Last Updated: October 19, 2012

Data Format Documentation

Instrument: Micro rain radar 2nd generation (MRR2), MC3E Field Campaign

The MRR2 data set is contained within daily compressed tar archives. The daily archive is named with the following convention,

mrr_mc3e_[latitude_longitude]_[date].tar.gz

where [latitude_longitude]=geographic location of instrument
(e.g., N363442.07_W0972640.90 is North 36°34'42.07" and West 97°26'40.90")
[date] = YYYYmmDD (e.g., 20110422)

and consists of ASCII formatted files containing measurements of the received spectral power and parameters derived from the measurements.

During MC3E the MRR2 was located adjacent to the NOAA S-band and UHF profilers and Parsivel at the SGP Central Facility.

The following files are contained within the tar archive:

- *.raw: (i.e., raw data or raw spectrum) raw mean spectral power received by the radar over 10 seconds for each height step
- *.pro: (i.e., processed or instantaneous data) spectral reflectivity corrected for noise and attenuation, drop size distribution, spectral drop density, fall velocity, attenuation, radar reflectivity, and integral rainfall parameters (e.g., rain rate, liquid water content) derived from one raw spectrum (methods described in Peters et al. 2005 and Peters et al. 2010)
- *.ave: (i.e., averaged data) contains the same parameters as the processed data derived except from multiple raw spectra integrated over 60 seconds

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Format of each file in MRR data set:

Level 0: raw spectrum data (*.raw)

Format: ASCII

Format of each line:
SEE APPENDIX

Level 1: processed or instantaneous data (*.pro)

Format: ASCII

Format of each line:
SEE APPENDIX

Level 2: averaged data (*.ave)

Format: ASCII

Format of each line:
SEE APPENDIX

References:

Peters, Gerhard, Bernd Fischer, Hans Münster, Marco Clemens, Andreas Wagner, 2005: Profiles of Raindrop Size Distributions as Retrieved by Microrain Radars. *J. Appl. Meteor.*, **44**, 1930–1949.
doi: http://dx.doi.org/10.1175/JAM2316.1

Peters, Gerhard, Bernd Fischer, Marco Clemens, 2010: Rain Attenuation of Radar Echoes Considering Finite-Range Resolution and Using Drop Size Distributions. *J. Atmos. Oceanic Technol.*, **27**, 829–842.
doi: http://dx.doi.org/10.1175/2009JTECHA1342.1

APPENDIX

The pages included in this Appendix are taken from the MRR-2 User Manual (METEK GmbH 2008) with expressed written consent of METEK GmbH.

METEK GmbH, 2008: MRR-2 Micro rain radar User Manual. METEK GmbH, Elmshorn, Germany, 46 pp.

6.3 Instantaneous and averaged data

6.3.1 Format description

Instantaneous and averaged data are archived in two separate directory structures (see chapter 7.1.2 Data Recording on page 40). Optional recording of so called raw data, which represent the unprocessed measuring data of the MRR-2, is only useful for special purposes.

The data format is human readable ASCII text. Each data set consists of one line. The order of the data lines and the used identifiers are listed below:

Identifier	Meaning	Unit	Remark
MRR	*Header Line*	n.A.	
H	*Height*	m	
TF	*Transfer Function*	dimensionless	
F*nn*	*Spectral Reflectivities*	dB	10·log ?$_{nn}$ with ?$_{nn}$ in m^{-1} *nn* from min(*h*) to max(*h*) [3]
D*nn*	*Drop Size*	mm	Center of size class
N*nn*	*Spectral Drop Densities*	m^{-3}mm^{-1}	$N(D_{nn})$ [3]
PIA	*Path Integrated Attenuation*	dB	
Z	*Radar Reflectivity*	dBZ	$10\log\left(\sum_{nn=\min(h)}^{nn=\max(h)} N(D_{nn})D_{nn}^{6}\right)$ *nn* from min(*h*) to max(*h*)
z	*Attenuated Radar Reflectivity*	dBZ	Z-PIA
RR	*Rain Rate*	mm h^{-1}	
LWC	*Liquid Water Contents*	g m^{-3}	
W	*Fall Velocity*	m s^{-1}	

[1] *See MRR-Physical Basics for details*.

The measured data are displayed in lines following the header. For each measured variable there is one line starting with a 3-character identifier of the variable. Each line represents a profile of this variable, i.e. a function versus height. Each data entry is 7 characters wide. Height is running from left to right

[3] *See MRR-Physical Basics for details*.

in increments according to the chosen height resolution of the MRR. Invalid or not calculable values are coded as 7 consecutive space characters. Space characters–at the end of a line are omitted in order to save disk space. So lines can have different lengths although representing the same number of height steps.

MRR – Header Line

Entries common to instantaneous and averaged data:

The header line marks the beginning of a data set. It starts with the identifying string ”MRR“, a space character and a date/time stamp.

The date/time stamp consists of 12 digits (format *YYMMDDhhmmss*), a

single space character and the name of the time zone. This name starts with the string „UTC“ and is optionally followed by an offset value (format ±*hh* or ±*hhss*).

The end of the header line shows a data quality parameter consisting of the identifying string “MDQ”, a single space character and a 3digit number between 0 and 100. It is the percentage of valid spectra collected during the averaging interval. Spectra can be invalid due to saturation of the AD converter – caused either by extreme precipitation or by some interference.

Entries only in averaged data:

Averaging time in seconds (“AVE”), height resolution in meters (“STP”), height of the ground level above sea level in meters (“ASL”), sampling rate (“SMP”) of the RADAR signal in the time domain (unit: Hz), parameters for the automatic noise level adjustment (“NF0” and “NF1” without unit), version number of the MRR Service (“SVS”), version number of the MRR firmware (“DVS”), serial number of the MRR (“DSN”) and the calibration constant (“CC”).

Each of the parameters in the header line starts with a delimiting space character, the 3-character identifier as shown above in the parentheses and a field of 6 characters for the numerical value (except of the serial number, which can consist of up to 10 numeric characters between 0 and 9).

Example (Each entry of the header line is shown in a separate line of the table) :

MRR*090612040200 UTC	The header line dates from June 12th, 2009, 4:02 AM, UTC.
AVE****60	Averaging time is 60 seconds.
STP****35	Height resolution is 35 meters.
ASL***147	The radar is sited 147 meters above sea level.
SMP*125e3	Sampling rate is 125,000 Hz.
NF0*1.000	Noise level 0 set to 1.000 (used only in older versions).
NF1*0.000	Noise level 1 set to 0.000 (used only in older versions).
SVS*5.20	Version number of the MRR Service is 5.20.
DVS*5.10	Version number of the MRR firmware is 5.10.
DSN*020704	Serial number of the MRR is 020704.
CC*2066000	Calibration constant is 2066000.
MDQ*100	Percentage of valid spectra is 100.

H - Height

Argument of the following data profiles corresponding to the settings described in chapter 6.2.3, page 20, and chapter 6.2.4, page 23. The units are meters above the radar system.

TF - Transfer Function

To each height step a value of the Transfer Function is assigned by which raw data are divided.

Fnn with nn from 0 to 63 - FFT Spectra

Each line represents a profile of spectral reflectivity corresponding to the spectral bin *nn*. As **Fnn** is corrected for the receiver noise floor negative values can occur, if the signal to noise ratio is low. These entries cannot be presented in the logarithmic domain and are replaced by space characters.

Dnn with nn from min(h) to max(h) - Drop Sizes

The drop size is described by the diameter of an equivolumic sphere. The spectral bins of drop numbers are of variable width in the size domain (in contrast with spectral bins in the frequency- and velocity-domain). In addition, the

widths of the size bins are slightly height dependent. Therefore the assignment of frequency-bin-index nn to diameter D is listed explicitly for each bin and height. The center of each size class is displayed.

Nnn with nn from min(h) to max(h) - Spectral Drop Densities

With the knowledge of the frequency of the Doppler-shift the calculation of the corresponding drop fall velocity is possible (equation 1.4.3.2 in MRR Physical Basics). Thus each FFT-line stands for a drop size interval. Chapter 2 in the Physical Basics shows how to derive from the received spectral power the number of drops for this drop size class, and finally – by divison through the variable class width – the spectral drop densities.
Only a sub-set of all 64 spectral bins is considered for the calculation. The lower (min(h)) and upper limit (max(h)) depends on the height as described in MRR Physical Basics (Fig. 7).
In case of negative values of Fnn negative drop number densities are calculated. Although they have no physical meaning they are retained in order to avoid statistical biases.

PIA - Path Integrated Attenuation [1)]

The two-way Path integrated attenuation by rain drops is calculated as described in chapter 3.2 MRR-Physical Basis and is used for correction of Nnn, Z, RR and LWC.

z - Attenuated Radar Reflectivity[2)]

z is the radar reflectivity factor (see chapter 3.1 MRR-Physical Basics) without attenuation correction

Z - Radar Reflectivity[2)]

Z is the radar reflectivity factor (see chapter 3.1 MRR-Physical Basics)

RR - Rain Rate[2)]

RR is the rain rate (see chapter 3.3 MRR-Physical Basics)

LWC - Liquid Water Content[2)]

LWC is the liquid water content (see equation 3.2.1 MRR-Physical Basics)

[2)] *In case of low signal to noise ratio negative values can occur. Although they have no physical meaning they are retained in order to avoid statistical biases*.

W - Fall Velocity

W is the characteristic falling velocity.
(First Moment of the Doppler spectrum, see chapter 3.4 MRR-Physical Basics).

The width of velocity-bins can be derived from the maximum number of height steps, the sampling rate (as shown in the header line) and the wave length of the RADAR signal. 32 height steps and 64 lines per step are calculated. For a sampling frequency of 125 kHz and a transmit frequency of 24.15 GHz, the resolution of the fall velocity can be calculated as:

$$\frac{125\ \text{kHz}}{2}\,\frac{1}{32\cdot 64}\,\frac{299700\ \text{km/s}}{2\cdot 24\ \text{GHz}} = 0.1905\ \text{m/s}$$

6.3.2 Example

Instantaneous and **averaged data** files have the same structure except of the header lines. The part of the header line, which is underlined in the example below, is only present in <u>averaged data</u>:

```
MRR 090612040200 UTC AVE    60 STP    35 ASL     0 SMP 125e3 NF0 1.000 NF1 0.000 SVS 5.20 DVS 5.10 DSN 020704 CC 2066000 MDQ 100
H      35     70    105    140    175    210    245    280    315    350    385    420    455    490    525    560    595    630    665    700    735    770    805    840    875    910    945    980   1015   1050   1085
TF  0.0115 0.0420 0.0999 0.1756 0.2542 0.3340 0.4255 0.5324 0.6030 0.6757 0.7565 0.7942 0.8366 0.8778 0.8914 1.0000 0.9683 0.9243 0.8838 0.8904 0.9040 0.8759 0.8538 0.8433 0.8346 0.7807 0.7749 0.7524 0.6890 0.6406 0.4225
F00 -65.29 -74.53 -82.05 -87.75 -90.83 -91.33 -91.50 -94.20              -106.26        -90.26 -89.09 -89.00 -91.35 -92.31              -97.45 -98.65        -91.66 -89.67 -82.65 -82.43 -83.39 -82.92 -82.32 -87.28 -83.34
F01 -66.94 -76.22 -84.02 -89.60 -92.92 -90.74 -90.22 -91.96 -98.48 -93.34 -92.11 -94.45 -86.71 -86.55 -86.06 -87.13 -86.23 -86.12 -87.00 -87.60 -89.90 -89.54 -83.82 -83.08 -80.77 -80.17 -79.91 -80.16 -80.55 -85.48 -84.48
F02 -72.75 -81.78 -88.82 -93.49 -95.53 -90.61 -89.73 -90.07 -91.23 -89.44 -88.96 -88.11 -84.14 -84.20 -83.97 -84.47 -83.51 -82.95 -83.39 -83.78 -85.48 -82.83 -80.38 -80.66 -79.75 -79.03 -78.00 -77.93 -79.20 -84.64 -84.43
F03 -82.02 -88.54 -91.72 -95.03 -94.67 -90.35 -89.07 -89.06 -89.11 -88.73 -87.65 -86.96 -83.49 -83.15 -83.76 -84.45 -83.31 -82.42 -82.31 -81.95 -82.49 -80.82 -79.11 -79.94 -79.96 -78.79 -77.68 -78.09 -79.97 -85.73 -84.42
F04 -88.10 -89.28 -91.25 -93.59 -93.01 -89.24 -88.55 -88.52 -87.96 -87.75 -86.36 -86.62 -83.91 -83.20 -84.08 -84.65 -83.34 -82.21 -81.64 -81.08 -80.83 -80.01 -78.92 -79.43 -79.85 -78.92 -78.32 -79.59 -81.30 -87.44 -89.43
F05 -87.30 -88.16 -90.08 -91.37 -90.76 -87.91 -87.93 -88.12 -87.23 -86.03 -85.55 -85.93 -83.96 -83.56 -83.46 -83.48 -83.08 -81.79 -80.80 -80.48 -80.31 -80.04 -79.39 -79.69 -79.70 -79.05 -79.05 -80.49 -81.83 -92.29
F06 -86.28 -87.67 -89.08 -89.78 -89.56 -87.00 -86.86 -87.26 -86.60 -84.90 -84.87 -85.42 -83.82 -83.16 -81.80 -81.73 -82.05 -81.64 -80.52 -80.39 -80.10 -80.05 -79.87 -79.89 -79.57 -79.54 -79.82 -80.68 -81.55 -91.37
F07 -85.61 -87.55 -87.62 -87.87 -88.59 -86.53 -85.65 -85.65 -85.22 -84.25 -84.12 -84.48 -83.35 -82.33 -80.94 -80.79 -81.24 -81.80 -81.09 -80.80 -80.21 -79.90 -80.26 -80.11 -80.14 -80.32 -80.92 -81.36 -80.73 -86.27 -90.26
F08 -85.09 -86.74 -85.56 -85.78 -87.12 -85.88 -84.82 -84.31 -83.53 -83.16 -83.51 -83.70 -82.61 -81.83 -80.95 -80.77 -81.04 -81.61 -81.21 -81.00 -80.65 -79.74 -80.34 -80.91 -81.45 -81.12 -81.86 -83.43 -80.90 -83.80 -86.63
F09 -83.82 -85.29 -84.11 -84.49 -85.50 -84.67 -83.86 -83.45 -82.85 -82.34 -82.85 -83.29 -82.07 -81.43 -80.82 -80.91 -81.09 -81.14 -80.36 -80.60 -80.82 -79.78 -79.96 -80.97 -81.79 -81.54 -81.74 -85.51 -83.05 -86.41 -87.24
F10 -81.72 -83.85 -83.09 -83.53 -84.12 -83.04 -82.34 -82.48 -82.97 -81.99 -81.72 -82.26 -81.23 -80.89 -79.95 -80.47 -80.97 -80.60 -79.69 -80.18 -80.62 -80.34 -80.30 -80.81 -81.04 -81.24 -81.55 -86.03 -87.40        -86.95
F11 -80.23 -82.49 -81.94 -82.30 -82.87 -81.75 -81.02 -81.68 -82.53 -81.59 -80.59 -80.79 -80.37 -80.35 -79.23 -79.76 -80.65 -80.37 -79.30 -79.57 -80.19 -80.93 -79.99 -80.16 -80.66 -80.97 -82.35 -85.89 -84.87-101.37 -83.71
F12 -79.40 -81.17 -80.57 -81.10 -81.90 -80.83 -80.14 -80.97 -81.54 -80.92 -79.88 -79.77 -79.65 -79.78 -79.11 -79.41 -79.88 -79.90 -78.92 -79.10 -79.78 -80.83 -79.01 -78.79 -80.08 -80.50 -82.59 -84.83 -81.59 -86.14 -78.92
F13 -78.57 -79.85 -79.34 -80.17 -80.79 -79.95 -79.19 -79.97 -80.56 -79.90 -79.10 -79.05 -78.80 -78.77 -78.83 -79.30 -79.17 -79.27 -78.68 -79.00 -79.44 -80.03 -78.76 -78.40 -79.50 -80.26 -81.78 -83.31 -80.78 -81.78 -74.26
F14 -77.86 -78.66 -78.36 -79.29 -79.47 -79.02 -78.43 -79.04 -79.33 -78.74 -78.19 -78.20 -77.69 -77.59 -78.06 -78.72 -78.69 -78.80 -78.75 -79.12 -79.01 -79.18 -78.82 -78.63 -79.50 -80.22 -80.71 -81.93 -79.66 -76.73 -69.46
F15 -77.06 -77.59 -77.41 -78.22 -78.28 -77.92 -77.74 -78.16 -78.00 -77.48 -77.22 -77.24 -76.68 -76.54 -76.80 -77.43 -77.98 -78.33 -78.52 -78.87 -78.50 -78.60 -78.48 -78.32 -79.13 -79.11 -78.99 -80.89 -77.10 -71.53 -65.20
F16 -75.62 -76.37 -76.39 -77.05 -77.13 -76.54 -76.42 -77.07 -76.64 -76.07 -76.25 -76.30 -75.84 -75.36 -75.42 -76.32 -77.01 -77.52 -77.90 -78.21 -77.66 -77.64 -77.62 -77.52 -77.96 -77.19 -77.11 -78.89 -73.66 -66.92 -61.51
F17 -74.28 -75.27 -75.46 -76.15 -76.17 -75.52 -75.10 -76.04 -75.61 -74.93 -75.36 -75.26 -74.86 -74.28 -74.56 -75.66 -76.04 -76.46 -76.79 -77.19 -76.41 -76.18 -76.40 -76.50 -76.91 -76.00 -75.74 -76.16 -70.42 -63.54 -58.70
F18 -73.30 -74.28 -74.44 -75.24 -75.17 -74.85 -74.28 -75.21 -74.97 -74.16 -74.31 -74.12 -73.73 -73.29 -73.78 -74.76 -75.05 -75.41 -75.66 -76.02 -75.32 -74.98 -75.23 -75.52 -75.95 -75.31 -74.85 -73.83 -67.66 -61.18 -56.98
F19 -72.19 -73.25 -73.11 -73.83 -73.90 -73.99 -73.53 -74.48 -74.45 -73.55 -73.39 -73.38 -73.07 -72.71 -73.02 -73.69 -74.16 -74.47 -74.70 -74.94 -74.59 -74.35 -74.37 -74.39 -74.76 -74.30 -73.62 -71.82 -65.18 -59.40 -56.03
F20 -71.06 -71.94 -71.65 -72.48 -72.64 -72.75 -72.76 -73.91 -73.58 -72.59 -72.57 -72.82 -72.54 -72.33 -72.47 -72.85 -73.39 -73.47 -73.71 -73.92 -73.92 -73.53 -73.45 -73.19 -73.43 -73.15 -72.01 -69.70 -62.92 -57.99 -55.55
F21 -70.02 -70.51 -70.34 -71.50 -71.71 -71.55 -71.83 -73.00 -72.18 -71.17 -71.48 -71.86 -71.54 -71.43 -71.38 -71.83 -72.46 -72.42 -72.58 -73.05 -73.21 -72.67 -72.50 -72.30 -72.43 -71.97 -70.28 -67.47 -61.00 -56.68 -55.21
F22 -68.79 -69.29 -69.18 -70.49 -70.98 -70.52 -70.58 -71.37 -70.74 -69.96 -70.42 -70.53 -70.18 -70.11 -70.08 -70.71 -71.41 -71.50 -71.35 -71.96 -72.40 -72.07 -71.61 -71.21 -71.26 -70.44 -68.25 -65.05 -59.54 -55.98 -55.17
F23 -67.82 -68.28 -67.92 -69.21 -70.09 -69.44 -69.18 -69.79 -69.44 -68.87 -69.17 -69.15 -69.06 -68.89 -69.10 -69.83 -70.32 -70.70 -70.43 -71.05 -71.55 -71.38 -70.36 -69.87 -69.98 -69.02 -66.26 -62.66 -58.11 -55.69 -55.47
F24 -67.15 -67.36 -66.44 -67.78 -68.80 -68.20 -67.68 -68.51 -68.14 -67.47 -67.70 -68.06 -68.37 -67.87 -68.08 -69.04 -69.32 -69.80 -69.84 -70.40 -70.56 -70.35 -69.20 -68.77 -68.81 -67.44 -64.25 -60.49 -56.56 -55.26 -55.78
F25 -66.05 -66.05 -65.20 -66.62 -67.44 -66.85 -66.12 -67.10 -66.86 -66.14 -66.49 -67.01 -67.58 -66.93 -66.97 -68.14 -68.35 -68.74 -69.28 -69.68 -69.55 -69.24 -68.32 -67.77 -67.46 -65.57 -62.26 -58.67 -55.36 -54.98 -56.32
F26 -64.87 -64.49 -64.33 -66.00 -66.29 -65.55 -64.75 -65.61 -65.58 -65.09 -65.48 -65.65 -66.37 -66.03 -65.95 -67.03 -67.47 -67.83 -68.44 -68.75 -68.79 -68.39 -67.40 -66.55 -65.95 -63.88 -60.49 -57.31 -54.80 -55.01 -56.92
F27 -63.97 -63.27 -63.33 -64.91 -64.92 -64.37 -63.66 -64.41 -64.32 -64.00 -64.29 -64.24 -64.95 -64.87 -64.77 -65.51 -66.43 -67.06 -67.47 -67.73 -68.02 -67.71 -66.55 -65.37 -64.70 -62.52 -59.00 -56.22 -54.55 -55.34 -57.81
F28 -62.71 -62.26 -62.06 -63.11 -63.14 -63.15 -62.71 -63.46 -63.21 -62.75 -62.88 -62.91 -63.54 -63.48 -63.52 -64.01 -65.01 -65.98 -66.46 -66.83 -67.19 -67.08 -65.77 -64.46 -63.50 -61.06 -57.75 -55.43 -54.59 -55.99 -59.16
F29 -61.64 -61.26 -60.96 -61.81 -61.73 -61.97 -61.99 -62.76 -62.47 -61.77 -61.73 -61.70 -62.10 -62.06 -62.24 -62.73 -63.41 -64.36 -65.13 -65.81 -66.21 -66.35 -64.87 -63.37 -61.92 -59.25 -56.59 -54.95 -54.97 -57.05 -60.88
F30 -60.93 -60.35 -60.19 -61.05 -60.86 -60.96 -61.18 -61.97 -61.69 -61.04 -60.94 -60.69 -60.86 -60.90 -61.05 -61.64 -61.97 -62.66 -63.51 -64.45 -64.83 -65.13 -63.87 -62.14 -60.43 -57.72 -55.79 -54.73 -55.43 -58.37 -62.82
F31 -60.03 -59.37 -59.43 -60.18 -60.14 -60.01 -60.14 -60.97 -60.75 -60.35 -60.31 -60.02 -59.96 -59.90 -60.10 -60.78 -60.95 -61.23 -61.88 -62.84 -63.17 -63.41 -62.83 -60.99 -59.02 -56.61 -55.45 -54.90 -56.19 -59.79 -64.76
F32 -59.11 -58.53 -58.62 -59.27 -59.40 -59.14 -59.28 -59.96 -59.81 -59.68 -59.59 -59.39 -59.37 -59.20 -59.25 -60.04 -60.05 -60.02 -60.45 -61.27 -61.84 -62.14 -61.81 -59.77 -57.60 -55.84 -55.46 -55.47 -57.31 -61.23 -66.56
F33 -58.30 -57.67 -57.79 -58.49 -58.75 -58.35 -58.59 -59.22 -59.21 -59.17 -58.87 -58.61 -58.78 -58.71 -58.53 -59.24 -58.93 -58.97 -59.41 -59.93 -60.69 -61.07 -60.77 -58.72 -56.67 -55.39 -55.52 -56.25 -58.70 -63.05 -68.60
F34 -57.80 -56.89 -57.20 -57.92 -58.22 -57.85 -58.24 -58.94 -59.08 -58.76 -58.23 -57.84 -57.96 -58.08 -58.04 -58.52 -57.94 -58.13 -58.72 -58.96 -59.58 -59.66 -59.47 -57.95 -56.27 -55.16 -55.58 -57.07 -60.24 -65.50 -71.44
F35 -57.42 -56.24 -56.86 -57.55 -57.72 -57.51 -58.11 -58.85 -58.89 -58.22 -57.86 -57.50 -57.42 -57.61 -57.79 -58.16 -57.49 -57.70 -58.21 -58.35 -58.95 -58.50 -58.10 -57.14 -56.13 -55.45 -56.09 -58.00 -61.53 -67.89 -74.75
F36 -56.94 -55.77 -56.65 -57.23 -57.32 -57.16 -57.70 -58.51 -58.44 -57.78 -57.74 -57.62 -57.39 -57.47 -57.60 -58.10 -57.66 -57.67 -57.74 -57.92 -58.48 -57.74 -57.13 -56.53 -56.19 -56.33 -57.35 -59.65 -63.32 -70.14 -77.61
F37 -56.69 -55.63 -56.60 -57.12 -57.06 -56.75 -57.22 -58.05 -58.10 -57.75 -57.78 -57.68 -57.46 -57.58 -57.64 -58.24 -57.98 -57.69 -57.39 -57.61 -57.87 -57.20 -56.69 -56.39 -56.33 -57.10 -59.08 -61.94 -65.92 -73.07 -79.88
F38 -56.67 -55.72 -56.69 -57.05 -56.76 -56.40 -57.05 -58.02 -58.14 -57.81 -57.68 -57.48 -57.26 -57.65 -57.86 -58.40 -58.14 -57.68 -57.27 -57.43 -57.40 -56.86 -56.47 -56.32 -56.65 -57.86 -60.77 -64.24 -68.62 -76.39 -79.07
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D07 0.3562 0.3559 0.3555 0.3552 0.3548 0.3545 0.3542 0.3538 0.3535 0.3531 0.3528 0.3524 0.3521 0.3517 0.3514 0.3510 0.3507 0.3503 0.3500 0.3497 0.3493 0.3490 0.3486 0.3483 0.3479 0.3476 0.3472 0.3469 0.3465 0.3462 0.3458
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D13 0.6023 0.6016 0.6008 0.6001 0.5993 0.5986 0.5979 0.5971 0.5964 0.5956 0.5949 0.5941 0.5934 0.5927 0.5919 0.5912 0.5904 0.5897 0.5889 0.5882 0.5875 0.5867 0.5860 0.5852 0.5845 0.5837 0.5830 0.5823 0.5815 0.5808 0.5800
D14 0.6471 0.6463 0.6455 0.6446 0.6438 0.6430 0.6422 0.6414 0.6405 0.6397 0.6389 0.6381 0.6372 0.6364 0.6356 0.6348 0.6340 0.6331 0.6323 0.6315 0.6307 0.6299 0.6290 0.6282 0.6274 0.6266 0.6258 0.6249 0.6241 0.6233 0.6225
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D18 0.8394 0.8382 0.8370 0.8358 0.8346 0.8335 0.8323 0.8311 0.8299 0.8287 0.8276 0.8264 0.8252 0.8240 0.8228 0.8216 0.8205 0.8193 0.8181 0.8169 0.8157 0.8146 0.8134 0.8122 0.8110 0.8098 0.8087 0.8075 0.8063 0.8051 0.8040
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D39 2.5515 2.5443 2.5372 2.5301 2.5230 2.5160 2.5089 2.5019 2.4950 2.4880 2.4811 2.4742 2.4673 2.4605 2.4537 2.4469 2.4401 2.4333 2.4266 2.4199 2.4132 2.4066 2.4000 2.3934 2.3868 2.3802 2.3737 2.3672 2.3607 2.3542 2.3478
D40 2.7002 2.6922 2.6842 2.6763 2.6684 2.6605 2.6526 2.6448 2.6370 2.6293 2.6215 2.6138 2.6062 2.5985 2.5909 2.5834 2.5758 2.5683 2.5609 2.5534 2.5460 2.5386 2.5312 2.5239 2.5166 2.5094 2.5021 2.4949 2.4877 2.4806 2.4735
D41 2.8636 2.8546 2.8455 2.8366 2.8276 2.8187 2.8099 2.8011 2.7923 2.7836 2.7749 2.7662 2.7576 2.7491 2.7406 2.7321 2.7236 2.7152 2.7069 2.6985 2.6902 2.6820 2.6738 2.6656 2.6575 2.6494 2.6413 2.6333 2.6253 2.6173 2.6094
D42 3.0448 3.0344 3.0241 3.0139 3.0037 2.9936 2.9835 2.9735 2.9636 2.9537 2.9438 2.9340 2.9243 2.9146 2.9049 2.8954 2.8858 2.8763 2.8669 2.8575 2.8482 2.8389 2.8296 2.8204 2.8113 2.8022 2.7931 2.7841 2.7752 2.7663 2.7574
D43 3.2480 3.2361 3.2242 3.2124 3.2006 3.1890 3.1774 3.1659 3.1545 3.1431 3.1318 3.1206 3.1094 3.0983 3.0873 3.0764 3.0655 3.0547 3.0439 3.0333 3.0226 3.0121 3.0016 2.9911 2.9808 2.9705 2.9602 2.9500 2.9399 2.9298 2.9198
D44 3.4796 3.4655 3.4516 3.4377 3.4240 3.4104 3.3968 3.3834 3.3701 3.3569 3.3437 3.3307 3.3178 3.3049 3.2922 3.2795 3.2669 3.2544 3.2421 3.2297 3.2175 3.2054 3.1933 3.1814 3.1695 3.1577 3.1459 3.1343 3.1227 3.1112 3.0998
D45 3.7485 3.7317 3.7149 3.6984 3.6820 3.6657 3.6496 3.6336 3.6178 3.6021 3.5866 3.5712 3.5559 3.5408 3.5257 3.5109 3.4961 3.4815 3.4669 3.4525 3.4383 3.4241 3.4101 3.3961 3.3823 3.3686 3.3550 3.3415 3.3281 3.3148 3.3016
D46 4.0694 4.0485 4.0279 4.0075 3.9873 3.9674 3.9477 3.9282 3.9089 3.8898 3.8710 3.8523 3.8338 3.8156 3.7975 3.7796 3.7619 3.7443 3.7270 3.7098 3.6928 3.6759 3.6592 3.6427 3.6263 3.6101 3.5940 3.5781 3.5623 3.5467 3.5312
D47 4.4672 4.4402 4.4135 4.3873 4.3615 4.3360 4.3109 4.2862 4.2618 4.2378 4.2140 4.1906 4.1676 4.1448 4.1223 4.1001 4.0782 4.0566 4.0352 4.0141 3.9933 3.9727 3.9523 3.9322 3.9123 3.8927 3.8732 3.8540 3.8350 3.8162 3.7977
D48 4.9907 4.9530 4.9161 4.8800 4.8447 4.8100 4.7761 4.7427 4.7101 4.6780 4.6466 4.6156 4.5853 4.5555 4.5262 4.4973 4.4690 4.4411 4.4137 4.3867 4.3601 4.3339 4.3082 4.2828 4.2578 4.2331 4.2088 4.1848 4.1612 4.1379 4.1149
D49 5.7582 5.6977 5.6392 5.5826 5.5279 5.4749 5.4235 5.3736 5.3252 5.2781 5.2322 5.1876 5.1441 5.1017 5.0603 5.0199 4.9804 4.9419 4.9042 4.8673 4.8312 4.7958 4.7612 4.7273 4.6940 4.6614 4.6294 4.5980 4.5672 4.5369 4.5071
D50                                                                                                          5.7853 5.7220 5.6610 5.6022 5.5453 5.4903 5.4370 5.3854 5.3353 5.2866 5.2393 5.1933 5.1486 5.1050 5.0624 5.0210
D51                                                                                                                                                                                                                  5.7677
N04 1.7e+7 1.3e+7 8.3e+6 4.9e+6 5.6e+6 1.3e+7 1.6e+7 1.6e+7 1.8e+7 1.9e+7 2.7e+7 2.5e+7 4.7e+7 5.6e+7 4.6e+7 4.1e+7 5.5e+7 7.2e+7 8.2e+7 9.4e+7 1.0e+8 1.2e+8 1.6e+8 1.4e+8 1.3e+8 1.6e+8 1.8e+8 1.4e+8 9.3e+7 2.3e+7 1.4e+7
N05 8.9e+6 7.3e+6 4.7e+6 3.5e+6 4.1e+6 7.9e+6 7.9e+6 7.6e+6 9.4e+6 1.2e+7 1.4e+7 1.3e+7 2.0e+7 2.2e+7 2.3e+7 2.3e+7 2.5e+7 3.4e+7 4.3e+7 4.7e+7 4.9e+7 5.3e+7 6.1e+7 5.8e+7 5.8e+7 6.7e+7 6.8e+7 4.9e+7 3.6e+7 3.3e+6-5.7e+6
N06 5.2e+6 3.8e+6 2.8e+6 2.4e+6 2.5e+6 4.6e+6 4.7e+6 4.3e+6 5.1e+6 7.6e+6 7.7e+6 6.8e+6 9.9e+6 1.2e+7 1.6e+7 1.6e+7 1.5e+7 1.7e+7 2.2e+7 2.3e+7 2.4e+7 2.5e+7 2.6e+7 2.6e+7 2.8e+7 2.8e+7 2.7e+7 2.2e+7 1.8e+7 1.9e+6-2.7e+6
N07 3.1e+6 2.0e+6 1.9e+6 1.9e+6 1.6e+6 2.5e+6 3.1e+6 3.2e+6 3.5e+6 4.4e+6 4.6e+6 4.2e+6 5.5e+6 7.0e+6 9.8e+6 1.0e+7 9.2e+6 8.2e+6 9.7e+6 1.0e+7 1.2e+7 1.3e+7 1.2e+7 1.3e+7 1.2e+7 1.2e+7 1.1e+7 9.6e+6 1.1e+7 3.1e+6 1.3e+6
N08 1.8e+6 1.2e+6 1.6e+6 1.6e+6 1.2e+6 1.6e+6 2.0e+6 2.3e+6 2.7e+6 3.0e+6 2.8e+6 2.7e+6 3.5e+6 4.2e+6 5.2e+6 5.4e+6 5.1e+6 4.5e+6 5.0e+6 5.3e+6 5.8e+6 7.2e+6 6.3e+6 5.5e+6 4.9e+6 5.4e+6 4.5e+6 3.2e+6 5.7e+6 3.0e+6 1.6e+6
N09 1.3e+6 964959 1.3e+6 1.2e+6 937657 1.1e+6 1.4e+6 1.5e+6 1.8e+6 2.0e+6 1.8e+6 1.6e+6 2.2e+6 2.5e+6 3.0e+6 2.9e+6 2.8e+6 2.8e+6 3.4e+6 3.2e+6 3.1e+6 3.9e+6 3.8e+6 3.0e+6 2.5e+6 2.7e+6 2.6e+6 1.1e+6 1.9e+6 907918 754334
N10 1.3e+6 768728 923905 840020 739504 953753 1.1e+6 1.1e+6 991462 1.2e+6 1.3e+6 1.2e+6 1.5e+6 1.7e+6 2.1e+6 1.9e+6 1.7e+6 1.8e+6 2.3e+6 2.0e+6 1.9e+6 2.0e+6 2.0e+6 1.8e+6 1.7e+6 1.7e+6 1.6e+6 564613 414979 -20941 465284
N11 1.0e+6 621685 711679 660284 583135 760609 906342 785129 649938 813113 1.0e+6 993357 1.1e+6 1.1e+6 1.5e+6 1.3e+6 1.1e+6 1.1e+6 1.5e+6 1.4e+6 1.2e+6 1.0e+6 1.3e+6 1.3e+6 1.1e+6 1.1e+6 780067 348279 443056 9440.2 584411
N12 767281 512404 592273 528738 442943 570640 675093 561459 496654 577079 739843 764211 793363 775179 913108 858995 776754 780217 986458 952714 821772 650838 997461 1.1e+6 793431 725081 451939 272152 577617 202885 1.1e+6
N13 576843 431121 488397 407029 355461 435667 522800 439910 387910 454876 551636 562480 601123 609885 607535 550143 571359 563326 650526 610362 555522 489453 661070 724471 567980 480128 341375 241834 436064 347849 2.0e+6
N14 429862 359385 388558 316192 306202 342264 395556 346791 326425 377830 432588 434691 493647 509447 461112 400309 406449 399950 407624 377887 391822 379743 416047 439166 362189 309788 278832 212242 360912 713077 3.8e+6
N15 333126 296551 311766 260891 259418 284571 299414 273867 286966 326201 349637 350815 402810 420326 398697 348319 309816 288807 279012 259424 285359 281594 292512 306142 256370 259686 269250 175144 422713 1.5e+6 6.7e+6
N16 304136 257262 258238 223607 221747 256341 265884 231201 257144 295662 286649 285947 321365 361754 360112 295804 255063 228728 211731 199175 228346 231565 234804 242549 221228 266613 274303 183597 616336 2.9e+6 1.0e+7
N17 274365 219690 212223 182470 183544 214996 239070 194280 216859 255903 233828 241443 267754 309082 292567 229114 212046 194450 182086 167784 202771 216297 207422 204869 188392 234147 251193 229915 868205 4.3e+6 1.3e+7
N18 230314 184889 179919 151115 154855 168328 194066 157963 168707 204982 200254 211194 233224 260683 235570 189852 179433 166845 159144 148261 176056 191974 183249 173401 158738 185544 208667 265910 1.1e+6 5.0e+6 1.3e+7
N19 200924 158461 165180 141569 140788 138946 155985 126885 128839 160355 167831 169881 184631 202743 190770 165220 149847 141021 135056 129349 141758 151370 152190 153406 142244 159680 189023 288862 1.3e+6 5.1e+6 1.1e+7
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N21 155008 139360 146398 113302 109202 114436 108330  83714 102135 130385 122737 113699 123647 128248 131122 119569 104688 106867 104113  94707  92357 105815 111147 117728 115660 129991 194264 375062 1.7e+6 4.6e+6 6.5e+6
N22 140816 126587 130999  98039  88663  99512  99203  83721  97790 118412 107914 106361 116653 119810 122141 106879  92034  91345  95763  84141  77016  84087  94614 105036 105269 128586 215446 455662 1.6e+6 3.8e+6 4.6e+6
N23 121124 109708 120646  90688  74869  87859  94385  83104  91132 105060  99072 100957 104094 109677 105738  90670  81853  76030  81973  71983  64860  68398  87586  99317  98064 123893 236655 549438 1.6e+6 2.8e+6 3.0e+6
N24  97263  93412 116639  86789  69463  80716  91907  76905  84704 100005  96142  89549  84413  96036  92550  75247  71525  64792  65056  58016  56647  60266  79499  89018  89371 124299 262051 630792 1.6e+6 2.2e+6 1.9e+6
N25  86051  86804 106888  77970  65343  75784  90697  73448  78559  93855  87626  78806  70042  82398  82805  64096  61947  57441  51361  47551  49606  54121  67806  78042  85081 133052 289222 670890 1.5e+6 1.6e+6 1.2e+6
N26  77397  85316  89612  61831  58577  70302  85628  71149  72620  82428  76274  74484  63873  70000  72325  57200  52484  49014  43238  40833  41059  45691  58164  71944  83760 136817 302889 639047 1.2e+6 1.1e+6 727434
N27  65034  77233  77047  54277  54943  63194  75355  64328  66657  72639  68916  70825  60905  62989  65385  56005  46039  40390  37312  35709  33954  36990  49099  65355  77473 129939 296993 572692 851860 718282 412021
N28  59026  66127  70259  55971  56345  57046  63899  54558  58683  66137  65170  65792  57746  59388  59866  54314  43849  35604  32366  30234  28302  29523  40584  55745  70727 126182 274944 475678 584131 428478 209074
N29  50985  56198  61063  51006  52755  50587  51158  43541  47225  56325  57750  59052  54748  56087  54753  49673  43251  35350  30083  26158  24278  23919  34233  49233  69992 131766 246784 364771 367922 231057  96781
N30  40194  46466  48851  40735  43229  42916  41426  35106  38049  44885  46703  50271  49188  49603  48721  43339  40800  35474  29685  24365  22737  21626  29404  44669  67396 128169 202369 262097 225946 116619  42418
N31  32791  38667  38739  33112  33966  35632  35121  29527  31592  35190  36132  39297  40590  41861  40777  35522  34810  33220  29146  23816  22513  21731  25332  39495  63409 112091 148329 170767 128777  57111  18438
N32  26779  30998  30818  27021  26688  28794  28357  24711  26040  27304  28354  30252  31003  32845  33046  28087  28609  29383  27140  22956  20519  19565  21557  35231  59064  89797  99531 101029  67060  27643 8231.6
N33  21174  24803  24561  21294  20373  22734  21943  19334  19721  20283  22167  23937  23517  24379  25869  22460  24626  24905  22963  20825  17844  16721  18303  29935  48723  66532  65672  56417  32615  12167 3448.5
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N34	15543	19429	18430	15880	15100	16759	15610	13544	13375	14668	16884	18871	18722	18590	19172	17529	20454	20027	17849	17282	15318	15391	16430	23729	35545	46676	43087	31116	15240	4622.4	1196.3
N35	11074	14746	13021	11318	11080	11857	10535	9071.8	9153.5	10891	12100	13423	13959	13631	13374	12554	14989	14600	13282	13155	11733	13308	14872	18890	24295	28910	25386	16667	7517.4	1769.8	372.01
N36	8063.7	10718	8927.8	7966.0	7954.2	8413.8	7584.7	6429.2	6668.3	7912.6	8156.4	8572.4	9241.6	9262.2	9187.0	8380.0	9491.1	9687.6	9774.1	9585.0	8641.0	10461	12281	14376	15828	15629	12579	7542.3	3299.7	699.22	127.95
N37	5579.9	7232.0	5896.5	5342.4	5529.4	6050.6	5548.5	4679.9	4724.6	5237.0	5312.6	5556.1	5978.6	5945.9	6001.2	5351.7	5813.2	6361.6	6982.7	6806.1	6566.6	7816.2	8969.7	9791.1	10116	8644.9	5594.9	2947.6	1201.5	236.46	50.288
N38	3660.6	4631.9	3782.0	3554.0	3882.1	4301.2	3788.2	3094.7	3073.3	3388.5	3572.4	3826.3	4115.9	3848.7	3753.9	3401.1	3693.0	4212.3	4742.4	4694.6	4822.6	5578.4	6223.4	6570.3	6224.6	4805.3	2510.5	1149.9	428.02	73.016	40.260
N39	2451.6	3052.0	2462.6	2454.8	2701.9	2879.9	2516.2	1986.3	1970.7	2224.8	2389.8	2510.6	2621.3	2340.3	2308.5	2145.4	2363.8	2776.2	3040.2	2991.0	3206.6	3590.5	4066.8	4184.1	3400.7	2300.2	1089.4	447.38	153.45	23.465	45.138
N40	1619.3	2074.6	1583.4	1582.6	1763.5	1834.0	1574.2	1260.2	1294.3	1402.1	1458.3	1450.0	1468.7	1288.6	1363.3	1331.0	1495.8	1722.1	1838.6	1847.8	2074.7	2231.3	2468.2	2294.7	1631.5	949.15	424.41	166.03	51.607	6.7670	45.100
N41	982.38	1326.3	973.26	959.24	1050.9	1068.5	858.33	744.14	829.82	857.60	842.94	812.12	831.79	723.97	797.48	805.01	917.07	1012.8	1109.3	1210.2	1333.5	1407.9	1414.7	1116.5	712.05	366.94	154.27	62.599	17.781	2.8902	43.531
N42	559.59	801.97	590.94	560.59	570.14	570.07	441.00	428.44	513.44	509.34	483.11	472.63	466.78	408.14	449.80	443.00	503.02	542.48	648.21	783.12	818.78	829.53	748.08	508.35	280.57	132.16	51.527	21.089	5.7216	1.2082	41.131
N43	311.72	452.26	341.63	311.89	298.49	296.60	243.05	266.12	315.43	285.84	267.08	259.91	236.88	207.13	222.80	211.03	240.93	268.09	351.68	453.51	472.69	455.83	358.53	206.85	103.39	45.136	16.576	5.5499	1.1879	0.9027	36.637
N44	169.68	239.35	178.44	164.85	152.13	148.30	137.29	172.38	192.97	159.46	138.54	126.42	111.82	93.173	92.717	91.467	109.10	127.54	181.10	233.85	246.11	239.27	169.73	76.829	36.747	15.236	5.1847	1.0163	0.1858	1.2911	32.235
N45	81.786	121.41	84.666	81.660	79.681	78.907	77.345	103.17	113.45	92.542	68.828	57.519	50.597	37.522	33.149	36.609	47.387	54.895	82.849	112.99	119.13	115.14	76.344	28.340	11.652	4.4790	1.2523	-0.1501	0.1087	1.4566	27.688
N46	34.401	57.447	38.938	39.926	41.450	43.409	45.297	54.983	60.493	52.144	33.413	25.366	20.018	12.808	11.334	13.548	17.845	20.532	31.125	48.032	53.157	48.112	29.404	9.4621	3.2046	1.0200	0.1508	-0.1471	0.2992	1.2458	21.402
N47	14.599	25.105	17.415	18.311	18.017	21.264	26.064	29.209	30.549	26.836	16.089	11.018	7.6411	4.1295	3.6462	4.5463	5.7951	6.7475	9.5651	16.130	19.956	17.000	9.3864	2.6096	0.7768	0.2122	0.0214	-0.0118	0.3312	0.8860	14.571
N48	6.0655	10.083	6.7792	6.7683	6.5345	9.1416	12.917	15.288	15.165	12.710	7.4520	4.6330	3.0609	1.3756	0.9208	1.3419	1.6967	1.8734	2.5597	4.3964	6.1000	4.8768	2.2767	0.5247	0.0722	-0.0227	9.6e-4	-0.0267	0.2702	0.6419	8.2911
N49	2.5061	3.6136	2.2706	1.9711	2.0213	3.5677	5.5743	7.8399	7.7926	5.9892	3.3414	1.7142	0.9998	0.3713	0.1577	0.3096	0.3850	0.3988	0.6132	1.0605	1.5677	1.1634	0.4705	0.1001	-0.0409	-0.0489	0.0142	0.0276	0.2706	0.4230	4.0321
N50																0.0510	0.0522	0.0533	0.1262	0.2087	0.3256	0.2438	0.1037	0.0316	0.0116	0.0055	0.0252	0.0680	0.2527	0.3298	1.8604
N51																															0.7945
PIA	0.000	0.028	0.054	0.076	0.097	0.120	0.143	0.162	0.182	0.204	0.226	0.248	0.270	0.292	0.315	0.334	0.354	0.374	0.395	0.414	0.433	0.453	0.475	0.500	0.528	0.565	0.610	0.667	0.743	0.833	0.939
z	32.52	33.54	32.65	32.07	31.98	32.17	31.91	31.51	31.60	31.57	31.22	31.08	30.90	30.59	30.51	30.04	30.24	30.28	30.36	30.40	30.31	30.37	30.39	30.55	30.90	31.57	32.08	32.73	33.37	33.36	33.33
Z	32.52	33.56	32.69	32.14	32.07	32.29	32.05	31.67	31.77	31.77	31.43	31.32	31.16	30.87	30.82	30.37	30.59	30.65	30.75	30.82	30.75	30.83	30.87	31.06	31.44	32.15	32.69	33.40	34.10	34.18	34.25
RR	2.93	3.25	3.09	2.58	2.52	2.71	2.69	2.31	2.41	2.68	2.69	2.72	2.74	2.79	2.81	2.49	2.47	2.42	2.41	2.30	2.24	2.35	2.62	3.00	3.46	4.53	5.96	8.08	12.16	16.29	20.79
LWC	0.17	0.18	0.17	0.14	0.14	0.15	0.16	0.14	0.14	0.16	0.17	0.17	0.18	0.19	0.19	0.17	0.17	0.18	0.19	0.18	0.18	0.20	0.22	0.23	0.25	0.31	0.40	0.50	0.76	1.07	1.49
W	6.57	6.73	6.57	6.66	6.68	6.81	6.84	6.95	6.90	6.72	6.57	6.51	6.53	6.42	6.45	6.48	6.58	6.68	6.83	6.99	7.09	7.10	7.00	6.77	6.50	6.20	5.88	5.53	5.11	4.61	4.16

6.4 Raw data

6.4.1 Format Description

Each data block in a **raw data** file begins with a header line which contains the date, the time and the time zone of the following data block. This line is preceded by the letter T and a colon (T means time). The format of the date/time stamp is YYMMDDhhmmss, which means year, month, day, hour, minute and second with 2 digits each. Date, time and time zone are separated by a space character. The header line is supplemented with the version number of the MRR firmware (following the identifier DVS), the serial number (of the MRR (following the identifier DSN), the calibration constant of the MRR (following the identifier CC) and the percentage of valid spectra (following the identifier MDQ).

The next data lines contains the measuring heights. It begins with the capital letter M, a colon, the small letter h, two space characters, and an equals sign (M means measured value, h means height). The following numbers (9 digits decimal each) represent the measuring heights in meters.

The height line is followed by the line of the transfer function. It starts with the capital character M, a colon, the capital letters T and F and one space character. The rest of that line represents the values of the transfer function for each height step (9 digits decimal each).

The line of the transfer function is followed by 64 data lines. Each one starts with the capital character M, a colon, the small letter f, and a 2-digit number of the spectra line (0 to 63). The rest of these lines represent the received spectral signal power in engineering units for each height step (9 digits decimal each).

The raw spectra include the receiver noise floor.

6.4.2 Example

```
T:090612024311 UTC DVS 5.10 DSN 020704 CC 2066000 MDQ 100
M:h  =     0    35    70   105   140   175   210   245   280   315   350   385   420   455   490   525   560   595   630   665   700   735   770   805   840   875   910   945   980  1015  1050  1085
M:TF = 0.003292 0.011523 0.041975 0.099863 0.175583 0.254184 0.334019 0.425514 0.532373 0.603018 0.675720 0.756516 0.794239 0.836626 0.877778 0.891358 1.000000 0.968313 0.924280 0.883813 0.890398 0.903978 0.875857 0.853772 0.843347 0.834568 0.780658 0.774897 0.752401 0.689026 0.640604 0.422497
M:f00=  4798  2205   166    46    22    20    20    20    19    18    18    23    24    24    19    15    15    18    16    15    18    15    12    12    10    10    11    10     7     6     6     4
M:f01=  2780  1272   107    33    19    20    25    23    22    20    22    28    29    27    22    18    18    20    18    21    25    21    15    14    12    12    12    12    11     8     7     5
M:f02=   541   246    33    20    22    22    27    27    26    25    26    32    34    34    32    28    23    25    25    24    28    30    25    17    17    16    13    13    14    15    10     8     6
M:f03=    39    22    17    20    25    24    27    28    28    26    26    31    35    33    28    24    29    28    25    27    28    25    19    21    19    14    14    14    13    11     8     6
M:f04=     4     9    18    22    25    24    27    30    29    26    24    26    30    27    24    27    34    30    25    24    25    24    20    22    20    14    15    14    12    12     9     6
M:f05=     3     9    19    26    27    24    26    30    29    31    26    21    25    22    20    30    36    31    26    23    23    22    18    19    17    12    13    13    11    12    11     7
M:f06=     3     9    20    32    32    24    24    28    30    33    27    22    27    24    21    30    35    30    27    23    23    19    18    16    14    11    11    11    12    13    12     7
M:f07=     3     9    21    38    38    27    24    25    27    30    27    25    30    27    24    31    33    31    29    26    24    20    20    16    13    11    13    13    11    12    12     7
M:f08=     3    10    23    49    48    32    26    24    22    29    30    27    29    30    31    34    32    31    32    28    25    22    24    16    13    13    16    15    10    10    11     6
M:f09=     4    11    28    61    54    36    29    25    24    30    33    28    29    35    38    35    36    33    32    27    24    21    23    15    15    17    17    15    10     9    10     6
M:f10=     5    13    34    70    56    38    34    30    32    32    34    33    33    43    46    38    41    37    30    25    24    19    19    17    20    20    17    14    12    12     9     5
M:f11=     4    16    44    85    60    39    38    35    37    34    35    39    36    47    54    48    47    39    30    24    22    19    20    21    26    20    16    14    13    14     8     4
M:f12=     5    18    55   107    71    48    47    42    42    41    40    43    37    46    57    54    55    45    30    24    21    20    20    23    29    21    16    15    14    13     7     4
M:f13=     7    19    65   137    93    75    60    46    47    52    51    47    38    47    56    52    61    52    34    23    23    24    21    29    33    28    21    18    17    13     6     5
M:f14=     9    23    84   198   141   127    88    49    53    61    56    48    39    53    62    59    68    60    42    29    28    29    26    37    40    38    31    24    21    15     9     6
M:f15=    12    34   139   329   220   182   124    60    62    75    64    54    45    65    80    78    80    71    52    39    34    35    41    47    49    41    36    29    24    17    12     7
M:f16=    15    52   236   522   336   215   136    69    74    88    74    65    59    78    92    93    91    84    63    49    42    46    65    64    57    42    37    31    28    19    12     8
M:f17=    24    75   325   698   485   275   150    81    85    90    85    79    83    99   100   101   101   101   102    83    58    54    61    78    72    61    48    41    33    31    22    12     7
M:f18=    48   120   374   710   569   364   199   116   115   112   105    94   106   132   127   108   112   125   106    71    68    70    77    73    61    48    42    32    30    23    12     7
M:f19=    98   215   526   747   595   418   242   166   178   168   133   115   126   152   157   123   132   157   136   101    88    78    71    73    63    44    38    29    27    25    15     9
M:f20=   177   377   803   915   652   452   268   217   240   236   188   149   155   169   192   159   168   182   170   139   115   101    76    65    63    43    36    29    27    29    19    11
M:f21=   290   582  1054  1084   739   488   303   257   276   295   262   195   187   206   243   201   190   179   179   150   125   121    96    67    71    52    40    36    36    38    24    12
M:f22=   492   873  1270  1406  1049   557   352   281   293   305   310   266   234   259   267   222   207   171   152   125   117   124   111    93    91    66    50    47    49    48    31    16
M:f23=   814  1437  1629  1947  1531   666   418   340   355   315   349   369   345   329   261   225   224   178   142   109   122   129   116   125   114    88    80    64    62    61    40    22
M:f24=  1103  2015  2193  2970  2137   816   526   473   506   421   509   486   480   405   278   248   249   225   176   140   141   135   131   158   147   131   124    91    88    88    55    33
M:f25=  1215  2304  3049  4586  3012   973   722   714   711   661   829   608   523   405   287   289   322   323   257   222   179   161   194   220   207   195   176   129   133   130    81    48
M:f26=  1202  2861  4088  5698  3567  1012   867   906   952  1013  1097   733   513   352   284   358   464   482   382   369   262   252   330   337   297   270   243   192   179   162   106    61
M:f27=  1692  3945  4978  5726  3427   893   775   923  1093  1218  1081   731   502   394   351   445   628   732   577   586   405   437   516   481   421   367   299   263   248   200   124    79
M:f28=  3428  4611  6013  6285  3599   883   731  1024  1164  1418  1153   719   516   513   543   565   807  1059   830   791   549   632   668   614   557   452   349   317   349   282   146    97
M:f29=  6270  5873  8179  7200  3957  1145   965  1395  1737  2134  1536   855   663   639   762   756  1113  1595  1225   983   714   817   814   673   573   450   403   404   446   355   166   105
M:f30=  9754  9622 11394  7165  4522  2175  1524  2165  2896  2947  1902  1066   893   830   948   934  1443  2246  2014  1453  1080  1073  1003   695   466   385   471   517   487   369   204   128
M:f31= 13520 15729 15559  7632  6648  4740  2698  3356  4341  3500  2201  1364  1043  1018  1095  1059  1805  2799  3242  2339  1587  1295  1095   675   317   315   525   557   425   331   251   187
M:f32= 15274 23192 21914 10788 11365  9077  5307  4776  5807  3976  2625  1708  1151  1200  1387  1756  2922  3657  4269  3481  2313  1489   825   465   161   207   414   451   340   289   266   227
M:f33= 13520 26471 25550 15241 18222 15080 10203  7315  7471  4865  3160  2005  1326  1568  2126  3210  4680  4528  4170  3876  2687  1273   441   202    62    92   211   307   320   276   245   176
M:f34=  9754 21874 22408 17097 22023 19192 16351 12855 11468  7592  4160  2636  2145  2913  3740  4692  5560  4499  3363  2929  1955   825   194    64    26    34    99   235   324   273   218   116
M:f35=  6270 15310 16602 15558 19843 18169 19653 18327 16854 11037  5469  4241  4229  5146  5376  5022  4785  3691  2351  1622   952   415    84    22    17    18    56   191   289   237   211   110
M:f36=  3428  9683 12461 12216 15018 13796 16298 18613 17631 10864  6094  6075  6527  6463  5080  3520  2864  2397  1243   674   375   171    40    15    15    16    36   163   246   176   178   103
M:f37=  1692  5905 11128 10153  9887  8186  9553 13447 12424  7651  5677  6779  7882  7002  3872  1817  1248  1158   474   212   126    64    24    16    16    18    31   136   175   119   114    68
M:f38=  1202  4727 11416 11332  6377  3700  4043  6282  5638  4052  4089  5560  6861  5684  2461   776   450   449   161    64    42    31    19    16    16    18    27    87    93    64    53    32
M:f39=  1215  4582 11578 12064  4531  1380  1280  1967  1806  1531  1950  2962  3602  2693  1117   307   172   177    65    28    22    22    18    14    15    17    19    37    35    25    21    16
M:f40=  1103  4033 10911 10304  2914   545   423   572   558   463   597   958  1075   770   369   128    84    80    33    19    16    18    18    13    15    18    17    17    17    15    14    10
M:f41=   814  3225  9611  8782  1958   260   208   227   195   151   155   230   224   179   115    60    50    38    23    20    16    17    17    13    15    18    16    15    16    14    13     9
M:f42=   492  2421  7508  7183  1576   130    97    97    79    64    65    76    66    62    51    37    34    24    22    20    19    18    17    14    14    16    14    13    14    12    12     8
M:f43=   290  1436  4351  4426  1007    58    41    42    38    38    43    39    36    41    34    29    25    21    23    21    21    20    18    16    15    15    13    12    12    12    13     7
M:f44=   177   675  2171  2315   502    33    25    28    32    33    33    26    26    33    29    25    23    21    22    23    22    20    19    16    16    13    11    11    13    14     8
M:f45=    98   318  1386  1407   254    30    24    24    31    31    27    21    22    27    26    24    23    20    19    22    24    23    20    20    15    14    13    12    11    14    12     7
M:f46=    48   149   828   804   135    27    23    21    27    29    25    22    23    23    24    25    23    18    18    23    24    23    18    18    13    11    12    14    12    13    11     7
M:f47=    24    60   332   325    67    25    22    19    25    29    25    24    26    25    27    27    26    22    19    25    25    25    21    17    16    12    11    12    14    13    11     7
M:f48=    15    21    96   101    35    27    24    19    22    29    26    25    28    27    30    27    25    23    19    23    23    19    15    15    12    11    13    14    13    10    10     8
M:f49=    12    10    33    38    23    27    25    18    20    28    24    21    25    25    25    21    19    18    19    22    21    19    16    16    12    10    12    14    13    10     9     7
M:f50=     9     8    19    24    22    26    23    20    24    29    25    19    21    20    19    18    18    16    17    20    23    22    21    18    17    13     9    11    14    14    11    10     7
M:f51=     7     7    14    22    26    27    23    22    27    31    27    18    21    20    18    18    18    17    20    25    23    21    20    16    14    10    12    14    12    11    11     6
M:f52=     5     7    12    20    27    28    26    27    28    31    28    20    23    24    21    18    18    14    19    26    22    20    20    16    13    11    11    13    12    13    13     7
M:f53=     4     6    11    17    24    26    26    28    29    33    29    26    27    24    20    19    20    16    19    23    22    20    18    16    14    13    13    14    13    14    13     8
M:f54=     5     8    13    19    24    23    24    26    30    33    31    30    27    22    20    22    23    17    18    20    20    20    18    16    16    15    14    15    14    14    10     8
M:f55=     4    10    15    21    26    23    23    26    28    30    33    32    25    20    22    25    25    20    20    19    17    19    18    16    18    16    13    14    13    12     9     6
M:f56=     3     9    15    21    25    22    22    22    25    32    34    27    22    23    24    24    21    23    21    18    19    16    14    17    17    14    15    12    11    10     6     6
M:f57=     3    10    19    25    24    21    22    20    21    24    31    35    31    26    22    22    24    22    26    24    20    19    14    13    16    17    14    17    12    11     9     6
M:f58=     3    11    24    30    26    22    23    23    22    28    28    28    30    29    22    19    24    24    26    25    21    17    14    15    17    17    14    17    12     9     8     6
M:f59=     3    10    24    31    26    23    23    25    24    20    25    23    26    29    21    18    21    22    24    24    21    17    15    17    18    18    15    16    12    10     8     6
M:f60=     4     9    21    28    25    22    21    26    26    21    25    24    25    28    21    21    21    20    20    20    19    17    16    18    17    17    16    15    11    10    10     6
M:f61=    39    25    18    24    24    20    18    24    29    25    25    25    27    27    22    23    21    20    19    18    17    17    16    18    18    16    17    15    10    10    11     6
M:f62=   541   254    29    20    24    21    18    24    30    28    22    24    29    28    22    22    21    19    19    16    15    16    16    16    18    14    10    11    10     6
M:f63=  2780  1279    95    32    23    21    18    22    24    23    19    23    27    27    21    18    18    19    18    15    15    14    14    14    12    12    14    11     9    10     8     4
```