Getting started with HD2 - Marmotte

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0.1	March 23, 2021	Initial writing

Abstract

This technical report to help me get familiar with the project and have all the important information and specifications relative to my tasks in one place.

1 HD2 Treaded Tank Robot Platform

Figure 1: Robot platform

- The robot is from superdroidrobots.com
- Can climb obstacles, ascend stairs and drive over most terrain
- Controled through Roboclaw motor controller
- We use 4 IG52-04 24VDC 285 RPM Gear Motor, 2 of them with encoders. Encoders are not needed for the other 2 as they are connected in line with the same track

Motor Configuration			Approximate Current Draw[1] (total for all motors)			
Gross Weight limit[2]	Front Motors	Rear Motors	Driving Flat Straight	Pivot Turns on Grass	Pivot Turns on Concrete	Ascending Stairs
IG52-02 24VDC 103 RPM Gear Motor						
120lbs	2	0	3.5A	12A	8A	8A
200lbs	2	2	5A	13A	9A	8.5A
IG52-02 24VDC 290 RPM Gear Motor						
120lbs	2	2	11A	40A	21A	20A
IG52-04 24VDC 285 RPM Gear Motor						
120lbs	2	0	5A	24A (~Stall)	9.5A	12.5A
200lbs	2	2	8.5A	22.5A	11.5A	16A

1. The current draw is approximate average. Higher inrush spikes, etc will be experienced.
2. The robot weighs about 60lbs with motors. The weight of the batteries, sensors, controllers, aux equipment, cargo, etc should be added to this to get the gross weight. The robot itself is designed to carry even more weight, but since its skid steering, turning in deep grass, carpet etc will be difficult with heavier loads. If using on smooth surfaces, dirt or other low friction surfaces, pivot turning with heavier loads can be achieved.

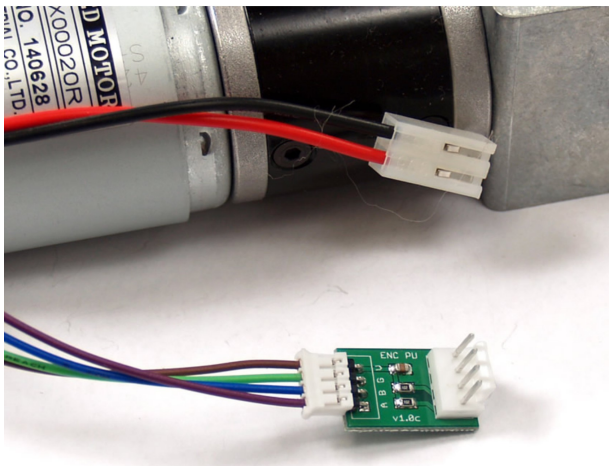
Figure 2: Motor config

2 D.C. Geared motors

- Name: IG52-04 24VDC 285 RPM Gear Motor
- Variable speed and reversible
- Dual channel quadrature encoder
- **Each channel requires a 1k pull up resistor to Vcc**

Motor

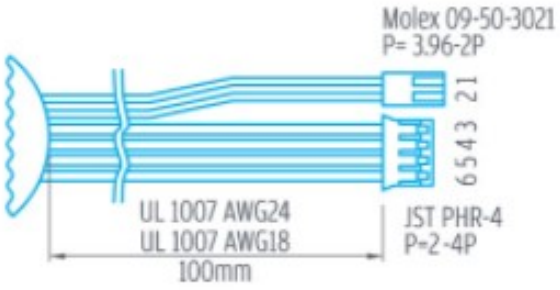
Pull up resistor attached



Cable layout

Two Channel Encoder Connections	
1. Black	: - Motor
2. Red	: + Motor
3. Brown	: Hall Sensor Vcc
4. Green	: Hall Sensor GND
5. Blue	: Hall Sensor A Vout
6. Purple	: Hall Sensor B Vout

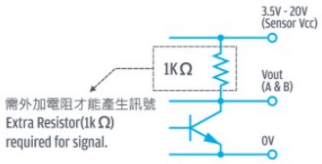
Schematic



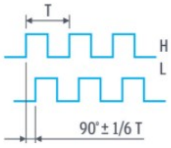
Electrical caracteristics

規格特性 Characteristics	代號 Symbol	測試條件 Test conditions	極小 Min.	基準 Ref.	最大 Max.	單位 Units
輸入電壓 Supply voltage	Vcc	- -	3.5	-	20	V
輸出飽和電壓 Output saturation voltage	Vce (sat)	Vcc = 14V ; IC = 20mA	-	300	700	mV
輸出漏電電流 Output leakage current	Icex	Vcc = 14V ; Vcc = 14V	-	< 0.1	10	μA
輸入電流 Supply current	Ice	Vcc = 20V Output open	-	5	10	mA
輸出上升時間 Output rise time	tr	Vcc = 14V ; RL = 820 Ω ; CL = 20pF	-	0.3	1.5	μS
輸出下降時間 Output fall time	tr	Vcc = 14V ; RL = 820 Ω ; CL = 20pF	-	0.3	1.5	μS

輸出電路 Output circuit



輸出波形 Output wave



- To reduce noise as much as possible in the system, twist positive and negative wires together and use ferrite beads at each motor connection.
- Bigger ferrite first over both wires and one smaller ferrite bead over each wire. (Don't forget the heatshrink)

3 Roboclaw 2x30A Motor Controller

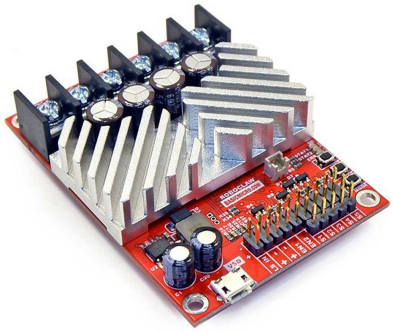
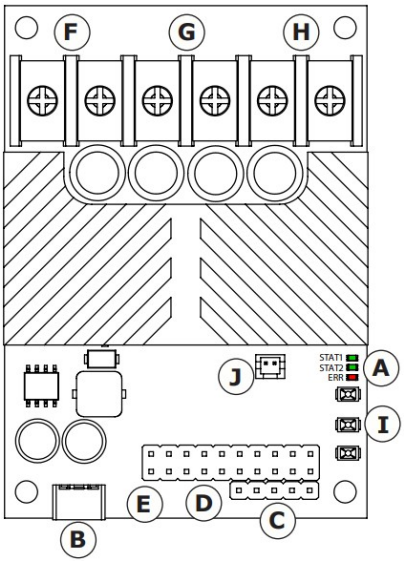
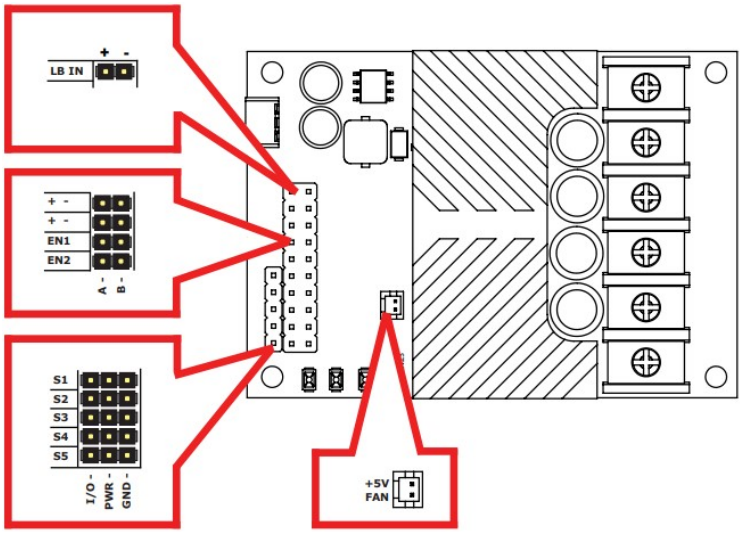


Figure 3: Motor Controller

Hardware overview



Control interface



- Connect batteries to the main terminal (G).
- Connect encoder through pull up resistor chip to pins in section D.
- See schematic below for details.
- For initial tests connect roboclaw through usb to computer (batteries have to be connected to roboclaw to function). Use motion studio to check if motors and sensors work.

ID	Function	DESCRIPTION
A	Status LEDs	Provides RoboClaw status information.
B	USB Port	Communicate with RoboClaw via USB.
C	Control Inputs	S1,S2,S3,S4 and S5 control inputs.
D	Encoder Inputs	Dual encoder input and power pins.
E	Logic Battery	Logic battery jumper setup and logic battery power input.
F	Motor Channel 1	Motor driver output screw terminals for channel 1.
G	Main Battery	Main battery screw terminal input.
H	Motor Channel 2	Motor driver output screw terminals for channel 2.
I	Setup Buttons	Configure RoboClaw. Can bypass and use IonMotion PC setup utility.
J	Fan Control	Automatic fan control. 5VDC Fan. On at 45°C and off at 35°C

Figure 4: Hardware overview reference table

NAME	UART TTL	ANALOG	R/C PULSE	FLIP SWITCH	E-STOP	HOME	LIMIT	V-CLAMP	Encoder
S1	RX	Motor 1	Motor 1						
S2	TX	Motor 2	Motor 2						
S3				X	X			X	
S4					X	Motor 1	Motor 1	X	
S5					X	Motor 2	Motor 2	X	
EN1									Motor 1
EN2									Motor 2
+5V									
FAN									

Figure 5: Control interface reference table

Characteristic	Min	Typ	Max	Rating
Main Battery	6		34	VDC
Logic Battery	6	12	34	VDC
Maximum External Current Draw (BEC)			3	A
Motor Current Per Channel		30(2)	60(1,2)	A
Motor Current Bridged		60(2)	120(1,2)	
On Resistance		4.3		mOhm
Logic Circuit Current Draw		30mA		mA
Input Impedance		100		Ω
Input	0		5	VDC
Input Low	-0.3		0.8	VDC
Input High	2		5	VDC
I/O Output Voltage	0		3.3	VDC
Digital and Analog Input Voltage			5	VDC
Analog Useful Range	0		2	VDC
Analog Resolution		1		mV
Pulse Width	1		2	mS
Encoder Counters		32		Bits
Encoder Frequency			9,800,000	PPS
RS232 Baud Rate (Note 3)			460,800	Bits/s
RS232 Time Out (Note 3)	10			ms
Temperature Range	-40	40	100	°C
Temperature Protection Range	85		100	°C
Humidity Range			100 (4)	%

Figure 6: Electrical specifications

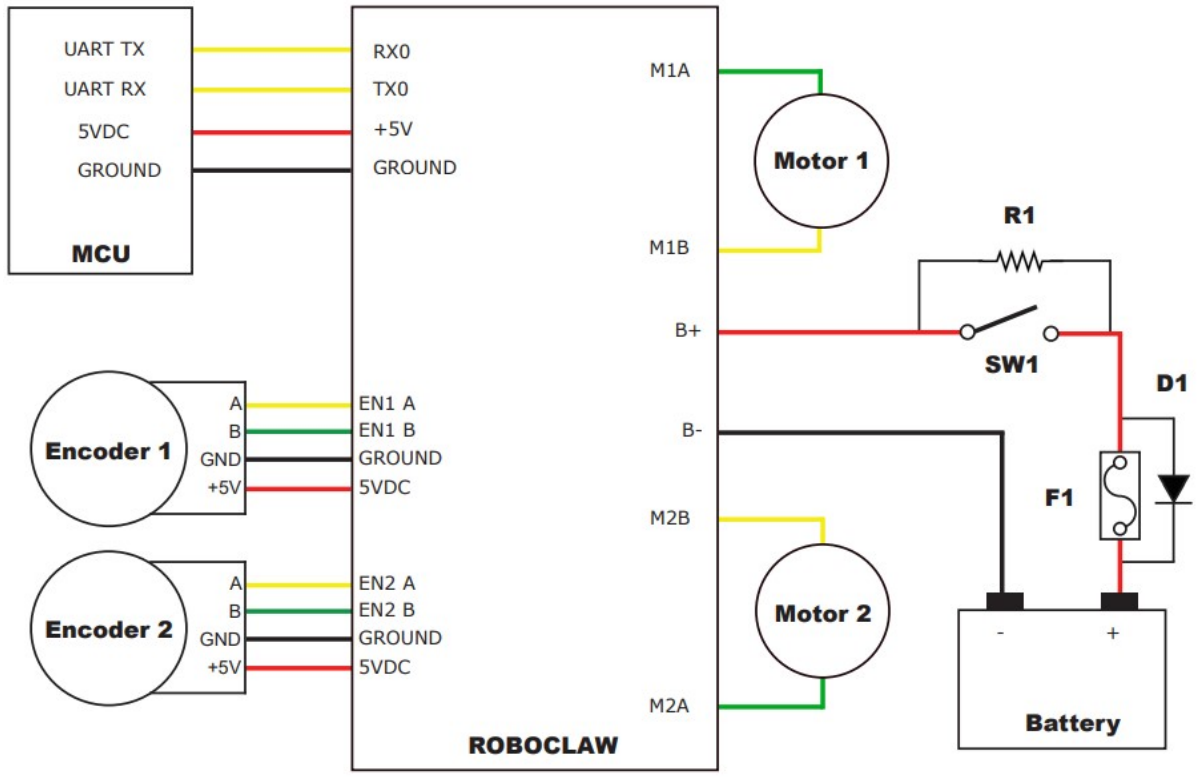


Figure 7: Safety wiring

4 The batteries

5 Motion studio

BasicMicro Motion Studio is the name of the software designed with the roboclaw and it can be found on the basicmicro website.

When connecting the roboclaw to motion studio it will automatically check for software updates. Then, for the applications that we use in the lab, we want to auto tune the motors in the velocity settings. We must do this in order for the roboclaw ros package to work properly.

6 ROS Driver

Different ROS drivers exist. We have tried two packages that seem to work for our preliminary testing. One uses a rospy file and the other is a roscpp file.

The first one is found on github here, and the seccond one is also found on github here.
To use these properly they can only be installed in the workspace one at a time because of the names of the files inside the packages that will get mixed up if they are both available.

7 Remote Control