

## 6.4 Processed and averaged data

### 6.4.1 Format description

Processed and averaged data are archived in two separate directory structures (see chapter 7.1.2 Data Recording on page 46). Optional recording of so called raw spectra which represent the unprocessed measuring data of the MRR-2, is possible.

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	<i>Header Line</i>	n.A.	
H	<i>Height</i>	m	
TF	<i>Transfer Function</i>	dimensionless	
F <sub>nn</sub>	<i>Spectral Reflectivities</i>	dB	10·log η <sub>nn</sub> with η <sub>nn</sub> in m <sup>-1</sup> nn from nn <sub>min</sub> (h) to nn <sub>max</sub> (h) <sup>3</sup>
D <sub>nn</sub>	<i>Drop Size</i>	mm	Center of size class
N <sub>nn</sub>	<i>Spectral Drop Densities</i>	m <sup>-4</sup>	N(D <sub>nn</sub> ) <sup>4</sup>
PIA	<i>Path Integrated Attenuation</i>	dB	
Z	<i>Radar Reflectivity</i>	dBZ	$10 \log \left( 10^{-3} \sum_{nn=nn_{\min}(h)}^{nn=nn_{\max}(h)} \frac{N_{nn} D_{nn}^6 + N_{nn-1} D_{nn-1}^6}{2} (D_{nn} - D_{nn-1}) \right)$ with $N_{nn_{\min}(h)-1} = 0$ ; $D_{nn_{\min}(h)-1} = 0$
z	<i>Attenuated Radar Reflectivity</i>	dBZ	The attenuated radar reflectivity factor z is calculated in the same way as Z except that attenuated spectral drop densities N <sub>nn,a</sub> are used. They differ from N <sub>nn</sub> by the constant factor a = 10 <sup>PIA/10</sup> : $N_{nn,a} = N_{nn}/a$
RR	<i>Rain Rate</i>	mm h <sup>-1</sup>	
LWC	<i>Liquid Water Contents</i>	g m <sup>-3</sup>	
W	<i>Fall Velocity</i>	m s <sup>-1</sup>	

<sup>3</sup> See MRR-Physical Basics for details.

<sup>4</sup> 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 in increments according to the chosen height resolution of the MRR. Invalid or not calculable values are coded as 7 consecutive space characters.

### **MRR – Header Line**

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  $\pm hh$  or  $\pm hhss$ ). The time stamp is generated from the PC time. Then several parameters follow:

- “AVE” **A**veraging time in seconds (“AVE”),
- “STP” height resolution in meters (“STP”),
- “ASL” height of the ground level **A**bove **S**ea **L**evel in meters (“ASL”),
- “SMP” **s**ampling rate of the RADAR signal in the time domain (unit: Hz),
- “SVS” version number of the MRR Service (service version number),
- “DVS” version number of the MRR firmware (device version),
- “DSN” serial number of the MRR (device serial number)
- “CC” calibration constant
- “MDQ” data quality parameter consisting of the identifying string. This number 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.
- “TYP” identifier for the kind of data: AVE-averaged data, PRO-processed data or RAW-raw spectra

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_110124040200_UTC	The header line dates from January 24th, 2011, 4:02 AM, timezone '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.
SVS_6.0.0.1	Version number of the MRR Service is 6.0.0.1
DVS_6.00	Version number of the MRR firmware is 6.00.
DSN_0502082121	Serial number of the MRR is 050208121.
CC_2066000	Calibration constant is 2066000.
MDQ_100	Percentage of valid spectra is 100
TYP_AVE	data are averaged data

## H - Height

Argument of the following data profiles corresponding to the settings described in chapter 6.3.3, page 26, and chapter 6.3.4, page 28. 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 spectra 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 division 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**

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<sup>1)</sup>**

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

**Z - Radar Reflectivity<sup>1)</sup>**

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

**RR - Rain Rate<sup>1)</sup>**

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

**LWC - Liquid Water Content<sup>1)</sup>**

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

<sup>1)</sup> *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 24.23 GHz, the resolution of the fall velocity can be calculated as:

$$\frac{125 \text{ kHz}}{2} \frac{1}{32 \cdot 64} \frac{299700 \text{ km/s}}{2 \cdot 24.23 \text{ GHz}} = 0,1887 \text{ m/s}$$

## 6.4.2 Processed and averaged data example

**Processed and averaged data** files have the same structure including the header lines. Only the data type identifier “TYP PRO” resp. “TYP AVE” at the end of the header line is different.

```

MRR 110124085700 UTC AVE      60 STP      10 ASL      0 SMP 125e3 SVS 6.0.0.1 DVS 6.00 DSN
0200708021 CC 2079868 MDQ 100 TYP AVE
H          35          70          105      ...      1015      1050      1085
TF 0.0115 0.0420 0.0999      ...      0.6890 0.6406 0.4225
F00 -65.29 -74.53 -82.05      ...      -82.32 -87.28 -83.34
F01 -66.94 -76.22 -84.02      ...      -80.55 -85.48 -84.48
F02 -72.75 -81.78 -88.82      ...      -79.20 -84.64 -84.43
F03 -82.02 -88.54 -91.72      ...      -79.97 -85.73 -84.42
F04 -88.10 -89.28 -91.25      ...      -81.30 -87.44 -89.43
F05 -87.30 -88.16 -90.08      ...      -81.83 -92.29
F06 -86.28 -87.67 -89.08      ...      -81.55 -91.37
F07 -85.61 -87.55 -87.62      ...      -80.73 -86.27 -90.26
F08 -85.09 -86.74 -85.56      ...      -80.90 -83.80 -86.63
F09 -83.82 -85.29 -84.11      ...      -83.05 -86.41 -87.24
F10 -81.72 -83.85 -83.09      ...      -87.40      -86.95
F11 -80.23 -82.49 -81.94      ...      -84.87-101.37 -83.71
F12 -79.40 -81.17 -80.57      ...      -81.59 -86.14 -78.92
F13 -78.57 -79.85 -79.34      ...      -80.78 -81.78 -74.26
F14 -77.86 -78.66 -78.36      ...      -79.66 -76.73 -69.46
F15 -77.06 -77.59 -77.41      ...      -77.10 -71.53 -65.20
F16 -75.62 -76.37 -76.39      ...      -73.66 -66.92 -61.51
F17 -74.28 -75.27 -75.46      ...      -70.42 -63.54 -58.70
F18 -73.30 -74.28 -74.44      ...      -67.66 -61.18 -56.98
F19 -72.19 -73.25 -73.11      ...      -65.18 -59.40 -56.03
F20 -71.06 -71.94 -71.65      ...      -62.92 -57.99 -55.55
F21 -70.02 -70.51 -70.34      ...      -61.00 -56.68 -55.21
F22 -68.79 -69.29 -69.18      ...      -59.54 -55.98 -55.17
F23 -67.82 -68.28 -67.92      ...      -58.11 -55.69 -55.47
F24 -67.15 -67.36 -66.44      ...      -56.56 -55.26 -55.78
F25 -66.05 -66.05 -65.20      ...      -55.36 -54.98 -56.32
F26 -64.87 -64.49 -64.33      ...      -54.80 -55.01 -56.92
F27 -63.97 -63.27 -63.33      ...      -54.55 -55.34 -57.81
F28 -62.71 -62.26 -62.06      ...      -54.59 -55.99 -59.16
F29 -61.64 -61.26 -60.96      ...      -54.97 -57.05 -60.88
F30 -60.93 -60.35 -60.19      ...      -55.43 -58.37 -62.82
F31 -60.03 -59.37 -59.43      ...      -56.19 -59.79 -64.76
F32 -59.11 -58.53 -58.62      ...      -57.31 -61.23 -66.56
F33 -58.30 -57.67 -57.79      ...      -58.70 -63.05 -68.60
F34 -57.80 -56.89 -57.20      ...      -60.24 -65.50 -71.44
F35 -57.42 -56.24 -56.86      ...      -61.53 -67.89 -74.75
F36 -56.94 -55.77 -56.65      ...      -63.32 -70.14 -77.61
F37 -56.69 -55.63 -56.60      ...      -65.92 -73.07 -79.88
F38 -56.67 -55.72 -56.69      ...      -68.62 -76.39 -79.07
F39 -56.58 -55.70 -56.72      ...      -71.30 -79.54 -76.80
F40 -56.55 -55.55 -56.81      ...      -74.26 -83.17 -75.03
F41 -56.89 -55.67 -57.11      ...      -77.12 -85.09 -73.43
F42 -57.52 -56.04 -57.47      ...      -80.29 -87.09 -71.92
F43 -58.26 -56.73 -58.05      ...      -85.37 -86.62 -70.68
F44 -59.10 -57.69 -59.07      ...      -91.70 -83.35 -69.50
F45 -60.47 -58.85 -60.52      ...      -92.25 -81.10 -68.44
F46 -62.44 -60.31 -62.11      ...      -86.14 -80.06 -67.83
F47 -64.36 -62.11 -63.82      ...      -83.99 -79.82 -67.78
F48 -66.33 -64.24 -66.10      ...      -83.16 -79.51 -68.51
F49 -68.08 -66.65 -68.83      ...      -81.42 -79.59 -69.91
F50 -68.54 -68.91 -71.61      ...      -79.92 -78.87 -71.48
F51 -69.15 -71.09 -75.12      ...      -78.53 -78.05 -73.16
F52 -72.35 -74.64 -79.86      ...      -77.95 -78.44 -75.32
F53 -78.57 -80.07 -85.16      ...      -77.73 -79.02 -76.51
F54 -86.06 -86.09 -90.41      ...      -77.82 -78.91 -77.15
F55 -92.17 -93.58 -98.15      ...      -78.16 -78.58 -77.54
F56 -95.49-101.59-100.05      ...      -78.48 -78.98 -77.33
F57 -95.83-102.37-101.13      ...      -78.59 -79.24 -77.07

```

F58	-97.76-109.34	...	-78.03	-79.33	-77.51
F59	-101.35-109.38	...	-77.11	-78.68	-78.96
F60	-97.25 -98.23-106.60	...	-76.41	-77.96	-79.56
F61	-85.64 -91.97 -96.80	...	-76.73	-78.26	-79.12
F62	-74.68 -83.22 -89.67	...	-77.84	-79.75	-80.12
F63	-67.85 -76.90 -84.03	...	-79.80	-82.65	-81.75
D00					
D01					
D02					
D03					
D04	0.2456 0.2454 0.2452	...	0.2404	0.2402	0.2400
D05	0.2817 0.2814 0.2812	...	0.2750	0.2748	0.2746
D06	0.3185 0.3182 0.3179	...	0.3104	0.3101	0.3098
D07	0.3562 0.3559 0.3555	...	0.3465	0.3462	0.3458
D08	0.3948 0.3944 0.3940	...	0.3835	0.3831	0.3827
D09	0.4343 0.4338 0.4334	...	0.4212	0.4208	0.4203
D10	0.4747 0.4742 0.4737	...	0.4599	0.4594	0.4588
D11	0.5162 0.5156 0.5150	...	0.4995	0.4989	0.4983
D12	0.5587 0.5580 0.5574	...	0.5400	0.5393	0.5386
D13	0.6023 0.6016 0.6008	...	0.5815	0.5808	0.5800
D14	0.6471 0.6463 0.6455	...	0.6241	0.6233	0.6225
D15	0.6931 0.6922 0.6913	...	0.6678	0.6669	0.6660
D16	0.7405 0.7395 0.7385	...	0.7127	0.7117	0.7108
D17	0.7892 0.7881 0.7870	...	0.7589	0.7578	0.7567
D18	0.8394 0.8382 0.8370	...	0.8063	0.8051	0.8040
D19	0.8911 0.8898 0.8886	...	0.8552	0.8539	0.8526
D20	0.9445 0.9431 0.9417	...	0.9055	0.9041	0.9027
D21	0.9997 0.9982 0.9967	...	0.9574	0.9559	0.9544
D22	1.0568 1.0551 1.0535	...	1.0109	1.0093	1.0077
D23	1.1159 1.1141 1.1123	...	1.0662	1.0645	1.0627
D24	1.1771 1.1752 1.1733	...	1.1235	1.1216	1.1197
D25	1.2407 1.2386 1.2365	...	1.1827	1.1807	1.1786
D26	1.3068 1.3046 1.3023	...	1.2442	1.2420	1.2398
D27	1.3757 1.3732 1.3708	...	1.3080	1.3056	1.3032
D28	1.4475 1.4449 1.4422	...	1.3743	1.3718	1.3692
D29	1.5226 1.5197 1.5168	...	1.4434	1.4406	1.4379
D30	1.6012 1.5980 1.5949	...	1.5155	1.5125	1.5095
D31	1.6836 1.6803 1.6769	...	1.5908	1.5876	1.5844
D32	1.7704 1.7668 1.7631	...	1.6697	1.6662	1.6627
D33	1.8620 1.8580 1.8540	...	1.7526	1.7488	1.7450
D34	1.9588 1.9545 1.9501	...	1.8397	1.8356	1.8315
D35	2.0617 2.0569 2.0521	...	1.9317	1.9272	1.9228
D36	2.1713 2.1661 2.1608	...	2.0291	2.0242	2.0193
D37	2.2887 2.2829 2.2771	...	2.1324	2.1271	2.1218
D38	2.4149 2.4085 2.4021	...	2.2427	2.2368	2.2310
D39	2.5515 2.5443 2.5372	...	2.3607	2.3542	2.3478
D40	2.7002 2.6922 2.6842	...	2.4877	2.4806	2.4735
D41	2.8636 2.8546 2.8455	...	2.6253	2.6173	2.6094
D42	3.0448 3.0344 3.0241	...	2.7752	2.7663	2.7574
D43	3.2480 3.2361 3.2242	...	2.9399	2.9298	2.9198
D44	3.4796 3.4655 3.4516	...	3.1227	3.1112	3.0998
D45	3.7485 3.7317 3.7149	...	3.3281	3.3148	3.3016
D46	4.0694 4.0485 4.0279	...	3.5623	3.5467	3.5312
D47	4.4672 4.4402 4.4135	...	3.8350	3.8162	3.7977
D48	4.9907 4.9530 4.9161	...	4.1612	4.1379	4.1149
D49	5.7582 5.6977 5.6392	...	4.5672	4.5369	4.5071
D50		...	5.1050	5.0624	5.0210
D51		...			5.7677
D52					
D53					
D54					
D55					
D56					
D57					
D58					
D59					
D60					
D61					
D61					
D62					
D63					
N00					

N01							
N02							
N03							
N04	1.7e+7	1.3e+7	8.3e+6	...	9.3e+7	2.3e+7	1.4e+7
N05	8.9e+6	7.3e+6	4.7e+6	...	3.6e+7	3.3e+6	-5.7e+6
N06	5.2e+6	3.8e+6	2.8e+6	...	1.8e+7	1.9e+6	-2.7e+6
N07	3.1e+6	2.0e+6	1.9e+6	...	1.1e+7	3.1e+6	1.3e+6
N08	1.8e+6	1.2e+6	1.6e+6	...	5.7e+6	3.0e+6	1.6e+6
N09	1.3e+6	964959	1.3e+6	...	1.9e+6	907918	754334
N10	1.3e+6	768728	923905	...	414979	-20941	465284
N11	1.0e+6	621685	711679	...	443056	9440.2	584411
N12	767281	512404	592273	...	577617	202885	1.1e+6
N13	576843	431121	488397	...	436064	347849	2.0e+6
N14	429862	359385	388558	...	360912	713077	3.8e+6
N15	333126	296551	311766	...	422713	1.5e+6	6.7e+6
N16	304136	257262	258238	...	616336	2.9e+6	1.0e+7
N17	274365	219690	212223	...	868205	4.3e+6	1.3e+7
N18	230314	184889	179919	...	1.1e+6	5.0e+6	1.3e+7
N19	200924	158461	165180	...	1.3e+6	5.1e+6	1.1e+7
N20	177710	146166	157718	...	1.6e+6	4.9e+6	8.7e+6
N21	155008	139360	146398	...	1.7e+6	4.6e+6	6.5e+6
N22	140816	126587	130999	...	1.6e+6	3.8e+6	4.6e+6
N23	121124	109708	120646	...	1.6e+6	2.8e+6	3.0e+6
N24	97263	93412	116639	...	1.6e+6	2.2e+6	1.9e+6
N25	86051	86804	106888	...	1.5e+6	1.6e+6	1.2e+6
N26	77397	85316	89612	...	1.2e+6	1.1e+6	727434
N27	65034	77233	77047	...	851860	718282	412021
N28	59026	66127	70259	...	584131	428478	209074
N29	50985	56198	61063	...	367922	231057	96781
N30	40194	46466	48851	...	225946	116619	42418
N31	32791	38667	38739	...	128777	57111	18438
N32	26779	30998	30818	...	67060	27643	8231.6
N33	21174	24803	24561	...	32615	12167	3448.5
N34	15543	19429	18430	...	15240	4622.4	1196.3
N35	11074	14746	13021	...	7517.4	1769.8	372.01
N36	8063.7	10718	8927.8	...	3299.7	699.22	127.95
N37	5579.9	7232.0	5896.5	...	1201.5	236.46	50.288
N38	3660.6	4631.9	3782.0	...	428.02	73.016	40.260
N39	2451.6	3052.0	2462.6	...	153.45	23.465	45.138
N40	1619.3	2074.6	1583.4	...	51.607	6.7670	45.100
N41	982.38	1326.3	973.26	...	17.781	2.8902	43.531
N42	559.59	801.97	590.94	...	5.7216	1.2082	41.131
N43	311.72	452.26	341.63	...	1.1879	0.9027	36.637
N44	169.68	239.35	178.44	...	0.1858	1.2911	32.235
N45	81.786	121.41	84.666	...	0.1087	1.4566	27.688
N46	34.401	57.447	38.938	...	0.2992	1.2458	21.402
N47	14.599	25.105	17.415	...	0.3312	0.8860	14.571
N48	6.0655	10.083	6.7792	...	0.2702	0.6419	8.2911
N49	2.5061	3.6136	2.2706	...	0.2706	0.4230	4.0321
N50				...	0.2527	0.3298	1.8604
N51				...			0.7945
N52							
N53							
N54							
N55							
N56							
N57							
N58							
N59							
N60							
N61							
N62							
N63							
PIA	0.000	0.028	0.054	...	0.743	0.833	0.939
z	32.52	33.54	32.65	...	33.37	33.36	33.33
Z	32.52	33.56	32.69	...	34.10	34.18	34.25
RR	2.93	3.25	3.09	...	12.16	16.29	20.79
LWC	0.17	0.18	0.17	...	0.76	1.07	1.49
W	6.57	6.73	6.57	...	5.11	4.61	4.16



## 6.5 Raw Spectra

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### 6.5.1 Format Description

Each data block in a **raw spectra** file begins with a header line.

Example:

```
MRR 090612024311 UTC DVS 6.00 DSN 200708021 BW 37300 CC 2079868 MDQ 100 58 58 TYP RAW
```

<	Identifier for MRR data
090612024311	date/time stamp in format YYMMDDhhmmss
UTC	time zone information
DVS_6.00	Device version number (firmware)
DSN_200708021	Device serial number
BW_37300	Bandwidth
CC_2079868	Calibration constant
MDQ_100 58 58	Micro Rain Radar Data quality: percentage of valid spectra, number of valid spectra and number of total spectra
TYP_RAW	Identifier for data type (raw)

The next data lines contain the measuring heights. It begins with the capital letter H (H means height) and two space characters. 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 characters TF (Transfer Function) 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 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.

## 6.5.2 Raw Spectra Example

```

MRR 090612024311 UTC DVS 6.00 DSN 0200708021 BW 37300 CC 2079868 MDQ 100 58 58 TYP RAW
H      0      35      70      ...      1015      1050      1085
TF 0.003292 0.011523 0.041975 ... 0.689026 0.640604 0.422497
F00  4798  2205  166  ...  6  6  4
F01  2780  1272  107  ...  8  7  5
F02  541   246   33  ...  10  8  6
F03   39    22   17  ...  11  8  6
F04   4     9   18  ...  12  9  6
F05   3     9   19  ...  12  11  7
F06   3     9   20  ...  13  12  7
F07   3     9   21  ...  12  12  7
F08   3    10   23  ...  10  11  6
F09   4    11   28  ...   9  10  6
F10   5    13   34  ...  12   9  5
F11   4    16   44  ...  14   8  4
F12   5    18   55  ...  13   7  4
F13   7    19   65  ...  13   6  5
F14   9    23   84  ...  15   9  6
F15  12    34  139  ...  17  12  7
F16  15    52  236  ...  19  12  8
F17  24    75  325  ...  22  12  7
F18  48   120  374  ...  23  12  7
F19  98   215  526  ...  25  15  9
F20  177  377  803  ...  29  19  11
F21  290  582  1054  ...  38  24  12
F22  492  873  1270  ...  48  31  16
F23  814  1437  1629  ...  61  40  22
F24  1103 2015 2193  ...  88  55  33
F25  1215 2304 3049  ...  130  81  48
F26  1202 2861 4088  ...  162  106  61
F27  1692 3945 4978  ...  200  124  79
F28  3428 4611 6013  ...  282  146  97
F29  6270 5873 8179  ...  355  166  105
F30  9754 9622 11394 ...  369  204  128
F31  13520 15729 15559 ...  331  251  187
F32  15274 23192 21914 ...  289  266  227
F33  13520 26471 25550 ...  276  245  176
F34  9754 21874 22408 ...  273  218  116
F35  6270 15310 16602 ...  237  211  110
F36  3428 9683 12461 ...  176  178  103
F37  1692 5905 11128 ...  119  114  68
F38  1202 4727 11416 ...   64  53  32
F39  1215 4582 11578 ...   25  21  16
F40  1103 4033 10911 ...   15  14  10
F41   814 3225 9611  ...   14  13   9
F42   492 2421 7508  ...   12  12   8
F43   290 1436 4351  ...   12  13   7
F44   177 675 2171  ...   13  14   8
F45   98  318 1386  ...   14  12   7
F46   48  149 828  ...   13  11   7
F47   24   60 332  ...   11  11   7
F48   15   21 96  ...   10  10   8
F49   12   10 33  ...   10   9   7
F50   9    8 19  ...   11  10   7
F51   7    7 14  ...   11  11   6
F52   5    7 12  ...   13  13   7
F53   4    6 11  ...   14  13   8
F54   5    8 13  ...   14  10   8
F55   4   10 15  ...   12   9   6
F56   3    9 15  ...   11  10   6
F57   3   10 19  ...   11   9   6
F58   3   11 24  ...   9   8   6
F59   3   10 24  ...   10   8   6
F60   4    9 21  ...   10  10   6
F61   39   25 18  ...   10  11   6
F62  541  254 29  ...   11  10   6
F63  2780 1279 95  ...   10   8   4

```