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TECHNICAL DOCUMENT

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1. INTRODUCTION

Blue Logic and WPC has established a "Subsea USB" development Program for wireless Power and Communication anticipating a future "Subsea USB infrastructure" due to the obvious advantages for most subsea applications. Several products of different sizes and capacities are under development and due to go into production.

The major advantage of such a connector system is the ability to transform electrical voltage over the connection, connect and disconnect with full power, and no galvanic contact with seawater. Most relevant requirements with regards to both electrical power and communication bandwidth are well within achievable range. This is also the case for all mechanical interfaces and requirements.

The system can be designed to be integrated into new builds and to be retrofitted on existing structures without need for modifications. The main goal is to facilitate for an all-electric instrumentation, operation and monitoring of the subsea structures. Modulatory and interchange ability will be the main key for success. The system shall allow equipment, i.e. sensors, used in one location, to be easily transferred to a new operating location.

1.1. GENERAL

The Subsea "USB" offers a fully integrated system for power and communication transfer. The solution is easy to use to provide a sleek and time saving operation.

The purpose of the Inductive Connectors is multipurpose connection:

- 1) to transfer Power up to 2,0KW.
- 2) to support Ethernet communication of up to 80Mbps
- 3) to support up to 120kbps RS232/RS485 communication.

The Inductive connectors are named differently according to their function.



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2. 0,5 – 2,0 KW CONNECTOR

2.1. INTRODUCTION

Due to the nature of this product, module based architecture of the electronics is used, hence reducing the number of electronic parts which needs to be tested, qualified and manufactured. Each wireless interface requires coil and electronics on the primary- and the secondary side. For optimum electrical performance and design, it is desirable to place the electronic close to the coil. The plan is therefore to integrate both the electronics and the coil in a common housing as far as practical possible.

Parameter	Specification
Input voltage Primary side*	+100-250VAC or 325VDC?
Output voltage	,+325VDC, and 24VDC
Communication**	RS232 and RS485 100kbps full duplex Ethernet 10/100 Base-T @ 80Mbps
Power	0,5 – 2,0 KW

Table 1 Electronic Specification

* Cover the range from 100VAC to 250VAC.

** It is not possible to use RS232 and RS485 at the same time, but both interfaces will be available.

From a mechanical perspective, the module based mind set has been fully applied, and the Blue Logic/ WPC proposed concept can be achieved with relatively few, "lego-based" mechanical building blocks of which all the required components and functions can be formed. See the following sub-sections for further information.

The Blue Logic/ WPC proposed solution will give an excellent flexibility with high focus on operational aspects which will give a unique possibility for also adding future sensors and equipment when requested.

In general, all the Subsea USB (Data and Power) connection points are designed using the same mechanical module based interface, only with a slightly different configuration.

All Wireless connection points will be based on the Blue Logic/ WPC spherical dome principle with the following unique features:

1. Very high power transfer capacity within a given connector diameter
2. Self-aligning and built in actively guiding during the mating sequence
3. High tolerance with regards to angular deviations and positioning accuracy
4. Robust and compact design due to the dome/spherical design
5. Excellent self-flushing capability during mating
6. Limited possibility for accumulation of debris when left unconnected

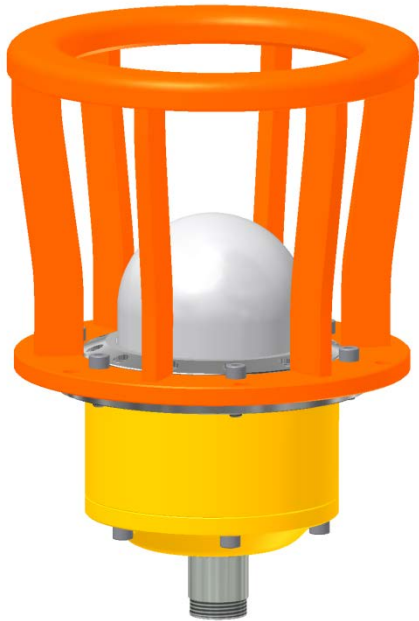


Figure 1 Typical Blue Logic/ WPC CAMSIP Inductive Receptacle (Secondary Side)

2.2. ROV OPEARABLE CONNECTION

The Blue Logic/WPC ROV Connector is "self-guiding" onto the receptacle due to the spherical inductive surface with an outer guide ring which fits into the female receptacle guide funnel. During mating, the connector is self-flushing when the water trapped inside the connector is flushed out through the grooves in the inductive surface. The Connector includes an atmospheric compartment where all electronic modules are installed. Current design is available with up to 2kW power transfer.

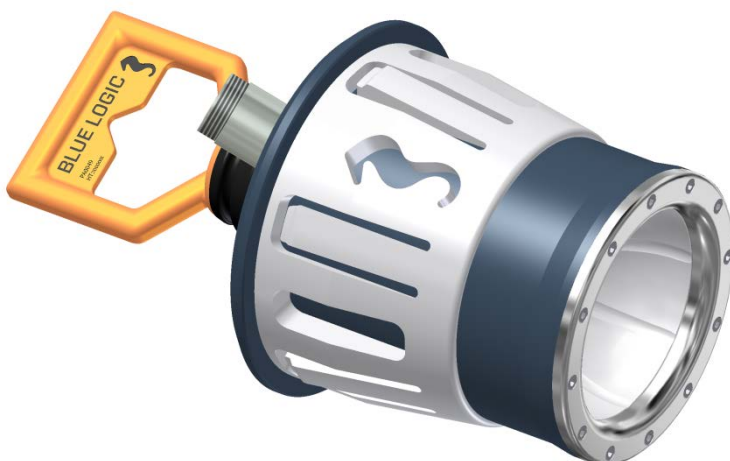


Figure 2 ROV "USB" Connector (Primary Side)

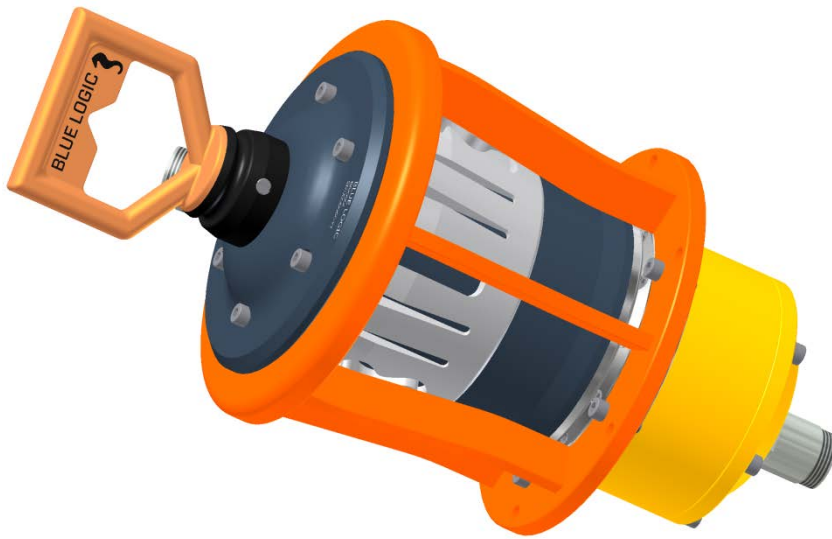


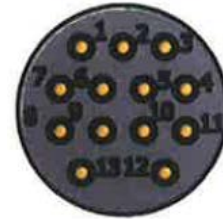
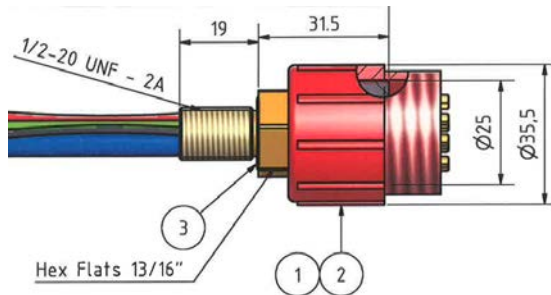
Figure 3 ROV "USB" Stab Connector Mated into Receptacle

The ROV Connector system has been designed so that it is not possible to damage the dome and thus the system can be integrated into most type of mechanical interfaces. It can be designed as a doughnut , a flat surface or even large slip ring. Induction work on the basis of two coils that can have several shapes.



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2.3. PRIMARY SIDE CONNECTION EXAMPLE

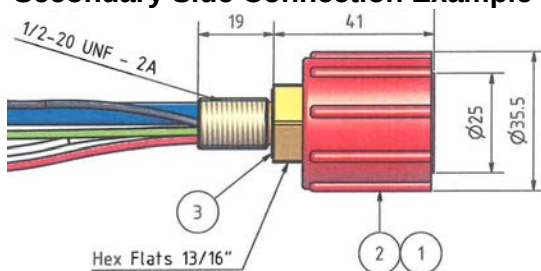


Connector: DBH13M			
Pin #	Color	PCB connection	Signal
1	Black	P100 (Pri P1 Filter)	CHASSIS
2	Orange	P112 (Pri P1 Filter)	+325VDC/110VAC (Into unit)*
3	White	P111 (Pri P1 Filter)	GND/110VAC (Into unit)*
4	(Blue) Brown	P108 (Pri M1 RSE)	RS232 TX (Out of unit)
5	(Blue) White/Brown	P109 (Pri M1 RSE)	RS232 RX (Into unit)
6	(Blue) Blue	P110 (Pri M1 RSE)	RS232 GND
7	(Blue) White/Blue	Not used	Not used
8	(Blue) Orange	P104 (Pri M1 RSE)	Ethernet0 TXp (Out of unit)
9	(Blue) White/Orange	P105 (Pri M1 RSE)	Ethernet0 TXn (Out of unit)
10	(Blue) Green	P106 (Pri M1 RSE)	Ethernet0 RXp (Into unit)
11	(Blue) White/Green	P107 (Pri M1 RSE)	Ethernet0 RXn (Into unit)
12	Red	Not used	Not used
13	Green	Not used	Not used

*110VAC only for ROV WDP

Table 2 Pinout Primary Side

2.3.1. Secondary Side Connection Example



Connector: DBH13F			
Pin #	Color	PCB	Signal
1	Black	P100 (Sec P1 Power)	CHASSIS
2	Orange	P104 (Sec P1 Power)	+325VDC (Out of unit)*
3	White	P105 (Sec P1 Power)	GND*
4	(Blue) Brown	P108 (Sec M1 RSE)	RS232 TX (Out of unit)
5	(Blue) White/Brown	P109 (Sec M1 RSE)	RS232 RX (Into unit)
6	(Blue) Blue	P110 (Sec M1 RSE)	RS232 GND

7	(Blue) White/Blue	Not used	Not used
8	(Blue) Orange	P104 (Sec M1 RSE)	Ethernet0 TXp (Out of unit)
9	(Blue) White/Orange	P105 (Sec M1 RSE)	Ethernet0 TXn (Out of unit)
10	(Blue) Green	P106 (Sec M1 RSE)	Ethernet0 RXp (Into unit)
11	(Blue) White/Green	P107 (Sec M1 RSE)	Ethernet0 RXn (Into unit)
12	Red	P102 (Sec P1 DCDC 30W 24VDC)	+24VDC (Out of unit)**
13	Green	P103 (Sec P1 DCDC 30W 24VDC)	GND

Table 3 Pinout Secondary Side

3. DEVELOPMENT STATUS

Adapting and qualifying the patented WPC Wireless inductive technology into real subsea products has been continuously ongoing since 2003 and different products and variants has been released throughout the last years demonstrating the obvious advantages with using Wireless Technology in Subsea applications.

The now proven technology is in the process of being further modularized and optimized with regards to:

- Efficiency
- Alignment
- Modularization
- Communication speeds
- Flexibility
- Mechanical design and robustness
- Fabrication techniques

Currently, development focus and effort are on the following products further described in the following sub-sections:

- 50W/ 80Mbps (Multipurpose low power instrument wireless USB)
- 500W/80Mbps(Multipurpose medium power instrument wireless USB)
- 2kW/80Mbps (High power wireless USB connector for Electrical Torque Tool Systems)

3.1. PRODUCTS

The following sub-sections briefly describe WPC/BL Inductive Products including a brief technology status.

3.1.1. 3-Stab

The WPC/ Ifokus Engineering developed and patented "3-Stab" system was developed during 2004. The concept is based on integration of an inductive coil system onto an ISO/API standard hydraulic Hot Stab thus allowing for simultaneous connection and transfer of hydraulic power, electrical power and communication in one compact and robust unit. Typical applications for the 3-Stab is ROV connection to trencher system's, torque tools, actuators, UPS's and even for supplying power, communication and Hot Water to diving bell systems.



Figure 4 3-Stab System with Male Stab and Receptacle

Available power and communication from the 3-Stab has conservatively set to 150W and 120kbs full duplex (found sufficient for most relevant applications)

3.1.2. 50W Subsea USB

The Blue Logic 50W Subsea USB Connector is a ROV friendly multipurpose wireless connector primarily designed for instrumentation, sensors and other relevant multipurpose ROV equipment where high communication speed, but with modest power requirements is requested. The Connector is 100% based upon WPC inductive technology and has a max communication speed of 80Mbps combined with 50W electrical power.

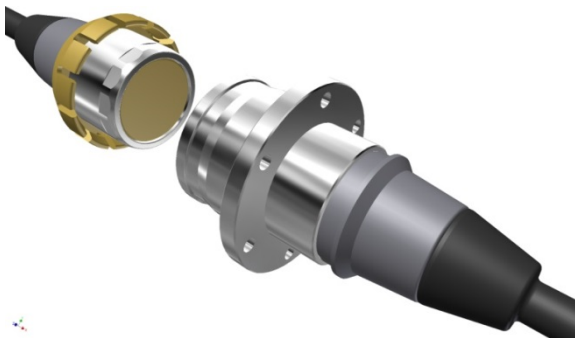


Figure 5 50W Subsea USB Connector

3.1.3. 150W Subsea USB System

The 150W Subsea USB System has been developed by Blue Logic in 2012. The connector technology has been based upon previously modules and experience gained during the 3-Stab development. The system is currently being installed and qualified in the Blue Logic designed Pipe Inspection/Repair Clamp system where all sensor communication and electrical power is transferred inductively through this connector. Communication speed is conservatively set to RS232/485 200kbs as this is sufficient for most relevant applications.

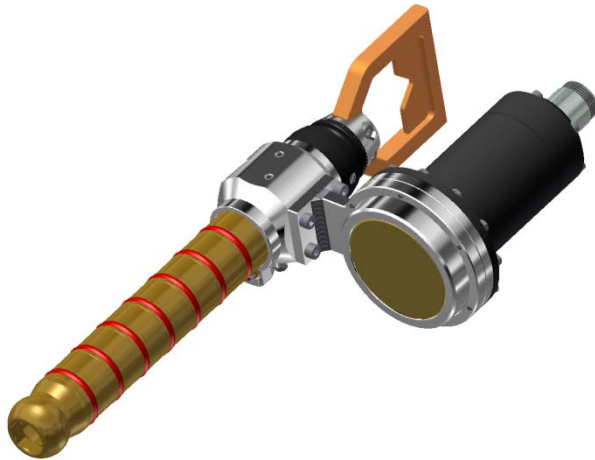


Figure 6 6-Port Hydraulic Male Connector w/ integrated inductive power and communication



Figure 7 6-Port Hydraulic female receptacle w/ integrated inductive power and communication

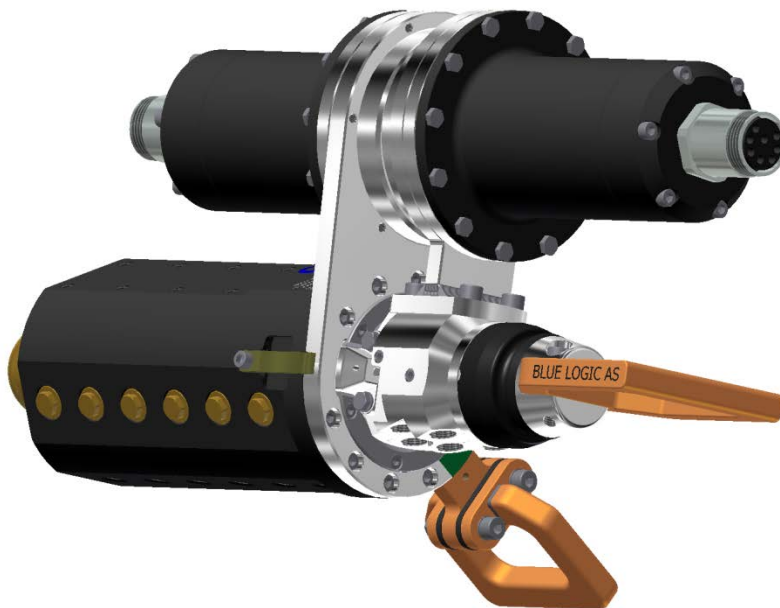


Figure 8 Hydraulic and inductive connector mated

3.1.4. Wireless Wire Transfer System

In some applications, where the secondary side is required to move relatively to the primary side, a special developed “Wire Based” primary side is used. This is especially beneficial and efficient when a linear or rotating movement is required subsea.

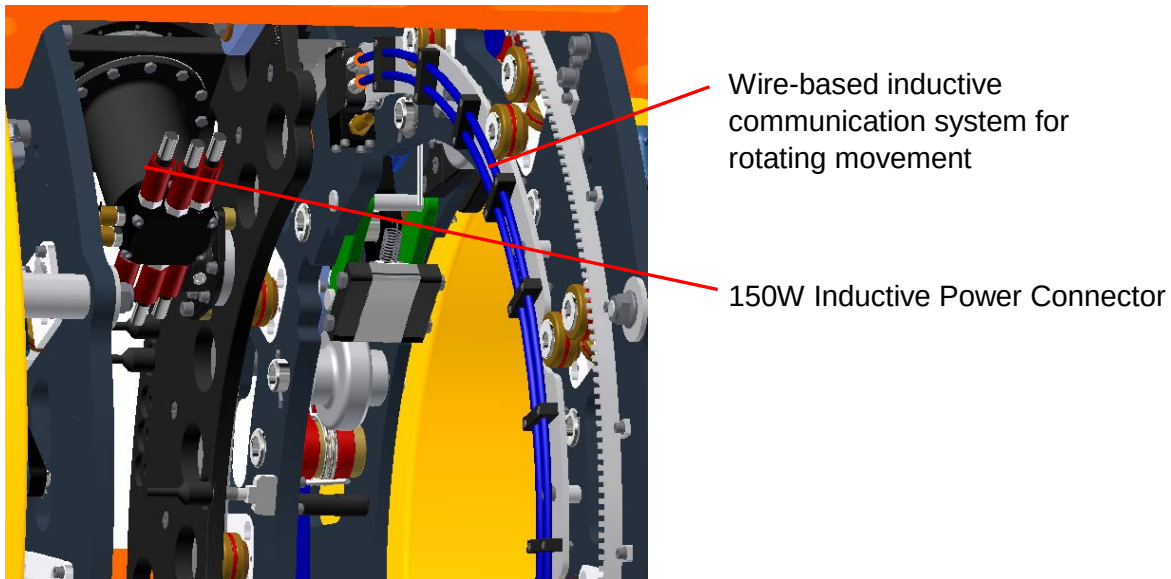


Figure 9 ROV Tool System with integrated wireless power and communication system

3.1.5. 2kW ROV Connector

The WPC/ Blue Logic developed 2kW ROV Connectors has primarily been developed for use in conjunction with ROV operated Electrical Powered Torque Tool. By use of this connector system, the ROV can effectively perform tool changes subsea without having to return to surface. The connector transfer both power and communication required for precise control and operation of the Blue Logic Electrical Torque Tool System.



Figure 10 – All Electric ISO Class 2-4 Torque Tool/Fail Safe Actuator

3.1.6. WPC Camera Station

With this camera station HERNIS launches into a new era with its new PEEK based manufacturing material and the patented WPC technology for wireless transmission of power.

The PT12 camera station offers 360 deg. endless rotations for enhanced user experience. Whereas endless rotation is traditionally solved with the use of slip rings HERNIS is utilizing patented wireless transmission technology that eliminates the risk of unreliable transmission due to wear and tear which reduces maintenance. This product is sold by [Hernis Scan Systems](#).



3.1.7. WPC EX Torch and Charger

WPC has developed a Torch and a Charger that are certified for use in hazardous areas.

Inductive charging makes this the only Torch in the market that is certified for charging within Zone 1 hazardous environments. This product is sold by [Hernis Scan Systems](#).

