

PHILIPS OPTICAL STORAGE

DSA INTERFACE BUS PROTOCOL & DSA COMMAND SET PREMIUM 10501

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Revision history

Version	Date	Remarks
Release 0.1	12-09-97	Derived from Premium 6000 DSA command description and adapted for Premium 7000
Release 0.2	24-11-97 03-03-00	Chapter 3.20. Added, Note: This command Update from Premium 10500

Preface

This document describes the DSA (Data Strobe Acknowledge) interface bus protocol and DSA command set of the Premium 10501.

The Premium 10501 is the reference tool for the VAU1254/1255 which can be used for High-end audio, Jukebox and Video-CD applications.

The DSA-interface is an interface used for communication between two processors. One is called the servo processor and the other the user processor.

The servo processor in the CD-Module controls all servo activities, like play, pause, jumping, reading subcode, etc.

The user processor controls the servo processor via the DSA-interface.

This document gives information to users who want to control the CD-Module, and for those who want to write the user processor control SW to make their own High-end Audio, Jukebox and Video-CD applications.

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DSA INTERFACE BUS PROTOCOL & DSA COMMAND SET PREMIUM 10501

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Introduction

1.1 Purpose

This document is the first release that describes the Data Strobe Acknowledge (DSA) interface of the Premium 10501 which can be used for High-end audio, Jukebox and Video-CD applications.

The DSA-interface is an interface used for communication between two processors. One is called the servo processor and the other the user processor.

The servo processor in the CD-Module controls all servo activities, like play, pause, jumping, reading subcode, etc.

The user processor controls the servo processor via the DSA-interface.

1.2 Scope

This document gives information to users who want to control the CD-Module, and for those who want to write user processor control SW to make their own High-en audio, Jukebox and Video-CD applications.

1.3 Update information

First document release:

Derived from DSA Command set for PREMIUM 6000 document, Release 1.1 from 25 October 1994.

Added: Search release in chapter 3.4 Command set summary
 Laser on/of in chapter 3.4 Command set summary
 Opcode 81, 82 in "Set Dac mode"

Changed: Some editorial improvements implemented

2. DSA-Interface

2.1 General description

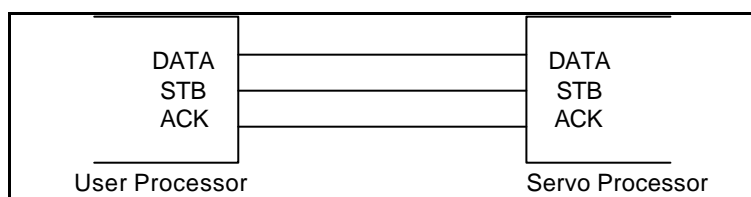
For the DSA-interface implementation in the CD-module, it is practical to use a 16-bit structure. The 16 bits contain a COMMAND- and a DATA-byte are transmitted in one string, first the COMMAND-byte, then the DATA byte. The meaning of the DATA-byte is determined by the COMMAND-byte. If the COMMAND needs no DATA-byte, a dummy value will be transmitted. The COMMAND and DATA byte will be sent with MSB first. All the DATA-bytes will be transmitted in HEX-format.

Both processors can send COMMANDS to the other without asking for request. This means for example, that the CD-module sends the new values to the User-processor every time the CD-time changes.

2.2 DSA-interface specification

The DSA-bus is an asynchronous, bi-directional, internal bus designed for communication between two micro processors in one set. It consists of three bi-directional lines:

- DATA - for starting synchronisation and data transfer
- STB - for data strobe (DATA is valid while STB is low)
- ACK - for starting synchronisation, data transfer-acknowledge and communication-acknowledge



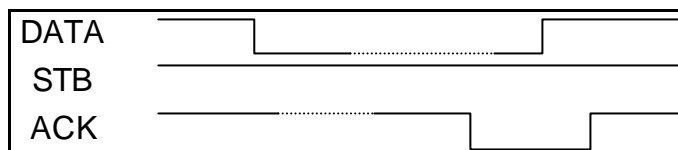
2.3 Description of communication

Each data communication consists of three phases:

- starting synchronisation - synchronises the transmitter and the receiver for a data transmission
- data transmission - the transmission of all data bits with the help of strobe and acknowledge signals
- communication acknowledge - the receiver lets the transmitter know whether the communication was error free or not. If the communication was not error free, there is a possibility to repeat it until it is OK

A processor is called a transmitter when it wants to transfer data, it starts with a synchronisation phase, transfers the data and on request it receives finally the communication acknowledge. The other processor becomes automatically the receiver.

2.3.1 Starting synchronisation



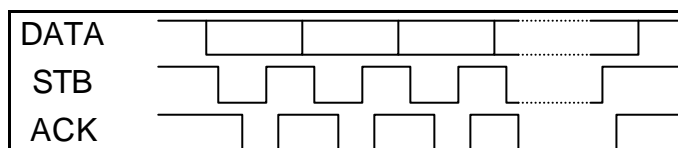
The transmitter clears the data line to let the other side know it wants to transmit some data. Then it is waiting until low level on the ACK line is received as an answer from the receiver which recognised the data transfer request and is ready for it.

Then the transmitter sets the DATA line high and waits for a high level on the ACK line a high level on the ACK line means the end of the starting synchronisation and both transmitter and receiver are ready for the data transfer.

It is possible that both processors want to send their data at the same time. Both clear the DATA line and wait for an acknowledge on the ACK line. Therefore, it is necessary to start a software time-out for the transmitter at the beginning of the synchronisation. After the time-out period (T_{syn}), the servo processor sets the DATA line inactive (high) and checks if the user processor is generating the synchronisation signal (the DATA line stays low). If yes, it first receives the data. Then the servo processor can try to transmit again by clearing the data line.

If the servo processor can't pass the synchronisation phase while it has already new data to send, then the old data will be 'overwritten'.

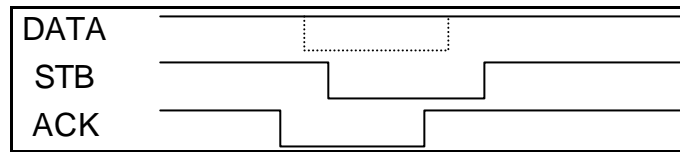
2.3.2 Data Transmission



In this part of the communication all data bits will be transferred from the transmitter to the receiver. The transmitter sets the DATA line according to the bit to be send. When the DATA line becomes stable, the transmitter clears the STB line to tell the receiver, that the information on the DATA line is valid. The receiver reads the DATA line after the STB line low status is recognised. Then the receiver clears the ACK line to let the transmitter know the data was read. The transmitter sets the STB line and waits for the ACK line high status. When the ACK line becomes high, one data bit is completely transferred. The number of bits transferred within one Data transmission phase is sixteen

If the servo processor can not transfer the 16 data bits within (T_{trf}), it sets the DATA and STB lines high and clears the ACK line to enter the communication phase.

2.3.3 Communication acknowledge



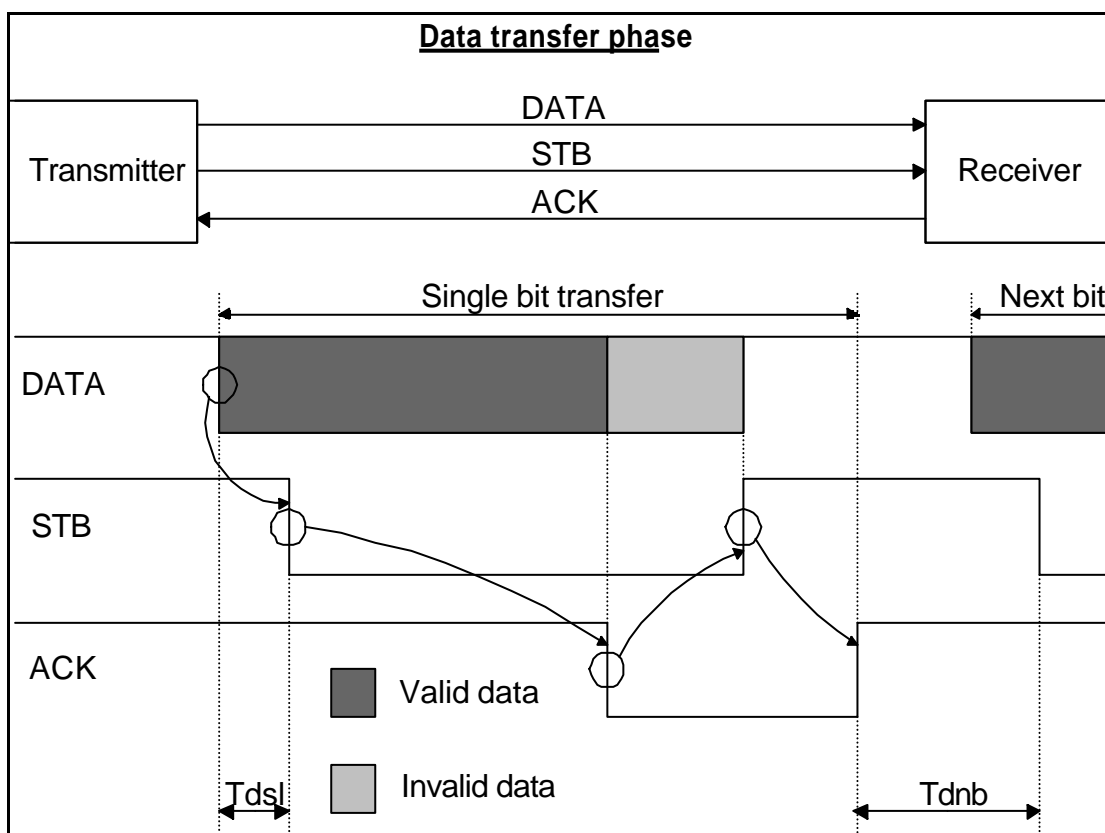
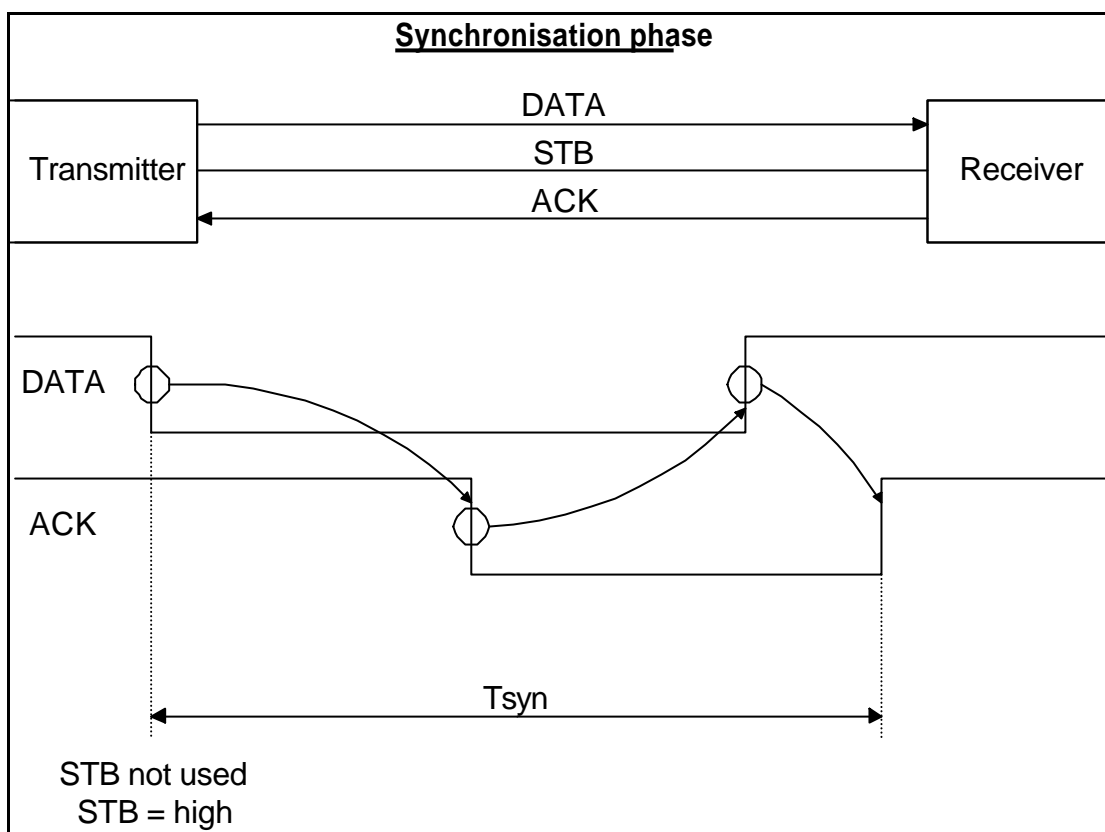
Spikes on the bus can cause the transmitter and the receiver to come out of synchronisation. Therefore, it is necessary to check the synchronisation status after each data transfer. This process is started by the transmitter.

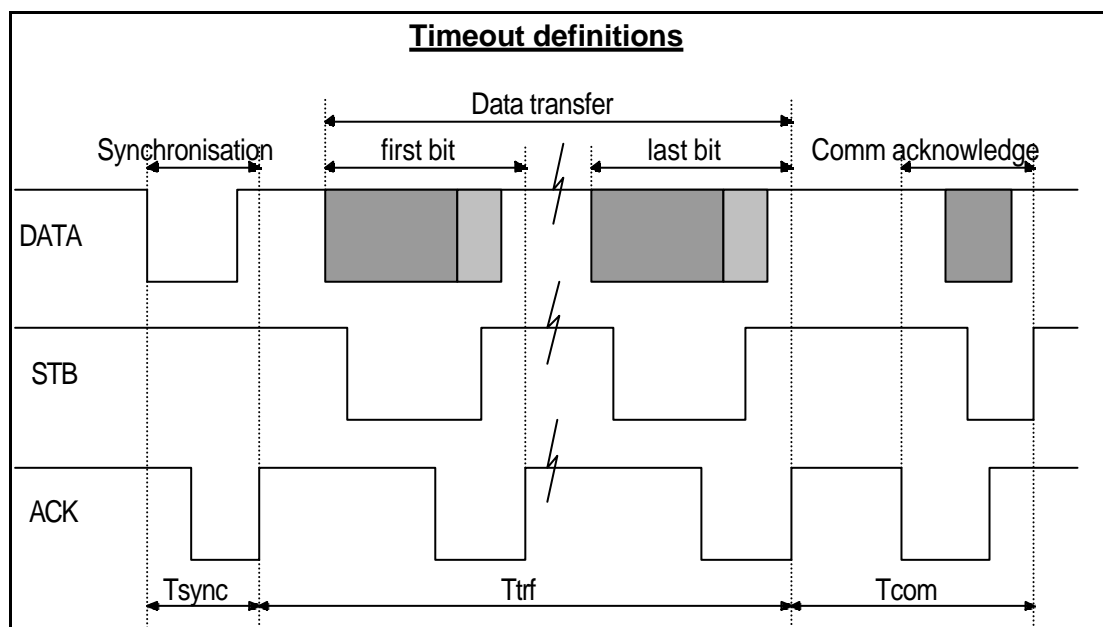
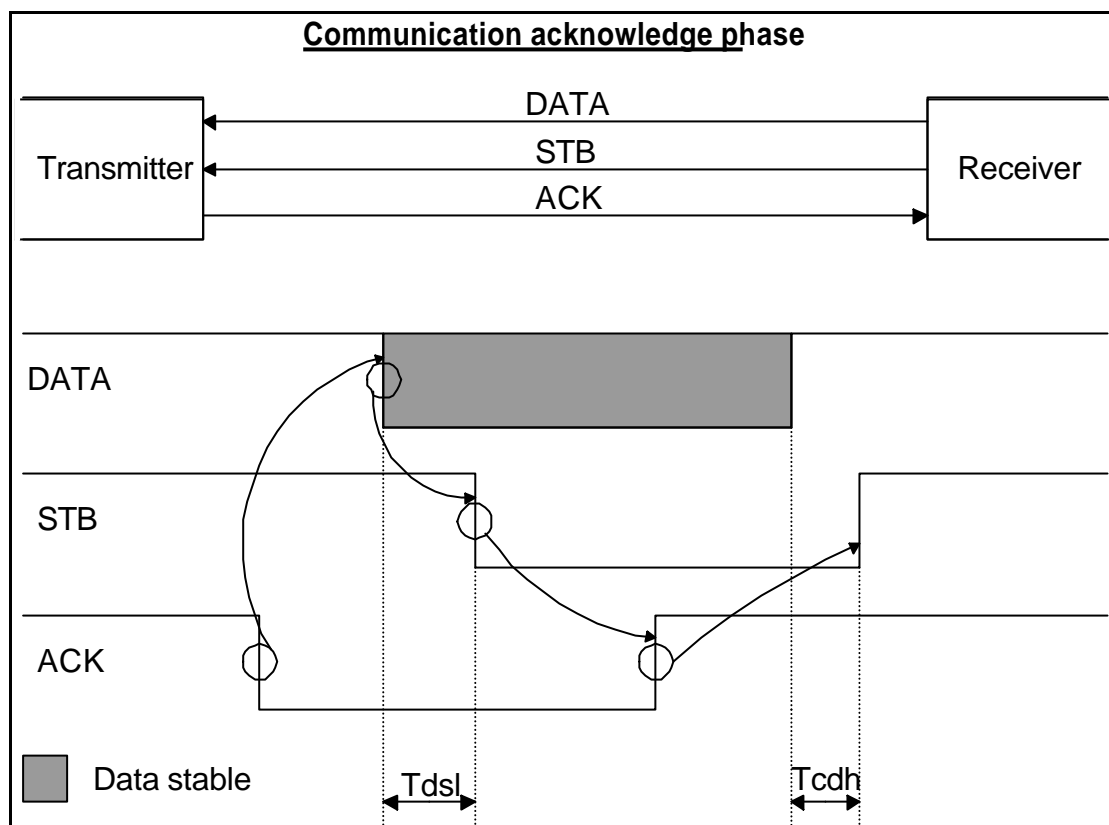
When all bits from the transmitter are sent, the transmitter clears the ACK line. At this time the receiver should have received the specified bit count accurately. If the receiver's bit counter is not equal to this specified count, the receiver clears the DATA line, otherwise this line remains high. After this, the receiver clears the STB line. This means for the transmitter, that the result of the comparison is valid on the DATA line. The transmitter reads the DATA line and then sets the ACK line high. This means for the receiver the DATA line was read by the transmitter. When the receiver recognises that the ACK line is high, it sets both the DATA and STB lines high. Now all communication is completed and the DSA-bus is free again.

If the communication was not error free, the transmitter should repeat (only once) the last communication starting with the synchronisation phase.

If the receiver doesn't react properly in the communication acknowledge phase within T_{com} , the servo processor (= transmitter) interprets this as a communication error and sets all lines high.

Timing diagrams for DSA communication are shown in next two pages.





Timing requirements table.

Phase	Symbol	Parameter	Min	Max	Unit
Synchronisation	Tsyn	synchronisation time out	-	250	msec
Data transfer	Tdsl	data stable before STB low	50	-	nsec
	Tdnb	STB low after ACK high	50	-	nsec
	Ttrf	Data transfer time-out	-	250	msec
Communication Acknowledge	Tcsl	data stable before STB low	50	-	nsec
	Tcdh	data high before STB high	-	0	nsec
	Tcom	communication acknowledge time-out	-	250	msec

3. DSA Command Set

Commands for the servo processor are divided into three groups:

- servo commands (servo state changes in these commands)
- info commands
- mode setting commands

A DSA command consists of one or more DSA command parameters. Each DSA command parameter has one unique opcode followed by the parameter itself.

When a DSA command consists of multiple command parameters then the DSA command will be executed after the last (= highest opcode) command parameter is received. The order of entering the command parameters is not fixed, except for the last command parameter because it triggers the command execution.

3.1 Vendor Unique DSA Commands

Some DSA commands are marked as vendor unique. Also some of the command opcodes (A0h - AFh) are reserved for vendor unique commands.

Only vendor unique commands may have different command specifications in a DSA implementation.

The VENDOR UNIQUE DSA commands are free to specify on customer request.

For the DSA implementation for Premium 10501 (this document), the vendor commands are specified in this document.

Vendor Unique commands are:

Command Name	Command opcode
Reserved	A0h - AFh

3.2 Command rules

- Rule 1: Commands within a group overrule each other (without notice). This means that the current command will be aborted and the just received command starts execution.
- Rule 2: If an info- or mode command is received during execution of a servo command the Servo processor starts processing the info- or mode and continues with the servo command.
- Rule 3: Servo commands overrule info- and mode commands. All actions needed will be done implicitly.
- Rule 4: When two commands are already accepted and in execution, for example a servo command (= first) and an info- or mode command (= second) and the third is an info- or mode command the current info/mode command will be terminated, if the third command is a servo command then both commands in execution will be aborted.

In principle there is no fixed command sequence to do an action with the CD-Module. All actions needed will be done implicitly. For example, Play track 10 while stopped, just invoke PLAY-TITLE command with value 10 (0Ah).

3.3 Command recovery

When a (valid) command fails in execution it must be recovered by retrying the same command for at least two times.

3.4 Command set summary

DSA Command table summary

Command name	Type	opcode	parameter
COMMANDS TO SERVO PROCESSOR			
Play title	servo	01h	Title number (hex)
Stop	servo	02h	xx
Read TOC	servo	03h	00
Pause	mode	04h	xx
Pause Release	mode	05h	xx
Search forward at low speed, with Border flag cleared	servo	06h	00h
Search forward at high speed, with Border flag cleared	servo	06h	01h
Search forward at low speed, with Border flag set	servo	06h	10h
Search forward at high speed, with Border flag set	servo	06h	11h
Search backward at low speed,	servo	07h	00h

Command name	Type	opcode	parameter
with Border flag cleared			
Search backward at high speed, with Border flag cleared	servo	07h	01h
Search backward at low speed, with Border flag set	servo	07h	10h
Search backward at high speed, with Border flag set	servo	07h	11h
Search release	servo	08h	-
Get title length	info	09h	Track number (hex)
Reserved	-	0Ah	-
Reserved	-	0Bh	-
Get complete time	info	0Dh	xx
Goto time	servo	10h	Abs. min. (hex)
		11h	Abs. sec. (hex)
		12h (start)	Abs. frm. (hex)
Read Long TOC	servo	14h	00
Set mode	mode	15h	Mode settings
Get last error	info	16h	xx
Clear error	info	17h	xx
Spin up	servo	18h	00
Play A-time till B-time	servo	20h	Absolute start time minutes (hex)
		21h	Absolute start time seconds (hex)
		22h	Absolute start time frames (hex)
		23h	Absolute stop time minutes (hex)
		24h	Absolute stop time seconds (hex)
		25h (start)	Absolute stop time frames (hex)
Release A->B time	mode	26h	xx
Get Disc Identifiers	info	30h	xx
Reserved	-	40h - 44h	-
Get disc status	info	50h	xx
Set volume	mode	51h	Volume level (hex)
Reserved	-	52h	-
Reserved	-	54h	-
Clear TOC	mode	6Ah	xx
Set DAC mode	mode	70h	DAC mode
Reserved for Vendor Unique	-	A0h-AFh	

Command name	Type	opcode	parameter
commands			
Reserved	-	80h - 83h	-
Reserved	-	C0h - C2h	-
SERVICE COMMANDS			
Service Mode Off	servo	F0h	00h
Request Servo Version Number and activate Service Mode		F0h	01h
Sledge off		F1h	00h
Sledge outside for 300msec		F1h	01h
Focus off		F2h	00h
Focus on		F2h	01h
Turntable motor off		F3h	00h
Turntable motor on		F3h	01h
Radial off		F4h	00h
Radial on		F4h	01h
Laser on		F5h	00h
Laser off		F5h	01h
Diagnostics		F6h	XX
High gain / Low gain		F7h	XX
Jump grooves		F8h	MSB number of grooves
		F9h(start)	LSB number of grooves
RESPONSE COMMANDS FROM SERVO PROCESSOR			
Found	servo	01h	Goto time Found/Paused/Paused Released /Spinned Up/Play A-B Start Found /Play A-B End Found
Stopped	servo	02h	xx
Disc status	info	03h	No disc present / disc present Disc size 8cm / 12 cm High/low reflectance disc Finalised/unfinalised disc
Error values	info	04h	Error value
Length of title	info	09h	Lsb byte of seconds of requested title (hex)
		0Ah	Msb byte of seconds of requested title (hex)
Reserved	servo	0Bh	-
			-
Reserved	servo	0Ch	-

Command name	Type	opcode	parameter
Reserved	servo	0Dh	-
Actual title	servo	10h	New track number (hex)
Actual index	servo	11h	New index number (hex)
Actual minutes	servo	12h	New minutes (hex)
Actual seconds	servo	13h	New seconds (hex)
Absolute time	info	14h	New abs. minutes (hex)
		15h	New abs. seconds (hex)
		16h	New abs. frames (hex)
Mode status	info	17h	Mode settings
TOC values	servo	20h	Min. track number (hex)
		21h	Max. track number (hex)
		22h	Start time lead-out min. (hex)
		23h	Start time lead-out sec. (hex)
		24h	Start time lead-out frm. (hex)
A->B Time released	mode	26h	xx
Disc identifiers	info	30h	Disc identifier 0 of the CD
		31h	Disc identifier 1 of the CD
		32h	Disc identifier 2 of the CD
		33h	Disc identifier 3 of the CD
		34h	Disc identifier 4 of the CD
Volume level	mode	51h	Volume level (hex)
Reserved	-	52h	-
Reserved	-	54h	-
Reserved		5Dh, 5Eh, 5Fh	-
Long TOC values	servo	60h	Track number (hex)
		61h	Control & Address field
		62h	Start time minutes (hex)
		63h	Start time seconds (hex)
		64h	Start time frames (hex)
Reserved	-	65h - 68h	-
TOC Cleared	info	6Ah	xx
DAC mode	mode	70h	DAC mode
Servo Version Number	servo	F0h	Servo version number

xx = don't care.

3.5 Play title

This command forces the CD-module to jump to the beginning of the requested track, indicated by 'title number'. If now the internal 'pause mode indicator' is cleared, the CD-module will start tracking, otherwise it goes in pause mode. If the CD-module is in STOP-mode, it starts up first and jump to the requested title.

Remark: The 'pause mode indicator' is an internal flag that indicates whether pause mode has to be entered after a PLAY-TITLE , GOTO TIME OR PLAY AB command. This flag can be set/cleared by PAUSE/PAUSE RELEASE command.

command: Play title 01h / <title number (hex)>

response:

When the start of a title (track) is reached, the CD-module will respond conform the setting of ATTI.

ATTI = 00 The CD-module sends the FOUND command.

ATTI = 10 The CD-module sends the new Title and the actual index, relative time to the User-processor and afterwards the FOUND command.

ATTI = 01 The CD-module sends the new Title and the actual index, absolute Time to the User-processor and afterwards the FOUND command.

The ATTI (Actual, Title, Time, Index) value can be set by the SET MODE command, the default value is 10b (binary).

During Play, the CD-module sends, if selected by ATTI, and when the item changes (TITLE, INDEX, TIME minutes, TIME seconds), the new values to the User-processor.

ATTI = 00 No new Title, Index or Time will be sent if they change.

ATTI = 10 New Title, Index or relative Time (min. or sec) will be sent if they change (only the item that change will be send)

ATTI = 01 New Title, Index or absolute Time (min. or sec) will be sent if they change (only the item that changes will be sent)

When the CD-module runs into the lead-out area, it goes into pause mode and sends the ACTUAL TITLE command with value AAh, which indicates lead-out.

response commands:

During play (only when the item changes)

ATTI = 00	
Found	01h / XX
ATTI = 01	
Actual title	10h / <new track number>
Actual index	11h / <new index number>
Actual abs. minutes	14h / <new minutes>
Actual abs. seconds	15h / <new seconds>
Found	01h / XX
ATTI = 10	
Actual title	10h / <new track number>
Actual index	11h / <new index number>
Actual rel. minutes	12h / <new minutes>
Actual rel. seconds	13h / <new seconds>
Found	01h / XX

The ATTI (Actual, Title, Time, Index) value can be set by the SET MODE command, the default value is 10b (binary).

Note: Illegal track values while the disc not mounted yet, results that the CD-Module (servo) starts tracking from the lead-in area.

3.6 Stop

This command stops playing the disc and brakes. After the STOP-procedure is finished, the CD-module answers with the STOPPED command to the User-processor.
This command also clears the internal 'pause mode indicator'.

command:	Stop	02h / XX
response command:	Stopped	02h / XX

3.7 Read TOC

This command forces the CD-module to read the TOC. After finishing this, the CD-module sends the 5 values TITLE MINIMUM, TITLE MAXIMUM and DISC-TIME MIN/SEC/FRM to the User-processor. After reading the TOC, the CD-module goes in pause mode at the beginning of the first track.

Note: This command does not alter the internal 'pause mode indicator'.

command:	Read TOC	03h / <00>
response commands:	TITLE MINIMUM	20h / <minimum Track number of the CD>
	TITLE MAXIMUM	21h / <maximum Track number of the CD>
	DISC-TIME MIN	22h / <maximum time minutes of the CD>
	DISC-TIME SEC	23h / <maximum time seconds of the CD>
	DISC-TIME FRM	24h / <maximum time frames of the CD>

3.8 Read Long TOC

This command forces the CD-module to read the TOC. The CD-module passes all track info. This track info consist of TRACK NUMBER, CONTROL & ADDRESS, ABSOLUTE START TIME (min,sec,frm). The CD-module keeps tracking in the TOC (it will jump back into the lead-in if it reaches the program area) until a new servo command is received.

command: Read Long TOC 14h / <00>

response commands: Interpretation of return code depends on <Track number> value

When: 0 <= Track number <= 63h

Track number	60h / <track number>
Control & address	61h / <control & address field>
Start time minutes	62h / <start time minutes>
Start time seconds	63h / <start time seconds>
Start time frames	64h / <start time frames>

When: Track number = B0h and address = 5

Track number	60h / < B0h>
Control & address	61h / <control & address field (= y5h)>
Start time minutes	62h / <start time minutes next possible program area >
Start time seconds	63h / <start time seconds next possible program area >
Start time frames	64h / <start time frames next possible program area >

(y = control)

When: Track number = 64h or 65h or 65h and address = 1

Track number	60h / < 64h or 65h or 66h >
Control & address	61h / <control & address field (= y1h)>
PMIN	62h / <pmin >
PSEC	63h / <psec>
PFRAM	64h / <pfrm>

(y = control)

Track #	PMIN	PSEC	PFRM	TYPE OF DISC
64h	first track number on disc	00h	00h	CD-DA or CD-ROM or CD-ROM XA (first track in Mode 1)
	number of CD-I tracks plus one	10h	00h	CD-I disc
	first track number on disc	20h	00h	CD-ROM XA (first track in Mode 2)
65h	last track number on disc	00h	00h	CD-DA or CD-ROM or CD-ROM XA
	number of CD-I tracks plus one	00h	00h	CD-I disc with No audio tracks
	last audio track number	00h	00h	CD-I disc WITH audio track(s)
66h	start leadout [min]	start leadout [sec]	start leadout [frm]	CD-DA or CD-ROM or CD-ROM XA or CD-I

3.9 Set Mode

With this command, the CD-module can be set in different modes.

After accepting the mode settings, the CD-Module responds with sending the **MODE STATUS** command, which reflects the current setting.

When mode = 00h then the current mode setting will be returned.

The default mode values after power up or reset are: speed = 1, mode = Audio (I²S 1 FS), ATTI = 10b (binary).

When the Audio mode is selected the last selected “I2S DAC mode” format will be installed.

When the CD-ROM mode is selected the last selected “I2S ROM mode” format will be installed.

The “I2S format” can be set by the 'Set DAC mode’ command.

command:	Set mode	15h / <mode>
	mode bit Mode	
	2 - 0	this sets the speed 001 = normal CD-DA speed, 010 = double speed Other values are reserved.
	3	0 = Audio mode, 1 = CD-ROM mode
	5 - 4	Actual Title, Time, Index (ATTI) setting 00 = no title, index or time send during play modes 01 = sending title, index and absolute time (min/sec) 10 = sending title, index and relative time (min/sec) 11 = reserved
	6	'pause at track-end' feature' 0: enter pause mode at end of track disabled 1: enter pause mode at end of track enabled
	7	reserved
command response:	Mode status	17h / <mode>

A complete update of track, index, minutes and seconds will follow when ATTI changes from 1 to 2 or vice versa.

The bit definitions for <mode> are the same as for the SET MODE command.

When the 'pause at track-end' feature is enabled (bit 6 = '1') the CD-Module will enters pause mode at the end of each track. Also during **PLAY A-B TIME**. Therefore it's recommended that during play A-B time the 'pause at track-end' is disabled.

The 'pause at track-end' feature is not valid for the search function, this means; when searching with border flag cleared while 'pause at track end' is enabled, the search will NOT stop at track-end!

The 'pause at track-end' feature can be used to play just one track.

The response, when reaching track-end (when 'stop at track-end' feature (bit 6 = '1') is enabled) will be the ACTUAL TRACK update with the next track value, so;

Actual title 10h / <next track number>

Note: When the 'pause at track end' feature (bit 6 = '1') is enabled, the 'Actual title' response is always send, even when ATTI = 0.

3.10 Get last error.

This command request the last encountered error. The CD-module responds with sending the ERROR VALUE command. The 'last error' will only be cleared by the CLEAR ERROR command.

command:	Get last error	16h / XX
response command:	Error value	04h / <error value>

3.11 Clear error.

This command clears the latest error code. The CD-module respond with sending the ERROR VALUES command with error code set to zero.

command:	Clear error	17h / XX
response command:	Error value	04h / <00>

3.12 Spin up

This command is used to spin up (mount the disc) it reads the TOC and seeks to the beginning (= the start time) of the first track in that program area and goes in 'pause mode'. If the disc is already spun up, the CD-module will treat this command as a seek to the start time of first track. When the SPIN UP command is ready, the CD-module sends the FOUND command.

Note: This command does not alter the internal 'pause mode indicator'.

command:	Spin up	18h / <00>
response command:	Found	01h / 43h

3.13 Pause

This command forces the CD-module to go into PAUSE mode (if tracking) and sets the internal 'pause mode indicator'. Setting the 'pause mode indicator' is always possible.

This command responds always with 'FOUND'.

Pause is released by the PAUSE RELEASE or STOP commands.

When the 'pause mode indicator' is set, the CD-module will always enter the pause mode after a jump (PLAY TRACK, GOTO TIME, PLAY A->B TIME).

command:	Pause	04h / XX
response command:	Found	01h / 41h

3.14 Pause Release

This command releases the PAUSE mode (if pausing) and clears the 'pause mode indicator'. During tracking any change in actual title, time, index (if selected by ATTI) will be sent by their corresponding commands.

command:	Pause release	05h / XX
response command:	Found	01h/ 42h

3.15 Search Forward/Backward

When the CD-module is in play mode, these commands start the Search Forward/Backward. At low speed the music is attenuated by -12dB, at high speed the music is muted.

The Border flag controls the behaviour of SEARCH on the end of a title: If the Border flag is set, it is not possible to leave the actual title with SEARCH, the CD-module stops searching ± 5 seconds before the end of the title or at the beginning of the title.
If the Border flag is not set then the whole Disc can be SEARCHED.

The Search function is released by the SEARCH RELEASE command.

command:	Search forward at low speed, with Border flag cleared	06h / 00
	Search forward at high speed, with Border flag cleared	06h / 01
	Search forward at low speed, with Border flag set	06h / 10
	Search forward at high speed, with Border flag set	06h / 11
	Search backward at low speed, with Border flag cleared	07h / 00
	Search backward at high speed, with Border flag cleared	07h / 01
	Search backward at low speed, with Border flag set	07h / 10
	Search backward at high speed, with Border flag set	07h / 11

response command:	no command
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Note:

It's recommended when searching with border flag set, that the 'pause at track-end' feature (selectable in SET MODE) is disabled.

3.16 Search Release

This command simply releases SEARCH.

command:	Search Release	08h / XX
response command:	no command	

3.17 Get title length

This command is used to get the time of a specified title (1 - 20) only from the first PROGRAM AREA on the disc (used for EDIT, PROGRAM, ...). The CD-module sends the time in seconds (high and low byte) back to the User-processor (which must recognise the last requested title number).

command:	Get title length	09h / <tracknumber>
response command:	Length of title (lsb)	09h / <Low byte of seconds of requested title>
	Length of title (msb)	0Ah / <High byte of seconds of requested title>

3.18 Get complete time

This command forces the CD-module to send the next ABSOLUTE DISC TIME to the User-processor when the disc is turning.

command:	Get complete time	0Dh / XX
response commands:		
	Absolute time minutes	14h / <new minutes>
	Absolute time seconds	15h / <new seconds>
	Absolute time frames	16h / <new frames>

3.19 Goto time

This command forces the CD-module to jump to the requested absolute time location. If now the internal 'pause mode indicator' is cleared, the CD-module will start tracking, otherwise it goes in pause mode.

The jump to the desired time position starts after receiving the FRAMES. When the requested time position is reached, 'Found' is sent.

command:	Goto time min.	10h / <absolute minutes>	[0- 63h]
	Goto time sec.	11h / <absolute seconds>	[0-3Bh]
	Goto time frm.	12h / <absolute frames >	(starts execution) [0-4Ah]
response command:	Found	01h/40h	

If the absolute time is invalid, the CD-module can respond with the ERROR VALUE command with error value set to 'illegal command'.

The absolute time must be greater than or equal to 0 : 02 : 00 (min, sec, frm) and less than or equal to last the leadout starting time.

During Play, the CD-module sends, if selected by ATTI, and when the item changes (TITLE, INDEX, TIME minutes, TIME seconds), the new values to the User-processor.

ATTI = 00	No new Title, Index or Time will be sent if they change.
ATTI = 10	New Title, Index or relative Time (min. or sec) will be sent if they change (only the item that changes will be sent).
ATTI = 01	New Title, Index or absolute Time (min. or sec) will be sent if they change (only the items that changes will be sent).

When the CD-module runs into the lead-out area it goes into pause mode and sends the ACTUAL TITLE command with value AAh which indicates lead-out.

Note: Illegal values while disc not mounted, results that the CD-Module (servo) starts tracking from the lead-in area.

3.20 Get Disc identifiers

This command forces the CD-module to send the five Disc identifiers.
The five Disc identifiers will be generated from the TOC by a special algorithm.
Its purpose is only for audio applications.

command:	Get Disc identifiers	30h / <00>
response commands:	Disc identifiers values	30h / <Disc identifier 0 of the CD> 31h / <Disc identifier 1 of the CD> 32h / <Disc identifier 2 of the CD> 33h / <Disc identifier 3 of the CD> 34h / <Disc identifier 4 of the CD>

Note: This command should only be sent after a “play” or “read TOC” command.

3.21 Play A-time till B-time

This command forces the CD-module to play from the requested absolute start time (A-time) till end time (B-time). If the internal 'pause mode indicator' is cleared, the CD-module will start tracking from A-time, otherwise it goes in pause mode at A-time.

The jump to the desired A-time starts after receiving the STOP FRAMES. When reached, the CD-module sends ACTUAL TITLE, ACTUAL TIME = the A-time (min/sec), if selected by ATTI, and ACTUAL INDEX, then it terminates always with the FOUND.

When the end time (B-time) is reached, the CD-module enters pause mode and sends the actual Title, index, minutes and seconds to the User processor.

A-time and B-time must be in one program area and B-time must be greater than or equal to A-time.

During Play A-time to B-time, the CD-module can send, if selected by ATTI, when something changes (TITLE, INDEX, TIME minutes, TIME seconds), the new values to the User-processor.

ATTI = 00	No new Title, Index or Time will be sent if they change.
ATTI = 10	New Title, Index or relative Time (min. or sec) will be sent if it changes (only the item that changes will be sent)
ATTI = 01	New Title, Index or absolute Time (min. or sec) will be sent if it changes (only the item that changes will be sent)

If any error is encountered, the command ERROR VALUES is sent from the CD-module and the PLAY A-TIME TILL B-TIME command is terminated (pause mode).

command:	20h / <absolute start time minutes>
`	21h / <absolute start time seconds>
	22h / <absolute start time frames>
	23h / <absolute stop time minutes>
	24h / <absolute stop time seconds>
	25h / <absolute stop time frames> (start execution)

command response:

A-time reached:

ATTI = 00	
Found	01h/ 44h
ATTI = 01	
Actual title	10h / <new track number>
Actual index	11h / <new index number>
Actual abs. minutes	14h / <new minutes>
Actual abs. seconds	15h / <new seconds>
Found	01h/ 44h
ATTI = 10	
Actual title	10h / <new track number>
Actual index	11h / <new index number>
Actual rel. minutes	12h / <new minutes>
Actual rel. seconds	13h / <new seconds>
Found	01h/ 44h

During play from A-time till B-time (only when the item changes)

ATTI = 00	
no commands	
ATTI = 01	
Actual title	10h / <new track number>
Actual index	11h / <new index number>
Actual abs. minutes	14h / <new minutes>
Actual abs. seconds	15h / <new seconds>
ATTI = 10	
Actual title	10h / <new track number>
Actual index	11h / <new index number>
Actual rel. minutes	12h / <new minutes>
Actual rel. seconds	13h / <new seconds>

B-time reached

ATTI = 00	
Found	01h/ 45h
ATTI = 01	
Actual abs. minutes	14h / <new minutes>
Actual abs. seconds	15h / <new seconds>
Found	01h/ 45h
ATTI = 10	
Actual rel. minutes	12h / <new minutes>
Actual rel. seconds	13h / <new seconds>
Found	01h/ 45h

The ATTI (Actual Title, Time and Index) value can be set by the SET MODE command, the default value is 10b (binary).

Note: Illegal values while disc not mounted, results that the CD-Module (servo) starts tracking from the lead-in area.

3.22 Release A->B time

This command releases the A time till B time feature. Only checking on B-time will be disabled. When the CD-Module was tracking, it keeps tracking.

command: Release A->B time 26h / XX

command response: A->B time released 26h / XX

3.23 Get Disc Status

This command forces the CD-module to send the current disc status.
The CD-module responds with sending the DISC STATUS command.

command: Get disc status 50h / XX

command response: disc status 03h / <disc status>

bit	disc status
0	0 = no disc present or TOC('s) not read. 1 = disc present and TOC('s) read.
1	for Jukebox application always zero 0
2	this bit is only valid when bit 0 is set 0 = disc size is 8 cm 1 = disc size is 12 cm
3	this bit is only valid when bit 0 is set 0 = high reflectance disc (CD-DA / CD-R) 1 = low reflectance disc (CD-RW)
4	this bit is only valid when bit 0 is set 0 = non-finalised disc 1 = finalised disc
5-7	reserved

3.24 Set Volume

With this command the audio volume can be controlled (only in audio mode).
The volume level is determined by the value (linear scale) with a range from 0 (= mute) till 255 (full scale) with a resolution of 2.

command: Set volume 51h / <volume value>

volume value	meaning
0	mute
1 - 254	fade
255	full scale

response command: Volume value 51h / <volume value>

3.25 Clear TOC

This command clears the TOC info stored in ram. This command is only allowed in stop mode. This command must be given by each disc change.

command: Clear TOC 6Ah / <xx >

response commands: TOC cleared 6Ah / <xx>

3.26 Set DAC mode (I2S output format)

This command sets the I2S output format. The command will be executed directly for the mode selected previously by 'SET MODE' command, otherwise it will be saved internally.

command: Set DAC mode 70h / <I2S mode>

response command: DAC mode 70h / <I2S mode>

<I2S mode>	I2S format	mode see SET MODE command
0	reserved	
1	I ² S - FS mode (default)	DAC mode
2	I ² S - 2 FS mode	DAC mode
3	I ² S - 4 FS mode	DAC mode
4	Sony 16 bit FS	DAC mode
5	Sony 16 bit 2 FS	DAC mode
6	Sony 16 bit 4 FS	DAC mode
7	Sony 18 bit FS	DAC mode
8	Sony 18 bit 2 FS	DAC mode
9	Sony 18 bit 4 FS	DAC mode
81	I ² S - CD-ROM mode	CD-ROM mode
82	EIAJ CD-ROM mode	CD-ROM mode

3.27 Service control commands

These commands control the Service mode of the CD-module. The service mode is entered by requesting the servo version number. Only in the service mode, it is possible to give additional commands such as radial, sledge, focus or turntable motor on/off. The other commands such as play track are not valid. The Service Mode is deactivated by the Service Mode Off command.

However there is no check on the correct usage of these service commands. The set should be in stop mode before trying any service commands. Also the order in which the commands are given, is not protected. For example, the radial should not be activated when the focus is off. A safe order would be: first put the focus on, then the disc motor and then the close radial loop.

commands:

Service Mode Off	F0h / 00
Request Servo Version Number and activate Service Mode*	F0h / 01
Sledge off	F1h / 00
Sledge outside for 300msec	F1h / 01
Focus off	F2h / 00
Focus on	F2h / 01
Turntable motor off	F3h / 00
Turntable motor on	F3h / 01
Radial off	F4h / 00
Radial on	F4h / 01
Laser off	F5h / 00
Laser on	F5h / 01
Diagnostics command	F6h / xx
High gain (Trigenta)	F7h / 00
Low gain (Trigenta)	F7h / 01

* only these commands give the response command(s), listed below

response commands:

Response on the REQUEST SERVO VERSION NUMBER command

Servo Version Number	F0h	/	<Servo	Version
----------------------	-----	---	--------	---------

Number>

Every service command will be explained below.

- Service Mode Off

This command switches the service mode off. If the service mode was activated, all servos are switched off.

- Request Servo Version Number and activate Service Mode

With this command the CD-module will enter the 'service mode'. It will respond with returning the Servo Version Number.

The sledge will be positioned at the inner most position.

- Sledge off

This command will stop moving the sledge. If it is stopped, the sledge will be positioned at the inner most position.

- Sledge outside for 300msec

This command forces the sledge to move outside for 300msec. After the 300msec, the sledge will be positioned back at the inner most position.

- Focus off

This command will switch off the focus loop. Because the focus loop has to be switched off also the radial loop, the spindle motor and the laser will be switched off.

- Focus on

This command puts the laser in focus. If the laser was off, it will be switched on.

- Turntable motor off

This command switches the spindle motor off. Because the spindle motor has to be switched off, also the radial loop will be switched off.

- Turntable motor on

This command will switch the spindle motor on. To achieve this, the laser will be switched on, also focus has to be found (disc present!).

- Radial off

This command will switch off the radial loop.

- Radial on

This command will switch on the radial loop. To achieve this, the laser will be switched on, focus has to be found (disc present!) and the spindle motor has to be turned on.

- Laser off

This command switches the laser off. Also the radial loop, the spindle motor, and the focus loop will be switched off.

- Laser on

This command will switch on the laser.

- *Diagnostics command*

This is a very dangerous command to use. It is possible to alter every CD10 setting, resulting in a failure of the CDM. You can always reset to the initial values via the calibrate switch on the PCB, or by power down of the CDM. Always use this command or the calibrate switch during STOP mode, not during PLAY !

DSA command : 0F6H
DSA value : xy
Where x is the address nibble and y the data nibble of the decoder register.

Purpose : To write the CD10 decoder registers 0 to F.

Examples :

- EBU output mode change (register A) :

1. Goto service mode.
2. 0F6H 0AAH EBU mode - flags on
3. 0F6H 0A2H EBU mode - flags off
4. Goto normal mode.

- Iref change (shadow registers A and C) :

1. Goto service mode.
2. 0F6H 0FDH Enable shadow registers
3. 0F6H 0AxH Set Iref D1D4
4. 0F6H 0CxH Set Iref R1R2
5. 0F6H 0FCH Disable shadow registers
6. Goto normal mode.

- Switch internal DAC on/off (shadow register 7) :

1. Goto service mode
2. 0F6H 0FDH Enable shadow registers
3. 0F6H 74H Disable internal DAC
4. 0F6H 77H Enable internal DAC
5. 0F6H 0FCH Disable shadow registers
6. Goto normal mode.

- *High/Low gain command*

DSA command : 0F7H
DSA value : 0 Gain switched for reading CD-RW
1 Gain switched for reading CD-DA and CD-R

Purpose : To be able to read also CD-RW discs.

- *Jump grooves command*

DSA command : 0F8H + 0F9H
DSA value : MSB most significant byte for the number of grooves
LSB least significant byte for the number of grooves

Purpose : To be able to move the sledge for a number of grooves

3.28 Error handling

Whenever an error is detected during the execution of a command, the CD-module sends after command execution the ERROR VALUE command to the User-processor.
If an error is encountered, the command in execution will be terminated.

Remark:

Because error codes are given only after command execution, an error will not be stated during “play”

To control errors during “play”, send regularly:

>: GET Complete time, command 0Dh/00

<: wait for the DSA command containing the minutes, seconds, frame

This time-code received must be higher than the previous one (logical during play).

It is also possible to use the “actual updates” for this false detection.

When the updates of the seconds are not appearing (for more than 1 second) or the new timecode is not successive, then an unrecoverable error situation has been detected.

The recovery could be handled by the DSA-command “Goto Time” to the last received timecode.

3.29 Error code table

Error code (dec, hex)	Meaning
0	No error
2	Focus error, or no disc
7	Subcode error, no valid subcode
8	TOC error, out of lead-in area while reading TOC
10, 0Ah	Radial error
12, 0Ch	Fatal sledge error
13, 0Dh	Turn table motor error
48, 30h	Emergency Stop
31, 1Fh	Search time out
32, 20h	Search binary error
33, 21h	Search index error
34, 22h	Search time error
40, 28h	Illegal command
41, 29h	Illegal value
42, 2Ah	Illegal time value
43, 2Bh	Communication error
44, 2Ch	Reserved
45, 2Dh	HF Detector Error

4. Emergency stop

With the LASER OFF hardware line an emergency stop can be achieved.

When making the LASER OFF line is grounded, the laser will be switched off immediate. Also, all servo's will become inactive.

When the emergency stop becomes active, the DSA command ERROR-VALUE with error-value 'EMERGENCY STOP' will be sent from CD-Module to User Processor.

5. Test Loops command set

Following test loops are available :

1. Play Track 1 & 24 for 10 seconds per track
2. Play Track random for 5 seconds per track
3. Play disc for until lead-out
4. Goto Time random

Enter following DSA commands :

Starting a test loop :

A6h	x	Start testloop number x
A7h	yyh	number of loops MSB
A8h	zzh	number of loops LSB

Testloop x is started for yyzzh times.
If yy and zz are 00, the number of testloops is infinite.

Stopping a test loop :

Give the DSA command STOP.
When an error occurred during a test loop, the loop is stopped automatically.

Asking for the number of loops done :

A5h	xx
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