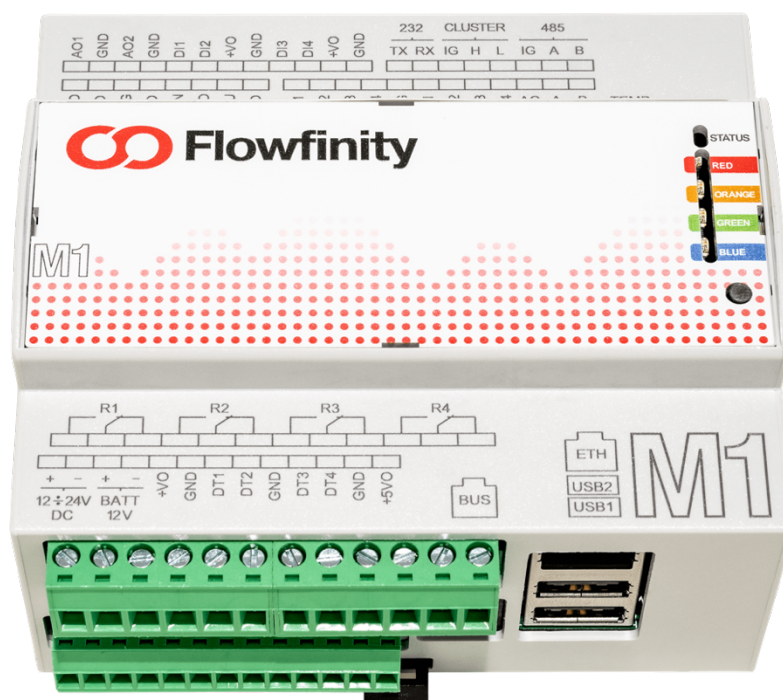
Flowfinity M1

Available Input / Output Interfaces

The Flowfinity M1 includes the following input / output lines and communications ports:

✓ Four discrete inputs (DI).

✓ Four digital input / output lines (DT), including support for PWM output. Optionally Wiegand and 1-Wire interfaces can be supported over DT terminals.

✓ Four built-in relays with NO / NC contacts (Normally Opened / Normally Closed).

✓ Four outputs for connecting tower lights or external relays.

✓ Four 0-10V precision voltage inputs with millivolt resolution. These inputs have been factory calibrated for millivolt-level accuracy.

✓ Four 4-20mA precision current inputs with microampere resolution.

✓ Two inputs for PT100 / PT1000 two-wire temperature sensors. Two general-purpose PT1000 sensors are included with Flowfinity M1.

✓ Two analog outputs configurable to 0-10V voltage mode or 4-20mA current mode.

✓ RS-232 serial port and isolated RS-485 serial port including support for MODBUS RTU protocol on both ports.

✓ External bus port for additional peripherals.

✓ Two external USB ports.

✓ Ethernet port for network connectivity.

These interfaces can be used to connect a wide variety of different sensors and industrial control devices to the Flowfinity M1. Please contact Flowfinity support for recommendations on specific sensor and control device compatibility.

Network Connectivity Security

The Flowfinity M1 controller does not provide any open TCP / IP ports in order to reduce the risk of a network-based attack. Only outbound TCP / IP connections are used to connect with the Flowfinity Actions server. There is no ability to establish an SSH session with the controller or perform any other kind of network login into the controller.

All communications from the Flowfinity M1 controller to the Flowfinity Actions server are encrypted using TLS protocol. In addition to relying on device passwords for authenticating IoT devices, Flowfinity Actions requires dual-factor authentication. The Flowfinity M1 controller supports this dual factor authentication protocol using a built-in ATECC608

security chip which serves as the hardware authentication token.

Hardware Reliability Features

The Flowfinity M1 controller was designed with a wide array of features to ensure reliability and availability, including:

✓ Dual internal SD cards pre-installed in the controller. The cards are industrial-grade and capable of extended temperature range operation. The SD cards are heavily over-provisioned with flash memory for long write endurance. If the currently active card fails the controller will reboot from the other SD card to resume service.

✓ Built in microcontroller designed for operation in extended temperature ranges and employing advanced measures such as SRAM ECC, flash ECC, and power-on memory self-test.

✓ Both the compute module and microcontroller are monitored by a software watchdog which will reset the device in case of software failure.

✓ Communication between critical internal components is protected with CRC codes for robustness and interference resilience.

✓ Power supply input is extensively protected and filtered for robust operation in noisy environments.

✓ Extensive onboard hardware and software monitoring combined with detailed telemetry delivered to Flowfinity IoT Device Manager provides the ability to monitor and manage a fleet of remotely deployed Flowfinity M1 controllers.

Power Input Configuration

The Flowfinity M1 main power input uses DC voltage between 10V and 50V.

The Flowfinity M1 is also designed to operate with an external backup lead acid battery which is charged and maintained automatically by the built-in charger while main power is available. In the event of power outage the Flowfinity M1 switches over to battery power and continues to operate both the controller and external sensors and peripherals. This built-in UPS function increases system availability and reliability. Also, by eliminating the need for external UPS hardware this function reduces cost and simplifies deployment where it is critical for the Flowfinity M1 to continue to monitor sensors, perform control actions and deliver notifications if the main power source is interrupted.

Available Power Outputs

The Flowfinity M1 provides regulated 12V or 24V power outputs for powering external sensors and peripherals, such as external relays. There is also stabilized 5V output for

powering devices connected to the four digital input / output lines. Both of these power outputs continue to be powered from the external battery if the main power supply is disconnected. Both power outputs can be disabled via configuration if desired.

Together these power outputs allow conveniently integrated deployments where all required sensors and peripherals are powered directly from the controller:

✓ VOUT which is configurable for either 12V or 24V regulated output. This means that the Flowfinity M1 will hold VOUT stable at 12V or 24V as configured, irrespective of power supply input voltage, battery voltage or VOUT load. This output can be used to power sensors, such as 4-20mA sensors, an external LTE modem, external relays, tower lights or other peripherals. VOUT is rated to provide up to 8W of power in either 12V mode or 24V mode.

✓ 5VOUT which provides 5V output for use with the four DT input/output terminals. This output can be used to power 5V sensors and peripherals as required and can provide up to 500mA current.

User Interface

The Flowfinity M1 is managed via IoT Device Manager inside of the Flowfinity Actions Configure tab. This management capability facilitates centralized deployment, monitoring, maintenance and control of multiple controllers.

The Flowfinity M1 front panel has been designed to have simplified user interface features:

✓ A STATUS light displaying controller status;

✓ Four fixed color application-controlled lights marked as BLUE, GREEN, ORANGE and RED. These lights are paralleled with BLU, GRN, ORG and RED outputs that can drive a tower light or external relays;

✓ A single button which is used for performing reset to factory settings and initial firmware installation, connectivity diagnostics and power off sequence.

Box contents

✓ Flowfinity M1 edge computing IoT controller. The controller ships pre-assembled and in most deployment situations it is not necessary to open the case prior to installation. Two industrial-rated memory cards are pre-installed and automatically managed by Flowfinity software. An internal battery for the real time clock is also pre-installed. This battery is used to keep track of time when controller is not powered.

✓ Compact 8GB USB flash drive containing firmware installer.

✓ Flat-head screwdriver. It is recommended to make controller screw terminal connections using this screwdriver because this screwdriver is insulated as an

additional safety precaution. The screwdriver can also be used for operating the latch when removing controller from DIN rail and, on rare occasions, for disassembling the controller case. If you use a different screwdriver with the controller terminals it is always recommended to use an insulated tool.

✓ Barrel connector pigtail adapter for connecting wall power adapters.

✓ Heavy duty fused battery cable for connecting Yuasa NP7-12 12V lead acid battery. Additional spare 3 Amp fuses are included with the battery cable.

✓ Two PT1000 temperature sensors with 2m / 6ft silicone cables. The sensors are identical, one sensor is used to measure battery temperature and the other sensor is used to measure ambient air temperature.

Prerequisites

Flowfinity Actions Server Account

The Flowfinity M1 edge computing controller requires an IoT device account on a Flowfinity Actions server. This can be a cloud based or self-managed Flowfinity Actions server. During installation the Flowfinity M1 controller downloads and installs firmware from Flowfinity Actions.

Each controller also requires a separate robot user account to execute applications on the controller.

You will also need access to a computer with regular USB port (known as USB Type A) or USB Type A adapter for configuring server account details during installation.

Power Supply

A power supply is not included with the controller and needs to be acquired separately.

The controller is powered using DC current supplied via positive and negative terminals marked as "12-24V DC". Supported voltage ranges of these power inputs are 10 to 50V DC, however in most cases 12V or 24V are the voltages of choice. When there is no preference, and a new power supply is being installed it is recommended to choose a 24V power supply.

For permanent electrician-mounted installations an industrial-rated power supply is recommended. Notice that industrial power supplies may have open high voltage terminals and wiring therefore for safety reasons these products must only be handled by certified electricians and in accordance with local electrical regulations.

For office, lab or desktop environments a 24V wall power adapter is recommended. It is suggested that power supply is rated for at least 36W output per controller.

An example of universally suitable wall power adapter is Ideal Power 15DYS850-240210W-K, which has 50W output (24V at 2.1A) and interchangeable plug for Australia, Europe, North America and UK.

An example of similar 40W (24V at 1.67A) wall power supplies with fixed plug are Mean Well SGA40U24-P1J for North America and SGA40E24-P1J for Europe. There are also 36W (24V at 1.5A) versions available which are shaped to require smaller clearance from the wall outlet, GST36U24-P1J for North America and GST36E24-P1J for Europe.

As an example of another vendor's suitable power supplies, CUI SWM30-24-NV-P5 for North America and SWM30-24-EV-P5 for Europe have 36W output (24V at 1.5A).

These power supplies can be purchased from various electronics distribution sources, including www.mouser.com. All mentioned wall power supplies are compatible with the

barrel pigtail adapter included with the controller, which is designed to be used with 2.1mm barrel plug.

Battery

The Flowfinity M1 is designed to operate with a lead-acid battery attached. The battery is not mandatory and the controller can power up and operate without a battery. It is recommended to include a battery with each controller installation where it is desired to avoid data loss due to power outage.

There are only two battery models that are supported- Yuasa NP7-12 and Yuasa NP7-12FR, the latter being a flame retardant version. Notice that the similarly labeled NP7-12L is not directly supported as it has larger terminals than do not fit the included battery cable, however special stepping down adapters can be used if required. There are many similar and compatible batteries generally available, however only brand-name Yuasa batteries are supported by the controller.

Please observe all instructions from the battery manufacturer when handling, installing, operating and disposing of batteries.

The Flowfinity M1 built-in battery charger is disabled by default. Once you connect a Yuasa NP7-12 battery you need to enable it in the hardware configuration section of the IoT Device Manager in Flowfinity Actions.

Network connectivity

Ethernet-based connectivity is required by the Flowfinity M1 to connect to the Flowfinity server. The M1 has a RJ45 socket that accepts standard CAT5e or CAT6 Ethernet cable. The cable is not included with the controller package and needs to be acquired separately.

DHCP address assignment needs to be operational on the Ethernet port that the Flowfinity M1 is connected to. The Flowfinity M1 obtains TCP / IP address information from DHCP service and uses it to connect to your Flowfinity Actions server.

The Flowfinity M1 requires access to NTP services to maintain its time reference. If you have internal NTP service you may have your network administrator specify its address using DHCP option 042 and that address needs to be accessible over NTP protocol from the M1 Ethernet port. If you would like to rely on Internet-hosted NTP services you need to make sure that your Internet-facing firewall allows M1 to communicate with external NTP servers using NTP protocol over UDP port 123.

Notice that the Flowfinity M1 controller is designed for frequent communication with Flowfinity Actions, as well as for downloading firmware updates from Flowfinity Actions server. This may result in sizable traffic over the network and as such it is not suitable for the low-volume IoT connectivity plans such as those that are measured in MB per year. A

smartphone-type data plan is required for Flowfinity M1 LTE connectivity, along with LTE-to-Ethernet router.

Mounting

The controller can be tested in a desk environment, provided that ambient air is at or below normal room temperature and air flow around controller is not impeded. For production deployments vertical mounting on a DIN rail or on a wall is required. DIN rail is an industry standard mounting component and it is not included with the controller package. The M1 has a DIN rail attachment with a latch on the back of the case. Vertical mounting facilitates convective airflow in the plastic case via the terminal openings and is important for controlling internal temperature of the controller.

Notice that for security reasons it is recommended to deploy the Flowfinity M1 controller in a physically secured space or equipment cabinet. Physical access by potential attackers to any equipment, including Flowfinity M1 controller, presents an increased security risk.

Initial Connections

NOTICE: Industrial power supplies may have open high voltage terminals and wiring and for safety reasons these products must only be handled by certified electricians and in accordance with local electrical regulations. Instructions in this section assume that a consumer-grade wall power adapter is being used which does not require involvement of a certified electrician.

NOTICE: Handle battery connections with care. Batteries can discharge violently when shorted. Do not connect battery terminals until the other end of the cable is connected and secured with screws.

NOTICE: Do not apply externally supplied negative voltage to 5VOUT or VOUT terminals. Doing so will damage the controller. When connecting 5VOUT or VOUT in parallel to other power sources always observe and double-check polarity of the connections to make sure that external negative voltage is not supplied to positive power outputs of the controller.

1. Disconnect the screw terminal connector that has power and battery inputs from the controller. This is the bottom connector on the same side as Ethernet slot. Screw terminal connector can be pulled out from the controller.

2. Hold the connector with screws facing up and wire inputs facing towards you.

3. Insert the barrel pigtail adapter red wire into the first terminal from the left (positive) and black wire into the second terminal from the left (negative). This corresponds to "12-24V DC" markings on the controller case. Use the screwdriver to tighten these two terminals. Screws need to be tight but do not apply excessive force to any of the screw terminals. These terminals are further referred to as "main power" in this manual.

4. Insert battery cable red wire into the third terminal from the left (positive) and black wire into the fourth terminal from the left (negative). This corresponds to "BATT 12V" markings on the controller case. Use screwdriver to tighten these two terminals.

5. Firmly insert the screw terminal connector back into the controller.

6. Disconnect the screw terminal connector that has temperature sensor inputs from the controller. This is the longer top connector on the opposite side from where the Ethernet slot is.

7. Hold the connector with screws facing up and wire inputs facing towards you.

8. Twist two red wires from the first temperature sensor together and insert them into the first terminal from the right. This is going to be the battery temperature sensor, it is marked as "TEMP B" on the controller case. Screw down this terminal but do not over tighten.

9. Twist the two red wires from the other temperature sensor together and insert them into the second terminal from the right. This is going to be the ambient air temperature sensor, and it is marked as "TEMP A" on the controller case. Screw down this terminal but do not over tighten.

10. Combine the white wires from each of the temperature sensors, twist them together and insert them into the third terminal from the right. This corresponds to "AG" marking

on the controller case, which stands for "Analog Ground". Screw down this last terminal but do not over tighten.

11. Firmly insert the screw terminal connector back into the controller.

12. Route the battery temperature sensor cable alongside battery cable and bundle the two cables together using electrical tape or another suitable fastener such as zip ties or cable VELCRO straps.

13. If you have Yuasa NP7-12 battery ready for installation, lay the battery temperature sensor flat on top of the battery and secure it to the battery using either cable ties or electrical tape wrapped two times around the battery (cable ties and electrical tape are not included in the package).

14. If you are installing the battery, connect red battery cable connector to the red (positive) contact of the battery and black connector to the black (negative) contact. The controller will not power on from the battery just yet, it can only power on when main power is connected. Be careful not to short battery terminals with each other.

15. Position the controller into its working position by laying it on a flat surface for testing or clipping it vertically onto DIN rail for production use.

16. Insert Ethernet cable plug into metal RJ-45 socket on the controller and make sure that the cable latch clicks into the socket to secure the cable. Make sure that the other end of this Ethernet cable is connected to a working Ethernet outlet providing DHCP address assignment and connectivity to your Flowfinity Actions server.

17. Insert the barrel connector from the power supply into the barrel pigtail adapter socket. Connect power supply to a suitable power outlet.

18. The top STATUS light should come up on the controller and it is now ready for firmware installation. A white light means that the controller is powered by the main power supply. If battery is attached controller may start charging the battery in which case the light will turn green. You may also hear internal fan spinning while battery charging is in progress. Should the main power be lost the controller would switch to battery power which will change the STATUS light color to orange. If you see the top STATUS light turn red that means that there is a malfunction that requires troubleshooting.

Installing Firmware

Step 1. Preparing Flowfinity server IoT device account

* requires Administrator access to Flowfinity Actions

1. Make sure that firmware repository on your Flowfinity Actions server has the firmware version that you would like to install. You can access the firmware repository in the Flowfinity Actions Configure tab.

2. Access IoT Device Manager in Configure tab and create a new IoT account, assign desired firmware version and select desired time zone for the controller.

3. As part of this process you will specify a user name and one-time activation password for the account.

Step 2. Preparing installation USB media

1. Insert the supplied USB flash key into your computer's USB port. The flash key contains a pre-loaded firmware installer. Do not remove or alter any files on the flash key other than as described below.

2. On the flash key find server.txt file and open it for editing.

3. Fill in URL of your server (e.g. https://cloud.flowfinity.com for cloud accounts, or the URL of your Flowfinity Actions instance).

4. Fill in account name and one time activation password.

5. Save the file and eject the USB key.

6. Remove the USB key from the computer.

Step 3. Performing installation

1. Make sure the Initial Connection section steps are completed and controller is powered on using main power supply. The firmware installer will not start if controller is only powered by battery power.

2. Insert prepared USB flash key into one of the USB slots on the controller.

3. Next, you need to enter an installation sequence using the push button on the front panel of the controller. Installation sequence initiates firmware installation from USB key. Installation sequence consists of four consecutive button presses of 2 seconds each. If you wait longer than 5 seconds between presses the sequence will abort and you will need to start over. For each successful 2 second button press the controller will light up one more light starting with lights marked as BLUE, GREEN, ORANGE and finally RED. To distinguish from normal operation of these lights, the lights indicating button presses will be white. When the last light is lit up controller goes into installation mode. All four lights will stay lit while installation is in progress.

4. Once the installation is started you will see blinking activity on USB key with its blue light, followed by green and orange lights on the controller's Ethernet connector indicating network activity. The top STATUS light will also be blinking steadily while installer is working.

5. The installation process takes approximately 20-30 minutes. You can monitor the installation progress in IoT Device Manager of the Flowfinity Actions Configure tab.

6. Once the installation is finished the controller will turn off the four white lights and will continue to have its top STATUS light blinking steadily. Installation completion status will also be reported in IoT Device Manager.

7. You can now remove the USB key from the controller and store it safely in case it is required for future re-installation of controller firmware.

Installation Troubleshooting

If the installation fails you may see all four white lights turn red. In this case you need to follow the following troubleshooting procedure:

1. If the four red lights are blinking it means that there is a problem with USB flash key media, such as missing installer or missing server.txt file;

2. If the four red lights are not blinking then you can access further information by doing a quick press of the front panel push button, the press time should be under 1 second long to avoid resetting installation status.
   The four red lights will briefly disappear in response to the quick button press, and no more than one light indicator will blink three times in white color helping identify the source of the problem as per the following:

   a. the light marked BLUE blinking white means that there is problem with basic network connectivity- i.e. network cable is not connected or there is no functioning DHCP service, you can also check status lights on the controller's Ethernet socket to confirm successful physical connectivity;

   b. the light marked GREEN blinking white means that there is no network connectivity to Flowfinity Actions server, such as a firewall blocking traffic for example;

   c. the light marked ORANGE blinking white means that user name and one time password specified in server.txt file of the USB flash key are not recognized by the Flowfinity Actions server;

   d. the light marked RED blinking white means that connection to Flowfinity Actions server has been successful and you need to refer to the installation status information displayed in the IoT Device Manager for further troubleshooting information.

Status Light Operation

The STATUS light indicates the state of the controller in one of three patterns:

✓ Solid light- Flowfinity M1 controller is powered however Compute Module inside controller is powered off, it is safe to discontinue power supply in this state;

✓ Regular blinking (half second on, half second off)- Compute Module is operational;

✓ Rapid blinking (rapid on/off switching)- Compute Module is powered but it is not operational (e.g. it is booting, shutting down, or is not functioning as expected).

In addition to light patterns there are different colors that STATUS indicator can be lit with, with the following meaning:

✓ White – normal operation of the controller, powered via main power input;

✓ Green – normal operation of the controller, battery is being charged from main power;

✓ Orange – operation on battery power, no power at the main power terminals;

✓ Red – malfunction

In case you have server connectivity from the controller established, the reasons for a red status light indicating malfunction can be viewed in the IoT Device Manager.

Powering Off Flowfinity M1

To prepare the Flowfinity M1 controller for powering off you must first shut down the compute module. This ensures that no file system corruption occurs when power is withdrawn. The compute module can be powered off by pressing and holding the button on the controller front panel. While you hold the button the indicator marked BLUE will be lit up with white color, then sequentially this white light will migrate to GREEN, ORANGE and finally RED indicators. When the RED indicator lights up white you may release the button.

At this point the compute module shutdown is initiated. Shutdown takes approximately 30 seconds, and when shutdown is complete the STATUS indicator will stop blinking and will stay lit continuously. There will also be triple beep sound when shutdown is complete. When you see STATUS indicator continuously lit it means that Compute Module is powered off and it is safe to withdraw power from the controller.

To turn controller back on again re-apply power to main power terminals. If you have not disconnected power since Compute Module shutdown you can turn the compute module back on by pressing the button on the front panel and releasing it after less than 1 second. Button press is acknowledged with a single beep sound. As you turn the compute module on you should first see rapid blinking of the STATUS light while the compute module is booting, followed by regular blinking pattern in a minute or two. Regular blinking pattern means that the compute module is operational.

Troubleshooting Server Connectivity Loss

If the STATUS indicator is blinking using the regular blinking pattern, it means that the compute module is operational and the controller should attempt to establish connectivity to the Flowfinity Actions server. If the IoT Device Manager in the Flowfinity Actions Configure tab indicates that connection with the controller is not established, you can use the following steps to aid in troubleshooting network connectivity:

1. Check the lights on the Ethernet port of the controller. If both lights are off it indicates that there is no Ethernet connection. Check cabling and also the status of the opposite end where the cable is terminated (i.e. switch, hub, router, etc).

2. If the lights on the Ethernet port are active you can run a diagnostic test to learn the connectivity status of the controller. To run a diagnostic test briefly press and then release within less than 1 second the button on the controller front panel and observe behavior of the bottom four lights on the front panel of the controller where one of the lights will blink three times in white color:

   a. if the indicator marked BLUE is blinking white it means that there is problem with basic network connectivity and controller could not obtain IP address via DHCP, i.e. there is no functioning and accessible DHCP service;

   b. if the indicator marked GREEN is blinking white it means that there is no network connectivity to Flowfinity Actions server. i.e. the controller failed to establish TCP/IP connection to the server;

   c. if the indicator marked ORANGE is blinking white it means that the controller failed to get authenticated by Flowfinity Actions server;

   d. if the indicator marked RED is blinking white it means that a connection to the Flowfinity Actions server has been successful and you need to refer to the status information displayed in the IoT Device Manager for further troubleshooting information.