DVD/CD Rewritable Drive

SERVICE MANUAL

MODEL: GWA-4164B/
GWA-4166B/
GSA-4166B

P/NO : 3828HS1049D

July, 2005
Printed in Korea

MODEL : GWA-4164B/GWA-4166B/GSA-4166B

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CAUTION - INVISIBLE LASER RADIATION WHEN OPEN AVOID EXPOSURE TO BEAM.

INTRODUCTION

This service manual provides a variety of service information.
It contains the mechanical structure of the DVD/CD Rewritable Drive and the electronic circuits in schematic form. This DVD/CD Rewritable Drive was manufactured and assembled under our strict quality control standards and meets or exceeds industry specifications and standards.
This DVD/CD Rewritable drive is an internal drive unit designed for use with IBM PC, HP Vectra, or compatible computer. It can write as much as 700 Mbytes of digital data into CD-R/RW disc, and can read as much as 700 Mbytes of digital data stored in a CD-ROM, CD-R and CD-RW disc.
It can write as much as 4.7Gbytes of digital data into DVD+R/RW disc, and can read as much as 4.7Gbytes of digital data stored in a DVD-ROM, DVD-R, DVD-RW, DVD+R and DVD+RW disc.
This DVD/CD Rewritable Drive can easily meet the upcoming MPC level 3 specification, and its Enhanced Intelligent Device Electronics (E-IDE) and ATAPI interface allows Plug and play integration in the majority of today's PCs without the need of an additional interface card.

GSA-4164B series Design Specfications

- **Write**

	GWA-4164B	GWA-4166B	GSA-4166B
Light Scribe	X	O	O
CD-R	40x w	40x w	**48x w**
CD-RW	32x w	32x w	32x w
DVD-R	16x w	16x w	16x w
DVD-RW	6x w	6x w	**8x w**
DVD-R DL	4x w	4x w	4x w
DVD+R	16x w	16x w	16x w
DVD+RW	8x w	8x w	8x w
DVD+R DL	6x w	6x w	6x w
DVD-RAM	X	X	**5x w**

- **Read**

	GWA-4164B	GWA-4166B	GSA-4166B
CD-ROM	40x	40x	**48x**
CD-R	40x	40x	**48x**
CD-RW	32x	32x	32x
DVD-ROM	16x	16x	16x
DVD-R	10x	10x	**16x**
DVD-RW	8x	8x	8x
DVD-R DL	8x	8x	8x
DVD+R	10x	10x	**16x**
DVD+RW	8x	8x	8x
DVD+R DL	8x	8x	8x
DVD-RAM	X	X	**5x**

FEATURES

1 General

1) Enhanced IDE (ATAPI) interface.
2) Internal Half-height Drive.
3) CD-R/RW, DVD-R/RW/+R/+R DL(Double Layer)/+RW read and write compatible CD Family and DVD-ROM read compatible.
4) Buffer Under-run prevention function embedded.
5) 2MB buffer memory.
6) Power loading and power eject of a disc. Bare media loading.
7) MTBF : 100,000 POH
8) Vertical and Horizontal installable.
9) Support LightScribe Direct Label Printing Technology

2. Supported disc formats

1) Reads data in each CD-ROM, CD-ROM XA, CD-I, Video CD, CD-Extra and CD-Text.
2) Reads data in Photo CD (Single and Multi session).
3) Reads standard CD-DA.
4) Reads and writes CD-R discs conforming to “Orange Book Part 2”.
5) Reads and writes CD-RW discs conforming to “Orange Book Parts 3”.
6) Reads data in each DVD-ROM, DVD-R(Ver.1.0, Ver.2.0 for Authoring).
7) Reads and writes in each DVD-R(Ver.2.0 for General), DVD-RW, DVD+R, DVD+R DL, DVD-R DL and DVD+RW.
8) LightScribe DVD+R conforming to “LightScribe Media Specification”
9) LightScrive CD-R conforming to “LightScribe Media Specification”

3. Supported write method

1) CD-R/RW : Disc at once, Session at Once, Track at once and Packet Write.
2) DVD-R : Disc at Once and Incremental Recording.
3) DVD-RW : Disc at Once, Incremental Recording and Restricted Overwrite.
4) DVD+R : Sequential Recording
5) DVD+R DL(Double Layer)/DVD-R DL(Dual Layer) : Sequential Recording
6) DVD+RW : Random Write
7) LightScribe Label Printing Functions complying with “LightScribe System Specification”

4. Audio

1) 16 bit digital data output through ATA interface.
2) Software Volume Control
3) Equipped with audio line output for audio CD playback.

SPECIFICATIONS

I. MODEL : GWA-4164B

1. SYSTEM REQUIREMENTS

-CPU: IBM Compatible Pentium4 1.6GHz (or faster)
(For High speed, 2GHz or faster recommended.)
-128MB Memory or greater

• SUPPORTING OPERATING SYSTEM

*** Operating System**

Window 98 Second Edition (Not supported in LightScribe)
Windows Millennium Edition(Me) (Not supported in LightScribe)
Window 2000 Professional
Window XP Home Edition, Professional

*** Recording tool**

(1) RecordNow (Sonic)
(2) DLA (sonic)
(3) Nero(Ahead)
(4) In CD(Ahead)
(5) Easy CD Creator (Roxio)
(6) Direct CD (Roxio)

2. GENERAL DESCRIPTION

2.1 Applicable disc formats

DVD	DVD-ROM:	4.7GB (Single Layer)
		8.5GB (Dual Layer)
	DVD-R:	3.95GB (Ver.1.0 : read only)
		4.7GB (Ver.2.0 for Authoring : read only)
		4.7GB (Ver.2.0 for General: read & write)
	DVD-RW:	4.7GB (Ver.1.1)
	DVD+R:	4.7GB
	DVD+R DL:	8.5GB
	DVD+RW:	4.7GB
CD	CD-ROM Mode-1 data disc	
	CD-ROM Mode-2 data disc	
	CD-ROM XA, CD-I, Photo-CD Multi-Session, Video CD	
	CD-Audio Disc	
	Mixed mode CD-ROM disc (data and audio)	
	CD-Extra	
	CD-Text	
	CD-R (Conforming to “Orange Book Part2”: read & write)	
	CD-RW (Conforming to “Orange Book Part3”: read & write)	

2.2 Disc diameter.....120mm
80mm (Horizontal only)

2.3 Data capacity

• User Data/Block DVD-ROM/R/RW/+R/+RW .....2,048 bytes/block
CD (Yellow Book) .....2,048 bytes/block(Mode 1 & Mode 2 Form 1)
2,336 bytes/block (Mode 2)
2,328 bytes/block (Mode 2 Form 2)
2,352 bytes/block (CD-DA)

2.4 RPC (Regional Playback Control) Phase2, **No Region**

3. DRIVE PERFORMANCE

3.1 Host interface X3T13 ATA/ATAPI5/1321D
INF-8090i Rev.5.3

3.2 Read/Write & Rotational speed

<Read>	CD-R/ROM, data/CD-I		17x ~ 40x (CAV), Approx. 8,100r/min
	CD-RW		15x ~ 32x (CAV), Approx. 6,500 r/min
	CD-DA (DAE)		17x ~ 40x (CAV), Approx. 8,100 r/min
	CD-DA (Audio out)/VideoCD		6x ~ 15x (CAV), Approx. 3,130 r/min
	DVD-ROM	Single layer	6.7x ~ 16x (CAV), Approx. 9,420 r/min
		Dual layer	3.3x ~ 8x (CAV), Approx. 5,180 r/min
	DVD-Video(CSS)		3.3x-8x(CAV)
	DVD-R	3.95GB	4.2x ~ 10x (CAV), Approx. 5,950 r/min
		4.7GB	4.2x ~ 10x (CAV), Approx. 5,950 r/min
	DVD-RW	4.7GB	3.3x ~ 8x (CAV), Approx. 4,720 r/min
	DVD+R	4.7GB	4.2x ~ 10x (CAV), Approx. 5,950 r/min
	DVD+R DL	8.5GB	3.3x ~ 8x (CAV), Approx. 4,720r/min
	DVD+RW	4.7GB	3.3x ~ 8x (CAV), Approx. 4,720 r/min

<Write>	CD-R	10x, 16x (CLV), 24x, 40x (CAV)
	CD-RW	4x (CLV), High speed Disc, 10x (CLV) Ultra speed Disc 16x(CLV), 24x(ZCLV), 32x(ZCLV)
	DVD-R	2x, 4x (CLV), 8x (ZCLV)
	DVD-RW	2x, 4x (CLV)
	DVD+R DL	2.4x (CLV)
	DVD+R	2.4x, 4x (CLV), 8x (ZCLV)
	DVD+RW	2.4x, 4x (CLV)
	DVD-R DL	4x(CLV)

* Rotational speed (CLV, ZCLV)

CD-ROM/R/RW	1x: Approx. 500 (Inside) to 210 r/min (Outside)
DVD-R/RW/ROM/+R/RW	1x: Approx. 1,390(Inside) ~ 580 r/min(Outside)

* LightScribe Label Printing

Pixel Resolution	600DPI
Track Resolution	500~1600TPI
Linear Velocity	0.25~0.75m/sec
Laser Power	30~60mW as Objective emission light of 780nm wavelength
Color	Monochrome

3.3 Data transfer rate

3.3.1 Sustained transfer rate

<Read>	CD-ROM/R		2,550 ~ 6,000 kbytes/s (40x) Max.
	CD-RW		2,250 ~ 4,800 kbytes/s (32x) Max.
	CD-DA(DAE)		2,550 ~ 6,000 kbytes/s (40x) Max.
	DVD-ROM	Single layer	9.28 ~ 22.16 Mbytes/s (16x) Max.
		Dual layer	4.58 ~ 11.08 Mbytes/s (8x) Max.
	DVD-R		5.73 ~ 13.85 Mbytes/s (10x) Max.
	DVD-RW		4.58 ~ 11.08 Mbytes/s (8x) Max.
	DVD+R		5.73 ~ 13.85 Mbytes/s (10x) Max.
	DVD+R DL		4.58 ~ 11.08 Mbytes/s (8x) Max.
	DVD+RW		4.58 ~ 11.08 Mbytes/s (8x) Max.
<Write>	CD-R	10x,16x (CLV)	1.5, 2.4 Mbytes/s (Mode-1)
		24x (ZCLV)	1.8 ~ 3.6 Mbytes/s (Mode-1)
		40x(CAV)	2.4 ~ 6.0 Mbytes/s(Mode-1)
	CD-RW	4x, 10x (CLV)	0.6, 1.5 Mbytes/s (Mode-1)
		16x (ZCLV)	1.8 ~ 2.4 Mbytes/s (Mode-1)
		24x (ZCLV)	1.8 ~ 3.6 Mbytes/s (Mode-1)
		32x(ZCLV)	1.8 ~ 4.8 Mbytes/s (Mode-1)
	DVD-R	2x, 4x(CLV), 8x(ZCLV)	2.77, 5.44, 5.44~11.08 Mbytes/s
	DVD-RW	1x, 2x, 4x(CLV)	1.38, 2.77, 5.44 Mbytes/s
	DVD+R	2.4x, 4x(CLV)	3.32, 5.54 Mbytes/s
		8x(ZCLV)	5.44~11.08 Mbytes/s
	DVD-R DL	4x (CLV)	5.44 Mbytes/s
	DVD+R DL		2.4x (CLV) 5.54Mbytes/s
	DVD+RW	2.4x, 4x (CLV)	3.32, 5.54 Mbytes/s

3.3.2 Burst transfer rate

Ultra DMA Mode 2	33.3 Mbytes/s Max.
Multiword DMA Mode 2	16.6 Mbytes/s Max.
PIO Mode 4	16.6 Mbytes/s Max.

3.4 Access time (Random)

* Typical value

DVD-ROM(SL)	140 ms Typ. (Note 1)
DVD-ROM(DL)	175 ms Typ. (Note 1)
CD-ROM	120 ms Typ. (Note 1)

Note :

1) Average random access time is the typcal value of more than 50 times including latency and error correction time.

Test Disc : DVD : ALMEDIO TDV-520 / TDR-820

CD : ALMEDIO TCDR-701 / HITACH HCD-1

**) Typical value defines a measured value in normal temperature (20 deg.C.) and horizontal position.*

3.5 Data error rate (Measured with 5 retries maximum)

DVD-R/RW/ROM	$<10^{-12}$
DVD+R/RW	$<10^{-12}$
CD-ROM/R/RW	$<10^{-12}$ (Mode-1)
	$<10^{-9}$ (Mode-2)

Condition : It is assumed that the worst case raw error rate of the disc is 10^{-3}

3.6 Data buffer capacity 2Mbytes

3.7 LightScribe Label Printing

* Note (1) DRF Parameters for this spec : LV=250mm/sec, TrackShift=85, Laser Power=34mW

3.7.1 Printing Time

1070TPI * 12cm Entire Disc.....less than 36 minutes
800TPI * 12cm Entire Disc.....less than 28 minutes
530TPI * 12cm Entire DIsc .....less than 20 minutes

3.7.2 Image Contrast complying to the colorimetry standard CIE L*a*b, defined as Delta L(ΔL)

1070TPI * LS CD-R Media (973423 : 795973).....higher than 28
800TPI * LS CD-R Media (973423 : 795973).....higher than 20
530TPI * LS CD-R Media (973423:795973).....higher than 12

4. Quality and Reliability

4.1 MTBF.....125,000 Power On Hours(Consecutive/Cumulative POH)
Assumption : .....Used in a normall office environment at room temperature.
-POH per year.....3,000
-ON/OFF cycles per year.....600
-Operating duty cycle.....20% of power on time (Seek: 5% of operating time)

4.2 Tray cycle test.....30,000 times
No degeneration in the mechanical part after test

4.3 Actuator mechanism.....1,000,000 full stroke seek

4.4 MTTR (Mean Time To Repair) .....0.5 h

4.5 Component life .....5 years or 2,000 h of Laser radiating time
Assumption : .....Used in a normall office environment.

5. POWER REQUIREMENTS

5.1 Source voltage

+5V ± 5% tolerance, less than 100 mVp-p Ripple voltage
+12V ± 10% tolerance, less than 100 mVp-p Ripple voltage

5.2 Current

Idle (Hold track state).....	+5V DC	0.6A Typ.	< 1.0 A Max.
	+12V DC	0.5A Typ.	< 1.0 A Max.
Write (Active)	+5V DC	0.9A Typ.	< 1.3 A Max.
	+12V DC	0.5A Typ.	< 1.2 A Max.
Read (Active).....	+5V DC	0.6A Typ.	< 1.2 A Max.
	+12V DC	0.6A Typ.	< 1.2 A Max.
Seek (Acess)	+5V DC	0.7A Typ.	< 1.2 A Max.
	+12V DC	1.0A Typ.	< 1.8 A Max.
Label Printing	+5V DC	0.7A typ.	< 1.0 A max.
	+12V DC	0.3A typ.	< 0.5 A max.

5.3 Standby

Sleep mode (No disc) .....2.5 W Typ. 3.0 W Max.

6. AUDIO PERFORMANCE

	Item	Typical	Test Signal	Test Condition	Note
AUDIO OUT	**Output Level**	0.7 Vrms	1KHz 0 dB	No Filter	at 47kΩ
	Frequency response	+/-3dB	20-20kHz 0dB		
	THD	0.1%	1KHz 0 dB	with IHF-A + 20KHz LPF	
Headphone output level(Optional)		-	-	-	None

7. Acoustic noise

Less than 50dB, A scale, at 0.5 m away from the drive

Note : 1. Disc : Less than unbalance 0.3 $x10^{-4}$ Nm
2. Installation : Horizontal
3. Ambient temperature : Normal temperature
4. Except loading, unloading and seek

8. Dimensions

External dimensions (W x H xD)	146x41.3x184.7mm
Front bezel (WxHxD)	148x42x5 mm

9. Mass .....880g+/-10g(net)

*** Please Contact the friendly staff of LG Service Care at: Website http: //www.LGEservice.com**

SPECIFICATIONS

II. MODEL : GWA-4166B

1. SYSTEM REQUIREMENTS

-CPU: IBM Compatible Pentium4 1.6GHz (or faster)
(For High speed, 2GHz or faster recommended.)
-128MB Memory or greater

• SUPPORTING OPERATING SYSTEM

*** Operating System**

Window 98 Second Edition (Not supported in LightScribe)
Windows Millennium Edition(Me) (Not supported in LightScribe)
Window 2000 Professional
Window XP Home Edition, Professional

*** Recording tool**

(1) RecordNow (Sonic)
(2) DLA (sonic)
(3) Nero(Ahead)
(4) In CD(Ahead)
(5) Easy CD Creator (Roxio)
(6) Direct CD (Roxio)

2. GENERAL DESCRIPTION

2.1 Applicable disc formats

DVD	DVD-ROM:	4.7GB (Single Layer)
		8.5GB (Dual Layer)
	DVD-R:	3.95GB (Ver.1.0 : read only)
		4.7GB (Ver.2.0 for Authoring : read only)
		4.7GB (Ver.2.0 for General: read & write)
	DVD-RW:	4.7GB (Ver.1.1)
	DVD+R:	4.7GB
	DVD+R DL:	8.5GB
	DVD+RW:	4.7GB
CD	CD-ROM Mode-1 data disc	
	CD-ROM Mode-2 data disc	
	CD-ROM XA, CD-I, Photo-CD Multi-Session, Video CD	
	CD-Audio Disc	
	Mixed mode CD-ROM disc (data and audio)	
	CD-Extra	
	CD-Text	
	CD-R (Conforming to “Orange Book Part2”: read & write)	
	CD-RW (Conforming to “Orange Book Part3”: read & write)	

2.2 Disc diameter 120mm
80mm (Horizontal only)

2.3 Data capacity

• User Data/Block
DVD-ROM/R/RW/+R/+RW .....2,048 bytes/block
CD (Yellow Book) .....2,048 bytes/block(Mode 1 & Mode 2 Form 1)
2,336 bytes/block (Mode 2)
2,328 bytes/block (Mode 2 Form 2)
2,352 bytes/block (CD-DA)

2.4 RPC (Regional Playback Control) Phase2, **No Region**

3. DRIVE PERFORMANCE

3.1 Host interface X3T13 ATA/ATAPI5/1321D
INF-8090i Rev.5.3

3.2 Read/Write & Rotational speed

<Read>	CD-R/ROM, data/CD-I		17x ~ 40x (CAV), Approx. 8,100r/min
	CD-RW		15x ~ 32x (CAV), Approx. 6,500 r/min
	CD-DA (DAE)		17x ~ 40x (CAV), Approx. 8,100 r/min
	CD-DA (Audio out)/VideoCD		6x ~ 15x (CAV), Approx. 3,130 r/min
	DVD-ROM	Single layer	6.7x ~ 16x (CAV), Approx. 9,420 r/min
		Dual layer	3.3x ~ 8x (CAV), Approx. 5,180 r/min
	DVD-Video(CSS)		3.3x ~ 8x (CAV)
	DVD-R	3.95GB	4.2x ~ 10x (CAV), Approx. 5,950 r/min
		4.7GB	4.2x ~ 10x (CAV), Approx. 5,950 r/min
	DVD-RW	4.7GB	3.3x ~ 8x (CAV), Approx. 4,720 r/min
	DVD+R	4.7GB	4.2x ~ 10x (CAV), Approx. 5,950 r/min
	DVD+R DL	8.5GB	3.3x ~ 8x (CAV), Approx. 4,720r/min
	DVD+RW	4.7GB	3.3x ~ 8x (CAV), Approx. 4,720 r/min
<Write>	CD-R		10x, 16x (CLV), 24x, 40x (CAV)
	CD-RW		4x (CLV), High speed Disc, 10x (CLV) Ultra speed Disc 16x(CLV), 24x(ZCLV), 32x(ZCLV)
	DVD-R		2x, 4x (CLV), 8x (ZCLV), 12x, 16x(CAV)
	DVD-RW		1x, 2x, 4x (CLV), 6x (ZCLV)
	DVD+R DL		2.4x (CLV), 6x, 8x
	DVD+R		2.4x, 4x (CLV), 8x (ZCLV), 12x, 16x (CAV)
	DVD+RW		2.4x, 4x, 8x (CLV)
	DVD-R DL		4x(CLV)

* Rotational speed (CLV, ZCLV)

CD-ROM/R/RW	1x: Approx. 500 (Inside) to 210 r/min (Outside)
DVD-R/RW/ROM/+R/RW	1x: Approx. 1,390(Inside) ~ 580 r/min(Outside)

* LightScribe Label Printing

Pixel Resolution	600DPI
Track Resolution	500~1600TPI
Linear Velocity	0.25~0.75m/sec
Laser Power	30~60mW as Objective emission light of 780nm wavelength
Color	Monochrome

3.3 Data transfer rate

3.3.1 Sustained transfer rate

<Read>	CD-ROM/R		2,550 ~ 6,000 kbytes/s (40x) Max.
	CD-RW		2,250 ~ 4,800 kbytes/s (32x) Max.
	CD-DA(DAE)		2,550 ~ 6,000 kbytes/s (40x) Max.
	DVD-ROM	Single layer	9.28 ~ 22.16 Mbytes/s (16x) Max.
		Dual layer	4.58 ~ 11.08 Mbytes/s (8x) Max.
	DVD-R		5.73 ~ 13.85 Mbytes/s (10x) Max.
	DVD-RW		4.58 ~ 11.08 Mbytes/s (8x) Max.
	DVD+R		5.73 ~ 13.85 Mbytes/s (10x) Max.
	DVD+R DL		4.58 ~ 11.08 Mbytes/s (8x) Max.
	DVD+RW		4.58 ~ 11.08 Mbytes/s (8x) Max.

<Write> CD-R .....10x,16x (CLV) .....1.5, 2.4 Mbytes/s (Mode-1)
24x (ZCLV).....1.8 ~ 3.6 Mbytes/s (Mode-1)
40x(CAV).....2.4 ~ 6.0 Mbytes/s(Mode-1)
CD-RW.....4x, 10x (CLV) .....0.6, 1.5 Mbytes/s (Mode-1)
16x (ZCLV).....1.8 ~ 2.4 Mbytes/s (Mode-1)
24x (ZCLV).....1.8 ~ 3.6 Mbytes/s (Mode-1)
32x (ZCLV).....1.8 ~ 4.8 Mbytes/s (Mode-1)
DVD-R.....2x, 4x(CLV), 8x(ZCLV)....2.77, 5.44, 5.44~11.08 Mbytes/s
12x, 16x (CAV).....8.91~16.62 Mbytes/s
8.91~22.16 Mbytes/s
DVD-R dual .....4x(CLV) .....5.44 Mbytes/s
DVD-RW.....1x, 2x, 4x(CLV).....1.38, 2.77, 5.44 Mbytes/s
DVD+R.....2.4x, 4x(CLV) .....3.32, 5.54 Mbytes/s
8x(ZCLV).....5.44~11.08 Mbytes/s
12x, 16x (CAV).....8.91~16.62Mbytes/s
8.91~22.16Mbytes/s
DVD+R DL .....2.4x (CLV) .....5.54 Mbytes/s
6x .....8.28 Mbytes/s
8x .....5.44~11.08 Mbytes/s
DVD+RW.....2.4x, 4x (CLV) .....3.32, 5.54 Mbytes/s

3.3.2 Burst transfer rate

Ultra DMA Mode 2.....33.3 Mbytes/s Max.
Multiword DMA Mode 2.....16.6 Mbytes/s Max.
PIO Mode 4.....16.6 Mbytes/s Max.

3.4 Access time (Random)

* Typical value

DVD-ROM(SL) .....140 ms Typ. (Note 1)
DVD-ROM(DL).....175 ms Typ. (Note 1)
CD-ROM .....120 ms Typ. (Note 1)

Note :

1) Average random access time is the typcal value of more than 50 times including latency and error correction time.

Test Disc : DVD : ALMEDIO TDV-520 / TDR-820

CD : ALMEDIO TCDR-701 / HITACH HCD-1

**) Typical value defines a measured value in normal temperature (20 deg.C.) and horizontal position.*

3.5 Data error rate (Measured with 5 retries maximum)

DVD-R/RW/ROM...$<10^{-12}$
DVD+R/RW .....$<10^{-12}$
CD-ROM/R/RW .....$<10^{-12}$ (Mode-1)
$<10^{-9}$ (Mode-2)

Condition : It is assumed that the worst case raw error rate of the disc is 10^{-3}

3.6 Data buffer capacity 2Mbytes

3.7 LightScribe Label Printing

* Note (1) DRF Parameters for this spec : LV=250mm/sec, TrackShift=85, Laser Power=34mW

3.7.1 Printing Time

1070TPI * 12cm Entire Disc.....less than 36 minutes
800TPI * 12cm Entire Disc.....less than 28 minutes
530TPI * 12cm Entire DIsc .....less than 20 minutes

3.7.2 Image Contrast complying to the colorimetry standard CIE L*a*b, defined as Delta L(ΔL)

1070TPI * LS CD-R Media (973423 : 795973).....higher than 28
800TPI * LS CD-R Media (973423 : 795973).....higher than 20
530TPI * LS CD-R Media (973423:795973).....higher than 12

4. Quality and Reliability

4.1 MTBF.....125,000 Power On Hours(Consecutive/Cumulative POH)
Assumption : .....Used in a normall office environment at room temperature.
-POH per year.....3,000
-ON/OFF cycles per year.....600
-Operating duty cycle.....20% of power on time (Seek: 5% of operating time)

4.2 Tray cycle test.....30,000 times
No degeneration in the mechanical part after test

4.3 Actuator mechanism .....1,000,000 full stroke seek

4.4 MTTR (Mean Time To Repair) .....0.5 h

4.5 Component life .....5 years or 2,000 h of Laser radiating time
Assumption : .....Used in a normall office environment.

5. POWER REQUIREMENTS

5.1 Source voltage

+5V ± 5% tolerance, less than 100 mVp-p Ripple voltage
+12V ± 10% tolerance, less than 100 mVp-p Ripple voltage

5.2 Current

Idle (Hold track state).....	+5V DC	0.6A Typ.	< 1.0 A Max.
	+12V DC	0.5A Typ.	< 1.0 A Max.
Write (Active)	+5V DC	0.9A Typ.	< 1.3 A Max.
	+12V DC	0.5A Typ.	< 1.2 A Max.
Read (Active).....	+5V DC	0.6A Typ.	< 1.2 A Max.
	+12V DC	0.6A Typ.	< 1.2 A Max.
Seek (Acess)	+5V DC	0.7A Typ.	< 1.2 A Max.
	+12V DC	1.0A Typ.	< 1.8 A Max.
Label Printing.....	+5V DC	0.7A typ.	< 1.0 A max.
	+12V DC	0.3 A typ.	< 0.5 A max.

5.3 Standby

Sleep mode (No disc) .....2.5 W Typ. 3.0 W Max.

6. AUDIO PERFORMANCE

	Item	Typical	Test Signal	Test Condition	Note
AUDIO OUT	**Output Level**	0.7 Vrms	1KHz 0 dB	No Filter	at 47kΩ
	Frequency response	+/-3dB	20-20kHz 0dB		
	THD	0.1%	1KHz 0 dB	with IHF-A + 20KHz LPF	
Headphone output level(Optional)		-	-	-	None

7. Acoustic noise

Less than 50dB, A scale, at 0.5 m away from the drive

Note : 1. Disc : Less than unbalance 0.3 x10^{-4} Nm
2. Installation : Horizontal
3. Ambient temperature : Normal temperature
4. Except loading, unloading and seek

8. Dimensions

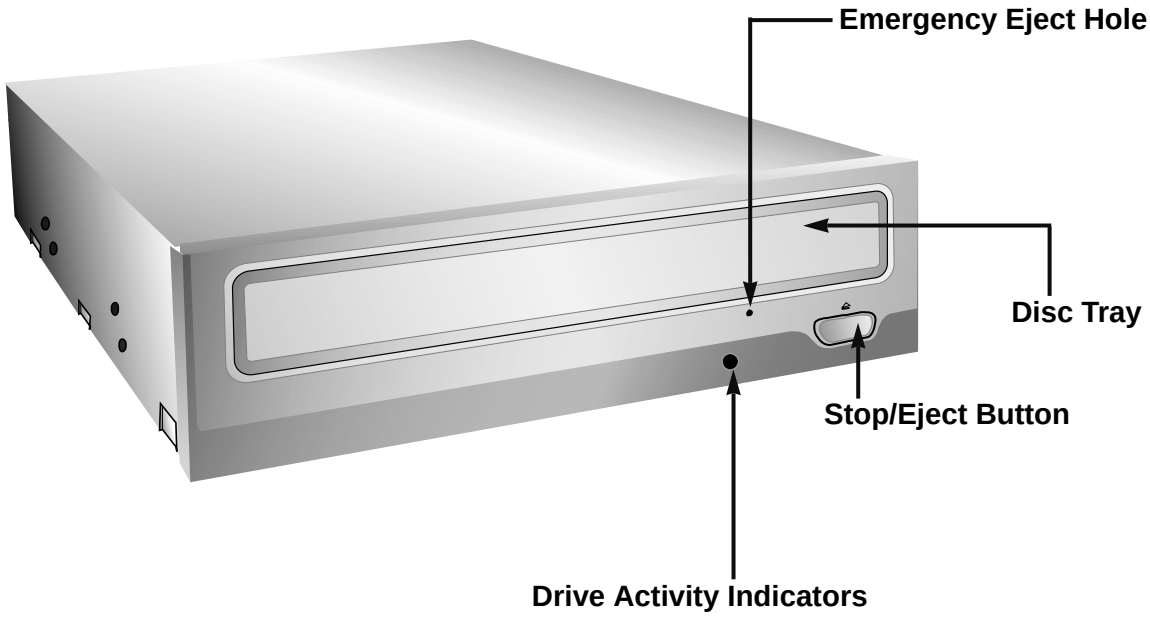
External dimensions (W x H xD)	146x41.3x184.7mm
Front bezel (WxHxD)	148x42x5 mm

9. Mass .....880g+/-10g(net)

*** Please Contact the friendly staff of LG Service Care at: Website http: //www.LGEservice.com**

LOCATION OF CUSTOMER CONTROLS

Front Panel



1. **Disc tray**

   This is the tray for the disc. Place the disc on the ejected disc tray, then lightly push the tray (or push the eject button) and the CD will be loaded.

   NOTE: Don't pull out or push in the disc tray forcibly. This might cause damage to the loading section of the drive.

2. **Stop/Eject button**

   This button is pressed to open the CD tray.
   This button works only when power is supplied to the drive.

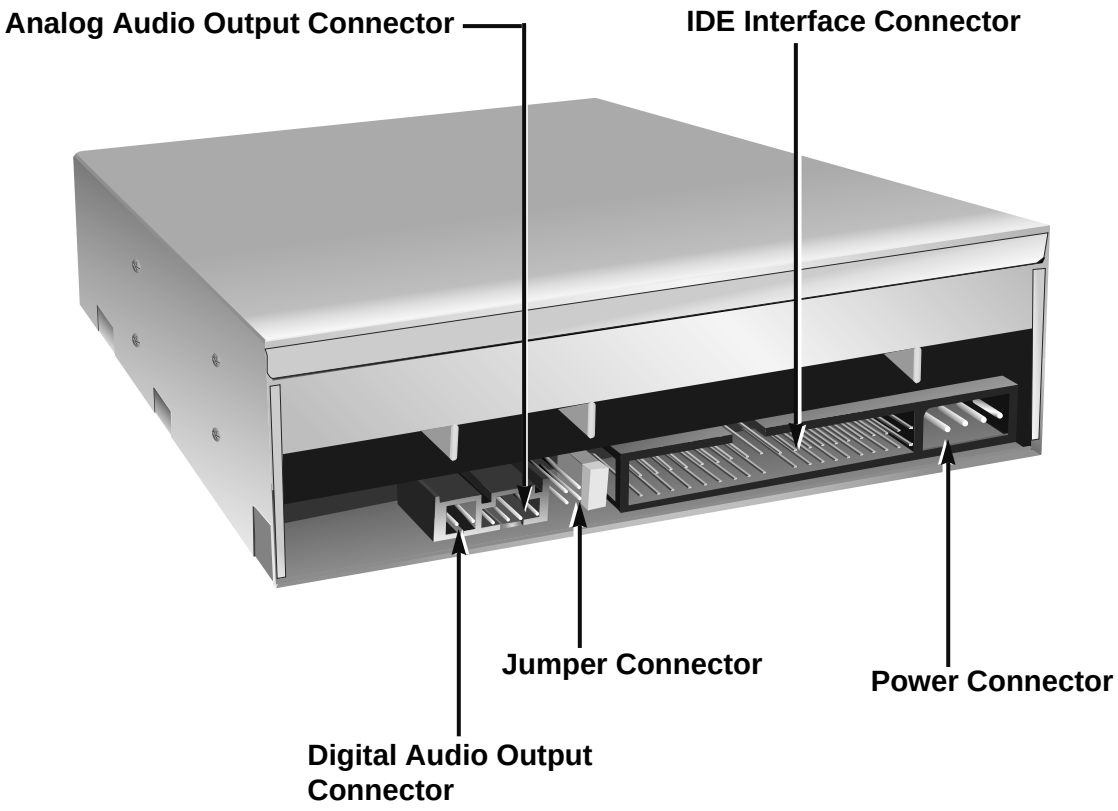
3. **Emergency Eject Hole**

   Insert a paper clip here to eject the Disc tray manually or when there is no power.

4. **Drive activity indicator**

   Green colored LED is used to indicate the operation of the Drive.

Rear Panel



1. Power Connector

Connects to the power supply (5-and 12-V DC) of the host computer.

NOTE : Be careful to connect with the proper polarity. Connecting the wrong way may damage the system (and is not guaranteed). Usually this connector can only be attached one-way.

2. IDE Interface Connector

Connect to the IDE (Integrated Device Electronics) Interface using a 40-pin flat IDE cable.

NOTE : Do not connect or disconnect the cable when the power is on, as this could cause a short circuit and damage the system. Always turn the power OFF when connecting or disconnecting the cable.

3. Jumper Connector

This jumper determines whether the drive is configured as a master or slave. Changing the master-slave configuration takes effect after power-on reset.

4. Analog Audio Output Connector

Provides output to a sound card (analog signal). Generally you need this to play a regular audio CD.

5. Digital Audio Output Connector

This connector is not supported.

DISASSEMBLY

1. CABINET and CIRCUIT BOARD DISASSEMBLY

1-1. Bottom Chassis

A. Release 4 screws (A) and remove the Bottom Chassis in the direction of arrow (1). (See Fig.1-1)

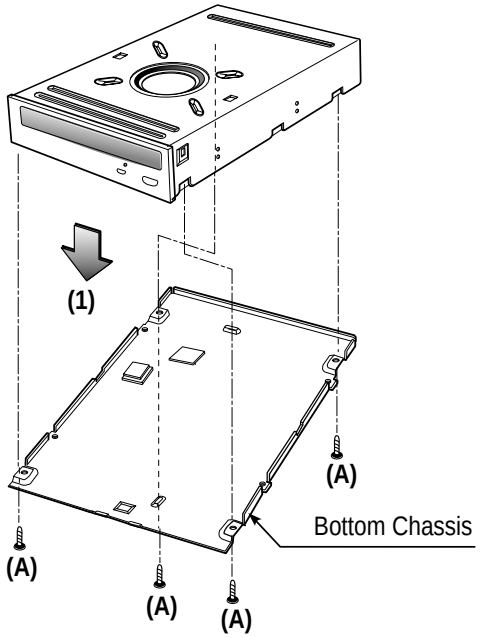


Fig. 1-1

1-2. Front Bezel Assy

A. Insert and press a rod in the Emergency Eject Hole and then the CD Tray will open in the direction of arrow (2).
B. Remove the Tray Door in the direction of arrow (3) by pushing the stoppers forward.
C. Release 3 stoppers and remove the Front Bezel Assy.

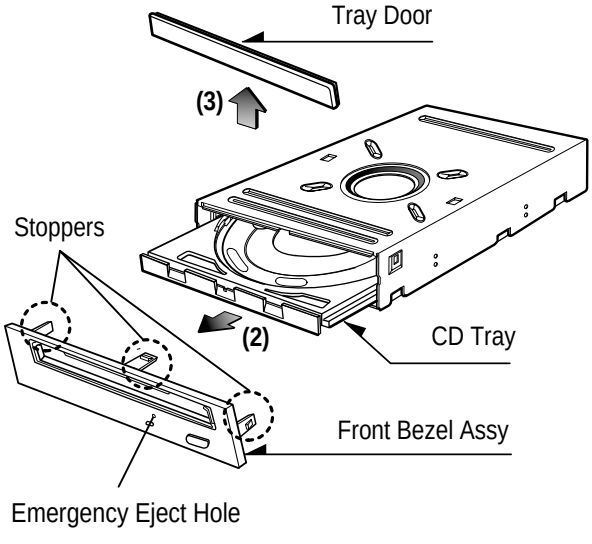


Fig. 1-2

1-3. Cabinet and Main Circuit Board

A. Remove the Cabinet in the direction of arrow (4). (See Fig. 1-3)
B. When the CD tray has been opened completely, lift 2 points (a) and remove the CD tray while drawing out simultaneously.
C. Remove the Soldering of the LD- and LD+ (b) for the Loading Motor, and then remove the Main Circuit Board.
D. At this time, be careful not to damage the 5 connectors of the Main Circuit Board.

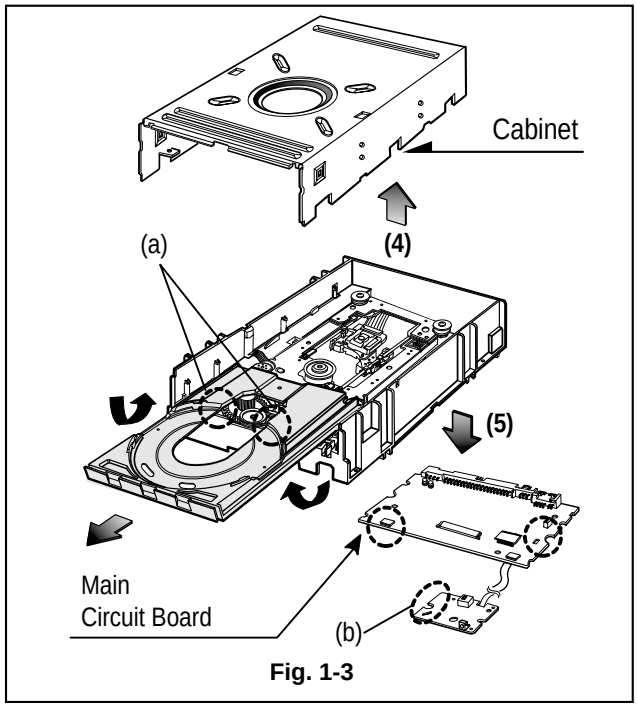


Fig. 1-3

2. MECHANISM ASSY DISASSEMBLY

2-1. Pick-up Unit

A. Release screws (B).
B. Separate the Pick-up Unit in the direction of arrow (6).

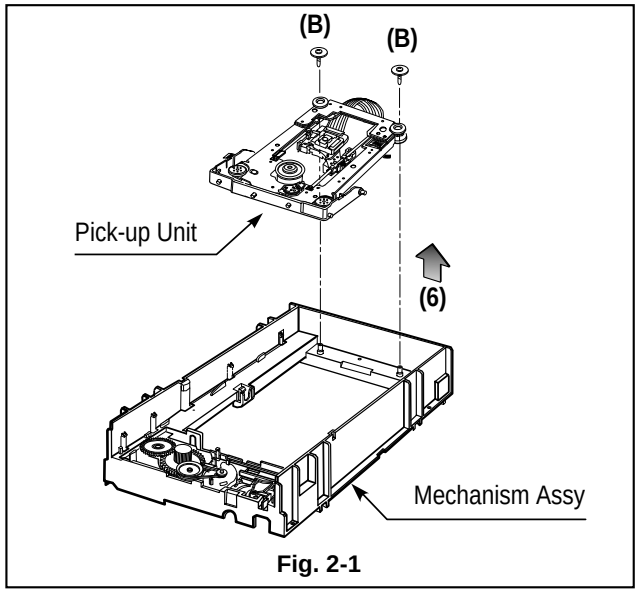


Fig. 2-1

2-2. Pick-up

A. Release 1 screw (C) and remove the Pick-up.

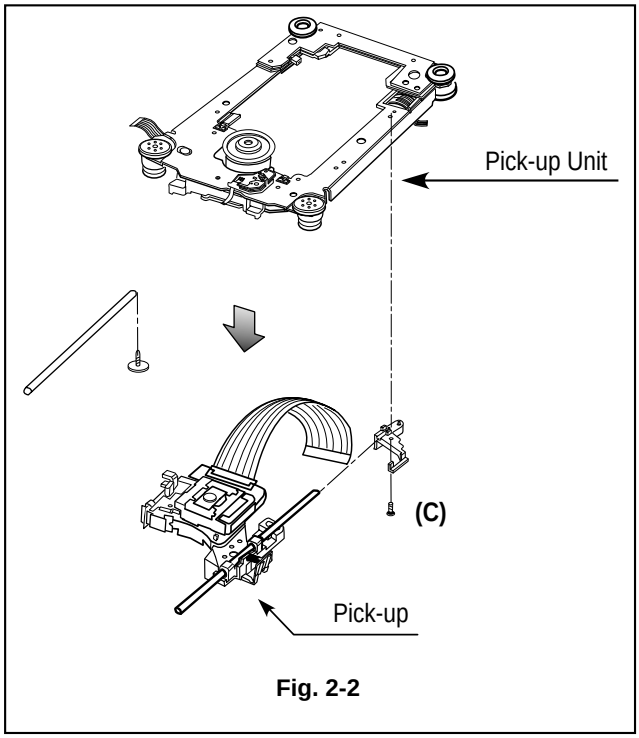
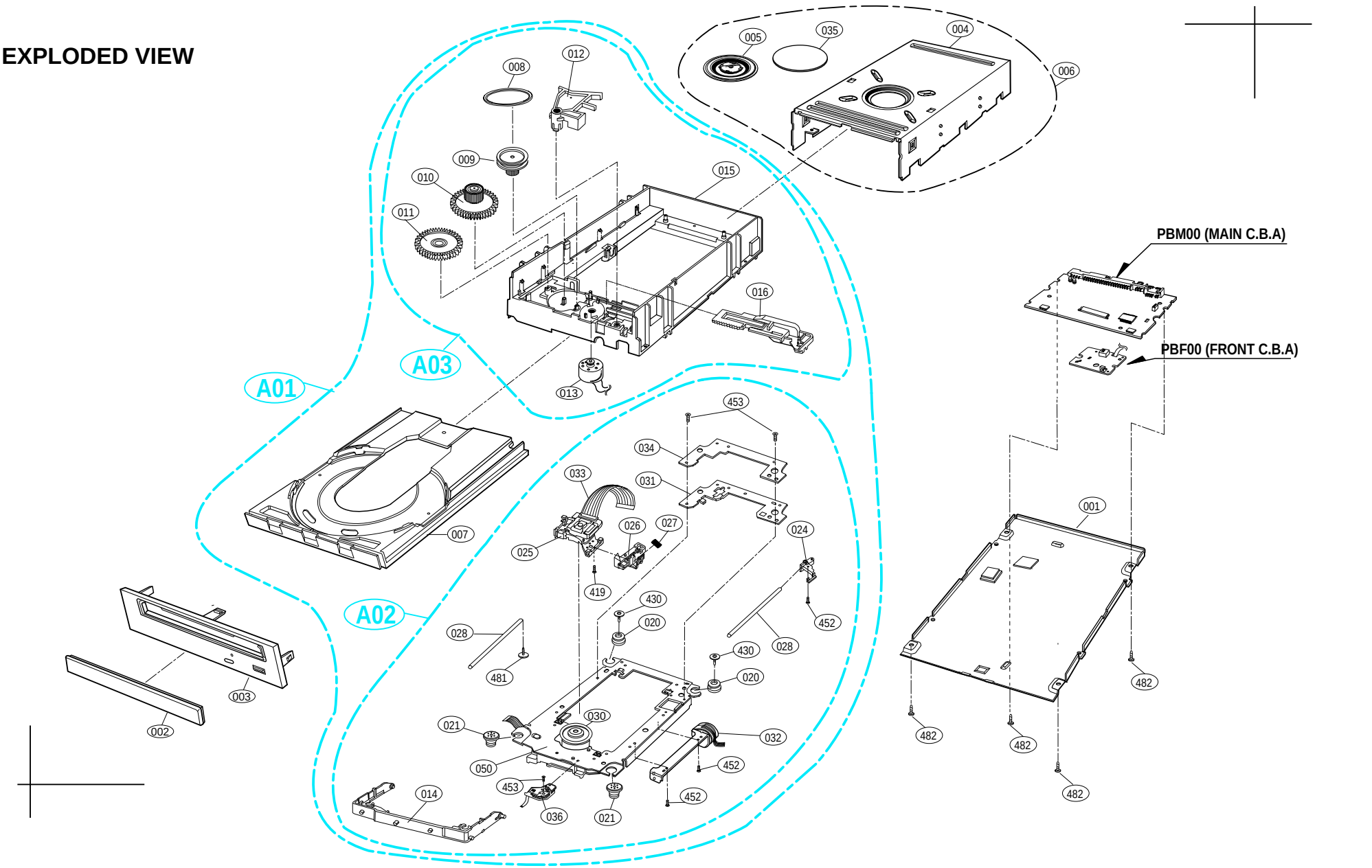


Fig. 2-2

EXPLODED VIEW



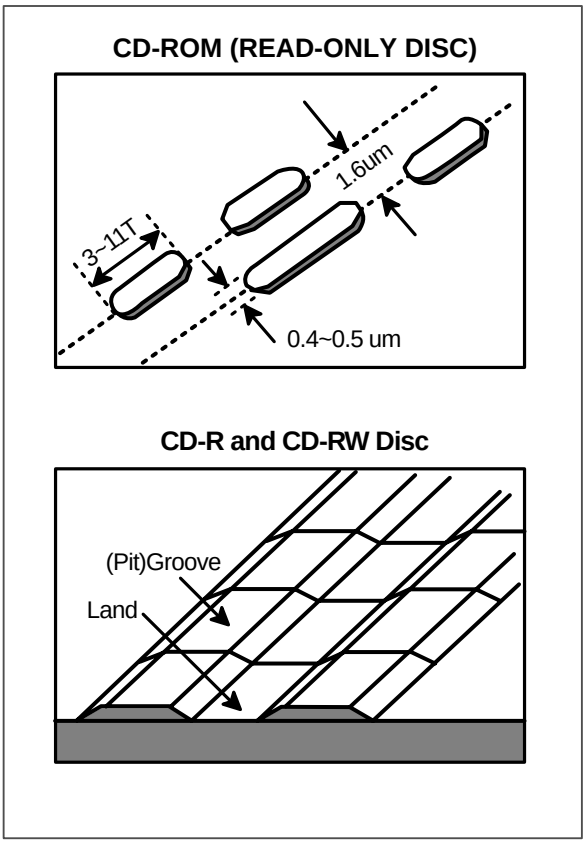
GLOSSARY

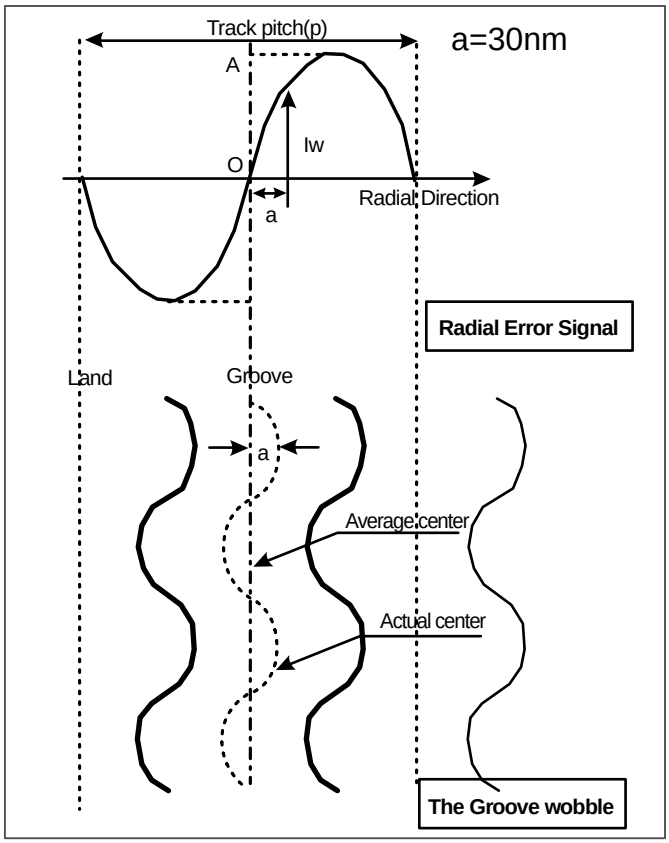
ATIP	Absolute Time in Pre-groove. With an additional modulation of the “Wobble”, the “Groove” contains a time code information.
Wobble	The pre-groove in the Disc is not a perfect spiral but is wobbled. With : – A typical amplitude of 30 nm – A spatial peried of 54~64 µm
CW	Continuous Wave. The laser light output is at a constant level.
DOW	Direct Over-Write. The action in which new information is recored over previously recorded information in CD-RW disc.
Overwrite	The action in which new information is recorded over previously recorded information.
(Pre-)Groove	The guidance track in which clocking and time code information is stored by means of an FM modulated wobble.
Land	Land is characterized in the following way: When radial signals are concerned,land is defined as the area between the grooves. When HF signal are concerned,land is defined as the area between the marks(pits) in tangential direction.
Hybrid Disc	A Multisession disc of which the first Session is mastered. On a hybrid disc, recorded and mastered information may co-exist.
Mastered Information	Information,stored as pits on the disc during the manufacturing process of the disc. (when making the master)
OPC	Optimum Power Control. Procedure is determined optimum recording power according to CD-R/RW Media in recording start step.
ROPC	Running OPC. The purpose is to continuously adjust the writing power to the optimum power that is required. When the optimum power may change because of changed conditions of disc and change in operating temperature.
Jitter	The 16 value of the time variation between leading and trailing edges of a specific (I3 … I11) pit or land as measured by Time Interval Analysis.
Deviation	The difference between a fixed value of Pit length and Land length.
TOC	Table Of Contents : in the Lead-in Area the subcode Q-channel contains information about the Tracks on the disc.
Packet Writing	A method of writing data on a CD in small increments. Two kinds of packets can be written : Fixed-length and Variable-length.
Write Strategy	The shape of the HF write signal used to modulate the power of the laser. The Write Strategy must be used for recordings necessary for disc measurements.
Information Area	Wobble, ATIP, Disc Identification, Write Power, Speed Range OPC Parameters, etc are recorded in the Information area of CD-RW Disc
Finalization	The action in which (partially) unrecorded or logically erased tracks are finished and the Lead-in and/or Lead-out areas are recorded or overwritten with the appropriate TOC subcode.
Logical Erase	A method to remove information from a disc area by overwriting it with an EFM signal containing mode 0 subcode A logically erased area is equivalent to an unrecorded
Physical Erase	The action in which previously recorded information is erased by overwriting with a CW laser output. After a Physical Erase action, the erased area on the CD-RW disc is in the unrecorded state again.
Session	An area on the disc consisting of a Lead-in area, a Program area, a lead-out area.
Multi session	A session that contains or can contain more than one session composed Lead-in and Lead-out

The differences of CD-R/CD-RW discs and General CD-ROM

1. Recording Layer

Recordable CD has a wobbled pre-groove on the surface of disc for laser beam to follow track.





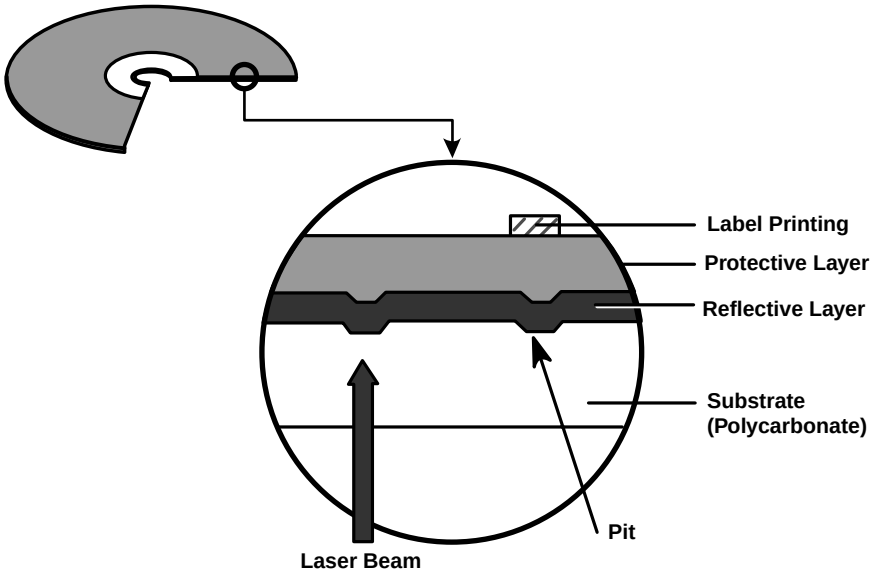
2. Disc Specification

ITEM	CD-ROM	CD-R	CD-RW
Standard	Yellow Book	Orange Book II	Orange Book III
Record	Not available	Write once	Re-Writeable
Tracking Signal I11/Itop (HF Modulation)	> 0.6	> 0.6	0.55 > M_{11}> 0.70
Read Laser Power(mW)	< 0.5 mW	< 0.7 mW	< 1.0 mW
Jitter	< 35 nsec	< 35 nsec	< 35 nsec
Reflectivity (R_{top})	70 %	65 %	15 % ~ 25 %
Remark) Write Laser Power(mW)		14-65 mW	6-45 mW

3. Disc Materials

1) CD-ROM disc

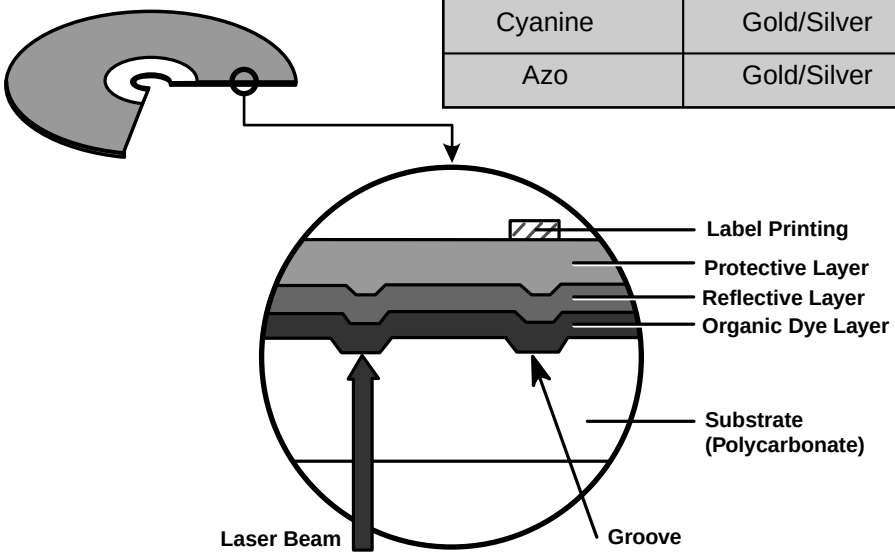
- It is composed of Silver _ colored aluminum plate and Reflective layer.
- Groove (Pit) of aluminum plate make a track.
- Laser wavelength : 780 nm, Laser Power (Read): 0.5mW
- Signal is detected by the difference of reflective beam intensity between “pit” and “Land” on the disc.



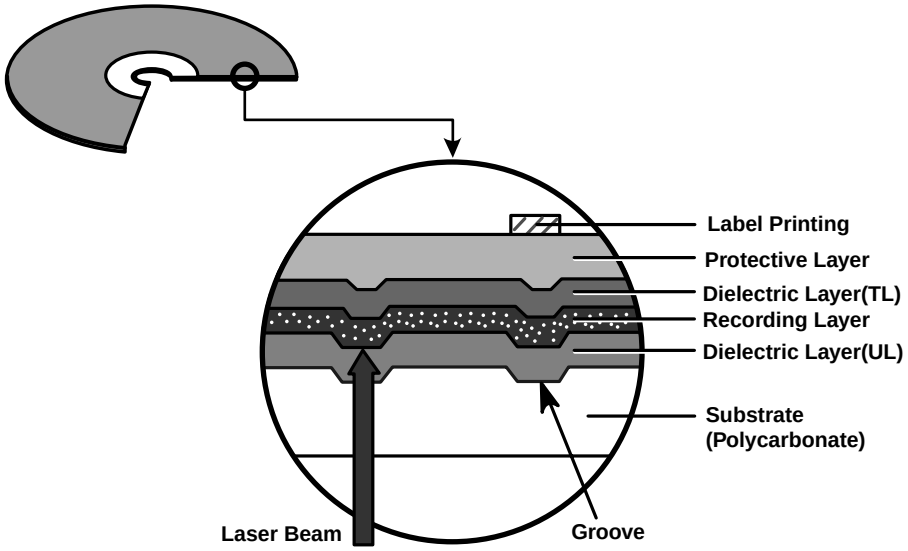
2) CD-R disc

- It is so-called WORM (Write Once Read Many) CD.
- It is composed of polycarbonate layer, Organic dye layer, Reflective layer, and Protective layer.Gold/Silver Reflective layer is used to enhance the reflectivity
- According to the kinds of Organic dye layer, it is divided by Green CD, Gold CD, Blue CD.
- Laser Wavelength : 780 nm, Laser Power (read) : 0.7 mW
- Recording Power : 8x(14~20mW), 16x(25~35mW)
- When some part of dye layer is exposed to laser heat, it’s color changs black.Therefore, writing and reading is enabled by the difference of reflectivity between changed part and unchanged part.
- Polycarbonate layer has Pre_Groove which make a Track.

Pigment	Reflective Layer	Color
Phtalocyanine	Gold/Silver	Yellow/White
Cyanine	Gold/Silver	Dark Green/Bright Green
Azo	Gold/Silver	Dark Blue

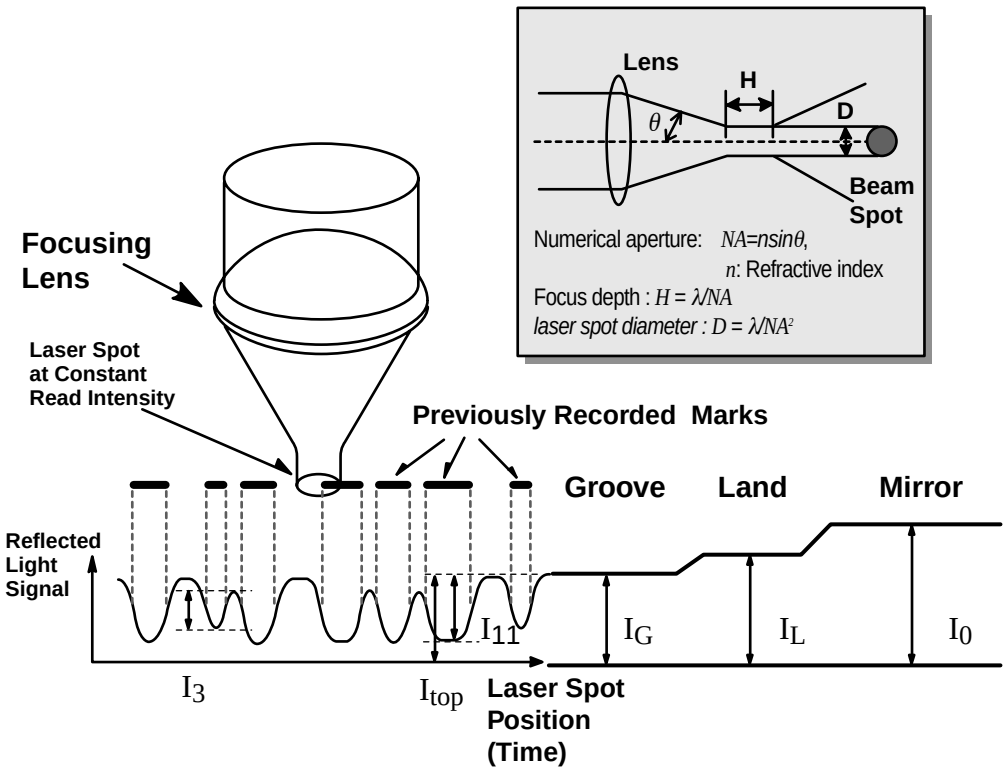


3) CD-RW Disc

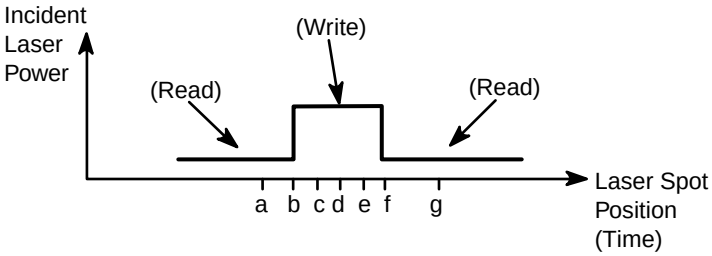


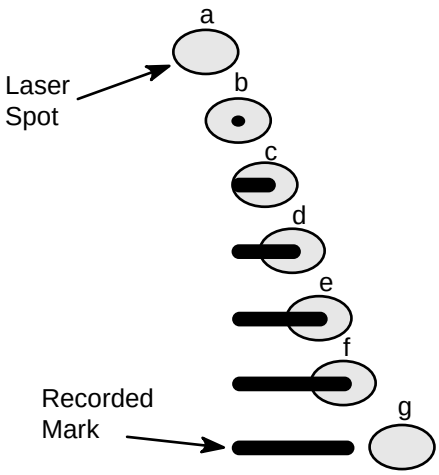
- It is composed of polycarbonate layer, alloy(silver, arsenic) layer, aluminum reflectivity layer, protective layer.
- An crystalized alloy layer is transformed into noncrystalized by the laser heat. Therefore, writing and reading is enabled by the difference of reflectivity.
- It is possible to overwrite about 1000 times.
- Laser Wavelength : 780 nm, Laser Power (Read) : 1.0mW
- Recording Power : Erase (4~18mW), Write (6~45mW)
- When disc rewriting, new data is overwritten previously recorded data.
- Polycarbonate layer has a Pre-Groove which make a track.

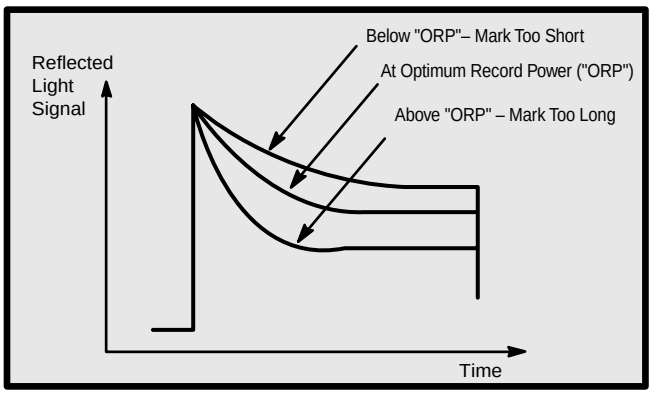
4. Reading process of Optical Disc

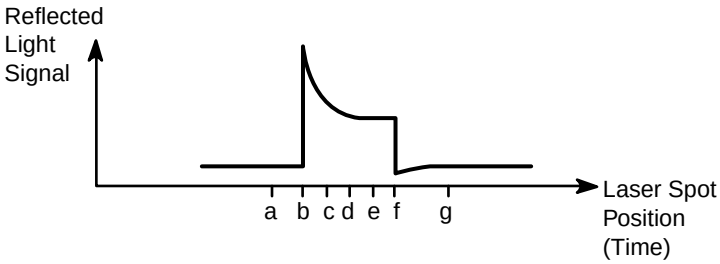


5. Writing Process of CD-R Disc

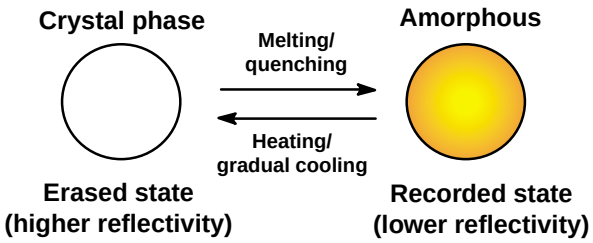


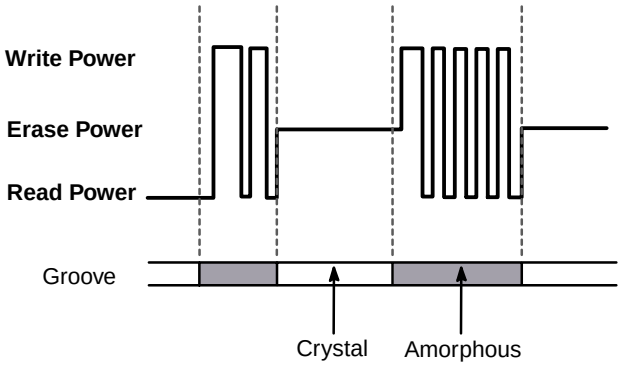






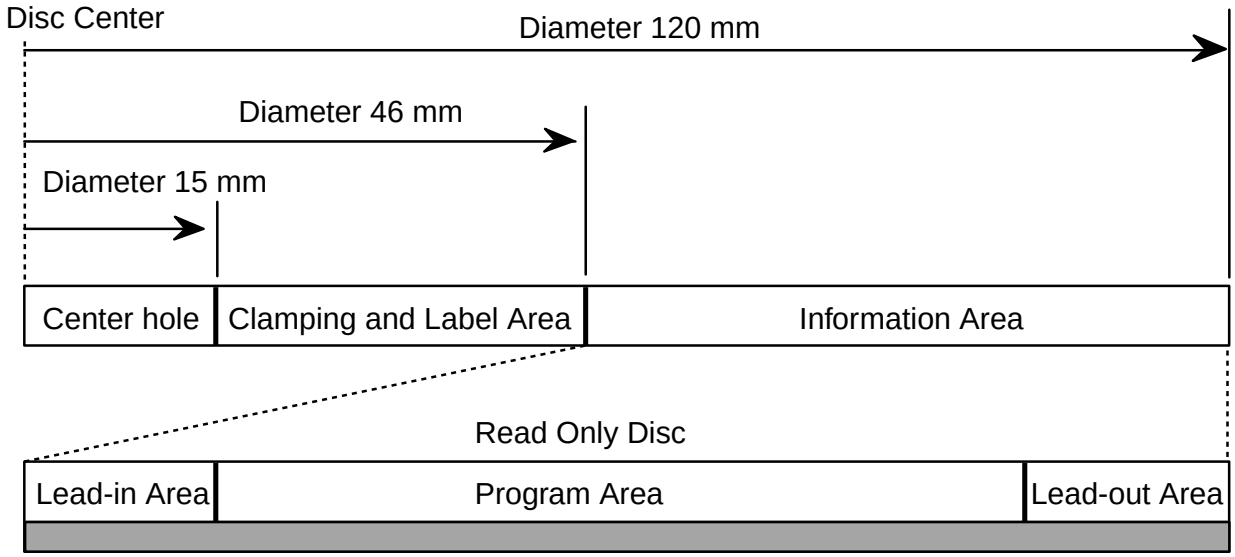
6. Writing process of CD-RW Disc



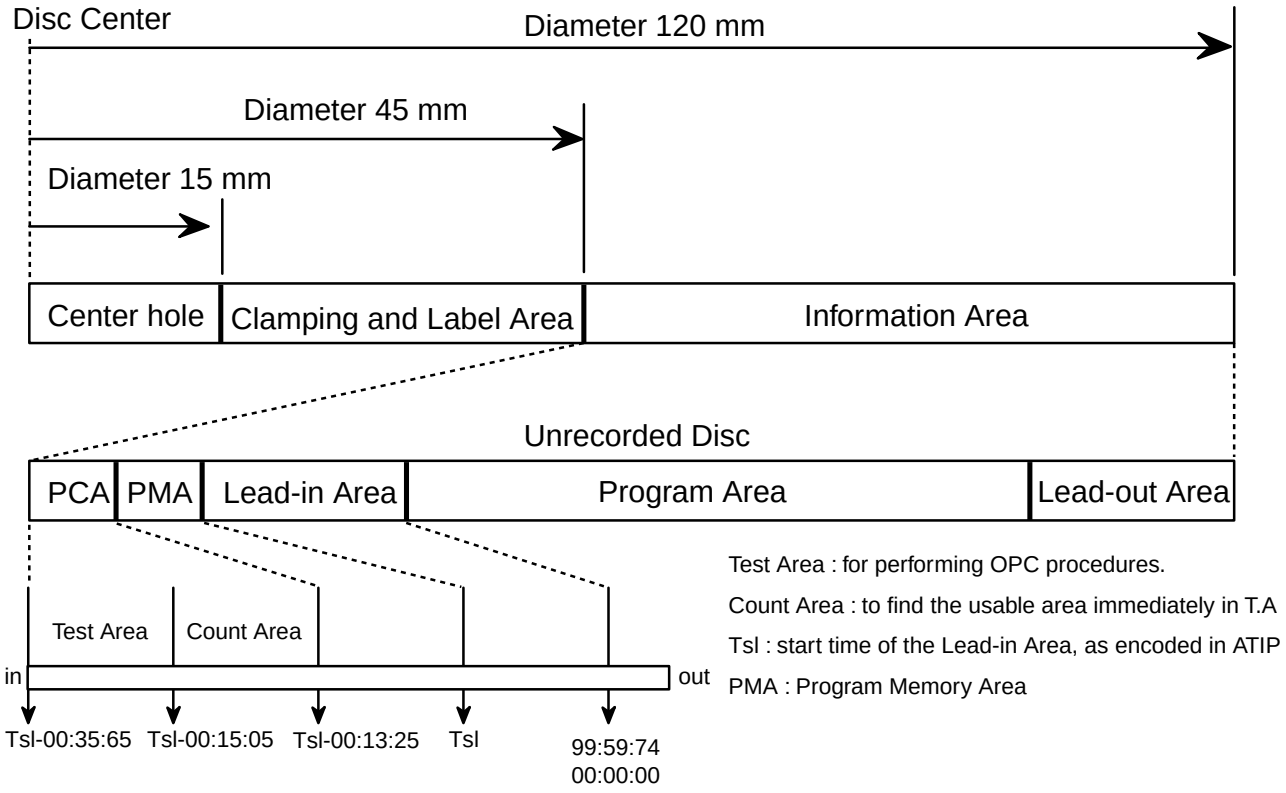


7. Organization of the PCA, PMA and Lead-in Area

1) Layout of CD-ROM disc



2) Layout of CD-R/RW disc



8. Function of PCA and PMA area

1) PCA (Power Calibration Area)

- PCA area is used to determine the correct Laser Power for a disc.
  - Method 1 : PCA area is divided by a track.
  - Method 2 : The previous Calibration value is referred.
  - Method 3 : ROPC is used to determine Laser Power value automatically in data writing.
- CD-R Disc can write maximum 99 Tracks but CD-RW Disc can write unlimited tracks because it has a rewritable function.

2) PMA (Program Memory Area)

- It has a track information (track No, track Start/End time) of every track before writing completed.
  - PMA area has the last written point and the next writable point of a disc.
  - In case of CD to CD copy, some writer may not write PMA area.

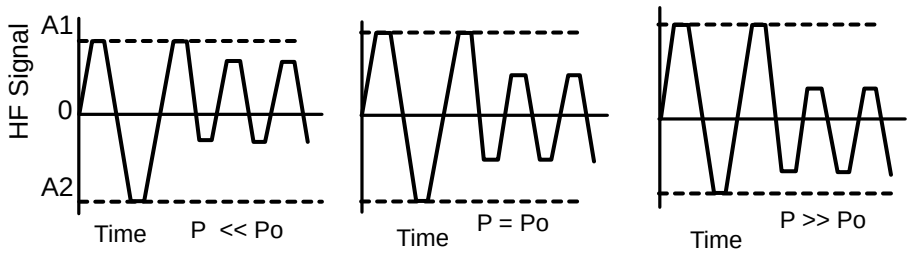
* When Disc is Finalized,
PMA information is transferred to the Lead_In area so that general Driver can read it.

* Because PCA and PMA area exist before Lead-In area, General CD Player or CD-ROM Drive can't read these areas.

9. OPC and ROPC

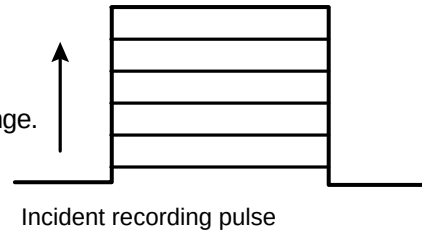
1) OPC (Optimum Power Control)

- This is the first step of writing process, because CD writer has its own laser power value and media have different writing characteristics,
  - This is determined by the Writing characteristic, speed, temperature, and humidity.
  - Laser wavelength is determined by the environmental temperature (775~795nm) and Optical Laser Power is determined by the test and retry.
- Asymmetry and optimum writing Power
  - EFM signal Asymmetry is determined by the writing power.
    Therefore, Optical Power which has the same value to the preset power value can be estimated by measuring HF signal Asymmetry on the PCA area.
- Measurement of Asymmetry
  * Parameter setting (Beta) : Using AC coupled HF signal before equalization
  Beta = (A1+A2)/(A1-A2)



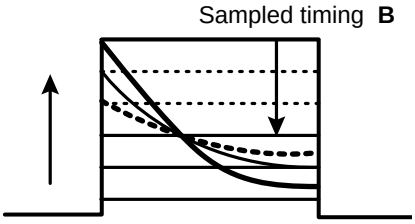
2) ROPC (Running Optimum Power Control)

- Variable primary factor of Optimum Power
  - – Change of Power sensitivity on the Disc. (limited to 0.05 *Po)
  - – Wavelength shift of the laser diode due to the operating temperature change.
  - – Change of the Spot aberration due to the Disc skew, Substrate thickness, Defocus.
  - – Change of Disc or Optics conditions due to the long term OPC
    ==> It is necessary to adjust continuously to obtain the Optimum Power.

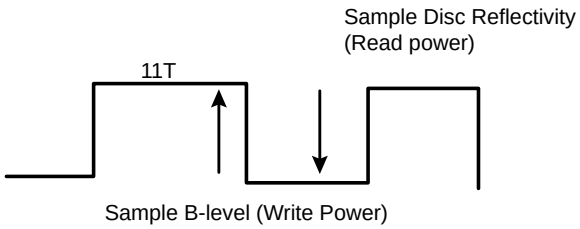


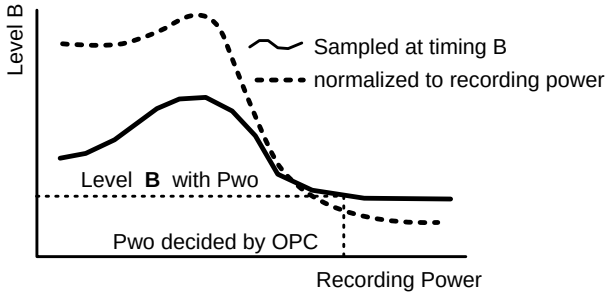
Incident recording pulse

- Principle of Running OPC
  - – To meet the factors mentioned above, a horizontal _ direction movement of a curve is uesd.
  - – Beta = *f*(B-level) = constant on the Recorded Disc
  - – Procedure of ROPC
    - a. Reference B-level is determined during OPC Procedure.
    - b. During Recording, B-level value is controlled to have a close Reference B-level value.
    - c. Normalization of B-level is used to eliminate the effect of reflectivity fluctuation.
      ==> The reflected B-level value is normalized by the disc reflectivity itself.

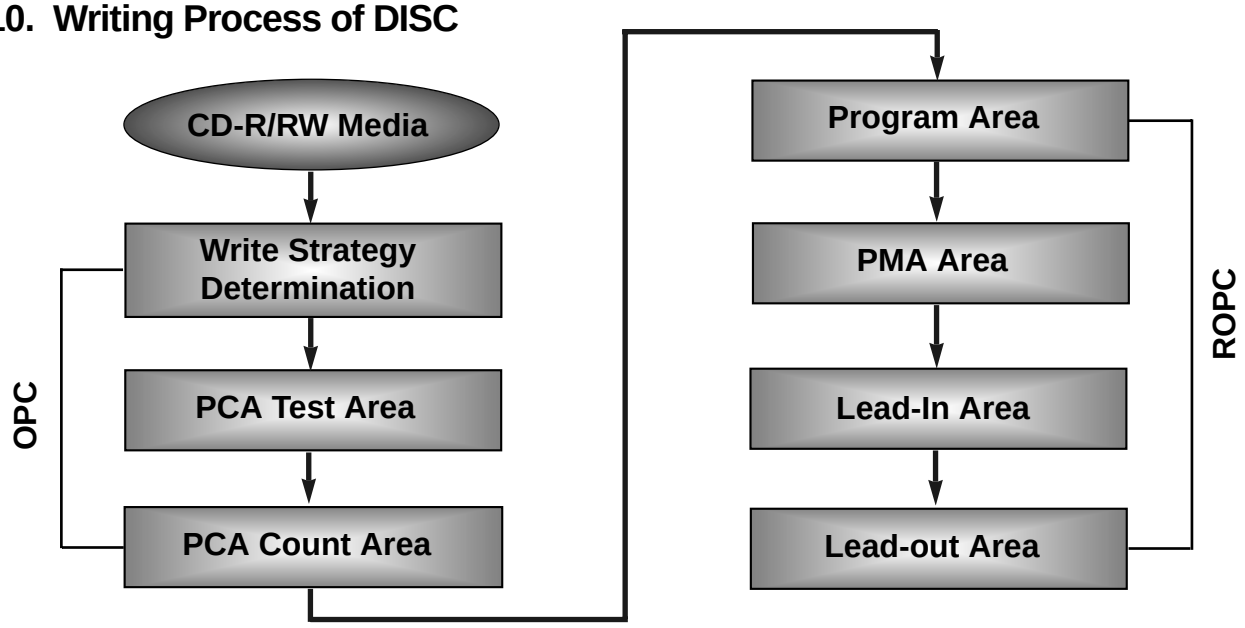


Reflected recording pulse





10. Writing Process of DISC



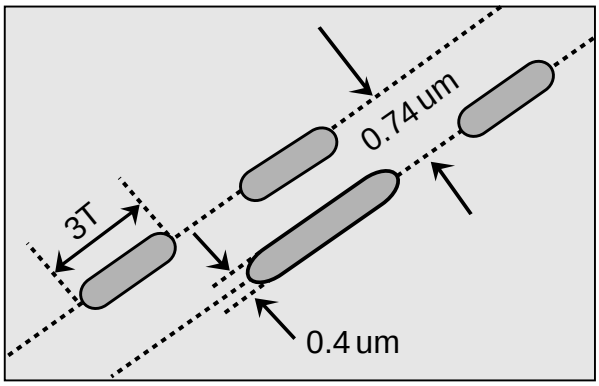
*** Recording Capacity of CD-R/RW (74Minute Recording media)**

- (2048 Byte/Sector) X (75 Sector/Second) X (60 Second/Minute) X 74 Minute
  = 681,984,000 Bytes = 682 Mbytes
- But the actual recording capacity is about 650 Mbytes. (according to the ISO 9660 standard, approximately 30 Mbytes are used to make directory structure and volume names.)

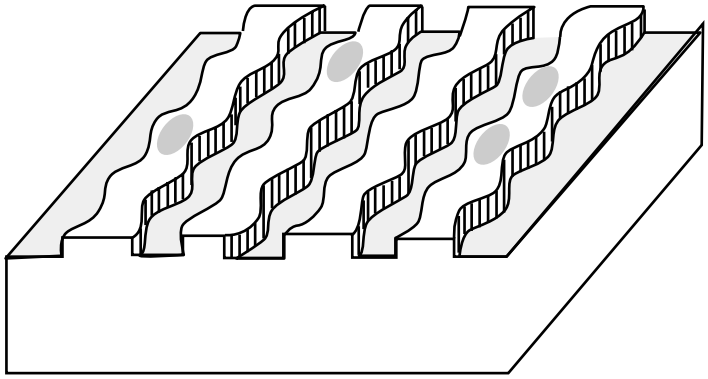
The differences of DVD-R/RW, DVD+R/RW discs and DVD-ROM

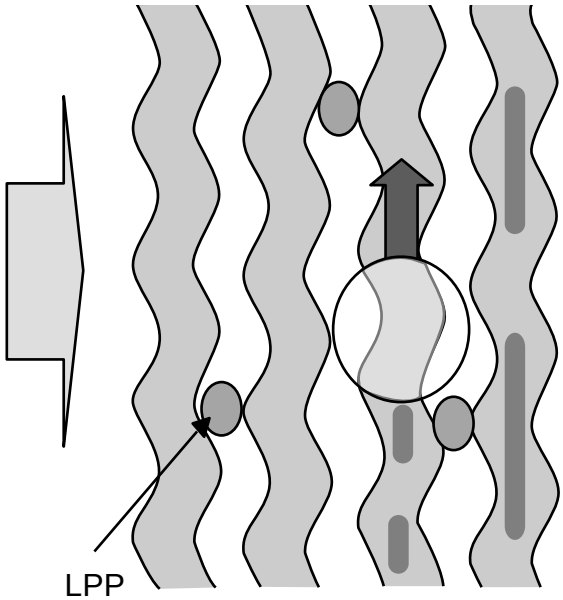
1. Recording Layer

DVD-ROM (Read Only Disc)



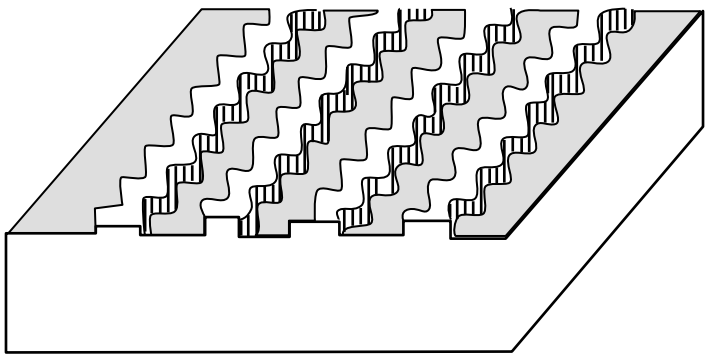
DVD-R/RW Disc

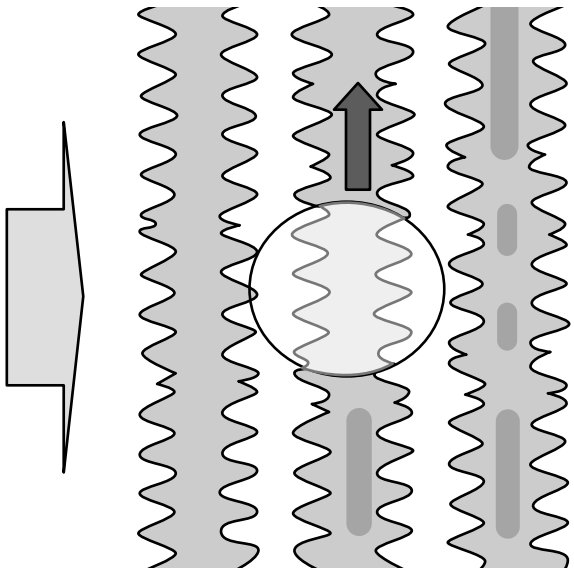




LPP
(Land Pre-Pit)

DVD+R/RW Disc





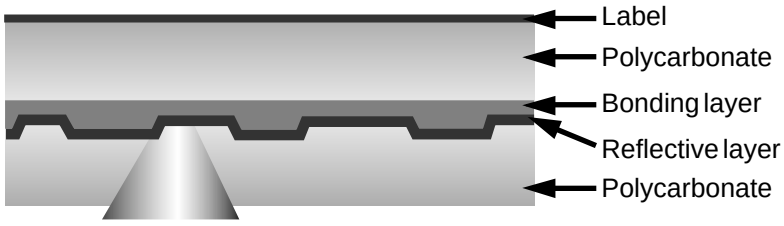
2. Disc Specification

	DVD-ROM		DVD-R	DVD-RW	DVD+R	DVD+RW
	Single-Layer	Dual-Layer				
Media Type	Read Only	Read Only	Dye	Phase change	Dye	Phase change
User data capacity	4.7GB	8.54GB	4.7GB	4.7GB	4.7GB	4.7GB
Wavelength	650nm	650nm	650nm	650nm	650nm	650nm
Reflectivity	45~85%	18~30nm	45~85%	18~30%	45~85%	18~30nm
Track pitch	0.74 μm	0.74 μm	0.74 μm	0.74 μm	0.74 μm	0.74 μm
Minimum pit length	0.4 μm	0.44 μm	0.4 μm	0.4 μm	0.4 μm	0.4 μm
Modulation	>0.6	>0.6	>0.6	>0.6	>0.6	>0.6
Channel bit- rate	26.16MHz	26.16MHz	26.16MHz	26.16MHz	26.16MHz	26.16MHz
Wobble Frequency	-	-	140KHz	140KHz	817.4KHz	817.4KHz
Addressing	26.16MHz	26.16MHz	Wobble & LPP	Wobble & LPP	Wobble(ADIP)	Wobble(ADIP)
Read Power (mW)					0.7 ± 0.1	0.7 ± 0.1
Write Power (mW)	-	-				
JItter	<8%	<8%	<8%	<8%	<9%	<9%

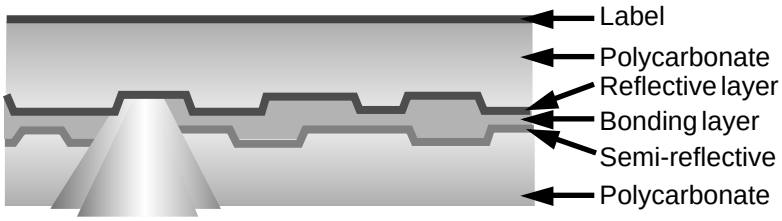
3. Disc Materials

1) DVD-ROM

<Single Layer >



<Dual Layer >

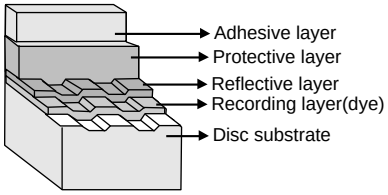


2) Recording format using organic dye material (DVD-R/DVD+R)

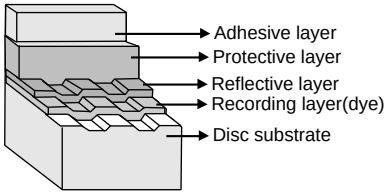
* The format that records data through the creation of recorded marks by changing the organic dye material with a laser beam.

> Disc structure

DVD-R



DVD+R



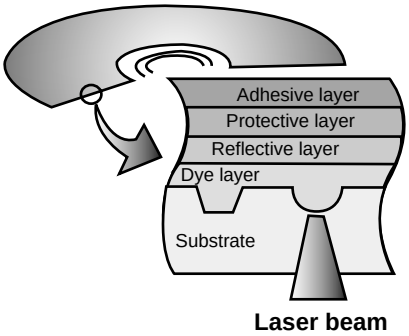
> Disc structure

[Recording]

Recording is done by changing the organic dye layer and the substrate with a laser when a strong is applied to a disc, the temperature of the ortanic dye material goes up, the dye is decomposed and the substrate changes at the same time. At this time, a durable bit is created as is the case with a CD-ROM.

[Playback]

Signals are read with the differences of the reflection of a laser from pits.

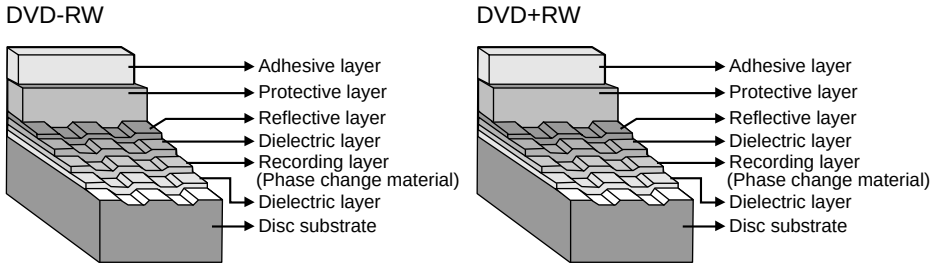


3) Recording format using phase-change recording material (DVD-RW/DVD+RW)

* Data is recorded by changing the recording layer from the amorphous status to the crystalline status, and played back by reading the difference of the reflection coefficient.

[Amorphous : Non-crystalline]

> Disc structure



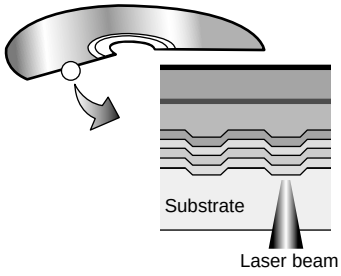
> Recording principles

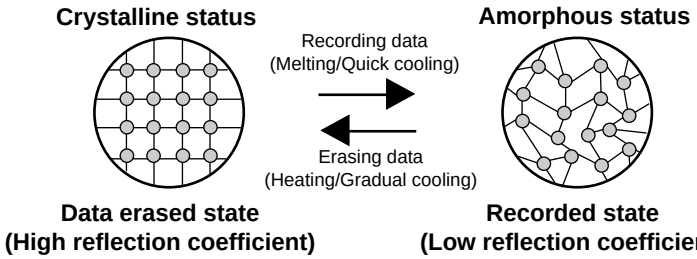
[Recording]

When a high-power laser is applied to the recording material, it melts and then becomes amorphous with a low reflection coefficient when it quickly cools off. When a mid-power laser is applied to heat gradually the recording material and then gradually cools it off, it becomes crystal with a high reflection coefficient.

[Playback]

A low-power laser is used for playback. The amount of reflected light depends on the status (amorphous or crystalline) of the recording material. This is detected by an optical sensor.





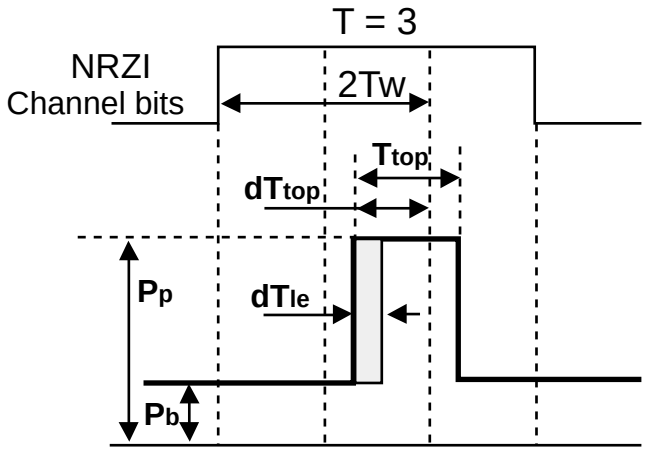
4. Writing Pulse Wave Form of DVD+R

For different speed ranges, different write strategies can be used. This document specifies 2 options:

- a pulsed write strategy, where each single mark is created by a number of subsequent separated short pulses.
- a blocked write strategy, where each single mark is created by one continuous pulse.

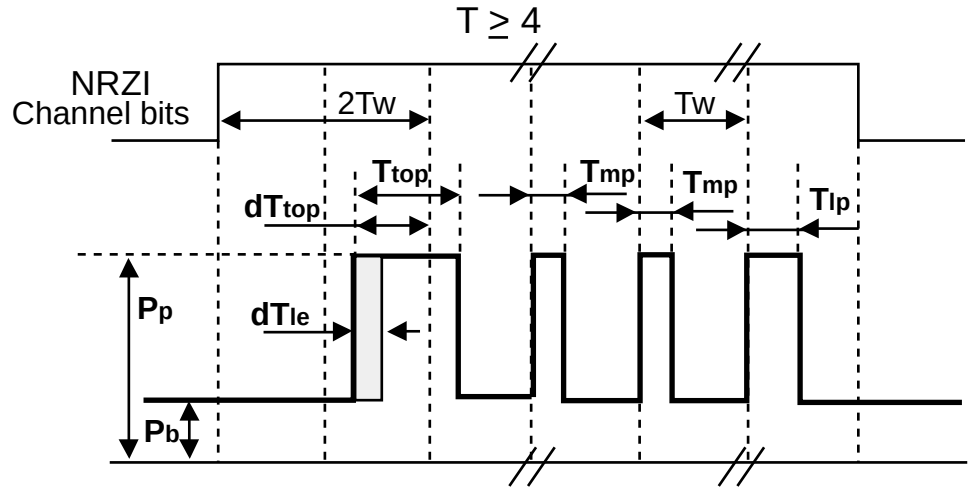
1) 1st Method : Using Pulsed Write Strategy

*** 3T :**



N = 3 : only the top pulse(T_{top}), first pulse lead-time dT_{top} , dT_{le}

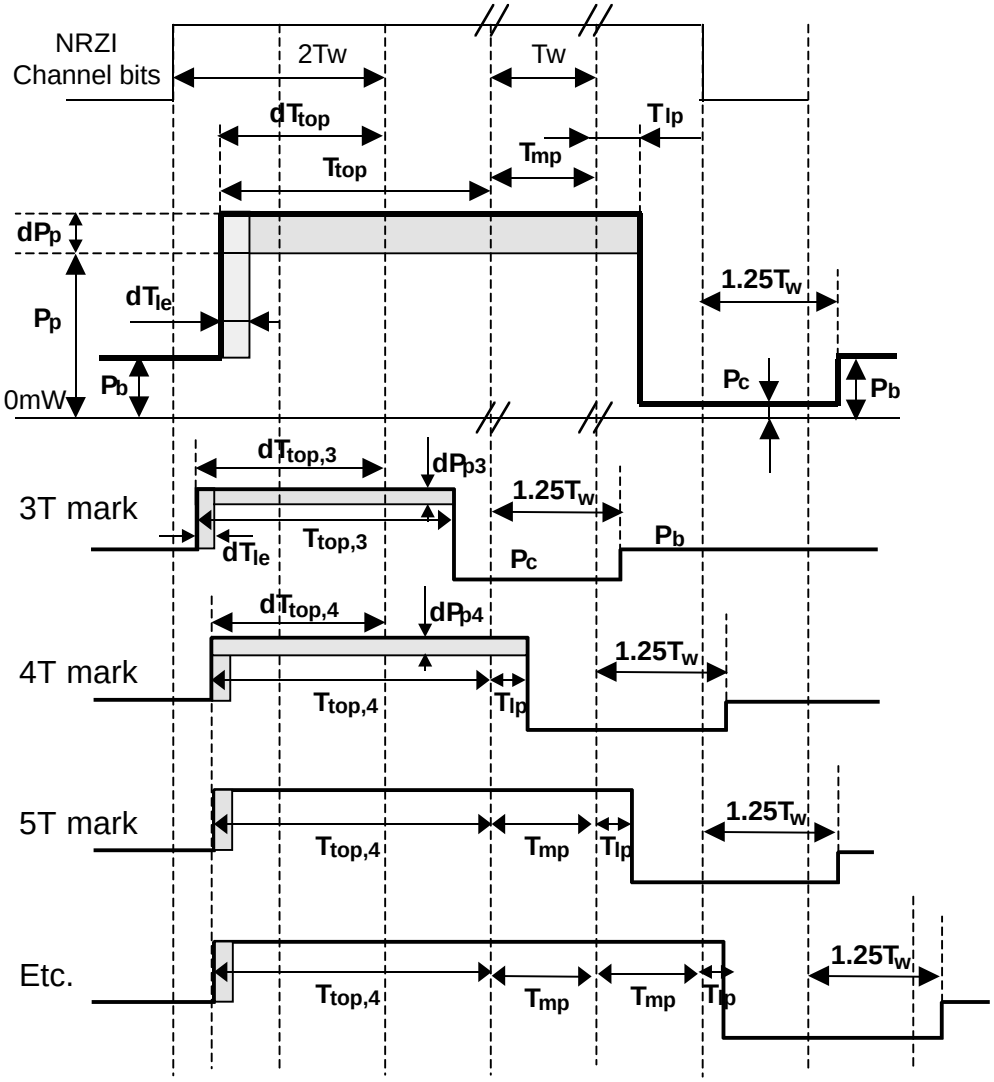
*** ≥ 4T :**



N ≥ 4 : the top pulse (T_{top}), multi-pulse (T_{mp}) and last pulse (T_{lp}), first pulse lead-time dT_{top}, dT_{le}

Pp : Actual write power
Pb : Bias Power

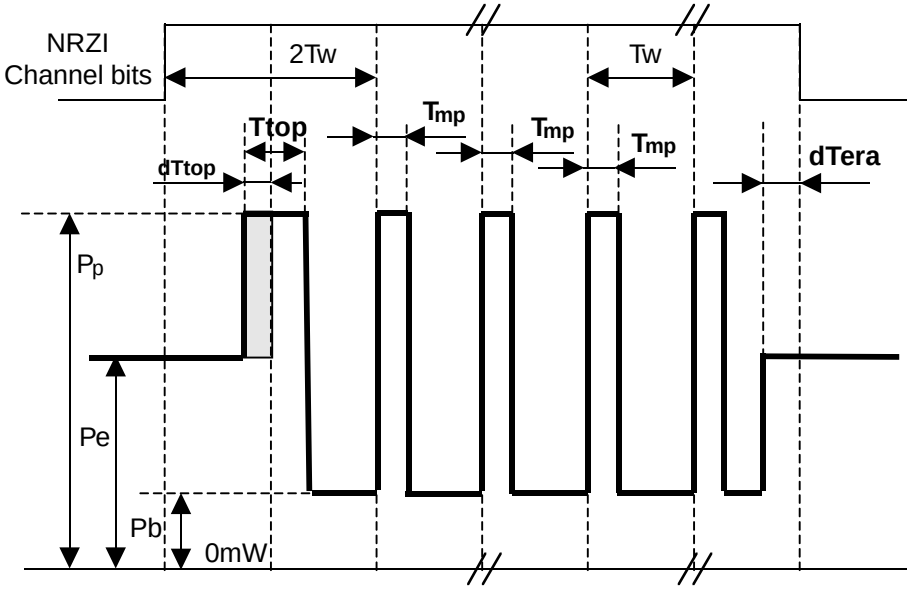
2) 2st Method : Using Blocked Write Strategy



⇨ **N = 3 : T_{top} (cm = 3) can be optimized individually.**
N ≥ 4 : T_{top} (cm ≥ 4) + (N-3) x T_W + T_{lp} , T_W = T_{mp}
P_c shall be < 0.1mW

Pp : Actual write power
Pb : Bias Power
dPp : Additional power (Only be applied for the 3T and 4T marks)
Pc : Cooling power (Especially at higher recording speeds, optimum cooling down of the recording layer after writing a mark may be needed.)

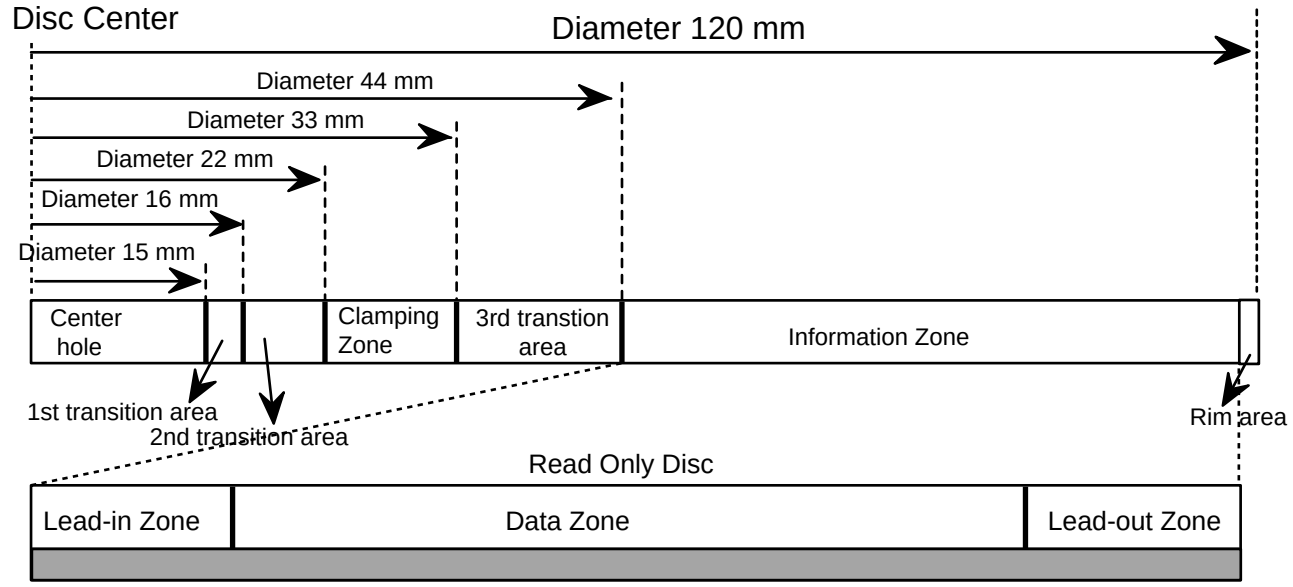
5. Writing Pulse Wave Form of DVD+RW



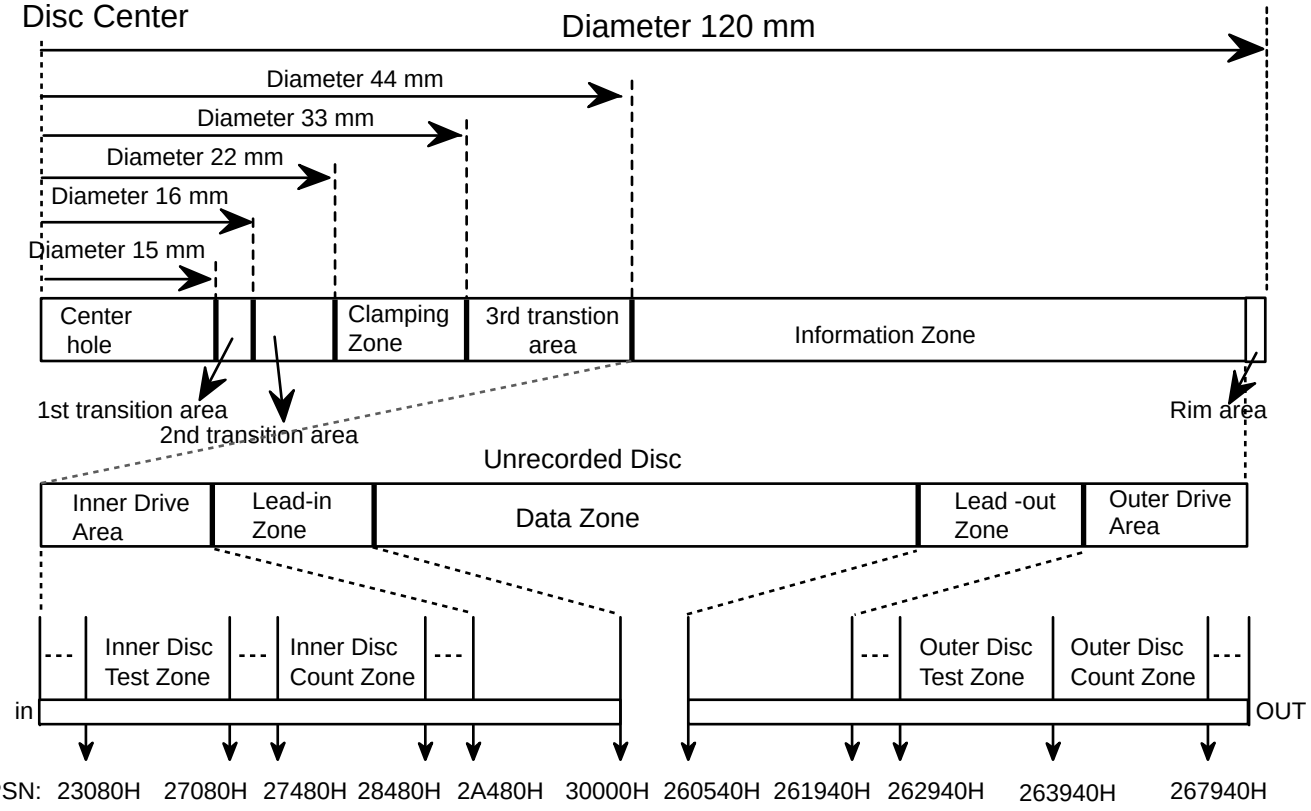
Pp : Actual write power
Pe : Erase Power
Pb : Bias Power

6. Organization of the Inner Drive Area, Outer Drive Area, Lead-in Zone and Lead-out Zone

1) Layout of DVD-ROM disc

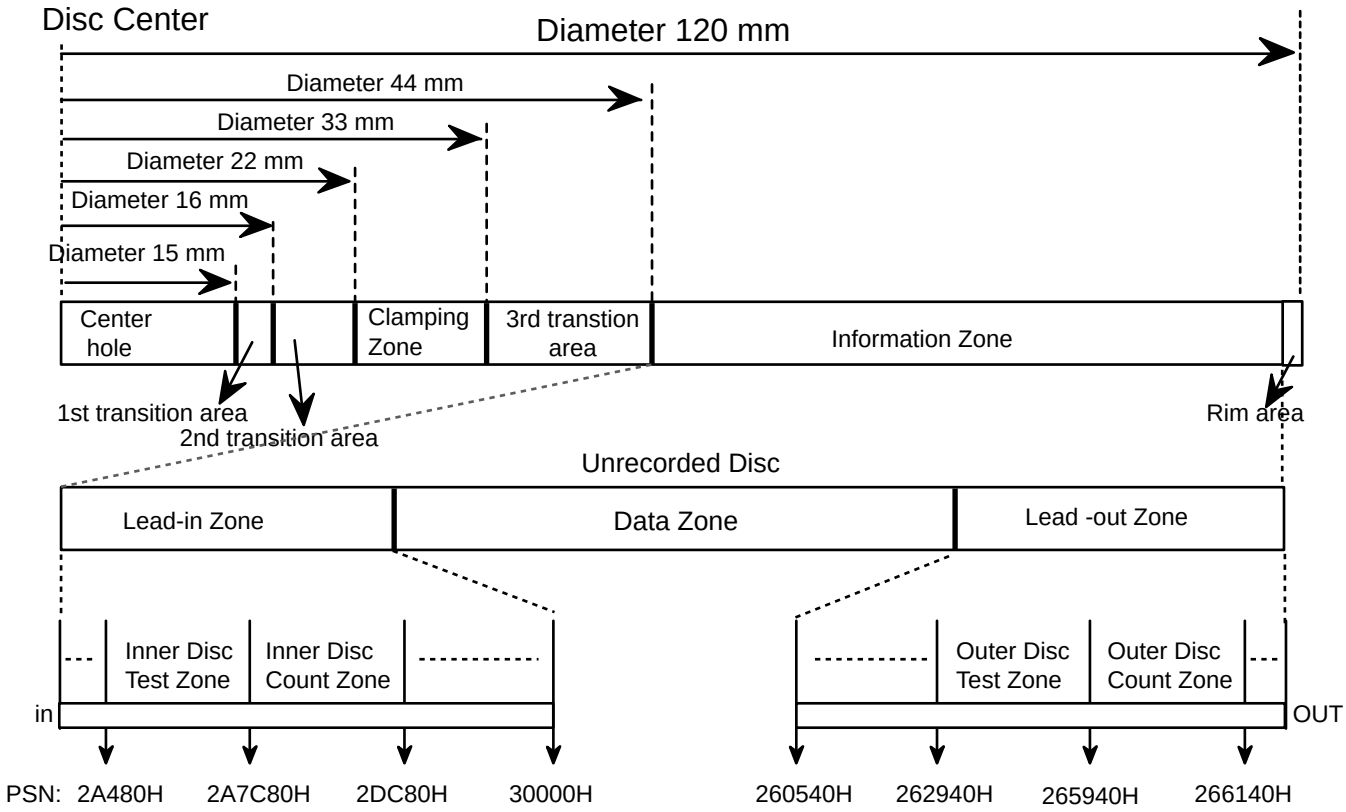


2) Layout of DVD+R disc



> Inner Disc Test Zone : for performing OPC procedures.
> Inner Disc Count Zone : for counting the number of OPC algorithm performed in IDT Zone.
> Outer Disc Test Zone : for performing OPC procedures.
> Outer Disc Count Zone : for counting the mumger of OPC algorithm performed in IDT Zone.

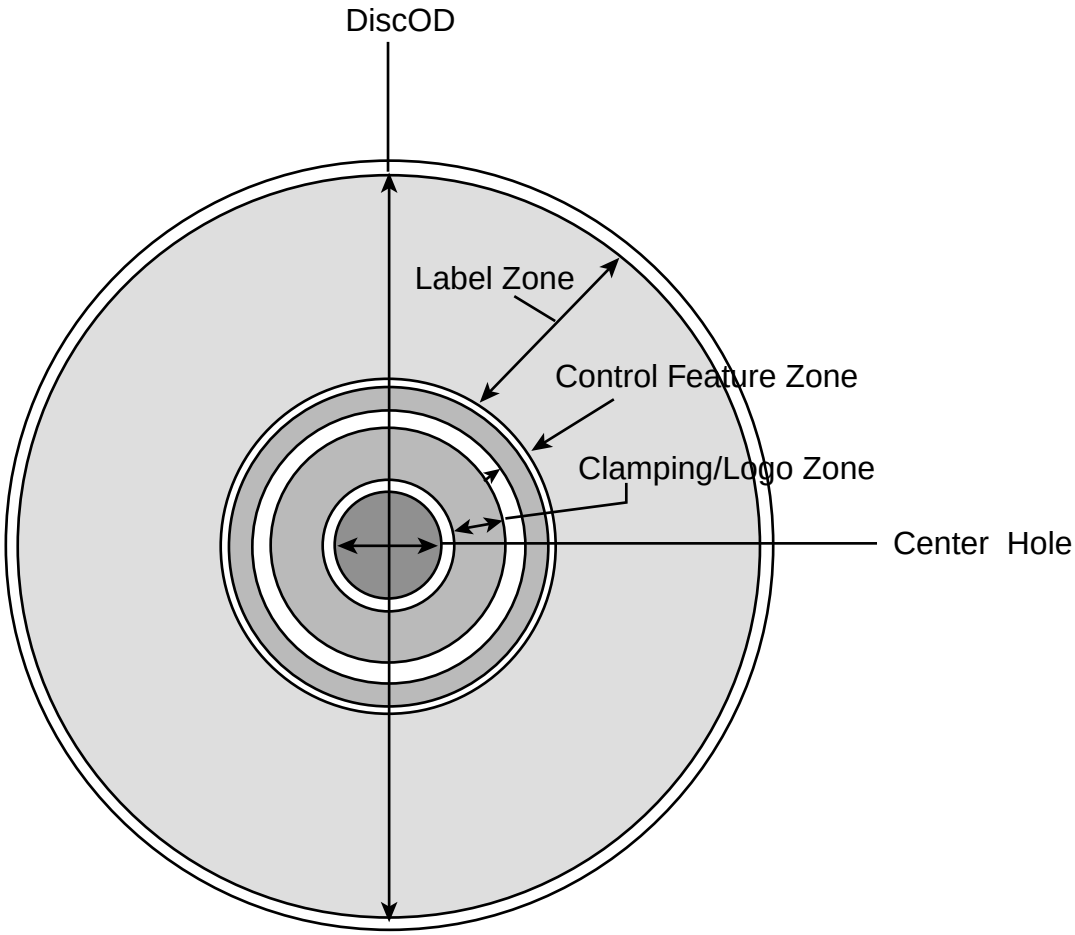
3) Layout of DVD+RW disc

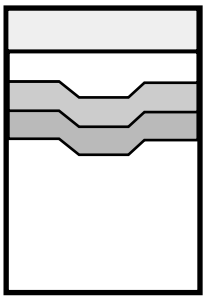


> Inner Disc Test Zone : for performing OPC procedures.
> Inner Disc Count Zone : for counting the number of OPC algorithm performed in IDT Zone.
> Outer Disc Test Zone : for performing OPC procedures.
> Outer Disc Count Zone : for counting the number of OPC algorithm performed in IDT Zone.

LightScribe Media

1. LightScribe Media

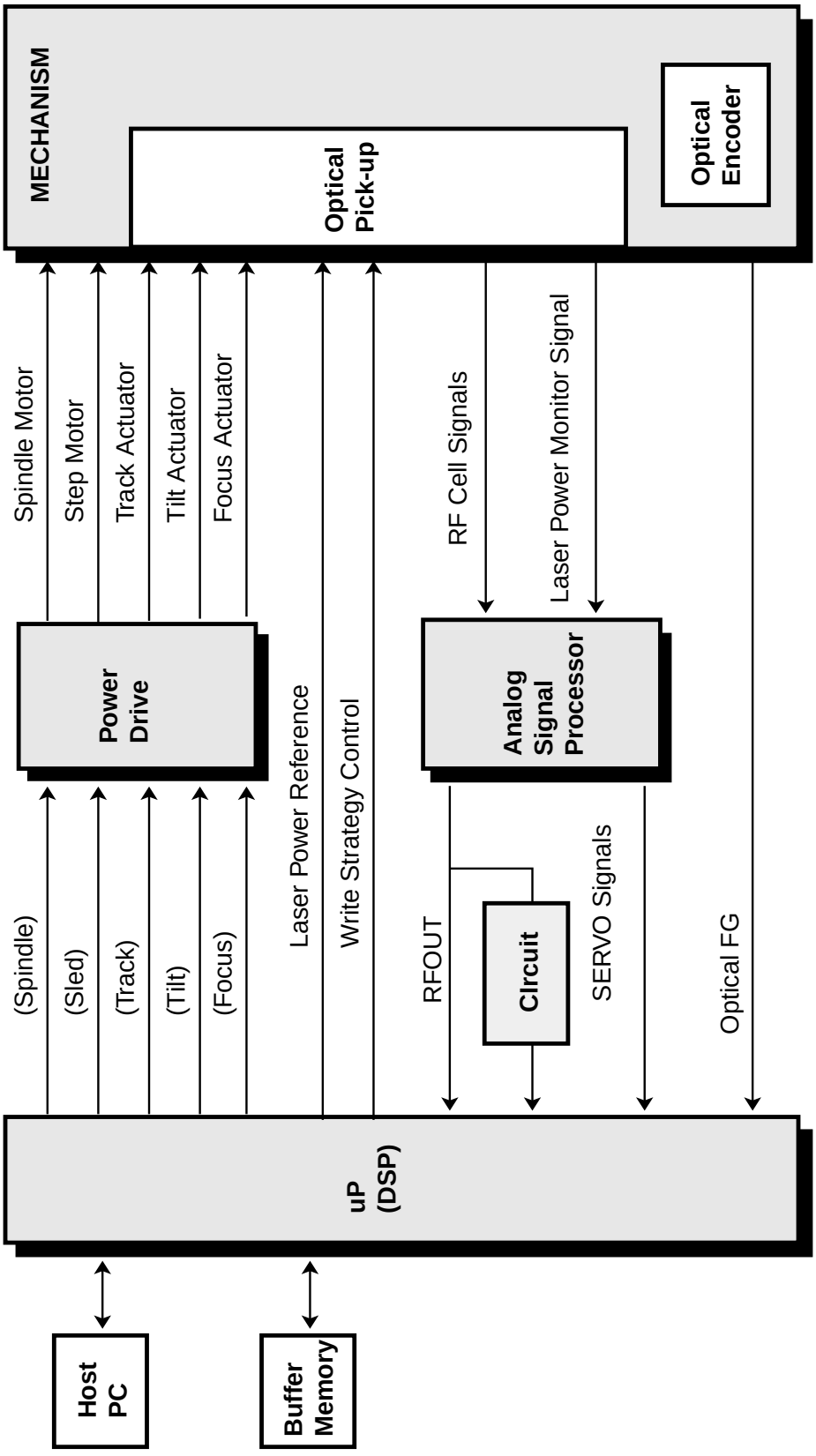




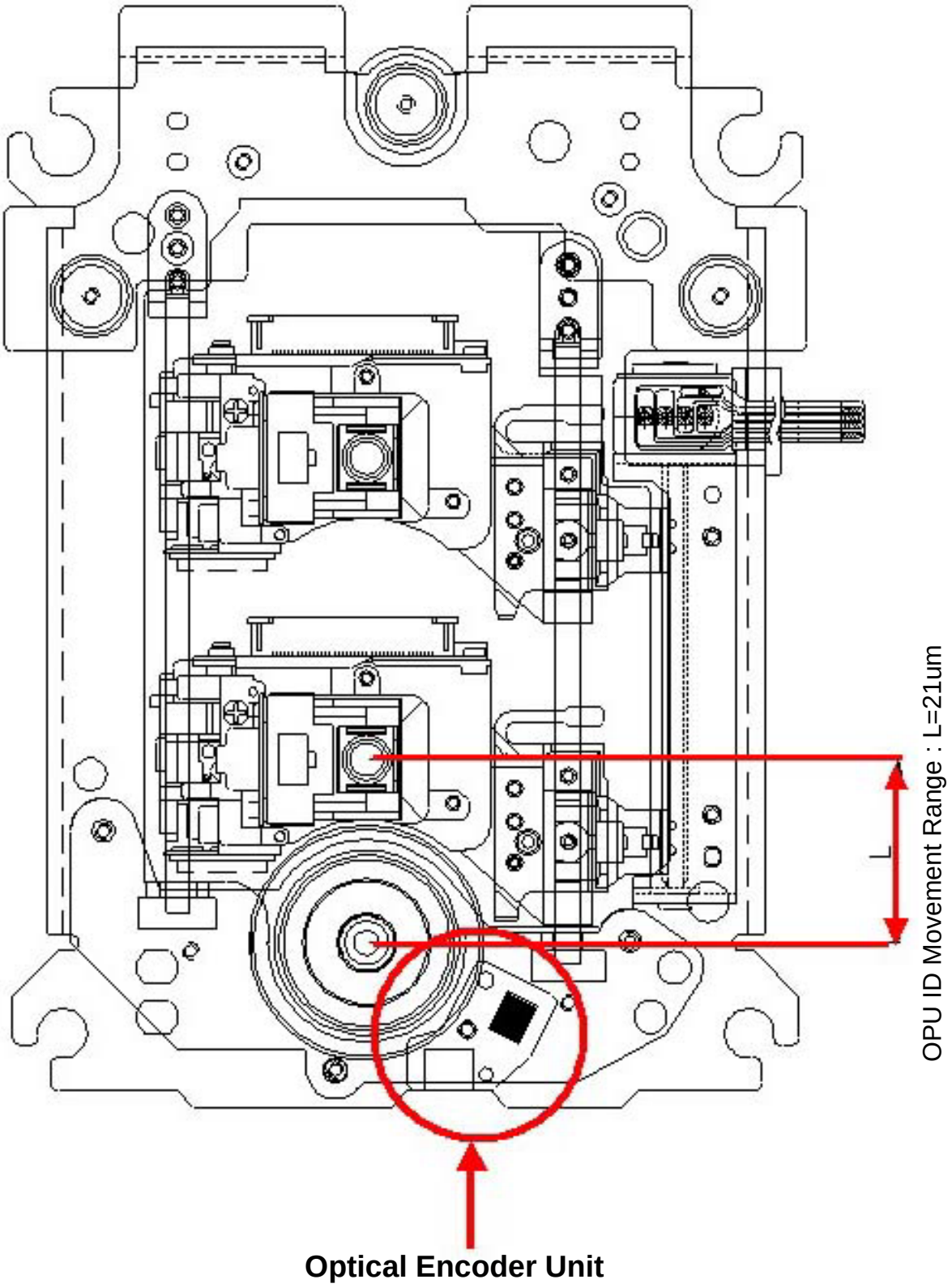
Screen Printed Imaging Layer
Clear Protective Coating
Reflective/Thermal Layer
Dye Data Layer

Polycarbonate
Substrate

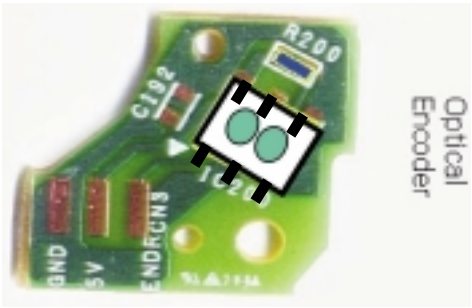
2. Hardware Block Diagram of LightScribe Label Printing



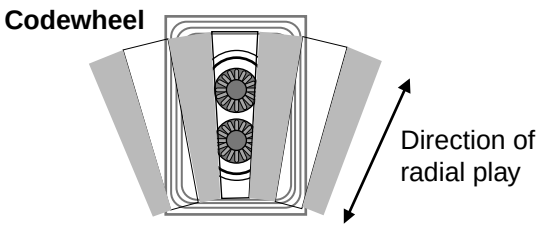
3. MD Assy For LightScribe



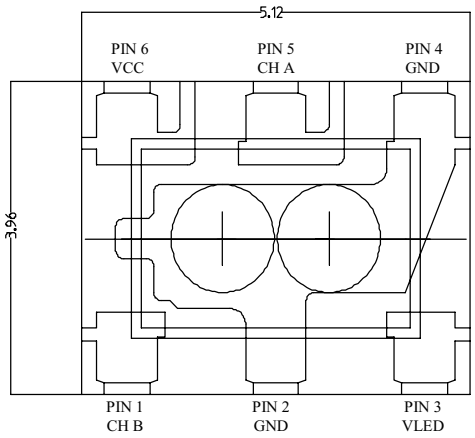
4. Optical Encoder Assy

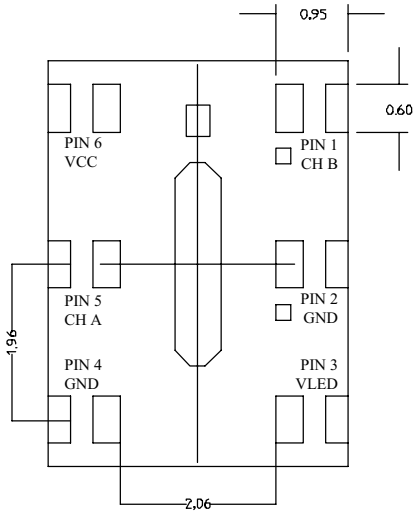


Encoder PCB

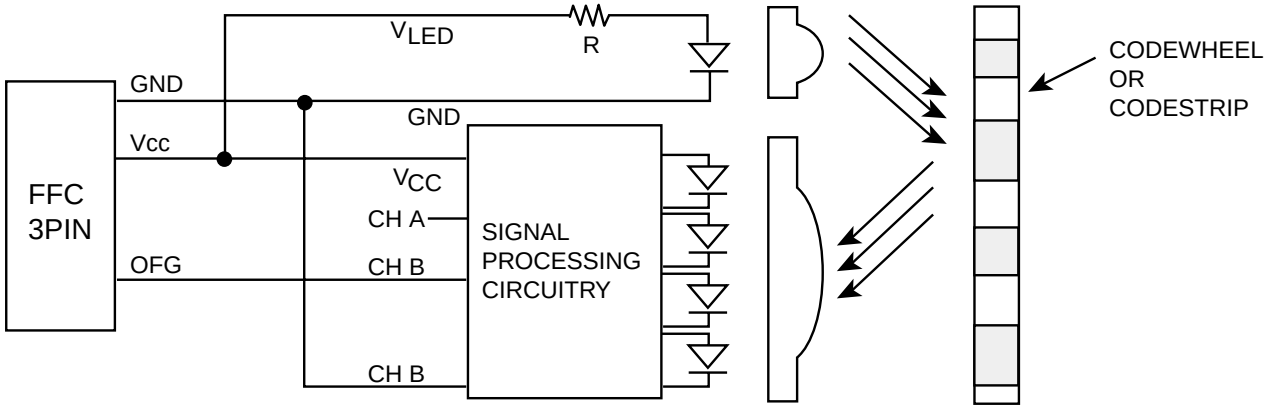


Optical Encoder IC



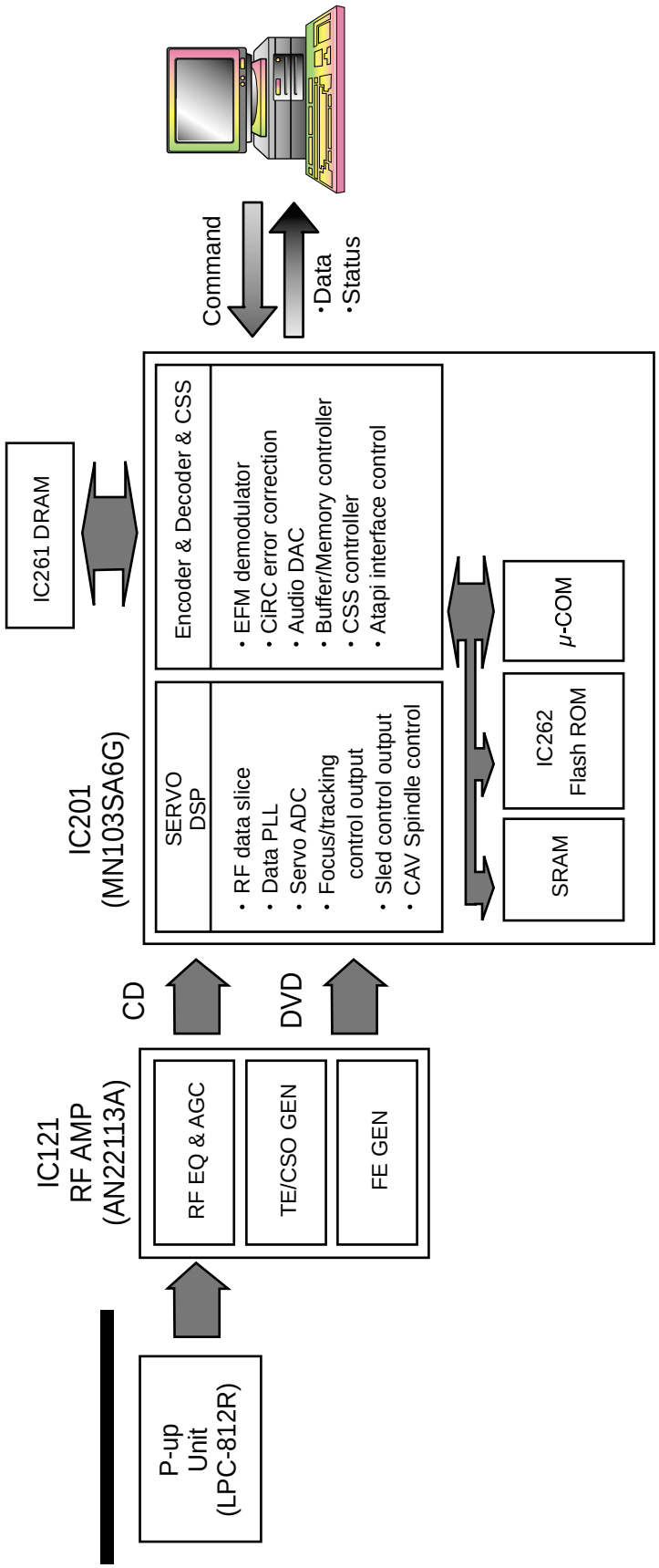


Schematic of Enc PCB



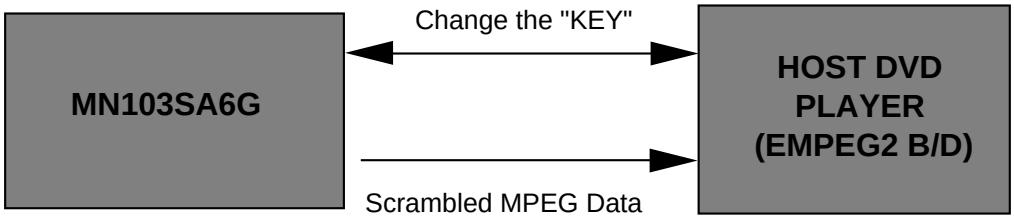
DVD & CD DATA PROCESSING

1. Data Processing Flow



2. Copy Protection and Regional Code Management Block

Block Diagram



KEY Management Control

Brief Process

1. Regional Code for DVD Disc

– DVD-ROM drive transfers the regional code of the control data to host by the command of host, the DVD player of host reads the regional code, and plays title in the case of allowed regional code only.

2. Management of DVD Disc for the scrambled of data

(1) DVD-ROM and DVD player of host generate the “KEY 1” respectively, transfer to opposite part, the “KEY 2” is received, recognizes the data transfer or not with this value, and generates the bus key encoded the data.

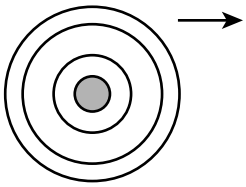
(2) Encoded “Disc Key” and “Title Key” host is transfer with the bus Key.

(3) DVD player of host reads the key value, and uses the value to restore the scrambled data.

* Refer to the next page for the details.

3. About Prevention the DVD-ROM from to be copy

A data is able to encode and record in the disc, if a copyright holder wants to prevent the disc from copying.



In case of a disc enhanced movie of 3 titles.....

DISC KEY (2048 Bytes) is used to encode the whole contents in the disc and TITLE KEY (5 Bytes) is used to encode the title respectively.

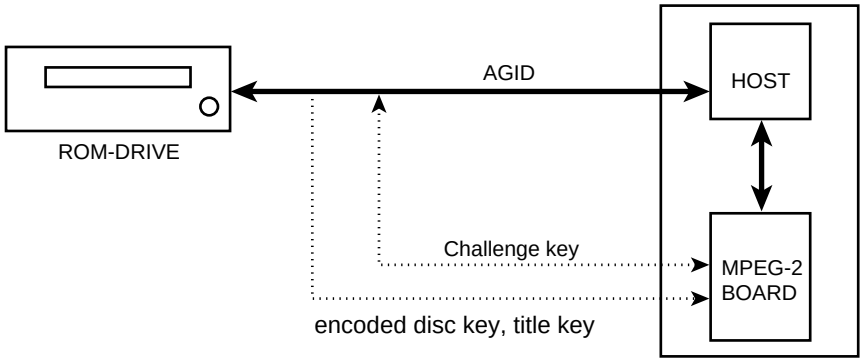
So, the data is encoded and stored in a disc through the unknown algorithms with a disc key and title key. (At this time, the disc key and title key are stored in a disc.)

...As above, the disc is able to copy when the disc key and title key are opened.

Then, ROM-DRIVE encodes the disc key and title key and transfers to MPEG-2 board.

If you want to play the disc prevented from the copy.....

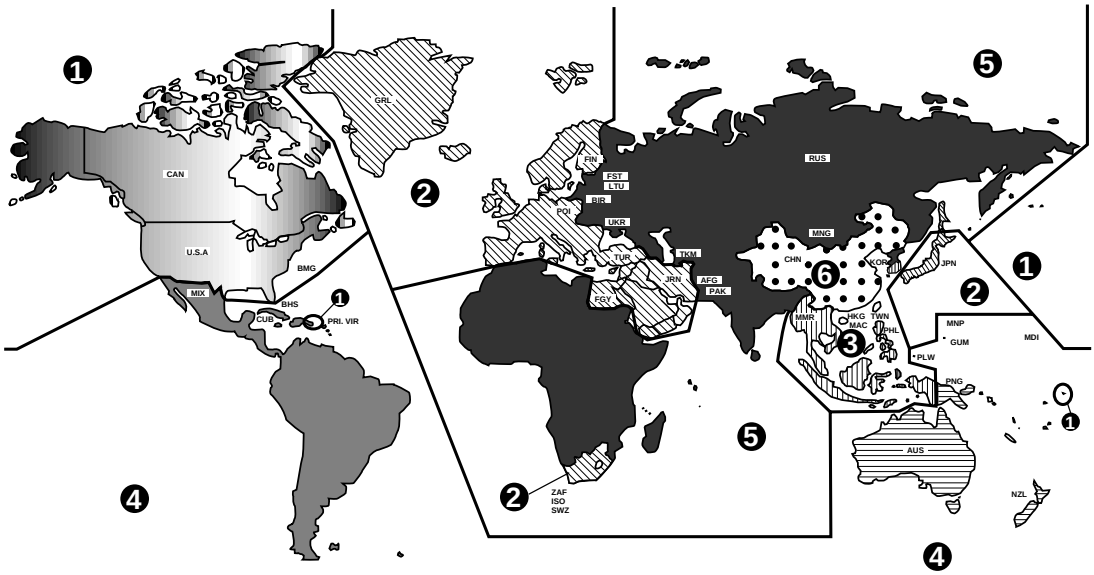
First of all, ROM-DRIVE and MPEG-2 board identify with each other through the procedure as described below.

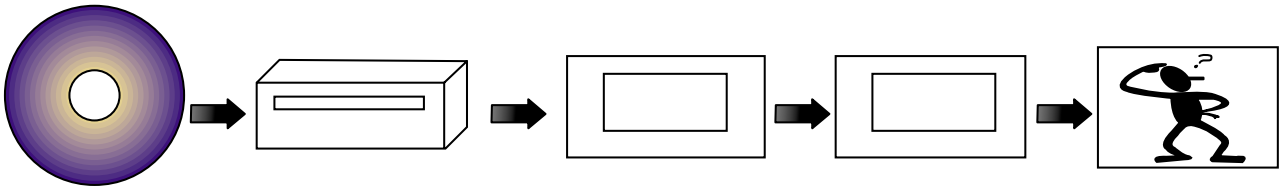


1. Drive and host gives and takes the ID of 2bit. This ID is AGID (Authentication Grant ID).
   The various decoder boards are attached to the host, in these, AGID sets the MPEG-2 board and drive.
2. After the AGID is set, MPEG-2 board generates the challenge key (10 Byte) and transfers to drive. The board and drive generate key 1 (5Byte) with the challenge key respectively. (Of course, the Algorithm generating the key 1 is not known.)
3. Compare with the generated key 1, if it corresponds each other, the first step of authentication is completed. This is a course to identify the MPEG-2 board with a drive.
4. The second step of authentication is a course to identify a drive with the MPEG-2 board.
   The dirve generates a challenge key and transfers it to the MPEG-2 board. The dirve and MPEG-2 board generate the key 2 (5Byte) with the challenge key, compare with each other, and if it corresponds and the secondary step of authentication is completed.
5. As above, the identification is completed.
6. The dirve and MPEG-2 board generate the Bus key with the key 1 and key 2 and own it.
7. Dirve encodes the disc key and title key with this Bus key and transfers to the MPEG-2 board.
8. The MPEG-2 board reads the encoded disc key and title key with the Bus key only.
9. MPEG-2 board lets data read from the drive to decode with the read disc key and title key and makes into the video signal by decoding.

4. About the DVD-ROM Regional Code

Regional code





DISC ROM - DRIVE MPEG-2 BOARD VGA CARD MONITOR

The disc has the regional code of 8 bit.

Example)
The disc manufactured in the U.S.A, has the number one.

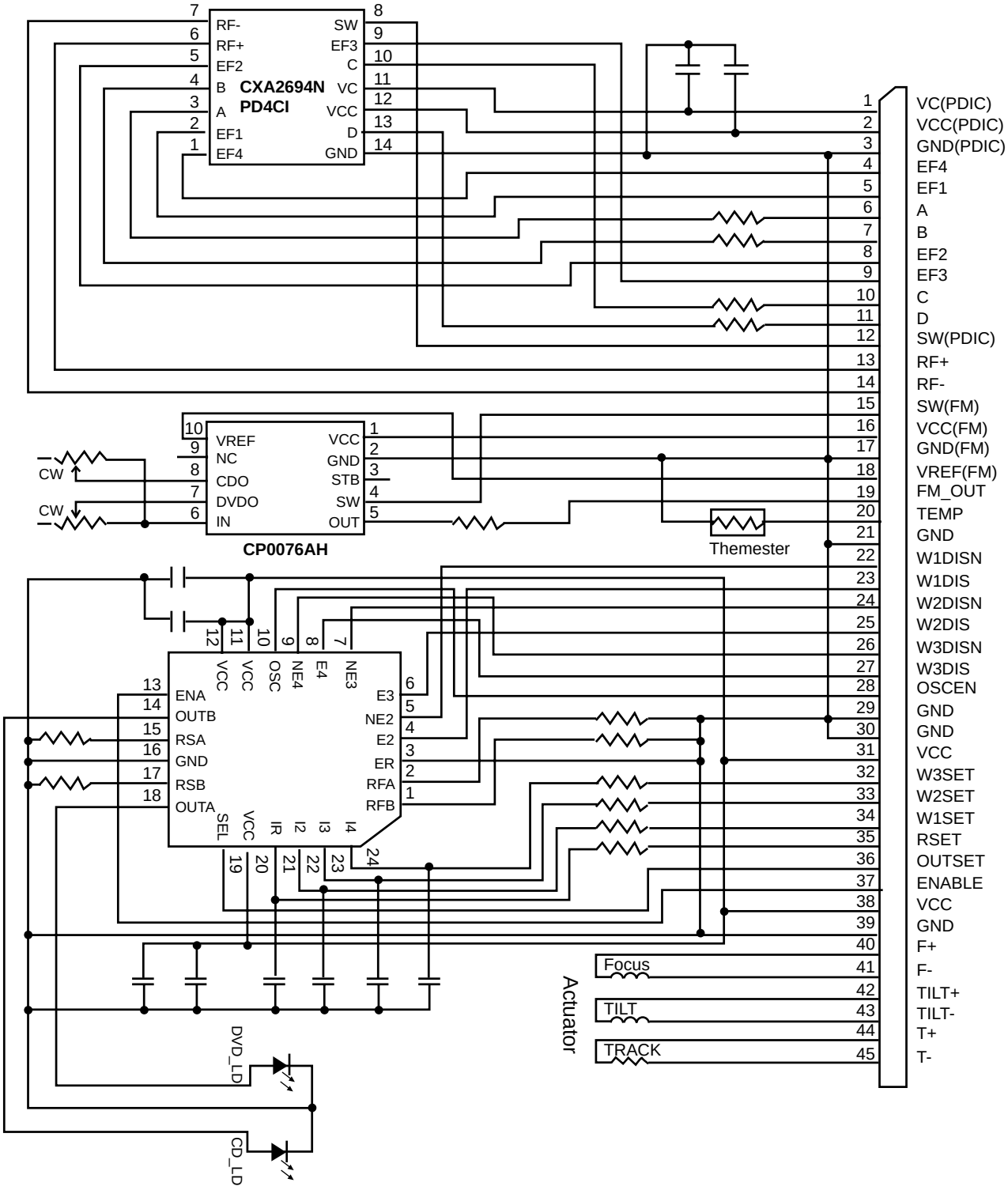
Transfer to MPEG-2 board reading the regional code.

If the board is setting to the regional code 1 for the U.S.A. ...
Check the received regional code to number 1, all or not, transfer the data to VGA card in accordance with only a case among the three case.

Receiving data from the MPEG-2 board and output through the monitor

INTERNAL STRUCTURE OF THE PICK-UP

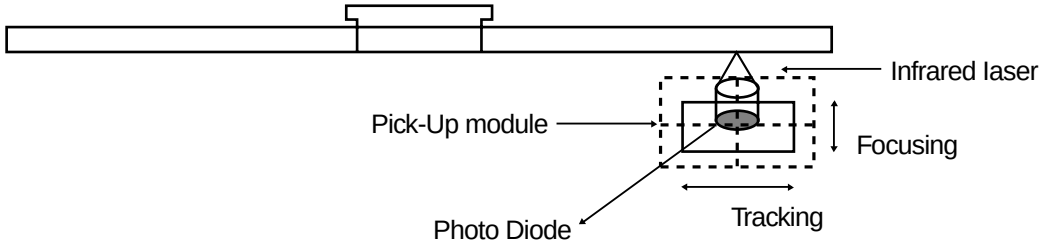
1. Block Diagram of the PICK-UP(LPC-812R)



2. Pick up Pin Assignment

No.	Pin Name	Signal Description
45	T-	Tracking Actuator drive signal-
44	T+	Tracking Actuator drive signal+
43	Tilt-	Tilting Actuator drive signal-
42	Tilt+	Tilting Actuator drive signal+
41	F-	Focusing Actuator drive signal-
40	F+	Focusing Actuator drive signal+
39	GND(LDD)	Ground connection for LDD
38	VCC(LDD)	Power supply for LDD
37	ENABLE	Disables output current regardless of OUTEN(ENABLE Low:No lout)
36	OUTSEL	High:selects DVD LD, Low:CD LD
35	RSET	Input voltage for current amplifier
34	W1SET	Input voltage for current amplifier
33	W2SET	Input voltage for current amplifier
32	W3SET	Input voltage for current amplifier
31	VCC(LDD)	Power supply for LDD
30	GND(LDD)	Ground connection for LDD
29	GND(LDD)	Ground connection for LDD
28	OSCEN	TTL control for Oscillator Enable (High Enable)
27	W3DIS	LVDS control for output current (High Enable)
26	W3DISN	LVDS control for output current (Low Enable)
25	W2DIS	LVDS control for output current (High Enable)
24	W2DISN	LVDS control for output current (Low Enable)
23	W1DIS	LVDS control for output current (High Enable)
22	W1DISN	LVDS control for output current (Low Enable)
21	GND(FPD)	Ground connection for PDIC, FPD, TEMP
20	TEMP	Output voltage for controlling temperature
19	FPD-OUT	APC amplifier output
18	VREF(FPD)	APC amplifier reference voltage output
17	GND(TEMP)	Ground connection for PDIC, FPD, TEMP
16	VCC(FPD)	Power supply for FPD
15	SW2(FPD)	FPD output gain Select (High : CD, Low:DVD)
14	RF-	Signal PDIC RF negative differential output
13	RF+	Signal PDIC RF positive differential output
12	SW1(PDIC)	PDIC output gain Select (L/M/H)
11	D	Signal PDIC output D
10	C	Signal PDIC output C
9	EF3	Signal PDIC output EF3
8	EF2	Signal PDIC output EF2
7	B	Signal PDIC output B
6	A	Signal PDIC output A
5	EF1	Signal PDIC output EF1
4	EF4	Signal PDIC output EF4
3	GND(PDIC)	Ground connection for PDIC, FPD, TEMP, LDD
2	VCC(PDIC)	Power supply for PDIC(+5V)
1	VC(PDIC)	Reference voltage input for PDIC)

3. Signal detection of the P/U



1) Focus Error Signal ==> (A+C)-(B+D)

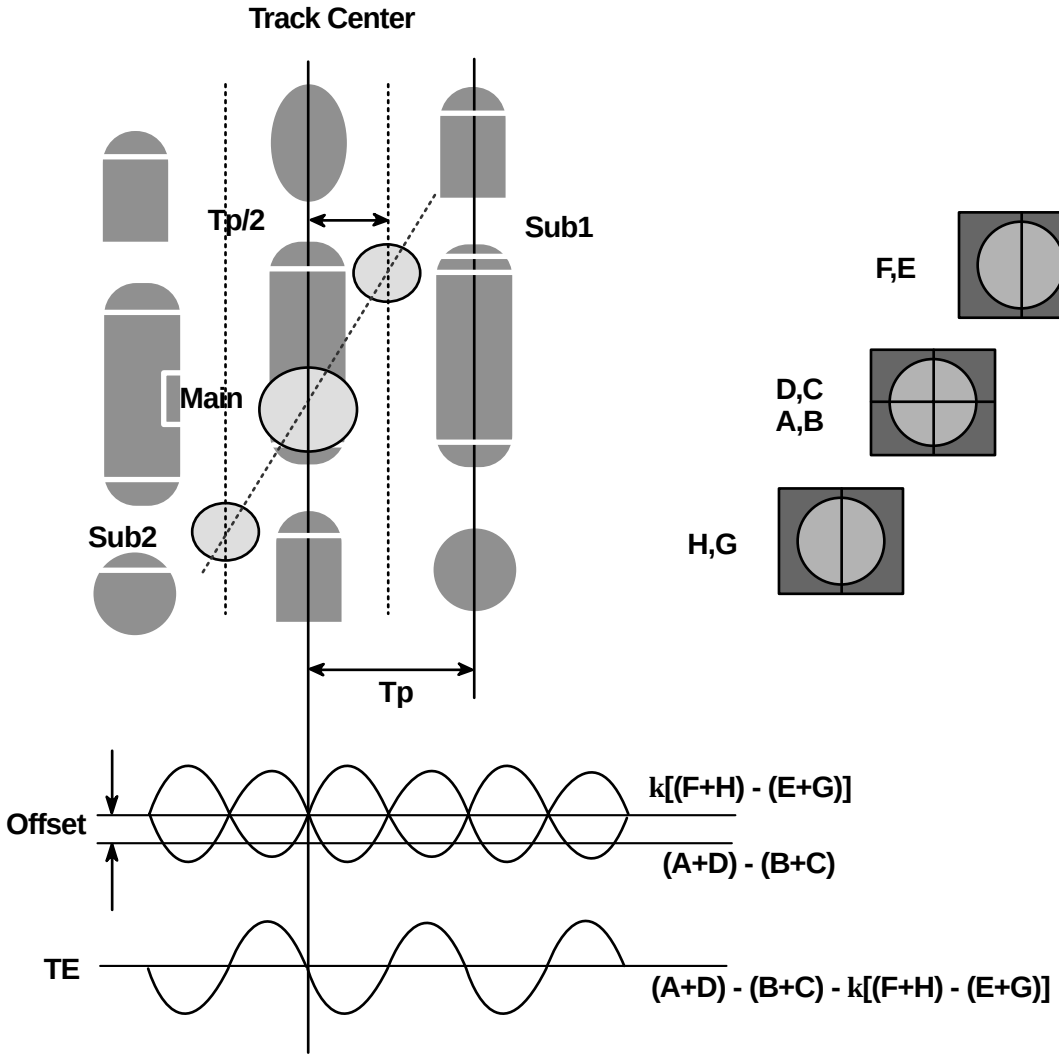
This signal is generated in RF IC (IC121 : AN22113A) and controls the pick-up's up and down to focus on Disc.

2) Tracking Error Signal (DPP Method) ==> {(A+D)-(B+C)}- *k* x {(EF_1+EF_4)-(EF_2+EF_3)}

This signal is generated in RF IC (IC121 : AN22113A) and controls the pick-up's left and right shift to find to track on Disc.

3) RF Signal ==> (A+B+C+D)

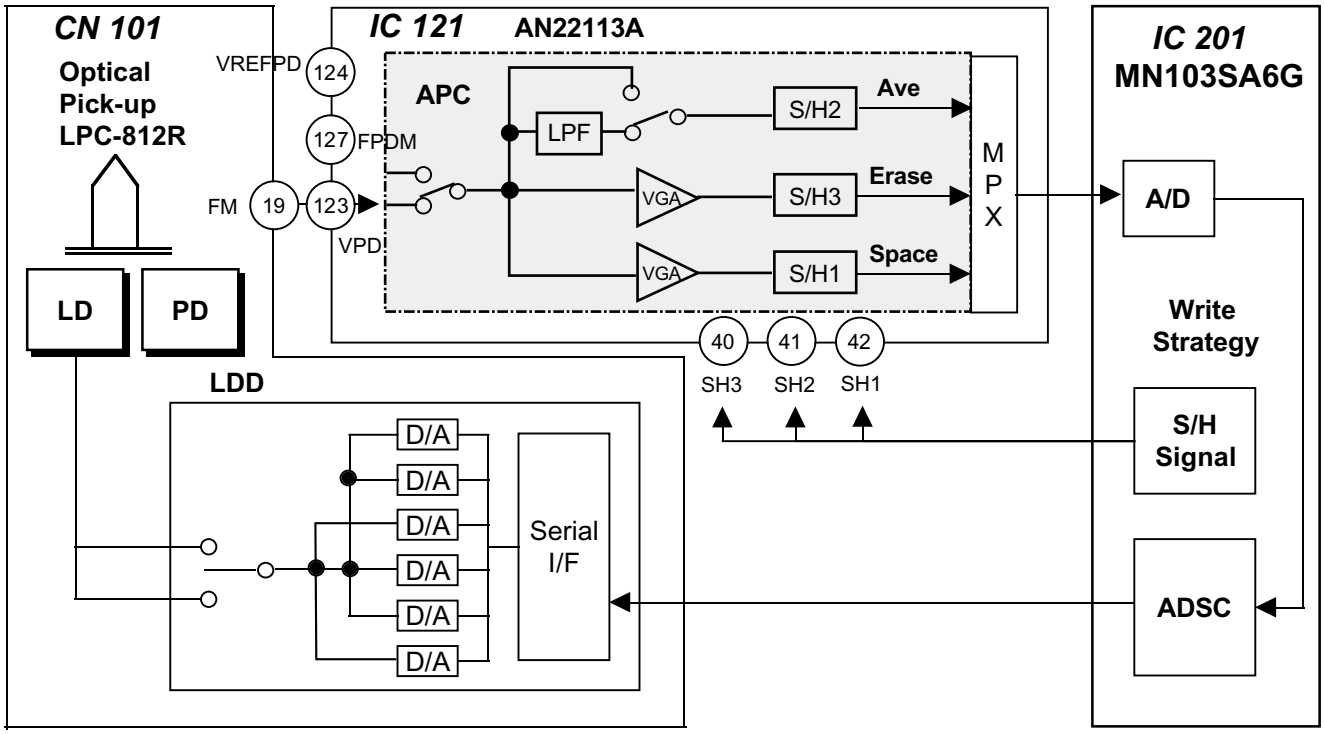
This signal is converted to DATA signal in DSP IC (IC201 : MN103SA6G).



DESCRIPTION OF CIRCUIT

1. ALPC (Automatic Laser Power Control) Circuit

1-1. Block Diagram

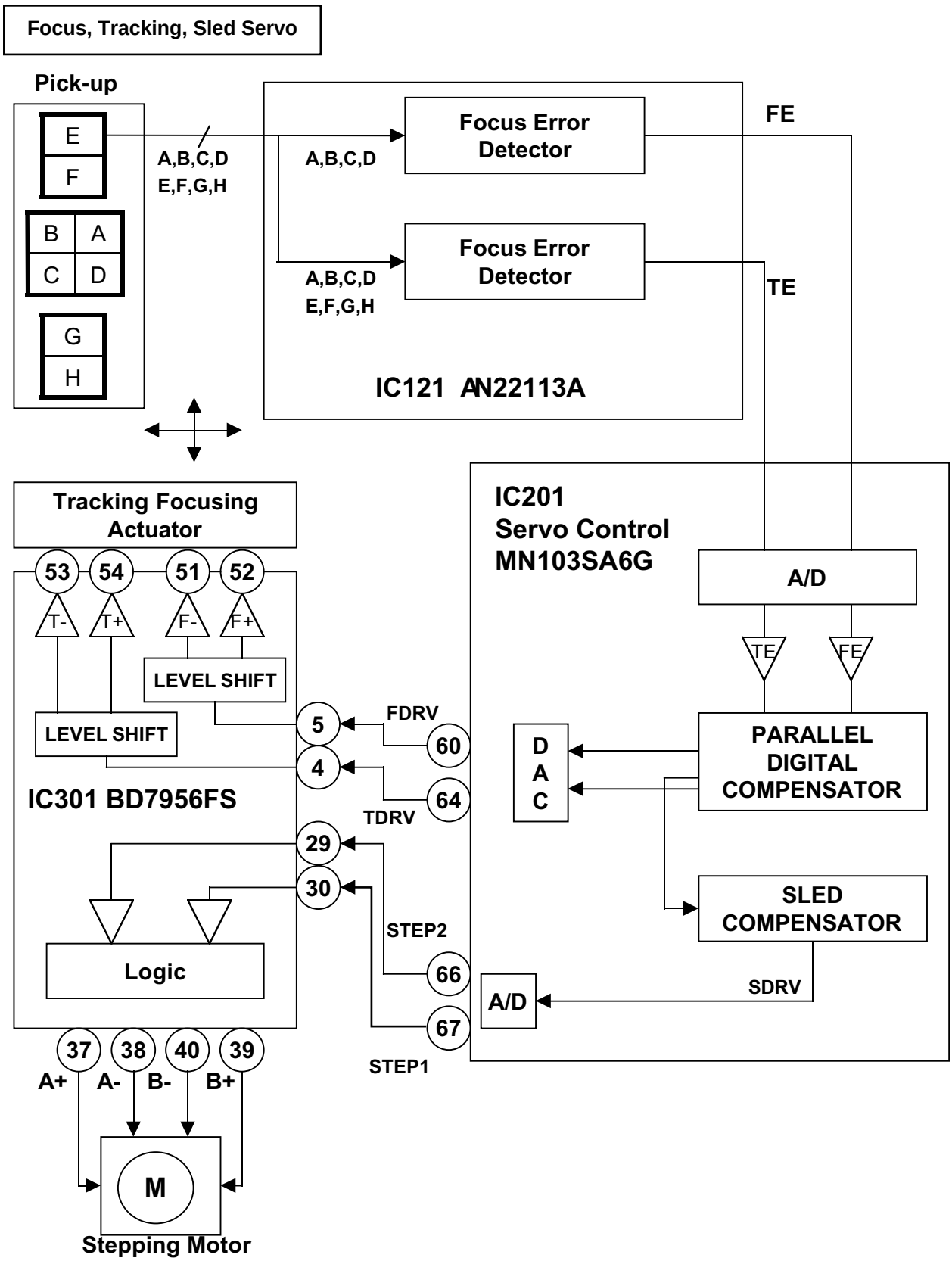


1-2. ALPC (Automatic Laser Power Control) Circuit Operation

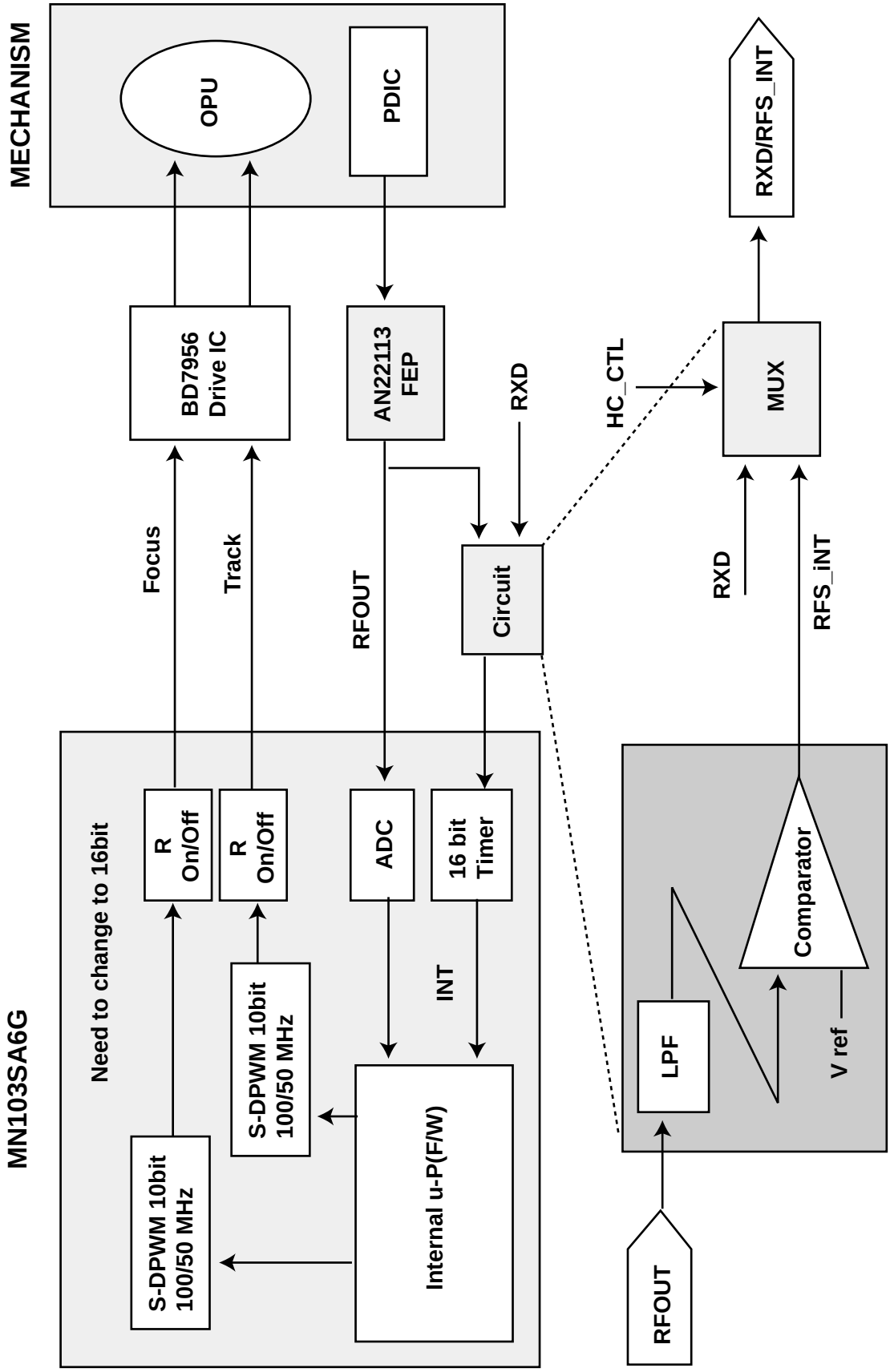
The ALPC block detects the laser output power of the front monitor. The power signal detected with the PD for front monitor detection is input the voltage from the VPD pin(123Pin) or the FPDM pin(127Pin), the reference signal of the input signal is input from the VREFPD pin(124Pin). The ALPC block generates the singals from the input laser power signals in the following detection systems. This block has four detection paths:All average value path, multi pulse average/peak value detection path, erase/bottom value detection path, space/playback power value detection path.

2. Focus/Tracking/Sled Servo Circuit

2-1. Focus, Tracking & Sled Servo Process

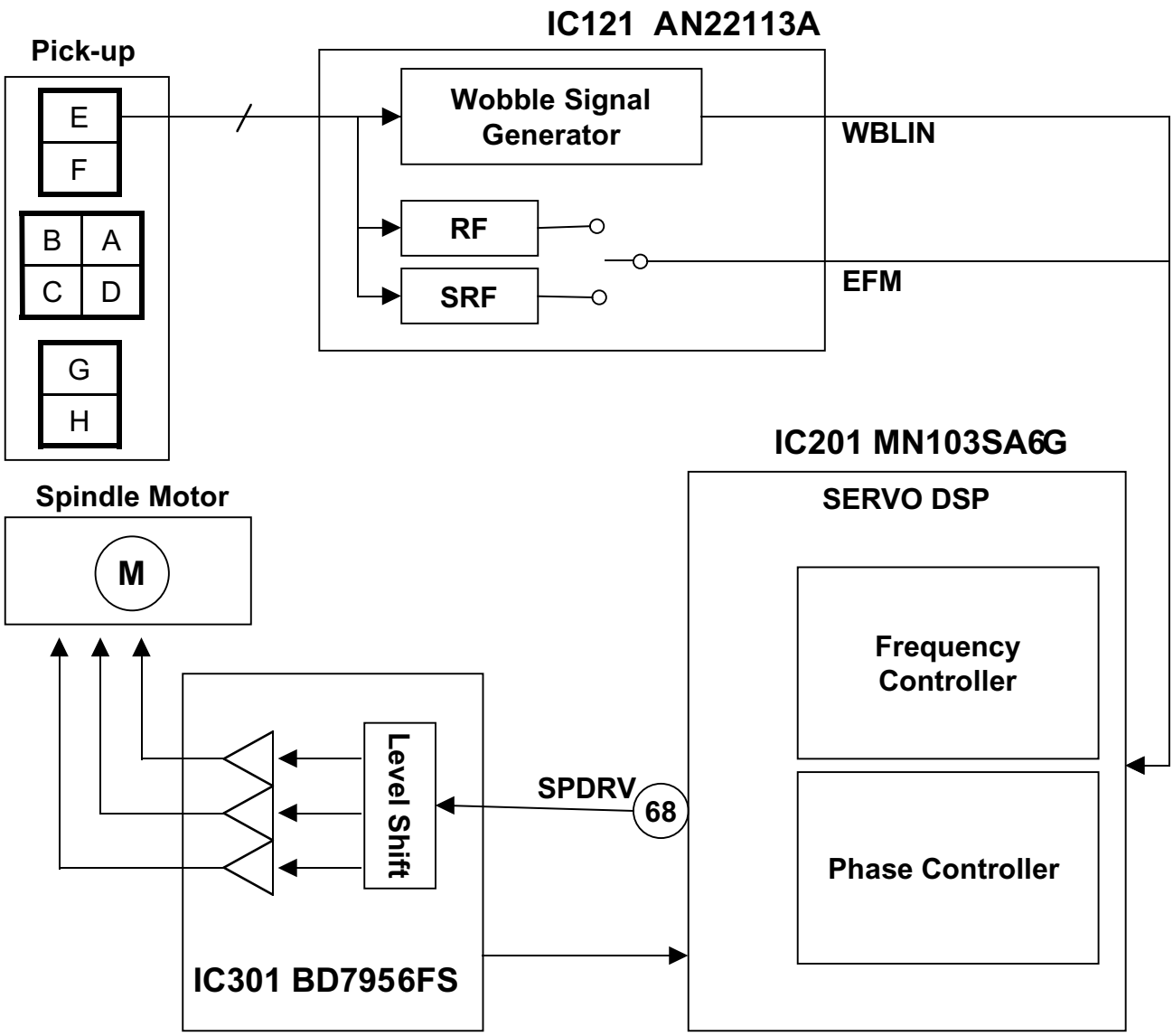


2-2. Focus & Tracking Servo Process(using the LightScribe)



3. Spindle Servo Circuit

3-1. Spindle Servo Process



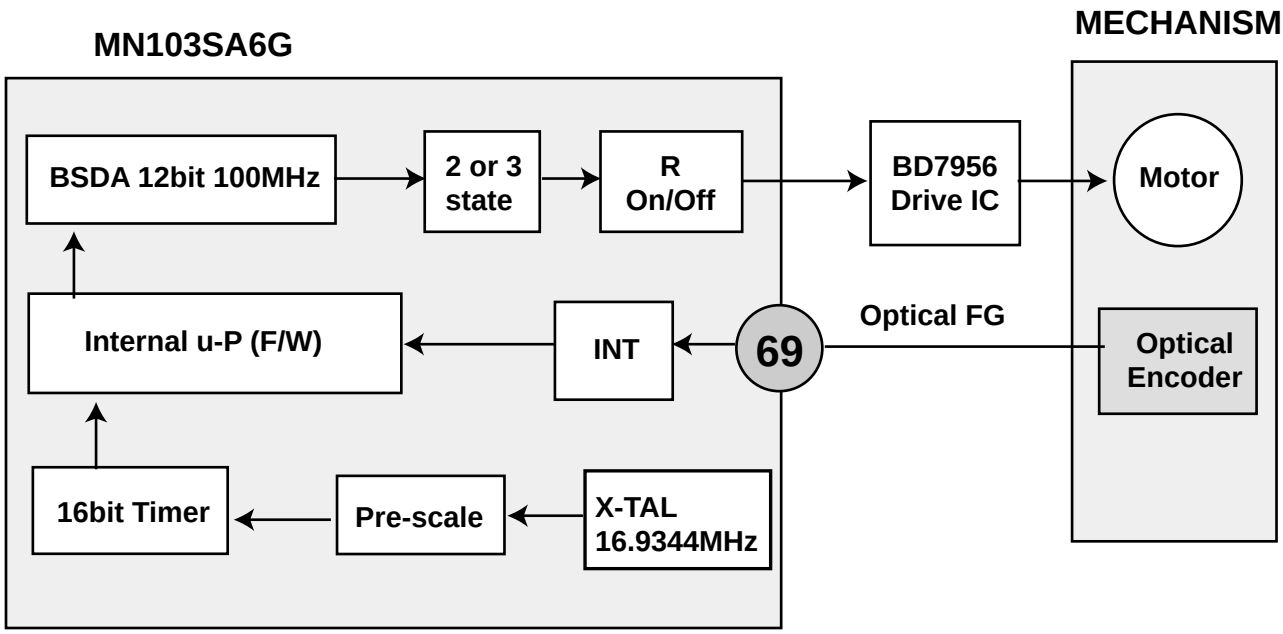
3-2. Spindle Servo

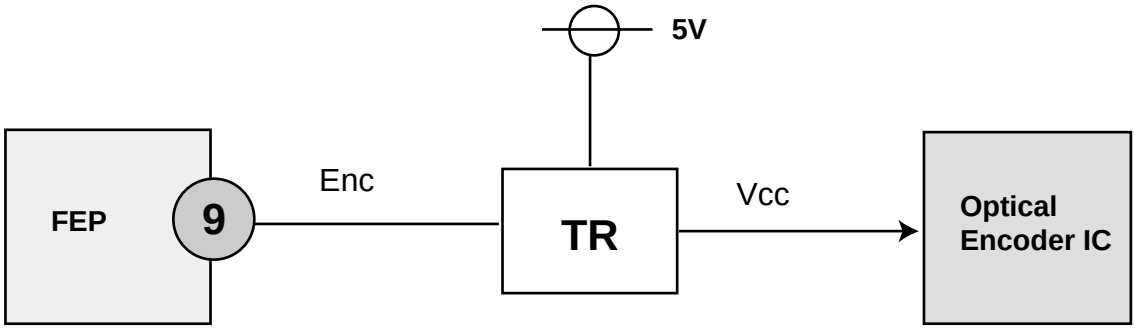
Spindle servo is as following ;

1) Wobble CLV 4x, 10x, 16x, 24x, 32x, 40x : Blank area in CD-R, CD-RW
2) Wobble CLV 1x, 2x, 2.4x, 4x, 8x : Blank area in DVD+/-R/RW
3) CD 15x CAV : Video CD, CD-DA(Audio out)
4) CD 32x CAV : CD-RW, CD-DA(DAE)
5) CD 40x CAV : CD-ROM/R
6) DVD 8x CAV : Single Layer DVD-ROM(Movie), Dual Layer DVD-ROM, DVD+RW, DVD-RW, DVD+R Double Layer
7) DVD 10x CAV : DVD+R, DVD-R
6) DVD 16x CAV : Single layer DVD-ROM(Data)

-Spindle Servo is controlled by IC201(MN103SA6G) and servo signal is output via SP-DRV(Pin70).

3-3. Spindle Servo Process(using the LightScribe)

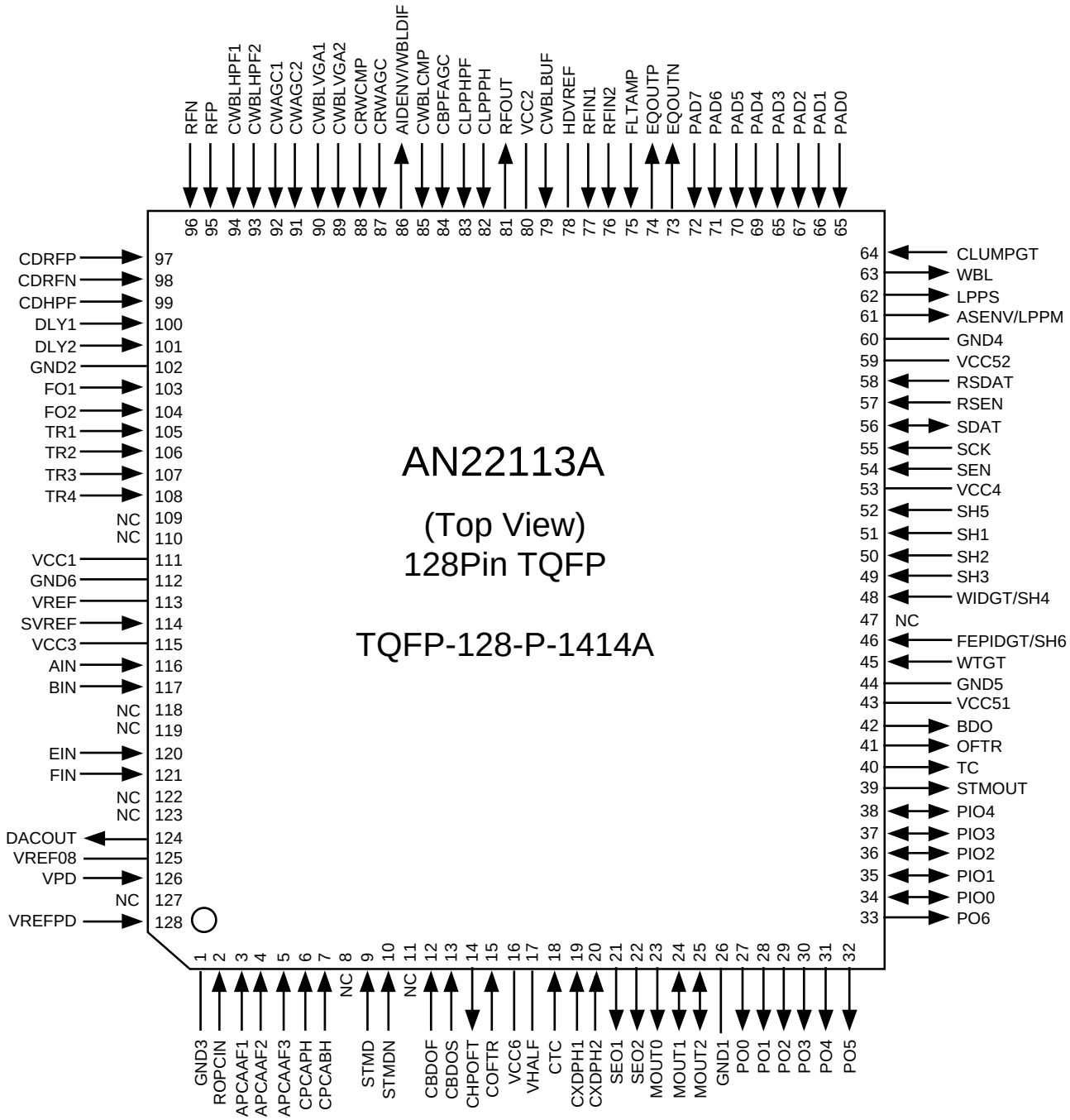




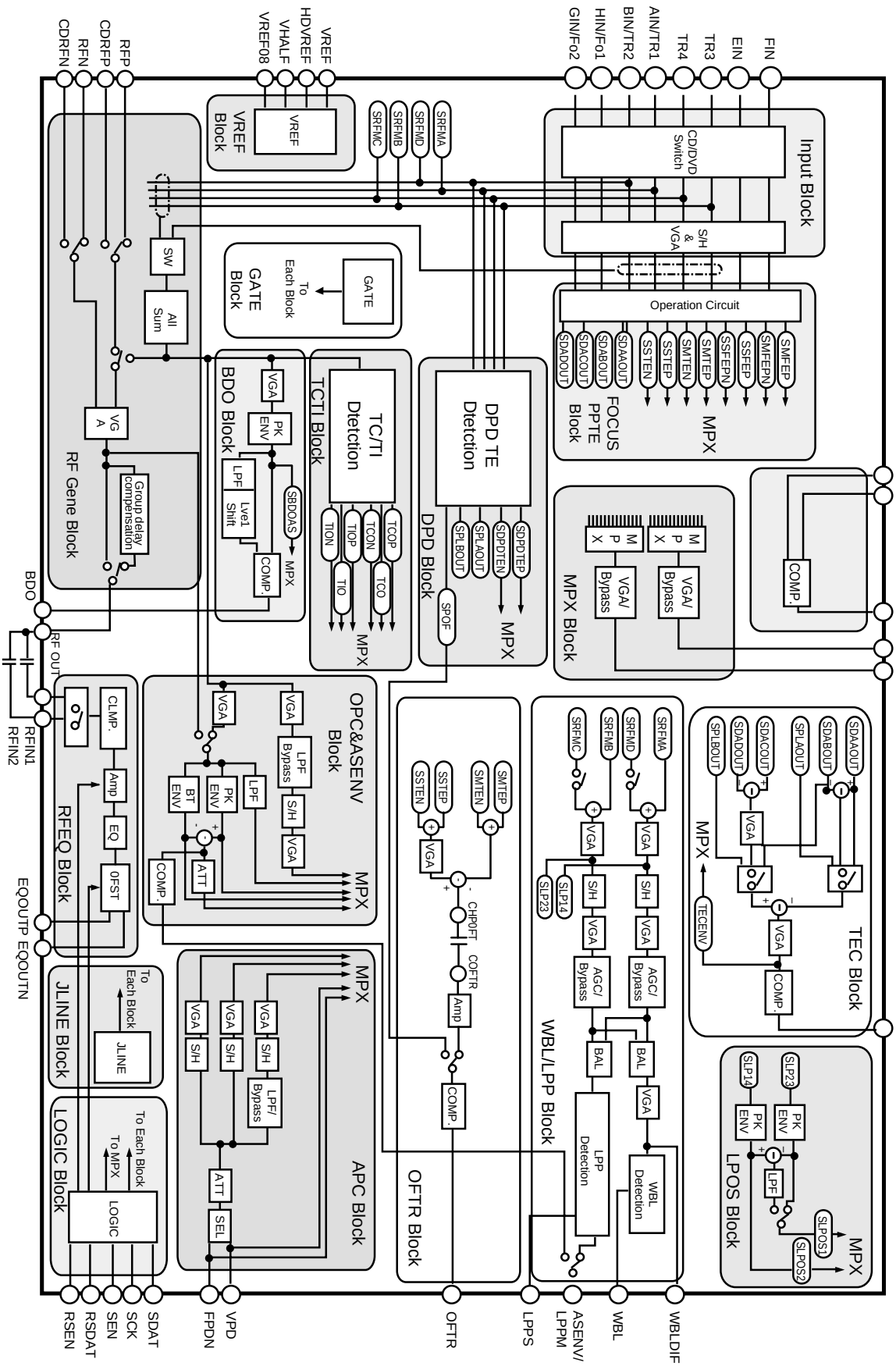
MAJOR IC INTERNAL BLOCK DIAGRAM AND PIN DESCRIPTION

IC121 (AN22113A) : FEP(RF) Analog Signal Processor

- **Pin Assignment**



Block Diagram



• Pin Assignment

Pin no.	Pin Name	Type	Function
1	GND3	PS	Ground pin for APC/OPC & ASENV
2	ROPCIN	I	Input pin after OPC addition
3	APCAAF1	I	Capacitor connection pin for APC mark system AAF
4	APCAAF2	I	Capacitor connection pin for APC average DC detection system AAF
5	APCAAF3	I	Capacitor connection pin for APC bottom detection system AAF.
6	CPCAPH	O	External capacitor connection pin for PCA peak hold.
7	CPCABH	O	External capacitor connection pin for PCA bottom hold.
8	NC	-	-
9	STMD	I	PD input pin for STM
10	STMDN	I	PD input pin for STM
11	N.C	-	-
12	CBDOF	I	Capactitor connection pin for BDO detection Fast Peak Env.
13	CBDOS	I	Capacitor connection pin for BDO detection LPF
14	CHPOFT	O	External capacitor connection pin for OFTR HPF
15	COFTR	I	External capacitor connection pin for OFTR
16	VCC6	PS	Power supply pin for DPD & internal current source power supply pin(3.3V)
17	VHALF	O	1/2 VCC(3.3V) output pin
18	CTC	I	Capacitor connection pin for TE binary floating
19	CXDPH1	I	PH capacitor connection pin 1 for LPOS
20	CXDPH2	I	PH capacitor connection pin 2 for LPOS
21	SEO1	O	Output pin 1 after selection of each error signal
22	SEO2	O	Output pin 2 after selection of each error signal
23	MOUT0	I	Analog monitor 0
24	MOUT1	I/O	Analog monitor 1
25	MOUT2	I/O	Analog monitor 2
26	GND1	PS	Ground pin for INPUT MATRIX/SERVO/VREF/DPD
27	PO0	O	CMOS output pin 0
28	PO1	O	CMOS output pin 1
29	PO2	O	CMOS output pin 2
30	PO3	O	CMOS output pin 3
31	PO4	O	CMOS output pin 4
32	PO5	O	CMOS output pin 5
33	PO6	O	CMOS output pin 6
34	PIO0	I/O	CMOS input pin or output pin 0
35	PIO1	I/O	CMOS input pin or output pin 1
36	PIO2	I/O	CMOS input pin or output pin 2
37	PIO3	I/O	CMOS input pin or output pin 3
38	PIO4	I/O	CMOS input pin or output pin 4
39	STMOUT	O	Encoder circuit comparator output
40	TC	O	Track cross signal output

Pin no.	Pin Name	Type	Function
41	OFTR	O	OFTR signal output
42	BDO	O	BDO output
43	VCC51	PS	Power supply pin for CMOS I/F & internal current source power supply pin 1(3.3V)
44	GND5	PS	Ground pin for CMOS I/F
45	WTGT	I	Light gate signal input (pull-down)
46	FEPIDGT/SH6	I	CAPA through signal input pin/ servo sampling signal input pin(pull-dowm)
47	NC	-	-
48	WIDGT/SH4	I	VFO through signal input pin ROPC mark detection sampling signal input pin (pull-down)
49	SH3	I	PCA average detection, APC space detection/Playback power detection/ Erase detection sample timing signal input pin(pulldown)
50	SH2	I	PCA peak/bottom detection, APC space detection/Playback power detection/ Erase detection sample timing signal input pin(pulldown)
51	SH1	I	ROPC space detection, APC space detection/Playback power detection sample timing signal input pin(pulldown)
52	SH5	I	Sample-and-hold timing signal input pin of wobble S/H at recording (pull-down)
53	VCC4	PS	Power supply pin for internal LOGIC(5.0V)
54	SEN	I	Serial enable input (pulldown)
55	SCK	I	Serial clock input (pullup)
56	SDAT	I/O	Serial signal data input
57	RSEN	I	Serial enable input for RF (pulldown)
58	RSDAT	I	Serial signal data input for RF
59	VCC52	PS	Power supply pin for CMOS I/F & internal current source power supply pin2 (3.3V)
60	GND4	PS	Ground pin for internal LOGIC
61	ASENV/LPPM	O	ASENV output/LPP mark output pin
62	LPPS	O	LPP space output pin
63	WBL	O	WBL binary output
64	CLUMPGT	I	RFAGC input bias circuit clamp setting input pin (pulldown)
65	PAD0	I	A/D input pin 0
66	PAD1	I	A/D input pin 1
67	PAD2	I	A/D input pin 2
68	PAD3	I	A/D input pin 3
69	PAD4	I	A/D input pin 4
70	PAD5	I	A/D input pin 5
71	PAD6	I	A/D input pin 6
72	PAD7	I	A/D input pin 7
73	EQOUTN	O	Equalizer filter ouptut N pin
74	EQOUTP	O	Equalizer filter output P pin
75	FLTAMP	I	FILTER final stage AMP reference voltage stabilization pin

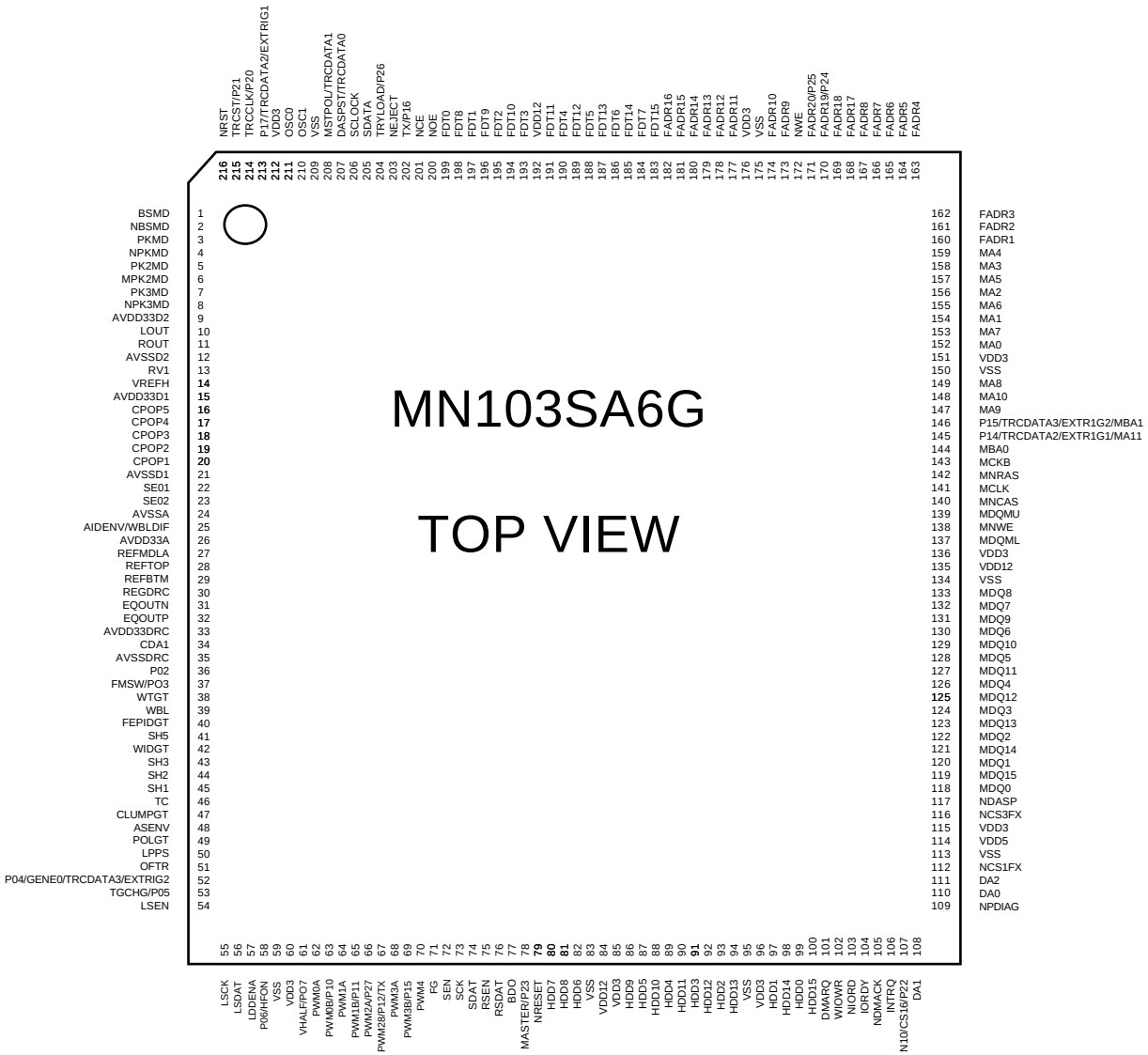
Pin no.	Pin Name	Type	Function
76	RFIN2	I	RFAGC signal input pin 2
77	RFIN1	I	RFAGC signal input pin 1
78	HDVREF	O	2.2V reference voltage output pin
79	CWBLBUF	I	Capacitor connection pin for WBLDIF
80	VCC2	PS	Power supply pin for RFGene/RFEQ/WBL/LPP (5.0V)
81	RFOUT	O	RFGene signal output pin
82	CLPPPH	I	Capacitor connection pin for LPP peak hold
83	CLPPHPF	I	Capacitor connection pin for LPPHPF
84	CBPFAGC	I	AGC adjustment capacitor connection pin after WBL BPF
85	CWBLCMP	I	Floating Capacitor connection pin for VGA before WBL binary
86	AIDENV/WBLDIF	O	ASENV binary output/Differential signal output pin for ADIP detection
87	CRWAGC	I	AGC adjustment capacitor connection pin for +RW
88	CRWCMP	I	Floating Capacitor connection pin for VGA before WBLDIF AGC
89	CWBLVGA2	I	Floating Capacitor connection pin 2 for VGA before SLR
90	CWBLVGA1	I	Floating Capacitor connection pin 1 for VGA before SLR
91	CWAGC2	I	AGC adjustment capacitor connection pin 2 for WBL extraction
92	CWAGC1	I	AGC adjustment capacitor connection pin 1 for WBL extraction
93	CWBLHPF2	I	Capacitor connection pin for N side HPF before WBLAGC
94	CWBLHPF1	I	Capacitor connection pin for P side HPF before WBLAGC
95	RFP	I	DVD RF differential input + pin
96	RFN	I	DVD RF differential input - pin
97	CDRFP	I	CD RF differential input + pin
98	CDRFN	I	CD RF differential input - pin
99	CDHPF	I	Internal RF additional floating capacitor connection pin
100	DLY1	I	Capacitor connection pin 1 for group delay correction
101	DLY2	I	Capacitor connection pin 2 for group delay correction
102	GND2	PS	Ground pin for RFGene/RFEQ/WBL/LPP
103	FO1/GIN	I	DVD focus signal input pin 1/CD sub signal input pin 3
104	FO2/HIN	I	DVD focus signal input pin 2/CD sub signal input pin 4
105	TR1	I	DVD tracking signal input pin 1
106	TR2	I	DVD tracking signal input pin 2
107	TR3	I	DVD tracking signal input pin 3
108	TR4	I	DVD tracking signal input pin 4
109	N.C	-	-
110	N.C.	-	-
111	VCC1	PS	Power supply pin for INPUT MATRIX/SERVO/VREF (5.0V)
112	GND6	PS	Ground pin for BG
113	VREF	O	1.65V reference voltage output pin
114	SVREF	I	OEIC signal reference level input pin
115	VCC3	-	Power supply pin for APC/OPC&ASENV(5.0V)

Pin no.	Pin Name	Type	Function
116	AIN	I	CD main signal input pin 1
117	BIN	I	CD main signla input pin 2
118	N.C.	-	-
119	N.C.	-	-
120	EIN	I	CD sub signal input pin 1
121	FIN	I	CD sub signll input pin 2
122	N.C.	-	-
123	N.C.	-	-
124	DACOUT	O	Wide Use DAC output pin
125	VREF08	O	0.8V referece Voltage output (for APC) pin
126	VPD	I	DVD front monitor signal input pin (for APC)
127	N.C.	I	-
128	VREFPD	I	Front light system reference level input pin

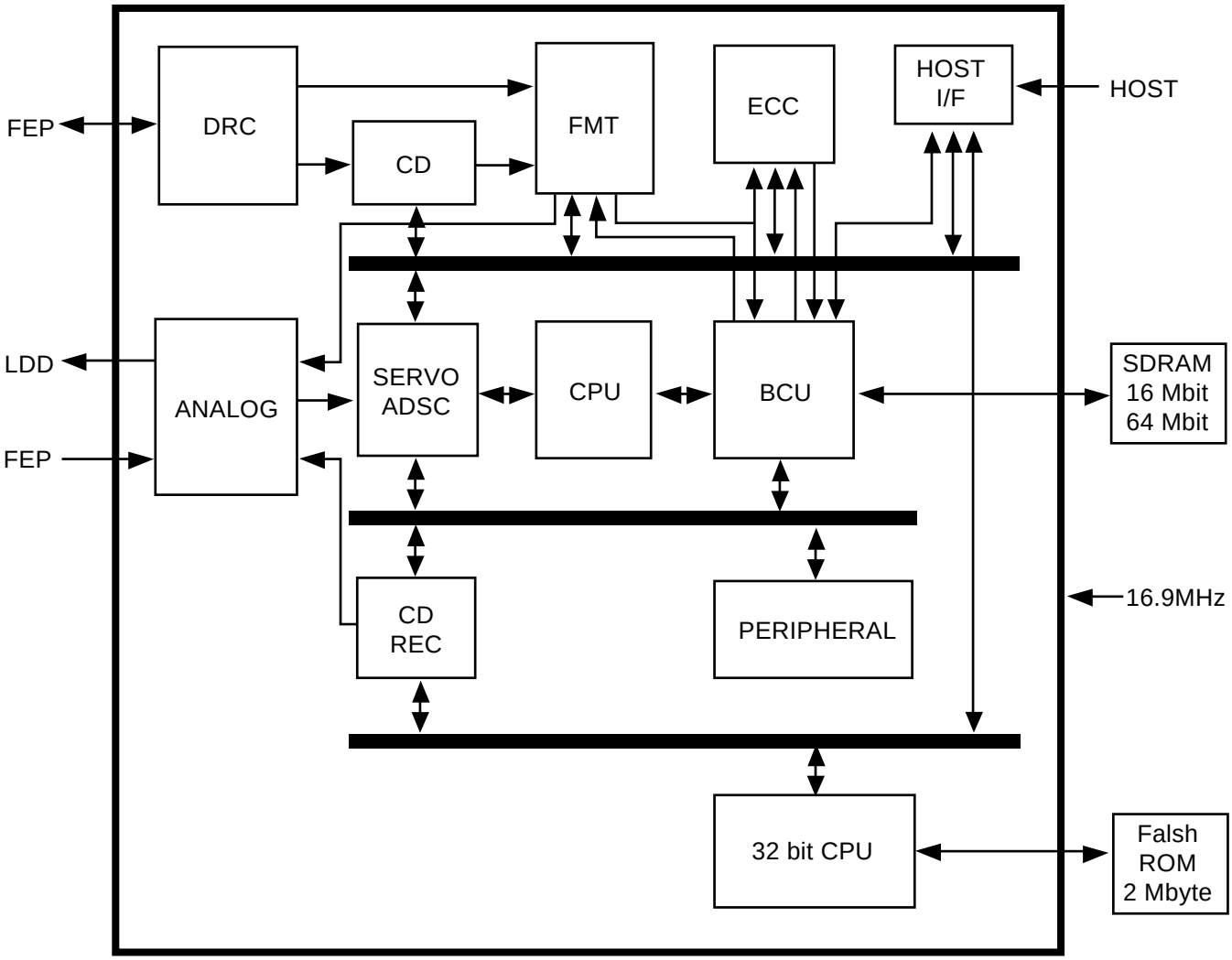
I : Input pin O: Output pin I/O : I/O pin PS : Power supply/Ground pin N.C: Non Connection

IC201 (MN103SA6G) : Encoder, Decoder & DSP Singal Processor

- **Pin Assigment**



- **Block Diagram (SODC:MN103SA6G)**



- **Pin Table**

Pin Number	Pin Name	I/O	Connection Target	Description
1	BSMD	O	PU	BIAS modulation signal differential current output
2	NBSMD	O	PU	NBIAS modulation signal differential current output
3	PKMD	O	PU	PEAK1 modulation signal differential current output
4	NPKMD	O	PU	NPEAK1 modulation signl differential current output
5	PK2MD	O	PU	PEAK2 modulation signal differential current ouptut
6	NPK2MD	O	PU	NPEAK2 modulation signal differential current ouptut
7	PK3MD	O	PU	PEAK3 modulation signal differential current ouptut
8	NPK3MD	O	PU	NPEAK3 modulation signal differential current ouptut
9	AVDD33D2	Power supply	Power supply	Analog V_{DD}(3.3V) for audio
10	LOUT	O	Audio AMP	Analog audio output (Lch)
11	ROUT	O	Audio AMP	Analog audio ouput (Rch)
12	AVSSD2	GND	GND	Analog Vss for audio
13	RV1	I/O	Res	Fixed current source for LVDS, WBL, and analog blocks
14	VREFH	I	FEP	2.2V reference voltage input
15	AVDD33D1	Power supply	Power supply	WOBBLE analog V_{DD}(3.3V)
16	CPOP5	I/O	Cap.Res	Filter connection pin for wobble PLL
17	CPOP4	I/O	Cap.Res	Filter connection pin for wobble PLL
18	CPOP3	I/O	Cap.Res	Filter connection pin for wobble PLL
19	CPOP2	I/O	Cap.Res	Filter connection pin for wobble PLL
20	CPOP1	I/O	Cap.Res	Filter connection pin for wobble PLL
21	AVSSD1	GND	GND	WOBBLE analog Vpp
22	SEO1	I	FEP	Error signal output after selection analog input
23	SEO2	I	FEP	Error signla output after selection analog input
24	AVSSA	GND	GND	Servo analog-to-digital converter analog Vss
25	AIDENV	I	FEP	TE signal for DVD-RAM
	WBLDIF			ADIP detector signal input
26	AVDD33A	Power supply	Power supply	Servo analog-to-digital converter analog V_{DD}(3.3V)
27	REFMDLA	O	Cap	Analog-to-digital converter reference voltage for ADIP
28	REFTOP	O	Cap	Analog-to-digital converter reference voltage for DRC(TOP)
29	REFBTM	O	Cap	Analog-to-digital converter reference voltage for DRC(BOTTOM)
30	REGDRC	O	Cap	DRC analog-to-digital converter analog V_{DD}(1.2V)
31	EQOUTN	I	FEP	RF differential signal (NEG)
32	EQOUTP	I	FEP	RF differential signal (POS)
33	AVDD33DRC	Power supply	Power supply	DRC analog-to-digital converter analog V_{DD}(3.3V)
34	CDA1	O	Cap	Smoothing capacitance for DRC-VCO
35	AVSSDRC	GND	GND	DRC analog Vss
36	PO2	I/O	-	CPU external interrupt, general-purpose I/O, laser fault detect signal

Pin Number	Pin Name	I/O	Connection Target	Description
37	FMSW	I/O	PU	Power monitor detector multiplier conversion signal
	PO3			General-purpose I/O
38	WTGT	O	FEP	Write gate
39	WBL	I	FEP	Wobble binary signal
40	FEPIDGT	O	FEP	CAPA punch out signal, main beam sampling signal
41	SH5	O	FEP	Write WOBBLE sample and hold sampling signal
42	WIDGT	O	FEP	VFO punch out signal, ROPC mark detection sampling signal
43	SH3	O	FEP	Sample timing signal for PCA mean value detection, APC space detection, read power detection, and erase detection
44	SH2	O	FEP	Sample timing signal for PCA peak, bottom detection, APC peak detection, and mean value detection
45	SH1	O	FEP	Sample timing signal for ROPC, space detection, APC space detection, and read power detection
46	TC	I	FEP	Track crossing signal input
47	CLUMPGT	O	FEP	RF AGC bias circuit clamp signal
48	ASENV	I	FEP	ASENV/LPP mark input
49	POLGT	O	FEP	CAPA polarity switch signal, sub beam sampling signal
50	LPPS	I	FEP	LPP space input
51	OFTR	I	FEP	Off track input
52	PO4	I/O	-	CPU external interrupt, general-purpose I/O
	GENE0			Inner limit switch input
	TRCDATA3			Trace data 3
	EXTRIG2			Trigger 2
53	TGCHG	I/O	OEIC	Write power switch signal
	P05			General-purpose I/O
54	LSEN	O	PU	LDD serial interface enable
55	LSCK	O	PU	LDD serial interface clock
56	LSDAT	I/O	PU	LDD serial interface data
57	LDDENA	O	PU	LDD enable signal
58	P06	I/O	-	CPU external interrupt(5V input)
	HFON			General-purpose I/O for external high frequency module(HFM) ON/OFF
59	VSS	GND	GND	Digital Vss
60	VDD3	Power supply	Power supply	I/O pad V_{DD}(3.3V)
61	VHALF	I/O	FEP	Drive pin central reference voltage input
	P07			General-purpose I/O
62	PWM0A	O	DRIVER	Focus drive differential PWM+ output, focus drive BSDA output
63	PWMOB	I/O	DRIVER	Focus drive differential PWM- output
	P10			General-purpose I/O

Pin Number	Pin Name	I/O	Connection Target	Description
64	PWM1A	O	DRIVER	Focus 2(tilt) drive differential PWM+ output, focus 2 drive BSDA output.
65	PWM1B	I/O	DRIVER	Focus 2(tilt) drive differential PWM-output
	P11			General-purpose I/O
66	PWM2A	I/O	DRIVER	Tracking drive differential PWM+ output, tracking drive BSDA output
	P27			General-purpose I/O
67	PWM2B	I/O	DRIVER	Tracking drive differential PWM-output
	P12			General-purpose I/O, IEC958-compliant digital output
	TX			Debugging serial TX
68	PWM3A	O	DRIVER	Traverse drive differential PWM+ output, stepper 1 drive output
69	PWM3B	I/O	DRIVER	Traverse drive differential PWM- output, stepper 2 drive output
	P13			General-purpose I/O
70	PWM4	O	DRIVER	Spindle drive output
71	FG	I	DRIVER	Spindle FG input(5V input)
72	SEN	O	FEP	FEP serial interface enable
73	SCK	O	FEP	FEP serial interface clock
74	SDAT	I/O	FEP	FEP serial interface data
75	RSEN	O	FEP	FEP serial interface enable2(RF)
76	RSDAT	O	FEP	FEP serial interface data2(RF)
77	BDO	I	FEP	Dropout signal
78	MASTER	I/O	HOST	ATAPI master/slave signal
	P23			General-purpose I/O
79	NRESET	I	HOST	ATAPI reset signal
80	HDD7	I/O	HOST	ATAPI data I/O
81	HDD8	I/O	HOST	ATAPI data I/O
82	HDD6	I/O	HOST	ATAPI data I/O
83	VSS	GND	GND	Digital Vss
84	VDD12	Power supply	Power supply	Internal logic Vpp(1.2V)
85	VDD3	Power supply	Power supply	I/O pad V_{DD}(3.3V)
86	HDD9	I/O	HOST	ATAPI data I/O
87	HDD5	I/O	HOST	ATAPI data I/O
88	HDD10	I/O	HOST	ATAPI data I/O
89	HDD4	I/O	HOST	ATAPI data I/O
90	HDD11	I/O	HOST	ATAPI data I/O
91	HDD3	I/O	HOST	ATAPI data I/O
92	HDD12	I/O	HOST	ATAPI data I/O
93	HDD2	I/O	HOST	ATAPI data I/O
94	HDD13	I/O	HOST	ATAPI data I/O
95	VSS	GND	GND	Digital Vss

Pin Number	Pin Name	I/O	Connection Target	Description
96	VDD3	Power supply	Power supply	I/O pad V_{DD}(3.3)
97	HDD1	I/O	HOST	ATAPI data I/O
98	HDD14	I/O	HOST	ATAPI data I/O
99	HDD0	I/O	HOST	ATAPI data I/O
100	HDD15	I/O	HOST	ATAPI data I/O
101	DMARQ	O	HOST	DMA request to ATAPI host
102	NIOWR	I/O	HOST	ATAPI host write signal
103	NIORD	I/O	HOST	ATAPI host read signal
104	IORDY	O	HOST	Ready signal to ATAPI host
105	NDMACK	I	HOST	ATAPI host DMA acknowledge signal
106	INTRQ	O	HOST	Interrupt request to ATAPI host
107	NIOCS16	I/O	HOST	ATAPI data bus width select signal
	P22			General-purpose I/O
108	DA1	I/O	HOST	ATAPI host address signal input
109	NPDIAG	I/O	HOST	Diagnostic signal from ATAPI slave to master
110	DA0	I/O	HOST	ATAPI host address signal
111	DA2	I/O	HOST	ATAPI host address signal
112	NCS1FX	I	HOST	ATAPI host chip select signal
113	VSS	GND	GND	Digital Vss
114	VDD5	Power supply	Power supply	5V reference power supply
115	VDD3	Power supply	Power supply	I/O pad V_{DD}(3.3V)
116	NCS3FX	I	HOST	ATAPI host chip select signal
117	NDASP	I/O	HOST	ATAPI drive active slave signal
118	MDQ0	I/O	SDRAM	SDRAM data
119	MDQ15	I/O	SDRAM	SDRAM data
120	MDQ1	I/O	SDRAM	SDRAM data
121	MDQ14	I/O	SDRAM	SDRAM data
122	MDQ2	I/O	SDRAM	SDRAM data
123	MDQ13	I/O	SDRAM	SDRAM data
124	MDQ3	I/O	SDRAM	SDRAM data
125	MDQ12	I/O	SDRAM	SDRAM data
126	MDQ4	I/O	SDRAM	SDRAM data
127	MDQ11	I/O	SDRAM	SDRAM data
128	MDQ5	I/O	SDRAM	SDRAM data
129	MDQ10	I/O	SDRAM	SDRAM data
130	MDQ6	I/O	SDRAM	SDRAM data
131	MDQ9	I/O	SDRAM	SDRAM data
132	MDQ7	I/O	SDRAM	SDRAM data

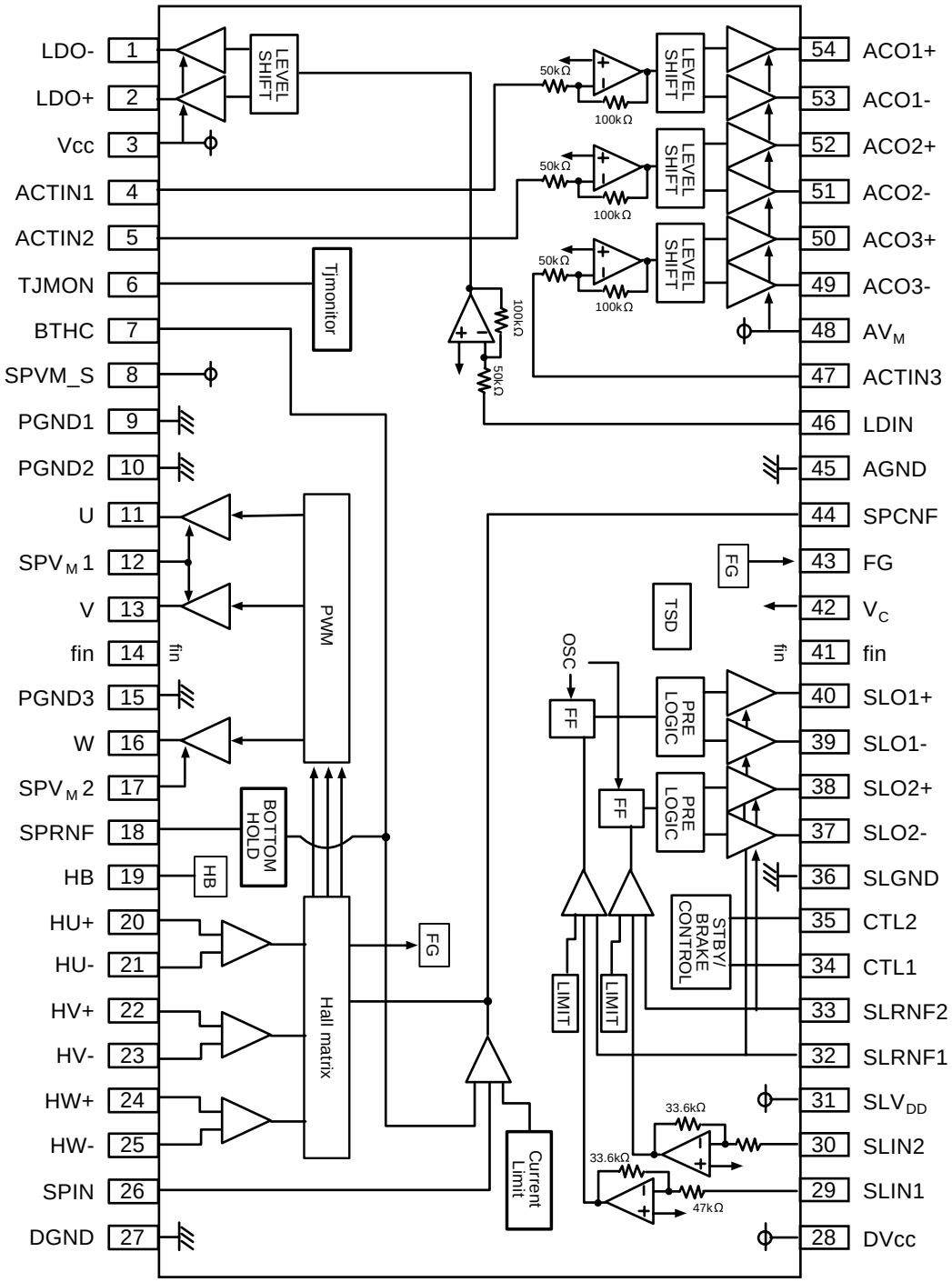
Pin Number	Pin Name	I/O	Connection Target	Description
133	MDQ8	I/O	SDRAM	SDRAM data
134	VSS	GND	GND	Digital Vss
135	VDD12	Power supply	Power supply	Internal logic Vpp(1.2V)
136	VDD3	Power supply	Power supply	I/O pad V_{DD}(3.3V)
137	MDQML	O	SDRAM	SDRAM DQML signal
138	MNWE	O	SDRAM	SDRAM write enable signal
139	MDQMU	O	SDRAM	SDRAM DQMU signal
140	MNCAS	O	SDRAM	SDRAM CAS signal
141	MCLK	I/O	SDRAM	SDRAM clock
142	MNRAS	O	SDRAM	SDRAM RAS signal
143	MCKE	O	SDRAM	SDRAM clock enable signal
144	MBA0	O	SDRAM	SDRAM bank switch 0
145	P14	I/O	SDRAM	General-purpose I/O
	TRCDATA2			Debugging trace data
	EXTRIG1			Trigger
	MA11			SDRAM address
146	P15	I/O	SDRAM	General-purpose I/O
	TRCDATA3			Debugging trace data
	EXTRIG2			Trigger
	MBA1			SDRAM bank switch 1
147	MA9	O	SDRAM	SDRAM address
148	MA10	O	SDRAM	SDRAM address
149	MA8	O	SDRAm	SDRAM address
150	VSS	GND	GND	Digital Vss
151	VDD3	Power supply	Power supply	I/O pad V_{DD}(3.3V)
152	MA0	O	SDRAM	SDRAM address
153	MA7	O	SDRAM	SDRAM address
154	MA1	O	SDRAM	SDRAM address
155	MA6	O	SDRAM	SDRAM address
156	MA2	O	SDRAM	SDRAM address
157	MA5	O	SDRAM	SDRAM address
158	MA3	O	SDRAM	SDRAM address
159	MA4	O	SDRAM	SDRAM address
160	FADR1	I/O	FLASH	Flash ROM address
161	FADR2	I/O	FLASH	Flash ROM address
162	FADR3	I/O	FLASH	Flash ROM address
163	FADR4	I/O	FLASH	Flash ROM address
164	FADR5	I/O	FLASH	Flash ROM address

Pin Number	Pin Name	I/O	Connection Target	Description
165	FADR6	I/O	FLASH	Flash ROM address
166	FADR7	I/O	FLASH	Flash ROM address
167	FADR8	I/O	FLASH	Flash ROM address
168	FADR17	I/O	FLASH	Flash ROM address
169	FADR18	I/O	FLASH	Flash ROM address
170	FADR19	I/O	FLASH	Flash ROM address
	P24			General-purpose I/O
171	FADR20	I/O	FLASH	Flash ROM address
	P25			General-purpose I/O
172	NWE	O	FLASH	Flash ROM write enable signal
173	FADR9	I/O	FLASH	Flash ROM address
174	FADR10	I/O	FLASH	Flash ROM address
175	VSS	GND	GND	Digital Vss
176	VDD3	Power supply	Power supply	I/O pad V_{DD}(3.3V)
177	FADR11	I/O	FLASH	Flash ROM address
178	FADR12	I/O	FLASH	Flash ROM address
179	FADR13	I/O	FLASH	Flash ROM address
180	FADR14	I/O	FLASH	Flash ROM address
181	FADR15	I/O	FLASH	Flash ROM address
182	FADR16	I/O	FLASH	Flash ROM address
183	FDT15	I/O	FLASH	Flash ROM data
184	FDT7	I/O	FLASH	Flash ROM data
185	FDT14	I/O	FLASH	Flash ROM data
186	FDT6	I/O	FLASH	Flash ROM data
187	FDT13	I/O	FLASH	Flash ROM data
188	FDT5	I/O	FLASH	Flash ROM data
189	FDT12	I/O	FLASH	Flash ROM data
190	FDT4	I/O	FLASH	Flash ROM data
191	FDT11	I/O	FLASH	Flash ROM data
192	VDD12	Power supply	Power supply	Internal logic V_{DD}(1.2V)
193	FDT3	I/O	FLASH	Flash ROM data
194	FDT10	I/O	FLASH	Flash ROM data
195	FDT2	I/O	FLASH	Flash ROM data
196	FDT9	I/O	FLASH	Flash ROM data
197	FDT1	I/O	FLASH	Flash ROM data
198	FDT8	I/O	FLASH	Flash ROM data
199	FDT0	I/O	FLASH	Flash ROM data
200	NOE	O	FLASH	Flash ROM output enable signal

Pin Number	Pin Name	I/O	Connection Target	Description
201	NCE	O	FLASH	Flash ROM chip enable signal
202	TX	I/O	-	IEC958-compliant digital output, debugging serial TX
	P16			General-purpose I/O
203	NEJECT	I/O	Mecha	Tray eject signal (SODC external interrupt)
204	TRYLOAD	I/O	Mecha	Tray eject signal (SODC external interrupt)
	P26			General-purpose I/O
205	SDATA	I/O	-	Debugger data, DRC monitor 0
206	SCLOCK	I/O	-	Debugger clock, DRC monitor 1
207	DASPST	I/O	-	DASP setting
	TRCDATA0			Trace data 0
208	MSTPOL	I/O	-	MASTER pin polarity switch
	TRCDATA1			Trace data 1
209	VSS	GND	GND	Digital Vss
210	OSCI	I	Xtal	Oscilator input (16.9344MHz)
211	OSCO	O	Xtal	Oscilator output
212	VDD3	Power supply	Power supply	I/O pad V_{DD}(3.3V)
213	P17	I/O	-	General-purpose I/O
	TRCDATA2			Trace data 2
	EXTRIG1			External interrupt
214	TRCCLK	I/O	-	Trace clock
	P20			General-purpose I/O
215	TRCST	I/O	-	Trace status
	P21			General-purpose I/O
216	NRST	I	Reset IC	Reset input (power on reset)

IC301 (BD7956FS) : CD-ROM/DVD-ROM 7CH POWER DRIVER

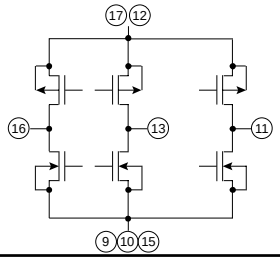
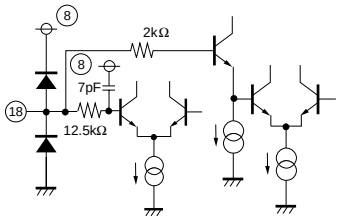
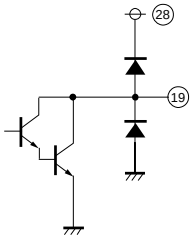
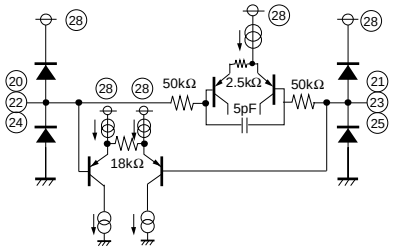
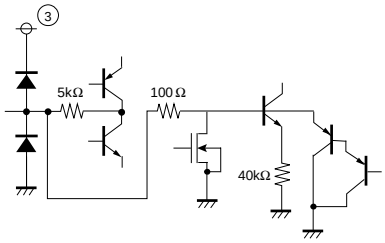
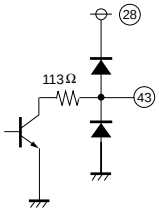
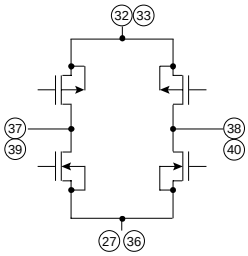
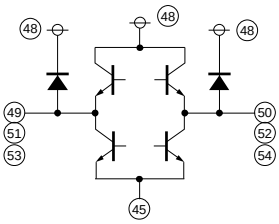
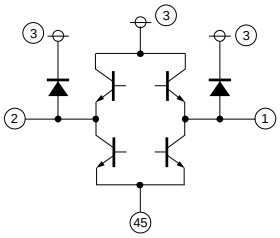
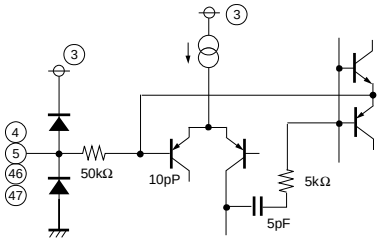
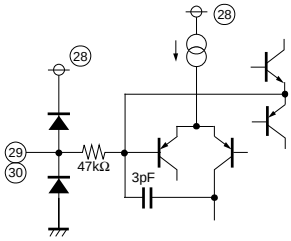
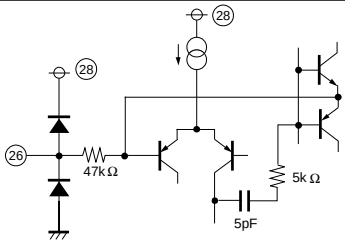
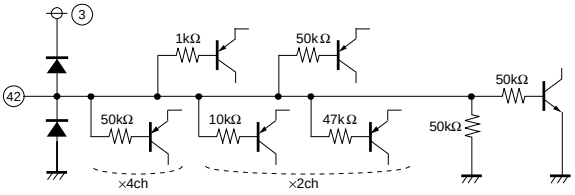
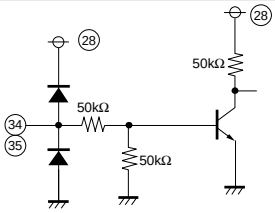
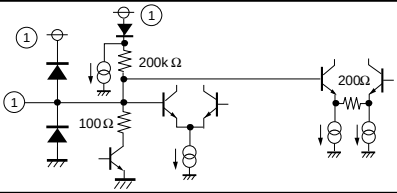
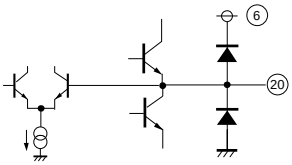
- **Block Diagram**



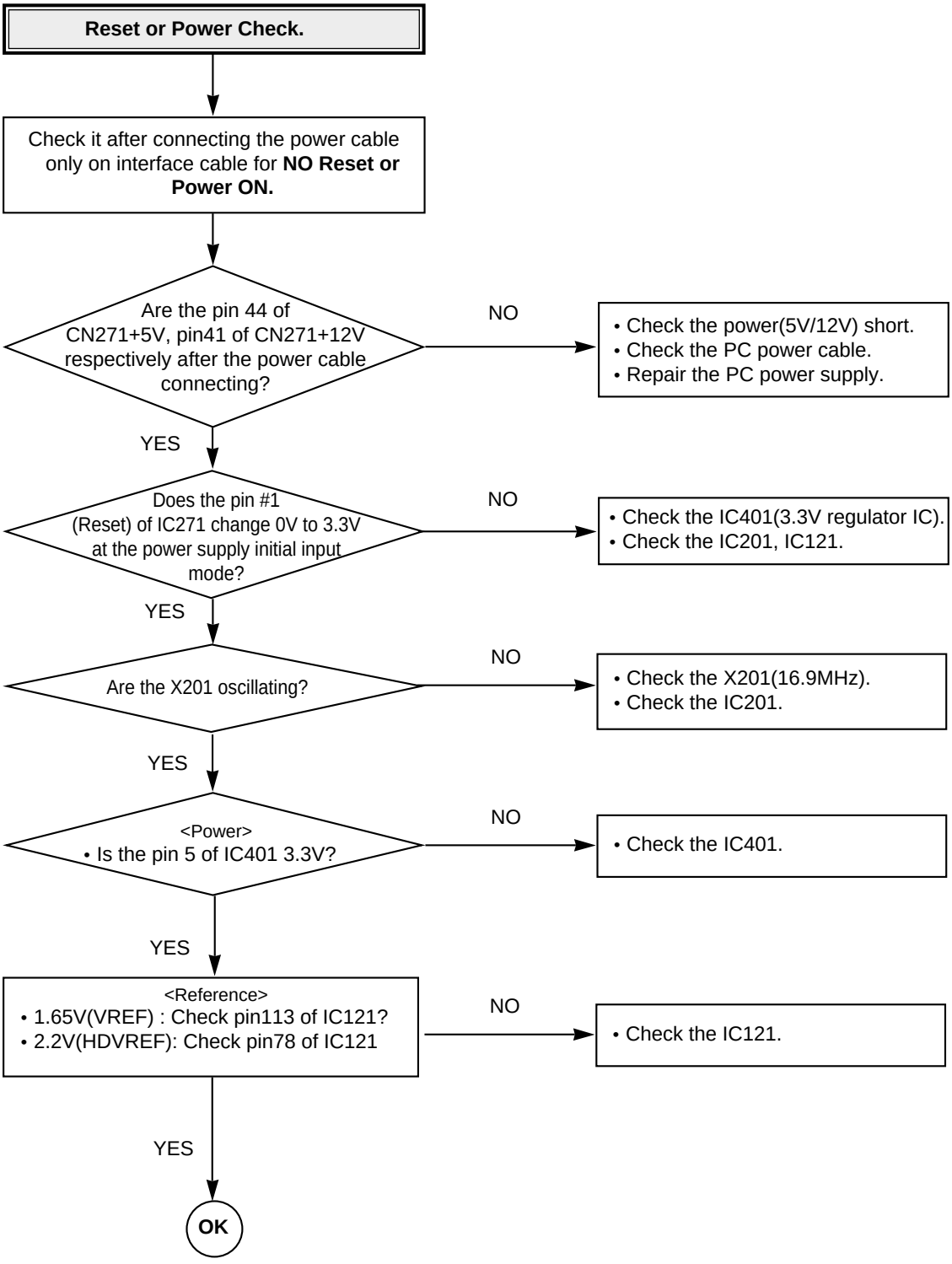
• Pin Function

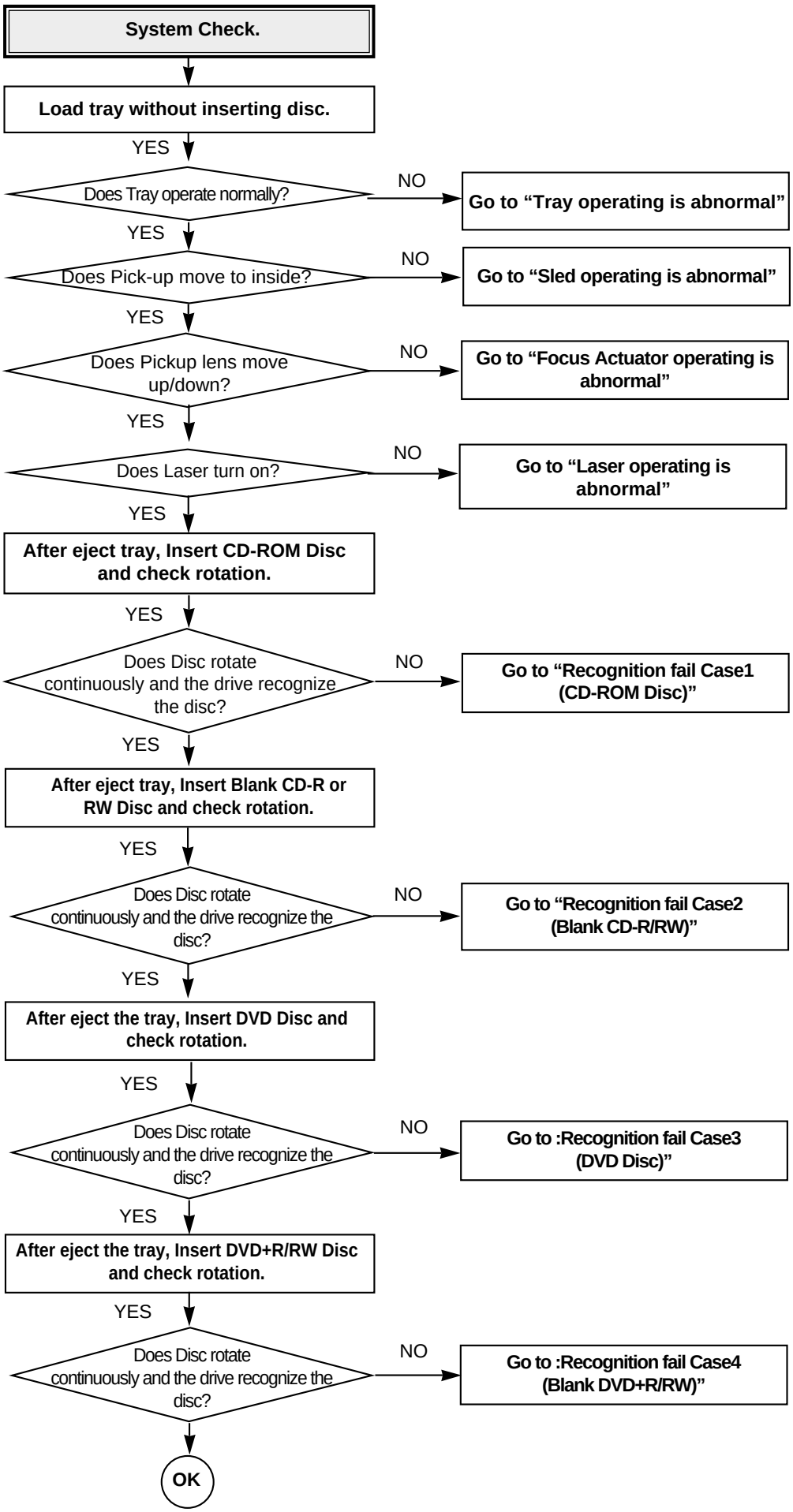
No	Symbol	Description	No	Symbol	Description
1	LDO-	Loading driver negative output	54	ACO1+	Actuator driver 1 positive output
2	LDO+	Loading driver positive output	53	ACO1-	Actuator driver 1 negative output
3	Vcc	BTL pre and Loading power supply	52	ACO2+	Actuator driver 2 positive output
4	ACTIN1	Actuator driver 1 input	51	ACO2-	Actuator driver 2 negative output
5	ACTIN2	Actuator driver 2 input	50	ACO3+	Actuator driver 3 positive output
6	TJMON	monitor of chip temperature	49	ACO3-	Actuator driver 3 negative output
7	BTHC	Capacitor connection terminal for spindle current bottom holding	48	AVM	Actuator driver block power supply
8	SPVM-S	Spindle driver sense power supply	47	ACTIN3	Actuator driver input 3
9	PGND1	Spindle driver power ground 1	46	LDIN	Loading driver input
10	PGND2	Spindle driver power ground 2	45	AGND	BTL driver block power ground
11	U	Spindle driver output U	44	SPCNF	Spindle driver feedback filter
12	SPVM1	Spindle driver power supply 1	43	FG	Frequency generator output
13	V	Spindle driver output V	42	Vc	Reference voltage input
14	fin	fin	41	fin	fin
15	PGND3	Spindle driver power ground 3	40	SLO1+	Sled driver 1 positive output
16	W	Spindle driver output W	39	SLO1-	Sled driver 1 negative output
17	SPVM2	Spindle driver power supply 2	38	SLO2+	Sled driver 2 positive output
18	SPRNF	Spindle driver current sense	37	SLO2-	Sled driver 2 negative output
19	HB	Hall bias	36	SLGND	Sled driver power ground
20	HU+	Hall amp.U positive input	35	CTL2	Driver logic control 2 input
21	HU-	Hall amp.U negative input	34	CTL1	Driver logic control 1 input
22	HV+	Hall amp.V positive input	33	SLRNF2	Sled driver 2 current sense
23	HV-	Hall amp.V negative input	32	SLRNF1	Sled driver 1 current sense
24	HW+	Hall amp.W positive input	31	SLVDD	Sled driver PowerMOS pre-supply
25	HW-	Hall amp.W negative input	30	SLIN2	Sled driver 2 input
26	SPIN	Spindle driver input	29	SLIN1	Sled driver 1 input
27	DGND	PWM block pre-ground	28	DVcc	PWM block control power supply

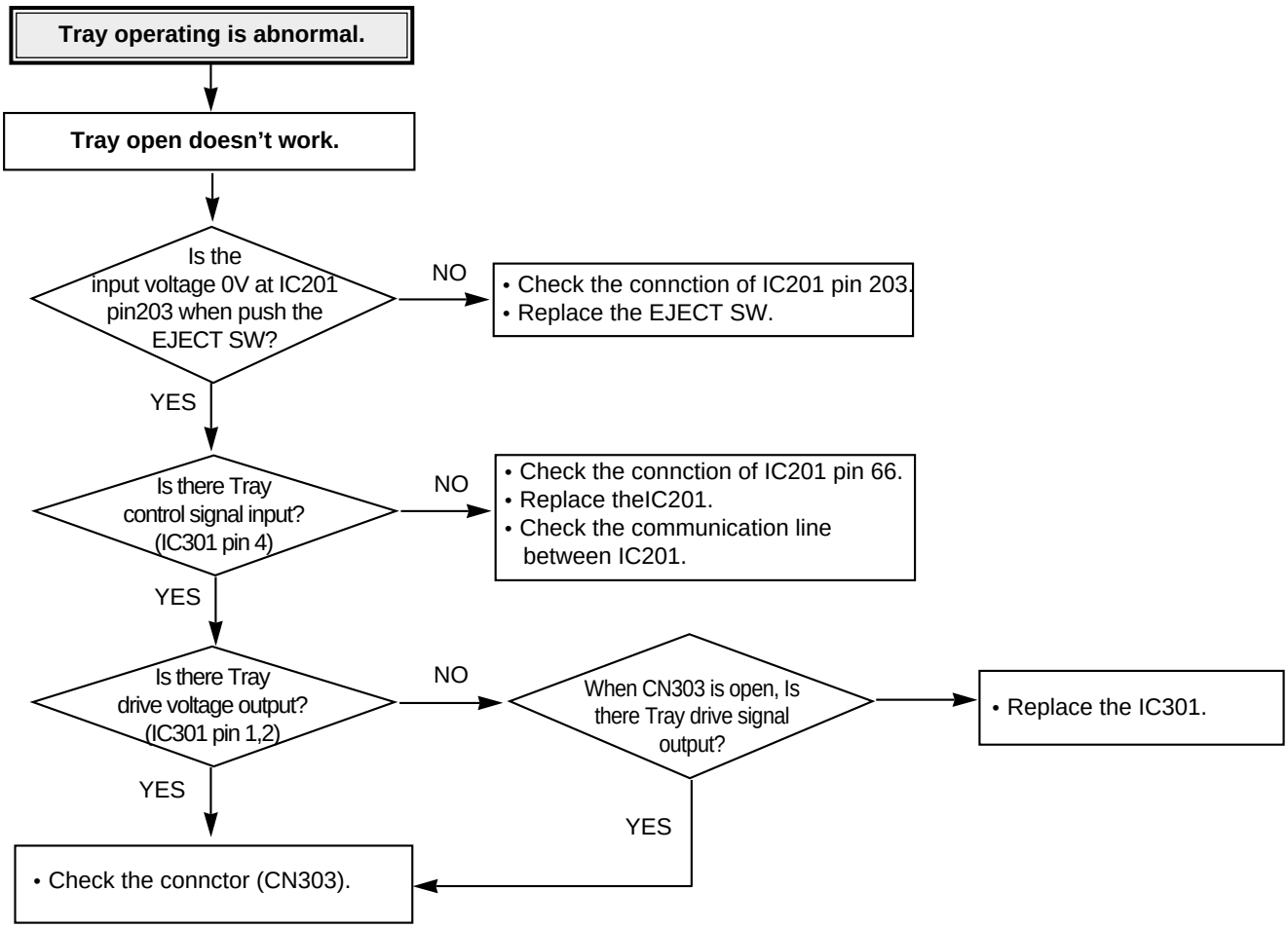
Input/Output circuit diagram

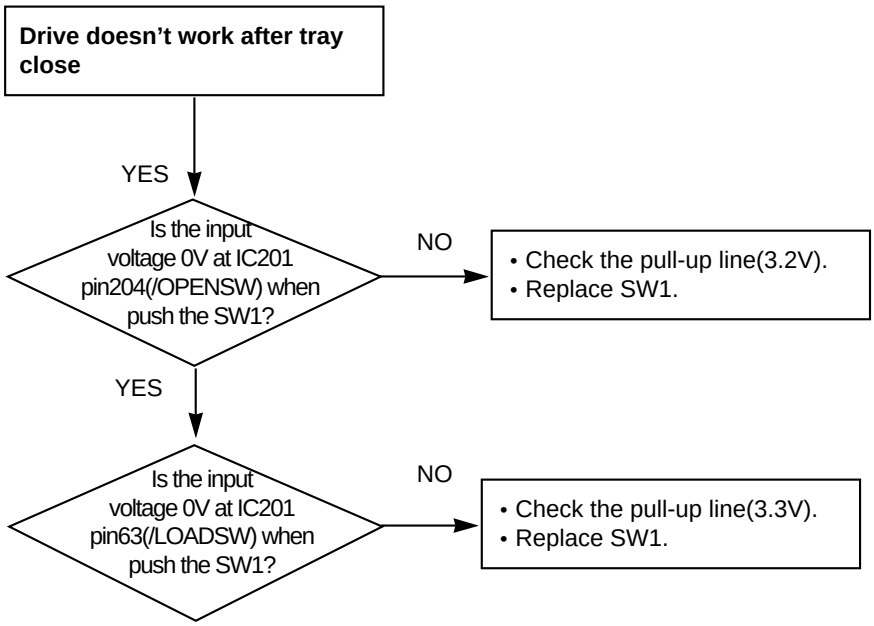
Three-phase motor driver output	Spindle driver current detection input	Hall bias
		
Hall signal input	**Splindle driver feedback filter pin**	**FG signal output**
		
PWM driver output SLED1, 2	**BTL driver output FO, TK**	**BTL driver output LD**
		
BTL driver input ACT1,2,3,LD	**PWM driver input SLED1, 2**	**PWM driver input Spindle**
		
Reference voltage input		**Control signal input**
		
BTHC terminal	**TJ output**	
		

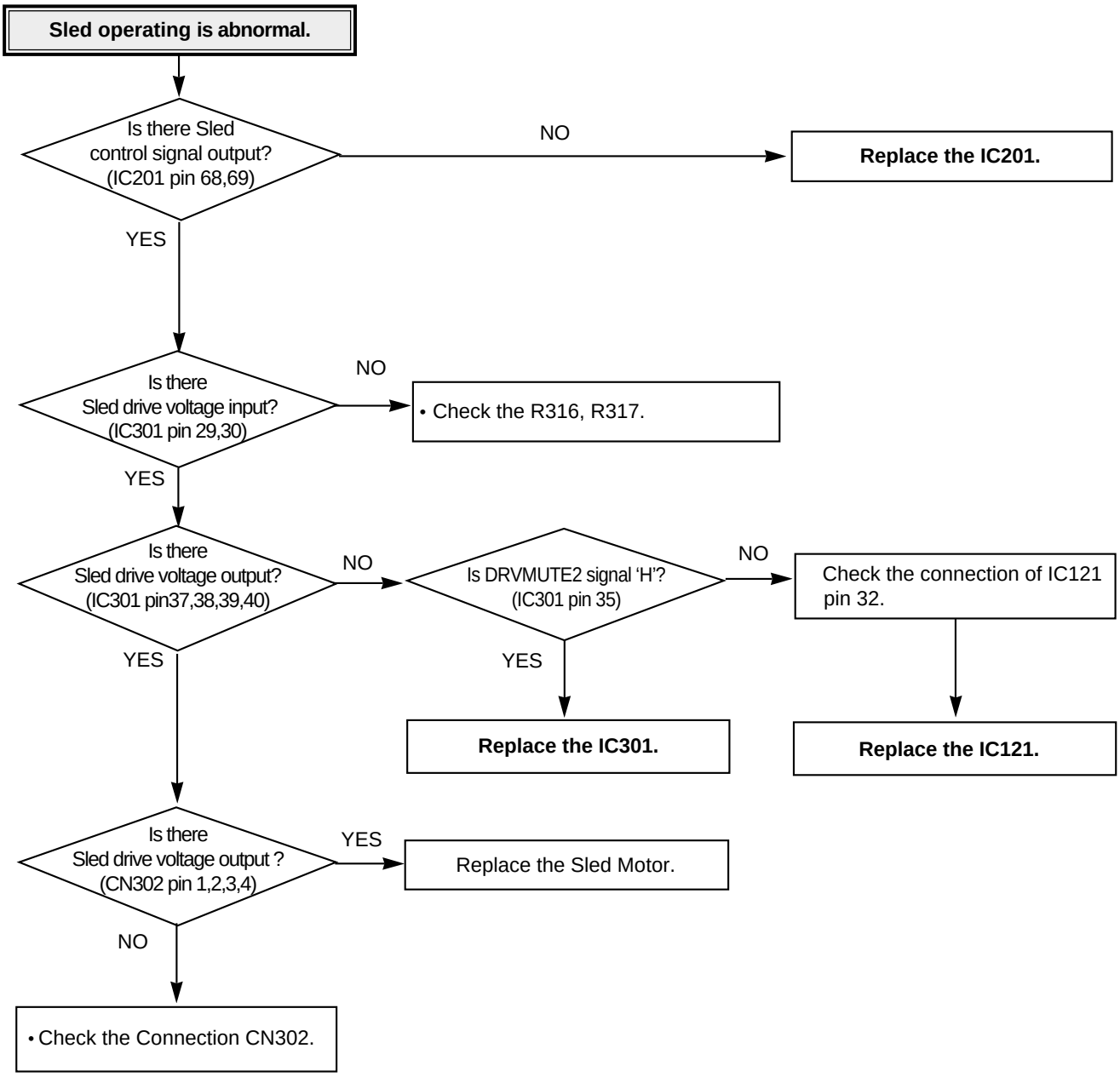
TROUBLESHOOTING GUIDE

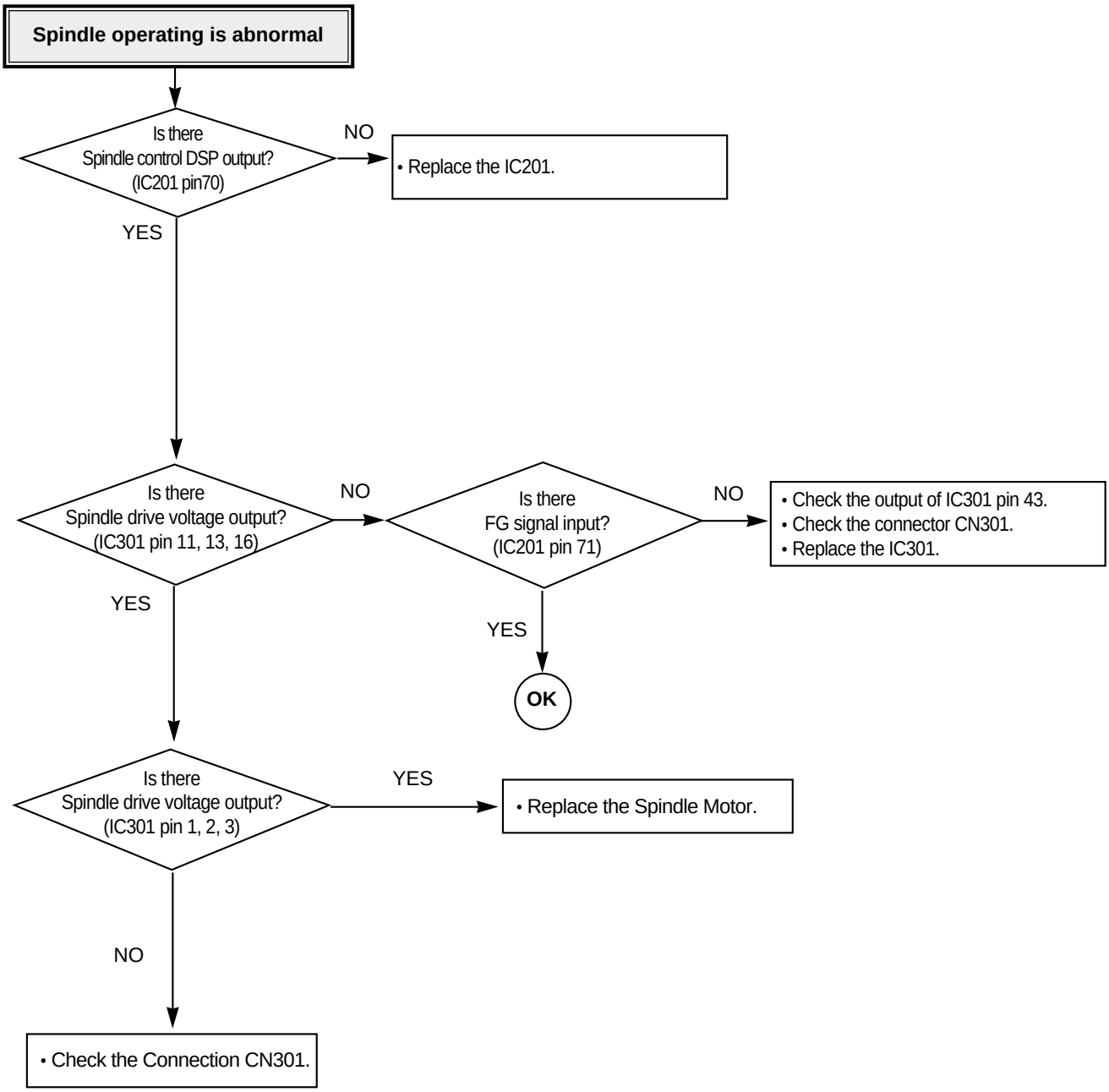


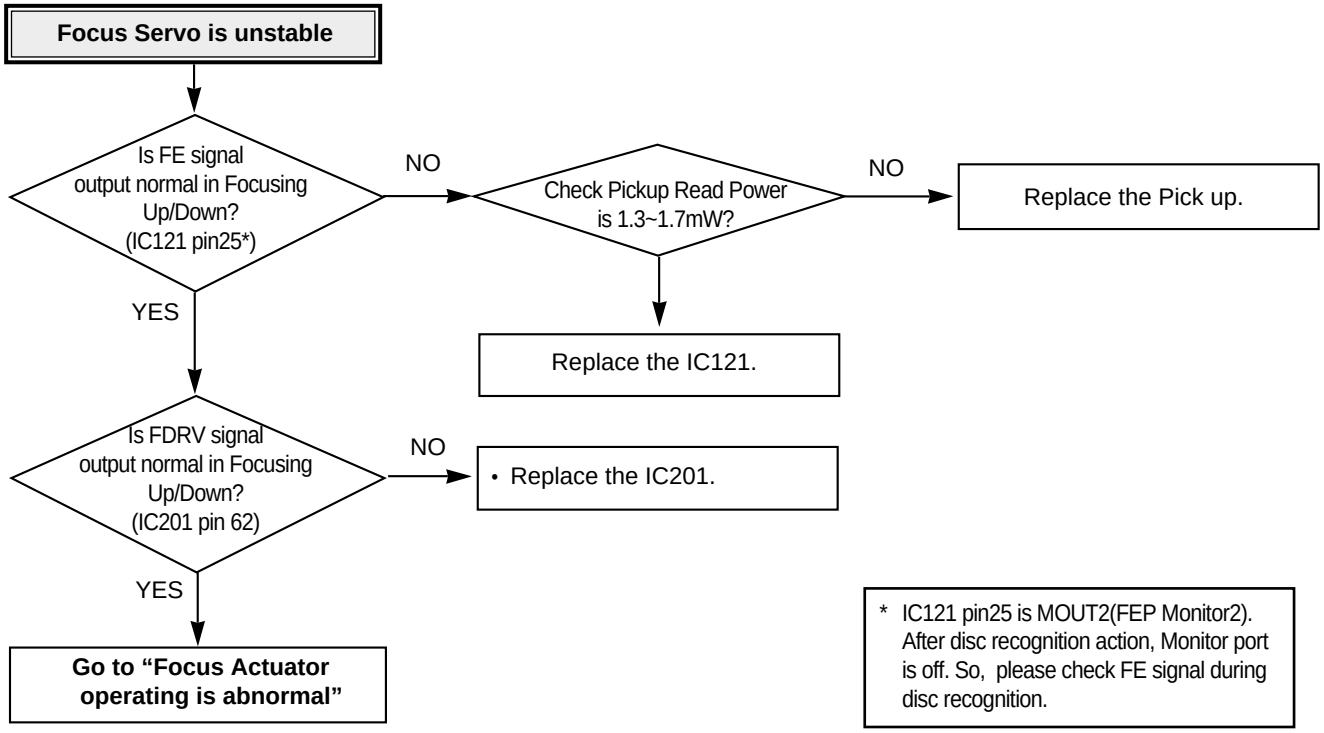

System Check.
Load tray without inserting disc.
YES
Does Tray operate normally?
NO
Go to “Tray operating is abnormal”
YES
Does Pick-up move to inside?
NO
Go to “Sled operating is abnormal”
YES
Does Pickup lens move up/down?
NO
Go to “Focus Actuator operating is abnormal”
YES
Does Laser turn on?
NO
Go to “Laser operating is abnormal”
YES
After eject tray, Insert CD-ROM Disc and check rotation.
YES
Does Disc rotate continuously and the drive recognize the disc?
NO
Go to “Recognition fail Case1 (CD-ROM Disc)”
YES
After eject tray, Insert Blank CD-R or RW Disc and check rotation.
YES
Does Disc rotate continuously and the drive recognize the disc?
NO
Go to “Recognition fail Case2 (Blank CD-R/RW)”
YES
After eject the tray, Insert DVD Disc and check rotation.
YES
Does Disc rotate continuously and the drive recognize the disc?
NO
Go to :Recognition fail Case3 (DVD Disc)”
YES
After eject the tray, Insert DVD+R/RW Disc and check rotation.
YES
Does Disc rotate continuously and the drive recognize the disc?
NO
Go to :Recognition fail Case4 (Blank DVD+R/RW)”
OK

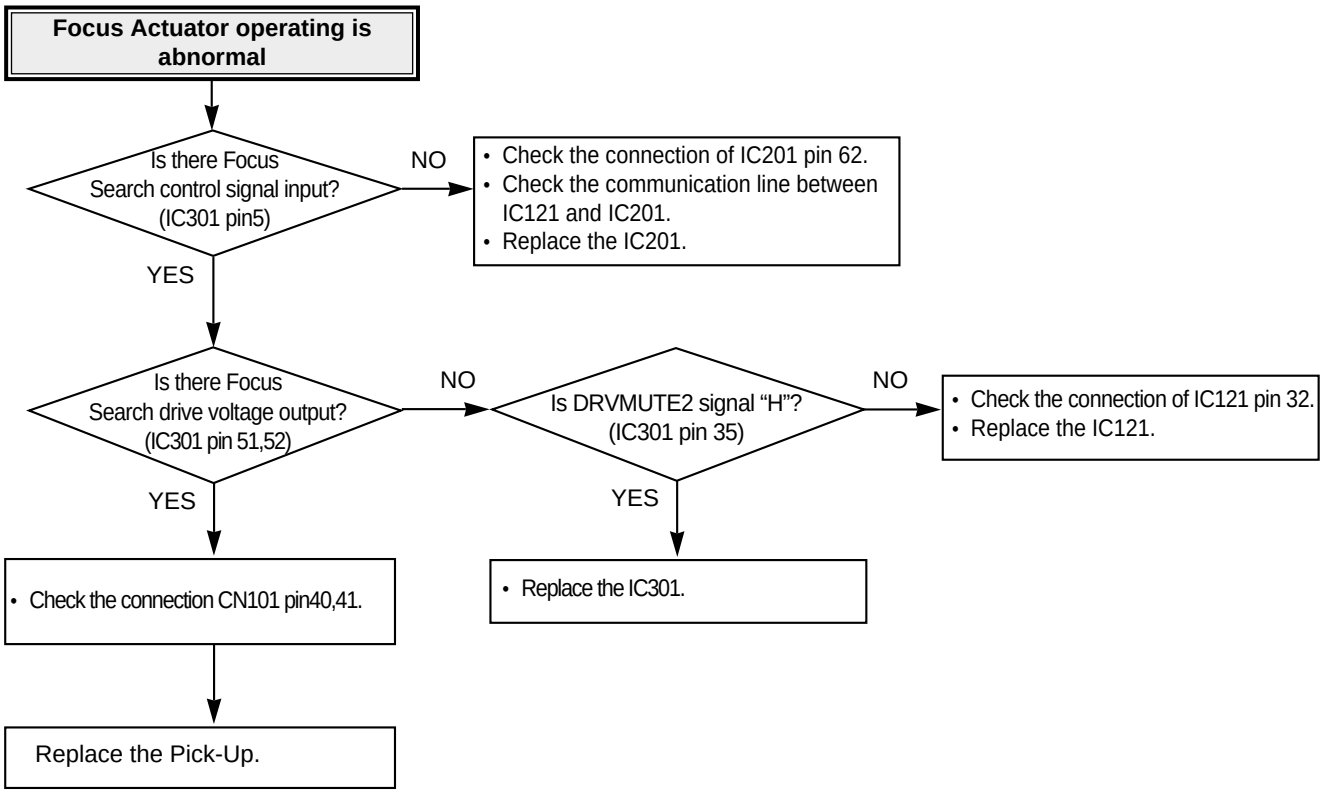

Tray operating is abnormal.
Tray open doesn't work.
Is the input voltage 0V at IC201 pin203 when push the EJECT SW?
NO
• Check the connction of IC201 pin 203.
• Replace the EJECT SW.
YES
Is there Tray control signal input? (IC301 pin 4)
NO
• Check the connction of IC201 pin 66.
• Replace theIC201.
• Check the communication line between IC201.
YES
Is there Tray drive voltage output? (IC301 pin 1,2)
NO
When CN303 is open, Is there Tray drive signal output?
• Replace the IC301.
YES
YES
• Check the connctor (CN303).

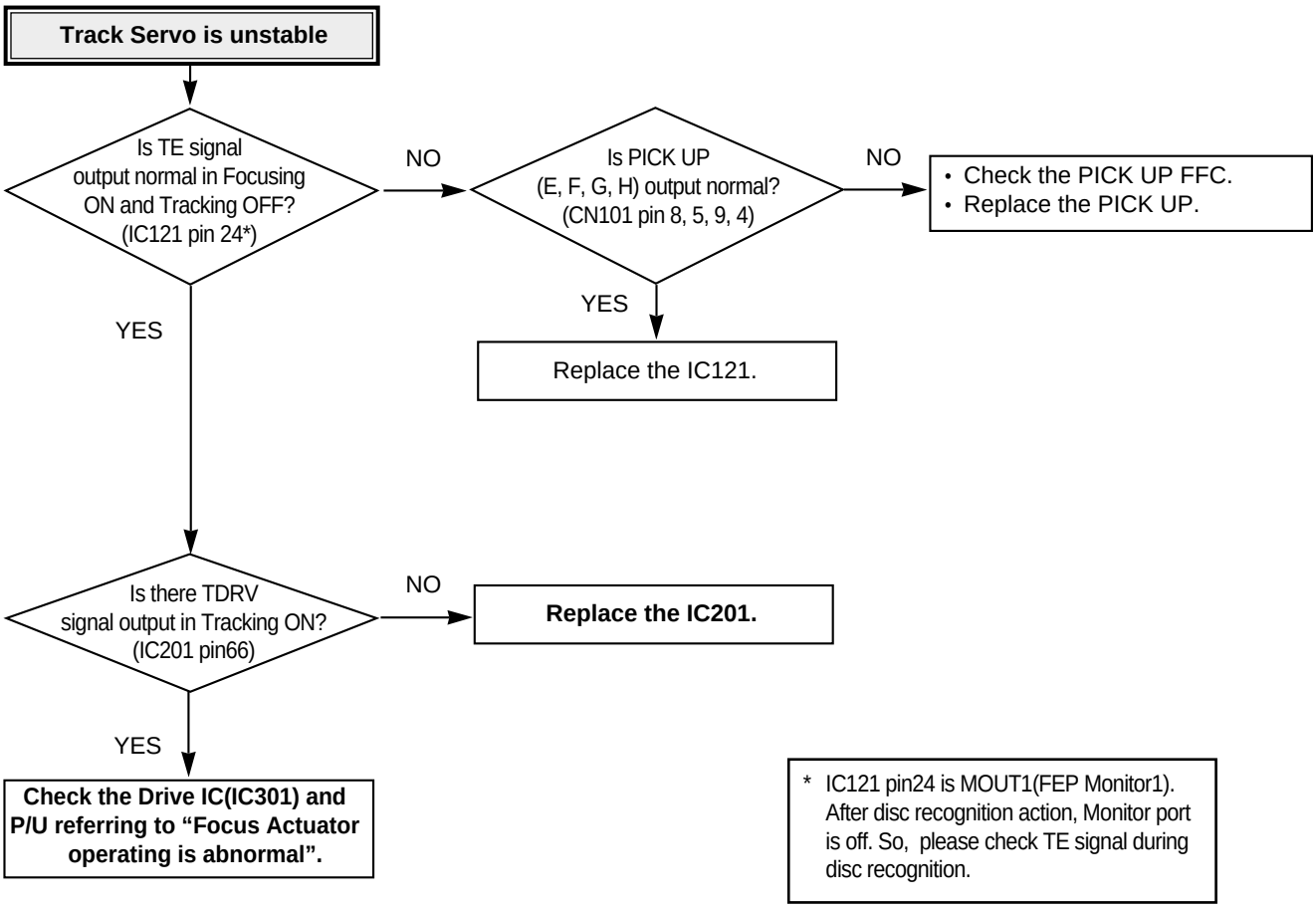

Drive doesn't work after tray close
YES
Is the input voltage 0V at IC201 pin204(/OPENSW) when push the SW1?
NO
• Check the pull-up line(3.2V).
• Replace SW1.
YES
Is the input voltage 0V at IC201 pin63(/LOADSW) when push the SW1?
NO
• Check the pull-up line(3.3V).
• Replace SW1.

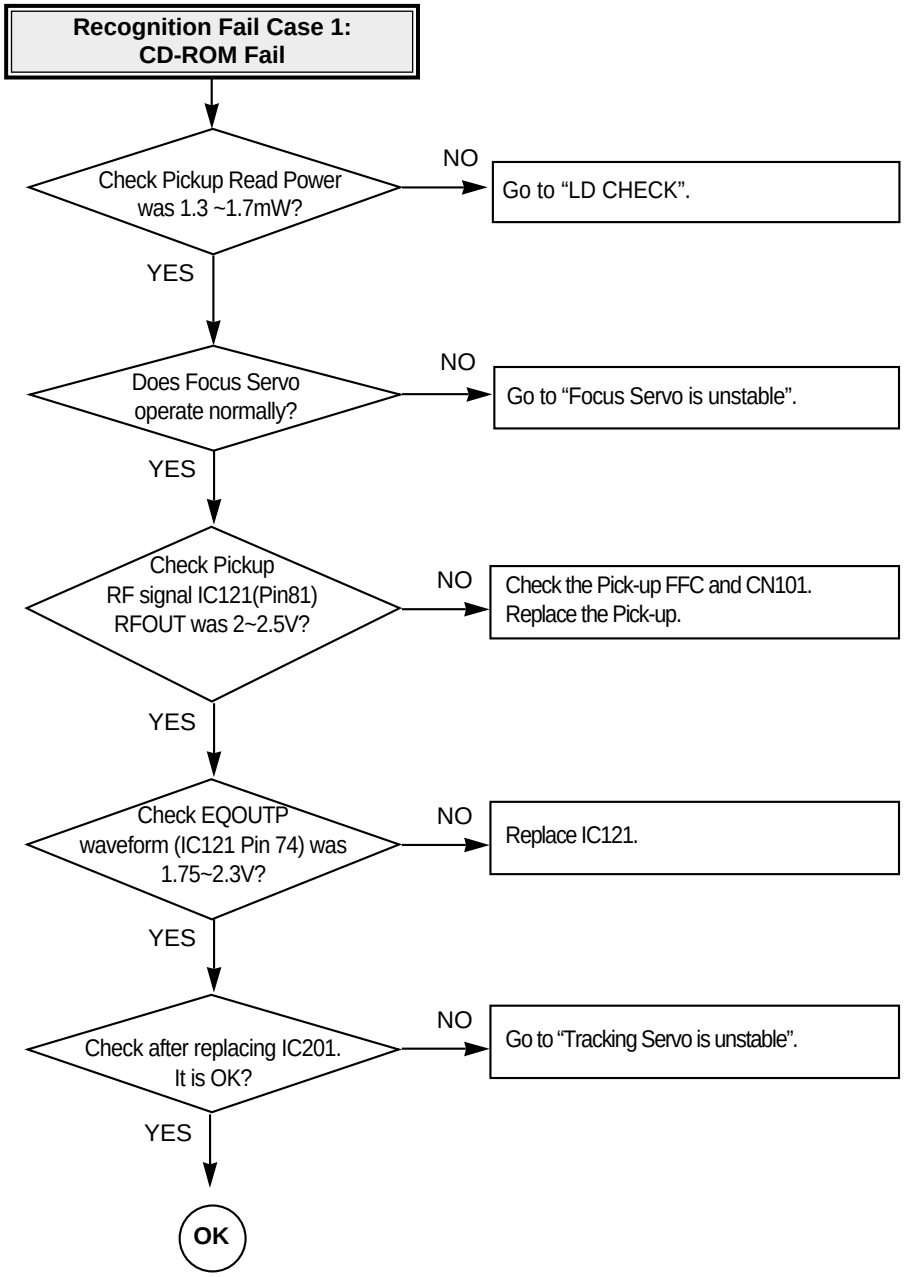

Sled operating is abnormal.
Is there Sled control signal output? (IC201 pin 68,69)
NO
Replace the IC201.
YES
Is there Sled drive voltage input? (IC301 pin 29,30)
NO
• Check the R316, R317.
YES
Is there Sled drive voltage output? (IC301 pin37,38,39,40)
NO
Is DRVMUTE2 signal 'H'? (IC301 pin 35)
NO
Check the connection of IC121 pin 32.
YES
YES
Replace the IC301.
Replace the IC121.
Is there Sled drive voltage output ? (CN302 pin 1,2,3,4)
YES
Replace the Sled Motor.
NO
• Check the Connection CN302.

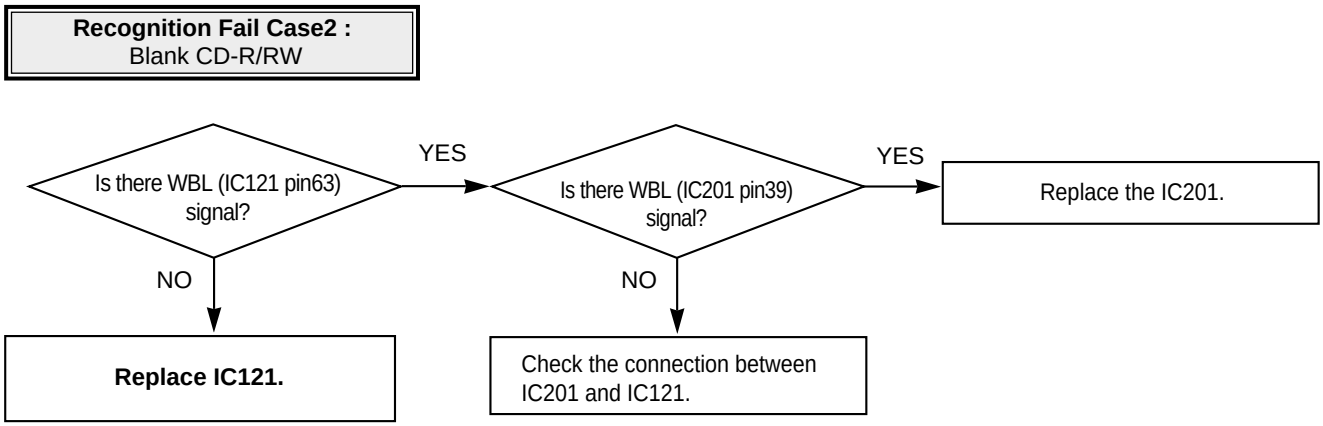

Spindle operating is abnormal
Is there
Spindle control DSP output?
(IC201 pin70)
NO
• Replace the IC201.
YES
Is there
Spindle drive voltage output?
(IC301 pin 11, 13, 16)
NO
Is there
FG signal input?
(IC201 pin 71)
NO
• Check the output of IC301 pin 43.
• Check the connector CN301.
• Replace the IC301.
YES
YES
OK
Is there
Spindle drive voltage output?
(IC301 pin 1, 2, 3)
YES
• Replace the Spindle Motor.
NO
• Check the Connection CN301.

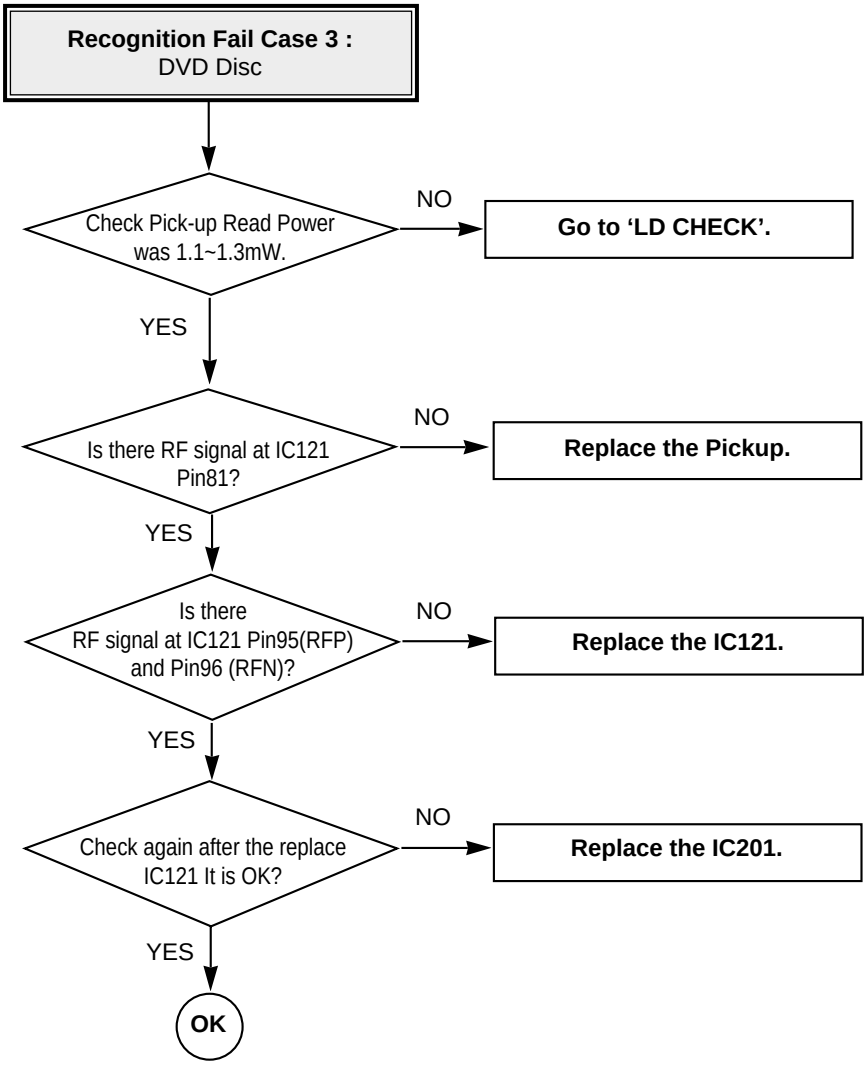

Focus Servo is unstable
Is FE signal output normal in Focusing Up/Down? (IC121 pin25*)
NO
Check Pickup Read Power is 1.3~1.7mW?
NO
Replace the Pick up.
YES
Replace the IC121.
Is FDRV signal output normal in Focusing Up/Down? (IC201 pin 62)
NO
• Replace the IC201.
YES
Go to "Focus Actuator operating is abnormal"
* IC121 pin25 is MOUT2(FEP Monitor2). After disc recognition action, Monitor port is off. So, please check FE signal during disc recognition.

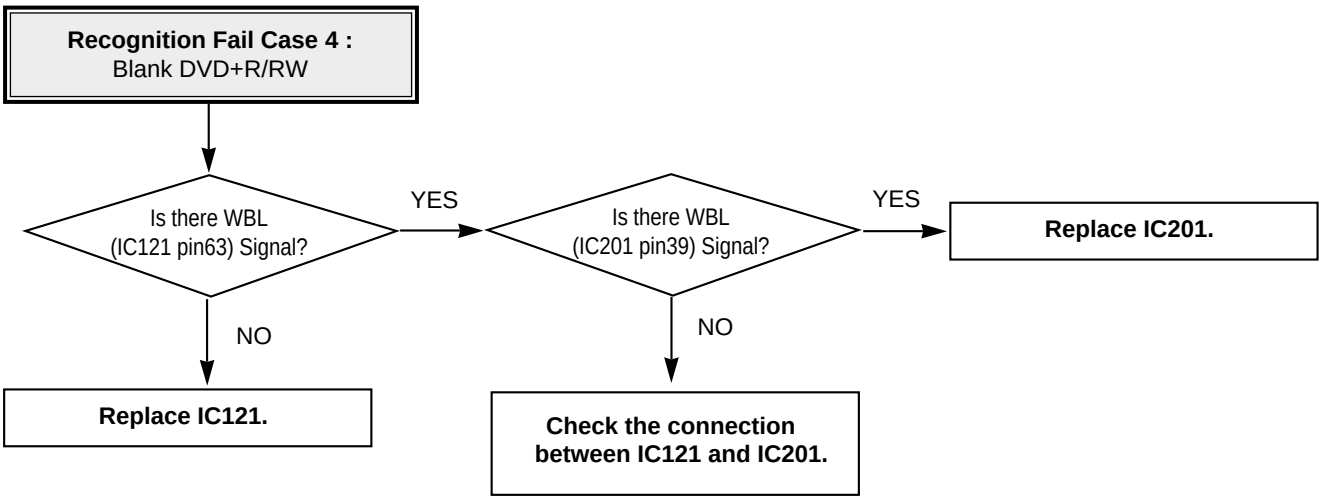

Focus Actuator operating is abnormal
Is there Focus Search control signal input? (IC301 pin5)
NO
• Check the connection of IC201 pin 62.
• Check the communication line between IC121 and IC201.
• Replace the IC201.
YES
Is there Focus Search drive voltage output? (IC301 pin 51,52)
NO
Is DRVMUTE2 signal "H"? (IC301 pin 35)
NO
• Check the connection of IC121 pin 32.
• Replace the IC121.
YES
YES
• Check the connection CN101 pin40,41.
• Replace the IC301.
Replace the Pick-Up.


Track Servo is unstable
Is TE signal output normal in Focusing ON and Tracking OFF? (IC121 pin 24*)
NO
Is PICK UP (E, F, G, H) output normal? (CN101 pin 8, 5, 9, 4)
NO
• Check the PICK UP FFC.
• Replace the PICK UP.
YES
Replace the IC121.
YES
Is there TDRV signal output in Tracking ON? (IC201 pin66)
NO
Replace the IC201.
YES
Check the Drive IC(IC301) and P/U referring to "Focus Actuator operating is abnormal".
* IC121 pin24 is MOUT1(FEP Monitor1). After disc recognition action, Monitor port is off. So, please check TE signal during disc recognition.

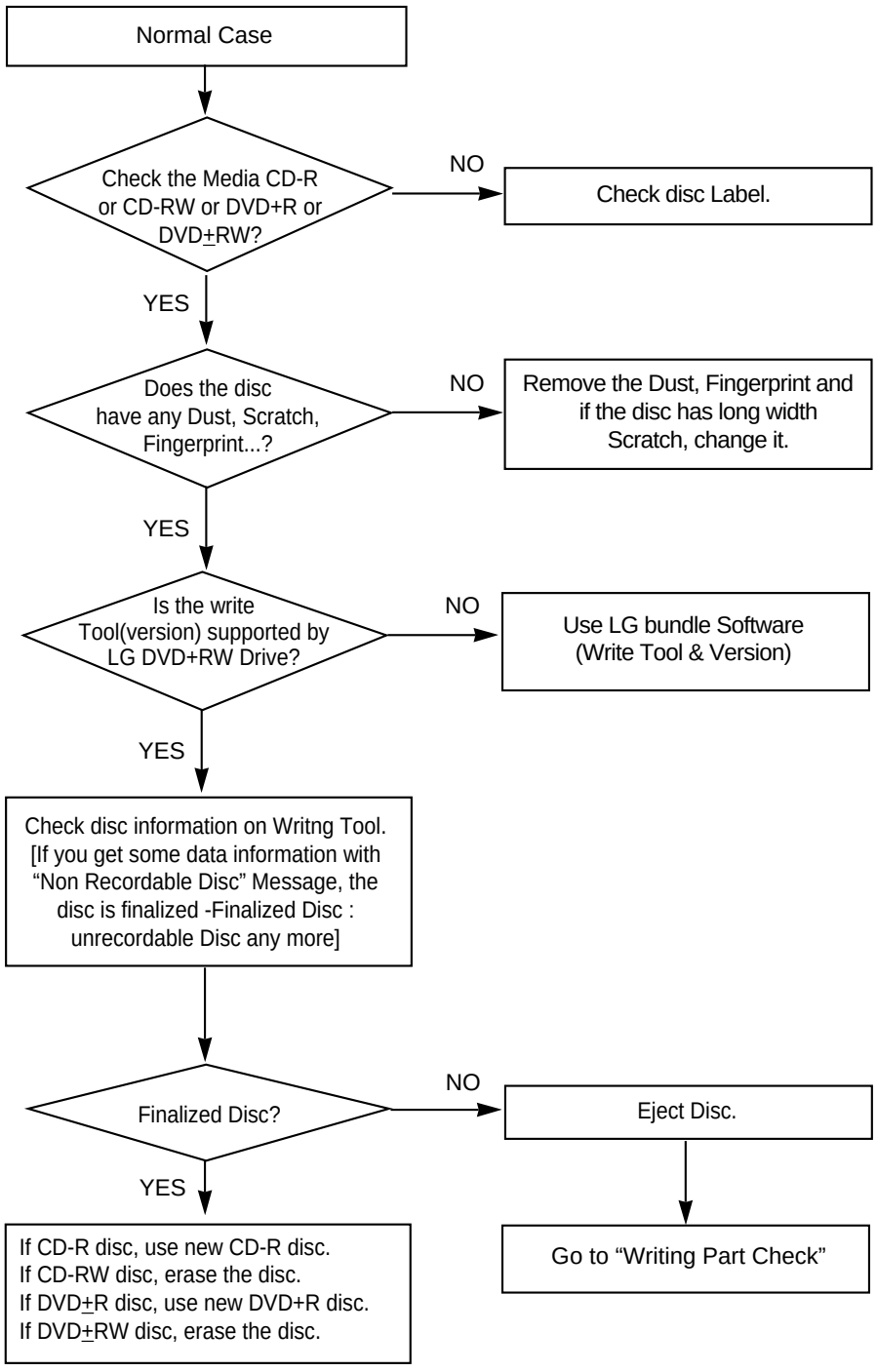

Recognition Fail Case 1:
CD-ROM Fail
Check Pickup Read Power was 1.3 ~1.7mW?
NO
Go to “LD CHECK”.
YES
Does Focus Servo operate normally?
NO
Go to “Focus Servo is unstable”.
YES
Check Pickup RF signal IC121(Pin81) RFOUT was 2~2.5V?
NO
Check the Pick-up FFC and CN101.
Replace the Pick-up.
YES
Check EQOUTP waveform (IC121 Pin 74) was 1.75~2.3V?
NO
Replace IC121.
YES
Check after replacing IC201. It is OK?
NO
Go to “Tracking Servo is unstable”.
YES
OK

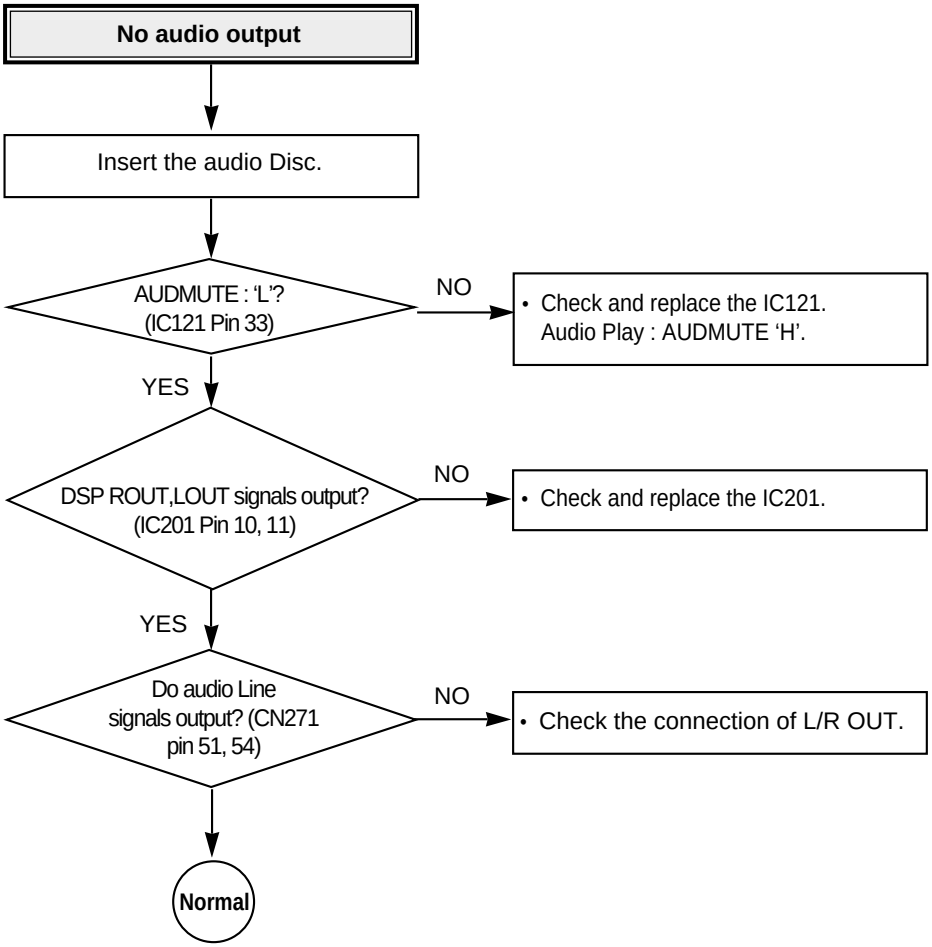

Recognition Fail Case2 :
Blank CD-R/RW
Is there WBL (IC121 pin63) signal?
YES
Is there WBL (IC201 pin39) signal?
YES
Replace the IC201.
NO
Replace IC121.
NO
Check the connection between IC201 and IC121.

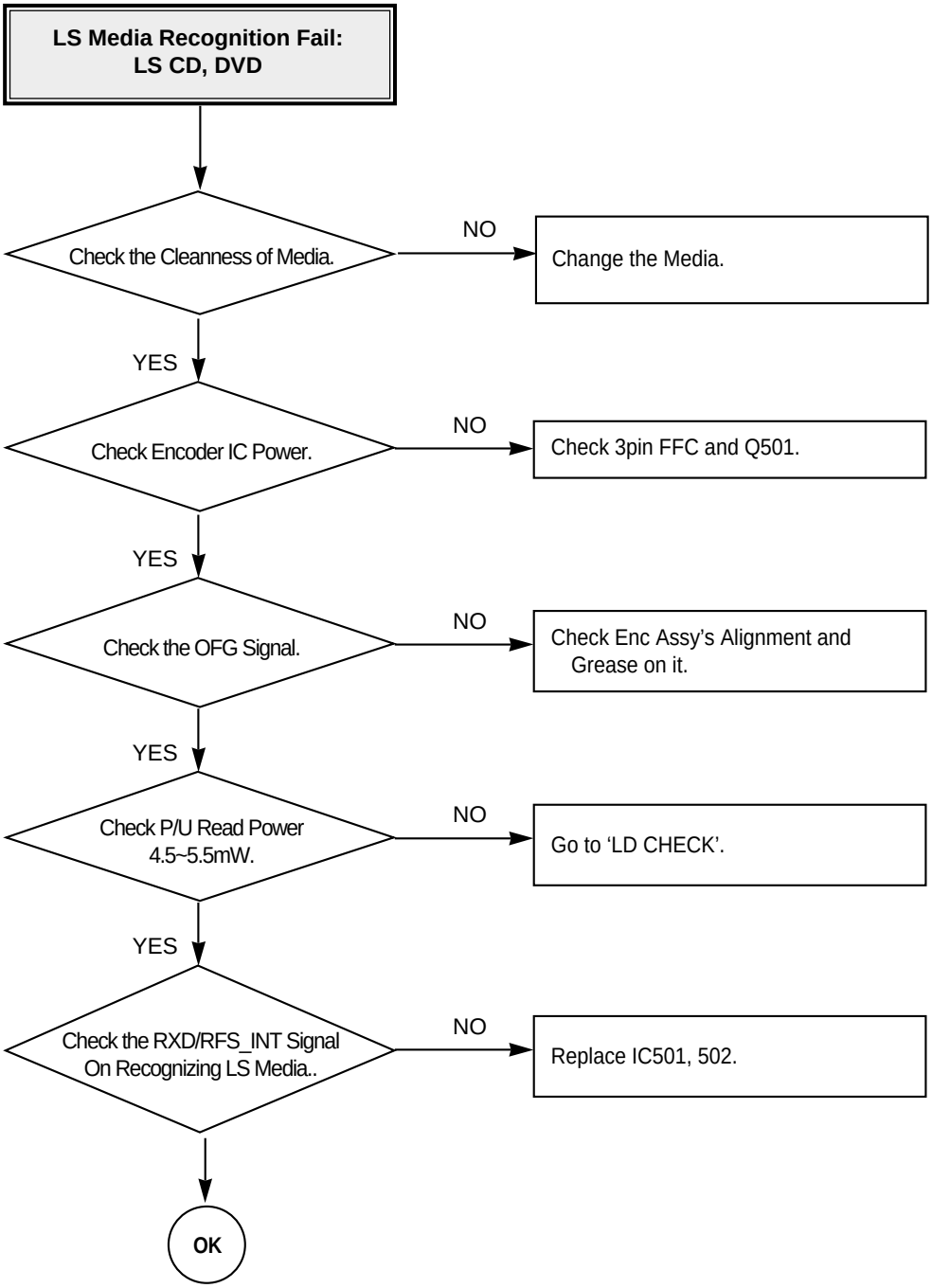

Recognition Fail Case 3 :
DVD Disc
Check Pick-up Read Power was 1.1~1.3mW.
NO
Go to 'LD CHECK'.
YES
Is there RF signal at IC121 Pin81?
NO
Replace the Pickup.
YES
Is there RF signal at IC121 Pin95(RFP) and Pin96 (RFN)?
NO
Replace the IC121.
YES
Check again after the replace IC121 It is OK?
NO
Replace the IC201.
YES
OK


Recognition Fail Case 4 :
Blank DVD+R/RW
Is there WBL (IC121 pin63) Signal?
YES
Is there WBL (IC201 pin39) Signal?
YES
Replace IC201.
NO
Replace IC121.
NO
Check the connection between IC121 and IC201.

In case of writing fail.



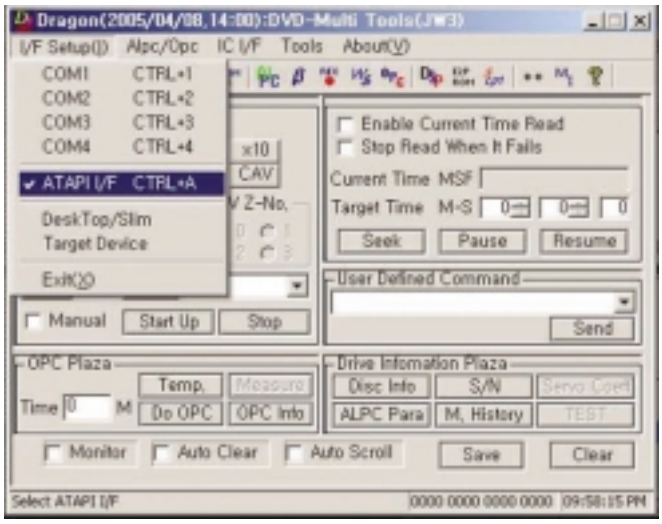

No audio output
Insert the audio Disc.
AUDMUTE : 'L'?
(IC121 Pin 33)
NO
• Check and replace the IC121.
Audio Play : AUDMUTE 'H'.
YES
DSP ROUT,LOUT signals output?
(IC201 Pin 10, 11)
NO
• Check and replace the IC201.
YES
Do audio Line
signals output? (CN271
pin 51, 54)
NO
• Check the connection of L/R OUT.
Normal


LS Media Recognition Fail:
LS CD, DVD
Check the Cleanness of Media.
NO
Change the Media.
YES
Check Encoder IC Power.
NO
Check 3pin FFC and Q501.
YES
Check the OFG Signal.
NO
Check Enc Assy's Alignment and
Grease on it.
YES
Check P/U Read Power
4.5~5.5mW.
NO
Go to 'LD CHECK'.
YES
Check the RXD/RFS_INT Signal
On Recognizing LS Media..
NO
Replace IC501, 502.
OK

• How to use Test Tool (Dragon)

A. Start

1. Install **GWA-4164B** –> PC Power ON –> **Execute** Windows.
2. Execute **Dragon_JW3.exe** on Windows (**Dragon_JW3.exe & Dragon.cfg** should be on same Directory).
3. If you use GWA-4164B, “Dragon(2005/04/08, 14:00)” will be displayed on the window Frame.
4. Select **I/F Setup** on the menu bar.
5. Select **ATAPI I/F** and then Click **OK**.
6. Select **Target Device** on the menu bar.
7. Select “**DVDRRW GWA-4164B**” on Target Device, and then Click **OK.**



[I/F Setup Menu]

[Target Device window]

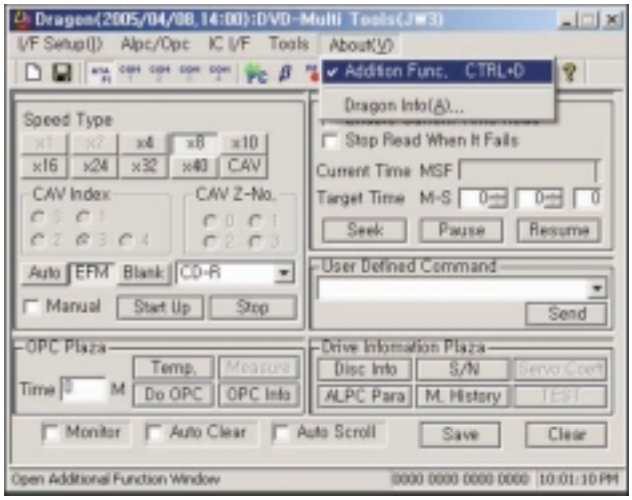
B. Check ALPC Parameters

1. Select **About** on the menu bar.
2. Click **Addition Func.** on About window -> New frame will be displayed.
3. Click **ALPC Para** tab and verify the specification.

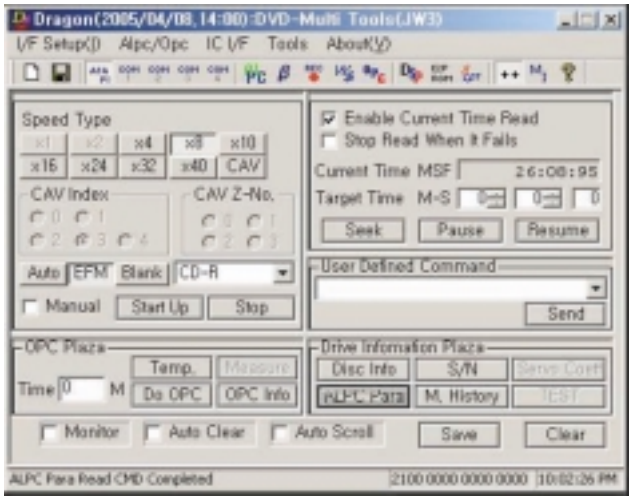
[ALPC Parameters]

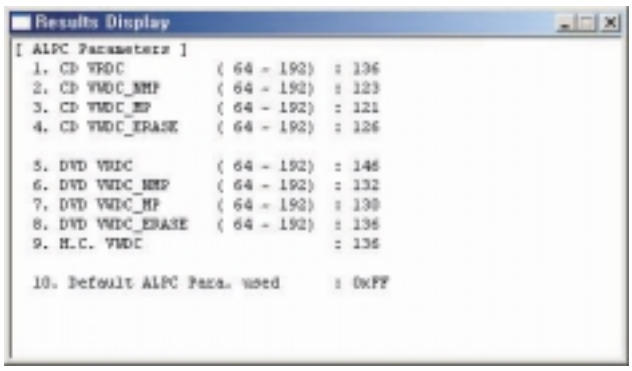
1) CD VRDC	: 117~153
2) CD VWDC_NMP	: 100~135
3) CD VWDC_MP	: 100~137
4) CD VWDC_ERASE	: 105~135
5) DVD VRDC	: 115~157
6) DVD VWDC_NMP	: 100~135
7) DVD VWDC_MP	: 100~135
8) DVD VWDC_ERASE	: 105~140
9) H.C. VWDC	: 100~150
10) Default ALPC Para. used	: 0xFF

4. **Close** window.



[Additional Function Menu]

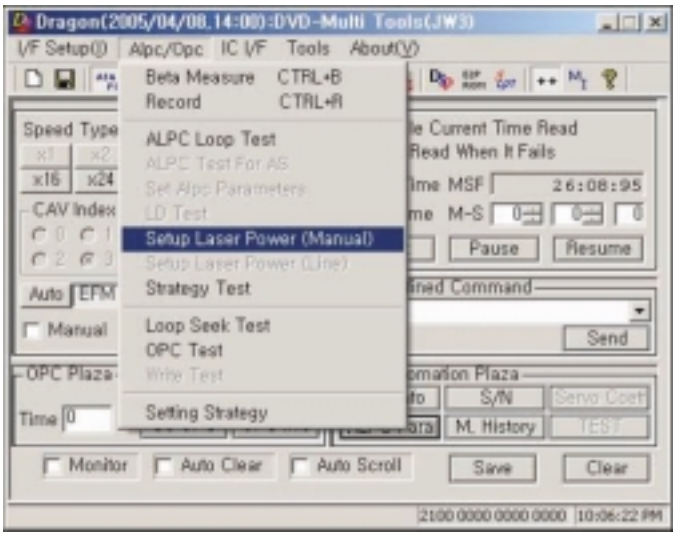




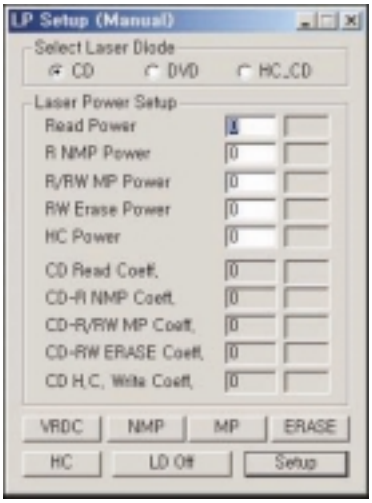
[ALPC Parameters Menu]

C. Laser Power Setup

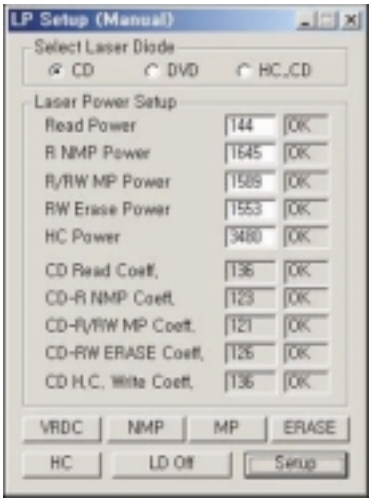
1. **Remove** disc on the tray.
2. Select **ALPC/OPC** on the menu bar, and then select **Setup Laser Power(Manual)** menu.
3. First, select CD and setup wave length of LD Power meter (780nm)
   (Wave Length : **CD(780nm), DVD(660nm)**, Measure Range : 0.01mW unit).
4. Click **VRDC** button on the **Laser Power Setup** window. Laser beam will be emitted from LD.
5. Measure LD Power with LD Power meter. Type the result in the blank(**Read Power** box).
   ex) 1.44mW -> 144, 0.99mW -> 99)
6. Click **NMP** button and measure LD Power with Power meter. Type the result in the blank(R NMP Power box).
   ex) 16.45mW -> 1645, 12.08mW -> 1208
7. Click **MP** button and measure LD Power with Power meter. Type the result in the blank(RW Erase Power box).
8. Click **ERASE** button and measure LD Power with Power meter. Type the result in the blank(RW Erase Power box).
9. Click **LD Off** button and then click **Setup** button, and result witll be displayed with **OK** or **NG**.
10. Select **HC_CD** and then click **HC** button.
11. Measure LD Power with Power meter. Type the result in the blank (HC Power).
12. Click **LD Off** button and then click **Setup** button, and result will be displayed with **OK** or **NG.**
13. Select **DVD** and change wave length of LD Power meter (660nm).
14. Follow above step 5, 6, 7, 8, 9.
15. Close **Laser Power Setup** window.



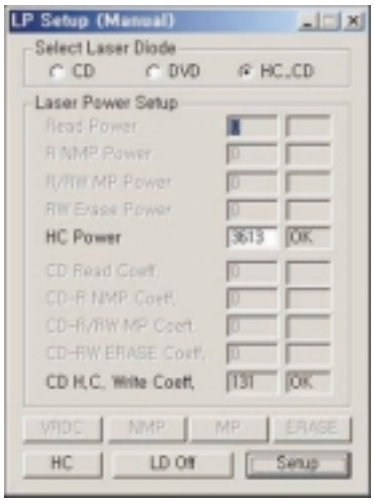
[Laser Power Setup window]



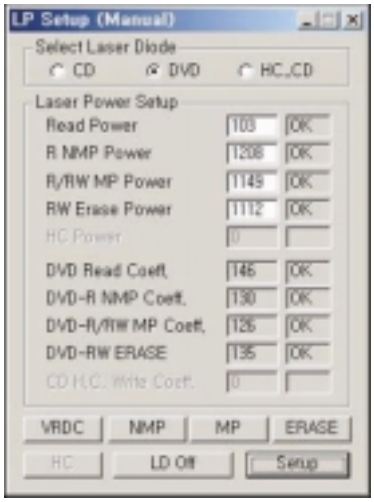
[Laser Power Setup Frame]



[CD Laser Power Setup Result]

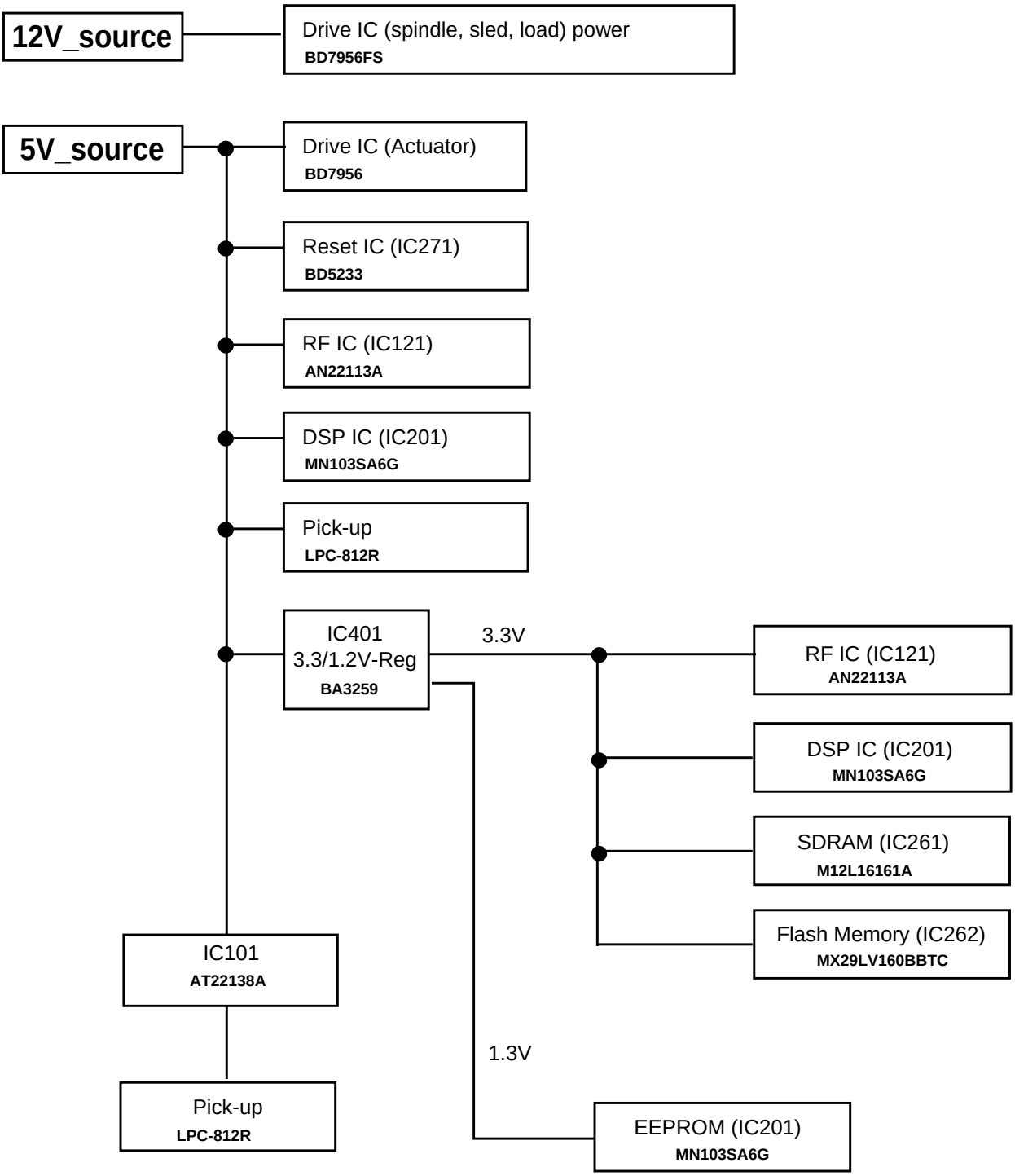


[HC_CD Laser Power Setup Result]

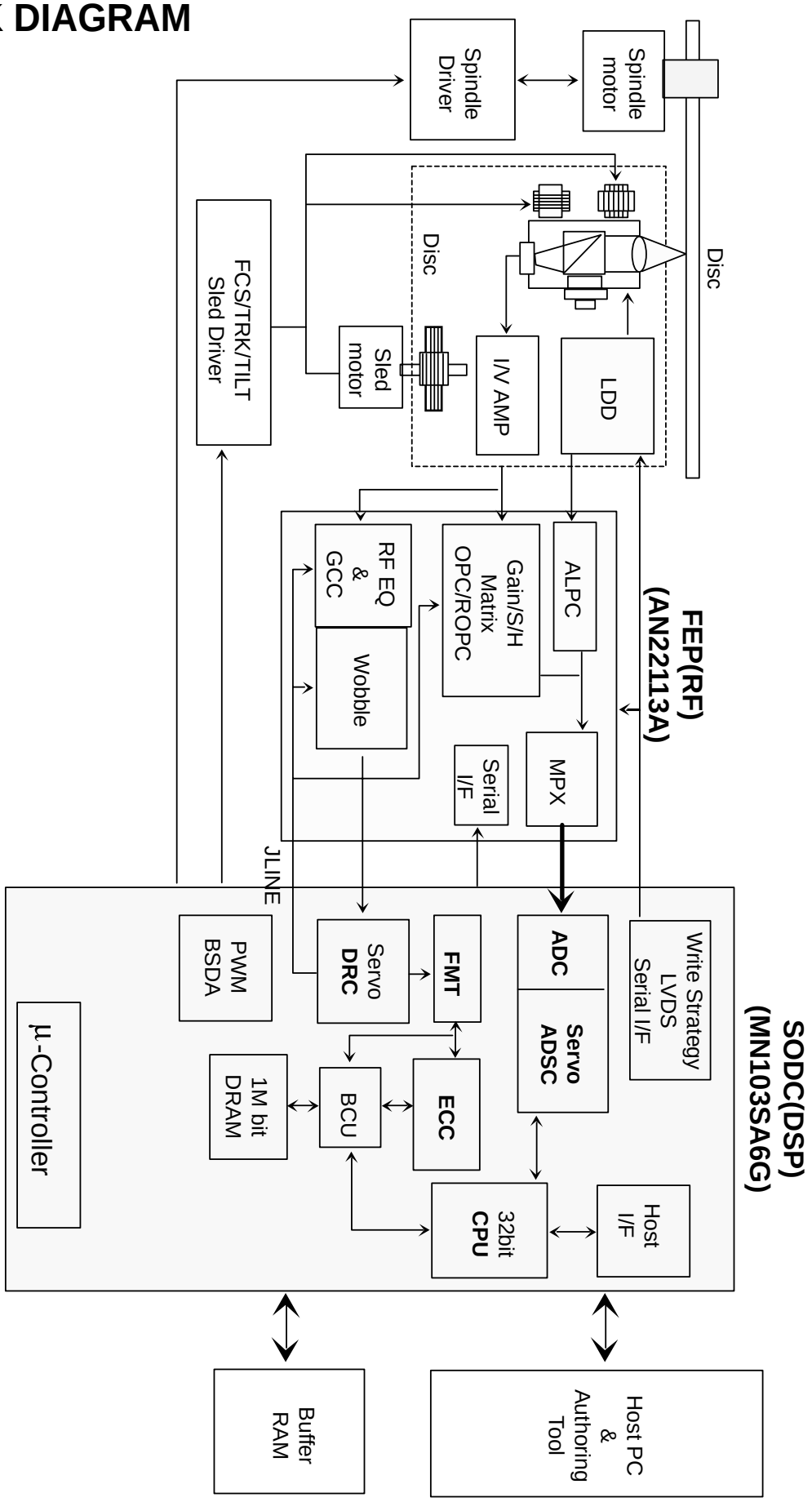


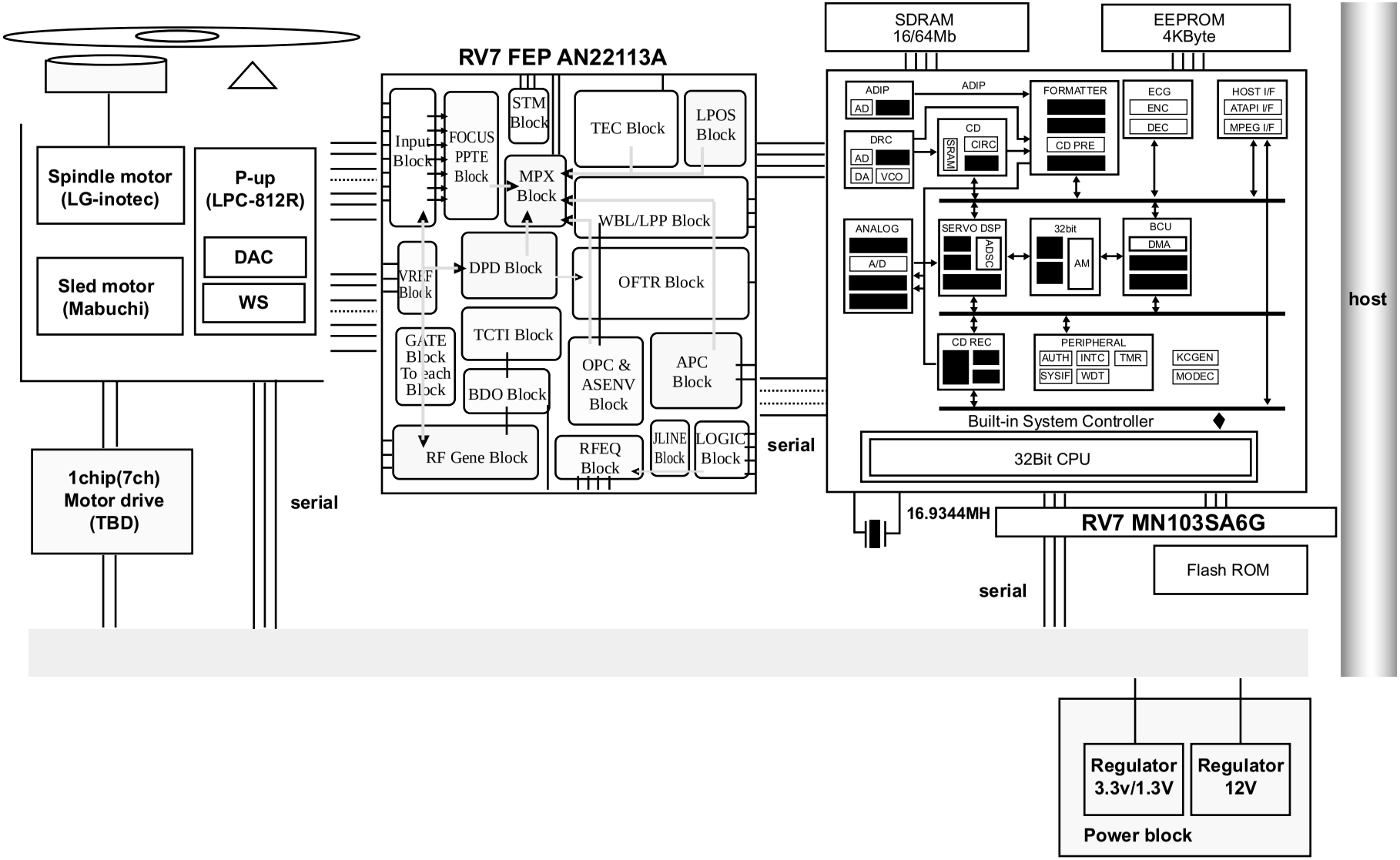
[DVD Laser Power Setup Result]

Power Supply System Diagram



BLOCK DIAGRAM




RV7 FEP AN22113A
Spindle motor (LG-inotec)
Sled motor (Mabuchi)
P-up (LPC-812R)
DAC
WS
1chip(7ch) Motor drive (TBD)
serial
Input Block
FOCUS PPTE Block
STM Block
MPX Block
TEC Block
LPOS Block
WBL/LPP Block
VREF Block
DPD Block
OFTR Block
GATE Block
TCTI Block
BDO Block
OPC & ASENV Block
APC Block
RF Gene Block
RFEQ Block
JLINE Block
LOGIC Block
serial
SDRAM 16/64Mb
EEPROM 4KByte
ADIP
AD
DRC
DA
VCO
CD
SRAM
CIRC
FORMATTER
CD PRE
ECG
ENC
DEC
HOST I/F
ATAPI I/F
MPEG I/F
ANALOG
A/D
SERVO DSP
ADSC
32bit
AM
BCU
DMA
CD REC
PERIPHERAL
AUTH
INTC
TMR
SYSIF
WDT
KCGEN
MODEC
Built-in System Controller
32Bit CPU
host
16.9344MH
RV7 MN103SA6G
Flash ROM
serial
Regulator 3.3v/1.3V
Regulator 12V
Power block