**Nanonis Binary File Format (3ds) Version 1**

A Nanonis binary file consists of an ASCII header followed by the binary experiment data.

LabVIEW routines to load and save binary data files (3ds) can be found in the Programming Interface.  
A reference implementation for importing 3ds data into Matlab or Octave can be found in *[load3ds.m](mk:@MSITStore:C:\\Program%20Files%20(x86)\\Nanonis%20V45\\SPM%20Controller\\Nanonis%20SPM%20Controller%20Help.chm::/Concepts/LoadRoutine3ds.html)*.

**Header**

The header consists of key-value pairs separated by an equal sign ('='). Some keys are mandatory (see list below), but arbitrary items can be added at will. An example of a key-value pair is (without the single quotes): 'Grid dim="24 x 24"'. The value is enclosed by double quotes if it contains spaces.  
The header is finalized by a line containing the text ':HEADER\_END:' followed by the windows end of line characters CR/LF (carriage return/line feed; ASCII codes 0D and 0A). The following keys are defined (required) in *version 1* of the binary file format.

|  |  |
| --- | --- |
| Grid dim | Dimension of the grid in number of points. Format is 'Nx x Ny' with Nx = Number of points in x, Ny = Number of points in y. |
| Grid settings | Grid position and dimension in physical units (m). Format is 'Cx;Cy;W,H,A' with Cx = grid center x, Cy = grid center y, W = grid width, H = grid height, A = angle. Cx, Cy, W, H are in meters (m), A in degrees (deg). |
| Sweep Signal | Name of the sweept parameter. This is a string, usually a signal name followed by its units in brackets. Example: 'Bias (V)'. |
| Fixed parameters | List of required parameters. These are stored at the beginning of each experiment. Usually the fixed parameters are 'Sweep Start' and 'Sweep End', i.e. the limits of the sweep signal. |
| Experiment parameters | Additional parameters stored for each experiment. These can contain the position where the experiment is taken ('X (m)', 'Y (m)', 'Z (m)') and other parameters. It's recommended to store at least the Z position as a parameter as this can be used to reconstruct the topography afterwards. |
| # Parameters (4 byte) | Total number of parameters stored with each experiment (= number of fixed parameters + number of experiment parameters). Each parameter is stored as a single precision floating point number using 4 bytes (big-endian). |
| Experiment size (bytes) | Size of experiment data in bytes. Each floating point number uses 4 bytes. When acquiring 1 channel forward and backward, 256 points, this will be 2 x 256 x 4 bytes = 2048 bytes. |
| Points | Number of acquired points in the experiment (e.g. bias spectroscopy). |
| Channels | Channels acquired in the experiment, separated by semicolons (';'). When acquiring data forward and backward 2 channels will be listed. Example: 'Current (A);Current [bwd] (A)'. |
| :HEADER\_END: | End of header. |

**Binary Data**

The binary data begins after the header. All data is stored in 4 byte big endian floats with the most significant bit (MSB) first.  
The experiments aren't separated, all data is written into the file continuously. Each experiment starts with the fixed parameters, followed by the experiment parameters and the experiment data (Channels one after the other). The size of the experiment data is defined in the header so it's easy to read a specific experiment. From the start of the binary data an experiment including the fixed and experiment parameters always takes (# Parameters) \* 4 + (Experiment size) bytes.

**Example**

The header of a binary file could look like follows:

**Grid dim="24 x 24"  
Grid settings=0.000000E+0;0.000000E+0;6.880776E-9;6.880776E-9;-2.244028E+1  
Sweep Signal="Bias (V)"  
Fixed parameters="Sweep Start;Sweep End"  
Experiment parameters="X (m);Y (m);Z (m);Z Offset (m);Settling time (s);Integration time (s)"  
# Parameters (4 byte)=8  
Experiment size (bytes)=2048  
Points=256  
Channels="Current (A);Current [bwd] (A)"  
Experiment="Grid Spectroscopy"  
Date="30.08.2006 14:52:45"  
User=user1  
:HEADER\_END:**

continued by, in hexadecimal representation:  
  
**0d 0a c0 00 00 00 40 00 00 00 b0 f6 18 55 b1 94 18 42 b0 84 7c 66 00 00 00 00 39 51 b7 17 38 d1 b7 17 ae ca c3 f0 ae c6 60 e3 ae c2 31 bf ae bf 5a a3 ae c5 af f1 ae be e8 94 ae ba 8e 31 ae b7 d9 79 ...**  
where 0d 0a is the end of line after the :HEADER\_END:. Then, c0 00 00 00 (= -2) is the first fixed parameter (Sweep Start) and so on. 38 d1 b7 17 (=1E-4) corresponds to the last parameter (Integration time (s)). After that 256 values of the first data channel (Current (A)) will follow, starting with ae ca c3 f0 (= -9.2207E-11). Next will be 256 values of the second data channel (Current [bwd] (A)). As no more channels were acquired this will finalize the first experiment and the data will continue with the parameters of the 2nd experiment.

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