MINIONS

MarINe Internet Of Nodes Specification

1 Introduction

1.1 Overview

The MINIONS Specification outlines a general, operational, electrical and mechanical specification to provide a standard for the development of Internet of Things (IoT) marine monitoring devices. The specification lists several requirements of systems and proposes a mechanical design to encourage uniformity and interoperability between devices and networks, as well as the open development of projects between groups.

1.2 Purpose

The primary purpose of this document is to define standards for IoT marine monitoring devices to ensure their suitability to the environment, aid cooperation and integration of projects, accelerate development of devices and networks, and accelerate advances in the field.

2 Requirements

2.1 General Requirements

1.1. Designs deviating from the MINIONS specification must ensure complete interoperability and compatibility with existing designs.
1.2. All parts shall remain attached to the device during launch and operation. No additional debris shall be created.
1.3. Total stored chemical energy must not exceed 100 Watt-Hours [1].

2.2 Mechanical Requirements

2.2.1 General Mechanical Requirements

1.3.1. Floating platforms shall consist of a floatation device, mounting platform, enclosures and mooring system
1.3.2. Enclosures must be IP68 and NEMA 6P rated against dust and water for all devices to be deployed above 5m depth. For devices being deployed beyond this depth, designers need to ensure that the enclosure is waterproof at the chosen depth for at least the duration of the mission [2][3].

1.3.3. The floatation device used shall be a SOLAS-compliant lifebuoy
1.3.4. The mounting platform shall be secured in the middle of the flotation device.
1.3.5. The platform shall accommodate up to 4 enclosures on its upper and lower surfaces, with a maximum of 8 enclosures in total.
1.3.6. Enclosures shall be fastened to the platform with four M6 [4] nuts, bolts and washers.

Floatation device, mounting platform and enclosure physical dimensions are specified in "

1.3.7. Physical Dimensions of Mechanical Components".

2.2.2 Materials

1.3.8. All metals used in the construction of the enclosure and platform shall be either Type 316 stainless steel or 5052 aluminium.
1.3.9. Where other metals are used, the designer must ensure the chosen metals have similar or better corrosion resistance in marine environments in accordance with ISO 9223 [5] and ISO 9226 [6].
1.3.10. All plastic must be HDPE, LDPE or PETG (if 3D printed).
1.3.11. Where other plastics are used, the designer must ensure that the material has a water absorption rate less than 0.30% in accordance with ISO62 [7], UV resistance similar to that of HDPE, LDPE and PETG, and that the plastic is durable for use at sea in accordance with ISO 15314:2018 [8].

2.3 Electrical Requirements

1.4. The communication protocol for external busses shall be RS485.
1.5. No standard supply voltage is specified, as different components require a wide array of supply voltages. Instead, designers must ensure a stable, regulated supply that is able to output the required voltage and current of each component. Special consideration in this regard must be given when interfacing with other MINIONS devices.
1.6. Batteries must comply with Requirement 1.3.
1.7. All MINIONS compliant devices that use batteries must incorporate battery circuit protection to avoid unbalanced cell conditions. The protection circuitry should ensure charge and discharge voltage limits, charge and discharge current limits and cell-balancing if multiple cells are used. Correct charging and discharging procedures/cycles specific to the chosen battery must be followed.
1.8. Wireless communications modules may use WiFi, Bluetooth, LoRa or MQTT technologies.

2.4 Operational Requirements

1.9. All equipment that is deployed must be retrieved once the project is complete. No part of the system's node/s, platform, mooring system, or any other part must remain at sea.
1.10. Approval must be acquired before deploying networks.
1.11. Systems must comply with their country's radio licence agreements and restrictions.

3 Physical Dimensions of Mechanical Components

3.1 Floatation device

The floatation device used shall be a SOLAS-compliant lifebuoy, with an outer diameter no greater than 800mm, and inner diameter no less than 400mm [9].

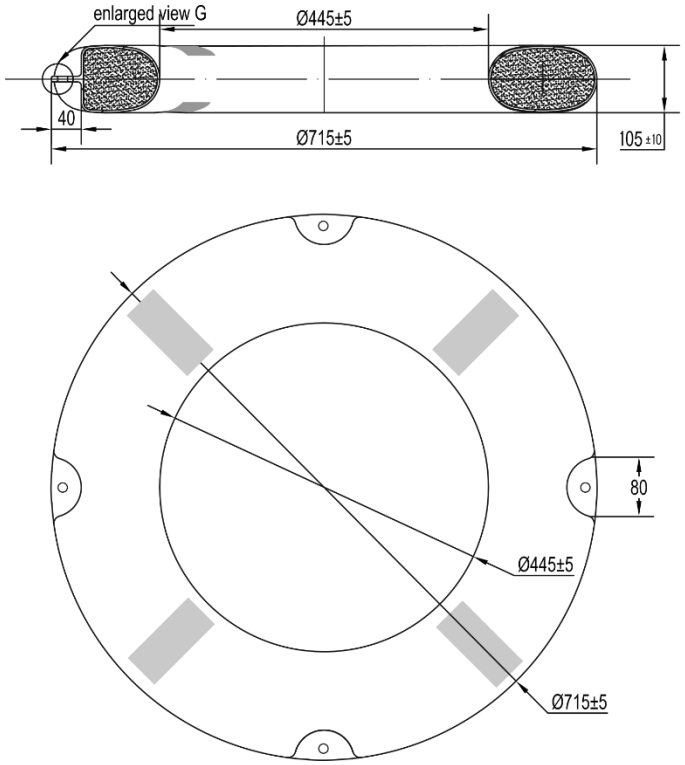

Figure 1: Illustration of a SOLAS-compliant lifebuoy [10]

3.2 Mounting platform

The mounting platform must be circular in shape and cut to fit the internal diameter of the flotation device. It must be possible to fit 4 MINIONS enclosures on each surface. Holes shall be drilled to for the tabs of the MINIONS enclosure must measure 6mm in diameter. The size and layout of the mounting platform are shown below.

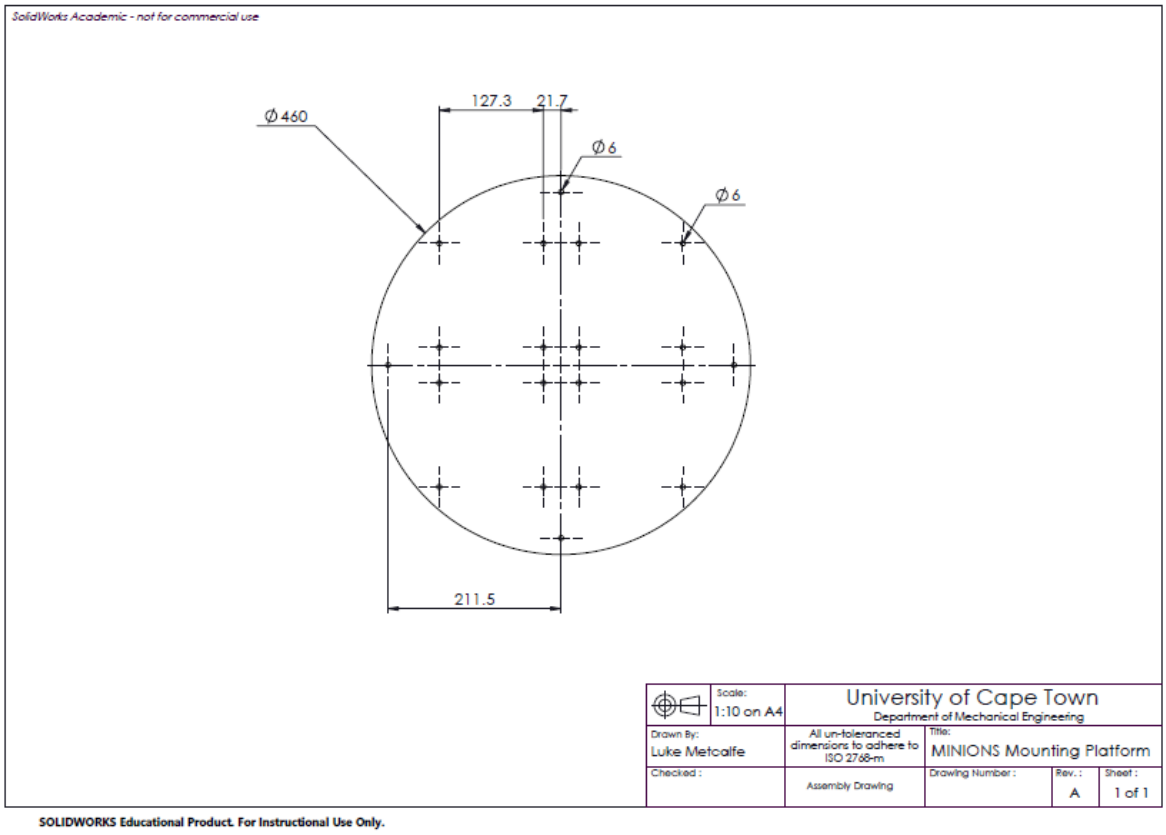

Figure 2: Top view of the MINIONS mounting platform

3.3 Enclosure

The enclosure shall be cylindrical in shape, with a height and diameter of 110mm. The enclosure must have four equally-spaced tabs at its bottom in order to be secured to the mounting platform. The tabs shall have 6mm holes, and the holes should have a pitch of 127.3mm. This corresponds to a diagonal pitch of 180mm apart. Mechanical drawings of the enclosure are shown in Figure 3 to Figure 5 below.

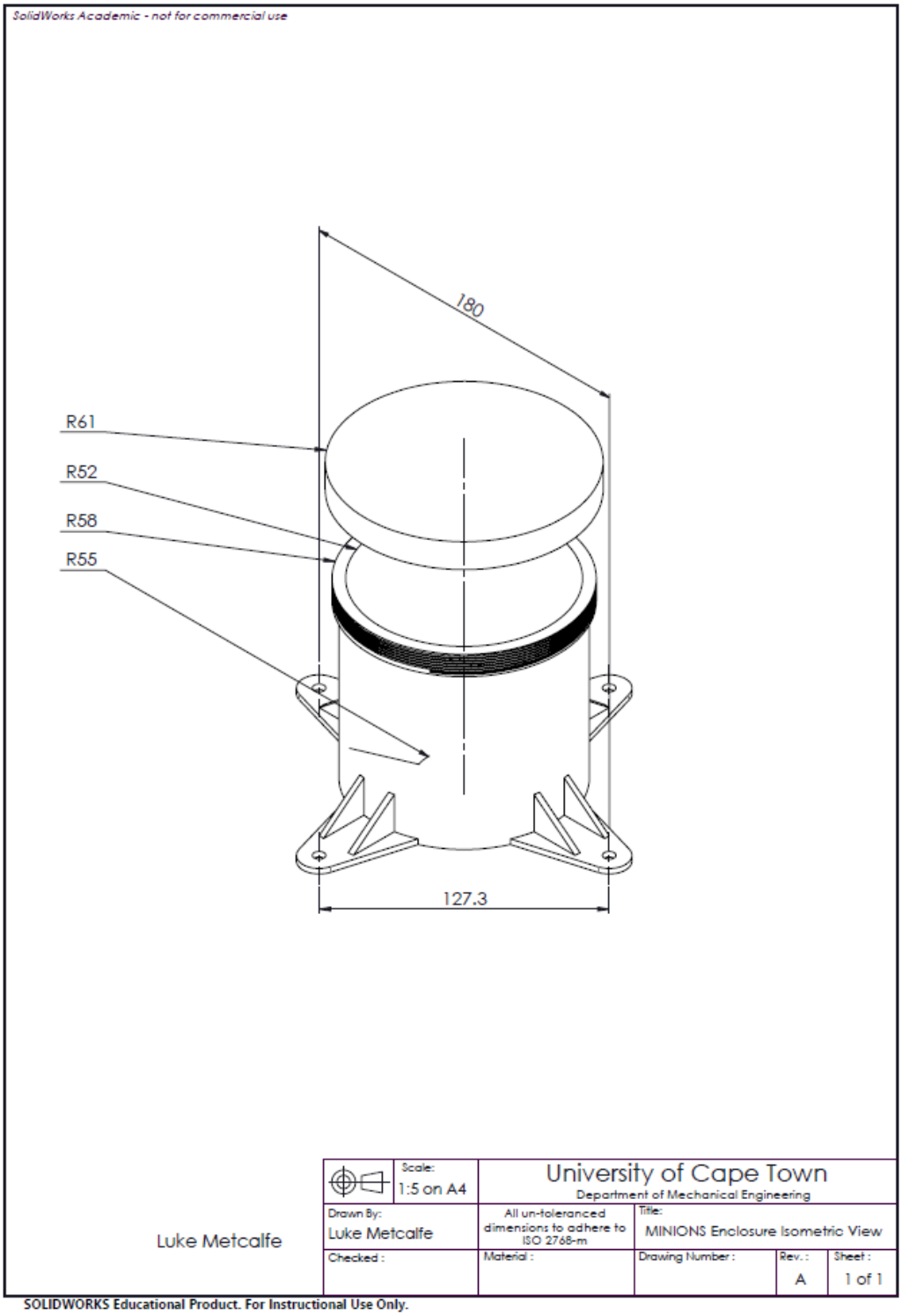

Figure 3: Isometric view of the MINIONS enclosure

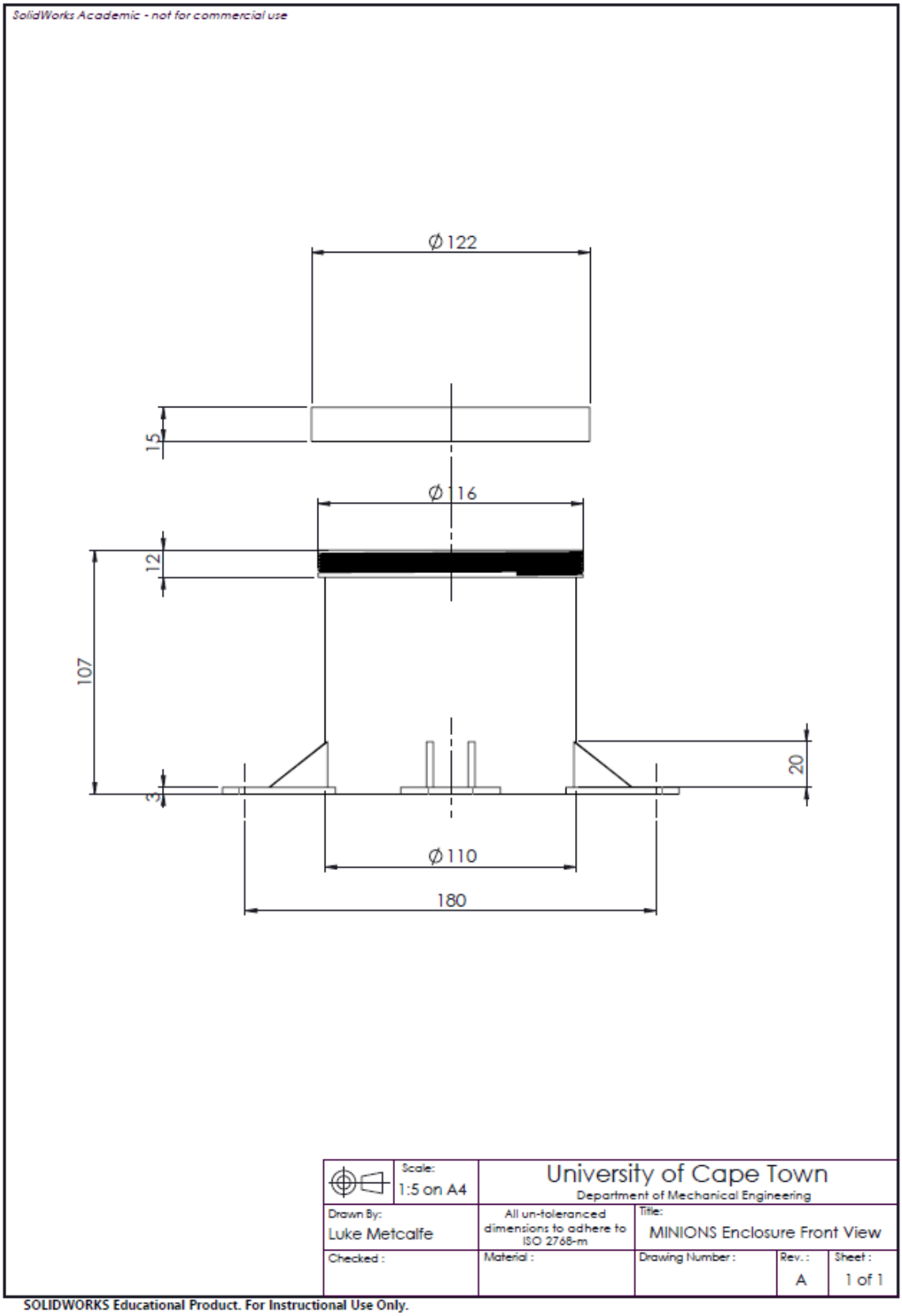

Figure 4: Front view of the MINIONS enclosure

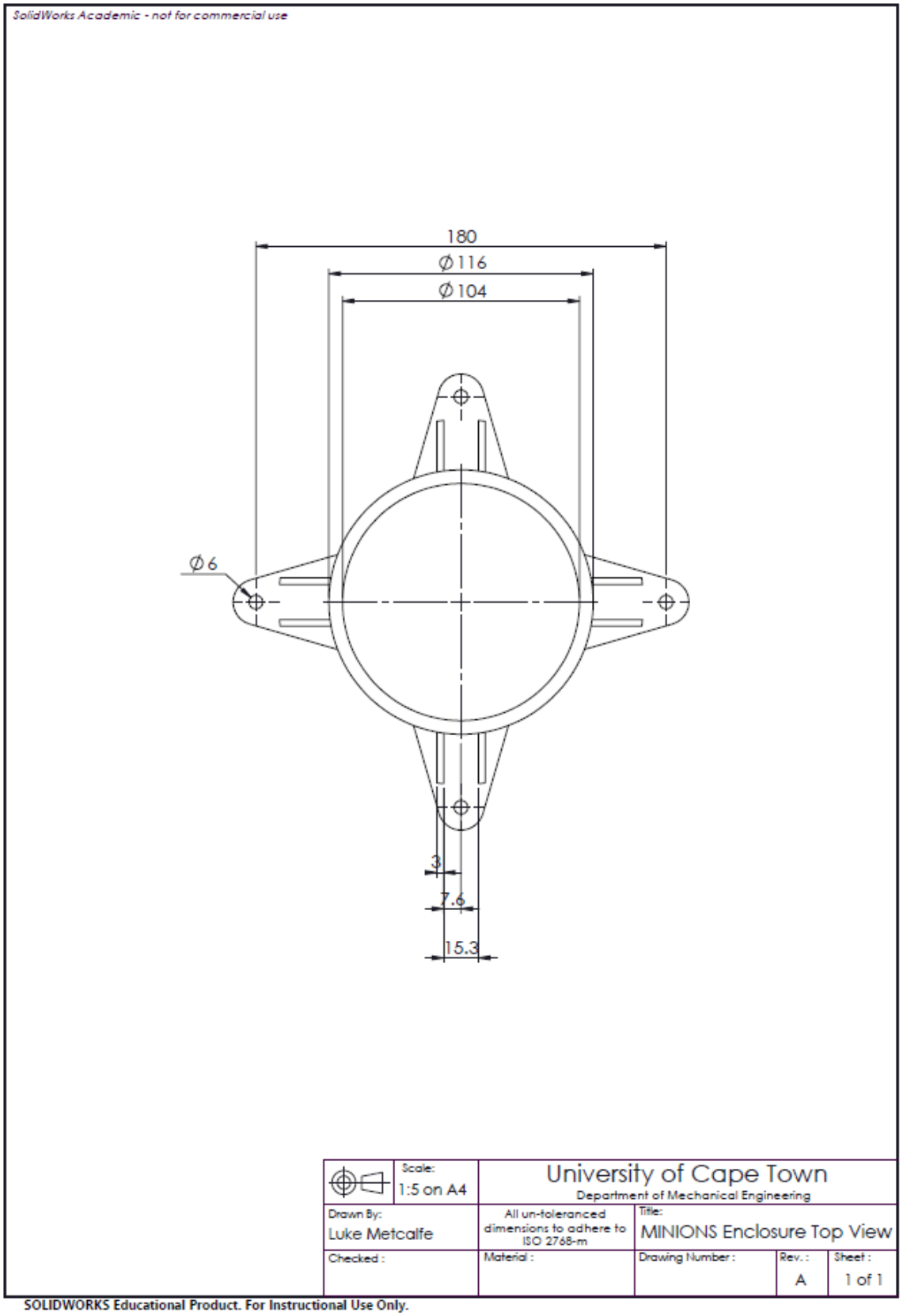

Figure 5: Top view of the MINIONS enclosure

3.4 Assembly

The assembly of the enclosures and mounting platform is shown in Figure 6 below.

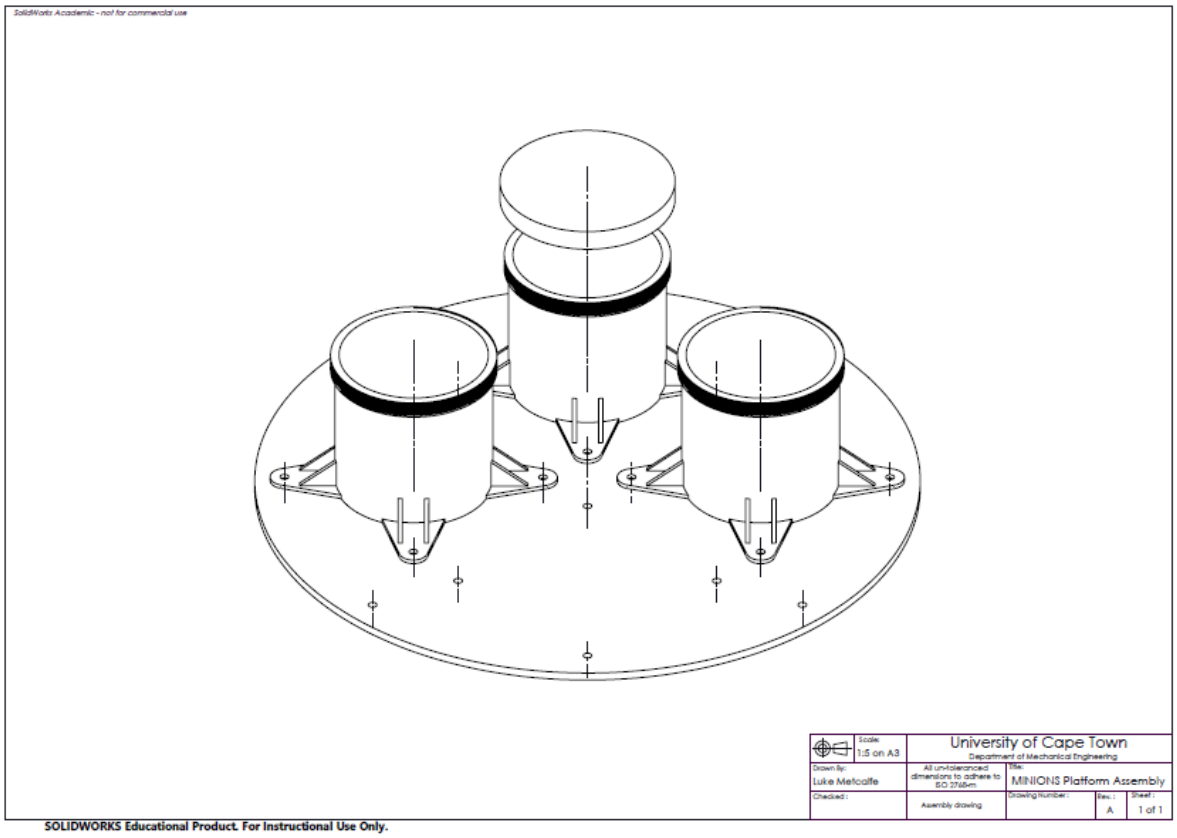

Figure 6: Isometric view of the assembly of the MINIONS mounting platform and three MINIONS enclosures

4 Appendix

References and Cited Standards.

[1] "49 CFR Part 175 - CARRIAGE BY AIRCRAFT | CFR | US Law | LII / Legal Information Institute." [Online]. Available: https://www.law.cornell.edu/cfr/text/49/part-175. [Accessed: 12-Oct-2019].

[2] "ISO - ISO 20653:2013 - Road vehicles — Degrees of protection (IP code) — Protection of electrical equipment against foreign objects, water and access." [Online]. Available: https://www.iso.org/standard/58048.html. [Accessed: 12-Oct-2019].

[3] "IEC 60529:1989+AMD1:1999+AMD2:2013 CSV | IEC Webstore | water management, smart city, rural electrification." [Online]. Available: https://webstore.iec.ch/publication/2452. [Accessed: 12-Oct-2019].

[4] "ISO - ISO 261:1998 - ISO general purpose metric screw threads — General plan." [Online]. Available: https://www.iso.org/standard/4165.html. [Accessed: 12-Oct-2019].

[5] "ISO - ISO 9223:2012 - Corrosion of metals and alloys — Corrosivity of atmospheres — Classification, determination and estimation." [Online]. Available: https://www.iso.org/standard/53499.html. [Accessed: 12-Oct-2019].

[6] "ISO - ISO 9226:2012 - Corrosion of metals and alloys — Corrosivity of atmospheres — Determination of corrosion rate of standard specimens for the evaluation of corrosivity." [Online]. Available: https://www.iso.org/standard/53502.html. [Accessed: 12-Oct-2019].

[7] "ISO - ISO 62:2008 - Plastics — Determination of water absorption." [Online]. Available: https://www.iso.org/standard/41672.html. [Accessed: 12-Oct-2019].

[8] "ISO - ISO 15314:2018 - Plastics — Methods for marine exposure." [Online]. Available: https://www.iso.org/standard/74668.html. [Accessed: 12-Oct-2019].

[9] "International Convention for the Safety of Life at Sea (SOLAS), 1974." [Online]. Available: http://www.imo.org/en/About/Conventions/ListOfConventions/Pages/International-Convention-for-the-Safety-of-Life-at-Sea-(SOLAS),-1974.aspx. [Accessed: 12-Oct-2019].

[10] Lalizas, "LALIZAS Lifebuoy Ring SOLAS, with Reflective Tape." [Online]. Available: https://www.lalizas.com/product/25-lifebuoy-rings/2833-lalizas-lifebuoy-ring-solas-with-reflective-tape. [Accessed: 12-Oct-2019].