SPT-115 Pan-Tilt User Manual

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Table of Contents

1. Introduction

Thank you for purchasing this Actuade product.

This User Manual contains safety instruction and necessary information for the use and operation of SPT-115-R Pan-Tilt Unit manufactured by Actuade AS.

The purpose of this document is to provide information and instruction to guide and assist operators in the proper installation, use and maintenance of the unit.

If in doubt, we strongly recommend that you contact Actuade AS.

Your feedback and experiences are important to us. Please send suggestions and comments about the product or documentation to:

Actuade AS
Wessels veg 2
7502 Stjørdal
Norway

Phone: +47 74 60 38 20
E-Mail: post@actuade.no
WEB: www.actuade.no

For unit repair related issues please contact: service@actuade.no

1.1. Notation used in this manual

The following notations have been used in this manual:

Bold is used for commands and menu selection.

Italic is used to give emphasis to information. It is also used for names of documents referred to in this manual.

Symbols	Meaning
DANGER	Indicates an imminent hazardous situation. If this is not avoided, death or serious injury to personnel could occur.
WARNING	Warning is used to draw attention to information of very high importance, for example to avoid injuries to personnel.
ATTENTION	Indicates a possible hazard. Care should be taken or slight or minor injury may result if you do not follow the instructions.
ADVICE	Describes a possibly harmful situation. Care should be taken to avoid damage to the system and surroundings.
NOTE	Note is used to draw attention to important or helpful information.
	Warning of a general hazard. The type of hazard is determined by the specific warning text.
	Warning of dangerous electrical voltage and its effects.
	Warning of Electric, magnetic and electromagnetic fields.
	Entanglement hazard symbol.
	Precautions when handling electrostatic sensitive components.

1.2. Warranty

Actuade AS warrants that all products of its own manufacture conform to Actuade specifications and are free from defects in material, design and workmanship when used under normal operating conditions.

The obligation of Actuade hereunder shall expire one (1) year after delivery to customer/user and is limited to repair or replacement of components that prove to be defective during the warranty period.

Actuade must be notified in writing of the defect or nonconformity within the warranty period. Shipment shall not be made without prior authorization by Actuade AS.

1.3. Disclaimer and Copyright

No responsibility is assumed with respect to patents or other rights of third parties with respect to descriptions in this manual.

Figures and illustration in this user manual are provided for reference only and may differ from the actual product appearance.

The contents of this manual are subject to change without notice.

All efforts have been made to ensure the accuracy of the contents of this manual.

The above notwithstanding, Actuade AS can assume no responsibility for any errors in this manual or their consequences.

1.4. Terms and Abbreviations

Term or abbreviation	Definition
ESD	Electrostatic discharge
EMC	Electromagnetic Compatibility
GND	Ground
NC	Not Connected
ROV	Remote Operated Vehicle
SPA	Subsea Pan unit
SPT	Subsea Pan Tilt unit
VDC	Voltage Direct Current

1.5. Declaration of Conformity

The product conforms to the EC Machinery Directive (2006/42/EG), Low Voltage Directive (2006/95/EC) and EMC guidelines (2014/30/EU).

1.6. Part number coding

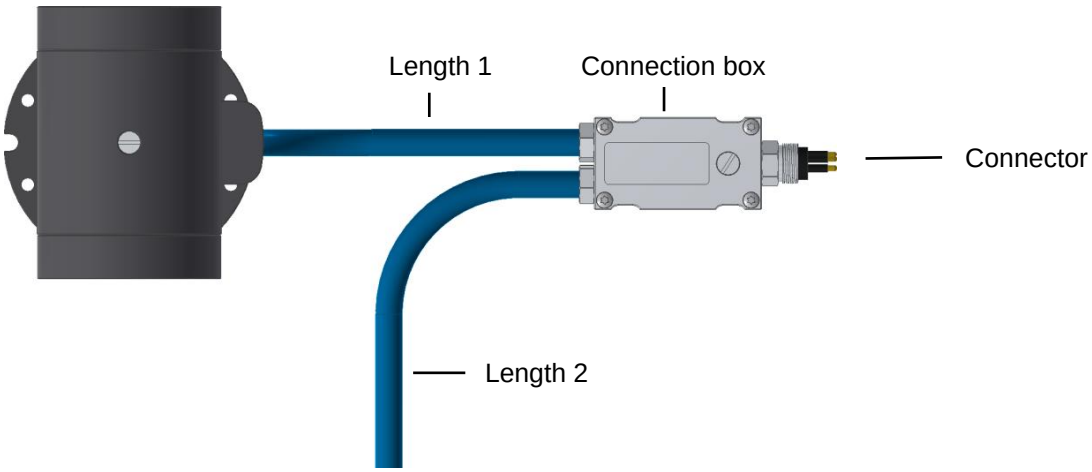
SPT-115 Pan/Tilt

SPA-115 Pan

	Type:	Housing/Torque	Interface	Length 1	Length 2	Connector
Unit:	**SPT**	**115**	**1**	**1.2 m**	**1.5 m**	****
Pan/Tilt Pan	**SPT** **SPA**	**1xx** Aluminum **2xx** 316 Steel **3xx** Titanium **x15** Nm nom. torque	**1** RS-232 **2** RS-485 **3** Analog	Please specify length	Please specify length	Please specify type, if you want to use another connector

** Seacon, Micro Wet-Con MC-HB-5M as standard

Ordering detail for Pan/Tilt Unit: SPT-115 / 1 / 1.2m / 1.5m / MC-HB-5M



Units without connection box can also be delivered.
In this case the unit has to be connected directly to ROV`s internal oil filled control canister.

2. Safety Instruction

This chapter includes safety information that the user needs to know in order to operate the equipment without doing harm to personnel or the environment.

Please read the Safety Instructions and make sure you understand them before using the unit.

Installation, operation and maintenance must be followed in accordance with the instruction described in this manual.

We recommend the unit to be returned to Actuade for service and repair. Opening and repair by your own will void warranty and you can be exposed to dangerous voltages and other risks.

Do not use the unit when you suspect water intrusion or does not respond normally of user commands. Please contact Actuade for help.

2.1. Health and environment

The unit is filled with **Shell S3M22** hydraulic oil to withstand the high pressure when used under water.

Health & Safety
Guidance on Health and Safety are available on the appropriate Material Safety Data Sheet, which can be obtained from: http://www.epc.shell.com/

Protect the environment
Take used oil to an authorized collection point. Do not discharge into drains, soil or water.

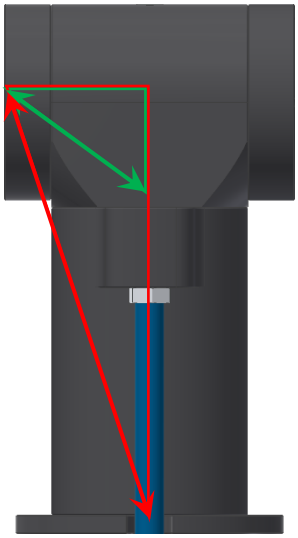
3. Unit Description

Our Pan-Tilt unit are designed for subsea use in typical areas of application for remote handling of cameras, lights and tools on ROVs and other subsea equipment.

We have increased these rugged unit with additional bearings to avoid damage on the shafts when the unit on the ROV is accidentally hit from a manipulation arm or shacked in thruster noise.

Key features:

- Compact unit with integrated stepper motor, low backlash harmonic drive and rugged bearings.
- Absolute position feedback gives you the exact position of the unit at startup or after power cycling.
- Easy to attach heavy payloads without compromising with absolute accuracy.
- Withstands high axial and radial forces as well as high tilting moments.
- The unit is connected to an external compensator device.
- No rotating connector at the unit housing.
- Operating depth: down to 6000m.
- ±175° scan range on both axis.



Our unique design make the unit more robust and have increased the torque stiffness to a new level.

The length of the lever arm is very important as torque is defined as the cross product of the lever-arm distance vector and the force vector.

For these rugged unit the lever arm (green) is reduced to less than 1/3 compared to existing units on the marked (red).

3.1. Handling of unit

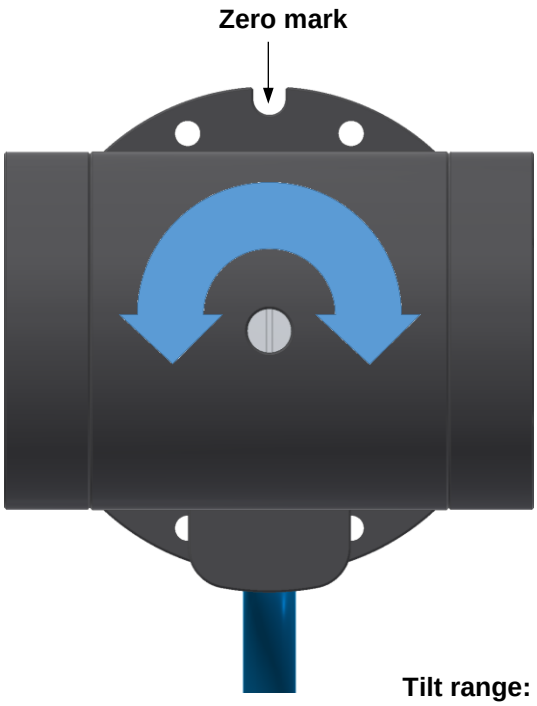
The unit contains precision mechanical and electronic components. To ensure that the unit is working correctly:

- Do not subject the unit to impact or shock.
- Avoid fast temperature changes.
- Do not expose the unit to direct sun or other strong light sources.
- Run the unit for longer periods only immersed in water.
- Flush the unit with fresh water after use in sea water.
- Keep the unit in a dry environment when not used.
- Do not scratch hard objects against the unit surface.

Follow instruction below for installation, operation and maintenance.

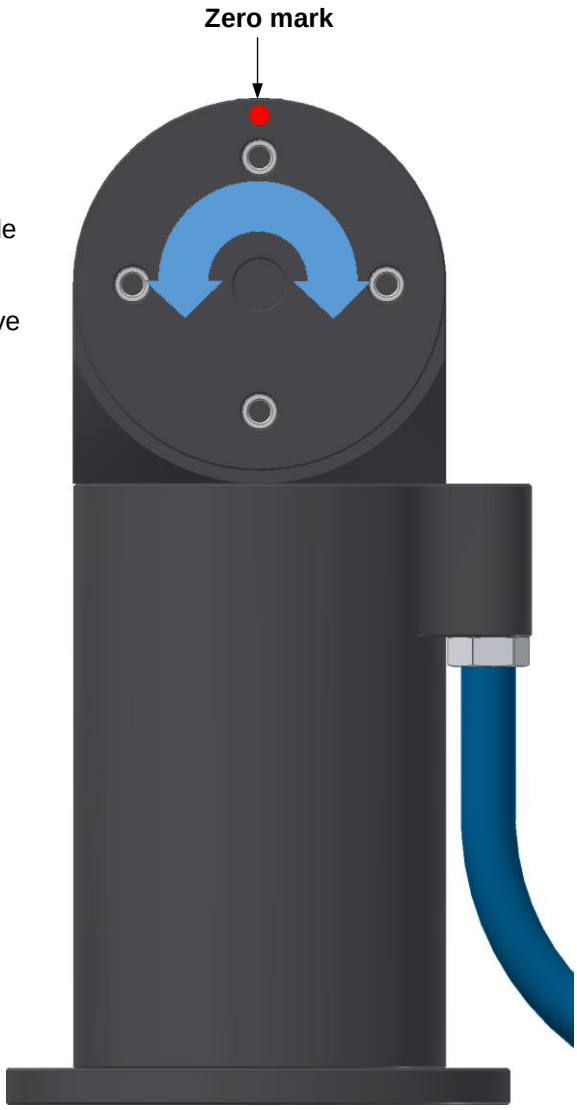
3.2. Pan – Tilt range

The unit as shown in the pictures below are in the **zero position** on both pan and tilt axis.



Pan range: ± 175°
Clockwise -> positive
Counterclockwise -> negative

Tilt range: ± 175° (for single sided yoke)
Clockwise -> positive
Counterclockwise -> negative



ADVICE	With a dual sided yoke the tilt range is depending on yoke and added payload.

You can set the pan and tilt range limits from the software user interface.

Se appendix 9.2.2 Commands, Position End Stops.

Factory defaults settings can always be restored.

4. Installation

ADVICE	Before use, the unit must be connected to a compensator and to be oil filled. **If you run the unit without oil, the gear will be damaged.**

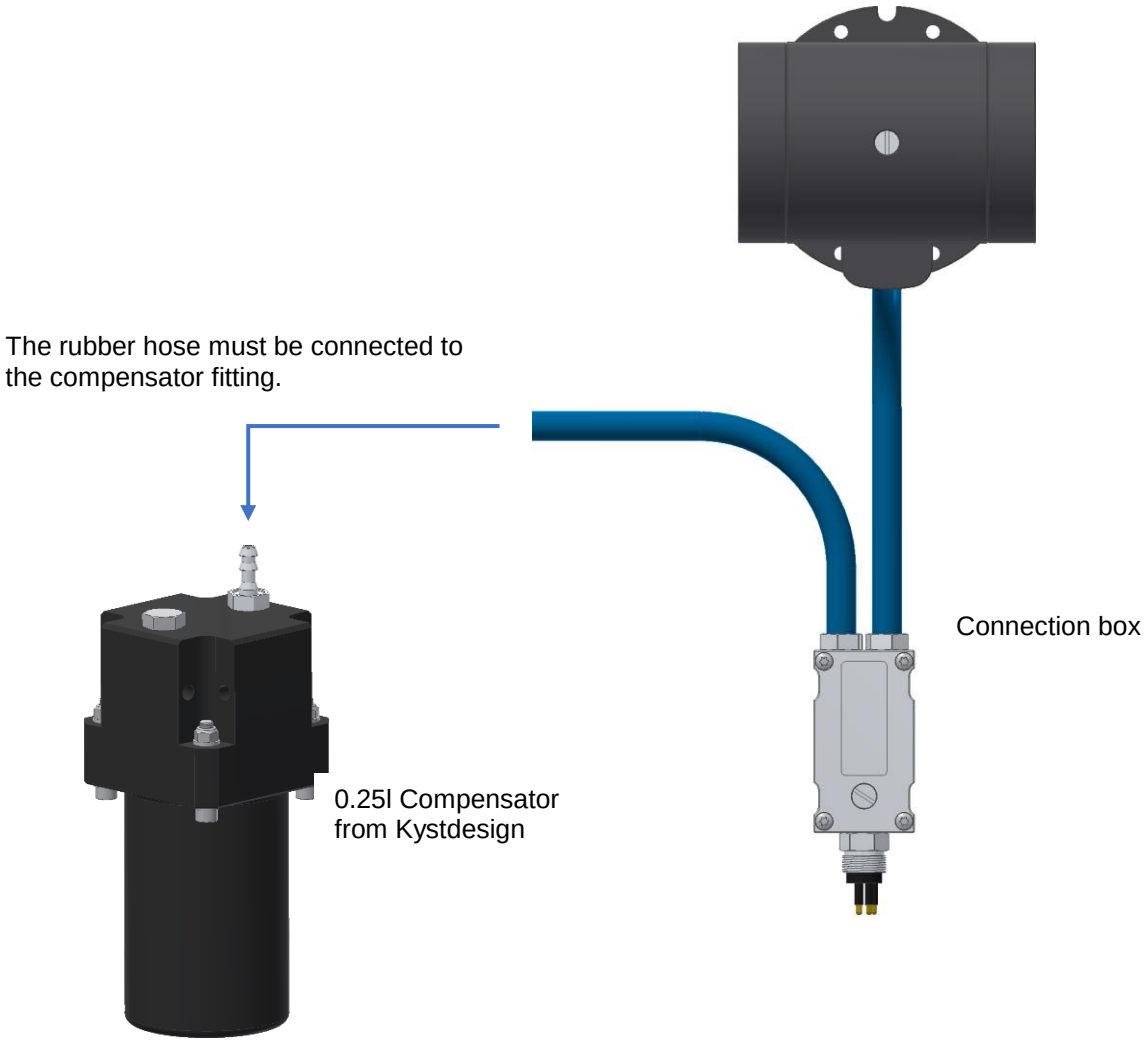
The unit must be connected to the pressure compensator and filled with **Shell S3M22** hydraulic oil before use.

The warranty becomes void when other lubricants that have not been recommended by Actuade AS are used.

Attach yoke and equipment after oil filling.

4.1. Connect to compensator

We recommend to use a compensator from Kystdesign with a volume of 0.25 liter for the SPT-115-R unit.
More information can be found here: http://kystdesign.no/hydraulics/compensators/



Push the hose completely on to the compensator fitting.

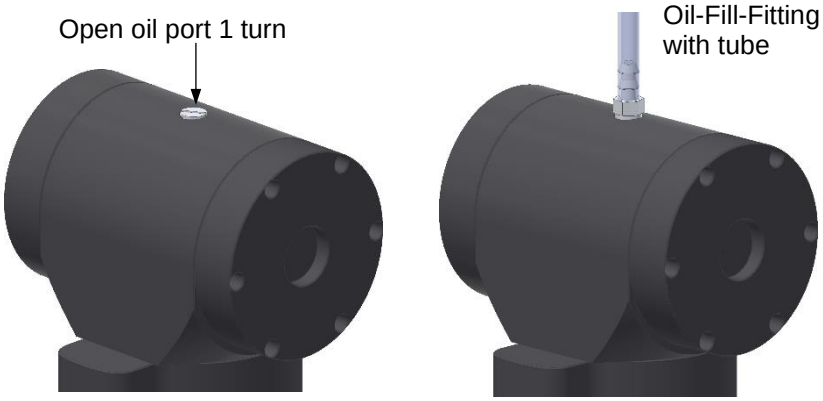
4.2. Ventilation ports

On the unit there are 4 ports (marked with red) for ventilation of entrapped air.

The positions are: top, bottom, side and connection box.

This makes it possible to vent the unit in almost any position.

Open the highest port "**1 turn"**
or
Remove the port and attach the Oil-Fill-Fitting with a tube to avoid spillover oil pollute the unit.



Pressurize the compensator and fill unit.

Flush the unit completely with **Shell S3M22** hydraulic oil.

After oil filling screw the vent port in again.

Check the unit for oil leakage.

When you remove the oil port screw check that the O-ring is located correct in the groove.

If you remove the O-ring, attach silicone grease on the O-ring before mounting.

The silicone grease will help to hold the O-ring in the groove.

4.3. Attach yoke and equipment

The yoke is mounted to the unit with 4 M6 screws.
On the opposite side there is a hole of Ø25mm and 6mm deep for support of the dual sided yoke.
For details see also chapter 9.4 Yoke Dimensions.

ADVICE	With a dual sided yoke the tilt range is depending on yoke and added payload.

Before you use the unit, check the tilt range with the attached equipment.

You can set the tilt range limit from the software user interface.
See chapter 5. Operation.

Picture shows the unit with mounted yoke, camera and lights.
You can also see the isolated pedestal between unit and ROV.

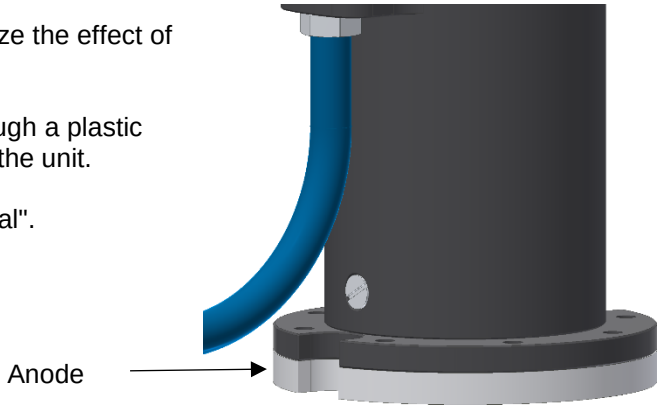
4.4. Protect the unit against corrosion

ADVICE	Ground leakage currents on the ROV must be avoided. This can destroy the unit in short time.

The unit is made of hard anodized aluminum to minimize the effect of corrosion.

You can completely isolate the unit from the ROV through a plastic holder or attach an aluminum or zinc-anode to protect the unit.

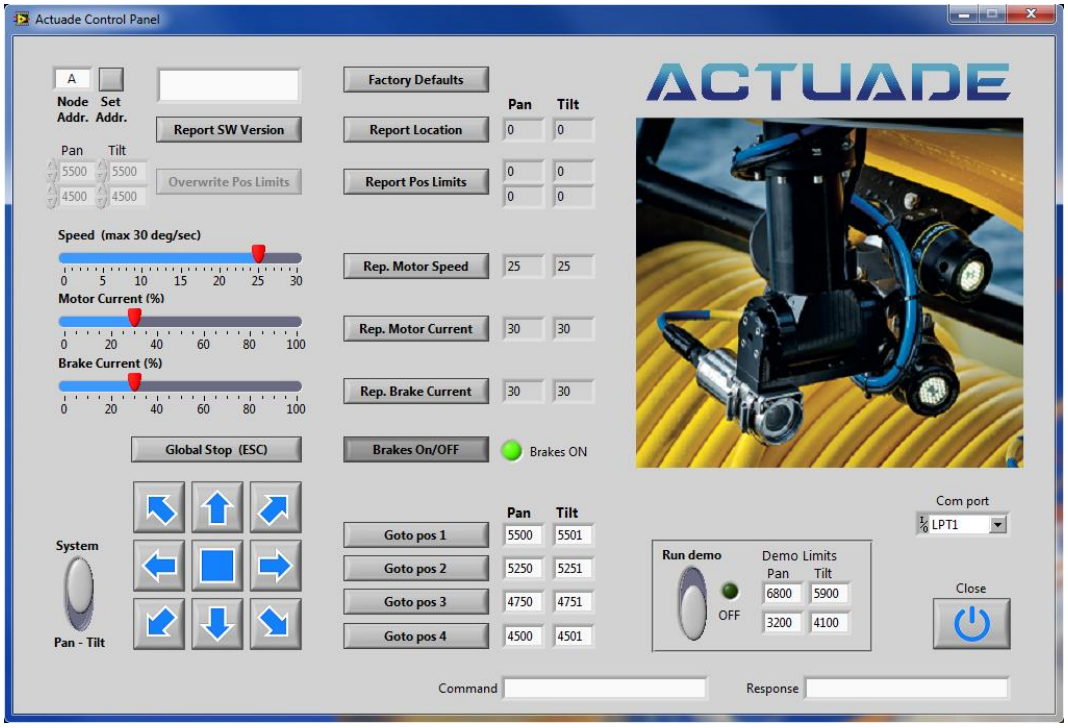
The anode will corrode as it acts as the "sacrificial metal".



5. Operation

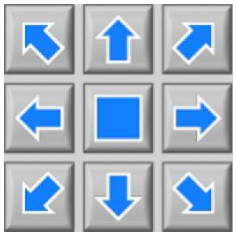
5.1. Actuade Control Panel

The Actuade Control Panel software is supplied with each unit to allow remote control from a PC.
You can easily send commands, set parameters and get feedback from the unit.



To run the software you have to install a Runtime Engine on you PC first.
Default parameters can be set in the ini-file.

You can change speed, motor or brake current if necessary by clicking into the respective slider.



Klick on the arrow buttons. The unit will move until you release the mouse-button.

The central button will move the unit to the home position.

With the "**Run Demo**" on, the unit will run randomly with both axis until you stop it again. Demo limits can be set to reduce movements.

If you have to stop the unit when moving you can klick "**Global Stop**" or press **ESC** button on your PC.

6. Maintenance

Flush the unit with fresh water after use in sea water.

Check the anode for corrosion. Change it, if the sacrificial has started and erosion is well visible.

Inspect the unit for damages on the anodized surface. If the damage is severe, base metal may be exposed to sea water and corrosion set in. Contact Actuade for evaluation and service options.

Inspect cables and connector for wear or damages.

Inspect the unit after each survey for oil leakage and other damages.

Check also the compensator fluid level for correct range. Refill oil if necessary.

NOTE	If the compensator oil level is too low, this may lead of entering sea water into the unit.

If in doubt, we strong recommend that you contact Actuade, giving the type designation and serial number for clarification.

6.1. Oil change

The unit contains precision mechanical gear which needs lubrication to work properly.

ADVICE	**The first oil change is necessary after 100 hours of operation.** Subsequent oil change intervals depend on the operating conditions, but should take place at intervals of approximately 1000 running hours.

NOTE	To change the oil, the used oil must be drained completely and fresh oil must be filled in. The mixture of lubricants of different specifications should generally be avoided.

The warranty becomes void when recommended lubrication not have not been performed.

7. Service / Repair

For troubleshooting, please contact: service@actuade.no

In the event that warranty service is required, Actuade AS must be notified in writing of the defect or nonconformity within the warranty period.

If in doubt, we strong recommend that you contact Actuade AS, giving the type designation and serial number for clarification.

Shipment shall not be made without prior authorization by Actuade AS.

Actuade does not recommend opening the unit as there are no user serviceable parts inside.
Only qualified service personal should perform servicing.

WARNING	Opening the unit exposes you to dangerous voltages. Opening and incorrect servicing will void the warranty.
	The gear assembly must be carried out very carefully and within a clean environment. Wrong assembly can permanent damage the gear.
	Incorrect assembly may cause electric shock and failure to the unit. Ground leakage currents can damage the unit.
	Electric, magnetic and electromagnetic fields are dangerous, in particular for persons with pacemakers, implants or similar.
	Electrostatic sensitive components are used and may be damaged if incorrect handled.

7.1. Damages on anodized surface

Fix damages to the anodized surface as soon as possible, and before corrosion takes place.

The best way to do this is to clean the surface and then attach a layer of nail lacquer.

8. Specifications

Electrical:

Input Voltage	24 VDC
Drive Current	300mA – 2.0 A each axis
Communication	RS-485, RS-232 or Analog
Connector	Customer selectable

Mechanical:

Angular Limits	Pan range: ± 175°, Tilt range: ± 175° (single sided yoke) or about ± 90-110° (dual sided yoke)
Angular Speed	Up to 30 deg/sec (Pan and Tilt simultaneously)
Single Step angle	0.018 deg
Position Feedback	12 bit resolution absolute (approx. 0.1°)
Gears	Precision strain wave
Backlash	< 3 arc minutes (approx. 0.05°)
Materials	Hard anodized Aluminum, Stainless Steel or Titanium

Environmental:

Operating Depth	Down to 6000 m (20,000 ft.)
Temperature Range	-20°C to +50°C (-4°F to +122°F) operating -30°C to +60°C (-22°F to +140°F) storage

Others:

Average Torque	15 Nm
Max Payload dual yoke [1)]	20 kg
Max Payload single yoke [1)]	10 kg
Size (H/W/D) (Flange Ø120 mm)	238 x 130 x 88 mm
Weight in Air [2)]	5.2 kg
Weight in Water [2)]	3.4 kg

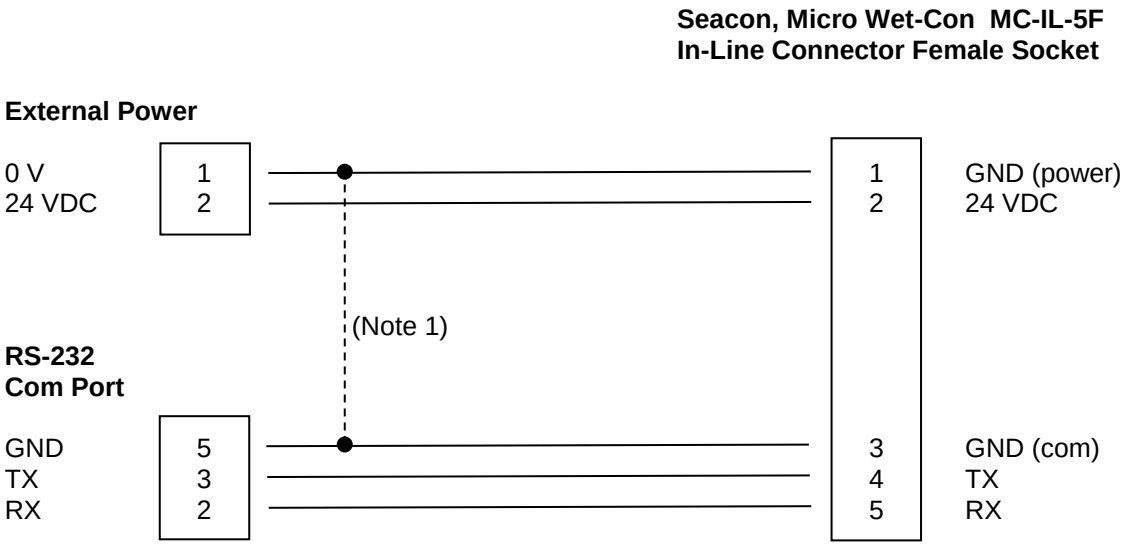
Notes:
1) Payload: Attached device weight in air
2) Weight for aluminium housing and without oil filling

Mounting Brackets/Yoke can be delivered on request.

9. Appendix

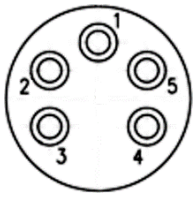
9.1. Connector configurations

9.1.1. RS-232 - Wiring diagram



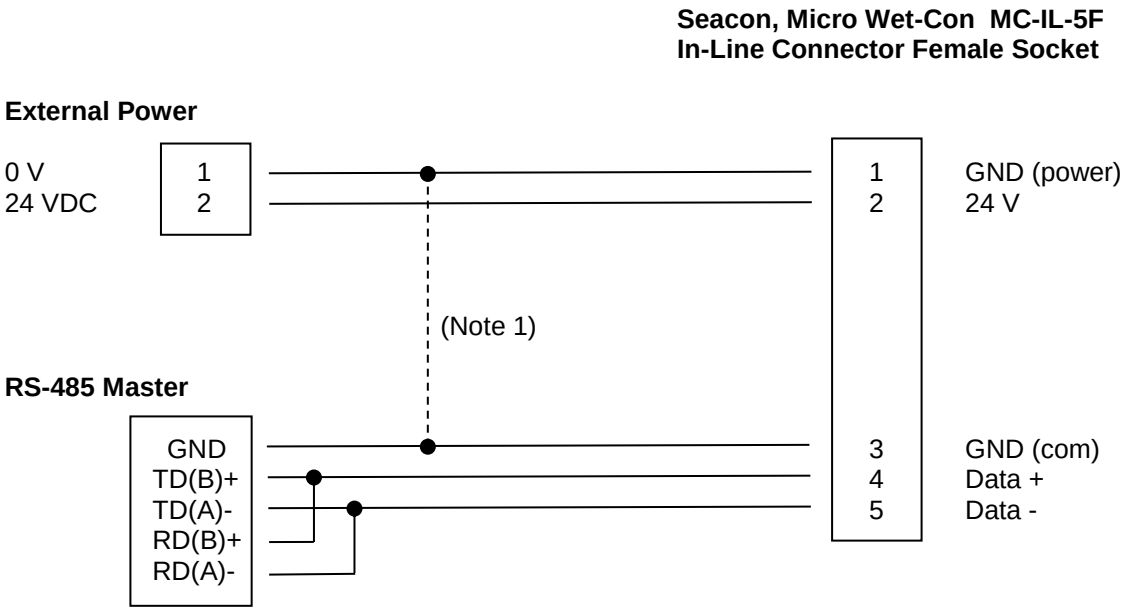
Note 1:
Optional external connection to ensure common GND level between Power supply and Com Port.

Socket: Seacon, Micro Wet-Con series, MC-IL-5F
(female face view)



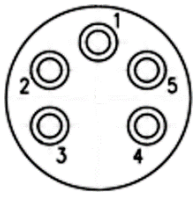
Other connectors and configurations available on request.

9.1.2. RS-485 - Wiring diagram



Note 1:
Optional external connection to ensure common GND level between Power supply and Master.

Socket: Seacon, Micro Wet-Con series, MC-IL-5F
(female face view)

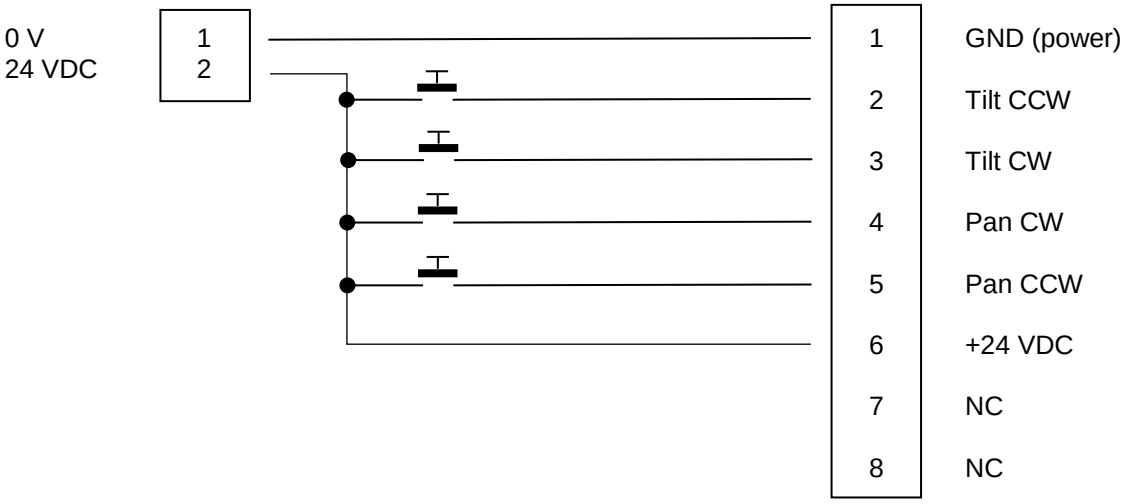


Other connectors and configurations available on request.

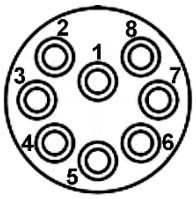
9.1.3. Analog control - Wiring diagram

Seacon, Micro Wet-Con MC-IL-8F
In-Line Connector Female Socket

External Power



Socket: Seacon, Micro Wet-Con series, MC-IL-8F
(female face view)



Other connectors and configurations available on request.

9.2. Communication protocol and commands

9.2.1. Protocol

The SPT-115 Pan/Tilt unit supports an industry standard serial communication protocol compromised of a structured 12 byte long command telegram in the following format:

Transmit telegram (to P/T unit):

Model	Address	Command			Data				R/W	EOL	
#	A	A	B	C	0	1	2	3	W	CR	LF

Receive telegram (from P/T unit):

Model	Address	Command			Data				R/W	EOL	
#	A	A	B	C	0	1	2	3	W	CR	LF

The transmitted and received telegram follows the same format as shown above.
Each segment of the telegram will be further explained in the following sections.

Default serial port communication settings are 9600/8-N-1, that is:

Baudrate setting of 9.600 bits per second, (8) data bits, no (N) Parity and (1) stop bit

MODEL

Model	Address	Command	Data	R/W	EOL

ASCII	Hex	Description
!	0x21h	All Devices
#	0x23h	Pan Unit
$	0x24h	Tilt Unit

MODEL [byte 1] must be "!" All Devices, "#" Pan Motor or "$" Tilt Motor

ADDRESS

Model	**Address**	Command	Data	R/W	EOL

ASCII	Hex	Description
A-Z	0x41h-0x5Ah	Device Address 1-26
a-z	0x61h-0x7Ah	Device Address 27-52

ADDRESS [byte 2] must be in the range A-Z and a-z (case sensitive)

COMMAND and DATA

Transmit Telegrams:

Model	Address	**Command**	**Data**	R/W	EOL

Receive Telegrams:

Model	Address	**Command**	**Data**	R/W	EOL

COMMAND [bytes 3-5] must be upper case alpha characters A-Z
DATA [bytes 6-9] must be positive integers in the range of 0-9

R/W – Read or Write

Model	Address	Command	Data	**R/W**	EOL

ASCII	Hex	Description
R	0x52h	Read Data
W	0x57h	Write Data

R/W [byte 10] of Write commands are always "W" and Read commands always "R"

EOL - End Of Line

Model	Address	Command	Data	R/W	**EOL**

ASCII	Hex	Description
CR	0x0Dh	Carriage return
LF	0x0Ah	Line feed

EOL [byte 11-12] must be CR (carriage return) followed by LF (line feed).

Welcome Message

The SPT-115 Pan/Tilt will "power-up" with the following welcome message:

PAN ACTUADE AS AF70-Pan&Tilt Ver.112-(A)
TILT ACTUADE AS AF70-Pan&Tilt Ver.112-(A)

(A) is the current Node Address.

9.2.2. Commands

Positioning Commands

Write Commands:

Command			Data	Description
Transmit				
M	**S**	**T**	**0000**	**Motor STOP** Issuing this command when the motor is in motion will first decelerate motor then bring it to a complete and full stop.
M	**M**	**F**	**0000**	**Motor Move Forward** Initiates forward (clockwise) motion at the speed set by the MSP (Motor Speed) command.
M	**M**	**B**	**0000**	**Motor Move Backward** Initiates backward (counterclockwise) motion at the speed set by the MSP (Motor Speed) command.
Receive				
M	**S**	**T**	**0x0000h - 0xFFFFh**	Reply will be a combination of Command and Drive Status represented in Hexadecimal format. (For more info, please contact Actuade)
M	**M**	**F**		
M	**M**	**B**		

Motor Speed

Write Command:

Command			Data	Description
Transmit				
M	**S**	**P**	**0000-0060**	**Motor Set Speed** Sets motor rotational speed between 0 and 60. With each step representing 0.5 degrees/sec. which translates to speeds between 0 and 30 degree/sec.
Receive				
M	**S**	**P**	**0000-0060**	Reply will be echo of Transmit.

Read Command:

Transmit				
M	**R**	**S**	**0000**	**Motor Report Speed**
Receive				
M	**R**	**S**	**0000-0060**	Reply will be current motor speed.

Move to Location

Write Command:

Command			Data	Description
Transmit				
M	**M**	**L**	**0905-9095**	**Motor Move to Location** Motor will move towards and stop at the given location of which center position will be 5000.
Receive				
M	**M**	**L**	**0905-9095**	Reply will be echo of Transmit.

Read Command:

Transmit				
M	**R**	**L**	**0000**	**Motor Report Location** This command will report the current motor position.
Receive				
M	**R**	**L**	**0905-9095**	Reply will be current motor position.

Motor Current

Write Command:

Command			Data	Description
Transmit				
M	**M**	**C**	**0000-0100**	**Motor Move Current** Set motor drive current between 10 and 100% of maximum motor current. This allows adjusting motor supply power and current according to run torque requirement.
Receive				
M	**M**	**C**	**0000-0100**	Receive will be an echo of Transmit.

Read Command:

Transmit				
M	**R**	**C**	**0000**	**Report Move Current**
Receive				
M	**R**	**C**	**0000-0100**	Reply will be current motor current.

Motor Brake

Write Commands:

Command			Data	Description
Transmit				
M	**B**	**S**	**0000**	**Motor Brake Set** Sets / Enables / Turns ON the motor brake
M	**B**	**R**	**0000**	**Motor Brake Release** Releases / Disables / Turns OFF the motor brake
Receive				
M	**B**	**S**	**0000**	Receive will be an echo of Transmit.
M	**B**	**R**	**0000**	

Read Command:

Transmit				
M	**R**	**K**	**0000**	**Report Brake Setting**
Receive				
M	**R**	**K**	**0000**	Motor Brake is Set / Enabled / ON
M	**R**	**K**	**1111**	Motor Brake is Released / Disabled / OFF

Brake Power

Write Command:

Command			Data	Description
Transmit				
M	**B**	**P**	**0000-0100**	**Motor Brake Power** Set motor brake power between 0 and 100% of maximum brake power. This allows adjusting motor supply power and current according to hold torque requirement.
Receive				
M	**B**	**P**	**0000-0100**	Receive will be an echo of Transmit.

Read Command:

M	**R**	**P**	**0000**	**Report Brake Power** Data in return will be the current set brake power.
Receive				
M	**R**	**P**	**0000-0100**	Reply will be current brake power.

Global Stop

Write Commands:

Command			Data	Description
Transmit				
G	**S**	**T**	**0000**	**Global STOP** Issuing this command will decelerate and stop all devices attached no matter their model and address.
none				There will be no reply for global command.

Position End Stops

Write Command:

Command			Data	Description
Transmit				
M	**L**	**F**	**0905-9095**	**Forward Motor Limit** Set End Stop in forward direction
M	**L**	**B**	**0905-9095**	**Backward Motor Limit** Set End Stop in backward direction

Read Command:

Transmit				
M	**R**	**B**	**0000**	**Report Backward Limit**
M	**R**	**F**	**0000**	**Report Forward Limit**
Receive				
M	**R**	**B**	**0905-9095**	Forward Motor Limit
M	**R**	**F**	**0905-9095**	Backward Motor Limit

Factory Defaults

Write Command:

Command			Data	Description
Transmit				
M	**F**	**R**	**0000**	**Restore Factory Defaults** This command will restore factory default parameters.
Receive				
M	**F**	**R**	**0000**	Reply will be echo of Transmit.

Firmware Version

Read Command:

Command			Data	Description
Transmit				
M	**R**	**V**	**0000**	**Report Firmware Version**
Receive				
M	**R**	**V**	**1121**	First three digits is Firmware Version "112x" When the last digit is "xxx1" a power-up reset has occurred. Afterwards it will be "xxx0" until a new power-up occurs.

Node Address

Write Command:

Command			Data	Description
Transmit				
G	**S**	**A**	**000A-000Z** **000a-000z**	**Global Set Address**

Read Command:

Transmit				
M	**R**	**A**	**0000**	**Report Motor Address**
Receive				
M	**R**	**A**	**000A**	Current Motor Address

Baudrate Setting

Write Command:

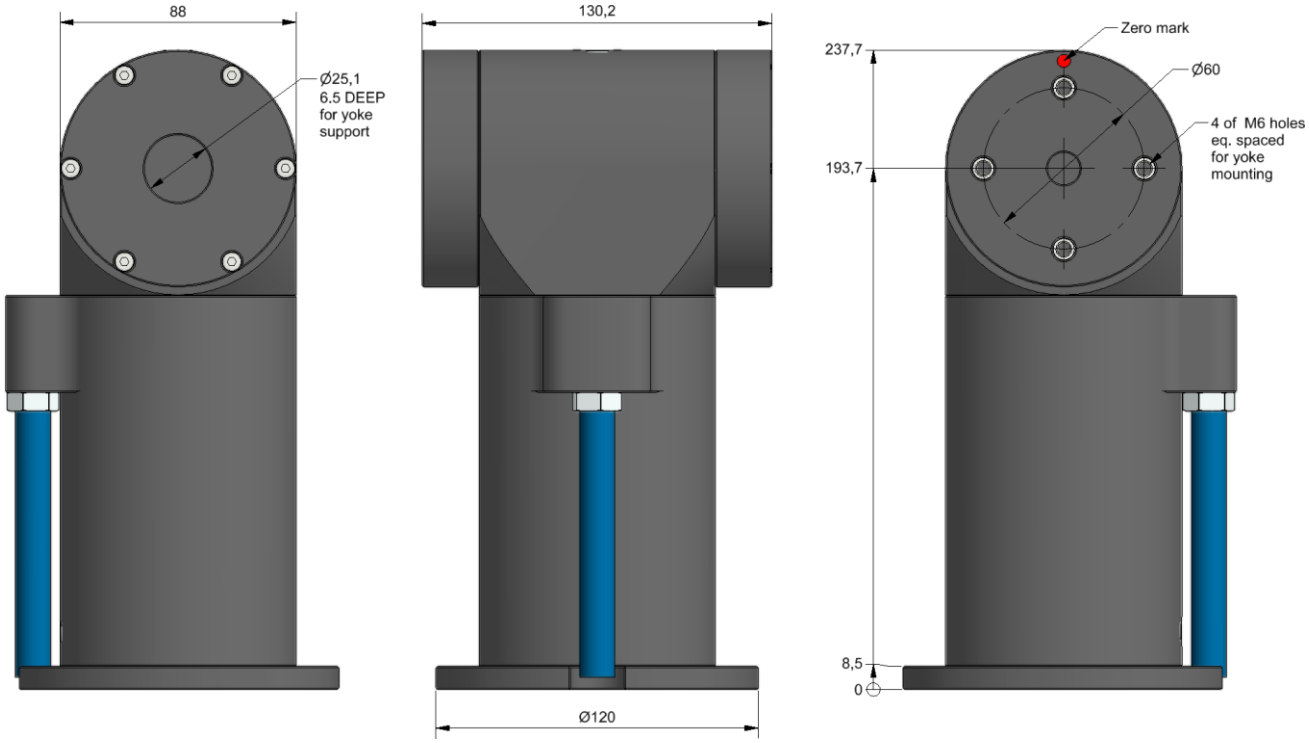
Command			Data	Description
Transmit				
G	**B**	**D**	**0012** **0024** **0048** **0096** **0144** **0192** **0288** **0384** **0560** **0576** **1152**	**Motor Baudrate** This command will alter the baudrate communication settings of the unit. Valid baudrate settings are:_ 1.200, 2.400, 4.800, 9.600, 14.400, 19.200, 28.800, 38.400, 56.000, 57.600 and 115.200 bits/sec.
Receive				
none				There will be no reply from this command but the unit will reset itself with the new Baudrate communication setting.

9.3. Unit dimensions

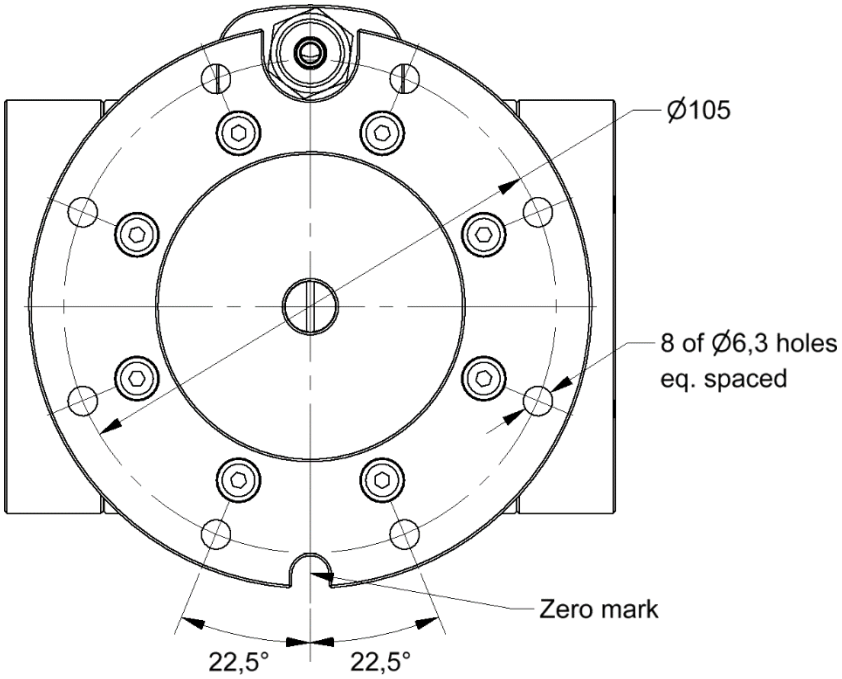
3D step files can be downloaded from http://www.actuade.no/products
Other formats on request.

Projection:

Dimensions in millimeter



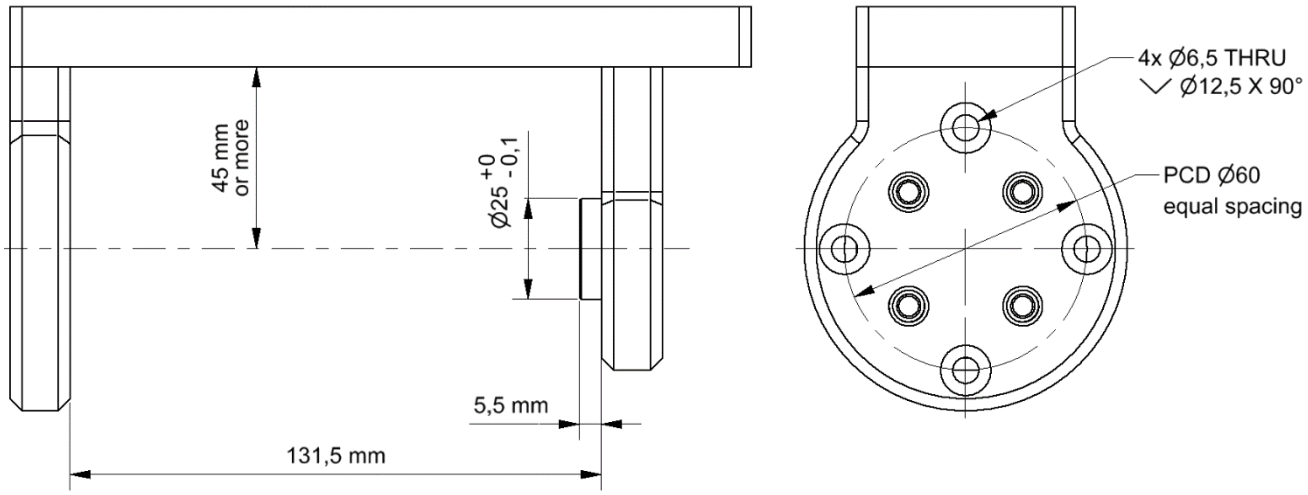
Mounting holes: (bottom view)

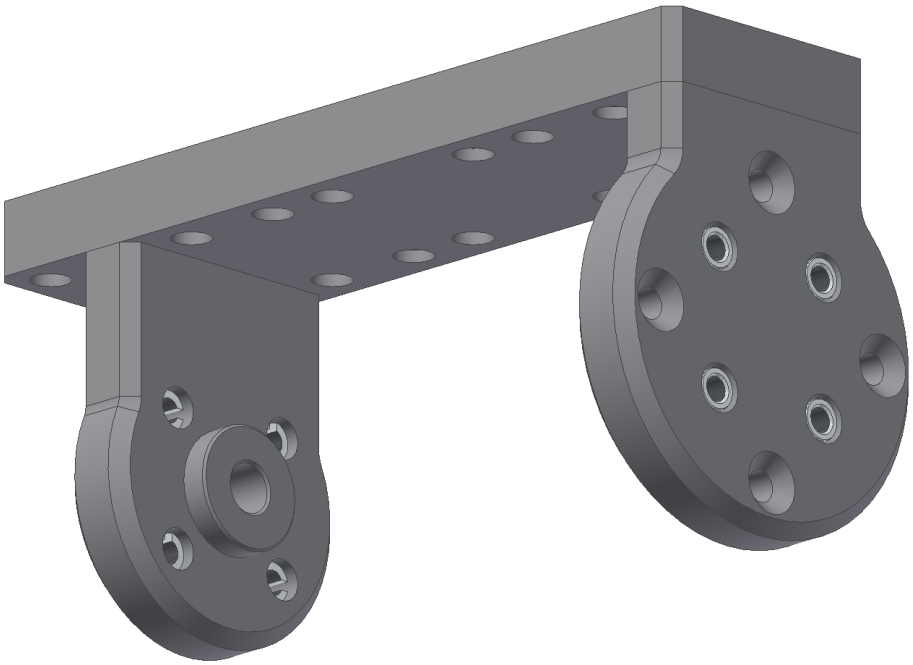


9.4. Yoke dimensions

The yoke dimensions is meant as a guideline and depending on the attached equipment.
Plastic material should be used to avoid ground currents between the unit and attached equipment.

You can made this locally by yourself or ask Actuade for help.





Example of a custom made yoke.