



# **Motion Application Program CNC**

## **Installation Manual**

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## **Health and Safety.**

1. The user should ensure that safe working practices are adhered to and that correct Personal Protective Equipment (PPE) is used at all times relevant to the nature of work undertaken and the type of machinery being operated.
2. Before powering up or using MAP CNC, the user should ensure that the machine being operated is clean, debris free and is being operated in a safe manner as required by the Laws, Rules, Regulations and Best Working Practices in force for the Country in which the equipment is being operated and that all safety devices are in undamaged and correct operating order.
3. This software (MAP) should not be used by personnel that have not been trained in the use of such software or the machinery it is used on.
4. TRM cannot be held liable for the miss-operation or incorrect programming of the system be it operating program or setup parameters.
5. Training and operation of machinery is solely the user's/owners responsibility and appropriate Risk Assessment records should be kept at all times.

## **Version Updates**

# User Interface

## Overview

Motion Application Program (MAP) CNC is a new way to programme motion control systems. G-Code can now be downloaded to the controller and have MAP commands inserted around it to control specific machine functions. This makes the system truly flexible and many

The database is used to store commands and position data for the motion control command sequence. The end user is presented with a user friendly front end with which to manipulate the database. The database can contain up to 65,000 different commands and due to the structure of MAP, it is a simple matter to change the system to suit another application.

Map is a very flexible language written in 'C'. It is easily adapted to other applications, as each of the user functions is written as a case statement. Adding commands is a quick and easy matter and for custom requirements we can 'roll up' a number of commands into a single macro command.

The user interface consists of an icon driven interface with scroll bar menus. The motion editor has a user friendly interface and has a pull-down menu system. Upon accessing the "Commands Menu" for example, the user is presented with a list of possible commands, the up and down arrow keys are then used to highlight the commands the user wishes to insert into the programme. Once the command is highlighted it may be entered in to the database by pressing the Enter key, then by using the right or left Arrow keys the user simply moves the cursor to the information they wish to edit. The system is programmed to accept data in a strict format which prevents the end user from entering erroneous data. If the end user attempts to enter data incorrectly the system will prompt advising the user of the data limits.

From a users point of view, a major benefit of using MAP is that no technical knowledge is required in order to programme the system. Using the MAP database principle any advanced application programme may be written such that the program can be run from a simple operator interface.

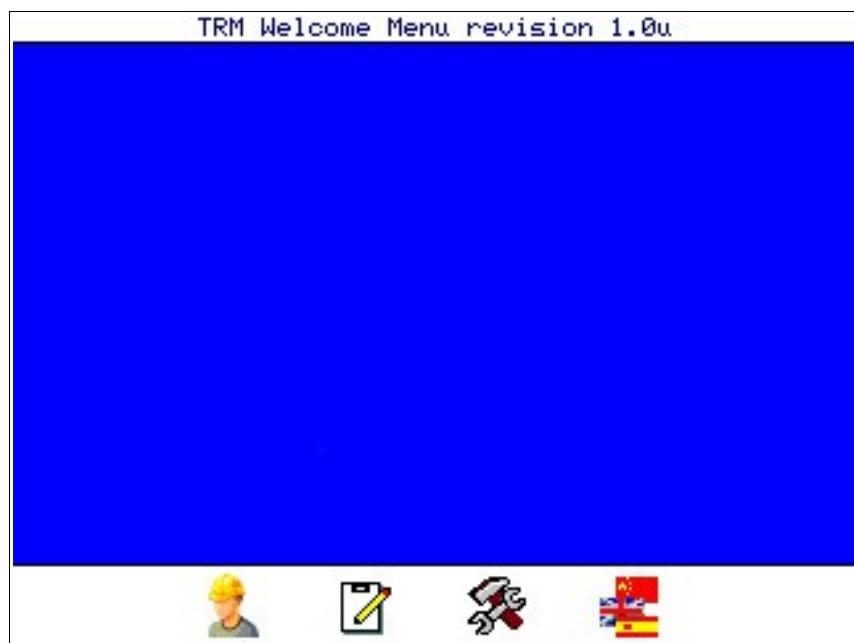
A MAP system requires calibration information in order to operate to standard measurements. The installer must programme the limits for the system which include motor and encoder details, axis dimension limits and operational options.

Please note that most menu's have a line number associated with that item, However that number is not shown for clarity. The top item will be 0.

For example bring up the commands menu and press 3 and then 6, the system will insert a 'Print\_Reg' command. This can be a great time saver for frequently used commands.

## Opening Screen

As shown below the opening screen for MAP is a very simple icon driven interface. At the top of the screen the revision number is shown so that when upgrades become available the user can check to see if there are any new features that may be useful and can then decide to upgrade if necessary.



At the bottom of the screen are four Icons which take you into the



Operator Interface



Edit/Create Screen



System Tools Menu



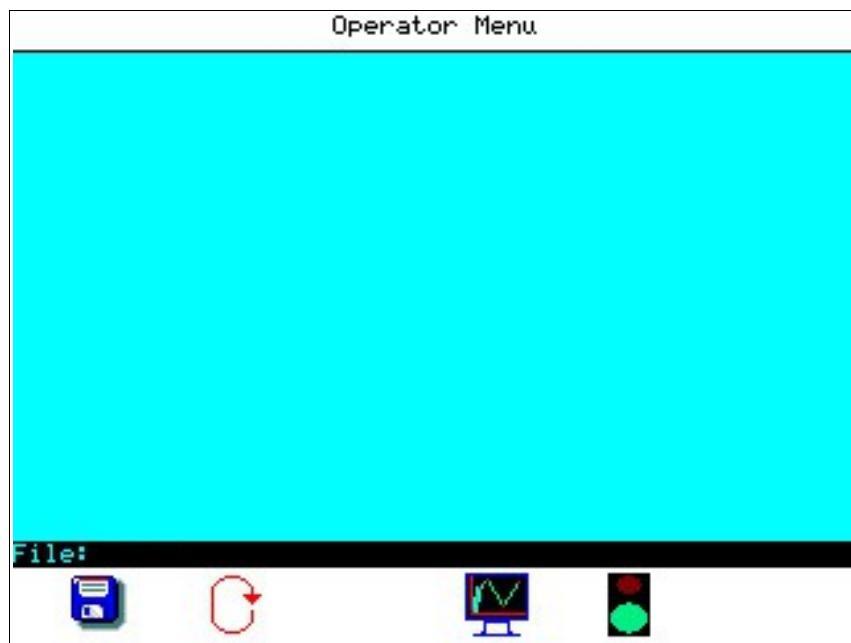
Language Picker

On non-touchscreen controllers, pressing the corresponding button below or to the side of the Icon will activate that option.

The central blue area can display a JPEG image 320 x 200 pixels of the machine, company logo or similar.

## Operator Menu

When the Operator menu is selected a simplified run screen is displayed. This gives the operator the information required to run the machine without the ability to edit and change machine settings or program flow.



Please see the Operators manual for further details on the use of this menu.

## Edit/Create Menu

When the Edit/Create menu is selected the controller will display the screen below:



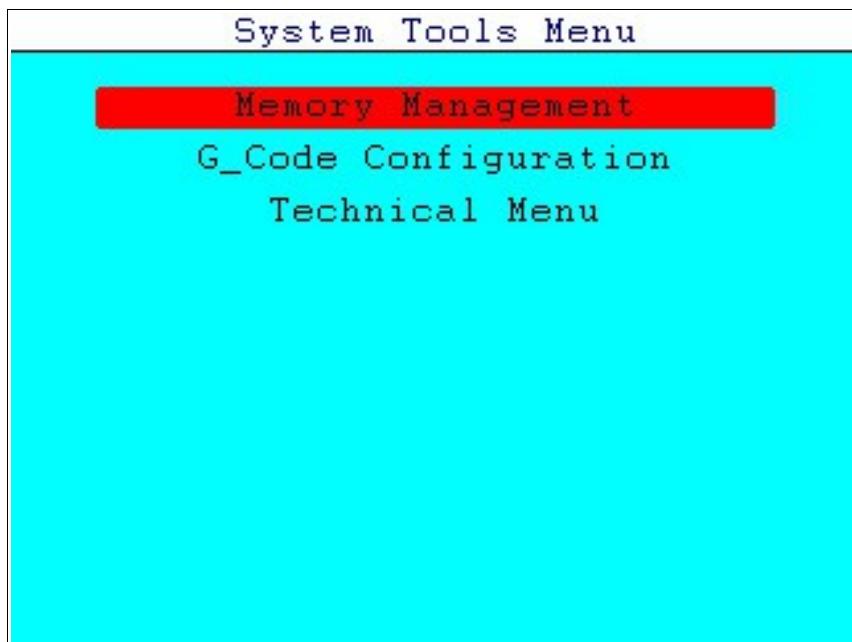
The text in the box at the top of the screen is intended to help with data entry as each command has it's own header. 'No.' represents the line number of the program, 'Command' is the name of the MAP command used and \*,\*,\* are the three heading that will change based on the command. Where a valid command is selected and a column displays '\*', no data should or can be entered.

The menu has a hint which is displayed in the information line, this hint changes to indicate to the operator what information is required.

Please see the Operators manual for further details on the use of this menu.

## System Tools Menu

All the technical information the controller needs to run the machine is stored here and most menus are password protected for security. For more information please review the MAP CNC Installation Manual.



## Language Menu

Selecting the Language option will display a pop-up box on screen with a list of languages available. Should your language not appear in the list please check with TRM's sales or support teams for updates or electronic manuals in that particular language.

Scroll to the language required and press enter, the box will disappear and the system will now work in the chosen language. There is no need to re-boot the controller.

# Electrical Installation

## Overview

When a controller is turned on for the first time the opening menu will be displayed. Before using the controller or doing anything else, the user is required to setup the system with the correct parameters for the machine.

This is quite simple as all of the settings are available in organised menu's with items grouped logically. For example the calibration menu contains all the settings for measurements on each axis, the Motion Control menu sets up the stability of the motors etc.

## Electrical Connections

### Motor Control DAC Outputs

Two channels of DAC are provided on the SMC and 4 on PMC4 etc. The output is +/- 10 volts with a maximum output impedance of 2200 ohms (with respect to the 0 volt rail) and is provided for motor control. Great care must be taken not to short the output to the 0v rail, or to subject it to an inrush of current etc. The DAC output stage incorporates a transient suppression device to protect the output in the event of a voltage discharge.

The DAC may be updated at intervals as low as 244 microseconds and has a resolution of 16 bits. This can be used as 11 bits in each direction. i.e. 32768 representing +10 volts, -32767 representing -10 volts and 0 representing 0 volts. This gives a system resolution of 305 micro-volts per digital increment, which produces extremely fine control.

### Analogue Input

8 analogue inputs are provided (PMC) and 4 (SMC), of which 4 might be used for using touch screen. The input voltage range is +/- 2 volts and the amplifier is of a high impedance type, the frequency response is greater than 100Khz. The ADC is a 12 bit signed type and is polled more than 1000 times per second.

The input voltage range of the amplifier can be altered by fitting a resistor in series with the input however please contact TRM for further information. If the voltage range is required to operate at voltages less than 2000 mV the amplifier may be altered as a factory option or alternatively the use of an external voltage amplifier is suggested.

The actual voltage range of the ADC is +/- 2047 milli volts. Zero volts input results in a zero count (the ADC is not auto zeroed and therefore there may be small errors around zero. A voltage of 2000 mV will produce a count of 2000 the resolution is therefore 1 mV.

## Digital Inputs

The SMC controller has 16 opto isolated and over-voltage protected inputs. Isolation from the outside world is important for noise immunity and also helps to filter out unwanted noise spikes that could toggle the input. The digital inputs have a frequency range exceeding 10 kHz, although in most control loops sampling these at greater than 1 kHz would require too much of the systems resources and would be unnecessary.

It is possible to set the inputs to be active high or active low as the figure below shows:

When an Input is selected active high it means the controller will read a '1' when active, in this case when the input reads any voltage between 5 to 48 Vdc . The configuration is as follow:

Figure 1 Digital Input Circuit (active high)

When a input is selected active low it means the controller will read a '1' when active, in this case when the input reads 0V. The configuration is as follows:

Digital Input Circuit (active low)

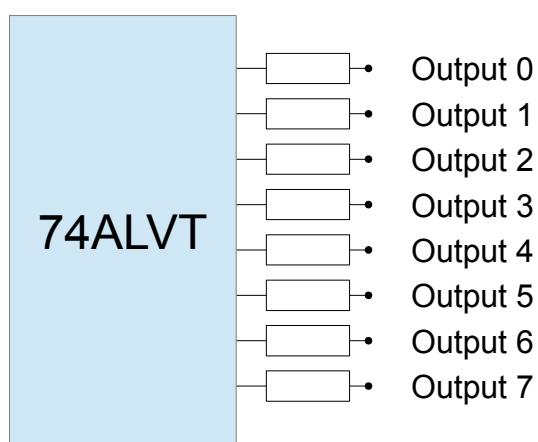
**WARNING! DO NOT CONNECT THE INPUTS TO A NEGATIVE OR AC. SUPPLY, SINCE THIS MAY CAUSE DAMAGE DUE TO EXCESSIVE CURRENT FLOW.**

## Outputs

The TRM controllers have 8 TTL outputs and also high power open drain Mosfet outputs. The quantity of these is dependant on the model of controller being used.

## TTL Outputs

The TTL output configuration is shown below:



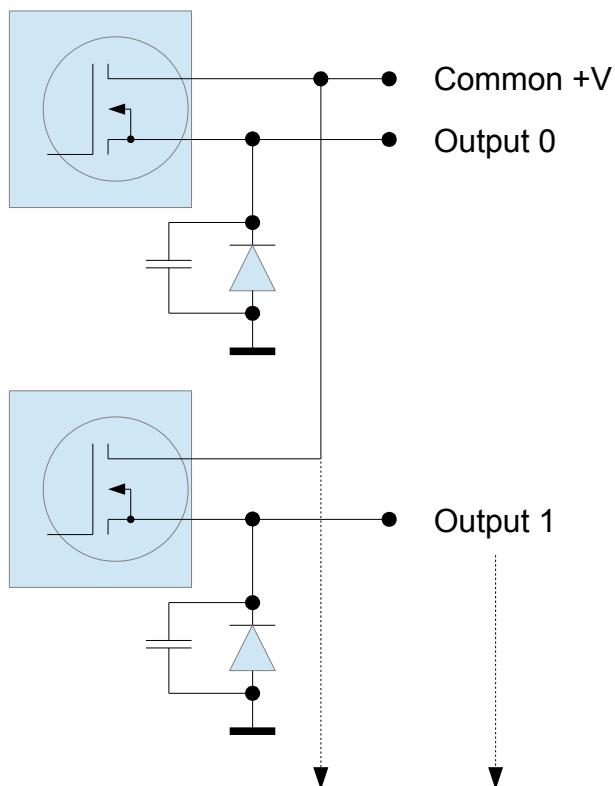
The output of the IC is connected via 33R resistors to limit noise and damage to the circuit.

SMC outputs source/sink 32 mA/64 mA @ 3V3 and PMC4 outputs +/- 35mA @ 5V. This means that basic signals can be sent and LED's activated.

If more voltage or current is required to say drive a relay then drivers 8+ can be used; see following section.

## Driver Outputs

The driver outputs are active high and can be operated at any voltage from 12V to 48 volts and at currents of up to 4 amps (SMC) and 12V to 36V at 1 amp (PMC4). Any number of drivers can be on at the same time providing a total of 6 amps is not exceeded, or heating of the connector pins may occur. Each driver has a freewheel diode and a capacitor to avoid damage to the drivers and to also suppress EMC emission. See figure below for a typical connection.



Should the drivers become accidentally reversed i.e. a negative voltage is applied to the drain with respect to the 0 volt rail, the diode will automatically conduct, clamping the maximum voltage to 0.7 of a volt with respect to ground, this prevents damage to the driver. The drivers can be used for controlling a number of applications and may be used as a TTL output where an external pull up resistor supplied.

As an example, assume that we wish to switch a solenoid. A typical connection for such a device is to connect one side of the solenoid to the driver and the other side to GND. Once the driver is turned on the solenoid is activated. Turning the driver off removes the supply and the solenoid de-activates.

It is also advisable to suppress any transients at source and therefore connect a Freewheel diode directly across the coil of the solenoid to suppress back EMF at source.

## Servo Amplifier ENABLE

A single opto rated at 30 volts 10 mA opto isolated output is provided for enabling servo amplifiers. This is an uncommitted transistor output with both pins being made available to allow high or low enable signals to be configured.

Please note that if there is a requirement to enable more than 2 drives in parallel the output will need to be buffered. This is due to the fact that most drives use an opto-isolated input that will need around 10mA to activate. TRM can supply a 4 output module to convert this if required which can be easily mounted on DIN rail.

## Serial

The controller provides two external serial ports these are a full RS232 compliant serial interface with the following signals:-

- Rx - Receive
- Tx - Transmit
- RTS - Ready to send
- CTS - Clear to send

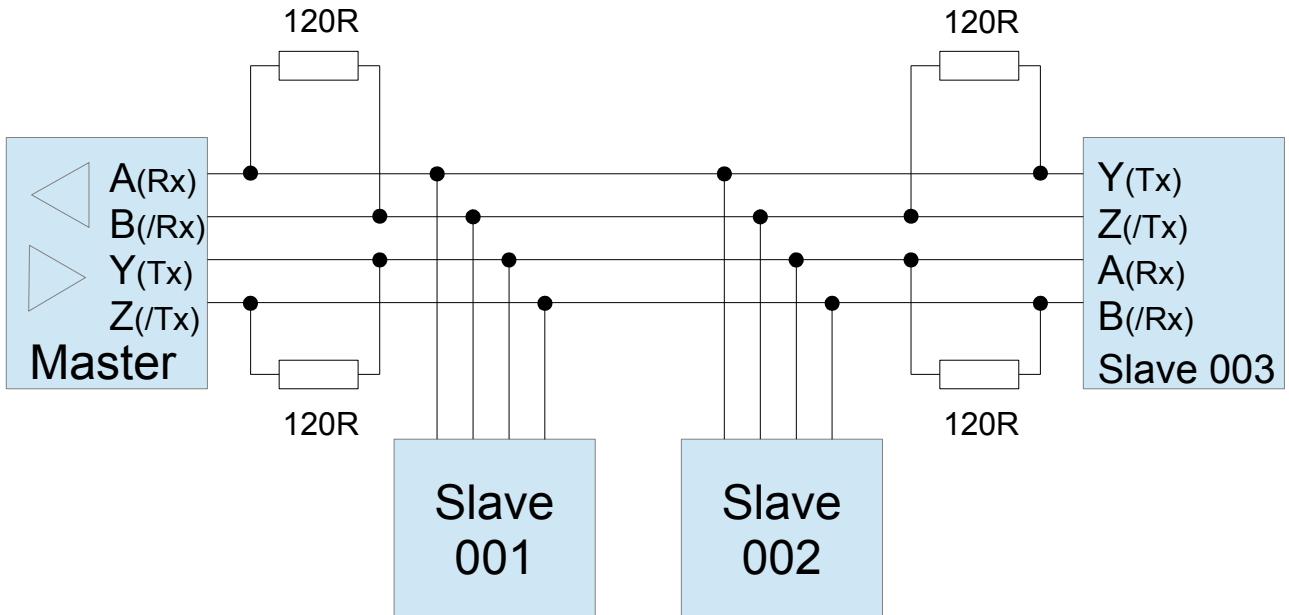
The second serial channel is dedicated to a four wire RS485 port. Both channels are controlled in the same manager software, accessed via the operating system. The baud rates can vary from 300 Hz to 230 kHz.

The RS232 port produces an output of plus and minus 10 volts in compliance with the RS232 directive.

The RS485 system consists of a UART and a duplex transceiver for RS-485 and RS-422 communication. The reduced slew-rate drivers minimise EMI and reduce reflections caused by improperly terminated cables, thus allowing error-free data transmission at data rates up to 213 KBPS.

Drivers are short-circuit current limited and are protected against excessive power dissipation by thermal shutdown circuitry that places the driver outputs into a high-impedance state. The receiver input has a fail-safe feature that guarantees a logic-high output if the input is open circuit.

The transceiver features a quarter-unit-load receiver input impedance, allowing up to 128 transceivers on the bus, the transceiver is designed for half-duplex or full duplex applications.



To minimise reflections, the line should be terminated at both ends in its characteristic impedance, and stub lengths off the main line should be kept as short as possible. The slew-rate-limited transceiver we use is more tolerant of imperfect termination. Nominal values for the termination resistors is 120 Ohms.

## Encoders

The encoder inputs are in addition to the digital inputs. There are various types of encoder available, most of which can be used with the PMC's input configuration, some of which are Line Driver and NPN open collector.

Theoretically, the maximum input frequency is 1 MHz, but in reality most encoders produce an output of less than 100 kHz. Typically this would result in the use of a 500 to 1000 PPR encoder. In some exceptional cases an encoder may run at around 300 kHz. A five volt, 500 mA supply is provided by the controller for the encoders.

The encoders should use continuous screened cable, the screen of which, should be terminated at the controller end only. This will avoid ground loops and other interference problems. Note that the encoder signal required are A, B, /A and /B.

**WARNING! ENCODER CABLES SHOULD BE ROUTED AWAY FROM ELECTRICALLY NOISY CABLES SUCH AS MOTOR SUPPLIES etc.**

## **Keypad**

The controllers keypad is designed to withstand harsh environments and is based on a printed circuit board design with individual tactile switches for each key.

Underneath the overlay is a plastic pressure plate which is used to prevent damage to the keys and to the overlay, caused by excessive operator pressure. When pressed, the key top sits flush with the fascia aluminium plate, preventing excessive pressure from damaging the key-switch.

Keys are rated to a minimum of 100,000 operations and are a high force actuation type to provide enhanced feedback to the operator should they need to wear gloves.

## **Keypad LED's**

The controller also has eight LED's which can be used as warning messages or as status messages for the operator. One LED, labelled 'KEY', is committed to indicating a key press. The remaining seven LED's are selected within the program via LED command as required by the system programmer.

Normally the Power LED would be on and the READY LED would be used when running a program. These can be changed by using the LED command.

## **Overlay**

The overlay is manufactured from polycarbonate and is extremely immune to most industrial substances, however the keypad should not be operated with sharp objects or and should not come into contact with solvents or other substances which may affect plastics. Should you wish to be advised further about suitability with chemicals involved in your process, please contact TRM for further advice.

TRM also offers a service in which the controllers overlay may be customised to suit a particular customers needs. Where customers wish to put their company logo/name/special keys etc. on the product, TRM will offer advice where required.

Charges for this service vary depending on the number of colours to be used, and the work involved. It is recommended that customers contact TRM for a quotation before considering a customised overlay.

## **Power Supply**

The SMC controller has an internal switch mode power supply which will operate from 7.5 volts up to a limit of 36 volts DC and should be fused externally at 2 amps. This enables the controller to be run from an unregulated 24 volt rail, providing it does not exceed the above specification. Under no circumstances must a voltage in excess of 36 volts be applied to the power supply or serious damage may occur as the controller is fitted with protection devices which clamp the input voltage.

The controller has a capacitor bank on-board which it uses to freewheel inductive currents back to. In some cases external switch mode power supplies feeding this load may trip out, in which case a lone power resistor of 0.5 ohms may be required in the positive supply line to limit current surge. The simplest form of power supply, consists of:

- A transformer with an 18 volt secondary winding
- A bridge rectifier
- A smoothing capacitor of around 10,000 uF
- Compliant fusing and filters

It is recommended that a discharge resistor of around 47K ohms be connected across the smoothing capacitor to avoid damage should it be shorted out when the power is turned off.

## Motors

The SMC Motion Controller can control a range of different types of motor, for example:-

- DC Servo motors
- Inverters
- Stepper motors
- AC Servo motors
- Linear Motors

As the controller is only a low power unit it will be necessary to interface to the motors with a Drive of a suitable type and capacity for the application. The command signal to the drive should also be checked to ensure compatibility.

Most rotary motors can be controlled in either an open loop or closed loop process depending on the desired accuracy of the system. Linear motors and Fixed length(travel) axis would generally need an encoder feedback to ensure the controller knew where the axis was at any given time.

## Wiring

This is a most important topic since bad wiring can cause major problems to any control system. In general it is wise to ensure that all inputs are run through screened cables, especially the encoder signals. It is also very important to wire the motor command signals from the controllers DAC'S using twisted pair screened cable with the screen terminated at the controller. Please remember that the encoder signals may have fast rise times and may produce substantial EMC.

Always ensure that the screened cables are properly grounded at one end only, it is preferable to ground the screen at the controller. It is recommended that the metal

chassis of the cable 'D' connector be connected to the screen and therefore this grounds the screens to the controller case, which should be grounded.

Motor armature and other noisy cables should be routed in such a manner as to gain maximum distance between them and the signal cables to avoid crosstalk. If noise is induced into the command cable the system will become unstable and potentially crash.

## Connectors

The controller uses 'D' type connectors for all of it's connections and it is recommended that good quality mating halves be used. It is worth remembering, the quality of your system depends largely on the integrity of the connectors. Always ensure that the connectors are gold plated or flashed and are of good quality.

Many people prefer to use solder bucket connectors since these are easily repaired. There are many manufacturers and specifications of D type connectors most of which are excellent products suitable for use with the SMC Motion Controller.

Where connectors with EMC filters built in are to be used it is important to remember that encoder signals are not to be filtered, as these contain high frequency pulses, which would be filtered out by the connectors resulting in errors in the motion control.

## Grounding the Power Supply

It is very important to ensure that the power supply is connected to the ground rail at only one place only. As the controller is the analogue signal source as far as the very sensitive DAC signals are concerned. All signal grounds and screens are then connected to that one point. Note that if the power supply is grounded in multiple points it is possible that voltages that exist as a result of resistance in the cables may cause ground loops in the signal cables this may cause loss of stability in the motion control system.

## DAC Wiring

The motor command signals must be returned to the controller ground. Each amplifier must be wired with an unique ground and motor command signal preferably in screened twisted pair.

Within the 44 way 'D' connector of the controller is adequate provision to connect the grounds. Do not connect the screen at both ends but at the controller end only. Always ensure that there is no possibility of ground loops within the earth's or screens on any important signals such as the motor command.

Should ground currents become a problem in the system, motor stability may be impossible since it is not unknown for 20 - 30 milli volts of ripple to occur on badly grounded systems.

## **Input Cable Wiring**

Treat all inputs as needing screened cables. Although the controller has opto-isolated inputs, it may be possible to run without screen cables. It is possible however for noise to be picked up by cables resulting in spurious input triggers. Remember that all inputs are relatively low current, therefore wires should be of suitable thickness i.e. 0.5 mm. All connectors used must also be suitable for low current use.

## **Wiring to Drivers**

The drivers may carry up to 4 amps each depending on the controller model, providing that the total of 6 amps for the system is not exceeded. It is therefore advisable to run the drivers in heavier gauge cable, where possible.

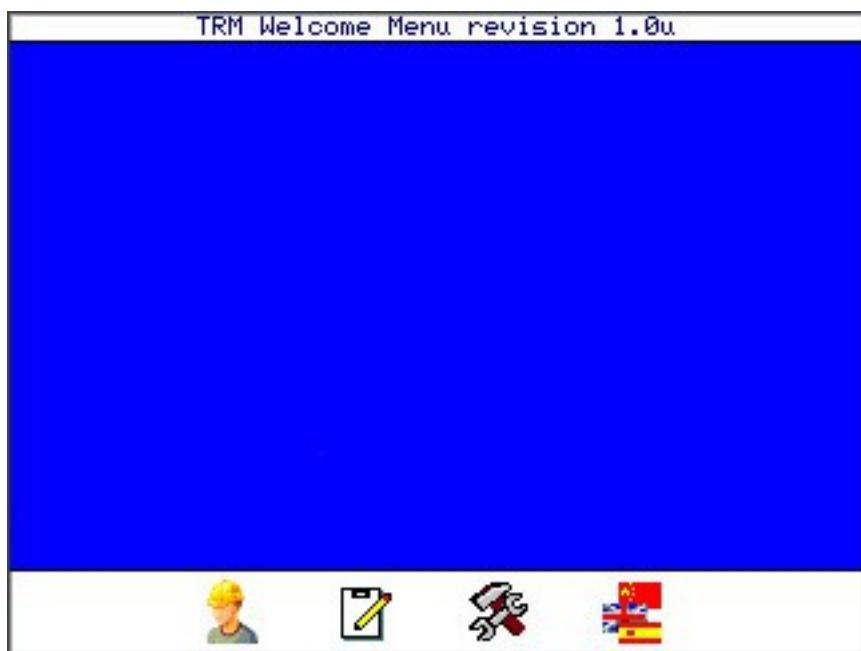
Screening is also a good idea since noise spikes which may be picked up on the 24 volt rail may be radiated around the system resulting in EMC problems. Again all screens should be connected at one end of the cable only.

Make sure that there are no earth loops in the wiring system.

## **Controller Terminations**

Please see the current product specification for pinout information and specifications.

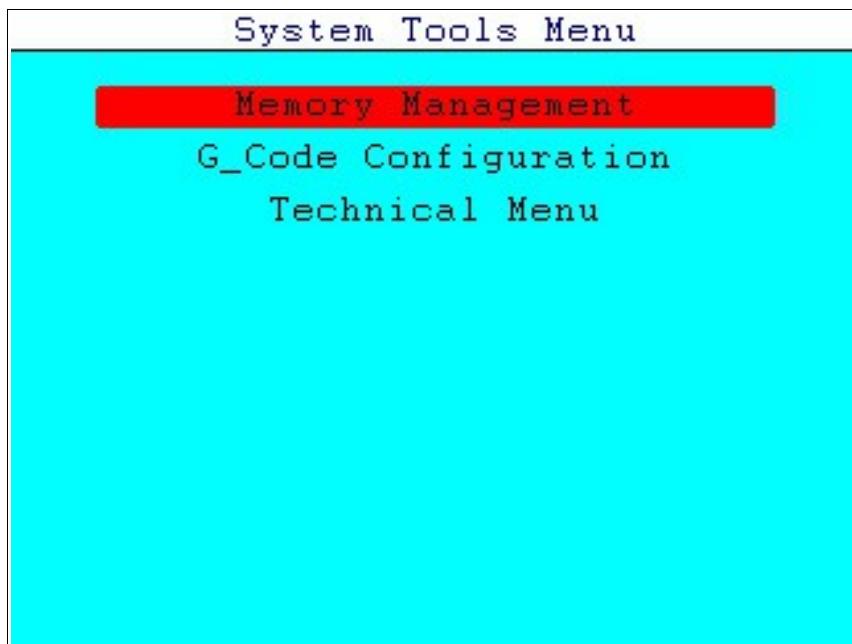
## Software Installation



To begin installation select the System Tools Menu option.

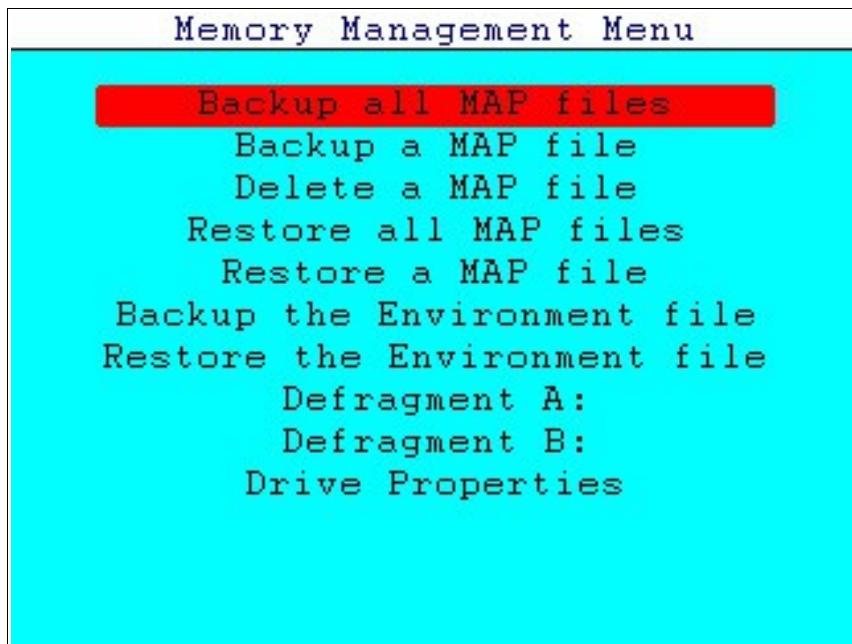
## System Tools Menu

From the System Tools Menu there are 3 options as follows:



## Memory Management

The Memory management menu is designed to allow the user to backup and restore system and user files.



## **Backup all MAP files**

Insert a FAT32 Formatted Pendrive into the USB port on the controller. Select this option and press enter. All the .map extension files on the controller will be written to the pendrive. If any of the files already exist on the pendrive the user will be prompted with a message asking if the user wants to overwrite them. This is a Yes/No response.

## **Backup a MAP file**

In order to backup just one file, the user can select this option. A popup box will appear allowing the user to select the file required. Using the + and - keys the user can navigate between drives. Normally the files will reside on the A: or B: drives.

## **Delete a MAP file**

In order to delete just one file, the user can select this option. A popup box will appear allowing the user to select the file required. Using the + and - keys the user can navigate between drives. Normally the files will reside on the A: or B: drives.

## **Restore all MAP files**

Select this option to recover all files from the pendrive with .map extensions. The user is not prompted to overwrite any files, use with care.

## **Restore a MAP file**

Similar to the previous option however the user can restore just one file. A popup box will appear allowing the user to select the file required. Using the + and - keys the user can navigate between drives. Normally the files will reside on the C: drives.

## **Backup the Environment file**

The environment files are where all the controllers settings and calibration information is stored. Once a machine has been setup correctly the first time this option should be used to save the configuration files in case they need to be restored in the future.

## **Restore the Environment file**

This may become necessary if a memory problem has occurred, a system update has taken place or an operator has changed some parameters intentionally. Insert the pendrive with the backup environment files and select this option. The system will restore these to the correct location and will be ready to run. Normally there is no need to re-boot the system.

## **Defragment A:**

Over time as files are written and deleted holes will appear in the filesystem. The controller can then reach a point where a program cannot be stored as there is not enough drive space left.

Run this option and all of the file system full be moved up into a contiguous block.

## **Defragment B:**

Over time as files are written and deleted holes will appear in the filesystem. The controller can then reach a point where a program cannot be stored as there is not enough drive space left.

Run this option and all of the file system full be moved up into a contiguous block.

## **Drive Properties**

This option displays the properties of all connected drives, these being:

- Drive Capacities
- Available Space
- Recoverable space
- Total Files
- Dir Optimisation

If Dir Optimisation is not 100% or Recoverable space is showing a value, then the optimisation routine can be run to recover this space. Due to the way the software is written the performance of the controller will not be affected by fragmented files.

## G\_Code Configuration Menu

From this menu it is possible to set various options relating to the operation of G code.

G Code Setup Menu	
Default Unit of measure	MM
Maximum Feed rate (mm/min)	0000.000
Default Quantity	00001
Serial Transfer file size	64K
Display Screen	Image
Product Height	00000.00
Tolerance	0.0000
X Park position	00000.0
Y Park position	00000.0
Z Park position	0000.0
Axis 3 Park position	0000.0
Pen active to move delay	0000
Pen inactive delay	000
Ignore start Character %	On
Permit manual tool change	Off
Show tool details	Off
Use Arc for G2/G3	Off

### **Default Unit of Measure**

The default unit of measure will be used if the g-code program does not specify the units. It is possible to select between inches and millimetres. The material thickness will always be set in millimetres.

### **Maximum Feed Rate**

The maximum feed rate can be set here in mm per minute. This allows the system to check for errors in downloaded code and prevent the system from trying to run at too high a speed.

### **Default Quantity**

If a repeating program is to be used this quantity can be set so that the program runs a set number of times. Most systems will have this set to the default of 1.

### **Serial Transfer Size**

Pressing enter will display a pop-up box with various size options. Set a file size of the maximum you would regularly use. This allocates memory sufficient for the file being processed with the minimum being 64K and the maximum being 16384K.

### **Display Screen**

Pressing enter will show various options for this setting. Either the screen can show an image, data, This allows the screen to be set so that following a download and

parse of the file for errors this screen will be shown. There are various ways that operators like to work and this feature allows the system to be customised for them.

## **Product Height**

This value is used to calculate the approximate area that a job is positioned in so that any tool movements can be checked and an error displayed if a potential collision is detected.

## **Tolerance**

A value can be programmed here as an acceptance value for arcs. Because the radius point of an arc and the start and finish ends are all calculated there may be a rounding error that means the command will cause an error. Setting an allowable tolerance here will define what Arc's will continue and which will fail.

## **X Park**

Set the position on the machine where the head will park when using a PARK command

## **Y Park**

Set the position on the machine where the head will park when using a PARK command

## **Z Park**

Set the position on the machine where the head will park when using a PARK command

## **Axis 3 Park**

Set the position on the machine where the head will park when using a PARK command

## **Pen Active to move delay**

Before a move can progress a delay can be programmed for a tool to be started up. This is typically used for routers to ensure the tool is up to speed and waterjet cutters etc. Normally the delay is very small however it can affect the finished product. This allows fine control over this aspect of the machine.

## **Pen Inactive Delay**

## **Ignore Start Character %**

Some file formats created in CAM programs inset a % symbol on some lines. By default the controller looks for this character and continues however if the file format to be used does not have this character present set this option to ON.

## **Permit manual Tool Change**

If a program is to be run with a single tool yet the G code has been downloaded with multiple tools this setting allows the controller to stop the machine and warn the operator. As tools can be different diameters and lengths it may be dangerous to continue with a tool in a particular instance.

Show Tool Details

Use Arc for G2/G3

## Technical Menu

The technical menu is password protected and allows access to many of the controllers parameters for the setup and safe operation of the machine. The password for this menu should be kept safe and only used by those competent or qualified to change them. Incorrect settings can make the machine dangerous.

Type the password and press enter to see further options as follows:



## Speed Settings Menu

It is vital that the maximum speeds of each axis are correctly set, if the maximum motor speed is set higher than the motor can attain, the system will lose control of the motor.

Speed Setup Menu		
Home Vel%	X	05.0
Home Vel%	Y	05.0
Home Vel%	Z	05.0
Home Vel%	J	05.0
Max Speed	X	100.0
Max Speed	Y	100.0
Max Speed	Z	100.0
Max Speed	J	100.0
Max. Acc lim.		040
Max. Deaccel.		040
Initial Vel%.		050.0
Default Jog Vel%:		10.0
Motor Speed RPM		
X=2000	Y=2000	Z=2000 A×3=2000

When setting the motor speed one must ensure that the limits of the system are respected, always set motors to run at a safe speed by taking the motor performance at minimum mains voltage and the maximum load on the motor and ensure that there is a little extra speed available to the controller (this should be in the region of 10 percent extra).

Check that in a DC motor system, the supply voltage to the motor is correct as to supply a 60Vdc motor with 45Vdc will result in the system trying to drive faster than it can actually achieve.

**For example:**

A 1.2Nm motor we use is specified at 60Vdc with a maximum 4400rpm. This gives us  $60/4.4 = 13.63$ Vdc per 1000rpm. If the voltage falls to 45Vdc, the motor can then only ever achieve 3300rpm yet the controller, being programmed at 4400rpm, will be trying to run faster and the position error will start to grow. This will be evident if the power graph is displayed on screen. If this is the case, re-calculate your maximum speeds to ensure the beast stability of the system.

### Home Vel

Home Velocity is the velocity that the system returns to home at and is set as a percentage of the maximum speed value per axis. This should normally be set quite low to ensure an accurate position is obtained. Remember that the zero point may

be near the end of the axis travel and therefore if the velocity is high there is a chance of the axis hitting the end of travel before the home switch is triggered.

## Max Speed

Maximum Speed is also set per axis and with other parameters, a calculation is made by the system with a RPM figure given on the bottom of the screen for reference. Please ensure you have setup the encoder details in the Calibration Screen before altering this as the RPM will be incorrect if the Encoder PPR or Stepper Motor "Steps per Rev" is changed later.

## Max Acc Lim / Max Deaccel.

Maximum acceleration and deceleration limits are a global setting (applies to all axis). The parameter is set in units of travel per period. This can be either quadrature pulses per sample period or units of travel per second. The normal system is set in QPSP unless stated on the menu. The formula for acceleration is given by:

$$Vi = (Ap / 255) \times 1250.$$

Where  $Vi$  = velocity increase per second squared, and  $Ap$  is the acceleration parameter entered by the user.

In reality is almost impossible for users to calculate the optimum maximum acceleration which often has to be set by measuring the motor current during acceleration and de-acceleration and ensuring that these are within design limits.

Where the system is set up in units per minute or second the acceleration and de-acceleration is set to reach a velocity increase per second of the acceleration parameter. For example an axis which has been calibrated in millimetres will accelerate at the rate of acceleration units per millimetre squared. In this case an axis will accelerate at the programmed number of units per millimetre second squared. If the figure 10 is entered for acceleration then the axis will accelerate and the rate of 10 millimetres per second squared.

A common mistake made by people setting up systems, is that the acceleration is set too high. If the acceleration is set too high then the motor will fail to reach the destination set by the controller and a huge following error will occur. Although the motor may recover its position in due course the motion profile will be wrong and ultimately the motor may burn out or cause uneven running of the axis.

More often than not, the accuracy of this setting can be checked by watching the power graph when running. If the graph shows red then the motor is not accelerating as fast as the demand and this setting should be reduced.

## **Initial Vel**

Initial Velocity is set as a percentage of the Max Velocity. The initial velocity is the velocity that the system will use until it encounters a SPEED command in the user program. Once a programme has completed the END command will reset the speed to the initial velocity.

## **Default Jog Speed**

This setting sets the default speed in percentage of the Max Acceleration speed for when jogging the motor in edit/create menu.

## Service Record Screen

This screen enables the service team to keep track of the distance moved by each axis in Meters. It shows the total moved for each axis since installation, what the accrued distance is since last service and what interval has been set for each axis. When the interval is reached a warning message will start to be displayed that the operator will have to acknowledge before continuing to operate the machine. If the interval is set to 0 no message will be displayed and the operator/installer/owner needs to have a maintenance schedule in place to ensure safe operation of the machine.

Service Record Menu			
Actuators:	Total	Accrued	Interval
Axis 0	000000060.8	000000000.0	000000000.0
Axis 1	000000000.0	000000000.0	000000000.0
Axis 2	000000000.0	000000000.0	000000000.0
Axis 3	000000000.0	000000000.0	000000000.0
Commission date	00-00-0000		
Last Serviced on	00-00-0000		
Service Interval	0000		
Total operation time	0000:06:27		
Operation Time since service	0000:06:27		
Service Number	000000		

A date can be set by the installer to record what date the machine was commissioned on. This date will then be used for calculating the “Service Interval” if this has been set (number of days).

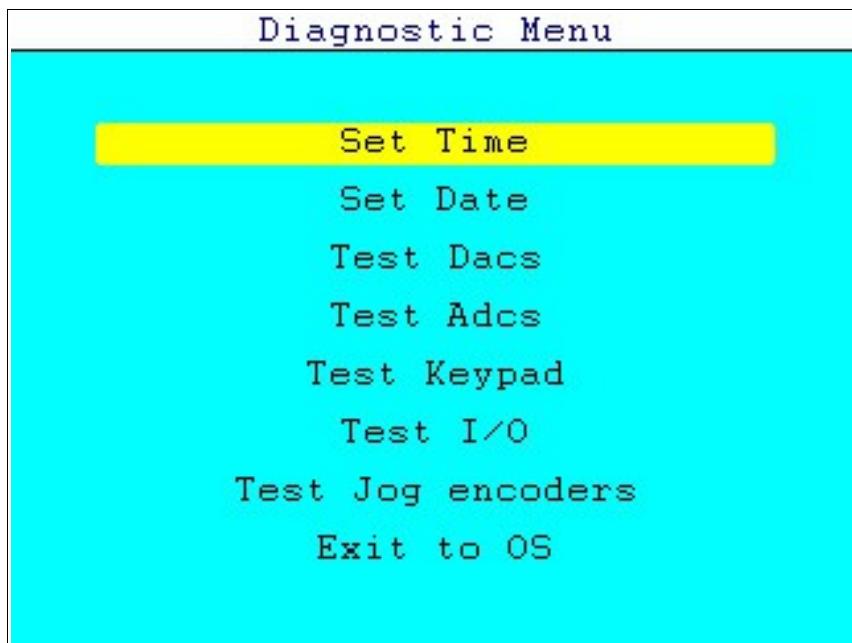
Once the machine has been serviced a date can be entered to record that.

Accrued operation time and total time that the machine has run are displayed and can then be recorded manually in a log book if used.

The service number field keeps track of the number of services that the machine has had since it was commissioned.

## Diagnostic menu

From the Technical Menu select the Diagnostic Menu. This menu is intended to assist engineers with test/diagnostics and is not intended for use by operators. The menu allows basic controller testing, setting of the real time clock etc.



Use this menu with great care as it is possible to start the motors at full speed. Always ensure that the equipment is in a safe condition prior to operating the test routines.

**TRM cannot be held liable for damage caused by the use of these facilities, they must only be used by competent personnel that are familiar with the system.**

### Set Time

After selecting the set time option, enter hours, minutes and finally seconds. The clock uses the 24 hour format. For example to set the time to 5:45:00pm. Enter 17 for the hour, the controller will add the colon so the display will read 17: Then enter the minutes, in this case 45, the controller will add the colon so the display will read 17:45: Now enter the zeros. The clock will start exactly when we finish typing the last digit in so enter the first 0 and wait for the reference clock to read 17:45:00 and enter the final 0. The time will be set and the controller will return the display to the diagnostic menu.

Please note that the clock is not self adjusting for winter/summer times and must be adjusted as required.

To return to the diagnostic menu at any time press MENU.

## **Setting the date**

Setting the date is similar to setting the time. From the diagnostic menu select Set Date. Note that the controller adds the colon and automatically returns to the diagnostic menu when complete.

To return to the diagnostic menu at any time press MENU.

## **The Test DACS Menu**

This menu is used by engineers to test the controller and amplifiers. The controller uses analogue voltages to control the position of the motors during motion control. The voltage range is positive through negative 10 volts (+/- 10 V). This voltage is produced via a digital to analogue converter (DAC).

### **Zero Volts**

Before checking anything else it is suggested that the zero volts is checked first. From the DAC test menu press 0. The controller will output zero volts on all axis. The controller will indicate that it has accepted the command by printing "0 volts" on the screen. This voltage will remain until the menu is exited or another key is pressed.

### **10 Volts**

This is used to make the controller output 10 volts from it's DACS. From the DAC test menu press 1. The controller will output 10 volts to all axis. The controller will indicate that it has accepted the command by printing "10 volts" two lines below the menu. This voltage will remain until the menu is exited or another key is pressed.

### **-10 Volts**

This is used to make the controller output minus -10 volts from it's DACS. The controller will output -10 volts to all axis. The controller will indicate that it has accepted the command by printing "-10 volts" two lines below the menu. This voltage will remain until the menu is exited or another key is pressed.

**The controller does not turn on the drive enable signal in this mode, however it is normally good practice to disconnect the motor electrically or mechanically to ensure damage will not occur.**

## **Ramp Drivers**

The DACS and the drivers are the most likely devices to be damaged if the machine has been damaged by over voltage transients etc. A varying width pulse is sent to each driver, using suitable loads and an oscilloscope it is then possible to check the drivers. The highest frequency is output to the first power driver and divides by 50% on each driver thereafter, this allows for open and short-circuits to be found quite easily.

**Please note that using this function will energise anything that is connected to the drivers. It is therefore normally good practice to disconnect any devices that may be damaged or cause damage.**

The controller will indicate that it has accepted the command by printing "Ramping Drv" on the screen. This voltage will remain until the menu is exited or another key is pressed.

## Ramp DACS

The DACS and the drivers are the most likely devices to be damaged if the machine has been damaged by over voltage transients etc. This function causes a sawtooth pattern to output to the DACS. Using suitable loads and an oscilloscope it is possible to check the DACS dynamically. The DACS produce a good quality linear sawtooth waveform. Any errors in the linear section of this waveform might indicate that the DACS have been damaged.

The controller will output the sawtooth to the DACS and it will print "Ramping DAC" on the screen. These voltages will remain until the menu is exited or another key is pressed.

## Test Keypad

This function allows the keypad to be tested on a key by key basis, the function displays the keys value and any character associated with the key e.g. '1' will show 0x30 and 0. To use this function from the Diagnostic Menu Test Keypad. The controller will clear the screen and print a message "Press keys in sequence. To exit use the same key twice". When the test is complete press the same key twice, this will return the operator to the Diagnostic Menu.

## Test IO menu

The test I/O menu is very useful as it allows a machine to be tested by controlling the drivers and verifying the inputs. The menu displays both the states of the inputs and the outputs. The outputs can be individually set on or off.

The first line of the display shows the number of the input in hexadecimal with the MSB on the left hand side. To the right of the heading is the hexadecimal value of the inputs which will be 0xFFFF as all the inputs are off. On the second line there is a binary representation of the inputs where 1 is high and 0 is low. Causing an input to change state will show on the screen as a change from 0 to 1 or 1 to 0 depending on the machine setup. Proceed to verify all inputs work independently.

On the next line down there is a heading for the drivers these are MSB on the left hand side with the driver number directly above each driver. In this case 0 represents off and 1 is on. When the menu starts all drivers are off. To turn a driver on press '1' on the keypad to turn it off again use '0'. The left and right hand arrow keys are used to scroll left or right allowing access to all drivers. The first 8 drivers

(0-7) are usually the TTL outputs and the power outputs are 8-F.

When testing is complete use the MENU key to exit to the diagnostic menu.

### Test Jog Encoders

This option is useful if you have Jog encoders setup on the system and need to verify the operation of them. There are 2 main pieces of information displayed, the Number of pulses received and the Input state (0 or 1)

Rotating the encoder 360 degrees should corroborate the number of pulses received with the number of pulses the encoder should generate. Rotating back 360 degrees should return the reading to zero. If this is not the case or you read an incorrect value, further investigation of the wiring and encoder condition should be checked.

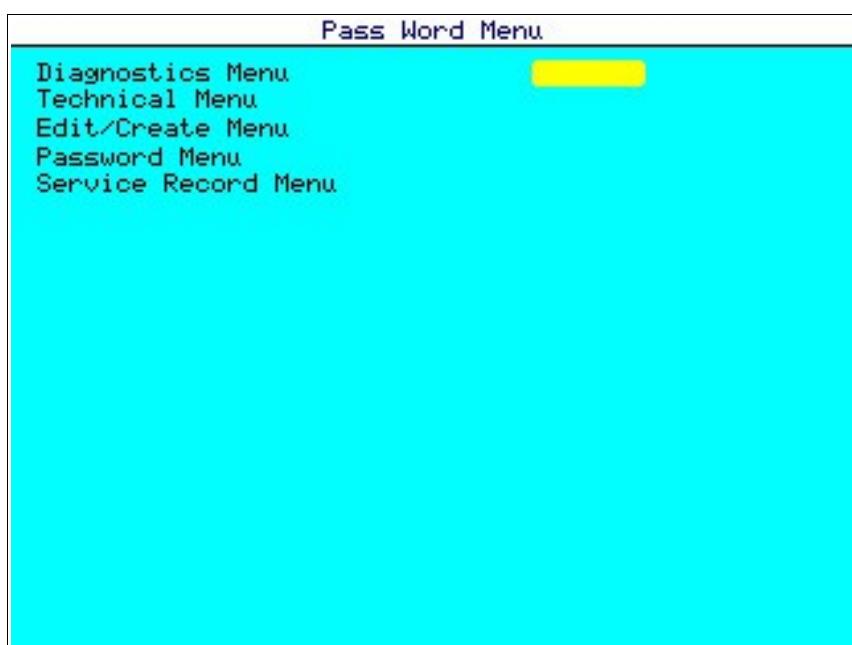
### Exit to OS

This option is used only under the instruction of your supplier. This is used to return to the operating system and is normally used for program updates or checking files.

The Time and Date are displayed at the bottom of the screen to enable verification and that the clock is running.

## Maintain Passwords

In this menu the user can set different passwords upto 6 characters long for some of the menus. We recommend setting your own passwords as soon as possible and not use the master password because the master password cannot be modified and any person that knows the master password will always be able to get into the menus and even alter the passwords set below.



## User messages

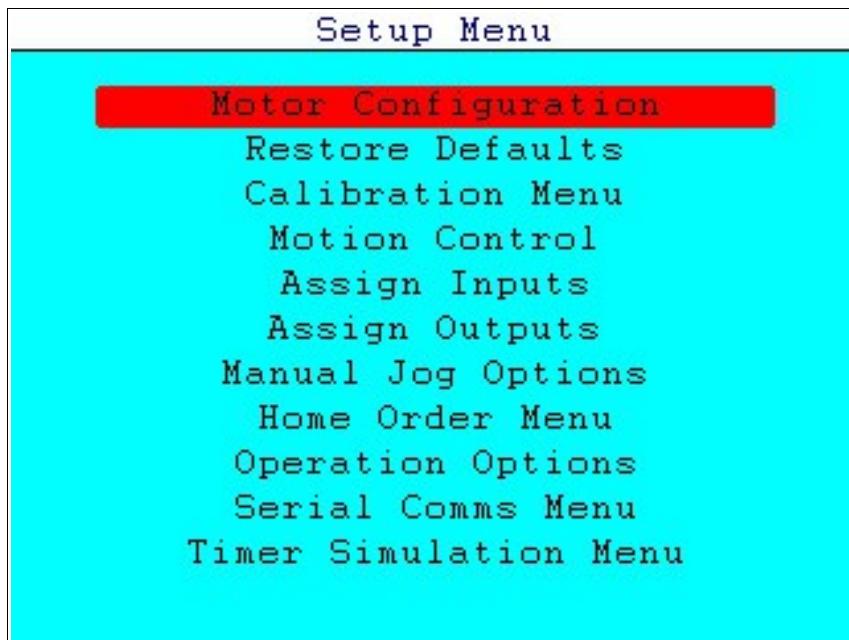
In this menu the user can write up to 32 messages which then can be used when creating a program. Once a message is written, the user can "call" the message in a program by using the MESSAGE command and specifying the number of the message.



Highlight the message required and type the text including numbers, and symbols as required. Scrolling down will automatically display the next set of messages.

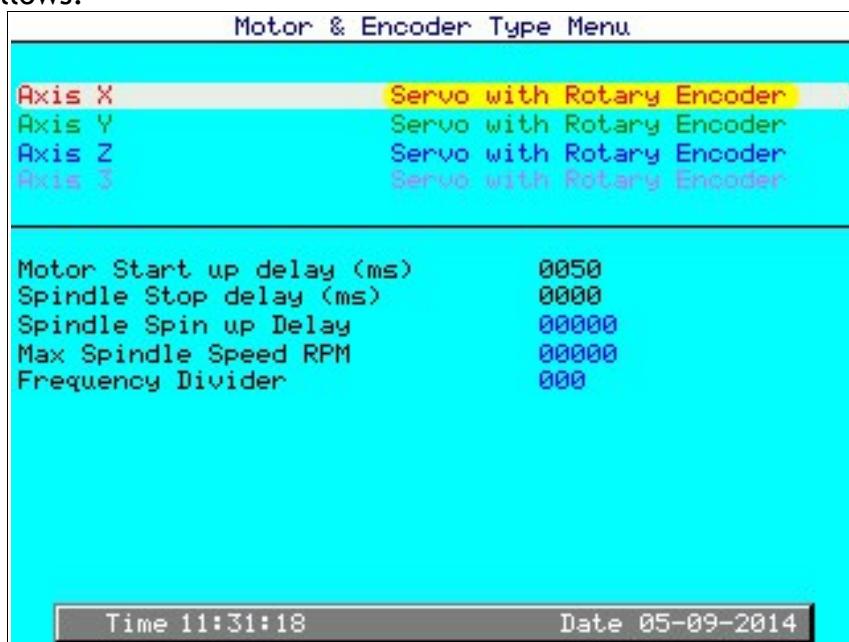
## Setup Menu

To continue installation select the option “Setup Menu” from the Technical menu. You will need to enter a password to navigate to this menu.



### Motor Configuration

In this menu the user can select the type of motors used. The user can select between stepper motor for each axis depending on controller model. The screen looks as follows:



## **Motor Type**

To select Servo or Stepper simply move the cursor to the desired axis and press ENTER, a pop up menu will appear from where you can select the type of motor to use. It is necessary to also select the correct type of encoder being used with an axis.

## **Motor Startup Delay**

A time delay facility has been provided to allow some types of motor drives to establish stable power before giving a move command as this will avoid the motor 'kicking'. The time is set in milliseconds and the value should be adjusted to suit the drive being used.

## **Spindle Stop Delay**

A delay can be set here to allow the spindle to come to a stop before any further actions can be carried out. One example is to prevent the operator reaching into the machine and potentially touching the tool before it has stopped. If this is to be used in such a situation ALL speeds should be tested to ensure a suitable time has been set.

## **Spindle Spin up Delay**

A time delay can be set to prevent a cut happening before the spindle is up to speed as normally there is no feedback from a spindle motor this setting has to be tested and adjusted to take into account machine wear and service status.

## **Max Spindle Speed**

Sets the maximum allowable spindle speed and errors any command that tries to go above this setting.

## **Frequency Divider**

When using a PWM output to a drive such as for the spindle, various frequencies are available depending on the drive to be used. A value set here will divide this value to bring the output frequency into operating range.

## **Restore Defaults**

Restore Factory Defaults is designed to load all the default configuration data into the controller, it is good practice for the technical person installing the system to run the factory defaults routine before entering the data for that particular machine.

**The user should backup the system before running this routine to enable system restore should settings be lost. This routine will change all I/O, motor and calibration settings, PROCEED WITH CAUTION.**

## Calibration Menu

At this point the menu might look a little daunting but it is really quite simple to set up. Take some time to enter the data the system needs as it will pay dividends later. The controller will show the following screen:

Calibration Menu	
Lead mm. or Degree of rotation	010.000
Gear Ratio	001.000
X Max. Travel mm.	5000.000
X Zero offset mm.	000.00
Play mm.	0.00
Type	ABS 0 is Home
Pulses/Steps Per Rev.	1000.0
Lead mm. or Degree of rotation	010.000
Gear Ratio	001.000
Y Max. Travel mm.	0000.000
Y Zero offset mm.	000.00
Play mm.	0.00
Type	ABS 0 is Home
Pulses/Steps Per Rev.	1000.0
Lead mm. or Degree of rotation	010.000
Gear Ratio	001.000
Z Max. Travel mm.	0000.00
Z Zero offset mm.	000.00
Play mm.	0.00
Type	ABS 0 is Home
Pulses/Steps Per Rev.	1000.0

Please note that the same information is required for each axis, an explanation for each setting follows:

### Lead (mm.)

The Lead is the distance that the load will travel for one revolution of the lead screw. If not using a lead screw and instead a conveyor, the circumference of the conveyor roller since it is the distance the load will travel in one revolution.

If using a rotating Table the user can work in degrees of rotation by entering the value '360' (degrees). If the user wants to work in revolutions the value has to be '1' (revolution).

### Gear ratio

The user has to enter the ratio of the gear box or the pulley system used, if one is not used and the motor is direct drive then enter '1'. If, for example the ratio is 5:1, the value has to be '5'.

### Setting the Maximum travel

The maximum travel represents a number of units of travel in the positive direction, e.g. if an axis has a working length of 400mm, 400 should be entered as the Maximum travel for that axis. The number entered should be the free travel and not

the end to end travel.

The value set here is used by the controller to ensure that the operator sets movements within the system boundaries. Note that if the value is set to zero the system will not test the data entered by the operator. If the axis is also defined as a relative axis the system will assume that the axis is controlling a conveyor belt or continuous process such as a pump, the product length in a move command can therefore be as long as the maximum number of digits in this case 9999 mm. A Revolve command will revolve until stopped.

In the absolute mode the controller will not permit the operator to enter position data greater than the +Ve limit. In the relative mode the controller will not permit a single or successive moves to exceed the limit if that limit is greater than zero.

## **Zero Offset**

The Zero Offset is designed for when the user wants to create an offset for home position, it will normally be '0' however some applications will require this option.

## **Play mm.**

This setting is designed to offset the error that might exist on for example, a lead screw. When moving back towards home to a position the system will move past by the amount of play programmed and then move forward to the correct position. This ensures that all positions are moved to on the same face of a leadscrew.

## **Type**

This setting refers to the "type of axis" e.g. Absolute or Relative. Once the cursor is on this setting press Enter and a pull down window will appear with the two options Absolute or Relative, select the desired type and press Enter.

### **Absolute axis**

Absolute measurement is very simple in that the required positions are entered by an absolute number. For example if axis 0 is 400 mm long, to move from zero to 350 and back to 50 requires the following instructions (see Edit/Create menu for more information):

**Move 350**

**Move 50**

The measurement is from the position where the axis was set when it started (normally came off the home switch).

### **Relative axis:**

Relative measurement is cumulative. The following program will cause three movements from 0 (or start position) to 100 mm. Then from 100 mm to 200 mm and back to 0 (or start position).

```
MOVE 100  
MOVE 100  
MOVE -200
```

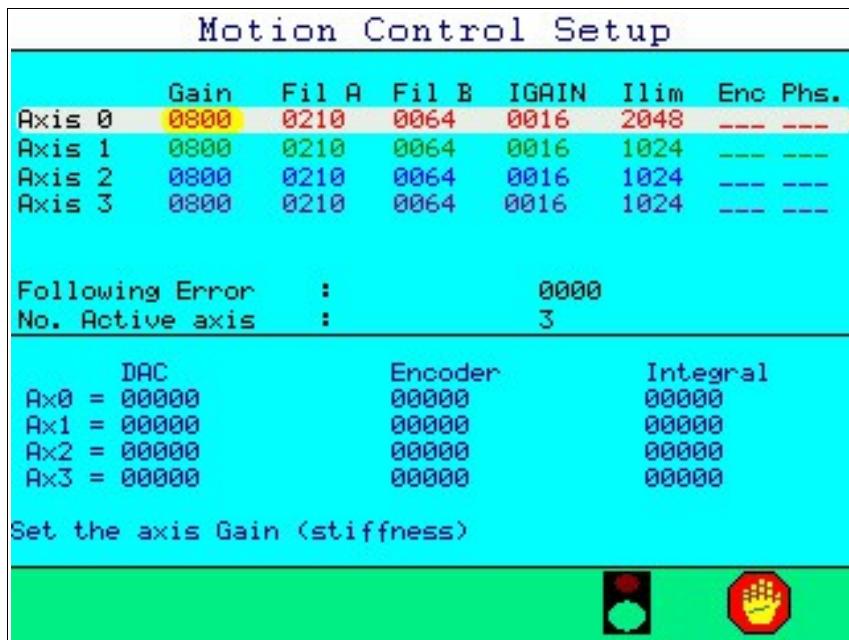
Relative axis are better for things like conveyor belts, cutting notches in a disc or depositing product via a pump. Most X/Y machine axis are absolute.

### Pulses/ Steps Per Rev.

This term refers to the encoder pulses per revolution or in the case of using stepper motors it refers to the steps per revolution. If your encoder is 1000ppr or 2500ppr then simply enter 1000 or 2500.

## Motion Control Menu

When selected the controller will change screen to the Motion Control screen shown below:



**Warning: if pressing Start (traffic light icon) the Motion control menu will turn the motors on (enable them). Ensure that the motors can revolve freely and that it is safe to power up the motors before entering this menu.**

In this menu the user can setup the stability parameters and rigidity of the system. The above image shows the screen of an SMC with only two servo axis, for controllers with more axes the parameters will be available for those axis.

### Gain

Determines how much position error will be allowed. The bigger the value the lower the position error allowed. Gain effectively sets the motor 'response' or stiffness. Setting this a little low on larger machines will result in a softer stopping action but could induce errors. This can be set to a rigid setting so long as the Acceleration and Deceleration settings are set correctly in the Speed Setup Screen.

**Permissible values are 1-9999 with 0 being 'off'**

### Filter A

This filter corrects the speed primary damping of the system. The bigger the value the lower the filter frequency. In this way, motors with poor acceleration characteristics will require higher values. For low inertia motor the value tends to be lower.

**Permissible values are 1-512 with 0 being 'off'**

## Filter B

This filter corrects the speed secondary damping of the system. The bigger the value the lower the filter frequency. As the secondary damping is of higher frequency compared to the primary damping this filter is normally lower than Filter A, however in some low inertia motors (AC servo motors) filter B could be higher than filter A.

**Permissible values are 1-255 with 0 being 'off'**

## Integral Gain

Integral Gain. This is the static position error. This parameter determines how quick the Integral gain grows from '0'. The bigger the value the faster the integral gain will grow.

**Permissible values are 1-999 with 0 being 'off'**

## Integral Limit

Integral Limit is the maximum value at which the Integral Gain can grow.

**Permissible values are 1-5000 with 0 being 'off'**

## Enc Phs

In order to select the correct direction and stability options There are four options available. Place the cursor in this column and press enter. A pop-up box will appear as shown below:

Motion Control Setup						
S-in	Fil A	Fil B	IGAIN	Ilim	Enc Phs.	
Axi --- ---	00	0210	0064	0016	2048	---
Axi --- INV	00	0210	0064	0016	1024	---
Axi INV ---	00	0210	0064	0016	1024	---
Axi INV INV	00	0210	0064	0016	1024	---
Following Error :			0000			
No. Active axis :				3		
DAC		Encoder		Integral		
Ax0 = -01639		00000		-524288		
Ax1 = 00819		00000		262144		
Ax2 = 00819		00000		262144		
Ax3 = -00036		00000		-11536		

“\_\_\_\_” Is the default setting and neither the encoder nor the armature are inverted. If the motor is stable it remains for the direction to be checked with a move command. Ensure the speed is set slow to avoid problems.

“\_\_ INV” Is for the armature to be inverted but not the encoder. Set this if the motor is not stable under the preceding setting.

“INV \_\_” Is for the encoder to be inverted but not the armature. This is the opposite of the preceding setting and will reverse the direction.

“INV INV” Is for both to be inverted. This is the opposite of the \_\_\_ setting and will reverse the direction of the motor.

It is possible using the above settings to invert either one or more axis. This changes the direction of the motor so that for example when two motors are mounted on the same axis but on opposite sides of a machine one would normally be turning in the wrong direction, this allows the user to correct this.

If the motors are powered up and are unstable rapidly rotating back and forth, it is likely that the encoder direction does not match the drive direction so that every time there is an error the motion controller tries to correct it and so the error grows. Before changing this setting stop the motion and exit the screen by pressing the menu key. Enter the Motion Control Screen again and any accumulated errors will have been set to zero. Set the phase as desired and retest the system.

## Following Error

This is the maximum permissible difference between the commanded position of an axis and its actual position. This is normally set to 0 on most machines to avoid nuisance tripping however there are some instances when the operator requires the machine to stop if an axis is not making position. This could be where the load is of a rubber type consistency and varies with batch and temperature.

*Permissible values are 1-9999 with 0 being 'off'*

## No. Active Axis

This setting is fairly simple in that the installer enters the number of motors being used. If set to 1 or 2 the system will lock out the second or third column in the edit create screen to avoid entering data in the wrong column.

*Permissible values are 1-x with 0 being 'off' (x = dependant on system)*

## Diagnostic Area

In the lower part of the screen are found some diagnostic information useful for when setting an axis up. The parameters are shown for each axis as follows:

DAC	Encoder	Integral
Ax0 = -000818	00000	-261648
Ax1 = 00000	00000	00000
Ax2 = 00000	00000	00000
Ax3 = 00000	00000	00000

Set the axis Gain (stiffness)

## DAC

This is the output command value being given by the controller, if there is not position error this should be '0' and if there is an error it should be any a +/- value depending on the direction of the error.

## Encoder

This is the raw encoder pulses received by the controller. This is also a very useful area during diagnostics as the motor can be rotated through 360° and the encoder count verified. Rotating back through 360° should return the count to zero, if this doesn't happen then there is likely a wiring fault or encoder fault either electrical or mechanical (slipping).

## Integral

This value grows to show how much force is required to return the position to zero when a load or friction is preventing it from doing so.

Once the system is stable and has been thoroughly tested, it is recommended that the end user write the values down or backup the system to USB Drive and store them in a safe place in-case they need to be reloaded in the future.

TIP - If all of the values shown read -00001 this indicates that the motion driver is not loaded and the operator should contact the installer or distributor for further advice.

## Assignable Inputs Menu

From the Setup Menu select option 4 Assignable Inputs Menu, the controller will draw the menu shown below. This is a scrollable menu and therefore all options are not shown in the image.

Assign Inputs Menu	
Home Switch X	Inp 00
Home Switch Y	InActive
Home Switch Z	InActive
Home Switch ax3	InActive
Emergency input	InActive
Permission to move	InActive
Start switch input	InActive
Pulse Counter input	InActive
Jog Wheel 0 Channel A	InActive
Jog Wheel 0 Channel B	InActive
Jog Wheel 1 Channel A	InActive
Jog Wheel 1 Channel B	InActive
Capture Input 0	InActive
Capture Input 1	InActive
Capture Input 2	InActive
Capture Input 3	InActive
Head 0 Home sensor	InActive
Head 0 Active sensor	InActive
Head 1 Home sensor	InActive
Head 1 Active sensor	InActive

Warning Bank1 must be Active Lo & Bit4 is in use

### Home Switch ax0,1,2

The home switch settings menu is designed to allow the user to tell the system which switches to use for the home positions for each axis. Pressing the enter key will show a drop down list of available inputs. If an axis does not have a Home switch then it's switch setting should be set to "Inactive". Note that most absolute axis require a home switch! If an axis is not homed, the rest position at start will be assumed to be the zero position.

Once the system has been 'homed' it will not need to go home again unless the program uses a home command.

### Emergency Input

Almost all systems should have an emergency switch system. The emergency switch should have at least two parts. One should operate an electrical break that turns the power off to the drives and other mechanically powered parts of the equipment (in Europe see the machinery safety directive) and the other part sends a signal to the controller to stop any movement in the drives as quickly as possible. Note in some systems the drives should be disconnected from the power supply via a timer. This allows the controller to stop any moving axis under control. LINEAR AXIS MAY BE DANGEROUS IF THEY ARE NOT STOPPED UNDER THE CONTROL OF THE CONTROLLER. This is because a moving axis without power or a brake has no means of stopping and may hit the limits of travel very hard. TRM can advise if required.

To make the system respond to the emergency input navigate to "Emergency Input" using the arrow keys. Select the number of the input that has been used for the emergency signal from the drop down list. If the system does not have an emergency system use "Inactive".

### **Permission to move**

The user can select an input from the drop down list which will allow the axis to move, if the input is not made the machine will not move when pressing start button, or will stop if it was running already. If no permission to move switch is required "Inactive" should be used.

### **Start switch input**

The user can select an input from the drop down list to start running the program. If no Start switch is required "Inactive" should be entered as the user will start the program with the designed keypad buttons.

### **Pulse Counter input**

The user can set an input to be used as a pulse counter which will be stored in a register. The user can select the input from the drop down menu.

### **Jog Wheel Inputs**

It is possible to use optional jog wheels, the user has to select any 2 available digital inputs for each of the jog wheels for A and B channels. These are simple manual jogs and have no inverted signal for A and B or Z signal.

### **Capture Input 0, 1**

Generates an interrupt and captures the encoder position at that time. **Not fully implemented, for future use.**

### **Head x Home Sensor**

The input can be set here to tell the system that all heads are in the home position and the machine is safe to move. If a series switch is used set all to the same input otherwise set to the input used.

### **Head x Active Sensor**

If a head is active this input will indicate to the system that it cannot move to a new position. The head may be still processing or it may have jammed and this option prevents broken tooling. All heads can be linked to this input so that any one head in the down position will stop the axes moving to the next position. If a series switch is used set all to the same input otherwise set to the input used.

Assign Inputs Menu	
Capture Input 0	InActive
Capture Input 1	InActive
Capture Input 2	InActive
Capture Input 3	InActive
Head 0 Home sensor	InActive
Head 0 Active sensor	InActive
Head 1 Home sensor	InActive
Head 1 Active sensor	InActive
Head 2 Home sensor	InActive
Head 2 Active sensor	InActive
Tool Setter	InActive
Edge Finder	InActive
Bank 3 inputs 15:12	TTL (0V active)
Bank 2 inputs 11:8	TTL (0V active)
Bank 1 inputs 7:4	TTL (0V active)
Bank 0 inputs 3:0	TTL (0V active)
Capture 0 polarity	Active Lo
Capture 1 polarity	Active Lo
Capture 2 polarity	Active Lo
Capture 3 polarity	Active Lo

Warning Bank1 must be Active Lo & Bit4 is in use

## Bank x Inputs

The opto isolated inputs are organised into 4 banks of 4 inputs. This parameter allows the user to allocate a bank to Pull High or Pull Low (PNP/NPN) type inputs. It must be noted that if the TRM (non CAN) interconnect system is used it uses input 4 as an OK signal and then bank 1 must be set to TTL (Active Low).

## Tool Setter

Setup the input here that a tool setter has been connected to.

## Edge Finder

Setup the input here that an edge finder has been connected to.

## Bank x Inputs

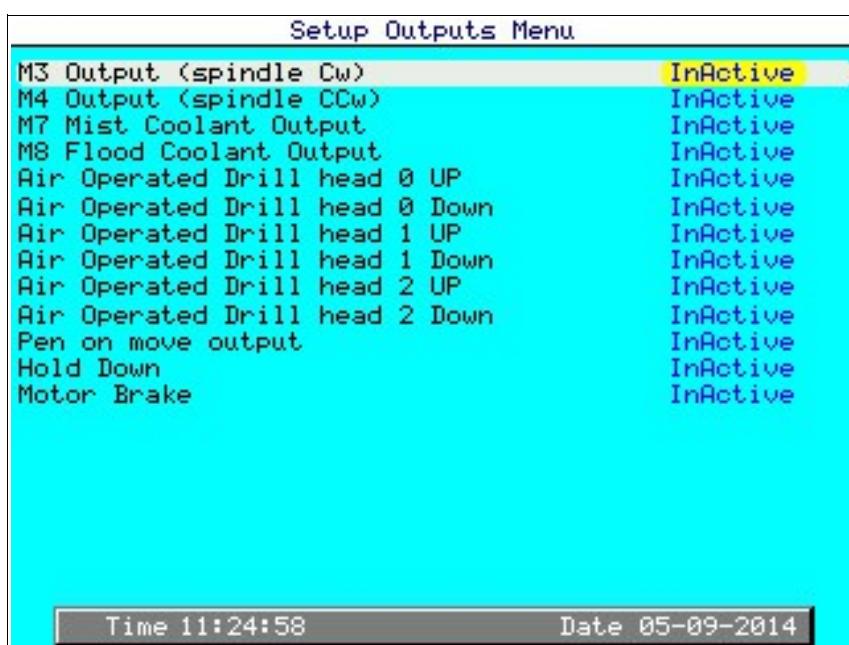
The polarity of inputs can be set here i.e. switch to 0V or switch to + volts. Inputs can be set in banks of 4 and a red warning bar will be shown if the TRM interface card is used as input 4 is used as an OK signal.

## Capture x polarity

The polarity of the signal to capture on for each of the Capture Inputs set above, i.e. rising edge or falling edge.

## Assignable Outputs Menu

Outputs can be configured in many ways and this menu allows the installer to set these as required.



### **M3,M4,M7,M8**

These outputs relate to the use of Gcode and an output can be assigned to a M code call from the Gcode being run.

### **Air Op**

The Air Operated Drill Head outputs are for use with the Drill command and assign which outputs are to be used to actuate the head to the up or down positions.

### **Pen on Move**

This assigns an output to actuate a cutter/pen or similar in the up or down positions. When a move command is used the pen will be actuated.

### **Hold Down**

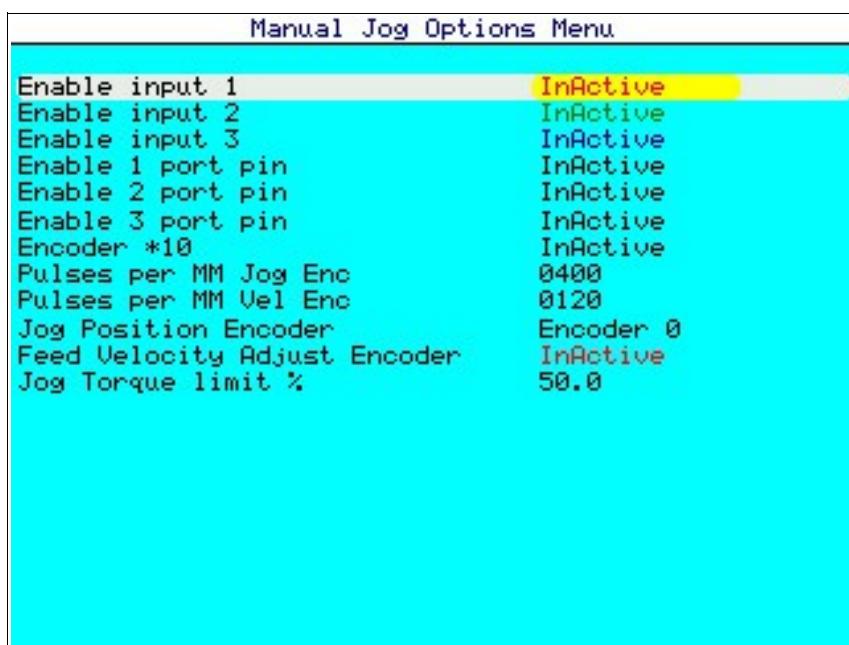
Is intended for a clamping operation on the machine to keep the part in place. This can be a clamp, a vacuum, a electro-magnetic clamp or similar and is activated when the program is run.

### **Motor Brake**

Here you can assign an output to turn a braked motor on or off as the motion control is started or stopped.

## Manual Jog Options

This menu allows the installer to setup a jog encoder input.



### Enable Input

Enable Input 1, 2 and 3 all have options available from a pop-up menu. Press enter on the selected item to show the menu, you will then have the following options available:

- 1) Inactive
- 2) Jog Enable
- 3) X Jog Enable
- 4) Y Jog Enable
- 5) Z Jog Enable

### Inactive

This turns off the option

### Jog Enable

Sets the type of enable to a global jog which is used when an “Enable x port pin” is set. Axis are then changed manually via the keypad. This is a suitable setting where

only one jog encoder is used and there is no other form of selecting an axis.

### X, Y, Z Jog Enable

These options enable jogging in only the axis selected. A different input can be set for each axis so that each can be moved independantly without the risk of the other axis being moved. Generally remote jog pendants would be used with these inputs so for example if X is set to IP5, Y to IP6, Z to IP7 the selector switch on the pendant can then be used to quickly change between axis.

### Enable Input Port 1,2,3

The enable input port number can be set to any available input being used to select a particular axis.

### Encoder \*10

This option allows the user to set an input so that when enabled the effective pulse count is multiplied by 10, i.e. sets coarse or fine movement.

### Pulses Per mm Jog Encoder

Allows the pulses per revolution to be set of the installed encoder. The PPR can be verified by firstly ensuring the inputs and jog options are correctly set then using the Test Jog Encoders menu turn the encoder by one revolution, the number of pulses can then be read on the Encoder count readout.

### Pulses Per mm Vel Encoder

Allows the pulses per revolution to be set of the installed encoder. The PPR can be verified by firstly ensuring the inputs and jog options are correctly set then using the Test Jog Encoders menu turn the encoder by one revolution, the number of pulses can then be read on the Encoder count readout.

### Jog Position Encoder

Select to configure which encoder is to be used or set to inactive if none. There are upto 3 internal direct jog encoder connections which can be selected here. These do not take up any of the digital inputs and therefore need little configuration.

### Feed Velocity Adjust Encoder

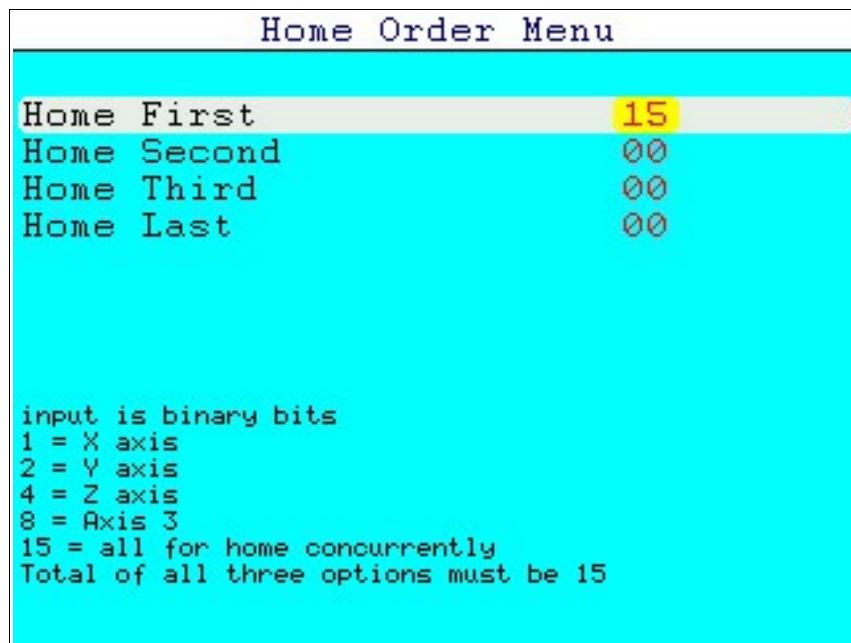
Select to configure which encoder is to be used or set to inactive if none. There are upto 3 internal direct jog encoder connections which can be selected here. These do not take up any of the digital inputs and therefore need little configuration.

### Jog Torque Limit

Setting the torque limit allows the system to run at a reduced power setting which would be used while setting a machine manually. This can be used as a safety feature as it ensures the axis cannot move at a fast speed endangering the operator.

## Home Order Menu

In this menu the user can set the order at which the home routine is executed. In some machines, CNC routers for instance, the Z axis is the first to go home as this will prevent any damage to the material.



In the above image there are 4 axis therefore the total entered needs to total 15. If for example the first is set to 1, second to 2 and third to 4 the total will be 7 and the axis will operate as follows:

The First axis will move to home with the other two stationary, once on the Home switch the second axis will start to move home. The other two axis will be stationary. Once on the home switch the third axis will start to move home while the first and second are stationary. Once all axis are on the home switches they will all move off the switch together and this will then be the Zero position.

If it is a milling machine for instance, it may be desirable to set the axis to 3, 3, 1 as this will home the Z first and then the X and Y will go home simultaneously.

## Operations Options Menu

The Operations Options menu allows the user to setup some basic defaults as to how the machine will operate, type a number or use the enter key for the selection window.

Options Setup Menu	
Decimal Places(mm)	2
Decimal Places(inch)	3
Measurement Standard	MM
Message on input	Off
Message on wait	Off
Home on power down	Off
Home on first Move command	Off
Screen Saver	Off
Password on Edit menu	Off
Clear Registers on start	Off
Use Interconnect system	On
Reset relative axis on start	Off
Display relative axis position	Off
Boot to Run Menu	Off
Use RS485 for serial	Off
Set OK_SIGNAL	Off
Always Require START button	Off
Use Z pulse for Axis X	Normal
Use Z pulse for Axis Y	Normal

Options Setup Menu	
Reset relative axis on start	Off
Display relative axis position	Off
Boot to Run Menu	Off
Use RS485 for serial	Off
Set OK_SIGNAL	Off
Always Require START button	Off
Use Z pulse for Axis X	Normal
Use Z pulse for Axis Y	Normal
Use Z pulse for Axis Z	Normal
Use Z pulse for Axis 3	Normal
E-Stop polarity when SAFE	Active Lo
Zero Origins on home?	Off
Zero Origins in jog menu?	Off
Hexidecimal for I/O values?	Off
Default program type	Component
Draw Y axis from	Lower Left
Stop live drawing?	Off
Show axis designation?	Off
Hide MAP line no?	Off

### Decimal Places (mm)

This setting is to set up the number of decimal places of precision the user wants to display on the position readout when working in millimetres.

## **Decimal Places (inch)**

This setting is to set up the number of decimal places of precision the user wants to display on the position readout when working in inches.

## **Measurement Standard**

The user can select the default measurement standard for the system (mm or In). This can be overridden during use by the options menu in the Edit/Create screen.

## **Message on input**

If set to “ON” and an “Input” command is used, a message will appear on screen telling the user that the controller is waiting for an input. If set to “OFF” the controller will just wait and not display a message.

## **Message on wait**

If set to “ON”, a message will appear on screen telling the user that the controller is waiting for a timer to count. If set to “OFF” the controller will just wait and not display a message.

## **Home on power down**

If set to “ON”, every time you run a program that requires the drives to be re-enabled the system will automatically go home. If set to “OFF” and following the initial Home, it will go home only after power to the controller has been turned off and on again or a “Home” command is used.

## **Home on Move command**

If this setting is left “OFF” the axis will always look for a home position before executing any command of the program. If “ON”, the axis will go home just when the first MOVE INDEX or ARC command, or any other motion control command, appears in a program.

## **Screen Saver**

The screen saver turns the LCD back light off after approximately 5 minutes of inactivity. Pressing any key on the keypad turns the back light back on.

## **Password on Edit Menu**

The user can turn On/Off the Password on Edit menu to prevent unauthorised access.

## **Clear registers on start**

Using the Enter key the user can select to clear all of the registers on start. Registers are value fields the user can use in a program to store calculated values. Do not set this option if you need to start from where the machine was left i.e. tracking a quantity of powder or liquid.

## **Use Interconnect System**

When using the TRM Interconnection system this setting has to be “ON” and if using simple breakout boards set to off.

## **Reset Relative axis on Start**

If set “ON”, every time you start a program the relative axis will reset to '0.00'.

## **Display relative axis position**

If set to “ON”, after a relative axis reaches position, then it will become '0.00'

## **Boot to Run Menu**

If Set to “ON”, when the controller is turned on it will go straight to the Run menu (operators menu).

## **Use RS485 for serial**

This is used for when linking 2 or more controllers together using the 15 pin serial port.

## **Set OK\_Signal**

If set to “ON”, Output 15 will turn “ON” when the controller is in the Edit/Create menu or in the Operators menu and a program is run. Once the stop button is pressed this signal is switched off. This can be used as an indicator to other parts of the machine or local equipment that a process is running. The output 15 should not then be used from within a edit/create program.

## **Always require START Button**

If set to “ON” and using the interface board, the controller will always request to press the START button even if there are no motors controlled in the program.

## **Use Z pulse for axis X, Y, Z, 3**

For future use - not currently implemented.

## **E-Stop Polariy when safe**

This relates to the E-stop Input if set and tells the system when it is in the safe position. i.e. the input is pulled high or pulled low.

## **Zero origins on home**

When set the origins programmed will be erased each time the system is homed.

## **Zero origins in Jog Menu**

## **Hexidecimal for IO values**

If set to yes the values on screen are shown as Hexadecimal. This can be some cases be easier to work with. Values are otherwise shown as Decimal. This option is not often used now as each IO command has a pop-up wizard to enable easy selection

of each IO bit.

## Default Program type

Not implemented for future use.

## Draw Y axis from

An option that allows the operator to select which corner drawing starts from. This is mainly dependant on which system is preferred. Options are from either lower left or top left.

## Stop live drawing

This option prevents the controller from drawing the shape of the tool path as it is run. If machining simple shapes this may be used to confirm what the product looks like and where the process is up to. Complex parts may not need this as the path will be overwritten and become unreadable.

## Show axis designation

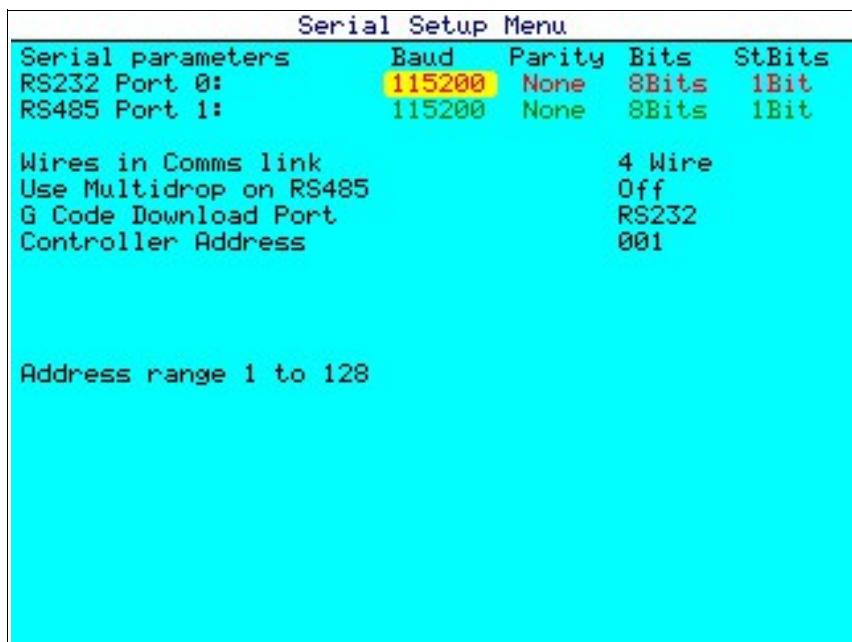
Each axis is called X, Y, Z and 3 internally. On some machines it is preferred to display these next to the DRO (position readout) so that the operator knows which axis the position relates to.

## Hide MAP line number

A simple yes/no option to remove the line numbering when “fast” commands are present in the program such as LED and Print\_Reg. As some commands take virtually no time to execute the drawing of the line number can slow the system down. Showing the line numbers may be useful for debugging a program but may then be turned off for production.

## Serial Set Up Menu

Here the user can set the controller for communication with one or more controllers. Has to set the controller address from 1 to 128 and the baud rate for either RS 232 or for RS485.



### Baud Rate

Eighteen of the usual baud rate speeds are available here in a drop down menu, remember that long cable lengths may need to run at slower speeds. Select the speed that is being used on the connected system.

### Parity

This option defines if there is a parity bit used in the transmitted packet. This is used for basic error detection and can be set to "None", "Odd" or "Even", this will not correct the packet but ask for it to be resent. Odd is a better option if it is to be used however most protocols automatically handle errors so most systems are set to "None".

### Bits

The number of bits used per packet is set here with the only options being 5, 6, 7 or 8.

### Stop Bits

The number of stop bits in a packet is set with this variable. Options are 1 or 2, stop bits sent at the end of every character allow the receiving signal hardware to detect the end of a character and to resynchronise with the character stream. Usually this will be set to "1".

## **Wires in Comms Link**

This setting applies to both RS232 and RS485 and indicates to the system if only RX and TX are used or if RTS and CTS are to be used too.

## **Use Multidrop on RS485**

There are two choices for this option, “On” and “Off”.

## **G Code Download Port**

The Download port is selectable between RS232 and RS485. The program will wait for data to be received on this port before continuing the process.

## **Controller Address**

The address can be set for use in RS485 multidrop communications. Be careful to not issue the same address to multiple controllers as the master will not be able to determine where a problem is located and will get conflicting packets. This can be set to a value between 1 and 128.

## Tool Offset positions

Here it is possible to offset the positions of the axis when using different size tools. As there may be horizontal drills etc, the user can offset in any axis.

Tool Offsets Menu		
	Diameter	Height
Tool 1	0000.00	0000.00
Tool 2	0000.00	0000.00
Tool 3	0000.00	0000.00
Tool 4	0000.00	0000.00
Tool 5	0000.00	0000.00
Tool 6	0000.00	0000.00
Tool 7	0000.00	0000.00
Tool 8	0000.00	0000.00
Tool 9	0000.00	0000.00
Tool 10	0000.00	0000.00
Tool 11	0000.00	0000.00
Tool 12	0000.00	0000.00
Tool 13	0000.00	0000.00
Tool 14	0000.00	0000.00
Tool 15	0000.00	0000.00
Tool 16	0000.00	0000.00

## Tool Calibration Menu

The tool calibration menu is used where a tool changer is fixed in place on a machine. The co-ordinates of each tool are programmed here relative to the zero position of the machine. Tool diameters will have already been set in the G-Code CAM setup. The operator needs to ensure that they match the setup of the machine.

Tooling Calibration Menu			
	X Pos	Y Pos	Z Pos
Drill Head 0	0000.00	0000.00	0000.00
Drill Head 1	0000.00	0000.00	0000.00
Drill Head 2	0000.00	0000.00	0000.00
Tool Changer 1	0000.00	0000.00	0000.00
Tool Changer 2	0000.00	0000.00	0000.00
Tool Changer 3	0000.00	0000.00	0000.00
Tool Changer 4	0000.00	0000.00	0000.00
Tool Changer 5	0000.00	0000.00	0000.00
Tool Changer 6	0000.00	0000.00	0000.00
Tool Changer 7	0000.00	0000.00	0000.00
Tool Changer 8	0000.00	0000.00	0000.00
Tool Setter	0000.00	0000.00	0000.00
Edge Finder	Height 0000.00	Diameter 0000.00	

### Tool Setter

The position for a tool setter can also be programmed. If this is fixed in a specific place on a machine the X and Y co-ordinates can be set, for both fixed and variable position toolsetters the height can also be set. This height is then deducted from the tool height to calculate the zero point.

### Edge Finder

The height and the diameter of the edge finder can be programmed so that the center can be found of the tool to the edge of the job.

## Canvas Menu

MAP Canvas Setup Menu			
	X Pos%	Y Pos%	Font
DRO X axis	079.0	001.0	1
DRO Y axis	079.0	008.0	1
DRO Z axis	079.0	015.0	1
DRO axis 3	079.0	022.0	1
Spindle RPM (S)	079.0	029.0	1
Tool (T)	079.0	036.0	1
Message Box Pos	010.0	085.0	1
Information Line		093.2	1
Graphics (use %)	X Pos	Y Pos	Xsize Ysize
Tool Path Image	000.0	000.0	075.0 075.0
Power Graph Image	079.0	044.0	020.0 010.0
Absolute Position DRO	079.0	065.0	019.0 025.0
Aux1 Object Image	000.0	000.0	000.0 000.0
Print Reg Font Size	1		
Print Reg Digits	4		
Print Reg precision	3		



The Canvas menu allows the installer or operator to change the run screen layout. Moving the position of items, the size and also if they are displayed or not. If a Jpeg image is used for the background in the run screen then the data can then be placed as required. Canvas items can also be changed and may need to be redrawn using the commands available from the drop down menu in the edit/create screen.

### DRO X, Y, Z, 3 axis, Spindle RPM, Tool, Message Box Pos

Each has the ability to be positioned in the X and Y screen position. The font size can be changed from 0, 1 or 2 with 0 being the smallest. Setting the x and y positions to 0 disables the item so it will not be shown.

### Information Line

The information line is slightly different in that it can only be positioned vertically in the y axis. This is because the line is the full width of the screen and cannot be hidden.

### Graphics

Some items are defined as graphical images as they not only have an X and Y positon but also a size in X and Y. Again setting the XY position to 0 will stop the item being displayed. Use the XY size settings to set the box size as needed.

## Registers

When the “print register” command is used the position is set in the edit/create screen however the font size, number of digits and number of digits following the “.” can be set here.

End.

We hope that you find the information you need in this manual. In the event that you are unsure or find that something is not covered please in the first instance contact your local distributor. If they are unable to help, it will then be referred back to TRM's Technical support staff.

