

This document was last updated on : April 07, 2012

## **CS-1 ChemShield Pin, Pad & Component descriptions:**

Please read this pdf attachment in correlation to info given on our website

Link: [Chemshapes.com](http://Chemshapes.com)

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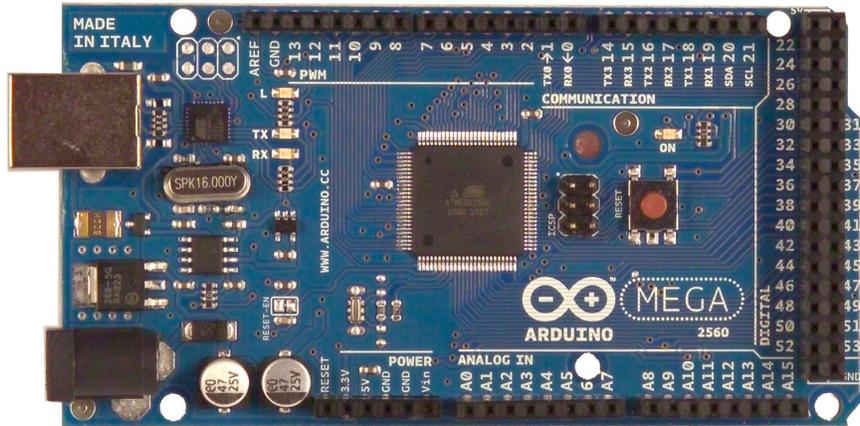
## What is a Arduino?

The Arduino board is a Micro controller Input /Output circuit board featuring the Atmega 8 processor from Atmel. The board is composed of a printed circuit board (PCB) and electronic parts. It connects to the PC via a USB port and cable .The programming code in C , the PC board and hardware is extremely versatile and open sourced for any one to contribute.

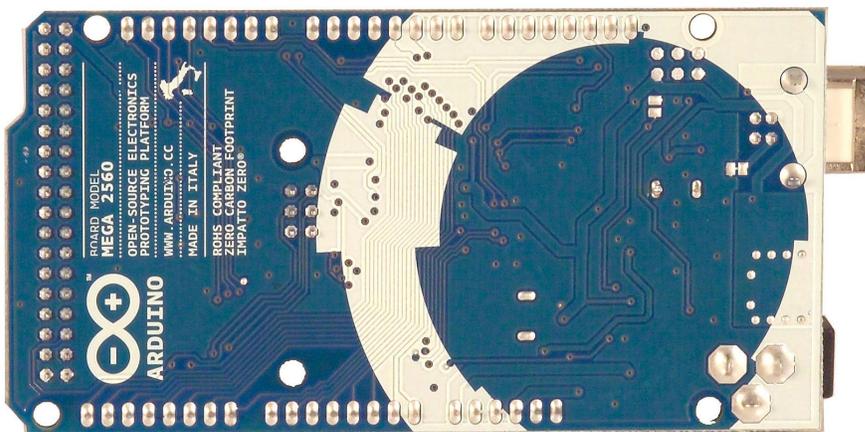
See <http://arduino.cc/en/Guide/Windows>

Fig. 1

(Fig.1) Top view.



(Fig. 2) Bottom view.



## **What is a Arduino Shield.? (Like the ChemShield)**

a Arduino Shield is a special purpose PC Board that can be plugged on top of the Arduino PCB to extending its capabilities. The different shields follow the same philosophy as the original toolkit , open source for everyone! they are easy to mount and very inexpensive for their capabilities.

See : <http://arduino.cc/en/Main/ArduinoShields>

The Chemshield is a 4.18 inch x 3.295 inch, double sided ARDUINO shield designed by ChemShapes and professionally done by a well known PCB manufacturer.

The Main purpose for the Chemshield is to provide a easy add-on stack shield for the Arduino Mega 2560 .

The main control signals will be send from the PC via USB to the Arduino .The Chemshield will relay signals from the ARDUINO micro controller to the printer via a main ribbon cable .It will supply power and signals to the motor drivers , solenoids and opto interrupt switches .

Our Shield's versatility by far exceed our expectations!. With all the extra expansion possibilities It can be a great start , not just for 3d printers but many types of devices. It will save you hours of valuable time. It is mainly designed for the CS-1, 3D Printer but it can be applied to any Hobby, Robotics or research and development projects.

We took a modular approach just like The CS-1 3D Printer Hardware.

It will be available as just the bare PC board , or assembled and ready to print.

### **It is packed with great Optional features!...,The CS-1 Chemshield's main features are:**

- a - Provides GROUND , 3.3VDC, 5VDC , 12VDC & 24VDC. And Power selection jumpers.
- b - (9X) Transistor switches(Lots of extra pads for more).
- c - 2X Polulu A4988 Stepper Drivers with micro step selection jumpers .  
<http://www.pololu.com/catalog/product/1183>
- d - a Dual DC-Motor driver, Polulu (TB 6612FNG) .  
<http://www.pololu.com/catalog/product/713>
- e - Many Smoothing Capacitors , Optional Resistors , and dozens of extra pads for a lot of extra component expansion.
- f - 16x open analog expansion ports, 27x Open Arduino Digital ports,( More if not all the drivers are used).
- g -LED Power Indicators.
- h - Jogging switch connector with de-bounce capacitors.
- l - Many ,many more pull up/down resistor/switch pads, Surface mount (SMT) pads,Through hole pads etc.....
- j - ICSP header ( In Circuit Serial Programming header).

k - Even though the space is provided for Polulu drivers and other main components, it does not have to be used for that specific purpose, The pads are arranged to take many type of components/configurations for any type of research and development project.

The main pads are all mostly square and ready to be utilized by any surface mount (SMD) or through hole (TH) components .

l- Apart from the main 30 pin PCB Header for a card or ribbon cable ,there are also 2x extra expandable rows of Pin headers ( one 20 pin and one 24 pin ) that can take either a ribbon cable or an extension card of your own design for further expansion.

m-The board also has a Alphabetical / numerical grid cross reference for easy location of components and makes communications over the Internet and e-mails very easy.

A – Q in vertical direction and 1 to 21 in horizontal direction,.

( Fig. 1 ) Top trace and pad layout. Note the alphabetical / Numerical cross reference for the board from 1-21 horizontal and A to Q vertical

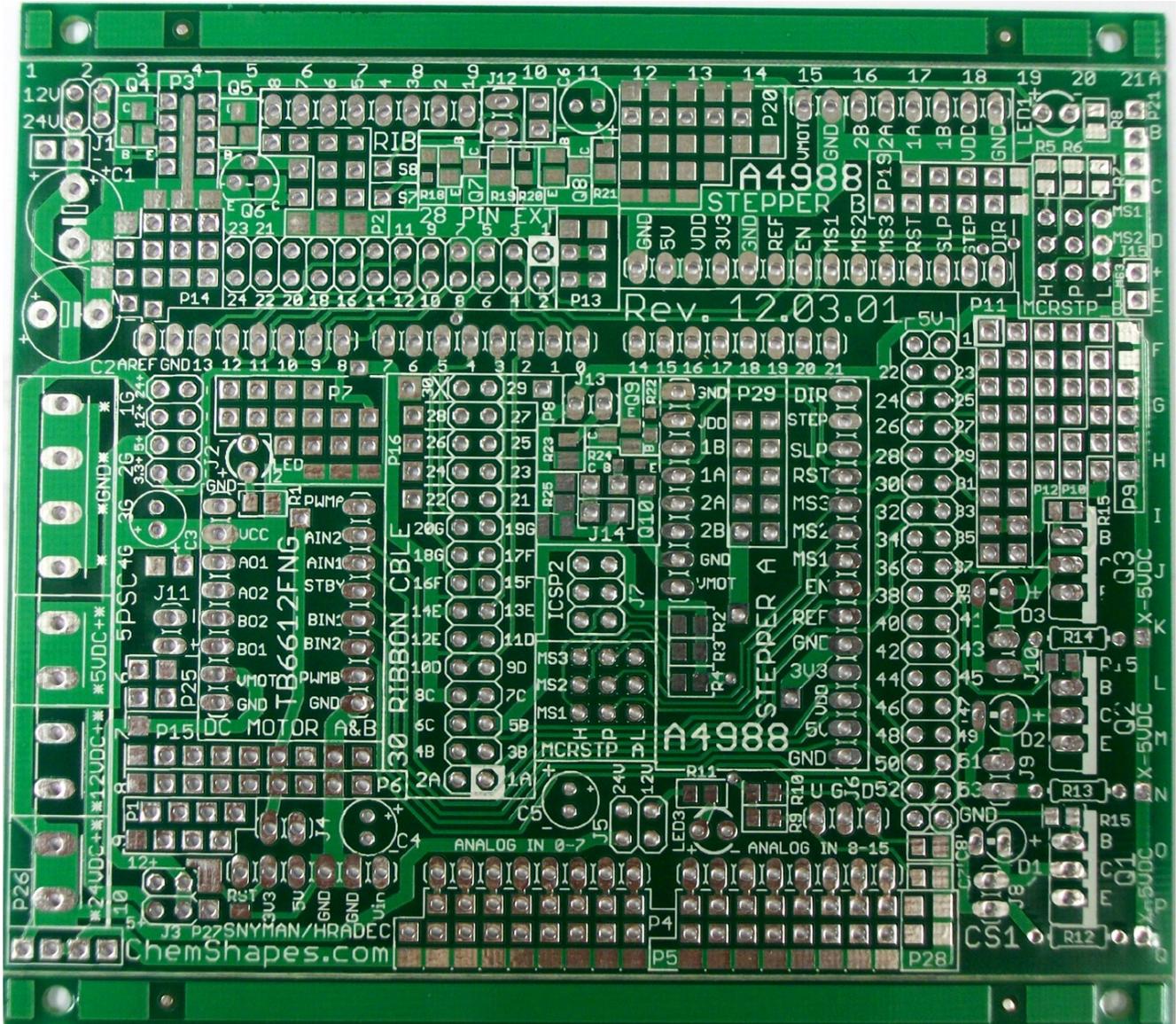
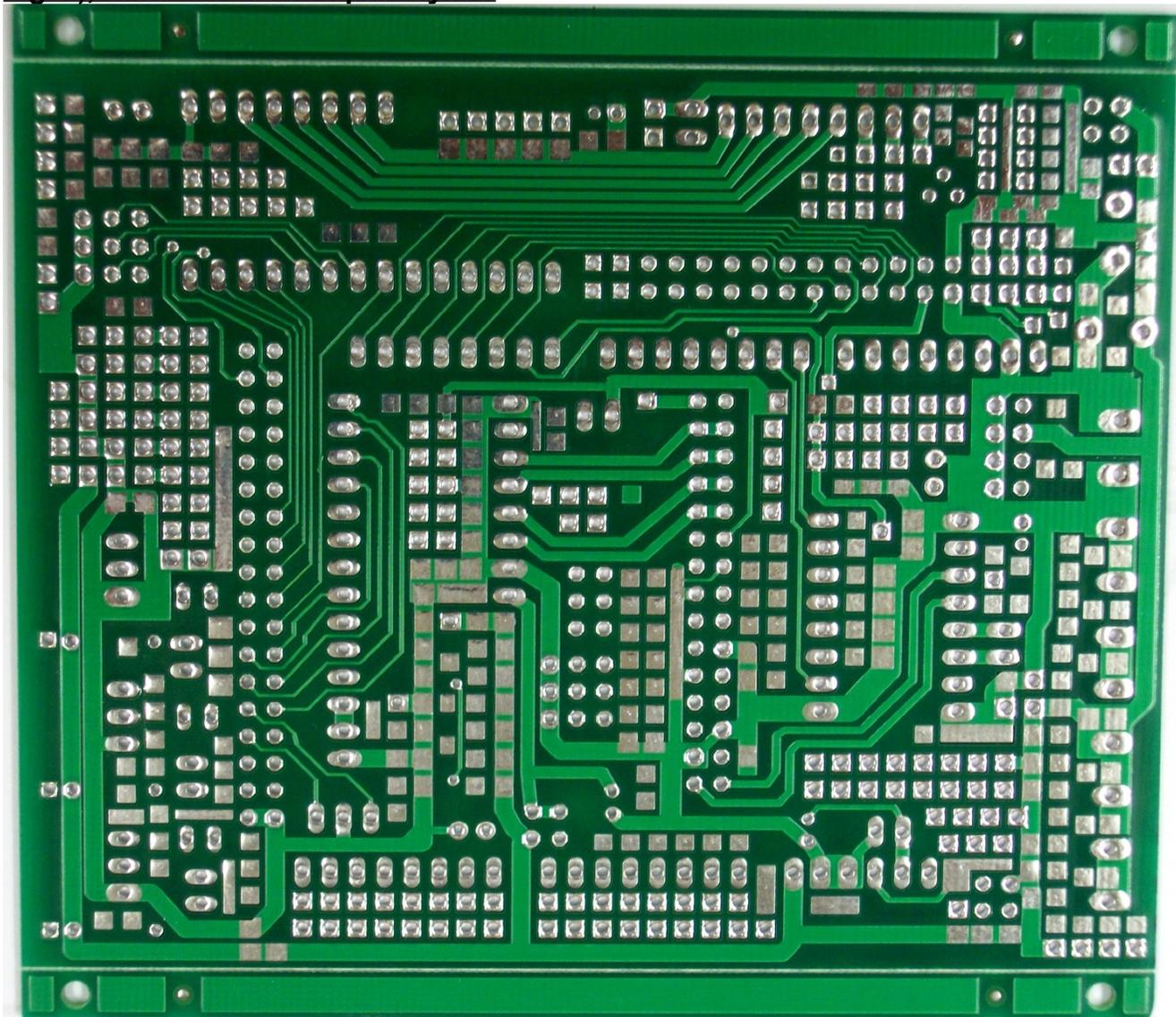
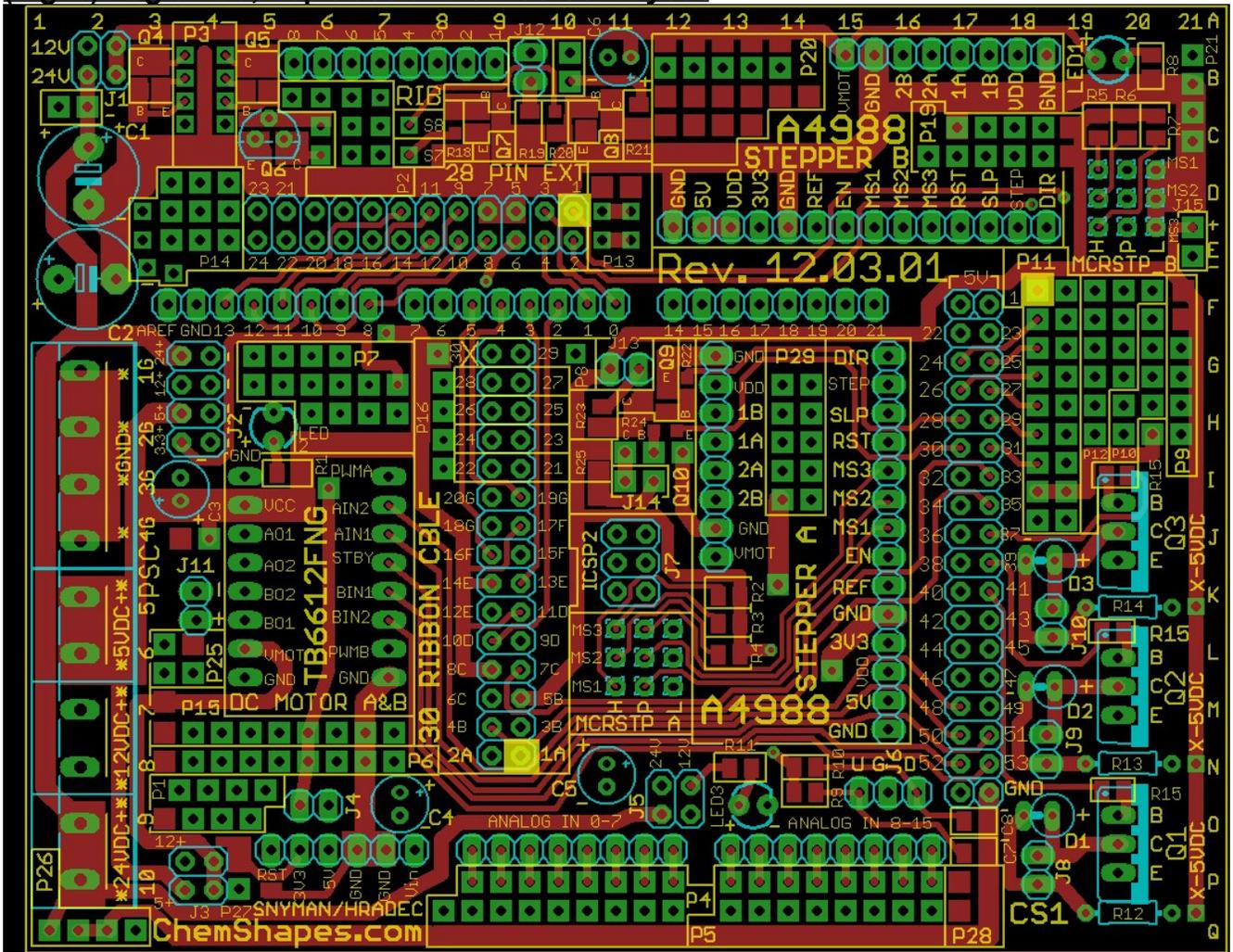


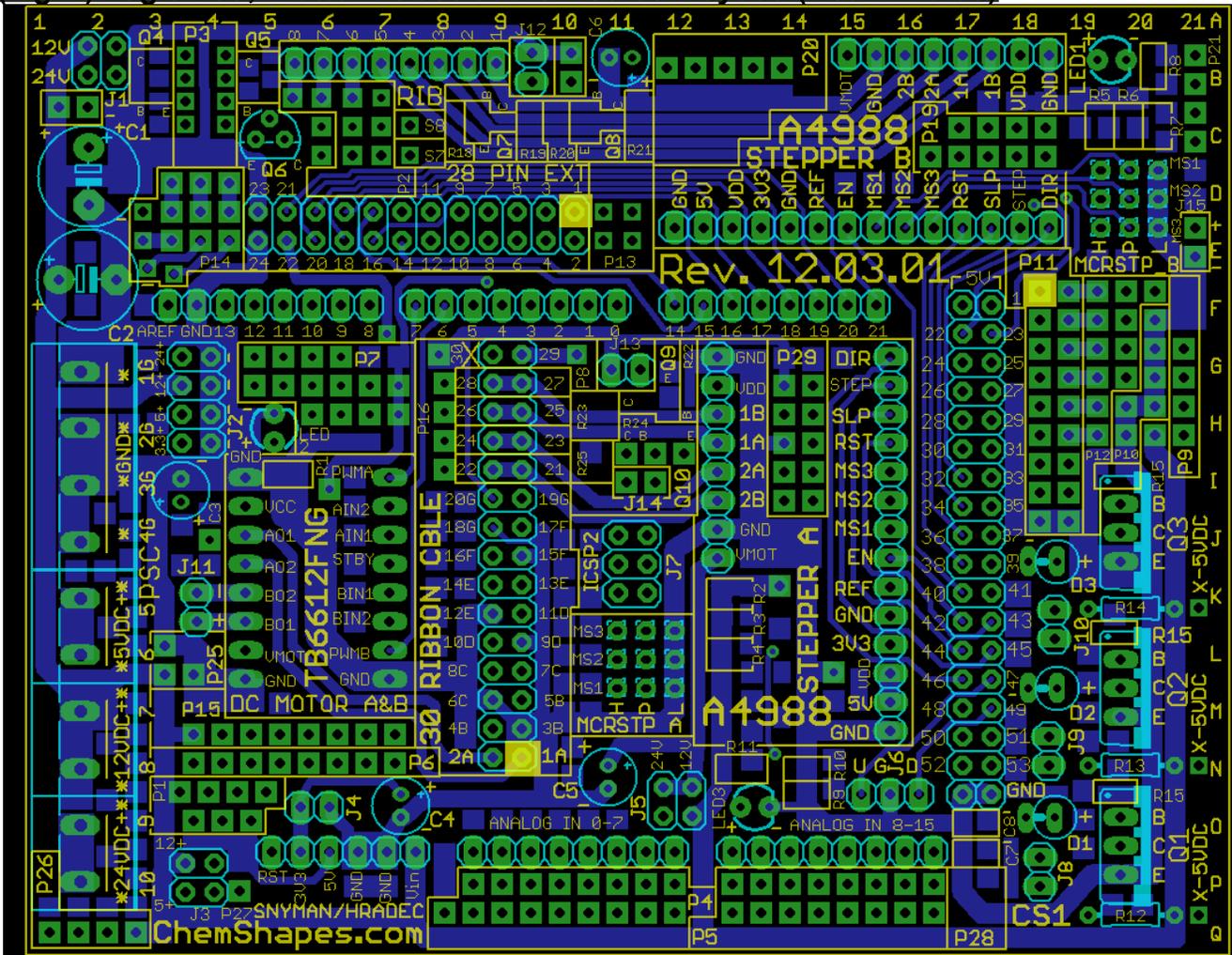
Fig. 2),Bottom trace and pad layout



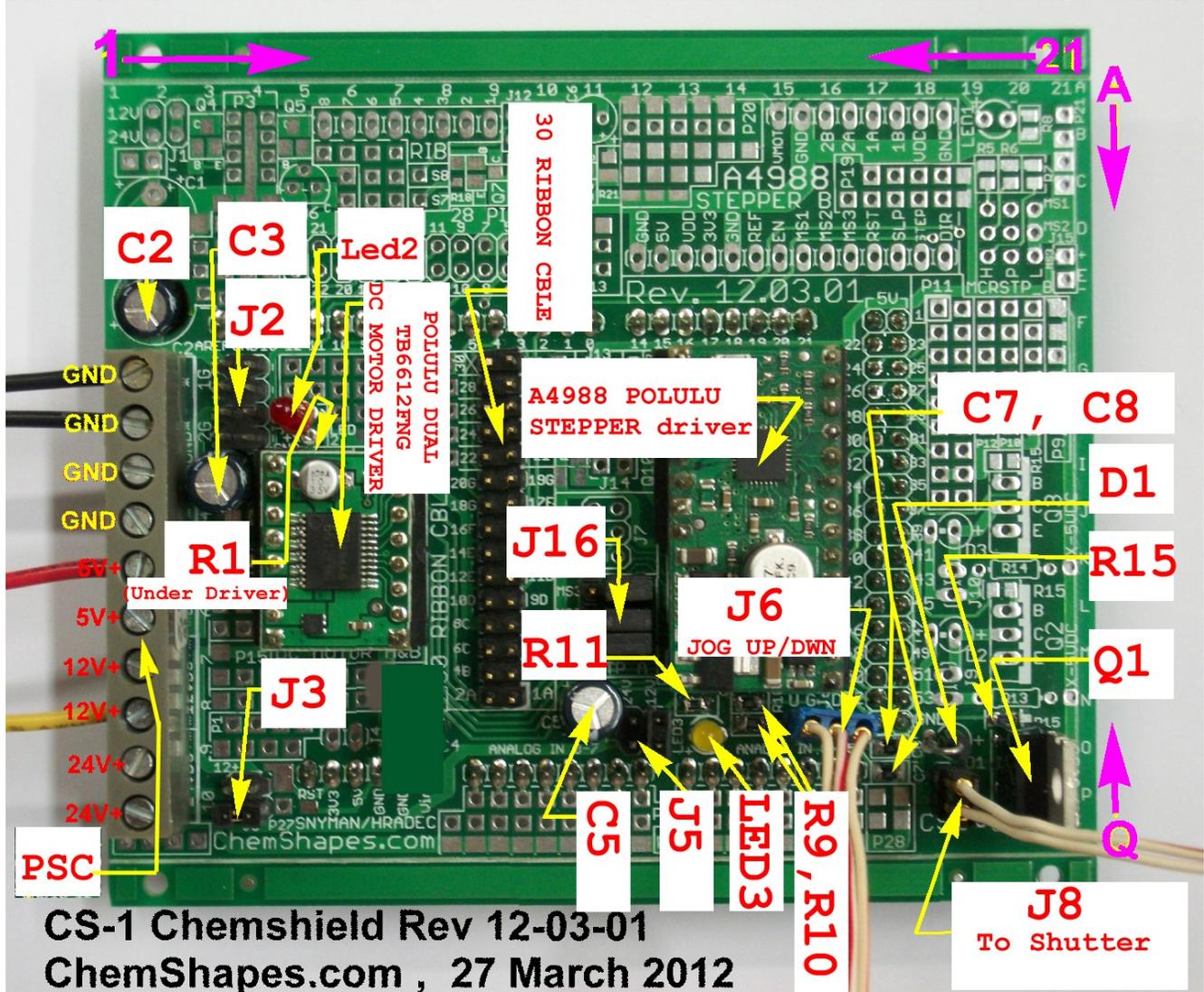
(Fig. 3) Eagle Cad, top trace and silkscreen layout



(Fig. 4) Eagle Cad, Bottom trace and Silkscreen layout. (Not mirrored)



(Fig. 5) Top view Of the CS-1 Chemshield Populated for the Arduino mega 2560



Shown in (Fig.5) is the minimum components needed to operate the ChemShapes CS-1 printer

## Here are the main components, with a description and quantity:

The asterisk “ \* “ Indicate the minimum parts needed for the CS-1 ChemShield the rest is optional and open for research and development expansion .

LED 1 to 3- Through hole (or smd Led)

Color of choice , 20 mA

**LED1 (A,19)** -Power indicator for Stepper Driver - B (Led 3mm package.0.01" Lead spacing)

\* **LED2 (H,5)** - Red power indicator for DC Driver ( Motor A & B) (Led 3mm package)

\* **LED3 (O,13)** -Yellow power indicator for Stepper Driver - A (Led 3mm package)

## Resistors

\* **R1 (I,6)** - 470 ohm Surface mount resistor , marked 471  
(M0805 Package), current limit for **Led2**

\* **R2 to R4 (K,14)** - 10 K ohm, Surface mount pull up resistors.  
(M0805 Package) marked 1002, current limit for **Led2**

**R5 to R7 (C,20)** - 10 K ohm, Surface mount pull up resistors.  
(M0805 Package) marked 1002, current limit for **Led2**

\* **R9 & R10 ( N,14)** - 10K ohm , next to each other , Surface mount  
(M0805 Package) Pull up resistor for JOG switch U (up) and D (down) at J6

\* **R11 (N,13)** - 1K ohm , Surface mount (M0805 Package)  
marked 1002, current limit for Led 3

\* **R12 (P,20)** - Current limiting for **Q1** , pending on load.  
( 0204/7 Package) Or use wire jumper through without  
resistor to either **5VDC+** rail or **12DC+** rail.

**R13,R14 (N,20 K,20)** - Current limiting for **Q2 & Q3** , pending on load.  
( 0204/7 Package) Or use wire jumper through without  
resistor to either **5VDC+** rail or **12DC+** rail.

\* **R15 (N,20)** - Base current limiting for **Q1** , 1K ohm , marked 102  
Surface mount (M0805 Package).

**R16,R17 (L,20 I,20)** - Base current limiting for **Q2 & Q3** , 1K ohm, marked 102  
Surface mount (M0805 Package)

**R18 (C,8)** - Base current limiting for **Q7** , Surface mount resistors (M0603 Package)

**R19 (C,9)** - Load current limiting for **Q7** collector, Surface mount resistors (M0805 Package)

-----  
**R20 (C,10)** - Base current limiting for **Q8**, Surface mount resistors (M0603 Package)

**R21 (C,11)** - Load current limiting for **Q8** collector, Surface mount resistors (M0805 Package)

-----  
**R22 (G,12)** - Base current limiting for **Q9**, Surface mount resistors (M0603 Package)

**R23 (H,11)** - Load current limiting for **Q9** collector, Surface mount resistors (M0805 Package)

-----  
**R24 (H,12)** - Base current limiting for **Q10**, Surface mount resistors (M0603 Package)

**R25 (I,11)** - Load current limiting for **Q10** collector, Surface mount resistors (M0805 Package)

### Transistors

**Q1 (O,20)** - **TIP122** Power Transistor (TO-220 Package). control signal from arduino pin **41**,  
 For switching shutter solenoid , through J8.

**Q2 (L,20)** - **TIP122** Power Transistor (TO-220 Package), control signal from arduino pin **39**.

**Q3 (J,20)** - **TIP122** Power Transistor (TO-220 Package), control signal from arduino pin **37**.

**Q4 (B,3)** - Surface mount (SMD) Transistor (SOT-23 Package) B,C,E Shown for a NPN Transistor.

**Q5 (B,5)** - SMD Transistor (SOT-23 Package)), B,C,E Shown for a NPN Transistor.

**Q6 (C,5)** – Through hole Transistor (TO-92) Package , connected to the through hole vias next to it. B,C,E Shown for a NPN Transistor

**Q7 (C,9)** - SMD Transistor (SOT-23 Package)), B,C,E Shown for a NPN Transistor, base signal input at pad **S7**. (C, 8)

**Q8 (C,11)** - SMD Transistor (SOT-23 Package)), B,C,E Shown for a NPN Transistor, Base signal input at pad **S8**. (C, 8)

**Q9 (G,12)** - SMD Transistor (SOT-23 Package)), B,C,E Shown for a NPN Transistor, Switching **J15** (G,11) with base signal input from arduino pin **33**.

**Q10 (I,12)** - Through hole Transistor (TO-92) Package , B,C,E Shown for a NPN Transistor, Switching **J16** (I,11) with base signal input from arduino pin **35**.

## Capacitors

- C1 (D,2) - 24VDC+** Power supply smoothing capacitor....100mF , (E5-8,5 Package).
- \* **C2 (E,2)-12VDC+** Power supply smoothing capacitor....100mF, (E5-8,5 Package).
- \* **C3 (I,3) - 100 mF,10V, (E2-5 Package), 5V Power supply smoothing capacitor .**
- C4 (O,7) - 100 mF, 10V, (E2-5 Package), 3.3V Power supply smoothing capacitor .**
- \* **C5 (N,11) - 100mF, 25V, Smoothing capacitor for Stepper A voltage supply (E2-5 Package)**
- C6 (B,11) -100mF, 25V , Smoothing capacitor for Stepper B voltage supply (E2-5 Package)**
- C7 , C8 (P,17) -100nF, 10V ,Surface mount De-bounce Capacitor for JOG up/dwn switch. (C2012 Package) Also see : <http://ikalogic.com/debouncing.php>**

## Diodes

- \* **D1 (O,19) - IN4001 , 50V , 1A "fly back suppression" , Protection Diode for Coils and relays or related coil devices. (RAD2,5L Package).**
- D2, D3 (M,19), (K,19) - IN4001 , 50V , 1A "fly back suppression" , Protection Diode for Coils and relays or related coil devices. (RAD2,5L Package).**

## Jumpers

- J1 (B,2) -12VDC or 24VDC Selection jumper for Stepper B (2X02 Package , 0.01" Pinhead connector).**
- J2 (H,4) - 3.3VDC+ , 5VDC+ ,12VDC or 24VDC+ Power supply Jumper. (2X04) Package , 0.01" Pinhead connector).**
- \* **J3 (P,4) - 5VDC+ or 12VDC+ . Power select for DC motor Driver TBN1266FNG. (2X02 Package , 0.01" Pinhead connector). "NOT A SUPPLY !, ONLY SELECT VOLTAGE"**
- J4 (N,6) -3.3VDC+ Power supply Jumper, Max source 50mA, (1X02 Package , 0.01" Pinhead connector) (Provided by Arduino Supply).**
- \* **J5 (N,12) - , 12VDC+ or 24VDC+ . Power select for Stepper motor A driver A4988. (2X02 Package , 0.01" Pinhead connector)."NOT A SUPPLY !, ONLY SELECT VOLTAGE"**
- \* **J6 (N,16) -Jog Switch cable connector , U Pulled low = Up, D Pulled low = Down,... To pull U or D low, short to Ground (G).(1X03 Package , 0.01" Pinhead connector).**

\***J7 (K,11)** -6 pin , (**ICSP**) ,In Circuit Serial Programming header  
(2X03 Package , 0.01" Pinhead connector).

\***J8,(P,19)** - For **Shutter** control by Arduino pin 41( via resistor R15 & transistor Q1).  
(1X02) Package , 0.01" Pinhead connector)

**J9 , J10** -2 Pin connectors for solenoids or relays(or other components).  
(1X02) Package , 0.01" Pinhead connector)  
**(N,18), J9** controlled by Arduino pin 39( via resistor R15 & transistor Q1)  
**(K,18), J10** controlled by Arduino pin 37( via resistor R15 & transistor Q1)

**J11 (K,4)** - 2 pin header For DC Motor B ,PWM Control from arduino pin **6**.

**J12 (B,10)** , **Left** = 2x Pin jumper for relays etc. (**12VDC**) , switched by **Q7** , **Right** = 2x Pin jumper for relays etc. (12vdc), switched by **Q8**.

**J13 (G,11)**- 2x Pin jumper for relays etc, (**5VDC**) , switched by Q9 and arduino pin **33**.

**J14 (I,11)** - 2x Pin jumper for relays etc, (**5VDC**) switched by Q10 and arduino pin **35**.

\***J16 (L,10)** – (3 X 03) Micro step selection set for Stepper **A** .(See truth table below).

**J17 (D,20)** – (3 X 03) Micro step selection set for Stepper **B** .(See truth table below).

#### Micro step Settings for Stepper driver A4988 Stepper motor A and B (L,11 & D,20)

MCRSTP (Microstep) Resolution Excitation Mode

Driver pin (P) in the middle , High on the left and Low on the right

#### Truth table:

Connect **P** and **L** = **Low** .....Connect **P** and **H** = **High**

**MS1 - MS2 - MS3**

<b>L</b>	-	<b>L</b>	-	<b>L</b>	Full Step 2 Phase
<b>H</b>	-	<b>L</b>	-	<b>L</b>	Half Step 1-2 Phase
<b>L</b>	-	<b>H</b>	-	<b>L</b>	Quarter Step W1-2 Phase
<b>H</b>	-	<b>H</b>	-	<b>L</b>	Eighth Step 2W1-2 Phase
<b>H</b>	-	<b>H</b>	-	<b>H</b>	Sixteenth Step 4W1-2 Phase

For example:

To set for quarter step , Set **MS2 High** , Connect between **H** and **P**, That pulls **P** (Pin) to **5v+(High)**

X - X - X **MS1**

X = X - X **MS2 <**

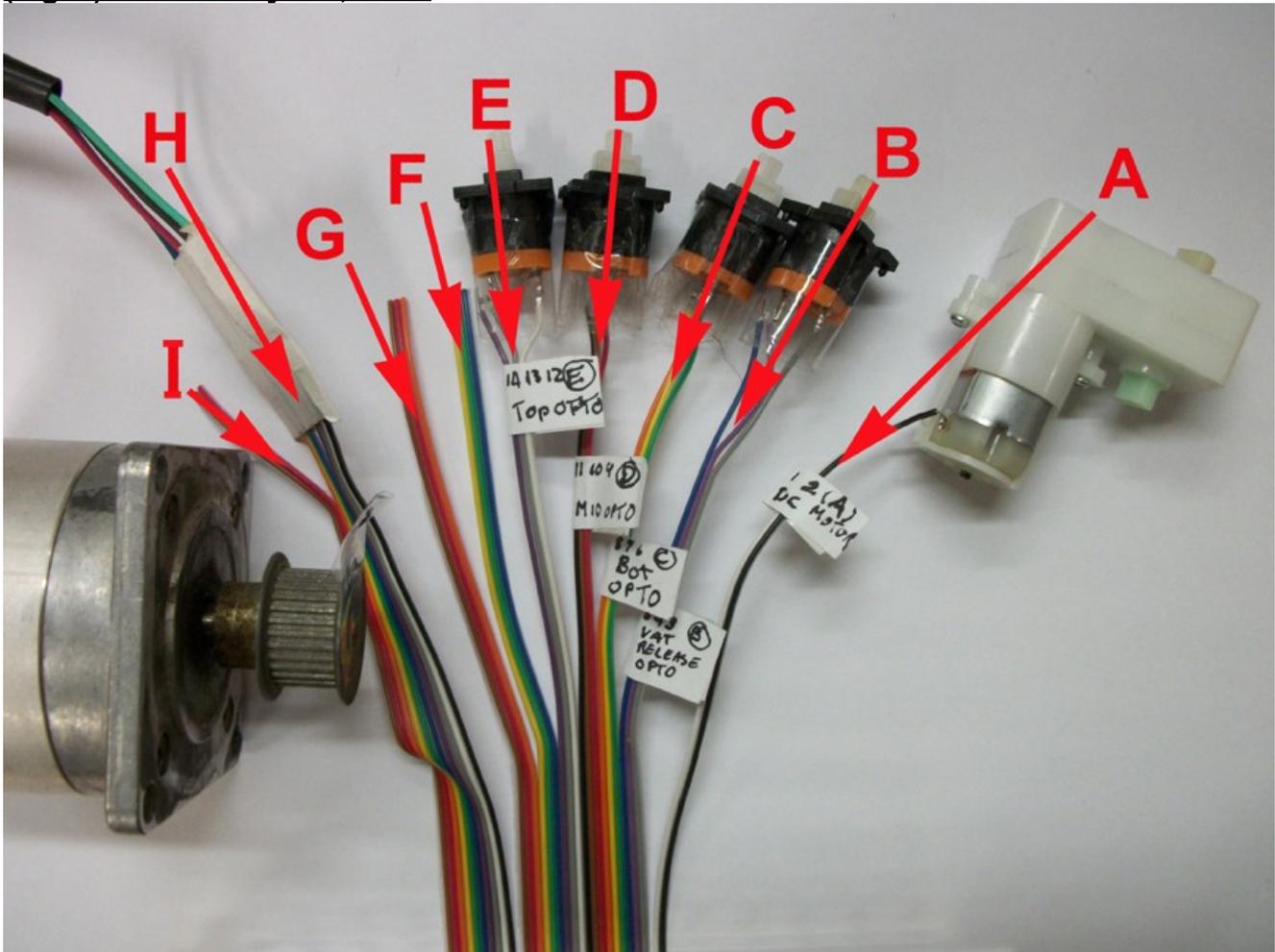
X - X - X **MS3**

H - P - L  
^ ^

Also see the pololu website here: <http://www.pololu.com/catalog/product/1183>

**30 RIBBON CBLE (K,9)-** (2X15 Package , 0.01" ) , (30 x) Pinhead connector.  
 Main IDC ribbon connector carry signals for stepper A and opto switch signals.  
 The letters matching indicate the pin numbers that are harnessed together in a 2x , 3x & 4x pin female IDC Connectors in the printer column.

**(Fig. 6) Harness layout , A to I**



**Below:**  
**Cable Pin# - To printer function.**

\*(Pin 1A & 2A = A Harness to DC Motor A)

\*1A (BLK) - DC Motor A -, (A02)

\*2A (WHT) - DC Motor A +, (A01)

*( All opto -3 wire harnesses have signal = middle, GND = left and 5V= right )*

\* (Pin 3B , 4B & 5B = B Harness to Vat release Rotary Interrupt switch.)

**\*3B (GREY) - GND**

**\*4B ( PRPLE) - From rotary opto interrupt Index signal pulse (To Arduino pin 35)**

**\*5B (BLUE) - 5V+DC**

\* (Pin 6C ,7C & 8C = C Harness to Bottom Opto Interrupt switch)

**\*6C (GRN) - GND**

**\*7C (YEL) - From Bottom opto interrupt signal pulse (To Arduino pin 33)**

**\*8C (ORNG) - 5V+DC**

\* (Pin 9D , 10D & 11D = D Harness to middel (slowdown) Opto Interrupt switch)

**\*9D (RED) - GND**

**\*10D (BRWN) - From middel opto interrupt signal pulse (To Arduino pin 2 )**

**\*11D (BLK) - 5V+DC**

\* (Pin 12E ,13E & 14E = E Harness to Top Opto Interrupt switch)

**\*12E (WHTE) - GND**

**\*13E (GREY) - From top opto interrupt signal pulse (To Arduino pin 3)**

**\*14E (PRPLE) - 5V+DC**

(Pin 15F , 16F & 17F = F Harness

**15F (BLUE) - GND**

**16F (GRN) - Signal pulse (To Arduino pin 5)**

**17F (YEL) - 5V+DC**

(Pin 18G , 19G & 20G = G Harness (not used)

**18G (ORNG) - GND**

**19G (RED) - Signal pulse (To Arduino pin 4)**

**20G (BRWN) - 5V+DC**

\* Harness H. , Note : Ribbon cable wires for stepper motor are doubled for higher amperage.

**\*21 (BLK) & 22 (WHTE) - Stepper Motor A, 2B**

**\*23 (GREY) & 24 (PRPLE) - Stepper Motor A, 2A**

**\*25(BLU) & 26 (GRN) - Stepper Motor A, 1A**

**\*27 (YEL) & 28 (ORNGE) - Stepper Motor A, 1B**

(Pin 29 & 30 = I Harness (not used)

**29 (RED) -To top left SMT pad at P8.(G,10)**

**30 (BRN) -Not used (Cut off),The IDC Female connector on the ribbon cable has a Keyed plug (peg) in hole #30 for correct orientation.**

**RIB (B,7)** - Secondary ribbon (8x) pinhead connector carry signals for stepper B and other signals (1X08 Package , 0.01" Pinhead connector)

**1** - Gnd

**2 to 5** - Stepper motor signals for Stepper B

**6 , 7 & 8** - Connected to the top left three pads at P17. at [\(C,6\)](#)

### **28 PIN EXT.(D,8)**

This is a dual row 24 Pin header (2 X 12pins) ,It can be used for either a extension card or a ribbon connector.

This header can be extended into **P14** and **P13**

**1** - Signal (To Arduino pin **23**)

**2** - Signal (To Arduino pin **22**)

**3** - Signal (To Arduino pin **0**)

**4** - Signal (To Arduino pin **1**)

**5** - **GND**

**6** - **3.3+VDC**

**7** - **GND**

**8** - Signal (To Arduino pin **8**)

**9** - Signal (To Arduino pin **9**)

**10** - Signal (To Arduino pin **10**)

**11** - Signal (To Arduino pin **11**)

**12** - Signal (To Arduino pin **12**)

**13** - Signal (To Arduino pin **13**)

**14** - Signal (To Arduino pin **14**)

**15** - Signal (To Arduino pin **15**)

**16** - Signal (To Arduino pin **16**)

**17** - Signal (To Arduino pin **17**)

**18** - Signal (To Arduino pin **18**)

**19** - Signal (To Arduino pin **19**)

**20** - Signal (To Arduino pin **20**)

**21** - Signal (To Arduino pin **21**)

**22** - **5VDC+**

**23** - **12VDC+**

**24** - **GND**

**Pads marked with a "P#" suffix are for surface mount (SMT) and through pads for lead components.**  
**They can be utilized from both sides of the PCB .The pad clusters areas are outlined.**

- P1 (N,4)** - (8x), 7x Through hole pads, the top left one is **12VDC+**,the 3x Top right is open, the bottom 3x through hole and left SMT pad is open .  
 (Underneath **P1** there is also is **3.3VDC+** and **5VDC+** surface mount rails)
- P2 (C,7)** - (8x) Through hole pads ,The 3x on top are connected to the left three ribbon "RIB" connector. the bottom 4x through holes are open,and the lower 3x surface pads are on the GND rail.
- P3(B,4)** - (8x) Through hole pads for Q4 & Q5 with a **GND** rail between them on top of the PCB, And a **12VDC+** rail between them on the bottom side of the PCB.  
 Also open SMD adjacent to them on the bottom side of the PCB  
 On the topside is 2x surface mount pads on the ground rail.
- P4 (P,11)** - (26x), Through hole pads , 8x connected to Arduino Analog In 0-7, 9x is open next to ground rail pads.
- P5 (P,15)** - (24x), Through hole pads , 8x connected to Arduino Analog In 8-15, 8x is open next to ground rail pads.
- P6 (N, 6)**- (8x) Through hole mount pads,Left to right:  
 Open SMT pad , 3x open through holes , **3.3VDC+** ,3x is open and the one on the right is **5VDC+**
- P7(G,6)** - (20x) Optional through hole pads,Top (6x) pads goes to Arduino Pins 8 to 13 , 1x to the lower left is grounded and ,9 through hole vias are open  
 The bottom row of through hole/ via pads are adjacent to a 4x SMD **5VDC+** rail on top of the PCB, and a 4x SMD **GND** rail on the bottom the of the PCB.
- P8(E,9)** - (1x) Signal pad for pin 29 on "**30\_RIBBON\_CBLE** "
- P9 (G,21)** - (6x) Through hole pads and 2x surface mount pads on **5V+DC** rail
- P10(G,20)** - (6X) Through hole pads , all on the **GND** rail.
- P11 (G,18)** - (18x) Through hole pads  
 These pins are so arranged that it can take a extension module 16 or 18 PIN .Use a 0.65mm thick pc board with female pinhead connector or a Ribbon connector of your own choice.  
 The left row :(from top down)  
**5VDC+, Arduino pin 24,25,26,27,29,31,GND,GND .**  
 The row on the right :(from top down)  
 The 6x on top,is connected(bridged) to P12 next to it,  
 and 3rd from the bottom is open 2nd one from the bottom is **12DC+** and the bottom is **GND**
- P12 (G,20)** - (11x Through hole pads), The left row is bridged over to the right row of **P11**  
 The 5x is on the right is all open.
- P13 (D,11)** - The 4x through hole pads ere extension holes for the "**28 PIN EXT**" socket .  
 (4x) Through hole pads (bridged left to right) and (2x) surface pads on the top .
- P14 (D,4)** - The 6x through hole pads in the middle are extension holes for the "**28 PIN**

**EXT"** socket . They are bridged to the pads around them for connection .

**P15 (M,4)** - (8x) Through hole pads and 2x SMT pads,  
Left bottom surface pads is open and the top surface mount pad is selected by **J3** .

Through holes left to right :1x through hole to the left is **12VDC+** , 2x is open,3.3VDC+, and the 4x to the right **GND**.

**P16 (D,1)** - surface mount pads on the 12VDC+ rail on the bottom side of the PCB.

**Px17x (xx,xx)** - 2X Through hole/via pads, 1x on the **24VDC+**, 1x on the **12DC+** rail , and 3x surface mount pads.

**P19 (C,17)** - (11x) 9x Through hole pad ,Top left through hole is **GND** the rest of them is open .

2x surface mount pads on the right is **5VDC+**.

**P20 (B,13)**- (23x), The 5x surface mount pads on the top have **VDC+** as selected at **J1.**, 4x Through hole/via open pads ,

10x surface mount pads open and the bottom row surface mount pads on the GND rail.

**P21(A,21)** - (4x)Through hole pads , Top 1x through hole pad is open and the 3x under it is on the **GND** rail.

**P23(I,14 Bottom of PCB)** - Various open surface mount pads under Stepper driver A on bottom side of board.

Some are open and some are Grounded. They are arranged that it can take surface mount transistors and various other SMD components

**P25(L,4)** (3x) Through hole pads,1x top is **GND** ,1X bottom left is **12DC+**, 1x on bottom/right is **GND**, 1x surface mount top/right is open.

**P26(Q,2)** (8x), 4x Through hole/via pads, 1x on the left is **24DC+** the two in the middle is **GND**,1x on the right is **12VDC+**. 4x Surface mount pads on the bottom of the PCB next to the vias.

**P27 (P,5)** - (1x) Open through hole/via pad, with a **3.3VDC+** surface mount pad above it, on the topside, and a **5.5VDC+** .surface mount pad above it on the bottom side.

**P28 (Q,17)** - (4x) Open surface mount pads, 2x on the right is on the GND rail,2x to the left is open. Underneath **P28** On the bottom of the PCB is 2x Surface mount pads on the 12DC+ Rail, one on the GND rail and 3x open pads.

**P29(H,14)** (10x) Through hole pads,This 2x 5 row of through holes are also ideal for a ribbon connector.

1x top left is **5VDC+**,1X bottom left is **12DC+**, middle left is **GND**.

underneath the PCB (under **P29**) there is also open SMT pads ,

**Pads under Q4 (B,3)** - (on the bottom of the pcb.) are SMD pads and a **12VDC+** rail next to them

## Arduino / Chemshield pin Connections:

### Arduino Pin # - Connected to:

0 (F,11) - 8 PIN EXT Connector (pin 3)

1 (F,11) - 8 PIN EXT Connector (pin 4)

\*2 (F,10) -30 Ribbon cable connector (pin 10D) , Goes to Middle opto interrupt. (Z- Mid)

\*3 (F,10) -30 Ribbon cable connector (pin 13E) ,Goes to Top Opto interrupt. (Z- Max)

4 (F,9) -30 Ribbon cable connector (pin 19G)

5 (F,9) -30 Ribbon cable connector (pin 16F)

6 (F,8) -Pulse width modulation for Motor B , ( DC Motor Driver, TB 6612FNG)

\*7 (F,8) -Pulse width modulation for Motor A , ( DC Motor Driver, TB 6612FNG)

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8(F,7) -30 Ribbon cable connector (pin 19).

9(F,6) -30 Ribbon cable connector (pin 9 ).

10(F,6) -30 Ribbon cable connector (pin 10).

11(F,5) -30 Ribbon cable connector (pin 11).

12(F,5) -30 Ribbon cable connector (pin 12).

13(F,4) -30 Ribbon cable connector (pin 13).

\*GND(F,4) - To ChemShield ground

AREF (F,3) - Not connected,Can be referenced on solder pad

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14(F,12) -30 Ribbon cable connector (pin 14).

15(F,12) -30 Ribbon cable connector (pin 15).

16(F,13) -30 Ribbon cable connector (pin 16).

17(F,13) -30 Ribbon cable connector (pin 17).

18(F,14) -30 Ribbon cable connector (pin 18).

19(F,14) -30 Ribbon cable connector (pin 19).

20(F,15) -30 Ribbon cable connector (pin 20).

21(F,15) -30 Ribbon cable connector (pin 21).

-----  
5v & 5V (F,17) -Open

22 (F,17) - 28 PIN EXT Connector (pin 2).

23 (F,18) - 28 PIN EXT Connector (pin 1).

24 (G,17) - P11 Left column 2nd from top.

25 (G,18) - P11 Left column 3d from top.

26 (G,17) - P11 Left column 4th from top.

27 (G,18) - P11 Left column 5th from top.

28 (H,17) - Activate signal to base for Q9 (G,12) pads.

29 (H,18) - P11 Left column 6th from top.

30 (H,17) - Activate signal to base for Q10 @ (G,12) pads.

31 (H,18) - P11 Left column 7th from top.

32 (I,17) - **Direction** signal pulse for Stepper driver **B**.

\*33 (I,18) - **30 Ribbon cable** connector (pin 7C), Goes to Bottom opto interrupt. (Z Min)

34 (I,17) - **Step B** pulse for Stepper driver **B**.

35 (I,18) - **30 Ribbon cable** connector (pin 4B)

36 (J,17) - **Sleep B** Signal for Stepper driver **B**.

- 37 (J,18) - Activate signal for base Q3 (NPN) base via R15
- 38 (J,17) - **Reset B** signal for Stepper driver **B**.
- 39 (J,18) - Activate signal for base Q2 (NPN) base via R15
- 40 (K,17) - **Enable B** for Stepper driver **B**
- \*41 (K,18) - Activate signal for base **Q1** (NPN) base via R15, (Shutter solenoid pin)
- \*42 (K,17) - **Enable A** for Stepper driver **A**
- \*43 (K,18) - **Reset A** signal for Stepper driver **A**.
- \*44 (K,17) - **Sleep A** Signal for Stepper driver **B**.
- \*45 (L,18) - **Step A** pulse for Stepper driver **A**.
- \*46 (L,17) - **Direction** signal pulse for Stepper driver **A** ,
- \*47(L,18) - **Jog up signal** to **J6-U** (N,15).
- \*48 (M,17) - DC motor **A** , **AIN2 @** (I,7) to **TB6612FNG**
- \*49 (M,18) - **Jog Down** signal to **J6-D** (N,16)
- \*50 (M,17) - DC motor **A** , **AIN1 @** (J,7) to **TB6612FNG**
- \*51 (M,18) - **Standby signal @** (J,7) for **TB6612FNG**, (motor **A & B**)
- 52 (N,17) - DC motor **B** , **BIN1 @** (K,7) to **TB6612FNG**
- 53 (N,18) - DC motor **B** , **BIN2 @** (K,7) to **TB6612FNG**
- \*GND (N,17) - To Chemshield GND
- \*GND (N,18) - To Chemshield GND

#### Power “take off” pins

- RST (O,5) - Not connected Short to pad next to it to reset
- 3V3 (O,6) - **Power take-off** on **J4** with smoothing capacitor **C4**
- 5V (O,6) - Open
- GND 2X (O,7) - To Chemshield GND
- Vin (O,8) - To ChemShield 12VDC+ supply

#### Analog Pins

- Analog 0-7 (O,7) - To pads P4
- Analog 8-15 (O,15) - To pads P5

#### \*PSC (K,3) - Power supply Conector(

- \*1G (G,2) , 2G (H,2) , 3 (I,2) , 4G (J,2) - 4X **Ground** Terminal connectors
- \*5 (K,2) & 6 (L,2) - 5VDC+
- \*7 (M,2) & 8 (N,2) - 12VDC+
- 9 (O2) & 10 (P,2) - 24V+ DC

**\*Polulu drivers:**

Information on the polulu drivers can all be found on their website too.

\*The Polulu Stepper driver A4988 for the Stepper motor (see listing for Fig.3) :  
<http://www.pololu.com/catalog/product/1183>

\*The Polulu DC Motor driver for the DC Geared Vat release motor (see listing for Fig.3):  
<http://www.pololu.com/catalog/product/713>

**Closing note:**

This document is the first release on March 28,2012 and was drawn up by ChemShapes.com , to eliminate any confusion , We would greatly appreciate if you can please report any errors that you might find to: [snyman@cfl.rr.com](mailto:snyman@cfl.rr.com)

Happy .....printing!!!

**Glossary:**

**CS-1** – ChemShapes 3D Printer Model-1

**ICSP** - In Circuit Serial Programming , A 6 Pin header For serial communications.

**PCB** - Printed Circuit Board.

**PC** – Personal Computer

**Shield** - a Arduino Shield is a special purposed PC Board that can be plugged on top of the Arduino PCB to extending its capabilities. The different shields follow the same philosophy as the original toolkit , open source for everyone! they are easy to mount and relatively very inexpensive for their capabilities.

**SMD** – Surface Mount Device

**SMT** – Surface Mount Technology

**TH** – Through Hole , refer to holes drilled though the PC board for components with leads vs Surface pads for components that get soldered on the pads with no holes (SMD).

**opto interrupt switches** - A switch that switches on and off when its light beam gets interrupted ,normally by moving plate or encoder wheel on a motor shaft . see :  
<http://hades.mech.northwestern.edu/index.php/Optointerrupter>