

FT Click Getting Started

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Introduction

FT Click is a compact smart transceiver add-on board that helps you add a Free Topology (FT) interface to any host board with the mikroBUS™ socket. Leveraging FT, the most reliable and easiest-to-scale wired communications media, FT Click lets you network sensors and devices to create IoT solutions for automation and control networks that are easier to develop, integrate and install. This Click board™ supports full communication stacks for LON® and BACnet FT, as well as FTMQ (MQTT like messaging format) on board to simplify integration of LON, BACnet, or custom IoT networks over twisted pair wire.

FT Click is ideal for markets including smart buildings, cities, machines, agriculture, manufacturing, transportation and many more where wireless communications do not provide the required reliability and scale.

FT Click boards feature Adesto's FT 6050 smart transceiver and IzoT ShortStack SDK, along with an STM32 MCU host processor.

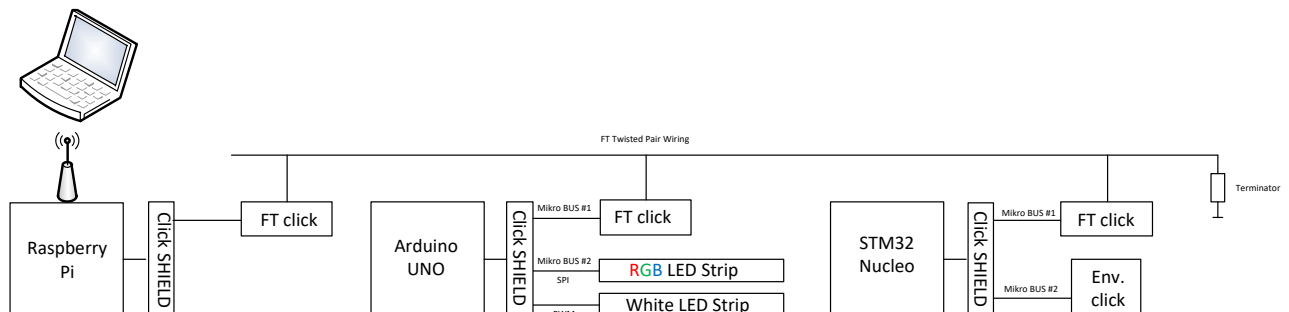
FT Click boards are produced and sold by MIKROE (<https://www.mikroe.com/ft-click>).

The Examples

Overview

There are example applications available for the Raspberry Pi, Arduino UNO and STM32 Nucleo. The examples communicate using FTMQ formatted messages.

At a minimum you will need to have a Raspberry Pi for control and monitoring purposes along with an Arduino UNO or STM32 Nucleo or both. You will also need a Windows PC.



Raspberry Pi

The Raspberry Pi serves a Node-RED dashboard for control and monitoring that can adjust the colour of the Arduino UNO's RGB strip using a colour picker and the colour of the white LEDs using sliders. The dashboard also displays the temperature, pressure, humidity and VOC data from the STM32 Nucleo.

Arduino UNO

There are two strips of LEDs attached to the Arduino UNO via the click SHIELD adaptor board. One LED strip is RGB and can be set to any colour. The other LED strip has white LEDs which can be colour tuned. A programmable group of LEDs are illuminated at once on each strip, with the group moving from left to right. The colour of both strips can be controlled by FTMQ messaging over the FT network.

STM32 Nucleo

An Environmental click sensor board is interfaced to an STM32 Nucleo board via an Arduino UNO click SHIELD board. The sensor measures temperature, pressure, humidity and VOCs and the data is regularly broadcast using FTMQ messages to the FT network.

Support

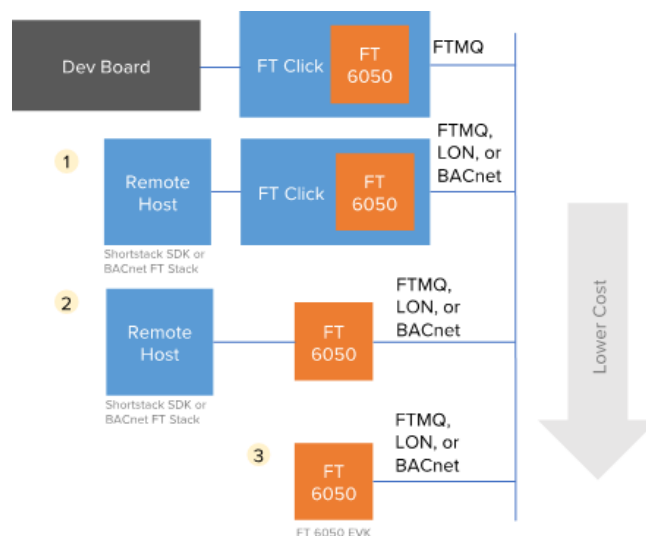
Should you need help during your FT Click project, please contact info@connect-ex.com

Next Steps for Product Development

Once you have created an FTMQ application using the FT Click, you can expand your application by taking advantage of the FT 6050 chip which supports LON and BACnet protocols. LON and BACnet protocols provide networking, data and application definitions needed to create networks that scale to thousands of devices communicating with each other and with remote applications as well as facilitating interoperability with other vendor devices.

In the process, you can reduce your hardware cost by designing with the Adesto FT 6050 Smart Transceiver directly. Here are a few options available to you — all of these options can take advantage of the ease-of-use, reliability, and performance of the FT media:

1. Implement LON or BACnet applications on any host with a mikroBUS interface using FT Click hardware and IzoT ShortStack SDK for LON or BACnet FT stack for BACnet.
2. Implement FTMQ, LON, or BACnet applications on any host combined with the Adesto FT 6050 Smart Transceiver, flash memory, and network interface firmware using the small ShortStack host code included with the IzoT ShortStack SDK.
3. For lowest cost, implement FTMQ, LON, or BACnet applications on the Adesto FT 6050 Smart Transceiver using Adesto's FT 6050 EVK. The LON and BACnet stacks for the FT 6050 Smart Transceiver are included with the FT 6050 EVK.



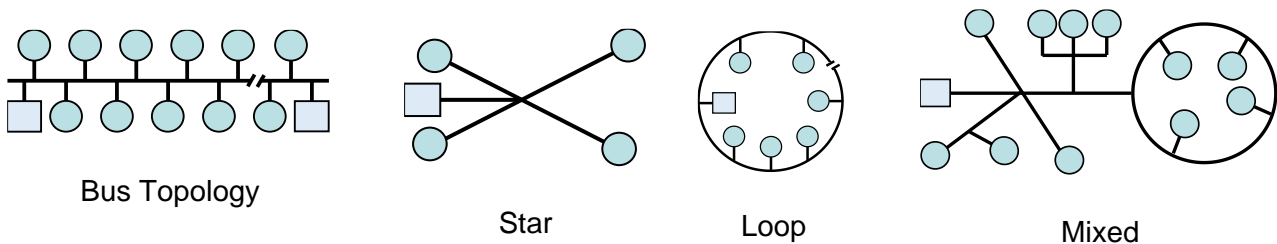
You can find more information about the FT 6050 [here](#), the IzoT ShortStack SDK [here](#) and the FT 6050 EVK [here](#).

Contact embedded-iot@adestotech.com for help on your next project.

Free Topology (FT)

FT (Free Topology) is an industry-wide adopted field network connectivity standard as specified in ISO/IEC 14908-2 (also known as the TP/FT-10 channel type)

- FT significantly reduces installation time and costs with simple polarity-insensitive wiring that enables the creation of complex networks that are less error-prone, more fault-tolerant and have high noise immunity.
- FT lets integrators create larger, more sophisticated control scenarios with more devices, longer wire runs and virtually no wiring topology limitations; supports bus, star, loop or any combination of topology simplifying future expansion.
- FT enables much faster, more reliable site commissioning – with built-in electrical isolation, there is no possibility of hard-to-diagnose site issues arising from mixing of manufacturer's differing isolation.



Wiring FT Click Transceivers

Each of the FT Click boards should be connected together using a suitable twisted pair cable and terminated with a single 52.3Ω 5% 0.25W resistor for free topology support. FT Click boards can be wired in a simple daisy chain basis thanks to the convenient connectors that require no tools.



Five cable types have been validated for the ISO/IEC 14908-2 TP/FT-10 channel, these cable types are:

- TIA 568A Category 5 cable, 24WAWG, 0.5mm
- Belden 8471 (PVC jacket) or equivalent cable, 16AWG, 1.3mm
- Belden 85102 (Tefzel jacket) or equal cable, 16AWG, 1.3mm
- Level IV cable, 22AWG, 0.65mm
- JY (st) Y 2x2x0.8, 20.4AWG, 0.8mm

The distance limitations, electrical characteristics and suppliers of these cables can be found [here](#)

However, due to the exceptional characteristics of the FT transceiver, it can use most types of unshielded or shielded twisted pair cable over limited distances, but it would be up to the user to qualify its characteristics. Belden 8442 or AlphaWire 6460 are alternatives to the approved cable types which available in small quantities.

Please note that the FT-10 channel supports link powered devices where both signal and power are on the same pair. In this case AC coupled terminators must be used such as Adesto's model 44100R terminator.

FTMQ Protocol

FTMQ is a simple messaging protocol to easily exchange data between nodes interconnected with FT Click modules that communicate using Adesto's Free Topology (FT) communication technology.

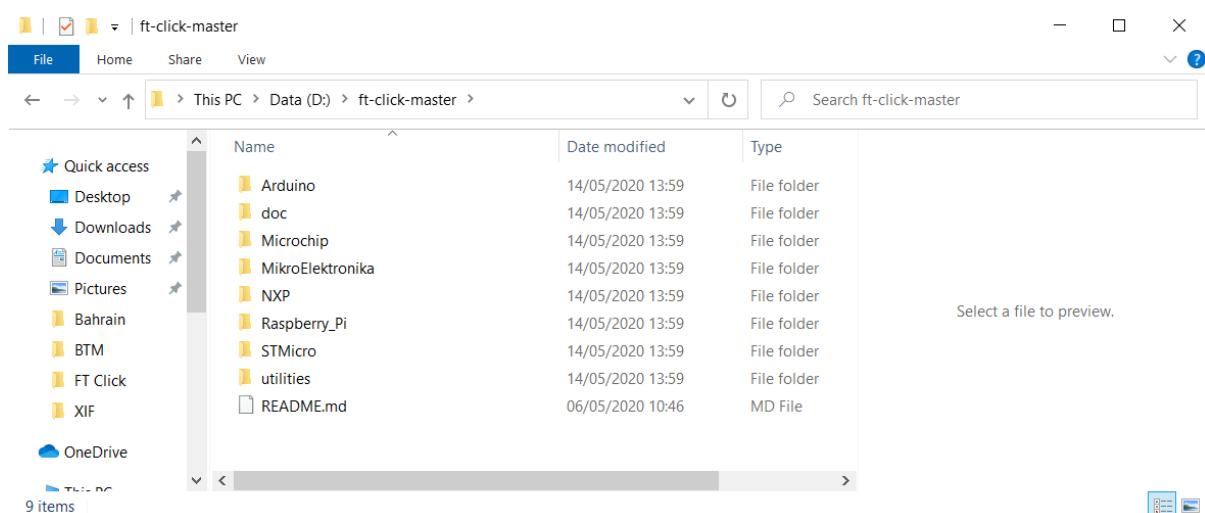
FTMQ aims to provide a very simple publish-subscribe communication model, with variable length packets formed of a topic and a payload.

When a FTMQ packet is sent, is broadcasted to all nodes in the FT network. Each recipient node filters the received messages and passes the required ones to the host application, based on the topic.

You can find documentation on the FTMQ protocol used in the examples [here](#).

Cloning the Repository

You will need to clone or download the Git repository that contains the examples from [here](#) to your local PC.



For rapid setup, a complete Raspberry Pi image for a model 3B+ is available [here](#)

Setting LonTalk Addresses

To be able to receive data, each FT Click needs to have a unique LonTalk address.

For small scale demos, the LonTalk address of a device can be set by hand.

You can also use the `ftclicks_commands.py` utility that is included in the repository. To use this utility, you need a computer with python installed and a TTL serial interface. However, the utility will only set the node address.

Alternatively, you can use a tool such as NodeUtil. Nodeutil will allow you to set the domain, subnet and node address. However, networks would typically be configured automatically using a tool such as Adesto's IzoT Commissioning Tool

<https://www.adestotech.com/embedded-product/izot-commissioning-tool-ct-4-1/>.

Subsequent releases of the FT Click firmware after version 1.01 will automatically set the LonTalk address using Interoperable Self Installation (ISI).

Setting the FT Click LonTalk Address Using `ftclick_commands.py`

Bill of Materials

You will need to purchase a suitable USB to TTL RS-232 adapter such as <https://uk.rs-online.com/web/p/interface-development-kits/7676200/> (FTDI TTL-232R-RPi).

Hardware Setup

1. With the FT Click removed from the shield board, connect the FT Click pins to your USB to TTL RS-232 adapter as follows (null modem):

FT Click	TTL RS-232 Interface
TX	RX (yellow)
RX	TX (orange)
GND	GND (black)

2. Connect a 3.3VDC supply to the 3V3 and GND pins of the FT Click using the headers and a suitable cable, the headers are 0.635mm (0.025") square.
3. Plug the USB to TTL RS-232 adapter into the USB port of your PC.

Software Setup

1. Download Python 3 from <https://www.python.org/downloads/windows/> and install.
2. Clone or download the python module docopt from <https://github.com/docopt/docopt>
3. Install docopt from a command prompt in the cloned or unzipped docopt-master folder by running the following command:

```
python setup.py install
```



```
C:\Windows\System32\cmd.exe
(c) 2019 Microsoft Corporation. All rights reserved.

D:\docopt-master>python setup.py install
running install
running bdist_egg
running egg_info
creating docopt.egg-info
writing docopt.egg-info\PKG-INFO
writing dependency_links to docopt.egg-info\dependency_links.txt
writing top-level names to docopt.egg-info\top_level.txt
writing manifest file 'docopt.egg-info\SOURCES.txt'
reading manifest file 'docopt.egg-info\SOURCES.txt'
reading manifest template 'MANIFEST.in'
writing manifest file 'docopt.egg-info\SOURCES.txt'
installing library code to build\bdist.win32\egg
running install_lib
running build_py
creating build
creating build\lib
copying docopt.py -> build\lib
creating build\bdist.win32
creating build\bdist.win32\egg
copying build\lib\docopt.py -> build\bdist.win32\egg
byte-compiling build\bdist.win32\egg\docopt.py to docopt.cpython-38.pyc
creating build\bdist.win32\egg\EGG-INFO
copying docopt.egg-info\PKG-INFO -> build\bdist.win32\egg\EGG-INFO
copying docopt.egg-info\SOURCES.txt -> build\bdist.win32\egg\EGG-INFO
copying docopt.egg-info\dependency_links.txt -> build\bdist.win32\egg\EGG-INFO
copying docopt.egg-info\top_level.txt -> build\bdist.win32\egg\EGG-INFO
zip_safe flag not set; analyzing archive contents...
creating dist
creating 'dist\docopt-0.6.2-py3.8.egg' and adding 'build\bdist.win32\egg' to it
removing 'build\bdist.win32\egg' (and everything under it)
Processing docopt-0.6.2-py3.8.egg
Copying docopt-0.6.2-py3.8.egg to c:\users\mark\appdata\local\programs\python\python38-32\lib\site-packages
Adding docopt 0.6.2 to easy-install.pth file

Installed c:\users\mark\appdata\local\programs\python\python38-32\lib\site-packages\docopt-0.6.2-py3.8.egg
Processing dependencies for docopt==0.6.2
Finished processing dependencies for docopt==0.6.2

D:\docopt-master>
```

Then check the installation as follows:

```
C:\Windows\System32\cmd.exe - python

D:\docopt-master>python
Python 3.8.3 (tags/v3.8.3:6f8c832, May 13 2020, 22:20:19) [MSC v.1925 32 bit (Intel)] on win32
Type "help", "copyright", "credits" or "license" for more information.
>>> import docopt
>>>
```

4. Download ccp from <https://pypi.org/project/ccp/#files>
Unzip to a local folder
Install ccp from a command prompt in unzipped ccp-1.1 folder by running the following command:

```
python setup.py install
```

```
C:\Windows\System32\cmd.exe
Microsoft Windows [Version 10.0.18363.752]
(c) 2019 Microsoft Corporation. All rights reserved.

D:\ccp-1.1>python setup.py install
Warning: 'classifiers' should be a list, got type 'tuple'
running install
running bdist_egg
running egg_info
writing ccp.egg-info\PKG-INFO
writing dependency links to ccp.egg-info\dependency_links.txt
writing requirements to ccp.egg-info\requires.txt
writing top-level names to ccp.egg-info\top_level.txt
reading manifest file 'ccp.egg-info\SOURCES.txt'
reading manifest template 'MANIFEST.in'
writing manifest file 'ccp.egg-info\SOURCES.txt'
installing library code to build\bdist.win32\egg
running install_lib
running build_py
creating build
creating build\lib
creating build\lib\ccp
copying ccp\client.py -> build\lib\ccp
copying ccp\__init__.py -> build\lib\ccp
creating build\bdist.win32
creating build\bdist.win32\egg
creating build\bdist.win32\egg\ccp
copying build\lib\ccp\client.py -> build\bdist.win32\egg\ccp
copying build\lib\ccp\__init__.py -> build\bdist.win32\egg\ccp
```

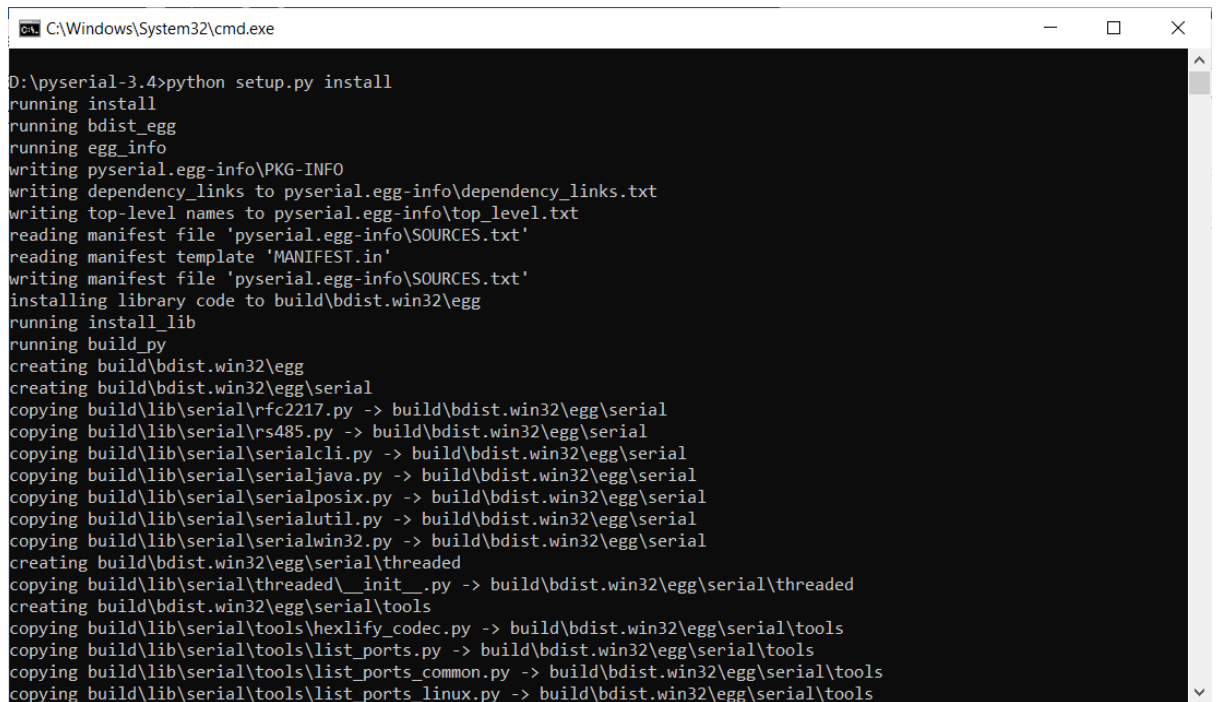
Then check the installation as follows:

```
Select C:\Windows\System32\cmd.exe - python
D:\ccp-1.1>python
Python 3.8.3 (tags/v3.8.3:6f8c832, May 13 2020, 22:20:19) [MSC v.1925 32 bit (Intel)] on win32
Type "help", "copyright", "credits" or "license" for more information.
>>> import ccp
>>>
```

5. Download pyserial from <https://pypi.org/project/pyserial/#files> and unzip to a local folder.

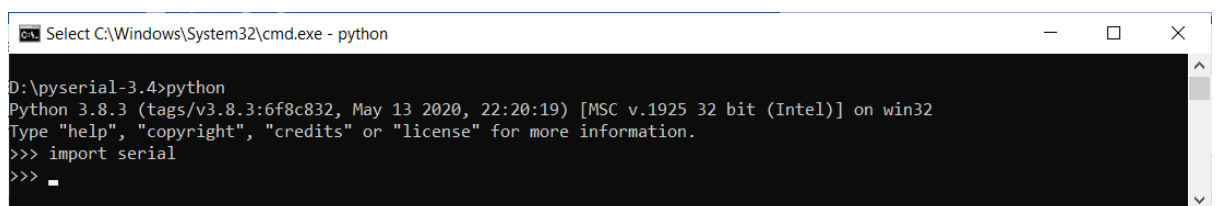
Install from a command prompt in unzipped pyserial folder by running the following command:

```
python setup.py install
```



```
C:\Windows\System32\cmd.exe
D:\pyserial-3.4>python setup.py install
running install
running bdist_egg
running egg_info
writing pyserial.egg-info\PKG-INFO
writing dependency links to pyserial.egg-info\dependency_links.txt
writing top-level names to pyserial.egg-info\top_level.txt
reading manifest file 'pyserial.egg-info\SOURCES.txt'
reading manifest template 'MANIFEST.in'
writing manifest file 'pyserial.egg-info\SOURCES.txt'
installing library code to build\bdist.win32\egg
running install_lib
running build_py
creating build\bdist.win32\egg
creating build\bdist.win32\egg\serial
copying build\lib\serial\rfc2217.py -> build\bdist.win32\egg\serial
copying build\lib\serial\rs485.py -> build\bdist.win32\egg\serial
copying build\lib\serial\serialcli.py -> build\bdist.win32\egg\serial
copying build\lib\serial\serialjava.py -> build\bdist.win32\egg\serial
copying build\lib\serial\serialposix.py -> build\bdist.win32\egg\serial
copying build\lib\serial\serialutil.py -> build\bdist.win32\egg\serial
copying build\lib\serial\serialwin32.py -> build\bdist.win32\egg\serial
creating build\bdist.win32\egg\serial\threaded
copying build\lib\serial\threaded\__init__.py -> build\bdist.win32\egg\serial\threaded
creating build\bdist.win32\egg\serial\tools
copying build\lib\serial\tools\hexlify_codec.py -> build\bdist.win32\egg\serial\tools
copying build\lib\serial\tools\list_ports.py -> build\bdist.win32\egg\serial\tools
copying build\lib\serial\tools\list_ports_common.py -> build\bdist.win32\egg\serial\tools
copying build\lib\serial\tools\list_ports_linux.py -> build\bdist.win32\egg\serial\tools
```

Check the install as follows:



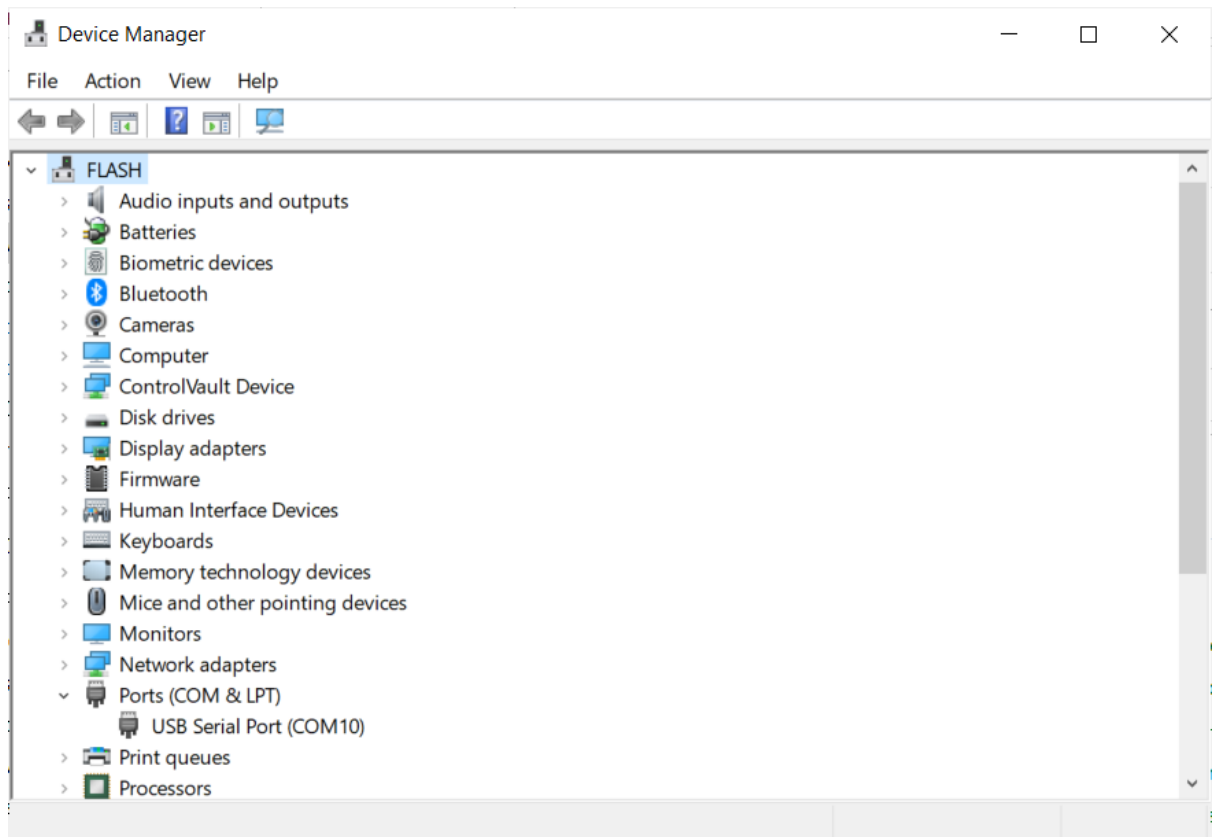
```
Select C:\Windows\System32\cmd.exe - python
D:\pyserial-3.4>python
Python 3.8.3 (tags/v3.8.3:6f8c832, May 13 2020, 22:20:19) [MSC v.1925 32 bit (Intel)] on win32
Type "help", "copyright", "credits" or "license" for more information.
>>> import serial
>>>
```

Configuration

1. To check the configuration, from the local repository copy utilities folder, execute the command:

```
python ftclick_commands.py <COMn> sw-ver
```

where <COMn> must be replaced with your actual COM port for the adaptor (such as COM3), which you can find from the Device Manager control panel applet in Ports (COM & LPT) as shown below:



2. This should return the current software version in the FT Click as shown below, if so, go to step 4, otherwise check the wiring from the cable to the FT Click and the power supply.

```
C:\Windows\System32\cmd.exe

D:\ft-click-master\utilities>python ftclick_commands.py COM10 sw-ver
command: 7
7 0 9 7 0 0
D:\ft-click-master\utilities>
```

3. To update the LonTalk node address use the command:

```
python ftclick_commands.py <COMn> nodeid-set <x>
```

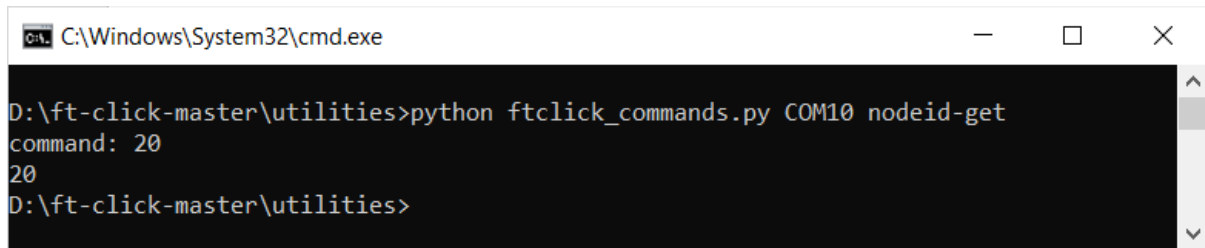
Where <COMn> is your COM port and <x> is the desired LonTalk Address. Please note this will only change the node address leaving the domain and subnet alone.

```
C:\Windows\System32\cmd.exe

D:\ft-click-master\utilities>python ftclick_commands.py COM10 nodeid-set 20
D:\ft-click-master\utilities>_
```

4. You can retrieve the assigned LonTalkAddress using the command:

```
python ftclick_commands.py <COMn> nodeid-get
```

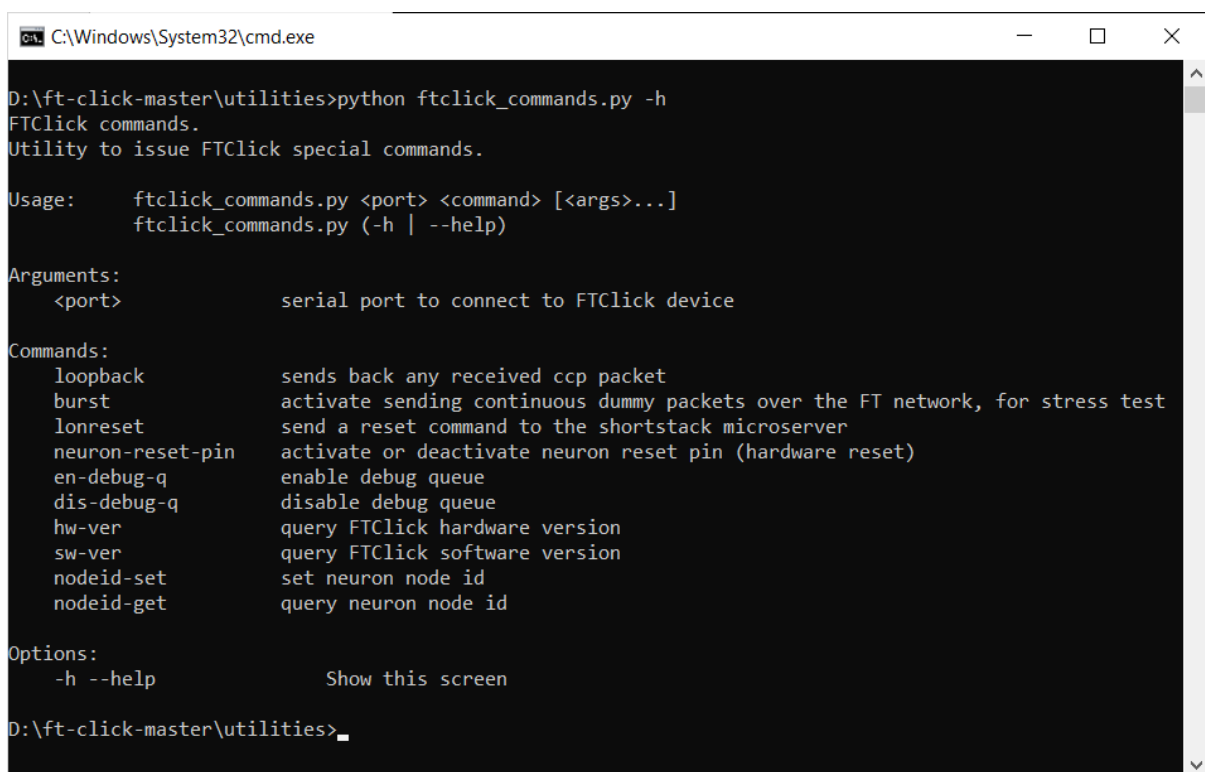


```
C:\Windows\System32\cmd.exe

D:\ft-click-master\utilities>python ftclick_commands.py COM10 nodeid-get
command: 20
20
D:\ft-click-master\utilities>
```

You can review the available commands using the following:

```
python ftclick_commands.py -h
```



```
C:\Windows\System32\cmd.exe

D:\ft-click-master\utilities>python ftclick_commands.py -h
FTClick commands.
Utility to issue FTClick special commands.

Usage:      ftclick_commands.py <port> <command> [<args>...]
            ftclick_commands.py (-h | --help)

Arguments:
  <port>          serial port to connect to FTClick device

Commands:
  loopback        sends back any received ccp packet
  burst           activate sending continuous dummy packets over the FT network, for stress test
  lonreset        send a reset command to the shortstack microserver
  neuron-reset-pin activate or deactivate neuron reset pin (hardware reset)
  en-debug-q      enable debug queue
  dis-debug-q     disable debug queue
  hw-ver          query FTClick hardware version
  sw-ver          query FTClick software version
  nodeid-set      set neuron node id
  nodeid-get      query neuron node id

Options:
  -h --help      Show this screen

D:\ft-click-master\utilities>
```

Using NodeUtil

Bill of Materials

You will need to purchase a U10 or U60 network interface from Digi Key at:

<https://www.digikey.com/products/en?keywords=echelon%20u10>

or

<https://www.digikey.com/product-detail/en/echelon-corporation/75060R-40/1499-1048-ND/6127986>

If you later transition to the IzoT Commissioning Tool you can use a U10 or U60 as the interface.

Downloads

Download the follow:

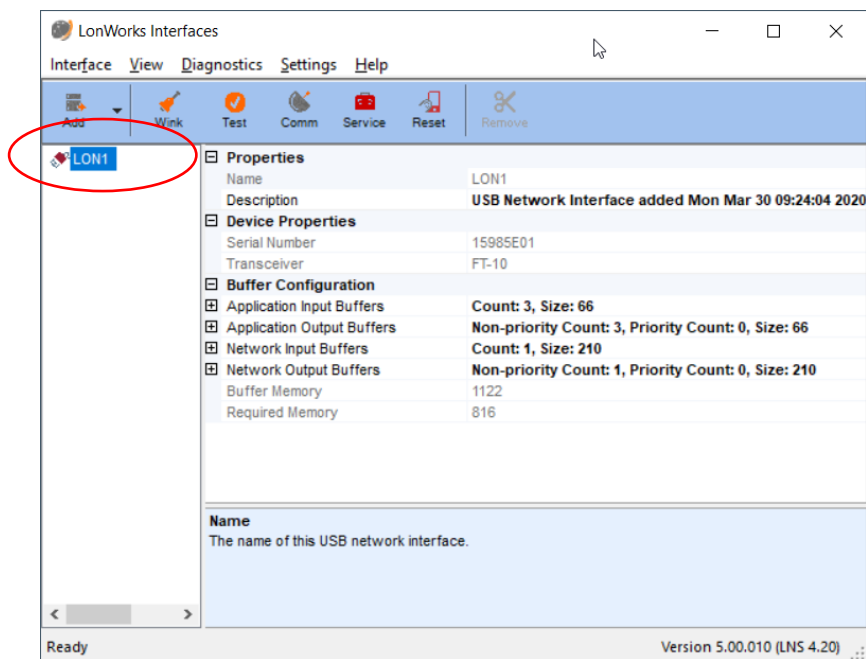
- NodeUtil from Adesto from <http://docs.adestotech.com/display/TOOL/NodeUtil+and+NodeLoad>
- IzoT Net Server from http://downloads.echelon.com/support/downloads/izot/IzoT_Net_Server/4.20.018/ap-IzoTNetServer420.exe
- Obtain a demo IzoT Net Server license from support@adestotech.com
- OpenLDV 5.0
http://downloads.echelon.com/support/downloads/software/networkinterfaces/153-0411-01B_OpenLDV500.exe

Software Installation

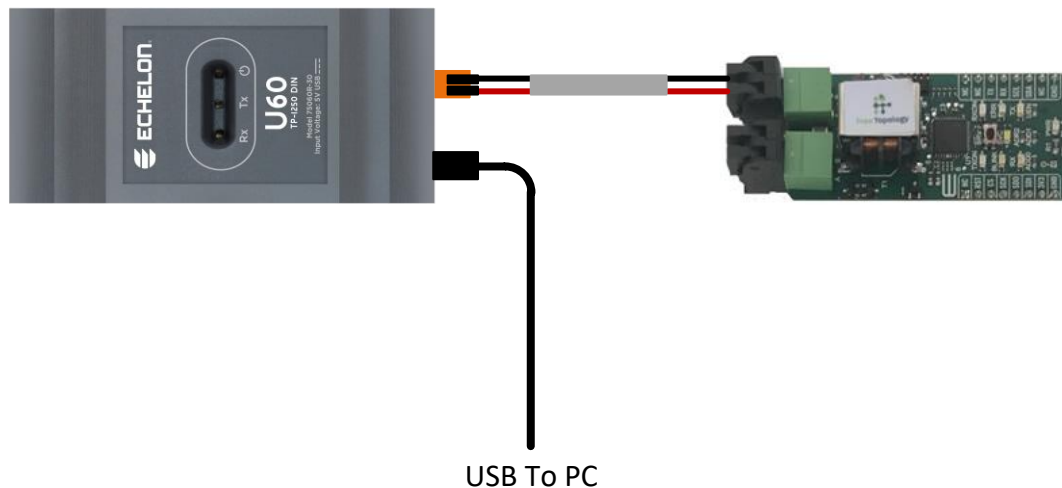
- Unzip Nodeutil.exe to a suitable location
- Install IzoT Net Server using the demo license key
- Install OpenLDV 5.0

Setup

Run the LonWorks Interfaces control panel applet and find the name for the network interface; in the following example, it is “LON1”.



Connect the Network Interface to the FT Click using twisted pair cable.
Connect the U10 directly to the PC or if using a U60, connect using the supplied USB Type A to USB Micro B cable as shown below.
If the FT Click is plugged into a shield board and powered through the board, you will have to connect a 3.3VDC supply between the FT click's 3V3 and GND pins.



Setting the LonTalk Address

1. From a command prompt run the following command (modify accordingly for your network interface name):

```
nodeutil -dlon1
```

2. Press the service pin on the FT Click and the service pin message will be registered as shown below:

```
Command Prompt - nodeutil -dlon1

F1-- Show Banner.
A -- (A)dd device to list.
C -- (C)lear the device list.
D -- Set the (D)omain of the network interface.
E -- (E)xit this application.
F -- (F)ind devices in the current domain.
1 -- Find devices in all (1)-byte domains.
2 -- ATM discovery.
G -- (G)o to device menu....
H -- (H)elp with commands.
L -- Display device (L)ist.
M -- Change device (M)ode or state.
P -- Send a service (P)in message.
Q -- (Q)uickly add device to list.
R -- (R)eboot 3150 device.
S -- Report device (S)tatus and statistics.
T -- (T)ransceiver parameters.
V -- Control (V)erbose modes.
W -- (W)ink a device.
Y -- Download Multiple Devices.
X -- E(X)peditioniously go to device.
Z -- Shell out to command prompt.
[ -- Performance test.
] -- Performance test / response validation.
< -- Redirect input from a file.
> -- Redirect output to a file.
NodeUtil> Received an ID message from device 1.
Program ID is 9FFFFFF0600A0402
NodeUtil>
```

3. (G)o to the (first) FT Click device by pressing “g 1” then enter (adjust the device number as required)

```

Command Prompt - nodeutil -dlon1
D -- Set the (D)omain of the network interface.
E -- (E)xit this application.
F -- (F)ind devices in the current domain.
1 -- Find devices in all (1)-byte domains.
2 -- ATM discovery.
G -- (G)o to device menu....
H -- (H)elp with commands.
L -- Display device (L)ist.
M -- Change device (M)ode or state.
P -- Send a service (P)in message.
Q -- (Q)uickly add device to list.
R -- (R)eboot 3150 device.
S -- Report device (S)tatus and statistics.
T -- (T)ransceiver parameters.
V -- Control (V)erbose modes.
W -- (W)ink a device.
Y -- Download Multiple Devices.
X -- E(X)peditioniously go to device.
Z -- Shell out to command prompt.
[ -- Performance test.
] -- Performance test / response validation.
< -- Redirect input from a file.
> -- Redirect output to a file.
NodeUtil> Received an ID message from device 1.
Program ID is 9FFFFFF06000A0402
NodeUtil> (G)o to device menu...
ID Neuron ID Program ID Key
0 FEAAA9BD0263 L5Mip *** network interface
1 00D071152445 9FFFFFF06000A0402 *** remote node
Enter device id for the device menu to enter (0-1) [1] :

```

The following device dialogue will appear:

```

Command Prompt - nodeutil -dlon1
G -- (G)o to another device.
H -- (H)elp with device commands.
I -- Network variable al(I)as table.
J -- (J)am network variable type.
K -- Chec(K) Neuron executable.
L -- (L)ist network variables.
M -- Change device (M)ode or state.
N -- (N)etwork Variable configuration table.
O -- Device advanced (O)ptions.
P -- (P)oll network variable.
Q -- (Q)uickly send a message.
R -- (R)ead device memory.
S -- Report device (S)tatus and statistics.
T -- (T)ransceiver parameters.
U -- (U)pdate input network variable.
V -- Control (V)erbose modes.
W -- (W)rite device memory.
X -- Create device interface ((X)IF) file.
Y -- Download Neuron executable.
Z -- Disas(Z)emble memory.
[ -- Performance test.
] -- Performance test / response validation.
$ -- Memory access.
= -- Signal strength.
* -- Refresh memory.
! -- Device IP address.
+ -- Load application symbols.
< -- Redirect input from a file.
> -- Redirect output to a file.
DEVICE:1>

```

4. Change the FT click's (D)omain table by typing "d 0 y 1 1 10 n ff y" (adjust the domain, subnet and node address as required. All devices should be in the same domain and subnet but must have unique node IDs)


```

Command Prompt - nodeutil -dlon1
V -- Control (V)erbose modes.
W -- (W)rite device memory.
X -- Create device interface ((X)IF) file.
Y -- Download Neuron executable.
Z -- Disas(Z)emble memory.
[ -- Performance test.
] -- Performance test / response validation.
$ -- Memory access.
= -- Signal strength.
* -- Refresh memory.
! -- Device IP address.
+ -- Load application symbols.
< -- Redirect input from a file.
> -- Redirect output to a file.
DEVICE:1> Device (D)omain table
Enter domain table index (0-1) [65535] : 0
Index Size Subnet Node Auth Key Domn ID
0 1 1 10 FF FF FF FF FF FF 01
Update this table entry? (Y/[N]):Y
Enter domain ID length: 0, 1, 3, 6, or (U)nused [1] : 1
Enter 1 bytes of domain ID [0]: 1
Enter subnet ID (0-255) [1] : 1
Enter node ID (0-127) [10] : 10
Set as clone domain? (Y/[N]):N
Enter 6 bytes of auth key [FF]: FF
Index Size Subnet Node Auth Key Domn ID
0 1 1 10 FF FF FF FF FF FF 01
Are you sure you really want to do this? (Y/[N]):Y
Successfully updated domain table entry
DEVICE:1>

```

5. Check the (S)tatus of the FT Click by typing "s". Ensure that the device state is "Configured, On-line" as shown below.

```

Command Prompt - nodeutil -dlon1
Enter 6 bytes of auth key [FF]: FF
Index Size Subnet Node Auth Key Domn ID
0 1 1 10 FF FF FF FF FF FF 01
Are you sure you really want to do this? (Y/[N]):Y
Successfully updated domain table entry
DEVICE:1> Report device (S)tatus and statistics
Device status:
Packet errors detected = 0
Transaction timeouts = 0
Receive trans full errors = 0
Lost msgs (no app buff) = 0
Missed msgs (no net buff) = 0
Packets received by device = 23
Packets addressed to device = 23
Messages sent to MAC layer = 4926
Retries = 0
Backlog overflows = 0
Late acks or responses = 0
Collisions detected = 0
Lost msgs (no exten buf) = 0
EEPROM lock = Clear
Last reset cause = Software
Device state = Configured, On-line
Firmware version number = 21.04.07
ROM version = 19
Flash BootLoader version = 8
Neuron model = FT 6050
Last error logged = None
Do you want to clear node status? (Y/[N]):N
DEVICE:1>

```

6. Repeat step 2 above for the next FT click,
7. Once finished disconnect all FT clicks from the network interface

Arduino

Bill of Materials

You will need to purchase the following:

- Quantity 1, Arduino UNO <https://www.digikey.com/products/en?keywords=1050-1041-ND>
- Quantity 1, Arduino UNO click SHIELD <https://www.digikey.com/products/en?keywords=1471-1341-ND%E2%80%8E>

- Quantity 1, Addressable White LED Strip 1m
<https://www.sparkfun.com/products/13898>
- Quantity 1, Addressable Lighting Dotstar 144 RGB LED Strip 1m
<https://www.digikey.com/products/en?keywords=1528-1481-ND>
- Quantity 1, FT Click <https://www.mikroe.com/ft-click>
- Quantity 1, 12VDC 2A Power Supply (5.4mm OD barrel connector)
- Quantity 1, 5VDC 2A Power Supply for the LED strips
- Quantity 1,

Downloads

You will need to download the following:

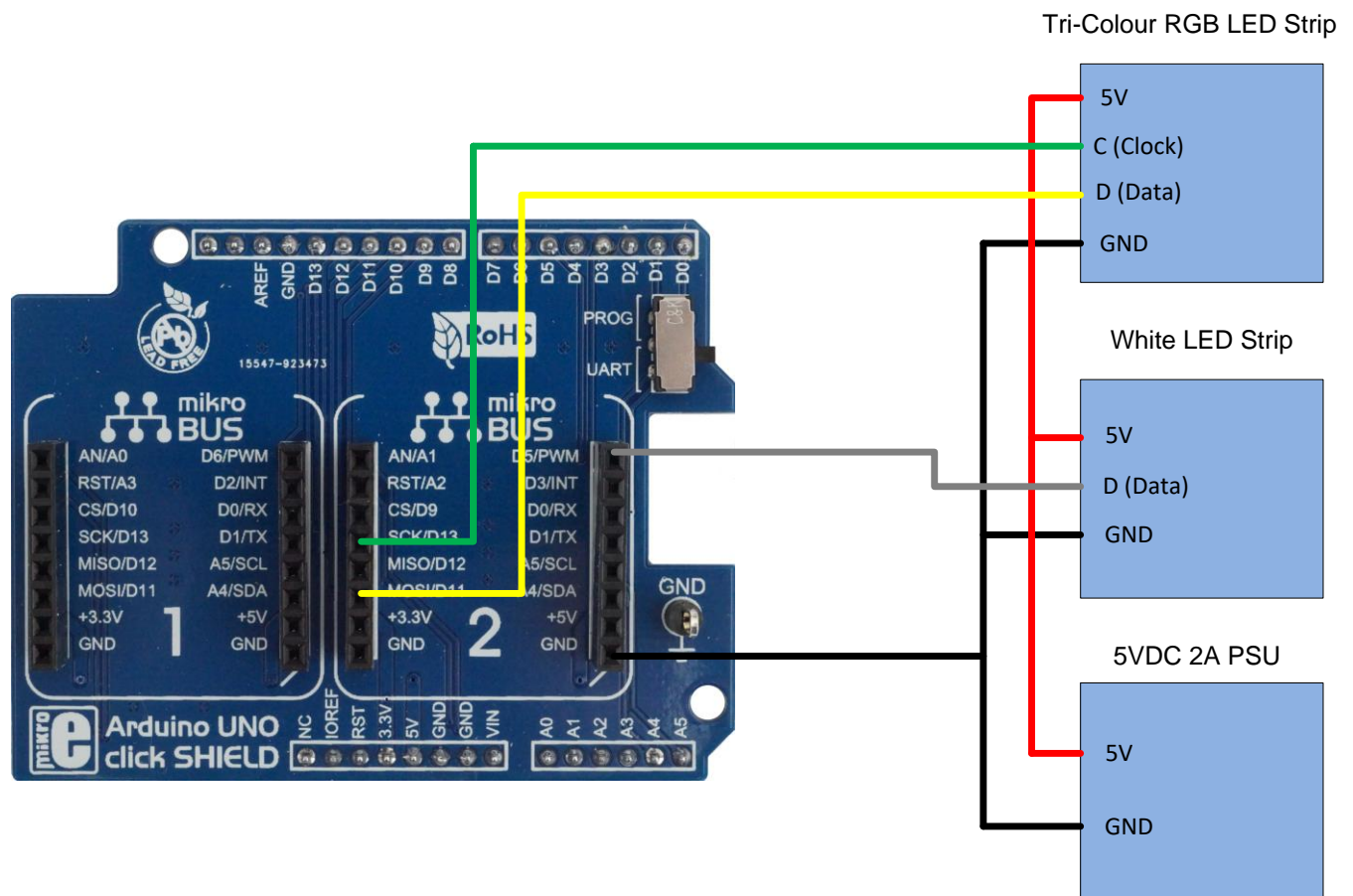
- Arduino IDE v1.8.11 <https://www.arduino.cc/en/Main/Software>

Software Installation

Install the Arduino IDE

Wiring

Connect the RGB and white LED strips to the Arduino UNO click shield adaptor in slot two as shown below using suitable headers.



LED Strip	Micro BUS Pin	LED Pin
RGB	MOSI/D11	D (Data)
RGB	SCK/D13	C (Clock)
White	D5/PWM	D (Data)

Assembly

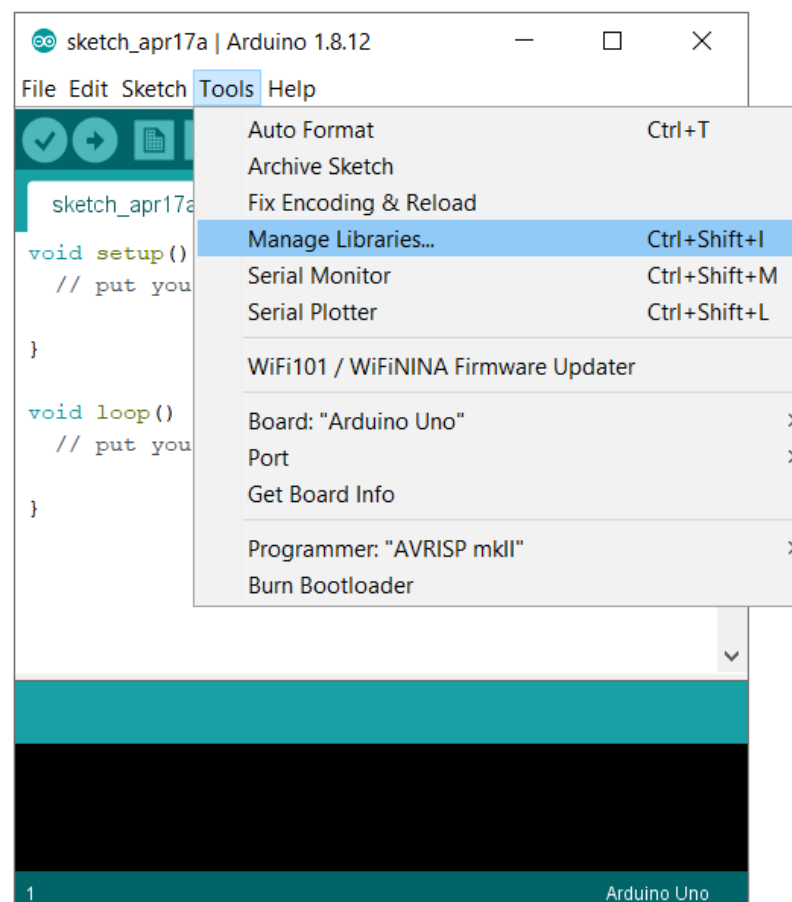
1. Plug the Arduino UNO click shield adaptor into the Arduino UNO board.
2. Plug the FT Click into the Arduino UNO click shield adaptor in slot number 1.

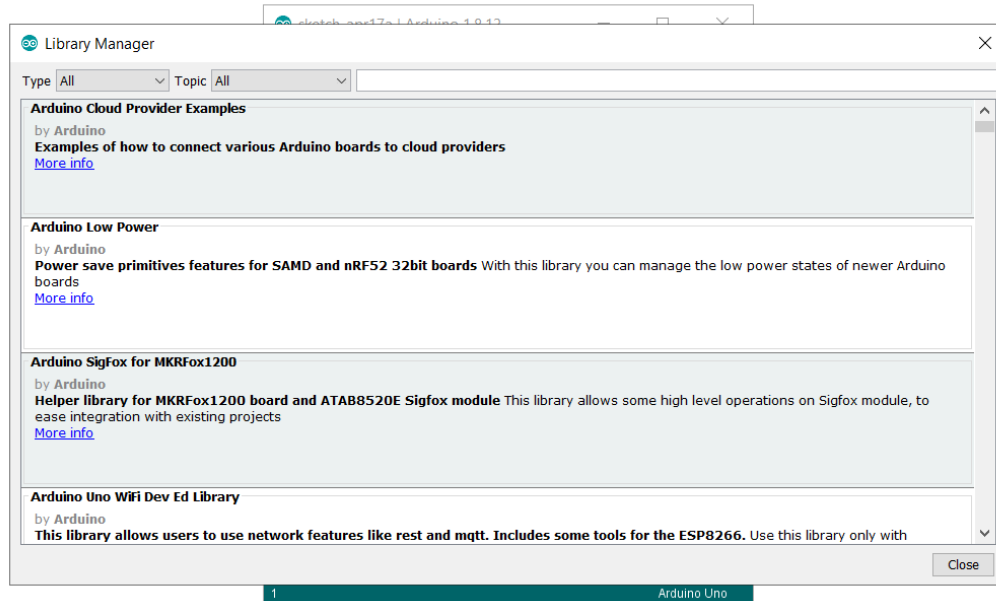


NOTE: The Arduino click shield has a 2-position switch. To program the Arduino with the shield mounted, the switch has to be in the “PROG” position. This position allows the Arduino to be programmed from the computer via the USB port, but prevents an FT Click module from communicating with the Arduino. For normal operation, the switch has to be in “UART” position, allowing the communications between the Arduino and the FT click.

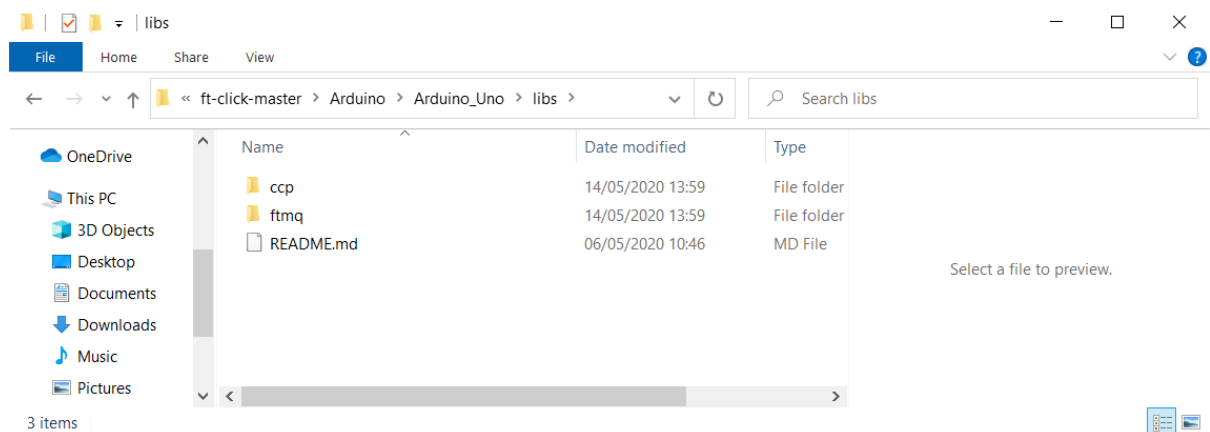
Configuration

1. Start the Arduino IDE and go to the library manager by selecting tools->Manage Libraries





2. See <https://www.arduino.cc/en/guide/libraries> for help on libraries
3. Search for and install the following libraries:
 - Adafruit Neopixel
 - Adafruit DotStar
 - Arduino Json
4. Copy the ccp and ftmq folders cloned from the downloaded repository \ft-click-master\Arduino\Arduino_Uno\libs folder into the Arduino libraries folder on your PC (typically C:\Program Files (x86)\Arduino\libraries)



Testing the LED strips

1. Load the sketch "ewdemo_test_strips.ino" from the Arduino\Arduino_Uno\examples\ewdemo_test_strips folder into the Arduino.
2. The led counts have to be adjusted in the source to match the number of LEDs in use.
3. The program will turn on both LED strips in groups, cycling the three base colours, and performing a shift along the strips.

```
ewdemo_test_strips | Arduino 1.8.12
File Edit Sketch Tools Help

ewdemo_test_strips $

#include <Adafruit_DotStar.h>
// Because conditional #includes don't work w/Ardu:
#include <SPI.h> // COMMENT OUT THIS LINE I
//#include <avr/power.h> // ENABLE THIS LINE FOR G

#define LED_COUNT 144 // Number of LEDs in White s
#define NUMPIXELS 144 // Number of LEDs in RGB str:

// Here's how to control the LEDs from any two pin:
#define DATAPIN 4
#define CLOCKPIN 5
//Adafruit_DotStar_strip(NUMPIXELS, DATAPIN, CLOCKPIN)

Error downloading https://downloads.arduino.cc/packag

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```

Demo code

1. Load the sketch “ewdemo_strips.ino” from the Arduino\Arduino_Uno\examples\ewdemo_strips into the Arduino.
2. Again the led counts have to be adjusted in the source to match the number of LEDs in use.

```
ewdemo_strips | Arduino 1.8.12
File Edit Sketch Tools Help

ewdemo_strips $

#include <ftmq.h>

//#include "ftmq.h"

#include <Adafruit_DotStar.h>
// Because conditional #includes don't work w/Ardu:
#include <SPI.h> // COMMENT OUT THIS LINE I
//#include <avr/power.h> // ENABLE THIS LINE FOR G

#define LED_COUNT 144 // Number of LEDs in White s
#define NUMPIXELS 144 // Number of RGB LEDs in str:

// Here's how to control the LEDs from any two pin:
#define DATAPIN 4
#define CLOCKPIN 5

13 Arduino Uno
```

Connect the FT Wiring

Connect the FT twisted pair wiring to the FT Click board.

Allocate a LonTalk Address

Allocate a unique LonTalk address using one of the methods illustrated above.

STM32micro Nucleo

Bill of Materials

What you will need to purchase:

- Quantity 1, STM32 Nucleo <https://www.digikey.com/products/en?keywords=497-16280-ND>
- Quantity 1, Arduino UNO click SHIELD
<https://www.digikey.com/products/en?keywords=1471-1341-ND%E2%80%8E>
- Quantity 1, BME 680 Environmental click
<https://www.digikey.com/products/en?keywords=1471-1849-ND>
- Quantity 1,
- Quantity 1, USB Type A to Micro B cable
- Quantity 1, FT Click <https://www.mikroe.com/ft-click>

Downloads

You will need to download the following:

- STM32CubeIDE v1.2.0 <https://www.st.com/en/development-tools/stm32cubeide.html#get-software>

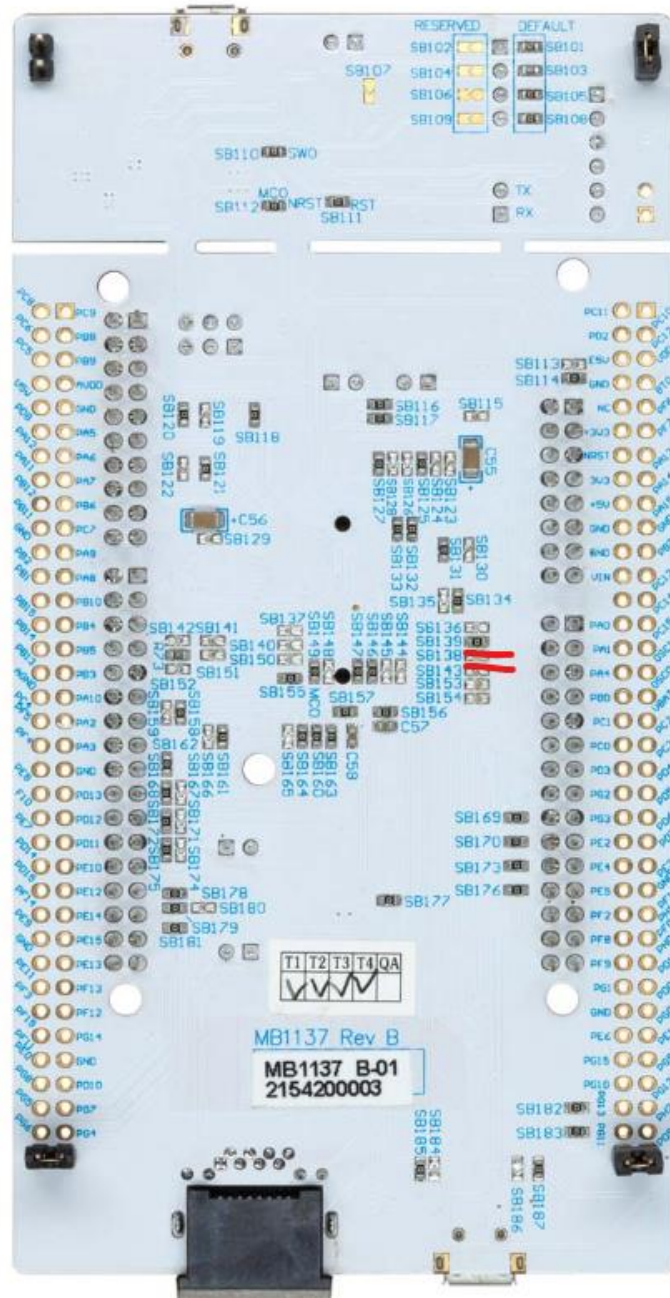
Software Installation

Install the STM32CubeIDE.

STM32micro Nucleo Board Changes

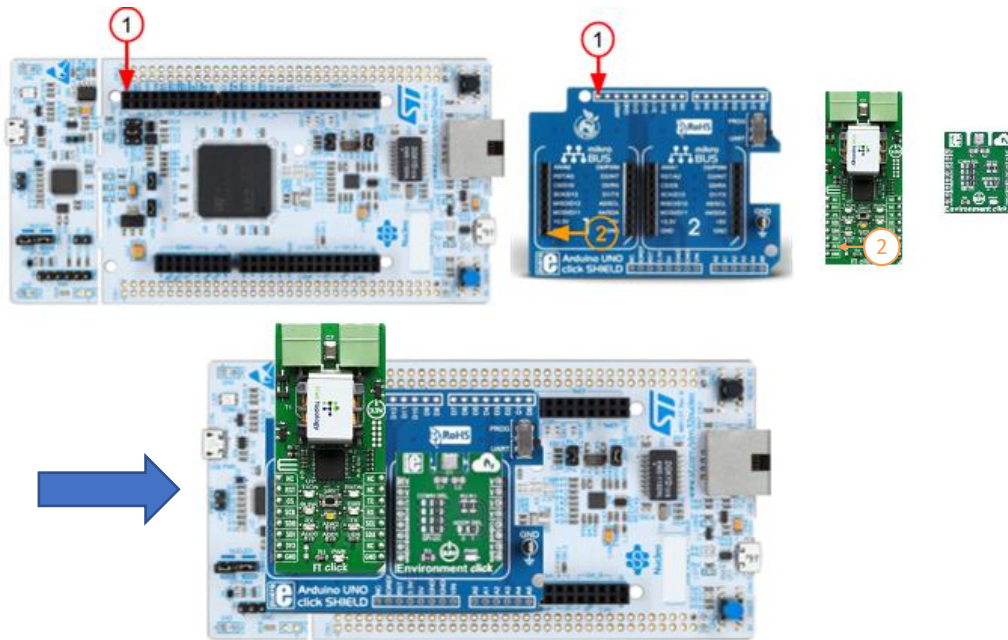
The STM32micro Nucleo boards need a set of changes in the solder jumpers to remap I2C to the Arduino header. They can be connected with solder or with 0W SMD resistors.

1. Remove the two 0Ω SMD resistor jumpers SB147 and SB157 as shown below:



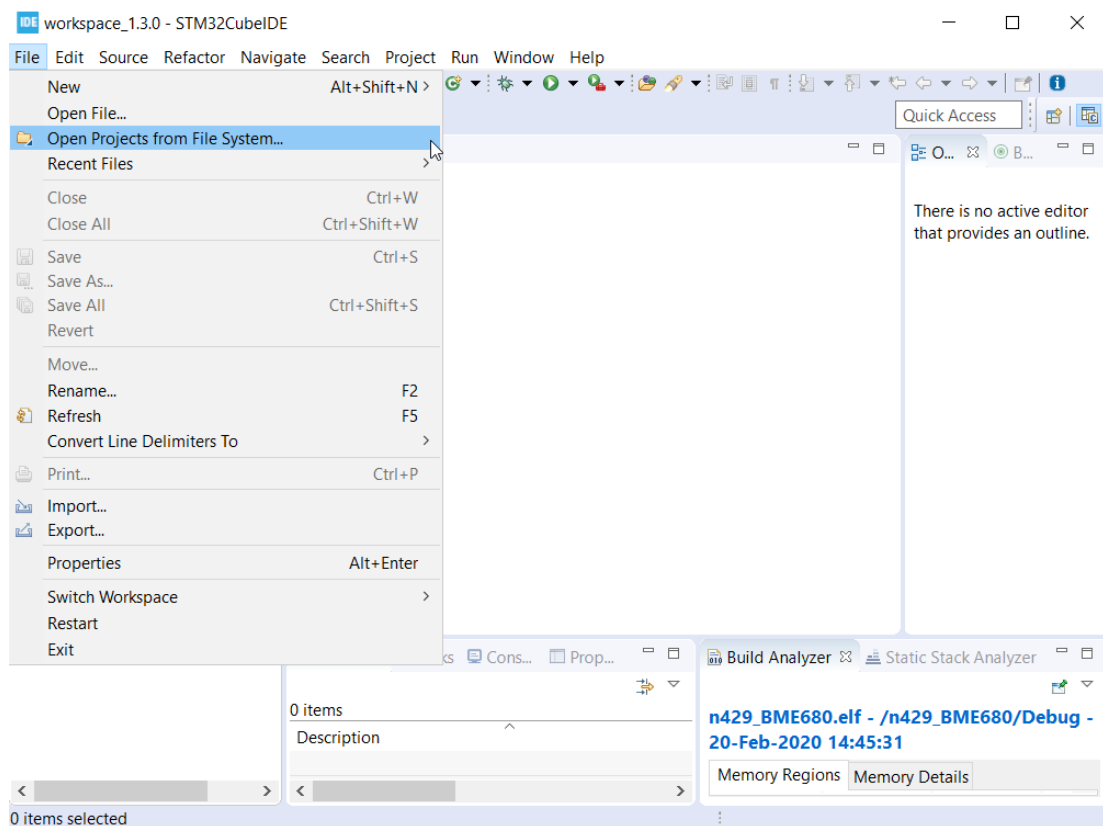
Assembly

1. Plug the Arduino UNO click shield adaptor into the STM32 Nucleo board aligning the pins as shown below.
2. Plug the FT Click into the Arduino UNO click shield adaptor socket 1.
3. Plug the BME680 click into the Arduino UNO click shield adaptor socket 2.

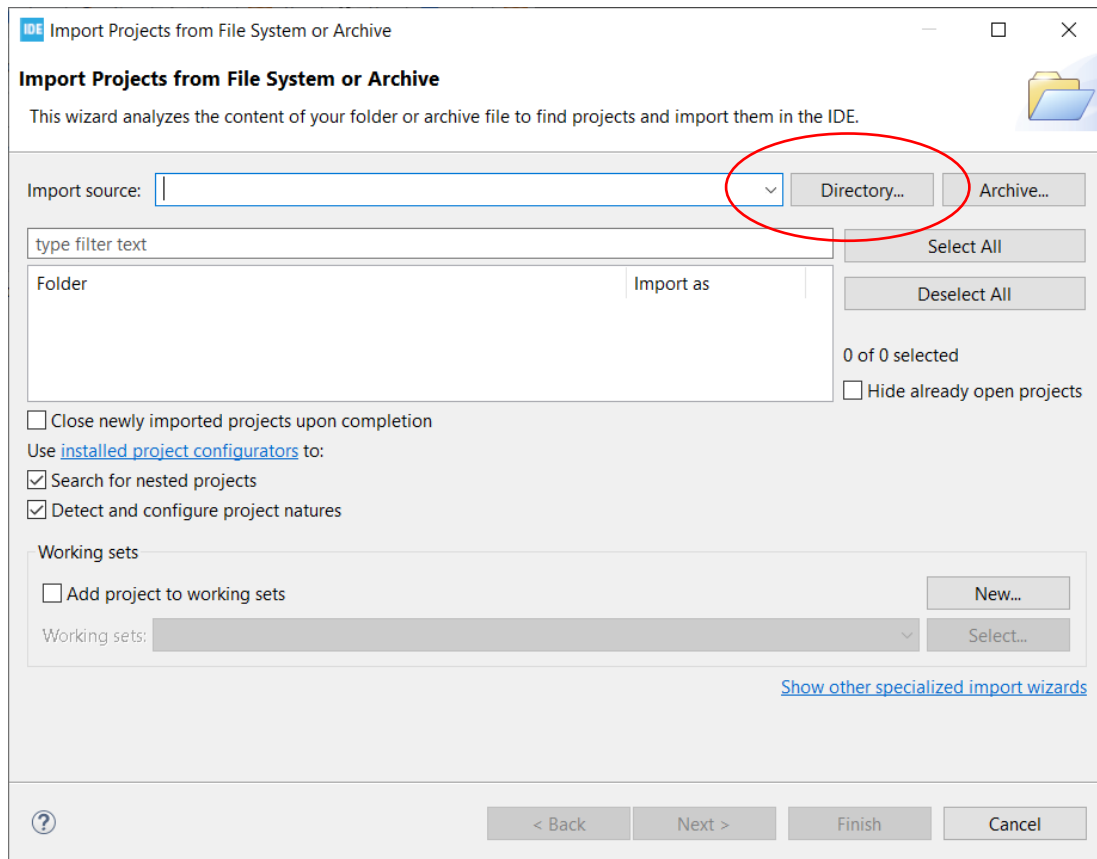


Import the Project and Run

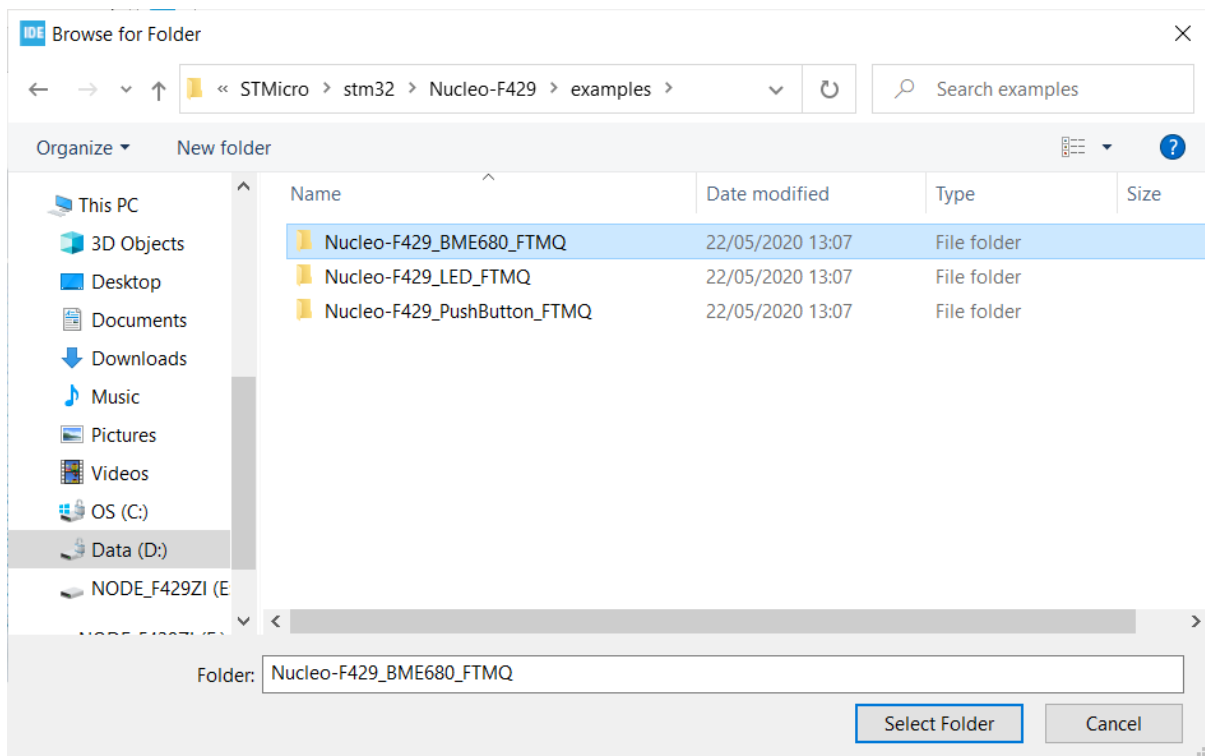
1. Start the STM32CubeIDE environment.
2. Import project from the downloaded repository \ft-click-master\STMicro\stm32\Nucleo-F429 folder into STM32CubeIDE by selecting **File->Open Projects from File System** as shown below:



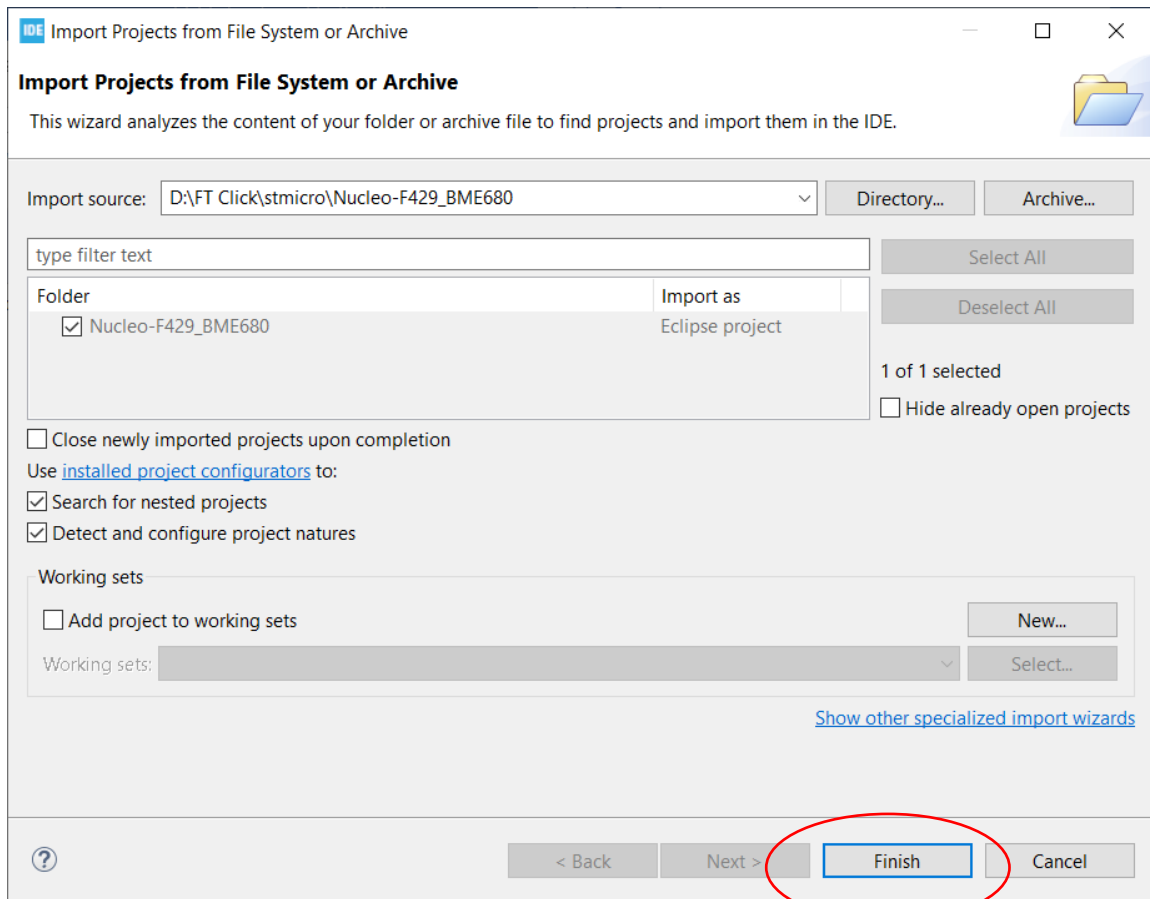
At the following dialogue click **Directory** as shown below:



Browse to the Nucleo-F429_MBE680_FTMQ folder downloaded from the repository, select it and click on **Select Folder** as shown below:

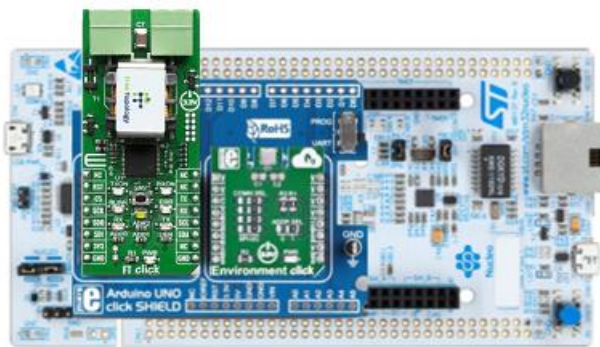


At the following dialogue, click **Finish**.

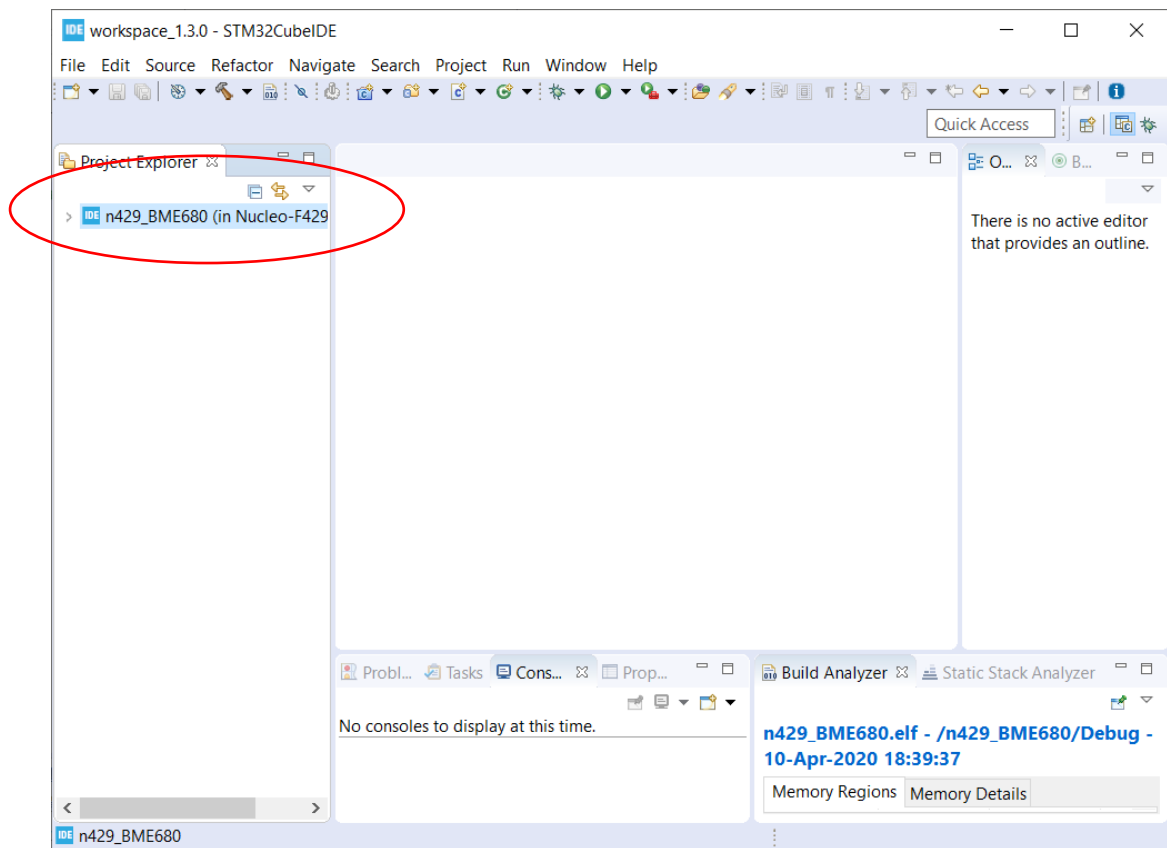


3. Connect Nucleo board to the PC
Using a USB micro B to USB A cable, connect the Nucleo board to the PC as shown below:

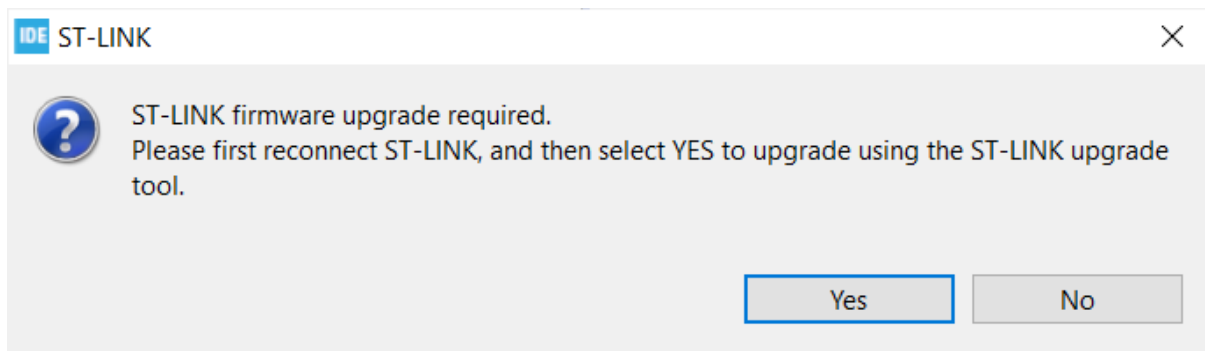
USB port for
power and
programming

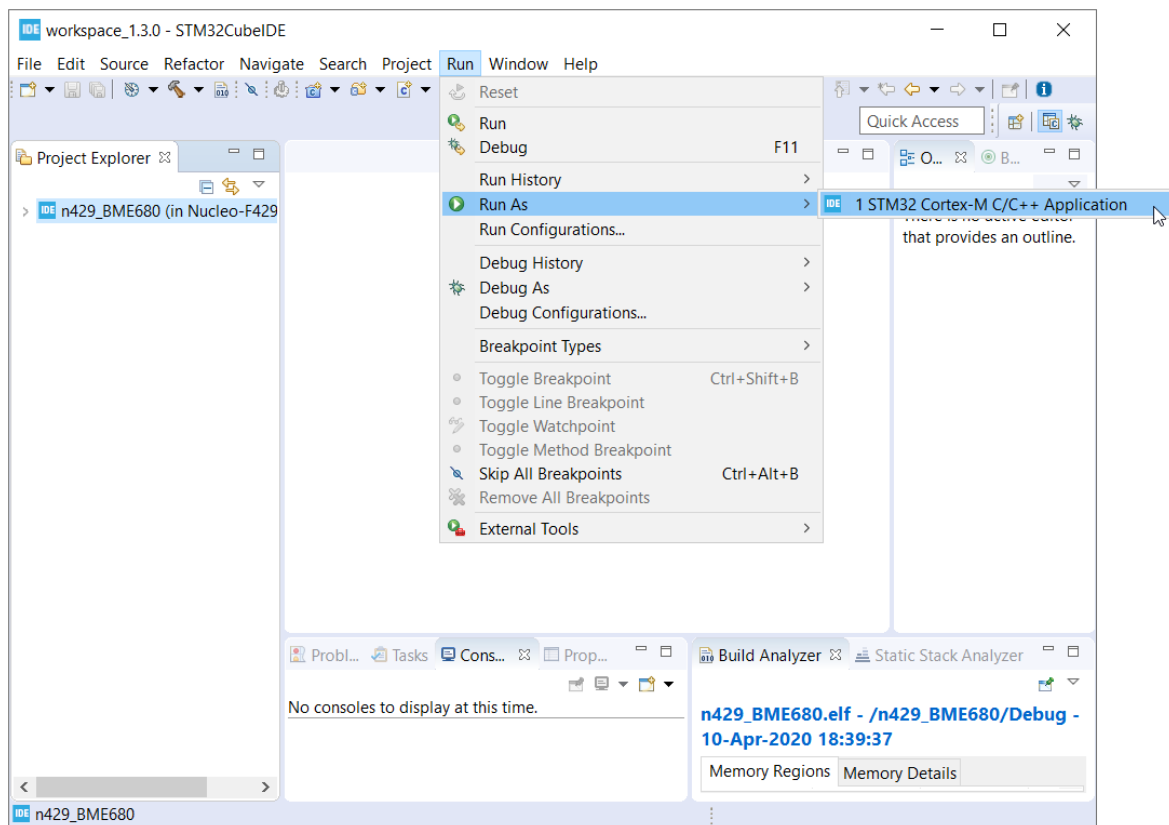
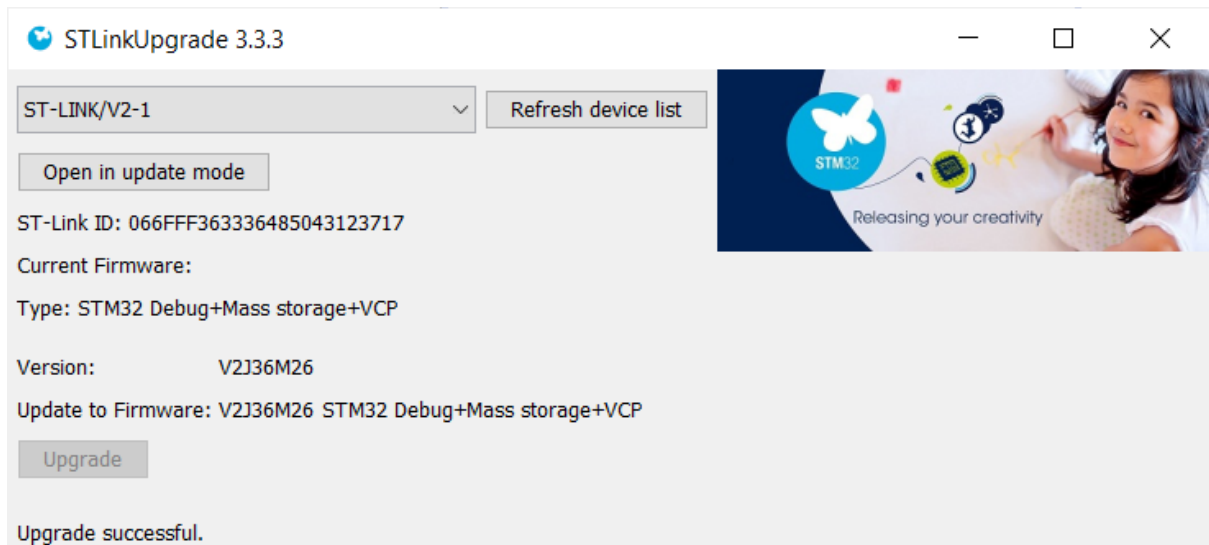


4. Select the project n429_MBE680_FTMQ in the project explorer, as shown below:



5. Select **Run->Run As** as shown below to upload the code to the board (or use **Run->Debug As**) and upgrade the ST-Link firmware if necessary by following the instructions.





6. You can now power the STM32 Nucleo board from a suitable USB power supply without the development environment.

Connect the FT Wiring

Connect the FT twisted pair wiring to the FT Click board.

Allocate a LonTalk Address

Allocate a unique LonTalk address using one of the methods illustrated above.

Raspberry Pi

Overview

There are two ways of setting up the Raspberry Pi, either from the pre-configured image (simple) or from scratch (complex).

Bill of Materials

You will need to purchase:

- Quantity 1, Raspberry Pi Model 3 B+
<https://www.digikey.com/products/en?keywords=1690-1025-ND%E2%80%8E>
- Quantity 1, PI 3 click Shield <https://www.digikey.com/products/en?keywords=1471-1858-ND>
- Quantity 1, FT Click <https://www.mikroe.com/ft-click>
- Quantity 1, Power Supply (do not use a normal USB charger outlet)
<https://www.digikey.com/products/en?keywords=1690-1022-ND>
- Quantity 1, 32GB Micro SD card complying with the guidelines at
<https://www.raspberrypi.org/documentation/installation/sd-cards.md>

Downloads

You will need to download:

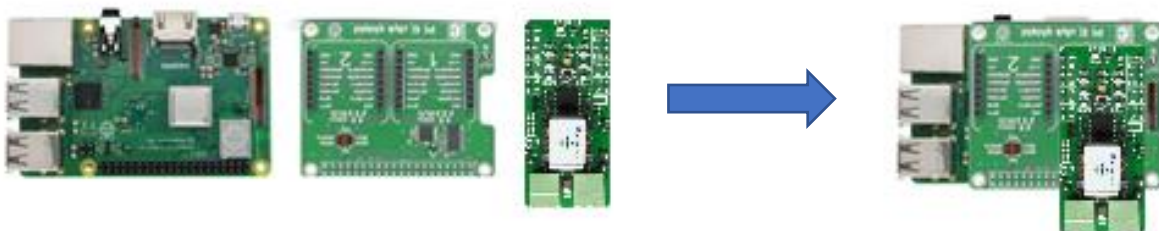
- Win32diskimager from <https://sourceforge.net/projects/win32diskimager/> or balenaetcher from <https://www.balena.io/etcher/>
- An SSH client such as PuTTY from <https://www.chiark.greenend.org.uk/~sgtatham/putty/latest.html>

Software Installation

1. Install Win32diaskmanager or baelnaetcher
2. Install Putty

Assembly

1. Plug the Pi click shield into the Raspberry Pi
2. Plug the FT Click into slot number 1 of the Pi click shield as shown below.



Setup Using the Pre-Configured Image

Program the micro SD Card

Download and unzip the file ft-click-1.01-pi.img.xz from [here](#) (it is not in the repository) to your local machine and then using write ft-click-1.01-pi.img to the micro SD card using either Win32diskimager or balenaetcher.

Setup the raspberry pi

1. Insert the programmed micro SD card into the socket on the underside of the Raspberry Pi with the gold fingers facing the PCB.
2. Power up the Raspberry Pi using the USB micro B port

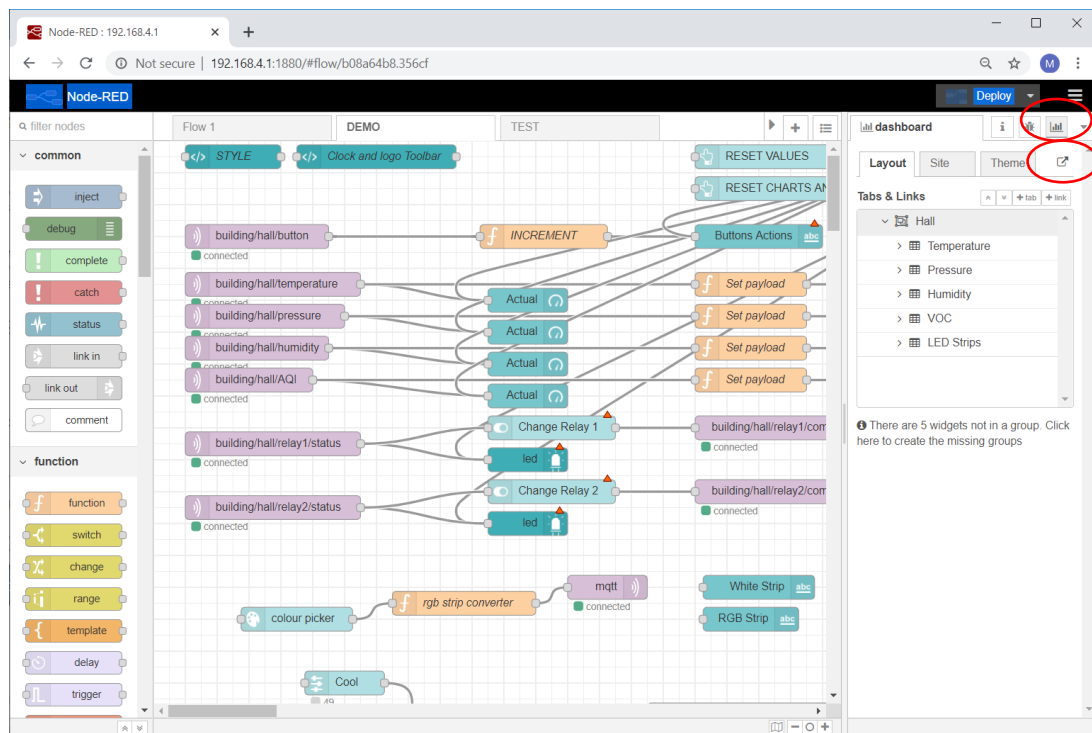
- After booting, the Raspberry Pi will establish a WiFi access point (this may take some time). Connect to it from your PC using the following credentials:

SSID: ft_raspi

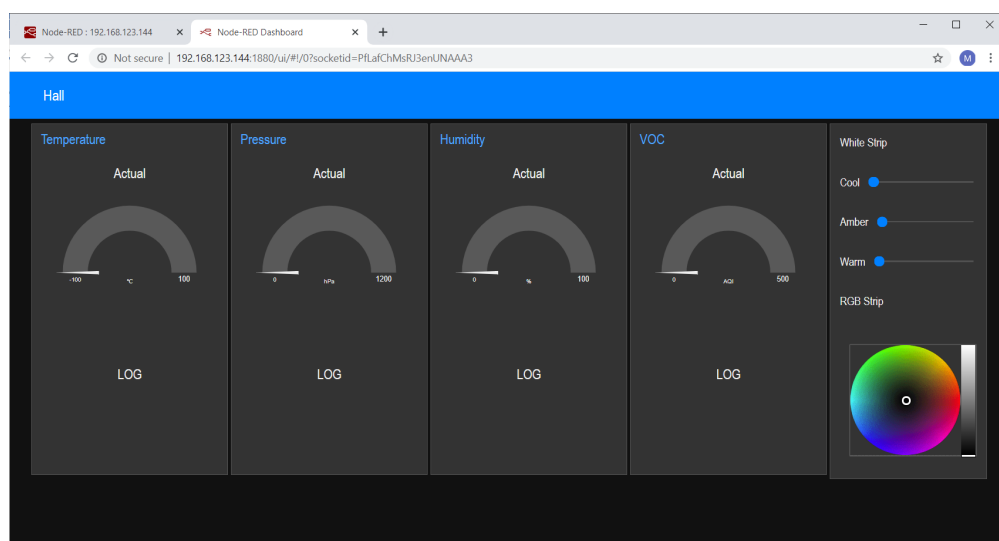
Key: makervideo

The Raspberry Pi's IP address will be 192.168.4.1 and can also be reached as raspberrypi.local if your PC can resolve mDNS names (you would need the Bonjour service running, which is part of iTunes).

- Once connected, connect to the Node-RED control panel at <http://192.168.4.1:1880>



- Launch the Node-RED dashboard by clicking the dashboard icon then the launch icon below it, as shown above. Note, monitoring and control will not be enabled until the Raspberry Pi's FT Click is connected to the FT wiring.



Proceed to [Testing the Node-RED Installation.](#)

Setup From Scratch

Install Node-RED

1. Download Raspberry Pi image from:
https://downloads.raspberrypi.org/raspbian_lite/images/raspbian_lite-2019-04-09/
2. Unzip and write the image 2020-02-13-raspbian-buster-lite.img using Win32diskimager or balenaetcher to the SD card.
3. Insert the programmed micro SD card into the socket on the underside of the Raspberry Pi with the gold fingers facing the PCB.
4. Connect the Ethernet interface of the Raspberry Pi to your local LAN using a suitable patch lead.
5. Power up the Raspberry Pi.
6. Enable SSH and Serial Port Hardware
SSH and Serial Port Hardware are not enabled on a Raspberry Pi by default, to enable them, you will have to connect a keyboard, mouse and monitor (using an HDMI cable) to your Raspberry Pi (if at the desktop start a terminal session), then use the following command:

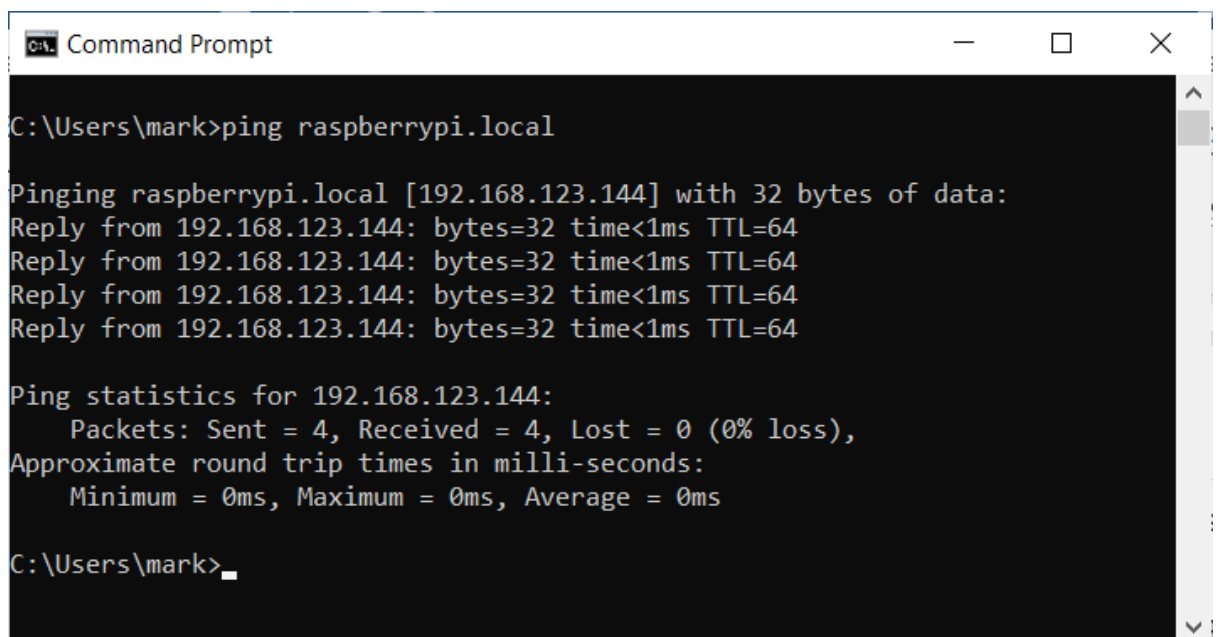
```
sudo raspi-config
```

Then select (5) Interfacing Options, select P2 SSH and select <Yes>, select <Ok>, select (5) Interfacing Options, select P6 Serial, select <No>, select <Yes>, select <Ok>, select <Finish>.

You can now power down (or reboot) the Raspberry Pi, disconnect the monitor, keyboard and mouse.

7. Find the IPV4 address for the Ethernet port from the DHCP server or if you have the Bonjour service running on your PC from a command prompt using:

```
ping raspberrypi.local
```



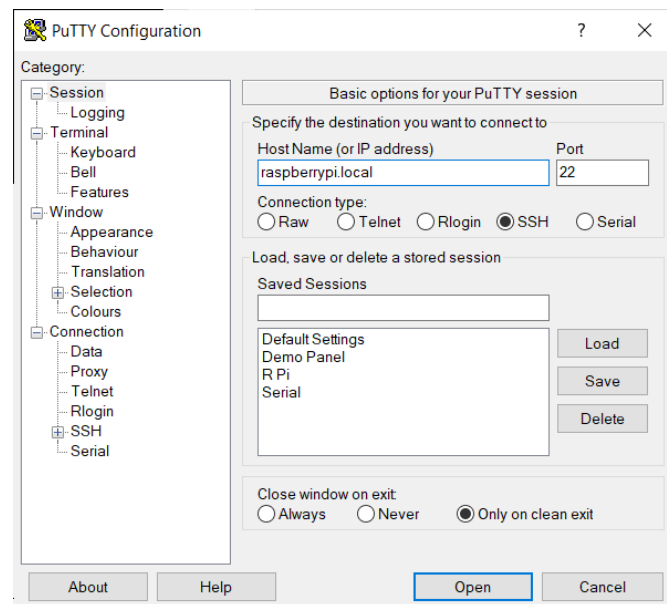
```
C:\Users\mark>ping raspberrypi.local

Pinging raspberrypi.local [192.168.123.144] with 32 bytes of data:
Reply from 192.168.123.144: bytes=32 time<1ms TTL=64
Reply from 192.168.123.144: bytes=32 time<1ms TTL=64
Reply from 192.168.123.144: bytes=32 time<1ms TTL=64
Reply from 192.168.123.144: bytes=32 time<1ms TTL=64

Ping statistics for 192.168.123.144:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\Users\mark>
```

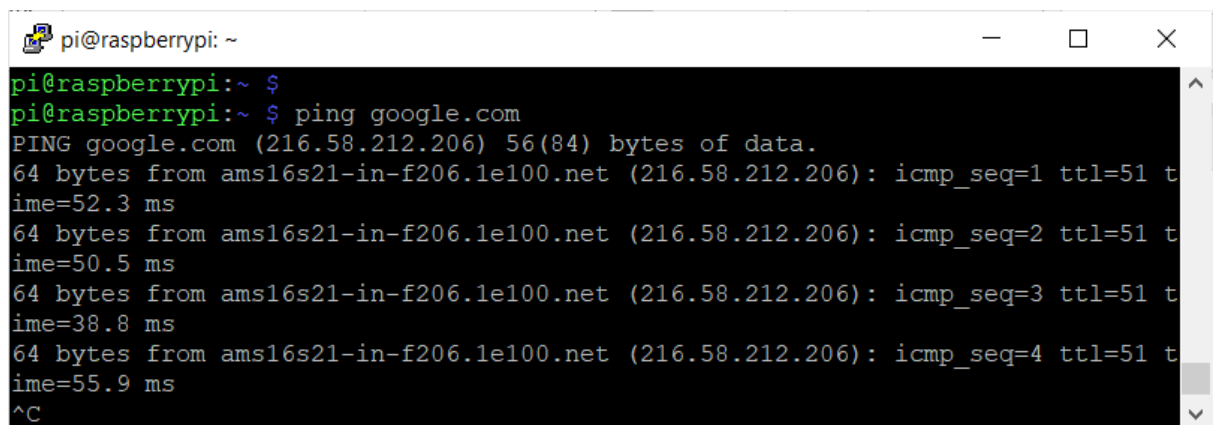

8. Connect to the Raspberry Pi using SSH



User: pi
Password: raspberry

9. From the SSH session, make sure you have a good internet connection using the following command:

```
ping google.com
```



Use Ctrl C to stop pinging.

10. Please note: once connected with an SSH session the following installation procedure may take up to an hour.
11. Update and upgrade the OS (you can copy the commands as below and right-click to paste into the SSH session, confirm as required):

```
sudo apt-get update  
sudo apt-get upgrade
```

12. Install some pre-requisites

```
sudo apt-get install git
sudo apt-get install build-essential
```

13. Install the message broker

```
sudo apt-get install mosquitto mosquitto-clients
```

14. Install Node-RED

```
bash <(curl -sL https://raw.githubusercontent.com/node-red/linux-installers/master/deb/update-nodejs-and-nodered)
```

15. Update and upgrade the OS again

```
sudo apt-get update
sudo apt-get upgrade
```

16. Run Node-RED as service on power-up

```
sudo systemctl enable nodered.service
```

17. Restart Node-RED

```
sudo systemctl restart nodered.service
```

18. Clone the repository

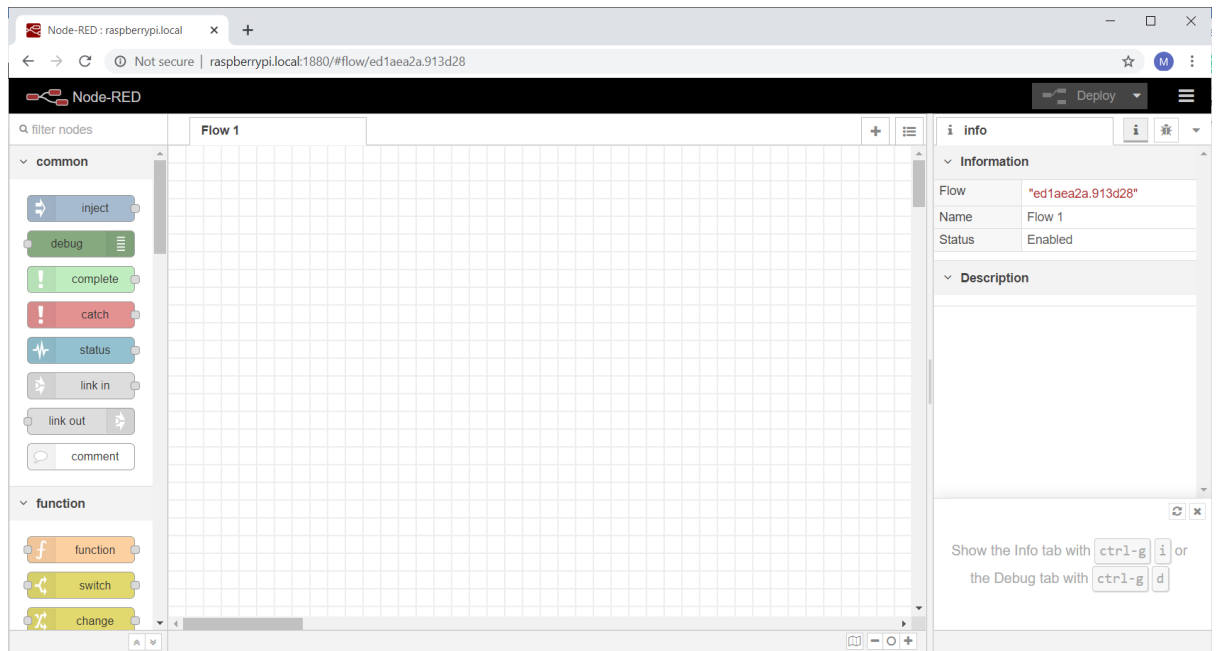
```
sudo git clone https://github.com/izot/ft-click.git
```

19. Reboot the Raspberry Pi

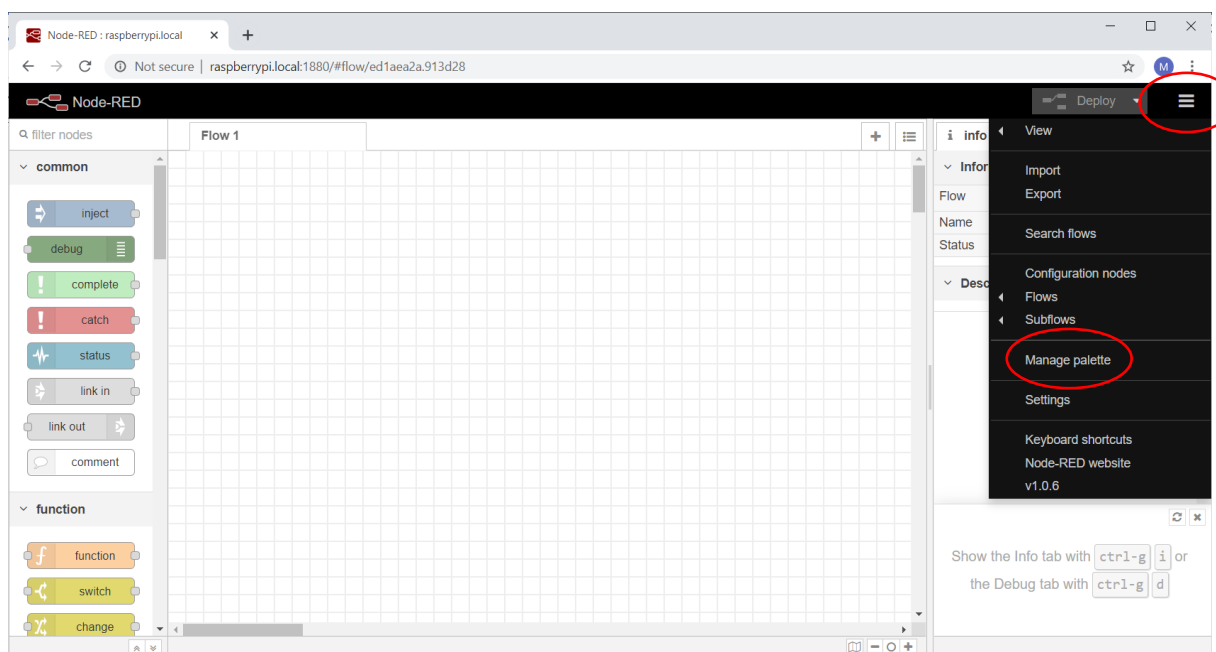
```
sudo reboot
```

Configure Node-RED

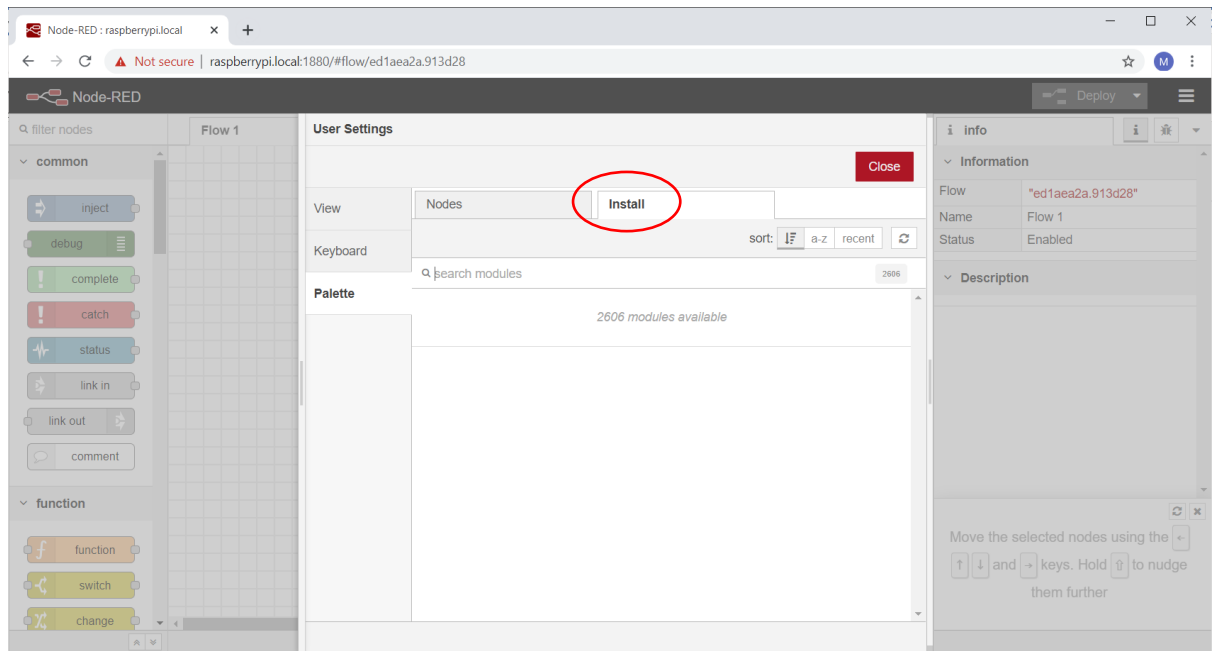
1. From a browser, access the Node-RED using raspberrypi.local:1880 or <R Pi IPV4 address>:1880



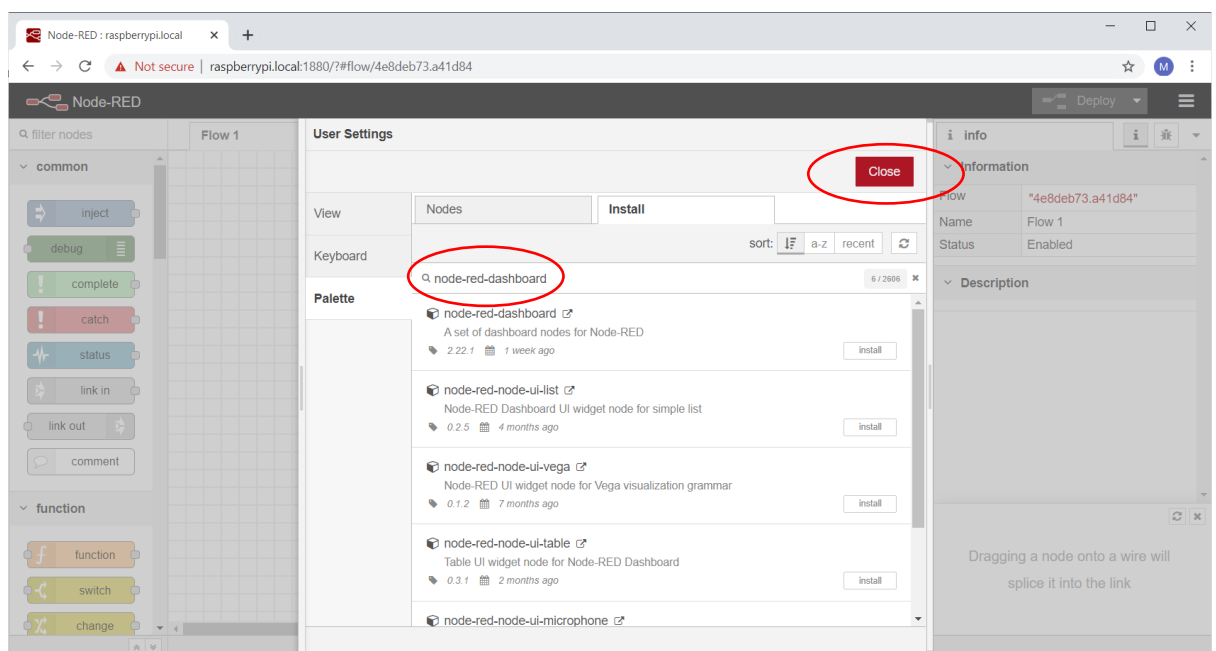
2. On node-red dashboard, click the **hamburger** select **Manage Palette**.



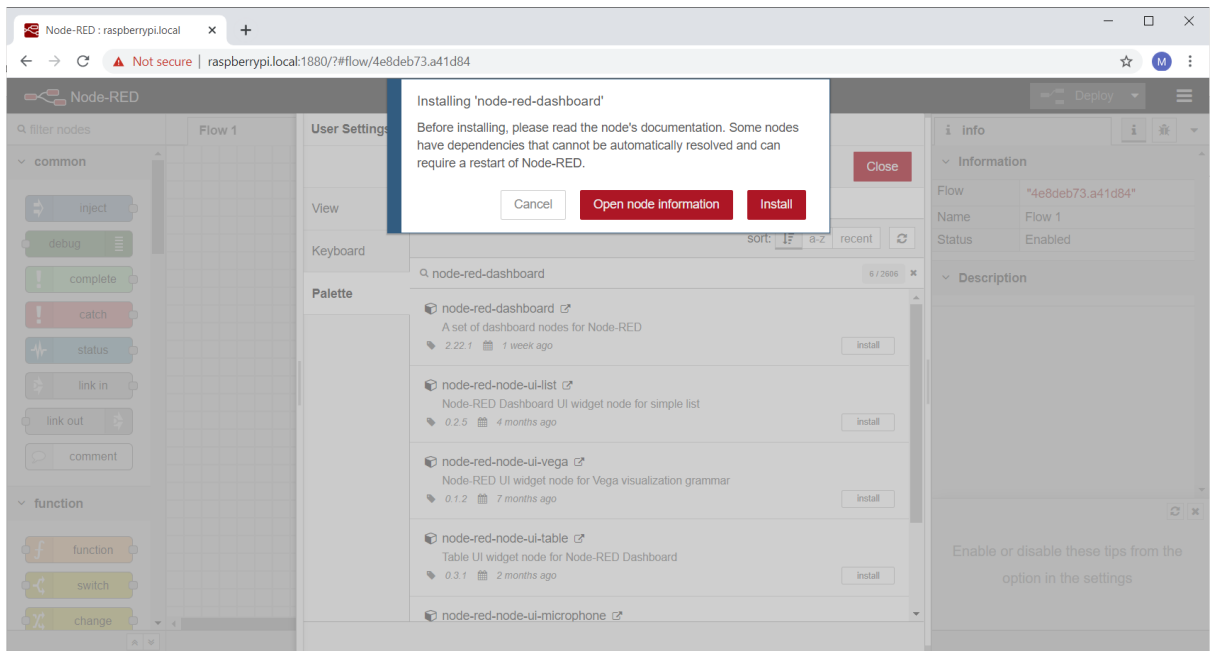
Select the install tab.



Search for and install **node-red-dashboard** and then **node-red-contrib-ui-led**.



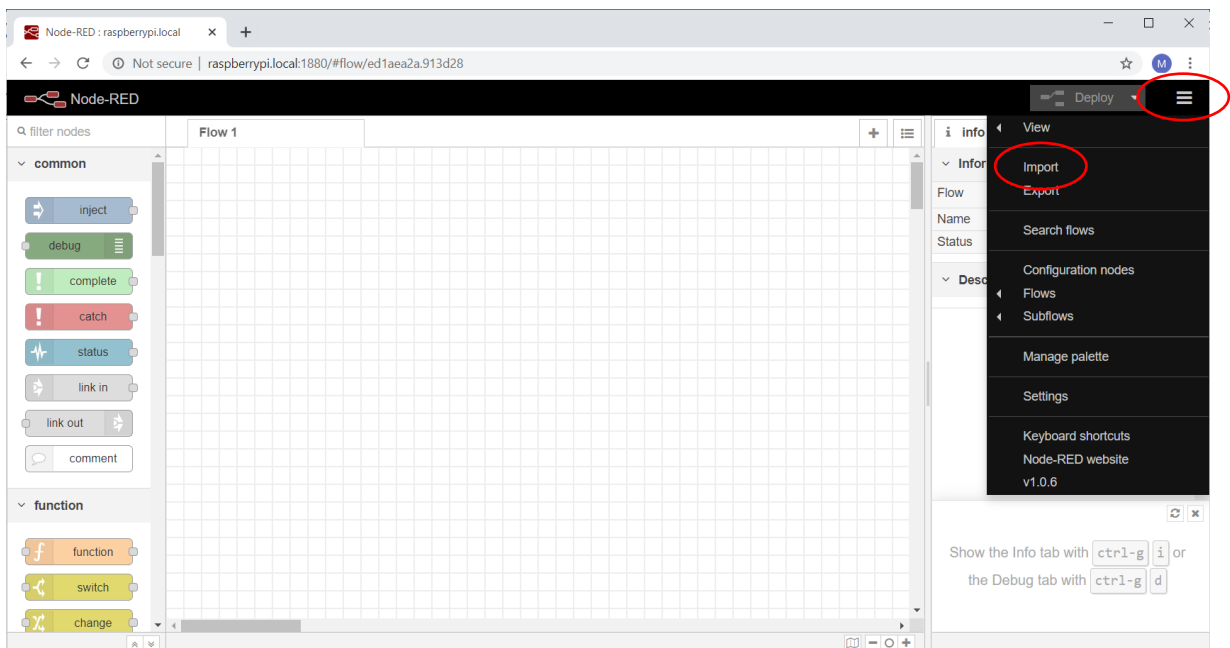
Confirm **install** as necessary



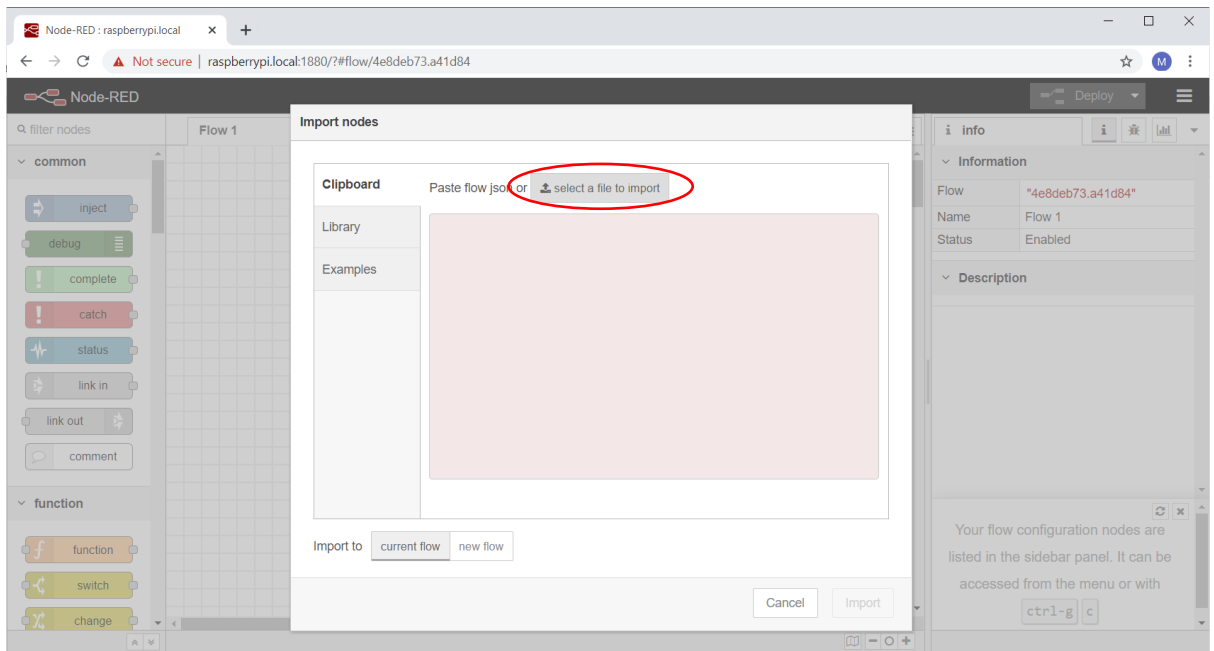
3. Click **Close**
4. Restart the Node-RED from the SSH session

```
sudo systemctl restart nodered.service
```

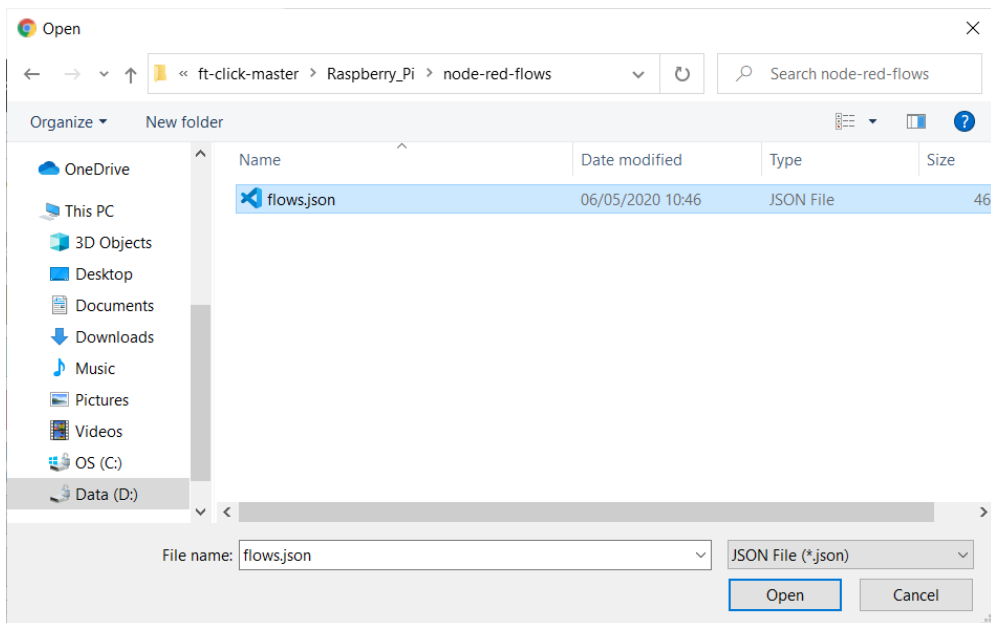
5. Import the node-red flow by clicking the **hamburger menu**, then selecting **Import**.



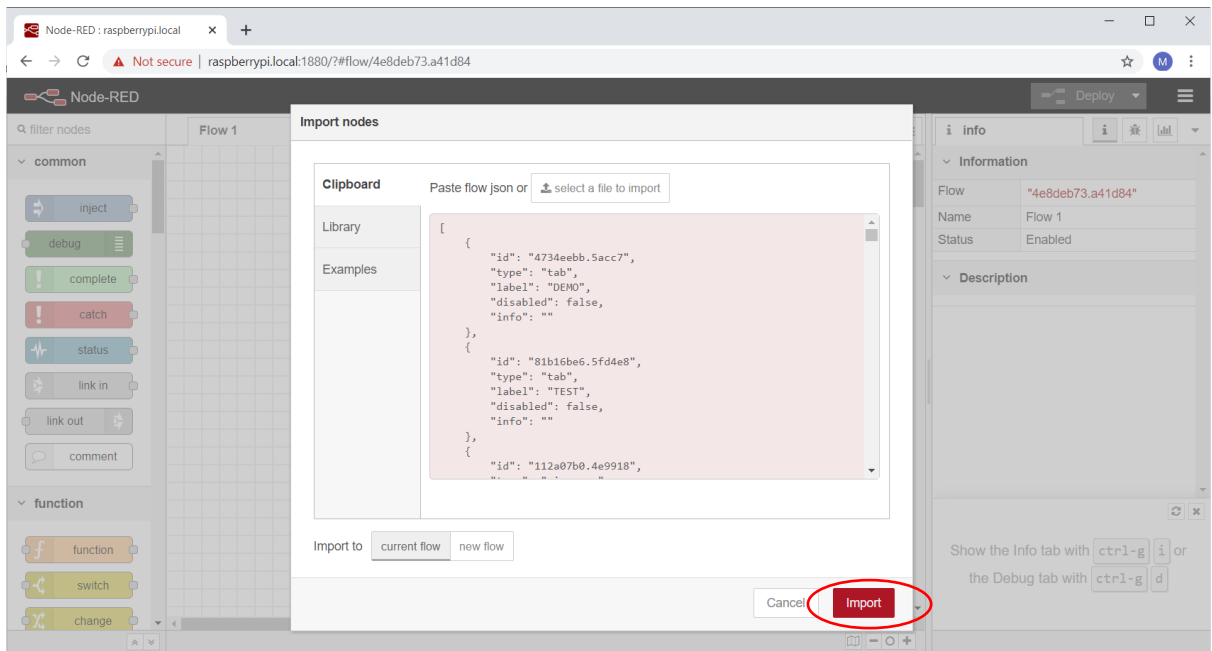
Click **select a file to import**



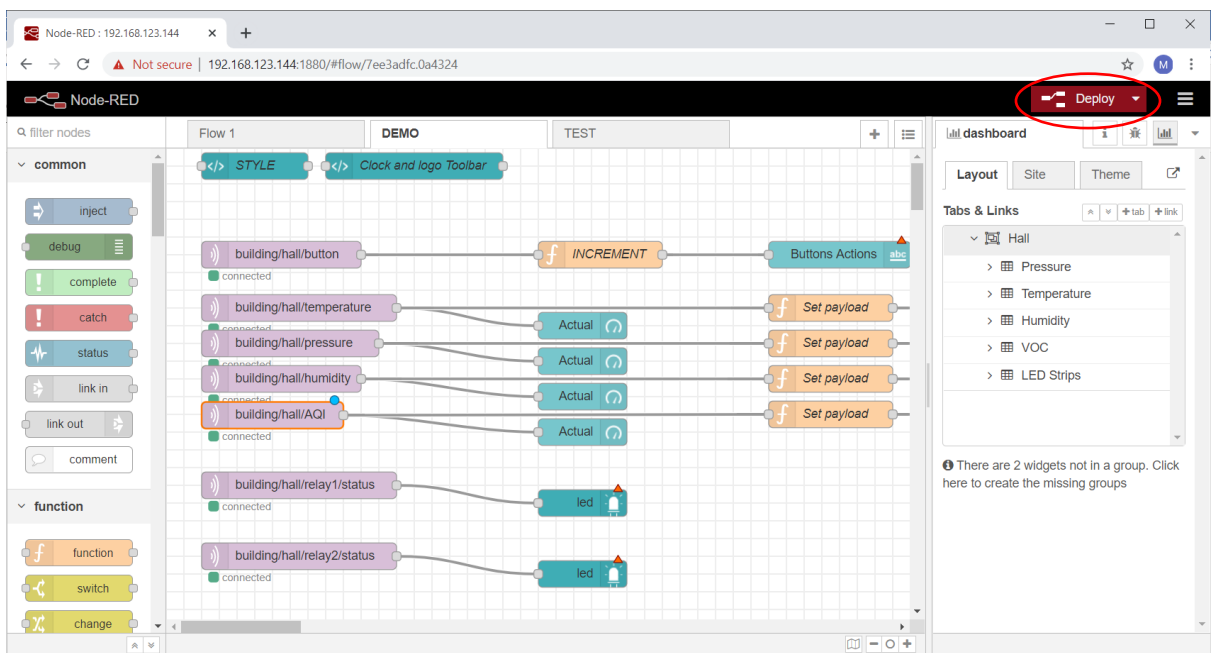
Navigate to the local copy of the repository and in the ft-click-master\Raspberry_Pi\node-red-flows folder, select **flows.json** and then click **Open**.



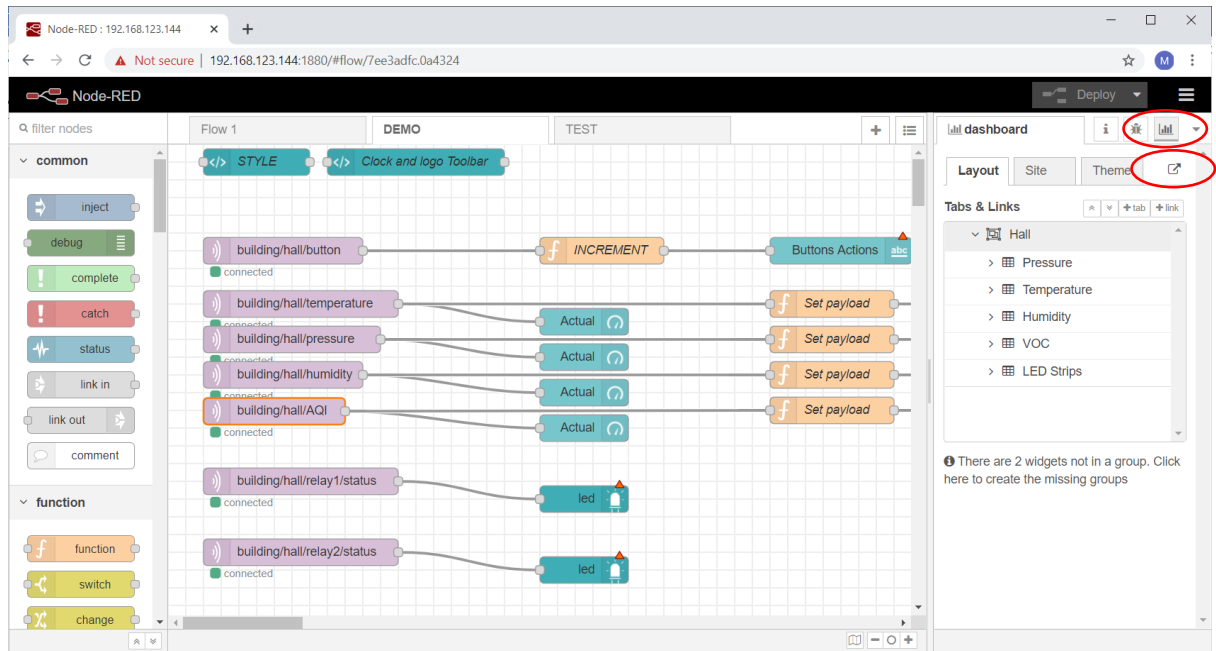
Click **Import**.



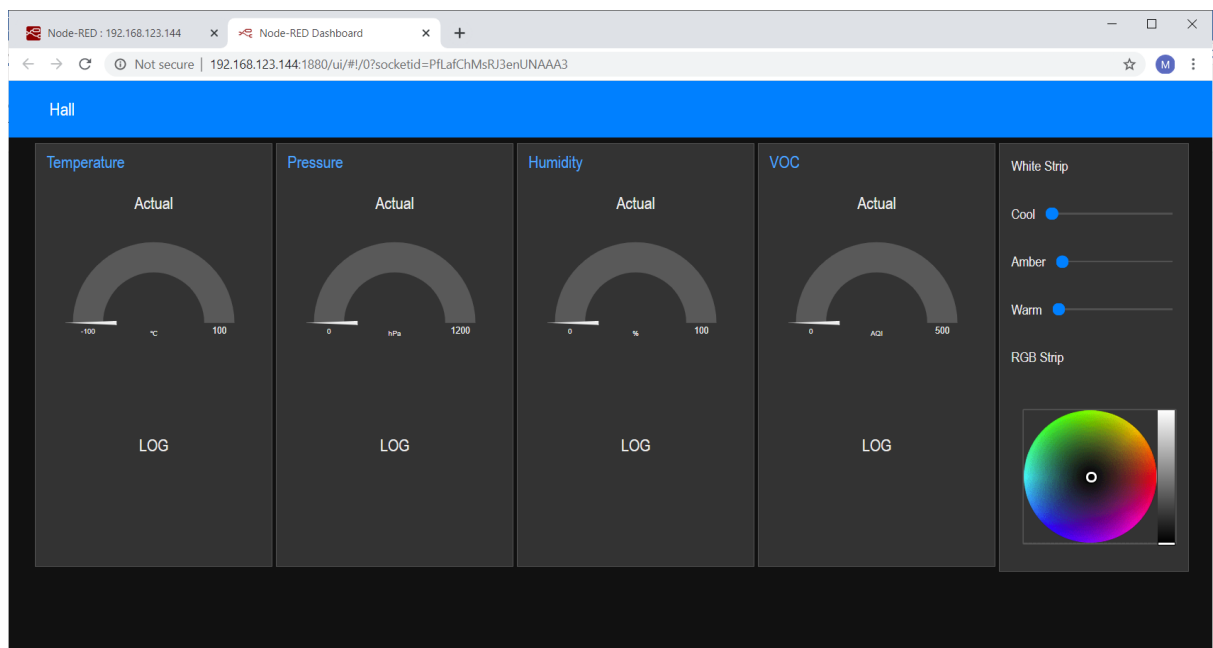
6. Deploy the flow by selecting the **DEMO** flow tab and clicking **Deploy** and then **Confirm** to the subsequent dialogue.



7. Launch the dashboard by clicking the **dashboard** button, then the **launch** button.

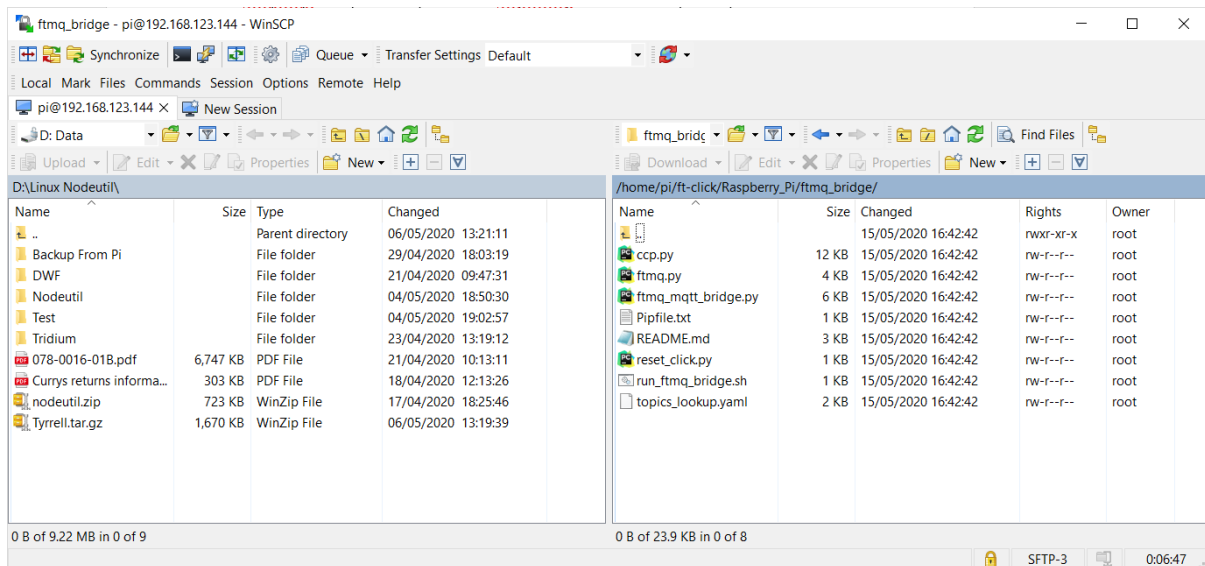


8. The dashboard should appear as follows:



Setup and Run the ftmq-bridge

The ftmq_mqtt bridge was copied to the Raspberry Pi when the repository was cloned above. The program will translate messages from mqtt to ftmq and vice versa. It needs the MQTT broker running and the ftmq serial device connected.



1. From the SSH session, install pre-requisites (confirming as necessary):

```
sudo apt install python3 python3-pip
sudo pip3 install --user pyserial pyyaml paho-mqtt docopt
```

2. Copy the ftmq_bridge directory to /etc/ftmq_bridge

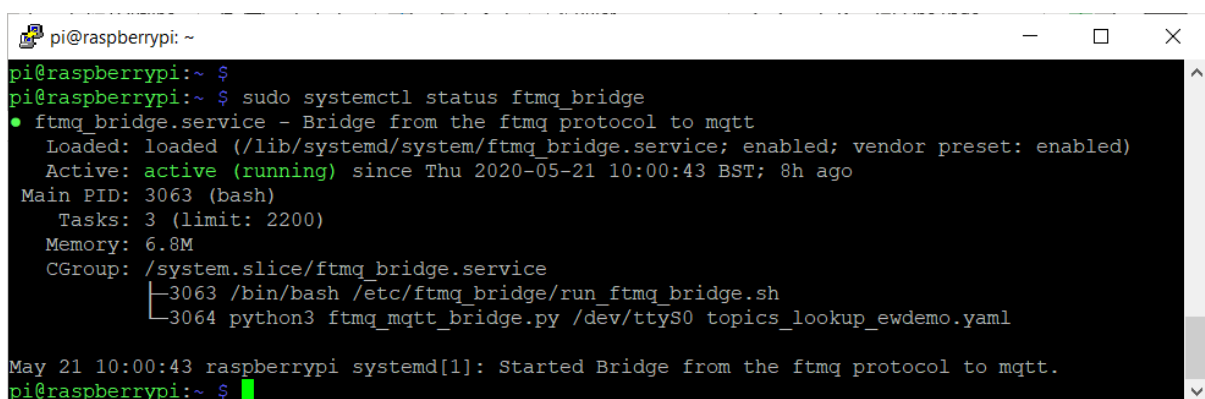
```
sudo mkdir /etc/ftmq_bridge
sudo cp ft-click/Raspberry_Pi/ftmq_bridge/* /etc/ftmq_bridge
sudo chmod +x /etc/ftmq_bridge/run_ftmq_bridge.sh
```

3. Copy the ftmq_bridge service, enable and start it

```
sudo cp ft-click/Raspberry_Pi/ftmq_bridge.service
/lib/systemd/system/
sudo systemctl enable ftmq_bridge.service
sudo systemctl start ftmq_bridge.service
```

4. Check the operation of the bridge

```
sudo systemctl status ftmq_bridge
```



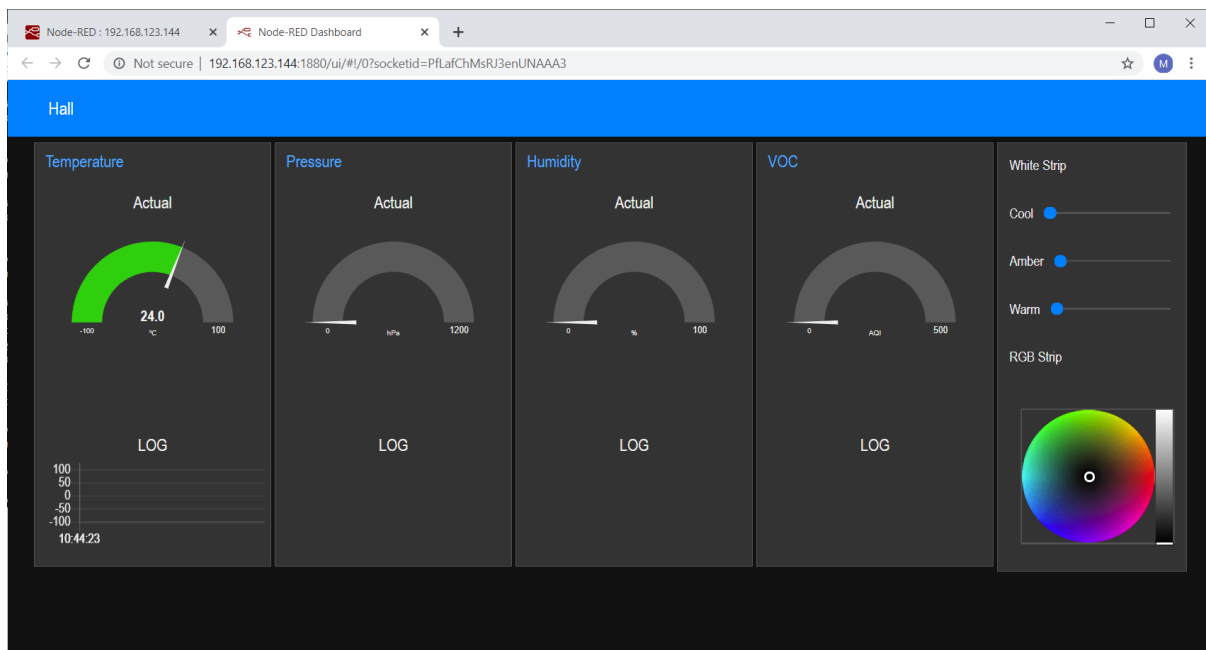
Testing the Node-RED Installation

Whether you have set up using the pre-configured image or from scratch, before you connect the FT wiring to the Raspberry Pi's FT click, you can test the Node-RED installation using a `mosquitto_pub` manual update or using the Data Simulator.

Manual Data Update

You can use the following command to change the temperature on the Node-RED dashboard from an SSH session:

```
mosquitto_pub -t 'building/hall/temperature' -m  
'{"temperature":24}'
```



Run the Data Simulator

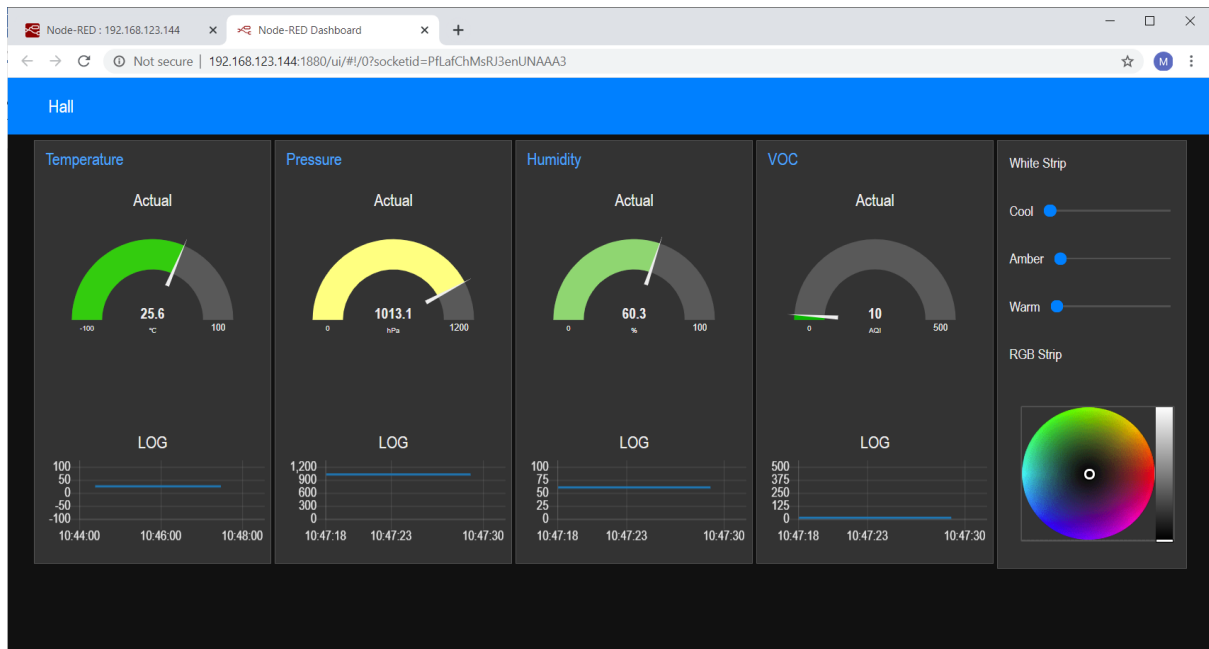
The simulator `sensor_data_publisher.py` is located in `ft-click/Raspberry_Pi/sensor_data_publisher.py`, the program will generate MQTT messages with simulated data.

1. Install pre-requisites from an SSH session:

```
sudo apt install python3 python3-pip  
pip3 install --user pyyaml paho-mqtt docopt
```

2. Run the utility

```
cd ft-click/Raspberry_Pi/  
python3 sensor_data_publisher.py
```



Connect the FT Wiring

Connect the FT twisted pair wiring to the FT Click board. Make sure there is a 52.3W terminator is in place at one point on the wiring segment.

Allocate a LonTalk Address

Allocate a unique LonTalk address using NodeUtil as illustrated above

Test the Network Operation

1. Adjust the RGB LED colour on the Arduino using the colour picker.
2. Adjust the white LED colour using the sliders.
3. Check that the gauges display sensor data from the STM32 Nucleo.

