

Modmon Data Format Documentation

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1 Introduction

I want to go over **modmon** data format and make a documentation how to translate and reform to the intuitive, compact, informative data format.

2 Translation

The full dictionary for each columns in **modmon** data format can be found in Appendix (Section 3). In this section, I will go over each columns (without redundant)'s meaning.

2.1 Selected Columns Definition

- **Date** : Date of the experiment
- **Time** : Time of the measurement
- **ChaSt (87)** : Charge state. The signal consists of [1,2,3,4] related to system (or inverter).
- **State (93)** : State. The signal consists of [1,2,3, 100] related to system (or inverter).
- **EBCBt (171)** : EBCB temperature sensor. I found out that not every dataset has this register.
- **MxCP (193)** : Max Charge Power Limit
- **MxDP (194)** : Max Discharge Power Limit
- **EBSen1 (225)** : Sensor that indicate active/inactive string at a given moment. Bit 0 to 12 represents each string and 0 indicate *inactive* and 1 indicate *active*. For example, if all 12 strings are active, it should have all 12 bits with 1 value which is 4095.
- **Current_01 (287)** : There are total 12 current measurements in each file. Since there are 12 strings per the experiment, *Current_01* to *Current_12* are saved in different registers. The full register map can be found in Appendix (Section 3).

- **Voltage_01 (288)** : As same as current, *Voltage_01* to *Voltage_12* are saved in different registers. In Gen 2,3, the string is made by the series connections of 12 modules. Thus, the summation of voltage measurements from all 12 modules (e.g. *Voltage_0101* to *Voltage_0112*) should be as same as this value. For example,

$$Voltage_01 = \sum_{i=01}^{12} Voltage_01(i), \quad (1)$$

for string 1. However, I found out there is a discrepancy between left and right side of the equation less than 1 percent error.

- **Voltage_0101 (557)** : It returns voltage values from String 1 module 1. There are 12 strings and 12 modules per each string. Thus, *Voltage_0101*, *Voltage_0102*, *Voltage_0103* ... *Voltage_1212* are saved in the different registers.
- **Temp_0101 (558)** : As same as voltage measurements, it returns temperature values from String 1 module 1.
- **SoC_0101 (558)** : As same as voltage measurements, it returns SoC values from String 1 module 1.
- **Other columns that I do not classify** :
SA1ESWh - maybe enegy value that we do not use.
SA1PAD - not sure what PAD means.
SA1ESds - not sure what ds means. there are lots of variations of this measurement, such as SA1ESds1, 1-2, 2, 2-2, L1, L1-2, L2, L2-2.

2.2 New Columns to be added

Power and **Energy** columns are added to the new data file. In order to evaluate power and energy, I need to use current, voltage, and time measurements to calculate them. For example, the equations to calculate power of string 1 and power of string 1 module 1 are expressed as,

$$\begin{aligned} Power_01 &= Voltage_01 \times Current_01, \\ Power_0101 &= Voltage_0101 \times Current_01, \end{aligned} \quad (2)$$

For example, the equations to calculate energy of string 1 and energy of string 1 moudle 1 are expressed as,

$$\begin{aligned} Energy_01 &= \int Power_01 dt = \frac{1}{2} \cdot \sum_{i=0}^{n-1} (Power_01[i+1] + Power_01[i]) \times (Time[i+1] - Time[i]), \\ Energy_0101 &= \int Power_0101 dt = \frac{1}{2} \cdot \sum_{i=0}^{n-1} (Power_0101[i+1] + Power_0101[i]) \times (Time[i+1] - Time[i]), \end{aligned} \quad (3)$$

where n is total number of measurements. Energy needs to be saved in two different columnes : charging and discharging depending on the direction of current (or sign of power).

2.3 Total Expected Table Size

Columns List:

8 columns : Date, Time, ChaSt, State, EBCBt, MxCP, MxDP, EBSen1

12 columns × 5 (Vol, Current, power, energy) : 12 string measurements for 4 variables.

12 columns × 12 × 6 (Vol, Temp, SoC, power, energy) : 12 modules measurements per each string for five variables.

Total number : 932 (original data frame 2125 columns)

3 Appendix

Full Dictionary

"Count": "count", "Date": "date", "Time": "time", "87": "ChaSt", "93": "State", "97": "Evt1", "98": "Evt1-2", "118": "W", "121": "SetOp", "139": "Hb32", "140": "Hb32-2", "144": "FWver", "145": "FWcksum", "146": "FWcksum-2", "161": "EBds1", "162": "EBds1-2", "163": "EBds2", "164": "EBds2-2", "169": "EBi1", "170": "EBv1", "174": "EBSoC", "187": "EBt_{max}", "188": "EBt_{max}loc", "193": "MxCP", "194": "MxDP", "199": "RegCtrl", "200": "RegCtrl-2", "201": "SysWSW1", "202": "SysWSW1-2", "203": "SysASW1", "204": "SysASW1-2", "205": "SysFSW1", "206": "SysFSW1-2", "207": "SysWSW2", "208": "SysWSW2-2", "209": "SysASW2", "210": "SysASW2-2", "211": "SysFSW2", "212": "SysFSW2-2", "225": "EBSen1", "226": "EBSen1-2", "227": "EBScont1", "228": "EBScont1-2", "229": "EBSalmsum1", "230": "EBSalmsum1-2", "231": "MBconns", "279": "SA1ESds1", "280": "SA1ESds1-2", "281": "SA1ESds2", "282": "SA1ESds2-2", "283": "SA1ESdsL1", "284": "SA1ESdsL1-2", "285": "SA1ESdsL2", "286": "SA1EDdsL2-2", "287": "Current₀1", "288": "Voltage₀1", "289": "SA1ESStmin1", "290": "SA1ESStmax1", "291": "SA1ESStavg1", "292": "SA1ESStvmin1", "293": "SA1ESStvmax1", "294": "SA1ESStavg1", "295": "SA1ESSoC", "296": "SA1ESWh", "297": "SA1ESSoCmin", "298": "SA1ESSoCmax", "299": "SA1PAD", "300": "SA1PAD-2", "301": "SA2ESds1", "302": "SA2ESds1-2", "303": "SA2ESds2", "304": "SA2ESds2-2", "305": "SA2ESdsL1", "306": "SA2ESdsL1-2", "307": "SA2ESdsL2", "308": "SA2ESdsL2-2", "309": "Current₀2", "310": "Voltage₀2", "311": "SA2ESStmin1", "312": "SA2ESStmax1", "313": "SA2ESStavg1", "314": "SA2ESStvmin1", "315": "SA2ESStvmax1", "316": "SA2ESStavg1", "317": "SA2ESSoC", "318": "SA2ESWh", "319": "SA2ESSoCmin", "320": "SA2ESSoCmax", "321": "SA2PAD", "322": "SA2PAD-2", "323": "SA3ESds1", "324": "SA3ESds1-2", "325": "SA3ESds2", "326": "SA3ESds2-2", "327": "SA3ESdsL1", "328": "SA3ESdsL1-2", "329": "SA3ESdsL2", "330": "SA3ESdsL2-2", "331": "Current₀3", "332": "Voltage₀3", "333": "SA3ESStmin1", "334": "SA3ESStmax1", "335": "SA3ESStavg1", "336": "SA3ESStvmin1", "337": "SA3ESStvmax1", "338": "SA3ESStavg1", "339": "SA3ESSoC", "340": "SA3ESWh", "341": "SA3ESSoCmin", "342": "SA3ESSoCmax", "343": "SA3PAD", "344": "SA3PAD-2", "345": "SA4ESds1", "346": "SA4ESds1-2", "347": "SA4ESds2", "348": "SA4ESds2-2", "349": "SA4ESdsL1", "350": "SA4ESdsL1-2", "351": "SA4ESdsL2", "352": "SA4ESdsL2-2", "353": "Current₀4", "354": "Voltage₀4", "355": "SA4ESStmin1", "356": "SA4ESStmax1", "357": "SA4ESStavg1", "358": "SA4ESStvmin1", "359": "SA4ESStvmax1", "360": "SA4ESStavg1", "361": "SA4ESSoC", "362": "SA4ESWh", "363": "SA4ESSoCmin", "364": "SA4ESSoCmax", "365": "SA4PAD", "366": "SA4PAD-2", "367": "SA5ESds1", "368": "SA5ESds1-2", "369": "SA5ESds2", "370": "SA5ESds2-2", "371": "SA5ESdsL1", "372": "SA5ESdsL1-2", "373": "SA5ESdsL2", "374": "SA5ESdsL2-2", "375": "Current₀5", "376": "Voltage₀5", "377": "SA5ESStmin1", "378": "SA5ESStmax1", "379": "SA5ESStavg1", "380": "SA5ESStvmin1", "381": "SA5ESStvmax1", "382": "SA5ESStavg1", "383": "SA5ESSoC", "384": "SA5ESWh", "385": "SA5ESSoCmin", "386": "SA5ESSoCmax", "387": "SA5PAD", "388": "SA5PAD-2", "389": "SA6ESds1", "390": "SA6ESds1-2", "391": "SA6ESds2", "392": "SA6ESds2-2", "393": "SA6ESdsL1", "394": "SA6ESdsL1-2", "395": "SA6ESdsL2", "396": "SA6ESdsL2-2", "397": "Current₀6", "398": "Voltage₀6", "399": "SA6ESStmin1", "400": "SA6ESStmax1", "401": "SA6ESStavg1", "402": "SA6ESStvmin1", "403": "SA6ESStvmax1", "404": "SA6ESStavg1", "405": "SA6ESSoC", "406": "SA6ESWh", "407": "SA6ESSoCmin", "408": "SA6ESSoCmax", "409": "SA6PAD", "410": "SA6PAD-2", "411": "SB1ESds1", "412": "SB1ESds1-2", "413": "SB1ESds2", "414": "SB1ESds2-2", "415": "SB1ESdsL1", "416": "SB1ESdsL1-2", "417": "SB1ESdsL2", "418": "SB1ESdsL2-2", "419": "Current₀7", "420": "Voltage₀7", "421": "SB1ESStmin1", "422": "SB1ESStmax1", "423": "SB1ESStavg1", "424": "SB1ESStvmin1", "425": "SB1ESStvmax1", "426": "SB1ESStavg1", "427": "SB1ESSoC", "428": "SB1ESWh", "429": "SB1ESSoCmin", "430": "SB1ESSoCmax", "431": "SB1PAD", "432": "SB1PAD-2", "433": "SB2ESds1", "434": "SB2ESds1-2", "435": "SB2ESds2", "436": "SB2ESds2-2", "437": "SB2ESdsL1", "438": "SB2ESdsL1-2", "439": "SB2ESdsL2", "440": "SB2ESdsL2-2", "441": "Current₀8", "442": "Voltage₀8", "443": "SB2ESStmin1", "444": "SB2ESStmax1", "445": "SB2ESStavg1", "446": "SB2ESStvmin1", "447": "SB2ESStvmax1", "448": "SB2ESStavg1", "449": "SB2ESSoC", "450": "SB2ESWh", "451": "SB2ESSoCmin", "452": "SB2ESSoCmax", "453": "SB2PAD", "454": "SB2PAD-2", "455": "SB3ESds1",

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