

## MUS File Format

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FIDO: 2:423/36.2

### 1. General Description

A .MUS file is a simple clone of .MID file. It uses the same instruments, similar commands and the same principle: a list of sound events. It consists of two parts: header and body.

NOTE: All numerical values mentioned in this document are zero-based. If not specified otherwise, all numbers are given in decimal. Hexadecimal numbers are suffixed by 'h' (e.g. 5Ch). Bits are numbered in this fashion: LSB (right-most) = 0, MSB (left-most) = 7.

### 2. MUS File Header

The MUS header has the following structure:

```
struct MUSheader {
    char    ID[4];           // identifier "MUS" 0x1A
    WORD    scoreLen;
    WORD    scoreStart;
    WORD    channels; // count of primary channels
    WORD    sec_channels; // count of secondary channels
    WORD    instrCnt;
    WORD    dummy;
    // variable-length part starts here
    WORD    instruments[];
};
```

NOTE: WORD is a 16-bit unsigned integer (little-endian)

The header has two parts: the fixed-length and the variable-length part. The former contains file identifier, score start and length, number of channels and number of used instruments. The latter part is actually a list of used instruments. The instruments are stored as numbers which are arranged in this fashion:

Instrument Number	Meaning
0 - 127	standard MIDI instruments
135 - 181	standard MIDI percussions (notes 35 - 81)

`scoreStart' is the absolute file position of the score and `scoreLen' is its length in bytes. Usage of a 16-bit number as length limits .MUS file size to 64KB.

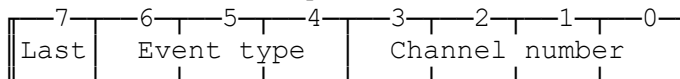
`channels' tells you how many channels are utilized in the song. The channel number 15 (percussions) is not included in the sum.

### 3. MUS File Body

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Unlike MID files, MUS body contains only one track. File body is a sequence of sound events and time records. A sound event consists of one or more bytes encoded as follows:

1st byte -- event descriptor:



`Event type' is one of these:

- 0 - release note
- 1 - play note
- 2 - pitch wheel (bender)
- 3 - system event (valueless controller)
- 4 - change controller
- 5 - ???
- 6 - score end
- 7 - ???

`Channel number' determines which channel this event refers to. Channels provide only logical score division. Every channel carries its own settings (instrument #, panning, volume) and the channel number specifies only which settings to use. In general, the channel number itself is almost irrelevant and may be chosen arbitrarily within the interval 0 to 14. The only exception is the channel number 15, which is dedicated ONLY to percussions.

`Last' - if set, the event is followed by time information. This means that this is the last event in a group of events which occur at the same time. The time information is a number of ticks to wait before processing next event. One tick is usually 1/140 sec (in Doom I, II and Heretic; Raptor uses 1/70 sec).

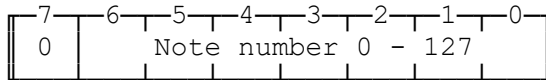
Time information can be read in this way:

1. time = 0
2. READ a byte
3. time = time \* 128 + byte AND 127
4. IF (byte AND 128) GO TO 2
5. RETURN time

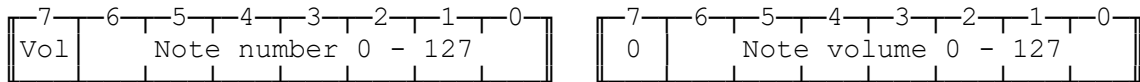
The time info is a series of 7-bit chunks. The bit #7 is set until the last byte whose bit 7 is zero. This scheme allows small numbers occupy less space than large ones.

## Event Type

0 Release note



1 Play note



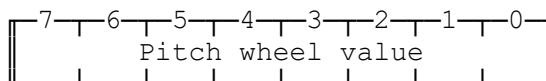
`Note volume' is present only if `Vol' bit is set. Otherwise the previous value is used and the second byte is not present.

NOTE: Each channel keeps track of its own last volume value.

More than one note can be played at once in one channel.

Channel 15 is dedicated to drums and percussions. `Note number' acts as an instrument selector there. See Appendix C

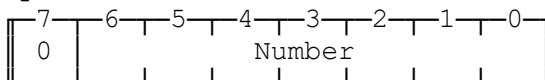
2 Pitch wheel



Sets pitch wheel (bender) value of a channel. Some handy values are shown in the table (all values in the range 0-255 can be used):

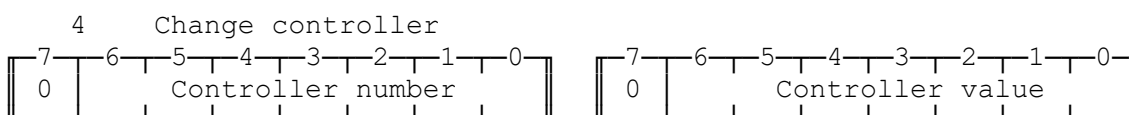
Value	Pitch change
0	two half-tones down
64	one half-tone down
128	normal (default)
192	one half-tone up
255	two half-tones up

3 System event (Valueless controller)



Number	MIDI ctrl	Description
10	120 (78h)	All sounds off
11	123 (7Bh)	All notes off
12	126 (7Eh)	Mono
13	127 (7Fh)	Poly
14	121 (79h)	Reset all controllers

NOTE: The second column (MIDI ctrl) lists the corresponding MIDI controller number. It is not needed unless you want to convert MUS file data to MIDI.



Number	MIDI ctrl	Description
0	N/A	Instrument (patch, program) number
1	0 or 32	Bank select: 0 by default
2	1 (01h)	Modulation pot (frequency vibrato depth)
3	7 (07h)	Volume: 0-silent, ~100-normal, 127-loud
4	10 (0Ah)	Pan (balance) pot: 0-left, 64-center (default), 127-right
5	11 (0Bh)	Expression pot
6	91 (5Bh)	Reverb depth
7	93 (5Dh)	Chorus depth
8	64 (40h)	Sustain pedal (hold)
9	67 (43h)	Soft pedal

NOTE: MUS controller 0 has no equivalent MIDI controller, but is encoded as MIDI event 0Cxh--patch change ('x' is the channel number)

5      Unknown  
Not known what data (if any) this command takes.

6      Score end  
No data.

Marks the end of score. Must be present at the end, otherwise the player may go off the rails. In DOOM this command restarts playing.

7      Unknown  
Not known what data (if any) this command takes.

## APPENDIX A - Note numbers

Octave	C	C#	D	D#	E	F	F#	G	G#	A	A#	B
0	0	1	2	3	4	5	6	7	8	9	10	11
1	12	13	14	15	16	17	18	19	20	21	22	23
2	24	25	26	27	28	29	30	31	32	33	34	35
3	36	37	38	39	40	41	42	43	44	45	46	47
4	48	49	50	51	52	53	54	55	56	57	58	59
5	60	61	62	63	64	65	66	67	68	69	70	71
6	72	73	74	75	76	77	78	79	80	81	82	83
7	84	85	86	87	88	89	90	91	92	93	94	95
8	96	97	98	99	100	101	102	103	104	105	106	107
9	108	109	110	111	112	113	114	115	116	117	118	119
10	120	121	122	123	124	125	126	127				

## APPENDIX B - Instrument Patch Map

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### Block 0-7 PIANO

- 0 Acoustic Grand Piano
- 1 Bright Acoustic Piano
- 2 Electric Grand Piano
- 3 Honky-tonk Piano
- 4 Rhodes Paino
- 5 Chorused Piano
- 6 Harpsichord
- 7 Clavinet

### Block 16-23 ORGAN

- 16 Hammond Organ
- 17 Percussive Organ
- 18 Rock Organ
- 19 Church Organ
- 20 Reed Organ
- 21 Accordion
- 22 Harmonica
- 23 Tango Accordion

### Block 32-39 BASS

- 32 Acoustic Bass
- 33 Electric Bass (finger)
- 34 Electric Bass (pick)
- 35 Fretless Bass
- 36 Slap Bass 1
- 37 Slap Bass 2
- 38 Synth Bass 1
- 39 Synth Bass 2

### Block 48-55 ENSEMBLE

- 48 String Ensemble 1
- 49 String Ensemble 2
- 50 Synth Strings 1
- 51 Synth Strings 2
- 52 Choir Aahs
- 53 Voice Oohs
- 54 Synth Voice
- 55 Orchestra Hit

### Block 64-71 REED

- 64 Soprano Sax
- 65 Alto Sax
- 66 Tenor Sax
- 67 Baritone Sax
- 68 Oboe
- 69 English Horn
- 70 Bassoon
- 71 Clarinet

### Block 80-87 SYNTH LEAD

- 80 Lead 1 (square)
- 81 Lead 2 (sawtooth)
- 82 Lead 3 (calliope)
- 83 Lead 4 (chiffer)

### Block 8-15 CHROM PERCUSSION

- 8 Celesta
- 9 Glockenspiel
- 10 Music Box
- 11 Vibraphone
- 12 Marimba
- 13 Xylophone
- 14 Tubular-bell
- 15 Dulcimer

### Block 24-31 GUITAR

- 24 Acoustic Guitar (nylon)
- 25 Acoustic Guitar (steel)
- 26 Electric Guitar (jazz)
- 27 Electric Guitar (clean)
- 28 Electric Guitar (muted)
- 29 Overdriven Guitar
- 30 Distortion Guitar
- 31 Guitar Harmonics

### Block 40-47 STRINGS

- 40 Violin
- 41 Viola
- 42 Cello
- 43 Contrabass
- 44 Tremolo Strings
- 45 Pizzicato Strings
- 46 Orchestral Harp
- 47 Timpani

### Block 56-63 BRASS

- 56 Trumpet
- 57 Trombone
- 58 Tuba
- 59 Muted Trumpet
- 60 French Horn
- 61 Brass Section
- 62 Synth Brass 1
- 63 Synth Bass 2

### Block 72-79 PIPE

- 72 Piccolo
- 73 Flute
- 74 Recorder
- 75 Pan Flute
- 76 Bottle Blow
- 77 Shakuhachi
- 78 Whistle
- 79 Ocarina

### Block 88-95 SYNTH PAD

- 88 Pad 1 (new age)
- 89 Pad 2 (warm)
- 90 Pad 3 (polysynth)
- 91 Pad 4 (choir)

84 Lead 5 (charang)  
 85 Lead 6 (voice)  
 86 Lead 7 (5th sawtooth)  
 87 Lead 8 (bass & lead)

92 Pad 5 (bowed glass)  
 93 Pad 6 (metal)  
 94 Pad 7 (halo)  
 95 Pad 8 (sweep)

#### Block 96-103 SYNTH EFFECTS

96 FX 1 (rain)  
 97 FX 2 (soundtrack)  
 98 FX 3 (crystal)  
 99 FX 4 (atmosphere)  
 100 FX 5 (brightness)  
 101 FX 6 (goblin)  
 102 FX 7 (echo drops)  
 103 FX 8 (star-theme)

#### Block 104-111 ETHNIC

104 Sitar  
 105 Banjo  
 106 Shamisen  
 107 Koto  
 108 Kalimba  
 109 Bag Pipe  
 110 Fiddle  
 111 Shanai

#### Block 112-119 PERCUSSIVE

112 Tinkle Bell  
 113 Agogo  
 114 Steel Drums  
 115 Woodblock  
 116 Taiko Drum  
 117 Melodic Tom  
 118 Synth Drum  
 119 Reverse Cymbal

#### Block 120-127 SOUND EFFECTS

120 Guitar Fret Noise  
 121 Breath Noise  
 122 Seashore  
 123 Bird Tweet  
 124 Telephone Ring  
 125 Helicopter  
 126 Applause  
 127 Gun Shot

### APPENDIX C - Percussion Key Map

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In channel #15, the note number does not affect the pitch but the instrument type. The default pitch for percussions is 60 (C-5).

#### Note Instrument

35 Acoustic Bass Drum  
 36 Bass Drum  
 37 Slide Stick  
 38 Acoustic Snare  
 39 Hand Clap  
 40 Electric Snare  
 41 Low Floor Tom  
 42 Closed High-Hat  
 43 High Floor Tom  
 44 Pedal High Hat  
 45 Low Tom  
 46 Open High Hat  
 47 Low-Mid Tom  
 48 High-Mid Tom  
 49 Crash Cymbal 1  
 50 High Tom  
 51 Ride Cymbal 1  
 52 Chinses Cymbal  
 53 Ride Bell  
 54 Tambourine  
 55 Splash Cymbal  
 56 Cowbell  
 57 Crash Cymbal 2  
 58 Vibraslap

#### Note Instrument

59 Ride Cymbal 2  
 60 High Bongo  
 61 Low Bongo  
 62 Mute High Conga  
 63 Open High Conga  
 64 Low Conga  
 65 High Timbale  
 66 Low Timbale  
 67 High Agogo  
 68 Low Agogo  
 69 Cabasa  
 70 Maracas  
 71 Short Whistle  
 72 Long Whistle  
 73 Short Guiro  
 74 Long Guiro  
 75 Claves  
 76 High Wood Block  
 77 Low Wood Block  
 78 Mute Cuica  
 79 Open Cuica  
 80 Mute Triangle  
 81 Open Triangle