

**WireWorks West**  **Inc.**

## COVER SHEET

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# **Software Specification**

## **Test Instrument Module System**

### **USB Stepper Motor Controller**

**Model: TIMS-0201**

### **Function Protocol**

## USB Stepper Motor Controller Function Protocol

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**USB Stepper Motor Controller Function Protocol**

## **1 INTRODUCTION**

This specification provides the information necessary to design, develop, manufacture, use and maintain either the firmware installed within the WireWorks West, Inc. model TIMS-0201, USB Stepper Motor Controller, or any user application control software.

## **2 SCOPE**

The information presented in this document is limited to the user functions of the TIMS-0201 module.

Information regarding any model specific manufacturing calibration and test functions, as well as any of the standard functions provided by the monitor firmware, is beyond the scope of this document.

## **3 CONTACT INFORMATION**

### **3.1 SALES AND SUPPORT**

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415-348-1408 Technical Support  
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**USB Stepper Motor Controller Function Protocol****4 REFERENCE DOCUMENTS**

<i><b>Description</b></i>	<i><b>Doc. No</b></i>	<i><b>Company/Author</b></i>	<i><b>Rev/Date</b></i>
TIMS Datalink Communication Protocol	DOC-000004	WWW/GSH	2/4-11-2005

## USB Stepper Motor Controller Function Protocol

## 5 SPECIFICATION

### 5.1 GENERAL

This subsection will present certain considerations, rules, and design constraints specific for the development of software for use with the TIMS-0201 USB Stepper Motor Controller module.

- ☐ The TIMS-0201 utilizes a single microcontroller device with a protocol address of 0xD0.

#### 5.1.1 Protocol Layer-1: Physical Layer

The TIMS-0201 utilizes a USB serial interface device that is compliant with USB 1.1 and 2.0 full speed requirements as specified by the USB.ORG committee.

- ☐ The USB serial device utilized is the USB232BM manufactured by Future Technology Device Inc. (FTDI)
- ☐ The internal microcontroller device transmits and receives a serial data stream with the following characteristics: 230K Baud, 8-bit data, no parity, 1 stop bit
- ☐ The TIMS-0201 may draw up to 500 ma of 5 VDC power from the USB interface

### 5.2 TERMINOLOGY

Term	Meaning
FWD	Forward: Direction in reference to the step counter being incremented
REV	Reverse: Direction in reference to the step counter being decremented

The step counter will be incremented by stepping in the forward direction, and decremented by stepping in the reverse direction.

The step counter will be incremented, or decremented, by one in half step mode and by two in the full step mode.

## USB Stepper Motor Controller Function Protocol

## 5.3 DATA CONVENTIONS

## 5.3.1 Signed or Unsigned 16-Bit Integers

Data[0] Data[1] -or- Data[0:1]			I16 - Bits[15:8] I16 - Bits[7:0] -or- I16
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## 5.3.2 Signed or Unsigned 32-Bit Integers

Data[0] Data[1] Data[2] Data[3] -or- Data[0:3]			I32 - Bits[31:24] I32 - Bits[23:16] I32 - Bits[15:8] I32 - Bits[7:0] -or- I32
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## 5.3.3 Single Precision Floating Point (SGL), IEEE-754 32-Bit

SGL Bits[31]            Sign Bit  
SGL Bits[30,23]       Exponent  
SGL Bits[22,0]        Fraction

Data[0] Data[1] Data[2] Data[3] -or- Data[0:3]			SGL - Bits[31:24] SGL - Bits[23:16] SGL - Bits[15:8] SGL - Bits[7:0] -or- SGL
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## USB Stepper Motor Controller Function Protocol

## 5.4 CONTROL FUNCTIONS

*TIMS-0201 Module Function Summary*

Function	Control Code	Comment
TIMS Factory Defaults Load	0x00FD	
Step Motor Status Get	0x0200	
User Settings Load	0x0201	
Stop	0x0210	
Brake	0x0211	Reserved for future operation
Single Step	0x0212	
Continuous Step	0x0213	
Seek Home	0x0214	
Seek Limit	0x0215	
Move Absolute	0x0216	
Move Relative	0x0217	
Step Count Get	0x0220	
Step Count Set	0x0221	
Encoder Count Get	0x0222	
Encode Count Set	0x0223	
Target Count Get	0x0224	
Soft Limits Get	0x0226	
Soft Limits Set	0x0227	
Mode Half Step Set	0x0228	Half/Full Step
Mode Counter Set	0x0229	Encoder/Step Count
Mode Soft Limits Set	0x022A	Enable/Disable
Current Limit Get	0x0230	
Current Limit Set	0x0231	
Motor Power Measure	0x0232	

## USB Stepper Motor Controller Function Protocol

*TIMS-0201 Module Specific Functions con't*

Function	Control Code	Comment
Step Rate Normal Get	0x0240	
Step Rate Normal Set	0x0241	
Step Rate Normal Save	0x0242	
Step Rate Seek Get	0x0244	
Step Rate Seek Set	0x0245	
Step Rate Seek Save	0x0246	
GPIO Configuration Get	0x0260	
GPIO Configuration Save	0x0261	
GPIO-DIO Get	0x0262	
GPIO-DIO Set	0x0263	
GPIO Counter Get	0x0264	
GPIO Counter Set	0x0265	
GPIO-ADC Get	0x026F	
PWM Set Point Set	0x0270	
PWM Set Point Set EE	0x0271	
PWM Set Point Get	0x 0276	
PWM Set Point Get EE	0x 0277	
PWM Actual Get	0x0278	
PWM Actual Get EE	0x0279	

## USB Stepper Motor Controller Function Protocol

## 5.4.1 Function: FACTORY DEFAULT LOAD (EE)

## Function Summary

<b>Description</b>	Restores factory default settings into non-volatile memory.
<b>Control Code</b>	0x00FD
<b>Supplied Variables</b>	None
<b>Returned Variables</b>	None
<b>Comments</b>	Factory Default Settings: Soft Limits: 2,147,483,647 Max, -2,147,483,648 Min Normal Step Rate: 200 Steps/Sec Seek Step Rate: 50 Steps/Sec GPIO Configuration: GPIO-0 thru -4 Digital In, GPIO-5 ADC 5Vref PWM Frequency: Low, 2441 Hz, 50% Duty

## Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
CONTROL	U16	0x00FD	
STATUS	U16	(xxx)	Don't care, ignored by receiver
REF	U8	(tbd)	
Data_Length	U8	0	
DATA	[u8]		See content below
Data[0]			Erroneous Dummy Byte

## Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
CONTROL	U8	0x00FD	
STATUS	U16	(tbd)	
REF	U16	(tbd)	Echo of Command Packet REF
Data_Length	U8	0	
DATA	[u8]		See content below
Data[0]			Erroneous Dummy Byte

## USB Stepper Motor Controller Function Protocol

## 5.4.2 Function: MOTOR STATUS READ

## Function Summary

<b>Description</b>	Returns the stepper motor controller status flags
<b>Control Code</b>	0x0200
<b>Supplied Variables</b>	None
<b>Returned Variables</b>	Status Flags (U16)
<b>Comments</b>	Refer to Status Flags table

## Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
CONTROL	U16	0x0200	
STATUS	U16	(xxx)	Don't care, ignored by receiver
REF	U8	(tbd)	
LENGTH	U8	0x00	
DATA	[u8]		See content below
Data[0]			Meaningless Dummy Byte
LRC	U8	Calculated	

## Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
CONTROL	U16	0x0200	
STATUS	U16	(tbd)	
REF	U8	(tbd)	Echo of Command Packet REF
LENGTH	U8	0x01	2 Bytes
DATA	[u8]		See content below
Data[0:1]			U16 – Status Flags
LRC	U8	Calculated	

## USB Stepper Motor Controller Function Protocol

## 5.4.3 Function: USER SETTING LOAD (EE)

## Function Summary

<b>Name</b>	fnc_STEPPER_USER_SETTING_LD
<b>Description</b>	Loads user specified settings previously stored in EEPROM into operating variables.
<b>Control Code</b>	0x0201
<b>Supplied Variables</b>	None
<b>Returned Variables</b>	None
<b>Comments</b>	

## Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
CONTROL	U16	0x0201	
STATUS	U16	(xxx)	Don't care, ignored by receiver
REF	U8	(tbd)	
LENGTH	U8	0	
DATA	[u8]		See content below
Data[0]			Erroneous Dummy Byte
LRC	U8	Calculated	

## Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
CONTROL	U16	0x0201	
STATUS	U16	(tbd)	
REF	U8	(tbd)	Echo of Command Packet REF
LENGTH	U8	0	
DATA	[u8]		See content below
Data[0]			Erroneous Dummy Byte
LRC	U8	Calculated	

## USB Stepper Motor Controller Function Protocol

## 5.4.3.1 Status Flags Table

Status Flags Table

Bit	Name	Description
0	BUSY	<b>Stepper Motor Busy</b> 1 = Busy, stepping operation in progress 0 = Not busy
1	MOVE	<b>Move to Target Position</b> 1 = Absolute or relative move to target position in progress 0 = Move function not in progress
2	SNGL	<b>Single Step</b> 1 = Single step in progress 0 = Move function not in progress
3	DIR	<b>Step Direction</b> 1 = Step forward, increment step counter 0 = Step reverse, decrement step counter
4	STEP	<b>Step Mode</b> 1 = Half step mode 0 = Full step mode
5	HOME	<b>Seek Home</b> 1 = Seek home position operation in progress. 0 = Seek home operation not in progress.
6	LIMIT	<b>Seek Limit</b> 1 = Seek limit position operation in progress. 0 = Seek limit operation not in progress.
7	COUNT	<b>Counter Mode</b> 1 = Use encoder counter in absolute or relative move operations. 0 = Use step counter in absolute or relative move operations.
8	SOFT	<b>Soft Limits Mode</b> 1 = Use of soft limits to stop stepping operation is enabled. 0 = Use of soft limits is disabled.
9	@HOME	<b>At Home Position</b> 1 = Home limit input is enabled and low. 0 = Home limit input is either not enabled or is high.
10	@FWD	<b>At FWD Limit Position</b> 1 = FWD limit input is enabled and low. 0 = FWD limit input is either not enabled or is high.
11	@REV	<b>At REV Limit Position</b> 1 = REV limit input is enabled and low. 0 = REV limit input is either not enabled or is high.
12	>MAX	<b>Max Soft Limit Exceeded</b> 1 = Current position exceeds the soft maximum position limit. 0 = Limit not exceeded.
13	@MAX	<b>At Max Soft Limit Position</b> 1 = Current position equals the soft maximum position limit. 0 = Limit and position not equal.
14	@MIN	<b>At Min Soft Limit Position</b> 1 = Current position equals the soft minimum position limit. 0 = Limit and position not equal.
15	<MIN	<b>Min Soft Limit Exceeded</b> 1 = Current position exceeds the soft minimum position limit. 0 = Limit not exceeded.

## USB Stepper Motor Controller Function Protocol

## 5.4.4 Function: STOP

## Function Summary

<b>Description</b>	Stops motor stepping operation
<b>Control Code</b>	0x0210
<b>Supplied Variables</b>	None
<b>Returned Variables</b>	None
<b>Comments</b>	

## Command Packet

<i>Element</i>	<i>Type</i>	<i>Value</i>	<i>Description</i>
TO	U8	0xD0	
FROM	U8	(tbd)	
CONTROL	U16	0x0210	
STATUS	U16	(xxx)	Don't care, ignored by receiver
REF	U8	(tbd)	
LENGTH	U8	0x00	
DATA	[u8]		See content below
Data[0]			Meaningless Dummy Byte
LRC	U8	Calculated	

## Response Packet

<i>Element</i>	<i>Type</i>	<i>Value</i>	<i>Description</i>
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
CONTROL	U16	0x0210	
STATUS	U16	(tbd)	
REF	U8	(tbd)	Echo of Command Packet REF
LENGTH	U8	0x00	
DATA	[u8]		See content below
Data[0]			Meaningless Dummy Byte
LRC	U8	Calculated	

## USB Stepper Motor Controller Function Protocol

## 5.4.5 Function: SINGLE STEP

## Function Summary

<b>Description</b>	Performs a single step in either the forward or reverse direction
<b>Control Code</b>	0x0212
<b>Supplied Variables</b>	Direction (u8)
<b>Returned Variables</b>	None
<b>Comments</b>	<p>Performs either a full or half step depending on the Full/Half Step Mode.</p> <p>Returns an error if Busy.</p> <p>Returns an error if Step FWD and at FWD Limit.</p> <p>Returns an error if Step REV and at REV Limit.</p> <p>The step counter will be incremented by stepping in the forward direction, and decremented by stepping in the reverse direction.</p> <p>The step counter will be incremented, or decremented, by one in half step mode and by two in the full step mode.</p>

## Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
CONTROL	U16	0x0212	
STATUS	U16	(xxx)	Don't care, ignored by receiver
REF	U8	(tbd)	
LENGTH	U8	0x00	1 Byte
DATA	[u8]		See content below
Data[0]			U8 - Direction: 0 = REV, else FWD
LRC	U8	Calculated	

## Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
CONTROL	U16	0x0212	
STATUS	U16	(tbd)	
REF	U8	(tbd)	Echo of Command Packet REF
LENGTH	U8	0x00	
DATA	[u8]		See content below
Data[0]			Meaningless Dummy Byte
LRC	U8	Calculated	



## USB Stepper Motor Controller Function Protocol

## 5.4.6 Function: CONTINUOUS STEPPING

## Function Summary

<b>Description</b>	Initiates continuous stepping in either the forward or reverse direction
<b>Control Code</b>	0x0213
<b>Supplied Variables</b>	Direction (u8)
<b>Returned Variables</b>	None
<b>Comments</b>	<p>Performs either a full or half step depending on the Full/Half Step Mode.</p> <p>Uses Normal step rate.</p> <p>Returns an error if Busy.</p> <p>Stops if Stepping FWD and reaches FWD Limit or Max Soft Limit.</p> <p>Stops if Stepping REV and reaches REV Limit or Min Soft Limit.</p>

## Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
CONTROL	U16	0x0213	
STATUS	U16	(xxx)	Don't care, ignored by receiver
REF	U8	(tbd)	
LENGTH	U8	0x00	1 Byte
DATA	[u8]		See content below
Data[0]			U8 - Direction: 0 = REV, else FWD
LRC	U8	Calculated	

## Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
CONTROL	U16	0x0213	
STATUS	U16	(tbd)	
REF	U8	(tbd)	Echo of Command Packet REF
LENGTH	U8	0x00	
DATA	[u8]		See content below
Data[0]			Meaningless Dummy Byte
LRC	U8	Calculated	

## USB Stepper Motor Controller Function Protocol

## 5.4.7 Function: SEEK HOME

## Function Summary

<b>Description</b>	Performs continuous stepping in either the forward or reverse direction until home detected
<b>Control Code</b>	0x0214
<b>Supplied Variables</b>	Direction (u8)
<b>Returned Variables</b>	none
<b>Comments</b>	Performs either a full or half step depending on the Full/Half Step Mode. Uses Seek step rate. Returns an error if Busy. Returns an error if a DIO not configured as Home input. Reverses direction if the Fwd or Rev limit is reached.

## Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
CONTROL	U16	0x0214	
STATUS	U16	(xxx)	Don't care, ignored by receiver
REF	U8	(tbd)	
LENGTH	U8	0x00	1 Byte
DATA	[u8]		See content below
Data[0]			U8 - Direction: 0 = REV, else FWD
LRC	U8	Calculated	

## Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
CONTROL	U16	0x0214	
STATUS	U16	(tbd)	
REF	U8	(tbd)	Echo of Command Packet REF
LENGTH	U8	0x00	
DATA	[u8]		See content below
Data[0]			Meaningless Dummy Byte
LRC	U8	Calculated	

## USB Stepper Motor Controller Function Protocol

## 5.4.8 Function: SEEK LIMIT

## Function Summary

<b>Description</b>	Performs continuous stepping in either the forward or reverse direction until either the FWD or REV limit, as indicated by direction, is detected
<b>Control Code</b>	0x0215
<b>Supplied Variables</b>	Direction (u8)
<b>Returned Variables</b>	None
<b>Comments</b>	Performs either a full or half step depending on the Full/Half Step Mode. Uses Seek step rate. Returns an error if Busy. Returns an error if a DIO is not configured as limit input or soft limits are not enabled.

## Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
CONTROL	U16	0x0215	
STATUS	U16	(xxx)	Don't care, ignored by receiver
REF	U8	(tbd)	
LENGTH	U8	0x00	1 Byte
DATA	[u8]		See content below
Data[0]			U8 - Direction: 0 = REV, else FWD
LRC	U8	Calculated	

## Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
CONTROL	U16	0x0215	
STATUS	U16	(tbd)	
REF	U8	(tbd)	Echo of Command Packet REF
LENGTH	U8	0x00	
DATA	[u8]		See content below
Data[0]			Meaningless Dummy Byte
LRC	U8	Calculated	

## USB Stepper Motor Controller Function Protocol

## 5.4.9 Function: MOVE ABSOLUTE

## Function Summary

<b>Description</b>	Initiates stepping to a specified position
<b>Control Code</b>	0x0216
<b>Supplied Variables</b>	Absolute Position (i32)
<b>Returned Variables</b>	Target Position (i32)
<b>Comments</b>	<p>Performs either a full or half step depending on the Full/Half Step Mode.</p> <p>Uses either step count or encoder count depending on Step/Encoder Count Mode.</p> <p>Uses Normal step rate.</p> <p>Returns an error if Busy.</p> <p>Returns an error if soft limits are enabled and absolute position is outside of the soft limits.</p> <p>Stops stepping if FWD or REV limit is enabled and reached.</p>

## Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
CONTROL	U16	0x0216	
STATUS	U16	(xxx)	Don't care, ignored by receiver
REF	U8	(tbd)	
LENGTH	U8	0x03	4 Bytes
DATA	[u8]		See content below
Data[0:3]			I32 - Absolute Position
LRC	U8	Calculated	

## Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
CONTROL	U16	0x0216	
STATUS	U16	(tbd)	
REF	U8	(tbd)	Echo of Command Packet REF
LENGTH	U8	0x03	4 Bytes
DATA	[u8]		See content below
Data[0:3]			I32 - Target Position
LRC	U8	Calculated	

## USB Stepper Motor Controller Function Protocol

## 5.4.10 Function: MOVE RELATIVE

## Function Summary

<b>Description</b>	Initiates stepping to a position relative to the current position
<b>Control Code</b>	0x0217
<b>Supplied Variables</b>	Relative Position (i32)
<b>Returned Variables</b>	Target Position (i32)
<b>Comments</b>	<p>Performs either a full or half step depending on the Full/Half Step Mode.</p> <p>Uses either step count or encoder count depending on Step/Encoder Count Mode.</p> <p>Uses Normal step rate.</p> <p>Returns an error if Busy.</p> <p>Returns an error if soft limits are enabled and the computed target position is outside of the soft limits.</p> <p>Stops stepping if FWD or REV limit is enabled and reached.</p>

## Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
CONTROL	U16	0x0217	
STATUS	U16	(xxx)	Don't care, ignored by receiver
REF	U8	(tbd)	
LENGTH	U8	0x03	4 Bytes
DATA	[u8]		See content below
Data[0:3]			I32 - Relative Position
LRC	U8	Calculated	

## Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
CONTROL	U16	0x0217	
STATUS	U16	(tbd)	
REF	U8	(tbd)	Echo of Command Packet REF
LENGTH	U8	0x03	4 Bytes
DATA	[u8]		See content below
Data[0:3]			I32 - Target Position
LRC	U8	Calculated	

## USB Stepper Motor Controller Function Protocol

## 5.4.11 Function: STEP COUNTER READ

## Function Summary

<b>Description</b>	Returns the step counter value for the current motor position
<b>Control Code</b>	0x0220
<b>Supplied Variables</b>	None
<b>Returned Variables</b>	Step Count (i32)
<b>Comments</b>	Step Position in half step units

## Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
CONTROL	U16	0x0220	
STATUS	U16	(xxx)	Don't care, ignored by receiver
REF	U8	(tbd)	
LENGTH	U8	0x00	
DATA	[u8]		See content below
Data[0]			Meaningless Dummy Byte
LRC	U8	Calculated	

## Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
CONTROL	U16	0x0220	
STATUS	U16	(tbd)	
REF	U8	(tbd)	Echo of Command Packet REF
LENGTH	U8	0x03	4 Bytes
DATA	[u8]		See content below
Data[0:3]			I32 – Step Count
LRC	U8	Calculated	

## USB Stepper Motor Controller Function Protocol

## 5.4.12 Function: STEP COUNTER WRITE

## Function Summary

<b>Description</b>	Sets the step counter value for the current motor position
<b>Control Code</b>	0x0221
<b>Supplied Variables</b>	Step Count (i32)
<b>Returned Variables</b>	None
<b>Comments</b>	Step Position in half step units Returns an error if Busy.

## Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
CONTROL	U16	0x0221	
STATUS	U16	(xxx)	Don't care, ignored by receiver
REF	U8	(tbd)	
LENGTH	U8	0x03	4 Bytes
DATA	[u8]		See content below
Data[0:3]			I32 – Step Count
LRC	U8	Calculated	

## Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
CONTROL	U16	0x0221	
STATUS	U16	(tbd)	
REF	U8	(tbd)	Echo of Command Packet REF
LENGTH	U8	0x00	
DATA	[u8]		See content below
Data[0]			Meaningless Dummy Byte
LRC	U8	Calculated	

## USB Stepper Motor Controller Function Protocol

## 5.4.13 Function: ENCODER COUNTER READ

## Function Summary

<b>Description</b>	Returns the encoder counter value for the current motor position
<b>Control Code</b>	0x0222
<b>Supplied Variables</b>	None
<b>Returned Variables</b>	Encoder Count (i32)
<b>Comments</b>	

## Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
CONTROL	U16	0x0222	
STATUS	U16	(xxx)	Don't care, ignored by receiver
REF	U8	(tbd)	
LENGTH	U8	0x00	
DATA	[u8]		See content below
Data[0]			Meaningless Dummy Byte
LRC	U8	Calculated	

## Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
CONTROL	U16	0x0222	
STATUS	U16	(tbd)	
REF	U8	(tbd)	Echo of Command Packet REF
LENGTH	U8	0x03	4 Bytes
DATA	[u8]		See content below
Data[0:3]			I32 – Encoder Count
LRC	U8	Calculated	



## USB Stepper Motor Controller Function Protocol

## 5.4.14 Function: ENCODER COUNTER WRITE

## Function Summary

<b>Description</b>	Sets the encoder counter value for the current motor position
<b>Control Code</b>	0x0223
<b>Supplied Variables</b>	Encoder Count (i32)
<b>Returned Variables</b>	None
<b>Comments</b>	Returns an error if Busy.

## Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
CONTROL	U16	0x0223	
STATUS	U16	(xxx)	Don't care, ignored by receiver
REF	U8	(tbd)	
LENGTH	U8	0x03	4 Bytes
DATA	[u8]		See content below
Data[0:3]			I32 – Encoder Count
LRC	U8	Calculated	

## Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
CONTROL	U16	0x0223	
STATUS	U16	(tbd)	
REF	U8	(tbd)	Echo of Command Packet REF
LENGTH	U8	0x00	
DATA	[u8]		See content below
Data[0]			Meaningless Dummy Byte
LRC	U8	Calculated	

## USB Stepper Motor Controller Function Protocol

## 5.4.15 Function: TARGET POSITION COUNT READ

## Function Summary

<b>Description</b>	Returns the target position counter value computed by the last move command
<b>Control Code</b>	0x0224
<b>Supplied Variables</b>	None
<b>Returned Variables</b>	Target Position (i32)
<b>Comments</b>	

## Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
CONTROL	U16	0x0224	
STATUS	U16	(xxx)	Don't care, ignored by receiver
REF	U8	(tbd)	
LENGTH	U8	0x00	
DATA	[u8]		See content below
Data[0]			Meaningless Dummy Byte
LRC	U8	Calculated	

## Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
CONTROL	U16	0x0224	
STATUS	U16	(tbd)	
REF	U8	(tbd)	Echo of Command Packet REF
LENGTH	U8	0x03	4 Bytes
DATA	[u8]		See content below
Data[0:3]			I32 – Target Position
LRC	U8	Calculated	

## USB Stepper Motor Controller Function Protocol

## 5.4.16 Function: SOFT LIMITS READ

## Function Summary

<b>Description</b>	Returns the soft FWD and REV limits for motor position
<b>Control Code</b>	0x0226
<b>Supplied Variables</b>	None
<b>Returned Variables</b>	Max Soft Position (i32) Min Soft Position (i32)
<b>Comments</b>	

## Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
CONTROL	U16	0x0226	
STATUS	U16	(xxx)	Don't care, ignored by receiver
REF	U8	(tbd)	
LENGTH	U8	0x00	
DATA	[u8]		See content below
Data[0]			Meaningless Dummy Byte
LRC	U8	Calculated	

## Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
CONTROL	U16	0x0226	
STATUS	U16	(tbd)	
REF	U8	(tbd)	Echo of Command Packet REF
LENGTH	U8	0x07	8 Bytes
DATA	[u8]		See content below
Data[0:3] Data[4:7]			I32 – Max Soft Limit I32 – Min Soft Limit
LRC	U8	Calculated	

## USB Stepper Motor Controller Function Protocol

## 5.4.17 Function: STEP SOFT LIMITS SET

## Function Summary

<b>Description</b>	Sets the soft FWD and REV limits for motor position, and saves the values into non-volatile memory.
<b>Control Code</b>	0x0227
<b>Supplied Variables</b>	New Max Soft Position (i32) New Min Soft Position (i32)
<b>Returned Variables</b>	None
<b>Comments</b>	Returns an error if Busy. Returns an error if Length not equal to 8 Returns an error if max not greater than min.

## Command Packet

Element	Type	Value	Description
TO	U8	0Xd0	
FROM	U8	(tbd)	
CONTROL	U16	0x0227	
STATUS	U16	(xxx)	Don't care, ignored by receiver
REF	U8	(tbd)	
LENGTH	U8	0x07	8 Bytes
DATA	[u8]		See content below
Data[0:3]			I32 – Max Soft Limit
Data[4:7]			I32 – Min Soft Limit
LRC	U8	Calculated	

## Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
CONTROL	U16	0x0227	
STATUS	U16	(tbd)	
REF	U8	(tbd)	Echo of Command Packet REF
LENGTH	U8	0x00	
DATA	[u8]		See content below
Data[0]			Meaningless Dummy Byte
LRC	U8	Calculated	

## USB Stepper Motor Controller Function Protocol

## 5.4.18 Function: STEP MODE (Half-Step/Full-Step)

## Function Summary

<b>Description</b>	Sets the state of the Step Mode (Half/Full)
<b>Control Code</b>	0x0228
<b>Supplied Variables</b>	New Step Mode State (u8)
<b>Returned Variables</b>	None
<b>Comments</b>	Returns an error if Busy. Note: If changing from half to full step mode and the step counter is odd, a single half step will be performed prior to any full steps as part of the next move function.

## Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
CONTROL	U16	0x0228	
STATUS	U16	(xxx)	Don't care, ignored by receiver
REF	U8	(tbd)	
LENGTH	U8	0x00	1 Byte
DATA	[u8]		See content below
Data[0]			U8 - Step Mode: 0 = Full, else = Half
LRC	U8	Calculated	

## Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
CONTROL	U16	0x0228	
STATUS	U16	(tbd)	
REF	U8	(tbd)	Echo of Command Packet REF
LENGTH	U8	0x00	
DATA	[u8]		See content below
Data[0]			Meaningless Dummy Byte
LRC	U8	Calculated	

## USB Stepper Motor Controller Function Protocol

## 5.4.19 Function: COUNTER MODE (Step/Encoder Counter)

## Function Summary

<b>Description</b>	Selects the counter to use for move functions (Encoder/Step)
<b>Control Code</b>	0x0229
<b>Supplied Variables</b>	New Move Counter Mode State (u8)
<b>Returned Variables</b>	None
<b>Comments</b>	Returns an error if Busy. Returns an error if selecting encoder counter and a DIO has not been configured for encoder input.

## Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
CONTROL	U16	0x0229	
STATUS	U16	(xxx)	Don't care, ignored by receiver
REF	U8	(tbd)	
LENGTH	U8	0x00	1 Byte
DATA	[u8]		See content below
Data[0]			U8 – Move Counter Mode: 0 = Step, else Encoder
LRC	U8	Calculated	

## Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
CONTROL	U16	0x0229	
STATUS	U16	(tbd)	
REF	U8	(tbd)	Echo of Command Packet REF
LENGTH	U8	0x00	
DATA	[u8]		See content below
Data[0]			Meaningless Dummy Byte
LRC	U8	Calculated	

## USB Stepper Motor Controller Function Protocol

## 5.4.20 Function: SOFT LIMITS MODE

## Function Summary

<b>Description</b>	Enables or disables the use of soft limits.
<b>Control Code</b>	0x022A
<b>Supplied Variables</b>	Soft Limits Mode (u8)
<b>Returned Variables</b>	None
<b>Comments</b>	Returns an error if Busy. If enabled, motor stepping is ceased when a limit is reached.

## Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
CONTROL	U16	0x022A	
STATUS	U16	(xxx)	Don't care, ignored by receiver
REF	U8	(tbd)	
LENGTH	U8	0x00	1 Byte
DATA	[u8]		See content below
Data[0]			U8 – Soft Limits Mode: 0 = Disable, else Enable
LRC	U8	Calculated	

## Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
CONTROL	U16	0x022A	
STATUS	U16	(tbd)	
REF	U8	(tbd)	Echo of Command Packet REF
LENGTH	U8	0x00	
DATA	[u8]		See content below
Data[0]			Meaningless Dummy Byte
LRC	U8	Calculated	

## USB Stepper Motor Controller Function Protocol

## 5.4.21 Function: CURRENT LIMIT READ

## Function Summary

<b>Description</b>	Returns the motor winding current limit.
<b>Control Code</b>	0x0230
<b>Supplied Variables</b>	None
<b>Returned Variables</b>	Current Limit (u8)
<b>Comments</b>	Motor current limit is expressed percentage from 0% to 100%.

## Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
CONTROL	U16	0x0230	
STATUS	U16	(xxx)	Don't care, ignored by receiver
REF	U8	(tbd)	
LENGTH	U8	0x00	
DATA	[u8]		See content below
Data[0]			Meaningless Dummy Byte
LRC	U8	Calculated	

## Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
CONTROL	U16	0x0230	
STATUS	U16	(tbd)	
REF	U8	(tbd)	Echo of Command Packet REF
LENGTH	U8	0x00	1 Byte
DATA	[u8]		See content below
Data[0]			U8 – Current Limit
LRC	U8	Calculated	



## USB Stepper Motor Controller Function Protocol

## 5.4.22 Function: CURRENT LIMIT WRITE

## Function Summary

<b>Description</b>	Set the motor winding current limit.
<b>Control Code</b>	0x0231
<b>Supplied Variables</b>	Current Limit (u8)
<b>Returned Variables</b>	None
<b>Comments</b>	Motor winding current limit is expressed percentage from 0% to 100%. Any value over 100% is coerced to be 100%.

## Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
CONTROL	U16	0x0231	
STATUS	U16	(xxx)	Don't care, ignored by receiver
REF	U8	(tbd)	
LENGTH	U8	0x00	1 Byte
DATA	[u8]		See content below
Data[0]			U8 – Current Limit
LRC	U8	Calculated	

## Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
CONTROL	U16	0x0231	
STATUS	U16	(tbd)	
REF	U8	(tbd)	Echo of Command Packet REF
LENGTH	U8	0x00	
DATA	[u8]		See content below
Data[0]			Meaningless Dummy Byte
LRC	U8	Calculated	

## USB Stepper Motor Controller Function Protocol

## 5.4.23 Function: MOTOR POWER READ

## Function Summary

<b>Description</b>	Measures and returns the motor source voltage and winding currents.
<b>Control Code</b>	0x0232
<b>Supplied Variables</b>	None
<b>Returned Variables</b>	Motor Source Voltage (SGL) Volts Motor Winding-A Current (SGL) Amps Motor Winding-B Current (SGL) Amps
<b>Comments</b>	

## Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
CONTROL	U16	0x0232	
STATUS	U16	(xxx)	Don't care, ignored by receiver
REF	U8	(tbd)	
LENGTH	U8	0x00	
DATA	[u8]		See content below
Data[0]			Meaningless Dummy Byte
LRC	U8	Calculated	

## Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
CONTROL	U16	0x0232	
STATUS	U16	(tbd)	
REF	U8	(tbd)	Echo of Command Packet REF
LENGTH	U8	0x0B	12 Bytes
DATA	[u8]		See content below
Data[0:3] Data[4:7] Data[8:11]			SGL – Motor Voltage SGL – Winding-A Current SGL – Winding-B Current
LRC	U8	Calculated	

## USB Stepper Motor Controller Function Protocol

## 5.4.24 Function: STEP RATE NORMAL READ

## Function Summary

<b>Description</b>	Returns the step rate for normal stepping operations
<b>Control Code</b>	0x0240
<b>Supplied Variables</b>	None
<b>Returned Variables</b>	Step Rate Normal (u16) Steps/Sec
<b>Comments</b>	

## Command Packet

<i>Element</i>	<i>Type</i>	<i>Value</i>	<i>Description</i>
TO	U8	0xD0	
FROM	U8	(tbd)	
CONTROL	U16	0x0240	
STATUS	U16	(xxx)	Don't care, ignored by receiver
REF	U8	(tbd)	
LENGTH	U8	0x00	
DATA	[u8]		See content below
Data[0]			Meaningless Dummy Byte
LRC	U8	Calculated	

## Response Packet

<i>Element</i>	<i>Type</i>	<i>Value</i>	<i>Description</i>
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
CONTROL	U16	0x0240	
STATUS	U16	(tbd)	
REF	U8	(tbd)	Echo of Command Packet REF
LENGTH	U8	0x01	2 Bytes
DATA	[u8]		See content below
Data[0:1]			U16 – Step Rate Normal
LRC	U8	Calculated	

## USB Stepper Motor Controller Function Protocol

## 5.4.25 Function: STEP RATE NORMAL WRITE

## Function Summary

<b>Description</b>	Sets the active step rate for normal stepping operations
<b>Control Code</b>	0x0241
<b>Supplied Variables</b>	Step Rate Normal (u16) Steps/Sec, Range: 4000 Max, 2 Min
<b>Returned Variables</b>	None
<b>Comments</b>	An error is returned if the setting is out of range.

## Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
CONTROL	U16	0x0241	
STATUS	U16	(xxx)	Don't care, ignored by receiver
REF	U8	(tbd)	
LENGTH	U8	0x01	2 Bytes
DATA	[u8]		See content below
Data[0:1]			U16 – Step Rate Normal
LRC	U8	Calculated	

## Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
CONTROL	U16	0x0241	
STATUS	U16	(tbd)	
REF	U8	(tbd)	Echo of Command Packet REF
LENGTH	U8	0x00	
DATA	[u8]		See content below
Data[0]			Meaningless Dummy Byte
LRC	U8	Calculated	

## USB Stepper Motor Controller Function Protocol

## 5.4.26 Function: STEP RATE NORMAL WRITE (EE)

## Function Summary

<b>Description</b>	Sets the active step rate for normal stepping operations, and saves the setting into non-volatile memory.
<b>Control Code</b>	0x0242
<b>Supplied Variables</b>	Step Rate Normal (u16) Steps/Sec, Range: 4000 Max, 2 Min
<b>Returned Variables</b>	None
<b>Comments</b>	An error is returned if the setting is out of range.

## Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
CONTROL	U16	0x0242	
STATUS	U16	(xxx)	Don't care, ignored by receiver
REF	U8	(tbd)	
LENGTH	U8	0x01	2 Bytes
DATA	[u8]		See content below
Data[0:1]			U16 – Step Rate Normal
LRC	U8	Calculated	

## Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
CONTROL	U16	0x0242	
STATUS	U16	(tbd)	
REF	U8	(tbd)	Echo of Command Packet REF
LENGTH	U8	0x00	
DATA	[u8]		See content below
Data[0]			Meaningless Dummy Byte
LRC	U8	Calculated	

## USB Stepper Motor Controller Function Protocol

## 5.4.27 Function: STEP RATE SEEK READ

## Function Summary

<b>Description</b>	Return the step rate for seek stepping operations
<b>Control Code</b>	0x0244
<b>Supplied Variables</b>	None
<b>Returned Variables</b>	Step Rate Seek (u16) Steps/Sec
<b>Comments</b>	

## Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
CONTROL	U16	0x0244	
STATUS	U16	(xxx)	Don't care, ignored by receiver
REF	U8	(tbd)	
LENGTH	U8	0x00	
DATA	[u8]		See content below
Data[0]			Meaningless Dummy Byte
LRC	U8	Calculated	

## Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
CONTROL	U16	0x0244	
STATUS	U16	(tbd)	
REF	U8	(tbd)	Echo of Command Packet REF
LENGTH	U8	0x01	2 Bytes
DATA	[u8]		See content below
Data[0:1]			U16 – Step Rate Seek
LRC	U8	Calculated	

## USB Stepper Motor Controller Function Protocol

## 5.4.28 Function: STEP RATE SEEK SET

## Function Summary

<b>Description</b>	Set the step rate for seek stepping operations.
<b>Control Code</b>	0x0245
<b>Supplied Variables</b>	Step Rate Seek (u16) Steps/Sec - Range: 4000 Max, 2 Min
<b>Returned Variables</b>	None
<b>Comments</b>	An error is returned if the setting is out of range.

## Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
CONTROL	U16	0x0245	
STATUS	U16	(xxx)	Don't care, ignored by receiver
REF	U8	(tbd)	
LENGTH	U8	0x01	2 Bytes
DATA	[u8]		See content below
Data[0:1]			U16 – Step Rate Seek
LRC	U8	Calculated	

## Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
CONTROL	U16	0x0245	
STATUS	U16	(tbd)	
REF	U8	(tbd)	Echo of Command Packet REF
LENGTH	U8	0	
DATA	[u8]		See content below
Data[0]			Meaningless Dummy Byte
LRC	U8	Calculated	

## USB Stepper Motor Controller Function Protocol

## 5.4.29 Function: STEP RATE SEEK WRITE (EE)

## Function Summary

<b>Description</b>	Sets the active step rate for seek stepping operations, and saves the setting into non-volatile memory.
<b>Control Code</b>	0x0246
<b>Supplied Variables</b>	Step Rate Seek (u16) Steps/Sec - Range: 4000 Max, 2 Min
<b>Returned Variables</b>	None
<b>Comments</b>	An error is returned if the setting is out of range.

## Command Packet

Element	Type	Value	Description
TO	U8	0Xd0	
FROM	U8	(tbd)	
CONTROL	U16	0x0246	
STATUS	U16	(xxx)	Don't care, ignored by receiver
REF	U8	(tbd)	
LENGTH	U8	0x01	2 Bytes
DATA	[u8]		See content below
Data[0:1]			U16 – Step Rate Seek
LRC	U8	Calculated	

## Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
CONTROL	U16	0x0246	
STATUS	U16	(tbd)	
REF	U8	(tbd)	Echo of Command Packet REF
LENGTH	U8	0x00	
DATA	[u8]		See content below
Data[0]			Meaningless Dummy Byte
LRC	U8	Calculated	



## USB Stepper Motor Controller Function Protocol

## 5.4.30 Function: GPIO CONFIGURATION READ

## Function Summary

<b>Description</b>	Returns the General Purpose IO pin configurations
<b>Control Code</b>	0x0260
<b>Supplied Variables</b>	None
<b>Returned Variables</b>	GPIO-0 Config (u8) GPIO-1 Config (u8) GPIO-2 Config (u8) GPIO-3 Config (u8) GPIO-4 Config (u8) GPIO-5 Config (u8)
<b>Comments</b>	Refer to the GPIO Configuration Table

## Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
CONTROL	U16	0x0260	
STATUS	U16	(xxx)	Don't care, ignored by receiver
REF	U8	(tbd)	
LENGTH	U8	0x00	
DATA	[u8]		See content below
Data[0]			Meaningless Dummy Byte
LRC	U8	Calculated	

## Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
CONTROL	U16	0x0260	
STATUS	U16	(tbd)	
REF	U8	(tbd)	Echo of Command Packet REF
LENGTH	U8	0x05	6 Bytes
DATA	[u8]		See content below
Data[0]			U8 – GPIO-0 Config
Data[1]			U8 – GPIO-1 Config
Data[2]			U8 – GPIO-2 Config
Data[3]			U8 – GPIO-3 Config
Data[4]			U8 – GPIO-4 Config
Data[5]			U8 – GPIO-5 Config
LRC	U8	Calculated	

## USB Stepper Motor Controller Function Protocol

## 5.4.31 Function: GPIO CONFIGURATION WRITE (EE)

## Function Summary

<b>Description</b>	Sets the General Purpose IO pin configurations, and saves settings into non-volatile memory
<b>Control Code</b>	0x0261
<b>Supplied Variables</b>	GPIO-0 Config (u8) GPIO-1 Config (u8) GPIO-2 Config (u8) GPIO-3 Config (u8) GPIO-4 Config (u8) GPIO-5 Config (u8)
<b>Returned Variables</b>	None
<b>Comments</b>	Returns an error if Busy. Refer to the GPIO Configuration Table

## Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
CONTROL	U16	0x0261	
STATUS	U16	(xxx)	Don't care, ignored by receiver
REF	U8	(tbd)	
LENGTH	U8	0x05	6 Bytes
DATA	[u8]		See content below
Data[0]			U8 – GPIO-0 Config
Data[1]			U8 – GPIO-1 Config
Data[2]			U8 – GPIO-2 Config
Data[3]			U8 – GPIO-3 Config
Data[4]			U8 – GPIO-4 Config
Data[5]			U8 – GPIO-5 Config
LRC	U8	Calculated	

## Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
CONTROL	U16	0x0261	
STATUS	U16	(tbd)	
REF	U8	(tbd)	Echo of Command Packet REF
LENGTH	U8	0x00	
DATA	[u8]		See content below
Data[0]			Meaningless Dummy Byte
LRC	U8	Calculated	

## USB Stepper Motor Controller Function Protocol

## 5.4.31.1 GPIO Configuration Table

GPIO Configuration Table

GPIO	Configuration
<b>0</b>	<b>GPIO-0</b> 0 = Digital Input 1 = Digital Output 2 = Home Limit Input 3 = FWD Limit Input 4 = REV Limit Input 5 = Quadrature Encoder Phase-A Input 6 = Quadrature Encoder Phase-B Input
<b>1</b>	<b>GPIO-1</b> 0 = Digital Input 1 = Digital Output 2 = Home Limit Input 3 = FWD Limit Input 4 = REV Limit Input 5 = Quadrature Encoder Phase-A Input 6 = Quadrature Encoder Phase-B Input
<b>2</b>	<b>GPIO-2</b> 0 = Digital Input 1 = Digital Output 2 = Home Limit Input 3 = FWD Limit Input 4 = REV Limit Input
<b>3</b>	<b>GPIO-3</b> 0 = Digital Input 1 = Digital Output 2 = Home Limit Input 3 = FWD Limit Input 4 = REV Limit Input 5 = Counter/Timer Input
<b>4</b>	<b>GPIO-4</b> 0 = Digital Input 1 = Digital Output 2 = Home Limit Input 3 = FWD Limit Input 4 = REV Limit Input 5 = PWM Output
<b>5</b>	<b>GPIO-5</b> 0 = Analog Input to 10-Bit ADC, 4.096 VDC Reference. 1 = Analog Input to 10-Bit ADC, USB 5 VDC Reference.

## USB Stepper Motor Controller Function Protocol

## 5.4.32 Function: GPIO-DIO READ

## Function Summary

<b>Description</b>	Returns the GPIO-DIO pin logic states
<b>Control Code</b>	0x0262
<b>Supplied Variables</b>	None
<b>Returned Variables</b>	GPIO-DIO (u8)
<b>Comments</b>	U8 bits 0 through 4 maps to GPIO-DIO pins 0 through 4 respectively. Both input and output states are read.

## Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
CONTROL	U16	0x0262	
STATUS	U16	(xxx)	Don't care, ignored by receiver
REF	U8	(tbd)	
LENGTH	U8	0x00	
DATA	[u8]		See content below
Data[0]			Meaningless Dummy Byte
LRC	U8	Calculated	

## Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
CONTROL	U16	0x0262	
STATUS	U16	(tbd)	
REF	U8	(tbd)	Echo of Command Packet REF
LENGTH	U8	0x00	1 Byte
DATA	[u8]		See content below
Data[0]			U8 – GPIO-DIO
LRC	U8	Calculated	

## USB Stepper Motor Controller Function Protocol

## 5.4.33 Function: GPIO-DIO WRITE

## Function Summary

<b>Description</b>	Write the GPIO-DO output pin logic states
<b>Control Code</b>	0x0263
<b>Supplied Variables</b>	GPIO-DIO (u8)
<b>Returned Variables</b>	None
<b>Comments</b>	U8 bits 0 through 4 maps to GPIO-DO pin 0 through 4 respectively. Only those pins configured as outputs will be effected.

## Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
CONTROL	U16	0x0263	
STATUS	U16	(xxx)	Don't care, ignored by receiver
REF	U8	(tbd)	
LENGTH	U8	0x00	1 Byte
DATA	[u8]		See content below
Data[0]			U8 – GPIO-DO
LRC	U8	Calculated	

## Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
CONTROL	U16	0x0263	
STATUS	U16	(tbd)	
REF	U8	(tbd)	Echo of Command Packet REF
LENGTH	U8	0x00	
DATA	[u8]		See content below
Data[0]			Meaningless Dummy Byte
LRC	U8	Calculated	

## USB Stepper Motor Controller Function Protocol

## 5.4.34 Function: GPIO COUNTER READ

## Function Summary

<b>Description</b>	Returns the GPIO Counter information
<b>Control Code</b>	0x0264
<b>Supplied Variables</b>	None
<b>Returned Variables</b>	Period to go (u8) Count Period (u8) Counter (u32) Overflow (u8)
<b>Comments</b>	Returns an error if input not configured for counter operation. If the Period To Go is 0 and the Count Period is >0 and <255 then the period to go will be refreshed with the count period and the counter will be cleared at the end of this function.

## Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
CONTROL	U16	0x0264	
STATUS	U16	(xxx)	Don't care, ignored by receiver
REF	U8	(tbd)	
LENGTH	U8	0x00	
DATA	[u8]		See content below
Data[0]			Meaningless Dummy Byte
LRC	U8	Calculated	

## Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
CONTROL	U16	0x0264	
STATUS	U16	(tbd)	
REF	U8	(tbd)	Echo of Command Packet REF
LENGTH	U8	0x06	7 Bytes
DATA	[u8]		See content below
Data[0] Data[1] Data[2:5] Data[6]			U8 – Period To Go U8 – Count Period U32 – Counter U8 – Counter Overflow; 1 = Overflow, 0 = OK
LRC	U8	Calculated	

## USB Stepper Motor Controller Function Protocol

## 5.4.35 Function: GPIO COUNTER WRITE

## Function Summary

<b>Description</b>	Sets the counter period
<b>Control Code</b>	0x0265
<b>Supplied Variables</b>	Count Period in milliseconds (u8) -- 0 = OFF, 255 = Always Counting, else N Milliseconds
<b>Returned Variables</b>	None
<b>Comments</b>	Returns an error if input not configured for counter operation.

## Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	Non-zero, (tbd) by sender
CONTROL	U16	0x0265	
STATUS	U16	(xxx)	Don't care, ignored by receiver
REF	U8	(tbd)	(tbd) by sender
LENGTH	U8	0x00	1 Byte
DATA	[u8]		See content below
Data[0]			U8 – Count Period
LRC	U8	Calculated	

## Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
CONTROL	U16	0x0265	
STATUS	U16	(tbd)	
REF	U8	(tbd)	Echo of Command Packet REF
LENGTH	U8	0x00	
DATA	[u8]		See content below
Data[0]			Meaningless Dummy Byte
LRC	U8	Calculated	

## USB Stepper Motor Controller Function Protocol

## 5.4.36 Function: PWM SET POINT WRITE

## Function Summary

<b>Description</b>	Sets the set point of the PWM frequency and duty cycle
<b>Control Code</b>	0x0270
<b>Supplied Variables</b>	Frequency (Hz) (SGL) Duty Cycle (%) (SGL)
<b>Returned Variables</b>	None <b>(DEBUG: returns 4 bytes for engineering verification. To be removed after completion of DVT and prior to final release)</b>
<b>Comments</b>	Device will coerce the set point into the closest possible setting.

## Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
CONTROL	U16	0x0270	
STATUS	U16	(xxx)	Don't care, ignored by receiver
REF	U8	(tbd)	
LENGTH	U8	0x07	8 Bytes
DATA	[u8]		see contents below
Data[0:3]			SGL – Frequency
Data[4:7]			SGL – Duty Cycle
LRC	U8	Calculated	

## Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
CONTROL	U16	0x0270	
STATUS	U16	(tbd)	
REF	U8	(tbd)	Echo of Command Packet REF
LENGTH	U8	0x00 0x03	4 Bytes
DATA	[u8]		See content below
Data[0]			Meaningless Dummy Byte U8 – Prescale U8 – Frequency U16 – Duty Period
LRC	U8	Calculated	



## USB Stepper Motor Controller Function Protocol

## 5.4.37 Function: PWM SET POINT WRITE (EE)

## Function Summary

<b>Description</b>	Sets the set point of the PWM frequency and duty cycle to EEPROM
<b>Control Code</b>	0x0271
<b>Supplied Variables</b>	Frequency (Hz) (SGL) Duty Cycle (%) (SGL)
<b>Returned Variables</b>	None <b>(DEBUG: returns 4 bytes for engineering verification. To be removed after completion of DVT and prior to final release)</b>
<b>Comments</b>	Device will coerce the set point into the closest possible setting.

## Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
CONTROL	U16	0x0271	
STATUS	U16	(xxx)	Don't care, ignored by receiver
REF	U8	(tbd)	
LENGTH	U8	0x07	8 Bytes
DATA	[u8]		see contents below
Data[0:3]			SGL – Frequency
Data[4:7]			SGL – Duty Cycle
LRC	U8	Calculated	

## Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
CONTROL	U16	0x0271	
STATUS	U16	(tbd)	
REF	U8	(tbd)	Echo of Command Packet REF
LENGTH	U8	0x00 0x03	4 Bytes
DATA	[u8]		See content below
Data[0]			Meaningless Dummy Byte U8 – Prescale U8 – Frequency U16 – Duty Period
LRC	U8	Calculated	

## USB Stepper Motor Controller Function Protocol

## 5.4.38 Function: PWM SET POINT READ

## Function Summary

<b>Description</b>	Reads the set point of the PWM frequency and duty cycle
<b>Control Code</b>	0x0276
<b>Supplied Variables</b>	None
<b>Returned Variables</b>	Frequency (Hz) (SGL) Duty Cycle (%) (SGL)
<b>Comments</b>	

## Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
CONTROL	U16	0x0276	
STATUS	U16	(xxx)	Don't care, ignored by receiver
REF	U8	(tbd)	
LENGTH	U8	0x00	
DATA	[u8]		See content below
Data[0]			Meaningless Dummy Byte
LRC	U8	Calculated	

## Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
CONTROL	U16	0x0276	
STATUS	U16	(tbd)	
REF	U8	(tbd)	Echo of Command Packet REF
LENGTH	U8	0x07	8 Bytes
DATA	[u8]		see contents below
Data[0:3]			SGL – Frequency
Data[4:7]			SGL – Duty Cycle
LRC	U8	Calculated	

## USB Stepper Motor Controller Function Protocol

## 5.4.39 Function: PWM SET POINT READ EE

## Function Summary

<b>Description</b>	Reads the set point of the PWM frequency and duty cycle from EEPROM
<b>Control Code</b>	0x0277
<b>Supplied Variables</b>	None
<b>Returned Variables</b>	Frequency (Hz) (SGL) Duty Cycle (%) (SGL)
<b>Comments</b>	

## Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
CONTROL	U16	0x0277	
STATUS	U16	(xxx)	Don't care, ignored by receiver
REF	U8	(tbd)	
LENGTH	U8	0x00	
DATA	[u8]		See content below
Data[0]			Meaningless Dummy Byte
LRC	U8	Calculated	

## Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
CONTROL	U16	0x0277	
STATUS	U16	(tbd)	
REF	U8	(tbd)	Echo of Command Packet REF
LENGTH	U8	0x07	8 Bytes
DATA	[u8]		see contents below
Data[0:3]			SGL – Frequency
Data[4:7]			SGL – Duty Cycle
LRC	U8	Calculated	

## USB Stepper Motor Controller Function Protocol

## 5.4.40 Function: PWM ACTUAL READ

## Function Summary

<b>Description</b>	Reads the actual PWM frequency and duty cycle
<b>Control Code</b>	0x0278
<b>Supplied Variables</b>	None
<b>Returned Variables</b>	Frequency (Hz) (SGL) Duty Cycle (%) (SGL)
<b>Comments</b>	

## Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
CONTROL	U16	0x0278	
STATUS	U16	(xxx)	Don't care, ignored by receiver
REF	U8	(tbd)	
LENGTH	U8	0x00	
DATA	[u8]		See content below
Data[0]			Meaningless Dummy Byte
LRC	U8	Calculated	

## Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
CONTROL	U16	0x0278	
STATUS	U16	(tbd)	
REF	U8	(tbd)	Echo of Command Packet REF
LENGTH	U8	0x07	8 Bytes
DATA	[u8]		see contents below
Data[0:3]			SGL – Frequency
Data[4:7]			SGL – Duty Cycle
LRC	U8	Calculated	

## USB Stepper Motor Controller Function Protocol

## 5.4.41 Function: PWM ACTUAL READ EE

## Function Summary

<b>Description</b>	Reads the actual PWM frequency and duty cycle from EEPROM
<b>Control Code</b>	0x0279
<b>Supplied Variables</b>	None
<b>Returned Variables</b>	Frequency (Hz) (SGL) Duty Cycle (%) (SGL)
<b>Comments</b>	Following initial connection of the module to USB, or following a reset command, the PWM output, if configured, will output the frequency and duty cycle indicated by this function.

## Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
CONTROL	U16	0x0279	
STATUS	U16	(xxx)	Don't care, ignored by receiver
REF	U8	(tbd)	
LENGTH	U8	0x00	
DATA	[u8]		See content below
Data[0]			Meaningless Dummy Byte
LRC	U8	Calculated	

## Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
CONTROL	U16	0x0279	
STATUS	U16	(tbd)	
REF	U8	(tbd)	Echo of Command Packet REF
LENGTH	U8	0x07	8 Bytes
DATA	[u8]		see contents below
Data[0:3] Data[4:7]			SGL – Frequency SGL – Duty Cycle
LRC	U8	Calculated	

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USB Stepper Motor Controller Function Protocol**5.4.41.1 PWM Frequency Settings**

## PWM Frequency Range

High Range: 10 MHz – 39 KHz, frequency expressed in KHz

Med Range: 2.5 MHz – 9 KHz, frequency expressed in KHz

Low Range: 625 KHz – 2441 Hz, frequency expressed in Hz

## Duty Cycle

0 – 100%

As the frequency in a given range increases, the accuracy of the duty cycle decreases. At the highest frequency of each range the resolution of the duty cycle is 4 steps; 100% (always outputs a 1), 75%, 50%, 25%, and 0% (always outputs a 0).

## USB Stepper Motor Controller Function Protocol

## 5.4.42 Function: STEP GPIO-ADC GET

## Function Summary

<b>Description</b>	Reads the GPIO analog input
<b>Control Code</b>	0x026F
<b>Supplied Variables</b>	None
<b>Returned Variables</b>	GPIO-AI in millivolts (u16)
<b>Comments</b>	

## Command Packet

<b>Element</b>	<b>Type</b>	<b>Value</b>	<b>Description</b>
TO	U8	0xD0	
FROM	U8	(tbd)	
CONTROL	U16	0x026F	
STATUS	U16	(xxx)	Don't care, ignored by receiver
REF	U8	(tbd)	
LENGTH	U8	0	
DATA	[u8]		See content below
Data[0]			Meaningless Dummy Byte
DATA	[u8]	None	
LRC	U8	Calculated	

## Response Packet

<b>Element</b>	<b>Type</b>	<b>Value</b>	<b>Description</b>
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
CONTROL	U16	0x026F	
STATUS	U16	(tbd)	
REF	U8	(tbd)	Echo of Command Packet REF
LENGTH	U8	2	
DATA	[u8]		See content below
Data[0] Data[1]			U16 – GPIO-AI, Bits[15:8] U16 – GPIO-AI, Bits[7:0]
LRC	U8	Calculated	