

PHILIPS LASER OPTICS

Data ~ Strobe ~ Acknowledge

DSA INTERFACE BUS PROTOCOL

VIDEO 7003

Philips Components Division

VIDEO 7003 DSA Interface Bus Description

DRAFT VERSION 0.2

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1. Introduction

1.1. Purpose

This document is the first release that describes the Data Strobe Acknowledge (DSA) interface for VIDEO CD applications.

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

The CD-Module controls the DSA-interface and all servo activities, like play, pause, jumping, reading subcode, etc

The user processor controls the CD-Module via the DSA-interface.

The CD-Module can handle disc types like: Audio, CD-ROM, CD-ROM XA (BRIDGE) and CD-I.

1.2. Scope

This Document is for customers who want to make their own VIDEO CD applications.

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.

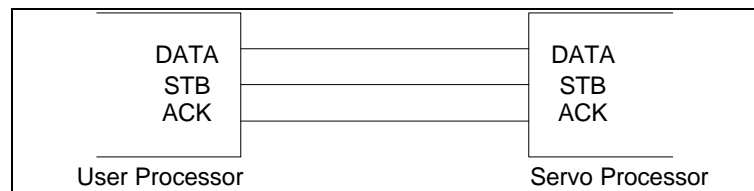
The COMMAND and DATA byte will be sent with MSB first. All the DATA-bytes will be transmitted in HEX-format.

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

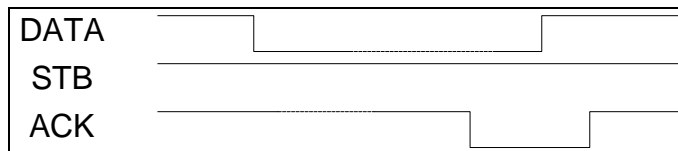
Each data communication consists of three phases:

- | | |
|-----------------------|---|
| g synchronisation | onizes the transmitted and the receiver for a data transmission |
| ansmission | nsmission of all data bits with the help of strobe and acknowledge signals |
| unication acknowledge | iever 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



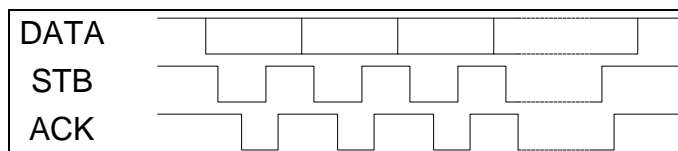
The transmitter clears the data line to let the other side know it wants to transmit some data. Then it is waiting until low level on the ACK line is received as an answer from the receiver which recognised the data transfer request and is ready for it.

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 receiver are ready for the data transfer.

It is possible that both processor want to sent 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 timeout for the transmitter at the beginning of the synchronisation. After the timeout 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'.

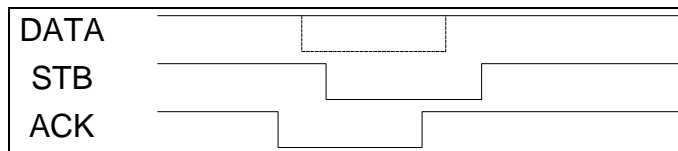
2.3.2. Data transmission



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

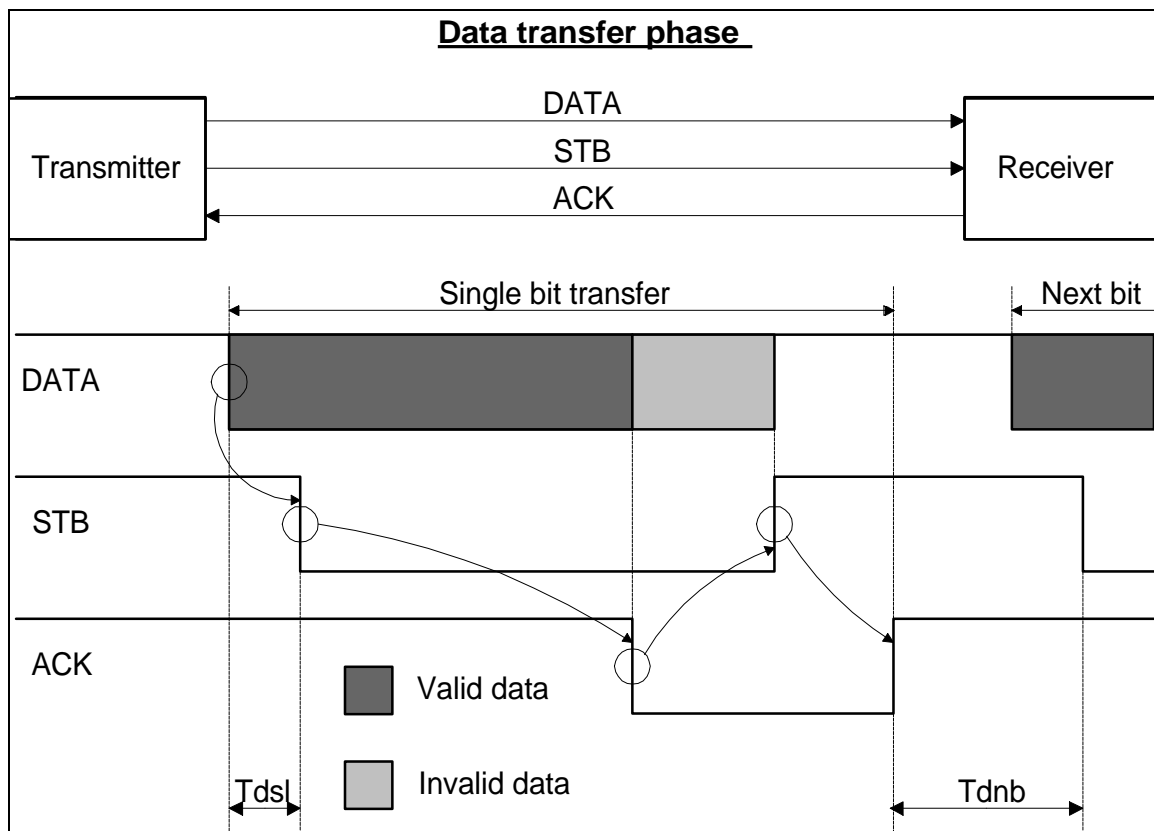
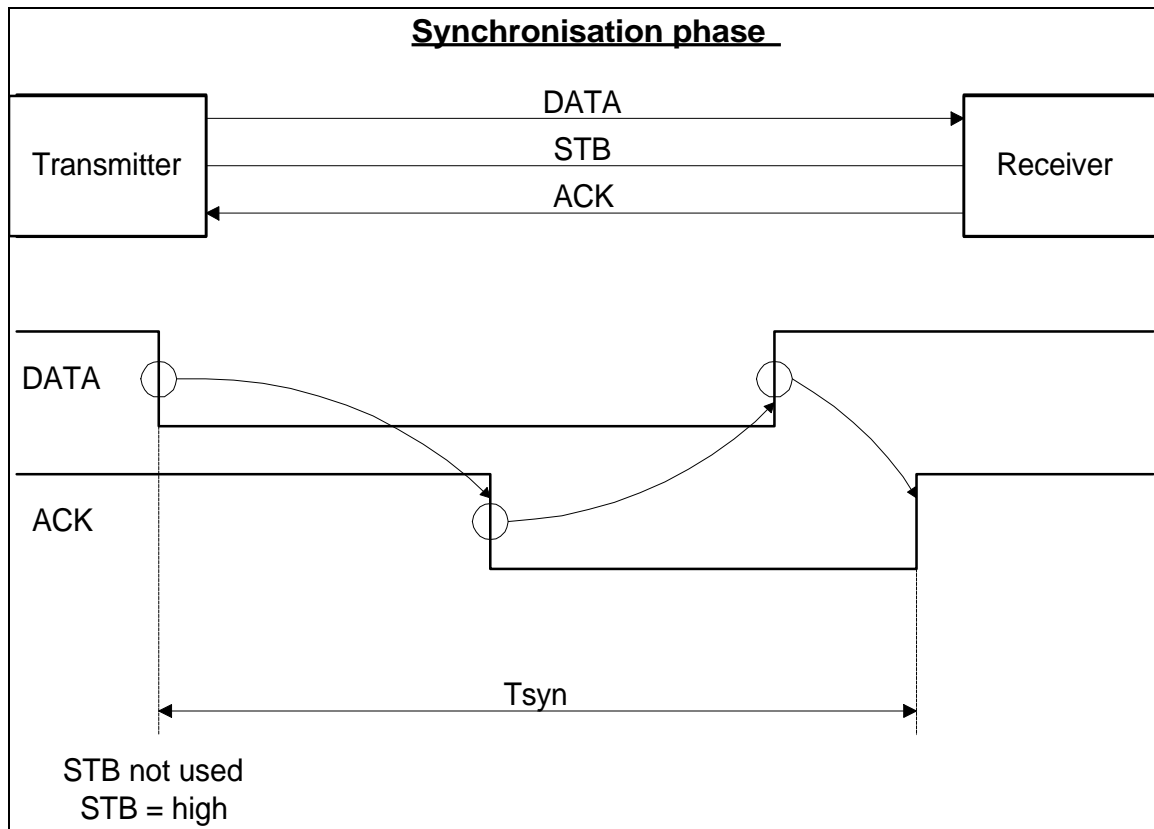


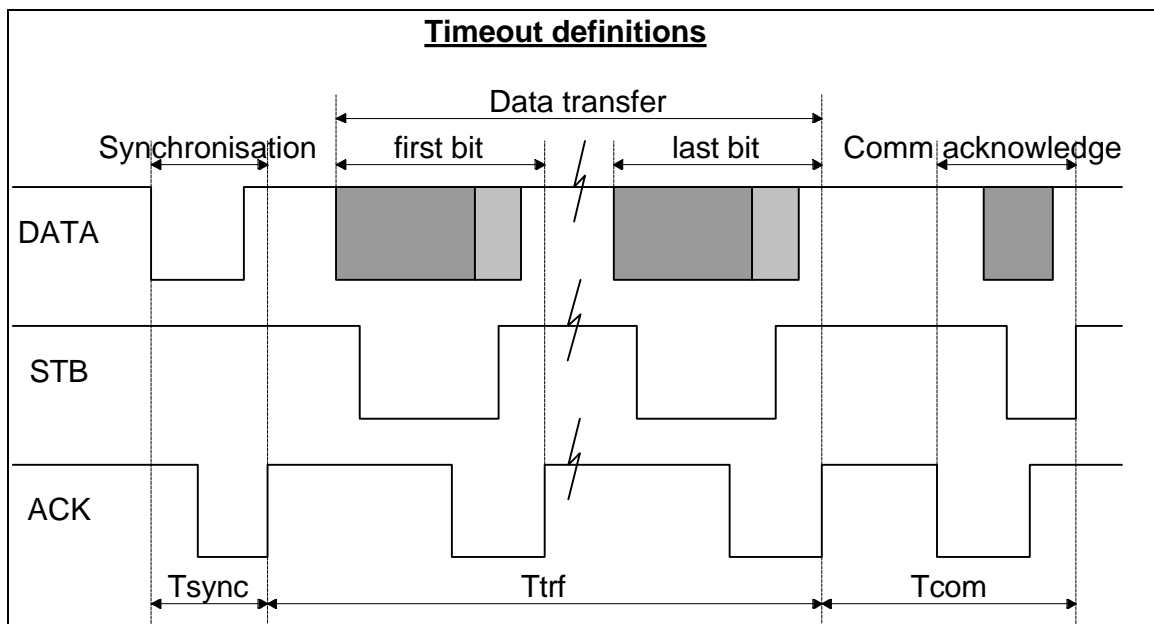
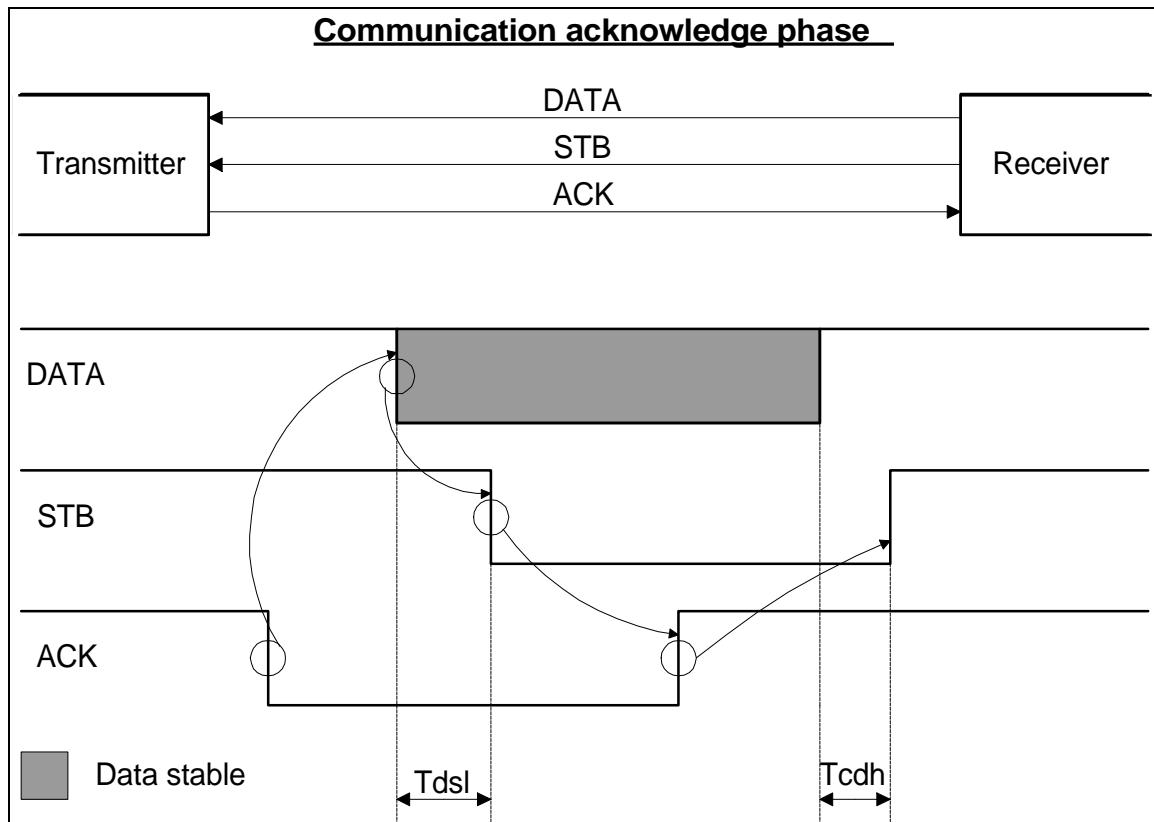
Spikes on the bus can cause the transmitter and the receiver to come out of synchronisation. Therefore, it is necessary to check the synchronisation status after each data transfer. This process is started by the transmitter. When all bits from the transmitter are sent, the transmitter clears the ACK 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 Tcom, 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 timeout	-	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. Command set

Command 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 more DSA command parameters. Each DSA command parameters has one unique opcode followed by the parameter itself.

When a DSA command consists of multiple command parameter 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. 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 command 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 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 the tray is open, just invoke PLAY-TRACK command with value 10 (0Ah).

3.2. 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	Session number (hex)
Pause	servo	04h	xx
Pause Release	servo	05h	xx
Reserved	servo	06h	-
Reserved	servo	07h	-
Reserved	servo	08h	-
Get title	servo	09h	Track number (hex)
Open tray	servo	0Ah	xx
Close tray	servo	0Bh	xx
Get complete time	info	0Dh	xx

Command name	Type	Opcode	Parameter
Goto time	servo	10h	Abs. min. (hex)
		11h	Abs. sec. (hex)
		12h (start)	Abs. frm. (hex)
Read Long TOC	servo	14h	Session number (hex)
Set mode	mode	15h	Mode settings
Get last error	info	16h	xx
Clear error	info	17h	xx
Spin up	servo	18h	Session number (hex)
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
Reserved	info	30h	-
Reserved	-	40h - 44h	-
Get disc status	info	50h	xx
Set volume	mode	51h	Volume level (hex)
Reserved	-	52h	-
Get session info	info	54h	xx
Set DAC mode	mode	70h	DAC mode
Set ROM mode	mode	71h	ROM mode
Rotate carousel clockwise	servo	80h	xx
Rotate carousel anti-clockwise	servo	81h	xx
Reserved	-	A0h - AFh	-
Reserved	-	82h - 83h	-
Reserved	-	C0h - C2h	-
SERVICE COMMANDS			
Service Mode off	servo	F0h	00h
Request Servo Version Number and active Service Mode	servo	F0h	01h
Sledge off	servo	F1h	00h
Sledge outside for 300msec	servo	F1h	01h
Focus off	servo	F2h	00h
Focus on	servo	F2h	01h
Turntable motor off	servo	F3h	00h
Turntable motor on	servo	F3h	01h
Radial off	servo	F4h	00h
Radial on	servo	F4h	01h
COMMANDS FROM SERVO PROCESSOR			
Found	servo	01h	xx
Stopped	servo	02h	xx
Disc status	info	03h	Info on disc and servo status
Error values	info	04h	Error value
		09h	Lsb byte seconds of title (hex)
Length of title	info	0Ah	Msb byte of seconds of title (hex)
Tray moving	servo	0Bh	00h Moving inside 01h moving outside
Tray open	servo	0Ch	xx

Command name	Type	Opcode	Parameter
Tray closed	servo	0Dh	xx
Actual title	servo	10h	New track number (hex)
Actual index	servo	11h	New track 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
Reserved	info	30h	-
		31h	-
		32h	-
		33h	-
		34h	-
Volume level	mode	51h	Volume level (hex)
Reserved	-	52h	-
Session info	info		Number of sessions (hex)
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	-
DAC mode	mode	70h	DAC mode
ROM mode	mode	71h	ROM mode
Carousel moving	servo	80h	Direction of rotation
Carousel stopped	servo	81h	New carousel slot number
Servo Version Number	servo	F0h	Servo version number

xx = don't care

3.3. 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, regardless of the tray status (opened or closed).

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 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 change will be send).

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.

During play (only when the item changes)

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

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

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

Note: Illegal track values while the tray (tray loader) was open, results in the CD-Module (servo) starting to track from the last lead-in area.

3.4. 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 : Stopped 02h / XX

3.5. Read TOC

This command forces the CD-module to read the TOC of the specified session. 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 of that (specified) program area.

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

command : Read TOC 03h / <session number (hex)>

 session number first session is associated with zero

response : TITLE MINIMUM 20h / <minimum Track number>
 TITLE MAXIMUM 21h / <maximum Track number>
 DISC-TIME MIN 22h / <maximum time, minutes>
 DISC-TIME SEC 23h / <maximum time, seconds>
 DISC-TIME FRM 24h / <maximum time, frames>

Note: An illegal session number while tray (tray loader) was open, results in the CD-Module (servo) starting to track from the last program area.

3.6. Read Long TOC

This command forces the CD-module to read the TOC of the CD (single or multisession disc). 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. The first session is associated with value servo.

command : Read long TOC 14h / <session number (hex)>

response : 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 byte)

When: Track number = 64h or 65h or 66h and address = 1

Track number 60h / <64h or 65h or 66h>
Control & address 61h / <control & address field (= y1)>
PMIN 62h / <pmin>
PSEC 63h / <psec >
PFRAM 64h / <pfrm >
(y = control byte)

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

3.7. 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 'dac mode' will be installed. Also, when the CD-ROM mode is selected the last selected rom mode will be installed. The 'dac/rom mode' can be set by the 'Set DAC/ROM mode' commands.

command : Set mode 15h / <mode>

bit Mode

2 - 0 this sets the CD rotation speed
001 = single 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 reserved

7 reserved

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.

3.8. Get last error.

This command requested 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 : Error value 04h / <error value>

3.9. 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 : Error value 04h / <00>

3.10. *Spin up*

This command is used to spin up in the specified session, 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-modules sends the FOUND command.

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

command : Spin up 18h / <session number (hex)>

response : Found 01h / XX

The first session is associated with number zero.

3.11. *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, STOP or the TRAY-OPEN 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 : Found 01h / XX

3.12. *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 : Found 01h / XX

3.13. *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).

This command is only valid for tracks in the first session., this is always the case in audio applications.

command : Get title length 09h / <track number>

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

3.14. *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 : Absolute time minutes 14h / <new minutes>
 Absolute time seconds 15h / <new seconds>
 Absolute time frames 16h / <new frames>

3.15. *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> [0-4Ah]

response : Found 01h / XX

If the absolute time is valid, 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 00 : 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.

3.16. 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 = 10	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)

response :

A-time reached:

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
<u>During play from A-time till B-time (only when the item changes)</u>		
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>
<u>B-time reached</u>		
ATTI = 00	Found	01h / XX
ATTI = 01	Actual abs. minutes	14h / <new minutes>
	Actual abs. seconds	15h / <new seconds>
	Found	01h / XX
ATTI = 10	Actual rel. minutes	12h / <new minutes>
	Actual rel. seconds	13h / <new seconds>
	Found	01h / XX

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

Note: Illegal value while the tray (tray loader) was open, result in the servo starting to track from the last lead-in area.

3.17. 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

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

3.18. 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

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	0 = no multi session disc

	1	= multi session disc
2	0	= not in PAUSE mode
	1	= PAUSE mode
3		reserved
4-5	Current carousel slot number	
	bits	5 4
	0	0 carousel error
	0	1 slot 1
	1	0 slot 2
	1	1 slot 3
6-7		reserved

3.19. 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 : Volume value 51h / <volume value>

3.20. Get session info

This command returns the number of finalised session on the disc.

command : Get session info 54h / XX

response : Session info 54h / <number of session>

3.21. Set DAC mode

This command sets the DAC mode, it will be activated directly when the audio mode is selected (set by 'SET MODE' command) otherwise it will be saved internally.

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

response : DAC mode 70h / <dac mode>

DAC Mode	Description
0	reserved
1	I ² S - FS mode (default)
2	I ² S - 2 FS mode
3	I ² S - 4 FS mode
4	Sony 16 bit FS

DAC Mode	Description
5	Sony 16 bit 2 FS
6	Sony 16 bit 4 FS
7	Sony 18 bit FS
8	Sony 18 bit 2 FS
9	Sony 18 bit 4 FS
10 - 255	reserved

3.22. Set ROM mode

This command sets the ROM mode, it will be activated directly when the rom mode is selected (set by "SET MODE" command) otherwise it will be saved internally.

command : Set ROM mode 71h / <rom mode>

response : ROM mode 71h / <rom mode>

ROM mode	Description
0	reserved
1	I ² S - CD-ROM mode (default)
2	EIAJ CD-ROM mode
3 - 255	reserved

3.23. Service

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
	Service Mode / servo number	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

response :

Response on the REQUEST SERVO VERSION NUMBER command

Servo Version Number	F0h / <Servo Version Number>
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The service commands are explained below :

- *Service Mode Off*

This command switches the service mode off. If the service mode was activated, all servo 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 (with disc loaded) 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.

3.24. Error handing

Whenever an error is detected the CD-module sends the ERROR VALUE command to the User-processor.

If an error is encountered, the command in execution will be terminated.

3.25. 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
46, 2Eh	Carousel error
47, 2Fh	Illegal carousel command
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	Tray error
45, 2Dh	HF Detector error

4. Loader management

This version of DSA is optimised for 3 disc operations. At power up or reset the CD-Module will execute tray-in and rotate carousel to slot 1.

4.1. Open Tray

Player module will activate the tray motor to open the tray. TRAY_MOVING command will be sent once the tray starts moving. If the CD-module is in PLAY mode, it will continue in the current mode. No STOP_PROCEDURE is performed by the CD-module. When the tray has reached its end position, the CD-module sends TRAY_OPEN. If time-out is reached before tray is fully extended, CD-module will send TRAY_ERROR and stops the tray.

command :	Open tray	0Ah / XX	
response :	Tray moving	0Bh / 01h	moving outside
	Tray opened	0Ch / XX	reached outside limit

4.2. Close Tray

Player module will activate the tray motor to close. TRAY_MOVING command will be sent once the tray starts moving. If the CD-module is in PLAY mode, it will continue in the same state. When the tray has reached its end position, the CD-module will send TRAY_CLOSE. If time-out is reached before the tray is fully closed, CD-module will send TRAY_ERROR command and stop the tray motor.

command :	Close tray	0Bh / XX	
response :	Tray moving	0Bh / 00h	moving inside
	Tray Closed	0Dh / XX	tray inside

4.3. Manual Tray Push

When the tray is open and it is pushed it will close. First the DSA command TRAY MOVING is sent and when the tray is in, the DSA command TRAY CLOSED will be sent.

4.4. Rotate carousel clockwise

This command rotates the carousel clockwise (looking from the top) by 1 slot. Once the carousel starts moving clockwise, CAROUSEL_MOVING command is sent. When the carousel has reached the next slot, the CAROUSEL_STOP command is sent along with the new slot number (1, 2 or 3). If time-out is reached before the carousel reached the next slot, CAROUSEL_ERROR is sent and the motor stopped.

command :	Rotate clockwise	80h / 00h	
response :	Carousel moving	80h / XX	
	where	XX = 1 : anticlockwise rotation	
		XX = 2 : clockwise rotation	
	Carousel stopped	81h / slot #	
	where	slot # = 1, 2, or 3	

5. Initialisation

5.1. Power-up sequence

On power-up, the following sequence is executed by the servo processor :

- 1) Initialise all ICs
- 2) Close tray
- 3) Locate carousel slot 1
- 4) Sends DSA command CAROUSEL SLOT #1

The user processor must wait for the CAROUSEL SLOT #1 command before sending any new DSA commands.

5.2. Default settings

Initial power-up settings for all programmable variables are as follows :

- ATTI = 10 : relative time sent
- Single speed setting
- Audio mode
- Error code = 0x00 : No error
- Pause release
- Volume = Full scale
- DAC mode = 1 : I²S - FS mode
- ROM mode = 1 : I²S - CD-ROM mode
- Carousel slot = 1