							Sheet									
	Header		0		Address	Sub-Address	Command	Data Length	Data							
0	0	0 0 0		FF	0-FF	0-FF	0-FF	0-FF								
	Notes	Action	Sub Addrose	Command	Command (HEX)	Data Longth	Data Byte:1	2	3	4	5	6 7 8	1 9	10	11	12
Main	Notes	NOOP	0	0	0	0	Dyte.1	2	,	-	3	, , ,	-	10		12
	Starts planned move	Reserve for core protocol Start	0	1 2	1 2	0										-
		Pause	0	3	3	0									$\overline{}$	
	Stops planned move. Must be executed before controller will accept other commands.	Stop	0	4	4	0										
	Toggles on/off state of debug LED	Debug LED	0	5	5	0										
		Timing Master Set Stored Name	0	7	7	1-10		String [1	-10 Characters, Null-terminated, N	ull padded1			_			_
		Set Device Address	0	8	8	1	2-255 [Byte]								=	
		Set Common Line for Step Pulsing Return Home All Motors	0	10	9 A	0	0,1,2 [Byte]									+
		Motors Max Step Rate	0	11	В	2	Steps/S	econd [Int]								
		Alt Input Edge (RISING, FALLING, or CHANGE)	0	12	С	1	0,1,2 [Byte]									
		Alt I/O Mode Set Joystick Watchdog	0	13	D F	2	Ring (0-255) [Byte] True/False (1,0) [Byte]	Tip (0-255) [Byte]					-			+
		Alt Output Before Shot Delay Time	0	15	F	2	Time (ms) [int]								
		Alt Output After Shot Delay Time Alt Output Before Shot Time	0	16 17	10	2	Time (ms) [int] ms) [int]					-			+
		Alt Output After Shot Time	0	18	12	2	Time (ms) [Int]							=	
		Alt Output Trigger level Max Program Run Time	0	19 20	13 14	4	HIGH/LOW (1,0) [Byte]	Max Run Time (mS) [Ulong]				+			+
		Start Program Delay	0	21	15	4	0 (0140) 4 (7) 1 0 1	Start Time Delay (second	ls) [Ulong]						=	
		Set SMS / Continuous Program Mode	0	22	16	1	0 (SMS), 1 (Time Lapse Cont.), 2 (Video Cont.) [Byte]									
	Causes the motors to go back and forth	Set Joystick Mode	0	23	17	1	True/False (1,0) [Byte]									
	Between the start and stop positions	Set Ping-Pong Flag	0	24	18	1	True/False (1,0) [Byte]									
		Status Request	0	100			<status type=""></status>		<returns> with hea</returns>	der and master	address in fr	ont (00 00 00 00 00	FF 00 00	01 Length I	Data)	
		Firmware Version	0	100	64	0	Value Type [Byte]	Version #								
		Run Status Run Time	0	101 102	65 66	0	Value Type [Byte] Value Type [Ulong]	True/False	Time (ms)				+			+
		Currently Exposing	0	103	67	0	Value Type [Ulong] Value Type [Byte]	True/False							=	
		Timing Master Value Name	0	104 105	68 69	0	Value Type [Byte] Value Type [String]	True/False	String [1-10 Charac	ers, Null-termin	ated, Null pa	edded]				
		Motors Max Step Rate Voltage Reading	0	106	6A 6B	0	Value Type [Uint] Value Type [Fixed]		Second	or oldo)					_	
		Current to Motors	0	108	6C	0	Value Type [Fixed]	Current (amps) (Fixe	point – must divide by 100 on mas ed point – must divide by 100 on ma	ister side)						
		Alt Input Edge (RISING, FALLING, or CHANGE) Alt I/O Mode	0	109 110	6E 6F	0	Value Type [Byte] Value Type [Int]	0,1,2 [Byte 0] Ring (0-255)	[Byte 1] Tip (0-255)				-			+
		Limit Switch High/Low Status	0	111	70	0	Value Type [Int] Value Type [Int]	(Byte 01 Ring, High/Low (1.0)	(Byte 1) Tip, High/Low(1.0)						$\overline{}$	
		Alt Output Before Shot Delay Time Alt Output After Shot Delay Time	0	112 113	70 71	0	Value Type [Uint] Value Type [Uint]	Time Time	(ms) (ms)				_			+
		Alt Output Before Shot Time Alt Output After Shot Time	0	114 115	72 73	0	Value Type [Uint] Value Type [Uint]		(ms) (ms)						_	
		Alt Output Trigger level	0	116	74	0	Value Type [Byte]	HIGH/LOW (1,0)								<u> </u>
		Start Program Delay SMS / Continuous Program Mode	0	117	75 76	0	Value Type [Ulong] Value Type [Byte]	0 (SMS), 1 (Cont.)	tart Time Delay (seconds)						_	-
		Controller Power Cycle	0	119	77	0	Value Type [Byte]	True/False (1,0) True/False (1,0)								
		Joystick Mode Ping-Pong Flag	0	120 121	78 79	0	Value Type [Byte] Value Type [Byte]	True/False (1,0) True/False (1,0)								
		Joystick Watchdog Mode Status	0	122	7A	0	Value Type [Byte] Value Type [Byte]	True/False (1,0)								
	Reports the percentage complete of the current program as a whole number	Program % Complete	0	123	7B	0	Value Type [Byte]	0-100								
Motors		NOOP Reserve for core protocol	1-3 1-3	0	0	0						-				1
	Cuts power to motor when not executing a	Motor Sleep	1-3	2	2	1	True/False (1,0) [Byte]									†
	move. True by default. Must enabled before executing a move.	Motor Enable	1-3	3	3	1	True/False (1,0) [Byte]						-			-
	Stops motor, even if a planned move is in	Stop Motor Now	1-3	4	4	0										
	progress. Number of steps the motor should move in										+					
	addition to the commanded distance when reversing direction. Number of microsteps per full motor step.	Set Backlash Steps	1-3	5	5	2	Step	s [Uint]								
General Motor Commands	There are 200 full steps per rotation of the motor (and ~3800 full steps per gearbox output shaft rotation)	Set Microstep Value	1-3	6	6	1	1, 2, 4, 8, 16 [Byte]									
	,	Set Motor Max Step Speed	1-3	7	7	2	Steps/Se	cond [Uint]								
	Flips motor direction, regardless of current program	Set Direction	1-3	8	8	1	0, 1 [Byte]								į.	
	Saves home limit position	Set Home Limit Here Set End Limit Here	1-3 1-3	9	9 A	0										1
	Saves end limit position	Send Motor to Home Limit	1-3	11	B	0										_
		Send Motor to End Limit	1-3	12	С	0										
	Does not apply to finite manual moves	Set Continuous Speed Set Motor Continuous Motion Accel/Decel Rate	1-3 1-3	13 14	D	4 4		Steps/Second [flo							=	
Manual Move Commands	Does not apply to finite manual moves Set Motor Continuous Motion Accel/Decel Rate Direct move command, does not require use of 'start' and 'stop' commands. Execute Simple Motor Move		1-3	15	F	5	Dir (0, 1) [Byte]	Steps/Second^2 [fli	Steps [Ulong]							_
pee of start the step community.													_		_	_
		Set Program Start point Set Program Stop point	1-3 1-3	16 17	10 11	4		Step position [lon Step position [lon	9]				<u> </u>			\pm
	1 = Linear, 2 = Quadratic, 3 = Inverted Quadratic	Set Easing (Ramping) Mode	1-3	18	12	1	1, 2, 3									
Programmed	How many shots should this motor wait	Set Lead-In Shots	1-3	19	13	2		[Uint]			\vdash					
Travel Commands	before moving?	Set Travel Shots(SMS) / Travel Time (Cont.)	1-3	20	14	4		hots (SMS) or Total Travel Time	(ms) (cont.) [Ulong]							\vdash
		Set Program Accel Set Program Decel	1-3 1-3	21	15 16	4 4	Acc	el Period - Shots (SMS) or Time	in ms (Cont.) [Ulong)]							
		Send Motor to Program Start Point	1-3	22 23	17	0	Dei	cel Period – Shots (SMS) or Time	iii iiia (Gulit.) [Ululig]							\pm
		Send Motor to Program Stop Point	1-3	24	18	0										

lanual SMS movement. Not yet nplemented. lanual SMS movement. Not yet nplemented.																
lanual SMS movement. Not yet	Advance One	SMS Increment	1-3	25	19	0										
	Go Back One	SMS Increment	1-3	26	1A	0										
ets the current position as home, disables mits, and sets start/stop positions to home	Depart Limite and Depart	am Start/Stop Positions	1-3	27	1B	0										
osition.	Reset Limits and Progr	ani stanziop rositions	1-3	21	10	l "										
he controller will automatically select the ighest resolution microstepping (up to 14 keping) that can be used to achieve the looping) that can be used to achieve the looping marameters. It will also report back es etting it uses. On will be reported when he command is called at an illegal time (i.e hen the motor is in motion). 255 will be looping the will be used to the understanding the understanding the understanding the understanding the understanding the understanding the understanding und		ram Microsteps	1-3	28	10	0	Value Type [Byte]	0, 4, 8, 16, 255								
	0		1.0	400					<returns> with hea</returns>		44	00000000	0.55.00.00	04	-1-1	
		Request Enable	1-3 1-3	100	64	0	<status type=""> Value Type [Byte]</status>	True/False (1,0)	<returns> with hea</returns>	der and master a	ddress in front (00 00 00 00 0	00 00 FF 00 00	01 Length D	ata)	
	Backlas	sh Steps	1-3	101	65	ŏ	Value Type [Uint]	Str	eps							
		ep Value	1-3	102	66	0	Value Type [Byte]	1, 2, 4, 8, 16								
		ction Step Speed	1-3	103 104	67 68	0	Value Type [Byte] Value Type [Int]	0, 1	Sanad							
	Fnd Lim	it Position	1-3 1-3	105	69	0	Value Type [Long]	Steps/	Position				_			
	Current Mo	tor Position	1-3	106	6A	0	Value Type [Long] Value Type [Byte]		Position							
	Motor I	Running	1-3	107	6B	0	Value Type [Byte]	True/False (1,0)								
	Continuo	us Speed	1-3	108	6C	0	Value Type [Psudo-floatFixed point – must divide by 100 on master side]		Steps/Second							
	Motor Continuous Mc	otion Accel/Decel Rate	1-3	109	6D	0	Value Type [Psudo-floatFixed point – must divide by 100 on master side]		Steps/Second^2							
	Eneing (Par	mping) Mode	1-3	110	6E	0	Value Type [Byte]	1 2 2					_			
	Program	Start point	1-3	111	6F	0	Value Type [Long]	1, 2, 3	Position							
	Program	Stop point	1-3	112	70	0	Value Type [Long]									
		/ Travel Time (Cont.)	1-3	113	71	0	Value Type [Ulong]		S) or Total Travel Time (ms) (cont.)						
		n Shots	1-3	114	72	0	Value Type [Int]	Sh Assal Desired					-			
	Progra	m Accel m Decel	1-3 1-3	115 116	73 74	0	Value Type [Ulong] Value Type [Ulong]	Accel Period Decel Period	 Shots (SMS) or Time in ms (Co Shots (SMS) or Time in ms (Co 	nt.) nt)			_			
		Cont. Program Move	1-3			0	Value Type [Psudo-floatFixed		Steps/Second	,						
	1			117	75		master side]									
	NC NC	NOD.		1 0	1 0	1 0										
			4	0	0	0										
	Reserve for	core protocol		0 1 2	0 1 2	0 0 1	True/False (1,0) [Byte]									
riggers exposure with length set by exposure Time* command.	Reserve for Camera	core protocol a Enable	4	0 1 2 3	0 1 2		True/False (1,0) [Byte]									
riggers exposure with length set by Exposure Time" command.	Reserve for Camera Expos	core protocol a Enable se Now er Time	4 4 4	3	3 4	0 4		Exposure Time (mS) [Ulong							
exposure Time" command.	Reserve for Camera Expos	core protocol a Enable se Now er Time	4 4	3	3	0		Exposure Time (mS) [(mS) [Uint]	Ulong]							
riggers exposure with length set by xposure Time command. he system will stop a move once it saches the max number of camera xposures.	Reserve for Camera Expos Trigge Focus Max	core protocol a Enable se Now er Time s Time Shots	4 4 4 4 4	3 4 5	3 4 5	1 0 4 2	Focus Time Count	(mS) [Uint] [Uint]	Ulong)							
he system will stop a move once it saches the max number of camera	Reserve for Camera Expos Trigge Focus Max Exposu	core protocol a Enable se Now er Time 5 Time Shots re Delay	4 4 4 4	3 4 5	3 4 5	1 0 4 2	Focus Time Count	(mS) [Uint] [Uint]	Ulong]							
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exposure Time* command. The system will stop a move once it the sposures. The system will stop a move once it the sposures. The sposures. The sposures the system is sposures to be sent to the sposure sposures.	Reserve for Cameri Exposu Trigge Focus Max Exposus Focus v Mirror Up (F	core protocol a Enable Benable se Now re Time STime Shots re Delay Shutter Repeat Shot)	4 4 4 4 4	3 4 5 6	3 4 5 6	1 0 4 2 2 2	Focus Time Count Delay (m True/False (1,0) Byte	(mS) [Uint] [Uint] S) [Uint]								
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Exposure Time' command. he system will stop a move once it acaches the max number of camera poposures. bis causes two trigger signals to be sent it accuments in the event that the user has camera in the sent of the camera in the camer	Reserve for Carmera Carmera Carmera Expose Focus Max Expose Service Focus Mirror Up (Focus Focus	core protocol 1 Enable e Now Time Time Shots Shots Request Shot) svall Request Finale Final	4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	3 4 5 6 7 8 9 10 100 101 102 103 104 105 106 106 107 108	3 4 5 6 7 8 9 A 64 65 65 66 67 68 68 68 68	1 0 4 4 2 2 2 2 1 1 1 1 4 4 4 4 4 4 4 4 4 4	Focus Time Count Count Delay (m True/False (1.0) [Byte] True/False (1.0) [Byte] Status Type Value Type [Byte] Value Type [Byte] Value Type [Unin] Value Type [Byte] Value Type [Byte] Value Type [Byte] Value Type [Unin]	(mS) [Um] [Um] [S] [Um] Interval Time (mS) [Um] TrueFalse (1.0) TrueFalse (1.0) Focus T Delay 1, 0	creturns> with hear	der and master a	ddress in front (4	00 00 00 00 0	00 FF 00 00	01 Length D	tata)	
exposure Time' command. he system will stop a move once it aches the max number of camera apposures. his causes two trigger signals to be sent to ecamera in the event that the user has no ecamera in "mirror up" mode.	Reserve for Carmera Carmera Carmera Expose Focus Max Expose Service Focus Mirror Up (Focus Focus	core protocol 1 Enable e Now Time Time Shots Shots Request Shot) svall Request Finale Final	4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	3 4 5 6 7 8 9 10 100 100 101 102 103 104 105 106 107	3 4 5 6 7 8 9 A 64 65 66 67 68 69 6A 6B	1 0 4 2 2 2 1 1 1 1 4 4 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Count Count Delay (m True/False (1.0) [Byte] True/False (1.0) [Byte] <status type=""> <status type=""> Value Type [Byte] Value Type [Byte] Value Type [Unit] Value Type [Unit] Value Type [Byte] Value Type [Byte] Value Type [Byte] Value Type [Byte]</status></status>	(mS) [Um] [Um] [S] [Um] Interval Time (mS) [Um] TrueFalse (1.0) TrueFalse (1.0) Focus T Delay 1, 0	<pre>creturns> with hea</pre>	der and master	ddress in front (ii	0000000	00 FF 00 00	01 Length D	tata)	
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Note: nodes do not give a response to broadcast commands.

Query Value Types	
0	Byte
1	Unsigned Int
2	Int
3	Long
4	Unsigned Long
5	Float
6	String

The floats are actually fixed points. They are multiplied by 100 and transmitted as longs, so they need to be divided by 100 on the master side to resolve the true value.