

Test Instrument Module System

USB Stepper Motor Controller

Model: TIMS-0201

Function Protocol

Software Specification

**Review Copy
Not Released**

USB Stepper Motor Controller Function Protocol**Revision History**

<i>ECO</i>	<i>Revision</i>	<i>Change Description</i>	<i>Date</i>	<i>Initial</i>
	01	Initial Draft	4/29/2004	GSH

USB Stepper Motor Controller Function Protocol

Table of Contents

1	INTRODUCTION	5
2	SCOPE	5
3	CONTACT INFORMATION	5
3.1	Sales and Support	5
4	REFERENCE DOCUMENTS	6
5	SPECIFICATION	7
5.1	General.....	7
5.1.1	Protocol Layer-1: Physical Layer.....	7
5.2	Control Functions.....	8
5.2.1	Function: STOP	11
5.2.2	Function: SINGLE STEP	15
5.2.3	Function: CONTINUOUS STEPPING	16
5.2.4	Function: SEEK HOME	17
5.2.5	Function: SEEK LIMIT	18
5.2.6	Function: MOVE ABSOLUTE	19
5.2.7	Function: MOVE RELATIVE	20
5.2.8	Function: GET STATUS	12
5.2.8.1	Status Flags Table	13
5.2.9	Function: SET POSITION – STEP COUNT	21
5.2.10	Function: GET POSITION – STEP COUNT	22
5.2.11	Function: SET POSITION – ENCODER COUNT	23
5.2.12	Function: GET POSITION – ENCODER COUNT	24
5.2.13	Function: GET TARGET POSITION	25
5.2.14	Function: SET SOFT POSITION LIMITS	26
5.2.15	Function: GET SOFT POSITION LIMITS	27
5.2.16	Function: SET STEP MODE.....	28
5.2.17	Function: SET MOVE COUNTER MODE	29
5.2.18	Function: SET SOFT LIMITS MODE.....	30
5.2.19	Function: SET MOTOR CURRENT LIMIT	31
5.2.20	Function: GET MOTOR CURRENT LIMIT	32
5.2.21	Function: MEASURE MOTOR POWER.....	33
5.2.22	Function: SET GPIO CONFIG.....	40
5.2.22.1	GPIO Configuration Table	41
5.2.23	Function: WRITE GPIO-DO.....	42
5.2.24	Function: READ GPIO-DIO	43
5.2.25	Function: SET GPIO-COUNTER PERIOD	44

USB Stepper Motor Controller Function Protocol

5.2.26	Function: READ GPIO-COUNTER.....	45
5.2.27	Function: READ GPIO-TIMER/COUNTER	Error! Bookmark not defined.
5.2.28	Function: SET GPIO-PWM CONFIG.....	52
5.2.29	Function: GET GPIO-PWM CONFIG	53
5.2.30	Function: READ GPIO-AI	54

USB Stepper Motor Controller Function Protocol

1 INTRODUCTION

This specification provides the necessary information to design, develop, manufacture, use and maintain the WireWorks West model TIMS-0201, Stepper Motor Controller, module control software.

2 SCOPE

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

3 CONTACT INFORMATION

3.1 SALES AND SUPPORT

WireWorks West, Inc.
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San Francisco, CA 94103

415-348-1400 Office
415-348-1414 Fax
415-348-1408 Technical Support
800-755-1400 Toll Free Sales

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USB Stepper Motor Controller Function Protocol

4 REFERENCE DOCUMENTS

<i>Description</i>	<i>Doc. No</i>	<i>Company/Author</i>	<i>Rev/Date</i>
SW Spec, SAMCOM	181-0001-xx	WWW/GSH	

USB Stepper Motor Controller Function Protocol

5 SPECIFICATION

5.1 GENERAL

This subsection will present certain consideration, 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.

- ☐ Serial data stream 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 CONTROL FUNCTIONS

TIMS-0201 Module Function Summary

Function	Control Code	Comment
No Operation	0x00	Unused Code Status = Unknown Code
User Defaults	0x0D	
Factory Defaults	0x0F	
Get Status	0x10	
Stop	0x11	
Break	0x12	Reserved for future operation
Single Step Fwd/Rev	0x13	
Continuous Stepping Fwd/Rev	0x14	
Seek Home Fwd/Rev	0x15	
Seek Limit Fwd/Rev	0x16	
Move to Absolute Position	0x17	
Move to Relative Position	0x18	
Set Position (Step Count)	0x20	
Get Position (Step Count)	0x21	
Set Position (Encoder Count)	0x22	
Get Position (Encoder Count)	0x23	
Get Target Position	0x24	
Save Soft Limits	0x26	
Get Soft Limits	0x27	
Set Step Mode	0x28	Half/Full Step
Set Counter Mode	0x2A	Encoder/Step Count
Set Soft Limits Mode	0x2C	Enable/Disable
Set Motor Current Limit	0x30	
Get Motor Current Limit	0x31	
Measure Motor Voltage & Winding Currents	0x32	

USB Stepper Motor Controller Function Protocol

TIMS-0201 Module Specific Functions con't

Function	Control Code	Comment
Save Seek Step Rate	0x40	
Set Seek Step Rate	0x41	
Get Seek Step Rate	0x42	
Save Normal Step Rate	0x44	
Set Normal Step Rate	0x45	
Get Normal Step Rate	0x46	
Save GPIO Configuration	0x60	
Get GPIO Configuration	0x61	
Write GPIO-DIO	0x62	
Read GPIO-DIO	0x63	
Set GPIO-Counter Period	0x64	
Read GPIO-Counter	0x65	
Save PWM Frequency	0x68	
Set PWM Frequency	0x69	
Get PWM Frequency	0x6A	
Save PWM Registers	0x6B	
Set PWM Registers	0x6C	
Get PWM Registers	0x6D	
Read GPIO-ADC	0x6F	

USB Stepper Motor Controller Function Protocol

5.3.1 Function: USER DEFAULTS

Function Summary

Description	Restores the users defined operating settings from non-volatile memory.
Control Code	0x0D
Supplied Variables	None
Returned Variables	None
Comments	

Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
REF	U8	(tbd)	
CONTROL	U8	0x0D	
STATUS	U8	(xxx)	Don't care, ignored by receiver
Data_Length	U8	0	
DATA	[u8]	none	

Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
REF	U8	(tbd)	Echo of Command Packet REF
CONTROL	U8	0x0D	
STATUS	U8	(tbd)	
Data_Length	U8	0	
DATA	[u8]	none	

USB Stepper Motor Controller Function Protocol

5.3.2 Function: FACTORY DEFAULTS

Function Summary

Description	Restores factory default setting into non-volatile memory.
Control Code	0x0F
Supplied Variables	None
Returned Variables	None
Comments	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)	
REF	U8	(tbd)	
CONTROL	U8	0x0F	
STATUS	U8	(xxx)	Don't care, ignored by receiver
Data_Length	U8	0	
DATA	[u8]	none	

Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
REF	U8	(tbd)	Echo of Command Packet REF
CONTROL	U8	0x0F	
STATUS	U8	(tbd)	
Data_Length	U8	0	
DATA	[u8]	none	

USB Stepper Motor Controller Function Protocol

5.3.3 Function: GET STATUS

Function Summary

Description	Get controller status flags
Control Code	0x20
Supplied Variables	None
Returned Variables	Status Flags (U16)
Comments	Refer to Status Flags table

Command Packet

<i>Element</i>	<i>Type</i>	<i>Value</i>	<i>Description</i>
TO	U8	0xD0	
FROM	U8	(tbd)	
REF	U8	(tbd)	
CONTROL	U8	0x20	
STATUS	U8	(xxx)	Don't care, ignored by receiver
Data_Length	U8	0	
DATA	[u8]	none	

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	
REF	U8	(tbd)	Echo of Command Packet REF
CONTROL	U8	0x20	
STATUS	U8	(tbd)	
Data_Length	U8	2	
DATA	[u8]		See content below
Data[0]			U16 – Status Flags, Bits[15:8]
Data[1]			U16 – Status Flags, Bits[7:0]

USB Stepper Motor Controller Function Protocol

5.3.3.1 Status Flags Table

Status Flags Table

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

USB Stepper Motor Controller Function Protocol

5.3.4 Function: STOP

Function Summary

Description	Stops motor stepping operation
Control Code	0x11
Supplied Variables	None
Returned Variables	None
Comments	

Command Packet

<i>Element</i>	<i>Type</i>	<i>Value</i>	<i>Description</i>
TO	U8	0xD0	
FROM	U8	(tbd)	
REF	U8	(tbd)	
CONTROL	U8	0x11	
STATUS	U8	(xxx)	Don't care, ignored by receiver
Data_Length	U8	0	
DATA	[u8]	none	

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	
REF	U8	(tbd)	Echo of Command Packet REF
CONTROL	U8	0x11	
STATUS	U8	(tbd)	
Data_Length	U8	0	
DATA	[u8]	none	

USB Stepper Motor Controller Function Protocol

5.3.5 Function: SINGLE STEP

Function Summary

Description	Performs a single step in either the forward or reverse direction
Control Code	0x13
Supplied Variables	Direction (u8)
Returned Variables	None
Comments	<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)	
REF	U8	(tbd)	
CONTROL	U8	0x13	
STATUS	U8	(xxx)	Don't care, ignored by receiver
Data_Length	U8	1	
DATA	[u8]		See content below
Data[0]			U8 - Direction: 0 = REV, else FWD

Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
REF	U8	(tbd)	Echo of Command Packet REF
CONTROL	U8	0x13	
STATUS	U8	(tbd)	
Data_Length	U8	0	
DATA	[u8]	none	

USB Stepper Motor Controller Function Protocol

5.3.6 Function: CONTINUOUS STEPPING

Function Summary

Description	Performs continuous stepping in either the forward or reverse direction
Control Code	0x14
Supplied Variables	Direction (u8)
Returned Variables	None
Comments	Performs either a full or half step depending on the Full/Half Step Mode. Uses Normal step rate. Returns an error if Busy. Stops if Stepping FWD and reaches FWD Limit. Stops if Stepping REV and reaches REV Limit.

Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
REF	U8	(tbd)	
CONTROL	U8	0x14	
STATUS	U8	(xxx)	Don't care, ignored by receiver
Data_Length	U8	1	
DATA	[u8]		See content below
Data[0]			U8 - Direction: 0 = REV, else FWD

Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
REF	U8	(tbd)	Echo of Command Packet REF
CONTROL	U8	0x14	
STATUS	U8	(tbd)	
Data_Length	U8	0	
DATA	[u8]	none	

USB Stepper Motor Controller Function Protocol

5.3.7 Function: SEEK HOME

Function Summary

Description	Performs continuous stepping in either the forward or reverse direction until home detected
Control Code	0x15
Supplied Variables	Direction (u8)
Returned Variables	none
Comments	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)	
REF	U8	(tbd)	
CONTROL	U8	0x15	
STATUS	U8	(xxx)	Don't care, ignored by receiver
Data_Length	U8	1	
DATA	[u8]		See content below
Data[0]			U8 - Direction: 0 = REV, else FWD

Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
REF	U8	(tbd)	Echo of Command Packet REF
CONTROL	U8	0x15	
STATUS	U8	(tbd)	
Data_Length	U8	0	
DATA	[u8]	none	

USB Stepper Motor Controller Function Protocol

5.3.8 Function: SEEK LIMIT

Function Summary

Description	Performs continuous stepping in either the forward or reverse direction until either the FWD or REV limit, as indicated by direction, is detected
Control Code	0x16
Supplied Variables	Direction (u8)
Returned Variables	None
Comments	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)	
REF	U8	(tbd)	
CONTROL	U8	0x16	
STATUS	U8	(xxx)	Don't care, ignored by receiver
Data_Length	U8	1	
DATA	[u8]		See content below
Data[0]			U8 - Direction: 0 = REV, else FWD

Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
REF	U8	(tbd)	Echo of Command Packet REF
CONTROL	U8	0x16	
STATUS	U8	(tbd)	
Data_Length	U8	0	
DATA	[u8]	none	

USB Stepper Motor Controller Function Protocol

5.3.9 Function: MOVE ABSOLUTE

Function Summary

Description	Initiates stepping to a specified position
Control Code	0x17
Supplied Variables	Absolute Position (i32)
Returned Variables	Target Position (i32)
Comments	<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)	
REF	U8	(tbd)	
CONTROL	U8	0x17	
STATUS	U8	(xxx)	Don't care, ignored by receiver
Data_Length	U8	4	
DATA	[u8]		See content below
Data[0]			I32 - Absolute Position, Bits[31:24]
Data[1]			I32 - Absolute Position, Bits[23:16]
Data[2]			I32 - Absolute Position, Bits[15:8]
Data[3]			I32 - Absolute Position, Bits[7:0]

Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
REF	U8	(tbd)	Echo of Command Packet REF
CONTROL	U8	0x17	
STATUS	U8	(tbd)	
Data_Length	U8	4	
DATA	[u8]		See content below
Data[0]			I32 - Target Position, Bits[31:24]
Data[1]			I32 - Target Position, Bits[23:16]
Data[2]			I32 - Target Position, Bits[15:8]
Data[3]			I32 - Target Position, Bits[7:0]

USB Stepper Motor Controller Function Protocol

5.3.10 Function: MOVE RELATIVE

Function Summary

Description	Initiates stepping to a position relative to the current position
Control Code	0x18
Supplied Variables	Relative Position (i32)
Returned Variables	Target Position (i32)
Comments	<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)	
REF	U8	(tbd)	
CONTROL	U8	0x18	
STATUS	U8	(xxx)	Don't care, ignored by receiver
Data_Length	U8	4	
DATA	[u8]		See content below
Data[0]			I32 - Relative Position, Bits[31:24]
Data[1]			I32 - Relative Position, Bits[23:16]
Data[2]			I32 - Relative Position, Bits[15:8]
Data[3]			I32 - Relative Position, Bits[7:0]

Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
REF	U8	(tbd)	Echo of Command Packet REF
CONTROL	U8	0x18	
STATUS	U8	(tbd)	
Data_Length	U8	4	
DATA	[u8]		See content below
Data[0]			I32 - Target Position, Bits[31:24]
Data[1]			I32 - Target Position, Bits[23:16]
Data[2]			I32 - Target Position, Bits[15:8]
Data[3]			I32 - Target Position, Bits[7:0]

USB Stepper Motor Controller Function Protocol

5.3.11 Function: SET POSITION – STEP COUNT

Function Summary

Description	Sets the step count value for the current motor position
Control Code	0x20
Supplied Variables	New Step Count (i32)
Returned Variables	None
Comments	Step Position in half step units Returns an error if Busy.

Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
REF	U8	(tbd)	
CONTROL	U8	0x20	
STATUS	U8	(xxx)	Don't care, ignored by receiver
Data_Length	U8	4	
DATA	[u8]		See content below
Data[0]			I32 – New Step Count, Bits[31:24]
Data[1]			I32 – New Step Count, Bits[23:16]
Data[2]			I32 – New Step Count, Bits[15:8]
Data[3]			I32 – New Step Count, Bits[7:0]

Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
REF	U8	(tbd)	Echo of Command Packet REF
CONTROL	U8	0x20	
STATUS	U8	(tbd)	
Data_Length	U8	0	
DATA	[u8]	none	

USB Stepper Motor Controller Function Protocol

5.3.12 Function: GET POSITION – STEP COUNT

Function Summary

Description	Gets the step count value for the current motor position
Control Code	0x21
Supplied Variables	None
Returned Variables	Current Step Count (i32)
Comments	Step Position in half step units

Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
REF	U8	(tbd)	
CONTROL	U8	0x21	
STATUS	U8	(xxx)	Don't care, ignored by receiver
Data_Length	U8	0	
DATA	[u8]	none	

Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
REF	U8	(tbd)	Echo of Command Packet REF
CONTROL	U8	0x21	
STATUS	U8	(tbd)	
Data_Length	U8	4	
DATA	[u8]		See content below
Data[0]			I32 – Current Step Count, Bits[31:24]
Data[1]			I32 – Current Step Count, Bits[23:16]
Data[2]			I32 – Current Step Count, Bits[15:8]
Data[3]			I32 – Current Step Count, Bits[7:0]

USB Stepper Motor Controller Function Protocol

5.3.13 Function: SET POSITION – ENCODER COUNT

Function Summary

Description	Sets the encoder count value for the current motor position
Control Code	0x22
Supplied Variables	New Encoder Count (i32)
Returned Variables	None
Comments	Returns an error if Busy.

Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
REF	U8	(tbd)	
CONTROL	U8	0x22	
STATUS	U8	(xxx)	Don't care, ignored by receiver
Data_Length	U8	4	
DATA	[u8]		See content below
Data[0]			I32 – New Encoder Count, Bits[31:24]
Data[1]			I32 – New Encoder Count, Bits[23:16]
Data[2]			I32 – New Encoder Count, Bits[15:8]
Data[3]			I32 – New Encoder Count, Bits[7:0]

Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
REF	U8	(tbd)	Echo of Command Packet REF
CONTROL	U8	0x22	
STATUS	U8	(tbd)	
Data_Length	U8	0	
DATA	[u8]	None	

USB Stepper Motor Controller Function Protocol

5.3.14 Function: GET POSITION – ENCODER COUNT

Function Summary

Description	Gets the encoder count value for the current motor position
Control Code	0x23
Supplied Variables	None
Returned Variables	Current Encoder Count (i32)
Comments	

Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
REF	U8	(tbd)	
CONTROL	U8	0x23	
STATUS	U8	(xxx)	Don't care, ignored by receiver
Data_Length	U8	0	
DATA	[u8]	None	

Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
REF	U8	(tbd)	Echo of Command Packet REF
CONTROL	U8	0x23	
STATUS	U8	(tbd)	
Data_Length	U8	4	
DATA	[u8]		See content below
Data[0]			I32 – Current Encoder Count, Bits[31:24]
Data[1]			I32 – Current Encoder Count, Bits[23:16]
Data[2]			I32 – Current Encoder Count, Bits[15:8]
Data[3]			I32 – Current Encoder Count, Bits[7:0]

USB Stepper Motor Controller Function Protocol

5.3.15 Function: GET TARGET POSITION

Function Summary

Description	Gets the target position value computed by the last move command
Control Code	0x24
Supplied Variables	None
Returned Variables	Target Position (i32)
Comments	

Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
REF	U8	(tbd)	
CONTROL	U8	0x24	
STATUS	U8	(xxx)	Don't care, ignored by receiver
Data_Length	U8	0	
DATA	[u8]	none	

Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
REF	U8	(tbd)	Echo of Command Packet REF
CONTROL	U8	0x24	
STATUS	U8	(tbd)	
Data_Length	U8	4	
DATA	[u8]		See content below
Data[0]			I32 – Target Position, Bits[31:24]
Data[1]			I32 – Target Position, Bits[23:16]
Data[2]			I32 – Target Position, Bits[15:8]
Data[3]			I32 – Target Position, Bits[7:0]

USB Stepper Motor Controller Function Protocol

5.3.16 Function: SAVE SOFT POSITION LIMITS

Function Summary

Description	Sets the soft FWD and REV limits for motor position, and saves the values into non-volatile memory.
Control Code	0x26
Supplied Variables	New Max Soft Position (i32) New Min Soft Position (i32)
Returned Variables	none
Comments	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)	
REF	U8	(tbd)	
CONTROL	U8	0x26	
STATUS	U8	(xxx)	Don't care, ignored by receiver
Data_Length	U8	8	
DATA	[u8]		See content below
Data[0]			I32 – New Max Soft Limit, Bits[31:24]
Data[1]			I32 – New Max Soft Limit, Bits[23:16]
Data[2]			I32 – New Max Soft Limit, Bits[15:8]
Data[3]			I32 – New Max Soft Limit, Bits[7:0]
Data[4]			I32 – New Min Soft Limit, Bits[31:24]
Data[5]			I32 – New Min Soft Limit, Bits[23:16]
Data[6]			I32 – New Min Soft Limit, Bits[15:8]
Data[7]			I32 – New Min Soft Limit, Bits[7:0]

Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
REF	U8	(tbd)	Echo of Command Packet REF
CONTROL	U8	0x23	
STATUS	U8	(tbd)	
Data_Length	U8	0	
DATA	[u8]	None	

USB Stepper Motor Controller Function Protocol

5.3.17 Function: GET SOFT POSITION LIMITS

Function Summary

Description	Returns the soft Fwd and Rev limits for motor position
Control Code	0x27
Supplied Variables	None
Returned Variables	Max Soft Position (i32) Min Soft Position (i32)
Comments	

Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
REF	U8	(tbd)	
CONTROL	U8	0x27	
STATUS	U8	(xxx)	Don't care, ignored by receiver
Data_Length	U8	0	
DATA	[u8]	None	

Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
REF	U8	(tbd)	Echo of Command Packet REF
CONTROL	U8	0x27	
STATUS	U8	(tbd)	
Data_Length	U8	8	
DATA	[u8]		See content below
Data[0]			I32 – Max Soft Limit, Bits[31:24]
Data[1]			I32 – Max Soft Limit, Bits[23:16]
Data[2]			I32 – Max Soft Limit, Bits[15:8]
Data[3]			I32 – Max Soft Limit, Bits[7:0]
Data[4]			I32 – Min Soft Limit, Bits[31:24]
Data[5]			I32 – Min Soft Limit, Bits[23:16]
Data[6]			I32 – Min Soft Limit, Bits[15:8]
Data[7]			I32 – Min Soft Limit, Bits[7:0]

USB Stepper Motor Controller Function Protocol

5.3.18 Function: SET STEP MODE

Function Summary

Description	Sets the state of the Step Mode (Half/Full)
Control Code	0x28
Supplied Variables	New Step Mode State (u8)
Returned Variables	None
Comments	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)	
REF	U8	(tbd)	
CONTROL	U8	0x28	
STATUS	U8	(xxx)	Don't care, ignored by receiver
Data_Length	U8	1	
DATA	[u8]		See content below
Data[0]			U8 - Step Mode: 0 = Full, else = Half

Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
REF	U8	(tbd)	Echo of Command Packet REF
CONTROL	U8	0x28	
STATUS	U8	(tbd)	
Data_Length	U8	0	
DATA	[u8]	None	

USB Stepper Motor Controller Function Protocol

5.3.19 Function: SET MOVE COUNTER MODE

Function Summary

Description	Sets, the counter to use for move functions (Encoder/Step)
Control Code	0x29
Supplied Variables	New Move Counter Mode State (u8)
Returned Variables	None
Comments	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)	
REF	U8	(tbd)	
CONTROL	U8	0x29	
STATUS	U8	(xxx)	Don't care, ignored by receiver
Data_Length	U8	1	
DATA	[u8]		See content below
Data[0]			U8 – Move Counter Mode: 0 = Step, else Encoder

Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
REF	U8	(tbd)	Echo of Command Packet REF
CONTROL	U8	0x29	
STATUS	U8	(tbd)	
Data_Length	U8	0	
DATA	[u8]	None	

USB Stepper Motor Controller Function Protocol

5.3.20 Function: SET SOFT LIMITS MODE

Function Summary

Description	Sets the soft limits mode, enable or disable the use if soft limits.
Control Code	0x2A
Supplied Variables	Soft Limits Mode (u8)
Returned Variables	
Comments	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)	
REF	U8	(tbd)	
CONTROL	U8	0x2A	
STATUS	U8	(xxx)	Don't care, ignored by receiver
Data_Length	U8	1	
DATA	[u8]		See content below
Data[0]			U8 – Soft Limits Mode: 0 = Disable, else Enable

Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
REF	U8	(tbd)	Echo of Command Packet REF
CONTROL	U8	0x2A	
STATUS	U8	(tbd)	
Data_Length	U8	0	
DATA	[u8]	None	

USB Stepper Motor Controller Function Protocol

5.3.21 Function: SET MOTOR CURRENT LIMIT

Function Summary

Description	Set the motor current limit.
Control Code	0x30
Supplied Variables	Current Limit (u8)
Returned Variables	None
Comments	Motor 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)	
REF	U8	(tbd)	
CONTROL	U8	0x30	
STATUS	U8	(xxx)	Don't care, ignored by receiver
Data_Length	U8	1	
DATA	[u8]		See content below
Data[0]			U8 – Current Limit

Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
REF	U8	(tbd)	Echo of Command Packet REF
CONTROL	U8	0x30	
STATUS	U8	(tbd)	
Data_Length	U8	0	
DATA	[u8]	None	

USB Stepper Motor Controller Function Protocol

5.3.22 Function: GET MOTOR CURRENT LIMIT

Function Summary

Description	Returns the motor current limit.
Control Code	0x31
Supplied Variables	None
Returned Variables	Current Limit (u8)
Comments	Motor current limit is expressed percentage from 0% to 100%.

Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
REF	U8	(tbd)	
CONTROL	U8	0x31	
STATUS	U8	(xxx)	Don't care, ignored by receiver
Data_Length	U8	0	
DATA	[u8]	None	

Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
REF	U8	(tbd)	Echo of Command Packet REF
CONTROL	U8	0x31	
STATUS	U8	(tbd)	
Data_Length	U8	1	
DATA	[u8]		See content below
Data[0]			U8 – Current Limit

USB Stepper Motor Controller Function Protocol

5.3.23 Function: MEASURE MOTOR POWER

Function Summary

Description	Returns the motor source voltage and winding currents.
Control Code	0x32
Supplied Variables	None
Returned Variables	Motor Source Voltage in millivolts (u16) Motor Winding-A Current in milliamps (u16) Motor Winding-B Current in milliamps (u16)
Comments	

Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
REF	U8	(tbd)	
CONTROL	U8	0x32	
STATUS	U8	(xxx)	Don't care, ignored by receiver
Data_Length	U8	0	
DATA	[u8]	None	

Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
REF	U8	(tbd)	Echo of Command Packet REF
CONTROL	U8	0x32	
STATUS	U8	(tbd)	
Data_Length	U8	6	
DATA	[u8]		See content below
Data[0] Data[1]			U16 – Motor Voltage, Bits[15:8] U16 – Motor Voltage, Bits[7:0]
Data[2] Data[3]			U16 – Winding-A Current, Bits[15:8] U16 – Winding-A Current, Bits[7:0]
Data[4] Data[5]			U16 – Winding-B Current, Bits[15:8] U16 – Winding-B Current, Bits[7:0]

USB Stepper Motor Controller Function Protocol

5.3.24 Function: SAVE NORMAL STEP RATE

Function Summary

Description	Set the step rate for normal stepping operations, and saves the setting into non-volatile memory.
Control Code	0x40
Supplied Variables	Steps/Sec (u16) - Range: 4000 Max, 2 Min
Returned Variables	None
Comments	An error is returned if the setting is out of range.

Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
REF	U8	(tbd)	
CONTROL	U8	0x40	
STATUS	U8	(xxx)	Don't care, ignored by receiver
Data_Length	U8	2	
DATA	[u8]		See content below
Data[0]			U16 – Steps/Sec, Bits[15:8]
Data[1]			U16 – Steps/Sec, Bits[7:0]

Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
REF	U8	(tbd)	Echo of Command Packet REF
CONTROL	U8	0x40	
STATUS	U8	(tbd)	
Data_Length	U8	0	
DATA	[u8]	None	

USB Stepper Motor Controller Function Protocol

5.3.25 Function: SET NORMAL STEP RATE

Function Summary

Description	Set the step rate for normal stepping operations
Control Code	0x41
Supplied Variables	Steps/Sec (u16) - Range: 4000 Max, 2 Min
Returned Variables	None
Comments	An error is returned if the setting is out of range.

Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
REF	U8	(tbd)	
CONTROL	U8	0x41	
STATUS	U8	(xxx)	Don't care, ignored by receiver
Data_Length	U8	2	
DATA	[u8]		See content below
Data[0]			U16 – Steps/Sec, Bits[15:8]
Data[1]			U16 – Steps/Sec, Bits[7:0]

Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
REF	U8	(tbd)	Echo of Command Packet REF
CONTROL	U8	0x41	
STATUS	U8	(tbd)	
Data_Length	U8	0	
DATA	[u8]	None	

USB Stepper Motor Controller Function Protocol

5.3.26 Function: GET NORMAL STEP RATE

Function Summary

Description	Return the step rate for normal stepping operations
Control Code	0x43
Supplied Variables	None
Returned Variables	Steps/Sec (u16)
Comments	

Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
REF	U8	(tbd)	
CONTROL	U8	0x43	
STATUS	U8	(xxx)	Don't care, ignored by receiver
Data_Length	U8	0	
DATA	[u8]	None	

Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
REF	U8	(tbd)	Echo of Command Packet REF
CONTROL	U8	0x43	
STATUS	U8	(tbd)	
Data_Length	U8	3	
DATA	[u8]		See content below
Data[0]			U16 – Steps/Sec, Bits[15:8]
Data[1]			U16 – Steps/Sec, Bits[7:0]

USB Stepper Motor Controller Function Protocol

5.3.27 Function: SAVE SEEK STEP RATE

Function Summary

Description	Set the step rate for seek stepping operations, and saves the setting into non-volatile memory.
Control Code	0x44
Supplied Variables	Steps/Sec (u16) - Range: 4000 Max, 2 Min
Returned Variables	None
Comments	An error is returned if the setting is out of range.

Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
REF	U8	(tbd)	
CONTROL	U8	0x44	
STATUS	U8	(xxx)	Don't care, ignored by receiver
Data_Length	U8	2	
DATA	[u8]		See content below
Data[0]			U16 – Steps/Sec, Bits[15:8]
Data[1]			U16 – Steps/Sec, Bits[7:0]

Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
REF	U8	(tbd)	Echo of Command Packet REF
CONTROL	U8	0x44	
STATUS	U8	(tbd)	
Data_Length	U8	0	
DATA	[u8]	None	

USB Stepper Motor Controller Function Protocol

5.3.28 Function: SET SEEK STEP RATE

Function Summary

Description	Set the step rate for seek stepping operations.
Control Code	0x45
Supplied Variables	Steps/Sec (u16) - Range: 4000 Max, 2 Min
Returned Variables	None
Comments	An error is returned if the setting is out of range.

Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
REF	U8	(tbd)	
CONTROL	U8	0x45	
STATUS	U8	(xxx)	Don't care, ignored by receiver
Data_Length	U8	2	
DATA	[u8]		See content below
Data[0]			U16 – Steps/Sec, Bits[15:8]
Data[1]			U16 – Steps/Sec, Bits[7:0]

Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
REF	U8	(tbd)	Echo of Command Packet REF
CONTROL	U8	0x45	
STATUS	U8	(tbd)	
Data_Length	U8	0	
DATA	[u8]	None	

USB Stepper Motor Controller Function Protocol

5.3.29 Function: GET SEEK STEP RATE

Function Summary

Description	Return the step rate for seek stepping operations
Control Code	0x46
Supplied Variables	None
Returned Variables	Steps/Sec (u16)
Comments	

Command Packet

<i>Element</i>	<i>Type</i>	<i>Value</i>	<i>Description</i>
TO	U8	0xD0	
FROM	U8	(tbd)	
REF	U8	(tbd)	
CONTROL	U8	0x46	
STATUS	U8	(xxx)	Don't care, ignored by receiver
Data_Length	U8	0	
DATA	[u8]	None	

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	
REF	U8	(tbd)	Echo of Command Packet REF
CONTROL	U8	0x46	
STATUS	U8	(tbd)	
Data_Length	U8	3	
DATA	[u8]		See content below
Data[0]			U16 – Steps/Sec, Bits[15:8]
Data[1]			U16 – Steps/Sec, Bits[7:0]

USB Stepper Motor Controller Function Protocol

5.3.30 Function: SAVE GPIO CONFIG

Function Summary

Description	Sets the General Purpose IO pin configurations, and saves settings into non-volatile memory
Control Code	0x60
Supplied Variables	GPIO-0 Config (u8) GPIO-1 Config (u8) GPIO-2 Config (u8) GPIO-3 Config (u8) GPIO-4 Config (u8) GPIO-5 Config (u8)
Returned Variables	None
Comments	Returns an error if Busy. Refer to the GPIO Configuration Table

Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
REF	U8	(tbd)	
CONTROL	U8	0x60	
STATUS	U8	(xxx)	Don't care, ignored by receiver
Data_Length	U8	6	
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

Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
REF	U8	(tbd)	Echo of Command Packet REF
CONTROL	U8	0x60	
STATUS	U8	(tbd)	
Data_Length	U8	0	
DATA	[u8]	None	

USB Stepper Motor Controller Function Protocol

5.3.30.1 GPIO Configuration Table

GPIO Configuration Table

GPIO	Configuration
0	GPIO-0 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
1	GPIO-1 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
2	GPIO-2 0 = Digital Input 1 = Digital Output 2 = Home Limit Input 3 = FWD Limit Input 4 = REV Limit Input
3	GPIO-3 0 = Digital Input 1 = Digital Output 2 = Home Limit Input 3 = FWD Limit Input 4 = REV Limit Input 5 = Counter/Timer Input
4	GPIO-4 0 = Digital Input 1 = Digital Output 2 = Home Limit Input 3 = FWD Limit Input 4 = REV Limit Input 5 = PWM Output
5	GPIO-5 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

5.3.31 Function: WRITE GPIO-DIO

Function Summary

Description	Write GPIO-DO output pin logic states
Control Code	0x62
Supplied Variables	GPIO-DIO (u8)
Returned Variables	None
Comments	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)	
REF	U8	(tbd)	
CONTROL	U8	0x62	
STATUS	U8	(xxx)	Don't care, ignored by receiver
Data_Length	U8	1	
DATA	[u8]		See content below
Data[0]			U8 – GPIO-DO

Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
REF	U8	(tbd)	Echo of Command Packet REF
CONTROL	U8	0x62	
STATUS	U8	(tbd)	
Data_Length	U8	0	
DATA	[u8]	none	

USB Stepper Motor Controller Function Protocol

5.3.32 Function: READ GPIO-DIO

Function Summary

Description	Read GPIO-DIO pin logic states
Control Code	0x63
Supplied Variables	None
Returned Variables	GPIO-DIO (u8)
Comments	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)	
REF	U8	(tbd)	
CONTROL	U8	0x63	
STATUS	U8	(xxx)	Don't care, ignored by receiver
Data_Length	U8	0	
DATA	[u8]	None	

Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
REF	U8	(tbd)	Echo of Command Packet REF
CONTROL	U8	0x63	
STATUS	U8	(tbd)	
Data_Length	U8	1	
DATA	[u8]		See content below
Data[0]			U8 – GPIO-DIO

USB Stepper Motor Controller Function Protocol

5.3.33 Function: SET GPIO-COUNTER PERIOD

Function Summary

Description	Set the counter period
Control Code	0x64
Supplied Variables	Count Period in milliseconds (u8)
Returned Variables	None
Comments	Returns an error if input not configured for counter operation.

Command Packet

<i>Element</i>	<i>Type</i>	<i>Value</i>	<i>Description</i>
TO	U8	0xD0	
FROM	U8	(tbd)	Non-zero, (tbd) by sender
REF	U8	(tbd)	(tbd) by sender
CONTROL	U8	0x64	
STATUS	U8	(xxx)	Don't care, ignored by receiver
Data_Length	U8	1	
DATA	[u8]		See content below
Data[0]			U8 – Count Period; 0 = OFF, 255 = Always Counting, else N Milliseconds

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	
REF	U8	(tbd)	Echo of Command Packet REF
CONTROL	U8	0x64	
STATUS	U8	(tbd)	
Data_Length	U8	0	
DATA	[u8]	none	

USB Stepper Motor Controller Function Protocol

5.3.34 Function: READ GPIO-COUNTER

Function Summary

Description	Returns GPIO Counter information
Control Code	0x65
Supplied Variables	None
Returned Variables	Period to go (u8) Count Period (u8) Counter (u32) Overflow (u8)
Comments	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)	
REF	U8	(tbd)	
CONTROL	U8	0x65	
STATUS	U8	(xxx)	Don't care, ignored by receiver
Data_Length	U8	0	
DATA	[u8]	None	

Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
REF	U8	(tbd)	Echo of Command Packet REF
CONTROL	U8	0x65	
STATUS	U8	(tbd)	
Data_Length	U8	7	
DATA	[u8]		See content below
Data[0] Data[1]			U8 – Period To Go U8 – Count Period
Data[2] Data[3] Data[4] Data[5]			U32 – Counter, Bits[31:24] U32 – Counter, Bits[23:16] U32 – Counter, Bits[15:8] U32 – Counter, Bits[7:0]
Data[6]			U8 – Counter Overflow; 1 = Overflow, 0 = OK

USB Stepper Motor Controller Function Protocol

5.3.35 Function: SAVE GPIO-PWM FREQUENCY

Function Summary

Description	Set the PWM frequency and duty cycle, and save setting into non-volatile memory. Actual PWM register settings computed are also saved into non-volatile memory.
Control Code	0x68
Supplied Variables	Range (U8) Frequency (U16) Duty Cycle (U8)
Returned Variables	None
Comments	See PWM Frequency Settings This function alters the current PWM Register function settings. This function is intended to provide a rapid means to set PWM output frequency and duty cycle. For higher accuracy control see the PWM Register functions.

Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
REF	U8	(tbd)	
CONTROL	U8	0x68	
STATUS	U8	(xxx)	Don't care, ignored by receiver
Data_Length	U8	4	
DATA	[u8]		See content below
Data[0]			U8 – Range
Data[1]			U16 – Frequency, Bits[15:8]
Data[2]			U16 – Frequency, Bits[7:0]
Data[3]			U8 – Duty Cycle

Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
REF	U8	(tbd)	Echo of Command Packet REF
CONTROL	U8	0x68	
STATUS	U8	(tbd)	
Data_Length	U8	0	
DATA	[u8]	none	

USB Stepper Motor Controller Function Protocol**5.3.35.1 PWM Frequency Settings**

PWM Frequency Range

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

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

2 = 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

5.3.36 Function: SET GPIO-PWM FREQUENCY

Function Summary

Description	Set the PWM frequency and duty cycle.
Control Code	0x69
Supplied Variables	Range (U8) Frequency (U16) Duty Cycle (U8)
Returned Variables	None
Comments	See PWM Frequency Settings This function alters the current PWM Register function settings. This function is intended to provide a rapid means to set PWM output frequency and duty cycle. For higher accuracy control see the PWM Register functions.

Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
REF	U8	(tbd)	
CONTROL	U8	0x69	
STATUS	U8	(xxx)	Don't care, ignored by receiver
Data_Length	U8	4	
DATA	[u8]		See content below
Data[0]			U8 – Range
Data[1]			U16 – Frequency, Bits[15:8]
Data[2]			U16 – Frequency, Bits[7:0]
Data[3]			U8 – Duty Cycle

Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
REF	U8	(tbd)	Echo of Command Packet REF
CONTROL	U8	0x69	
STATUS	U8	(tbd)	
Data_Length	U8	0	
DATA	[u8]	none	

USB Stepper Motor Controller Function Protocol

5.3.37 Function: GET GPIO-PWM FREQUENCY

Function Summary

Description	Returns the PWM frequency and duty cycle.
Control Code	0x6A
Supplied Variables	None
Returned Variables	Range (U8) Frequency (U16) Duty Cycle (U8)
Comments	See PWM Frequency Table The PWM Register functions do not alter these settings, therefore if PWM Register functions have been used, these settings will not reflect the actual output condition.

Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
REF	U8	(tbd)	
CONTROL	U8	0x6A	
STATUS	U8	(xxx)	Don't care, ignored by receiver
Data_Length	U8	0	
DATA	[u8]	none	

Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
REF	U8	(tbd)	Echo of Command Packet REF
CONTROL	U8	0x6A	
STATUS	U8	(tbd)	
Data_Length	U8	4	
DATA	[u8]		See content below
Data[0]			U8 – Range
Data[1]			U16 – Frequency, Bits[15:8]
Data[2]			U16 – Frequency, Bits[7:0]
Data[3]			U8 – Duty Cycle

USB Stepper Motor Controller Function Protocol

5.3.38 Function: SAVE GPIO-PWM REGISTERS

Function Summary

Description	Set the PWM registers, and save settings into non-volatile memory
Control Code	0x6B
Supplied Variables	Prescale (U8) PWM Period (U8) Duty Period (U16)
Returned Variables	None
Comments	See PWM Register Settings This function does not change any PWM Frequency function settings.

Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
REF	U8	(tbd)	
CONTROL	U8	0x6B	
STATUS	U8	(xxx)	Don't care, ignored by receiver
Data_Length	U8	4	
DATA	[u8]		See content below
Data[0]			U8 – Prescale
Data[1]			U8 – PWM Period
Data[2]			U16 – Duty Period, Bits[15:8]
Data[3]			U16 – Duty Period, Bits[7:0]

Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
REF	U8	(tbd)	Echo of Command Packet REF
CONTROL	U8	0x6B	
STATUS	U8	(tbd)	
Data_Length	U8	0	
DATA	[u8]	none	

USB Stepper Motor Controller Function Protocol

5.3.38.1 PWM Register Settings

PWM Prescale

0 = Base frequency/period = 10 MHz/100ns

1 = Base frequency/period = 2.5 MHz/250ns

2 = Base frequency/period = 625 KHz/1.6us

PWM Period

Period = (PWM Period+1) * 4 * (Base Period) * Prescale

Frequency = 1/Period

PWM Duty Period

10-Bit max resolution

Period = (PWM Duty Period+1) * (Base Period) * Prescale

Note: A Duty period greater than the PWM period will result in the output always being a 1.

The effective duty period value is in the range of zero to (PWM Period +1 *4), but less than 0x0400.

PWM Resolution (max) = $\lceil \log(10 \text{ MHz}/F_{\text{pwm}}) \rceil / \log(2)$ bits

USB Stepper Motor Controller Function Protocol

5.3.39 Function: SET GPIO-PWM REGISTERS

Function Summary

Description	Set the PWM registers.
Control Code	0x6C
Supplied Variables	Prescale (U8) PWM Period (U8) Duty Period (U16)
Returned Variables	None
Comments	See PWM Register Settings This function does not change any PWM Frequency function settings.

Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
REF	U8	(tbd)	
CONTROL	U8	0x6C	
STATUS	U8	(xxx)	Don't care, ignored by receiver
Data_Length	U8	4	
DATA	[u8]		See content below
Data[0]			U8 – Prescale
Data[1]			U8 – PWM Period
Data[2]			U16 – Duty Period, Bits[15:8]
Data[3]			U16 – Duty Period, Bits[7:0]

Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
REF	U8	(tbd)	Echo of Command Packet REF
CONTROL	U8	0x6C	
STATUS	U8	(tbd)	
Data_Length	U8	0	
DATA	[u8]	none	

USB Stepper Motor Controller Function Protocol

5.3.40 Function: GET GPIO-PWM REGISTERS

Function Summary

Description	Return the PWM register settings.
Control Code	0x6D
Supplied Variables	None
Returned Variables	Prescale (U8) PWM Period (U8) Duty Period (U16)
Comments	See PWM Register Settings

Command Packet

Element	Type	Value	Description
TO	U8	0xD0	
FROM	U8	(tbd)	
REF	U8	(tbd)	
CONTROL	U8	0x6D	
STATUS	U8	(xxx)	Don't care, ignored by receiver
Data_Length	U8	0	
DATA	[u8]	none	

Response Packet

Element	Type	Value	Description
TO	U8	(tbd)	Echo of Command Packet FROM
FROM	U8	0xD0	
REF	U8	(tbd)	Echo of Command Packet REF
CONTROL	U8	0x6D	
STATUS	U8	(tbd)	
Data_Length	U8	4	
DATA	[u8]		See content below
Data[0]			U8 – Prescale
Data[1]			U8 – PWM Period
Data[2]			U16 – Duty Period, Bits[15:8]
Data[3]			U16 – Duty Period, Bits[7:0]

USB Stepper Motor Controller Function Protocol

5.3.41 Function: READ GPIO-AI

Function Summary

Description	Reads the GPIO analog input
Control Code	0x6F
Supplied Variables	None
Returned Variables	GPIO-AI in millivolts (u16)
Comments	

Command Packet

<i>Element</i>	<i>Type</i>	<i>Value</i>	<i>Description</i>
TO	U8	0xD0	
FROM	U8	(tbd)	
REF	U8	(tbd)	
CONTROL	U8	0x6F	
STATUS	U8	(xxx)	Don't care, ignored by receiver
Data_Length	U8	0	
DATA	[u8]	None	

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	
REF	U8	(tbd)	Echo of Command Packet REF
CONTROL	U8	0x6F	
STATUS	U8	(tbd)	
Data_Length	U8	2	
DATA	[u8]		See content below
Data[0]			U16 – GPIO-AI, Bits[15:8]
Data[1]			U16 – GPIO-AI, Bits[7:0]