ST4 API Reference
API - V0.110

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EMOTILINK COMMAND PROTOCOL: Reference Guide

This document is an early release. It is the set of commands to access and control the spectrum ST4. 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 "ST4 API Issue"

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 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

Development Table Quick Reference

Assets	Internal Authoring	External Upload	Read	Recall	Load from SD	Save to SD
Preset	G21	G21	G752	G20	G763	G762
Trace	G22	G753	G750	G22	G765	G764
Move	G22	G753	G750/G751	G23	G761	G760
Motor Profile	G100	G100	G101	G102	G767	G766

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:

1. X – Pan Absolute Position
2. Y – Tilt Absolute Position
3. Z – M3 Absolute Position
4. W – M4 Absolute Position
5. F – Tilta Focus Absolute Position (0-9999)
6. I – Tilta Iris Absolute Position (0-9999)
7. C – Tilta Zoom Absolute Position (0-9999)

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

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

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
- Focus, Iris and Zoom range is between 0-9999
- Rapid Moves on Tilta have High Torque use with care!

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

1. X – Pan Absolute Position
2. Y – Tilt Absolute Position
3. Z – M3 Absolute Position
4. W – M4 Absolute Position
5. F – Tilta Focus Absolute Position (0-9999)
6. I – Tilta Iris Absolute Position (0-9999)
7. C – Tilta Zoom Absolute Position (0-9999)
8. T – Move Time
9. A – Acceleration Time (or Ramp Time)

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.

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

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
- Focus, Iris and Zoom range is between 0-9999

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.

Parameters:

1. M -**M**otor – M1 for Pan, M2 for Tilt, M3 for M3, M4 for M4, M5 for Focus, M6 for Iris, M7 for Zoom
2. P - **Position**: Absolute Motor Position (M5-7 have range 0-9999)
3. T – Move Time
4. A – Acceleration Time (Ramp Time)

Example:

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

```
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 R2
```

```
Moving Focus to: P9999 T5.00 A2.40
```

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.
- 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
- Focus, Iris and Zoom range is between 0-9999

G2 – Jog Position Incremental – Stops enforced

Description:

Jogs motor a particular number of steps.

Parameters

1. X – Pan Absolute Position
2. Y – Tilt Absolute Position
3. Z – M3 Absolute Position
4. W – M4 Absolute Position
5. F – Tilta Focus Absolute Position (0-9999)
6. I – Tilta Iris Absolute Position (0-9999)
7. C – Tilta Zoom Absolute Position (0-9999)

Example:

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

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

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
- Focus, Iris and Zoom range is between 0-9999

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

1. P – Preset ID: Range of 0-127
2. T – Run Time: 1.0 to 60.0 (Optional)
3. A – Accel Time: 1.0 to 60.0 (Optional)

Example:

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

```
G21 P0 T8.0 A2.0
Preset 0 Set
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) as well but inherently the position data of the preset will also change

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.**

Parameters

1. P – Preset ID: Range of 0-127
2. T – Run Time: 1.0 to 60.0 (Optional)
3. A – Accel Time: 1.0 to 60.0 (Optional)
4. X – Pan Absolute Position (Optional)
5. Y – Tilt Absolute Position (Optional)
6. Z – M3 Absolute Position (Optional)
7. W – M4 Absolute Position (Optional)
8. F – Tilta Focus Absolute Position: Range of 0-9999 (Optional)
9. I – Tilta Iris Absolute Position: Range of 0-9999 (Optional)
10. C – Tilta Zoom Absolute Position: Range of 0-9999 (Optional)

Example:

```
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
```

Notes:

- The position parameters are optional. If any of the 7 axes are excluded, then the current position of the motor is used in the preset. **Must include all 7 axis positions if you want to set a custom position!**

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

1. R – Record Trace: Range 1-4
2. P – Recall Trace: Range 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

G23 – Recall/Playback a Programmed Shot (after being loaded from SD card)

Description:

This command is used to Play a programmed shot that has been reloaded from memory.

Parameters

1. None

Example:

```
G761 PNEW NREDO2.st4
Load Successful
G23
```

Notes:

- This command only works after loading a move from SD Card or once on the Programmed Shots Summary or Completion Screens.

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

1. L – Loop ID: Range 0-7
2. N – Number of Loops: 0 = Infinite (default) Range 0-65535

Example:

```
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
```

Notes:

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

1. L – Loop ID: Range 0-7
2. A – Point A Index: Range 0-127
3. B – Point B Index: Range 0-127
4. T – Run Time: 1.0 to 60.0 (Optional)
5. A – Accel Time: 1.0 to 60.0 (Optional)
6. C – Dwell Time A (ms): Min. 300
7. D – Dwell Time B (ms): Min. 300

Example:

```
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
```

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 an asymmetrical timing between the two directions.

G100 – Sets Motor Performance

Description:

This is an advanced command that must be used carefully as this controls power and speeds used by the ST4's motors. Do not set maxes on any axis at a default. It is recommended to use the example parameters below and slowly make changes.

Parameters:

1. M -**M**otor – M – 1-4, M1 Pan, M2, Tilt, M3, M4
2. U – User Tuning Profile: 1 or 2
3. D - Mo**D**e 1 for normal, 2 for quiet
4. V - **V**MAX: 1 to 600000, positive integer values only
5. A - **A**MAX: 1 to 65535, positive integer values only
6. R - Power During **R**un: 1 to 15 positive integer values only
7. S - Power During **S**top: 0 to 5 positive integer values only

Example:

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

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.*

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 Pan, Tilt, M3 and M4 and not to additional FIZ control on the Ext. Port.

Parameters:

1. M - Motor: 1 for Pan, 2 for Tilt, 3 for M3, 4 for M4

Example:

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

Notes:

G102 – Set Motor Profile

Description:

Parameters:

1. P – Motor Profile: Range 0-7

Example:

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

Notes:

-

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.

Parameters:

1. M - Motor: 1 for Pan, 2 for Tilt, 3 for M3, 4 for M4
2. P (Optional) - Position: any singed 32 bit integer number between - 2100000000 to 2100000000, If not entered, 0 will be defaulted.

Examples:

```
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
```

Notes:

-

G201 - Zero All Motors

Description:

Sets Pan, Tilt, M3 and M4 motor position register to 0. This command only applies to Pan, Tilt, M3 and M4 and not to additional FIZ control on the Ext. Port.

Parameters:

None

Example:

```
G201
All Motors Zeroed
```

Notes:

-

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. This command only applies to Pan, Tilt, M3 and M4 and not to additional FIZ control on the Ext. Port.

Parameters:

1. M - Motor: 1 for Pan, 2 for Tilt, 3 for M3, 4 for M4
2. P - Position: (optional) any integer number -2100000000 to 2100000000, if left clear, this will set the STOPB to the STOPA to the **minimum** value, clearing the stop in practice

Example:

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:-2100000000
```

Note:

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

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. This command only applies to Pan, Tilt, M3 and M4 and not to additional FIZ control on the Ext. Port.

Parameters:

1. M - Motor: 1 for Pan, 2 for Tilt, 3 for M3, 4 for M4
2. P - Position: (optional) any integer number -2100000000 to 2100000000, if left clear, this will set the STOPB to the **maximum** value, clearing the stop in practice

Example:

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:2100000000
```

Note:

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

G213 –Set Motor Virtual STOPA to the current position

Description:

This reads the current position and set STOPA to the current position for the requested motor. This command only applies to Pan, Tilt, M3 and M4 and not to additional FIZ control on the Ext. Port.

Parameters:

1. M - Motor: 1 for Pan, 2 for Tilt, 3 for M3, 4 for M4

Example:

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

```
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
```

Note:

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

G214 –Set Motor Virtual STOPB to the current position

Description:

This reads the current position and set STOPB to the current position for the requested motor. This command only applies to Pan, Tilt, M3 and M4 and not to additional FIZ control on the Ext. Port.

Parameters:

1. M - Motor: 1 for Pan, 2 for Tilt, 3 for M3, 4 for M4

Example:

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

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

Note:

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

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. This command only applies to Pan, Tilt, M3 and M4 and not to additional FIZ control on the Ext. Port.

Parameters:

1. M - Motor: 1 for Pan, 2 for Tilt, 3 for M3, 4 for M4

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.

```
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:-2100000000
G215 M3
M3 Virtual StopA set to:-2100000000
```

Note:

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. This command only applies to Pan, Tilt, M3 and M4 and not to additional FIZ control on the Ext. Port.

Parameters:

1. M - Motor: 1 for Pan, 2 for Tilt, 3 for M3, 4 for M4

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.

```
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:2100000000
G216 M3
M3 Virtual StopB set to:2100000000
```

Note:

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:

1. M -**M**otor – M1 for Pan, M2 for Tilt, M3 for M3, M4 for M4, M5 for Focus, M6 for Iris, M7 for Zoom
2. V - **V**elocity: -500000 to 500000

Example:

```
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
```

Notes:

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

G500 – Status - What's moving and location

Description:

This command only applies to Pan, Tilt, M3 and M4 and not to additional FIZ control on the Ext. Port.

Parameters:

None

Example:

Returns has 5 values

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

The next 4 values are the current location of each of the Pan, Tilt, M3, and M4 Values. 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

G300 M3 V10000
Velocity Move: M3 10000
G500
0010 2958,22723,304512,8722        ←Can see that M3 is Moving
```

Notes:

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 ST4 is not sending move commands to the motors. If they are being driven externally to the ST4 this will not stop Ext. Port Motors.

Parameters:

None

Example:

```
G911
```

Notes:

- If Ext. Port Motors are being driven externally to the ST4 this will not stop Ext. Port Motors.

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
```

Notes:

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:

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

Example:

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

G410/G411 – Focus Off/On

Description:

Turn on and off Focus

Parameters:

None

Example:

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

Notes:

G420/G421 –Shutter Off/On

Description:

Turn on and off Shutter

Parameters:

None

Example:

```
G421 S2000
Shutter On
G420 S150
Shutter Off
```

Notes:

PROGRAMMED SHOTS GROUP

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:

```
G700
Version: ST4_RC007_36
```

Notes:

G710 – Turn on/off Pre/Post amble

Description:

By default, the spectrum doesn't add any tags to delimit the start and end of a response. Most terminal programs will parse this just fine, but if you need to systematically and buffer multiple commands and response, delimiters are helpful.

This command either sets an internal flag (volatile) in the spectrum and then returns the version. If the pre/post amble is set, then the spectrum prepends all returns with "<STX>" and appends all returns with "<ETX>".

Parameters:

1. S -**Set** – 1 adds pre/post amble to all returns of <STX> and <ETX>. All other values including omission, returns the spectrum to the default state of no prepends/appends.

Example:

```
G700
Version: ST4_RC007_36
G710
Version: ST4_RC007_36
G710 S1
<STX>Version: ST4_RC007_36<ETX>
G710 S0
Version: ST4_RC007_36
```

Notes:

"<STX>" and "<ETX>" are control characters, not 5 byte strings.
"\x02", //hex 02, dec 2, <STX>
"\x03" //hex 03, dec 3, <ETX>

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:

- 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

Example:

```
G720 S0
Position Stream Off
G720 S100
Position Stream 2Hz
G720 S10
Position Stream 20Hz
```

Notes:

G730 - Update System Settings

Description:

This command allows access to change various system settings

Parameters:

- Ports: U for USB Port, E for Ext. Port
  - USB Options:
    0. USB Off
    1. eMotimo API
    2. Dragonframe4.1+
  - Ext. Options:
    0. Ext. Off
    1. Tilta Nuc M
- 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:

```
G730 U2 E1 B5
USB Port: eMotimo API
Ext. Port: Tilta Nuc M
Brightness: 50%
```

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

G750 – Export Move/Trace from RAM

Description:

Returns the move parameters and the line-by-line export of the move.

Parameters:

1. T – Trace ID: Range 1-4 (Optional)

Example:

```
G750
Total Shots:240
Framerate:24
0,0,91024,-23259,-3552,0,0,0
<Placeholder, response very large>


G750 T1
Total Shots:900
Framerate:24
0,0,91024,-23259,-3552,0,0,0
<Placeholder, response very large>
```

Note:

- Excluding the Trace ID parameter will return the positions of a Programmed Shot (fps * Duration = # of Frames). While including the preset parameter will return the positions of a trace move (900 Frames)

G751 – Smart Export by Axis

Description:

Returns the move parameters and the line-by-line export of the selected axis.

Parameters:

1. 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:

```
G751 A0011110
Total Shots:240
Framerate:24
Frame,Tilt,M3,M4,Focus
<Placeholder, response very large>
```

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:

```
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
```

Note:

G753 – Import Move Data by Axis

Description:

Parameters:

1. A – Axis: 1 for Pan, 2 for Tilt, 3 for M3, 4 for M4, 5 for Focus, 6 for Iris, 7 for Zoom
2. F – Number of Frames: Range 1-125, **Must have leading 0s for width of 3 bytes**

Example:

Set the first 2 Frames of the Pan Axis with the values 12345 and 23456 (Slashes are escape characters for hex format in our terminal not part of the command structure)

```
G753 A0 F002 \0x39\0x30\0x00\0x00\0xA0\0x5B\0x00\0x00 ← Vals 12345 and 23456 (Hex LSB 4-Byte vals)
```

Note:

- This command uses LSB hex format for the position data.
- The Number of Frames parameter needs to have leading 0s

G760 – Save Move by Filename

Description:

Save the current programmed move to the SD card by giving a Project ID and a basic filename

Parameters:

1. P - Project ID: 3 AlphaNumeric Characters (A-Z, 0-9)
2. N - Move File Name: 4 AlphaNumeric Characters (A-Z, 0-9)

Example:

```
G760
```

```
Save Failed
G760 PLOG
Save Failed
G760 PLOG NLONGNAME
Save Successful
```

Notes:

- If the format of the command has more than 3 characters for the PID or 4 for the file, then the command will return an error message.

G761 – Load Move by Filename

Description:

Load a programmed move from the SD card by specifying the Project ID and the filename

Parameters:

1. P - Project ID: 10 AlphaNumeric Characters (A-Z, 0-9)
2. N - File Name: 10 AlphaNumeric Characters (A-Z, 0-9)

Example:

```
G761
JOS
NUT
PRO
ST4
Load Failed
G761 PST4
1000.st4
1001.st4
1002.st4
1003.st4
1004.st4
1005.st4
1006.st4
1007.st4
1008.st4
1009.st4
1010.st4
1011.st4
1012.st4
1013.st4
1014.st4
1015.st4
1016.st4
1017.st4
1018.st4
1019.st4
1020.st4
Load Failed
G761 PST4 N1001.st4
Load Successful
```

Notes:

- If the File or Project ID does not exist or the format of the command has more than 10 characters for the PID or for the file name, then the command will return an error message.
- If there is no SD Card detected, then an error message will be returned warning that there was no SD Card detected

G762 – Save Presets by Filename

Description:

Save a set of GoTo Presets to the SD card by specifying the Project ID and the filename

Parameters:

1. P - Project ID: 10 AlphaNumeric Characters (A-Z, 0-9)
2. N - File Name: 10 AlphaNumeric Characters (A-Z, 0-9)

Example:

```
G762 PTST NEXAMPLE
Save Successful

G762 PTST NEXAMPLETOOLONG
Save Failed

G762 PTST NEXAMPLE
No SD Card Detected
```

Notes:

- If the File or Project ID does not exist or the format of the command has more than 10 characters for the PID or for the file name, then the command will return an error message.
- If there is no SD Card detected, then an error message will be returned warning that there was no SD Card detected

G763 – Load Presets by Filename

Description:

Load a set of GoTo Presets from the SD card by specifying the Project ID and the filename

Parameters:

1. P - Project ID: 10 AlphaNumeric Characters (A-Z, 0-9)
2. N - File Name: 10 AlphaNumeric Characters (A-Z, 0-9)

Example:

```
G763
PRE
TST
Load Failed
G763 PTST
EXAMPLE.st4
Load Failed
G763 PTST NEXAMPLE.st4
Load Successful
```

Notes:

- If the File or Project ID does not exist or the format of the command has more than 10 characters for the PID or for the file name, then the command will return an error message
- If there is no SD Card detected, then an error message will be returned warning that there was no SD Card detected

G764 – Save Traces by Filename

Description:

Save recorded traces to the SD card by specifying the Project ID and the filename

Parameters:

1. P - Project ID: 10 AlphaNumeric Characters (A-Z, 0-9)
2. N - File Name: 10 AlphaNumeric Characters (A-Z, 0-9)

Example:

```
G764 PTRACE NEXAMPLE
Save Successful
```

Notes:

- If the File or Project ID does not exist or the format of the command has more than 10 characters for the PID or for the file name, then the command will return an error message.
- If there is no SD Card detected, then an error message will be returned warning that there was no SD Card detected

G765 – Load Traces by Filename

Description:

Load a set of Traces from the SD card by specifying the Project ID and the filename

Parameters:

1. P - Project ID: 10 AlphaNumeric Characters (A-Z, 0-9)
2. N - File Name: 10 AlphaNumeric Characters (A-Z, 0-9)

Example:

```
G765
TRACEPID
TRACE
Load Failed
G765 PTRACE
EXAMPLE.st4
Load Failed
G765 PTRACE NEXAMPLE.st4
Load Successful
```

Notes:

- If the File or Project ID does not exist or the format of the command has more than 10 characters for the PID or for the file name, then the command will return an error message.
- If there is no SD Card detected, then an error message will be returned warning that there was no SD Card detected

G766 – Save Motor Profile by Filename

Description:

Save current motor profile to the SD card by specifying the Project ID and the filename

Parameters:

1. P - Project ID: 10 AlphaNumeric Characters (A-Z, 0-9)
2. N - File Name: 10 AlphaNumeric Characters (A-Z, 0-9)

Example:

```
G766 PMOTPROFILE NEXAMPLE
Save Successful

G766 PMOTPROFILETOOLONG NEXAMPLE
Save Failed
```

Notes:

- If the File or Project ID does not exist or the format of the command has more than 10 characters for the PID or for the file name, then the command will return an error message.
- If there is no SD Card detected, then an error message will be returned warning that there was no SD Card detected

G767 – Load Motor Profile by Filename

Description:

Load a Motor Profile from the SD card by specifying the User Motor Profile ID, Project ID and the filename. This Profile will be written to a User Tuning Motor Profile and saved to EEPROM as the current motor profile to ensure this motor setup will stick on power cycles.

Parameters:

1. U – User Motor Profile ID: 1 or 2
2. P - Project ID: 10 AlphaNumeric Characters (A-Z, 0-9)
3. N - File Name: 10 AlphaNumeric Characters (A-Z, 0-9)

Example:

```
G767
Com'd Not Recognized
G767 U1
MOTORTEST
MOTPROFILE
Load Failed
G767 U1 PMOTPROFILE
EXAMPLE.st4
Load Failed
G767 U1 PMOTPROFILE NEXAMPLE.st4
Load Successful
```

Notes:

- If the File or Project ID does not exist or the format of the command has more than 10 characters for the PID or for the file name, then the command will return an error message.
- If there is no SD Card detected, then an error message will be returned warning that there was no SD Card detected

EXPANSION PORT GROUP

G810/G811 - Record Start/Stop

Description:

Used to start and stop through Tilta Run/Stop cables plugged into the Ext. Port.

Parameter:

1. R – Record: 1 to Start, 0 to Stop, Omission of parameter will toggle

Example:

```
G430
Camera Recording Started
G430
Camera Recording Stopped
G430 R1
Camera Recording Started
G430 R1
Camera Recording Started
G430 R0
Camera Recording Stopped
```

Notes:

G812 – Tilta Commands – Torque and Auto Calibration working but Manual Calibration has no input control to move motors yet

Description:

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

Parameters:

- T - Torque: Torque values range from 1-100 (50 is the Default Recommended Torque)
- C - Calibrate: C0 for Auto (For lenses with hard stops), C1 for Manual (For lenses without stops)
  - Options:
    - M1 for Focus Calibration
    - M2 for Iris Calibration
    - M4 for Zoom Calibration
    - M7 to Calibrate all Motors

Example:

Notes:

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.

Open Software Requests

Placeholder – KEYS GROUP – Read/Write

Emulates control inputs from the PS4 Remote Control and 9 Way switch.

Key Monitor

As keys are pressed and inputs given output the codes as they are read. This function will be disabled until UART DMA in place and throughput and blocking time is too high.

Document Versioning and Changelog

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