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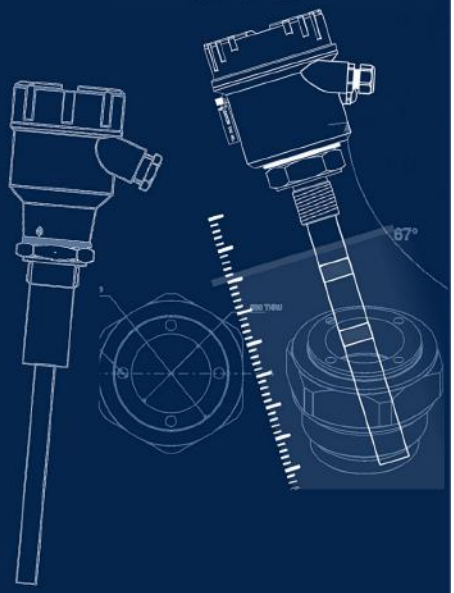
INSTRUCTION MANUAL

CAPVEL-ICT

Capacitance Level Transmitter

Version 2.0



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Revision History

Revision	Date	Author(s)	Description
1.0	18 Jan 2014	RND	First Version Editing
1.1	25 Aug 2014	MRK	Applications Revision
1.2	28 Jun 2015	RND	Features Revision
1.3	10 Dec 2015	RND	Specs Revision
1.4	23 Jul 2016	RND	Specs Revision
2.0	08 Jan 2017	BRND	Revised Format
2.1	17 Sep 2017	BRND	Branding Revisions

[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.

General 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

2 Operating Principle

CAPVEL 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 non-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.

Figure 1: Capvel

3 System Description

CAPVEL is composed of cast aluminium housing, supplied with suitable mounting arrangement viz.NPT, BSP or Flanges and two metallic cable entries. An external Earthing / Grounding terminal is also provided. The sensing rod which is mostly Teflon coated. This sensing rod can be replaced by flexible probe for some applications. The stilling tube is also provided for turbulent fluids, irregular width tanks, non-metallic tanks or for fluids with low dielectric (e.g. diesel).
Opening the threaded aluminium cover, an electronic insert could be found. This is the electronic unit which converts the level into 4-20 mA signal depending on the calibration. The status LED is a bi-color LED that blinks alternately in Red and Green to indicate instrument is in process of converting the level to 4-20 mA signal. Two DIP switches are provided to calibrate the 4 mA and 20 mA points. The calibration is easy and a complete procedure is given in "Calibration" page. The two wires connected at the back are pre-connected sensor wires and should not be disturbed. Also while calibration try to keep hands away from the wires of terminal 6 and 7.
Now referring to the "Connection Diagram", Capvel can be wired in two possible combinations. Preferred one is galvanically isolated, 4-wire combination where only one source of power is available, 3-wire, non-isolated combination can also be used. The converted level signal can be sensed using a 4-20 mA indicator or PLC 4-20 mA input or multimeter in 40 mA range or any-other device that takes 4-20 mA signal as input.

4 Features

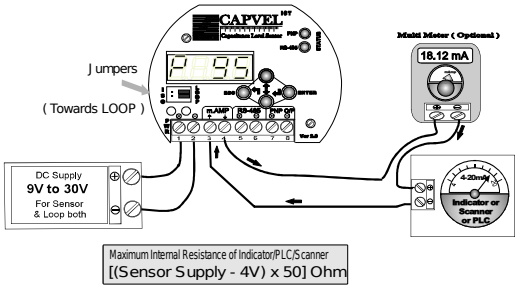
5 Applications

6 Capvel-BT Features

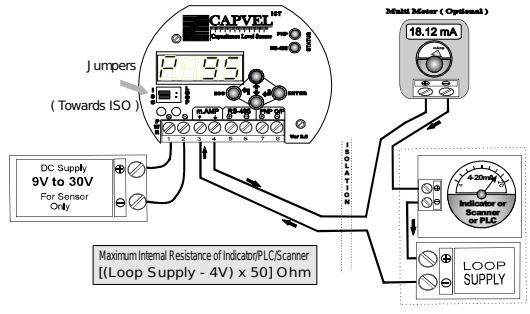
- User Interface : 2 DIP switches + 2 LED
- Output-1 : 4-20 mA, Galvanically Isolated
- Output-2 : Rs-485 Digital Data

7 Capvel-ICT Features

- User Interface : 4 Digit Display with 4 Keys + 2 LED
- Output-1 : 4-20 mA, Galvanically Isolated
- Output-2 : Rs-485 Digital Data
- Output-3 : Controlling Devices connected with External Relay



3-wire Single Supply Operation



4-wire Dual Supply Operation (Galvanic Isolated)

Figure 2: Connection Diagram

8 Mechanical Specification

For Mechanical Specification please refer Table 1

PARAMETER	VALUE
Housing	Cast aluminium weather and Flame proof suitable for mounting in hazardous area Gas Group IIA and IIB as per IS-2148
Mounting	• Integral with sense rod or probe with SS /MS(plated) • Screw - 1"/1 1/2" BSP/NPT (M) • Flanged - (As per your order)
Cable Entry	2 X 1/2"/3/4" BSP/NPT, Brass
Gland type	Double Compression Gland
Sensing	Fully or Partially Teflon Coated Rod, Flexible Probe SS316
Stilling Tube	Pipe, GI / SS
Overall Dimensions	Please refer enclosed probe drawing

Table 1: Mechanical Specifications

9 Electrical Specification

For Electrical Specification please refer Table 2

PARAMETER	VALUE
Mains	• Capvel-BT : 9V to 55V DC • Capvel-ICT : 9V to 30V DC
Power Consumption	• Capvel-BT : Max. 0.5 watt @12 V • Capvel-ICT : Max. 1 watt @12 V

Table 2: Electrical Specifcations

10 Measurement Specification

For Measurement Specification please refer Table 3

PARAMETER	VALUE
Measurement Span	15 to 3000 pf above Zero
Response Time	0.5 to 5 secs.(Adjustable)
Accuracy	+/- 1% FSL or better
Electronics Ambient Temp.	$0°$C. to $+60°$C
Fail-Safe Feature	Reverse Calibratable (Low Level: 20 mA, High Level: 4 mA)

Table 3: Measurement Specifications

11 Installation Guidelines

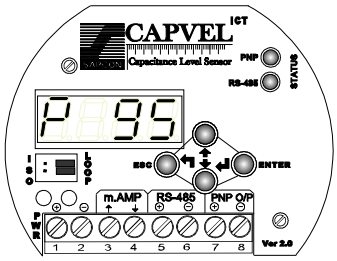
Note:
During installation, all electrical connections must be powered OFF and the fuel tank must be empty.

11.1 Tank Mounting Installation

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

12 Electrical Connections

13 Calibration



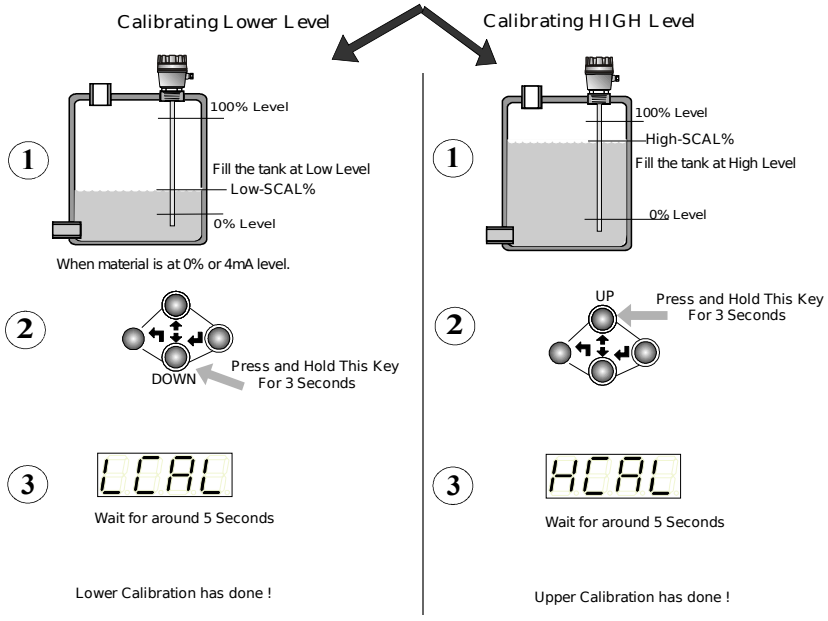
We need to calibrate the sensor at any two levels before taking any reading from it.

In Calibration Process we "Tell" the sensor to remember these two levels to use as reference in all calculations

Factory setting is :-
Low SCAL=0% and High SCAL = 100%.

We may adjust these levels any time by "SCAL" Menu

Procedure of Calibration

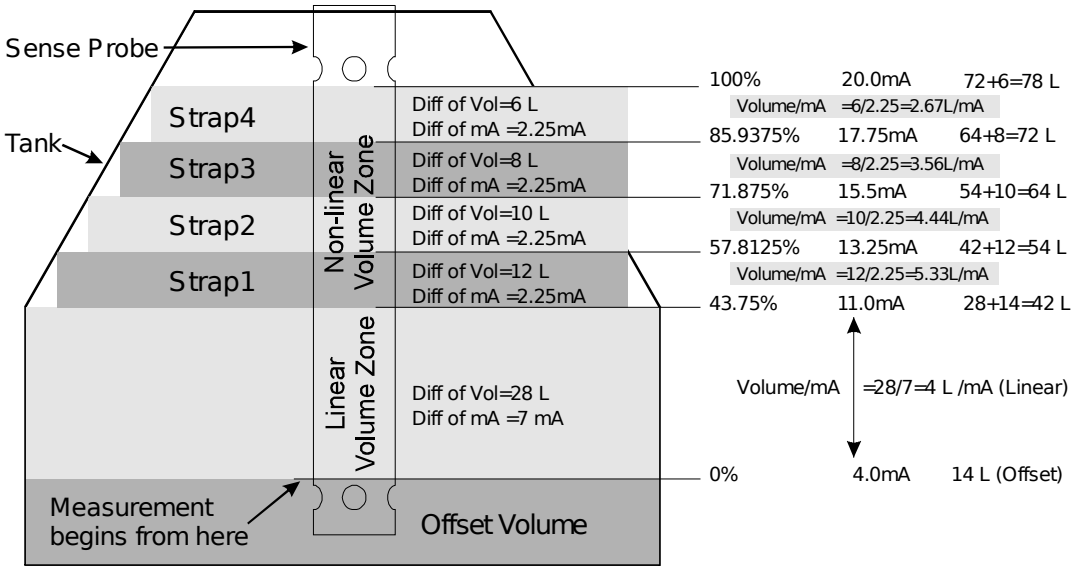


Now the Sensor is in RUN MODE again !

We can Calibrate 4mA and 20mA in any order according to our choice.
The order of empty-fill or fill-empty is immaterial.

Figure 3: Calibration

Method of approximating volume of fluid in irregular shape tanks
for PLC/SCADA using CAPVEL 4-20mA output



Change of volume per mA is linear from bottom to mid level, while it is non-linear at top
(volume per mA decreases as level approaches 20mA)
PLC thus should convert level (mA) to volume from 4 to 11.0 mA linearly as :-

Volume = Offset Volume+Change of Volume per mA x (measured mA - 4)

However, as soon as non-linear range starts (11.0mA) PLC should begin level to volume conversion differently.

The tank now should be strapped into a number of small zones (of level) where volume within each zone could be safely considered linear. Then as long as level stays between those individual straps, volume can be calculated as

Volume = Previous Volume + (difference of volume / difference of mA) x (measured mA - 4)

Previous level is volume measured before existing strap
Difference of volume is Maximum Volume - Min Volume within the strap
Difference of mA is Maximum mA - Min mA within the strap
Measured mA is mA just received by PLC

For example shown above, Volume of tank at various mA is:

```
= 14L+(28L/7mA)    x(measured mA-4) if measured mA is between 4.0mA & 11.0mA
= 42L+(12L/2.25mA)x(measured mA-4) if measured mA is between 11.0mA & 13.25mA
= 54L+(10L/2.25mA)x(measured mA-4) if measured mA is between 13.25mA & 15.5mA
= 64L+(8L/2.25mA) x(measured mA-4) if measured mA is between 15.5mA & 17.75mA
= 72L+(6L/2.25mA) x(measured mA-4) if measured mA is between 17.75mA & 20.0mA
```

Volume at various strapping level can be found by taking notes of amount of fluid needed to raise the level, or it can be calculated mathematically from tank dimensions.

Also, the more the number of straps the better the approximation is.

Caution :- Devices that work on capacitance principle for measurement of level of fluids, are for indicative purpose only. These devices should never be used for inventory control, weights and measures or any other place where highly accurate measurement of fluid level/volume/weight etc is needed.

Figure 4: Tank Strapping

14 Error Display and Remedy

For Error Display and Remedy please refer Table 4

CODE	ERROR DISPLAY	ERROR DESCRIPTION	TROUBLESHOOTING
1	PrOP	Probes are OPEN circuited	Check the probes with multimeter
2	PrSC	Probes are SHORT circuited	Check the probes with multimeter
3	ECAL	Calibration Error	Calibration is wrong, Please recalibrate correctly
4	PrHI	Over Capacitance	Tank and probe dimensions are not matched
5	PrLO	Under Capacitance	Tank and probe dimensions are not matched
6	RFOP	Internal reference got open circuited	Internal fault in sensor
7	RFSC	Internal reference got short circuited	Internal fault in sensor
8	RFHI	Internal reference saturated	Internal fault in sensor
9	RFLO	Internal reference negligible	Internal fault in sensor
10	OSC	Oscillations stopped	Internal fault in sensor

Table 4: Error Display and Remedy

15 Menu and Description

For Menu please refer Table 5 and 6

MENU	SUB MENU	CHANGE	DESCRIPTION	REMARK
rLdr (Relay Drive)	r. FS	FS. H <>FS. L	Fail Safe Selection FS.H/ FS.L:Fail Safe High/Low	
rLdr (Relay Drive)	r.oPt	o.Ind<>o.PUM	Control Action Selection Ind : Individual, PUM : Pump	
rLdr (Relay Drive)	r. SP	S.000<>S.100	Set point Only in Individual Controlling	
rLdr (Relay Drive)	r.SPH	h.001<>h.100	Higher Set point Only in Pump Controlling	SPH must be higher than SPL
rLdr (Relay Drive)	r.SPL	L.000 <>L.099	Lower Set point Only in Pump Controlling	SPH must be higher than SPL
rLdr (Relay Drive)	r.Cd	C.000 <>C.100	Cover Delay in Seconds	
rLdr (Relay Drive)	r.Ud	U.000 <>U.100	Uncover Delay in Seconds	
SCAL (Scal Factor)	SC.-H	H.020<>H.100	Higher SCALE LEVEL	SCAL-HIGH must be 20% or more Higher than SCAL-LOW
SCAL (Scal Factor)	SC.-L	L.000<>L.080	Lower SCALE LEVEL	SCAL-HIGH must be 20% or more Higher than SCAL-LOW
dISP(Display)		d.PER<>d.AmP	Display Options PER : Percentage, AmP : mAmp	

Table 5: Menu

MENU	SUB MENU	CHANGE	DESCRIPTION	REMARK
trbu (Turbulence)		t.001 <>t.010	Turbulence Immunity	
vts (Vehicle Mode)	1 = ON	0 = OFF	Immunity to vehicle generated fluctuations	Only usefully in Vehicle Tracking Systems
	c. ID	Id.00 <>id.99	Communication ID of Sensor on RS-485 Network	
Com (Communication Settings)	c.bAU	b.00.3<>b.38.4	Communication Baud Rate 9.6 x 1000 = 9600bps and so on	
Com (Communication Settings)	c.Flo	F.CMd<>F.AUt	Flow Control • CMD : Send data when Commanded • AUT : Send Data Automatically	
Com(Communication Settings)	c.dur	d.001<>d.250	Auto Data Sending Duration in Seconds	(Flow : AUT)
othr	o.LEN	LE0.0 <>LE9.9	Probe Length in meters	Only for optimization
othr	o.PRF	PR.1 <>PRF.9	Profile	Only for optimization
InFo	i.SEr	12345678	Serial No	Factory Sated and Read Only
InFo	i.dAt	12345678	Mfd. Date in DD-MM-YY format	Factory Sated and Read Only

Table 6: Menu

16 RS-485 Serial Commands for Communication with Capvel

For RS-485 Serial Commands please refer Table 7

COMMAND DESCRIPTION	COMMAND TO BE SEND TO SENSOR	EXPECTED RESPONSE FROM INSTRUMENT	EXPLAINATION
Level would be calculated by dividing incoming five digit number with 10.Please note that:- Application Software must have to take care of any possible errors during turn-on or off durations, change in nature of service material etc.	<A,PER?>or <B,PER?>or <a,PER?>or <z,PER?>or <Z,PER?>	<A,PER=01000,H> <B,PER=01000,N> <a,PER=00625,N> <z,PER=00000,N> <Z,PER=00000,L>	100.0% (OVER) 100.0% (NORMAL) 62.5% (NORMAL) 0% (NORMAL) 0%(LOW)

Table 7: Percentage Level Information

COMMAND DESCRIPTION	COMMAND TO BE SEND TO SENSOR	EXPECTED RESPONSE FROM INSTRUMENT	EXPLAINATION
Asking single letter ID of instrument on RS-485 network	<*,ID?>	<A,ID?-A>	Instrument is telling it's ID
Setting single letter ID of instrument on RS-485 network.Example-setting id as:- 'A' (Capital A)	<*,ID=A>	<A,OK>	ID is taken by instrument and this is the acknowledgement from it

Table 8: Configuring and Asking Sensor ID on Network

17 Settings

18 Maintenance

19 Support Training

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:

- Instrument Model and Serial Number
- Purchase Order Number and Date of Purchase
- Description of the query
- 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:

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