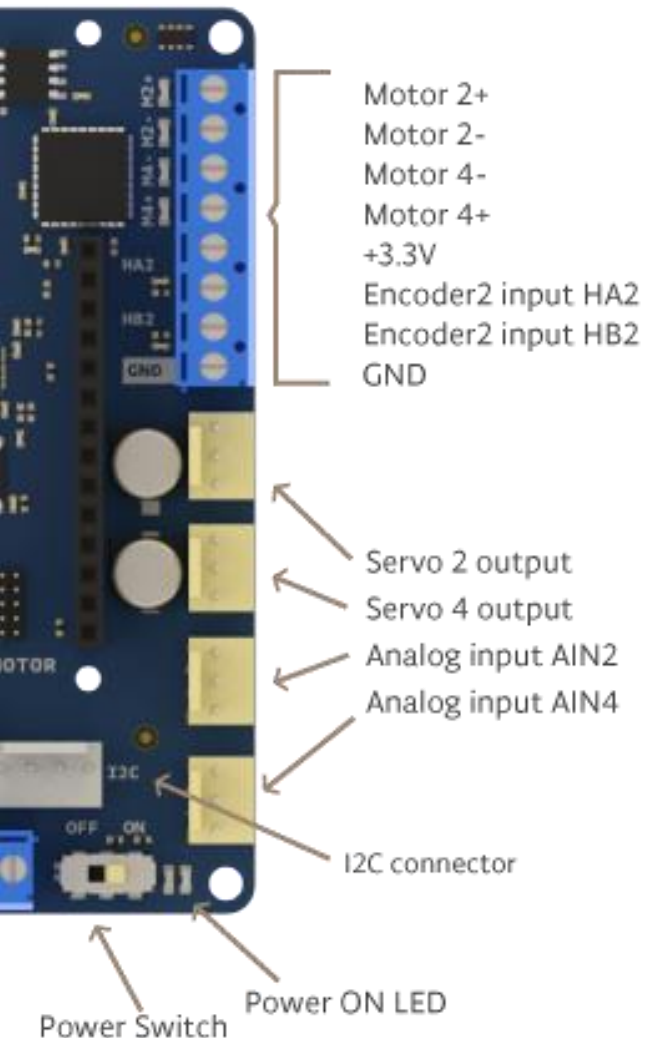




Dr Francesco Ciriello

Department of Engineering



4CCE1MCP: Design Making a Connection

Week 23

Parts List

What you can use for the project

Components & Materials

- Components provided in the MCP Group Kit (details in this slide deck)
- Components from your First Year Hardware at Home Kit
- Fasteners, Gears, Shafts and Materials stored in the Makerspace for MCP
- Any materials that you upcycle into your project

Tools & Makerspace equipment

- 3D printers
- Lasercutter
- Vacuum former
- Wire bender
- Bandsaw, Dremels and other power tools in makerspace
- Hand tools in makerspace

Warning: You are not allowed to use different electrical components, including any replacement motors, batteries or power supplies, compared to the ones provided.

Makerspace Induction

Warning: You will need to have completed the makerspace induction session to access the makerspace.

Most of you have already completed this induction for other Design projects, but please reach out via email to francesco.ciriello@kcl.ac.uk and charlotte.palmer@kcl.ac.uk (copy both of us) if you are unsure about this

Components - Electronic

ID	Per Group	Description
16	3	MP-708-0002 Servomotor 6V
17	1	Brushed DC motor with Rotary Encoder 3 mm shaft 6V 15000 rpm 0.068 Nm
18	2	Motor 7.98 W, 6 → 15 V, 78.4 gcm, 9869 rpm, Shaft Diameter 2.31mm
24	1	Arduino Nano 33 IoT Boards
25	1	Arduino ABX00023 MKR1010 WiFi Enabled IoT Board ESP32
26	1	Arduino ASX00003 MKR Motor Carrier Board
27	6	NiMH AA Batteries
28	1	6 AA Cell Battery Holder
29	1	FTDI Chip, 9W Plug In Power Supply 9V dc, 1A, 1 Output Universal, European Plug, UK, US
31	2	Roline Male USB A to Male Micro USB B, 800mm, USB 2.0 USB Cable Assembly

Components – Mechanical – Stored in Kit

ID	Per Group	Description
1	4	Airgineers 5042 3-Blade Propellers
2	4	Rapid Polythene Fan
9	10	Modelcraft 10434 Shaft Collar 3mm with Grub Screw Pack 10
10	10	Modelcraft 10434 Shaft Collar 4mm with Grub Screw Pack 10
12	8	Rapid Reducer 4mm to 2mm
14	2	Rapid Steel Shafts Pack of 50 2mm Dia. x75mm
19	2	RS PRO Timing Belt Pulley, Aluminium, Zinc Plated Steel 6.4mm Belt Width x 2mm Pitch, 20 Tooth
20	1	RS PRO, Timing Belt, 60 Teeth, 121.92mm 6mm
21	2	2mm ID Ball Bearing
22	4	RS PRO Miniature Ball Bearing - Plain Race Type, 3mm I.D, 10mm O.D
23	4	RS PRO Miniature Ball Bearing - Plain Race Type, 4mm I.D, 13mm O.D
32	1	Hammond RP1245C Watertight ABS Enclosure 165 x 125 x 75 Clear Lid Grey

Components – Mechanical – Stored in Makerspace

ID	Per Group	Description
3	1	TR Fastenings Metric Pan Head Machine Screws - Pozidriv® M2 12mm - Box Of 100
4	1	Affix Pozi Pan Head Machine Screws BZP M3 16mm - Pack Of 100
5	1	Affix Steel Nuts BZP M3 - Pack Of 100
6	1	Affix Steel Washers BZP M3 - Pack Of 100
7	1	Pozidriv® M3 25mm - Box Of 100
8	1	Yahata Neji Steel Hex Nut, Chrome Plated, M2
11	Kit	Gear Pack 4 assorted colours, 5 assorted sizes, 4mm centre hole Diameters: 10, 13, 22, 32, 42mm & Rack
13	10	Rapid Steel Axle 300mm x 3.0mm Diameter - Pack of 50
15	1	Reely 10581 Steel Shaft 4x500mm

Materials

Per Group	Description
2	3 mm Clear Acrylic AC.CLR0000.03.6030
2	Plywood 3mm WO.PLYSTD.03.6030
2	3.0MM Balsa Wood Sheet Size 500X300mm WO.BALSA.03.5030

Tip: There is also a healthy supply of scrap materials available in the Makerspace that you can ask for.

Parts List All

ID	Notes	Per Group	Description
1		4	Airgineers 5042 3-Blade Propellers
2		4	Rapid Polythene Fan
3	Held in Makerspace	1	TR Fastenings Metric Pan Head Machine Screws - Pozidriv® M2 12mm - Box Of 100
4	Held in Makerspace	1	Affix Pozi Pan Head Machine Screws BZP M3 16mm - Pack Of 100
5	Held in Makerspace	1	Affix Steel Nuts BZP M3 - Pack Of 100
6	Held in Makerspace	1	Affix Steel Washers BZP M3 - Pack Of 100
7	Held in Makerspace	1	Pozidriv® M3 25mm - Box Of 100
8	Held in Makerspace	1	Yahata Neji Steel Hex Nut, Chrome Plated, M2
9		10	Modelcraft 10434 Shaft Collar 3mm with Grub Screw Pack 10
10		10	Modelcraft 10434 Shaft Collar 4mm with Grub Screw Pack 10
11	Held in Makerspace	Kit	Gear Pack 4 assorted colours, 5 assorted sizes, 4mm centre hole Diameters: 10, 13, 22, 32, 42mm & Rack
12		8	Rapid Reducer 4mm to 2mm
13	Held in Makerspace	10	Rapid Steel Axle 300mm x 3.0mm Diameter - Pack of 50
14		2	Rapid Steel Shafts Pack of 50 2mm Dia. x75mm
15	Held in Makerspace	1	Reely 10581 Steel Shaft 4x500mm
16		3	MP-708-0002 Servomotor 6V
17		1	Brushed DC motor with Rotary Encoder 3 mm shaft 6V 15000 rpm 0.068 Nm
18		2	Motor 7.98 W, 6 → 15 V, 78.4 gcm, 9869 rpm, Shaft Diameter 2.31mm
19		2	RS PRO Timing Belt Pulley, Aluminium, Zinc Plated Steel 6.4mm Belt Width x 2mm Pitch, 20 Tooth
20		1	RS PRO, Timing Belt, 60 Teeth, 121.92mm 6mm
21		2	2mm ID Ball Bearing
22		4	RS PRO Miniature Ball Bearing - Plain Race Type, 3mm I.D, 10mm O.D
23		4	RS PRO Miniature Ball Bearing - Plain Race Type, 4mm I.D, 13mm O.D
24		1	Arduino Nano 33 IoT Boards
25		1	Arduino ABX00023 MKR1010 WiFi Enabled IoT Board ESP32
26		1	Arduino ASX00003 MKR Motor Carrier Board
27		6	NiMH AA Batteries
28		1	6 AA Cell Battery Holder
29		1	FTDI Chip, 9W Plug In Power Supply 9V dc, 1A, 1 Output Universal, European Plug, UK, US
30		1	1.8mm Screwdrivers
31		2	Roline Male USB A to Male Micro USB B, 800mm, USB 2.0 USB Cable Assembly
32		1	Hammond RP1245C Watertight ABS Enclosure 165 x 125 x 75 Clear Lid Grey
33		1	Rapid 27 x 20 x 11cm 4L Storage Container

Arduino MKR 1010 WiFi board



Part Name

Arduino MKR WiFi 1010
Code: ABX00023

Part Doc

<https://store.arduino.cc/products/arduino-mkr-wifi-1010>

Coding in Arduino

<https://docs.arduino.cc/hardware/mkr-wifi-1010>

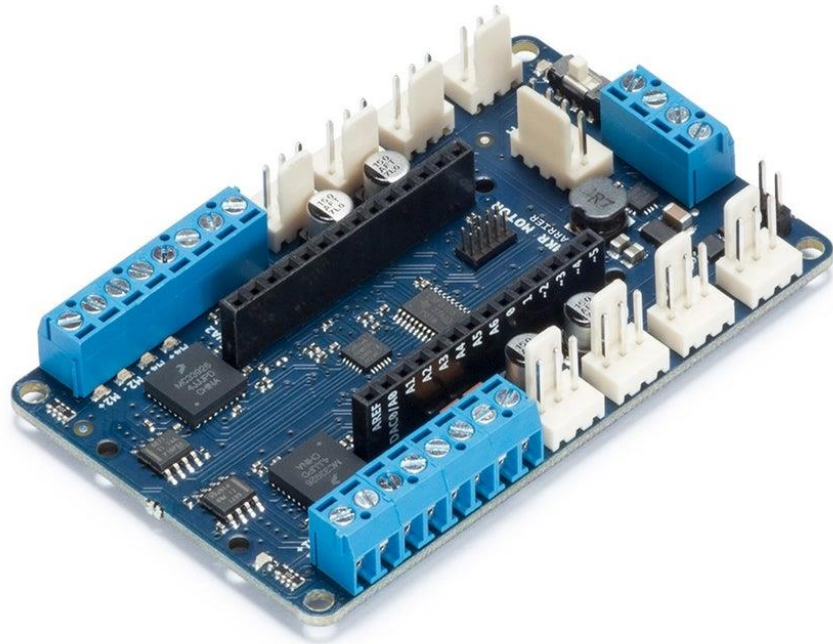
Coding in Simulink

<https://uk.mathworks.com/help/supportpkg/arduino/setup-and-configuration.html>

Intended Use

On-ship receiver and micro-controller

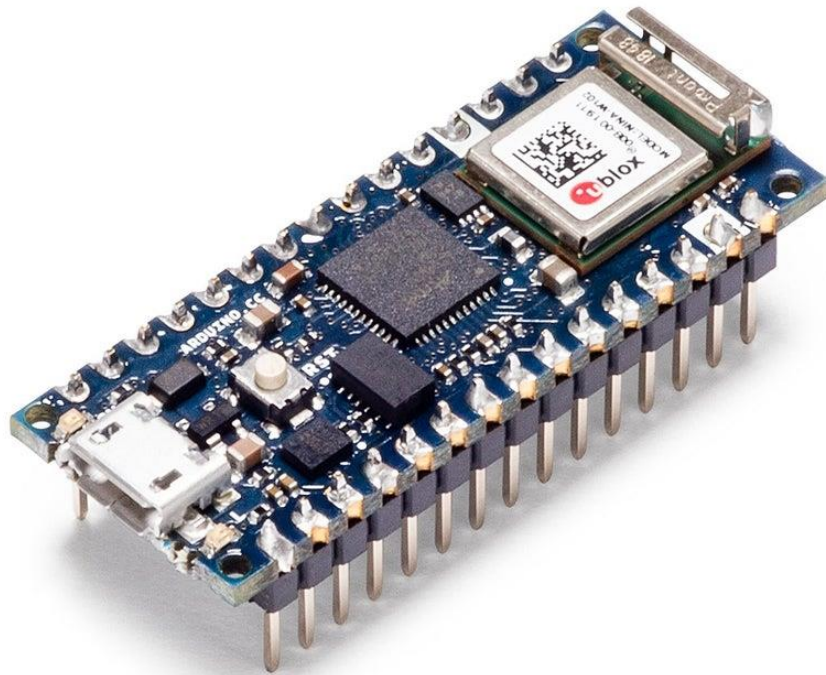
Arduino MKR Motor Carrier



Warning: We have modified the motor carriers so that you can connect them to a power supply or battery using a single plug DC connector. Please do not tamper with these connectors.

Part Name	Arduino MKR Motor Carrier Code: ASX00003
Part Doc	https://store.arduino.cc/products/arduino-mkr-motor-carrier
Coding in Arduino	https://docs.arduino.cc/hardware/mkr-motor-carrier
Coding in Simulink	https://uk.mathworks.com/help/supportpkg/arduino/arduino-motor-carrier.html
Intended Use	Arduino MKR board slots into the carrier, which acts as voltage divider and H-bridge between the board and motor circuits.

Arduino Nano 33 IoT Board



Part Name

Arduino Nano 33 IoT with headers
Code: ABX00032

Part Doc

<https://store.arduino.cc/products/arduino-nano-33-iot-with-headers>

Coding in Arduino

<https://docs.arduino.cc/hardware/nano-33-iot>

Coding in Simulink

<https://uk.mathworks.com/help/supportpkg/arduino/setup-and-configuration.html>

Intended Use

Ground control transmitter. Connect to potentiometers to make an RC joystick.

Servomotors



Part Name	6V Motor Servo, 360 Degrees - MP-708-0002
Part Doc	https://cpc.farnell.com/multicomp-pro/mp-708-0002/servo-motor-360deg/dp/MC02859
Coding in Arduino	https://www.arduino.cc/reference/en/libraries/arduinomotorcarrier/servo/
Coding in Simulink	https://uk.mathworks.com/help/supportpkg/arduino/ref/servowrite.html
Intended Use	Position control of rudder or other mechanisms, <i>e.g.</i> to collect floating debris

Brushed DC Motor



Warning: We have soldered cables to the terminals of the motor. Please do not tamper with these connectors.

Part Name	RS PRO Geared DC Motor, 7.98 W, 6 → 15 V, 78.4 gcm, 9869 rpm, 2.31mm Shaft Diameter
Part Doc	https://uk.rs-online.com/web/p/dc-motors/2389737
Coding in Arduino	https://www.arduino.cc/reference/en/libraries/arduinomotorcarrier/motor/
Coding in Simulink	https://uk.mathworks.com/help/supportpkg/arduino/referencelist.html - use M1/M2 or M3/M4 blocks
Intended Use	Drive propeller drivetrain

Brushed Geared DC Motor with Encoder



Warning: We have soldered cables to the terminals of the motor. Please do not tamper with these connectors.

Part Name	Brushed DC motor with Rotary Encoder 3 mm shaft 6V 15000 rpm 0.068 Nm
Part Doc	https://uk.farnell.com/dfrobot/fit0483/dc-geared-motor-brushed-100-1/dp/3769971?st=dfrobot
Coding in Arduino	https://www.arduino.cc/reference/en/libraries/arduinomotorcarrier/ - see Motor and Encoder doc
Coding in Simulink	https://uk.mathworks.com/help/supportpkg/arduino/referencelist.html - see M1/M2, M3/M4, encoder blocks
Intended Use	Precise motor control with feedback, can be useful for current controlled position or velocity applications

NiMH Batteries



Warning: Hazardous item. Remove the battery from the battery holder when not in use.

Tip: Use the power supply socket provided as you are prototyping.

Tip: Battery chargers are available to use in the Makerspace.

Part Name	Rechargeable Battery, 1.2 V, Nickel Metal Hydride, 2 Ah, AA MP001183
Part Doc	https://uk.farnell.com/multicomp-pro/mp001183/battery-aa-ni-mh-2ah-1-2v-pk4/dp/3255434
Coding in Arduino	https://www.arduino.cc/reference/en/libraries/arduinomotorcarrier/ - see Battery doc
Coding in Simulink	https://uk.mathworks.com/help/supportpkg/arduino/referencelist.html - see battery
Intended Use	Power supply to on-ship motor carrier and board Use up to 6 batteries to deliver 7.2V

Air propellers



Part Name

Airineers 5042 3-Blade Propellers
SKU533153

Part Doc

<https://www.rapidonline.com/airineers-5042-3-blade-propellers-pk-20-5-sets-70-1196>

Intended Use

Large propeller intended for use in air.

100 mm diameter
5 mm bore size

Water propellers



Part Name

Rapid Polythene Fan

Part Doc

<https://www.rapidonline.com/rapid-polythene-fan-each--06-0690>

Intended Use

Propeller intended for use in water.

50 mm diameter
2 mm bore size

Shaft Collars

shaft collar



grub screw

Part Name	Modelcraft 10434 Shaft Collar with grub screw 3mm and 4mm
Part Doc	<p>https://www.rapidonline.com/modelcraft-10434-shaft-collar-3mm-with-grub-screw-pack-10-50-9084</p> <p>https://www.rapidonline.com/modelcraft-10541-shaft-collar-4mm-with-grub-screw-pack-10-50-9085</p>
Intended Use	<p>Rigidly connect to a rotating shaft to fix a component in place, <i>e.g.</i> gear.</p> <p>Preferably fix the grub screw on the flat surface of a half shaft.</p>

Reducers



Part Name

Reducers 4mm to 2mm

Part Doc

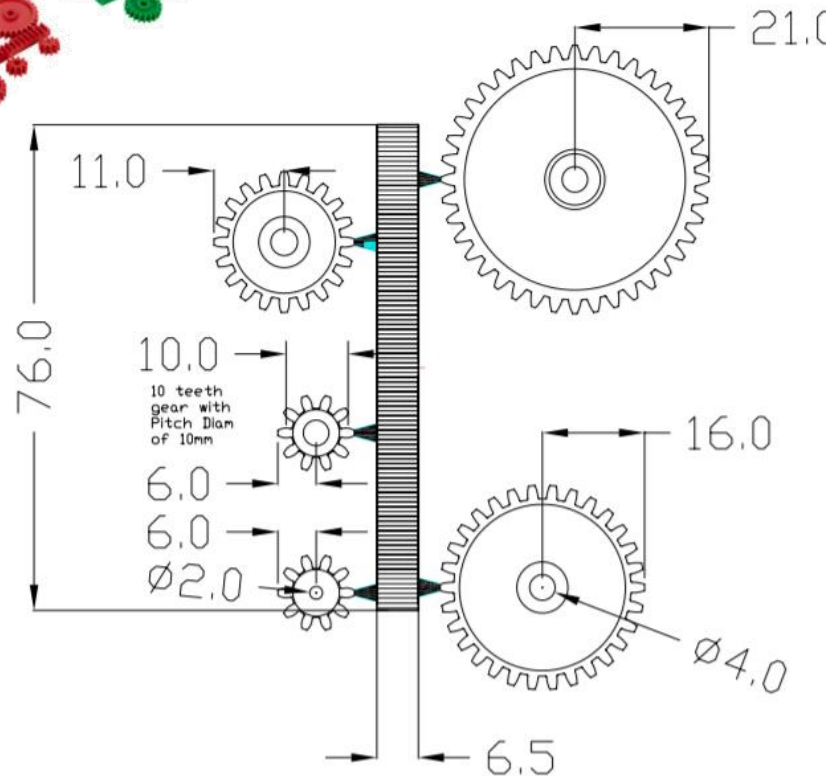
<https://www.rapidonline.com/reducers-4mm-to-2mm-300345>

Intended Use

Connect 4 mm bore size gears to a 2mm shaft.

Tip: You could try to gently drill through the 2 mm hole to make this part fit on a 3 mm shaft

Gear packs (in makerspace)



Part Name

Rapid Gear Pack 100

Part Doc

<https://www.rapidonline.com/rapid-gear-pack-100-37-0280>

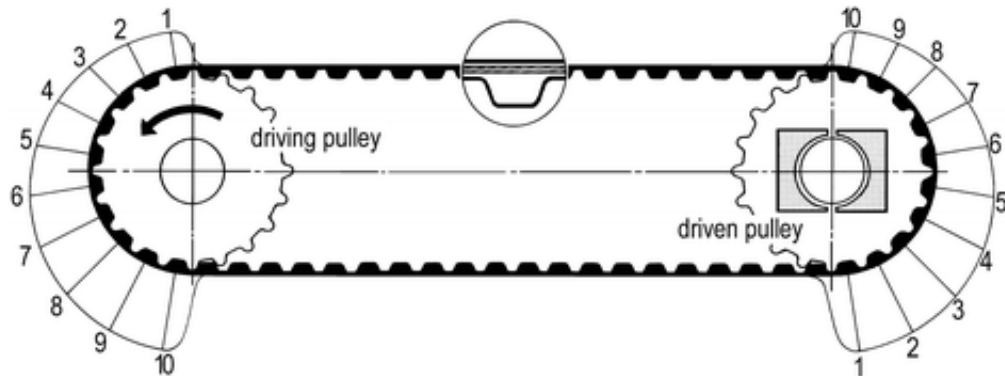
Intended Use

Combine with shafts, collars and reducers to build a gearbox between motor and propeller / other mechanisms

- Use to increase the speed of revolution of the propeller to provide additional thrust
- Use to reduce the speed of revolution of a motor to increase the resolution of an encoder

Use as a rack and pinion to convert rotational to translational motion

Timing belt and pulley



Part Name

RS PRO Timing Belt Pulley, Aluminium, Zinc Plated Steel 6.4mm Belt Width x 2mm Pitch, 20 Tooth

Part Doc

<https://uk.rs-online.com/web/p/belt-pulleys/7784770>

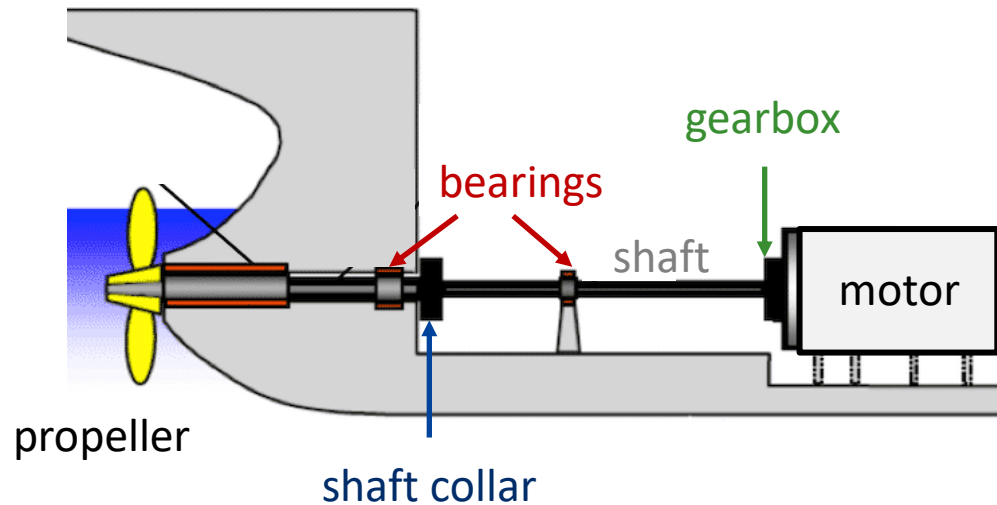
<https://uk.rs-online.com/web/p/timing-belts/7785032>

Intended Use

Fix pulley to a shaft with a grub screw

Connect two timing pulleys with a timing belt to build a belt system

Ball bearings



Part Name

2mm, 3mm and 4 mm ID Ball Bearing

Part Doc

<https://uk.rs-online.com/web/p/ball-bearings/6125723>

<https://uk.rs-online.com/web/p/ball-bearings/6189884>

<https://uk.rs-online.com/web/p/ball-bearings/6189862>

Intended Use

Either

- Fix a ball bearing to a shaft, possibly using a shaft collar with a grub screw
- Fix a ball bearing to a housing.

[Advice on connect ball bearings](#)

Shafts

2 mm x 75 mm

3 mm x 300 mm

4 mm x 500 mm

Part Name

Rapid Steel Shafts 2mm Dia. X75mm
Rapid Steel Axle 300mm x 3.0mm
Reely 10581 Steel Shaft 4x500mm

Part Doc

<https://www.rapidonline.com/rapid-steel-shafts-pack-of-50-2mm-dia-x75mm-37-0350>

<https://www.rapidonline.com/rapid-steel-axle-300mm-x-3-0mm-diameter-pack-of-50-06-6032>

<https://www.rapidonline.com/reely-10581-steel-shaft-4x500mm-50-9062>

Intended Use

Motor to propeller shaft
Shafts on gearbox
General use

Water-tight enclosure



Part Name

Hammond RP1245C Watertight ABS Enclosure 165 x 125 x 75 Clear Lid Grey

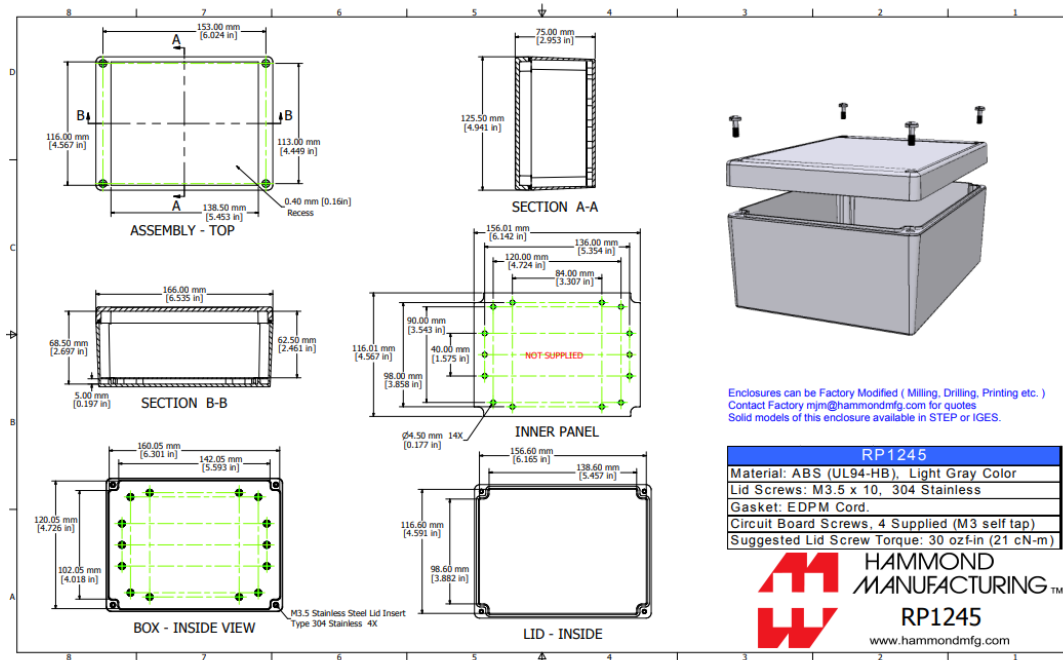
Part Doc

<https://www.rapidonline.com/hammond-rp1245c-watertight-abs-enclosure-165-x-125-x-75-clear-lid-grey-30-1438>

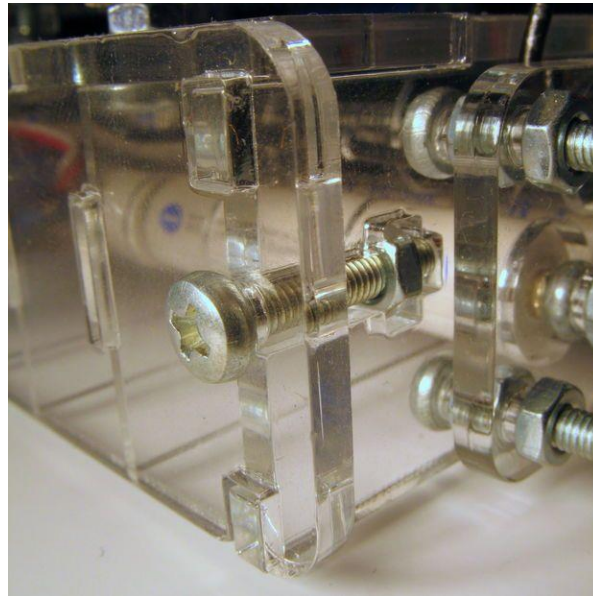
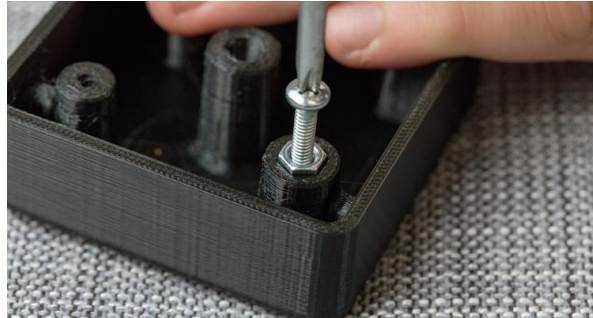
Intended Use

Protect the Arduino board, motor carriers, motors and batteries from water ingress

Design connections and housing between the enclosure and components using lasercut and 3d printed parts



Fasteners



Part Name

Assorted M2 and M3 machine screws, washers and nuts

Part Doc

M2 x 12
M3 x 16
M3 x 25
M2 nuts
M3 nuts
M3 washers

Intended Use

Connect board, carrier and other components to housings.