

## Data Sheet

Flüssigkeitsstandscharter  
Typen **LLS 4000 und LLS 4000U**

Kompakter, kostengünstiger und zuverlässiger Schalter für Flüssigkeitsstandmessungen



The LLS 4000/4000U liquid level switch is designed to detect the state (gas or liquid) of the refrigerant in front of the sensing head, while installed in a wide range of refrigeration applications.

The LLS level switch comes in 2 variants, LLS 4000 and LLS 4000U. They are identical except for the connector thread interface to the system. The LLS 4000 is provided with G 3/4" thread, while the LLS 4000U is provided with NPT 3/4" thread.

The LLS 4000/4000U liquid level switch is based on the proven reflectometry measuring technology (microwave level measurement) adapted specifically for the new LLS 4000/4000U switch.

LLS 4000/4000U liquid level switches can be used to control the liquid level of many different refrigerants in vessels, accumulators, receivers, standpipes, etc. The switches are normally installed in a pair of two, controlling the upper liquid level and the lower liquid level.

The level switch includes a relay that switches by change in refrigerant state. The on site configuration of the LLS allows the normally open/closed relay setting depending on the desired correlation.

For SIL applications a SIL2 version is available with blocked configuration (not configurable).

All configuration and readings from the LLS switch are performed through Bluetooth and a downloadable special Danfoss app.

## Features

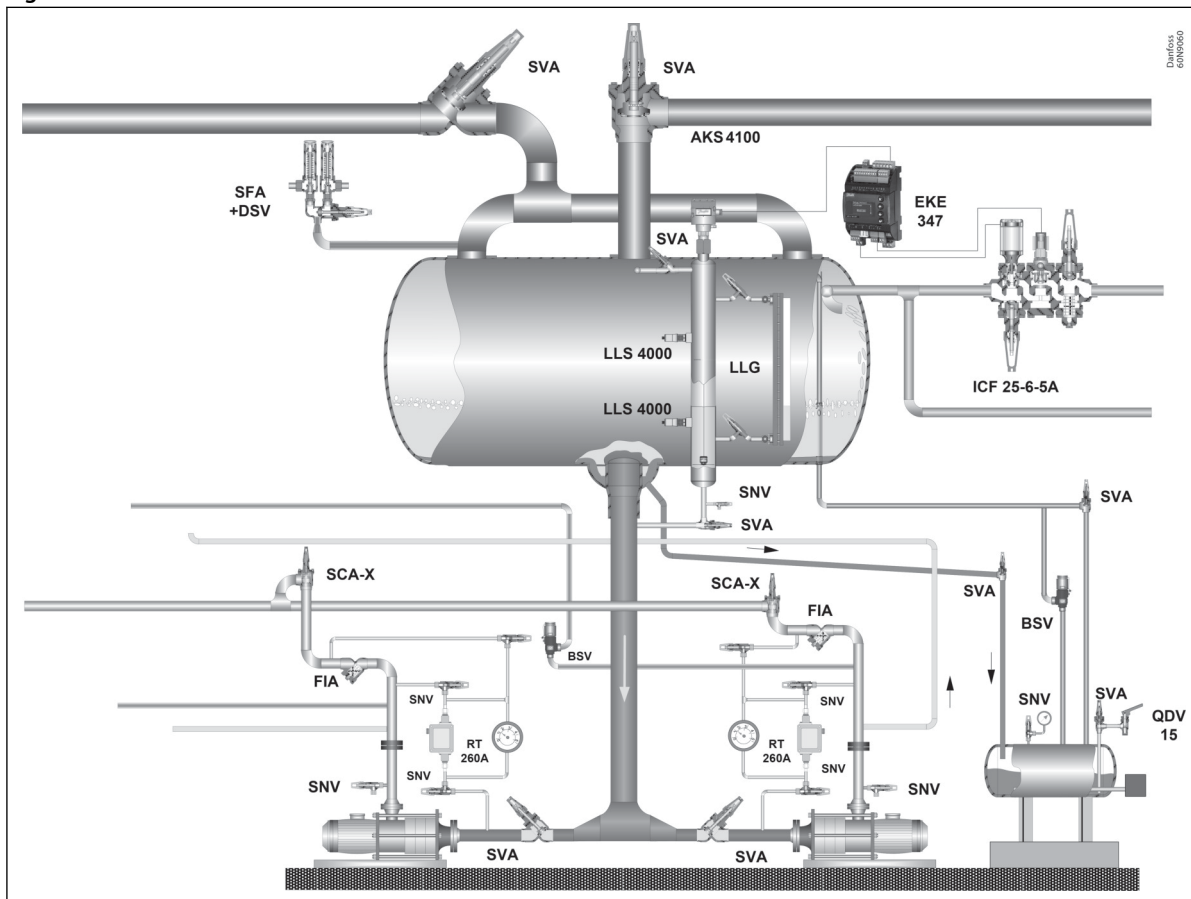
- Plug and play liquid level switch
- Easy installation and minimum or no need for configuration
- SIL design with redundancy on microprocessor and relay
- Convenient communication with all units via Bluetooth and a Danfoss app
- SIL2 compliant version
- Two commonly used connection variants
- Maintenance free
- Replacement of electronic part without removing mechanical part (not applicable for SIL2 devices)
- Applicable for ammonia and commonly used H(C)FCs
- Applicable for R1234ze(E) with POE oils (miscible) or oil free systems
- Applicable for refrigerant oils in Ammonia and H(C)FC systems with a refrigerant gas temperature up to max. 80 °C
- For other medias and mixed medias, please contact Danfoss
- Well proven reflectometry measuring principle
- Conforms to: Telecommunications Directive RED 2014/53 EU. Low voltage directive 2014/35/EU. EMC directive 2014/30/EU. ROHS 2011/65/EU
- Approvals: SIL2, FCC, IC, EAC, UA, CMIIT, ANATEL, NBTC CRN

## Applications

To control if a liquid level is within predefined allowed limits, two LLS 4000 are installed in an upper and a lower limit position respectively. By this setup the liquid level is between the two level switches and the lower switch will sense liquid, while the upper will sense gas.

In case the liquid level moves outside the limits, one of the switches will sense opposite and switch the built-in relay. This relay switch function should be used for alarm settings. This is made easy when connected to the system PLC.

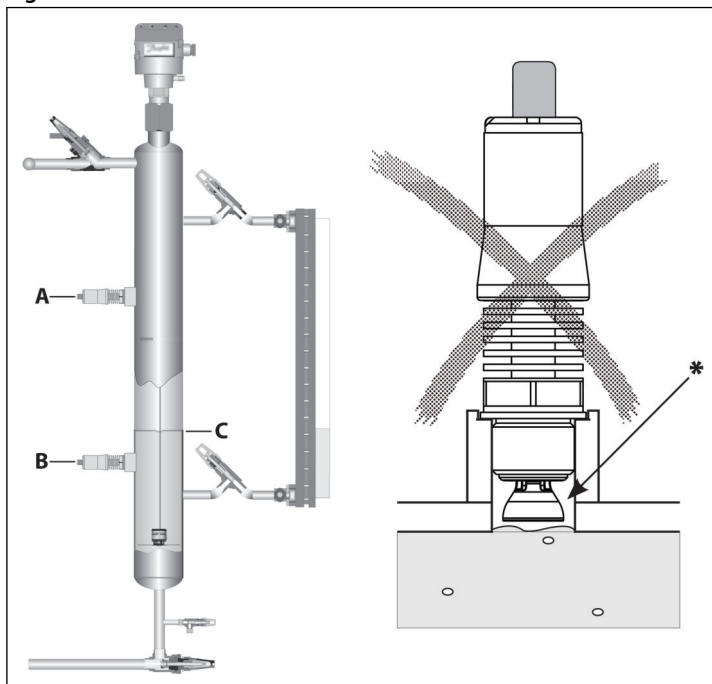
**Figure 1: LLS locations**



**NOTE:**

The LLS can be used wherever liquid levels of selected refrigerants and refrigerant oils must be controlled.

Figure 2: LLS orientation



<b>A</b>	Upper LLS 4000/U
<b>B</b>	Lower LLS 4000/U
<b>C</b>	Liq. Level

**NOTE:**

Horizontal installation recommended. Vertical or inclined installation not recommended: \* **Risk of Gas Pockets**

The LLS comes in two versions:

- A standard version, which is applicable for most refrigeration or processing plants, and is fully configurable regarding type of liquid and relay setting.
- A SIL2 version applicable for SIL compliant process plants. This version is non-configurable regarding relay setting (see [Configurable parameters](#)) and is intended specific as the **upper** level switch.

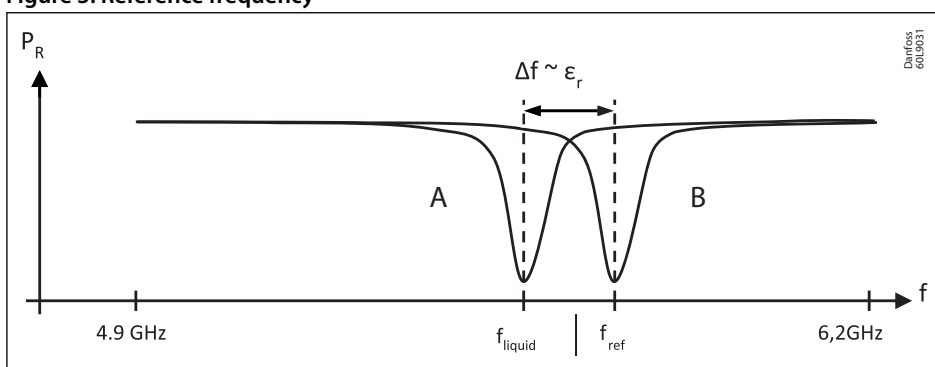
**Measuring principle**

The measurement principle of the LLS is based on reflectometry with a 4.8 GHz to 6.4 GHz linear sweep (Microwave switch technology). The reflected signal is characterized by a resonance frequency.

The resonance frequency in air is taken as a reference ( $f_{ref}$ ). When the sensing element is in contact with the liquid, the resonance frequency is shifting to a lower frequency. This is due to the change of the dielectric constant of the medium.

The point level switch monitors the resonance frequency and indicates whether the sensing element is surrounded by liquid or gas. The figure below shows the reference frequency with air (dielectric constant  $\epsilon_r=1$ ) in front of the sensing element and with a liquid dielectric constant  $\epsilon_r>1.35$ .

Figure 3: Reference frequency



<b>A</b>	With liquid
<b>B</b>	Without liquid

## Media

### Refrigerants

Table 1: Approved media

	Media	Saturation temperature range
Ammonia and listed H(C)FCs and HFOs.  <b>NOTE:</b> For other medias and mixed medias, please contact Danfoss.	R717 (Ammonia)	-50 °C – +105 °C (-58 °F – +221 °F)
	R22 (HCFC)	-50 °C – +86 °C (-58 °F – +187 °F)
	R507A (HCFC)	-50 °C – +60 °C (-58 °F – +140 °F)
	R134a (HFC)	-50 °C – +91 °C (-58 °F – +196 °F)
	R404A (HFC)	-50 °C – +63 °C (-58 °F – +145 °F)
	R407A (HFC)	-50 °C – +72 °C (-58 °F – +162 °F)
	R410A (HFC)	-50 °C – +61 °C (-58 °F – +142 °F)
	R513A (HFC)	-50 °C – +83 °C (-58 °F – +181 °F)
	R1234ze(E) (HFO) <sup>(1)</sup>	-50 °C – +85 °C (-58 °F – +185 °F)
	PAO (Oil) <sup>(2)</sup>	Max 5000 cP and +120 °C (Max 5000 cP and +248 °F)
	POE (Oil) <sup>(2)</sup>	Max 5000 cP and +120 °C (Max 5000 cP and +248 °F)
	Mineral (Oil) <sup>(2)</sup>	Max 5000 cP and +120 °C (Max 5000 cP and +248 °F)

<sup>(1)</sup> R1234ze(E) with POE oils (miscible)

<sup>(2)</sup> When detecting oils in Ammonia, H(C)FC and HFO systems, the refrigerant gas temperature above the oil must be lower than 80 °C

### New refrigerants

Danfoss products are continually evaluated for use with new refrigerants depending on market requirements.

When a refrigerant is approved for use by Danfoss, it is added to the relevant portfolio, and the R number of the refrigerant (e.g. R513A) will be added to the technical data of the code number. Therefore, products for specific refrigerants are best checked at [store.danfoss.com/en/](https://store.danfoss.com/en/), or by contacting your local Danfoss representative.

## Product specification

### Elektrische Daten

Tabelle 2: Elektrische Daten

Merkmale	Montagevorschriften
Spannungsversorgung	24 V DC +/-25 %, 80 mA Standardversorgungsspannung des Typs: SELV (Safety Extra Low Voltage, Sicherheitskleinsspannung) mit einer Stromgrenze von max. 8 A.
Relais (Solid State)	Max. 30 V DC, 200 mA Es kann die gleiche Versorgungsspannung wie für die Versorgung verwendet werden. Bitte beachten: Bei Anwendungen mit SIL2-Anforderung ist möglicherweise eine weitere separate SELV-Versorgungsspannung erforderlich. Min. Schaltspiele: 1000000 Standard-Verzögerung zwischen Erfassung und Relais-Schaltung: PV02: 1 Sekunde PV03: 2 Sekunden Die Versionsnummer des Produkts befindet sich auf dem Produktetikett. Siehe <a href="#">Bild 9: Nameplate</a> Die tatsächliche Verzögerung hängt stark von der Medienviskosität ab und ist vor der Inbetriebnahme zu prüfen.
Überspannungskategorie	Kategorie II für Versorgung und Ausgang
Elektrischer Anschluss	M12 (4-polig) Steckanschluss am Gerät
Messtechnik	Mikrowellen-Reflektometrie (Nicht TLPR-Kategorie)
Kommunikationsoption	Bluetooth erfüllt ETSI EN 300 328

### Mechanical data

Table 3: Mechanical data

Features	Specifications
Max. medium viscosity	5000 cP (Un-detection is delayed up to 20 seconds)
Max. working pressure	140 bar (2030 psi)
Ambient temperature range	-40 °C – 65 °C (-40 °F – 149 °F)
Medium temperature range	-50 °C – 120 °C (-58 °F – 248 °F) Observe restrictions on saturation temperature for approved medias
Operating environment	Pollution degree 3, altitude 2000 max., outdoor use Relative humidity RH4 to RH99 % (IEC 60721-3-4: 1995 Class 4K4)
Connection type	G 3/4" or NPT 3/4"
Weight	350 g (0.77 lb)
Enclosure rating	IP 66 / IP 67 IEC 60529: 1989 + A1: 1999 + A2: 2013 NEMA 250: 4X
Housing material (electronics)	Transparent and UV resistant. Compliance with IEC 60695-11-10, UL 94 HB
Housing material (mechanics)	Stainless Steel 316L
Vibration resistance	Long term random 7,54 g RMS (Curve A, IEC 60068-2-64) Level on pipes and brackets in direct and immediate vicinity of motors, compressors etc
Resonance frequency	600 – 650 Hz

## LLS 4000 Nachrüstsatz AKS 38

Bild 4: Werkstoff AKS 38 Nachrüstgehäuse

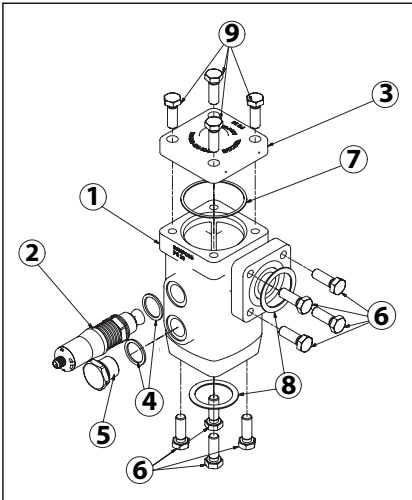


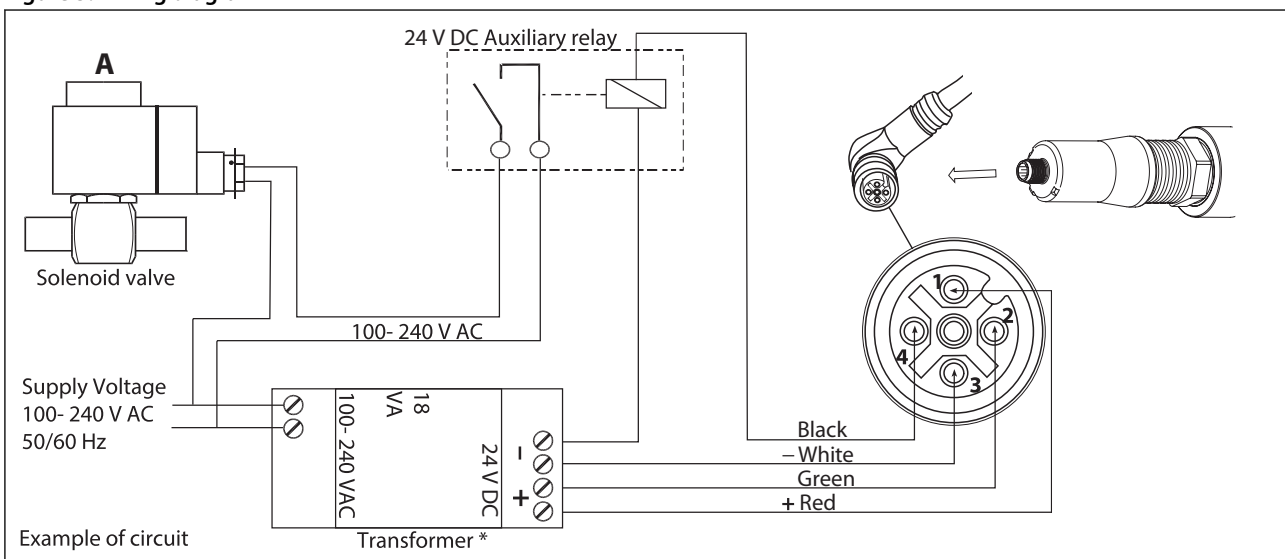
Tabelle 4: Werkstoff/Technische Daten AKS 38 Nachrüstgehäuse

Pos.	Artikel	Material	Menge <sup>(1)</sup>
1	Gehäuse	Gusseisen, zinkchromatiert, EN-GJS-400-18-LT	1
2	LLS 4000/U	Edelstahl	1
3	Kopfdeckel	Gusseisen, zinkchromatiert, EN-GJS-400-18-LT	1
4	Alu-Dichtung	Aluminium	2
5	Stecker	Edelstahl	1
6	Flanschbolzen	Edelstahl, A2-70 (DIN 267-11)/ASTM A-276	8
7	Dichtung	Asbestfreier Faserstoff	1
8	Flanschdichtung	Asbestfreier Faserstoff	2
9	Abdeckungsschrauben	Edelstahl, A2-70 (DIN 267-11)/ASTM A-276	4
	Druckbereich	Das Gehäuse AKS 38 ist auf einen maximal zulässigen Betriebsüberdruck von 28 barg/406 psig ausgelegt.	
	Temperaturbereich	-50 bis +65 °C/-58 bis +149 °F	

<sup>(1)</sup> Menge enthalten in LLS 4000 Nachrüstsatz AKS 38

## Wiring diagram

Figure 5: Wiring diagram



**NOTE:**

\*A. Coil voltage must match supply voltage

**NOTE:**

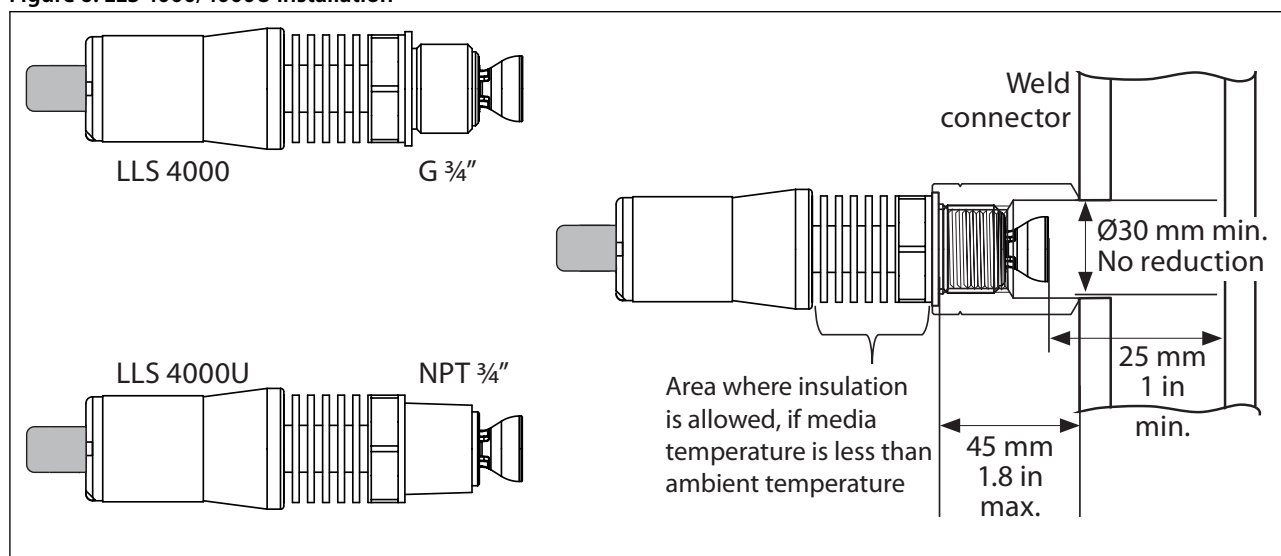
For ON/OFF level control with 1 x LLS 4000 an externally time delay may be used. The time delay shall be set with care and provide a differential NOT higher than 50 – 75 mm under all operating conditions.

**Connection types**

Beside the two versions the LLS also comes with two different thread types, LLS 4000 and LLS 4000U. They are identical except for the connector thread for installation to the system. The LLS 4000 is provided with G 3/4" thread, while the LLS 4000U is provided with NPT 3/4" thread.

For connection to the actual part of the system appropriate weld connectors are needed. Danfoss offers weld connectors for both G and NPT 3/4" thread as accessory. Please note geometric restrictions below.

Figure 6: LLS 4000/4000U installation



**Electrical installation/connection**

The LLS 4000 level switch must be installed as one unit (mechanical and electrical assembled) without disassembly to avoid the need for recalibration.

For powering the device, a low power source (LPS) must be used with safety extra low voltage output (SELV) and current limited to 8A maximum.

After connecting the M12 female cable to the power supply and relay circuit the M12 plug can be installed on the M12 male connector and the power can be switched on.

At this stage the green light LED will turn on and be visible through the transparent housing (see [Figure 8](#)).

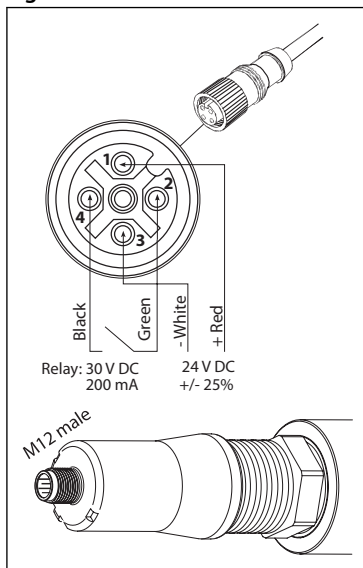
The LLS is now ready for configuration via the Danfoss Bluetooth app (see [Configurable parameters](#)).

**Danfoss M12 cables** (ordered separately)

- M12 straight cable female x 2 meter,
- M12 straight cable female x 8 meter
- (M12 angle cable are not recommended)

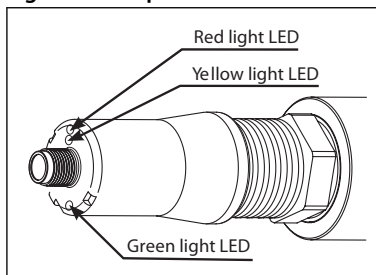


Figure 7: M12 cable connection



## **LED light indicators**

Figure 8: LED position



There are three LED indicators inside the LLS 4000 behind the transparent cover.

- Green indicates the state of power to the switch
  - If flashing: Bluetooth connection is established
- Yellow indicates if liquid is in front of switch
- Red indicates if alarm is present

## **Configurable parameters**

The set-up of the LLS 4000 is easy and simple, since only few parameters in the LLS software are configurable.

These are:

- Media type - Ammonia, HFC, HCFC; HFO or Oil. Factory default: Ammonia
- Relay NO (normally open when no liquid) or NC (normally closed when no liquid). Factory default: Normally closed

For plants where factory defaults are valid, the installation and set-up is simply Plug & play.

**Table 5** shows possible configurations, relay state for given configuration/liquid level and LED indications.

Table 5: Configuration chart

	Level	Open at no Liquid (Normally Open) (1)	Closed at no Liquid (Normally Closed) (1)	Voltage connected	Level detection	LLS Fault
				Green LED	Yellow LED	Red LED
High Level sensor			<b>SIL2 fixed configuration</b> 	●		
				●	●	
Low Level sensor				●	●	
				●		
Voltage supply outside spec.						
LLS 4000/4000U fault <sup>(4)</sup>				●	● <sup>(5)</sup>	●

<sup>(1)</sup> Configuration dependent. Non-SIL2 fully configurable. SIL2 fixed configuration and only applicable for High Level sensor

<sup>(2)</sup> Not recommended in these applications: A High Level Alarm may not be registered at a power failure

<sup>(3)</sup> Not recommended in these applications: A Low Level Alarm may not be registered at a power failure

<sup>(4)</sup> For failure types please connect the device to the Bluetooth App, enter fault state mode, and read the failure type

<sup>(5)</sup> Fault can be detected at any detected level, ie. two or all three lights on

## Maintenance/service & calibration precautions

### NOTE:

The LLS 4000 is considered maintenance free, but there are a few precautions that needs attention.

The fins shall be kept free of dirt, dust, paint and oil etc. that potentially reduces the thermal heat transfer from the fins to the air.

For LLS cleaning use soft cloth dry or wet or compressed air.

If the electronic part is separated from the mechanical part during installation, service or maintenance, the ingress of any foreign substances to the electronic or mechanical part shall be avoided.

Generally the separating of electronic and mechanical parts should be avoided due to calibration, and the mixing of mechanical and electronic parts from different switches must be avoided. In case of the incident mixing of mechanical and electronic parts from different switches, subsequent recalibration might be required.

Prior to calibration the following must be ensured:

The LLS must be out of liquid state (in gas phase), otherwise the calibration might end up incorrect.

This can be secured by either emptying the actual vessel or uninstall the LLS to ambient air.

While in "dry" surroundings, connect power to the LLS switch and perform the calibration.

The Danfoss LLS app includes the calibration possibility. Calibration is not applicable for devices configured for SIL2 devices).

Ice build-up on the LLS switch reduces the accessibility for the Bluetooth connection.

- 10 cm icecap reduces the distance from app device to the LLS to 1 meter
- 20 cm icecap is considered as the maximum to be able to connect

Ice as such do not impact the functionality of the product as far as the minimum ambient temperature is respected.

## **Bluetooth communication**



- A special Danfoss LLS app can be downloaded from Android google play or IOS app store.
- All communication with all LLS installed in a plant is done by use of this app. Communication can only happen with one LLS at a time.
- Each LLS switch includes its own serial number, which will appear in the app when connected. At the same time the green light LED in the actual connected LLS will be flashing.



Bluetooth® word mark and logos are registered trademarks of Bluetooth SIG Inc.

Android and Google Play are registered trademark of Google LLC. App Store is registered trademarks of Apple Inc.

## **Bluetooth configuration**

Always download or update to latest App version. Devices with Firmware PV01 (see product label) must be Firmware updated to latest firmware before configuration. Please contact Danfoss.

The first time parameter setting of an individual LLS switch is done by opening of the app and performing a scan for devices. The app will get a list of LLS that are present at the actual location. The list will include a name and the matching serial number for each of the present LLS.

The name and configurable parameters of any LLS can be changed at any time.

1. Choose the first item on the list and observe which LLS' green LED is flashing
2. Log-in with the provided PIN code. (Default code is 0000. For safety reason the PIN code should be changed afterwards)
3. Touch the Menu Icon
4. Touch the Log-in
5. Enter the Password provided
  - Default code is 12131400. For safety reason the Password should be changed afterwards
6. Rename the device to an up to 24 symbol name (8 symbols displayed)
7. Check the parameter settings and if needed change one or both parameters Media type/ Switch state.
  - Changing media type may require a restart (power off/on) of the LLS 4000/U
8. Note the ID: Name, serial number, media type and switch state
9. Close the app and observe that the green light stops flashing
10. This LLS is now ready for operation
11. If more LLS are present choose the next item on the list and repeat steps 1 to 10

## **Safety/Approvals**

### **⚠ WARNING:**

This is a Class A device. This device may cause radio interference in residential areas. In case of interference, the operator may be required to take appropriate measures. This instrument has to be mounted on a metallic tank. The device is intended to be used in industrial areas.



## Flüssigkeitsstandscharter, Typen LLS 4000 und LLS 4000U

This device complies with FCC and ISCED RF radiation exposure limits set forth for general population. This device must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

The Product Marketing name of the instrument is 'LLS 4000 series'.

### Dimensions and weights

Table 6: Dimensions and weights

LLS 4000 [mm]	LLS 4000U [in]
<p>Weight: approx. 350 g / 0.77 lbs</p>	<p>Weight: approx. 350 g / 0.77 lbs</p>

Figure 10: Weld connector 3/4" G or NPT female

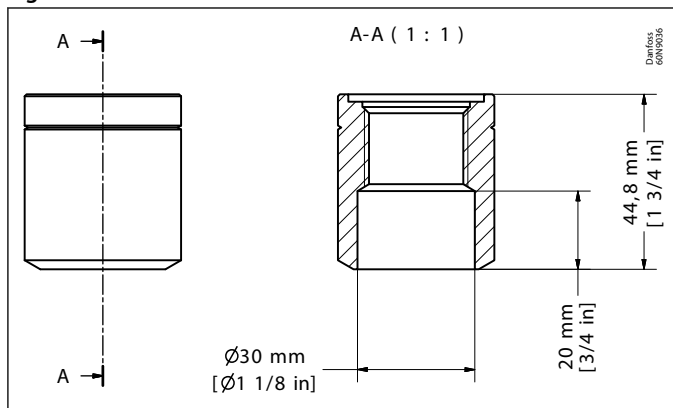
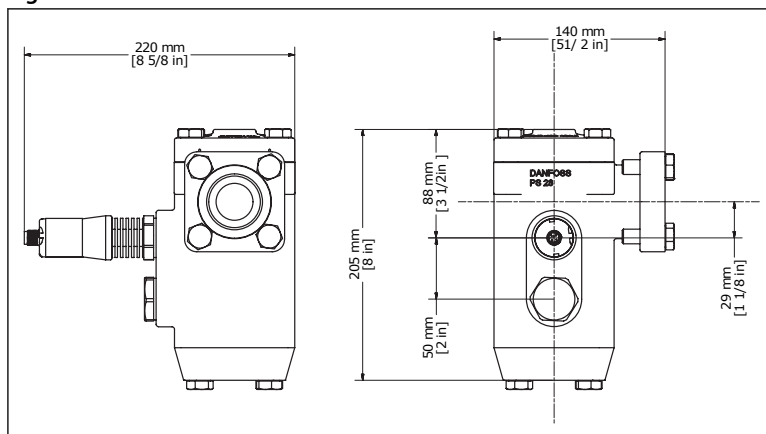


Figure 11: LLS 4000 Retrofit AKS 38 kit



## Ordering

### Bestellung

**Tabelle 7: LLS 4000/4000U**

Beschreibung	Artikelnummer
Flüssigkeitsstandscharter LLS 4000, G ¾", mit Aluminiumdichtung (ohne Schweißanschluss & M12-Kabel)	<b>084H6001</b>
Flüssigkeitsstandscharter LLS 4000 SIL2, G ¾", mit Aluminiumdichtung (ohne Schweißanschluss & M12-Kabel)	<b>084H6002</b>
Flüssigkeitsstandscharter LLS 4000U, NPT ¾" (ohne Schweißanschluss & M12-Kabel)	<b>084H6003</b>
Flüssigkeitsstandscharter LLS 4000U SIL2, NPT ¾" (ohne Schweißanschluss & M12-Kabel)	<b>084H6004</b>

**Tabelle 8: Ersatzteile/Zubehör**

Beschreibung	Artikelnummer
Schweißstutzen G ¾"	<b>084H6012</b>
Schweißstutzen G ¾" Edelstahl	<b>084H6014</b>
Schweißanschluss NPT ¾" (ohne Teflonband)	<b>084H6015</b>
Elektronisches Oberteil LLS 4000/U inklusive O-Ring zwischen elektronischem und mechanischem Teil (Ersatzteil nicht anwendbar für SIL2-Geräte; 084H6002 und 084H6004)	<b>084H6010</b>
M12 Danfoss Kabelbuchse Durchgangsausführung, 2 m Kabel(6,6 ft)	<b>034G2201</b>
M12 Danfoss Kabelbuchse Durchgangsausführung, 8 m Kabel(26,2 ft)	<b>034G2200</b>
LLS 4000/U Inspektions-Kit Enthält: 5 Aludichtungen für G ¾"-Anschluss, 5 O-Ringe zwischen elektronischem und mechanischem Teil	<b>084H6011</b>

**Tabelle 9: AKS 38 Nachrüstung**

Beschreibung	Artikelnummer
LLS 4000 Nachrüstung AKS 38, Satz inkl. 1 x LLS 4000 G ¾"	<b>148H3504</b>
AK-PS 075, 0,75 A/100-240 V 50/60 Hz Versorgungsspannung	<b>080Z0053</b>

**Certificates, declarations, and approvals**

The list contains all certificates, declarations, and approvals for this product type. Individual code number may have some or all of these approvals, and certain local approvals may not appear on the list.

Some approvals may change over time. You can check the most current status at danfoss.com or contact your local Danfoss representative if you have any questions.

**Table 10: EU conformity**

Radio Equipment Directive (RED) 2014/53/EU	EN 300 328 V2.1.1 EN 62311: 2008
Low voltage directive 2014/35/EU	EN 61010-1 (edition III)
EMC directive 2014/30/EU	EN 61326-1: 2013
PED	2014/68/EU, A4P3
ROHS 2011/65/EU	2011/65/EU 2015/863/EU

**Table 11: Approvals**

<b>Approvals</b>	CE: PED, EMC, RED, RoHS, LVD CRN SIL2 FCC IC EAC UA CMIIT ANATEL NBTC
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## Online-Support

Danfoss bietet neben unseren Produkten ein breites Spektrum an Support, einschließlich digitaler Produktinformationen, Software, mobiler Apps und fachkundiger Beratung. Siehe die folgenden Möglichkeiten.

### Der Danfoss Product Store



Der Danfoss Product Store ist Ihr One-Stop-Shop für alles, was mit dem Produkt zu tun hat – egal, wo auf der Welt Sie sich befinden oder in welchem Bereich der Kühlbranche Sie tätig sind. Erhalten Sie schnellen Zugriff auf wichtige Informationen wie Produktspezifikationen, Bestellnummern, technische Dokumentation, Zertifizierungen, Zubehör und mehr. Auf [store.danfoss.de](https://store.danfoss.de) stöbern.

### Technische Dokumentation finden



Finden Sie die technische Dokumentation, die Sie für die Inbetriebnahme Ihres Projekts benötigen. Erhalten Sie direkten Zugriff auf unsere offizielle Sammlung von Datenblättern, Zertifikaten und Erklärungen, Handbüchern und Anleitungen, 3D-Modellen und Zeichnungen, Fallbeispielen, Broschüren und vielem mehr.

Suchen Sie jetzt unter [www.danfoss.com/de-de/service-and-support/documentation](https://www.danfoss.com/de-de/service-and-support/documentation).

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Erstellen Sie Ihr kostenloses Danfoss Learning-Konto unter [www.danfoss.com/de-de/service-and-support/learning](https://www.danfoss.com/de-de/service-and-support/learning).

### Erhalten Sie lokale Informationen und Support



Lokale Danfoss-Websites sind die Hauptquelle für Hilfe und Informationen über unser Unternehmen und unsere Produkte. Erhalten Sie Infos zur Produktverfügbarkeit, die neuesten regionalen Nachrichten oder kontaktieren Sie einen Experten in Ihrer Sprache.

Hier finden Sie Ihre Danfoss-Website vor Ort: [www.danfoss.com/en/choose-region](https://www.danfoss.com/en/choose-region).

### Ersatzteile



Greifen Sie direkt von Ihrem Smartphone auf den Ersatzteil- und Servicesatz-Katalog von Danfoss zu. Die App enthält eine große Auswahl an Komponenten für Klimatechnik- und Kühlungsanwendungen, wie Ventile, Schmutzfänger, Druckschalter und Sensoren. Laden Sie die Ersatzteil-App kostenlos herunter unter [www.danfoss.com/en/service-and-support/](https://www.danfoss.com/en/service-and-support/)

[downloads](https://www.danfoss.com/en/service-and-support/).

### Coolselector®2 – Finden Sie die besten Komponenten für Ihr HVAC/R-System



Coolselector®2 erleichtert Ingenieuren, Beratern und Designern die Suche und Bestellung der besten Komponenten für Kälte- und Klimaanlage. Dazu müssen Sie lediglich Berechnungen auf Grundlage Ihrer Betriebsbedingungen ausführen und anschließend die beste Komponentenzusammenstellung für Ihre Anlage auswählen.

Laden Sie Coolselector®2 kostenlos unter [Coolselector.Danfoss.de](https://Coolselector.Danfoss.de) herunter.

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