



Seatooth®

Radio Frequency (RF) Electromagnetic Broadband Modem for through water and through ground communications.



USER MANUAL

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INTRODUCTION

WFS (WIRELESS FIBRE SYSTEMS LIMITED) is the world's leading developer of through-water and through-ground Radio Frequency (RF), electromagnetic communications and sensing products.

The Seatooth® uses the latest RF digital technology to enable high data rate transmission over short range underwater.

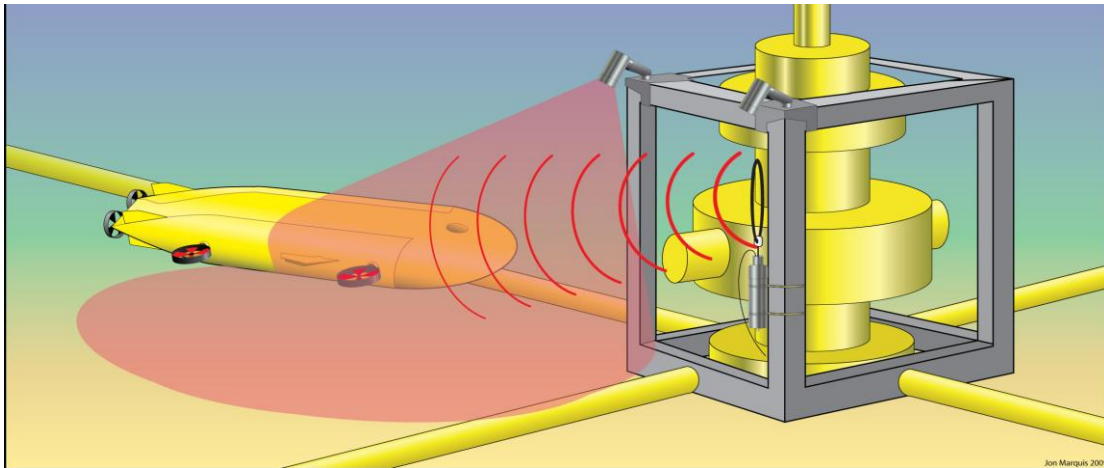
Seatooth® is a transparent Ethernet bridge with a bit rate of 100kbps shared between upstream and downstream.

A network bridge is a device which connects network segments at the layer 2 of the OSI model known as the Data-link layer, and Seatooth® does just that; it sits in-line on an Ethernet network between 2 network segments. It's referred to as a transparent bridge because it has no addresses – it simply accepts and forwards traffic as if it weren't there

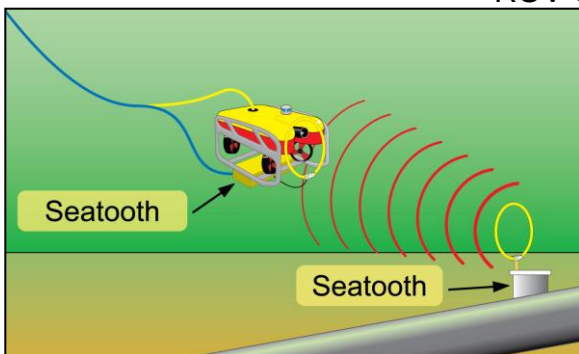
Key Features	Benefits
Crosses water/air interface	Removes need for cable to shore Removes need for repeater buoy Unobtrusive, covert, no navigation hazard
High data transfer rate	Reduced operating time Reduced operating costs Fast access to data
Connector replacement`	No connector mate at depth or complex vehicle docking
Transceiver	Two way communications
Shorter download times	Reduced power consumption
Immunity to acoustic noise	Can operate in littoral or near offshore facilities / vessels generating acoustic noise
Immunity to particulates	Can operate in turbid water
Immunity to multi-pathing	Can operate in shallow water or congested environments such as harbours/estuaries
No effect on acoustic transmission	No interference with or harm to aquatic life No interference with acoustic sensors or Sonar

This document is designed to quickly familiarize you with the hardware and the software components of the Seatooth®. In addition you will find setup, cable connections, software installation and operating instructions for the Seatooth®.

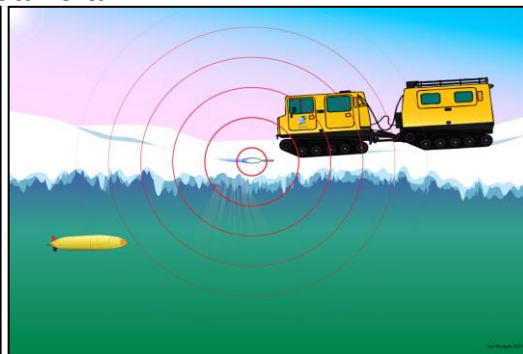
TYPICAL APPLICATIONS DRAWINGS



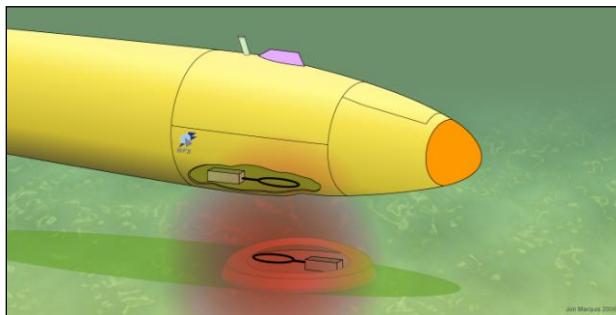
ROV Camera



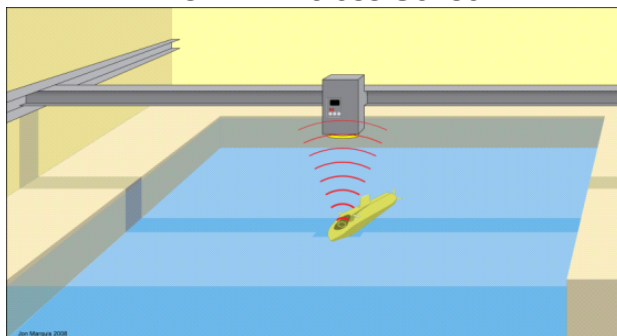
ROV – Wireless Sensor



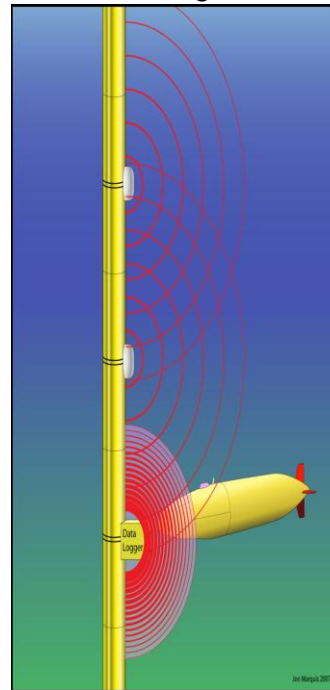
AUV through Ice



ROV – Wireless Sensor



Test Tank Comms



Riser Comms

SETUP

HOUSINGS

There are two options for housing the Seatooth®: one will enable the user to fit the Seatooth® to a DIN rail and the other is a depth rated (50m) waterproof enclosure.

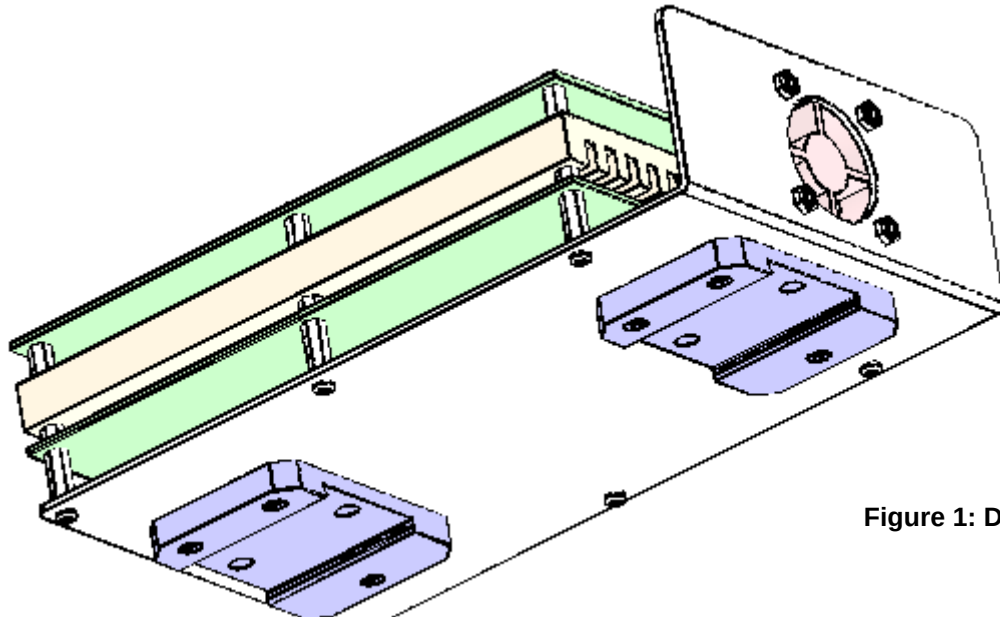


Figure 1: DIN Rail

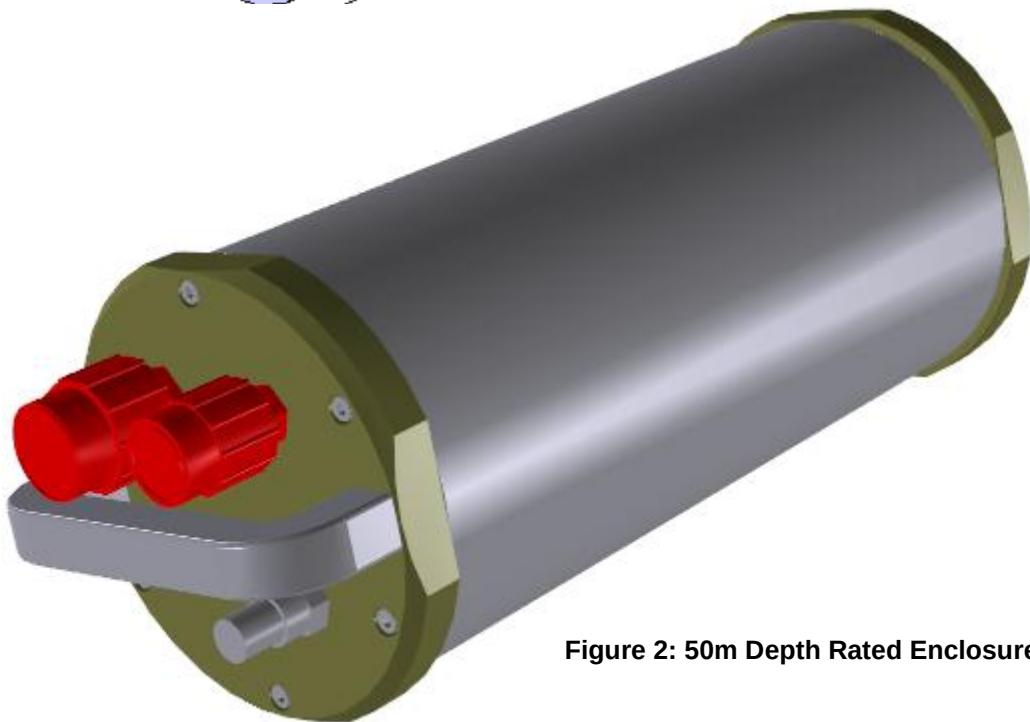


Figure 2: 50m Depth Rated Enclosure

DIN RAIL HOUSING HANDLING PROCEDURES

GENERAL

Seatooth is designed to be fitted to a DIN rail within a suitable enclosure. The unit must be handled with care as it is vulnerable to ESD damage (See below) and mechanical damage during fitting and wiring operations.

POWER SUPPLY

The Seatooth® requires electric power at 24v DC nominal supply, operating current typically between 500mA. The Seatooth® will however function correctly at any voltage in the range 20v DC to 28v DC. The power supply should be from a regulated and smooth (low ripple) power supply for best results. An unregulated or un-smoothed supply should not be used.

ELECTROSTATIC SENSITIVE DEVICES

Certain semiconductor devices used in the equipment are liable to damage due to static voltages.

Observe the following precautions when handling these devices in their un-terminated state, or sub-units containing these devices:

- Persons working on the modem must be earthed by a wrist strap via a 1MΩ resistor to a suitable discharge reference point within the equipment.
- Outer clothing worn must be unable to generate static charges.

PRE AND POST-DIVE CHECKS:

- Check that the interconnecting cables are secure, do not bend past their recommended bend radius and are undamaged.
- Check that the mountings are secure.

STORAGE

If the Seatooth® is taken out of service the connectors should be cleaned and blanked off.

SUBSEA HOUSING HANDLING PROCEDURES

GENERAL

The Seatooth® is designed for low maintenance operation using corrosion resistant materials, and generally speaking does not require any preventative maintenance. In addition there are no user serviceable parts inside the Seatooth®.

PRE AND POST-DIVE CHECKS:

- Check that the interconnecting cables are secure, do not bend past their recommended bend radius and are undamaged.
- Check that the mountings are secure.
- Locking tabs are in place on the Subsea enclosure.
- Check connector locking sleeves are in place.

STORAGE

If the Seatooth® is taken out of service, the connectors should be cleaned and blanked off and the unit thoroughly washed with fresh water.

ANTENNA HANDLING PROCEDURE

GENERAL

The antenna outer covering is made from polyurethane and is potted into an acetyl antenna joint. Continued reliability of the antennas is reliant on the joints not being bent or forced in such a way that would result in distorting the antenna shape.

PRE AND POST-DIVE CHECKS:

- Check connector locking sleeves are in place.

STORAGE

If the Seatooth® is taken out of service the connectors should be cleaned and blanked off.

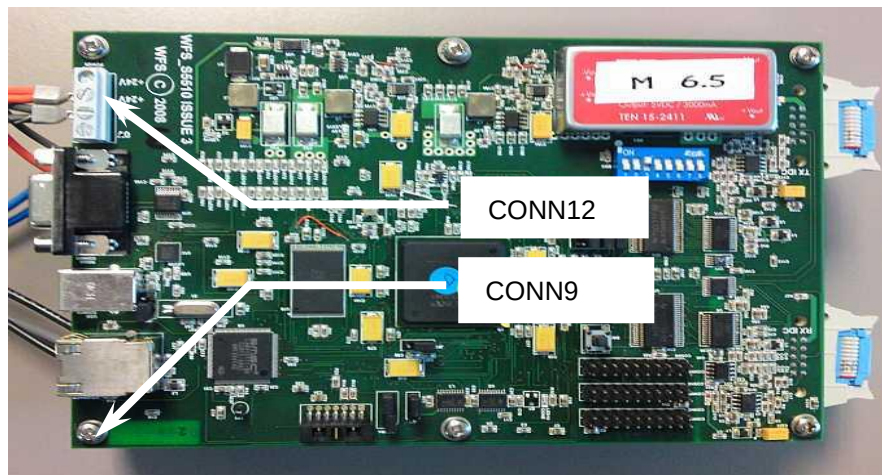
CONNECTORS HANDLING PROCEDURE

The connector should be made up in accordance with Subconn guidelines, as detailed below (taken from MacArtney Subconn standard literature):

- The connector should not be exposed to long-term heat or sunshine. If this occurs, and the connectors are very dry, soak in fresh water before use.
- Ensure the connectors are lubricated - the recommended lubricant is Molykote 44 Medium - but use sparingly. Half a match head dose per contact is adequate.
- Any accumulation of sand or mud in the female contact should be removed with fresh water. Failure to do so could result in the splaying of the female contact and damage to the O-ring seals.
- Do not over tighten the bulkhead nuts.
- Do not disconnect by pulling on the cable and avoid sharp bends at cable entry.
- When using bulkhead connectors see that there are no angular loads as this destroys the connector.
- When disconnecting, pull straight, not at an angle. Ensure the above points are fulfilled to get the best out of your connectors. If in doubt, please contact your local distributor or MacArtney A/S for advice. The mated connector should be retained using the locking sleeve supplied. This ensures that the connector does not become inadvertently partially or fully disconnected.

CONNECTIONS

DIN RAIL CONNECTIONS



Function	Board	Connector	Type	Pin	Comments
10BaseT Ethernet Port	Digital	CONN9	RJ45 Connector	All	Use a cross-over/straight cable to connect to this port as required
Power Supply (+ve)	Digital	CONN12	Screw Terminal	1	24V DC 0,5A.
Power Supply (-ve)	Digital	CONN12	Screw Terminal	3	Pins 2,4 are used to provide power to the Analogue board
Receive Antenna (A)	Analogue	PL10	Screw Terminal	1	Antenna A, B can be exchanged
Receive Antenna (B)	Analogue	PL10	Screw Terminal	3	
Receive Antenna (Screen)	Analogue	PL10	Screw Terminal	2	May be omitted for short cables
Transmit Antenna (A)	Analogue	TB402	Screw Terminal	TX COIL	Antenna A, B can be exchanged. Q DAMP terminals on TB402 must be linked.
Transmit Antenna (B)	Analogue	TB402	Screw Terminal	TX COIL	

ENCLOSURE CONNECTIONS

This section describes the connectors used on the Seatooth modem to provide Ethernet, power and antenna ports.

Three different Subconn connectors are used for these functions and they are chosen so that connectors cannot be fitted to a port with which they are not compatible.

For each function, the connector type is shown along with the mating part and the pin-out is defined.

ETHERNET CONNECTOR

Table 1 below shows the Ethernet bulkhead connector fitted to the Seatooth subsea enclosure and the mating in-line connector.

Ethernet Connection		
Connector Type	Subconn DBH8F	
Mating Part	Subconn DIL8M	

Table 1: Ethernet Connector

The Subconn in-line connector has a special subsea cable consisting of 4 pairs individually bound and surrounded by water block compound, a foil wrap and a braided screen. The wrap and the screen are not connected to any pins on the connector.

The cables are colour coded as described in Table 2 below.

BH8F and DIL8M Connectors			
Pin #	Signal	Pair	Colour
1	BI_DD-	4	Brown
2	BI_DD+		White/Brown
3	BI_DC+	1	Blue
4	BI_DC-		White/Blue
5	BI_DA-	2	Orange
6	BI_DA+		White/Orange
7	BI_DB-	3	Green
8	BI_DB+		White/Green

Table 2: Ethernet Subconn Connector Cable Colour Code

To complete the Ethernet connection, each signal must be routed to the appropriate pin of the final termination (typically an RJ45 jack) by way of any intermediate cable splices or connectors that are required.

POWER CONNECTORS

Power connections are made using miniature 4 pin Subconn connectors. The modem requires a voltage in the range 22 to 28V capable of supplying 0.5A. The connector pins are allocated as follows:

Modem Power Connections	
Pin	Function
1	Battery +ve (24 V nominal)
2	Battery -ve
3	(Not connected)
4	(Not connected)

Table 3: Modem Power Connections

Modem Power Connector	
Connector Type	Subconn MCBH4M
Connector Mating Part	Subconn MCIL4F

Table 4: Modem Power Connector

Battery Connections	
Pin	Function
1	Battery +ve (24 V nominal)
2	Battery -ve
3	Charger +ve (use pin#2 for return)
4	(Not connected)

Table 5: Battery Connections

Battery Connector	
Connector Type	Subconn MCBH4F
Connector Mating Part	Subconn MCIL4M

Table 6: Battery Connector

ANTENNA CONNECTOR

The connections for the antenna are made using an 8-pin Subconn connector.

The battery connections are only applicable where internal batteries are fitted, however a link is provided between pin #8 and #7 to allow the modem power to be cut when the antenna is removed.

Pin No.	Function	Colour
1	Tx Antenna A	Black
2	Tx Antenna B	White
3	Rx Antenna A	Red
4	Rx Antenna B	Green
5	Battery –VE	Orange
6	Screen	Blue
7	Battery Return to modem	White/Black
8	Battery +VE	Red/Black

Table 7: Antenna Connections

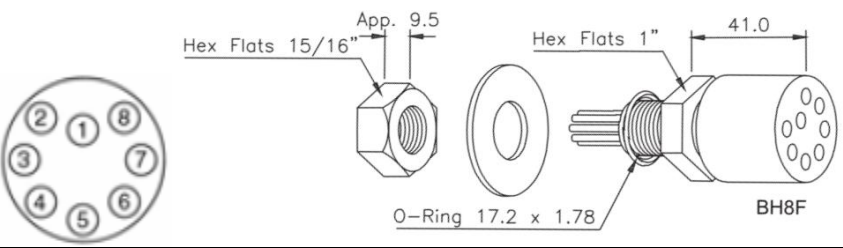
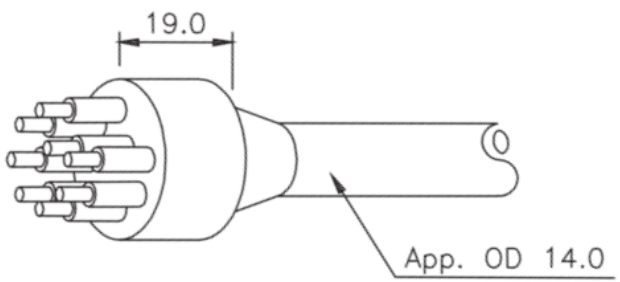
Antenna Connections	
Connector Type	Subconn BH8F 
Connector Mating Part	Subconn IL8M 

Table 8: Antenna Connector

Figure 3: Subconn Ethernet Connector

INSTALLATION

SAFETY NOTE

Before commencing installation of the Seatooth®:

- Refer to Safety Notes in this manual.
- All relevant parts of this section of the manual should be read and understood.

MECHANICAL INSTALLATION

When deciding where to mount the Seatooth®, consideration should be given to:

- Seatooth®'s location relative to magnetically active materials on the host system
- Rigidity of the mounting arrangement
- Collision protection
- Positioning the flask outside the loop of the antenna
- Positioning to allow sufficient airflow for cooling. (DIN Rail version only)

ANTENNA INSTALLATION

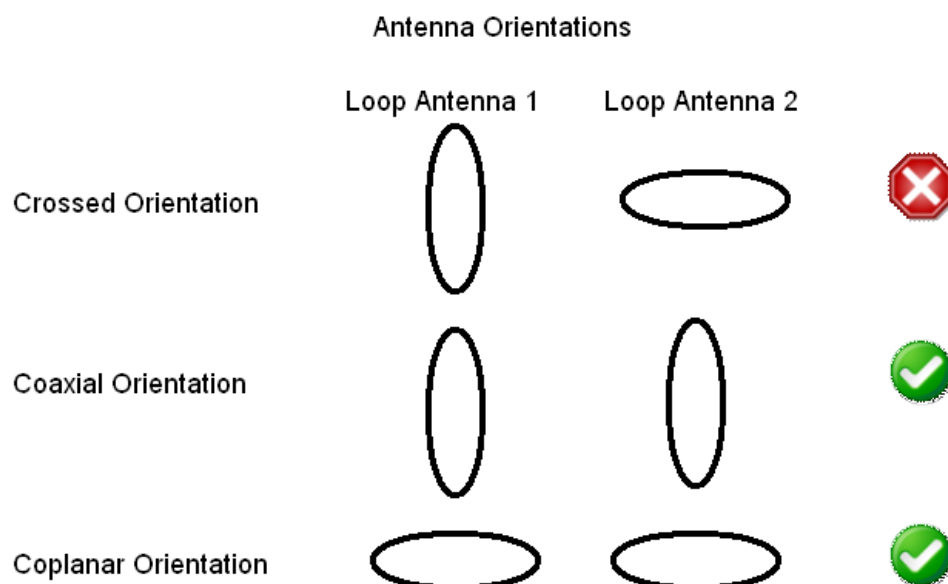


Figure 4: Antenna Orientation

NOTE: The orientation of the antennas is very important and will affect the system performance!

Coaxial and coplanar antenna orientations are optimal options for better signal strength as illustrated. The crossed orientation is the worst orientation and will result in degraded performance.

EMI (ELECTROMAGNETIC INTERFERENCE)

To reduce the effects of fixed magnetic disturbances on the Seatooth® output, it should be mounted as far as is practically possible from the following:

- Ferrous or other magnetically active materials (including fasteners or brackets used to mount the Seatooth®)
- Sources of electrically induced magnetic fields such as motors and transformers.
- Moving equipment (e.g. manipulator arms, pan & tilt units etc.)

RIGIDITY

The Seatooth® should be rigidly mounted so that flexibility and / or system vibration does not affect the outputs.

COLLISION PROTECTION

To protect against accidental damage, the Seatooth® should be mounted in a protected location. The protection around the Seatooth® should not be manufactured from a ferrous material.

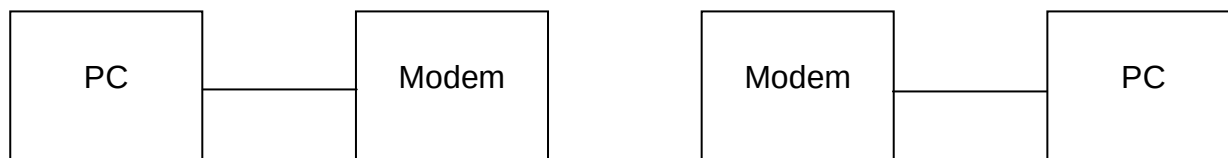
OPERATING INSTRUCTIONS

The Seatooth® modem is intended to be part of a LAN system; it is connected using an RJ45 socket providing a 10baseT physical connection.

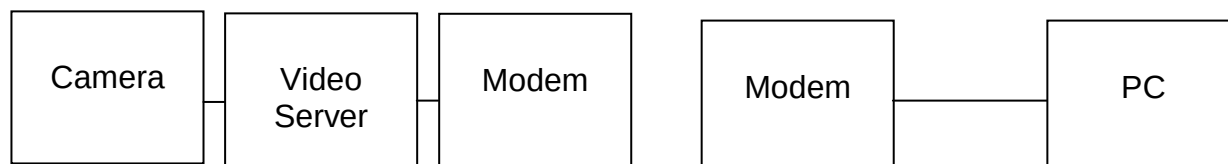
- The modem can transfer any valid Ethernet packet structure including UDP and TCP/IP.
- The modems are transparent and have no IP or other address.
- **The antenna must be connected before the modems are switched on.**

Below are typical setup block diagrams:

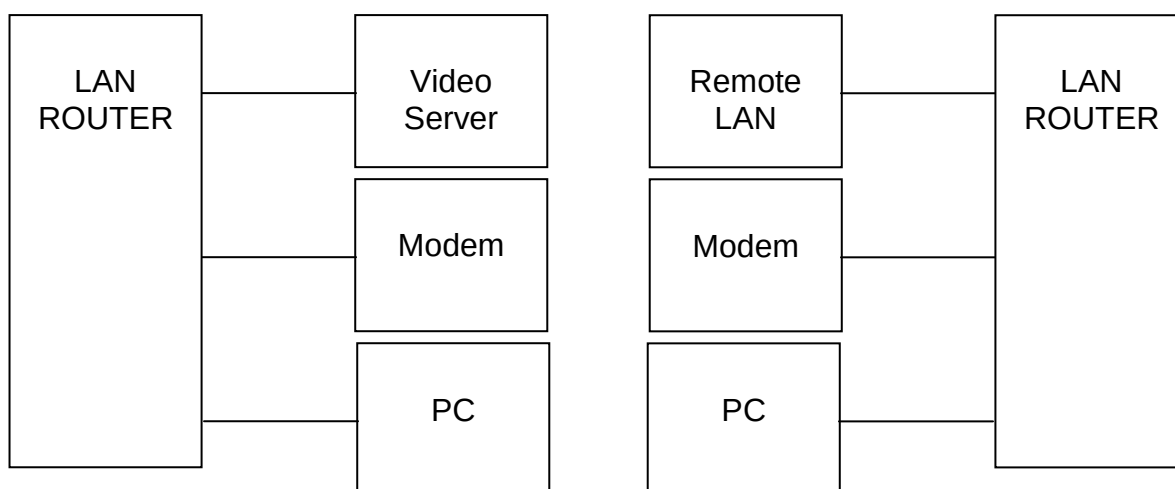
1. PC to PC Link



2. Video Link to PC



3. LAN Bridge



SAFETY & REGULATIONS

SAFETY STATEMENTS

GENERAL

All installation, operation, maintenance and repair works must be carried out by competent personnel.

It is the responsibility of the installer to ensure Seatooth® modems and associated components are installed in suitable locations and in a safe manner.

Seatooth® should be installed, commissioned, operated and maintained in accordance with this instruction manual. It should be used within the maximum operating conditions given in Appendix A - Seatooth® Supply Specification. Failure to do so may lead to safety hazards or equipment failure.

Before starting installation, commissioning, operation or maintenance of the SEATOOTH®, personnel should read and understand all relevant sections of this manual.

Any queries, comments or suggestions regarding the content of this manual or the safe installation, operation or maintenance of the Seatooth® should be referred to WFS.

ELECTRICS

DIN RAIL ELECTRICS

Hazardous voltages may be present on any screw terminal and the printed circuit assemblies, ensure power supply is off before working on modem connections.

ENCLOSURE ELECTRICS

There are no user serviceable parts inside the Seatooth® in the Subsea enclosure. Before doing any work inside the Seatooth® the electrical power supply to the Seatooth® should be isolated and the power connector unplugged. Be aware hazardous voltages may be present on bulkhead connectors.

REGULATIONS

ROHS COMPLIANCE

All the components used in the production of this unit are RoHs Compliant.

CONTACT DETAILS

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Web: www.wirelessfibre.co.uk Email: service@wirelessfibre.co.uk

WFS Defense Inc

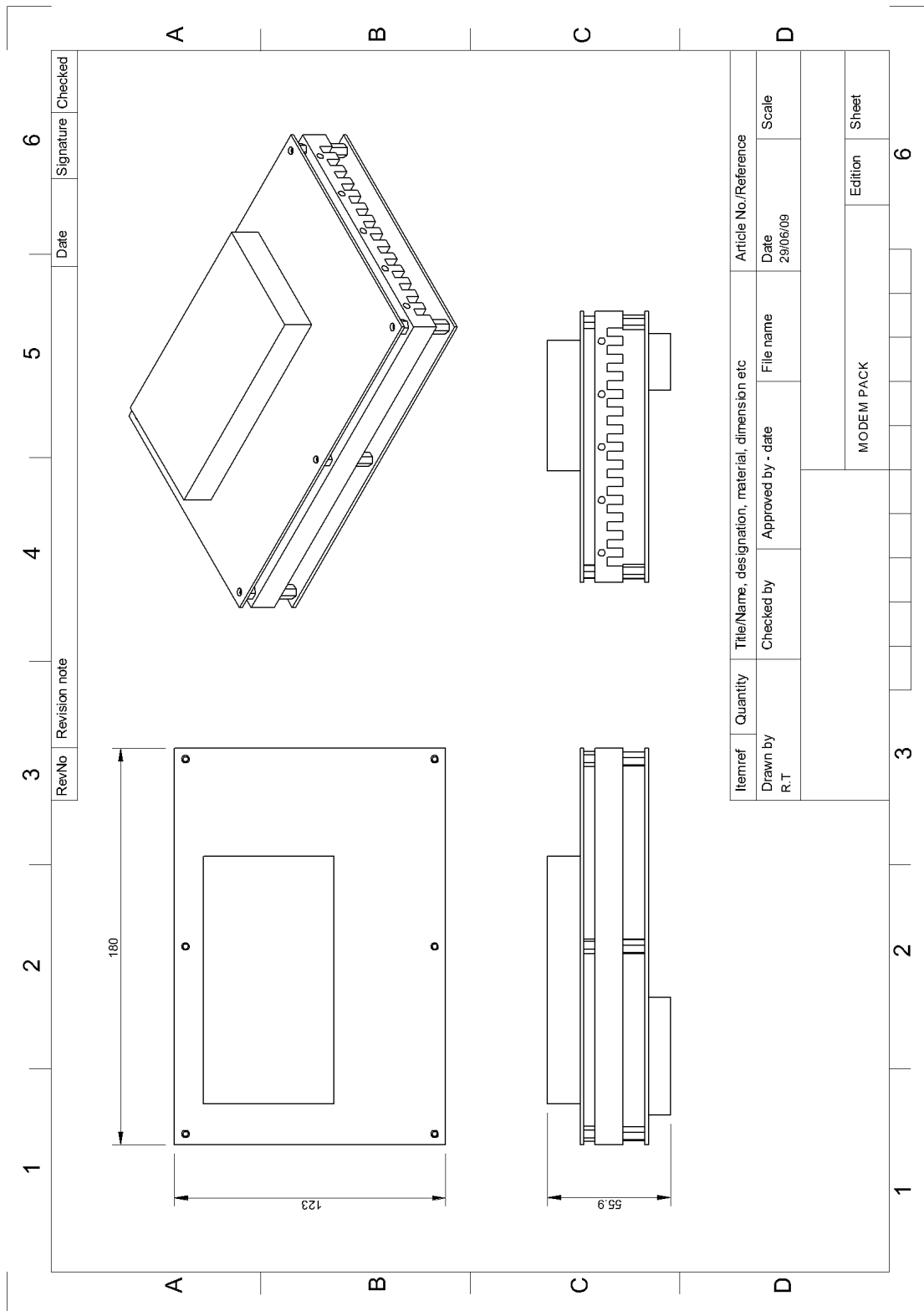
P.O. Box 10036, Alexandria, VA 22310, USA

Tel: +1 (703) 229-3121

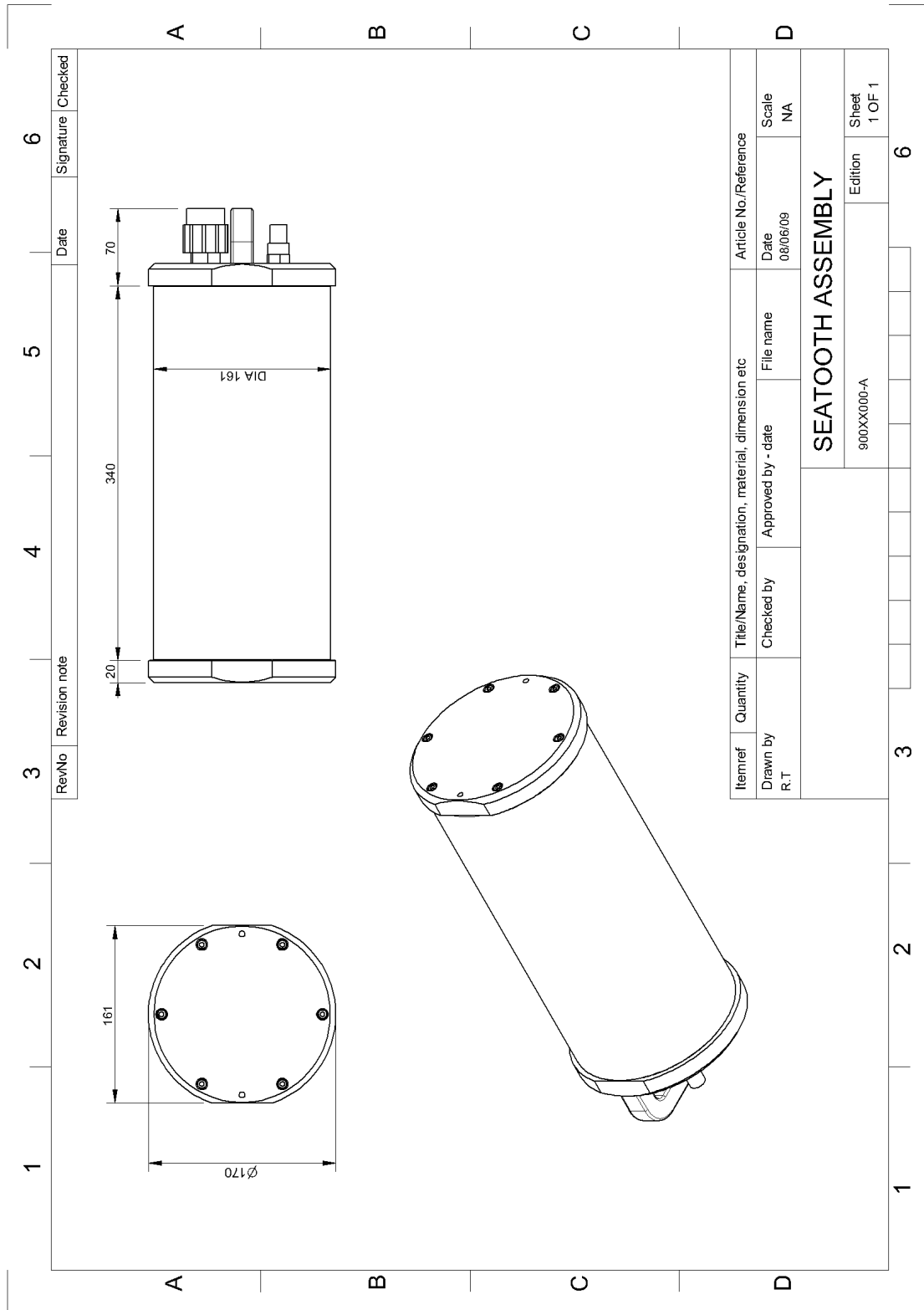
Web: www.wfsdefense.com Email: service@wfsdefense.com

Seatooth® Specifications			
Item	Value	Units	Comments
Common			
Function	Transparent Ethernet bridge		
Operating Temperature Range	0 to 40	°C	
Storage Temperature Range	-10 to 50	°C	
Bandwidth	100	kbps	Shared between upstream and downstream data
Range in air	10	m	Typical, standard 0.5m diameter antennas
Range in sea water	5	m	Typical, standard 0.5m diameter antennas
Interface	10baseT Ethernet		
Subsea Enclosure			
Dimensions	Depends on enclosure	mm	enclosure only, including flange cap
Weight in air	Depends on enclosure		approximate, including battery and antenna
Maximum operating depth	100	m	
Antenna connection	Subconn BH8F		mates with IL8M, also used for battery charging
Data Connection	Subconn DBH8M		mates with DIL8F
Battery Connection	Subconn MCBH4M		Mates with MCIL4F
Power requirements	24	V	DC 0.5A
Endurance	4	H	(with 2700 mAH NiMH battery)
DIN Rail Fitting			
Dimensions			Modem only
Weight in air			
Antenna connections	Screw terminal		Transmit x2, Receive x2+screen
Power connections	Screw terminal		
Data Connection	RJ45		
Power Requirement	20 to 28	V.DC	0.5A capacity, ripple <1%

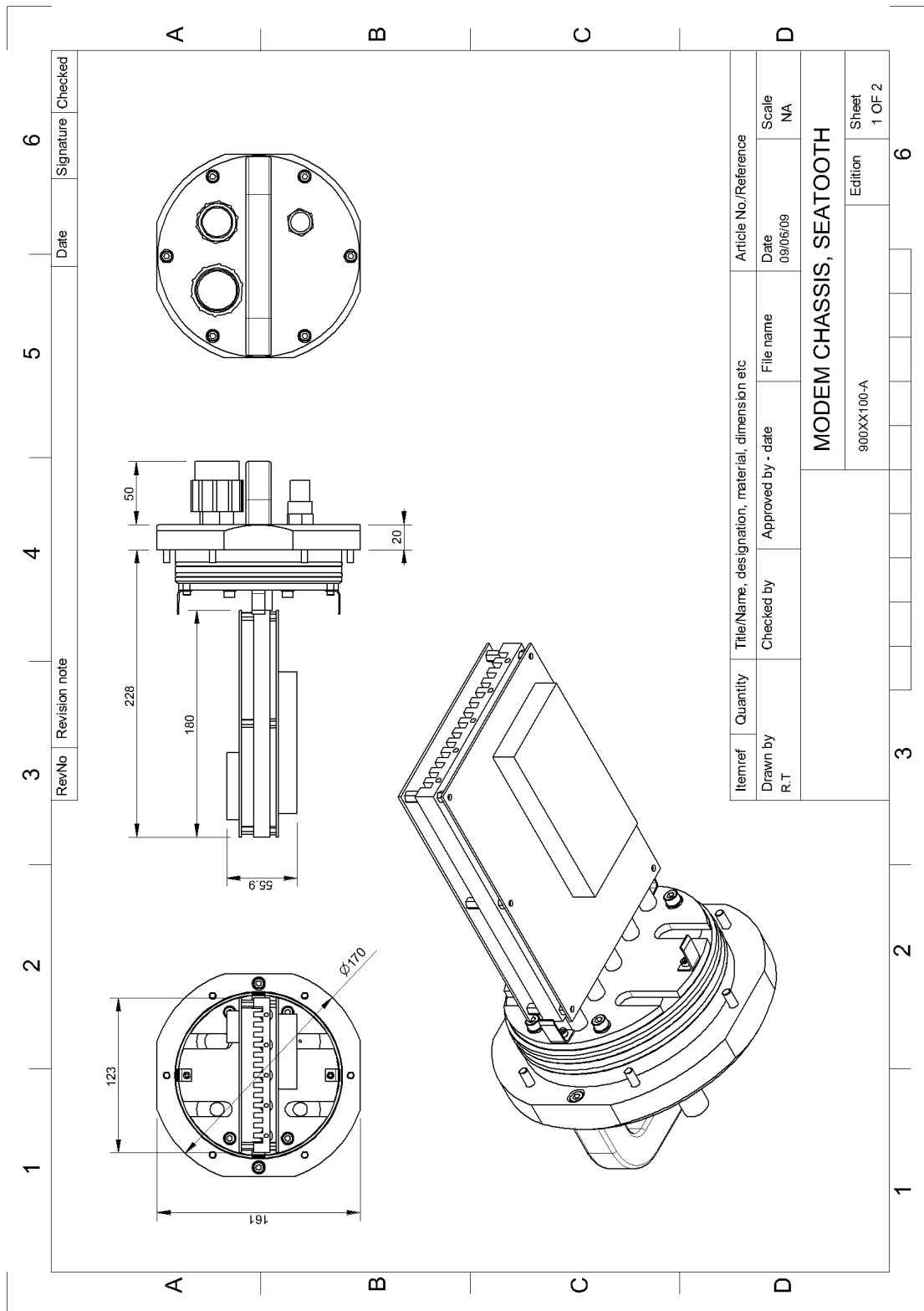
Appendix 1: Seatooth Specification



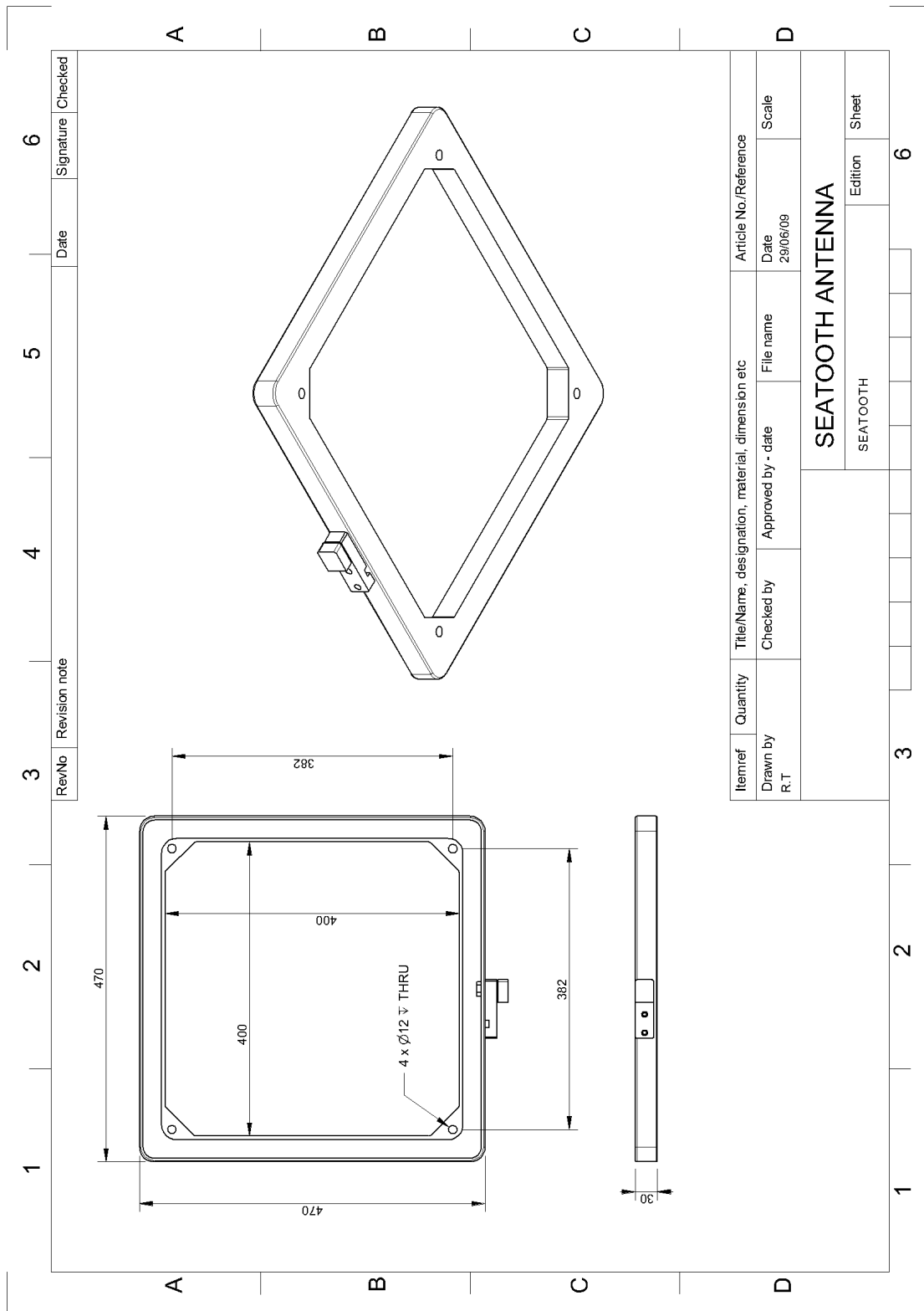
Appendix 2: DIN Rail Housing Dimensions



Appendix 3: Subsea Housing Exterior Dimensions



Appendix 4: Subsea Housing - Internal Chassis



Appendix 5: Subsea Antenna