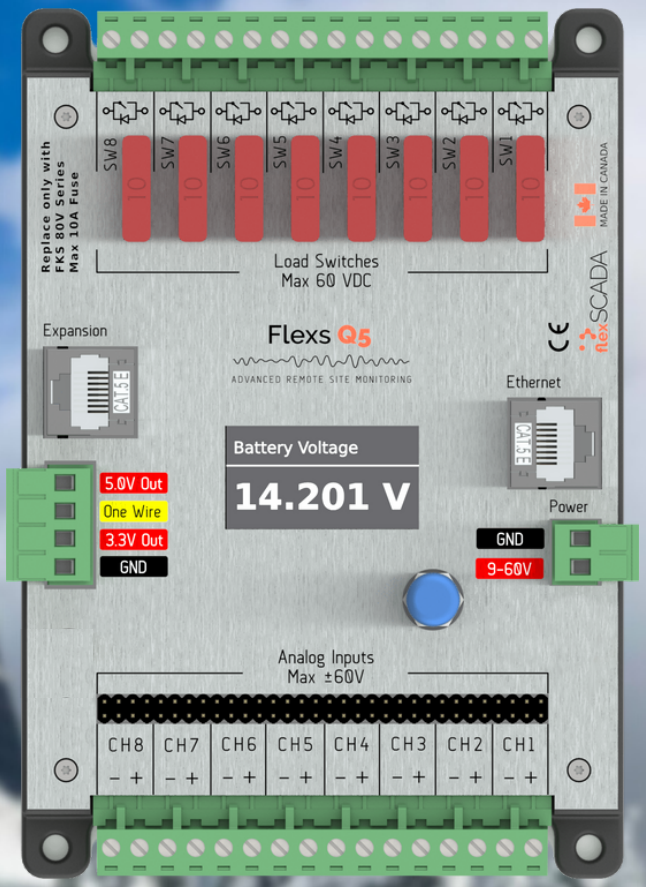
flexSCADA



FlexsQ5 / Q5 Pro

ADVANCED REMOTE SITE MONITORING

Rev: 3.7 Updated: 2021/09/17 Firmware: V96

USER GUIDE

TABLE OF CONTENTS

GOT QUESTIONS?

Can't find what you're looking for?
We love hearing from our customers!
Please contact us with any questions.

CONTACT

+1 877.352.7398
support@flexscada.com
www.flexscada.com
P.O. Box 277
Lytton, B.C. V0K 1Z0
Canada

CONTENTS

GLOSSARY

1-wire/one-wire - a sensor protocol developed by Dallas Semiconductors
A - Amps (Unit of Current)
AC - Alternating Current
AVG - Average
Bit - The smallest possible amount of data: 0 or 1
Bool or Boolean - true or false, usually represented with a single bit
Byte - 8 bits
CH - Channel
CT - Current Transformer
DC or VDC - Direct Current
DFU - Define Firmware Updater
DHCP - Dynamic Host Configuration Protocol
DNS/NS - Domain Name Service (server that converts names to IPs)
FET - MOSFET (Type of semiconductor switch)
FW - Firmware
Floating Point - Any non-whole number
HTTP - HyperText Transfer Protocol
HTTPS - Secure HyperText Transfer Protocol
HVD - High Voltage Disconnect
HW - Hardware
Hz - Hertz (Cycles per second)
I2C - Communication protocol
INS - Instantaneous Value
IP - Internet Protocol v4
IPv6 - Internet Protocol v6
IoT - Internet of Things
JSON - JavaScript Object Notation
kSPS - Thousand Samples Per Second
LAT/LNG - GPS Latitude/Longitude (Decimal Degrees Format)
LVD - Low Voltage Disconnect
MAC - Media Access Control
mA - Milliamps (1000th of an Amp)
mJ - Megajoules
MODBUS - Communication protocol used for Industrial PLC's
Mbps - Megabits Per Second
NTP - Network Time Protocol
Ohms - Unit of Impedance
PF - Power Factor
PING or IMCP - Internet Control Message Protocol
PoE - Power Over Ethernet
RMS - Root Mean Square
SLAAC - IPv6 Stateless Address Autoconfiguration
SNMP - Simple Network Management Protocol
SW - Switch
Subnet/Netmask/NM - Refer to Internet Protocol
TCP - Transmission Control Protocol
THD - Total Harmonic Distortion
TX - Transmit
UART - TTL Level Serial
UID - Unique Identifier
V - Volts
VDC - Volts DC
VT - Voltage Transformer
W - Watt (Unit of Power)

1.0 - Hardware Specifications

PHYSICAL

Dimensions: 157 mm x 108 mm x 40 mm (Mounting Holes: 96 mm x 144 mm - 4 x 3mm)
Also mount with standard DIN Rail - Recommended DIN Rail space: 120 mm
Temperature Rating: –40 to 85°C (industrial rated components)
Environment: Max 95% relative humidity, non-condensing (ETSI300-019-1.4 Standard)
Weight: 200g

POWER REQUIREMENTS

Voltage: 9 - 60 VDC (reverse polarity protected)
Power Consumption: 0.6 W @ 12V Typical (varies based on configuration)

ANALOG INPUTS

Analog Conversion: 24 bit; 0.05 mV @ ±60 V range; 0.004 mV precision @ ±5 V range
Voltage Range: ±60 V (fully differential, bi-polar) (0.5 MΩ. Imp)
Current Range: 0 - 25 mA (requires hardware jumper change)

LOAD SWITCHES

Max Voltage: 60 VDC
Max Current: 8 A Max Cont (100 A Surge <1 ms) (50% derating above 50° C)
Switch Type: Isolated solid state N-Channel FET /w fly-back protection
Fusing: ATO blade style fuse (replace only with fuses rated for correct voltage range)
Software Fuse: 500 mA to 5 A ***PRO ONLY***
Current Sensing: 0 to 5 A ***PRO ONLY***

REGULATED OUTPUTS

5.0 V output: 500 mA Max
3.3 V output: 500 mA Max (Typ 3.47V)

ETHERNET

- 10/100 Mbps Operation
- Long-Range 300 Meter at 10 Mbps
- IEEE 802.3az Energy Efficient Ethernet
- ±15 kV IEC 61000-4-2 Level 4 ESD Protection
- IEEE 802.3 Auto-Negotiation
- IPv4: DHCP, Static; IPv6: SLAAC, DHCPv6, Static
- Passive PoE: Pins 4, 5+; 7, 8- @ 9 to 56V

1.1 - What's Included

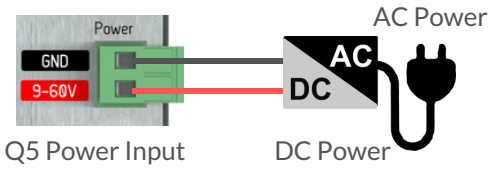
1 x Flexs Q5
1 x DIN Rail Mounting Kit

1.2 - Getting Started

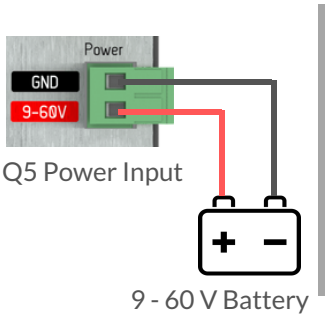
This section provides a brief overview on how to connect to a FlexsQ5 for the first time.
Attach the Q5 to a power source (9 to 60 VDC) using the two pin power terminal located beside the Ethernet port.
The Q5 can alternatively be powered via POE over the Ethernet port.

DO NOT POWER THIS DEVICE DIRECTLY FROM AN AC POWER SOURCE! DOING SO WILL VOID YOUR WARRANTY!

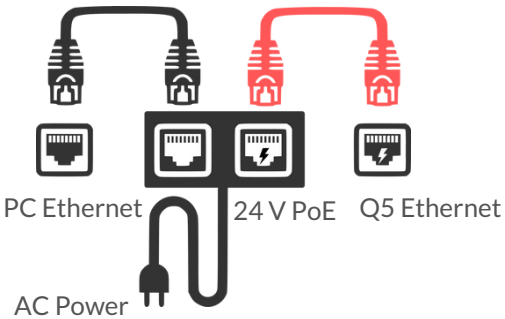
Powering with a DC Power Supply



Powering with a Battery

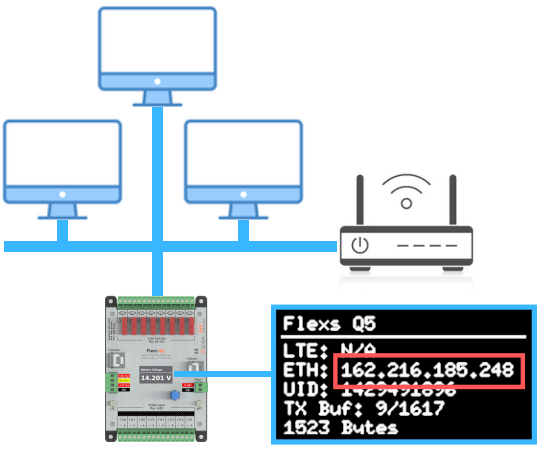


Powering with a Passive PoE



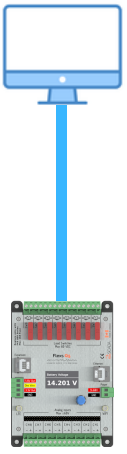
Once power is connected, the Q5 display will illuminate indicating that the Q5 has successfully started.
The Q5 will then search for a router on the network to get an IP address. If the Q5 fails to find a router within the first 10s of bootup, it will fallback to standalone mode. In standalone mode, the Q5 will use the fallback IP (default 192.168.1.20).

Network Connected Mode



Connect using the IP assigned by your network.
This IP can be found on the Q5 display
(highlighted in red above)

Standalone Mode

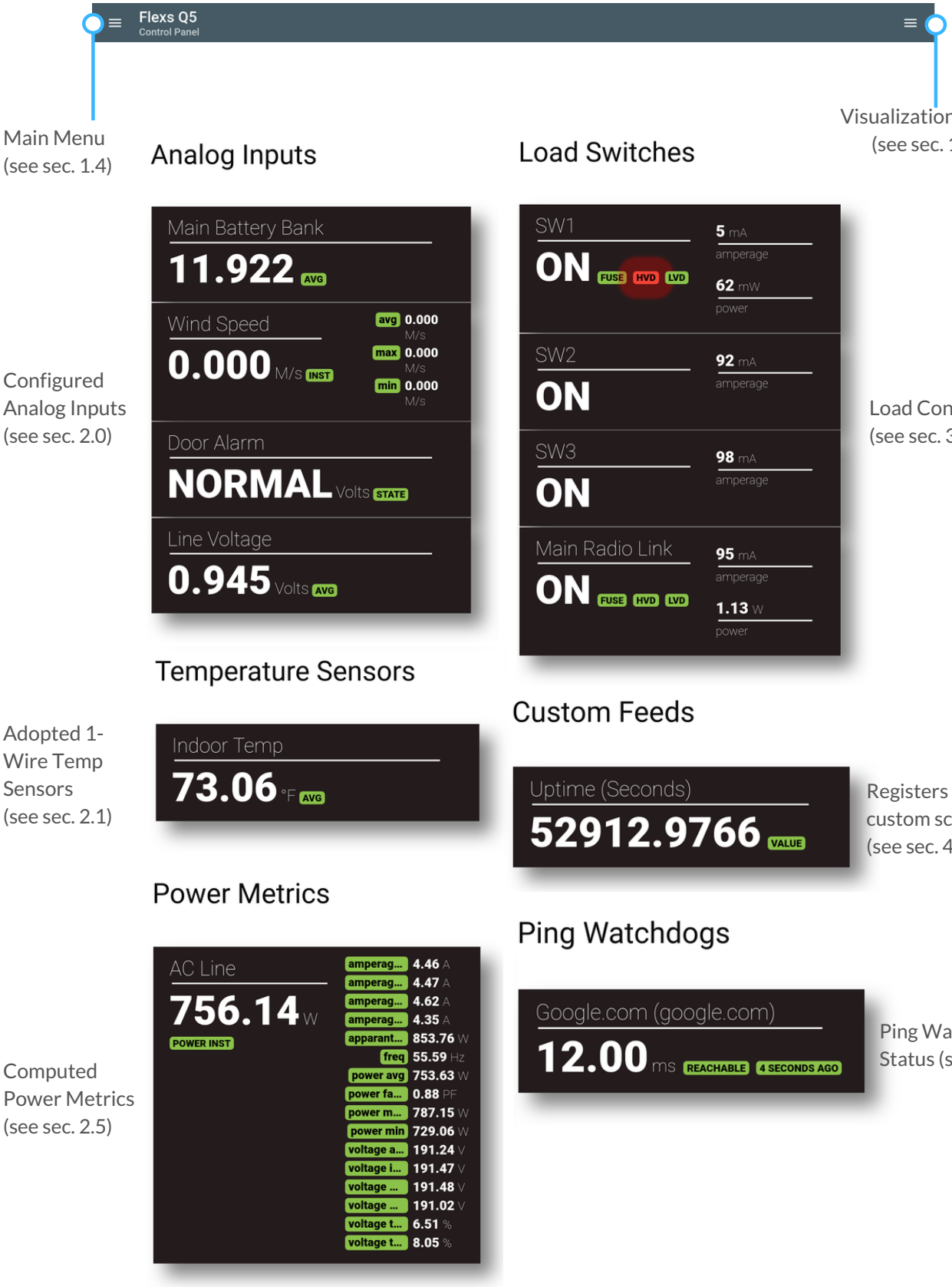


Connect using the following addresses:
http://192.168.1.20 OR with IPv6
http://[fe80::744]

Using Chrome, Firefox or Safari enter the device IP in the address bar to load the Q5's web interface.

The default password for the device is "flexscada".
IT IS HIGHLY RECOMMENDED TO CHANGE THIS PASSWORD WITH A SECURE PASSWORD TO AVOID UNAUTHORIZED ACCESS TO THE DEVICE.

1.3 Web Interface Overview



Plugins

Plugins can be enabled from the "Device Options" menu item.

Plugin Main Menu Items

MorningStar
MPPT Controller Monitoring
(see sec. 8.1)

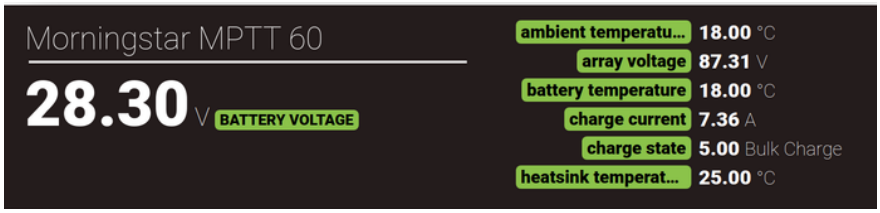
SWARM™
Satellite Data Modem
(see sec. 8.2)

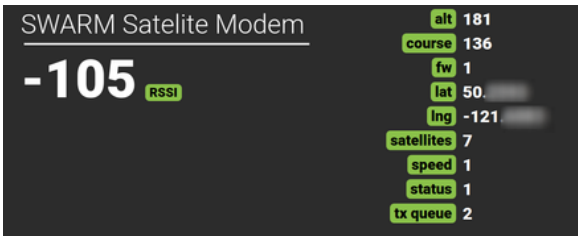
BME680
Environmental Sensor
(see sec. 8.3)

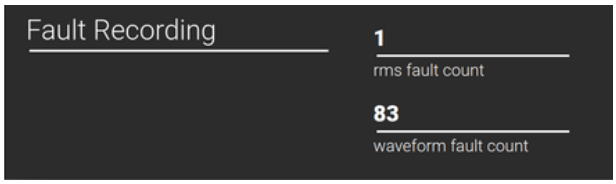
Line Fault Capture
AC / DC Fault Capture
(see sec. 8.4)

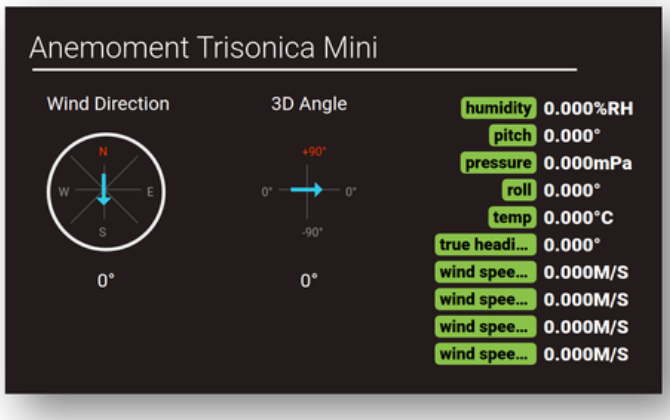
Trisonica Mini
Anemoment 3D Wind Sensor

Added Dashboard Items

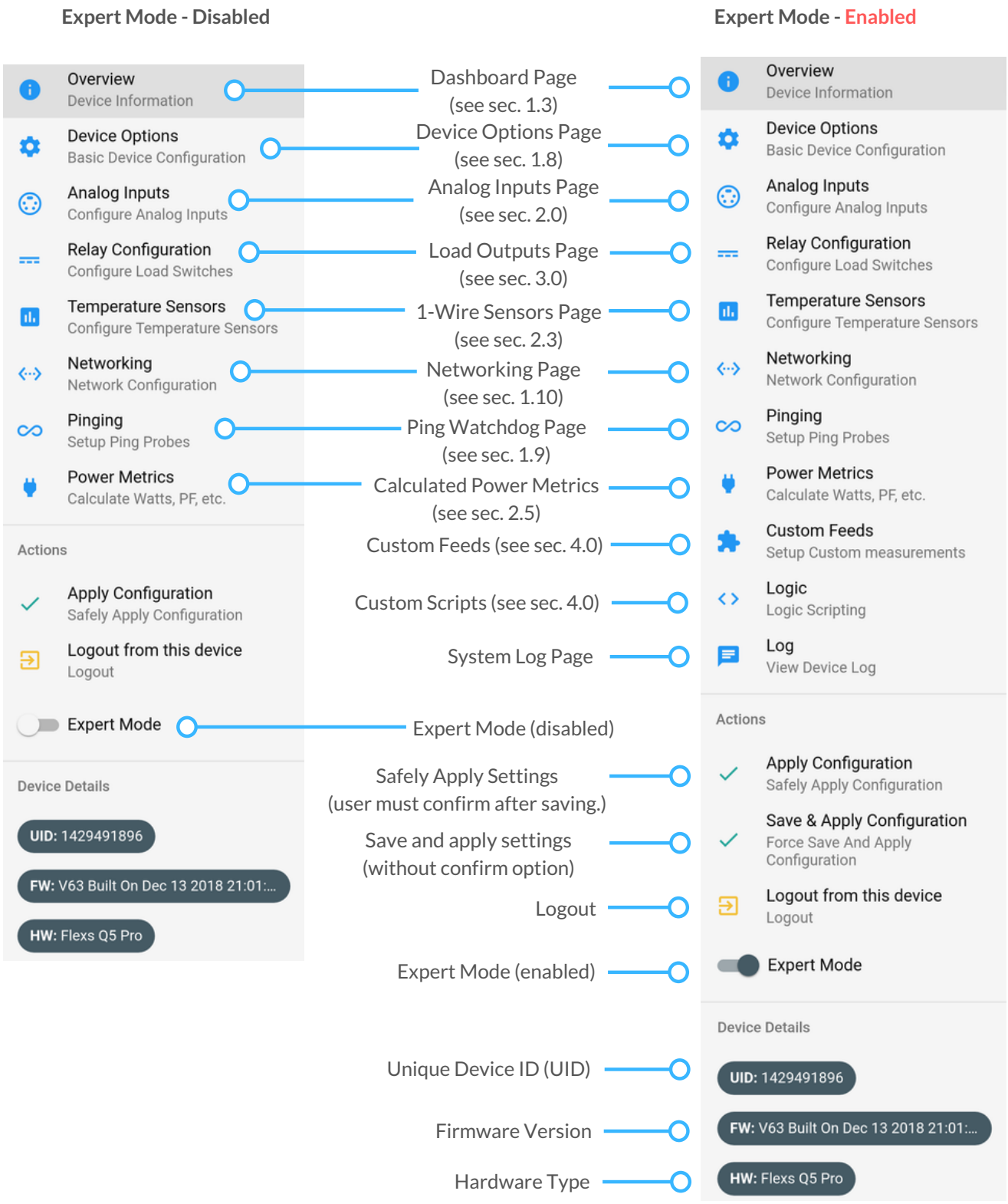




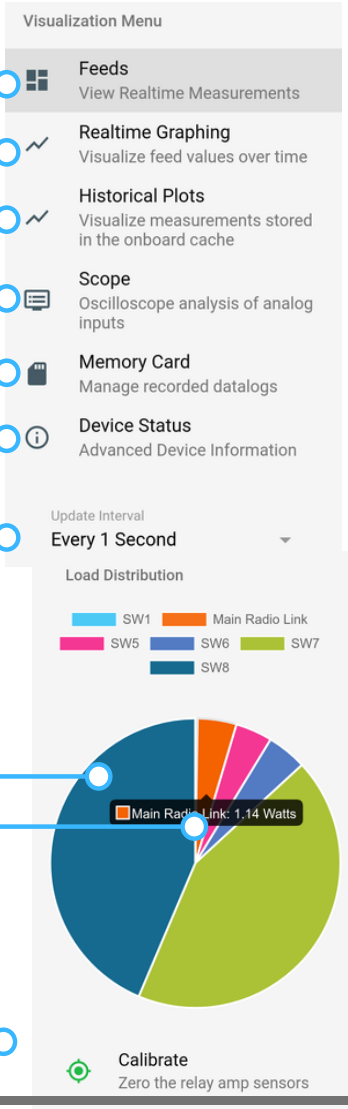




1.4 - Main Menu


Expert Mode - Disabled
Expert Mode - Enabled
Overview
Device Information
Device Options
Basic Device Configuration
Analog Inputs
Configure Analog Inputs
Relay Configuration
Configure Load Switches
Temperature Sensors
Configure Temperature Sensors
Networking
Network Configuration
Pinging
Setup Ping Probes
Power Metrics
Calculate Watts, PF, etc.
Actions
Apply Configuration
Safely Apply Configuration
Logout from this device
Logout
Expert Mode
Device Details
UID: 1429491896
FW: V63 Built On Dec 13 2018 21:01:...
HW: Flexs Q5 Pro
Dashboard Page (see sec. 1.3)
Device Options Page (see sec. 1.8)
Analog Inputs Page (see sec. 2.0)
Load Outputs Page (see sec. 3.0)
1-Wire Sensors Page (see sec. 2.3)
Networking Page (see sec. 1.10)
Ping Watchdog Page (see sec. 1.9)
Calculated Power Metrics (see sec. 2.5)
Custom Feeds (see sec. 4.0)
Custom Scripts (see sec. 4.0)
System Log Page
Expert Mode (disabled)
Safely Apply Settings (user must confirm after saving.)
Save and apply settings (without confirm option)
Logout
Expert Mode (enabled)
Unique Device ID (UID)
Firmware Version
Hardware Type
Overview
Device Information
Device Options
Basic Device Configuration
Analog Inputs
Configure Analog Inputs
Relay Configuration
Configure Load Switches
Temperature Sensors
Configure Temperature Sensors
Networking
Network Configuration
Pinging
Setup Ping Probes
Power Metrics
Calculate Watts, PF, etc.
Custom Feeds
Setup Custom measurements
Logic
Logic Scripting
Log
View Device Log
Actions
Apply Configuration
Safely Apply Configuration
Save & Apply Configuration
Force Save And Apply Configuration
Logout from this device
Logout
Expert Mode
Device Details
UID: 1429491896
FW: V63 Built On Dec 13 2018 21:01:...
HW: Flexs Q5 Pro

1.5 - Visualisation Menu



Dashboard Page (see sec. 1.3)

Input Graphing Page (see sec. 1.6)

Cache Graph Page (see sec. 1.6)

Input Oscilloscope Page (see sec. 1.8)

Memory Card (see sec. 8.0)

Advanced Device Info

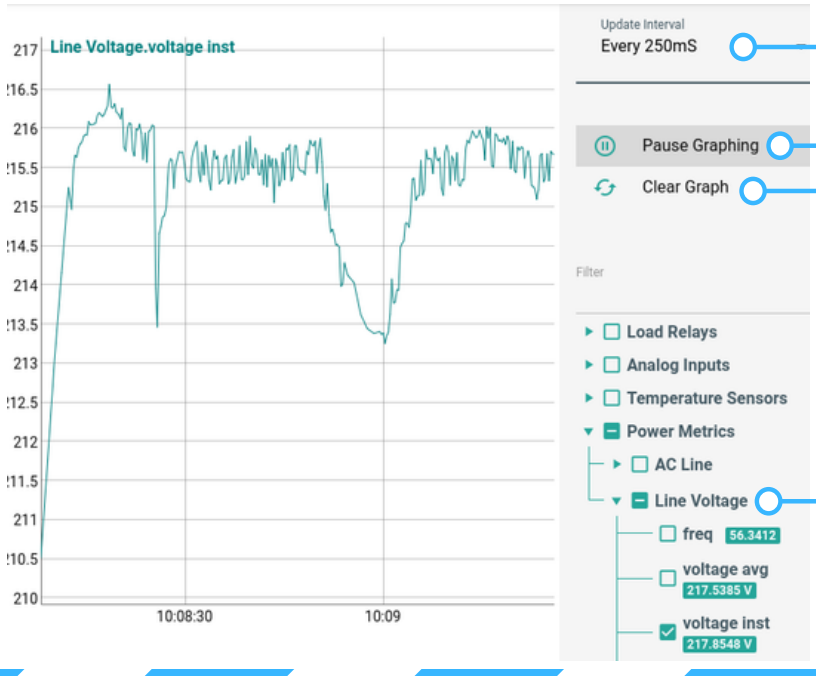
Data Update Interval

View Load Watts (PRO ONLY)

Load Distribution (PRO ONLY)

Manually Zero Load Sensors (PRO ONLY)

1.6 - Input Graphing Page



Data Update Interval

Pause/Start Data Collection

Clear Graph Of All Data

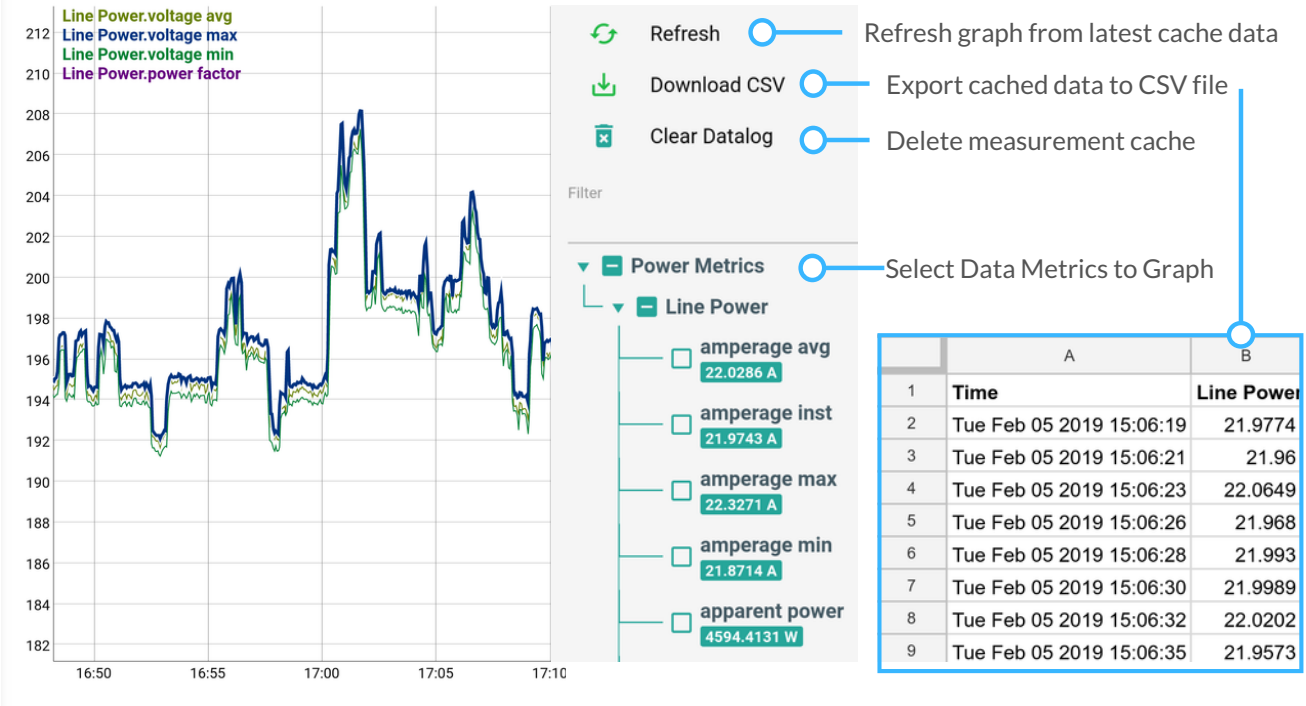
The graphing tool is used to view short term trends, such as current or voltage readings. The Update Interval range can be configured from 100ms to 1 minute.

Select Data Metrics to Graph

Cache Graph Page

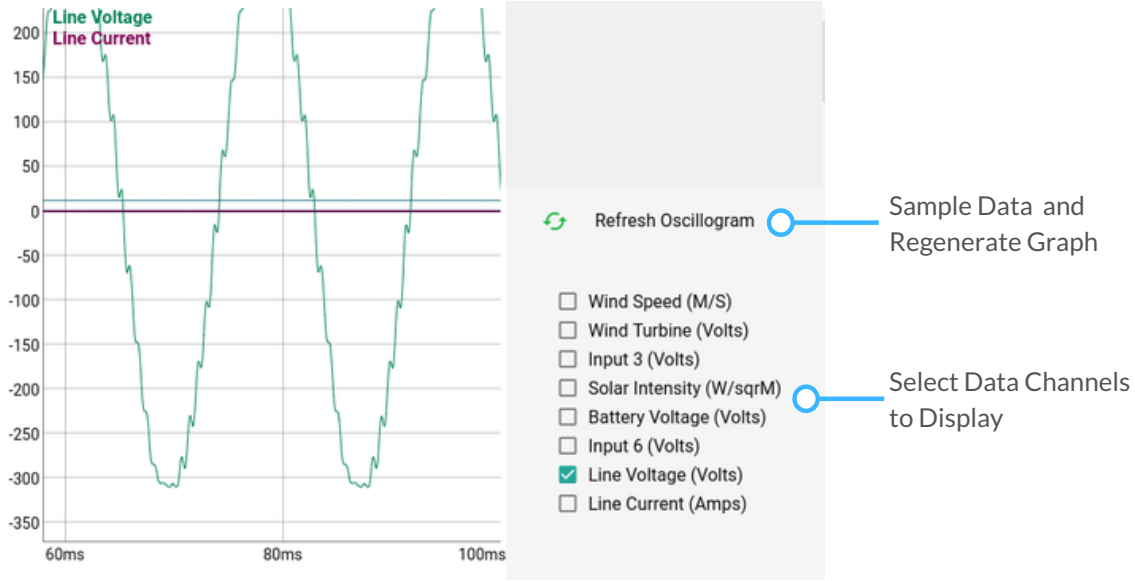
The internal memory is used to cache measurements when the device is unable to upload data to our cloud server or when the device is operating in standalone mode.
Note: The Q5 does **not** have an internal battery to keep cached measurement data or system time between power failures. When operating in standalone mode the NTP server field in the *Device Options* page must be set. We recommend using our cloud service, SNMP or some other offsite method for long term measurement data storage.

WARNING! REMOVING POWER WILL CAUSE LOSS OF ALL LOCALLY CACHED DATA!



	A	B
1	**Time**	**Line Power**
2	Tue Feb 05 2019 15:06:19	21.9774
3	Tue Feb 05 2019 15:06:21	21.96
4	Tue Feb 05 2019 15:06:23	22.0649
5	Tue Feb 05 2019 15:06:26	21.968
6	Tue Feb 05 2019 15:06:28	21.993
7	Tue Feb 05 2019 15:06:30	21.9989
8	Tue Feb 05 2019 15:06:32	22.0202
9	Tue Feb 05 2019 15:06:35	21.9573

1.7 - Input Oscilloscope Page



The oscilloscope tool provides a close-up look at how "clean" your power source is.
When the refresh button is clicked, 2,000 simultaneous readings are taken across all 8 channels and then displayed in the web interface. The sample rate of the Q5 is 8,000 samples/second (i.e. 8 samples taken each millisecond).

1.8 - Device Options Page

Device Name and Description are displayed in the cloud platform. These are useful when searching for a device.

Device Name
Flexs Q5

Description of this device

Description

Coordinates will autofill when a GPS module is attached.

GPS (Lat) GPS (Lng)

Unit System

Unit System

Metric

Log Level

Event logging level

Errors Only

Power Scaling

CPU Clock Speed

Balanced (approx 500mW)

Transmit measurements to cloud at this interval. **Also used for avg, min and max values on the dashboard.**

Measurement Interval
Every 10 Seconds

Measurements will be taken on this interval and queued for transmission to the cloud at the Cloud Sync Interval

Sync configuration data with cloud at this interval. If disabled NTP field will show below.

Cloud Sync Interval
Every Minute

Device connects with the cloud at this interval to upload queued measurements and to check for any pending commands such a changes or software updates.

Default address - change this only when running customer hosted cloud software.

Cloud Server Address
http://iot.flexscada.com:7001

The cloud server address is the server that the Flexs Q5 syncs with to upload measurements.
If you are using FlexSCADA's cloud hosting you'll use http://iot.flexscada.com:7001, otherwise you'll use your own hosting addres

Log measurements to Memory Card

Memory Card Logging
Recording enabled at measurement interval

Data will be logged in .CSV format at the configured measurement interval with a new file created every month.
To avoid overly large data files which may be diffacult top open, we strongly recommend increasing the measurement interval to a minutes.
Memory card utilization can be seen from the `Device Info` tab of the visualization menu.

☐ Log config changes to memory card

This option will store a copy of the configuration to the Memory Card each time it is changed.
Use with caution as the configuration file may contain sensitive or private information which could then be obtained via physical d access.

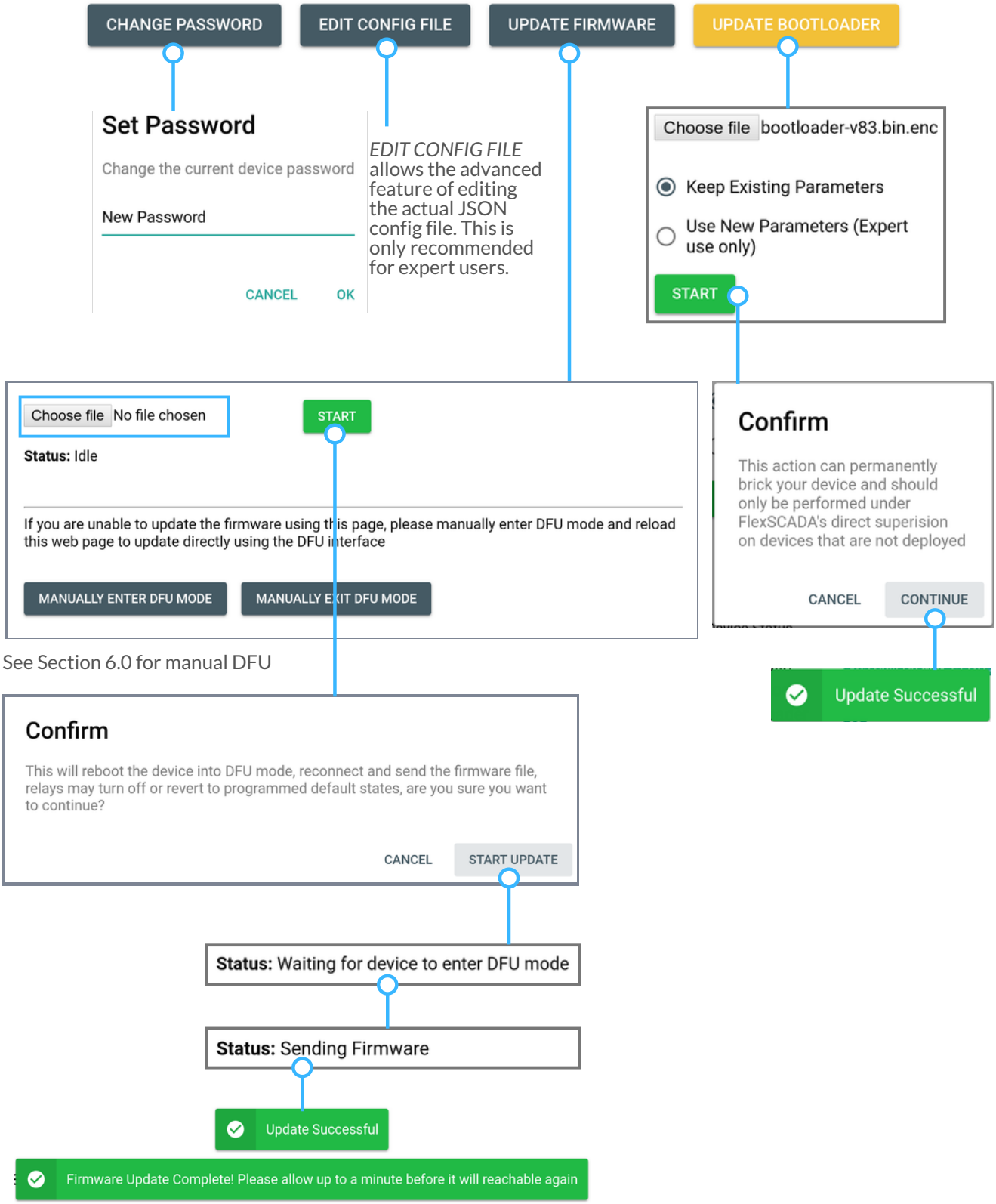
Cloud Sync Interval
Disabled

If *cloud sync* is disabled for standalone use, the *NTP server* field should be set to keep the device clock set.

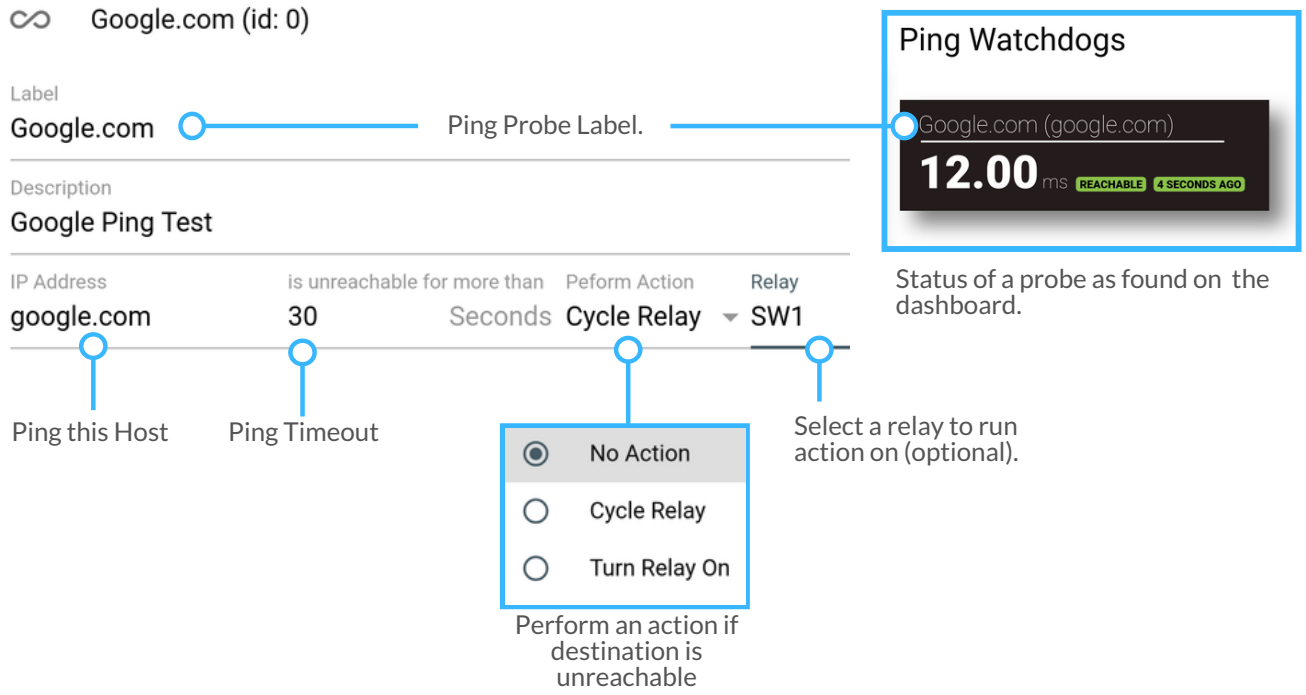
NTP Server Address
pool.ntp.org

CHANGE PASSWORD | EDIT CONFIG FILE | UPDATE FIRMWARE | UPDATE BOOTLOADER

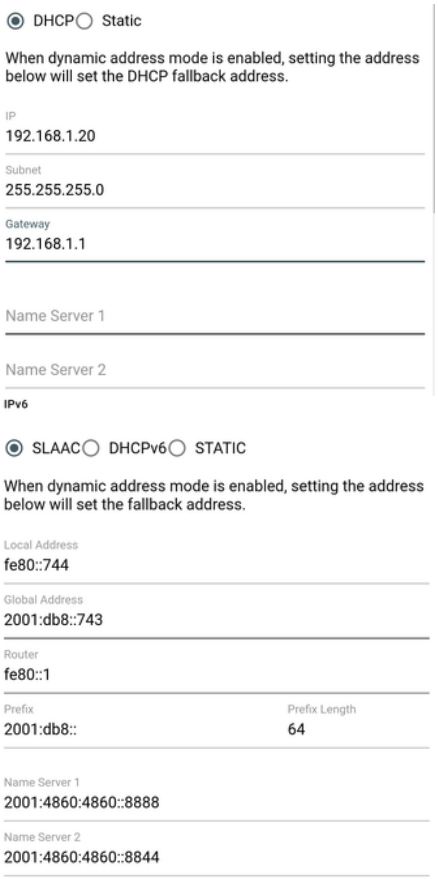
See next page for details on these buttons


CHANGE PASSWORD
EDIT CONFIG FILE
UPDATE FIRMWARE
UPDATE BOOTLOADER
Set Password
Change the current device password
New Password
CANCEL
OK
EDIT CONFIG FILE allows the advanced feature of editing the actual JSON config file. This is only recommended for expert users.
Choose file bootloader-v83.bin.enc
Keep Existing Parameters
Use New Parameters (Expert use only)
START
Choose file No file chosen
START
Status: Idle
If you are unable to update the firmware using this page, please manually enter DFU mode and reload this web page to update directly using the DFU interface
MANUALLY ENTER DFU MODE
MANUALLY EXIT DFU MODE
Confirm
This action can permanently brick your device and should only be performed under FlexSCADA's direct superision on devices that are not deployed
CANCEL
CONTINUE
Update Successful
See Section 6.0 for manual DFU
Confirm
This will reboot the device into DFU mode, reconnect and send the firmware file, relays may turn off or revert to programmed default states, are you sure you want to continue?
CANCEL
START UPDATE
Status: Waiting for device to enter DFU mode
Status: Sending Firmware
Update Successful
Firmware Update Complete! Please allow up to a minute before it will reachable again

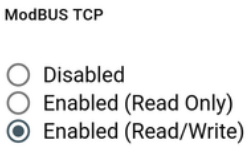
1.9 - Ping Probes Page



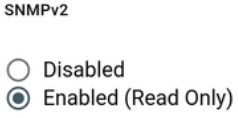
1.10 - Network Page



If the network mode is set to DHCP, the device will request an IP from a DHCP server on the network. Should the Q5 fail to get an IP it will fall back to the IP configuration entered here. The same applies to IPv6. The FlexesQ5 supports both IPv4 and IPv6 at the same time.
Additionally, this page includes options for enabling and disabling SNMP, Modbus TCP and modifying the SSL Certificate.



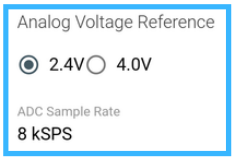
See Section 5.1 ModBUS



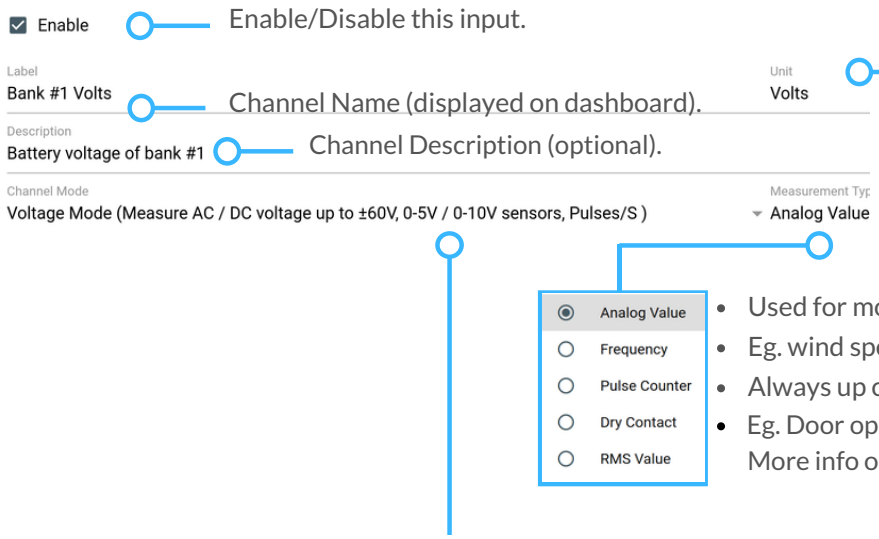
See Section 5.0 SNMP

2.0 - Analog Inputs

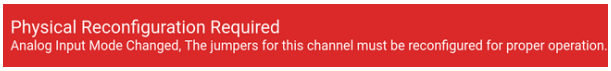
There are several types of inputs, each of which can be roughly categorized as Analog, Frequency, Pulse Counter and Alarm Contacts. This section provides greater detail on how to use and configure each of these input types.



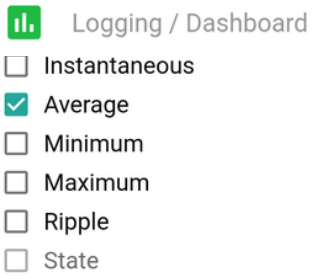
These expert options should not be changed unless directed by FlexSCADA.

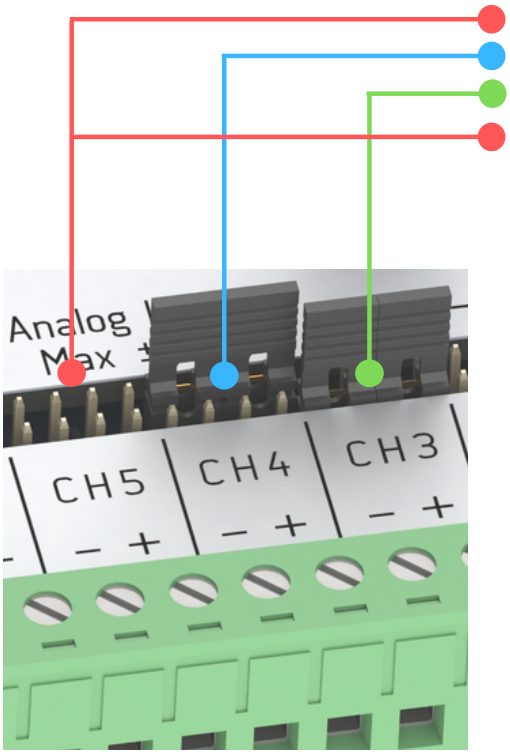


DETAILED HARDWARE / CONFIG ON NEXT PAGE.



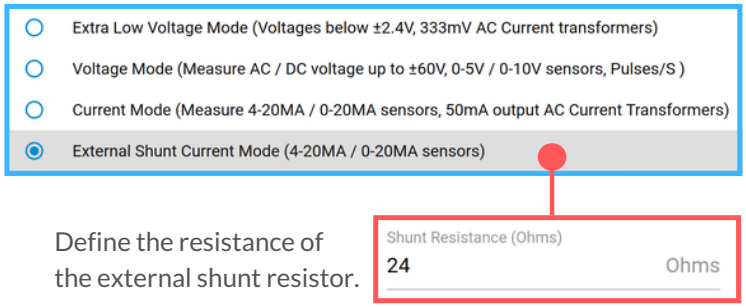
In the *Logging / Dashboard* section, you must enable the metrics you wish to be visible on the dashboard or sent to the cloud for graphing. Some items may be grayed out, depending on the input configuration chosen. For example, the State metric is only valid when the *Measurement Type* is set to Alarm Contact.
For min, max and average time period see Section 1.8 - Measurement Interval.





FAILURE TO MAKE THIS HARDWARE CONFIGURATION *CHANGE BEFORE CONNECTING YOUR INPUT MAY DAMAGE YOUR DEVICE AND VOID YOUR WARRANTY!*

ANALOG INPUT - CHANNEL MODE DROP-DOWN



Define the resistance of the external shunt resistor.

The Q5 hardware has been designed to accept a wide range of inputs.
To insure proper operation, it is important to select the correct *Channel Mode* and corresponding hardware configuration.

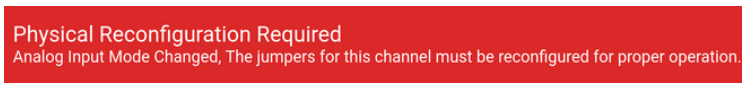
Extra Low Voltage Mode is used where high accuracy in a very low voltage range is required. The max voltage range for this mode is ±2.4V AC/DC.

Voltage Mode accepts a wide voltage range (±60V AC/DC) and can be used for a number of functions (alarm contacts, battery voltages, 0-5V sensors, AC Power Metrics, etc). See sec 2.1 for examples

Current Mode is used for current based sensors, such as 4-20mA sensors and current transformers. See sec 2.2 for examples.

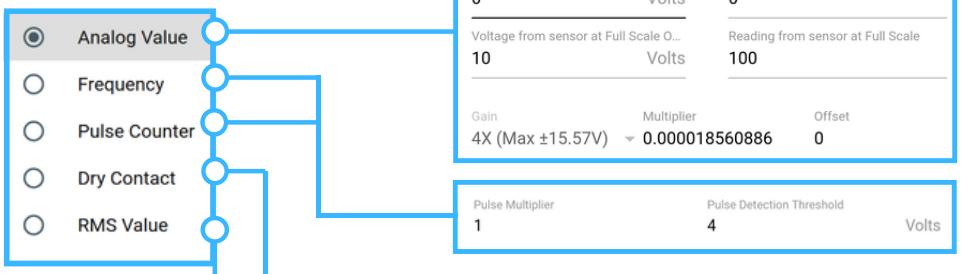
External Shunt Current Mode allows the user to add an external shunt allowing for greater flexibility in applications requiring current sensing greater than 20 mA. See section 2.2

When changing between input Channel Modes, you will be alerted about a required hardware change to the jumpers on the Q5. When making this change the Q5 must be powered down.



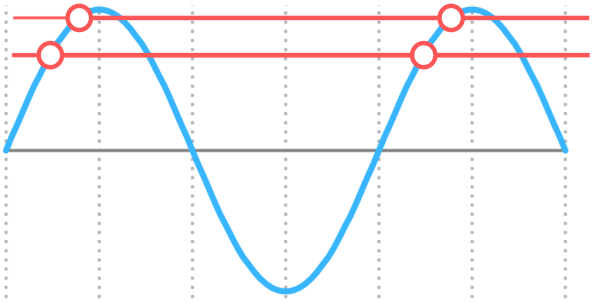
Understanding Measurement Types

This section details the various *Measurement Types* supported by the Q5.
Each channel provides the following *Measurement Type's* option:



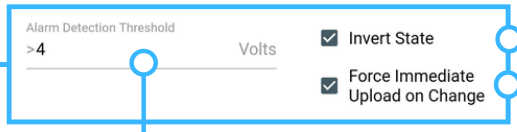
For additional information on the Analog Value option and Input Scaling calculator refer to sections 2.1 and 2.2.

Both *Frequency* and *Pulse Counter* require a threshold to recognize when a valid signal has been detected. This is known as the *Pulse Detection Threshold*. To avoid counting the same rising edge twice, the signal must exceed 20% of the *Pulse Detection Threshold* in order to be considered a valid pulse (see graphic below).



Frequency is the number of valid pulses per second or hertz (Hz).
Alternately, *Power Metrics* can be used to find the frequency of an input (see section 2.5 for more information).
Pulse Counter is a total count of all pulses since the Q5 has booted.

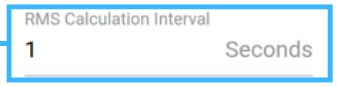
Pulse Multiplier is used to adjust sensor readouts. For example, the spec sheet for an anemometer reads as follows: **Output Frequency: 1,1 HZ / m/s.** But **we want** the sensor to read out the exact m/s on our graphs. The multiplier could be set to 1 / 1.1 = **0.909 multiplier**.
In another example a flow sensor reads **450 output pulses/liter.** The multiplier could adjust the output to read in liters/minute. We are looking at Hz (pulses per second) so we need to divide by 60 seconds. 450 / 60 = 1 liter per 7.5 pules/s = 1 (liter) / 7.5 (pulses) = **0.133333 multiplier.**



Alarm under threshold.

Send update to cloud when alarm is triggered.

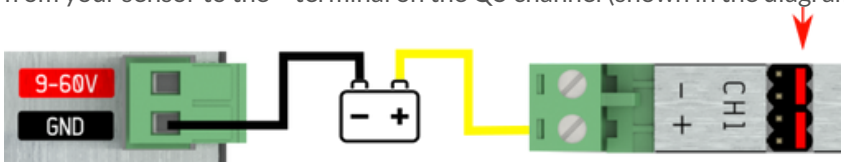
Threshold over or under which to trigger alarm.



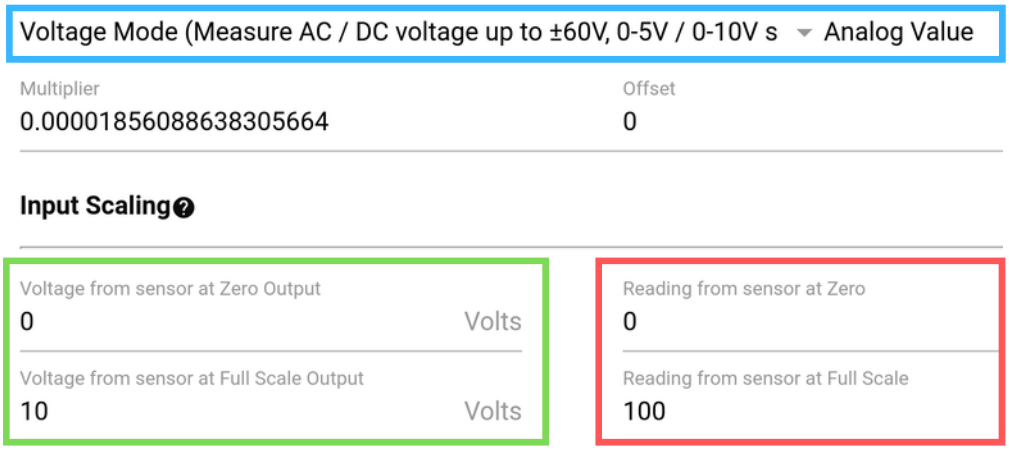
Time period for the RMS value to be calculated.

2.1 - Voltage Input

Below is an example of a typical 0-10V sensor attached and configured for use with the Q5. When installing, first confirm that the Q5 is configured in Voltage Mode (see section 2.0 for details on voltage mode). Next, attach the analog output from your sensor to the + terminal on the Q5 channel (shown in the diagram below).

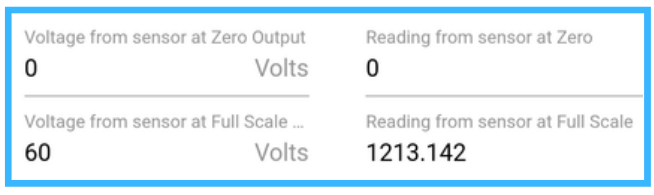


Navigate to the *Analog Inputs* menu, select the channel, then select *Voltage Mode* under *Channel Mode*. Next select *Analog Value* under the *Measurement Type* drop down (Channel Mode and Measurement Type are highlighted in the blue box).



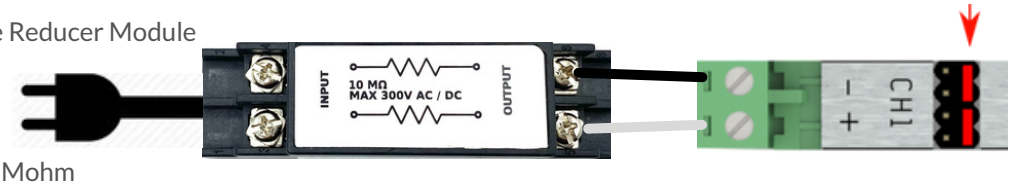
Set the sensor range using the specs found on the side of the sensor or in the provided data sheet. In the above example, 0V corresponds to 0 PSI and 10V corresponds to 100 PSI. Enter the voltage output range of the sensor's analog output in the green box. If the sensor output was a 0-5V signal level, the values in the green box would be 0 and 5 instead of 0 and 10.
The *Multiplier*, *Offset* and *Gain* are automatically set when using the *Input Scaling* section.

Higher Voltages



For higher voltages (up to 300V) the Q5 Voltage Reducer hardware module (ACC-Q5-HV10M) may be used with the following configuration. For more details on AC power, refer to section 2.5.

Input Scaling for Q5 Voltage Reducer Module
Scaling: 60V = 1213.142v

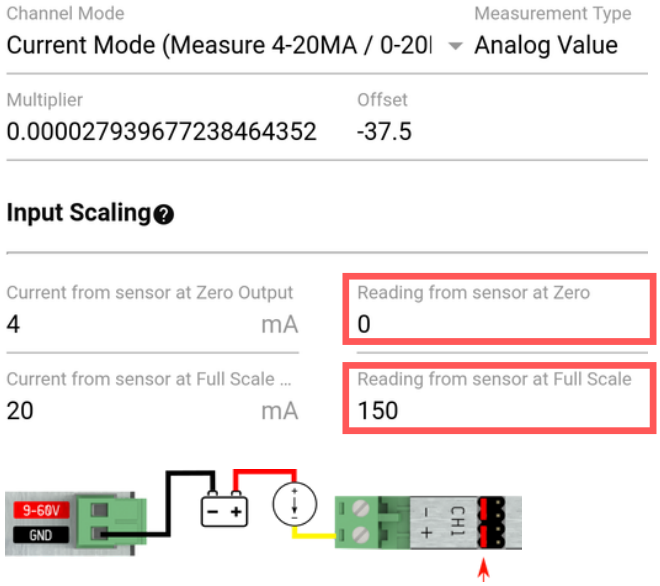


Final Input Impedance: 10.5Mohm
Voltage scaling components are UL/IEC 60950 & 60065 compatible and UL 1676 recognized

2.2 - Current Inputs

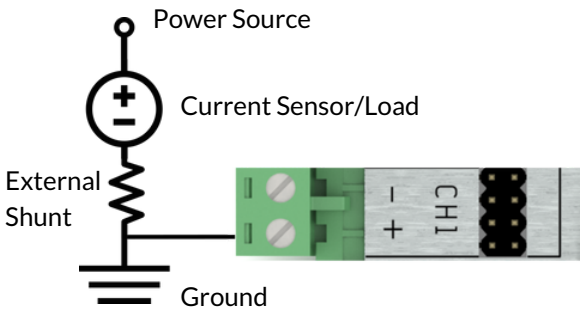
The 4 - 20 mA sensor is the de facto industry standard. This section details how to configure the Q5 to accept this type of input. As the Q5 does not power current loops, external power will need to be provided in order for your current loop to function.
To utilize this feature the hardware jumpers must be configured in *Current Mode* (see section 2.0). Next, configure the input from the *Analog Inputs* menu. The Channel Mode and Measurement Type must be configured as shown below. The configuration example below shows a 4 - 20 mA sensor with a range of 0 - 150 PSI. The sensor range for the specific sensor must be entered as shown in the red boxes.

WARNING! EXCEEDING THE CURRENT RATINGS OF THE Q5 WILL DAMAGE YOUR DEVICE AND VOID THE WARRANTY!



Hardware configuration example for a 4 - 20 mA sensor.

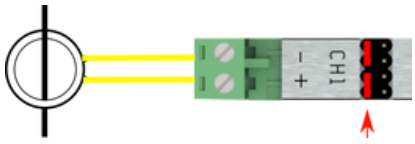
External Shunt Mode



For DC Current loads greater than 20 mA or in situations where large transient current is likely to occur an external shunt resistor can be used as shown above.

Note: All jumpers configuration jumpers are removed and the channel is set to External Current Shunt Mode and the resistance of the shunt defined in the configuration.

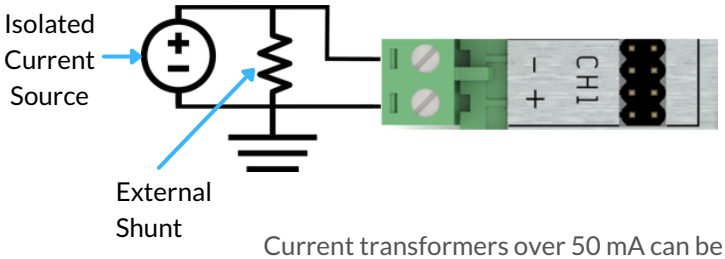
Current Transformers < 50mA



Current transformers up to 50ma (max) can also be used with the Q5 without the need for additional conditioning hardware. Current transformers are connected as shown above.

Note: some current transformers output a voltage based output such as 0.333v for this type of CT please use voltage input configuration instead of current.

Current Transformers > 50mA

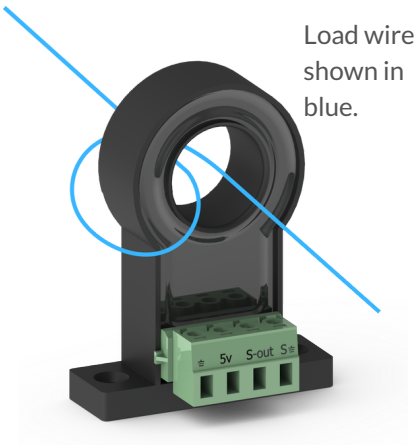


Current transformers over 50 mA can be used with an external shunt resistor as shown above.
Note: All jumpers configuration jumpers are removed and the channel is set to *External Current Shunt Mode* and the resistance of the shunt defined in the configuration. Additionally, one side is clamped to ground.

Current Sensors

Current sensors (not to be confused with current transformers) take a current signal and convert it to an analog voltage output. FlexSCADA and its resellers can provide a 100 A non-invasive current sensor which can be configured as shown below. They are capable of measuring AC or DC current.

Scale Ratio



To double the accuracy and halve the range the load wire can be looped through the sensor a second time. In the above example, the new max range is ±50 A.

Reading from sensor at Zero

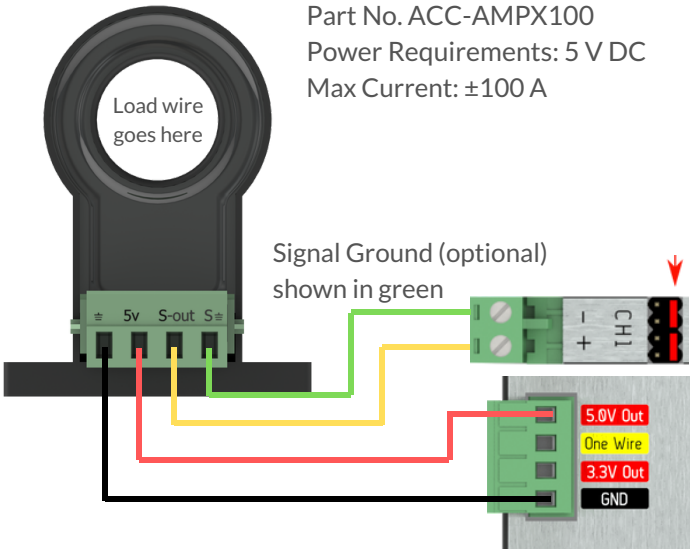
0

Reading from sensor at Full Scale

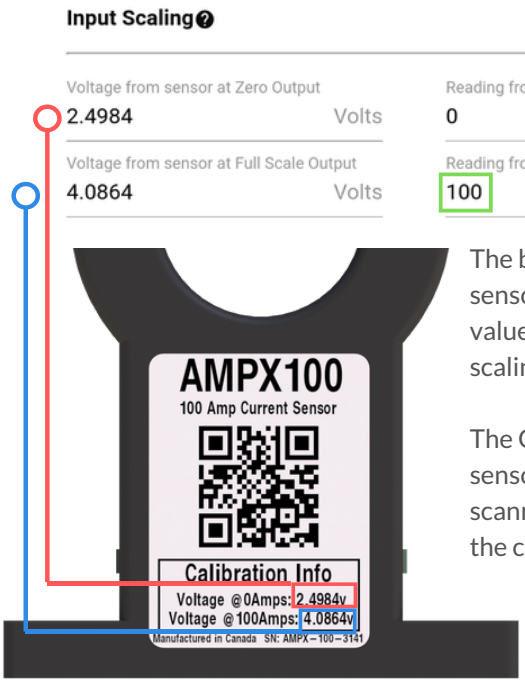
50

Input Scaling with two loops.

The load wire can be looped through the sensor as many times as needed to get the desired scale. Only the ***Full Scale*** field is modified to reflect this ratio change.



Part No. ACC-AMPX100
Power Requirements: 5 V DC
Max Current: ±100 A

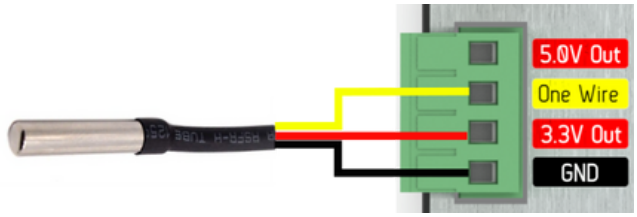


The back of the current sensor contains the values required for input scaling on the FlexsQ5.

The QR code on the sensor can also be scanned to download the calibration report.

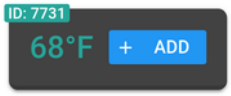
2.3 - 1-Wire Sensors

The Q5 supports 1-wire sensors. The below diagram shows how to connect and provide a 1-wire sensor with power and data communication. The Q5 supports up to 64 sensors, each sharing the same 3 wires.

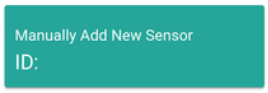


To attach additional one-wire sensors a standard wiring bus will be required, as the terminals are not physically capable of holding more than a few sensors.
Each one-wire sensors has a unique digital ID that makes it possible to view its value without interfering with the other sensors.

Once the sensors have been connected, they must be configured. In the web interface, navigate to the *Temperature Sensors* menu. Located at the bottom of the page you will see "*1 unconfigured sensors found on this device*" followed by the unconfigured sensor showing an ADD button (any one-wire sensor can be used in this way).
Alternately, it is possible to pre-add the sensors using the ID found on the sensors sold by FlexSCADA and its re-sellers. All one-wire sensors will have a unique ID. FlexSCADA one-wire sensors have been labeled with this pre-existing ID for ease of use.



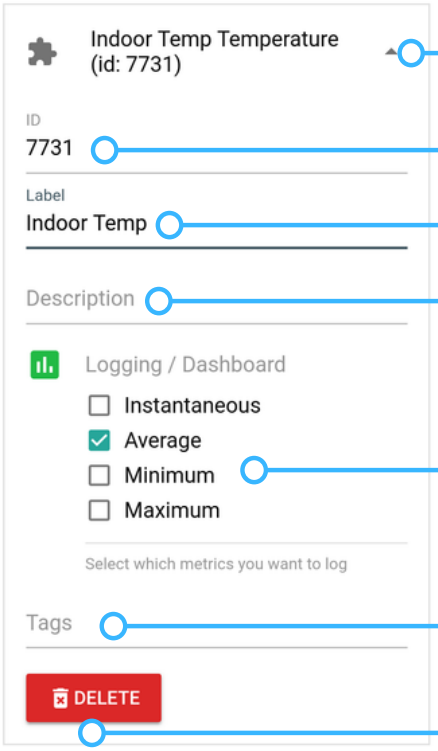
Adopt unconfigured temp sensor.



Manually add temp sensor. (Sensor ID found on sensor wire shown right.)

The display units can be modified in the *Device Options* menu.

The below example shows a newly added temp sensor, along with the options to name the sensor and choose which metrics to log or add to the dashboard.



Show/Hide sensor options.

ID of the sensor, this can be updated if a sensor needs to be replaced.

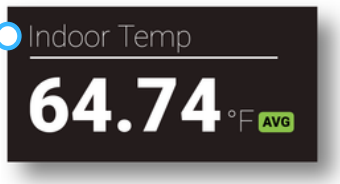
Sensor Label - this label is used on the dashboard and in the graphing.

Detailed sensor description. (optional)

Select what metrics you wish to graph or display on the dashboard. For min, max and average time period see Section 1.8 - Measurement Interval.

Tags help in selecting datasets when graphing. An example might be "greenhouse 1" allowing an easy way to select sensors belonging to that greenhouse.

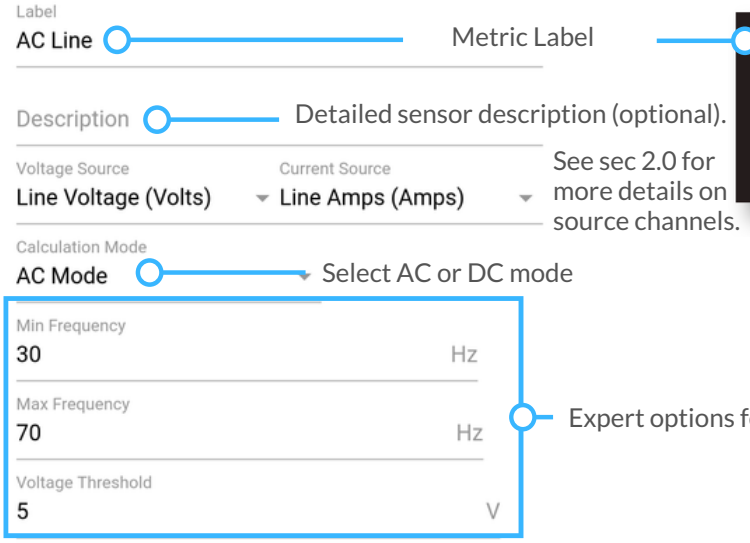
Delete this sensor.

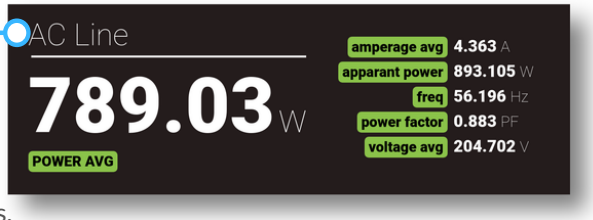


New temp sensor displayed on the dashboard.

2.5 - Power Metrics

The *Power Metrics* menu provides the ability to calculate a number of power related metrics for both DC and AC power. With AC power it is possible to calculate watts, amps, volts, power factor, apparent power, frequency and Total Harmonic Distortion (THD). With DC the main use for power metrics is for calculating wattage.





Power Metrics as displayed on the dashboard.

Logging / Dashboard

- [ ] Inst Power (Watts, Real)
- [x] Avg Power (Watts, Real)
- [ ] Min Power (Watts, Real)
- [ ] Max Power (Watts, Real)

Calculated Real Power

Instantaneous, Average, Minimum and Maximum can be selected for graphing or logging of each available metric. For min, max and average time period see Section 1.8 - Measurement Interval.

- [ ] Avg Apparent Power (W)

Calculated as Volts x Amps

- [x] Avg Power Factor (PF)

Ratio of Real Power to Apparent Power

- [ ] Inst Voltage (Vrms)
- [x] Avg Voltage (Vrms)
- [ ] Min Voltage (Vrms)
- [ ] Max Voltage (Vrms)

Calculated Voltage

- [ ] Inst Voltage THD (%)
- [ ] Avg Voltage THD (%)

Total Harmonic Distortion

- [ ] Inst Amperage (Lrms)
- [x] Avg Amperage (Lrms)
- [ ] Min Amperage (Lrms)
- [ ] Max Amperage (Lrms)

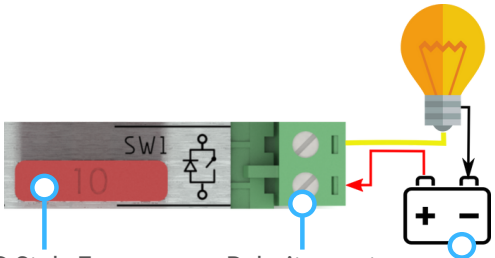
Calculated Amperage

- [x] Line Frequency (Hz)

Calculated AC Frequency

3.0 - Relay Configuration

Both the Q5 and Q5 Pro include 8 solid state load relays capable of switching up to 10A DC (Max 100W). The pro version includes internal current sensing on all 8 relays capable of accurately measuring loads up to 5 Amps DC.



ATO Style Fuse (PRO ONLY)

Polarity must be correct, or load will not turn off.

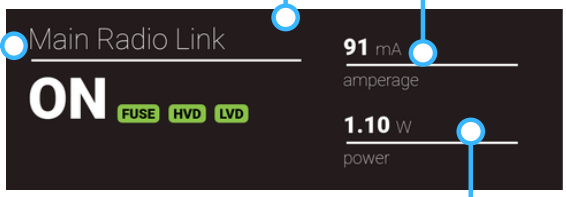
Load switch only, circuit must be powered.

Toggle State

Toggle State for 10 seconds

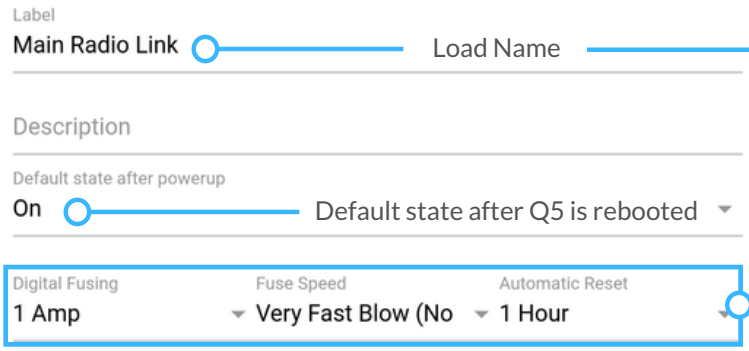
Reset Low/High Voltage Disconnect or Digital Fusing (PRO ONLY)

Load Current (PRO ONLY)



Load Relay as found on the dashboard

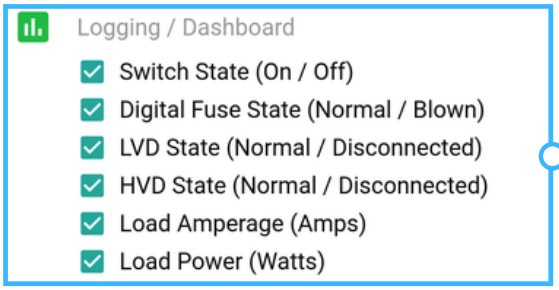
Load Voltage is required to calculate wattage (PRO ONLY).



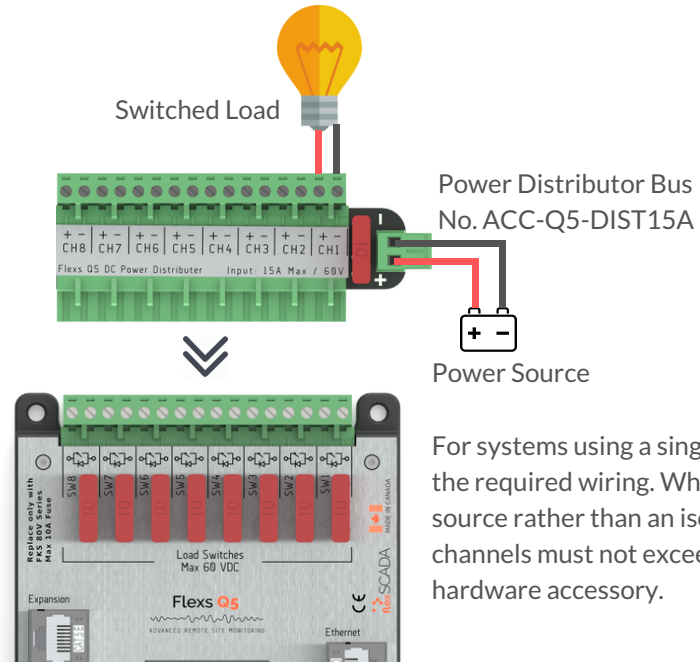
Digital Fusing (PRO ONLY)

Eg Battery voltage powering this device, required for Low/High Voltage Disconnect.

Low and High Voltage Disconnect serve the same purpose; protecting the load from damage in the event of extreme power fluctuations.



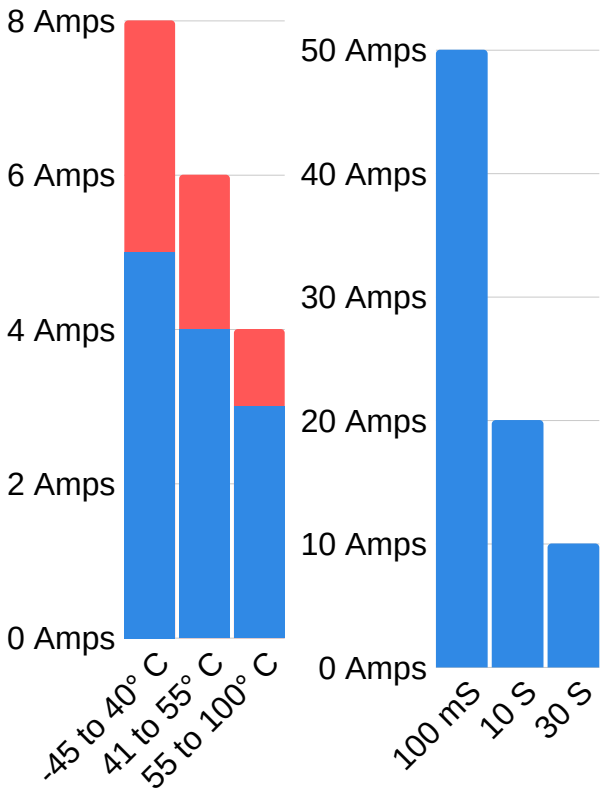
Choose the metrics to be logged or displayed on the dashboard. *LVD*, *HVD* and *Load Power* require *Load Voltage* to be provided. *Load Amperage*, *Load Power* and *Digital Fusing* are available with the Q5 Pro only.



For systems using a single voltage we offer a distribution bus to cut down on the required wiring. When using the distributor each channel acts as a power source rather than an isolated switch. The max combined load across all channels must not exceed 15 A. No software configuration is required for this hardware accessory.

3.1 - Relay Specifications

The Q5 Relays are subject to environmental de-rating as detailed below.



Red - under 30 Volts.
Blue - 30 to 60 Volts.

Max on time in 1 minutes period.

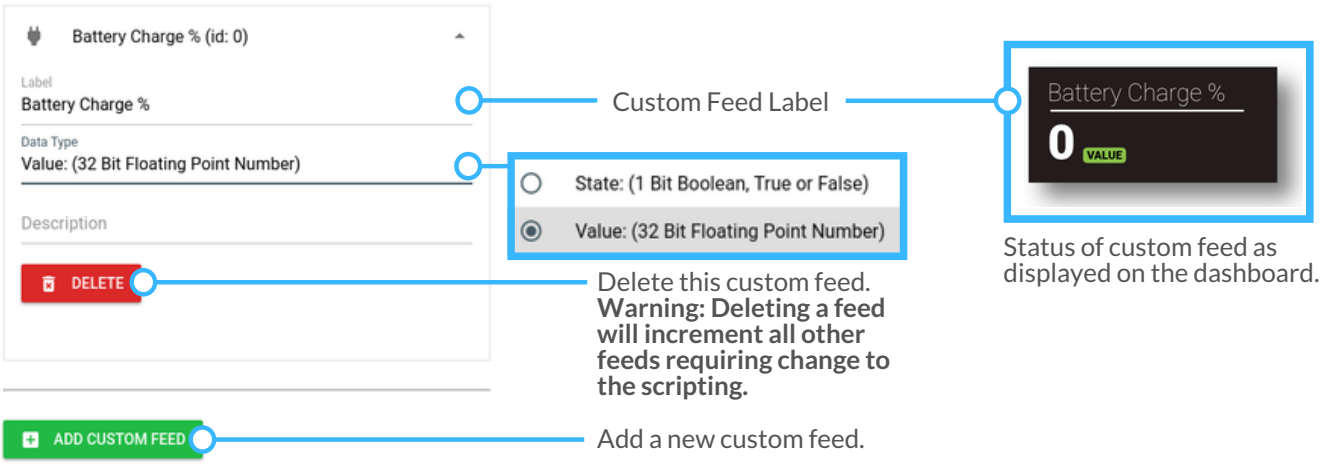
Technical Specifications

- Switch Impedance: 8 mOhms (Not including fuse)
- Max Open Voltage: 70 VDC
- Power Consumption: 2 mW in closed state
- Isolation Level: +/- 125 V (Channel to Channel or Channel to Q5 Ground)
- Max Surge Rating: 250 A transient pulsed; tp ⩽ 10 µs
- Max Current Sensing: 5 A (PRO ONLY)
- Contains fly-back suppression for switching inductive loads such as relays, motors, etc.(up to 140 mJ (Max 250 A Peak Current)

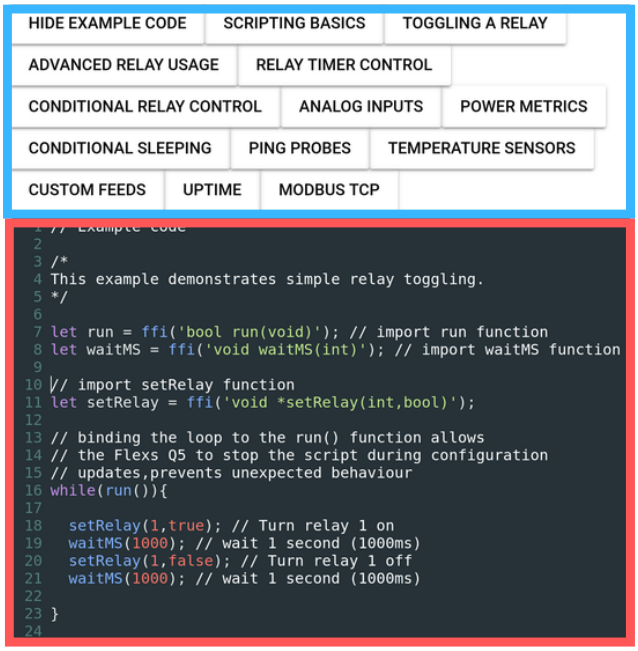
4.0 - Scripting

The FlexsQ5 has an on-board scripting language that utilizes JavaScript syntax. This scripting provides access to all on-board analog inputs, temperature sensors, load outputs, custom feeds and Modbus TCP.

Custom feeds are a location where you can store data generated by your scripts. This data is uploaded to the cloud server and can also be viewed on the dashboard. Additionally you can access custom feeds from SNMP. See section 5.0.
Custom feeds can be configured as either a bool (true or false) or as a floating point number (a number with decimal places). See the on board "Custom Feeds" example for more info on how to write to the custom feeds.



Logic menu is where all the action with scripting takes place. Included on this page are a number of helpful examples (highlighted in blue). Below you will find the syntax highlighted code editor (highlighted in red).



All scripting is managed as a secondary priority to the main functions of the Q5 (to avoid interruptions to system tasks). For a more in-depth look at scripting, please see the on board examples.
Any errors in the scripting will prevent all of the script from functioning. Details on where the error is located can be seen at the top of the page upon saving the settings.

The line in your script causing the error.

Error shown at top of page, indicating the line causing the problem.

4.1 - HTTP API

The FlexsQ5 has a HTTP/HTTPS API that allows for a number of parameters to be accessed or modified. Below are some examples of how to use this API.
All requests must be authenticated using the BASIC AUTH headers with the password hashed using SHA256.

```php
<?php

//Change the following variables as needed
$ip = '192.168.1.20';
$password = 'flexscada';

//Initialize CURL
$curl = curl_init();

//Set CURL Options
curl_setopt_array($curl, array(
  CURLOPT_URL =>
  "http://$ip/api/metrics",// /metrics or /crypto
  CURLOPT_RETURNTRANSFER => true,
  CURLOPT_TIMEOUT => 2,
  CURLOPT_CUSTOMREQUEST => "GET",
  CURLOPT_USERPWD =>
  ":" . hash('sha256', $password . "FlexsQ5!")
));

//Run CURL Request
$response = curl_exec($curl);
$err = curl_error($curl);

curl_close($curl);

//if no error was found
if (!$err) {
  //Decode the JSON Response
  $returnedData = json_decode($response, true);
  //Return the decoded data
  print_r($returnedData);
} else {
  // If there was an error, show that
  echo "cURL Error #:" . $err;
}
```


```json
{
  "inputs": [
    {
      "ch": 1,
      "label": "Main Battery",
      "unit": "V",
      "value": {
        "inst": 49.142,
        "avg": 48.992,
        "min": 47.501,
        "max": 49.50,
        "ripple": 0.0021,
        "state": 0
      }
    }
  ],
  "relays": [
    {
      "ch": 1,
      "label": "Main Microwave",
      "state": 0,
      "load_avg": -0.0009,
      "load_inst": -0.0118,
      "power_avg": 0,
      "hvd_tripped": 0,
      "lvd_tripped": 1,
      "fuse_tripped": 0
    }
  ],
  "temp_sensors": [
    {
      "id": 7731,
      "index": 0,
      "label": "Indoor Temp",
      "registered": true,
      "value_inst": 0,
      "value_avg": 0
    }
  ],
  "power_metrics": [
    {
      "id": 0,
      "label": "AC Line",
      "voltage": {
        "avg": 2.6372,
        "max": 2.6423,
        "min": 2.6319
      },
      "amperage": {
        "avg": 3.023,
        "max": 3.1572,
        "min": 2.9257
      },
      "real_power": {
        "avg": -7.0377,
        "max": -6.7507,
        "min": -7.4345
      },
      "powerfactor": -0.8828,
      "apparent_power": 7.9723,
      "thd": 30.641
    }
  ],
  "epoch": 1548106981
}
```


This PHP example requests all the metrics from the FlexsQ5. The response shown left includes all enabled channels and relays. The /crypto endpoint displays IP Address info and other system parameters.

The above example code can be downloaded here:
https://pastebin.com/y66r1niS

```php
<?php

//Change the following variables as needed
$ip = '192.168.1.20';
$password = 'flexscada';

//Initialize CURL
$curl = curl_init();
//Valid Commands
//set_relay = set relay state
//reset_relay = reset softfuse, LVD or HVD
//pulse_relay = toggle relay for 10 sec
//toggle_relay = change relay state
$postData['command'] = 'set_relay'; //valid command
$postData['channel'] = 1; //Relay Channel Number
//Only valid on set_relay command
$postData['state'] = 1; // 0 = OFF; 1 = ON

//Set CURL Options
curl_setopt_array($curl, array(
  CURLOPT_URL =>
  "http://$ip/api/ctrl",
  CURLOPT_RETURNTRANSFER => true,
  CURLOPT_TIMEOUT => 2,
  CURLOPT_CUSTOMREQUEST => "POST",
  CURLOPT_POSTFIELDS => json_encode($postData),
  CURLOPT_USERPWD =>
  ":" . hash('sha256', $password . "FlexsQ5!")
));

//Run CURL Request
$response = curl_exec($curl);
$err = curl_error($curl);

curl_close($curl);

//if no error was found
if (!$err) {
  //Decode the JSON Response
  $returnedData = json_decode($response, true);
  //Return the decoded data
  print_r($returnedData);
} else {
  // If there was an error, show that
  echo "cURL Error #:" . $err;
}
```

This PHP example shows how to set a relay state on the flexsQ5.

```
{
    "status": "success"
}
```

The Q5 will respond with the above reply indicating that the state change was successful.

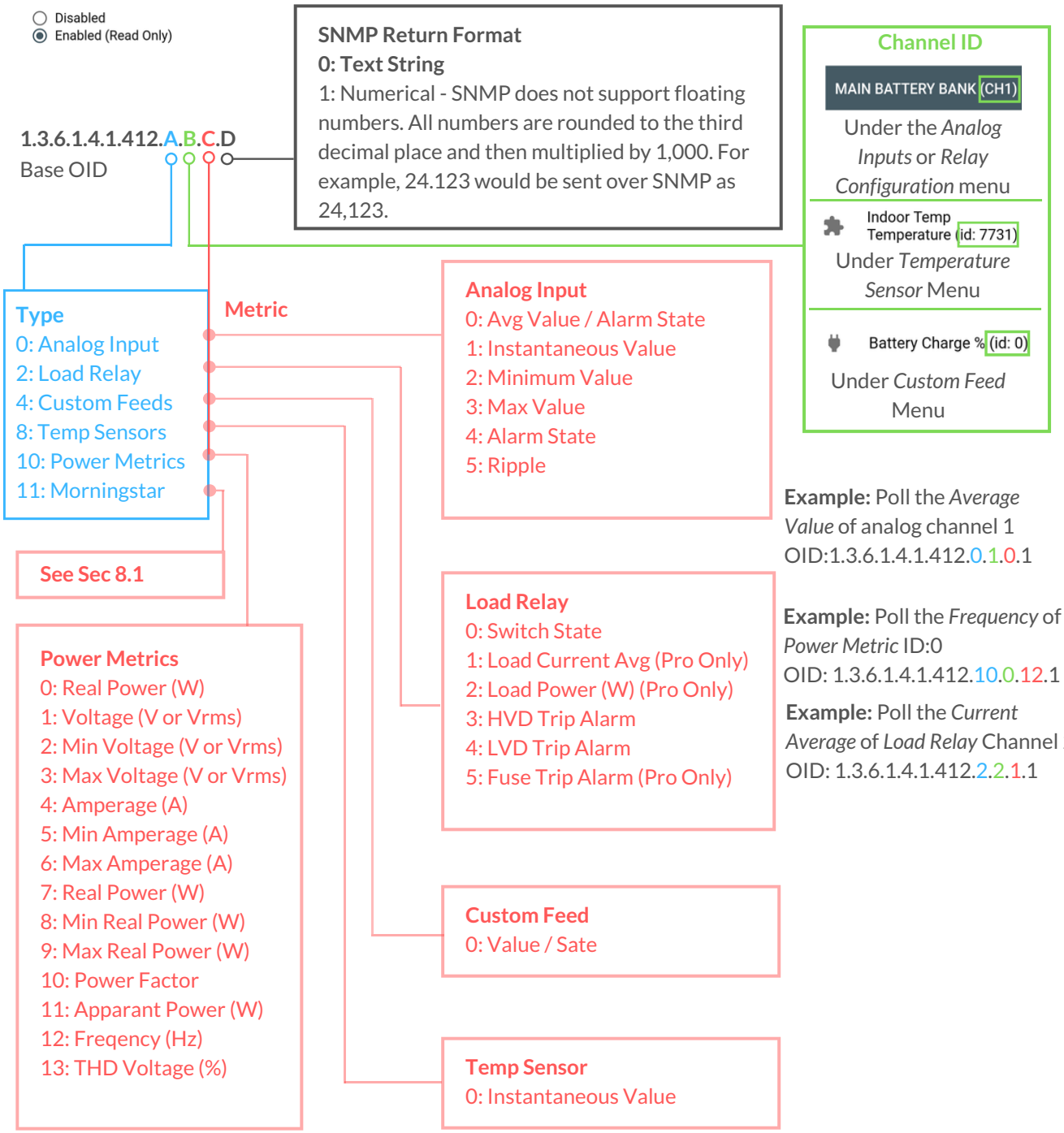
Using this same API endpoint it is also possible to reset the soft fuse, toggle the relay and toggle the relay for a timed 10 seconds.

In this manual we have only shown examples written in PHP, however the Q5 API can be accessed from any code language using the correct HTTP requests.

The example shown left can be downloaded here: https://pastebin.com/fsvaPpP4

5.0 - SNMP

Simple Network Management Protocol (SNMP) has been used by networks for over 30 years, making it one of the most widely supported protocols.
The Q5 supports SNMP version 1 and 2c, with the default community of "public". At this time, the community can not be changed to encourage better security methods such as a VPN.
Enable SNMP in the *Networking* menu as shown.

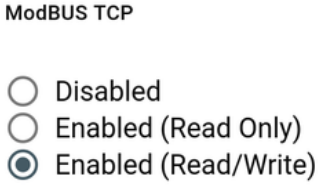


Example: Poll the average value of *channel 1* using the *NetSNMP* command line tool.

 # snmpget -v2c -c public <IP Address> 1.3.6.1.4.1.412.0.1.0.1

5.1 - MODBUS TCP

MODBUS TCP is used by a verity of industrial applications involving PLC's and HMI's, currently the Q5 only supports MODBUS over TCP. If MODBUS via RS485 is required a third-party converter will be required. MODBUS devices can assume two roles: Slave and Master. On the Q5 the Slave role can be enabled under the Networking Menu as shown below. All Master related functionality can be accessed through custom scripting.



Relay Outputs - Read/Write - Coil
Reg 101 - Relay 1
.....
Reg 108 - Relay 8

Read all relay states: modpoll.exe -0 -m tcp -t 1 -r 101 -c 8 -1 <IP Address>

Analog Inputs - Read - 32b Float
Reg 30000+30001 - Input 1 (Average)
.....
Reg 30014+30015 - Input 8 (Average)

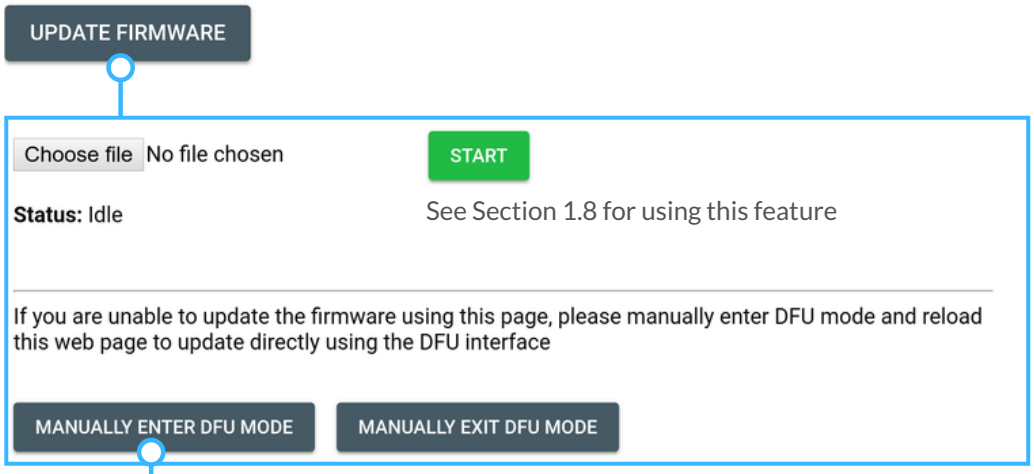
Read all input values: modpoll.exe -0 -m tcp -t 4:float -r 30000 -c 8 -1 <IP Address>

Custom Feed Boolean/Sate - Read/Write - Coil
Reg 300 - Custom Feed ID:0
Reg 301 - Custom Feed ID:1
....
Read custom feed state: modpoll.exe -0 -m tcp -t 1 -r 300 -c 1 -1 <IP Address>

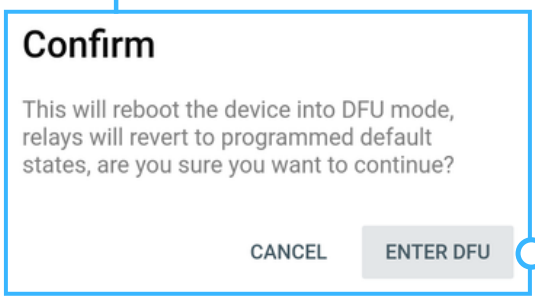
Custom Feed - Read/Write - 32b Float
Reg 400+401 - Custom Feed ID:0
Reg 402+403 - Custom Feed ID:1
....
Read custom feed value: modpoll.exe -0 -m tcp -t 4:float -r 400 -c 1 -1 <IP Address>

6.0 - Device Firmware Updater

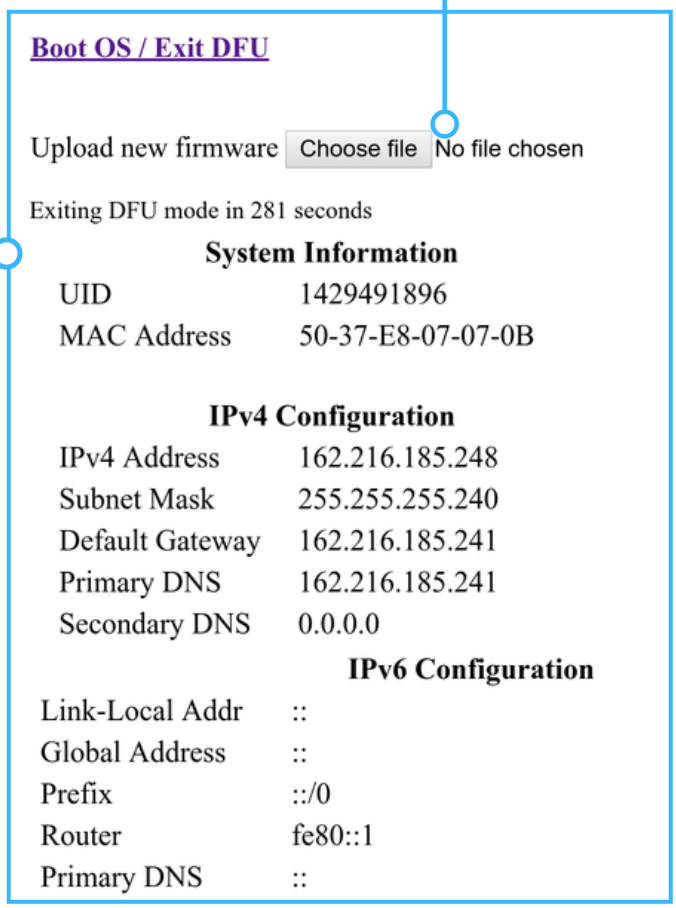
FlexSCADA will occasionally release new firmware to add additional functionality to the Q5. This section explains how the Manual Device Firmware Updater (DFU) works, note that under normal circumstances this can be done as shown in section 1.8 without using the manual mode.
Select *Device Options* from the main menu. On the *Device Options Page*, you will find the *Update Firmware* Button.



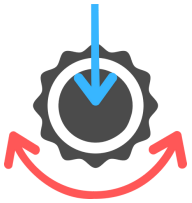
After selecting and starting the upload do not unplug or refresh the page for 30 seconds.



After refreshing the page, you should be in DFU mode (shown at right).
You have 5 minutes to find and upload your firmware before the Q5 will revert back to the main operating system. You can also exit the DFU mode by clicking the link marked *"Exit DFU"*.
The UID, MAC and current IP configuration are also visible from the DFU mode.



It is also possible to manually force the device into DFU mode by holding the control knob down while power is applied to the device. This is also mentioned in Section 7.0.

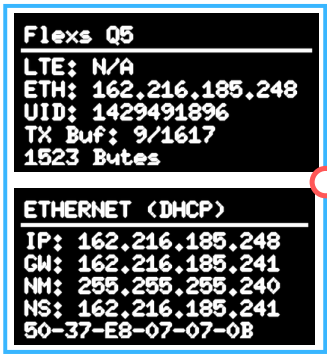


Rotating goes between pages, clicking accesses additional views.

7.0 - Device Interface

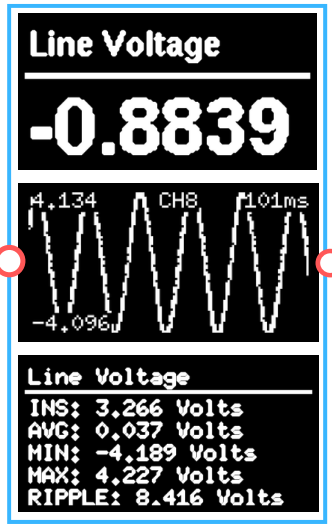
Using the multi-function knob on the Q5, it is possible to view a number of parameters without using the web interface. The knob can be rotated and pressed to navigate between pages or access additional views. In the case of relays, clicking the knob allows you to change the state of the relay. The naming and scaling of each view found below corresponds to what has been configured in the web interface.

Pressing the knob while the power is applied will put the device in DFU mode - See Section 6.0. Continuing to hold the knob for an additional 60 seconds will reset the configuration to factory default.

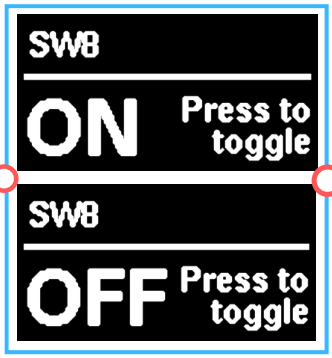


Q5 Homes Page - showing current IP, device UID, available buffer for readings and Bytes of readings taken.

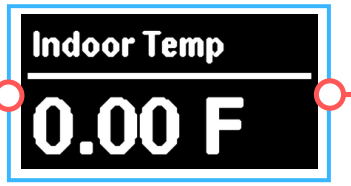
Ethernet Page - Shows current IP, Gateway, Netmask, Name Server and MAC Address.



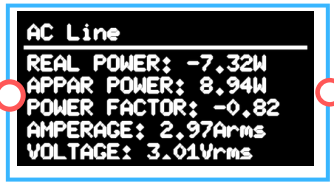
Analog Input Page - See Section 2.0. There will be one page for each enabled analog input. Press the knob to switch between views.



Load Relay Page - Press the knob to switch relay ON/OFF. See Section 3.0 for more info on naming relay channels.



One Wire Sensors Page - See Section 2.3 for more details.



Power Metrics Page - See Section 2.5 for more details.

Custom Feed Page - See Section 4.0 for more details.

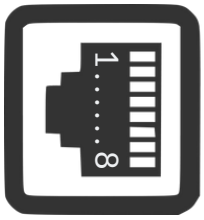
Ping Page - See Section 1.9 for more details.

8.0 - Expanded Functionality

This section details how some of the expansion interfaces and software on the Q5 can be used for more advanced applications where customer hardware or software are important.

RJ45 Expansion Connector

WARNING! CONNECTING A POE TO THIS PLUG WILL DAMAGE YOUR Q5 AND VOID YOUR WARRANTY!

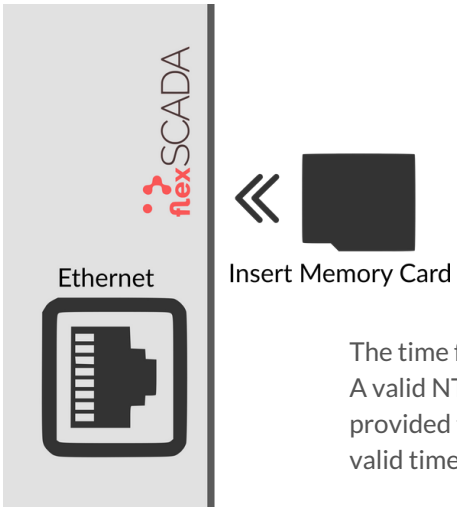


Expansion

Expansion Pinout
1 . . . . . I2C-SCL / UART-TX (I/O)
2 . . . . . I2C-SDA / UART-RX (I/O)
3 . . . . . 3.3V DC OUT (500 mA Max)
4 . . . . . GND
5 . . . . . 5V DC OUT (500 mA Max)
6 . . . . . IO Push/Pull 1.8 V / 5 V Open Drain Out
7 . . . . . GND
8 . . . . . One-Wire (I/O)

Note: The UART and IO pins are usable only through scripting or one of the plugins mentioned below. For more detailed information contact support.

Memory Expansion



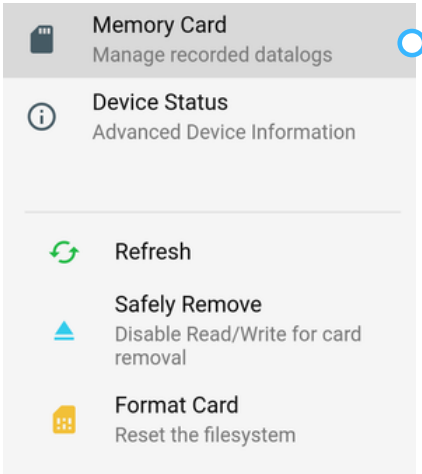
The Q5's internal memory allows for roughly 1 month* of readings to be stored before older data is erased. In applications where extensive long term data-logging is required the Q5 may be outfitted with an external memory card for additional capacity. For more info on how to use this feature please contact FlexSCADA.
*Actual duration depends on measurement interval and number of metrics being logged.

The time field is UNIX Timestamp. A valid NTP must be provided to have valid time data.

Each metric enabled will be included in the CSV.

timestamp	SW1.state	Channel 1.avg	Channel 1.inst
1558122824	0	0.0013	-0.0007
1558122834	0	0.0013	0.0053
1558122844	0	0.0013	0.0055
1558122854	0	0.0013	0.0053
1558122864	0	0.0013	0.0032

Left hand side menu shows the memory card



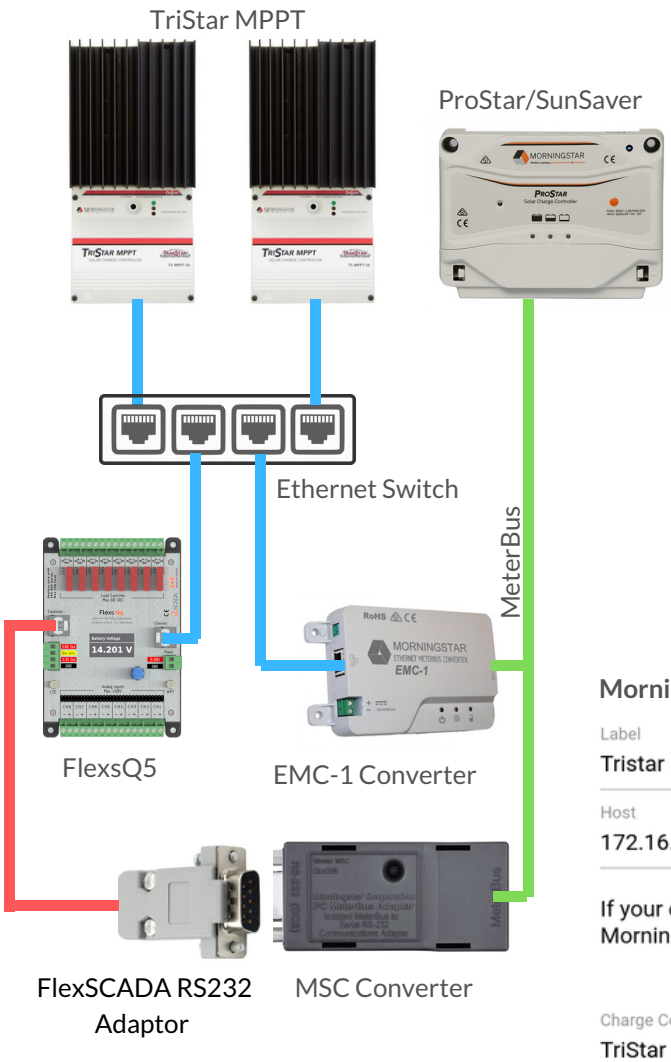
Each time the configuration is changed a new CSV file will be created along with a new JSON cfg file.

If enabled, both measurement logs and config files will be stored in the above folders.

8.1 - Morningstar Plugin

This section details how to use the Morning Star plugin to access data from the charge controller

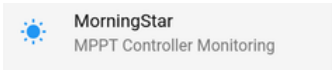
Physical Connection Options



The Q5 must have access to the IP of either the EMC-1 or TriStar MPPT. The Plugin uses ModBus TCP over port 502 which must not be blocked by any firewalls.

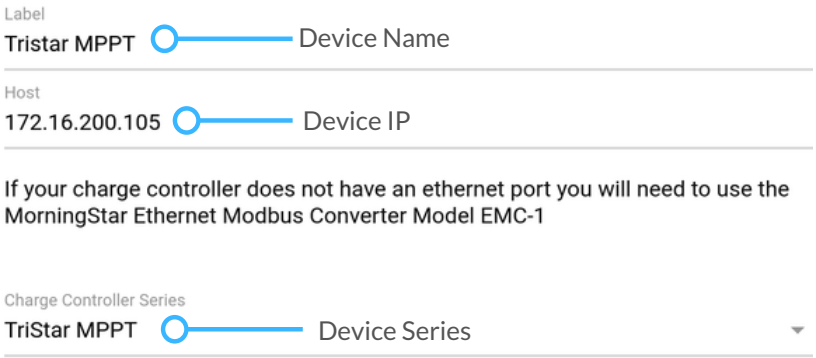
Once the hardware connections have been made the Morningstar Plugin must be enabled in Device Options menu.

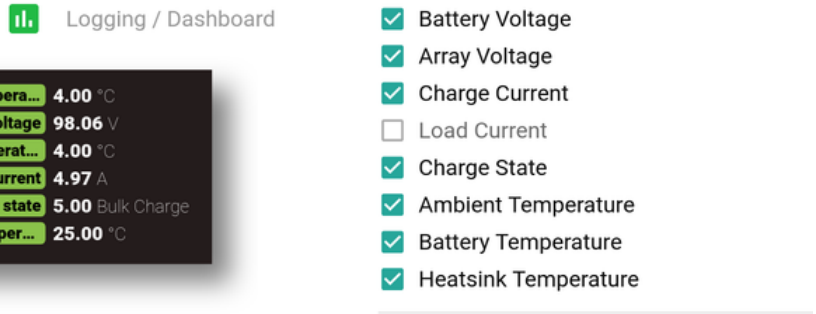
After the plugin has been enabled a new menu will appear in the main menu.



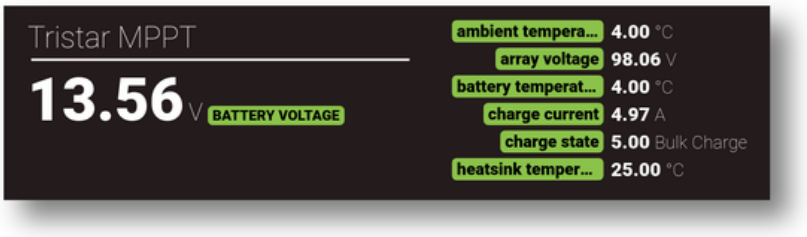
Click the  button to add a new device; up to 32 devices can be added.

Morningstar Plugin Menu



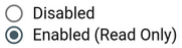


View of charger controller on dashboard



Morningstar Plugin SNMP

SNMP Must be enabled under the *Networking* menu.



SNMP Return Format
0: Text String
1: Numerical - SNMP does not support floating numbers. All numbers are rounded to the third decimal place and then multiplied by 1,000. For example, 24.123 would be sent over SNMP as 24,123.

1.3.6.1.4.1.412.11.A.B.C
Base OID

Charger ID
Tristar MPPT (id: 0)

Example: Poll the battery volts from charger "0"
OID:1.3.6.1.4.1.412.11.0.1.1

Power Metrics
1: Battery Voltage;
2: Array Voltage;
3: Charge Current;
4: Load Current;
5: Ambient Temp;
6: Battery Temp;
7: Heatsink Temp;
8: Charge State;
9: Last Successful Poll (Sec. Ago)
10: Error Code;
Should read 0 for success

0: START
1: NIGHT_CHECK
2: DISCONNECT
3: NIGHT
4: FAULT
5: BULK_CHARGE
6: ABSORPTION
7: FLOAT
8: EQUALIZE

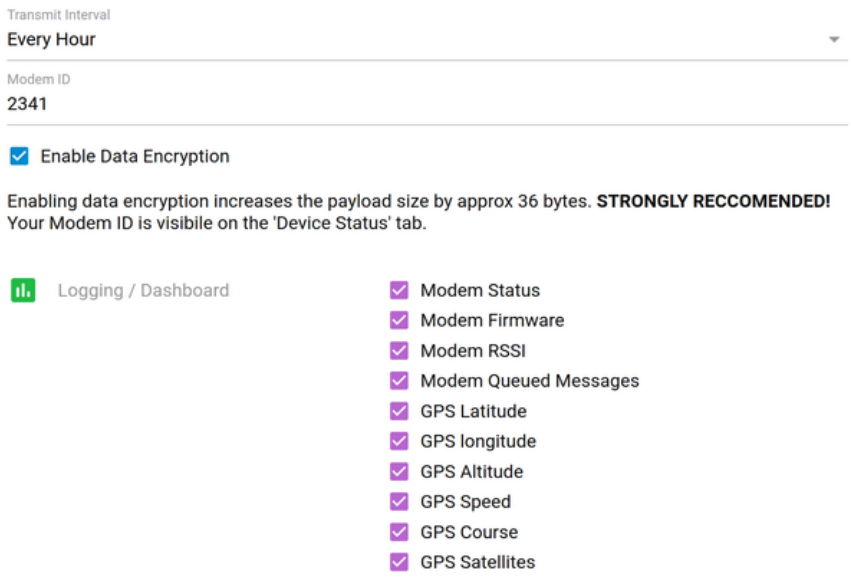
Direct Modbus access to Morningstar charge controller from Scripting

```
24
25 let run = ffi('bool run(void)');
26 let waitMS = ffi('void waitMS(int)');
27
28 let getFeed = ffi('double getFeed(int)');
29 let setFeed = ffi('void setFeed(int,double)');
30
31 let mbGetStatus = ffi('int mbGetStatus()');
32
33 let mbConnect = ffi('int mbConnect(char*,int,int)');
34 let mbDisconnect = ffi('void mbDisconnect()');
35
36 let mbSetReg = ffi('void mbSetReg(int,char*,double)');
37 let mbGetReg = ffi('double mbGetReg(int,char*)');
38
39
40 while(run()){
41
42   //Connect to the Tristar
43   if(mbConnect('172.16.200.105',502,1) === 0){
44
45   //Get Scale Factor - Reg #3 - we count from reg 0
46   let iscale = mbGetReg(2,'U32ABCD');
47
48   //Success getting scale factor
49   if(mbGetStatus() === 0){
50
51     //Get raw Amps Reg #29 - we count from reg 0
52     let rawAmps = mbGetReg(28,'U16AB');
53
54     //SunSaver and ProStar Chargers use type F16AB
55     //Without the need for scaling
56
57     //Success getting raw amps
58     if(mbGetStatus() === 0){
59
60       //Calcuate Amps
61       let amps = (iscale * rawAmps) / 32768;
62
63       //Set custom feed 0 with amps of the solar charger
64       setFeed(0, amps);
65     }
66
67   }
68
```

8.2 - SWARM Plugin

The FlexsQ5 software has support for the SWARM satellite data radio and is capable of acting as a primary data path or backup data path when a primary link goes down. Due to the data constraints of the SAWRM network a subset of the normal transmitted measurements are selected.

SWARM network allows for 750 transmissions per month this should be kept in mind when selecting the transmit interval



Select which metrics will be transmitted over the SWARM™ network

This list is updated each time a new input/output/custom feed is configured and must be re-selected. The total payload must not exceed 192B. Each analog value is 4 Bytes and each discrete value is 1bit (8 bits per Byte).

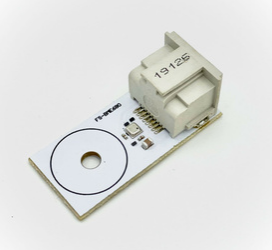
View from the dashboard

FlexSCADA is currently working on a SWARM accessory, however at this time the module is not finished. Customers can use their own modules or request a prototype version from FlexSCADA.

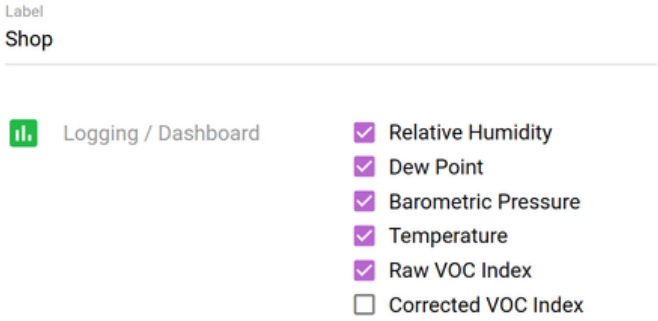
Another limitation at this point in the bridge between the FlexSCADA cloud and the SWARM Hive. We expect this to be done Q4 of 2021.

8.3 - BME680 - Environmental Sensor

FlexSCADA manufactures a environmental sensor for monitoring Humidity, Temp and VOC's. The sensor uses the expansion port on the Q5 with a standard RJ45 / Ethernet cord.



BME680 Sensor Module

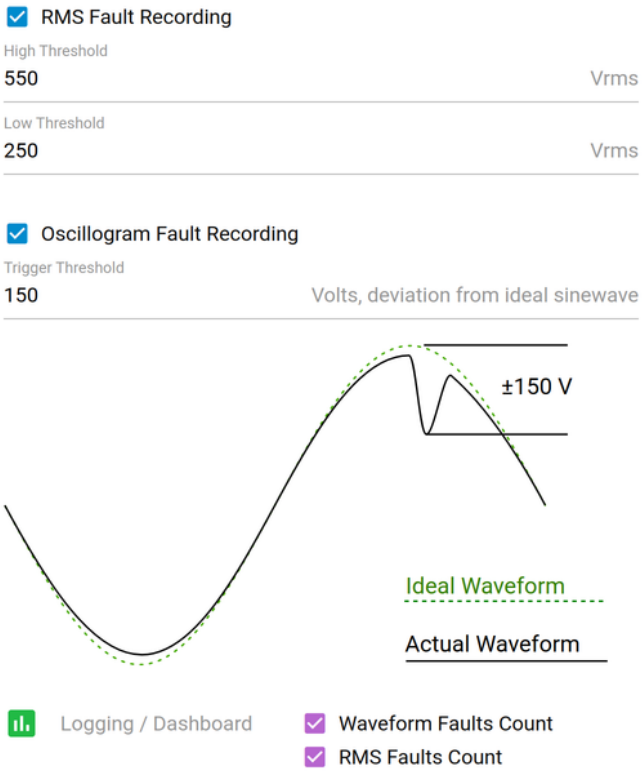


Plugin Configuration Menu

View from the dashboard

8.4 Line Fault Capture Plugin

This section details how to use the line fault capture plugin, this plug in useful to capture AC power events on a cycle by cycle level or in a DC system on a threshold basis. Inputs are configured as shown in section 2.0, then power metrics are setup for any inputs interested in being monitored and when the plugin is enabled under the Device Options menu the plugin will appear in the main menu.

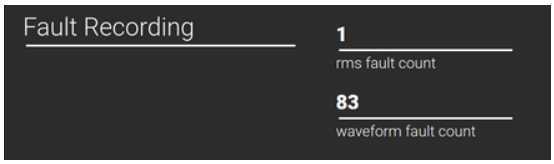


Voltage channels configured in power metrics are all monitored.

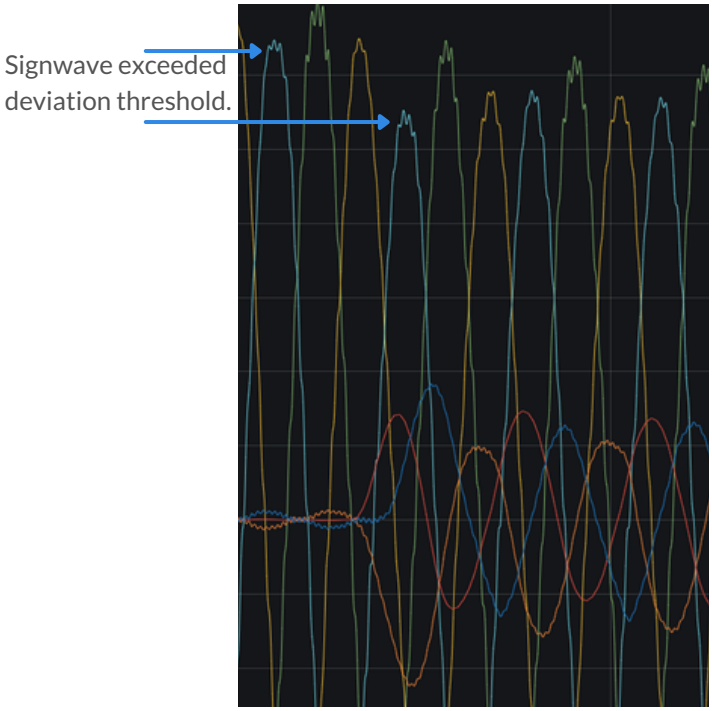
High / Low Thresholds will both trigger an fault event capture.

The *Trigger Threshold* detects deviations from an ideal signwave and captures a fault event when the threshold is exceeded.

An oscillogram can also be triggered from the Q5 scripting.



View from Dashboard



9.0 - Warranty Terms

The FlexsQ5 comes with a 3 year limited manufacturer warranty. The FlexsQ5 Pro comes with a 5 year limited manufacturer's warranty.
For warranty coverage the following terms and conditions apply:

- The product must have failed while operating within the specifications outlined in this document.
- Water or moisture damage is not covered.
- Physical damage to the product as a result of improper use will not be covered.
- Buyer must submit an RMA via our website showing proof of purchase.
- Buyer must ship the product to our RMA department for review.

Please contact us with any additional warranty questions.

10.0 - Security Measures

FlexSCADA takes security very seriously. Our list of high-profile users includes military, government and some of the world's largest oil companies, who have all come to trust the security measures incorporated into our product.

The following measures have been taken to make the FlexsQ5 secure:

- All cloud payload data is encrypted by 256 bit AES-CBC with a pre-shared key and SHA256 hashing for data integrity.
- FlexSCADA cloud can be self hosted to avoid any connections over the Internet.
- Can be used standalone without Internet access.
- Fully supports HTTPS with customer SSL Certificates.
- Our cloud data sync protocol is open to third-party security auditing.
- Device operates with a Real Time Operating System (RTOS) which means there isn't a kernel with possible security vulnerabilities.
- The FlexsQ5 employs an ST Microelectronics chipset which is designed in the US and Europe. By doing this we avoid vulnerabilities which may be hidden within foreign chipsets.
- All software and hardware development takes place within North America.

Important! Measures the customer should take to improve security:

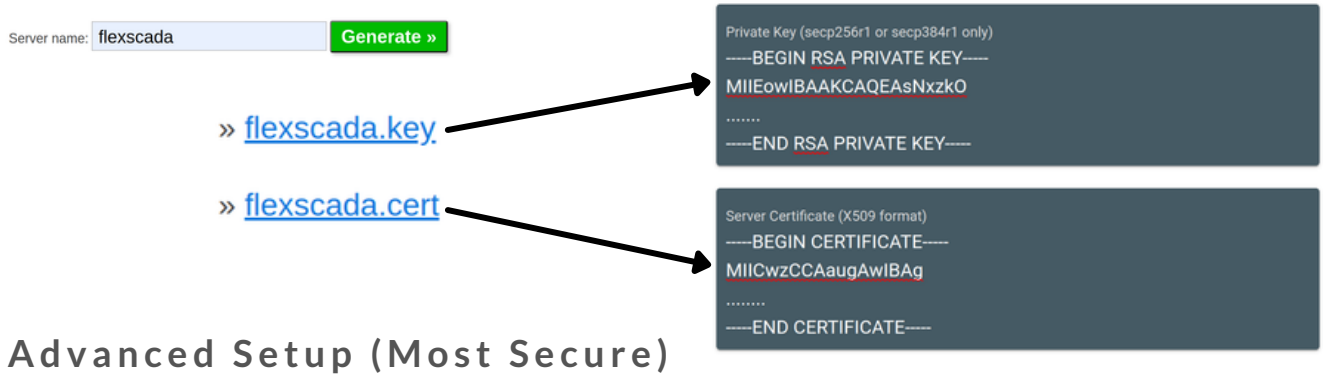
- Change the default password to a secure password.
- Always operate the FlexsQ5 behind a firewall or on a local network.
- Always use unencrypted protocols such as HTTP, SNMP, and Modbus over a secure VPN or local network.
- Secure physical access to the device to avoid local tampering.
- Setup HTTPS certificates and only access the device over HTTPS. (see next page)
- If External Memory card is in use disable configuration from being saved under *Device Options*.

10.1 Setting up HTTPS

In this page we will guide you through two ways of creating a self-signed SSL certificate used for establishing HTTPS on a FlexsQ5.

Quick Setup (Less Secure)

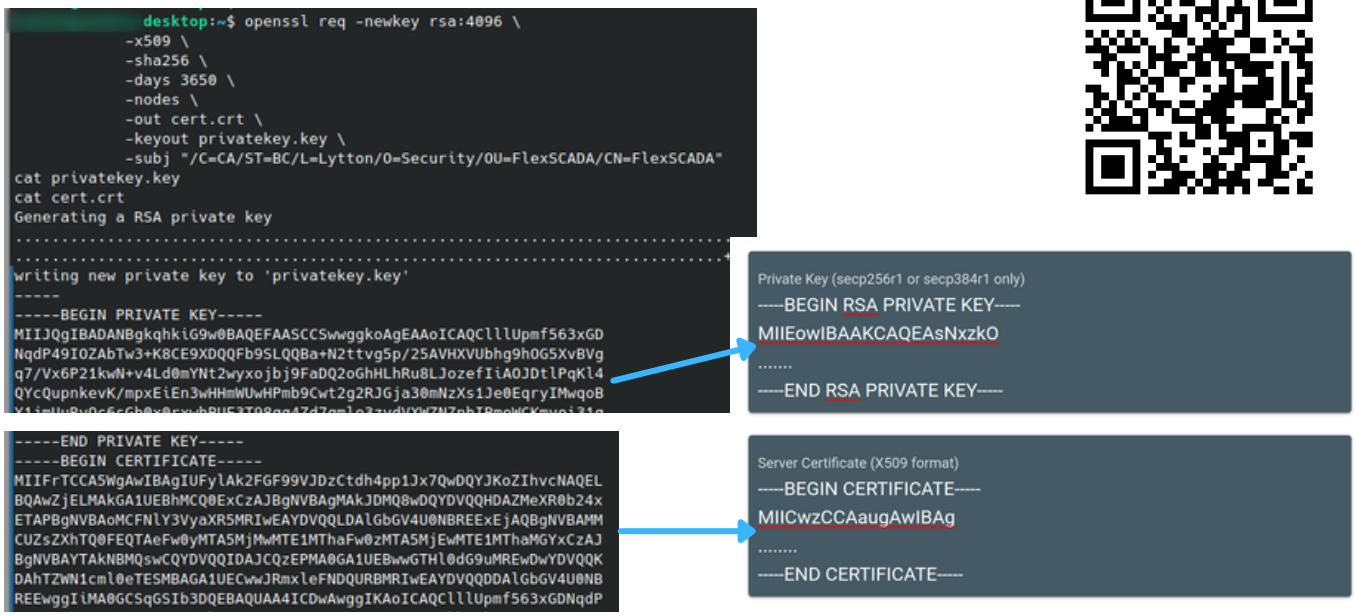
Visit https://www.selfsignedcertificate.com/ fill in the server name and download the key and cert files. Then open each file with a text editor. Under the *Networking* menu locate the HTTPS section and paste the keys as shown. Save and apply and you are done.



Advanced Setup (Most Secure)

This method requires OpenSSL to be installed on the machine running the command, the example below is from an linux environment.

Find the command here or scan the QR: https://pastebin.com/cf6Wq7qA



Under the Networking menu locate the HTTPS section and paste the keys as shown. Save and apply and you are done.

NOTE: Because this is a self-signed SSL certificate you will get a warning in your browser saying that "**Your connection is not private**". Unless you have a domain name directing to the Q5 and buy a proper certificate you will get this warning message. In the Chrome browser - Select "**Advanced**" and then click "**Proceed to [IP of Q5] (unsafe)**". The page should then load.
HTTPS is very complex and we can only briefly touch on the basics within this manual. For more additional support please contact your web host admin.