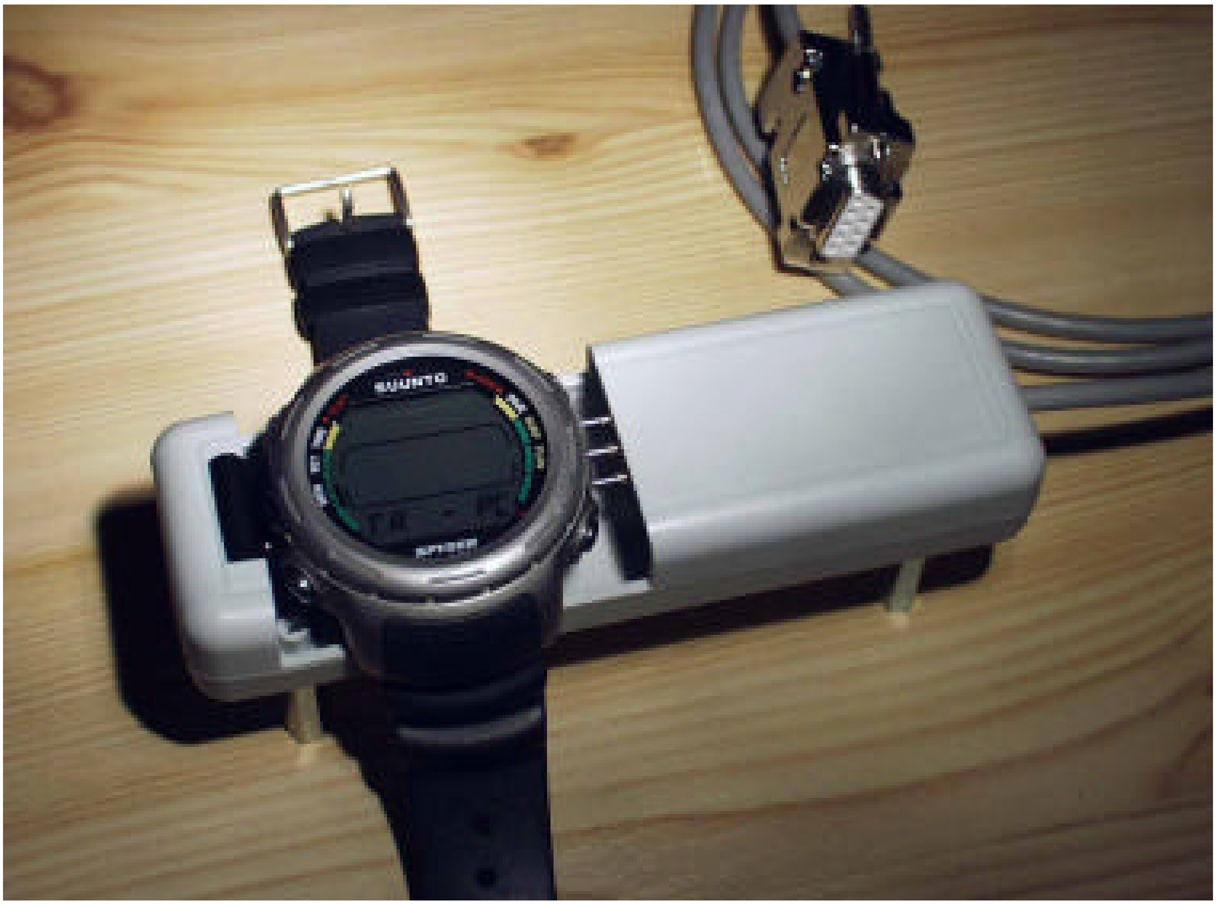
DIY - PC - Interface for Suunto Spyder ACW



Foreword and History

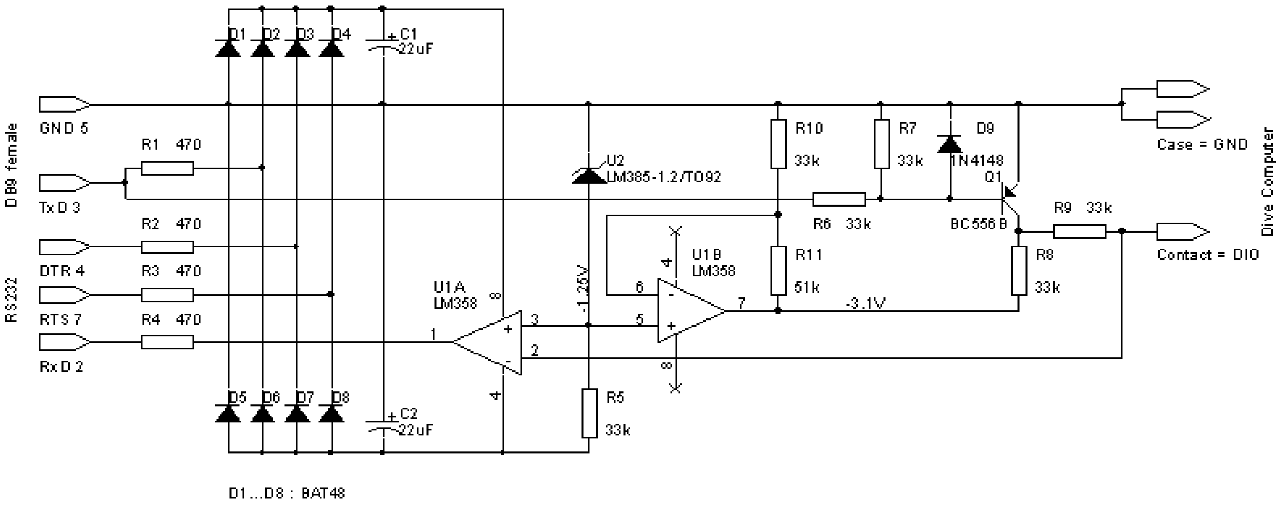
This instruction is intended for people with a certain amount of manual skills and some experience in completing electronic assembly kits. You don't have to understand the function of each component of the circuit and you do not have to be a computer expert.

The circuit described here has proven to be reliable and safe. A correct assembled device will never harm the dive computer nor the PC it is attached to. However I do not take any responsibility for any kind of damage. If you decide to rebuild this unit, it’s on your own risk.

The software program for reading the ACW's memory and manage the logbooks can be downloaded from the Suunto homepage www.suunto.fi free of charge. I recommend the Suunto Dive Manager V.1.2.

The circuit was developed because I simply didn't want to spend over 150 US$ for a box obviously not worth more than 50. I was convinced that Suunto won't give me any hint or tip about their interface and I knew nobody who could loan me one to copy. So I analyzed the "water sensor" contact on the ACW and traced the RS232 when the software tried to communicate over the (not present) interface to the (not present) ACW. I quickly learned about the basics of the communication like baudrate, levels, impedances... So I became able to develop a first prototype. It was provisional and looked scanty but it worked. Then I refined the mechanical concept and built a nice housing around. Then I showed the piece to a friend who just bought a Spyder and therefore I had to build another one. And then another one and so on.

Schematic



Circuit description

When you look at the schematic you can find no highly sophisticated components like line drivers, multiplexers or similar. For the required baudrate of 2400 bits/second the cheap and easy-available components are sufficient.

Roughly the circuit consists of two level shifters and their power supply.

D1...D8 and C1, C2 care for the power supply, R1...R3 provide some protection. PC data output lines momentarily on high logic levels provide positive, those on low level provide negative supply voltage. The purpose of D1 and D5 are not obviously clear, but they are necessary to protect either of the power supply capacitors from being negative charged and possibly even causing damage to the attached computer, e.g. via the input protection diodes of U1A.

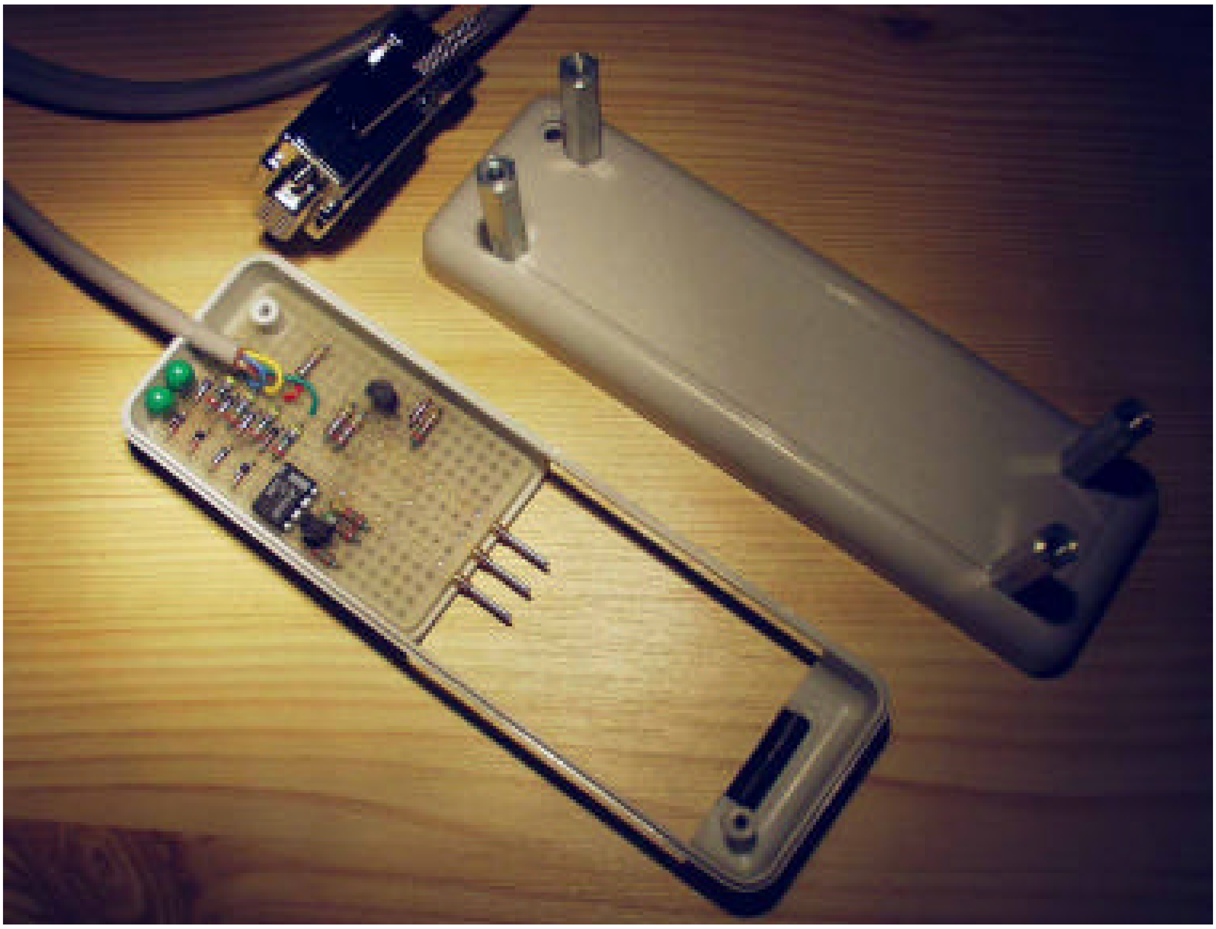
IC1b along with R10, R11 provides an output voltage of -3.2V, thats the logic-high level of the ACW. Logic-low level is ground, which is also the metal case of the ACW.

T1 together with R6...R8 act as an inverting level shifter for the PC's TxD line. D9 protects T1's base from being reverse biased. R9 adds some impedance for the period when the ACW is transmitting data because there is no separate contact on the ACW. This is quite a simple approach for the "control" of the half-duplex communication but I didn't want to implement multiplexers and handshake controls in the interface. And it works.

IC1a acts as inverting level shifter from the small ACW levels to the RS232 levels. R4 serves for some protection.

Just a word about the bandgap reference IC2 which is certainly the "most expensive" component in the circuit. I took this approach for the following reason: the device gives an accurate reference for the logic level of the ACW as well as for the threshold of the level shifter, quite independent on the power supply voltage or temperature. IC2 can be replaced by 3, forward biased, series connected 1N4148 silicon diodes or a red LED when R11 is changed to 33kΩ, but this reduces the temperature range and variations of the power supply voltage become more critical. The same applies for the replacement of the shottky diodes D1...D8 in the power supply part with 1N4148's, where the circuit becomes more dependent on the RS232 drivers of the PC.

Electronics Assembly



There are several ways to get the components soldered together - more and less reliable ones. All of these methods require a certain amount of manual skills and experience with soldering. The simplest way is to use a printed circuit board, provided that you have one. The other, more inefficient but almost everywhere available is the use of Veroboard. I often use this technique to build prototypes. If you spend some time to think about a clever placement of the components, you need only very few pieces of thin wire for connection.

It's favorable to take the mechanical aspects into consideration when you design the electronics assembly. I used spring loaded contacts with rounded tips and soldered the sleeves directly on the Veroboard. The position of the PCB inside the housing is then chosen such that the ACW fits in respect to the contacts. See the picture of the open cradle.

Test

It’s favorable to test the circuit before putting it into operation. All you need is a dual output adjustable power supply (two 9V batteries do the job, either) and a voltmeter.

1) Set DTR to +9V and RTS to –9V (all voltages in respect to GND). You should now be able to measure the potentials –1.25V, -3.2V indicated on the schematic.
2) Now connect TxD to –9V, too. The voltage at the computer I/O contact should become around –50mV and the voltage at RxD should be around –8.5V.
3) Finally change TxD to +9V. The computer I/O contact should become around –3V and the voltage at RxD should be near +8V.

Are these tests successful, you can plug the interface to the PC and see if the Dive Manager software recognizes it by the test routine. Now you can perform your first data transfer.

Parts List
(The remarks in brackets are for easier finding equivalents)

Electronics:

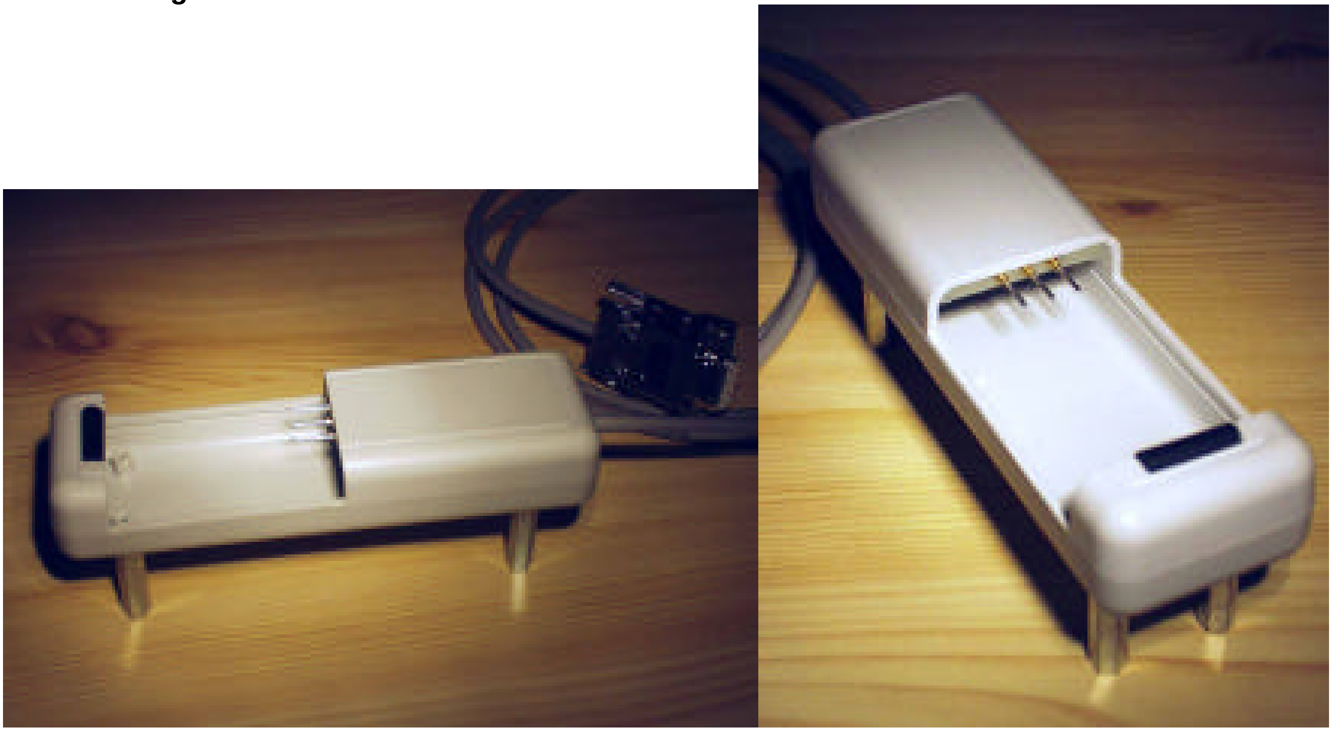
U1	1	LM358
U2	1	LM385-1.2
Q1	2	BC556 (PNP, 100mA)
D1...D8	8	BAT48 (100mA Shottky)
D9	1	1N4148 (100mA silicon diode)
C1, C2	2	22µF/16V
R1…R4	4	470Ω
R5…R10	6	33kΩ
R11	1	51kΩ

all resistors > 0.25W

Others:

Cable	1	5-core, 1-2 meters
Connector	1	DB9 female
Contacts	3	Ingun part-# 112 313 100 R 1502 (don’t forget the solder sleeves)
PCB	1	Veroboard
Housing	1	Conrad part-# 54 12 14
Pillars	4	M3 * 20mm
Rubber profile 10mm		

The Housing



Some electronics people will have their trouble with the construction of the mechanical parts of the interface. I have found a very nice and handy housing at the German distributor "Conrad" that requires only little machining. See how I machined the housing for inserting the ACW on the pictures.

One disadvantage is that the cradle is too light. It can be compensated for when you add some heavy pillars on the bottom. This lifts it up from the table which is good when you have the ACW with rubber wrist straps.

To keep the ACW secure in place while communicating I added a piece of rubber normally used to protect sharp edges.

That's it! Inspire yourself with the pictures and improve the design even more.

In Case of Problems

First of all there are no known problems with the PC-interface or the Suunto software. In most of the cases the problem with the data transfer is due to dirt on the water sensor contact, improper COM-port selection or the "COM time delay" value is not suitable for the hardware used. Here are some hints & tips:

When you often get the Transfer Timed Out error message, try the following:

1. Make sure that you have your PC-interface properly connected to your PC following the instructions of the program and the Help utility. Run the TEST program from the Transfer Menu - PC Interface Setup window which should recognize the COM-port to which the PC-interface is connected to. Now make sure that this COM-port is the one you have selected.
2. You can set the "COM time delay" in the Interface Setup window of the Dive Log program. The value depends on the hardware used (is it a powerful PC or not, and some other PC settings). It is advisable to experiment with different values and see which one works the best. A value of 10 should be appropriate for 95% of all computers.
3. The spring contact in the middle (out of 3) of the cradle is the most important one. Sometimes this pin does not make a proper contact to the water-sensor of your ACW. Carefully clean the three PC-interface pins and the water-sensor of your ACW with a soft eraser or dry cloth.
4. Insert the ACW into the cradle and carefully twist your ACW just a little bit to ensure a proper contact of the middle pin. Now look at your ACW's display and notice a short 'blink'. This blink tells you that the connection is made correctly and that your ACW is ready to transmit. According to the program's Help, you should set your ACW in TR-PC mode before inserting the unit into the PC-interface. However some users have good experiences when setting the ACW in PC-TR mode after the unit is inserted.
5. If you had an unsuccessful transmission just scroll through MEM - LOG - HIS to TR-PC with the upper left button of the ACW (without removing the ACW from the cradle) to try again.
It is also advisable to set the ACW to MEM-mode (upper right button) before inserting into the cradle and after inserting scroll to TR-PC. Now notice the 'blink'.
6. Do not move or touch your ACW and PC-Interface while transmitting because any movements may interrupt the transfer and you have to start all over again.
7. To confirm the proper working of your ACW's TR-PC mode you can also simulate the 'blinking' effect (see 4) by using an open-bent paper-clip. Connect the paper-clip's ends between the water-sensor and the metal chassis of your ACW. Now notice the 'blink'.