KONGSBERG

ACS500

Acoustic Control System

Instruction Manual
Gisma test port system

937128/F

Document information

- **Product**: Kongsberg ACS500
- **Document**: Instruction Manual
- **Document part number**: 937128
- **Revision**: F
- **Date of issue**: 22 June 2021

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Warning

The equipment to which this manual applies must only be used for the purpose for which it was designed. Improper use or maintenance may cause damage to the equipment and/or injury to personnel. You must be familiar with the contents of the appropriate manuals before attempting to operate or work on the equipment.

Kongsberg Maritime disclaims any responsibility for damage or injury caused by improper installation, use or maintenance of the equipment.

Disclaimer

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Support information

If you require maintenance or repair, contact Kongsberg Maritime's support organisation. You can also contact us using the following address: km.support.hpr@kongsberg.com. If you need information about our other products, visit https://www.kongsberg.com/maritime.

Table of contents

About this manual

The purpose of this manual is to provide the descriptions and procedures required to install, operate and maintain the system.

Target audience

This manual is intended for all users of the system.

Online information

All relevant end-user documentation provided for your ACS500 system can be downloaded from our website.

https://www.kongsberg.com/maritime

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ACS500

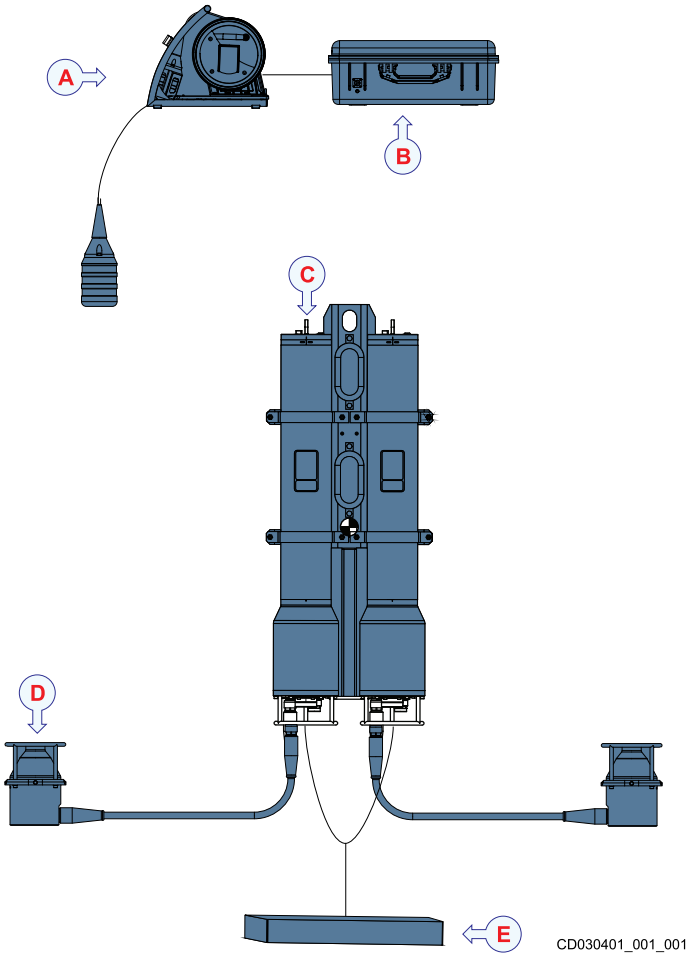
Topics

System description

ACS500 is designed for optimal control of subsea valves. It is pressure rated to 4000 metres depth. ACS500 may be used to control a blowout preventer as an emergency system or other subsea valve control functions.

System diagram

The system diagram identifies the main components of a basic ACS500 system. Only the main connections between the units are shown. Detailed interface capabilities and power cables are not shown.



A Dunking transducer

B Acoustic Command Unit

C Subsea Control Unit

D Transducer

E Customer solenoid package

System units

Acoustic Command Unit

The ACU is a computer with a touch screen in a splash proof portable case.

This is the main interaction unit of the system. It has a rechargeable battery with approximately 10 hours continuous operation on a fully charged battery.

Dunking transducer

The dunking transducer is the part that is lowered into the water to send signals down to the subsea part of the system and retrieve signals back.

Several types of transducers are available for different usage.

Transducer

The subsea transducers are mounted on the subsea structure.

There are different remote transducers available for many uses.

Subsea Control Unit

The subsea control unit is mounted on the subsea structure.

The SCU is connected to the valve solenoids. The commands are sent from the ACU, via the transducers to the SCU, and to the solenoids.

Scope of supply

Important

See Scope of delivery in the registration form for the units in your system.

Support information

Should you need technical support for your ACS500 system you must contact a Kongsberg Maritime office. A list of all our offices is provided on our website. You can also contact our main support office in Norway.

Manuals and technical information can be downloaded from our support website.

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Installation

Topics

Installing the SCU

The SCU is delivered on a mounting bracket.

Prerequisites

You need 4 M12 bolts with nuts and spring washers, appropriate for the subsea structure where you are hanging up the bracket.

Procedure

1 Mount the bracket onto the subsea structure by the hooks behind the SCUs.

Note

The bracket is constructed to hold the units in an upright position.

2 Secure the SCU with four M12 bolts with nuts and spring washers.

3 Tighten the bolts to the torque recommended by the bolt manufacturer.

Installing the transducer

The subsea transducers are mounted on the subsea structure.

Context

The transducers are preferably mounted on arms that can swing 2 metres or more outside the subsea structure once it has been launched. They should be located as far away from the subsea structure and other reflective surfaces as possible, to reduce the effects of acoustic shadowing and echoes.

You need 6 M6 bolts with nuts and spring washers, appropriate for the structure you are mounting the transducers on.

Note

The subsea transducer should be positioned minimum 2.5 metres from the subsea structure.

Procedure

1 Secure the transducer with six M6 bolts, nuts and spring washers.

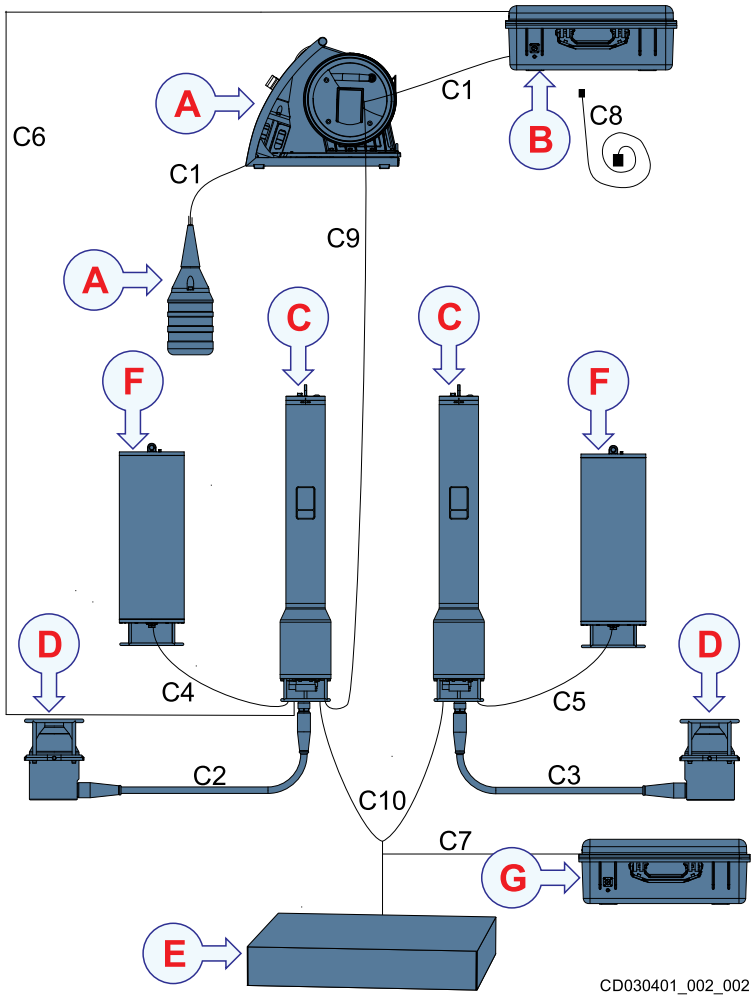
2 Tighten the bolts to the torque recommended by the bolt manufacturer.

Cabling

Topics

Cable plan

The cables are part of the delivery with the main units.



A Dunking transducer

B Acoustic Command Unit

C Subsea Control Unit

D Transducer

E Customer solenoid package

F External quad battery unit

G Field simulator

List of cables

A set of cables is required to connect the system units to each other, and to the relevant power source(s).

Cable	Signal	From/To	Comments
C1	Transducer cable	Dunking transducer cable	
C2	Transducer cable	From transducer to SCU	
C3	Transducer cable	From transducer to SCU	
C4	DC Power cable	From quad battery to SCU	Optional
C5	DC Power cable	From quad battery to SCU	Optional
C6		From ACU to SCU	
C7		From field simulator to interface cable	For deck testing, replacing solenoids
C8	AC Power cables	From ACU to AC power	
C9		From dunking transducer to SCU	For deck testing, using HiPAP transducer
C10		From SCU to customer's solenoid package	

Installing the ACS500 cables

All cables are provided in the delivery or with the relevant item.

Procedure

1 Connect the cable from the transducer to the SCU. (C2, C3)

2 Connect the cable from the quad battery to the SCU. (C4, C5)

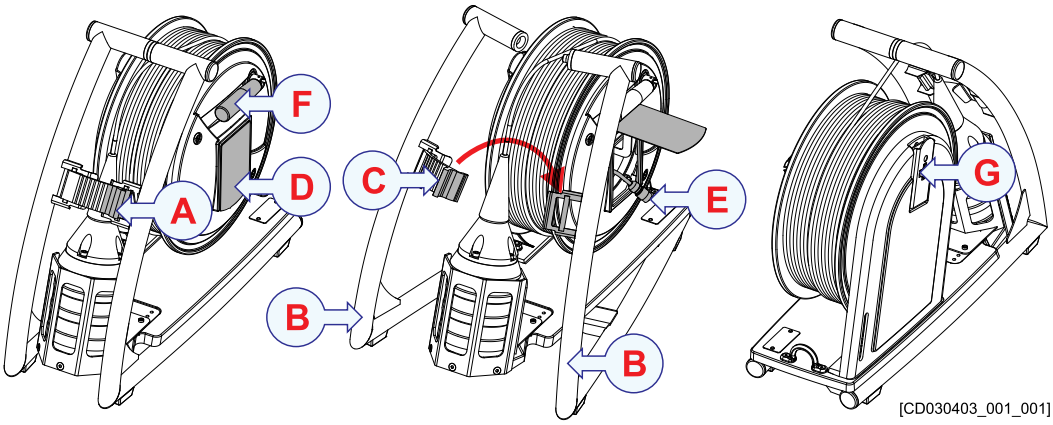
3 Connect the cable from both SCUs to the customer's solenoid package. (C10)

Operating procedures

Topics

Opening the cable drum

Context



A Closed locking clip

B Bars

C Closed locking clip

D Cover plate

E Cable from dunking transducer to ACU, 1.5 m long

F Handle

G Drum lock

Procedure

1 Pull the locking clip **A** towards you to open the unit.

2 Unlock the transducer cable by pulling the drum lock **G** slightly out.

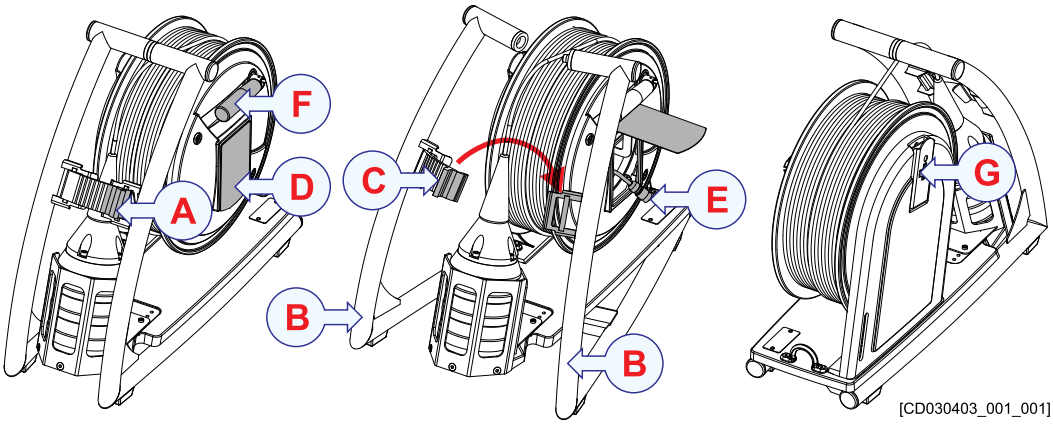
3 Reel out the dunking transducer to the right depth, and lock the cable by pushing the drum lock **G** back in.

4 Lift up the cover **D** to find the cable connection to the ACU.

5 Connect the cable to connector **B** on the ACU.

Closing the cable drum

Context



A Closed locking clip

B Bars

C Closed locking clip

D Cover plate

E Cable from dunking transducer to ACU, 1.5 m long

F Handle

G Drum lock

Procedure

1 Roll up the cable **E** and place it under the cover **D**.

2 Pull inn the dunking transducer.

3 Clean the transducer and the cable with freshwater.

4 Use the handle **F** to reel in the transducer cable.

5 Place the transducer in the basket.

6 Lock the transducer cable by pushing the drum lock **G** in.

7 Fold in the handle **F**.

8 Press the two bars **B** together and press the locking clip **C** into position.

Turning on the SCU

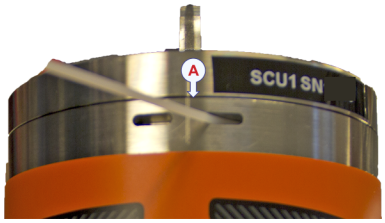
The batteries are delivered separate from the SCU for safety reasons.

Context

The battery must be inserted and connected before deploying the SCU.

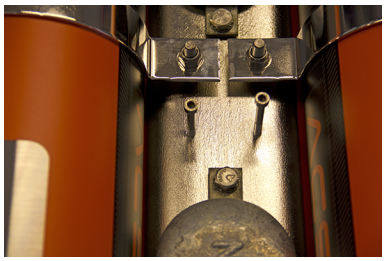
Procedure

1 Pull out the locking cord. **(A)**



2 Open the top cap.

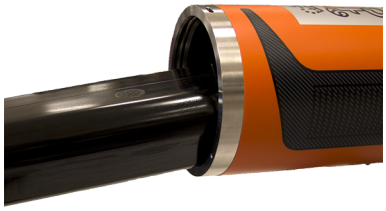
The two M5 screws between the units can be used to push open the top cap. Insert the screws in the holes on the top cap and screw until the cap is off.



Make sure the screws are back in place between the units for the next use.

3 Insert the battery.

Inserting the battery at an angle makes this easier. Press firmly to make sure the battery is properly inserted.

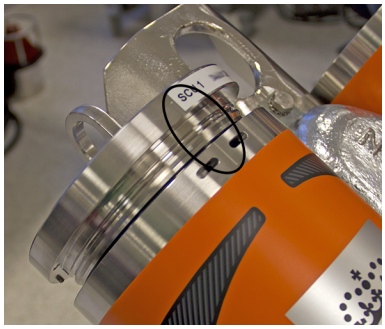


4 Place a bag of dry silica-gel desiccant on the top of the battery.

5 Switch the on/off switch inside the top to on.

6 Replace the top.

Make sure the alignment marks meet.



7 Insert the locking cord by pushing it sideways around the body.

Further requirements

Perform a watertightness test.

Testing the watertightness, page 46

Turning on the ACU

The Acoustic Control Unit is the topside computer for the system.

Procedure

1 Open the suitcase.

2 Press the on/off button on the right to **ON**.

Starting normal operation

Prerequisites

The subsea part of the system is started and operating.

Procedure

1 Place the ACU in a suitable location.

2 Turn on the ACU.

Turning on the ACU, page 22

3 Place the cable drum with the dunking transducer close to the ACU.

Opening the cable drum, page 19

4 Pull out the cable and lower the transducer to a depth at least 10 metres below the lowest draft of the platform or vessel.

5 Connect the transducer cable to the transducer connector on the right side of the ACU.

6 Select the tab with the SCU you want to use.

7 Tap **Read** in the **Battery Status** section.

8 Tap the function you want in the SCU section.

9 Press **Execute** on the left side of the ACU and tap **Execute** on the touch screen at the same time.

10 Check the colour and text on the valve symbol to see if the operation was successful.

- Green – The valve operation is done.
- Dark green – The valve operation is done and the systm has sent a warning.

  The warning is shown by the valve symbol. **Low battery** or **High currents** are examples of warnings.
- Red – An error happened during the valve operation.

  The error message is shown by the valve symbol.

Checking the battery status on the ACU

Check the battery level to see if the unit needs recharging or new batteries.

Procedure

1 Turn on the ACU.

2 Check the battery indicator on the right side of the ACU.

The LED lights green for a fully charged battery, orange for half full and red when the battery is almost empty.

Checking the battery status on the SCU

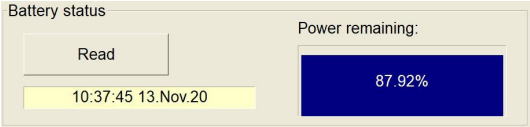
Check the battery level to see if the unit needs recharging or new batteries.

Procedure

1 Turn on the ACU.

2 Select the tab with the SCU you want to use.

3 Tap **Read** in the **Battery Status** section.



Result

- When the remaining battery power drops below 20 % the indicator turns yellow.
  The SCU is still functioning and a battery change will be necessary soon.
- When the remaining battery power drops below 10 % the indicator turns red.
  Change the battery to make sure you have uninterrupted operation.

For external batteries, the percentages should be divided by the total number of batteries.

Number of external batteries	Yellow level	Red level
0	20 %	10 %
1	10 %	5 %
2	7 %	3 %
3	5 %	2.5 %
4	4 %	2 %

Setting the telemetry power for the ACU

You should always try the default setting before changing the power level.

Context

When you increase the power level, always increase one step at a time before sending a command to the SCU.

Caution

When you are using the **Maximum** *power level, the dunking transducer must be connected and deployed to minimize risk for electronic and transducer damage.*

Procedure

1 Select the **System Configuration** tab.

2 Use the arrows in the **Topside Telemetry Power** section to select the setting you want.

3 Tap **Set** to confirm.

4 A dialog box will confirm when the power setting is changed.

Setting the telemetry power for the SCU

You should always try the default setting before changing the power level.

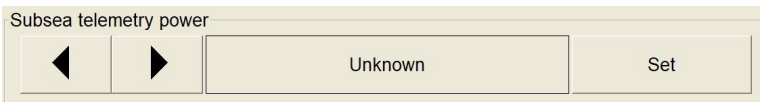
Context

When you increase the power level, always increase one step at a time before sending a command to the SCU.

Procedure

1 Select the **System Configuration** tab.

2 Use the arrows in the **Subsea Telemetry Power** section to select the setting you want.



3 Tap **Set** to confirm.

4 A dialog box will confirm when the power setting is changed.

Changing the acoustic mode

Change between FSK and Cymbal acoustic mode. One or the other might work better under different acoustic conditions.

Procedure

1 Select the **System Configuration** tab.

2 Select the SCU you want to change in the **Acoustic Protocol** section.

3 Tap the acoustic mode you want in the **Acoustic Protocol** section.

4 Confirm the change in the dialog box.

Checking the communication

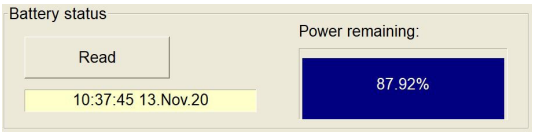
Always try to read the battery status as a check before starting any valve operations.

Procedure

1 Turn on the ACU.

2 Select the tab with the SCU you want to use.

3 Tap **Read** in the **Battery Status** section.



4 If there is no response, try three times before continuing with the next step. If you have communication continue with normal valve operations.

5 Continue increasing the power level, both for the ACU and the SCU. Check the communication by reading the battery status between each step. If you have communication continue with normal valve operations.

Turning on the ACU, page 22

Setting the telemetry power for the ACU, page 25

6 Try the alternative SCU. Go back to a lower power setting before you start. Check the communication by reading the battery status between each step. If you have communication continue with normal valve operations.

7 Try the same steps with the alternative acoustic protocol and always start with a lower power setting both on the ACU and SCU.

Changing the acoustic mode, page 26

Checking the system status

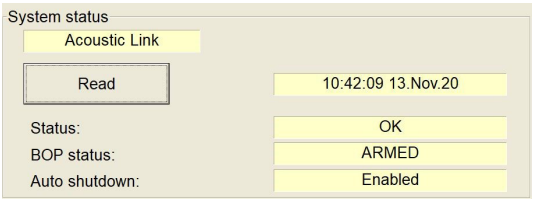
Always try to read the battery status as a check before starting any valve operations.

Procedure

1 Turn on the ACU.

2 Select the tab with the SCU you want to use.

3 Tap **Read** in the **System Status** section.



Checking the sensor input

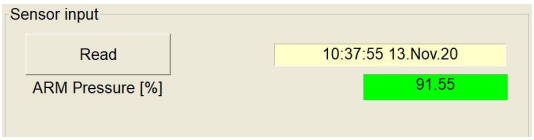
Always try to read the battery status as a check before starting any valve operations.

Procedure

1 Turn on the ACU.

2 Select the tab with the SCU you want to use.

3 Tap **Read** in the **Sensor Input** section.



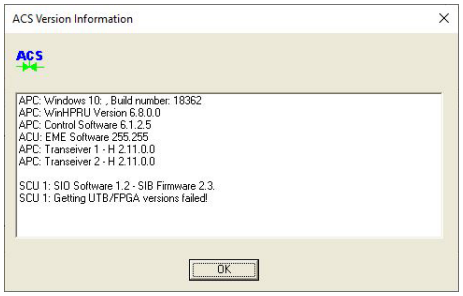
Checking the current software version

Procedure

1 Select the **System Configuration** tab.

2 Tap the SCU you want to see the software version of in the **Get Software Version** section in the **Misc** section.

3 Wait for the dialog box with all the relevant software versions from both the ACU and the selected SCU.



Emergency sequence

The emergency sequence is a redundancy operator function for emergencies. There is a predefined sequence of valves that are closed with a two hands two buttons operation.

Context

The emergency sequence must be defined in the system. Check the *Registration form* for the settings in your system.

This sequence is an emergency solution when Microsoft Windows is not working. The emergency sequence can only be sent from the ACU, not from HiPAP.

Procedure

1 Unscrew the button on the emergency button cover on the right side of the ACU.

2 See the LEDs inside.

If the **Run** LED is red, there is an error. The emergency system is not available, try restarting the system.

The **Finished** LED is green for 15 seconds. Continue when both LEDs are off.

3 Press **Emergency** and tap **Execute** simultaneously for 5 seconds to start the emergency sequence.

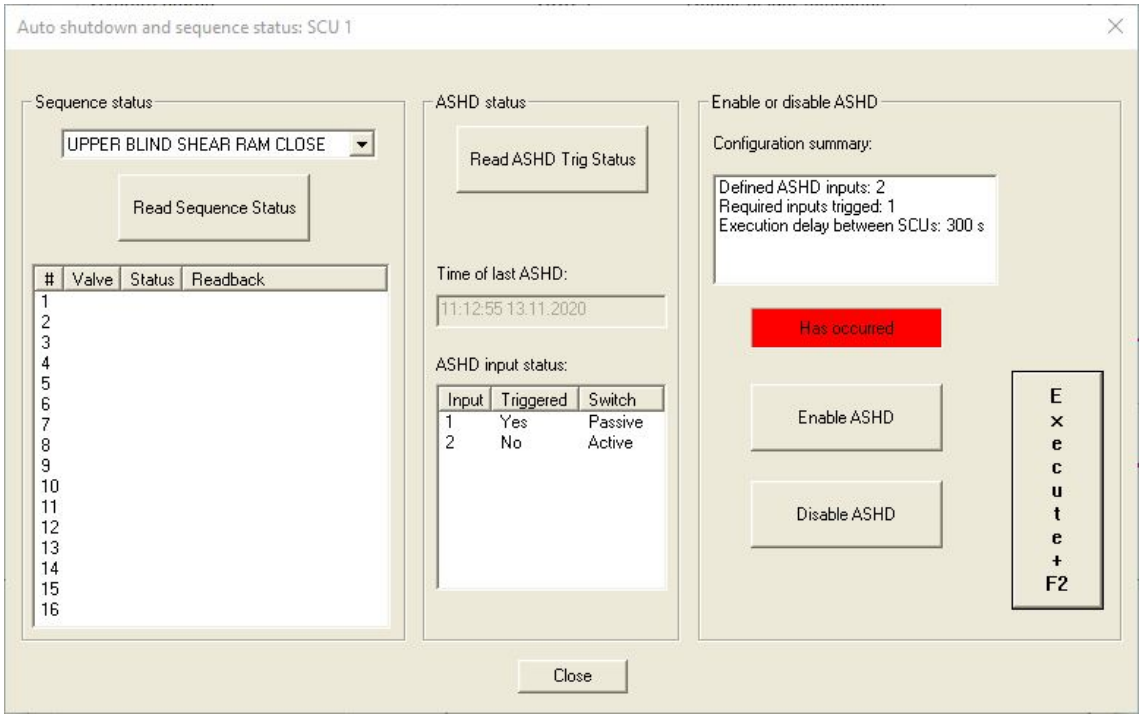
4 When the LEDs are green, the sequence has been executed.

Enable Auto Shutdown

The Auto Shutdown system is a predefined automated shutdown sequence. When the ASHD inputs are triggered, the system will execute a predefined sequence of valves designed to automatically shut down the controlled system or BOP.

Prerequisites

The Auto Shutdown must be predefined in the system. See your Registration form for your settings.



Procedure

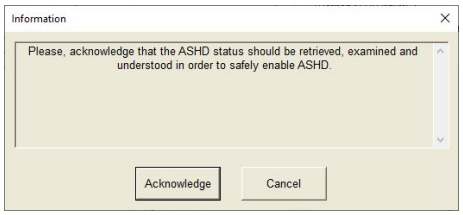
1 Select the SCU1 or the SCU2 tab, depending on the SCU you want to use.

The Auto Shutdown function should be activated for both SCU's.

2 Tap the **Auto Shutdown** button in the SCU tab.

3 Tap **Enable ASHD**.

4 Tap **Acknowledge**.



5 Repeat for the other SCU.

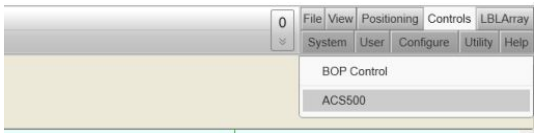
Operating ACS500 from APOS

ACS can be controlled both from the ACU and APOS.

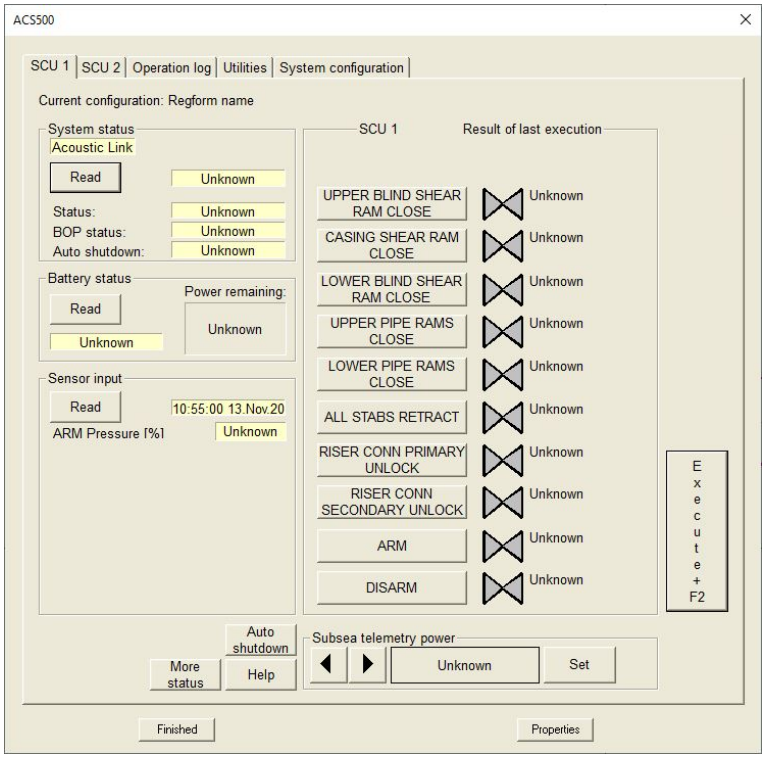
Procedure

1 Start APOS.

2 Select **Control** in the main menu.



3 Select **ACS500**.



The ACS500 program is the same as on the ACU.

Notice

The two hand operation is clicking Execute and pressing F2.

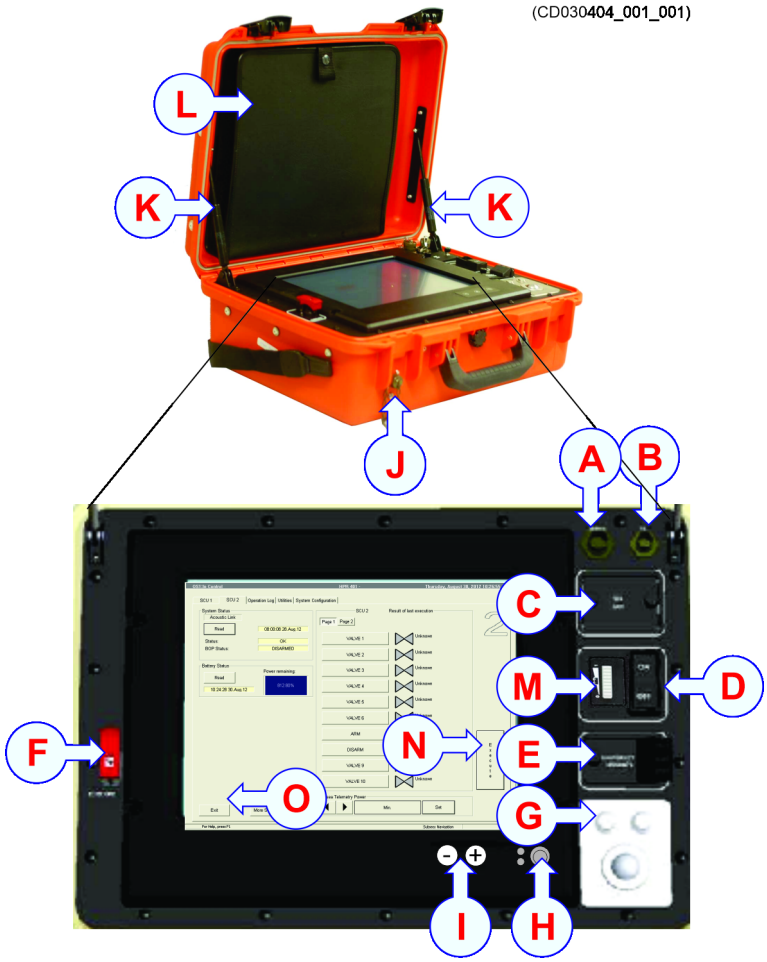
4 Select **Finished** to close the session.

User interface

Topics

Acoustic Command Unit

The ACU is a computer with a touch screen in a splash proof portable case.



A Serial line connector for service personnel only

B Dunking transducer connector

C USB and LAN connectors for service personnel only

D ON/OFF switch

E Emergency control button

F Execute button

- Use with ACU control menu to do valve operations
- Use with the Emergency control button to start an emergency sequence

G Trackball

H This will only turn off the computer, the hardware will still drain the battery. Use button **D** to power off the system.

I Screen Brightness

J Charger connector

K Springs

L Battery charger cable is stored in the folder

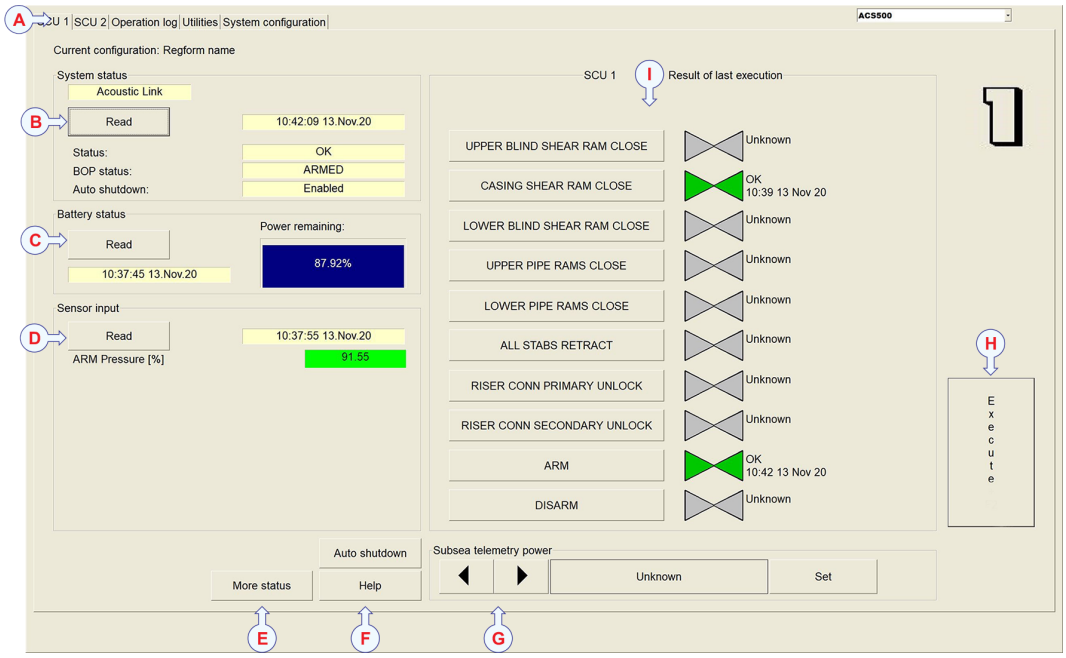
M Battery level

N Execute button

O Exit button This will only turn off the computer, the hardware will still drain the battery. Use button **D** to power off the system.

P Online help button

User interface familiarization



A Main menu

B System status

C Battery status

D Sensor input

E More Status

F Help

G Subsea Telemetry Power

H Execute button

I SCU Solenoid Information

Main menu

The **Main** menu is located at the top of the presentation.

Description

- **SCU tab**

  The SCU tabs have the operational functions for the two subsea control units.

  SCU tab description, page 34

- **Operation Log tab**

  All commands and replies are logged here. The log is common for both SCUs.

  Operation Log tab description, page 37

- **Utilities tab**

  The **Utilities** tab is only visible to service engineers.

- **System Configuration tab**

  The **System Configuration** tab is where you can change the power settings and other functions.

  System Configuration tab description, page 37

SCU tab description

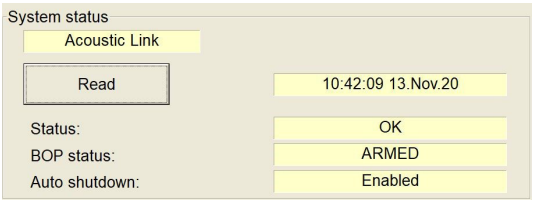
The SCU tabs have the operational functions for the two subsea control units.

How to open

Select the SCU1 or the SCU2 tab, depending on the SCU you want to use.

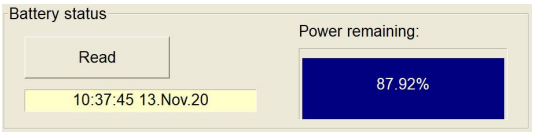
Description

System Status



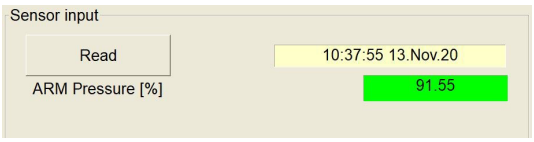
Select **Read** to check the status of the current SCU.

Battery Status



Select **Read** to check the battery of the current SCU.

Sensor Input



The status of the sensors in your system.

Valves view

This is an overview of all the valve applications and their status.

Auto shutdown status description

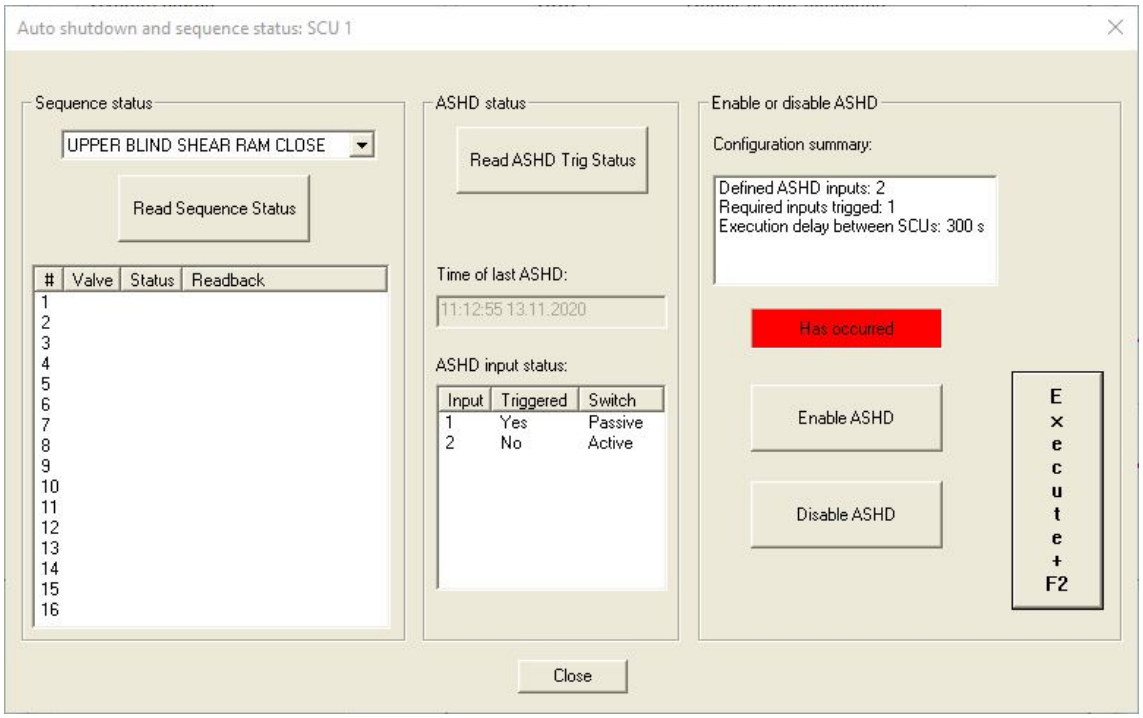
The Auto Shutdown system is a predefined automated shutdown sequence. When the ASHD inputs are triggered, the system will execute a predefined sequence of valves designed to automatically shut down the controlled system or BOP. The Auto Shutdown must be predefined in the system. See your Registration form for your settings.

Prerequisites

Auto Shutdown must be enabled to work.

How to open

Tap the **Auto Shutdown** button in the SCU tab.



Description

Auto Shutdown is an optional function that has to be activated. The conditions for starting an auto shutdown is defined in the registration form. When these conditions are met, the system starts moving the valves in a predefined sequence to close down the system. The **Auto Shutdown** function has to be activated as well as predefined.

Important

The **Auto Shutdown** function must be disabled before recovering the system.

The interface cables must not be connected or disconnected while the **Auto Shutdown** function is enabled.

Details

Sequence status

Read Sequence status shows the result of the selected sequence in the drop down box.

ASHD status

Read ASHD Trig Status shows information of the last Auto Shutdown and the state of the switches.

Enable or disable ASHD

Enable or disable the Auto Shutdown function with the buttons.

You have to confirm the action in a separate dialog box.

Operation Log tab description

All commands and replies are logged here. The log is common for both SCUs.

How to open

Select the **Operation Log** tab.

Description

The operation log shows the last 500 operations for both SCUs. All operations are saved to disk, so even if many more operations have been done, there is still a log.

Select **Copy to disk** to save the last three month's logs. Select **System report** to save a small report showing how the system is at the moment.

Utilities tab description

The **Utilities** tab is only visible to service engineers.

System Configuration tab description

The **System Configuration** tab is where you can change the power settings and other functions.

How to open

Select the **System Configuration** tab.

Description

Settings

Find the addresses and channel addresses for both SCUs in the **SCU** area.

Select protocol for the SCUs in the **Acoustic protocol** area.

Change the telemetry power for the ACU in the **Topside telemetry** area.

Check the current software versions on the SCUs in the **Misc** area.

Select **Replace SCU** when the physical installation of the new SCU is done. **Select site** is for ACUs that operate more than one site. **Valve functions** shows how the system is configured. **Sequences** shows any sequences of valves in the system.

Select **Save config** to save any changes you have done.

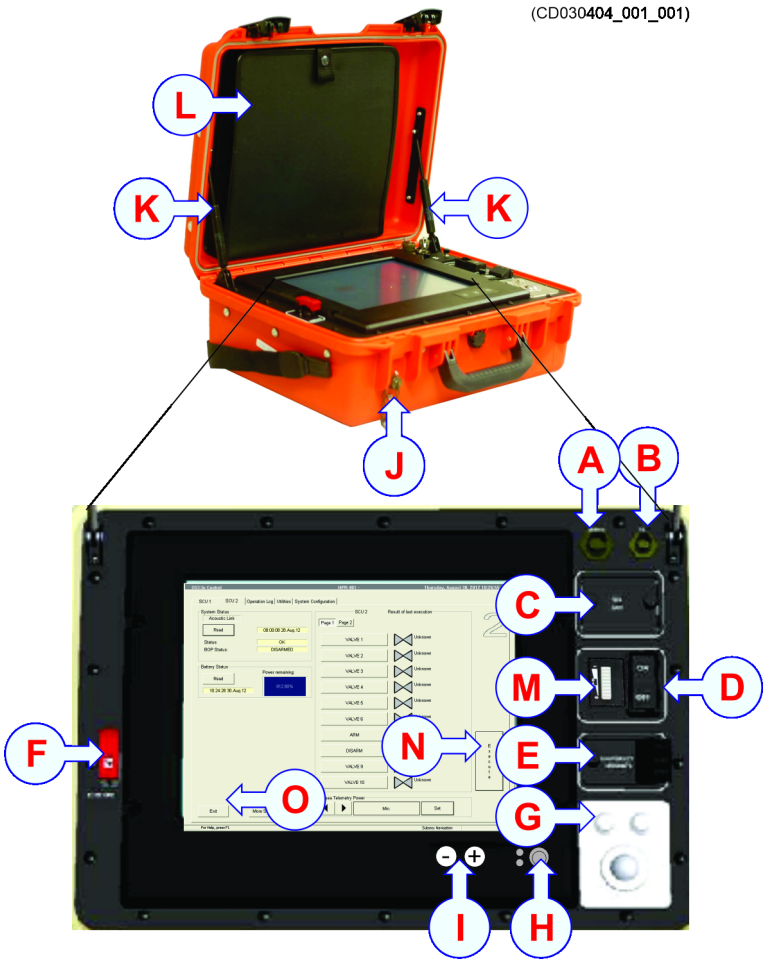
Maintenance

Topics

Charging the ACU

Charging the battery is connected with some risk, please read the information and follow the charge procedure carefully

Context



The charger cable is stored in the folder **L**.

Procedure

1 Place the ACU near a standard power socket.

2 Get the charger cable from the folder **L**.

3 Connect the charger cable to connector **J** and to a power socket.

Charging a fully depleted battery takes about 7 hours.

Changing the ACU battery

The rechargeable battery needs to be replaced typically every 10 years. This depends on use.

Procedure

1 Open the suitcase.

2 Take off the supports on both sides of the lid by unscrewing one screw on each side.

3 Unscrew 18 screws on the front panel.

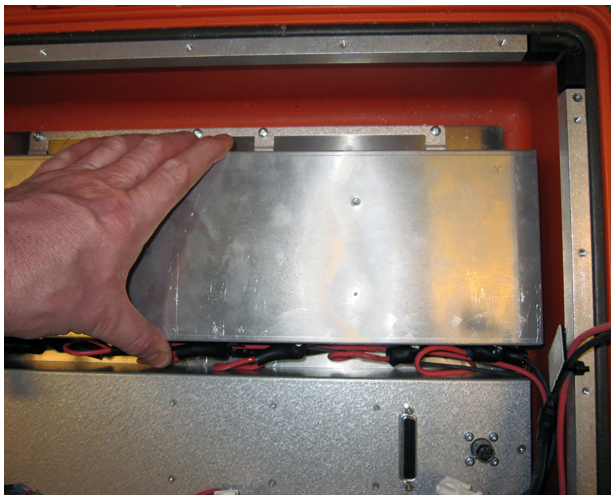
4 Lift the panel computer from the case.

5 Unplug all cables to the computer and the battery.

6 Unscrew the 4 screws holding the battery in place.

7 Pull the battery towards you and lift it up.

The battery is held in place by 4 metal clips in the bottom of the case.



8 Insert the new battery.

9 Follow the instructions in the reverse order.

Replacing the panel computer

The panel pc must be replaced with a Kongsberg model with the ACS500 program installed.

Context

This procedure describes how to replace the panel pc.

Procedure

1 Unscrew the front panel from the suitcase.

Keep the screws.

2 Remove the connections to the computer.

3 Unscrew the old computer from the panel and remove it.

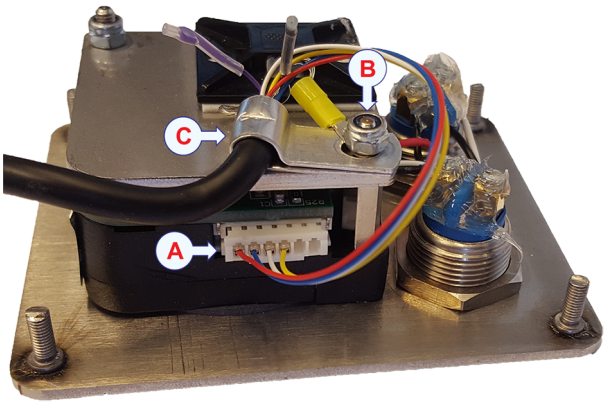
Keep the screws.

4 Check if you have a PS/2 cable from the rollerball to the computer.

The PS/2 cable has a round connector and must be exchanged with a cable with a flat USB connector.

a Remove the connector attached to the rollerball carefully (**A**).

The rollerball is shown on its own for clarity, there's no need to remove it from the front panel to change the cable.



b Remove the nut that holds the cable strain relief and the earthing cable on the rollerball (**B**)

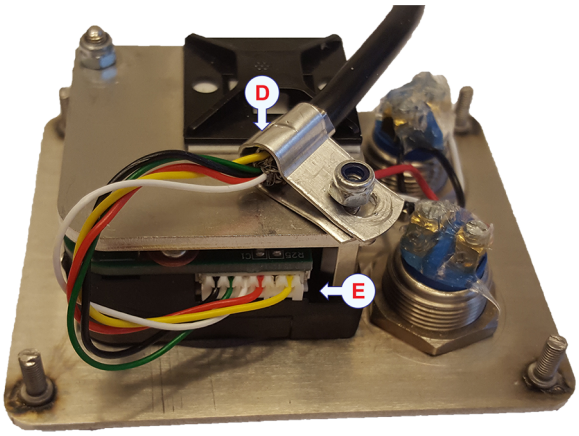
c Open the strain relief and remove the old PS2 cable (**C**).

d Insert the new USB rollerball cable in the strain relief.

e Make sure the metal clamp for the earthing is fitted inside the strain relief (**D**).

f Insert the cable strain relief and tighten the nut.

g Insert the plug (**E**).

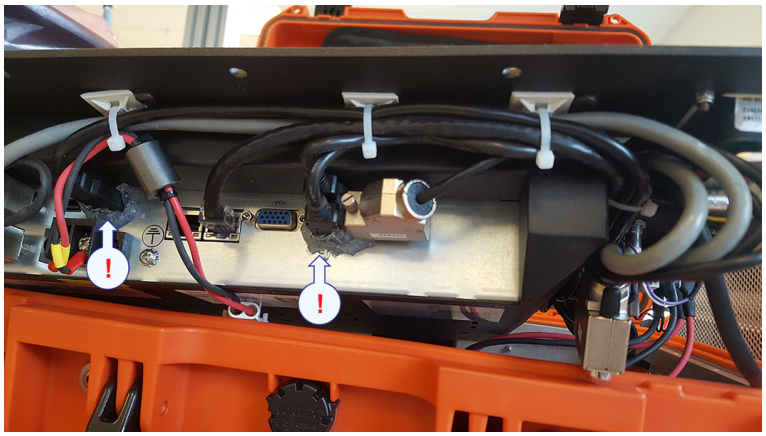


5 Insert the new panel computer and fasten it with the 4 screws.

6 Connect all plugs to the new computer.

7 If available, secure the USB plugs with hot-melt glue (**!**) to prevent the plugs from shaking loose after replacing the computer.

8 Insert the front panel and fasten it with it's screws.



Cleaning and inspecting the dunking transducer

Clean the dunking transducer every time it has been deployed.

Procedure

1 Clean the transducer, cable and cable drum with lots of fresh water to remove any salt water and dirt.

2 Make sure that the transducer face is clean and free of defects.

3 Check that the retaining strap is in good condition and will prevent the transducer from falling out of its holder during transport.

4 Check that the connector on the surface end is in good condition and the rubber seal is fitted.

5 Make sure that the protective cap is connected to the drum and is fitted to the surface connector when the unit is not in use.

6 Put a few drops of oil on the drum and roller bearings, around the winding handle and on the break screw thread.

This will help prevent corrosion and ensure trouble-free operation when the unit is required.

7 Check the lifting strop and look for cuts, frays and other damage.

Cleaning the SCU

Clean the SCU every time it's taken out of the water.

Procedure

1 Remove any growth and dirt with a stiff brush or a wooden or plastic scraper.

Be careful not to damage the unit.

2 Make sure all dirt, slime and growth is removed.

3 Clean the unit thoroughly with lots of fresh water.

4 Dry the unit.

5 Dry any water around the end caps and the vent screw.

6 If the unit is not to be dismounted from the valve package before performing maintenance, erect a protective cover over the unit to prevent water and dirt coming inside the unit when the lid is opened.

Changing the SCU battery

Prerequisites

WARNING

A battery malfunction may have caused high pressure to build up inside the transponder.

You must never stand in front of, or at the back of the unit, when you open it. Open the transponder in a safe place out on the deck, shielded from people and vital equipment.

Use a full face mask with minimum BE-filter, and protective equipment made of rubber or plastic.

The unit must be cleaned and dried before opening, so that no dirt or water seeps into it when it's opened.

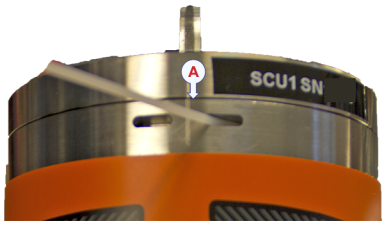
Note

Read the lithium batteries safety procedure before handling batteries.

Do not connect the + and – electrodes on the batteries with metal or wire..

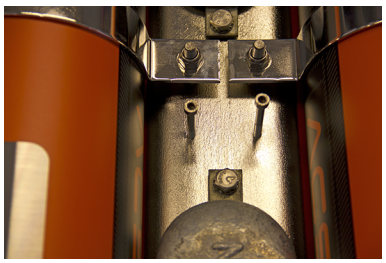
Procedure

1 Pull out the locking cord. **(A)**



2 Open the top cap.

The two M5 screws between the units can be used to push open the top cap. Insert the screws in the holes on the top cap and screw until the cap is off.



Make sure the screws are back in place between the units for the next use.

3 Remove the spent battery.

4 Insert the new battery.

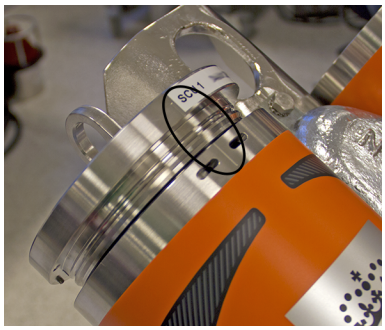
Inserting the battery at an angle makes this easier. Press firmly to make sure the battery is properly inserted.

5 Place a bag of dry silica-gel desiccant on the top of the battery.

6 Switch the on/off switch inside the top to on.

7 Replace the top.

Make sure the alignment marks meet.



8 Insert the locking cord by pushing it sideways around the body.

Testing the watertightness

This procedure describes using our interseal test kit. The same principles can be used for other tests.

Context

A Inlet for reservoir (not used)

B Outlet port (connect to Digital pressure indicator)

C Volume adjuster

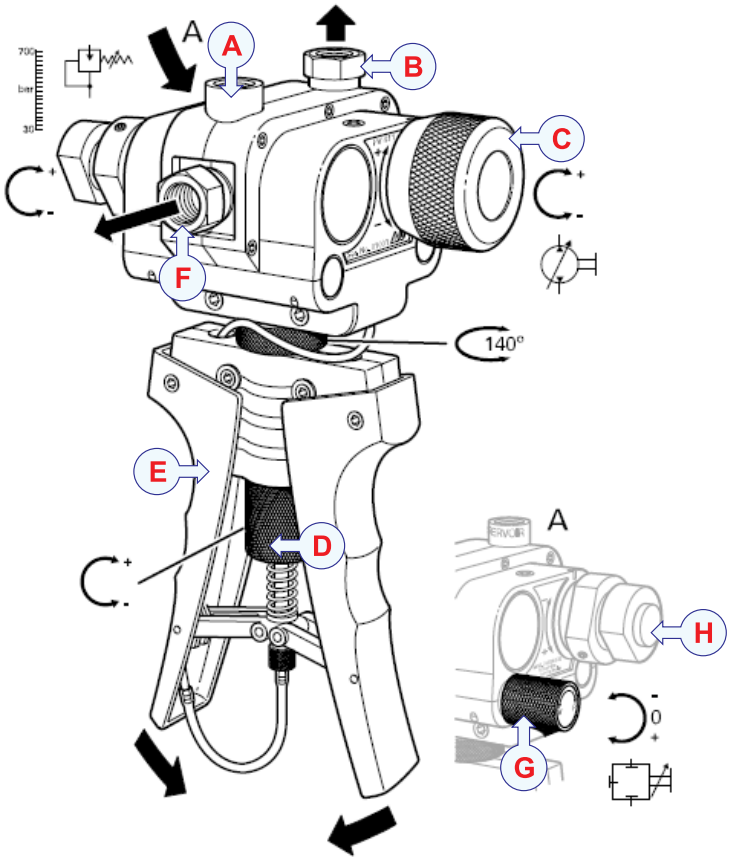
D Limit adjuster

E Scissor-action handles

F Outlet port (connect to unit to be tested)

G Selector valve

H Pressure relief valve



Use this test to confirm that the unit is watertight.

Procedure

1 Make sure there is an O-ring in the outlet port **B**.

2 Connect the Digital pressure indicator to outlet port **B** and use a spanner to tighten.

3 Make sure there is a small O-ring in the flexible pipe and connect the adapter fitting to the test port for the seal being tested.

4 Make sure there is an O-ring in the other end of the flexible pipe and connect a ¼ BSP.

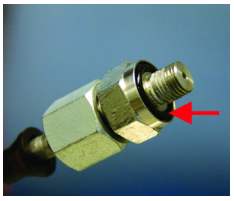
5 Place a washer on the ¼ BSP and connect to the outlet port **F** on the test kit.

6 Make sure the unit to be tested, and the connections are clean.

7 Verify that the O-rings on the fittings are lubricated properly.

8 Connect the flexible pipe between the interseal test kit and the unit to be tested.

9 Start the Digital pressure indicator by pressing the power on button **A**



10 If the pressure unit is not Bar, see the Digital pressure indicator manual to change it.

11 Close the selector valve , **G** by turning it clockwise.

12 Use the scissor-action handles to pump up the pressure to 11 bar.

13 Adjust with the volume adjuster, **C** if necessary.

14 Let the system rest for 10 minutes, and write down the pressure.

15 Let the system rest for another 10 minutes, and check the pressure again.

16 Make sure that the pressure has dropped less than 100 mbar.

This verifies that the unit is sealed.

17 Open the selector valve, **G** carefully to remove the pressure by turning it counterclockwise.

Replacing a SCU

Duplicating the configuration from one SCU to a new SCU is done with a serial line from the ACU to the SCU.

Prerequisites

Contact Konsberg Maritime customer support to receive a code for duplicating the configuration of the old SCU to the new.

- Select the **System Configuration** tab.
- Select **Replace SCU**.
- Note or take a picture of the code in the dialog box.

Procedure

1 Remove the connectors from the old SCU.

2 Remove the old SCU from the bracket.

3 Make sure the new SCU has the battery inserted before installing it.

4 Install the new SCU on the bracket.

5 Place the ACU near the SCU.

6 Connect the serial line cable (SL A65 G7) to connector A on the SCU labelled SERIAL.

7 Connect the other end of the serial line cable to the smallest connector on the SCU end cap.

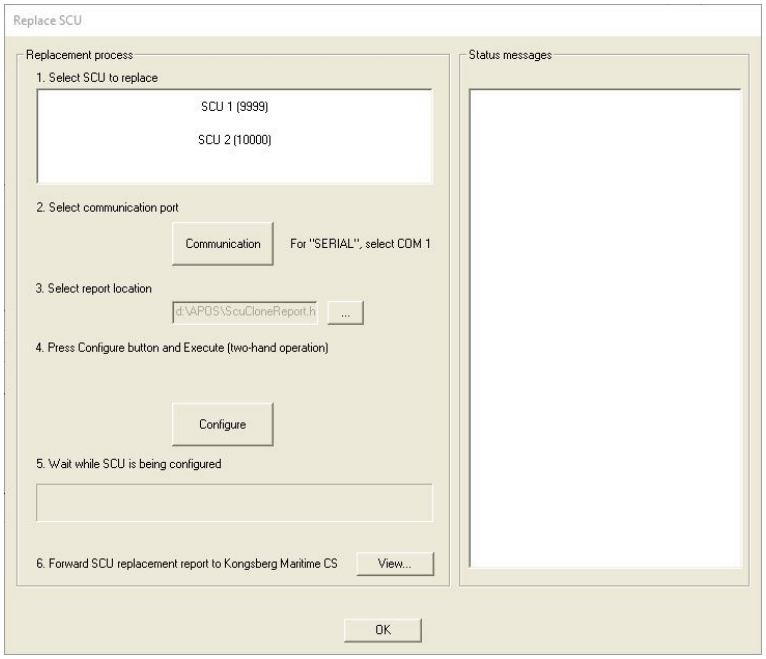
8 Turn on the ACU.

9 Select the **System Configuration** tab.

10 Select **Replace SCU**.

11 Type the code received from Kongsberg Maritime.

12 Select **OK**.



13 Select the SCU you are about to replace.

14 Select communication port.

This is normally COM 1.

15 Select report location.

16 Select **Configure** and **Execute** at the same time.

This is a two hand operation.

17 Wait while the configuration is being duplicated.

See the **Status messages** on the right hand side of the dialog box for updates.

18 Select **View** to get the Duplication report.

19 Email the Duplication report to Kongsberg Maritime Customer Support.

20 Select **OK**.

21 Remove the serial line cable.

22 Connect all cables.

Result

The new SCU is ready for operation.

Changing the batteries in the external quad battery unit

Read the lithium batteries safety procedure before handling batteries.

Prerequisites

WARNING

A battery malfunction may have caused high pressure to build up inside the transponder.

You must never stand in front of, or at the back of the unit, when you open it. Open the transponder in a safe place out on the deck, shielded from people and vital equipment.

Use a full face mask with minimum BE-filter, and protective equipment made of rubber or plastic.

Do not connect the + and – electrodes on the batteries with metal or wire.

Context

Procedure

1 Remove any growth and dirt with a stiff brush or a wooden or plastic scraper.

2 Make sure all dirt, slime and growth is removed.

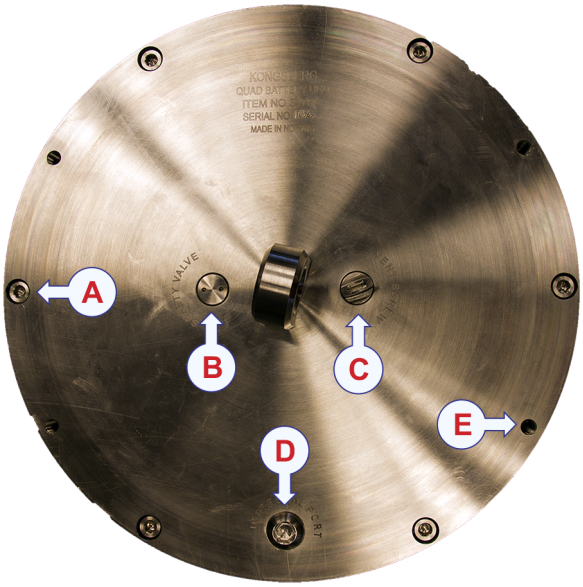
3 Clean the unit thoroughly with lots of fresh water.

4 Dry the unit.

5 Dry any water around the end caps and the vent screw.

6 If the unit is not to be dismounted from the valve package before performing maintenance, erect a protective cover over the unit to prevent water and dirt coming inside the unit when the lid is opened.

7 Unscrew the 6 screws **A** from the top cap.



8 Insert longer M6 screws in the holes **E**, to push open the lid.

If this is difficult, there might be a pressure difference. Open the vent screw **C** for relief and continue opening the lid.

9 Remove the spent batteries.

10 Insert the new batteries.

11 Replace the top.

12 Clean and screw in the vent screw if it has been opened.

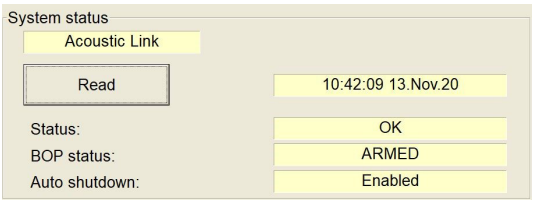
Fault-finding

No response from the SCU

The SCU gives no or incorrect response:

- Check if the correct SCU is activated.
- Check the System Configuration.

System status



- Unknown – Read System status.
- OK – Normal operation
- Telemetry failed – The last telemetry command was not confirmed OK from the SCU.

  Check the connection to the transducer and repeat the telemetry function.
- VALVE ERROR (red background)

  The SCU is DISARMED, other valves are still Active (Open) – Check the valve in the **More Status** dialog box.

  A new ARM command may trigger an active valve directly! – Check for sensor failure.
- Liquid detected (red background)

  Liquid is detected inside the SCU.
- Analogue sensor error – Detected SCU error bit message regarding Analogue Sensor connection; Check the SCU/BOP Interface and Sensor.
- Current lower than the low limit, valve operated OK, measured current lower than defined limit. – Repeat reading.

  Check Sensor and configuration values. In **More Status**, read last solenoid currents.
- Current higher than the high limit, valve operated OK, measured higher than defined limit. – Repeat reading.

  Check Sensor and configuration values. In **More Status**, read last solenoid currents.
- Sequence aborted, ongoing sequence of valve operations in the SCU are confirmed aborted – Read System status in order to check the valve status.

  Repeat the sequence if necessary.
- Sequence already executing – A valve sequence is already performing.

  Wait for status from the SCU.
- Automatic shutdown, optional function.
- SW watchdog, error bit from the SCU regarding software watchdog operation. – Wait 1 minute to power off the SCU and perform a Read status operation.

  Check if the error messages are still present. Report incident for a possible service operation.
- Low battery, warning bit from SCU – Execute a Read battery command.

When a battery has less than 20 % capacity, there is a yellow background in the value. When a battery has less than 10 % capacity, there is a red background in the value. Try to operate the other SCU.

- Current leakage – the SCU is not allowed to perform a valve operation in this condition.

  Read the actual current value in **More Status**. Check battery status. Try to operate the other SCU. Possible failure could be caused by water leakage of different kinds. **Service may be required.**

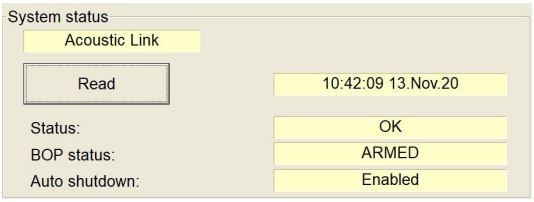
- Current overflow – error detected, valve operation will not be performed correctly.

  Read the actual current value in **More Status**. Check battery status. Try to operate the other SCU.Solenoid current drive will be stopped in order to not damage electronics and solenoids. Possible failure could be caused by water leakage of different kinds. **Service may be required.**

- Parameter CRC – Software CRC check in SCU indicated that the SCU is not properly configured.

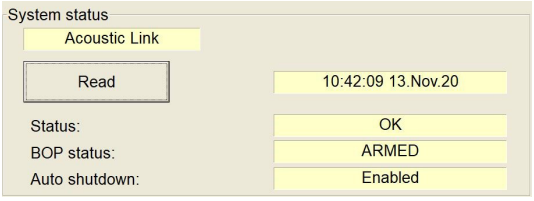
  The SCU should be configured properly and tested on-deck by using a simulator. Service personnel assistance is required.

Link status



- Acoustic link – Normal operation
- Serial link yellow – Test/service operation only; configure the ACU correctly in the **Utilities** menu (Service operation).
- Error (red) – ACU Control software failure; Reset the ACU by turning the power off and on again. If the system is still faulty, service is needed.

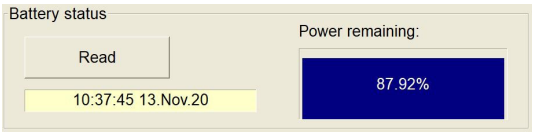
BOP status



- Unknown, status not available – Read **System status**.

- ARMED, System shows BOP is ARMED – Check if this is the expected status for the BOP.
- DISARMED, System shows BOP is DISARMED – Check if this is the expected status for the BOP.

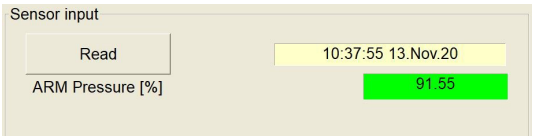
Battery status



- When a battery has less than 20 % capacity, there is a yellow background in the value. When a battery has less than 10 % capacity, there is a red background in the value.

  Check the other SCU or change the battery.

Sensor input

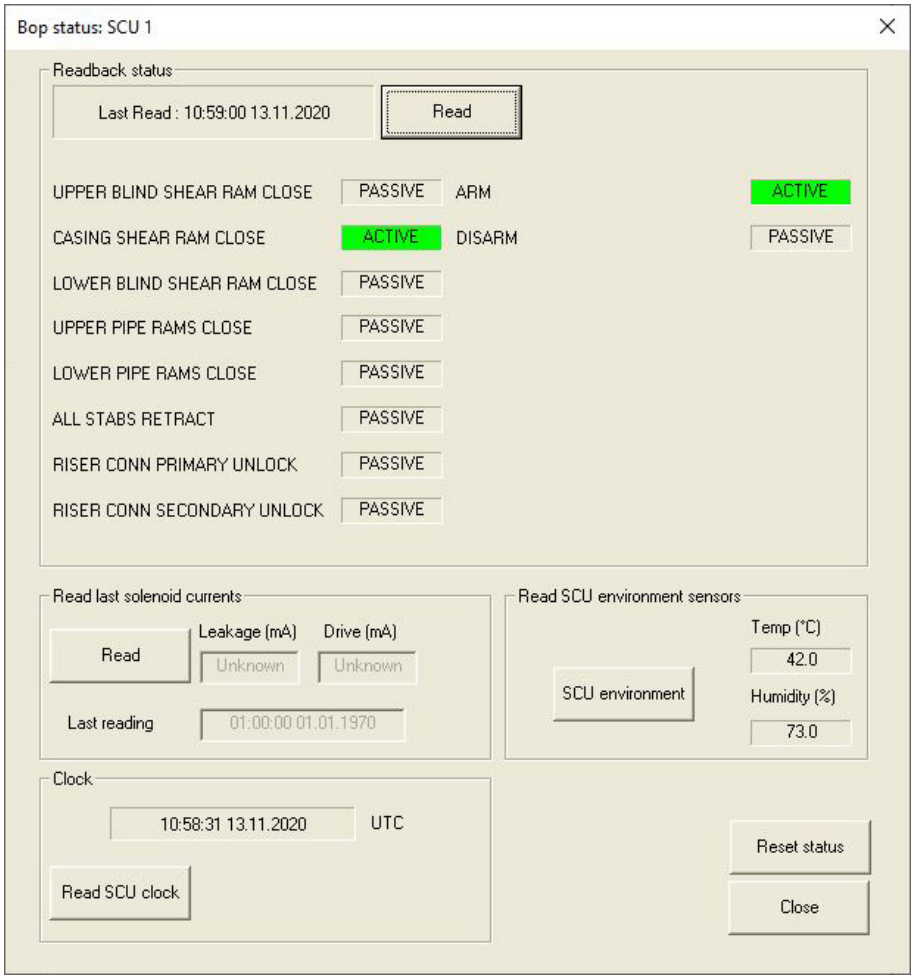


Output values may be configured in different ways, mA, Psi, % etc. Normal current sensor values should be between 4 and 20 mA.

The background colours indicate:

- Green for normal values.
- Yellow when the values are outside of 4 to 20 mA.
- Red for systems with set values for alarm limits, and the value is outside this limit.
- If a value is less than 1 mA, there might be an error with a faulty or not connected sensor.

More status



This group of functions is used to show an overview over the status (active/passive) of all digital readbacks.

Check real time clock values. Check last executed solenoid current and possible leakage value.

SCU environment gives the current temperature and humidity inside the SCU unit.

Valve operation messages

Message	Description	Action
Press execute buttons	When choosing a valve function, you get this message in order to proceed in the process.	Press Execute, tap and hold Execute on the touch screen at the same time until the command is executed.
Running	Confirming ongoing valve execution process, when receiving command	

Message	Description	Action
	confirmation from the SCU.	
OK	Valve operation executed OK, correct readback status confirmed. Solenoid current measurement within defined limits.	
Failed	Valve operation may be executed correctly. Readback status received is not as expected.	Check details including current values in More Status. Try to repeat operation if possible. Check sensors and configuration values.
High current	Warning, Dark green colour, this specific operation is OK, but the solenoid current measured is above the defined upper limit. Group B: Status will be updated with a warning message.	Check current reading valve in More status. If the valve is significantly outside the defined scope, check the SCU system.
Low current	Warning, Dark green colour, this specific operation is OK, but the solenoid current measured is above the defined upper limit. Group B: Status will be updated with a warning message.	Check current reading valve in More status. If the valve is significantly outside the defined scope, check the SCU system.
Unknown	This valve has not been operated yet in the operation window.	
Not armed, Force?	Operation of a normal valve, when the system is not in ARM mode. Warning to operator.	Continue operation by pressing the Execute buttons for 5 seconds.
Valve already Armed. Executed. Force?	When a Valve is already active (open) then an attempt to execute it twice will give this message.	Continue operation by pressing the Execute buttons for 5 seconds.
Cancelled	Executing a valve function and then pressing the Abort button will give this message.	

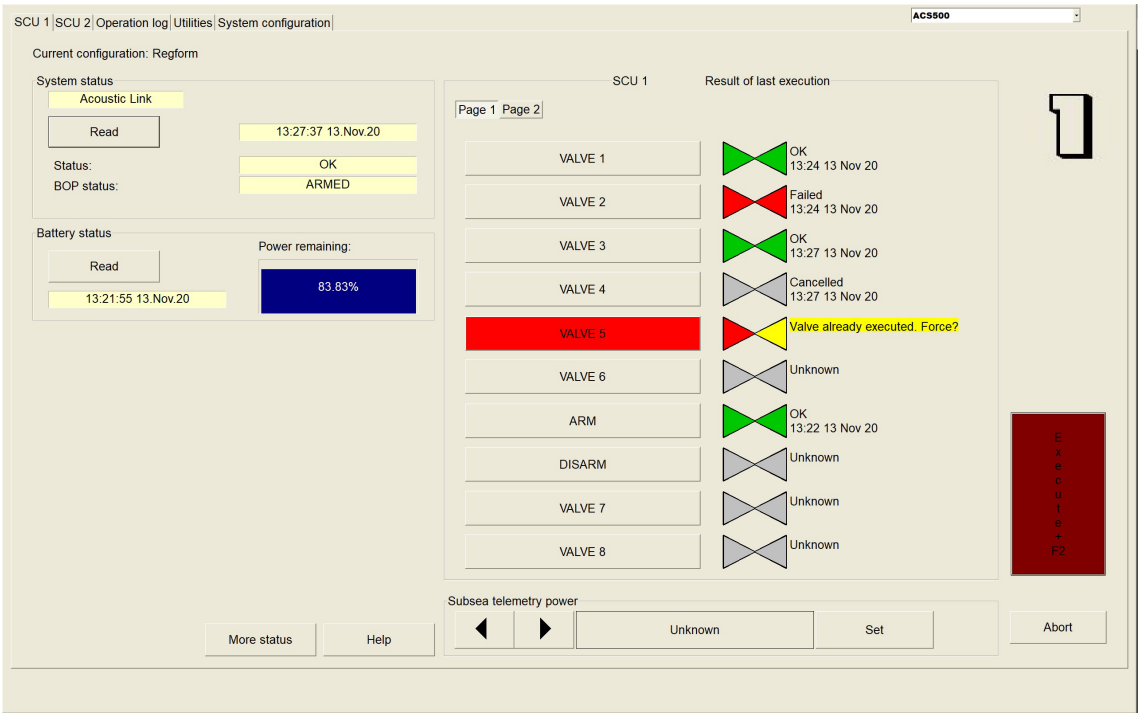
Message	Description	Action
Timeout-Force?	When starting up a command and not receiving acoustic confirmation from SCU then we get a Timeout warning.	Proceed with ACU Execute message by pressing the Execute buttons for 5 seconds. Alternatively, repeat the complete function.
Already armed! Force?	Warning. If the BOP is already Armed, then this message is displayed to the operator.	Continue ARM operation by pressing the Execute buttons for 5 seconds if appropriate.
Already disarmed. Force?	Warning. If the BOP is already Armed, then this message is displayed to the operator.	Continue ARM operation by pressing the Execute buttons for 5 seconds.
Valve error?	*Caution* *If a DISARM function is executed and the readback sensor shows that an active (open) valve is present, the BOP may be in a dangerous state. Check the sensors and the valve status. DO NOT ARM the system before checking out the problem.*	Possible solution: Repeat the DISARM function in order to reset all valves.
Not armed Force? (red colour)	Text and colour when main status of SCU has discovered an VALVE ERROR (displayed in Status window, BOP Status: DISARMED)	Read System Status and check details in More Status.
VALVES NOT RESET!!	*Caution* *When the BOP is in DISARM state and a normal valve is active. Trying to activate ARM function will give this message combined with Status: VALVE ERROR.*	Check BOP state and sensors. Try to repeat the DISARM function in order to RESET valve positions/Readback sensors.

Message	Description	Action
Timeout	General message when no final confirmation of a valve operation is received from the SCU. The Red background colour occurs when Status: VALVE ERROR.	Try to read System Status in More Status. Changes in the SCU/BOP status?
Analogue sensor error	Detected SCU error bit message regarding Analogue Sensor connection.	Check BOP Interface and sensor.
Sequence aborted	Message to confirm that SCU has stopped the execution of a Valve sequence operation.	
Sequence already executing	*Caution* *A valve sequence is already ongoing in the SCU.*	Wait for status reply from the SCU.
SW Watchdog	Status message bit from SCU. Watchdog event detected.	Check SCU function, if repetition of the message then prepare for service/exchange of the unit.
Low battery	Status message bit from SCU. Low battery event detected.	Check Battery status/remaining capacity. If needed then prepare for battery change. If possible use alternative Unit with more battery capacity prior to battery change.
Invalid configuration	SCU error bit, configuration of SCU is not valid.	Check if error is repeating. Service upgrade/configuration and test on deck is required.
Parameter CRC	Error bit from SCU indicating need for SCU configuration process.	Service upgrade/configuration and test on deck is required.

Message	Description	Action
Current leakage	*Caution* *Fatal Error detected. SCU will not execute the valve function due to current leakage in the system.*	Try to read leakage value in More Status. Check other valve functions and/or the other SCU Unit. Service/exchange of Unit or interface cabling may be required.
Current overflow	*Caution* *Fatal Error detected. SCU will not execute the valve function due to current overflow in the system, in order to protect the SCU electronics and the solenoids.*	Try to read the last actual current value in More Status. Check other valve functions and/or the other SCU Unit. Service/exchange of Unit or interface cabling may be required.

Case 1: The valve package is not in **Arm** mode

The valve package is not in Arm mode when activating a valve function and has not received OK valve status.



The time stamp shows when an ACS function has been executed.

Valve 1 is the first function that has been executed correctly with an OK readback and current measurement status.

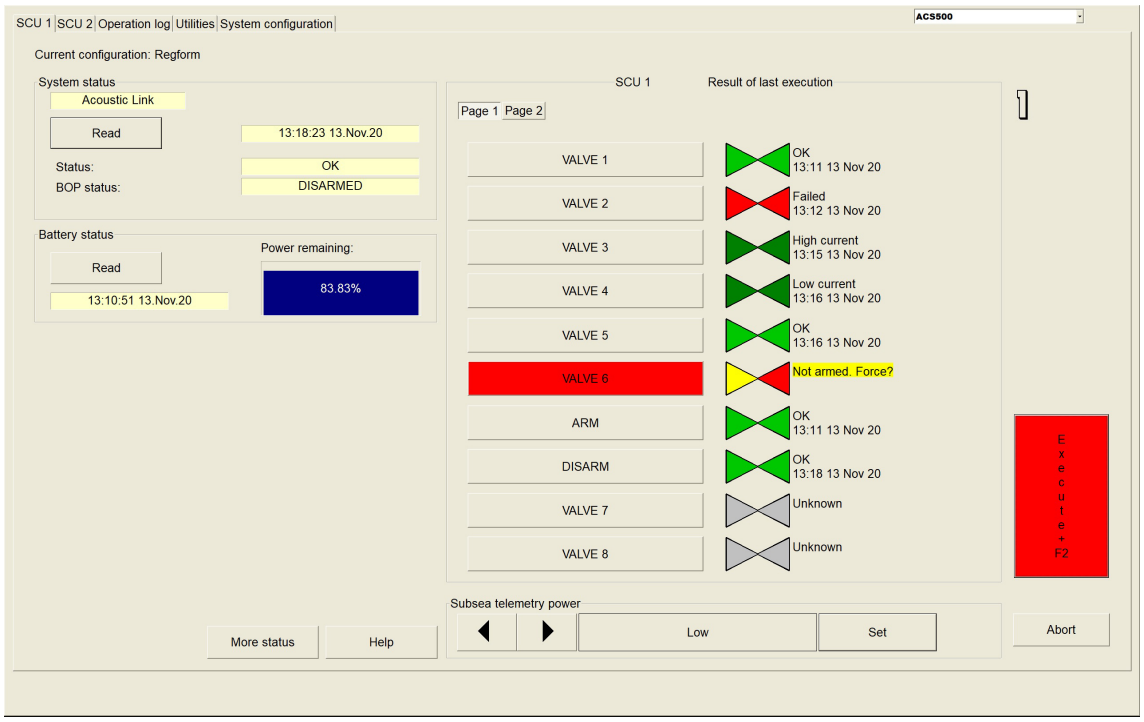
Valve 2 is executed OK, but readback sensor does not confirm OK. Valve status after execution, is sensor OK?

Valve 3 and Valve 4 is executed OK, but current readback value is not within specified window, showing either a Low or High current warning. The actual current value may be checked in the **More Status** menu.

Valve 5, ARM and DISARM functions were executed OK.

When trying to execute Valve 6 after DISARM of the valves, we receive a yellow warning message: "Not Armed. Force?" together with a blinking Execute button on the screen. In order to really execute Valve 6, the ARM function should be active prior to valve execution. Press and tap both Execute buttons to force and continue the Valve 6 operation within 10-15 seconds.

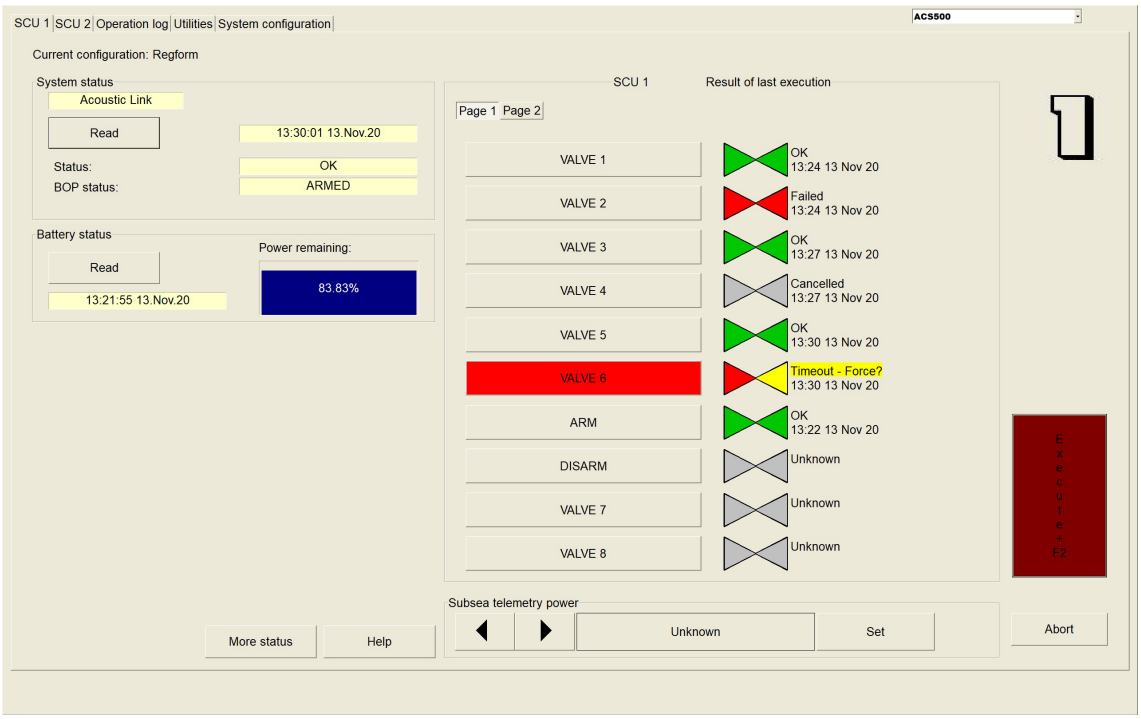
Case 2: Trying to activate a valve function twice



Valve 4 has a "Cancelled" status, this valve is not confirmed executed OK, and no status was received from the SCU.

Valve 5 execution is stopped with a yellow warning "Valve already executed. Force?" This message occurs when the previous status from the readback sensor in the SCU is that Valve 5 is already in active mode. It is still possible to perform the execution once again by pressing the Execute buttons a second time (hold buttons for 5 seconds).

Case 3: Getting no status reply after execution of a valve

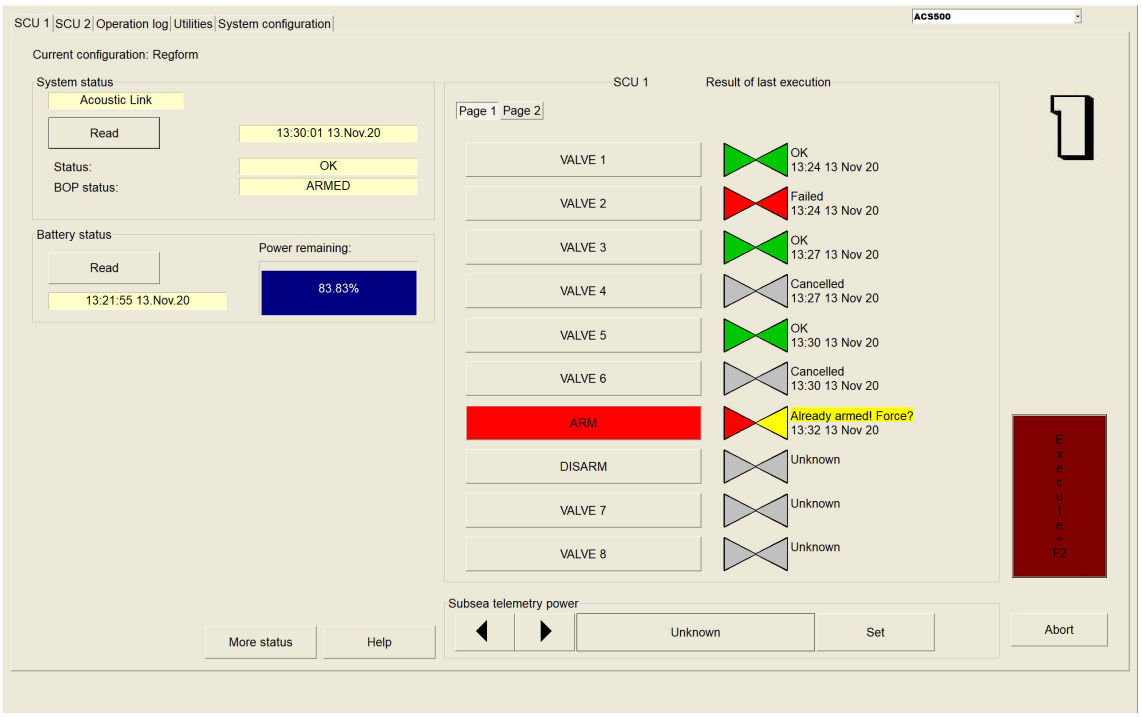


In this figure we are waiting for a missing status reply from the SCU, giving a warning: "Timeout-Force?.

Note

In a critical operational phase we may still try to execute the function (in Cymbal only, regarding timeout window setup values), without receiving any status read back info from the valve/SCU. KM recommends to abort the function and try again, or change to the other SCU, if the situation is not Critical

Case 4: Trying to activate the **Arm** function twice



This figure illustrates the case were we try to execute ARM when the valve readback sensor indicates that the valve package is already armed. This is only a yellow warning. Press and tap both execute buttons for 5 seconds in order to perform the function.

Case 5: Executing a **Disarm** function when a valve function is still active

Executing a Disarm function when a valve function is still active after Disarm.

In this figure a possible critical error situation has occurred, giving status "VALVE ERROR". The status in the SCU indicates that the valve package is DISARMED at the same time as other valves are active. Any attempt to execute the ARM function in this situation may cause error due to unwanted execution of the active valves in the system. When trying to execute the DISARM function when ARM sensor is not Active we get a red background for status "Not armed. Force?" on the valve. DISARM function execution is possible by pressing and tapping the two Execute buttons.

Caution

The operator should consider the complete valve situation before forcing any execution. Using the More Status menu in order to get a better overview over the valve readback situation is recommended.

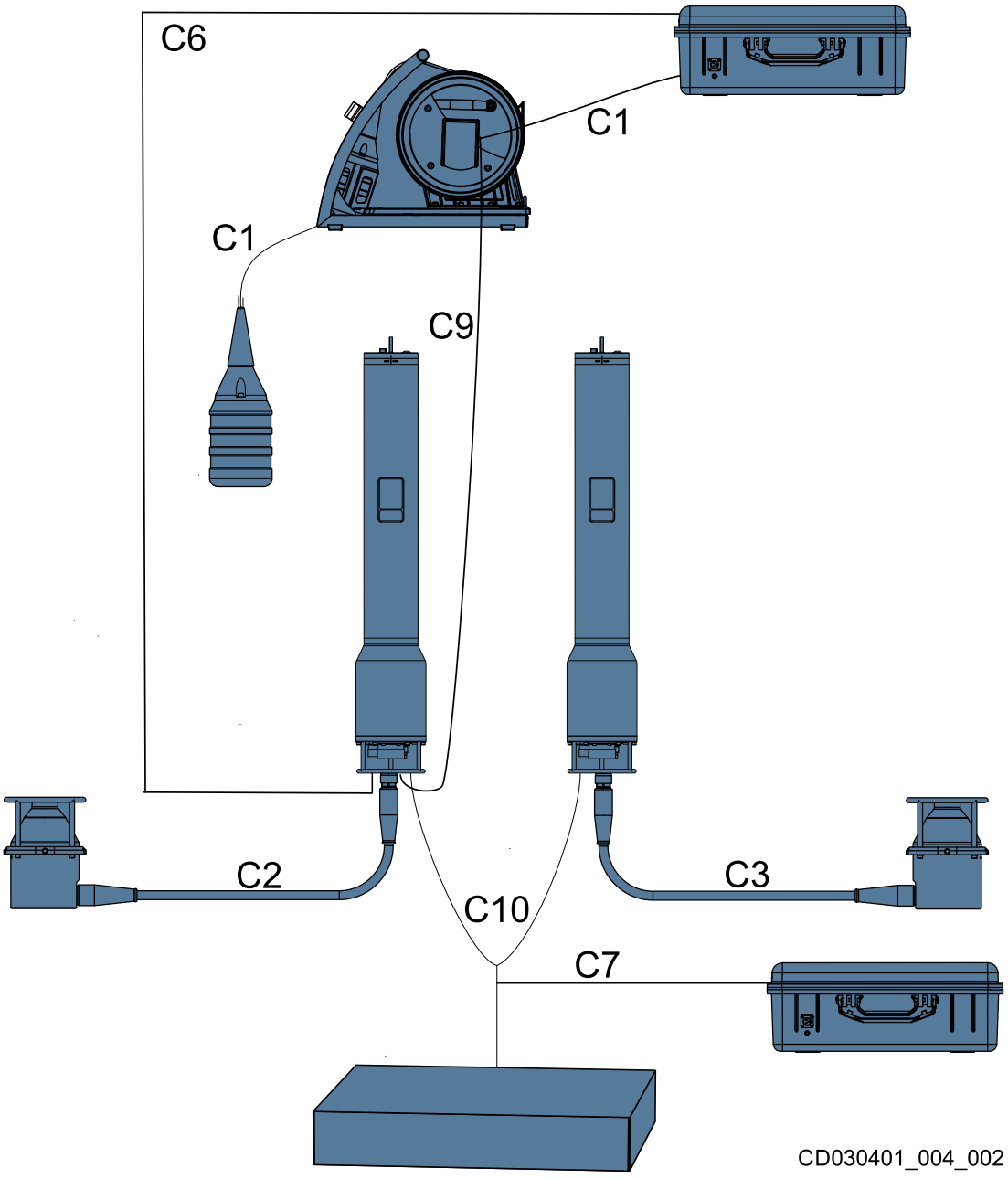
Simulation and test

Connecting the test equipment

The simulator can be connected directly to the SCU or via the dunking transducer. Directly to the SCU is the preferred method.

Context

Connecting via the dunking transducer is not preferred. The transducer is not made to function in air. Use this method only when testing the complete system including the transducers.



Procedure

1 For testing the complete system in air, place the dunking transducer close to the transducer and connect the cable C1 from the dunking transducer to the ACU.

2 For testing without the transducers, connect the test cable C6 from the ACU to the SCU and the field simulator test cable C7 from the simulator to the y-split cable C10.

3 For testing with HiPAP and APOS, connect the HiPAP test cable C9 from the SCU to the cable from the dunking transducer C1.

Testing the transducers

Connecting via the dunking transducer is not preferred. The transducer is not made to function in air.

Procedure

1 Place the dunking transducer near the transducer.

2 Connect the cable C1 from the dunking transducer to the ACU.

3 Turn on the ACU by pressing the on/off button to ON.

4 Set telemetry power to Low or Min.

Communication in air might damage the transducers.

Setting the telemetry power for the ACU, page 25

Setting the telemetry power for the SCU, page 25

5 Test the communication by reading the battery level on both SCU's.

Checking the battery status on the SCU, page 24

Further requirements

Testing the system, page 65

Testing ACS500 in APOS, page 66

Testing the system

Test the rest of the Acoustic Control System with a cabled connection to the SCU.

Prerequisites

Make sure the dunking transducer is disconnected from the system.

Context

Systems with dynamic switches can read the valve status when the solenoid function has been carried out. Systems with static switches can read the valve status at any time.

Procedure

1 Connect the cable C6 from the SCU to the ACU.

2 Connect cable C7 from the field simulator to the y-split cable.

Test all functions.

3 Start with **DISARM** (if available).

4 Tap **DISARM**.

5 Press Execute, tap and hold Execute on the touch screen at the same time until the command is executed.

6 When the green LED for the valve operation lights up on the simulator (this might take some minutes), wait for a second or two, then toggle the valve switch.

   The switch simulates that the hydraulic pilot pressure has opened the slide valve. This should result in a correctly confirmed valve operation.

7 When the LED is switched off, check that the correct status message is displayed on the ACU screen.

   FAILED is shown in the **Result** section if something went wrong.

8 Continue with the **ARM** function (if available).

9 Tap **ARM**.

10 Press Execute, tap and hold Execute on the touch screen at the same time until the command is executed.

11 Execute all other stack functions from the ACU by tapping the correct function and executing.

12 Simulate any analogue sensors.

   The toggle switch on the simulator will simulate low current 6 mA or high current 18 mA.

13 Execute one of the valve functions to simulate these values.

14 Tap SCU 2 and test all the functions with this SCU as well.

15 Remove cable C7 between the field simulator and the y-split cable.

16 Connect y-split cable C10 to the proper system.

17 Repeat all test with the proper solenoids connected.

Testing ACS500 in APOS

Testing the system is also possible using APOS and HiPAP.

Context

Systems with dynamic switches can read the valve status when the solenoid function has been carried out. Systems with static switches can read the valve status at any time.

Procedure

1 Connect cable C9 from the dunking transducer cable to the SCU.

2 Connect cable C7 from the field simulator to the y-split cable.

3 Lower the dunking transducer to get a clear signal to the HiPAP transducer.

4 Test all functions. Start with **DISARM** (if available).

5 Tap **DISARM**.

6 Press Execute, tap and hold Execute on the touch screen at the same time until the command is executed.

7 When the green LED for the valve operation lights up on the simulator (this might take some minutes), wait for a second or two, then toggle the valve switch.

   The switch simulates that the hydraulic pilot pressure has opened the slide valve. This should result in a correctly confirmed valve operation.

8 When the LED is switched off, check that the correct status message is displayed on the ACU screen.

   FAILED is shown in the **Result** section if something went wrong.

9 Continue with the **ARM** function (if available).

10 Tap **ARM**.

11 Press Execute, tap and hold Execute on the touch screen at the same time until the command is executed.

12 Execute all other stack functions from the ACU by tapping the correct function and executing.

13 Simulate any analogue sensors.

   The toggle switch on the simulator will simulate low current 6 mA or high current 18 mA.

14 Execute one of the valve functions to simulate these values.

15 Tap SCU 2 and test all the functions with this SCU as well.

16 Remove cable C7 between the field simulator and the y-split cable.

17 Connect y-split cable C10 to the proper system.

18 Repeat all test with the proper solenoids connected.

Spare parts

Topics

Ordering spare parts

To make the order process as short and efficient as possible, you must provide accurate information about the product, the part you need, and yourself.

The following information must be provided with your order:

- Part name and/or description
- Our part number
- Number of items required
- Your shipment address
- Preferred shipment method
- Required date of delivery from us

For certain spare parts (typically complete units, printed circuit boards and software) the vessel name is also useful, as this allows us to update our vessel database.

ACU spare part

The Acoustic Control Unit is the topside computer for the system.

- **Part name**: ACU30
- **Part number**: 320101

ACU panel computer spare part

The Acoustic Control Unit is the topside computer for the system.

- **Part name**: ACU panel computer spare part
- **Part number**: 449969

ACU battery spare part

The Acoustic Control Unit is the topside computer for the system.

- **Part name**: ACU battery spare part
- **Part number**: 460655

TDD30V Spare part

The dunking transducer is the part that is lowered into the water to send signals down to the subsea part of the system and retrieve signals back.

- **Part name**: TDD30V Spare part
- **Part number**: 320680

TDD303 Spare part

The dunking transducer is the part that is lowered into the water to send signals down to the subsea part of the system and retrieve signals back.

- **Part name**: TDD303 Spare part
- **Part number**: 301518

TDD180 Spare part

The dunking transducer is the part that is lowered into the water to send signals down to the subsea part of the system and retrieve signals back.

- **Part name**: TDD180 Spare part
- **Part number**: 320822

SCU complete unit spare part

The subsea control unit is mounted on the subsea structure.

- **Part name**: SCU complete unit spare part
- **Part number**: See the registration form for your part number.

SCU battery spare part

- **Part name**: SCU battery spare part
- **Part number**: 319554

SCU spare part kit for top cap

The spare part kit consists of:

- 1 x Seal screw
- 1 x Locking cord
- 1 x Electromagnetic interference (EMI) gasket
- 1 x O-ring 112 mm
- 3 x O-rings 107 mm
- 2 x O-rings 12 mm
- 2 x O-rings 11 mm
- 2 x O-rings 10 mm

- **Part name**: SCU spare part kit for top cap
- **Part number**: 341594

SCU top cap spare part

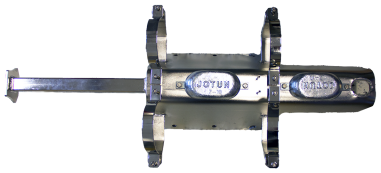
The subsea control unit is mounted on the subsea structure.

- **Part name**: SCU top cap spare part
- **Part number**: 336650

SCU bracket spare part

The subsea control unit is mounted on the subsea structure.

- **Part name**: SCU bracket spare part
- **Part number**: 328316



SCU serial line cable spare part

This is for cabled communication between the SCU and the ACU.

- **Part name**: SCU serial line cable spare part SL A6 5 G7
- **Part number**: 416396

SCU sealing cap for 12–pin connector spare part

The subsea control unit is mounted on the subsea structure.

- **Part name**: SCU sealing cap for 12–pin connector spare part
- **Part number**: 332269

SCU external quad battery unit spare part

- **Part name**: SCU external quad battery unit spare part
- **Part number**: 347007

TDR180 34GT Spare part

- **Part name**: TDR180 34GT Spare part
- **Part number**: 336616

TDR30V 34GT Spare part

- **Part name**: TDR30V 34GT Spare part
- **Part number**: 336611

Transducer cable spare part

- **Part name**: Transducer cable spare part
- **Part number**: 336622

Field simulator spare part

The simulator is used for simulating the valves when the SCU is at the surface, to check the system functionality.

- **Part name**: SIM 30-41 SC
- **Part number**: 388008

Interseal pressure test kit

- **Part name**: Interseal pressure test kit
- **Part number**: 359195

Technical specifications

Topics

Performance specifications

These performance specifications summarize the main functional and operational characteristics of the system.

Subsea Control Unit

- **Depth rating**: 4000 m
- **Operating frequency**: 23.6–27.6 kHz
- **Wake up codes, Cymbal**: M53/M54
- **Maximum transmission power**: 300 W

Transducer

- **Operating frequency**: 21–31 kHz

TDD30V

- **Transducer beam**: 30° at -3 dB

TDD303

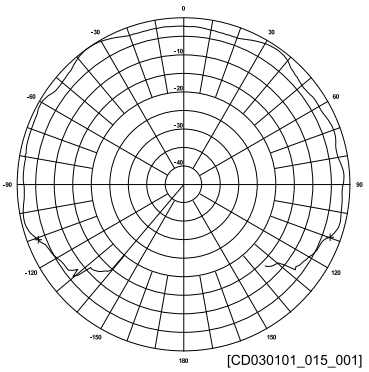
- **Transducer beam**: 50° at -3 dB

TDD180

- **Transducer beam**: 90° at -3 dB

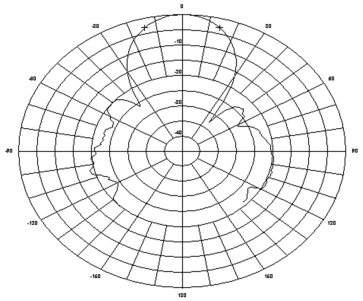
TDR180

- **Transducer beam**: 90° at -3 dB



TDR30V

- **Transducer beam**: 30° Vertical at -3 dB



Interface specifications

The ACS500 communication system consists of a modem implemented on the Universal Transponder Board (UTB) in both the ACU and the SCU. Each UTB board is directly connected to a transducer in order to send acoustic telegrams in water depths up to 4000 metres.

The ACS500 communication system consists of a modem implemented in both the ACU surface unit and the SCU subsea unit. An acoustic telegram is sent from the ship/rig. The signal is received by one of the subsea transducers depending on which SCU the operator has addressed. The telegram is then transferred to the SCU control module which will perform the control of valve solenoids and read back for sensors. A signal is sent back to the ship/rig as a confirmation that the operation is completed.

The modem is using the optimal and fast Cymbal spread spectrum coherent acoustic link. The Cymbal link system will operate with reduced battery consumption at severe signal to noise ratio compared to the older FSK systems.

Standard cymbal link configuration

- Spread spectrum transmission
- 25.6 kHz centre frequency ± 2 kHz

Weights and outline dimensions

These weights and outline dimension characteristics summarize the physical properties of the system.

Acoustic Command Unit

- **Outline dimensions**:
  - **Depth**: 386 mm
  - **Width**: 488 mm
  - **Height**: 185 mm
- **Weight**: 19.5 kg

Dunking transducer

- **Outline dimensions**:
  - **Depth**: 590 mm
  - **Width**: 225 mm
  - **Height**: 500 mm
- **Weight**: 25 kg

TDR30V

- **Outline dimensions**:
  - **Diameter**: 166 mm
  - **Height**: 212 mm
- **Weight**: 15 kg
- **Cable length**: 15 m

TDR180

- **Outline dimensions**:
  - **Diameter**: 166 mm
  - **Height**: 235 mm
- **Weight**: 16.5 kg
- **Cable length**: 15 m

External quad battery unit

- **Outline dimensions**:
  - **Diameter**: 304 mm
  - **Height**: 947.5 mm
- **Weight**: 165 kg

Power specifications

These power characteristics summarize the supply power requirements for the ACS500 system.

Acoustic Command Unit

- **Voltage requirement**: 100-240 VAC, 50/60 Hz
- **Operating voltage**: 10-18 VAC
- **Battery voltage**: 14 VDC
- **Battery lifetime**: 10 hours continuous use
- **Battery type**: Lead-acid battery
- **Maximum transmission power**: 300 W

Subsea Control Unit

- **Operating voltage**: 14 VDC
- **Battery capacity**: 128 Ah
- **Battery voltage**: 14 VDC
- **Battery type**: Non-rechargeable lithium battery Li/$SOCl_2$

External quad battery unit

- **Battery capacity**: 4 x 128 Ah
- **Battery voltage**: 14 VDC
- **Battery type**: Non-rechargeable lithium battery Li/$SOCl_2$

Environmental specifications

These environmental specifications summarize the temperature and humidity requirements for the ACS500 Acoustic Control System.

Acoustic Command Unit

- **Operating temperature**: -5 to 55 °C
- **Storage temperature**: -30 to 70 °C
- **Degree of protection**: IP54

Operational specification for on deck testing purposes: -20 to +55 °C. The ACU must be in standby/ON mode before being exposed to temperatures lower than -5 °C.

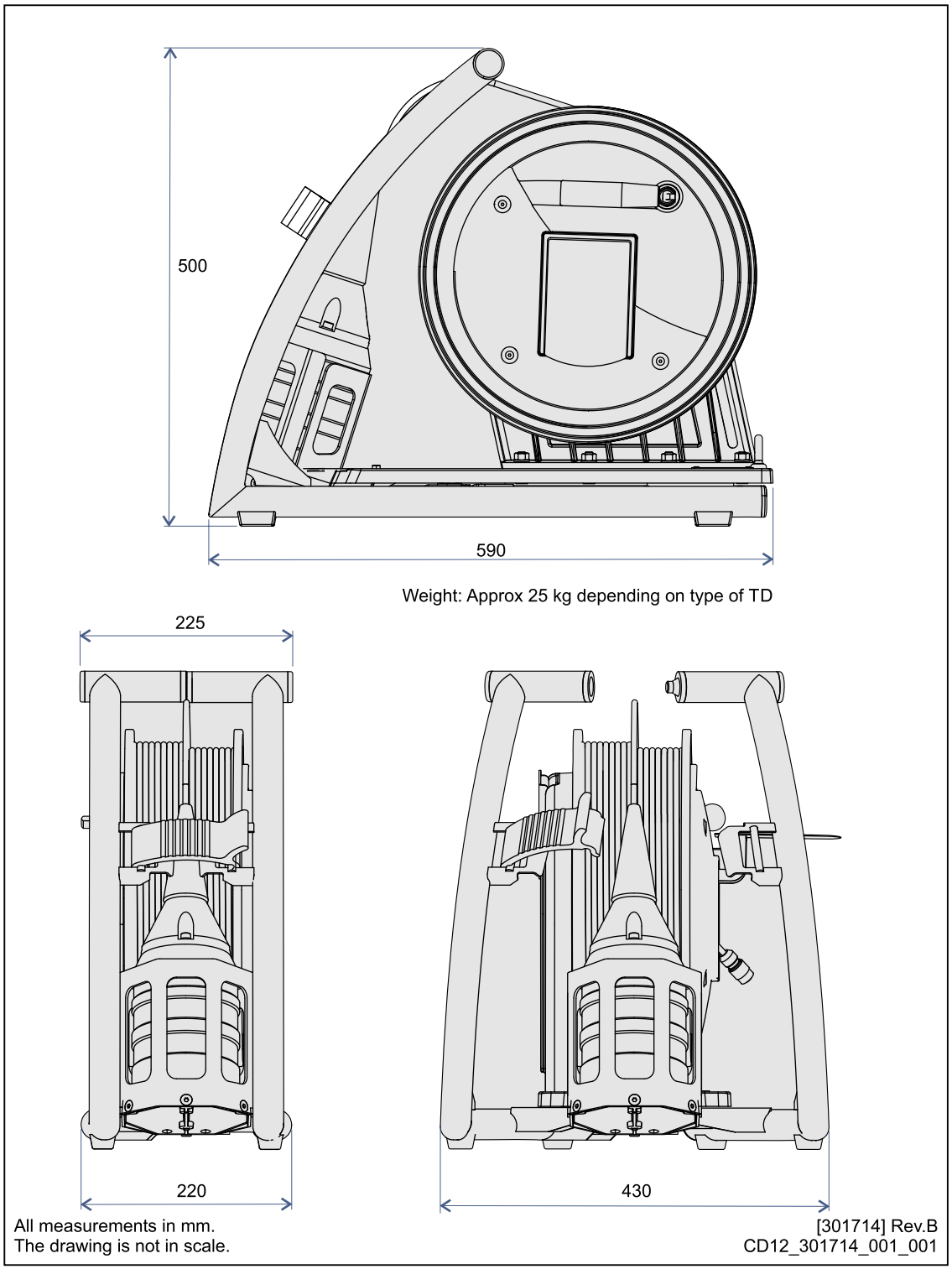
Subsea Control Unit

- **Operating temperature**: -5 to 55 °C
- **Storage temperature**: -30 to 70 °C

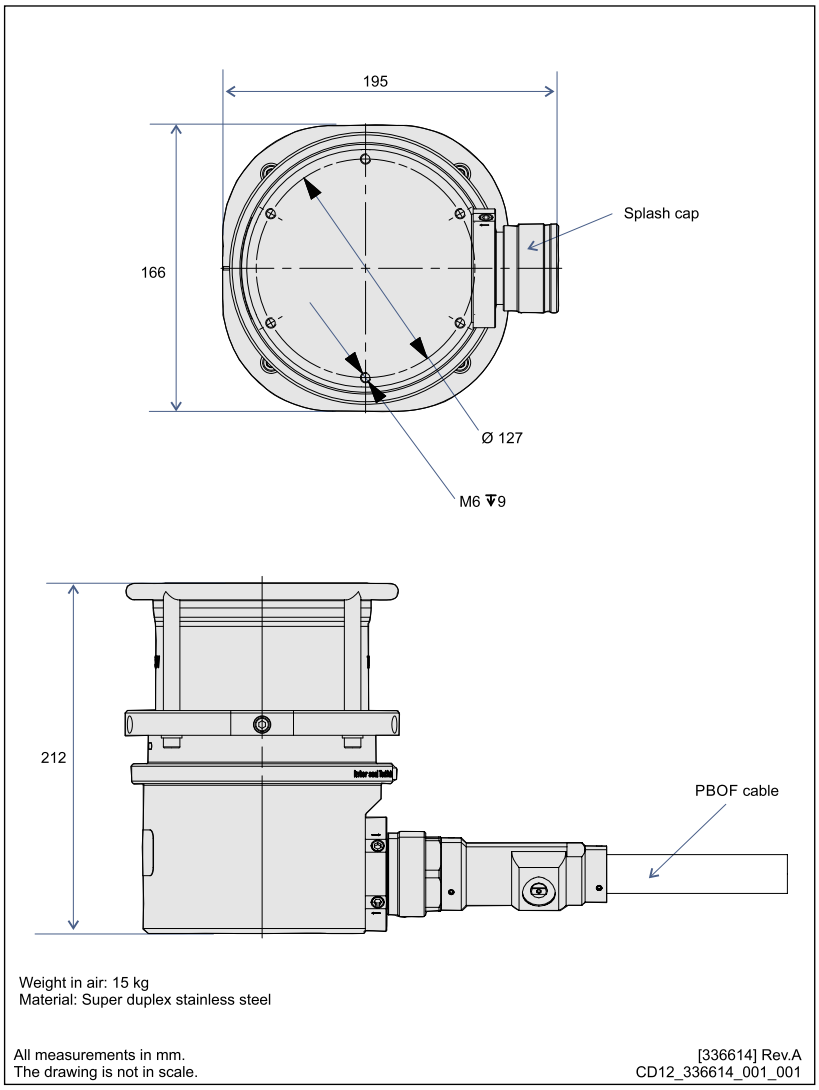
Drawing file

Topics

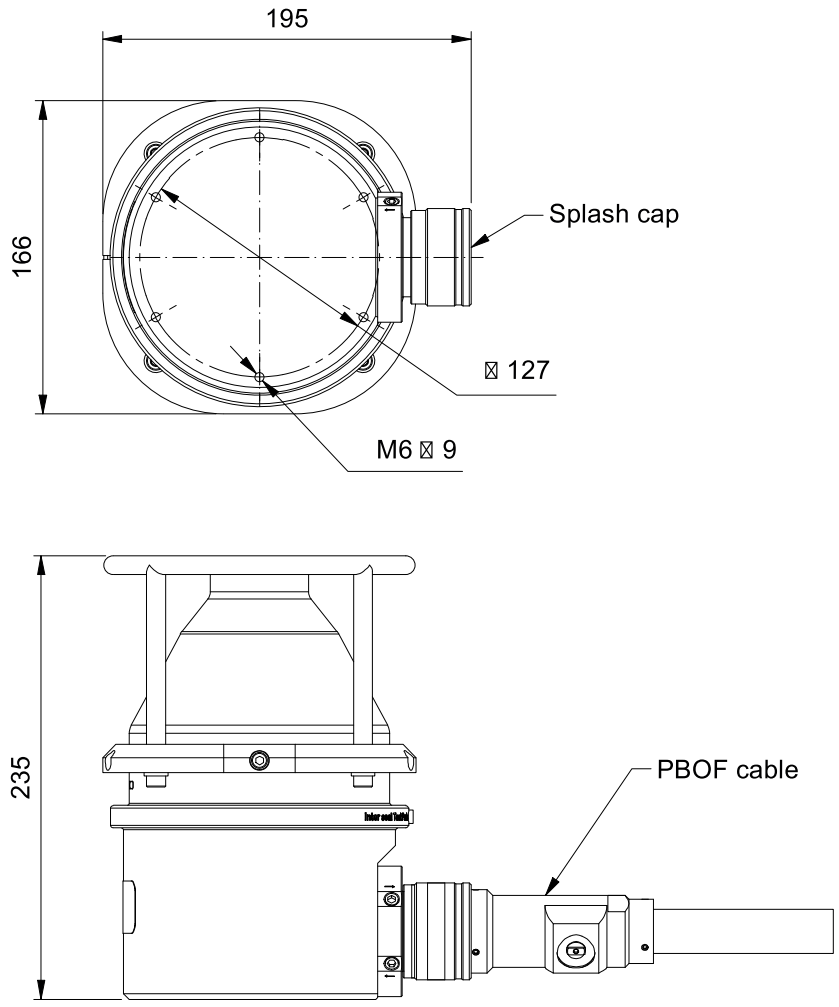
Dunking transducer outline dimensions



TDR30V 34GT Outline dimensions



TDR180 34GT Outline dimensions

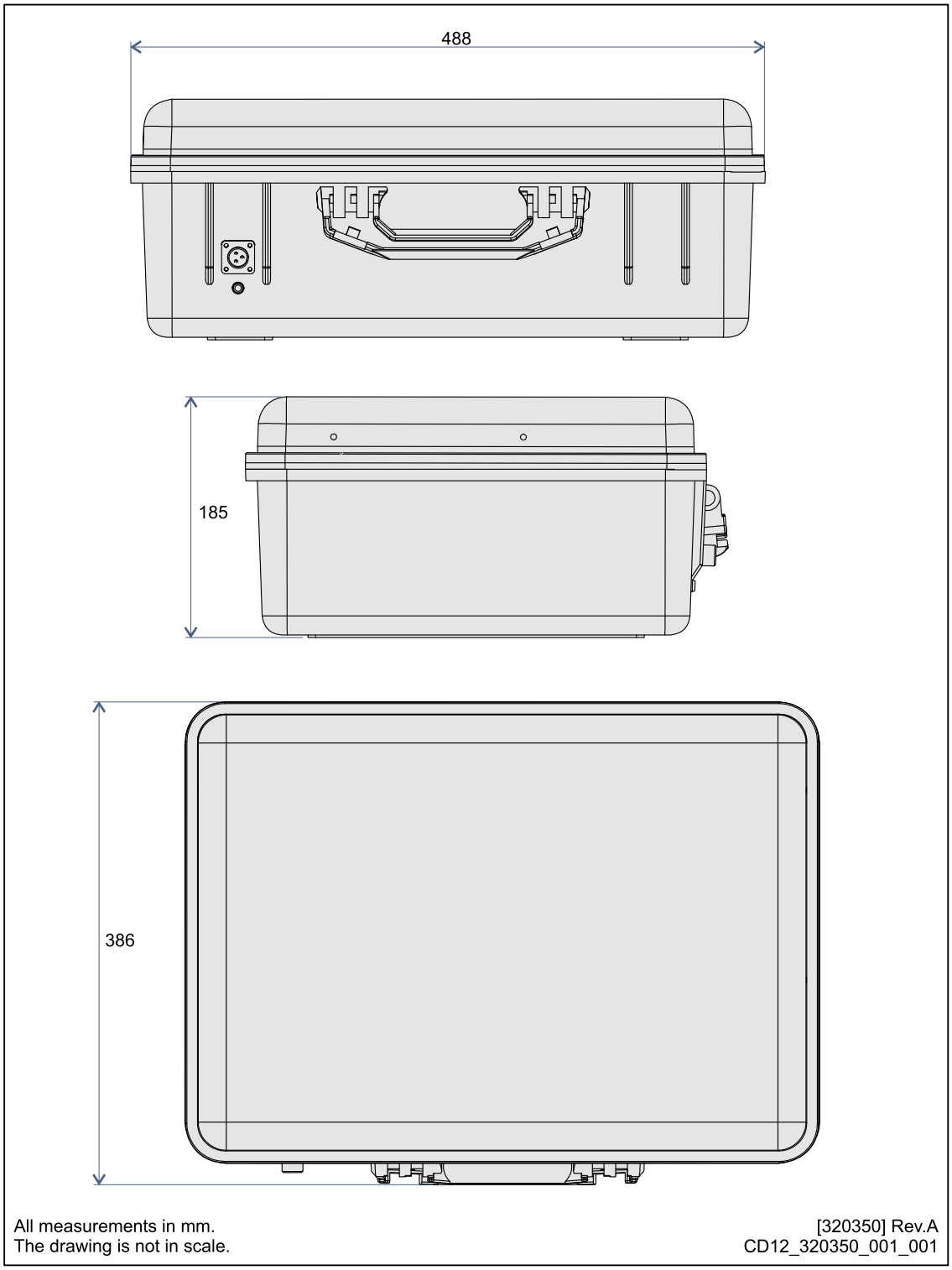


Weight in air: 16.5kg
Weight in water: 13.3kg

All measurements in mm.
The drawing is not to scale.
Information may be omitted. Observe the source drawing for additional details.

[426553] Rev.A
AI12_426553_001_001

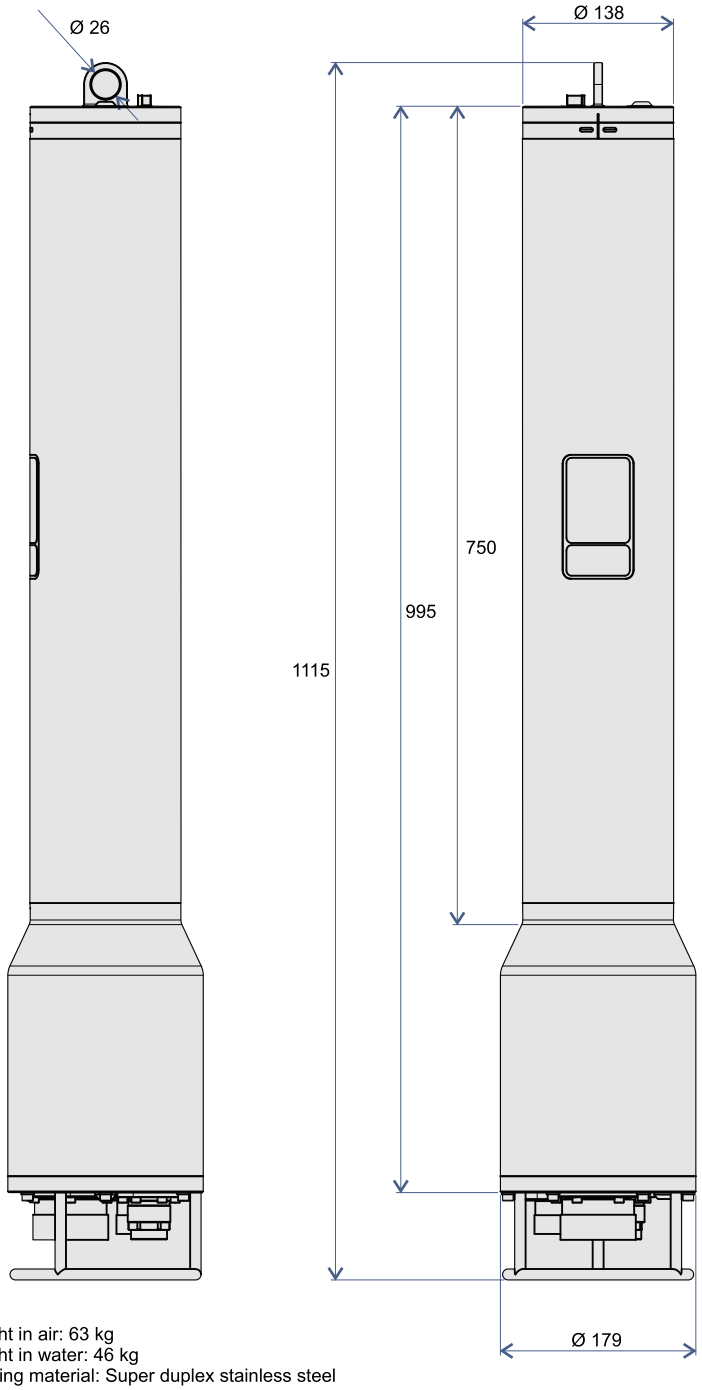
ACU30 Outline dimensions



All measurements in mm.
The drawing is not in scale.

[320350] Rev.A
CD12_320350_001_001

SCU Outline dimensions

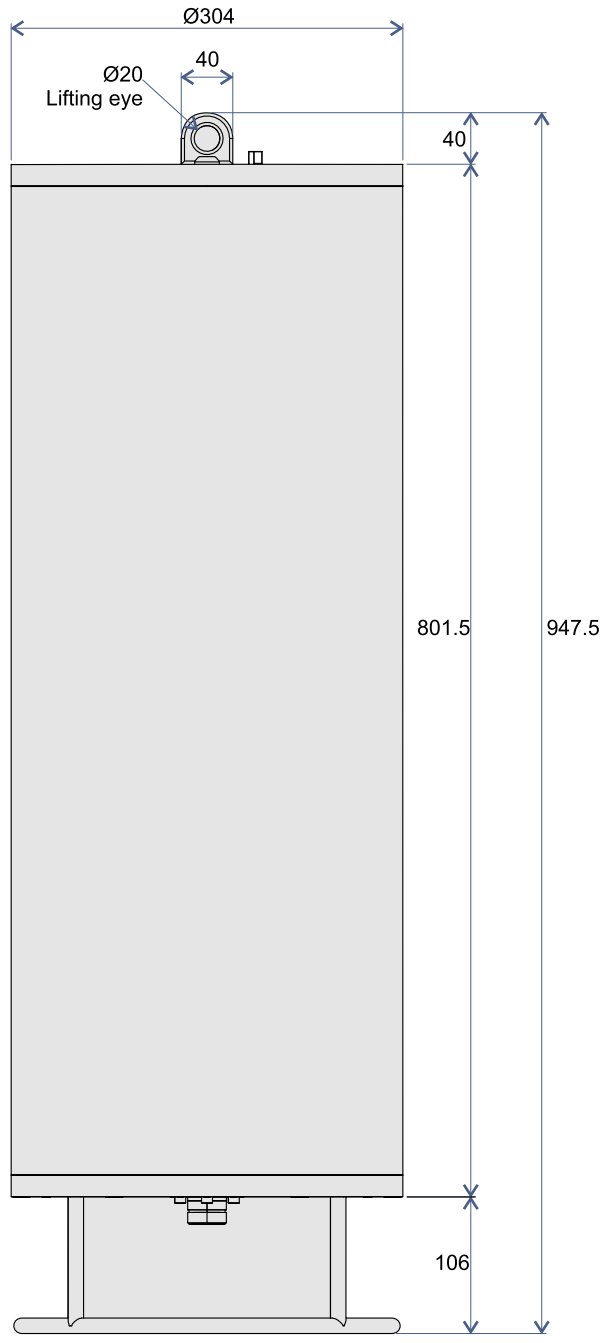


Weight in air: 63 kg
Weight in water: 46 kg
Housing material: Super duplex stainless steel

All measurements in mm.
The drawing is not in scale.

[319382] Rev.A
CD12_319382_001_001

Quad battery unit outline dimensions

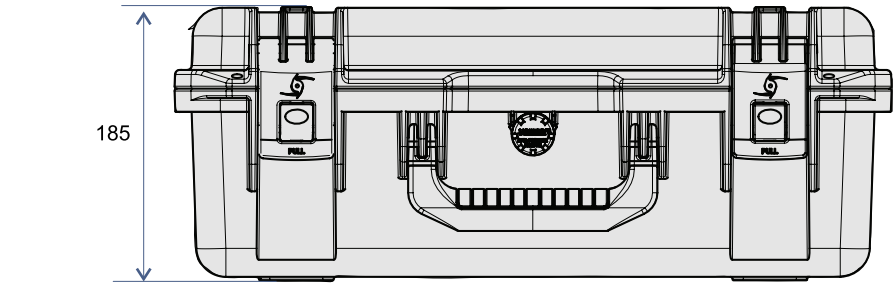


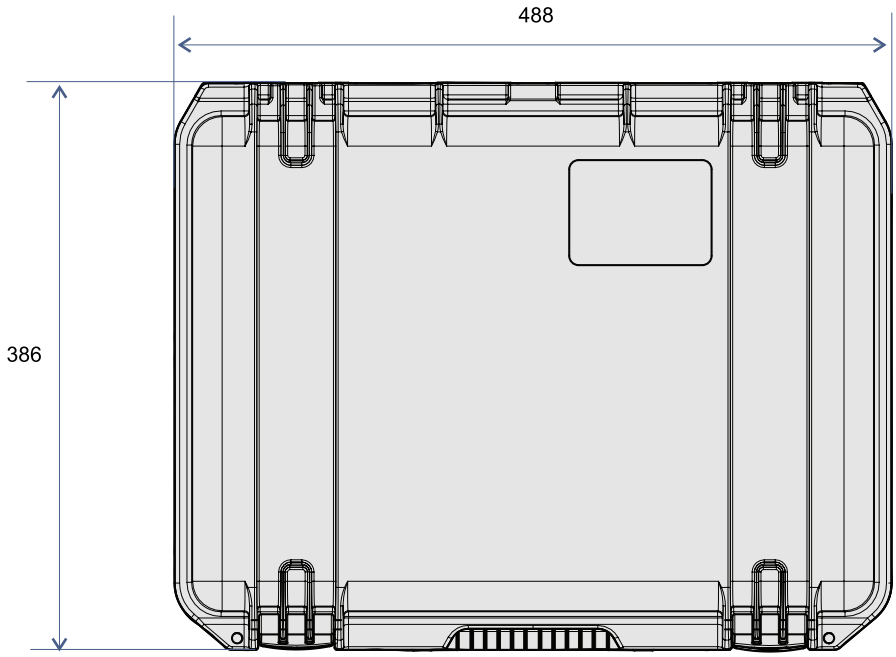
Housing material:
Super Duplex Stainless Steel
Weight in air: 165 kg
Weight in water: 145 kg

All measurements in mm.
The drawing is not in scale.

[320911] Rev.B
CD12_320911_001_001

Field simulator outline dimensions





Weight: approx. 6 kg

All measurements in mm.
The drawing is not in scale.

[391598] Rev.A
CD12_391598_001_001

Type approval certificate

DNV

TYPE APPROVAL CERTIFICATE

Certificate No:
TAA00000TS
Revision No:
3

This is to certify:

That the BOP control system

with type designation(s)
Acoustic BOP Control System ACS500

Issued to
Kongsberg Maritime AS
HORTEN, Norway

is found to comply with
DNVGL-OS-E101 – Drilling facilities, Edition January 2018

Application :

See next page.

Product(s) approved by this certificate is/are accepted for installation on all vessels classed by DNV.

Location classes:

Temperature	**A**
Humidity	**B**
Vibration	**A**
EMC	**B**
Enclosure	**A**

Issued at **Høvik** on **2021-03-19**

This Certificate is valid until **2026-03-18**.
DNV local station: **Sandefjord**

Approval Engineer: **Jan Olav Moen**

for **DNV**
Digitally Signed By: Moen, Jan Olav
Location: DNV Høvik, Norway
Signing Date: 19.03.2021, on behalf of

Per Esvall
Head of Section

This Certificate is subject to terms and conditions overleaf. Any significant change in design or construction may render this Certificate invalid.
The validity date relates to the Type Approval Certificate and not to the approval of equipment/systems installed.

Job Id: **262.1-019479-5**
Certificate No: **TAA00000TS**
Revision No: **3**

Product description

The Type Approval is valid with the following Operational Modes and System Functions:

Item:	Description	P/N
ACU30	Acoustic Command Unit	320101
SCU 35-24V 37P TC WA	Subsea Control Unit 5000m 24V with Gisma 37 pin test port connector wiring A	413507
SCU 35-48V 37P TC WA	Subsea Control Unit 5000m 48V with Gisma 37 pin test port connector wiring A	413517
SCU 34-24V 37P WA	Subsea Control Unit 24V with Gisma 37 pin connector wiring A	417592
SCU 34-24V 37P WB	Subsea Control Unit 24V with Gisma 37 pin connector wiring B	417593
SCU 34-24V 37P WC	Subsea Control Unit 24V with Gisma 37 pin connector wiring C	417595
SCU 34-24V 37P WD	Subsea Control Unit 24V with Gisma 37 pin connector wiring D	417597
SCU 34-24V 37P WE	Subsea Control Unit 24V with Gisma 37 pin connector wiring E	417599
SCU 34-24V 37P WF	Subsea Control Unit 24V with Gisma 37 pin connector wiring F	417600
SCU 34-48V 37P WA	Subsea Control Unit 48V with Gisma 37 pin connector wiring A	417603
SCU 34-48V 37P WB	Subsea Control Unit 48V with Gisma 37 pin connector wiring B	417604
SCU 34-48V 37P WC	Subsea Control Unit 48V with Gisma 37 pin connector wiring C	417605
SCU 34-24V 24P TC WA	Subsea Control Unit 24V with MacArtney 24 pin test port connector wiring A	417606
SCU 34-24V 24P TC WB	Subsea Control Unit 24V with MacArtney 24 pin test port connector wiring B	417610
SCU 34-24V 24P TC WC	Subsea Control Unit 24V with MacArtney 24 pin test port connector wiring C	417611
SCU 34-24V-37p 10Ch-X	Subsea Control Unit 24V with Gisma 37 pin 10Ch-X	415881
SCU 34-48V 24P TC WA	Subsea Control Unit 48V with MacArtney 24 pin test port connector wiring A	369340
SCU 34-24V 37P TC WA	Subsea Control Unit 24V with Gisma 37 pin test port connector wiring A	336600
SCU 34-48V 37P TC WA	Subsea Control Unit 48V with Gisma 37 pin test port connector wiring A	336633
SCU 34-24V 55P TC WA	Subsea Control Unit 24V with Gisma 55 pin test port connector wiring A	336644
SCU 34-48V 55P TC WA	Subsea Control Unit 48V with Gisma 55 pin test port connector wiring A	336648
SCU 34 – 24V 24P TC	Subsea Control Unit 24V with MacArtney 24 pin test port connector	332255
SCU 34 24V-37p	Subsea Control Unit 24V with Gisma 37 pin connector	317950
SCU 34 – 48V 37p	Subsea Control Unit 48V with Gisma 37 pin connector	363668
TDD30V	Dunking Transducer Unit TDD30V	320680
TDD301 MF	Dunking Transducer TDD301 MF	129-220871
TDD303 MF	Dunking Transducer TDD303 MF	301518
TDD180	Dunking Transducer TDD180	320822
TDD50V 30L	Dunking Transducer TDD50V with 30m transducer cable and backpack	369519
TDR30V SCU St	Transducer Remote TDR30V SCU St	320098
TDR40V 34S	Transducer Remote TDR40V 34S	364096
TDR180 SCU St	Transducer Remote TDR180 SCU St	320890
TDR30V 34T	Transducer Remote TDR30V 34T	368967
TDR180 34T	Transducer Remote TDR180 34T	370168
TDR30V 34GT	Transducer Remote TDR30V 34GT	336611
TDR90V 34GT	Transducer Remote TDR90V 34GT	336615
TDR180V 34GT	Transducer Remote TDR180V 34GT	336616
TDR30V 35GT	Transducer Remote TDR30V 35GT	413587
External Quad Battery Unit SCU	External Quad Battery Unit SCU	347007

Software Version
ACU30:

Unit	Description
Panel PC	PC R12ID3S-MRM-2 Microsoft windows 7
UTB circuit board	DSP software: ACS Release: v_5_06
UTB circuit board	FPGA firmware: UTBFPGA_v_2_11
SIO circuit board	Microcontroller software: EME software v_1.6

Job Id: **262.1-019479-5**
Certificate No: **TAA00000TS**
Revision No: **3**

SCU 34:

Unit	Description
UTB circuit board	DSP software: ACS Release: v_5_07
UTB circuit board	FPGA firmware: UTBFPGA_v_2_11
SIO circuit board	Microcontroller software: scu_flash_ v_1_30
SIB circuit board	FPGA firmware: v_1_3

Application/Limitation

The system is found to comply according to DNV's current understanding of interpretation and implementation of:

• DNV GL Statutory Interpretations DNVGL-SI-0166 Verification for Compliance with Norwegian Shelf Regulations, July 2018
• DNV GL Offshore Standard DNVGL-OS-E101, "Drilling facilities", January 2018
• Control Systems for Drilling Well Control Equipment and Control Systems for Diverter Equipment, API Specification 16D, Third Edition, November 2018
• Well Control Equipment System for Drilling Wells, API Standard 53, Fifth edition, December 2018

The Type Approval covers the type-tested hardware as listed under Product description.

Product certificate
Each delivery of the application system is to be certified according to DNVGL-OS-D202 Ch.3 Sec.1 [4] / DNVGL-OS-E101 Ch.3 Sec.3. The certification test is to be performed at the manufacturer of the application system according to an approved test program before the system is shipped to the yard. After the certification the clause for application software control will be put into force.

Clause for application software control
All changes in software are to be recorded as long as the system is in use on board. The records of all changes are to be forwarded to DNV for evaluation and approval. Major changes in the software are to be approved before being installed in the computer.

Type Approval documentation

322135O Instruction Manual, ACS500 Emergency Acoustic BOP Control System
331046aa Report, ACS500 FMECA Workshop 9 – 11 February 2009
804047A Report, Transponder Analysis on the effect of external pressure
804827B Report, Transponder Analysis on the effect of external pressure
331172J Factory Acceptance Test, Emergency Acoustic BOP Control System
2009-3103 EMC and environmental testing of emergency acoustic BOP control system ACS500
2012-3354 EMC Test of ACS500 Emergency BOP control system
20355 Applica report: Testing of Subsea Control Unit SCU and Subsea Transducer Unit with new connectors GISMA series 16.

Tests carried out

Applicable tests according to class guideline DNVGL-CG-0339, November 2015.

Type Test of Software was carried out. The test was according to an approved test program. After the Type Test of Software the software version nos. were registered.

Periodical assessment

For retention of this Type Approval, a DNV surveyor shall perform a periodical assessment after two years (+/- 90 days) and after 3.5 years (+/- 90 days). The objective of the periodical assessment is to verify that the conditions for the Type Approval have not been altered. (Ref DNVGL-CP-0338 Type approval scheme).

This type approval certificate replaces type approval certificate TA00000TS rev 1.

END OF CERTIFICATE

Battery safety

Topics

SECTION 1: Identification

The specification describes the technical parameters for the xxx.

The ACS500 contains a custom made Li-Ion xxx.

- **Battery name**: L14.4 (48) SCU battery
- **Part number**: 319554
- **Manufacturer**: Kongsberg Maritime AS
- **Address**: Strandpromenaden 50, 3190 Horten, Norway
- **Telephone**: +47 33 03 24 07
- **Telefax**: +47 33 04 29 87
- **Email address**: km.support.hpr@kongsberg.com
- **Website**: https://www.kongsberg.com/maritime

Note

The xxx is provided as a solid and sealed unit. It cannot be opened to reveal individual cells.

SECTION 2: Hazards identification

The battery is not provided with any hazards identification. It is not classified as dangerous or hazardous with normal use.

The battery must not be opened or burned. It contains dangerous ingredients. Exposure to the ingredients contained within the battery cells could be harmful. The battery cells include a barrier, preventing exposure to the user and environment. The battery cells are not classified as hazardous according to Regulation (EC) No. 1272/2008.

The chemicals in the battery cells are contained in a sealed enclosure. Risk of exposure occurs only if the cell is mechanically, thermally or electrically abused to the point of compromising the enclosure. If this occurs, exposure to the electrolyte solution contained within can occur by inhalation, ingestion, eye contact and skin contact. The electrolyte solution can be corrosive and may cause irritation and burns.

Other hazards

- Overcharge: If the cells that form the battery block are overcharged, the results may be a thermal runaway.
- External fire: Internal pressure and thermal runaway may be the consequences if the cells inside the battery are exposed to temperatures above 85 °C.
- Internal short circuit: Internal short circuit in a cell. Destruction of the separator can cause a short circuit between the anode and cathode. Thermal runaway and fire is possible.

- Water ingress: Internal pressure, thermal runway and chemical reactions may be the consequence.

The SCU is fitted with a pressure relief valve. The relief valve prevents overpressure. Noxious gases and ingredients will then leak out of the SCU until the chemical reactions have stopped. Products generated by the chemical reactions during an emergency may however clog this pressure release valve.

SECTION 3: Composition

The battery is a solid, manufactured article.

A battery pack consists of several individual cells that are electrically connected, both in series and parallel.

The battery packs have different number of cells and power capacity. All transponder batteries include protection against short circuits (circuit breakers) and reverse current (diodes).

The lithium metal cells have the following chemical formula:

Lithium thionyl chloride — $Li/SOCl_2$

- **Negative electrode**: Lithium
- **Positive electrode**: Carbon
- **Electrolyte**: A solution of lithium tetrachloroaluminate ($LiAlCl_4$) in thionyl chloride

Battery identification:

- **Battery name**: L14.4 (48)
- **Part number**: 319554
- **Battery weight**: 6.5 kg
- **Lithium weight**: 183 g

In case of hazardous events, the noxious gases are:

- Thionyl chloride ($SOCl_2$)
- Sulphur dioxide (SO_2)
- Hydrogen sulphide (H_2S)
- Hydrogen chloride (HCl)
- Chlorine (Cl_2)

For additional information about the cells inside the sealed battery pack, see the safety data sheet provided by the cell manufacturer.

- **Manufacturer**: Saft
- **Cell type**: LSH 20
- **Manufacturer's website**: https://www.saftbatteries.com/

SECTION 4: First aid measures

The battery will release toxic fumes if burned or exposed to fire.

If subjected to gas from a burning battery, remove the source of contamination or move yourself and any victims to fresh air. Seek medical advice.

- **Inhalation**: The chemicals are lung irritant. Avoid inhaling any vented gases. Remove the victim and yourself from exposure. Rest and keep warm. If breathing is difficult, seek emergency medical attention.
- **Skin contact**: The chemicals are skin irritant. Rinse immediately with copious amount of water and soap for at least 15 minutes. Wipe immediately away excess material with waterless hand cleaner. Remove contaminated clothing and wash it thoroughly before reuse.
- **Eye contact**: The chemicals are eye irritant. Flush immediately with copious amount of clear tepid water for at least 15 minutes.
- **Ingestion**: Exposure to the chemicals may cause tissue damage to throat and gastro/respiratory tract if swallowed. If ingested, rinse mouth and surrounding area with tepid water. Dilute by drinking plenty of water. Seek medical advice.

SECTION 5: Firefighting measures

The SCU is designed to withstand damage to the internal battery pack. Non-flammable materials are used. In case of fire, move the battery away from the fire area if you can do it without compromising your own safety. Extreme mechanical abuse to the battery may result in a ruptured seal and exposure.

1 If possible, move the battery and/or the SCU away from the fire.

2 Cool it down using lots of cold water.

   a Immerse the battery and/or the SCU in the sea for minimum 24 hours.

   b If this method is impossible, it can be cooled down with a fire hose.

Cooling down the battery with a large amount of cold water is the only way to reduce or stop the internal chemical reactions, or to limit the fire/explosions to as few battery cells as possible. The chemical reactions/fire will continue without additional supply of oxygen, so an extinguisher such as Lith-X will not work properly.

Applying water directly onto a battery may develop hydrogen gas, due to the possible electrolysis if the battery terminals are exposed to water. Mixed with air, this gas is very inflammable/explosive. However, if the water cooling takes place on deck or in a storage room with good ventilation, there will never be enough hydrogen gas to exceed the lower explosive limit of hydrogen in air (about 4 %).

Note

In case of an external fire, always remove Subsea Control Units and lithium batteries.

SECTION 6: Accidental release measures

During normal operation, accidental release measures are not applicable. Extreme mechanical abuse to the battery may result in a ruptured seal and exposure.

As an immediate precautionary measure, isolate the spill or leak area at least 25 metres (75 feet) in all directions. Keep unauthorized personnel away. Stay upwind, and keep out of low areas. Ventilate closed areas before entering. Wear adequate personal protective equipment.

Prevent material from contaminating soil and from entering sewers or waterways. Stop the leak if safe to do so. Contain the spilled liquid with dry sand or earth. Clean up the spills immediately.

Absorb spilled material with an inert absorbent (dry sand or earth). Scoop contaminated absorbent into an acceptable waste container. Collect all contaminated absorbent and dispose of it according to relevant regulations. Scrub the area with detergent and water; collect all contaminated water for proper disposal.

SECTION 7: Handling and storage

Do not open, dissemble, crush or burn the battery.

1 Do not expose the battery to water, sea water or other high-conductivity liquids.

2 Avoid mechanical or electrical abuse.

3 Do not expose the battery to temperatures outside the range of -40 °C to +80 °C.

4 Store in a dry location.

   Recommended relative air humidity is 40 to 70 %. To minimize any adverse affects on the battery performance it is recommended that it is kept at room temperature (25 °C +/- 5 °C). Elevated temperatures can result in shortened life.

5 Do not store the battery in direct sunlight.

6 Keep the battery out of reach of children.

The storage room must be properly ventilated. It must be provided with sturdy racks with dedicated cradles for the batteries, and allow for easy removal of batteries in case of fire. The room must be designated and clearly identified as a storage area, and entrance should be restricted. The room must not be used as a general rest or work area.

Note

The storage room must have a sprinkler system or a fire station. A suitable fire hose (with water) must be placed outside or in the proximity of the room.

SECTION 8: Exposure control and personal protection

Airborne exposures to hazardous substances are not expected when the battery is used for its intended purpose. No protection (respiratory, skin and/or eye) is then required. If the battery is damaged, and you are exposed to the chemicals inside, proper personal protection is required.

In the event of fire or physical damage to the battery, follow the mandatory rules for personal protection.

- **Fire or explosion**: Use a self-contained breathing apparatus.
- **Exposure to noxious gas**: Use a full-face mask with minimum BE filter and protective equipment of rubber or plastic. (*B* refers to protection against inorganic gases and *E* refers to protection against sulphur dioxide.)

SECTION 9: Physical and chemical properties

The battery pack is provided as a solid and sealed unit. No chemicals are exposed during normal use and transportation.

The battery pack is provided as a solid and sealed unit. The battery pack cannot be opened to reveal the individual cells.

For additional information about the cells inside the sealed battery pack, see the safety data sheet provided by the cell manufacturer.

Cell manufacturer

- **Manufacturer**: Saft
- **Manufacturer's website**: https://www.saftbatteries.com/

SECTION 10: Stability and reactivity

The battery is stable. No specific handling requirements apply.

In normal use, the battery pack is placed inside the sealed SCU.

Water ingress into the SCU can cause dangerous situations.

Short-circuiting, overheating, mechanical damage and exposure to water can start chemical reactions and cause high currents inside the lithium battery. This can generate noxious gases and/or cause danger of explosion. The chemical reactions will continue without additional supply of oxygen, as the battery cells contain the necessary ingredients for maintaining the chemical reactions.

1 Do not open, dissemble, crush or burn the battery.

2 Do not expose the battery to water, sea water or other high-conductivity liquids.

3 Avoid mechanical or electrical abuse.

4 Do not expose the battery to temperatures outside the range of -40 °C to +80 °C.

5 Store in a dry location.

Recommended relative air humidity is 40 to 70 %. To minimize any adverse affects on the battery performance it is recommended that it is kept at room temperature (25 °C +/- 5 °C). Elevated temperatures can result in shortened life.

6 Do not store the battery in direct sunlight.

7 Keep the battery out of reach of children.

SECTION 11: Toxicological information

Acute oral, dermal and inhalation toxicity data are not available for this battery.

Risk of irritation occurs only if the battery is abused to the point of breaking the container and opening it to reveal the individual cells. If this occurs, irritation to the skin, eyes and respiratory tract may occur.

SECTION 12: Ecological information

Provided that the battery pack is disposed of according to local regulations and/or law, it will not have any environmental impact.

SECTION 13: Disposal considerations

Dispose of the batteries in accordance with local, state and federal laws and regulations for batteries.

A lithium thionyl chloride battery does not contain any heavy metals, and is therefore not regarded as special waste (contains only biodegradable parts).

A used lithium battery can contain a significant amount of residual energy. It is the danger of explosion that presents a problem when disposing a battery. Used batteries must therefore be handled with the same care as new ones.

Note

For safe disposal, contact the nearest local company that has been approved to collect and dispose of lithium batteries.

SECTION 14: Transport information

Transportation must be performed in accordance with rules and regulations stated for transportation of dangerous goods in the applicable countries.

Certification: UN 38.3

Transport identification codes:

- **Aircraft**: IATA DGR
- **Sea transport**: IMDG
- **Railway**: RID
- **Road transport**: ADR

Original shipping boxes must be used for all transport.

Air transport of all units with new lithium batteries, and new separate lithium batteries, is only permitted on board cargo aircraft. The goods must be clearly labelled: CARGO AIRCRAFT ONLY.

The transponders with batteries or batteries must be shipped must be shipped in accordance with the prevailing national regulations.

- Separate lithium batteries
  - UN no. 3090, Class 9 Miscellaneous (Lithium batteries)
- Lithium batteries contained in equipment
  - UN no. 3091, Class 9 Miscellaneous (Lithium batteries)

Note

During transport a lithium battery must always be disconnected from the electronics.

SECTION 15: Regulatory information

Not applicable.

SECTION 16: Other information

The battery manufacturer's safety datasheet is available on their website.

Saft: http://www.saftbatteries.com/

Index

T

U

W

X