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SAPCON INSTRUMENTS PVT. LTD.

30+ Years in Process Control Instrumentation

An ISO 22000 company

Capvel - FUEL

Volumetric Fuel Level Sensor

For Fuel Monitoring in DG Sets and Vehicle Tracking Systems

p: +91-731-4757575 f: +91-731-2475475 e: sales@sapcon.in w :sapconinstruments.com

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Revision History

Revision	Date	Author(s)	Description
1.3	20 Jan 2015	RND	First Version Editing
1.4	23 Jul 2016	RND	Specs Revision
1.5	08 Jan 2017	BRND	Revised Format
1.6	17 Sep 2017	BRND	Branding Revisions
2.0	25 Nov 2017	BRND	Instructions on New User Installation, Troubleshooting Added
2.1	14 Dec 2017	BRND	Details on MODBUS
2.2	19 Mar 2018	BRND	MODBUS-Rtu Figures Revision
2.3	13 May 2018	BRND	Settings-Commands Tables Added

[1]

[1]

- The images shown in this manual may differ from the actual instrument / housing in terms of dimensions, color and design. Please refer to GA drawings for dimensional details.
- Values (of performance) described in this manual were obtained under ideal testing conditions. Hence, they may differ under industrial environment and settings.

Safety Instructions

- Instrument shouldn't block the material filling inlet.
- Secure the cover of housing tightly. Tighten the cable glands. For side mounting, the cable glands should point downwards.
- For side mounting, provide a baffle to prevent the material from falling on the probe.
- When handling forks, do not lift them using their tines. While using them with solids, ensure that material size is less than 10mm.
- Deforming the shape of the tines may interfere with the fork's operating frequency.
- Make all electrical connections as instructed in the manual. Don't power on the device before verifying the connections.

1 Introduction

Fuel monitoring is an integral part of sectors like fleet management, vehicle tracking, civil construction, telecommunications, oil and gas, etc. It helps in optimizing operational costs, managing assets efficiently and improving profitability.

SAPCON's Capvel-FUEL is a volumetric fuel level sensor that addresses the problem of fuel management. It is a compact level transmitter based on the principle of capacitance. It comes with a step-by-step guide in the form of a desktop application called 'Capvel-FUEL-Connect'. Aided by pictures, this app helps configure and calibrate the sensor correctly in just a few button clicks.

Figure 1: Capvel-FUEL Sensor

2 Operating Principle

Capvel-FUEL measures fuel level using the principle of capacitance. The sense rod and the metallic wall of still tube of the sensor form the two plates of a capacitor. The application material (diesel) forms the dielectric between these plates. The amount of capacitance formed is proportional to the level of diesel between the plates. Capvel-FUEL utilizes a specially developed capacitance change gauging circuit to measure any change in the level of fuel. Translation of level from capacitance is done according to the calibrating point of the probe.

Capvel-FUEL uses a fast microcontroller to evaluate the level of material in the tank in different formats such as level in milli-meters, percentage and volume of fuel in milli-litres. The sensor also contains built-in algorithms for temperature drift and turbulence compensation.

3 Applications

Capvel-FUEL is specially developed for applications requiring fuel measurement and management. Some applications that Capvel-FUEL is ideal for are:

- Fleet Management
- Vehicle Tracking Systems
- Diesel Generators
- Monitoring non-conductive materials in stationary tanks in sectors like:
  - Civil construction
  - Telecommunications
  - Oil and gas

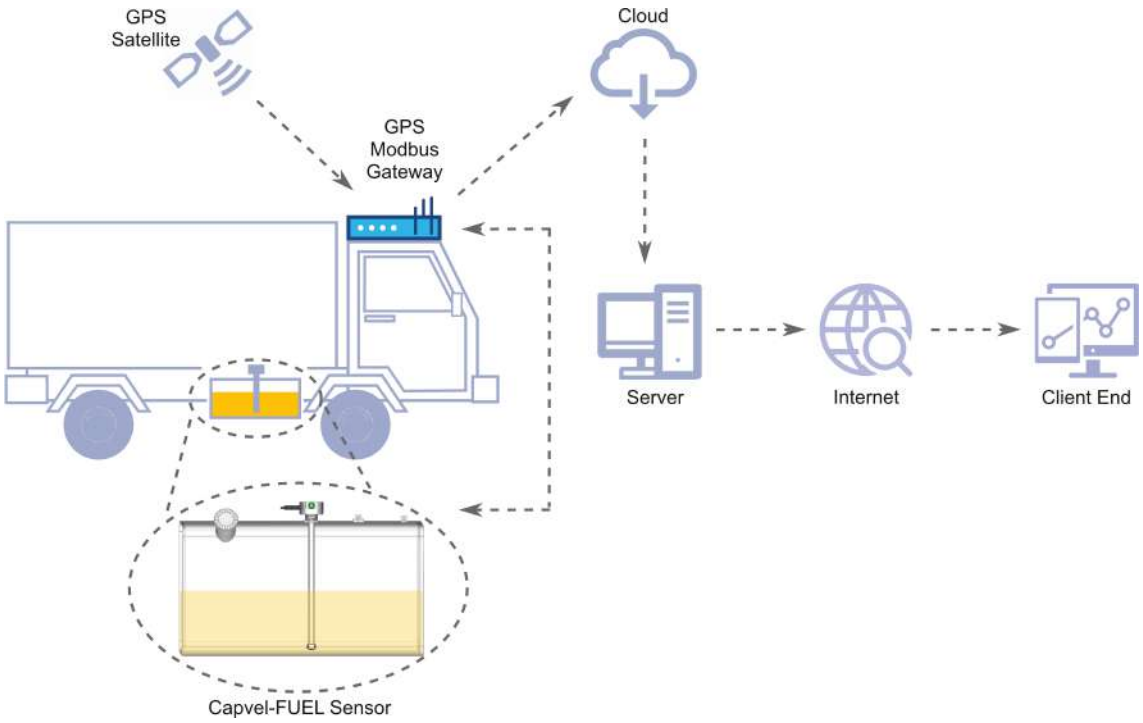
4 Features

- Level to volume configuration
- Compact and adjustable probe size
- Power Supply: 7 - 30 V DC
- Compatible with analog fuel gauge meters
- Operating Temperature:
  - Electronics: -20°C to +70°C
  - Probe: Up to +80°C
- Special algorithm for compensating turbulence and temperature drift
- Mobile Application Guided Installation (using a Calibrator, shown in Figure 2)
- IP-68 certification

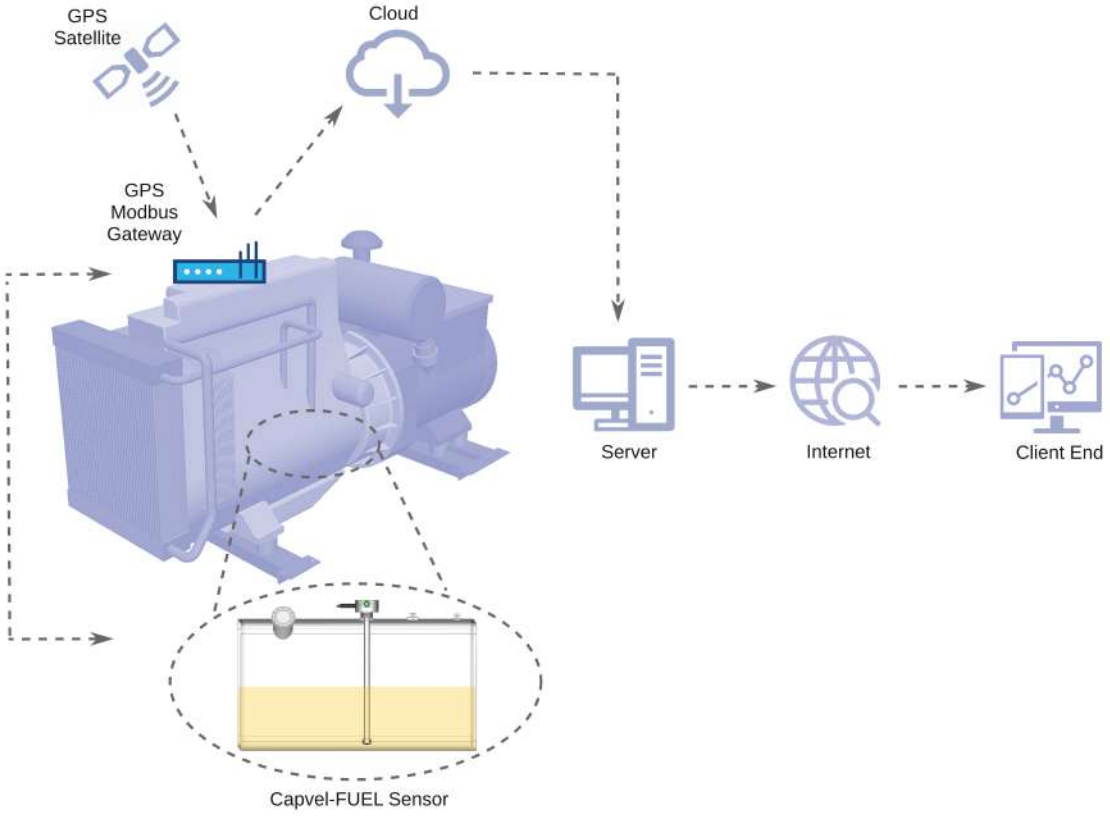
Figure 2: Capvel-FUEL Calibrator Box

5 System Architecture

The system architecture for Capvel-FUEL is shown in Figure 3. Figure 4 describes the dimensional drawing for a standard model of Capvel-FUEL. The dimensions shown in Figure 4 can vary depending on the probe length and the mounting arrangement. A dimensional drawing for a customized order can be made available on request.



(a) System Architecture for Vehicle Tracking Systems



(b) System Architecture for Diesel Generator Sets

Figure 3: System Architecture

6 Electrical Specifications

Please refer to Table 1 for Electrical Specifications.

PARAMETER	VALUE
Input Power Supply	7 - 30 V DC
Output	• 0.5 - 4.5 V Analog voltage output (Adjustable to 0.2 - 4.9 V Analog output) (Maximum load of $10\mu A$) • Analog fuel dial output (Please refer to Figure 18) • Modbus-Rtu RS-485
Bi-Color LED Indication	• Green for Normal • Any other LED indication for error (refer to Table 16).
Current Consumption	55 mA maximum at 12 V DC

Table 1: Electrical Specifications

7 Application Specifications

Please refer to the following table for Application Specifications.

PARAMETER	VALUE
Accuracy	$\pm 1\%$ of full scale probe length, or $\geq \pm 2mm$, whichever is greater
Resolution	Adjustable (minimum 1mm)
Temperature Drift	$800ppm/^{\circ}C$

Table 2: Application Specifications

8 Mechanical Specifications

Please refer to Table 3 for mechanical specifcations.

PARAMETER	VALUE
Housing	Aluminum
Cable Entry	6 Pin DIN Connector; PG 13.5
Operating Temperature	$-20°$C to $+70°$C (Electronics)
High Temperature	$80°$C for standard probe
Operating Pressure	up to 5 bars
Mounting	• SAE 5-bolt pattern, SAE 6-bolt pattern, 1 inch BSP Thread • Flange mounting as per user specification
Dimensions	Refer to GA Drawing
Insulation	• Part-PTFE • Part-Delrin
Cable Conduit	Polyethylene, Operating Temperature: $-15°$C to $+60°$C

Table 3: Mechanical Specifications

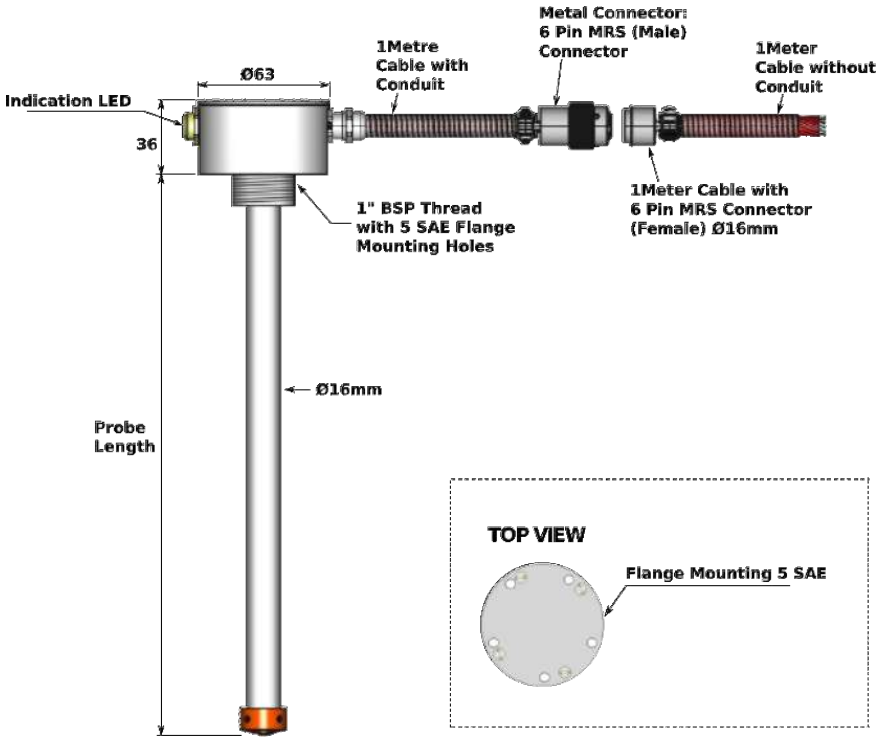


Figure 4: GA Drawing of Capvel-FUEL

9 Installation Guidelines

Note:
During installation, all electrical connections must be powered OFF and the fuel tank must be empty.

Note:
Do not check Capvel-FUEL in water or any conductive material. Ingress of water in the probe may result in erroneous output.

9.1 Installation for New Users

New users are recommended to first evaluate the performance of Capvel-FUEL in a more convenient setup before installing the product in the application tank. To carry out performance evaluation, please follow the steps mentioned below.

- Prepare a narrow transparent Test Tank, with its height equal to the height of the application tank as shown in the following figure (Figure 5).

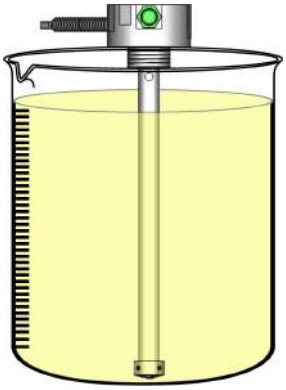


Figure 5: Test Tank

- Make sure you have ease of filling and draining the tank as per your requirement.
- Mark this Test Tank along its height at distances of $1mm$.
- Refer to Section Electrical Connections. Power up and connect the device to the GPRS/GPS gateway
- Calibrate and evaluate the performance of Capvel-FUEL .
- Verfiy Modbus-Rtu ouputs, analog voltage with respect to the changes in the fuel level.
- After a satisfactory experience, proceed to Section Tank Mounting Installation for installing Capvel-FUEL in your application tank.

9.2 Tank Mounting Installation

Note:
It is recommended that the tank must be empty while following the steps in this section.

- Identify the location to mount the fuel sensor such that probe is perpendicular to the surface of the fuel.
- If present, remove the pre-fit old fuel sensor and clean the area before installation of Capvel-FUEL sensor. (Refer to Figure 6.)

Figure 6: Pre-fit Old Fuel Level Sensor

- Place the rubber gasket and ensure that the holes of gasket are aligned with the bores in the tank.(Refer to Figures 7, 8.)

Figure 7: Gasket Fitting

Figure 8: Gasket

- Place the Capvel-FUEL sensor and tighten through the bolts. (Ensure that the bolt or screw heads are completely sunk into the sensor.) Refer to Figure 9.

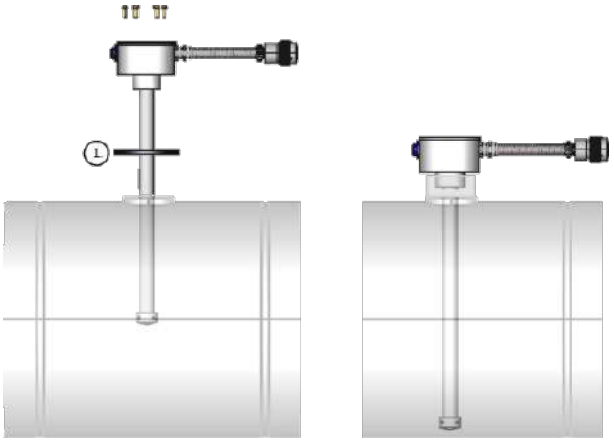


Figure 9: Mounting Arrangement

- Pre-order correspondent mounting arrangement to replace the standard sensor with SAE-5 bolt bores or SAE-6 bolt bores layout.

- Determine the mounting area for Capvel-FUEL on the tank and mark it. It is recommended that the center of the tank is used for mounting. (Refer to Figure 10.)

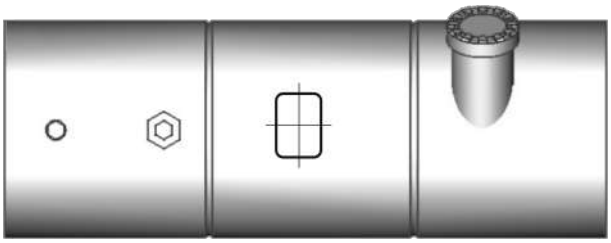


Figure 10: Selecting and Marking Mounting Area

- Drill a 35 mm diameter hole at center of mounting area, then put Capvel-FUEL sensor in it.

- Mark and drill the bolt holes. (Refer to Figure 11.)

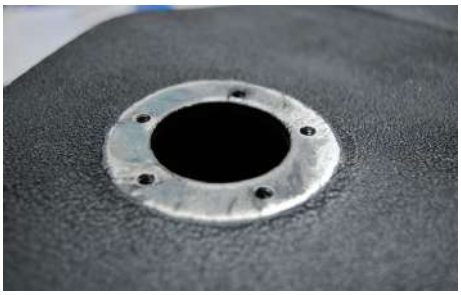


Figure 11: Tank after Drilling

- Now put gasket and fix the Capvel-FUEL sensor using self-threaded bolts. Refer to Figures 8, 9.

- Make sure there is a clearance of at least 5mm from the bottom surface of the tank, as shown in Figure 9.

Note: Make sure the tank is in no way inclinded to the floor; inclination can result in erroneous output. To verify your application tank, check fuel level in the tank with a dip stick at opposite ends of the tank, along the lenght of the tank. Make sure the readings at both the ends are the same, i.e. H1 = H2. Refer to Figure 12.

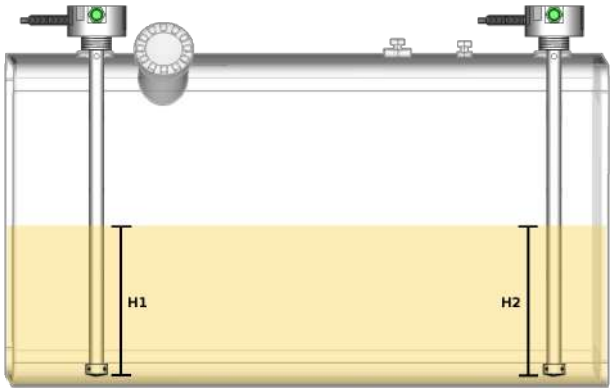


Figure 12: Tank Parallel to the Ground

9.3 Adjusting Length of Probe

- Determine the exact length of Capvel-FUEL probe. Measure the indicated part as per Figure 13. Remember, the probe length calculation must include the insulation bush fit at the bottom of the probe.

- Place probe into the mounting hole / nozzle and mark the extra length, say x, above the tank's mounting surface as shown in Figure 14.

- Remove the insulation bush for bottom separator of Capvel-FUEL by loosening the M2 grub screws as shown in Figure 15.

- Clearance of at least $5mm$ from that tank's bottom surface is necessary to avoid sludge / dirt. With the passage of time, accumulated sludge / dirt can block the entry of fuel inside the probe.

- With a help of a saw carefully make a straight cut of length $x+5mm$ from the bottom of the probe as shown in Figure 16. Support the probe adqeuately at the other end to avoid bending of the probe.

- Clean the bottom part of probe after cutting.

- After that, again fit the bush by re-tightening the M2-grub screws.

- Now, we install Capvel-FUEL sensor as shown in Figure 17.

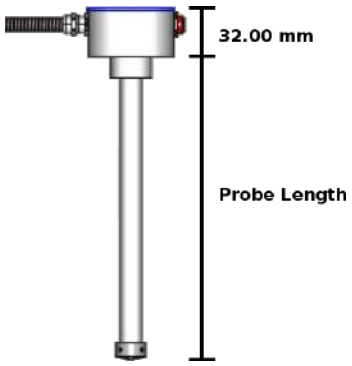


Figure 13: Calculating Probe Length

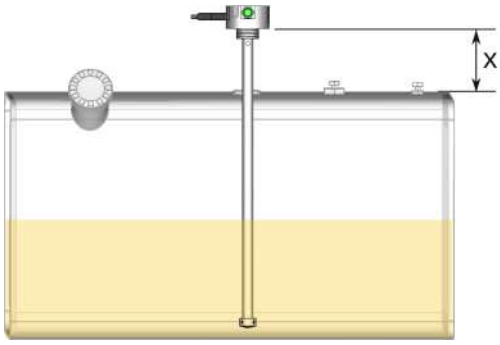


Figure 14: Calculating Extended Length

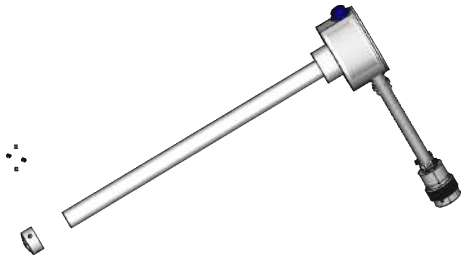


Figure 15: Removing M2 Grub Screw

Figure 16: Cutting of Extended Probe Length

10 Electrical Connections

Figure 18 describes the connection details for connecting Capvel-FUEL with the battery, the Calibrator box and the fuel gauge meter.

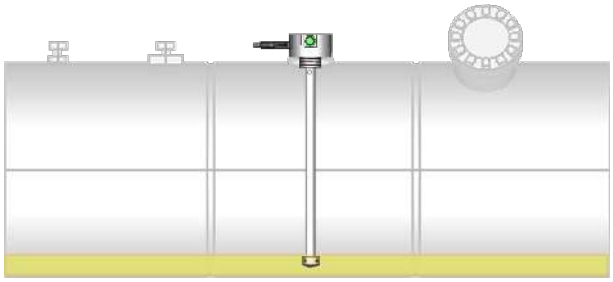


Figure 17: Top Mounting after Installation

- Firstly, check continuity test between +V(Red wire) and Gnd(Black wire) of Capvel-FUEL through multimeter. Refer to Table 4. **If the there is continuity, DO NOT connect the device to Battery or Power Supply. Doing so can cause fire.**
- Before connecting the wires to various terminals, check the voltage levels appearing at those terminals. They must be within the voltage range specified in Table 4.
- Connect the +V(Red wire) of Capvel-FUEL to '+ve' terminal of battery/DC adapter. Connect the Gnd(Black wire) of Capvel-FUEL to '-ve' terminal of battery/DC adapter. Refer to Figure 18.
- Connect yellow wire(D+/A) of Capvel-FUEL sensor to the Receiver Terminal(D+/A/Rx) of the Calibrator Box.
- Connect orange wire(D-/B) of Capvel-FUEL sensor to the Transmitter Terminal(D-/B/Tx) of the Calibrator box.

Electrical connections for the instrument will change with the models. Please refer to Figure 18 and precautions mentioned below before connecting the device.

- **Power Supply Rating**
  Make sure the power supplied to the instrument is within the specified range mentioned in Table 4.
- **Earthing Tank Body**
  Body of the vessel/tank should be connected to Earth to avoid electrical noise from affecting the measurement. For DG sets, standard earthing practices should be followed.
- **Power Supply Fluctuations, Ripples & Noise**
  External noise, power supply ripples or frequent fluctuations could affect output stabilty, output precision and also shorten the life of the instrument.
  In case of electrically noisy environments, it is recommended to use exterenal line suppressors and filters to reduce the risk of damage to the circuit.

Note:
Modbus-Rtu Connections
Capvel-FUEL has 2-wired half-duplex configuration for RS-485/EIA-485.
For connecting Capvel-FUEL on a multi-device RS-485 bus, refer to Figure 25.

Note:
If you encounter noise or fluctuations in your output, connect the Signal-Ground and Supply-Ground to Earth.

Note:
Always connect the Cable-Shield to body Earth.

PIN NO.	WIRE	WIRE COLOR	DESCRIPTION	VOLTAGE LEVEL
1	Gnd	● Black	Power Supply '-ve' Terminal	0.0 V
2	Meter	● Brown	Analog Fuel Gauge Meter Output Terminal	0 - 5.7 V
3	+V	● Red	Power Supply '+ve' Terminal	7 - 30 V
4	Tx/D-	● Orange	RS-485 D+/Serial Transmitter Terminal	0.5 V
5	Rx/D+	● Yellow	D-/Serial Receiver Terminal	4.7 V
6	A/O	● Green	Analog Voltage Output Terminal	Open

Table 4: Wire Description and Allowable Voltage Levels

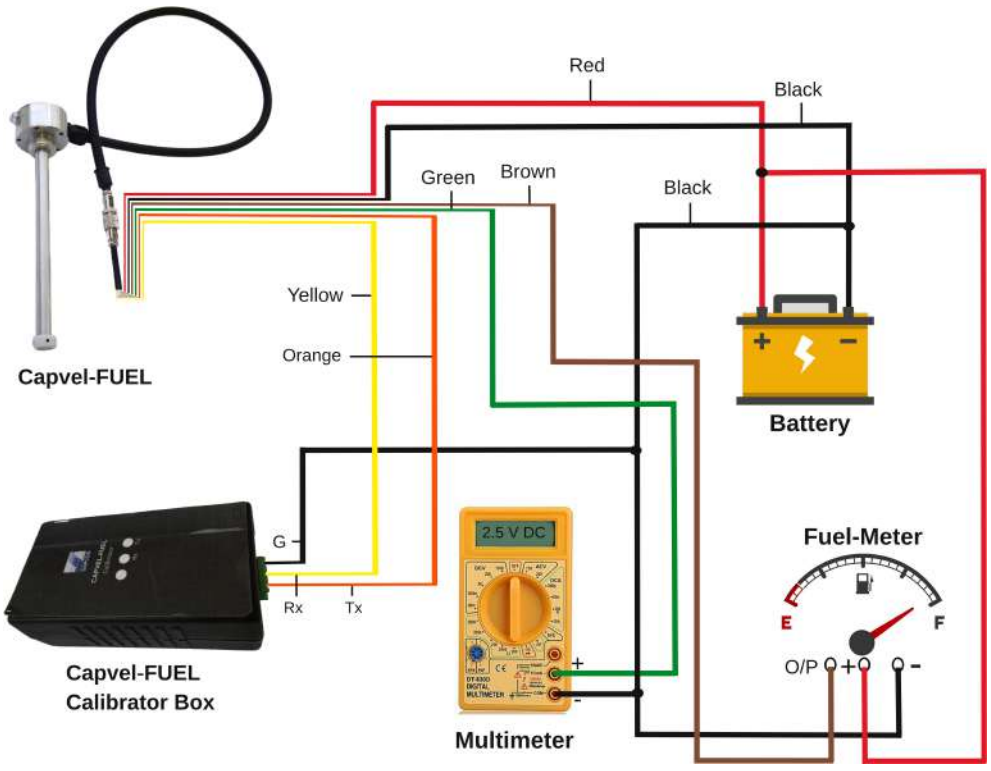


Figure 18: Connection Diagram for Calibration

11 Modes of Calibration

- Quick Calibration (Using Magnetic Key)
- **Recommended:** Comprehensive Calibration with Volume Configuration (Using Desktop Application Software)

11.1 Selecting Mode of Calibration

The calibrator box helps select the mode of operation using a switch key. The switch can be moved left or right.

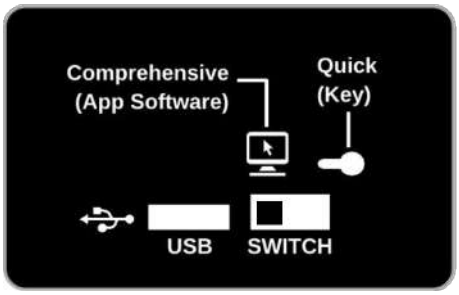


Figure 19: Switch to Select Calibration Mode

'Right' Switch Position
The right position of switch is described using the icon of a mangnetic key on the calibrator box. When the switch is moved to the right, the 'Quick Calibration' mode is selected which is performed using the magnetic key. It allows to only calibrate the 'High Level' and 'Low Level' for the sensor for the tank type in use.

The 'High Level' corresponds to 100% while the 'Low Level' corresponds to 0% fuel level in the tank. This enables $(0.5-4.5V)$ or $(0.2-4.9V)$ output corresponding to calibration as per your selection of range. With 'Quick Calibration', only Percentage fuel output can be fetched on RS-485/Modbus- Rtu.

'Left' Switch Position
The left position of switch is described using the icon of a desktop system on the calibrator box. When the switch is moved to the left, the 'Comprehensive' calibration mode is selected. This mode requires the desktop application software setup provided with the sensor.

This mode allows selecting a tank type, saving tank configuration profiles (length, width, height, diameter) and calibrating 'High Level' and 'Low Level' of the sensor. The desktop application helps to correctly setup volume output and also perform advanced configuration.

12 Quick Calibration

- Please refer to Section Electrical Connections for electrical wiring connections.
- Connect the calibrator with the sensor.
- For using this mode, move the switch on the calibrator box to the right. This will select the 'Quick' mode which is also described using the magnetic key icon on the calibrator box.
- Only for Quick High/Low calibration, please use the magnetic key provided with Capvel-FUEL sensor.

(a) Magnetic Key - Front

(b) Magnetic Key - Back

Figure 20: Magnetic Key

Note:
Always wait for at least 10 seconds after filling fuel to desired 'High' and 'Low' level points before calibrating the sensor.

12.0.1 Quick 'Low' Calibration

- For Low Callibration, empty the fuel to a level such that only 10mm of the probe is dipped in the fuel. (Refer to Figure 21.)
- Now place and hold the Magnetic key at the 'L' point marked on the calibrator box for at least 2 seconds; the sensor's Green LED will blink 3 times.
- Low calibration is confirmed if the Green LED blinks 3 times.
- If low calibration is not successful, please refer to Table 16 to debug the issue.

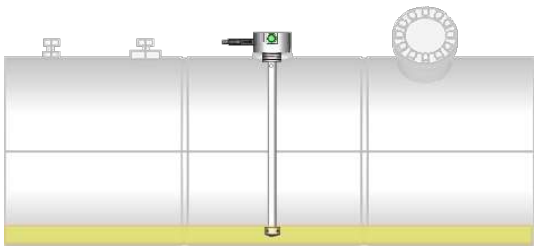


Figure 21: Low Level Calibration

12.0.2 Quick 'High' Calibration

- For High Calibration, fill the tank such that 100% of the probe length is dipped in fuel. (Refer to Figure 22.)
- Now place and hold the Magnetic key at the 'H' point marked on the calibrator box for at least 2 seconds; the RED LED of the sensor will blink 3 times.
- High calibration is confirmed if Red LED blinks 3 times.
- If high calibration fails, please refer to Table 16 to debug the issue.

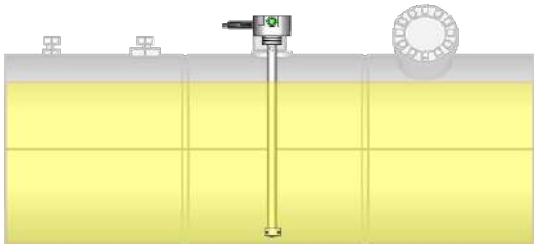


Figure 22: High Level Calibration

12.0.3 Post-Calibration

In 'Quick Calibration' mode, the Calibrator box is powered using its internal battery. So after the calibration is done, please switch off the calibrator box by moving the switch to 'Comprehensive Calibration' mode. This will save the internal battery of the calibrator box for future use.

13 Comprehensive Calibration with Volume Configuration

This mode requires the desktop application software setup along with a USB and a calibrator box. This mode allows selecting tank type, saving tank configuration profiles (length, width, height, diameter) and calibrating 'High Level' and 'Low Level' of the sensor.

Please contact Customer Support to receive the latest software setup.

- Please refer to Section Electrical Connections for electrical wiring connections.
- Check System Requirements as mentioned in Section Minimum System Requirements
- Connect the calibrator with the sensor.
- For using this mode, move the switch on the calibrator box to the left. This will select the 'Comprehensive / Application Software' mode which is also described using the desktop icon on the calibrator box.
- Use a micro-USB to USB cable commonly used for charging smartphones / tablets. One end of the USB will be connected with the calibrator box in the 'USB' slot. The other end of the USB will be connected to the desktop which will run the software setup.
- Download and install Virtual Comport Driver from FTDI. Select the correct and latest driver as per your operating system and processor architecture (32-bit or 64-bit). http://www.ftdichip.com/Drivers/VCP.htm
- Refer to Virtual installation COM Port guides at http://www.ftdichip.com/Support/Documents/InstallGuides.htm.
- Please also refer to the installation guide at: Installation_Guide_for_Windows7.pdf
- Specify the driver location for the driver to work.
- Please restart the system.
- Please download and install the application software setup provided with Capvel-FUEL sensor.

13.0.1 Minimum System Requirements

- **Operating System:** Microsoft XP SP3, Windows 7, Windows 10, Ubuntu (Setup available on request)
- **RAM:** 1GB
- 1 USB Port

13.0.2 Desktop App Accessibility

- **Welcome Splashscreen**

  Welcome to Capvel-FUEL-Connect App. On launching the application, the following greeting will appear.

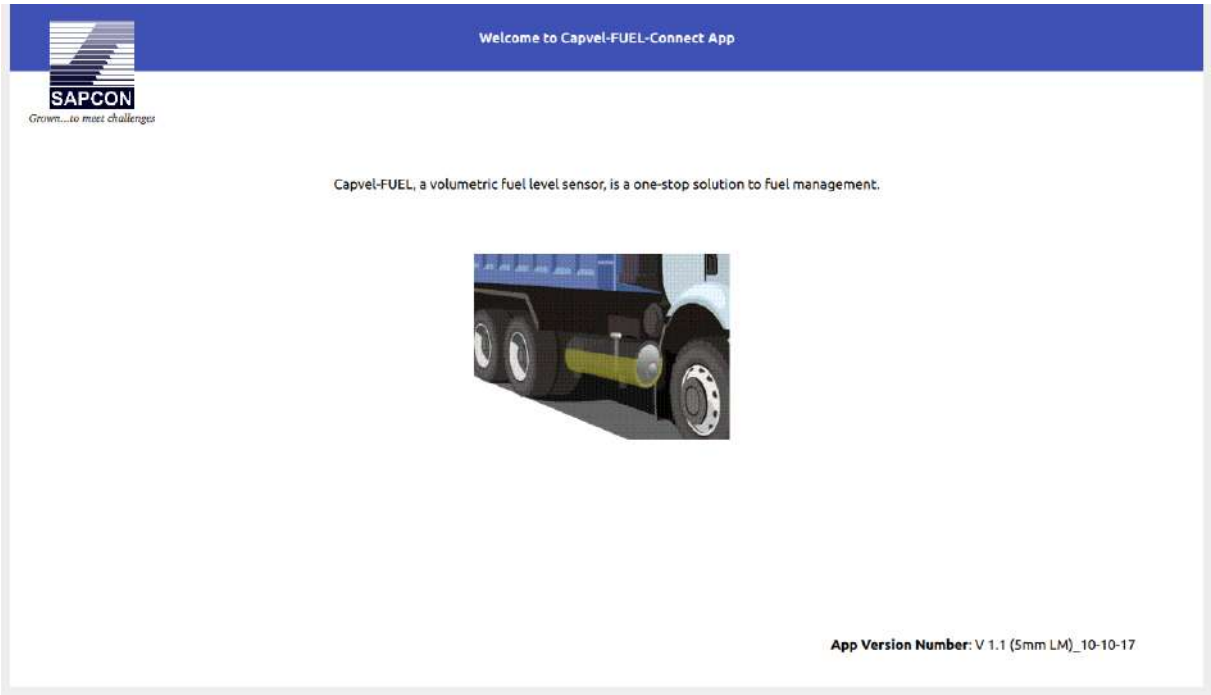


Figure 23: Capvel-FUEL-Connect App Screenshot

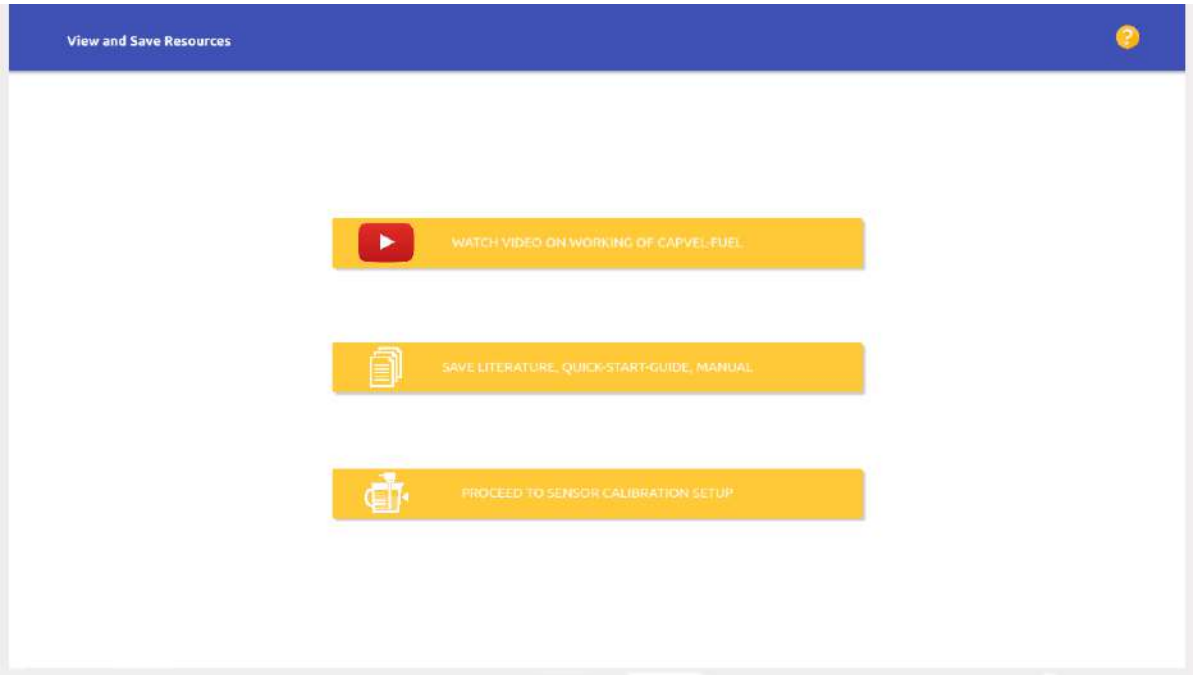
- **'View and Save Resources' Window**

  Before proceeding, watching an animated video on the special features of Capvel-FUEL , and documentation on the installation and calibration of the sensor may be helpful. Please select one of the options.

  Watch Video on Working of Capvel-FUEL : Select this option if you wish to watch an animated video on Capvel-FUEL . It describes how Capvel-FUEL is friendly to both drivers and operators, and how it is better than conventional fuel level sensors. This option will open a video link in your default web browser. This app will remain unaffected and you may return to the app after watching the video.

  Save Literature, Quick-Start-Guide, Manual: This option will take you to the download link of documentation in your default web browser. The documentation includes an introductory literature with features of Capvel-FUEL , a Quick-Start-Guide that comes handy for installation, and an instruction manual that details all the steps for correct wiring, installation and calibration of the sensor. This app will remain unaffected and you may return to the app downloading the documents.

  Proceed to Sensor Calibration Setup: This option will lead you to the configuration and calibration setup of the tank and sensor. It is recommended that you select this option after watching the video and reading the documentation. However, you may directly opt for this if you are already acquainted with using Capvel-FUEL.



- **Connection Window**

  Please select if you wish to connect with the sensor using Bluetooth or Serial Port connection. The selection will also depend on the type of connection supported by your calibrator box. The current range of calibrators only support Serial Port for communicating with the sensor.

  For using Bluetooth: Please ensure that your desktop's Bluetooth is 'ON' and 'Visible'. In this app, you will be able to detect and select only Sapcon sensors.

  For using Serial Port: Please ensure that your device port is 'Open' and allows 'Read', 'Write' operations.

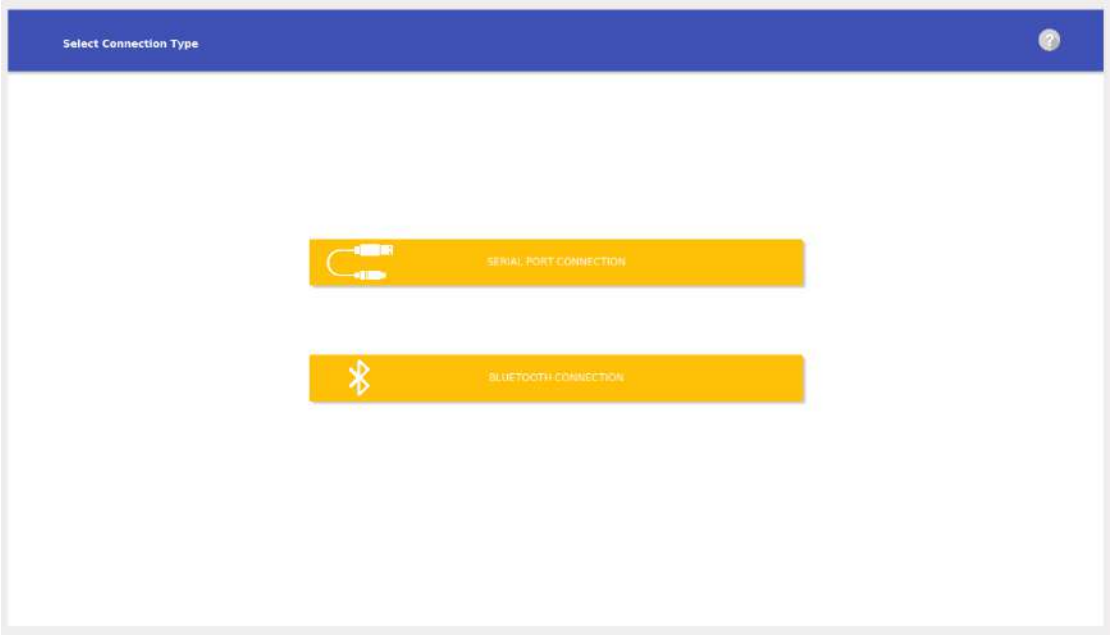
  If Serial Port is not visible:

  1. On Microsoft Windows:

  - Check if VCP driver is installed as instructed in Section Comprehensive Calibration with Volume Configuration.
  - Restart your system after installation and check again.

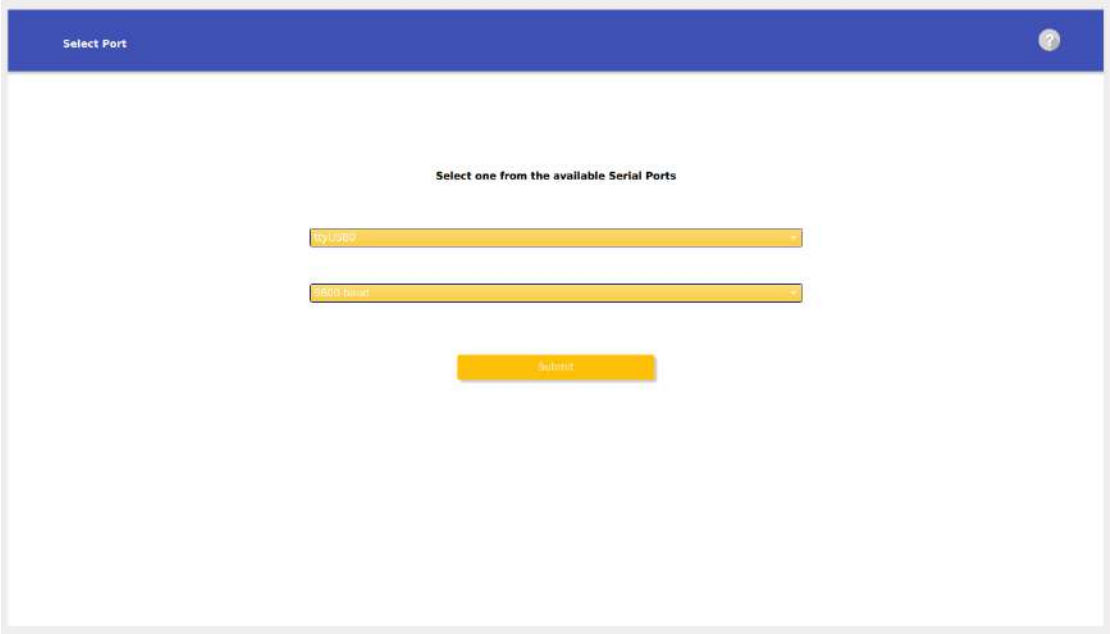
  2. For Ubuntu or other GNU/Linux operating systems:

  - Make sure the current user is part of the 'dialout' group.
  - Use command: *sudo adduser <username> dialout* .
  - Restart the system and check again. The serial port will appear as 'ttyUSBx'.



- **'Select SAPCON-BT Device / Serial Port:' Window**

  Please select the desired SAPCON-BT device or Serial Port for operation. The default baud rate for **Serial Port Communication** is 9600 baud.



- **Configuration Window**

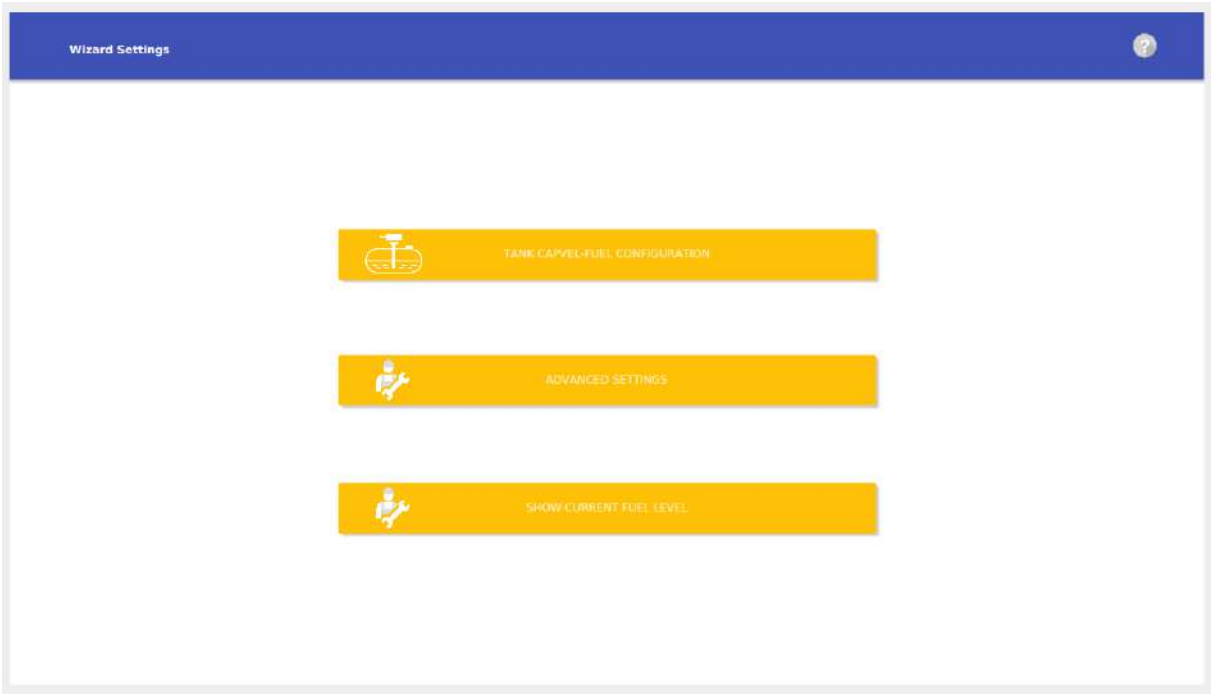
Three options are available to configure your tank and sensor. Please select an option based on your requirement.

Tank Capvel Configuration: Select this option if you are configuring your Capvel sensor for the first time. This will let you configure your tank (type, dimensions, etc.) as well.

Advanced Settings: This option is for Sapcon Engineers. Please do not change settings using this option unless advised to do so.

Show Current Fuel Level: Select this option to read the current level of fuel in different formats (%, Volts, mm, etc.). It will also display a summary of all other tank and sensor specifications.

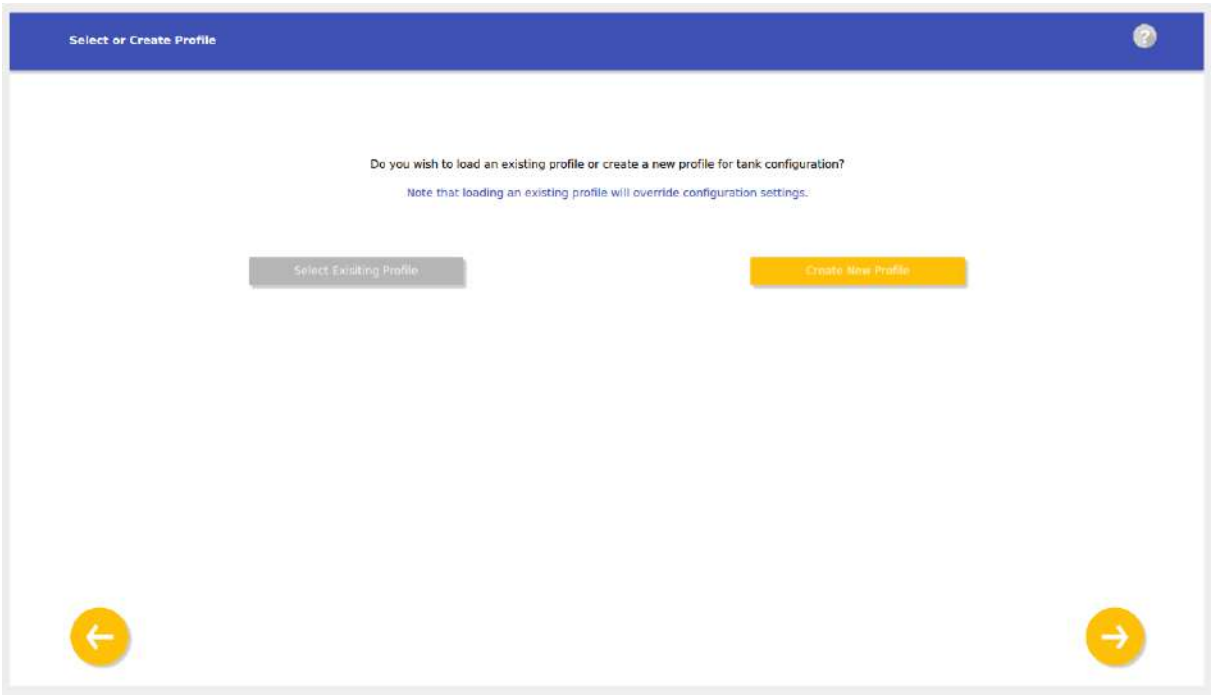
Note:
'Advanced Settings' option is meant for Sapcon Engineers to debug the sensor in case of any issue. End users are discouraged to use this option.



- **'Profile Select/Create' Window**

  Select Existing Profile: Use this option if you have already stored a configuration profile. A configuration profile is useful in configuring tanks which have the same dimensions, and if they all use Capvel-FUEL with the same specifications (probe length, 'Turbulence' value, etc.). All the settings can be loaded using just one button click.

  Create New Profile: Use this option for if you are configuring your tank and Capvel-FUEL sensor for the first time. You can later choose to save this profile in upcoming steps. This profile can configure the remaining tanks and sensors without having to enter all the information all over again.



- **Tank Selection Window**

  Select the tank type (shape) you wish to configure by clicking on the tank image. Choose from a variety of five tank types:

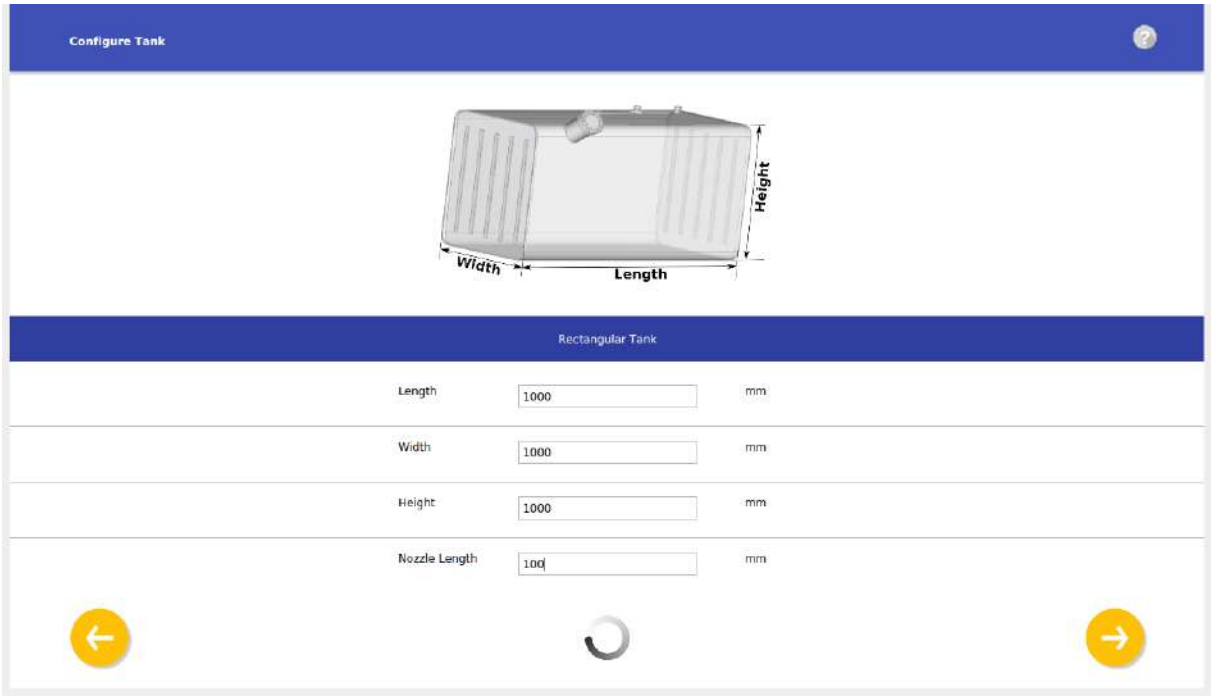
  1. Rectangular Tank
  2. Horizontal Cylinder Tank
  3. Vertical Cylinder Tank
  4. Horizontal Oval Tank
  5. Vertical Oval Tank

  Note:
  Please note that the accuracy of fuel level detection depends on the correct selection of the tank type.

- **Tank Configuration Window**

  At this stage, the internal dimensions (in millimeters) of the selected tank type are to be set as per the dimension labels shown in the figure in the window.
  To measure the internal tank dimensions, please subtract the thickness of the metal sheet from external tank dimensions.

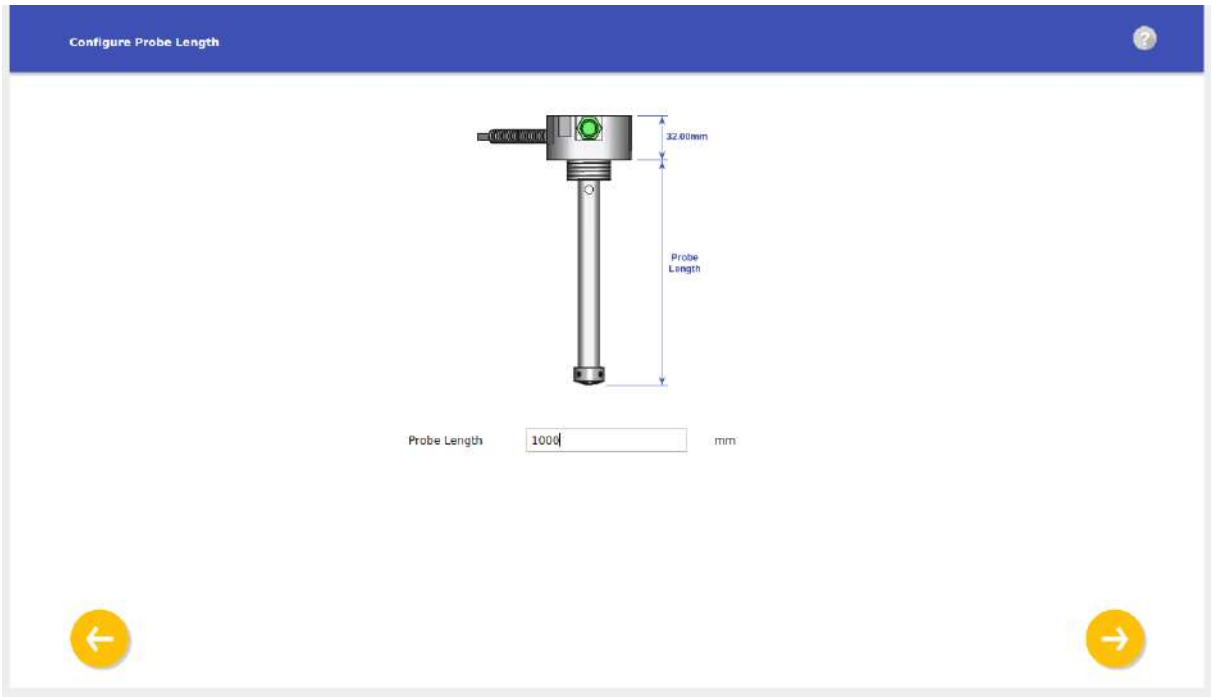
> **Note:**
> Please note that the accuracy of fuel level detection depends on the correctness of the internal tank dimensions.



- **Probe Length Configuration Window**

  This window is used to enter the probe length of your Capvel-FUEL sensor. To measure the probe length, begin measuring from the threads up to the end of the probe as shown in the figure.

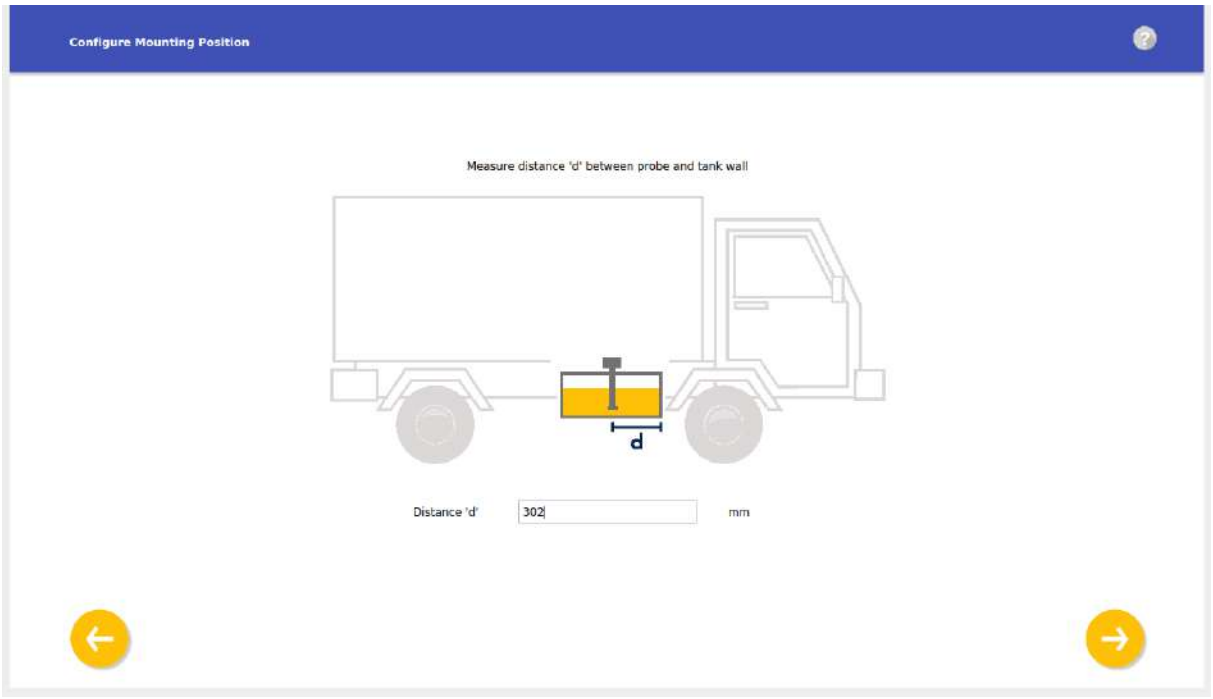
> **Note:**
> Please do not include the housing in your probe length measurement.



- **'Sensor Mounting Position' Configuration Window**

  Please enter the mounting distance between the Capvel-FUEL sensor and the vertical side wall of the fuel tank.

  When Capvel-FUEL sensor is installed in a vehicle's fuel tank, consider that vertical side wall of the tank which is nearest to the driver, as shown in the figure.



- **Low Level Configuration Window**

Please follow the following steps to measure the 'Low Level'.

> **Note:**
> The accuracy of fuel level detection depends on this measurement.

a) Fill the tank such that at least 10mm of the sensor probe is dipped in the fuel. The figure shows the 'Ideal Low Level' as per the details entered by you in the previous steps.

b) Let this level stabilize for 20 seconds and do not disturb the tank until calibration is done.

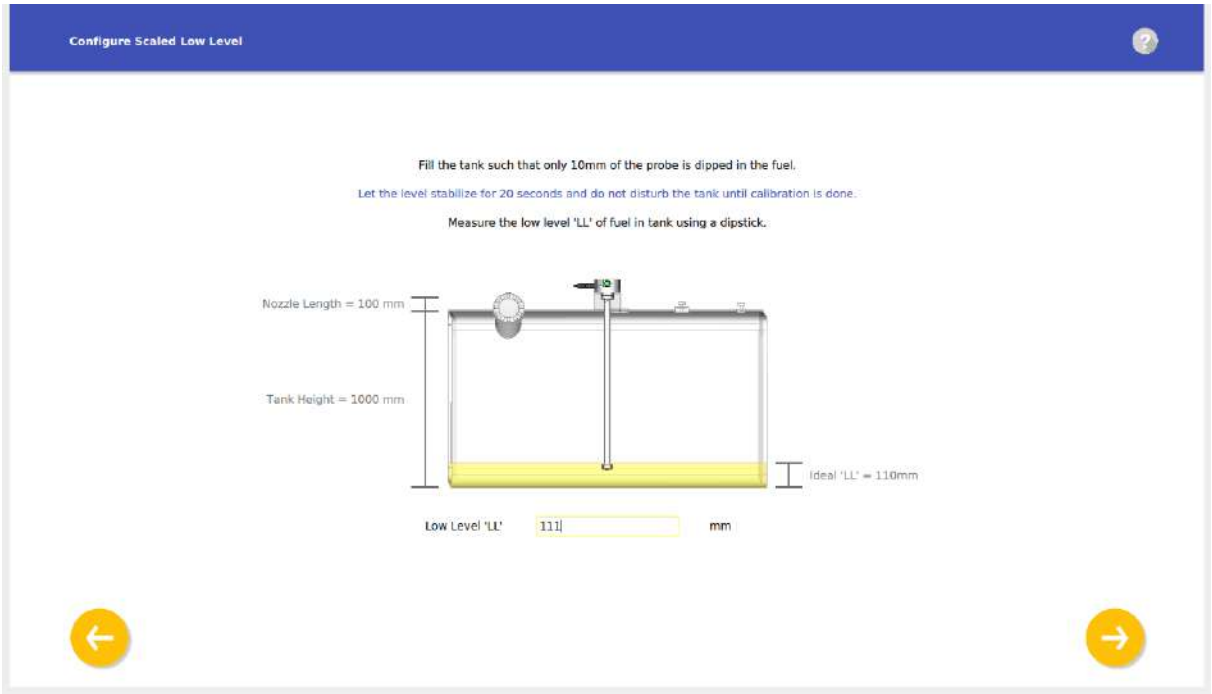
c) Now take a dip stick and dip it into the tank filled with diesel.

d) Take the dip stick out from the tank and measure the wet part of the dip stick (in mm), say **'LL'**.

e) The measured length, 'LL', will be the 'Low Level' for this configuration.

f) Enter this measured 'LL' value in the text box and click on the 'Submit' Button.

g) Upon successful low level calibration, the app will proceed to 'High Level Configuration Window'.



- **High Level Configuration Window**

Please follow the following steps to measure the 'High Level'.

> **Note:**
> The accuracy of fuel level detection depends on this measurement.

a) The figure shows the 'Ideal High Level' and 'Minimum High Level' as per the details entered by you in the previous steps. Fill the tank such that the level of fuel in the tank is more than the 'Minimum High Level'. Ideally, fill the tank such that the level is equal to 'Ideal High Level' for accurate fuel level detection.

b) Let this level stabilize for 20 seconds and do not disturb the tank until calibration is done.

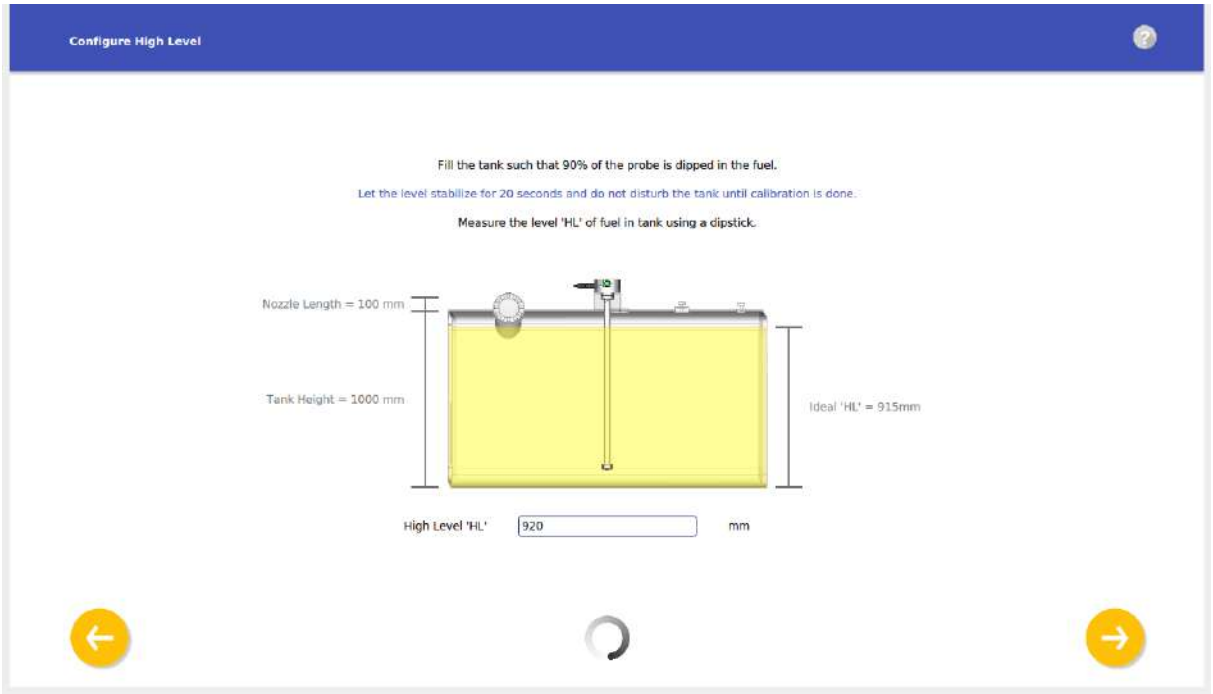
c) Now take a dip stick and dip it into the tank filled with diesel.

d) Take the dip stick out from the tank and measure the wet part of the dip stick (in mm), say **'HL'**.

e) The measured length, 'HL', will be the 'High Level' for this configuration.

f) Enter this measured 'HL' value in the text box and click on the 'Submit' Button.

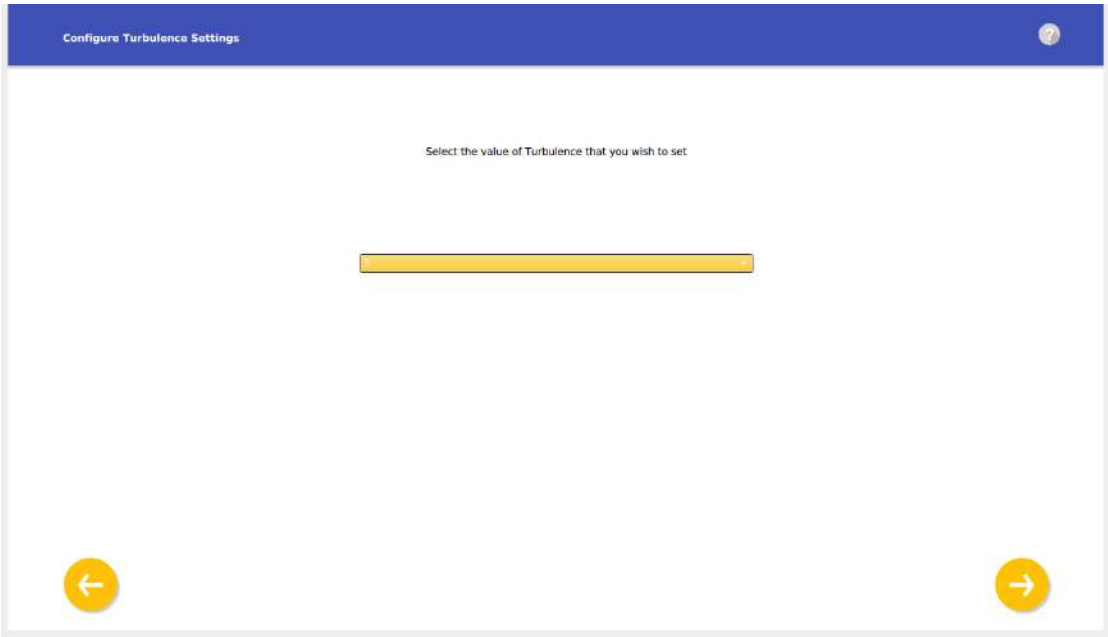
g) Upon successful low level calibration, the app will proceed to 'Turbulence Configuration Window'.



- **Turbulence Configuration Window**

  Using this window, please enter the turbulence value that you would like to set. The value depends on the application of use (road conditions, presence of external vibrations or jerks.)

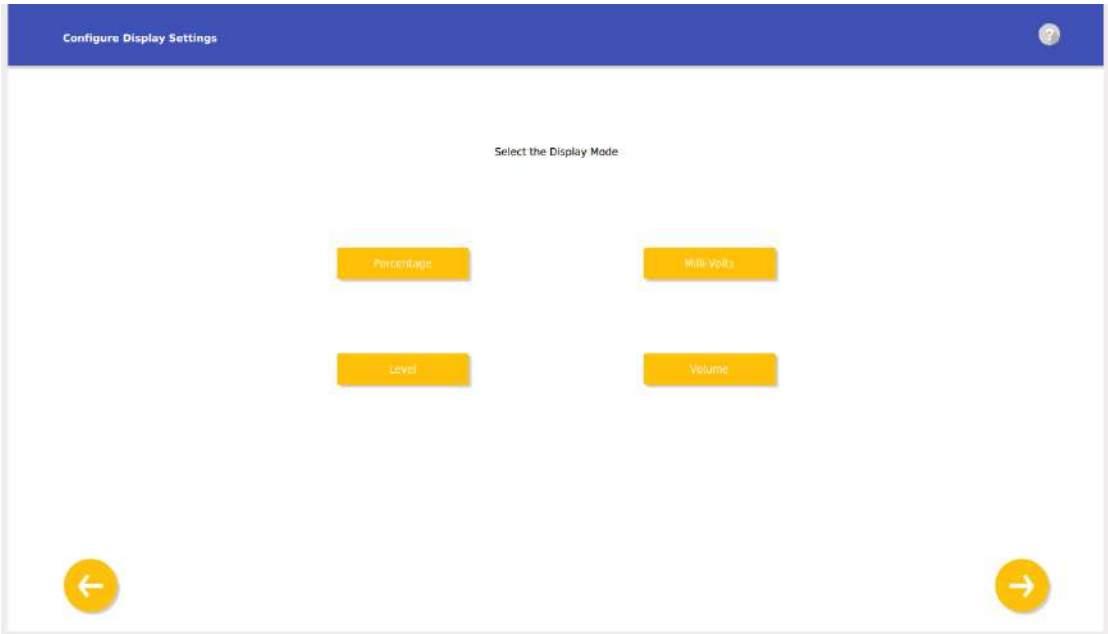
  The value of 'Turbulence' is directly proportional to the precision of fuel level detection.



- **Display Settings Window**

  Select between four options for checking the fuel level output:

  1. Level in Percentage (%)
  2. Level in Milli-Volts (mV)
  3. Level in Milli-Meters (mm)
  4. Volume in Litres (L)



- **'Show Fuel Level' Window**

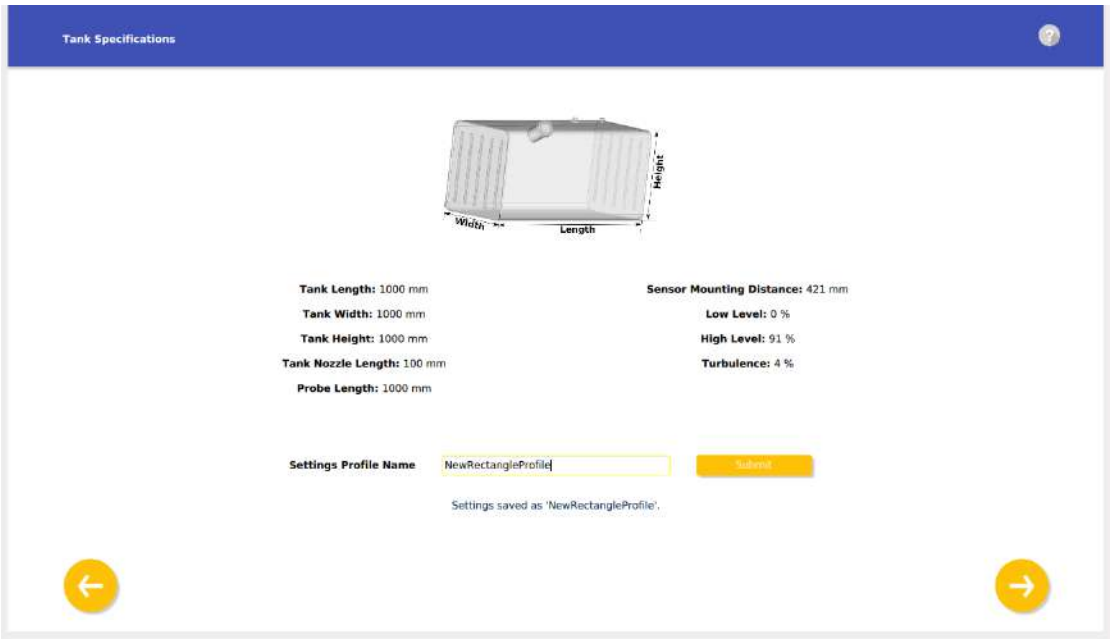
  This window shows the current level of fuel in a format specified by you in the last window. To change the output format, click the 'Back Arrow' button and select the desired output format.

- **Tank Specifications Window**

  This window shows a summary of all details entered by you for this configuration. Furthermore, at this point, you can choose to save these settings in a configuration profile.

  A configuration profile stores all these details in the system. It is particularly useful if you wish to configure more tanks which have the same dimensions, and if they all use Capvel-FUEL with the same specifications (probe length, 'Turbulence' value, etc.).

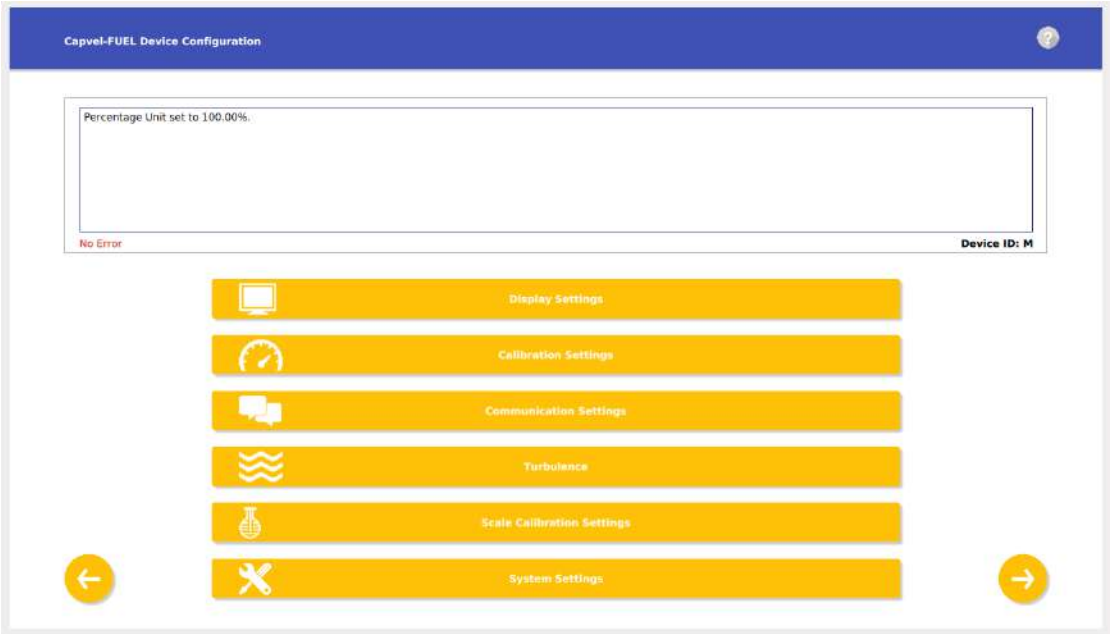
  All the settings can then be loaded using just one button click without having to enter all the information all over again.



- **Advanced Settings Window (Developer API/Commands)**

  This section describes the various commands that can be used to configure the sensor. The 'Advanced Settings' option in the Capvel-FUEL-Connect app offers an interface to communicate with the sensor using ASCII text commands. The tables in the following subsections describe such commands. This feature allows changing device configuration from a remote location possible even without access to a laptop at the site location.

Note:
'Advanced Settings' option is mainly meant for Sapcon Engineers to debug the sensor in case of any issue. End users are discouraged to use this option unless otherwise advised by any Sapcon engineer.



Note:
In the following tables, the value 'xxxx' in the commands and the responses defines the CRC code. If the generated value of 'xxxx' in the command sent and the response received matches, only then further communication is allowed.

Note:
A unique CRC code is generated each time any command is fired and its response is received. The CRC codes depend on the values being sent in the command and the response.

1. **Display Settings**
   The following table describes the commands that get fired upon clicking specific buttons under the Display Settings window.

BUTTON NAME	COMMAND	RESPONSE	REMARKS	CODE
Percentage Display	<A,PER?,xxxx>	<A,PER=09270,N,xxxx,OK>	In response string, '09270' indicates a level of 92.70% and 'N' defines the error code. Please refer to Error Indication Table 16 for a list of errors and their indications.	N,O,S,C
Voltage Output Display	<A,MVOL?,xxx>	<A,mVOL=04500,N,OK>	In response string, '04500' indicates output of 4.5V and 'N' defines the error code. Please refer to Error Indication Table 16 for a list of errors and their indications.	N,O,S,C
Level in Volume	<A,VOL?,xxx>	<A,VOL=09048,N,OK>	In response string, '09048' indicates a level of 90.48 litres and 'N' defines the error code. Please refer to Error Indication Table 16 for a list of errors and their indications.	N,O,S,C
Level in Millimeters	<A,LVL?,xxx>	<A,LVL=28541,N,OK>	In response string, '28541' indicates a level of 28541mm and 'N' defines the error code. Please refer to Error Indication Table 16 for a list of errors and their indications.	N,O,S,C

Table 5: Display Settings Commands

2. **Calibration Settings**

BUTTON NAME	COMMAND	RESPONSE	REMARKS
High Calibration	<A,CAHH,10779>	<A,CAHH=00029986,xxxxx,OK>	'OK' in response string indicates that High Calibration is successfully done and '00029986' denotes high level calibration counts.
Low Calibration	<A,CALL,2911>	<A,CALL=00026345,xxxxx,OK>	'OK' in response string indicates that Low Calibration is successfully done and '00026345' denotes low level calibration counts.

Table 6: Calibration Settings Commands

3. **Communication Settings**

BUTTON NAME	COMMAND	RESPONSE	REMARKS
Present ID	<*,ID?,xxx>	<A,ID=A,xxxx,OK>	Used to find the ID of the instrument
Set ID	<A,ID=A,xxxx>	<A,ID=A,xxxx,OK>	Value of ID must range between 0-9 or A-Z
Present MODBUS ID	<*,MID?,xxxxx>	<A,mID=1,xxx,OK>	Used to find the MODBUS ID of the instrument
Set MODBUS ID	<A,MID=00001,xxx>	<A,mID=1,xxxx,OK>	Value of MODBUS ID must range between 0-9
Flow Control	<A,SCMD,xxx> or <A,AUTO,xxx>	<A,SCMD,xxxx,OK>	
Time Interval	<A,CDUR=00001,x>	<A,CDUR,xxxxx,OK>	Value must range between 1-99

Table 7: Communication Settings Commands

4. **Turbulence Settings**

BUTTON NAME	COMMAND	RESPONSE	REMARKS
Select a Value of Turbulence	<A,TRUB=00001,xxx>	<A,TRUB=00001,xxxx,OK>	Value of Turbulence must range between 0-9

Table 8: Turbulence Settings Commands

5. **Scale Calibration Settings**

BUTTON NAME	COMMAND	RESPONSE	REMARKS
Scale High Calibration	<A,SCAH=00080,x>	<A,SCAH=00080,00023562,x,OK>	Value represents percentage value and must range between 0-100
Scale Low Calibration	<A,SCAL=00020,x>	<A,SCAL=00020,00010202,x,OK>	Value represents percentage value and must range between 0-100
Direct High Calibration	<A,DCLH=30986,x>	<A,CAHH=00030986,xxxx,OK>	Value represents percentage value and must range between 0-100
Direct Low Calibration	<A,DCLL=26600,x>	<A,CALL=00026600,xxxx,OK>	Value represents percentage value and must range between 0-100

Table 9: Scale Calibration Settings Commands

6. **Tank Configuration Settings**

BUTTON NAME	COMMAND	RESPONSE	REMARKS
Tank Type	<A,TYP=00002,xxx>	<A,TYP=00002,xxxxx,OK>	Value between 1-5
Tank Length	<A,TL=00200,xxxx>	<A,TL=00200,xxxxx,OK>	Value is in mm
Tank Width	<A,TW=00200,xxx>	<A,TW=00200,xxxxx,OK>	Value is in mm
Tank Height	<A,TH=00200,xxxx>	<A,TH=00200,xxxxx,OK>	Value is in mm
Tank Diameter	<A,TD=00300,xxx>	<A,TD=00300,xxxx,OK>	Value is in mm
Tank Side-length	<A,TS=00200,xxx>	<A,TS=00200,xxxxx,OK>	Value is in mm
Tank Nozzle Length	<A,TN=00200,xxx>	<A,TN=00200,xxxxx,OK>	Value is in mm
Sensor Mounting Distance	<A,MD=00200,xxx>	<A,MD=00200,xxxxx,OK>	Value is in mm

Table 10: Tank Configuration Settings Commands

7. **System Settings**

BUTTON NAME	COMMAND	RESPONSE	REMARKS
Probe Length	<A,PRLT=00200,x>	<A,PRLT=00200,xxxx,OK>	Value is in mm and must range between 100-01500mm
Accuracy	<A,PRAC=00002,x>	<A,PRAC=00002,xxxxx,OK>	Value must range between 1-10
Output Menu	<A,OUTPUT?,45890>	<A,Probe count,,,,,,,,,,,,>	Please refer to Output Command Parameters and Description Table 12
Default Settings	<A,DEF>	<A,DEF,OK>	Resets all values of the instrument to the default setting values
Terminal			Allows to communicate with the sensor by entering any kind of command as per the requirement

Table 11: System Settings Commands

COMMAND PARAMETER	EXAMPLE VALUE	DESCRIPTION
ID	A	ID of the instrument
Percentage	5002	Represents 50.02%
Voltage	4500	Represents 4.50 V
Volume	282743123	Represents 28.2743123 Litres
Level (in mm)	284	Represents 284mm
Low Cal Count	26435	Low Calibration Counts
High Cal Count	30523	High Calibration Counts
Scale Low	10	Represents 10%
Scale High	90	Represents 90%
EEPROM Ref1 Count	31200	
EEPROM Ref2 Count	28500	
DAC High Data	940	For maximum voltage (4.5V)
DAC Low Data	14000	For minimum voltage (0.5v)
Fault	8	Refer to Table 16
Probe Length	400	Represents 400mm
Accuracy	1	Represents +/- 1mm
Internal Temperature	382	Represents 38.2°C
Turbulence	10	
Tank Length	1000	Represents value in mm
Tank Width	1000	Represents value in mm
Tank Height	1000	Represents value in mm
Tank Diameter	1000	Represents value in mm
Tank Side-length	1000	Represents value in mm
Tank Nozzle Length	25	Represents value in mm
Sensor Mounting Distance	10	Represents value in mm
Tank Type	1	Represents the type of tank
Current Ref1 Count	30900	
Current Ref2 Count	28600	
Current Sense Count	29500	
Filter Count		
Final Count		
Tank Capacity	10	Represents value in litres
Version	V1.2	Represents the version of the app being used

Table 12: Output Command Parameters and Description

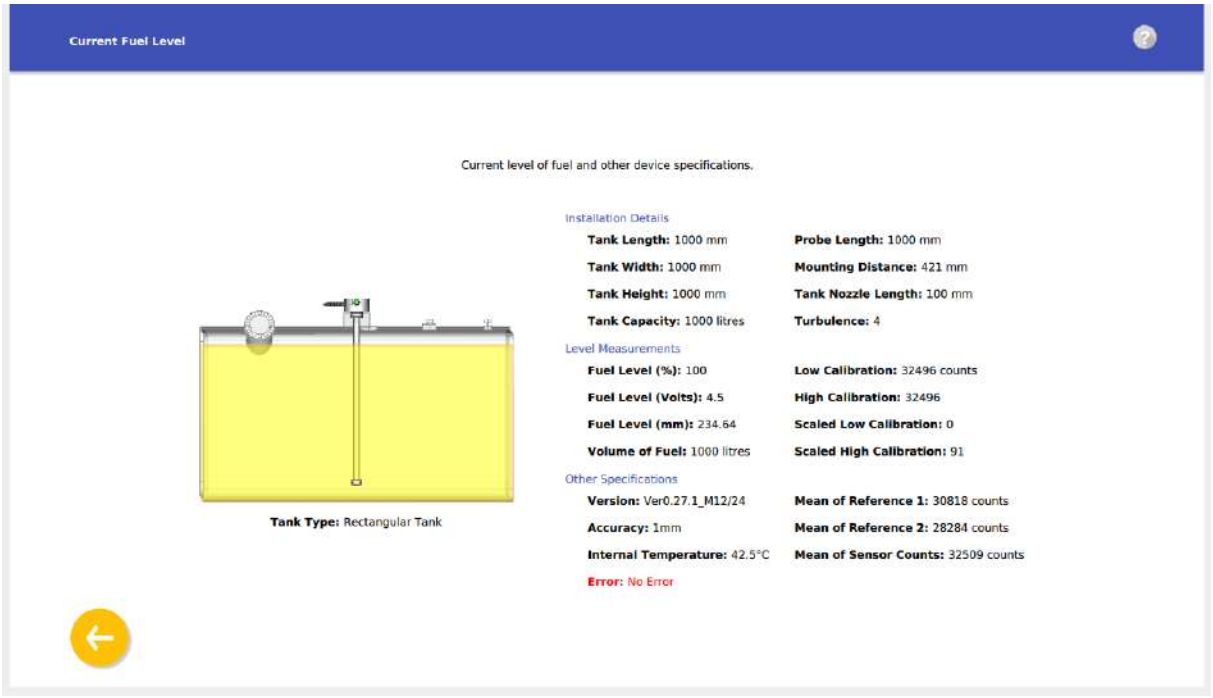
- **Real-time Current Fuel Level Window**

  This window shows the current level of fuel in real-time in the tank figure. The level of fuel is updated every few seconds depending on the 'Time-Interval' value entered.

  You can change the updating frequency using the 'Advanced Settings' option.

  The real-time value of the current fuel level is shown in all output formats (%, mV, mm and Litres).

  This window also shows a summary of all details (tank dimensions, 'Low Level', 'High Level', etc.) entered by you for this configuration.



14 MODBUS-Rtu Output

MODBUS©Protocol is a messaging structure, widely used to establish master-slave communication between intelligent devices. A MODBUS message sent from a master to a slave contains the address of the slave, the 'command' (e.g. 'read register' or 'write register'), the data, and a check sum (LRC or CRC). Since Modbus protocol is just a messaging structure, it is independent of the underlying physical layer, for RS-485 has been used as a physical layer. MOSBUS-Rtu serves as the primary output for Capvel-FUEL .

Before going live, test and verfiy the MODBUS-Rtu output by following the steps mentioned below.

1. Please use a standard MODBUS-Rtu sofware of your choice or chose from the following:
   - Modbus Poll(tested)
   - QModbus Master
   - There are several libraries such as libmodbus, Qt, etc. with which you can build a app of your own.
2. Electrical Connections for Capvel-FUEL are as per Section Electrical Connections.
3. RS-485 Communication Settings: The default settings if the device are mentioned below, these need to be fed to the MODBUS-Rtu software:
   - Baudrate: 9600, Data Bits: 8, Parity: None, Stop Bits: 1.
   - Baudrate is configurable, please refer to the 'Developer API' section for more.
4. Identify output and internal measurement parameters of interest from Table 13.
5. Note that some parameters such a *volume in mili-liters* correspond to two 16-bit register locations, representing LSB and MSB. Data from these registers needs to be combined before converting to decimal notation.
6. It is recommended that all registers given in Figure 24 be queried. Ideally this should be done using a single query, as shown in Figure 24.

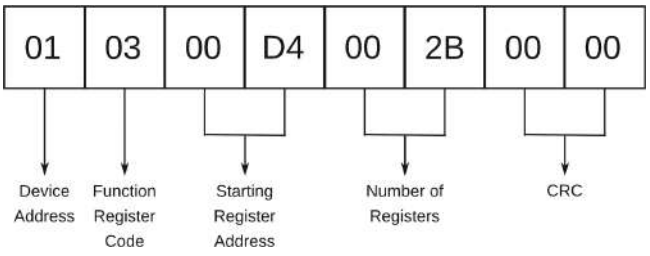


Figure 24: Example Modbus-Rtu Query Format

Note:
Querying all registers help Sapcon's support team to locate a configuration issue immediately from a remote location.

7. A detailed explanation of MODBUS-Rtu is out of the scope of the product manual. Please refer to protocol standards for more details.
8. Impedance Matching: If all the above has been correctly configured and problem persists, it is likely that impedance matching will have to be performed.
9. Testing Sofware: Before going live with a modem as the Modbus-Rtu master, use debugging software such as Modbus Poll on a desktop/laptop to verify communication with Capvel-FUEL . Capvel-FUEL Calibrator can be used as a converter from USB to RS-485.

14.1 Modbus-Rtu Topology

The following figure represents a general MODBUS-Rtu topology for 2-wire connection.

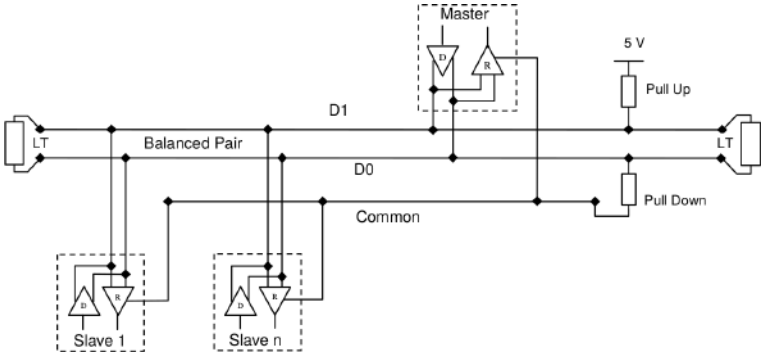


Figure 25: General 2-wire MODBUS-Rtu Topology

14.2 Modbus-Rtu Register Table

Please refer to Table 13 for a detailed description of the modbus register.

Note:
For 16-bit registers such as Volume(214-215), MSB (Most Significant Byte) and LSB (Least Significate Byte) have to be concatenated before representing their data in decimal format.

PARAMETER	ADDRESS in DECIMAL	DATA TYPE	MODE	NOTE
Level (in percent)	212 / 203 / 002	Int	Read only	-
Level (in volt)	213	Int	Read only	-
Volume (in millilitre)	214 / 215 or 000 (in litre 16 bit)	ulong	Read only	MSB_add / LSB_add
Level (in mm)	216 / 204 / 001	Int	Read only	-
Min Calib count	217 / 218	ulong	Read only	MSB_add / LSB_add
Max Calib count	219 / 220	ulong	Read only	MSB_add / LSB_add
Scale Low calib	221	Int	Read only	-
Scale High calib	222	Int	Read only	-
Ref1 Calib count	223 / 224	ulong	Read only	MSB_add / LSB_add
Ref2 Calib count	225 / 226	ulong	Read only	MSB_add / LSB_add
High DAC value	227	Int	Read only	-
Low DAC value	228	Int	Read only	-
Fault	229	Int	Read only	-
Probe Length	230	Int	Read only	-
Accuracy	231	Int	Read only	-
Internal Temp	232	Int	Read only	-
Turbulence	233	Int	Read only	-
Nozzle length	234	Int	Read only	-
Tank Length	235	Int	Read only	-
Tank Diameter	236	Int	Read only	-
Tank Height	237	Int	Read only	-
Tank Width	238	Int	Read only	-
Tank Side	239	Int	Read only	-
Tank Type	240	Int	Read only	-
Ref1 Mean count	241 / 242	ulong	Read only	MSB_add / LSB_add
Ref2 Mean count	243 / 244	ulong	Read only	MSB_add / LSB_add
Sense Mean Count	245 / 246	ulong	Read only	MSB_add / LSB_add
Filter Count	247 / 248	ulong	Read only	MSB_add / LSB_add
Current Per count	249 / 250	ulong	Read only	MSB_add / LSB_add
Tank Mount distance	251	Int	Read only	-
Tank Capacity	252 / 253	ulong	Read only	MSB_add / LSB_add
Firmware Version	254	Int	Read only	-

Table 13: Modbus Register

14.3 Troubleshooting Process

If Capvel-FUEL is not responding to MODBUS queries as expected, the following troubleshooting steps should be followed. Identify and narrow down on specific issue(s) out of the list with the solutions mentioned.

Identify your problem

1. Intermittent Response Time Out Error or Intermittently not responding to a query.
    - Try increasing the response time out of the Modbus-Rtu master to 5000ms.
    - There could be an impedance mismatch between the gateway, bus and Capvel-FUEL .

2. Capvel-FUEL does not respond to a valid query made from a specific Modbus-Rtu Master/Gateway, but responds to other Masters -
    - The Modbu-RTU Master/Gateway could be malfunctioning. Replace the device if possible.
    - There could be an impedance mismatch between the gateway, bus and Capvel-FUEL. Try matching the impedance of the bus by placing terminations resistances of 120 ohms between D+ and D-. Also refer to Modbus-Rtu specifications for more details on adding termination resistances.

3. Capvel-FUEL does not respond to a valid query made from any Master/Gateway.
    - Connect device to its desktop application on the laptop via Sapcon's Calibrator. Check if the application successfully connects to the fuel sensor with different Baudrates. Restore to factory settings and check communication again. Verify details on default communication settings.
    - Please refer to Table 16 and fix the error as per the LED indication being observed. Then, try communicating with the device again.

4. A slave device is not responding when connected on the same bus with a specific slave or group of slaves.
    - Check if each slave on the bus has a unique Modbus-ID. A duplicate slave IDs can cause communication errors.
    - A particular slave could be causing the standalone voltage level on the bus to change. Check voltage standalone voltage level on the bus.

5. Capvel-FUEL does not respond with longer RS-485 cables or an echo of Modbus query is observed instead of a response.
    - This is likely due to impedance mismatch, try matching bus impedance.
    - Bus topology guidelines of the Modbus-Rtu specification should be followed.
    - If problem persists, RS-485 repeaters might have to be used for longer lengths (>250m).

6. CRC Error and Other Fixes
    - Check if there is a change in voltage levels on the bus between "D+ and Common" and "D- and Common".
    - Some slaves could use a very low pull up/pull down resistance on D+, D-. Check the standalone voltage levels of each slave, try to bring D+ to 2.5V - 2.8V, by using external Pull-Up or a external voltage divider between D+ and Common.

15 Compatability with Communication Gateways

Capvel-FUEL can be connnected to communication in two possible ways:

- with Modbus-Rtu as a slave device **(**Recommended)
- with Analog Voltage Output **(**Max. current load of $10\mu A$)

For details on connecting and configuring a Communication Gateway, please refer to the gateway's installation manual provided by the manufacturer.

There are tried and tested communication gateways based on Modbus-Rtu which have been configured as per Modbus Register Table 13. Please contact our sales team at sales@sapcon.in for a list of such devices.

16 Advanced Configuration

16.1 Developer API/Commands

Most configuration paraments of Capvel-FUEL can be set by using ASCII text commands as mentioned in Table 14. These commands can be used via the Capvel-FUEL -Connect App or could be used by Firmware Developers of GPRS gateway devices. The 'Advanced Settings' option in the Capvel-FUEL-Connect app offers a terminal from where these commands can be sent to the fuel sensor. This makes it possible for changing device configuration from a remote location possible even without access to a laptop at the site location.

Note:
These commands are meant primarily for Sapcon engineers to debug the sensor in case of any issue. Please consult a Sapcon Engineer before using these commands.

COMMANDS	RESPONSE	DESCRIPTION
<A,PER?,xxxx>	<A,PER=xxxx,xxxx,OK>	For Level in Percentage, e.g- <A,PER=09270,N,OK>,means level=92.70per and 'N' define error Refer to Table 16 for a list of errors and their indication.
<A,AMP?,xxxx>	<A,AMP=xxxx,xxxx,OK>	For mAMP value e.g- <A,AMP=20000,N,OK>,means level=20.00amp and 'N' define error Refer to Table 16 for a list of errors and their indication.
<A,CAHH,xxxx>	<A,CAHH=xxxxxxxx,xxxx,OK>	For High Calibration e.g- <A,CAHH=00029986,OK>, i.e High calibration value = 29986.
<A,CALL,xxxx>	<A,CALL=xxxxxxxx,xxxx,OK>	For Low Calibration e.g- <A,CALL=00027880,OK>, i.e Low calibration value = 27880.
<*,ID?,xxxx>	<A,ID=id,xxxx,OK>	To Know the Present ID of instrument e.g- <A,ID=A,OK>.
<*,ID=x,xxxx>	<A,ID=x,xxxx,OK>	Set ID of instrument between x=0-9, A-Z e.g- <*,ID=A> then response <A,ID=A,OK>.
<A,SCMD,xxxx>	<A,SCMD,xxxx,OK>	It is used to set communication flow in command mode.
<A,AUTO,xxxx>	<A,AUTO,xxxx,OK>	It is used to set communication flow in AUTO mode.

Table 14: Commands Description - Part 1

Note:
Here, xxxx defines the CRC. If the generated value of xxxx Command and Response matches, only then further communication is possible.

COMMANDS	RESPONSE	DESCRIPTION
<A,CDUR=00xxx,xxxx>	<A,CDUR=00xxx,xxxx,OK>	It is used to set transmission Time duration (in sec) of communication flow in AUTO mode, value of x between 0-99, e.g- <A,CDUR=00001> then response <A,CDUR=00001,OK>.
<A,TURB=00xxx,xxxx>	<A,TURB=00xxx,xxxx,OK>	It is used to set Turbulence value of x between 1-9 e.g- <A,TURB=00001> then response <A,TURB=00001,OK>.
<A,SCAH=00xxx,xxxx>	<A,SCAH=00xxx,000xx,xxx,OK>	It is used for scale high calibration of instrument e.g- if want to calibrate instrument at high level at 80 percent then <A,SCAH=00080> then response <A,SCAH=00080,00028400,OK> i.e 28400 value is for 80 percent level.
<A,SCAL=00xxx,xxxx>	<A,SCAL=00xxx,000xx,xxx,OK>	It is used for scale low calibration of instrument e.g- if want to calibrate instrument low level at 20 percent then <A,SCAL=00020> then response <A,SCAL=00020,00027000,OK> i.e 27000 value is for 20 percent level.
<A,PRLT=0xxxx,xxxx>	<A,PRLT=0xxxx,xxxx,OK>	It is used to set probe length of instrument value of x between 100-1500 e.g- <A,PRLT=00200> then response <A,PRLT=00200,OK> i.e probe length set to 200 mm.
<A,PRAC=0xxxx,xxxx>	<A,PRAC=0xxxx,xxxx,OK>	It is used to set accuracy per mm of instrument value of x between 1-1500 e.g- <A,PRAC=00001> then response <A,PRLT=00001,OK> i.e accuracy per mm set to 1.
<A,DEF,xxxx>	<A,DEF,xxxx,OK>	It is used for factory reset of Instrument, using this command all the setting of instrument restore to factory setting.

Table 15: Commands Description - Part 2

Note:
Here, xxxx defines the CRC. If the generated value of xxxx Command and Response matches, only then further communication is possible.

17 Settings

17.1 Factory Reset

To restore all configuration and setting to the factory set, follow the following steps:

1. Connect the calibrator to the sensor
2. Open Capvel-FUEL-Connect app on desktop and connect the device.
3. Now, first select connection media Communication (Sapcon Calibrator) to App accessible via switch.
4. After installing Capvel-FUEL's application
5. Then, go to Advance Settings » Systems Settings » Default Settings.
6. After clicking on Default Settings, factory default settings are configured.

17.2 Error Indication

In Capvel-FUEL , errors are indicated for operators mishandling of the instrument in the view of instrument protection and proper setting of the instrument.

Error Indication:
Normal functioning of Capvel-FUEL is indicated by continuously glowing Green LED. On encountering any Error(s), the Status LED starts blinking RED and GREEN alternately at a faster rate. Any other pattern apart from normal blinking indicates erroneous functioning of Capvel-FUEL . To avoid errors, please:

- Ensure that all the connections are proper.
- Ensure that the instrument is mounted correctly and fitted tightly.
- During calibration, fuel should be on high/low point of probe.

ERROR CODE	DESCRIPTION	LED INDICATION	TROUBLESHOOTING
N (0)	Instrument with no error	Continuous GREEN blinking	No error.
O (2)	Probe open	GREEN blinking	Remove electronic insert from the housing and check cable connection with the probe.
S (3)	Probe short-circuit	RED blinking	Moisture deposition in the probe connector. Clean the connector and use the instrument.
OCAP (4)	Over-capacitance	3 times RED & GREEN blinking followed by continuous GREEN glow	Capacitance is much more higher than calibrated capacitance range.
UCAP (5)	Under-capacitance	5 times RED & GREEN blinking followed by continuous GREEN glow	Capacitance is much more less then the calibrated capacitance range.
C (8)	Calibration error	RED-GREEN blinking	Recalibrate the instrument, make sure that probe is calibrated in an empty metallic tank.
F (9)	Unstable Recalibrate Count	-	-

Table 16: Error Indication

18 Order Code

The desired parameters that you want in your Capvel-FUEL sensor can be combined to form a customized order code. The options for different parameters are described below.

VAT : CAPVEL-VAT : Volumetric Fuel Level Sensor (Use for Vehicle Tracking Systems and DG sets)

- **Housing**
  - HAL : Compact Aluminium Housing (IP-68) with 5 SAE mounting holes
  - FP2C : Cast Aluminium weather & flame proof Stoving Enamel painted suitable for gas group IIC
- **Probe Housing Cable Entry (Depends on "Housing")**
  - PAM12 : 6 Pin Male + Female connector with 1 meter cable (Only with "HAL")
  - PCB5D : 1/2" BSP, DC Gland, Brass (Only with "FP2C")
- **Output**
  - MA485 : RS485 Modbus-RTU, Current Output (Analog Dial Gauge Compatible), Analog Output DC 0-5 V
- **Power Supply**
  - DC2 : 7 to 30 V DC
- **Mounting**
  - MB10AL : Screwed Thread, 1" BSP, Aluminium
  - FB10MS3 : Slip on Flange 1" BSP Thread with 3 nos mounting holes at PCD 60, MS Plated
- **Probe Length**
  - 1H4H : 100 to 400 mm
  - 4.1H10H : 410 to 1000 mm
  - 10.1H20H : 1010 to 2000 mm

A sample order code would look like the following:

VAT-HAL-PAM12-MA485-DC2-MB10AL-4.1H10H

19 Maintenance

The electronics of Capvel-FUEL instrument need no maintenance. When cleaning and checking the tank, free the probe from deposits. Make sure that the cable ducts and the lid are tightly sealed so that no moisture seeps into the instrument.

20 Customer Support

Thank you for going through the instructions given in this manual. To further ease the process of installation and use, we have developed special demo videos which are hosted on YouTube.

Sapcon's YouTube channel, SAPCON INSTRUMENTS, lists all these videos: https://goo.gl/dnxfcz

Should you require further information regarding installation, use or working of the instrument, please don't hesitate to contact us. Kindly provide the following information at the time of contacting:

(i) Instrument Model and Serial Number
(ii) Purchase Order Number and Date of Purchase
(iii) Description of the query
(iv) Your contact details

In an attempt to serve you better, we are open seven days a week (9:30am to 7:30pm). We are available at:

- www.sapconinstruments.com
- sales@sapcon.in
- +91-731-4757575