USER MANUAL
for
Dual Step Motor Chopper Drive Shield for Arduino Uno – Autoshade 100105

INTRODUCTION

Originally developed for prototyping the shade screen controller, this chopper drive shield is used with an Arduino Uno controller to provide up to 2 amps current controlled power to any dual winding step motor. Voltage rating is 12 VDC. Two separate drives are contained on each shield and each shield may be programmed for up to 4 different I2C addresses allowing up to 8 step motors to be controlled.

The shield uses four TI DRV8871 PWM driver IC's that are rated at 3.6 amps (peak) current and 45 VDC max input voltage. It connects to an Arduino Uno using the 2 wire I2C serial interface signals SCL and SDA. This allows open source software drivers to be used such as Adafruit_MotorShield and AccelStepper.

HARDWARE DESCRIPTION AND CONNECTION

The board requires 5 VDC obtained from the Arduino Uno and 12 VDC which is applied through J3. See Figures 1 and 2. The 12 VDC power is used for the motor drive and is also fed through diode D1 to the Arduino Vin pin which in turn powers the 5 VDC supply on the Uno logic board. So the entire system may be powered from a single 12 VDC supply.

If multiple chopper driver shields are stacked to power multiple step motors, the I2C addresses must be programmed differently. This is done by shorting the pads shown as A0 and A1. With both A0 and A1 open, the default address is 7C. With A0 shorted, the address is 7D, with A1 shorted the address is 7E, and with both A0 and A1 shorted the address is 7F.

When multiple boards are stacked, only one 12 VDC connection is required. This is because the 12 V is distributed to all the shields using the spare pin on the 8 pin power header.

This chopper drive was designed for the Arduino Uno Rev3 which did not use pin 1 on the power supply header. When using it with any other boards, be sure to check that this pin is not connected to any sensitive circuitry. In particular, the Uno Rev4 Wi-Fi connects this pin to the microprocessor and applying 12 VDC will damage it. The safest approach is to cut the trace to pin 1. If you are using multiple chopper drive shields, cut the trace on the bottom most chopper drive board in the stack.

The DRV8871 IC's are current limited, and this current limit is set by resistors R1 through R4. The resistance is calculated from R(Kohms) = 64/I(Amps). For a current limit of 1.6 amps, R = 40 Kohms and this is the default value provided with the board. For a different current limit, you can remove the surface mount resistors R1A-R4A and replace them with ¼ watt resistors R1-R4. Or if you want to increase the current to say 2 amps, you can simply parallel the 40.2K surface mount resistors with 164K ¼ watt resistors to get the required 32K resistance. (The 164K resistors are included).

The TI driver IC's are rated at 3.6 amps peak and 45 VDC max. However, the internal temperature of these parts rises quickly depending on the current, ambient temperature and heat sinking. At a current limit of 1.6 amps, this shield will operate continuously at room temperature. But at 2.0 amps, the internal temperature limiter in the DRV8871 begins to interrupt the drive after about 2 minutes. These are rough numbers as they depend on air flow, ambient temperature, etc.

The voltage may be increased but two cautions should be observed. The 5 VDC power supply built into the Arduino Uno logic is not designed for an input greater than 12 VDC. So if a higher voltage is used for the motor drivers, remove the diode D1 and supply the Uno via the 3.1 mm connector on the Uno itself. Also, the polarized capacitors used on the chopper drive shield are rated at 25 VDC, so that voltage should not be exceeded.

When selecting a power supply for the chopper shield, be sure to calculate the power required from the winding dissipation. For example, to power a 3 ohm per winding step motor at 2 amps operating in the "DOUBLE STEPPING" mode (where both windings are powered simultaneously to obtain maximum torque), the motor winding power is $2(I^2)R$ or 24 watts for this example. A 12 VDC 2 amp power supply would be marginal for this case; a 3 amp supply should instead be used. Note that this calculation assumes that only one step motor is used at the same time.

Connect the motors to J1 and/or J2. One winding connects between pins 1 and 2 and the other winding between pins 3 and 4. The windings should NOT be grounded.

The shield contains a resistive voltage divider R9 and R10 that converts the 12 VDC down to 4.8 VDC for the Uno A to D converter on AD0. If you decide to use a higher applied voltage, this divider should be removed or modified.

SOFTWARE DESCRIPTION AND OPERATION

The Chopper Drive 100105 uses the same I2C software interface as the Adafruit Motor Shield V2 (ID1438). The required software drivers are found by downloading AccelStepper from

http://www.airspayce.com/mikem/arduino/AccelStepper/AccelStepper-1.59.zip

and Adafruit_Motor_Shield from

https://github.com/adafruit/Adafruit_Motor_Shield_V2_Library/archive/master.zip

The following example also uses the Adafruit LCD display shield (ID399) to set the speed of the step motor to a constant speed. To use this display, download the drivers Adafruit_RGBLCDShield from

https://github.com/adafruit/Adafruit-RGB-LCD-Shield-Library/archive/master.zip

Install the above three drivers in your Arduino library folder as usual.

The example sketch MyAFMotorDriverTest was used for testing a step motor in a dynamometer to determine the torque vs speed of the motor under various winding and current drive conditions. Using the Up and Down buttons, the speed is selected to be 1,51, 101, …751 steps per second; then the right or left button is pressed to start the motor connected to the right or left side port on the shield. To stop the motor and select a different speed, etc. press the reset button. This may seem like an awkward way to change speed, but by not checking continually for whether a button has been pressed, it allows the motor to run very smoothly and fast.

Download the file MyAFMotorDriverTest.ino from the site Autoshade.mx/downloads and put it in a folder called MyAFMotorDriverTest in your My Documents | Arduino directory. The sketch is highly commented and requires not much further explanation.

If you are interested in an application that uses this shield and sketch to characterize and select a step motor and current drive for a specific application, see the write up “Selecting a Step Motor and Driver for an Arduino Automated Shade Screen Project” on the web site www.Instructables.com.

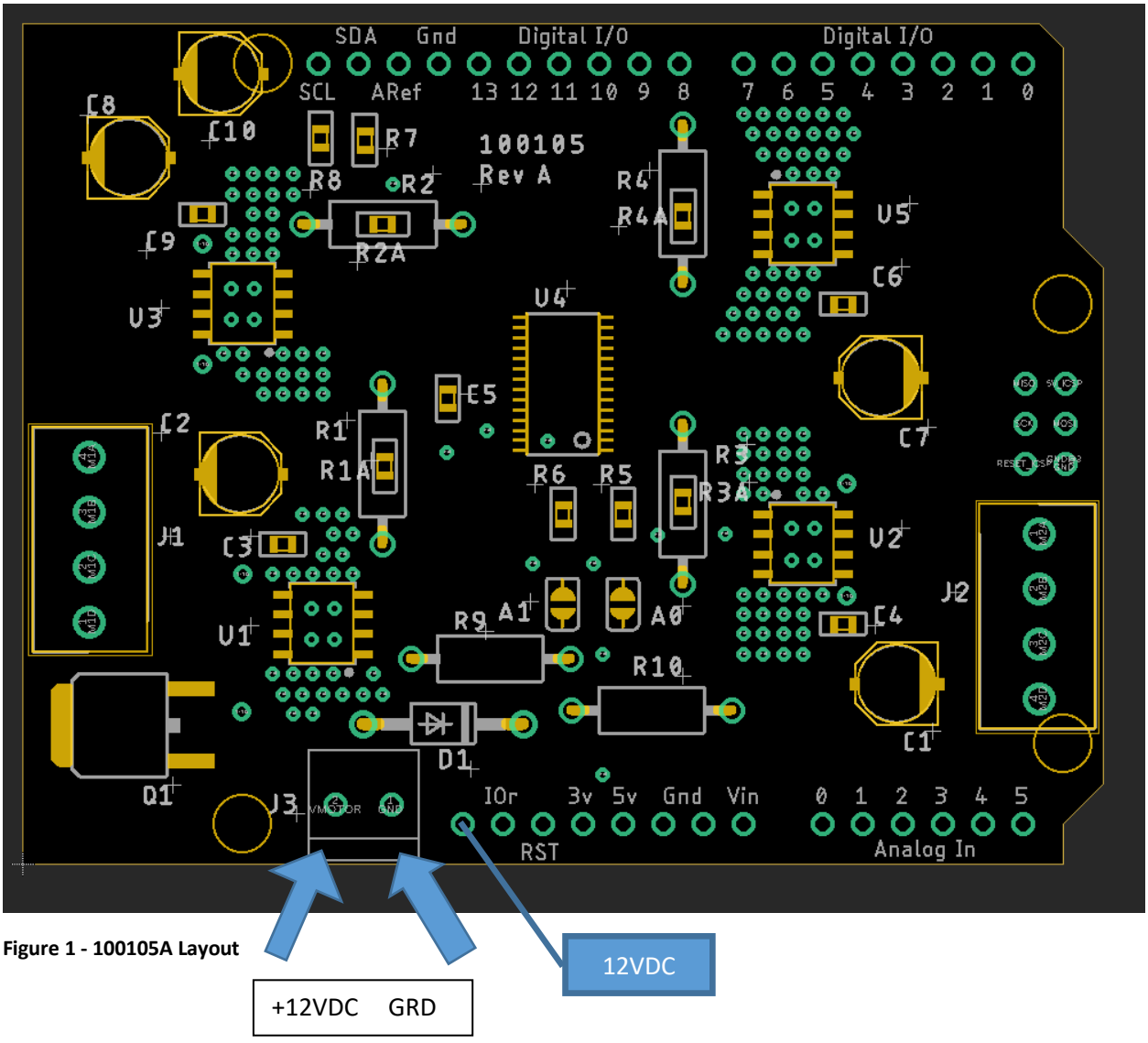

Figure 1 - 100105A Layout

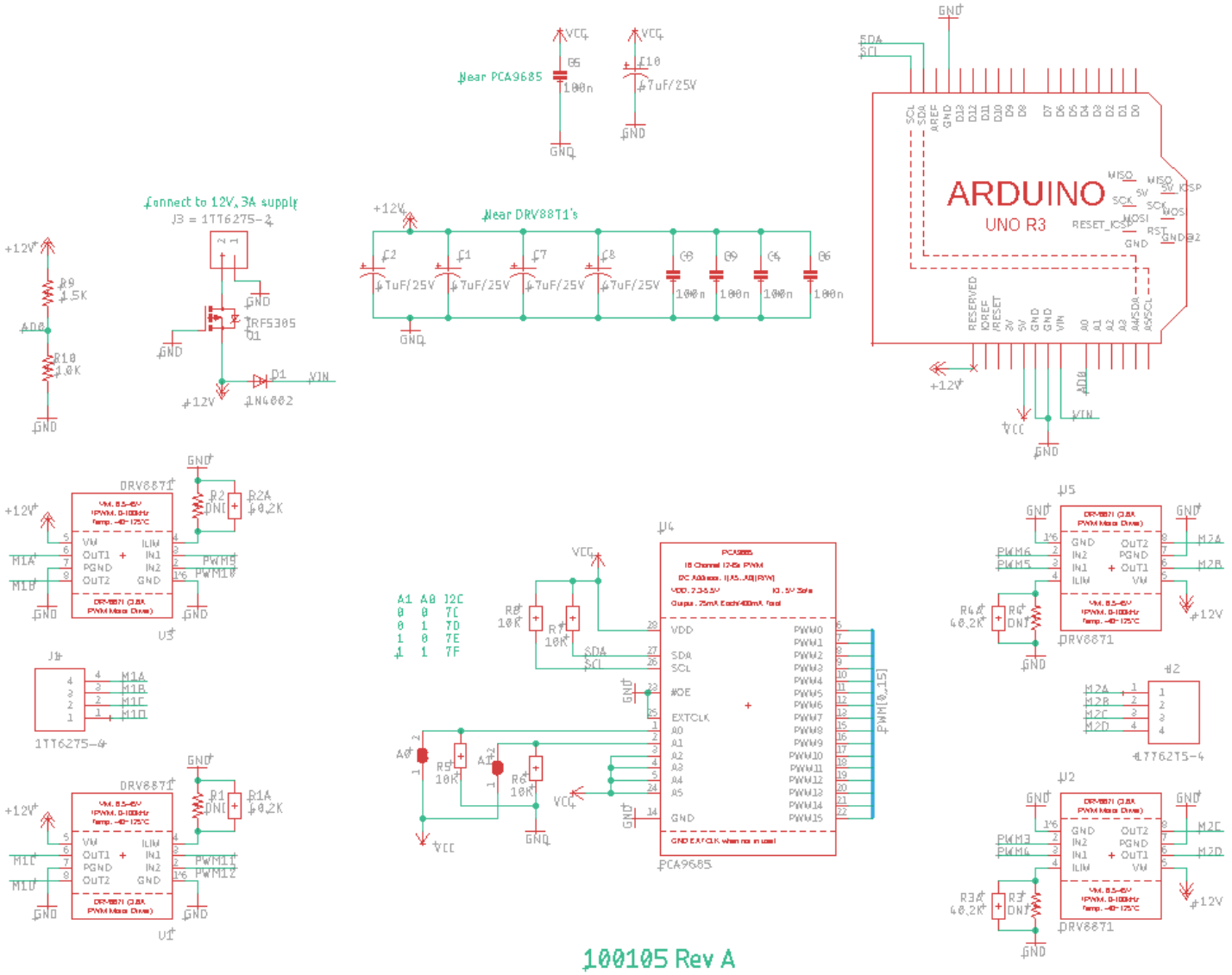

Figure 2 - 100105A Schematic