

Application Note: Data Logging

Overview:

Our customers have many, and varied, data logging requirements. To facilitate this, the ***E-Meter™***, sold by our sister company Heart Interface as the ***Link 10™***, may be ordered with an optional RS232 computer data port. This port provides once per second updates. The data stream contains all of the information that is available from the front panel, except that the historical information is not available.

Step 1: Capture of Data:

The first step is to capture the ASCII text file so that it can be manipulated. There are several approaches to this task.

1. Direct capture by a computer. Because the data from the E-Meter is in simple ASCII at 9600 baud, (8-N-1), it is easily captured using a serial port of a computer. In order to capture this data, all you will need is standard communications software. In the PC environment, you can use *Procomm™* (DOS), *Terminal™* in *Windows 3.1™* or *Windows for WorkGroups™* or *HyperTerm™* in *Windows 95™* and *Windows NT™*. If you are using a Mac, try *MacTel™*. In all cases, remember that the cable required is a NULL MODEM cable. Common straight through cables with data pairs the same at either end will not work.

You should be aware when using the data connections to the meter that while the shell of the DB-9 connector is not grounded, one data line is at the same potential as Pin #1 of the meter. This means that used in an electric vehicle, it is possible for metal parts of the computer to be at the same potential as the negative (-) of the battery pack being measured. Therefore, to avoid shock hazard in the event of a fault, we recommend the used of an opto-isolator with at least twice the voltage rating of the pack being measured.

2. Capture of the data using a network device, such as a dedicated serial port on a computer or network administered device is possible. The most common type of installation here is where a personal computer with several serial ports, and a modem, is accessed remotely on a dial-up basis. The operator, using PC terminal emulation software such as *Co-session™* or *PC-Anywhere™*, then uses a communications program running under the emulation shell to obtain desired data.
3. Another way to capture data is by using one of *Cruising Equipment's Memory Module™* units. These units will hold up to one megabyte of data and store it to S-RAM which is powered by a lithium battery. Data can be retained in excess of four years. The Memory Module is a good choice where unattended operation is required.

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4. Memory Modules have the additional benefit of onboard data parsing. In other words, the Memory Module will record every data record (one per second), every tenth record (one each 10 seconds), every 60th record (one per minute), or every 600th record (one record each 10 minutes). The Memory Module will record data in one of two ways, operating as a stop when full recording device or as a circular buffer device. In operation, this gives the user the opportunity to capture *either* the first one MB of data *or* the most one MB of data for analysis.

Regardless of the method chosen to accumulate records, at the end of the process you will have a large text file. The next problem is what to do with the text file.

Step 2: Data Import

In order to make the data collected available, the file will need to be closed and named. This process varies depending on the method of collection used.

1. If you have collected data directly, using a PC, simply name and save the text file to a desired directory.
2. If you have used Co-session or PC-Anywhere, as a terminal emulator, and are using a communications package operating under the emulator shell, you will need to name and save the text data file and then perform a file download to the local computer. The data file may be compressed to speed file transfer time using popular data compression software such as Pk Ware's PK-Zip and PK-Unzip. When the file is downloaded to the local computer, and decompressed, if compression was used, it may then be analyzed.
3. If you are using a Memory Module, you need to stop the recording, following the instructions in the Memory Module manual. You then plug a standard serial cable (not a null modem cable!) into the Memory Module.

Next, you will log into the Memory Module which using standard communications software (Procomm, Terminal, HyperTerm, MacTel as described previously). You will be presented with a downloading menu on the local computer when you establish communications with the Memory Module. Note that you will be able to download into your computer at a higher data rate than 9600 if desired. Use the 19.2 KB setting to minimize transfer time. Next, you'll name and save the file to the desired location.

Step 3: Data Analysis

Three common platforms are used for the analysis of the large text files. Let's begin with the most simple.

1. One method, which we use extensively, is to take the text file and simply open it with a current version of Microsoft *Excel*™ for *Windows*. Using the **File, Open**

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commands, you name your data text file. *Excel* will then prompt you through the import process using the **Text Import Wizard**. All you will need to tell *Excel* is that you wish to import comma delimited records and the software will bring up the data into columns. Refer to your E-Meter's manual for the appropriate column headings. You may then highlight desired columns, parse records, and perform any statistical operations necessary for analysis.

2. You may wish to use a database. This is similar to the use of the spreadsheet approach, except that instead of each record being a "row" of a spreadsheet, each record is not an individual record in a database. Database analysis may be desirable if you find your text file is too big for your spreadsheet. Some spreadsheets are limited to graphing only a few thousand data points.
1. The most sophisticated approach is to use a scientific analysis engine such as *LabViews*[™] which provides for complete analysis and multiple chart functions.

Whichever method used, you'll find that data from your **E-Meter / Link 10** will quickly become a cornerstone of your development efforts.

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Data Logging Using Windows –95/98

The E-Meter and Memory Module are specifically designed to be platform independent. In other words, you can retrieve data using whatever computer you have handy, anything from a small Palm Pilot™ to a large mainframe polls multiple satellite transceivers. The only thing you *must remember* is that the computer you're using must be able to capture ASCII text using a communications program looking at a 9600 8-N-1 serial source.

For Windows™ 95/98 Users:

1. Click on the START button. Select PROGRAMS.
2. Select ACCESSORIES. Under ACCESSORIES select HyperTerminal.
3. Once in the HyperTerminal window, click on the Hypertrm.exe icon.
4. HyperTerminal is now open with the Connection Description window inside.
5. Next, enter the name E-METER or MEMORY MODULE and select the icon you want. Click OK.
6. The Phone number window now appears. In this window is a box called "Connect Using". Click on the down arrow button located to the far right of the "Connect Using" dialog box.
7. Select the COM port that your E-Meter or Memory Module is connected to (Usually this is COM1 or COM2). Click OK.
8. The Port Settings box now appears. Set the port to 9600, 8, none, 1, Hardware. This sets the E-Meter/Memory Module script to use 9600 baud communications, 8 data bits, no parity bit, 1 stop bit, and hardware flow control. Click OK.
9. If you are using an E-Meter, data will begin appearing on your screen, as it is reported out of the meter once per second. If you are using a Memory Module, press the space bar twice, and then follow on screen directions to download data.

Note if your computer is 66 MHz clock speed or slower: Users of relatively slow Windows based computers may find occasional errors when downloading large data files from a Memory Module. This is because the Windows program does a lot of "housekeeping" tasks in background. If you are in the midst of downloading data and you see a partial line of data, it is likely because Windows went off and did some housekeeping while in that line. Users of versions of Windows prior to 95 may resolve this minor issue by running Windows in the foreground only mode, as described in your operating system manual. If you are running a slow computer, the drop out issue may only appear when downloading a Memory Module at 19.2 KB. *Don't forget - you will need to change your HyperTerm settings to use the high speed download option and cycle Memory Module power to restore 9600 baud capture from an E-Meter.* More

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robust third party communications software, such as ProComm for Windows 95 may eliminate the problem, as will using a faster computer.

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SUMMARY: E-Meter Data output:

Output Format:

RS232 , 9600 baud ASCII 8-N-1 comma delimited fields with CR/LF record delimiting.

Data Sentence Structure:

Time, KWhrs, Amps, Volts, Ahrs, Peukert Ahrs, Peukert Amps, Time remaining, Bar Graph state, Temperature (degrees C.) **[CR/LF]**

Time is elapsed seconds since last Amp-hour reset. Kilowatt-hours are signed + or -, Amp-Hours are signed + or -, Amps are signed + or -, Volts are positive, time remaining is in hours or tenths of hours.

Peukert Amps and Peukert Amp-hours are compensated for Peukert's equation. These numbers are primarily intended for our development and troubleshooting. Please do not attempt to interpret these numbers unless you are skilled in the art.

The Bar Graph state is indicated by the following integers:

1<20%, 2<40%, 3<60%, 4<80%, 5<100%, 6 = Full (Charged Params met)

If the Low Battery Output is activated, the Bar Graph state is indicated as alpha characters:

A<20%, B<40%, C<60%, D<80%, E<100%, F = Full (Charged Params met)

Pin Out:

The serial connection is via the DB-9 connector on the rear deck of Your Meter. See additional notes on Page 11. The pin connections are as follows:

Pin 2 Receive Data line

Pin 3 Transmit Data line

Pin 5 Ground. This is connected to battery pack (-) being measured by the E-Meter.

The shell of the DB-9 is NOT grounded.