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INSTRUCTION MANUAL

CASPER NAMUR

Capacitance Level Limit Switch

Version 1.1



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Revision History

Revision	Date	Author(s)	Description
1.0	20 May 2021	RND	First Version Editing
1.1	14 Aug 2021	RND	Addition of Remote Calibration

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- 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

Casper is a microcontroller-based capacitance level limit switch. It is suitable for fine, coarse, bulky solids, non-sticky slurries, and liquids. The measuring system consists of an electronic insert and a probe. It works by utilizing the dielectric property of the application material.



Figure 1: Casper Product Image

2 Operating Principle

Casper works on the principle of capacitance. The probe comprises a sense electrode, electrically isolated from the metallic tank using a suitable insulator. The sense and the vessel wall serve as the two electrodes of a capacitor with the service material acting as the dielectric. A change in the level of material causes a change in the dielectric, which in turn causes the value of this tank capacitor to change.

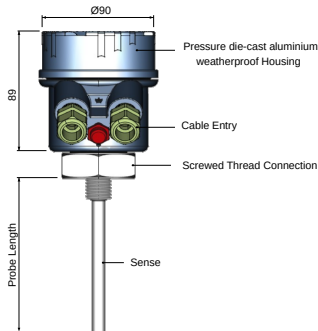


Figure 2: Description of Parts

3 Features

- 8.5 ± 0.2 V DC via Namur Isolator should contain $1K\Omega$ Internal Resistor (e.g. EX ia IIC, T6 (Zone 0, gas group 2))
- Customizable probe size.
- High temperature probe suitable for applications up to 200°C .
- Self-diagnosis for probe and electronics.
- Popular with a wide range of materials: low-to-high dielectric conductive materials / non-conductive material.

4 Applications

- Brewery
- Chemicals
- Dairy
- Food and Beverages
- Grain Handling

5 Application Specifications

For hazardous areas, the environmental temperature conditions at the installation site should be within the specified limit as per Table 1. The acceptable ambient temperature depends upon the Gas Group and Process Temperature. Additionally, maintain the surface temperature (T_{surface}) up to 75°C . Exceed the T_{surface} value over the permitted limit may lead to disaster conditions.

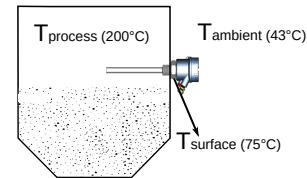


Figure 3: Temperature Conditions at Installation Site

PARAMETER	VALUE
Response Time	2 - 8 Sec (Depending on build-up and dielectric constant)
Sensitivity	Refer Table No. 6
Process Temperature	Up to 200°C *
Ambient Temperature	Up to 43°C *

Table 1: Application Specifications

* These are the experimented values given on the basis of laboratory test conditions.

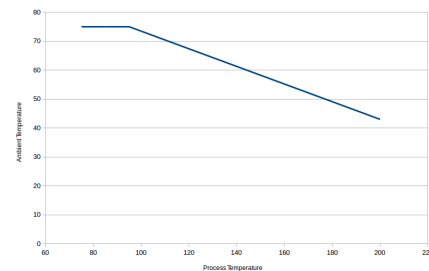


Figure 4: Relationship between Ambient and Process Temperature

6 Electrical Specifications

Please refer to Table 2 for Electrical Specifications.

PARAMETER	VALUE
Input Power Supply	NMR: 8.5 ± 0.2 V DC. Namur type current output ($I_{ON} \geq 2.1$ mA, $I_{OFF} \leq 1.2$ mA) Namur compliance can be attained with a Namur certified isolator.
Switching	Single-point level switching / Pump Control Logic
Switching Indication	Red - Alarm & Green - Normal
Fail-safe	Field Selectable: Open - Fail-safe High (For High Level) Close - Fail-safe Low (For Low Level)

Table 2: Electrical Specifications

7 Mechanical Specifications

Please refer to Table 3 for Mechanical Specifications.

PARAMETER	VALUE
Housing	<ul style="list-style-type: none"> • SCUTE: Pressure die-cast aluminium weatherproof (Rating IP-68) • FP2C: Cast aluminium, weatherproof & flameproof, powder coated, suitable for Gas Groups IIA, IIB & IIC as per IS-2148 (Rating IP-66)
Cable Gland	2 x 1/2" BSP/NPT , PG 13.5
Operating Temperature	-20°C to 60°C (Electronics)
Mounting	<ul style="list-style-type: none"> • Screwed: 1/2", 1", 1 1/2", 3/4" BSP / NPT • Flanged: As per user specification
Probe Length	100 mm to 3000 mm
Insulation	Full PTFE

Table 3: Mechanical Specifications

8 Namur Isolation Barrier Specs

The 'NMR' electronics of the Casper requires the following specifications to be functional:

PARAMETER	VALUE
Functional Operating Voltage	8.5 ± 0.2 V DC
Internal Source Resistance	1K Ω
Absolute Maximum Voltage	UI & UO = 13 V
Current Consumption	II & IO = 16 mA
Power Consumption	PI & PO = 65 mW
Input Capacitance	0 μ F
Input Inductance	LI = 22 μ H
Certification	Ex ia IIC T6 Ga (-20°C \leq Tamb \leq 60°C)

Table 4: Namur Isolation Barrier Specifications

9 Installation Guidelines

The Casper can be installed in the vessel in almost any position. While installing, please take care of the following points:

- Ensure that atleast 10 mm for the "Grounding" electrode on the Casper probe should be completely inside the application tank. i.e. No part of sense electrode should be inside the nozzle.

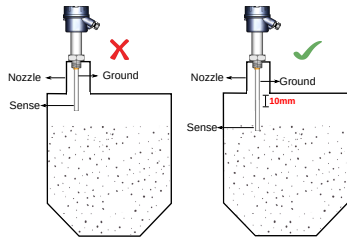


Figure 5: Grounding Length in an Application Tank

- Before Installing the device, ensure that the calibration process has been already carried out in safe area (Zone 2) then install the instrument in hazardous area as shown in Figure 11

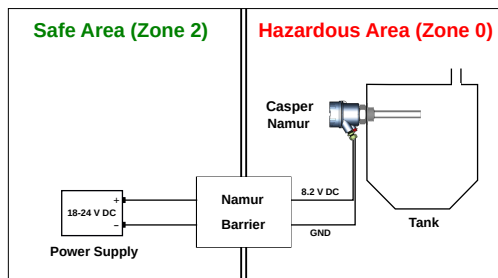


Figure 6: Calibration at safe zone

- For remote calibration, install the instrument in an application tank and then perform the calibration process in hazardous area (Zone 0).
- The instrument shouldn't block the material filling inlet.
- Secure the cover of housing tightly. Tighten the cable glands.
- For side-mounting, provide a baffle to prevent the material from falling on the probe. Please refer to Figure 7.
- To prevent the ingress of moisture and water seepage in side mounting position, the cable entries should always point downwards as shown in Figure 8.
- Make all electrical connections as instructed in the manual. Don't power on the device before verifying connections.

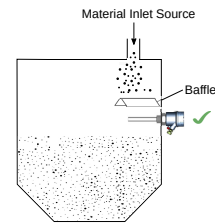


Figure 7: Casper with Baffle

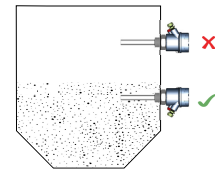


Figure 8: Cable Gland Arrangement

- Weatherproofness of enclosure is guaranteed only if the cover is in place glands adequately tightened. Damage due to accidental entry of water can be avoided if the instrument is installed in a rain shade.
- If the ambient temperature is high, the instrument should not be installed to receive direct sunlight. In case such a position of shade is not available, a heat shield should be fitted above the instrument especially if the operating temperature is 60 °C.
- While screwing the Casper, the hexagonal mounting bush should be turned and not the housing.

10 Electrical Connections

Please refer to the Figure 9 for electrical connections while connecting the instrument in an application tank.

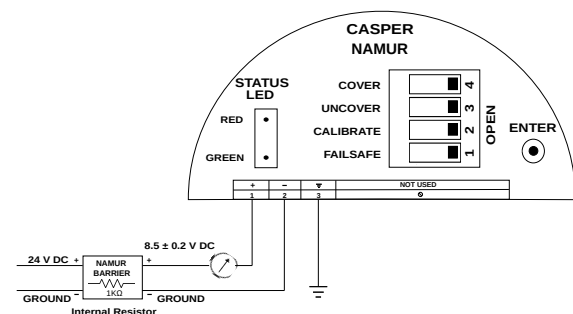


Figure 9: Electrical Connection during installation

11 Calibration

Calibration for the level sensor has to be carried out at the installation site. Calibration cannot be skipped and is essential for level sensor's operation. Calibration of Casper can be performed with the help of two different methods which are as follows:

- Normal Calibration

- Remote Calibration

11.1 Normal Calibration

Note: Perform the Normal Calibration of the level instrument only in a Safe Zone (Zone 2).

11.1.1 Calibration for Non-conductive Material

This calibration is also known as **Air Calibration** and **Calibration without material**. It should be done without the application material (i.e only air, no material).

It is recommended to first calibrate the Casper in a more convenient setup in Safe Zone(Zone 2) before installing it in an application tank.

To carry out calibration process, please follow the steps mentioned below:

- Prepare a transparent Metallic Test Tank as shown in the following Figure 10.

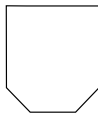


Figure 10: Metallic Test Tank

- Refer to given Figure 9 for Electrical Connections to power up and connect the device.
- Dip the Casper into test tank as shown in Figure 11.

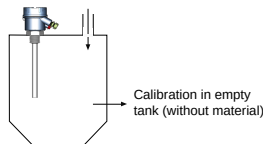


Figure 11: Calibration without Material

- Unscrew the cover and ensure that all DIP switches are in the OPEN position as shown in Figure 12. Make sure that the status LED is not blinking for error.

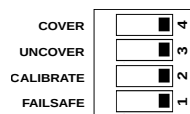


Figure 12: DIP Switch

- To start the calibration process, set the CALIBRATE switch to CLOSE (Opposite of OPEN in a DIP switch) position as shown in Figure 13.
- Press and hold ENTER key. The STATUS LED will glow in RED color.
- Release the ENTER key and set the CALIBRATE switch back to OPEN position.

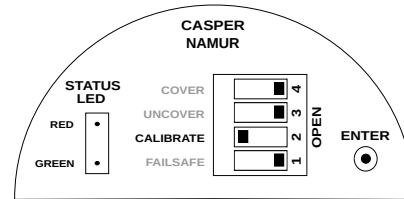


Figure 13: Calibration Switch Position

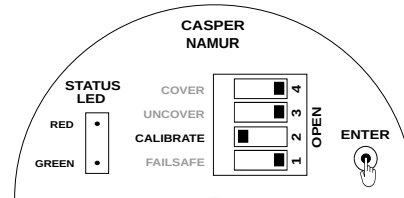


Figure 14: Setting Calibration

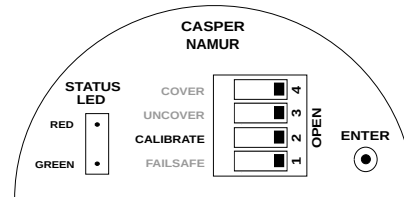


Figure 15: Saving Calibration

- Air calibration is done.
- Proceed to Section [Installation Guidelines](#) for installing the product in an application tank.

11.1.2 Calibration for Conductive Material

This calibration is also known as **Calibration with material**. For applications using conductive materials (water, acid based pastes etc.), Casper needs to be calibrated with an application material. This will make the instrument specific to the application material i.e. if the application material is changed; calibration should be repeated.

It is recommended to first calibrate the Casper in a more convenient setup in Safe Zone(Zone 2) before installing it in the application tank.

To carry out calibration process, please follow the steps mentioned below:

- Prepare a transparent Metallic Test Tank as shown in the following Figure 10.
- Refer to given Figure 9 for Electrical Connections to power up and connect the device.
- Dip the Casper in test tank & fill the tank with the application material such that the Casper's probe is completely covered with the material.
- Unscrew the cover and make sure that all DIP switches are in the OPEN position as shown in Figure 12. Ensure that the STATUS LED is not blinking for error.

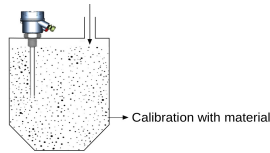


Figure 16: Calibration for Conductive Material

- To start with the calibration, set the CALIBRATE & COVER switch to CLOSE (Opposite of OPEN for DIP switch) position as shown in Figure 17.

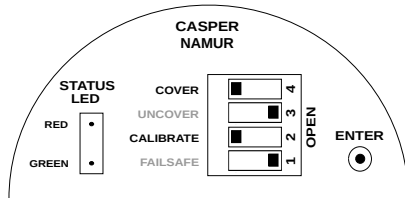


Figure 17: High Calibration Switch Position

- Press and hold ENTER key, the STATUS LED will glow in RED color as shown in Figure 18.

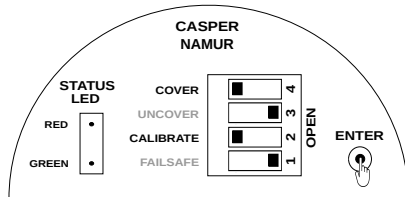


Figure 18: Setting Calibration

- Release the ENTER key and wait for 25 - 30 seconds.
- Set the CALIBRATE and COVER switch back to OPEN position as shown in Figure 19.

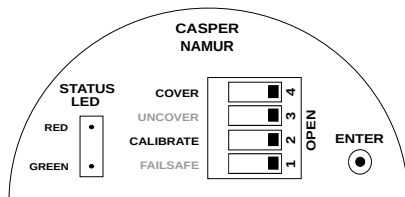


Figure 19: Saving Calibration

- High Calibration is complete.
- Proceed to Section [Installation Guidelines](#) for installing the product in an application tank.

11.2 Remote Calibration

Note: Remote calibration is performed when test tank is not available in Safe Zone (Zone 2) and calibration needs to be performed in Hazardous Zone (Zone 0).

11.2.1 Calibration for Non-conductive Material

This calibration is also known as **Air Calibration** and **Calibration without material**. It should be done without the application material (i.e only air, no material).

Note: Power OFF the level instrument before starting the calibration process.

To carry out calibration process, please follow the steps mentioned below:

- Ensure that all DIP switches are in the OPEN position.

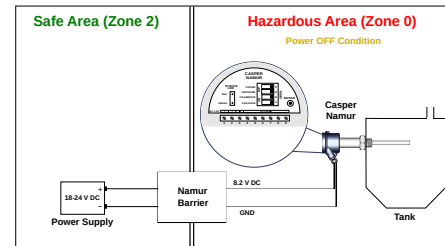


Figure 20: Air Calibration Setup

- Set the CALIBRATE switch to CLOSE (Opposite of OPEN in a DIP switch) position as shown in Figure 13.
- Close the cover of housing properly before powering on the instrument.
- Power ON the instrument and wait for a minimum of 60 seconds.

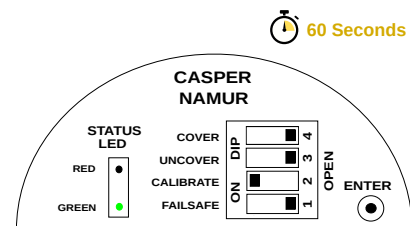


Figure 21: Power ON Condition

- Power OFF the instrument.
- Open the housing cover and set the CALIBRATE switch back to OPEN position as shown in Figure 15.
- Close the cover of housing properly.
- Power ON the instrument.
- Low calibration is completed.

11.2.2 Calibration for Conductive Material

For applications using conductive materials (water, acid based pastes etc.), Casper needs to be calibrated with the application material. This will make the instrument specific to the application material i.e. if the application material is changed; calibration should be repeated.

Note: Power OFF the level instrument before starting the calibration process.

To carry out calibration process, please follow the steps mentioned below:

- Ensure that all DIP switches are in the OPEN position.

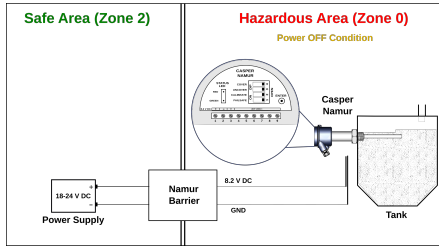


Figure 22: Remote High Calibration Setup

- Set the CALIBRATE and COVER switch to CLOSE (Opposite of OPEN in a DIP switch) position as shown in Figure 17.
- Close the cover of housing properly before powering on the instrument.
- Power ON the instrument and wait for a minimum of 60 seconds.

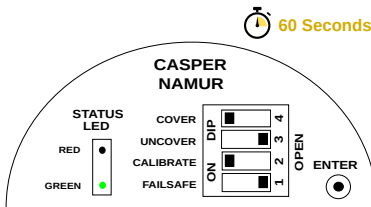


Figure 23: High Calibration Power ON Condition

- Power OFF the instrument.
- Open the housing cover and set the CALIBRATE and COVER switch back to OPEN position as shown in Figure 19.
- Close the cover of housing properly.
- Power ON the instrument.
- High calibration is completed.

12 Output Current Configuration

Note: Perform the operation of Output Current Configuration of the level instrument only in a Safe Zone (Zone 2).

Namur isolation barriers as specified in the Table 5 tend to have variation in their "Functional Operating Voltage". Change to the "Functional Operating Voltage" may cause a change in power consumption for Casper Namur level sensor. The output current can be configured is required as

per the procedure mentioned below:

If the output current of alarm condition exceeds or goes below the specified limit only then use Low Current Configuration or High Current Configuration as per the current value.

STATUS	OUTPUT CURRENT
Normal Condition	$\leq 1.2\text{mA}$
Alarm Condition	$\geq 2.1\text{mA}$ and $< 3\text{mA}$

Table 5: Operating Conditions of Output Current

12.1 Low Current Configuration

If the output current of alarm condition is exceed over **3mA** then the instrument does not operate properly which results instrument will not be able to switch. To resolve this condition, the value of output current should be adjusted by setting Low Current Configuration. To set this mode please follow the procedure given below:

- Set the COVER and UNCOVER switch to CLOSE position.

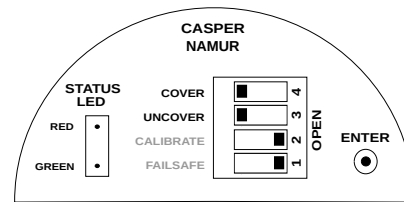


Figure 24: Switch Position Low Current Configuration

- Press and Hold the ENTER key, RED Status LED will start blinking.

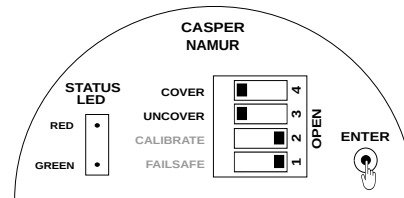


Figure 25: Setting of Low Current Configuration

- Blink the RED LED 2 times and release the ENTER key.
- Low Current Configuration mode is set.

12.2 High Current Configuration

If the output current of alarm condition goes below **2.1mA** then the instrument does not operate properly which results instrument will not be able to switch. To resolve this condition, the value of output current should be adjusted by setting High Current Configuration. **Indication of this mode is**

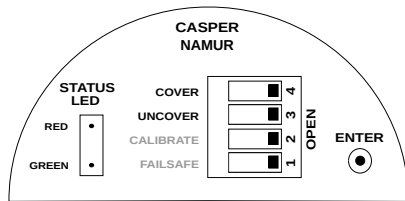


Figure 26: Saving of Low Current Configuration

shown by constantly glowing GREEN LED of STATUS LED. To set this mode please follow the procedure given below:

- Set the COVER and UNCOVER switch to CLOSE position as per Figure 24.
- Press and Hold the ENTER key, RED Status LED will start blinking as per Figure 25.
- Blink the RED LED only once and release the ENTER key as per Figure 26.
- High Current Configuration mode is set.

13 Sensitivity

Note: Set the sensitivity value between 1-5.

The instrument has 5-point sensitivity level to suit a wide range of application materials. Sensitivity value should be decided with respect to the dielectric constant of the application material. Refer to table 6 for selecting a suitable value. By default, the sensitivity is set to 3 to suit a wide range of materials. Traverse the following steps to set the sensitivity:

Note: Set the Sensitivity of the level instrument only in a Safe Zone (Zone 2).

1. Power OFF the instrument and unscrew the electronics insert from the enclosure using screw driver.

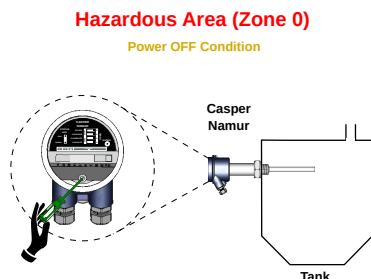


Figure 27: Sensitivity Setting

2. Kept the electronics in Safe Zone (Zone 2) and then set the Sensitivity.
3. Refer to given Figure 9 for Electrical Connections to power up and connect the device.
4. Select a sensitivity value for the product as per table 6.

DIELECTRIC CONSTANT	SENSITIVITY VALUE
High	1 – 2
Low	3 – 5 (default)

Table 6: Switching Sensitivity

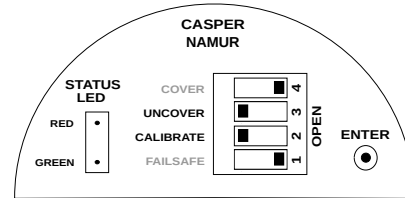


Figure 28: Sensitivity Switch Position

5. Set the CALIBRATE and UNCOVER switch to CLOSE position.
6. To modify the set value, Press ENTER and HOLD the key, RED Status LED will start blinking. Count the number of times the LED blinks and release the ENTER key after the required value. e.g. For setting the sensitivity to 4, count up to four blinks and release the ENTER key.

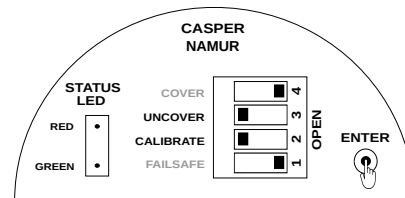


Figure 29: Setting Sensitivity Position

7. To save the sensitivity value, set the CALIBRATE and UNCOVER switches back to OPEN position.

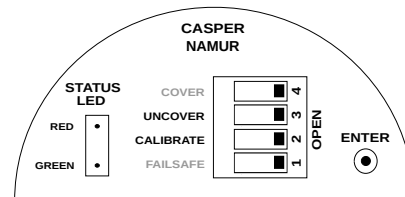


Figure 30: Saving Sensitivity

8. Check operation of Casper by filling in and draining out the material.
9. If the instrument does not switch when covered fully with the material, try again with a higher value of sensitivity.
10. If the instrument switches when covered fully with the material, but does not switch back to normal state

when uncovered, try again with a lower sensitivity value.

14 Failsafe

In a condition of device failure, known errors and input power failure the outputs of the device resemble the ALARM condition. This is meant to prevent overflow or dry run conditions in case of failures.

Prevent Overflow - High Level Switch Failsafe High (default) is set by moving the FAILSAFE switch to OPEN position.

1. When not in contact with the material, LED turns GREEN.
2. When in contact with the material, LED turns RED.

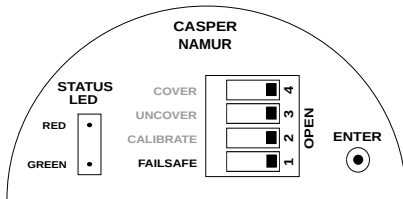


Figure 31: Failsafe High

Prevent Dry run - Low Level Switch Failsafe Low is set by moving the FAILSAFE switch to CLOSE position.

1. When in contact with the material, LED turns GREEN.
2. When not in contact with the material, LED turns RED.

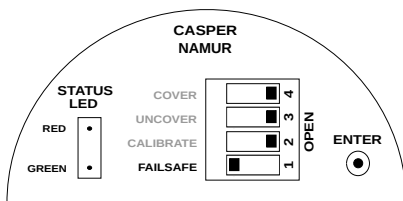


Figure 32: Failsafe Low

15 Factory Reset

Follow the steps given below to reset the time delays and sensitivity value to default values. Factory Rest does not reset any calibration values.

1. Set the CALIBRATE, COVER and UNCOVER switches to CLOSE position.
2. Press and hold the ENTER key until the STATUS LED blinks.
3. Set the CALIBRATE, COVER and UNCOVER switches back to OPEN position.
4. This will set the time delay to 0 and the sensitivity level to 3.

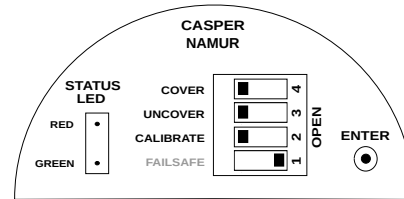


Figure 33: Switch Position

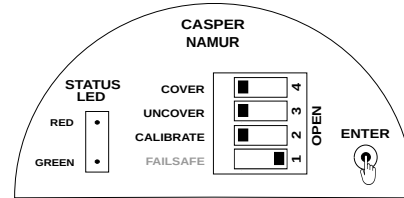


Figure 34: Setting Default Value

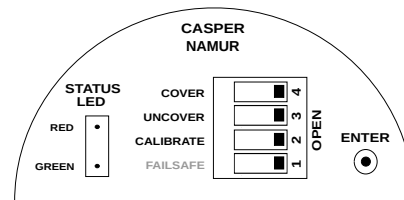


Figure 35: Saving Default Value

16 Certification

Please refer to Table 7 for Certifications.

CERTIFICATION	ITEM SELECTION
IS/IEC 60529: 2001 (IP68)	SCUTE
IS/IEC 60529: 2001 (IP66)	FP2C
IS/IEC 60079-1:2014 (Ex 'd')	FP2C
Ex ia IIC T3 Ga	NMR-DC6

Table 7: Certifications

17 Maintenance

The electronics of Casper needs no maintenance. When cleaning and checking the vessel, free the Casper from deposits. If the material has tendency to form a hard sticky deposit, the instrument must be checked more often. Make sure that the cable ducts and the lid are tightly sealed so that no moisture seeps into the instrument.

18 Error Indication

On error, the status LED starts blinking RED and GREEN alternately at a faster rate. Normal LED blinks are always at the rate of 1 blink per second, in either RED or GREEN color. In some cases, a GREEN or a RED blinking could indicate an error. Refer to Table 8 for a list of errors and their indication.

LED ERROR INDICATION	DESCRIPTION	TROUBLESHOOTING
RED-GREEN Blinking	Calibration Error	Recalibrate the instrument, make sure that the probe is calibrated in an empty metal-body tank.
RED Blinking	Probe Short-Circuit	Moisture deposition in the probe connector. Clean the connector and use the instrument.
GREEN Blinking	Probe Open	Remove the electronic insert from the housing and check the cable connections of the probe.
3 Times GREEN Blinking and 1 Red Blink	Illegal Key Combination	Switch all DIP switches to open position. Use only legal combination of keys.
3 Times RED Blinking and 1 GREEN Blink	Circuit Error	Contact the Customer Support department at Sapcon.

Table 8: Error Indication

19 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

20 Product Selection Order Code

Product

CPR : Casper - Microcontroller based Capacitance type Level Limit Switch (Use in Fine Powder, Bulky Solids, Slurries, Liquids etc.)

Type

I : Integral (sensor in same unit)

Housing

SCUTE : Pressure die-cast aluminium weatherproof (Rating IP68)

FP2C : Cast aluminium weather & flameproof powder coated paint suitable for Gas Group IIC (Rating IP-66)

Probe Housing Cable Entry

PCPG13 : PG 13.5, Polyamide

PCB5D : 1/2" BSP, DC Gland, Brass

PCN5D : 1/2" NPT, DC Gland, Brass

Output

NMR : Namur type current output at 8.5 ± 0.2 V DC ($I_{ON} \geq 2.1$ mA and $I_{OFF} \leq 1.2$ mA)

Power Supply

DC6 : 8.5 ± 0.2 V DC supplied by NAMUR certified isolator should contain 1K Ω Internal Resistor

Reference (Except 1/2", 3/4" Mounting)

REF : Yes (Incase of Non-Metallic Tanks)

STWGI : Still Well

STWS4 : Still Well

STWS6 : Still Well

Probe Type

RDP : Rod Probe

Mounting

MB5S6 : Screwed Thread, BSP 1/2", SS 316

MN5S6 : Screwed Thread, NPT 1/2", SS 316

MB75S6 : Screwed Thread, BSP 3/4", SS 316

MN75S6 : Screwed Thread, NPT 3/4", SS 316

MB10S6 : Screwed Thread, BSP 1", SS 316

MN10S6 : Screwed Thread, NPT 1", SS 316

MB15S4 : Screwed Thread, BSP 1-1/2", SS 304

MB15S6 : Screwed Thread, BSP 1-1/2", SS 316

MN15S4 : Screwed Thread, NPT 1-1/2", SS 304

MN15S6 : Screwed Thread, NPT 1-1/2", SS 316

FA10MS : 1" ANSI/ASME B16.5 Flange, MS Plated

FA10S6 : 1" ANSI/ASME B16.5 Flange, SS 316

FA15MS : 1-1/2" ANSI/ASME B16.5 Flange, MS Plated

FA15S4 : 1-1/2" ANSI/ASME B16.5 Flange, SS 304

FA15S6 : 1-1/2" ANSI/ASME B16.5 Flange, SS 316

FA20MS : 2" ANSI/ASME B16.5 Flange, MS Plated

FA20S4 : 2" ANSI/ASME B16.5 Flange, SS 304

FA20S6 : 2" ANSI/ASME B16.5 Flange, SS 316

FA25MS : 2-1/2" ANSI/ASME B16.5 Flange, MS Plated

FA25S4 : 2-1/2" ANSI/ASME B16.5 Flange, SS 304

Mounting

- FA25S6 : 2-1/2" ANSI/ASME B16.5 Flange, SS 316
- FA30MS : 3" ANSI/ASME B16.5 Flange, MS Plated
- FA30S4 : 3" ANSI/ASME B16.5 Flange, SS 304
- FA30S6 : 3" ANSI/ASME B16.5 Flange, SS 316
- F20MS : 10 mm thick Flange conforming to 2" ANSI/ASME B16.5 Flange, MS Plated
- F20S6 : 10 mm thick Flange conforming to 2" ANSI/ASME B16.5 Flange
- F25MS : 10 mm thick Flange conforming to 2-1/2" ANSI/ASME B16.5 Flange, MS Plated
- F25S4 : 10 mm thick Flange conforming to 2-1/2" ANSI/ASME B16.5 Flange, SS 304
- F25S6 : 10 mm thick Flange conforming to 2-1/2" ANSI/ASME B16.5 Flange
- F30MS : 10 mm thick Flange conforming to 3" ANSI/ASME B16.5 Flange, MS Plated
- F30S4 : 10 mm thick Flange conforming to 3" ANSI/ASME B16.5 Flange, SS 304
- F30S6 : 10 mm thick Flange conforming to 3" ANSI/ASME B16.5 Flange
- TC10S6 : : 1" Tri-Clamp conforming to ISO 2852
- TC15S6 : : 1-1/2" Tri-Clamp conforming to ISO 2852
- TC20S6 : : 2" Tri-Clamp conforming to ISO 2852

Insulation Type

- P : Part PTFE Insulated
- F : Full PTFE Insulated

Sense

- SS6 : SS 316

Grounding Length (Optional)

- GGI : GI (Galvanized Iron)
- GS4 : SS 304
- GS6 : SS 316

Operating Temperature

- 10T : Upto 100°C
- 25T : Upto 250°C

Standoff Material (Only with "25T")

- STGI : GI (Galvanized Iron)
- STS4 : SS 304
- STS6 : SS 316

Probe Length

- 1H5H : 100 mm to 1500 mm (Only with 1/2" Mounting)
- 5H30H : 500 mm to 3000 mm (Only with "Grounding")
- 1H30H : 100 mm to 3000 mm