

WM1 Motor Driver Arduino Shield

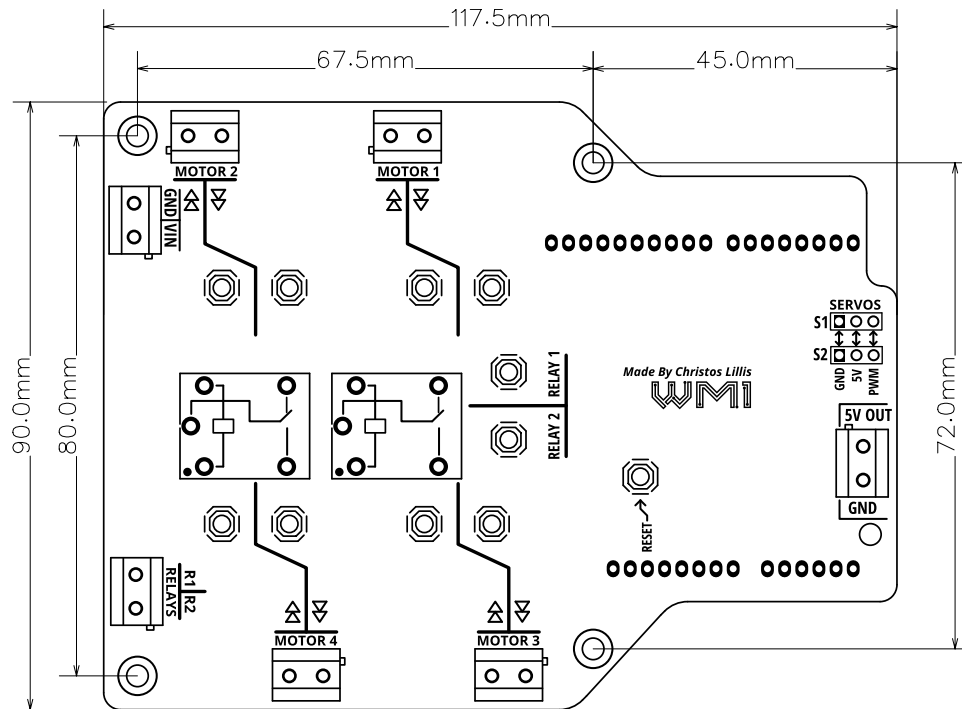


Figure 1: Simplified board drawing

Features

- 4 × Solid State Full-Bridge PWM Motor Drivers
- 2 × Relay Half-Bridge Motor Drivers
- 2 × 5V Servo Headers
- Integrated 5V 3A Buck Converter
- Stackable Shield compatible with Arduino UNO or MEGA

Applications

- Engineering Education
- Competitive Robotics

Arduino Pin Mapping

Table 1: Arduino UNO and Mega Pin Assignments

Arduino Pin	WM1 Pin	Pin Description
D2	RELAY 1	Control pin for relay attached to port labeled R1
D3	M2 PWM	PWM control pin for MOTOR 2 port
D4	RELAY 2	Control pin for relay attached to port labeled R2
D5	M3 PWM	PWM control pin for MOTOR 3 port
D6	M1 PWM	PWM control pin for MOTOR 1 port
D7	M1 DIR	Direction control pin for MOTOR 1 port
D8	M2 DIR	Direction control pin for MOTOR 2 port
D9	SERVO 1	Signal pin for servo labeled S1
D10	SERVO 2	Signal pin for servo labeled S2
D11	M4 PWM	PWM control pin for MOTOR 4 port
D12	M3 DIR	Direction control pin for MOTOR 3 port
D13	M4 DIR	Direction control pin for MOTOR 4 port

Note: If not required for the chosen application, all pins with the exception of R1 and R2 (D2 and D4) can be used freely for purposes other than those specified without adverse effects. Direction indicator LEDs will still illuminate but they can be ignored.

Electrical Specifications

Table 2: WM1 Electrical Specifications

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Input Voltage	V_{in}	7	—	12	V	Recommended Arduino input voltage
Total Input Current	I_{in}	0.1	—	$< I_{FUSE}$	A	
Fuse Current	I_{FUSE}	—	10	15*	A	Fast Blow
Solid State Driver Current	I_{SS}	—	1.5	3	A	Dependant on overall thermal conditions
Relay Driver Current	I_{RLY}	—	3	7†	A	
Buck Converter Voltage	V_{buck}	4.5	5	5.5	V	
Buck Converter Current	I_{buck}	—	2	3	A	

* Max recommended input fuse is 10A. See fusing functional description for details

† Relay current rating is based on a resistive load, for inductive loads such as motors max current must be derated or relay lifespan will be diminished

Current ratings are based on short duration loading typical of educational robotics applications. Continuous current capacity will depend on overall thermal conditions

Functional Descriptions

Solid State Motor Drivers

The primary motor drive capability for the WM1 is provided by four [RZ7889](#) Full-Bridge motor driver ICs. These are intended to be used for small DC motors. These drives are able to utilise pulse width modulated (PWM) signals from the Arduino to vary the effective voltage seen by the motor. By default the RZ7889 requires 2 independent PWM signals to control in each direction. To make more effective use of the Arduino UNO's limited PWM pins, the WM1 board includes discrete logic which allows a single PWM pin and a digital direction pin to be used instead. The logic used can be seen in figure 2. It is intended that an *analogWrite()* be used on the PWM pin to control the duty cycle, and a *digitalWrite()* be used on the DIR pin to control the direction. Examples can be found in the [WM1 example code repository](#). The RZ7889 also includes short-circuit and over-current protections, to reduce the possibility of permanent damage if those events occur.

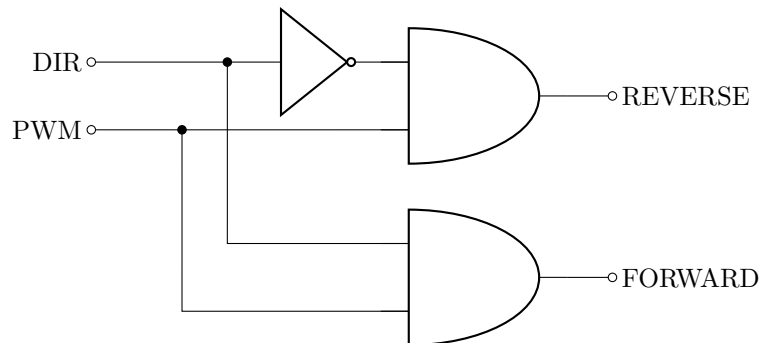


Figure 2: PWM-Direction Control Logic

Relay Motor Drivers

To drive larger motors the WM1 also includes 2 SPDT relay Half-Bridges. These can be configured as a single Full-Bridge to provide bi-directional control of a single motor by connecting both of the motors terminals to the ports R1 and R2. They can also be used as independent Half-Bridges to provide unidirectional control of two motors by connection a single motor terminal to a relay port and the other externally to ground. Relays cannot switch fast enough for PWM control to be used and so relays should only be controlled with *digitalWrite()* and the user should limit to switching at <1 Hz.

Override Switches and LED Indicators

Both the solid state and relay motor drivers all include a pair of override switches, which can be used to manually drive the motor in the direction indicated by the arrow on the silkscreen. These are intended to allow motor control without the need for software, for the purposes of setup, mechanical testing, and debugging. The switches are binary and thus will always drive the motors at 100% duty cycle. The switches will take precedence over the Arduino commands and can assert their output high even if the Arduino is driving it low.

All motor drivers also include indicator LEDs on their control lines to allow the functionality of software to be determined visually without needing to connect a motor. The LED corresponding to the driven direction will light up with the brightness roughly indicative of the duty cycle of the PWM.

5V Buck Converter

The WM1 includes a 5V step-down buck converter based on the [TPS54331](#). The 5V rail generated from the buck converter is used to power the servo headers and relay coils internally, as well as the 5V output port. The maximum current the buck converter can deliver must be shared between these three loads. The TPS54331 also includes current limiting and a thermal shutdown, to reduce the possibility of permanent damage in adverse conditions. The Arduino itself is still powered by its own independent linear regulator to prevent boot-loops if the buck's protection features are triggered.

Servo Headers

The WM1 includes two servo headers to enable control of RC-style servo actuators. These are powered off the WM1's internal buck converter and thus can power larger servos than could be handled by the Arduino's internal regulator. The header's pin mapping is clearly marked on the board, and can also be found in table 3.

Table 3: Servo Header Pin Mapping

Name and Function	Pin Number	Colour
GND (Ground)	1	Brown
5V (Power)	2	Red
PWM (Control)	3	Orange

Note: Colour varies significantly by servo manufacturer. Colours only provided here as a guide. Always check the colour assignments in the servo data-sheet

Reverse Voltage Protection and Fusing

The WM1 is protected against reverse voltage on the VIN port by a reverse-biased diode which will trip the fuse and protect the more sensitive electronics downstream. This is referred to a 'blow-through' reverse voltage protection. The fuse will need to be replaced after a reverse voltage event.

The input of the WM1 includes a fuse holder to mount a 1/4" by 1-1/4" (6 × 30mm) barrel fuse. Fast blow fuses should be used. The fuse holder is rated for fuses up to 15A. The recommended fuse current is 10A due to the current rating of the reverse voltage protection diode. The 'blow-through' reverse voltage protection is only validated to work for fuses <10A.

Reset Switch

The WM1 includes a reset switch labeled 'SRST' to initiate a restart of the Arduino. The functionality is identical to that of the Arduino UNO's reset switch which is blocked by the WM1 board.

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Datasheet is only intended as a guide. It is provided to user "as is" and it is up to the user to validate the specifications within the context of their application