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HardWaves ONE

"General Purpose WINE Board"

User Manual

Document Status	
Last Change	Aug 8, 2014
Status	Preliminary
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Revisions	12/09/13 Initial Standard revision (based on GPWB specs). 07/30/14 Update with images and I/O signals

Summary

The "*HardWaves ONE*" board (HW1) aims to implement an All-In-One WINE (Wireless Intelligent NEtwork) solution to interface digital and analog I/O signals.

Notes about TLP

The **Traffic Light Protocol** (TLP) was created to encourage greater sharing of sensitive information. The originator signals how widely they want their information to be circulated beyond the immediate recipient.
The TLP is designed to improve the flow of information between individuals, organizations or communities in a controlled and trusted way. It is important that everyone understands and obeys the rules of the protocol. Only then can trust be established and the benefits of information sharing realized. The TLP is based on the concept of the originator labeling information with one of four colors to indicate what further dissemination, if any, can be undertaken by the recipient. The recipient must consult the originator if wider dissemination is required.

The four colors and their meanings

There are four colors (or traffic lights):

- **RED - personal for named recipients only**
  In the context of a meeting, for example, RED information is limited to those present at the meeting. In most circumstances, RED information will be passed verbally or in person.
- **AMBER - limited distribution**
  The recipient may share AMBER information with others within their organization, but only on a 'need-to-know' basis. The originator may be expected to specify the intended limits of that sharing.
- **GREEN - community wide**
  Information in this category can be circulated widely within a particular community. However, the information may not be published or posted publicly on the Internet, nor released outside of the community.
- **WHITE - unlimited**
  Subject to standard copyright rules, WHITE information may be distributed freely, without restriction.

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1 System capabilities

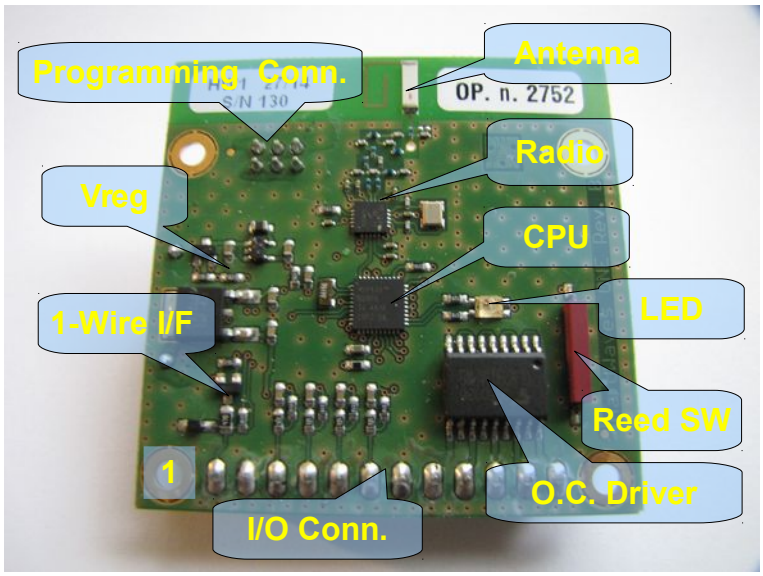
The HW1 board implements some interfaces to bind external hardware/sensors.

This interfaces are:

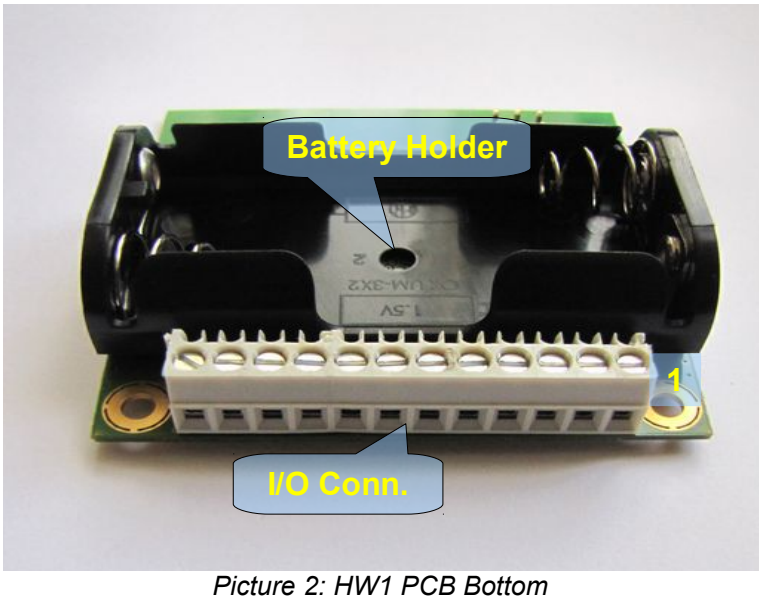
- **4 analog/digital** input ports;
- **4 digital** output ports;
- **1 1-Wire™ I/O** port;
- **1 UART/Programming** communication port.

Moreover, some ancillary circuitry implements power supply conditioning.

Primary batteries, installed in an on-board battery holder, are the power source for standalone devices.



Picture 1: HW1 PCB Top



Picture 2: HW1 PCB Bottom

1.1. Power Supply

Power cam be supplied by 2 AA Alkaline primary batteries or via external supply connection. See patagraph 3.

1.2. Inputs

HW1 provides analog single-ended acquisition, in the range 0÷2.5[V], on 4 ADC inputs. The built-in ADC provides **10 bits** resolution.

Analog and digital inputs share the same pins on the I/O termination block.

Input voltages must be hardware programmed via an **external** resistor partition, to rescale and prevent hardware damages.

1.3. Outputs

HW1 will provide 4 Open-Drain digital outputs. Max voltage 50 [V], max current 1 [A], with internal clamp diodes on each channel. Clamp common cathodes output will be wired on a pin of termination block.

1.4. 1-Wire™ I/O

A direct LVTLL I/O pin provides a 3.3 [V] switchable I/O aimed to power a 1-Wire™ bus and/or some external load like NTC temperature sensors. Since 1-Wire™ 3.3 [V] bus requires strong pull-up, an on-board MOSFET-P drive is used.

1.5. LVTTL Serial Interface (UART)

The MSP core serial port is available as general purpose serial interface, with UART speed up to 115200 [bps].

This will be a direct unprotected connection to MSP430 core, available on a dedicate feature connector.

1.6. On board sensors

The MSP430G2955 core has a (relative) low precision internal temperature sensor that can be read and linearized.

A better precision can be achieved connecting a simple NTC 10K sensor, with a very little cost.

1.7. User interface

HW1 provides a simple user interface based on two colors SMD LED (green/red) to show states and/or information.

A magnetic contact (reed) implements the user interaction via a small magnet, that can operate on an enclosed (and possibly sealed) HW1.

2 Schematic blocks

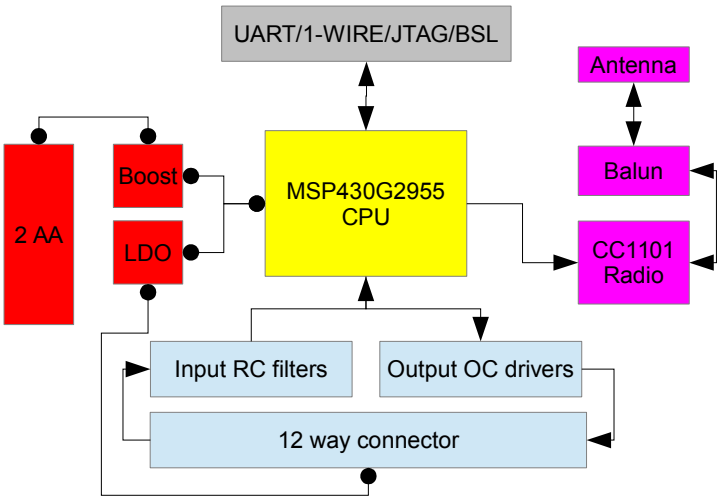


Illustration 1: HW1 schematic blocks

3 Battery and Supply

HW1 PCB is equipped by a low-cost battery holder for 2 AA primary batteries.

Two types of AA primary batteries can be used:

- alkaline, 1800-2600 [mAh] nominal capacity;
- lithium, 2700-3400 [mAh] nominal capacity.

HW1 implements an efficient, high frequency, 3.3 [V] boost converter, with typical 5 [uA] quiescent current and 95 [%] efficiency.
It can operate down to 0.9 [V], extending effective battery life.

To improve flexibility, a 36 [Vdc] max input voltage regulator, wired to clamp pin of termination block, is provided.

Picture 3: 2 AA PCB Battery Holder by MPD

4 I/O Connector(s)

A comfortable solution for wire-to-PCB connection is a screw termination block. Wires in the range 16-26 AWG could be connected.

Analog and digital signals are shared on the same pins of the 12 way termination block.

PCB provides another connector for external power supply,core programming/debugging and 2-wires UART connecion.

Picture 4: On-Shore 3.5 [mm] pitch PCB Termination Blocks

PIN	Direction	Signal	Function
1	I/O	1-Wire ™ BUS	Expansions access, LVTTL BUS
2	Power	GND	1-Wire ™ BUS reference
3	IN	Analog/Digital Input #1	Input MAX logic level 3 [Vdc], analog 2.5 [Vdc]
4	IN	Analog/Digital Input #2	Input MAX logic level 3 [Vdc], analog 2.5 [Vdc]
5	IN	Analog/Digital Input #3	Input MAX logic level 3 [Vdc], analog 2.5 [Vdc]
6	IN	Analog/Digital Input #4	Input MAX logic level 3 [Vdc], analog 2.5 [Vdc]
7	Power	GND	Voltage reference
8	Power	Supply / CLAMP	MAX 36 [Vdc] Power Supply
9	OUT	Open Collector Ouput #1	MAX 36 [Vdc] 1 [A] Output (Active Low)
10	OUT	Open Collector Ouput #2	MAX 36 [Vdc] 1 [A] Output (Active Low)
11	OUT	Open Collector Ouput #3	MAX 36 [Vdc] 1 [A] Output (Active Low)
12	OUT	Open Collector Ouput #4	MAX 36 [Vdc] 1 [A] Output (Active Low)

Tabella 1: I/O connector signals

Warning!!! Some voltage limits come from hardware. **Exceeding 3.6 [Vdc] on terminations 1 to 6 may cause an irreversible damage to micro-controller.**

4.1.Connection examples

Due the flexibility of the I/O connector, a level of “hardware programmability” is possible.

4.1.1 Analog/Digital Inputs

Up to 4 inputs can be wired on termination block, both analog or digital (LVTTL levels).

The built-in 10 [bit] ADC (Analog to Digital Converter) of MSP430 micro-controller can convert analog signals up to 2500 [mV], that means about 2.5 [mV/bit].

A resistive voltage divider (see theory at http://en.wikipedia.org/wiki/Voltage_divider) MUST be provided to scale down voltage at a safe level.

4.1.2 LED Drive

Picture 5 shows the connection of 4 LEDs, with external power supply.

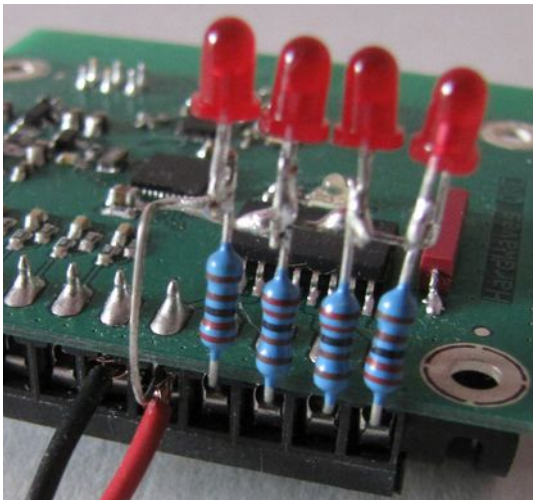
Black wire is reference voltage (GND), while red one is the **supply/clamp** voltage (MAX 36 [Vdc]).

Each LED has its own current limiting resistor: the value depends on:

- supply voltage and
- maximum nominal LED forward current.

Open Collector outputs **require external power source** and can continously **sink up to 1 [A]**.

While external power is active, no current is drawn from batteries.



Picture 5: LEDs with external power

The theory is explained at http://www.evilmadscientist.com/2012/basics-open-collector-outputs/.

4.1.3 Solenoid Drive

Up to 4 solenoids (AKA "*relay coil*") can be driven exactly as LEDs.

It's mandatory to connect one (common) side of coils to **supply/clamp** termination, and the other one to open collector termination.

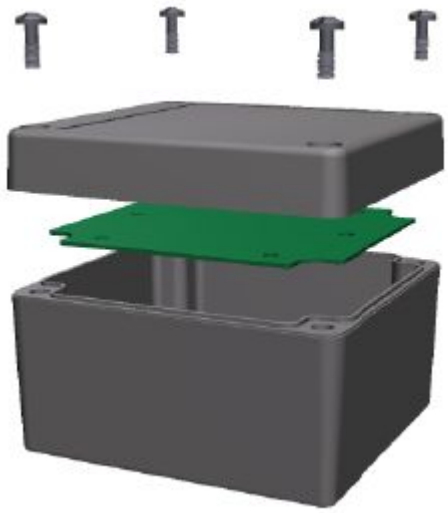
Open Collector outputs can continously sink up to 1 [A], enough for almost any coil.

5 Enclosure (optional)

Due the main use in harsh or unfriendly environments, an IP65 grade ABS enclosure is required. Enclosures with integrated battery holders/door can't assure required IP grade.

RP1065 by Hammond manufacturing allow an comfortable fixing of PCB on the lid, allowing easy access to battery holder and termination block.

The user interface based on LEDs visibility is grant via a hole sealed by a polycarbonate adhesive stitch set on the cover.



Picture 6: RP1065 by Hammond Manufacturing