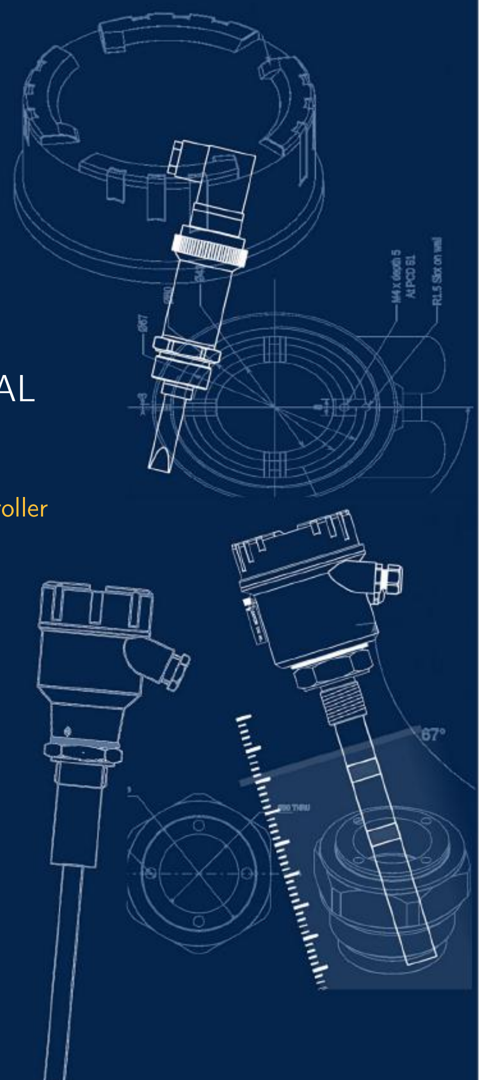
SAPCON

*Grown...to meet challenges*



# INSTRUCTION MANUAL

## MPILC

### Microprocessor Based Level Controller

Version 2.1

## SAPCON INSTRUMENTS PVT. LTD.

30+ Years in Process Control Instrumentation
An ISO 22000 company
www.sapconinstruments.com

Custom-built International Standard Products | 80,000+ Successful Installations | Exporting to 90+ Countries | 7500+ Clients

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# Revision History

| Revision | Date | Author(s) | Description |
|---|---|---|---|
| 1.0 | 27 Feb 2014 | RND | First Version Editing |
| 1.1 | 15 Aug 2014 | MRK | Applications Revision |
| 1.2 | 20 May 2015 | RND | Features Revision |
| 1.3 | 12 Nov 2015 | RND | Specs Revision |
| 1.4 | 25 Jun 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

Sapcon MPILC series instruments are RISC Processor based Capacitance type Continuous Level Indicators with built-in Three Point Switching.The instrument is suitable for measuring the level of conductive or non conductive liquids, slurries and powdered or fine grained solids homogeneous composition having a stable dielectric constant. Apart from level indication, the built-in three point electronic level limit switch offers the switching functions for alarm annunciation and/or control application at the set point levels.The set points are independent of each other and are continuously configurable over the entire range.

Figure 1: MPILC

# 2 Operating Principle

In an application, the measuring electrode (sense probe) and the container wall (ground or reference probe) form a capacitor. The amount of capacitance of this capacitor is governed by the dielectric constant of the material between the two electrodes (sense probe metallic container wall or reference probe or ground).

The value of this capacitor is dependent on the level of material, since the dielectric of the material is effective only to the level to which the material is filled. MPILC measures the change of capacitance to measure the change of level of the material. Since this is a relative measurement, a proper calibration is thus always necessary.

# 3 Features

- Latest RISC Core Micro-controller Technology.
- Measured Level is Displayed Continuously from -50% to 150%.
- Multipurpose 5 digit Seven Segment LED Display for best resolution and better viewing from distance.

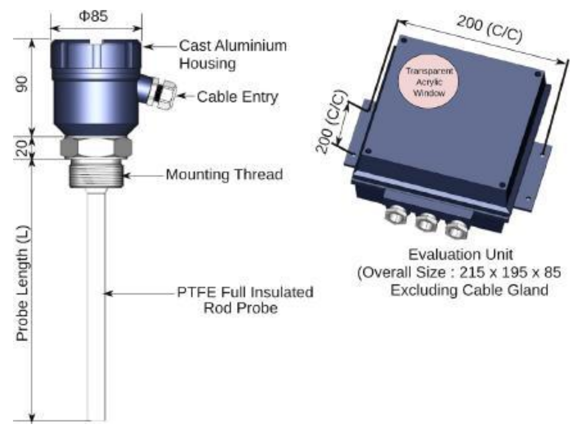



Figure 2: Part Diagram

- Two wire Pulse Coded Digital Communication from Sensor to 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 three independent switch points.
- Galvanically Isolated True Two Wire 4-20 mA Proportional to 0% and 100% 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 aluminium weatherproof stoving enamel painted suitable for wall/back Panel mounting. |
| Cable Entries | 3 Numbers of 1/2"/3/4"/BSP/NPT/Double Compression. |
| Ambient Temperature Range | -20 deg.C. to +60 deg. C. |
| Power Supply | Universal Mains 90 to 265 V AC, 50/60Hz and 24 V DC(@ 3Watt). |
| 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 length of 1000 Meters are thus are supported with the Grounded Weather Shields. |
| Zero% Range | 30pf tp 250pf |
| 100% Range | 10pf to 4500pf(Difference from Zero%) Current- 4 to 20 mA.RL max = 700 Ohm using internal Isolated supply.RL max = 1 KOhm for external loop supply of 24 V DC. |
| Output | 3 potential free relays with one set of potential free charge over contact per relay.<br>Contact Ratings : 6 Amp @230 V AC 50/60Hz for non-inductive loads. |
| Indication | Continuous: -50% to 150% digitally on 1/2"seven segment display. |
| Switching | 5mm Red Leds for alarm indication. |
| Switching Hysteresis | 1% in single point switching, 1 to 98% Selectable in pump control. |
| Failsafe Select | Field Selectable through interactive relay configuration menu. |
| Dimensions | Refer Enclosed Drawings |
| Weight | 2.3Approx. |

Table 1: Evaluation Unit

## 4.2 Electronic Insert-LDC117, LDCM111

For Electronic Insert please refer to Table 2.

| PARAMETER | VALUE |
|---|---|
| Housing | Plastic, potted with epoxy resin. |
| Power Supply | 16 V DC @ 5 mA derived from sensor communication interface of Evaluation Unit. |
| Measuring Frequency | 250KHz to 20KHz.Reverse frequency measurement. |
| Operating Ambient Temperature | $-20°$C to $+60°$C |
| Sensitivity | 10 counts per pf |
| Output | Digitally encoded current(5mA-8mA)pulse. |

Table 2: Electronic Insert

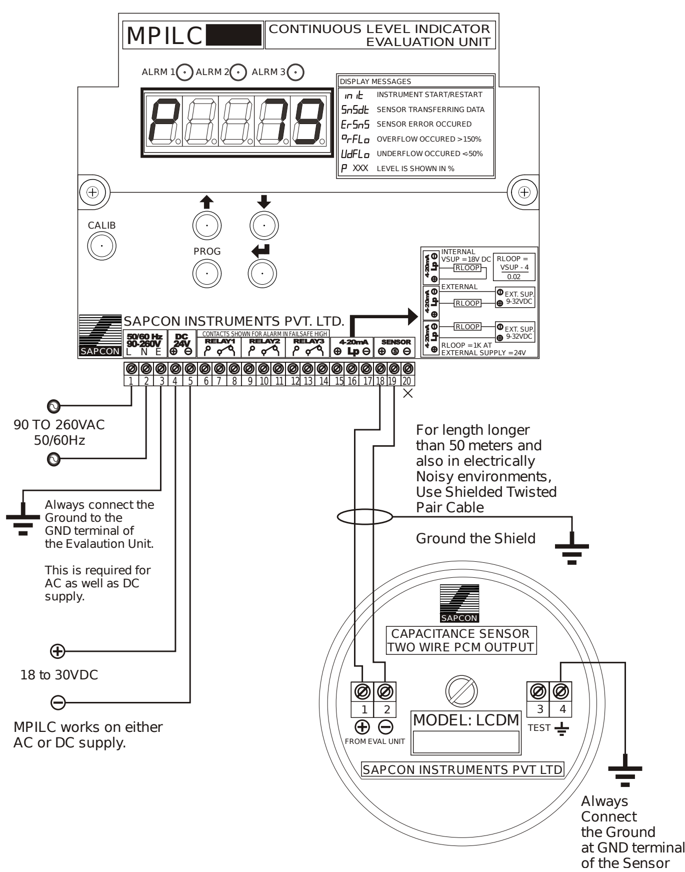
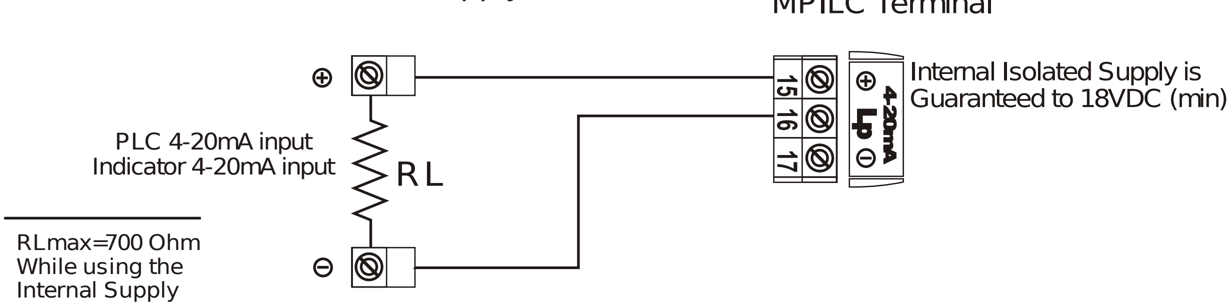
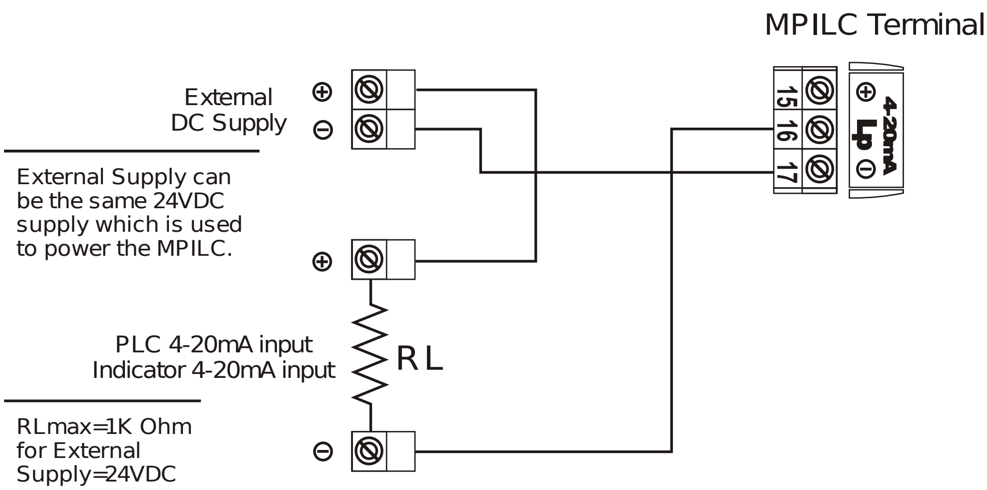



Figure 3: Connection Diagram : Sensor and Power Supply

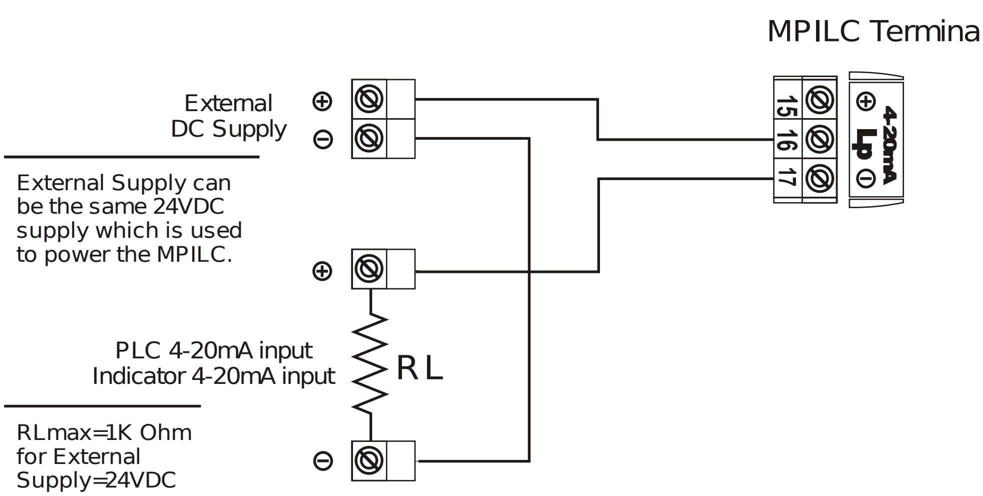
## Internal Isolated DC Power Supply:




## 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: Connection Diagram : 4-20mA Combinations

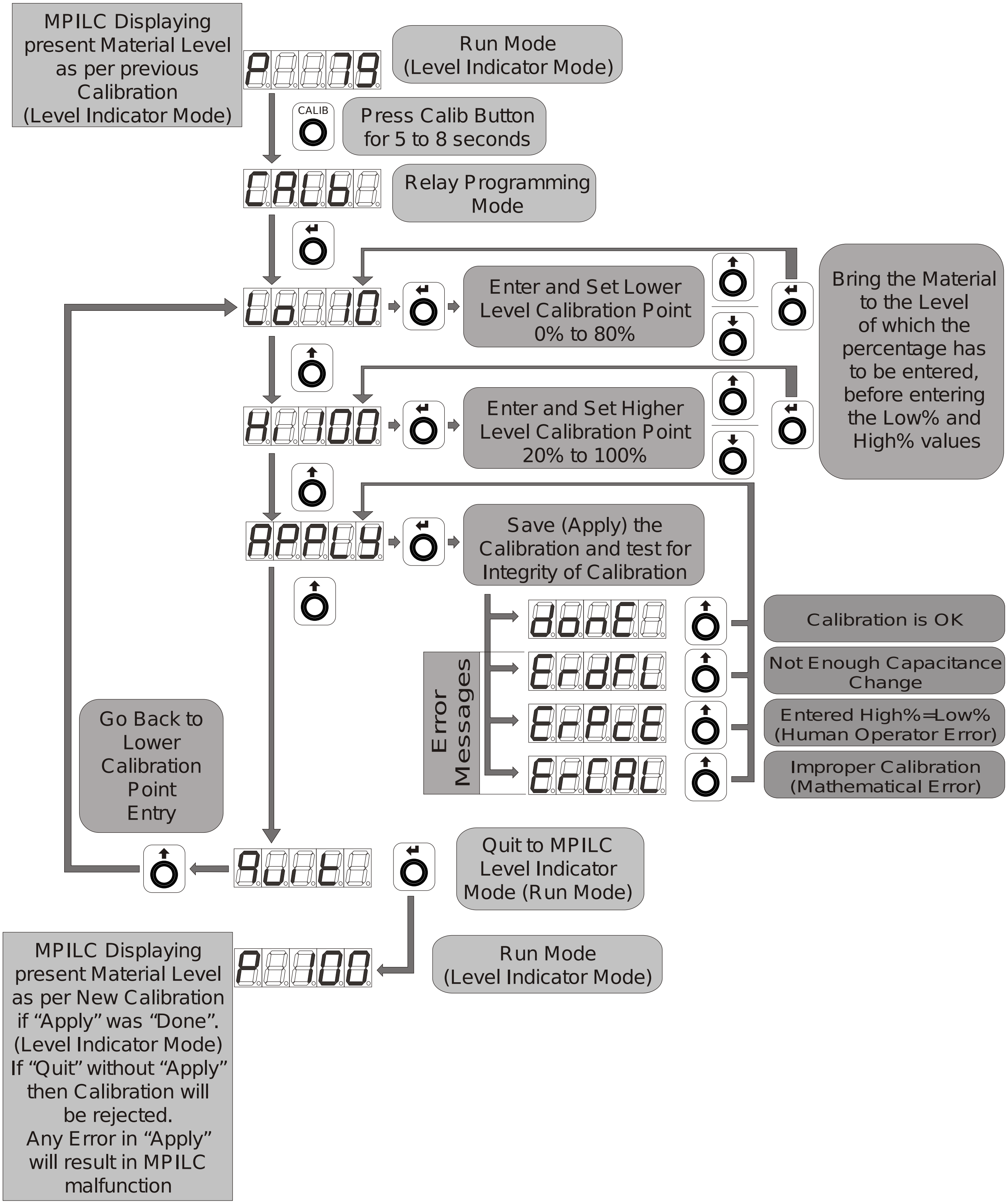



Figure 5: Quick Reference : Calibration

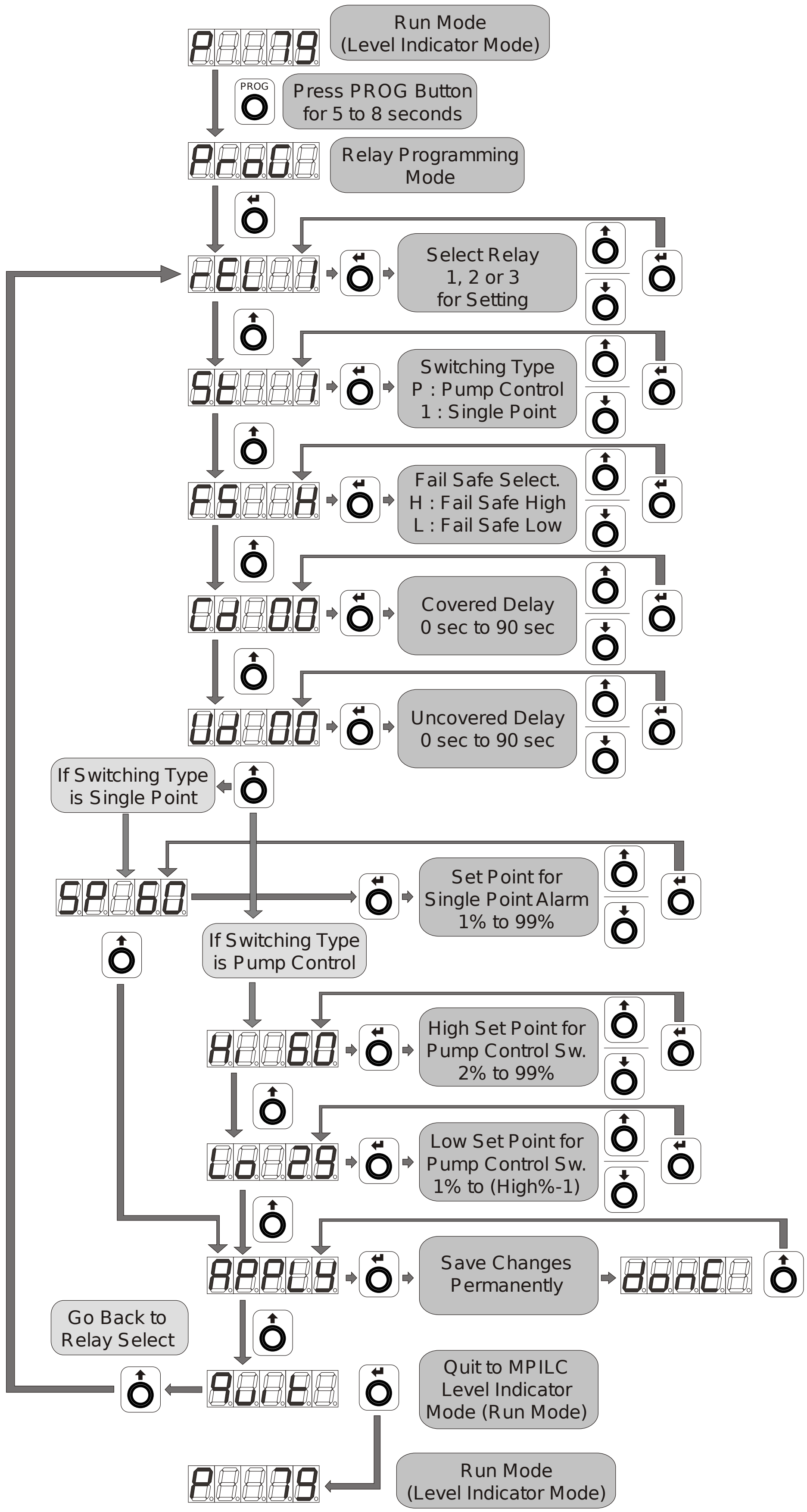



Figure 6: Quick Reference : Relay Programming

# How to calibrate MPILC?

| Calibration Condition | Page No. |
|---|---|
| When tank can be emptied to 0% and can be filled to 100% | C-01 to C-03 |
| When tank cannot be emptied to 0% or cannot be filled to 100% or both | C-04 to C-05 |
| When tank can be emptied or filled for the purpose of calibration in a long range of time or few days. | C-06 to C-09 |

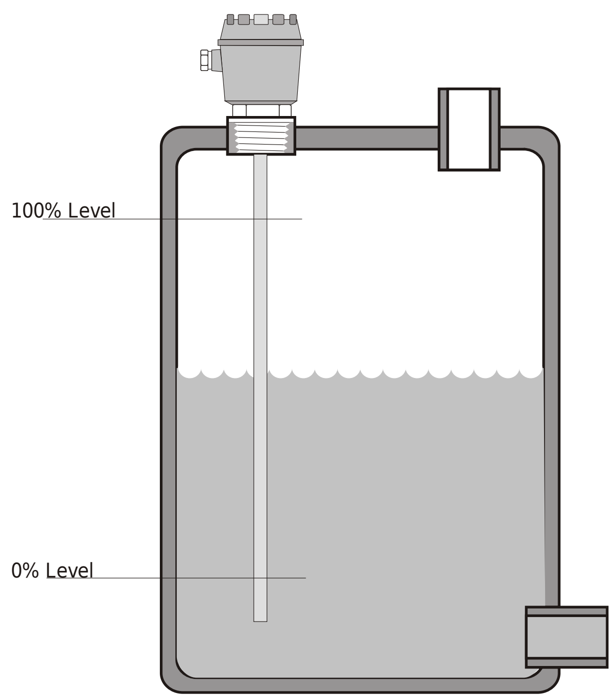
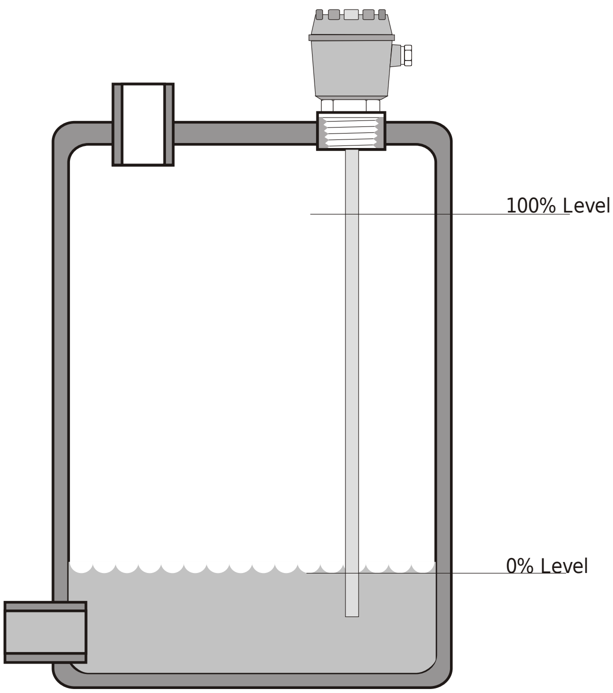



Figure 7: Calibration

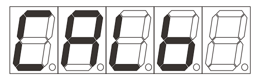
## Zero to 100% : When the tank can be Emptied to 0% and can be Filled to 100%

### Calibrating Low Point at 0%:




Empty the Tank to desired zero% level.

Press CALIB Button for 5 to 8 seconds.

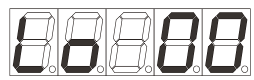



Will appear on the display.

Release CALIB Button.

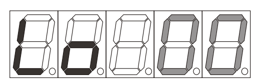
Press Button.

*The Calibration Mode is now Entered.




Previously entered Low Calibration Point Value will be displayed.

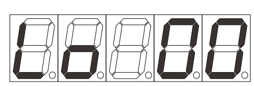
Press Button.




Last two digits will start blinking. Blinking indicates that Low Calib Point can be modified using buttons:

For now, the material level is at 0%, therefore change the last two digits to 00 .

Press Button.




Last two digits will stop blinking. This means that Low Calib Point is read at existing material level for 0% level indication.

The Low Level Calibration point is just calibrated to read existing material level as 0%.

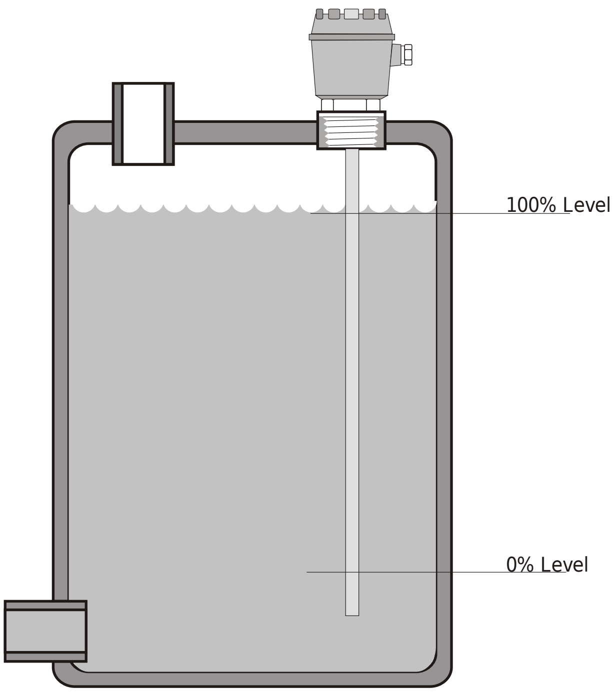
Note that 100% should be calibrated before reseting of the instrument due to events like power failure.

In case if filling to 100% may take long time and an electric power failure/interruption is expected, refer the topic “Calibrating High and Low level at long intervals of time”.

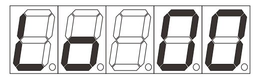
Figure 8: Calibration

## Zero to 100% : When the tank can be Emptied to 0% and can be Filled to 100%

### Calibrating High Point at 100%:

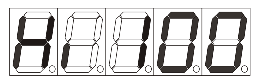



Fill the Tank to desired 100% level.



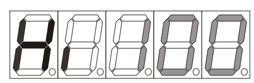

Display indication from the last step.

Press Button.




Previously entered High Calibration Point Value will be displayed.

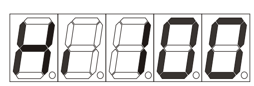
Press Button.




Last three digit will start blinking. Blinking indicates that High Calib Point can be modified using buttons:

For now, the material level is at 100%, therefore change the last three digits to 100 .

Press Button.




Last three digits will stop blinking. This means that High Calib Point is read at existing material level for 100% level indication.

The High Level Calibration point is just calibrated to read existing material level as 100%.

Since now Low and High both Calibration points are entered with respect to their material levels, the Calibration will now be Saved (Applied).

Saving (Applying) the values is essential, so that MPILC can recall the calibration after the electric power supply is interrupted.

Figure 9: Calibration

## Zero to 100% : When the tank can be Emptied to 0% and can be Filled to 100%

### Saving the Calibration Permanently:

**Hi 100** — Display indication from the last step

Press ↑ Button.

**APPLY** — "Apply" means that Low and High Calibrated point entered so far will be analyzed and will be stored in permanent memory if no Calibration Error is present.

Press ↵ Button. — Pressing Enter Button "Applies" the Calibration points. MPILC will check the Calib Points against the Material Level Values.
One of the following message will appear on display:

**donE** **ErdFL** **ErPCE** **ErCAL**

Meaning of The Apply Menu Messages:

| | |
|---|---|
| donE | No problem is found with the Calibration Points against the Material Level. Calibration Values are saved in Permanent Memory. |
| ErdFL | Capacitance change with the changing Material Level is too low against the entered Calibration points. Calibration Values are, however, saved in Permanent Memory. |
| ErPCE | High Set Point is accidently made equal to the Low Set point during numeric entry by human error of calibrating person. Calibration Values are, however, saved in Permanent Memory. |
| ErCAL | Calibration is not acceptable by the MPILC. Re-calibration is required. Calibration Values are, however, saved in Permanent Memory. |

In case of any error here. The calibration ** must ** be performed once again.

Press ↑ Button. **APPLY** Will appear once again.

Press ↑ Button again.

**QuIt** — Quit menu will allow to get back to Run Mode (Level Indicator Mode) of MPILC.
*Quit without "Apply" will discard any change in MPILC Calibration.

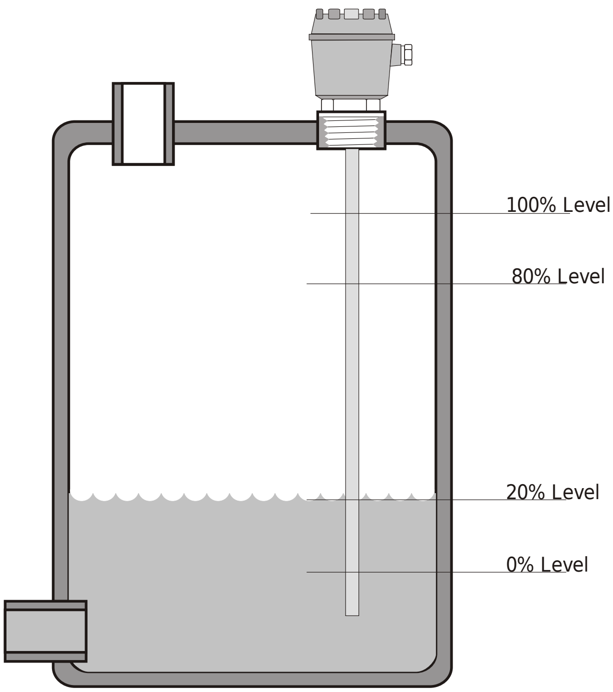
- Press ↵ Button to Exit back to Run ( Level Indicator Mode ) Mode of MPILC.
- Press ↑ Button to Roll Back to Low Calibration Point Entry Menu. **Lo 00**

Figure 10: Calibration

## Intermediate Calibration : When tank can't be Emptied to 0% or Filled to 100% or both

### For Example: 20% to 80%Calibration:

Calibrating Low Point at 20%:



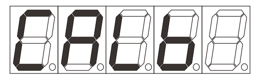

Please note that calibrating at intermediate values like 80%-20%, 70%-30% etc. may not be as accurate for the purpose of level indication as it could be for 0%-100%.

Use this feature only if the accuracy of indication is of lesser concern.

Keep maximum difference between the Low Calib and High Calib Points for better Result.

Empty the Tank to desired 20% level.

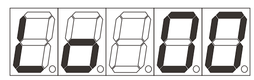
Press CALIB Button for 5 to 8 seconds.




Will appear on the display. Release CALIB Button.

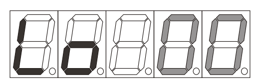
Press ↵ Button.

*The Calibration Mode is now Entered.




Previously entered Low Calibration Point Value will be displayed.

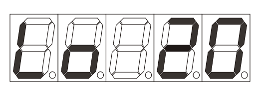
Press ↵ Button.



Last two digits will start blinking. Blinking indicates that Low Calib Point can be modified using buttons: ↑ ↓

For now, the material level is at 0%, therefore change the last two digits to 20 .

Press ↵ Button.




Last two digits will stop blinking. This means that Low Calib Point is read at existing material level for 20% level indication.

The Low Level Calibration point is just calibrated to read existing material level as 20%.

Note that 100% (or 80% or any other High Calib Point) should be calibrated before reseting of the instrument due to events like power failure.

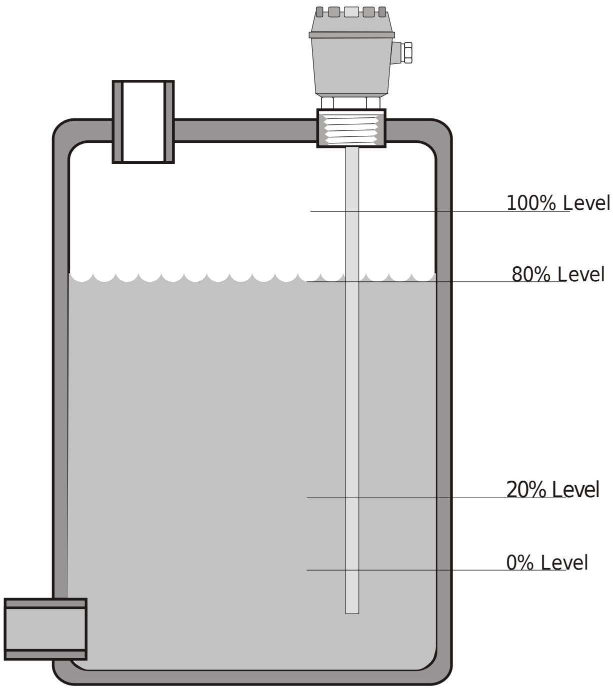
In case if filling to High Calib Point may take long time and an electric power failure/interruption is expected, refer the topic "Calibrating High and Low level at long intervals of time"

Figure 11: Calibration

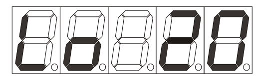
Intermediate Calibration : When tank can't be Emptied to 0% or Filled to 100% or both

For Example: 20% to 80%Calibration:

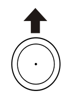
Calibrating High Point at 80%:

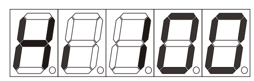



Fill the Tank to desired 80% level.

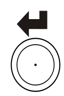


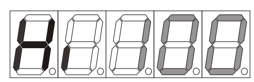

Display indication from the last step.

Press  Button.

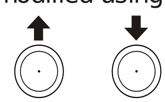



Previously entered High Calibration Point Value will be displayed.

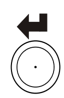
Press  Button.

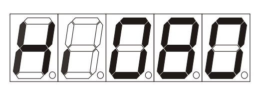



Last three digit will start blinking. Blinking indicates that High Calib Point can be modified using buttons:



For now, the material level is at 80%, therefore change the last three digits to 080 .

Press  Button.




Last three digits will stop blinking. This means that High Calib Point is read at existing material level for 80% level indication.

Please note that calibrating at intermediate values like 80%-20%, 70%-30% etc. may not be as accurate for the purpose of level indication as it could be for 0%-100%.

Use this feature only if the accuracy of indication is of lesser concern.

Keep maximum difference between the Low Calib and High Calib Points for better Result.

The High Level Calibration point is just calibrated to read existing material level as 80%.

Since now Low and High both Calibration points are entered with respect to their material levels, the Calibration will now be Saved (Applied).

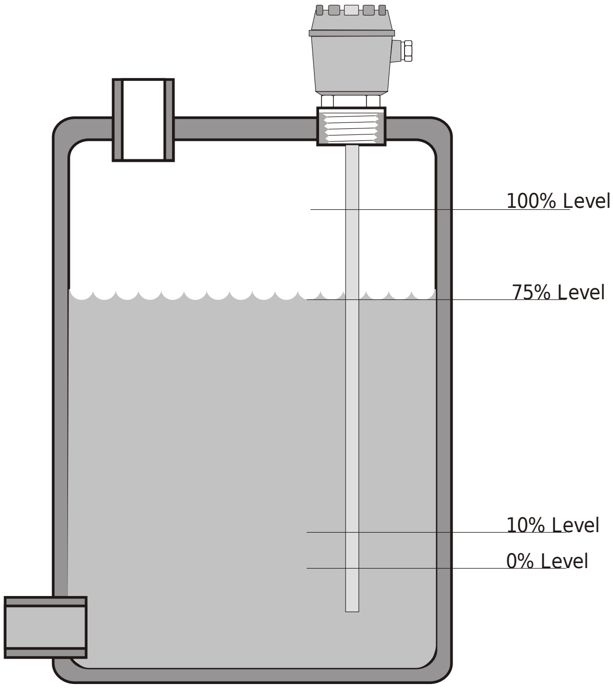
Saving (Applying) the values is essential, so that MPILC can recall the calibration after the electric power supply is interrupted. Refer the topic "Saving the Calibration Permanently" for information on how to save or apply the Calibration points.

Figure 12: Calibration

## Calibrating High and Low level at long intervals of time:

## For Example: 10% to 75%Calibration in 2 days

### Calibrating High Point at 75%:



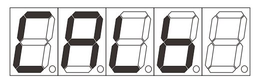

Please note that calibrating at intermediate values like 80%-20%, 70%-30% etc. may not be as accurate for the purpose of level indication as it could be for 0%-100%.

Use this feature only if the accuracy of indication is of lesser concern.

Keep maximum difference between the Low Calib and High Calib Points for better Result.

Suppose there is a case that at the time of commissioning of MPILC, the level is at 75%. And this level will fall in next 2-3 days to 10%. In this example it will shown how to calibrate MPILC over the long intervals of time.

Press CALIB Button for 5 to 8 seconds.

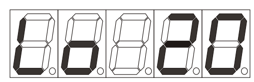


Will appear on the display.

Release CALIB Button.

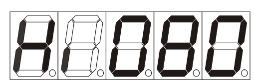
Press Button.

*The Calibration Mode is now Entered.



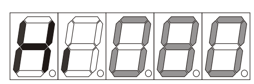
Previously entered Low Calibration Point Value will be displayed.

Press Button.



Previously entered High Calibration Point Value will be displayed.

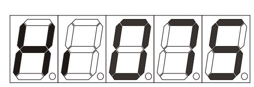
Press Button.



Last three digits will start blinking. Blinking indicates that High Calib Point can be modified using buttons:

For now, the material level is at 75%, therefore change the last two digits to 075 .

Press Button.



Last three digits will stop blinking. This means that High Calib Point is read at existing material level for 75% level indication.

Figure 13: Calibration

## Calibration Over Long Intervals of Time (Days):

### Saving Calibration Point for delayed Calibration:

Hi075 — Display indication from the last step

Press ↑ Button.

APPLY — "Apply" means that Low and High Calibrated point entered so far will be analyzed and will be stored in permanent memory if no Calibration Error is present.

Press ↵ Button. Pressing Enter Button "Applies" the Calibration points. MPILC will check the Calib Points against the Material Level Values.
One of the following message will appear on display:

donE ErdFL ErPCE ErCAL

**Meaning of The Apply Menu Messages:**

| | |
|---|---|
| donE | No problem is found with the Calibration Points against the Material Level. Calibration Values are saved in Permanent Memory. |
| ErdFL | Capacitance change with the changing Material Level is too low against the entered Calibration points. Calibration Values are, however, saved in Permanent Memory. |
| ErPCE | High Set Point is accidently made equal to the Low Set point during numeric entry by human error of calibrating person. Calibration Values are, however, saved in Permanent Memory. |
| ErCAL | Calibration is not acceptable by the MPILC. Re-calibration is required. Calibration Values are, however, saved in Permanent Memory. |

Note that Calibration Points are always saved. This means that if there is any error due to faulty calibration for the moment, it will be get corrected when the other calib point is properly calibrated. In this case any error will be rectified after the Low Calin point is properly calibrated.

Press ↑ Button. APPLY Will appear once again.

Press ↑ Button again.

Quit — Quit menu will allow to get back to Run Mode (Level Indicator Mode) of MPILC.
*Quit without "Apply" will discard any change in MPILC Calibration.

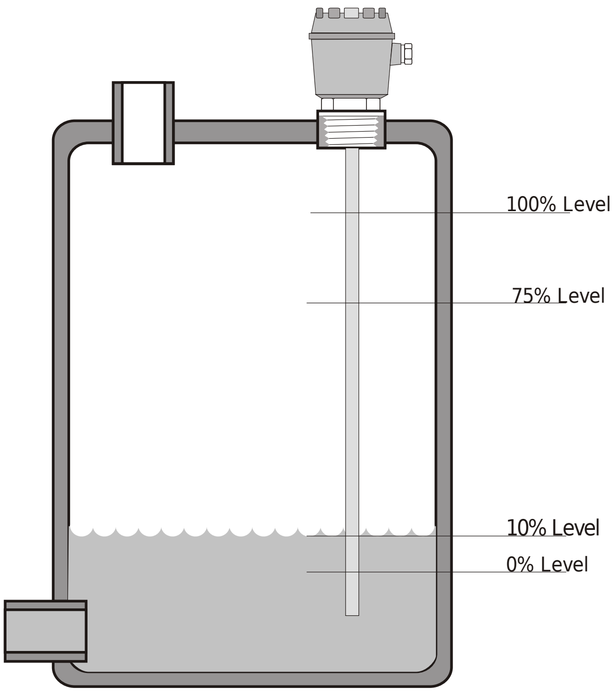
Press ↵ Button to Exit back to Run Mode (Level Indicator Mode) of MPILC.
MPILC may give incorrect indication since the calibration is not yet complete.
Therefore, don't connect any control to the relays and 4-20mA loop.

Figure 14: Calibration

## Calibration Over Long Intervals of Time (Days):

### For Example: 10% to 75%Calibration:

### Calibrating Low Point at 10% after 2 days:



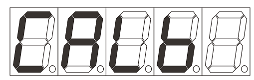

Please note that calibrating at intermediate values like 80%-20%, 70%-30% etc. may not be as accurate for the purpose of level indication as it could be for 0%-100%.

Use this feature only if the accuracy of indication is of lesser concern.

Keep maximum difference between the Low Calib and High Calib Points for better Result.

Now, after calibrating and saving (Applying) the 75% level 2 days back, the level is now emptied down to 10%.
The Low Calib Point will now be set to complete the Calibration.

Press CALIB Button for 5 to 8 seconds.

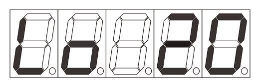



Will appear on the display.

Release CALIB Button.

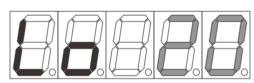
Press Button.

*The Calibration Mode is now Entered.




Previously entered Low Calibration Point Value will be displayed.

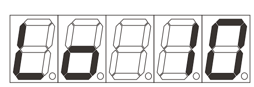
Press Button.




Last two digits will start blinking. Blinking indicates that Low Calib Point can be modified using buttons:

For now, the material level is at 10%, therefore change the last two digits to 10 .

Press Button.




Last two digits will stop blinking. This means that Low Calib Point is read at existing material level for 10% level indication.

The Low Level Calibration point is just calibrated to read existing material level as 10%.

Since the High Calib Point was already set 2 days back. Corrected Low Calib Point will now be Saved.

Figure 15: Calibration

## Calibration Over Long Intervals of Time (Days):

### Saving Calibration Point after delayed Calibration:

`Lo 10` Display indication from the last step

Press ↑ Button.

`Hi 075` High Calib Point set value entered 2 days back.

Press ↑ Button.

`APPLY` "Apply" means that Low and High Calibrated point entered so far will be analyzed and will be stored in permanent memory if no Calibration Error is present.

Press ↵ Button. Pressing Enter Button "Applies" the Calibration points. MPILC will check the Calib Points against the Material Level Values.
One of the following message will appear on display:

`donE` `ErdFL` `ErPCE` `ErCAL`

**Meaning of The Apply Menu Messages:**

| | |
|---|---|
| `donE` | No problem is found with the Calibration Points against the Material Level. Calibration Values are saved in Permanent Memory. |
| `ErdFL` | Capacitance change with the changing Material Level is too low against the entered Calibration points. Calibration Values are, however, saved in Permanent Memory. |
| `ErPCE` | High Set Point is accidently made equal to the Low Set point during numeric entry by human error of calibrating person. Calibration Values are, however, saved in Permanent Memory. |
| `ErCAL` | Calibration is not acceptable by the MPILC. Re-calibration is required. CalibrationValues are, however, saved in Permanent Memory. |

In case of any error here. The calibration ** must ** be performed once again.

Press ↑ Button. `APPLY` Will appear once again.

Press ↑ Button again.

`quit` Quit menu will allow to get back to Run Mode (Level Indicator Mode) of MPILC.
*Quit without "Apply" will discard any change in MPILC Calibration.

Press ↵ Button to Exit back to Run Mode (Level Indicator Mode) of MPILC.

Figure 16: Calibration

# Programming the Relays of MPILC

## Complete Relay Configuration Guide with Application Example

<u>Note:</u> Application is explained while keeping an intentional fault in the in the example. A proposed solution is later is explained. It is, however, left on the experience and discretion of the Instrumentation Personnel of the Plant t decide how to use the various available futures of MPILC skillfully for the purpose of automation/control of a given Process.

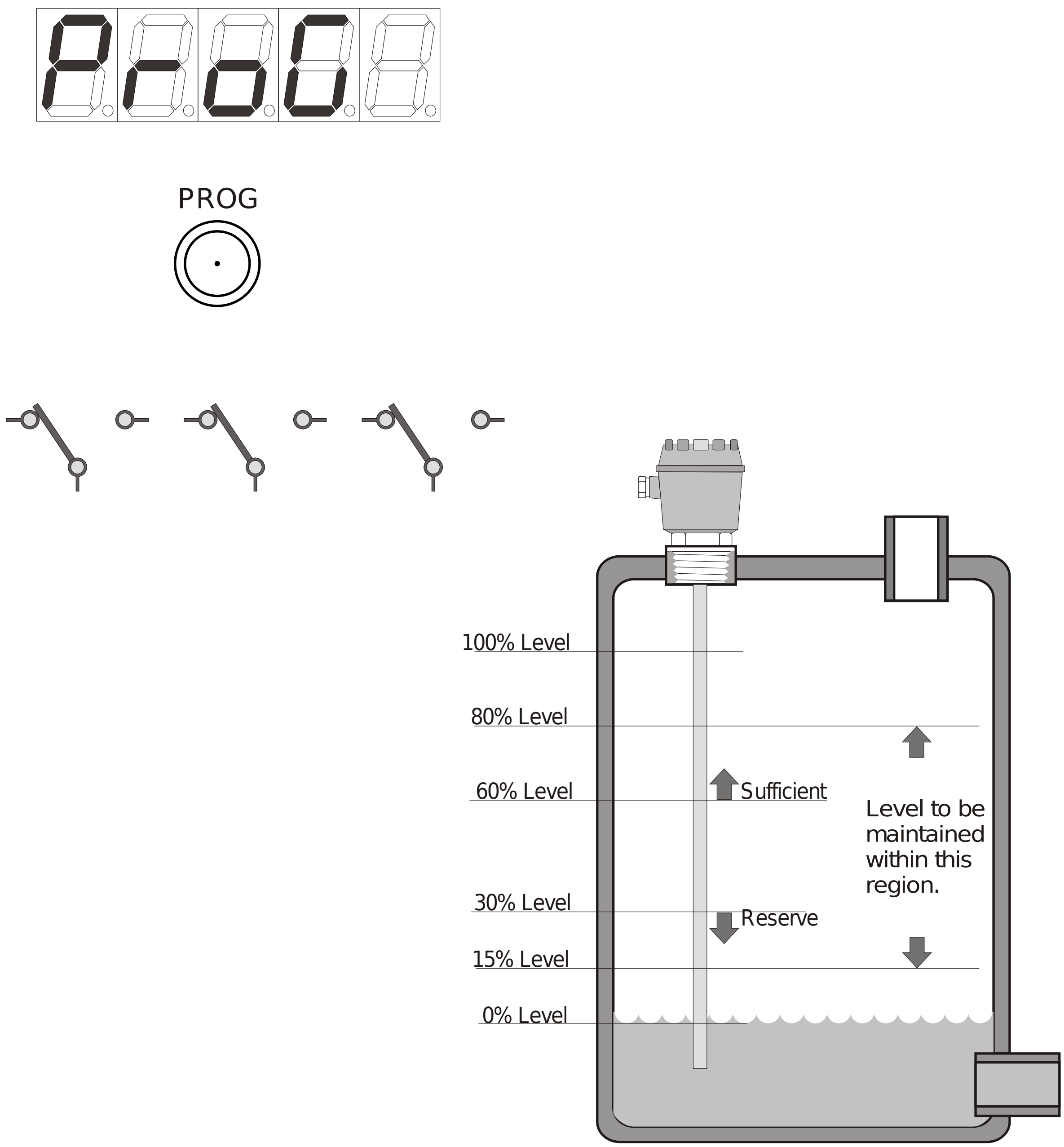
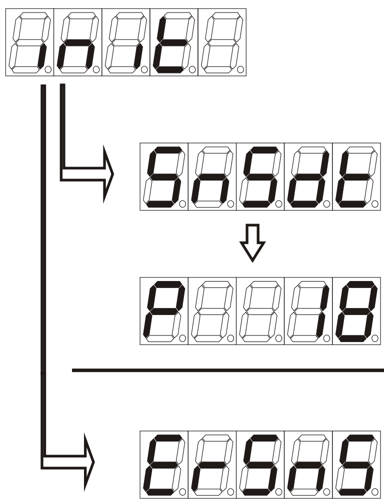



Figure 17: Programming

## Operation of MPILC After Power On:

### Various Display Messages at Power On Sequence




MPILC is Powered ON

This message will appear for 1 second if sensor is alright.

Sensor is found and MPILC is communicating with sensor.

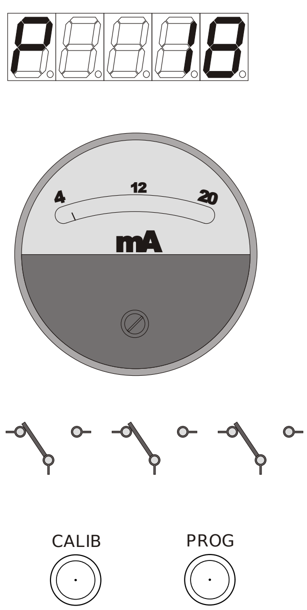
This message will appear for maximum 4 seconds if Sensor to MPILC line is not passing through an electrically noisy enviornment.

Process Value (Level) is shown in % depending on the calibration.

In this example of display it is showing 18%.

Sensor is not found by MPILC due to following reasons:-

- Sensor is not connected properly.
- Sensor is faulty.




When MPILC is showing Level %, the MPILC is said to be in Run Mode or Level Indicator Mode

This is normal working mode of MPILC.

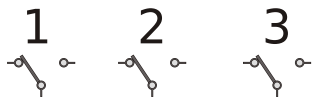
During this mode following operations will be performed as long as power supply is maintained.

- Measuring and Indicating Level as per Calibration.
- Output on 4-20mA as per indicated percent value.
  - 0% or less is always 4mA
  - 100% is always 20mA
  - Anything above 100% maximum 20.3 mA
- Operation of Three Potential Free Relays.

While in this mode, MPILC can be Calibrated using CALIB key and Relay Operation Set Points and Delays can be set using PROG key.

Figure 18: Programming

## About MPILC Relays:

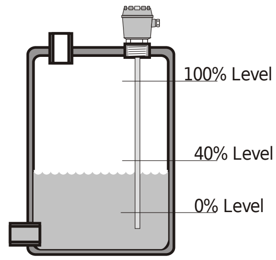



Single Point Switching

Set Point = 40%

Fail Safe High
No Alarm

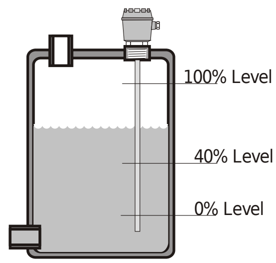
Fail Safe Low
Alarm




Set Point = 40%

Fail Safe High
Alarm

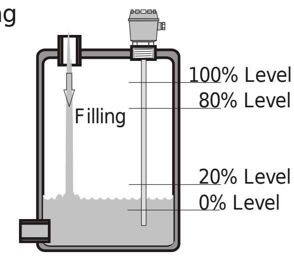
Fail Safe Low
No Alarm




Pump Control Switching

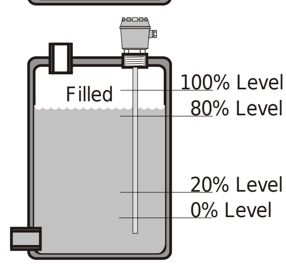
High Set Point = 80%
Low Set Point = 20%
Fail Safe High
No Alarm

Fail Safe Low
Alarm Started



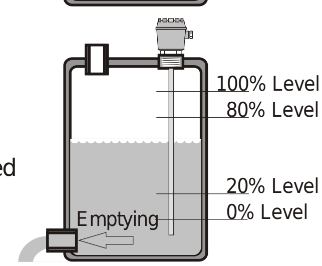

High Set Point = 80%
Low Set Point = 20%
Fail Safe High
Alarm Started

Fail Safe Low
Alarm Stopped



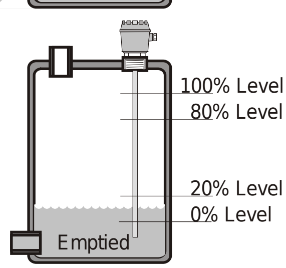

High Set Point = 80%
Low Set Point = 20%
Fail Safe High
Alarm Continued

Fail Safe Low
No Alarm




High Set Point = 80%
Low Set Point = 20%
Fail Safe High
Alarm Stopped

Fail Safe Low
Alarm Started




There are There Potential free Relays in MPILC.

Relay 1
Relay 2
Relay 3

Each Relay is having Two Operating Modes:

Single Point Switching

Pump Control Switching

Relays Can be set to give Alarm in following Conditions:

Single Point Switching

Fail Safe High or Maximum Fail Safe
Alarm Starts when Level >= Set Point Level
Alarm Stops when Level < Set Point Level

Fail Safe Low or Minimum Fail Safe
Alarm Starts when Level < Set Point Level
Alarm Stops when Level >= Set Point Level

Pump Control Switching

Fail Safe High or Maximum Fail Safe
Alarm Starts when Level >= High Set Point Level
Alarm Stops when Level < Low Set Point Level

Fail Safe Low or Minimum Fail Safe
Alarm Starts when Level < Low Set Point Level
Alarm Stops when Level >= High Set Point Level

---

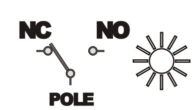
Relays have following configurable delay timers:

Covered Delay (0 to 90 Seconds)
Time Delay to recognize Alarm Level Condition.

Uncovered Delay (0 to 90 Seconds)
Time Delay to recognize No Alarm Level Condition.

---

During Alarm
Relay is at NC (Normally Connected)
Relay LED Glows (Red)




During No Alarm
Relay is at NO (Normally Open)
Relay LED Turns Off

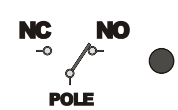
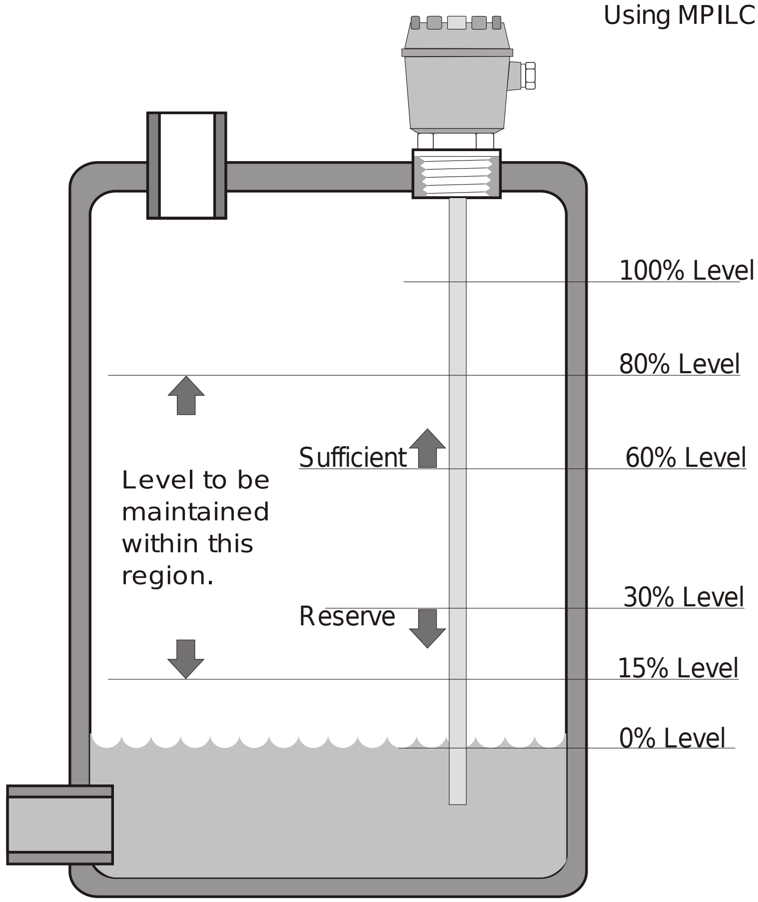



Figure 19: Programming

## How To Configure Relay Outputs:

## Application Example:

Suppose that it is required in an application to keep a tank filled between the two levels 80% and 15%. And two signals are required when level is above 60% indicating sufficient material and when the level falls below 30% indicating reserve material.




Using MPILC this application can be implemented as:-

N/C contact of Relay 1 will operate the fill tank valve as long as Level is not filled to 80% from 15%.

1. Keep level between 80% and 15%.

   Take Relay#1.

   Configure it for Pump Control Switching.

   Select its Fail Safe Low.

   Set Covered and Uncovered delay as per system delay needs. In this example 0 second will be used.

   Set High Set Point to 80%.

   Set Low Set Point to 15%.

N/C contact of Relay 2 will operate the Sufficient Level Indicator Lamp.

2. Issue Sufficient Signal at level >=60%.

   Take Relay#2.

   Configure it for Single Point Switching.

   Select its Fail Safe High.

   Set Covered and Uncovered delay as per system delay needs. In this example 1 second will be used.

   Set its Set Point to 60%.

N/C contact of Relay 3 will operate the Reserve Level Indicator Lamp.

3. Issue Reserve Signal at level <30%.

   Take Relay#3.

   Configure it for Single Point Switching.

   Select its Fail Safe Low.

   Set Covered and Uncovered delay as per system delay needs. In this example 1 second will be used.

   Set its Set Point to 30%.

Example Application Relay Connection Diagram

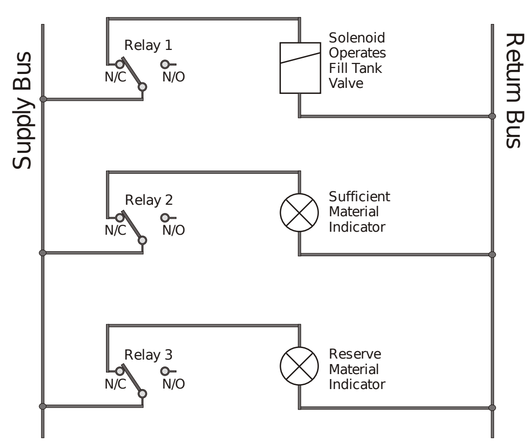
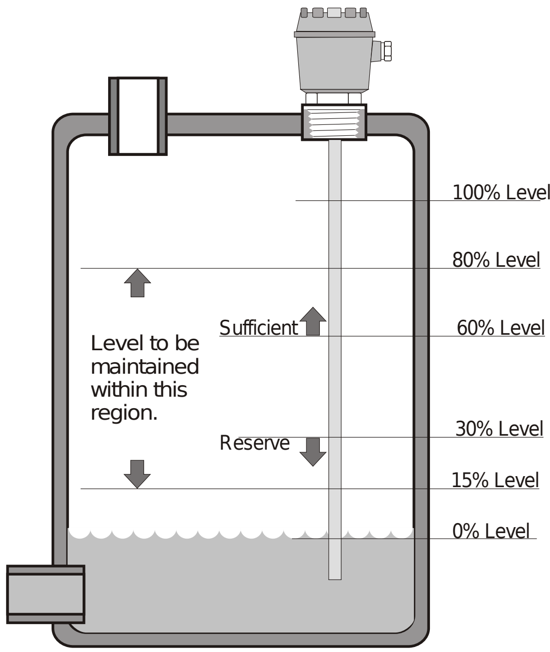



Figure 20: Programming

## Entering Relay Parameters:

## Application Example (Continued):



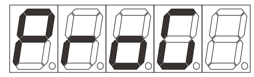

N/C contact of Relay 1 will operate the fill tank valve as long as Level is not filled to 80% from 15%.

1. Keep level between 80% and 15%.

   Take Relay#1.
   
   Configure it for Pump Control Switching.
   
   Select its Fail Safe Low.
   
   Set Covered and Uncovered delay as per system delay needs. In this example 0 second will be used.
   
   Set High Set Point to 80%.
   
   Set Low Set Point to 15%.

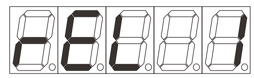
Following procedure will set the Relay#1 parameters as per application example requirement.

Press PROG Button for 5 to 8 seconds.



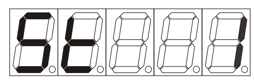
Will appear on the display.

Release PROG Button.



Will appear on the display.
Indicating that current setting will be for Relay#1.

Press ↑ Button.



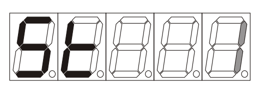
Will appear on the display.
ST indicates Switching Type for the selected Relay.

ST=1 means Single Point Switching

ST=P means Pump Control Switching

Since in present Example Pump Control is needed. ST will be changed from its value 1 to P.

Press ↵ Button.

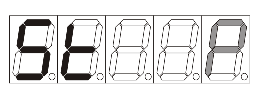


Last Digit will Start Blinking

Pressing ↑ Button will make it P

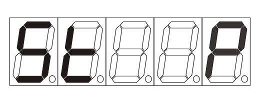
Pressing ↓ Button will make it 1

Press ↑ Button.



1 changed to P while still blinking.

Press ↵ Button.

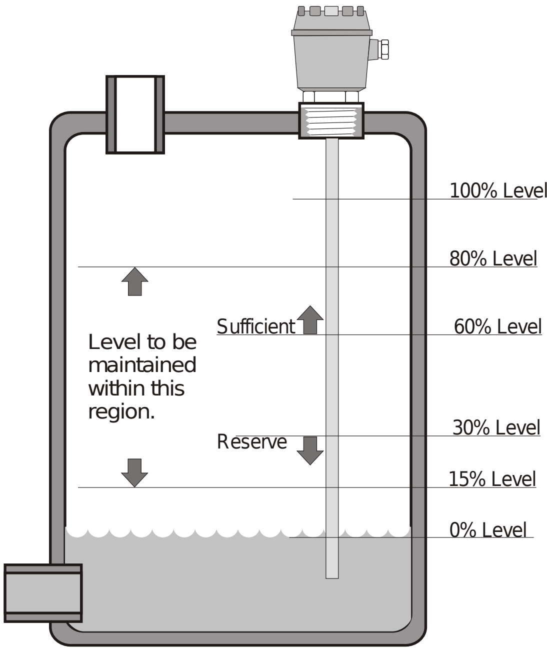


P stopped blinking.
Pump Control Switching is thus Selected for Relay 1.

Figure 21: Programming

## Selecting Fail Safe for Relay

## Application Example (Continued):




N/C contact of Relay 1 will operate the fill tank valve as long as Level is not filled to 80% from 15%.

1. Keep level between 80% and 15%.

    Take Relay#1.

    Configure it for Pump Control Switching.

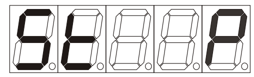
    Select its Fail Safe Low.

    Set Covered and Uncovered delay
    as per system delay needs.
    In this example 0 second will be used.

    Set High Set Point to 80%.

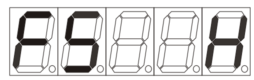
    Set Low Set Point to 15%.

Following procedure will set the Relay#1 parameters as per application example requirement.




Display from last step.

Press Button.




Will be displayed.

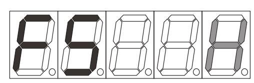
FS indicates Fail Safe Type for the selected Relay.

FS=H means Fail Safe High.

FS=L means Fail Safe Low.

Since in present Example, Low Fail Safe is required. FS will be changed to L.

Press Button.

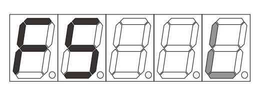



Last Digit will Start Blinking

Pressing Button will make it H

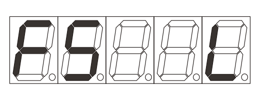
Pressing Button will make it L

Press Button.




H changed to L while still blinking.

Press Button.

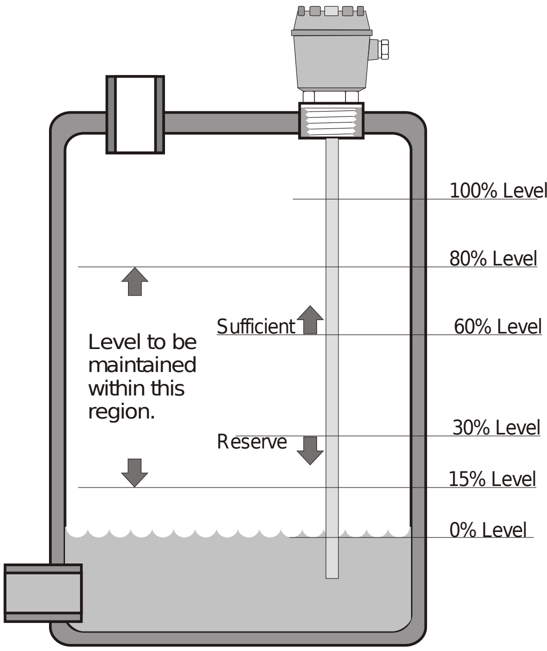



Last Digit will Stop Blinking. Indicates that Fail Safe is now Changed to Low for Relay 1.

Figure 22: Programming

## Setting Delay Timers:

## Application Example (Continued):




N/C contact of Relay 1 will operate the fill tank valve as long as Level is not filled to 80% from 15%.

1. Keep level between 80% and 15%.

   Take Relay#1.

   Configure it for Pump Control Switching.

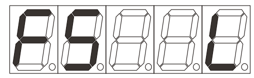
   Select its Fail Safe Low.

   Set Covered and Uncovered delay as per system delay needs. In this example 0 second will be used.

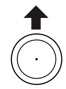
   Set High Set Point to 80%.

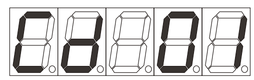
   Set Low Set Point to 15%.

Following procedure will set the Relay#1 parameters as per application example requirement.

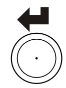


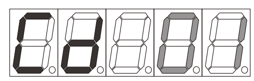
Display from last step.

Press  Button.

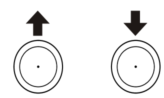


Previously entered Covered Delay will be displayed.
It is required to change it to 0 sec for present application.

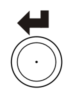
Press  Button.

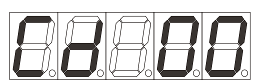


Last two digits will start blinking. Blinking indicates that Covered Delay can be modified using buttons:

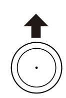


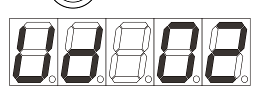
For now, required Covered Delay is 0 sec, therefore change the last two digits to 00.

Press  Button.

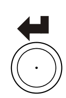


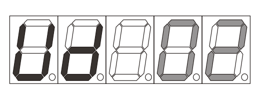
Last two digits stopped blinking. The Covered Delay is now set to 0 second.

Press  Button.

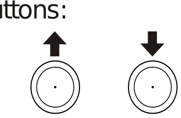


Previously entered Uncovered Delay will be displayed.

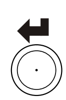
Press  Button.

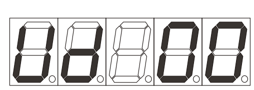


Last two digits will start blinking. Blinking indicates that Uncovered Delay can be modified using buttons:



For now, required Uncovered Delay is 0 sec, therefore change the last two digits to 00.

Press  Button.

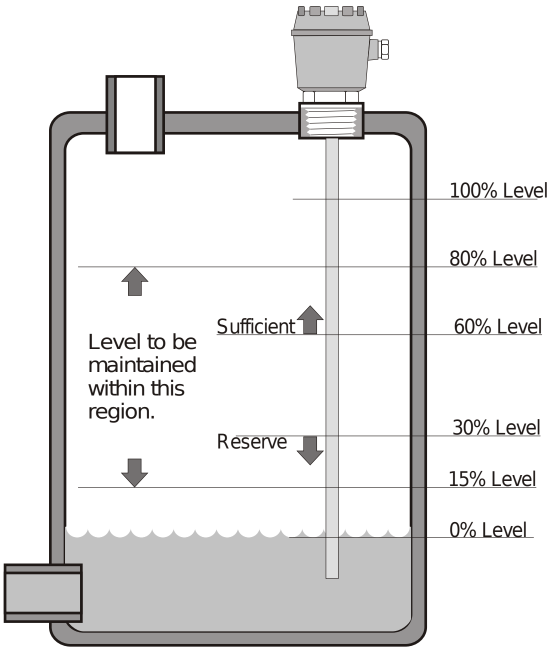


Last two digits stopped blinking. The Uncovered Delay is now set to 0 seconds.

Figure 23: Programming

## Entering Pump Control Switch Points:

## Application Example (Continued):

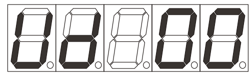



N/C contact of Relay 1 will operate the fill tank valve as long as Level is not filled to 80% from 15%.

1. Keep level between 80% and 15%.

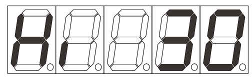
   Take Relay#1.
   Configure it for Pump Control Switching.
   Select its Fail Safe Low.
   Set Covered and Uncovered delay as per system delay needs.
   In this example 0 second will be used.
   Set High Set Point to 80%.
   Set Low Set Point to 15%.

Following procedure will set the Relay#1 parameters as per application example requirement.



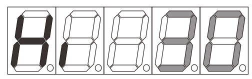

Display from last step.

Press Button.




Previously entered High Set Point will be displayed.
It is required to change it to 80% for present application.

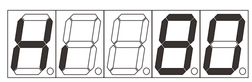
Press Button.




Last two digits will start blinking. Blinking indicates that High Set Point can be modified using buttons:

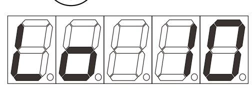
For now, required High Set Point is 80%, therefore change the last two digits to 80 .

Press Button.



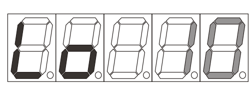

Last two digits stopped blinking. The High Set Point is now set to 80%

Press Button.




Previously entered Low Set Point will be displayed.

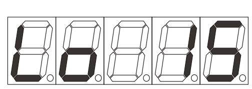
Press Button.




Last two digits will start blinking. Blinking indicates that Low Set Point can be modified using buttons:

For now, required Low Set Point is 15%, therefore change the last two digits to 15 .

Press Button.



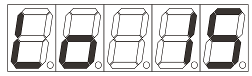

Last two digits stopped blinking. The Low Set Point is now set to 15%

Figure 24: Programming

## Selecting Next Relay for Entry:

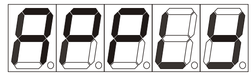
## Application Example (Continued):

Following procedure will select Relay#2 for parameters setting as per application example requirement.



Display from last step.

Press Button.

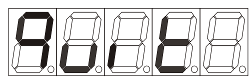


MPILC is asking for if the relay parameters are required to be saved.

“Apply should be done when no more changes are required.

Therefor in this example, the modified values will be applied in when all the entries for all three Relays are over.

Press Button.



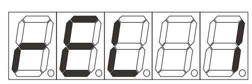
Pressing enter key here will “quit” to the Run mode.

“Quit” without “Apply” will discard any changes.

“Quit” will not be entered.

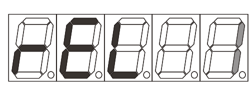
Proceeding for next Relay.

Press Button.

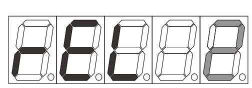


Here, the next relay will be selected by pressing enter.

Press Button.

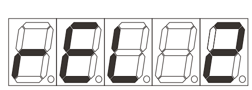


Last Digit starts blinking, indicates that new Relay # can be selected by using:



For now change it to 2.

Press Button.



Digit stops blinking.
Relay 2 is thus selected for parameter entry.

N/C contact of Relay 2 will operate the Sufficient Level Indicator Lamp.

2. Issue Sufficient Signal at level >=60%.

Take Relay#2.

Configure it for Single Point Switching.

Select its Fail Safe High.

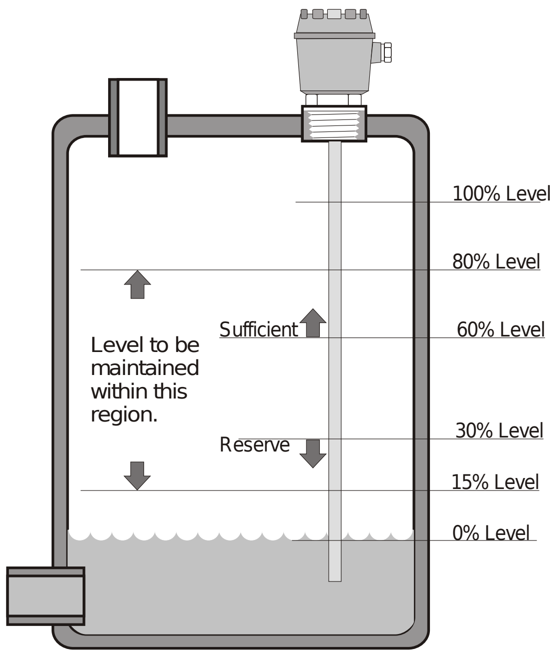
Set Covered and Uncovered delay
as per system delay needs.
In this example 1 second will be used.

Set its Set Point to 60%.

Figure 25: Programming

## Entering Relay 2 Parameters:

## Application Example (Continued):




N/C contact of Relay 2 will operate the Sufficient Level Indicator Lamp.

2. Issue Sufficient Signal at level >= 60%.

Take Relay#2.

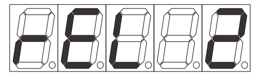
Configure it for Single Point Switching.

Select its Fail Safe High.

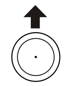
Set Covered and Uncovered delay as per system delay needs. In this example 1 second will be used.

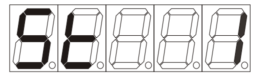
Set its Set Point to 60%.

Following procedure will modify the parameters setting of Relay #2 as per application example requirement.

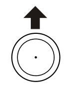


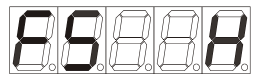
Display from last step.

Press  Button.

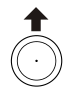


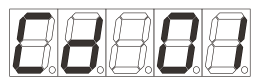
Previously entered Switching Type. This is already in Single Point Sw. Change if it is P, else no change is required.

Press  Button.

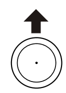


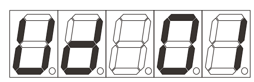
Previously entered Fail Safe Type. This is already in Fail Safe High. Change if it is L, else no change is required.

Press  Button.

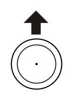


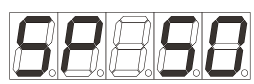
Previously entered Covered Delay. This is already 1 sec. Therefore no change is required.

Press  Button.

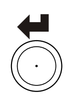


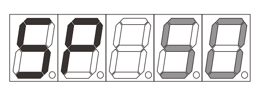
Previously entered Uncovered Delay. This is already 1 sec. Therefore no change is required.

Press  Button.

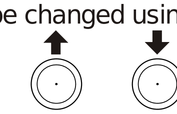


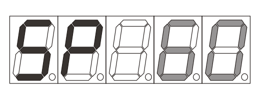
Previously entered Set Point for Relay 2 switching. This is at 50%. Change it to 60% by pressing Enter button.

Press  Button.

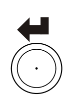


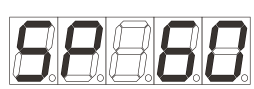
Last two digit will start blinking. Blinking indicates that Set Point can be changed using buttons:





For now Alarm is required at 60%, therefore change last two digits to 60.

Press  Button.



Stopped blinking. The Alarm Set Point for Relay#2 is just changed to give alarm above 60% level.

Figure 26: Programming

## Selecting Next Relay for Entry:

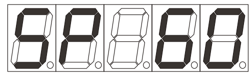
## Application Example (Continued):

N/C contact of Relay 3 will operate the Reserve Level Indicator Lamp.

3. Issue Reserve Signal at level <30%.

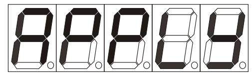
    Take Relay#3.
    Configure it for Single Point Switching.
    Select its Fail Safe Low.
    Set Covered and Uncovered delay as per system delay needs. In this example 1 second will be used.
    Set its Set Point to 30%.

Following procedure will select Relay#3 for parameters setting as per application example requirement.




Display from last step.

Press Button.

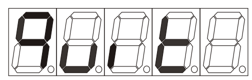



MPILC is asking for if the relay parameters are required to be saved.

“Apply should be done when no more changes are required.

Therefor in this example, the modified values will be applied in when all the entries for all three Relays are over.

Press Button.



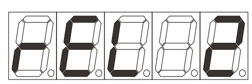
Pressing enter key here will “quit” to the Run mode.

“Quit” without “Apply” will discard any changes.

“Quit” will not be entered.

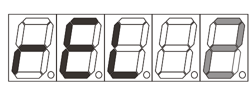
Press Button.

Proceeding for next Relay.

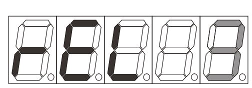


Here, the next relay will be selected by pressing enter.

Press Button.

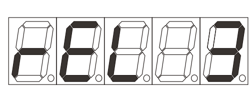


Last Digit starts blinking, indicates that new Relay # can be selected by using:



For now change it to 3.

Press Button.

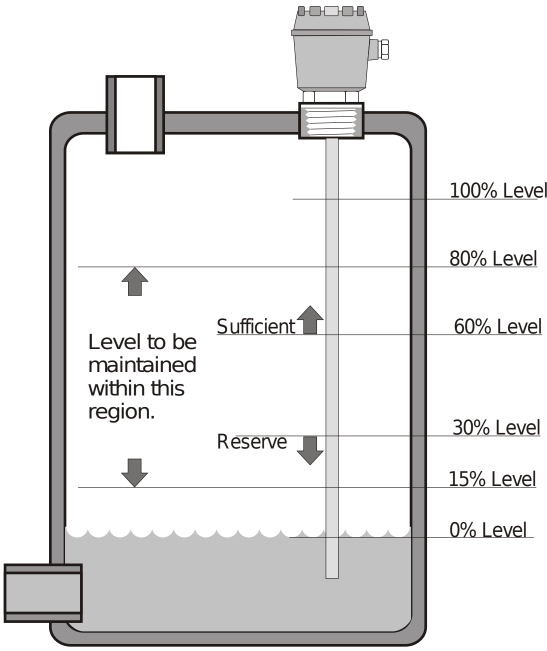


Digit stops blinking. Relay 2 is thus selected for parameter entry.

Figure 27: Programming

## Entering Relay 3 Parameters:

## Application Example (Continued):




N/C contact of Relay 3 will operate the Reserve Level Indicator Lamp.

3. Issue Reserve Signal at level <30%.

Take Relay#3.

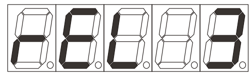
Configure it for Single Point Switching.

Select its Fail Safe Low.

Set Covered and Uncovered delay as per system delay needs. In this example 1 second will be used.

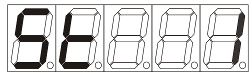
Set its Set Point to 30%.

Following procedure will modify the parameters setting of Relay #2 as per application example requirement.



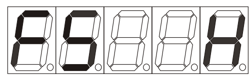

Display from last step.

Press Button.



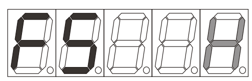

Previously entered Switching Type. This is already in Single Point Sw. Change if it is P, else no change is required.

Press Button.




Previously entered Fail Safe Type. This is in Fail Safe High. Change if to Fail Safe Low will be required.

Press Button.

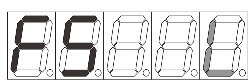



Last Digit "H" will Start Blinking

Pressing Button will make it H

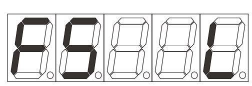
Pressing Button will make it L

Press Button.



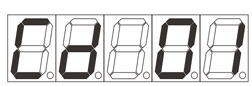

H changed to L while still blinking.

Press Button.



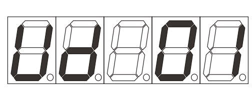

Last Digit will Stop Blinking. Indicates that Fail Safe is now Changed to Low for Relay 1.

Press Button.




Previously entered Covered Delay. This is already 1 sec. Therefore no change is required.

Press Button.



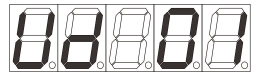

Previously entered Uncovered Delay. This is already 1 sec. Therefore no change is required.

Figure 28: Programming

## Entering Relay 2 Parameters:

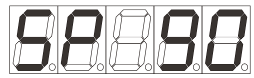
## Application Example (Continued):

Following procedure will modify the parameters setting of Relay #2 as per application example requirement.



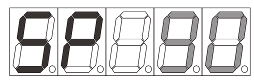

Display from last step

Press Button.

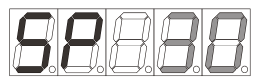



Previously entered Set Point for Relay 3 switching. This is at 90%. Change it to 30% by pressing Enter button.

Press Button.

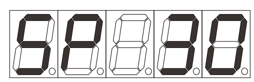



Last two digit will start blinking. Blinking indicates that Set Point can be changed using buttons:



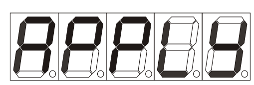

For now Alarm is required at 30%, therefore change last two digits to 30.

Press Button.




Stopped blinking. The Alarm Set Point for Relay#3 is just changed to give alarm above 30% level.

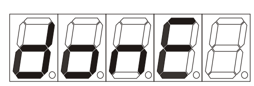
Press Button.



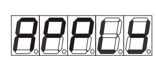

At this moment since all the Relay Parameters have been entered, the changed parameters should be saved permanently.

Press Button.

To save the changes the "Apply" will now be "Done".

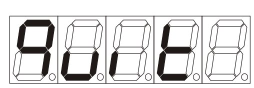



Parameters Saved (Applied).

Press Button. 

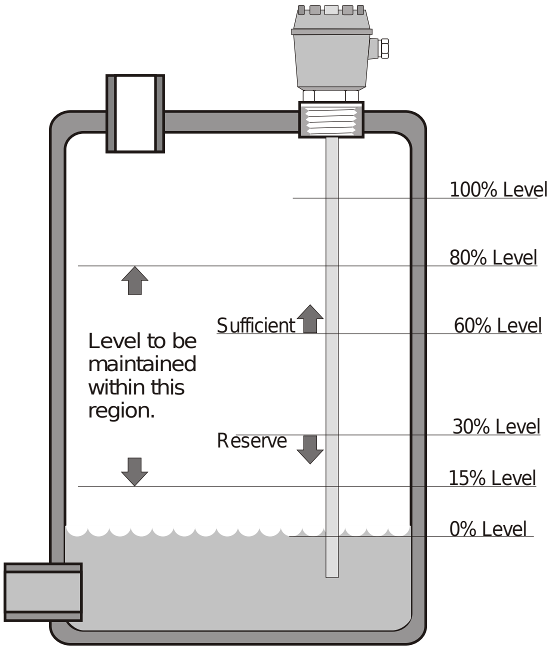
Will appear once again.

Press Button again.




Programming Mode can be quit now as all Relay settings are saved (applied).

Press Button to get back to Run Mode.




N/C contact of Relay 2 will operate the Sufficient Level Indicator Lamp.

2. Issue Sufficient Signal at level >=60%.

Take Relay#2.

Configure it for Single Point Switching.

Select its Fail Safe High.

Set Covered and Uncovered delay as per system delay needs. In this example 1 second will be used.

Set its Set Point to 60%.

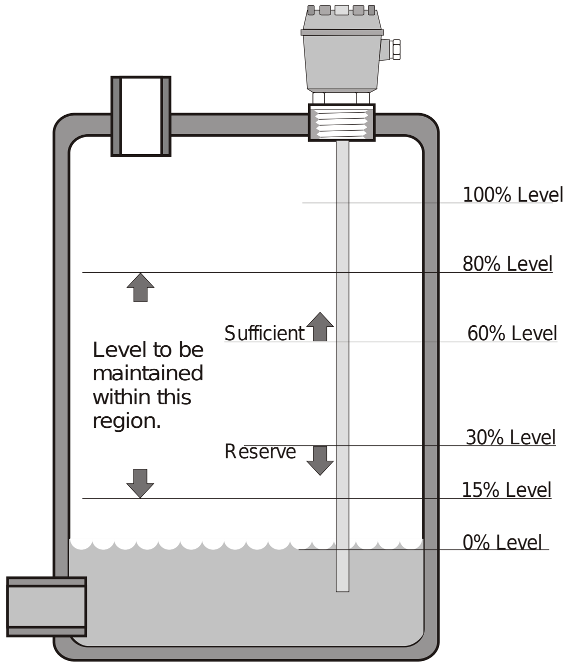
Figure 29: Programming

## Problem with the Application:

## Application Example:

Suppose that it is required in an application to keep a tank filled between the two levels 80% and 15%. And two signals are required when level is above 60% indicating sufficient material and when the level falls below 30% indicating reserve material.

In Proposed MPILC solution the Relay 1 was configured to provide the required "keep it filled" action.:



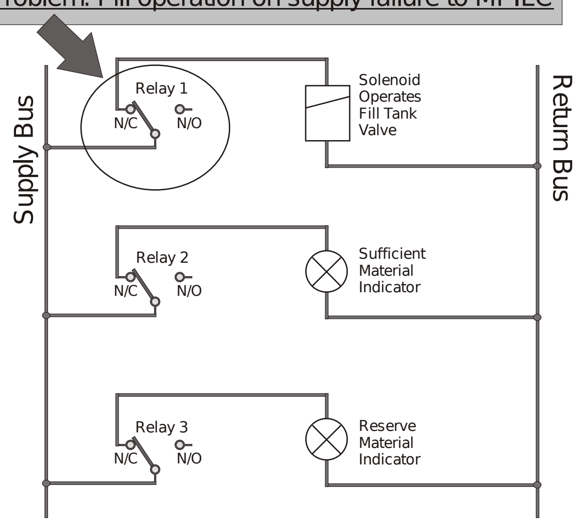

N/C contact of Relay 1 will operate the fill tank valve as long as Level is not filled to 80% from 15%.

1. Keep level between 80% and 15%.

   Take Relay#1.
   Configure it for Pump Control Switching.
   Select its Fail Safe Low.
   Set Covered and Uncovered delay as per system delay needs. In this example 0 second will be used.
   Set High Set Point to 80%.
   Set Low Set Point to 15%.

Example Application Relay Connection Diagram

Problem: Fill operation on supply failure to MPILC



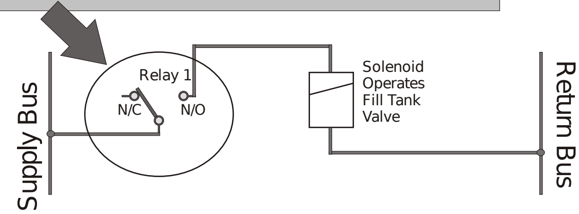

However, observing the proposed circuit, it becomes clear that:

Power Failure to MPILC will result in the filling operation, which will cause Overflow as it can never be guaranteed how long power to MPILC may not be available.

The Solution for this problem is to use the Normally Open Contact of the relay.

This will prevent any fill operation when supply to MPILC fails.

Solution: Use N/O Contact for Fill operation




This Solution creates another problem that now the Fill Operation will stop on Level<15% and will Start on Level >=80% causing more overflow, with present settings.

Solution: Use Relay 1 in Fail Safe High.

This will solve the overflow problem of the example application.

After this solution:

The Alarm LED will now on MPILC will now have another meaning. It will now mean lit-up to show that Tank has the Material and Fill Operation is Not in the process.

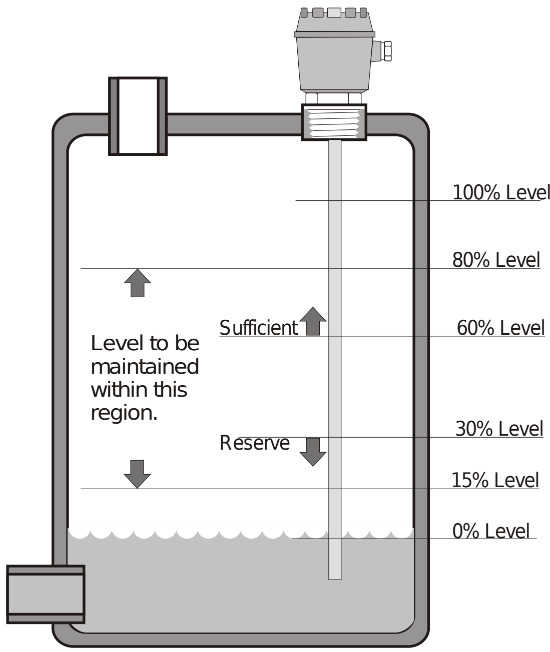
Fill Valve Solenoid will operate when Alarm LED of Relay 1 is turned off.

Alarm means that N/C is connected to Common.

Figure 30: Programming

## Entering Relay Parameters:

## Application Example (Continued):




N/C contact of Relay 1 will operate the fill tank valve as long as Level is not filled to 80% from 15%.

1. Keep level between 80% and 15%.

   Take Relay#1.

   Configure it for Pump Control Switching.

   Select its Fail Safe High.

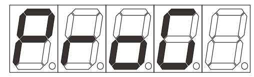
   Set Covered and Uncovered delay
   as per system delay needs.
   In this example 0 second will be used.

   Set High Set Point to 80%.

   Set Low Set Point to 15%.

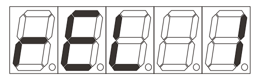
Following procedure will set the Relay#1 parameters as per application example modified solution.

Press PROG Button for 5 to 8 seconds.



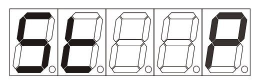
Will appear on the display.

Release PROG Button.



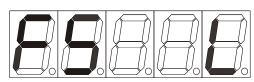
Indicating that current setting will be for Relay#1.

Press Button.



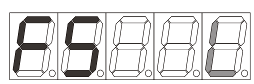
Switching Type is Pump Control.

Press Button.



Previous Setting that was done for application was Fail Safe Low. It will now be changed to High - H.

Press Button.

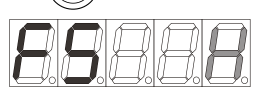


Last Digit - L - will Start Blinking

Pressing Button will make it H

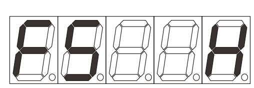
Pressing Button will make it L

Press Button.



L changed to H while still blinking.

Press Button.



Last Digit will Stop Blinking. Indicates that Fail Safe is now Changed to High for Relay 1.

Figure 31: Programming

## Saving Edited Relay Settings:

## Application Example (Continued):

Following procedure skips direct to save (apply) the relay settings and quit to run mode.

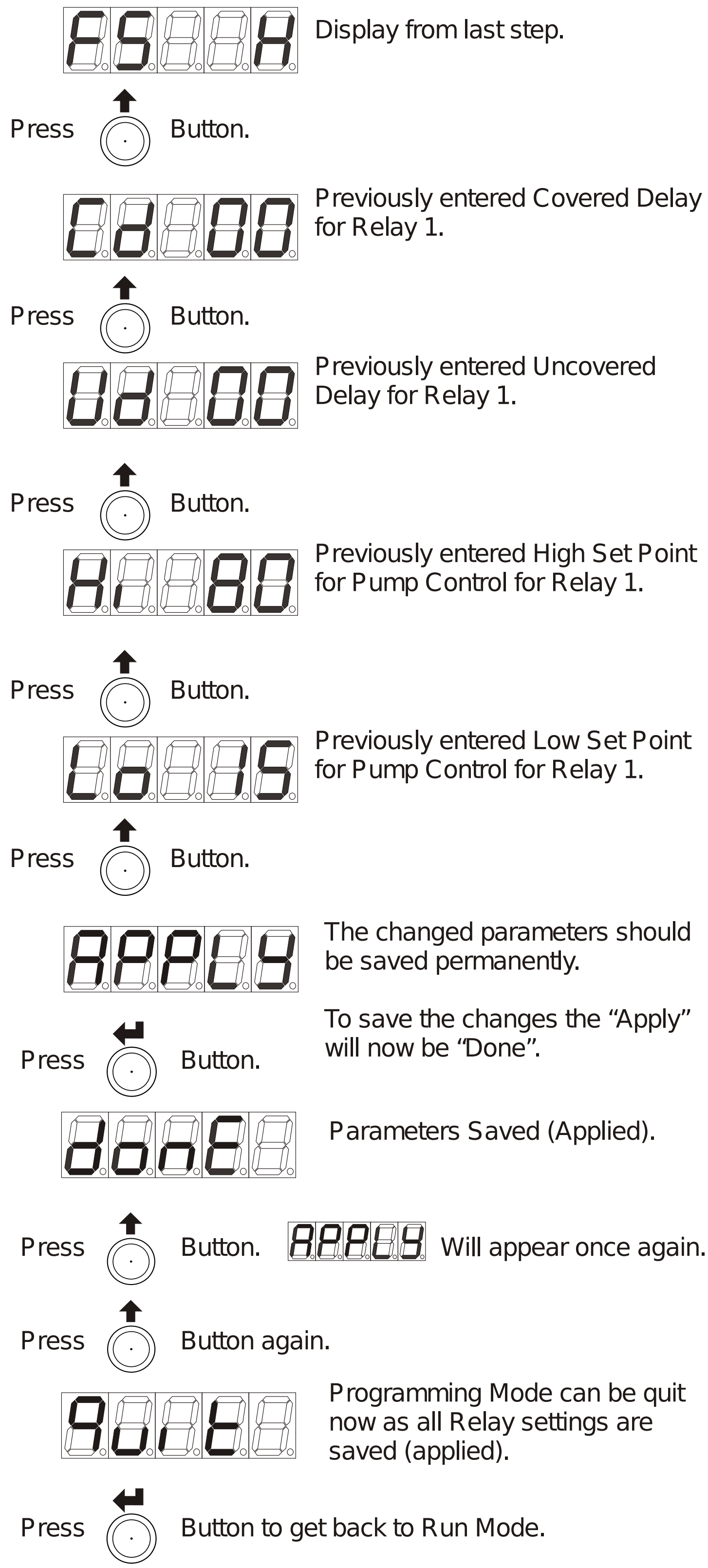
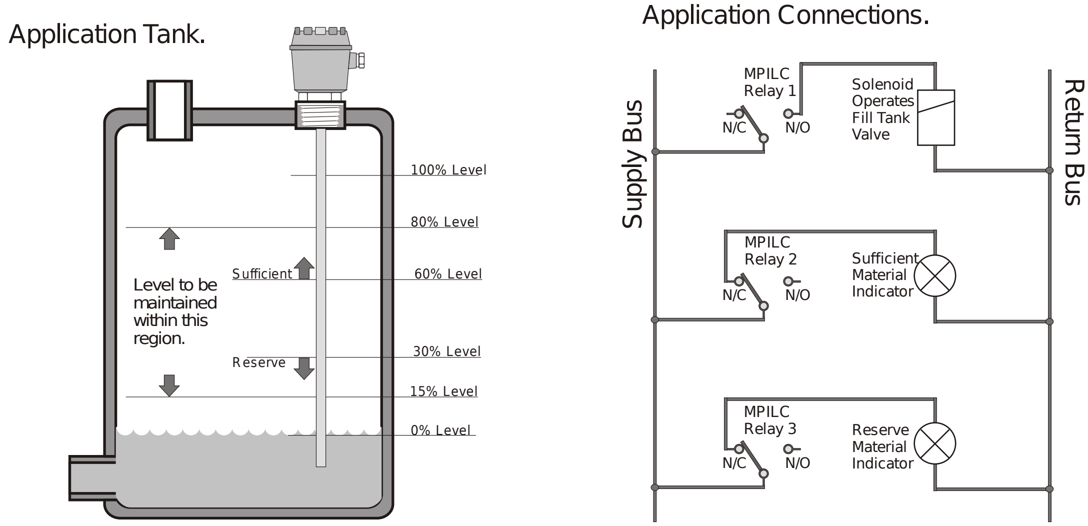
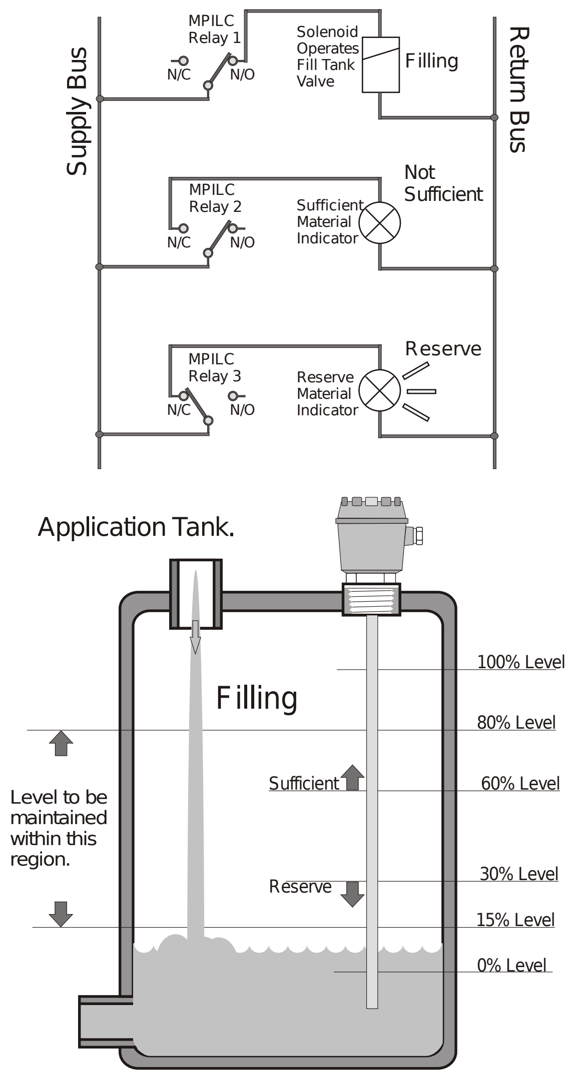



Figure 32: Programming

## Process In Action:

## Application Example (Continued):




Relay 1: Filling Valve Controller
Pump Control, Fail Safe High
Level < Low Set Point means No Alarm in FS High.
No Alarm means Common connects to N/O and
Alarm LED is off.
Filling Process is Started (Filling).

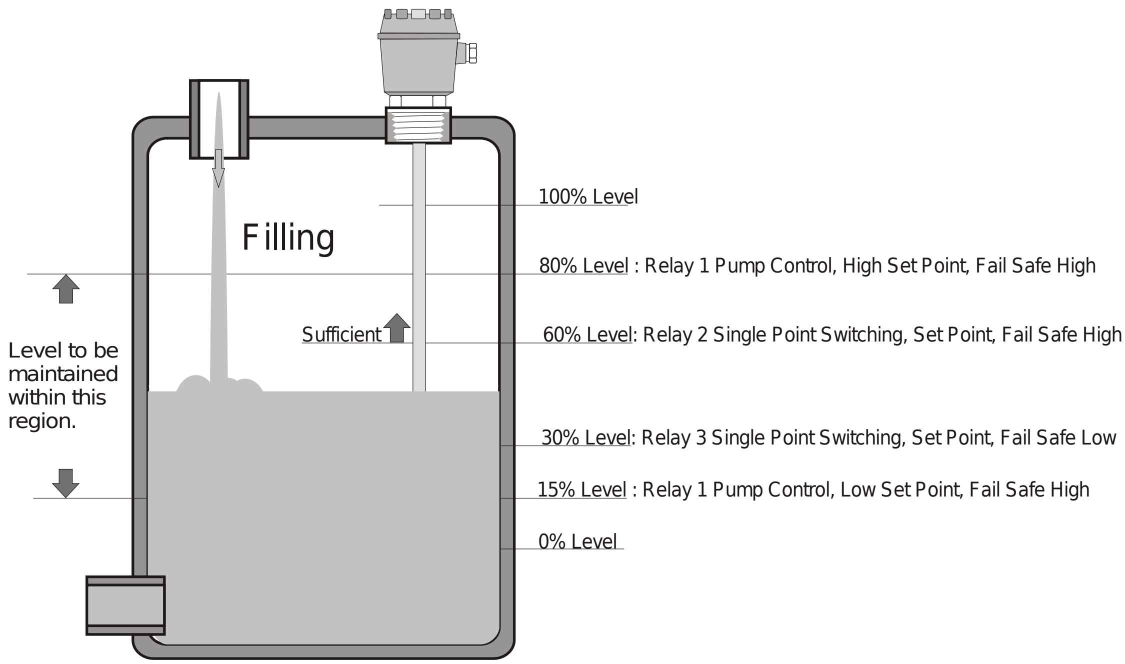
Relay 2: Sufficient Lamp Controller
Single Point, Fail Safe High
Level < Set Point means No Alarm in FS High.
No Alarm means Common connects to N/O and
Alarm LED is off.
Indication for “Sufficient” is off (Not Sufficient).

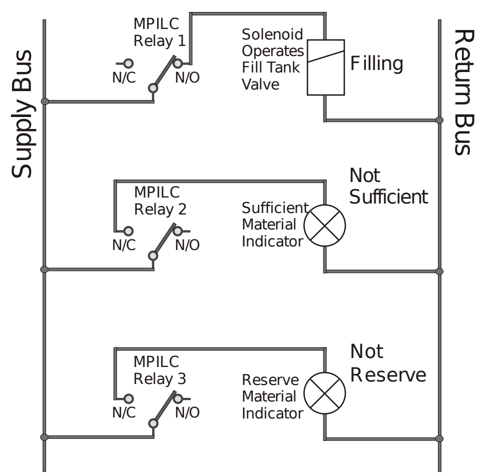
Relay 3: Reserve Lamp Controller
Single Point, Fail Safe Low
Level < Set Point means Alarm in FS Low.
Alarm means Common connects to N/C and
Alarm LED is on.
Indication for “Reserve” is on (in Reserve).

Figure 33: Programming

## Process In Action - Step 2:

## Application Example (Continued):




Relay 1: Filling Valve Controller
Pump Control, Fail Safe High
Level < High Set Point means No Alarm in FS High.
No Alarm means Common connects to N/O and
Alarm LED is off.
Filling Process is Continued (Filling).

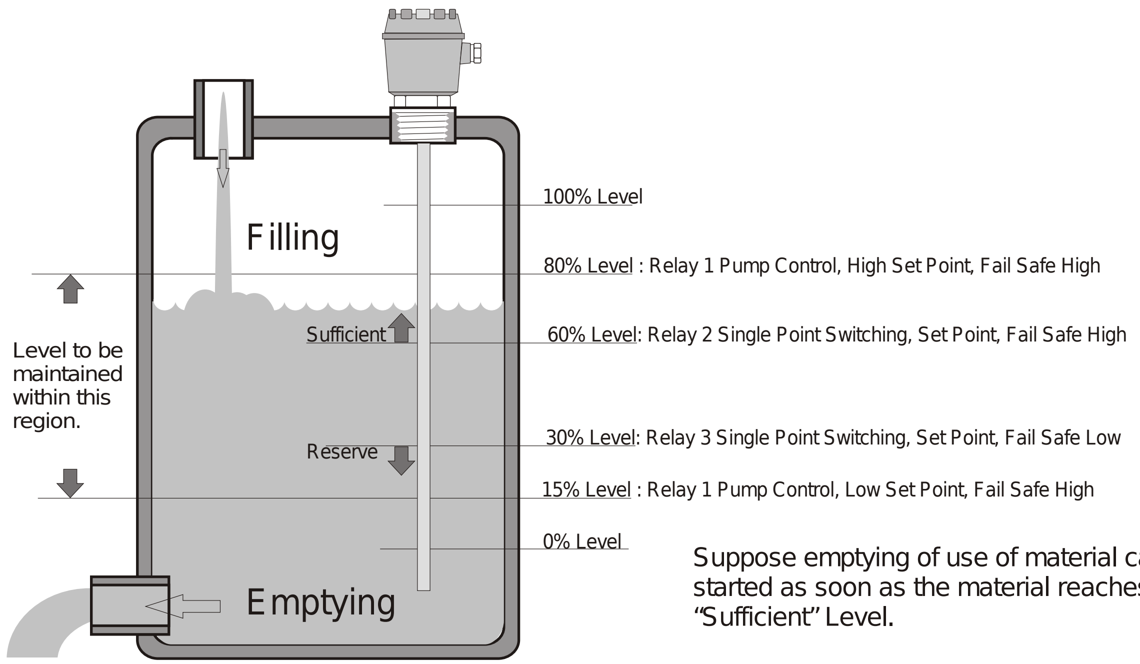
Relay 2: Sufficient Lamp Controller
Single Point, Fail Safe High
Level < Set Point means No Alarm in FS High.
No Alarm means Common connects to N/O and
Alarm LED is off.
Indication for "Sufficient" is off (Not Sufficient).

Relay 3: Reserve Lamp Controller
Single Point, Fail Safe Low
Level > Set Point means No Alarm in FS Low.
No Alarm means Common connects to N/O and
Alarm LED is off.
Indication for "Reserve" is off (Not Reserve).

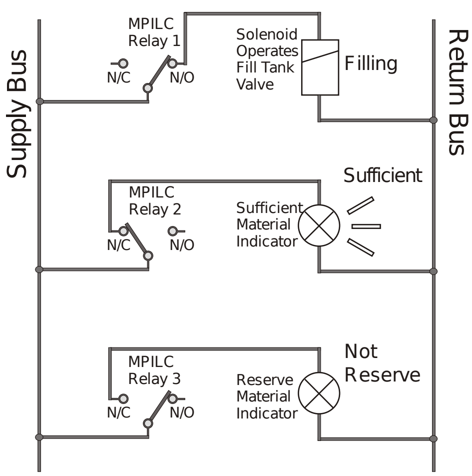
Figure 34: Programming

## Process In Action - Step 3:

## Application Example (Continued):




Suppose emptying of use of material can be started as soon as the material reaches its "Sufficient" Level.




Relay 1: Filling Valve Controller
Pump Control, Fail Safe High
Level < High Set Point means No Alarm in FS High.
No Alarm means Common connects to N/O and Alarm LED is off.
Filling Process is Continued (Filling).

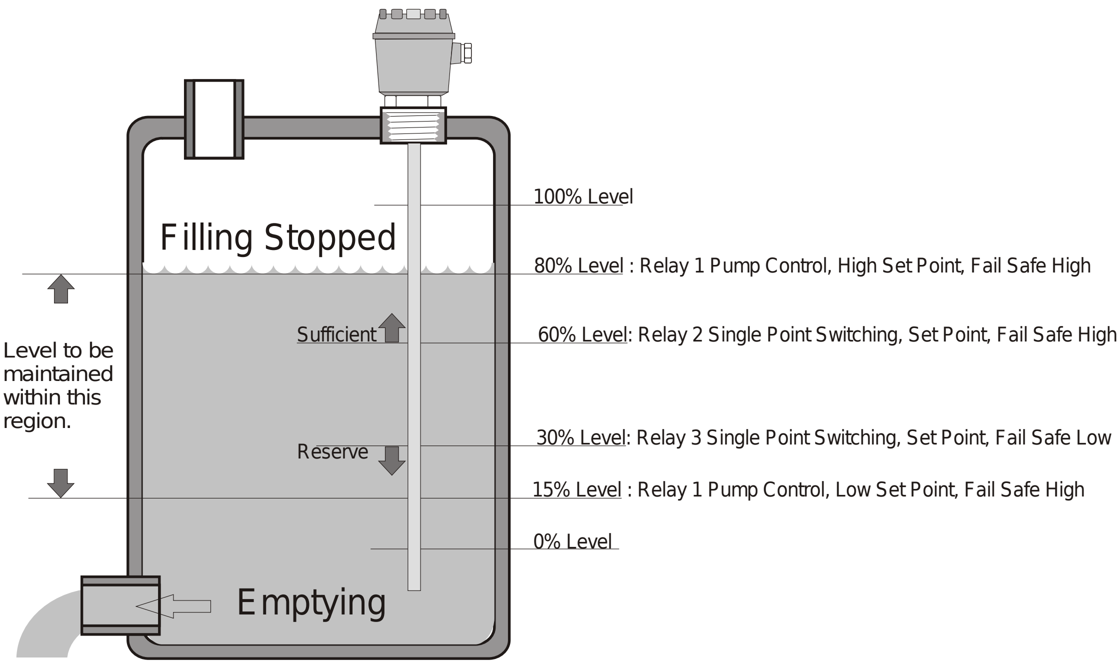
Relay 2: Sufficient Lamp Controller
Single Point, Fail Safe High
Level >= Set Point means Alarm in FS High.
Alarm means Common connects to N/C and Alarm LED is on.
Indication for "Sufficient" is on (Sufficient).

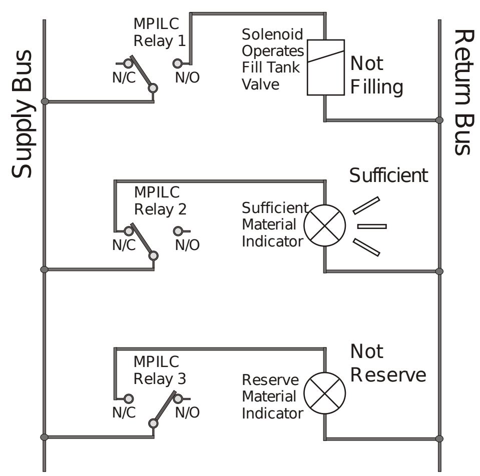
Relay 3: Reserve Lamp Controller
Single Point, Fail Safe Low
Level > Set Point means No Alarm in FS Low.
No Alarm means Common connects to N/O and Alarm LED is off.
Indication for "Reserve" is off (Not Reserve).

Figure 35: Programming

## Process In Action - Step 4:

## Application Example (Continued):




Relay 1: Filling Valve Controller
Pump Control, Fail Safe High
Level >= High Set Point means Alarm in FS High.
Alarm means Common connects to N/C and
Alarm LED is on.
Filling Process is Stopped (Not Filling).

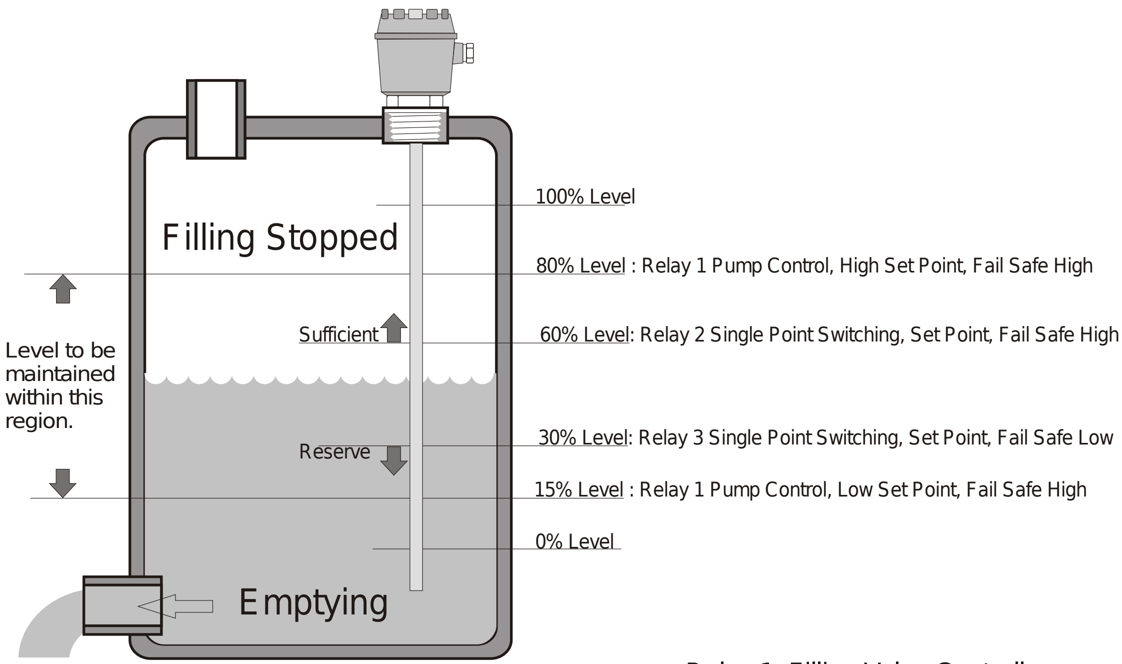
Relay 2: Sufficient Lamp Controller
Single Point, Fail Safe High
Level >= Set Point means Alarm in FS High.
Alarm means Common connects to N/C and
Alarm LED is on.
Indication for "Sufficient" is on (Sufficient).

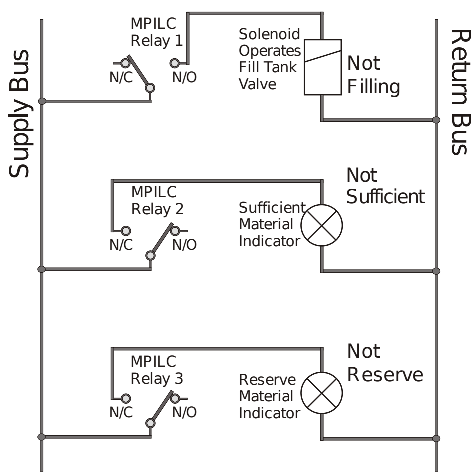
Relay 3: Reserve Lamp Controller
Single Point, Fail Safe Low
Level > Set Point means No Alarm in FS Low.
No Alarm means Common connects to N/O and
Alarm LED is off.
Indication for "Reserve" is off (Not Reserve).

Figure 36: Programming

## Process In Action - Step 5:

## Application Example (Continued):




Relay 1: Filling Valve Controller
Pump Control, Fail Safe High
Level < High Set Point, but the Alarm will Continue as long as Low Set Point is not reached.
Therefore, It is Alarm for Fail Safe High.
Alarm means Common connects to N/C and Alarm LED is on.
Filling Process is Stopped (Not Filling).

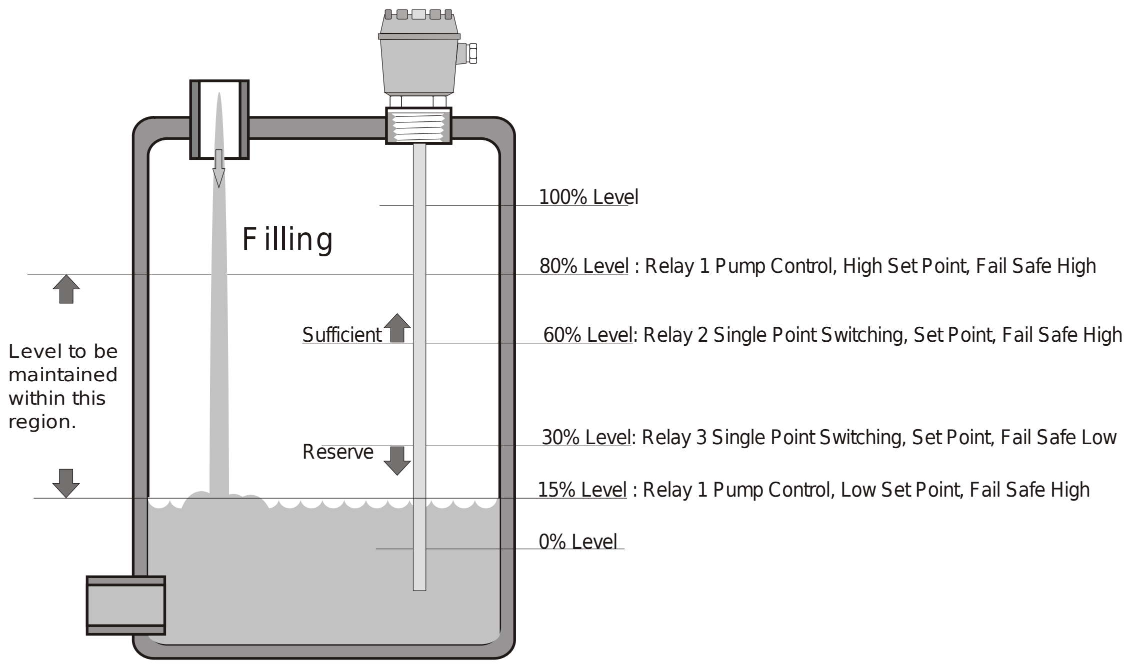
Relay 2: Sufficient Lamp Controller
Single Point, Fail Safe High
Level < Set Point means No Alarm in FS High.
No Alarm means Common connects to N/O and Alarm LED is off.
Indication for "Sufficient" is off (Not Sufficient).

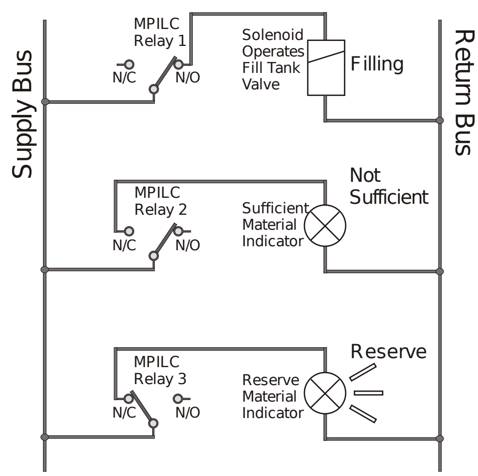
Relay 3: Reserve Lamp Controller
Single Point, Fail Safe Low
Level > Set Point means No Alarm in FS Low.
No Alarm means Common connects to N/O and Alarm LED is off.
Indication for "Reserve" is off (More than Reserve).

Figure 37: Programming

## Process In Action - Last Step:

## Application Example (Continued):




Relay 1: Filling Valve Controller
Pump Control, Fail Safe High
Level < Low Set Point, Alarm will stop for FS High.
No Alarm means Common connects to N/O and
Alarm LED is off.
Filling Process is Started (Filling).

Relay 2: Sufficient Lamp Controller
Single Point, Fail Safe High
Level < Set Point means No Alarm in FS High.
No Alarm means Common connects to N/O and
Alarm LED is off.
Indication for "Sufficient" is off (Not Sufficient).

Relay 3: Reserve Lamp Controller
Single Point, Fail Safe Low
Level < Set Point means Alarm in FS Low.
Alarm means Common connects to N/C and
Alarm LED is on.
Indication for "Reserve" is on (in Reserve).

The Complete Process is thus shown in Action. It should be clear by now that :-

1. Alarm means the Common Terminal of Relay is connected to N/C Terminal. (Relay Coil is De-Energised).
2. Alarm LED on front Panel of MPILC is on (lit) only for Alarm Condition.
3. Change Over Potential Free Contacts are available to make the process safe for any error in process.
4. Fail Safe High and Fail Safe Low can be chosen to invert the Relay Operation Logic to suit the process requirements.

Figure 38: Programming

# 5 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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- sales@sapcon.in
- +91-731-4757575