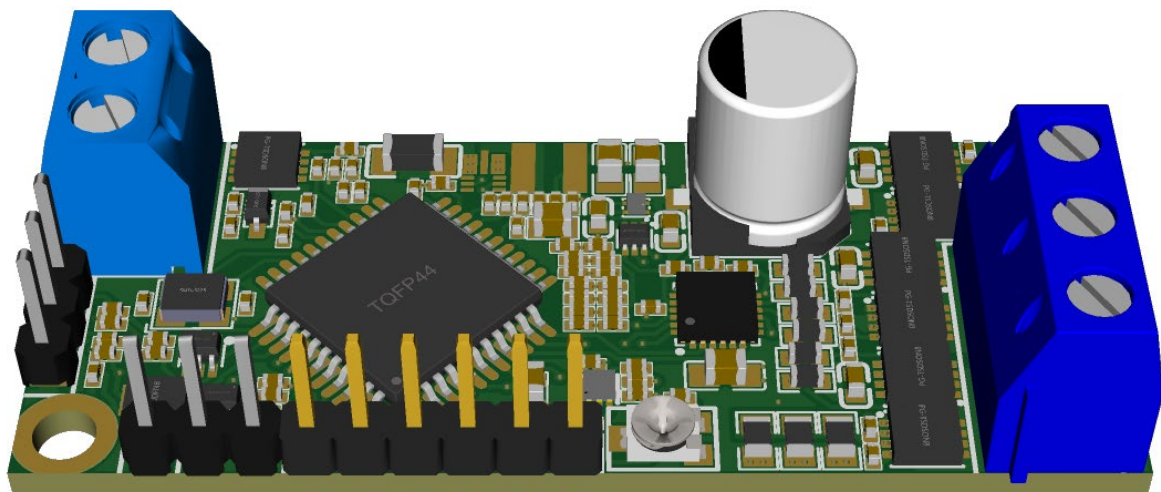




EQI UARTUser Manual

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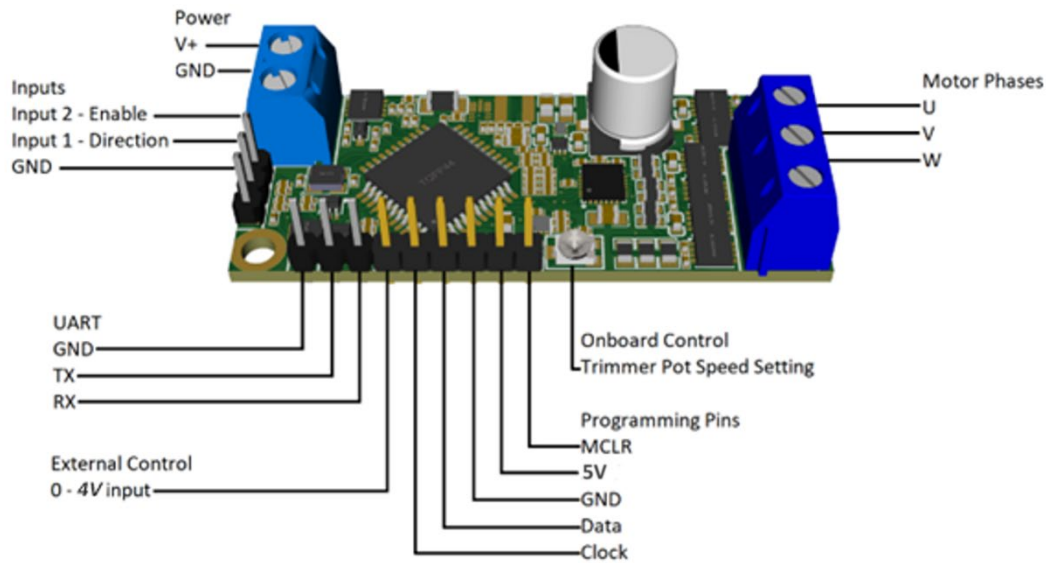
Overview

User Manual for the new EQI UART controller by TCS.

Specifications

Max Power	300	<i>WATTAGE</i>
Rated Power	150	<i>WATTAGE</i>
Max Voltage	28	<i>VOLTAGE</i>
Running Current	6	<i>AMPS</i>
Max Current	15	<i>AMPS</i>

Connections



Power Supply Connections

Power Supply between 5-28Vdc. The controller is protected against reverse polarity; however, care should be taken to ensure the polarity is correct before Powering the controller.

Motor Connections

Motor connections are not critical, if any two phases are changed the motor direction will change!

Analogue Input

IMPORTANT: If you wish to use an external signal or 10K Potentiometer, please ensure that you set the on-board POT to '0'. If you fail to do this, the controller will still be operating off the on-board POT value.

Connect the external analogue input between the "GND" and the "0-4V" connections. The analogue input runs through an RC low pass filter. This provided discrete filtering of the analogue signal to ensure the signal is not affected by noise, as well as introducing a hardware slew rate of the input signal. **The MAXIMUM Voltage is 5V, DO NOT EXCEED!** You can control speed from 0-4v but will gain NO more performance after 4v!

NOTE: An external 10K POT or [TCS-650](#) can be used, simply connect analogue (BROWN) wire to 0-4v pin, Ground wire to 'GND' pin on board and then Positive (RED) to '5V' pin.

PWM Signal Control

Simply turn the onboard POT fully off (anti-clockwise) and connect your PWM source to the analogue pin on the 9-pin header side and have a common ground (GND) between the EQI-UART and PWM source and it should work. **Note: Do NOT exceed 5V input on that analogue pin as it can cause damage to the board.**

The controller will work from 1KHz to 25KHz with no issue.

Onboard Pot

Allows you to controller the speed of the pump from off position to 100% duty (SPEED PRESET BY TCS).

The analogue input runs through an RC low pass filter. This provided discrete filtering of the analogue signal to ensure the signal is not affected by noise, as well as introducing a hardware slew rate of the input signal.

UART Connections

3V3 MAX voltage on either the RX or TX pins. The UART connections can be connected directly to a PC Serial Port using an FTDI cable “**TCS-651**”.

Note: Ensure the RX and TX lines are crossed over to enable correct communication. E.g. - TX from PC goes to RX of the controller, and RX from PC goes to TX of the controller. Also, ensure a common GND between the devices.

WIRES:

- **BLACK** – GND
- **ORANGE**– Rx
- **YELLOW** – Tx

OR

- **BLACK** – GND
- **WHITE**– Rx
- **GREEN** – Tx

UART Control

The UART is used to set up all the required user-settable parameters.

Please note that all parameters will be stored in EEPROM, this means that they are non-volatile, and the controller will remember these settings even after losing power!

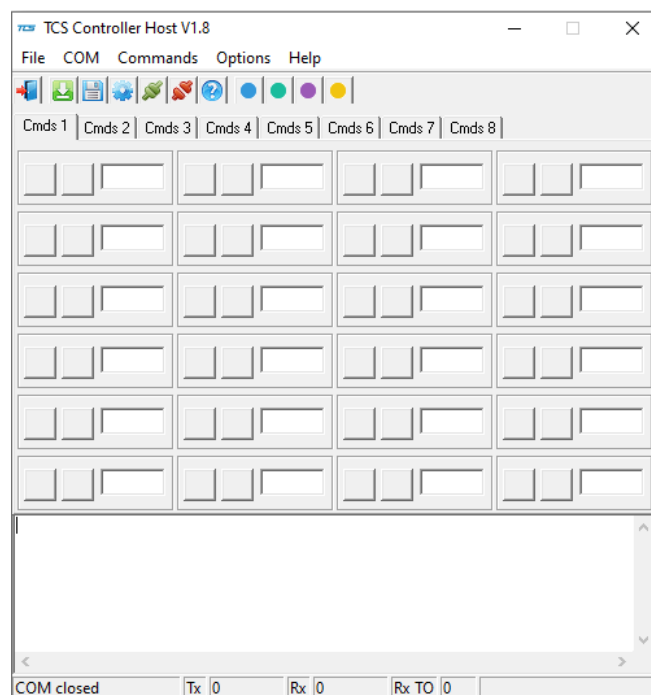
TCS will provide an “.ini” file (also known as a ‘configuration file’) that can be uploaded into TCSHost software that can be used to modify settings and parameters to suit the required application. These “.ini” files can be modified and saved for each of the application requirements using TCS Host.

Using the UART

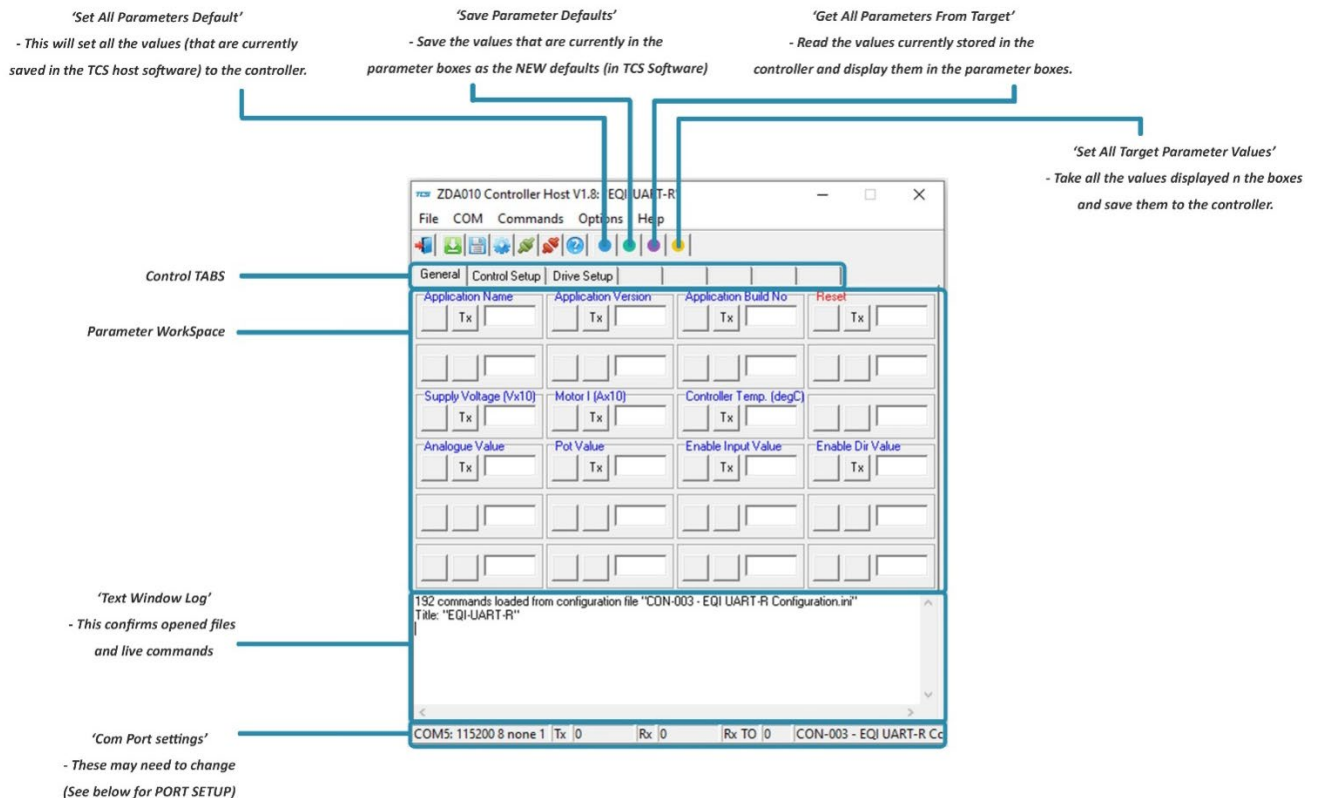
The UART communication can be done from any serial terminal program or microcontroller. If bespoke software, a microcontroller, or PLC with RS232 or RS485 communications are required. *Please contact TCS for more information.*

Using ‘TCS Controller host’ Software

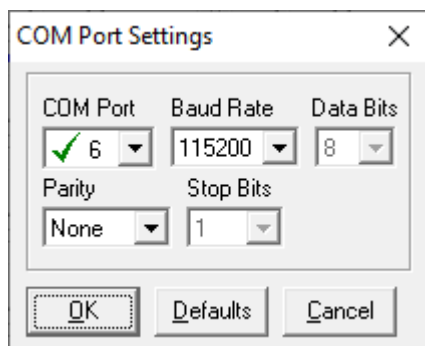
The Software can be found on our website that you’ll need to download. Depending on your security settings you may be asked to verify that the “.exe” file has come from a verified source. You will need to approve this with your security system.



When first opened the software, it will be blank, you will need to open the initial “.ini” with the settings of the required motor/pump/application created by TCS. To do this, Click File > Load Config and then locate the file location where the “.ini” file was saved. ***E.g. – ‘CON-001 – EQI UART-R Configuration.ini’.***



Port Setup



The first time the .ini file is loaded, it will attempt to open the Com Port number LAST saved in the .ini file!

COM Port- This will change depending on the USB slot used on your PC. Please see the 'device manager' on the PC to determine the correct port to be used.

To change the Com Port settings, click 'COM' tab> Settings or click the  Icon.

Baud Rate – The baud rate is fixed at **115200 bits/sec**, the UART will not work if the baud rate is mismatched.

Parity – ensure **No Parity is used!**

Stop Bits – **one stop bit is used!**

General TAB

This tab is used to read some general information within the controller. To receive data, click the “Tx” button.

Application Name

Provides information on the Hardware and version.

Application Version

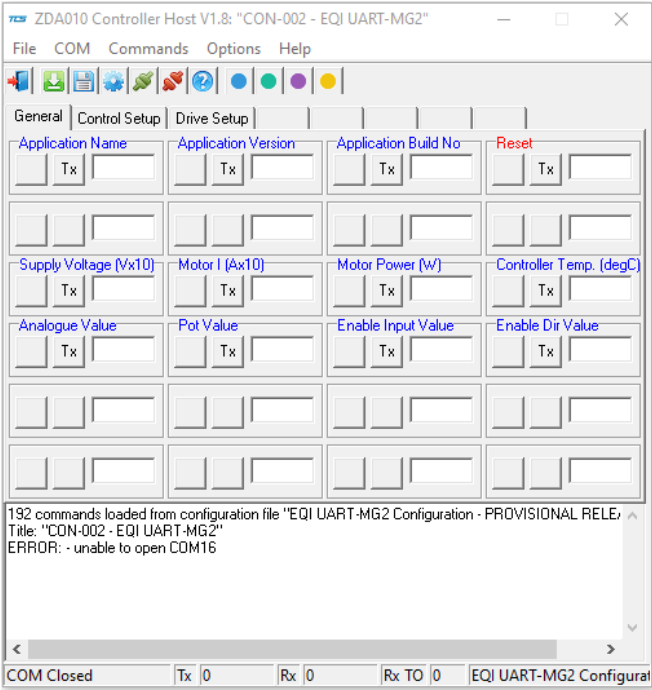
Provides information on the Firmware. 101 indicates Version 1.01.

Build Number

Firmware Build Number. Provides information of the Firmware Build. 100 indicates V1.00.

Reset

Resets the microcontroller when pressed.



Supply Voltage (Vx10)

Reads the Voltage of the supply x 10. So, a value of 125 gives 12.5V.

Motor I (Ax10)

Reads the Motor Current x 10. So, a value of 42 gives 4.2A.

Controller Temp (degC)

Reads the controller Temperature in degrees C. So, a value of 38 gives 38degC.

Analogue Value

Reads the Raw analogue value of the Analogue input. Range between 0-4095.

Enable Input Value

Reads the Enable input (Note – May be inverted from physical input depending on “Invert Settings” Value)

Direction Input Value

Reads Direction input (Note – May be inverted from physical input depending on “Invert Settings” Value)

Pot Value

Reads the Raw Potentiometer value of the onboard Pot Range between 0-4095.

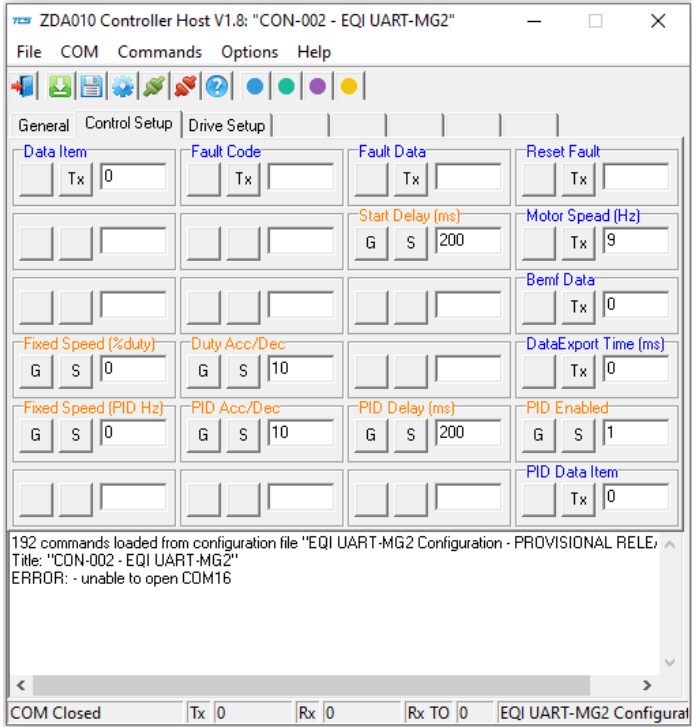
Motor Power (W)

Reads the wattage the board/motor is drawing.

Control Setup TAB

These are the parameters used to setup various applications.

For Parameters (variables that are stored in non-volatile EEPROM Memory) each Box has a “G” and an “S” button. The “G” button is for GET parameter from the controller, where the “S” is the SET parameter in the controller.

Data Item Reads various variables within the Drive Module.		Invert Settings Changes Polarity of the Inputs (NOT AVAILABLE FOR CUSTOMERS)	
Fault Code Reads the Drive Fault Code if something has gone wrong.		Start Delay Delays the time between powering up and motor starting (if Enable input is true)	
Fault Data Reads the data of the fault.		Analogue Scaler Scales the Analogue input and the Pot input. (NOT AVAILABLE FOR CUSTOMERS)	
Reset Fault Resets the fault code.		Duty Acc/Dec Acceleration and Deceleration rates when no PID is used.	
Fixed Speed (% Duty) Sets the PWM duty cycle when no PID is used.		PID Enable 1 = PID is switched ON, 0 PID is switched OFF. (NOT AVAILABLE FOR CUSTOMERS)	
Fixed Speed (PID Hz) Sets the Target Frequency when the PID is used. Have to set 'fixed speed %duty' parameter to 100% to activate this!!	PID Acc/Dec Acceleration and Deceleration rates when the PID is used.	PID Delay (ms) Sets the time delay between motor starting and the PID switching on.	PID Data Item Returns variables within the PID Module.
Motor Speed (Hz) Reads the motor speed. To get RPM value, simply times (x) Hz by 60. e.g. – 174hz x 60 = 10440RPM	Bemf Data Starts BEMF recording (Not used, can be deleted).	Data Export Time (ms) Sets the timing between data points when exporting. 0 = No export Data.	

DriveSetup TAB

These are the parameters used for setting up various pumps.

Data Item

Reads various variables within the Drive Protect Module.

Fault Code

Reads the Drive Protect Fault Code if something has gone wrong.

Fault Data

Reads the data of the fault.

Reset Fault

Resets the fault code.

Min Duty Cycle (%)

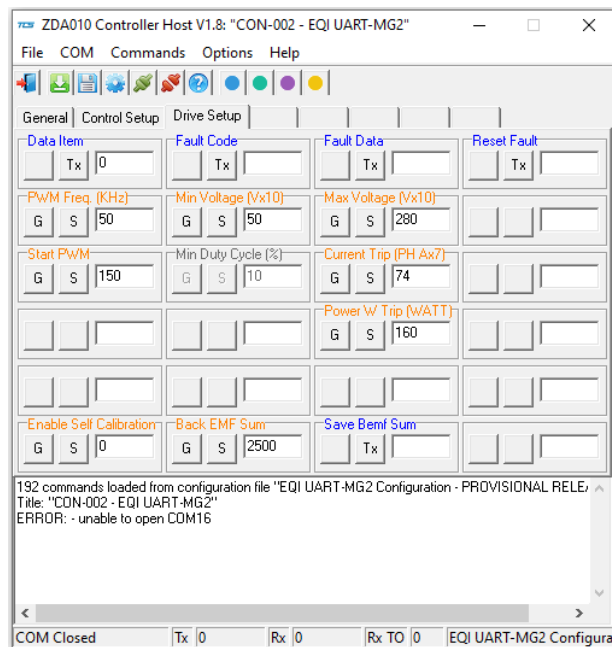
Deceleration End Duty Cycle.

Min Frequency (Hz)

Deceleration End Frequency on PID.

Back EMF Sum

This is the Self calibration value.



PWM Frequency (Khz)

Sets the PWM Frequency to the motor. (NOT AVAILABLE FOR CUSTOMERS)

Min Voltage (Vx10)

Minimum supply voltage x 10 before the controller stops motor and generates fault code. I.e. 50 = 5.0V.

Max Voltage (Vx10)

Maximum supply voltage x 10 before the controller stops motor and generates fault code. E.g. - 165 = 16.5V.

Start PWM

PWM Duty Cycle used to Start the motor.

Max Trip Current (PHx7)

Individual phase amp value x 7

Max Trip Power

Read 'Motor Power' parameter on 'general' tab and then use that value to decide where to limit power. Enter value and press set.

Save BEMF Sum

Click this button to save the current BEMF value to be used on Power up.

Changing Application profiles

If changing the controller from one pump to another, you will first need to load in the .ini file for that motor, then click the “Set All target Parameter Values” button . The controller will then need to be reset so either Power the supply off then on again, or click the “Reset” button in the “General” TAB.

If you change any parameters want to save the ‘ini’ file so these default next time when opening the file, simply press input desired parameter values you want and then press **GREEN** then **BLUE** and go to ‘file’ and ‘Save Config’.

Setting Details

Control Setup Data Items

These variables can be read for greater detail. The number typed into the box selects which data Item is to be read. Example, a value of 3 will return the variable for the Speed Demand.

Data Item Number	Details
0	State – what state the module is in (i.e., stopped, running, waiting for command etc..)
1	Fault Code
2	Fault Data
3	Speed Demand
4	Enable Input
5	Direction Input
6	Analogue Value
7	Pot Value
8	Speed Demand Slewed
9	Motor Speed
10	Supply Voltage
11	Controller Temperature

Fault Codes& Fault Data

Fault Code	Cause	Fault Data Reading
0	No Fault	NA
1	Max Motor Current	101 = 10.1A last Reading
2	Max Power	301 = 301W last reading
3	Min Supply Voltage	49 = 4.9V
4	Max Supply Voltage	251 = 25.1V
5	Controller Temperature	101 = 101 degC
6	Motor Failed Start	5 = five failed attempts to start motor
7	Motor Stalled	100 = 100ms between seeing valid Commutation Point

Invert Settings

Invert Settings Value	Description
0	Both Enable and direction inputs are NOT inverted
1	Only Enable input is Inverted
2	Only Direction input is Inverted
3	Both the Enable and the Direction Inputs are inverted(DEFAULT)

Input Settings

On-board POT	This will be set as default to run from 0% to 100% duty.
Using an external analogue signal (0-4v) or External 10K POT	Plug in your desired analogue signal and set the on-board POT to '0', the controller will then detect the next available signal input and run according to that.

Bemf Sum

This value is set to 2500 as default and will run with this value every time the controller is powered up unless the "Save Bemf Sum" Tx button is pressed. Pressing the "Save Bemf Sum" Tx button saves the current value into 'EEPROM' (On-board memory) to allow a smoother start on the next power up.

This value can change drastically with various motors and windings. If there are issues starting certain motors, it may be because this initial value is too far away, and the calibration can NOT home in. In this case, it is possible to manually change the parameter.

Changing the PWM frequency will also drastically change this value!

PWM Frequency

The value is set to default at 50Khz. This value may need to increase for high-speed motors with low coil inductance and possibly reduced to save switching losses (efficiency) for slow motors with higher inductance.

Note that changing the PWM frequency will affect many different parameters within the controller, so caution must be used when doing this! **Please advise TCS if you require further help with this!**

UART COMMAND PROTOCOLS

To summarise how it works, it's an ASCII protocol with "ZD" as a header (every packet of data needs to start with a ZD). Then there is the command which is a few characters that have some sort of relevance to what you are asking. Then if you are asking for data, you can just put in the "/"r" to finish the command off, or if your setting data you need to add the "=" and the value in before the "/"r".

It's simple but works well. All the possible commands/Parameters are below.

General Commands

Command Description	Command String	Result meaning	Read/Write?
Application Name	ZDVERSTR\r	ZDVERSTR = ZDBLMUL15-4\r Version = ZDBLMUL15-4	Read Only
Application Version	ZDVER\r	ZDVER = 100\r Version 1.00	Read Only
Application Build Number	ZDVERBN\r	ZDVERBN = 1000\r Build number = 1000	Read Only
Reset	ZDreset\r	N/A, no reply	Write Only, no reply
Supply Voltage (Vx10)	ZDvsup\r	ZDvsup = 200\r Supply Voltage = 20V	Read Only
Motor I (Ax10)	ZDimot\r	ZDimot = 3\r Motor Current = 0.3A	Read only
Motor Power (W)	ZDpmot\r	ZDpmot = 3\r Motor Power = 3W	Read only
Controller Temp. (degC)	ZDctemp\r	ZDctemp = 24\r Controller Temp = 24 degC	Read Only
Analogue Value	ZDanip\r	ZDanip = 150\r Analogue Value = 150	Read Only
Pot Value	ZDpotv\r	ZDpotv = 150\r Pot Value = 150	Read only

Enable Input Value	ZDdinp1\r	ZDdinp1 = 1\r Enable Input Value = 1	Read Only
Enable Dir Value	ZDdinp2\r	ZDdinp2 = 1\r Enable Dir Value = 1	Read Only

Control Setup Commands

Command Description	Command String	Result meaning	Read/Write?
Data Item	ZDdcdati = x\r	ZDdcdati = 0\r ZDdcdati = 9, dcDatai 0 = State, drive control data item state = 9. Check Control Setup Data Items for more info on data items.	Read only
Fault Code	ZDdcfltc\r	ZDdcfltc = 3\r Fault code = 3 = Min Voltage. For specific fault codes check Fault Codes & Fault Data	Read Only
Fault Data	ZDdcfltd\r	ZDdcfltd = 251\r Fault data = 25.1V For specific fault data check Fault Codes & Fault Data	Read Only
Reset	ZDdcrlt\r	ZDdcrlt\r, fault reset	Write Only
Invert Settings	ZDInvSet\r	ZDInvSet = 0\r Invert Setting = 0. For more information check Invert Settings.	Read/ Write
Start Delay	ZDSrtDly\r	ZDSrtDly = 5000\r Start delay = 5 seconds.	Read/ Write
Motor Speed (Hz)	ZDdcdati = 9\r	ZDdcdati = 120\r 120 = 120Hz.	Read Only
Analogue Scaler Mult	ZDAnlScIm\r	ZDAnlScIm = 2\r Analogue Scalar multiplier = 2.	Read/ Write
Analogue Scaler Div	ZDAnlScId\r	ZDAnlScId = 2\r	Read/ Write

		Analogue Scalar divider = 2.	
Bemf Data	ZDDatEmf\r	ZDDatEmf = 2500\r Bemf Data = 2500.	Read Only
Fixed Speed (%Duty)	ZDFixSpd\r	ZDFixDps = 500\r Fixed speed (%Duty) = 500 = 50%	Read/ Write
Duty Acc/Dec	ZDDCADRT\r	ZDDCADRT = 10\r Duty Acc/Dec = 10.	Read/ Write
DataExport Time (ms)	ZDDatExp\r	ZSDatExp = 0\r DataExport Time = 0ms.	Read Only.
Fixed Speed (PID Hz)	ZDFSpdPd\r	ZDFSpdPd = 100\r Fixed Speed (PID Hz) = 100.	Read/ Write
PID Acc/Dec	ZDDCADPd\r	ZDDCADPd = 5\r PID Acc/Dec rate = 5.	Read/ Write
PID Delay (ms)	ZDPIDDLy\r	ZDPIDDLy = 200\r PID Delay = 200mS.	Read/ Write
PID Enabled	ZDPIDEn\r	ZDPIDEn = 1\r PID = 1 = enabled	Read/ Write
PID Data Item	ZDpiddat = x\r	ZDpiddat = 0 Check PID Data Items for more information.	Read

Drive Setup Commands

Command Description	Command String	Result meaning	Read/Write?
Data Item	ZDdddati = x\r	ZDdddati = 0\r If x = 0, Data reply = state. For more information check Drive Data Items.	Read Only.
Fault Code	ZDddfltc\r	ZDddfltc = 3\r Fault code = 3 = Min Voltage. For specific fault codes check Fault	Read Only

		Codes & Fault Data	
Fault Data	ZDddfltd\r	ZDddfltd = 251\r Fault data = 25.1V For specific fault data check Fault Codes & Fault Data	Read Only
Reset Fault	ZDddrflt\r	ZDddrflt\r, fault reset	Write Only
PWM Freq. (KHz)	ZDDDPWMF\r	ZDDDPWMF = 40\r PWM Frequency = 40KHz.	Read/ Write
Min Voltage (Vx10)	ZDMinVol\r	ZDMinVol = 50\r Min Voltage = 5V.	Read/ Write
Max Voltage (Vx10)	ZDMaxVol\r	ZDMaxVol = 250\r Max Voltage = 25V.	Read/ Write
Start	ZDddstart\r	ZDddstart Motor Starts	Write Only
Start PWM	ZDDDSMDC\r	ZDDDSMDC = 150\r Start PWM = 15%	Read/ Write
Min Duty Cycle (%)	ZDMinDut\r	ZDMinDut = 60\r Min Duty Cycle = 6%	Read/ Write
Max Current Trip (Ax10)	ZDDDMIMX\r	ZDDDMIMX = 100\r Max Current = 10A	Read/ Write
Stop	ZDddstop\r	ZDddstop Motor Stops	Write Only
Min Frequency (Hz)	ZDMinFrq\r	ZDMinFrq = 100\r Min Frequency = 100 Hz.	Read/ Write
Max PowerTrip (Ax10)	ZDDDMPMX\r	ZDDDMPMX = 315 Max Power Trip = 31.5A	Read/ Write
Enable Self Calibration	ZDDSCEN\r	ZDDSCEN = 1\r Self-Calibration Enabled	Read/ Write
Back EMF Sum	ZDDDRBES\r	ZDDDRBES = 2500\r BEMF Sum Target = 2500.	Read/ Write

Save Bemf Sum	ZDsavbmfr	ZDsavbmfr	Write
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