NEPTUNE Subsea System User Manual

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Author:	Graham Cunliffe
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OceanWorks International
120 – 6741 Cariboo Road
Burnaby, BC V3N 4A3
Canada
www.oceanworks.com

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List of Abbreviations

The following abbreviations are used throughout this document.

AC	Alternating Current
ADC	Analogue to Digital Converter
DC	Direct Current
HV	High Voltage
JB	Junction Box
LV	Low Voltage
MVC	Medium Voltage Converter
NEPTUNE	North-East Pacific Time-series Undersea Networked Experiments
RFU	Rabbit Field Utility
ROV	Remotely Operated Underwater Vehicle
UDP	User Datagram Protocol

1. Introduction

1.1. Purpose of Document

The purpose of the document is to provide the user with a reference to the nature of the North-East Pacific Time-series Undersea Networked Experiments (NEPTUNE) Junction Box (JB) subsea hardware and software; the deployment and operational use thereof.

1.2. Reference Documents

The documents in Table 1.2.1 are relevant to the operation of the JB and should be read in unison with this report.

Table 1.2.1. List of Reference Documents

Document Title	Document Revision	Document Number
Assembly Drawings		
NEPTUNE Lifting Frame Assembly Drawing	3	0848-250-T30000
NEPTUNE Assembly Alignment Fixture	2	0848-250-T20000
Other Documents		
0848-RPT001 NEPTUNE Junction Box System Design Document	2.0	0848-RPT001
Junction Box Telnet Command Manual	1.4	N/A
NEPTUNE Calibration File Format	N/A	N/A

1.3. General Information

The NEPTUNE JB is cylindrical, 13.2” (33.5 cm) in diameter by 40” (101.6 cm) in length. It should be noted that this length does not include the SeaCon connectors which extend approximately 1” (2.5 cm) beyond the end plate of the JB.

The JB weighs approximately 400 lbs (181kg) in air and approximately 202 lbs (91.5kg) in fresh water.

The JB is equipped with the two following custom tooling items:

- NEPTUNE Lifting Frame Assembly, part number 0848-250-T30000
- NEPTUNE Assembly Alignment Fixture, part number 0848-250-T20000

The NEPTUNE Lifting Frame Assembly is designed to be used for both lifting and securing the JB during transportation. The NEPTUNE Assembly Alignment Fixture is designed to be used when inserting the JB chassis into the pressure vessel.

The JB is shipped in a custom fabricated crate. The crate empty weight is approximately 60 lbs (27.2 kg) and must be accounted for when handling the crated JB.

2. Principles of Operation

2.1. General Operation

The JB receives 400VDC from a Medium Voltage Converter (MVC) and distributes low voltage (LV) to six to ten instrument ports at 12VDC, 15VDC, 24VDC, 48VDC and high voltage (HV) to up to three ports at 400VDC as defined in the NEPTUNE Junction Box System Design Document (0848-RPT001). The JB has a single 1000Baset fiber or 100BaseT copper uplink and up to ten Ethernet links and four EIA232, EIA422 or EIA485 (2-wire or 4-wire) serial links.

The JB is controlled by the subsea software which can be accessed remotely via TELNET. The user is able to control the state of the instrument ports and is provided feedback in the form of telemetry from the JB.

2.2. Transportation

During transportation the JB must be kept within the temperature range of -20°C to +70°C. The JB should be transported in crates that provide sufficient protection to the JB and, if fit, the extruding ODI penetrator. O-rings for the JB face SeaCon connectors should not be fit, but rather bagged, tagged and attached to the ODI penetrator. The SeaCon connectors and ODI Remotely Operated Underwater Vehicle (ROV) connector should have dust caps installed to prevent contaminants from entering them.

2.3. Installation

When connecting the uplink and instruments to the JB, ensure that O-rings are installed in the SeaCon faces and that all connectors (SeaCon and ODI) are properly seated. Do not hot swap either the SeaCons or the ODI.

2.4. Safety Considerations

During transportation and installation, the NEPTUNE Lifting Frame Assembly should be used to move the JB whenever possible. All lifting devices, slings, support fixtures, cradles and other equipment used to move or secure the JB must be rated for safe working loads that exceed that of the JB (crated and uncrated).

3. Deployment Procedure

3.1. Mechanical and Electrical Interfaces

The junction box end plate has 10 SeaCon connectors, numbered J1 through J10. The steps below outline the installation of cables on the JB SeaCon connectors:

- Check that the JB output ports are disabled.
- Check that the connectors are clean and free of dust or debris.
- Install o-ring in the face of the SeaCon connector. Ensure that the o-ring is properly lubed, that there is no dust or debris on it and that it is seated properly in the connector.
- Align the key slots of the cable connector with that of the JB SeaCon.
- Keeping the key slots aligned, push the cable connector onto the JB SeaCon. If the key slots are not properly aligned, slowly rotate the cable connector until it slides onto the JB SeaCon.
- Turn the threaded portion of the cable connector until it is hand tight.

The steps below outline the installation of cables to the ODI Remote Operated underwater Vehicle (ROV) connector:

- Check that the power supply to the JB is not live.
- Check that the connector faces are clean and free of dust or debris.
- Align the key slots of the connectors.
- Push the cable into the ODI ROV receptacle.
- Ensure that no yellow is visible on the side of the ODI ROV connector. If yellow is visible a proper mate was not made. In this case remove the connectors and restart the process.

Precautions must be taken so that the weight of the cables is not born by the connectors and suitable strain relief techniques must be employed to prevent damage to the connectors. Care must also be taken to prevent kinking of the cables.

3.2. Pre-deployment Testing

Prior to deploying the JB confirm the following:

- JB powers up.
- All internal JB network devices can be pinged via the primary and secondary uplinks.
- JB ports can be controlled via Telnet and expected voltage outputs are seen at the ports.
- Communication links can be established on serial ports (if applicable).
- Communication links can be established on 100BaseT ethernet ports.

During this testing, the JB must be secured in a manner that prevents it from rolling on the surface that it is placed upon. The NEPTUNE Lifting Frame Assembly is an option for this.

Do not apply power to the JB unless it is electrically bonded to the power supply chassis. This ensures that there is no potential between the JB chassis and earth ground. This bonding protects personnel who are either floating with respect to earth or bonded to earth via ESD measures. This bonding can be achieved by connecting the JB to earth ground with a #8AWG or larger wire. Using a large gauge wire simulates the deployed environment of the JB where the resistance seen between the earth reference point of all devices approaches 0Ω. The holes in the pressure vessel can heads used to fasten the can head mounting jig are an ideal bonding point for the JB. OceanWorks strongly recommends that earth bonding of the JB is standard procedure whenever the JB is powered outside of seawater.

3.3. Command Interface

The command interface to the subsea software is achieved via TELNET. For more information refer to the Junction Box Telnet Command Manual.

3.4. Data Handling Interface

Telemetry data is transmitted from the subsea system as a UDP data stream. Refer to Appendix A where the UDP data structure is defined.

4. Recovery Procedure

When recovering the JB, first ensure that the JB is not powered. Once this has been established the ODI ROV cable can be disconnected. Before disconnecting instrument cables, dry the JB can head so that there is no liquid present on or around the SeaCon connectors. Compressed air or a heater can be used to make sure that all liquid is removed.

If the JB is to be opened, follow the same procedure as with the SeaCon cables to make sure that no liquid enters the pressure vessel. The NEPTUNE Assembly Alignment Fixture, part number 0848-250-T20000, should be used when opening the JB to make sure that components of the pressure vessel are not damaged.

5. Junction Box Operational Modes and Procedures

5.1. Power ON/OFF and Initiation of Software

When the JB is powered up all of the breakers enter a safe state (output disabled) and the control computer automatically boots the subsea software. A 60 second lockout is imposed on the breakers so that they cannot be switched on before their input Negative Time Constant (NTC) thermistors have returned to their high impedance value. This protects the breakers in the case of a rail crash, i.e. if the JB looses power from the MVC with breakers on, the breakers cannot be switched back on before it is safe to do so without causing damage.

Once the subsea software has booted, telemetry data is sent via the UDP data stream.

After the initial 60 second lockout period has passed, control of the JB breakers via TELNET is possible.

5.2. Operational Calibration Procedures

Refer to the NEPTUNE Calibration File Format document for a detailed description of how to create a JB calibration file.

5.3. Methods of Commanding and Collecting Data from the System

The subsea software is controlled via TELNET. Refer to the Junction Box Telnet Command Manual for more information.

Refer to Appendix A for information regarding JB telemetry data.

6. Software Operational Procedure

6.1. Software Start-up

The JB control computer starts running the subsea software automatically when the JB is powered up. Telemetry data is sent to the surface as soon as the subsea software has started.

On start-up, the JB control computer performs the initialization operations that are summarized below:

- The control computer board and Analogue to Digital Converters (ADC) are initialized. This phase takes approximately 30ms.
- The Ethernet interface and communications are initialized. This phase takes approximately 3630ms.
- The Ethernet controller type is determined and appropriate set-up actions are performed based on the controller type. This phase takes approximately 140ms.
- Internal data structures for telemetry are set up and the breakers are commanded to enter the OFF state via software. This occurs approximately 3800ms after power on.
- The JB controller software enters its main loop in which Telnet commands are responded to, telemetry data is acquired, fault conditions are detected and telemetry is transmitted via UDP. The main loop is typically started 3900ms after power on.

6.2. Normal Operations

6.2.1. System Status Conditions

The subsea software defines the system status bits given in Table 6.2.1.1.

Table 6.2.1.1. Subsea Software System Status Bits

System Status Condition	System Status Bit	Bit = 0	Bit = 1
Command Link Status	1	OFF	ON
Auto-calibration Bit	5	OFF	ON
ADC Setting Bit	7	± 10VDC	0-5VDC

6.2.2. Breaker Status Conditions

The subsea software defines the breaker status bits given in Table 6.2.2.1.

Table 6.2.2.1. Subsea Software Breaker Status Bits

Breaker Status Condition	Breaker Status Bit	Bit = 0	Bit = 1
FET ON Bit	0	OFF	ON
Rely ON Bit	1	OFF	ON
Over-current INHIBIT Bit	8	NOT INHIBITED	INHIBITED
Breaker Hold-off Bit	9	NO HOLD-OFF	WAITING FOR HOLD- OFF TIME

6.3. Fault Conditions

6.3.1. System Fault Conditions

The subsea software generates a system fault for the conditions given in Table 6.3.1.1.

Table 6.3.1.1. Subsea Software System Fault Conditions

Fault Condition	System Status Bit
TCP send error	2
Auto-calibration error	6

6.3.2. Breaker Fault Condition

The subsea software monitors critical breaker parameters and compares them to user specified limits at frequency of 1Hz. If a fault is detected, the breaker experiencing it will be shut down. The error conditions are given in Table 6.3.2.1.

Table 6.3.2.1. Subsea Software Breaker Shut Down Conditions

Breaker Fault Condition	Breaker Status Bit	Bit = 0	Bit = 1
Over-current Fault	3	NO FAULT	FAULT
Ground-fault	4	NO FAULT	FAULT
Low Voltage Fault	5	NO FAULT	FAULT
High Voltage Fault	6	NO FAULT	FAULT

7. Maintenance Procedures

7.1. Periodic Maintenance Requirements

The following mechanical items should be checked when the JB has been recovered from a subsea deployment:

- Check pressure vessel for signs corrosion.
- Check cable pins for signs of corrosion.
- Replace SeaCon connector o-rings.
- Replace pressure vessel can head o-rings if JB is opened.
- Check the alignment of paint marks on pressure vessel fasteners, pressure release valve and purge plug.

Updated firmware should be flashed to the JB upon availability. This firmware includes:

- Subsea software
- MOXA EDS510A firmware
- MOXA EDS508A firmware
- MOXA NPort 5450I firmware

7.2. Test Equipment and Special Tools Required

It is recommended that the test equipment and special tools given listed below be utilized when bench testing the JB to allow for complete testing and operation of the device.

- 400VDC Power Supply
- LV DC Load Bank
- HV (400VDC) DC Load Bank
- HV Insulation Strength Tester
- Digital Multimeter
- Current Clamp Meter
- Oscilloscope
- Laptop
- Managed Ethernet Switch
- Junction Box Serial Isolation Card Assembly
- Ethernet Serial Server
- 6 x CAT5e Patch Cables
- 2 x EIA232 Crossover Cable
- 2 x EIA485 Crossover Cable

- NEPTUNE Lifting Frame Assembly
- NEPTUNE Assembly Alignment Fixture

7.3. Flashing Junction Box Firmware

The following section details the steps required to download the NEPTUNE subsea controller firmware.

Tools required:

- Rabbit Field Utility (RFU) version 2.5 (Z-World)

When the RFU is run, the main screen as seen in Figure 7.3.1 is presented.

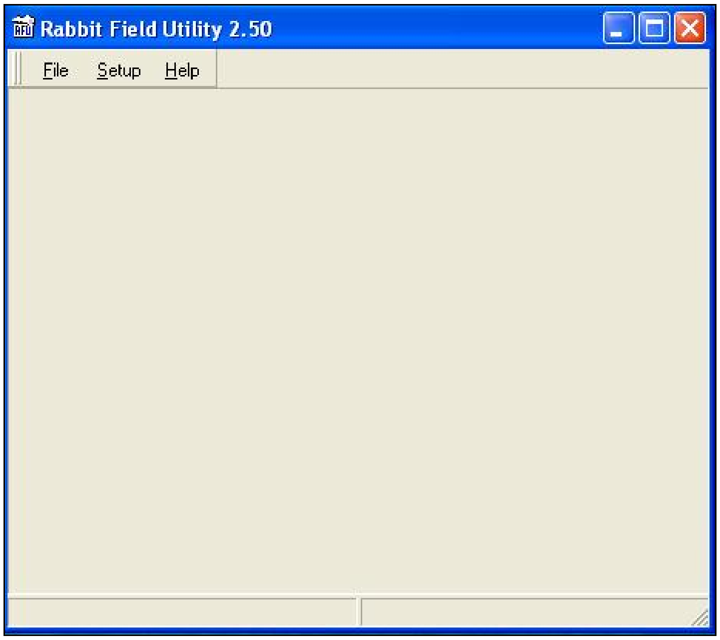

Figure 7.3.1. RFU Main Screen

Communications with the JB must be set up. This is accomplished by selecting "Setup" on the menu bar of the main screen. The "Communications Options" screen given in Figure 7.3.2 will be displayed.

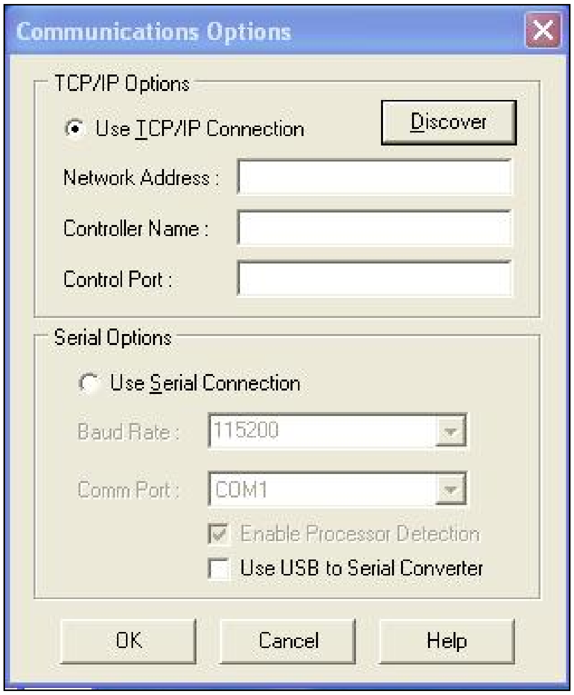

Figure 7.3.2. RFU "Communications Options" Screen

Ensure that the TCP/IP option "Use TCP/IP Connection" radio button is selected. If the Network Address displayed is correct, click the "OK" button to proceed. Otherwise, the RFU needs to find programmer units that it can communicate with. This is accomplished by clicking the "Discover" button. The "Discovery" screen given in Figure 7.3.3 is then displayed.

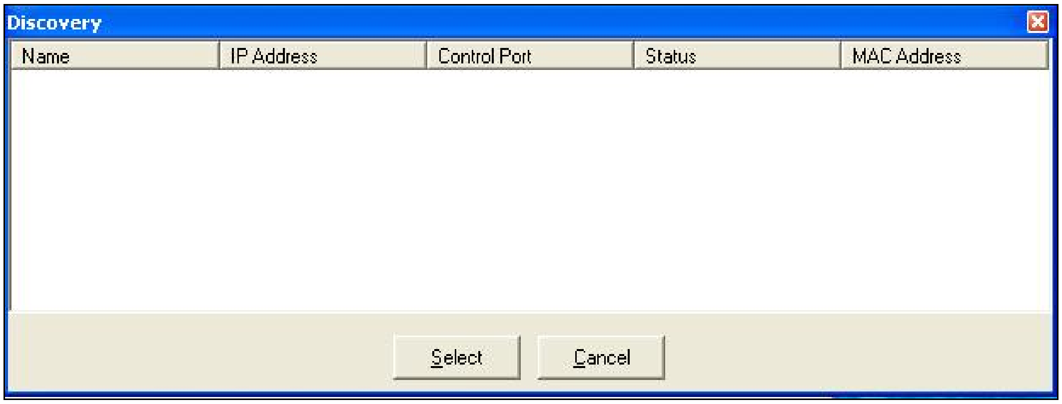

Figure 7.3.3. RFU "Discovery" Screen

Once the RFU has located programmers that it can communicate with, a list of such programmers is presented in the "Discovery" screen. Select the desired programmer by clicking the line that it is presented on and then click the "Select" button. The result of these actions should be to place the desired programmer's IP address in the "Communications Options" screen as shown in Figure 7.3.4.

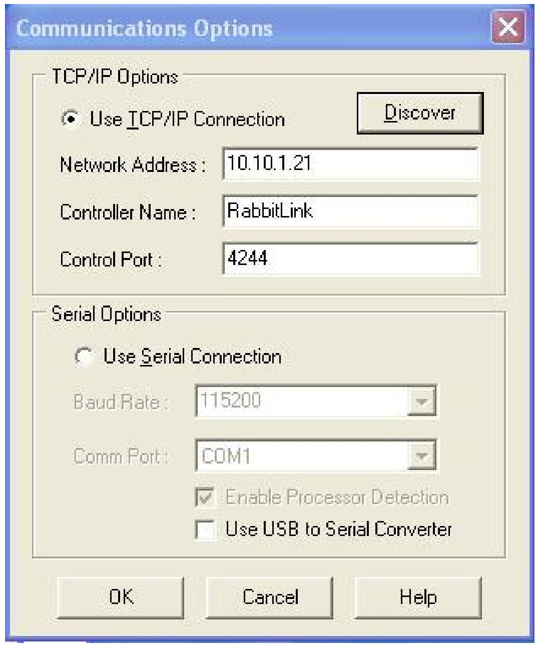

Figure 7.3.4. RFU "Communications Options" Screen with Programmer Information

If the programmer's IP address displayed in the "Network Address" field is correct, click the "OK" button. Now select "File" on the menu bar in the main screen. This will bring up the "Choose Flash Image" screen (see Figure 7.3.5), where you select the binary image to download to the JB.

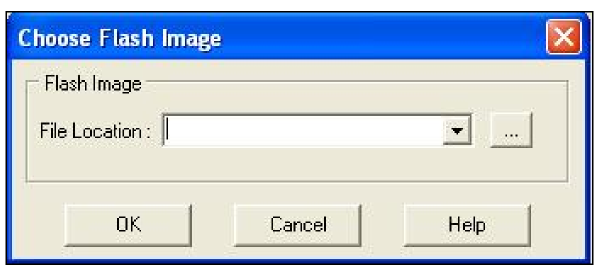

Figure 7.3.5. RFU "Choose Flash Image" Screen

Browse for the desired file by clicking the browse button. A screen similar to that shown in Figure 7.3.6 will be displayed.

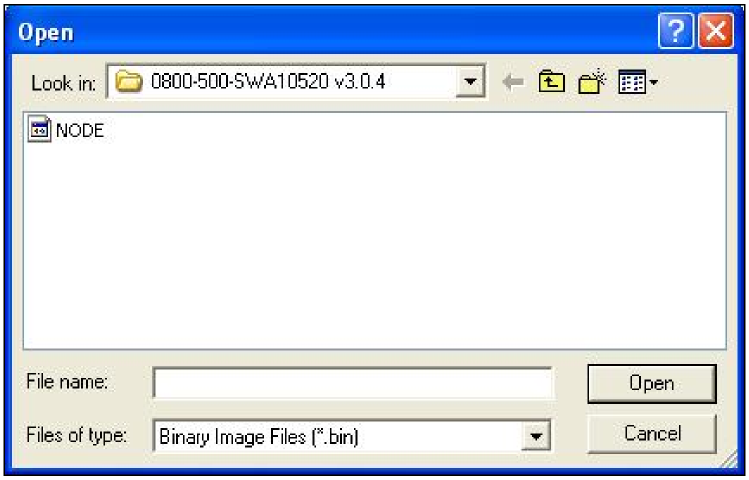

Figure 7.3.6. RFU "Browse for Image" Screen

Once the correct image has been located, click the file name to select it. The "Passphrase" screen (see Figure 7.3.7) is then presented.

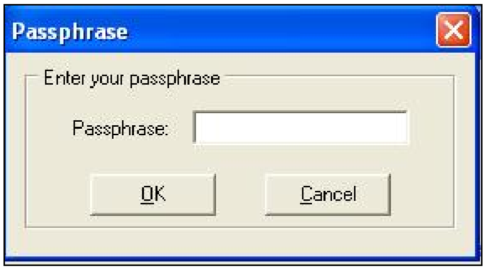

Figure 7.3.7. RFU "Passphrase" Screen

There is no passphrase imposed on the system, so click the "OK" button to start loading the image. This will take approximately 70 seconds to accomplish.

7.4. Software Tools

The following software tools are required for the maintenance of the JB:

- Z-World© Dynamic C integrated development environment, version 9.21.
- Z-World© Remote Field Utility (RFU,) version 2.5 (required for loading the binary image onto the sub-sea controller). It is possible (and useful) to compile and load directly to the sub-sea board from the IDE and for development and testing of the software this is the preferred mode of operation.

It is strongly recommended that for the final "production" load of the software the code be compiled to the target board (compiler Project Options) and then loaded via the RFU. The target board is:

- 44MHz BL2600, 512K Flash, 256K+512K SRAM
  Rabbit 3000 Revision: IL1T/IZ1T

The above procedure ensures that the binary (.bin) image is the one that is being run on the board and thus can be loaded to other JBs as required.

While not a prerequisite for the maintenance of the subsea code, OceanWorks strongly recommends the use of a network protocol analyzer such as WIRESHARK. This type of software is very useful in isolating problems pertaining to IP addressing and validating the contents of the User Datagram Protocol (UDP) telemetry stream.

7.5. Subsea Code Modules

The sub-sea code consists of the following modules (libraries in Dynamic C terminology):

7.5.1. Node.C

This is the main program module for the subsea code. Program start and initialisation are performed here as well as the main program loop in which commands are received and responded to; telemetry is acquired and transmitted and fault conditions are detected.

The error handler is also in this module. The error handler is invoked if the watchdog timer expires. The error handler forces a restart of the sub-sea software (equivalent to power cycling the controller board).

7.5.2. JBDEFS.Lib

This module contains all defines and global data structures required by the sub-sea software. Global values are identified by the prefix "G_" for example: G_newIpAddr.

Defined constants are capitalized, for example: FAULT_CHECK_INTERVAL.

There are some definitions pertaining to the TCP communications that are derived from the module JBTCP.LIB (Section 7.5.3).

7.5.3. JBTCP.Lib

This module contains some additional definitions specific to the TCP routines.

7.5.4. JBAQUISITION.Lib

This module contains the initialisation modules for the telemetry related data structures and help function; the telemetry acquisition functions and the breaker command functions.

7.5.5. COMMANDINTERFACE1.Lib

This module contains the command parser code. The command and possible devices are identified here and the execution of the function is dispatched to the appropriate function in the module COMMANDINTERFACE.Lib (Section 7.5.6).

7.5.6. COMMANDINTERFACE.Lib

This module contains the TCP communications code and the various functions that are dispatched as a result of processing a command in the module COMMANDINTERFACE1.Lib (Section 7.5.5).

7.5.7. BROADCASTINTERFACE1.Lib

This module contains the code that synthesizes the UDP telemetry stream and transmits the data.

7.5.8. ALARMACTION.Lib

This module contains the code that detects violations of breaker current, voltage and ground-fault limits. Appropriate actions (e.g. shutting down the breaker) are taken and the relevant error status is set (the latter is transmitted in the telemetry stream).

LIB.Dir

This file contains a list of all the modules (custom and Z-World) required to compile the sub-se controller code. The following lines (located at the start of the file) MUST be maintained as the modules, or their folder is renamed:

C:\Projects\0848-100-SWA10520 v2.3.1\JBDEFS.LIB
C:\Projects\0848-100-SWA10520 v2.3.1\JBTCP.LIB
C:\Projects\0848-100-SWA10520 v2.3.1\COMMANDINTERFACE.LIB
C:\Projects\0848-100-SWA10520 v2.3.1\COMMANDINTERFACE1.LIB
C:\Projects\0848-100-SWA10520 v2.3.1\BROADCASTINTERFACE.LIB
C:\Projects\0848-100-SWA10520 v2.3.1\JBAQUISITION.LIB
C:\Projects\0848-100-SWA10520 v2.3.1\ALARMACTION.LIB
C:\Projects\0848-100-SWA10520 v2.3.1\BL26XX.LIB

The above file is used by the compiler to specify which libraries are required to compile the sub-sea code. The appropriate library file MUST be specified in the compiler Project.

The file BL26XX.LIB is a Z-World library file that is specific to the BL2600 Wolf board. Specifically, the function AnaIn defined in this library has been modified in order to remedy a bug in the supplied library. The sub-sea software MUST be complied using this modified library file.

APPENDIX A – The UDP Data Structure

A.1. Introduction

The NEPTUNE system UDP data frame format is described in the following section. The UDP frame type 102 is described, as of subsea software release v2.4.6 and later.

A.2. Number Representation

Numbers, as represented in the Rabbit microprocessor, are little-endian, hence the most significant byte in the two byte numeric values is at the higher address of the two bytes in the data stream.

UDP telemetry values are in ADC ticks and are integer values between 0 and 2047.

A.3. UPD Data Frame Format

The format of the raw format UDP data is as follows:

Frame Header		16 Bytes
	Packet Type	1
	Device Id	9
	Frame Counter	2
	System Status	2
	Digital Input State	2
Breaker Array		22 * 10 = 220 Bytes
Breaker 1	Status	2
	Peak Current Value	2
	Current Value	2
	Current Limit	2
	Current Timeout	2
	Voltage Value	2
	Voltage Low Limit	2
	Voltage High Limit	2
	Ground Fault Value	2
	Ground Fault Low Limit	2
	Ground Fault High Limit	2
• • •		
Hotel Array		7 * 12 = 84 Bytes
Input 1	Status	1
	Value	2
	Low Limit	2
	High Limit	2
• • •		
Message Array		63 * 1= 63 Bytes
Message 1	Status	1
	Message	63
• • •		

The UDP data structure and element sizes are presented in detail in Section A.8. Sections A.4 through A.7 provide details on the frame header, Beaker array, Hotel array and message data respectively.

A.4. Frame Header

The frame header consists of five fields, described below:

Packet Type	Unsigned byte	1 bytes
Device Id	Character array	9 bytes
Frame Counter	Unsigned integer	2 bytes
System Status	Unsigned integer	2 bytes
Digital Input State	Unsigned integer	2 bytes

The system status has the following format:

7	6	5	4	3	2	1	0
ADC mode	ACL Err	ACL On	Master On	TCM2 Status	TCP Snd Err	CL Status	unused

15	14	13	12	11	10	9	8
unused	unused	unused	unused	unused	unused	WD trip bit	EH set bit

The following abbreviations are used in the above bit field description:

CL status	- 1 indicates TCP link established; 0 No link.
TCP Snd Err	- 1 indicates that a TCP send error occurred.
TCM2 Status	- 1 indicates that the TCM2 compass is present[1].
Master On Bit	- 1 indicates that the Node is master; 0 not master[2].
ACL On Bit	- 1 indicates that auto-calibration is on; 0 off.
ACL Err Bit	- 1 indicates an error in the 2.5v reference voltage[3].
ADC mode	- 1 indicates that the ADC is in 0-5v range mode[4].
EH set bit	- 1 indicates that the last reboot was done by the error handler[5].
WD trip bit	- 1 indicates that the last reboot was due to the watchdog timing out[6].

[1] The TCM2 compass is present only in a VENUS NODE A sub-sea system.
[2] Master status only applies to VENUS NODE A sub-sea systems.
[3] This bit is set if the difference between the ADC ticks for the 2.5 volt reference and the computed value for the ADC setting is greater than 61. For the ±10 volt ADC the 2.5 volt reference is nominally 1280 ticks and for 0-5 volt ADC the reference is 1024.
[4] VENUS uses a ±10 volt ADC range; NEPTUNE uses 0-5 volt.
[5] Sub sea firmware release r2.4.5 and up.
[6] Sub sea firmware release r2.4.5 and up.

The digital input state has the following format:

7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	0

15	14	13	12	11	10	9	8
HB Led	Fault Led	1	1	RLT CP	FET CP	RLY Ch.	FET Ch.

The following abbreviations are used in the above bit field description:

FET Ch. - 1 indicates that the FET control signal line is high[7].
RLY Ch. - 1 indicates that the relay control signal line is high.
FET CP - 1 indicates that the FET clock signal line is high.
RLY CP - 1 indicates that the relay clock signal line is high.
Fault Led - 1 indicates that the SIIM interface board fault LED is ON[8].
HB Led - 1 indicates that the SIIM interface board "heartbeat" LED is ON[9].

A.5. Breaker Array

The breaker array consists of ten repeating groups of fields, each breaker being represented by the following data:

Status	Unsigned integer	2 bytes
Peak Current Value	Signed integer	2 bytes
Current Value	Signed integer	2 bytes
Current Limit	Signed integer	2 bytes
Current Timeout	Signed integer	2 bytes
Voltage Value	Signed integer	2 bytes
Voltage Low Limit	Signed integer	2 bytes
Voltage High Limit	Signed integer	2 bytes
Ground Fault Value	Signed integer	2 bytes
Ground Fault Low Limit	Signed integer	2 bytes
Ground Fault High Limit	Signed integer	2 bytes

The breaker status has the following format:

[7] The FET and RLY channel and clock signal lines are high by default.
[8] The fault LED is turned on whenever a breaker is tripped by the sub-sea controller software due to a breaker limit being exceeded.
[9] During normal operation this bit is toggled at 1 Hz.

7	6	5	4	3	2	1	0
VR Fault	UV Fault	OV Fault	Ground Fault	OC Fault	OC Warn	RLY ON	FET ON

15	14	13	12	11	10	9	8
unused	unused	unused	unused	unused	unused	Alarm Inhibit	Hold Off

The following abbreviations are used in the above bit field description:

RLY	- Relay
OC	- Over Current
OV	- Over Voltage
UV	- Under Voltage
VR	- Voltage Ripple[10]
Hold Off	- Set if breaker hold-off time is greater than zero.
Alarm Inhibit[11]	- Set when breaker is turned on for one UDP frame.

A.6. Hotel Array

The hotel array consists of twelve repeating groups of fields, each analogue input being represented by the following data:

Status	Unsigned integer	1 byte
Value	Signed integer	2 bytes
Low Limit	Signed integer	2 bytes
High Limit	Signed integer	2 bytes

The analogue data status has the following format:

7	6	5	4	3	2	1	0
unused	unused	unused	unused	unused	unused	High Fault	Low Fault

The Low Fault and High Fault indications correspond to the value exceeding the specified limits for the input[12].

[10] This fault condition is set by the VENUS system shore station software only
[11] Note that that this bit should never be one for more than one UDP frame at a time. The bit is set to prevent alarm checking for one second after a breaker is turned on so as to allow for the telemetry to stabilise.
[12] This mechanism is included in case there is a need in the future to deal with analogue inputs other than the breakers requiring fault checking. At this time the status field is not used.

A.7. Message Data

The message data consists of a single message field, represented by the following data:

Status	Unsigned integer	1 byte
Message Text	Character array	63 bytes

Message status is described is described below:

7	6	5	4	3	2	1	0
unused	unused	unused	unused	unused	unused	Msg Error	Msg Exists

The Message Exists (Msg. Exists) bit is turned on when a message is required to be returned in the UDP stream (VENUS NODE.) If no message data is required (NEPTUNE and VENUS SIIM) then this it is zero.

The Message Error (Msg. Error) is set if there was an error in reading the message that is stored in the message text.

A.8. UDP Data Stream Object

udpBreakerObject

Type	Name	Size	Offset
unsigned short	status	2	0
short	peakCurrent	2	2
short	current	2	4
short	overCurrentLimit	2	6
short	overCurrentTimeout	2	8
short	voltage	2	10
short	voltageLowLimit	2	12
short	voltageHighLimit	2	14
short	groundFault	2	16
short	groundFaultLowLimit	2	18
short	groundFaultHighLimit	2	20
	Total Size of UDP Breaker Object	22	

udpAnalogueInputObject

Type	Name	Size	Offset
unsigned char	status	1	0
short	value	2	1
short	valueLowLimit	2	3
short	valueHighLimit	2	5
	Total Size of Analogue Input Object	7	

udpMessageObject

Type	Name	Size	Offset
unsigned char	status	1	0
char	message text	64	1
	Total Size of UDP Message Object	65	

udpDataFrame

Type	Name	Size	Offset
unsigned char	packetType	1	0
char	deviceId	9	1
unsigned short	digitalInputState	2	10
unsigned short	systemState	2	12
unsigned short	counter	2	14
udpBreakerObject	breakerObjectArray	220	16
udpAnalogueInputObject	analogueInputArray	84	236
udpMessageObject	messageObjectArray	65	320
	Total Size of Internal Data frame	384	