UWIS INDUCTIVE MODULE
UWIS-INDS100

OPERATION DESCRIPTION
AND USER MANUAL

A wireless inductive data link for digital data transmission above and under water

REVISION 1.0 - April 2018 T.Toivola
REVISION 2.0 - April 2020 T.Toivola (RF power, gain and duty cycle added)
REVISION 3.0 - June 2020 T.Toivola (Chapter 9, No RX only mode)
REVISION 4.0 - July 2020 P.Arvonen (Chapter 10)

Contents

1.   Object of the Document

This document contains description the functional operation of the
UWIS Inductive module and user manual.

2.   Features

Nominal features for UWIS UWIS-INDS100 inductive link are as
follows:

1 The device implements the current UWC protocol specification

2 Communication range is 1.5 meters minimum

3 Frame error rate is less than 1% at 1.0 meter range

4 There are no interference to another UWC device

5 The device accept typical outside interference while maintaining
communication range and frame error rate specifications

3.   Operating frequencies

Divisors using an 8 MHz peripheral clock (PERCLK) are shown in
Table 1 with operating frequencies.

Table 1 Operating frequencies.

TXFREQ	Transmit carrier frequency	123076.92 Hz	PERCLK / 65
TXPEAKPOWER	Transmit peak power	25 dBm	
TXDUTYCYCLE	Transmit duty cycle	20 ms / 1000ms	
ANTENNAGAIN	Integral coil antenna gain	2.15 dBi max	
BITRATE	Bit rate	8791.21 Hz	TXFREQ / 14
SAMPLERATE	Receiver Sample Rate	43956.04 Hz	PERCLK/182
RXFREQ	Receive carrier frequency	123076.92 Hz	
RS232	Serial data bit rate	115200 baud	

4.   Modulation

The UWC inductive link uses binary phase-shift keying (BPSK)
modulation. The BPSK modulation works by shifting the phase of the
transmit carrier by 180 degrees for every transmit bit that is
zero. When the transmit bit is one, the carrier is transmitted
without change. The bandwidth used is roughly equal to the bit
rate.

5.   Host interface

Inductive module is connected to the host with 7-pin interface
cable.

Table 2 Host interface

Pin	Name	Signal	Value
1	3V	3V regulated supply	3V +-5%
2	USORX	RS232 serial bus TX	115200 baud 8N2 0/3V
3	USOTX	RS232 serial bus TX	115200 baud 8N2 0/3V
4	GND	Ground	
5	Mute	Mute control to switch off TX	0/3V control line
6	-	Reserved	
7	12V	12V regulated supply	12V +-5%

6.   MCU

MCU EMF32G210 convert serial data to inductive TX-signal and
receive inductive RX-signal converting it to serial data. MCU runs
with 16MHz clock generating needed frequencies according embedded
firmware.

7.   TX amplifier

MCU gives digital timing and modulation for external mux. Mux
gives modulated digital output for transmitter output amplifier.
Digital signal is then filtered to analog signal with needed
bandwidth. Analog signal is possible to mute with host mute signal
to avoid known collisions. Analog amplifier feeds output coil.
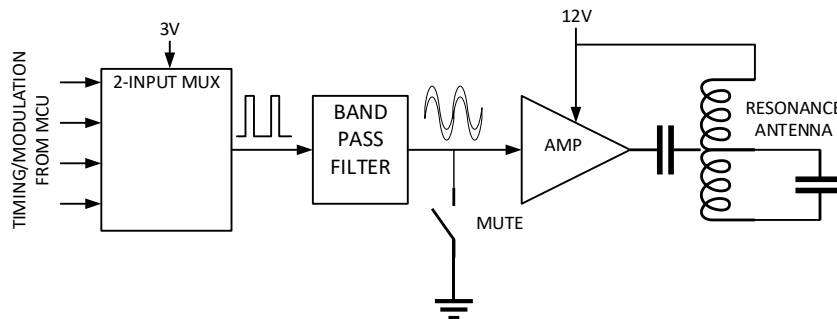Output coil is tuned to 123 kHz to achieve needed range.

Figure 1 Transmitter block diagram

8.   RX amplifier

Receiver coil is tuned to max receiver sensitivity. Low noise amplifier amplify received signal for MCU ADC conversion. MCU receive differential signal for BPSK detection.
There is no RX only function mode on this device, TX is always functional and so receiver only mode cannot be measured.
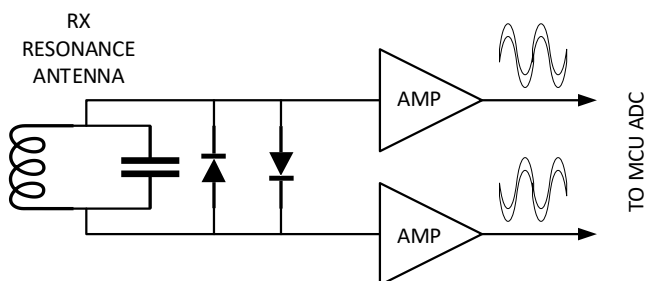

Figure 2 Receiver block diagram

9.   Module usage position

Inductive module is located inside the host enclosure to achieve mechanical, moisture or ESD protection. Host device nominal location and direction gives optimal range for inductive antenna.
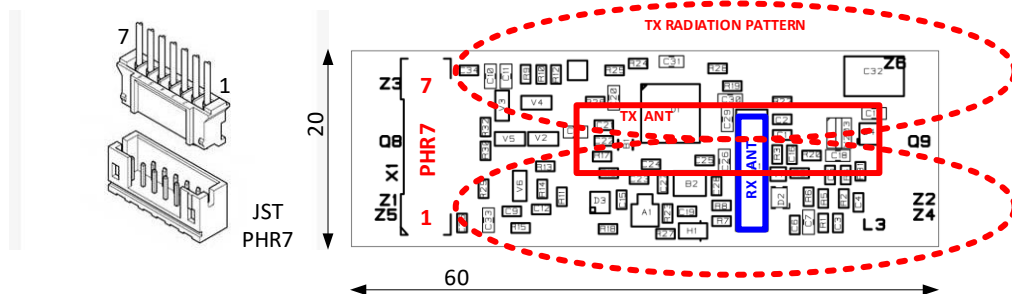
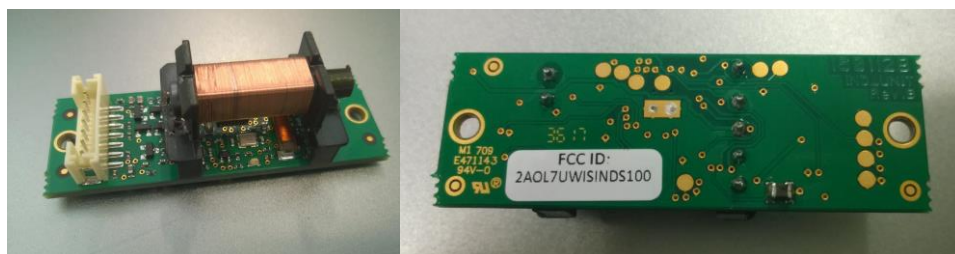*Figure 3 Module antenna and connector locations*

Figure 4 UWIS-INDS100 picture

10. FCC Statement

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference, and

(2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.