

To the novice, electric car racing seems the most cost effective way of getting started in this hobby/sport. But, as some recent articles have pointed out, once past the novice stage, the electric racer is always faced with the problem of keeping his/her battery packs in top notch condition. One method is to continually invest in new matched packs (expensive!), the other is to send packs away to one of the many firms that offer re-matching services. The H-H Systems Pro-Trak Battery Management System (hereafter known as the BMS) was designed with the object of providing the purchaser with a machine that negated the need to use proprietary services for re-matching etc, yet was simple enough for the average racer to use for re-matching, rather than merely as a basic charger/discharger.

THE H-H SYSTEMS PRO-TRAK BMS

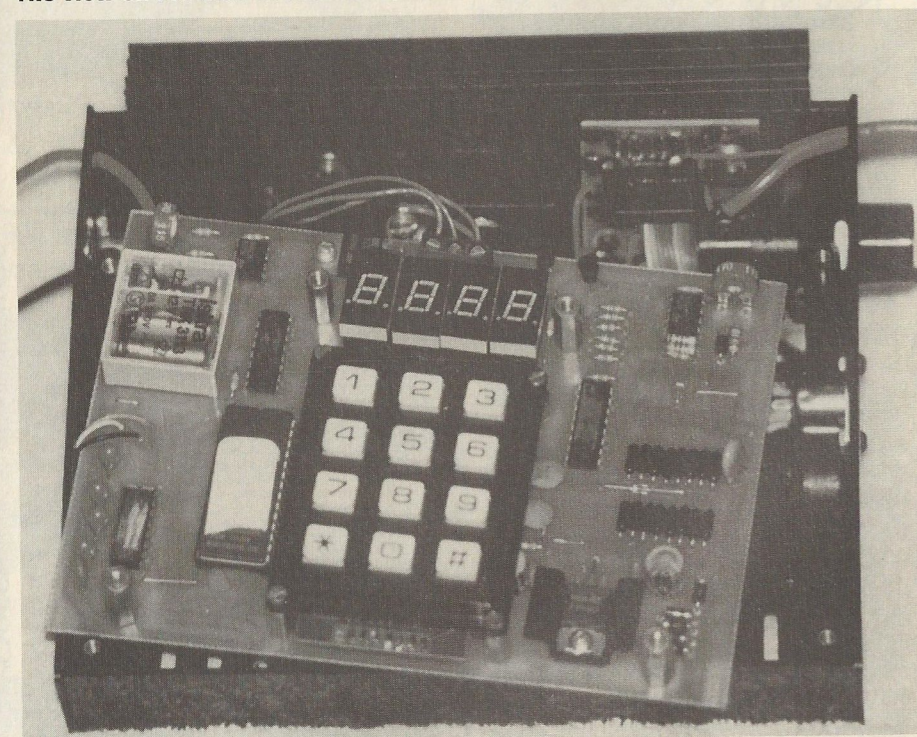
Description

Quite compact, the BMS isn't much larger than an average charger, being housed in a neat black plastic case, with the sloping top housing the digital 4 figure display and a 12 symbol keypad, with the yellow finish nicely contrasting the black key function descriptions. On the right hand side are the positive and negative leads for the nicad pack connections, and a DIN socket, the function of which is to accept the connections to the individual cells (not used when the BMS is used as a basic charger trackside), the 15 amp fuse is also easily accessible on this face.

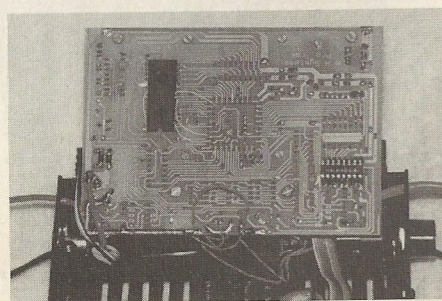
From the left hand side project the leads to connect to the 12v battery or alternatively a



The view on removal of the fascia panel.



Neat and compact construction



smoothed 12-13v mains supply. The charge rate can be adjusted (bear in mind a separate ammeter is needed for this) via an access hole above another DIN socket, this being the connection for a printer, an Epson RX-80 compatible type being required. An internal inspection revealed an internal cooling fan, this being thoughtfully situated in such a way that the discharge circuitry receives its full benefit. The general layout and neat soldering gave a reassuring impression of quality manufacture.

Its Capabilities

- 1 Basic Charger (mode 0).
 - 2 Basic Pack Discharger (mode 1).
 - 3 Cycler (mode 2). Pack charged/rested (duration user programmable)/repeaked/discharged/discharge data sent to printer.
 - 4 Cycler (mode 3). Pack charged/charge data sent to printer/rested/repeaked/discharged/discharge data sent to printer.
- Mode 3 is the basis of the matching process used by the better cell matching experts worldwide.

Initial Tests

If this tester could use the BMS, basically anybody could, since I have never laid a finger on a computer or keyboard in my life! The instruction booklet was clear, comprehensive and well laid out much to my relief! The initial tests were carried out without a printer, the results being correlated by manually running through the figures held in the Pro-Trak's memory. I dare say the majority of users would use it in this fashion. The results were as I hoped because the packs initially tested were all fairly new and were all shown to be well matched in capacity (mAh), voltage and Kj. What was needed were some packs that were known to be suspect to 'put through the mill'.

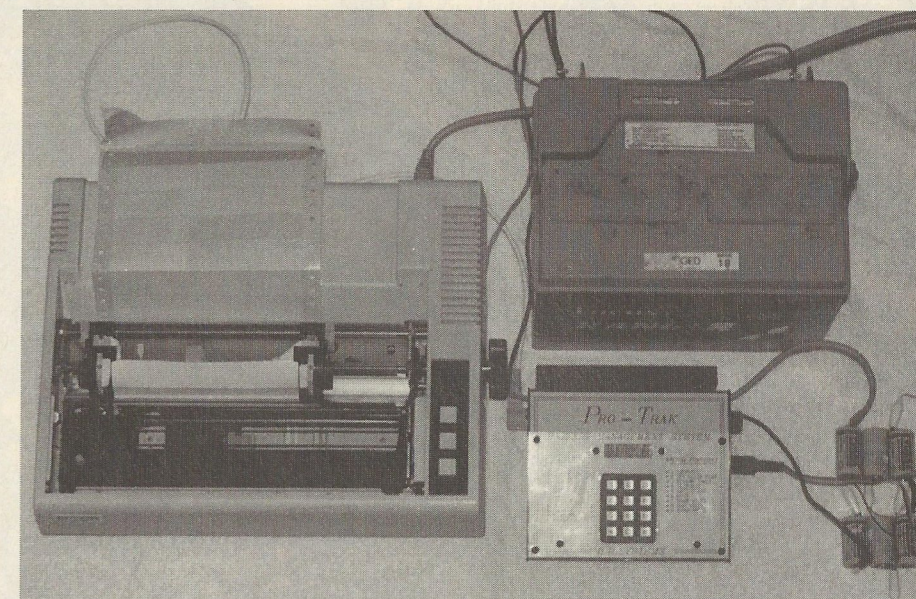
Tests Using A Printer

Not having any packs that could be called 'doubtful' in my possession, I paid a visit to my local battery matching establishment. There I was provided with six packs of cells that had been returned, having been abused by either overcharging, reverse charging or wrongful connections (eg + to + etc!). To aid my purpose (that being to produce some useable matched packs) and to see at a glance what the BMS was capable of, I laid my hands on a printer. Having followed the instructions to the letter, literally everything I asked of it was performed without any hitches.

The most badly damaged cells showed up immediately in that the charge figures were very poor, whilst the discharge figures were appalling! These cells were removed from the packs and, using the information now available to me, the remaining cells were assembled into new packs, the main criteria being the capacity in mAh (the correlation between mAh and discharge time being very close indeed). A point worth noting is that the BMS discharges packs to 6v OR until the weakest cell discharges to 0.1v.

When the 'weeding out' process has been accomplished and the good cells re-matched with similar cells, the discharge cut-off point was

Cell	Time	Cap.	Peak	E/Volt	Cell	Time	Cap.	Peak	E/Volt	Cell	Time	Cap.	Peak	E/Volt	Pack 0	Time	Cap.	Peak	E/Volt
Cell 1	1221	1695	1.66	1.62	Cell 2	1221	1695	1.66	1.63	Cell 3	1229	1706	1.64	1.62	Pack 0	1229	1706	9.93	9.73
Cell 4	1174	1630	1.68	1.63	Cell 5	1217	1690	1.66	1.63	Cell 6	1146	1591	1.66	1.60					
CHARGE DATA																			
Cell 1	Time 558	Cap. K/Joule	E/Volt	Cell 2	Time 558	Cap. K/Joule	E/Volt	Cell 3	Time 556	Cap. K/Joule	E/Volt	Pack 0	Time 556	Cap. K/Joule	E/Volt				
Cell 1	558	1550	7.81	1.00	Cell 2	558	1550	7.68	1.00	Cell 3	556	1544	7.83	0.99	Pack 0	556	1544	46.63	5.88
Cell 4	Time 554	Cap. K/Joule	E/Volt	Cell 5	Time 553	Cap. K/Joule	E/Volt	Cell 6	Time 551	Cap. K/Joule	E/Volt								
Cell 4	554	1538	7.75	0.99	Cell 5	553	1536	7.68	0.96	Cell 6	551	1530	7.60	0.94					



The complete 'home-brew' set up

found to be very close from cell to cell i.e. a sharp 'dump'. Mode 3 was used throughout this process, the end result being three well matched packs.

To produce my matched packs, I went on mAh and discharge times. As it happened, the Kj and voltage figures were also pretty close. With more cells at my disposal, more closely matched packs could have been produced, taking into account the charge time and discharge Kj.

To illustrate the repeatability of the figures obtained, one pack was tested giving the discharge results in chart 1. Having had a day's rest, the same pack was re-tested with the results shown in chart 2.

CHART 1

Cell	1	2	3	4	5	6
End volts	0.99	0.99	1.0	1.01	0.89	1.0
mAh Cap.	1525	1530	1530	1535	1525	1520

CHART 2

Cell	1	2	3	4	5	6
End volts	1.00	1.01	1.01	1.02	0.96	0.98
mAh Cap.	1527	1530	1530	1530	1528	1520



This shot shows the means of individual cell connection.

Conclusions

Dislikes

The 12v leads were rather short. The crocodile clips for the 12v connections were too small for the average battery post. The method of individual cell connection was rather fiddly and also prone to possible errors in the order of attachment (a purpose built tray would alleviate any problems in this area).

Likes

Compact size, ease of use, ability to double as a trackside charger/discharger or as a complete cell analyser in the kitchen, garage or workshop. The price is directly comparable with that of a charger and plain pack discharger purchased separately. The build quality was good and, what is more, it's British! Recommended.

Made by: H.H. Systems, 59 Allendale Crescent, Shiremoor, Newcastle upon Tyne, England.

Distributed by H.H., No.1 Race Supplies and Modelsport, Otley.