

# Rudder Limit Unit 105-320.NG001

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## Manual

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The present manual has been drawn up as a description and reference book.  
It will help answer questions and will solve problems in the quickest possible manner.

Before operating the equipment read and follow the instructions and hints in this manual.

For this purpose refer to the table of contents and read the corresponding chapters thoroughly.

If you have any further questions, please contact us on the following address:

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Since errors can hardly be avoided in the documentation in spite of all efforts, we should appreciate any remark and suggestion.  
Subject to alterations.

**CHANGE HISTORY**

Date	Change
June 2017	New Edition

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## ANNEX


Dimensional Drawing 105-320.HP005 for 105-320.NG001  
Dimensional Drawing 105-320.HP015 for 105-320.NG001 E01  
Connection Diagram 130-626.HP008

**0 General****0.1 Safety****0.1.1 Safety Regulations**


The following safety symbols are used in this manual:

<b>WARNING</b> 	Warning statements indicate a hazardous situation that, if not avoided, could result in minor, moderate or serious injury or death.
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<b>CAUTION</b> 	Caution statements indicate a hazardous situation that, if not avoided, could result in equipment damage or environmental damage.
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	Notes indicate information considered important but not hazard related.
---	---

**0.1.2 General Safety Instructions**

<b>WARNING</b> 	Requirements for steering gears and steering gear control systems are defined in SOLAS, by Classification Societies and Flag States. Please make sure that your steering gear and steering gear control system is compliant to such requirements
---	---

**WARNING**



Please note that the rudder limit function limits the available rudder angle dependent on the speed.

**WARNING**



Alert outputs must be connected to a central Alert Panel/Signal Unit. Alert Panel or Signal Unit must have an acoustic and optical alarm indication.

**WARNING**



Installation and commissioning must be performed by well-trained, qualified personnel.

**WARNING**








While connecting cables to the equipment, do not bend cables to an acute angle, pinch, twist, or impart excessive force. Cracks or damage to the cable coating can cause fire or electric shock.

**WARNING**



When establishing cable connections ensure that the cables are disconnected from any power supply. It is essential to ensure that all cables are disconnected from the power supply. If necessary, measure the voltage beforehand and/or disconnect the relevant distributor.



<p><b>WARNING</b></p> 	<p>It is essential to ensure that all connections have a common ground point on the ship. Any additional components (optional) must also be connected to the common ground point.</p>
<p><b>WARNING</b></p> 	<p>Maintenance and repair must be performed by trained and qualified personnel who are knowledgeable in equipment safety requirements.</p>
<p><b>WARNING</b></p> 	<p>Device may be damaged! Exchange of spare parts, when power is on can cause severe damage to the equipment. Exchange of spare parts only with the supply voltage switched off or disconnected.</p>
<p><b>WARNING</b></p> 	<p>Observe precautions for handling electrostatic sensitive devices.</p>
<p><b>WARNING</b></p> 	<p>Use care during maintenance and repair to avoid contact with energized electrical conductors. Applicable safety regulations must be followed, such as VDE, VBG 4, OSHA 1919, and other consensus safety standards.</p>

ESD = Electrostatic Sensitive Device

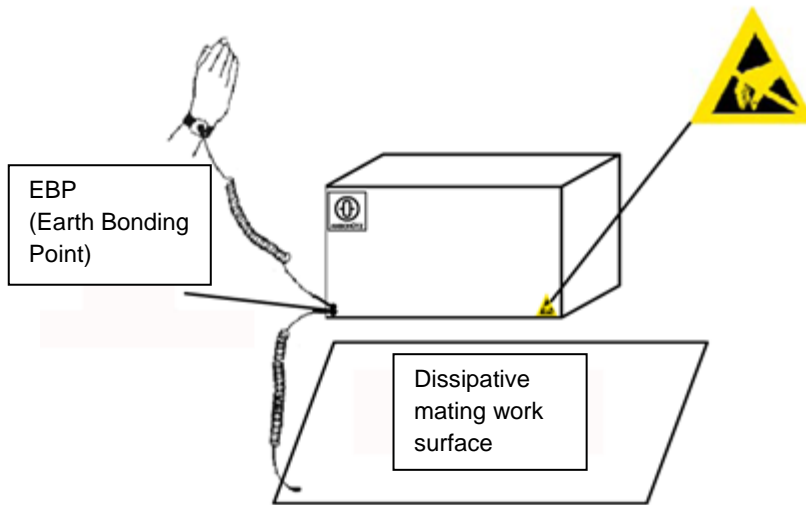


Figure 0-1 Electrostatic Sensitive Device

Devices/assemblies which are labelled as shown are electrostatic sensitive. This label indicates that handling or use of this item may result in damage from ESD if proper precautions are not taken. To perform installation and/or calibration work appropriate protective measures must be deployed. All necessary equipment for this protective measures can be supplied (on special order) with the RAYTHEON Anschütz Ident.-Number 1.990106


**1 Introduction**

Many vessels have steering gears with rudder angles above +/- 35° as described in SOLAS Chapter II, Regulation 29. The reason for that is that the steering effectiveness should be improved especially at low speeds.

However, a large rudder angle (e.g. 45° or more) may result in a high cross acceleration at high speeds which may cause danger to the ship, crew, passengers and load.

The same may apply to pod drives - the combination of propulsion and steering.

For this reason the rudder angle should be limited (e.g. to +/-35°) – dependent on the speed - in order to increase safety.

<p><b>WARNING</b></p> 	<p>Requirements for steering gears and steering gear control systems are defined in SOLAS, by Classification Societies and Flag States. Please make sure that your steering gear and steering gear control system is compliant to such requirements.</p>
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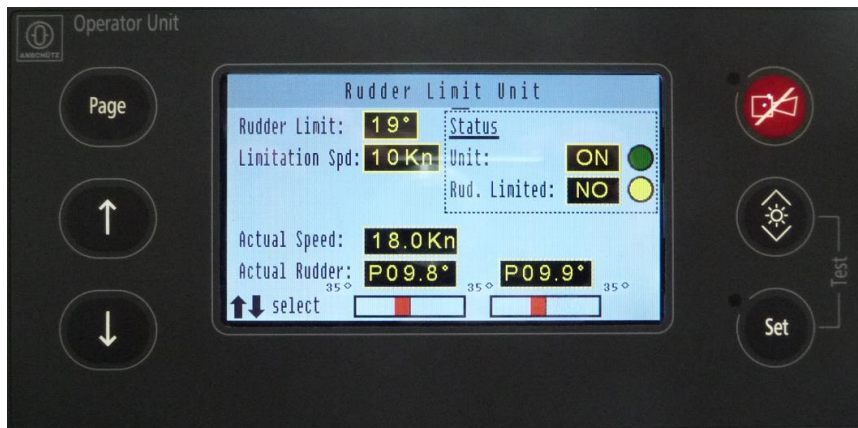


Figure 1-1 Rudder Limit Unit

## 1.1 Functional Description

The Rudder Limit Unit is supplied with actual speed, the steering mode (“NFU direct” or “Main”) and the actual rudder angle via the CAN bus of the NautoSteer AS steering gear control system.

The operator inputs the threshold for speed (which speed value should activate the rudder limit function) and the rudder limit angle (value to which the rudder angle should be limited).

The rudder angle is limited, if the vessel reaches or exceeds the threshold for speed.

The rudder limit function can be used in both independent control systems of NautoSteer AS, the “NFU direct” and the “Main” mode. Please note that this function in “NFU direct” mode requires modifications in the “NFU direct” path of the control system and thus it is project specific.

The Rudder Limit Unit provides also a “rudder return” function that can be configured during the commissioning phase. This function returns the rudder to the rudder limit angle (if the rudder is above the rudder limit angle) when the vessel reaches or exceeds the threshold for speed. This function is only available in “Main” mode.

## 1.2 Technical Data

For dimensions, weight and type of enclosure, see appended Dimensional Drawing 105-320.HP005.




Supply Voltage: 24 V DC  
18 V DC to 32 V DC

Ambient temperature: -25 °C to +55 °C

Current consumption: Approx. 250 mA

## 2

## Operation

<p><b>WARNING</b></p> 	<p>Please note that the rudder limit function limits the available rudder angle dependent on the speed.</p>
<p><b>WARNING</b></p> 	<p>Please make yourself familiar when using the rudder limit function. The availability of some functions (rudder limit function in “NFU direct” mode, rudder return function and override) are project specific.</p>
<p><b>WARNING</b></p> 	<p>Please note that the rudder will not be limited in case of failures, such as missing speed or a system failure.</p>

## 2.1 Operation of the Rudder Limit Unit



Figure 2-1 Operating elements

The Rudder Limit Unit provides the following operation elements:

“Page” button

Returns the user interface to the main view

“Arrow-up” and “Arrow-down”

Allows to toggle between the different input fields

Allows to alter the values in the input fields

“Set” button

Activates the input fields for data alteration

Sets / confirms the altered values

“Dim” button

Adjustment of the brightness of the display

“Alert” button

For indication and acknowledgements of alerts

**2.2 Information Provided on the Rudder Limit Unit and Required User Inputs**



Figure 2-2 Information provided and required user inputs

“Rudder Limit” (user input)

This value describes to which angle the rudder is limited when the vessel reaches or exceeds the threshold for speed (the “Limitation Spd”). The rudder will be returned this rudder angle if the “rudder return” function is activated (only possible in the commissioning phase) and the rudder is above the rudder limit angle and the vessel reaches or exceeds the threshold for speed (the “Limitation Spd”).

“Limitation Spd” (user input)

This value defines the threshold for speed. When the vessel reaches or exceeds this threshold for speed then the rudder angle is limited or returned (if configured) to the “Rudder Limit” angle.

Status field “Unit” (user input)

This field is used to activate or de-activate the rudder limit function. “ON” means activated and “OFF” means de-activated. The color of the circle has the following meaning:  
no color: Rudder limit function switched off  
green: Rudder limit function switched on

Status field “Rud. Limited”

This field displays if the rudder angle is limited or not. “NO” means that the full rudder angle is available. “YES” means that only the rudder angle is available as defined in “Rudder Limit”. The color of the circle has the following meaning:  
no color: Rudder limit function switched off  
yellow: “Rudder Angle Limited” - the limited rudder angle is available for steering control  
orange: Warning that the actual rudder is on or above the limit and the rudder angle cannot be further increased but only decreased.

“Actual Speed”

This field displays the actual speed of the vessel.

#### “Actual Rudder”

This field displays the actual rudder of the vessel. It is displayed as a numerical value, together with a P (for port-direction) or a S (for starboard direction). In addition the rudder angle is displayed graphically. The Rudder Limit Unit can display up to two rudders.

### 2.3 Indications, Alerts and their Meaning



Figure 2-3 Alerts are presented at the message bar of the Rudder Limit Unit

#### “Rudder Angle Limited”

The limited rudder angle is available for steering control.

This caution appears for 10 seconds, when the limitation speed (“Limitation Spd.”) has been reached or exceeded. After the 10 seconds this status is indicated by a yellow circle behind “Rud. Limited”.

#### “Rudder Angle on Limit”

The actual rudder is on the limit and the rudder angle cannot be further increased but only decreased.

This warning is also indicated by “Rud. Limited” = “Yes” and an orange circle.

#### “Actual Rudder above Rudder Limit”

This warning occurs if rudder angle and speed are above the values of “Rudder Limit” and “Limitation Spd”. This warning is only available if the Rudder Return function has not been activated during the commissioning phase. This warning is escalated after 60s into a warning, if not acknowledged.

#### “Rudder Returned to Limit”

The rudder is returned to the “Rudder Limit” value (only available if the Rudder Return function has been activated during the commissioning phase).

This warning occurs if rudder angle and speed are above the values of “Rudder Limit” and “Limitation Spd”.





In order to avoid any toggle conditions of the rudder limit functions the following hysteresis have been implemented:  
For speed 0.5kn (e.g. for “Limitation Spd” of 10kn):  
activation of the “Rudder Angle Limited” caution at 10kn, deactivation at 9.5kn.  
For rudder angle 0.5° and 1° (e.g. for “Rudder Limit” of 30°).  
activation of the “Rudder Angle on Limit” warning at 30°  
activation of the “Rudder Angle above Rudder Limit” warning at 31°

#### “Speed Error”

This warning occurs, if the speed input is not available or invalid.

System response: The maximum rudder angle is available in case of a Speed Error.

#### “Rudder Angle Failure”

This warning occurs, if the rudder angle input is not available or invalid.

System response: The maximum rudder angle is available in case of a Rudder Angle Failure

#### System Failure

This warning occurs, if the rudder limit function is not available.

System response: The maximum rudder angle is available in case of a System Failure

#### “CAN Communication”

This warning occurs, if the CAN bus communication is disturbed.

System response: The maximum rudder angle is available in case of a CAN Communication failure

#### “Steering Mode Failure”

This warning occurs, if the steering mode is not available or invalid.

System response: The maximum rudder angle is available in case of a Steering Mode Failure.

## 2.4 Rudder Limit and Override

Some classification societies require an Autopilot override or a “general override”.

Override with NFU bustiller or FU bustiller

During the commissioning phase it can be configured if the rudder angle is also limited during override or if the maximum rudder angle is available for override

Override with NFU-direct tiller

The rudder limit function for „NFU-direct” tiller is project specific as mentioned above. If the system has been designed for the rudder limit function in “NFU direct” mode then it can be configured during the commissioning phase if the rudder angle is also limited during override or if the maximum rudder angle is available for override.

## 2.5 Rudder Return Function

The Rudder Limit Unit provides a “rudder return” function that can be configured during the commissioning phase. This function returns the rudder to the rudder limit angle (if the rudder is above the rudder limit angle), when the vessel reaches or exceeds the threshold for speed.


Please note that this function is only available in “Main” steering mode.

## 2.6 Dimming and Day & Night Mode

The “Dim” button can be used in order to adjust the brightness of the display.

To toggle between Day & Night mode activate the “Set” button and the “Dim” button one after the other.

## 2.7 Test of the Rudder Limit Unit

<p><b>WARNING</b></p> 	<p>No alert can be displayed while the test function is performed.</p>
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This test should be performed in case of a failure assumption concerning the display, the LEDs the horn or the pushbuttons.

By pressing the pushbuttons “DIM” and “SET” simultaneously a display, LED and pushbutton function test is performed.

The test starts by displaying different display colors and an acoustical signal (horn). It is to check if there are missing pixels and if the acoustical signal is clear.

The last color is white and additionally the software version is displayed.

Simultaneously the LEDs "SET" and "Alarm" are alight constant, the LED "Alarm" in colors red and green, the LED "SET" in yellow only. It is to check if the LEDs light up.

After this test the pushbutton test is performed. The operator is requested to press a pushbutton within a defined time (time bar). It is to check the function of a pushbutton.

After the test is successful finished, the initial display is shown again.

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### **3 Installation, Connection and Configuration**

#### **3.1 General Information**

The rudder limit function can be used in both independent control systems of NautoSteer AS, the “NFU direct” and the “Main” mode.

Please note that the rudder limit function in “NFU direct” mode requires project specific engineering / project specific connection diagrams.

In “Main” mode the rudder limitation is done via the Follow-up Amplifiers. This function is available, starting with the following software versions:

FU-Amplifier AS, type 139-158.NG001 E01

Software: 139-158.P0001 E01.15 (for version with OLED display)

Software: 139-158.P0001 E02.15 (version without OLED display)

FU-Amplifier AS, type 139-158.NG002 E01

Software: 139-158.P0002 E01.15 (for version with OLED display)

Software: 139-158.P0002 E02.15 (version without OLED display)

FU-Amplifier Proportional AS, type 139-159.NG00x

Software: 139-159.P0001 E00.06

For the configuration of the rudder limit function the Configuration Tool AS is required. This function is available, starting with the following software version: NB42-232.P0001 E00.16


#### **3.2 Required Data**


The Rudder Limit Unit requires the actual rudder and speed. Both are input via the CAN bus of NautoSteer AS to the Rudder Limit Unit.


The actual rudder is sent from the Feedback Unit AS via the Follow-up Amplifiers to the CAN bus.


The speed (through water) needs to be input e.g via the Alarm Status Interface AS to the CAN bus.


### 3.3 Installation and Safety Hints

<p><b>WARNING</b></p> 	<p>Installation and commissioning must be performed by well-trained, qualified personnel.</p>
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<p><b>WARNING</b></p> 	<p>Observe the distance to magnetic compass when mounting place is defined.</p>
---	---

<p><b>WARNING</b></p> 	<p>When establishing cable connections ensure that the cables are disconnected from any power supply. It is essential to ensure that all cables are disconnected from the power supply. If necessary, measure the voltage beforehand and/or disconnect the relevant distributor.</p>
---	--

<p><b>WARNING</b></p> 	<p>While connecting cables to the equipment, do not bend cables to an acute angle, pinch, twist, or affect excessive force. Cracks or damage to the cable coating can cause fire or electric shock.</p>
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<p><b>WARNING</b></p> 	<p>Observe precautions for handling electrostatic sensitive devices (ESD).</p>
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### 3.3.1 Installation

The installation of the Rudder Limit Unit is performed according to appended Dimensional Drawing 105-320.HP005.

Voltage supply must be performed according the following sections.



Do not forget to connect the earthing flat plug at the backside of the housing.

### 3.3.2 Connections

**WARNING**

When applying the supply voltage (24 V DC), the Rudder Limit Unit Indicator is set into operation.  
There is no separate power switch.

**WARNING**

The shielding clamp should not be used to clamp the connected cables mechanically.  
The cables have to be clamped separately.

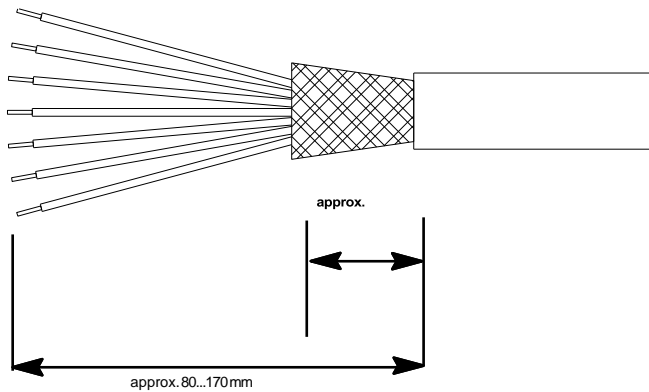


Figure 3-1 Requirements for stripping the connecting cable

1. Strip the cable over a length of approximately 80 to 170 mm (see Figure 4-1).  
Be careful not to damage the screening.  
Please note:  
The cable length to strip off must be adapted to the length between the clamp and the terminals.
2. Trim the screening until approximately 15 mm is on the cable.
3. Insert the cable ends into the terminal strip and tighten the terminal screws.
4. Clamp the cable shield by fastening the suitable shielding clamp in the slits of the bent mounting plate. The shielding clamp is available in three sizes.



Shrinking sleeves must be used.  
However, do not strip the shrinking sleeves over the screening.



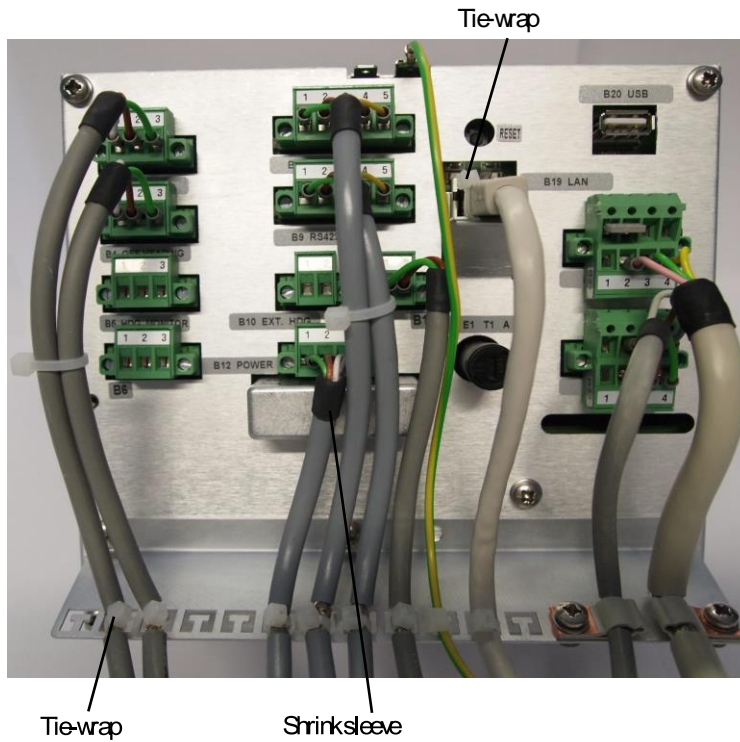



Figure 3-2 Example for a proper cable connection



It is recommended to fasten the connected cables with tie-wraps to the housing of the Course to Steer Indicator (shown in Figure 3-2).

### 3.3.3 Connecting the Supply Voltage at Plug B9

<p><b>WARNING</b></p> 	<p>By applying the 24 V DC supply voltage, the Rudder Limit Unit is set into operation. There is no separate power switch. When establishing cable connections, ensure that the cables are disconnected from any power supply.</p> <p>It is essential to ensure that all cables are disconnected from the power supply, if necessary measure the voltage beforehand and/or disconnect the relevant distributor.</p>
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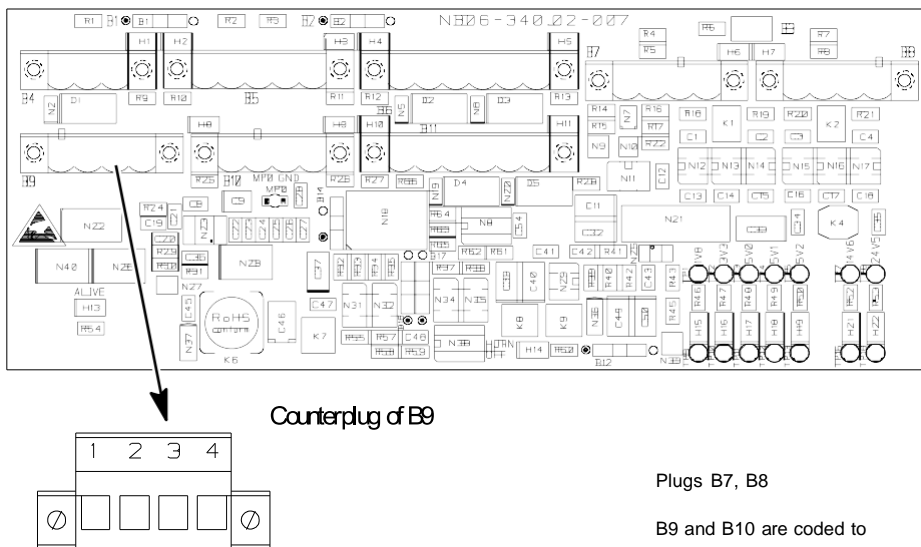
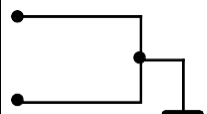


Figure 3-3 Connecting the Supply Voltage at Plug B9

Plug/terminal	Remarks	
B9/1		+24 V DC Power
B9/2		
B9/3		GND
B9/4		

3.3.4 Connect CAN-Bus at Plugs B7 and B8

<b>i</b>	The CAN bus address needs to be set during commissioning.
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<b>i</b>	The termination of the CAN-Bus depends on its application within a NautoSteer AS steering gear control system.
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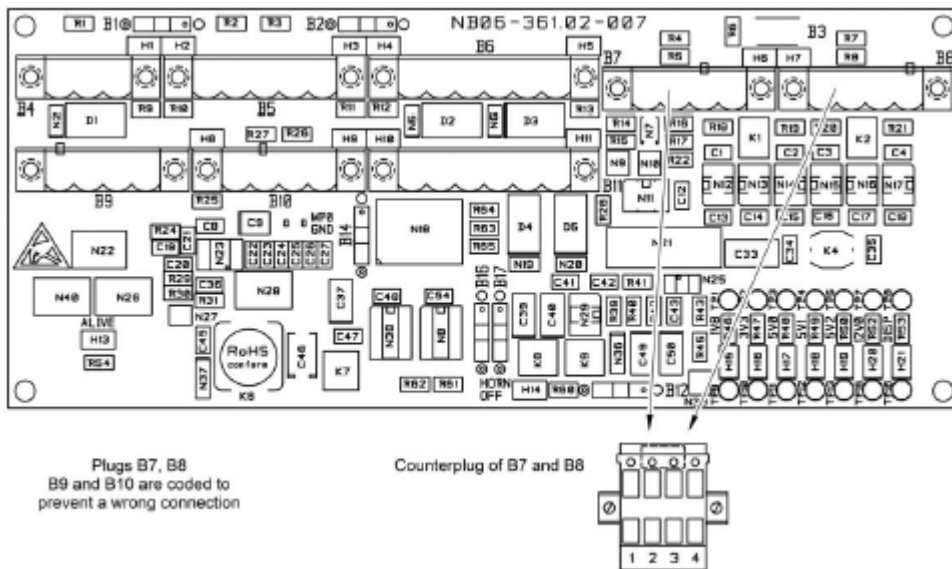



Figure 3-4 Connect CAN-Bus at plugs B7 and B8

Plug/terminal	Remarks
B7/1 B8/1	CAN Termination (jumper between terminal 1 and 2)
B7/2 B8/2	CAN Low (L)
B7/3 B8/3	CAN High (H)
B7/4 B8/4	CAN Ground

### 3.3.5 Connecting the Status Output “SYSTEM FAILURE” at Plug B4

<p><b>WARNING</b></p> 	<p>Alert outputs must be connected to a central Alert Panel/Signal Unit. Alert Panel or Signal Unit must have an acoustic and optical alarm indication.</p>
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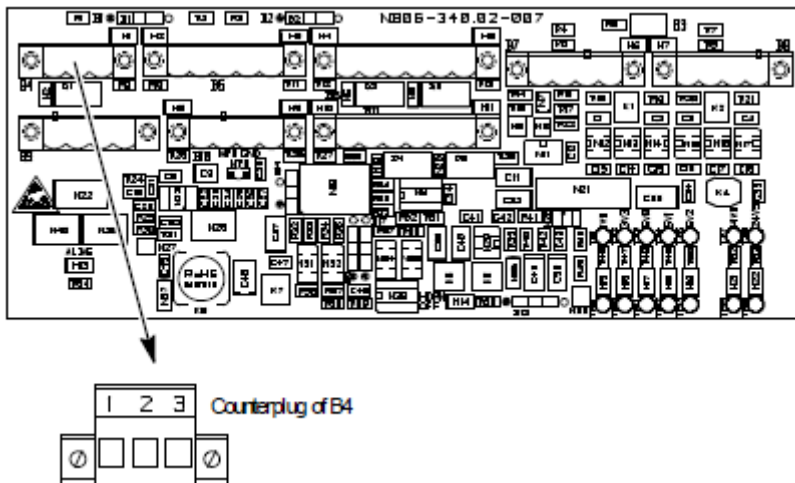
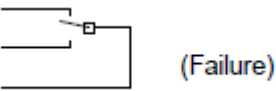



Figure 3-5 Connecting the status output „SYSTEM FAILURE“ at plug B4

Plug/terminal	Remarks
B4/1	
B4/3	
B4/2	

3.3.6 Connecting the relay switching outputs 1 to 4 at plugs B6 and B11

<p><b>WARNING</b></p> 	<p>The use of the relay switching outputs is project specific. Please refer to the project specific drawings.</p>
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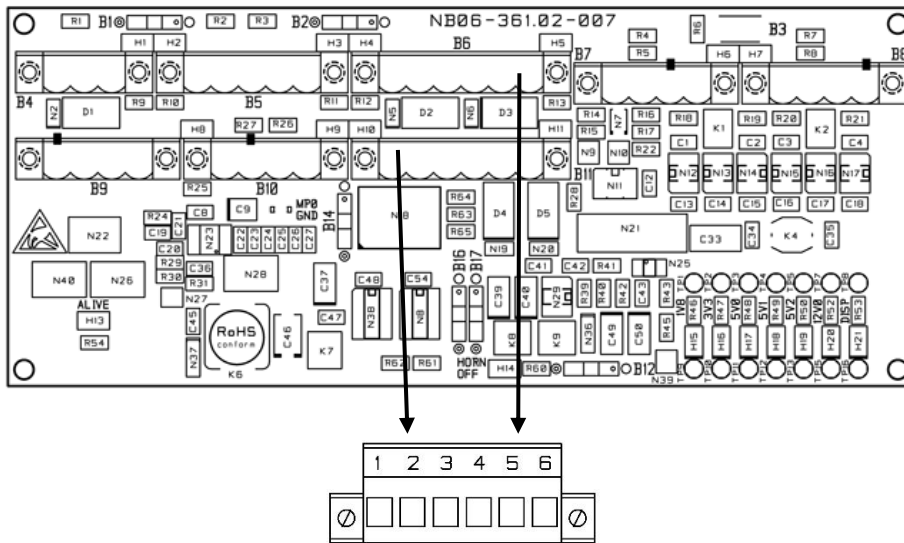
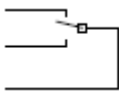
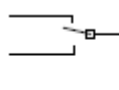


Figure 3-6 Connecting the relay switching outputs 1-4 at plugs B6 and B11

Plug/terminal	Remarks
B6/1 B11/1	 <p>B6 = Output 1 B11 = Output 3</p>
B6/3 B11/3	
B6/2 B11/2	
B6/4 B11/4	 <p>B6 = Output 2 B11 = Output 4</p>
B6/6 B11/6	
B6/5 B11/5	

### 3.4 Configuration and Adjustments



The Configuration Tool AS is necessary to configure the Rudder Limit Unit.  
The use of this Service Tool is allowed only for RAYTHEON Anschütz service personnel.

The following adjustments/configurations can be made with the Configuration Tool AS:

1. Address within a CAN Bus architecture (application)
2. System data (operating time, type number, serial number, software version)
3. Rudder Limit enabled/disabled (Rudder limit function can also be switched on and off at the Rudder Limit Unit)
4. Rudder Limit [deg] (can also be set at the Rudder Limit Unit)
5. Limitation Speed [kn]: Defines the threshold for speed (can also be set at the Rudder Limit Unit)  
Rudder Scale [deg]: Defines the scaling of the graphical actual rudder indication at the Rudder Limit Unit
6. Rudder return disabled: The return function is switched off, when the checkbox is activated
7. No Limit While NFU direct: The rudder angle is not limited in NFU-direct steering mode, when the checkbox is activated
8. No Limit While Override: The rudder angle is not limited in Override, when the checkbox is activated

## **4 Maintenance, Fault Finding and Repair**

### **4.1 Maintenance**

On a 3 month basis:

The function test according to section 2.7 should be performed.

On a 12 month basis:

Check cables for proper connections.

### **4.2 Repair**

A repair of the Rudder Limit Unit is possible at manufacturer's facility only. The Rudder Limit Unit has to be replaced completely.

The Rudder Limit Unit must be checked for proper function after replacement.

Intentionally left blank



**5 Disposal**

The Rudder Limit Unit or components of it can be disposed according to the respective national regulations for electronic waste without harmful material (according to 2002/96 EC WEEE - disposal for Waste Electrical and Electronic Equipment).