GOLD CONTROLLER
USER MANUAL

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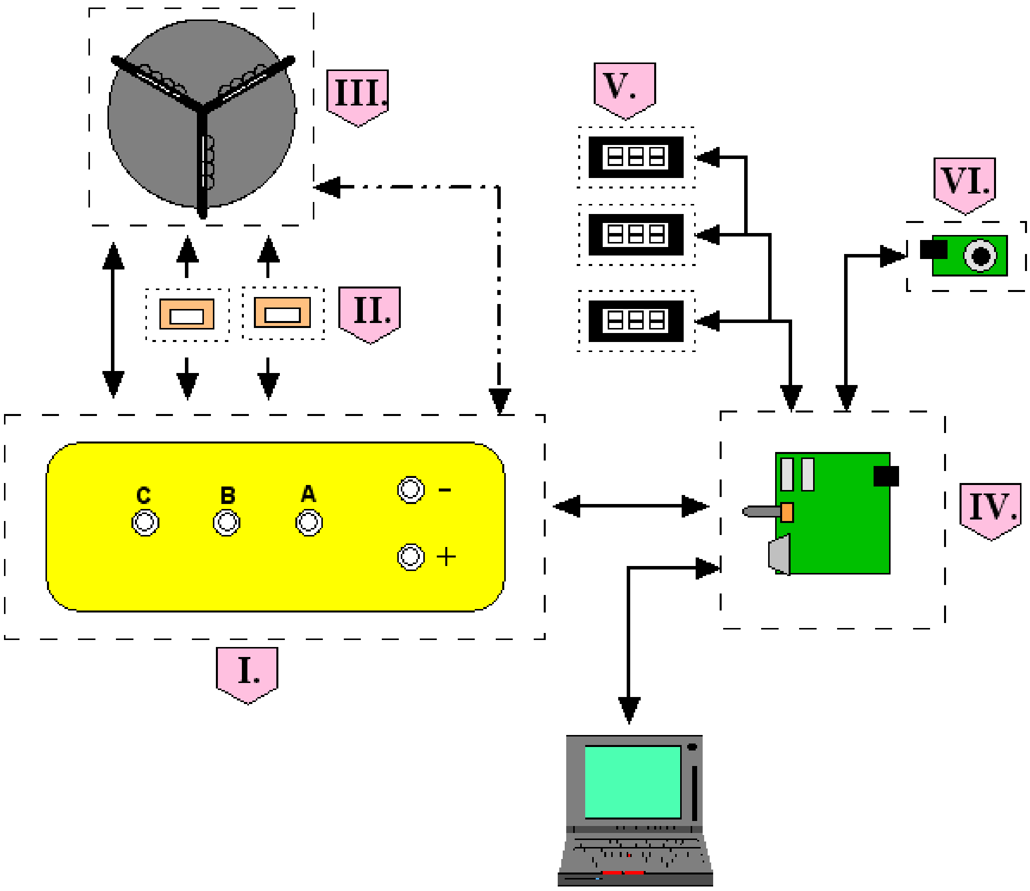
Table of Contents

1. Connection and Operation

A Tritium motor controller system is comprised of a number of components. The description given in this section is for a typical arrangement of the motor drive system and associated peripherals. Graphics shown are meant as an aid for system assembly and are only representative of components that could possibly be used.



I.	Gold Power Controller	IV.	Gold Driver Controls
II.	Hall Effect Sensors	V.	Gold Driver Display
III.	3-Phase Motor	VI.	Digital Encoder

Figure 1. A typical arrangement for a motor controller system

1.1 Gold Power Controller

The Gold Power Controller is the hub of the drive system and the interface between the driver and the motor. It has five high power connection points and a number of low power digital and analog I/O ports that are accessed through various connector sockets.

1.1.1 High Power

Two of the high power connection points, marked with +/- labels are for the voltage bus. The controller and all peripheral products are powered from this power source, unless otherwise stated. Breaking this power supply will disable all driving capabilities of the controller. Residual charge in components will operate the controller for a very brief time, after which the controller will become inert, disabling any functionality of the electronics.

WARNING: The main supply to the controller should never be turned off whilst the controller is still under load ie driving the motor.

The remaining 3 high power connection terminals (labelled A, B & C in Figure 1) are the three phase connections from the motor.
Note: Cable lugs should be firmly attached by nuts in the screw terminals. Users should avoid excessive tightening of these terminals as they can cause physical stresses on internal circuitry that can lead to a reduced product life. All cables and connectors should be rated appropriately and are chosen at the discretion of the user.

1.1.1.1 Protection

Tritium recommends that users should always fuse the connection between the high power source and the motor controller. The fuse should be placed inline and be preferably a DC fuse of the fast-blow variety. Doing so will minimise damage to the controller caused by an external high power fault.

1.1.2 Controller Front Panel

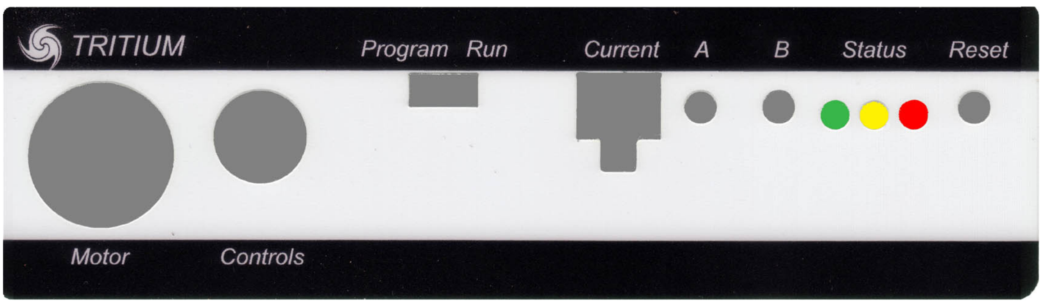


Figure 2. The front panel of the motor controller

Label	Function
Motor	The connection socket for the motor signal cable described in Section 0.
Controls	The connection socket for the RS-485 communications. This cable can come from the Driver Control Board or a PC. Further details are in Section 1.4.
Program / Run	This is a two position switch used when reprogramming the controller DSP. During normal operation, it should be set to the 'Run' position. It should only be set to 'Program' when programming the controller as outlined in Section 3.
Current	This is the 4-way connection socket for the hard-current hall effect sensors (Section 1.3).
A	General Pushbutton A
B	General Pushbutton B
Status	The three status LEDs indicate the following: GREEN – This will be on when there is power to the electronics in the controller. YELLOW – This LED will flash on and off when the controller is receiving valid communications packets. RED – This is a fault indicator and if activated, the controller will not respond to any driving input signals. The controller will only resume normal operation if the Reset button is pressed or the power is cycled. ▪ The LED is off during normal operation. ▪ Constant flashing indicates a hard current limit shutdown ▪ A repeated pattern of two flashes followed by a pause indicates that the controller has shut down due to a bad hall effect signal from the motor ▪ A repeated pattern of three flashes followed by a pause indicates the controller has shut down due to an overvoltage error.
Reset	Pressing this button resets the software in the controller.

1.1.2.1 RS-485 Communications

The connector pinout for the RS-485 communications are shown in Figure 3. This plug is labelled 'Controls' on the controller front panel. This plug connects to either the Driver Controls (Section 1.4) or to a PC to enable configuration changes to the controller (see Section 5).

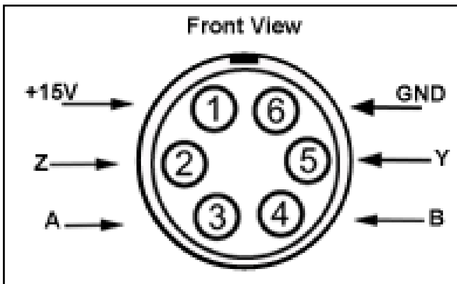


Figure 3. Pinout of the RS-485 communications socket.

1.2 (*III.*) 3-Phase Motor

Apart from the three high power connections mentioned in Section 1.1.1, there are four additional signals between the motor and controller - three hall effects and a temperature sensor. These signals interface with the controller using the plug and configuration shown in Figure 4.

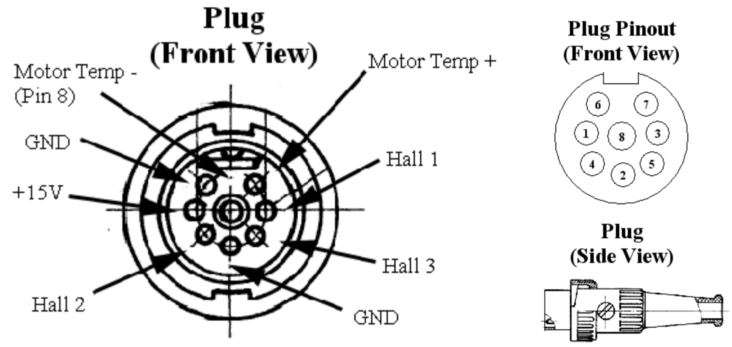


Figure 4. Motor signal plug pin diagram

The mandatory pins to be connected are the +15V, GND and Hall signals. These provide power to the hall effects inside the motor and the outputs are sent via the Hall lines. The MotorTemp pins are optional, as they are intended to be used with a 10kΩ thermistor with a negative temperature coefficient, inside the motor.

1.2.1 Inductors

Depending on the type of motor being driven, phase inductors may be required. If this is the case then they are to be arranged as shown in Figure 5. Each phase lead will be connected to an inductor **before** the lead passes through a hall effect sensor (see Section 1.3) or onto the power controller.

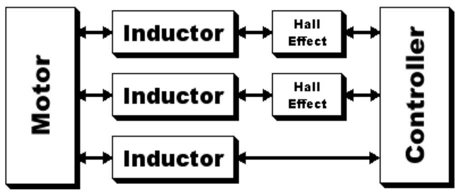


Figure 5. Motor wiring arrangement with inductors.

1.3 (*II.*) Hall Effect Sensors

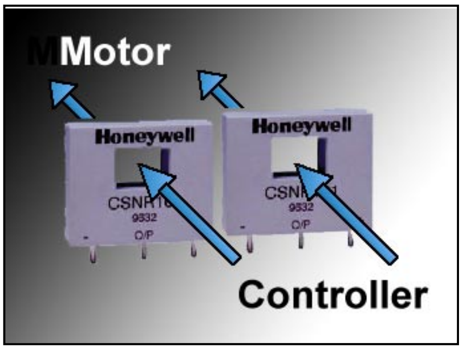


Figure 6. Blue lines indicate direction of phase leads through sensor windows.

The Gold Power Controller uses a dual system for regulating current flowing through the controller to either the motor or power source. The first system controls the current in response to driver requests and adheres to set parameters. This is performed by the onboard hardware. The second system is a failsafe that protects the controller by shutting down the hardware in the event of an exceptional current surge outside of the set limits. This 'hard current' system requires that two high current hall effect sensors each be placed around a phase lead from the controller to the motor. It **does not** matter which phase leads are used (A, B or C) or what orientation the sensors are arranged in.

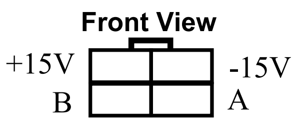


Figure 7. Pinout for the Hall Effect socket.

The hall effect sensors are connected to the controller by means of 4-way micro-fit cables. They are daisy chained, in any order, and then connected to the socket on the controller front panel shown in Section 1.1.2.

1.4 (*IV.*) Gold Driver Control

The Gold Driver Control acts as a junction box for driver interfaces, telemetry and controller commands.
The Gold Power Controller (*I.*) communicates with the Driver Control via a custom RS-485 serial cable, shown in Figure 9. The driver control sends the requested driving conditions to the controller, which in turn sends all telemetry information back to the driver controls. For more information regarding the communications protocol between the driver controls and the motor controller refer to Section 6.

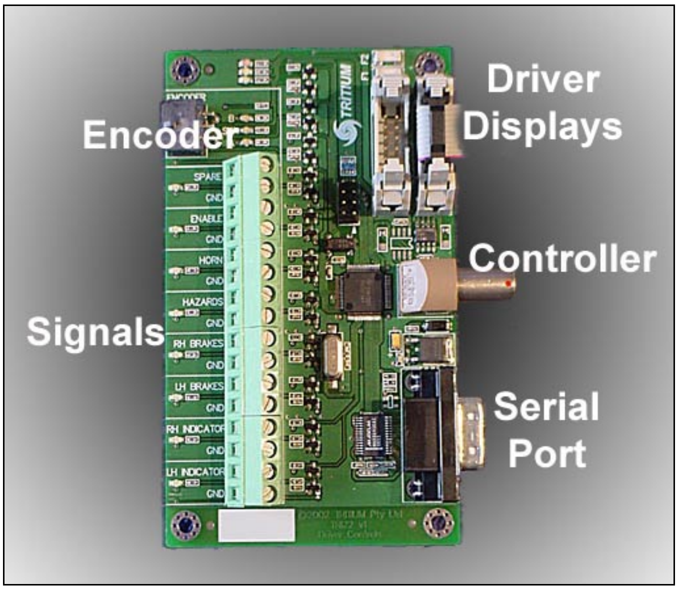


Figure 8. Connector functions of the Gold Driver Display

The standard DB-9 serial connector is an RS-232 output port designed to convey telemetry data to a wireless modem or computer for performance analysis. The baud rate for this port is fixed at 115200bps.

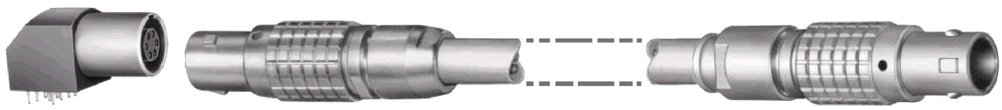
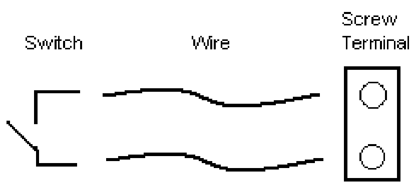


Figure 9. RS-485 Cable plugs and socket.

There is also a 6-way locking connector that goes to the **Digital Encoder** (refer to Section 1.4.2) and two IDC output ports that send selected telemetry data to the **Gold Driver Displays (*V.*)**. Up to six Driver Displays can be 'daisy chained' on each IDC ribbon cable.

1.4.1 Screw Terminals (Signals)

The 16 green screw terminals require some of the input switches to be attached before operation of the motor controller. All of these switches should be normally-open two position. The current and voltage levels used by the control board are small and will not supersede the power ratings of the chosen switches and do not pose an electrical shock hazard to the user.
The terminals are arranged in connection pairs for each function. The inputs are adjacent to each other and will be labelled with the function name on one terminal input and 'GND' on the other. Both of these inputs must be connected to work. Each input pair also has a corresponding LED on the PCB. This LED will turn on when the switch is in the 'on' position.



The following labelled connections must/should be connected before operation:

Label	Required	Function	Description
Enable	Mandatory	Kill Switch	When the kill switch is in the off position, all motor driving functions are disabled regardless of user inputs. When the kill switch is on, then normal operation is resumed.
Spare	Mandatory	Fwd/Rev Switch	The direction switch indicates the direction (forward or reverse) in which to drive the motor.
LH & RH Brake	Strongly Advised	Brakes	Many applications using the Gold Controller will use a dual braking system for the motor – regenerative braking and mechanical braking. A switch that becomes closed when the mechanical braking is used should be connected to either (or both if there is more than one mechanical system) of these inputs. It will 'zero' the controls and place the motor controller into neutral. This prevents the controller from driving the motor against the braking system.

1.4.2 (VI) Encoder Board

The digital encoder used to drive the controller is a combined rotary encoder and pushbutton. It is connected to the Gold Driver Control via a 6-way locking connector cable.

To accelerate in the direction selected by the 'Direction' switch, described in Section 1.4.1, the encoder is turned in the clockwise direction. This increases the encoder value. To reduce the acceleration at any time, the encoder can be turned in the anticlockwise direction. Pressing down on the encoder shaft will push the button, which zeroes the encoder and hence the throttle value.

Once the encoder value has reached zero, by either turning the encoder anticlockwise or pressing the pushbutton, continuing to turn the encoder anticlockwise will activate the regenerative braking system. Similarly to acceleration, turning the encoder anticlockwise from zero will indicate the level of braking desired. The encoder value will be negative during regenerative braking. Turning the encoder clockwise will then reduce (become more positive) the level of braking until the encoder value reaches zero. Again, pressing on the pushbutton will reset the controls to zero and braking will cease.

There is also a red LED on the encoder PCB. The intensity of this LED increases as the magnitude of the encoder value increases.

1.5 (V.) Multifunction LCD Driver Display

The Multifunction Driver Display (Figure 10, top) uses a single pushbutton, labelled 'Select', to cycle through four predetermined telemetry values delivered from the Gold Driver Control. The displays are 8-segment numeric and show up to four digits. They are connected and powered by an IDC ribbon cable.

The motor controller uses PWM control when driving forward and current control in regen. This control behaviour can be observed using the Throttle and Motor Current values. If the user is driving forward, the Throttle display changes as the encoder is turned and Motor Current displays a fixed value. When changing into Regen, the Throttle value becomes fixed and the Motor Current reading will vary.

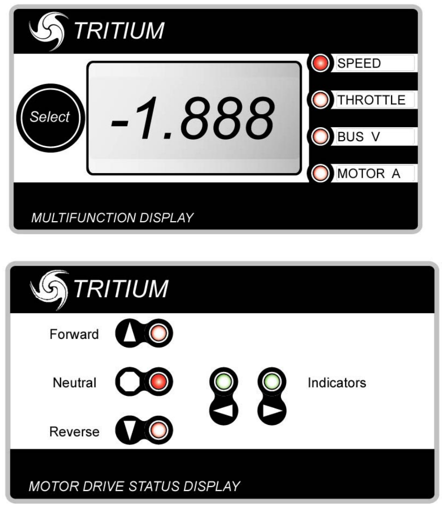


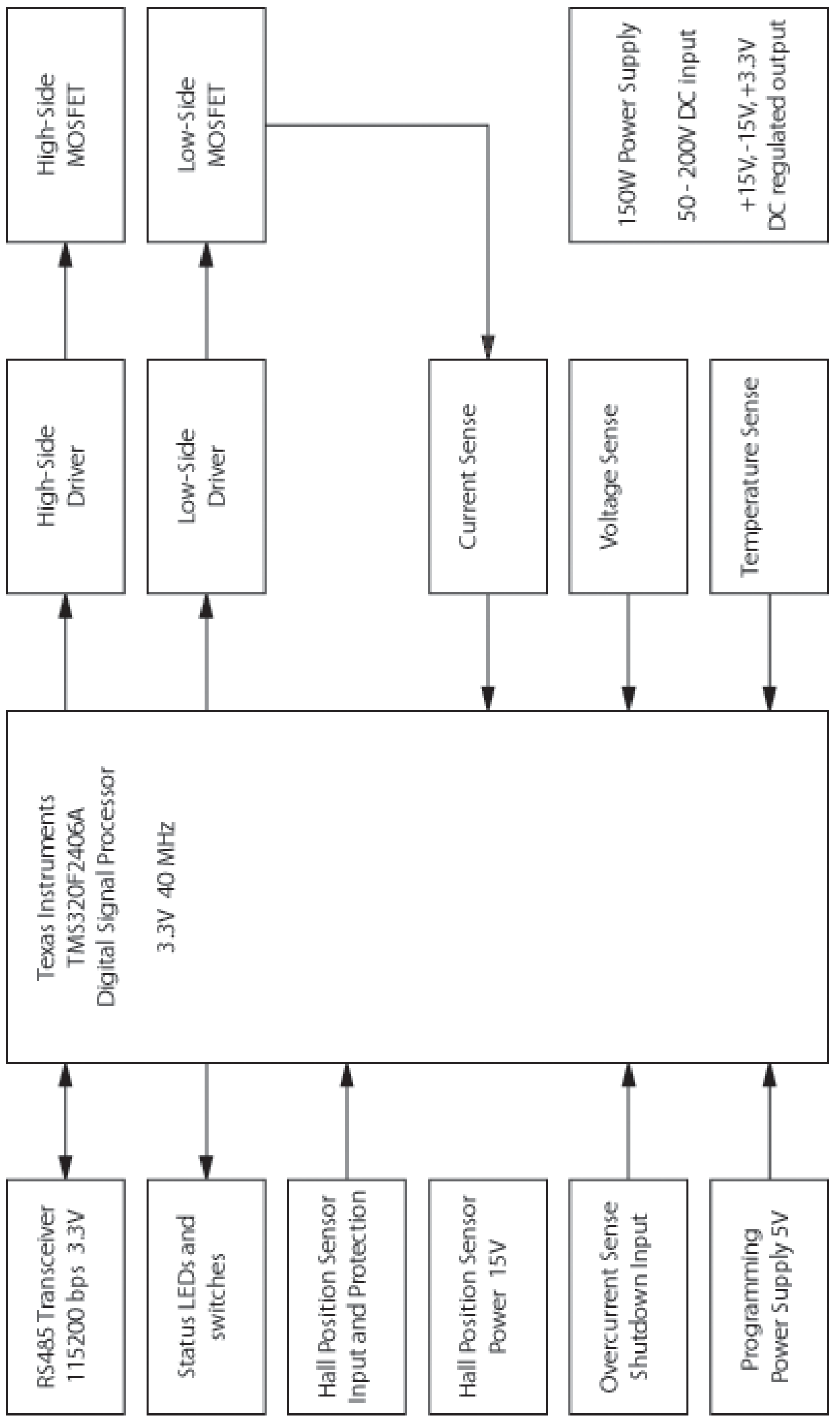
Figure 10. The Multifunction LCD Display (top) and LED Status Display (bottom).

LED Status Display

The LED Driver Display is shown in Figure 10 (bottom). The two indicator lights (left and right) are green. The remaining LEDs – Forward, Neutral and Reverse – can be either red or green when turned on. The following table shows how these three LEDs will be arranged for different driving arrangements.

		LEDs		
	Situation	**Forward**	**Neutral**	**Reverse**
	Kill Switch is Off	Off	RED	Off
	LH or RH Brake Switch is On (braking)	RED	GREEN	RED
Direction Switch is Off (FWD)	-	-	-	-
	Throttle = zero (controller in neutral)	GREEN	GREEN	Off
	Throttle > 0 (driving)	GREEN	Off	Off
	Throttle < 0 (regenerative braking)	Off	Off	RED
Direction Switch is On (REV)				
	Throttle = zero (controller in neutral)	Off	GREEN	GREEN
	Throttle > 0 (driving)	Off	Off	GREEN
	Throttle < 0 (regenerative braking)	RED	Off	Off

2. Hardware Block Diagram



3. Software

3.1 Programming the Controller

The controller uses a Texas Instruments TMSLF2407 DSP running at 40MHz.

I. Connect the RS-485 cable from the controller to a serial port on a PC – you will require an RS-232 to RS-485 adapter board (Tritium can supply these if required).
II. Set the Program/Run switch to the 'Program' position.
III. Reset the controller.
IV. Download the compiled software using relevant tools. Confirm that programming was successful.
V. Return the Program/Run switch to the 'Run' position.
VI. Reset the controller.

3.2 Programming the Driver Controls

The Driver Controls are operated by a Texas Instruments MSP430 controller.

I. Connect a parallel port programmer (Tritium can supply these if required) to the PC.
II. Using an 8-way IDC cable connect the programmer to the 8-pin IDC header on the Driver Controls.
III. Reset the Driver Control board by cycling the power.
IV. Download the compiled software using relevant tools. Confirm that programming was successful.
V. Disconnect the IDC connector from the board.
VI. Reset the Driver Control by cycling the power.

4. Operation Procedures

4.1 Connection and Testing

It is important to verify that the required components of the drive system are all functioning correctly before operating outside of controlled conditions. Our recommended testing procedure is as follows:

1. Connect the Gold Power Controller, Driver Controls, encoder board and Driver Display as outlined in Section 1.
2. Connect the power source to the controller and turn on the system. You should verify that all products have turned on and that the displays appear to be showing the correct values.
3. Turn off the power and connect the motor.
4. Turn on the power and again verify that all units are powered and the displays are operating correctly. Configure the motor using PhasorSense as outlined in Section 4.2.
5. Using the digital encoder, carefully increase the power to the motor until it is spinning at a reasonable speed (approx. 100rpm). Operate the motor for a brief period, verifying that the driver displays are operating correctly. It will be

immediately obvious if there is a connection problem with the motor. Turn the digital encoder back to a zeroed position and allow the motor to coast to a halt.

6. Repeat this test for the motor in reverse.
7. Again, test the motor and peripherals in both directions, but this time use the regenerative braking to halt the motor.
8. Once these systems are operating correctly, connect any further peripherals desired and test them.
9. Test the motor driving and regenerative braking for higher speeds and powers.

4.2 PhasorSense

The PhasorSense feature of the Gold Power Controller is custom software that will detect the phase/hall effect configuration of the motor. After a motor has been connected to the controller, the PhasorSense routine needs to be run only once. The detected configuration is recorded by the motor controller. Turning the power off and on will not erase the configuration.

The PhasorSense routine **must** be operated each time a new motor is connected or the existing motor is reconnected.

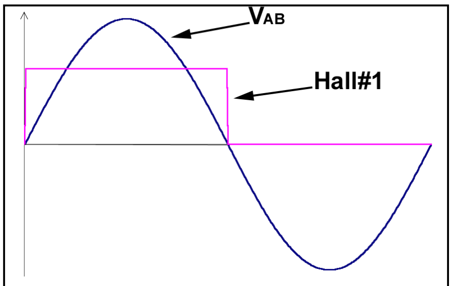


Figure 11. Hall effect output and phase back EMF relationship.

1. Hold down the 'B' button shown in Figure 2.
2. While still pressing the 'B' button, press and release the 'Reset' button. Release the 'B' button.
3. Make note of the configuration of the LEDs on the controller.
4. *Manually* spin the motor to a reasonable speed and wait for the LED pattern to change.
5. Your phase configuration has now been recorded – you may operate the controller as normal.

5. Motor Controller Interface Program

The Motor Controller Interface (MCI) program is a Windows™ based program intended for bench testing the drive system and for changing parameter settings of the controller.

To begin the program run the `MCIprog.exe` file. A window will appear asking you which comm port the computer is connected to the motor controller with. Select the appropriate port and then click OK. The program will only begin if the Gold Power Controller is turned on and the communications are operating correctly.

WARNING: It is recommended that you close all other Windows™ programs before running the interface program. Failure to do so can cause communications errors.

5.1 System Control

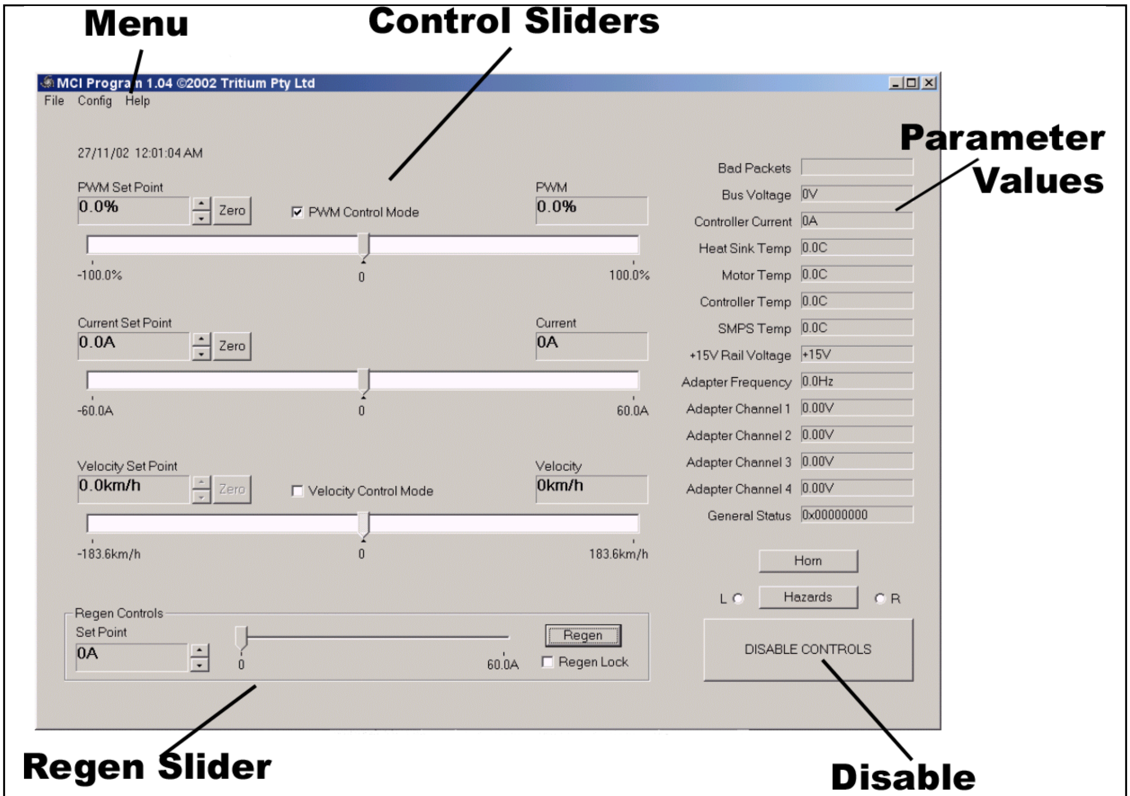


Figure 12. MCI Prog Main Window

The program window in Figure 12 can be used to control the motor and to view all available data. Each parameter value is displayed down the right hand side of the window and is updated automatically. Further explanations of these parameters are given in Section 5.3. There is a large button labelled 'DISABLE CONTROLS' that turns the on-screen controls on and off to prevent accidental driving of the motor. There are three control sliders that can be used to set the PWM, current or velocity to drive the motor at. One of these sliders is shown in Figure 14. The program uses either a PWM control method or a velocity control method, which is selected by checking the box above the appropriate slider. When in either of these modes, the controller will attempt to reach the desired PWM or velocity level whilst keeping within the limits set by the Current Set Point slider.

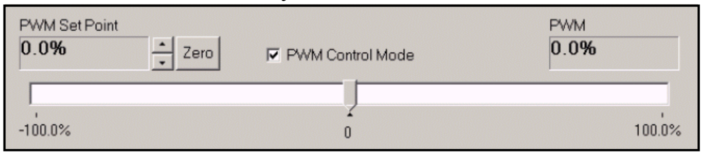


Figure 14. PWM Control Slider

Figure 13. Regen control slider

Each control slider operates in the same manner. The slider is initially at the zero point on the bar. If it is moved to the right, then the set point is changed in the forward direction, whilst moving it to the left changes the set point in the reverse direction. The level set by the slider is reflected in the window on the top left of the slider. For finer control over the set point value, buttons that increment or decrement the value in single steps are placed to the right of the set point window. Pressing the ‘Zero’ button instantly resets the slider back to the zero point on the bar. The window to the top right of the bar shows the actual level that the controller is at.
There is a fourth slider (Figure 13) that is used to control the current level for regenerative braking. When driving the motor, the ‘Regen’ button can be pressed at any time to begin braking regeneratively. This also zeroes any of the drive signals. Regen will only operate whilst the button is depressed. Releasing the button will leave the motor free to coast. Clicking on the ‘Regen Lock’ checkbox will put the controller into regen mode permanently until the box is unchecked. Similar to the other sliders, there is also a display window with up/down buttons that change the set point in single step increments/decrements.

5.2 Configuration

There are many parameters that can be modified within the controller to configure its operation for a specific motor or situation. To download the current configuration from the motor controller, select Config – Download Config from MC from the menu as shown in Figure 15. To edit this configuration select Config – Edit Config from the window menu and the Config Edit window will open as shown in Figure 16. Once you have edited the configuration, hit the ‘Record and Close’ button to close the Config Edit window and return to the main program window. In the Config menu select Upload Config to MC. Once this has completed successfully, your changes will have been *permanently* recorded in the controller.

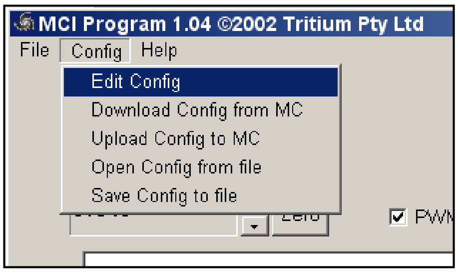


Figure 15. The Config menu in the program main window.

The Open Config from file and Save Config to file options allow you to save and load custom configurations without having to retype parameter values every time the controller configuration is changed.

WARNING Changing settings incorrectly may damage the power controller and associated parts.

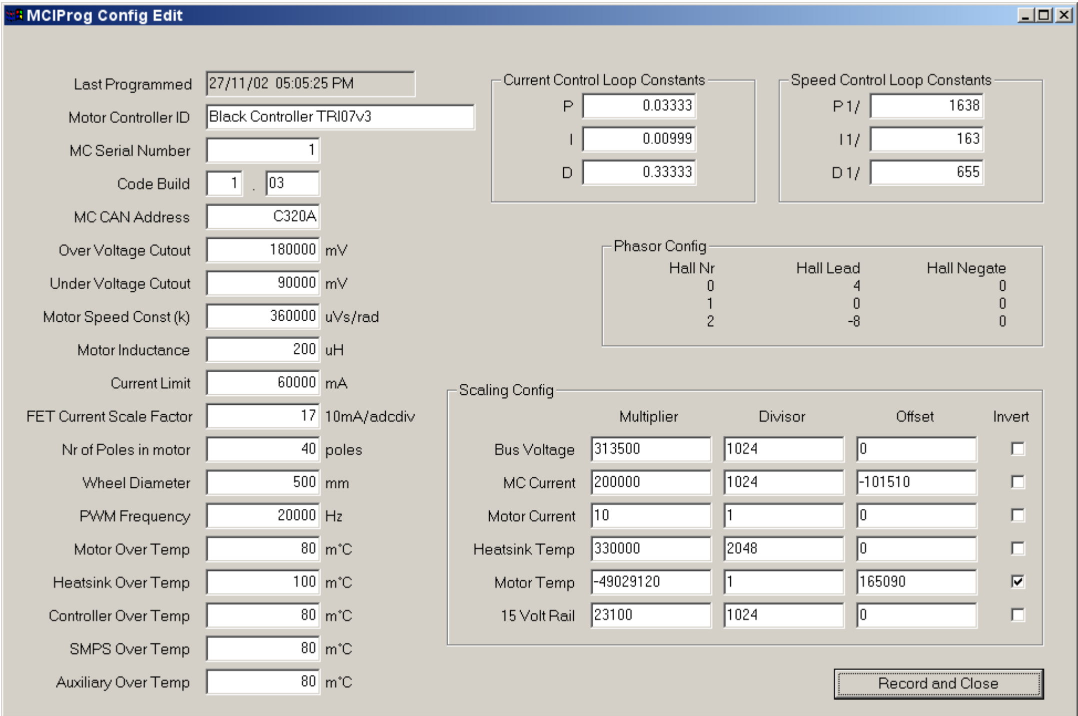


Figure 16. The Config Edit window allows users to modify parameters within the controller

Table 1. Parameters of the Config Edit window

Config Edit Parameters		
Parameter	**Description**	**Dependent Values**
Last Programmed	Date and time stamp of the last time the controller was programmed.	
MC Serial Number	Unique serial number identifying the motor controller.	
Code Build	Version and Revision of the software program.	
MC CAN Address	Can be set to the desired CAN address to identify the controller on a CAN Bus network.	
Over Voltage Cutout	When the input voltage is at this value or higher, all controller functions will be disabled and a system reset is required to continue operation. This SHOULD NOT be set above the maximum bus voltage stated in Section 1.	
Under Voltage Cutout	When the input voltage is at this value or lower, all controller functions will be disabled and a system reset is required to continue operation. This SHOULD NOT be	

	set below the minimum bus voltage given in Section 1.	
Motor Speed Const (k)	The speed constant of the motor being driven by the controller.	
Motor Inductance	The inductance of the motor as seen by the controller. This value should include any external inductors connected to the motor.	
Current Limit	The maximum current supplied by the *controller* to the *motor*. (This is **not** the same as the current supplied to the controller by the power source.)	
FET Current Scale Factor	NOT ADJUSTABLE Constant set by MOSFET hardware characteristics.	
Nr of Poles in motor	The number of magnetic poles in the motor.	
Wheel Diameter	Effective diameter of the wheel, including the tyre, for a wheel motor. This value should be scaled according to any gearing systems used if the motor is not a wheel motor.	
PWM Frequency	NOT ADJUSTABLE The frequency that the MOSFETs are switched at in the controller..	
Motor Over Temp	When the motor temperature reaches this value or higher, the controller will no longer drive the motor. Users should experience a gradual performance drop as the temperature approaches this value.	
Heatsink Over Temp	When the heatsink temperature measured by the controller reaches this value or higher, the controller will no longer drive the motor. Users should experience a gradual performance drop as the temperature approaches this value.	
Controller Over Temp	When the ambient temperature within the controller casing reaches this value or higher, the controller will no longer drive the motor. Users should experience a gradual performance drop as the temperature approaches this value.	
SMPS Over Temp	When the temperature of the internal switched-mode power supply reaches this value or higher, the controller	

	will no longer drive the motor. Users should experience a gradual performance drop as the temperature approaches this value.	
Auxiliary Over Temp	When the temperature of an auxiliary board within the controller reaches this value or higher, the controller will no longer drive the motor. Users should experience a gradual performance drop as the temperature approaches this value.	

Table 2. Parameters of the Speed Control Loop dialog

Speed Control Loop Constants		
Parameter	**Description**	**Dependent Values**
P 1/	The denominator of the proportional scaling term used in the speed control loop of the controller.	
I 1/	The denominator of the integral scaling term used in the speed control loop of the controller.	
D 1/	The denominator of the differential scaling term used in the speed control loop of the controller.	

Table 3. Description of motor hall effect parameters.

Phasor Config		
Note: The table in this dialog consists of three rows of data. The top row is for the case that the EMF produced in phase path A-B is positive. The second row is for phase path B-C and the bottom row is for phase path C-A.		
Parameter	**Description**	**Dependent Values**
Hall Nr	Hall numbers [0, 1, 2] correspond to Hall pins [1, 2, 3] on the motor connection outlined in Section 0. Their row position in the table corresponds to which of the hall effect lines from the motor is active when phase A-B, B-C and C-A are active. For example, if the number 2 was in the top row, then Hall Effect 2 from the motor will be active when the EMF of phase path A-B is positive.	
Hall Lead	The number of *electrical* degrees that a hall effect signal will lead (or lag if negative) the phase voltages.	
Hall Negate	If a hall effect sensor is placed too far out of alignment with a phase winding in the motor, then the hall effect value may need to be negated to obtain the best performance.	

Table 4. Scaling parameters

Scaling Config		
Parameter	**Description**	**Dependent Values**
Multiplier	The number that the corresponding parameter is multiplied by when scaled.	
Divisor	The number that the corresponding parameter is divided by when scaled.	
Offset	The number that is added after the parameter has been scaled using the multiplier and divisor.	
Invert	If checked, then the parameter value will be inverted *before* it is scaled by the multiplier, divisor or offset.	
Formula:	$((((\pm[parameter]) \times [multiplier]) \div [divisor]) + [offset])$	
Bus Voltage	The voltage at the input terminals to the controller.	
MC Current	The current supplied from the power source to the controller (negative if in regen ie current flows from the controller back into the power source).	
Motor Current	The current that the controller is supplying to the motor. This is negative if the motor is in regen.	
Heatsink Temp	The temperature of the heatsink casing of the controller.	
Motor Temp	The internal temperature of the motor.	
15 Volt Rail	The voltage level of the controller's internal 15V supply rail.	

5.3 Parameter Values

Parameter	Description	Formula
Bad Packets	This is a red progress bar that will increase each time a communications packet was not transmitted or received correctly between the PC and the controller. It will decrease with each correctly transmitted packet.	
Bus Voltage	The voltage at the power input terminals to the controller.	
Controller Current	The current supplied by the power source to the controller.	
Heatsink	The temperature of the heatsink casing of the controller.	

Temp		
Motor Temp	The internal temperature of the motor.	
Controller Temp	The internal ambient temperature of the controller case.	
SMPS Temp	The temperature if the internal switched mode power supply of the controller.	
+15V Rail Voltage	The voltage level of the controller's internal 15V supply rail.	
Adapter Frequency	Not Used	
Adapter Channel 1	Not Used	
Adapter Channel 2	Not Used	
Adapter Channel 3	Not Used	
Adapter Channel 4	Not Used	
General Status	The general status bits from the communications packet, displayed as a hexadecimal number. For descriptions of what each bit represents, refer to the communications specification in Section 6.	

6. Controller Communications Protocol

Comms specs for TRI07v4/TRI22v1/TRI23v1, as of 3/3/2003.
David Finn, James Kennedy.

All packets are to be sent most significant byte first (**MSB first**).

Operation mode

In operation mode there are 4 types of packets, they are as follows:

The driver controls are the master for the network. At a frequency of between 4 and 10 Hz the driver controls must issue a driver controls info packet. Faster then 10Hz can casue the controller to become over run and not all the packets will be received, this does not worry the controller but will become confusing to the driver controls, as it will not always get a response to every packet it sends. Slower then 4Hz will casue the controller to time out, when this happens the controller zeros the power to the motor until it gets the next good packet.

Data	Data type	Unit step	Comment
TRITIUM	char[7]		Start of packet header
Packet type	char		1 = driver controls set points
Packet type -ve	char		-1
Packet length	unsigned short	bytes	Does not include the header
16 bit check sum	unsigned short		Does not include the header
16 bit XOR	unsigned short		Does not include the header
Set Point PWM%	long	0.1%	Send speed 0 if sending %
Set Point motor current	long	mA	Always send current
Set Point Velocity	long	mm/sec	Send 0% if sending speed
Auxillary Command	unsigned long	Code commands to do simple tasks. 0x00000001 = Horn 0x00000002 = Brake 0x00000004 = Right Indicator 0x00000008 = Left Indicator 0x00000010 = Stop Mode	

Data	Data type	Unit step	Comment
TRITIUM	Char[7]		Start of packet header
Packet type	char		2 = motor controller info
Packet type -ve	char		-2
Packet length	unsigned short	bytes	Does not include the header
16 bit check sum	unsigned short		Does not include the header
16 bit XOR	unsigned short		Does not include the header
Adj Set Point PWM%	long	0.1%	
Adj Set Point motor current	long	mA	
Adj Set Point Velocity	long	mm/sec	
Adj Auxillary Command	unsigned long	Code commands to do simple tasks. 0x00000001 = Horn 0x00000002 = Brake 0x00000004 = Right Indicator 0x00000008 = Left Indicator 0x00000010 = Stop Mode	
Actual PWM%	long	0.1%	
Actual motor current	long	mA	
Actual Velocity	long	mm/sec	
Bus Voltage	long	mV	
Controller current	long	mA	

Heat Sink Temp	long	m°C	
Motor Temp	long	m°C	
Controller Temp	long	m°C	
SMPS Temp	long	m°C	
+15V	long	mV	
Adapter PCB Freq	long	Hz	
Adapter PCB Analog Channel 1	long	mV	
Adapter PCB Analog Channel 2	long	mV	
Adapter PCB Analog Channel 3	long	mV	
Adapter PCB Analog Channel 4	long	mV	
General Status	unsigned long	Coded reason for ignoring a driver control command. 0x00000001 = Invalid Quadrant requested 0x00000002 = Overvoltage 0x00000004 = Heat Sink over temp 0x00000008 = Motor over temp 0x00000010 = +15V rail down 0x00000020 = SMPS over temp 0x00000040 = Controller over temp	

Configuration Mode

In configuration mode there are two types of packets, there are as follows:

Data	Data type	Unit step	Comment
TRITIUM	char[7]		Start of packet header
Packet type	char		5 = request current config info
Packet type -ve	char		-5
Packet length	unsigned short	bytes	Does not include the header
16 bit check sum	unsigned short		Does not include the header
16 bit XOR	unsigned short		Does not include the header

Data	Data type	Unit step	Comment
TRITIUM	char[7]		Start of packet header
Packet type	char		if sent from controller in response to packet type 5 : 6 = current config info if sent to controller : 7 = set config info to
Packet type -ve	char		-6 / -7
Packet length	unsigned short	bytes	Does not include the header
16 bit check sum	unsigned short		Does not include the header
16 bit XOR	unsigned short		Does not include the header
Controller text ID	char[32]		Eg “GOLD CONTROLLER TRI07V4”
Controller serial number	unsigned long		000031
code build number major minor	 unsigned char unsigned char		 1 01 1.01
file programmed	long	secs	secs since 1970 Jan 1
Phasorsense config Vab Hall Nr Vab Hall Negate Vab Hall Lead	 unsigned char unsigned char char	 0 or 1 degrees	
Phasorsense config	unsigned		

Vbc Hall Nr Vbc Hall Negate Vbc Hall Lead	char unsigned char char	0 or 1 degrees	
Phasorsense config Vca Hall Nr Vca Hall Negate Vca Hall Lead	unsigned char unsigned char char	0 or 1 degrees	
Hall Fwd Seq	An array of 8 unsigned shorts	the hall number	0x01, 0x03, 0x02, 0x06, 0x04, 0x05, 0x00, 0x00
FET current senseing scale	unsigned short		((ADCdivVolt/(OpAmpGain*FETRes))/10) = 17 FETRes = 4mΩ OpAmpGain = 2.13V/V ADCdivVolt = 3223uV/adcdiv
Current Loop Proportional constant	unsigned short		0.025*65536 ~ 1638 P term is 0.025
Current Loop Intergral term, minimum error before change	unsigned short	1/100A	200
Current Loop Intergral term, maximum didt I term is allowed to cause	unsigned short	1/100A	300
Speed Loop P Constant	unsigned short		40
Speed Loop I Constant	unsigned short		400
Speed Loop D	unsigned short		600
over voltage point	long	mV	180000
empty voltage point	long	mV	90000
motor speed constant (k)	long	uVs/rad	360000
motor & external inductance	long	uH	200
current limit	long	mA	5000
poles of the motor	long		40
wheel diameter	long	mm	500
PWM Freq	long	Hz	20000
Motor overtemp	long	m°C	80
HeatSink overtemp	long	m°C	100
Controller overtemp	long	m°C	80
SMPS overtemp	long	m°C	80
Auxiliary overtemp	long	m°C	80
Bus Voltage multiplier	long		313500
Bus Voltage divisor	long		1024
Bus Voltage offset	long		0
Bus Voltage invert	unsigned char		0
Controller current multiplier	long		200000
Controller current divisor	long		1024
Controller current offset	long		-101510
Controller current invert	unsigned char		0

Motor current multiplier	long		10
Motor current divisor	long		1
Motor current offset	long		0
Motor current invert	unsigned char		0
Heat Sink Temp multiplier	long		330000
Heat Sink Temp divisor	long		2048
Heat Sink Temp offset	long		0
Heat Sink Temp invert	unsigned char		0
Motor Temp multiplier	long		-49029120
Motor Temp divisor	long		1
Motor Temp offset	long		165090
Motor Temp invert	unsigned char		1
+15 multiplier	long		23100
+15 divisor	long		1024
+15 offset	long		0
+15 invert	unsigned char		0
Can Address	unsigned long		

Data	Data type	Unit step	Comment
TRITIUM	char[7]		Start of packet header
Packet type	char		8 = set config info response
Packet type -ve	char		-8
Packet length	unsigned short	bytes	Does not include the header
16 bit check sum	unsigned short		Does not include the header
16 bit XOR	unsigned short		Does not include the header

NOTICE