RF Amp embedded Digital Servo DSP for CD

LC78615/LC78616

Command Specification Sheet

ON Semiconductor

Version 1.01
(2014.03.28)

Table of Contents

Update History

Version 1.01(2014.03.28)

Deleted bit1 function of System Option of Set Mode command

Added ErrorCode (36h - 39h) and Warning Code (E7h - EAh)

Version 1.00 (2014.02.20)

Deleted Servo Spindle Kick command because it is incompatible

Version 0.04 (2013.10.07)

Changed Index range of Write Servo RAM command and Read Servo RAM command (80h、84h、88h、D0h、D8h).

Version 0.03 (2013.10.02)

Added comment forSet Command Return Mode command

Corrected Index range for Write Servo RAM command, Read Servo RAM command, (80h～87h、D0h～D3h).

Added Get Current Status command Error (36、37、38)

Added Warning Code (E7、E8、E9)

Version 0.02 (2013.09.18)

Mode specification change onLBA Play command

Specification change on Start ROM Correct command (Correction of the comment)

Added New command; Set Command Return Mode

Added comment for Read Servo RAM command (D0h、D1h、D2h、D3h、D8h、E1h).

Version 0.01 (2013.04.02)

New Document

1 Introduction

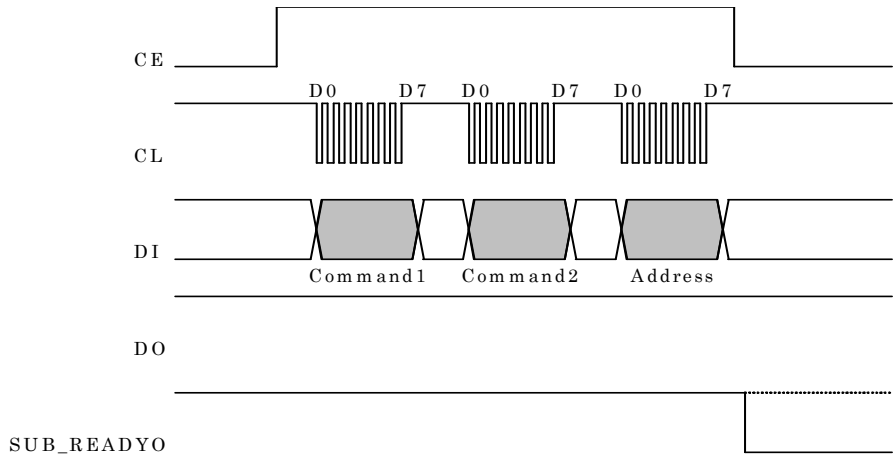
As support documentation for P13, please refer to “LC78615_16 Port Setting Specification sheet” and “LC78615_16 Failsafe Specification sheet” as well.

2 Communication Protocol

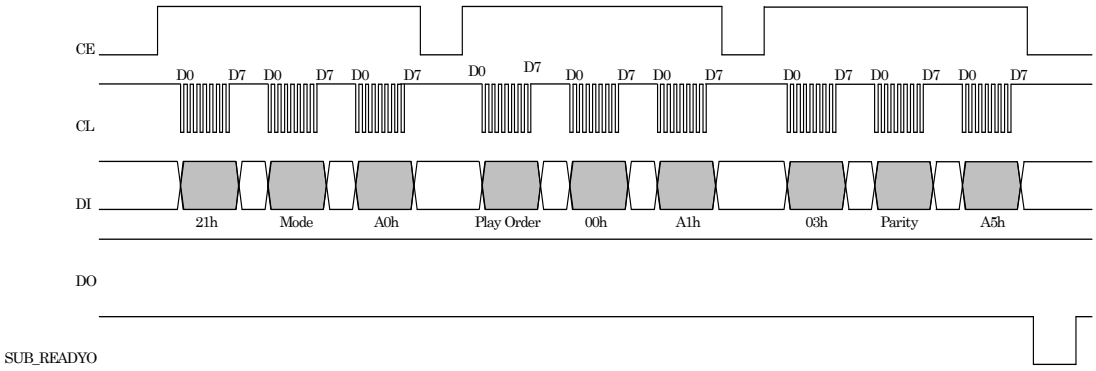
2.1 Command Transmission

When sending commands from host MCU, transmit Command1, Command2, and Address in this order after CE rise. Transmission will end by CE fall after sending an Address. Writing “A5h” in the Address is considered as all commands are written and the sequencer will drop SUB_READYO to start analyzing transmitted command. When sequencer completes its analysis for commands received, it will launch SUB_READYO. Communication is not accepted during received command analysis (i.e. when SUB_READYO port is in Low period). Transmitted and received data are LSB First.

Please be sure to pad “00h” when Command2 is ‘Reserved’ and transmit 3bytes; Command1, Command2, and Address.

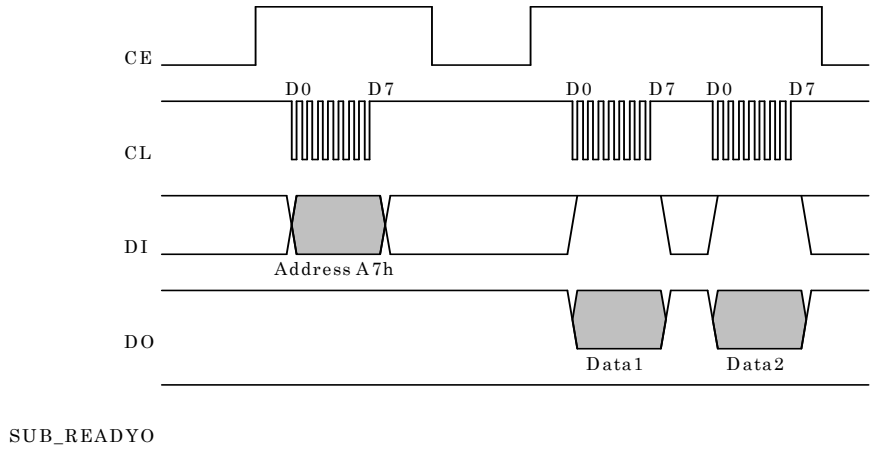


In case of transmitting Play command

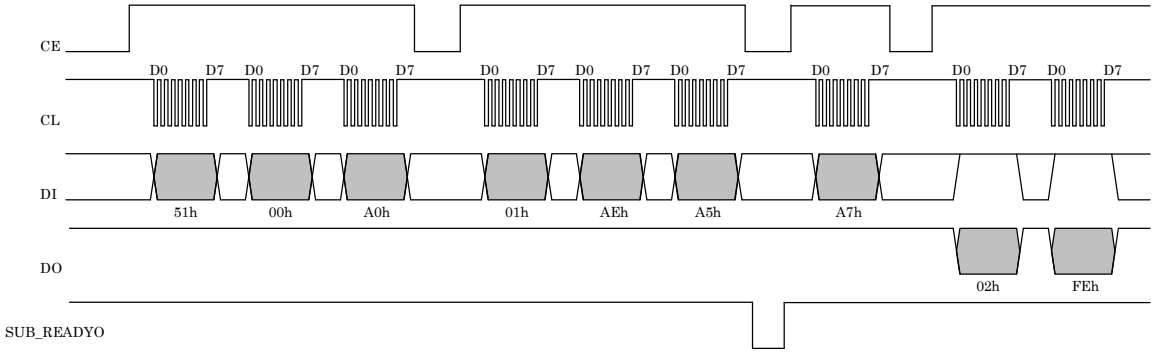


2.2 Data Reception

When Host MCU is receiving a data, it starts the CE and transmits “A7h” to the Address. After the reception, it will get back to Data reception mode by shutting down the CE. Data can be received by transmitting clock after shutting down the CE again. When the host is receiving data, be sure to output “FFh” (High) from DI port.



In case of requesting Disc discrimination result;



2.3 Communication Error

When sequencer receives command from the host and if it is determined as either 1) parity does not match or 2) the command is invalid then the sequencer will consider that as a communication error and destroy the command. In order to inform the host about such communication error, it will output LOW from “SUB_READYO” port for 30msec. Please consider it as another communication error if “SUB_READY0” port does not rise within 15msec after the command transmission. In such a case, please execute recovery process (e.g. re-send command) accordingly. This LOW period is different in some command and the period is described for each command separately.
(Reset IC, Stop DSP Clock,Start DSP Clock, End ROM Correct)
Indefinite data will come out from the sequencer when communication error is generated.

3 Command List

3.1 Command list and Correspondence table per Device

Command	Operation Code	Model				
					LC78616	LC78615
Reset IC	01h				○	○
Clear Information	02h				○	○
Set Mode	03h				○	○
Stop DSP Clock	04h				○	○
Start DSP Clock	05h				○	○
Set Play Mode	06h				○	○
Set FF & FR Mode	07h				○	○
Set FF & FR Attenuate Mode	08h				○	○
Set SDRAM Capacity	09h				○	−
Set Command Return Mode	0Ah				○	○
Start ROM Correct	0Bh				○	○
End ROM Correct	0Ch				○	○
Abort	12h				○	○
Stop	20h				○	○
Play	21h				○	○
Pause	22h				○	○
Skip	23h				○	○
Play CD Track Number	24h				○	○
Play CD Absolute Time	25h				○	○
Fast Forward & Fast Reverse	29h				○	○
Random	30h				−	○
Repeat	31h				○	○
Scan	32h				−	○
Set Play Order	33h				○	○
LBA Play	36h				○	○
Get Firmware Version	50h				○	○
Get Disc Type	51h				○	○
Get TOC	52h				○	○
Get Current Status	53h				○	○
Get CD-Text Information	54h				○	−
Get System Information	59h				○	○
Get Memory Remaining	5Ah				○	−
Get Track Information	5Eh				○	○
Get Session Information	5Fh				○	○

Get Current Text Data	60h				○	−
Get CD-Text Data	62h				○	−
Get Random Parameter	74h				−	○
Write Servo RAM	80h				○	○
Write Servo Parameter	81h				○	○
Write Auto Adjust Data	82h				○	○
Write Servo Command	83h				○	○
Write Servo RAM with Index	84h				○	○
Write Servo Parameter with Index	85h				○	○
Write Auto Adjust Data with Index	86h				○	○
Write Servo Command with Index	87h				○	○
Write Playback Parameter	88h				○	○
Write DSP	91h				○	○
Read Servo RAM	D0h				○	○
Read Servo Parameter	D1h				○	○
Read Auto Adjust Data	D2h				○	○
Read Servo Command	D3h				○	○
Read Playback Parameter	D8h				○	○
Read DSP	E1h				○	○

3.2 Command list and Correspondence table per Media/Error warning

command	Operation Code	Apply Media						Error/Warning				Error Clear
		CD-DA		Mixed-CD		Stream IN		E1	E2	E3	Warning	
				CD–DA								
Reset IC	01h	○		○						○	○	○
Clear Information	02h	○		○								
Set Mode	03h	○		○								
Stop DSP Clock	04h	○		○						○		○
Start DSP Clock	05h	○		○						○		
Set Play Mode	06h	○		○								
Set FF & FR Mode	07h	○		○								
Set FF & FR Attenuate Mode	08h	○		○								
Set SDRAM Capacity	09h	○		○								
Set Command Return Mode	0Ah											
Start ROM Correct	0Bh											
End ROM Correct	0Ch											
Abort	12h	○		○						○		○
Stop	20h	○		○						○		○
Play	21h	○		○				○	○	○	○	○
Pause	22h	○		○					○	○	○	○
Skip	23h	○		○					○	○		○
Play CD Track Number	24h	○		○				○	○	○	○	○
Play CD Absolute Time	25h	○		○				○	○	○	○	○
Fast Forward & Fast Reverse	29h	○		○					○	○	○	○
Random	30h	○		○					○	○	○	○
Repeat	31h	○		○					○	○		
Scan	32h	○		○					○	○	○	○
Set Play Order	33h	○		○								
LBA Play	36h	○		○								○
Get Firmware Version	50h	○		○								
Get Disc Type	51h	○		○								
Get TOC	52h	○		○								
Get Current Status	53h	○		○								
Get CD-Text Information	54h	○		○								
Get System Information	59h	○		○								
Get Memory Remaining	5Ah	○		○								

Get Track Information	5Eh	○		○								
Get Session Information	5Fh	○		○								
Get Current Text Data	60h	○		○								
Get CD-Text Data	62h	○		○								
Get Random Parameter	74h	○		○								
Write Servo RAM	80h											
Write Servo Parameter	81h											
Write Auto Adjust Data	82h											
Write Servo Command	83h											
Write Servo RAM with Index	84h											
Write Servo Parameter with Index	85h											
Write Auto Adjust Data with Index	86h											
Write Servo Command with Index	87h											
Write Playback Parameter	88h											
Write DSP	91h											
Read Servo RAM	D0h											
Read Servo Parameter	D1h											
Read Auto Adjust Data	D2h											
Read Servo Command	D3h											
Read Playback Parameter	D8h											
Read DSP	E1h											

4 Reset IC

This provides request to place reset on CD-DSP.

Address	Command1	Command2
A0h	Operation Code (01h)	Reserved
A1h	Reserved	Reserved
A2h	Reserved	Reserved
A3h	Reserved	Reserved
A4h	Reserved	Reserved
A5h	Length (01h)	Parity Data

Sending this command will reset F/E block inside the IC. But it will remain information that sequencer maintains (Auto adjustment result and TOC information).
It is recommended to send this command during STOP. Even if the sequencer receives this command in other timing besides STOP, it will convert the command to STOP for execution.
During this command process, normally, LOW output will continue from SUB_READYO port for 70msec.
(However, if STOP transition occurs, LOW output will continue during that transition period as well).

5 Clear Information

It makes requests to clear automatic adjustment result and TOC information.

Address	Command1	Command2
A0h	Operation Code (02h)	Option
A1h	Reserved	Reserved
A2h	Reserved	Reserved
A3h	Reserved	Reserved
A4h	Reserved	Reserved
A5h	Length (02h)	Parity Data

Option

Code	Description
00h	Requests to clear Automatic adjustment result
01h	Requests to clear TOC information
02h	Requests to clear both Automatic adjustment result and TOC information

This command is valid only during STOP (excluding STOP transition).

6 Set Mode

This is a sequencer operation setting. It sets Multi-session analysis mode, Port setting, and System options.

Address	Command1	Command2
A0h	Operation Code (03h)	Multi-Session Mode
A1h	Port Setting	System Option
A2h	Reserved	Reserved
A3h	Reserved	Reserved
A4h	Reserved	Reserved
A5h	Length (04h)	Parity Data

Multi-Session Mode

Bit	Description
7	Reserved : Be sure to set this to "0"
6	Reserved : Be sure to set this to "0"
5	Reserved : Be sure to set this to "0"
4	Reserved : Be sure to set this to "0"
3	Reserved : Be sure to set this to "0"
2	0 : If a session with CD-DA track exists after the 2nd session, then the session after that is invalid (Default) 1 : Analyze everything even if a session with CD-DA track exists after the 2nd session
1	0 : If the 1st session is all CD-DA track, than do not execute analysis after the 2nd session. (Default) 1 : Even if the 1st session is all CD-DA track, execute analysis after 2nd session.
0	0 : Analyze Multi-session (Default) 1 : Do not analyze Multi-session

Port Setting

Code (BCD)	Description
00h - FFh	Port setting (Default : 00h) ※ Please refer to "LC78615_16 Port setting Specification sheet" for more information.

System Option

Bit	Description
7	Reserved : Be sure to set this to “0”
6	Reserved : Be sure to set this to “0”
5	Reserved : Be sure to set this to “0”
4	Reserved : Be sure to set this to “0”
3	Reserved : Be sure to set this to “0”
2	CIRC setting when playing CD-DA track 0 : Dual correction (Default) 1 : Quadruple correction
1	Reserved : Be sure to set this to “0”
0	SDRAM SUM check during Standby 0 : Invalid (Default) 1 : Valid (only on LC78616) ※ Please refer to “LC78615_16 Failsafe Specification sheet” for more information

This command is valid when Current status is in either “STOP (TOC read incomplete)” or “Reset start detection”condition.

Please transmit Reset IC command or execute Automatic adjustment when the Port setting has been changed.

※ Please refer to “LC78615_16 Port setting Specification sheet” for more information about the contents of Port setting.

※ Please refer to “LC78615_16 Failsafe Specification sheet” for more information about SDRAM SUM check specification during Standby.

7 Stop DSP Clock

This clock prepares to stop CD-DSP clock oscillation.

Address	Command1	Command2
A0h	Operation Code (04h)	Reserved
A1h	Reserved	Reserved
A2h	Reserved	Reserved
A3h	Reserved	Reserved
A4h	Reserved	Reserved
A5h	Length (01h)	Parity Data

It is recommended to send this command during STOP. Even if the sequencer receives this command in other timing besides STOP, it will migrate the command to STOP for execution.

During this command process, LOW output from SUB_READYO port will continue. It executes SDRAM standby process in SDRAM compatible models so it may take 10msec, 60msec, or 280msec depending on its setting value.
(However, if STOP transition occurs, LOW output will continue during that transition period as well).
Please refer to “LC78615_16 Failsafe Specification sheet” for more details about the setting value and required time.
All commands except “Start DSP Clock” are prohibited after sending this command.

8 Start DSP Clock

This clock restarts the CD-DSP clock oscillation.

Address	Command1	Command2
A0h	Operation Code (05h)	Reserved
A1h	Reserved	Reserved
A2h	Reserved	Reserved
A3h	Reserved	Reserved
A4h	Reserved	Reserved
A5h	Length (01h)	Parity Data

This command is valid only from the condition where the clock is stopped by "Stop DSP Clock" command.

During this command process, LOW output from SUB_READYO port will continue. It executes SDRAM standby return process in SDRAM compatible models so it may take 10msec, 60msec, or 280msec depending on its setting value.

Please refer to "LC78615_16 Failsafe Specification sheet" for more details about the setting value and required time.

9 Set Play Mode

When sequencer judges the disc type as a Mixed CD, this sets an operation mode when it detects CD-ROM track.

Address	Command1	Command2
A0h	Operation Code (06h)	Play Mode
A1h	Reserved	Reserved
A2h	Reserved	Reserved
A3h	Reserved	Reserved
A4h	Reserved	Reserved
A5h	Length (02h)	Parity Data

Play Mode

Code	Description
00h	Do not playback tracks that are considered as CD-ROM by the TOC information (Default)
01h	Out of all the track range; if CD-ROM track is detected within subcode's digital bit during CD-DA playback, it will skip to the next track.
02h	Based on TOC information; Playback range is determined from the first CD-DA track to the last CD-DA track. If CD-ROM is detected within this range, it will skip to the next track.
03h	Based on TOC information; Playback range is determined from the first CD-DA track to the last CD-DA track. If CD-ROM track is detected within this range, it will put on Mute and play.
04h	Plays all tracks. If CD-ROM track is detected, it will put MUTE and playback.

If the track specified by Play CD Track Number command does not exist in the playback range, it will output a warning code "Receive disk dependent invalid command (Ignore the command and continue its operation after the outbreak of the warning).

This mode will go back to its default by transmitting "01h" (TOC information clear) or "02h" (Automatic adjustment result, TOC information clear) of the Clear Information.

10 Set FF & FR Mode

This mode will set Fast forward and Fast Reverse of the sequencer.

Address	Command1	Command2
A0h	Operation Code (07h)	FF/FR Speed
A1h	Play Time(MSB)	Play Time(LSB)
A2h	Jump Time(MSB)	Jump Time(LSB)
A3h	Reserved	Reserved
A4h	Reserved	Reserved
A5h	Length (06h)	Parity Data

FF/FR Speed

Code	Description
00h	Changes the parameter of CD-DA FF/FR Speed1 (Slow)
01h	Changes the parameter of CD-DA FF/FR Speed2 (Middle)
02h	Changes the parameter of CD-DA FF/FR Speed3 (Fast)

Play Time

Code (HEX)	Description
0032h – 2710h	Playback time during FF/FR (msec) CD-DA Default : 150msec (96h) / common to Speed1, 2, and 3

Jump Time

Code (HEX)	Description
0032h – 2710h	Junp time during FF/FR (msec) CD-DA Default: [Speed1] 500msec (1F4h), [Speed2] 1000msec (3E8h), [Speed3] 1500msec (5DCh)

Settable time is in unit of 50msec. It will truncate other numbers that are not in a multiple of 50.

11 Set FF & FR Attenuate Mode

This mode will change Fast Forward & Fast Reverse command's attenuate operation.

Address	Command1	Command2
A0h	Operation Code (08h)	Mode
A1h	Reserved	Reserved
A2h	Reserved	Reserved
A3h	Reserved	Reserved
A4h	Reserved	Reserved
A5h	Length (02h)	Parity Data

Mode

Code	Description
00h	Attenuate setting : - 12dB (Default)
01h	Attenuate setting : - 6dB

The mode set by this command will become valid by setting attenuate (01h) usingFast Forward & Fast Reverse command.

12 Set SDRAM Capacity

This will set external SDRAM capacity.

Address	Command1	Command2
A0h	Operation Code (09h)	Mode
A1h	Reserved	Reserved
A2h	Reserved	Reserved
A3h	Reserved	Reserved
A4h	Reserved	Reserved
A5h	Length (02h)	Parity Data

Mode

Code	Description
00h	SDRAM 16Mbit (Default)
01h	SDRAM 64Mbit

Be sure to execute Reset IC command after transmitting this command.

This command is valid only for LC78616

13 Set Command Return Mode

This mode sets the notification method for command communication error.

Address	Command1	Command2
A0h	Operation Code (0Ah)	Mode
A1h	Reserved	Reserved
A2h	Reserved	Reserved
A3h	Reserved	Reserved
A4h	Reserved	Reserved
A5h	Length (02h)	Parity Data

Mode

Code	Description
00h	Former mode (LC78613/614 compatible mode)
01h	Command status reception mode (Returns command reception status to the 1st byte of the received data)

Return Data (For this command)

Byte	Data
0	Command return status
1	Mode (Echo back)
2	Parity data

Return Data (Example of other command)

Byte	Data
1	Command return status
2	Parity data

Command Return Status

Byte	Description
All except EEh and EFh	Command is received without an issue
EEh	Command communication error for cases such as 1) Command parity from the host does not match or 2) Is is judged as invalid command
EFh	This byte is set when receiving; Undetermined Operation code, Undetermined code, Undetermined bit pattern, Data which exist outside the determined range, A command at unacceptable timing, and A command that cannot be executed at that point.

If Mode=01 is set with this command, it will return Command return status to the 1st byte of the received data in all commands hereafter.
It will return 0xEE for Command communication error (Command parity from the host does not match or it is judged as an invalid command). 0xEE is returned when the command is judged as invalid (when warning codes 91h ~ 96h are set) with command operation code abnormality and such.

Even commands without received data will start to return Command Return Status and Parity Data. In such case 0x01 is returned when command reception is normal.

For commands with received data, be sure to start received data analysis after confirming its 1st byte being neither 0xEE nor 0xEF.

In case of command (D0h, D1h, D2h, D3h, D8h, E1h), Command reception status is returned to the 1st byte of the Return data by setting Mode = 01. Received data will shift back by 1 byte thereafter.

If ROM correct is executed, be sure to reset this command after the ROM correct.
(Unnecessary if Mode = 00)
SUB_READY operation specification at the time of communication error will not change by transmitting this command.
(Please see Communication Error section of the “Communication Protocol)

Ex 1) Reset IC command

Mode＝00 and without communication error	Received data : None
Mode＝00 and with communication error	Received data : None
Mode＝01 and without communication error	Received data : 01 FF (01→Normal reception; FF→ Parity)
Mode＝01 and with communication error	Received data : EE 12 (EE→Communication error; 12→Parity)

Ex 2) Get Firmware Version command

Mode＝00 and without communication error	Received data : 31 30 30 30 20 20 20 20 36 31 36 36 44 30 32 46
Mode＝00 and with communication error	Received data : None
Mode＝01 and without communication error	Received data : 31 30 30 30 20 20 20 20 36 31 36 36 44 30 32 46
Mode＝01 and with communication error	Received data : EE 12

Ex 3) Read Servo RAM command

Mode＝00 and without communication error	Received data : 00 00 21 DF
Mode＝00 and with communication error	Received data : None
Mode＝01 and without communication error	Received data : 01 00 00 21 DF (1st byte is a reception status)
Mode＝01 and with communication error	Received data : EE 12

14 Start ROM Correct

This prepares for the ROM correct.

Address	Command1	Command2
A0h	Operation Code (0Bh)	Reserved
A1h	Reserved	Reserved
A2h	Reserved	Reserved
A3h	Reserved	Reserved
A4h	Reserved	Reserved
A5h	Length (01h)	Parity Data

It is prohibited to send any other commands except Get Firmware Version command and Get Current Status command before sending this command (immediately after reset).

15 End ROM Correct

This informs the transmission completion of ROM correct.

Address	Command1	Command2
A0h	Operation Code (0Ch)	Reserved
A1h	Reserved	Reserved
A2h	Reserved	Reserved
A3h	Reserved	Reserved
A4h	Reserved	Reserved
A5h	Length (01h)	Parity Data

16 Abort

It makes request to the sequencer to stop its operation.

When this command is transmitted during CD playback, it cancels the playback and makes a transition to STOP condition. Resume information will be maintained.

Address	Command1	Command2
A0h	Operation Code (12h)	Reserved
A1h	Reserved	Reserved
A2h	Reserved	Reserved
A3h	Reserved	Reserved
A4h	Reserved	Reserved
A5h	Length (01h)	Parity Data

This command is invalid during STOP.

Sequencer will clear error information when this command is transmitted.

17 Stop

It makes a request to stop CD playback. Resume information becomes manipulable by setting Resume mode.

When it is requested to clear resume information, sequencer will stop disc rotation and return the pickup to its inner perimeter after clearing the resume information.

Address	Command1	Command2
A0h	Operation Code (20h)	Mode
A1h	Reserved	Reserved
A2h	Reserved	Reserved
A3h	Reserved	Reserved
A4h	Reserved	Reserved
A5h	Length (02h)	Parity Data

Mode

Code	Description
00h	Maintain resume information and stop
01h	Clear resume information and stop
02h	After clearing resume information and stop, move the pickup to the inner perimeter which is even further inside than its inner detection SW

Sequencer will clear error information when this command is transmitted.

18 Play

Makes a request for CD playback.

Address	Command1	Command2
A0h	Operation Code (21h)	Mode
A1h	Play Order	Reserved
A2h	Reserved	Reserved
A3h	Reserved	Reserved
A4h	Reserved	Reserved
A5h	Length (03h)	Parity Data

Mode

Code	Description
00h	Executes automatic adjustment and TOC read then playback the 1st track.
01h	Start playback from its stop position. If automatic adjustment and TOC read are not complete, it will execute these two actions and playback from the 1st track.
02h	Executes automatic adjustment and TOC read then PAUSE.

Play Order

Bit	Description
7	Reserved
6	Reserved
5	0 : When Disc repeat is ON, it continues FR even if it detects the beginning of the disc during FR. 1 : Put on PAUSE if the beginning of the disc is detected during FR.
4	0 : When Disc repeat is ON, it continues Playback or FF even if it detects the end of the disc during its playback or FF. 1 : Put on PAUSE if the end of the disc is detected during Playback or FF.
3	Reserved
2	Reserved
1	0 : Continues FR even if it detects the beginning of the track during FR. 1 : Put on PAUSE if the beginning of the track is detected during FR.
0	0 : Continues Playback or FF even if it detects the end of the track during its playback or FF. 1 : Put on PAUSE if the end of the track is detected during Playback or FF.

Sequencer will clear error information when this command is transmitted.

If the Disc type is CD-ROM, it will PAUSE after reading TOC.

If the disc type is unsupported, it will STOP after reading TOC.

19 Pause

It makes a request to pause the CD. Transmit PLAY command to cancel the pause.

Address	Command1	Command2
A0h	Operation Code (22h)	Reserved
A1h	Reserved	Reserved
A2h	Reserved	Reserved
A3h	Reserved	Reserved
A4h	Reserved	Reserved
A5h	Length (01h)	Parity Data

This command is valid when TOC read is complete. Sequencer can accept this command even if TOC read is incomplete, but objective mode transition may not be executed without TOC information.

Sequencer will clear error information when this command is transmitted.

20 Skip

It makes a request to search a track before/after the current playback.

Address	Command1	Command2
A0h	Operation Code (23h)	Direction
A1h	Reserved	Reserved
A2h	Reserved	Reserved
A3h	Reserved	Reserved
A4h	Reserved	Reserved
A5h	Length (02h)	Parity Data

Direction

Code	Description
00h	Forward direction
01h	Backward direction
02h	Go back to the beginning of what is currently playing

This command is valid when TOC read is complete. Sequencer can accept this command even if TOC read is incomplete, but objective mode transition may not be executed without TOC information.

Sequencer will clear error information when this command is transmitted.

Back skip during random playback is invalid.

If foreward skip is transmitted during random playback, it will skip to the next track which is selected randomly.

21 Play CD Track Number

This is to Play specified track.

Address	Command1	Command2
A0h	Operation Code (24h)	Play Order
A1h	Track Number	Mode
A2h	Reserved	Reserved
A3h	Reserved	Reserved
A4h	Reserved	Reserved
A5h	Length (03h/04h)	Parity Data

Play Order

Bit	Description
7	Reserved
6	Reserved
5	0 : When Disc repeat is ON, it continues FR even if it detects the beginning of the disc during FR. 1 : Put on PAUSE if it detects the beginning of the disc during FR.
4	0 : When Disc repeat is ON, it continues Playback or FF even if it detects the end of the disc during its playback or FF 1 : Put on PAUSE if it detects the end of the disc during Playback or FF.
3	Reserved
2	Reserved
1	0 : Continues FR even if it detects the beginning of the track during FR. 1 : Put on PAUSE if the beginning of the track is detected during FR.
0	0 : Continues Playback or FF even if it detects the end of the track during its playback or FF. 1 : Put on PAUSE if the end of the track is detected during Playback or FF.

Track Number

Code (BCD)	Description
01h - 99h	CD-DA track number

Mode

Code (BCD)	Description
00h	Playback from a beginning of the specified track (LC78692x/3x compatible mode)
01h	Pause at the beginning of a specified track
80h	Playback from the end of a specified track
81h	Pause at the end of a specified track

If non-existing track number is specified before completing TOC read, it will search the last track. If non-existing track number is specified after completing TOC read, the command is considered invalid.

Sequencer will clear error information when this command is transmitted.

When the length is set to 03h, it will operate as LC78692x/3x compatible mode.

Any command besides Mode 00 will become invalid if it is transmitted before the completion of TOC read.

22 Play CD Absolute Time

This will search for specified Absolute Time to begin playback.

Address	Command1	Command2
A0h	Operation Code (25h)	Play Order
A1h	AMIN	ASEC
A2h	AFRAME	Mode
A3h	Reserved	Reserved
A4h	Reserved	Reserved
A5h	Length (05h/06h)	Parity Data

Play Order

Bit	Description
7	Reserved
6	Reserved
5	0 : When Disc repeat is ON, it continues FR even if it detects the beginning of the disc during FR. 1 : Put on PAUSE if it detects the beginning of the disc during FR.
4	0 : When Disc repeat is ON, it continues Playback or FF even if it detects the end of the disc during its playback or FF 1 : Put on PAUSE if it detects the end of the disc during Playback or FF.
3	Reserved
2	Reserved
1	0 : Continues FR even if it detects the beginning of the track during FR. 1 : Put on PAUSE if the beginning of the track is detected during FR.
0	0 : Continues Playback or FF even if it detects the end of the track during its playback or FF. 1 : Put on PAUSE if the end of the track is detected during Playback or FF.

AMIN

Code (BCD)	Description
00h - 99h	Absolute Time (Minute)

ASEC

Code (BCD)	Description
00h - 59h	Absolute Time (Second)

AFRAME

Code (BCD)	Description
00h - 74h	Absolute Time (Frame)

Mode

Code (BCD)	Description
00h	Playback after searching for the specified Absolute Time (LC78692x/3x compatible mode)
01h	Pause after searching for the specified Absolute Time.

If Absolute Time (which is over lead-out starting time) is specified before completing TOC read, it will search near Lead-out starting time. If Absolute Time which is over the Lead-out starting time is specified after completing TOC read, the command is considered invalid.
If Lead-in/Lead-out in between sessions is specified, it will search near the Lead-out position of the previous session.
Sequencer will clear error information when this command is transmitted.
When the length is set to 05h, it will operate as LC78692x/3x compatible mode.
Any command besides Mode 00 will become invalid if it is transmitted before the completion of TOC read.

23 Fast Forward & Fast Reverse

It makes a request for Fast Forward and Fast Reverse from current playback position. Audio output during FF/FR operation can be changed with the Mute parameter. By setting Play Order Parameter, user can pause the playback at the beginning or the end of a track/disc.

Address	Command1	Command2
A0h	Operation Code (29h)	Direction
A1h	Speed	Attenuate
A2h	Play Order	Reserved
A3h	Reserved	Reserved
A4h	Reserved	Reserved
A5h	Length (05h)	Parity Data

Direction

Code	Description
00h	Fast Forward
01h	Fast Reverse

Speed

Code	Description
00h	Speed1 (Slow)
01h	Speed2 (Middle)
02h	Speed3 (Fast)

Attenuate

Code	Description
00h	MUTE the audio output during FF/ FR
01h	Attenuate the audio output during FF/ FR
02h	MUTE-OFF the audio output during FF/ FR

Play Order

Bit	Description
7	Reserved
6	Reserved
5	0 : When Disc repeat is ON, it continues FR even if it detects the beginning of the disc during FR. 1 : Put on PAUSE if it detects the beginning of the disc during FR.
4	0 : When Disc repeat is ON, it continues Playback or FF even if it detects the end of the disc during its playback or FF 1 : Put on PAUSE if it detects the end of the disc during Playback or FF.
3	Reserved
2	Reserved
1	0 : Continues FR even if it detects the beginning of the track during FR. 1 : Put on PAUSE if the beginning of the track is detected during FR.
0	0 : Continues Playback or FF even if it detects the end of the track during its playback or FF. 1 : Put on PAUSE if the end of the track is detected during Playback or FF.

This command is valid when TOC read is complete. The command is invalid if they are transmitted before the completion of TOC read.
Sequencer will clear error information when this command is transmitted.
If it reaches the end of a track by Fast forward in random playback, it will skip to the next randomly selected track and fast forward.
If it reaches the beginning of a track by Fast reverse in random playback, it will pause.

24 Random

It makes request to Start/End random playback. When random playback starts, all tracks in the disc will be selected randomly.

Address	Command1	Command2
A0h	Operation Code (30h)	Mode
A1h	Option	Parameter1
A2h	Parameter2	Parameter3
A3h	Reserved	Reserved
A4h	Reserved	Reserved
A5h	Length (06h)	Parity Data

Mode

Code	Description
00h	Cancel random playback (Option and Parameter are invalid)
01h	Random playback request
02h	Random playback request (Pause at the beginning of each track)

Option

Code	Description
00h	Interrupt currently playing music and start random playback
01h	Start random playback without interrupting currently playing music.
02h	Interrupt currently playing music, start random playback from where it left off by using Parameter1～3.
03h	Start random playback from where it left off without interrupting what is currently playing by using Parameter1～3.

Parameter1 – Parameter3

Code	Description
00h – FFh	Parameter for random resume playback (Option = 00h, 01h are invalid)

This command is valid only on LC78615.
This command is valid when TOC read is complete. The command is invalid if they are transmitted before the completion of TOC read.
Mode = 02h will place pause at the beginning of each music. Therefore, to start playback, use PLAY command (Mode=01h) to release the pause.

In case of Option=02h and Option=03h; Set a value which is obtained by Get Random Parameter command into Parameter 1～3 for random resume playback.
In case of Option=00h and Option=01h (Not executing random resume playback); Set 00h to Parameter 1～3.
Random resume will operate even if there may be an error in a value of Parameter 1～3.

When Disc repeat is ON, it will continue random playback even after playing the last music and go into the 2nd round.
When Disc repeat is OFF, random playback is cancelled after playing the 1st round and switches back to the normal playback mode after playing the last music.
Random mode is cancelled when Scan command is transmitted during random playback.
Random mode is also cancelled when Repeat command's Track repeat request is transmitted during random playback.
When this command is transmitted during scanning, scanning will be cancelled.
When this command is transmitted during track repeat, track repeat will be cancelled.
Sequencer will clear error information when this command is transmitted.

<Random resume playback method>

① Obtains parameter by using Get Random Parameter command each time when the music changes during random playback.
② Instantaneous interrupt will occur - DSP power gets turned OFF
③ DSP power is turned ON and DSP is initialized.
④ Set Play command Mode=02h and wait for aut-adjust and TOC read complete pause.
⑤ After pause, use Play CD Absolute Time command to specify resume position.
⑥ Transmit this command's Option=03h when the status of Get Current Status changes to 04h (During playback). At this point, parameter which is obtained by Get Random Parameter command are set to Parameter 1～3.
⑦ When it is done playing the current music, DSP will compute next song from received parameter to continue on with the random playback.

25 Repeat

This makes a request to Start/Stop Repeat playback. It will playback currently playing track repeatedly by starting this Track repeat. By starting Disc repeat, it will go back to the first track of the disc when the last track is finish and playback from the beginning.

Address	Command1	Command2
A0h	Operation Code (31h)	Mode
A1h	Reserved	Reserved
A2h	Reserved	Reserved
A3h	Reserved	Reserved
A4h	Reserved	Reserved
A5h	Length (02h)	Parity Data

Mode

Code	Description
00h	Track repeat cancel
01h	Disc repeat cancel
02h	Reserved
03h	Track repeat request
04h	Disc repeat request

This command is valid when TOC read is complete. Sequencer can accept this command even if TOC read is incomplete, but objective mode transition may not be executed without TOC information.

When Track repeat request is made during random playback, the random playback will get cancelled.

When Track repeat request is made during scan playback, the scan playback will get cancelled.

When Random command is transmitted during track repeat, the track repeat is cancelled.

When Scan command is transmitted during track repeat, the track repeat is cancelled.

26 Scan

This requests the beginning/ending of the Scan play. When the scanning begins, it starts playing the track from the beginning until specified ending time and searches for the next track after the play. This scan-play is for all tracks in the disc.

Address	Command1	Command2
A0h	Operation Code (32h)	Mode
A1h	Option	Play Time
A2h	Reserved	Reserved
A3h	Reserved	Reserved
A4h	Reserved	Reserved
A5h	Length (04h)	Parity Data

Mode

Code	Description
00h	Scan Cancel (Option is invalid)
01h	Scan play request

Option

Code	Description
00h	Begin scan play by interrupting currently playing track
01h	Begin scan play including currently playing track

Play Time

Code (BCD)	Description
01h – 59h	Scan play time (Second)

This command is only valid in LC78615.
This command is valid when TOC read is complete. Sequencer can accept this command even if TOC read is incomplete, but objective mode transition may not be executed without TOC information.

When Disc repeat is OFF;
When scan begins, it plays music for a specified period of time from the beginning of the track and then search for a next track.

When scan is complete for all tracks in the disc, it will stop scanning and go back to regular playback. When scan is set during its playback, scanning will start from the next track and once again, when scan is complete for all tracks in the disc, it will stop scanning and go back to regular playback.

When Disc repeat is ON;
It goes into the 2nd round after scanning all tracks in the disc once and continues to scan.
Scan is cancelled when other operational commands (e.g. Play, Stop) are transmitted during scan play.

If Random command is transferred during scan play, scan will get cancelled.
If Track repeat request of Repeat command is transferred during scan play, scan will get cancelled.

If this command is transferred during random play, the random play will get cancelled.
When this command is transferred during Track repeat, Track repeat will get cancelled.
Sequencer will clear error information when this command is transmitted.

27 Set Play Order

It changes the Play order.

Address	Command1	Command2
A0h	Operation Code (33h)	Play Order
A1h	Reserved	Reserved
A2h	Reserved	Reserved
A3h	Reserved	Reserved
A4h	Reserved	Reserved
A5h	Length (02h)	Parity Data

Play Order

Bit	Description
7	Reserved
6	Reserved
5	0：Continues to FR even if the beginning of a disc is detected during FR. (Only when Disc repeat is ON) 1：It will PAUSE if the beginning of a disc is detected during FR.
4	0：Continues to Playback or FF even if the end of a disc is detected during Playback or FF. (Only when Disc repeat is ON) 1：It will PAUSE if the end of a disc is detected during Playback or FF.
3	Reserved
2	Reserved
1	0：Continues to FR even if it detects the beginning of a track during FR. 1：It will PAUSE if the beginning of a track is detected during FR.
0	0：Continues to Playback or FF even if the end of a track is detected during Playback or FF. 1：It will PAUSE if the end of a track is detected during Playback or FF.

28 LBA Play

This is a command to be in use when decoding ROM tracks with an exteral decoder.

Address	Command1	Command2
A0h	Operation Code (36h)	Mode
A1h	CIRC Setting	LBA (MSB) / AMIN
A2h	LBA / ASEC	LBA (LSB) / AFrame
A3h	Reserved	Reserved
A4h	Reserved	Reserved
A5h	Length (06h)	Parity Data

Mode

Code	Description	
00h	Specify an address to LBA;	Search is complete when detecting -1 frame
01h	Specify an address to ATIME	Search is complete when detecting -1 frame
02h	Specify an address to LBA	Search is complete when detecting frame after -1 frame
03h	Specify an address to ATIME	Search is complete when detecting frame after -1 frame
04h	Specify an address to LBA	Search is complete when detecting -1 track
05h	Specify an address to ATIME	Search is complete when detecting -1 track

CIRC Setting

Code	Description
00h	CIRC Quadruple correction
01h	CIRC Double correction

LBA

Code	Description
00000000h –0006DD39h	Logical block address

AMIN

Code (BCD)	Description
00h - 99h	Absolute Time (Minute)

ASEC

Code (BCD)	Description
00h - 59h	Absolute Time (Second)

AFRAME

Code (BCD)	Description
00h - 74h	Absolute Time (Frame)

Port OPCDM will become 'LO' at the point of receiving this command.
When the Mode is '00h' or '01h';
At the point of detecting -1 frame of the specified address by searching, status of Get Current Status will become "Currently playing" and OPCDM will become 'HI' at the same time.
If it cannot detect -1 frame (e.g. due to a scratch), it will try to detect again. If OPCDM does not change to 'HI' or if it takes time, please send this command again (if the same address does not work, try using a different address).
When the Mode is '02h' or '03h';
When executing Search, Get Current Status will become "Play" once it detects a frame before the specified address or any frames after that. At the same time, OPCDM port will become 'HI'.
When the Mode is '04h' or '05h';
When executin Search, Get Current Status will become "Play" once it detects a frame before the specified address within a range of a track before that frame (10 frames if it is inner circumference; 25 frames if it is outer circumference). At the same time, OPCDM port will become 'HI'.
If internal recovery occurs by a scratch or an oscillation during playback, Port OPCDM will become 'LO'.

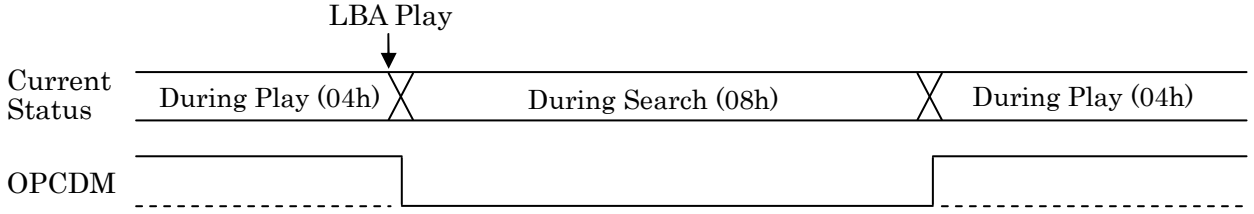


Figure 1 : Current Status and OPCDM Timing

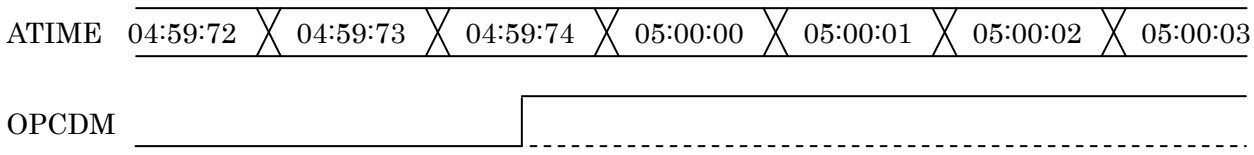


Figure 2 : OPCDM timing from 'LO' to 'HI' in the Target ATIME of 05:00:00
(In case of Mode = 00h, 01h)

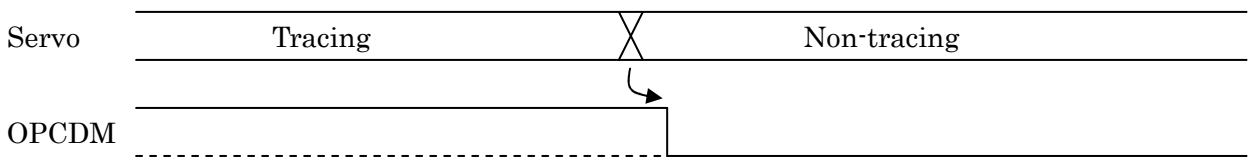


Figure 3 : OPCDM timing from 'HI' to 'LO' in case of Internal recovery occurrence due to scratch, oscillation, etc.

This command is valid in TOC read completed condition.
Sequencer will clear error information when this command is transmitted.
Transmitting this command will make a sequencer to clear all conventional Play order.
It is necessary to set Set Mode command's Port setting into an appropriate mode in order to utilize this command. (Please refer to "LC78615_16 Port Setting Specification sheet" for more detail about Port Settings)

Also, please refer to "LC78615_16 Application note" for 3-line output settings.
If ATIME is specified to be more than a Lead-out starting time, then it will search somewhere closeto the Lead-out starting time.

29 Get Firmware Version

It obtains the model name and the version information of a firmware.

Address	Command1	Command2
A0h	Operation Code (50h)	Reserved
A1h	Reserved	Reserved
A2h	Reserved	Reserved
A3h	Reserved	Reserved
A4h	Reserved	Reserved
A5h	Length (01h)	Parity Data

Return Data

Byte	Data
1-4(ASCII)	Sequencer Version
5-8(ASCII)	Reserved (Insert Space)
9-15(ASCII)	Model Name
16	Parity Data

30 Get Disc Type

It makes a request for Disk discrimination result.

Address	Command1	Command2
A0h	Operation Code (51h)	Reserved
A1h	Reserved	Reserved
A2h	Reserved	Reserved
A3h	Reserved	Reserved
A4h	Reserved	Reserved
A5h	Length (01h)	Parity Data

Return Data

Byte	Data
1	Disc Type
2	Parity Data

Disc Type

Byte	Description
00h	No Disc
01h	Disc under discrimination
02h	Unsupported Disc
03h	CD-DA
04h	CD-DA with CD-TEXT
05h	CD-ROM
06h	Mixed CD

31 Get TOC

It makes a request for TOC information. Starting time information which is recorded to the TOC range by Track Number specification can be obtained.

Also, First track number, Last track number, and lead-out starting time can be obtained by specifying '0' into the Track Number.

Address	Command1	Command2
A0h	Operation Code (52h)	Track Number
A1h	Mode	Reserved
A2h	Reserved	Reserved
A3h	Reserved	Reserved
A4h	Reserved	Reserved
A5h	Length (02h/03h)	Parity Data

Track Number

Code (BCD)	Description
00h	Obtain First track number, Last track number, and Lead-out starting time
01h - 99h	Obtain start time of a specified Track number

Mode

Code (BCD)	Description
00h	LC78692x/3x Compatible mode
01h	Cotrol/Address Data obtaining mode

Return Data (Track Number 00h)

Byte	Data
1	Status
2 (BCD)	First Track Number
3 (BCD)	Last Track Number
4 (BCD)	Start time of Lead-out (Minute)
5 (BCD)	Start time of Lead-out (Second)
6 (BCD)	Start time of Lead-out (Frame)
7 (BCD)	First Track Number of CD-DA
8 (BCD)	Last Track Number of CD-DA
9	Parity Data

Return Data (Track Number 01h – 99h)

Byte	Data
1	Status
2 (BCD)	Track Number
3 (BCD)	Start time of Track Number (Minute)
4 (BCD)	Start time of Track Number (Second)
5 (BCD)	Start time of Track Number (Frame)
6	Mode 00 : Parity Data Mode 01 : Cotrol/Address of Track Number
7	Mode 01 : Parity Data

Status

Byte	Data
00h	TOC Data - Invalid
01h	TOC Data - Valid

If this command is published when TOC read is imcomplete, then the status of the Return Data's 1st byte will have 'TOC data invalid'. Specify a track number by using BCD code.
Track number and Time parameter in returned data will come out with BCD code.
It will operate as LC78692x/3x compatible mode when the Length is set to '02h'.

32 Get Current Status

This obtains the track number and play time of what is playing at that point.

Address	Command1	Command2
A0h	Operation Code (53h)	Mode
A1h	Reserved	Reserved
A2h	Reserved	Reserved
A3h	Reserved	Reserved
A4h	Reserved	Reserved
A5h	Length (01h/02h)	Parity Data

Mode

Code (BCD)	Description
00h	LC78692x/3x Compatible mode
01h	New mode

Return Data

Byte	Data
1	Status
2	Mode 00 : Mechanical Status Mode 01 : Detail Servo Status
3	Error
4	Function Status
5	Play Order
6 (BCD)	Mode 00 : 00h Mode 01 : Memory Remaining
7 (BCD)	Track Number
8 (BCD)	Mode 00 : 00h Mode 01 : Cotrol/Address
9 (BCD)	Index
10 (BCD)	Program Time (Frame)
11 (BCD)	Program Time (Minute)
12 (BCD)	Program Time (Second)
13 (BCD)	Absolute Time (Frame)
14 (BCD)	Absolute Time (Minute)
15 (BCD)	Absolute Time (Second)
16	Parity Data

Status

Code	Description
00h	STOP (TOC read incomplete)
01h	STOP
02h	Disc Braking (In transition to STOP)
03h	TOC read in progress
04h	Currently Playing
05h	On Pause
06h	Fast Forward in progress
07h	Fast Back in progress
08h	Search in progress
09h	Pause at the beginning of a track
0Ah	Pause at the end of a track
0Dh	Pause at the beginning of a Disc
0Eh	Pause at the end of a Disc
0Fh	Reset Start detection

Mechanical Status

Code	Description
00h	The type of currently playing track is unclear
01h	The type of currently playing track is CD-DA
02h	The type of currently playing track is CD-DA with CD-TEXT
06h	The type of currently playing track is CD-ROM

Error

Code	Error Type	Description
00h	-	No Error
11h	E1	Detecting Mirror area (i.e. non-recorded area)
12h	E1	Focus error occurrence
19h	E2	Tracking error
20h	E2	Automatic adjustment error
21h	E2	Search is not completing
22h	E2	TOC read is not completing
24h	E2	Sub-code is undetectable for a certain period of time
31h	E3	Pick inner SW 'ON' is undetectable
32h	E3	Cannot communicate with DSP
33h	E3	Pick inner SW 'OFF' is undetectable
35h	E3	SDRAM Abnormality
36h	E3	Detects Focus and Tracking voltage DC limite

37h	E3	Detect Tracking oscillation
38h	E3	Detect Focus oscillation

Function Status

Bit	Description
7	0 : Track repeat OFF 1 : Track repeat ON
6	0 : Disc repeat OFF 1 : Disc repeat ON
5	Reserved
4	0 : Scan OFF 1 : Scan ON
3	Reserved
2	Reserved
1	0 : Random OFF 1 : Random ON
0	Reserved

Play Order

Bit	Description
7	Reserved
6	Reserved
5	0 : When Disc repeat is ON - Continues to FB even if the beginning of a disc is detected during FB. 1 : It will PAUSE if the beginning of a disc is detected during FB.
4	0 : When Disc repeat is ON – Continues to Playback or FF even if the end of a disc is detected during Playback or FF. 1 : It will PAUSE if the end of a disc is detected during Playback or FF.
3	Reserved
2	Reserved
1	0 : Continues to FB even if it detects the beginning of a track during FB. 1 : It will PAUSE if the beginning of a track is detected during FB.
0	0 : Continues to Playback or FF even if the end of a track is detected during Playback or FF. 1 : It will PAUSE if the end of a track is detected during Playback or FF.

Detail Servo Status

Code	Description
00h	Under suspension (Either in Initial or Brake complete status)
01h	DSP Initialization in progress
02h	Pickup initialization in progress
03h	Disc brake in progress
04h	Servo ON ＋ Automatic adjustment in progress
05h	TOC read in progress
06h	Search in progress
07h	Playing
08h	On Pause
09h	Restart in process
0Ah	Recovery in process
0Bh	In Error halt
0Ch	Spindle kick in progress

Memory Remaining

Code	Description
00h-64h	Remaining amount of Stream

Track number and time parameter are output with BCD code.

It will operate as LC78692x/3x compatible mode when the Length is set to '01h'.

Contents of Mode 01h Memory Remaining is same as Get Memory Remaining command (5Ah) contents.

(※ Memory Remaining is fixed to '00h' in LC78615)

33 Get CD-Text Information

This obtains CD-Text Character codes and Language codes.

Address	Command1	Command2
A0h	Operation Code (54h)	Mode
A1h	Block Number	Reserved
A2h	Reserved	Reserved
A3h	Reserved	Reserved
A4h	Reserved	Reserved
A5h	Length (03h)	Parity Data

Mode

Code (BCD)	Data
00h	Requests for Character code and Language code in each CD-TEXT block
01h	Requests for 0~7 CD-TEXT block Character code
02h	Requests for 0~7 CD-TEXT block Language code

Block Number

Code (BCD)	Data
00h – 07h(Mode 00h)	CD-TEXT Block number
00h (Mode 01h,02h)	Fixed to '00h' when the Mode is either 01h or 02h

Return Data1 (Mode 00h)

Byte	Data
1	Status
2 (BCD)	Block Number
3	Character Code
4	Language Code
5	Parity Data

Return Data2 (Mode 01h, 02h)

Byte	Data
1	Status
2	01h (Character code) / 02h (Language code)
3	Block 0 Character Code / Language Code
4	Block 1 Character Code / Language Code
5	Block 2 Character Code / Language Code
6	Block 3 Character Code / Language Code

7	Block 4　Character Code / Language Code
8	Block 5　Character Code / Language Code
9	Block 6　Character Code / Language Code
10	Block 7　Character Code / Language Code
11	Parity Data

Status

Bit	Description
7	0 : Block 7 data is Invalid 1 : Block 7 data is Valid
6	0 : Block 6 data is Invalid 1 : Block 6 data is Valid
5	0 : Block 5 data is Invalid 1 : Block 5 data is Valid
4	0 : Block 4 data is Invalid 1 : Block 4 data is Valid
3	0 : Block 3 data is Invalid 1 : Block 3 data is Valid
2	0 : Block 2 data is Invalid 1 : Block 2 data is Valid
1	0 : Block 1 data is Invalid 1 : Block 1 data is Valid
0	0 : Block 0 data is Invalid 1 : Block 0 data is Valid

This command is valid in LC78616 only.
CD-Text data status can be confirmed by referring corresponding bit per status block if a disc does not have CD-Text data or if it does not have an applicable block.

34 Get System Information

This obtains sequencer warning information.

Address	Command1	Command2
A0h	Operation Code (59h)	Mode
A1h	Reserved	Reserved
A2h	Reserved	Reserved
A3h	Reserved	Reserved
A4h	Reserved	Reserved
A5h	Length (02h)	Parity Data

Mode

Code	Description
00h	Asks for the presence of Warning information
01h	Clear all Warning information
02h	Outputs Warning information and clears that information
03h	Outputs Warning information and maintains that information

Return Data (Mode 00h)

Byte	Data
1	Status
2	Parity Data

Status

Code	Description
00h	With warning information
01h	No warning information

Return Data (Mode 01h)

Byte	Data
1	00h
2	Parity Data

Return Data (Mode 02h, 03h)

Byte	Data
1	Warning Information Code 1
2	Warning Information Code 2
3	Warning Information Code 3
4	Warning Information Code 4
5	Warning Information Code 5
6	Warning Information Code 6
7	Warning Information Code 7
8	Warning Information Code 8
9	Warning Information Code 9
10	Warning Information Code 10
11	Warning Information Code 11
12	Warning Information Code 12
13	Warning Information Code 13
14	Warning Information Code 14
15	Warning Information Code 15
16	Parity Data

Please refer to Servo Flowchart for more specific information about the Warning information.

35 Get Memory Remaining

This obtains remaining amount of Stream which is in a track buffer.

Address	Command1	Command2
A0h	Operation Code (5Ah)	Reserved
A1h	Reserved	Reserved
A2h	Reserved	Reserved
A3h	Reserved	Reserved
A4h	Reserved	Reserved
A5h	Length (01h)	Parity Data

Return Data

Byte	Data
1	Memory Remaining
2	Parity Data

Memory Remaining

Code	Description
00h-64h	Stream remaining amount

Remaining value of '64h' indicates that the track buffer is full.

※ Return data may be inaccurate if Get Current Status is Stopped (TOC incomplete) or if Mechanical Status = 00h.

※ Please use this Return data when the status of Get Current Status is in STOP (TOC read complete) or during playback, Pause, FF, FB, or in other Pause status.

This command is valid in LC78616 only.

36 Get Track Information

This obtains Control/Address information of a specified track.

Address	Command1	Command2
A0h	Operation Code (5Eh)	Track Number
A1h	Reserved	Reserved
A2h	Reserved	Reserved
A3h	Reserved	Reserved
A4h	Reserved	Reserved
A5h	Length (02h)	Parity Data

Track Number

Code (BCD)	Description
01h - 99h	CD-DA Track number

Return Data

Byte	Data
1	Status
2 (BCD)	CD-DA Track number
3 (Nibble)	Upper: Control
	Lower: Address
4	Parity Data

Status

Byte	Data
00h	TOC data Invalid
01h	TOC data Valid

Status of the 1st byte on the Return Data will be invalid if this command is issues in TOC read incompleted situation.Track number can be specified with BCD code.

37 Get Session Information

This makes a request for Session information. It specifies a Session number to obtain Starting time and Track mode information recorded in the TOC range.

Address	Command1	Command2
A0h	Operation Code (5Fh)	Session Number
A1h	Reserved	Reserved
A2h	Reserved	Reserved
A3h	Reserved	Reserved
A4h	Reserved	Reserved
A5h	Length (02h)	Parity Data

Session Number

Code	Description
00h	Obtains number of total session. This also obtains a track number if the 1st track is considered as ROM data by checking track information from its last session.
01h - 99h (BCD)	Obtain specified Session number information

Return Data（Session Number 00h）

Byte	Data
1	STATUS 01 : Valid 00 : Invalid
2 (BCD)	Session number (00h)
3 (BCD)	Total number of Session
4 (BCD)	Track number which a ROM track was found first by searching from the last session
5	Parity Data

Return Data（Session Number 01h-99h）

Byte	Data
1	STATUS 01 : Valid 00 : Invalid
2 (BCD)	Session number (01h-99h)
3 (BCD)	Specified Session Starting track
4 (BCD)	Specified Session Last track
5	Parity Data

Status of the 1st byte on the Return Data will be invalid if this command is issues in TOC read incompleted situation.

38 Get Current Text Data

This obtains information which is specified by currently playing track mode. Character information is outputted in a unit of 10 Byte.

Address	Command1	Command2
A0h	Operation Code (60h)	Mode
A1h	Block Number/Page(MSB)	Page(LSB)
A2h	Reserved	Reserved
A3h	Reserved	Reserved
A4h	Reserved	Reserved
A5h	Length (04h)	Parity Data

Mode

Code	Description
02h	Obtains CD-TEXT Song titles
03h	Obtains CD-TEXT Artist names
04h	Obtains CD-TEXT Album titiles
05h	Obtain CD-TEXT Album artist names

Block Number/Page(MSB)

Nibble	Description
Upper(0h – 1h)	Character information page numbers (upper side)
Lower(0h – 7h)	CD-TEXT Block number

Page (LSB)

Code (HEX)	Description
00h – FFh	Character information page numbers (lower side)

Return Data

Byte	Data
1	Status
2	Character Code
3	Language Code
4 (HEX)	Length (MSB)
5 (HEX)	Length (LSB)
6	String Data 1
7	String Data 2
8	String Data 3

9	String Data 4
10	String Data 5
11	String Data 6
12	String Data 7
13	String Data 8
14	String Data 9
15	String Data 10
16	Parity Data

Status

Code	Description
00h	No Character information
01h	Character information analysis in progress
02h	Character information available

Character Code

Code	Description
00h	Character code (See Pg. 83)

Language Code

Code	Description
00h	Language code (See Pg. 84)

Length

Code (HEX)	Description
0000h – 0C00h	Character data length

This command is valid in LC78616 only.

When TOC read is incomplete, the Return Data status will be 'Character information analysis in progress'. When TOC read is complete and it is comfirmed that no corresponding data is included, then Return Data status will be 'No Character information available'

39 Get CD-Text Data

This obtains Mode specified information. Character information is outputted in a unit of 10 Byte.

Address	Command1	Command2
A0h	Operation Code (62h)	Mode
A1h	Block Number/Page(MSB)	Page(LSB)
A2h	Track Number	Reserved
A3h	Reserved	Reserved
A4h	Reserved	Reserved
A5h	Length (05h)	Parity Data

Mode

Code	Description
00h	Obtains Track/Disc title which is specified by the Track Number
01h	Obtains Track/Disc artist name which is specified by the Track Number

Block Number/Page (MSB)

Code (BCD)	Description
Upper(0h – 1h)	Character information page number (upper side)
Lower(0h – 7h)	CD-TEXT Block number

Page(LSB)

Code (HEX)	Description
00h – FFh	Character information page number (lower side)

Track Number

Code (BCD)	Description
00h	Disc
01h – 099h	Track number

Return Data

Byte	Data
1	Status
2	Character Code
3	Language Code
4 (HEX)	Length (MSB)
5 (HEX)	Length (LSB)
6	String Data 1

7	String Data 2
8	String Data 3
9	String Data 4
10	String Data 5
11	String Data 6
12	String Data 7
13	String Data 8
14	String Data 9
15	String Data 10
16	Parity Data

Status

Code	Description
00h	No Character information
01h	Character information analysis in progress
02h	Character information available

Character Code

Code	Description
00h - FFh	Character code (See Pg. 83)

Language Code

Code	Description
00h - FFh	Language code (See Pg. 84)

Length

Code (HEX)	Description
0000h – 0C00h	Character data length

This command is valid in LC78616 only.
When TOC read is incomplete, the Return Data status will be 'Character information analysis in progress'. When TOC read is complete and it is comfirmed that no corresponding data is included, then Return Data status will be 'No Character information available'

40 Get Random Parameter

This obtains a parameter for Random resume playback.

Address	Command1	Command2
A0h	Operation Code (74h)	Reserved
A1h	Reserved	Reserved
A2h	Reserved	Reserved
A3h	Reserved	Reserved
A4h	Reserved	Reserved
A5h	Length (01h)	Parity Data

Return Data

Byte	Data
1	Parameter 1
2	Parameter 2
3	Parameter 3
4	Parity Data

This command is valid in LC78615 only.

This command is only valid during Random playback.

This command obtains Resume parameter information during random playback and uses it for instantaneous interrupt.

Please obtain the parameter each time when the music changes.

Please refer to Random command for more information about Random resume playback.

41 Write Servo RAM

This rewrites Servo RAM table inside the sequencer. It can rewrite up to 4 parameters of continuous index by providing this command once.

Address	Command1	Command2
A0h	Operation Code (80h)	Index
A1h	Data1(MSB)	Data1(LSB)
A2h	Data2(MSB)	Data2(LSB)
A3h	Data3(MSB)	Data3(LSB)
A4h	Data4(MSB)	Data4(LSB)
A5h	Length (04h/06h/08h/0Ah)	Parity Data

Index

Code (HEX)	Description
00h – 90h	Servo RAM index

Data1 – Data4

Code (HEX)	Description
0000h – FFFFh	Data to be written into Servo RAM table

It is necessary to either transmit Reset IC command or to execute Automatic adjustment in order to validate the rewritten result.

42 Write Servo Parameter

This rewrites Servo parameter table inside the sequencer. It can rewrite up to 4 parameters of continuous index by providing this command once.

Address	Command1	Command2
A0h	Operation Code (81h)	Index
A1h	Bank	Data1
A2h	00h	Data2
A3h	00h	Data3
A4h	00h	Data4
A5h	Length (04h/06h/08h/0Ah)	Parity Data

Index

Code (HEX)	Description
00h – C4h(Bank0) 00h – 68h(Bank1)	Servo parameter index

Bank

Code (HEX)	Description
00h – 01h	Servo parameter bank

Data1 – Data4

Code (HEX)	Description
00h – FFh	Data to be written into Servo parameter table

43 Write Auto Adjust Data

This rewrites Servo automatic adjusted value table inside the sequencer. It can rewrite up to 4 parameters of continuous index by providing this command once.

Address	Command1	Command2
A0h	Operation Code (82h)	Index
A1h	Data1(MSB)	Data1(LSB)
A2h	Data2(MSB)	Data2(LSB)
A3h	Data3(MSB)	Data3(LSB)
A4h	Data4(MSB)	Data4(LSB)
A5h	Length (04h/06h/08h/0Ah)	Parity Data

Index

Code (HEX)	Description
00h – 3Dh	Servo automatic adjustment data index

Data1 – Data4

Code (HEX)	Description
0000h – FFFFh	Data to be written in the Servo RAM table

Rewrite the adjustment value by transmitting this command after stopping completed automatic adjustment. Adjusted value will be reflected to Servo by playback. When Automatic adjustment result is cleared by using Clear Information during STOP, the data which was transmitted by this command will be destroyed.

44 Write Servo Command

This rewrites Servo command register table inside the sequencer. It can rewrite up to 4 parameters of continuous index by providing this command once.

Address	Command1	Command2
A0h	Operation Code (83h)	Index
A1h	00h	Data1
A2h	00h	Data2
A3h	00h	Data3
A4h	00h	Data4
A5h	Length (04h/06h/08h/0Ah)	Parity Data

Index

Code (HEX)	Description
00h – 66h	Servo command register index

Data1 – Data4

Code (HEX)	Description
00h – FFh	Data to be written in the Servo RAM table

It is necessary to either transmit Reset IC command or to execute Automatic adjustment in order to validate the rewritten result.

45 Write Servo RAM with Index

This rewrites Servo RAM table inside the sequencer. It can rewrite up to 3 parameters by providing this command once.

Address	Command1	Command2
A0h	Operation Code (84h)	Index1
A1h	Data1(MSB)	Data1(LSB)
A2h	Index2	Data2(MSB)
A3h	Data2(LSB)	Index3
A4h	Data3(MSB)	Data3(LSB)
A5h	Length (04h/07h/0Ah)	Parity Data

Index1 – Index3

Code (HEX)	Description
00h – 90h	Servo RAM index

Data1 – Data3

Code (HEX)	Description
0000h – FFFFh	Data to be written in to the Servo RAM table

It is necessary to either transmit Reset IC command or to execute Automatic adjustment in order to validate the rewritten result.

46 Write Servo Parameter with Index

This rewrites Servo parameter table inside the sequencer. It can rewrite up to 3 parameters by providing this command once.

Address	Command1	Command2
A0h	Operation Code (85h)	Index1
A1h	Bank1	Data1
A2h	Index2	Bank2
A3h	Data2	Index3
A4h	Bank3	Data3
A5h	Length (04h/07h/0Ah)	Parity Data

Index1 – Index3

Code (HEX)	Description
00h – C4h(Bank0) 00h – 68h(Bank1)	Servo parameter index

Bank1 – Bank3

Code (HEX)	Description
00h – 01h	Servo parameter bank

Data1 – Data3

Code (HEX)	Description
00h – FFh	Data to be written in to the Servo parameter table

47 Write Auto Adjust Data with Index

This rewrites Servo automatic adjusted value table inside the sequencer. It can rewrite up to 3 parameters by providing this command once.

Address	Command1	Command2
A0h	Operation Code (86h)	Index1
A1h	Data1(MSB)	Data1(LSB)
A2h	Index2	Data2(MSB)
A3h	Data2(LSB)	Index3
A4h	Data3(MSB)	Data3(LSB)
A5h	Length (04h/07h/0Ah)	Parity Data

Index1 – Index3

Code (HEX)	Description
00h – 3Dh	Servo automatic adjustment data index

Data1 – Data3

Code (HEX)	Description
0000h – FFFFh	Data to be written in to the Servo RAM table

Rewrite the adjustment value by transmitting this command after stopping completed automatic adjustment. Adjusted value will be reflected to Servo by playback. When Automatic adjustment result is cleared by using Clear Information during STOP, the data which was transmitted by this command will be destroyed.

48 Write Servo Command with Index

This rewrites Servo command register table inside the sequencer. It can rewrite up to 3 parameters by providing this command once.

Address	Command1	Command2
A0h	Operation Code (87h)	Index1
A1h	00h	Data1
A2h	Index2	00h
A3h	Data2	Index3
A4h	00h	Data3
A5h	Length (04h/07h/0Ah)	Parity Data

Index1 – Index3

Code (HEX)	Description
00h – 66h	Servo command register index

Data1 – Data3

Code (HEX)	Description
00h – FFh	Data to be written in to the Servo RAM table

It is necessary to either transmit Reset IC command or to execute Automatic adjustment in order to validate the rewritten result.

49 Write Playback Parameter

This rewrites Anti-shock control / CD playback control parameter table inside the sequencer.

Address	Command1	Command2
A0h	Operation Code (88h)	Index
A1h	Data	Reserved
A2h	Reserved	Reserved
A3h	Reserved	Reserved
A4h	Reserved	Reserved
A5h	Length (03h)	Parity Data

Index

Code (HEX)	Description
00h –0Ah (LC78615) 00h –6Ah (LC78616)	Anti-shock control / CD playback control parameter index

Data

Code (HEX)	Description
00h – FFh	Data to be written in to the Anti-shock parameter RAM table.

Rewritten result will become valid immediately. Therefore, it is recommended to rewrite during STOP.

50 Write DSP

This rewrites CD-DSP Servo command register and Servo RAM.

Address	Command1	Command2
A0h	Operation Code (91h)	Mode
A1h	Address	REGWD2
A2h	REGWD1	REGWD0
A3h	Reserved	Reserved
A4h	Reserved	Reserved
A5h	Length (06h)	Parity Data

Mode

Code (HEX)	Description
00h	CD-DSP Servo command register
01h	CD-DSP Servo RAM

Address

Code (HEX)	Description
00h – FFh	Command register : Command register address Servo RAM : Servo RAM address

REGWD2

Code (HEX)	Description
00h – FFh	Command register : WRITE data Servo RAM : WRITE data (MSB)

REGWD1

Code (HEX)	Description
00h – FFh	Command register : WRITE data Servo RAM : WRITE data (LSB)

REGWD0

Code (HEX)	Description
00h – FFh	Command register : WRITE data Servo RAM : 00h

51 Read Servo RAM

This reads out Servo RAM table inside the sequencer.

Address	Command1	Command2
A0h	Operation Code (D0h)	Index
A1h	Reserved	Reserved
A2h	Reserved	Reserved
A3h	Reserved	Reserved
A4h	Reserved	Reserved
A5h	Length (02h)	Parity Data

Index

Code (HEX)	Description
00h – 90h	Servo RAM index

Return Data

Byte	Data
1(HEX)	Address
2 (HEX)	Data(MSB)
3 (HEX)	Data(LSB)
4	Parity Data

If 'Command status reception mode' is set by Set Command Return Mode command, Command reception status is returned to the 1st byte of Return Data. After that, reception data will shift by 1 byte

52 Read Servo Parameter

This reads out Servo parameter table inside the sequencer.

Address	Command1	Command2
A0h	Operation Code (D1h)	Index
A1h	Bank	Reserved
A2h	Reserved	Reserved
A3h	Reserved	Reserved
A4h	Reserved	Reserved
A5h	Length (03h)	Parity Data

Index

Code (HEX)	Description
00h – C4h (Bank0) 00h – 68h (Bank1)	Servo parameter index

Bank

Code (HEX)	Description
00h – 01h	Servo parameter bank

Return Data

Byte	Data
1(HEX)	Index
2 (HEX)	Bank
3 (HEX)	Data
4	Parity Data

If 'Command status reception mode' is set by Set Command Return Mode command, Command reception status is returned to the 1st byte of Return Data. After that, reception data will shift by 1byte

53 Read Auto Adjust Data

This reads out Servo automatic adjusted value table inside the sequencer.

Address	Command1	Command2
A0h	Operation Code (D2h)	Index
A1h	Reserved	Reserved
A2h	Reserved	Reserved
A3h	Reserved	Reserved
A4h	Reserved	Reserved
A5h	Length (02h)	Parity Data

Index

Code (HEX)	Description
00h – 3Dh	Servo automatic adjustment data index

Return Data

Byte	Data
1(HEX)	Index
2 (HEX)	Data(MSB)
3 (HEX)	Data(LSB)
4	Parity Data

If 'Command status reception mode' is set by Set Command Return Mode command, Command reception status is returned to the 1st byte of Return Data. After that, reception data will shift by 1byte

54 Read Servo Command

This reads out Servo command register table inside the sequencer.

Address	Command1	Command2
A0h	Operation Code (D3h)	Index
A1h	Reserved	Reserved
A2h	Reserved	Reserved
A3h	Reserved	Reserved
A4h	Reserved	Reserved
A5h	Length (02h)	Parity Data

Index

Code (HEX)	Description
00h – 66h	Servo command register index

Return Data

Byte	Data
1(HEX)	Index
2 (HEX)	00h
3 (HEX)	Data
4	Parity Data

If 'Command status reception mode' is set by Set Command Return Mode command, Command reception status is returned to the 1st byte of Return Data. After that, reception data will shift by 1byte

55 Read Playback Parameter

This reads out Anti-shock control / CD playback control parameter table inside the sequencer.

Address	Command1	Command2
A0h	Operation Code (D8h)	Index
A1h	Reserved	Reserved
A2h	Reserved	Reserved
A3h	Reserved	Reserved
A4h	Reserved	Reserved
A5h	Length (02h)	Parity Data

Index

Code (HEX)	Description
00h –0Ah (LC78615) 00h –6Ah (LC78616)	Anti-shock control / CD playback control parameter index

Return Data

Byte	Data
1(HEX)	Index
2 (HEX)	Data
3	Parity Data

If 'Command status reception mode' is set by Set Command Return Mode command, Command reception status is returned to the 1st byte of Return Data. After that, reception data will shift by 1byte

56 Read DSP

This reads out CD-DSP Servo command register.

Address	Command1	Command2
A0h	Operation Code (E1h)	Mode
A1h	Address	Reserved
A2h	Reserved	Reserved
A3h	Reserved	Reserved
A4h	Reserved	Reserved
A5h	Length (03h)	Parity Data

Mode

Code (HEX)	Description
00h	CD-DSP Servo command register (Bank0)
01h	CD-DSP Servo RAM
02h	CD-DSP Servo command register (Bank1)

Address

Code (HEX)	Description
00h – FFh	Command register : Command register address Servo RAM : Servo RAM address

Return Data

Byte	Data
1(HEX)	Address
2 (HEX)	Command register : READ data (REGRD2) Servo RAM : READ data (MSB)
3 (HEX)	Command register : READ data (REGRD1) Servo RAM : READ data (LSB)
4(HEX)	Command register : READ data (REGRD0) Servo RAM : 00h
5	Parity Data

If 'Command status reception mode' is set by Set Command Return Mode command, Command reception status is returned to the 1st byte of Return Data. After that, reception data will shift by 1byte

57 Parity Data

57.1 Transmission command

Add Length byte data (which starts from operation code) and Length data itself, 2s complement of this sum shall be set to Transmission command Parity data.

Ex) Parity data for Play command
21h (Operation Code) + 01h (Mode) + 03h (Play Order) + 03h (Length) = 28h
(28h ^ FFh) + 01h = D8h

Ex) Parity data for Disc discrimination command
51h (Operation Code) + 01h (Length) = 52h
(52h ^ FFh) + 01h = AEh

57.2 Reception Data

For the Parity data of Reception data, 2s complement of all data sum is set.

Ex) Disc discrimination result
(03h (Return) ^ FFh) + 01h = FD

Be sure to purge the data if Parity data does not match when receiving a data.

58 Character Code

Code	Description
00h	ISO 8859-1
01h	ISO 646, ASCII
02h – 7Fh	Reserved
80h	Music Shift-JIS Kanji
81h	Korean Character Code
82h	Mandarin Chinese Character Code
83h - EFh	Reserved
F0h	Unknown
F1h	ISO 8859-1
F2h	ASCII
F3h	UTF-8 (No BOM)
F4h	UTF-16 (No BOM)
F5h	Shift-JIS/EUC
F6h	UTF-16 (Little Endian)
F7h	UTF-16 (Big Endian)
F8h - FFh	Reserved

59 Language Code

Code	Description
00h	Unused (No language)
06h	Czech
07h	Danish
08h	German
09h	English
0Ah	Spanish
0Fh	French
15h	Italian
1Bh	Hungarian
1Dh	Dutch
1Eh	Norwegian
20h	Polish
21h	Portuguese
26h	Slovenian
27h	Finnish
28h	Swedish
29h	Turkish
56h	Russian
65h	Korean
69h	Japanese
70h	Greek
75h	Chinese

60 Warning Code

Code	Description
10h	DSP Servo RAM initialization process timeout
11h	ADJ Focus search Defocus process timeout
12h	ADJ Focus search swing mode process timeout
13h	ADJ Focus search FSTOP Defocus process time out
14h	ADJ Focus search Process timeout
15h	ADJ Focus search Focus introduction failure
16h	DRF down during ADJ Focus search (50msec after Focus-in)
17h	DRF down during ADJ Focus search (Continuous check failure)
18h	PLAY Focus search Process timeout
19h	PLAY Focus search Focus introduction failure
1Ah	DRF down during PLAY Focus search (50msec after Focus-in)
1Bh	DRF down during PLAY Focus search (Continuous check failure)
1Eh	PUIN Switch detection during PLAY (during Tracing)
1Fh	PUIN Switch detection during JUMP
20h	PUIN Switch detection during Automatic adjustment
21h	Execute SLED inner drive after 2 failures of Focus search
22h	Reached max number of trials for FE-DC Offset adjustment
23h	TE-DC Offset adjustment timeout
24h	TE-DC Offset adjustment timeout
25h	Reached max number of trials for TE-DC Offset adjustment
26h	RF Offset adjustment (Setup mode) timeout
27h	LVSIF Adjustment 1 (Setup mode) timeout
28h	LVSIF Adjustment (Setup mode) timeout during RF Gain adjustment
29h	LVSIF Adjustment 2 (Setup mode) timeout
2Ah	Gain down limit of RF gain
2Bh	Gain down limit of FE gain
2Ch	Gain down limit of TE gain
2Dh	Gain up limit of RF gain
2Eh	Gain up limit of FE gain
2Fh	Gain up limit of TE gain
30h	FE-DC Offset adjustment timeout
31h	Offset adjustment timeout
35h	FE-DC Offset adjustment timeout
36h	Offset adjustment timeout
37h	RF Offset adjustment (Measurement mode) timeout
38h	ADLOAD timeout of Tentative DRF detection level setup

39h	ADLOAD measurement result clip of Tentative DRF detection level setup
3Ah	LVSIF adjustment 1 (Measurement mode) timeout
3Bh	Reached max number of trials for LVSIF adjustment 1
3Ch	PHBH of blank disc judge1 is less than threshold value
3Dh	ADLOAD (PH) timeout in DRF detection level setup
3Eh	ADLOAD (BH) timeout in DRF detection level setup
3Fh	PH-BH level measurement is PH≦BH in DRF detection level setup
40h	Lacking PH-BH level in PH-BH level measurement of DRF detection level setup
41h	Number of PH-BH level measurement limit of DRF detection level setup
42h	TBAL adjustment Retry
43h	Reached max number of trials for TBAL adjustment
44h	TBAL adjustment timeout
45h	DRF down during TBAL adjustment
46h	Reached max number of trials for TE gain
47h	TE clip with TE gain adjustment
48h	PHBH of blank disc judge2 is less than threshold value
49h	LVSIF adjustment (Measurement mode) timeout during RF gain adjustment
4Ah	Reached max number of trials for LVSIF adjustment during RF gain
4Bh	Gain down limit of RF gain adjustment
4Ch	Gain up limit of RF gain adjustment
4Dh	RFDC level shift limit
4Eh	Reached max number of trials for RF gain adjustment
4Fh	LVSIF adjustment 2 (Measurement mode) timeout
50h	Reached max number of trials for LVSIF adjustment 2
51h	ADLOAD(PH) timeout for each detection level setup
52h	ADLOAD(BH) timeout for each detection level setup
53h	PH-BH level adjustment is PH≦BH in each detection level measurement
54h	PH-BH level measurement limit for each detection level measurement
57h	Tracking gain adjustment timeout
58h	DRF down during Tracking gain adjustment
59h	Focus gain adjustment timeout
5Ah	DRF down during Focus gain adjustment
5Bh	LVSIF adjustment incompletion during PLAY-RFAGC
5Ch	TE gain adjustment Gain down limit
5Dh	TE gain adjustment Gain up limit
5Eh	Lacking gain after reaching TE gain max adjustment
5Fh	DRF down during Start-up WRQ wait

60h	DRF down during Play WRQ wait
61h	FBIAS adjustment Initial jitter measurement timeout
62h	Positive（＋）direction jitter measurement timeout during FBIAS adjustment
63h	Negative（－）direction jitter measurement timeout during FBIAS adjustment
64h	DRF down during FBIAS adjustment
65h	Exceeded maximum transition range of FBIAS adjustment
66h	Tracking introduction timeout
67h	Tracking gainup timeout
68h	BHREF_RATE measurement ADLOAD timeout
69h	BHREF_RATE measurement BH data incorrect
6Ah	BHREF_RATE measurement BHL data incorrect
6Bh	Start-up WRQ wait timeout
6Ch	Play WRQ wait timeout
6Dh	Over limit Gain after gaining up RF Gain adjustment
6Eh	RF gain adjustment LVSIF value is reaching its max on the Positive side
6Fh	Long jump WRQ wait timeout
70h	PUIN Switch detection during long jump
71h	DRF down during long jump
74h	DRF down during short jump
75h	Track jump timeout
76h	Change setting value of Play-BHREF adjustment
77h	Detected inverse rotation during Disc brake
78h	Lacking PH-BH level in PH-BH level measurement of Each detection level measurement
79h	Detect data area during TOC read
7Ah	Detect Lead-out area during TOC read
7Bh	TOC read process timeout per Session
7Ch	TOC read process timeout of all Sessions
7Dh	Open session detection (Session earch force-quit)
80h	DRF down during Disc brake
81h	Disc brake process timeout
82h	CD-TEXT read process timeout
83h	Detect mirror area (i.e. not recorded area) during search
84h	LSI Shock detection
86h	Memory decrease (less than 5%)
87h	Empty memory detection
90h	Check SUM of SDRAM data when recovering from Standby

91h	Received undefined operation code
92h	Received undefined code
93h	Received undefined bit pattern
94h	Received data which is excluded from defined range
95h	Received command at unacceptable timing
96h	Received a command which is impracticable at that point (Command invalid)
A0h	Search error
A1h	Reached over the limit time while waiting for the Target
A2h	Number of Continueous retry reached its Max value
A3h	Reached over Servo search limit time
A4h	Detected SubQ discontinuity
B3h	Detected overspeed
B4h	Detected non targeted range
B9h	Set RETRY LEVEL1 due to Retry occurrence
BAh	Set RETRY LEVEL3 due to Retry occurrence
BBh	Set RETRY LEVEL4 due to Retry occurrence
BCh	Set RETRY LEVEL5 due to Retry occurrence
BDh	Set RETRY LEVEL6 due to Retry occurrence
BEh	Set RETRY LEVEL7 due to Retry occurrence
BFh	RETRY LEVEL 6, 5 are set by passing CRC check 3 times continuously
C0h	RETRY LEVEL 4 is set by passing CRC check 3 times continuously
C1h	RETRY LEVEL 3 is set by passing CRC check 3 times continuously
C2h	RETRY LEVEL 2,1,0 are set by passing CRC check 3 times continuously
C3h	Short skip (100 frame jump) retry
C5h	Servo error retry (e.g. DRF down)
C6h	Middle skip retry
C7h	Long skip retry
D1h	DRF down during LVSIF 1 adjustment
D2h	DRF down during DRF detection level setup
D3h	DRF down during blank disc judge 1 process
D4h	DRF down during Servo ON (Excluding WRQ wait time)
D5h	DRF down during RF gain adjustment
D6h	DRF down during LVSIF 2 adjustment
D7h	DRF down during RF-AGC adjustment
D8h	DRF down during each detection level setup
D9h	DRF down during TOC read
DAh	DRF down during Session search
DBh	DRF down during PLAY (during Tracing)

DCh	Detect mirror area (i.e. not recorded area) during Automatic adjustment
DDh	Detect mirror area (i.e. not recorded area) during TOC read
DEh	Detect mirror area (i.e. not recorded area) during Session search
DFh	Detect mirror area (i.e. not recorded area) during PLAY/PAUSE
E1h	SubQ error during TOC read
E2h	SubQ error during Session search
E3h	SubQ error during PLAY/PAUSE
E4h	SubQ error during Search
E5h	PUIN switch detection during TOC read
E6h	PUIN switch detection during Session search
E7h	Detect voltage output DC fix of Tracking
E8h	Detect voltage output DC fix of Focus
E9h	Detect Tracking oscillation
EAh	Detect Focus oscillation