



## **M100 Installation Manual**

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## **1 Disclaimer of Liability and Limitation of Warranty**

Where the M100 card is supplied as a component and not as part of a complete control system it is assumed that the purchaser has sufficient electrical and electronic knowledge to handle the component competently.

It is further assumed that the purchaser has sufficient knowledge of safe working practices and the relevant Health & Safety regulations which apply to working with electrical and electronic systems to work safely with the component.

Conqueror Design and Engineering Limited will not accept any liability for any damage to systems or personnel that may result from the incorrect installation or usage of the hardware supplied. Nor will Conqueror Design and Engineering Limited replace or repair any supplied equipment that has been damaged as a result of such incorrect misuse or installation.

## 2 Introduction to the M100 card

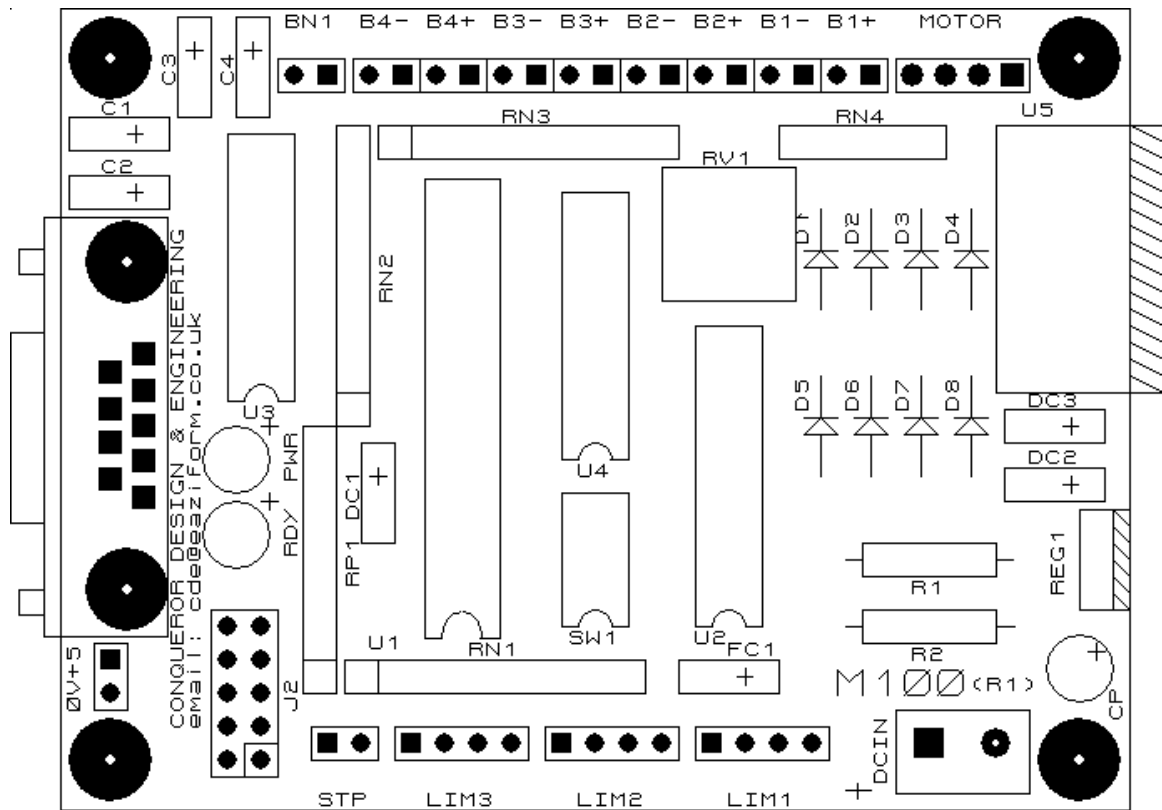


The M100 card has been designed to control CNC lathes, milling machines, PCB drills, routers, etc. In fact any machine which has 1, 2, 3 or 4 stepper motor driven axes.

The M100 card contains a bi-polar chopper drive for one stepper motor and can be easily connected to additional drive cards to control more sophisticated systems.

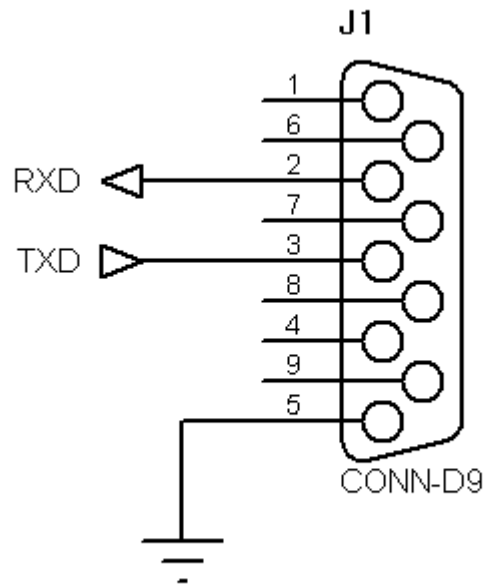
A machine fitted with an M100 can be operated in a simplified stand-alone manual mode (for cleaning and maintenance, etc.) without requiring a host computer.

## 2.1 Components of the M100 card



The card is supplied with EaziCNCLite editing and programming software for Microsoft Windows. Please refer to the separate EaziCNCLite manual for details on operating the EaziCNCLite software.

## 2.2 RS232 Serial Interface



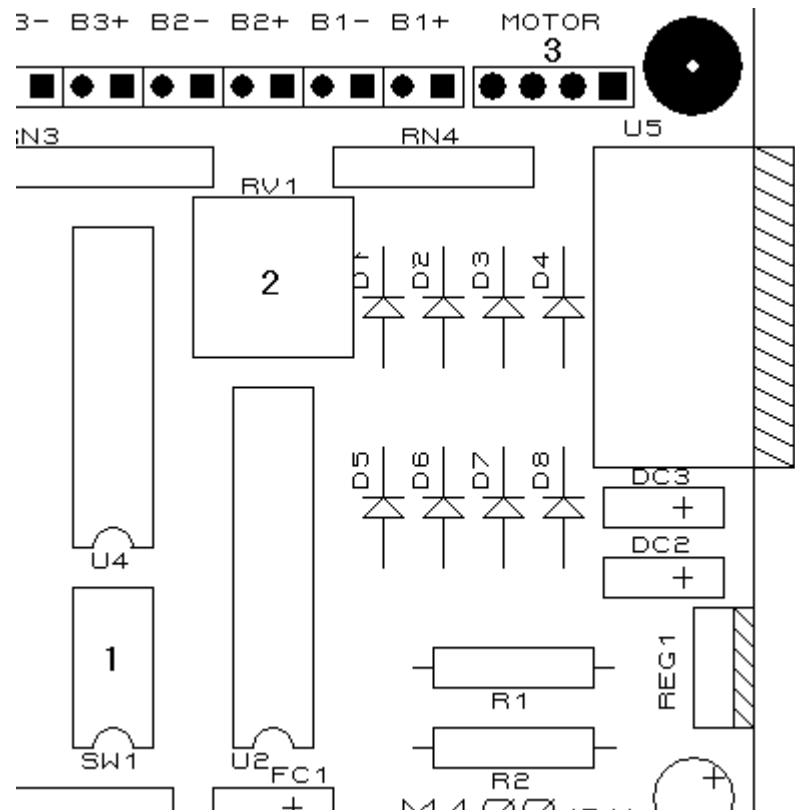
Pin	Signal
2	Receive Data (RCD)
3	Transmit Data (TXD)
5	Ground

The serial port is configured as a standard PC AT 9-pin port. A standard PC-AT to PC-AT serial cable (a cross-over cable) can be used.

The default protocols are 38,400 baud, 8 data bits, no parity and 1 stop bit.

The board will use XON/XOFF flow controls by default.

## 2.3 Bi-Polar Stepper Motor Drive



The stepper motor control has a 4-way switch block for setting drive characteristics (1), a potentiometer for controlling the current output to the motor (2) and a 4-way connector block for attaching the stepper motor (3).

The stepper motor connector block (3) connections are from left to right (when the card is held with the text/silk-screen correctly oriented)... B-, B+, A- and A+ where A and B are the stepper motor phases.

*N.B. When connecting a motor if the motor runs in the opposite direction to that required then reverse either the A+ and A- connections or the B+ and B- connections. It is only necessary to reverse one of the motor phases.*

The switch block controls the following functions...



Switch	Function
1	Manual Mode (see note in <a href="#">Manual Operation section</a> )
2	PWRSV. Selects power save mode in non-micro-stepping modes (switch 4 off) or PLL mode in micro-stepping modes (switch 4 on)
3	STP/2. Selects half-stepping if switch 4 is off or octi-micro-stepping if switch 4 is on.
4	STP/4. Selects micro-stepping mode. Quarter-stepping if switch 3 is off and octi-stepping if switch 3 is on.

The potentiometer is used to fine-tune the output current to the motors... fully anti-clockwise is 0% of the selected current range and fully clockwise is 100% of the selected current range.

***\*Warning\* Never connect or reconnect any wires to the stepper motors when there is any power to the board. It is also advisable to allow several minutes for the capacitors in the motor power supply to discharge and to check the input terminals for the stepper motor power supply to ensure that any capacitors ARE fully discharged before working on the system.***

### 2.3.1 Compatible Motors

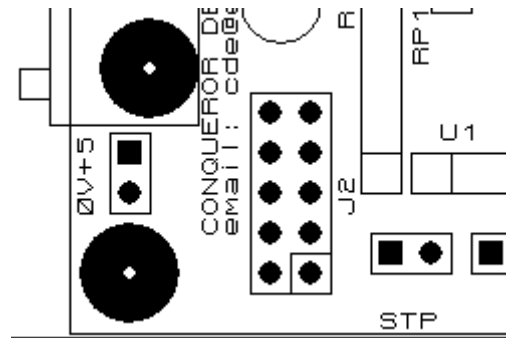
The following motors have been tested with the card...

<b>Motor Size (W x H x L)</b>	<b>Voltage</b>	<b>Current (Amps.)</b>	<b>Holding Torque (mNM)</b>	<b>Holding Torque (Oz-In)</b>
23 Standard 57 x 57 x 40	11.2	0.33	320	45
	3.4	1.0	340	48
	2.3	1.5	330	47
23 Standard 57 x 57 x 52	10.1	0.44	650	91
	5.0	1.0	690	98
	2.3	2.1	640	91
23 Standard 57 x 57 x 67	4.2	1.6	1,090	154
	3.4	1.9	1,130	160
23 High Perf. 57 x 57 x 41	4.6	1.0	470	67
	2.1	2.1	480	68
23 High Perf. 57 x 57 x 55	6.2	1.0	980	138
	2.9	2.1	980	138
23 High Perf. 57 x 57 x 79	4.2	2.1	1,610	228
34 Standard 82 x 82 x 62	5.8	1.3	1,820	258
	3.0	1.7	1,500	212
34 High Perf. 82 x 82 x 67	7.0	1.4	2,800	396

Torques quoted are for bi-polar drive.

Other motors with similar voltages and current requirements will also be compatible

## 2.4 Connector for External Stepper Motor Drives



Pin	Function
1	VCC (+5-volts).
2	Ground (0-volts).
3	STPX. Clock/Step-pulse for X motor.
4	STPY. Clock/Step-pulse for Y motor.
5	STPZ. Clock/Step-pulse for Z motor.
6	STPE. Clock/Step-pulse for E/U motor.
7	DIR. Motor step direction. Shared by all drives.
8	ENABLE. Used to idle the stepper motor drives when not in use.
9	RE1 - digital output #1
10	RE2 - digital output #2

Connector J2 at the bottom left of the M100 card can be used to attach separate stepper motor drive cards...

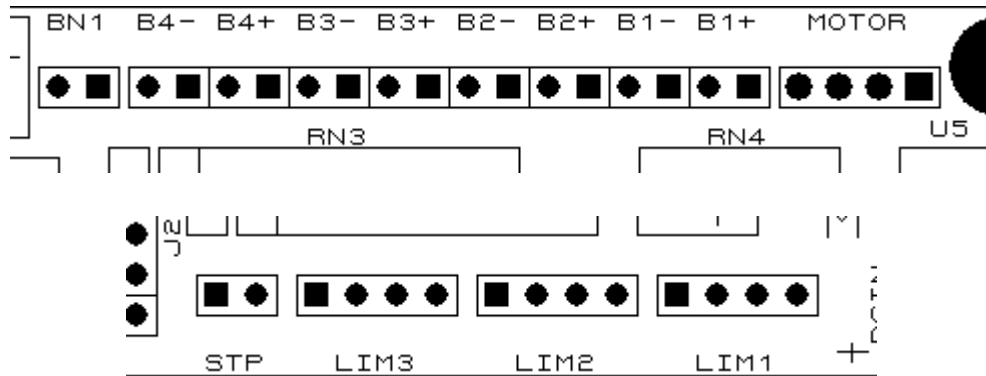
- when current or voltage ratings higher than those supported by the M100 are needed
- when more than one axis needs to be controlled
- when existing 3rd party drive cards need to be used

If the stepper motor drive card STEP1 or STEP1HP is/are used then the connections to the cards can be made via a straight ribbon cable "bus" and the cards can be configured to identify as X, Y, Z or U. If other drive cards are used then it will probably be necessary to use a terminal block or Y-cables to connect the shared signals to the different cards.

The digital outputs RE1 and RE2 are also available on this connector. These outputs may be used to drive or sink 25 mA @ 5 Volt. Miniature 5 volt relays (or solid-state relays) can be used to boost the control of these outputs up to any level.

## 2.5 Connectors for Jog-buttons, Limit-switches, Optical Encoders and the Safety Circuit

The connectors for the jog-buttons, limit-switches, optical encoders and the safety circuit are located along the top and bottom edges of the board...



In each case the square pad located inside each connector indicates pin1.

### X+, X-, Y+, Y-, Z+ and Z- Axis Jog-button and BN1 connectors

Pin	Function
1	Button signal. Short to pin 2 to activate button (i.e., connect the switch across the 2 pins)
2	Ground

### STP - Safety circuit connector

Pin	Function
1	Safety circuit +.
2	Safety circuit -

### LIM1, LIM2 and LIM3 Limit-switch connectors

Pin	Function
1	Positive travel limit signal. Short to pin 2 to activate limit (i.e., connect the switch across the 2 pins)
2	Ground (0-volts).
3	Negative travel limit signal. Short to pin 4 to activate limit (i.e., connect the switch across the 2 pins)
4	Ground (0-volts).

### 3 Manual Operation without a Computer

If no computer is attached the machine can be used in a rudimentary manner using the following jog-button and BN1 (button 1) combinations. The jog-buttons operate as normal in manual mode when BN1 is not pressed.

Keys pressed	Action
BN1 & X+	Enter manual mode.
BN1 & X-	Exit manual mode.
BN1 & Y+	Turn spindle/spindle-relay on
BN1 & Y-	Turn spindle/spindle-relay off
BN1 & Z+	Toggle rapid and feed modes.
BN1 & Z-	Toggle Coolant on/off

If no button has been pressed for several minutes the machine will be switched out of manual mode.

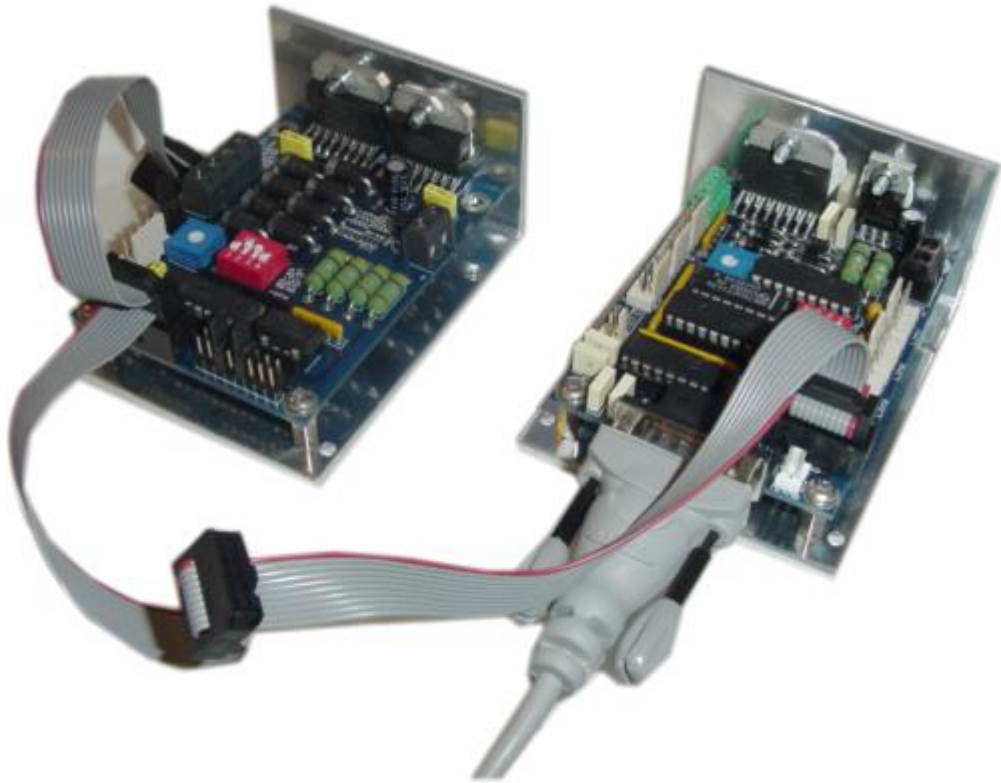
When in manual mode the status LED (the green LED) will flash to indicate that the jog-buttons are active.

***N.B. Switch 1 of the switch block can also be used to place the card into manual mode on power-up. This will allow the motors to be controlled using the jog-buttons. It is not possible to exit manual mode or to use the card with the computer software if this switch is on.***

## 4 Connecting additional motor drive cards

The M100 can be connected to up to 4 additional stepper motor drive cards (the 4<sup>th</sup> card can replace the onboard stepper motor drive if higher power output is required).

The connection for additional drive cards is a 10-pin IDC connector. If our STEP1 or STEP1HP cards are used then a simple ribbon cable with bussed connectors can be used to connect the cards together...

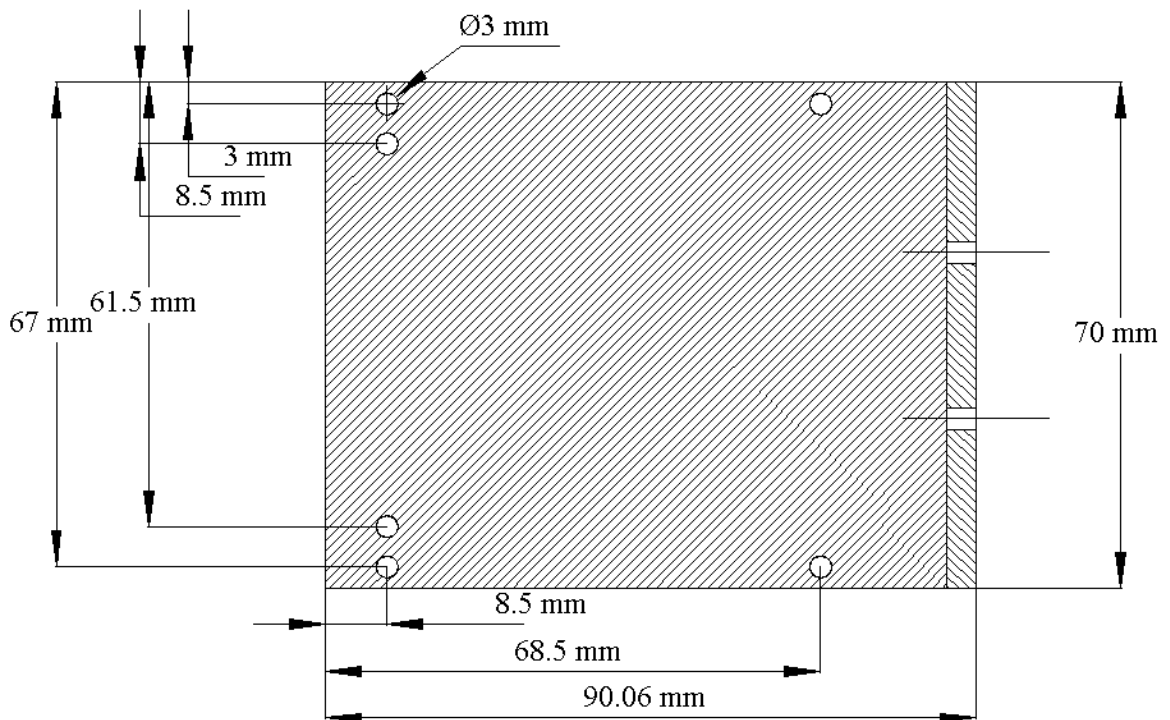


...each STEP1 or STEP1HP card is then set to be either X, Y, Z or E/U using the jumpers (JP1) on the card.

*N.B. If using STEP1 or STEP1HP cards remember to remove the jumpers JP3 so that the +5 volt lines of all the cards are not connected. This will reduce heat-dissipation in the voltage regulators.*

If 3rd party cards are used then you may find it convenient to use the optional [Opto-isolator](#) card to simplify splitting the step-clock and direction signals between several cards.

## 5 Mechanical/Mounting Details



Above is the drawing of the base of the M100 card heat-sink. The outer 4 holes in the base can be used for mounting the card.

The card should be mounted with 10 mm. of additional clearance all around where possible.

**\*IMPORTANT!\* The heat-sink fitted is not isolated. It is connected to the ground/negative rail of the supply. If it is necessary to isolate the heat-sink it will need to be detached and an isolating kit used to reattach it - this will reduce the efficiency of the heat-sink.**

## 6 Appendices

### 6.1 Command Set

Command	Parameters	Description
Ctrl-E (#5)	-	Echo On. Echoes characters back to the terminal and enables user friendly responses (data sent to the terminal will have a tag, i.e, "P0:0" instead of just "0").
Ctrl-N (#14)	-	Echo Off. Stops characters from being echoed back to the terminal and disables user friendly responses.
<ESC>	-	Escape. Stops any current moves or commands. Clears the command buffers. This command does not need to be completed with a carriage return (CR).
@	-	At. Returns the current position and status data in compressed hex format. This command does not need to be completed with a carriage return (CR).
D	n<CR>	Message-mode. Controls whether messages are sent to the console. n=0 - do not show messages n=1 - show messages (including updates when moving) n=2 - debugging mode
EC	-	Error Clear. Clears any error state on the machine. <i>N.B. this clears user-stops, power-up errors, etc. it will not and cannot clear errors such as 'safety activated'.</i>
ES	-	Error Status. Displays the error code of the machine. Error codes... 0 - No error 1 - Stopped by user 2 - Stopped - limit triggered 3 - Power interrupted 6 - Checksum Error



Command	Parameters	Description
I	n<CR>	Info. <n> is the item of information 0 - board ID 1 - firmware version 2 - firmware date 3 - processor type <blank> - firmware banner
MA	<CR>	Manual Mode. To exit manual mode the <ESC> command must be sent.
P	n[ Rv]<CR>	Parameter. Query (or set) a parameter. See control parameters for a description. P99 will display parameters 0 to 19. P199 will display parameters 20 to 39.
SX	f<CR>	Set X coordinate to <f>
SY	f<CR>	Set Y coordinate to <f>
SZ	f<CR>	Set Z coordinate to <f>
SE	f<CR>	Set E coordinate to <f>
SH	<CR>	Show Home. Displays the currently set home/starting position (set by a G54 command).
ST	<CR>	Status. Show current status.

Any valid ISO line will also be interpreted and executed on the machine tool. For a list of valid ISO (G&M-codes) see [G-Codes](#) and [M-Codes](#).

## 6.2 G-Codes

G-Code	Parameters	Description
G00*	X, Y, Z, U	Rapid Move
G01*	X, Y, Z, U, F	Feed Move
G02*	X, Y, Z, U, F, R	Arc Clockwise Move
G03*	X, Y, Z, U, F, R	Arc Counter-Clockwise Move
G04	S	Dwell. S=Seconds to delay.
G05	P	Sets the contour mode on and off.
G06	X, Y, Z, U, I, J, K, L	Cubic Spline function (only available when running with the EaziCNC software)
G07	X, Y, Z, U, I, J, K, L, A, B, C, D	Bezier Spline function (only available when running with the EaziCNC software)
G17	-	Use XY plane for circular interpolation (Top)
G18	-	Use XZ plane for circular interpolation (Front)
G19	-	Use YZ plane for circular interpolation (Side)
G28	X, Y, Z, U	Home Axis
G40	-	Tool-nose compensation off (default mode)
G41	R	Tool-nose compensation Left-of-Line
G42	R	Tool-nose compensation Right-of-Line
G43	-	Tool-length compensation (positive)
G44	-	Tool-length compensation (negative - default mode)
G45	-	Cancel Tool-length compensation.
G54	X, Y, Z, U	Set home/reset position.
G70	-	Imperial coordinates (only available when running with the EaziCNC software)
G71	-	Metric coordinates (default mode)
G90	-	Absolute coordinates (default mode)
G91	-	Incremental coordinates (only available when running with the EaziCNC software)
G92	X, Y, Z, U	Set datum point.

*N.B. The codes marked with \* are modal. Modal codes are active on any subsequent lines that do not have a code given.*

### 6.3 M-Codes

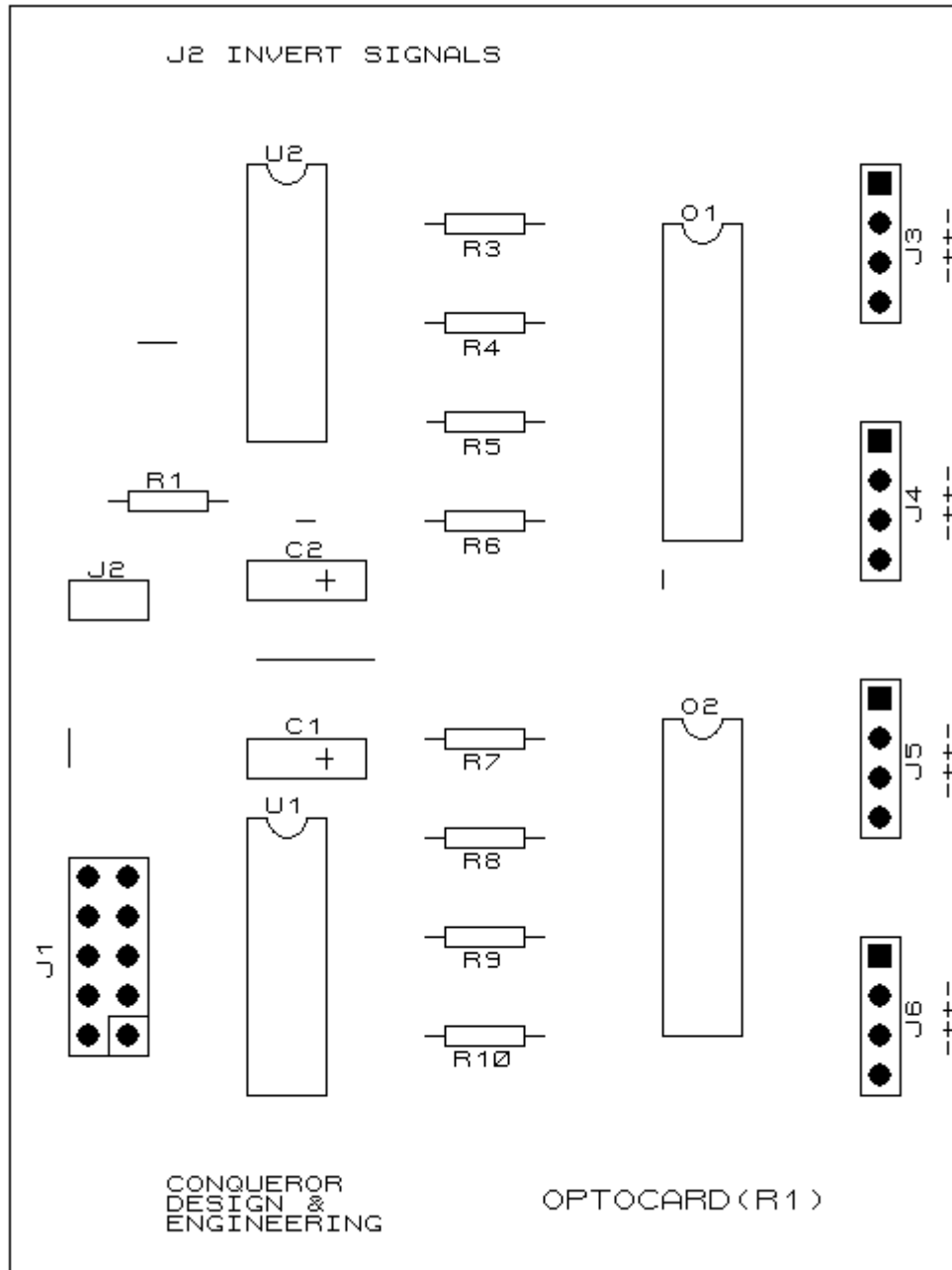
M-Code	Parameters	Description
M00	-	Programme Stop
M01	-	Optional Stop
M02	-	Programme End (same as M30)
M03	S	Spindle Start Clockwise
M04	S	Spindle Start Counter-clockwise
M05	-	Spindle Stop
M06	R, T, X, Y, Z	Tool Change
M08	-	Coolant On
M09	-	Coolant Off
M13	S	Spindle Start Clockwise + Coolant On
M14	S	Spindle Start Counter-clockwise + Coolant On
M15	-	Spindle Stop + Coolant Off
M30	-	Programme End (same as M02)
M47	R	Return to Programme Start. R is the repeat count (if given)
M90	P	Relay P On
M91	P	Relay P Off
M92	P	Wait for input P to be Low
M93	P	Wait for input P to be High
M98	-	Motor Drives On
M99	-	Motor Drives Off

## 6.4 Control Parameters

Parameter	Type	Description
0	Binary Byte	Bit0 (1) - limit switches enabled Other bits currently reserved.

*N.B. The parameters are not saved by the M100 when power is removed. The EaziCNCLite or EaziCNC programme will automatically update the parameters whenever a reset is detected.*

### 6.5 Optional Opto-isolator card



The opto-isolator card, **OPTOCARD(R1)**, allows the external stepper drive card signals to be connected to drive cards which do not operate at 5-volt TTL signal levels. The card also splits the direction signal into 4 separate outputs to make it easier to connect drive cards which need individual directions signals. The card is suitable for interfacing to logic levels of 5-50 volts.

The J1 connector pin out is as follows...

Pin	Function
1	VCC (+5-volts).
2	Ground (0-volts).
3	STPX. Clock/Step-pulse for X motor.
4	STPY. Clock/Step-pulse for Y motor.
5	STPZ. Clock/Step-pulse for Z motor.
6	STPE. Clock/Step-pulse for E/U motor.
7	DIR. Motor step direction. Shared by all drives.
8	No connection.
9	No connection.
10	No connection.

The J2 connector can be used to invert the signals going to the external cards. The standard signals are active-low. Connecting a shorting link across J2 will make the signals active-high. The board is supplied with a shorting link on connector J2.

The J3, J4, J5 and J6 connectors are for connecting the external drive cards for the X, Y, Z and E/U motors respectively. The pin out of the connectors is (pin 1 is indicated by the square pad)...

Pin	Function
1	Step clock -
2	Step clock +
3	Direction +
4	Direction -

...each opto-isolator can shunt 25 mA. The opto-isolated outputs are only suitable for driving logic inputs. To connect to a standard logic interface the - (negative) terminal of the isolator will be connected to the ground (0v) rail of the logic system and the + (positive) terminal of the isolator will be connected to the logic signal. When the isolator is active current will flow from the + (positive) terminal to the - (negative) terminal.

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