Instruction

Type AKS 4100/4100U
Cable version

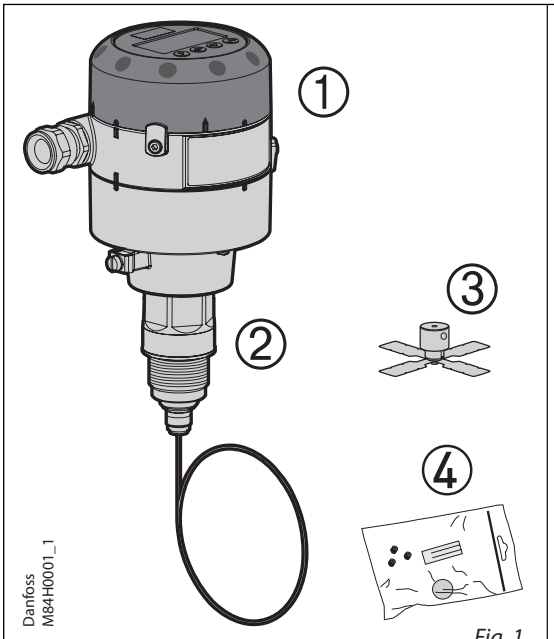


Fig. 1

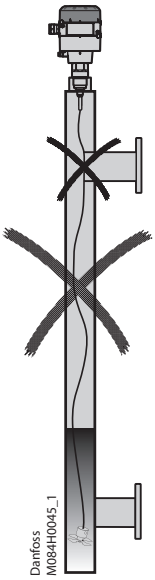


Fig. 2a

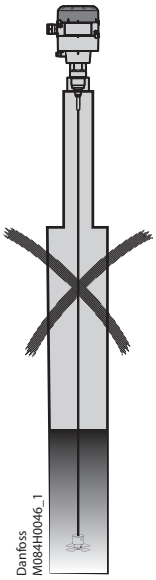


Fig. 2b

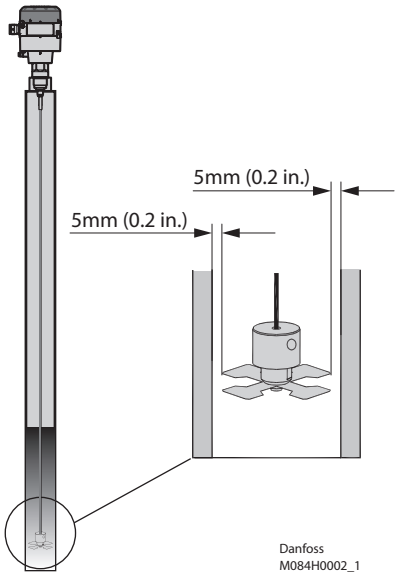
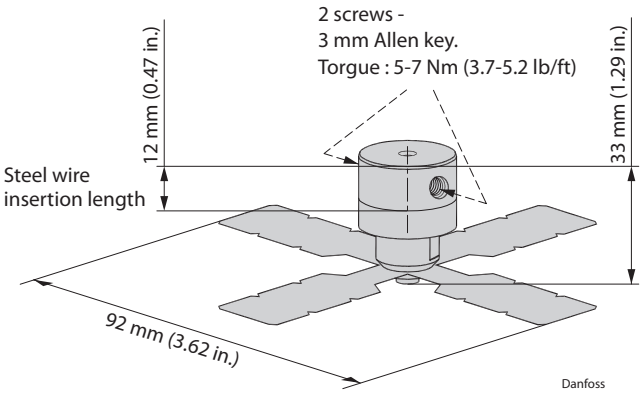


Fig. 2c



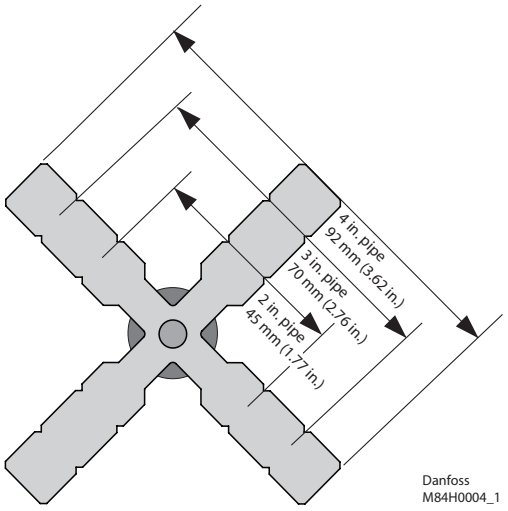
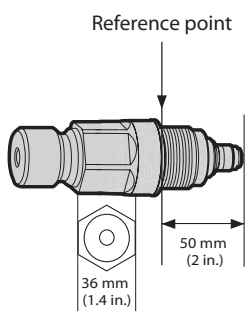


Fig. 3

	Standpipe / Column					
	2 in. pipe		3 in. pipe		4 in. pipe	
Inner diameter	52 mm	2.05 in.	78 mm	3.07 in.	102 mm*	4.02 in.*
Total length of guided blades after cutting	45 mm	1.77 in.	70 mm	2.76 in.	92 mm*	3.62 in.*

* No need to cut guided blades



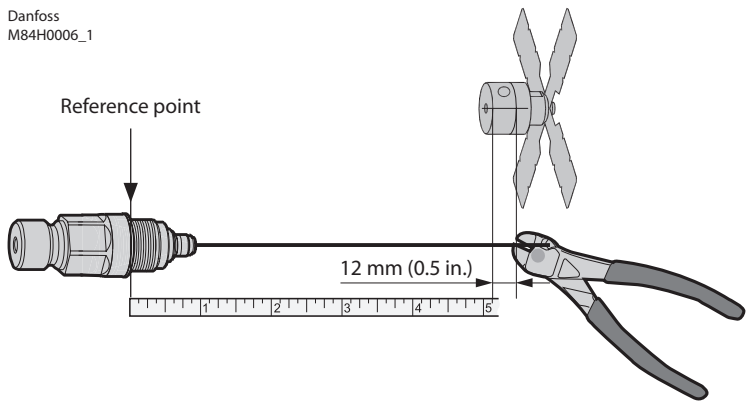


Fig. 4

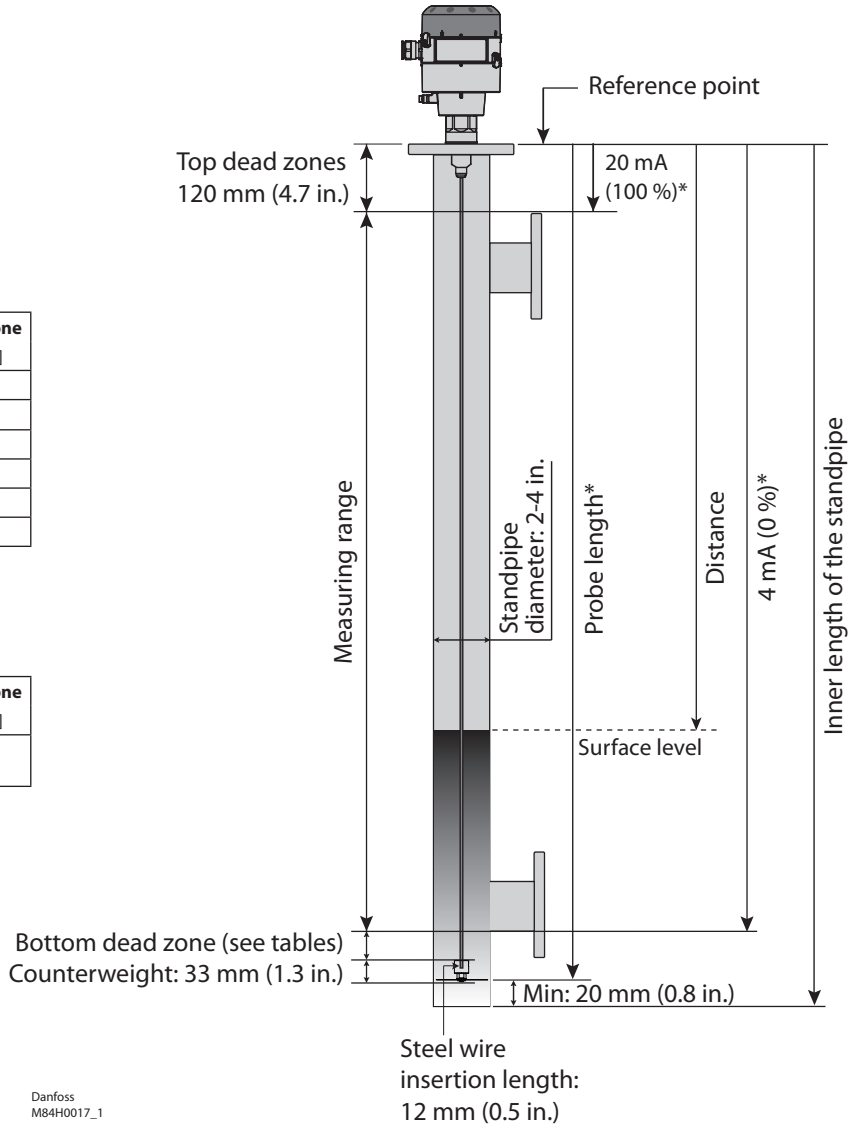
Bottom deadzone values based on the factory setting of dielectric constant

Refrigerant	Probe length range		Bottom dead zone	
	[mm]	[in.]	[mm]	[in.]
Ammonia, HFC, HCFC	800	31.5	115	4.2
	801 - 999	31.5 - 39	120	4.7
	1000 - 1999	39 - 79	150	5.9
	2000 - 2999	79 - 118	180	7.1
	3000 - 3999	118 - 157	210	8.3
	4000 - 5000	157 - 197	240	9.4

Improved Bottom dead zone values after the adjustment of dielectric constant

Refrigerant	Probe length range		Bottom dead zone	
	[mm]	[in.]	[mm]	[in.]
Ammonia, HFC, HCFC	800 - 5000	31.5 - 197	90	3.5

* Values to be entered into HMI Quick Setup menu and recorded on the setting label.
Stick the setting label onto the Signal Converter either inside or outside.



Danfoss
M84H0017_1

Fig. 5

Danfoss
M84H0031_1

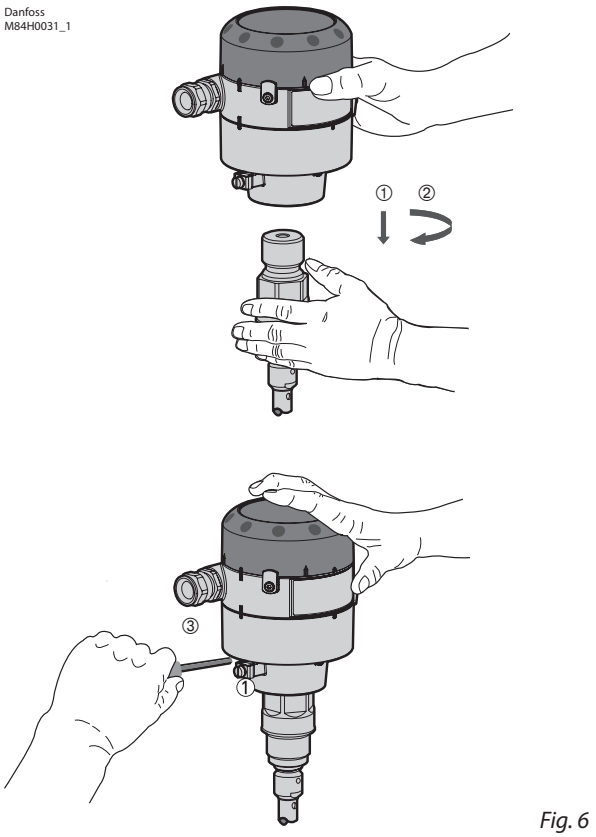
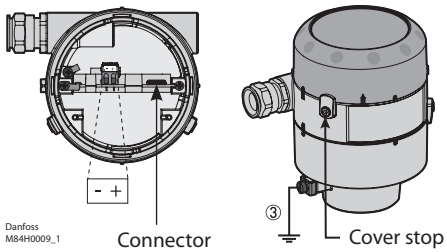
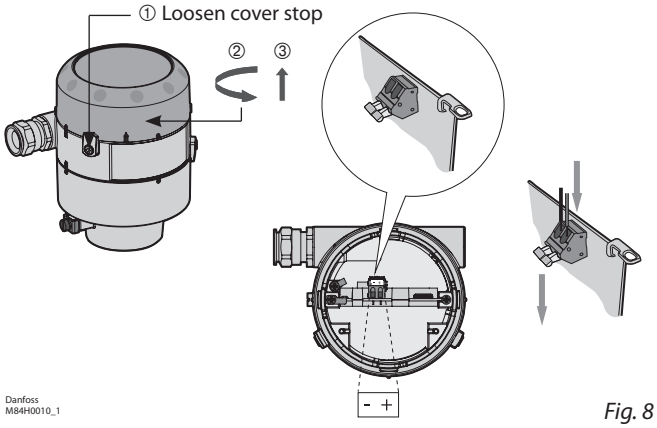


Fig. 6



Danfoss
M84H0009_1

Fig. 7



Danfoss
M84H0010_1

Fig. 8

AKS 41/41U to AKS 4100/4100U

AKS 41/41U with a.c supply to AKS 4100/4100U with d.c supply

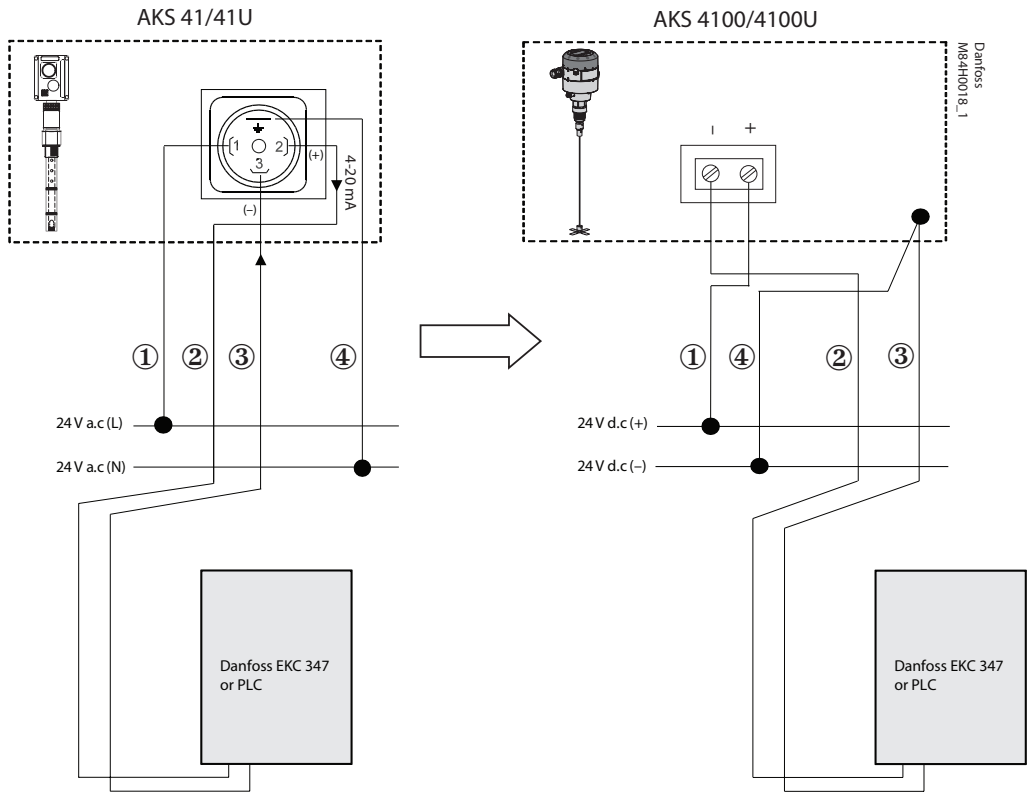


Fig. 9

AKS 4100/4100U connected to EKC 347

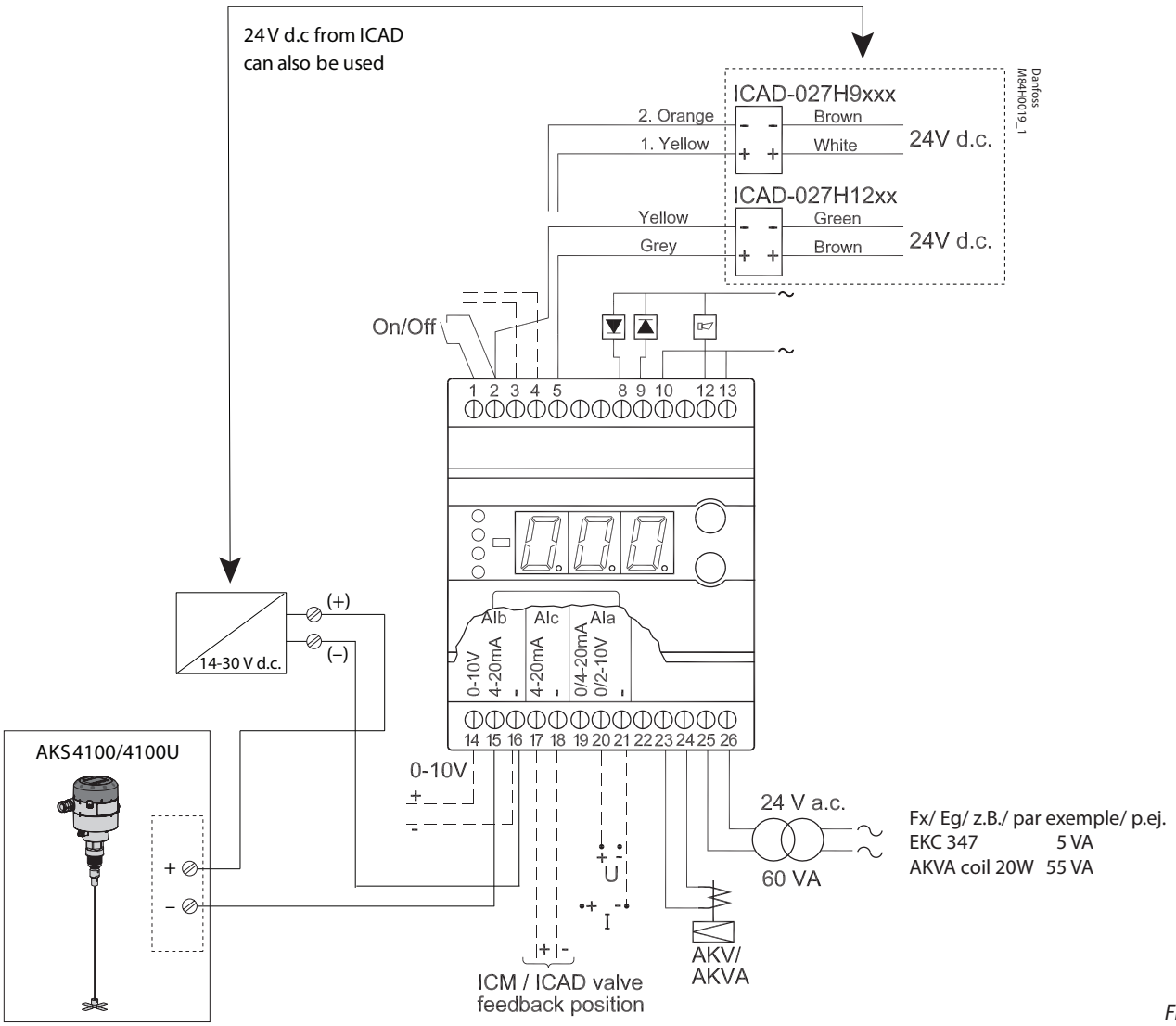


Fig. 10

AKS 4100/4100U connected to PLC

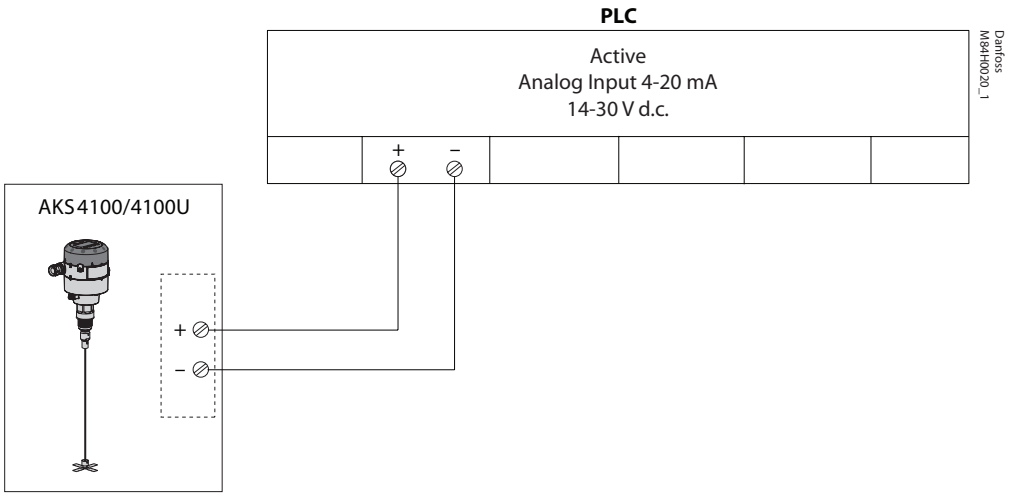
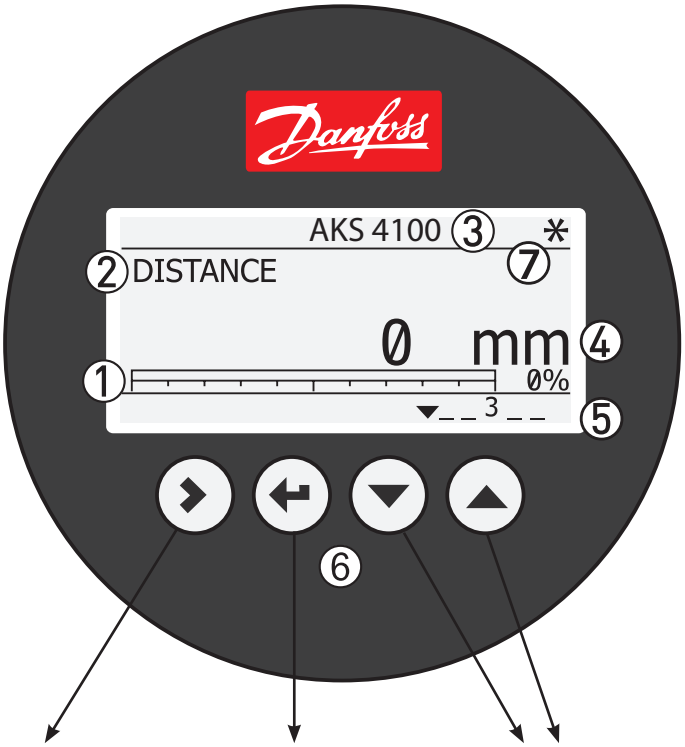


Fig. 11



Enter menu system
Enter QUICK SETUP

Unit change at distance/level readout:
m, cm, mm, in, ft

Change between:
Distance*
Level**
Output (%)***
Output (mA)****

Fig. 12

① 4-20 mA output displayed as bar graph and in percentage [%]

② Measurement name (in this example, DISTANCE)

③ Device tag name

④ Measurement reading and unit

⑤ Device status (markers)
1 = Hardware problem (any hardware problem making the device unable to provide a correct measurement (communication, memory problem…)
2 = No Reference Pulse
3 = Low Voltage or Measurement Old
4 = Level Lost

⑥ Keypad buttons

⑦ Flashing star indicating unit in operation.

* DISTANCE is a display option.
If the display is set to "DISTANCE" the displayed value will be the distance from the Reference point to the top surface of the liquid refrigerant (see fig. 5).

** LEVEL is display option.
If the display is set to "LEVEL" then the value displayed will be:
PROBE LENGTH (entered in QUICK SETUP) – DISTANCE (see fig. 5).

*** OUTPUT (%) is display option.
Will represent the level of refrigerant,in percent, scaled (entered in QUICK SETUP) according to: SCALE 4 mA (0%), SCALE 20 mA (100%) (see fig. 5).

**** OUTPUT I (mA) is display option.
Will represent the level of refrigerant,in 4-20 milliampere, scaled (entered in QUICK SETUP) according to: SCALE 4 mA (4 mA), SCALE 20 mA (20 mA) (see fig. 5).

English

Please observe that AKS 4100/4100U is intended to always be installed in a standpipe (column/bypass/stilling well). A Standpipe is commonly used when:

- Servicing the AKS 4100
- There is highly conductive foam in the tank.
- The liquid is very turbulent or agitated.

Refrigerants

AKS 4100/4100U is designed specifically to measure liquid level in the most commonly used refrigerants, including R717(ammonia), HCFC, HFC and non corrosive gases/liquids.

AKS 4100/4100U can also be used with R744 (CO_2) in the coaxial version. Please see the technical brochure for further details.

Basic data

AKS 4100/4100U is a passive 2-wired 4-20 mA sensor that is loop powered.

Supply Voltage
14-30 V d.c. Min/Max. value for a max. output of 22 mA at the terminal

Load
RL [Ω] ≤ ((Uext -14 V)/20 mA).
– Default (Error output set to 3.6 mA)
RL [Ω] ≤ ((Uext -14 V)/22 mA).
– (Error output set to 22 mA)

Cable gland

AKS 4100	PG 13, M20×1.5 ; (cable diameter: 6-8 mm (0.24-0.31in.)
AKS 4100U	½ in. NPT

Terminals (spring loaded)
0.5-1.5 mm^2 (~20-15 AWG)

Enclosure
IP 67 (~NEMA type 4X)

Refrigerant temperature
–60°C/100°C (–76°F/212°F)

Refrigerants
The listed refrigerants are qualified and approved by Danfoss:

R717 / NH_3:	–40°C / +50°C (–40°F / +122°F)
R744 / CO_2:	–50°C / +15°C (–58°F / +59°F)
HCFC:	
R22:	–50°C / +48°C (–58°F / +118°F)
HFC:	
R404A:	–50°C/ +15°C (–58°F / +59°F)
R410A:	–50°C /+15°C (–58°F / +59°F)
R134A	–40°C /+50°C (–40°F /+122°F)

(Further details in the Technical Brochure)

Ambient temperature
–40°C / +80°C (–40°F / +175°F)
For HMI : –20°C / +60°C (–4°F / +140°F)

Process pressure
–1 barg / 100 barg (–14.5 psig / 1450 psig)

Mechanical process connection with 5 m (197 in.) Ø2 mm (0.08 in.) stainless cable:

AKS 4100	G1 inch pipe thread. Aluminium gasket included
AKS 4100U	¾ in. NPT

(Further details in the Technical Brochure)

Mechanical Installation

Preparations prior to Mechanical Installation
Disassemble the Signal Converter from the Mechanical process connection (use 5´mm hex key, **see fig. 6**). Fit the red protection cover on top of the Mechanical process connection to protect it againt any moisture or dirt paticles.

Content supplied (fig. 1)
① Signal Converter (with or without HMI)
② Mechanical process connection with 5 m (197 in.) Ø2 mm (0.08 in.) stainless wire
③ Counterweight
④ Accessory bag comprising:
3 mm set screws.
Red cover to protect mechanical process connection ② prior to mounting Signal converter.
Setting label.

Note:
If standpipe diameter differs in width **(fig. 2b)** the Cable version is not recommended. Coaxial version should be used.

Adjustment of the counterweight blades
Allow 5 mm space between the guided blades and the inner wall of the pipe **(see fig. 2c)**. Use side cutters to trim the guided blades to fit the actual standpipe diameter **(see fig. 3)**.

Adjustment of the cable probe

Please observe that the stainless steel wire is not permanently creased or kinked.

Always use the reference point, at the **Mechanical Process Connection (see fig. 4)**, as a starting point for all measuring to determine:

- Where to cut the cable.
- Probe length **(see fig. 5)**
- Scale 4 mA **(see fig. 5)**
- Scale 20 mA **(see fig. 5)**

Note the probe length, Scale 4 mA and Scale 20 mA for use later when programming the HMI (Human Machine Interface) on the AKS 4100/4100U.

Follow these instructions and **see fig. 4 & 5**:

1. Measure the inner length of the Standpipe.
2. *Preparation before cutting the cable*
   Known data:
   Space below counterweight: 20 mm (0.8 in.)
   Steel wire insertion length in counterweight: 12 mm (0.5 in.)
   counterweight height: 33 mm (1.3 in.)

   Max Probe length =
   Standpipe inner length
   – Space below counterweight (20 mm (0.8 in.))

   The cable length =
   Max probe length
   + Steel wire insertion length in counterweight (12 mm (0.5 in.))
   – Counterweight height (33 mm (1.3 in.))
3. Measure out the cutting point of the cable. Measure from the reference point **(fig. 4)** and cut the cable
4. Fit the counterweight on the cable and secure the two set screws with a 3 mm Allen Key **(fig. 3)**.
5. Lower the counterweight down through the threaded hole. **Make sure that the counterweight is gliding down through the pipe without any resistance and that the cable is straight (not touching the inner walls of the stand pibe or any incoming piping (see fig. 2a)).**
6. Use a torque wrench to tighten the mechanical process connection **(fig. 1, item 2)** to 120 Nm (89 lb/ft).

Calculating the measuring range

4 mA *setting for max. measuring range:*
= Max probe length
– Counterweight height (33 mm (1.3 in.))
– Bottom dead zone (see fig. 5)

20 mA *setting for max. measuring range:*
= Top dead zone (see fig. 5)

Example
Known data:
Space below counterweight: 20 mm (0.8 in.)
Steel wire insertion length in counterweight: 12 mm (0.5 in.)
counterweight height: 33 mm (1.3 in.)

Preconditions:
Factory setting is used
Refrigerant = Ammonia
Standpipe inner length = 3100 mm (122 in.)
Max probe length =
3100 mm – 20 mm = 3080 mm
(122 in. – 0.8 in. = 121.3 in.)

The cable length:
Max probe length =
+ Steel wire insertion length in counterweight (12 mm (0.5 in.))
– Counterweight height (33 mm (1.3 in.))
3080 mm + 12 mm – 33 mm = **3059 mm**
(121.3 in. + 0.5 in. – 1.3 in. = **120.4 in.)**

4 mA *Setting for Max. Measuring Range:*
Max probe length (3080 mm (121.3 in.))
– Counterweight height (33 mm (1.3 in.))
– Bottom dead zone (see fig. 5)
(210 mm (8.3 in.)) = **2837 mm (111.7 in.)**

20 mA *Setting for Max. Measuring Range:*
= Top dead zone (see fig. 5) = 120 mm (4.7 in.)

How to mount the AKS 4100/4100U Converter (see fig 6)

1. Unscrew the set screw with a 5 mm Hexagon key in the Signal converter.
2. Push the Signal Converter downwards to stop on the Mechanical process connection
3. Turn the Signal Converter to the wanted position and tighten the set screw with a 5 mm Hexagon key

Electrical installation/connection

Output terminals (fig. 7 and 8):
1. Current output –
2. Current output +
3. Grounding terminal

Electrical installation procedure
1. Use a 2.5 mm Allen wrench to loosen the cover stop.
2. Remove the terminal compartment cover from the housing.
3. Do not disconnect the wire from the terminal compartment cover.
   Put the terminal compartment cover adjacent to the housing.
4. Connect the wires to the device.
   Tighten the cable entry glands.
5. Attach the terminal compartment cover to the housing.
6. Use a 2.5 mm Allen wrench to tighten the cover stop.

Start up:
- Connect the converter to the power supply.
- Energize the converter.

Devices with the HMI display option only:
After 10 seconds the screen will display "Starting up". After 20 seconds the screen will display the software version numbers. After 30 seconds the default screen **(fig. 12)** will appear.

Precausions when changing from AKS 41/41U to AKS 4100/4100U

Note:
AKS 41/41U supports both a.c. and d.c. supply whereas the AKS 4100/4100U is using d.c. supply only. **Follow the instructions in fig. 9.**

Connecting to controller or PLC
Follow the instructions in **fig. 10 or 11**.

Note:
The current output will be set to 3.6 mA whenever the AKS 4100/4100 detects an error like: "Level lost", "Overfill error" or "Reference pulse lost".

Quick Setup →

Note:
The signal converter can be programmed with or without mechanical process connector assembled.

Quick Setup (all values below are only examples)

- Connect the device to the power supply (see the section "Electrical installation/ connection".
- Press (›) 3 times.

```
AKS 4100

QUICK SETUP ?

YES                NO
```

- Press (›)

```
AKS 4100
PROBE TYPE
SINGLE CABLE
```

- Press (▼) or (▲) to select either SINGLE or COAXIAL. Press (↵) to confirm.

```
AKS 4100
PROBE  LENGTH
        05000 mm
```

- Press (›) to change the PROBE LENGTH.
  Press (›) to change the position of the cursor.
  Press (▼) to decrease the value or (▲) to increase the value.
  Press (↵) to confirm.

```
AKS 4100
SCALE 4 mA
        04946 mm
```

- Press (›) to change of SCALE 4 mA.
  Press (›) to change the cursor position.
  Press (▼) to decrease the value or (▲) to increase the value.
  Press (↵) to confirm.

```
AKS 4100
SCALE 20 mA
        00070 mm
```

- Press (›) to change of SCALE 20 mA.
  Press (›) to change the cursor position.
  Press (▼) to decrease the value or (▲) to increase the value.
  Press (↵) to confirm.

```
AKS 4100

QUICK SETUP
COMPLETED IN  8
```

- Wait for QUICK SETUP to complete 8-second timeout

```
AKS 4100
1.0.0
QUICK SETUP
```

- Press (↵) to confirm.

```
AKS 4100
1.0.0
STORE NO
```

- Press (▼) or (▲) to select either STORE NO or STORE YES.
  Press (↵) to confirm.

Default screen appears:

```
AKS 4100
DISTANCE
        5000 mm
```

Quick Setup completed

You have the possibility of checking your settings by pressing (›) twice.

```
AKS 4100
SINGLE CABLE          5000 mm
(0%) 4 mA             4877 mm
(100%) 20 mA           120 mm
```

Press (↵) (▲) (↵) to return to default screen.

How to force mA output (all values below are only examples)

Default screen

```
AKS 4100
DISTANCE
        5000 mm
```

- Press (›)

```
AKS 4100
1.0.0
QUICK SETUP
```

- Press (▲)

```
AKS 4100
2.0.0
SUPERVISOR
```

- Press (›)

```
AKS 4100
2.0.0
_________
```

Enter password:
(›) (↵) (▼) (▲) (›) (↵)

```
AKS 4100
2.1.0
INFORMATION
```

- Press (▲)

```
AKS 4100
2.2.0
TESTS
```

- Press (›)

```
AKS 4100
2.2.1
SET  OUTPUT
```

- Press (›)

```
AKS 4100
SET  OUTPUT
3.5 mA
```

- Press (▼) to decrease the value or (▲) to increase the value.
  Press (↵) to confirm.

```
AKS 4100
SET  OUTPUT
8 mA
```

- Press (↵) 4 times to return to default screen.

Default screen appears:

```
AKS 4100
DISTANCE
        5000 mm
```

Force mA completed and disabled

Optional Procedure

If the temperature condition in the stand pipe is known, a constant (dielectric constant of the refrigerant gas) **can be** entered (parameter 2.5.3 GAS EPS.R), in order to obtain lower Top and Bottom Dead Zone values **(see fig. 5)**.

How to enter dielectric constant of refrigerant gas (all values below are only examples)

Default screen

AKS 4100
DISTANCE
5000 mm

- Press ›

AKS 4100
1.0.0
QUICK SETUP

- Press ▲

AKS 4100
2.0.0
SUPERVISOR

- Press ›

AKS 4100
2.0.0
_____

Enter password: › ↵ ▼ ▲ › ↵

AKS 4100
2.1.0
INFORMATION

- Press ▲ 4 times.

AKS 4100
2.5.0
APLICATION

- Press ›

AKS 4100
2.5.1
TRACING VEL.

- Press ▲ 2 times.

AKS 4100
2.5.3
GAS EPS. R

- Press › to check/change GAS EPS.R. (Select the correct value from the tables below and on page 8)
  Press › to change cursor-position.
  Press ▼ to decrease the value or ▲ to increase the value.

AKS 4100
GAS EPS. R
1.066

- Press ↵ to confirm.

AKS 4100
2.5.3
GAS EPS. R

- Press ↵ 3 times.

AKS 4100
1.0.0
STORE NO

- Press ▼ or ▲ to select between STORE NO or STORE YES.
  Select STORE YES by pressing ↵

Default screen appears:

AKS 4100
DISTANCE
5000 mm

Entering the dielectric constant of refrigerant gas completed

Saturated vapour dielectric constant (default value: 1.066)

R717 (NH_3)

Temperature range:
–40°C → +50°C (–40°F → +122°F)

Temperature [°C]	Temperature [°F]	Dielectric constant of refrigerant gas Parameter 2.5.3 GAS EPS.R
–40 → –18	–40.0 → 0	1.01
–17 → –5	1 → 23	1.02
–4 → 4	24 → 39	1.03
5 → 12	40 → 54	1.04
13 → 18	55 → 64	1.05
19 → 24	65 → 75	1.06
25 → 28	76 → 82	1.07
29 → 33	83 → 91	1.08
34 → 37	92 → 99	1.09
38 → 40	100 → 104	1.10
41 → 44	105 → 111	1.11
45 → 47	112 → 117	1.12
48 → 50	118 → 122	1.13

R22

Temperature range:
–50°C → +48°C (–58°F → +118°F)

Temperature [°C]	Temperature [°F]	Dielectric constant of refrigerant gas Parameter 2.5.3 GAS EPS.R
–50 → –25.0	–58 → –13	1.00
–24 → –10	–12 → 14	1.02
–9 → 0	15 → 32	1.03
1 → 8	33 → 46	1.04
9 → 15	47 → 59	1.05
16 → 21	60 → 70	1.06
22 → 26	71 → 79	1.07
27 → 31	80 → 88	1.08
32 → 35	89 → 95	1.09
36 → 39	96 → 102	1.10
40 → 42	103 → 108	1.11
43 → 45	109 → 113	1.12
46 → 48	114 → 118	1.13

R744 (CO_2)

Temperature range:
–50°C → +15°C (–58°F → +59°F)

Temperature [°C]	Temperature [°F]	Dielectric constant of refrigerant gas Parameter 2.5.3 GAS EPS.R
–50.0 → –42.0	–58.0 → –43	1.01
–41.0 → –28.0	–42 → –18	1.02
–27.0 → –17.0	–17 → 2	1.03
–16.0 → –9.0	3 → 16	1.04
–8.0 → –3.0	17 → 27	1.05
–2.0 → 2	28 → 36	1.06
3 → 7	37 → 45	1.07
8 → 11	46 → 52	1.08
12 → 14	53 → 58	1.09
15	59	1.10

R134a

Temperature range:
–40°C → +50°C (–40°F → +122°F)

Temperature [°C]	Temperature [°F]	Dielectric constant of refrigerant gas Parameter 2.5.3 GAS EPS.R
–40.0 → –18	–40 → –0	1.01
–17 → –4	1 → 25	1.02
–3 → 5	26 → 41	1.03
6 → 13	42 → 56	1.04
14 → 20	57 → 68	1.05
21 → 25	69 → 77	1.06
26 → 30	78 → 86	1.07
31 → 34	87 → 94	1.08
35 → 38	95 → 100	1.09
39 → 42	101 → 108	1.10
43 → 45	109 → 113	1.11
46 → 48	114 → 119	1.12
49 → 50	120 → 122	1.13

Saturated vapour dielectric constant

R410A

Temperature range:
–50°C → +15°C (–58°F → +59°F)

Temperature [°C]	Temperature [°F]	Dielectric constant of refrigerant gas Parameter 2.5.3 GAS EPS.R
–50 → –47	–58 → –52	1.01
–46 → –35	–51 → –31	1.02
–34 → –26	–30 → –14	1.03
–25 → –19	–13 → –2	1.04
–18 → –13	–1 → 9	1.05
–12 → –8	10 → 18	1.06
–7 → –4	19 → 25	1.07
–3 → 0	26 → 32	1.08
1 → 4	33 → 40	1.09
5 → 7	41 → 45	1.10
8 → 10	46 → 50	1.11
11 → 12	51 → 54	1.12
13 → 15	55 → 59	1.13

R404A

Temperature range:
–40°C → +15°C (–40°F → +59°F)

Temperature [°C]	Temperature [°F]	Dielectric constant of refrigerant gas Parameter 2.5.3 GAS EPS.R
–40 → –35	–40 → –31	1.02
–34 → –26	–30 → –14	1.03
–25 → –19	–13 → –2	1.04
–18 → –14	–1 → 7	1.05
–13 → –9	8 → 16	1.06
–8 → –4	17 → 25	1.07
–3 → 0	26 → 32	1.08
1 → 3	33 → 38	1.09
4 → 6	39 → 43	1.10
7 → 9	44 → 49	1.11
10 → 12	50 → 54	1.12
13 → 15	55 → 59	1.13

How to change the language setting (Default: English)

Default screen

AKS 4100
DISTANCE
5000 mm

- Press ›

AKS 4100
1.0.0
QUICK SETUP

- Press ▲

AKS 4100
2.0.0
SUPERVISOR

- Press ›

AKS 4100
2.0.0
_____

Enter password: › ↵ ▼ ▲ › ↵

AKS 4100
2.1.0
INFORMATION

- Press ▲ 6 times

AKS 4100
2.7.0
DISPLAY

- Press ›

AKS 4100
2.7.1
LANGUAGE

- Press ›

AKS 4100
LANGUAGE
ENGLISH

- Press ▼ or ▲ to see the language possibilities
  Press ↵ to confirm.

AKS 4100
2.7.1
LANGUAGE

- Press ↵ 3 times

AKS 4100
2.0.0
STORE NO

- Press ▼ or ▲ to select between STORE NO or STORE YES.
  Select STORE YES by pressing ↵
  Default screen appears:

AKS 4100
DISTANCE
5000 mm

Language setup completed

Reset to factory setting

Default screen

AKS 4100
DISTANCE
5000 mm

- Press › once and ▲ twice

AKS 4100
3.0.0
SERVICE

- Press ›

AKS 4100
3.0.0
_____

Enter password: › ↵ › ▼ › ▲

AKS 4100
3.1.0
SENSOR

- Press ▲ twice

AKS 4100
3.3.0
CONFIG/RESET

- Press ›

AKS 4100
3.3.1
RESET FACTORY

- Press ›

AKS 4100
RESET FACTORY
NO

- Select YES by pressing ▲ and confirm with ↵
- Press ↵ 3 times to return to default screen.

  Default screen appears:

AKS 4100
DISTANCE
5000 mm

Factory reset completed

www.danfoss.com/ir