

Waldorf Microwave 2 System Exclusive Specifications,
Software release 2.16

Changes from 2.01 to 2.09 marked with !!
Changes from 2.09 to 2.16 marked with !!!

If you find any documentatation bug herein, please mail it to
bugs@waldorf-gmbh.de

1. General

Sys-Ex dumps and requests will always be in the following form:

F0h IDW DEV IDM LOC -----Data----- CHKSUM F7h

where

- h : Hex
- IDW : Waldorf MIDI ID = 3Eh
- IDE : Equipment ID = 0Eh for MicroWave 2
- DEV : Device number, 00h to 7Eh, 7Fh = broadcast
- IDM : Message ID
- LOC : Location
- Data : whatever data bytes, 00h to 7Fh
- CHKSUM : Sum of all databytes truncated to 7 bits.
The addition is done in 8 bit format, the result is
masked to 7 bits (00h to 7Fh). A checksum of 7Fh is
always accepted as valid.
IMPORTANT: the MIDI status-bytes as well as the
ID's are not used for computing the checksum.
If there are no data-bytes in the message (simple
request), the checksum will always be 00h.

1.1 Message IDs (IDM)

Message IDs (IDM) are organized in a matrix where the row
defines the data type and the column identifies the type
of dump. The data type is coded in the four least significant
bits of the IDM. Following data types are currently defined:

Label	Value	Description
SNDx	x0h	Sound data type
MULx	x1h	Multi data type
WAVx	x2h	Wave data type
WCTx	x3h	Wave control table data type
GLBx	x4h	Global Parameters
DISx	x5h	Display
RMTx	x6h	Remote control
MODx	x7h	Mode (sound/Multimode)
INFx	x8h	Information

The dump type is coded in the upper three bits of IDM,
note that bit seven cannot be used. Following dump types
are currently defined:

Label	Value	Description
xxxR	0xh	Request
xxxD	1xh	Dump
xxxP	2xh	Parameter Change
xxxS	3xh	Store command
xxxL	4xh	Recall Command
xxxC	5xh	Compare command

Not all combinations of dump types and data types are currently supported, only those given below:

Request (xxxR = 0x)				
Dump (xxxD = 1x)				
Parameter Change (xxxP = 2x)				
Store (xxxS = 3x)				
Recall (xxxL = 4x)				
Compare (xxxC = 5x)				
Data Type				
00	10	20		SNDx x0 Sound
01	11			MULX x1 Multi
02	12			WAVx x2 Wave
03	13			WCTx x3 Wavetable
04	14	24		GLBx x4 Global Parameters
05	15	25	45	DISx x5 Display
		26		RMTx x6 Button / Dial remote
07	17			MODx x7 Mode !!!

So following valid IDM exist:

Label	Value	Description
SNDR	00h	Sound Request
SNDD	10h	Sound Dump
SNDP	20h	Sound Parameter Change
MULR	01h	Multi Request
MULD	11h	Multi Dump
WAVR	02h	Wave Request
WAVD	12h	Wave Dump
WCTR	03h	Wave Control Table Request
WCTD	13h	Wave Control Table Dump
GLBR	14h	Global Parameter Request
GLBD	14h	Global Parameter Dump
DISR	05h	Display Request
DISD	15h	Display Dump
DISP	25h	Display Parameter Change
DISL	45h	Display Recall
RMTD	26h	Remote Dump
MODR	07h	Mode Request
MODD	17h	Mode Dump

2. Details

2.11 SNDR

```
*****  
SNDR      00h      Sound Request
```

Upon reception of a valid sound request the MW2 will dump the selected Sound(s). The location is given in two bytes with following conventions:

```
BB NN      Location  
-----  
00 00 .. 00 7F Locations A001..A128  
01 00 .. 01 7F Locations B001..B128  
10 00      All Sounds  
20 00      Sound Mode Edit Buffer  
30 00 .. 30 07 Multi Instrument Edit Buffers  
-----
```

So the full format of a SNDR Dump is:

Index	Label	Value	Description
0	EXC	F0h	Marks Start of SysEx
1	IDW	3Eh	Waldorf Electronics GmbH ID
2	IDE	0Eh	Microwave 2 ID
3	DEV		Device ID
4	IDM	00h	here SNDR (Sound request)
5	BB	see Text	Location
6	NN	see Text	Location
7	XSUM	(BB+NN)&7Fh	Checksum
8	EOX	F7h	End of SysEx

```
*****
```

2.12 SNDD

```
*****  
SNDD      10h      Sound Dump
```

A sound dump is used to transfer sound data from and to the Microwave 2. The location is given in two bytes with following conventions:

```
BB NN      Location  
-----  
00 00 .. 00 7F Locations A001..A128  
01 00 .. 01 7F Locations B001..B128  
10 00      All Sounds  
20 00      Sound Mode Edit Buffer  
30 00 .. 30 07 Multi Instrument Edit Buffers  
-----
```

So the full format of a SNDD Dump is:

Index	Label	Value	Description
0	EXC	F0h	Marks Start of SysEx
1	IDW	3Eh	Waldorf Electronics GmbH ID
2	IDE	0Eh	Microwave 2 ID
3	DEV		Device ID
4	IDM	10h	here SNDD (Sound Dump)
5	BB	see above	Location

6	NN	see above	Location
7-262	SDATA	see 3.1	Sound data
263	XSUM	(BB+NN+SDATA)&7Fh	Checksum
264	EOX	F7h	End os SysEx

Or in case of All Sounds Dump:

Index	Label	Value	Description
0	EXC	F0h	Marks Start of SysEx
1	IDW	3Eh	Waldorf Electronics GmbH ID
2	IDE	0Eh	Microwave 2 ID
3	DEV		Device ID
4	IDM	10h	here SNDD (Sound Dump)
5	BB	see above	Location
6	NN	see above	Location
7-65542	SDATA[256]	see 3.1	256 times Sound data from A001 to B128
65543	XSUM	(BB+NN+SDATA)&7Fh	Checksum
65544	EOX	F7h	End os SysEx

2.13 SNDP

SNDP 20h Sound Parameter Change

Upon reception of a valid Sound Parameter Change dump, the specified parameter will change its value immediately according to the given value. The location is given in one byte with following conventions:

LL	Location
00h	Sound Mode Edit Buffer or...
00h..07h	Multi Mode Instrument 1..8 sound buffer

The Parameter index is given in two bytes:

HH	PP	Parameter index
00h	00..7Fh	Parameters with indices 0 to 127
01h	00..7Fh	Parameters with indices 0 to 127

See 3.1 for a detailed list of parameters and indices.

So the actual Format is:

Index	Label	Value	Description
0	EXC	F0h	Marks Start of SysEx
1	IDW	3Eh	Waldorf Electronics GmbH ID
2	IDE	0Eh	Microwave 2 ID
3	DEV		Device ID
4	IDM	20h	here SNDP (Sound Parameter change)
5	LL	see above	Location
6	HH	see above	Parameter index high bit
7	PP	see above	Parameter index

8	XX	see 3.1	New Parameter value
9	EOX	F7h	End of Exclusive

Note that the checksum is omitted here.

2.21 MULR

MULR 11h Multi Request

Upon reception of a valid multi request the MW2 will dump the selected Multi(s). The location is given in two bytes with following conventions:

BB NN	Location
00 00 .. 00 7F	Locations 001..128
10 00	All Multis
20 00	Edit Buffer

So the full format of a MULR Dump is:

Index	Label	Value	Description
0	EXC	F0h	Marks Start of SysEx
1	IDW	3Eh	Waldorf Electronics GmbH ID
2	IDE	0Eh	Microwave 2 ID
3	DEV		Device ID
4	IDM	01h	here MULR (Multi request)
5	BB	see Text	Location
6	NN	see Text	Location
7	XSUM	(BB+NN)&7Fh	Checksum
8	EOX	F7h	End os SysEx

2.22 MULD

MULD 21h Multi Dump

A multi dump is used to transfer multi data from and to the Microwave 2. The location is given in two bytes with following conventions:

BB NN	Location
00 00 .. 00 7F	Locations 001..128
10 00	All Multis
20 00	Edit Buffer

So the full format of a MULD Dump is:

Index	Label	Value	Description
0	EXC	F0h	Marks Start of SysEx
1	IDW	3Eh	Waldorf Electronics GmbH ID
2	IDE	0Eh	Microwave 2 ID

3	DEV		Device ID
4	IDM	11h	here MULD (Multi Dump)
5	BB	see above	Location
6	NN	see above	Location
7-38	MDATA	see 3.2	Multi data
39-66	IDATA	see 3.3	Instrument #1 data
67-94	IDATA	see 3.3	Instrument #2 data
95-122	IDATA	see 3.3	Instrument #3 data
123-150	IDATA	see 3.3	Instrument #4 data
151-178	IDATA	see 3.3	Instrument #5 data
179-206	IDATA	see 3.3	Instrument #6 data
207-234	IDATA	see 3.3	Instrument #7 data
235-262	IDATA	see 3.3	Instrument #8 data
263	XSUM	(BB+NN+DATA)&7Fh	Checksum
264	EOX	F7h	End os SysEx

2.23 MULP

MULP 20h Multi Parameter Change

Upon reception of a valid Multi Parameter Change dump, the specified parameter will change its value immediately according to the given value. In Sound Mode, all MULP messages will be ignored. The location is given in one byte with following conventions:

LL	Location

20h	Multi Edit Buffer
01h..07h	Multi Mode Instrument 1..8 buffer

The Parameter index is given in one byte:

PP	Parameter index

00..1Fh	Parameters with indices 0 to 31

See 3.2 for a detailed list of Multi parameters and indices, or 3.3 for a detailed list of Instrument parameters and indices.

The actual Format is:

Index	Label	Value	Description

0	EXC	F0h	Marks Start of SysEx
1	IDW	3Eh	Waldorf Electronics GmbH ID
2	IDE	0Eh	Microwave 2 ID
3	DEV		Device ID
4	IDM	21h	here MULP (Sound Parameter change)
5	LL	see above	Location
7	PP	see above	Parameter index
8	XX	see 3.2/3.3	New Parameter value
9	EOX	F7h	End of Exclusive

2.31 WAVR

WAVR 02h Wave Request

Upon reception of a valid wave request the MW2 will dump the selected Wave. The location is given in two bytes with following conventions:

HH LL	Location
00 00 .. 00 7F	ROM Waves 000..127
01 00 .. 01 7F	ROM Waves 128..255
01 00 .. 01 2B	ROM Waves 256..299
07 68 .. 07 7F	User Waves 1000..1023
08 00 .. 08 7F	User Waves 1024..10151
09 00 .. 09 61	User Waves 1152..1249

So the full format of a WAVR Request is:

Index	Label	Value	Description
0	EXC	F0h	Marks Start of SysEx
1	IDW	3Eh	Waldorf Electronics GmbH ID
2	IDE	0Eh	Microwave 2 ID
3	DEV		Device ID
4	IDM	02h	here WAVR (Wave request)
5	HH	see Text	Location
6	LL	see Text	Location
7	XSUM	(HH+LL)&7Fh	Checksum
8	EOX	F7h	End os SysEx

2.32 WAVD

WAVD 12h Wave Dump

A wave dump is used to transfer wave data from and to the Microwave 2. The location is given in two bytes with following conventions:

HH LL	Location
00 00 .. 00 7F	ROM Waves 000..127
01 00 .. 01 7F	ROM Waves 128..255
02 00 .. 02 2B	ROM Waves 256..299
07 68 .. 07 7F	User Waves 1000..1023
08 00 .. 08 7F	User Waves 1024..10151
09 00 .. 09 61	User Waves 1152..1249

So the full format of a WAVD Dump is:

Index	Label	Value	Description
0	EXC	F0h	Marks Start of SysEx
1	IDW	3Eh	Waldorf Electronics GmbH ID
2	IDE	0Eh	Microwave 2 ID
3	DEV		Device ID
4	IDM	12h	here WAVD (Wave Dump)

5	HH	see above	Location
6	LL	see above	Location
7-134	WDATA	see 3.4	Wave data
135	XSUM	(HH+LL+WDATA)&7Fh	Checksum
136	EOX	F7h	End os SysEx

2.41 WCTR

WCTR 03h Wave Control Table Request

Upon reception of a valid wave control table request, the MW2 will dump the selected Table. The location is given in two bytes with following conventions:

HH LL	Location
-----	-----
00 00 .. 00 7F	Control Table of Wavetables 001..128
-----	-----

Note that some Wavetables are generated algorithmically and have no control table, an attempt to request such a table will fail.

The full format of a WCTR Request is:

Index	Label	Value	Description
0	EXC	F0h	Marks Start of SysEx
1	IDW	3Eh	Waldorf Electronics GmbH ID
2	IDE	0Eh	Microwave 2 ID
3	DEV		Device ID
4	IDM	03h	here WCTR (Wavetable request)
5	HH	see Text	Location
6	LL	see Text	Location
7	XSUM	(HH+LL)&7Fh	Checksum
8	EOX	F7h	End os SysEx

2.42 WCTD

WAVD 13h Wave ControlDump

A Control Table dump is used to transfer Wavetable Control Table data from and to the Microwave 2. The location is given in two bytes with following conventions:

HH LL	Location
-----	-----
00 00 .. 00 7F	Control Table of Wavetables 001..128
-----	-----

Note that only Wavetables 96 to 128 are User Wavetables, an attempt to overwrite a wavetable outside this range will fail.

The full format of a WAVD Dump is:

Index	Label	Value	Description
-----	-----	-----	-----

0	EXC	F0h	Marks Start of SysEx
1	IDW	3Eh	Waldorf Electronics GmbH ID
2	IDE	0Eh	Microwave 2 ID
3	DEV		Device ID
4	IDM	13h	here WCTD (Wavetable Dump)
5	HH	see above	Location
6	LL	see above	Location
7-262	WCTDATA	see 3.5	Wave control table
263	XSUM	(HH+LL+WCTDATA)&7Fh	Checksum
264	EOX	F7h	End of SysEx

2.51 GLBR

WCTR 04h Global Parameter Request

Upon reception of a valid Global Parameter request, the MW2 will dump the Global Parameters. No location is given.

The full format of a GLBR Request is:

Index	Label	Value	Description
0	EXC	F0h	Marks Start of SysEx
1	IDW	3Eh	Waldorf Electronics GmbH ID
2	IDE	0Eh	Microwave 2 ID
3	DEV		Device ID
4	IDM	04h	here GLBR (Global Parameter request)
7	XSUM	0	Checksum
8	EOX	F7h	End os SysEx

2.52 GLBD

GLBD 14h Global Parameter Dump

A Global Parameter dump is used to transfer Global Parameter date from and to the Microwave 2.

The full format of a GLBD Dump is:

Index	Label	Value	Description
0	EXC	F0h	Marks Start of SysEx
1	IDW	3Eh	Waldorf Electronics GmbH ID
2	IDE	0Eh	Microwave 2 ID
3	DEV		Device ID
4	IDM	14h	here GLBD (Global Parameter Dump)
5-36	GDATA	see 3.6	Global Parameter Data
37	XSUM	GDATA&7Fh	Checksum
38	EOX	F7h	End of SysEx

2.53 GLBP

GLBP 24h Global Parameter Change

Upon reception of a valid Global Parameter Change dump, the specified parameter will change its value immediately according to the given value.

See 3.6 for a detailed list of parameters and indices.

The actual Format is:

Index	Label	Value	Description
0	EXC	F0h	Marks Start of SysEx
1	IDW	3Eh	Waldorf Electronics GmbH ID
2	IDE	0Eh	Microwave 2 ID
3	DEV		Device ID
4	IDM	24h	here GLBP (Global Parameter change)
5	PP	see above	Parameter index
6	XX	see 3.1	New Parameter value
7	EOX	F7h	End of Exclusive

Note that the checksum is omitted here.

2.61 DISR

DISR 05h Display Request

Upon reception of a valid Display Request request, the MW2 will dump the contents of the LCD. No location is given.

The full format of a DISR Request is:

Index	Label	Value	Description
0	EXC	F0h	Marks Start of SysEx
1	IDW	3Eh	Waldorf Electronics GmbH ID
2	IDE	0Eh	Microwave 2 ID
3	DEV		Device ID
4	IDM	05h	here DISR (LCD request)
7	XSUM	0	Checksum
8	EOX	F7h	End os SysEx

2.62 DISD

DISR 15h Display Dump

A Display Dump message is used to transfer LCD contents from and to the Microwave 2.

The full format of a DISD Request is:

Index	Label	Value	Description
0	EXC	F0h	Marks Start of SysEx
1	IDW	3Eh	Waldorf Electronics GmbH ID
2	IDE	0Eh	Microwave 2 ID

```

3      DEV          Device ID
4      IDM          15h      here DISD (LCD dump)
5-84  LCDDATA      ASCII    Upper and lower row of LCD
85    LEDDATA      LEDs Bitmask:
                                01: MIDI
                                02: Column #1
                                04: Column #2
                                08: Column #3
                                10: Column #4
                                20: Column #5
                                40: Play
86    XSUM          0        Checksum
87    EOX          F7h      End os SysEx

```


2.63 DISP

```
DISP    25h      LCD Parameter change
```

A LCD Parameter Change is used to change a single character in the LCD of the the Microwave 2.

The full format of a DISP Dump is:

Index	Label	Value	Description
0	EXC	F0h	Marks Start of SysEx
1	IDW	3Eh	Waldorf Electronics GmbH ID
2	IDE	0Eh	Microwave 2 ID
3	DEV		Device ID
4	IDM	25h	here DISP (LCD Parameter change)
5	LOC	0-79	Index of character in LCD
6	CHAR	ASCII	New character
7	XSUM	(LOC+CHAR)&7Fh	Checksum
8	EOX	F7h	End of SysEx

2.64 DISL

```
DISL    45h      LCD Recall
```

Upon reception of a Display Recall message, the LCD and the LEDs will be updated in order to discard a possibly previously dumped LCD content.

The full format of a DISL Dump is:

Index	Label	Value	Description
0	EXC	F0h	Marks Start of SysEx
1	IDW	3Eh	Waldorf Electronics GmbH ID
2	IDE	0Eh	Microwave 2 ID
3	DEV		Device ID
4	IDM	45h	here DISL (LCD Recall)
5	XSUM	0	Checksum
6	EOX	F7h	End of SysEx

2.71 RMTP

RMTP 26h Remote Control Parameter Change

The remote control Parameter change is used to remotely control the encoders and buttons of the Microwave 2. Operation might still introduce bugs.

The Element to move is coded in one byte:

UU	Element
00	Encoder #1 (left)
01	Encoder #2
02	Encoder #3
03	Encoder #4
04	Encoder #5 (big red one)
05	Play/Shift button
06	Soundpar #1/Store button
07	Soundpar #2/Recall button
08	Soundpar #3/Compare button
09	Multipar/Undo button
0A	Global/Utility button
0B	Power button

Another byte defines the movement to be simulated:

MM	Encoder	Button
00	encoder left turn -64	released
01	encoder left turn -63	pressed
2-63	encoder left by MM	pressed
64	no encoder move	pressed
65	encoder right by one	pressed
66-127	encoder right by MM	pressed

The full format of a RMTP Dump is:

Index	Label	Value	Description
0	EXC	F0h	Marks Start of SysEx
1	IDW	3Eh	Waldorf Electronics GmbH ID
2	IDE	0Eh	Microwave 2 ID
3	DEV		Device ID
4	IDM	26h	here RMTP
5	UU	see text	Element
6	MM	see text	Simulated movement
7	XSUM	(UU+MM)&7Fh	Checksum
8	EOX	F7h	End od SysEx

2.81 MODR

MODR 07h Mode Request

The full format of a MODR Dump is:

Index	Label	Value	Description
0	EXC	F0h	Marks Start of SysEx
1	IDW	3Eh	Waldorf Electronics GmbH ID
2	IDE	0Eh	Microwave 2 ID
3	DEV		Device ID
4	IDM	07h	here MODR
5	EOX	F7h	End of SysEx

2.82 MODD

MODD 17h Mode Dump

The full format of a MODD Dump is:

Index	Label	Value	Description
0	EXC	F0h	Marks Start of SysEx
1	IDW	3Eh	Waldorf Electronics GmbH ID
2	IDE	0Eh	Microwave 2 ID
3	DEV		Device ID
4	IDM	17h	here MODD
5	Mode	0-1	0: Sound 1:Multi
6	EOX	F7h	End of SysEx

3. Data Formats

3.1 SDATA - Sound Data

Note: All Parameters marked as "reserved" should be set to 0 for future compatibility.

Index	Range	Value	Parameter
0	0-1	1	Sound Format Version, currently 1, Format 0 is unpublished
1	16-112	-4...+4	Osc 1 Octave in Steps of 12
2	52-76	-12...+12	Osc 1 Semitone
3	0-127	-64...+64	Osc 1 Detune
4		reserved	
5	0-122	0-120,harmonic,global	Osc 1 Pitch Bend Range
6	0-76	-100%...+200%	Osc 1 Keytrack
7	0-127		osc 1 FM Amount !!
8		reserved	
9		reserved	
10		reserved	
11		reserved	
12	16-112	-4...+4	Osc 2 Octave in Steps of 12
13	52-76	-12...+12	Osc 2 Semitone
14	0-127	-64...+64	Osc 2 Detune

15	reserved	
16	0-1	off/on
17	0-122	0-120,hm.,gl.
18	0-76	-100%..+200%
19	0-1	off/on
20	reserved	
21	reserved	
22	reserved	
23	reserved	
24	reserved	
25	0-127	0..127
26	0-63	0..60,tri,sqr,saw
27	0-127	free,3-257 degree
28	0-127	-64..+64
29	0-127	-64..+64
30	0-127	-200%...+197%
31	0-1	off/on
32	reserved	
33	reserved	
34	reserved	
35	reserved	
36	0-63	0..60,tri,sqr,saw
37	0-127	free,3-257 degree
38	0-127	-64..+64
39	0-127	-64..+64
40	0-127	-200%...+197%
41	0-1	off/on
42	0-1	off/on
43	reserved	
44	reserved	
45	reserved	
46	reserved	
47	0-127	0..127
48	0-127	0..127
49	0-127	0..127
50	0-127	0..127
51	0-127	0..127
52	reserved	
53	0-5	off,1-5
54	0-5	off,1-5
55	0-1	saturate/overflow
56	reserved	
57	0-1	off/on
58	0-82	see List 3.11
59	0-82	see List 3.11
60	0-82	see List 3.11
61	0-82	see List 3.11
62	0-127	0..127
63	0-127	0..127
64	0-9	see List 3.15
65	0-127	-200%..+197%
66	0-127	-64..+63
67	0-127	-64..+63
68	reserved	
69	reserved	
70	0-127	Context Sensitive
71	reserved	
72	reserved	
73	0-127	0..127
74	0-1	6dB LP,6dB HP
75	0-127	-200%..+197%

	Osc 2 Sync
	Osc 2 Pitch Bend Range
	Osc 2 Keytrack
	Osc 2 Link
	Wavetable
	Wave 1 Startwave
	Wave 1 Start Phase
	Wave 1 Envelope Amount
	Wave 1 Envelope Velocity Amount
	Wave 1 Keytrack
	Wave 1 Limit
	Wave 2 Startwave
	Wave 2 Start Phase
	Wave 2 Envelope Amount
	Wave 2 Envelope Velocity Amount
	Wave 2 Keytrack
	Wave 2 Limit
	Wave 2 Link
	Mix Wave 1
	Mix Wave 2
	Mix Ringmod
	Mix Noise
	Mix External [XT only] !!
	Aliasing
	Time Quantization
	Clipping
	Accuracy !!
	Play Parameter #1 !!
	Play Parameter #2 !!
	Play Parameter #3 !!
	Play Parameter #4 !!
	Filter 1 Cutoff
	Filter 1 Resonance
	Filter 1 Type !!
	Filter 1 Keytrack
	Filter 1 Envelope Amount
	Filter 1 Envelope Velocity Amount
	Filter 1 Special Parameter !!
	Filter 2 Cutoff
	Filter 2 Typ
	Filter 2 Keytrack

76	0-7[MW2] 0-35[XT]	Effect Type (still subject to Change) !!
77	0-127 0..127	Amplifier Volume
78	reserved	
79	0-127 -64..+63	Amplifier Envelope Velocity Amount
80	0-127 -200%..+197%	Amplifier Keytrack
81	0-127	Effect Parameter #1 !!
82	0-1 off/on	Chorus !!
83	0-127	Effect Parameter #2 !!
84	0-127 left 64-center-right 63	Panning
85	0-127 -200%..+197%	Panning Keytrack
86	0-127	Effect Parameter #3 !!
87	0-1 off/on	Glide Active
88	0-3 porta,gliss,fp.,fg.	Glide Type
89	0-1 exp./linear	Glide Mode
90	0-127 0..127	Glide Time
91	reserved	
92	0-2 off,on,hold	Arpeggiator Active
93	1-127 extern,50-300 BpM	Arpeggiator Tempo
94	0-15 1/1..1/32	Arpeggiator Clock
95	1-10 1..10	Arpeggiator Range
96	0..16 off,user,1..15	Arpeggiator Pattern
97	0-3 up,down,alt,random	Arpeggiator Direction
98	0-3 note,n.rev,played,p.rev	Arpeggiator Note Order
99	0-1 root note/last note	Arpeggiator Velocity
100	0-1 off/on	Arpeggiator Reset on Pattern Start
101	0-15 1..16	Arpeggiator User Pattern Length
102	0-15 ----,---*,---*,---*	Arpeggiator User Pattern Pos 1-4
103	0-15 -*---,*---,*---,*---	Arpeggiator User Pattern Pos 5-8
104	0-15 *---,*---,*---,*---	Arpeggiator User Pattern Pos 9-12
105	0-15 **---,**---,**---,**---	Arpeggiator User Pattern Pos 13-16
106	reserved	
107	reserved	
108	0-1 Poly/Mono	Allocation Mode
109	0-2 normal/dual/unisono	Assignment
110	0-127 0..127	Detune
111	reserved	
112	0-127	De-Pan !!
113	0-127 0..127	Filter Env Attack
114	0-127 0..127	Filter Env Decay
115	0-127 0..127	Filter Env Sustain
116	0-127 0..127	Filter Env Release
117	0-2 normal,single,retrigger	Filter Env Trigger
118	reserved	
119	0-127 0..127	Amplifier Env Attack
120	0-127 0..127	Amplifier Env Decay
121	0-127 0..127	Amplifier Env Sustain
122	0-127 0..127	Amplifier Env Release
123	0-2 normal,single,retrigger	Amplifier Env Trigger
124	reserved	
125	0-127 0..127	Wave Env Time 1
126	0-127 0..127	Wave Env Level 1
127	0-127 0..127	Wave Env Time 2
128	0-127 0..127	Wave Env Level 2
129	0-127 0..127	Wave Env Time 3
130	0-127 0..127	Wave Env Level 3
131	0-127 0..127	Wave Env Time 4
132	0-127 0..127	Wave Env Level 4
133	0-127 0..127	Wave Env Time 5
134	0-127 0..127	Wave Env Level 5
135	0-127 0..127	Wave Env Time 6
136	0-127 0..127	Wave Env Level 6

137	0-127	0..127	Wave Env Time	7
138	0-127	0..127	Wave Env Level	7
139	0-127	0..127	Wave Env Time	8
140	0-127	0..127	Wave Env Level	8
141	0-2	normal, single, retrigger	Wave Env Trigger	
142	0-1	off/on	Wave Key On Loop	
143	0-7	1..8	Wave Key On Loop Start	
144	0-7	1..8	Wave Key On Loop End	
145	0-1	off/on	Wave Key Off Loop	
146	0-7	1..8	Wave Key Off Loop Start	
147	0-7	1..8	Wave Key Off Loop End	
148	reserved			
149	0-127	0..127	Free Env Time	1
150	0-127	-64..+63	Free Env Level	1
151	0-127	0..127	Free Env Time	2
152	0-127	-64..+63	Free Env Level	2
153	0-127	0..127	Free Env Time	3
154	0-127	-64..+63	Free Env Level	3
155	0-127	0..127	Free Env Release Time	
156	0-127	-64..+63	Free Env Release Level	
157	0-2	normal, single, retrigger	Free Env Trigger	
158	reserved			
159	0-127	0..127 (or Notation)	LFO 1 Rate !!	
160	0-5	sin, tri, sqr, saw, rnd, S&H	LFO 1 Shape	
161	0-127	0..127	LFO 1 Delay	
162	0-3	off/on/on/Clock	LFO 1 Sync !!	
163	0-127	-64..+63	LFO 1 Symmetry	
164	0-127	0..127	LFO 1 Humanize	
165	reserved			
166	0-127	0..127 (or notation)	LFO 2 Rate !!	
167	0-5	sin, tri, sqr, saw, rnd, S&H	LFO 2 Shape	
168	0-127	0..127	LFO 2 Delay	
169	0-3	off/on/on/Clock	LFO 2 Sync !!	
170	0-127	-64..+63	LFO 2 Symmetry	
171	0-127	0..127	LFO 2 Humanize	
172	0-127	free, 3-357 degree	LFO 2 Phase	
173	reserved			
174	0-31	see List 3.12	Modifier Delay Source	
175	0-127	0..127	Modifier Delay Time	
176	0-31	see List 3.12	Modifier 1 Source 1	
177	0-31	see List 3.12	Modifier 1 Source 2	
178	0-15	see List 3.14	Modifier 1 Type	
179	0-127	0..127	Modifier 1 Parameter	
180	0-31	see List 3.12	Modifier 2 Source 1	
181	0-31	see List 3.12	Modifier 2 Source 2	
182	0-15	see List 3.14	Modifier 2 Type	
183	0-127	0..127	Modifier 2 Parameter	
184	0-31	see List 3.12	Modifier 3 Source 1	
185	0-31	see List 3.12	Modifier 3 Source 2	
186	0-15	see List 3.14	Modifier 3 Type	
187	0-127	0..127	Modifier 3 Parameter	
188	0-31	see List 3.12	Modifier 3 Source 1	
189	0-31	see List 3.12	Modifier 3 Source 2	
190	0-15	see List 3.14	Modifier 3 Type	
191	0-127	0..127	Modifier 3 Parameter	
192	0-31	see List 3.12	Mod 1 Source	
193	0-127	-64..+63	Mod 1 Amount	
194	0-33	see List 3.13	Mod 1 Destination	
195	0-31	see List 3.12	Mod 2 Source	
196	0-127	-64..+63	Mod 2 Amount	
197	0-33	see List 3.13	Mod 2 Destination	

198	0-31	see List 3.12	Mod 3 Source
199	0-127	-64..+63	Mod 3 Amount
200	0-33	see List 3.13	Mod 3 Destination
201	0-31	see List 3.12	Mod 4 Source
202	0-127	-64..+63	Mod 4 Amount
203	0-33	see List 3.13	Mod 4 Destination
204	0-31	see List 3.12	Mod 5 Source
205	0-127	-64..+63	Mod 5 Amount
206	0-33	see List 3.13	Mod 5 Destination
207	0-31	see List 3.12	Mod 6 Source
208	0-127	-64..+63	Mod 6 Amount
209	0-33	see List 3.13	Mod 6 Destination
210	0-31	see List 3.12	Mod 7 Source
211	0-127	-64..+63	Mod 7 Amount
212	0-33	see List 3.13	Mod 7 Destination
213	0-31	see List 3.12	Mod 8 Source
214	0-127	-64..+63	Mod 8 Amount
215	0-33	see List 3.13	Mod 8 Destination
216	0-31	see List 3.12	Mod 9 Source
217	0-127	-64..+63	Mod 9 Amount
218	0-33	see List 3.13	Mod 9 Destination
219	0-31	see List 3.12	Mod 10 Source
220	0-127	-64..+63	Mod 10 Amount
221	0-33	see List 3.13	Mod 10 Destination
222	0-31	see List 3.12	Mod 11 Source
223	0-127	-64..+63	Mod 11 Amount
224	0-33	see List 3.13	Mod 11 Destination
225	0-31	see List 3.12	Mod 12 Source
226	0-127	-64..+63	Mod 12 Amount
227	0-33	see List 3.13	Mod 12 Destination
228	0-31	see List 3.12	Mod 13 Source
229	0-127	-64..+63	Mod 13 Amount
230	0-33	see List 3.13	Mod 13 Destination
231	0-31	see List 3.12	Mod 14 Source
232	0-127	-64..+63	Mod 14 Amount
233	0-33	see List 3.13	Mod 14 Destination
234	0-31	see List 3.12	Mod 15 Source
235	0-127	-64..+63	Mod 15 Amount
236	0-33	see List 3.13	Mod 15 Destination
237	0-31	see List 3.12	Mod 16 Source
238	0-127	-64..+63	Mod 16 Amount
239	0-33	see List 3.13	Mod 16 Destination
240	32-127	ASCII	Name 1
241	32-127	ASCII	Name 2
242	32-127	ASCII	Name 3
243	32-127	ASCII	Name 4
244	32-127	ASCII	Name 5
245	32-127	ASCII	Name 6
246	32-127	ASCII	Name 7
247	32-127	ASCII	Name 8
248	32-127	ASCII	Name 9
249	32-127	ASCII	Name 10
250	32-127	ASCII	Name 11
251	32-127	ASCII	Name 12
252	32-127	ASCII	Name 13
253	32-127	ASCII	Name 14
254	32-127	ASCII	Name 15
255	32-127	ASCII	Name 16

3.11 Play Parameters

Value	Index	Parameter
0	1	Osc 1 Octave
1	2	Osc 1 Semitone
2	3	Osc 1 Detune
3	5	Osc 1 Pitchbend
4	6	Osc 1 Keytrack
5	12	Osc 2 Octave
6	13	Osc 2 Semitone
7	14	Osc 2 Detune
8	17	Osc 2 Pitchbend
9	18	Osc 2 Keytrack
10	25	Wavetable
11	26	Wave 1 Startwave
12	27	Wave 1 Phase
13	28	Wave 1 Env Amount
14	29	Wave 1 Velo Amount
15	30	Wave 1 Keytrack
16	36	Wave 2 Startwave
17	37	Wave 2 Phase
18	38	Wave 2 Env Amount
19	39	Wave 2 Velo Amount
20	40	Wave 2 Keytrack
21	47	Mix Wave 1
22	48	Mix Wave 2
23	49	Mix Ringmod
24	50	Mix Noise
25	53	Aliasing
26	54	Quantize
27	55	Clipping
28	62	Filter 1 Cutoff
29	63	Filter 1 Resonance
30	64	Filter 1 Type
31	65	Filter 1 Keytrack
32	66	Filter 1 Env Amount
33	67	Filter 1 Velo Amount
34	73	Filter 2 Cutoff
35	74	Filter 2 Type
36	75	Filter 2 Keytrack
37	77	Sound Volume
38	79	Amp Envelope Velo Amount
39	80	Amplifier Keytrack
40	81	Chorus
41	84	Panning
42	85	Pan Keytrack
43	87	Glide on/off
44	88	Glide Type
45	92	Arpeggiator on/off/hold
46	93	Arp Tempo
47	94	Arp Clock
48	95	Arp Range
49	96	Arp Pattern
50	97	Arp Direction
51	98	Arp Note Order
52	99	Arp Velocity
53	108	Allocation
54	109	Assignment
55	113	Filter Env Attack
56	114	Filter Env Decay
57	115	Filter Env Sustain

58	116	Filter Env Release
59	119	Amplifier Env Attack
60	120	Amplifier Env Decay
61	121	Amplifier Env Sustain
62	122	Amplifier Env Release
63	159	LF01 Rate
64	160	LF01 Shape
65	161	LF01 Delay
66	162	LF01 Sync
67	163	LF01 Symmetry
68	164	LF01 Humanize
69	166	LF02 Rate
70	167	LF02 Shape
71	168	LF02 Delay
72	169	LF02 Sync
73	170	LF02 Symmetry
74	171	LF02 Humanize
75	172	LF02 Phase
76	7	Osc 1 FM Amount !!
77	70	Filter 1 Special !!
78	90	Glide Time !!
79	--	Control W !!
80	--	Control X !!
81	--	Control Y !!
82	--	Control Z !!

3.12 Modulation Sources

Index	Modulation Source
0	off
1	LF01
2	LF01 * Modwheel
3	LF01 * Aftertouch
4	LF02
5	Filter Envelope
6	Amplifier Envelope
7	Wave Envelope
8	Free Envelope
9	Key Follow
10	Keytrack
11	Velocity
12	Release Velocity
13	Aftertouch
14	Poly Pressure
15	Pitch Bend
16	Modwheel
17	Sustain Control
18	Foot Control
19	Breath Control
20	Control W
21	Control X
22	Control Y
23	Control Z
24	Control Delay

25	Modofier #1
26	Modofier #2
27	Modofier #3
28	Modofier #4
29	MIDI Clock
30	minimum
31	Maximum

3.13 Modulation Destinations

Index	Modulation Destination
0	Pitch
1	Osc 1 Pitch
2	Osc 2 Pitch
3	Wave 1 Pos
4	Wave 2 Pos
5	Mix Wave 1
6	Mix Wave 2
7	Mix Ringmod
8	Mix Noise
9	Filter 1 Cutoff
10	Filter 1 Resonance
11	Filter 2 Cutoff
12	Volume
13	Panning
14	Filter Env Attack
15	Filter Env Decay
16	Filter Env Sustain
17	Filter Env Release
18	Amlifier Env Attack
19	Amlifier Env Decay
20	Amplifier Env Sustain
21	Amplifier Env Release
22	Wave Envelope Times
23	Wave Envelope Levels
24	Free Envelope Times
25	Free Envelope Levels
26	LF01 Rate
27	LF01 Level
28	LF02 Rate
29	LF02 Level
30	Mod #1 Amount
31	Mod #2 Amount
32	Mod #3 Amount
33	Mod #4 Amount
34	FM Amount
35	F1 Extra (Wave/BP offset/Osc2 FM/S&H Rate)

3.14 Modifiers

Index	Operand	Operation
0	+	Addition

1	-	Subtraction
2	*	Multiplication
3	/	Division
4	XOR	Bitwise exclusive-or
5	OR	Bitwise inclusive-or
6	AND	Bitwise and
7	S&H	Sample & Hold
8		Ramp
9		Switch
10		Abs value
11		Min value
12		Max value
13		Lag processor
14		Control filter
15		Differentiator

3.15 Filter 1 Types

Index	Filter Type
0	24 dB Lowpass
1	12 dB Lowpass
2	24 dB Bandpass
3	12 dB Bandpass
4	12 dB Highpass
5	Sine Waveshaper followed by 12 dB Lowpass
6	12 db Lowpass followed by Waveshaper !!
7	Dual 12 dB Low/Bandpass parallel !!
8	12 db Lowpass FM-Filter !!
9	12 db Lowpass with Sample & Hold !!

3.2 MDATA - Multi Data

Index	Range	Value	Parameter
0	0-127	0..127	Multi Volume
1	0-121	0..120,global	Control W
2	0-121	0..120,global	Control X
3	0-121	0..120,global	Control Y
4	0-121	0..120,global	Control Z
5	1-127	extern,50..300 BpM	Arpeggiator Tempo
6	reserved		
7	reserved		
8	reserved		
9	reserved		
10	reserved		
11	reserved		
12	reserved		
13	reserved		
14	reserved		
15	reserved		

16	32-127	ASCII	Name 1
17	32-127	ASCII	Name 2
18	32-127	ASCII	Name 3
19	32-127	ASCII	Name 4
20	32-127	ASCII	Name 5
21	32-127	ASCII	Name 6
22	32-127	ASCII	Name 7
23	32-127	ASCII	Name 8
24	32-127	ASCII	Name 9
25	32-127	ASCII	Name 10
26	32-127	ASCII	Name 11
27	32-127	ASCII	Name 12
28	32-127	ASCII	Name 13
29	32-127	ASCII	Name 14
30	32-127	ASCII	Name 15
31	32-127	ASCII	Name 16

3.3 IDATA - Instrument Data

Index	Range	Value	Parameter
0	0-1	A/B	Sound Bank
1	0-127	1..128	Sound Number
2	0-17	global,omni,1-16	MIDI Channel
3	0-127	0..127	Volume
4	16-112	-48..+48	Transpose
5	0-127	-64..+63	Detune
6	0-1	Main Out/Sub Out	Output
7	0-1	off/on	Status
8	0-127	left64..center..right63	Panning
9	0-2	off/on/inverse	Pan Mod
10		reserved	
11		reserved	
12	1-127	1..127	Lowest Velocity
13	1-127	1..127	Highest Velocity
14	0-127	0..127	Lowest Key
15	0-127	0..127	Highest Key
16	0-2	off,on,hold,Sound Arp	Arpeggiator Active
17	0-15	1/1..1/32	Arpeggiator Clock
18	1-10	1..10	Arpeggiator Range
19	0..16	off,user,1..15	Arpeggiator Pattern
20	0-3	up,down,alt,random	Arpeggiator Direction
21	0-3	note,n.rev,played,p.rev	Arpeggiator Note Order
22	0-1	root note/last note	Arpeggiator Velocity
23	0-1	off/on	Arpeggiator Reset on Pattern Start
24	0-18	off/Ch1-16/Inst/global	Arpeggiator Notes out !!
25		reserved	
26		reserved	
27		reserved	

3.4 WDATA - Wave Data

A Wave consists of 128 eight Bit samples, but only the first 64 of them are stored/transmitted, the second half is same as first except the values are

negated and the order is reversed:

$$\text{Wave}[64+n] = -\text{Wave}[63-n] \quad \text{for } n=0..63$$

Not that samples are not two's complement format, to get a signed byte, the most significant bit must be flipped:

signed char s = Wave[n]^0x80;

Index	Range	Value	Parameter
0	0-15	00h..F0h	Sample 1, most significant nibble
1	0-15	00h..0Fh	Sample 1, least significant nibble
2	0-15	00h..F0h	Sample 2, most significant nibble
3	0-15	00h..0Fh	Sample 2, least significant nibble
4	0-15	00h..F0h	Sample 3, most significant nibble
5	0-15	00h..0Fh	Sample 3, least significant nibble
[...]			
126	0-15	00h..F0h	Sample 64, most significant nibble
127	0-15	00h..0Fh	Sample 64, least significant nibble

3.5 WCTDATA - Wave Control table Data

A Wave control table consists of 64 entries that indicate a wave for the specific position. If the index is not valid, the position will be filled with a spectral interpolation of the neighbour waves. The last three Waves will always be triangle, square and sawtooth, and the first index must be valid. Valid indices are currently:

0-200 for ROM Waves 0 to 299,
 1000-1249 for User Waves 1000 to 1249

Index	Range	Value	Parameter
0	0-15	0000h..F000h	Index 1, most significant nibble, upper half
1	0-15	0000h..0F00h	Index 1, least significant nibble, upper half
2	0-15	0000h..00F0h	Index 1, most significant nibble, lower half
3	0-15	0000h..000Fh	Index 1, least significant nibble, lower half
4	0-15	0000h..F000h	Index 2, most significant nibble, upper half
5	0-15	0000h..0F00h	Index 2, least significant nibble, upper half
6	0-15	0000h..00F0h	Index 2, most significant nibble, lower half
7	0-15	0000h..000Fh	Index 2, least significant nibble, lower half
[...]			
252	0-15	0000h..F000h	Index 64, most significant nibble, upper half
253	0-15	0000h..0F00h	Index 64, least significant nibble, upper half

254	0-15	0000h..00F0h	Index 64, most significant nibble, lower half
255	0-15	0000h..000Fh	Index 64, least significant nibble, lower half

3.6 GDATA - Global Parameters

Note: Global Parameters are very unordered.

!!! All indices were wrong in previous documentations, sorry.

Index	Range	Value	Parameter
0		reserved	
1	1		version of GDATA, currently 1 !!!
2	0-2	A,B,Multi	Startup Soundbank or 2:Multi Mode
3	0-127	1..128	Startup Sound Number
4	1-17	omni,1-16	MIDI Channel
5	0-2	sound,multi,combined	Program Change Mode
6	0-126	0..126	Device ID DEV
7	0-121	0..120,harmonic	Bend Range
8	0-120	0..120	Controller W
9	0-120	0..120	Controller X
10	0-120	0..120	Controller Y
11	0-120	0..120	Controller Z
12	0-127	0..127	Main Volume
13		reserved	
14		reserved	
15	52-76	-12..+12	Transpose
16	54..74	430Hz..450Hz	Master Tune
17	0-127	0..127	Display Timeout
18	0-127	0..127	LCD Contrast
19		reserved	
20		reserved	
21		reserved	
22		reserved	
23	0-127	1..128	Startup Multi Number
24	0-16	off/Chn11-16	Arpeggiator Note out Channel !!
25	0-1	off/on	MIDI Clock output
26	0-3	off/Ctl/SysEx/Ctl+SysEx	Parameter send
27	0-1	off/on	Parameter receive
28	0-3	1..4	Input Gain [XT only] !!
29		reserved	
30		reserved	
31		reserved	

4.) Device Inquiry

The Microwave 2 responds to the Universal Device Inquiry message F0,7E,<channel>,06,01,F7 if <channel> is set to 7F or if <channel> matches the specific Device ID. The Microwave 2 will respond with the following:


```

F0,7E,06,02      Universal Device Header
3E,              Waldorf Electronics Manufacturer ID
0E,00,          Device family code : Microwave 2
XX,YY,          Device family member code, see below
VV,VV,VV,VV,    Software revision, ASCII, e.g. "2.09"
F7              EOX

```

Device family member codes (XX,YY):

```

00,00           Microwave 2
01,00           Microwave 2 with XT Mainboard (has Delay
Effects !)
03,00           Microwave XT
05,00           Microwave PC on Terratec EWS Frontmodule
09,00           MW2/XT with expandable Mainboard, 10 Voices !!!
19,00           Expanded MW2/XT, 30 Voices !!!

```

!!! All features are coded as bitmask, so more combinations are possible.
The bitmask values:

```

01  Mainboard 2.0
02  XT Frontboard
04  MWPC
08  Expandable Mainboard
10  Voice Expansion

```

2.82 INFR

```

INFR  07h      Information Request

```

This only works for Microwave PC on Terratec EWS Frontmodule !

The full format of a INFR Dump is:

Index	Label	Value	Description
0	EXC	F0h	Marks Start of SysEx
1	IDW	3Eh	Waldorf Electronics GmbH ID
2	IDE	0Eh	Microwave 2 ID
3	DEV		Device ID
4	IDM	08h	here INFR
5	Typ	xx	Typ of information
6	EOX	F7h	End of SysEx

2.83 INFD

```

INFD  18h      Information Dump

```

The full format of a INFD Dump is:

Index	Label	Value	Description
0	EXC	F0h	Marks Start of SysEx
1	IDW	3Eh	Waldorf Electronics GmbH ID
2	IDE	0Eh	Microwave 2 ID

```

3      DEV      Device ID
4      IDM      18h      here INFD
5      Typ      xx      Typ of Information give
6...   ii...    Information specific
6+N    EOX      F7h      End of SysEx

```


Information types

```

xx      Information      N      ii
-----
00:     Sampling rate    1      0: 32000 1:40000 2:44100 3:48000
01:     Routing          3      out1,out2,out3 :triple output assignments bitvectors
02:     MIDI Switches    1      bit 0: Serial MIDI in on/off 1: IIC MIDI in 2: IIC
MIDI out
03:     Ext In Select    1      0: Digital input 1 1:Digital input2 (Dream 9407)

```

Output assignments:

out1 (ESSIO TX0) (digital out 1)	Bit 3 In1 (ESSIO Rx)	Bit 2 In2 / 9407 (ESSI1 RX)	Bit 1 MW Main	Bit 0 MW Sub
out2 (ESSI1 TX0) (digital out 2)	Bit 3 In1 (ESSIO Rx)	Bit 2 In2 (ESSI1 RX)	Bit 1 MW Main	Bit 0 MW Sub
out3 (ESSI1 TX1) (Dream Input)	Bit 3 In1 (ESSIO Rx)	Bit 2 In2 (ESSI1 RX)	Bit 1 MW Main	Bit 0 MW Sub

So a complete routing dump is
F0,3E,0E,DEV,18,1,out1,out2,out3,F7

Default routing:

```

out1 = 0Fh
out2 = 0Fh
out3 = 0Fh
That is all signals to all outputs.

```

MIDI Switches:

0: off , else on

So a complete MIDI Switch dump is

F0,3E,0E,DEV,18,2,MM,F7

Default switching:

```

MM = 7, That is all in-/outputs on
MIDI IIC in is currently ignored to ensure all others can be turned on again.

```