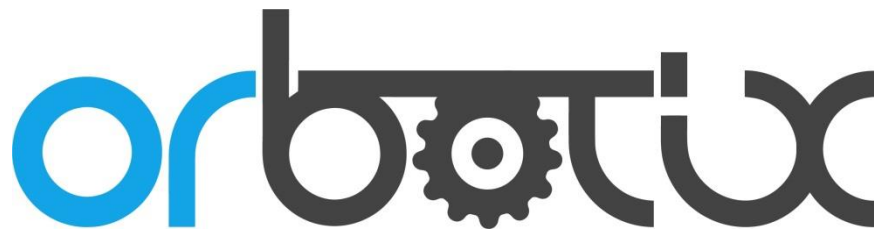


# Sphero Shell Commands

document revision 2.3

NOTE: If you are reading this, you're viewing the internal super secret version of this document and this text should have a purple background and be underlined with dots.

To sanitize for external release select: File -> Options -> Display and uncheck Print Hidden Text.



Introduction .....	3
[System].....	4
[Control System].....	4
[LEDs] .....	5
[Raw Motor] .....	5
[Configuration Block].....	5
[Standby/Sleep].....	6
[Voltage Commands].....	6
[Debugging] .....	6
[Gyro Sensor].....	7
[Accelerometer Sensor] .....	8
[Bluetooth] .....	8
[Collision Detection].....	8
[Macros] .....	9
[orbBasic].....	9
[Misc].....	9
Appendix A .....	10
Revision History .....	11

## Introduction

In addition to binary API commands (that begin with FFh FFh ...) the communications processor will also accept ASCII characters. This out-of-band data is buffered separately until a CR (0Dh) character is received and then it is submitted to the Shell Processor for decoding and execution. This document lists and describes the various commands along with which version of the firmware they were introduced (if added in 2012).

If the FW version field contains an F then this command will only work at the factory.

Note that you will need to place Sphero into User Hack mode to enable the Shell. The simple byte string

```
FFh FFh 02h 42h 33h 02h 01h 85h
```

will accomplish this transition, and the mode persists across power cycles. So you only need to send it once.

You can connect to the Shell through a standard terminal program (like TeraTerm) and you will want to configure it to send a CR when Enter is pressed, and interpret LF (0Ah) as a linefeed. Turn local echo off.

Parameters are italicized. Numbers expected to be decimal. Multiple parameters are separated by a space (for example `lc 255 128 64`).

## [System]

Command	Description	Ver
ver	Returns module versions	
sv	<del>Displays various state variables</del>	3.24
vxr x.y	Temporary override of the Main App version to x.y	0.87
br	Get board revision ID and raw ADC value	
chd	Display chassis ID	1.12
chw x	Assign chassis ID to x [0..65525]	1.12(F)
sof x	Set option flag x [0..31] or 32 to display (see Appendix A)	1.15
cof x	Clear option flag x [0..31] or 32 to display	1.15
x 11	Soft reset of Sphero	
r x	Clear the core RCC flag (x=0) or display the RCC_CSR register (x > 0)s	
st	Display detailed results of processor self test	
%	Display CPU utilization information	
rtd	Display realtime performance counters	1.23
rtz	Clear realtime performance counters	
smd	Display device mode	
smn	Set device mode to Normal	
smu	Set device mode to User Hack	
smf	Set device mode to Factory	
smv	Set device mode to Development	
elt x	Enable (x=1) or disable the lifetest macro to run upon shake-awake	3.23

## [Control System]

Command	Description	Ver
l x	Enable the control system (x>0) or disable it (l=0)	
pd	Display PID constants for pitch, roll, yaw	
ppp x	Set proportional gain on pitch axis to x	
ppi x	Set integral gain on pitch axis to x	
ppd x	Set differential gain on pitch axis to x	
prp x	Set proportional gain on roll axis to x	
pri x	Set integral gain on roll axis to x	
prd x	Set differential gain on roll axis to x	
pyp x	Set proportional gain on yaw axis to x	
pyi x	Set integral gain on pitch yaw to x	
pyd x	Set differential gain on pitch yaw to x	
hss x	Set fast heading slew rate to x [40..1200 degrees/sec]	1.16
hsg	Display fast heading slew rate	1.16
sr x y	Synthesize a roll command at heading x [0..359] and speed y [0..255] (removed in 1.21)	1.20-
roll x y	Synthesize a roll command at heading x [0..359] and speed y [0..255]	1.21
sp x y	Set stopping parameters: Stop rate, Integral bleedoff	
ed	Display encoder proportional value	
ep	Set encoder proportional value	
sh x	Set heading to x [0..359]	1.41
dom	Display current pitch, roll, yaw angles [-180 to +179]	

vdx x	Set vector drive limit to x [0..200]	3.37
sl	Start self leveling routine with parameters assigned by slp	1.20
slp x y z	Display self leveling parameters if x=y=z=0 or assign x to the angle limit ([1..90] degrees), y to the timeout ([1..255] seconds) and z as the level criteria met threshold in 1/100ths of a second [1..255].	1.20

## [LEDs]

Command	Description	Ver
lc r g b	Set the RGB LED to r,g,b [0..255]	
bl x	Set the back LED brightness to x [0..255]	

## [Raw Motor]

Note that the control system must first be disabled for these to have an effect.

Command	Description	Ver
mf x	Command both motors forward with raw power x [0..255]	
mb x	Command both motors backward with raw power x [0..255]	
ml x	Set left motor power to x [0..255], right is set to 0	
mr x	Set right motor power to x [0..255], left is set to 0	
mh 0	Halt motors	
ms x	Spin clockwise; left motor set to forward, right to backward and both powers to x [0..255]	
mc x	Spin counterclockwise; left motor set to backward, right to forward and both powers to x [0..255]	
bme	Enable motor driver chip	
bm	Disable motor driver chip	
elc	Retrieve left encoder count	
erc	Retrieve right encoder count	
elz	Zero left encoder count	
erz	Zero right encoder count	

## [Configuration Block]

Command	Description	Ver
cw	Write config block from RAM into flash	
cr	Read config block from flash into RAM (overwriting current copy)	
cd 2	Display config block info	
ci 1234	Initialize the configuration block to software defined defaults	F
cf!	Reload factory configuration, lose all user config and statistics	0.82

## [Standby/Sleep]

Command	Description	Ver
zd	Display awake and sleep durations	
za x	Set awake timeout to x seconds [ $10 \cdot 2^{32} - 1$ ]	
zs x	Auto-wakeup x seconds in the future (0 = never, otherwise [ $1 \cdot 2^{32} - 1$ ]). Paid attention to by the zz command.	
zz x	Go to sleep and wakeup in x seconds if $x > 0$ , else wakeup in zs seconds [ $0 \cdot 2^{32} - 1$ ]	
zq	Enter deep sleep if supported by hardware.	1.25

## [ Commands]

Command	Description	Ver
vd	Display voltage setpoints and coefficients	
vp x	Display raw power system info if $x=1$ , else display charging statistics	
vl x	Set low battery threshold to x in hundredths of a volt [675..725]	
vc x	Set critical battery threshold to x in hundredths of a volt [625..675]	
vc1 x	Set battery voltage calibration point 1 to x (7.0 = 7.0 volts)	F
vc2 x	Set battery voltage calibration point 2 to x (7.0 = 7.0 volts) and calculate slope/intercept	F
vi x	Manually set battery voltage intercept (ex. -0.16)	F
vs x	Manually set battery voltage slope (ex. -0.16)	F

## [Debugging]

Each of these commands takes one optional parameter x where  $x=0$  disables the debugging info and  $x>0$  enables it. Entering the command without a parameter is also a way to enable it.

Command	Subsystem/sensor	Ver
da x	Accelerometer	
dc x	Control system	
dg x	Gyro	
db x	Gyro bias	
dr x	Gyro bias one shot	
do x	IMU orientation	
dv x	Power system	
de x	Encoder system	3.0
dx x	Matrix (see Morpheus for more info)	
ds x	Shell Speed	3.54
di x	Collision detection	
dz	All debugging disabled	

## [Gyro Sensor]

Hint: x = pitch, y = roll, z = yaw

Command	Description	Ver
gd	Display gyro coefficients	
gr	Display current gyro registers	
gci	Initialize gyro calibration	
ggcp x y	Calculate and set pitch scale coefficient for specified bucket	
ggcr x y	Calculate and set roll scale coefficient for specified bucket	
ggcy x y	Calculate and set yaw scale coefficient for specified bucket	
gbpa x y z	Set pitch CCW bucket coefficient: bucket, speed (LSBs), coefficient	
gbra x y z	Set roll CCW bucket coefficient: bucket, speed (LSBs), coefficient	
gbya x y z	Set yaw CCW bucket coefficient: bucket, speed (LSBs), coefficient	
gbpc x y z	Set pitch CW bucket coefficient: bucket, speed (LSBs), coefficient	
gbrc x y z	Set roll CW bucket coefficient: bucket, speed (LSBs), coefficient	
gbyc x y z	Set yaw CW bucket coefficient: bucket, speed (LSBs), coefficient	
gro	Display one shot gyro debug info (use with dr)	
gco	Display gyro cutoff table	
gom x y z	Set gyro orthogonality matrix: row, column, value	
gomd	Display gyro orthogonality matrix	
gob x y z	Set gyro orthogonality matrix biases: row, column, value	
gobd	Display gyro orthogonality matrix biases	
gcd	Display gyro calibration	
gcyd	Display gyro yaw angle	
gcpd	Display gyro pitch angle	
gcrd	Display gyro roll angle	
gtt	Display current gyro thermal value	
gb	Display gyro temperature calculated bias values	
ga x	Enable gyro bias adjust debugging when x>0, disable when x=0	
gac	Display gyro bias adjust count	
gacz	Zero gyro adjust count	
ge x	Enable gyro bias adjust when x>0, disable when x=0	
gn x	Set gyro Z axis notch filter size in LSBs	
ggs	Start logging gyro bias values (used with gbd)	1.10
ggd	Stop logging and display gyro bias values (used with ggs)	1.10
ggdm	Stop logging and display minimum gyro bias values (used with ggs)	1.10
ggdx	Stop logging and display maximum gyro bias values (used with ggs)	1.10
gm	Display minimum and maximum gyro readings	
gmz	Clear minimum and maximum gyro readings	

## [Accelerometer Sensor]

Hint: x = pitch, y = roll, z = yaw

Command	Description	Ver
ss	Display standard deviations for each sensor and axis	
sd	Calculate standard deviations for each sensor and axis	
ad	Display accelerometer bias and scale coefficients	
acb x y z	Set accelerometer bias values to x, y, z	
acl	Log the average of 1000 data points	
acd	Return the three averages of the data collected by acl	
ar	Dump the accelerometer registers	
<del>asts</del>	<del>Set accelerometer stillness threshold</del>	
<del>astg</del>	<del>Display accelerometer stillness threshold</del>	
aom x y z	Set accelerometer orthogonality matrix: row, column, value	
aomd	Display accelerometer orthogonality matrix	
am	Display accumulated min/max accelerometer data	
amz	Clear accumulated min/max accelerometer data	
agr	Display current accelerometer range	
asr x	Temporarily reset the accelerometer range: 0 for 2g, 1 for 4g, 2 for 8g and 3 for 16g	1.16
<del>aicg</del>	<del>Display stillness threshold for Sphero in-charger</del>	
<del>aics x</del>	<del>Set stillness threshold for Sphero in-charger</del>	

## [Bluetooth]

Command	Description	Ver
be	Enable module power and Sphero Tx	
bd	Disable module power and Sphero Tx	
bt	Disable module power (leave Tx enabled)	1.41
+x	Set internal Bluetooth name (example "+Sphero-WOW")	
od	Display Rx message overruns count	
oz	Zero Rx message overruns count	
bz	Assign new random color name	0.82
ba	Display MAC address	
uarttx x	Enable (x=1) or disable the UART Tx line to the Bluetooth module	3.23
setmac x	Reset the MAC address to x (in decimal). You can only do this twice.	3.23

## [Collision Detection]

Command	Description	Ver
id	Display collision thresholds	1.10
ie x	Enable collision detection if x>0, else disable	1.10
ih x	Set post-collision inhibit time (milliseconds)	1.10
ixt	Set X axis collision base threshold	1.10
ixs	Set X axis collision speed coefficient	1.10
iyt	Set Y axis collision base threshold	1.10
iys	Set Y axis collision speed coefficient	1.10



## [Test Results]

Command	Description	Ver
tr x y	Set PCBAtestResults to x and PCBAtestStation to y	
tc x y	Set AGCTestResults to x and AGCTestStation to y	
td	Display test results	
tz	Zero all test results	

## [Macros]

Command	Description	Ver
mac x	Run macro ID x	
kil	Abort any active macro	
maci	Initialize the executive and erase any persistent macros	

## [orbBasic]

Command	Description	Ver
basrmu	Display the line number MRU table	1.15
basstats	Display various stats about the current program	1.15
rrun x	Run a program from RAM starting at line x	1.15
frun x	Run a program from flash starting at line x	1.15
break	Abort any running program	1.15
hash x	Generate a 32-bit hash of the provided string	1.15

## [Misc]

Command	Description	Ver
ct	Assign circle test threshold value	1.25
ctd	Display circle test threshold value	1.25
epd	Display peak value found during circle test	1.25
tdd	Display tap configuration	3.28
et	Enable double tap test mode (toggles back LED)	3.28
tg	G Range 2 4 8 16	3.28
tt	Tap Threshold 0-31	3.28
to	ODR 250 500 1000	3.28
ts	Tap shock time 50ms 75ms	3.28
tq	Tap Quiet time 30ms 20ms	3.28
tu	Tap Dur time 50ms 100ms 150ms 200ms 250ms 375ms 500ms 700ms	3.28
tsp	Tap Samples taken during wakeup 2 4 8 16	3.28
tsl	Sleep Duration 1ms 2ms 4ms 6m 10ms 25ms 50ms 100ms 500ms 1000ms	3.28
cntc	Clear L1 counters	
cntd	Display L1 counters	
bodd	Display manufacturing date info (born on date)	3.37
credits	Display the name of awesome guys	3.54

## Appendix A

Here is a list of the current option flags and what they control.

bit #	description
0	Set to prevent Sphero from immediately going to sleep when placed in the charger <b>and</b> connected over Bluetooth.
1	Set to enable Vector Drive, that is, when Sphero is stopped and a new roll command is issued it achieves the heading before moving along it.
2	Set to disable self-leveling when Sphero is inserted into the charger.
3	Set to force the tail LED always on.
4	Set to enable motion timeouts
5	Reserved
6-7	Sleep number 00=Normal, 01=Light sleep, 10=Heavy sleep, 11=N/A
8-31	Reserved

So to permanently turn the tail LED on the command is:

```
sof 3
```

To disable Vector Drive, use:

```
cof 1
```

## Revision History

Revision	Date	Who	Description
2.3	24 Oct 2013	QM	Removed cpd aics aicg astg asts. Modified: vp1 vp2 in vp x11 in x 11 Added: ds
2.2	17 Jun 2013	DH, JA	Added double tap debug commands in Misc section Added sleep number configuration in Option Flags Removed sf, gcy, gcp, gcr, gcs, gt1, gt2, gf, gtd, gti, gl, gcsc, gcsa, gcpc, gcrc, gcyc, gcpa, gcra, gcya, acs, aczd, azcs, azca, bp, rload, rlist, vdm, vdd Added gacz, ggcp, ggcr, ggcy, gbpa, gbra, gbya, gbpc, gbrc, gbyc, gro, gco, gom, gomd, gob, gobd, asts, astg, aom, aomd, od, oz, sp, cntc, cntd
2.1	26 Apr 2013	DD	"el" became "elt", "setuart" became "uarttx", added "setmac", removed "sv". All for FW release 3.24
2.0	31 Jan 2013	DD	Added el, "hs" was lost (?) so I replaced it with sh, setuart, ... Added bt
1.3	19 Dec 2012	DH	Added Encoder commands elc, erc, elz, erz Removed back EMF commands
1.3	31 Oct 2012	JA	Removed gcy, gcp, gcd
1.2	9 Sept 2012	DD	Added ct, ctd, cpd, zq, and Appendix A.
1.1	24 Aug 2012	DD	Added rtd, rtz and %.
1.0	9 Aug 2012	Dan Danknick	Initial revision (converted from old format)