

Cycle Analogger: MicroSD Data Logging for the Cycle Analyst

The Cycle Analogger reads a serial data stream from the Cycle Analyst and writes it to a text file stored on a MicroSD flash memory card. This allows for the capture of an electric vehicle's power consumption and performance data in a compact and portable device. The Cycle Analogger GPS also includes a GPS unit and logs a separate text file with the vehicle's positional data in NMEA 0183 format at 1Hz.

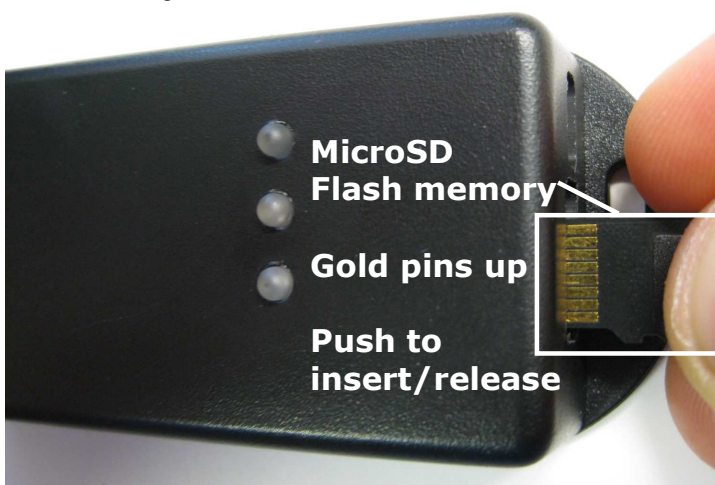
Power Supply

The Cycle Analogger is designed to be powered directly from an electric bike battery pack. It has an input voltage range of 10-100V DC and draws less than 1/2W. The power supply connection is a 5.5mm OD x 2.1mm ID DC jack with the outer sleeve GND and the inner pin V+. The power supply and serial data connections are not electrically isolated and therefore the Cycle Analogger should be powered directly from the Cycle Analyst V+ and GND connections available on the CA circuit board.



MicroSD Flash Memory

A MicroSD or MicroSDHC flash memory card is required (1GB MicroSD included) as a medium on which to store the data. A 1GB MicroSD card will have space for about 500 hrs of combined GPS and Cycle Analyst data or over 9000 hrs of 1Hz Cycle Analyst data alone. The MicroSD card socket is a push-push type. Push the card to insert it until it clicks into place and pushing it again will release the card. The gold fingers of the MicroSD card must be facing the same direction as the status LEDs to insert the card.



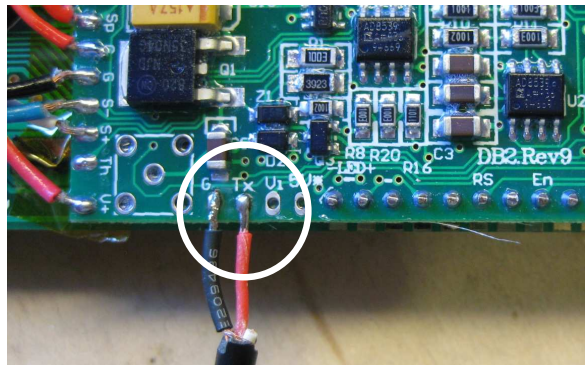
USB Mini Connector for Removable Storage Access

A USB mini connector is provided to allow easy connection to a computer for transferring data. When connected to a PC, the Cycle Analogger's MicroSD card will appear as an external drive with no drivers required.



Cycle Analyst Connection

Connection to the Cycle Analyst's TTL (0-5V) serial data output is provided via a 3.5mm TRS (Tip, Ring, Sleeve) jack, exactly as used by stereo audio cables. The sleeve connection (black) of the plug should be soldered to the Cycle Analyst circuit board's ground (G) pad and the ring connection (red) should be soldered to the pad labeled Tx. The tip connection (white) of the stereo plug should be left unconnected.



Mode Switch and Operation

A three-way mode switch on the side of the Cycle Anologger is used to control the operation. In the middle position, the device is off. To turn the device on in logging mode, slide the switch toward the 3.5mm Cycle Analyst data connector. To log data from the CA (and GPS, if installed), power must be available at the DC power jack. If the device is left with the switch in logging mode position, the device will turn on and start logging automatically once power is available at the DC jack. In order to read the data on the MicroSD card using the USB connection, the switch should be slid to the USB/MicroSD card side of the device. With the switch in this position, the Cycle Anologger will be powered from the computer's USB port and power from the DC plug is not required.

The switch can be left in 'log' position and a new log file will be started each time power is removed and restored to the DC jack. Alternatively, if there is no power or ignition switch on the vehicle and power is still present at the DC jack when the vehicle is left sitting, the switch can be moved into the middle (off) position to cut off battery consumption and stop writing to the current log file. A new log file will be started when the switch is moved back to the 'log' position.



LED Indicators

There are three LED indicators on the Cycle Analogger to provide operational feedback. The one closest to the three-way switch indicates that the device is turned on (in either log or USB mode) and that the appropriate power source is present. The middle LED (green) will blink to indicate that data is being written to the MicroSD card. The third LED, furthest from the switch indicates information about the GPS unit (if included). The GPS LED will flash fast (10 times per second) to indicate that the GPS is on but has not yet acquired a 'fix' on its location. Data about the GPS's current state of operation is still being logged, but complete positional data is not yet available. When the GPS LED slows to flashing only once per second, the fix has been acquired and accurate positional data is available.

GPS Device

When the GPS device is powered on outside in a new location (cold start) the typical time to fix is 35 seconds but can sometimes take a couple of minutes if there are tall buildings or other interfering objects. The Cycle Analogger GPS includes a backup battery which maintains GPS data so the GPS will often fix within a couple of seconds of being powered on outdoors in the same location it was recently turned off.

It should also be noted that while the latitude and longitude data received from the GPS is regularly accurate within a few metres or less, when operating around tall buildings or trees the altitude data received often resembles the height of the surrounding objects more so than the actual device's altitude. If accurate elevation data is required for trips in the presence of tall structures, it might be desired to cross reference the latitude and longitude recorded with a database of ground/road elevation at those points.

Log Files

Each time the data logger is turned on in log mode, a new file is created for both the Cycle Analyst and the GPS module. The files are named CA_logxxxx.txt and GPS_logxxxx.txt where 'xxxx' is the subsequent log number starting at '0000' and incrementing by 1 each time a new log is started. When using a GPS model, if a valid 'fix' is obtained while the log is being written, the time of first fix is appended to the file name. (Ex. "CA_log0957 (23 Apr 2010 08 59 UTC).txt")

Cycle Analyst Serial Data

The Cycle Analyst data streams the elapsed amp-hours, voltage, amperage, speed and elapsed distance for each sample at either 1Hz or 5Hz (see Cycle Analyst manual 'Serial Output' for instructions on changing this).

ah	V	A	S	D
1.3845	38.11	0.04	0.00	4.2647
1.3853	36.79	5.14	0.00	4.2647
1.3890	33.86	15.41	5.90	4.2657
1.3912	35.47	9.43	7.97	4.2677
1.3943	34.36	13.27	11.41	4.2703
1.3980	34.19	13.65	14.03	4.2738
1.4009	35.30	9.39	14.76	4.2779
1.4009	38.00	0.07	13.17	4.2818
1.4029	33.09	18.18	14.92	4.2856
1.4083	32.21	20.49	17.42	4.2901
1.4132	33.08	16.92	18.30	4.2951
1.4179	33.00	16.74	19.31	4.3003
1.4225	32.78	17.15	20.30	4.3059
1.4273	32.80	16.92	21.05	4.3116
1.4320	32.64	17.18	21.42	4.3175

GPS Serial Data (NMEA 0183 format)

The GPS module (if included) writes log files using the NMEA 0183 protocol at 1Hz. The included sentences are:

- GGA – Fix data, 3D location and accuracy
- GLL – Geographic latitude/longitude
- GSA – Satellite data and dilution of precision
- GSV – Satellites in view
- RMC – Recommended minimum data
- VTG – Velocity made good and ground speed

An example of a GPS log file with the NMEA sentences is shown below.

```

$GPGGA,181226.166,4914.6110,N,12306.1448,W,0,03,,51.6,M,-16.8,M,,0000*7C
$GPGLL,4914.6110,N,12306.1448,W,181226.166,V,N*5D
$GPGSA,A,1,12,02,27,,,,,,,,,,,,,*1A
$GPGSV,3,1,12,12,75,292,28,02,65,153,35,27,20,198,26,04,55,074,32*7F
$GPGSV,3,2,12,25,34,302,32,09,30,209,30,10,15,121,34,17,09,075,29*7F
$GPGSV,3,3,12,29,08,258,21,14,05,297,,20,,018,,48,,31*4C
$GPRMC,181226.166,V,4914.6110,N,12306.1448,W,,231110,,N*6A
$GPVTG,,T,,M,,N,,K,N*2C
$GPGGA,181227.166,4914.6063,N,12306.1452,W,0,03,,51.6,M,-16.8,M,,0000*73
$GPGLL,4914.6063,N,12306.1452,W,181227.166,V,N*52
$GPGSA,A,1,12,02,27,,,,,,,,,,,,,*1A
$GPGSV,3,1,12,12,75,292,28,02,65,153,35,27,20,198,26,04,55,074,33*7E
$GPGSV,3,2,12,25,34,302,33,09,30,209,30,10,15,121,33,17,09,075,29*79
$GPGSV,3,3,12,29,08,258,21,14,05,297,18,20,,018,,48,,33*47
$GPRMC,181227.166,V,4914.6063,N,12306.1452,W,,231110,,N*65
$GPVTG,,T,,M,,N,,K,N*2C
$GPGGA,181228.166,4914.6077,N,12306.1403,W,0,03,,51.6,M,-16.8,M,,0000*7D
$GPGLL,4914.6077,N,12306.1403,W,181228.166,V,N*5C
$GPGSA,A,1,12,02,27,,,,,,,,,,,,,*1A
$GPGSV,3,1,12,12,75,292,29,02,65,153,35,27,20,198,26,04,55,074,32*7E
$GPGSV,3,2,12,25,34,302,32,09,30,209,31,10,15,121,29,17,09,075,29*72
$GPGSV,3,3,12,29,08,258,21,14,05,297,,20,,018,,48,,34*49
$GPRMC,181228.166,V,4914.6077,N,12306.1403,W,,231110,,N*6B
$GPVTG,,T,,M,,N,,K,N*2C

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A GPS Information web site has a listing of the NMEA sentences with detailed information <http://www.gpsinformation.org/dale/nmea.htm>

Backup Battery

The 3V Lithium CR2032 type backup battery is required only for GPS logging and is therefore included with the GPS model only. The included cell should last 3-5 years under normal operation and can be replaced with a similar type CR2032 battery available at a local electronics store. If the GPS LED is not lighting up at all on a GPS equipped model, the backup battery may need replacing.

Enclosure

The Cycle Analogger is housed in a slim black plastic box with a flanged lid offering flexible mounting options. The box measures 80 x 40 x 20 mm plus the extended flanges. Note that the openings for the MicroSD card and other connectors are susceptible to water damage and therefore precautions must be taken to protect the Analogger when using in wet conditions.

Supplemental Software

There are a couple of pieces of software Cycle Analogger users might find helpful for visualizing their freshly logged data. Grin Technologies (www.ebikes.ca) did not produce either of these programs and therefore we cannot offer direct support for them. Links are offered here simply as a suggestion of a place to get started.

E-DATA

One enthusiastic user has written a program which produces a graph of Cycle Analyst data logged for a given trip. It reads CA log files and displays elapsed amp-hours, battery voltage, current, power, elapsed watt-hours and speed as a function of elapsed time in a single graph.

E-DATA available:

<http://endless-sphere.com/forums/viewtopic.php?f=2&t=17458&start=0&hilit=edata>

NMEA to KMZ Converter

We have also found a very useful program for converting NMEA log files to KMZ files (for importing to Google Earth).

NMEA to KMZ Converter available: <http://homepage2.nifty.com/k8/gps/#003>

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