eMotimo API Reference
API - V0.112

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EMOTILINK COMMAND PROTOCOL (ECP): Reference Guide

This document is an early release. It is the set of commands to access and control all eMotimo Devices. It is intended for developers, and not for regular users. Functionality will be added as requested. Bugs can be reported to help@emotimo.com with the subject line "eMotimo API Issue"

Format for Issue/Functionality Request:

Device Model: (Ex. ST4, ST4.3, SA2.6, etc.)

Firmware Version: (Ex. ST4_RC008_011) This is found on Splash Screen or last page of Settings Menu

Issue/Feature Description:

ACCESSING ECP IN SPECTRUM ST4

VIA SERIAL PORT

Please only use our cables - **https://emotimo.com/products/usb-to-i-o-port-cable-for-spectrum-st4. Each is tested before it heads out. In the past we have tried to support users with their own custom cable builds and modification, but it has proven to be costly and frustrating for both the customizer and us. If you are comfortable making or sourcing your own cable, please do, but unfortunately, no support from eMotimo can be made available if there are issues.**

Setting up a connection to the spectrum using the following serial protocol:

Baudrate: 57600 bits per second when **eMotimo API** is selected from I/O Port
Baudrate: 230400 bits per second when **eMotimoFastAPI** is selected from I/O Port
Data Bits: 8
Parity: None
Stop Bits: 1
Flow Control: None
Line Ending Character: /n or <LF> complete each command with this character

TRS (tip, ring, sleeve) connection through spectrum I/O Port.

Tip: spectrum ST4 TX and External Micro RX **
Ring: spectrum ST4 RX and External Micro TX
Sleeve: spectrum ST4 Ground External Micro TX Ground

Logic Voltage: 0V to 3.3V to 5.0V for High (internal level shifting) **TLL Logic Levels.**
NEVER USE RS232 levels, CAN, or RS485 levels. These will damage the I/O Port

DEFINED PARAMETER GROUP

MOTOR GROUP

G0 – Go Rapid

Description:

Goes to a particular position defined by absolute coordinates of all axes. Each motor moves independently to position using the currently set max velocities and acceleration for each axis. Use this when coordinated moves are not needed.

Parameters:

Parameter Description	Letter Code	ST4 Range	ST4.3 Range	SA2.6 Range
Pan Absolute Position	X	-2000000000 to 2000000000	-2000000000 to 2000000000	-1800 to 1800
Tilt Absolute Position	Y	-2000000000 to 2000000000	-2000000000 to 2000000000	-560 to 1460
M3 Absolute Position	Z	-2000000000 to 2000000000	-2000000000 to 2000000000	-2000000000 to 2000000000
M4 Absolute Position	W	-2000000000 to 2000000000	-2000000000 to 2000000000	-2000000000 to 2000000000
Focus Absolute Position	F	N/A	0 to 9999	0 to 9999 (TN Focus) 0 to 4095 (RS Focus)
Tilta Iris Absolute Position	I	N/A	0 to 9999	0 to 9999
Tilta Zoom Absolute Position	C	N/A	0 to 9999	0 to 9999
Roll Absolute Position	R	N/A	N/A	-300 to 300

Example:

Go to absolute pan position 10000, tilt position 20000, M3 position -15000, M4 position 2000, Focus position 1000, Iris position 2000, Zoom position 3000

ST4.3:

```
G0 X10000 Y20000 Z-15000 W2000 F5000 I7000 C9999
Rapid to: X10000,Y20000,Z-15000,W2000,F5000,I7000,C9999
```

SA2.6:

```
G0 X-1790 Y500 Z2000 W4000 F500 I500 C500 R150
Rapid to: X-1790,Y500,Z2000,W4000,F500,I500,C500,R150
```

Notes:

- Virtual Stops are not adhered to when using G0 and G1.
- If no value is given for an axis, no move command is given to that axis.
- Expansion Port must be set to Tilta Nuc M in the settings to drive the Focus, Iris and Zoom axis
- Rapid Moves on Tilta have High Torque use with care!
- For SA2.6 Model Pan, Tilt and Roll is only available with CAN1 Set to RS2/3
- Focus Parameter controls both TN Focus and RS Focus so choose which you prefer to use

Model	Firmware Version Last Tested
ST4	ST4_RC008_021
ST4.3	ST4_RC008_021
SA2.6	SA2_RC001_007_B3

G1 – Go Coordinated

Description:

goes to a particular position defined by absolute coordinates of all axes. Use this command when all axes need to arrive at the same time (Cinematic).

Parameters:

Parameter Description	Letter Code	ST4 Range	ST4.3 Range	SA2.6 Range
Pan Absolute Position	X	-2000000000 to 2000000000	-2000000000 to 2000000000	-1800 to 1800
Tilt Absolute Position	Y	-2000000000 to 2000000000	-2000000000 to 2000000000	-560 to 1460
M3 Absolute Position	Z	-2000000000 to 2000000000	-2000000000 to 2000000000	-2000000000 to 2000000000
M4 Absolute Position	W	-2000000000 to 2000000000	-2000000000 to 2000000000	-2000000000 to 2000000000
Focus Absolute Position	F	N/A	0 to 9999	0 to 9999 (TN Focus) 0 to 4095 (RS Focus)
Tilta Iris Absolute Position	I	N/A	0 to 9999	0 to 9999
Tilta Zoom Absolute Position	C	N/A	0 to 9999	0 to 9999
Roll Absolute Position	R	N/A	N/A	-300 to 300
Move Time (unit: .1 = .1 sec)	T	1.0 to 60.0	1.0 to 60.0	1.0 to 60.0
Acceleration/Ramp Time (unit: .1 = .1 sec)	A	.5 to 30.0	.5 to 30.0	.5 to 30.0

Example:

Go to absolute pan position 10000, tilt position 20000, M3 position -15000, M4 position 2000 in 1.5 seconds with an acceleration time (ramp time) of 0.25seconds on each side.

ST4.3:

```
G1 X10000 Y20000 Z-15000 W2000 F1000 I2000 C3000 T1.5 A0.25
Move to:X10000,Y20000,Z-15000,W2000,F1000,I2000,C3000
```

SA2.6:

```
G1 X300 Y-500 Z-15000 W2000 F1000 I2000 C3000 R-150 T1.5 A0.25
Move to:X300,Y-500,Z-15000,W2000,F1000,I2000,C3000,R-150
```

Notes

- Virtual Stops are not adhered to when using G0 and G1.
- If the move cannot be achieved in the time required, it will move at the fastest speed possible with the current VMAX and AMAX settings.
- If no value is given for an axis, the current position is used for planning. Watch out this will stop motors that might be moving from a velocity command (G300).
- Expansion Port must be set to Tilta Nuc M in the settings to drive the Focus, Iris and Zoom axis
- For SA2.6 Model Pan, Tilt and Roll is only available with CAN1 Set to RS2/3
- Focus Parameter controls both TN Focus and RS Focus so choose which you prefer to use

Model	Firmware Version Last Tested
ST4	ST4_RC008_021
ST4.3	ST4_RC008_021
SA2.6	SA2_RC001_007_B3

G11 – Go Single Axis Planned

Description:

Use this for planning each axis individually. The advantage of this command compared to the G1 is that omitted values will not "stomp out" other axis that might be controlled via other commands like G300 velocity set. **The RS Motors are not supported in API V112.**

Parameters:

Parameter Description	Letter Code	ST4 Range	ST4.3 Range	SA2.6 Range
Motor ID	M	1 – Pan 2 – Tilt 3 – M3 4 – M4	1 – Pan 2 – Tilt 3 – M3 4 – M4 5 – TN Focus 6 – TN Iris 7 – TN Zoom	***1 – RS Pan (Unsupported V112)*** ***2 – RS Tilt (Unsupported V112)*** 3 – M1 4 – M2 5 – TN Focus 6 – TN Iris 7 – TN Zoom ***8 – RS Roll (Unsupported V112)*** ***9 – RS Focus (Unsupported V112)***
Absolute Motor Position	P	Pan Range: -2000000000 to 2000000000 Tilt Range: -2000000000 to 2000000000 M3 Range: -2000000000 to 2000000000 M4 Range: -2000000000 to 2000000000	Pan Range: -2000000000 to 2000000000 Tilt Range: -2000000000 to 2000000000 M3 Range: -2000000000 to 2000000000 M4 Range: -2000000000 to 2000000000 TN Focus Range: 0 to 9999 TN Iris Range: 0 to 9999 TN Zoom Range: 0 to 9999	RS Pan Range: -1800 to 1800 RS Tilt Range: -560 to 1460 M1 Range: -2000000000 to 2000000000 M2 Range: -2000000000 to 2000000000 TN Focus Range: 0 to 9999 TN Iris Range: 0 to 9999 TN Zoom Range: 0 to 9999 RS Roll Range: -300 to 300 RS Focus Range: 0 to 4095
Move Time (unit: .1 = .1 sec)	T	1.0 to 60.0	1.0 to 60.0	1.0 to 60.0
Acceleration/Ramp Time (unit: .1 = .1 sec)	A	.5 to 30.0	.5 to 30.0	.5 to 30.0

Example:

Drive M3 to absolute position 30000 over 3 seconds with an acceleration time of .25 seconds on either side of the move.

ST4.3:

```
G11 M3 P30000 T3 A.25
Moving M3 to: P30000 T3.00 A0.25

G11 M3 P1000000 T3 A.25          ←Impossible Move Constrained by Velocity and Acceleration
Moving M3 to: P1000000 T8.51 A1.25
G11 M5 P9999 T5 A2.4
Moving Focus to: P9999 T5.00 A2.40
```

SA2.6:

```
G11 M5 P5999 T3 A.25
Moving TN1 to: P5999 T3.00 A0.25
```

Notes:

- If the move cannot be achieved in the time required, it will move at the fastest speed possible with the current VMAX and AMAX settings.
- For Tilta Motors (M5-M7) a 0 Acceleration Time will result in a linear motion planning
- Expansion Port must be set to Tilta Nuc M in the settings to drive the Focus, Iris and Zoom axis
- For SA2.6 Model Pan, Tilt and Roll is only available with CAN1 Set to RS2/3

Model	Firmware Version Last Tested
ST4	ST4_RC008_021
ST4.3	ST4_RC008_021
SA2.6	SA2_RC001_007_B3

G2 – Jog Position Incremental – Stops Enforced

Description:

Jogs motor a particular number of steps.

Parameters:

Parameter Description	Letter Code	ST4 Range	ST4.3 Range	SA2.6 Range
Pan Position Increment	X	-2000000000 to 2000000000	-2000000000 to 2000000000	-1800 to 1800
Tilt Position Increment	Y	-2000000000 to 2000000000	-2000000000 to 2000000000	-2020 to 2020
M3 Position Increment	Z	-2000000000 to 2000000000	-2000000000 to 2000000000	-2000000000 to 2000000000
M4 Position Increment	W	-2000000000 to 2000000000	-2000000000 to 2000000000	-2000000000 to 2000000000
Focus Position Increment	F	N/A	-9999 to 9999	-9999 to 9999 (TN Focus) -4095 to 4095 (RS Focus)
Tilta Iris Position Increment	I	N/A	-9999 to 9999	-9999 to 9999
Tilta Zoom Position Increment	C	N/A	-9999 to 9999	-9999 to 9999
Roll Position Increment	R	N/A	N/A	-600 to 600

Example:

Jog the following steps Pan 1000, tilt -2000, M3 -1500, M4 2000, Focus 5000, Iris 3000, Zoom 2500

ST4.3:

```
G2 X1000 Y-2000 Z-1500 W2000 F5000 I3000 C2500
Jog by:X1000,Y-2000,Z-1500,W2000,F5000,I3000,C2500
```

SA2.6:

```
G500
Positions: 0000,41,258,0,0,0,0,0,201,0
G2 X-200 Y-200 Z-1500 W2000 F5000 I3000 C2500 R-100
Jog by:X-200,Y-200,Z-1500,W2000,F5000,I3000,C2500,R-100
G500
Positions: 0000,-158,57,-1500,2000,5000,3000,2500,101,0
```

Notes:

- If you are trying to jog over a stop, it will stop at the stop – expected. If you are already over a stop, it will jog back to the limit.
- Expansion Port must be set to Tilta Nuc M in the settings to drive the Focus, Iris and Zoom axis

Model	Firmware Version Last Tested
ST4	ST4_RC008_021
ST4.3	ST4_RC008_021
SA2.6	SA2_RC001_007_B3

G20 – Recall a Preset

Description:

This command is used to conduct a coordinated move to a preset position with defined run times and ramp times. Including the Run Time and Ramp Time parameters here will update the preset timing but not change the position data associated with the preset.

Parameters:

Parameter Description	Letter Code	ST4 Range	ST4.3 Range	SA2.6 Range
Preset ID	P	0-127	0-127	0-31
Run Time (unit: .1 = .1 sec) (Optional)	T	1.0 to 60.0	1.0 to 60.0	1.0 to 60.0
Acceleration Time (unit: .1 = .1 sec) (Optional)	A	.5 to 30.0	.5 to 30.0	.5 to 30.0

Example:

Set Preset 0 with Run Time 8 seconds and ramp time of 2 seconds. Then Recall that Preset.

ST4.3:

```
G21 P0 T8.0 A2.0
Preset 0 Set: 8.0 2.0
G20 P0
Recalling Preset 0
```

SA2.6:

```
G21 P0 T8.0 A2.0
Preset Set: 0 8.0 2.0
G500
0000,-938,-525,-9000,12000,9999,9999,9999,-287,0
G2 X200 Y200 Z-1500 W2000 F5000 I3000 C2500 R100
Jog by:X200,Y200,Z-1500,W2000,F5000,I3000,C2500,R100
G2 X200 Y200 Z-1500 W2000 F5000 I3000 C2500 R100
Jog by:X200,Y200,Z-1500,W2000,F5000,I3000,C2500,R100
G20 P0
Recalling Preset 0
```

Notes:

- The Run Time and Ramp Time parameters are optional. Each Preset has a default Run Time of 5 seconds and Ramp Time of 1 second. These values can be updated when setting the preset (G21) also but position data will change unless the Command Type Argument is used

Model	Firmware Version Last Tested
ST4	ST4_RC008_021
ST4.3	ST4_RC008_021
SA2.6	SA2_RC001_007_B3

G21 – Set a Preset

Description:

This command is used to setup a key position that can be recalled later. **Excluding any axis position parameter will result in all axis position parameters being ignored and the current position of the Rig will be used instead. Also note that when using a custom position for your rig stops are not enforced.**

Parameters:

Parameter Description	Letter Code	ST4 Range	ST4.3 Range	SA2.6 Range
Preset ID	P	0 – 127	0 – 127	0 – 31
Run Time (unit: .1 = .1 sec) (Optional)	T	1.0 to 60.0	1.0 to 60.0	1.0 to 60.0
Acceleration Time (unit: .1 = .1 sec) (Optional)	A	.5 to 30.0	.5 to 30.0	.5 to 30.0
Pan Absolute Position (Optional)	X	-2000000000 to 2000000000	-2000000000 to 2000000000	-1800 to 1800
Tilt Absolute Position (Optional)	Y	-2000000000 to 2000000000	-2000000000 to 2000000000	-560 to 1460
M3 Absolute Position (Optional)	Z	-2000000000 to 2000000000	-2000000000 to 2000000000	-2000000000 to 2000000000
M4 Absolute Position (Optional)	W	-2000000000 to 2000000000	-2000000000 to 2000000000	-2000000000 to 2000000000
Focus Absolute Position (Optional)	F	N/A	0 to 9999	0 to 9999 (TN Focus) 0 to 4095 (RS Focus)
TN Iris Absolute Position (Optional)	I	N/A	0 to 9999	0 to 9999
TN Zoom Absolute Position (Optional)	C	N/A	0 to 9999	0 to 9999
RS Roll Absolute Position (Optional)	R	N/A	N/A	-300 to 300
Command Type (Optional) (Default: 0)	N	0 – Set Time and Position 1 – Set Time Only	0 – Set Time and Position 1 – Set Time Only	0 – Set Time and Position 1 – Set Time Only

Example:

ST4.3:

```
G752 P0                                                    ← Default on Power On
Preset 0: X0 Y0 Z0 W0 F0 I0 C0 RunTime: 50 RampTime: 10
G21 P0                                                     ← Set Preset with Current Position of Rig
Preset 0 Set
G752 P0
Preset 0: X43780 Y-167994 Z49157 W97910 F5000 I5000 C6465 RunTime: 50 RampTime: 10
G21 P0 X1000 Y2000 Z3000 W4000 F100 I200 C300 T3.0 A.5     ← Set Preset with Custom Position & Time
Preset 0 Set
G752 P0
Preset 0: X1000 Y2000 Z3000 W4000 F100 I200 C300 RunTime: 30 RampTime: 5
```

SA2.6:

```
G752 P0                                                    ← Default on Power On
Preset 0: X0 Y0 Z0 W0 F0 I0 C0 R0 D0 RunTime: 50 RampTime: 10
G500
Positions: 0000,-940,-492,0,0,0,0,0,-286,0
G21 P0 T5.0 A2.0                                           ← Set Preset with Current Position of Rig
Preset Set: 0 5.0 2.0
G752 P0
Preset 0: X-940 Y-492 Z0 W0 F0 I0 C0 R-286 D0 RunTime: 50 RampTime: 20
G21 P0 X-900 Y1400 Z3000 W4000 F100 I200 C300 R200 T3.0 A.5 ← Set Preset with Custom Position
Preset Set: 0 3.0 0.5
G752 P0
Preset 0: X-900 Y1400 Z3000 W4000 F100 I200 C300 R200 D100 RunTime: 30 RampTime: 5
G20 P0
Recalling Preset 0
G500
Positions: 0000,-898,1400,3000,4000,100,200,300,199,97
```

Notes:

- The position parameters are optional. If any of the axis are excluded, then the current position of the motor is used in the preset. **Must include all axis positions if you want to set a custom position!**

Model	Firmware Version Last Tested
ST4	ST4_RC008_021
ST4.3	ST4_RC008_021
SA2.6	SA2_RC001_007_B3

G22 – Recall a Trace / Start Record of Trace

Description:

This command is used to record and to recall traces. Recording a trace puts the rig in a Live Control mode where it is looking for input to move the motors and will record the positions into a smaller freeform move that can then be replayed using the recall parameter.

Parameters:

Parameter Description	Letter Code	ST4 Range	ST4.3 Range	SA2.6 Range
Record Trace (Optional)	R	1 – 4	1 – 4	1 – 4
Recall Trace (Optional)	P	1 – 4	1 – 4	1 – 4

Example:

```
G22 R1
Recording Trace 1
G22 P1
Playing Trace 1
```

Notes:

- Traces are 900 frames or 37.5 seconds long at 24 frames per second

Model	Firmware Version Last Tested
ST4	ST4_RC008_021
ST4.3	ST4_RC008_021
SA2.6	**Unsupported in V112**

G24 – Start GoTo Looping Mode

Description:

This command can be used to start a looping mode that will continuously move between two presets either indefinitely or for a set number of Loops.

Parameters:

Parameter Description	Letter Code	ST4 Range	ST4.3 Range	SA2.6 Range
Loop ID	L	0 – 7	0 – 7	0 – 7
Number of Loops (Default: 0 = Inf.)	N	0-65535	0-65535	0-65535

Example:

ST4.3:

```
G0 X1000 Y0 Z50000 W100000 F5000 I5000 C8500
Rapid to:,X1000,Y0,Z50000,W100000,F5000,I5000,C8500
G21 P0
Preset 0 Set
G0 X1000 Y-80000 Z100000 W150000 F5000 I5000 C3500
Rapid to:,X1000,Y-80000,Z100000,W150000,F5000,I5000,C3500
G21 P1
Preset 1 Set
G25 L0 A0 B1 C500 D1000
Loop 0 Set: P0 to P1
G24 L0 N10
Entering Looping Mode: 0
```

SA2.6:

```
G0 X-100 Y0 Z25000 W10000 F5000 I5000 C8500 R100
X-100,Y0,Z25000,W10000,F5000,I5000,C8500,R100
G21 P0 T5.0 A2.0
Preset Set: 0 5.0 2.0
G0 X100 Y200 Z-25000 W-10000 F2000 I5000 C8500 R-100
Rapid to: X100,Y200,Z-25000,W-10000,F2000,I5000,C8500,R-100
G21 P1 T5.0 A2.0
Preset Set: 1 5.0 2.0
G25 L0 A0 B1 C500 D1000
Loop 0 Set: P0 to P1
G24 L0 N3
Entering Loop: 0
```

Notes:

Model	Firmware Version Last Tested
ST4	ST4_RC008_021
ST4.3	ST4_RC008_021
SA2.6	SA2_RC001_007_B3

G25 – Setup a Loop

Description:

This command is used to setup a Loop. This defines which two Presets are going to be used as the endpoints for the loop. The target run time and ramp time between the two endpoints and the dwell times upon reaching either endpoint of the loop.

Parameters:

Parameter Description	Letter Code	ST4 Range	ST4.3 Range	SA2.6 Range
Loop ID	L	0 – 7	0 – 7	0 – 7
Point A Index	A	0 – 127	0 – 127	0 – 31
Point B Index	B	0 – 127	0 – 127	0 – 31
Run Time (Unit: .1 sec) (Optional)	T	1.0 to 60.0	1.0 to 60.0	1.0 to 60.0
Acceleration/Ramp Time (Unit: .1 sec) (Optional)	R	.5 to 30.0	.5 to 30.0	.5 to 30.0
Dwell Time A (Unit: msec, Min: 300) (Optional)	C	300 to 60000	300 to 60000	300 to 60000
Dwell Time B (Unit: msec, Min: 300) (Optional)	D	300 to 60000	300 to 60000	300 to 60000
Command Type (Optional) (Default: 0)	N	0 – Set Time and Position 1 – Set Time Only	0 – Set Time and Position 1 – Set Time Only	0 – Set Time and Position 1 – Set Time Only

Example:

ST4.3:

```
G0 X1000 Y0 Z50000 W100000 F5000 I5000 C8500
Rapid to:,X1000,Y0,Z50000,W100000,F5000,I5000,C8500
G21 P0
Preset 0 Set
G0 X1000 Y-80000 Z100000 W150000 F5000 I5000 C3500
Rapid to:,X1000,Y-80000,Z100000,W150000,F5000,I5000,C3500
G21 P1
Preset 1 Set
G25 L0 A0 B1 C500 D1000
Loop 0 Set: P0 to P1
G24 L0 N10
Entering Looping Mode: 0
G24
Exiting Loop: -1
```

SA2.6:

```
G0 X-100 Y0 Z25000 W10000 F5000 I5000 C8500 R100
Rapid to: X-100,Y0,Z25000,W10000,F5000,I5000,C8500,R100
G21 P0 T5.0 A2.0
Preset Set: 0 5.0 2.0
G0 X100 Y200 Z-25000 W-10000 F2000 I5000 C8500 R-100
Rapid to: X100,Y200,Z-25000,W-10000,F2000,I5000,C8500,R-100
G21 P1 T5.0 A2.0
Preset Set: 1 5.0 2.0
G25 L0 A0 B1 C500 D1000
Loop 0 Set: P0 to P1
G24 L0 N3
Entering Loop: 0
G24
Exiting Loop: -1
```

Notes:

- The Run Time and Ramp Time parameters are optional. If excluded, then the individual timing for the presets will be used instead. This could allow a loop with asymmetrical timing between the two directions.

Model	Firmware Version Last Tested
ST4	ST4_RC008_021
ST4.3	ST4_RC008_021
SA2.6	SA2_RC001_007_B3

G100 – Sets Motor Performance

Description:

This is an advanced command that must be used carefully as this controls power and speeds used by the motor drivers. Do not set maxes on any axis at a default. It is recommended to use the example parameters below and slowly make changes. **For SA2.6 RS and Tilta Motors can only adjust the Velocity Max all other arguments for these motor types will be ignored**

Parameters:

Parameter Description	Letter Code	ST4 Range	ST4.3 Range	SA2.6 Range
Motor ID	M	1 – Pan 2 – Tilt 3 – M3 4 – M4	1 – Pan 2 – Tilt 3 – M3 4 – M4	1 – RS Pan 2 – RS Tilt 3 – M1 4 – M2 5 – Tilta Focus 6 – Tilta Iris 7 – Tilta Zoom 8 – RS Roll 9 – RS Focus
User Tuning Profile	U	1 or 2	1 or 2	1 or 2
Mode	D	1 – Normal 2 - Quiet	1 – Normal 2 - Quiet	1 – Normal 2 - Quiet
Velocity Max	V	1 to 600000	1 to 600000	RS Pan/Tilt/Roll – 1000 – 16000 M1 - 1 to 600000 M2 - 1 to 600000 RS Focus – 5 - 80 Tilta Motors – 5 - 150

Acceleration Max	A	1 to 65535	1 to 65535	1 to 65535
Power During Run	R	1 to 15	1 to 15	1 to 15
Power During Stop	S	0 to 5	0 to 5	0 to 5

Example:

Set the pan axis VMAX to 150000, AMAX 5000, Current During run of 8, Current while stationary of 3.

ST4.3:

```
G100 M1 U1 D1 V150000 A4000 R8 S3
Motor performance set for Pan
G100 M2 U1 D1 V300000 A7000 R10 S2
Motor performance set for Tilt
G100 M3 U1 D1 V400000 A6000 R10 S5
Motor performance set for M3
G100 M4 U1 D1 V250000 A5000 R13 S1
Motor performance set for M4
```

SA2.6:

```
G100 M3 U1 D1 V100000 A1500 R10 S5
Motor performance set for M1
G100 M1 U1 V15000                  ← Velocity is the only settable Parameter for RS/TN Motors
Motor performance set for Pan
```

Notes:

- *It is not recommended or allowed to set the value of R higher than 15, or S higher than 5. Turning motor to their max power for run or hold uses a high amount of current and can trip overcurrent protection or produce excessive heat in the spectrum st4. Although no indication in the return value is shown, the high limits are enforced.*
  ***See understanding V and A values for a motor.*
- DJI RS Joystick smoothness is set on gimbal for SA2.6 and not available via DJI API or eMotimo API
- This command re-starts motor drivers with new settings and saves them to non-volatile memory, can takes about .2 seconds. Don't send these commands too quickly.

Model	Firmware Version Last Tested
ST4	ST4_RC008_021
ST4.3	ST4_RC008_021
SA2.6	SA2_RC001_007_B3

G101 – Returns Motor Performance Values

Description:

This will return the current motor profile values of the requested axis. Max Velocity, Max Acceleration, the Run Current and the Hold Current. This command only applies to physical motor drivers and not to additional FIZ control on the Ext. Port.

Parameters:

Parameter Description	Letter Code	ST4 Range	ST4.3 Range	SA2.6 Range
Motor ID	M	1 – Pan 2 – Tilt 3 – M3 4 – M4	1 – Pan 2 – Tilt 3 – M3 4 – M4	1 – RS Pan 2 – RS Tilt 3 – M1 4 – M2 5 – Tilta Focus 6 – Tilta Iris 7 – Tilta Zoom 8 – RS Roll 9 – RS Focus

Example:

ST4.3:

```
G102 P6
Motor Profile Set: User Defined 2
G101 M1
Motor performance set for Pan: Vel.: 250000, Accel.: 5000, IRUN: 8, IHOLD: 3
```

SA2.6:

```
G102 P5
Motor Profile Set: User Defined 1
G101 M1
Motor performance set for Pan: Vel.: 9000
G101 M2
Motor performance set for Tilt: Vel.: 15000
G101 M3
Motor performance set for M3: Vel.: 191000, Accel.: 1850, IRUN: 20, IHOLD: 10
G101 M4
Motor performance set for M4: Vel.: 90000, Accel.: 2000, IRUN: 12, IHOLD: 1
G101 M5
Motor performance set for TN1: Vel.: 100
G101 M6
Motor performance set for TN2: Vel.: 100
G101 M7
Motor performance set for TN3: Vel.: 100
G101 M8
Motor performance set for Roll: Vel.: 2000
G101 M9
Motor performance set for Focus: Vel.: 2000
```

Notes:

Model	Firmware Version Last Tested
ST4	ST4_RC008_021
ST4.3	ST4_RC008_021
SA2.6	SA2_RC001_007_B3

G102 – Set Motor Profile

Description:

This command lets you set the current motor profile of your eMotimo device.

Parameters:

Parameter Description	Letter Code	ST4 Range	ST4.3 Range	SA2.6 Range
Motor Profile	P	0 – Quiet/Fast 1 – Quiet/Medium 2 – Quiet/Slow 3 – Timelapse 4 – Fastest 5 – User Defined 1 6 – User Defined 2 7 – Inertia Wheels	0 – Quiet/Fast 1 – Quiet/Medium 2 – Quiet/Slow 3 – Timelapse 4 – Fastest 5 – User Defined 1 6 – User Defined 2 7 – Inertia Wheels	0 – Quiet/Fast 1 – Quiet/Medium 2 – Quiet/Slow 3 – Timelapse 4 – Fastest 5 – User Defined 1 6 – User Defined 2 7 – Inertia Wheels (**Beta Only**)

1. P – Motor Profile: Range 0-7

Example:

```
G102 P1
Motor Profile Set: Quiet/Medium
G102 P6
Motor Profile Set: User Defined 2
```

Notes:

Model	Firmware Version Last Tested
ST4	ST4_RC008_021
ST4.3	ST4_RC008_021
SA2.6	SA2_RC001_007_B3

G200 - Set Motor Position

Description:

Sets the internal motor position to a value, does not move the motor. This is good for zeroing a particular axis. This command only applies to Pan, Tilt, M3 and M4 and not to additional FIZ control on the Ext. Port. It also does not apply to any RS Motors on the CAN1 Port.

Parameters:

Parameter Description	Letter Code	ST4 Range	ST4.3 Range	SA2.6 Range
Motor ID	M	1 – Pan 2 – Tilt 3 – M3 4 – M4	1 – Pan 2 – Tilt 3 – M3 4 – M4	1 – M1 2 – M2
Position (Optional, Default: 0)	P	-2000000000 to 2000000000	-2000000000 to 2000000000	-2000000000 to 2000000000

Examples:

ST4.3:

```
G200 M1 P10000
Pan position set to:10000
G200 M1 P0
Pan position set to:0
G200 M2 P300
Tilt position set to:300
G200 M2
Tilt position set to:0
```

SA2.6:

```
G200 M1 P100000
M1  position set to:100000
G0 Z0
Rapid to: X0,Y0,Z0,W0,F-1,I-1,C-1,R0
G500
Positions: 10,0,0,49474,0,0,0,0,0,0 ←Can see that M1 is Moving to new 0 Point
```

Notes:

Model	Firmware Version Last Tested
ST4	ST4_RC008_021
ST4.3	ST4_RC008_021
SA2.6	SA2_RC001_007_B3

G201 - Zero All Motors

Description:

Sets the physical drivers motor position registers to 0. This command applies to Pan, Tilt, M3 and M4 on the ST4/ST4.3 and the M1, M2 on the SA2.6. It does not affect the additional FIZ control on the Ext. Port or RS Gimbals.

Parameters:

None

Example:

ST4.3:

```
G500
0000 1000,0,50000,100000
G201
All Motors Zeroed
G500
0000 0,0,0,0
```

SA2.6:

```
G500
Positions: 00,0,0,0,0,0,0,0,0,0
G200 M1 P100000
M1 position set to:100000
G200 M2 P50000
M2 position set to:50000
G500
Positions: 00,0,0,100000,50000,0,0,0,0,0
G201
All Motors Zeroed
G500
Positions: 00,0,0,0,0,0,0,0,0,0
```

Notes:

Model	Firmware Version Last Tested
ST4	ST4_RC008_021
ST4.3	ST4_RC008_021
SA2.6	SA2_RC001_007_B3

G202 – Home RS Gimbal

Description:

This command recenters the RS Gimbals Pan, Tilt and Roll axis. It only applies to the SA2.6 model. This command will be unrecognized by all other models.

Parameters:

None

Example:

SA2.6:

```
G202
Ok
```

Notes:

Model	Firmware Version Last Tested
ST4	N/A
ST4.3	N/A
SA2.6	SA2_RC001_007_B3

G203 – Request RS Gimbal Position

Description:

This command is helpful when using the RS Gimbal. We do not always keep current positions for the RS Gimbal as it is time intensive. We only maintain these registers when the motors are being controlled live from the Gaming controller (Ex. Live Motion Menu, Setting Keyframes). If you want to make sure the Gimbal registers are current send this command wait about 5ms and then send next command so the gimbal has time to update the eMotimo with current information. This command is only relevant to SA2.6 models.

Parameters:

None

Example:

SA2.6:

```
G500
Positions: 00,-260,-82,0,0,0,0,0,-8,0
G203
Ok
G500
Positions: 00,-529,-85,0,0,0,0,0,-6,0
```

Notes:

Model	Firmware Version Last Tested
ST4	N/A
ST4.3	N/A
SA2.6	SA2_RC001_007_B3

G211 – Set Motor Virtual STOPA to a value or clear

Description:

Sets internal Stop A, one side of virtual Stop – use this for the lower value.

Parameters:

Parameter Description	Letter Code	ST4 Range	ST4.3 Range	SA2.6 Range
Motor ID	M	0 – Clear All 1 – Pan 2 – Tilt 3 – M3 4 – M4	0 – Clear All 1 – Pan 2 – Tilt 3 – M3 4 – M4 5 – Tilta Focus 6 – Tilta Iris 7 – Tilta Zoom	0 – Clear All 1 – RS Pan 2 – RS Tilt 3 – M1 4 – M2 5 – Tilta Focus 6 – Tilta Iris 7 – Tilta Zoom 8 – RS Roll 9 – RS Focus
Position (Optional, Default: -2000000000)	P	Pan Range: -2000000000 to 2000000000 Tilt Range: -2000000000 to 2000000000 M3 Range: -2000000000 to 2000000000 M4 Range: -2000000000 to 2000000000	Pan Range: -2000000000 to 2000000000 Tilt Range: -2000000000 to 2000000000 M3 Range: -2000000000 to 2000000000 M4 Range: -2000000000 to 2000000000 TN Focus Range: 0 to 9999 TN Iris Range: 0 to 9999 TN Zoom Range: 0 to 9999	RS Pan Range: -1800 to 1800 RS Tilt Range: -560 to 1460 M3 Range: -2000000000 to 2000000000 M4 Range: -2000000000 to 2000000000 TN Focus Range: 0 to 9999 TN Iris Range: 0 to 9999 TN Zoom Range: 0 to 9999 RS Roll Range: -300 to 300 RS Focus Range: 0 to 4095

Example:

ST4.3:

Set Tilt Virtual Stop A to -588800, then clear it.

```
G211 M2 P-588800
Tilt Virtual StopA set to:-588800
G211 M2
Tilt Virtual StopA set to:-2000000000
```

SA2.6:

```
M3 P25000
StopA:3,25000
G212 M3 P-25000
StopB:3,-25000
G211 M3
StopA:3,-2000000000
G212 M3
StopB:3,2000000000
```

Note:

- **Virtual StopA must be lower in value than Virtual Stop B**
- **G211 M0 will reset all axis A Stops to the default minimum seen in the ranges listed above**

Model	Firmware Version Last Tested
ST4	ST4_RC008_021
ST4.3	ST4_RC008_021
SA2.6	SA2_RC001_007_B3

G212 – Set Motor Virtual STOPB to a value or clear

Description:

Sets internal Stop B, one side of virtual Stop – use this for the higher value.

Parameters:

Parameter Description	Letter Code	ST4 Range	ST4.3 Range	SA2.6 Range
Motor ID	M	0 – Clear All 1 – Pan 2 – Tilt 3 – M3 4 – M4	0 – Clear All 1 – Pan 2 – Tilt 3 – M3 4 – M4 5 – Tilta Focus 6 – Tilta Iris 7 – Tilta Zoom	0 – Clear All 1 – RS Pan 2 – RS Tilt 3 – M1 4 – M2 5 – Tilta Focus 6 – Tilta Iris 7 – Tilta Zoom 8 – RS Roll 9 – RS Focus
Position (Optional, Default: 2000000000)	P	Pan Range: -2000000000 to 2000000000 Tilt Range: -2000000000 to 2000000000 M3 Range: -2000000000 to 2000000000 M4 Range: -2000000000 to 2000000000	Pan Range: -2000000000 to 2000000000 Tilt Range: -2000000000 to 2000000000 M3 Range: -2000000000 to 2000000000 M4 Range: -2000000000 to 2000000000 TN Focus Range: 0 to 9999 TN Iris Range: 0 to 9999 TN Zoom Range: 0 to 9999	RS Pan Range: -1800 to 1800 RS Tilt Range: -560 to 1460 M3 Range: -2000000000 to 2000000000 M4 Range: -2000000000 to 2000000000 TN Focus Range: 0 to 9999 TN Iris Range: 0 to 9999 TN Zoom Range: 0 to 9999 RS Roll Range: -300 to 300 RS Focus Range: 0 to 4095

Example:

ST4.3:

Set Tilt Virtual Stop B to 120000, then clear it.

```
G212 M2 P120000
Tilt Virtual StopB set to:120000
G212 M2
Tilt Virtual StopB set to:2000000000
```

SA2.6:

```
M3 P25000
StopA:3,25000
G212 M3 P-25000
StopB:3,-25000
G211 M3
StopA:3,-2000000000
G212 M3
StopB:3,2000000000
```

Note:

- **Virtual StopA must be lower in value than Virtual Stop B**
- **G212 M0 will reset all axis B Stops to the default maximum seen in the ranges listed above**

Model	Firmware Version Last Tested
ST4	ST4_RC008_021
ST4.3	ST4_RC008_021
SA2.6	SA2_RC001_007_B3

G213 –Set Motor Virtual STOPA to the current position

Description:

This reads the current position and sets STOPA to the current position for the requested motor.

Parameters:

Parameter Description	Letter Code	ST4 Range	ST4.3 Range	SA2.6 Range
Motor ID	M	1 – Pan 2 – Tilt 3 – M3 4 – M4	1 – Pan 2 – Tilt 3 – M3 4 – M4 5 – Tilta Focus 6 – Tilta Iris 7 – Tilta Zoom	1 – RS Pan 2 – RS Tilt 3 – M1 4 – M2 5 – Tilta Focus 6 – Tilta Iris 7 – Tilta Zoom 8 – RS Roll 9 – RS Focus

Example:

Move to a known position (stops not adhered to) and set virtual stop for M3 Virtual Stop A to that position.

ST4.3:

```
G1 X10000 Y20000 Z-15000 W2000 T1.5 A0.25
Move to:X10000,Y20000,Z-15000,W2000
G213 M3
M3 Virtual StopA set to:-15000
```

SA2.6:

```
G213 M3
StopA:3,55000
G2 Z30000
Jog by:X0,Y0,Z30000,W0,F0,I0,C0,R0
G214 M3
StopB:3,85000
```

Note:

- **Virtual StopA must be lower in value than Virtual Stop B**

Model	Firmware Version Last Tested
ST4	ST4_RC008_021
ST4.3	ST4_RC008_021
SA2.6	SA2_RC001_007_B3

G214 –Set Motor Virtual STOPB to the current position

Description:

This reads the current position and sets STOPB to the current position for the requested motor.

Parameters:

Parameter Description	Letter Code	ST4 Range	ST4.3 Range	SA2.6 Range
Motor ID	M	1 – Pan 2 – Tilt 3 – M3 4 – M4	1 – Pan 2 – Tilt 3 – M3 4 – M4 5 – Tilta Focus 6 – Tilta Iris 7 – Tilta Zoom	1 – RS Pan 2 – RS Tilt 3 – M1 4 – M2 5 – Tilta Focus 6 – Tilta Iris 7 – Tilta Zoom 8 – RS Roll 9 – RS Focus

Example:

Move to a known position (stops not adhered to and set virtual stop for M3 Virtual Stop B to that position.

ST4.3:

```
G1 X10000 Y20000 Z45000 W2000 T1.5 A0.25
Move to:X10000,Y20000,Z45000,W2000
G214 M3
M3 Virtual StopB set to:45000
```

SA2.6:

```
G213 M3
StopA:3,55000
G2 Z30000
Jog by:X0,Y0,Z30000,W0,F0,I0,C0,R0
G214 M3
StopB:3,85000
```

Note:

- **Virtual StopA must be lower in value than Virtual Stop B**

Model	Firmware Version Last Tested
ST4	ST4_RC008_021
ST4.3	ST4_RC008_021
SA2.6	SA2_RC001_007_B3

G215–Query Motor Virtual STOPA

Description:

This returns the current STOPA value for the motor. If the stop is not set, the value of the return is the full numerical limit.

Parameters:

Parameter Description	Letter Code	ST4 Range	ST4.3 Range	SA2.6 Range
Motor ID	M	1 – Pan 2 – Tilt 3 – M3 4 – M4	1 – Pan 2 – Tilt 3 – M3 4 – M4 5 – Tilta Focus 6 – Tilta Iris 7 – Tilta Zoom	1 – RS Pan 2 – RS Tilt 3 – M1 4 – M2 5 – Tilta Focus 6 – Tilta Iris 7 – Tilta Zoom 8 – RS Roll 9 – RS Focus

Example:

Move to a known position (stops not adhered to) and set virtual stop for M3 Virtual Stop A to that position. Query Stop A, clear the STOPA and then query STOPA again.

ST4.3:

```
G1 X10000 Y20000 Z-15000 W2000 T1.5 A0.25
Move to:X10000,Y20000,Z-15000,W2000
G213 M3
M3 Virtual StopA set to:-15000
G215 M3
M3 Virtual StopA set to:-15000
G211 M3
M3 Virtual StopA set to:-2000000000
G215 M3
M3 Virtual StopA set to:-2000000000
```

SA2.6:

```
G215 M3
M1 StopA:55000
G216 M3
M1 StopB:85000
```

Note:

Model	Firmware Version Last Tested
ST4	ST4_RC008_021
ST4.3	ST4_RC008_021
SA2.6	SA2_RC001_007_B3

G216–Query Motor Virtual STOPB

Description:

This returns the current STOPA value for the motor. If the stop is not set, the value of the return is the full numerical limit.

Parameters:

Parameter Description	Letter Code	ST4 Range	ST4.3 Range	SA2.6 Range
Motor ID	M	1 – Pan 2 – Tilt 3 – M3 4 – M4	1 – Pan 2 – Tilt 3 – M3 4 – M4 5 – Tilta Focus 6 – Tilta Iris 7 – Tilta Zoom	1 – RS Pan 2 – RS Tilt 3 – M1 4 – M2 5 – Tilta Focus 6 – Tilta Iris 7 – Tilta Zoom 8 – RS Roll 9 – RS Focus

Example:

Move to a known position (stops not adhered to) and set virtual stop for M3 Virtual Stop B to that position. Query Stop B, clear the STOPB and then query STOPB again.

ST4.3:

```
G1 X10000 Y20000 Z45000 W2000 T1.5 A0.25
Move to:X10000,Y20000,Z45000,W2000
G214 M3
M3 Virtual StopB set to:45000
G216 M3
M3 Virtual StopB set to:45000
G212 M3
M3 Virtual StopB set to:2000000000
G216 M3
M3 Virtual StopB set to:2000000000
```

SA2.6:

```
G215 M3
M1 StopA:55000
G216 M3
M1 StopB:85000
```

Note:

Model	Firmware Version Last Tested
ST4	ST4_RC008_021
ST4.3	ST4_RC008_021
SA2.6	SA2_RC001_007_B3

G217 – Recall Motor Virtual STOPA

Description:

This command will send all axis to the Stop A position if it has been set. If a motor has an unset stop then it will stay in place.

Parameters:

None

Example:

ST4.3:

```
G1 X10000 Y20000 Z0 W2000 T1.5 A0.25
Move to:X10000,Y20000,Z0,W2000
G213 M3
M3 Virtual StopA set to:0
G1 X10000 Y20000 Z45000 W2000 T1.5 A0.25
Move to:X10000,Y20000,Z45000,W2000
G214 M3
M3 Virtual StopB set to:45000
G217
Move to Stop A: X-2000000000,Y-2000000000,Z0,W-2000000000,F0,I0,C0
G218
Move to Stop B: X2000000000,Y2000000000,Z45000,W2000000000,F9999,I9999,C9999
```

SA2.6:

```
G215 M3
M1 StopA:55000
G216 M3
M1 StopB:85000
G217
Move to Stop A: X1800,Y900,Z55000,W-2000000000,F-1,I-1,C-1,D300,V0 <- Note M1 is the only axis with a set stop and will be the only moving motor
G218
Move to Stop B: X1800,Y1750,Z85000,W2000000000,F-1,I-1,C-1,D300,V4095
```

Note:

Model	Firmware Version Last Tested
ST4	ST4_RC008_021
ST4.3	ST4_RC008_021
SA2.6	SA2_RC001_007_B3

G218 – Recall Motor Virtual STOPB

Description:

This command will send all axis to the Stop B position if it has been set. If a motor has an unset stop then it will stay in place.

Parameters:

None

Example:

ST4.3:

```
G1 X10000 Y20000 Z0 W2000 T1.5 A0.25
Move to:X10000,Y20000,Z0,W2000
G213 M3
M3 Virtual StopA set to:0
G1 X10000 Y20000 Z45000 W2000 T1.5 A0.25
Move to:X10000,Y20000,Z45000,W2000
G214 M3
M3 Virtual StopB set to:45000
G217
Move to Stop A: X-2000000000,Y-2000000000,Z0,W-2000000000,F0,I0,C0
G218
Move to Stop B: X2000000000,Y2000000000,Z45000,W2000000000,F9999,I9999,C9999
```

SA2.6:

```
G215 M3
M1 StopA:55000
G216 M3
M1 StopB:85000
G217
Move to Stop A: X1800,Y900,Z55000,W-2000000000,F-1,I-1,C-1,D300,V0 <- Note M1 is the only axis
with a set stop and will be the only moving motor
G218
Move to Stop B: X1800,Y1750,Z85000,W2000000000,F-1,I-1,C-1,D300,V4095
```

Note:

Model	Firmware Version Last Tested
ST4	ST4_RC008_021
ST4.3	ST4_RC008_021
SA2.6	SA2_RC001_007_B3

G219 – Clear Stops by Axis

Description:

This command lets you clear stops for a given axis. This prevents the need for sending two commands to clear a single axis stops. You can also use this command to reset all virtual stops back to the default values. This can be useful on the SA2.6 for gimbals which have persistent limits. If you accidentally set limits and forget to clear them your gimbal may not behave how you expect the next time you use it. This command can reset the gimbal limits all at once so you get back to the default ranges.

Parameters:

Parameter Description	Letter Code	ST4 Range	ST4.3 Range	SA2.6 Range
Motor ID	M	0 – Clear All Axis Stops 1 – Pan 2 – Tilt 3 – M3 4 – M4	0 – Clear All Axis Stops 1 – Pan 2 – Tilt 3 – M3 4 – M4 5 – Tilta Focus 6 – Tilta Iris 7 – Tilta Zoom	0 – Clear All Axis Stops 1 – RS Pan 2 – RS Tilt 3 – M1 4 – M2 5 – Tilta Focus 6 – Tilta Iris 7 – Tilta Zoom 8 – RS Roll 9 – RS Focus

Example:

ST4.3:

```
G215 M3
M3 Virtual StopA set to:-2000000000
G216 M3
M3 Virtual StopB set to:2000000000
G213 M3
Virtual StopA set to:3,0
G2 Z30000
Jog by:X0,Y0,Z30000,W0,F0,I0,C0
G214 M3
Virtual StopB set to:3,30000
G217
Move to Stop A: X-2000000000,Y-2000000000,Z0,W-2000000000,F-1,I-1,C-1
G218
Move to Stop B: X2000000000,Y2000000000,Z30000,W2000000000,F-1,I-1,C-1
G219 M0
Reset Stops:0
G215 M3
M3 Virtual StopA set to:-2000000000
G216 M3
M3 Virtual StopB set to:2000000000
```

SA2.6:

```
G215 M3
M1 StopA:-2000000000
G216 M3
M1 StopB:2000000000
G213 M3
StopA:3,85000
G2 Z30000
Jog by:X0,Y0,Z30000,W0,F0,I0,C0,R0
G214 M3
StopB:3,115000
G217
Move to Stop A: X1800,Y900,Z85000,W-2000000000,F0,I0,C0,D300,V0
G218
Move to Stop B: X1800,Y1750,Z115000,W2000000000,F9999,I9999,C9999,D300,V4095
G219 M0
Reset Stops:0
G215 M3
M1 StopA:-2000000000
G216 M3
M1 StopB:2000000000
```

Note:

Model	Firmware Version Last Tested
ST4	ST4_RC008_021
ST4.3	ST4_RC008_021
SA2.6	SA2_RC001_007_B3

G300 – Sets Motor Velocity

Description:

This is inherently a dangerous command as by setting a motor velocity, it will continue to run until it hits it virtual stops unless another command is given to stop it. Use with care. Velocities are limited to 500000. This can be used as a Jog command but watch out motors need a stop command to end the Jog.

Parameters:

Parameter Description	Letter Code	ST4 Range	ST4.3 Range	SA2.6 Range
Motor ID	M	1 – Pan 2 – Tilt 3 – M3 4 – M4	1 – Pan 2 – Tilt 3 – M3 4 – M4 5 – TN Focus 6 – TN Iris 7 – TN Zoom	1 – RS Pan 2 – RS Tilt 3 – M1 4 – M2 5 – TN Focus 6 – TN Iris 7 – TN Zoom 8 – RS Roll 9 – RS Focus
Velocity	V	Pan: -500000 to 500000 Tilt: -500000 to 500000 M3: -500000 to 500000 M4: -500000 to 500000	Pan: -500000 to 500000 Tilt: -500000 to 500000 M3: -500000 to 500000 M4: -500000 to 500000 TN Focus: -25 to 25 TN Iris: -25 to 25 TN Zoom: -25 to 25	RS Pan: -15000 to 15000 RS Tilt: -15000 to 15000 M1: -500000 to 500000 M2: -500000 to 500000 TN Focus: -25 to 25 TN Iris: -25 to 25 TN Zoom: -25 to 25 RS Roll: -15000 to 15000 RS Focus: -100 to 100

Example:

ST4.3:

```
G212 M3 P1
M3 Virtual StopB set to:1
G300 M3 V100000
Velocity Move: M3 100000
G211 M3 P-100000
M3 Virtual StopA set to:-100000
G300 M3 V-100000
Velocity Move: M3 -100000
```

SA2.6:

```
G300 M3 V100000
Velocity Move: M1 100000
G300 M3 V0
Velocity Move: M1 0
G300 M8 V100000
Velocity Move: Roll 15000 <-Notice limited to max 15000 for this axis
G300 M8 V0
Velocity Move: Roll 0
```

Notes:

- **If a value of velocity is passed in that is greater than 500000, it will be defaulted to zero**

Model	Firmware Version Last Tested
ST4	ST4_RC008_021
ST4.3	ST4_RC008_021
SA2.6	SA2_RC001_007_B3

G301 – Set Motor Velocity Profile Driven

Description:

This is inherently a dangerous command as by setting a motor velocity, it will continue to run until it hits it virtual stops unless another command is given to stop it. Use with care. Velocities are limited to the velocity max of the current motor profile. This can be used as a Jog command but watch out motors need a stop command to end the Jog. This command passes a value of -500 to 500 that converts to a percentage (+/-500 = +/-100% and +/-250 = +/-50%) of the current Velocity Max of the active motor profile.

Parameters:

Parameter Description	Letter Code	ST4 Range	ST4.3 Range	SA2.6 Range
Motor ID	M	1 – Pan 2 – Tilt 3 – M3 4 – M4	1 – Pan 2 – Tilt 3 – M3 4 – M4 5 – TN Focus 6 – TN Iris 7 – TN Zoom	1 – RS Pan 2 – RS Tilt 3 – M1 4 – M2 5 – TN Focus 6 – TN Iris 7 – TN Zoom 8 – RS Roll 9 – RS Focus
Velocity	V	Pan: -500 to 500 Tilt: -500 to 500 M3: -500 to 500 M4: -500 to 500	Pan: -500 to 500 Tilt: -500 to 500 M3: -500 to 500 M4: -500 to 500 TN Focus: -100 to 100 TN Iris: -100 to 100 TN Zoom: -100 to 100	RS Pan: -500 to 500 RS Tilt: -500 to 500 M1: -500 to 500 M2: -500 to 500 TN Focus: -100 to 100 TN Iris: -100 to 100 TN Zoom: -100 to 100 RS Roll: -500 to 500 RS Focus: -100 to 100

Example:

SA2.6:

```
G301 M8 V-500
Velocity Move: Roll -500
G301 M8 V0
Velocity Move: Roll 0
G301 M8 V250
Velocity Move: Roll 250 <-Notice jogging in opposite direction at half the speed
G301 M8 V0
Velocity Move: Roll 0
```

Notes:

Model	Firmware Version Last Tested
ST4	ST4_RC008_021
ST4.3	ST4_RC008_021
SA2.6	SA2_RC001_007_B3

G302 – Set Position of Tilta Motors

Description:

This command lets you set the absolute position of the TN Motors. This is good for driving a motor by position incrementally since the TN Motors are encoded.

Parameters:

Parameter Description	Letter Code	ST4 Range	ST4.3 Range	SA2.6 Range
Motor ID	M	N/A	5 – TN Focus 6 – TN Iris 7 – TN Zoom	5 – TN Focus 6 – TN Iris 7 – TN Zoom 9 – RS Focus
Position	P	N/A	TN Focus: 0 to 9999 TN Iris: 0 to 9999 TN Zoom: 0 to 9999	TN Focus: 0 to 9999 TN Iris: 0 to 9999 TN Zoom: 0 to 9999 RS Focus: 0 to 4095

Example:

Send Position Update to the Zoom motor at 10Hz at 10steps for every message for 1 second. Send Focus to a position far away from where it currently is. **Warning: Sending far from current position will have high torque and likely will kick a motor should only do this for quick easy setup.**

ST4.3:

```
G302 M7 P8000
G302 M7 P8010
G302 M7 P8020
G302 M7 P8030
G302 M7 P8040
G302 M7 P8050
G302 M7 P8060
G302 M7 P8070
G302 M7 P8080
G302 M7 P8090
G302 M5 P3000
```

SA2.6:

```
G302 M9 P670
RS Focus Position: 670
G302 M9 P680
RS Focus Position: 680
G302 M9 P690
RS Focus Position: 690
G302 M9 P700
RS Focus Position: 700
G302 M9 P710
RS Focus Position: 710
G302 M9 P720
RS Focus Position: 720
G302 M9 P730
RS Focus Position: 730
G302 M9 P740
RS Focus Position: 740
G302 M9 P750
RS Focus Position: 750
G302 M9 P740
RS Focus Position: 740
G302 M9 P730
RS Focus Position: 730
G302 M9 P720
RS Focus Position: 720
G302 M9 P710
RS Focus Position: 710
G302 M9 P700
RS Focus Position: 700
G302 M9 P690
RS Focus Position: 690
G302 M9 P680
RS Focus Position: 680
G302 M9 P670
RS Focus Position: 670
G302 M9 P660
RS Focus Position: 660
G302 M9 P650
RS Focus Position: 650
```

Notes:

Model	Firmware Version Last Tested
ST4	ST4_RC008_021
ST4.3	ST4_RC008_021
SA2.6	SA2_RC001_007_B3

G500 – Status - What's moving and location

Description:

ST4/ST4.3:

Returns have 8 values.

4digit set – Is moving flag for Pan,Tilt,M3,M4. 1 indicates moving, 0 indicates still

The next 7 values are the current location of each of the Pan, Tilt, M3, M4, TN Focus, TN Iris, TN Zoom Values. **Note the ST4 shows the Tilta values even though this model does not support the use of the Tilta Motors.**

SA2.6:

Returns have 10 values.

2 digit set – Is moving flag for M1,M2. 1 indicates moving, 0 indicates still.

The next 9 values are the current location of each of the RS Pan, RS Tilt, M1, M2, TN Focus, TN Iris, TN Zoom, RS Roll, RS Focus Values.

Parameters:

None

Example:

ST4.3:

In the 1st G500 below, no motor is moving, and the pan value is 11297, tilt value is 132545, M3 4530 and M4 -26249. In the 2nd example you can see that the M3 motor was given a velocity command (G300) and then when status is checked again the M3 motor is moving.

```
G500
0000 11297,132545,4540,-26249,0,0,0
G300 M3 V10000
Velocity Move: M3 10000
G500
0010 2958,22723,304512,8722,0,0,0  ←Can see that M3 is Moving
```

SA2.6:

```
G500
Positions: 00,237,-490,0,0,4850,0,0,35,625
G301 M3 V-500
Velocity Move: M1 -500
G500
Positions: 10,237,-490,204993,0,4850,0,0,35,625 ←Can see that M1 is Moving
```

Notes:

Model	Firmware Version Last Tested
ST4	ST4_RC008_021
ST4.3	ST4_RC008_021
SA2.6	SA2_RC001_007_B3

G911 – Stop All Motors

Description:

Initiates a hard stop of all motors. This is not depowering but decelerating quickly. This should not be used as a general stop, but as an emergency stop. For Ext. Port motors this only ensures that eMotimo Motion Controller is not sending move commands to the motors. If they are being driven externally to the eMotimo Motion Controller (Ex. Tilta Hand Controller) this will not stop Ext. Port Motors.

Parameters:

None

Example:

```
G911
```

Notes:

- If Ext. Port Motors are being driven externally to the eMotimo Motimo Controller this will not stop Ext. Port Motors.

Model	Firmware Version Last Tested
ST4	ST4_RC008_021
ST4.3	ST4_RC008_021
SA2.6	SA2_RC001_007_B3

G999 – Keep Connection Alive

Description:

This command should be sent at a regular interval to keep connection open. Needed especially when using Velocity commands or motor can halt unexpectedly when the connection closes and resets. Connection will reset 30 seconds after the last received message.

Parameters:

None

Example:

```
G999
Connection Alive
```

Notes:

Model	Firmware Version Last Tested
ST4	ST4_RC008_021
ST4.3	ST4_RC008_021
SA2.6	SA2_RC001_007_B3

CAMERA CONTROL GROUP

Series of commands to interact with the camera triggering port. This could be fire a shot, focus, or fire a shot with a specific amount of time.

G400 – Trigger Shutter/Focus NOW

Description:

Trigger Focus and Shutter for a set period of MS from the camera port

Parameters:

Parameter Description	Letter Code	ST4 Range	ST4.3 Range	SA2.6 Range
Time of Shutter Trigger (Unit: msec)	S	1 to 5000	1 to 5000	1 to 5000

1. S -Shutter: - time in ms of Shutter Trigger

Example:

```
G400 S2000
Shutter/Focus 2000ms
G400 S150
Shutter/Focus 150ms
```

Notes:

Model	Firmware Version Last Tested
ST4	ST4_RC008_021
ST4.3	ST4_RC008_021
SA2.6	SA2_RC001_007_B3

G410/G411 – Focus Off/On

Description:

Turn on and off Focus

Parameters:

None

Example:

```
G411
Focus On
G410
Focus Off
```

Notes:

Model	Firmware Version Last Tested
ST4	ST4_RC008_021
ST4.3	ST4_RC008_021
SA2.6	SA2_RC001_007_B3

G420/G421 –Shutter Off/On

Description:

Turn on and off Shutter

Parameters:

None

Example:

```
G421
Shutter On
G420
Shutter Off
```

Notes:

Model	Firmware Version Last Tested
ST4	ST4_RC008_021
ST4.3	ST4_RC008_021
SA2.6	SA2_RC001_007_B3

G440 – Tally On/Off

Description:

Turn on and off RSI Tally Light. Excluding the Brightness value will toggle between 10% and 100% brightness. Setting the brightness to 0% will turn the RSI light off and it will remain off for shooting. Useful if you are shooting on reflective surfaces.

Parameters:

Parameter Description	Letter Code	ST4 Range	ST4.3 Range	SA2.6 Range
Brightness (Optional)	B	N/A	N/A	0 – 100

Example:

SA2.6:

```
G440
G440
G440 B0
```

Notes:

Model	Firmware Version Last Tested
ST4	N/A
ST4.3	N/A
SA2.6	SA2_RC001_007_B3

VIRTUAL CONTROLS

G600 – Emulates UI Controls

Description:

This can be used to control the UI of the ST4 emulates the 8-Way inputs.

Parameters:

Parameter Description	Letter Code	ST4 Range	ST4.3 Range	SA2.6 Range
Control Input	C	0 – Enter/Select 1 – Up 2 – Right 3 – Down 4 – Left 5 – Back 6 – Enter/Select Hold 7 – Triangle 8 – Circle	0 – Enter/Select 1 – Up 2 – Right 3 – Down 4 – Left 5 – Back 6 – Enter/Select Hold 7 – Triangle 8 – Circle	0 – Enter/Select 1 – Up 2 – Right 3 – Down 4 – Left 5 – Back 6 – Enter/Select Hold 7 – Triangle 8 – Circle

Example:

```
G600 C1
Input: Up
```

Notes:

Model	Firmware Version Last Tested
ST4	ST4_RC008_021
ST4.3	ST4_RC008_021
SA2.6	SA2_RC001_007_B3

SYSTEM GROUP - S

G700 – Returns current firmware Version

Description:

This can be used to retrieve the current firmware version of your rig

Parameters:

None

Example:

ST4.3:

```
G700
Version: ST4_RC008_021_B5
```

SA2.6:

```
G700
Version: SA2_RC001_007_B3
```

Notes:

Model	Firmware Version Last Tested
ST4	ST4_RC008_021
ST4.3	ST4_RC008_021
SA2.6	SA2_RC001_007_B3

G720 – Turn on/off Data Streaming of telemetry feed

Description:

The spectrum can output real-time telemetry of its motor position over the serial port. The commands will set up streaming that will report only when there is a change at a target frequency of up to 200Hz.

Parameters:

Parameter Description	Letter Code	ST4 Range	ST4.3 Range	SA2.6 Range
Frequency	S	0 – Off 1 – 200Hz 2 – 200/2Hz = 100Hz Etc.	0 – Off 1 – 200Hz 2 – 200/2Hz = 100Hz Etc.	N/A
Axis (Optional) (Default: Report All Axis)	A	See Description Below	See Description Below	N/A

1. S -**Set** – 0 turns off the streaming. Any positive value helps to set a divisor to manage target frequency of updates. The base frequency is 200Hz for updates. For example, 200Hz/100= 2 Hz. Or 200Hz/10=20Hz
2. A – Axis: A 7-byte binary array variable either setting an axis to be reported (1) or to not report (0) Ex. 0000101 will report Pan and M3

Example:

ST4.3:

```
G720 S2
Position Stream 100Hz
f0,t1298735,24.32,0,0,30000,0,5000,5000,5000
f0,t1299928,24.32,15,0,30000,0,5000,5000,5000
f0,t1299960,24.32,136,0,30000,0,5000,5000,5000
f0,t1299992,24.32,376,0,30000,0,5000,5000,5000
f0,t1300024,24.32,735,0,30000,0,5000,5000,5000

G720 S2 A0000011 <-Report Pan and Tilt Position only
Position Stream 100Hz
f0,t1858509,24.37,32110,62506
f0,t1858541,24.37,32291,62506
f0,t1858573,24.37,32590,62506
f0,t1858605,24.37,33010,62506
```

Notes:

Model	Firmware Version Last Tested
ST4	ST4_RC008_021
ST4.3	ST4_RC008_021
SA2.6	**Unsupported in V112**

G730 - Update System Settings

Description:

This command allows access to change various system settings

Parameters:

Parameter Description	Letter Code	ST4 Range	ST4.3 Range	SA2.6 Range
USB Port (Optional)	U	0 – USB Off 1 – eMotimo API 2 – Dragonframe4.1+	0 – USB Off 1 – eMotimo API 2 – Dragonframe4.1+	0 – USB Off 1 – eMotimo API 2 – Dragonframe4.1+
Expansion Port (Optional)	E	N/A	0 – Ext. Off 1 – Tilta Nuc M	0 – Ext. Off 1 – Tilta Nuc M
Brightness	B	0 – 10	0 – 10	0 – 10
Screen Timeout	T	1 – 120	1 – 120	1 – 120

B - Brightness: brightness values range 0 (off) to 10 (brightest)

T - Screen Timeout: 1-120 min (To Prevent Screen Burning) Default 5 min until dim 10 min until off

Example:

ST4.3:

```
G730 U1 E1 B5
USB Port: eMotimo API
Ext. Port: Tilta Nuc M
Brightness: 50%
```

SA2.6:

```
G730 U2 E0 B5
USB Port: Dragonframe4.1+
Ext. Port: Off
Brightness: 50%
Screen Timeout: 5 min
```

Notes:

- Any parameter left out of the command structure will remain unchanged. In this case the current setting will still be reported back.
- Brightness of <4 will not be maintained on power cycle these will always be overwritten to 40% brightness to not leave the OLED in a disabled or dim state that is hard to recover from

Model	Firmware Version Last Tested
ST4	ST4_RC008_021
ST4.3	ST4_RC008_021
SA2.6	SA2_RC001_007_B3

G752 – Read Preset Settings

Description:

This command will return the current position settings and timing settings associated with a given preset

Parameters:

1. P – Preset ID: Range 0-127

Example:

ST4.3:

```
G752 P0                                                  ← Default on Power On
Preset 0: X0 Y0 Z0 W0 F0 I0 C0 RunTime: 50 RampTime: 10
G21 P0                                                   ← Set Preset with Current Position of Rig
Preset 0 Set
G752 P0
Preset 0: X43780 Y-167994 Z49157 W97910 F5000 I5000 C6465 RunTime: 50 RampTime: 10
G21 P0 X1000 Y2000 Z3000 W4000 F100 I200 C300 T3.0 A.5   ← Set Preset with Custom Position & Time
Preset 0 Set
G752 P0
Preset 0: X1000 Y2000 Z3000 W4000 F100 I200 C300 RunTime: 30 RampTime: 5
```

SA2.6:

```
G752 P0                                                  ← Default on Power On
Preset 0: X0 Y0 Z0 W0 F0 I0 C0 R0 D0 RunTime: 50 RampTime: 10
G500
Positions: 0000,-940,-492,0,0,0,0,0,-286,0
G21 P0 T5.0 A2.0                                         ← Set Preset with Current Position of Rig
Preset Set: 0 5.0 2.0
G752 P0
Preset 0: X-940 Y-492 Z0 W0 F0 I0 C0 R-286 D0 RunTime: 50 RampTime: 20
G21 P0 X-900 Y1400 Z3000 W4000 F100 I200 C300 R200 T3.0 A.5 ← Set Preset with Custom Position
Preset Set: 0 3.0 0.5
G752 P0
Preset 0: X-900 Y1400 Z3000 W4000 F100 I200 C300 R200 D100 RunTime: 30 RampTime: 5
G20 P0
Recalling Preset 0
G500
Positions: 0000,-898,1400,3000,4000,100,200,300,199,97
```

Notes:

Model	Firmware Version Last Tested
ST4	ST4_RC008_021
ST4.3	ST4_RC008_021
SA2.6	SA2_RC001_007_B3

EXPANSION PORT GROUP

G810 - Record Start/Stop

Description:

Used to start and stop through Tilta Run/Stop cables plugged into the Ext. Port. Omission of parameter will toggle the record state.

Parameter:

Parameter Description	Letter Code	ST4 Range	ST4.3 Range	SA2.6 Range
Record (Optional)	R	N/A	0 – Stop Recording 1 – Start Recording	0 – Stop Recording 1 – Start Recording

Example:

```
G810
Camera Recording Started
G810
Camera Recording Stopped
G810 R1
Camera Recording Started
G810 R1
Camera Recording Started
G810 R0
Camera Recording Stopped
```

Notes:

Model	Firmware Version Last Tested
ST4	ST4_RC008_021
ST4.3	ST4_RC008_021
SA2.6	SA2_RC001_007_B3

G812 – Tilta Commands

Description:

When the Spectrum or Conductor Ext. Port is configured with the Tilta Integration various settings can be adjusted on the Tilta Motors.

Parameters:

Parameter Description	Letter Code	ST4 Range	ST4.3 Range	SA2.6 Range
Motor	M	N/A	1 – Focus 2 – Iris 3 – Zoom 7 – All Tilta Motors	1 – Focus 2 – Iris 3 – Zoom 7 – All Tilta Motors
Torque (Optional) **(Recommended: 50%)**	T	N/A	1 – 100	1 – 100
Calibrate (Optional)	C	N/A	0 – Auto	0 – Auto

Currently Manual Calibration of Tilta Motors is not supported through the eMotimo API and has to be done throught the Tilta Hand Controller instead.

Example:

```
G812 M1 T25 <- Set torque to 25%
G812 M1 C0
Ok
```

Notes:

Model	Firmware Version Last Tested
ST4	ST4_RC008_021
ST4.3	ST4_RC008_021
SA2.6	SA2_RC001_007_B3

Understanding Velocity and Acceleration Values for each axis

To help programmers plan their motion better, detailed information on gearing by axis and constants to relate motor move parameters to real world units is needed.

Understanding Velocity (V). This is a constant that relates to the maximum **microsteps per second** that our motor drivers will deliver. Based on the motor / gearing, it relates to angular and linear velocities with real-world units. Since the spectrum ST4 only has Pan and Tilt motors / gearing, real world units can only be related for these axes. The M3 and M4 axis are customizable so real world units for angular and linear velocity cannot be fully determined since only part of the equation is known.

For Positions – note – ms refers to microstep, not milliseconds – timing will always be related as seconds, or sec.

PAN			TILT	
1179151.515	**ms/rev Pan Shaft**		3125148.789	**ms/rev Tilt Shaft**
3275.420875	**ms/degree**		8680.968858	**ms/degree**
0.000305304	**deg/microstep**		0.000115195	**deg/microstep**
1179151.515	**ms in a 360**		3125148.789	**ms in a 360**

For Velocities, the values entered for move commands and motor setup is not steps per second, rather, it is a factor of that based on other parameters that are hardware dependent. For the ST4, **the translation the constant is 0.953674316**

Example calculation:

You want the Pan to spin at 10 degrees per second. This is (10 deg/sec) * (3275.420875 ms/deg)= 32754.20875 ms/sec

To get to a programmed velocity you take 32754.20875 / **0.953674316=** 34345. 34345 is what you would put into G300 command to set the VMAX value for the Pan Axis.

Known Issues

Document Versioning and Changelog

eMotimo API Reference API - V0.112 February 16, 2024–

Model	Minimum Required Firmware Version
ST4	ST4_RC008_023
ST4.3	ST4_RC008_023
SA2.6	SA2_RC001_007_B4

- Added support for the SA2.6 model
- Added commands specific to RS Gimbals (G202, G203)
- Updated the Examples for all commands
- Updated the Parameter lists for all commands
- Added Position control for FIZ motors (G302)
- Added a Velocity control that is driven by motor profile settings (G301)
- Fixed issue with G21 command that was overwriting the Ramp Time if it was excluded
- General Bug Fixes
- Removed Several System Group commands that are not supported by all models, These will be added back in to V113 as they are fully tested for each model

eMotimo API Reference API - V0.111 Unreleased

Model	Minimum Required Firmware Version
ST4	ST4_RC008_021
ST4.3	ST4_RC008_021
SA2.6	SA2_RC001_005

- Synchronized the API between all eMotimo Moudles
- Updated the Entire Documentation and added Notes for Version each command was last tested
- Updated all Parameter Lists to be organized by Model
- Added Endline (“/n”) character to each message response to aid in parsing response messages
- Fixed some bugs with Import by Axis (G753)
- Added Start Frame to Import by Axis (G753) for moves longer than 125 frames
- Added Import by Frame Command (G754)
- Added an Axis Selection Parameter to Data Stream (G720)

ST4 API Reference API - V0.110 July 27, 2022–

ST4_RC008_019 and above

- Updated Documentation Format
- Added motor control for Expansion Port Tilta Motors in appropriate commands
- Updated Telemetry Streaming to Include Voltage and be in ASCII
- Added a smart Export by Axis (G751)
- Added Save/Load Moves and Assets Commands (G760-G767)
- Added a Motion Planning by Axis (G11) to be used in conjunction of G300 commands without conflict

- Added Expansion Port Group Commands
- Added G730 command for updating various system settings
- Motor Performance Commands updated and extended (G100-G102)
- Port Reset after 30 seconds added to Recover from Pulled Cables
- G999 command Added to Keep Connection alive. Prevent unwanted motor halts on Port Reset
- Added Commands for Setting/Authoring/Recalling Assets (G20-G23)
- Added Commands to setup a looping mode between two defined points (G24/25)

ST4 API Reference API - V0.109 **March 3, 2020**–

ST4_RC007_80 and above

- Added information on Line Ending Character
- <Placeholder, need to add checksum and only process commands that begin with G>

ST4 API Reference API - V0.108 **Jan 29, 2020**–

ST4_RC007_70 and above

- Fixed typo

ST4 API Reference API - V0.107 **Jan 6, 2020**–

ST4_RC007_70 and above

- Added position streaming G720 function

ST4 API Reference API - V0.106 **Feb 5, 2019** –

ST4_RC007_42 and above

- Addition of details in Understanding Velocity and Acceleration Values

ST4 API Reference API - V0.105 **July 5, 2018** – Versioning implemented initial version created.

This works with
ST4_RC007_42 and above

- Addition of G215 and G216

ST4 API Reference API - V0.104 **May 30, 2018** – Versioning implemented initial version created.

This works with
ST4_RC007_36 and above

- Bugfix – for Min Max default values for stops resolved. Affects G211, G212, G213 and G214
- Addition of G700, G710