HYPERION Emeter II & RDU
Extended User Manual v2.09

NOTE: This manual is designed as companion to Emeter II QUICK GUIDE. Be sure to read the Quick Guide Manual first. Manuals and links to Firmware and PC Software Index – click here .

Introduction
Emeter II was designed as a standalone tool which may be used to:
- Measure, record and analyse the key performance factors for electric systems and models, either on the Bench or "In-Action" via the Remote Data Unit (RDU).
- Set control parameters for Hyperion Digital Servos and Electronic Speed Control units (ESC)
- Simplify testing of components of an electric power unit with pulse-width servo driver, servo tester, battery internal resistance and capacity checks.
- Support Automated Test Routines, with auto-terminate parameter choices
- Support the operation of the models and vehicles tested in the field with multiple stopwatches, countdown timer, altimeter (height) and temperature gauges.

It operates in the field or at the workbench without the need for a Personal Computer but can also easily communicate with Hyperion Emeter Suite PC software when desired.

Caution - Before you start

- This is a sophisticated unit which will be an important tool in your electric powered model program. Please be careful with it!

- We recommend a case of some sort for use in the field and, as with most electronics, keep the Emeter well away from dirt or water.

- Take special care not to press on the screen display surface as this can cause damage

- Emeter II is protected against damage from reversed input polarity, but it will not function correctly in this state.

- Do not exceed a maximum of 70 volts for the main power pack (MPP)

Terminology (see also Quick Guide terminology section)

Tx and **Rx** – commonly used abbreviations for the RC Transmitter(Tx) and Receiver(Rx)

OPTO – Opto Couped ESC use a pulsating beam of light to pass Receiver signals to the ESC, without an electrical connection through which current (and interference) could flow. However, a separate battery to supply the receiver and servos is required for OPTO ESC.

Bench-Test and **In-Action** Modes - There are two basic modes of operation – 'Bench-Test' mode in which the RDU and the Emeter are cabled together during testing, and 'In-Action' mode where the RDU is used alone. In Bench-Test mode, data is recorded directly to the SD card, whereas In-Action mode stores the data in the RDU from where it is later uploaded to the Emeter SD card.

Wiring of Power Leads
The RDU is clearly labelled on the underside with 'LOAD' and 'INPUT' , each with positive and negative wires marked. These should be connected as follows:

* Main Power Packs (hereafter termed MPP) which normally comprise multiple cells in series. ALWAYS CONNECT MPP TO RDU **INPUT** SIDE, no matter charging or discharging the MPP.

* Chargers/Dischargers - CONNECT TO RDU **LOAD** SIDE whenever charging or discharging MPP

* ESCs   - CONNECT TO RDU **LOAD** SIDE when testing motors

Note that the RDU will work out the direction of the current flow and will accumulate it as either milliamp-hours **Out** or milliamp-hours **In**. The current flow as shown on various displays will never show as a negative figure. If you are charging an MPP, the current will be going **In** to the MPP, and if discharging it will show on Emeter as going **Out** of the MPP.

- There are many different connectors in use today. Your choice must take into account compatibility with the equipment you will test, and with the current (A) rating of the connector. Good soldering is vital to avoid power losses (often evident from warmth in the connectors while in use) or, worse, total failure.

- For brushless motors, which normally have three wires going into the motor, the RDU must be plugged into circuit between the MPP and the ESC. **Do NOT attempt to connect RDU between the ESC and the MOTOR as damage may occur to the ESC**

With most chargers, it may be necessary to connect the RDU INPUT to the Main Power Pack prior to connecting the RDU LOAD side to the charger, or a charger error may be indicated.

Connecting to the Emeter II and RDU

- With so many functions which can be performed by Emeter II, there are a large number of plugs and sockets on the meter and the RDU. A few general tips are offered here to help you make the right connections!

- Each socket on the RDU and the Emeter II has the wiring either printed or moulded into the case near the socket.

- Matching plugs on the Hyperion cables are labelled

- The individual pins on each socket are also labelled using a convention which includes
  o '-' (negative power) which should be a black or brown wire
  o '+' (positive power) which should be a red or orange wire
  o 's' for the signal wire (often white)
  o Plus various others dependant on the particular lead in question

- If using Futaba style 3 pin plugs with the plastic moulded side lug, then these cannot be fitted to the Emeter II the wrong way around because of the lug

- On the Emeter case, there are two sockets labelled 'Servo Driver' – one for the servo or ESC and the second for an Rx pack connection for non-BEC type ESC testing. Use either socket for each of the servo and receiver pack – the dual sockets simply act as a 'Y' lead

- The screen, in many cases, will show a diagram of the required connections or offer alternative instructions to guide you through. If you connect a lead into the wrong socket, or connect it the wrong way around, then you will be re-prompted.

- The final step should always be to connect the MPP (Main Power Pack) as this gives the best opportunity to spot connection errors. In addition, some functions rely on switching on either the Emeter II or connection of power to the RDU to reset parameters or other data.

- Don't panic if you find you have inserted a plug the wrong way around – no damage to the Emeter II or RDU will occur, but the function will not work.

- Note that "PC CONN" text is embossed above the right-most Emeter II 3-pin port, next to the 4-pin locking port. This is NOT for connecting to PC at this time, but is reserved for Hyperion ATLAS DIGITAL Servo programming now, and future connections later. Emeter II to PC interface is via SD Card file transfer.

During a bench-test, the user may control the input signal to the ESC, by turning the potentiometer (Pot) on the Emeter. This changes the motor speed which is measured by the single phase sensor wire and fed back via the RDU to the Emeter, along with other data such as volts, amps, temperatures and even efficiency and propeller thrust, under some circumstances

As an alternative to manual turning of the pot., Emeter II can create and use Test Profiles. These define any number of positions to which the servo is to move, or how fast the ESC is to drive the moto plus the time to be spent there before moving on to the next position. When a test profile is combined with the above wiring diagram, the result is a very compact motor test system.

The Remote Data Unit – RDU
The RDU contains a high precision shunt capable of handling high currents and voltages. See RDU full specifications and current handling notes on final page of Quick Guide. The shunt resistance is a low 200 microhms for minimal effect on the circuit being measured. The RDU also holds and houses data and sensors for measuring voltage, current, height (altitude from start), rpm, temperatures and other data. Other sensors, such as Air Speed, will be introduced during 2009.

- For **continuous** use, it is recommended that you limit the current through the RDU to about 75 amps, half the shunt rating; it is normal for the shunt to become warm during high current measurements, but should really never exceed 55 degrees Celsius under normal use.

- Note that calibration is initially carried out by the factory and, once set, should require no further change, although users do have the facility to re-calibrate if necessary. An RDU will give the same readings regardless of the Emeter II into which it is plugged.

- Note also, that the RDU electronics will gather their power from either the MPP or the Emeter II, depending on which of the two power sources is connected. Thus the automatic reset of various RDU figures such as cumulative mA-h capacity will not occur unless both sources of power to the RDU electronics are disconnected.

- A blinking green light on the RDU indicates that it has power and is ready to monitor or record voltages, currents etc. A red, blinking, light indicates that In-Action data logging is currently in progress

- The current (Jan '09) list of extras which may be fitted to the RDU includes:
    - The 4 wire Emeter<>RDU cable (also used for Emeter<>TITAN ESC programming)
    - A 3 wire Phase Sensor lead for recording RPM
    - A 4 wire auxiliary input for up to 3 temperature sensors or future expansion.
    - A 3 wire Rx lead which is used either to control In-Action logging with the RDU set to a trigger type of 'Manual' or to record the pulse width of the Rx channel on the log files. A male-to-male lead will be required for the manual control of logging and a 'Y' lead with two male plugs and a female socket for monitoring/logging the throttle channel.

On-Screen Help and Navigation
Emeter II performs so many different functions that it is necessary to spread the options across a multi-level menu. In simple terms, this has been achieved by placing all items which relate to electrical measurements under their own menu called 'Readings'. All non-reading type screens such as stopwatches, servo programming and servo testing and others are then reached from the MAIN Menu.

Within this manual, button numbers are shown in quotes for example 'A', 'B', 'C' or 'D' and have an abbreviated description on the bottom row of the display. Button 'A' on the MAIN menu will display Tips on RDU and Emeter II firmware version upgrades and other general functions. Navigation through the menus is achieved by pressing 'D' until the required menu item shows in larger characters. Once this occurs,

- press 'B' to display screen help relating to the selected function or
- Press 'C' to go to the selected function.

After switching the Emeter on, the function which was in use at the previous switch off time will re-appear. In most cases, 'A' will cause a return to the previous, higher menu item or screen. Certain actions may cause deletion of data which could be critical. You will be warned if this is the case and requested to confirm the action.

The Emeter II will not allow you to switch to a function requiring the RDU if the RDU is not plugged in.

Most Emeter II functions can be performed simultaneously with other, different functions. For example, a stopwatch and count down timer could be left running while using the ESC driver to run a motor test which is logged to the SD card…

The Internal Battery

Emeter II can be charged both while it is in use or switched off. A lead with a 4.5 mm plug (supplied with EmeterII) connected to a 12 – 15 volt source is required. This source may be either a 12 volt, 0.1 amp minimum wall (mains) power supply or a car battery via a cigarette lighter plug. The latter could be plugged in while driving to the flying field, lake or car track. **Do not use a battery charger** as this will expect to control the charge rate in a manner which does not match the internal charge circuitry, will probably signal an error, and **likely damage the Emeter**.

Charging will occur at 85 ma and take 9 - 12 hours at this rate from a fully discharged state

The battery will last between 18 and 50 hours, depending on use of screen back light, connection of RDU and other factors.

In Bench-Test mode with the RDU and Emeter II connected, some actions such as accumulation of ma-h in/out and peak or minimum voltages and currents will continue even if the Emeter II is switched off. This reduces internal battery discharge rate to zero. The Emeter II will display the accumulated and peak figures from the RDU when switched on.

MAIN MENU shows internal battery state by means of a simple capacity indicator. Recharge before this falls to 0 %. The date and time may need to be reset if the internal battery is allowed to go flat.

Description of Functions

After switching on with no buttons pressed, the unit will display a Start-up screen with the Firmware Version No. for about 1 second. Holding any one button down while switching on will display the start-up screen until the button is released allowing more time to check the firmware version number.

Emeter II will then automatically check for any log files on the RDU which have not yet been transferred to the SD Card. If these exist, then the option to download now or to defer until later is given.

If files have been downloaded, then a switch is made to the Log Files function, otherwise the Emeter II will switch to the screen in use when it was last turned off.

The Menu Hierarchy

READINGS	ANALYSER	Primary screen for display of measured Time, Volts, Amps, RPM, Temperatures, Height and calculated mA-h In, mA-h Out Watts, Thrust and Efficiency
	TACHO	Optical and Phase Sensor Tacho config.
	BATTERY	Present, min and max volts, amps, mA-h In, mA-h Out
	PEAKS	Max/min volts, Max temp, RPM, height, Pack Resistance
	SNAPSHOTS	Analyser, tacho, battery, peaks screens.
	PROP CONST	Prop. name, power and thrust constants
PROGRAMMING	TITAN ESC ATLAS DIGITAL SERVO ATLAS ESC (from v2.08)	Note that "ATLAS ESC" programming supports Scorpion "Commander2" and upcoming Hyperion ATLAS ESC.
STOPWATCHES	LAP COUNT	

	DUAL MODE	
	AUTO MODE	
	COUNT DOWN	
TESTING	DRIVING SERVO/ESC	
	CYCLE TESTING	
	CREATE/SELECT PROFILE	
	PROFILE TEST OPERATION (also set termination parameters)	
LOG FILES	LOG FILE LIST	SUMMARY ENQUIRY
		Graphs
		LOG FILE DETAILS
RDU SETUP	Start Mode	Time, Amps or Manual trigger
	Trigger Amps	
	Start Delay	
	Record Secs	
	Samples/sec	4,2,1 /sec or 2,4,8 secs/sample
		Press and hold 'D' for 3 secs to gain access to these two functions
	Upgrade RDU firmware version	
	Calibrate RDU volts/amps	
EMETER II SETUP	Date	
	Time	
	LCD Light	
	Contrast	
	Beeps	
	Height	
	Temperature (C/f)	

The Analyser Screen

- This is the primary screen for display of Time, Volts, Amps, RPM, Watts, Temperatures, Altitude, Thrust and Efficiency. It is also a point at which data logging in Bench-Test mode can be started or stopped. Some of the key issues surrounding the different readings are mentioned briefly

- Connect the Emeter II, RDU and any extra sensors as shown in your bookmarked wiring diagram. The green LED on the RDU should start flashing and you are ready to start the test. The Emeter II and RDU without other accessories will give the following:

    o <u>Voltage 0 – 70 volts with 2 decimal places</u>. The voltage supplied by the MPP is one of the most important factors in model performance. In fact, for a given model and motor, it is the most important. Only prop changes or gear ratio changes can have as large an effect. Voltage monitoring and control is also vital when charging Nickel Cadmium, Nickel Metal Hydride, Lithium Polymer and Lithium Ion cells.

    o <u>Current 0.2 – 300 amps peak with 1 decimal place</u>. The current is the result of applying the voltage to the controller/motor combination. If the voltage increases, then so, too,

will the current and usually by a larger percentage. Current flowing though a device always causes heat in that device. ESCs have stated current and voltage limits and it is important for you to know whether you are under or over the limits. Current also controls charge and discharge times.

- o <u>Watts 0 – 10000</u>. Watts are calculated by Emeter, as the product of Volts and Amps.

- o <u>RPM</u> are related to the power – see later discussion on prop constants. The rpm, along with prop pitch and diameter must be matched to the application; this subject is discussed in the Prop Talk article to be published Feb 2009.

- o <u>Height</u> – the RDU contains a built-in height and ambient temperature sensor. Height is set to zero on connecting power to the RDU. For improved accuracy, it is recommended that a few minutes be allowed for the sensor to stabilise both for pressure and temperature before applying power to the RDU. The location of the RDU in the model is critical to accurate height readings, especially with fast moving models with air ducts for cooling. Ideally, the RDU needs to be located out of slipstream.

- o <u>mAh-In and Out</u> – these two fields record the electrical capacity either put into the MPP while charging, or taken out of the MPP during a discharge. A charge current of 5 amps for 0.5 hrs (30 mins), for example, would record 5 * 1000 * 0.5 = 2500 milliamp hours. These figures control the run time possible with the given MPP.

  mAh-In and mAh-Out figures are set to zero when switching the RDU on, but can also be zeroed on the BATTERY screen. They accumulate regardless of whether the Emeter II is switched on or not.

- There are two ways to keep the data for subsequent analysis – either in one of the eight SNAPSHOT memories or by starting logging to a file on the SD card prior to the test run. Only one data logging run can take place at a time, but it can be controlled from one of three places as indicated below.

- Prop Constants can be specified before the test commences and, if so, will result in a calculation and display of the motor/ESC efficiency and thrust. (see later for more details of prop constants)

- In order to save Analyser figures, press 'D' with data displayed on the Analyser screen. This will freeze the figures and change the label on 'C' to 'Save'. On pressing 'C', the SAVE DATA screen will appear, giving the option of 8 Snapshot locations in which to save the figures. Those which already contain data will show with an asterisk and the cursor will be positioned at the first empty Snapshot location.

- Over-ride the location if desired by pressing 'D' and then 'C' to save the figures. This will give a brief message confirming the chosen Snapshot location and then returns you to the Analyser screen which will now have continued processing and will be displaying the latest data

- If you wish to log the data to a file on the SD card, then, prior to commencing the test, press 'C' on the Analyser or Battery screens, or (Mode) on the Profile Test screen. The Emeter II will choose the lowest unused log file number and start logging all Analyser fields to the file, including the date/time at which the test was conducted. A warning message with the log file number will blink on the screen to indicate that recording is in progress.

- It is possible to switch to other Emeter II functions while recording is taking place, but recording can only be stopped from the Analyser, Battery or Profile Test screens**.** Recording should be stopped before switching the Emeter II off, or there is a minute possibility of corruption of the data on the SD card.

Tachometers

- There are two tachometers within the Emeter II package. An optical tacho sensor is fitted to the front of EmeterII case and is activated by pointing the Emeter II towards the prop at a distance of 10 and 20 cm. from the propeller.

- The second tacho plugs into the RDU and analyses the pulses in any one of the three input wires of a brushless motor. The Phase Sensor analyses these pulses electronically to determine the RPM

- Each type of tachometer has its own advantages and limitations, described below.

Optical RPM Measurement (Tacho Source = eMeter)

- The fluctuating light caused by the rotation of the prop. is sensed and counted over a period of either 1 or 2 seconds
- Allow a couple of secs. for readings to steady and press 'D' to hold the result.
- The Emeter assumes a two bladed prop. Press 'C' to change this to alternatives in the range of 1 – 6 blades (high blade counts for EDF mainly).

- With a geared motor, the motor RPM will normally be higher than the prop. RPM, but it is the prop rpm which is being measured and quoted, so the gear ratio is not really relevant.
- Beware of using the optical tacho with fluorescent or other Mains powered lighting which will give false readings, such as 3000 or 3600 rpm.
- The optical RPM sensor will function over a large range of propeller sizes, RPM and lighting conditions. It has even able to measure 40 mm diameter model boat props spinning in the air. Experiment with different sensor positions. In some cases, best results may be achieved by testing in the shade. With the motor running, move the optical sensor at the top of the Emeter to about 10~20 cm. from the prop., taking all due care. Small propellers may require closer positioning

- With the optical tacho, it is possible to select one of two RPM timing techniques:
    - The average of a 2 second count for RPM below 9,000 and 1 sec. count above 9,000
    - the simple use of a 1 second count regardless of RPM
- The latter has the benefit of a slightly faster reading, but for low RPM figures, is less accurate. It is recommended that tacho averaging be switched on. The resolution of the two alternatives are 30 rpm for tacho averaging off and 15 rpm if averaging is on and rpm < 9000, based on the use of a 2 bladed prop.
- This is achieved on the CONFIG TACHO screen reached by pressing 'C'. Press 'D' repeatedly to move to the Tacho Average field and 'B' or 'C' to change to 'On'. Save your changes by pressing 'A'
- The number of prop. blades should also be set on this same screen and will affect RPM readings for the optical tacho. For example, fitting a three bladed prop, but leaving the Emeter blade figure at 2 would cause the optical tacho to read 50% high

Phase Sensor RPM Measurement (Tacho source = RDU)

- The 3 pin plug on the phase sensor lead fits into the RDU RPM socket and requires the single wire to be connected to any of the three cables which supply power to the brushless motor. It is most useful to make an in-line adapter from a set of M/F connectors matching your motor connectors, so the tach lead can easily be attached or removed at will.
- Although the tacho averaging feature does not apply to the Phase Sensor Tacho, and the prop blade count is not relevant, two other variables are necessary – gear ratio and magnet count
- Because this type of sensor counts motor RPM, the results must be divided by the gear ratio to determine the prop RPM. Specify the ratio on the CONFIG TACHO screen as previously described
- Similarly the magnet pole count must be specified for the brushless motor which is commonly any even number between 2 and 14. (14 magnets is default, and suits the vast majority of "outrunner" type motors in use today). If you do not know this number for your motor, then set up a static test in which you can measure the RPM with both tachos simultaneously. Switch to the CONFIG TACHO screen and start the motor running with prop attached. Alter the Motor Magnet field to an even number which gives the same or near-same rpm for both tachos and save the new parameters. Slight variations are to be expected due to the different timing techniques used for the two measurements.

- The resolution of the Phase Sensor tacho depends on the number of motor magnets. For a 2 pole motor, the resolution is 120 rpm, while for a 14 pole outrunner the resolution is 17 rpm The rpm figure shown on the screen is updated twice per second, regardless of the Sample Rate of the RDU. The Phase Sensor tacho will give responsive and accurate results for all motor types on a percentage resolution basis. See also, the section entitled ESC Driver Test Profile for implications and an example.

The advantages of Optical Tacho over Phase Sensor

- Slightly easier to handle since no RDU leads are needed.
- Will work with any type of motor with a propeller, brushed or brushless, or even fuel engines. (unlike Phase Sensor which can only work with brushless motors)
- Does not have complication of magnet poles

The advantages of Phase Sensor Tacho over Optical

- Potentially steadier readings
- Not affected by fluorescent lighting which causes significant difficulty with optical unit
- May be easier to get readings with ducted fans compared to optical
- Is the only practical alternative for measuring RPM with the model in action
- Compared with optical sensor, has faster screen refresh time for similar rpm resolution figure if using a high-magnet-count motor.

Special Note

If the tacho screen is configured to 'RDU' (Phase Sensor), but the RDU is not connected, then the tacho source will be defaulted back to Emeter and both magnet motor and gear ratios will be zeroed. These fields will be re-instated after re-connection of the RDU

BATTERY Screen

- The Battery screen shows much of the data available from the Analyser screen, but, in addition, focuses more on the battery performance by including minimum, maximum voltages or currents.

- Press 'D' to hold present values, including the time of day and save to Snapshot 1-8 in the normal manner. This will preserve both the battery data and the time, along with the mA-h into and out of the pack. Press 'B' (Clr) on either Battery or Peaks screens to clear the mA-h or maximum/minimum figures

PEAKS Screen

General - Peak values are recorded in the RDU the whole time for which power is supplied to the RDU (either from the MPP or the Emeter II) or from when 'B' (Clr) is pressed on the Battery screen. These values are lost when switching the Emeter off and disconnecting the RDU from the MPP unless saved to SNAPSHOT 1 – 8.

Max Volts - This figure could be used while charging NiCad or NiMh cells to confirm the status of a peak detect type of charge. Also useful for confirming the charging status of Lipo battery packs.

Min Volts – similar comments to above for Max Volts, but also important for monitoring accuracy of the ESC Low Voltage Cut-out function with LiPo or Nickel cells. If the voltage is allowed to go too low, then there is a great risk of permanent damage to LiPo cells

Max Amps – is of great importance in determining the ability of MPPs, ESCs and motors to handle the current load being imposed on these power system components

Max RPM – largely of academic interest, but also can be compared with prop. rpm limitations

Max Height and Max Temps 1,2,3 – Somewhat self-explanatory....

Pack Resistance – This figure is of great importance when seeking top performance from your model. Any unexpectedly high pack resistance, such as an extra 5% will cause a 5% drop in voltage, a larger 10% drop in amps and an even larger 15% drop in power

The industry standard method of measuring internal resistance of cells involves use of pulsed currents. The Emeter II technique is simpler, but still gives consistent and useful results. The RDU is connected into a circuit such as the bookmarked one shown earlier and the PEAKS screen is selected. The motor is switched to full power and 'B' is pressed to clear maxima and minima. The motor should then be switched off completely. Within a second or two, an extra line will be shown on the PEAKS screen saying n.nnn ohms.

The actual value displayed will vary with:

- The number and type of cells

- The temperature of the cells

- The state of charge of the cells

- The condition of the cells

A high performance sub C NiMh cell of 4200 ma-h capacity is quoted as having an internal resistance of around 3.5 milliohms. So, a 10 cell pack has about 10 * 3.5 / 1000 = 35 milliohms. If you have such a pack and the Emeter test indicates more than 50 milliohms, then there is a problem evident. This might be due to

- Poor assembly of cells into a pack

- Poor wiring or connectors (try measuring the voltage loss from the start of the wiring through to the input to the ESC)

- Cells too cold (both LiPo and Ni technologies suffer from cold cells)

- Cells are worn out or damaged

Whatever the reason, the Emeter II will help to identify it and confirm the success of any remedy.


Using SNAPSHOTS

- A snapshot is a complete set of readings at a given time and is created from either Analyser, Tacho, Battery or Peaks screens. Up to eight Snapshots may be stored in Emeter II in a format matching the originating screen. Data logging, on the other hand, is aimed at monitoring the movement in the figures. Effectively, a snapshot is equivalent to a still photo, while data logging is the video equivalent

- Creating the snapshot - When readings are displaying, they may be held by pressing 'D'. The button 'C' label changes to 'Save' and, when pressed, will take you to the Snapshot screen. By default, the cursor will be positioned on the first vacant snapshot number. Press button 'C' again to save in this location or Button 'D' (next) to select a different number, followed by button 'C' (Save)

- If you decide not to save in any memory location, press button 'A' to escape

- You will be informed of the snapshot location used to save the data, and the Emeter will automatically switch back to the original display and continue the monitoring process

- Snapshot Recall - Snapshot data may be recalled onto the Snapshot screen by selecting the required snapshot number using button 'D' (next)

- Memorised data is retained even if the Emeter is switched off or the battery goes flat. In order to clear unwanted data, switch to Snapshot mode, select the required location

- number and, with the data displayed, press button 'C' (Clr)

Propeller Constants

Props Constant Introduction - The technique of calculating the motor power required to drive a propeller by means of prop Constants is employed by a number of electric flight performance prediction models. Examples are Christian Persson's and Helmut Schenk's Drivecalc www.drivecalc.de . Another site is www.badcock.net

- These free sites allow access to two large databases with masses of data on props, motors, batteries and other power system components. Much of the data on props was derived for both packages from Hyperion tests. Drivecalc would be the most active of the three with facilities for data entry by members of the public
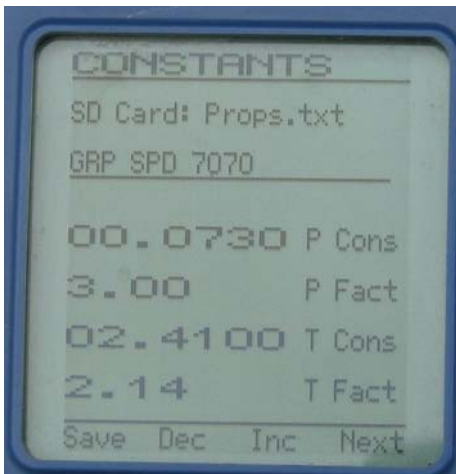
- Emeter II can hold a 'propeller library' on the SD Card, previously populated with data extracted from DriveCalc or alternative package. The data held in the library is the prop name and the four prop constants detailed below. As explained in Prop Talk, Aeronaut folding props can have 3 differently sized and 5 differently angled centre pieces, so each pair of blades could have 15 different variations. These would be held as 15 different propellers within the databases. While the SD card and the Emeter II have no limitations to the number of props, the time taken to browse through thousands of records could be better spent flying!

- If you do want to use prop. constants regularly, then the recommendation is to create a subset of the Persson/Schenk database and cull out any props which are of no interest. For example, if you are a Park/Indoor Flier, then the larger sizes of Aeronaut folders might be of no interest. Edit your desired subset of prop makers and/or sizes on PROPS.TXT using a PC and overwrite the PROPS.TXT file in the SD Card data directory.

- 'Prop Talk' (online Feb 2009) contains other suggestions for estimating constants for any un-tested props and renewed activity on this topic is expected around the World, so stay tuned!

- If you are only a casual user of prop. constants, then simply key the figures directly on the Prop Const screen. Prop name will be set to 'Other' and any subsequent motor testing will calculate and save the efficiency (either on the snapshot or the data log)

- <u>Constants</u> - Emeter II handles four different constants, two for motor power calculations and two for thrust. First of these is here termed the 'power constant'; it is determined, largely, by the prop pitch, diameter, number of blades, and prop shape.

- The second parameter is a 'power factor' which is often given a value of 3.0 to indicate an exact cube law relationship between the power required to drive the prop and the RPM which result.

- With the Emeter, it is possible to specify power factors other than 3.0 for increased accuracy. By comparison with the motor input power, Emeter II can give you an estimated motor/ESC efficiency figure

- The final two constants are the 'thrust constant' and the 'thrust factor' which are used in Emeter II to calculate the thrust generated by a propeller when turning at a given rpm. A comparison of thrust versus model weight will give you an excellent idea of the initial rate of climb of your model

- The 'constants' also vary to a small degree according to the Altitude above Sea Level and the ambient temperature. The Hyperion website carries a link to the www.badcock.net computer model which includes a database of propellers and can display the required constants for any given altitude and temperature

- In order to see these constants, press button 'B' (Prop) from any of the Analyser, Tacho or Snapshot screens or select Prop Const from the READINGS menu. You will now be on the CONSTANTS screen.

- <u>Using Existing Prop</u> - if you have the required prop defined on the PROPS.TXT file, then browse to it by pressing 'C' (Incr) or 'B' (Decr) This will display the existing values which will be used after pressing 'A' (Save).

- <u>Setting the constants yourself</u>

- Press 'D' (Next), to change any existing prop. name to 'Other' and to start the entry of the constants.

- Note that you cannot change the constants for an existing prop. with Emeter II (this can only be achieved by changing the PROPS.TXT file on a PC). You can, however, use an existing prop as a basis for creation of a new set of constants for prop name 'Other'. Use 'D' to browse through the constants figures, incrementing or decrementing each figure in turn to the required value.

- You can increment past '9' to reach zero or decrement from zero to reach '9'. Once you have the desired figures, press 'A' to save. If you decide against saving the changes, switch the Emeter II off (although not recommended if Bench-Test data logging is in progress - better would be to 'save' the unwanted values, then to re-enter the CONSTANTS screen and re-instate the original values

- Once saved, your new prop, figures will be used in all subsequent thrust, power and efficiency calculations. You may also apply prop constants to any Snapshot retrospectively. Just recall the Snapshot, press 'B' (Prop) and follow the usual procedure above

Power, Efficiency

- First, it should be understood that these calculations are not always applicable or sensible. For example, as the model picks up speed, the prop rpm rise and the current into the motor will decrease. The prop power and thrust constants are always measured at zero airspeed and it is likely that the increased rpm at reduced input power would yield an efficiency in excess of 100%would, if the model is flying a full speed

- The log files created directly on the SD Card by Bench-Test mode will contain the efficiency and thrust which may be viewed or graphed from the Log Files function

- The log files copied from the SD Card after data logging with In-Action mode will not contain the Efficiency and Thrust for the reasons mentioned and, so these two values cannot be viewed or graphed from the Log Files function

- Efficiency and Thrust will be created on the Snapshot files if the constants exist when taking the snapshot. They may also be added to the snapshot retrospectively by calling up the snapshot and switching to the CONSTANTS screen picking the propeller or entering the constants and pressing 'A' (Save) as described earlier

- Note also, that the 'Active' prop constants are held only once within the Emeter II; they are not held once for each of the eight snapshot locations. The efficiency figures which were calculated using the prop constants are, however, held separately for each memory location. There are some implications if you store motor performance results from different propellers. Take care to ensure that you have the correct constants in place for the given snapshot location, before you re-save on the prop configuration screen. Failure to do so could cause the constants for prop. 1 to be applied to the test results for prop 2. and the prop 2 efficiency figures will be useless.

- **Beware** that these efficiency figures are only as accurate as the data supplied for prop constants. A number of enthusiasts around the World continue to test various brands of propellers in order to build an accurate database of prop constants, so please check the sites from time to time.

- Emeter II gives a measure of the overall efficiency of the motor, the controller the wiring and the connectors. For low cell counts and high currents, this overall efficiency may seem much lower than you might expect. While some motors are capable of attaining 93% efficiency, such as the 2009 Hyperion ZS series outrunners, the way we load motors in RC use often means that efficiency will be much lower at the current point measured. What is more important, however, is that you now have a tool to quickly and accurately **COMPARE** different combinations, rather than a perfect accounting of "real" efficiency.

- The input power to the ESC and motor is simply the product of the voltage and the current and

is shown expressed in watts and the output power is calculated by the Emeter II as being:

- Output power (watts) = (rpm in 1000s) ^ power factor * power constant

- The power calculated from the prop. constants and RPM will be shown on the TACHO screen both as Watts and Brake Horse Power. This applies equally to electric, internal combustion or any other form of powerplant. Now you can compare the performance of electric and glow powered motors! There are many reported cases where, on the ground, the electric motor has more rpm than the recommended glow plug motor. This ground test is a little unfair on the ic motors which increase their power as they wind out. Electric motors unload and decrease the input current to the motor, and so the power usually falls.

Thrust

- Many experts in R/C flying around the World have published results of thrust measuring test rigs. The prop thrust relates to rpm in a similar fashion to power and rpm, except that, for thrusts, there is an approximate square law, compared with the cube law for power.

- Thrust (gms) = (rpm in 1000s) ^ thrust factor * thrust constant

- Thrust readings can tell you much about the initial potential climb rates or the likely performance of a 3D type aerobatic model. Again, see the Prop Talk article.


Programming ESC and Servos

Titan ESC Programming   [menu: MAIN>PROGRAMMING>TITAN ESC]

- There's no easier way to program a Hyperion brushless ESC than with the Hyperion Emeter II - anywhere, home or field**.** Unlike many other programmers, you need not have a motor attached, nor is an additional battery required.

  For safety's sake, you must NOT connect the model's main battery pack to the ESC during programming. All programming power is supplied by the Emeter's onboard battery.

- Connect the 4 wire "RDU" cable to the Emeter II 'Titan Prog' port and Hyperion Titan series speed controller with the negative black wire of the cable plugged into the socket pin named 'Gnd'

- Proceed to the Titan ESC screen and follow the instructions, as shown and press 'D' to connect the ESC and Emeter II. If there is a fault in the connection the screen will remain unchanged – check your wiring and start again

- A correct connection will result in the display of the current ESC parameters
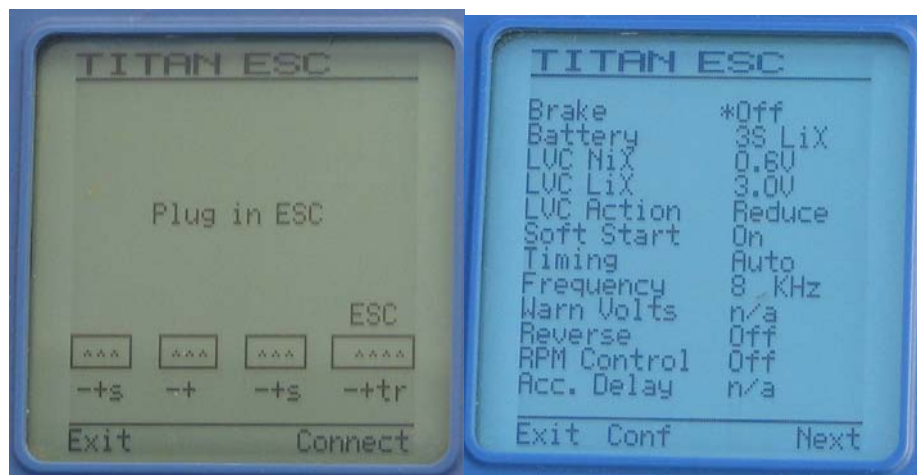
- Emeter II will check the type of Titan ESC and show n/a (not applicable) for any parameters which do not apply to that particular ESC

- Other parameters may have associated validations applied, such as the maximum number of cells and these validations may well vary depending on the model/rating of your ESC

- Press 'D' to move the asterisk to the field which you wish to change

Atlas Digital Servo Programmer   [menu: MAIN>PROGRAMMING>ATLAS SERVO]

Plug the Hyperion ATLAS DIGITAL Servo into Emeter II as per on-screen diagram

Press 'D' and, by using 'B' or 'C', make changes to:

- Direction
- Deflection
- Speed
- Center
- Deadband Width
- Save changes with 'A'

Atlas ESC Programmer   [menu: MAIN>PROGRAMMING>ATLAS ESC]

- This feature is available in EM firmware release 2.08 onward. The new ATLAS ESC will be released on about March 15 2009. SCORPION brand CommanderII ESC can also be programmed via this function. (Scorpion ESC with the IR remote programming should all be compatible)

  NOTE! As shown on the initial screen, the Potentiometer Dial (POT) MUST be set to full minimum position now (fully counterclockwise), and Rx battery attached if 50v~68V types. Do NOT connect ESC with POT in full clockwise (max) position, or the ESC will reset to defaults after 10 seconds.

- The initial screen requires that you choose the 'TYPE' for the controller first: 15v, 26v, 50v or 68v ESC versions. 'Type' determines the maximum number of cells which may be used and voltage "steps" available.

- Then pressing 'D' (Go) will then take you to the ATLAS ESC Detail screen which allows changes to any of up to 12 parameters: Some parameters vary in value for the different types – the values below are based on the 15 volt unit (* show default)

  - Low Voltage Cut-off 5 -13 volts for 15 volt ESC (LVC)   [defaults 15V&26V=6V, 50V&68V=10V)
  - LVC Action – Cut 50% Power*, No-Cut, Pulse (PCT)
  - Current Overload Protection – On*, Off   (COP)
  - Motor Acceleration Time Delay – 0.15*, 0.3, 0.45, 0.7, 1.3 secs (MAT)
  - Start Boost – Soft, Medium or Strong (SB)
  - Rotation – Normal, Reverse   (RO)
  - Motor Timing – Auto, 5, 15, 20, 25, 30 degrees   (TIM)
  - ESC Drive Frequency – 8 kHz*, 16 kHz, or 32 kHz   (FREQ)
  - Brake – None*, Very Soft, Soft, Hard, Very Hard (BRK)
  - Heli Soft Start – Gov, No Gov   (SS) [engages Slow Spool Up, with or without GOV mode]
  - SS Duration – Short 10sec., Medium 15sec.*, Long 20sec. (SSD) if SS is engaged, controls spool duration
  - Governor – Soft 1, Medium 2*, Hard 3, Soft 4, Medium 5, Hard 6
  - DEFAULTS/AIR – the last selectable option allows reset to defaults, also called AIRPLANE MODE in Scorpion documentation. If SS Heli Slow Start has been set once, DEFAULTS/AIR must be used to turn SS OFF (and GOV if engaged) when desired. Whenever a setting which changes multiple settings is programmed (such as SS or DEFAULTS), the Emeter will display the current setting for each function which has been changed.

Note that the ESC hardware does not allow reading of settings currently in the ESC. Therefore when the programming screen first appears, each settting shows only a dash (--). To change a function, use 'D' (Next) button to highlight the function, and 'C' (Set) button repeatedly to choose the setting you desire. After making changes, press 'B' (Save) button to update the ESC, or 'A' (Exit) to avoid changes.

An update will result in each changed detail being written to the Atlas (or Scorpion) ESC, one at a time. If no data has been changed, the update process will be by-passed. With several changed fields, this process may take a minute but progress messages keep you informed.

Stopwatches

Three variations of stopwatch are handled by the Emeter II. These are designed to assist timing of R/C model competitions and offer more functionality than a normal standalone stopwatch. The three types are:

- A lap count and lap timing watch for any type of activity of a repetitive nature such as racing cars around a track, model boats around a course, F5B or F5D model aircraft competition or even swimming or athletics

- A dual stopwatch is used for timing one activity within a second for example one individual lap within a multi-lap race, injury time during game time, or flight time during working time in a model glider event

- An autostart variation to the dual stopwatch in which a synchronised start of two watches is required. An example of this is the Limited Motor Run type of model aircraft competition in which the motor run time and flight time both start at launch

On entering any one of the three stopwatch screens, a check is made for any previous timing data for this particular stopwatch mode. If this exists, then the stopwatch will display the previous data.

If the data was initially captured using a different stopwatch mode, then a warning is issued and the option to clear data is given.

All stopwatch and countdown functions will remain running while using other Emeter II screens.

All events such as watch starts, stops and lap split times are included in the list and may be recalled later if the Emeter II is switched to another function
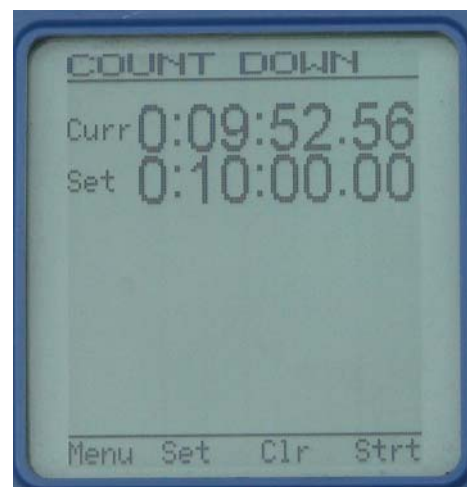
Lap Counter/Timer Stopwatch

* Records up to 100 'events' which may be lap times or stopwatch starts/stops
* Start stopwatch with Button 'D' - shows time as Prim(ary)
* Press 'C' at end of each lap. Lap time and the lap number show on lower half of screen.
* Splt is the value of Primary time as at last button C press
* Press 'D' (stop) to pause both Primary and lap timers.
* Press 'C' to Recall laps from beginning

With stopwatch stopped, clear times by pressing 'B' Clear and 'D' to confirm

Dual Mode Stopwatch

* Use 'D' for primary stopwatch and 'C' to start/stop the secondary stopwatch
* Secondary watch only runs while primary is running; if stopped by a primary stop, then after a primary start, the secondary watch will also require to be re-started

All events such as watch starts and stops are included in the list and may be recalled later until over-written by re-use of stopwatch.

<u>Auto Mode Stopwatch</u>

Use 'D' to start both primary and secondary stopwatches automatically at the same time. Thereafter, 'D' controls primary stopwatch and 'C' secondary stopwatch. Other than the synchronised start, the Auto mode is identical to the Dual Mode

Secondary watch only runs while primary is running; if stopped by a primary stop, then after a primary start, the secondary watch will also require to be re-started

<u>Countdown Timer</u>

* This timer will count down from any set time in the range 1 sec. to 10 hours.
* Press 'B' (set) followed by 'B' or 'C' (increase or decrease) to change countdown start time. Hold these buttons down for accelerated change
* Press 'D' to save – current time will be reset to countdown start time.
* Press 'D' to start countdown and 'D' a second time to stop/pause if required.

When the countdown timer is running, pressing 'A' will allow use of most other Emeter II functions, such as Tacho or servo test without interrupting the countdown.

At the end of the specified time:

- A 3 second long 'beep' will sound even if the Emeter II is in use on a different screen/function

- The current time will start increasing

- TIME OVER' will be displayed

Servo Tester

Two major issues combine towards a successful model installation and Emeter II can assist with both of these. They are:

- Power issues such as volts, amps, watts, prop. size, efficiency, thrust and battery capacity

- Control issues, such as servo throws, reliability, ESC and Digital servo programming and setting up a test bed to conduct motor tests in which no transmitter and receiver are needed

Power issues are covered earlier in this manual in sections on the Analyser, Tacho, Battery, Peaks and Prop. Constants screens

On the control issues, there are also several ways in which the Emeter can help to tune the model set-up or track faults, all of which can be loosely grouped under a 'Servo Tester' heading. These are shown in table form. The 4th column indicates whether this option can be used at same time as other Emeter II functions (Simultaneous) and the right-most column whether the pulse width can be set or seen

	Controlled By	Rx Battery	Simultaneous	Pulse Width
Servo Driver	Manual turn of Pot.	Yes	Yes	Not shown
ESC Driver opto	Manual turn of Pot.	Yes	Yes	Not shown
ESC Driver BEC	Manual turn of Pot.	No	Yes	Not shown
Servo Cycler	User defined end points	Yes	No	Can set high & low points
Servo Driver profile	User defined test profile	Yes	No	Yes – full control
ESC Driver profile opto	User defined test profile	Yes	No	Yes – full control

ESC Driver profile BEC	User defined test profile	No	No	Yes – full control

For all cases in the above table, plug in servo or ESC and, if needed, optional receiver battery as per on-screen diagram. Note that the two plugs can be inserted with either the left-most port 1 or port 2 on the Emeter II.

Note also that the servo driver is opto-isolated and may be used independently of, or combined with, many other Emeter functions

Servo Driver

This function allows testing of servos to check that they work smoothly, reliably and without jumping. The servo will receive pulse widths of approximately 900 microsecs to 2100 microsecs as the pot. is turned from one limit to the other. This is slightly more than the standard range of 1000 to 2000 ,uS so, if installed in a model make sure that the servo does not bind at the limits. Turn pot. to drive servo. (see the Quick Guide for standard pulse widths at each marker on the dial)

ESC Driver – OPTO

This provides an alternative way to test an ESC for bench testing of both the ESC and the motor, regardless of the motor type – brushed or brushless. Take special care to keep clear of the whenever the MPP (Main Power Pack) is connected. It is very simple to turn the pot. and this may cause the motor to start unexpectedly

If you wish to use a BEC ESC without the BEC, for example if the number of servos to be driven would cause an overload on the BEC voltage regulator, then it is a relatively simple process to remove the red wire from the ESC plug. Tape this red wire back to itself and insulate it. This technique does not result in an opto coupled ESC, but does allow the use of a separate receiver power back, which would be capable of driving extra servos

ESC Driver – BEC

This is essentially the same as the opto or non-BEC procedure, except that no Rx Battery is needed. Instead, power is drawn from the MPP (Main Power Pack). The circuit diagram in the Quick Guide shows all the components for a simple, comprehensive test procedure based on the Emeter II and a BEC ESC.

Manual control of the ESC and motor, whether BEC or not, is a very simple way to test motors without using the Transmitter and Receiver.

Servo Cycler

One of the most common times for failure of many electrical components is, often, soon after they are first put into use. Cycle testing of servos will improve confidence that they are functioning correctly in a new model. This works for any servo and can be carried out on the SERVO TESTER screen as follows:

- As instructed on the screen, move the potentiometer (pot) to the start position and press 'C' (next). Move pot to end position and press 'C" (Start) Both the start and end positions will display the pulse width which will be in the approximate range 900 – 2100 microseconds

- The servo will cycle between the two nominated end points

- Press 'C' to stop cycle testing

Servo Driver Test Profiles   (see section 8.5 of Quick Guide first)

[menu: MAIN>TESTING>RUN PROFILE…. PROFILE TEST]

A more sophisticated way of driving a servo automatically is to use a Test Profile or series of instructions programmed to send the servo to a user-defined set of positions. (see QuickGuide 8.5)

Note that the maximum time you can set in milli-seconds is 65,000 (65 seconds). If you wanted to run for 3 minutes, for example, you need to repeat lines such that the total equals your desired time:

01000,60000
01000,60000   (3 lines at 1000uS of 60 seconds each for 3-minute total)
01000,60000

Pulse-width standards vary according to transmitter/servo makers. See the [ATLAS SERVO GUIDE](#) for some other major makers' center/right/left pulse-width positions in uS.

Use of existing profile. When on the SERVO TESTER screen press 'B' (Load) to display all known test Profiles. Press 'D' to browse through the list and 'C' (go) to pick.

ESC Driver Test Profile with Opto Coupling or BEC   (see section 8.6 of Quick Guide first)
This is identical to the above servo testing from an automated profile, except that the ESC replaces the Servo. It is particularly powerful as a means of standardising motor test runs, for example ramping a motor up to full speed and back down again in an accurate, repeatable fashion.

It is not possible to run the ANALYSER screen at the same time as PROFILE TEST, however from the PROFILE TEST, it is possible to control data logging by pressing 'C'

Once logging has started, press 'D' to start running the test profile. Press 'C' again to stop logging. The results can subsequently be played back on the Log Files screens and can include all the usual data, including efficiency, thrust and output power, if propeller constants are available.

We strongly recommend that any test profile which is to be used for driving an ESC and a motor, **should have the first 3 seconds set to a motor-off signal** of 900 uS. If, during a profile controlled ESC motor test, there is an urgent need to terminate the run quickly, then it is only necessary to press 'D' Stop. This will cause processing to go back to the first data record in the profile test file (which corresponds to motor off) and to wait there for the next action by the user.

Example profile below showing appropriate first line of 3 seconds OFF:

PW-uS, DELAY-mS   (These notes in parentheses should NOT appear in the Test Profile File!)
00900,03000   (Throttle **OFF**, **3 seconds - this should always be the first entry**)
01300,05000   (Throttle approx. 33% 5 seconds)
01700,05000   (Throttle approx. 66% 5 seconds)
02100,20000   (Full Throttle 20 seconds)
01700,05000   (Throttle approx. 66% 5 seconds)
01300,00500   (Throttle approx. 33% 5 seconds)

'MOTRTEST.dat' as above is included as a sample in the v2.08/2.09 upgrade file package, fyi.

Added ability to control test profiles exists from v2.08 firmware and later with these settings: CURRENT (max), TMP1 (max), TMP2 (max), TMP3 (max), mAh-OUT (max), VOLTAGE (min). As such, users will have the option of stopping tests automatically if any TMP, mAh-OUT, or CURRENT exceed max selected value, or if VOLTAGE falls below the minimum you have set. Very handy for

automating testing, and insuring that no equipment is over-stressed!!   In v2.08 or higher, the PROFILE TEST screen's button 'C' is titled CFG. Selecting CFG will take you to a new screen allowing the above parameters to be set. While actually viewing the PROFILE TEST screen during a run, all the parameters chosen will also be shown as you have set them.

NOTE while in PROFILE TEST mode, AMBIENT TEMP (inside RDU) is also tracked as a termination parameter. If the internal Temp of the RDU reaches 60 deg C (which is should never do in normal use) - or if any other parameter setting is exceeded - the test will terminate and reason will be shown under the parameter settings area.

NOTE that the RDU normally keeps a continuous record of mAh-IN and mAh-OUT as long as the RDU remains powered (either by Emeter, or MMP to RDU Input). However, during each Automated TEST ROUTINE, these figures are zeroed at the beginning of each test, to insure accurate logs of mAh-OUT per each automated session.

A word of warning should be given on the subject of rpm figures for rapidly changing test profiles. When measuring rpm, especially using a phase sensor pick-up on a low magnet count motor, inaccuracies and inconsistencies may arise if the test profile throttle setting period is too short. Allow 2-second throttle periods minimum when making test profiles to avoid this issue.

Log Files and Data Logging
Logging is the name given to the process in which the voltage, current, rpm and other readings which exist at any point in time, are written to an output medium so that they can be read in and analysed later. Data Logging may be carried out when in Bench-Test or in In-Action modes. The following differences exist:

- In Bench Test mode, the log file records are written directly to the SD card, along with the actual hour/minutes/seconds at which the logging action was performed. The date of the Bench-Test run is included with the log file name
- With In-Action mode, the log file records are written directly to the RDU Memory chip, along with a time which is relative to the start of recording. The actual time at which the logging action was performed is not known to the RDU.
- The date and time of the In-Action log file download is included with the log file name when the data is downloaded from the RDU memory to the SD Card
- It is possible to identify Bench-Test log files from In-Action ones by the form of the timestamp in the log file details; Bench-Test will have a time with valid hours, minutes, secs., while In-Action will have a time starting with 00:00:01 and incrementing up from this figure
- A further difference between the two types of log records is that only Bench-Test records can carry an efficiency or thrust figure; the prop constants required for these calculations do not apply to a model which is in motion.

Logging in Bench-Test Mode

* Go to either the ANALYSER or BATTERY screens and press button 'C' – Log
* Start the run you wish log
* Press 'C' to cease logging under full user control

Each start creates a new log file with unique file number and showing date and time. Blinking message on screen acts as recording indicator

Warning, there is a small chance of corrupting the SD card if you switch power off to Emeter II while logging is in progress – press 'C' on BATTERY or ANALYSER screens to stop logging first

Set RDU data logging parameters for In-Action mode

An objective for setting the RDU control parameters should be to minimise the number of readings taken and to allow homing in on the relevant information as quickly as possible. The trigger types listed later are all aimed at this objective.

There are three different techniques for triggering the start of In-Action recording:
- Start as soon as the current from the MPP exceeds a specified level

- Start a specified number of seconds after connecting power to the RDU
- Start under the user's manual control via a spare receiver channel

Terminating the logging can be either through the use of a recording time parameter or through manual user control
* Go to MAIN MENU > RDU SETUP
* Set Trigger type for start of logging

Amps – start logging when actual current exceeds specified trigger amperage;
if amps fall below trigger level, then logging will stop if the recording time has expired.

Increase amps above trigger current to resume logging. In these circumstances, there will be multiple sets of data readings – one set for each time the actual current rises above then falls below the specified trigger amps.

These different sets will all be down-loaded to the SD card as a single file. The time display resets to 0 at the start of each set. For continuous logging after AMP start, set expiry record time=0 or very high

If the RDU is unplugged from the main power source, then, once the RDU and power source are re-connected, a new data log file will be created.

The download action, if chosen, will copy all files from the RDU to the SD card

- **Time** – this option is used for motor-less models which cannot use an AMPS based trigger. Logging begins once start delay seconds have elapsed after RDU connected to Main Power Pack and continues until the RDU is disconnected or the record time expires. In this case, the MPP could be any pack mounted in the model, including the receiver pack

- **Manual** – logging controlled by signal from spare receiver channel, plugged to RDU Rx Port. Pulse width < 1.3 msecs. will stop logging and > 1.7 msecs. starts logging

- Set recording expiry time (in secs.) for data logging session or zero for unlimited length

- Set sample rate from 4 per second to 8 secs. per sample. This sample rate applies to both In-Action and Bench-Test modes. Note earlier comment that rpm are only refreshed twice per second

Save logging parameters by pressing 'A'

General Notes on Logging
- Logging is indicated by a red flashing light on the RDU
- Failure to start logging is most frequently the result of having the RDU still connected to the Emeter
- A switched off Emeter II can be regarded as being disconnected

Set up RDU in model for In-Action data logging

Connect optional rpm sensor to RDU RPM port and any one of brushless motor input leads. Note that the ambient temperature and height will be recorded automatically by sensors built in to the RDU.

Connect TMP1 sensor to the 4 pin plug on the RDU marked 'AUX' and items to be monitored (tmp2,3 plug to tmp1). Where possible, use adhesive tape to prevent movement and to ensure good contact (example, motor, power pack and ESC).

Connect RDU main power wires to ESC
When ready to run model, connect RDU to power pack. Green LED should flash on RDU at the sample rate. Green LED changes to red while logging is in progress. Time based logging will stop when the Record Secs. on the RDU SET-UP have elapsed or the RDU is disconnected from the model's power-pack.

Amps triggered logging will stop when the Record Secs have elapsed AND the current drops below the trigger amps. Logging will resume again if the current rises above the trigger amps; a fresh Record Secs time will apply. This principle is especially useful if you want to concentrate on short motor runs,

while not being interested in longer motor-off periods. For this type of recording, the number of log file records will be reduced greatly. Of course, it is also possible to record all time by specifying a zero Record Secs., or a very large value.

If Manual control of logging is required, then fit a 3 wire cable, with servo plugs on each end , between the Rx output channel which is to control the logging and the RDU socket which is labelled 'Rx'

After the recording run has been completed

First of all, disconnect the RDU from the Main Power Pack (MPP). This will terminate the recording process if not already stopped by the Record Expiry Time parameter

Connect the RDU to the Emeter via the 4 wire cable, and switch power on. You will receive a message that 'New dataset found! Shall I download it?' Press 'D' to download immediately or 'A' to defer the download until later. Make a note of the log file number which was created

Examining the Log file information
Use MAIN > LOG FILES to show the list of log files which currently exist on the SD card and press 'D' to highlight the log file to be examined. The date and time of the log file will give you a good idea which file is of interest if you do not know the number. Press 'C' to display the summary of the run.

The log summary screen analyses the readings for the whole log file, selecting out key values which are maxima or minima (Peak Watts, Peak TMP 1,2,3 are also shown if v2.08 firmware of higher). The detail screen shows the values throughout the run and includes a value for Time. The figure shown is the time relative to the start of the current period. As described in the section on amps based triggers for data logging, there may be multiple motor runs held on the RDU. If a record time is in force, and the motor is switched off, then each new motor run will create a new set of log file records on the same physical log file. Each new set will reset the Time to zero hours, mins and secs.

Graphing Log Files
As an alternative presentation technique it is possible to show a simple graph on the Emeter II screen. Any two of the four variables volts, amps, height and rpm may be selected for the graph's Y Axes and these can be plotted against an x Axis of time. The graph axes auto-scale, based on the peaks for the entire log file, and the axes selected are retained even after power off.
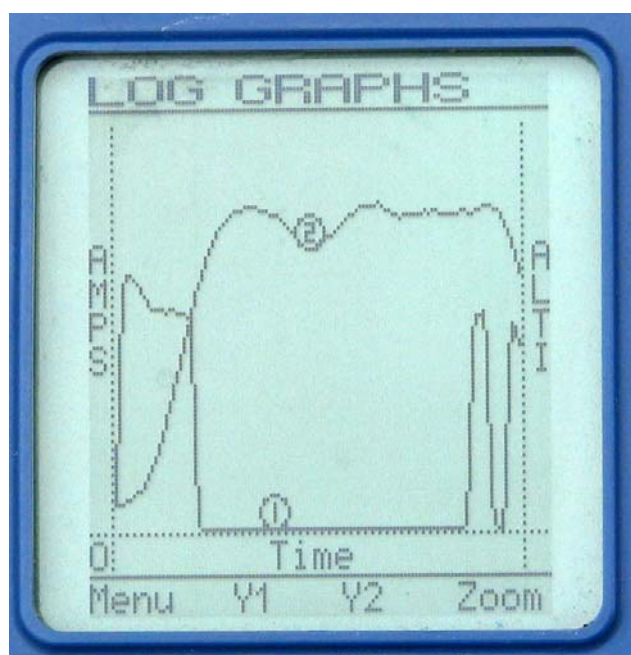
Note – this graph is an early version and may be different in production Emeter screens.

RDU Setup

RDU Setup allows the viewing and changing of various parameters which control the way in which RDU functions. Some notes on these parameters appear, in the section of the User Manual which explains their use. The following have not yet been covered:

Samples/Sec may have values of 4 per second through to 8 secs per sample, set by using 'D' , followed by 'B' or 'C' and 'A' to save. The actual rate chosen should consider the nature of the data being logged, bearing in mind the following guidelines:

- If the data does not change for, say, 10 cycles, then use a smaller number of cycles per second
- Log runs of battery charges, or discharge tests are a good candidate for 4 or 8 secs. per sample rates
- For reasons explained elsewhere in this manual, rpm figures are refreshed at most twice per second. Use of a 4 per sec. sample rate will result in two consecutive identical readings
- Use of a longer sample period will result in smoother, averaged readings

Upgrades to the RDU firmware are run from the RDU Setup screen. Because they are relatively rarely used, and yet are critical to the operation of the RDU, a special safeguard exists to protect against accidental triggering.

When on the RDU Setup screen press 'D' for **3 seconds** until the double 'beep' is heard. You now have access to the Upgrade Firmware function. If sure that you want to proceed then press 'C' – Go, with the Upgrade option underlined. This will check for the presence of a good RDUFW.bin file on the SD Card, show the version number of the current firmware and ask for confirmation that you wish to go ahead with the upgrade.

An upgrade takes about 10 seconds. If successful you will be shown the new version number which can always be checked by repeating the above process, but not confirming. Accidental upgrades with the same RDUFW.bin file do no harm to the installed firmware.

RDU Calibration
NOTE: RDU are calibrated at factory so calibration should generally not be necessary.

Voltage Calibration **-** This is also protected by the three secs. press of 'D' on the RDU Setup screen. Plug the RDU into a power source with a known voltage. Decrement/increment to match the voltage using 'B' and 'C' and then save twice

Current (amps) Calibration **-** Plug the RDU into a power source, discharge with a known current. Decrement/increment to match the current using 'B' and 'C' and then save twice

EMETER Set-up
Date and Time Press 'D' (next) to move to date or time lines.
Press 'B' or 'C' to decrease or increase the fields as required. Hold button down for accelerated change. These fields are used to add a timestamp to log files or snapshots

Screen Backlight Press 'D' to move to LCD Light line and pick
- 'Off' for no backlight
- 'On' for constant backlight
- 'Auto' for backlight on for 10 secs. whenever a button is pushed

Contrast Press 'D' to move to Contrast and pick a number between 15 and 30 for optimum clarity

Button Beeps Press 'D' to move to Beeps and pick 'On' or 'Off' for a 'click' or 'beep' each time a button is pressed

Height & Temperature Units The Log Files hold figures in Metres and Celsius. The EmeterII will convert display to Feet and Fahrenheit if so specified here.

UPDATES in v2.08 Firmware
* Addition of Min/Max Control Parameters for Automated Testing (see pg. 19 above)
* Addition of Peak Watts, Peak TMP 1,2,3 to appropriate Emeter II screens
* Addition of ESC Programming for Hyperion ATLAS and Scorpion Commander ESC (see pg. 14 above)

UPDATES in v2.09 Firmware (Only bug fixes; no feature changes from v2.08)
   FIXED:
* Intermittent FAIL to SAVE RDU configuration settings
* Peak RPM not accurate if user entered RDU setup while motor test in progress
* If atmospheric pressure was abnormally low at RDU power ON time, HEIGHT data corrupted

DOC Version 2.08/2.09
9 Feb 2009