

## **CAPVEL-LP : User Manual & Datasheet**

Contact level transmitter based on capacitance measurement



Grown..... to meet challenges

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## 1 Introduction

CAPVEL-LP is a capacitance based continuous level transmitter. It consist of a sensing rod and electronic insert. In case of non metallic tank or tank contains turbulant liquid there is provision to give still well tube. CAPVEL-LP is compact and easy to install measuring device and is suitable for all conductive and non conductive liquids.

## 2 Operating Principle

CAPVEL-LP is composed of specially developed Capacitance Change Gauging circuit. It uses fast RISC based processor to perform all the complicated jobs of evaluating the Level out of the capacitance. This capacitance is formed by the sense Rod and the metallic container wall. Where containers are non-metallic or not-uniformly wide or having turbulent fluid, a metallic stilling well is provided. The amount of capacitance is proportional to the level of material between the sense rod and metallic wall of stilling tube or container.

## 3 Features

- Power Supply (24-50 VDC)
- 4-20 mA Loop Powered (2-Wire)
- Temperature Durability (Up to 60 C) (High Temperatur Model on demand)
- Internal Tempeperature Compensation
- Easy two point calibration setting
- suitable for wide range of liquids
- Low cabling cost

## 4 Specifications

### 4.1 General Specifications

### 4.2 Mechanical Specifications

### 4.3 Electrical Specifications

<b>Accuracy</b>	±2% of Full Scale*
<b>Resolution</b>	±0.5% of Total Span
<b>Response Time</b>	3 sec. (typical)
<b>Measurement Span</b>	15 To 3000 pf above zero

Table 1: General Specifications

\* as per results obtained under standard operating conditions

<b>Enclosure</b>	IP-65, Cast Aluminium
<b>Cable Entry</b>	2 x 1/2" BSP/NPT, Brass
<b>Operating Pressure</b>	Suitable up to 10 bar
<b>Mounting</b>	1-1/2" BSP/NPT Threaded / Flange mounting available on demand
<b>Dimensions</b>	Refer figure 1 and 2
<b>Gland type</b>	Single/Double compression gland, PG-13.5

Table 2: Mechanical Specifications

<b>Internal Enclosure</b>	ABS plastic
<b>Supply</b>	24 – 50 V DC
<b>Operating Temperature</b>	0° to +80° (Probe) 0° to +60° (Electronics)
<b>Current Consumption</b>	20mA maximum
<b>Certificates</b>	CE / CMRI (Flame proof)

Table 3: Electrical Specifications

### 4.4 Output Specifications

<b>Analog</b>	4-20 mA (Galvanically isolated/ not isolated) <b>2-Wire Loop Power</b>
<b>Digital</b>	RS-485 (Optional)
<b>Sensor Indication</b>	Two LED's for status indication
<b>Digital Indication</b>	Data(+) and Data(-)* (With RS-485 Model)(Optional)

Table 4: Output Specifications

\* Device is compatible with GSM/GPRS system.

## 5 Application Note

CAPVEL-LP is suitable for the following sets of applications

- Water treatment plants
- Pharmaceutical & Dairy
- Fuel level sensing
- Breweries & Distilleries
- Utilities
- Vehicle tracking system

## 6 Dimensional Layout

In **figure 1 and 2** you can see dimensional layout of CAPVEL level transmitter. Figure 1 and 2 are showing back view and the side view of the instrument respectively.

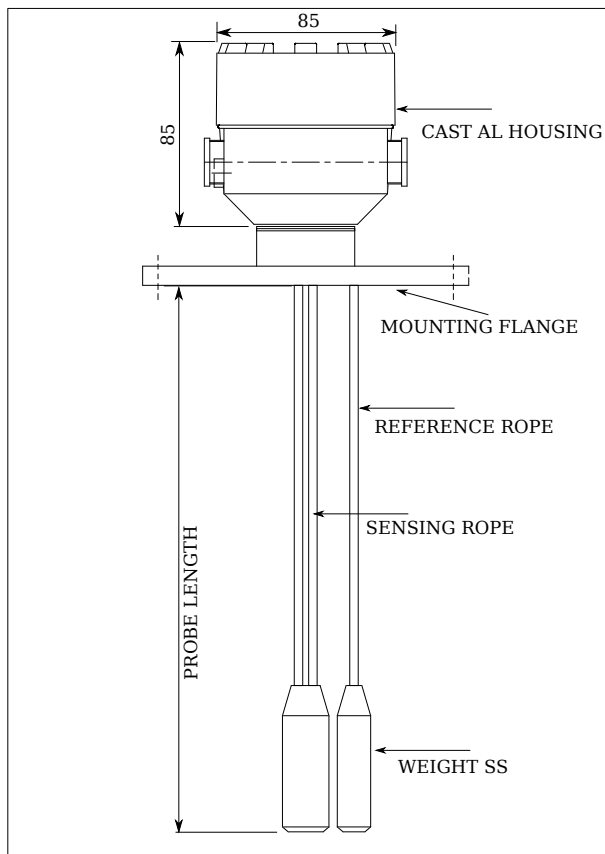


Figure 1: CAPVEL-LP Back View  
(Flange Mounting, Rope Construction)  
(Dimensions are in mm)

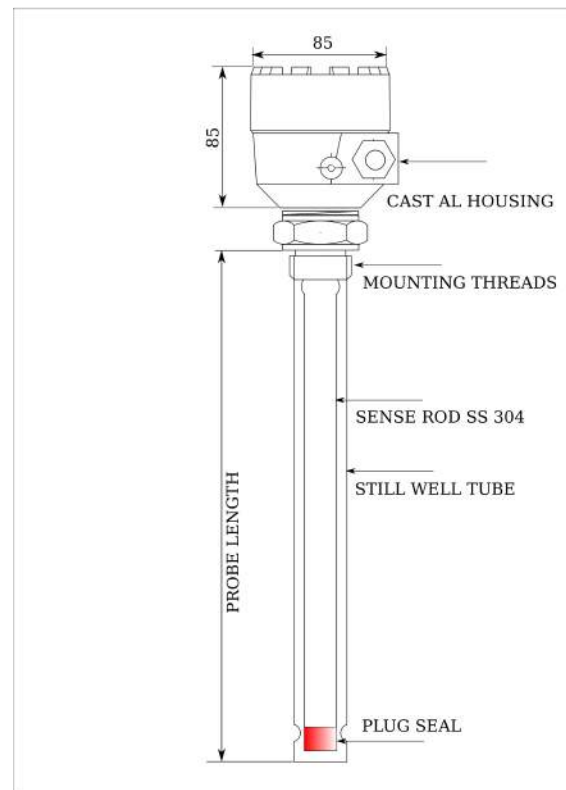


Figure 2: CAPVEL-LP Side View  
(Threaded Mounting, Rod Construction)  
(Dimensions are in mm)

## 7 Guidelines

### 7.1 Tank Mounting Installations

#### 7.1.1 For Regular Metallic Tank

Always mount the sensor perpendicular to the liquid surface and keep the sensor rod closer to tank wall. Generally for metallic tanks single sensor rod (**without reference / grounding tube**) is sufficient if the material is of high dielectric constant.

In case of oil, diesel (**Material of low dielectric**) and tank diameter is big, keep the distance of sensing rod closer to tank wall.

#### 7.1.2 For Regular Non Metallic tanks

In case of non metallic / lined tanks there is always a need of reference electrode. It can be in form of reference probe or still well grounding tube. Reference probe is generally recommended for corrosive liquids while still well tube will be suitable to avoid turbulence of liquid. It will help to provide better readings.

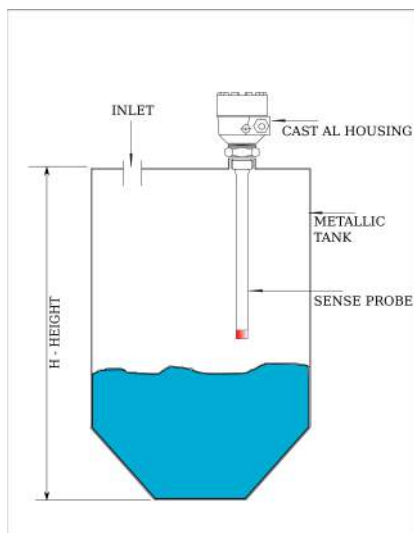
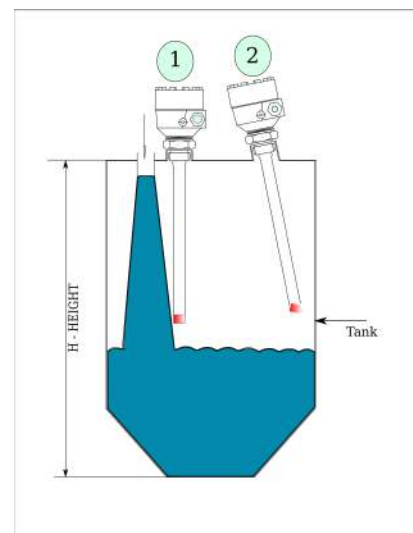


Figure 3: Mounting-Regular Metallic Tanks



1. Infront of the Inlet
2. Not Perpendicular to Liquid

Figure 5: Incorrect Method of Mounting

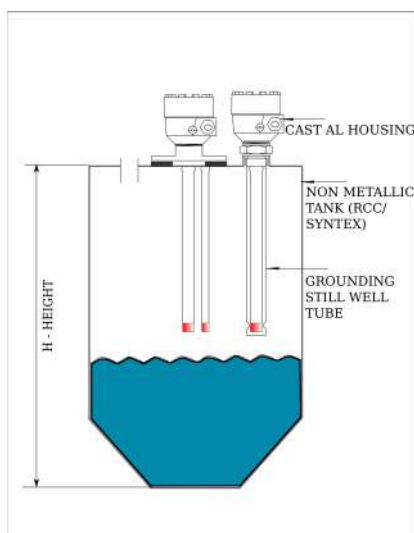


Figure 4: For Non Metallic Tanks

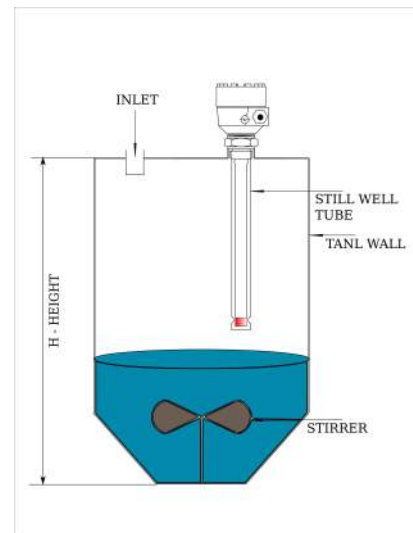


Figure 6: In Agitator Tank

### 7.1.3 Tanks contain Stirrer or Agitator

If the agitator is present in the tank, preferably mount the sensor in centre between agitator blade and side wall. Always prefer to have sensor with still well rod to avoid turbulence.(Refer Figure 6)

## 7.2 Mounting with Process connections

### 7.2.1 Threaded Mountings

CAPVEL-LP is available with BSP/NPT threaded connection of various size. Generally 1-1/2" BSP consider as a standard mounting size with still well

tube. Please ensure a matching socket is available to tighten threads in the tank.

To install CAPVEL-LP , insert the thread end of probe into the aperture at the top of the tank.(Refer Figure 7)

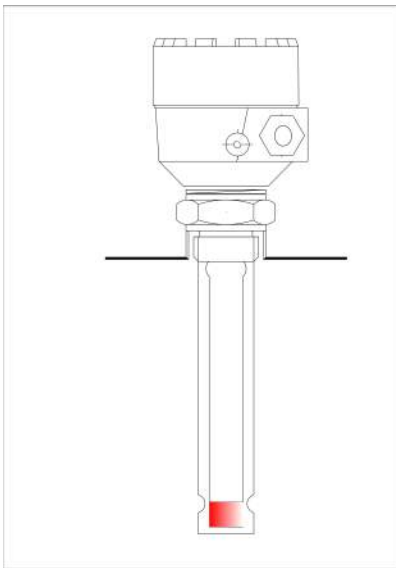


Figure 7: Threaded Connection

### 7.2.2 Flange Mountings

CAPVEL-LP is also available with a flange connection as per your requirement. The material of MS / SS is available. The flange size is available from 1-1/2" to various sizes depending on the tank construction. (Refer Figure 8)

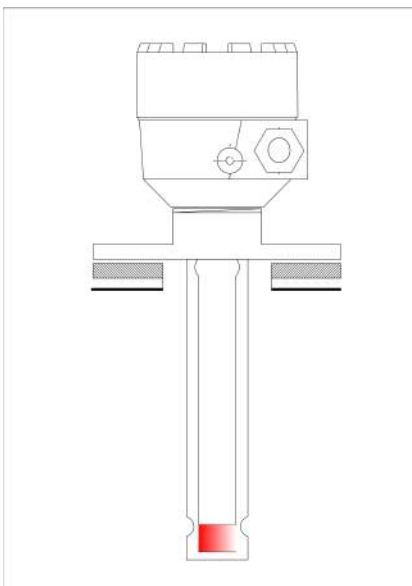


Figure 8: Flange Connection

#### NOTE:

- When Installing threaded connection please ensure to have matching socket available at site.
- When Installing a threaded flange, ensure that it matches the mounting threads of the sensor unit.
- Tighten the thread by **RELEVANT TOOL**. When tightening the thread, hold the upper part of the unit and make sure that the seal is leak proof.

### 7.3 Electrical Connections

There are 02 PUTs available including supply, output and ground connection in CAPVEL-LP . As this is a loop powered model, there is no separate terminals required for external power supply. Refer figure 9 for details.

**NOTE:** Please refer to the connection diagram for your model before connecting the device.

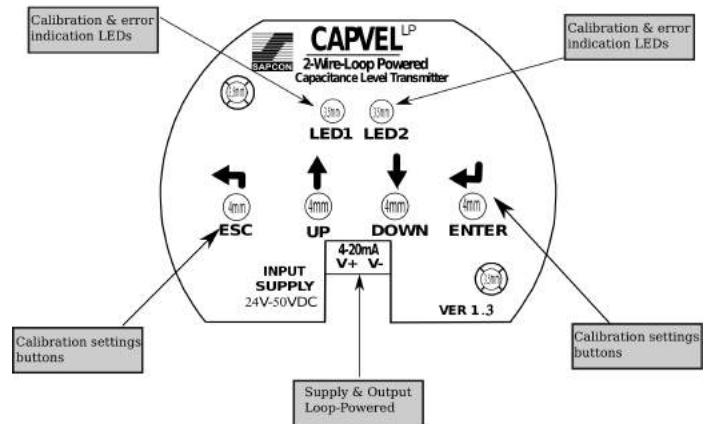


Figure 9: Electrical TOP Panel

### 7.3.1 Wiring Diagram for Power Supply

CAPVEL-LP comes with DC Power Supply Range of (24 – 50 VDC).As this is a two wire system the same terminal will be used for getting 4-20mA output.(Refer figure 10).

Follow the steps mentioned below for connection-

1. Connect the available DC supply from PLC or external supply to PUT 1 and 2 for respective positive (V+) and negative (V-).
2. If available you can connect multimeter or output source in series with same loop, as it will carry the output 4-20mA also.

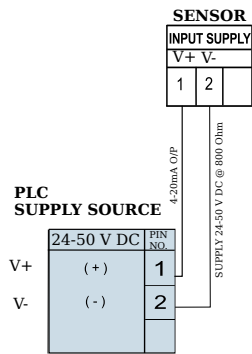


Figure 10: Input Supply Connections

### 7.3.2 Wiring Diagram for 4-20 mA Output

CAPVEL-LP can be connected with only active PLCs as it require supply source from the same device.

Kindly follow the steps mentioned below :

#### FOR ACTIVE PLC

1. Connect the PLC's + and - to PUT 1 and 2 respectively.(Refer fig 11)
2. You can also connect a Multimeter or a Digital indicator in series with the PLC for display.

## 8 Calibration Procedure

CAPVEL-LP is not measuring level directly, its basic element is to measure two different level as HIGH and LOW,between this the device is giving the output. Current output is proportional to the (capacitance) level percentage. 4mA is assigned to the 0 capacitance percentage (low level).20mA is assigned to 100% capacitance (High Level).

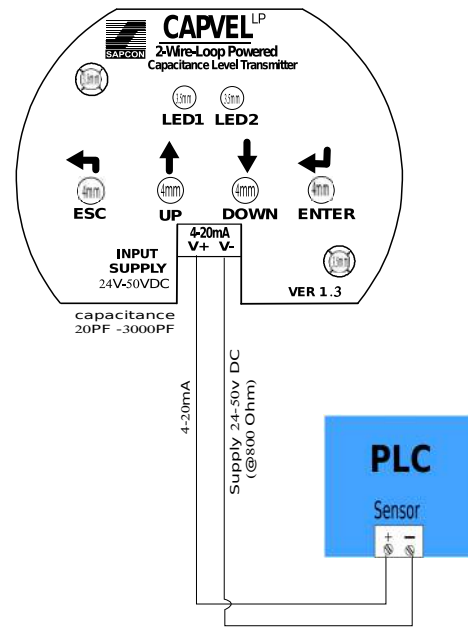


Figure 11: 4-20 mA Connections(Active PLC)

Current output of the fault indication is 21mA, with a delay of 5 seconds.Current output can be programmed for inverse operation: 4mA =100% (full), 20mA = 0% (empty).

## 8.1 Key Operations

General usage of Keys has been described in table 6.

<b>Enter</b>	To enter in to <b>PROGRAMMING MODE</b>
<b>Esc</b>	To <b>EXIT</b> from programming mode without saving the data.
<b>Up</b>	To set <b>HIGH CALIBRATION</b> point.
<b>Down</b>	To set <b>LOW CALIBRATION</b> point.

Table 5: Key Operations

## 8.2 Programming Features

- 4mA output current (Direct) assignment to the minimum (0%) level.
- 20mA output current (Direct) assignment to the maximum (100%) level.
- 4 mA output current (indirect) assignment to the minimum (0%) level by means of an intermediate level.



- 20 mA output current (Indirect) assignment to the maximum (100%) level by means of an intermediate level.
- Fault indication by current output: 21mA.
- Reset to the Factory Default.

After connecting power supply, both the LED's will glow simultaneously for few microsecond. It shows the device has got the sufficient power to run and both the LED's are healthy.

### 8.3 Programming Procedure

As CAPVEL-LP is two wire system, it does not include any display because of the power consumption limitations. You can look in to the LED's status to find the calibration settings.

#### 8.3.1 Programming Steps

CAPVEL-LP can be easily programmed by the two point calibration settings. Although the device is factory set but it is always recommended to calibrate the instrument in the original service material.

Follow the below steps to calibrate CAPVEL-LP over a required span :-

1. Press **ENTER** key up to 5 sec to go in to programming mode.
2. Now, For low level calibration, set the material level at desired set point and press **DOWN** key.
3. The right LED will blink to save 4mA count.
4. Immediately both the LEDs will blink and sensor will exit from programming mode. **AUTO EXIT FUNCTION**
5. Similarly for **HIGH LEVEL CALIBRATION** fill the material at desired high level point.
6. Press **ENTER** for 5 seconds to go in to programming mode.
7. Press **UP** key once, the **LEFT** key will blink to save the 20mA count.
8. Both the LED will blink and sensor will exit from programming mode.
9. You can press ESC key any where, if you do not want to save the mA count.

10. Sensor will exit from programming mode without saving the mA counts.
11. Now the CAPVEL-LP has been calibrated over a required SPAN.

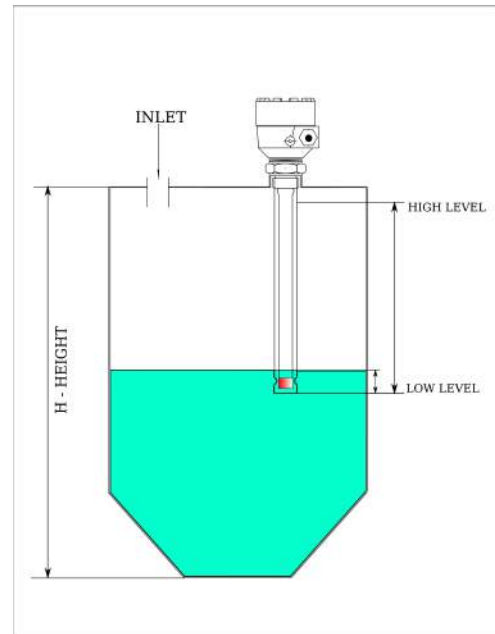


Figure 12: Low Level Calibration

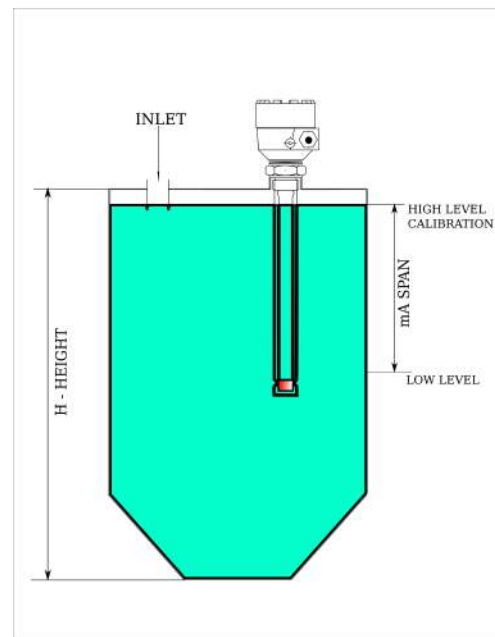


Figure 13: High Level Calibration

### 8.3.2 Indirect Calibration

If the tank is partially filled, there is a provision in CAPVEL-LP of **INDIRECT ASSIGNMENT** of minimum and maximum level to the output current with partially filled tanks.

$$\text{mA by } \%x = 16 * x/100+4$$

Indirect assignment requires the output current to be measured with higher accuracy. A current meter should be inserted in the 4 ... 20 mA loop before starting calibration. Assuming a tank filled up to 15% approximately and the task is to accomplish indirect assignment of low level to 4 mA the procedure is the following. Since the current output at the level of 20% is  $\text{lout} = (16 \text{ mA} \times 0.20) + 4 \text{ mA} = 7.2 \text{ mA}$  the current output should be changed with the keys up/ Down, until the value of 7.2 appears on the current meter.

This procedure should be repeated with another, higher level for indirect assignment of 20 mA to the maximum level.

Obviously for the sake of greater accuracy (it is not even sure whether the assumption of 20% is correct) the direct assignment should be carried out as soon as possible.

Please follow the below steps to set **Partial Low Level** for partially filled tanks :-

1. Press **DOWN** key and keep it pressed, there will not be any change in LED's state.
2. Press **ESC** key and keep it pressed, then release both the keys.
3. **RIGHT LED** will blink. Now CAPVEL-LP is in **Indirect Programming mode**.
4. Set output current with **UP and DOWN** keys to the required values.
5. Please note that the current meter should be inserted in 4 – 20mA loop.
6. Press **ENTER** key, Right LED will blink to save the 4mA count.
7. Both the LED will blink and device will exit from programming mode.

Now follow the below steps to set **Partial High Level** for partially filled tanks :-

1. Press **UP** key and keep it pressed, there will not be any change in LED's state.

2. Press **ESC** key and keep it pressed, then release both the keys.
3. **LEFT LED** will blink. Now CAPVEL-LP is in **Indirect Programming mode**.
4. Set output current with **UP and DOWN** keys to the required values.
5. Please note that the current meter should be inserted in 4 – 20mA loop.
6. Press **ENTER** key, Left LED will blink to save the 20mA count.
7. Both the LED will blink and device will exit from programming mode.

## 9 Calibration Procedure with LCD Display

CAPVEL-LP is available in display also. The similar two-wire system has been established with an additional feature of LCD display to show the readings on display. Current output is proportional to the (capacitance) level percentage. 4mA is assigned to the 0 capacitance percentage (low level). 20mA is assigned to 100% capacitance (High Level). Current output of the fault indication is 21mA, with a delay of 5 seconds.

### 9.1 Key Operations

General usage of Keys has been described in table 6.

<b>Enter</b>	To enter in to <b>PROGRAMMING MODE</b> or to <b>Save the Setting</b>
<b>Esc</b>	To <b>EXIT</b> from programming mode / submenu without saving the data.
<b>Up</b>	To set <b>HIGH CALIBRATION</b> point / Scrolling the submenu.
<b>Down</b>	To set <b>LOW CALIBRATION</b> point / Scrolling the submenu.

Table 6: Key Operations for CAPVEL-LP LCD display

### 9.2 Programming Features For LCD Display

- 4mA output current (Direct) assignment to the minimum (0%) level.

- 20mA output current (Direct) assignment to the maximum (100%) level.
- 4 mA output current (indirect) assignment to the minimum (0%) level by means of an intermediate level. It is defined by SCALE CALIB option.
- Through SCALE CALIB feature you can set 20 mA output current (Indirect) assignment to the maximum (100%) level by means of an intermediate level.
- Fault indication by current output: 21mA.
- Reset to the Factory Default.

After connecting power supply, LCD will ON and it will show CAP-LP/VER or else it will show CALIB Error. If LCD is running properly it means device has got sufficient power to run, then it will come on Normal mode.

### 9.3 Programming Procedure

As CAPVEL-LP is two wire system, it has now included with LCD display with minimum power consumption. Now you can look in to the LCD display for various calibration settings.

#### 9.3.1 Programming Steps

CAPVEL-LP can be easily programmed by the two point calibration settings. Although the device is factory set but it is always recommended to calibrate the instrument in the original service material.

Follow the below steps to calibrate CAPVEL-LP with LCD display over a required span :-

1. Press **ENTER** key to go in to programming mode. The LCD display will show **CAL**. PGM (2sec) then **CAL**
2. Now, again press **ENTER** key. The LCD display will show **HI**. (It is ready for High Calibration).
3. For high level calibration, set the material level at required set point then press **ENTER** key. Display will show **HI-CAL-SAVE** and return to high calibration.
4. For low calibration press **DOWN** key. The LCD display will show **Lo**. (It is ready for Low calibration).

5. For low level calibration, set the material level at required set point then press **ENTER** key. The LCD display will show **Lo-CAL-SAVE** and return to low calibration.
6. Press **ESC** to exit from programming mode. (Display Show CAL).
7. Again press **ESC** key to exit from programming mode. (The LCD display show the level of the material per/mA.)
8. Now the CAPVEL-LP LCD display has been calibrated over a required SPAN.

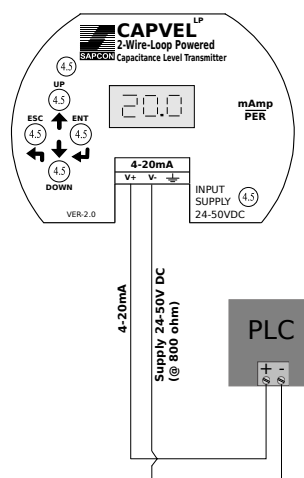


Figure 14: Connection with PLC

There are some more features which is available with CAPVEL-LP LCD display to show various types of settings like **dis** (For display Per/mA), **COM** (For communication), **trb** (For Turbulance), **SCA** (For Scale calibration). Follow the below steps for **DISPLAY SETTING** :-

1. Press **ENTER** key going to programming mode. The LCD display will show **CAL**. Then press **DOWN** key.
2. You will see the menu **dis** on LCD screen.
3. Press **ENTER** to see the sub menu.
4. Here you will get two different options as **AMP** and **PER**, this shows the readings to be display in mA or in percentage.

5. Press **ENTER** on the option you want, controller will save the command and exit automatically.

Now for CAPVEL-LP LCD display Communication setting, please follow the below steps :-

1. Press **ENTER** key to see the submenu when lcd show **COM**.
2. Here you will get three submenu like **id**, **Flo** and **dur**. You can set these submenu as per your requirement.

Similarly for **Turbulence Settings** follow the below steps :-

1. Press **ENTER** to see the submenu when lcd shows **trb**.
2. Here you will get **tb1 - tb9**.
3. You can set the turbulence value from 1 to 9. (In case of turbulence).
4. It limits the output fluctuation and gives the average value of current fluctuation.

CAPVEL-LP is also available with a feature of **SCAL FACTOR** which means you can set you desire level at any point by giving the percentage value as per your need. For eg. you want a particular level at 80% of total span you can set it by **SCAL H** Similarly you can set a semi low level limit by **SCAL L**.

Follow the below steps to use this feature :-

1. Press **DOWN** key four times and come to the option **SCA**.
2. Press **ENTER** key, the LCD will show **SCH**.
3. Press **ENTER** again, LCD will show **H 80**
4. Now set the desire semi high level limit say 70% **H 70**
5. Press **ENTER** to save the value.
6. Now Press **DOWN** key to show **SCL**
7. Repeat the same procedure with low level setting and press **ENTER** to save.

## 10 Error Indication & Remedies

CAPVEL-LP has some external mode of checks to identify malfunctions or incorrect operating conditions. **The LED indicates the error messages as per the operating condition. Also if an error is identified CAPVEL-LP changes its analog output to 21 mA.** (Refer Table 9)

The **LCD indicates** the error message as per the operating condition. Also if an error is identified **CAPVEL-LP LCD** changes its analog output value to 21mA (Refer Table 8)

## 11 Handling Precaution

1. Install the instrument as per given in mounting arrangement diagrams.
2. Do not Mount the instrument from side of the tank (Always avoid horizontal positions).
3. Mounting threads should tightened properly.
4. Always choose a still well option in case of turbulence in tank.
5. Ensure the proper connection & settings.
6. Do not remove electronics from probe unless needed or to change it.
7. Check the continuity between probe ground & tank ground (Metallic Tank).
8. Read the instruction manual before installing the system.

MENU	SUB MENU	CHANGE	DESCRIPTION	REMARK
CAL(Calibration)	HI		High Calibration	Press UP key
	Lo		Low Calibration	Press DOWN key
DIS (Display)	Per	Per / Amp	Display option PER (Percentage), AMP (Mili Ampere)	
	AMP			
COM (Communication)	ID	A to Z,0-9	Communication ID RS 485 Network	
	Flo	CMD,Aut	Flow Control CMD:- For command mode Aut :- Auto mode as per define duration	
	Dur	S00-S99	SUR:- Duration in seconds *2 for auto mode	
	TRB	TB1-TB9	Turbulence immunity	
SCA (Scal Factor)	SCH	H40-H99	Higher SCALE LEVEL	SCALE-High must be 20% more higher than SCAL-LOW
	SCL	L00-L60	Lower SCALE LEVEL	

Table 7: User Menu for CAPVEL-LP LCD display

CODE	ERROR DISPLAY	ERROR Description	Troubleshooting	Remark
1	PRO	Probe are OPEN circuited	Check the probe with multimeter	mAmp output 21mA
2	PRS	Probe are SHORT circuited	Check the probes with Multimeter	mAmp output 21mA
3	CAL	Calibration Error	Calibration is wrong, please recalibrate correctly	mAmp output 21mA
4	PrH	Over Capacitance	Tank and probe dimensions are not matching	mAmp output 21mA
5	PrL	Under Capacitance	Tank and Probe dimensions are not matching	mAmp output 21mA
6	Rfo	Internal reference got open circuited	Internal fault in sensor	mAmp output 21mA
7	RfS	Internal Reference got open circuited	Internal fault in sensor	mAmp output 21mA
8	OSC	Oscillations Stopped	Internal Fault in sensor	mAmp output 21mA

Table 8: Error Display &amp; Remeady for CAPVEL-LP LCD display

CODE	ERROR Description	LED Blinking	Current Output	Error on SERIAL	TROUBLE SHOOTING
1	Calibration Error	Alternatively LED 1 and LED 2 two times Blinking.	21mA	ECAL	Calibration is wrong, please recalibrate correctly
2	Probes are OPEN circuited	LED 1 and LED2 Blinking in 1 sec	21mA	PrOP	Check the probes with multimeter
3	Probes are SHORT Circuited	LED 1 and LED2 continue ON	21mA	PrSC	Check the probes with Multi Meter
4	OVER Capacitance	LED 1 Two Times Blinking with 500ms Delay	21mA	PrHI	Tank and Probe Dimensions are not matched
5	Under CAPACITANCE	LED2 TWO times blinking then 500ms delay	21mA	PrLO	Tank and Probe Dimensions are not macted
6	Internal Reference got open circuited	LED1 Three times blinking then 500ms Delay	-	RFOP	Internal Fault in sensor
7	Internal Reference got short circuited	LED2 three times blinking then 500ms delay	-	RFSC	Internal Fault in sensor
8	Hardware Failure	Alternate LED1 and LED2 blinking in 1 seconds.	21mA	-	Contact services

Table 9: Error Indications &amp; Remedies for CAPVEL-LP LED Indication

## 12 Warranty

Instrument is manufactured as per the purchase order specification. Standard guarantee for twelve months from the date of commissioning or eighteen months from the date of supply. Which ever is earlier. Guarantee is against manufacturing defects. We undertake to correct such defects which are due to workmanship, at our expenses, Instrument should be forwarded to us on freight paid basis with seals unbroken. The guarantee is valid for our customer and does not extent to third parties or caused by mishandling, accident or abnormal conditions.

## 13 Customer service

If you require any assistance or support feel free to contact us at given below address along with following information :

- Instrument Model and serial no.
- Purchase order no. and date.
- Problem observed.

**SAPCON® INSTRUMENTS (P) LIMITED**  
**131, PALSHIKAR COLONY**  
**INDORE (M.P.) 452004**  
**0731-4757575**  
**sales@sapcon.in**