C2Pro

Quick Start Guide

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Quick Start Guide

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1 Preface

1.1 Meaning of Symbols

A host of symbols is used throughout the document, representing the following:

⚠	**Warning:**	Failure to heed this warning may pose a risk to the safety of USV personnel, and/or may damage the equipment.
⚠	**Important:**	Equipment may not work as intended if this information is ignored.
ⓘ	**Information:**	Additional information, to add to the understanding and knowledge of USV personnel.

1.2 Warning ⚠

- Users are responsible for the safety of their vessel, and the passengers and crew onboard.
- Never leave the control station unattended and stay alert for navigational hazards; the USV **cannot** avoid obstacles.
- Never operate the system under the influence of drugs or alcohol.
- Always refer to this manual for operational information.
- Always complete the **pre-operations checklist** before operating the USV.

1.3 Caution ⚠

- You should learn to operate the USV in hazard-free open water.
- Always cross check the latest naval charts for new construction projects.
- You must ensure the SIM cards of the 4G router are charged before any operation.

1.4 Disclaimer

- Please ensure that you take all relevant safety precautions while operating your unmanned surface vehicle (USV). The manufacturers and suppliers of all MAP-Tech products, including the C2Pro GCS, are not responsible for any accident that may occur from the use of their equipment or otherwise.
- The information contained in this document is accurate at the time it was produced. MAP-Tech cannot accept any liabilities for missing or outdated information. Additionally, due to our policy of constant product improvement, specifications may change without notice. To keep up-to-date with our products and services, contact your supplier or visit our website.
- MAP-Tech is not responsible for any damage or injury caused by the integration of third-party equipment with the USV or MAP Pro Autonomous Conversion System.
- The C2Pro and related equipment do not contain any user-serviceable parts. All maintenance and service work must be carried out by an authorized dealer. You may lose your product warranty otherwise.
- The warranty on this product is void if you sell the product to another party, as well as in the event of any equipment failure due to improper use or handling.

1.5 Best Practices

Please use this section as a guide. It is not intended to be a substitute for formal training in USV operations or any requirement of law.

1. Only a licensed captain should take manual control of the USV.
2. Ensure all personnel is trained in manned and unmanned operations of the USV.
3. Ensure the captain is familiarized with all safety aspects of the vessel.
4. Respect the concerns of the public and maritime community as they relate to USV operations.
5. Ensure a communication protocol is in place with the GCS.

6. Complete the pre-operations checklist before an operation.
7. Ensure only trained personnel familiar with the operation are involved.

2 Start-Up Procedure

ⓘ *Before using the GCS, make sure your USV is powered on.*

2.1 C2Pro Setup

Powering on the C2Pro

1. Connect the C2Pro to a **shore power supply** (rated at 230V/16A @ 50 Hz).
2. Turn the **master** switch on the front of the C2Pro to the **ON** position, as shown below:

Fig. 1: Master switch on the C2Pro

3. Click the power button on the C2Pro to power up the monitors, as shown below in Fig. 2:

Fig. 2: Power button and indicators on the C2Pro

ⓘ The C2Pro can be operated for only **1 hour** without an external power source.

ⓘ If you are using the shore power inlet to supply power to the C2Pro, the charging LED will light up as well.

ⓘ For more information on the C2Pro, refer to the ***C2Pro Quick User Guide***.

Checking for an Internet connection

1. From the Start window, open the command line window (search “CMD”):

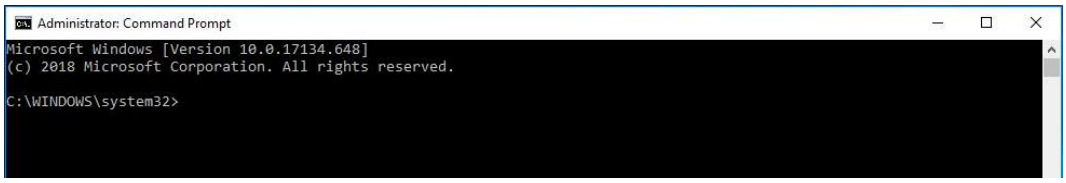


Fig. 3: CMD window

2. Enter the following command to ping the 1.1.1.1 DNS:

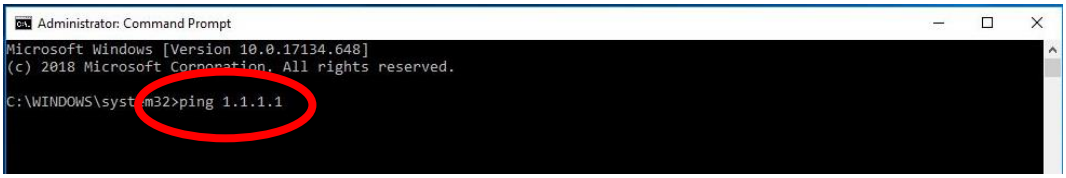


Fig. 4: Checking for an Internet connection

3. If the ping is successful, proceed with the rest of the procedure:

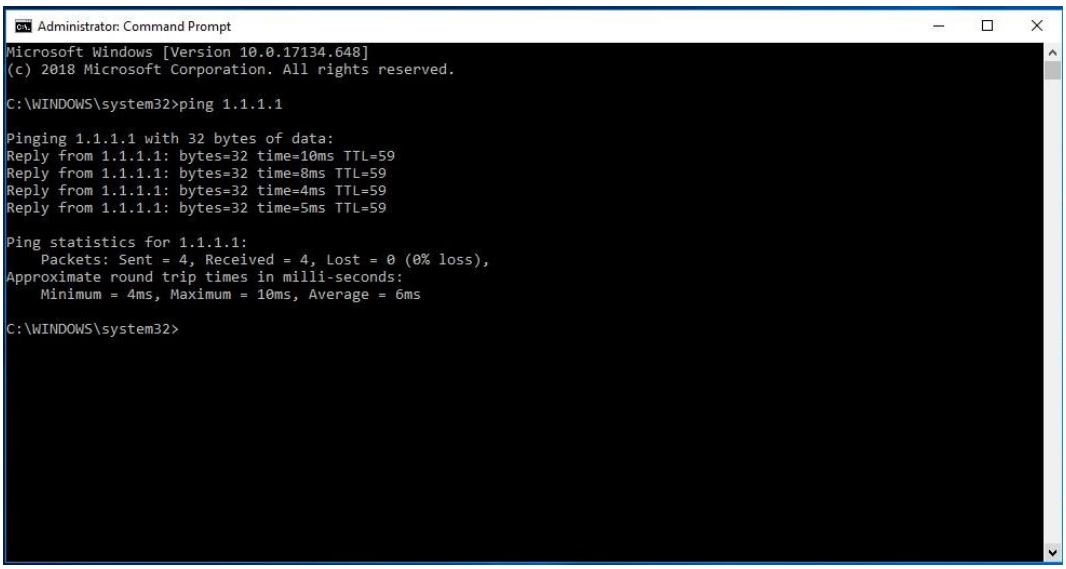


Fig. 5: Internet connection confirmed

ⓘ You must have an Internet connection on the C2Pro to conduct an unmanned operation with your USV.

ⓘ The router you are using to provide your C2Pro with an Internet connection must **not** be on the same subnet as the MAP Pro (192.168.1.x). Please change the IP address of the router before proceeding.

2.2 C2Pro Desktop

Desktop Layout

The computer equipped on the C2Pro runs the Windows 10 operating system. The Desktop is illustrated below:

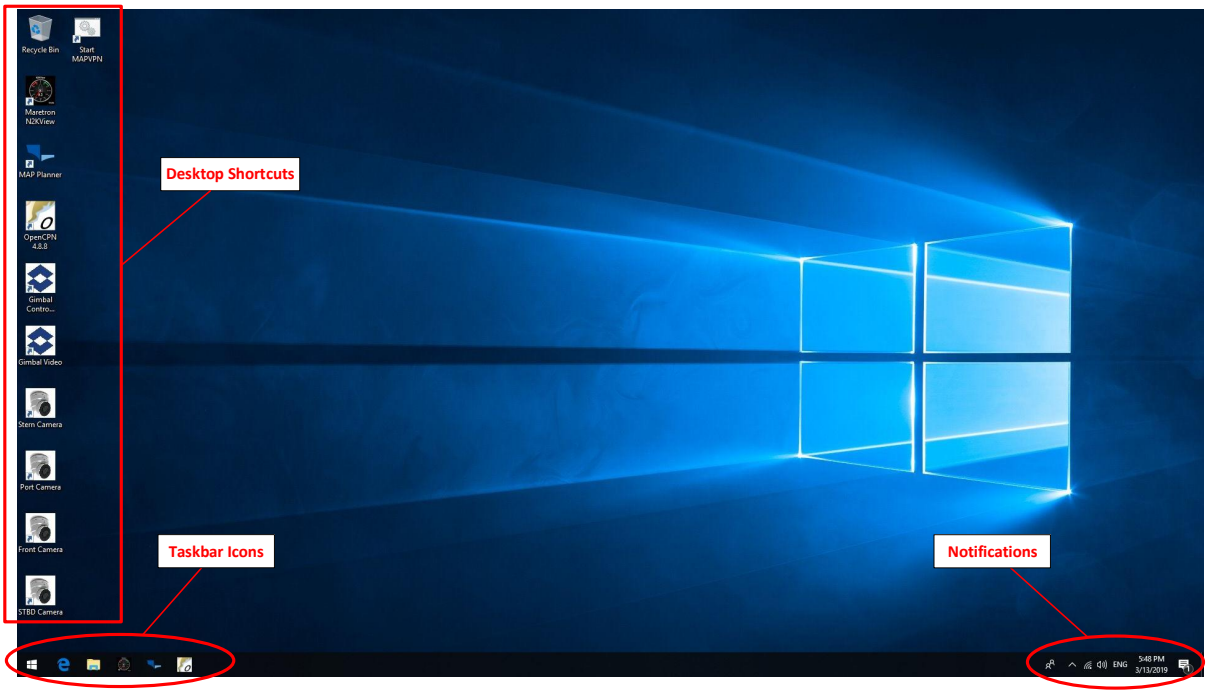
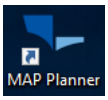
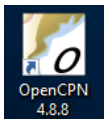


Fig. 6: Desktop on the C2Pro

Applications on the C2Pro

To successfully operate the USV from the C2Pro, you may use the following applications available on the Desktop, listed with their functions below:

Table 1: Applications on the C2Pro Desktop

Application Name	Application Icon	Function
MAP Planner		• Enable remote manual control • Plan routes in autonomous mode • Switch operating modes of the MAP Pro Autopilot • Monitor USV position
Vessel Management Software (Edition: Maretron N2KView)		• View engine data from the USV • View USV orientation data
OpenCPN		• Control the radar • View navigational information from the radar
Gimbal Video		• View video stream from the EO/IR gimbal of the USV

Gimbal Control Software		• Access the control interface of the EO/IR gimbal of the USV
Fixed Camera		• Access video stream from a fixed camera (ex., front, stern, port, STBD, cabin)

You may also access some of these applications from the Taskbar icons, as shown below:

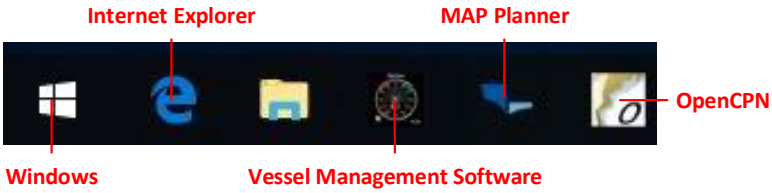


Fig. 7: Application icons on the C2Pro Taskbar

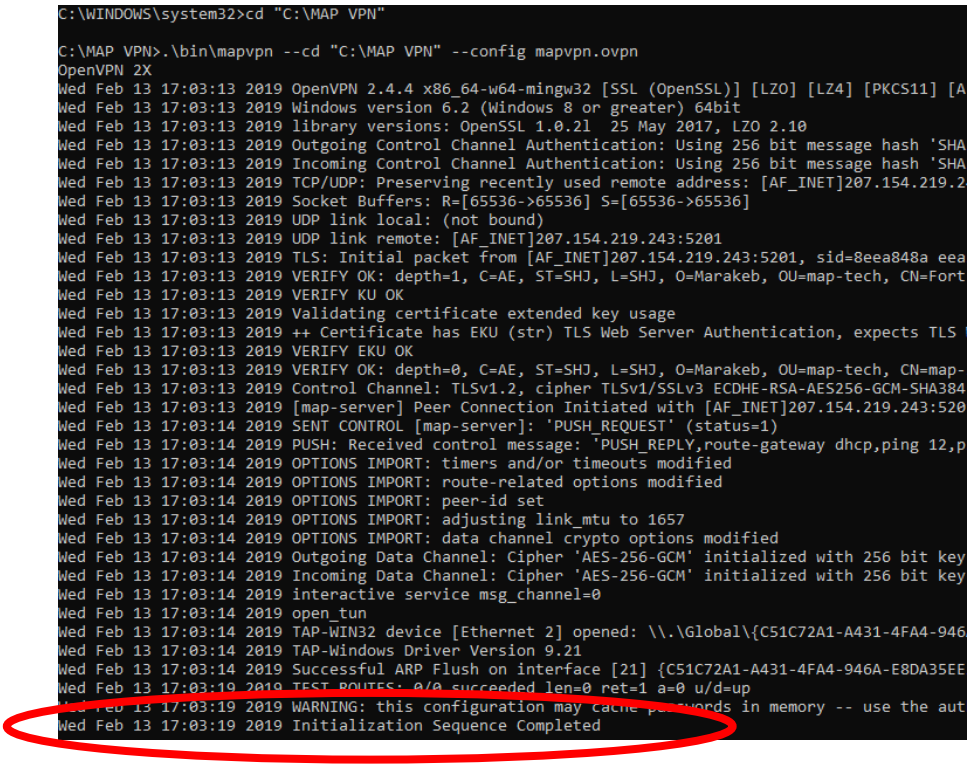
MAP VPN Initialization

⚠ Run the MAP VPN before every operation. Otherwise, you will not be able to connect to the USV.

1. From the GCS Desktop, run the **MAP VPN** by clicking on the **Start MAP VPN** application:

Fig. 8: MAP VPN application

2. From the resulting window, search for the following message ("*Initialization Sequence Completed*") to indicate that the VPN is running:



```
C:\WINDOWS\system32>cd "C:\MAP VPN"

C:\MAP VPN>.\bin\mapvpn --cd "C:\MAP VPN" --config mapvpn.ovpn
OpenVPN 2X
Wed Feb 13 17:03:13 2019 OpenVPN 2.4.4 x86_64-w64-mingw32 [SSL (OpenSSL)] [LZO] [LZ4] [PKCS11] [A
Wed Feb 13 17:03:13 2019 Windows version 6.2 (Windows 8 or greater) 64bit
Wed Feb 13 17:03:13 2019 library versions: OpenSSL 1.0.2l  25 May 2017, LZO 2.10
Wed Feb 13 17:03:13 2019 Outgoing Control Channel Authentication: Using 256 bit message hash 'SHA
Wed Feb 13 17:03:13 2019 Incoming Control Channel Authentication: Using 256 bit message hash 'SHA
Wed Feb 13 17:03:13 2019 TCP/UDP: Preserving recently used remote address: [AF_INET]207.154.219.2
Wed Feb 13 17:03:13 2019 Socket Buffers: R=[65536->65536] S=[65536->65536]
Wed Feb 13 17:03:13 2019 UDP link local: (not bound)
Wed Feb 13 17:03:13 2019 UDP link remote: [AF_INET]207.154.219.243:5201
Wed Feb 13 17:03:13 2019 TLS: Initial packet from [AF_INET]207.154.219.243:5201, sid=8eea848a eea
Wed Feb 13 17:03:13 2019 VERIFY OK: depth=1, C=AE, ST=SHJ, L=SHJ, O=Marakeb, OU=map-tech, CN=Fort
Wed Feb 13 17:03:13 2019 VERIFY KU OK
Wed Feb 13 17:03:13 2019 Validating certificate extended key usage
Wed Feb 13 17:03:13 2019 ++ Certificate has EKU (str) TLS Web Server Authentication, expects TLS
Wed Feb 13 17:03:13 2019 VERIFY EKU OK
Wed Feb 13 17:03:13 2019 VERIFY OK: depth=0, C=AE, ST=SHJ, L=SHJ, O=Marakeb, OU=map-tech, CN=map-
Wed Feb 13 17:03:13 2019 Control Channel: TLSv1.2, cipher TLSv1/SSLv3 ECDHE-RSA-AES256-GCM-SHA384
Wed Feb 13 17:03:13 2019 [map-server] Peer Connection Initiated with [AF_INET]207.154.219.243:520
Wed Feb 13 17:03:14 2019 SENT CONTROL [map-server]: 'PUSH_REQUEST' (status=1)
Wed Feb 13 17:03:14 2019 PUSH: Received control message: 'PUSH_REPLY,route-gateway dhcp,ping 12,p
Wed Feb 13 17:03:14 2019 OPTIONS IMPORT: timers and/or timeouts modified
Wed Feb 13 17:03:14 2019 OPTIONS IMPORT: route-related options modified
Wed Feb 13 17:03:14 2019 OPTIONS IMPORT: peer-id set
Wed Feb 13 17:03:14 2019 OPTIONS IMPORT: adjusting link_mtu to 1657
Wed Feb 13 17:03:14 2019 OPTIONS IMPORT: data channel crypto options modified
Wed Feb 13 17:03:14 2019 Outgoing Data Channel: Cipher 'AES-256-GCM' initialized with 256 bit key
Wed Feb 13 17:03:14 2019 Incoming Data Channel: Cipher 'AES-256-GCM' initialized with 256 bit key
Wed Feb 13 17:03:14 2019 interactive service msg_channel=0
Wed Feb 13 17:03:14 2019 open_tun
Wed Feb 13 17:03:14 2019 TAP-WIN32 device [Ethernet 2] opened: \\.\Global\{C51C72A1-A431-4FA4-946
Wed Feb 13 17:03:14 2019 TAP-Windows Driver Version 9.21
Wed Feb 13 17:03:14 2019 Successful ARP Flush on interface [21] {C51C72A1-A431-4FA4-946A-E8DA35EE
Wed Feb 13 17:03:19 2019 TEST ROUTES: 0/0 succeeded len=0 ret=1 a=0 u/d=up
Wed Feb 13 17:03:19 2019 WARNING: this configuration may cache passwords in memory -- use the aut
Wed Feb 13 17:03:19 2019 Initialization Sequence Completed
```

Fig. 9: Initializing the MAP VPN

3. Minimize the CMD window in Fig. 9. Keep the window minimized throughout the operation.

⚠ Do not close the window in Fig. 9 on page 9. Otherwise, you will lose connection to the USV.

ⓘ You can check if the TAP adapter is connected after the MAP VPN has been initialized. Check the adapter options on your computer for the following:

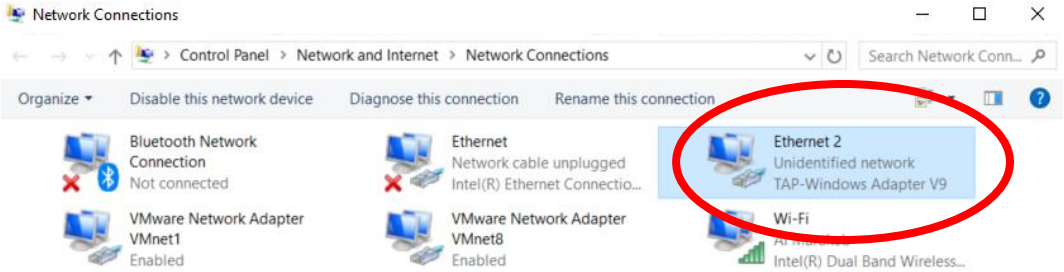


Fig. 10: The TAP adapter

⚠ Ensure the IPv4 properties of the TAP adapter are correct:

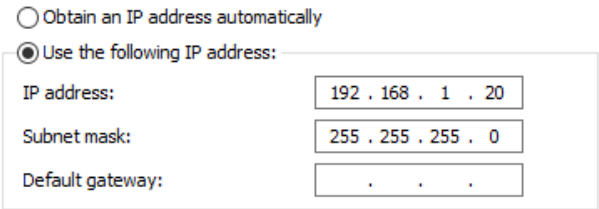


Fig. 11: Correct IP address and subnet mask for the TAP adapter

4. Open a new CMD window.
5. Repeat the steps on page 6 to ping the following IP address:
   - 192.168.1.2

ⓘ This is the IP address of the MAP VPN server. It confirms that the C2Pro is on its network.

⚠ If the ping is unsuccessful, check the C2Pro Internet connection or your TAP adapter settings.

6. If the ping is successful, repeat step 5 for the following IP address:
   - 192.168.1.10

ⓘ This is the IP address of the MAP Pro on your USV. It confirms that the C2Pro and the USV are on the network of the server from step 5.

⚠ If the ping is unsuccessful, make sure your USV has an Internet connection.

Activating the MAP USB Joystick

*The following procedure requires the use of the MAP Planner application. For more details, please refer to the **MAP Planner Manual**.*

1. Click on the MAP Planner icon from the Taskbar on the GCS monitor.
2. From the top of the screen, click on the **Connect** button, in order to access the MAP Pro of your USV:

Fig. 12: Connecting to the MAP Pro

3. From the MAP Planner window, select the option for **joystick control**, as shown below:

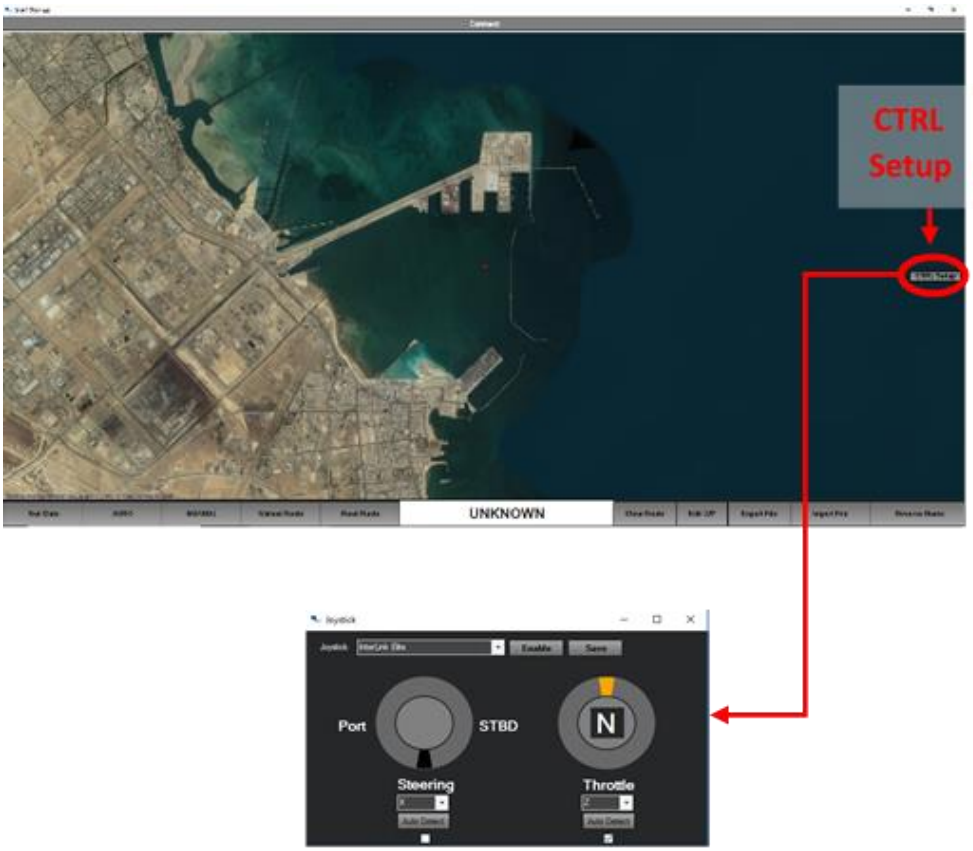


Fig. 13: The **joystick** window on the MAP Planner

4. Enable the MAP USB Joystick, as instructed in Fig. 14:

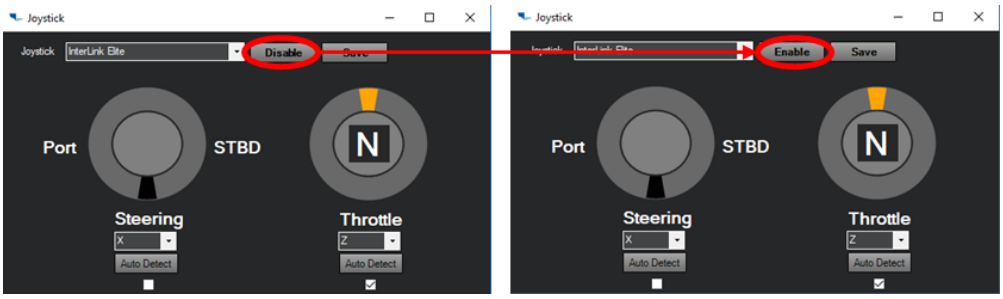


Fig. 14: Enabling the MAP USB Joystick from the MAP Planner

5. Set the MAP USB Joystick controls to the **neutral** (center) position, shown below:

Fig. 15: MAP-Tech USB Joystick in the neutral position

2.3 USV Control and Navigation

Vessel Operations

Please refer to the MAP Planner Manual for more information on this section.

Steering the USV

1. Ensure the MAP USB Joystick is enabled.
2. Use the control axis on the **right** to steer the vessel left or right (port or starboard), as shown below:

Fig. 16: MAP-Tech USB Joystick

Controlling USV throttle

1. Ensure the MAP USB Joystick is enabled.
2. Use the control axis on the **left** to increase or decrease the throttle of the vessel, as shown below:

Fig. 17: MAP-Tech USB Joystick

Route Planning

You can use the **MAP Planner** to upload a route for the USV to follow autonomously. You may either create the route yourself or upload a predetermined route. Please refer to the MAP Planner Manual on instructions on how to accomplish that.

Remote Switching

The Map Pro Autopilot on your USV is equipped with 5 programmable solid-state relays, as shown in Fig. 18**.** These relays can be controlled through the MAP USB Joystick or the optional redundant controller (refer to Appendix A) packaged with your MAP Pro Autonomous Conversion System. Their configuration is illustrated below:

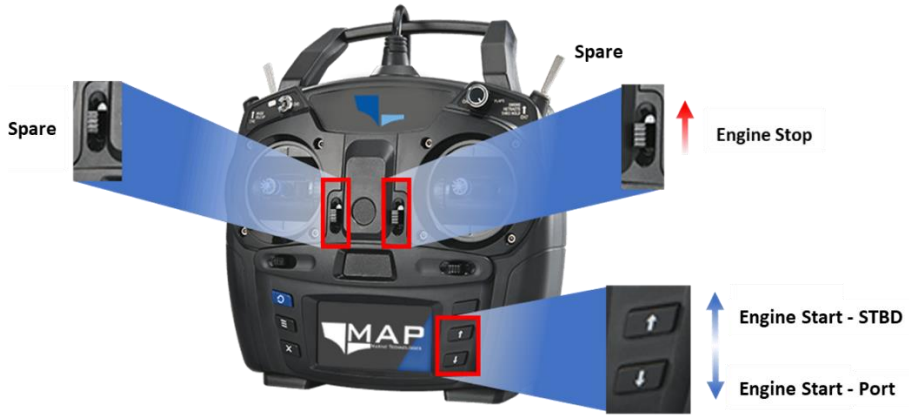


Fig. 18: Programmable solid-state relays on the MAP USB Joystick

Opening the Vessel Management Software

1. From the Taskbar on the C2Pro, click on the **Vessel Management Software** .
2. Select **Accept** when prompted.
3. Observe the controls on the Vessel Management Software from the interface below:

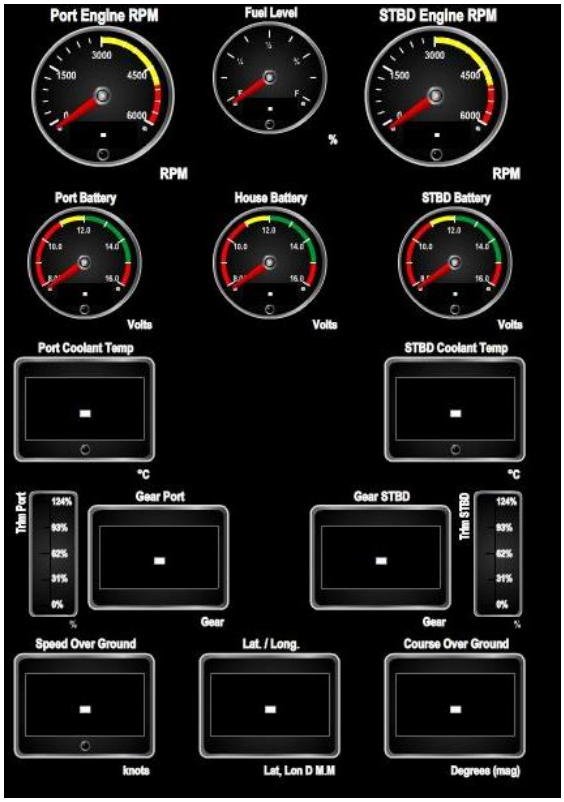
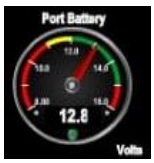
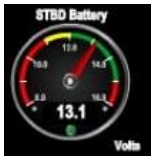


Fig. 19: Vessel Management Software

ⓘ When you open the Vessel Management Software, you can verify whether a communications link has been established between the USV and GCS. If there is no link, the engine data widgets do not display any information.

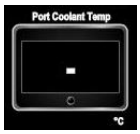
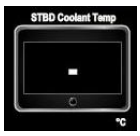
On the application interface, you will find a set of gauges, with their functions described in Table 2:

Table 2: Gauges on the Vessel Management Software

Gauge	Description	Function
Engine RPM gauges	 	• Display the RPM of the port and STBD engines
Fuel level meter		• Displays the fuel level of the USV as a percentage (%) of the total volume
Battery voltage gauges	  	• Display voltage levels for the port, STBD, and electronics batteries, in volts

Below the gauges are two widgets, describing the pressure engine coolant temperatures:

Table 3: Coolant temperature widgets on the Vessel Management Software

Gauge	Description	Function
Engine coolant temperature widgets	 	• Display the temperatures of the port and STBD engine coolants, in °C

Next, two widgets display the current gear selection for the USV engines:

Table 4: Gear selection widgets on the Vessel Management Software

Gauge	Description	Function
Gear selection widgets	 	• Display the current gear selection of the engines: F – forward, R – reverse, N – neutral

Besides the gear selection widget for each engine is the engine trim level meter:

Table 5: Trim level meters on the Vessel Management Software

Gauge	Description	Function
Engine trim level meters	 	• Display the trim level of the port and STBD engines, in %

The final set of widgets relays information on the speed, position and orientation of the vessel:

Table 6: Dynamic vessel data on the Vessel Management Software

Gauge	Description	Function
Speed over ground		• Reports the speed of the vessel w.r.t. to ground, in knots
Course over ground		• Displays the direction in which the vessel is moving with respect to magnetic north, in degrees
Latitude/Longitude		• Displays the position of the vessel in terms of latitude and longitude

Changing radar transmission mode

1. Click on the OpenCPN program installed on the GCS Desktop.
2. In the OpenCPN application, click on the radar icon . This icon can appear in any of the forms shown below, depending on the status of the radar:

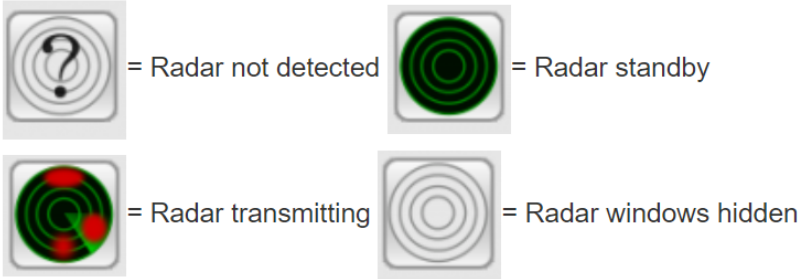


Fig. 20: Options for the radar icon in OpenCPN

3. Right-click anywhere on the interface of OpenCPN.
4. From the resulting menu, click on **Radar Control**:

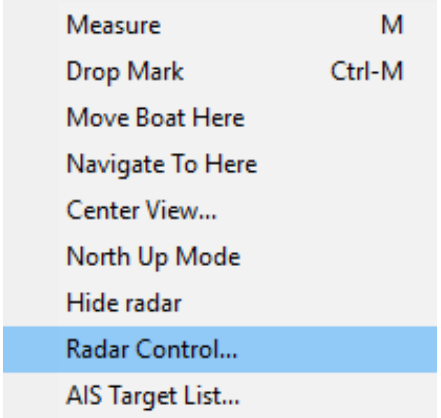


Fig. 21: OpenCPN menu

5. Change the transmission mode of the radar from the window below:

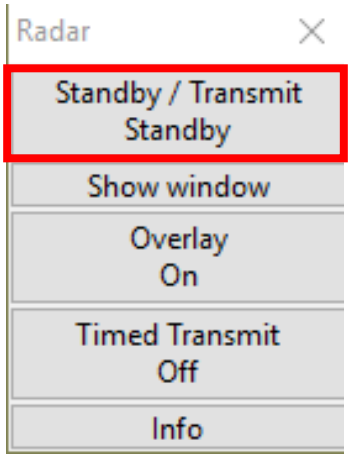


Fig. 22: Changing the status of the radar

Viewing radar data

1. Click on the OpenCPN program installed on the GCS Desktop.
2. In the OpenCPN application, click on the radar icon .
3. Right-click anywhere on the interface of OpenCPN.

4. From the resulting menu, click on **Radar Control**:

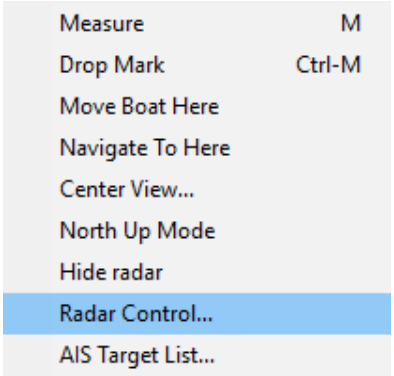


Fig. 23: OpenCPN menu

5. Click on **Show window**:

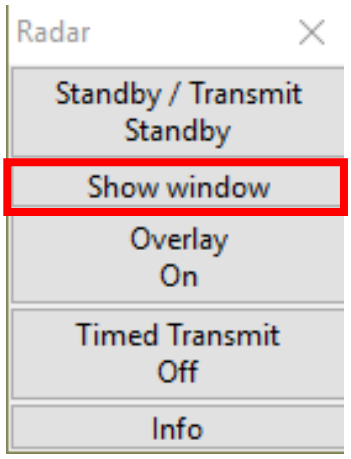


Fig. 24: Opening the OpenCPN window with radar data

6. View radar information from the resulting window:

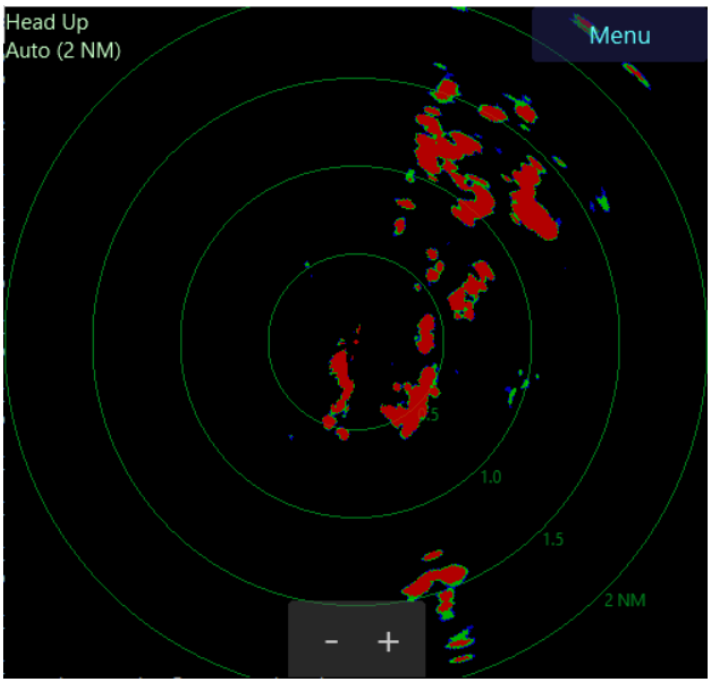
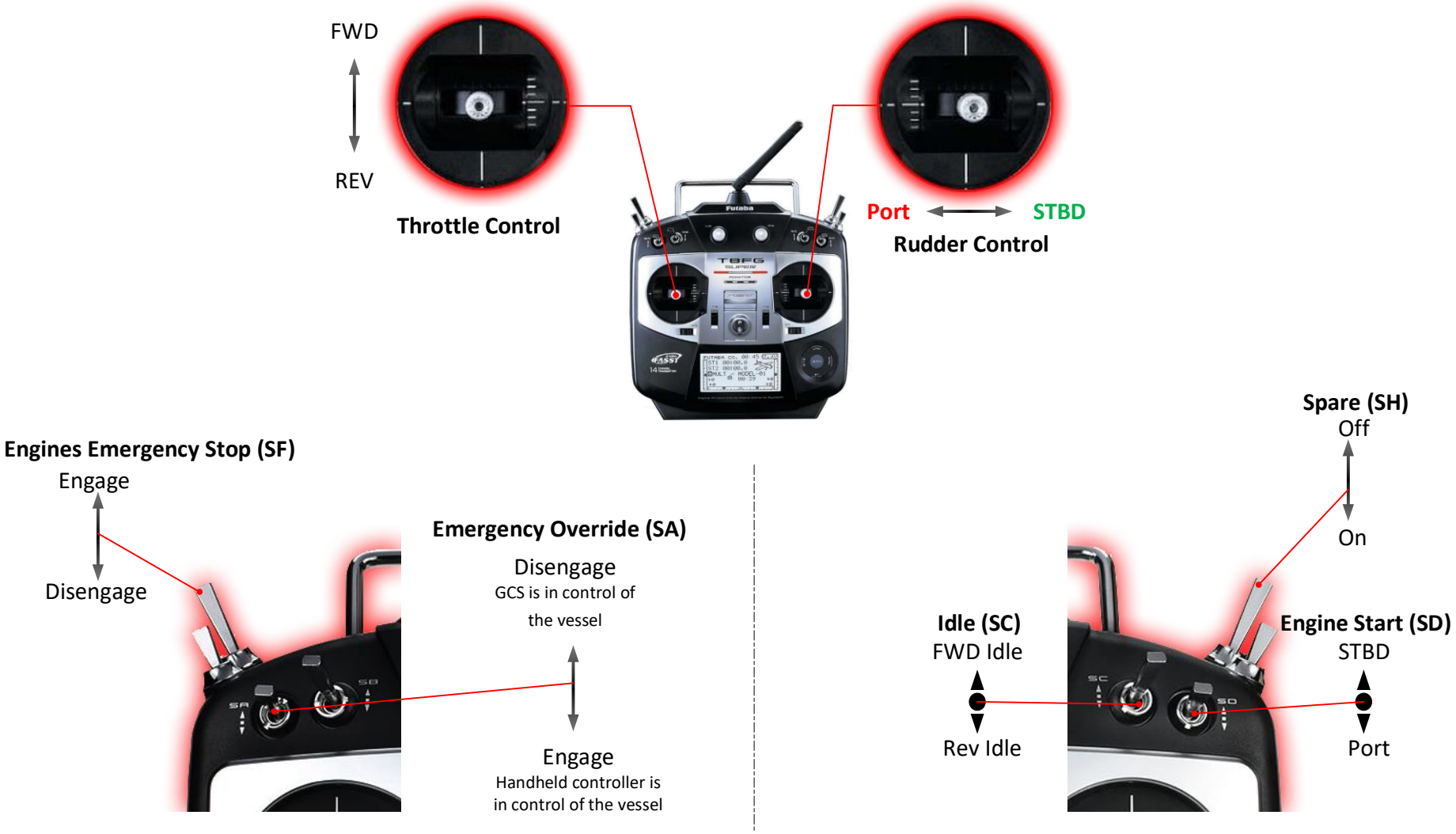


Fig. 25: Viewing radar data on OpenCPN

Appendix A Redundant RC Controller

The following are the controls of the **redundant RC controller** to control your USV at a short range (<1m). The same controls map to the **MAP USB Joystick**:



Appendix B Equipment IP Addresses

This section contains the IP addresses relevant to the **MAP Pro Autonomous Conversion System** for **Britton Maritime Services**:

IP addresses of the fixed cameras:

Camera	IP Address
Front	192.168.1.171
Port	192.168.1.170
STBD	192.168.1.172
Stern	192.168.1.173

IP addresses of the EO/IR gimbal:

Equipment	IP Address
Control interface	192.168.1.174
Video encoder	192.168.1.180

IP address of the IPG100:

Equipment	IP Address
IPG100	192.168.1.160

IP addresses of the USV-GCS network:

Equipment	IP Address
MAP VPN server	192.168.1.2
C2Pro	192.168.1.20
MAP Pro (USV)	192.168.1.10