

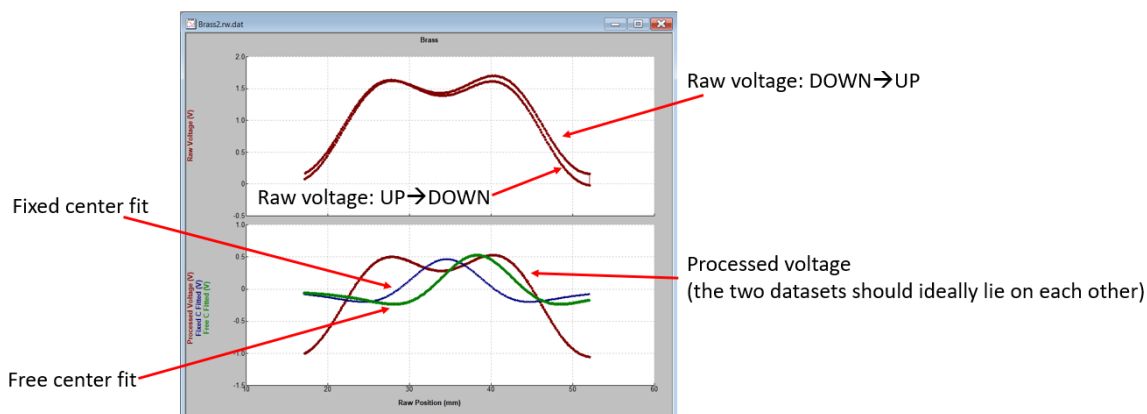


## MPMS3 Application Note 1500-022

### MPMS3 *.rw.dat* file format

This Application Note describes the format of the MPMS3 *.rw.dat* (i.e. ‘raw’) files generated during a DC scan. Harvesting data, in particular the processed voltages, from this file is necessary when performing manual background subtractions.

When viewing the *.rw.dat* file in MultiVu the following pre-formatted window, shown below in Fig. 1, will open:



**Figure 1.** A *.rw.dat* file as viewed in MultiVu.

Each DC scan performed by the MPMS3 actually consists of two *Raw Voltage* scans, one where the transport moves DOWN→UP and the other when the transport moves UP→DOWN. From these two raw scans the drift, which is assumed to be linear over the course of the scan, is calculated and subsequently subtracted to create the *Processed Voltage* data, which has also been vertically shifted to center the waveform around  $V=0$ . Finally, the Processed Voltage is fit assuming both a free and fixed sample center producing the *Free C Fitted* (green) and *Fixed C Fitted* data (blue).

Note, the data shown in Fig. 1 is a brass sample holder with quartz braces measured at 7 T and therefore presents a relatively large background signal that cannot be well-fit assuming a simple well-localized dipole moment. These types of waveforms must first be subtracted from sample measurements such that the data can be properly fit to calculate the magnetic moment, as described in Application Note 1500-023.

Upon opening the *.rw.dat* file in, e.g. Notepad, one will see what follows in Fig. 2 below.

File Edit Format View Help

```

[Header]
; DC Raw Data File (default extension .raw)
; Copyright 2012, Quantum Design, Inc. All rights reserved.
TITLE,Brass
FILEOPENTIME,3733739417.85515,04/24/2018,1:50 pm
BYAPP,SQUID AC,0.9.1.0
INFO,MPMS3 Option Release 1.1.16 Build 388, Release 2.3.4.15,APPHAME
INFO,TCI131,COIL_SERIAL_NUMBER
INFO,0,MOMENT_UNITS
INFO,Brass,SAMPLE_MATERIAL
INFO,Brass,SAMPLE_COMMENT
INFO,,SAMPLE_MASS
INFO,,SAMPLE_VOLUME
INFO,,SAMPLE_MOLECULAR_WEIGHT
INFO,,SAMPLE_SIZE
INFO,,SAMPLE_SHAPE
INFO,Brass,SAMPLE HOLDER
INFO,Standard,SAMPLE HOLDER_DETAIL
INFO,66,SAMPLE_OFFSET
DATATYPE,COMMENT,1
DATATYPE,TIME,2
STARTUPAXIS,X,3
STARTUPAXIS,V1,4
STARTUPAXIS,V2,5
STARTUPAXIS,V2,6
STARTUPAXIS,V2,7
STARTUPAXIS,V3,8
STARTUPAXIS,V3,9
RECORDS,FROM_TO_RECORDS,1,608
[Data]
Comment,Time Stamp (sec),Raw Position (mm),Raw Voltage (V),Processed Voltage (V),Fixed C Fitted (V),Free C Fitted (V)
;low temp = 299.992594228516 K;high temp = 300.004364013672 K;avg. temp = 299.999684651693 K;low field = 69999.8203125 Oe;high field = 69999.8203125 Oe;drift = 0.033
,3733739405.43692,17.2039661407471,0.07922985782027245,-1.00175189971924
,3733739405.45692,185,0,69999.8203125,163,-3829,49
;3 Time Stamp Position Raw Voltage Processed
,3733739405.49692,1 DOWN-UP DOWN-UP UP-DOWN
,3733739405.51692,17.8948287963867,0.138406112790108,-0.94551774520874
,3733739405.53692,18.0681037902832,0.157807298554047,-0.926587104797363
    
```

**Main Header**

**Column Labels**

**Scan Header (DOWN-UP)**

**Start of first combined DC scan measured at 69999 Oe**

The Scan Headers separate the DOWN-UP and UP-DOWN scans

The scan headers also include information regarding the temperature and field at the start and end of each scan. These can be used to identify which temperature/field each scan was acquired at.

Figure 2. A .raw.dat file as viewed in Notepad.

The data file begins with a general header [Header] containing the indicated information relevant to the measurement as a whole. The data recorded during the DOWN-UP and then UP-DOWN DC scans is then saved after the primary [Data] header. Additionally, between each DOWN-UP and UP-DOWN scan is a header specific to the following scan and referred to as the *Scan Header* in this document. The *Scan Header* contains the following information:

**low temp [K]:** The lowest temperature recorded during the combined DC scan

**high temp [K]:** The highest temperature recorded during the combined DC scan

**avg. temp [K]:** The average temperature recorded during the combined DC scan

**low field [Oe]:** The lowest magnetic field recorded during the combined DC scan

**high field [Oe]:** The highest magnetic field recorded during the combined DC scan

**drift [V/s]:** The amount of drift between the DOWN-UP and UP-DOWN scans

**slope [V/mm]:** The linear slope between the DOWN-UP and UP-DOWN scans

**squid range:** The SQUID range [1, 10, 100, or 1000] used during the combined DC scan

**\*Note, early versions of MultiVu erroneously defaulted the range to a fixed value of 1000. This issue has been resolved in the latest version of MultiVu (2.3.4.15 or later).**

**given center [mm]:** The center position as set during the sample installation wizard

**calculated center [mm]:** The calculated center position from the *Free C Fitted* data

**amp fixed [V]:** The amplitude of the *Fixed C Fitted* data

**amp free [V]:** The amplitude of the *Free C Fitted* data

The DOWN→UP and UP→DOWN scans are separated by the same *Scan Header*, as shown in Fig. 3.

```

,3733739409.27692,50.3065528869629,0.240867033600807,-0.968280971050262
,3733739409.29692,50.4796524047852,0.228624492883682,-0.981193363666534
,3733739409.31692,50.6522402531738,0.212861895561218,-0.00262300121384
,373 Time Stamp 1,2,50 Position 15,0,2 Raw Voltage 15,-1 Processed 18
,373 Time Stamp 1,2,50 DOWN→UP 15,0,-1 DOWN→UP 15,-1 DOWN→UP 15,-1
,3733739409.37692,51.1093115234375,0.181802308308162,-1.03114008803503
,3733739409.39692,51.3408660888672,0.176189830839935,-1.03696072101593
,3733739409.41692,51.5127601623535,0.167493373155594,-1.04632234573364
,3733739409.43692,51.6846542358398,0.163953840732574,-1.05052697658359
,3733739409.45692,51.8568954467773,0.160544738173485,-1.05460262298584
,3733739409.47692,52.028621673584,0.156369403004646,-1.0594425201416
;low temp = 299.992584228516 K;high temp = 300.004364013672 K;avg. temp = 299.999684651693 K;low field = 69999.8203125 Oe;high field = 69999.8203125 Oe;drift = 0.033
,3733739410.57651,51.0284461975098,-0.0210422910749912,-1.05834090709686
,3733739410.57651,51.0284461975098,-0.0210422910749912,-1.05834090709686
,373 Time Stamp 1,1,51 Position 15,0,1 Raw Voltage 1665,-1 Processed 1641
,373 Time Stamp 1,1,51 UP→DOWN 15,0,-1 UP→DOWN 15,0,-1 UP→DOWN 15,0,-1
,3733739410.63651,51.1575889587402,0.01097778583765,-1.02969074249268
,3733739410.67651,50.9846534729004,0.0233183670789003,-1.01801943778992
    
```

**Figure 3.** A .rw.dat file as viewed in Notepad indicating the transition between the DOWN→UP and UP→DOWN scans.

After the completion of the raw DOWN→UP and UP→DOWN scans the *Fixed C Fitted and Free C Fitted* data is recorded, as shown below in Fig. 4.

```

,3733739414.39651,18.9412078857422,0.346416085958481,-0.81892067193985
,3733739414.41651,18.768102645874,0.324557483196259,-0.84144914150238
,3733739414.43651,18.5960330963135,0.30130198597908,-0.865370512008667
,373 Time Stamp 1,1,18 Position 166,0,1 Raw Voltage 1447,-1 Processed 797394
,373 Time Stamp 1,1,18 UP→DOWN 166,0,1 UP→DOWN 166,0,1 UP→DOWN 166,0,1
,3733739414.49651,18.079177022124,0.292523898124695
,3733739414.51651,17.9070682525635,0.225200474262238,-0.944138109683991
,3733739414.53651,17.734655380249,0.208450004458427,-0.961555778980255
,3733739414.55651,17.5615520477295,0.193054020404816,-0.977621614933814
,3733739414.57651,17.389310836792,0.18227519094944,-0.989066958427429
,3733739414.59651,17.2168960571289,0.167814344167709,-1.00419497489929
,3733739415.58447,17.1299991607666,-0.0818874016404152,-0.0622999221086502
,3733739415.60447,17.3050003051758,-0.0841386169195175,-0.0634807795286179
,3733739415.62447,17.4799995422363,-0.0864673107862473,-0.0647071450948715
,3733739415.64447,17.6550006866455,-0.0888748317956924,-0.0659807473421097
,37337 Time Stamp 1,17,18 Position 166,0,1 Fixed Center 7994575,-0.6 Free Center 7398
,37337 Time Stamp 1,18,18 DOWN→UP 166,0,1 DOWN→UP 166,0,1 DOWN→UP 166,0,1
,3733739415.70447,18.1000000000000,-0.093020200000000,0.0941803,-0.070000000000000
,3733739415.72447,18.3549995422363,-0.0993154495954514,-0.0715846344828606
,3733739415.74447,18.5300006866455,-0.102131716907024,-0.073122650384903
,3733739415.76447,18.7049999237061,-0.105030782520771,-0.0747194960713386
    
```

**Figure 4.** A .rw.dat file as viewed in Notepad indicating the transition between the raw/processed data and the fixed and free center fits.

Finally, a *Scan Header* is used to then delineate the transition to a new combined DC scan, as shown below in Fig. 5.

```

,3733739419.44447,50.9049987792969,-0.0965821146965027,-0.200150743128689
,3733739419.46447,51.0799980163574,-0.0939312949776649,-0.195973634719849
,3733739419.48447,51.2549980163574,-0.09168008312949776649,-0.191796324719849
,373 Time Stamp 1,51,4 Fixed Center 6024,-1 Free Center 5845
,3733739419.52447,51.4299980163574,-0.089428968008312949776649,-0.187619014719849
,3733739419.54447,51.7799987792969,-0.0841386392712593,-0.178885415196419
,3733739419.56447,51.9549980163574,-0.0818874016404152,-0.174605295062065
;low temp = 299.994750976502 K;high temp = 300.004516601562 K;avg. temp = 300.000593397352 K;low field = 43976.40234375 Oe;high field = 43976.40234375 Oe;drift = -0.
,3733739466.72577,17.204309463501,0.0275495983660221,-0.598500609397888
,3733739466.74577,17.3763790130615,0.0319595411419868,-0.59317378177643
,3733739466.76577,17.5493106842041,0.0407839491963387,-0.58345118198395
,3733739466.78577,17.7223106842041,0.0447839491963387,-0.5737306622277869
,3733 Time Stamp 1,17,18 Position 18,0,4 Raw Voltage 18,-0,1 Processed 13
,3733 Time Stamp 1,18,18 DOWN→UP 18,0,4 DOWN→UP 18,0,4 DOWN→UP 18,0,4
,3733739466.84577,18.2403450012207,0.0763042494654655,-0.544247031211853
,3733739466.86577,18.4131031063177,0.080678037066164,-0.530054317114470
    
```

**Figure 5.** A .rw.dat file as viewed in Notepad indicating the transition between the raw data recorded for two different magnetic fields

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