



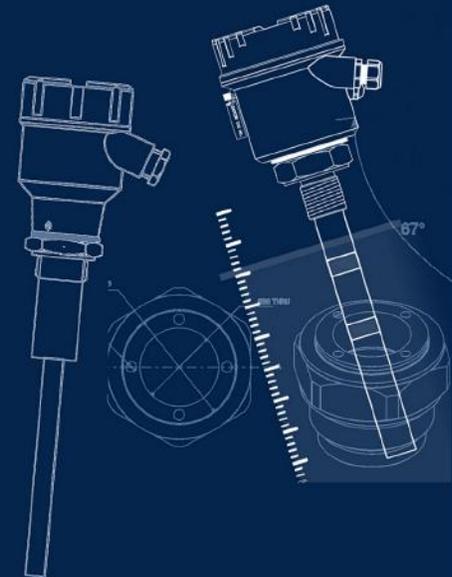
Grown...to meet challenges

INSTRUCTION MANUAL

LOSS OF HEAD

Capacitance Based Switch

Version 2.1



SAPCON INSTRUMENTS PVT. LTD.

30+ Years in Process Control Instrumentation

An ISO 22000 company

www.sapconinstruments.com

Contents

Revision History	3
1 Introduction	4
2 Operating Principle	4
3 Features	4
4 Technical Specifications	5
4.1 Evaluation Unit	5
4.2 Electronic Insert	6
5 Installation & Calibration Guidelines	6
5.1 ROF Relays	6
5.2 ROF 4-20 mA Loop	6
5.3 Relay Setting	7
5.4 4-20mA Loop Setting	7
5.5 Relay and 4-20 mA Loop Setting Procedure	7
6 Displays	9
6.1 Primary Displays	9
6.2 Display Selection	9
7 Electrical Connections	9
8 Customer Support	14

List of Figures

1 LOH	4
2 System Diagram	4
3 SAPSONIC LOH Connection Diagram - Sensor and Power Supply	9
4 SAPSONIC LOH Connection Diagram - 4-20mA Combinations	10
5 SAPSONAR Quick Reference - Relay and Loop Configuration	11
6 SAPSONAR Quick Reference - Relay Programming Configuration	12
7 SAPSONAR Quick Reference - 4-20mA Loop Programming Configuration	13

List of Tables

1 Evaluation Unit	5
2 Electronic Insert	6

Revision History

Revision	Date	Author(s)	Description
1.0	13 Mar 2014	RND	First Version Editing
1.1	05 Sep 2014	MRK	Applications Revision
1.2	20 Feb 2015	RND	Features Revision
1.3	28 Oct 2015	RND	Specs Revision
1.4	23 Jun 2016	RND	Specs Revision
2.0	08 Jan 2017	BRND	Revised Format
2.1	17 Sep 2017	BRND	Branding Revisions

1

1

- **Copyright:** All content on this document, such as text, graphics, logos and images is the property of Sapcon Instruments Pvt. Ltd. The selection, arrangement and presentation of all materials on this document and the overall design of this document is the exclusive property of Sapcon Instruments Pvt. Ltd.
- 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

'Sapcon MPLOH' series instruments are RISC Processor based ultrasonic type continuous differential level indicators with built-in switching functions. The instrument is suitable for measuring the loss of head in water canals. MPLOH is capable of displaying either difference of heads (LOH), High Head and Low Head in millimeters as well as one of the head or LOH can be associated with 4-20 mA loop. The 4-20 mA Loop associated will then be available to be read as percentage and also as absolute mm.

The three relays can be configured to either of the head / LOH as single point of pump control, thereby enabling six combinations of switching in both relays independent of each other.



Figure 1: LOH

2 Operating Principle

In an application, the measuring ultrasonic sensor is provided level through RS-485 protocol. The ultrasonic measure the level of water known as Head. By measuring heads at two points called High Head and Low Head a difference can be calculated. This difference is loss of head. MPLOH measures the heads in mm and thus a calibration at site might be required. The two sensors digitally send their level values of head heights in digital format over the same set of wires, a shielded cable should be used to assure flawless operation.

3 Features

- Latest RISC Core Micro-controller Technology.
- Heads and Difference are measured in millimeters and percentage is also provided for 4-20 mA associated Head / Difference.

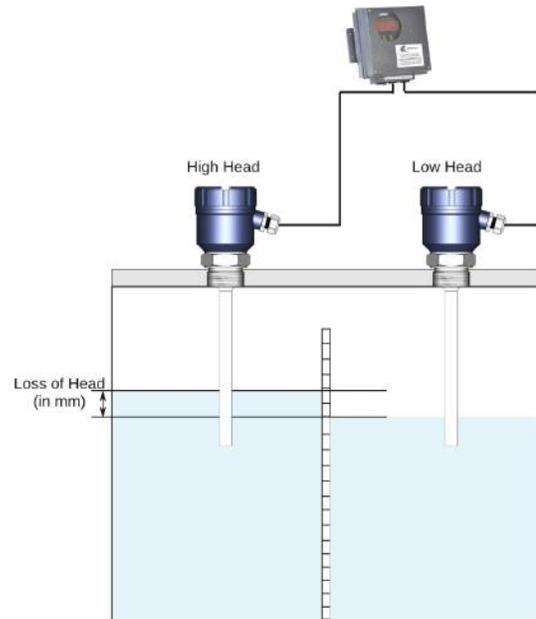


Figure 2: System Diagram

- Multipurpose 5 digit Seven Segment LED Display for best resolution and better viewing from distance.
- Two wire Digital Communication RS-485 enabling two sensors(excluding supply) to be connected on same pair of wires to the evaluation unit. Supporting as much as 1 KM distance between Sensor and Evaluation Unit with shielded two core cables.
- Three Independent Potential Free relays, providing flexibility of selecting six combinations of switching.
- Galvanically Isolated True Two Wire 4-20 mA Proportional to 0.0% and 100.0% level is available for remote indication purposes.
- Two wire implementation solves the malfunction problems that occurs with various PLC 4-20 input interfaces and thus better suits for higher end automation.
- 4-20 mA Loop can handle 700 Ohm Loop Resistance with Internal Isolated Supply. The loop resistance can be 1K Ohm for External DC Supply of 24 Volts.

4 Technical Specifications

4.1 Evaluation Unit

For Evaluation Unit, please refer to Table 1.

PARAMETER	VALUE
Housing	Cast Aluminum, Weather Proof, Stoving Enamel Painted. Suitable for Back Panel / Wall Mounting.
Cable Entries	3 Numbers of 1/2" or 3/4" BSP/NPT/ Double Compression.
Operating Ambient Temperature	-20°C to +60°C
Power Supply	Universal mains 90 to 265 VAC, 50/60Hz (@ 2.9 Watt)
Sensor to Evaluation Unit Cable	2-Core; Resistance per core not to exceed 30 Ohms. Use of shielded twisted pair cables is recommended for long runs of cable. Cable lengths of 1000 meters are thus supported with grounded cable shields.
Zero% Range	30pf to 250pf
100% Range	Level given by ultrasonic level instruments (Sapsonic) for high head and low head (Difference from Zero%) Current 4 to 20mA. RL max = 700 Ohm using internal Isolated Supply. RL max = 1K Ohm for external loop supply of 24 V DC. Current 4 to 20mA. RL max = 700 Ohm using internal Isolated Supply. RL max = 1K Ohm for external loop supply of 24 V DC.
Outputs	3 Potential free relays with one set of potential free change over contact per relay. Contact Ratings : 6 Amp @ 230 V AC 50/60 Hz for non-inductive loads.
Indication	<ul style="list-style-type: none"> • High head and low head value measured by sapsonic ultrasonic level measurement instruments. Range should be entered accurately sapsonic. • 4-20mA associated head/difference : -50% to 150% digitally on seven segment display • Switching: 5 mm Red LED's for alarm indication. Continuous: -50% to 150% digitally on 1"2 seven segment display • Switching: 5 mm Red LED's for alarm indication.
Switching Hysterisis	10mm in single point switching.
Failsafe Select	Field selectable through interactive relay configuration menu.

Table 1: Evaluation Unit

4.2 Electronic Insert

For Electronic Insert, please refer to Table 2.

PARAMETER	VALUE
Electronic Insert	LDC117, LCDM 111: (High Head and Low Head both)
Housing	IP-65, Cast Aluminium
Power Supply	90 - 265 V AC / 18 - 55 V DC (on same terminal)
Measuring Frequency	250Khz to 100Khz. Reverse Frequency Measurement.
Operating Ambient Temperature	<ul style="list-style-type: none"> • 0°C to +80°C (Sensor) • 0°C to +60°C (Electronics)
Sensitivity	10 counts per pF
Output	Analog : 4-20 mA (Galvanically isolated / not isolated), 22mA Error Indication; Digital : RS-485 (Custom ASCII)

Table 2: Electronic Insert

5 Installation & Calibration Guidelines

5.1 ROF Relays

LOH has three relays:

- [rEL 1]
- [rEL 2]
- [rEL 3]

All three relays are independently programmable for Level or Flow. In both operations (Level or Flow) all three relays have the following:

- Alarm Status : Means presence of Alarm.
- Pump Control : Two point (hysteresis) Switching of a relay
Requires High and Low set-points to be entered.
- Single Point : Single Point Switching of a relay.
- Covered Status : Level or Flow Rate is Higher then the High Set Point
- Uncovered Status : Level or Flow Rate is Lower then the Low Set Point
- Fail Safe Selection : Alarm Selection for Covered or Uncovered Status
- Covered Delay Setting: Delay from Covered to Alarm or No Alarm Status
- Uncovered Delay Setting: Delay from Uncovered to Alarm or No Alarm Status
- Both Covered and Uncovered Delays are set in Seconds
- High Set Point : High Level (mm) set point, High Flow Rate set point
- Low Set Point : Low Level (mm) set point, Low Flow Rate set point
For Single Point switching single Alarm Set Point is used.

5.2 ROF 4-20 mA Loop

LOH has One Galvanically Isolated, PLC friendly, 4-20 mA loop. 4-20 mA can be set to follow either Level or Flow Rate percentage. Setting 4-20 mA loop for Level or Flow Rate will Cause the respective percentage display to be visible in display mode selection. Percentage can be forward or reverse. Dynamic range of percentage display is +150.0% to -50.0% 4-20 mA loop operates from zero% to 100% only. For details, refer to Figure 4.

5.3 Relay Setting

To set the three relays first have a plan about how to use the relays.

Each relay can give alarm for either Head Level or Flow Rate.

Head Level and Flow Rate can be used in combination among three relays.

Suppose the following setting is required:

- Relay 1 will give Alarm when Flow Rate is Higher than 54.0cusec (units).
- Relay 2 will give Alarm when Head level is Higher than 700mm.
- Relay 3 will give Alarm when Head level has raised to 600mm and will continue to give alarm until head falls to 300mm.

Relay 1 requires:

- Switch Type: Flow Rate Alarm Single Point Switching.
- Failsafe: To be selected High, (Higher Flow Rate → Alarm).
- Cover Delay: Set as per turbulence at measuring head may be zero.
- Uncover Delay: Set as per turbulence at measuring head may be zero.
- Set Point: Set at 54.0 as required by the example.

Relay 2 requires:

- Switch Type: Level Alarm Single Point Switching.
- Failsafe: To be selected High, (Higher Flow Rate → Alarm).
- Cover Delay: Set as per turbulence at measuring head may be zero.
- Uncover Delay: Set as per turbulence at measuring head may be zero.
- Set Point : Set at 700 as required by the example.

Relay 3 requires:

- Switch Type : Level Alarm Pump Control Switching.
- Failsafe : To be selected High, (Higher Flow Rate → Alarm)
- Cover Delay : Set as per turbulence at measuring head may be zero.
- Uncover Delay : Set as per turbulence at measuring head may be zero.
- Set Point : Set at 600 as required by the example.
- Set Point : Set at 300 as required by the example.

5.4 4-20mA Loop Setting

Since relay, 4-20 mA loop and Weir have same container menu, it is advisable to set 4-20 mA and Weir Data along the way.

Suppose 4-20 mA is required to be coupled to Flow Rate. Selecting 4-20 mA loop for Flow Rate will make Flow Percentage available for display in display selection modes and will debar level percentage from the display mode list.

Suppose zero percent Flow Rate is when Flow Rate is zero.

Suppose 100 percent flow rate is when Flow Rate is 64.0cusecs units.

4-20 mA settings requires:

- Loop Setting : To be selected Flow, Loop is coupled to flow rate.
- Loop Zero : Set at 0.0 as required by the example.
- Loop Full : Set at 64.0 cusecs as required by the example.

5.5 Relay and 4-20 mA Loop Setting Procedure

When ROF is displaying the measurements,

- Press PROG Key for 6 to 8 seconds.
- [ProG] will appear on display.
- Press ENTER Key.
- [rEL 1] will appear. rEL 1 indicates that relay 1 will be configured.
- Press UP key.
- [St xx] will appear. These xx may have following values:
 - L1: Level Type Relay in Single Point Switching.
 - LP: Level Type Relay in Pump Control Switching
 - F1: Flow Rate Relay in Single Point Switching.
 - FP: Flow Rate Relay in Pump Control Switching.
- Press ENTER Key, xx will start blinking.
- Press UP or DOWN Key select appropriate Switching Type for Relay 1 which will be F1 : Flow Rate Single Point in this example.
- Press ENTER Key, blinking will stop to indicate that switching type is selected.
- Press UP Key.
- [FS x] will appear. This x can have following values:
 - H for Fail Safe High or Maximum Fail Safe.
 - L for Fail Safe Low or Minimum Fail Safe.
- Press ENTER Key, x will start blinking.
- Press UP or DOWN Key select appropriate Fail Safe Type for Relay 1 which will be H : Fail Safe High in this example.
- Press ENTER Key, blinking will stop to indicate that Fail Safe High is selected.
- Press UP key.
- [C xx] will appear. Here, xx can have a value from 0 to 90.
- Indicating previously set Covered Delay.
- Press ENTER Key, xx will start blinking.
- Press UP or DOWN Key reach to required Covered Delay for Relay 1 which will be 1 second in this example.
- Press ENTER Key, blinking will stop to indicate that Covered Delay of 1 second is selected for relay 1.
- Press UP key.
- [U xx] will appear. Here, xx can have a value from 0 to 90.

- Indicating previously set Uncovered Delay.
- Press ENTER Key, xx will start blinking.
- Press UP or DOWN Key reach to required Uncovered Delay for Relay 1 which will be 1 second in this example.
- Press ENTER Key, blinking will stop to indicate that Uncovered Delay of 1 second is selected for relay 1.
- Press UP key.
- [Axxx.x] will appear. Here, xxx.x indicates the previously selected Set point for Single Point Switching.
- Press ENTER Key, xxxx will start blinking.
- Press UP or DOWN Key reach to required Switching Set Point for Relay 1 which will be 54cusec (units) in this example.
- Press ENTER Key, blinking will stop to indicate that Switching Point is selected at 54cusec (units) for relay 1.
- Press UP Key.
- [rEL 1] will appear again. This is a role back, pressing UP Key again allows to see the parameter settings for selected relay.
- Relay 1 in this case.
- Now the selected Relay will be changed to Relay 2.
- Press ENTER Key.
- [rEL 1] will start blinking. Blinking indicates that relay number can now be changed.
 - [rEL 2] → Relay 2 can be selected for editing/viewing parameters
 - [rEL 3] → Relay 3 can be selected for editing/viewing parameters
 - [4-20L] → 4-20 mA loop can be selected for loop parameters
 - [APPLY] → For Saving the parameters and exit.
 - [quit] → For Exit without saving the changes.
 - Pressing DOWN key will roll through in reverse order.
- Back to operation, Pressing UP Key once, [rEL 2] will appear and it is still blinking.
- Press ENTER Key.
- [rEL 2] will stop blinking, indicates relay 2 parameters can now be viewed and edited.
- Use UP/DOWN and ENTER Keys as it was done for relay 1 to select the following:
 - [St L1] Switch Type : Level Alarm Single Point Switching.
 - [FS H] Fail Safe : High (Alarm when Level is High).
 - [C 1] Cover Delay : 1 sec (Delay from Level High to Alarm).
 - [U 1] Uncover Delay: 1 sec (Level Low to No Alarm Delay).
 - [A 700] Alarm Set Point : 700mm.
- Eventually roll back will happen after setting the Alarm Set Point.
- [rEL 2] will appear.
- Press UP Key.
- [rEL 3] will start blinking.
- Press UP Key again to select Relay 3.
- [rEL 3] will stop blinking, indicates relay 3 parameters can now be viewed and edited.
- Use UP/DOWN and ENTER Keys as it was done for relay 1 to select the following:
 - [St LP] Switch Type: Level Alarm Pump Control Switching.
 - [FS H] Fail Safe: High (Alarm when Level is High).
 - [C 1] Cover Delay: 1 sec (Delay from Level High to Alarm).
 - [U 1] Uncover Delay: 1 sec (Level Low to No Alarm Delay).
 - [H 600] High Set Point: 600mm Alarm Starts here.
 - [L 300] Low Set Point: 300mm Alarm Ends here.
- Roll back will happen after setting the Low Set Point.
- [rEL 3] will appear.
- Press ENTER Key.
- [rEL 3] starts blinking.
- Press UP Key.
- [4-20L] will appear and it is blinking. Here 4-20 Loop parameters can be edited. This menu will hold the following:
 - 4-20 mA Hardware is coupled to Level or Flow Rate % data.
 - Percentage data of Level or Flow Rate % value.
 - 4 mA or 0% Level mm or Flow Rate units entry.
 - 20 mA or 100% Level mm or Flow Rate units entry.
- Press ENTER Key.
- [4-20L] stops blinking. Indicating that 4-20 mA loop parameters can now be viewed and edited.
- Press UP Key.
- [LP x] appears. Here x can have a value of L (Level) or F (Flow Rate) Like relay Failsafe Parameter, it can edited by using:
 - Press ENTER ⟨blink⟩ Press UP/DOWN ⟨L/F edit⟩
 - Press ENTER ⟨blink stops⟩ ⟨L/F selected⟩
 - Select F (Flow Rate) for present example.
- Press UP Key.
- [Zxxx.x] appears. Z requires little creative reading for seven segment. This is entry point to set 0% or 4mA value.
- Decimal point will not appear for user units (K n En

- try).
- As done for relay set point entries, enter 0.0 for this ex.
- Press UP Key.
- [Fxxx.x] appears. This is entry point to set 100% or 20mA value.
- Decimal point will not appear for user units(K n Entry).
- As done for relay set point entries, enter 64 for this ex.
- Press UP key and roll back will occur.
- [4-20L] appears again.
- Press ENTER, [4-20L] starts blinking.
- Press UP Key.

6 Displays

6.1 Primary Displays

The primary displays are:

- [init] : Instrument Power On
- [SnSdt] : Communication initiated with SAPSONIC (sensor)
- [ErSnS] : Trouble with sensor communication
- [hxxxx] : Head Level in mm (xxxx mm)
- [Pxxx.x] : Head Level in Percentage (xxx.x%)
- [Fxxxx] : Flow in user units for $Q=K*L n$

Flow in cusec (xxx.x) for following Selected Weirs:

- [1] Cipoletti Weir
- [2] Fully Contracted Rectangular Weir
- [3] Standard Suppressed Rectangular Weir
- [4] 90 Degree Notch Triangular

- [dxxx.x] : Flow (Discharge) in Percentage (xxx.x%)
- [L Hi] : Level is more than 2000mm or 150%
- [L Lo] : Level is less than -400mm or -50%
- [F Hi] : Flow is higher than 9999 Flow Rate Units (or 999.9 cusecs)
- [F Lo] : Flow Rate percentage is Less than -50%

6.2 Display Selection

To select a display mode from <level mm> <level%> <Flow> <Flow%> Press UP key when ROF is displaying the measurement. The displayed mode will change. When the desired display mode appears, Press Enter Key to select it. Pressing UP key again will change the display mode but selected (Entered) display mode will appear after power on.

7 Electrical Connections

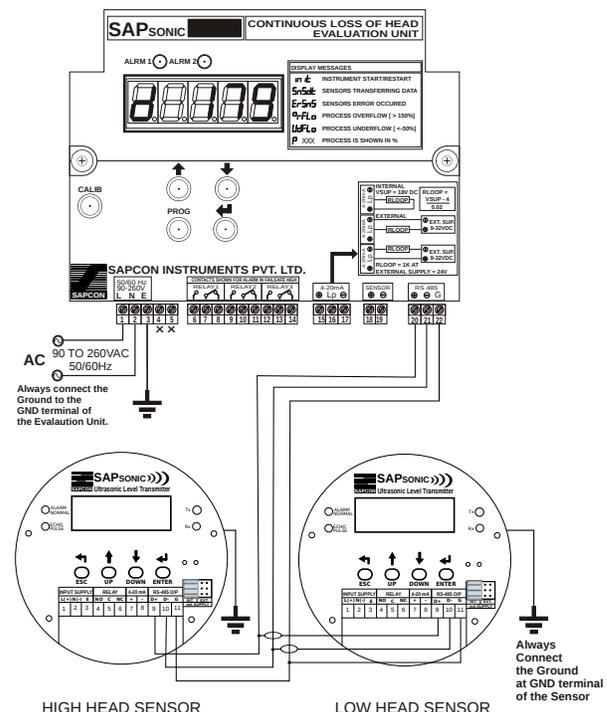
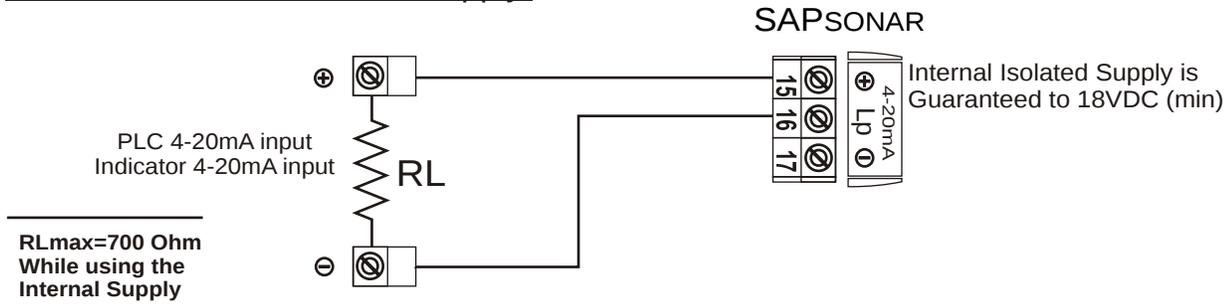
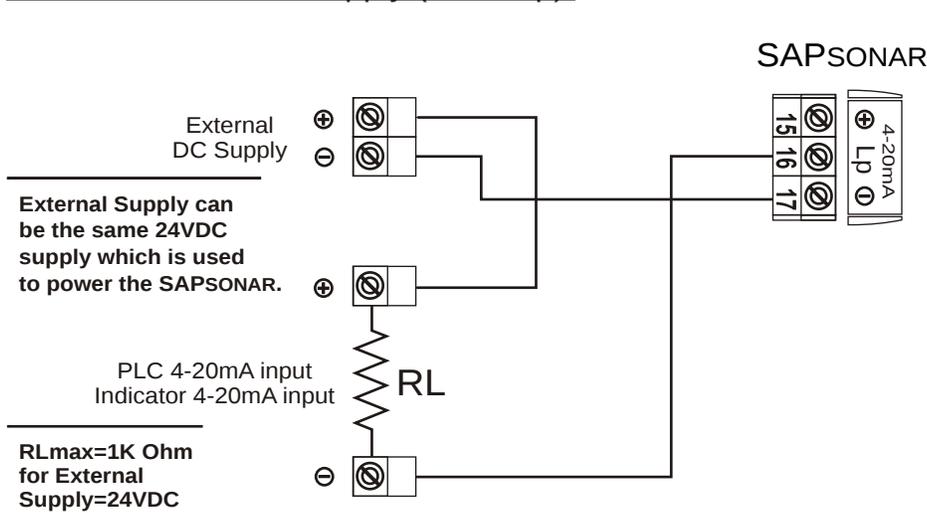


Figure 3: SAPSONIC LOH Connection Diagram - Sensor and Power Supply

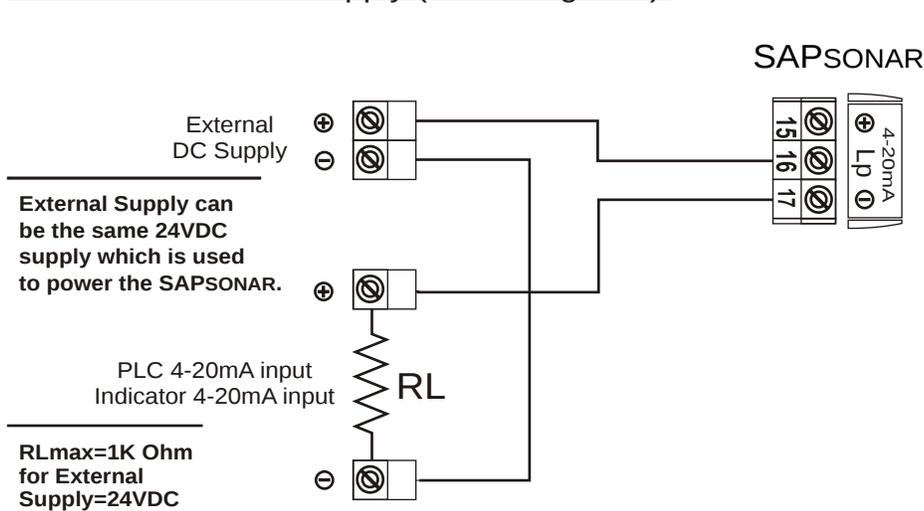
Internal Isolated DC Power Supply:



External DC Power Supply (RL to Lp):



External DC Power Supply (RL to Negative):



Loop Resistance = (Loop Supply Voltage – 4) ÷ 0.02 (Ohm)

Figure 4: SAPSONIC LOH Connection Diagram - 4-20mA Combinations

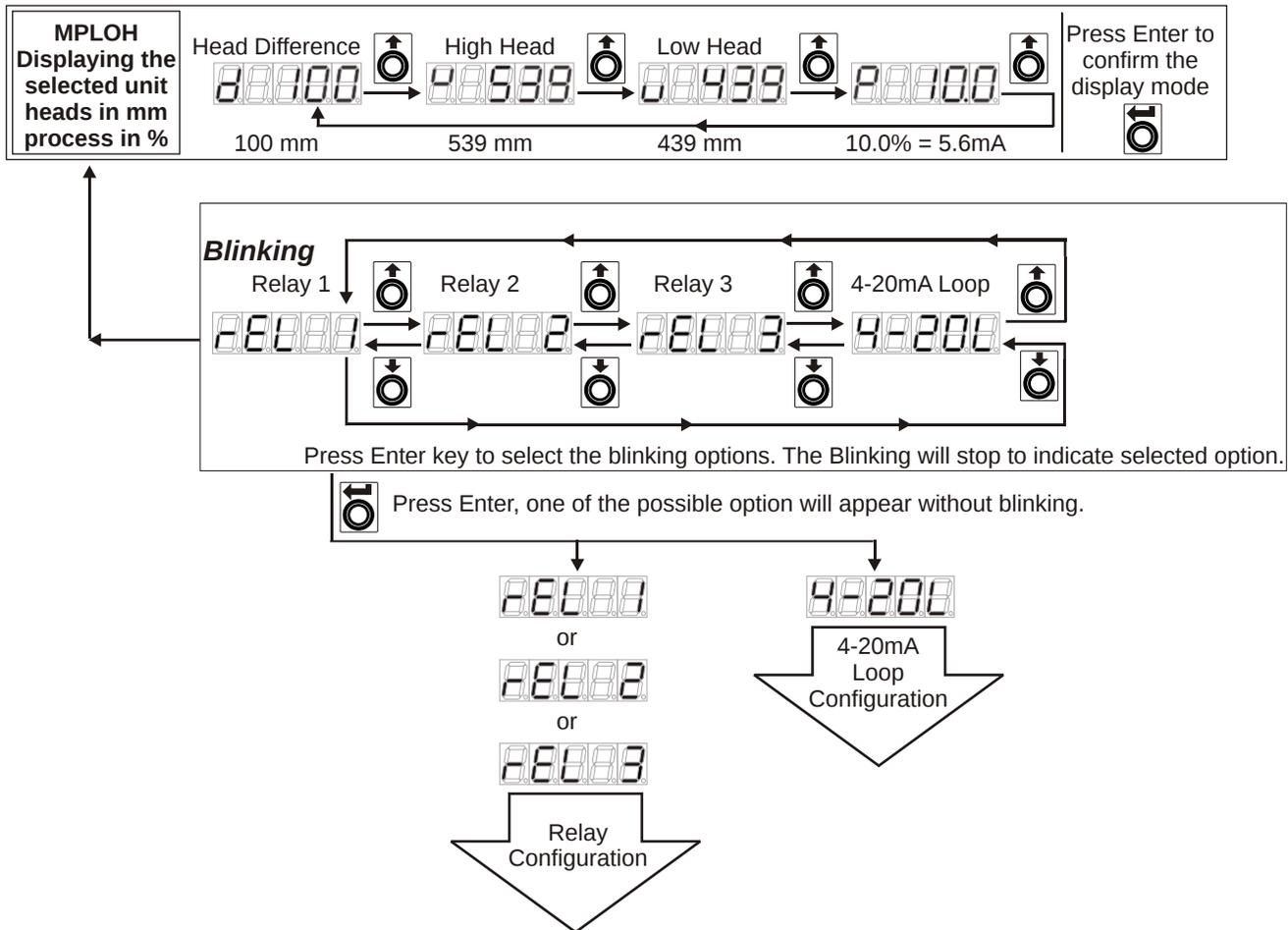


Figure 5: SAPSONAR Quick Reference - Relay and Loop Configuration

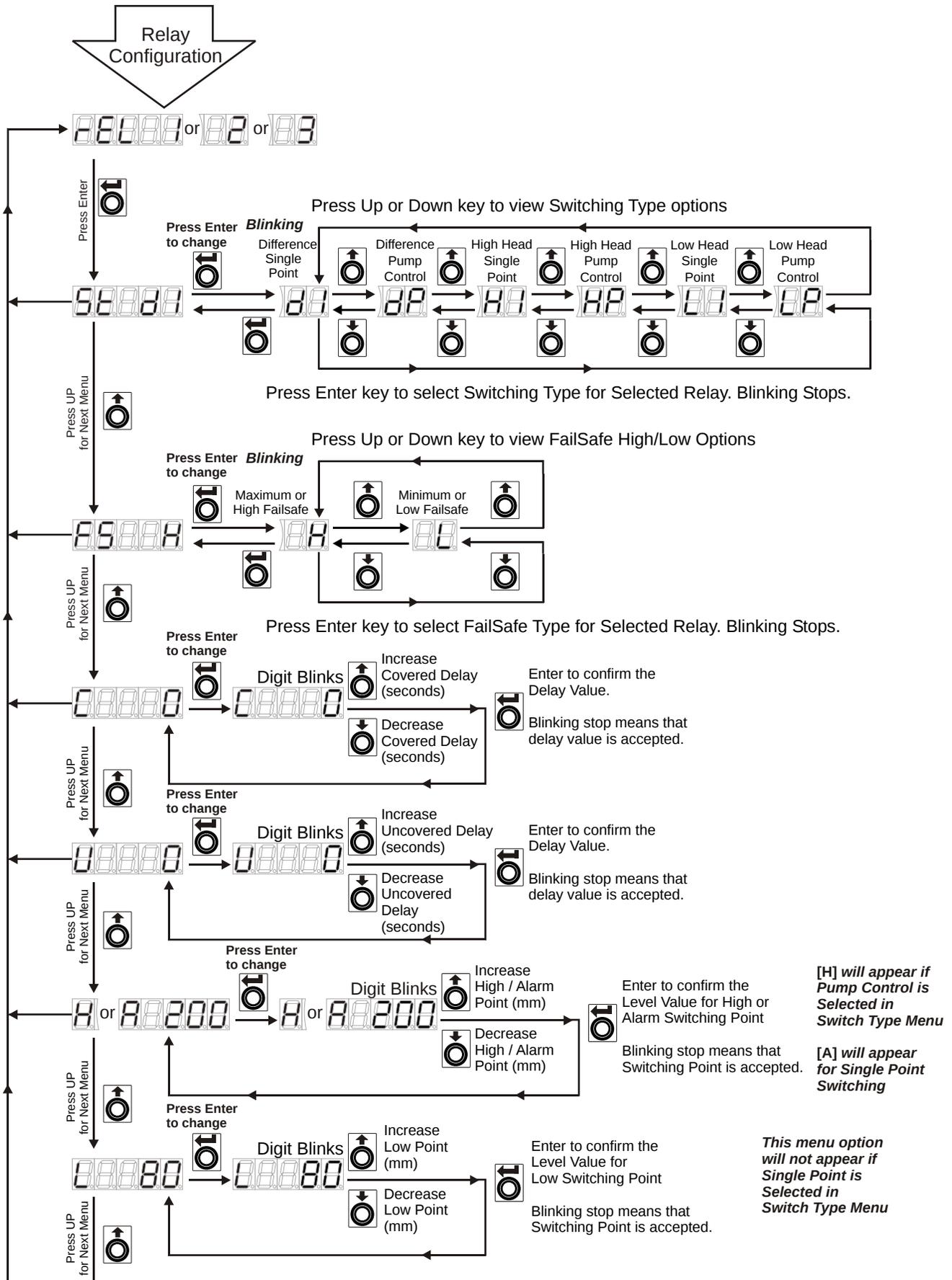


Figure 6: SAPSONAR Quick Reference - Relay Programming Configuration

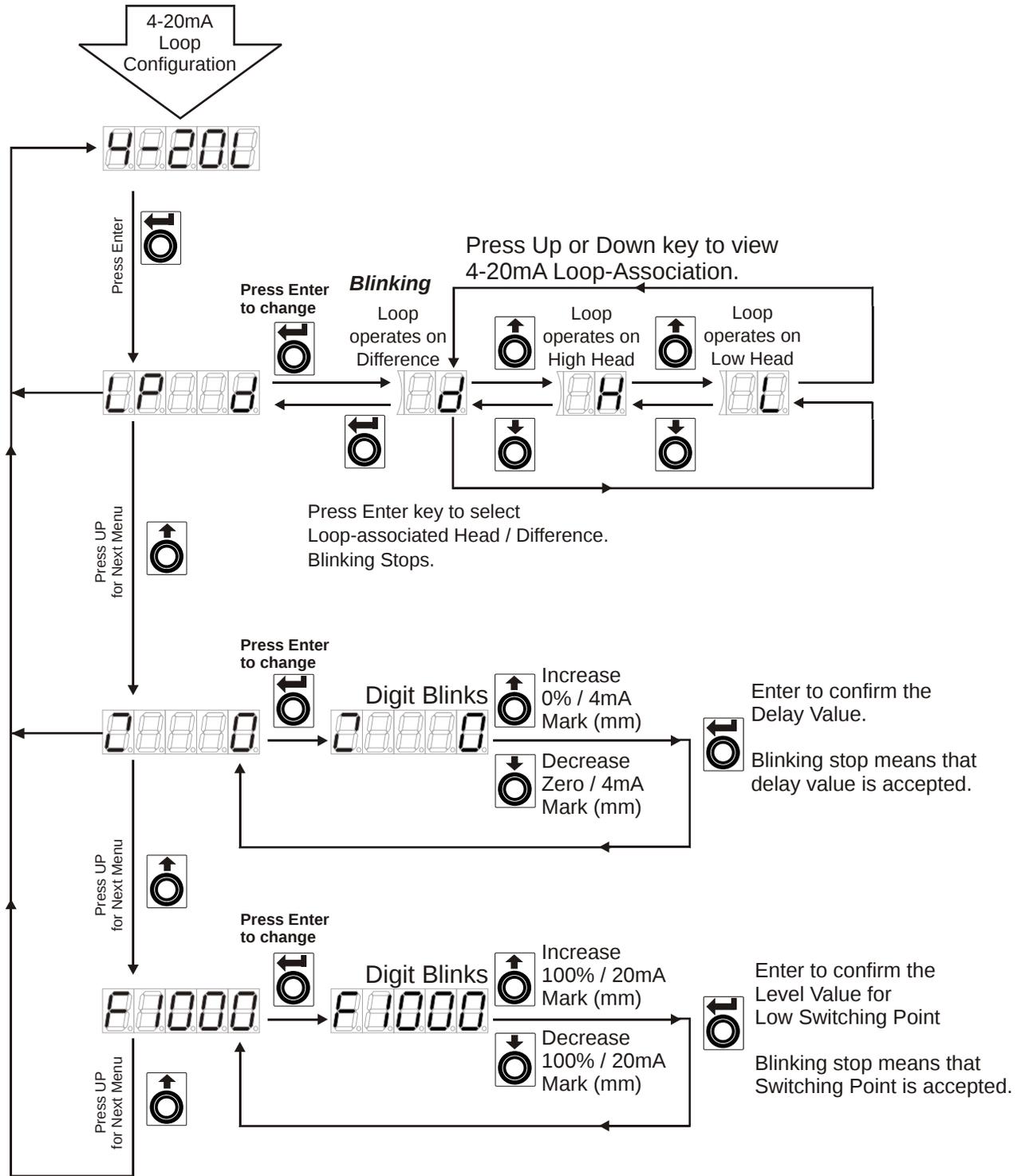


Figure 7: SAPSONAR Quick Reference - 4-20mA Loop Programming Configuration

8 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:

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