『Maple Bus 1.0』
Function Type Specifications
FT$_{10}$: Exchange Media Function

Revision 0.50

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1. OVERVIEW OF EXCHANGE MEDIA FUNCTION

1.1 Definition of Exchange Media Function

Exchange media refers to a medium on which information can be written or read, and which can be removed from the device; this function enables the media to be exchanged.

(1) The medium (media) capable of storing data must allow the data to be written and read, or at least one of these. Otherwise, there are no restrictions on external appearance.

(2) The Maple Bus 1.0 Standard Specifications must be complied with.

1.2 Characteristics and limitations of the Exchange Media Function

The exchange media function has the following characteristics and limitations.

(1) ROM, RAM, EEPROM, Flash, magnetic recording media, and other recording media can be used without distinction.

(2) The user is not required to be aware of the file format.
The data recording method is automatically adapted to the media, and therefore the application is not required to be aware of it.

(3) The data size that can be written at a time depends on the connected media.

(4) Long file names are supported, depending on the device.

1.3 Default configuration

2. DEVICE ID

Device IDs conform with the device ID stipulations in the Maple Bus 1.0 Standard Specifications.

The notation used is the memory image in the host.

2.1 Configuration of the device ID

In Maple Bus 1.0, device IDs are configured as shown below.

bit	7	6	5	4	3	2	1	0
1st Data	FT_{31}	FT_{30}	FT_{29}	FT_{28}	FT_{27}	FT_{26}	FT_{25}	FT_{24}
2nd Data	FT_{23}	FT_{22}	FT_{21}	FT_{20}	FT_{19}	FT_{18}	FT_{17}	FT_{16}
3rd Data	FT_{15}	FT_{14}	FT_{13}	FT_{12}	FT_{11}	FT_{10}	FT_{9}	FT_{8}
4th Data	FT_{7}	FT_{6}	FT_{5}	FT_{4}	FT_{3}	FT_{2}	FT_{1}	FT_{0}
5th Data	$FD1_{31}$	$FD1_{30}$	$FD1_{29}$	$FD1_{28}$	$FD1_{27}$	$FD1_{26}$	$FD1_{25}$	$FD1_{24}$
6th Data	$FD1_{23}$	$FD1_{22}$	$FD1_{21}$	$FD1_{20}$	$FD1_{19}$	$FD1_{18}$	$FD1_{17}$	$FD1_{16}$
7th Data	$FD1_{15}$	$FD1_{14}$	$FD1_{13}$	$FD1_{12}$	$FD1_{11}$	$FD1_{10}$	$FD1_{9}$	$FD1_{8}$
8th Data	$FD1_{7}$	$FD1_{6}$	$FD1_{5}$	$FD1_{4}$	$FD1_{3}$	$FD1_{2}$	$FD1_{1}$	$FD1_{0}$
9th Data	$FD2_{31}$	$FD2_{30}$	$FD2_{29}$	$FD2_{28}$	$FD2_{27}$	$FD2_{26}$	$FD2_{25}$	$FD2_{24}$
10th Data	$FD2_{23}$	$FD2_{22}$	$FD2_{21}$	$FD2_{20}$	$FD2_{19}$	$FD2_{18}$	$FD2_{17}$	$FD2_{16}$
11th Data	$FD2_{15}$	$FD2_{14}$	$FD2_{13}$	$FD2_{12}$	$FD2_{11}$	$FD2_{10}$	$FD2_{9}$	$FD2_{8}$
12th Data	$FD2_{7}$	$FD2_{6}$	$FD2_{5}$	$FD2_{4}$	$FD2_{3}$	$FD2_{2}$	$FD2_{1}$	$FD2_{0}$
13th Data	$FD3_{31}$	$FD3_{30}$	$FD3_{29}$	$FD3_{28}$	$FD3_{27}$	$FD3_{26}$	$FD3_{25}$	$FD3_{24}$
14th Data	$FD3_{23}$	$FD3_{22}$	$FD3_{21}$	$FD3_{20}$	$FD3_{19}$	$FD3_{18}$	$FD3_{17}$	$FD3_{16}$
15th Data	$FD3_{15}$	$FD3_{14}$	$FD3_{13}$	$FD3_{12}$	$FD3_{11}$	$FD3_{10}$	$FD3_{9}$	$FD3_{8}$
16th Data	$FD3_{7}$	$FD3_{6}$	$FD3_{5}$	$FD3_{4}$	$FD3_{3}$	$FD3_{2}$	$FD3_{1}$	$FD3_{0}$

Table 2.1   Device IDs

FT   : Function type the peripheral is equipped with.

FD1   : 1st function definition block.

FD2   : 2nd function definition block.

FD3   : 3rd function definition block.

(1) FT_{31}～FT_{0} : Function type

Defines the type of function the peripheral is equipped with.

There are 32 function types altogether.

(2) FD_{31}～FD_{0} : Function definition block

These blocks define the individual elements constituting the function.

(1 peripheral can be equipped with 3 different functions)

2.2 Function types

This section describes the function type FT within the device ID.

The Exchange Media Function function type is defined by $FT_{10} = 1$.

bit	7	6	5	4	3	2	1	0
1st Data	FT_{31}	FT_{30}	FT_{29}	FT_{28}	FT_{27}	FT_{26}	FT_{25}	FT_{24}
2nd Data	FT_{23}	FT_{22}	FT_{21}	FT_{20}	FT_{19}	FT_{18}	FT_{17}	FT_{16}
3rd Data	FT_{15}	FT_{14}	FT_{13}	FT_{12}	FT_{11}	1	FT_9	FT_8
4th Data	FT_7	FT_6	FT_5	FT_4	FT_3	FT_2	FT_1	FT_0

Table 2.2　Function Type for the Exchange Media Function

For example, in the case of a peripheral device for which only the Exchange Media Function is implemented, the function type is defined by FT = 00-00-04-00h.

If other functions are implemented in a peripheral device, the function type bit that corresponds to that function is set to "1."

2.3 Function definition block

This section describes the function definition block (FD) within the device ID.

The function definition block is a 32-bit data table that is inherent to each function. The elements that comprise a function, the data transmission and reception methods, etc., are all determined on the basis of this data.

The following table shows the configuration of the function definition block for the Exchange Media Function.

bit	7	6	5	4	3	2	1	0
1st Data	MD_3	MD_2	MD_1	MD_0	LN	SD	FD_9	FD_8
2nd Data	FD_7	FD_6	FD_5	FD_4	FD_3	FD_2	FD_1	FD_0
3rd Data	TR_7	TR_6	TR_5	TR_4	TR_3	TR_2	TR_1	TR_0
4th Data	TW_7	TW_6	TW_5	TW_4	TW_3	TW_2	TW_1	TW_0

Table 2.3　Exchange Media Function Definition Block Configuration

MD　　　: Number of media

　　　　　Set the number of media which can be connected.

　　　　　The number of media can be set from 1 to 16.

　　　　　Number of media = (MD + 1)

LN   : Long file name

Specify whether a long file name can be used.

File name length	LN
Long file name	0
Short file name	1

Table 2.4   LN flag values

SD   : Subdirectories

Specify whether or not subdirectories can be used.

File name length	SD
Subdirectories present	0
No subdirectories	1

Table 2.5   SD flag values

TR   : Time read setting

This indicates the time units that are read out by the function.

Bit	7	6	5	4	3	2	1	0
TR	TR$_7$	TR$_6$	TR$_5$	TR$_4$	TR$_3$	TR$_2$	TR$_1$	TR$_0$
Time unit	-	Year	Month	Day	Hour	Minute	Second	Day of the week
Cannot be read	0	0	0	0	0	0	0	0
Can be read	-	1	1	1	1	1	1	1

Table 2.6   TR Values

TW   : Time write setting

Indicates the units with which a date/time can be written to the media.

bit	7	6	5	4	3	2	1	0
TW	TW$_7$	TW$_6$	TW$_5$	TW$_4$	TW$_3$	TW$_2$	TW$_1$	TW$_0$
Time unit	-	Year	Month	Day	Hour	Minute	Second	Day of the week
Cannot be read	0	0	0	0	0	0	0	0
Can be read	-	1	1	1	1	1	1	1

Table 2.7 TW Values

Unit

 Year: Indicates the year by the western calendar.

 Month: Indicates the month.

 Day: Indicates the day.

 Hour: Indicates the hour.

 Minute: Indicates the minute.

 Second: Indicates the second.

 Day of the week: Indicates the day of the week.

Bit 7 is fixed to "0."

FD   : Reserved

This value is set to "0."

3. FILE SPECIFICATIONS

3.1 File configuration

Since the exchange function supports various media, the access unit is not the block, but the file.

Without the application being aware of the file structure or file system, a file can be accessed.

File access is carried out by specifying a file number.

The file structure data is as follows.

Item	Data Size	Description
File name	256 bytes or 8 bytes	Specifies the file name. A maximum of 256 characters may be specified. (Or 128 two-byte characters.) This depends on the LN bit value.
File type (extension)	3 bytes	Specifies the file type. If the file type is 3 bytes or less, fill with 20h blanks.

File attributes	1 byte	Specifies the file attributes.
		The file attributes include the following.
		By specifying a combination of the bits, any of the attributes can be present simultaneously.
		    Read-only "01h"
		    Hidden file "02h"
		    System file "04h"
		    Volume label "08h"
		    Directory "10h"
		    Unarchived file "20h"

Size	4 bytes	This is the size of the file. The value is in bytes, from 00000000h (0 bytes) to FFFFFFFFh (4294967295 bytes).
Date stamp	8 bytes	Year, month, day, and time in BCD format, and day-of-week from 00h to 06h; the day-of-week values 00h to 06h correspond to Monday to Sunday. E.g. 19|99|12|31|23|59|dow|00h| The last byte is always 00h. The values that can be specified depend on the value of TW. Settings which cannot be made have the value 00h. This is ignored on writing.

Table 3.8   File parameters

4. COMMANDS

This section describes those commands that the Exchange Media Function supports out of the commands included in the Maple Bus 1.0 Standard Specifications.

All of the setting examples assume that the Exchange Media Function is connected to LM-Bus No. 1 of port A.

4.1 Control commands

4.1.1 Get_Media_Info

Issuing right	: Host
Command code	: 0Ah
Data capacity	: 02h (8 bytes)
Data	: Function type : 4 bytes
	MD : 1 bytes
	Fixed value : 3 bytes
Expected return value	: [Data Transfer]
Description	: This command is used to get, from the Exchange Media Function, the media information that is necessary in order to use the other commands.
	This command must be issued first after connection has been confirmed.
	An example of this command is shown below.

Data address	Data	Example setting	Description
+0000h	Command code	0Ah	Specifies [Get_Media_Info]
+0001h	Receiver AP	01h	Expansion device (LM-Bus No. 1)
+0002h	Sender AP	00h	Port A
+0003h	Data size	02h	The data size is 8 bytes
+0004h	Function type	00h	Specifies the function type as "Exchange Media"
+0005h		00h	
+0006h		04h	
+0007h		00h	
+0008h	MD	00h	Specifies the media number
+0009h		00h	
+000Ah	Fixed value	00h	Fixed to "00h"
+000Bh		00h	

Table 4.9   Get_Media_Info Command Example

When the Exchange Media function receives this command, it sends the media information shown in Table 4.2 by

means of the [Data Transfer] command.

For details on [Data Transfer], refer to section , "Data Transfer."

When a command is issued to a media which is not connected, [File Error] is returned.

Data address	Data	Example setting	Description
+0000h	Command code	08h	Specifies [Data Transfer]
+0001h	Receiver AP	00h	Port A
+0002h	Sender AP	01h	Expansion device (LM-Bus No.1)
+0003h	Data size	07h	The data size is 28 bytes
+0004h	Function type	00h	Specifies the function type as "Exchange Media"
+0005h		00h	
+0006h		04h	
+0007h		00h	
+0008h to +001Fh	Media information		Refer to Table 4.11

Table 4.10   Response to the Get_Media_Info Command

Data address	+0	+1	+2	+3	+4	+5	+6	+7
+0008h	MD	Reserved			Total size			
+0010h	Remaining amount				Total number of files			
+0018h	Read unit		Write unit		Reserved			

Table 4.11   Media Information Configuration

Item	Data Size	Description
MD	1 byte	Returns the media No. specified by the command.
Reserved	3 bytes	Returns 000000h.
Total capacity	4 bytes	Indicates the total capacity in bytes, in hexadecimal.
Remaining capacity	4 bytes	Indicates the remaining capacity of the media in byte, in hexadecimal.
Total number of files	4 bytes	Indicates the number of files held on the media, in hexadecimal.
Read unit	2 bytes	Indicates the number of bytes that can be read from the media in a single operation.
Write unit	2 bytes	Indicates the number of bytes that can be written to the media in a single operation.
Reserved	4 bytes	Returns 00000000h.

Table 4.12   Media Information Parameters

Depending on the media, it is not necessarily true that the total file size plus the remaining capacity is equal to the total capacity.

To get the size of individual files see [Get_File_Info].

For details on [Get_File_Info], refer to section , "Get_File_Info."

For unformatted media the total capacity is returned as 00000000h.

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4.1.2 Get_File_Info

Issuing right	: Host
Command code	: ??h
Data size	: 03h (12 bytes)
Data	: Function type : 4 bytes
	MD : 1 byte
	Fixed value : 3 bytes
	File No. : 4 bytes
Expected return value	: [Data Transfer]
Description	: This command requests the information for the specified File No. of the media connected to the exchange media function.
	An example of this command is shown below.

Data address	Data	Example setting	Description
+0000h	Command code	??h	Specifies [Get_File_Info]
+0001h	Receiver AP	01h	Expansion device (LM-Bus No.1)
+0002h	Sender AP	00h	Port A
+0003h	Data size	03h	The data size is 12 bytes
+0004h	Function type	00h	Specifies the function type as "Exchange Media"
+0005h		00h	
+0006h		04h	
+0007h		00h	
+0008h	MD	00h	Specifies the media number
+0009h		00h	
+000Ah	Fixed value	00h	Specifies "00h"
+000Bh		00h	
+000Ch		00h	
+000Dh	File No.	00h	Specifies the file number
+000Eh		00h	
+000Fh		00h	

Table 4.13   Get_File_Info Command Example

When the exchange media function receives this command, it transmits the file information for the file specified by the file No. to the host, using [Data Transfer].

If the specified File No. is invalid, [File Error] is transmitted.

Table 4.14 shows an example of the file information transmitted with [Data Transfer].

Data address	Data	Example setting	Description
+0000h	Command code	08h	Specifies [Data Transfer]
+0001h	Receiver AP	00h	Port A
+0002h	Sender AP	01h	Expansion device (LM-Bus No.1)
+0003h	Data size	09h+n	The data size is (36 + n x 4) bytes
+0004h	Function type	00h	Specifies the function type as "Exchange Media"
+0005h		00h	
+0006h		04h	
+0007h		00h	
+0008h	MD	00h	Specifies the media number
+0009+		00h	
+000Ah	Fixed value	00h	Specifies "00h"
+000Bh		00h	
+000Ch		00h	
+000Dh	File No.	00h	Specifies the file number
+000Eh		00h	
+000Fh		00h	
+00010h to	File information		Refer to Table 4.15

Table 4.14   File Information Example

Data address	+0	+1	+2	+3	+4	+5	+6	+7
+0010h	File name							
+0018h	File type			Attributes	Capacity			
+0020h	Date							
+0028h to	Long file name							

Table 4.15   File Information Configuration

Item	Data Size	Description
File name	8 bytes	Returns the file name as eight single-byte characters (four two-byte characters).
File type	3 bytes	Returns the file type as three single-byte characters.
Attributes	1 byte	Returns the attributes. (For details see Section 3.1, "File configuration.")
Capacity	4 bytes	Returns the file capacity in byte.
Date	8 bytes	Returns the date. (For details see Section 3.1, "File configuration.") The read-out value depends on the setting of TR. Values which cannot be read are returned as 00h.
Long file name	n x 4 bytes	Returns the long file name as a maximum of 256 single-byte characters (128 two-byte characters). (If LN=0 only) Returns 00h at the end of the file name. If the file name length is a multiple of 4 bytes, the following 4 bytes are all returned as 00h.

Fig. 4.16   File Information Parameters

4.1.3 Set_File_Info

Issuing right	: Host
Command code	: ??h
Data size	: 09h + n (36 bytes + n x 4 bytes)
Data	: Function type : 4 bytes
	MD : 1 byte
	Fixed value : 3 bytes
	File No. : 4 bytes
	File name : 8 bytes
	File type : 3 bytes
	Attributes : 1 byte
	Capacity : 4 bytes
	File name : n x 4 bytes
Description	: This command records (writes) the file information for the file No. specified to the exchange media function.
	An example of this command is shown below.

Data address	Data	Example setting	Description
+0000h	Command code	??h	Specifies [Set_File_Info]
+0001h	Receiver AP	01h	Expansion device (LM-Bus No.1)
+0002h	Sender AP	00h	Port A
+0003h	Data size	09h + n	The data size is (36 + n x 4) bytes
+0004h	Function type	00h	Specifies the function type as "Exchange Media"
+0005h		00h	
+0006h		04h	
+0007h		00h	
+0008h	MD	00h	Specifies the media number
+0009h		00h	
+000Ah	Fixed value	00h	Specifies "00h"
+000Bh		00h	
+000Ch		00h	
+000Dh	File No.	00h	Specifies the file number
+000Eh		00h	
+000Fh		00h	
+0010h to	File infrmation		Refer to Table 4.15 File Information Configuration

Table 4.17   Set_File_Info Command Example

When LN = 0, it is not necessary to set the file name.
Since it is automatically generated from the long file name, fill file name with 20h characters.
When deleting a file, set the first character of the file name to E5h.
When creating a new file, specify a capacity of 00h, and set File No. to the number obtained by adding one to the total number of files obtained from [Get_Media_Info].
The capacity is automatically calculated from the subsequently issued [File_Write], and stored.
For details on [File_Write], refer to section 4.1.5, "File_Write."

If the specified File No. is invalid, [File Error] is transmitted.

4.1.4 File_Read

Issuing right   : Host

Command code   : ??h

Data size   : 03h   (12 bytes)

Data   : Function type   : 4 bytes

                               MD   : 1 byte

                               Fixed value   : 3 bytes

                               File No.   : 4 bytes

Description   : This command gets the data for the specified File No. to the exchange media function.

An example of this command is shown below.

Data address	Data	Example setting	Description
+0000h	Command code	??h	Specifies [File_Read]
+0001h	Receiver AP	01h	Expansion device (LM-Bus No.1)
+0002h	Sender AP	00h	Port A
+0003h	Data size	03h	The data size is 12 bytes
+0004h	Function type	00h	Specifies the function type as "Exchange Media"
+0005h		00h	
+0006h		04h	
+0007h		00h	
+0008h	MD	00h	Specifies the media number
+0009h		00h	
+000Ah	Fixed value	00h	Specifies "00h"
+000Bh		00h	
+000Ch		00h	
+000Dh	File No.	00h	Specifies the file number
+000Eh		00h	
+000Fh		00h	

Table 4.18   File_Read Command Example

When the exchange media function receives this command, it transmits the data for the file specified by the file No. to the host, using [Data Transfer].

By repeatedly issuing the same command, all of the data within the file can be obtained.

Since the information on the data size which can be read in a single operation is stored in the media information, the number of File_Read operations required to get all of the data is as follows.

File capacity ÷ Read unit = No. of operations

If the specified file No. is invalid, [File Error] is transmitted.

Table 4.19 shows an example of the file data transmitted by Data Transfer].

Data address	Data	Example setting	Description
+0000h	Command code	08h	Specifies [Data Transfer]
+0001h	Receiver AP	00h	Port A
+0002h	Sender AP	01h	Expansion device (LM-Bus No.1)
+0003h	Data size	03h+n	The data size is (12 + n x 4) bytes
+0004h	Function type	00h	Specifies the function type as "Exchange Media"
+0005h		00h	
+0006h		04h	
+0007h		00h	
+0008h	MD	00h	Specifies the media number
+0009+		00h	
+000Ah	Fixed value	00h	Specifies "00h"
+000Bh		00h	
+000Ch		00h	
+000Dh	File No.	00h	Specifies the file number
+000Eh		00h	
+000Fh		00h	
+0010h to	File data		

Table 4.19   File Data Example

4.1.5 File_Write

Issuing right   : Host
Command code   : ??h
Data size   : 03h + n   (12 bytes + n x 4 bytes)
Data   : Function type : 4byte
            MD   : 1 byte
            Fixed value   : 3 bytes
            File No.   : 4 bytes
            File data   : n x 4 bytes
Description   : This command writes the data for the file No. specifies to the exchange media function.
            An example of this command is shown below.

Data address	Data	Example setting	Description
+0000h	Command code	??h	Specifies [File_Write]
+0001h	Receiver AP	01h	Expansion device (LM-Bus No.1)
+0002h	Sender AP	00h	Port A
+0003h	Data size	03h+n	The data size is (12 + n x 4) bytes
+0004h	Function type	00h	Specifies the function type as "Exchange Media"
+0005h		00h	
+0006h		04h	
+0007h		00h	
+0008h	MD	00h	Specifies the media number
+0009h		00h	
+000Ah	Fixed value	00h	Specifies "00h"
+000Bh		00h	
+000Ch		00h	
+000Dh	File No.	00h	Specifies the file number
+000Eh		00h	
+000Fh		00h	
+0010h to	File data		

Table 4.20 File_Write Command Example

When the exchange media function receives this command, it sends [Device Reply] to the host.
If the specified file No. is invalid, [File Error] is transmitted.
By repeatedly issuing the same command, all of the data within the file can be changed.
Since the information on the data size which can be written in a single operation is stored in the media information, the number of File_Write operations required to change all of the data is as follows.

File capacity ÷ Write unit = No. of operations

Once the file is changed to the end, issue a [Get_Last_Error].
When the writing ends normally, the file capacity up to this point is calculated, and the capacity within the file information is automatically updated.

For details on [Get_Last_Error], refer to section , "Get_Last_Error."

4.1.6 Get_Last_Error

Issuing right	: Host
Command code	: 0Dh
Data size	: 02h (8 bytes)
Data	: Function type : 4 bytes
	MD : 1 byte
	Fixed value : 3 bytes
Description	: Checks whether an error occurred on the immediately previously issued command (group of commands) with respect to the media specified by MD, to the exchange media function.
	If the result is no error, this returns [Device_Reply], and if there has been an error, [File Error].
	An example of this command is shown below.

Data address	Data	Example setting	Description
+0000h	Command code	0Dh	Specifies [Get_Last_Error]
+0001h	Receiver AP	01h	Expansion device (LM-Bus No.1)
+0002h	Sender AP	00h	Port A
+0003h	Data size	02h	The data size is 8 bytes
+0004h	Function type	00h	Specifies the function type as "Exchange Media"
+0005h		00h	
+0006h		04h	
+0007h		00h	
+0008h	MD	00h	Specifies the media number
+0009h		00h	
+000Ah	Fixed value	00h	Specifies "00h"
+000Bh		00h	

Fig. 4.21   Get_Last_Error Command Example

This is issued on the access following the command (group of commands) checking the error.

4.1.7 Data Transfer

Issuing right   : Exchange Media Function

Command code   : 08h

Data size   : For [Get_Media_Info]   : 07h (28 bytes)

                               For [Get_File_Info]   : 09h + n (36 + n x 4 bytes)

                               For [File_Read]   : 03h + n (12 + n x 4 bytes)

Data   : For [Get_Media_Info]

                               Function type   : 4 bytes

                               Media information : 24 bytes

                               For [Get_File_Info]

                               Function type   : 4 bytes

                               MD   : 1 byte

                               Fixed value   : 3 bytes

                               File No.   : 4 bytes

                               File information   : 24 + n x 4 bytes

                               For [File_Read]

                               Function type   : 4 bytes

                               MD   : 1 byte

                               Fixed value   : 3 bytes

                               File No.   : 4 bytes

                               File data   : n x 4 bytes

Description   : Data is returned in response to a request from the host .

                          With [Get_Media_Info], media information is returned.

                          With [Get_File_Info], file information is returned.

                          With [File_Read], file data is returned.

                          An example of this command is shown below.

Data address	Data	Example setting	Description
+0000h	Command code	08h	Specifies [Data Transfer]
+0001h	Receiver AP	00h	Port A
+0002h	Sender AP	01h	Expansion device (LM-Bus No.1)
+0003h	Data size	03h + n	The data size is (12 + n x 4) bytes
+0004h	Function type	00h	Specifies the function type as "Exchange Media"
+0005h		00h	
+0006h		00h	
+0007h		02h	
+0008h	MD	00h	Specifies the media number
+0009h		00h	
+000Ah	Fixed value	00h	Specifies "00h"
+000Bh		00h	
+000Ch to	File data		

Table 4.22   Data Transfer Command Example

4.1.8 Device Reply

Issuing right	: Exchange Media Function
Command code	: 07h
Data size	: 00h
Data	: none
Description	: When a command from the host completes normally within the function, this is transmitted to the host as a reply command.
	An example of this command is shown below.

Data address	Data	Example setting	Description
+0000h	Command code	07h	Specifies [Device Reply]
+0001h	Receiver AP	00h	Port A
+0002h	Sender AP	01h	Expansion device (LM-Bus No.1)
+0003h	Data size	00h	The data size is 0 byte

Table 4.23　Device Reply Command Example

4.1.9 Device Request

Issuing right	: Host
Command code	: 01h
Data size	: 00h
Data	: none
Expected return value	: [Device Status]
Description	: This command requests [Device Status] from the peripheral device of the transfer destination AP.
	After function initialization, until this command is transmitted, the function does not respond to other commands.
	An example of this command is shown below.

Data address	Data	Example setting	Description
+0000h	Command code	01h	Specifies [Device Request]
+0001h	Receiver AP	01h	Expansion device (LM-Bus No.1)
+0002h	Sender AP	00h	Port A
+0003h	Data size	00h	The data size is 0 byte

Table 4.24　Device Request Command Example

4.1.10 All Status Request

Issuing right	: Host
Command code	: 02h
Data size	: 00h
Data field	: None
Expected return value	: [Device All Status]
Description	: This command requests all device statuses (both Fixed Device Status and Free

Device Status) from the receiver AP peripheral device.

An example of this command is shown below.

Data address	Data	Example setting	Description
+0000h	Command code	02h	Specifies [All Status Request]
+0001h	Receiver AP	01h	Expansion device (LM-Bus No.1)
+0002h	Sender AP	00h	Port A
+0003h	Data size	00h	The data size is 0 bytes

Table 4.25   All Status Request Command Example

4.1.11 Device Reset

Issuing right	: Host
Command code	: 03h
Data size	: 00h
Data area	: None
Expected return value	: [Device Reply]
Order of operation	: (1) [Device Reply] is returned.
	(2) The peripheral is initialized.
Description	: This command can be used to initialize the device specified as the Receiver

AP.

The storage media is not initialized.

An example of this command is shown below.

Data address	Data	Example setting	Description
+0000h	Command code	03h	Specifies [Device Reset]
+0001h	Receiver AP	01h	Expansion device (LM-Bus No.1)
+0002h	Sender AP	00h	Port A
+0003h	Data size	00h	The data size is 0 bytes

Table 4.26   Device Reset Command Example

4.1.12 Device Kill

Issuing right   : Host

Command code   : 04h

Data size   : 00h

Data field   : none

Expected return value   : [Device Reply]

Operation sequence   : (1) [Device Reply] is returned.

                                         (2) The peripheral stops operating.

Description   : This command does not request any operation on the part of the peripheral device that is specified as the Receiver AP.

The Exchange Media Function goes into standby (consuming only the standby current), and does not accept any commands.

In order to make the Exchange Media Function resume operations, it is necessary either to execute a hardware reset or to turn off the power and then restart.

An example of this command is shown below.

Data address	Data	Example setting	Description
+0000h	Command code	04h	Specifies [Device Kill]
+0001h	Receiver AP	01h	Expansion device (LM-Bus No.1)
+0002h	Receiver AP	00h	Port A
+0003h	Data size	00h	The data size is 0 bytes

Table 4.27   Device Kill Command Example

4.1.13 Device Status

Issuing right   : Peripheral device

Command code   : 05h

Data size   : 1Ch (28)

Data field   : Device ID   : 16 Bytes

                                      Destination code   : 1 Byte

                                      Product name   : 31 Bytes

                                      License   : 60 Bytes

                                      Standby current consumption   : 2 Bytes

                                      Maximum current consumption: : 2 Bytes

Description   : This command returns Fixed Device Status data in response to [Device Request] from the host.

An example of this command is shown below.

Data address	Data	Example setting	Description
+0000h	Command code	05h	Specifies [Device Status]
+0001h	Receiver AP	00h	Port A
+0002h	Sender AP	01h	Expansion device (LM-Bus No.1)
+0003h	Data size	1Ch	The data size is 112 bytes
+0004h to +0013h	Device ID		Specifies the device ID
+0014h	Destination code		Specifies the destination code.
+0015h to +0033h	Product name		Specifies the product name
+0034h to +006Fh	License		Specifies the license
+0070h +0071h	Standby current consumption		Specifies the standby current consumption
+0072h +0073h	Maximum current consumption		Specifies the maximum current consumption

Table 4.28   Device Status Command Example

4.1.14 Device All Status

Issuing right	: Peripheral device	
Command code	: 06h	
Data size	: 1Ch + n	
Data field	: Fixed Device Status	: 112 Bytes
	Device ID	: 16 Bytes
	Destination code	: 1 Byte
	Product name	: 31 Bytes
	License	: 60 Bytes
	Standby current consumption	: 2 Bytes
	Maximum current consumption	: 2 Bytes
	Free Device Status	: n x 4 Bytes
Description	: This command returns both the Fixed Device Status and Free Device Status in response to	

the [All Status Request] command from the host.

4.2 Error commands

4.2.1 Function Type Unknown

Issuing right   : Peripheral device

Command code   : FEh

Data size   : 00h

Data field   : none

Description   : This error command is returned when the function type that was received does not exist
                         for the peripheral device.

Possible causes   : (1) The function type specification is incorrect.
                        (2) The data description is incorrect.
                        (3) The device ID was garbled.
                        (4) The data became garbled during transmission.

Remedies   : (1) Correct the function type specification.
                        (2) Correct the data description.
                        (3) Send [Device Request] again to get the device ID.
                        (4) Try the transmission again. (Retry three times, and then handle in the same manner
                            as a time out.)

4.2.2 Command Unknown

Issuing right   : Exchange Media Function

Command code   : FDh

Data size   : 00h

Data field   : none

Description   : This error command is returned when the command that was received is not supported
                        by the Excahnge Media Function.

Possible causes   : (1) The command specification is incorrect.
                        (2) The data description is incorrect.
                        (3) The device ID was garbled.
                        (4) The data became garbled during transmission.

Remedies   : (1) Correct the command specification.
                        (2) Correct the data description.
                        (3) Send [Device Request] again to get the device ID.
                        (4) Try the transmission again. (Retry three times, and then handle in the same manner
                            as a time out.)

4.2.3 Transmit Again

Issuing right	: Host, Exchange Media Function
Command code	: FCh
Data size	: 00h
Data field	: none
Description	: This error command requests that the same data be transmitted again when some type of error was found in data that was received.
Possible causes	: (1) A parity error occurred.
	(2) A data overflow occurred.
	(3) The data became garbled during transmission.
	(4) Other cause.
Remedies	: Send the data again. (Retry three times, and then handle in the same manner as a time out.)

4.2.4 File Error

Issuing right	: Exchange Media Function
Command code	: FBh
Data size	: 01h
Data	: Function error code : 4 bytes
Description	: This command is send to the host as a reply command when some type of error occurred in the Exchange Media Function while processing a command from the host (if a series of commands being processed were divided into several groups, those instructions are regarded as one process).
	An example of this command is shown below.

Data address	Data	Example setting	Description
+0000h	Command code	FBh	Specifies [File Error]
+0001h	Receiver AP	00h	Port A
+0002h	Sender AP	01h	Expansion device (LM-Bus No.1)
+0003h	Data size	01h	The data size is 4 bytes
+0004h	Function error code		Refer to Table 4.10
+0005h			
+0006h			
+0007h			

Table 4.29   File Error Command Example

The function error code details are displayed below.

bit	7	6	5	4	3	2	1	0
1st Data	FE_{31}	FE_{30}	FE_{29}	FE_{28}	FE_{27}	FE_{26}	FE_{25}	FE_{24}
2nd Data	FE_{23}	FE_{22}	FE_{21}	FE_{20}	FE_{19}	FE_{18}	FE_{17}	FE_{16}
3rd Data	FE_{15}	FE_{14}	FE_{13}	FE_{12}	FE_{11}	FE_{10}	FE_{9}	FE_{8}
4th Data	FE_{7}	FE_{6}	FE_{5}	FE_{4}	FE_{3}	FE_{2}	FE_{1}	FE_{0}

Table 4.30   Function Error Codes

If a particular error occurred, that corresponding item is set to "1;" if that error did not occur, that item is set to "0."

The errors are described below.

If the action taken by the host does not clear the error, then disconnect processing is executed and a user message is output.

FE$_0$: PT Error

Description	: The specified partition does not exist.
Function operation	: All data involved when the error occurred is damaged.
Host action	: Send the data again (up to three times).

FE$_1$: Phase Error

Description	: The Phase + 1 value is greater than the value of RA (when executing Block_Read).
	The Phase + 1 value is greater than the value of WA (when executing Block_Write).
	The Phase value changed by an amount other than "+1".
	(For example: Phase 0 -> 2 -> 1)
Function operation	: All data involved when the error occurred (the entire block) is damaged.
Host action	: Send the data again (up to three times).
	In the case of a block, start over from Phase = 0.

FE$_2$: Block Error

Description	: The specified partition does not exist.
Function operation	: All data involved when the error occurred (the entire block) is damaged.
Host action	: Send the data again (up to three times).

FE$_3$: Physical Write Error

Description	: The data was not written in the storage device (media) correctly.
Function operation	: The incorrect data is written in the storage device (media), and is not erased.
Host action	: Send the data again (up to three times).
	If this error is detected even after three retries, the data is saved in the save area.

FE$_4$: Length Error

Description	: The specified data size does not match the size of the data that was sent.
Function operation	: All data involved when the error occurred (the entire block) is damaged.
Host action	: Send the data again (up to three times).

FE$_5$: Domain Error

Description	: An access was made to an access-prohibited area.
Function operation	: All data involved when the error occurred (the entire block) is damaged.
Host action	: Change the area being accessed and then send the data again.

FE$_6$: Drive not Ready

Description	: Removable media was not mounted.

Function operation : All data involved when the error occurred (the entire block) is damaged.

Host action : Send the data again (up to three times, then handle in the same manner as a time out.)

FE$_7$: CRC Error

 Description : While the CRC flag was set to "1," a CRC error occurred while receiving block data.

 Function operation : All data involved when the error occurred (the entire block) is damaged.

 Host action : Recalculate the CRC and then send the data again (up to three times).

FE$_{31}$: Undefined Error

 Description : An undefined error occurred.

 Function operation : All data involved when the error occurred (the entire block) is damaged.

 Host action : Send the data again (up to three times, then handle in the same manner as a time out.)

All other error codes are reserved.

4.3 Protocol flow

The following diagram provides a general overview of the basic communications protocol between the host and the Storage Function.
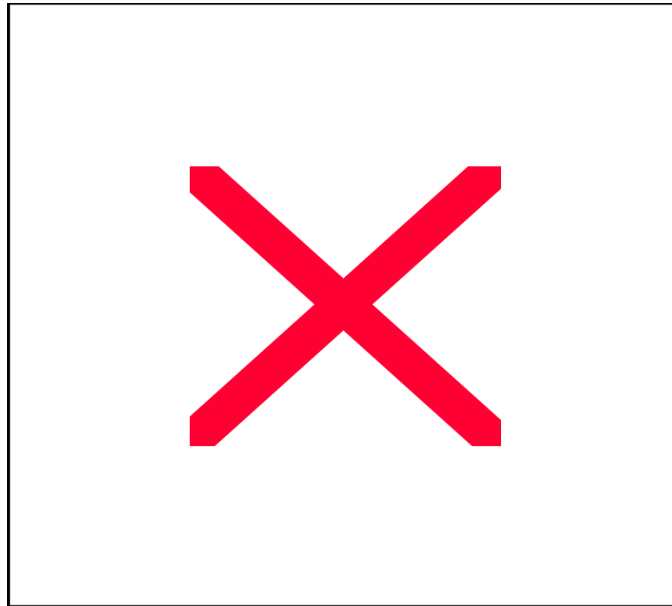

Fig. 4.31   Overview of Communications Protocol

4.4 Get_Media_info processing flow

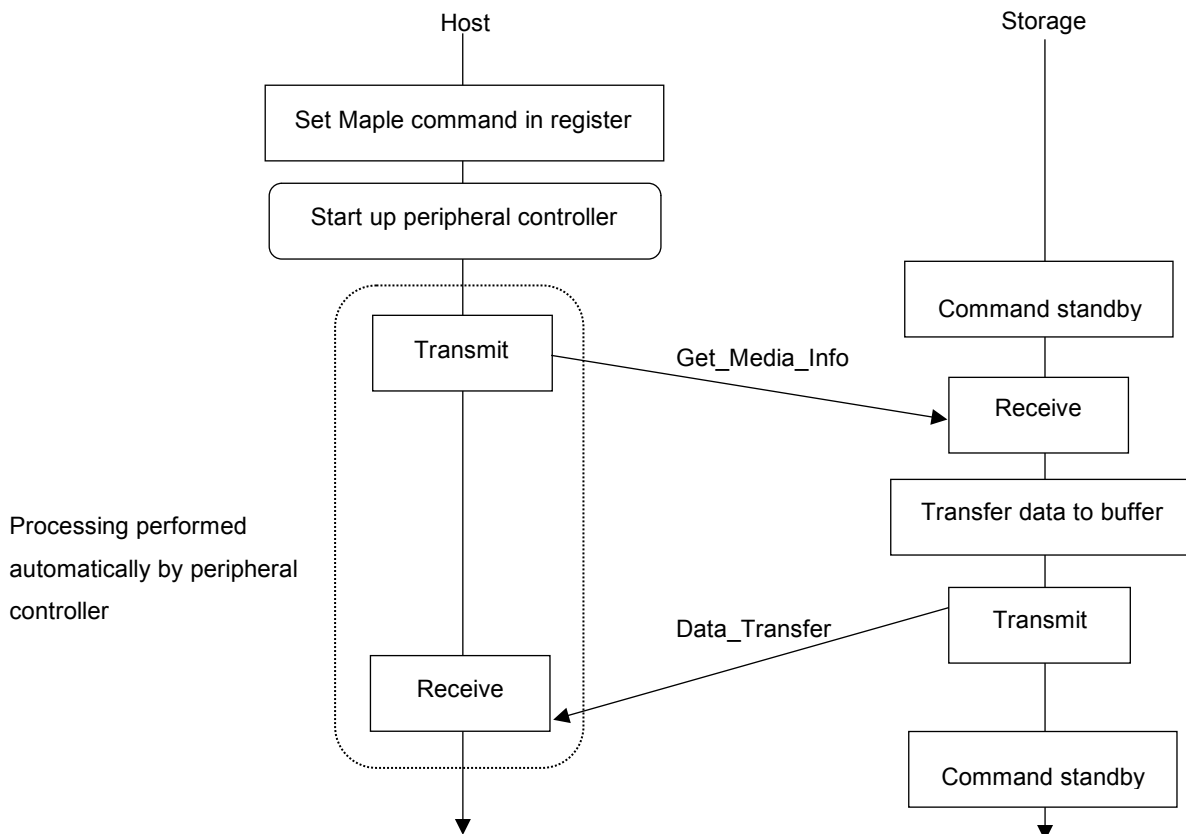The flow of processing for the Get_Media_Info operation is shown below.

Fig. 4.32   Overview of Get_Media_Info Processing Flow

4.5 Block_Read processing flow

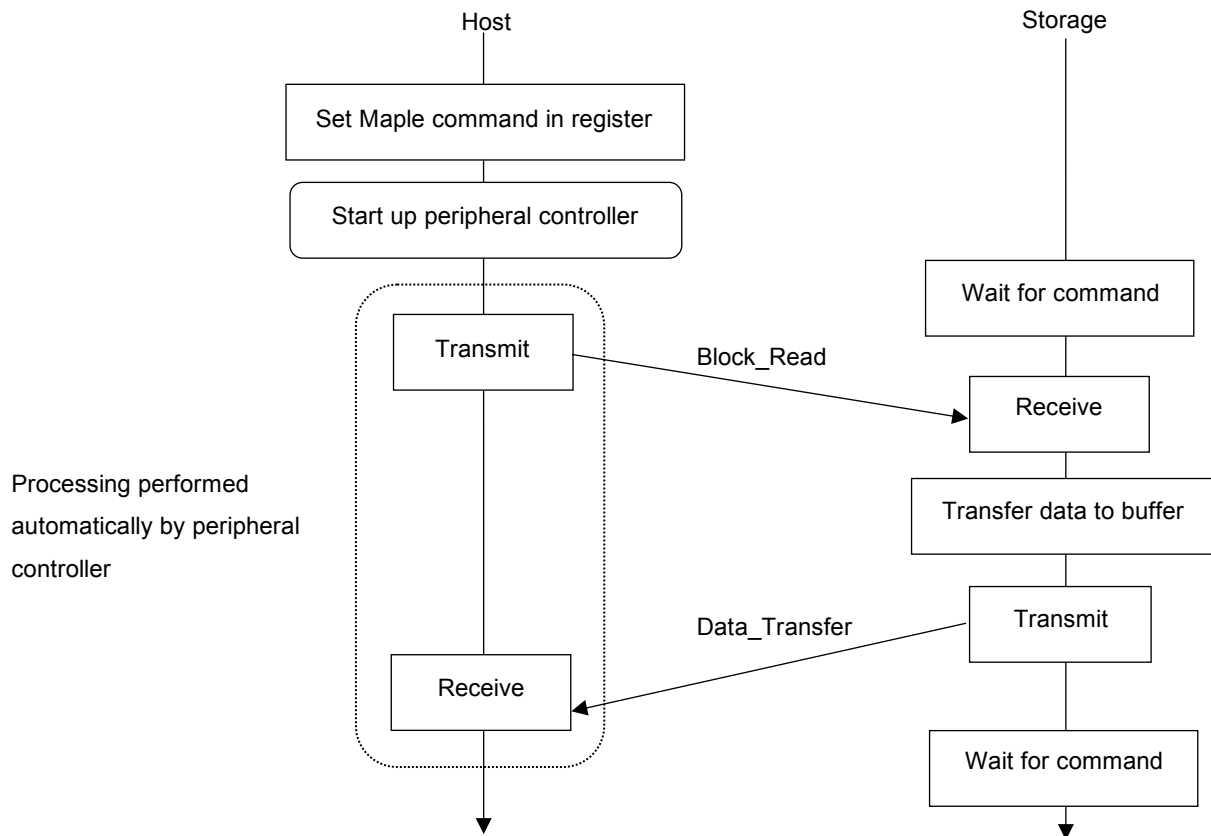The flow of processing for the Block_Read operation is shown below.

Fig. 4.33   Overview of Block_Read Processing Flow

If phases are used, the above process is repeated the necessary number of times.

4.6 Block_Write processing flow

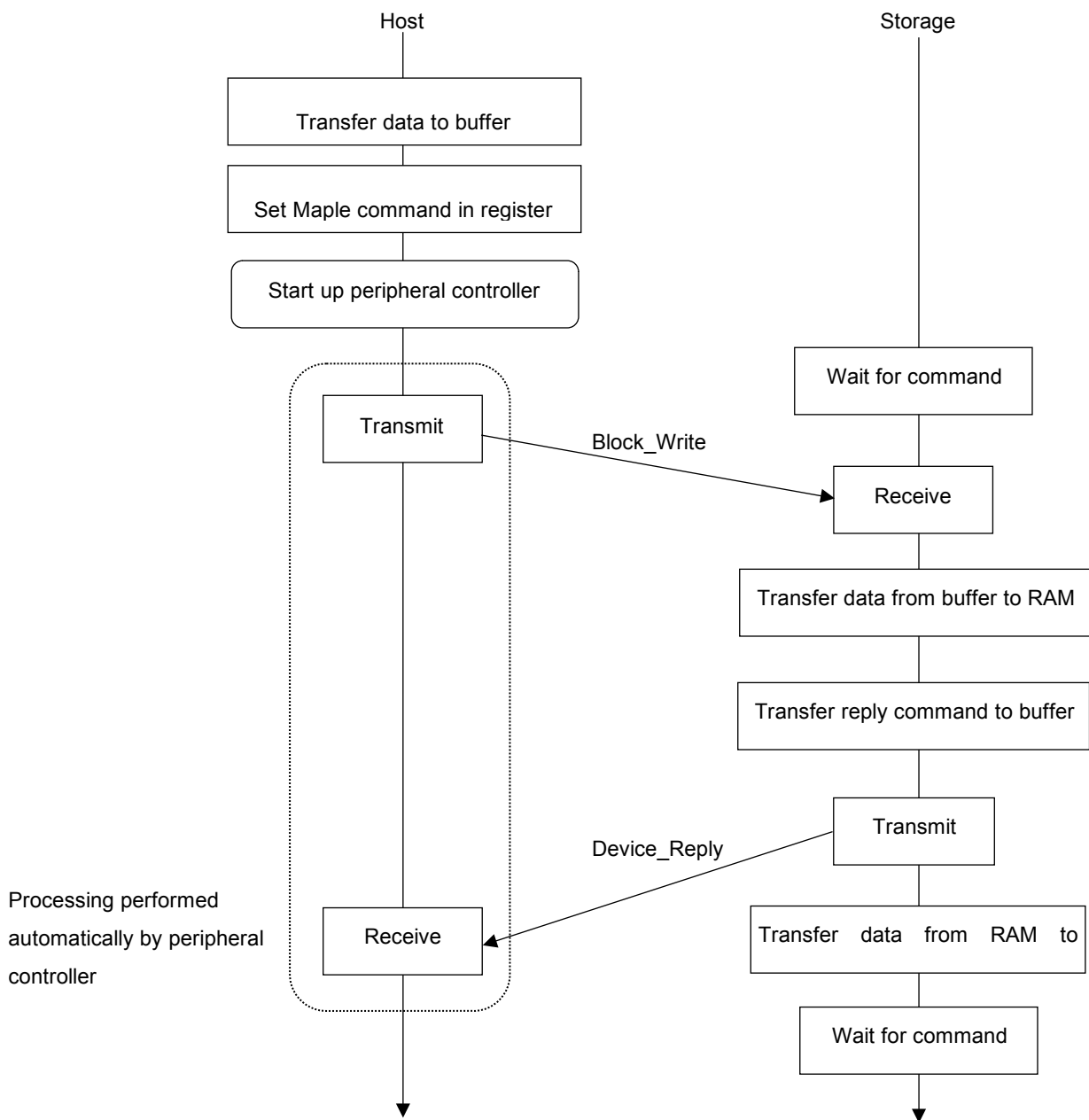The flow of processing for the Block_write operation is shown below.

Fig. 4.34   Overview of Block_Write Processing Flow

If phases are used, the above process is repeated the necessary number of times.

After the [Block_Write] processing is completed, a check for errors in the write data is made by sending [Get_Last_Error] to the host in the next access.

4.7 Get_Last_Error processing flow

The flow of processing for the Get_Last_Error operation is shown below.

Host   Storage

Set Maple command in register

Start up peripheral controller

Wait for command

Transmit ———Get_Last_Error———> Receive

Transfer data to buffer

Processing performed
automatically by peripheral
controller

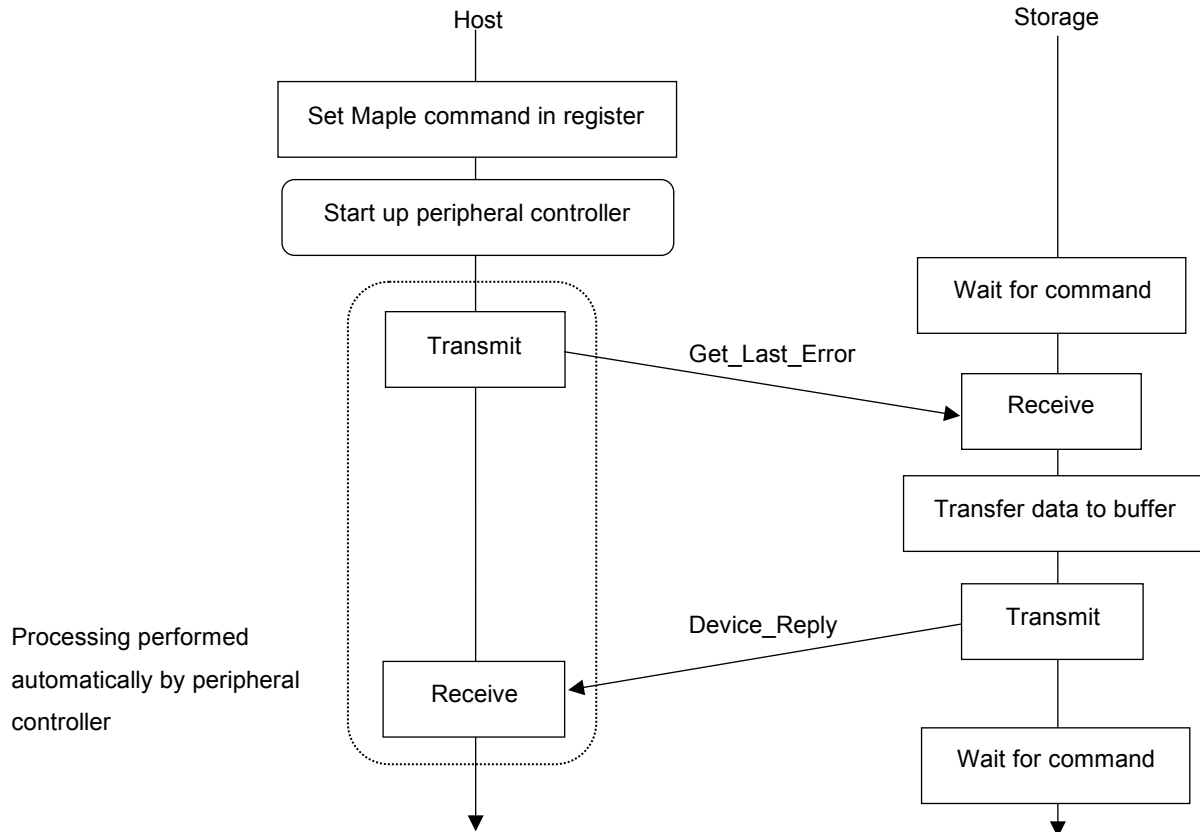Receive <———Device_Reply——— Transmit

Wait for command

Fig. 4.35   Overview of Get_Last_Error Processing Flow

5. AFTERWORD

Until the official version (Rev. 1.0) is distributed, contents will be modified to a small or large extent.