

Emeter Quick Guide to Features

The Hyperion Emeter can be used to carry out a large range of functions related to Electric Flight. The range has expanded greatly since the introduction to the Market in early 2005. This guide to functionality acts as both a quick reference and as an index to the full, revised, manual. The manual itself goes into greater depth with explanations of many of the issues surrounding Electric Flight

Note that most of the functions will require one of four connector leads. Details are included in the table which also lists the buttons to be pushed whilst switching on. Button numbers are shown in quotes eg 'A' and have a corresponding abbreviation on the bottom row of the display

Terminology and Optional Extras

ESC - Electronic Speed Controller is used to vary the speed of the model's motors

BEC - Battery Eliminator Circuitry in the ESC, used to power receiver/servos from flight pack in lieu of separate receiver pack

Shunt is for measuring voltage, current and for re-charging the Emeter. A 100 Amp shunt is supplied with the unit as standard. A 20 amp shunt is available as an extra for low power work. Both shunts carry wiring information on their blue plastic covers

Servo Test/ESC Driver – optional extra – this requires a servo 'Y' lead

ESC Programming lead. This is a four wire lead used only for programming Hyperion Titan Speed Controllers – optional extra

PC Interface cable – optional extra for serial PC port or via USB adaptor. This is required for:

- Emeter firmware updates
- For PC capture of data directly from the Emeter

	Function	Switch-on buttons	Screen/Mode	Cables/wiring	Details
1	Read RPM		TACHO	-	1 – 7 blades 0 - >60,000 rpm. Press 'C' to set no.of blades. Default is always 2 blades
2	Toggle Tacho averaging	A	Startup Average on or off	-	On counts rpm over 2 secs if < 9,000 rpm. Counts rpm over 1 sec if > 9,000 rpm Off counts over 1 sec always
3	Read Volts	-	MOTOR or BATT	Shunt	3 to 60 volts, 2 dec places
4	Read Amps	-	MOTOR or BATT	Shunt	0 – over 100A (1 dec place) 0 – over 20A (2 dec places) NOTE ensure no current is flowing at Emeter switch-on or use the re-zero amps feature
5	Watts into ESC/Motor	-	MOTOR	Shunt	0 – 9999 watts, calculated as the product of Volts * Amps
6	Set Prop Constants	-	Config	-	Press 'B' from TACHO, MOTOR or MEM screens
7	Motor/ESC Efficiency	-	MOTOR	Shunt	Displays efficiency if Prop Constants in place and less than 100%
8	Motor Power		TACHO	-	Display power in Watts and BHP if prop. constants have been entered in place

9	Capacity milliamp-hours input	-	BATT Accumulates even when on other screens	Shunt	From 0 – 9999 mA-h. Records charged capacity automatically, whenever current is flowing through the shunt. Press 'B' to clear mA-h 'In'
10	Capacity milliamp-hours output	-	BATT Accumulates even when on other screens	Shunt	From 0 – 9999 mA-h. Records discharged capacity automatically, whenever currently is flowing through the shunt. Press 'B' to clear mA-h 'Out'
11	Timer	-	BATT Timer also continues even when on other modes	Shunt	0 – 10 hours Press 'B' to clear timer Press, 'C' to start/stop timer Press 'D' to Hold the display whilst the timer continues to run and 'D' 2 nd time to resume.
12	Max Volts	-	PEAKS	Shunt	Peak values recorded for whole session or until 'B' (Clr) pressed. These values are lost when switching the Emeter off unless saved to memory
13	Min Volts	-	PEAKS	Shunt	As above designed to protect Lipos
14	Max Amps	-	PEAKS	Shunt	As above designed to protect Lipos
15	Max RPM	-	PEAKS	-	As above
16	Pack resistance Ohms	-	PEAKS	Shunt	Start discharge, press 'B' (Clr), stop disch or Press 'B' (Clr), start and stop discharge
17	Calibrate volts	A and B	Calibration	Shunt	Plug shunt into power source with known voltage. Increment/decrement to match voltage. Save twice
18	Calibrate amps	A and B	Calibration	Shunt	Plug shunt into power source Discharge at known current Increment/decrement to match amps. Save twice. Repeat for 20A shunt, if required
19	Re-zero amps	-	BATT or MOTOR	Shunt	Zeroise amps by holding 'B' (Cfg/CLr) down for 4 secs until Amps Zeroised message
20	Display Hold	-	TACHO, MOTOR, BATT, PEAKS	-	Press 'D' to hold – 2 nd press continues, as if no hold took place
21	Memory save	-	As for Hold	Shunt	Press 'C' to save in one of 5 memories for later recall, select memory - 2 nd press resumes original activity. Data stored in 1 st empty memory by default
22	Memory Recall and Clear	-	MEM1 to MEM5	-	Press 'A' to reach MEM1 screen and 'D' to scroll through MEM1 to MEM5. Clear memory by pressing 'C'
23	Recover from flat Emeter Battery	-	All except config and calibrate	Shunt	If Emeter Battery goes flat , switch off, recharge then call up MEM5 screen to display last known readings
24	Titan ESC Programmer	-	ESC Prog Screens	4 wire ESC cable	Connect ESC to Emeter and switch on. Emeter will autodetect if connection to ESC is correct. No flight pack to be connected
	For ESC and servo driver functions below				Plug 2-wire extension or 'Y' lead into Emeter with –ve (brown/black) lead nearest to display +ve (red) not connected signal wire (orange, white or yellow) into pin 2 of Emeter, count from shunt end of case

25	Servo tester	A,B,C	SERVO	Modified servo Y lead + Rx pack	Connect leads as above. Push 'A', 'B', 'C' and switch on Press 'B', then 'B', 'C', 'D' to configure to 1000, 1500, 2000 milli secs initially for End1, centre and End2. Press 'A' (save) Press 'C' to start/stop auto cycling																														
26	ESC driver – non BEC	A,B,C	SERVO	Modified servo Y lead	Connect leads as above Configure to 1500, 1000, 2000 milli secs initially for stop, half and full speed .																														
27	ESC driver – BEC	A,B,C	SERVO	* Servo extension lead less red wire	Connect leads as above. Configure to 1500, 1000, 2000 milli secs initially for stop, half and full speed * Servo extension lead can be omitted if +ve pin removed from ESC plug																														
28	Firmware downloads			PC link cable	Download the firmware revision, un-zip, connect the PC link cable and double click on the Emeter v1.2x.exe file																														
29	PC data capture			PC link cable	Refer separate instructions																														
30	Charging the Emeter		Max source voltage for continuous charge = 10v Hours quoted are for totally flat Emeter battery	Shunt	<table border="1"> <thead> <tr> <th>Source Volts</th> <th>Charge Rate mA</th> <th>Hours</th> </tr> </thead> <tbody> <tr><td>7</td><td>7</td><td>19</td></tr> <tr><td>8</td><td>9</td><td>14</td></tr> <tr><td>9</td><td>10</td><td>13</td></tr> <tr><td>10</td><td>11</td><td>12</td></tr> <tr><td>12</td><td>13</td><td>10</td></tr> <tr><td>14</td><td>15</td><td>8</td></tr> <tr><td>20</td><td>18</td><td>6.5</td></tr> <tr><td>25</td><td>21</td><td>5.5</td></tr> <tr><td>30</td><td>24</td><td>4.5</td></tr> </tbody> </table>	Source Volts	Charge Rate mA	Hours	7	7	19	8	9	14	9	10	13	10	11	12	12	13	10	14	15	8	20	18	6.5	25	21	5.5	30	24	4.5
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25	21	5.5																																	
30	24	4.5																																	
31	Other tips				Alternative Tachometer Inputs																														
					Increasing Measurement Accuracy																														
					Part throttle Efficiency																														
					Estimating your own prop constants																														
					In flight recording																														

Hyperion Emeter Manual

by Mark and Phil Connolly for Hyperion HK

Caution - Before you start

- This is a sophisticated unit which will be an important tool in your Electric Flight program. Please be careful with it!
- We recommend a case of some sort and, like any electronics, keep the Emeter well away from dirt or water.
- Take special care not to press on the LCD surface as this can cause damage
- See the notes on polarity below. DO NOT reverse input polarity!
- Do not exceed a maximum of 60 volts for the flight pack

Wiring

Positive



Negative

Deans
ULTRA
Connectors

- Correct polarity of the flight pack is essential - reversed polarity may destroy the unit (just as it would destroy most ESCs) The supplied Deans ULT plugs have a standard polarity and a small '+' may be seen against the positive pin or socket, moulded into the red plastic
- In addition the blue plastic cover to the shunt is marked 'Load' and 'Battery' and also shows the + and - . **The end marked 'Battery' is always to be connected to the flight pack**, whilst the end marked 'Load' will be connected either to the ESC or to your charger, depending on the task being performed
- The Emeter must be plugged into circuit between the flight pack and the ESC. **Do NOT attempt to connect it between the ESC and the motor as damage may occur to both the Emeter and the ESC**
- With some chargers, it may be necessary to connect the shunt to the flight pack prior to connecting the shunt to the charger or a false error may result

Shunts

- Two shunts are available one for currents of up to 100 amps and one for 20 amps. The former is suitable for high power motors, but will have less accuracy for measuring low currents such as those used for indoor flight.
- The figures of 20 and 100 amps are indicative only and are not necessarily the maximum figures which can be recorded by each probe
- For continuous use, it is recommended that you limit the current through the shunt to about half the shunt rating; it is normal for the shunt to become warm during high current measurements
- If the maximum current for the given shunt is exceeded, then no damage will occur, but the unit will indicate '>Max' in the Amps and Watts displays. Motor efficiency will not be shown under these circumstances
- The 20 amp probe is for use with lowered powered models and will give more accurate readings when measuring charged or discharged capacity of packs at low currents. We recommend it for monitoring of battery charge/discharge cycles
- The Emeter detects which shunt or probe is in use and shows this briefly at startup. It also displays currents differently with 2 decimal places for the 20 amp probe but only one for the 100 amp case.
- Note that interchanging probes between two separate Emeter may cause variations in current readings. These can be adjusted by the calibration screen, covered later in this document.

Description of Functions

After switching on with no buttons pressed and when not connected to an ESC, the unit will display a Startup screen with the Firmware Version No. and indicate the type of shunt fitted (either 20A or 100A). After 2 secs. the TACHO screen will be displayed.

1 – Tacho Mode - Measuring RPM

- This is the first mode displayed after startup. The Emeter assumes a two bladed prop. Press button 'C' to change this to alternatives in the range of 1 - 7 blades. The higher blade counts are for ducted fan units. It may not be possible to measure ducted fan speeds when installed in a model, depending on your duct design and available lighting.
- Tacho mode does not require a shunt to be plugged in. Beware of using the tacho with fluorescent or other Mains powered lighting which will give false readings, such as 3000 or 3600 rpm.
- The RPM sensor will function over a large range of propeller sizes, RPM and lighting conditions. Experiment with different sensor positions, but avoid pointing directly at bright sky or sunlight. 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 cms of the prop., taking all due care. Small propellers may require closer positioning.

- By default, the unit will display a 2 bladed prop speed to the nearest 15 RPM, if turning at below 9,000 RPM or to the nearest 30 RPM if above. For 3 or 4 bladed props, these figures are reduced proportionally. It is normal for the tacho to take about 3 seconds to give a steady reading, while it counts the revolutions to this level of accuracy. Wait for a steady reading to occur.
- The button 'D' (hold) may be used to hold the present values on the screen (see sections 20 and 21)

2. Tacho Averaging Toggle

- It is possible to toggle between the use of
 - a 2 sec average for rpm below 9,000 and 1 sec. count above 9,000 as above or
 - 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
- To toggle between the two type of rpm measurement, simply hold button 'A' down whilst switching the Emeter on. A brief message will be displayed indicating whether the averaging function is on or off. Once the choice has been made, it will remain in effect until you repeat the toggle process.

3. Volts

- May be measured by plugging the shunt lead into the Emeter and connecting the shunt itself to the Flight Pack. Switch to MOTOR mode or BATTERY mode by pressing button 'A' once or twice. The BATT mode also shows the peak voltage which is useful when charging cells with a peak detect type of charge (Nickle Cadmium or Nickle Metal Hydride)
- The Emeter will read up to 60 volts, however beware leaving high voltage packs connected to a switched-off Emeter as this could overcharge the internal cells

4. Amps

- May also be seen in either MOTOR or BATT mode. Dependant on the shunt which is in use, amps will be shown with either 1 or 2 decimal places (for 100 amp and 20 amp shunts) .
- Be aware that the Emeter zeros its amp reading when switched on. It is, therefore critical that no current be flowing through the shunt when switching on. (see also the Re-zero amps function)
- Failure to observe this rule could show a negative current after switching power off but note that MOTOR mode will not record a current which is flowing in the opposite direction to that expected. (unlike BATTERY Mode)

5. Watts in to ESC/motor and using MOTOR Mode

- MOTOR mode will show the voltage and current of a motor when running and multiply these two figures together to give the power in to the ESC and motor, measured in Watts. For example, a motor supplied with 10 volts and drawing a current of 20 amps has an input power of $10 * 20 = 200$ watts
- To set up for this mode of use, connect the Emeter to the flight pack and ensure that the Rx pack (or the BEC switch) is turned off. Connect the ESC to the Emeter unit, taking precautions to keep clear of the propeller. Switch the Transmitter on and select motor off stick position. Switch both the Emeter and the Rx pack/BEC on and, with the model secured firmly, switch the motor on via the transmitter. Voltage and current will display, along with the input power to the ESC (see sections 20 and 21 for details of the hold and save functions)

6. Prop Constants

The input power to the ESC and motor is simply the product of the voltage and the current and is shown expressed in watts. The Emeter allows for the capture or entry of two propeller parameters.

- The first of these is here termed the 'prop 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.

- 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 a computer model which includes a database of propellers and can display the required constants for any given altitude and temperature. You may care to list the constants for the propellers in your possession, your altitude and typical ambient temperatures. They can then be input into the Emeter
- The Emeter must be used in MOTOR, recording volts, amps and rpm for the efficiency calculations
- The formula used for calculation of motor output power parallels that used by various computerised Electric Flight performance simulators and can be determined by the measuring the prop constant and the power factor
- In order to set these parameters, press button 'B' (Cfg - Configuration) when in MOTOR or TACHO modes. This will display the existing values. You may then increment or decrement the Prop Constant and Power Factor figures by buttons 'B' and 'C', using button 'D' to skip to the next number to be changed. When you have the correct values, press button 'A' to save these results. Note that it is possible to increment past 9 to zero or to decrement past 0 to 9.

7. Motor/ESC Efficiency

- On the MOTOR mode display, the Emeter will use the prop constants and rpm to calculate the output power and expresses this as a percentage of the input power, thus giving an efficiency for the ESC, wiring, connectors and motor
- If the prop constant is not entered, or yields a result which exceeds 100% efficiency, then the efficiency line will not be displayed on the motor mode screen
- Any prop parameter values entered will be retained by the Emeter, even after switching off
- Note that prop constants may also be entered after the volts, amps and RPM measurements have been memorised - see the 'Useful Tricks' section later
- Note also, that the prop constants are held only once within the Emeter ie they are not held once for each of the five memory 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 memory location, before you re-save on the prop. configuration screen. Failure to do so could apply the constants for prop. 1 to be applied to the test results for prop 2. and the prop 2 efficiency figures will be rubbish
- **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 site from time to time.
- The Emeter 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 80% efficiency under ideal circumstances, the way we load motors in RC use often means that efficiency will be much lower. What is more important, however, is that you now have a tool to quickly and accurately COMPARE different combinations.

8. Motor Power

- 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!

Battery Mode Functions

Connect the Emeter probe between the charger and flight pack and ensure that no current is flowing when the Emeter is switched on.

Note that the operation of the Emeter prior to firmware release v1.21 varies from that described below, in that mA-h accumulation only occurred while the clock was running. Now these accumulations occur automatically.

9. Charging and Input Milliamp Hours

- BATTery mode can be selected by pressing button 'A' twice after startup and shows voltage and current. It also shows the peak voltage alongside the running voltage figure. Thus, for NiXX cells which require a peak detect charger, it is possible to predict the end of charge which will occur shortly after the voltage falls to lower than the peak voltage

- A milliamp-hour (mA-h) figure measures the charge capacity put into the flight pack. This feature is intended to supplement cheaper battery chargers which do not have such recording capability
- The amount of charge put into a flight pack will depend mainly on the amount previously taken out and the Emeter mA-h input figure will give a clear indication of how much remaining flight time would have been possible. For example, a 3000 mA-h pack which, after use, accepts 2000 mA-h of charge could have flown a maximum of 50% longer (less safety and other margins)

10. Discharging and output Milliamp Hours

- As with charging, a second mA-h line shows the amount of charge taken out of the flight pack, providing an alternative method of estimating possible remaining flight time. Note that when discharging it is essential to have a low voltage cut out, or flight pack damage may occur
- The Emeter will record current regardless of the direction without a change to the wiring. The direction of current can be determined from the mA-h in or out figures
- It is possible to record both 'in' and 'out' mA-h figures with the Emeter if you have a charger with a battery discharge/charge cycle capability
- Both the 'in' and 'out' mA-h figures should relate closely to the labelled capacity on packs being measured since the commonly accepted method of identifying flight packs includes the mA-h rating eg GP3300, RC2400, PQ2000 have nominal capabilities of delivering 3.3, 2.4 and 2 amps for 1 hour. In practice significant variations occur and the Emeter allows accurate measurement of these variations

11. Timer Function

- The timer function allows you to keep track of how long a pack has been on charge. It is controlled manually by pressing button C (start) - the clock will record seconds, minutes and hours. If needing to conduct lengthy tests over many hours, then first ensure that the Emeter NiMH cells are fully charged
- Pressing button 'C' (which now says 'stop') will stop only the clock The accumulation of mA-h in or out will still continue. This would allow you to have a temporary pause in the timing.
- The button 'D' (hold) applies and works as described later
- During the charge or discharge, the peak and latest battery voltages are displayed. This is especially useful as an indication of when a peak detect charge is about to stop
- Button 'B' (Clr) allows for readings to be zeroised, including the time, the peak voltage and the mA-h figures.
- If a charger is in use which allows a charge and discharge cycle of the flight pack, then both cycles will be recorded

Use of the PEAKS Screen

12. Maximum Volts

- This records the maximum volts detected by the shunt for the whole time during which the Emeter is turned on, or since button 'B' (clear) was last pressed.
- Normally, this will be the flight pack voltage when the Emeter is first connected for discharge testing, or the Peak voltage reached during the charge cycle.
- The former should be compared with the rating of the ESC and/or the motor, and the latter is of critical importance during charging of Lipos

13. Minimum Volts

- This records the lowest voltage measured by the shunt for the whole time during which the Emeter is turned on, or since button 'B' (clear) was last pressed. Switch the Emeter on after plugging the shunt into the flight pack, or press button 'B' to prevent this figure from reading zero volts
- The minimum voltage is also critical for Lipo flight packs; discharging them to too low a voltage will shorten their life. The Emeter can be used to confirm that the low voltage cut-out point of the ESC is set correctly

14. Maximum Amps

- This records the maximum amps detected by the shunt for the whole time during which the Emeter is turned on, or since button 'B' (clear) was last pressed.

- This figure is critical for the flight pack, the ESC and the motor, all three of which will have maximum current ratings
- If the Emeter is mounted in the model to record Amps and reduced throttle is used during launch or take off, switching to full throttle for a particular part of the flight, then, after landing, the maximum would show the current used at that point eg when pulling up from a 3D hover

15. Maximum RPM

- This records the maximum RPM detected by the tacho for the whole time during which the Emeter is turned on, or since button 'B' (clear) was last pressed.
- Normally, a model aircraft propeller will speed up as the model accelerates. If the Emeter is mounted in the model in such a way as to record RPM, then, after landing, the maximum RPM would give a good measure of the degree to which the motor unloads

16. Measuring Flight Pack Internal Resistance

- Flight pack internal resistance plays a major part in determining the level of performance of electric powered model aircraft. It would be no exaggeration to say that World Championships have been decided by this factor. The lower the resistance figure, the higher the RPM which result from the higher voltage appearing at the ESC and motor
- Internal resistance figures are normally measured by monitoring the voltages with a pulsed current. However, the Emeter can give a measure of the flight pack internal resistance by monitoring the voltage with and without a heavy current. These figures are captured by the PEAKS Screen which then applies Ohm's law to calculate the resistance as follows:
 - connect the shunt as normal to the flight pack and ESC/motor
 - select the PEAKS screen.
 - switch the motor on, let readings steady and press button 'B' to clear previous figures
 - switch the motor off or reduce the current to less than 10% of the maximum
 - after 1 second, the resistance is then displayed in ohms and as shown in the photo
- This feature simply uses the max and min voltage and the max and latest amps, to calculate the resistance. As with motor efficiency, the figure is an overall one and includes plugs and wiring, so it is a little higher than the manufacturer's figure using AC. Nevertheless, it clearly shows the difference between a good and a bad pack and also the effect of cold vs hot NiMH cells.
- You can actually make two slightly different tests on the PEAKS screen
 - Switch motor on, press 'B', switch motor off as above or
 - Press 'B', switch motor on, switch motor off. This will give a slightly higher reading in most cases
- Note that the resistance figure is not saved in memory. This is because it is not measured like other figures (amps, rpm etc) but is calculated. The PEAKS screen will hold the data after the test, as long as you don't switch the Emeter off. It is also not fed to the PC software via the Emeter-PC data link - the PC software would, however, be able to calculate the pack resistance from the supplied volts and amps figures

Emeter Calibration

The Emeter comes with a default factory calibration of the voltage and 100 Amp shunt and these will be sufficiently accurate for most purposes. The 20 Amp shunt is supplied as an optional extra with a calibration value. Currents displayed with either shunt, however, are subject to manufacturing tolerances in the shunts and you may observe small differences if, for example, you borrow a different shunt.

Follow these steps if you wish to recalibrate your shunt, or have made you own custom shunt:

17. Voltage Calibration

- To switch to calibration mode, press both button A and B, whilst switching power on to the unit. Release the buttons to display the Calibration Screen. If you know the calibration values to be used for current and voltage, then simply use the 'increment', 'decrement' and 'next' buttons 'B', 'C' and 'D' to set these values.

- If you do not know the calibration values beforehand, then connect the Emeter into circuit with a constant voltage which is also monitored by an independent, accurate, meter.
- With no current flowing, use buttons 'B' and 'C' to increment or decrement the voltage until it matches the standard meter. Press button A 'save'. This is a permanent change which cannot be undone, except by repeating the calibration steps.
- In order to prevent accidental recalibration, you will be asked to repeat the 'Save' command this time pressing button 'D'. Once this is done, your new setting will be retained for all further Emeter use. If you do not wish to proceed with the re-calibration, then press button 'A' (Esc) instead of the repeat 'Save'
- Note that the same voltage calibration settings apply regardless of the shunt

18. Current Calibration

- Switch to calibration mode as before. If you know the calibration values to be used for current, then simply use the 'increment' , 'decrement' and 'next' buttons 'B', 'C' and 'D' to set these values. This should be the case if you acquire the optional 20 Amp shunt
- If you do not know the required settings, then you will need to connect a known accurate meter in series with the shunt and pass a constant current through both meters. Use the buttons again to adjust the Emeter reading to match that of the known accurate meter
- Note that it is possible to calibrate both a 20 amp and a 100 amp shunt separately. Each set of figures will be retained independently by the Emeter

19. Re-Zero Current

- under some circumstances (usually incorrect connection sequence) you may have a value in the amps readout of the BATTERY or MOTOR modes when no current is actually flowing. This can be corrected without switching the unit off, by pressing the button 'B' for at least two seconds.
- You will receive a message indicating that amps have been re-zeroed and may then continue to use the unit. This has no bearing on the amps calibration described above, although, without the re-zero, the actual amps readout would be affected by both features.

20. Display Hold

- When in TACHO, BATT, MOTOR or PEAKS modes, pressing button 'D' will hold the present values on the screen even 'though the measurements continue. For example the 'Hold' action on the BATTERY screen during the charge process will continue to accumulate mA-h in figures and the clock will continue ticking over
- Pressing button 'D' a second time will continue the activity as if nothing had happened
- The Hold feature allows you time to write figures down at your leisure

21. Memory Save

- Any combination of tacho, motor, battery or peaks displays may be stored in one of five sets of memory numbered 1 - 5. To store data, first select button 'D' (hold) on the activity being monitored. Button 'C' will change to save and, when pressed, will take you to the memory screen.
- By default, the cursor will be positioned on the first vacant memory number. Press button 'C' again to save in this location or Button 'D' (next) to select a different memory, 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 memory location used to save the data, and the Emeter will automatically switch back to the original display and continue the monitoring process

22. Memory Recall and Clear

- Memorised data may be recalled by pressing button 'A' until the memory screen is shown and selecting the required memory number by pressing 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 memory mode, select the required memory number and, with the data displayed, press button 'C' (Clr)

23. Recover from flat Emeter Battery

- The Emeter battery will last about 6 hours when in standalone mode or about 4.5 hours when connected to a PC. via the RS232 DB9 plug and cable

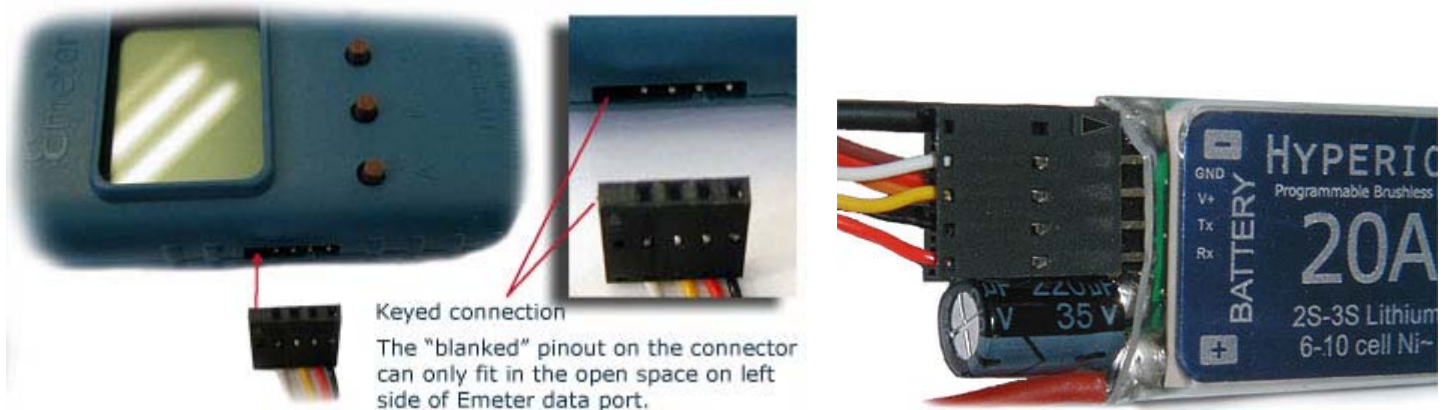
- If the internal battery registers a low battery warning, then the contents of the latest screen will be stored in MEM1. Whilst it is not wise to allow the battery to go flat, this does mean that your valuable test results are preserved.
- To recover these results, switch the Emeter off and recharge at least partly. Then switch on and call up memory 5 which will show the 'lost' figures.

24. Titan ESC Programmer

- **There's no easier way** to program a brushless ESC than with the Hyperion Emeter - anywhere, home or field. Unlike most 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.

- To start, check that the Emeter power switch is in the OFF position, marked "0" on the side of the case. Now connect the programming patch cable to the Emeter and Hyperion Titan series speed controller. The patch cable between Emeter and Titan ESC does not have a polarity - either end can be attached to the Emeter or ESC, but you must observe the correct attachment of connector to the Titan ESC, as shown in the second picture below.



The blanked pinout on the other connector (see arrow on connector in pic above) is always next to the GND pins on the Titan ESC connector. Note: the polarity information on the ESC heatsink (GND V+ Tx Rx) is NOT necessarily intended to match particular **wire colours** on the connector.

Now, power ON the Emeter, by sliding the switch to position marked "1" on right side of case. If everything is connected properly, and the Emeter batteries are charged, you'll be greeted with the screen below. If the Emeter should go instead to Tachometer mode, re-check your connection polarity to the Titan ESC.



After a few seconds, the display will shift to page one of Titan programming mode, pictured below. There are three buttons used during programming and corresponding cues on the screen:

Button 'A' ESC - Push at any time to save your changes and exit

Button 'B' CFG - Push to scroll through the options on each page

Button 'D' NEXT - Push to move to next page

(see additional notes at page bottom)

1: Brake



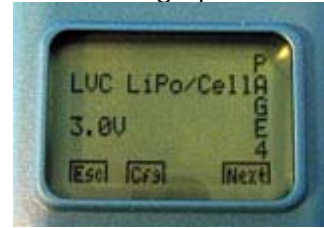
2: Battery Type



3: NiCd/NiMH auto-cut



4: Li-Po auto-cut voltage per cell



5: Auto-Cut Type



Page 6: Soft Start



7: Timing Mode



8: Frequency Mode (or warn voltage for W types)



9: Reverse Rotation



10: RPM Control



Push button 'D' to return to page 1, BRAKE



Press button 'A' to end your programming at any time



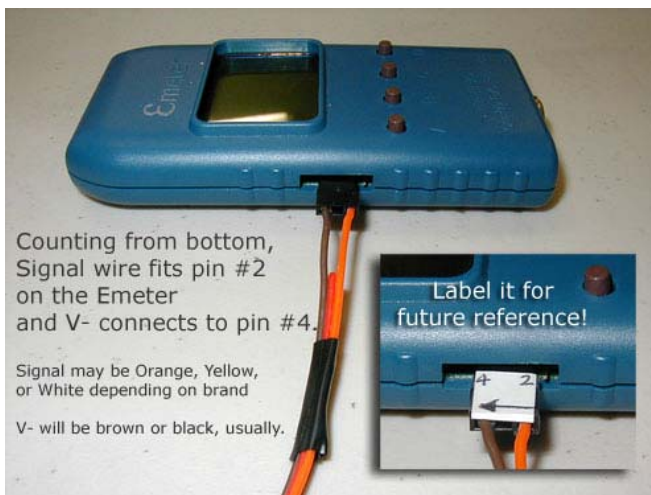
25. Servo Tester

- This function gives you an independent means of testing a servo without the need for a transmitter or receiver. It is very useful for tracking down problems when the servo fails to operate correctly

The Emeter Servo Tester function requires:

- Emeter v1.08 Emeter Firmware or later installed and
- A standard servo "Y" cable, slightly modified:





STARTING THE SERVO TESTER MODE

- Connect the Female connector on Y-Cable to the Emeter as shown above
- Connect a 4.8V Receiver Battery Pack to one Male connector on the Y-Cable (signal wire is unused, but can be retained "as is")
BE SURE that battery polarity (+ , -) is correct, or you will damage the servo
- Connect your Servo to the remaining male end on the Y-Cable, **again paying attention to polarity!**
- Hold down buttons A, B, and C on the Emeter and switch Emeter power ON
- Release buttons when the Servo Tester screen comes up

FIRST TIME ONLY

- **Configure End-Point 1, Neutral Point, and End-Point 2**
ENDPOINT 1: 1000
NEUTRAL: 1500
ENDPOINT 2: 2000
- Most servos on the market today will reach accurate centre and a large deflection with these values. However, some servos may be non-standard, and could be over-driven, which can damage the servo.
- If you have any concern, you can leave the end points at the default value to start (1000 / 2000) and compare the servo arm travel in degrees with that resulting from normal use via the transmitter and receiver. If not 45 degrees per side, you can likely decrease/increase the values to 800 / 2200.

Press "B" [Cfg] to start setting end points and neutral point

Press "C" [Dec] to Decrease value for EndPoint 1, or "B" [Inc] to Increase the value

Press "D" [Next]

Press "C" [Dec] to Decrease value for Neutral Point, or "B" [Inc] to Increase the value

Press "D" [Next]

Press "C" [Dec] to Decrease value for EndPoint 2, or "B" [Inc] to Increase the value

Press "A" [Save] to return to Test mode

USING THE SERVO TESTER

- Press button "A" [End] to deflect the servo in one direction
- Press button "D" [End] to deflect the servo in the opposite direction
- Press button "C" [Strt] to start automatic cycling, Left - Centre - Right - Centre -Left - Centre - Right, continuously....
- Press button "C" [Stop] for 2 seconds (or more) to end Automatic Mode
- Turn OFF the Emeter power switch to end servo testing
Disconnect Emeter, Battery, and Servo from the Y-Cable

Note: If installed in a model, your servos may be setup to give full deflection of a control surface at well under full servo travel. This occurs if you reduced the travel settings in your transmitter. Cycling the servo while it is installed in the model like this could damage the model, and/or the servo. So, it is best to **disconnect servos from control surfaces before using the servo tester.**

26. ESC Driver – Non BEC Controllers via Servo Test Function

- The servo test function creates one of three signals, depending on the buttons which are pushed and these signals are suitable for driving an ESC. This can be very useful for tracing faults, or checking for correct functioning of the ESC at the field, without the need to switch the transmitter on. (Someone else may be using 'your' frequency!)
- Beware that the Emeter servo test function used in the above way to drive an **ESC** and motor, would normally require that the low end button be pressed continuously to keep the motor switched off. Depending on the brand of ESC, connecting the flight pack with none of the Emeter buttons pressed (which is equivalent to half throttle) may or may not allow the motor to start.
- **IMPORTANT NOTE** Even if the ESC 'arming' sequence prevents premature startup of the motor, there is the potential for problems when completing the test, if you release the Emeter End1 throttle button in order to disconnect the battery.
- Thus it is strongly recommended that you set the Emeter end points such that the motor will be off when no button is pushed. Follow the instructions for servo testing to set the following End and Centre points
 - End1 1500
 - Centre 1000
 - End2 2000
- **Start with no propeller on the motor** and switch the Emeter on with buttons 'A', 'B' and 'C' pressed to select Servo Test mode.
- Connect the ESC three wire lead which normally goes to the throttle plug on your receiver into the 'Y' lead and the 'Y' lead into the side of the Emeter, as shown in the photographs of servo testing
- Connect up the receiver pack to the 'Y' lead
- Connect the flight pack, the ESC and the motor. Leave the Emeter shunt unplugged for this process. **YOU CANNOT MEASURE CURRENTS WITH THE EMETER IN SERVO TEST MODE**
- Switch the receiver battery pack on and press button 'A' (End1). If all is working the motor should run at half speed. Press button 'D' to run at full speed, but beware of manufacturer's rpm or other limits when running an unloaded motor at full throttle
- If the motor fails to start, then a possible reason with some ESC units is that the Arming Function for the ESC has not encountered a low enough signal. Try changing End1 from 1000 down to 900 or further if necessary
- **AS ALWAYS, TREAT ANY 'LIVE' ELECTRIC POWERPLANT WITH THE RESPECT IT DESERVES AND DOUBLE CHECK EACH ACTION BEFORE YOU TAKE IT**
- Once you have checked out for correct operation, you can disconnect the flight pack, re-fit the propeller and re-test

27. ESC Driver – BEC Controllers via Servo Test Function

- If your **ESC** has BEC, then you only need a servo extension lead, not a Y lead to connect the **Emeter** to the **ESC**. Follow the above instructions to see how to connect the lead to the Emeter and how to configure the end points.
- It may even be possible to withdraw the red wire from the ESC three-wire plug and to plug the two remaining wires directly to the Emeter. Beware of damaging the ESC plug, if you choose to omit the servo extension lead. Later on, you will be relying on this plug to give you control of the model!

28. Firmware downloads - See <http://media.hyperion.hk/dn/pc/all.htm>

29. PC Data Capture

- The cable used for Firmware upgrades also allows for communication between the Emeter and a PC
- Software for this may be downloaded free from <http://media.hyperion.hk/dn/pc/all.htm>

30. Charging the Emeter

- The Emeter is supplied with an in-built 4 cell NiMh pack which will last about 6 hours before giving a **Low Battery** indication. When connected to a PC, this duration is reduced to about 4.5 hours. If left on further without re-charging, this warning will disappear.
- All memorised data, including prop constants will be retained, even if the Emeter battery is fully discharged.
- The Emeter is re-charged simply by connecting it, via the shunt "battery" connector, to a flight pack of 6 to 20 Nicads/NiMh cells, or two to six Lithium cells. Alternatively, it may be connected to a car battery, taking full care to ensure the correct polarity. A lead which plugs in to the cigarette lighter in your car is recommended. **The Emeter power switch must be in the 'off' position for charging to occur.**
- Connection and use with Flight Packs of up to 60 volts is possible, but do not leave the Emeter continuously connected with these higher voltages or overheating of the charging circuitry may occur. This will show itself as warmth at the Emeter power switch. 30 volts is the recommended maximum
- If charging from higher voltages, check for any signs of warmth at the bottom of the Emeter and cease charging if any is detected. The maximum voltage for which continuous charging can be carried out is 10 volts.
- The flight pack must have a minimum of 150 ma-h spare capacity
- From a fully discharged state, charging will take between 8 hours for a 12 cell Nicad/NiMh cell flight pack (15 ma), up to 19 hours for a 6 cell NiMh/Nicad flight pack (7 ma).
- Beware leaving the Emeter plugged in to a small capacity Lipo pack for extended periods, or the Lipo voltage may fall below the minimum level for long life, resulting in permanent damage to the pack

31. Other Tips and Tricks

- **Alternative Tacho Inputs** – in some cases, such as ducted fans or poor lighting conditions, stable RPM readings may prove difficult to obtain. Emeter users have found two alternatives to the normal method. These are described briefly for the more experimentally minded Emeter owners to try.
The first uses optic fibres of about 2 mm diameter and whatever length is required to carry the light from an awkward-to-reach source to the tacho hole at the top of the Emeter. This not only avoids the need to place the Emeter close to the rotating fan or propeller, but also prevents unwanted stray light from entering the Emeter. Mains powered fluorescent or incandescent lighting can play havoc with tacho readings
- Another alternative has also been used with considerable success for full power measurements with brushless motors. This consists of a white light emitting diode and a 1k ohm resistor connected in series with the two unconnected leads wired across any two of the three leads passing in to the brushless motor. For use down to half throttle solder a 100nF condenser in parallel to the LED
- As the motor runs, the alternating voltage from the ESC causes the LED to flicker and, by shining the LED into the Tacho hole will give a very stable reading. The Emeter no. of blades needs to be set to the no. of pole pairs so, for a 12 pole motor, set blades to 6. Thanks go to Christian Persson for this idea
- **Increasing Measurement Accuracy** – for most motor measurements, you will find that the voltage and current can change significantly during the first 3 seconds of motor run. It is wise to wait for 3 seconds before holding data via the button 'D'.
- **Efficiency and part throttle use** The Emeter can be used to show the effect on efficiency when operating at less than full power. For various reasons, brushless systems in particular will usually have reduced efficiency when operating at part throttle. This may be observed very simply using the five memory locations. First, clear all memory locations on the Emeter. Couple up the unit in the normal manner for efficiency measurement and input the prop constants.
- Now set the motor running at full power and press the hold button (D) once and the save button (C) twice. Throttle back slightly, wait for the RPM to steady and repeat this save process up to five times. Switch off, disconnect the Flight Pack and study the memorised results by recalling memories 1 - 5. You may be surprised at what you find!

- Note that the waveforms of currents flowing through a brushless motor at part throttle are very complex and the displayed amps figure may not be totally accurate

Beware running a power system for lengthy periods on the test-bench at partial throttle with an ESC which is close to its maximum rating. Extra heat may well result from the part throttle operation and cause damage to the ESC or motor.

- **Deriving your own prop constants** If you have a prop with an unknown prop constant, then you can get an approximate value by running the powerplant with a known prop which gives a similar load (ie amps draw) on the same number of cells.
- The voltage and current determine the efficiency of a motor, regardless of the prop which is being driven. However, small variations in the voltage and current will not cause significant changes to the efficiency.
- Use a trial and error approach in setting the prop constant for the unknown prop until you match the efficiency given by the known prop. For example, if the known prop gives 75% and the unknown prop gives 65%, then for your second trial, increase the prop constant figure by 75/65 and then retest.
- The Emeter simplifies the 'trial and error' process. Record the volts, amps and RPM in one of the five memory locations as previously explained. Disarm the powerplant and disconnect the Emeter (you may even switch it off, if you wish to carry out this process at a later date).
- Now call up that memory location where you have recorded the motor performance data and press button B (Cfg). Set the new values for Prop Const and Pwr Fact as described previously and then press 'Save (button A). You will now be returned to the Memory Display screen with the new efficiency figure re-calculated. Continue this process until the re-calculated efficiency figure matches that of the known prop.
- **In flight data recording** is possible if your model will carry the weight and size of the Emeter which are 90 gms (3.2 ozs) including the shunt and 100 * 50 * 20 mm (4" * 2" * 0.75") plus the shunt
- If you switch to BATT mode, then the Emeter will keep track of the capacity drawn out of the pack as you fly. Start the timer by pressing button C just before you launch and when you land, immediately press button C again to stop the timer and then hold and save the Battery mode readings in one of the five memories. Without switching the Emeter off, change to PEAKS mode and hold and save these readings in another memory location.

At any time later, you can now come back to these saved readings and see:

- the total capacity drawn from the flight pack - if you fly until the BEC cut-out operates, this will tell you the capacity you get from the pack in a real situation which could make interesting comparisons with the manufacturer's figures
- you could also make decisions on whether to launch a second time based on the capacity remaining after a shorter flight
- the average current drawn - divide the ma-h figure by the time
- the highest current drawn throughout the flight
- the lowest voltage reached by the pack - to tell you whether the BEC cutout is functioning correctly
- the 'at-rest' voltage from the pack after the flight and the peak voltage which, normally would be the voltage on first connecting up the circuit - I do wonder if you start flying with cold NiMH cells whether the off-load voltage would rise once the cells warm up - certainly, the voltage under load is known to increase quite substantially in some cases

Have fun!

Philip Connolly for Hyperion