

# MA-3 Sound Format Specification

– SMAF / MA-1 / MA-2 –

Version 1.6  
May 29, 2002

Yamaha Corporation

[Notes]

This document is the specification of MA-3 Sound Middleware as sample source code.  
This explains the expected operation of Sound Middleware, but doesn't guarantee operation of sample middleware.

Copyright to this document is the property of Yamaha Corporation.  
Transfer or copying of this document in part or in whole requires the permission of Yamaha Corporation.  
The contents of this document are subject to change without notice.



Copyright © 2001-2002 YAMAHA Corporation  
All rights reserved

CONFIDENTIAL

## Contents

1 Introduction .....	4
2 Decision of tracks to be processed .....	4
3 File Chunk (MMMD).....	5
4 Contents Info Chunk (CNTI) .....	6
4.1 Contents Class (necessary).....	7
4.2 Contents Type (necessary) .....	7
4.3 Contents Code Type (necessary).....	7
4.4 Copy Status (necessary).....	7
4.5 Option .....	8
4.5.1 L2: Information of LED on/off synchronization .....	8
5 Score Track Chunk (MTR*).....	9
5.1 Format Type (necessary).....	10
5.2 Sequence Type (necessary).....	10
5.3 TimeBase_D, TimeBase_G (necessary).....	10
5.4 Channel Status (necessary) .....	11
5.5 Seek & Phrase Info Chunk (optional).....	12
5.6 Setup Data Chunk (optional).....	12
5.7 Sequence Data Chunk (necessary).....	13
5.7.1 End of Sequence (EOS).....	13
5.7.2 Duration .....	13
5.7.3 Event.....	14
5.7.3.1 Note Message .....	14
5.7.3.2 Program change.....	15
5.7.3.3 Bank Select.....	15
5.7.3.4 Octave Shift.....	15
5.7.3.5 Modulation .....	16
5.7.3.6 Volume.....	17
5.7.3.7 Pan.....	17
5.7.3.8 Expression .....	18
5.7.3.9 NOP.....	18
5.7.3.10 Exclusive Message .....	19
5.7.3.11 MA-1 .....	20
6 PCM Audio Track Chunk (ATR*).....	25
6.1 Format Type (necessary).....	26
6.2 Sequence Type (necessary).....	26
6.3 Wave Type (necessary).....	26
6.4 TimeBase_D, TimeBase_G (necessary).....	27
6.5 Seek & Phrase Info Chunk (optional).....	27
6.6 Setup Data Chunk (optional).....	27
6.7 Sequence Data Chunk (necessary).....	28
6.7.1 End of Sequence (EOS).....	28
6.7.2 Duration .....	28
6.7.3 Event.....	29

6.7.3.1 Wave Message .....	29
6.7.3.2 Volume.....	29
6.7.3.3 NOP.....	29
6.8 Wave Data Chunk (necessary) .....	30

Note:

For explanation of explanation of SMAF configuration, the following formats are defined for use.

Definition format	Meaning	Definition format	Meaning
UINT8	8 bits without code	SINT8	8 bits with code
UINT16	16 bits without code	SINT16	16 bits with code
UINT32	32 bits without code	SINT32	32 bits with code

Revision

Version	Date	Contents
0.8	June 1, 2001	Initial edition
1.0	June 29, 2001	No. of Wave Data of PCM Audio Track Chunk is limited to 32.
1.1	August 3, 2001	Addition of description regarding decision of SMAF contents type
1.2	September 20, 2001	Addition the related table of the depth of modulation and data value.
1.3	November 26, 2001	Expression short Change the Message value translation table.
1.4	December 10, 2001	Description about st and sp was added. Description about the note message of Gate Time '0' was added. Description of M2 tag was deleted.
1.5	January 30, 2002	Clerical error was corrected. The description of voice selection exclusive message was deleted.
1.6	May.29, 2002	The description of the interpretable contents code type was added. Expression short message value conversion table was changed.

## 1 Introduction

This document describes SMAF / MA-1 / MA-2 data that are supported by MA-3 SMAF converter.

For data that do not conform to SMAF specifications shown in this document, the reproduction is not guaranteed.

Moreover, even if data meet the specification shown by this document, the completely same pronunciation as MA-2 was not guaranteed.

## 2 Decision of tracks to be processed

Classification of SMAF contents is performed as described below. By referring to ContentsType of ContentsInfoChunk, classify them roughly into SMAF MA-1/2 contents and SMAF MA-3 contents first, and then decide the SMAF contents based on their Track numbers.

Rough classification of the contents are as described by the following table.

ContentsType	SMAF contents class	Remarks
0x00~0x2F	MA-1/2	For MA-1/2 co-existent SMAF, MA-2 is reproduced preferentially.
0x30 or more and lower 4 bits are 0 or 1	MA-1/2	For MA-1/2 co-existent SMAF, MA-2 is reproduced preferentially.
0x32~0x3F	MA-3	Standard is 0x32,0x33. Others depend on the carrier.
0x42~0x4F	MA-3	Standard is 0x42,0x43. Others depend on the carrier.
0x52~0x5F	MA-3	Standard is 0x52,0x53. Others depend on the carrier.

Moreover, when contents of MA-1/2 are classified into MA-1 contents and MA-2 contents, they are classified based on the Track number as described by the following table.

	Score Track #	PCM Audio Track #
MA-1	0	-
MA-2	1 - 4	0

One SMAF file can store data for multiple devices.

In this case, when Tracks that comply with MA-2 exist, the Tracks that comply with MA-2 are to be processed. When only Tracks that comply with MA-1 exist, the Tracks that comply with MA-1 are to be processed.

The specifications for SMAF / MA-1 shown by this document are specifications of Score Track #0, and specifications for SMAF / MA-2 are specifications of Score Track #1-4 and PCM Audio Track #0. The difference of specifications between MA-1 and MA-2 is only Exclusive Message, and other items are common.

### 3 File Chunk (MMMD)

An example of minimum configuration of SMAF files which supports playback of music data by MA-3 converter is as follows. Two chunks including Contents Info Chunk that is essential for SMAF specification, and Score Track Chunk or PCM Audio Track Chunk that includes data to be reproduced by MA-3 synthesizer are needed.

```
< File Chunk >
= Header =
UINT32:      ID="MMMD"
UINT32:      Size           // Body size of File Chunk (including CRC) [bytes]

= Body =
  < Contents Info Chunk >
  = Header =
  UINT32:      ID="CNTI"
  UINT32:      Size           // Body size of Contents Info Chunk [bytes]
  = Body =
  :
  =====

  < Score Track Chunk / PCM Audio Track Chunk >
  = Header =
  UINT32:      ID="MTR*"or"ATR*"
  UINT32:      Size           // Body size of Track Chunk [bytes]
  = Body =
  :
  =====

WORD:        CRC
< end >
```

The head of Body section of File Chunk has to be Contents Info Chunk. The order of other Chunks is not defined.

#### 4 Contents Info Chunk (CNTI)

This is a chunk that stores information regarding data.

The structure of Contents Info Chunk is as described below.

```
< Contents Info Chunk >
= Header =
UINT32:      ID="CNTI"
UINT32:      Size           // Contents Info Chunk の Body size [bytes]
= Body =
UINT8:      Class           // contents class (necessary)
UINT8:      Type           // contents type (necessary)
UINT8:      Code Type      // character code (necessary)
UINT8:      Copy Status    // copy definition (necessary)
UINT8:      Copy Counts    // copy count (necessary)
UINT8:      Option[n]     // Example of optional data
=====
< end >
```

Contents Info Chunk is essential in the head of Body section of File Chunk. SMAF files can include only one Contents Info Chunk.

Contents Class, Contents Type, Contents Code Type and Copy Status and Copy Counts are essential in the head of Body section of Contents Info Chunk, and they have to be stored in the specified order.

Option is not essential, and is not required to be present.

#### 4.1 Contents Class (necessary)

Represents class of contents.

The value to be supported varies among carriers.

#### 4.2 Contents Type (necessary)

Represents type of contents.

The definition varies among Contents Classes.

#### 4.3 Contents Code Type (necessary)

Identifies character code system that is used for data representation of option. The interpretable code system is described in below.

**Table 1 The interpretable contents code type and its character code system**

Contents code type	Character code classification	Language
0x00	Shift_JIS	Japanese
0x01	Latin-1	English, French and Others
0x02	EUC-KR	Korean
0x23	UTF-8	Unicode
0xFF	Octet Stream	Binary value

#### 4.4 Copy Status (necessary)

Represents copy definition that the contents have.

#### 4.5 Option

For MA-3 converter, only the data that are set with the following two tags are used.

The information does not necessarily have to be stored.

##### 4.5.1 L2: Information of LED on/off synchronization

Name	Tag name	Hex
MA-2 LED channel	L2	0x4C 0x32

Designates synchronized channels when play synchronization mode is selected for LED on/off control of MA-2.

The value of Data means the synchronized channels as described below.

Data	Description
0x00	FM channel 0
0x01	FM channel 1
0x02	FM channel 2
0x03	FM channel 3
0x04	FM channel 4
0x05	FM channel 5
0x06	FM channel 6
0x07	FM channel 7
0x08	FM channel 8
0x09	FM channel 9
0x0A	FM channel 10
0x0B	FM channel 11
0x0C	FM channels 0-3
0x0D	FM channels 4-7
0x0E	FM channels 8-11
0x0F	ADPCM

When this tag is not set, channel synchronization for LED on/off is not performed.

## 5 Score Track Chunk (MTR\*)

This is a chunk that stores sequence data for reproduction of synthesizers.

Track with No. 0 complies with SMAF specification for MA-1, and Tracks with Nos. 1 to 4 comply with SMAF specification for MA-2. Track Chunks are not required to be stored in the order of Track numbers.

The structure of Score Track Chunk is as shown below.

```
< Score Track Chunk >
= Header =
UINT32:      ID="MTR*" // * represents a Track number.
UINT32:      Size      // Body size of Score Track Chunk [bytes]
= Body =
UINT8:       Format Type=0x00 // Type definition of Score Track 0: Handy Phone Standard (necessary)
UINT8:       Sequence Type=0x00 // Type definition of Sequence Data 0: Stream Sequence (necessary)
UINT8:       TimeBase_D // Standard time of Duration in Sequence Data (necessary)
UINT8:       TimeBase_G // Standard time of Gate time in Sequence Data (necessary)
UINT16:      Channel Status // Status information of 4 channels in the Track (necessary)
```

```
< Seek & Phrase Info Chunk > (Option)
= Header =
UINT32:      ID="MspI"
UINT32:      Size      // Body size of Seek & Phrase Info Chunk [bytes]
= Body =
UINT32:      Start Point // Reproduction starting position of Sequence Data [bytes]
UINT32:      Stop Point // Reproduction stopping position of Sequence Data [bytes]
UINB8:      PhraseList[n]
UINT8:      Sub-sequence List[n]
=====
```

```
< Setup Data Chunk > (Option)
= Header =
UINT32:      ID="Mtsu"
UINT32:      Size      // Body size of Setup Data Chunk [bytes]
= Body =
UINT8:      Exclusive Message[n] // tone parameter, etc.
=====
```

```
< Sequence Data Chunk > (necessary)
= Header =
UINT32:      ID="Mtsq"
UINT32:      Size      // Body size of Sequence Data Chunk [bytes]
= Body =
UINT8:      SeqData[n] // Sequence Data string
=====
```

```
=====
< end >
```

For Body section of Score Track Chunk, Format Type, Sequence Type, TimeBase\_D, TimeBase\_G and Channel Status are necessary, and they have to be stored in the specified order. Sequence Data Chunk is necessary. Tone parameters to be used are to be stored in Setup Data Chunk. For SMAF for MA-2, all tone parameters can be stored in one Track, or can be stored separately in individual Tracks.

The order of storage of sub-chunks is not defined.

### 5.1 Format Type (necessary)

Defines the type of Track Chunk.

Format Type	Description
0x00	Handy Phone Standard

This must be 0x00.

### 5.2 Sequence Type (necessary)

Defines the type of Sequence Data.

Format Type	Description
0x00	Stream Sequence

This must be 0x00.

### 5.3 TimeBase\_D, TimeBase\_G (necessary)

Defines standard time that is used in Sequence Data.

TimeBase\_D is the standard time of Duration, and TimeBase\_G is the standard time of GateTime.

Timebase_D,G	Description
0x00	1 msec
0x01	2 msec
0x02	4 msec
0x03	5 msec
0x04~0x0F	Reserved
0x10	10 msec
0x11	20 msec
0x12	40 msec
0x13	50 msec
0x14~0xFF	Reserved

Default is 0x02.

0x00 and 0x01 are to be prohibited.

The values of TimeBase\_D and TimeBase\_G of all Tracks must be the same.

## 5.4 Channel Status (necessary)

Defines the status of 4 channels in the Track. 4 bits define the status of one channel.

Data Count	b7	b6	b5	b4	b3	b2	b1	b0
Data #0	Channel 1			Channel 2				
	KCS	VS	Ch Type	KCS	VS	Ch Type		
Data#1	Channel 3			Channel 4				
	KCS	VS	Ch Type	KCS	VS	Ch Type		

- Key Control Status (KCS)

Designates whether Key Control is to be performed for applicable channel when a request of Key Control is received. Vibration is enabled when this bit is ON.

KCS	Description
0x0	OFF
0x1	ON

- Vibration Status (VS)

Designates whether Vibration is to be performed for applicable channel when a request of Vibration Control is received. Key Control is enabled when this bit is ON.

VS	Description
0x0	OFF
0x1	ON

- Ch Type

Designates Channel Type for applicable Channel. This information is disregarded and does not affect playback.

Ch Type	Description
0x0	No Care
0x1	Melody
0x2	No Melody
0x3	Rhythm

### 5.5 Seek & Phrase Info Chunk (optional)

Stores information for starting / stopping from a specific position in Sequence Data.

Any one data is to exist as far as Chunk exists.

Each data is to be described by dividing as "tag (2 bytes)" + ": (0x3A)" + " Data " + ", (0x2C)".

- Start Point : Reproduction starting position (optional)
- Stop Point : Reproduction stopping position (optional)
- Phrase List : Not supported (optional)
- Sub-sequence List : Not supported (optional)

Name	Tag name	Hex
Start	st	0x73 0x74
Stop	sp	0x73 0x70

Each data value is the number of bytes from the head of body of Sequence Data Chunk.

This chunk is optional, and thus, it does not necessarily have to exist. Also, all four information does not necessarily have to be stored. When it does not exist, Start Point is to be "0", and Stop Point is to be Sequence Data End (the value is the size of Sequence Data [bytes]).

When Start Point is set up, the play start position is pinpointed based on the sum total of Duration to there. But, this sum total of Duration needs to be the same in all Tracks. (When not same, it becomes an error.) And, when Stop Point is set up, the play end position is pinpointed based on the sum total of Duration to there. But, Especially this sum total of Duration does not need to be the same. (The play is ended in accordance with the longest data.)

Phrase List and Sub-sequence List are not interpreted even though they exist.

### 5.6 Setup Data Chunk (optional)

Stores a range of Exclusive Messages that perform setting tone parameter or others before the start of reproduction. Duration is not included.

Setup Data Chunk body = (Exclusive Message)+

For Exclusive Messages that are stored in this chunk, only setting of tone parameter is processed.

This chunk is optional, and thus, it does not necessarily have to exist in all Score Track. However, it has to exist in at least one Score Track, and must store data of all tone parameters that are used.

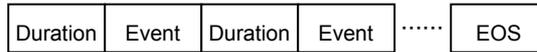
Exclusive Message is described later.

### 5.7 Sequence Data Chunk (necessary)

Stores actual play data.

Sequence Data Chunk consists of data string of Duration and Event pair and End of Sequence.

Sequence Data Chunk body = ((Duration Event)| (End of Sequence))+



#### 5.7.1 End of Sequence (EOS)

A string of four 0x00s are used for End of Sequence to show the end of the sequence. Although EOS is not necessary, it is recommended to include it to clearly show the end of the sequence.

End of Sequence = ¥x00 ¥x00 ¥x00 ¥x00

#### 5.7.2 Duration

1 byte or 2 bytes are used to represent Duration. When MSB of the first byte is "0", 1 byte is used. When it is "1", 2 bytes are used. When the second byte exists, MSB is zero at all times.

Data Count	b7	b6	b5	b4	b3	b2	b1	b0
Data#0	S	Data1						
Data#1	0	Data2						

With MSB (=S) of the first byte, the range of value that can be represented is as follows.

S	Step
0x0	0 to 127
0x1	128 to 16511

When S=1, the value to be represented is equal to 14 bit data with data1 at MSB side and data2 at LSB side plus 128.

## 5.7.3 Event

Supports some events that are defined with SMAF specification. The events that are supported are as described below.

## 5.7.3.1 Note Message

Designates Note On / Note Off. Monophonic tone generation is to be used.

When Gate Timer is '0', it is not pronounced.

	b7	b6	b5	b4	b3	b2	b1	b0
Data #0	Channel		Octave		Note Number			
Data #1	Gatetime (1st byte)							
Data #2	Gatetime (2nd byte) [optional]							

GateTime = 0 is to be prohibited.

Channel	Description
0x0	Channel #0
0x1	Channel #1
0x2	Channel #2
0x3	Channel #3

Octave	Description
0x0	Low
0x1	Mid Low
0x2	Mid High
0x3	High

The maximum number of key scales that can be represented at the same time is 4 octaves.

The interval that exceeds this range is represented by using Octave Shift of Control Change.

Note Number	Description
0x0	Prohibited
0x1	C#
0x2	D
0x3	D#
0x4	E
0x5	F
0x6	F#
0x7	G
0x8	G#
0x9	A
0xA	A#
0xB	B
0xC	C
0xD - 0xF	Prohibited

A of Mid High is to be 440 (Hz).

## 5.7.3.2 Program change

Sets the tones of applicable channels. The tone number designates Program Change No. of tone parameter that is set with Setup Data Chunk. Operation when the tone with designated number does not exist is not guaranteed.

This must be set before tone generation of applicable channel. Operation when it is not set is not guaranteed.

	b7	b6	b5	b4	b3	b2	b1	b0
Data #0	0x00							
Data #1	Channel		1	1	0x0			
Data #2	Value							

Value	Description
0x00 to 0x7F	Voice Number
0x80 to 0xFF	Reserved

## 5.7.3.3 Bank Select

Sets the bank of applicable channels. This message is used to designate banks, and then, tone of applicable bank is set by receiving Program Change. Bank number designates Bank Select No. of tone parameter that is set with Setup Data Chunk.

	b7	b6	b5	b4	b3	b2	b1	b0
Data #0	0x00							
Data #1	Channel		1	1	0x1			
Data #2	Value							

Value	Description
0x00 to 0x7F	Bank Number (Normal)
0x80 to 0xFF	Bank Number (Drum)

## 5.7.3.4 Octave Shift

Sets amount of octave shift of applicable channels. The value that determines the amount of shift is to be absolute value. (not added to previous shift)

	b7	b6	b5	b4	b3	b2	b1	b0
Data #0	0x00							
Data #1	Channel		1	1	0x2			
Data #2	Value							

Value	Description
0x00	No Shift (Original)
0x01	+1 Octave
0x02	+2 Octave
0x03	+3 Octave
0x04	+4 Octave
0x05 to 0x80	Reserved
0x81	-1 Octave
0x82	-2 Octave
0x83	-3 Octave
0x84	-4 Octave
0x85 to 0xFF	Reserved

## 5.7.3.5 Modulation

Changes the depth of vibrato of applicable channels.

(standard type)

	b7	b6	b5	b4	b3	b2	b1	b0
Data #0	0x00							
Data #1	Channel		1	1	0x3			
Data #2	Value							

Value	Description
0x00 to 0x7F	Data (default 0x00)
0x80 to 0xFF	Reserved

(shortened type)

	b7	b6	b5	b4	b3	b2	b1	b0
Data #0	0x00							
Data #1	Channel		1	0	Value			

Value	Description
0x1 to 0xE	Data (default 0x1)
0x0,0xF	Reserved

Data 0x1 to 0x0E of shortened type correspond to the value equivalent to 0x0E steps when compared with Data 0x00 to 0x7F of standard type. The relationship of data between standard type and shortened type for Modulation is as shown in the following table.

Shortened type	Standard type	Shortened type	Standard type
0x1	0x00	0x8	0x38
0x2	0x08	0x9	0x40
0x3	0x10	0xA	0x48
0x4	0x18	0xB	0x50
0x5	0x20	0xC	0x60
0x6	0x28	0xD	0x70
0x7	0x30	0xE	0x7F

And, the conversion from data value (standard type) to the depth is as follows.

Data value	Modulation depth
0x00	OFF
0x01 to 0x10	x 1
0x11 to 0x30	x 2
0x31 to 0x50	x 4
0x51 to 0x7F	x 8

## 5.7.3.6 Volume

Changes volume of applicable channels.

	b7	b6	b5	b4	b3	b2	b1	b0
Data #0	0x00							
Data #1	Channel		1	1	0x7			
Data #2	Value							

Value	Description
0x00 to 0x7F	Data
0x80 to 0xFF	Reserved

The use of the following formula is recommended.

$$\text{Gain[dB]} = \text{MUTE}, \text{ Data} = 0$$

$$\text{Gain[dB]} = 20 * \log (\text{Data}^2 / 127^2), \text{ Data} > 0$$

## 5.7.3.7 Pan

Sets stereophonic sound field position of applicable channels. Positions the sound of channels in any point between L side (0x00) to R side (0x7F).

	b7	b6	b5	b4	b3	b2	b1	b0
Data #0	0x00							
Data #1	Channel		1	1	0xA			
Data #2	Value							

Value	Description
0x00 to 0x7F	Data (default 0x40)
0x80 to 0xFF	Reserved

The use of the following formula is recommended.

$$\text{Left Channel Gain[dB]} = 20 * \log (\cos (\pi / 2 * \text{Data} / 127))$$

$$\text{Right Channel Gain[dB]} = 20 * \log (\sin (\pi / 2 * \text{Data} / 127))$$

## 5.7.3.8 Expression

Changes volume in the music in applicable channels.

(standard type)

	b7	b6	b5	b4	b3	b2	b1	b0
Data #0	0x00							
Data #1	Channel		1	1	0xB			
Data #2	Value							

Value	Description
0x00 to 0x7F	Data (default 0x7F)
0x7F to 0xFF	Reserved

The use of the following formula is recommended.

$$\text{Gain[dB]} = \text{MUTE} \quad , \text{Data} = 0$$

$$\text{Gain[dB]} = 20 * \log(\text{Data}^2 / 127^2) \quad , \text{Data} > 0$$

(shortened type)

	b7	b6	b5	b4	b3	b2	b1	b0
Data #0	0x00							
Data #1	Channel		0	0	Value			

Value	Description
0x1 to 0xE	Data (default 0xE)
0x0,0xF	Reserved

Data 0x1 to 0x0E of shortened type correspond to the value equivalent to 0x0E steps when compared with Data 0x00 to 0x7F of standard type. The relationship of data between standard type and shortened type for Expression is as shown in the following table.

Shortened type	Standard type	Shortened type	Standard type
0x1	0x00	0x8	0x4F
0x2	0x1F	0x9	0x57
0x3	0x27	0xA	0x5F
0x4	0x2F	0xB	0x67
0x5	0x37	0xC	0x6F
0x6	0x3F	0xD	0x77
0x7	0x47	0xE	0x7F

## 5.7.3.9 NOP

Performs no operation.

	b7	b6	b5	b4	b3	b2	b1	b0
Data #0	0xFF							
Data #1	0x00							

## 5.7.3.10 Exclusive Message

Performs setting of various parameters specialized for device.

	b7	b6	b5	b4	b3	b2	b1	b0
Data #0	1	1	1	1	1	1	1	1
Data #1	1	1	1	1	0	0	0	0
Data #2	Message Size							
Data #3	0	1	0	0	0	0	1	1
Data #4	0	0	0	0	0	0	1	1
Data #5	Data							
:	:							
Data End	1	1	1	1	0	1	1	1

Message Size is to be Byte Count from Data\_#3 to Data End.

Data #3 is Yamaha's manufacturer ID (0x43), Data #4 is Format ID, and YMU757 (MA-1) is to be (0x02), and YMU759 (MA-2) is to be (0x03). Other ID are ignored even though they are designated.

Data\_#5 and after constitute data string for parameter setting.

## 5.7.3.11 MA-1

## 5.7.3.11.1.1 Tone parameters

Data Count	Type	b7	b6	b5	b4	b3	b2	b1	b0
Data #1	Address	0	0	0	0	0	Voice No.		
Data #2	Bank No	Bank Select No							
Data #3	PC No.	Program Change No							
Data #4	Basic Octave	EN1	EN2	EN3	EN4	0	0	BO	
Data #5	Modulator	ML			VIB	EGT	SUS	RR (H)	
Data #6		RR (L)		DR			AR (H)		
Data #7		AR (H)		SL			TL (H)		
Data #8		TL (L)			WAV		FL		
Data #9	Carrier	ML			VIB	EGT	SUS	RR (H)	
Data #10		RR (L)		DR			AR (H)		
Data #11		AR (L)		SL			TL (H)		
Data #12		TL (L)			WAV		FL		
Data #13	Multiple Setting	Modulator ML[C#1-C4]				Carrier ML[C#1-C4]			
Data #14		Modulator ML[C#2-C5]				Carrier ML[C#2-C5]			
Data#15		Modulator ML[C#3-C6]				Carrier ML[C#3-C6]			
Data#16		Modulator ML[C#4-C7]				Carrier ML[C#4-C7]			

## • Voice No

This is a number for setting tone data of MA-1. For MA-1, the maximum number of tones is limited to 8, and a value in the range from 000b to 111b can be designated. This information is disregarded and is not used.

## • Bank Select No

Bank Select No.	Description
0x00 to 0xFF	Bank Select No.

Designates Bank Select No. of tones. A number in the range from 0x00 to 0x7F can be designated. This value becomes the number that is designated with Bank Select Event in the sequence data.

## • PC No. (Program Change No.)

Program Change No.	Description
0x00 to 0x7F	Program Change No.

This is Program Change No. of tones, and a number in the range from 0x00 to 0x7Fh can be designated. This value becomes the number that is designated with Program Change Event in the sequence data.

- When the voice information that both bank numbers and program numbers are the same is registered, it is processed as follows.

Voice registration rule (At Standby)

Registration is possible by 16 voices in the order of arrival (data which Track number is small and previously in Mtsu). (With no exception handling about above-mentioned)

Voice determination rule (At data play)

Searches a voice in order of data registration and ends the searching it in the found place. (First-arrival preference)

- Modulator, Carrier, Multiple Setting, Basic Octave parameter

For the details, refer to Application Manual for YMU757.

## 5.7.3.11.2 MA-2

## 5.7.3.11.2.1 Tone parameters

Data Count	Type	b7	b6	b5	b4	b3	b2	b1	b0	
Data #5	Address	0	0	0	0	Voice No.				
Data #6	Bank No.	Bank Select No								
Data #7	PC No.	0	Program Change No							
Data #8	Voice Info	LFO			FB			ALG		
Data #9	Basic Octave	0	0	0	0	0	0	BO		
Data #10	Operator 1	MULTI				VIB	EGT	SUS	KSR	
Data #11		RR				DR				
Data #12		AR				SL				
Data #13		TL						KSL		
Data #14		DVB	DAM			AM	WS			
Data #15	Operator 2	MULTI				VIB	EGT	SUS	KSR	
Data #16		RR				DR				
Data #17		AR				SL				
Data #18		TL						KSL		
Data #19		DVB	DAM			AM	WS			
Data #20	Operator 3	MULTI				VIB	EGT	SUS	KSR	
Data #21		RR				DR				
Data #22		AR				SL				
Data #23		TL						KSL		
Data #24		DVB	DAM			AM	WS			
Data #25	Operator 4	MULTI				VIB	EGT	SUS	KSR	
Data #26		RR				DR				
Data #27		AR				SL				
Data #28		TL						KSL		
Data #29		DVB	DAM			AM	WS			

## • Voice No

This is a number for registration of tones into tone register of YMU759. Since up to 16 tones can be registered into YMU759, a number in the range from 00h to 0Fh can be designated. This information is disregarded and is not used.

## • Bank Select No

Bank Select No.	Description
0x00 to 0xFF	Bank Select No.

Designates Bank Select No. of tones, which is a number designated with Bank Select Event in Sequence Data.

- PC No. (Program Change No.)

Program Change No.	Description
0x00 to 0x7F	Program Change No.

Designates Program Change No. of tones, which is a number designated with Program Change Event in Sequence Data.

- When the voice information that both bank numbers and program numbers are the same is registered, it is processed as follows.

Voice registration rule (At Standby)

Registration is possible by 16 voices in the order of arrival (data which Track number is small and previously in Mtsu). (With no exception handling about above-mentioned)

Voice determination rule (At data play)

Searches a voice in order of data registration and ends the searching it in the found place. (First-arrival preference)

- When values other than '1' are set as BO (Basic Octave), there are data which cannot take compatibility with playback of MA-2.

- Voice Info、 Basic Octave、 Operator

For the details, refer to Application Manual for YMU759.

In case of 2OP tones, only Operators 1 and 2 are set, where Data #2 is 0x12, and in case of 4OP tones, Operators 1 to 4 are set, where Data #2 is 0x1C.

## 5.7.3.11.2.2 Pitch Bend

Changes the pitch of applicable channels upward or downward by changing F-Number.

Data Count	Type	b7	b6	b5	B4	b3	b2	b1	b0
Data #0	Address	1	0	0	1	0	0	0	0
Data #1	Index	1	0	1	1	Channel			
Data #2	F-Num1	F-Number							

Data Count	Type	b7	b6	B5	B4	b3	b2	b1	b0
Data #0	Address	1	0	0	1	0	0	0	0
Data #1	Index	1	1	0	0	Channel			
Data #2	F-Num2	0	0	KON	OCT			F-Number	

- Channel

Channels 0 to 15 correspond to channel numbers 0 to 15 in this order.

- OCT

Sets octave information. Eight octaves from 0 to 7 can be represented.

- F-Number

Sets frequency information.

The relationship between desired frequency and F-Number, OCT is shown by the following formula.

$$\text{F-Number} = (f \times 2^{19} / f_s) / 2^{\text{OCT}-1}$$

f: desired frequency, f<sub>s</sub>: Sampling frequency 49.7kHz

F-Number obtained for one octave by using this formula is as follows.

OCT=4 (C4 to C5), A4=440Hz, MULTI=1

Scale	Frequency (Hz) *	F-Number (Dec)
C	261.6	345
C#	277.2	365
D	293.7	387
D#	311.1	410
E	329.6	435
F	349.2	460
F#	370.0	488
G	392.0	517
G#	415.3	547
A	440.0	580
A#	466.2	615
B	493.9	651
C	523.3	690

- KON

Controls tone generation of each channel. "1" generates tone of corresponding channel. "0" stops the tone generation. When Pitch Bend is present during note tone generation, this message is used to control tone generation of the tone. F-Number that corresponds to Pitch Bend is given by the above formula.

## 6 PCM Audio Track Chunk (ATR\*)

This is a chunk that stores tone generation of ADPCM by using event format.

PCM Audio Track with track number "0" conforms to SMAF specification for MA-2.

The structure of PCM Audio Track Chunk is as follows.

```

< PCM Audio Track Chunk >
= Header =
UINT32:      ID="ATR*"          // * represents a Track number.
UINT32:      Size                // Body size of PCM Audio Track Chunk [bytes]
= Body =
UINT8:       Format Type=0x00     // Type definition of PCM Audio Track 0: Handy Phone Standard (necessary)
UINT8:       Sequence Type=0x00 // Type definition of Sequence Data 0: Stream Sequence (necessary)
UINT16:      Wave Type           // Format definition of Wave Data Chunk (necessary)
UINT8:       TimeBase_D         // Standard time of Duration in Sequence Data (necessary)
UINT8:       TimeBase_G         // Standard time of Gatetime in Sequence Data (necessary)

< Seek & Phrase Info Chunk > (Option)
= Header =
UINT32:      ID="Asp"
UINT32:      Size                // Body size of Seek & Phrase Info Chunk [bytes]
= Body =
UINT32:      Start Point         // Reproduction starting position of Sequence Data [bytes]
UINT32:      Stop Point         // Reproduction ending position of Sequence Data [bytes]
UINT8:       PhraseList[n]
UINT8:       Sub-sequence List[n]
=====

< Setup Data Chunk > (Option)
= Header =
UINT32:      ID="Atsu"
UINT32:      Size                // Body size of Setup Data Chunk [bytes]
= Body =
UINT8:       Exclusive Message[n]// Tone parameters, etc.
=====

< Sequence Data Chunk > (necessary)
= Header =
UINT32:      ID="Atsq"
UINT32:      Size                // Body size of Sequence Data Chunk [bytes]
= Body =
UINT8:       SeqData[n]         // Sequence Data string
=====

< Audio Track Wave Data Chunk > (necessary)
= Header =
UINT32:      ID="Awa*"
UINT32:      Size                // Body size of Audio Track Wave Data Chunk [bytes]
= Body =
UINT8:       WaveData[n]       // Wave Data string
=====

=====
< end >

```

Format Type, Sequence Type, Wave Type, TimeBase\_D and TimeBase\_G are necessary for Body section of PCM Audio Track Chunk, and must be stored in the designated order. Sequence Data Chunk is necessary. Waveform data to be reproduced are to be stored into Audio Track Wave Data Chunk, and at least one Audio Track Wave Data Chunk is to be present.

The order of store of subchunks is not defined.

## 6.1 Format Type (necessary)

Defines type of Track Chunk.

Format Type	Description
0x00	Handy Phone Standard

This must be 0x00.

## 6.2 Sequence Type (necessary)

Defines type of Sequence Data.

Format Type	Description
0x00	Stream Sequence

This must be 0x00.

## 6.3 Wave Type (necessary)

Defines format of Wave Data Chunk.

	b7	b6	b5	b4	b3	b2	b1	b0
Data #0	M/S	Format			Sampling Freq			
Data #1	Base bit				Reserved			

Channel	Description
0x0	Mono

Format	Description
0x1	ADPCM

Sampling Freq	Description
0x0	4 kHz
0x1	8 kHz

Base Bit	Description
0x0	4 bit

Only above values are applicable, and others result in an error.

#### 6.4 TimeBase\_D, TimeBase\_G (necessary)

Defines standard time that is used in the Sequence Data.

TimeBase\_D is the standard time of Duration, and TimeBase\_G is the standard time of GateTime.

Timebase D,G	Description
0x00	1 msec
0x01	2 msec
0x02	4 msec
0x03	5 msec
0x04 to 0x0F	Reserved
0x10	10 msec
0x11	20 msec
0x12	40 msec
0x13	50 msec
0x14 to 0xFF	Reserved

0x00 and 0x01 are to be prohibited.

The values of TimeBase\_D and TimeBase\_G of all Tracks must be the same.

#### 6.5 Seek & Phrase Info Chunk (optional)

Stores information for starting / stopping from a specific position in Sequence Data.

Any one data is to exist as far as Chunk exists.

Each data is to be described by dividing as "tag (2 bytes)" + ": (0x3A)" + " Data " + ", (0x2C)".

- Start Point : Reproduction starting position (optional)
- Stop Point : Reproduction stopping position (optional)
- Phrase List : Not supported (optional)
- Sub-sequence List : Not supported (optional)

Name	Tag name	Hex
Start	st	0x73 0x74
Stop	sp	0x73 0x70

Each data value is the number of bytes from the head of body of Sequence Data Chunk.

This chunk is optional, and thus, it does not necessarily have to exist. Also, all four information does not necessarily have to be stored. When it does not exist, Start Point is to be "0", and Stop Point is to be Sequence Data End (the value is the size of Sequence Data [bytes]).

When Start Point is set up, the play start position is pinpointed based on the sum total of Duration to there. But, this sum total of Duration needs to be the same in all Tracks. (When not same, it becomes an error.) And, when Stop Point is set up, the play end position is pinpointed based on the sum total of Duration to there. But, Especially this sum total of Duration does not need to be the same. (The play is ended in accordance with the longest data.)

Phrase List and Sub-sequence List are not interpreted even though they exist.

#### 6.6 Setup Data Chunk (optional)

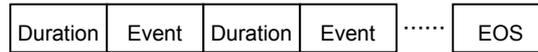
Ignore.

### 6.7 Sequence Data Chunk (necessary)

Stores actual playing data.

Sequence Data Chunk consists of data string of Duration and Event pair and End of Sequence.

Sequence Data Chunk body = ( (Duration Event)| (End of Sequence))+



#### 6.7.1 End of Sequence (EOS)

A string of four 0x00s are used for End of Sequence to show the end of the sequence. Although EOS is not necessary, it is recommended to include it to clearly show the end of the sequence.

End of Sequence = ¥x00 ¥x00 ¥x00 ¥x00

#### 6.7.2 Duration

1 byte or 2 bytes are used to represent Duration. When MSB of the first byte is "0", 1 byte is used. When it is "1", 2 bytes are used. When the second byte exist, MSB is zero at all times.

Data Count	b7	b6	b5	b4	b3	b2	b1	b0
Data#0	S	Data1						
Data#1	0	Data2						

With MSB (=S) of the first byte, the range of value that can be represented is as follows.

S	Step
0x0	0 to 127
0x1	128 to 16511

When S=1, the value to be represented is equal to 14 bit data with data1 at MSB side and data2 at LSB side plus 128.

## 6.7.3 Event

Supports some events defined with SMAF specification. The supported events are described below.

The event which is not described in below is processed as NOP.

## 6.7.3.1 Wave Message

Designates Wave reproduction On / Off for channels that are set. Monophonic tone is to be used.

When Gate Timer is '0', it is not pronounced.

	b7	b6	b5	b4	b3	b2	b1	b0
Data #0	Channel		Wave Number					
Data #1	Gatetime (1st byte)							
Data #2	Gatetime (2nd byte) [optional]							

Channel	Description
0x0	Channel #0

Wave Number	Description
0x01 to 0x3E	Wave ID
0x00,0x3F	Prohibition

## 6.7.3.2 Volume

Changes volume of applicable channels.

	b7	b6	b5	b4	b3	b2	b1	b0
Data #0	0x00							
Data #1	Channel	1	1	0x7				
Data #2	Value							

Value	Description
0x00 to 0x7F	Data
0x80 to 0xFF	Reserved

The use of the following formula is recommended.

Gain[dB] = MUTE , Data = 0

Gain[dB] = 20\*log (Data<sup>2</sup>/127<sup>2</sup>) , Data > 0

## 6.7.3.3 NOP

Performs no operation.

	b7	b6	b5	b4	b3	b2	b1	b0
Data #0	0xFF							
Data #1	0x00							

### 6.8 Wave Data Chunk (necessary)

Stores ADPCM data. When Track Chunk is present, at least one track chunk is needed.

The last one byte of Chunk ID represents Wave Number.

For Wave Number, a number in the range from 0x01 to 0x3E can be set, where the total number of Wave Data Chunks is to be 32 or less. When two or more same Wave Numbers exist, the one that exist earlier is to be adopted.

Wave Number	Description
0x00	Prohibition
0x01 to 0x3E	Wave ID
0x3F to 0xFF	Prohibition

Body section stores ADPCM data.